715

LANDING ANALOG DISPLAYS ROUTINE (R10) REV 03 12/03/69

PURPOSE: (1) TO MONITOR THE "DISPLAY INERTIAL DATA" DISCRETE THE ABSENCE OF WHICH INDICATES THE CREW HAS SELECTED FOR DISPLAY ON THE LM METERS ONE OR MORE OF THE LGC-CALCULATED DISPLAY PARAMETERS. THESE PARAMETERS ARE:

(A) FORWARD VELOCITY - SEE SECTION 5 OF R567 FOR DEFINITION.

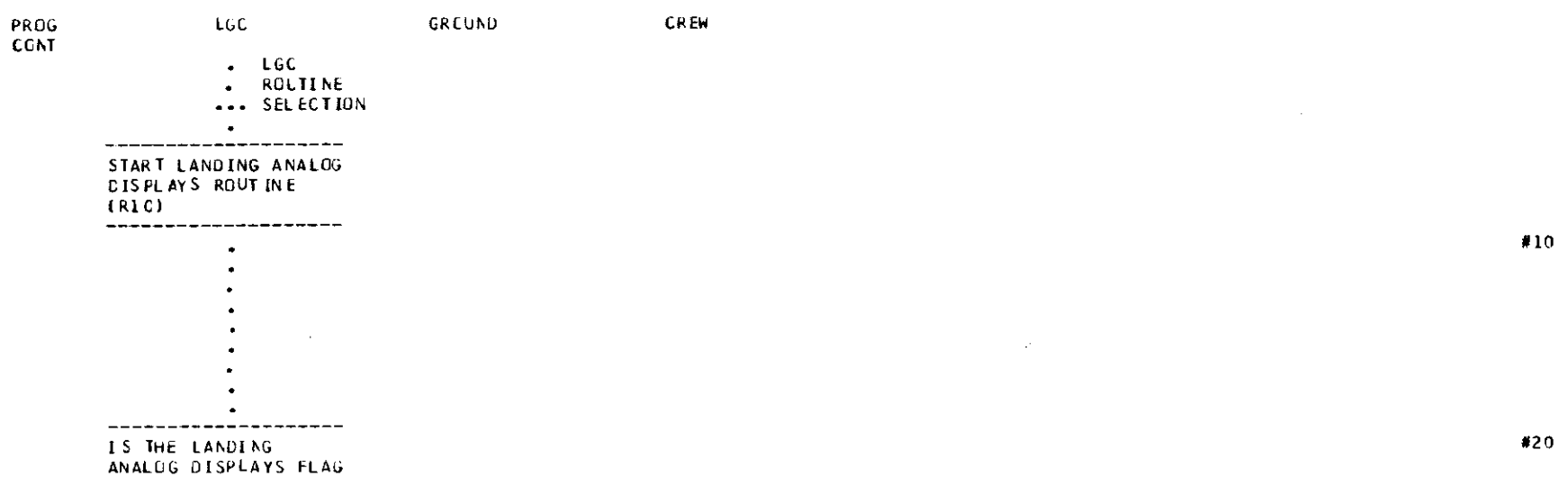
(B) LATERAL VELOCITY - SEE SECTION 5 OF R567 FOR DEFINITION.

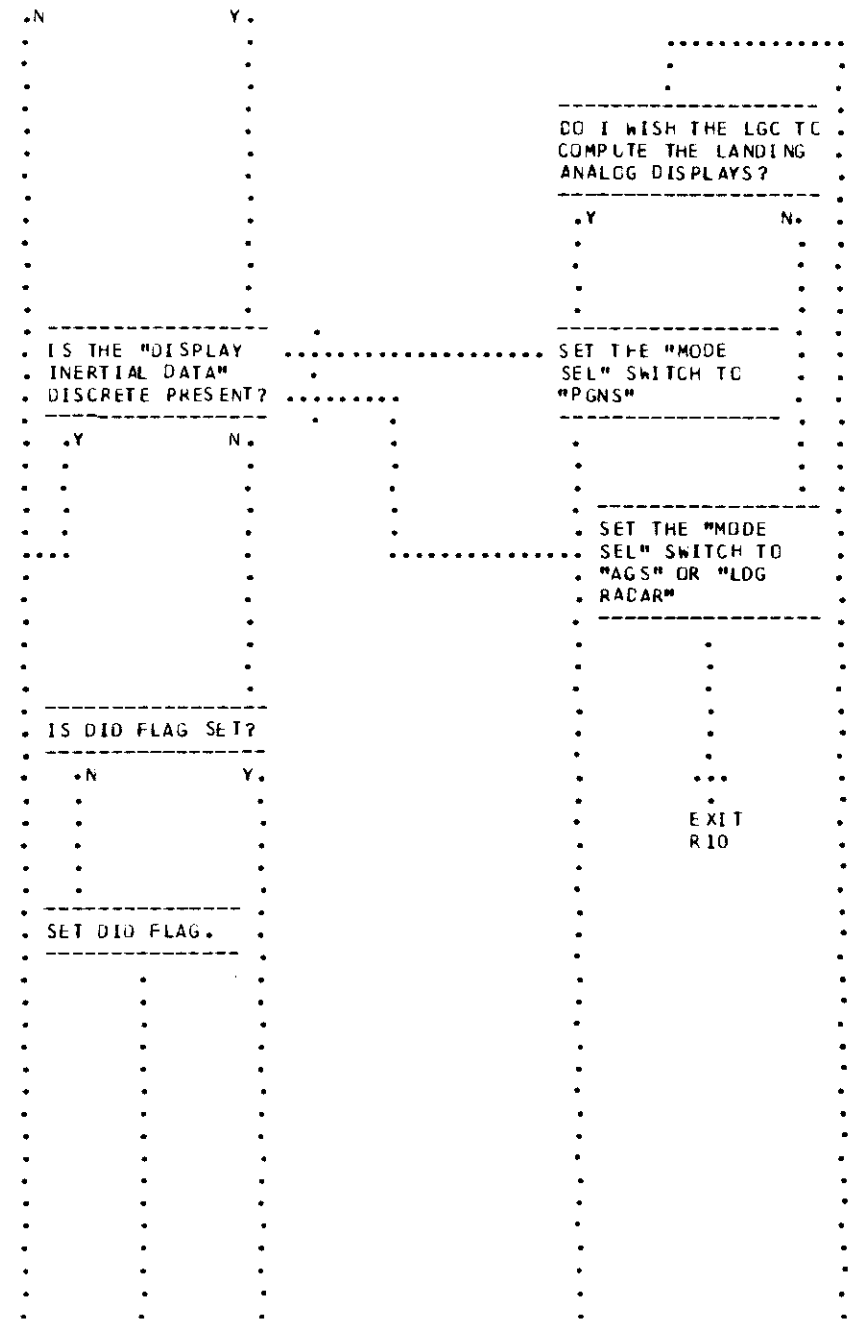
(C) ALTITUDE - THE PRESENT ALTITUDE OF THE LM ABOVE THE LUNAR RADIUS AT THE DESIGNATED LANDING SITE.

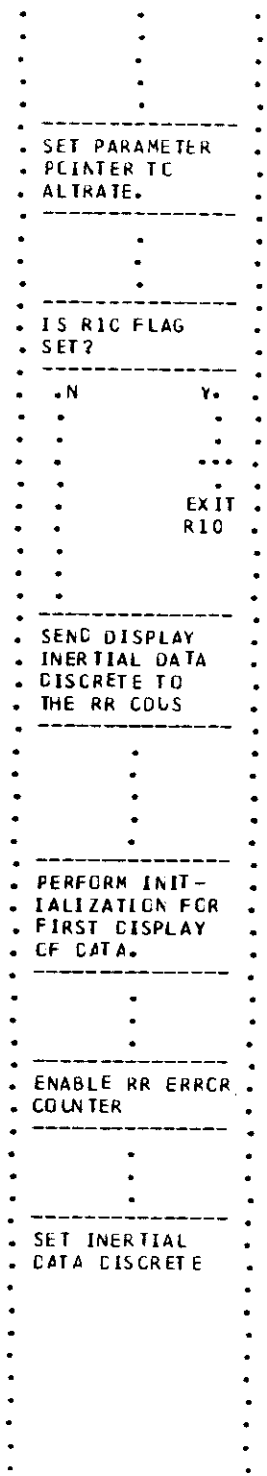
(D) ALTITUDE RATE - THE PRESENT RATE OF CHANGE OF ALTITUDE ((C) ABOVE).

(2) TO CALCULATE THESE DISPLAY PARAMETERS AND TRANSMIT THEM TO THE LM METERS WHEN THE "DISPLAY INERTIAL DATA" DISCRETE IS NOT PRESENT.

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY CALLED EVERY .25 SECONDS BY THE ABORT DISCRETES MONITOR ROUTINE (R11), BUT ONLY
++ DURING P12,63,64,65,66,70, OR 71. HOWEVER, THE ROUTINE WILL BE INHIBITED FROM USING THE RR CDUS (FORWARD AND
+03 LATERAL VELOCITY CROSSPOINTERS) DURING P12,P70, OR P71. THUS ONLY ALTITUDE AND ALTITUDE RATE (TAPE METERS) WILL BE
+285 DISPLAYED DURING P12, P70, OR P71.
++




SET?
N
Y
DO I WISH THE LGC TO COMPUTE THE LANDING ANALOG DISPLAYS?
#30
Y
N
IS THE "DISPLAY INERTIAL DATA" DISCRETE PRESENT?
SET THE "MODE SEL" SWITCH TO "PGNS"
#40
Y
N
SET THE "MODE SEL" SWITCH TO "AGS" OR "LDG RADAR"
#50
IS DIO FLAG SET?
N
Y
EXIT R10
#60
SET DIO FLAG.
#70



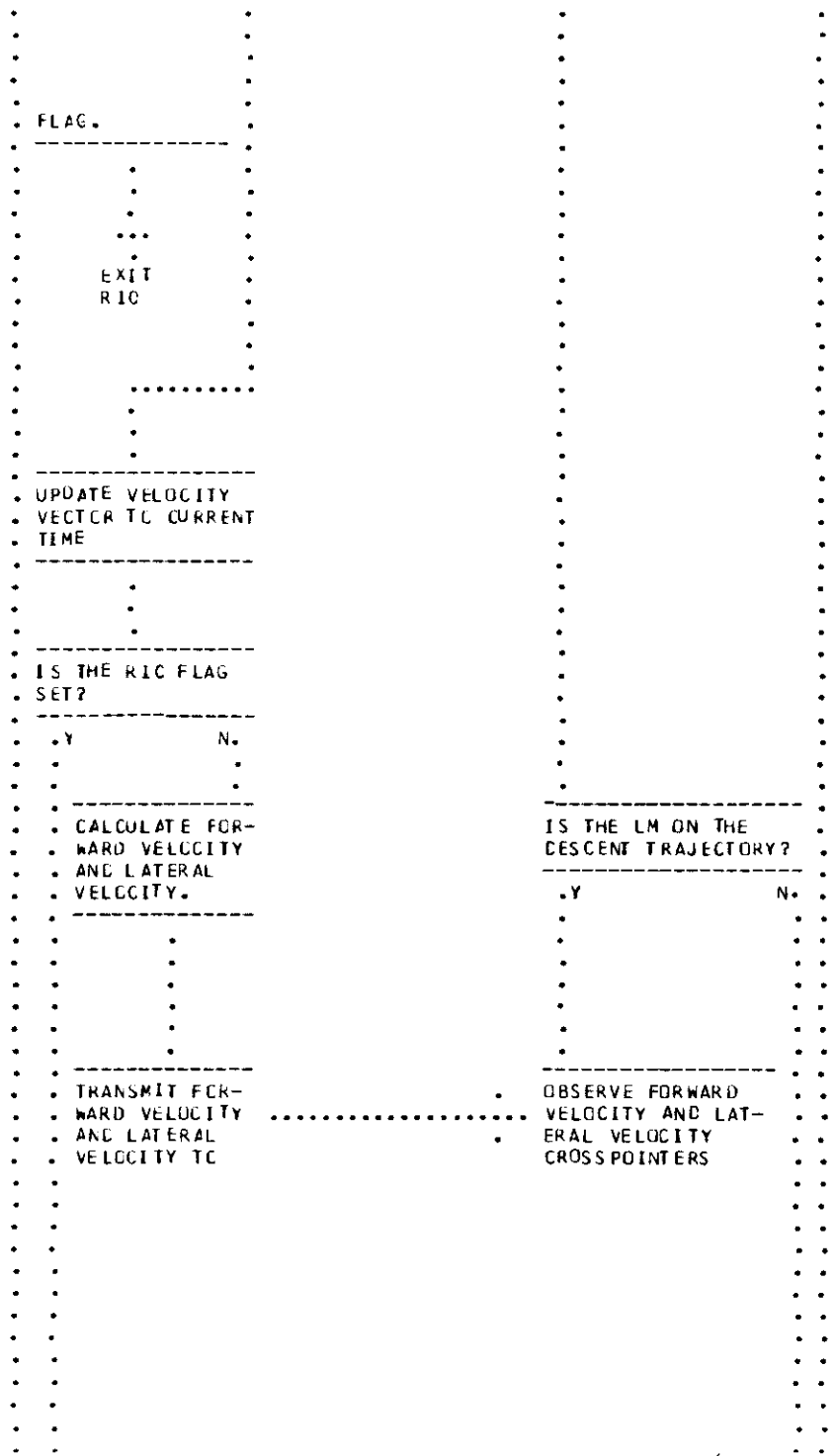
#80

#90

#100

#110

#120



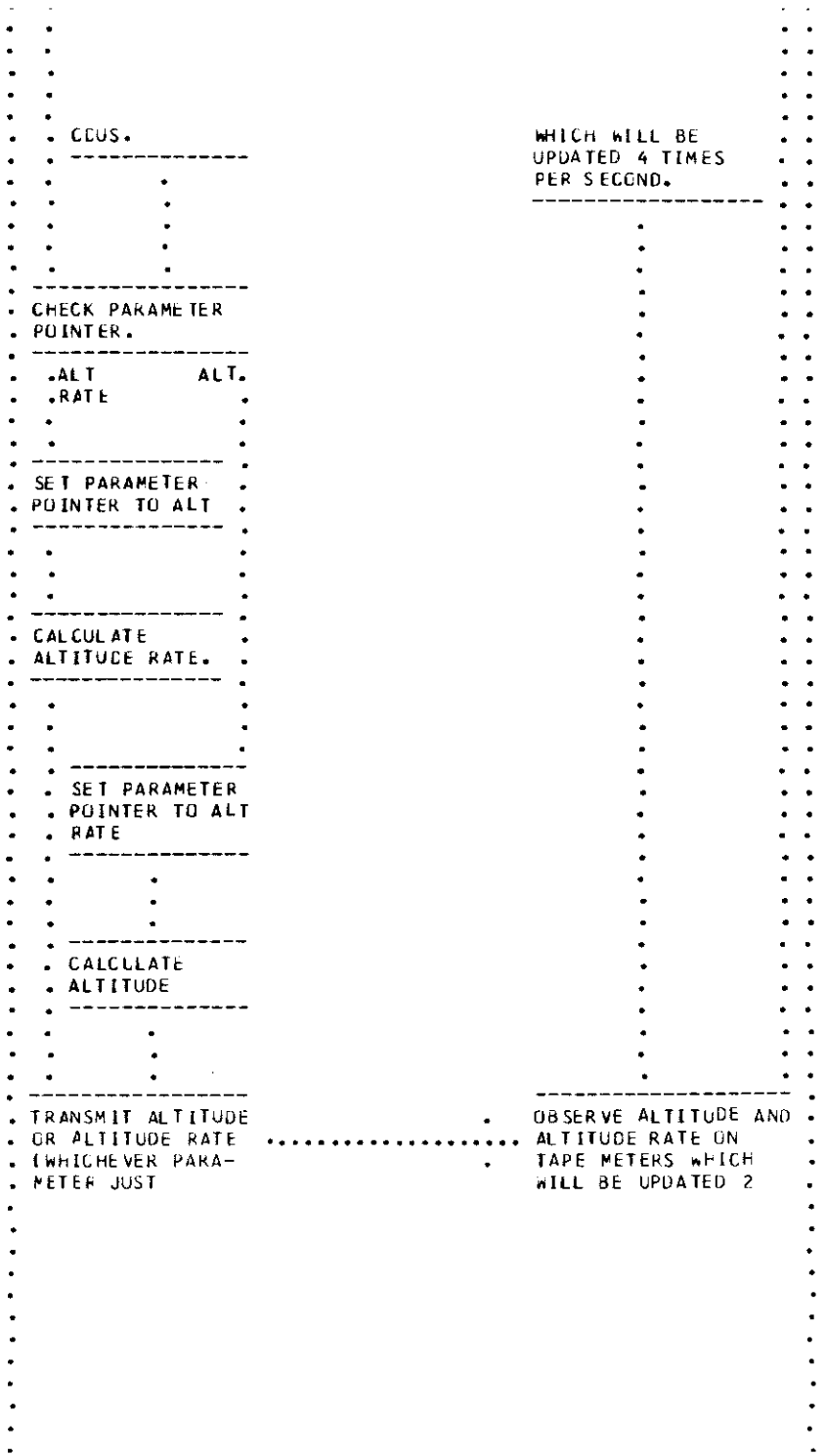
#130

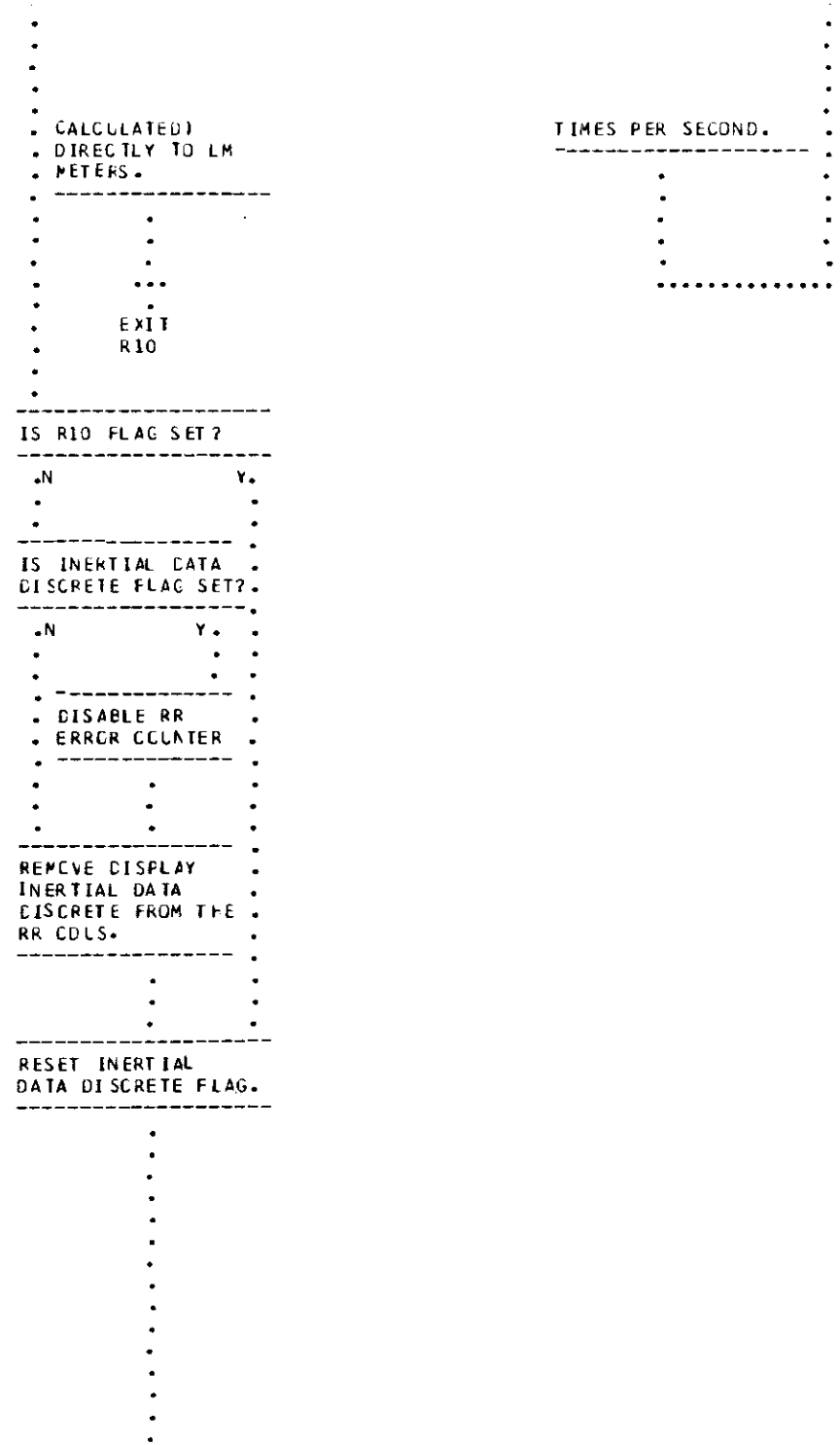
#140

#150

#160

#170


CDUS.
WHICH WILL BE UPDATED 4 TIMES PER SECOND.
CHECK PARAMETER POINTER.
#180
.ALT
.RATE
ALT.
SET PARAMETER POINTER TO ALT
#190
CALCULATE ALTITUDE RATE.
#200
SET PARAMETER POINTER TO ALT RATE
CALCULATE ALTITUDE
#210
TRANSMIT ALTITUDE OR ALTITUDE RATE (WHICHEVER PARA-METER JUST
OBSERVE ALTITUDE AND ALTITUDE RATE ON TAPE METERS WHICH WILL BE UPDATED 2



#220

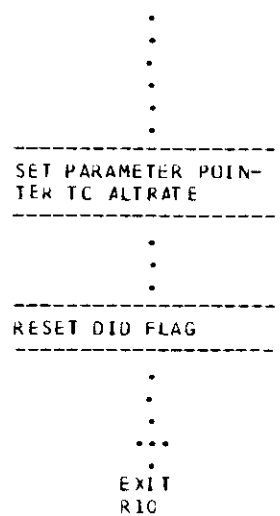
#230

#240

#250

#260

720



#270

#280

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 475, 499, 617
REV 02 EDITORIAL
REV 03(LUM 1C) PCR 285

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723

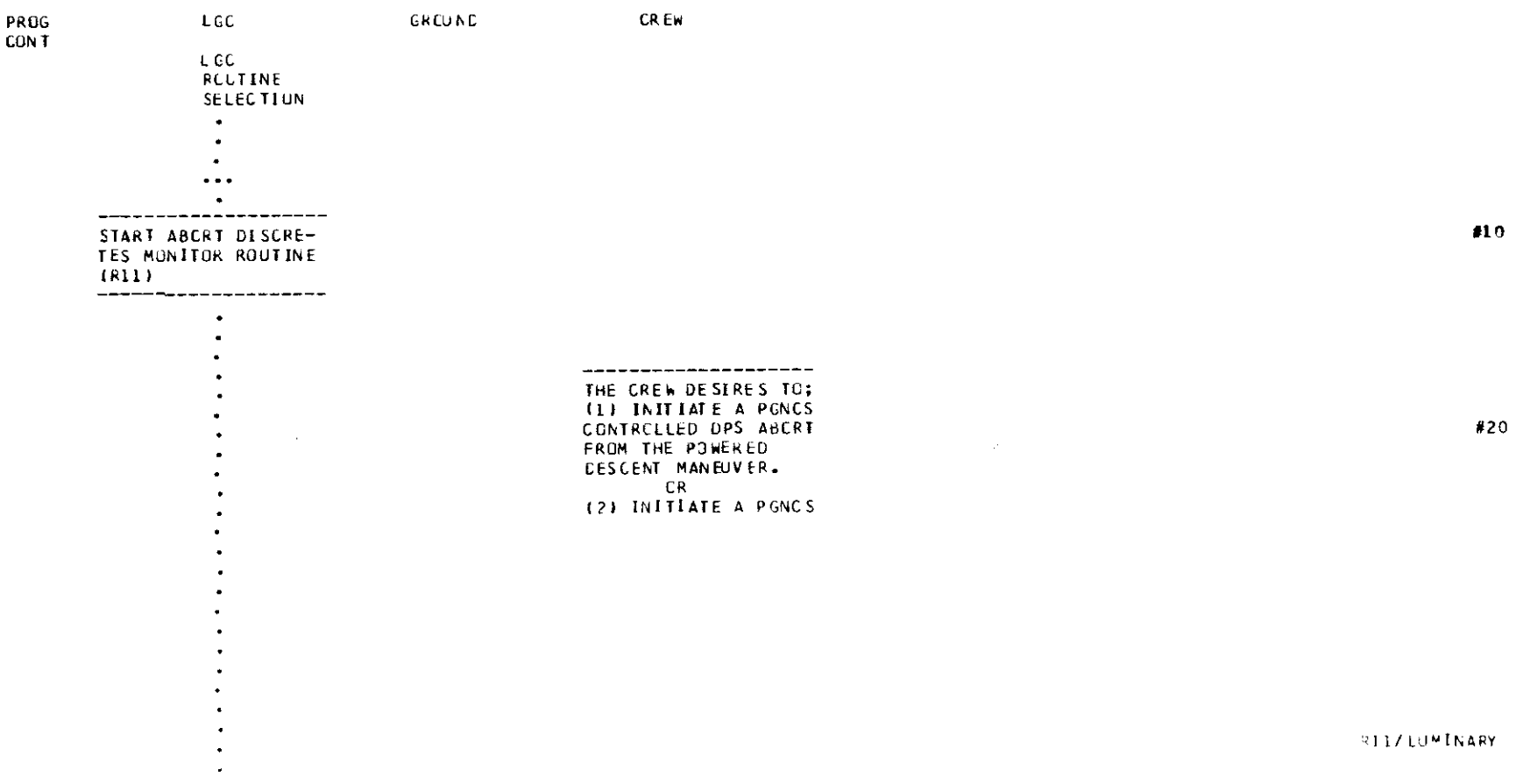
ABORT DISCRETES MONITOR ROUTINE (R11) REV 02 12/03/69

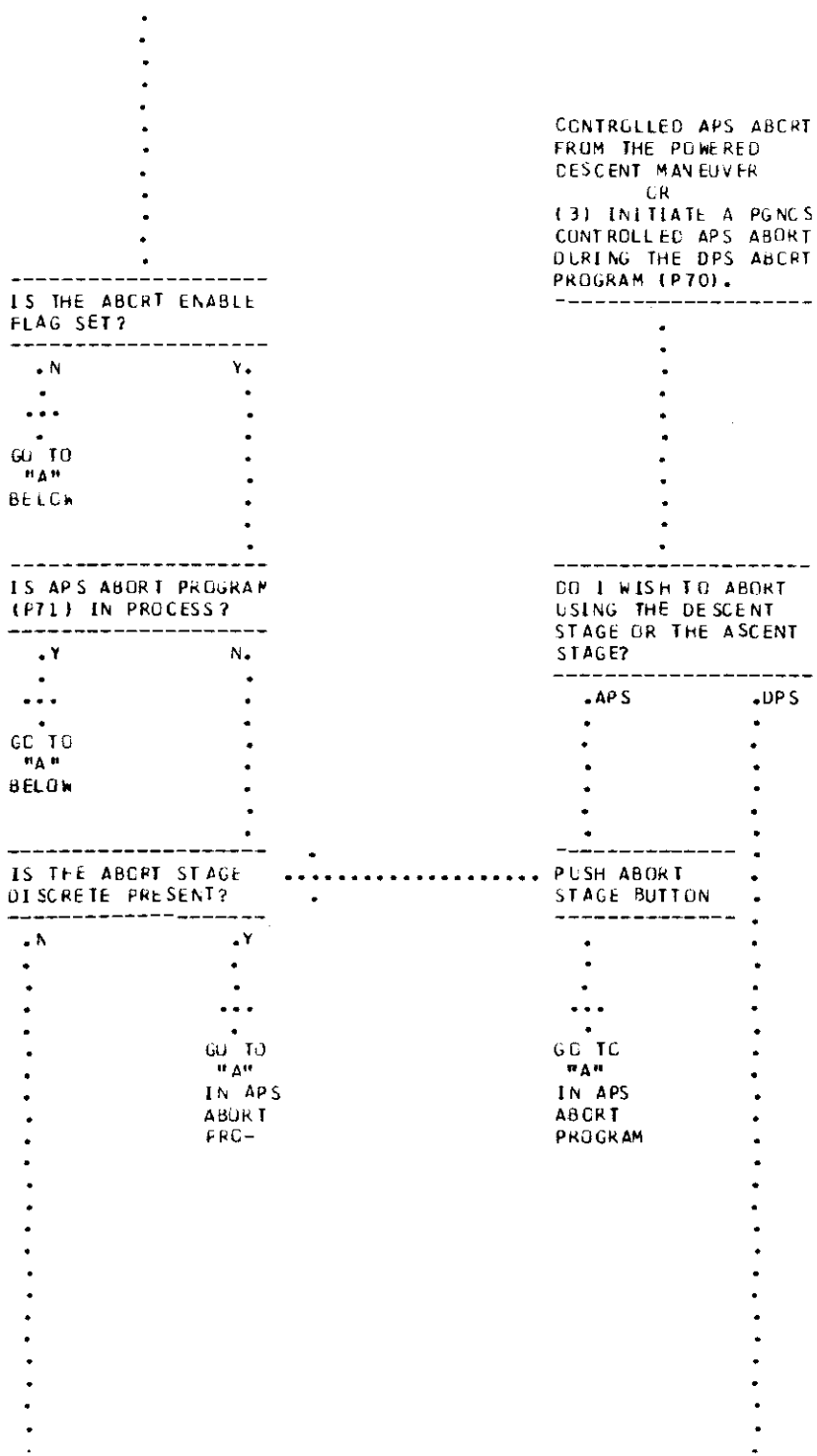
PURPOSE: (1) TO MONITOR THE ABORT AND ABORT STAGE DISCRETES TO THE LGC WHICH INDICATE WHETHER THE CREW DESIRES TO ABORT FROM THE POWERED LANDING MANEUVER AND IF SO THE TYPE OF ABORT (DPS OR APS) DESIRED.

(2) TO SELECT THE CORRECT LGC PROGRAM FOR THE TYPE OF ABORT COMMANDED BY THE CREW.

(3) TO CALL THE LANDING ANALOG DISPLAYS ROUTINE (R1C). (SEE ASSUMPTION (1)).

ASSUMPTIONS: (1) THIS ROUTINE IS CALLED EVERY 0.25 SECONDS BY THE R10/R11/R12 SERVICE ROUTINE (R09), BUT ONLY DURING P12,63, 64,65,66,70, OR 71 WHEN SERVICER (AVERAGE G) IS IN PROCESS. IN TURN IT CALLS THE LANDING ANALOG DISPLAYS ROUTINE (R1C).
++
+02
+285
++




IS THE ABORT ENABLE FLAG SET?
.N
Y.
GO TO "A" BELOW
IS APS ABORT PROGRAM (P71) IN PROCESS?
.Y
N.
GO TO "A" BELOW
IS THE ABORT STAGE DISCRETE PRESENT?
.N
.Y
GO TO "A" IN APS ABORT PRO-
CONTROLLED APS ABORT FROM THE POWERED DESCENT MANEUVER
OR
(3) INITIATE A PGNCS CONTROLLED APS ABORT DURING THE DPS ABORT PROGRAM (P70).
DO I WISH TO ABORT USING THE DESCENT STAGE OR THE ASCENT STAGE?
.APS
.DPS
PUSH ABORT STAGE BUTTON
GO TO "A" IN APS ABORT PROGRAM

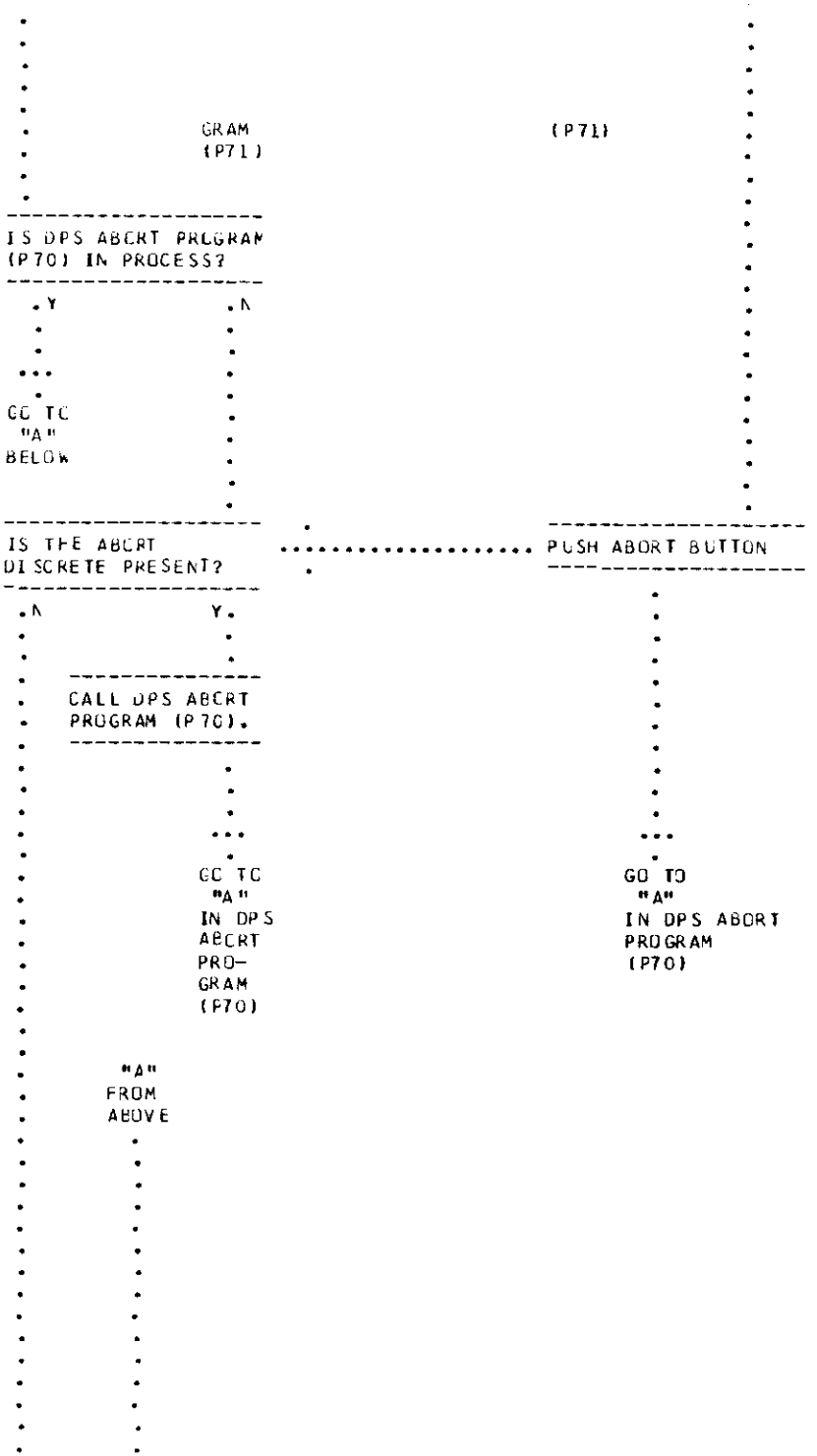
#30

#40

#50

#60

#70


GRAM
(P71)
(P71)
IS DPS ABORT PROGRAM (P70) IN PROCESS?
Y
N
GO TO "A" BELOW
IS THE ABORT DISCRETE PRESENT?
PUSH ABORT BUTTON
N
Y
CALL DPS ABORT PROGRAM (P70).
GO TO "A" IN DPS ABORT PRO-GRAM (P70)
GO TO "A" IN DPS ABORT PROGRAM (P70)
"A" FROM ABOVE

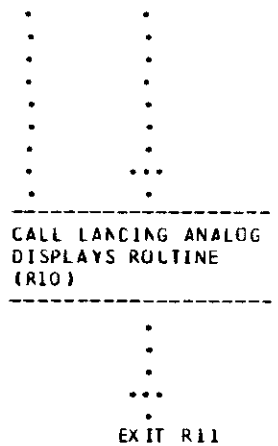
#80

#90

#100

#110

#120



#130

CHANGE CONTROL NOTES

LOGIC REV 01 NC PCR'S
REV 02(LUM 1C) PCR 285

926

DESCENT STATE VECTOR UPDATE ROUTINE (R12) REV 04 12/03/69

PURPOSE

(1) TO OBTAIN VEHICLE RANGE AND VELOCITY DATA RELATIVE TO THE LUNAR SURFACE FROM THE LR.

(2) TO INCORPORATE THE LR RANGE AND VELOCITY DATA INTO THE LM STATE VECTOR.

(3) TO NOTIFY THE CREW OF ABNORMALITIES IN THE PROCESS OF LGC INTERROGATION OF THE LR.

(4) TO COMMAND THE LR TO POSITION #2, AND ISSUE AN ALARM IF THAT COMMAND IS NOT SUCCESSFUL.

(5) TO CALL THE POWERED FLIGHT RR DESIGNATE ROUTINE (R29) IF THE LR BYPASS FLAG IS SET.

ASSUMPTIONS:

(1) THE NECESSARY PARAMETERS (AS DESCRIBED IN SECTION 5.3.4 OF R567) FOR CONVERSION OF THE LR DATA TO STATE VECTOR UPDATES ARE STORED IN THE LGC.

(2) THE FORMAT OF THE LR DATA AND THE TECHNIQUE OF ITS TRANSFER TO THE LGC ARE AS DESCRIBED IN SECTION 5.3.4 OF R567.

(3) THE LR PERMIT FLAG HAS BEEN RESET PRIOR TO THE START OF THIS ROUTINE BY R00. UNTIL THIS FLAG IS SET BY A MANUAL DSKY ENTRY (SEE (4) BELOW), NO LR DATA WILL BE INCORPORATED INTO THE LM STATE VECTOR.

(4) THERE ARE 2 EXTENDED VERBS AVAILABLE TO THE CREW TO ALLOW MANUAL CONTROL OF THE USE OF LR DATA FOR STATE VECTOR UPDATING. THEY ARE ;

++
+04
+EDIT
+285
+
+
+
+
+
+
+
+
+
+04
++

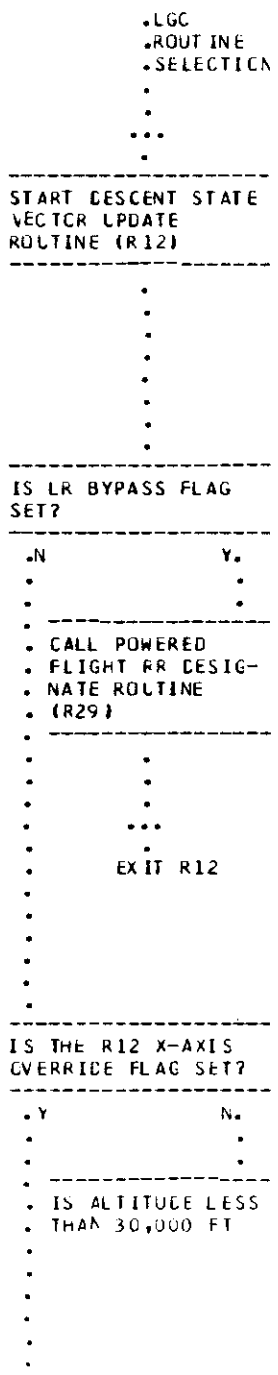
V57E SETS (OR RESETS) THE LR PERMIT FLAG, ENABLING USE OF GOOD LR DATA.

V58E RESETS THE LR PERMIT FLAG, PREVENTING USE OF ALL LR DATA.

(5) THE L, R, M, AND S COUNTERS WERE ZEROED BY P63. THE LR BYPASS FLAG WAS SET BY R00 AND RESET BY P63. THE FOLLOWING FLAGS WERE RESET BY R00: VX INHIBIT, HIGATE, NO LR READ, R12 X-AXIS OVERRIDE, LR PERMIT, VELOCITY DATA, READ VELOCITY, RANGE DATA, LPOS2, V FLASH, AND H FLASH.

(6) THIS ROUTINE IS CALLED EVERY 2 SECONDS BY SERVICER (AVERAGE G), BUT ONLY DURING P12,63,64,65,66,70 OR 71. HOWEVER THE ROUTINE IS IMMEDIATELY BYPASSED IF THE LR BYPASS FLAG IS SET. THIS FLAG IS ALWAYS SET BY R00, P70 AND P71. IT IS RESET BY P63.

PROG CONT	LGC	GROUND	CREW



#10

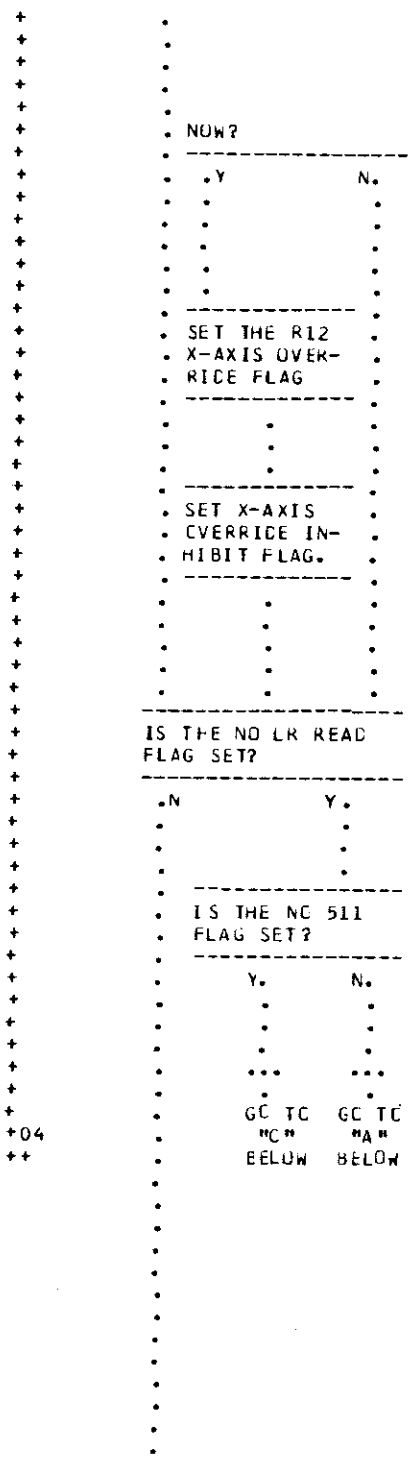
#20

#30

#40

#50

++
+04
+EDIT



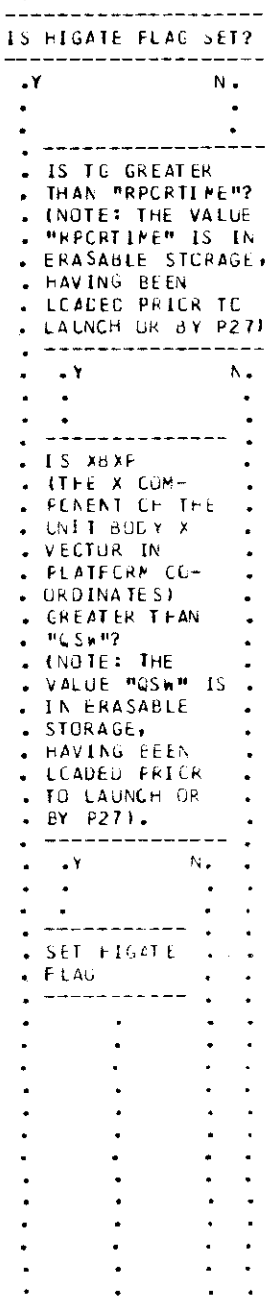
#60

#70

#80

#90

#100



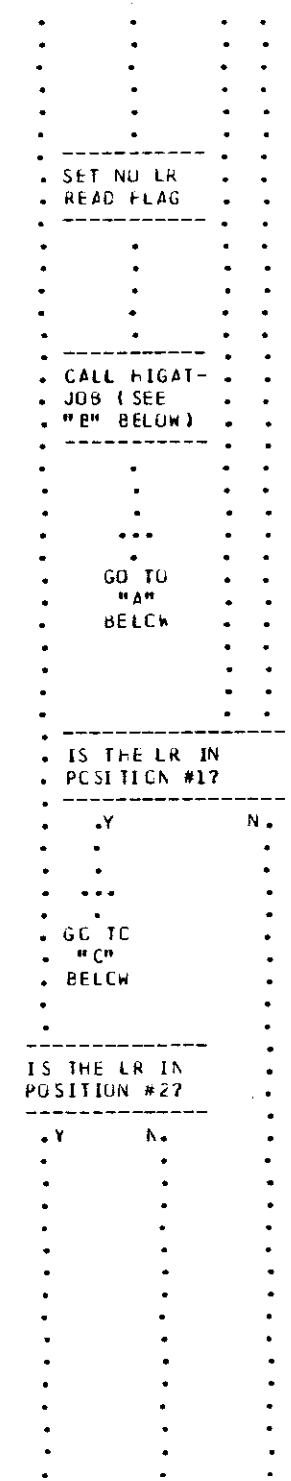
#110

#120

#130

#140

#150



#160

#170

#180

#190

#200

TURN ON PROGRAM ALARM LIGHT BUT DO NOT CHANGE PRESENT DISPLAY. STORE ALARM CODE 00511.

GO TO "A" BELOW

MONITOR DSKY:
DISCREPANCIES IN LR/LGC OPERATION THAT ARE NOT PRIORITY ALARMS WILL BE ALARMED AS FOLLOWS:

#210

(A) PROGRAM ALARM LIGHT AND STORED ALARM CODE:
(1) 00520-(SEE R20) NO RADAR SAMPLING REQUESTED FROM RADAR AT THIS TIME.

#220

(2) 00511-LR NOT IN POSITION #1 PRIOR TO HI-GATE OR NOT IN POSITION #2 SUBSEQUENT TO HI-GATE

#230

#240

"C" FROM ABOVE

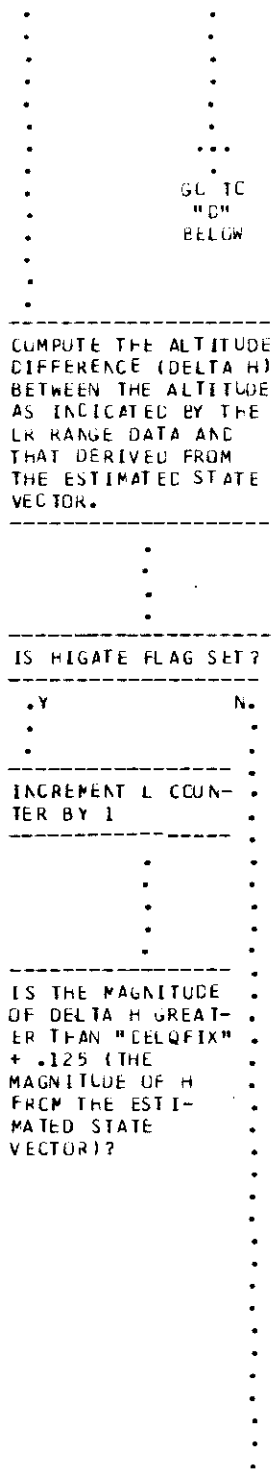
#250

IS RANGE DATA FLAG SET?

Y

N.

732

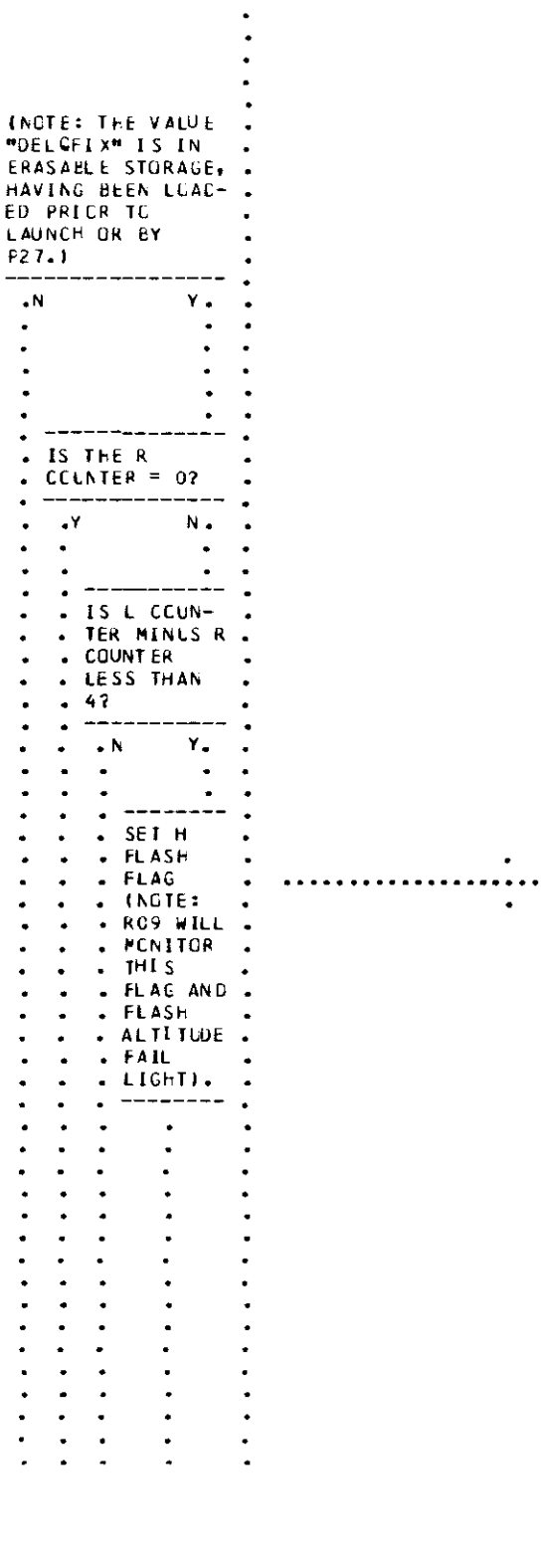


(B) ALTITUDE FAIL LIGHT ON STEADY:
(1) LR RANGE DATA GOOD DISCRETE WAS NOT PRESENT BEFORE AND AFTER LR ALTITUDE SAMPLING.

(C) VELOCITY FAIL LIGHT ON STEADY:
(1) LR VELOCITY DATA GOOD DISCRETE WAS NOT PRESENT BEFORE AND AFTER LR VELOCITY SAMPLING. (SEE R20)

(D) ALTITUDE FAIL LIGHT FLASHING:
(1) LR ALTITUDE REASONABILITY TEST WAS FAILED.

(E) VELOCITY FAIL LIGHT FLASHING:
(1) LR VELOCITY REASONABILITY



TEST WAS FAILED.

#310

735

#350

SET R COUNTER= L COUNTER.

#360

GO TO "D" BELOW

RESET h FLASH FLAG (NOTE: R09 WILL MONITOR THIS FLAG AND TURN OFF FLASH OF ALTITUDE FAIL LIGHT IF ON)

#370

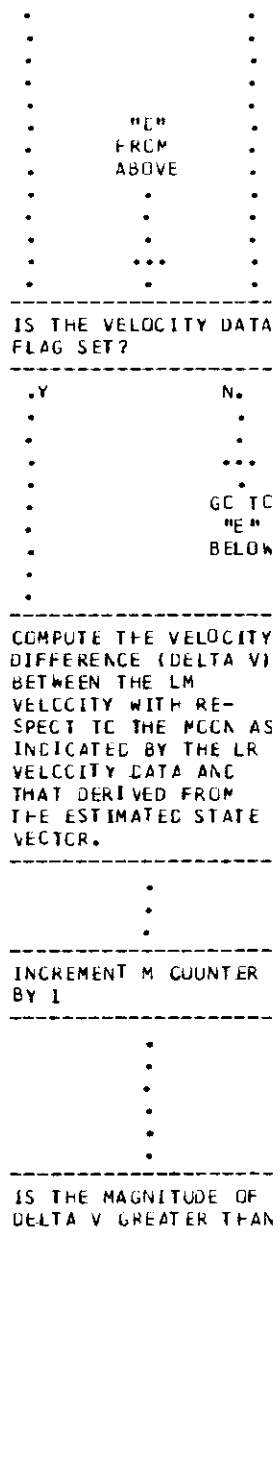
IS LR PERMIT FLAG SET?

#380

Y / N

UPDATE THE PRESENT LM POSITION VECTOR USING LR RANGE DATA.

#390



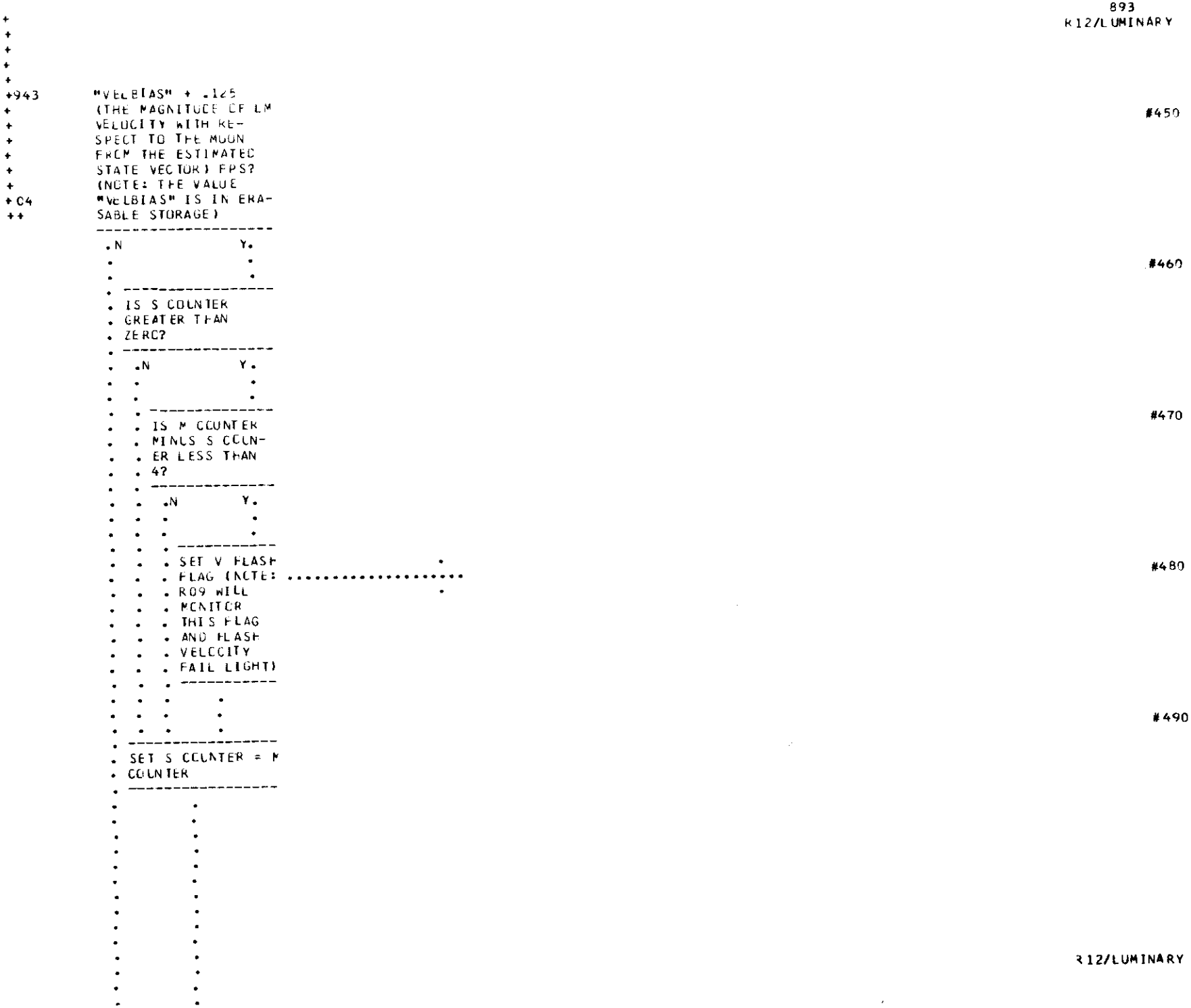
#400

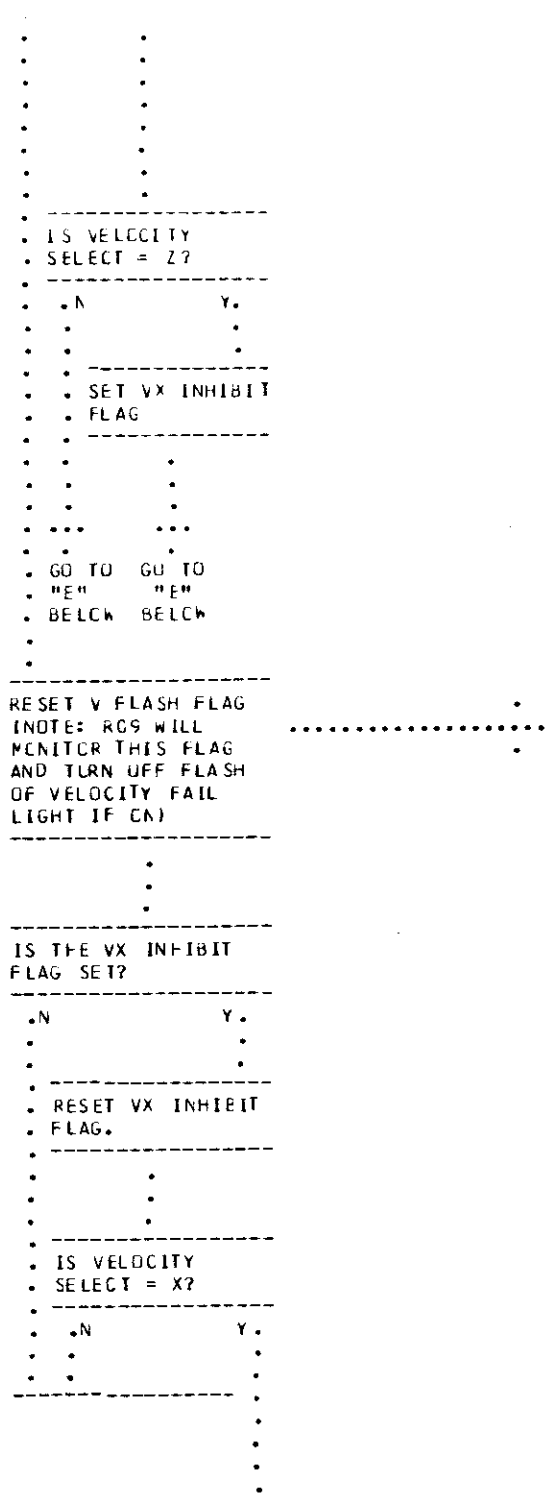
#410

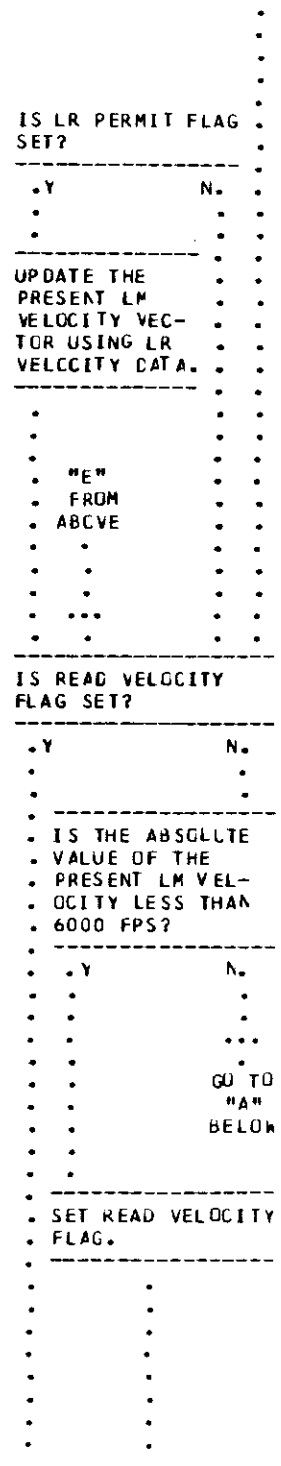
#420

#430

#440


"VELBIAS" + .125
(THE MAGNITUDE OF LM
VELOCITY WITH RE-
SPECT TO THE MOON
FROM THE ESTIMATED
STATE VECTOR) FPS?
(NOTE: THE VALUE
"VELBIAS" IS IN ERA-
SABLE STORAGE)
.N
Y.
IS S COUNTER
GREATER THAN
ZERO?
.N
Y.
IS M COUNTER
MINUS S COUN-
ER LESS THAN
4?
.N
Y.
SET V FLASH
FLAG (NOTE:
R09 WILL
MONITOR
THIS FLAG
AND FLASH
VELOCITY
FAIL LIGHT)
SET S COUNTER = M
COUNTER
#450
#460
#470
#480
#490


#500
IS VELOCITY SELECT = Z?
N
Y
SET VX INHIBIT FLAG
#510
GO TO "E" BELOW
GO TO "E" BELOW
#520
RESET V FLASH FLAG
(NOTE: RCS WILL MONITOR THIS FLAG AND TURN OFF FLASH OF VELOCITY FAIL LIGHT IF ON)
#530
IS THE VX INHIBIT FLAG SET?
N
Y
RESET VX INHIBIT FLAG.
#540
IS VELOCITY SELECT = X?
#550
N
Y



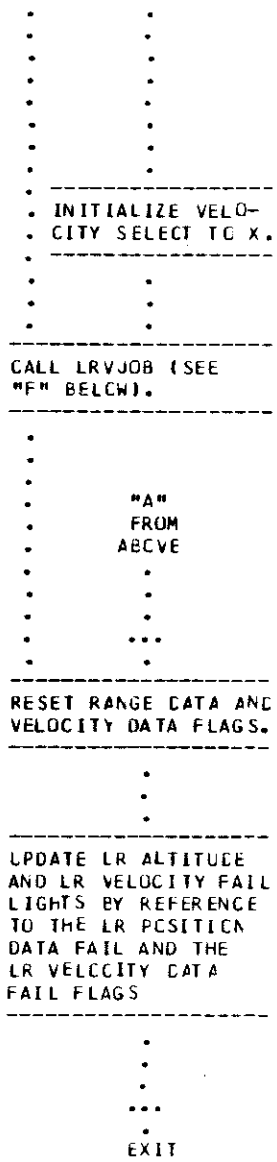
#560

#570

#580

#590

#600



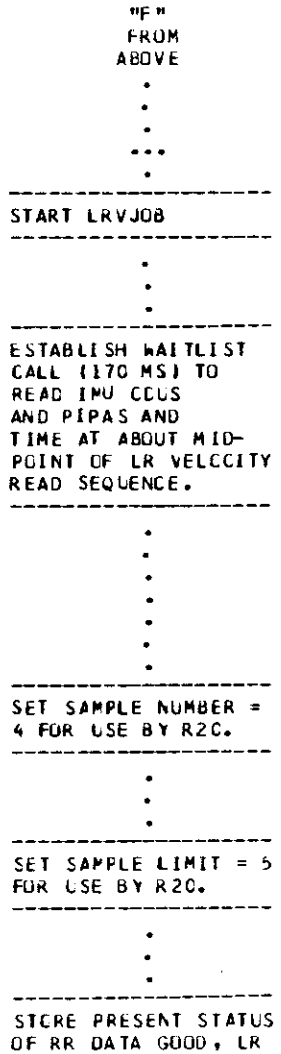
#610

#620

#630

#640

#650



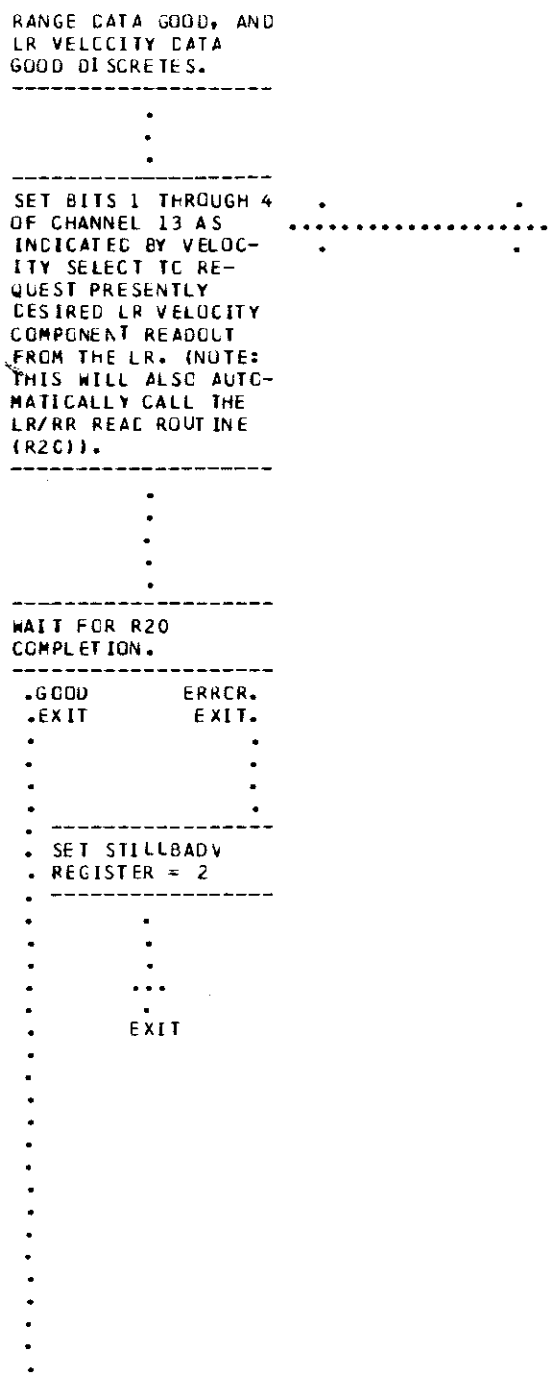
#660

#670

#680

#690

#700



#710

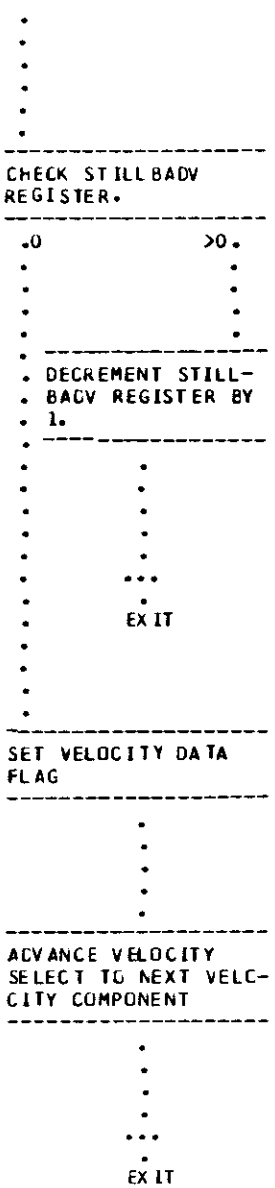
#720

#730

#740

#750

743



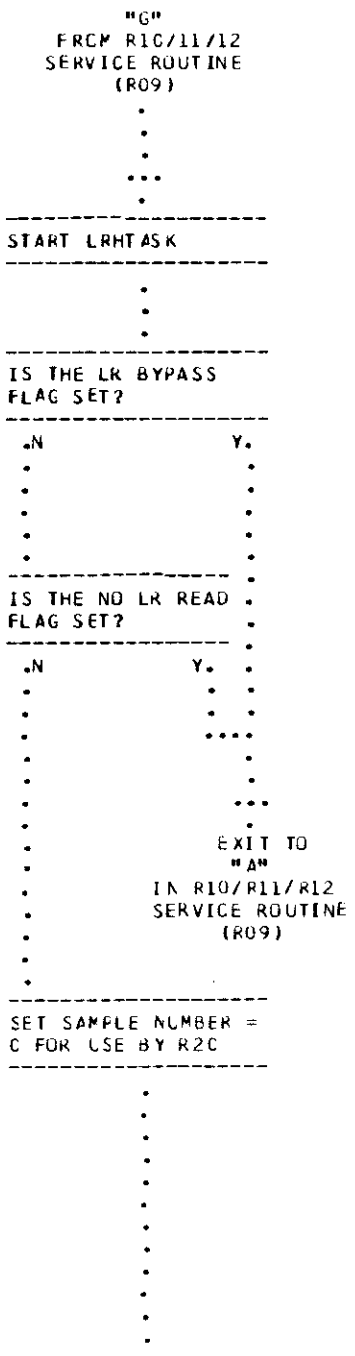
#760

#770

#780

#790

#800



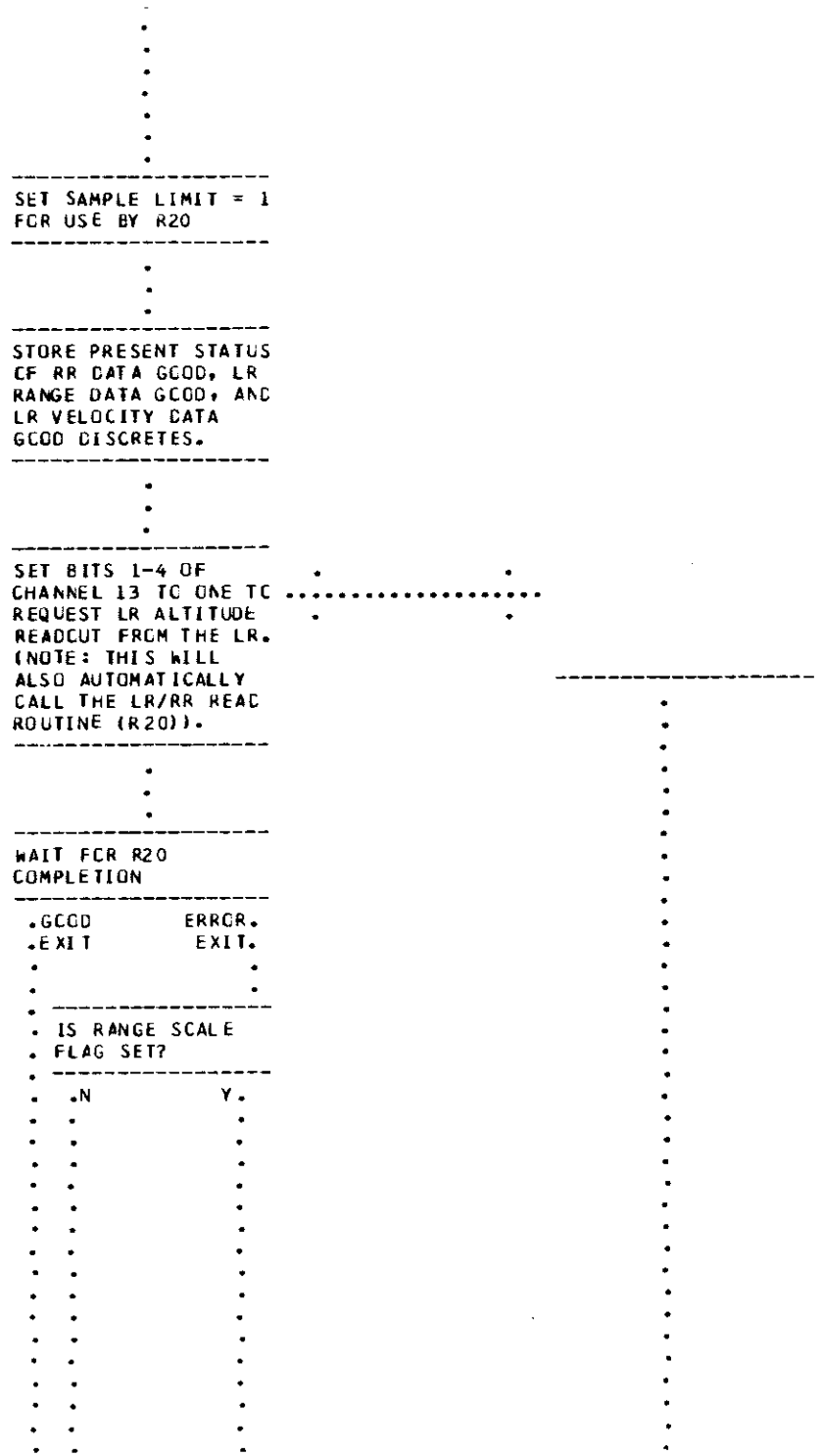
#810

#820

#830

#840

#850



#860

#870

#880

#890

#900

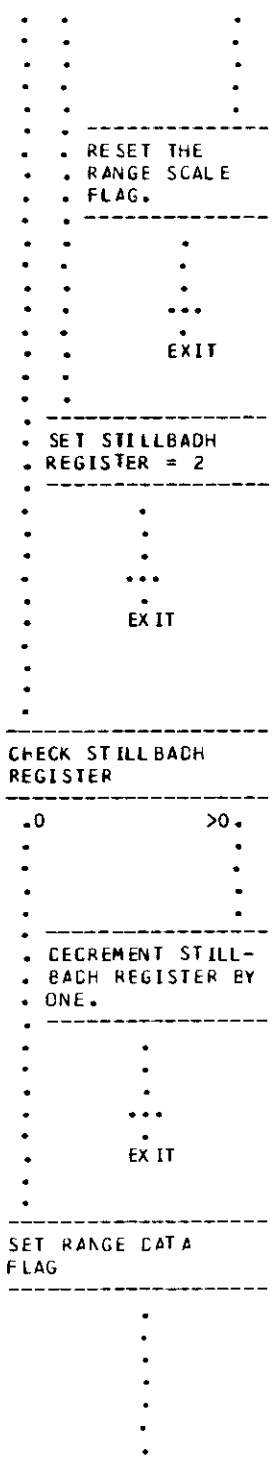
#910

#920

#930

#940

#950



EXIT

#960

"B"
FROM
ABOVE

#970

START HIGATJOB

SET LR POSITION FLAG

#980

IS LR ALREADY IN
POSITION #2?

#990

Y

N

GO TO
"G"
BELOW

#1000

COMMAND LR TO
POSITION #2.

#1010

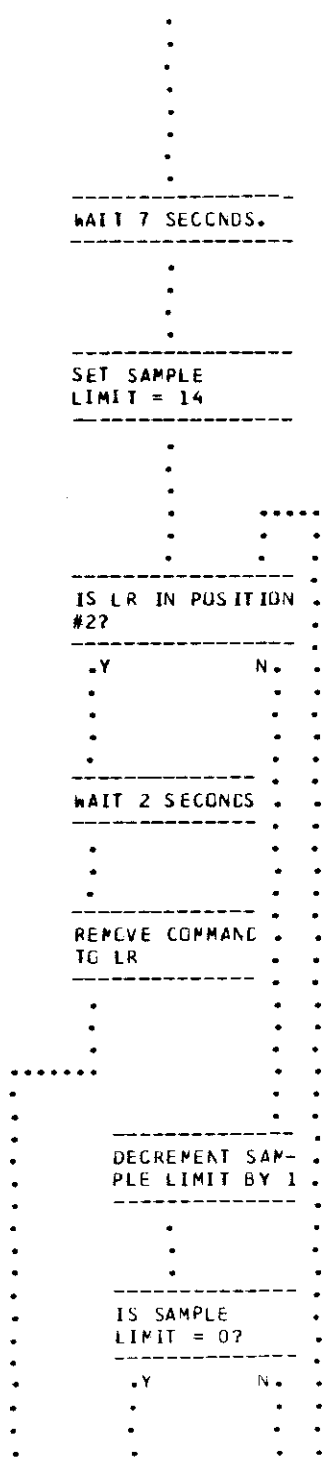
#1020

#1030

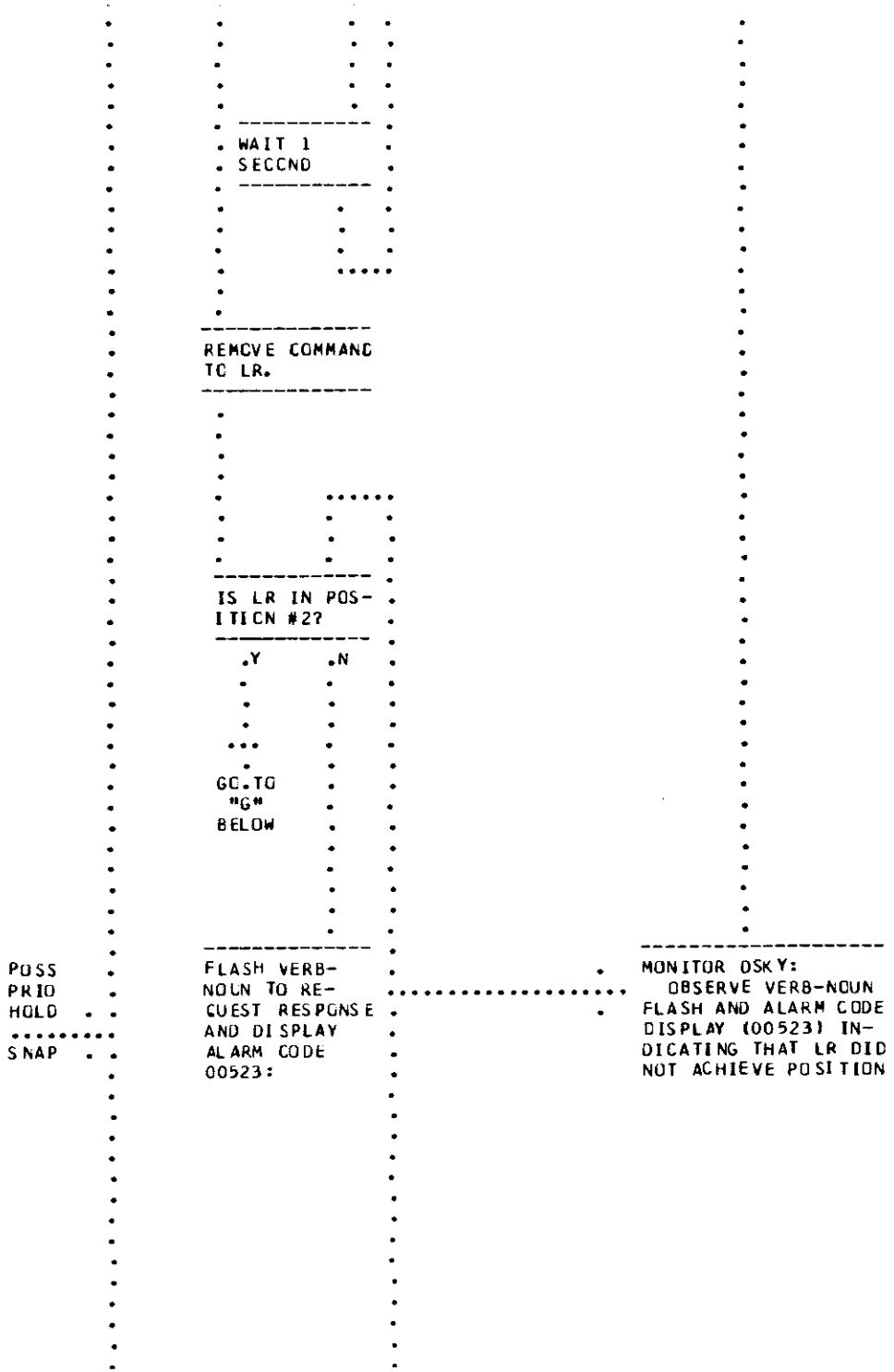
#1040

#1050

#1060



749



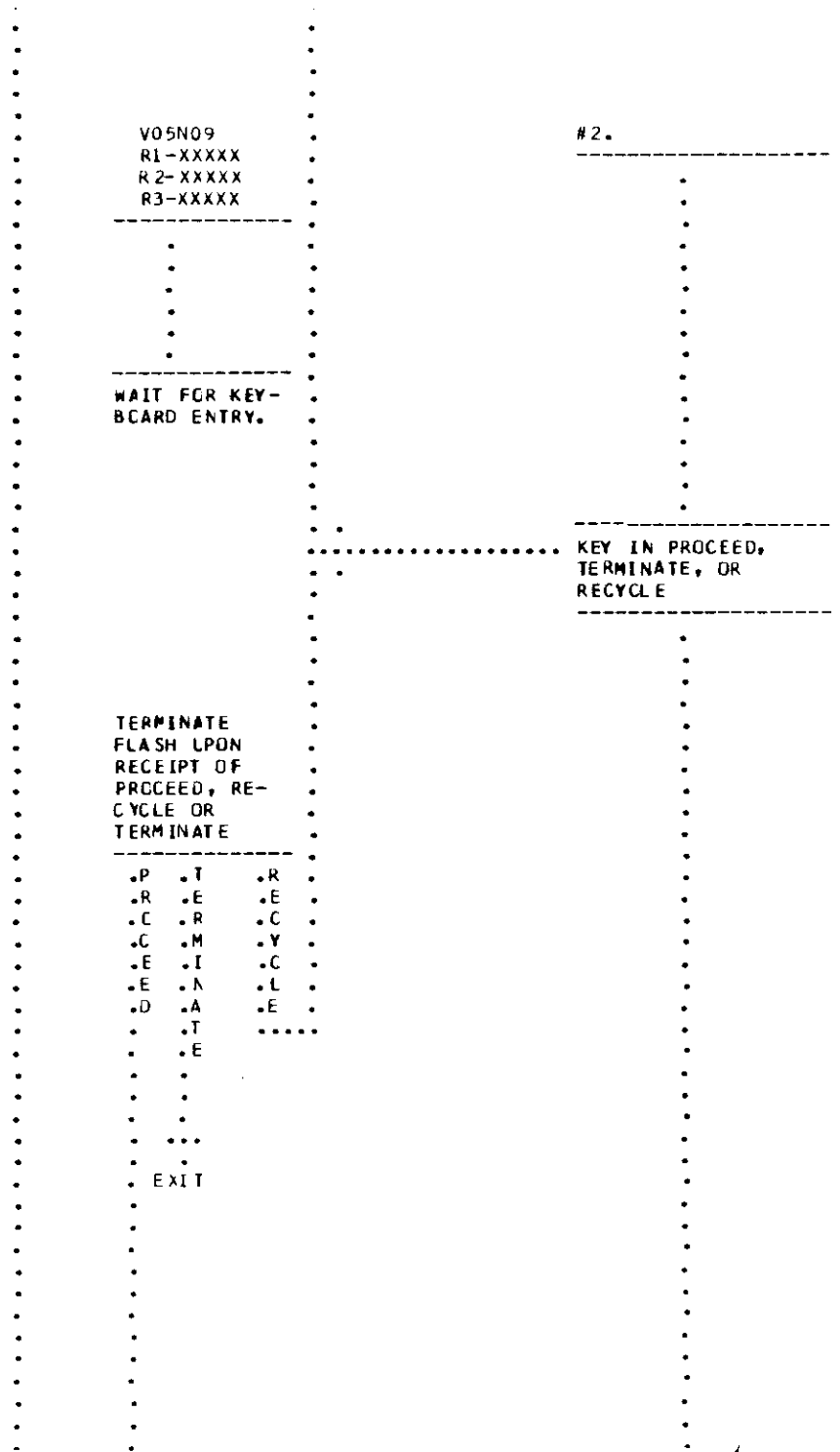
#1070

#1080

#1090

#1100

#1110



#1120

#1130

#1140

#1150

#1160

751

R12

SET THE NC 511 FLAG

#1170

IS THE LR IN POSITION #1? (NOTE: IF THE LR IS NOT IN POSITION #1, IT COULD BE EITHER IN POSITION #2, OR IN BETWEEN POSITIONS #1 AND #2)

#1180

N Y

"G" FROM ABOVE

#1190

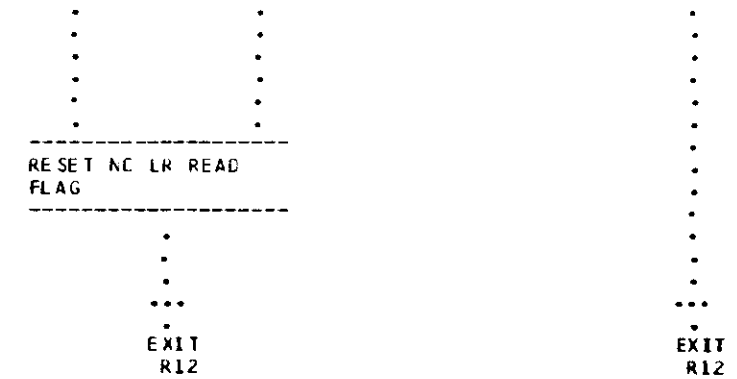
USE LR DATA AS IF THE LR WERE IN POSITION #2

USE LR DATA AS IF THE LR WERE IN POSITION #1

#1200

SET LR POSITION FLAG

#1210



#1220

CHANGE CONTROL NOTES

LOGIC REV 00 PCR 13
REV 01 PCR 118,137,214,216,226,234,244,246,248,253,568,632,639
REVS 02,03(LUM 1B) PCR 817,82C,839,855, EDITORIAL
REV 04(LUM 1C) PCR 285,943, EDITORIAL

752

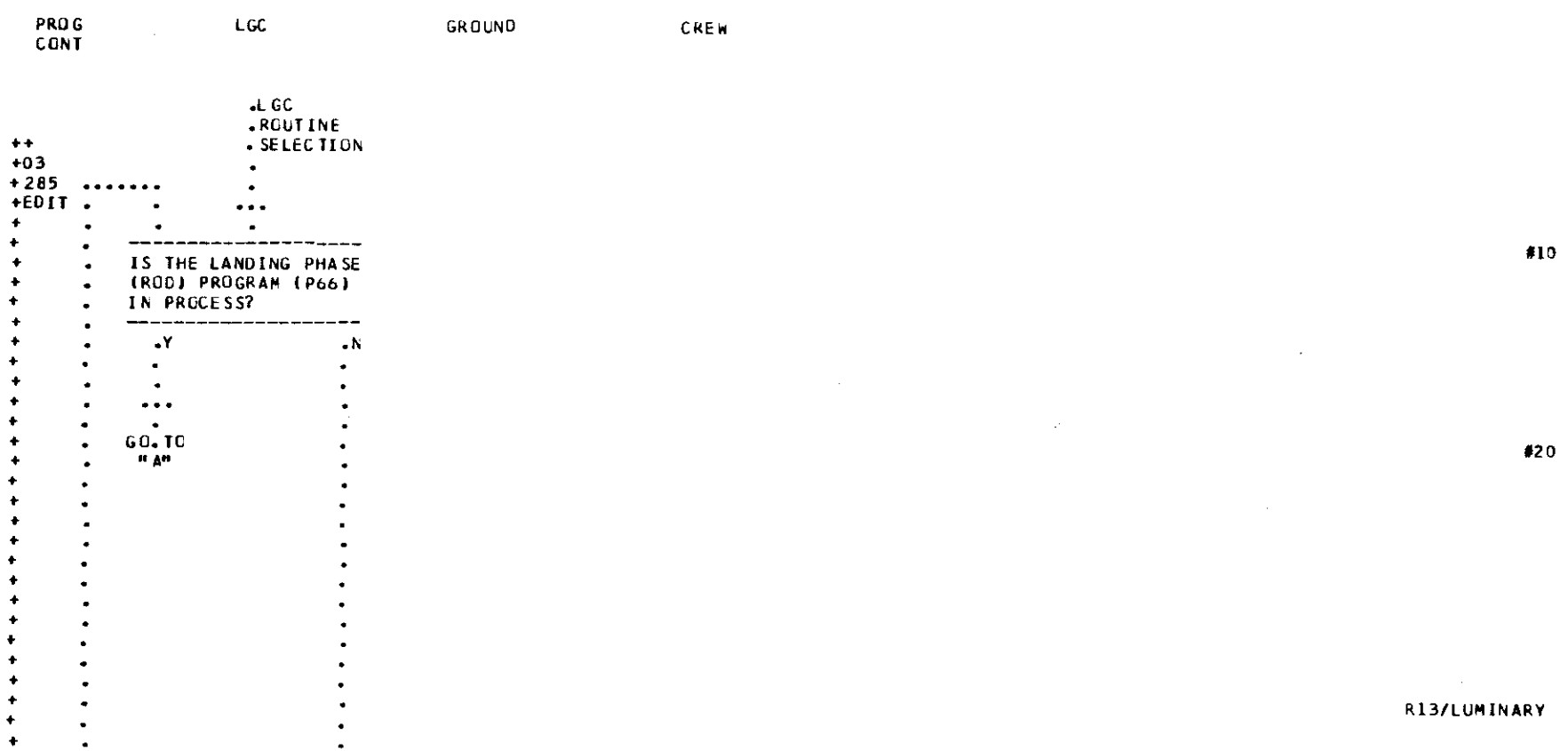
LANDING AUTO MODES MONITOR ROUTINE (R13) REV 03 12/03/69

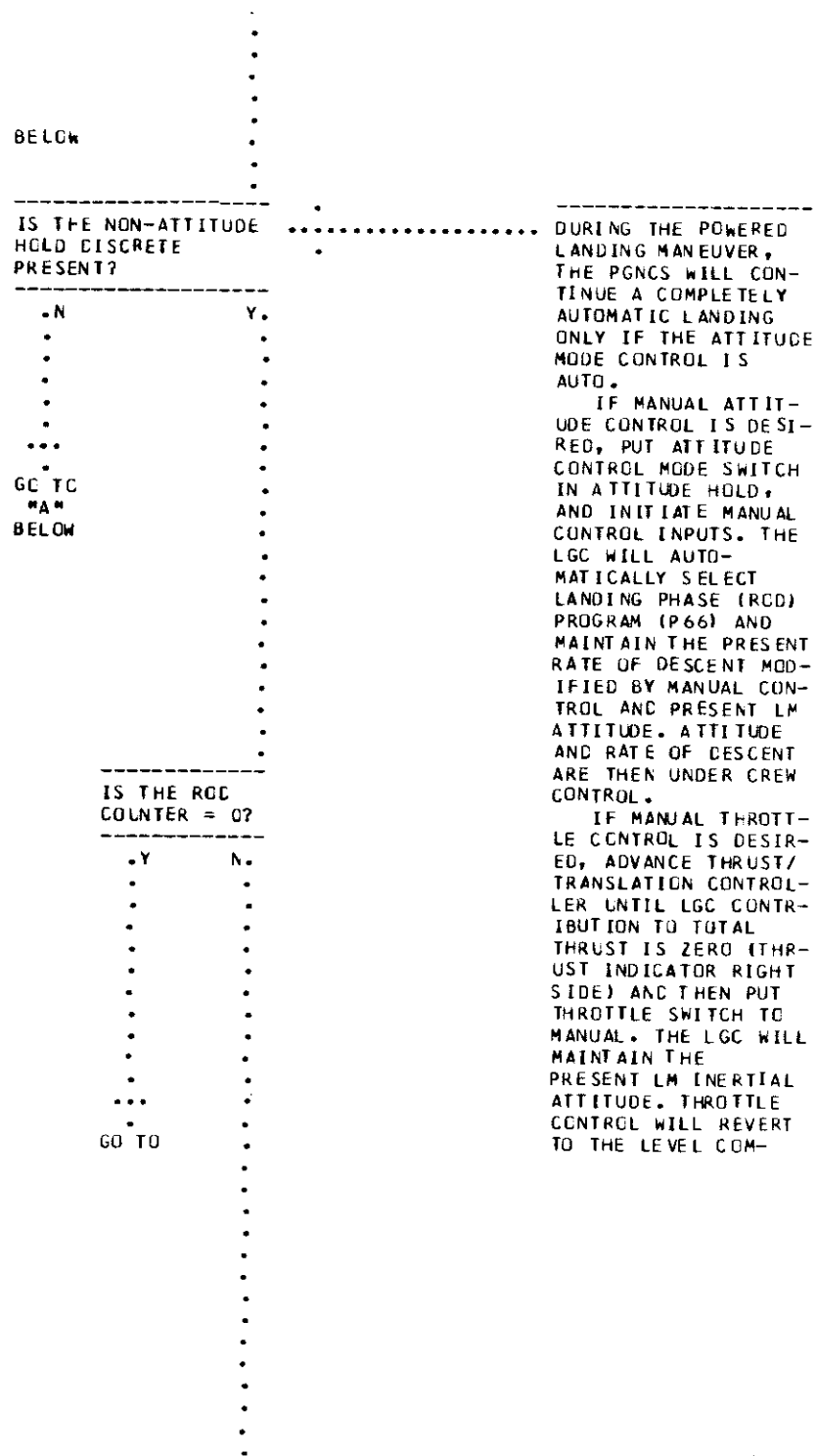
PURPOSE: (1) TO MONITOR THE AUTO STABILIZATION DISCRETE DURING THE POWERED LANDING MANEUVER IN ORDER TO DETECT IF AND WHEN THE ATTITUDE MODE CONTROL SWITCH IS MOVED FROM AUTO TO ATTITUDE HOLD.

ASSUMPTIONS: (1) THIS ROUTINE WILL OPERATE IDENTICALLY FOR EITHER PGNCS OR AGS GUIDANCE CONTROL SELECTION.

(2) THIS ROUTINE IS AUTOMATICALLY CALLED EVERY 2 SECONDS BY THE LANDING GUIDANCE CALCULATION CYCLE ONLY DURING THE LUNAR LANDING (P63,64,65, OR 66) AFTER THROTTLE UP IN P63. IT IS TERMINATED BY V37E68E SELECTION OF P68.

(3) PLACING THE THROTTLE CONTROL SWITCH INTO MANUAL IN P63, P64, P65 OR P66 WILL CUT OFF THE LGC (I.E. AUTO) THROTTLE SIGNAL; THUS ENGINE THRUST LEVEL WILL IMMEDIATELY DROP TO THAT COMMANDED BY WHICHEVER HAND THROTTLE IS "LIVE". THEREFORE A TRANSITION FROM AUTO-THROTTLE TO MANUAL THROTTLE CONTROL CANNOT BE SMOOTH: IF THE SWITCH IS PUT IN MANUAL BEFORE THE MANUAL THROTTLE IS BROUGHT UP, THRUST WILL DROP; IF THE MANUAL THROTTLE IS BROUGHT UP BEFORE THE SWITCH IS "SWITCHED", SINCE THE MANUAL AND AUTO-THROTTLE SIGNALS ARE ADDED, THERE WILL BE IRREGULAR THROTTLING AS THE LGC CORRECTS FOR THE EXCESSIVE THRUST.





DURING THE POWERED LANDING MANEUVER, THE PGNCS WILL CONTINUE A COMPLETELY AUTOMATIC LANDING ONLY IF THE ATTITUDE MODE CONTROL IS AUTO.

IF MANUAL ATTITUDE CONTROL IS DESIRED, PUT ATTITUDE CONTROL MODE SWITCH IN ATTITUDE HOLD, AND INITIATE MANUAL CONTROL INPUTS. THE LGC WILL AUTOMATICALLY SELECT LANDING PHASE (ROD) PROGRAM (P66) AND MAINTAIN THE PRESENT RATE OF DESCENT MODIFIED BY MANUAL CONTROL AND PRESENT LM ATTITUDE. ATTITUDE AND RATE OF DESCENT ARE THEN UNDER CREW CONTROL.

IF MANUAL THROTTLE CONTROL IS DESIRED, ADVANCE THRUST/TRANSLATION CONTROLLER UNTIL LGC CONTRIBUTION TO TOTAL THRUST IS ZERO (THRUST INDICATOR RIGHT SIDE) AND THEN PUT THROTTLE SWITCH TO MANUAL. THE LGC WILL MAINTAIN THE PRESENT LM INERTIAL ATTITUDE. THROTTLE CONTROL WILL REVERT TO THE LEVEL COM-

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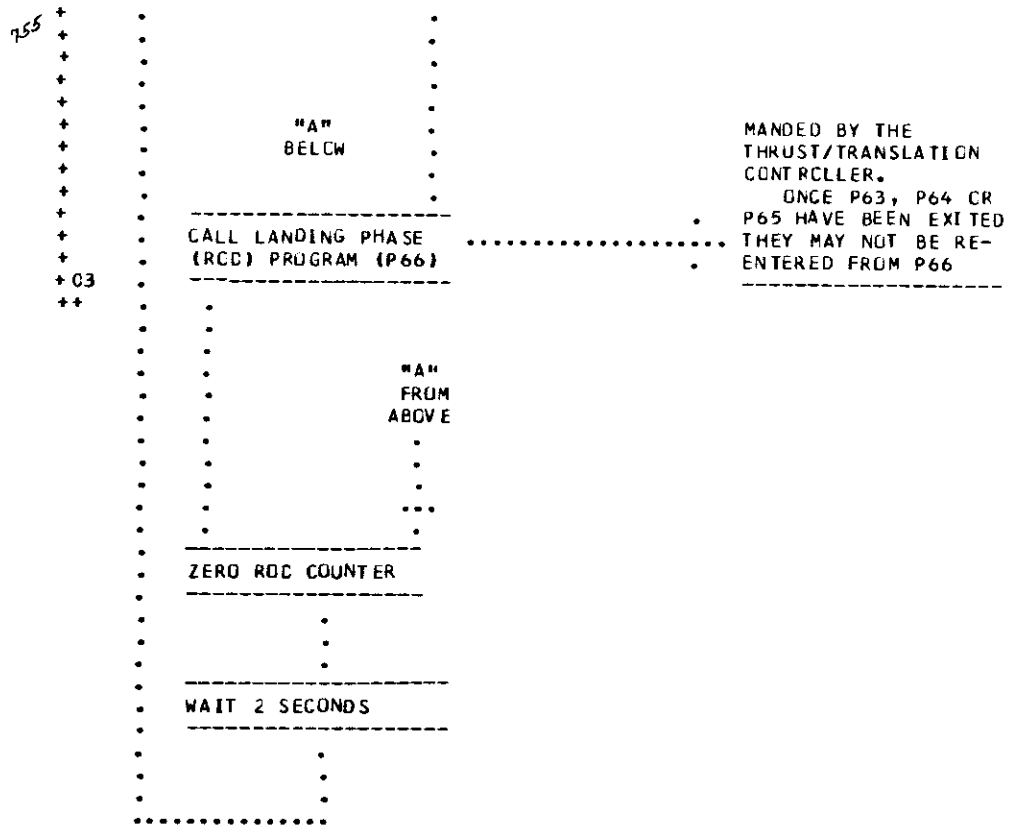
754



CHANGE CONTROL NOTES

REV 01 EDITORIAL
REV 00(LUM 1A) PCR 700,737
REV 02 EDITORIAL
REV 03(LLM 1C) PCR 285,EDITORIAL

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LR/RR READ ROUTINE (R20) REV 02 08/07/69

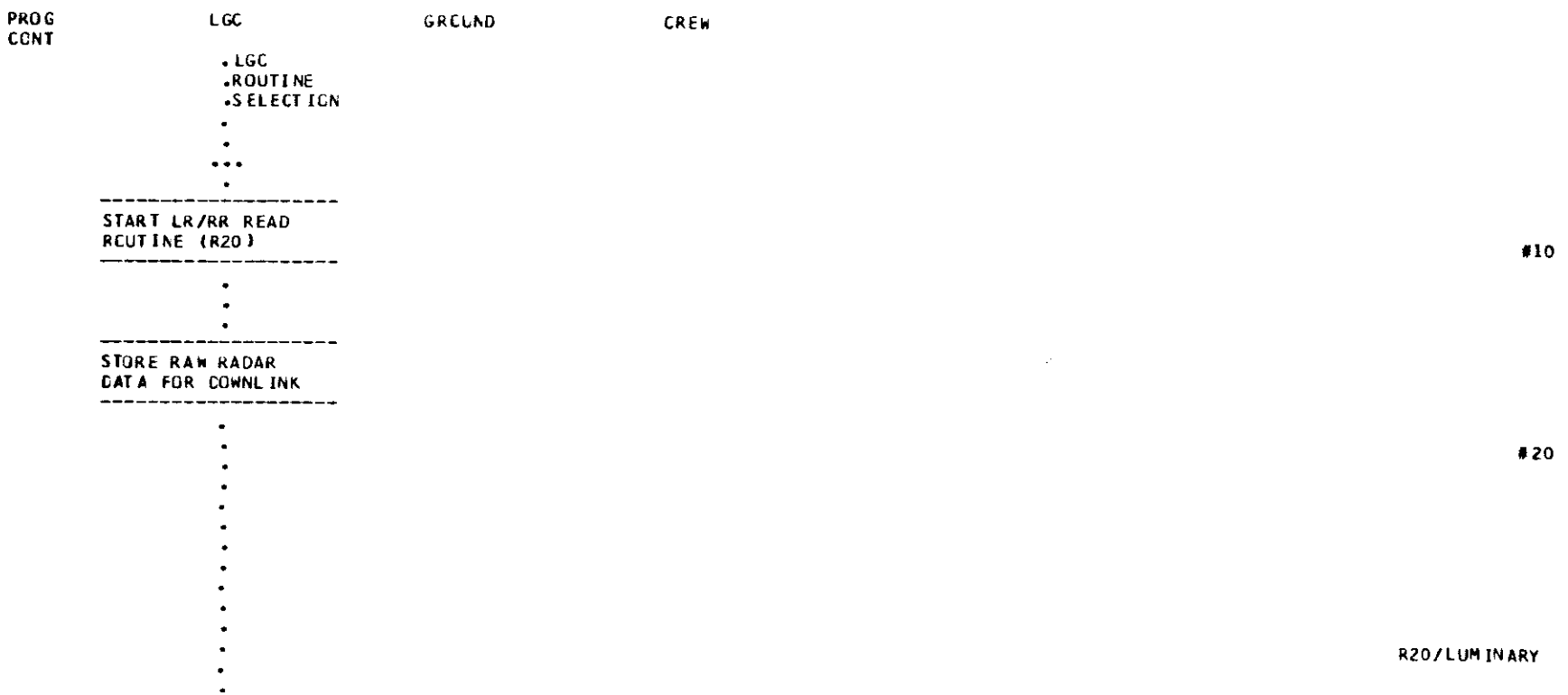
PURPOSE: (1) READ THE LR/RR PARAMETER REQUESTED BY THE CALLING ROUTINE TO PERFORM VARIOUS CHECKS TO ENSURE THAT THE SYSTEM IS OPERATING CORRECTLY, AND TO ISSUE AN ALARM IF ERRORS OCCUR IN LR OR RR READING.

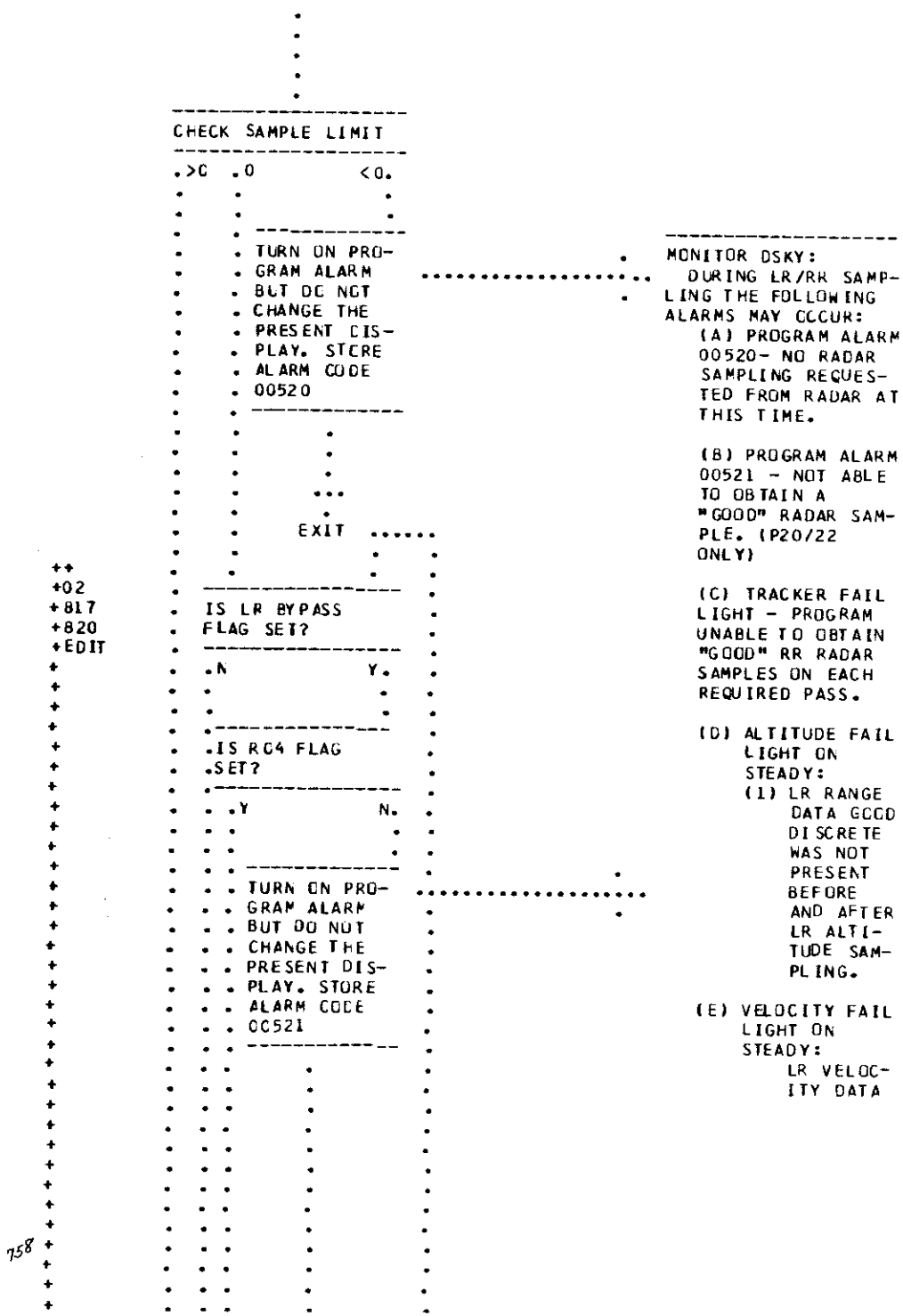
ASSUMPTIONS: (1) THE NUMBER OF SAMPLES (SAMPLE NUMBER) WAS SET BY THE CALLING ROUTINE AS FOLLOWS:
SAMPLE NUMBER = 0 FOR LR ALT, RR RANGE RATE, RR RANGE
SAMPLE NUMBER = 4 FOR LR X VELOCITY, Y VELOCITY, AND Z VELOCITY

(2) THE CALLING ROUTINE HAS REQUESTED A PARAMETER SAMPLE FROM ONE OF THE RADARS BY APPROPRIATE SPECIFICATION OF BITS 1 THROUGH 4 OF CHANNEL 13.

(3) THE LIMIT ON THE NUMBER OF SAMPLING CYCLES (SAMPLE LIMIT) HAS BEEN SPECIFIED BY THE CALLING ROUTINE TO BE EQUAL TO THE SAMPLE NUMBER PLUS 1.

(4) THIS ROUTINE IS AUTOMATICALLY CALLED BY A RADARUPT (LGC INTERRUPT) CAUSED BY EXPIRATION OF A TIME DELAY (85-95 MS) AFTER BIT 4 OF CHANNEL 13 IS SET. THE ROUTINES THAT SET BIT 4 OF CHANNEL 13 ARE THE LR/RR SELF TEST ROUTINE (R04), THE DESCENT STATE VECTOR UPDATE ROUTINE (R12), THE RR DATA READ ROUTINE (R22), THE POWERED FLIGHT DESIGNATE ROUTINE (R29), AND THE LR SPURIOUS TEST (R77).




CHECK SAMPLE LIMIT
>0
0
<0
TURN ON PRO-
GRAM ALARM
BUT DO NOT
CHANGE THE
PRESENT DIS-
PLAY. STORE
ALARM CODE
00520
EXIT
IS LR BYPASS
FLAG SET?
N
Y
IS RC4 FLAG
SET?
Y
N
TURN ON PRO-
GRAM ALARM
BUT DO NOT
CHANGE THE
PRESENT DIS-
PLAY. STORE
ALARM CODE
00521
MONITOR DSKY:
DURING LR/RR SAMP-
LING THE FOLLOWING
ALARMS MAY OCCUR:
(A) PROGRAM ALARM
00520- NO RADAR
SAMPLING REQUES-
TED FROM RADAR AT
THIS TIME.
(B) PROGRAM ALARM
00521 - NOT ABLE
TO OBTAIN A
"GOOD" RADAR SAM-
PLE. (P20/22
ONLY)
(C) TRACKER FAIL
LIGHT - PROGRAM
UNABLE TO OBTAIN
"GOOD" RR RADAR
SAMPLES ON EACH
REQUIRED PASS.
(D) ALTITUDE FAIL
LIGHT ON
STEADY:
(1) LR RANGE
DATA GOOD
DISCRETE
WAS NOT
PRESENT
BEFORE
AND AFTER
LR ALTI-
TUDE SAM-
PLING.
(E) VELOCITY FAIL
LIGHT ON
STEADY:
LR VELOC-
ITY DATA
++
+02
+817
+820
+EDIT
758

#30

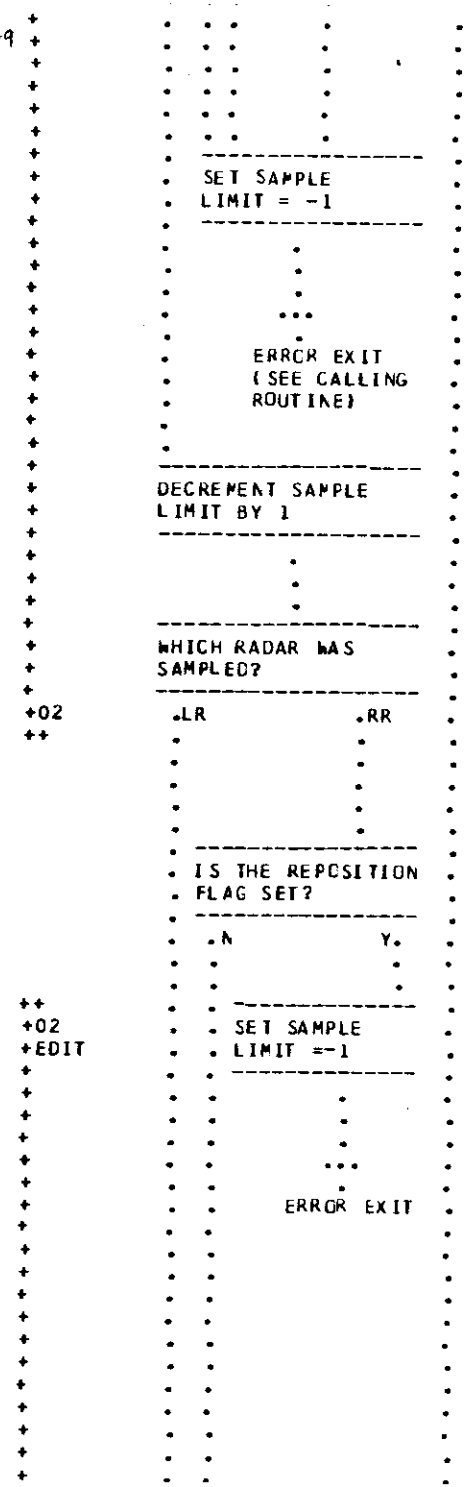
#40

#50

#60

#70

759



GOOD DISCRETE WAS NOT PRESENT BEFORE AND AFTER LR VELOCITY SAMPLING.

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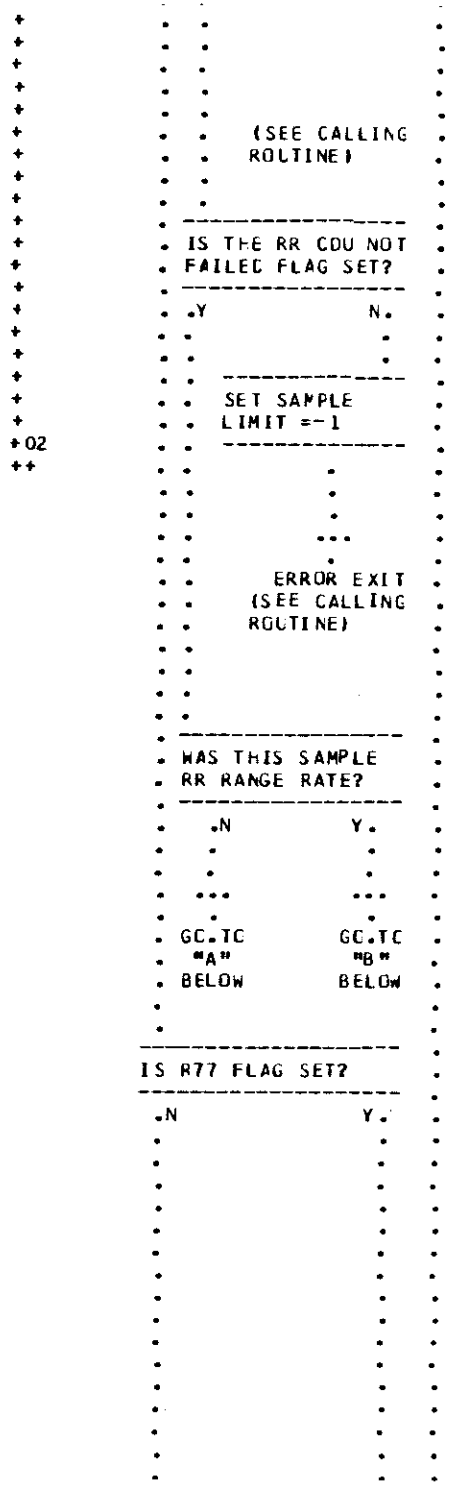
#120



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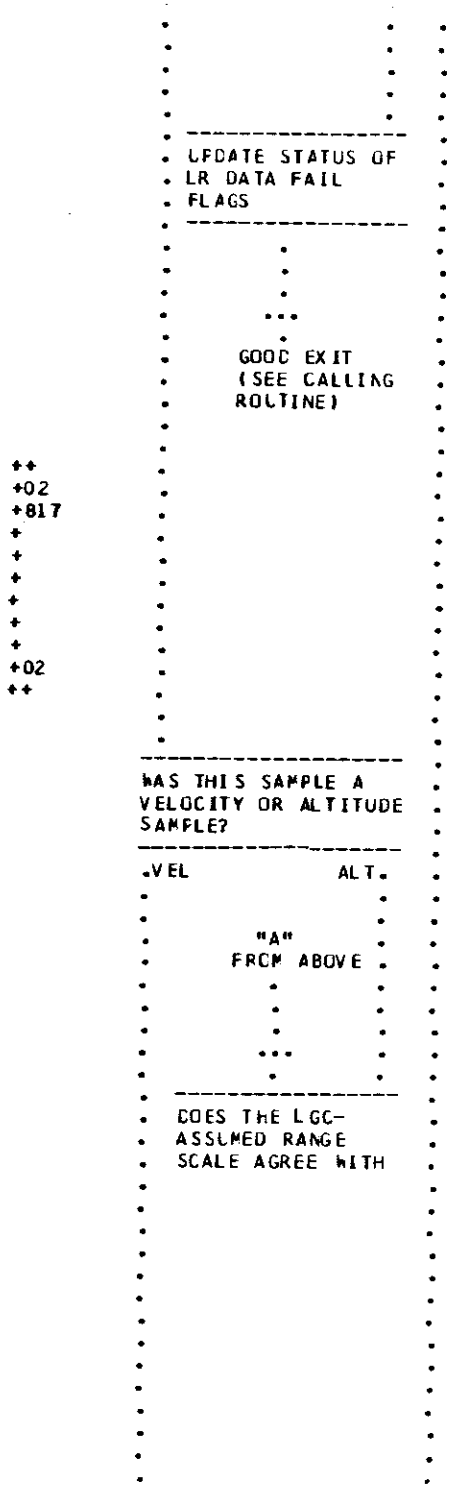

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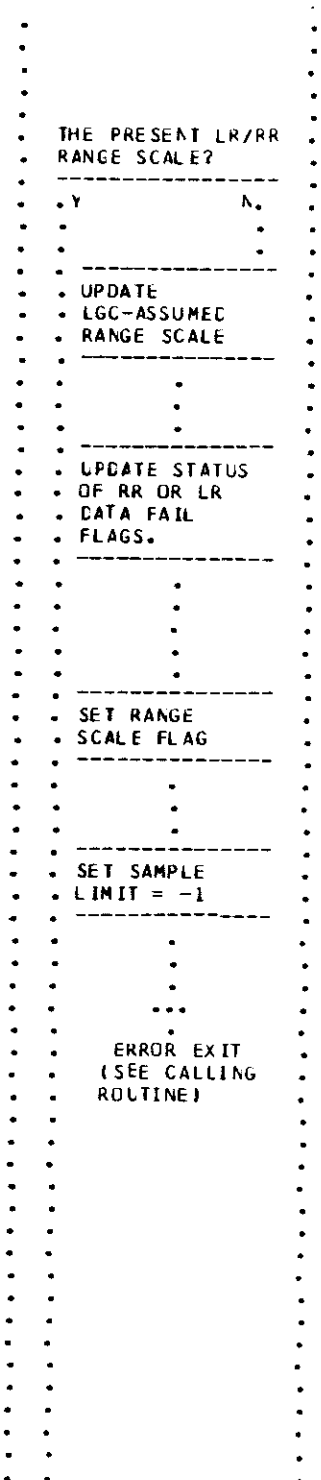

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+02
+EDIT
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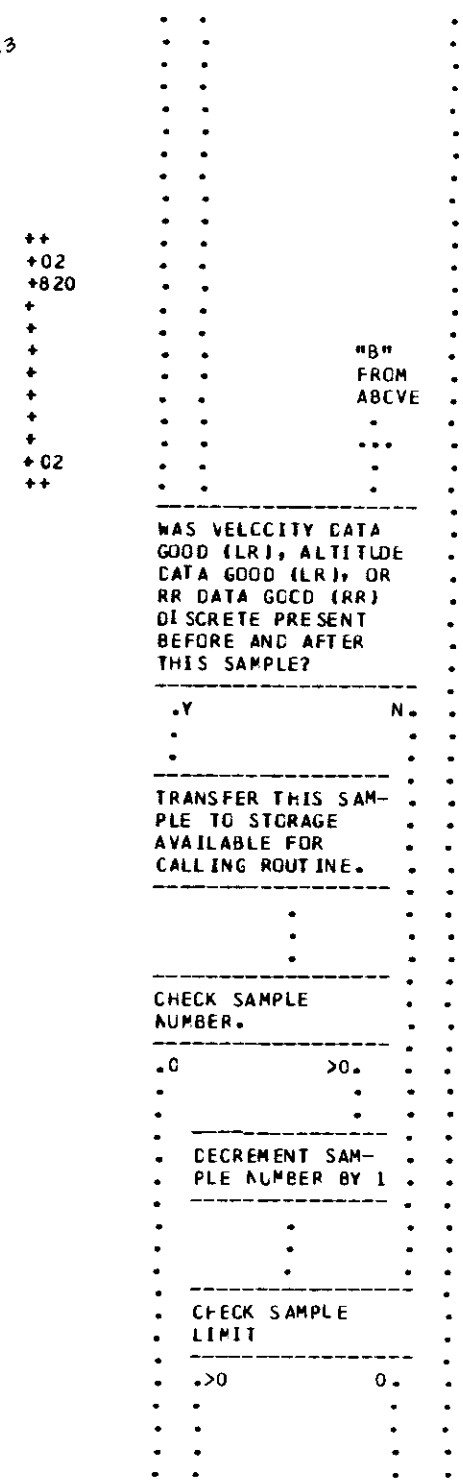

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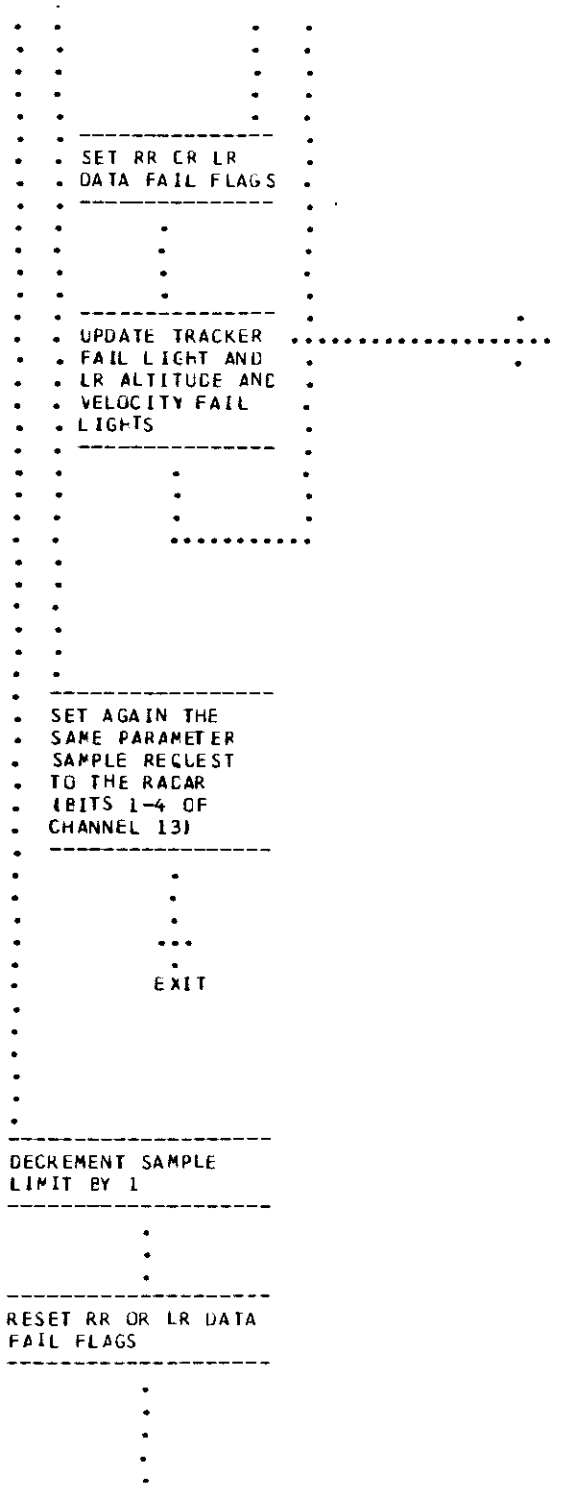

++
+02
+EDIT
+
+
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+
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+02
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++
+C2
+EDIT
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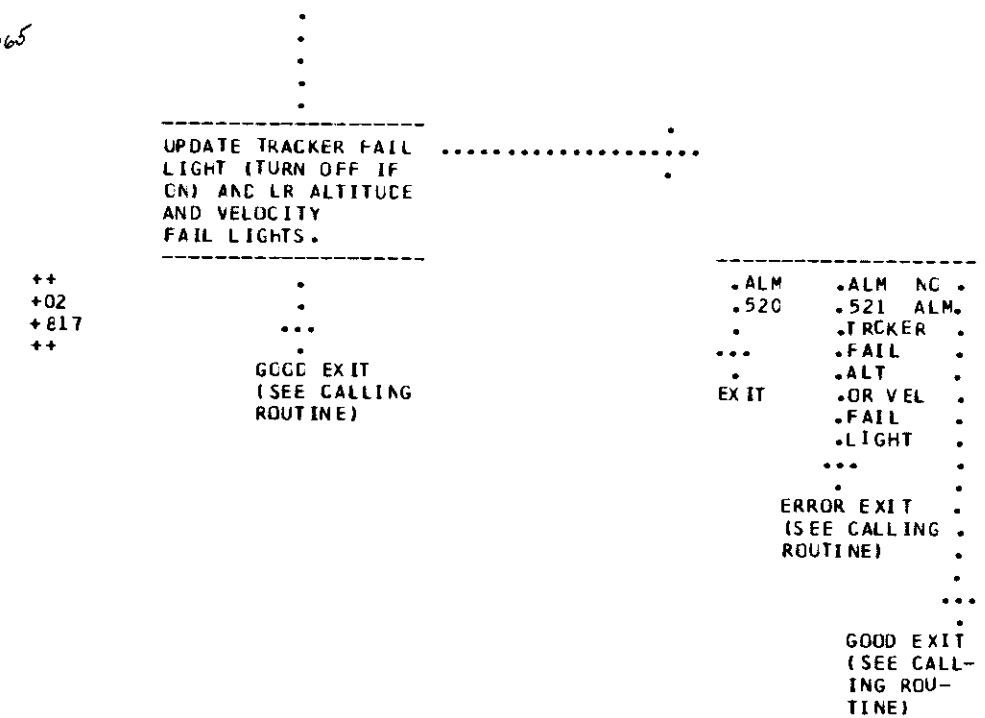
#330
#340
#350
#360
#370



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CHANGE CONTRCL NOTES

LOGIC REV 01 PCR 214,457
REV 02(LUM 1B) PCR 817,820,EDITORIAL

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RR DESIGNATE ROUTINE (R21) REV 02 12/03/69

PURPOSE: (1) TO POINT THE RENDEZVOUS RADAR (RR) AT THE CSM UNTIL AUTOMATIC ACQUISITION OF THE CSM IS ACCOMPLISHED BY THE RADAR WHILE THE LM IS IN ORBIT OR ON THE LUNAR SURFACE.

ASSUMPTIONS: (1) THE RR SERVOS MAY BE COMMANDED BY THE LGC AFTER THE LGC ISSUES THE TRACK ENABLE DISCRETE UNTIL RANGE RATE LOCKON IS ACHIEVED BY THE RR.

(2) THE SELECTION AND TERMINATION OF P20,P22, AND P25 ARE SUBJECT TO SPECIAL OPERATING PROCEDURES DIFFERENT FROM THOSE FOR ALL OTHER PROGRAMS:

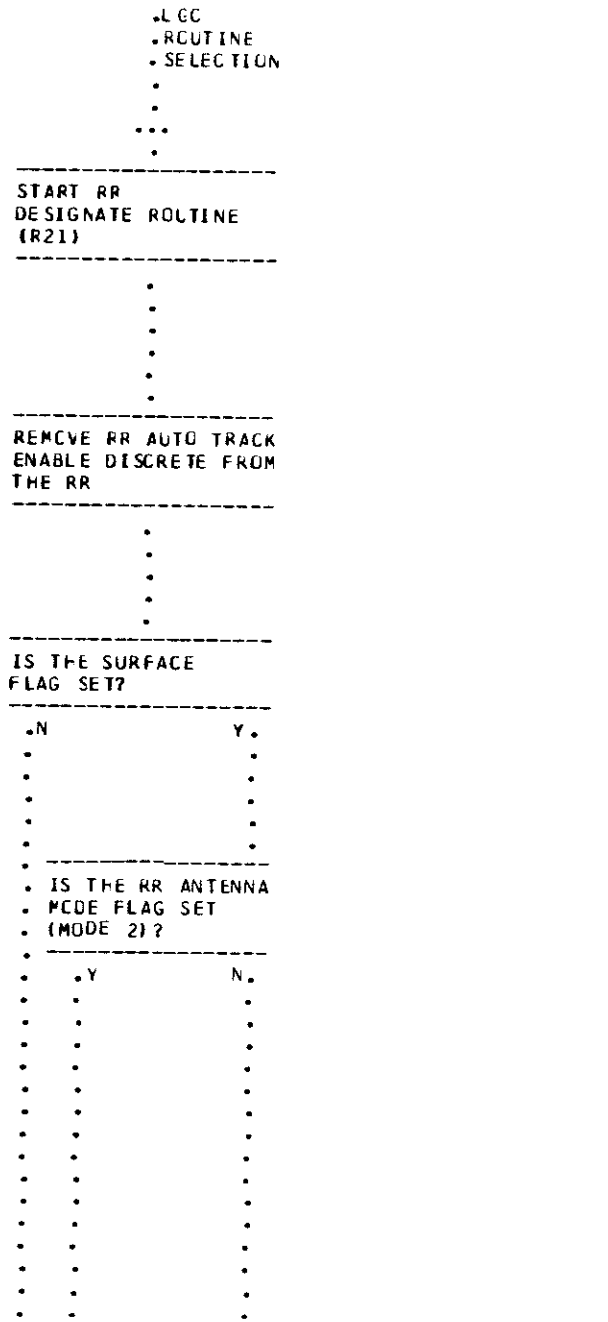
(A) SELECTION
- (1) ALWAYS BY V37EXXE.
- (2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHENEVER EITHER P20,22, OR 25 IS RUNNING.
- (3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER DISPLAYED IN THE DSKY PROG LIGHTS.
- (4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM AND OPERATION OF THE NEW.

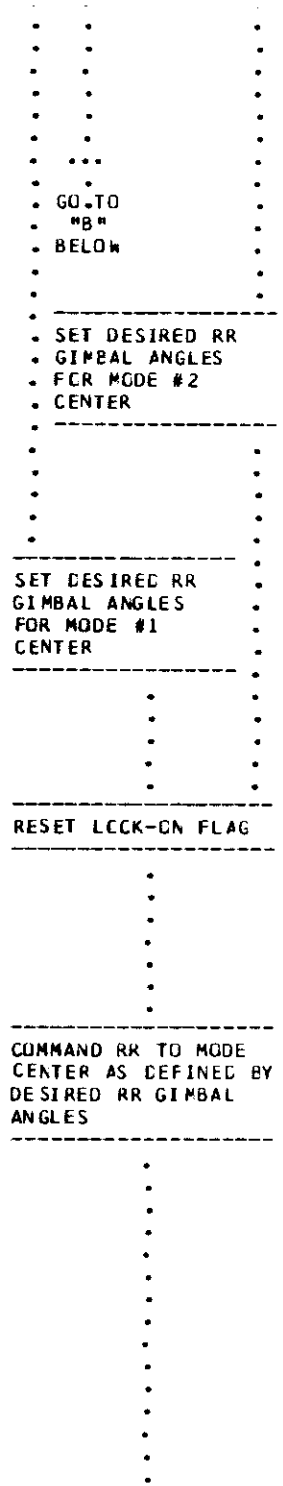
(B) TERMINATION
- (1) BY SELECTION OF P00, V56E OR BY V34E.
- (2) P00 SELECTION WILL TERMINATE P20,22, AND 25 AND ANY OTHER PROGRAM IN PROCESS, AND ESTABLISH PCC.
- (3) V56E SELECTION WILL SELECT THE TERMINATE TRACKING ROUTINE (R56) WHICH WILL TERMINATE ONLY P20 OR P25 IF EITHER OF THESE PROGRAMS IS RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES R56 WILL SELECT R00. V56E MAY BE PERFORMED ANY TIME DURING P20,22, OR 25 OPERATION.
- (4) THE LGC WILL ACT UPON V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THIS DISPLAY WAS ORIGINATED BY P20,22, OR 25, V34E WILL RESULT IN AN IDENTICAL LGC RESPONSE TO THAT OF V56E, THAT IS, SELECTION OF R56. IF THIS DISPLAY WAS NOT ORIGINATED BY P20,22, OR 25 (SUCH AS P32 WHILE RUNNING WITH P20) THE LGC WILL GO TO R00, HOWEVER THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).
- (5) ALTHOUGH IT IS NOT CLEARLY SHOWN IN THE LOGIC BELOW A V34E RESPONSE TO A PRIORITY DISPLAY MUST BE DELAYED 2 SECONDS FROM DISPLAY INITIATION WHEREAS THE DELAY IS NOT NECESSARY FOR A V56E RESPONSE.

(3) THIS ROUTINE IS AUTOMATICALLY CALLED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20) AND THE LUNAR SURFACE NAVIGATION PROGRAM (P22).

PROG	LGC	GROUND	CREW

CONT


.LGC
.ROUTINE
.SELECTION
START RR
DESIGNATE ROUTINE
(R21)
#10
REMOVE RR AUTO TRACK
ENABLE DISCRETE FROM
THE RR
#20
IS THE SURFACE
FLAG SET?
#30
.N
Y.
IS THE RR ANTENNA
MODE FLAG SET
(MODE 2)?
#40
.Y
N.


GO TO "B" BELOW
SET DESIRED RR GIMBAL ANGLES FOR MODE #2 CENTER
SET DESIRED RR GIMBAL ANGLES FOR MODE #1 CENTER
RESET LOCK-ON FLAG
COMMAND RR TO MODE CENTER AS DEFINED BY DESIRED RR GIMBAL ANGLES

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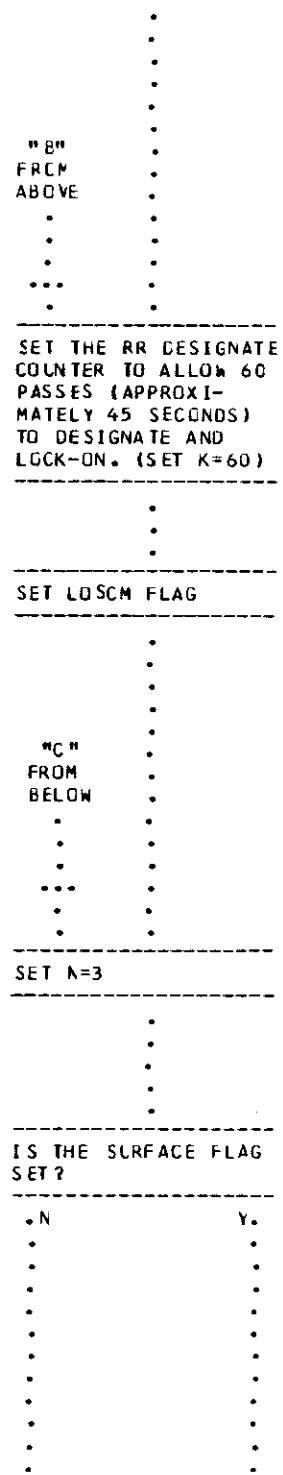

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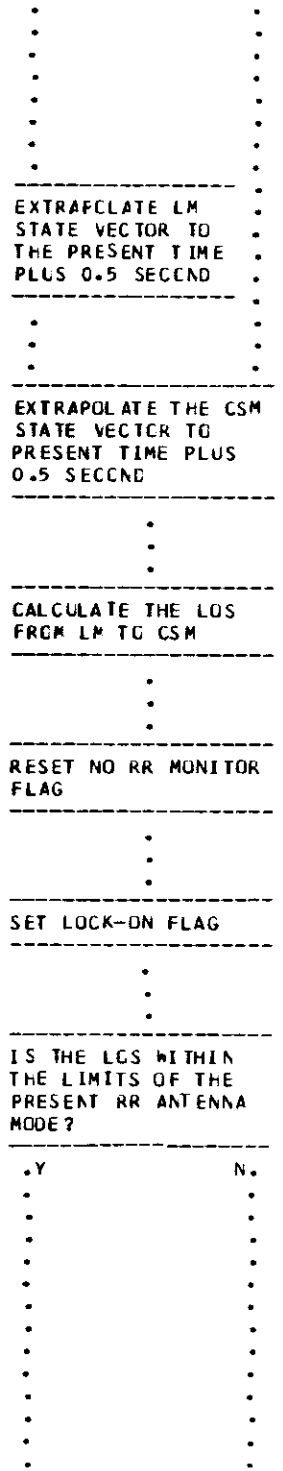

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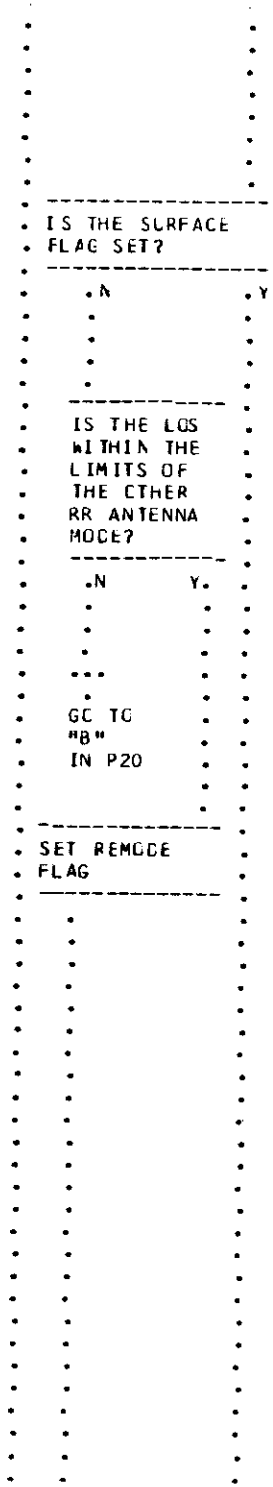

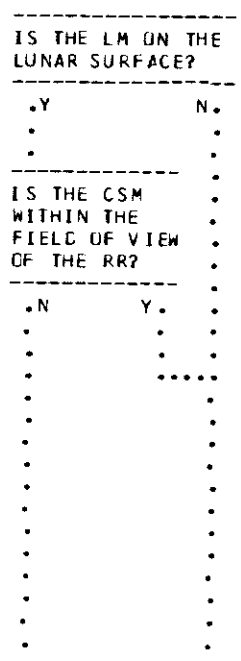

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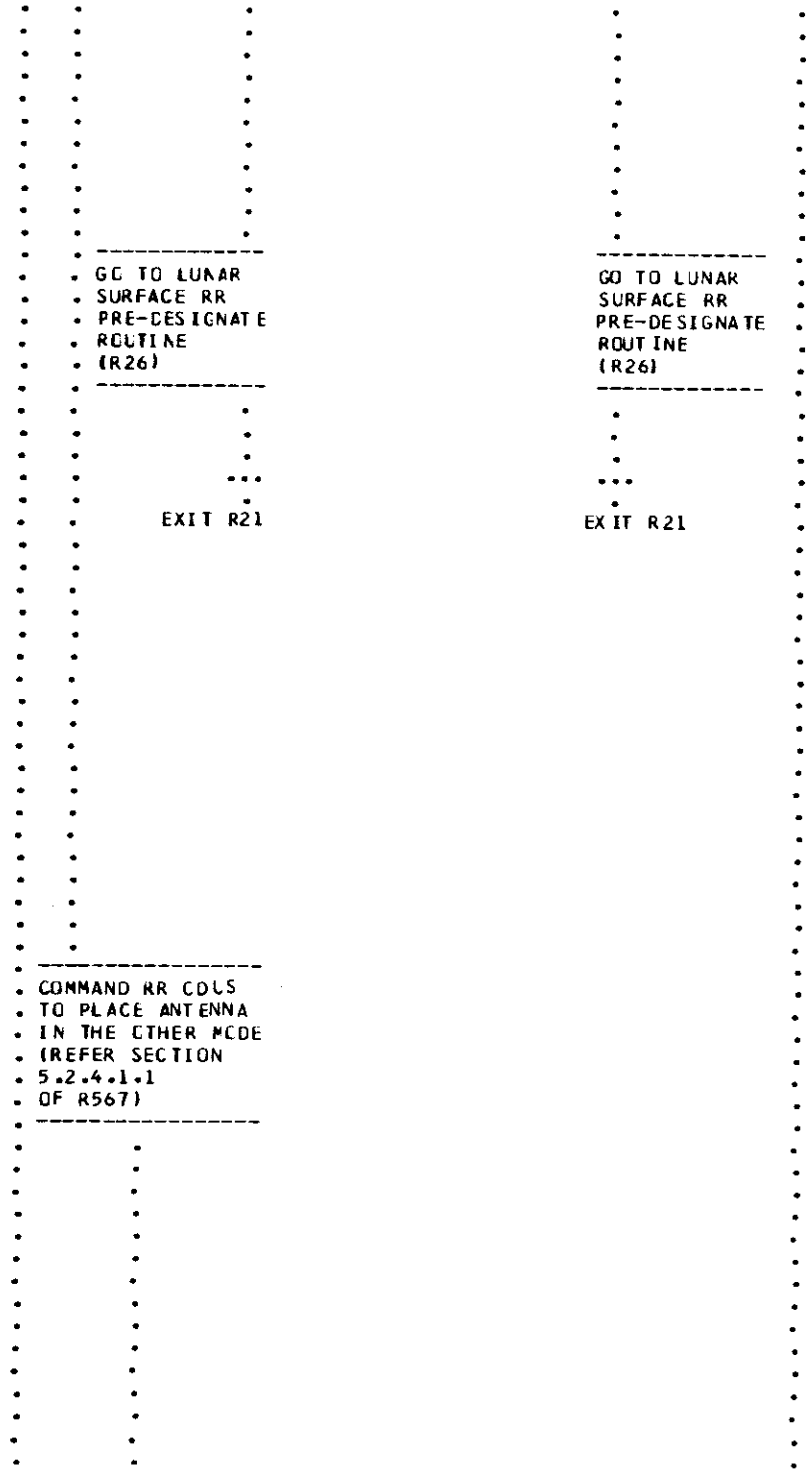

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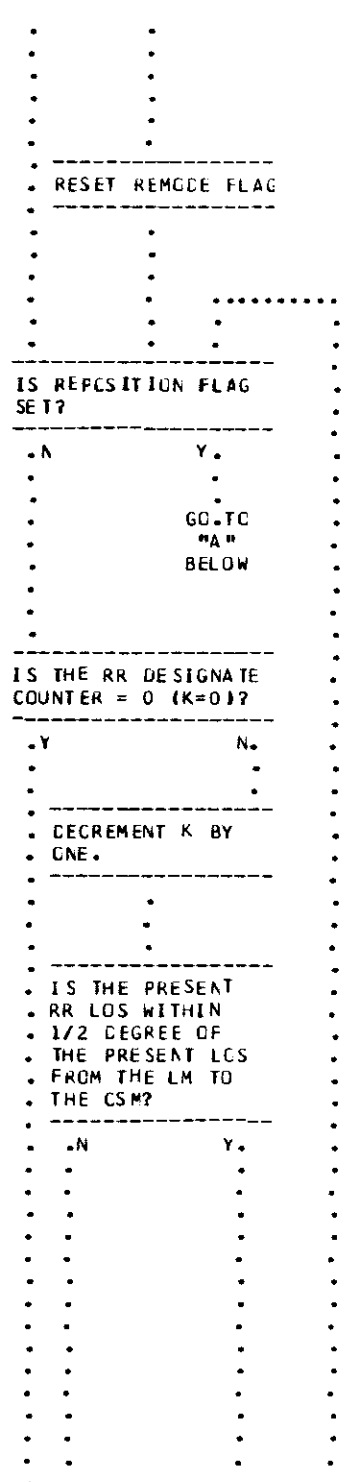

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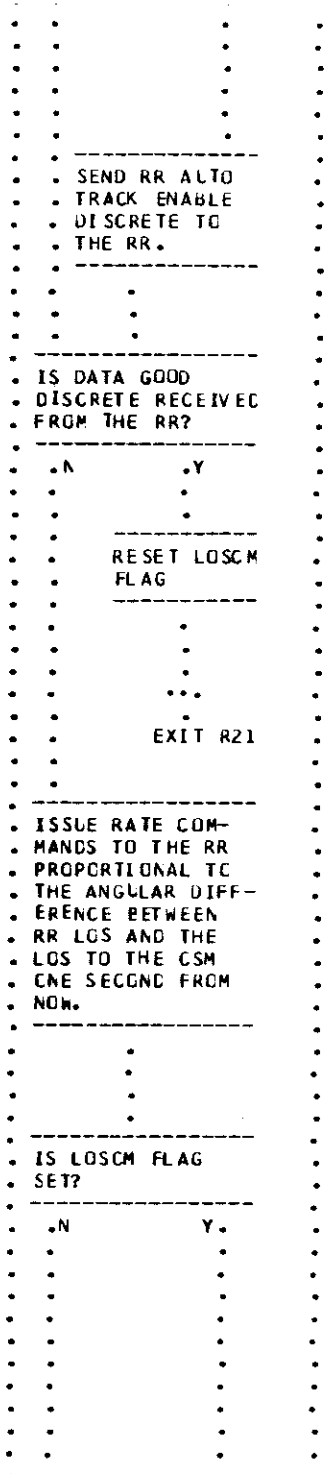

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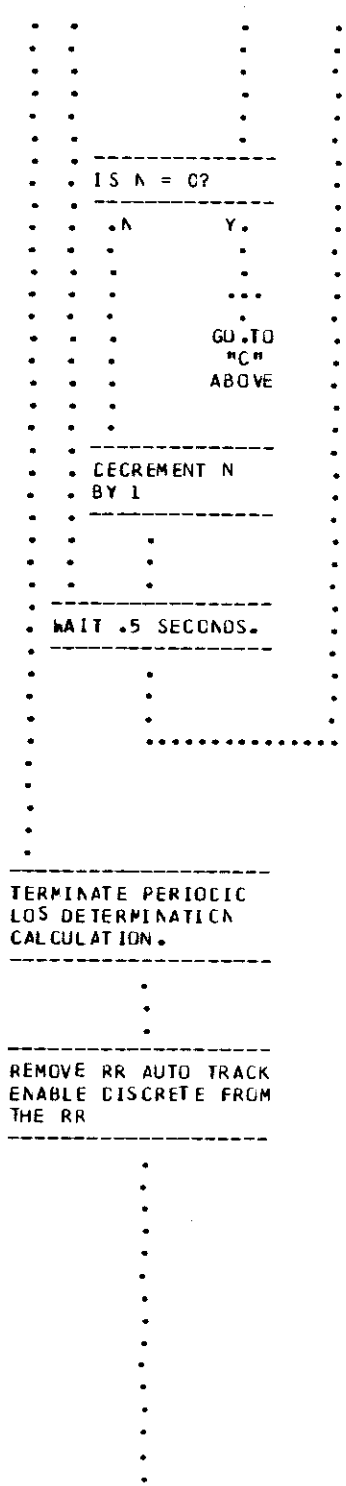

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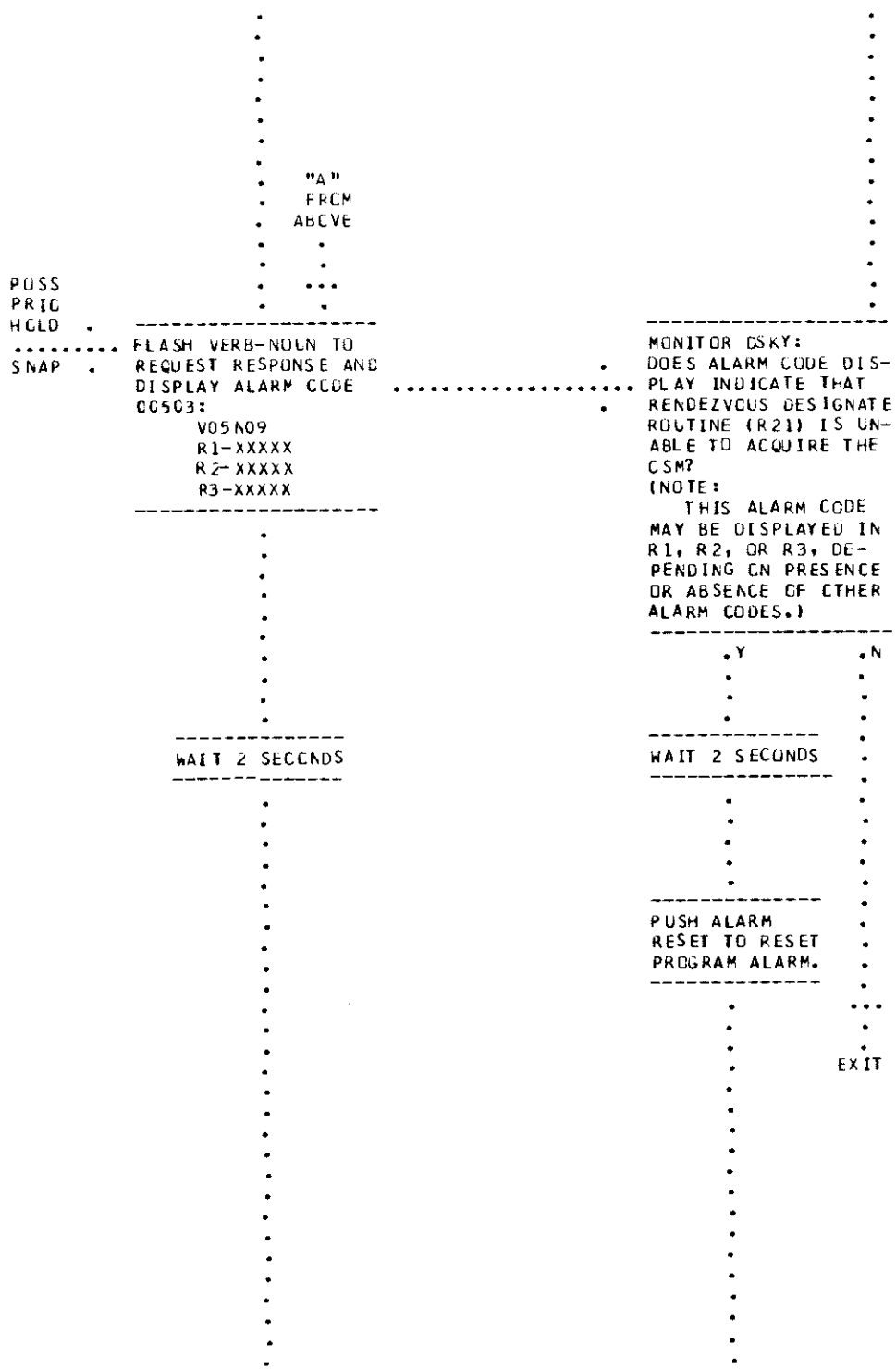

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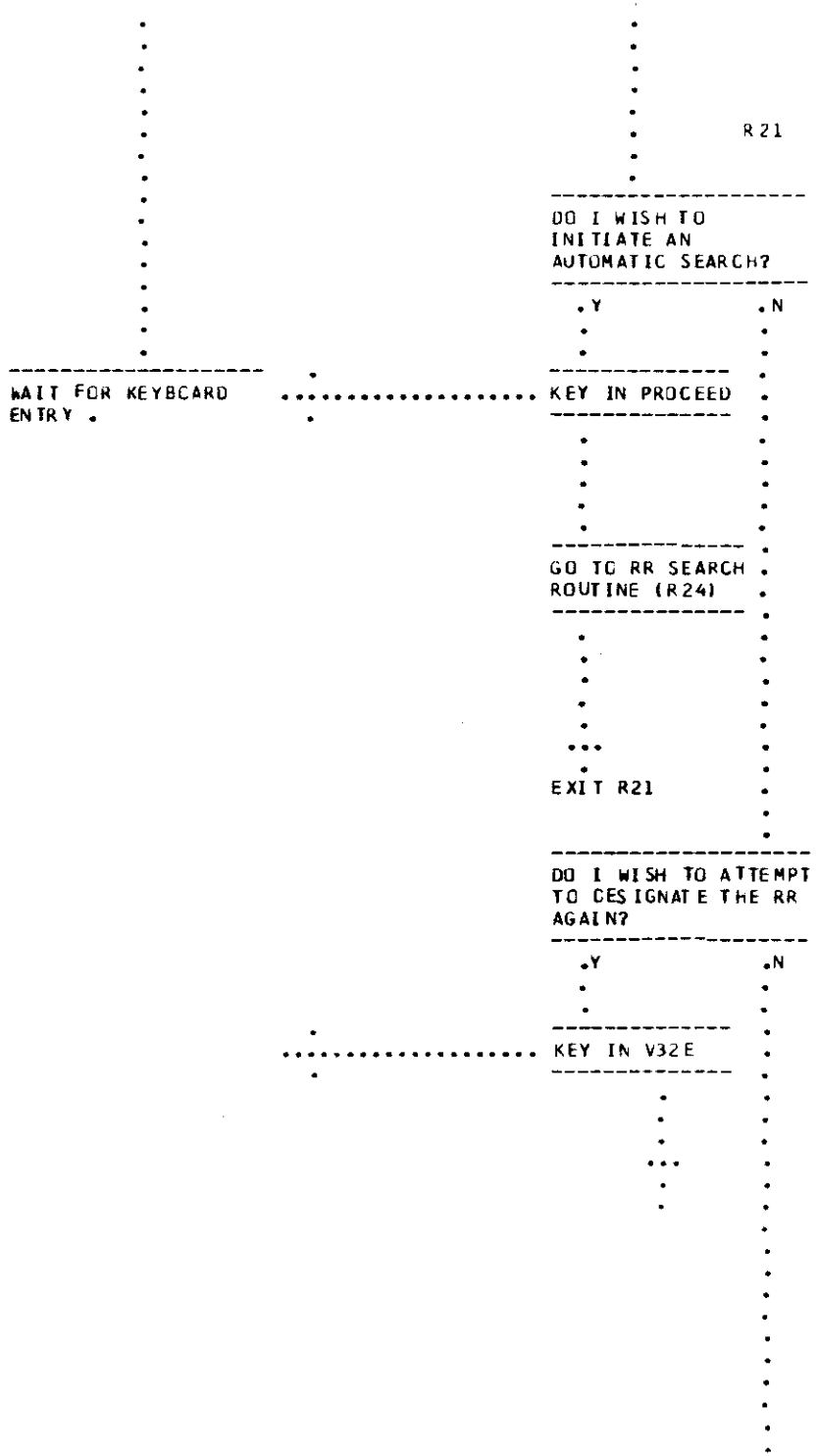

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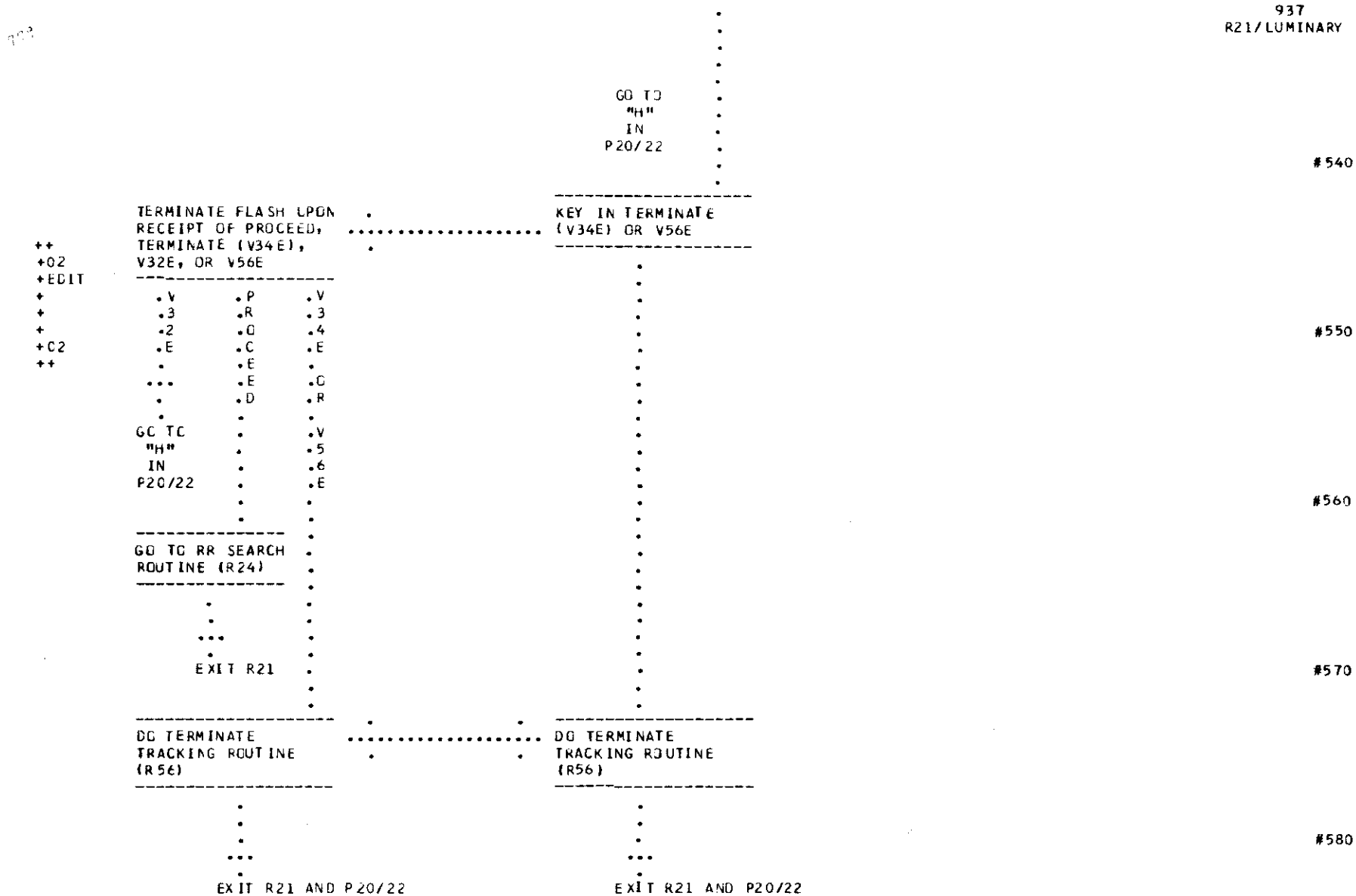

GO TO "H" IN P20/22
#540
KEY IN TERMINATE (V34E) OR V56E
TERMINATE FLASH UPON RECEIPT OF PROCEED, TERMINATE (V34E), V32E, OR V56E
++
+02
+EDIT
+
+
+
+C2
++
.V .3 .2 .E . ... .
.P .R .O .C .E .E .D .
.V .3 .4 .E .C .R .V .5 .6 .E .
#550
GO TO "H" IN P20/22
#560
GO TO RR SEARCH ROUTINE (R24)
EXIT R21
#570
DO TERMINATE TRACKING ROUTINE (R56)
DO TERMINATE TRACKING ROUTINE (R56)
#580
EXIT R21 AND P20/22
EXIT R21 AND P20/22

CHANGE CONTROL NOTES

REV 01 PCR 226,432,451,562,640
REV 00(LUM 1A) PCR 722
REV 01(LUM 1B) EDITORIAL
REV 02 EDITORIAL

RR DATA READ ROUTINE (R22) REV 02 12/03/69

PURPOSE:

(1) TO PROCESS AUTOMATIC RR MARK DATA TO UPDATE THE STATE VECTOR OF EITHER LM OR CSM AS DEFINED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20), OR THE LUNAR SURFACE NAVIGATION PROGRAM (P22).

(2) TO MAINTAIN THE LM +Z AXIS ALIGNED ALONG THE LOS FROM THE LM TO THE CSM WITHIN THE IMPULSE LIMIT CYCLE OF THE DAP WHEN P20 IS IN PROCESS.

ASSUMPTIONS:

(1) THE ROUTINE IS AUTOMATICALLY CALLED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20), OR THE LUNAR SURFACE NAVIGATION PROGRAM (P22).

(2) THE SELECTION AND TERMINATION OF P20,P22, AND P25 ARE SUBJECT TO SPECIAL OPERATING PROCEDURES DIFFERENT FROM ALL OTHER PROGRAMS;

(A) SELECTION

(1) ALWAYS BY V37EXXE.

(2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHENEVER EITHER P20,22, OR 25 IS RUNNING.

(3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER IN THE OSKY PROG LIGHTS.

(4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM AND OPERATION OF THE NEW.

(B) TERMINATION

(1) BY SELECTION OF P00, V56E OR BY V34E.

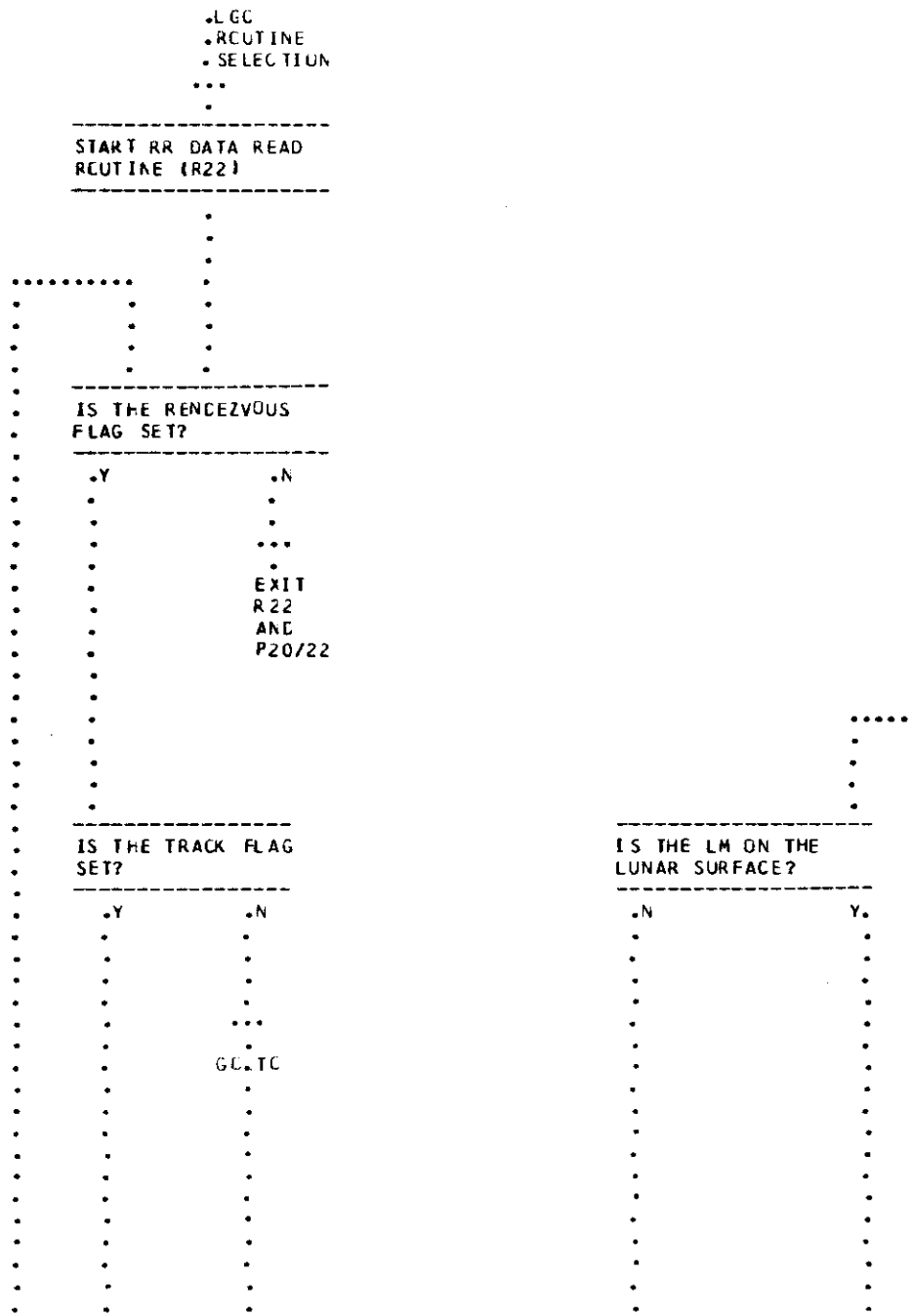
(2) P00 SELECTION WILL TERMINATE P20,22,AND 25 AND ANY OTHER PROGRAM IN PROCESS; AND ESTABLISH P00.

(3) V56E SELECTION WILL SELECT THE TERMINATE TRACKING ROUTINE (R56) WHICH WILL TERMINATE ONLY P20 OR P25 IF EITHER OF THESE PROGRAMS IS RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES R56 WILL SELECT R00. V56E MAY BE PERFORMED ANY TIME DURING P20,22, OR 25 OPERATION.

(4) THE LGC WILL ACT UPON V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THIS DISPLAY WAS ORIGINATED BY P20,22, OR 25; V34E WILL RESULT IN AN IDENTICAL LGC RESPONSE TO THAT OF V56E, THAT IS, SELECTION OF R56. IF THIS DISPLAY WAS NOT ORIGINATED BY P20,22, OR 25 (SUCH AS P32, WHILE RUNNING WITH P20) THE LGC WILL GO TO R00, HOWEVER THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).

(5) ALTHOUGH IT IS NOT CLEARLY SHOWN IN THE LOGIC BELOW A V34E RESPONSE TO A PRIORITY DISPLAY MUST BE DELAYED 2 SECONDS FROM DISPLAY INITIATION WHEREAS THE DELAY IS NOT NECESSARY FOR A V56E RESPONSE.

PROG CONT	LGC	GROUND	CREW


.LGC
.ROUTINE
.SELECTION
START RR DATA READ
ROUTINE (R22)
IS THE RENDEZVOUS
FLAG SET?
.Y
.N
EXIT
R22
AND
P20/22
IS THE TRACK FLAG
SET?
.Y
.N
GO.TC
IS THE LM ON THE
LUNAR SURFACE?
.N
Y.

#10

#20

#30

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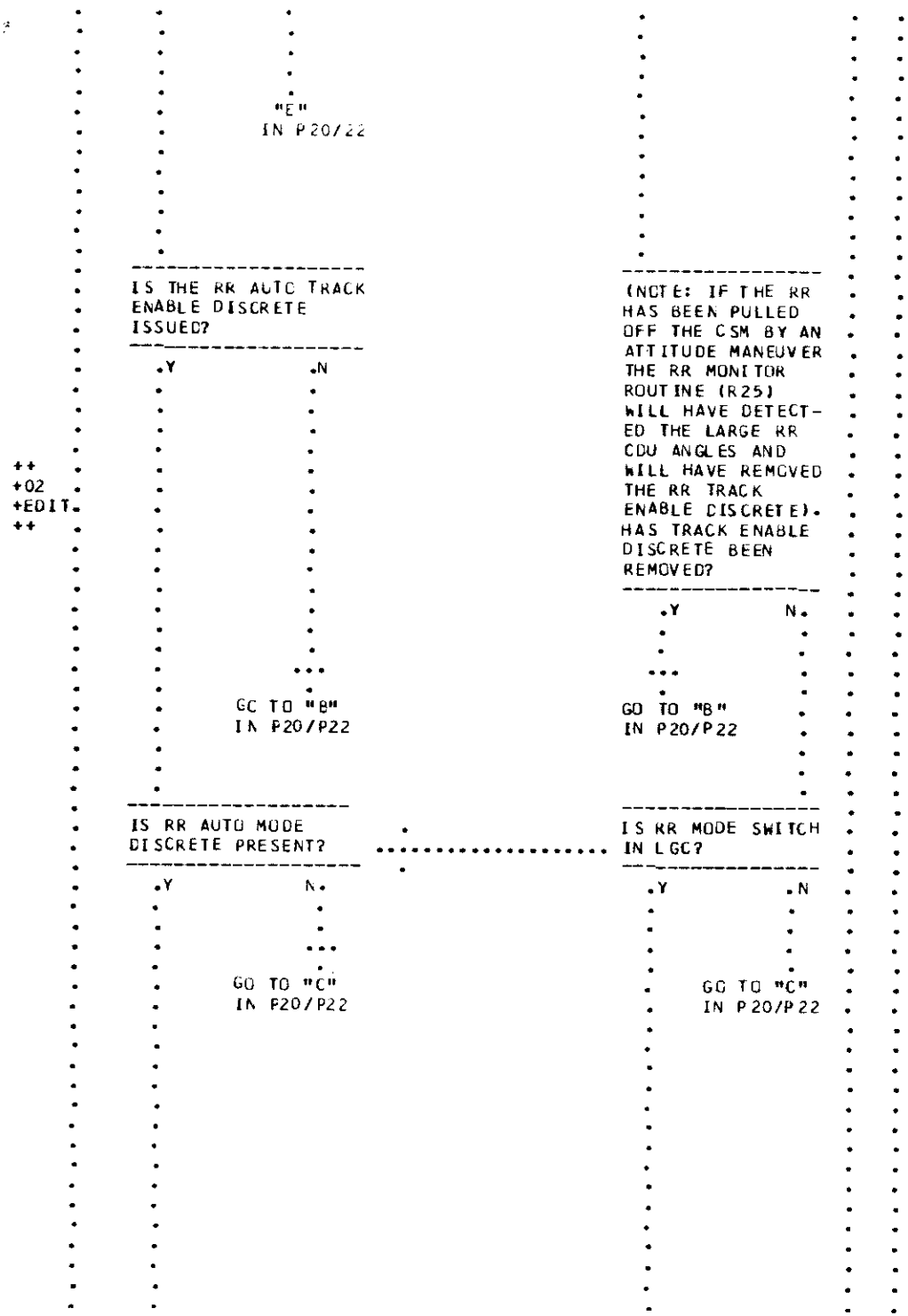

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+02
+EDIT
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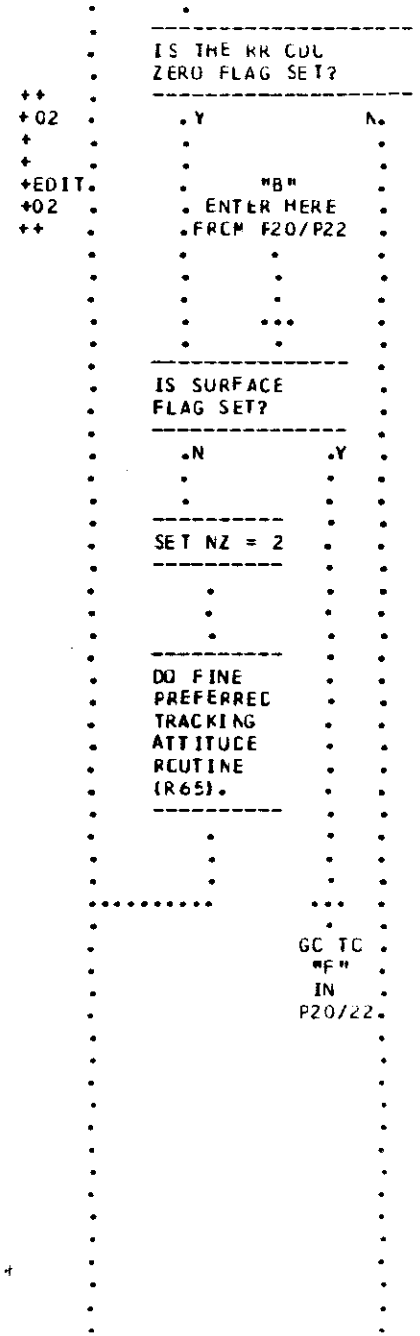

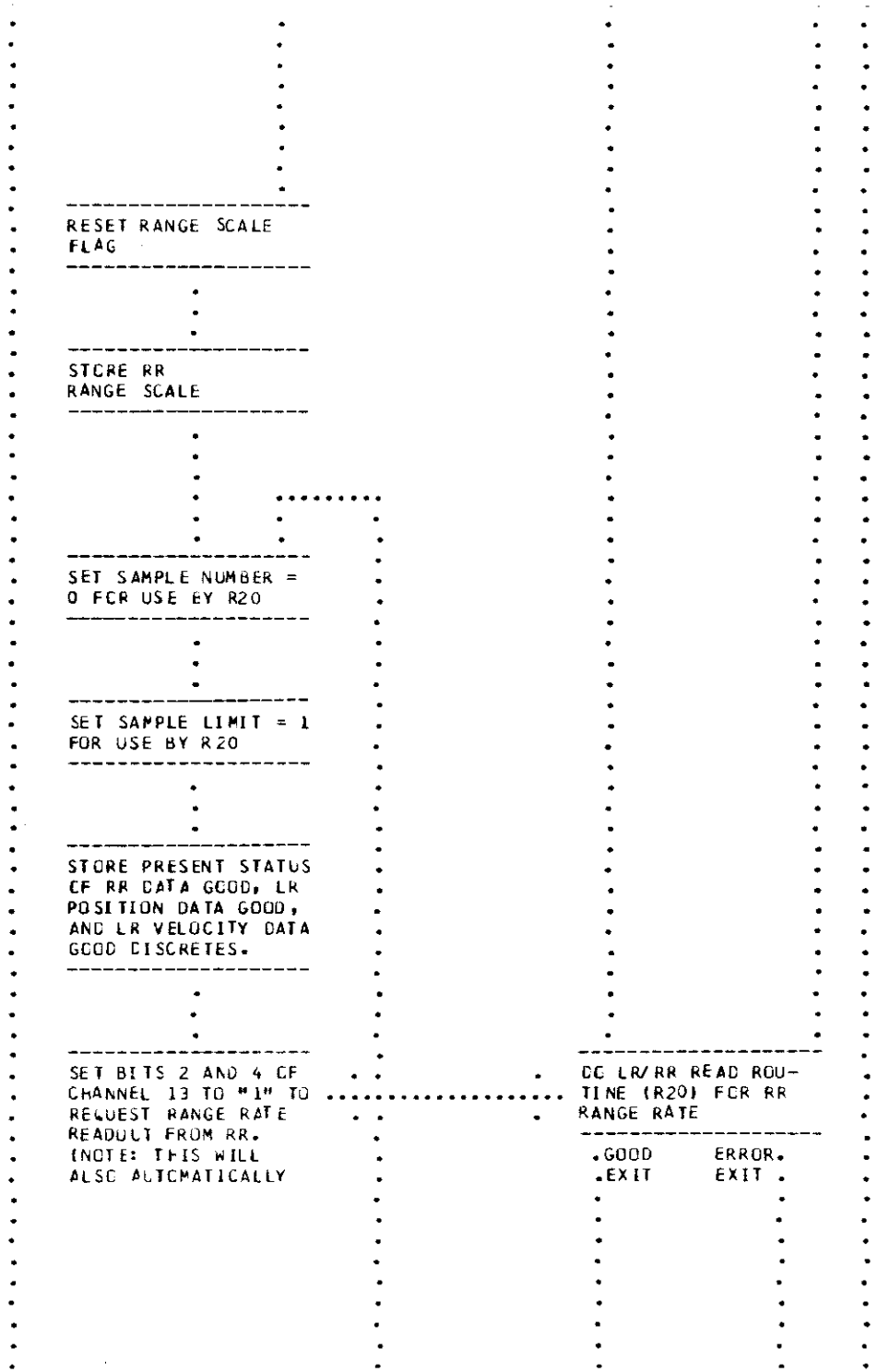

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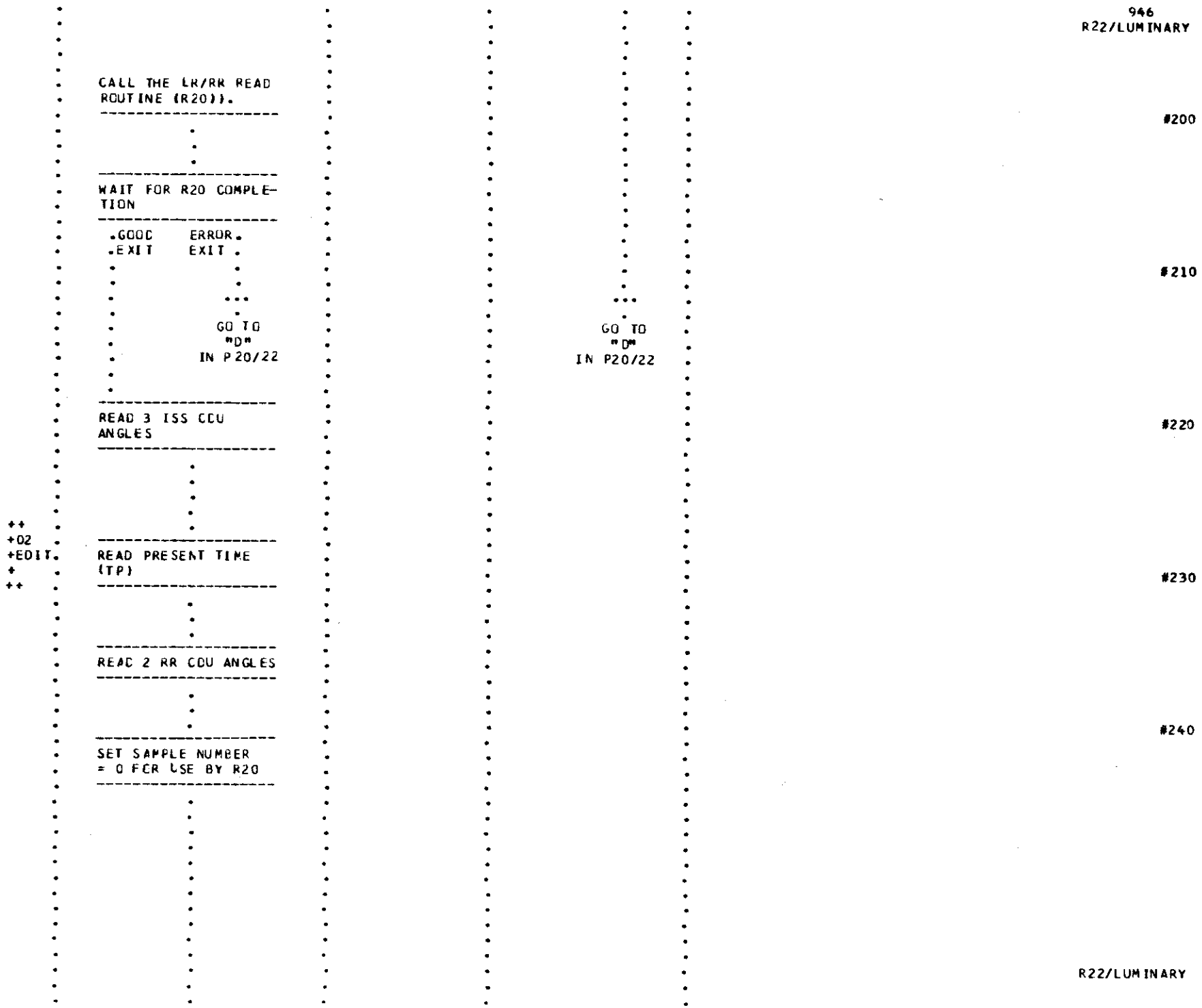
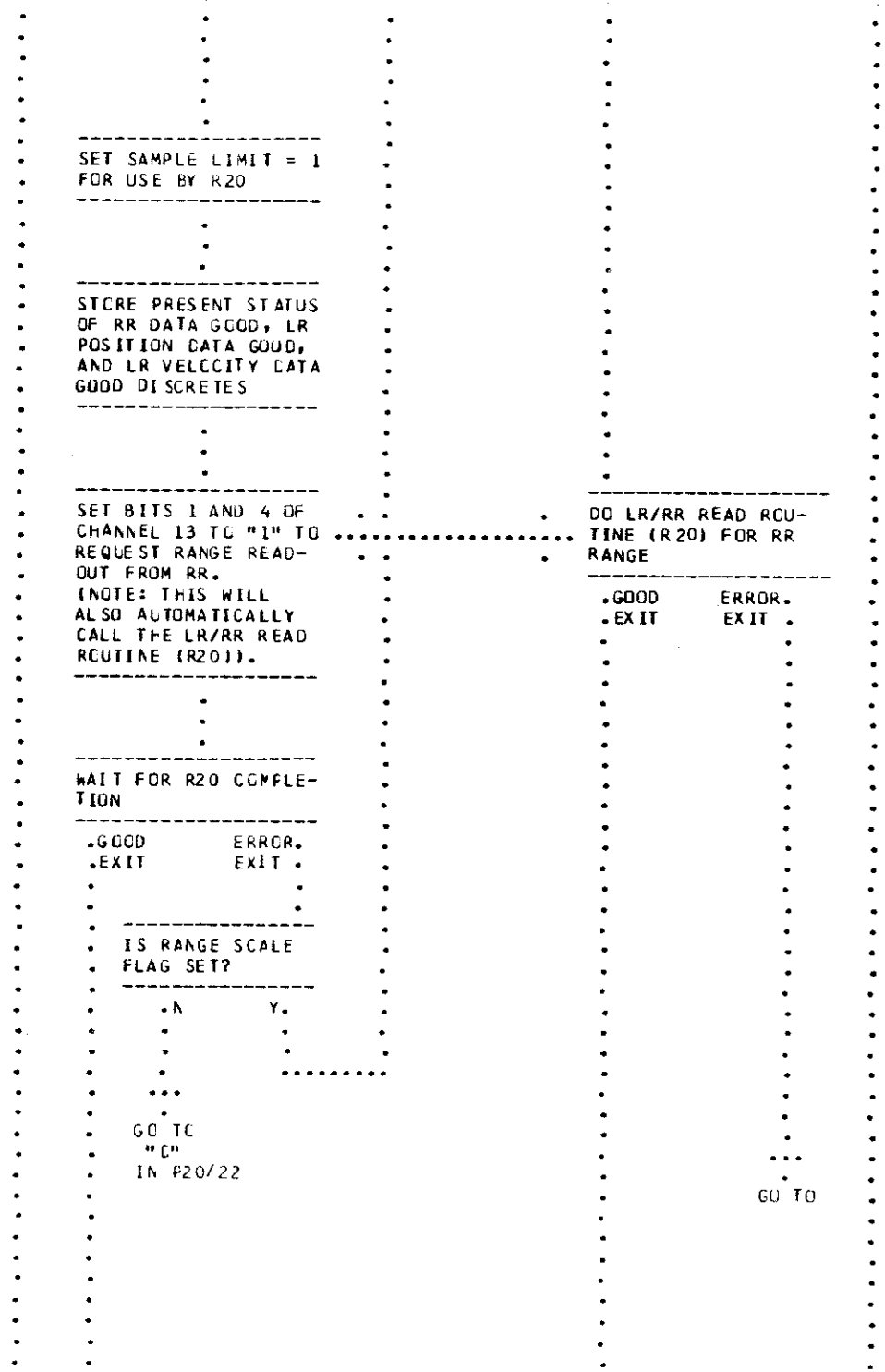
#180

#190


CALL THE LR/RR READ ROUTINE (R20)).
#200
WAIT FOR R20 COMPLE-TION
.GOOD EXIT
ERROR EXIT .
#210
GO TO "D" IN P20/22
GO TO "D" IN P20/22
READ 3 ISS CDU ANGLES
#220
++
+02
+EDIT
+
++
READ PRESENT TIME (TP)
#230
READ 2 RR CDU ANGLES
#240
SET SAMPLE NUMBER = 0 FOR USE BY R20



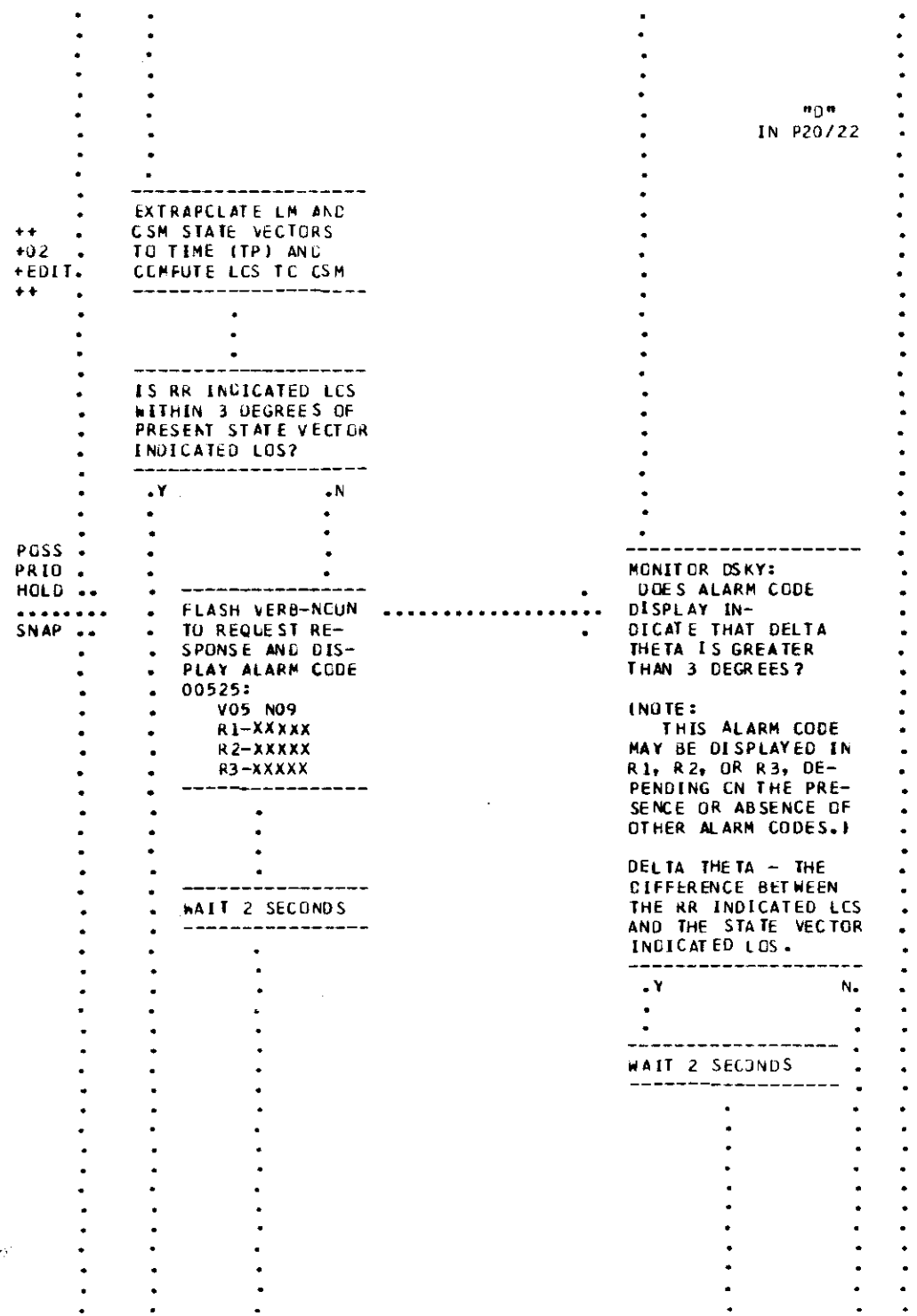
#250

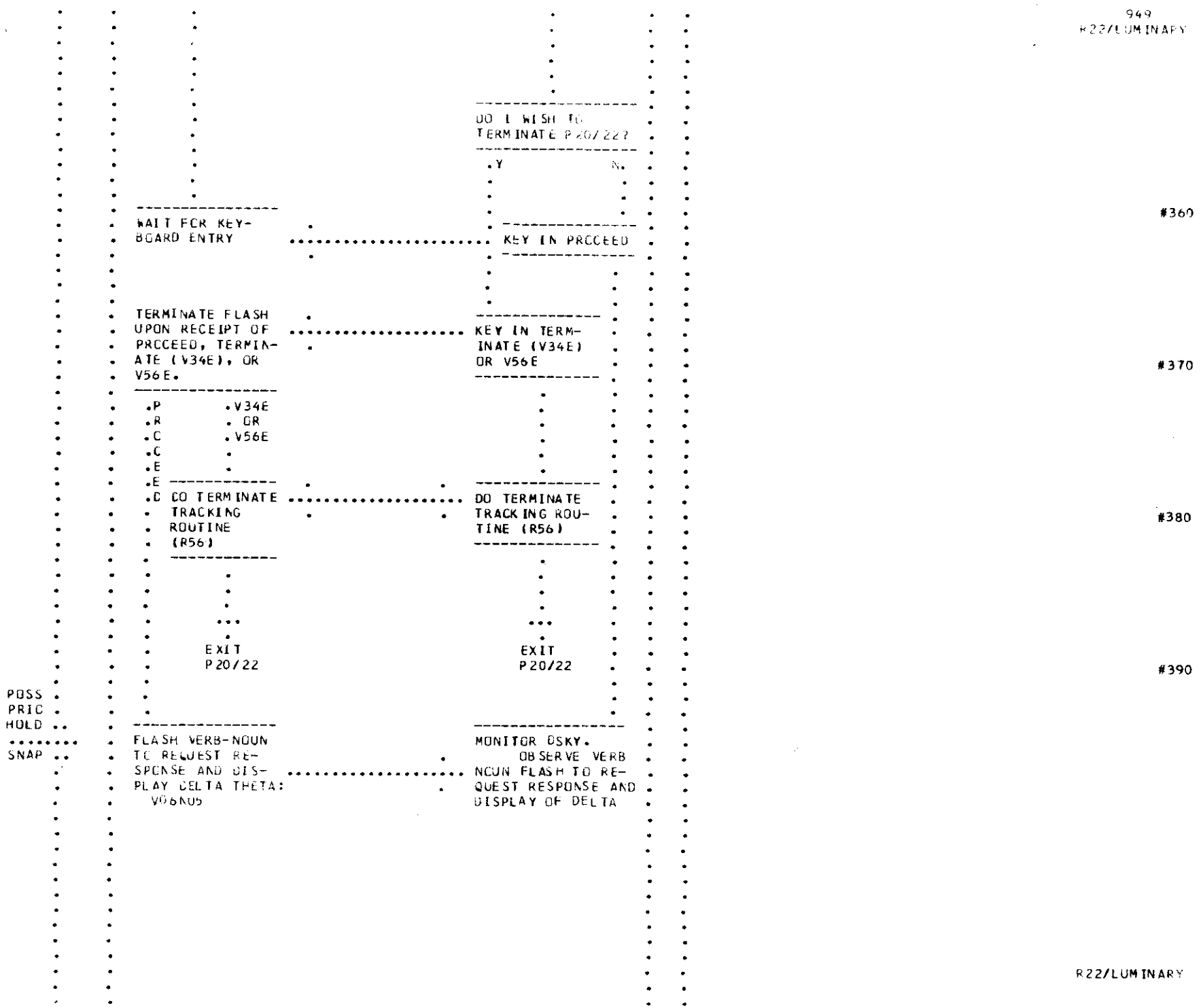
#260

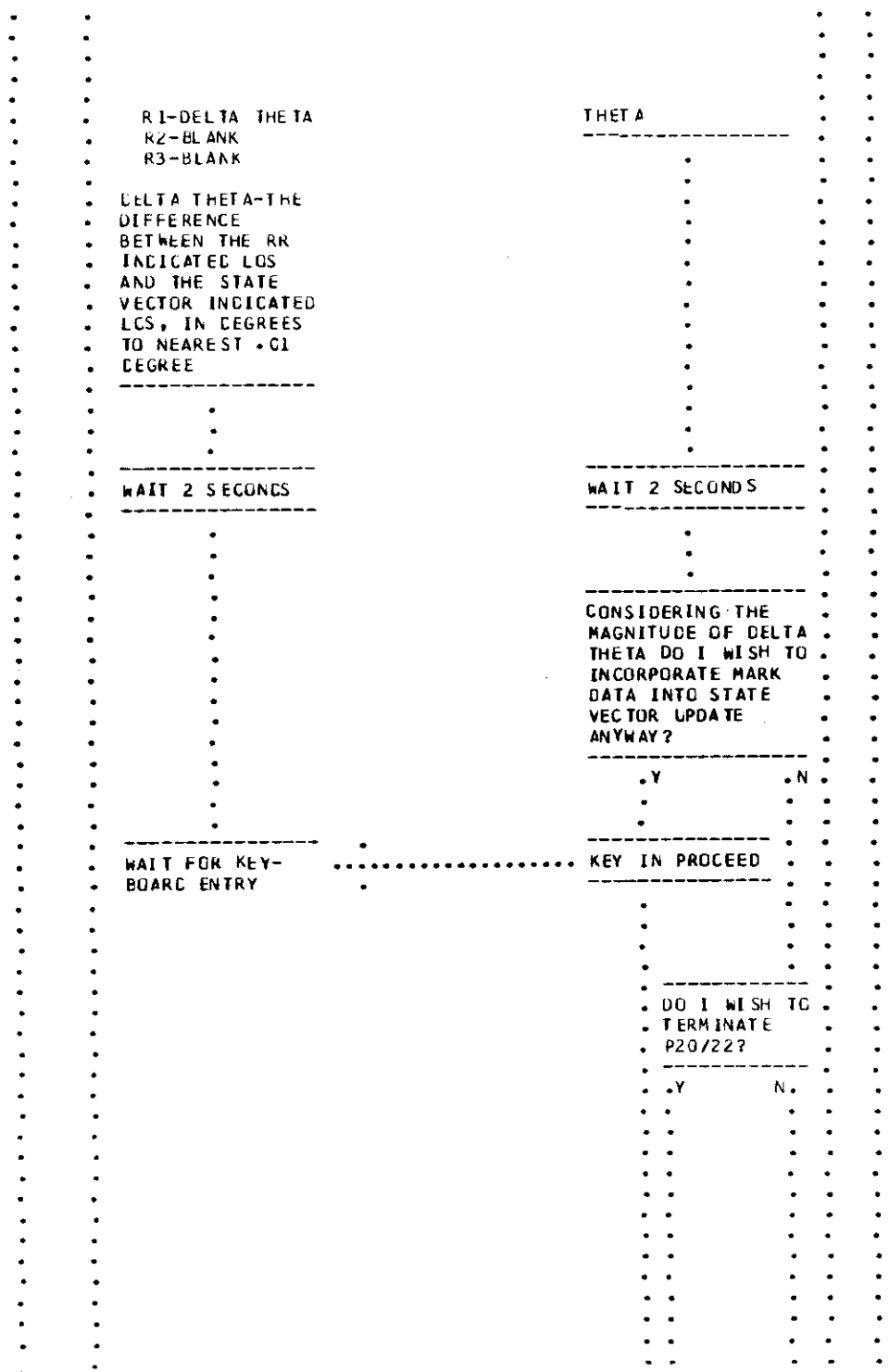
#270

#280

#290


"D"
IN P20/22
#300
EXTRAPOLATE LM AND CSM STATE VECTORS TO TIME (TP) AND COMPUTE LOS TO CSM
++
+02
+EDIT.
++
#310
IS RR INDICATED LOS WITHIN 3 DEGREES OF PRESENT STATE VECTOR INDICATED LOS?
.Y
.N
#320
POSS PRIO HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY ALARM CODE 00525:
V05 N09
R1-XXXXX
R2-XXXXX
R3-XXXXX
MONITOR DSKY: DOES ALARM CODE DISPLAY INDICATE THAT DELTA THETA IS GREATER THAN 3 DEGREES?
(NOTE: THIS ALARM CODE MAY BE DISPLAYED IN R1, R2, OR R3, DEPENDING ON THE PRESENCE OR ABSENCE OF OTHER ALARM CODES.)
#330
DELTA THETA - THE DIFFERENCE BETWEEN THE RR INDICATED LOS AND THE STATE VECTOR INDICATED LOS.
#340
.Y
N.
WAIT 2 SECONDS
#350
WAIT 2 SECONDS


DO I WISH TO TERMINATE P20/22?
Y
N
WAIT FOR KEY-BOARD ENTRY
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF PROCEED, TERMINATE (V34E), OR V56E.
KEY IN TERMINATE (V34E) OR V56E
#360
#370
P
R
C
C
E
E
D
V34E
OR
V56E
DO TERMINATE TRACKING ROUTINE (R56)
DO TERMINATE TRACKING ROUTINE (R56)
#380
EXIT P20/22
EXIT P20/22
#390
POSS PRIC HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY DELTA THETA: V06N05
MONITOR DSKY. OBSERVE VERB NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF DELTA



#400

#410

#420

#430

#440

VERIFY THAT ACQUISITION HAS NOT BEEN BY SIDELOBE.

KEY IN RECYCLE V32E

GO TO "D" IN P20/P22.

TERMINATE FLASH UPON RECEIPT OF PROCEED. RECYCLE, TERMINATE (V34E), OR V56E

KEY IN TERMINATE (V34E) OR V56E

PROCEED

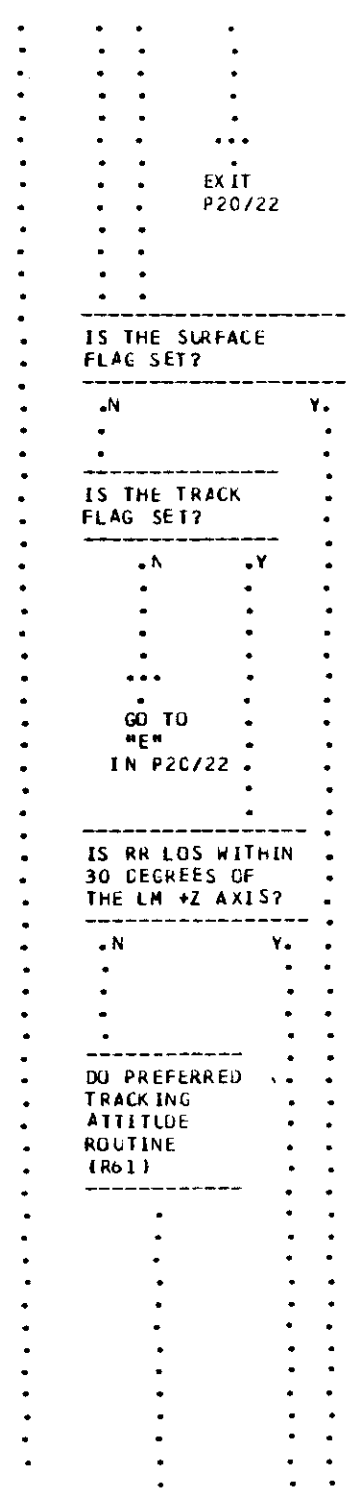
RECYCLE

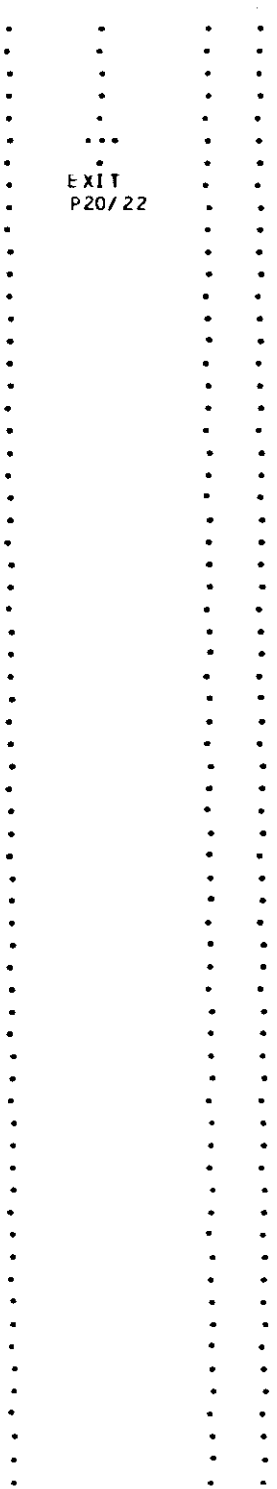
V34E OR V56E

GO TO "D" IN P20/22

DO TERMINATE TRACKING ROUTINE (R56)

DO TERMINATE TRACKING ROUTINE (R56)





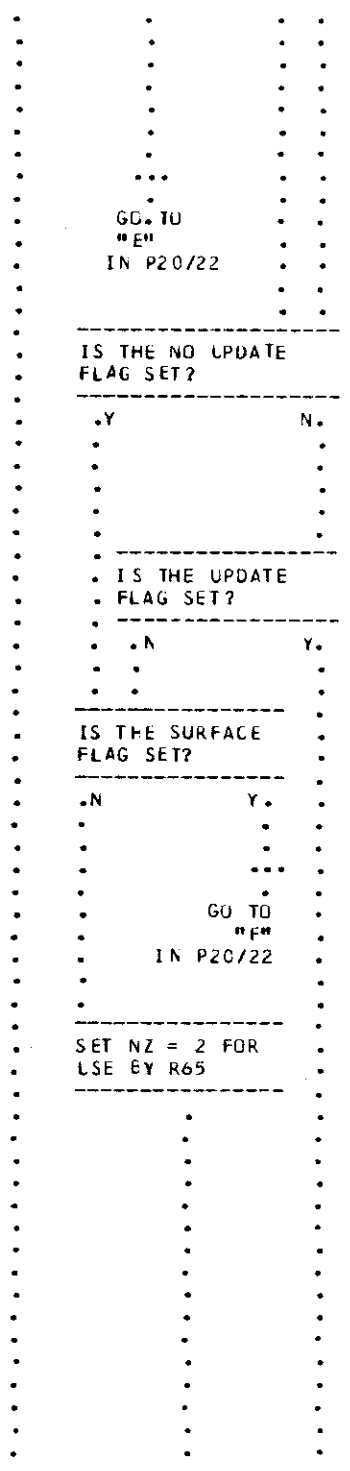
#510

#520

#530

#540

#550



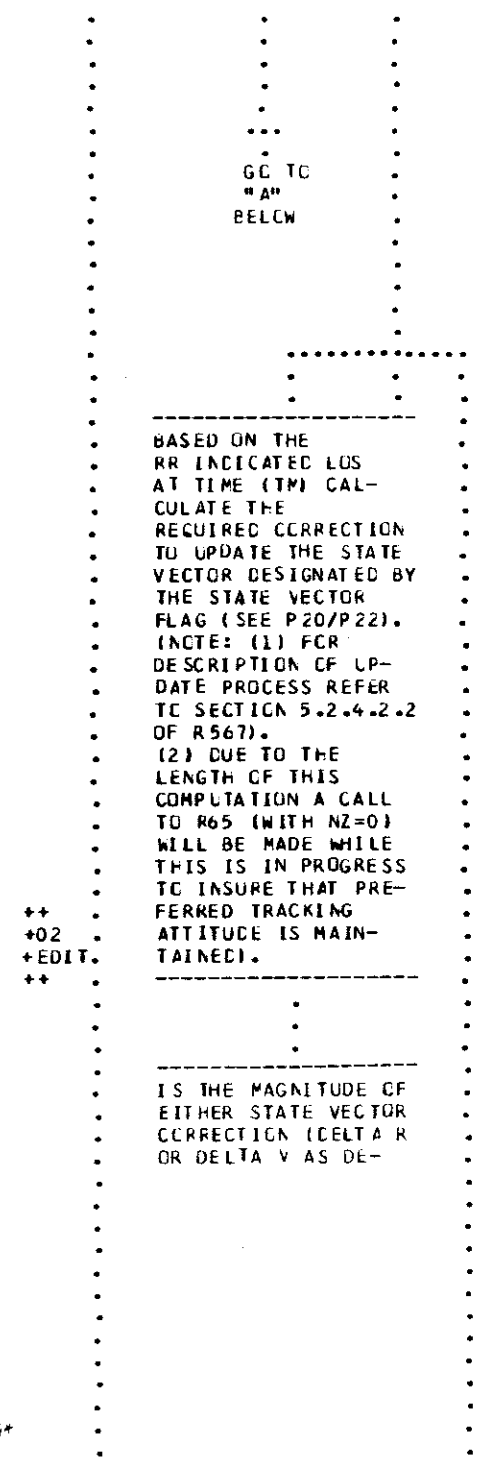
#560

#570

#580

#590

#600



++
+02
+EDIT.
++

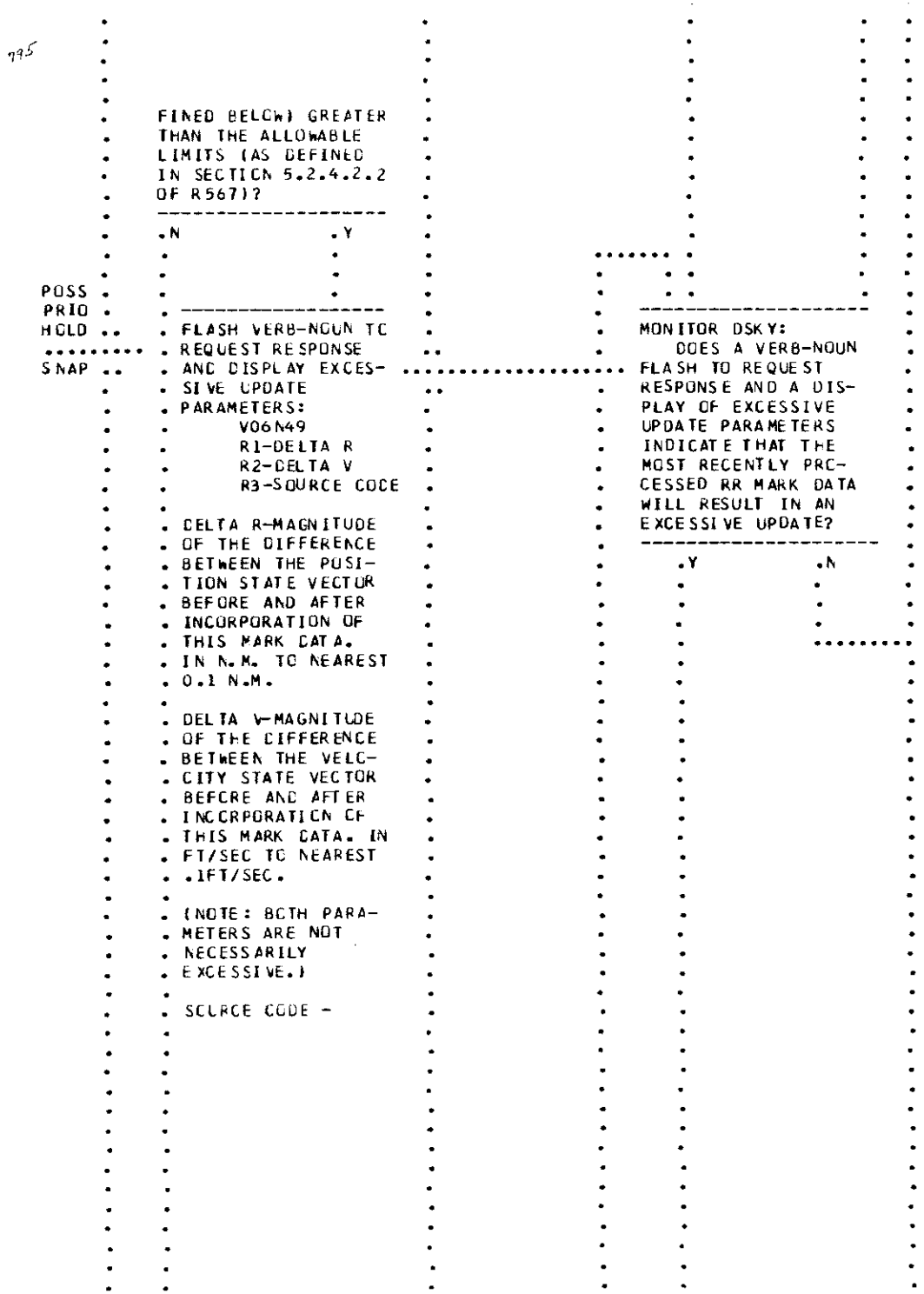
#610

#620

#630

#640

#650

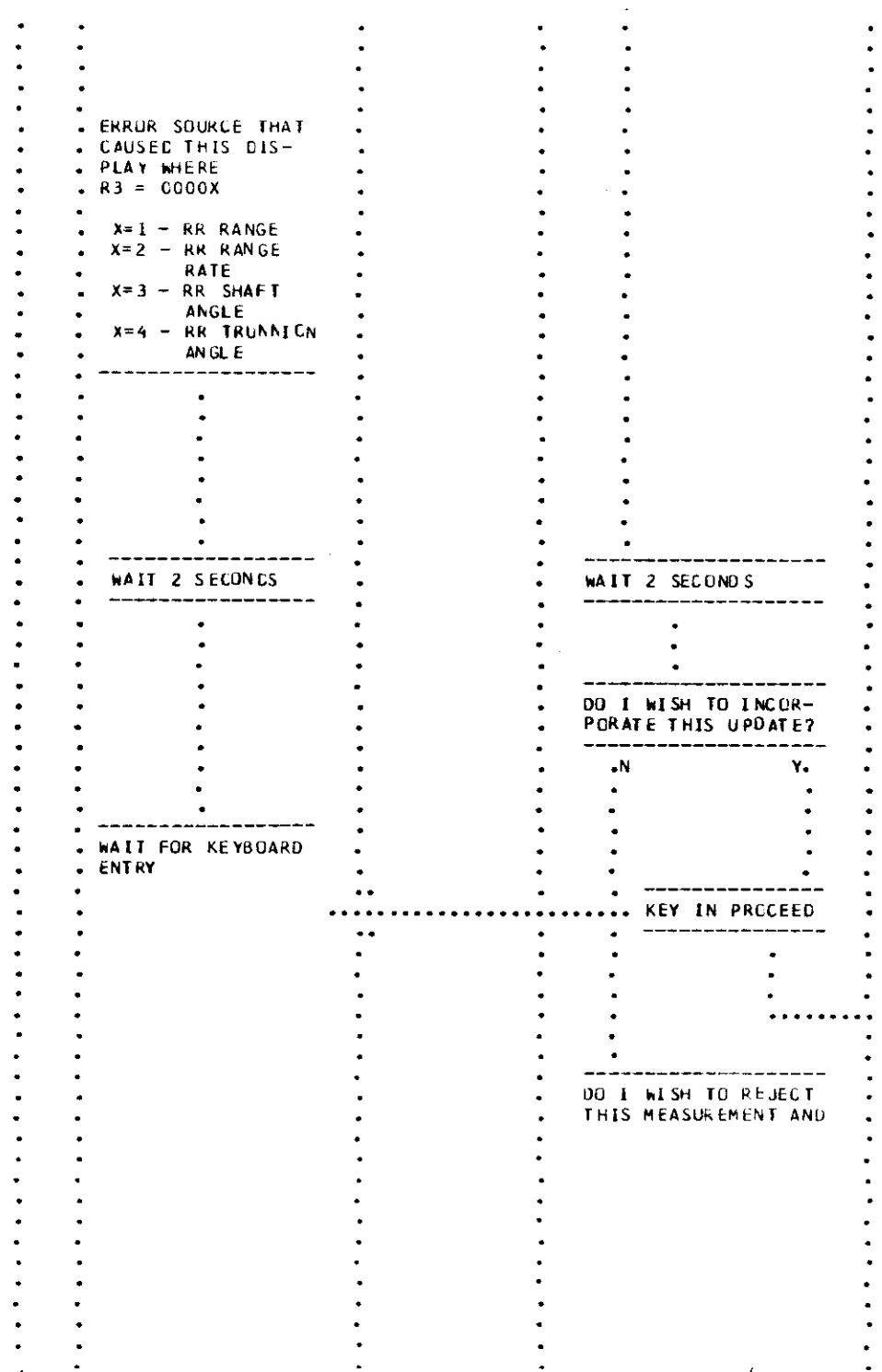


#660

#670

#680

#690



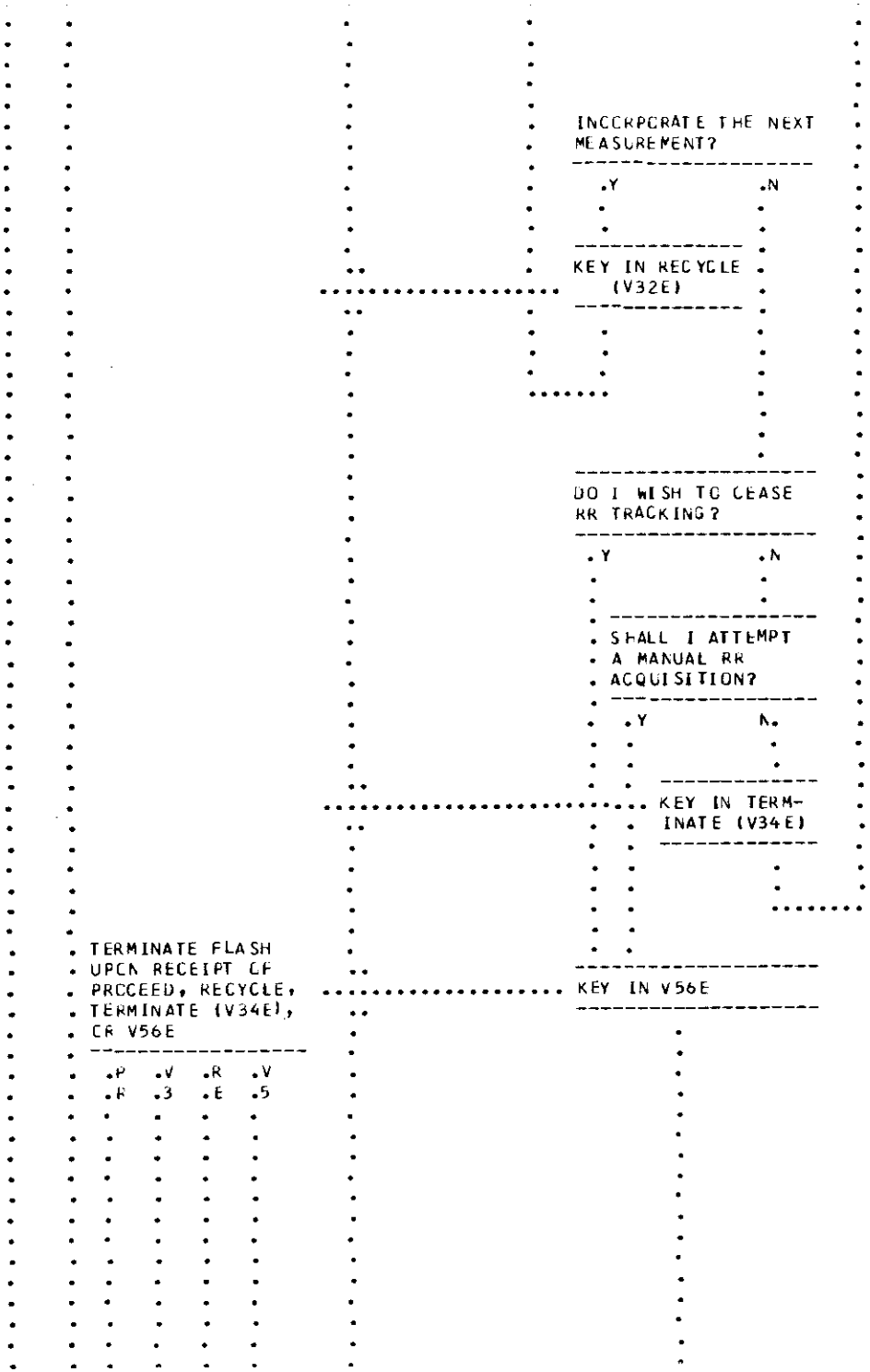
#700

#710

#720

#730

#740



#750

#760

#770

#780

#790

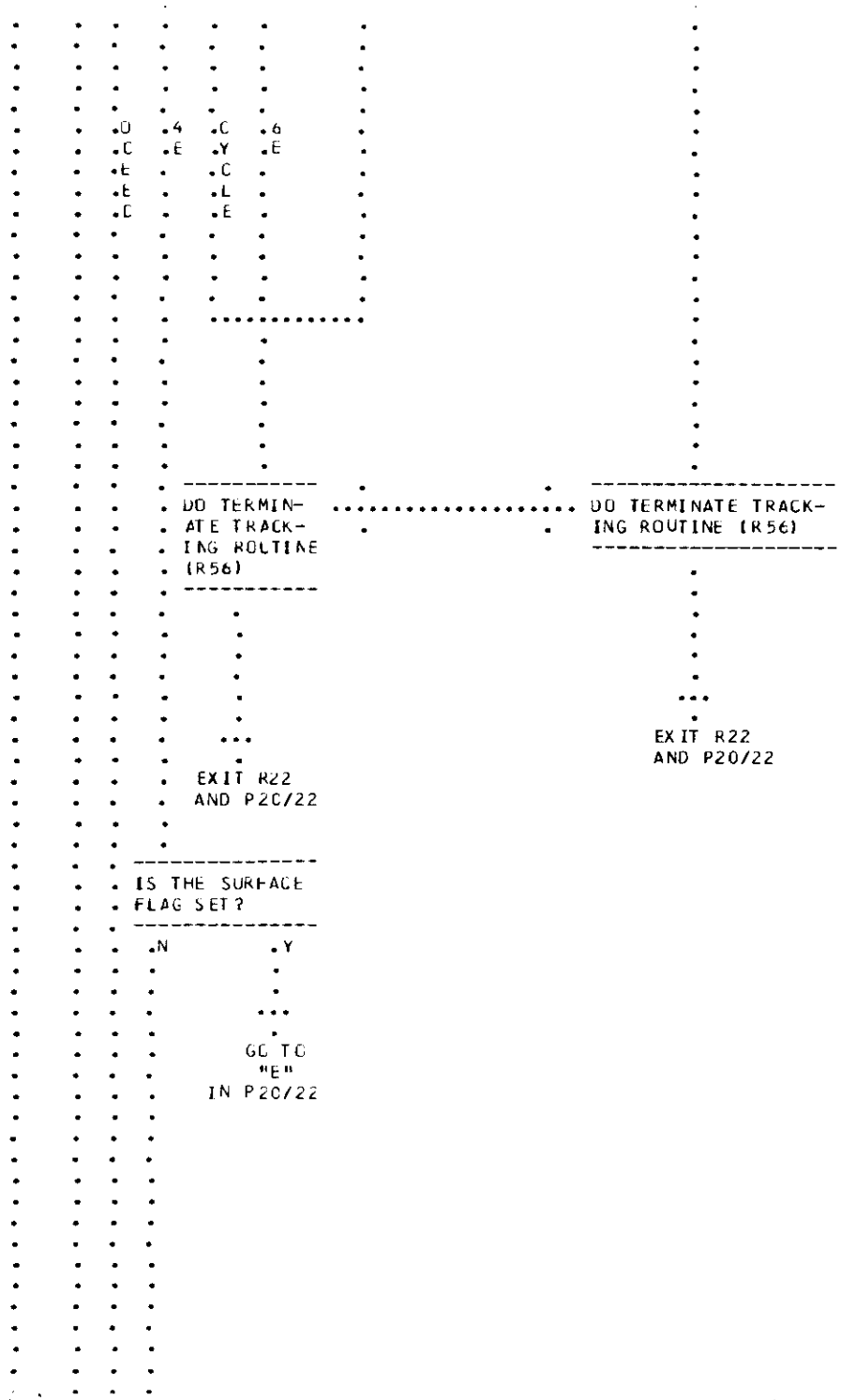
#800

#810

#820

#830

#840



SET NZ=0 FOR
USE BY R65

GO TO
"A"
BELOW

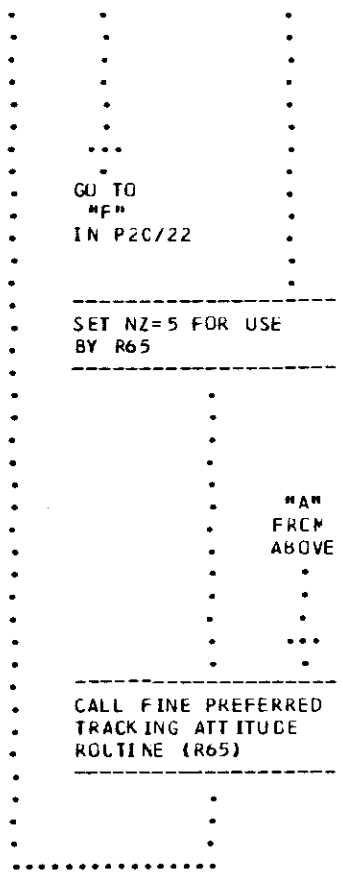
INCORPORATE STATE
VECTOR CORRECTION
INTO STATE VECTOR
DESIGNATED BY THE
STATE VECTOR UP-
DATE OPTION (SEE
P20/P22).

INCREMENT RR TRACK-
ING MARK COUNTER BY
ONE.

IS SURFACE FLAG SET?

Y

N



#900

#910

#920

CHANGE CONTROL NOTES

REV 01 PCR 39,226,400,451,562
REV 00(LUM 1A) PCR 736
REV 01(LUM 1B) PCR 818,EDITORIAL
REV 02 EDITORIAL

800

RR MANUAL ACQUISITION ROUTINE (R23) REV 02 08/07/69

PURPOSE: (1) TO ACQUIRE THE CSM BY MANUAL OPERATION OF THE RENDEZVOUS RADAR(RR) WHILE THE LM IS IN FLIGHT.

ASSUMPTIONS: (1) THE ROUTINE IS AUTOMATICALLY CALLED BY THE RENDEZVOUS NAVIGATION PROGRAM (P20) IN RESPONSE TO AN ASTRONAUT REQUEST FOR A MANUAL ACQUISITION.

(2) THE RR MANUAL ACQUISITION ROUTINE (R23) MAY ONLY BE SELECTED IF P20/22 IS NOT RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM.

(3) THE SELECTION AND TERMINATION OF P20,P22, AND P25 ARE SUBJECT TO SPECIAL OPERATING PROCEDURES DIFFERENT FROM ALL OTHER PROGRAMS;

(A) SELECTION

(1) ALWAYS BY V37EXXE.

(2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHENEVER EITHER P20,22, OR 25 IS RUNNING.

(3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER IN THE OSKY PROG LIGHTS.

(4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM AND OPERATION OF THE NEW.

(B) TERMINATION

(1) BY SELECTION OF P00, V56E OR BY V34E.

(2) P00 SELECTION WILL TERMINATE P20,22, AND 25 AND ANY OTHER PROGRAM IN PROCESS; AND ESTABLISH P00.

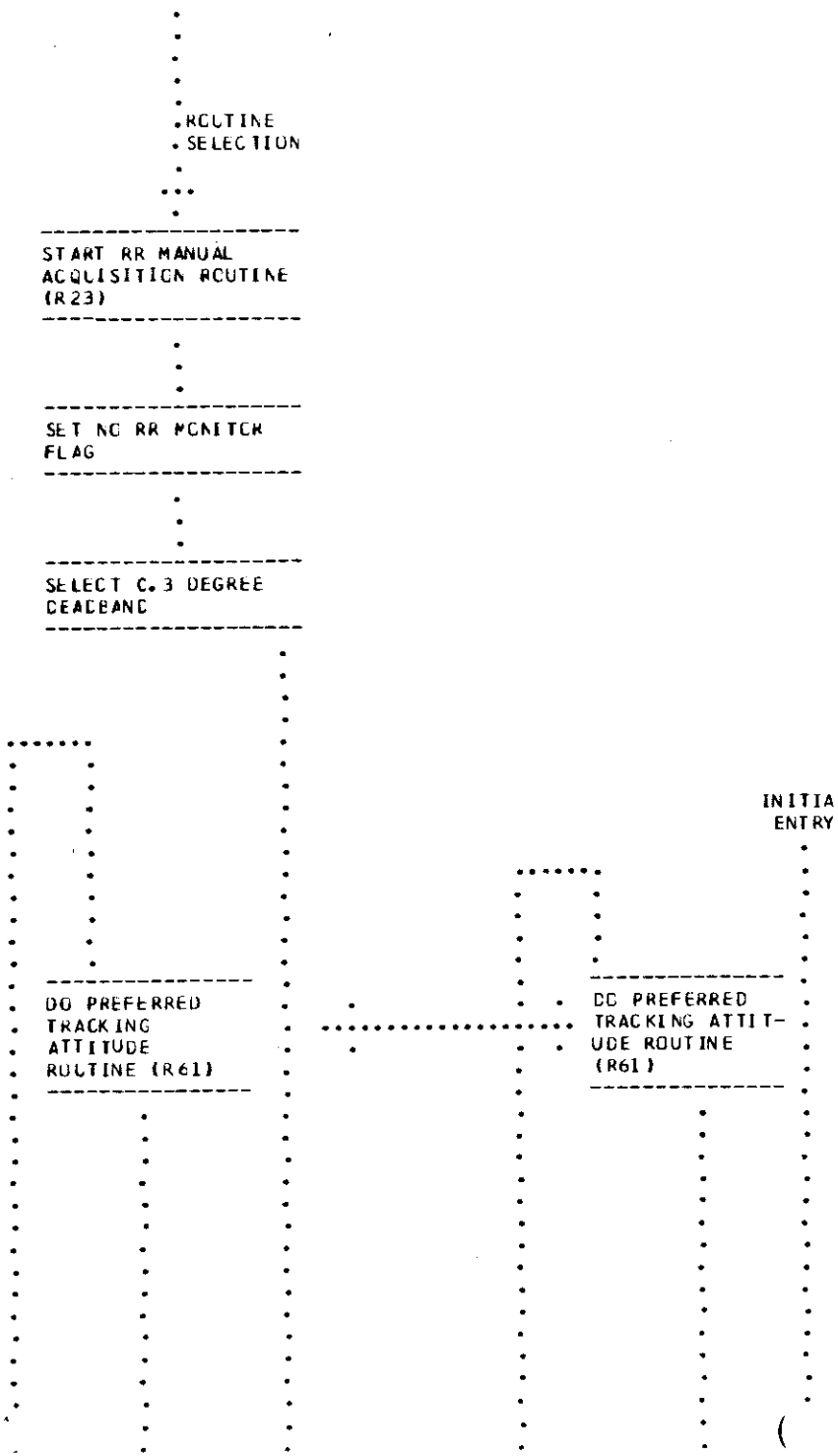
(3) V56E SELECTION WILL SELECT THE TERMINATE TRACKING ROUTINE (R56) WHICH WILL TERMINATE ONLY P20 OR P25 IF EITHER OF THESE PROGRAMS IS RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES R56 WILL SELECT R00. V56E MAY BE PERFORMED ANY TIME DURING P20,22 OR 25 OPERATION.

(4) THE LGC WILL ACT UPON V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THIS DISPLAY WAS ORIGINATED BY P20,22, OR 25; V34E WILL RESULT IN AN IDENTICAL LGC RESPONSE TO THAT OF V56E, THAT IS, SELECTION OF R56. IF THIS DISPLAY WAS NOT ORIGINATED BY P20,22, OR 25 (SUCH AS P32, WHILE RUNNING WITH P20) THE LGC WILL GO TO R00, HOWEVER THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).

++
+02
+EDIT
++

(5) ALTHOUGH IT IS NOT CLEARLY SHOWN IN THE LOGIC BELOW A V34E RESPONSE TO A PRIORITY DISPLAY MUST BE DELAYED 2 SECONDS FROM DISPLAY INITIATION WHEREAS THE DELAY IS NOT NECESSARY FOR A V56E RESPONSE.

PROG CONT	LGC	GROUND	CREW
	.LGC		


ROUTINE
SELECTION
START RR MANUAL ACQUISITION ROUTINE (R23)
SET NO RR MONITOR FLAG
SELECT C.3 DEGREE DEADBAND
DO PREFERRED TRACKING ATTITUDE ROUTINE (R61)
INITIAL ENTRY
DO PREFERRED TRACKING ATTIT- UDE ROUTINE (R61)

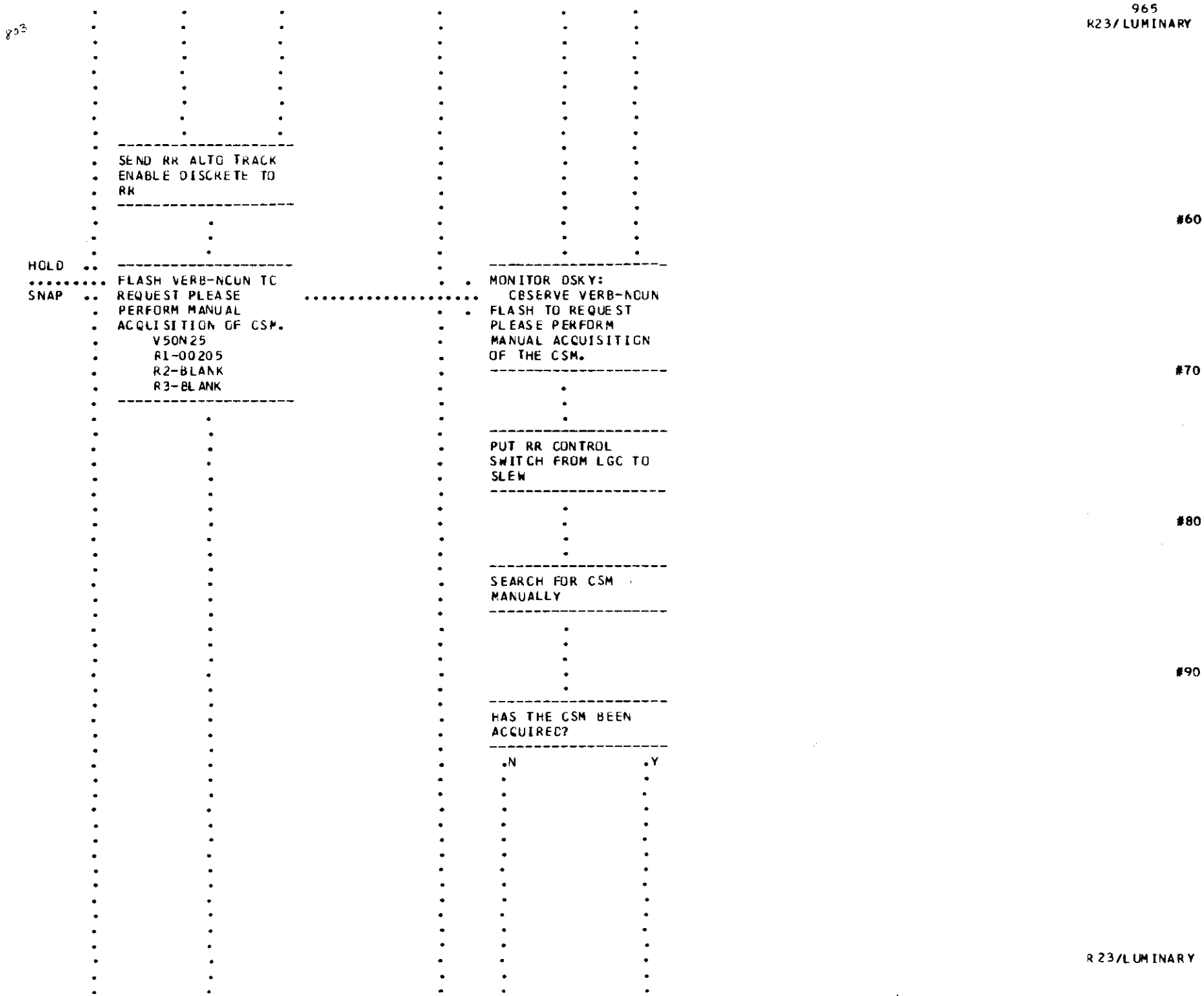
#10

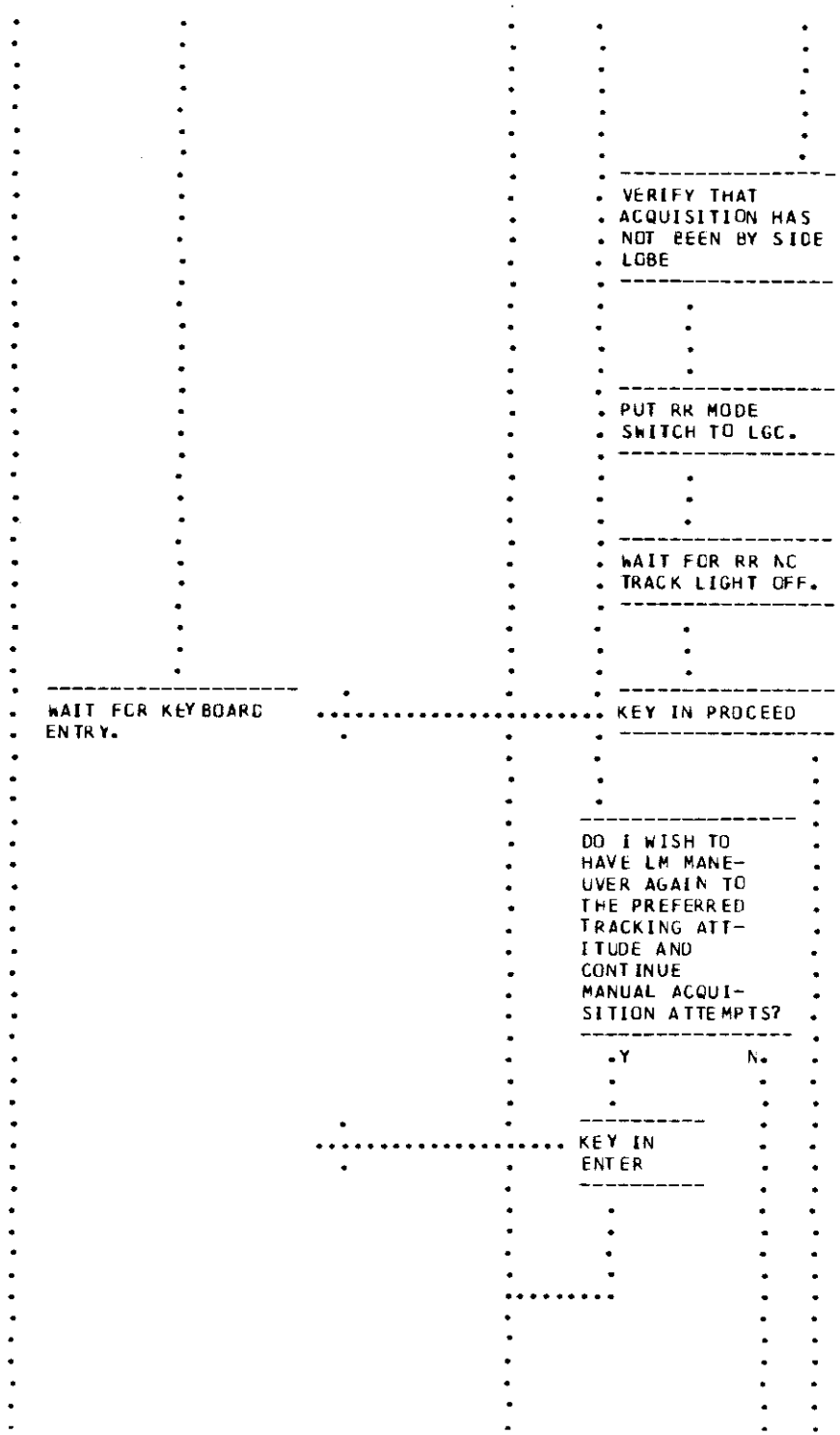
#20

#30

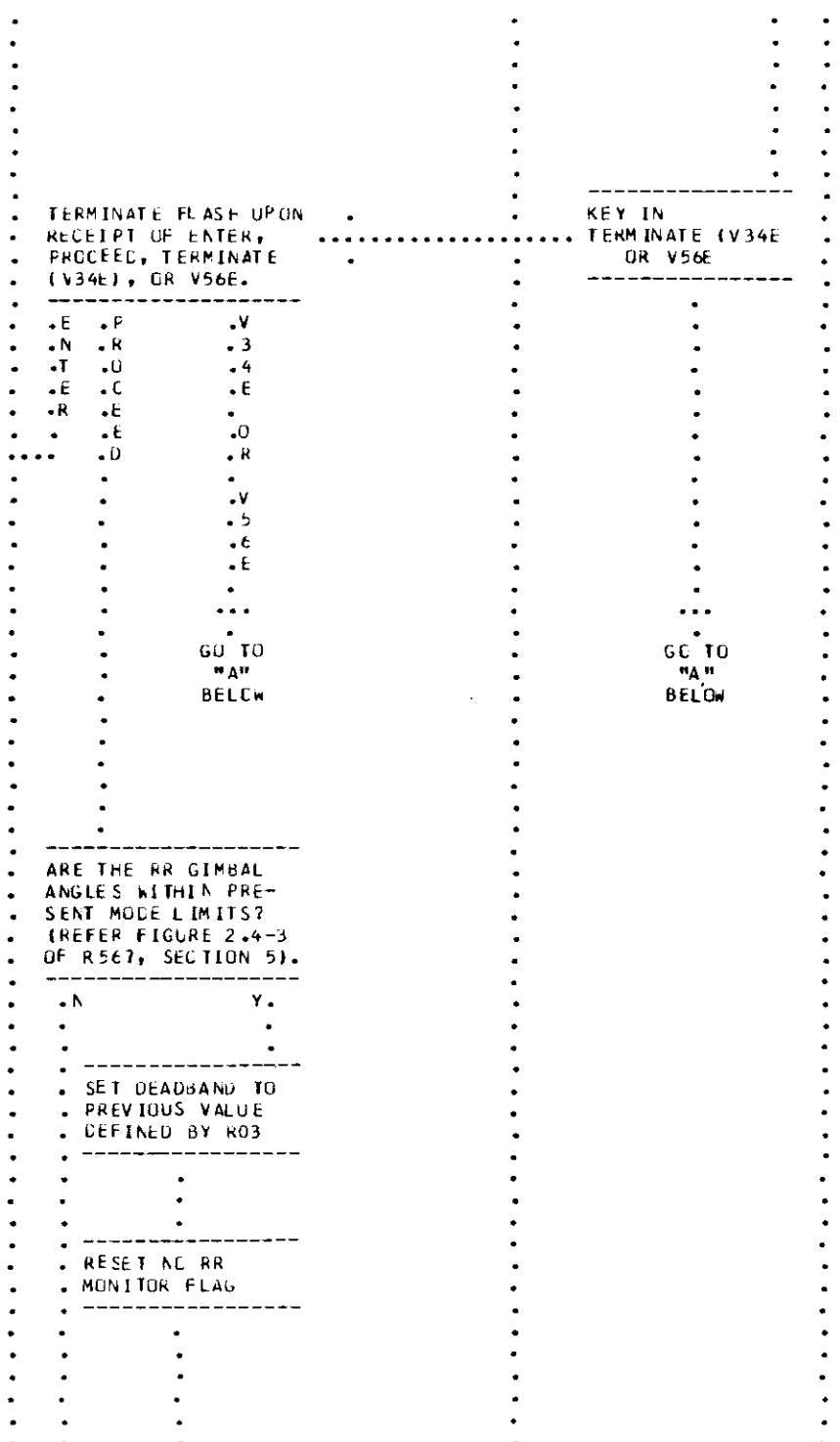
#40

#50


SEND RR AUTO TRACK ENABLE DISCRETE TO RR
HOLD
SNAP
FLASH VERB-NOUN TO REQUEST PLEASE PERFORM MANUAL ACQUISITION OF CSM.
V50N25
R1-00205
R2-BLANK
R3-BLANK
MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST PLEASE PERFORM MANUAL ACQUISITION OF THE CSM.
#60
#70
PUT RR CONTROL SWITCH FROM LGC TO SLEW
#80
SEARCH FOR CSM MANUALLY
#90
HAS THE CSM BEEN ACQUIRED?
N
Y


VERIFY THAT ACQUISITION HAS NOT BEEN BY SIDE LOBE
#100
PUT RR MODE SWITCH TO LGC.
#110
WAIT FOR RR NC TRACK LIGHT OFF.
#120
WAIT FOR KEYBOARD ENTRY.
KEY IN PROCEED
DO I WISH TO HAVE LM MANEUVER AGAIN TO THE PREFERRED TRACKING ATTITUDE AND CONTINUE MANUAL ACQUISITION ATTEMPTS?
#130
Y
N
#140
KEY IN ENTER
#150

805



#160

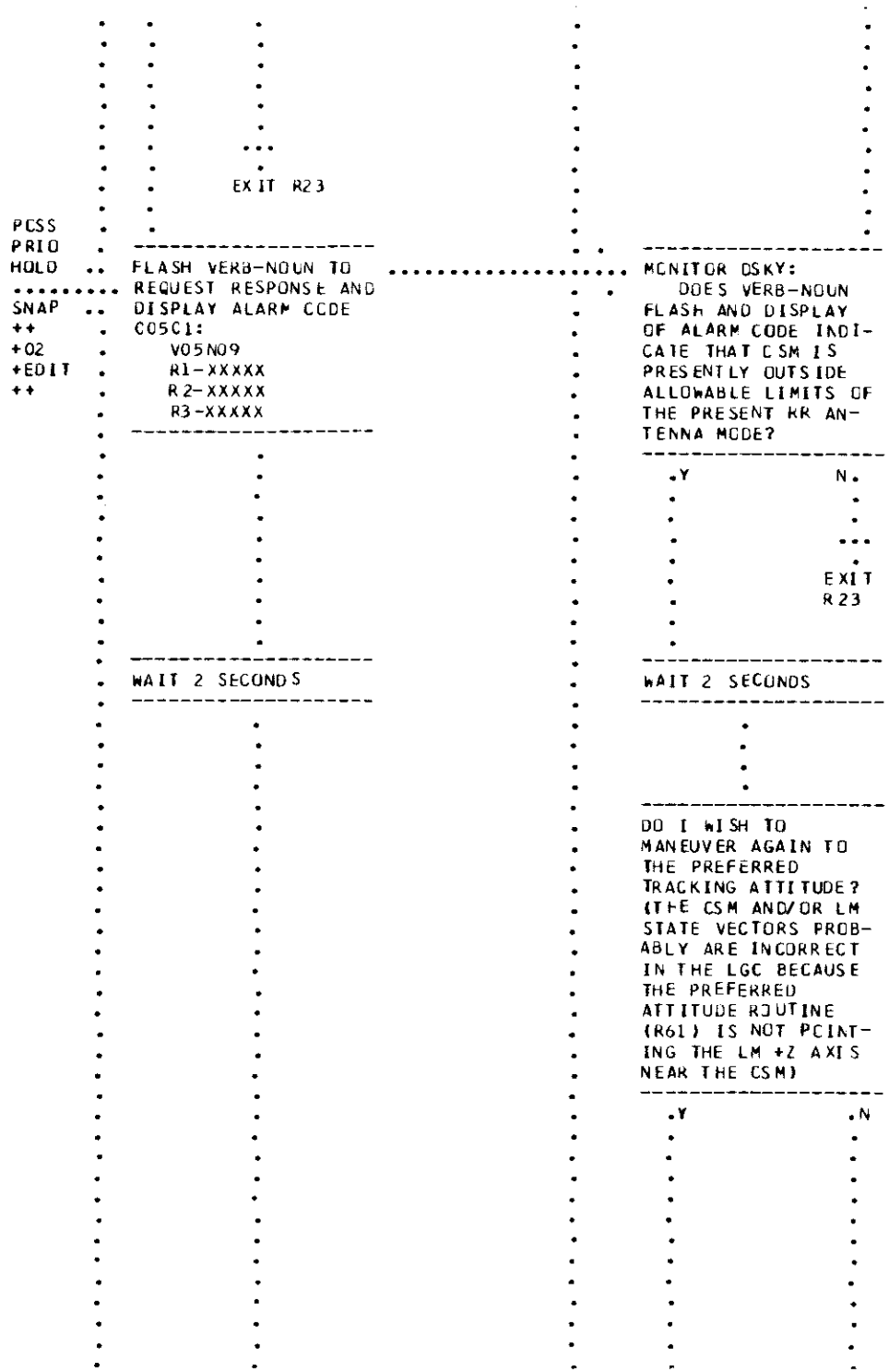
#170

#180

#190

#200

#210



#220

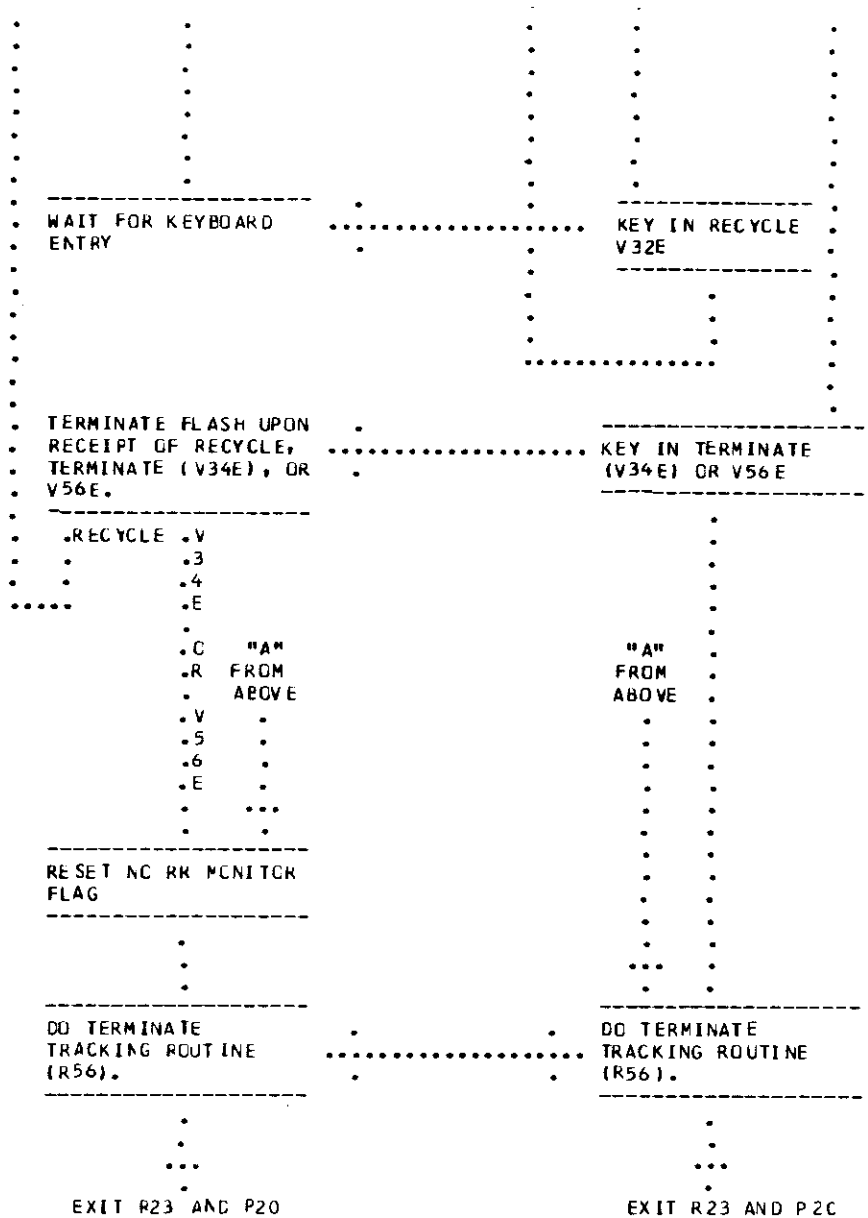
#230

#240

#250

#260

806



#270

#280

#290

#300

#310

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 86,226,409,451,562
REV 02 EDITORIAL

808

RR SEARCH ROUTINE (R24) REV 02 08/07/69

PURPOSE: (1) TO ACQUIRE THE CSM BY A SEARCH PATTERN WHEN THE RENDEZVOUS RADAR HAS FAILED TO ACQUIRE THE CSM IN THE AUTOMATIC TRACKING MODE.

(2) TO ALLOW THE ASTRONAUT TO CONFIRM THAT REACQUISITION HAS NOT BEEN BY SIDELOBE.

ASSUMPTION: (1) THE ROUTINE IS AUTOMATICALLY CALLED BY THE RR DESIGNATE ROUTINE (R21) IN RESPONSE TO AN ASTRONAUT REQUEST FOR A SEARCH ACQUISITION.

(2) THE SELECTION AND TERMINATION OF P20, P22, AND P25, ARE SUBJECT TO SPECIAL OPERATING PROCEDURES DIFFERENT FROM ALL OTHER PROGRAMS;

(A) SELECTION

(1) ALWAYS BY V37EXXE.

(2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHENEVER EITHER P20, 22, OR 25 IS RUNNING.

(3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER IN THE DSKY PROG LIGHTS.

(4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM AND OPERATION OF THE NEW.

(B) TERMINATION

(1) BY SELECTION OF P00, P22, V56E OR BY V34E.

(2) P00 SELECTION WILL TERMINATE P20, 22, AND 25 AND ANY OTHER PROGRAM IN PROCESS, AND ESTABLISH P00.

(3) V56E SELECTION WILL SELECT THE TERMINATE TRACKING ROUTINE (R56) WHICH WILL TERMINATE ONLY P20 OR P25 IF EITHER OF THESE PROGRAMS ARE RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES R56 WILL SELECT R00. V56E MAY BE PERFORMED ANY TIME DURING P20, 22, OR 25 OPERATION.

(4) THE LGC WILL ACT UPON V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THIS DISPLAY WAS ORIGINATED BY P20, 22, OR 25; V34E WILL RESULT IN AN IDENTICAL LGC RESPONSE TO THAT OF V56E, THAT IS SELECTION OF R56. IF THIS DISPLAY WAS NOT ORIGINATED BY P20, 22, OR 25 (SUCH AS P32, WHILE RUNNING WITH P20) THE LGC WILL GO TO R00, HOWEVER THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).

++
+02
+EDIT
+
+
+02
++

(5) THE INITIALIZATION OF THE w MATRIX (SEE SECTION 5.2.4.2 OF R567) IS ENABLED BY:

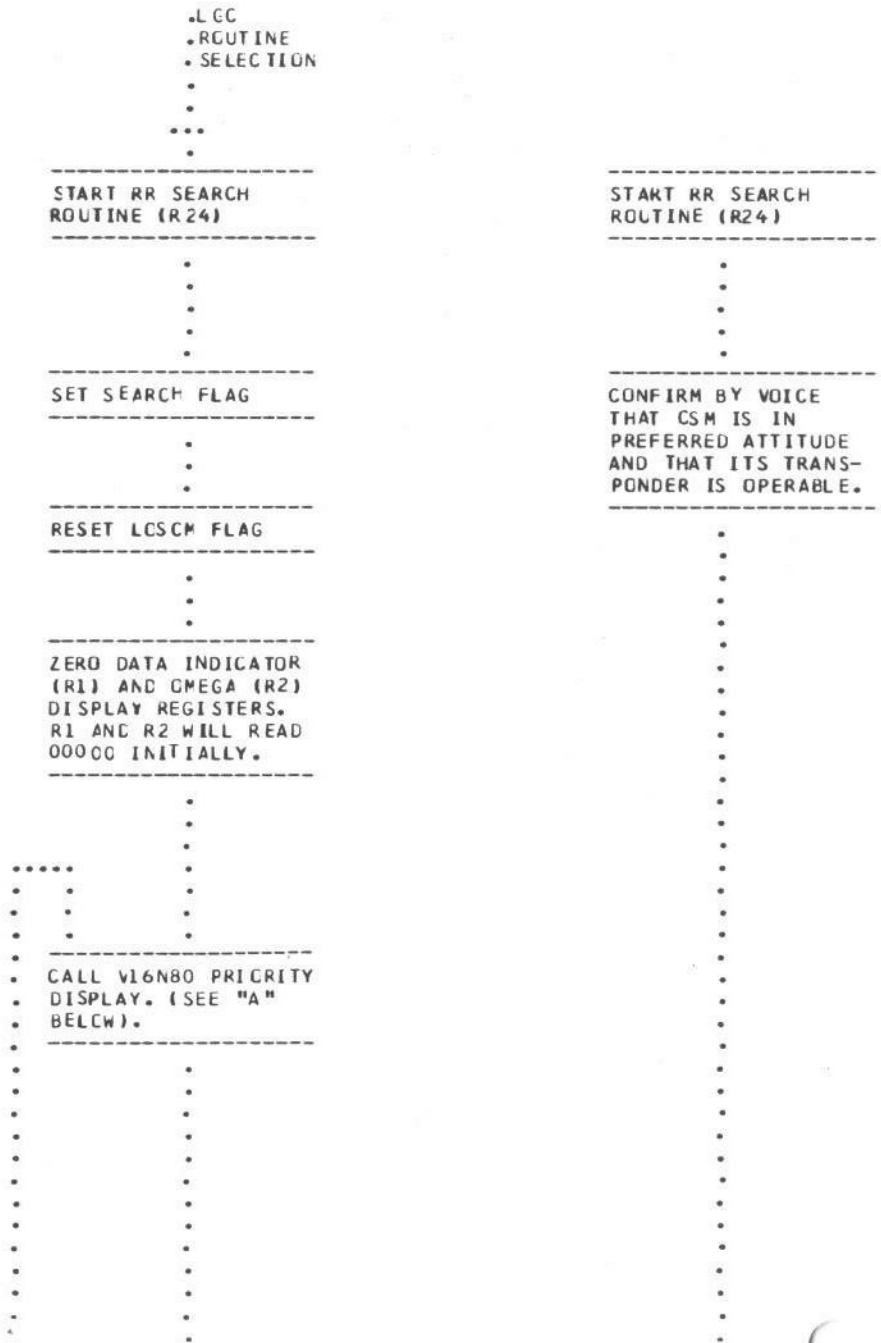
(A) A MANUAL DSKY ENTRY.

(B) COMPUTER FRESH START.

(C) STATE VECTOR UPDATE FROM THE GROUND (P27) (EXCEPT FOR UPDATE OF LANDING SITE VECTOR WHEN THE LM IS ON THE LUNAR SURFACE).

(D) THE POWERED ASCENT PROGRAM (P12) INVALIDATES THE W-MATRIX USED BY P22 AND CAUSES P20 TO RE-INITIALIZE THE W-MATRIX WHEN SELECTED.

PROG CONT	LGC	GROUND	CREW


.LCC
.ROUTINE
.SELECTION
START RR SEARCH ROUTINE (R24)
SET SEARCH FLAG
RESET LCSCM FLAG
ZERO DATA INDICATOR (R1) AND OMEGA (R2) DISPLAY REGISTERS. R1 AND R2 WILL READ 00000 INITIALLY.
CALL V16N80 PRIORITY DISPLAY. (SEE "A" BELOW).
START RR SEARCH ROUTINE (R24)
CONFIRM BY VOICE THAT CSM IS IN PREFERRED ATTITUDE AND THAT ITS TRANS-PONDER IS OPERABLE.

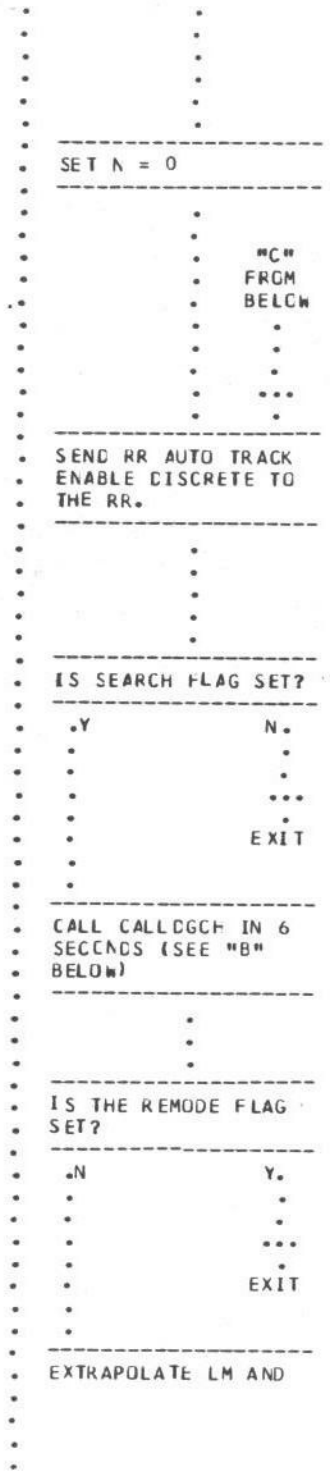
#10

#20

#30

#40

#50



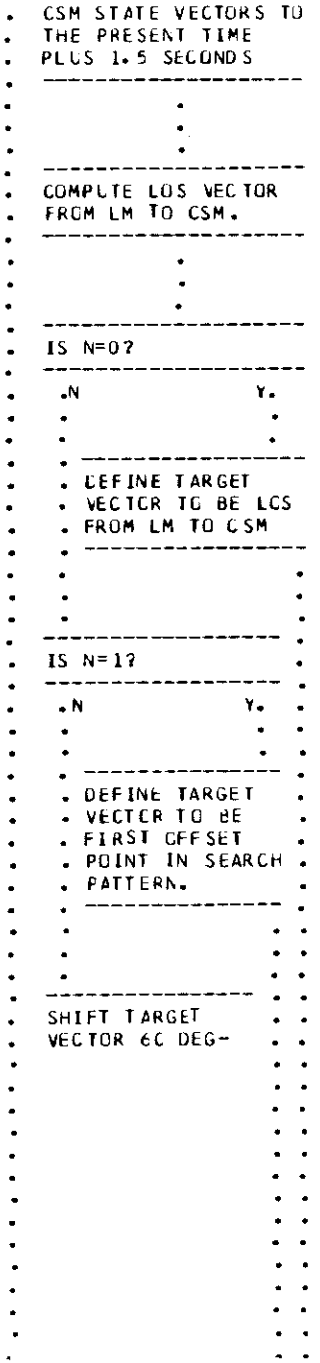
#60

#70

#80

#90

#100



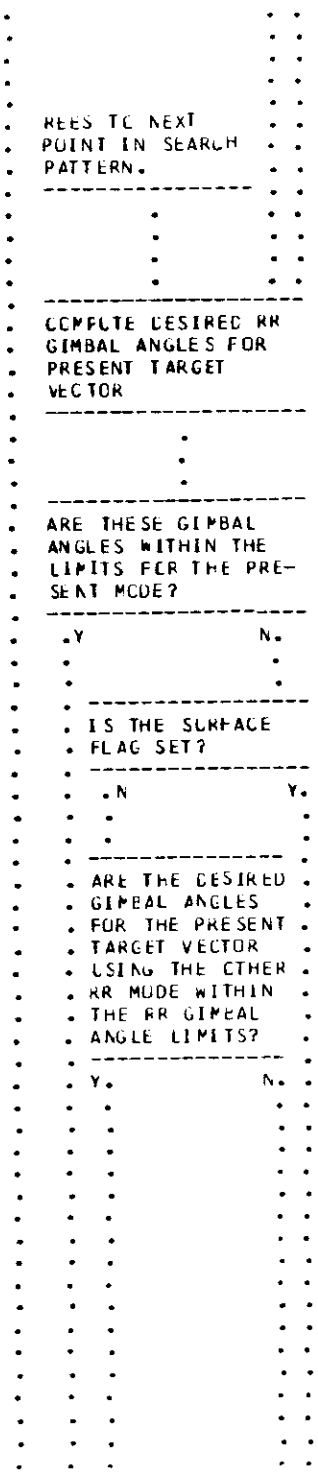
#110

#120

#130

#140

#150



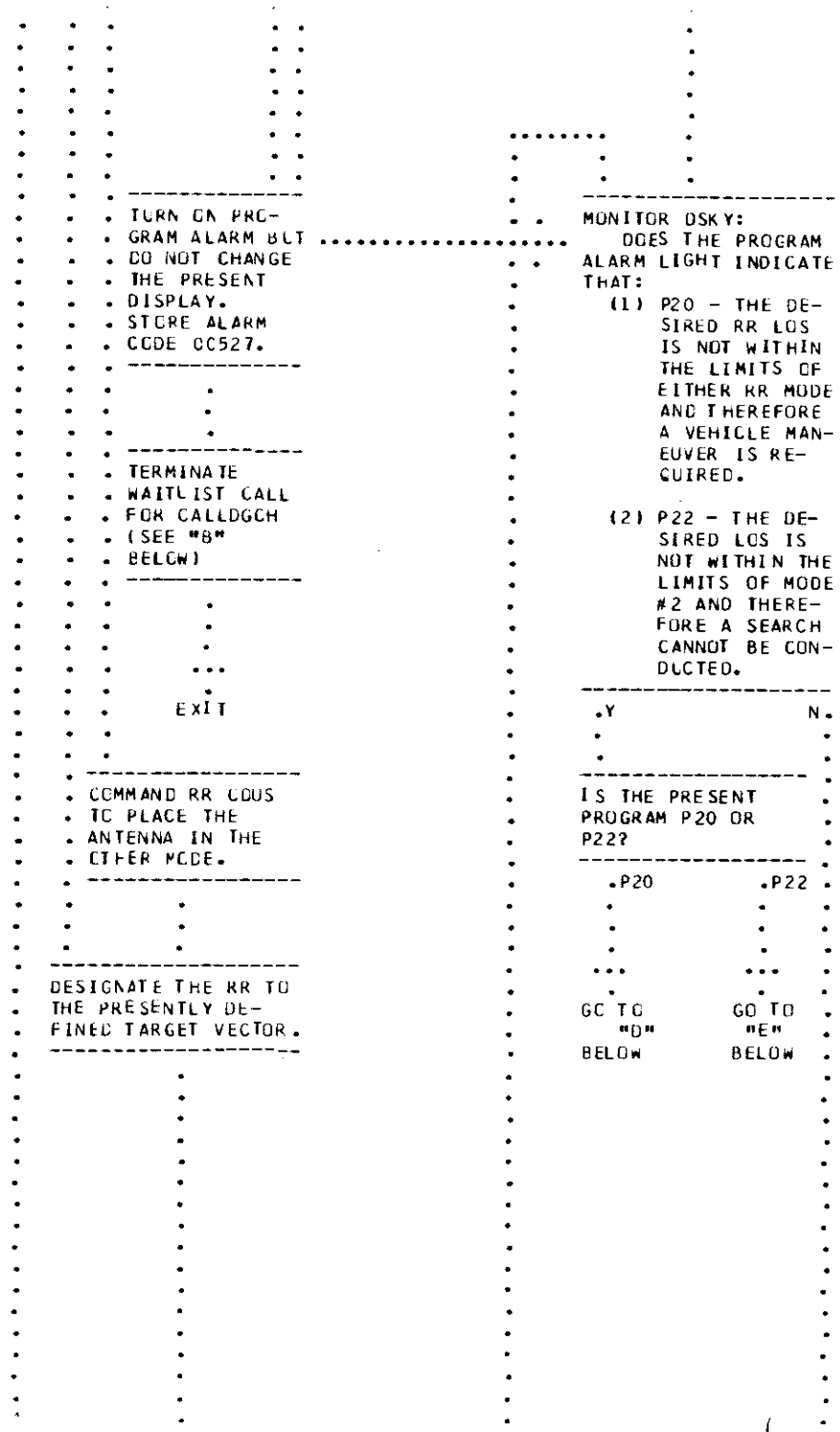
#160

#170

#180

#190

#200



#210

#220

#230

#240

815

#250

#260

#270

#280

#290

#300

CALCULATE THE ANGLE BETWEEN THE RR LOS AND THE LM +Z AXIS (OMEGA) FOR DISPLAY IN R2.

EXIT

"A" FROM ABOVE

PRIO HOLD MON

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY RR SEARCH PARAMETERS:
V16N8C
R1-DATA INDICATOR
R2-OMEGA
R3-BLANK

R1 WILL INITIALLY DISPLAY 00000. R1 WILL DISPLAY 11111 IF THE RR DATA GOOD DISCRETE IS RECEIVED INDICATING THAT THE SEARCH HAS BEEN SUCCESSFUL

R2 WILL INITIALLY DISPLAY 00000. WHEN RR DESIGNATION HAS COMMENCED IT WILL DISPLAY OMEGA, THE ANGLE BETWEEN THE RR LOS AND THE LM +Z AXIS. IN DEGREES TO NEAREST 0.01 DEGREE.

WAIT 2 SECONDS.

MONITOR DSKY:
OBSERVE FLASHING VERB-NOUN TO REQUEST RESPONSE AND TO INDICATE THAT AN LGC-CONTROLLED SEARCH PATTERN IS IN PROCESS.

DOES 11111 IN R1 INDICATE THAT THE CSM HAS BEEN ACQUIRED?

.N

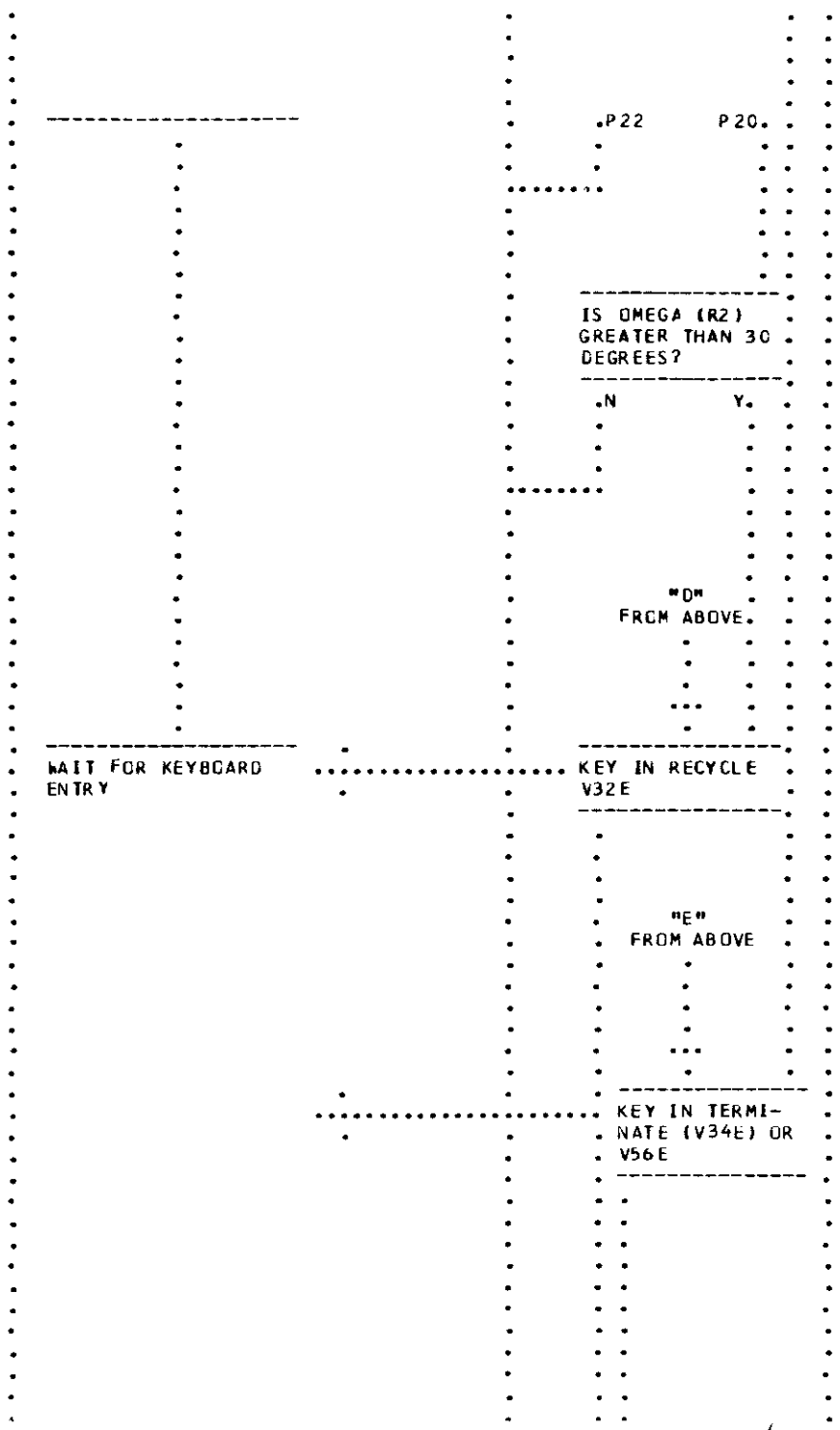
Y.

SHALL I CONTINUE THE SEARCH?

.Y

.N

IS THE PRESENT PROGRAM P20 OR P22?



#310

#320

#330

#340

#350

#360

HAS THE CSM BEEN ACQUIRED BY SIDELOBE?

N / Y

#370

REACQUIRE CSM IN CENTER LOBE MANUALLY.

#380

SET RR MODE SWITCH TO LGC

#390

WAIT FOR NO TRACK LIGHT TO GO OFF

KEY IN PROCEED.

#400

GO TO "A" IN P20/22

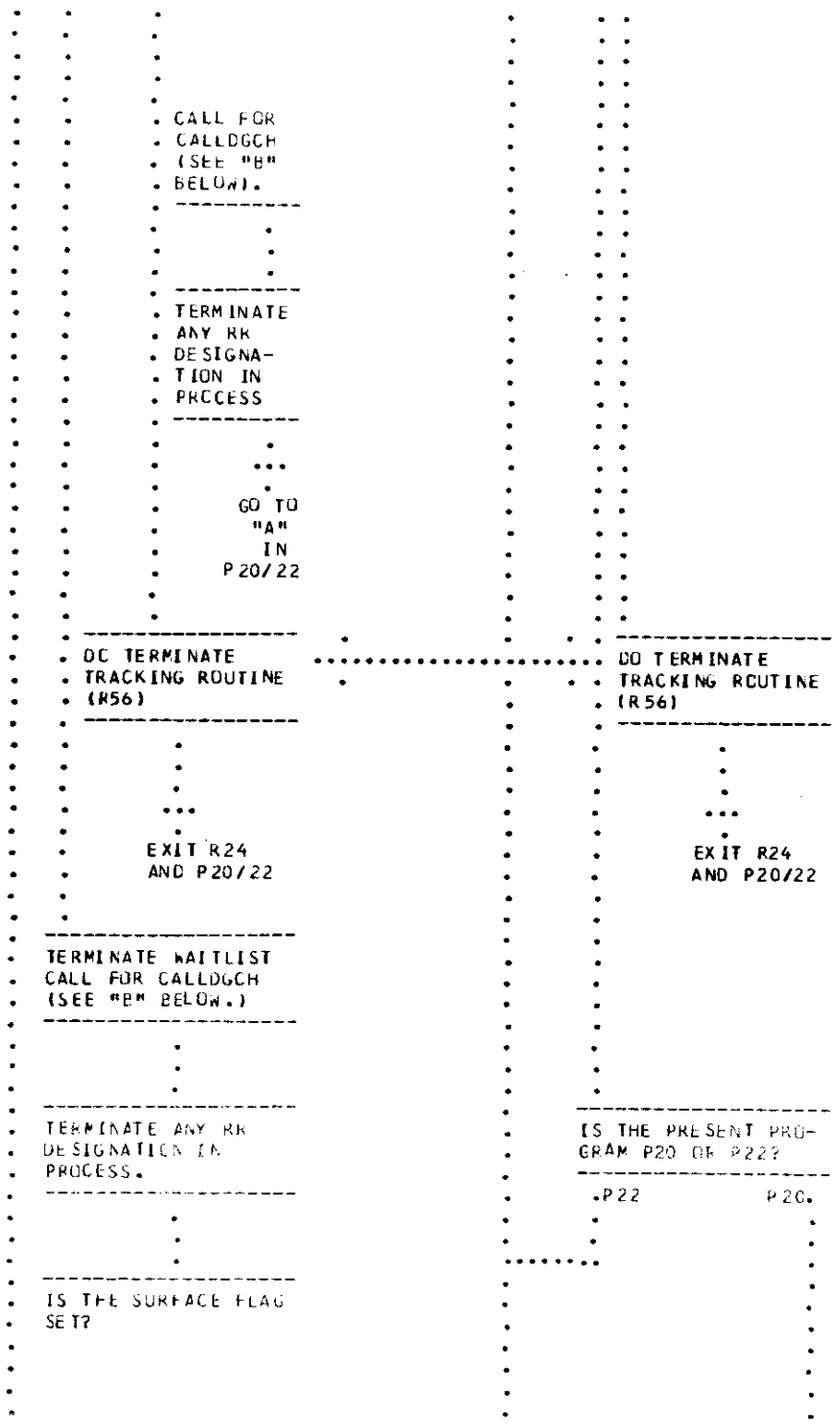
TERMINATE FLASH UPON RECEIPT OF PROCEED, RECYCLE, TERMINATE (V34E), OR V56E.

R E C Y C L E

V56E OR V34E

P R O C E E D

TERMINATE WAITLIST



#410

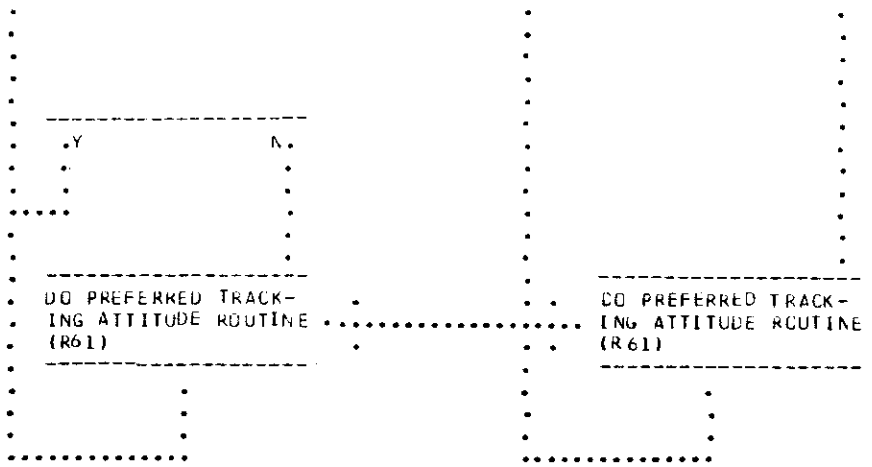
#420

#430

#440

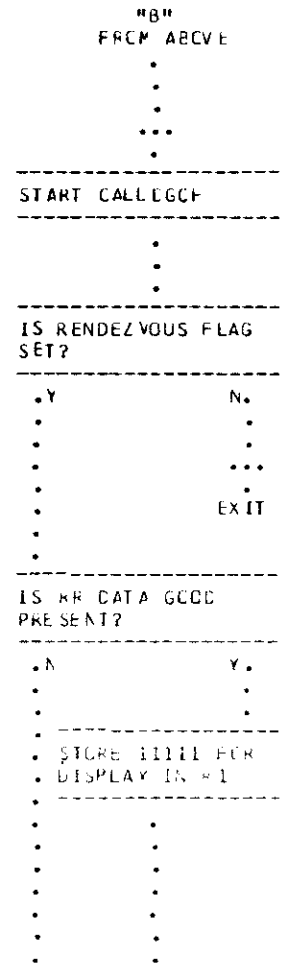
#450

#460



#470

#480

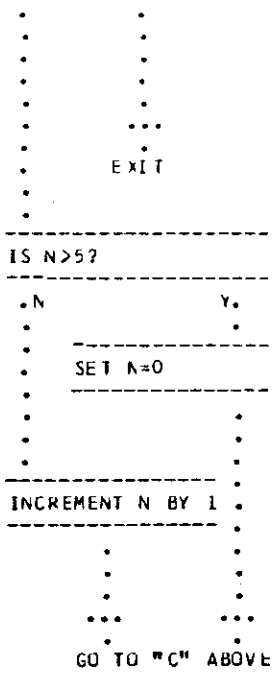


#490

#500

#510

#520



#530

#540

#550

CHANGE CONTROL NOTES

REV 00 PCR 124
REV 01 PCR 409, 451, 562
REV COLUMN 1A) PCR 744
REV 02 EDITORIAL

R R MONITOR ROUTINE (R25) REV 03 12/03/69

PURPOSE: (1) TO MONITOR THE RR STATUS WITH RESPECT TO MODE CHANGES, RR CDU FAILURE, AND RR GIMBAL POSITIONS.

(2) TO COMMAND THE RR GIMBALS TO ONE OF TWO REFERENCE POSITIONS (DEPENDENT UPON RR ANTENNA MODE) IF THE RR GIMBAL ANGLES EXCEED PREDEFINED LIMITS (AS DESCRIBED IN FIG 2.4-3 OF SECTION 5 OF R-567).

(3) TO ZERO THE RR CDUS WHEN THE RR IS FIRST PUT IN AUTO MODE.

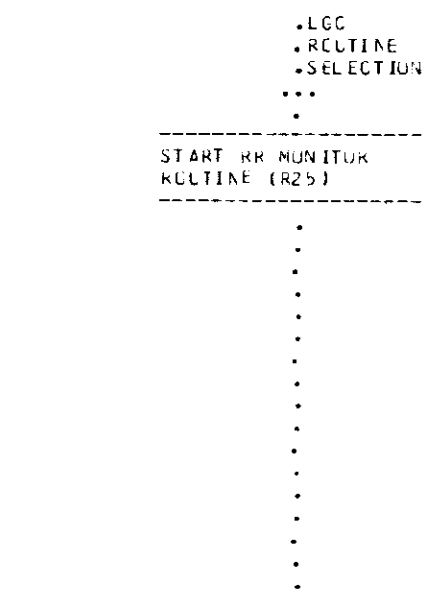
ASSUMPTIONS: (1) THE PREDEFINED LIMITS OF PURPOSE (2) ABOVE ALLOW THE ANGLE BETWEEN THE LM +Z AXIS AND THE RR LOS TO BE GREATER THAN 30 DEGREES DURING NORMAL RR TRACKING UNDER CONTROL OF THE RENDEZVOUS NAVIGATION PROGRAM (P20) OR THE LUNAR SURFACE NAVIGATION PROGRAM (P22).

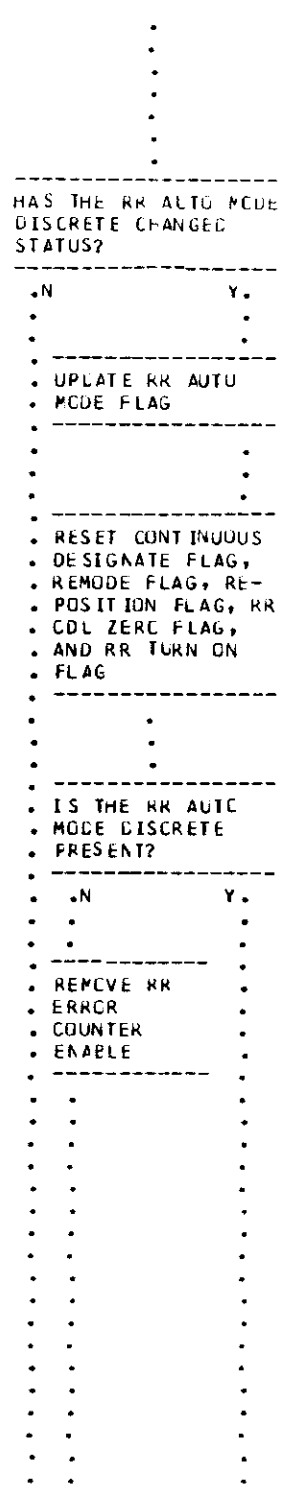
WHILE IN FLIGHT, THE 30 DEGREE LIMIT DEFINED IN THE RR DATA READ ROUTINE (R22) WILL ACT TO KEEP THE RR LOS WITHIN THIS LIMIT w.R.T. THE LM +Z AXIS. THIS WILL BE ACCOMPLISHED BY LM ATTITUDE MANEUVERS UNDER THE CONTROL OF THE PREFERRED TRACKING ATTITUDE ROUTINE (R61). THEREFORE, IN FLIGHT, WHEN THE TRACK FLAG (SEE P20) IS SET, THE LIMITS DEFINED BY THIS ROUTINE SHOULD NEVER BE EXCEEDED AND IT SHOULD ONLY BE NECESSARY FOR THIS ROUTINE TO CONTROL THE RR GIMBALS WHEN THE TRACK FLAG IS RESET (AS DURING MANEUVERS FOR THRUSTING, ETC).

WHILE ON THE LUNAR SURFACE RR DESIGNATION IS INHIBITED IF THE LOS TO THE CSM IS NOT WITHIN THE ALLOWABLE RR GIMBAL LIMITS OF MODE # 2.

(2) THIS ROUTINE IS AUTOMATICALLY CALLED EVERY 0.48 SECONDS WHENEVER THE LGC IS ON.

++
+03 (3) THIS ROUTINE WILL SET THE RR CDU ZERO DISCRETE IF THE RR MODE SWITCH IS NOT IN THE LGC POSITION.
+EDIT
++




HAS THE RR AUTO MODE DISCRETE CHANGED STATUS?
N
Y
UPDATE RR AUTO MODE FLAG
RESET CONTINUOUS DESIGNATE FLAG, REMODE FLAG, REPOSITION FLAG, RR CDU ZERO FLAG, AND RR TURN ON FLAG
IS THE RR AUTO MODE DISCRETE PRESENT?
N
Y
REMOVE RR ERROR COUNTER ENABLE

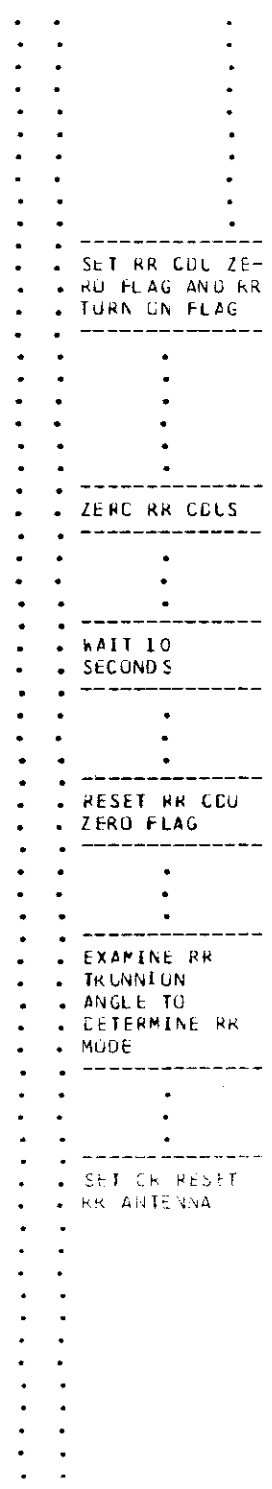
#20

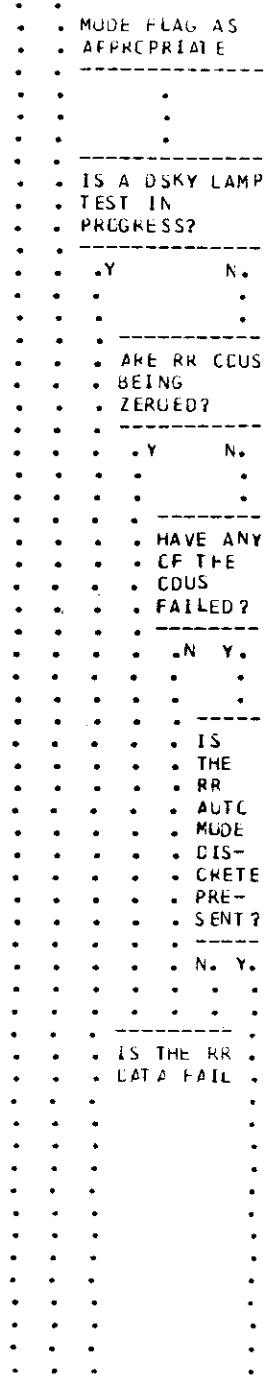
#30

#40

#50

#60


SET RR CDU ZERO FLAG AND RR TURN ON FLAG
#70
ZERO RR CDUS
#80
WAIT 10 SECONDS
#90
RESET RR CDU ZERO FLAG
EXAMINE RR TRUNNION ANGLE TO DETERMINE RR MODE
#100
SET CH RESET RR ANTENNA
#110

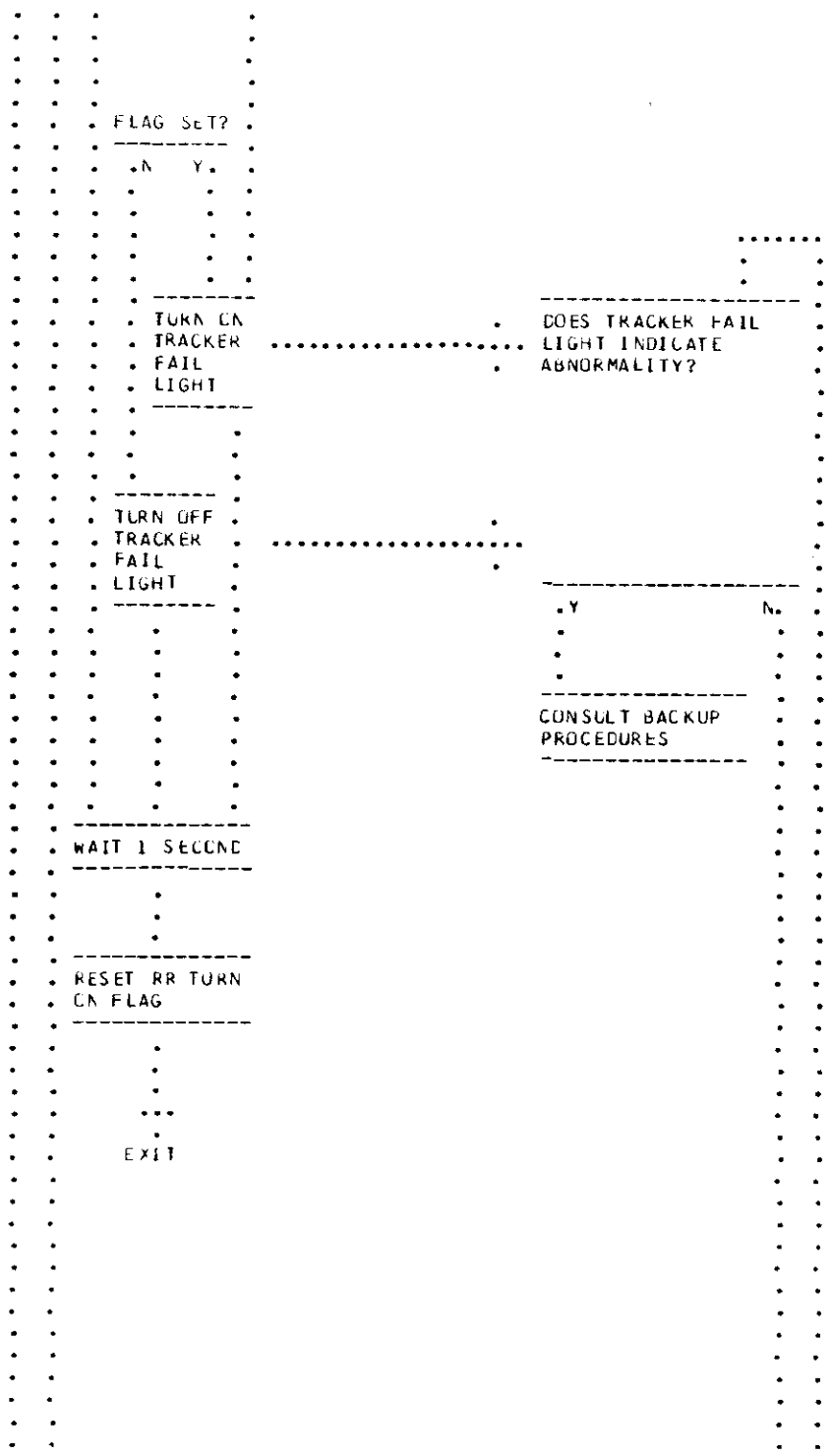


#120

#130

#140

#150



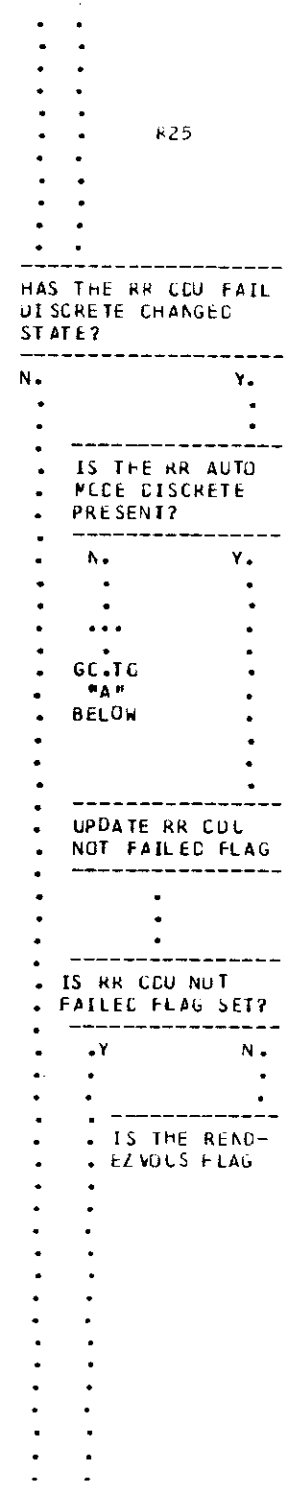
#160

#170

#180

#190

#200



++
+03
+EDIT
++

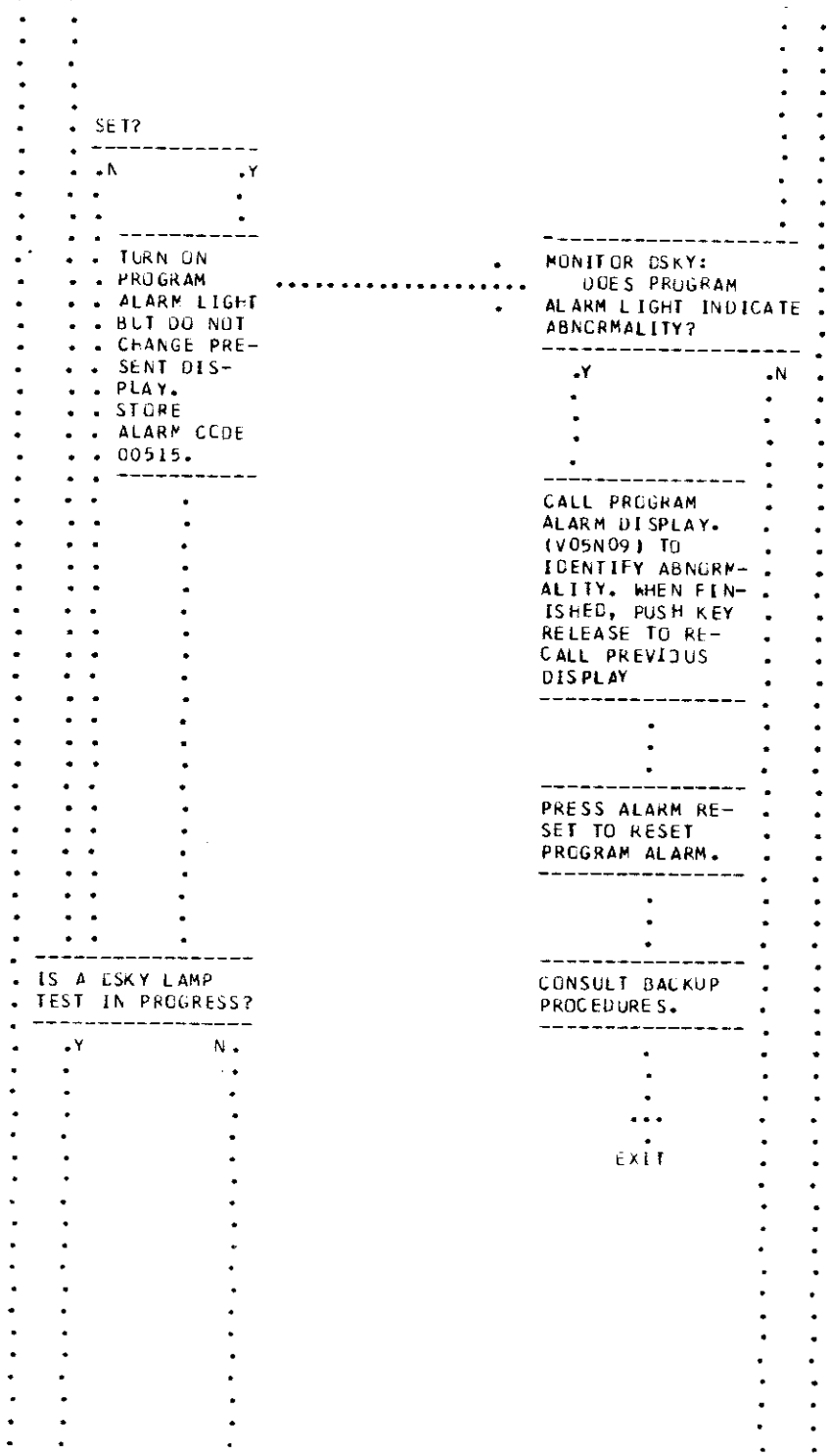
#210

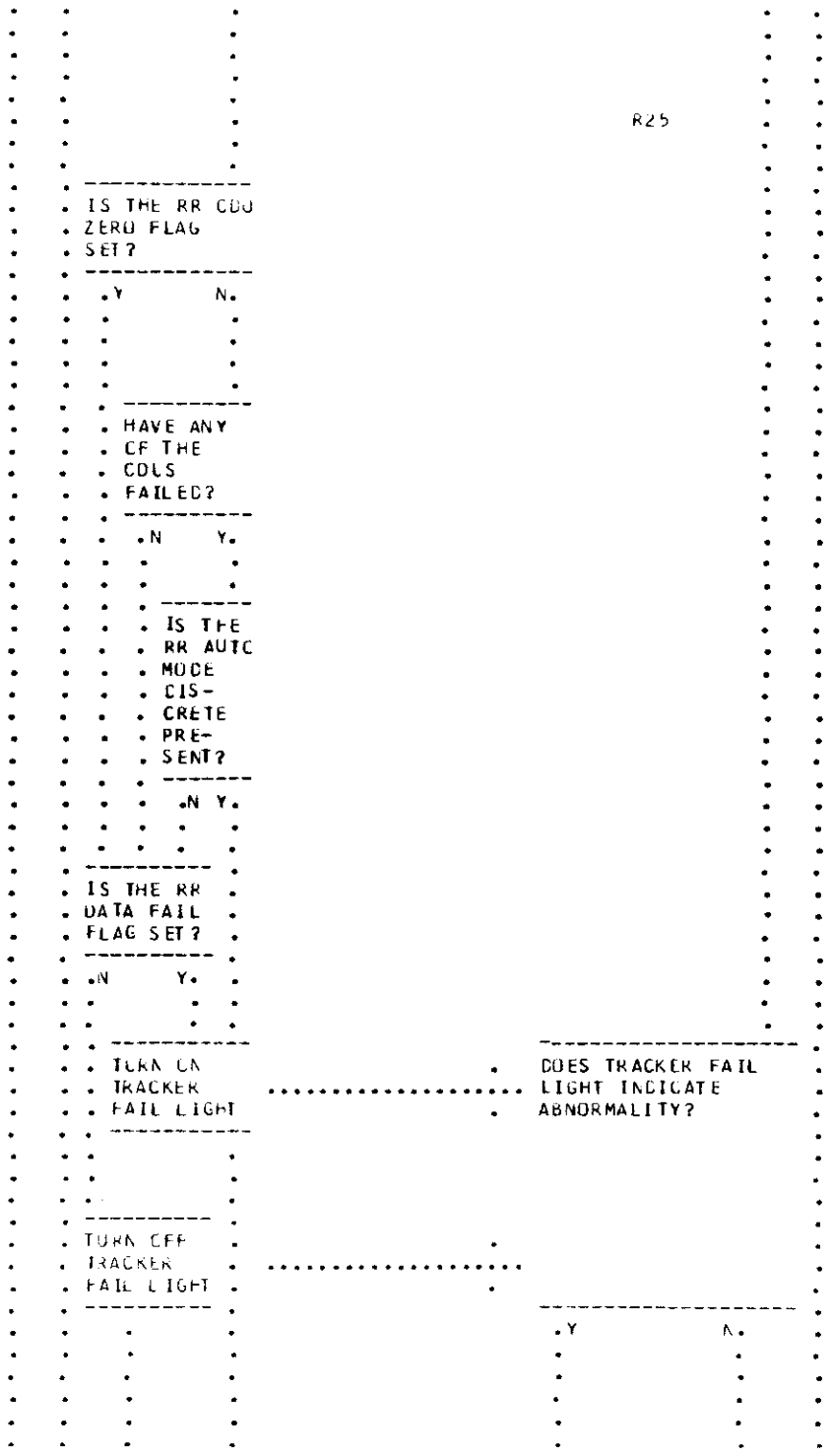
#220

#230

#240

#250


SET?
.N
.Y
TURN ON PROGRAM ALARM LIGHT BUT DO NOT CHANGE PRESENT DISPLAY. STORE ALARM CODE 00515.
MONITOR DSKY: DOES PROGRAM ALARM LIGHT INDICATE ABNORMALITY?
.Y
.N
CALL PROGRAM ALARM DISPLAY. (V05N09) TO IDENTIFY ABNORMALITY. WHEN FINISHED, PUSH KEY RELEASE TO RECALL PREVIOUS DISPLAY
PRESS ALARM RESET TO RESET PROGRAM ALARM.
IS A DSKY LAMP TEST IN PROGRESS?
.Y
N.
CONSULT BACKUP PROCEDURES.
EXIT
#260
#270
#280
#290
#300


R25
IS THE RR CDU ZERO FLAG SET?
Y
N
#310
HAVE ANY OF THE CDUS FAILED?
N
Y
#320
IS THE RR AUTO MODE DIS-CRETE PRE-SENT?
N
Y
#330
IS THE RR DATA FAIL FLAG SET?
N
Y
#340
TURN ON TRACKER FAIL LIGHT
DOES TRACKER FAIL LIGHT INDICATE ABNORMALITY?
#350
TURN OFF TRACKER FAIL LIGHT
Y
N

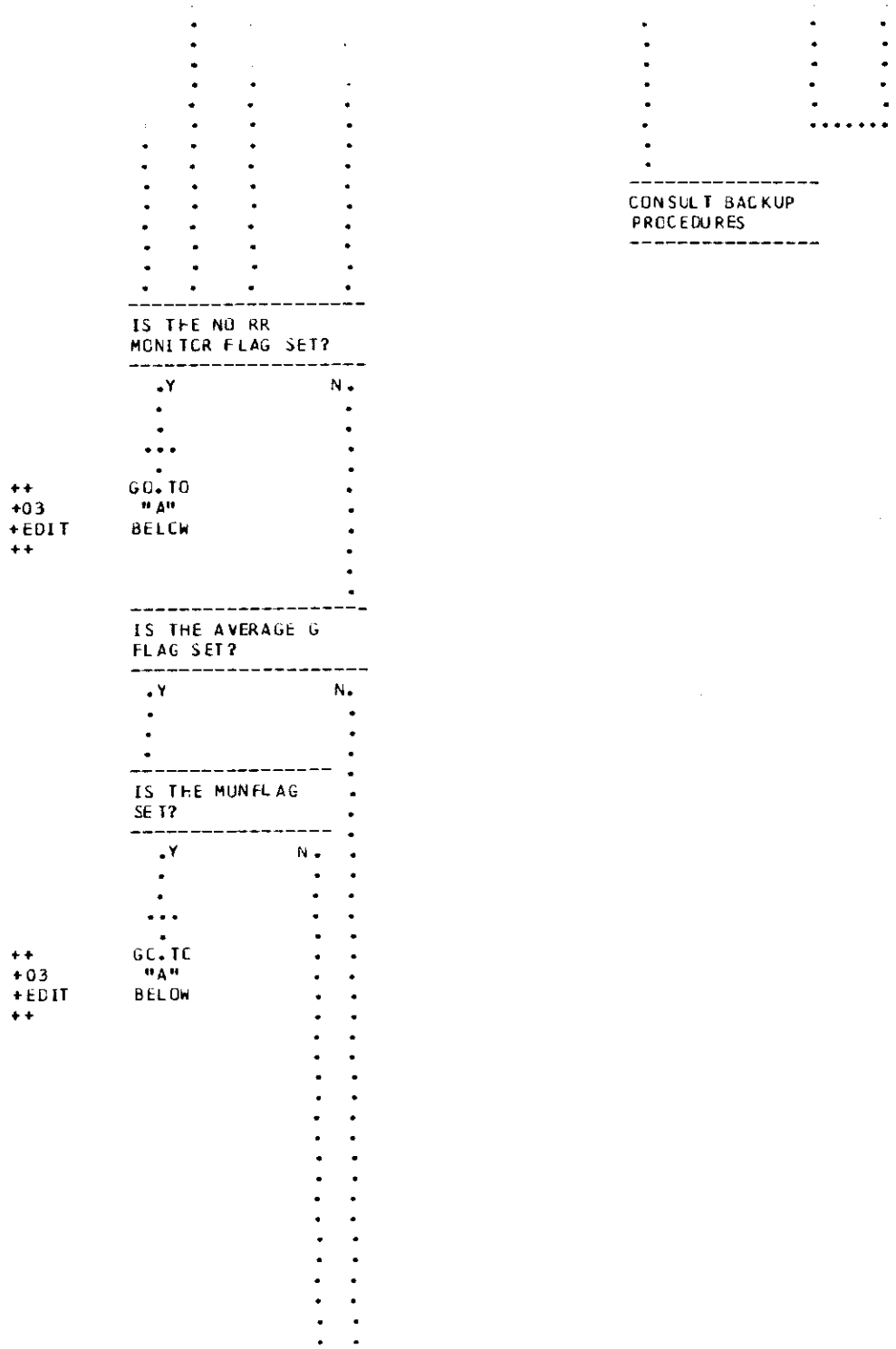
#360

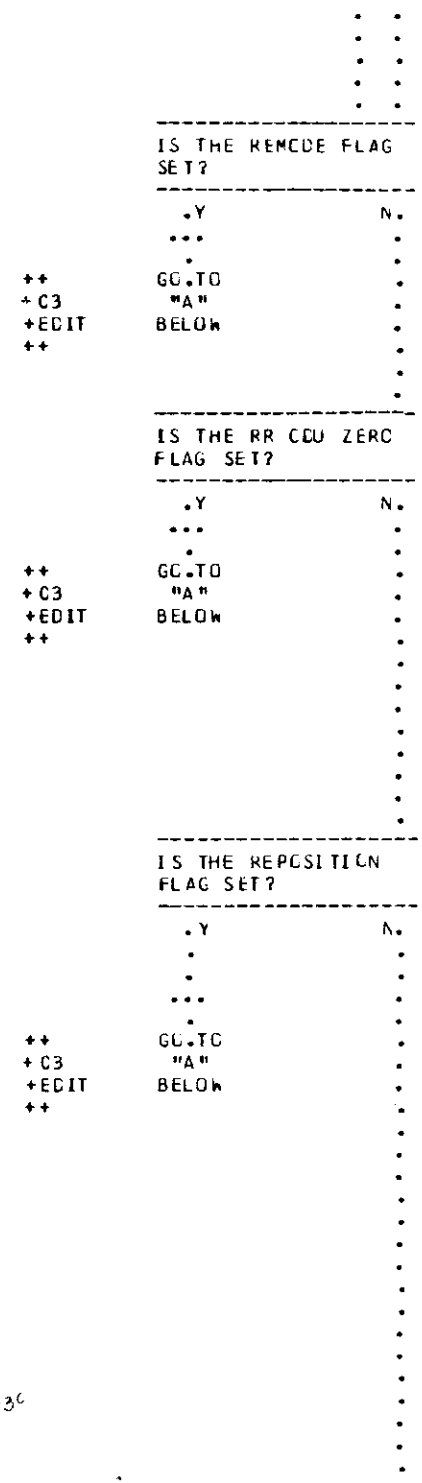
#370

#380

#390

#400





#410

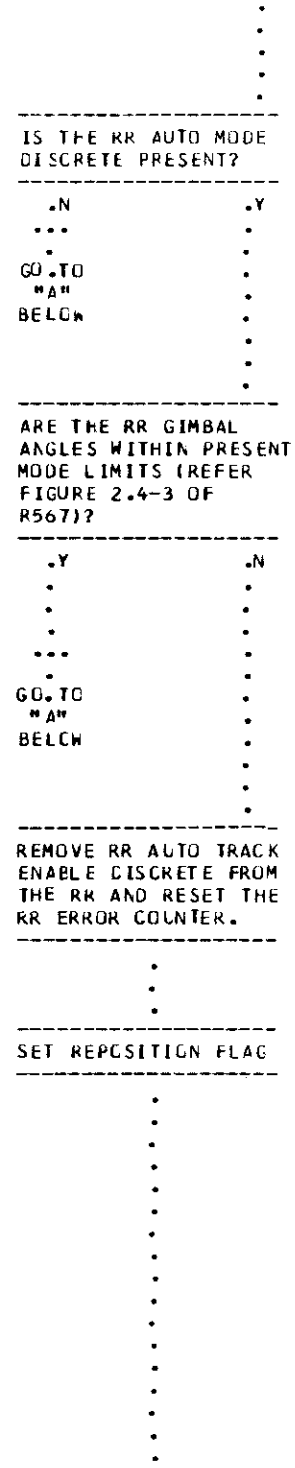
#420

#430

#440

#450

83



++ GO.TO
+03 "A"
+EDIT BELOW
++

++ GO.TO
+03 "A"
+EDIT BELOW
++

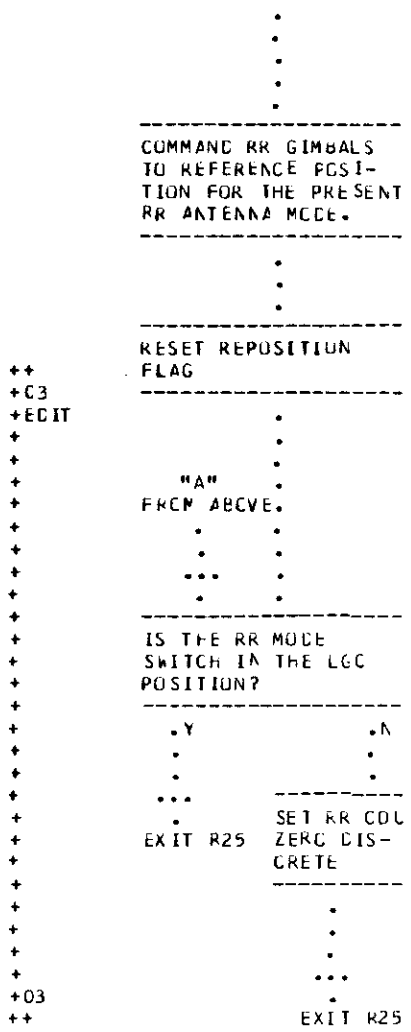
#460

#470

#480

#490

#500



#510

#520

#530

#540

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 97, 410
REV 02(LUM 18) PCR 848
REV 03 EDITORIAL

833

LUNAR SURFACE RR PRE-DESIGNATE ROUTINE (R26) REV 02 12/03/69

PURPOSE: (1) TO DETERMINE THE RR LOS TO THE CSM AT THE TIME WHEN THE CSM ENTERS THE RR FIELD OF VIEW.

(2) TO DESIGNATE THE RR, BEFORE ARRIVAL OF THE CSM IN THE FIELD OF VIEW, TO AN ORIENTATION THAT WILL PERMIT THE ACQUISITION OF THE CSM IMMEDIATELY UPON ITS ENTRY INTO THE FIELD OF VIEW.

ASSUMPTIONS: (1) P22 WILL NOT BE INITIATED BY THE CREW UNTIL LESS THAN 10 MINUTES BEFORE THE CSM IS EXPECTED TO ARRIVE WITHIN THE RR FIELD OF VIEW.

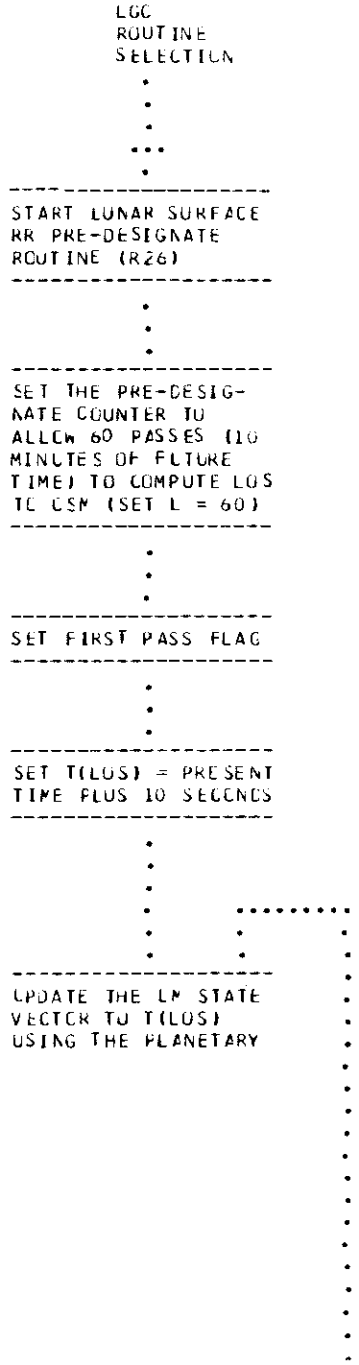
(2) THE SELECTION AND TERMINATION OF P20, P22, AND P25 ARE SUBJECT TO SPECIAL OPERATING PROCEDURES WHICH DIFFER FROM THOSE FOR ALL OTHER PROGRAMS:

(A) SELECTION
- (1) ALWAYS BY V37EXXE.
- (2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION, THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHEN EITHER P20 OR P22 OR P25 IS RUNNING.
- (3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER DISPLAYED IN THE DSKY PROG LIGHTS.
- (4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM AND OPERATION OF THE NEW.

(B) TERMINATION
- (1) BY SELECTION OF P00, V56E, OR V34E.
- (2) SELECTION OF P00 WILL TERMINATE P20, P22, P25, AND ANY OTHER PROGRAM IN PROCESS, AND ESTABLISH P00.
- (3) SELECTION OF V56E CALLS THE TERMINATE TRACKING ROUTINE (R56) TO TERMINATE ONLY P20 OR P25, IF EITHER OF THESE PROGRAMS IS RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES, R56 WILL SELECT R00. V56E MAY BE PERFORMED AT ANY TIME DURING P20, P22, OR P25 OPERATION.
- (4) THE LGC WILL RECOGNIZE V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THE FLASHING VERB-NOUN DISPLAY WAS ORIGINATED BY P20, P22, OR P25; V34E WILL PRODUCE AN LGC RESPONSE IDENTICAL TO THAT OF V56E, I.E.: SELECTION OF R56. IF THE DISPLAY WAS NOT ORIGINATED BY P20, P22, OR P25 (FOR EXAMPLE, BY P32 WHILE RUNNING IN CONJUNCTION WITH P20) THE LGC WILL GO TO R00, BUT THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).

(3) THIS ROUTINE IS CALLED AUTOMATICALLY BY THE RR DESIGNATE ROUTINE (R21) DURING THE LUNAR SURFACE NAVIGATION PROGRAM (P22) IF THE CSM HAS NOT YET ARRIVED IN THE RR MODE 2 FIELD OF VIEW.

PROG CONT	LGC	GROUND	CREW

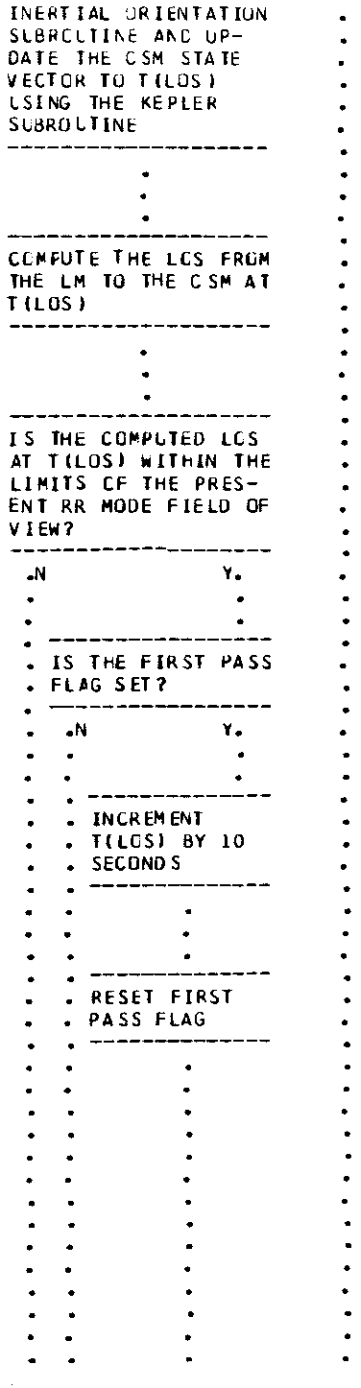

LGC
ROUTINE
SELECTION
START LUNAR SURFACE
RR PRE-DESIGNATE
ROUTINE (R26)
SET THE PRE-DESIG-
NATE COUNTER TO
ALLOW 60 PASSES (10
MINUTES OF FUTURE
TIME) TO COMPUTE LOS
TO CSM (SET L = 60)
SET FIRST PASS FLAG
SET T(LOS) = PRESENT
TIME PLUS 10 SECONDS
UPDATE THE LM STATE
VECTOR TO T(LOS)
USING THE PLANETARY

#10

#20

#30

#40


INERTIAL ORIENTATION SUBROUTINE AND UPDATE THE CSM STATE VECTOR TO T(LOS) USING THE KEPLER SUBROUTINE
COMPUTE THE LOS FROM THE LM TO THE CSM AT T(LOS)
IS THE COMPUTED LOS AT T(LOS) WITHIN THE LIMITS OF THE PRESENT RR MODE FIELD OF VIEW?
N
Y
IS THE FIRST PASS FLAG SET?
N
Y
INCREMENT T(LOS) BY 10 SECONDS
RESET FIRST PASS FLAG

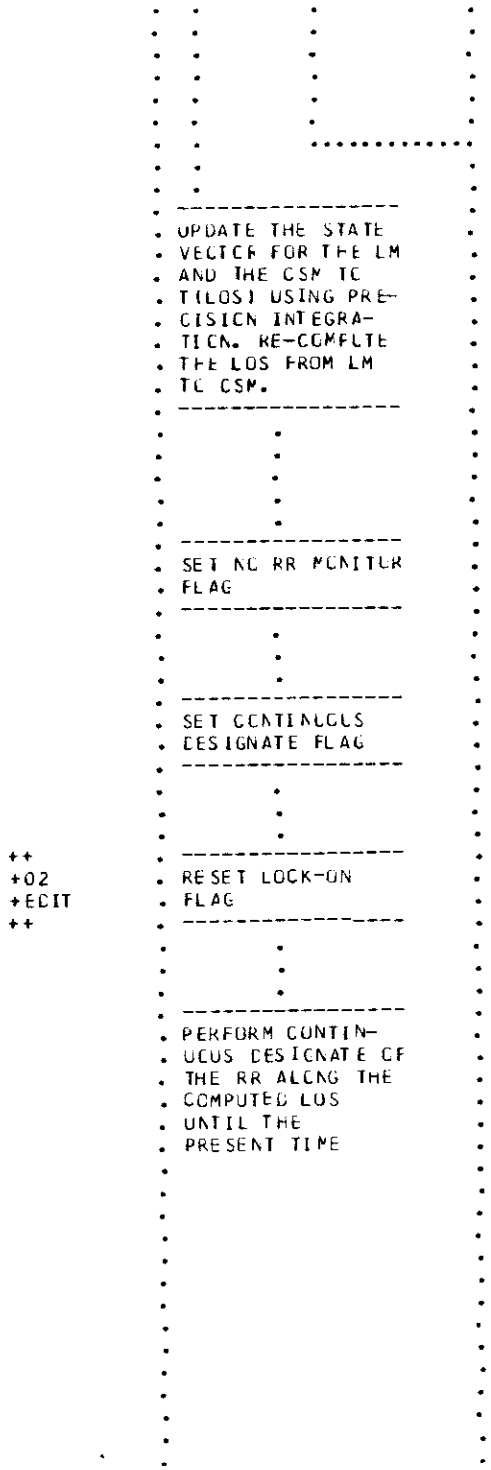
#50

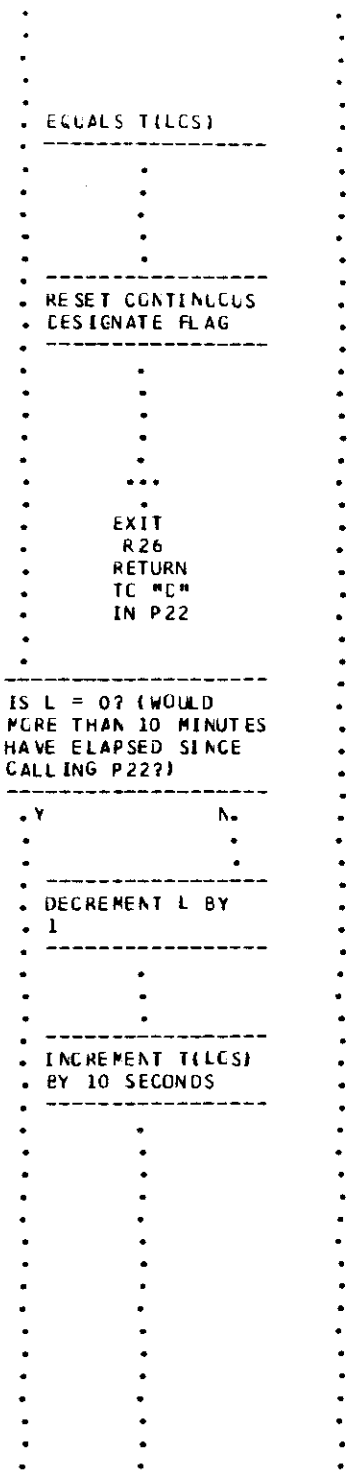
#60

#70

#80

#90


#100
UPDATE THE STATE VECTOR FOR THE LM AND THE CSM TO T(LOS) USING PRECISION INTEGRATION. RE-COMPUTE THE LOS FROM LM TO CSM.
#110
SET NO RR MONITOR FLAG
#120
SET CONTINUOUS DESIGNATE FLAG
#130
++
+02
+EDIT
++
RESET LOCK-ON FLAG
PERFORM CONTINUOUS DESIGNATE OF THE RR ALONG THE COMPUTED LOS UNTIL THE PRESENT TIME
#140



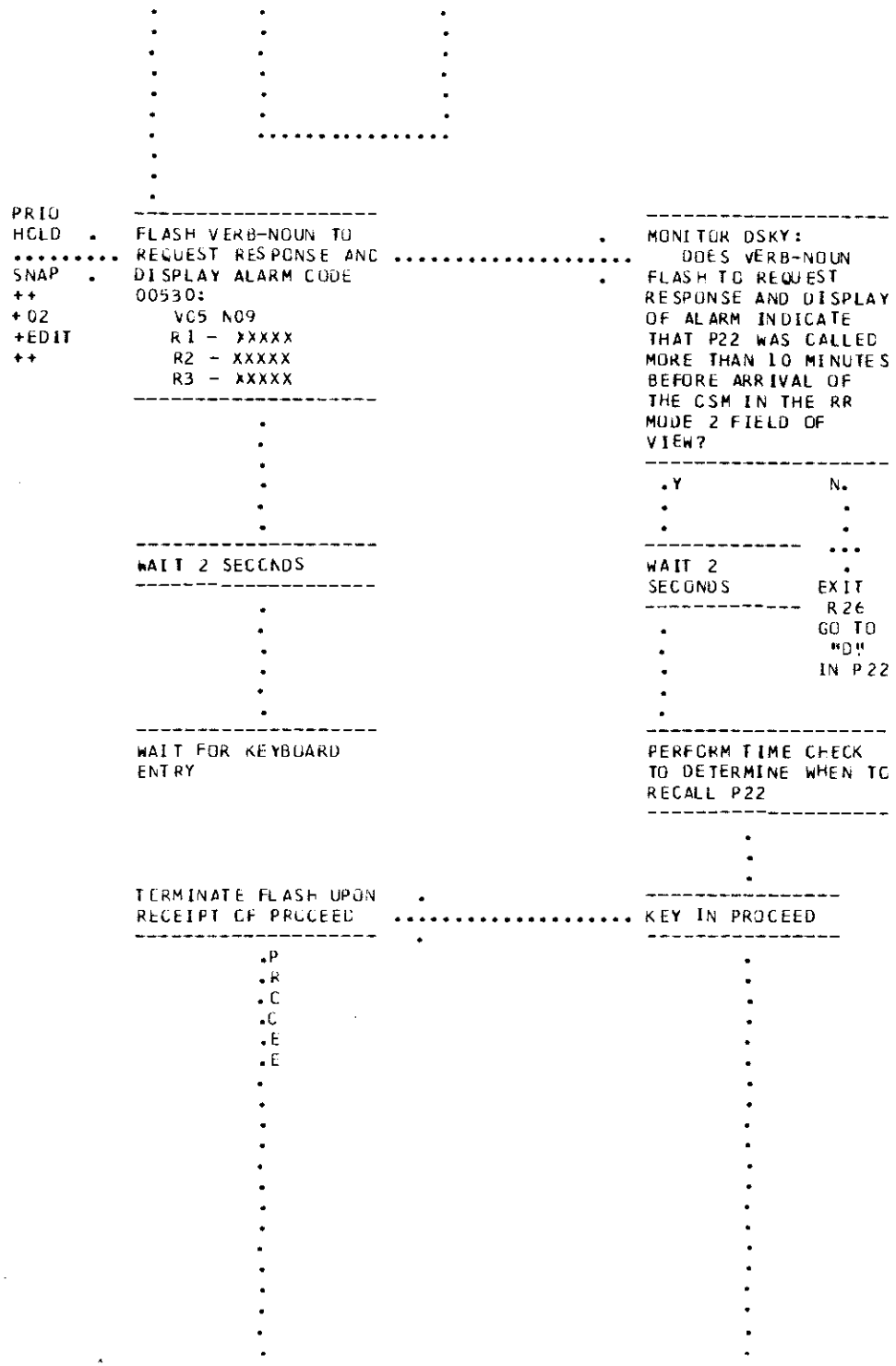
#150

#160

#170

#180

#190



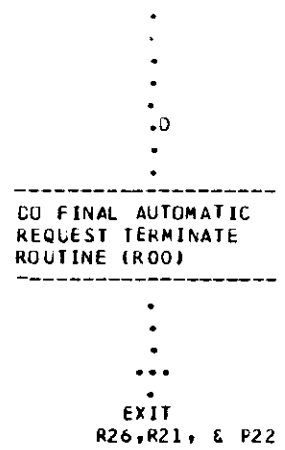
#200

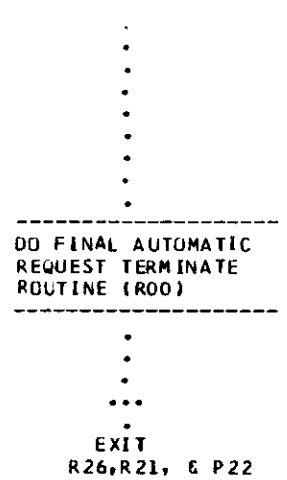
#210

#220

#230

839





#240

#250

CHANGE CONTROL NOTES

LOGIC REV 00(LUM 1A)		PCR 722 (ORIGINATED)
REV 01		EDITORIAL
REV 02		EDITORIAL

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POWERED FLIGHT RR DESIGNATE ROUTINE (R29) REV 03 12/03/69

PURPOSE: (1) TO POINT THE RENDEZVOUS RADAR (RR) AT THE CSM UNTIL AUTOMATIC ACQUISITION OF THE CSM IS ACCOMPLISHED BY THE RADAR WHILE THE LGC IS PERFORMING P12.

(2) TO READ RR DATA FOR DOWNLINK TRANSMISSION WHEN THE LGC IS PERFORMING P12.

ASSUMPTIONS: (1) THE RR SERVOS MAY BE COMMANDED BY THE LGC AFTER THE LGC ISSUES THE TRACK ENABLE DISCRETE UNTIL RANGE RATE LOCKON IS ACHIEVED BY THE RR.

(2) THIS ROUTINE WILL DESIGNATE THE RR TO THE CSM ONLY WHEN THE LM/CSM LOS IS WITHIN THE RR ANTENNA COVERAGE OF MODE 2 (REFER FIG 2.4-3 OF SECTION 5 OF #567).

(3) THIS ROUTINE IS AUTOMATICALLY ENABLED BY P12 BY RESET OF THE NO R-29 FLAG.

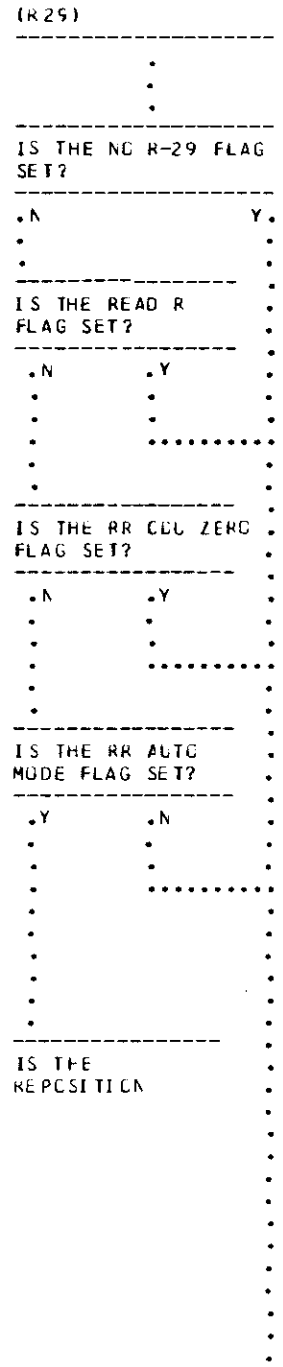
(4) THIS ROUTINE IS AUTOMATICALLY DISABLED AFTER P12 BY SET OF THE NO R-29 FLAG BY R00.

(5) IF TIG IS SLIPPED BY THE STATE VECTOR INTEGRATION (MIDTOAVE) ROUTINE (R41) DURING P12, THE CSM STATE VECTOR IN THE LGC IS NOT UP TO DATE AND THIS ROUTINE MAY BE UNABLE TO ACCOMPLISH RR LOCK ON.

(6) THE ROUTINE IS CALLED EVERY 2 SECONDS BY SERVICER (AVERAGE G) VIA THE DESCENT STATE VECTOR ROUTINE (R12), BUT ONLY DURING P12 (WHEN THE LR BYPASS FLAG IS SET). AVERAGE G IS TERMINATED BY THE FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (R00) WHICH FOLLOWS P12, AND BY P68.

PROG CONT	LGC	GROUND	CREW
	LGC ROUTINE SELECTION		
START POWERED FLIGHT RR DESIGNATE ROUTINE			

#10


(R29)
IS THE NO R-29 FLAG SET?
N
Y
IS THE READ R FLAG SET?
N
Y
IS THE RR CDU ZERO FLAG SET?
N
Y
IS THE RR AUTO MODE FLAG SET?
Y
N
IS THE REPOSITION

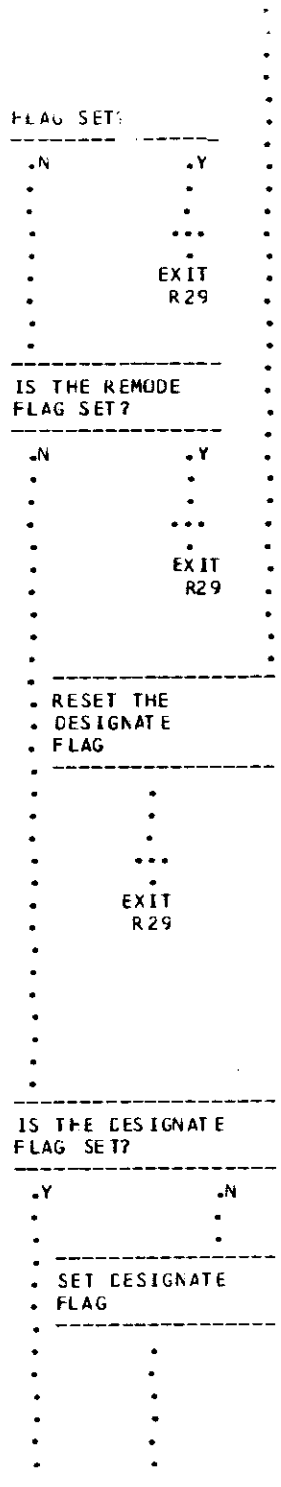
#20

#30

#40

#50

#60



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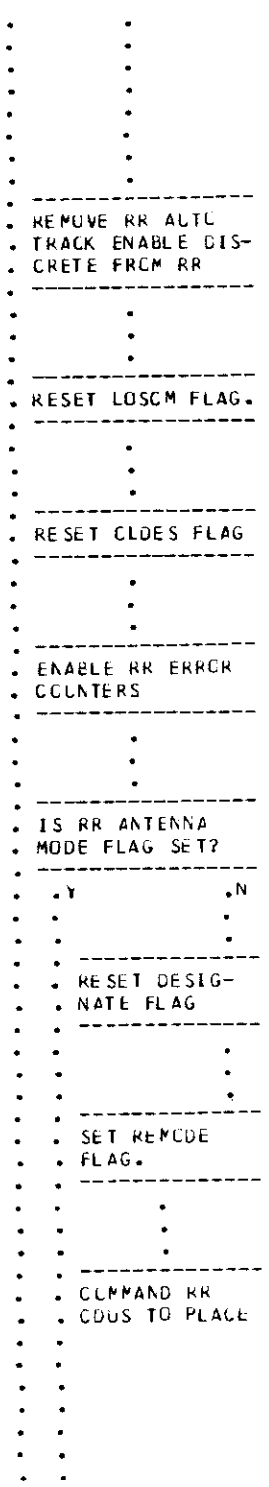
#110



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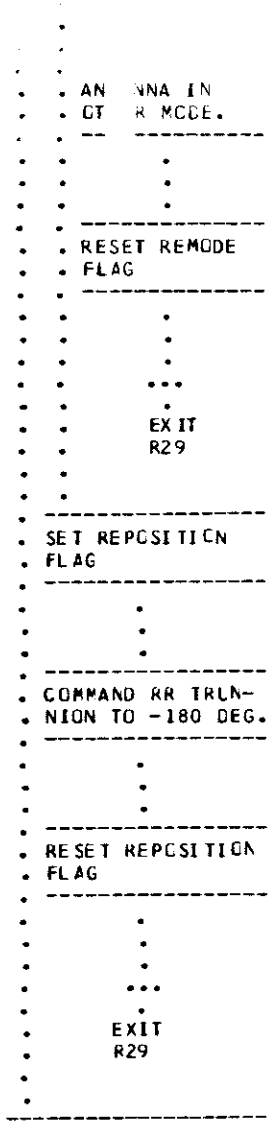

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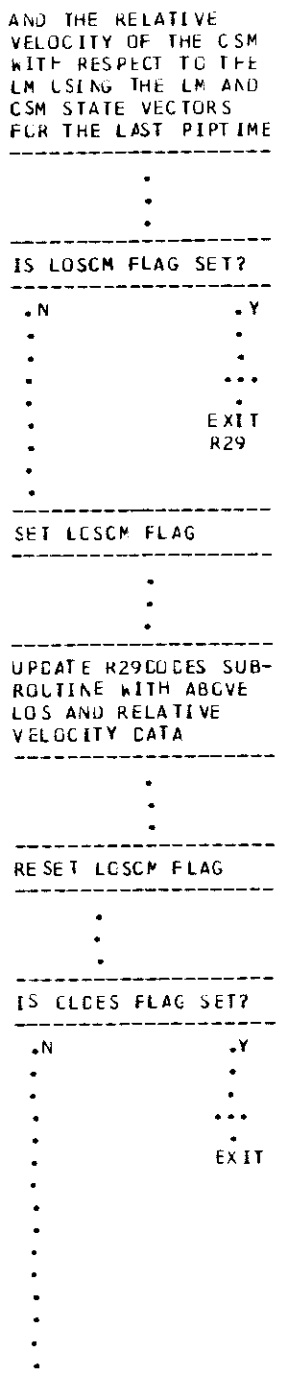

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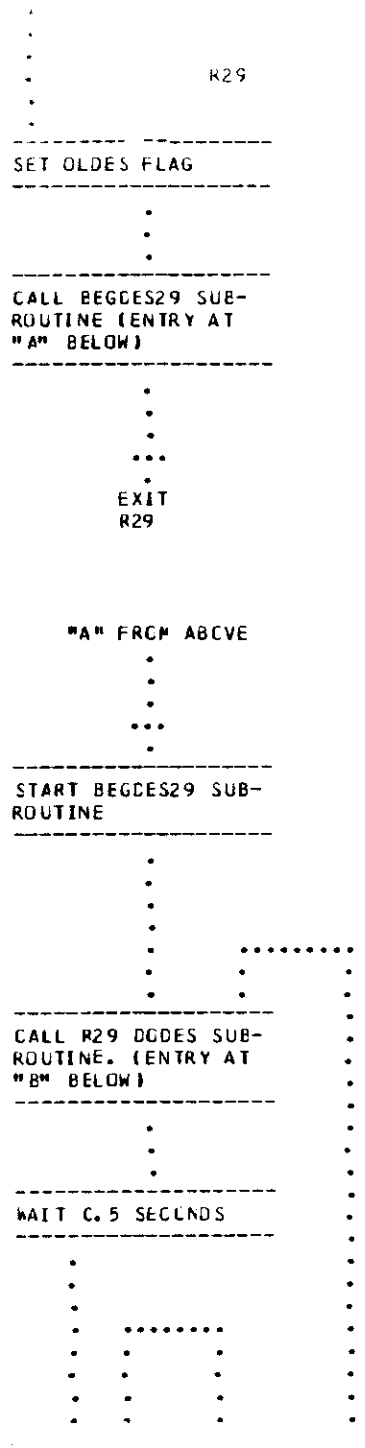

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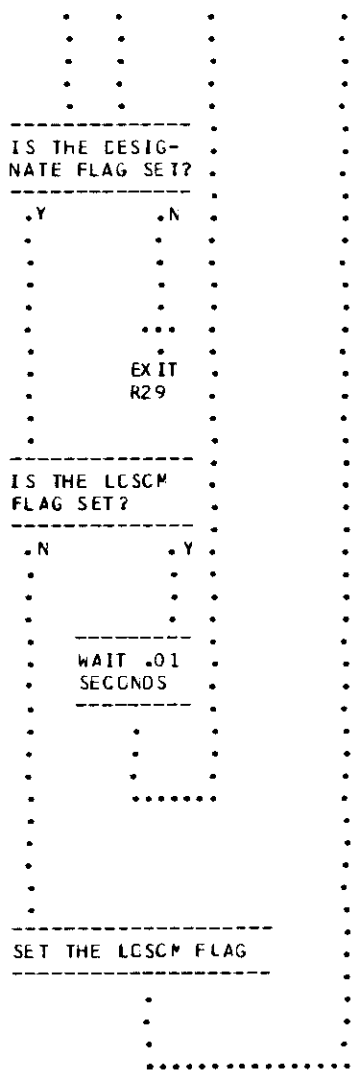
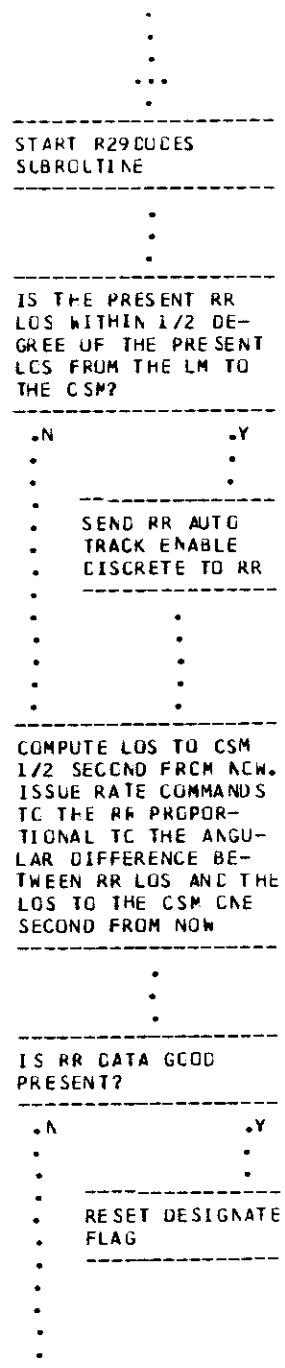
#360

#370



"B" FROM ABOVE



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#390

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#410

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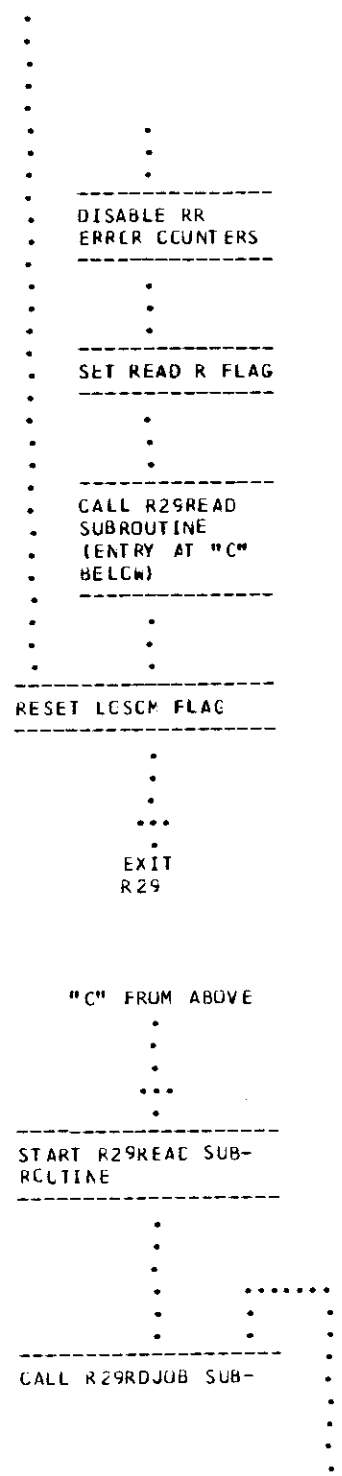
#430



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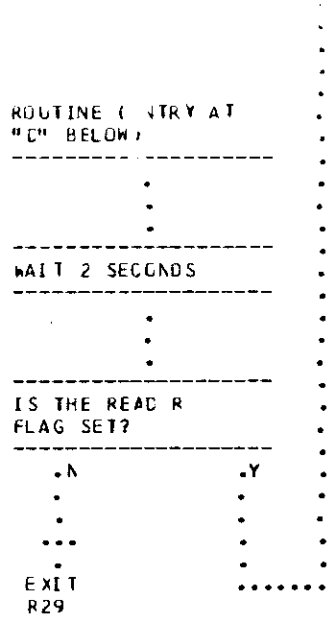

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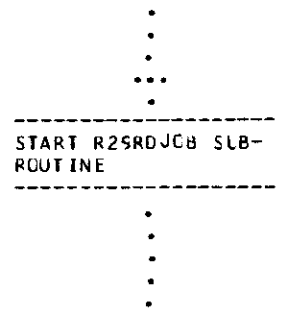

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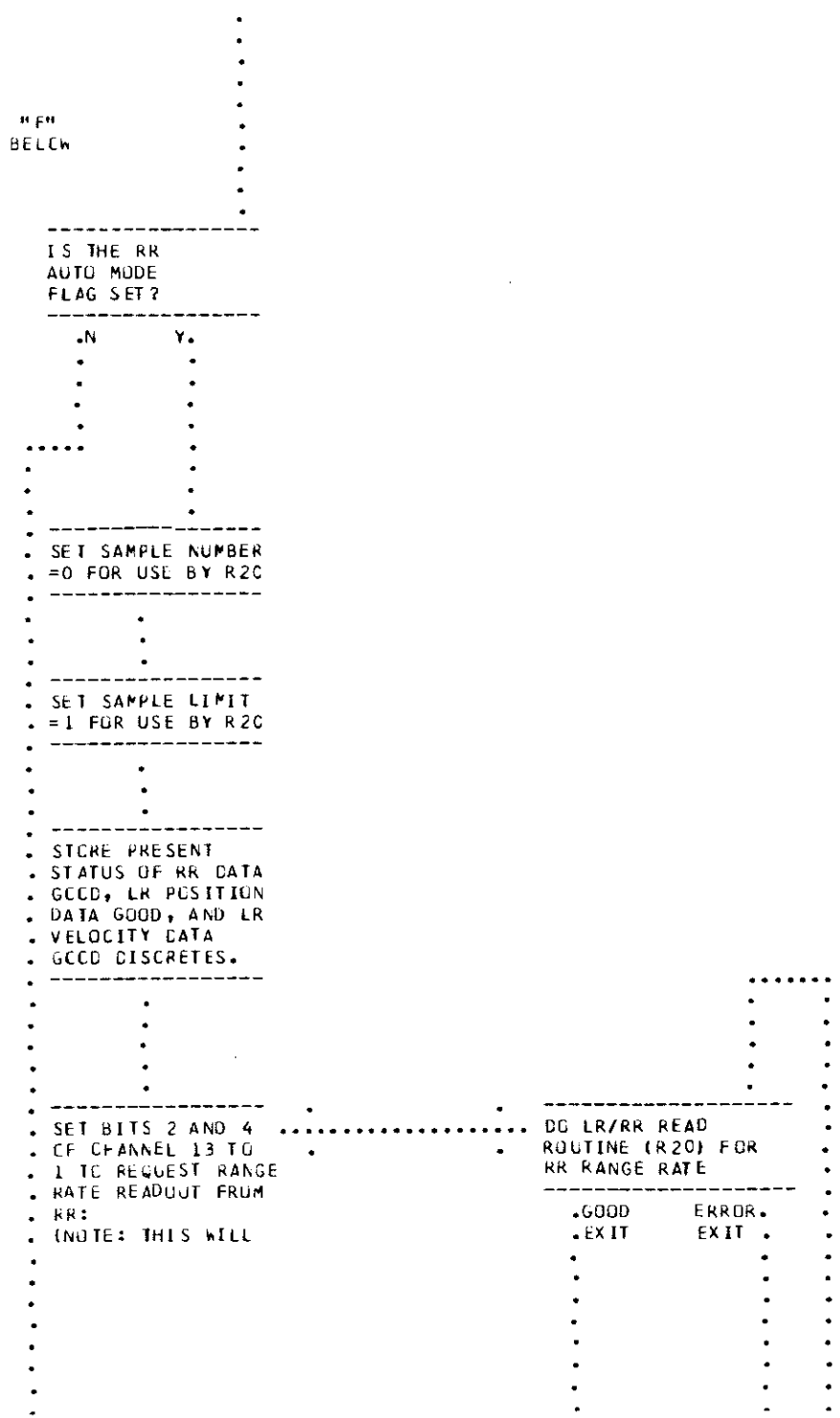

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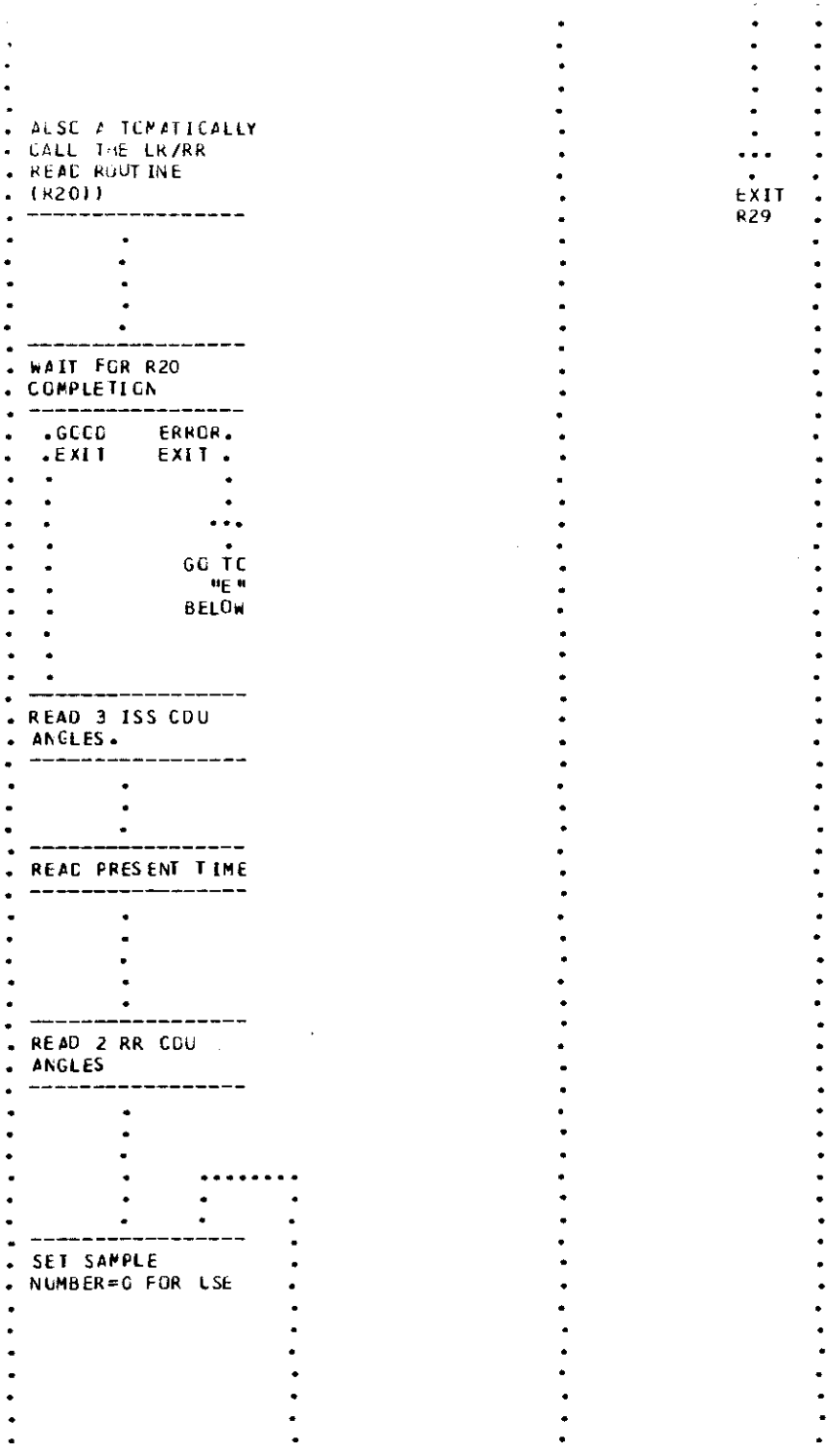

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#620

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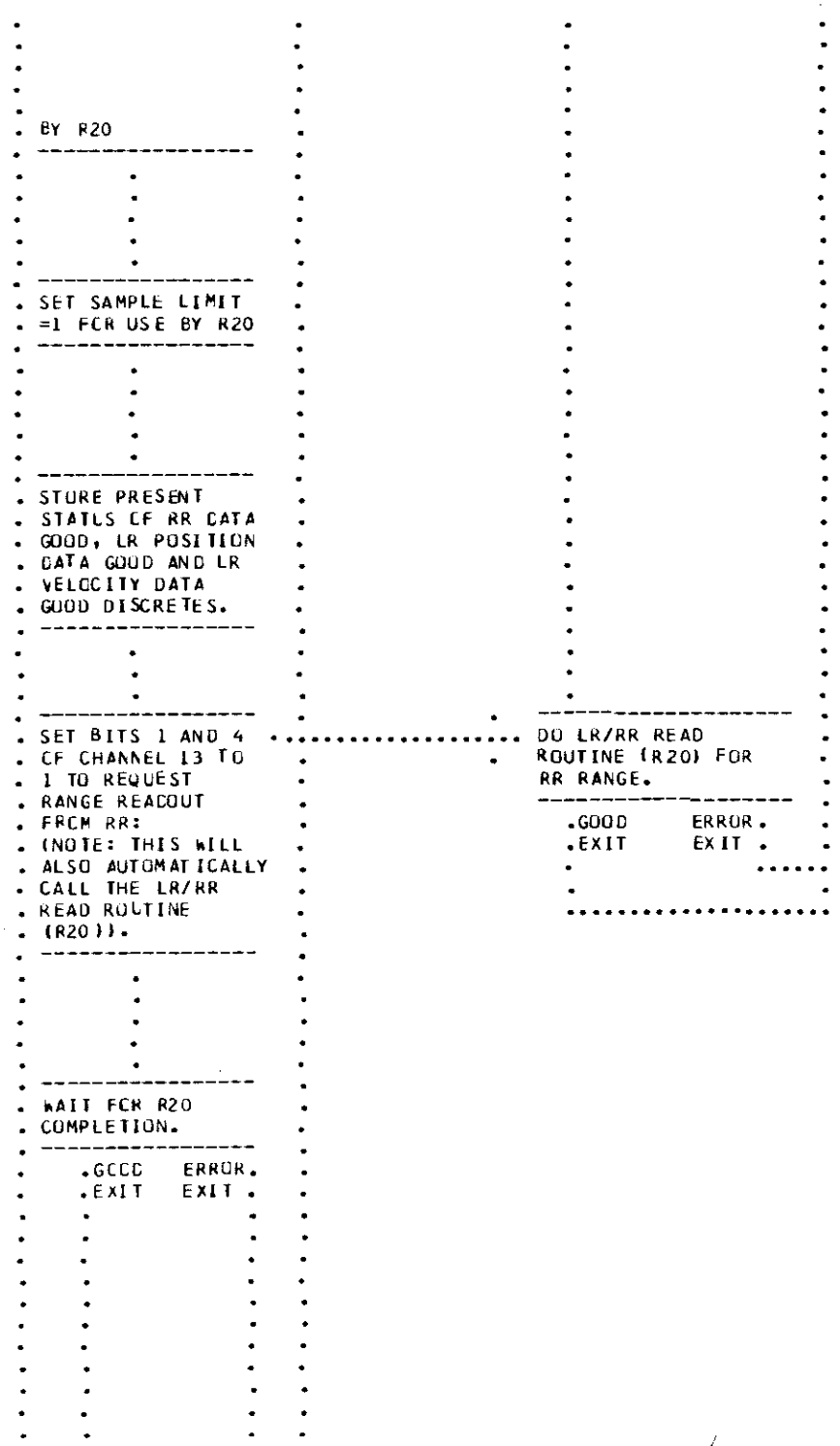
#640



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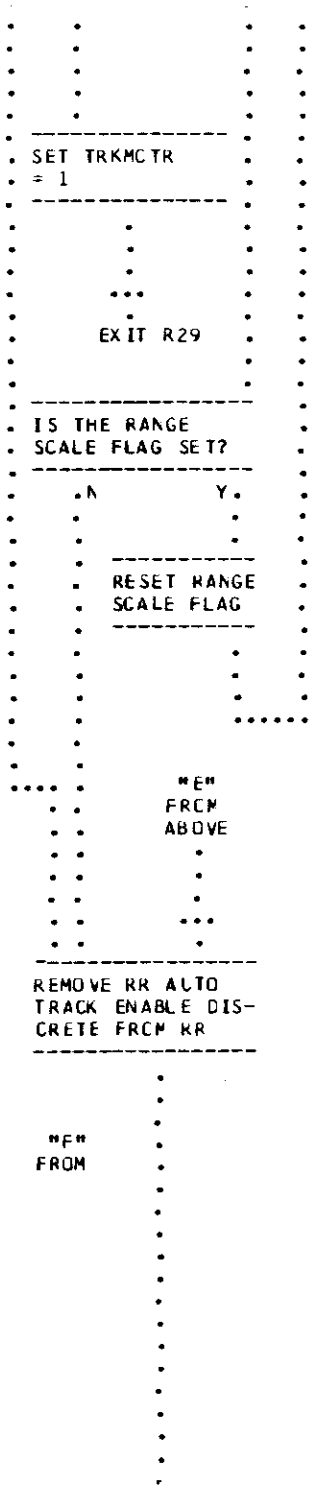
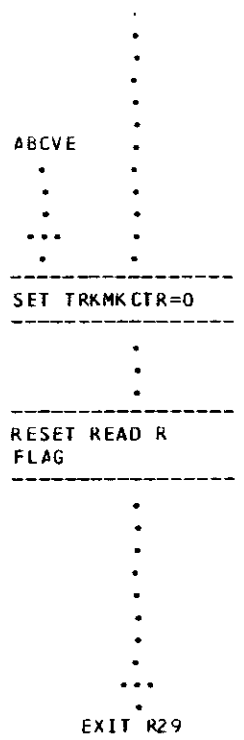


#710

#720

#730

#740



#750

#760

#770

CHANGE CONTROL NOTES

```
LOGIC REV CC   PCR 13
      REV 01   PCR 39,559,568
      REV 02(LUM 1B)   PCR 779,845, EDITORIAL
      REV 03 EDITORIAL
```

856

857

ORBIT PARAMETER DISPLAY ROUTINE (R30) REV 03 12/03/69

PURPOSE: (1) TO PROVIDE THE ASTRONAUT PERTINENT ORBITAL PARAMETERS COMPUTED BY THE LGC 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 LGC WILL SET TFF EQUAL TO -59859 AND COMPUTE TF PER AND STORE IT IN N32. THE ASTRONAUT MAY CALL IT BY KEYING IN V16N32E.

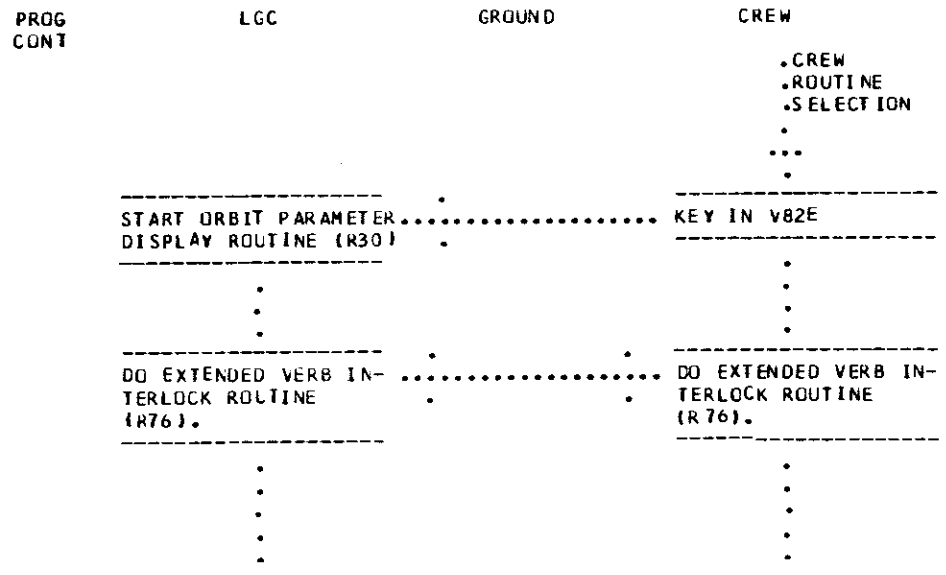
(4) TO MONITOR THE PROGRESS OF STATE VECTOR INTEGRATION, THE TIME ASSOCIATED WITH THE ADVANCING (REGRESSING) STATE IS AVAILABLE BY KEYING IN V06N38E:

V06N38
R1-TET-HRS
R2-TET-MINS
R3-TET-SECS.

TET-THE TIME (GET) TO WHICH THE STATE VECTOR INTEGRATION PROCESS HAS PRESENTLY CALCULATED THE STATE VECTOR. IN HRS,MINS, AND SECS TO NEAREST .01 SEC.

(5) THIS ROUTINE MAY BE SELECTED WHILE THE LM IS EITHER IN EARTH OR LUNAR ORBIT.

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



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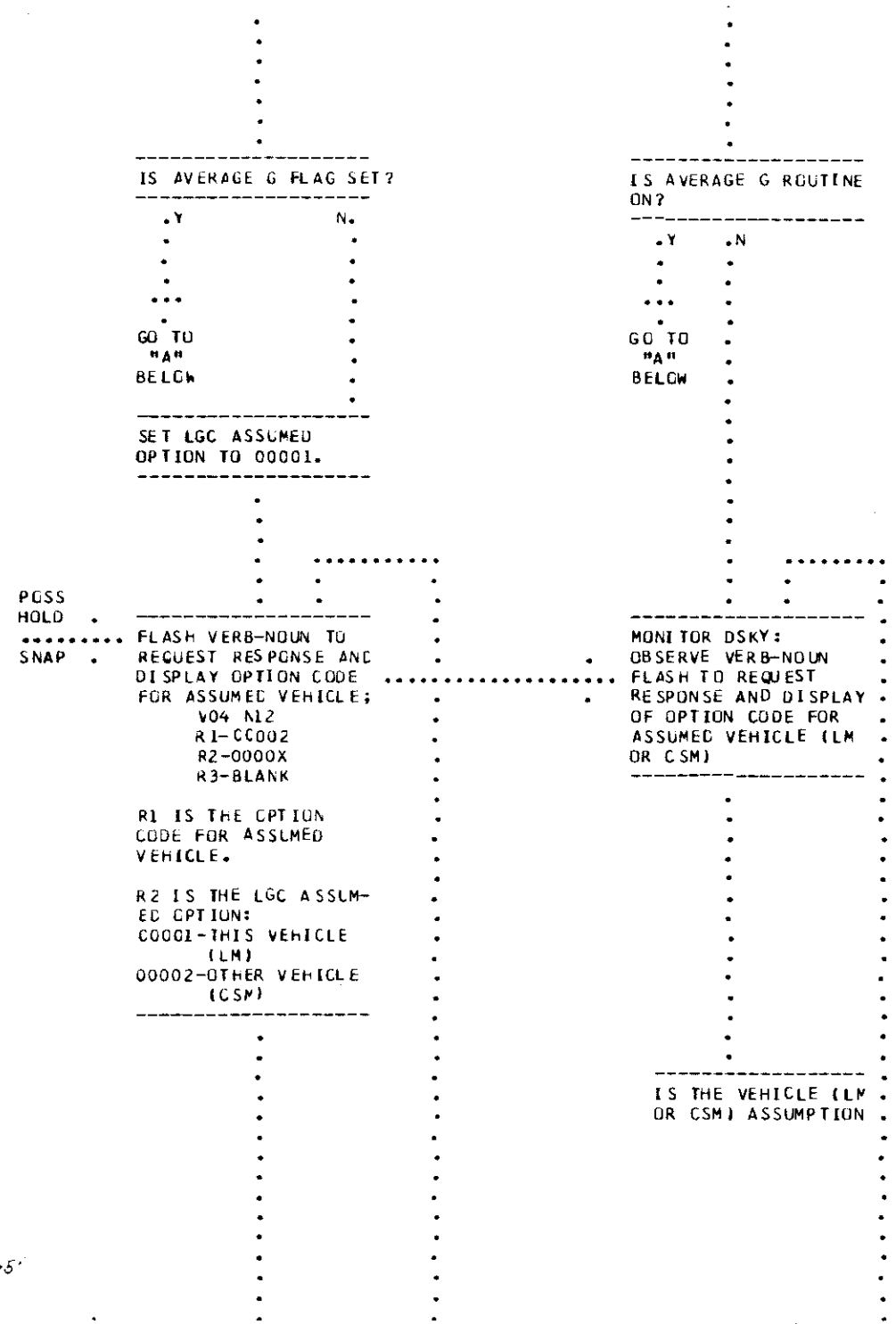


#20

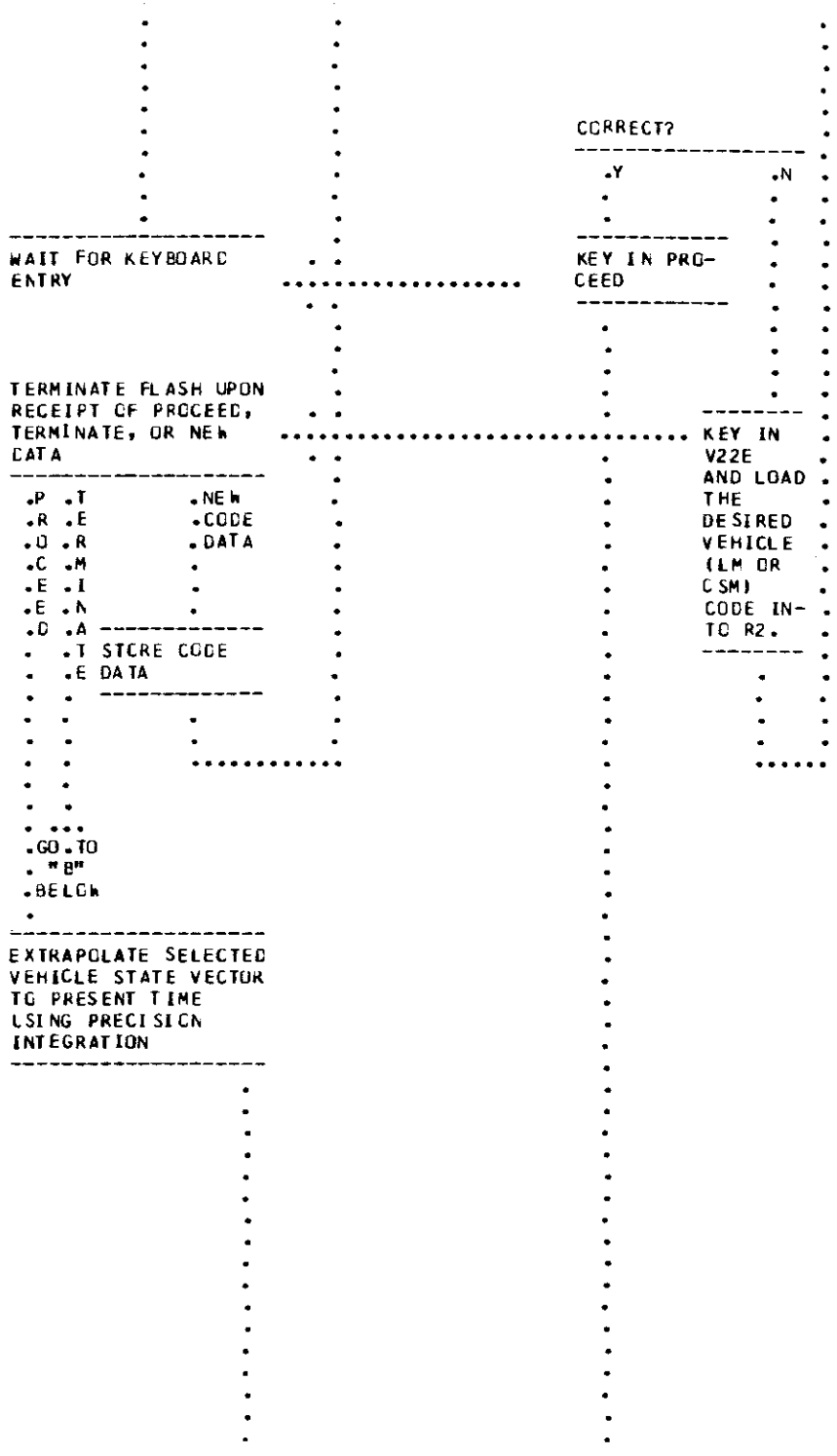
#30

#40

#50

#60

#70

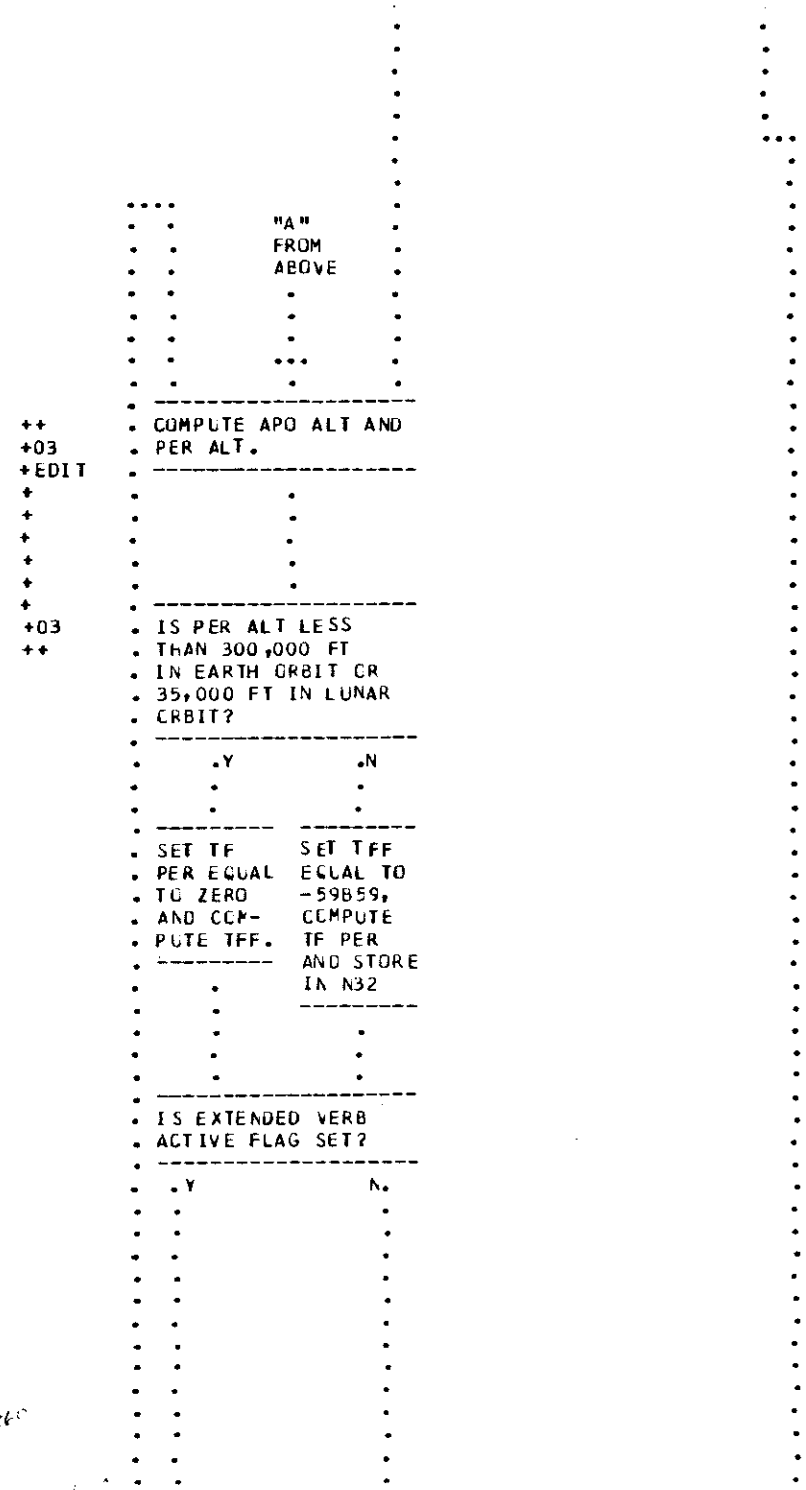

CORRECT?
.Y
.N
WAIT FOR KEYBOARD ENTRY
KEY IN PROCEED
TERMINATE FLASH UPON RECEIPT OF PROCEED, TERMINATE, OR NEW DATA
KEY IN V22E AND LOAD THE DESIRED VEHICLE (LM OR CSM) CODE INTO R2.
.PROCEED
.TERMINATE
.NEW CODE
.NEW DATA
STORE CODE DATA
GO TO "B" BELOW
EXTRAPOLATE SELECTED VEHICLE STATE VECTOR TO PRESENT TIME USING PRECISION INTEGRATION

#80

#90

#100

#110



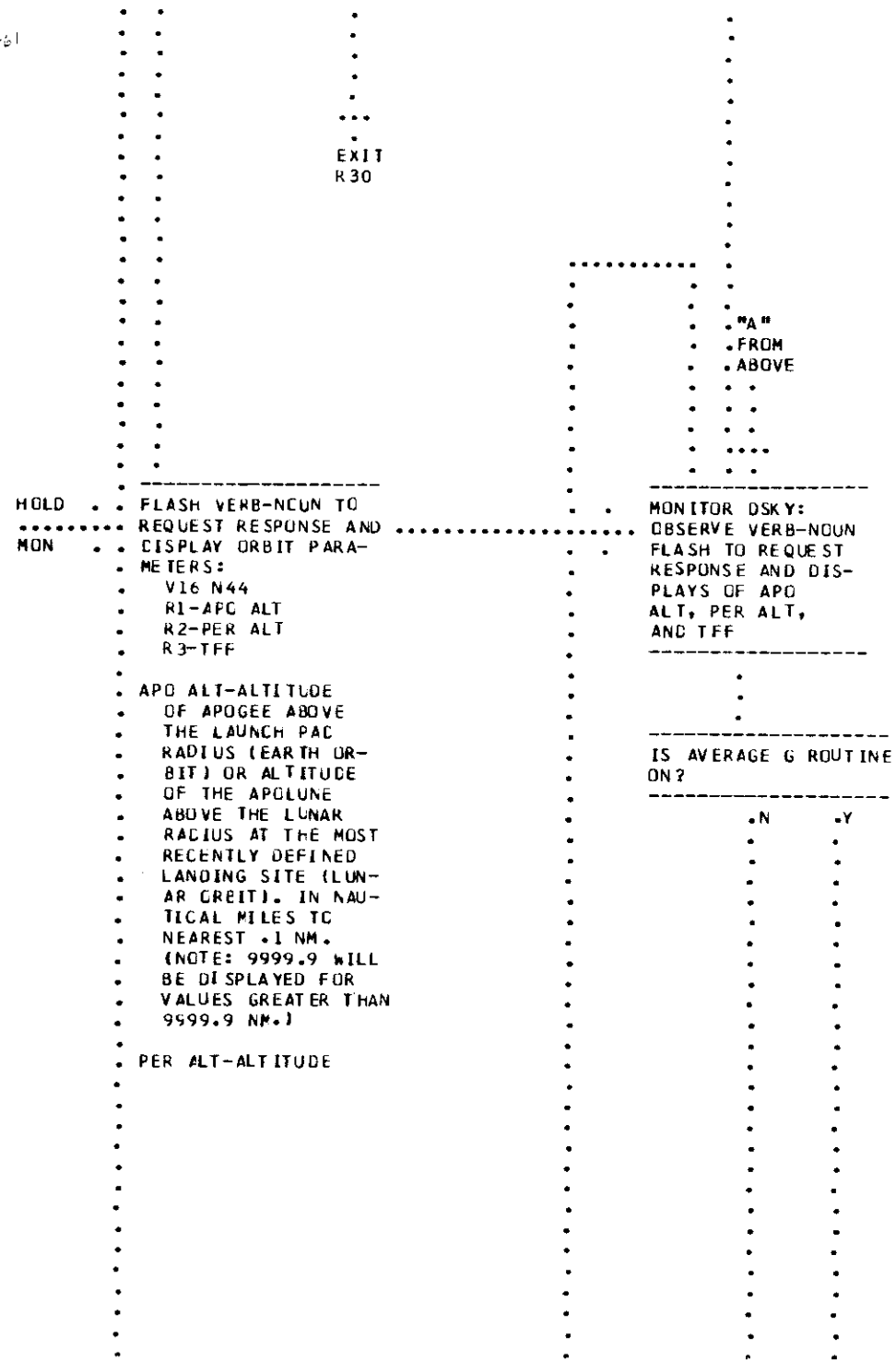
#120

#130

#140

#150

#160



#170

#180

#190

#200

#210

OF PERIGEE ABOVE THE LAUNCH PAD RADIUS (EARTH ORBIT) OR ALTITUDE OF THE PERILUNE ABOVE THE LUNAR RADIUS AT THE MOST RECENTLY DEFINED LANDING SITE (LUNAR ORBIT). IN NAUTICAL MILES TO NEAREST .1 NM. (NOTE: 9999.9 WILL BE DISPLAYED FOR VALUES GREATER THAN 9999.9 NM.)

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 RECENTLY DEFINED LANDING 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.)

DO I WISH TO HAVE THE CALCULATION REPEATED? (SEE ASSUMPTION 1)

.Y N.

#220

#230

#240

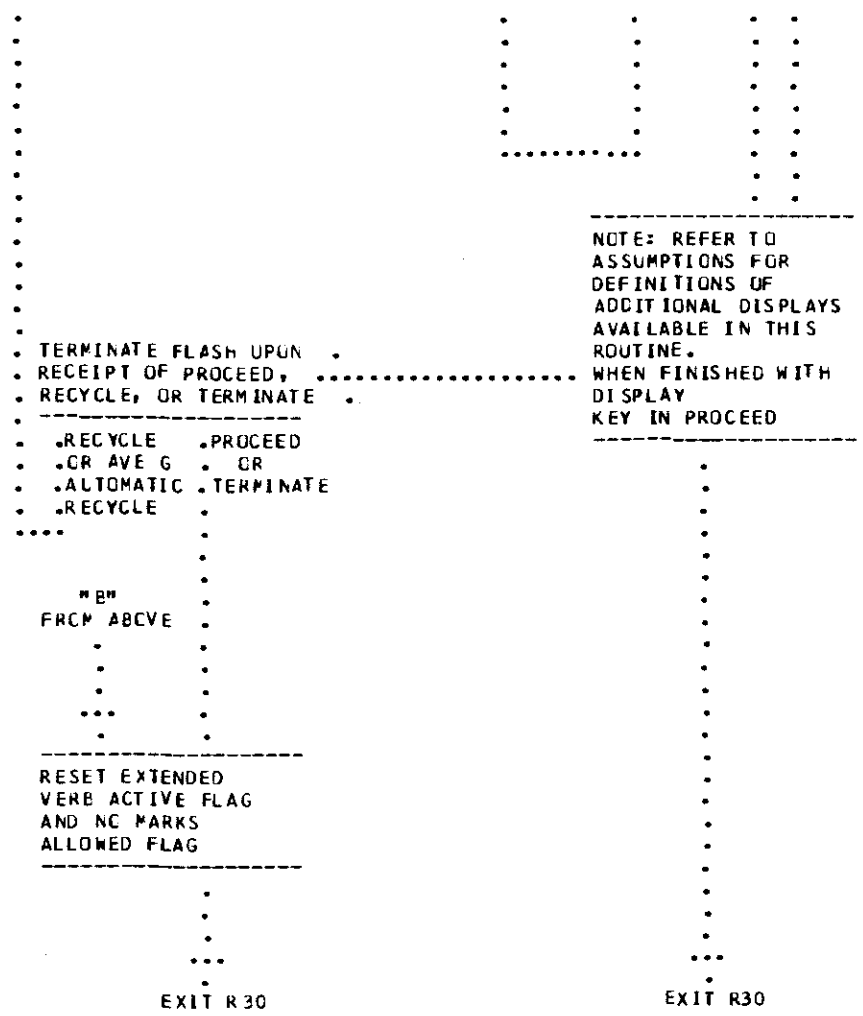
#250

WAIT FOR KEYBOARD ENTRY

KEY IN RECYCLE V32E

#260

863



CHANGE CONTROL NOTES

LOGIC REV 01 PCR 405,490,518,604,614
REV 02 EDITORIAL
REV 03 EDITORIAL

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RENDEZVOUS PARAMETER DISPLAY ROUTINE (R31) REV 03 12/03/69

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

ASSUMPTIONS: (1) RANGE AND RANGE RATE ARE CALCULATED BY THE LGC 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 IF THE ISS IS NOT ON AND ALIGNED. THE RENDEZVOUS RADAR IS NOT REQUIRED TO BE OPERATING.

(2) TO MONITOR THE PROGRESS OF STATE VECTOR INTEGRATION; THE TIME ASSOCIATED WITH THE ADVANCING (REGRESSING) STATE IS AVAILABLE BY KEYING IN V06N38E:

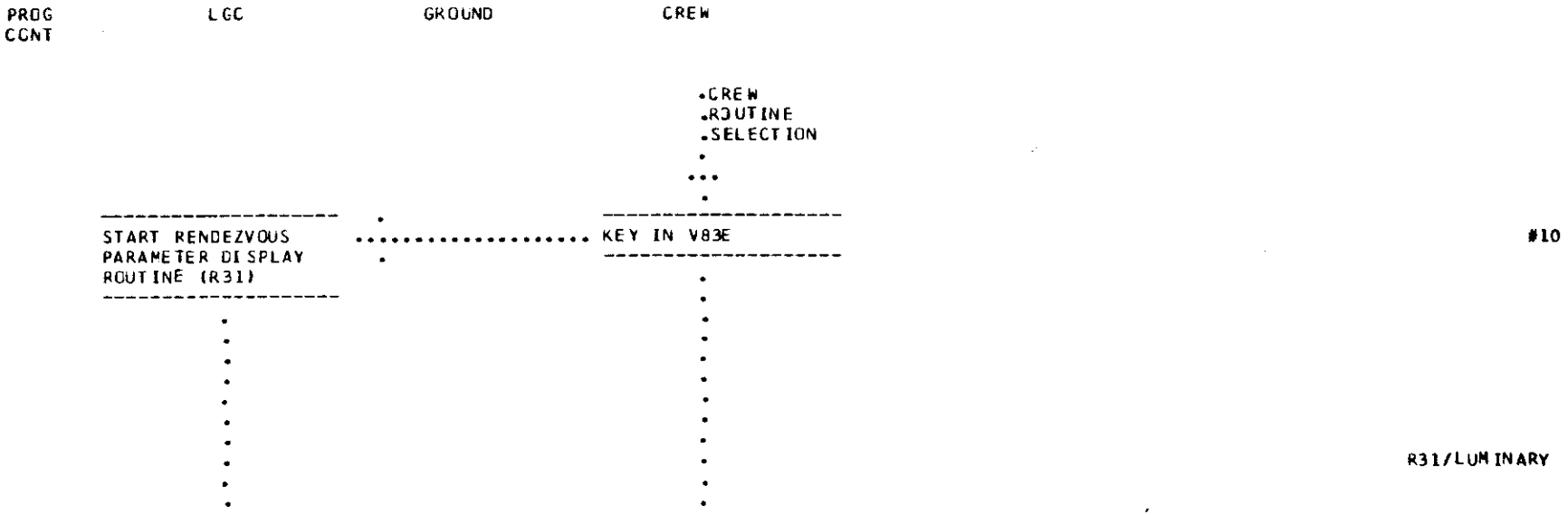
V06N38
R1-TET-HRS
R2-TET-MINS
R3-TET-SECS

TET-THE TIME (GET) TO WHICH THE STATE VECTOR INTEGRATION PROCESS HAS PRESENTLY CALCULATED THE STATE VECTOR. IN HRS,MINS, AND SECS TO NEAREST .01 SEC.

(3) IF NAVIGATION MARKS ARE MADE AFTER THIS ROUTINE IS SELECTED AND RUNNING, THE EFFECT OF THE MARKS ON THE STATE VECTOR WILL NOT BE EXHIBITED IN THE DISPLAY OF RANGE AND RANGE RATE. TO SEE THE EFFECT OF THE NAVIGATION MARKS ON THE RANGE AND RANGE RATE IN N54, THE ASTRONAUT MUST TERMINATE THIS ROUTINE (PROCEED) AND RE-SELECT IT (V83E).

(4) IF R31 IS RUN FOR A LONG TIME IN COASTING FLIGHT THE RANGE AND RANGE RATE INFORMATION IN N54 WILL BEGIN TO DEGENERATE BECAUSE OF THE CONIC EXTRAPOLATIONS OF THE STATE VECTORS.

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



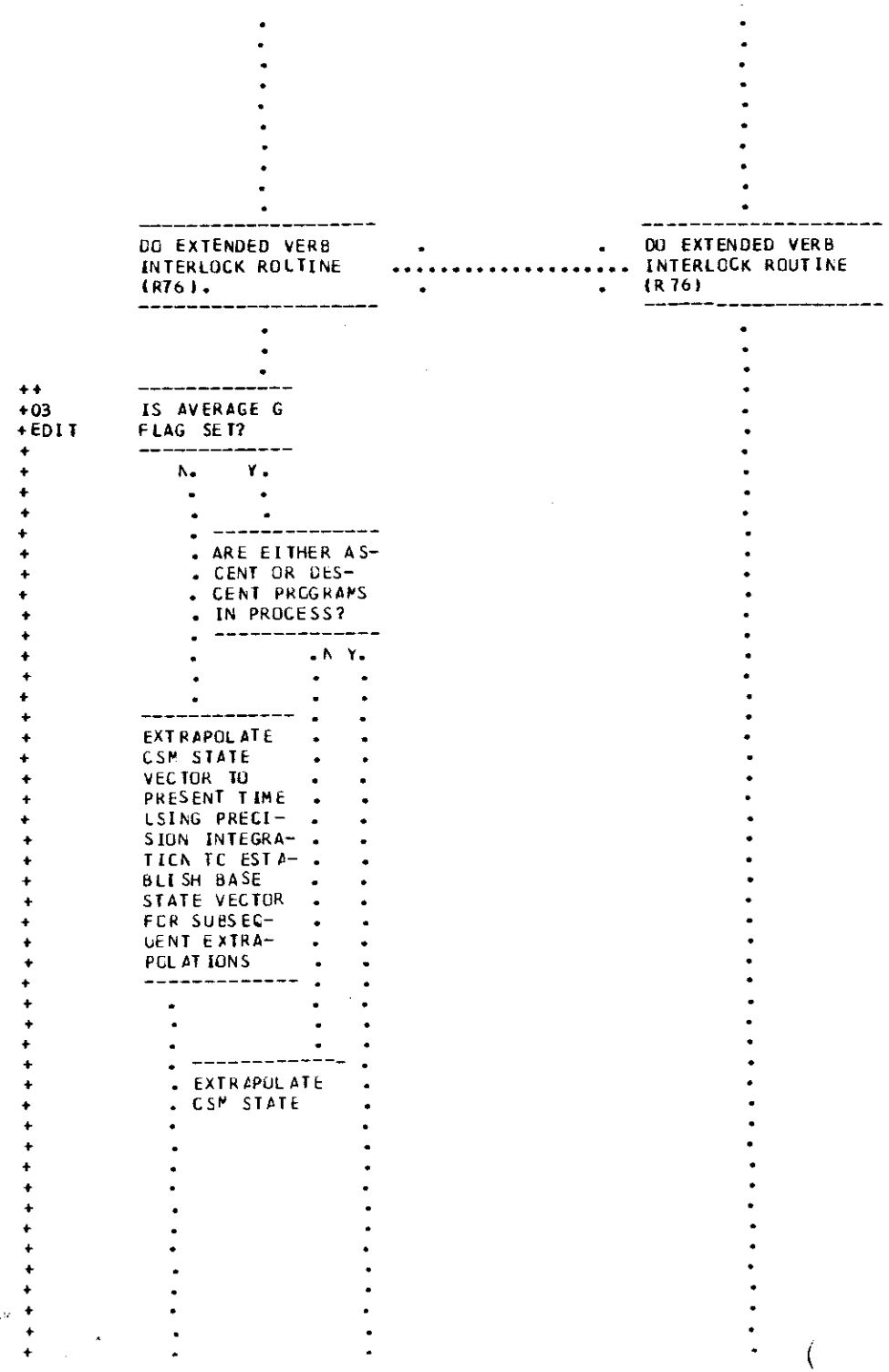
#20

#30

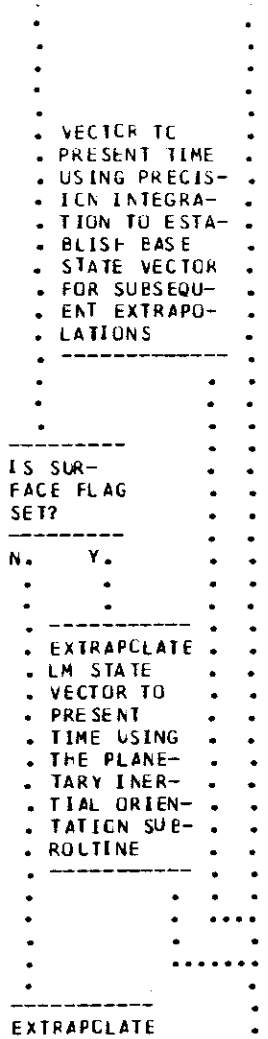
#40

#50

#60


DO EXTENDED VERB INTERLOCK ROUTINE (R76).
DO EXTENDED VERB INTERLOCK ROUTINE (R76)
++
+03
+EDIT
IS AVERAGE G FLAG SET?
N.
Y.
ARE EITHER ASCENT OR DESCENT PROGRAMS IN PROCESS?
N
Y.
EXTRAPOLATE CSM STATE VECTOR TO PRESENT TIME USING PRECISION INTEGRATION TO ESTABLISH BASE STATE VECTOR FOR SUBSEQUENT EXTRAPOLATIONS
EXTRAPOLATE CSM STATE

867



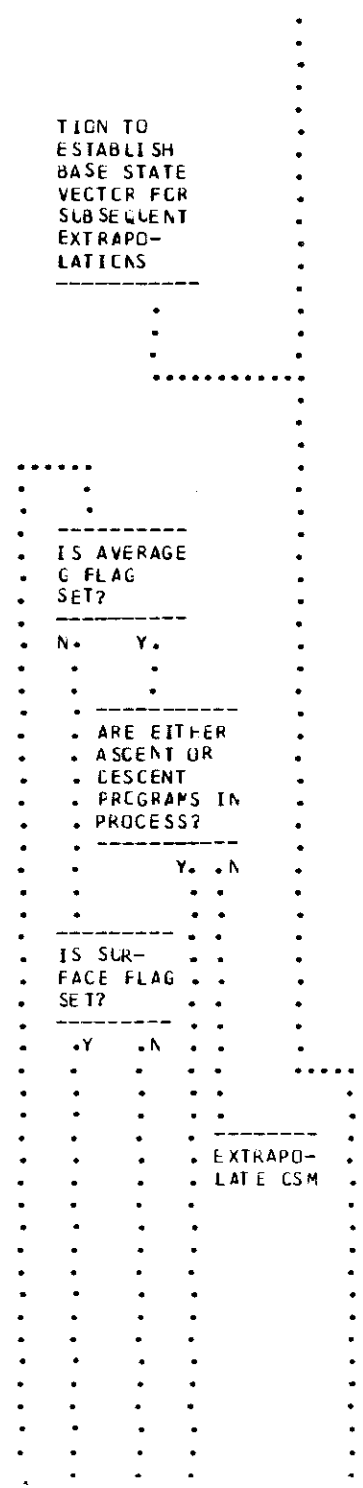
#70

#80

#90

#100

#110

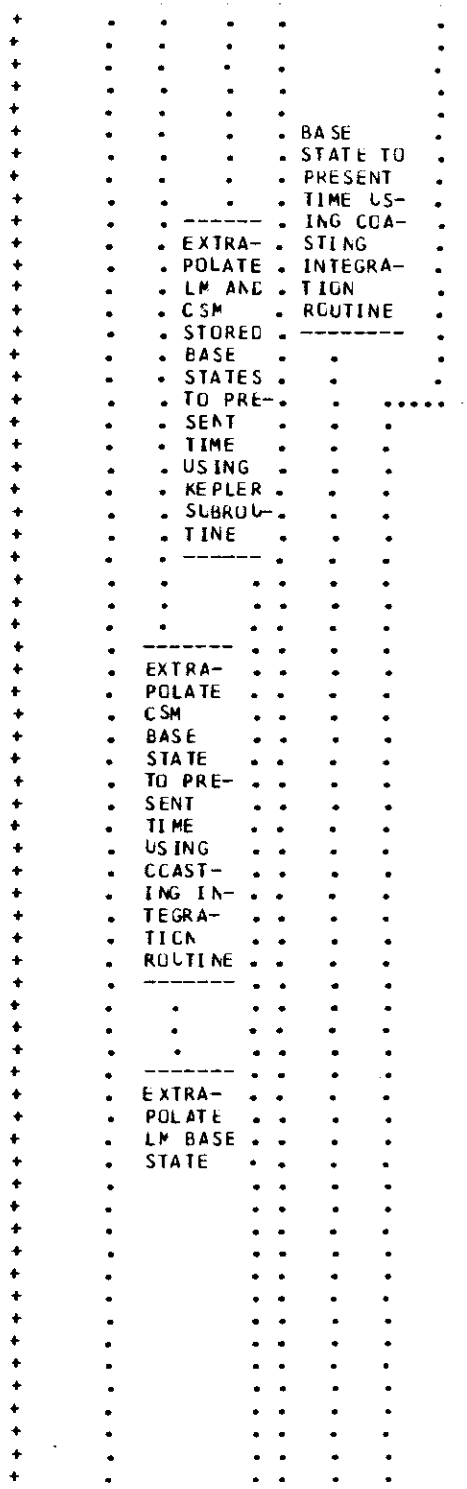


#120

#130

#140

#150



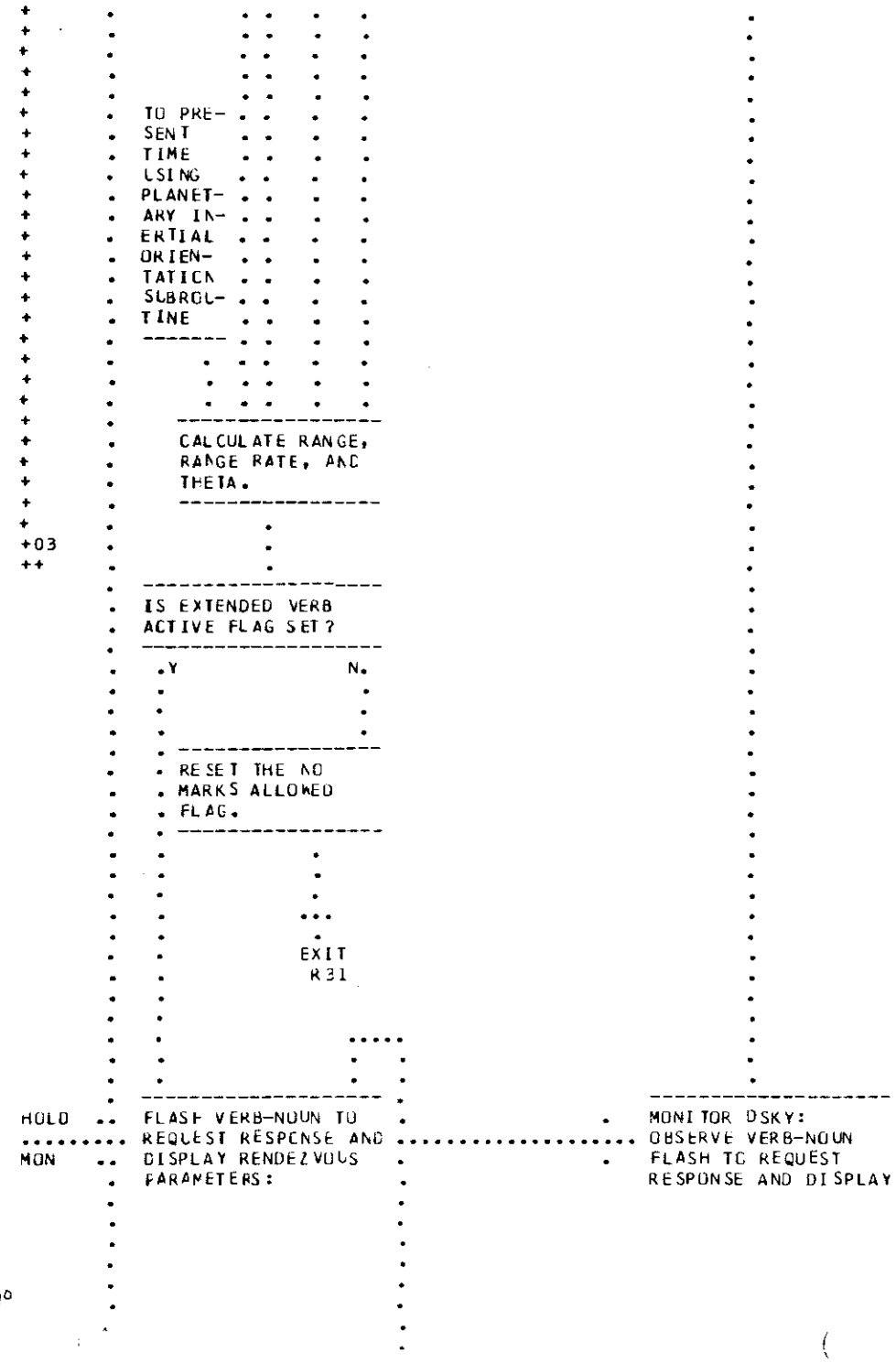
#160

#170

#180

#190

#200



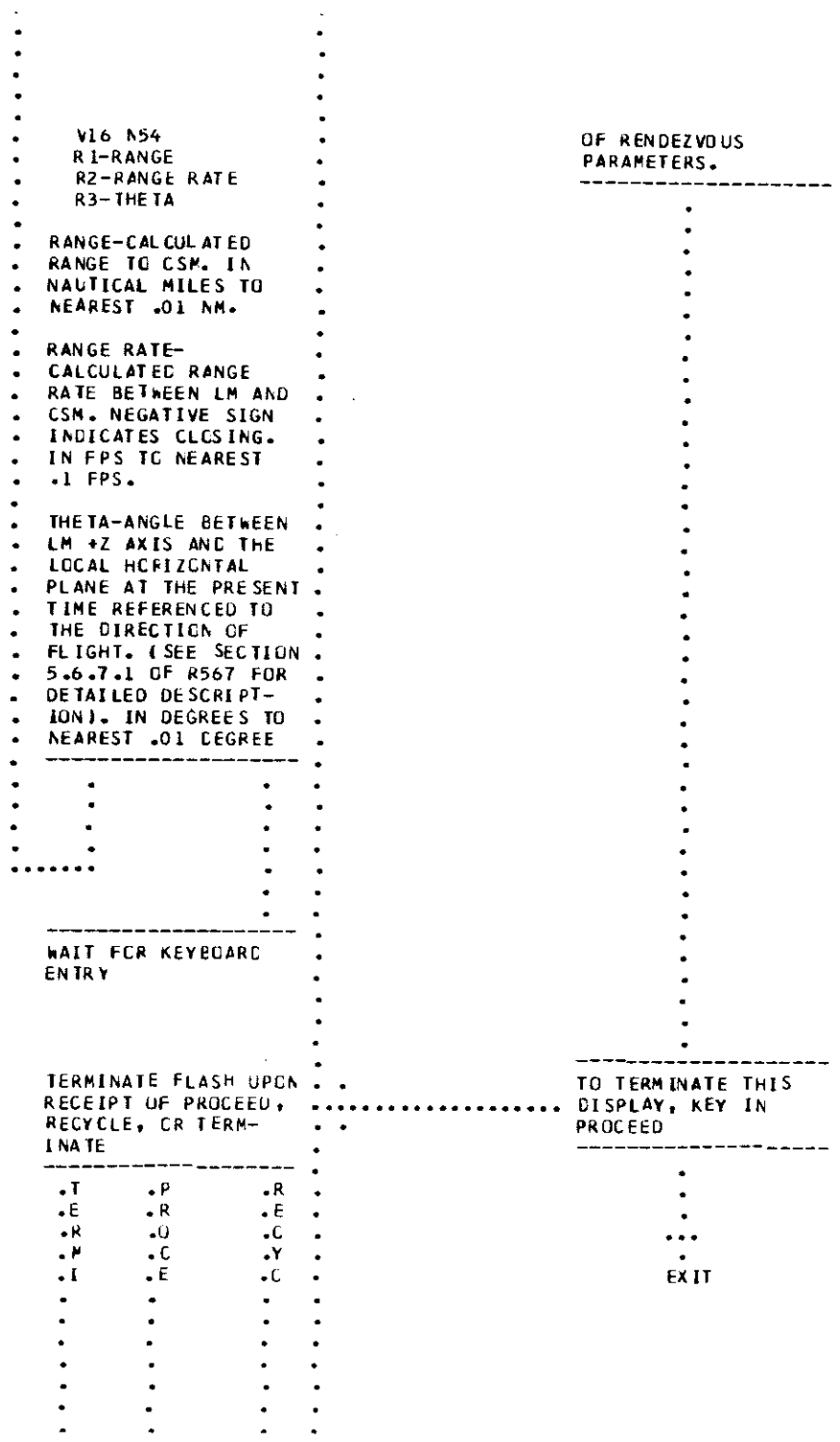
#210

#220

#230

#240

#250



#260

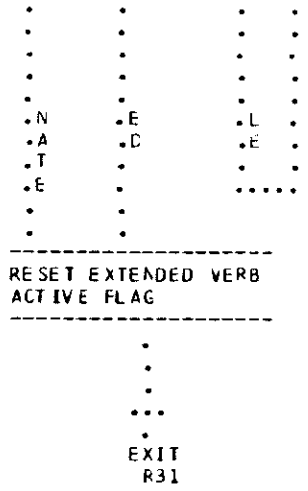
#270

#280

#290

#300

#310



R31

#320

#330

CHANGE CONTROL NOTES

REV 01 PCR 190,614,622
REV 02(LUM 1A) PCR 654,EDITORIAL
REV 03 EDITORIAL

813

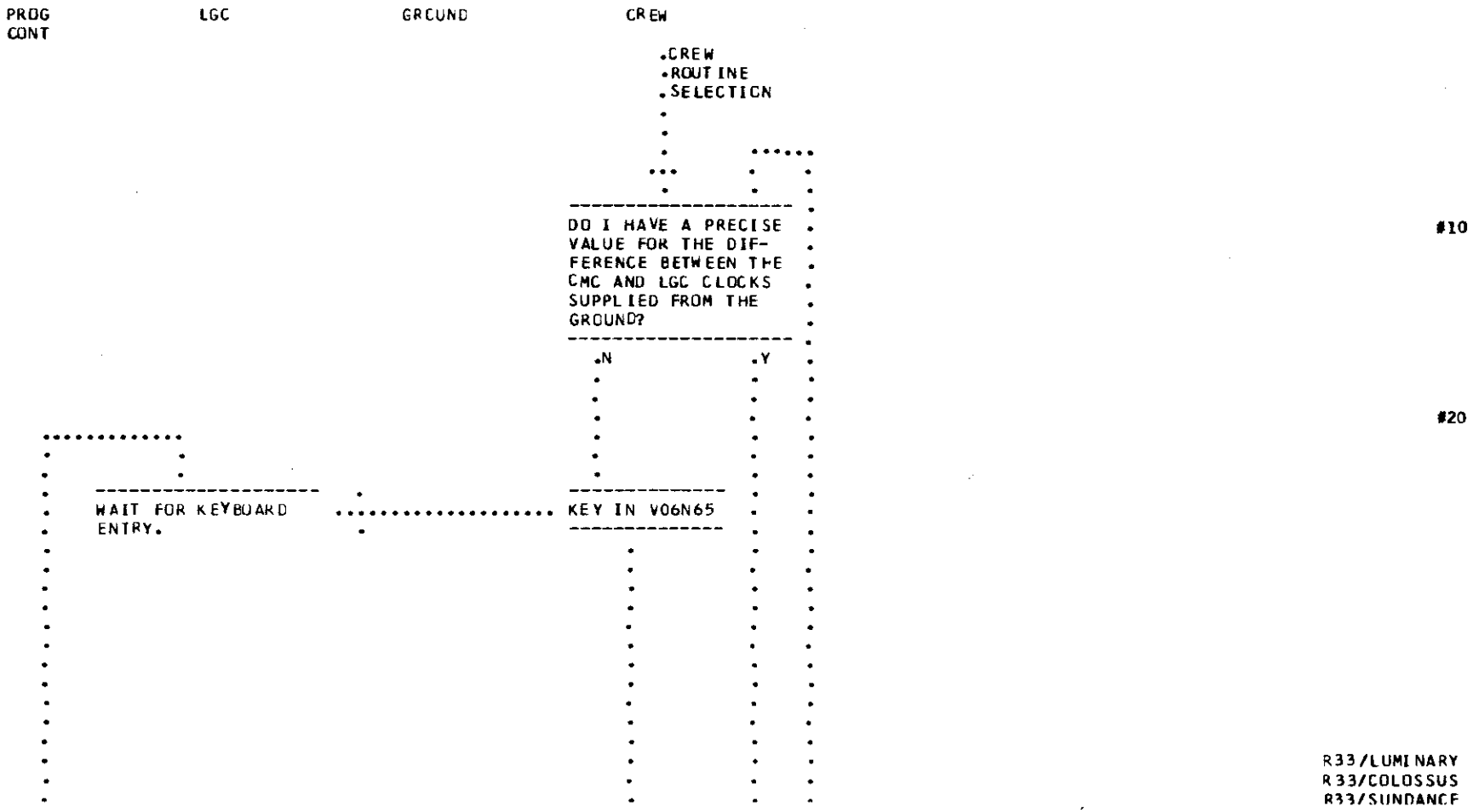
LGC/CMC CLOCK SYNCHRONIZATION ROUTINE (R33) REV 01 01/09/69

PURPOSE: (1) TO SYNCHRONIZE THE LGC CLOCK WITH THE CMC CLOCK.

ASSUMPTIONS: (1) SYNCHRONIZATION REQUIRES A DETERMINATION OF THE VALUE OF THE DIFFERENCE BETWEEN THE TWO CLOCKS. THIS VALUE MAY BE OBTAINED DIRECTLY FROM COORDINATED READING OF THE TWO CLOCKS OR MAY BE PROVIDED BY THE GROUND FROM DOWNLINK MONITORING OF THE CLOCKS.

(2) THE LGC IS ON. THE CMC NEED ONLY BE ON UNTIL SATISFACTORY COMPARATIVE READINGS HAVE BEEN MADE BY THE CREW OR GROUND.

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



R33/LUMINARY
R33/COLOSSUS
R33/SUNDANCE

#30

CONFIRM SELECTION OF THIS ROUTINE (R33) IN THE OTHER VEHICLE.

#40

PERFORM COUNTDOWN WITH CREW MEMBER IN OTHER VEHICLE TO INSURE SIMULTANEOUS DEPRESSION OF BOTH ENTER KEYS.

#50

KEY IN ENTER

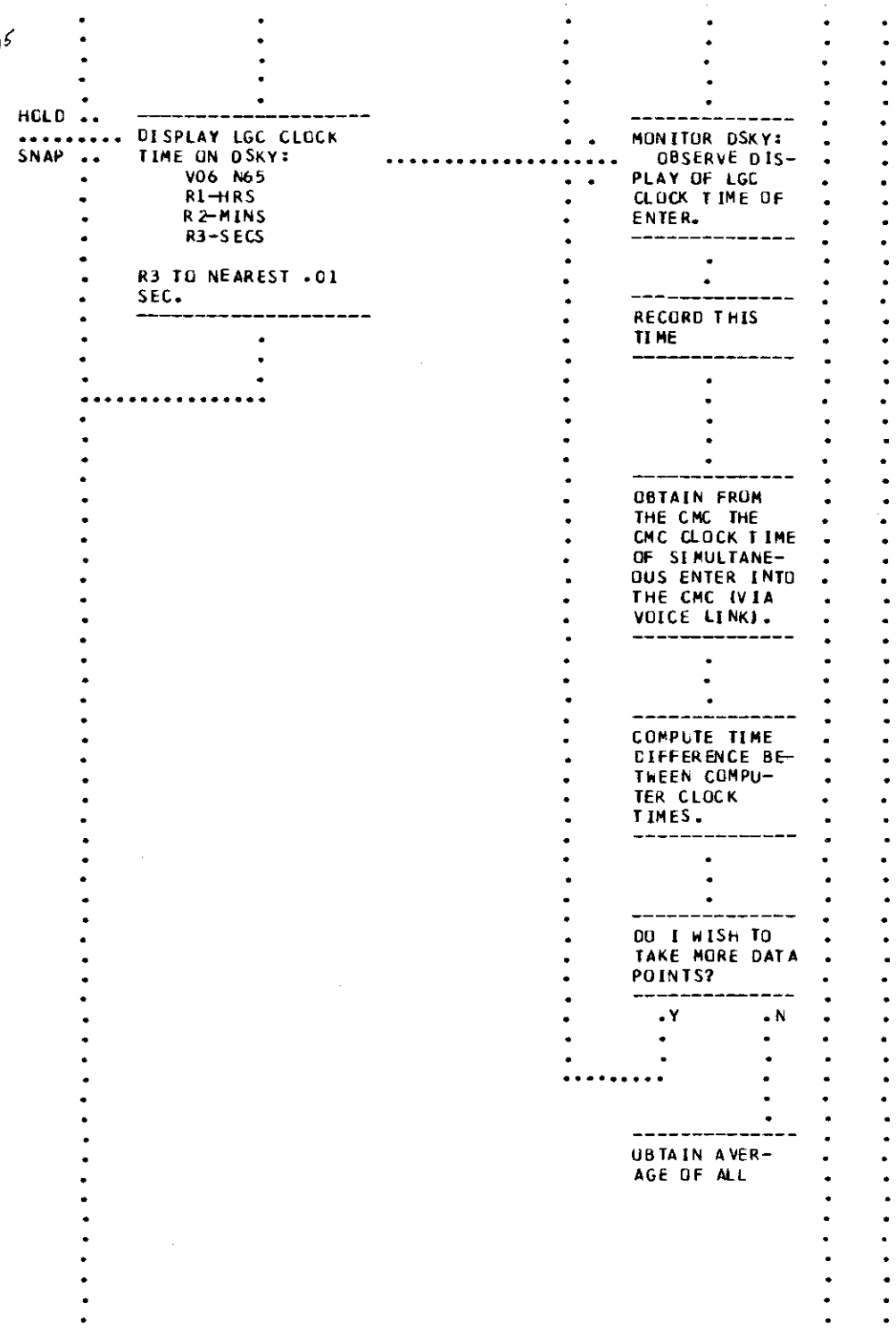
CONTINUE UPON RECEIPT OF ENTER

#60

.ENTER

RECORD CONTENTS OF LGC CLOCK AT TIME OF ENTER

#70



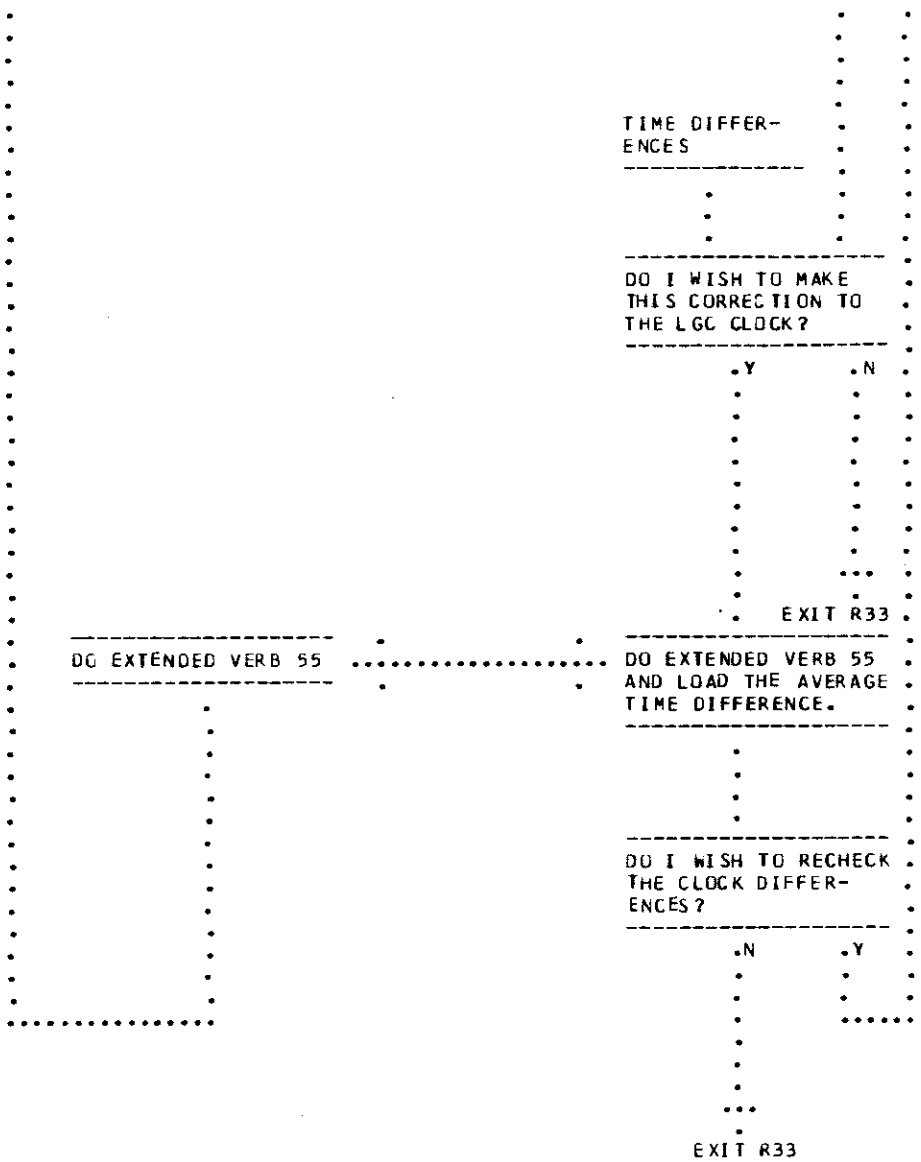
#80

#90

#100

#110

#120



#130

#140

#150

#160

#170

CHANGE CONTROL NOTES

LOGIC REV C1 PCR 513

896

817

RENDEZVOUS OUT-OF-PLANE DISPLAY ROUTINE (R36) REV 02 12/03/69

PURPOSE: (1) TO DISPLAY AT ASTRONAUT REQUEST LGC CALCULATED RENDEZVOUS OUT-OF-PLANE PARAMETERS (Y, Y DOT, PSI)

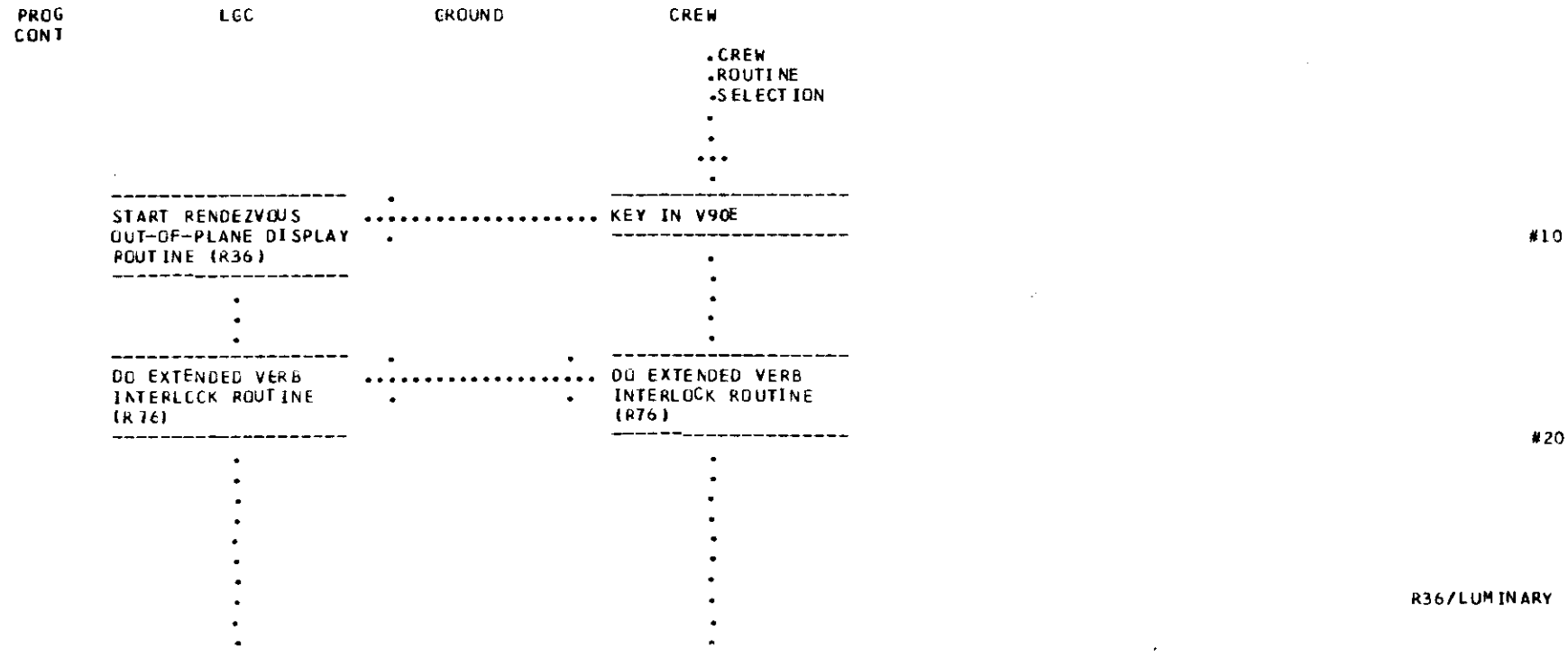
ASSUMPTIONS: (1) THESE PARAMETERS ARE CALCULATED BY THE LGC ON THE BASIS OF THE STORED LM AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON.

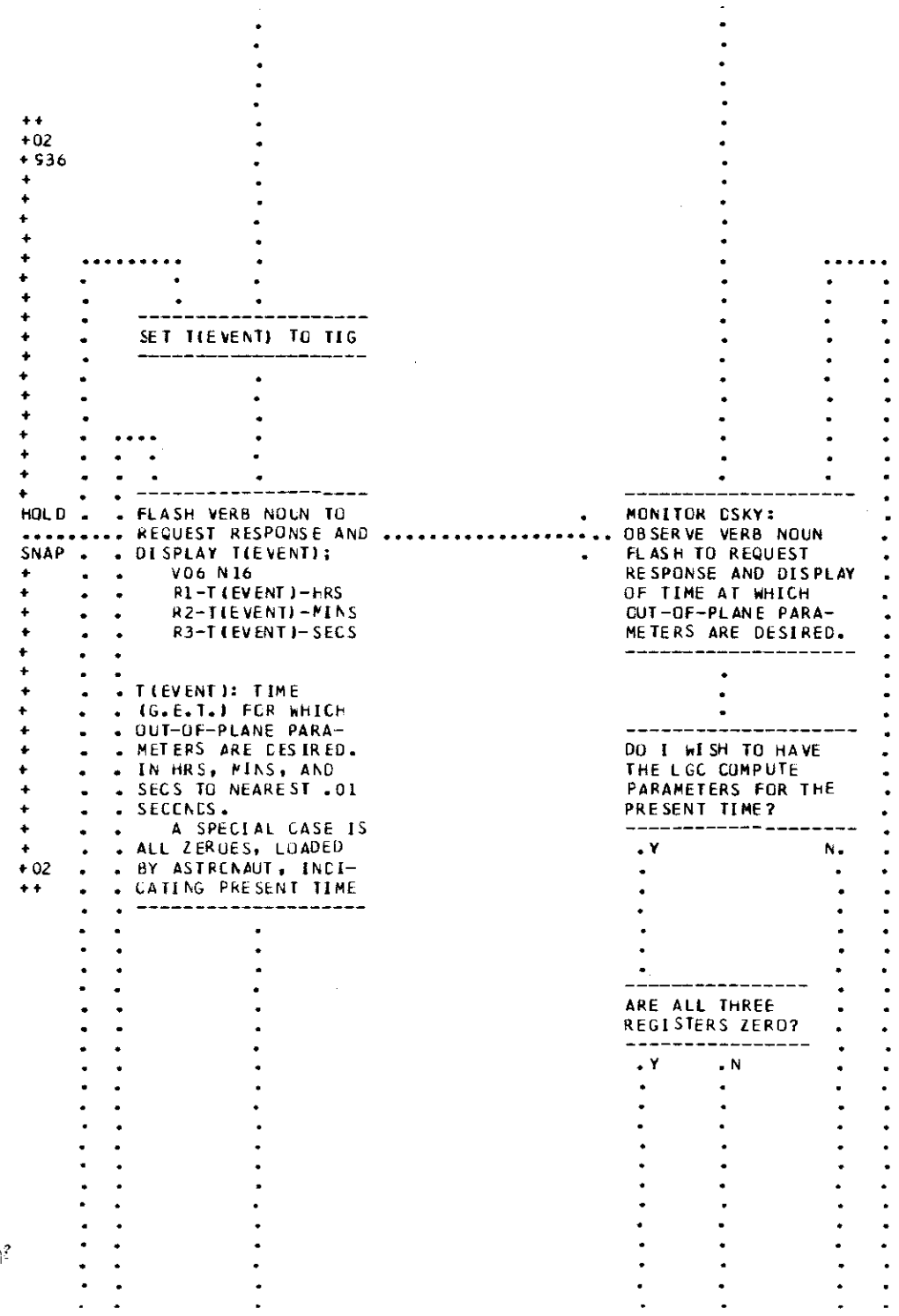
(2) TO MONITOR THE PROGRESS OF STATE VECTOR INTEGRATION, THE TIME ASSOCIATED WITH THE ADVANCING (REGRESSING) STATE IS AVAILABLE BY KEYING IN V06N38E:

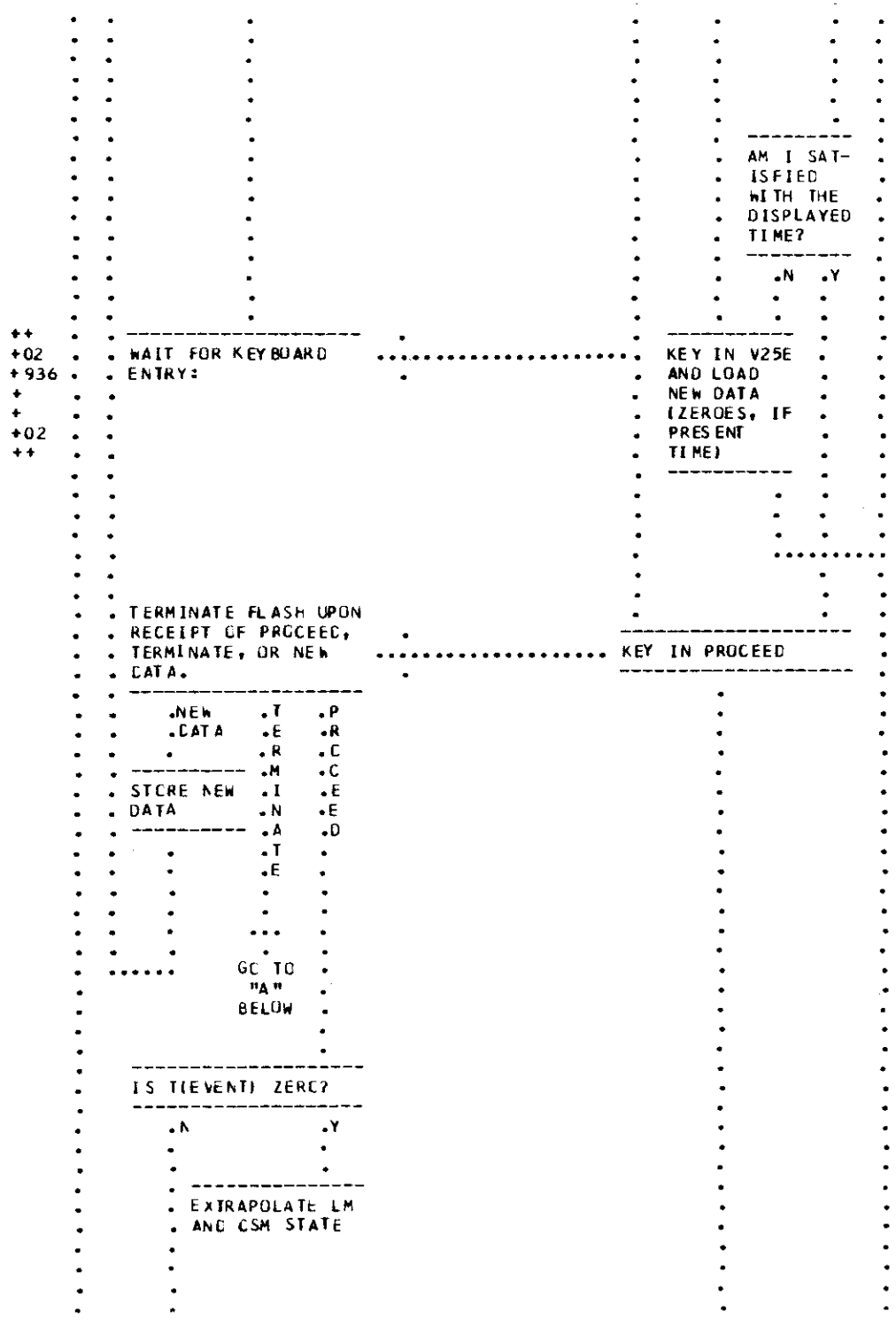
V06N38
R1-TET-HRS
R2-TET-MINS
R3-TET-SECS

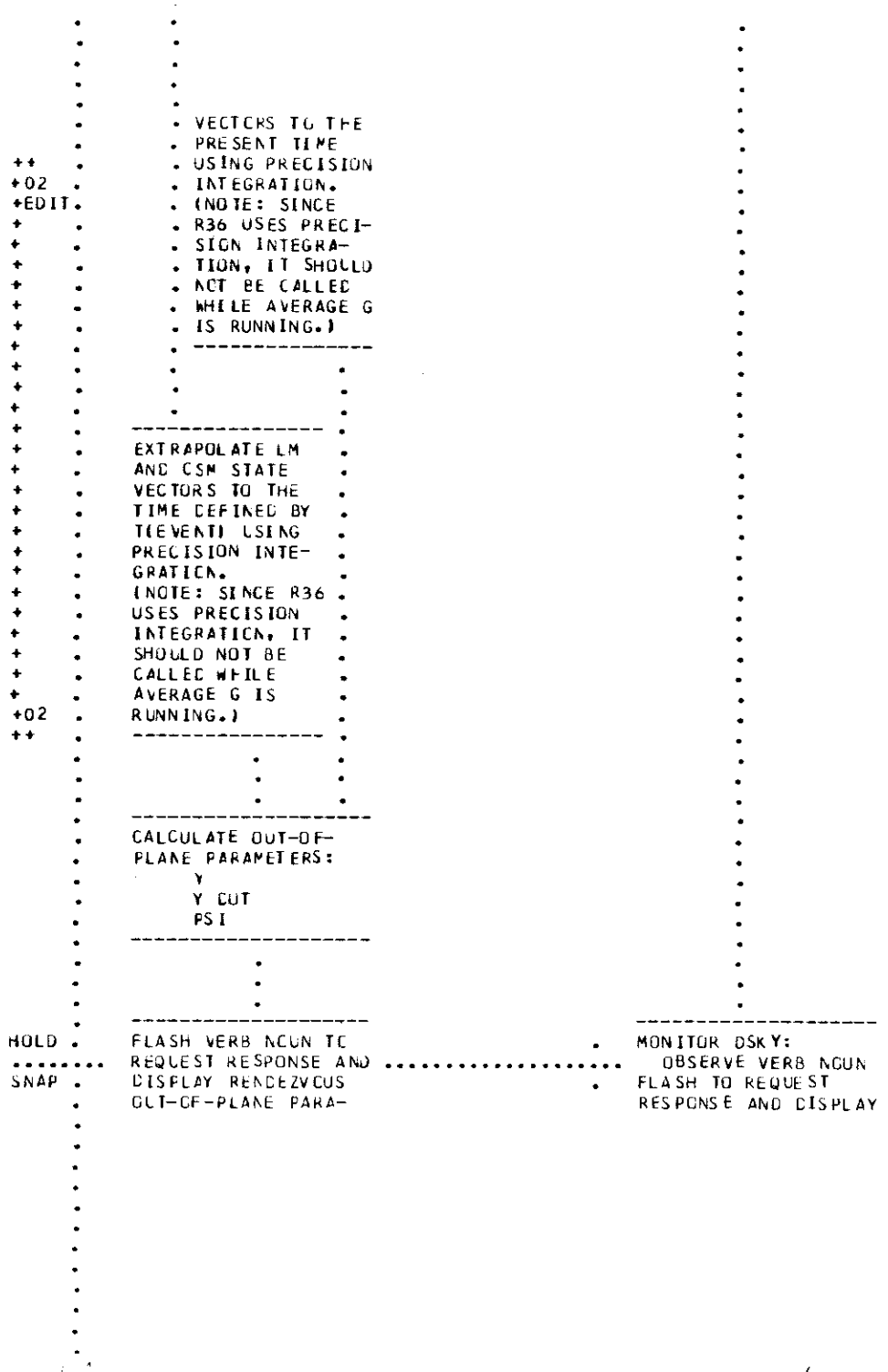
TET-THE TIME (GET) TO WHICH THE STATE VECTOR INTEGRATION PROCESS HAS PRESENTLY CALCULATED THE STATE VECTOR. IN HRS,MINS, AND SECS TO NEAREST .01 SEC.

++
+02 (3) THIS ROUTINE SHOULD NOT BE CALLED WHILE AVERAGE G IS RUNNING.
+EDIT
+02 (4) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
++




++
+02
+936
HOLD
SNAP
SET T(EVENT) TO TIG
FLASH VERB NOUN TO REQUEST RESPONSE AND DISPLAY T(EVENT);
V06 N16
R1-T(EVENT)-HRS
R2-T(EVENT)-MINS
R3-T(EVENT)-SECS
T(EVENT): TIME (G.E.T.) FOR WHICH OUT-OF-PLANE PARAMETERS ARE DESIRED. IN HRS, MINS, AND SECS TO NEAREST .01 SECONDS.
A SPECIAL CASE IS ALL ZEROES, LOADED BY ASTRONAUT, INDICATING PRESENT TIME
+02
++
MONITOR DSKY: OBSERVE VERB NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF TIME AT WHICH OUT-OF-PLANE PARAMETERS ARE DESIRED.
DO I WISH TO HAVE THE LGC COMPUTE PARAMETERS FOR THE PRESENT TIME?
.Y
N.
ARE ALL THREE REGISTERS ZERO?
.Y
.N
#30
#40
#50
#60
#70


AM I SAT-
ISFIED
WITH THE
DISPLAYED
TIME?
.N .Y
++
+02
+936
+
+
+02
++
WAIT FOR KEYBOARD
ENTRY:
KEY IN V25E
AND LOAD
NEW DATA
(ZEROES, IF
PRESENT
TIME)
#80
#90
TERMINATE FLASH UPON
RECEIPT OF PROCEED,
TERMINATE, OR NEW
DATA.
KEY IN PROCEED
#100
.NEW .T .P
.DATA .E .R
. .R .C
.M .C
STORE NEW .I .E
DATA .N .E
.A .D
#110
.T
.E
GO TO
"A"
BELOW
#120
IS T(EVENT) ZERO?
.N .Y
EXTRAPOLATE LM
AND CSM STATE



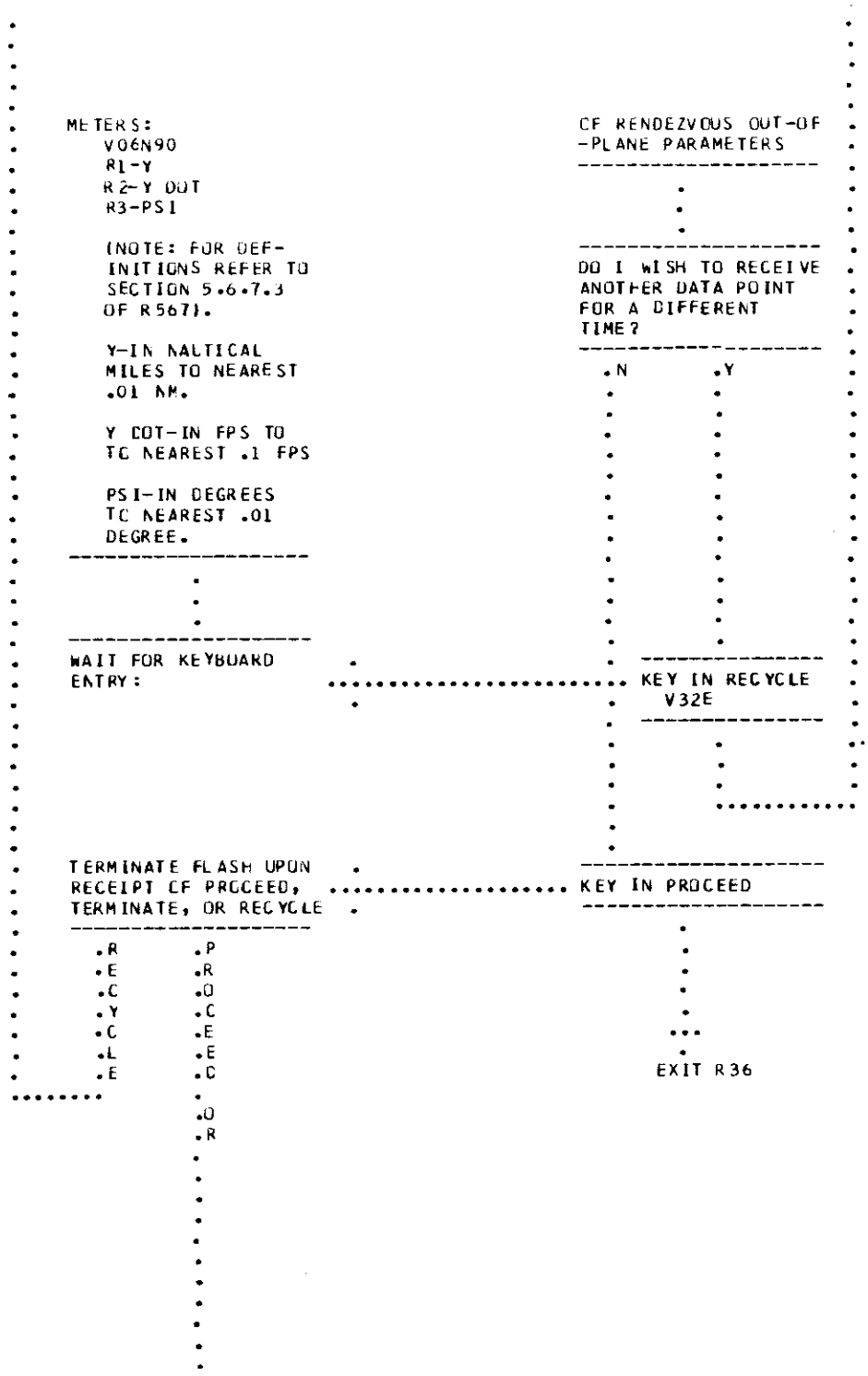
#130

#140

#150

#160

#170



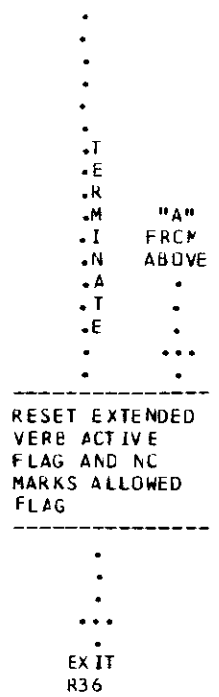
#180

#190

#200

#210

#220



#230

#240

#250

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 407,614
REV 02(LUM 1C) PCR 936.2,EDITORIAL

383

DPS/APS THRUST FAIL ROUTINE (R40) REV 03 12/03/69

PURPOSE: (1) TO MONITOR THE IMU PIPA OUTPUTS FOR EVIDENCE OF DPS OR APS THRUST.

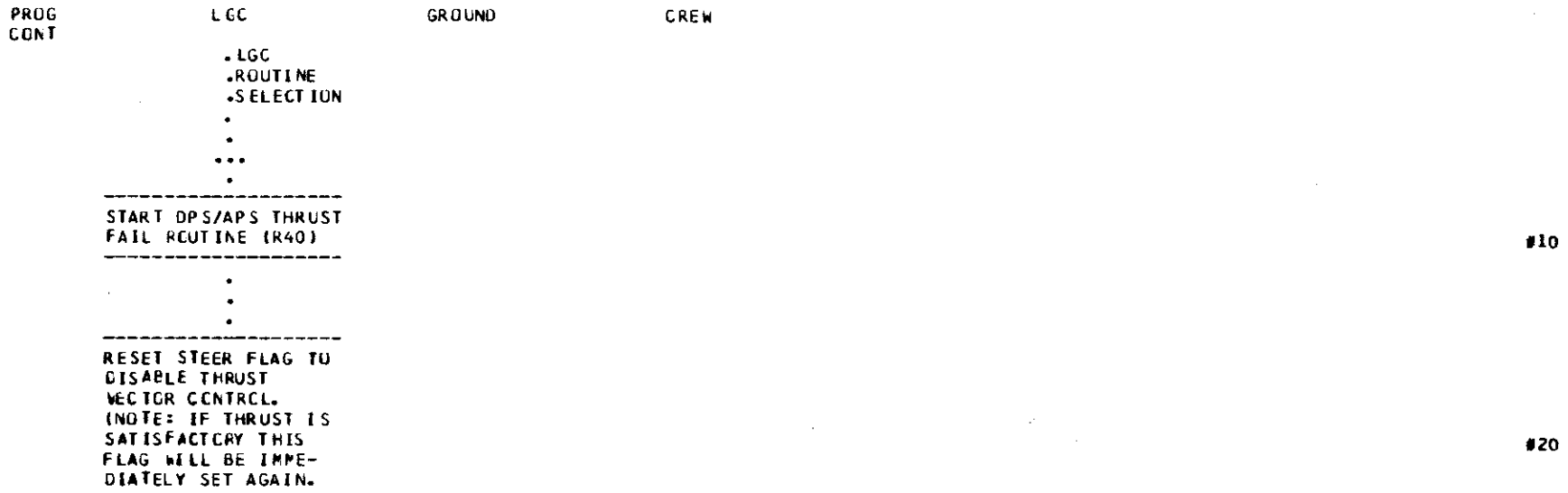
(2) TO INITIATE ENGINE FAIL PROCEDURES IF THE THRUST MONITOR INDICATES A LACK OF ENGINE THRUST.

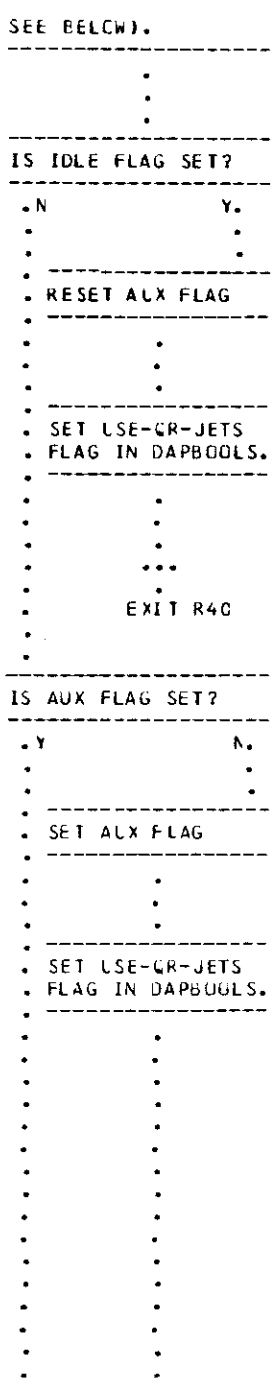
ASSUMPTIONS: (1) THIS ROUTINE IS CALLED EVERY 2 SECONDS BY SERVICER.

(2) THE THRUSTING PROGRAM WILL DEFINE THE THRESHOLD VALUE FOR THE DELTA V COMPARISON TO BE ONE OF THREE VALUES:
(A) DPS WITH DOCKED CSM = 12 CM/SEC
(B) DPS WITH LM ALONE = 36 CM/SEC
(C) APS WITH LM ALONE = 308 CM/SEC

THE DPS VALUES ((A) AND (B)) ARE SUCH THAT NORMAL 10% THROTTLING WILL NOT INDICATE A THRUST FAILURE.

(3) THE THRUSTING PROGRAM WILL INITIALLY SET THE DELTA V COUNTER TO 4.





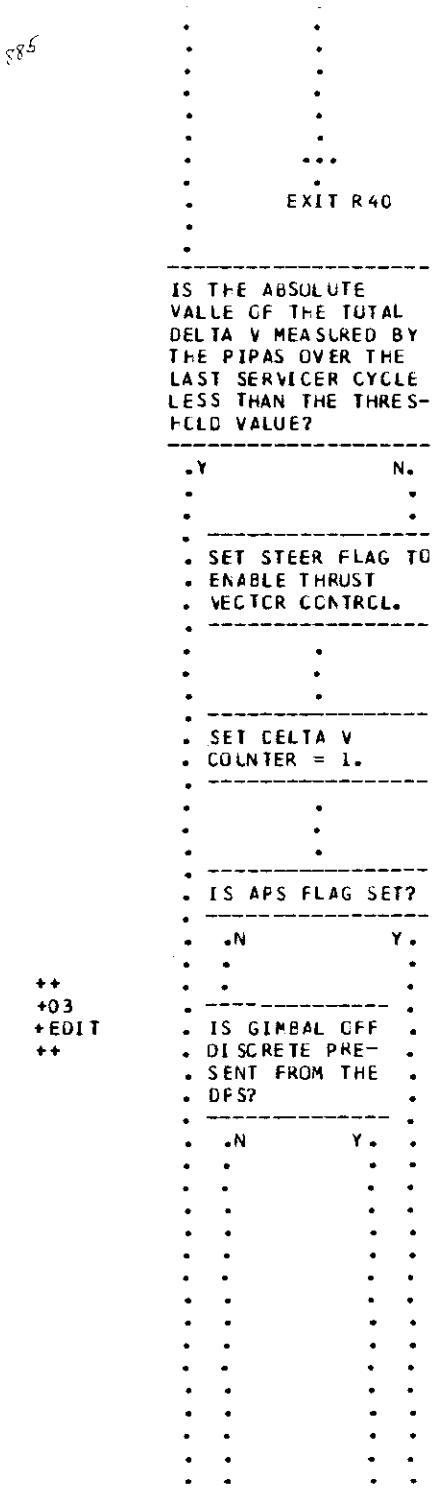
#30

#40

#50

#60

884



#70

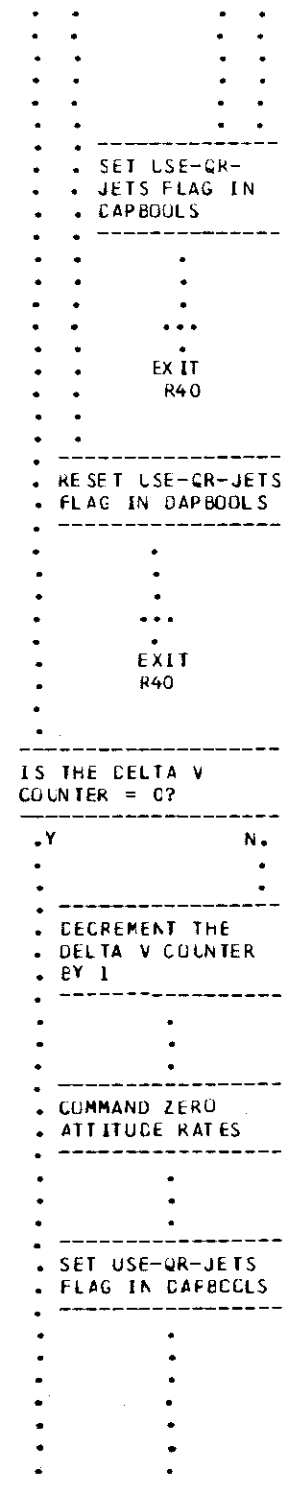
#80

#90

#100

#110

++
+03
+EDIT
++



#120

#130

#140

#150

#160

#170

886

EXIT R40

#180

SET IDLE FLAG TO DISABLE R4C ON NEXT SERVICER PASS

#190

SET THE DELTA V COUNTER = 4

#200

CALL V97 DISPLAY (SEE "A" BELOW.)

EXIT R40

"A" FROM ABOVE

#210

CHANGE VERB BUT RETAIN PRESENT NOUN AND DISPLAYS IN R1, R2 AND R3. FLASH VERB-NOUN TO REQUEST PLEASE PERFORM ENGINE FAIL PROCEDURE: V97NXX

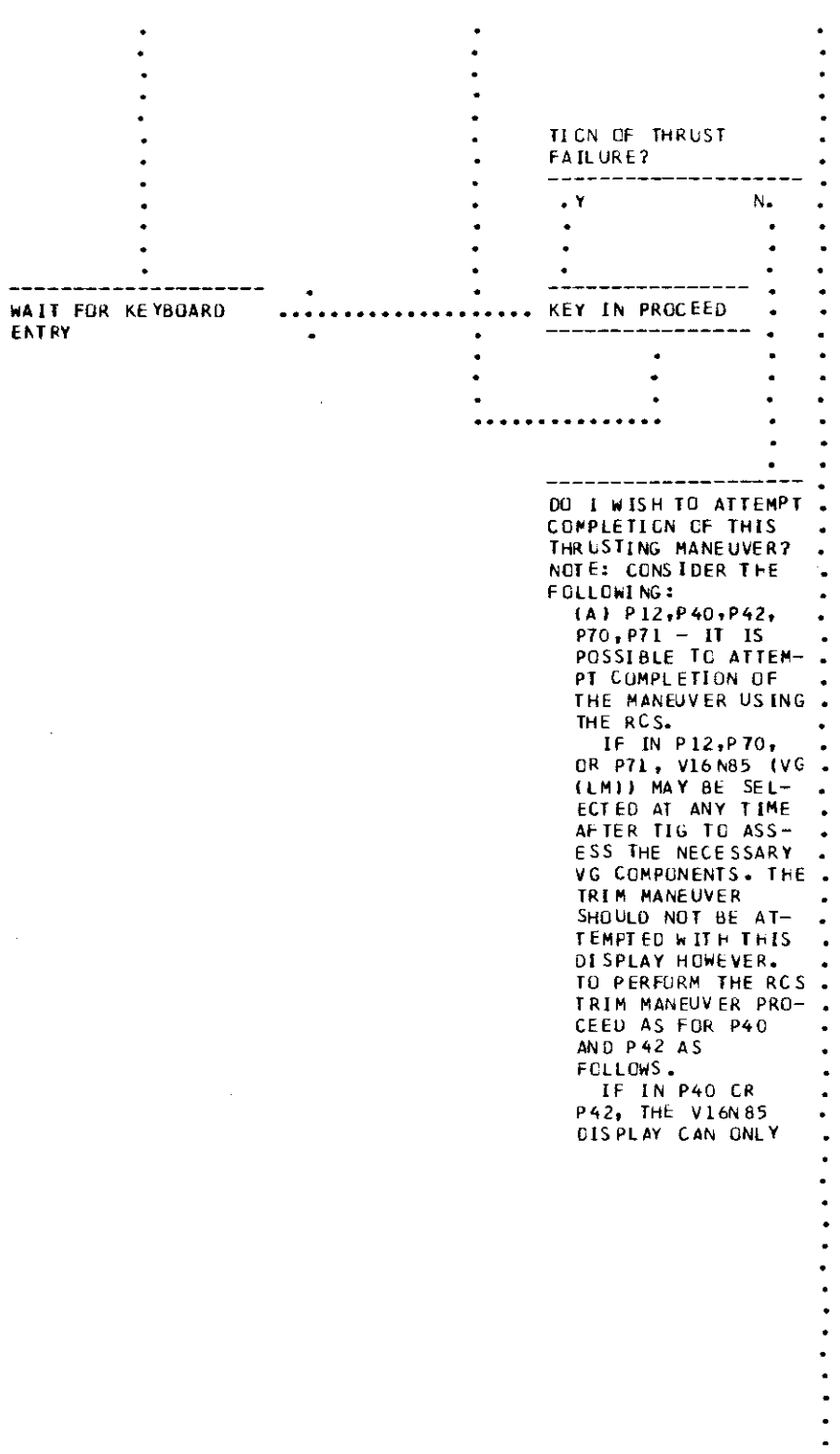
MONITOR DSKY: DOES VERB-NOUN FLASH REQUEST PLEASE PERFORM ENGINE FAIL PROCEDURES?

#220

.Y

N.

DO I WISH TO VERIFY THE LGC INTERPRETA-



#230

#240

#250

#260

#270

BE OBTAINED BY OPTING FOR THE RCS TRIM MANEUVER, I.E.: KEY IN "ENTER" IN RESPONSE TO V97 (NOW), THEN "ENTER" IN RESPONSE TO V99, THEN "PROCEED" IN RESPONSE TO V16N40 (V16N63 FOR P12, P70 AND P71).
(B) P40,P42 - THE NORMAL DISPLAY (V06N40-TFC,VG, DELTA VM) IS AVAILABLE TO ASSESS ANTICIPATED DURATION OF BURN.
(C) P12,70,71 - FOR AN ATTEMPTED RESTART OF THE MAIN ENGINE THE LGC WILL MAKE NO CALCULATION TO ANTICIPATE A POSSIBLE MINIMUM IMPULSE BURN. V16N77 (TG AND V(Y)) MAY BE SELECTED AT THIS TIME TO ASSESS TG. THE NORMAL DISPLAY (V16N63 -VI,H DOT, AND H) IS ALSO AVAILABLE TO ASSESS VI.
(D) P70 - FOR AN ATTEMPTED RESTART OF THE DPS THE LGC WILL EXERCISE NO THROTTLE CONTROL (THROTTLE WILL BE SET TO MINIMUM). THE ASCENT GUIDANCE WILL NOT ATTEMPT TO CONTROL THE THRUST VECTOR

#280

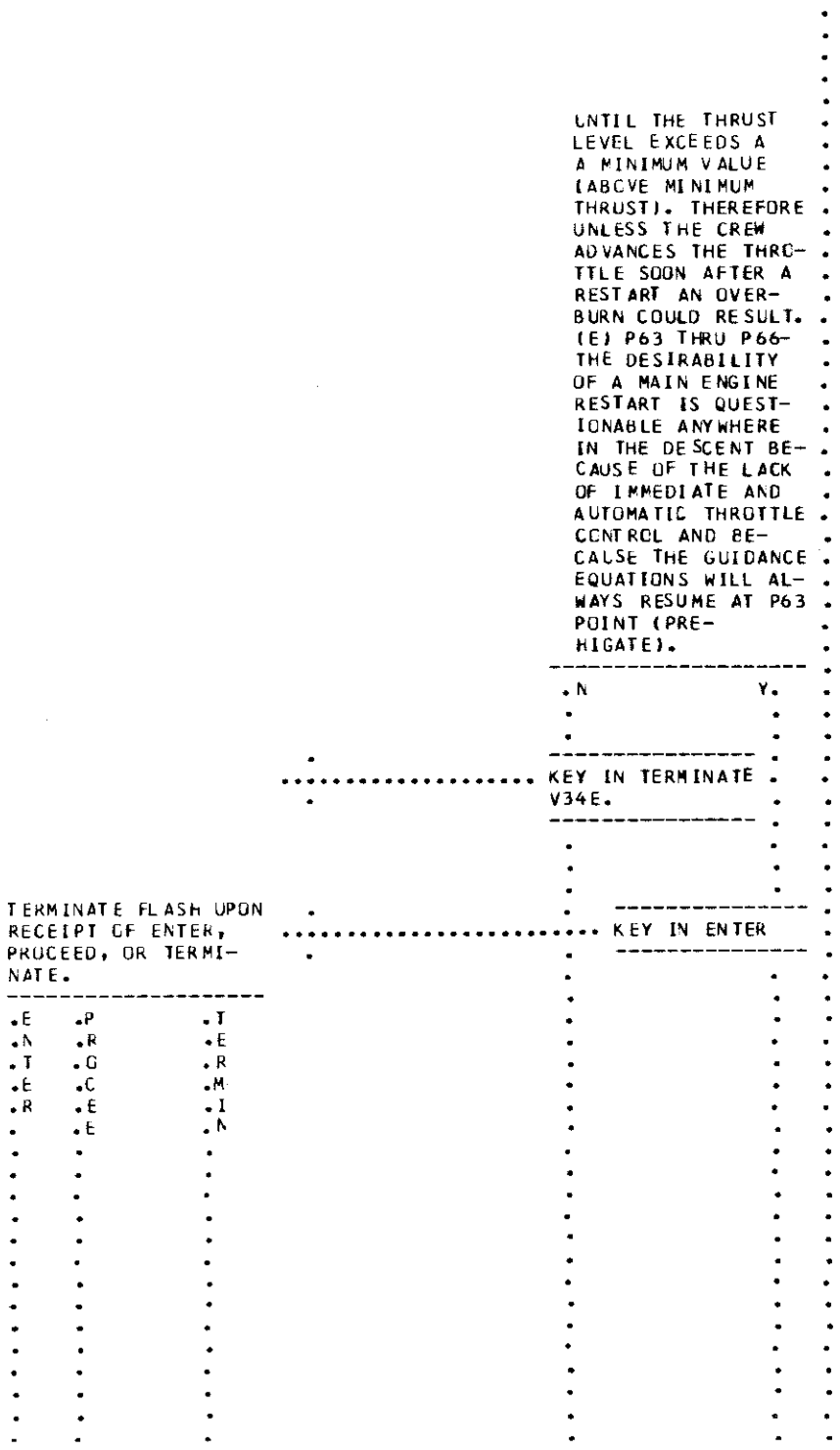
#290

#300

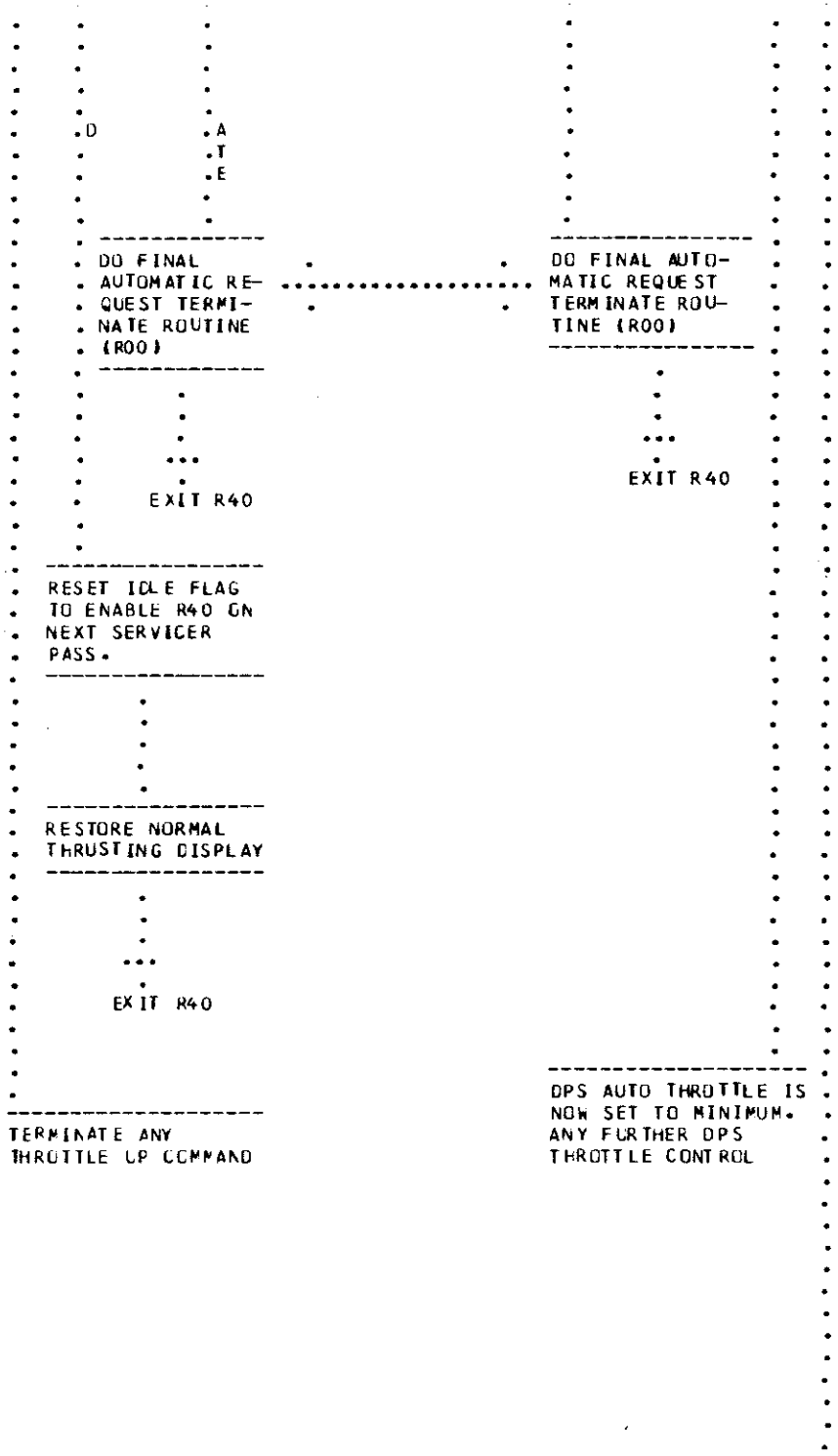
#310

#320

++
+03
+285
++



#330
#340
#350
#360
#370



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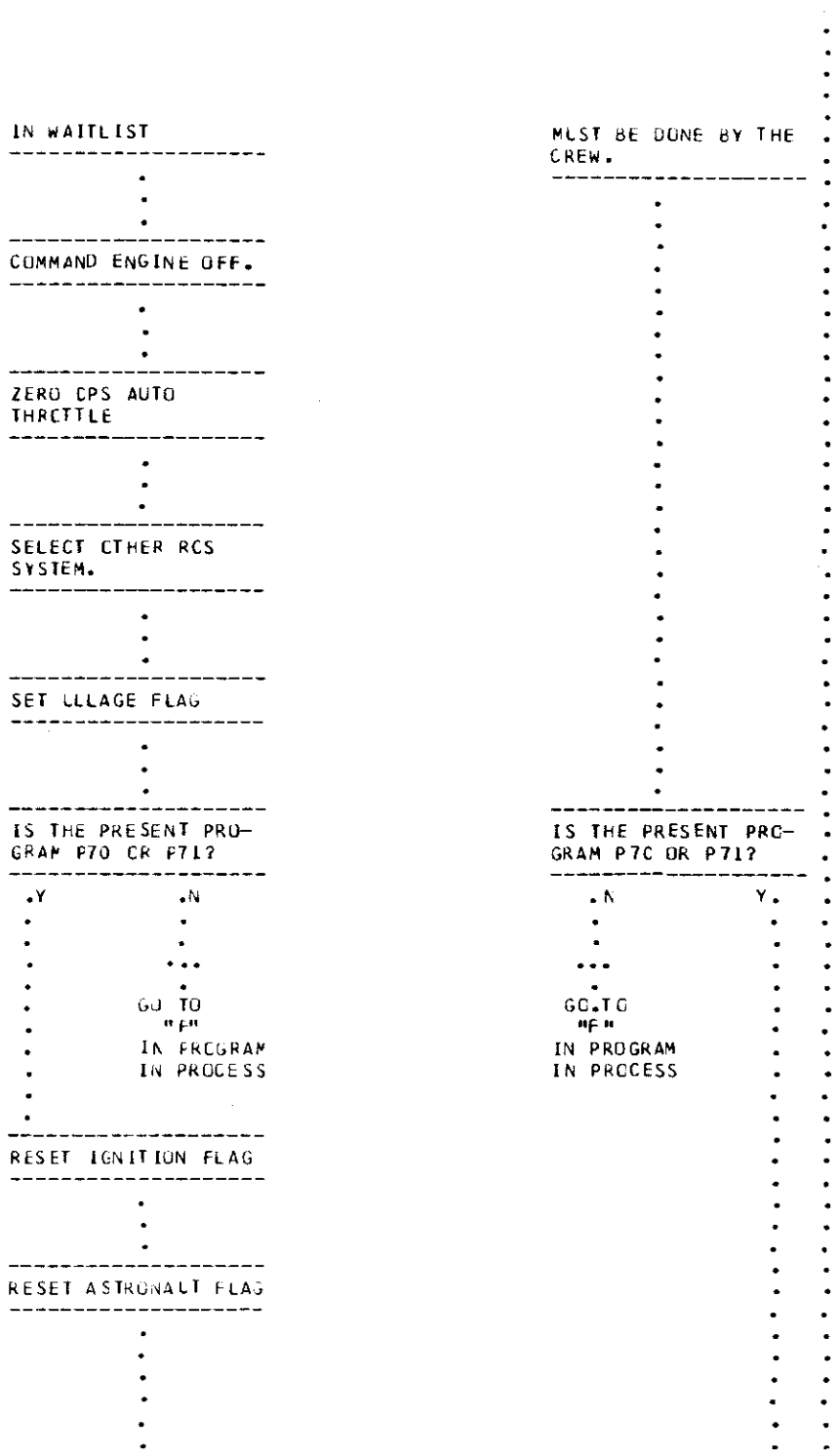

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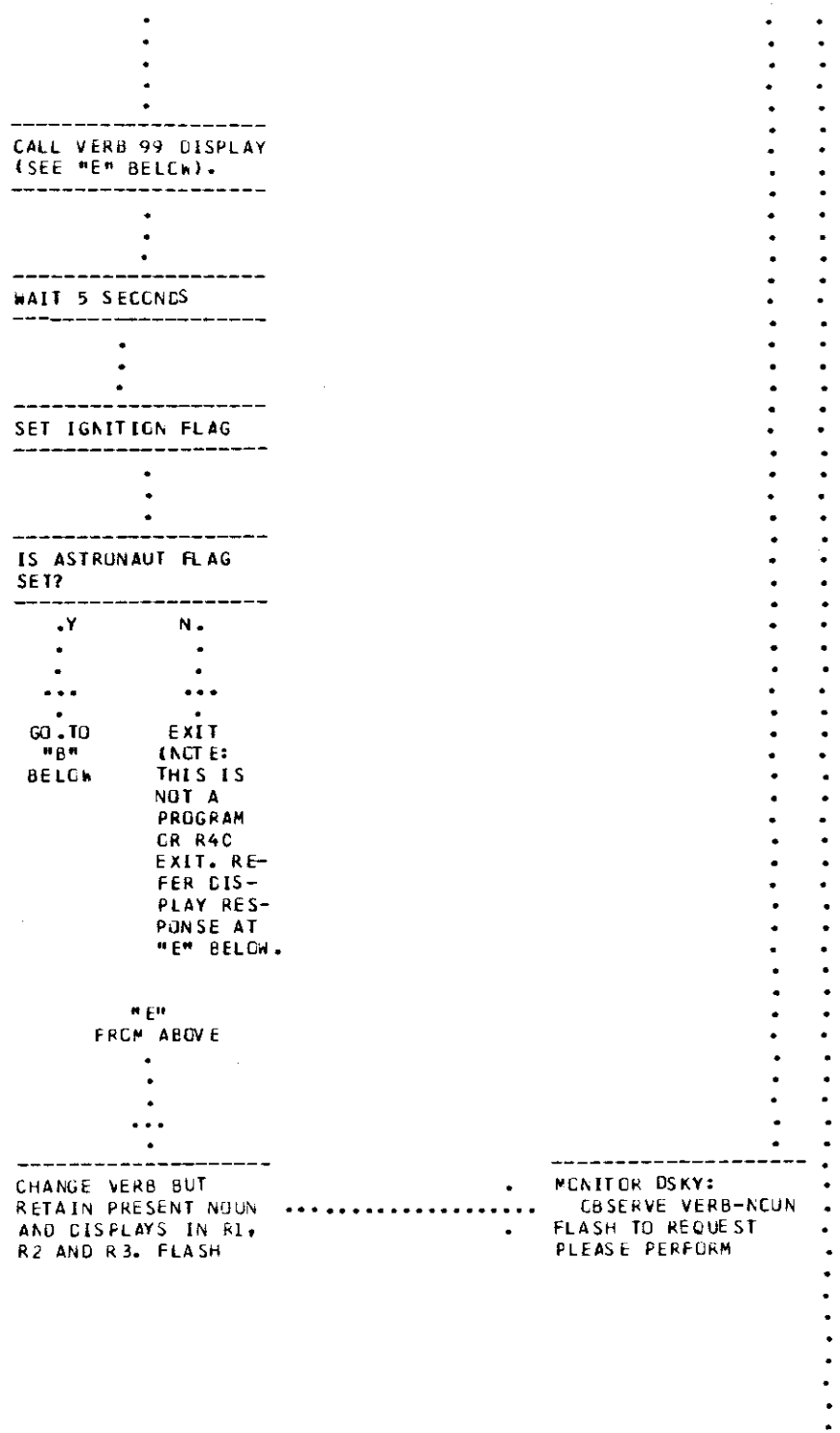

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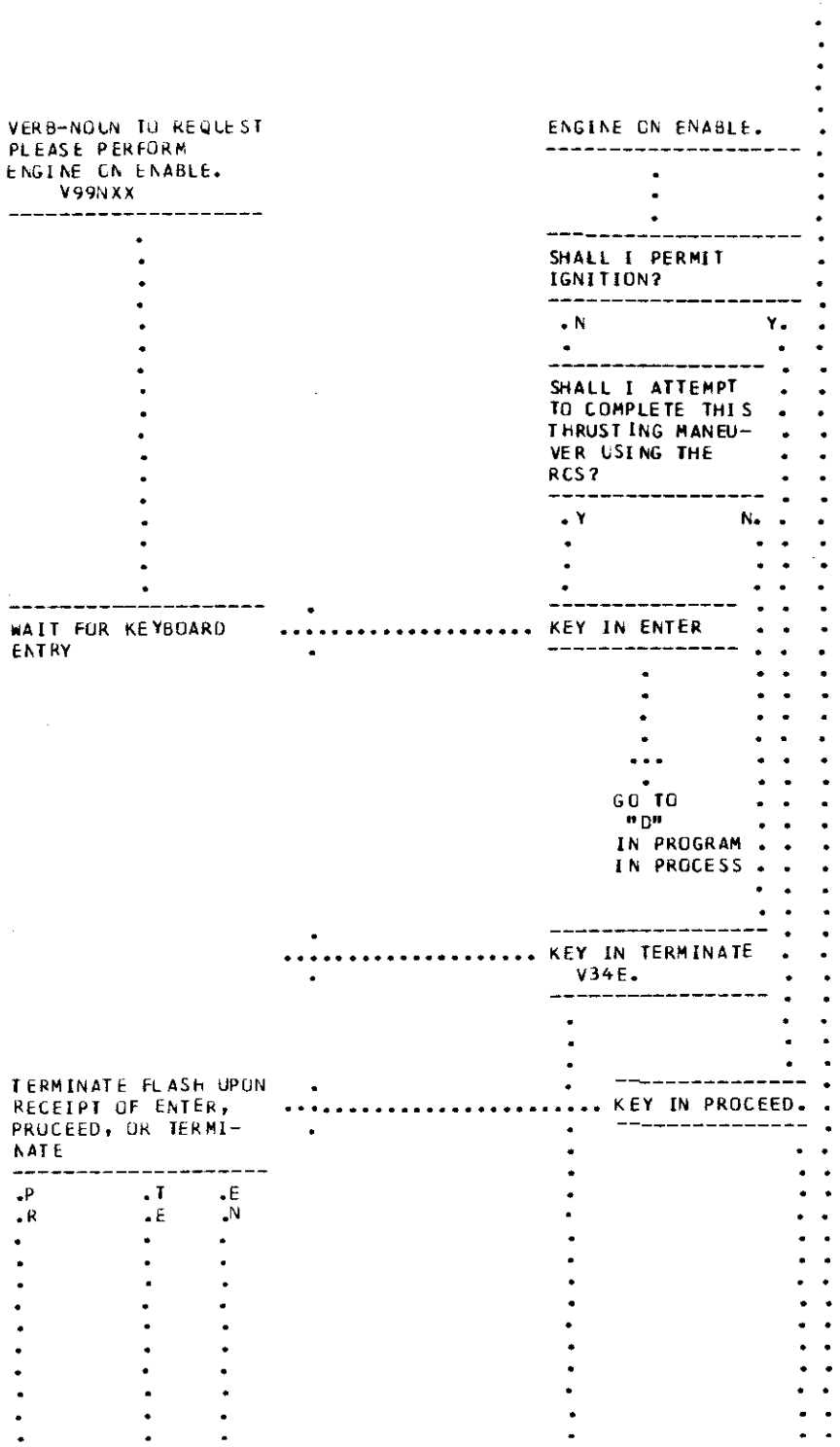
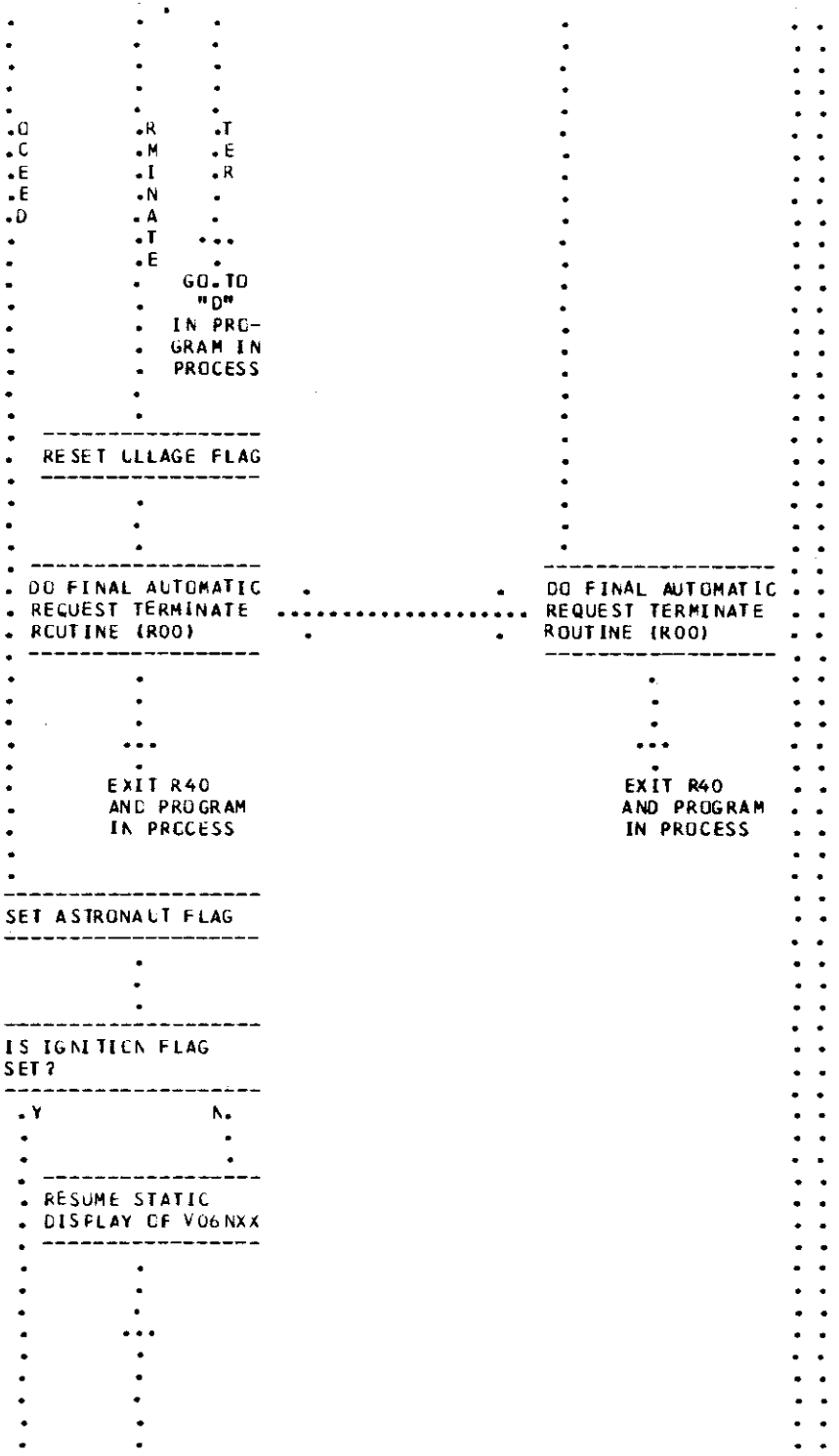

VERB-NOUN TO REQUEST
PLEASE PERFORM
ENGINE ON ENABLE.
V99NXX
ENGINE ON ENABLE.
#530
SHALL I PERMIT
IGNITION?
N
Y
#540
SHALL I ATTEMPT
TO COMPLETE THIS
THRUSTING MANEU-
VER USING THE
RCS?
Y
N
#550
WAIT FOR KEYBOARD
ENTRY
KEY IN ENTER
GO TO
"D"
IN PROGRAM
IN PROCESS
#560
KEY IN TERMINATE
V34E.
#570
TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED, OR TERMI-
NATE
KEY IN PROCEED.
P
R
T
E
E
N



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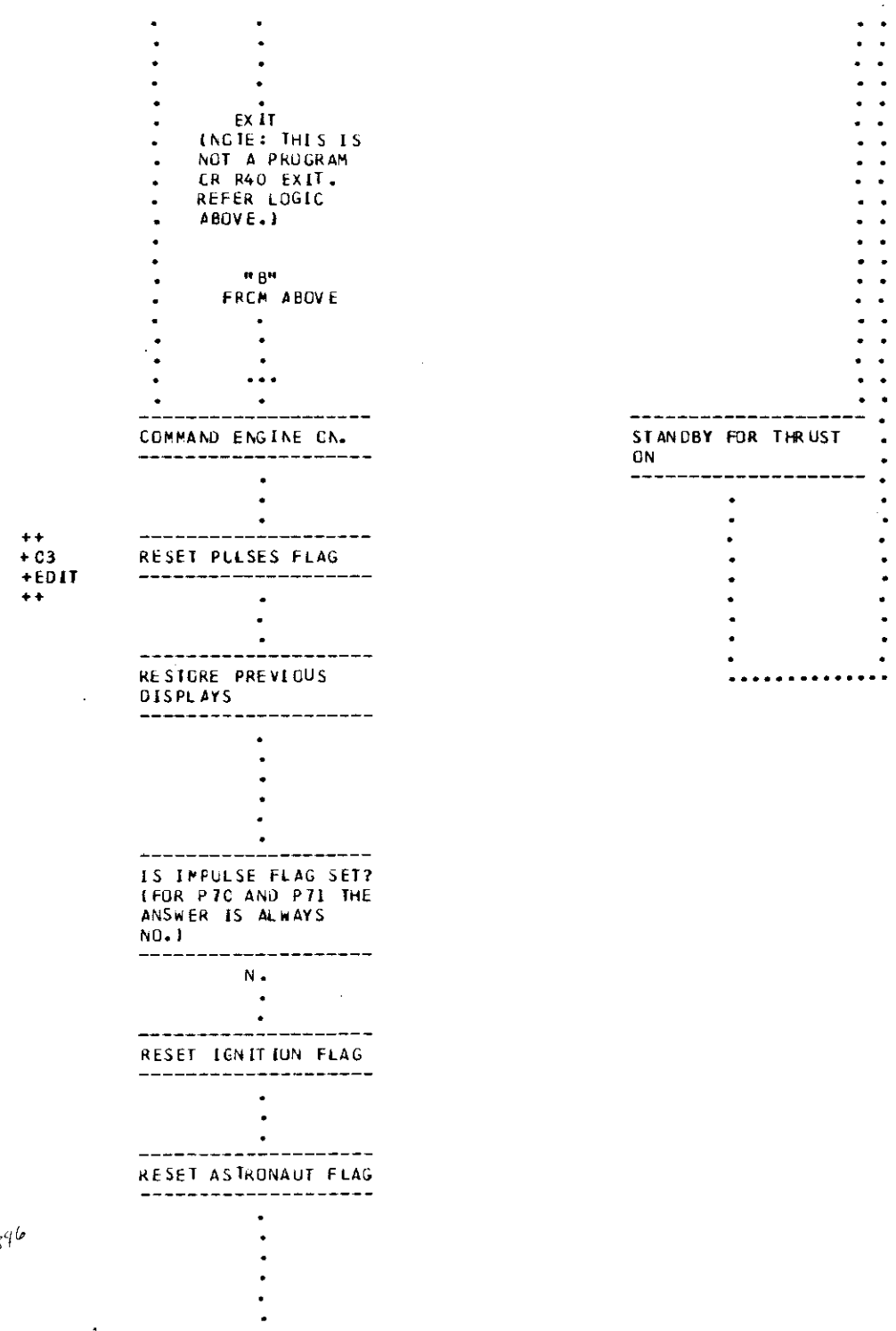

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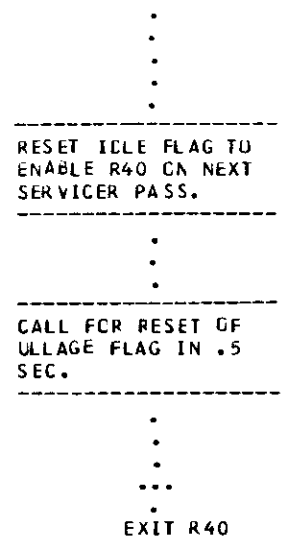
897



#700

#710

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 8,121,144,472,612
REV 02(LUM 1B) PCR 838, EDITORIAL
REV 03(LUM 1C) PCR 285, EDITORIAL

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897

STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41) REV 03 12/03/69

PURPOSE: (1) TO INTEGRATE THE STATE VECTOR OF THIS VEHICLE TO THE TIME AT WHICH THE AVERAGE G ROUTINE WILL BE TURNED ON BY THE CALLING PROGRAM.

(2) TO DEFINE A NEW TIG IN THE EVENT THE STATE VECTOR CANNOT BE INTEGRATED TO THE TIME ORIGINALLY DEFINED AND TO ESTABLISH A PROGRAM ALARM TO INFORM THE CREW THAT TIG HAS BEEN SLIPPED.

ASSUMPTIONS: (1) THERE IS A SIGNIFICANT AMOUNT OF TIME REQUIRED BY THE LGC TO UPDATE THE LM STATE VECTOR. THE FOLLOWING APPROXIMATE TIMES APPLY:

++ 1.7 SECONDS PER TIME STEP IN EARTH ORBIT
+03 3.6 SECONDS PER TIME STEP IN LUNAR ORBIT
+EDIT .70 SECONDS ON LUNAR SURFACE (NO TIME STEPS INVOLVED IN THIS CASE)
++ WHERE TIME STEP IS EQUAL TO:
250 SECONDS IN EARTH ORBIT
350 SECONDS IN LUNAR ORBIT

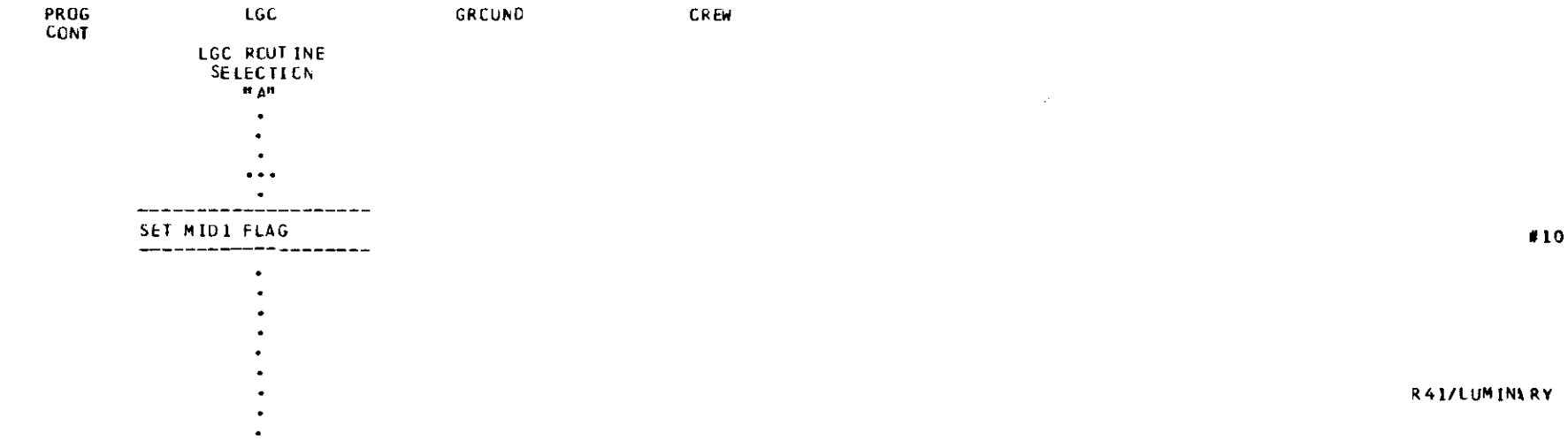
(2) TO MONITOR THE PROGRESS OF STATE VECTOR INTEGRATION, THE TIME ASSOCIATED WITH THE ADVANCING (REGRESSING) STATE IS AVAILABLE BY KEYING IN V06N38E:

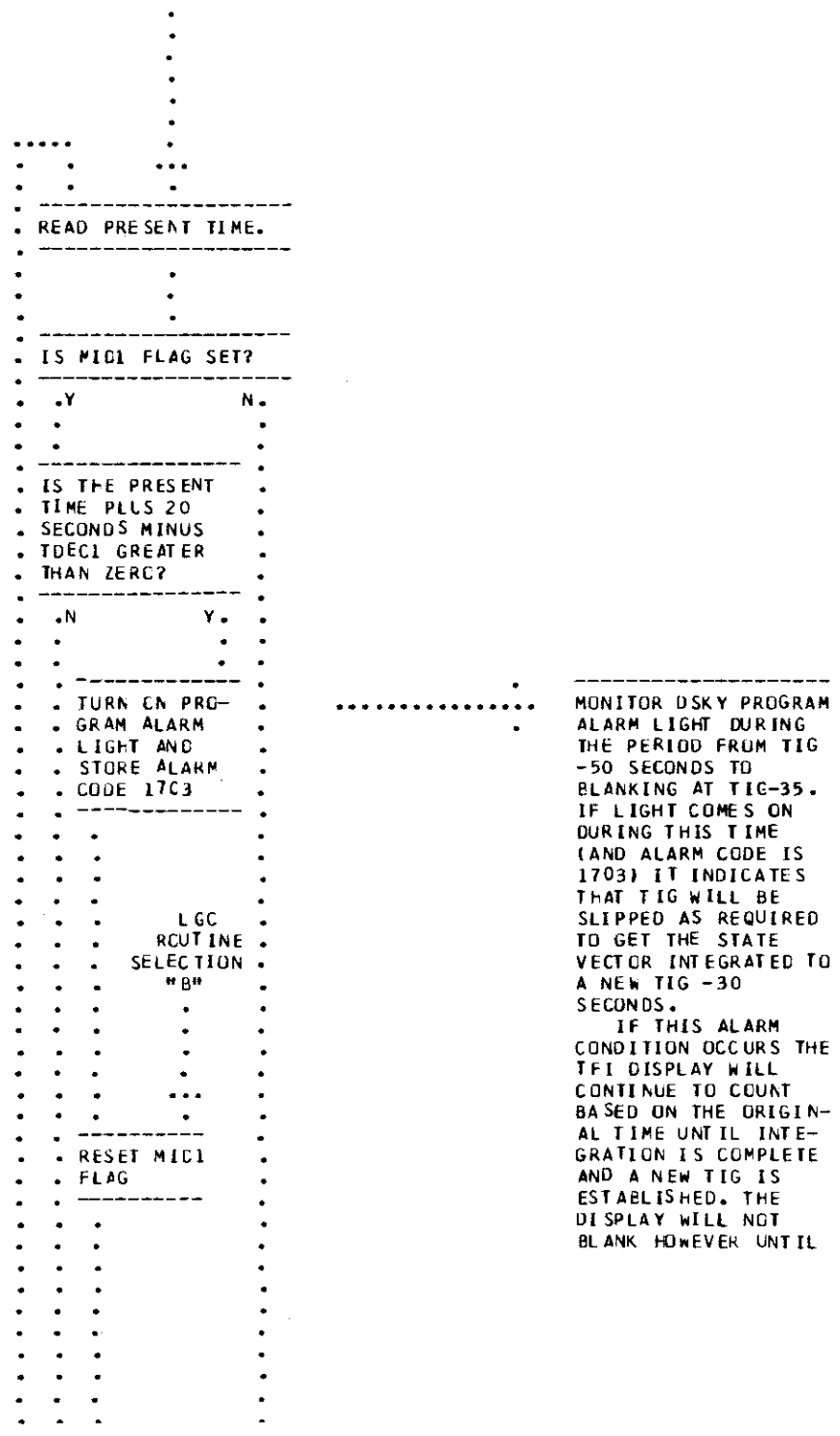
V06N38
R1-TET-HRS
R2-TET-MINS
R3-TET-SECS

TET-THE TIME (GET) TO WHICH THE STATE VECTOR INTEGRATION HAS PRESENTLY CALCULATED THE STATE VECTOR. IN HRS., MINS., AND SECS. TO NEAREST .01 SEC.

(3) IF TIG IS SLIPPED BY THIS ROUTINE DURING P12 THE CSM STATE VECTOR IN THE LGC IS NOT UP-TO-DATE, AND THE POWERED FLIGHT RR DESIGNATE ROUTINE (R29) MAY BE UNABLE TO ACCOMPLISH RR LOCK-ON.

(4) THE ROUTINE IS AUTOMATICALLY SELECTED BY P12, P40, P41, P42, P47, AND P63.





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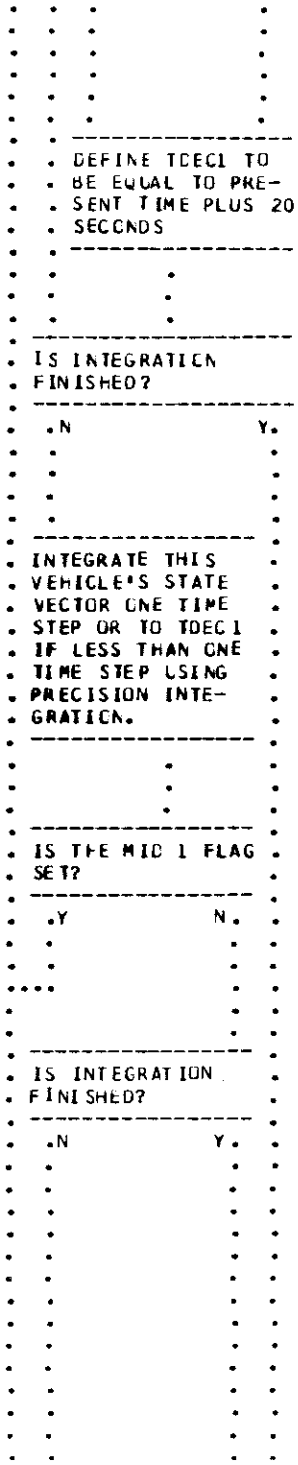
#40

#50

#60

900

901



THE NEW TIG HAS BEEN ESTABLISHED AND TFI IS REVISED.

#70

#80

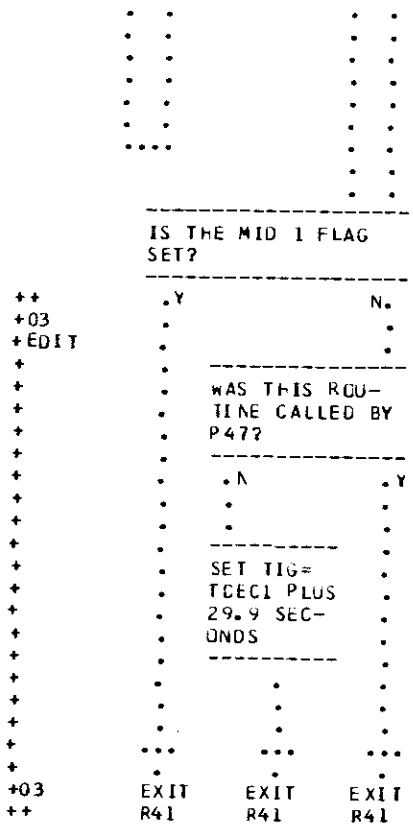
OBSERVE THAT THE COMPUTER ACTIVITY LIGHT GOES OFF WHICH INDICATES THAT THIS ROUTINE IS COMPLETE

#90

EXIT R41

#100

#110



#120

#130

#140

CHANGE CONTROL NOTES

REV 01 PCR 437,559,614
REV 00(LUM 1A) PCR 758,761.1
REV 03 EDITORIAL

902

AGS INITIALIZATION ROUTINE (R47) REV 03 12/03/69

PURPOSE: (1) TO PROVIDE THE AGS ABORT ELECTRONICS ASSEMBLY (AEA) WITH THE LM AND CSM STATE VECTORS (POSITION, VELOCITY, TIME) IN LM IML COORDINATES BY MEANS OF THE LGC DIGITAL DOWNLINK.

(2) TO ZERO THE ICDU, LGC, AND AEA GIMBAL ANGLE COUNTERS SIMULTANEOUSLY IN ORDER TO ESTABLISH A COMMON ZERO REFERENCE FOR THE MEASUREMENT OF GIMBAL (EULER) ANGLES WHICH DEFINE LM ATTITUDE WITH RESPECT TO THE IMU STABLE MEMBER.

(3) TO ESTABLISH THE GROUND ELAPSED TIME OF AEA CLOCK ZERO IF THE AEA CLOCK IS ZEROED DURING THIS ROUTINE.

ASSUMPTIONS: (1) THE LGC DOWNLINK DATA FORMAT AND SCALING ARE DEFINED IN SECTION 2 OF R567.

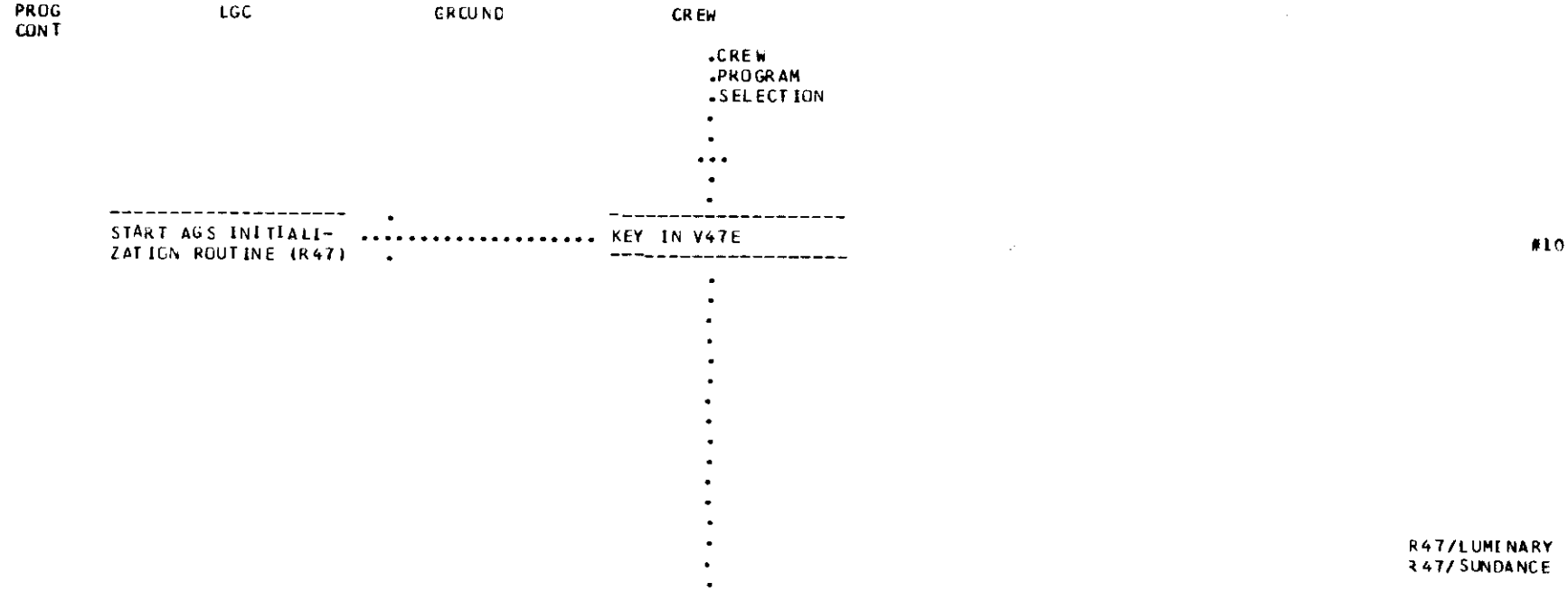
(2) THE CAPABILITY TO SELECT AN LGC PROGRAM (V37E--E OTHER THAN P00) IS INHIBITED BY THE LGC DURING THIS ROUTINE WHEN THE NO-DO-VERB-37 FLAG IS SET. V37 USE AT THIS TIME WILL RESULT IN A PROGRAM ALARM (01520). RESTORATION OF PROGRAM SELECTION CAPABILITY REQUIRES COMPLETION OF THIS ROUTINE OR SELECTION OF P00.

(3) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY AND IS COORDINATED WITH THE PARALLEL AEA PROGRAM BY ASTRONAUT PROCEDURE. THIS ROUTINE MAY BE CALLED AT ANY TIME THAT ANOTHER EXTENDED VERB IS NOT IN PROCESS.

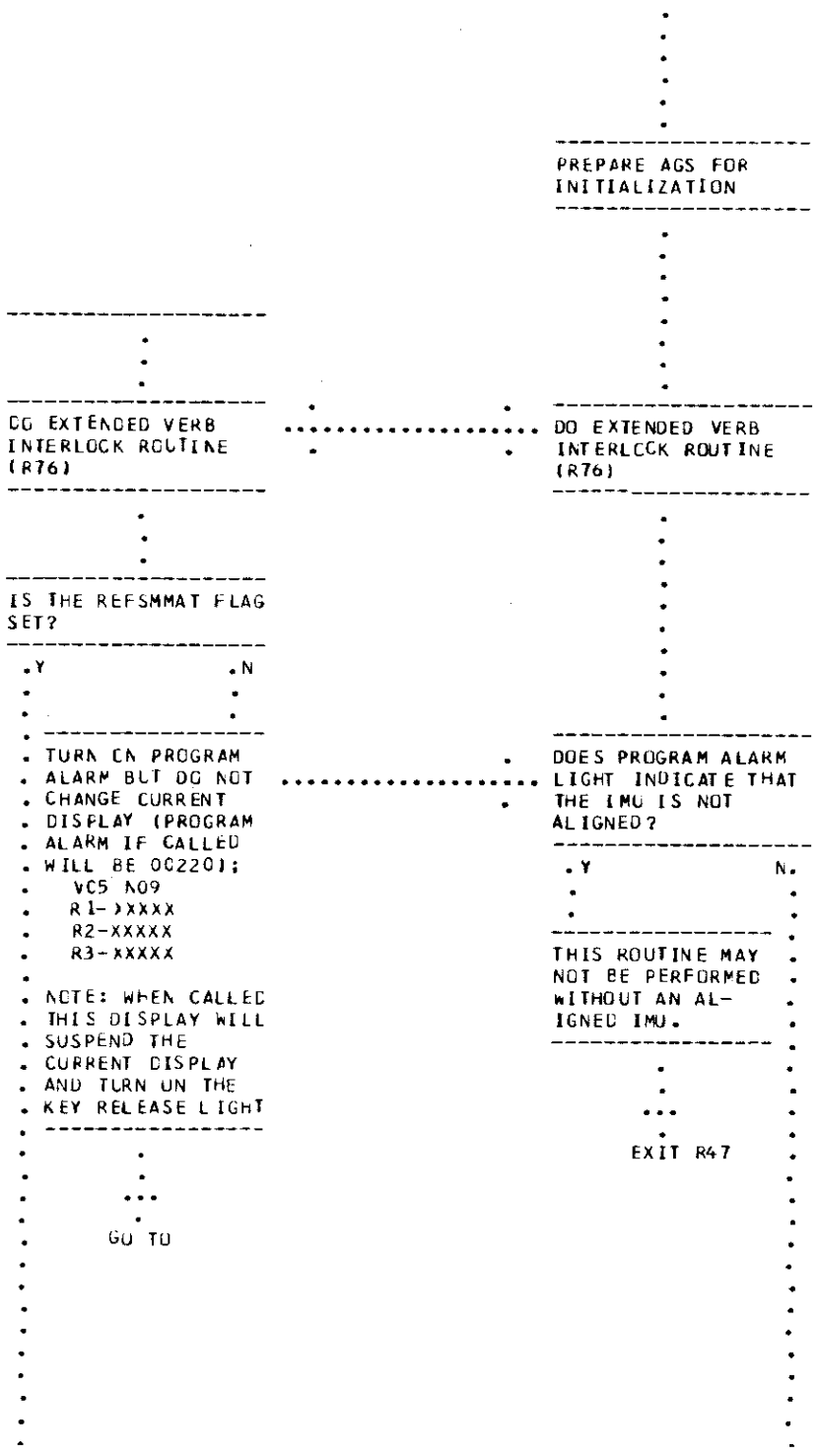
++
+03
+EDIT
++

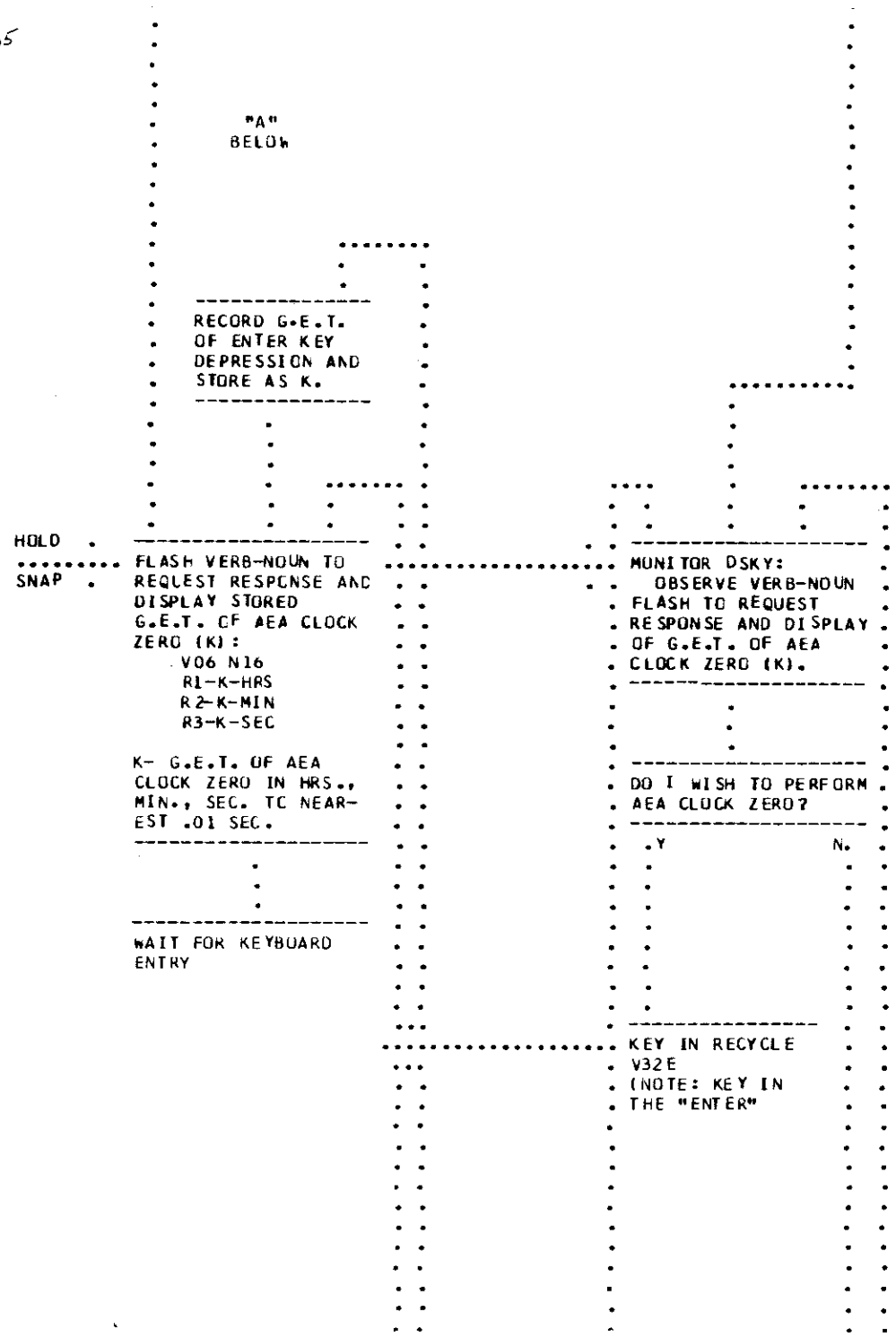
(4) ZEROING OF THE ICDU, LGC, AND AEA GIMBAL ANGLE COUNTERS OCCURS WHEN THE IMUSE FLAG IS NOT SET AND THE IMU IS NOT BEING USED.

(5) THE DAP IS TURNED OFF DURING CDU ZERO.



#10


PREPARE AGS FOR INITIALIZATION
#20
DO EXTENDED VERB INTERLOCK ROUTINE (R76)
DO EXTENDED VERB INTERLOCK ROUTINE (R76)
#30
IS THE REFSMMAT FLAG SET?
.Y
.N
#40
TURN ON PROGRAM ALARM BUT DO NOT CHANGE CURRENT DISPLAY (PROGRAM ALARM IF CALLED WILL BE 00220);
VC5 N09
R1-XXXXX
R2-XXXXX
R3-XXXXX
NOTE: WHEN CALLED THIS DISPLAY WILL SUSPEND THE CURRENT DISPLAY AND TURN ON THE KEY RELEASE LIGHT
GO TO
DOES PROGRAM ALARM LIGHT INDICATE THAT THE IMU IS NOT ALIGNED?
.Y
N.
#50
THIS ROUTINE MAY NOT BE PERFORMED WITHOUT AN ALIGNED IMU.
EXIT R47
#60



#70

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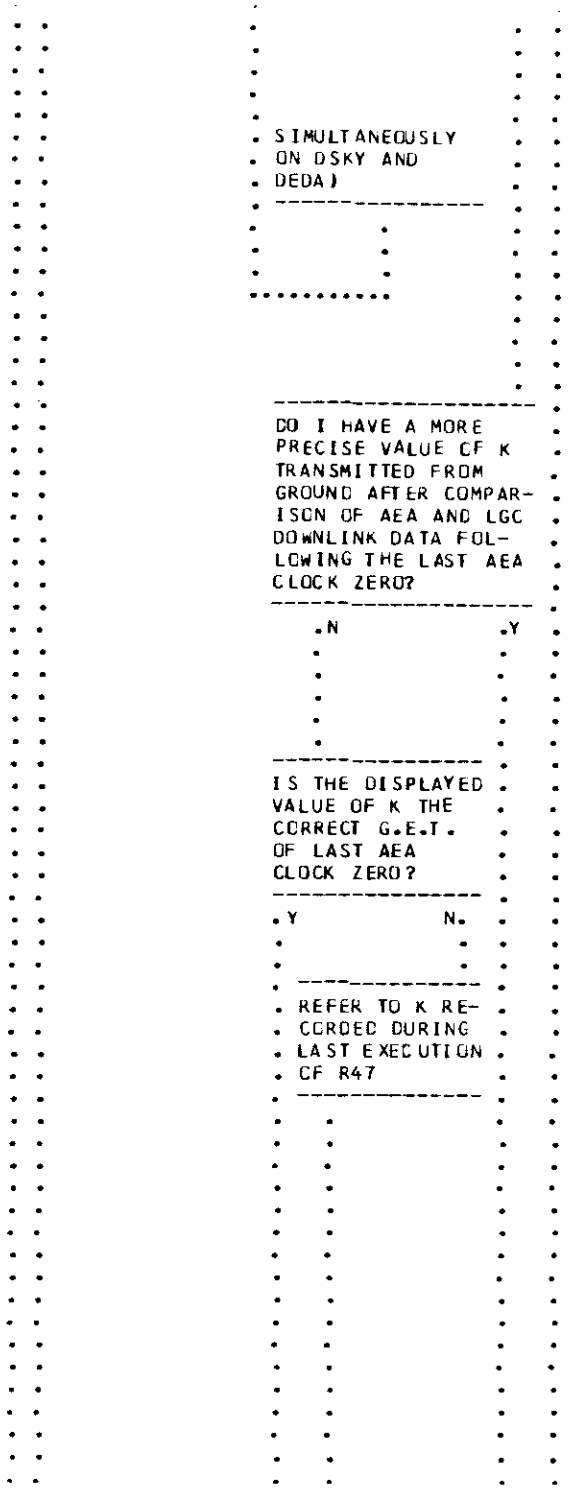
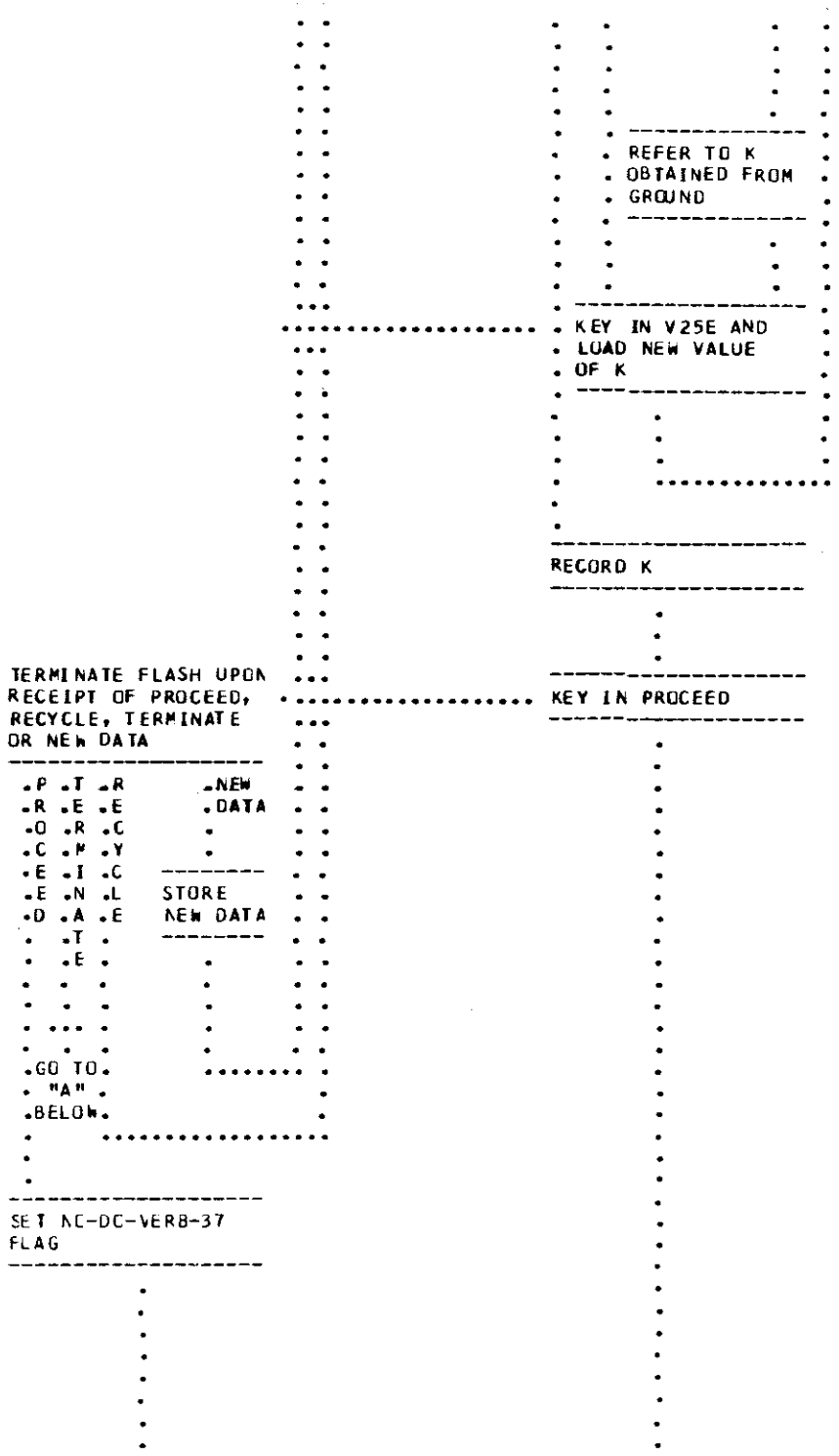

SIMULTANEOUSLY ON DSKY AND DEDA)
#120
DO I HAVE A MORE PRECISE VALUE OF K TRANSMITTED FROM GROUND AFTER COMPARISON OF AEA AND LGC DOWNLINK DATA FOLLOWING THE LAST AEA CLOCK ZERO?
#130
N
Y
#140
IS THE DISPLAYED VALUE OF K THE CORRECT G.E.T. OF LAST AEA CLOCK ZERO?
#150
Y
N.
REFER TO K RECORDED DURING LAST EXECUTION OF R47
#160



#170

#180

#190

#200

#210

MAINTAIN STATIC DISPLAY OF K IN R1, R2, AND R3.
(NOTE: V50N16 WILL FLASH UPON COMPLETION OF TRANSMISSION OF DOWN LINK LIST 10 TIMES.)

#220

#230

EXTRAPOLATE CSM AND LM STATE VECTORS TO PRESENT TIME USING PRECISION INTEGRATION
(NOTE: EARTH/LUNAR SCALING IS DONE AUTOMATICALLY IN THE INTEGRATION SUBROUTINE.)

#240

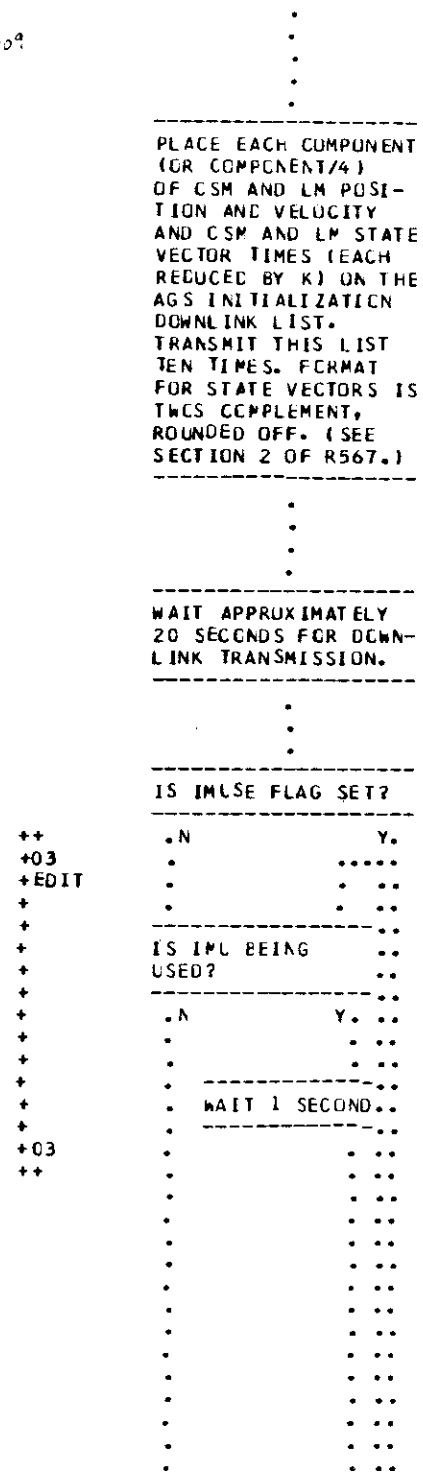
#250

TRANSFORM CSM AND LM STATE VECTORS INTO IMU COORDINATES.

#260

SUBTRACT K FROM EACH STATE VECTOR TIME

#270



#280

#290

#300

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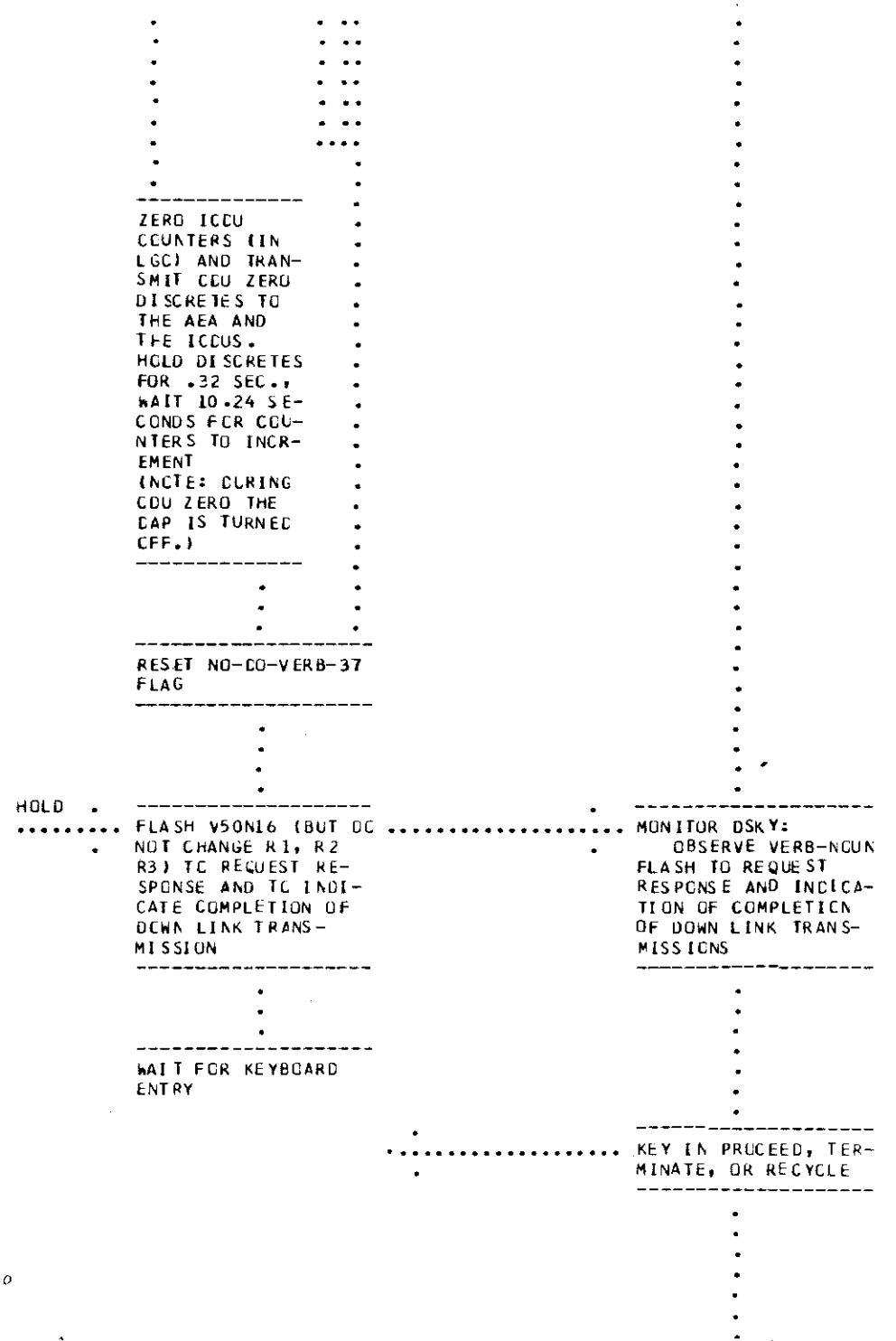
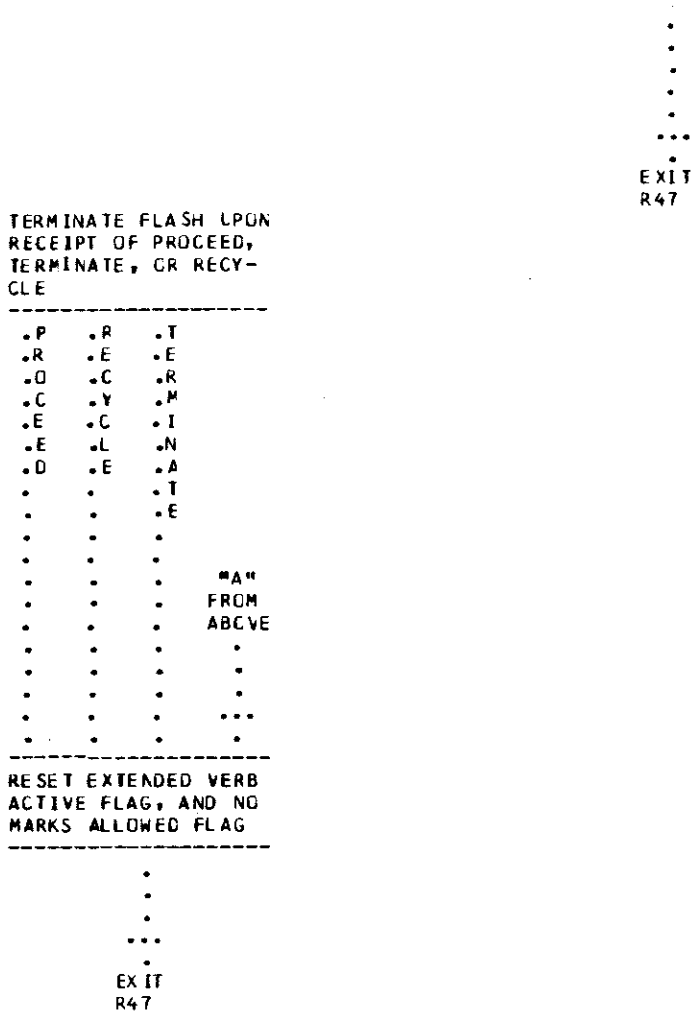
#320


ZERO ICDU COUNTERS (IN LGC) AND TRANSMIT CDU ZERO DISCRETES TO THE AEA AND THE ICDUS. HOLD DISCRETES FOR .32 SEC., WAIT 10.24 SECONDS FOR COUNTERS TO INCREMENT (NOTE: DURING CDU ZERO THE DAP IS TURNED OFF.)
#330
RESET NO-CO-VERB-37 FLAG
#340
HOLD
FLASH V50N16 (BUT DO NOT CHANGE R1, R2 R3) TO REQUEST RESPONSE AND TO INDICATE COMPLETION OF DOWN LINK TRANSMISSION
#350
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND INDICATION OF COMPLETION OF DOWN LINK TRANSMISSIONS
#360
WAIT FOR KEYBOARD ENTRY
#370
KEY IN PROCEED, TERMINATE, OR RECYCLE



CHANGE CONTROL NOTES

LOGIC REV 01 PCR 184,408
REV 02 EDITORIAL
REV 03 EDITORIAL

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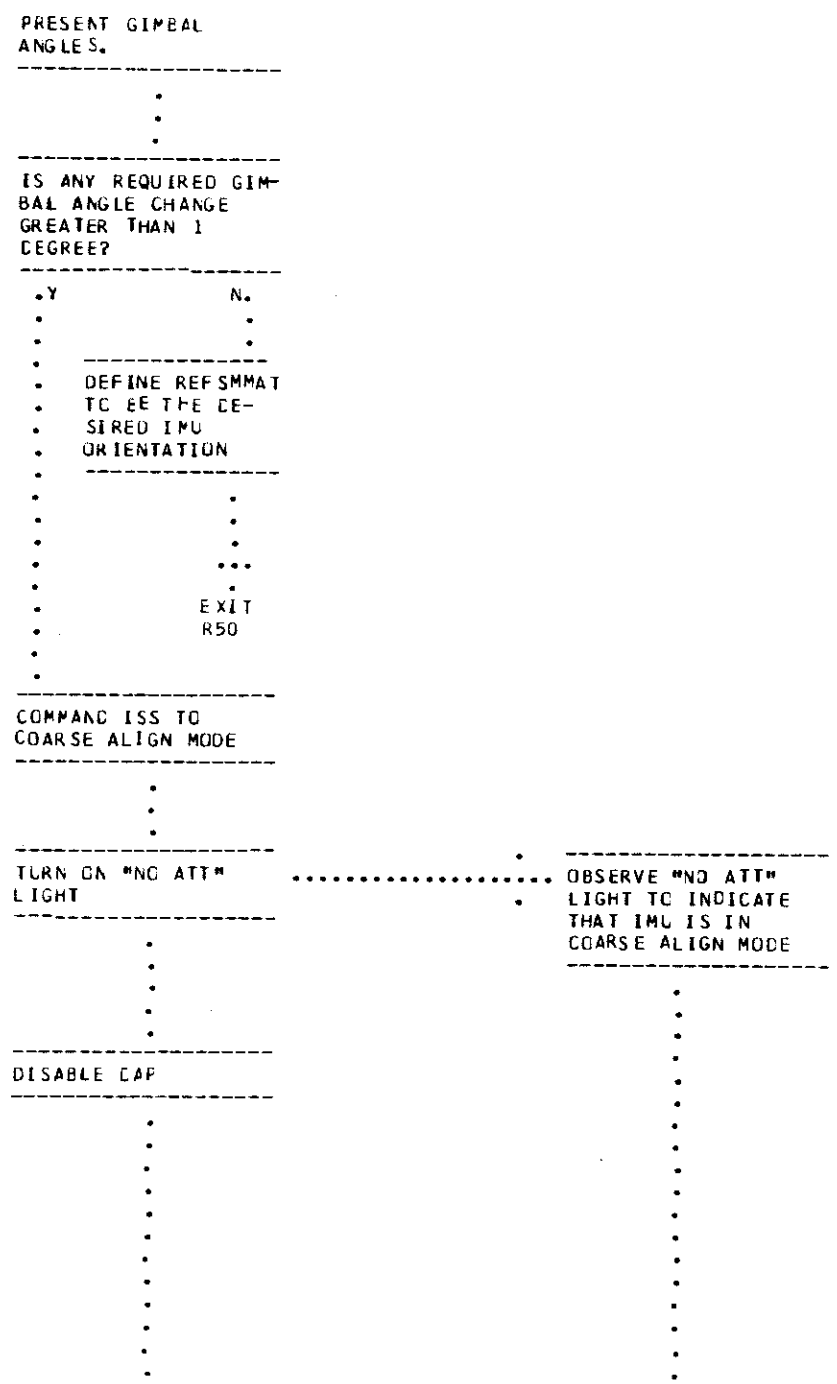
913

COARSE ALIGN ROUTINE (R50) REV 01 08/09/69

PURPOSE: (1) TO COARSE ALIGN THE IMU TO A DESIRED INERTIAL ORIENTATION.

ASSUMPTIONS: (1) THE DESIRED IMU INERTIAL ORIENTATION HAS BEEN SPECIFIED BY THE CALLING PROGRAM.

(2) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52).


PRESENT GIMBAL ANGLES.
IS ANY REQUIRED GIMBAL ANGLE CHANGE GREATER THAN 1 DEGREE?
Y
N
DEFINE REFSMMAT TO BE THE DESIRED IMU ORIENTATION
EXIT R50
COMMAND ISS TO COARSE ALIGN MODE
TURN ON "NO ATT" LIGHT
OBSERVE "NO ATT" LIGHT TO INDICATE THAT IMU IS IN COARSE ALIGN MODE
DISABLE CAP

#40

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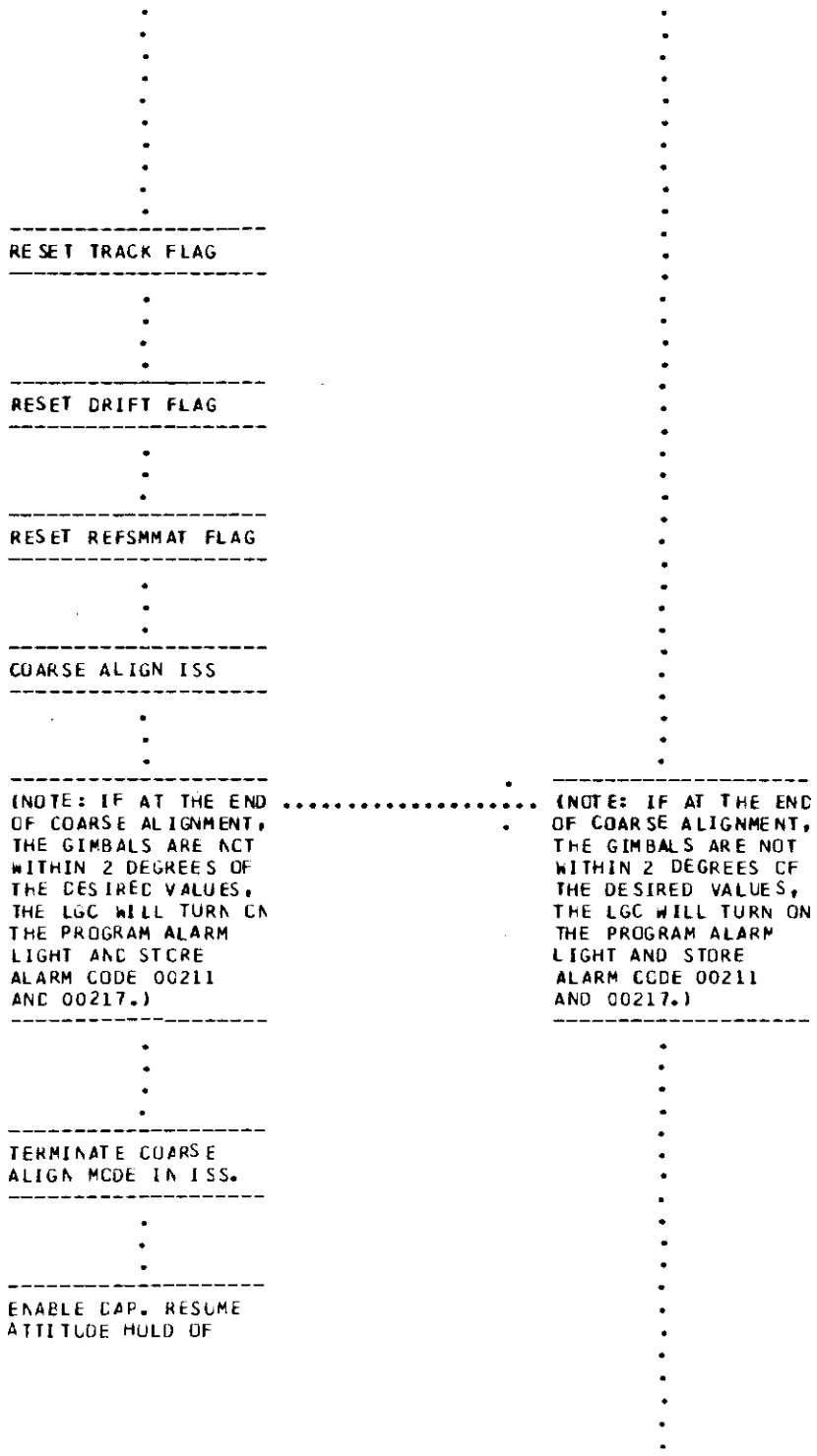

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#120

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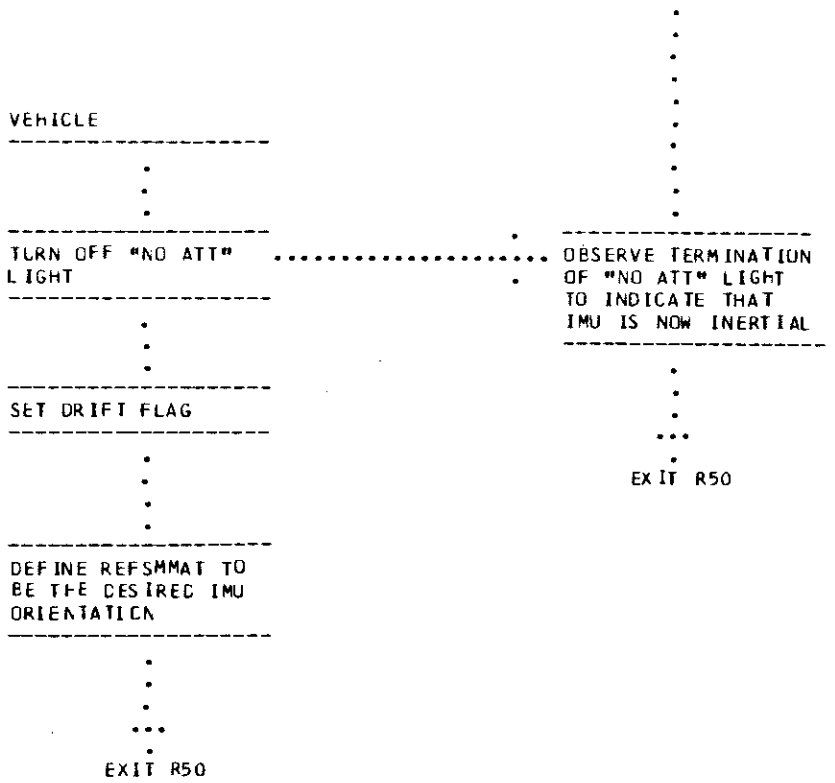


#150

#160

#170

CHANGE CONTROL NOTES

LOGIC REV 01 NO PCR'S

916

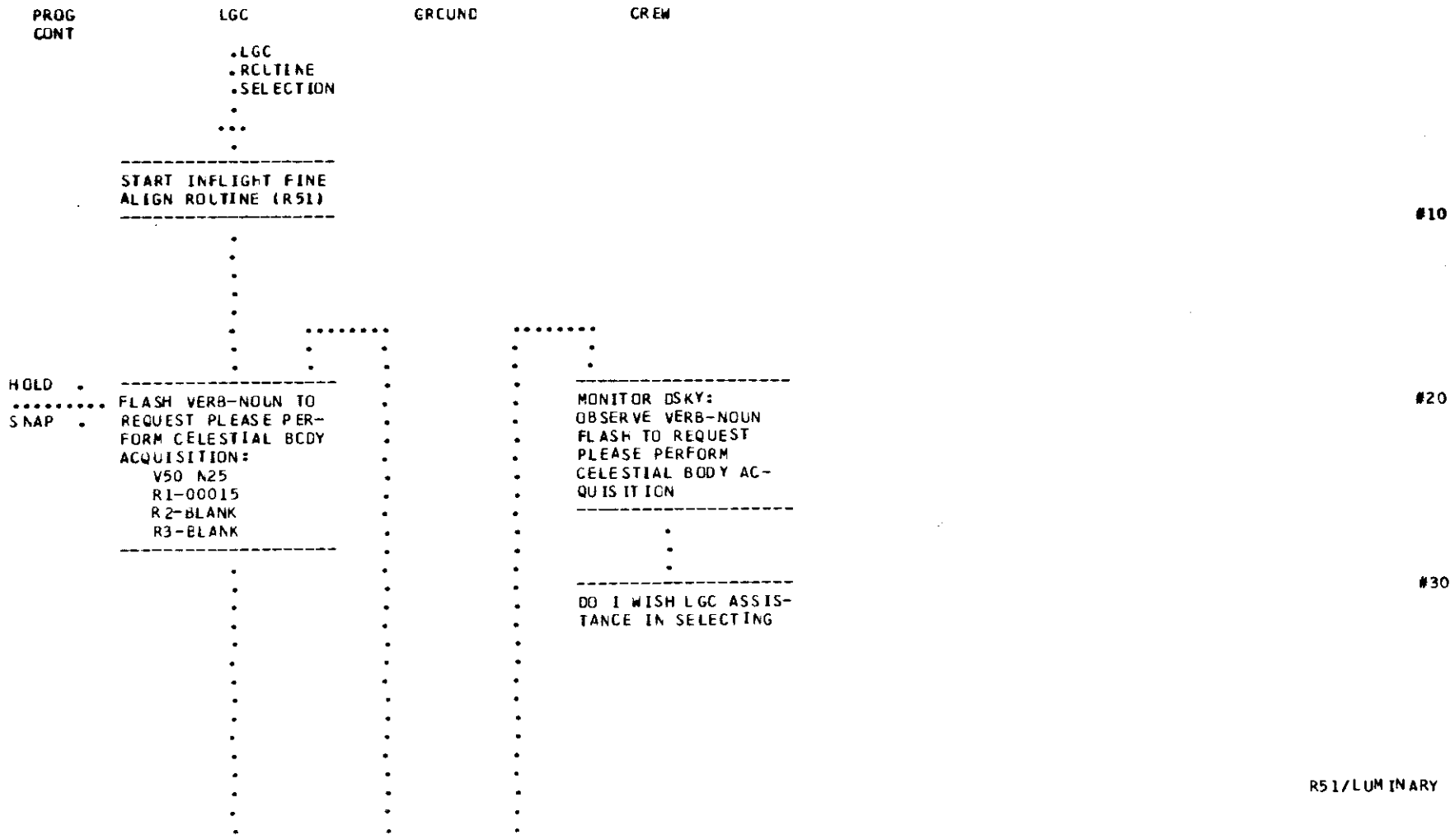
91'1

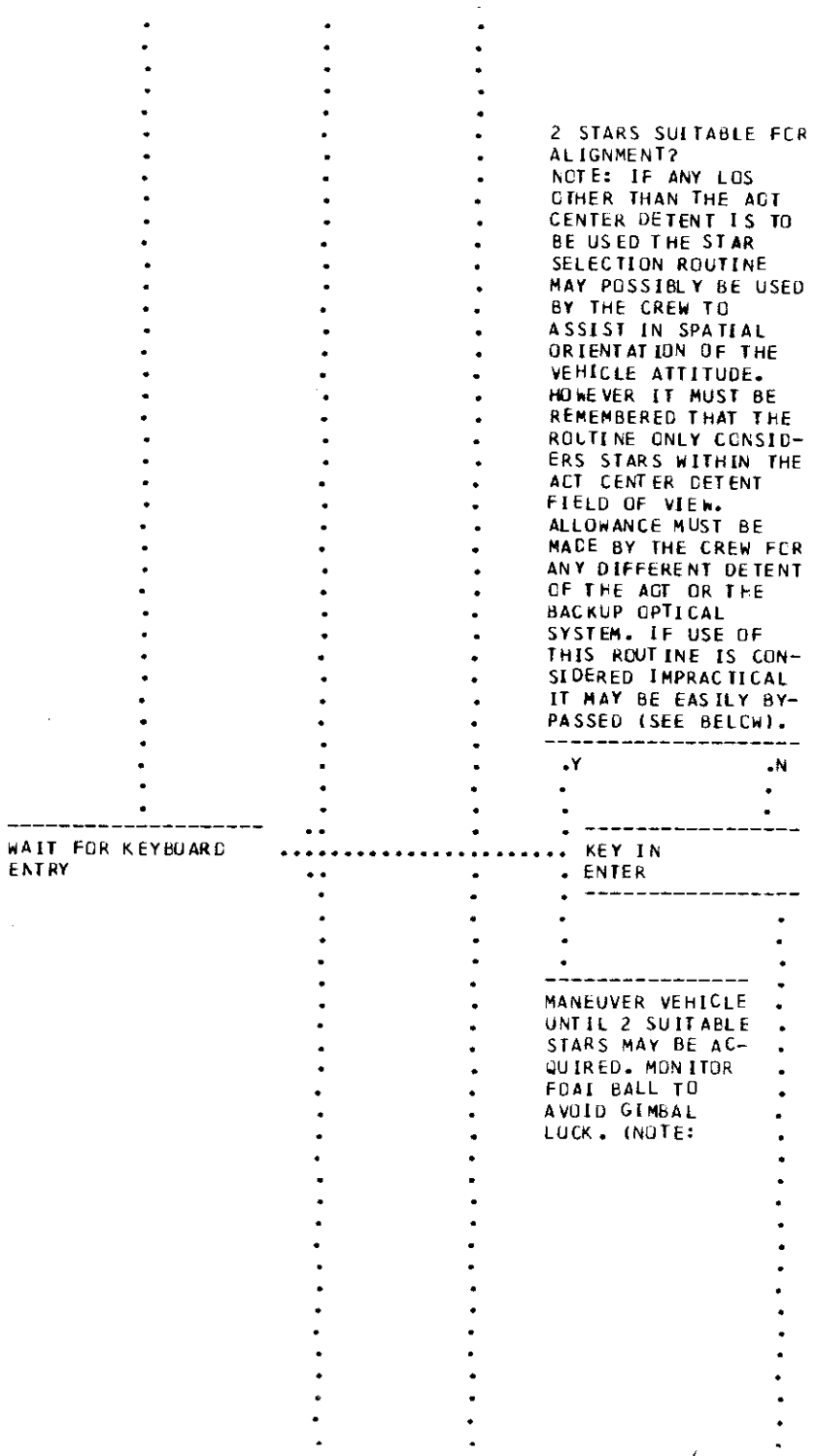
INFLIGHT FINE ALIGN ROUTINE (R51) REV 03 12/03/69

PURPOSE: (1) TO OBTAIN THE NECESSARY STAR, PLANET OR SUN SIGHTINGS AND THEN TO FINE ALIGN THE IMU TO A DESIRED INERTIAL ORIENTATION WHILE THE LM IS IN FLIGHT.

ASSUMPTIONS: (1) THE DESIRED IMU INERTIAL ORIENTATION HAS BEEN SPECIFIED BY THE CALLING PROGRAM.

(2) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IML REALIGN PROGRAM (P52), AND THE BRAKING PHASE PROGRAM (P63).




2 STARS SUITABLE FOR ALIGNMENT?
NOTE: IF ANY LOS OTHER THAN THE AOT CENTER DETENT IS TO BE USED THE STAR SELECTION ROUTINE MAY POSSIBLY BE USED BY THE CREW TO ASSIST IN SPATIAL ORIENTATION OF THE VEHICLE ATTITUDE. HOWEVER IT MUST BE REMEMBERED THAT THE ROUTINE ONLY CONSIDERS STARS WITHIN THE ACT CENTER DETENT FIELD OF VIEW. ALLOWANCE MUST BE MADE BY THE CREW FOR ANY DIFFERENT DETENT OF THE AOT OR THE BACKUP OPTICAL SYSTEM. IF USE OF THIS ROUTINE IS CONSIDERED IMPRACTICAL IT MAY BE EASILY BYPASSED (SEE BELOW).
.Y
.N
WAIT FOR KEYBOARD ENTRY
KEY IN ENTER
MANEUVER VEHICLE UNTIL 2 SUITABLE STARS MAY BE ACQUIRED. MONITOR FDAI BALL TO AVOID GIMBAL LOCK. (NOTE:

#40

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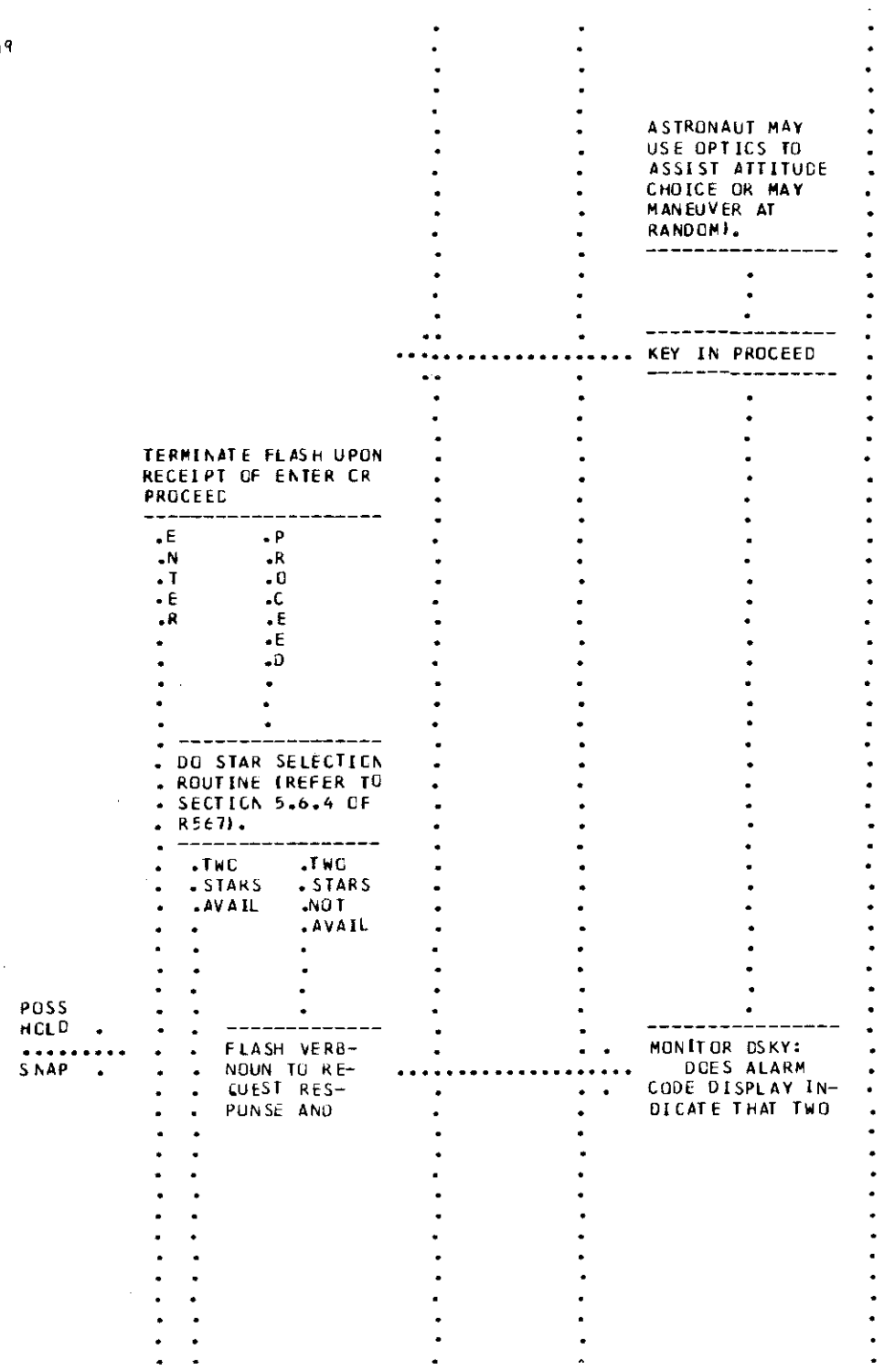

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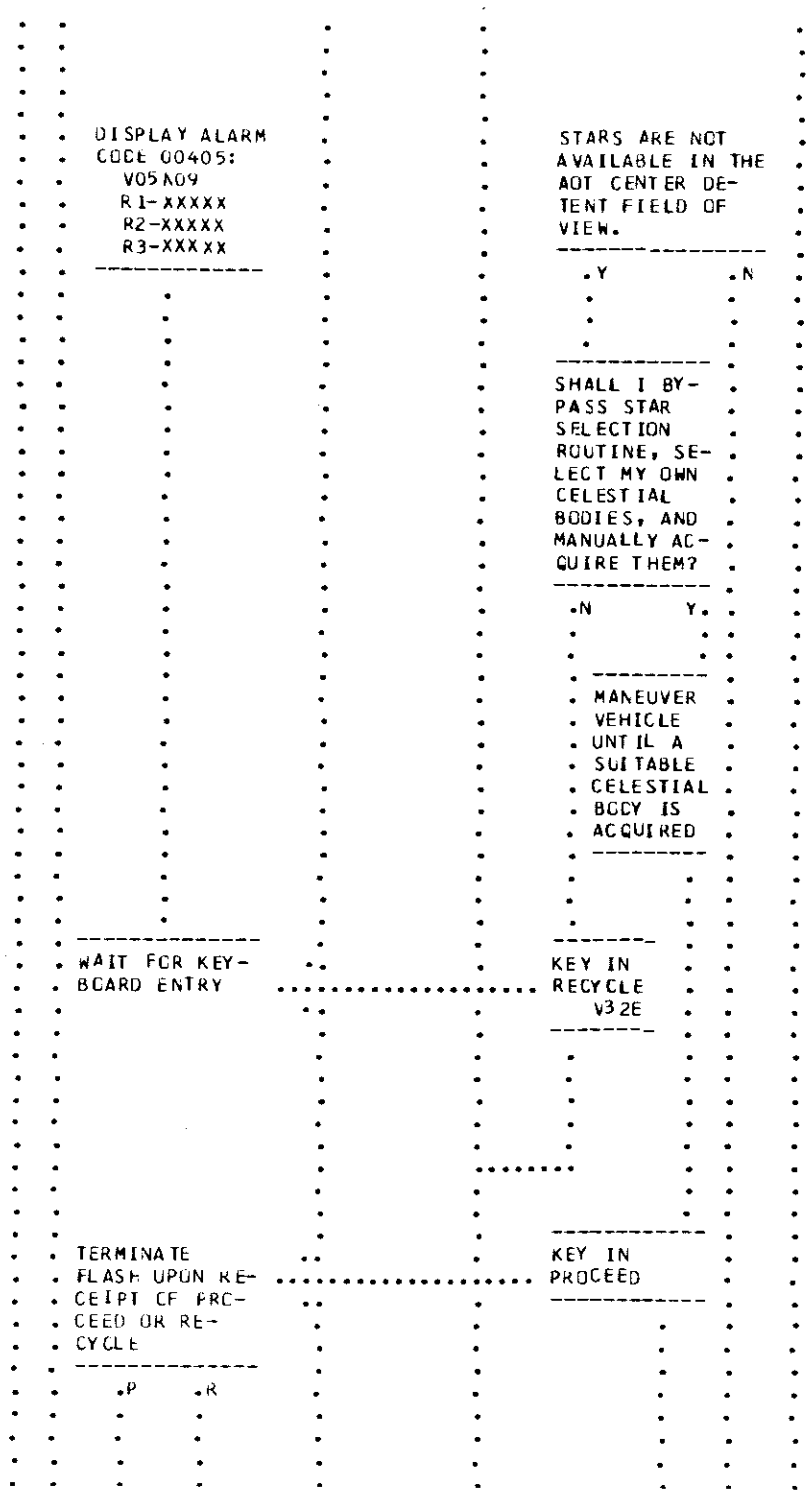

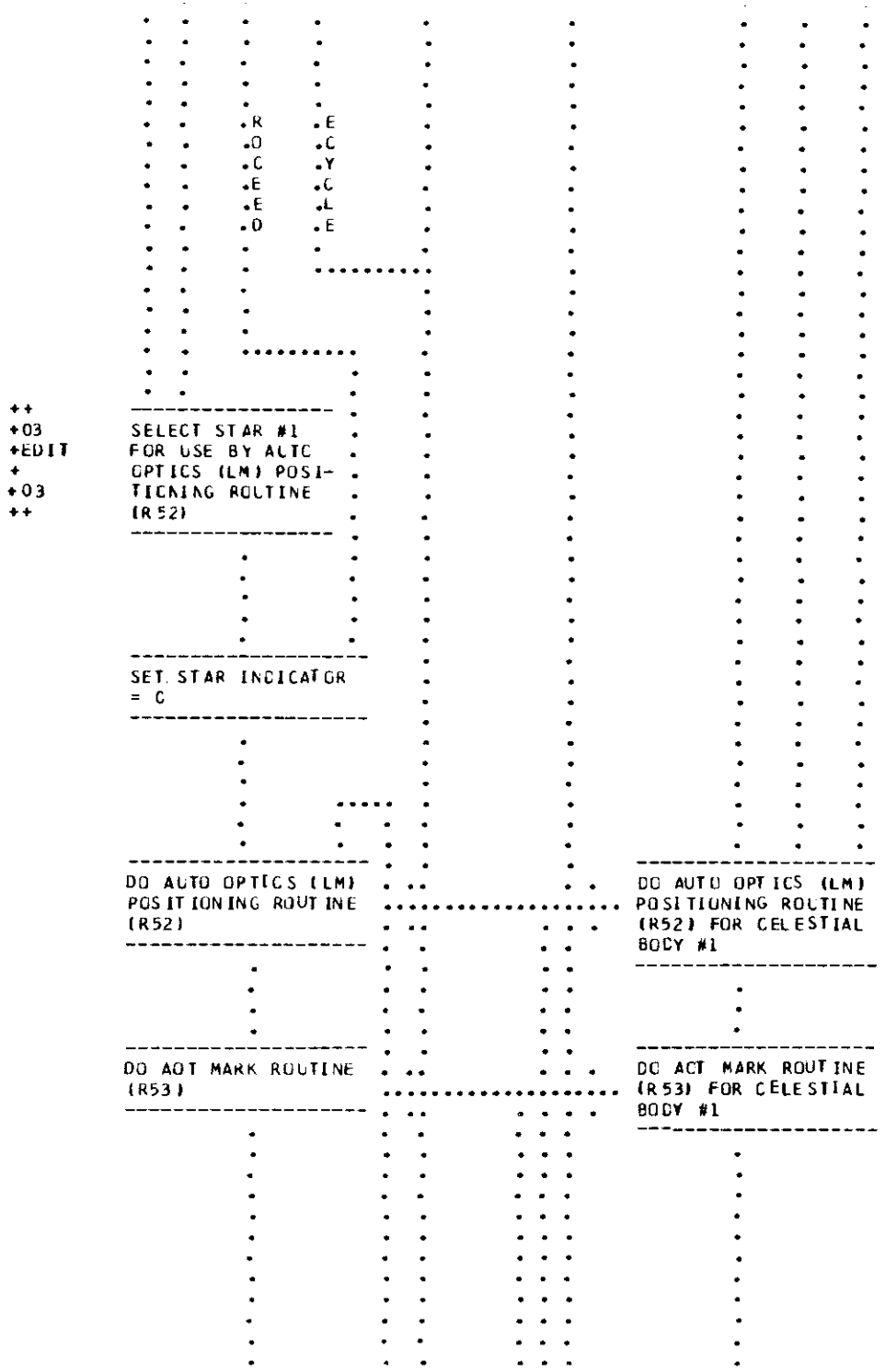

#190

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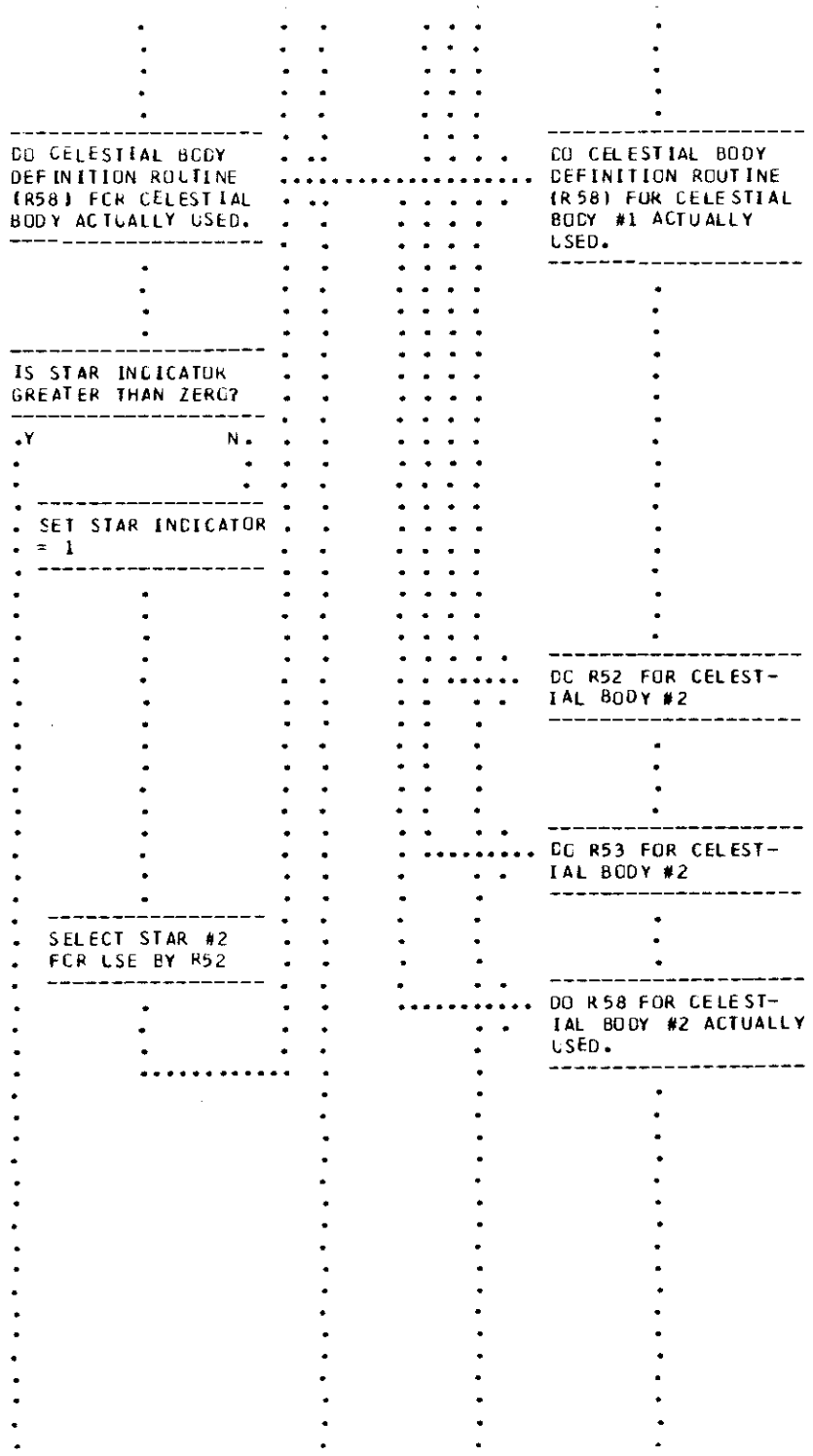
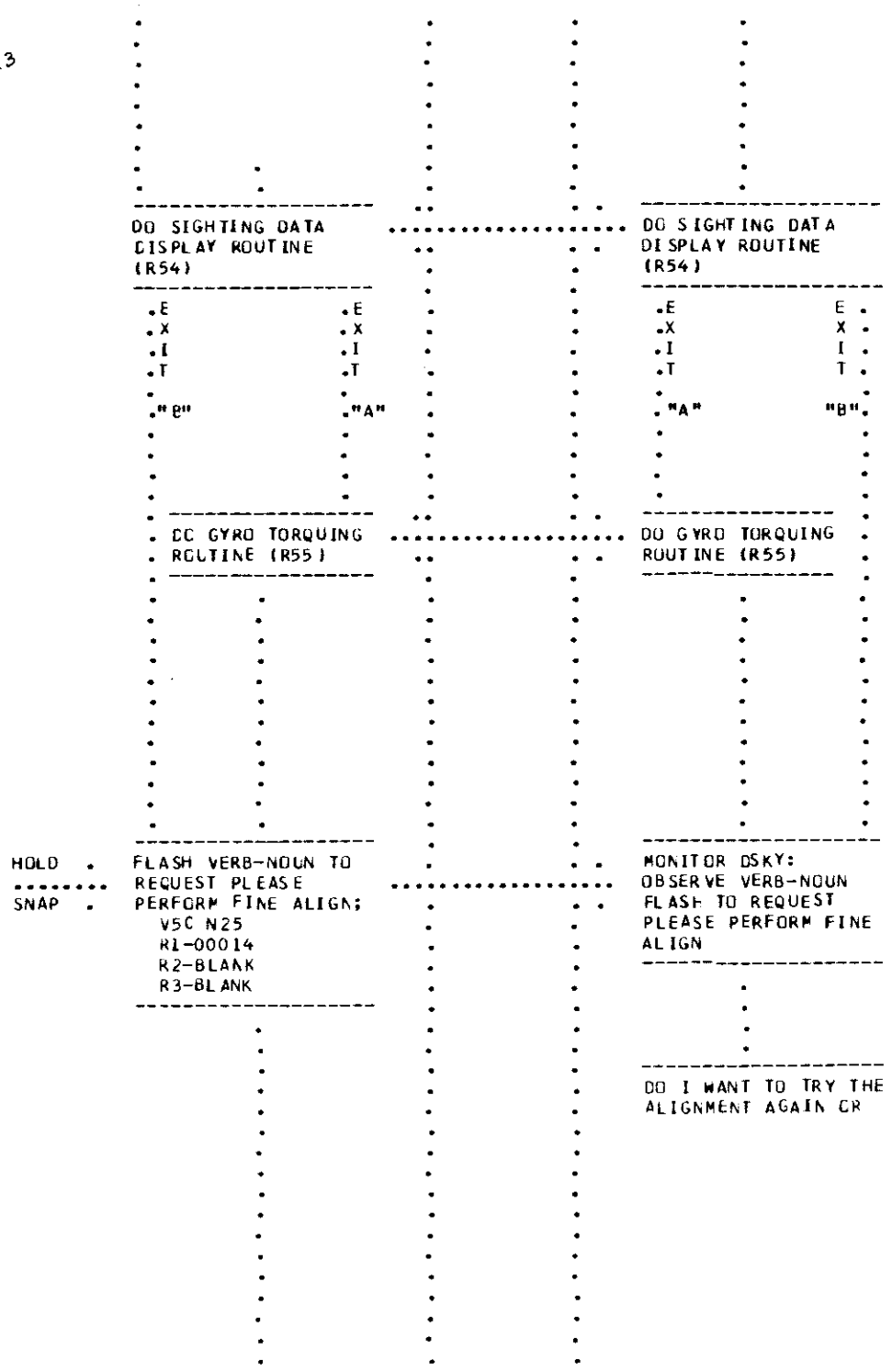

DO CELESTIAL BODY DEFINITION ROUTINE (R58) FOR CELESTIAL BODY ACTUALLY USED.
IS STAR INDICATOR GREATER THAN ZERO?
.Y
N.
SET STAR INDICATOR = 1
SELECT STAR #2 FOR USE BY R52
DO CELESTIAL BODY DEFINITION ROUTINE (R58) FOR CELESTIAL BODY #1 ACTUALLY USED.
#250
#260
++
+03
+EDIT
+03
++
DO R52 FOR CELESTIAL BODY #2
#270
DO R53 FOR CELESTIAL BODY #2
#280
DO R58 FOR CELESTIAL BODY #2 ACTUALLY USED.

922

923



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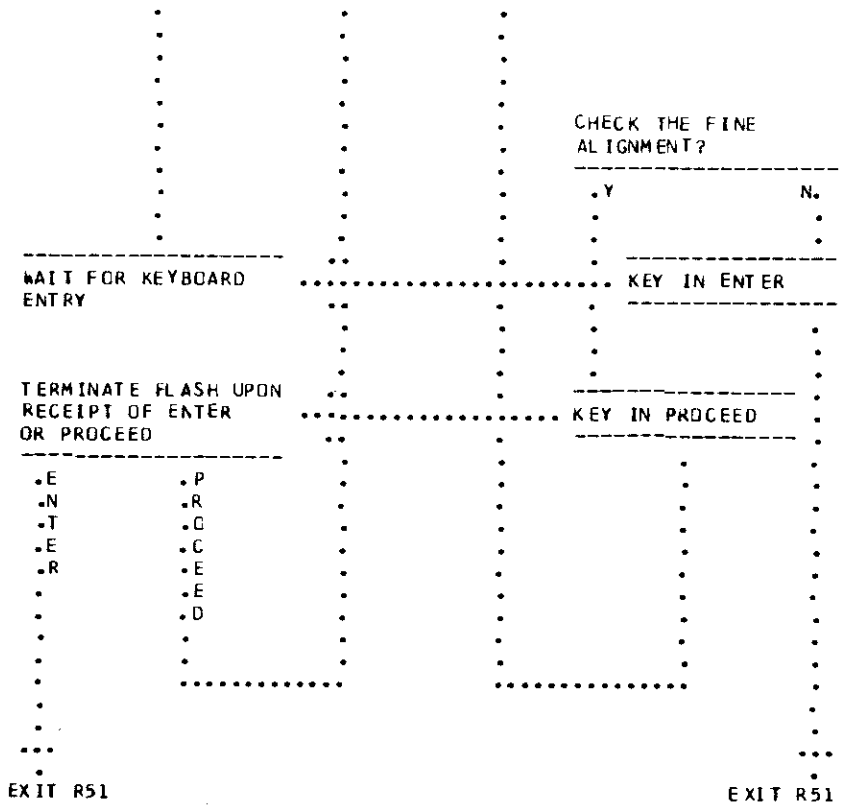


CHANGE CONTROL NOTES

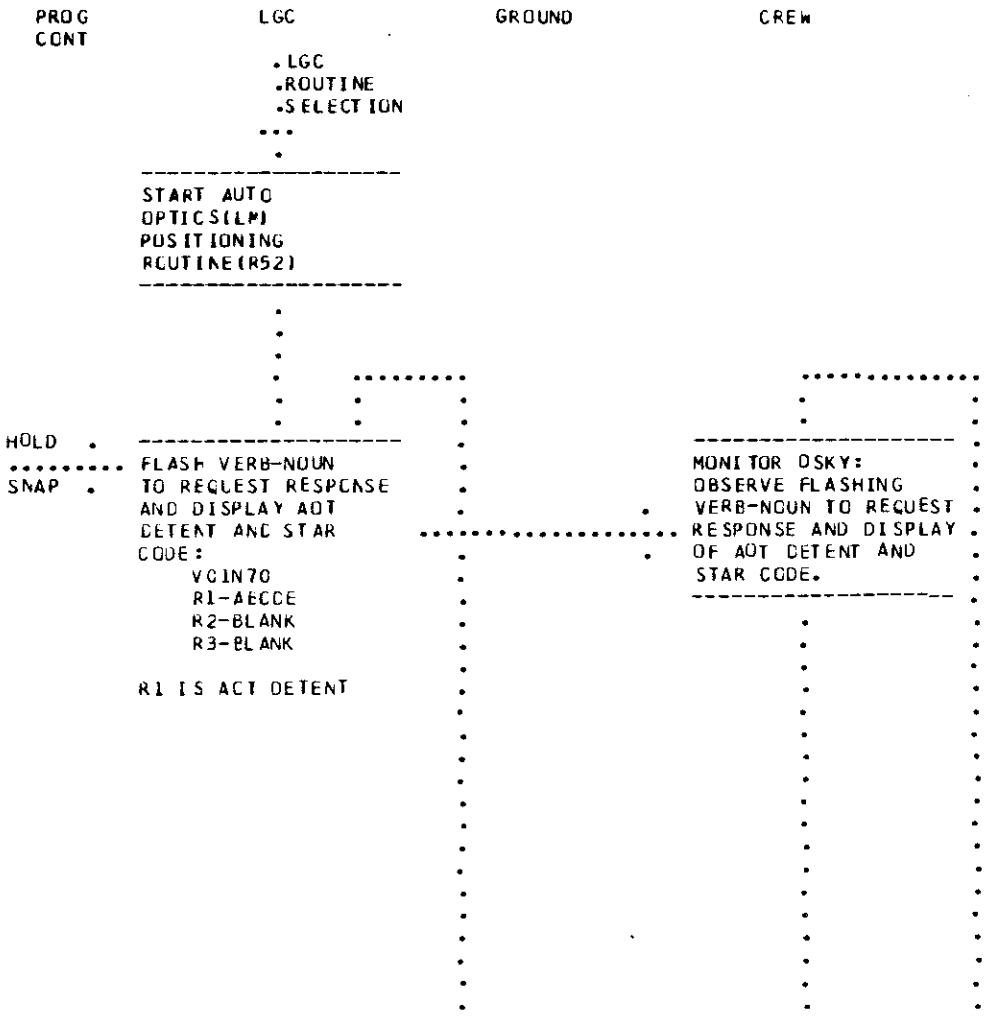
REV 01 PCR 134
REV 02 EDITORIAL
REV 03 EDITORIAL

924

AUTOMATIC OPTICS(LM) POSITIONING ROUTINE(R52) REV 03 12/03/69

PURPOSE: (1) TO POINT THE LOS OF ANY AOT DETENT OR THE LOS OF A BACKUP OPTICAL SYSTEM AT A SPECIFIED CELESTIAL BODY BY MANEUVERING THE LM.

ASSUMPTION: (1) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE INFLIGHT FINE ALIGN ROUTINE (R51).



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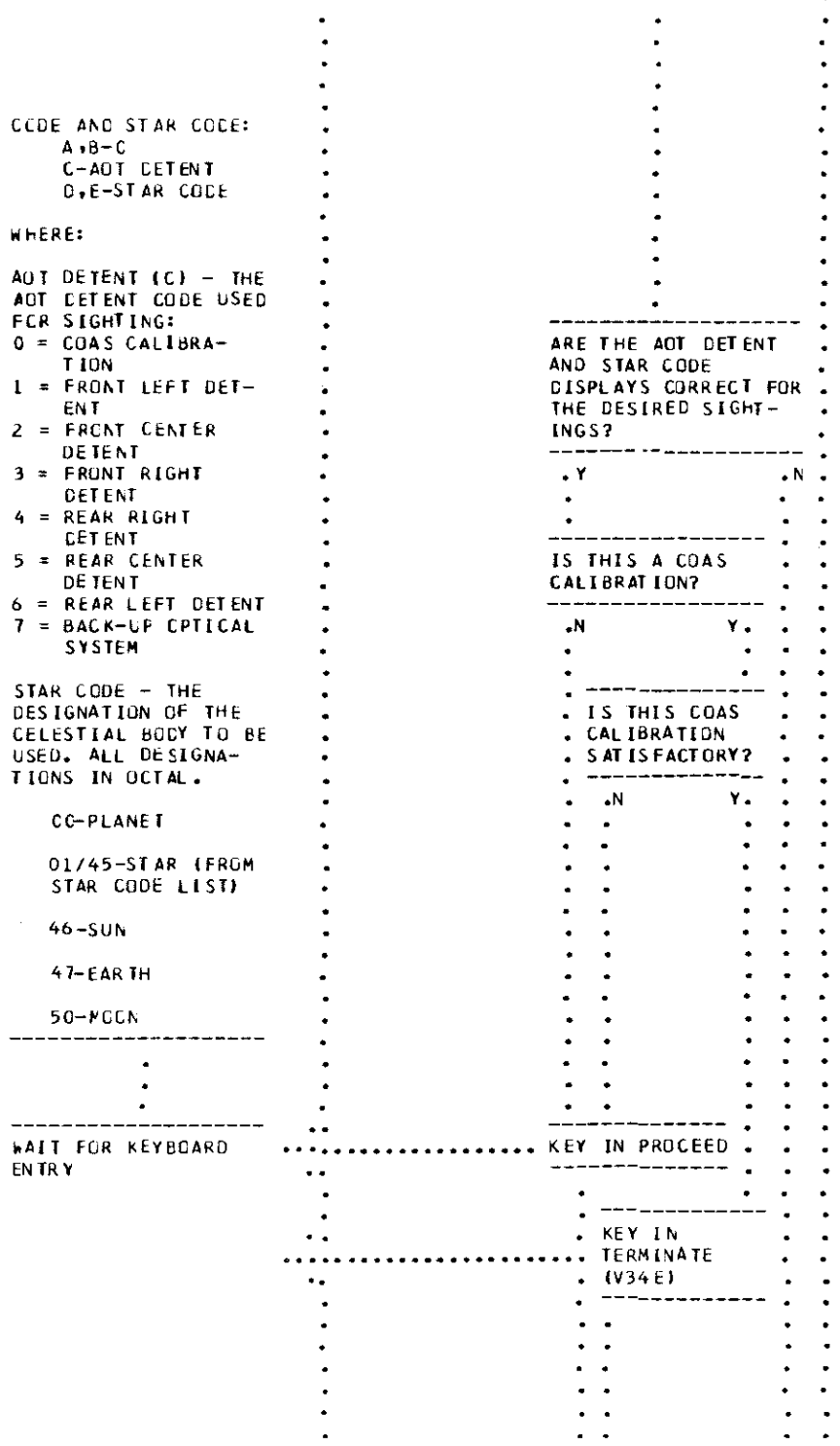
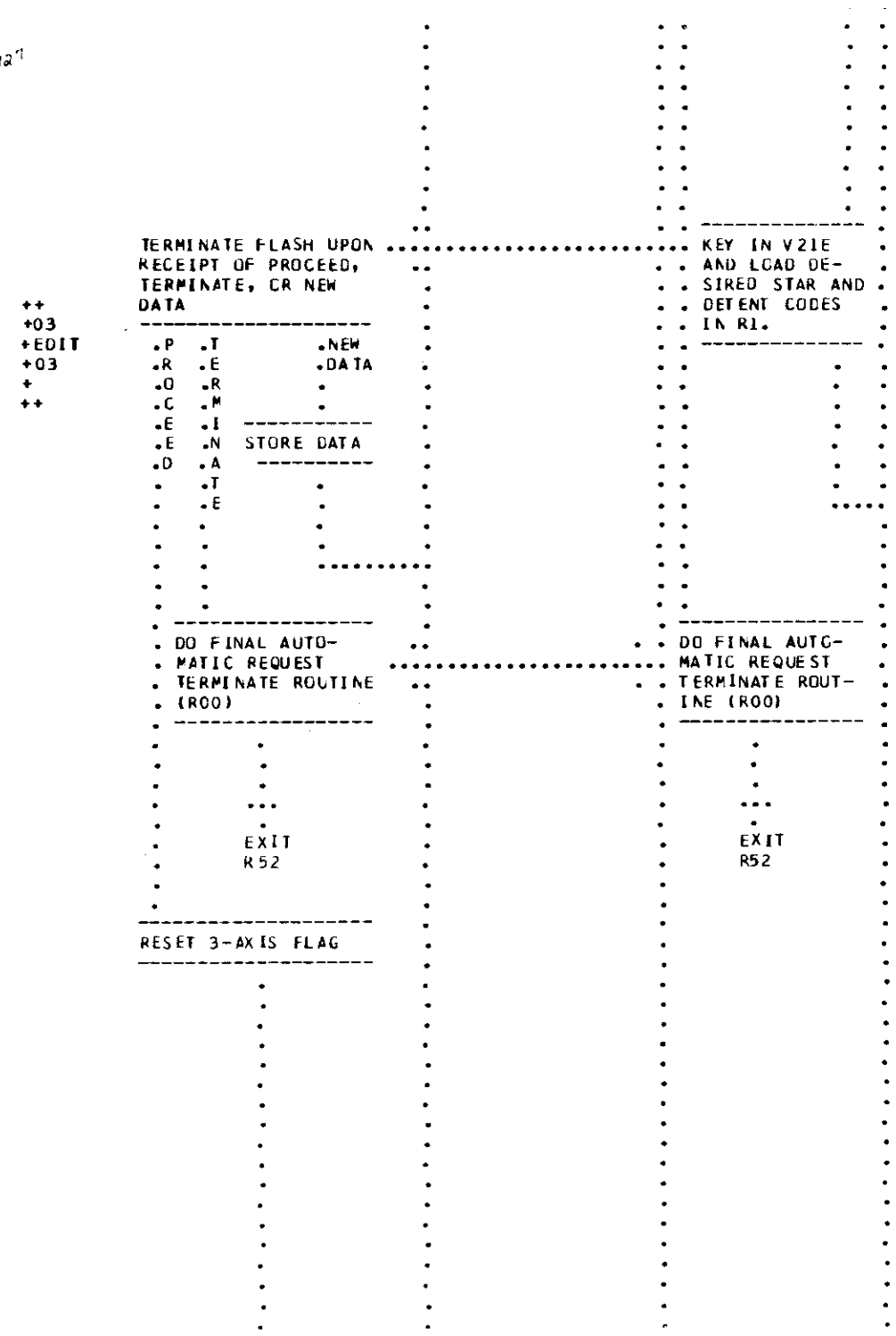


92



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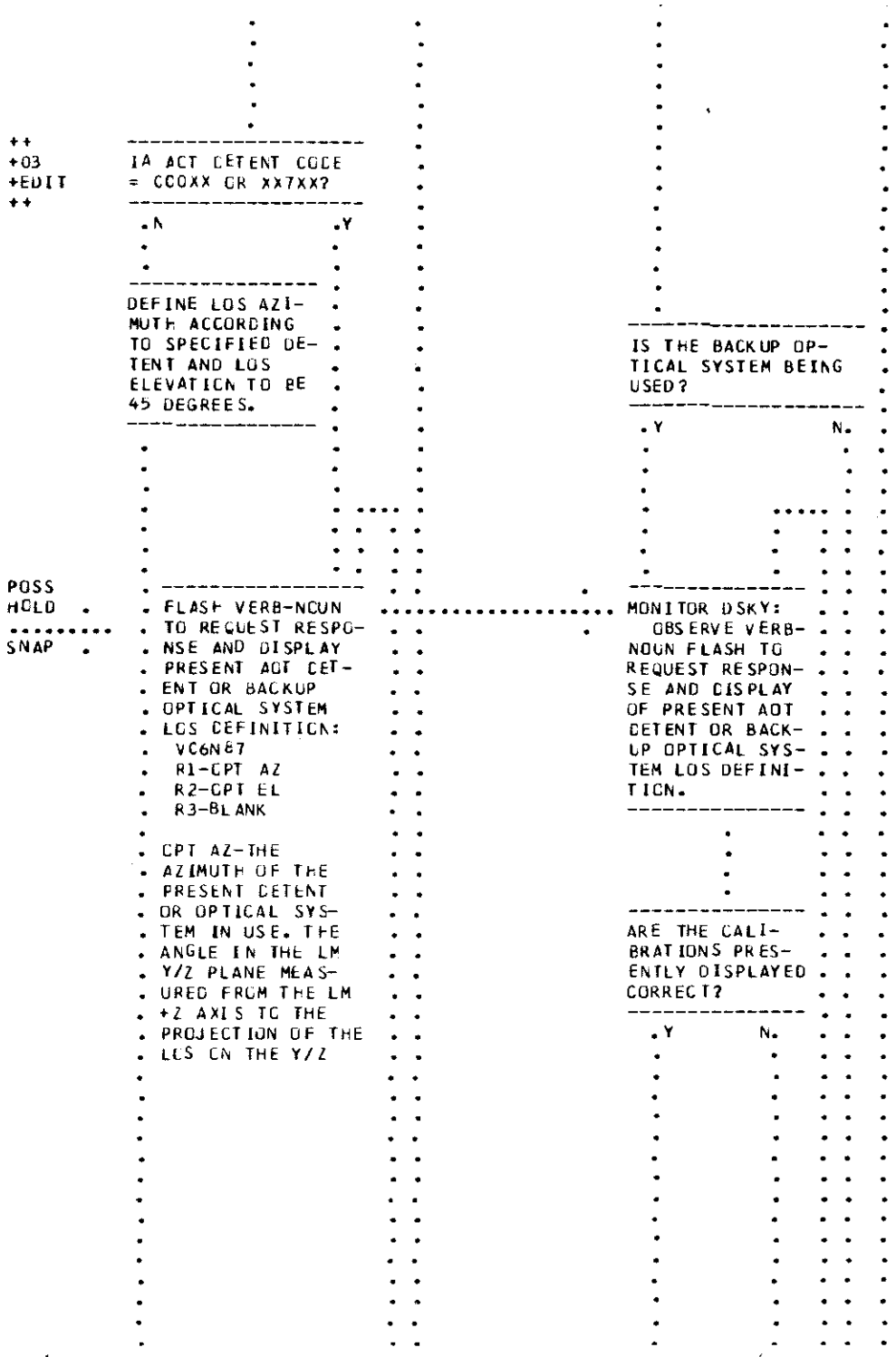
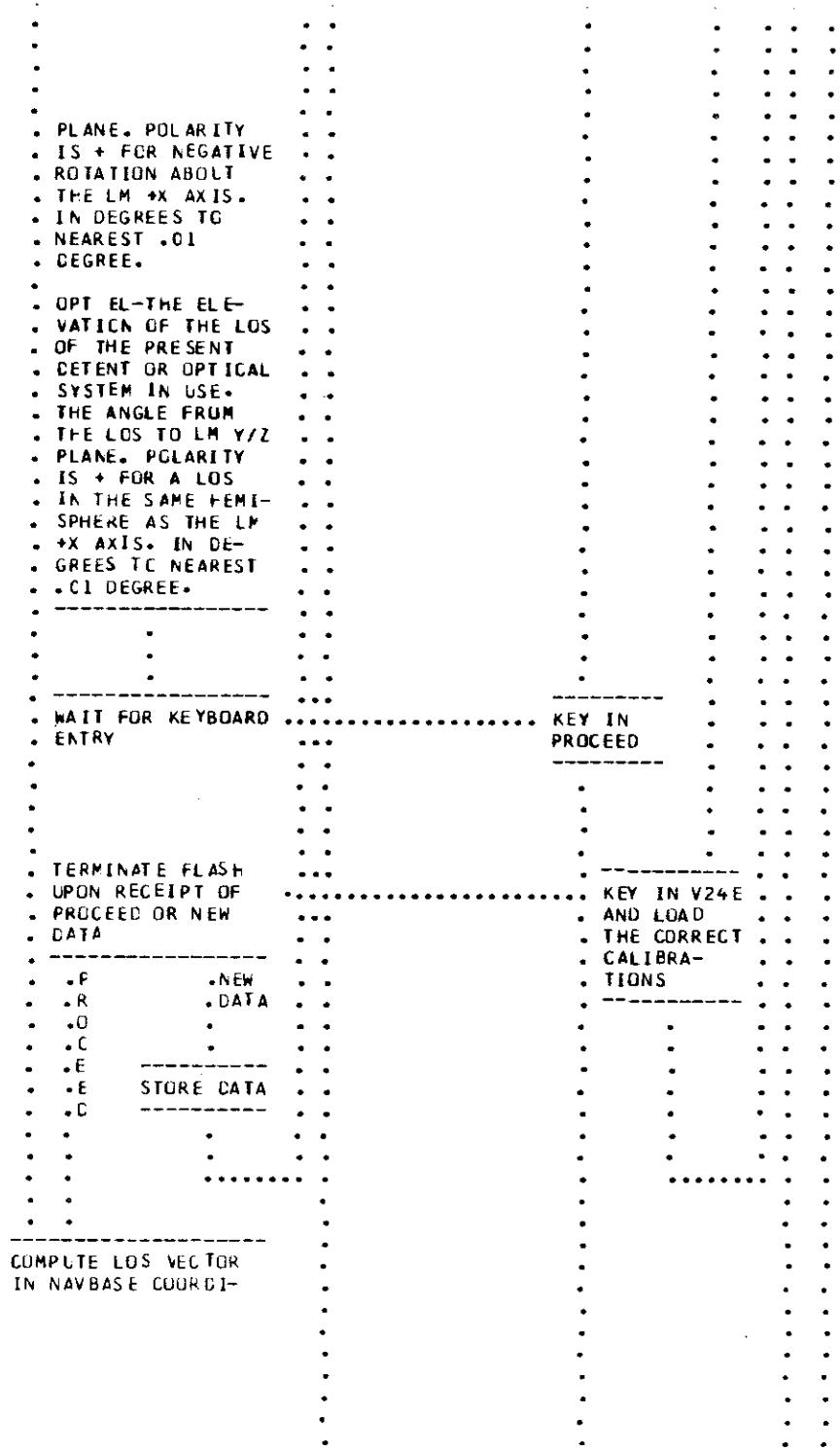

++
+03
+EDIT
++
IA ACT DETENT CODE = CCOXX OR XX7XX?
.N
.Y
DEFINE LOS AZIMUTH ACCORDING TO SPECIFIED DETENT AND LOS ELEVATION TO BE 45 DEGREES.
IS THE BACKUP OPTICAL SYSTEM BEING USED?
.Y
N.
POSS HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY PRESENT AOT DETENT OR BACKUP OPTICAL SYSTEM LOS DEFINITION:
V06N87
R1-CPT AZ
R2-CPT EL
R3-BLANK
CPT AZ-THE AZIMUTH OF THE PRESENT DETENT OR OPTICAL SYSTEM IN USE. THE ANGLE IN THE LM Y/Z PLANE MEASURED FROM THE LM +Z AXIS TO THE PROJECTION OF THE LOS ON THE Y/Z
MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF PRESENT AOT DETENT OR BACKUP OPTICAL SYSTEM LOS DEFINITION.
ARE THE CALIBRATIONS PRESENTLY DISPLAYED CORRECT?
.Y
N.
#140
#150
#160
#170
#180



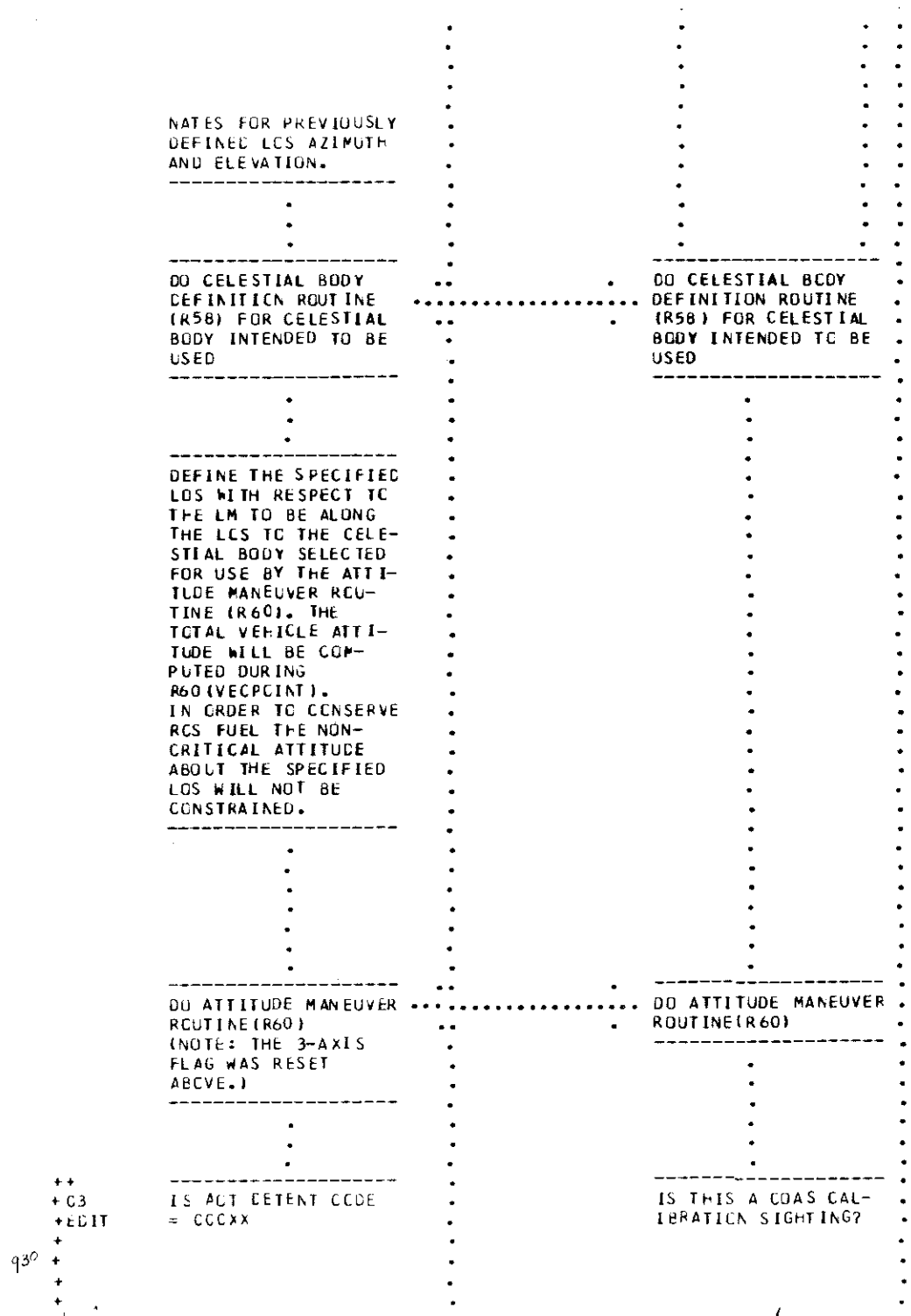
#190

#200

#210

#220

#230



#240

#250

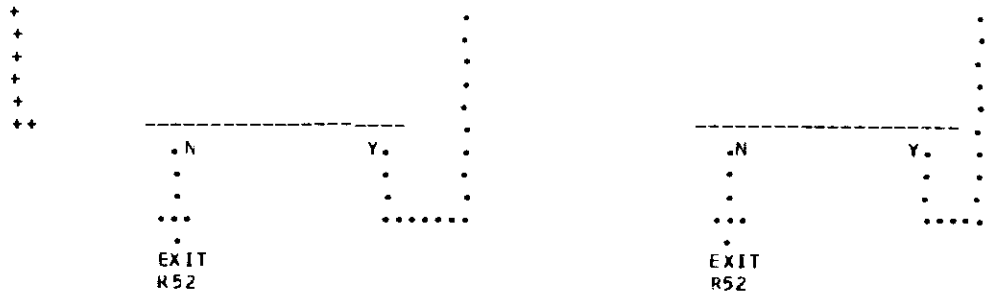
#260

#270

#280

#290

931



#300

CHANGE CONTROL NOTES

REV 01 EDITORIAL
REV 00(LUM 1A) PCR 699,702
REV 02 EDITORIAL
REV 03 EDITORIAL

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933

ACT MARK ROUTINE (R53) REV 02 12/03/69

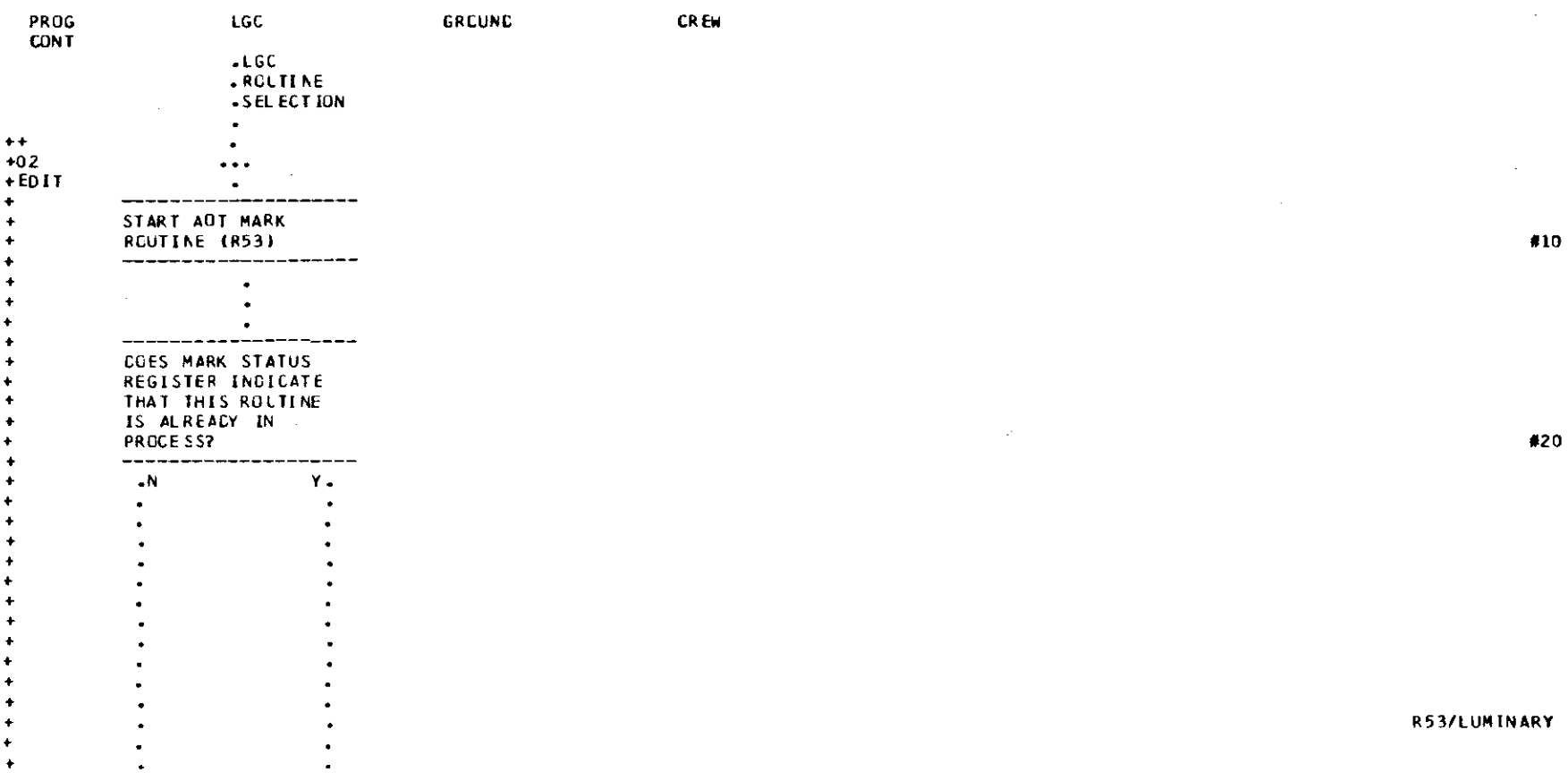
PURPOSE: (1) TO REQUEST AND PROCESS SIGHTING MARKS (USING THE AOT OR THE COAS) ON CELESTIAL BODIES FOR USE BY THE ALIGNMENT PROGRAMS (LUNAR SURFACE AND INFLIGHT).

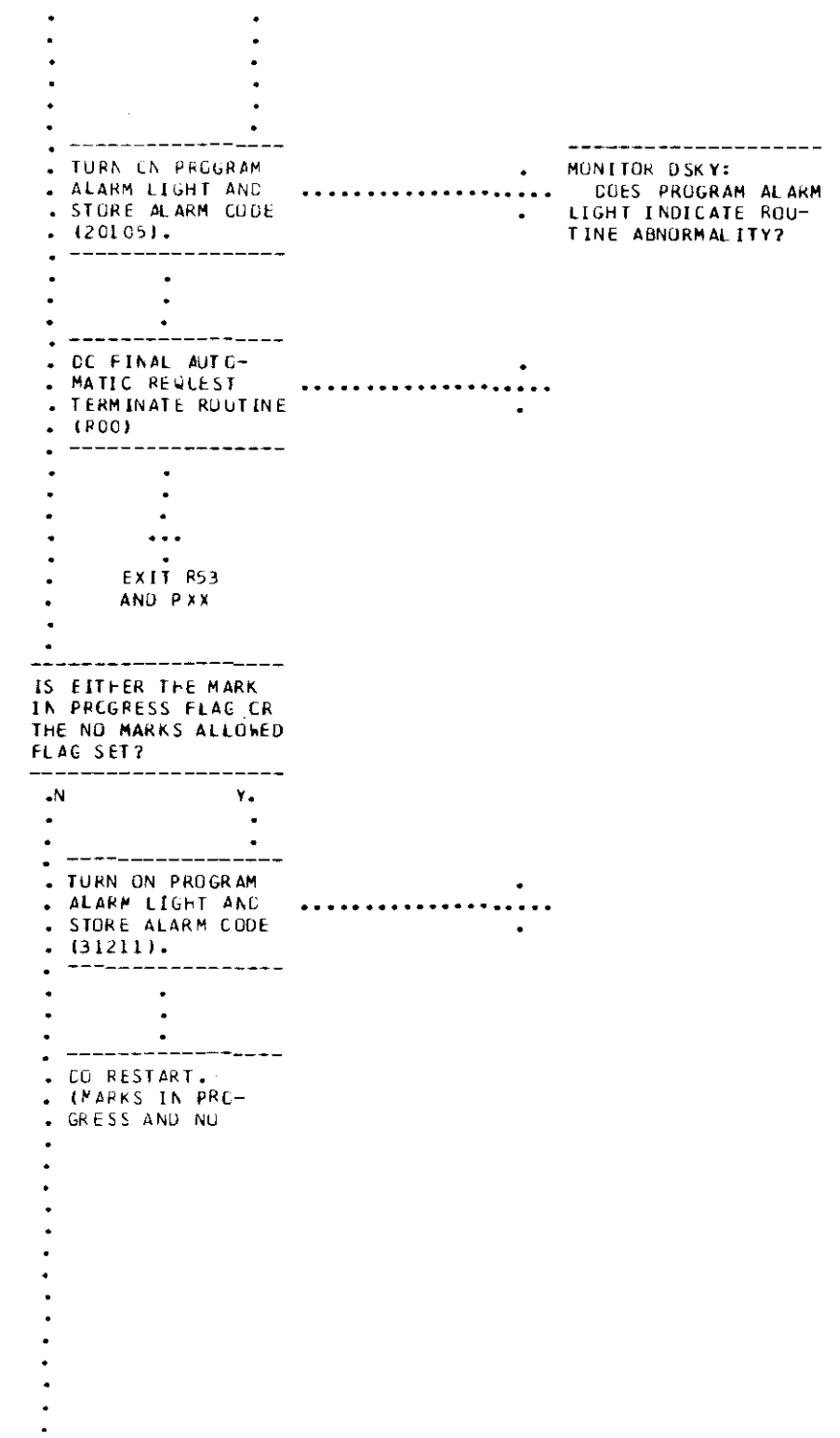
ASSUMPTIONS: (1) MULTIPLE SIGHTINGS (SINGLE FOR LUNAR SURFACE; X,Y PAIRS INFLIGHT) UP TO A MAXIMUM OF FIVE MAY BE USED TO DETERMINE THE AVERAGE LOS VECTOR TO THE CELESTIAL BODY.

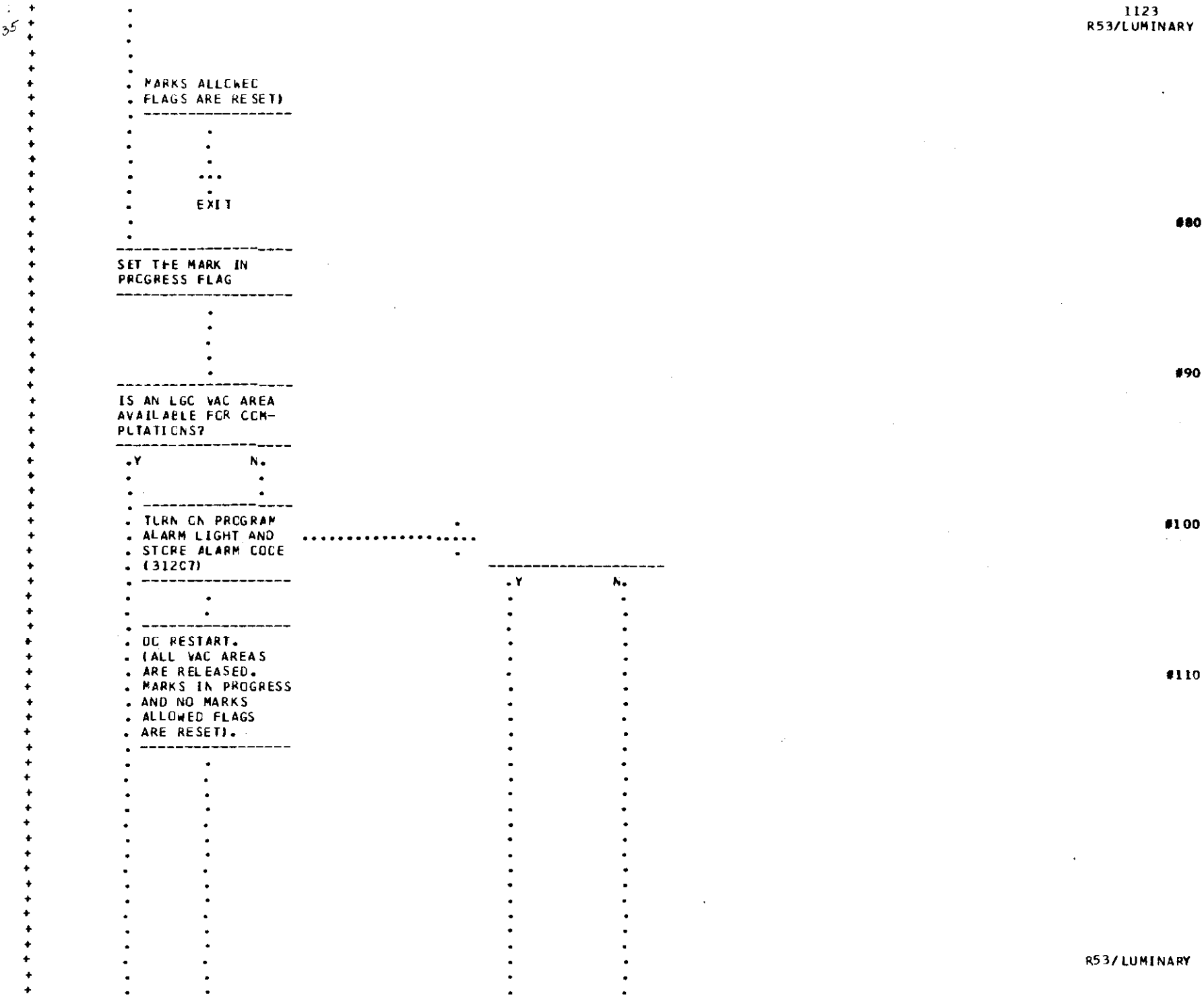
++
+02 (2) A BACKUP OPTICAL SYSTEM (COAS) MAY BE USED FOR SIGHTINGS, HOWEVER IN THIS CASE THE CREW MUST LOAD CALIBRATED
+EDIT LOS AZIMUTH AND ELEVATION DATA ASSOCIATED WITH THIS LOS.
++

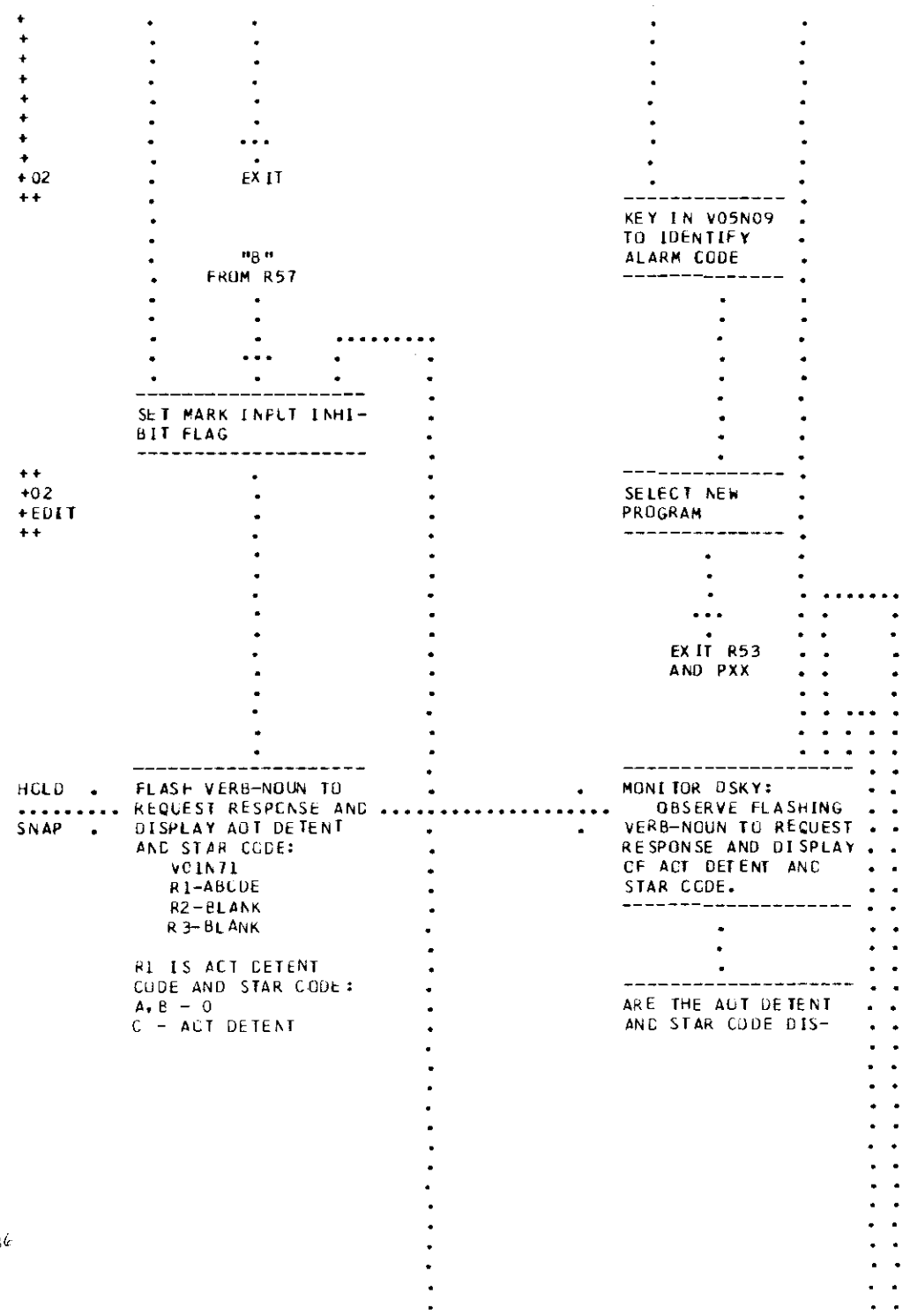
(3) THIS ROUTINE IS AUTOMATICALLY CALLED BY P51,R51, AND R59.

(4) THIS ROUTINE ENABLES THE MARKRUPT ROUTINE (R57) WHICH IS AUTOMATICALLY CALLED BY CREW ACTIVITY WITH ANY OF THE FOLLOWING BUTTONS/SWITCHES: MARK X BUTTON, MARK Y BUTTON, MARK REJECT BUTTON, DES RATE SWITCH (+ OR - ROD).




TURN ON PROGRAM ALARM LIGHT AND STORE ALARM CODE (20105).
MONITOR DSKY:
DOES PROGRAM ALARM LIGHT INDICATE ROUTINE ABNORMALITY?
#30
DO FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (P00)
#40
EXIT R53 AND PXX
IS EITHER THE MARK IN PROGRESS FLAG OR THE NO MARKS ALLOWED FLAG SET?
#50
N
Y
TURN ON PROGRAM ALARM LIGHT AND STORE ALARM CODE (31211).
#60
DO RESTART. (MARKS IN PROGRESS AND NO
#70


MARKS ALLOWED
FLAGS ARE RESET)
EXIT
#80
SET THE MARK IN
PROGRESS FLAG
#90
IS AN LGC VAC AREA
AVAILABLE FOR COM-
PUTATIONS?
Y
N.
TURN ON PROGRAM
ALARM LIGHT AND
STORE ALARM CODE
(31207)
#100
Y
N.
DC RESTART.
(ALL VAC AREAS
ARE RELEASED.
MARKS IN PROGRESS
AND NO MARKS
ALLOWED FLAGS
ARE RESET).
#110



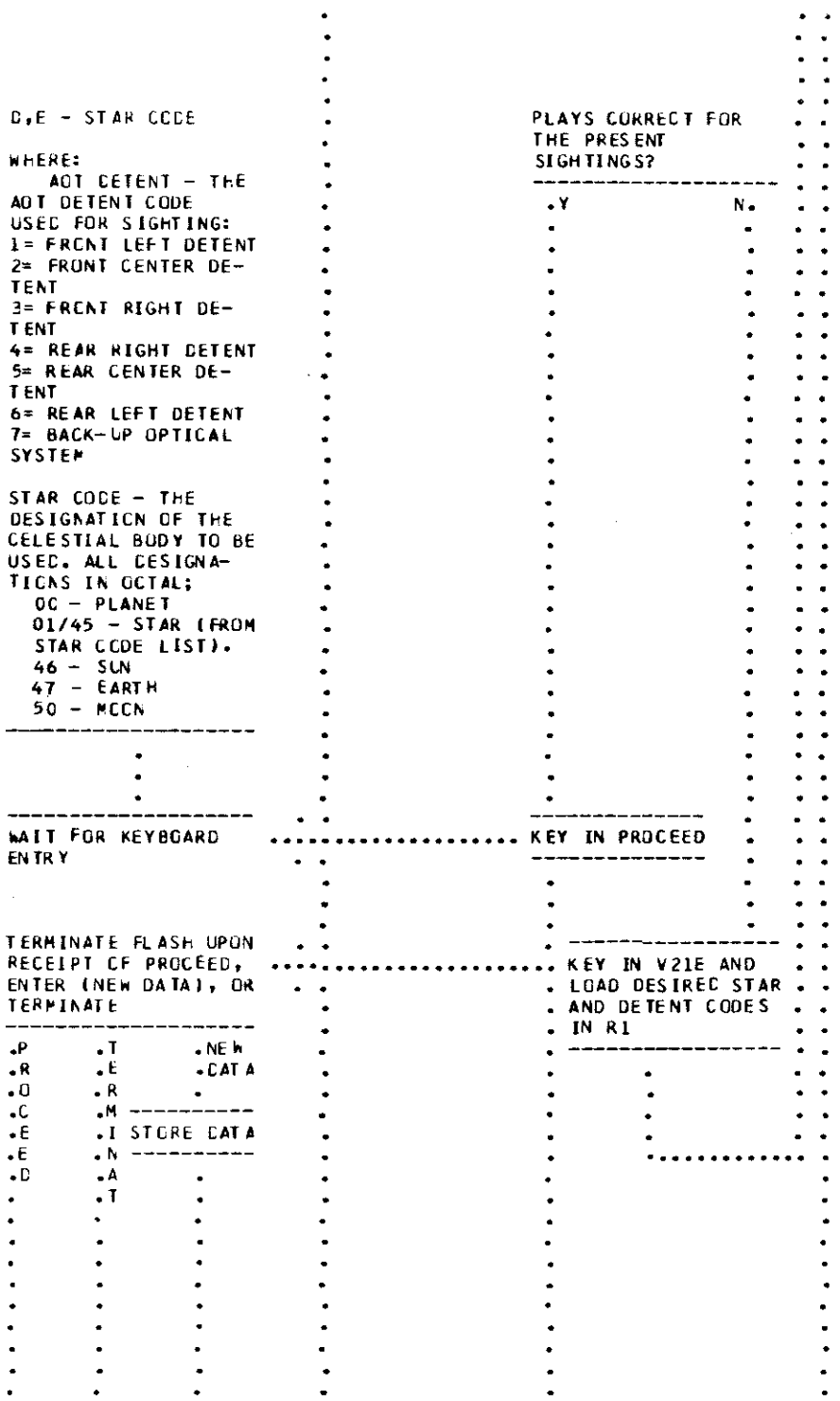
#120

#130

#140

#150

#160



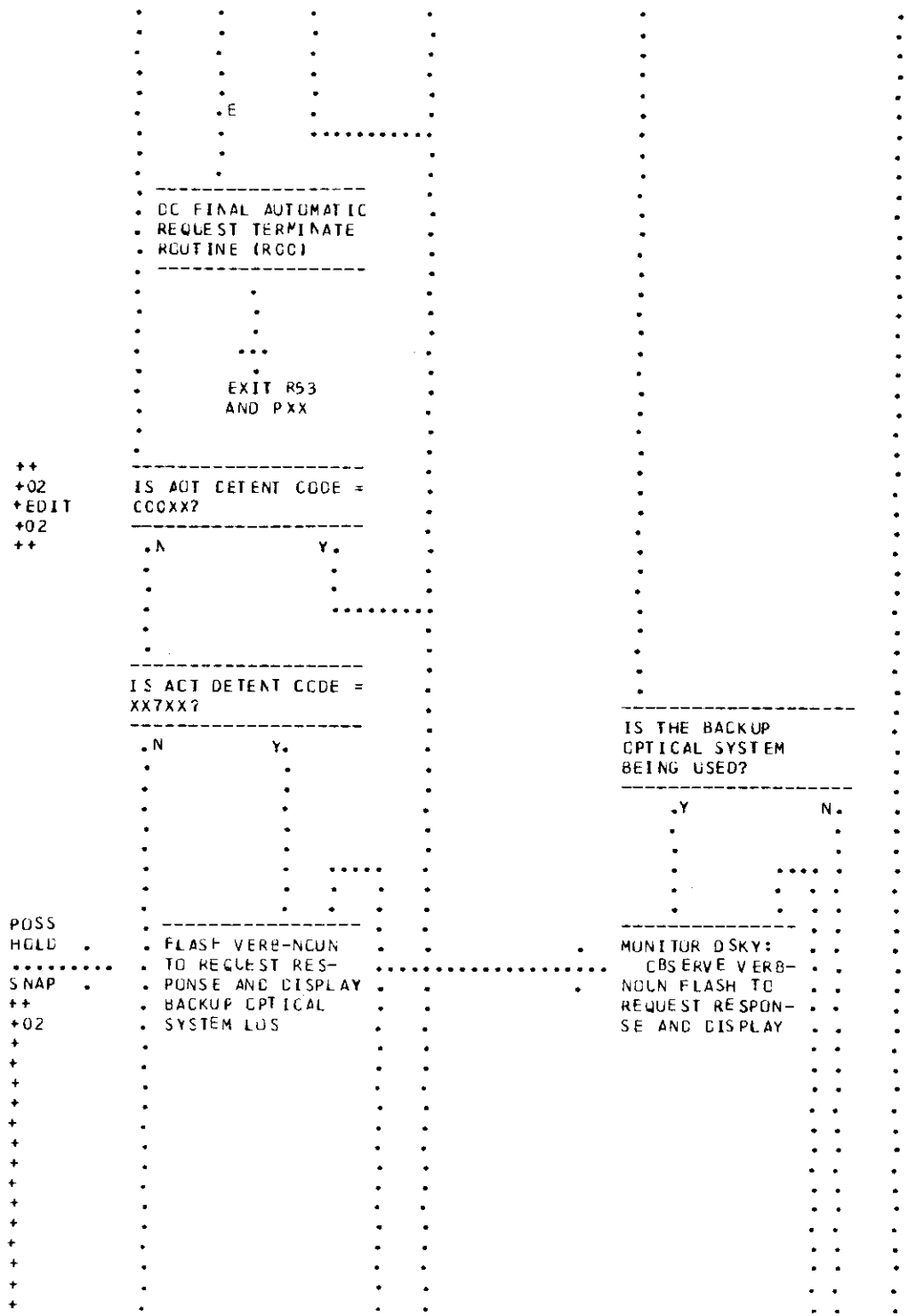
#170

#180

#190

#200

#210



#220

#230

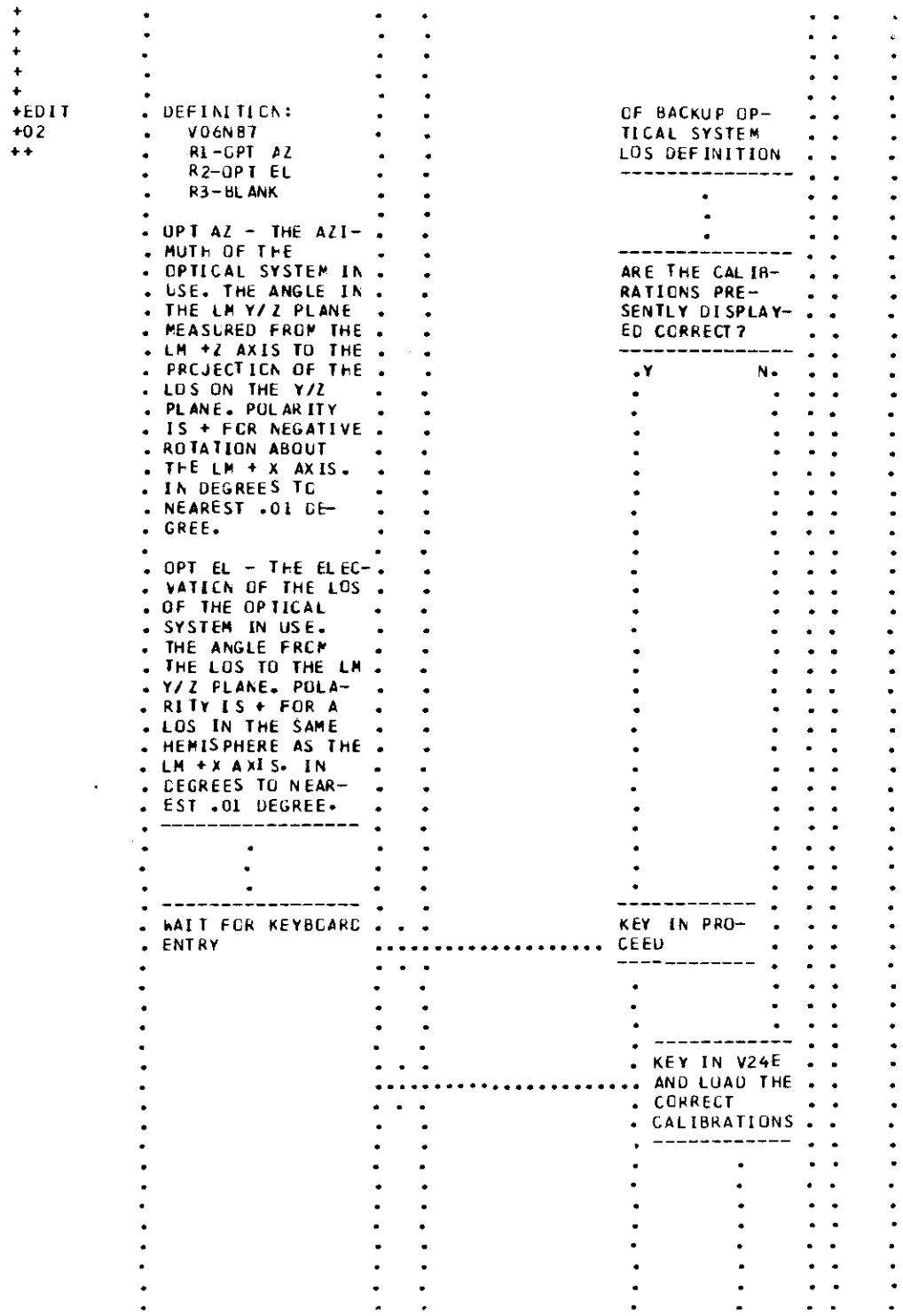
#240

#250

#260

++
+02
+EDIT
+02
++

POSS
HOLD
SNAP
++
+02
+


+EDIT
+02
++
DEFINITION:
V06N87
R1-OPT AZ
R2-OPT EL
R3-BLANK
OPT AZ - THE AZIMUTH OF THE OPTICAL SYSTEM IN USE. THE ANGLE IN THE LM Y/Z PLANE MEASURED FROM THE LM +Z AXIS TO THE PROJECTION OF THE LOS ON THE Y/Z PLANE. POLARITY IS + FOR NEGATIVE ROTATION ABOUT THE LM + X AXIS. IN DEGREES TO NEAREST .01 DEGREE.
OPT EL - THE ELEVATION OF THE LOS OF THE OPTICAL SYSTEM IN USE. THE ANGLE FROM THE LOS TO THE LM Y/Z PLANE. POLARITY IS + FOR A LOS IN THE SAME HEMISPHERE AS THE LM +X AXIS. IN DEGREES TO NEAREST .01 DEGREE.
WAIT FOR KEYBOARD ENTRY
OF BACKUP OPTICAL SYSTEM LOS DEFINITION
ARE THE CALIBRATIONS PRESENTLY DISPLAYED CORRECT?
Y
N
KEY IN PROCEED
KEY IN V24E AND LOAD THE CORRECT CALIBRATIONS
#270
#280
#290
#300
#310

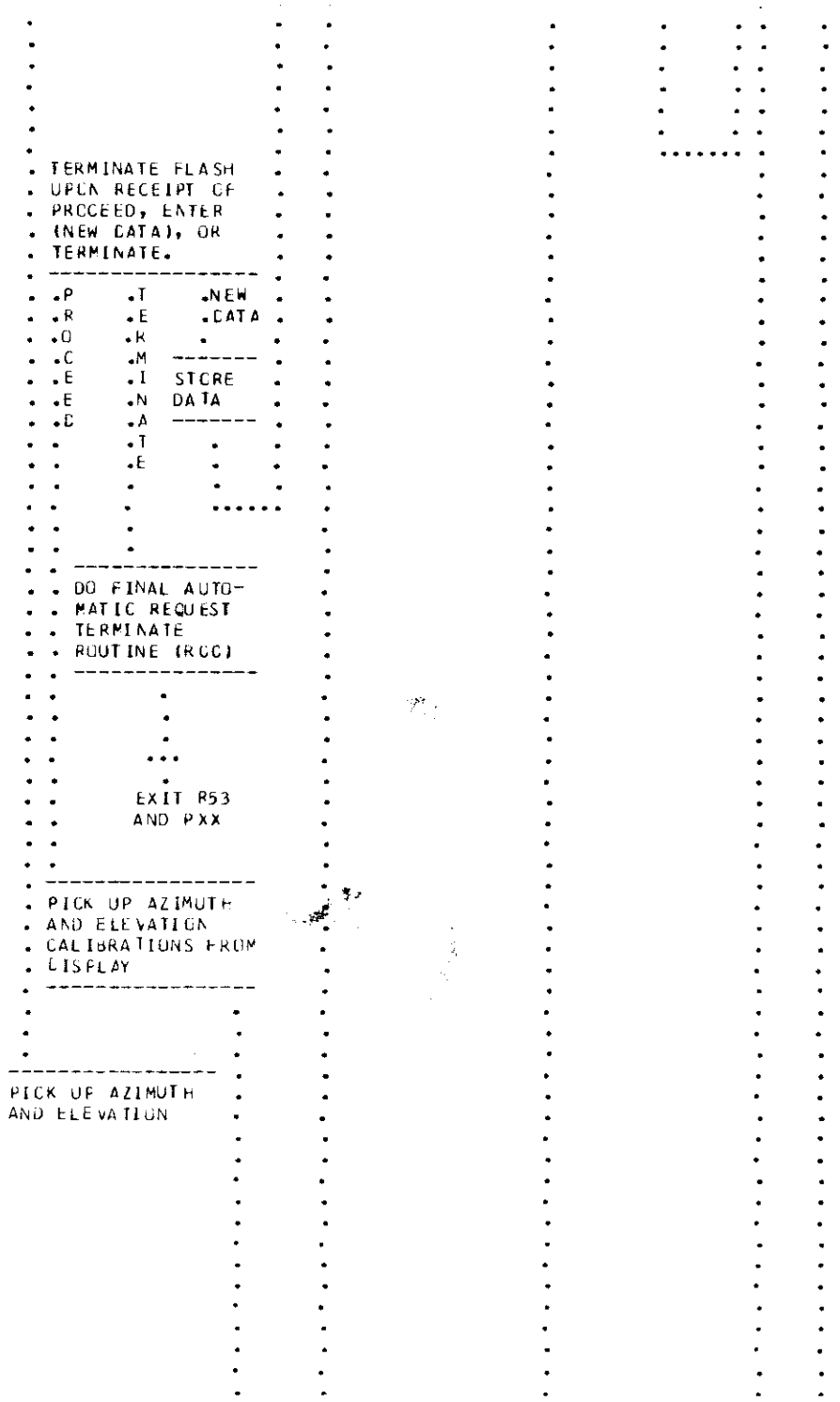
#320

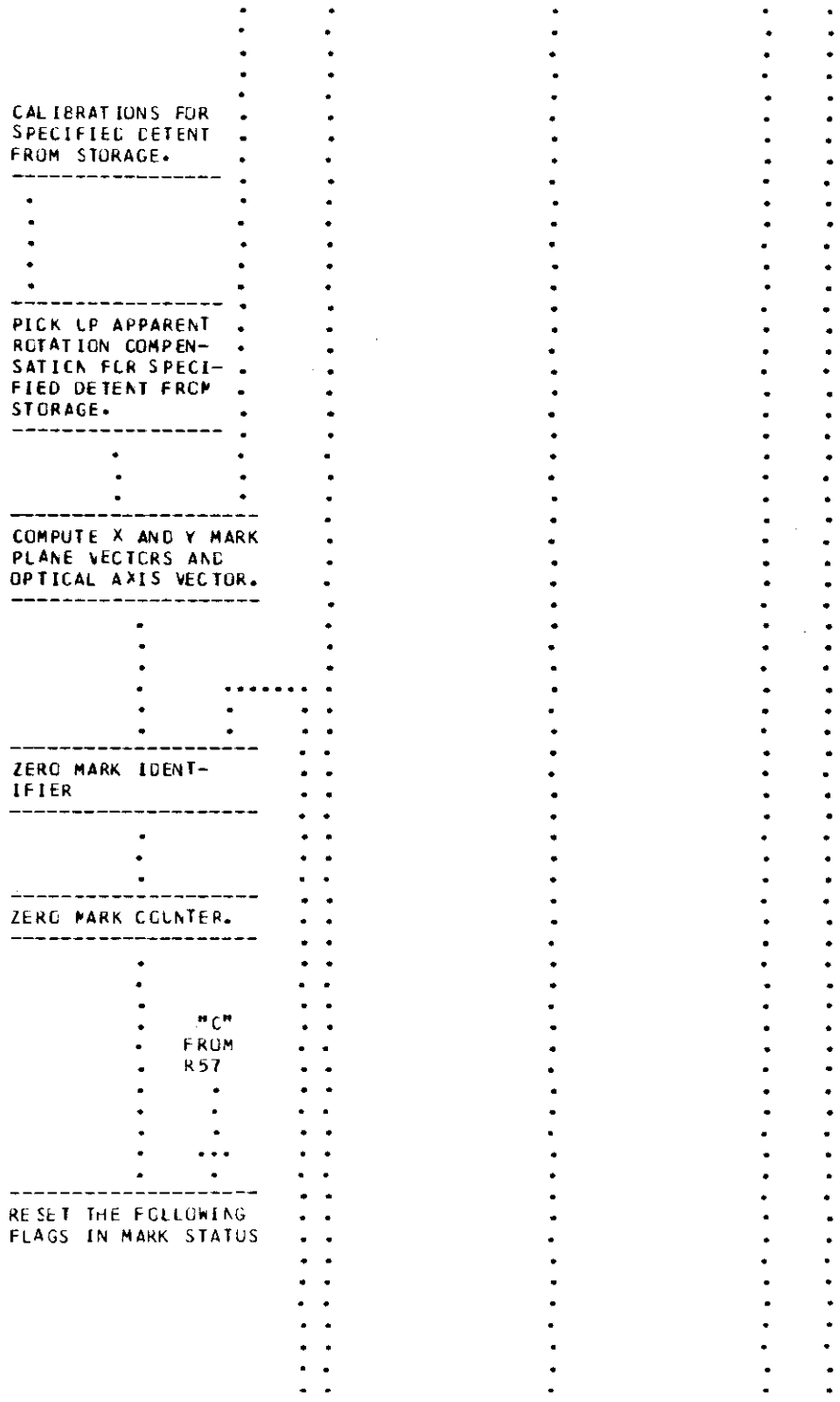
#330

#340

#350

#360





#370

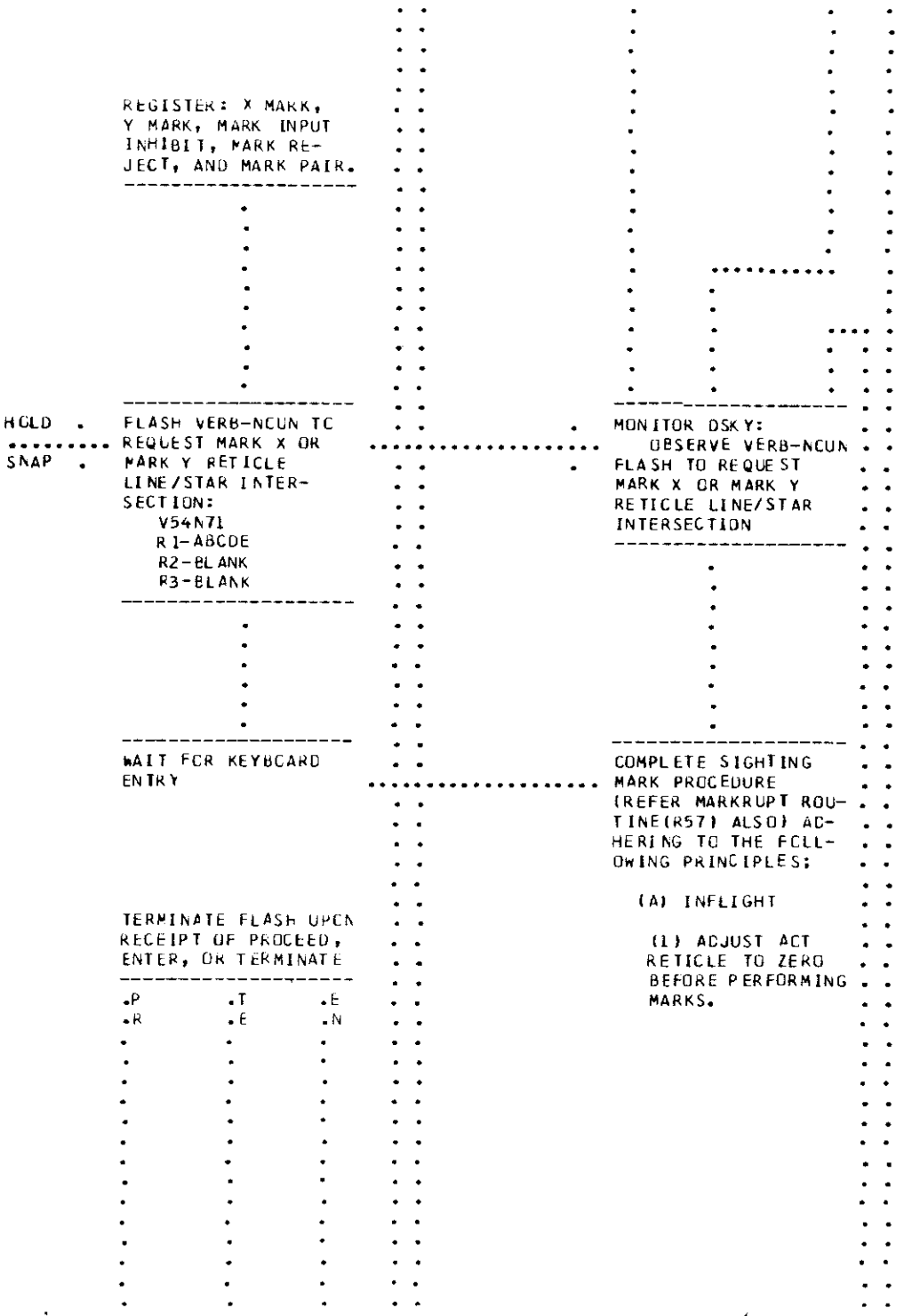
#380

#390

#400

#410

#420

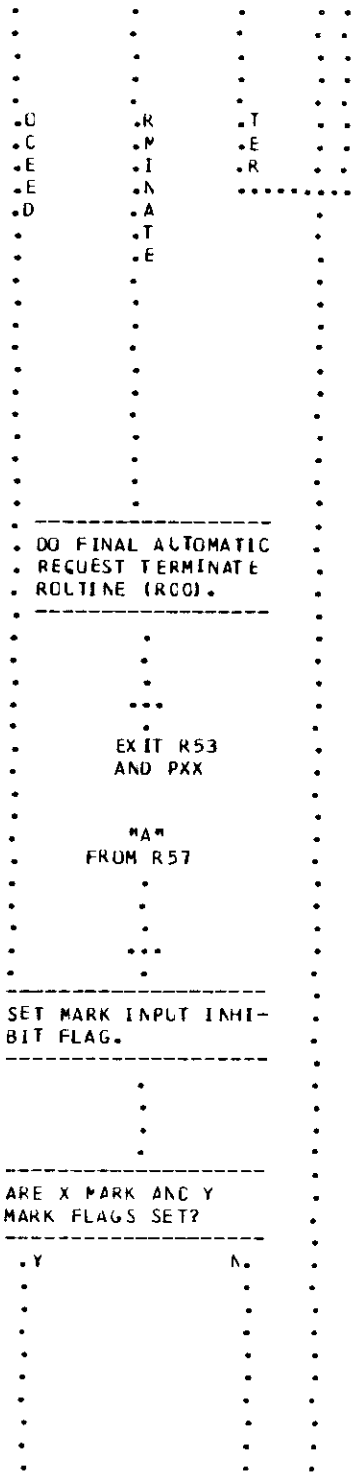


#430

#440

#450

#460



(2) A MARK IS MADE WHEN THE TARGET BODY CROSSES THE X OR Y RETICLE LINE BY PRESSING THE APPROPRIATE MARK BUTTON.

(3) MARKS MUST BE MADE IN X AND Y PAIRS.

(4) SEQUENCE OF MARKS IN EACH PAIR (X,Y OR Y,X) IS IRRELEVANT.

(5) MARK REJECTS MAY BE MADE TO THE DEPTH OF ONE PAIR OR PARTIAL PAIR.

(6) THE LGC WILL PROCESS UP TO AND INCLUDING 5 MARK PAIRS FOR EACH CELESTIAL BODY. THE LGC WILL AVERAGE ALL OF THE LOS TO DEFINE A FINAL LOS.

(7) AFTER EACH PAIR THE CREW MAY; TERMINATE THE MARKING (KEY IN "PROCEED"): CONTINUE MARKING ON THE SAME CELESTIAL BODY (IF LESS THAN 5 PAIRS ARE ALREADY STORED IN THE LGC) (USE APPROPRIATE MARK BUTTONS); OR THROW AWAY ALL DATA ON PRESENT CELESTIAL BODY, SELECT A NEW BODY AND CONTINUE

#470

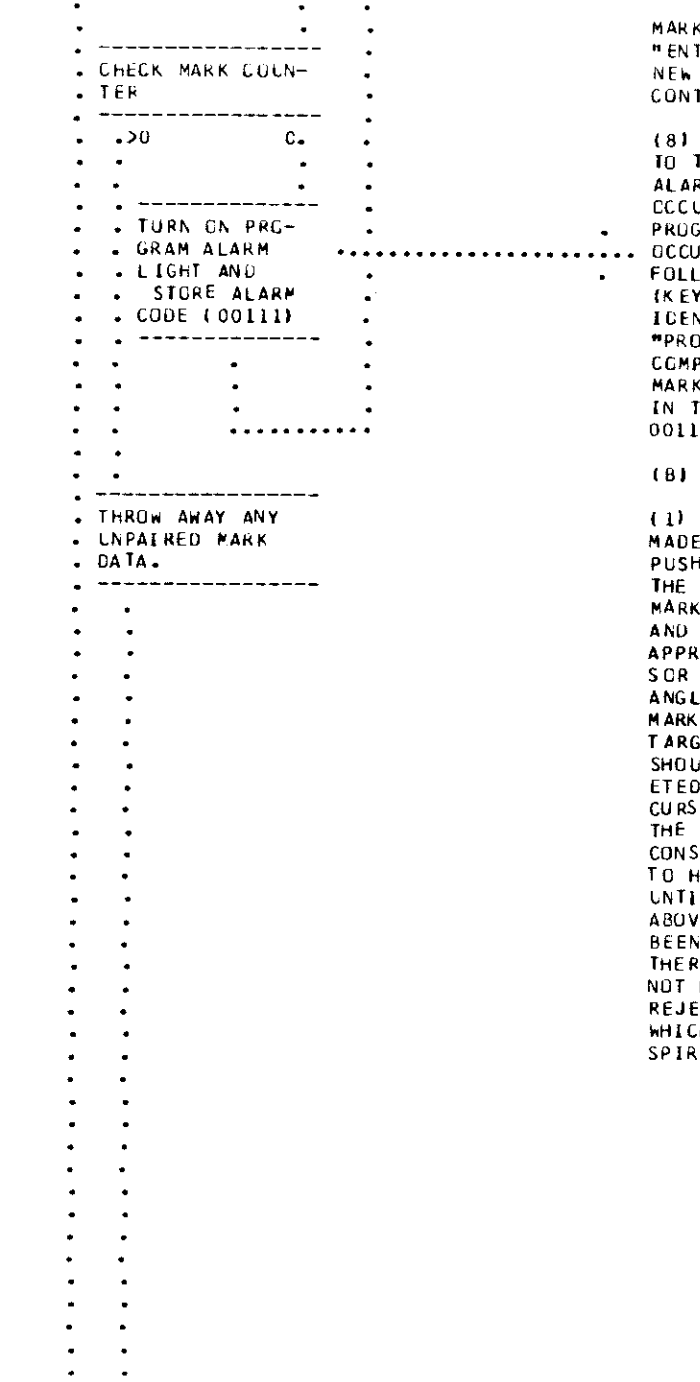
#480

#490

#500

#510

#520



MARKING (KEY IN "ENTER", DEFINE NEW BODY AND CONTINUE MARKING)

(8) IN ADDITION TO THOSE PROGRAM ALARMS WHICH MAY OCCUR IN R57 A PROGRAM ALARM MAY OCCUR IN THE FOLLOWING CASE (KEY IN V05N09 TO IDENTIFY): A "PROCEED" WHEN NO COMPLETE PAIR OF MARKS IS STORED IN THE LGC (CODE 00111). #530

(8) SURFACE #540

(1) MARKS ARE MADE SINGLY BY PUSHING EITHER THE MARK X OR MARK Y PUSHBUTTON AND LOADING THE APPROPRIATE CURSOR AND SPIRAL ANGLES FOR THAT MARK ACTION (THE TARGET BODY SHOULD BE BRACKETED BY THE CURSOR/SPIRAL). THE LGC WILL NOT CONSIDER A MARK TO HAVE BEEN MADE UNTIL BOTH OF THE ABOVE STEPS HAVE BEEN PERFORMED. THEREFORE IT IS NOT NECESSARY TO REJECT A MARK FOR WHICH CURSOR & SPIRAL ANGLE IN- #550 #560

FORMATION HAVE NOT BEEN LOADED. ANOTHER MARK ACTION WILL "WRITE OVER" THE PREVIOUS ONE.

(2) A MARK REJECT WILL REJECT A MARK AND ITS ASSOCIATED CURSOR AND SPIRAL ANGLES TO ANY DEPTH AS LONG AS ANY MARKS REMAIN. (MARK COUNTER >0).

(3) OPTIMALLY A MARK SHOULD BE MADE BETWEEN ITS CURSOR AND SPIRAL ANGLE RECORDING WHICH REQUIRES THAT THE FIRST ANGLE BE WRITTEN DOWN OR REMEMBERED. (DSKY WILL NOT REQUEST CURSOR AND SPIRAL INFORMATION UNTIL A MARK PUSHBUTTON ACTION IS MADE). IN THAT THE SPIRAL READING IS CONSIDERED TO BE MORE DIFFICULT, IT SHOULD BE MADE FIRST, THEN THE MARK, THEN CURSOR READING.

(4) THE LGC WILL PROCESS UP TO AND INCLUDING 5 MARKS FOR EACH CELESTIAL BODY. THE LGC WILL AVERAGE ALL

#570

#580

#590

#600

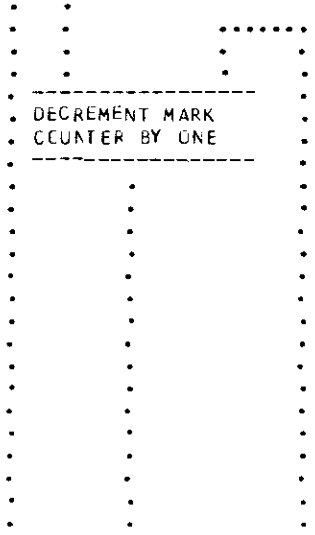
#610

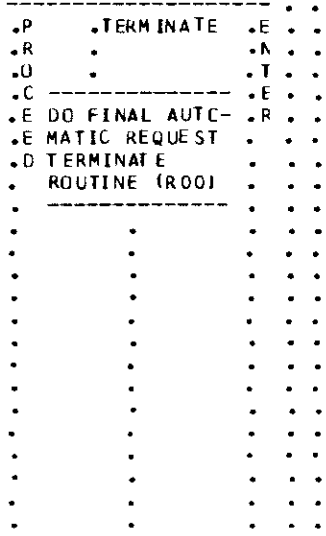
OF THE LOS TO DEFINE A FINAL LOS.

(5) AFTER EACH MARK (AS DEFINED IN (8)(1) ABOVE) THE CREW MAY; TERMINATE THE MARKING (KEY IN "PROCEED"); CONTINUE MARKING ON THE SAME CELESTIAL BODY (IF LESS THAN 5 MARKS ARE ALREADY STORED IN THE LGC); OR THROW AWAY ALL DATA ON PRESENT CELESTIAL BODY, SELECT A NEW BODY AND CONTINUE MARKING (KEY IN "ENTER", DEFINE NEW BODY AND CONTINUE MARKING) #620 #630 #640

(C) INFLIGHT OR SURFACE

(1) THIS ROUTINE AND THE PRESENT ALIGNMENT PROGRAM MAY BE TERMINATED AT ANY TIME BY KEYING IN TERMINATE (V34E). #650

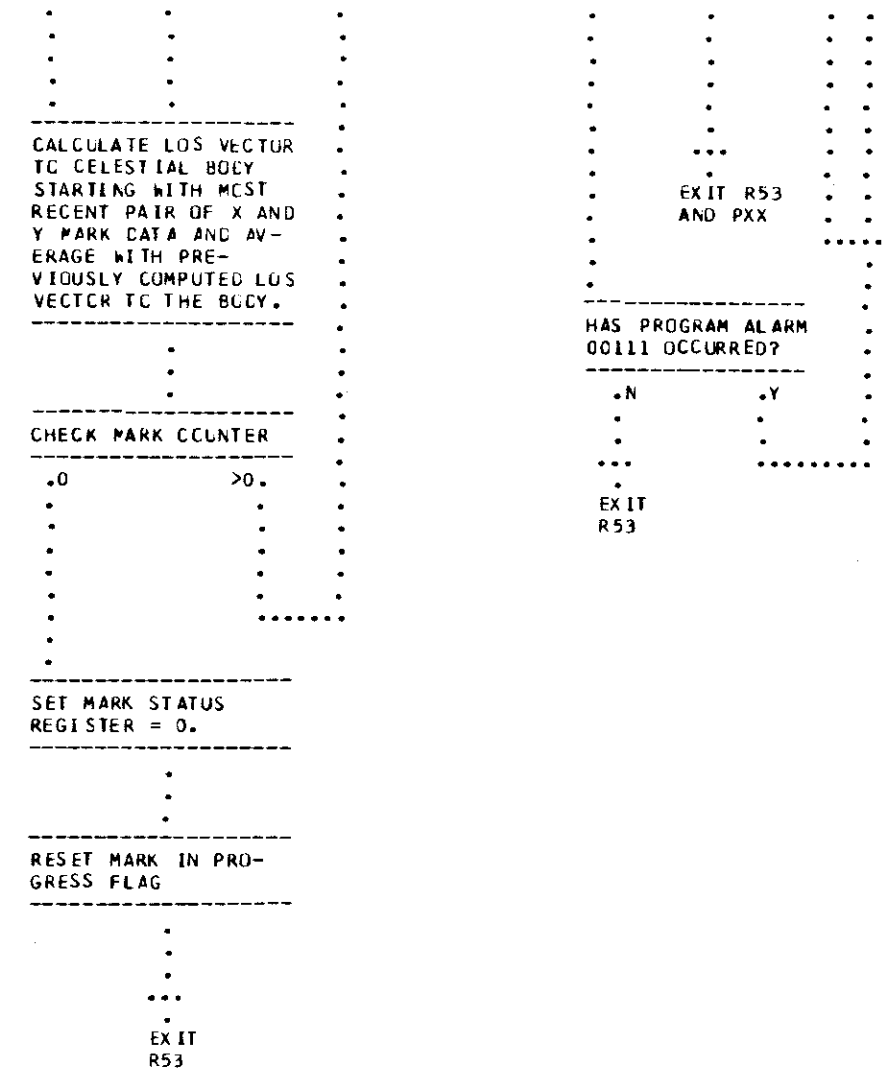




#660

947

++
+02
+EDIT
++



#670

#680

#690

#700

#710

CHANGE CONTROL NOTES

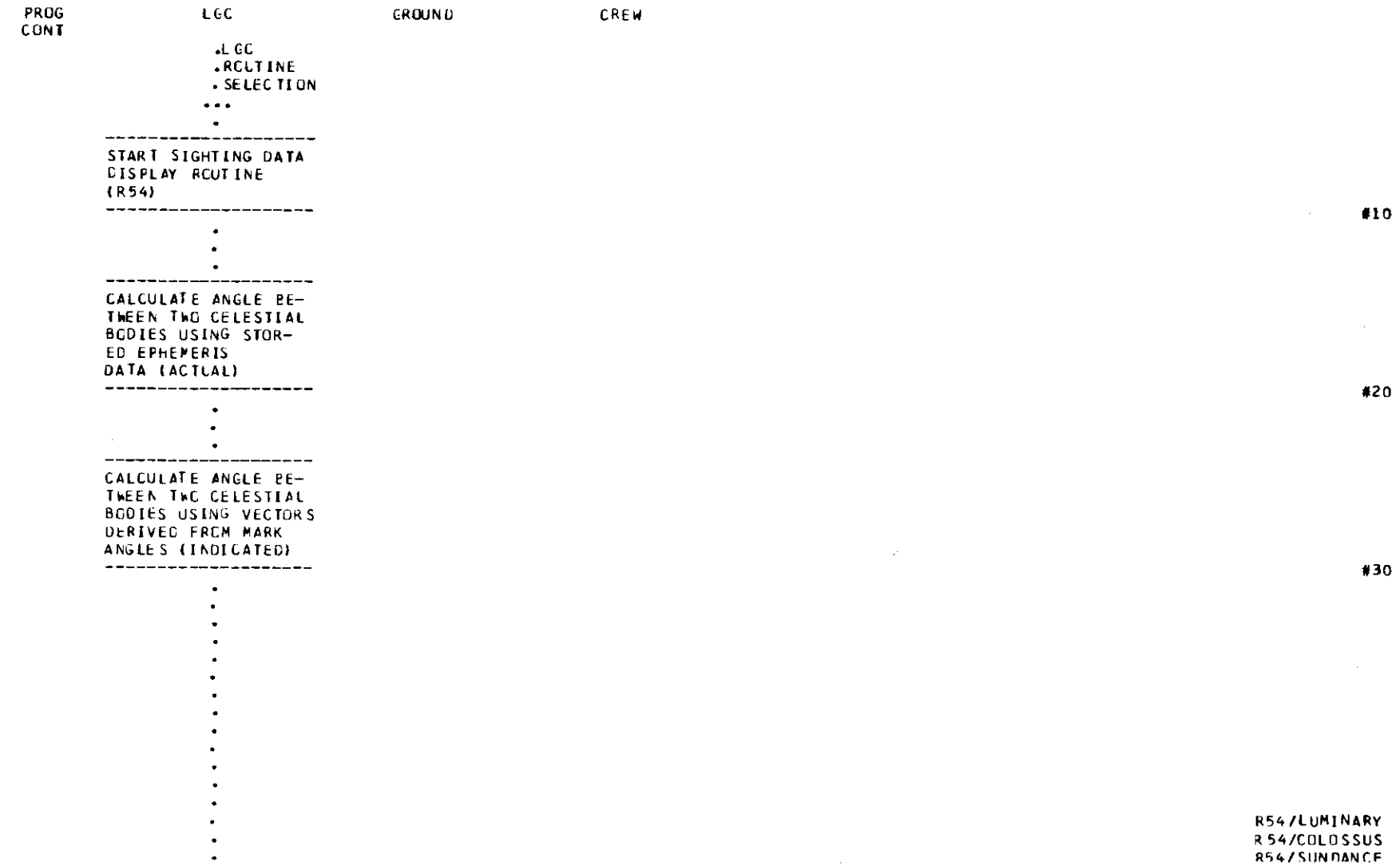
LOGIC REV 01 PCR 527
LOGIC REV 00(LUM 1A) PCR 699
LOGIC REV 01(LUM 1B) PCR 801.2
REV C2 EDITORIAL

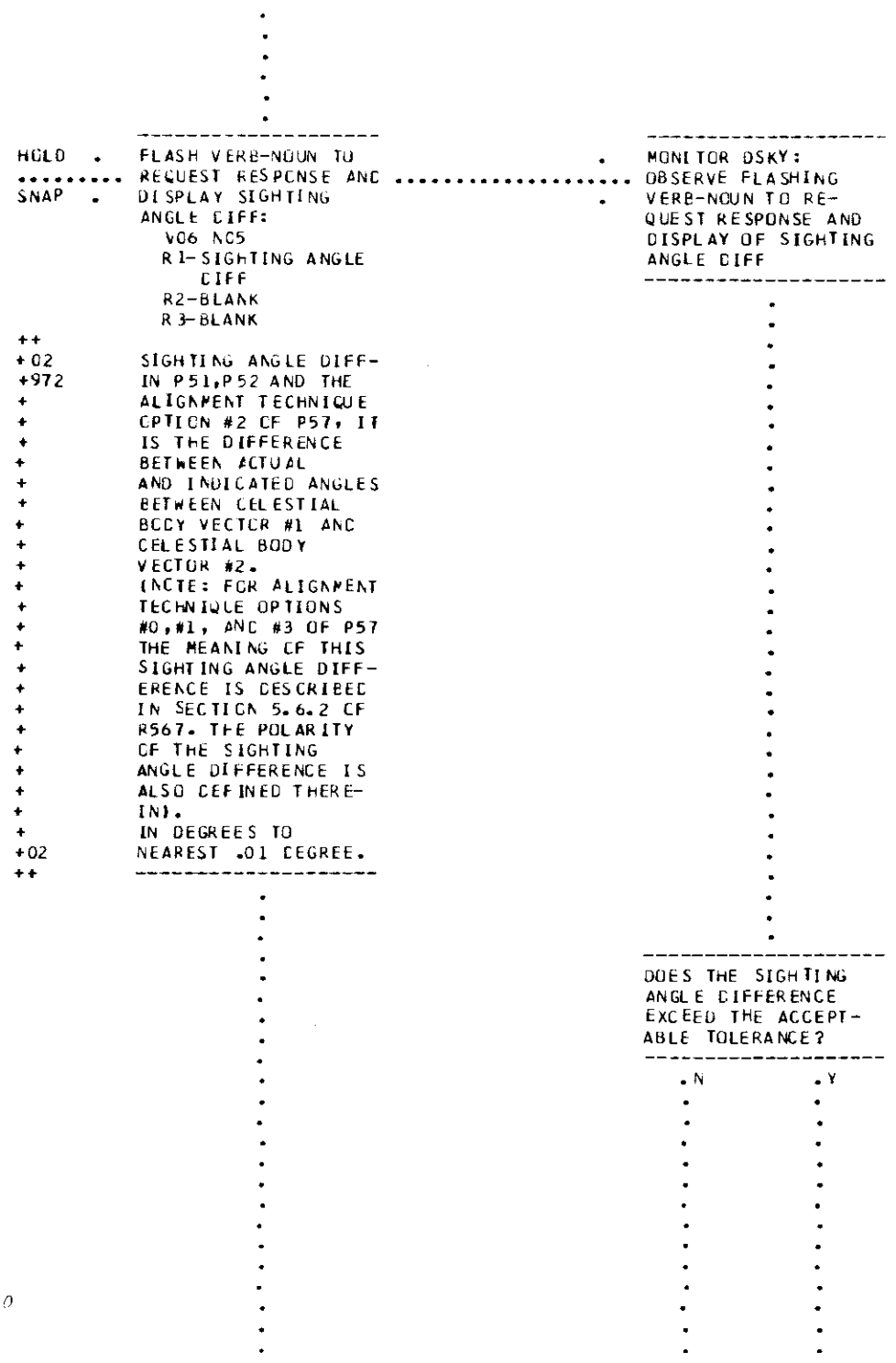
9#9

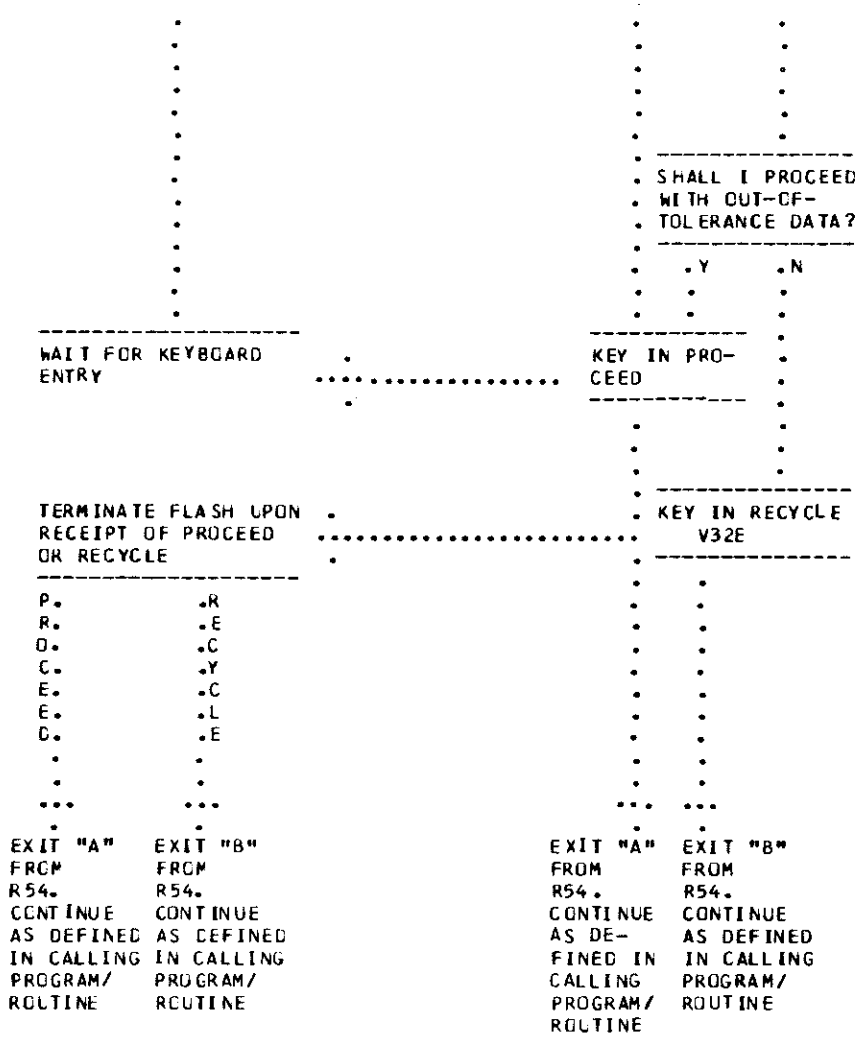
SIGHTING DATA DISPLAY ROUTINE (R54) REV 02 12/03/69

PURPOSE: (1) TO DISPLAY THE ACCURACY OF A PAIR OF CELESTIAL BODY SIGHTINGS, OR ALIGNMENT VECTORS.

ASSUMPTIONS: (1) THE ROUTINE IS NORMALLY AUTOMATICALLY SELECTED BY THE IMU ORIENTATION DETERMINATION PROGRAM (P51), THE INFLIGHT FINE ALIGN ROUTINE (R51), OR THE LUNAR SURFACE ALIGN PROGRAM (P57).




HOLD
SNAP
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY SIGHTING ANGLE DIFF:
V06 N05
R1-SIGHTING ANGLE DIFF
R2-BLANK
R3-BLANK
++
+02
+972
SIGHTING ANGLE DIFF- IN P51,P52 AND THE ALIGNMENT TECHNIQUE OPTION #2 OF P57, IT IS THE DIFFERENCE BETWEEN ACTUAL AND INDICATED ANGLES BETWEEN CELESTIAL BODY VECTOR #1 AND CELESTIAL BODY VECTOR #2.
(NOTE: FOR ALIGNMENT TECHNIQUE OPTIONS #0,#1, AND #3 OF P57 THE MEANING OF THIS SIGHTING ANGLE DIFF- ERENCE IS DESCRIBED IN SECTION 5.6.2 OF R567. THE POLARITY OF THE SIGHTING ANGLE DIFFERENCE IS ALSO DEFINED THERE- IN).
IN DEGREES TO NEAREST .01 DEGREE.
+02
++
MONITOR DSKY: OBSERVE FLASHING VERB-NOUN TO RE- QUEST RESPONSE AND DISPLAY OF SIGHTING ANGLE DIFF
DOES THE SIGHTING ANGLE DIFFERENCE EXCEED THE ACCEPT- ABLE TOLERANCE?
N
Y
#40
#50
#60
#70
#80



CHANGE CONTROL NOTES

REV 01 NO PCRS
REV 02(LUM 10) PCR 972

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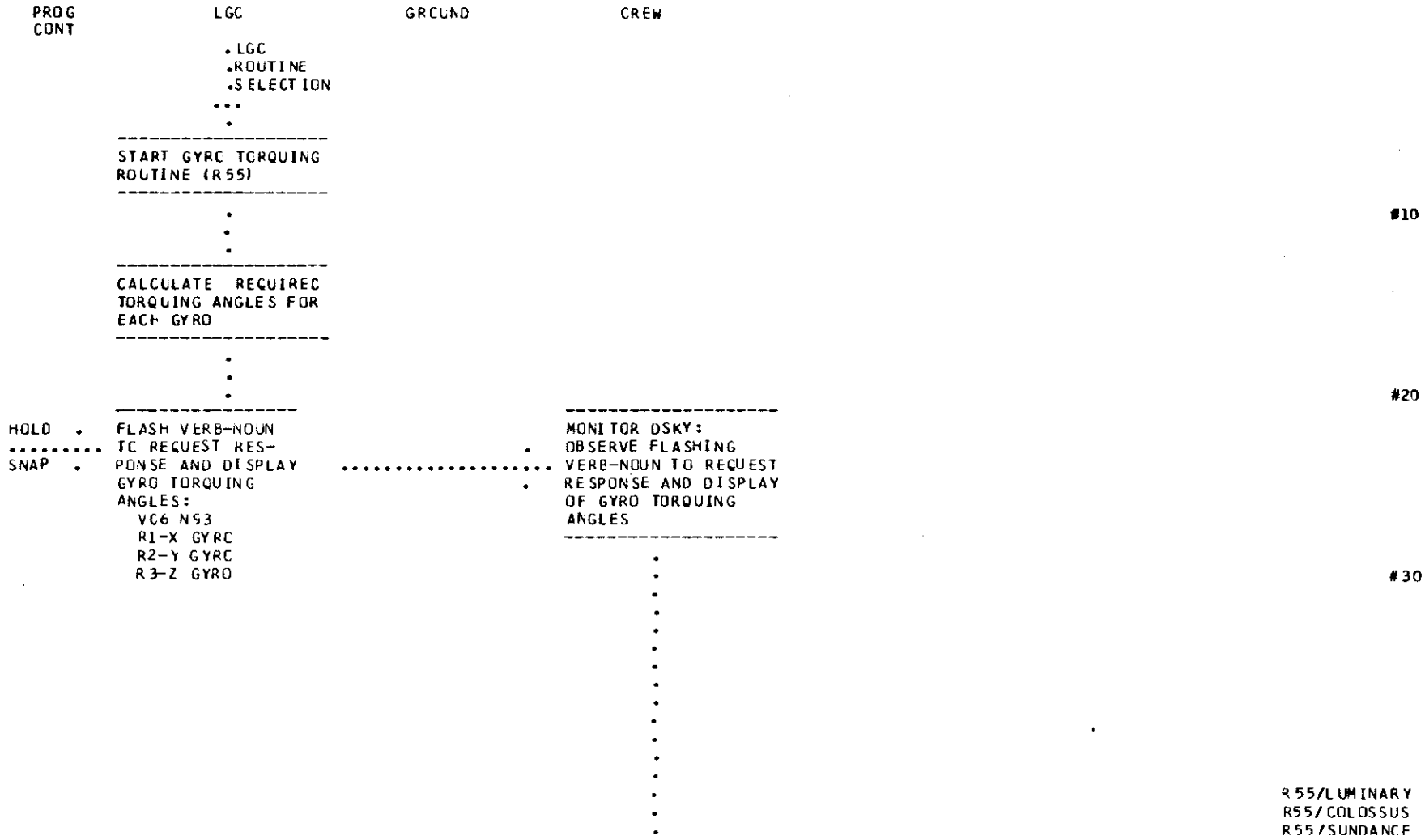
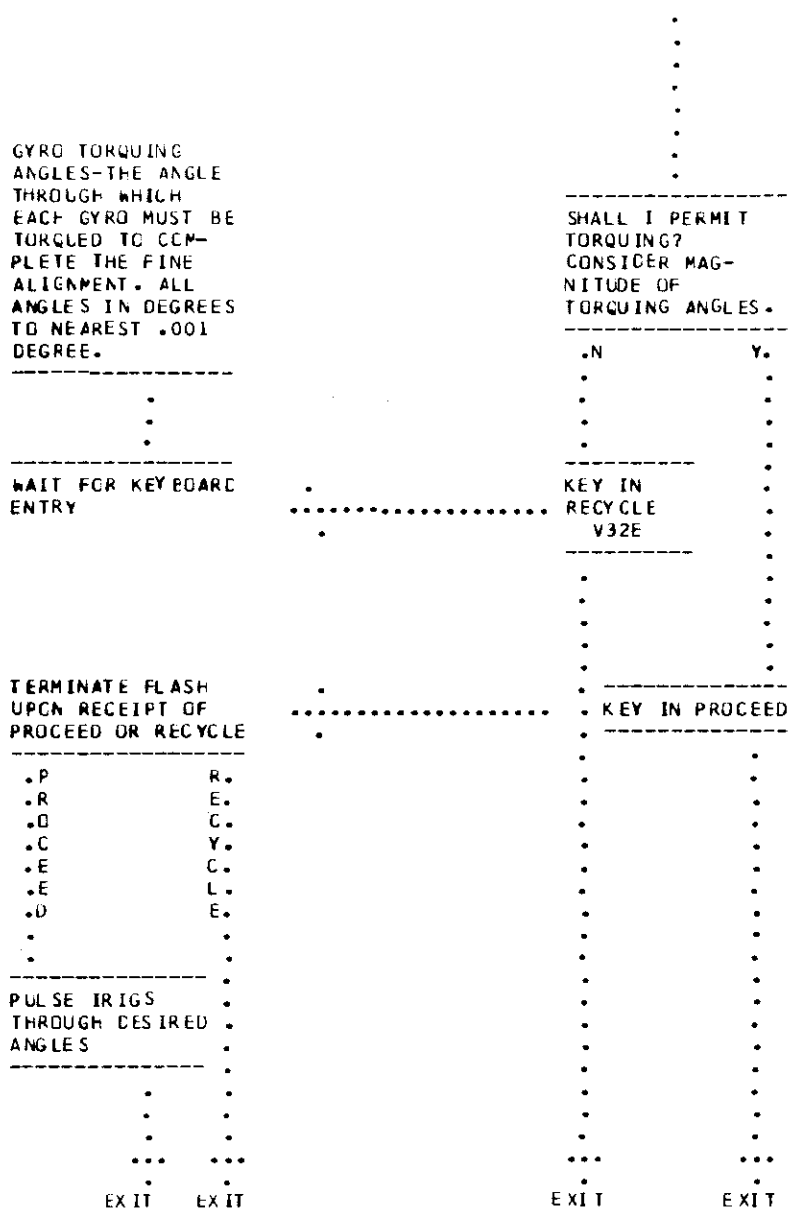
GYRC TCRQUINC ROUTINE (R55) REV 01 01/07/69

PURPOSE: (1) TC CALCULATE GYRO TORQUING ANGLES FOR FINAL (FINE) ALIGNMENT OF THE INERTIAL PLATFORM DURING AN INFLIGHT ALIGNMENT; TO DISPLAY THESE ANGLES AND TC TORQUE THE GYROS.

ASSUMPTICNS: (1) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE INFLIGHT FINE ALIGN ROUTINE (R51).



R55/LUMINARY
R55/COLOSSUS
R55/SUNDANCE


GYRO TORQUING ANGLES-THE ANGLE THROUGH WHICH EACH GYRO MUST BE TORQUED TO COM-PLETE THE FINE ALIGNMENT. ALL ANGLES IN DEGREES TO NEAREST .001 DEGREE.
WAIT FOR KEYBOARD ENTRY
TERMINATE FLASH UPON RECEIPT OF PROCEED OR RECYCLE
.P R.
.R E.
.O C.
.C Y.
.E C.
.E L.
.O E.
PULSE IRIGS THROUGH DESIRED ANGLES
EXIT
EXIT
SHALL I PERMIT TORQUING? CONSIDER MAG-NITUDE OF TORQUING ANGLES.
.N Y.
KEY IN RECYCLE V32E
KEY IN PROCEED
EXIT
EXIT

#40

#50

#60

#70

CHANGE CONTROL NOTES

NO PCRS

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757

TERMINATE TRACKING ROUTINE (R56) REV 03 12/03/69

PURPOSE: (1) TO TERMINATE PROGRAMS P20,P22, OR P25

ASSUMPTIONS: (1) THE SELECTION AND TERMINATION OF P20, P22, AND P25 ARE SUBJECT TO SPECIAL OPERATING PROCEDURES DIFFERENT FROM THOSE FOR ALL OTHER PROGRAMS:

(A) SELECTION

(1) ALWAYS BY V37EXXE

(2) IF ANY OTHER PROGRAM IS RUNNING AT THE TIME OF P20/22/25 SELECTION, THE NEW PROGRAM WILL REPLACE THE OLD. THIS INCLUDES P20/22/25 SELECTION WHEN ANY OF P20,22, OR 25 IS RUNNING.

(3) IF P20 OR P25 IS RUNNING, SELECTION OF ANY PROGRAM OTHER THAN P00 OR P22 WILL RESULT IN P20 OR P25 CONTINUING, AND THE NEW PROGRAM ALSO OPERATING WITH ITS NUMBER DISPLAYED IN THE DSKY PROG LIGHTS.

(4) IF P20 OR P25 IS RUNNING, SELECTION OF P00 OR P22 WILL RESULT IN THE TERMINATION OF THE OLD PROGRAM, AND OPERATION OF THE NEW.

(B) TERMINATION

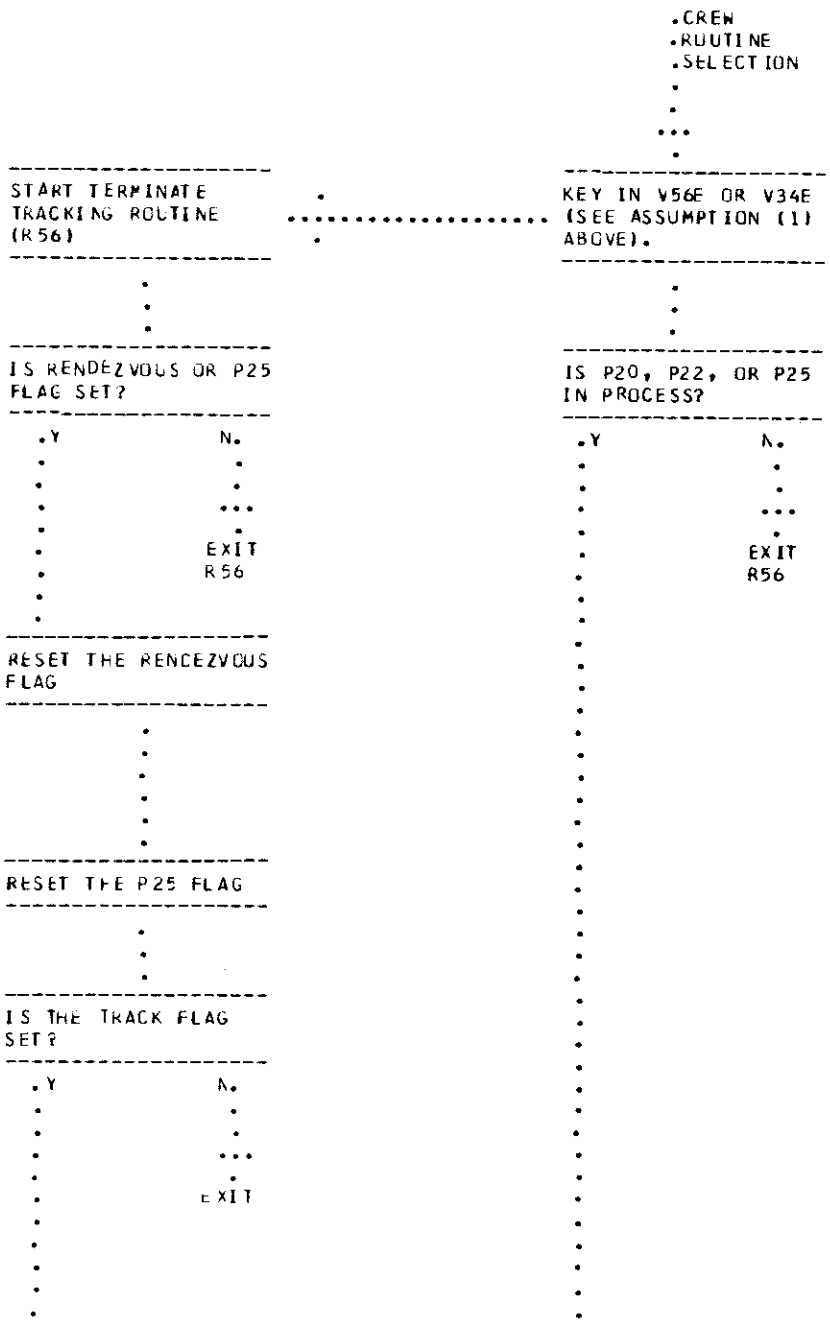
(1) BY SELECTION OF P00, V56E, OR BY V34E.

(2) P00 SELECTION WILL TERMINATE P20,22, AND 25 AND ANY OTHER PROGRAM IN PROCESS, AND ESTABLISH P00.

(3) V56E SELECTION WILL SELECT THE TERMINATE TRACKING ROUTINE (R56) WHICH WILL TERMINATE ONLY P20 OR P25 IF EITHER OF THESE PROGRAMS IS RUNNING IN CONJUNCTION WITH ANOTHER PROGRAM. IN ALL OTHER CASES R56 WILL SELECT R00. V56E MAY BE PERFORMED ANY TIME DURING P20,22, OR 25 OPERATION.

(4) THE LGC WILL ACT UPON V34E ONLY IN RESPONSE TO A FLASHING VERB-NOUN. IF THIS DISPLAY WAS ORIGINATED BY P20,22, OR 25, V34E WILL RESULT IN AN IDENTICAL LGC RESPONSE TO THAT OF V56E, THAT IS, SELECTION OF R56. IF THIS DISPLAY WAS NOT ORIGINATED BY P20,22, OR 25 (SUCH AS P32, WHILE RUNNING WITH P20) THE LGC WILL GO TO R00, HOWEVER THE PROGRAM IN THE BACKGROUND WILL CONTINUE. THE NEW PROGRAM SELECTED FOLLOWS THE SELECTION RULES ABOVE, (A).

PROG CONT	LGC	GROUND	CREW


.CREW
.ROUTINE
.SELECTION
START TERMINATE TRACKING ROUTINE (R56)
KEY IN V56E OR V34E (SEE ASSUMPTION (1) ABOVE).
IS RENDEZVOUS OR P25 FLAG SET?
IS P20, P22, OR P25 IN PROCESS?
.Y
N.
EXIT R56
RESET THE RENDEZVOUS FLAG
RESET THE P25 FLAG
IS THE TRACK FLAG SET?
EXIT

#10

#20

#30

#40

#50

R56

#60

RESET THE TRACK
FLAG, UPDATE FLAG,
AND IMUSE FLAG

#70

WAIT FOR ANY
INTEGRATION IN
PROCESS TO FINISH.

++
+03
+EDIT
++

COMMAND ZERO
VEHICLE RATES

#80

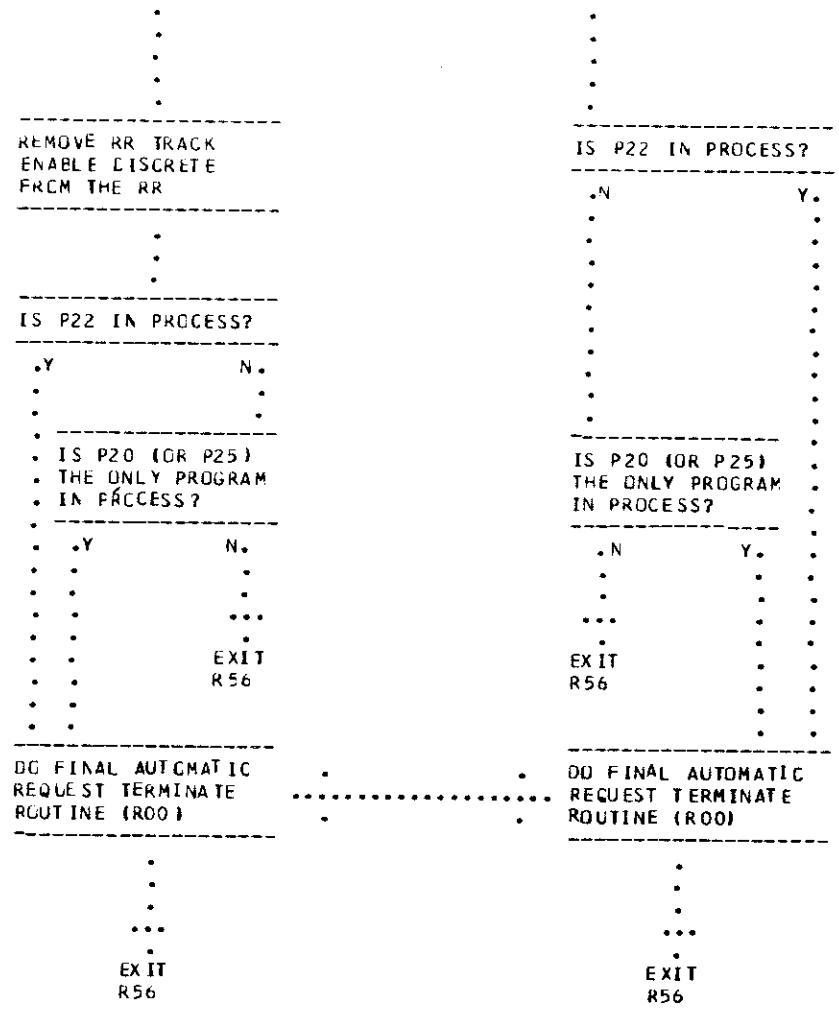
SET DEADBAND TO
PREVIOUS VALUE
DEFINED BY RC3

#90

RESET DESIGNATE FLAG

RESET CONTINUOUS
DESIGNATE FLAG

#100



#110

#120

#130

#140

CHANGE CONTROL NOTES

LOGIC REV 01 PCR 451
LOGIC REV 02 EDITORIAL
REV 03 EDITORIAL

960