MARKKLT KLUTINE (r57)

(1) TO ACCEPT AND PROCESS CREW INPUTS (MARK X, MARK Y, AND MARK REJECT) ASSOCIATED WITH THE ALIGNMENT MARKING PROCESS.

(2) TO ACCEPT AND STORE CREW INPUTS (PLUS AND MINUS ROE COMMANDS) ASSOCIATED WITH THE RATE OF DESCENT PHASE (P66) OF THE LUNAR LANDING.

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY CALLED WHENEVER THE MARK X PUSBBUTTON, MARK Y PUSBBUTTON, MARK REJECT PUSBBUTTON, OR THE DES RATE (+ OR -) SWITCH ARE USED BY THE CREW, EITHER IN FLIGHT OR ON THE LUNAR SURFACE.

PROG
CONT

LGC

GROUNO

CREW

* LGC
* ROUTINE
* SELECTION
* *
* *
-------------------
START MARKKLT
KLUTINE (r57)
-------------------

STORE PRESENT VALUES
OF CDUX, CDUY, CDUZ
AND TIME.
-------------------

WAS THIS ROUTINE
CALLED BY MARK X,
MARK Y, OR MARK
REJECT ACTIVITY?
-------------------

* Y
* N
*
AS THIS ROUTINE CALLED BY A * OR - RDG COMMAND?

Y N

TURN ON PROGRAM ALARM AND STORE ALARM CODE (00113).

MONITOR DSKY;
DOES PROGRAM ALARM INDICATE THAT ROUTINE OPERATION IS INCORRECT?

Y N

STOR RDG COMMAND FOR POSSIBLE USE BY P66.

KEY IN VOSM09 TL IDENTIFY ALARM CODES, THOSE WHICH COULD OCCUR AND CREW RESPONSE REQUIRED ARE AS FOLLOWS:

1A) 00107-MURE THAN 5 MARKS (SURFACE) MARK PAIRS (FLIGHT) HAVE BEEN TAKEN TERMINATE MARKING SEQUENCE BY KEYING IN "PROCEED".

1B) 00112-MARK-ING SEQUENCE NOT DESIRED AT THIS TIME, DO NOT PUSH MARK X, MARK Y, OR MARK REJECT PUSH-

IS MARK INPUT INHIBIT FLAG SET?

N Y

EXIT

EXIT RDG
DOES MARK STATUS
REGISTER INDICATE
THAT R53 IS IN PRO-
CESS AND MARKS ARE
BEING ACCEPTED?

Y  N

----------------------------------------
TURN ON PROGRAM
ALARM AND STORE
ALARM CODE
(C0112).

----------------------------------------

EXIT R57

----------------------------------------
WAS THIS ROUTINE
CALLED BY MARK RE-
JECT ACTIVITY?

N  Y

----------------------------------------
IS THE SURFACE
FLAG SET?

N  Y

----------------------------------------
CHECK THE
MARK COUNTER.

>0  0.

----------------------------------------

BUTTONS.

(C) 00113-
ALTHOUGH R57
WAS CALLED NO
MARKS APPEAR
IN CHANNEL 16.
HARDWARE OR
SOFTWARE
FAILURE. REFER TO
BACK-UP PROCEDURES

----------------------------------------

(D) 00114- A
DUPLICATE
MARK HAS BEEN
MADE (X AFTER
X, Y AFTER Y-
IN FLIGHT
ONLY). MONITOR
DSKY MARK RE-
QUEST AND
MAKE CORRECT
MARK.

----------------------------------------

(E) 00115-MARK
REJECT HAS
BEEN ATTEMPTED
WITH NO
MARKS TO RE-
JECT. MONITOR
DSKY MARK RE-
QUEST AND
MAKE CORRECT
MARK.
RAS MARK REJECT
FLAG PREVIOUSLY
SET?

N
Y

RESET X MARK
AND Y MARK
FLAG

SET VERB
PCINTER TO
V54

RESET THE MARK
FLAG CORRESPON-
DING TO THE
PRESENT MARK
IDENTIFIER


eeh
FROM
BELOW

SET VERB PCINTER TO NEXT
APPROPRIATE MARK REQUEST.
IS SURFACE FLAG
Set 1?

Y
N

POSS\n
MOLD\n
* * * * * *

SNAP\n
* * * * * *

AS DEFINED BY

VERB POINTER

FLASH VERB-

NOUN TO RE-

CLEST MARK

(X, Y, OR X OR

Y) RETICLE

LINE/STAR

INTERSECTION:

WX<X71

R1-ABCD

R2-BLANK

R3-BLANK

R1 IS NOT DE-

TENT CODE AND

STAR CODE:

A\n
B-D

C-ACD DE-

TENT

D-E-STAR

WHERE:

ACT DETENT-

THE ACT DE-

TENT POSI-

TICN USED

FOR SIGHT-

ING:

+G3

+EDIT

1 (LEFT FRONT),

2 (FRONT CENT-

ER),

3 (RIGHT FRONT),

4 (RIGHT

REAR).


5 (REAR CENTER),
   6 (LEFT REAR),
   7 (A BACKUP OPTICAL SYSTEM WILL BE USED).

STAR CODE THE DESIGNATION OF THE CELESTIAL BODY TO BE USED. ALL DESIGNATIONS IN OCTAL:
  00-PLANET
  CI/45-STAR
  (FROM STAR CODE LIST)
  46-SUN
  47-EARTH
  50-MCGA

WAIT FOR KEYBOARD ENTRY

TERMINATE
FLASH UPON RECOMPLETE SIGHTING MARK PROCEDURE (REFER AOT MARK ROUTINE R53) ALSO ADHERING TO THE FOLLOWING PRINCIPLES:
   (A) INFLIGHT
      (1) ADJUST AOT RETICLE TO ZERO BEFORE PERFORMING MARKS.
      (2) A MARK IS MADE WHEN THE TARGET BODY
GO TO...<br><br>MAP...<br><br>IN R52, IN R53.<br><br>------------------<br><br>DO FINAL AUTOMATIC REQUEST<br>TERMINATE<br>ROUTINE (KOU)<br><br>------------------<br><br>EXIT R57<br>AND RXK<br><br>"tell"
<br><br>FROM "teller" <br><br>POSS <br><br>MLED <br><br>TO REENTRY <br><br>SHAP <br><br>FLASH VERDNUM <br><br>PLAY REQUIRED

CROSSES THE X OR Y RETICLE LINE BY PRESSING THE APPROPRIATE MARK BUTTON.<br><br>(3) MARKS MUST BE MADE IN X AND Y PAIRS.<br><br>(4) SEQUENCE OF MARKS IN EACH PAIR (X,Y OR Y,X) IS IRRELEVANT.<br><br>(5) MARK REJECTS MAY BE MADE TO THE LEFT OF ONE PAIR OR PARTIAL PAIR.<br><br>(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.<br><br>(7) AFTER EACH PAIR THE CHECK 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; ERASE AWAY ALL DATA ON PRESENT CELESTIAL BODY. SELECT A NEW BODY AND CONTINUE MARKING (KEY IN).
"ENTER", DEFINE NEW BODY AND CONTINUE MARKING.

(a) IN ADDITION TO THOSE PROGRAM ALARMS WHICH MAY OCCUR IN R57 A PROGRAM ALARM MAY OCCUR IN THE FOLLOWING CASE (KEY IN VCSN09 TO IDENTIFY): A "PROCEED" WHEN NC COMPLETE PAIR OF MARKS IS STORED IN THE LGC (CODE 0011).

(b) SURFACE

(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 and spiral angle information have not been loaded.

R57/LUMINARY
(1) 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 50).

(2) Optimaly a mark should be made between its cursor and spiral angle recording which requires that the first angle be written down or remem
bered. (Sky will not request cursor and spiral information until a mark pushbutton action is made.) If that the spiral reading is considered 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 of the LUS to define a final LCS.
(5) AFTER EACH MARK (AS DEFINED IN (B)(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).

(C) INFLIGHT OR SURFACE

(1) THIS ROUTINE AND THE PRESENT ALIGNMENT PROGRAM MAY BE TERMINATED AT ANY TIME BY KEYING IN TERMINATE (V34E).
DO FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (RGG)

EXIT R57 AND PXX

SET MARK PAIR FLAG

STORE CURSOR AND SPIRAL VALUES

IS MARK PAIR FLAG SET?

N
Y

GL TC "A" IN R53

CHECK MARK COUNTER

++03
+EDIT
++

<4
>4
MEM
FROM BELOW.

TURN ON PROGRAM ALARM
AND STORE ALARM CODE
(00107).

IS THE SURFACE FLAG
SET?

N Y

EXIT GO TO
R57 "MEM"
ABCVE

INCREMENT MARK
COUNTER BY 1

GC IC "MEM"
HAS THIS ROUTINE CALLED MY MARK X ACTIVITY?

Y  N

SET MARK IDENTIFIER TO Y.

SET MARK IDENTIFIER TO X.

IS SURFACE FLAG SET?

N  Y

C3  EDIT

ZERO MARK STORE INDEX REGISTER

SET X AND Y MARK FLAGS.

IS MARK P/X FLAG SET?

N  Y

D  E

...
ALAR L CODE

EXIT R57

STORE MARK PARAMETERS FOR USE BY R53

IS SURFACE FLAG SET?

N
Y

GO TO
"O"
ABOVE

SET X MARK OR Y MARK FLAG TO MATCH MARK IDENTIFIER.

ARE X MARK AND Y MARK FLAGS SET?

N
Y

R57/LUMINARY
SET MARK PAIR FLAG

CHANGE CONTROL NOTES

REV 01  EDITORIAL
REV 02 (LUM 1A) PCR 659, EDITORIAL
REV 03  EDITORIAL
CELESTIAL BODY DEFINITION ROUTINE (R58)

PURPOSE:
(1) TO OBTAIN THE CORRECT CELESTIAL BODY VECTOR FROM INFORMATION SPECIFIED BY THE CREW DURING IMU ALIGNMENTS.

ASSUMPTION:
(1) THIS ROUTINE IS AUTOMATICALLY CALLED BY P51, P57, R51 AND R52.

```
PROG CCT
   LGC
   GROUND
   CREW

   LGC
   ROUTINE
   SELECTION
   *
   *
   *
   *

START CELESTIAL BODY DEFINITION ROUTINE (R58)

   *
   *

   IS STAR CODE=XXX00?
   .N  Y.
   *
   *
   *
   *

   WAS THE TARGET DEFINED TO THE LGC A PLANET (R1=XXX00)?
   .Y  N.
   *
   *
   *
   *

   IS THE STAR CODE XXX46, XXX47 OR XXX50?
   .N  Y.
   *
   *
   *
   *
   *

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   EXIT R58
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R58/LUMINARY
```
POSITION VECTOR:

\[ \mathbf{V}_{\text{GEO}} \]
\[ \mathbf{R}_\ell \times \mathbf{F} \mathbf{L} \]
\[ \mathbf{R}_\ell \cdot \mathbf{Y} \mathbf{P} \mathbf{L} \]
\[ \mathbf{R}_\ell \cdot \mathbf{Z} \mathbf{P} \mathbf{L} \]

\[ \mathbf{X} \mathbf{P} \mathbf{L} = \text{THE X COMPONENT OF THE LGC ASSUMED} \]
\[ \text{UNIT POSITION VECTOR AT \text{G} \text{E} \text{T.}, IN REFERENCE} \]
\[ \text{COORDINATES TO THE \text{FIFTH PLACE (XXX..))} \]

\[ \mathbf{Y} \mathbf{P} \mathbf{L} = \text{SAME AS X FOR Y COMPONENT.} \]

\[ \mathbf{Z} \mathbf{P} \mathbf{L} = \text{SAME AS X FOR Z COMPONENT.} \]

\[ \text{WAIT FOR KEYCARD ENTRY} \]

\[ \text{KEY IN PROCEED.} \]

\[ \text{EXIT R58} \]

\[ \text{TERMINATE FLASH LPG \text{A RECEIPT OF PROCEED}\}} \]
\[ \text{OR ENTER (NEW DATA)} \]

\[ \mathbf{P} \]
\[ \mathbf{R} \]
\[ \mathbf{\Delta} \]
\[ \mathbf{E} \]
\[ \mathbf{D} \]

\[ \text{EXIT R58} \]

\[ \text{OF LGC ASSUMED} \]
\[ \text{PLANET POSITION} \]
\[ \text{VECTOR} \]

\[ \mathbf{y} \]
\[ \mathbf{h} \]

\[ \text{ARE THE POSITION} \]
\[ \text{VECTOR COMPONENTS} \]
\[ \text{CORRECT?} \]

\[ \text{KEY IN V25E AND} \]
\[ \text{LOAD THE CORRECT} \]
\[ \text{POSITION VECTOR} \]
\[ \text{COMPONENTS.} \]
CHANGE CONTROL NOTES

REV 01  EDITORIAL
REV 02  EDITORIAL
REV 03  EDITORIAL
LLNAR SURFACE SIGHTING MARK ROUTINE (R59)

PURPOSE:
1. WHILE ON THE LUNAR SURFACE, TO PERFORM ADT SIGHTINGS ON A CELESTIAL BODY (NAVIGATION STAR, PLANET, OR THE SUN) FOR USE BY THE LUNAR SURFACE ALIGN PROGRAM (P57).

ASSUMPTIONS:
1. THIS ROUTINE IS ONLY USED ON THE LUNAR SURFACE.
2. NAVIGATION STARS MAY OR MAY NOT BE VISIBLE. THE SUN OR A PLANET MAY OR MAY NOT BE VISIBLE. ALTHOUGH VISIBLE, THE CELESTIAL BODY MAY BE AT TOO HIGH AN ELEVATION TO BE EFFECTIVE FOR AZIMUTH DETERMINATION DURING THE ALIGNMENT OPTION WHICH REQUIRES A SIGHTING ON ONLY ONE CELESTIAL BODY (OPTION 00003). THE MAXIMUM USEABLE ELEVATION IN THIS CASE IS 70 DEGREES ABOVE THE LUNAR HORIZON. FOR ALIGNMENT OPTIONS REQUIRING SIGHTINGS ON TWO CELESTIAL BODIES THE LOS BETWEEN THESE BODIES SHOULD FORM A MINIMUM ANGLE OF 50 DEGREES.
3. A NEUTRAL DENSITY FILTER FOR THE ADT IS AVAILABLE FOR USE DURING SUN SIGHTINGS.
4. MULTIPLE PAIRS OF SIGHTINGS MAY BE USED TO DETERMINE THE "AVERAGE" LOS VECTOR TO THE BODY.
5. THE REAR DETENTS OF THE ADT MAY BE USED IF NECESSARY.
6. THE ROUTINE IS AUTOMATICALLY CALLED BY THE LUNAR SURFACE ALIGN PROGRAM (P57).

PROG CONT LGC GROUND CREW

... GROUND CREW ...

START LUNAR SURFACE SIGHTING MARK ROUTINE (R59).

IS THE REPSTIFT FLAG SET?

N Y

#10 ...

#20
A PLANET?

**...**

\[ A \quad Y \]

**...**

GO TO

**...**

\[ \mathbf{A} \quad \mathbf{B} \]

BELLOW

**...**

CALCULATE STAR LUS
IN NAV BASE
COORDINATES FROM
STORED STAR DATA

**...**

SET ADT POSITION
CODE TO 1 AND PICK
UP AZ FROM ERASABLE
STORAGE, SET EL TO
+ 45 DEGREES

**...**

CALCULATE OPTICAL
AXIS OF THE ADT FOR
PRESENTLY DETERMINED
ADT POSITION CODE IN
NAVBASE COORDINATES.

**...**

IS THE ANGLE BETWEEN
THE STAR LCS AND THE
+G2
++

Within 30 degrees of the optical axis for any of the 6 AOT positions?

N
Y

Do I wish to proceed without LGC supplied acquisition data?

Y
N

Wait for keyboard entry

Key in recycle V32E

Terminate flash upcall receipt of proceed or recycle

Key in proceed

R  
C  
E  
C  
Y  
C  
E  
E  
F  

Go to
IS THE ANGLE BETWEEN THE STAR LCS AND THE ADT OPTICAL AXIS IN ITS PRESENT POSITION LESS THAN 0.5 DEGREE?

SET REQUIRED CURSOR AND SPIRAL ANGLES TO ZERO

CALCULATE REQUIRED CURSOR AND SPIRAL ANGLES

HOLD FLASH VERB NOUN TO REQUEST RESPONSE AND DISPLAY REQUIRED CURSOR AND SPIRAL ANGLES AND POSITION CODE:

R06 N79 R1=CURSOR ANGLE R2=SPIRAL ANGLE R3=POSITION CODE

MONITOR DSKY: OBSERVE VERB NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF REQUIRED CURSOR AND SPIRAL ANGLES AND ADT POSITION CODE.
CURSOR ANGLE - THE ANGLE DISPLAYED ON THE AUT READOUT COUNTER WHEN THE TARGET IS BRACKETED BY THE CURSOR, IN DEGREES TO NEAREST .01 DEGREE.

SPIRAL ANGLE - THE ANGLE DISPLAYED ON THE AUT READOUT COUNTER WHEN THE TARGET IS BRACKETED BY THE SPIRAL, IN DEGREES TO NEAREST .01 DEGREE.

POSITION CODE - THE AUT POSITION TO BE USEC FOR THE SIGHTING: 1, 2, 3 = FORWARD POSITIONS; 4, 5, 6 = REAR POSITIONS.

ARE THESE ACQUISITION CONDITIONS ACCEPTABLE SO THAT I DO NOT WISH TO SELECT ANOTHER TARGET?

Y N.

WAIT FOR KEYBOARD ENTRY

KEY IN RECYCLE VISE
ATTITUDE MANEUVER ROUTINE (R60)

PURPOSE:
(1) TO MANEUVER THE LM TO AN ATTITUDE SPECIFIED BY THE PROGRAM IN PROCESS.

ASSUMPTIONS:
(1) THE FINAL ATTITUDE DESIRED, DEFINED AS FOLLOWS, HAS BEEN STORED BY THE CALLING PROGRAM:
(A) A SPECIFIC BODY FIXED VECTOR AND A DIRECTION IN SPACE TO WHICH THIS VECTOR IS TO BE ALIGNED (THE 3-AXIS FLAG IS RESET).
(B) A THREE AXIS (ORTHOGONAL) INERTIAL ORIENTATION TO WHICH THE THREE BODY AXES ARE TO BE ALIGNED (THE 3-AXIS FLAG IS SET).

(2) THE MANEUVER MAY BE PERFORMED AUTOMATICALLY BY THE PGACS OR PERFORMED MANUALLY WITH AN OPTIONAL FINAL AUTOMATIC PGACS-CONTROLLED TRIM MANEUVER. THIS OPTIONAL TRIM MANEUVER SHOULD BE CONSIDERED ESSENTIAL FOR MANEUVERS TO THRUSTING ATTITUDES.

(3) THE DockED CONFIGURATION OF THE VEHICLES HAS BEEN CORRECTLY DEFINED TO THE LGC VIA R03.

(4) THE PGACS CAN GENERATE TWO TYPES OF ATTITUDE ERRORS FOR DISPLAY ON THE FDO:
MODE I - SELECTED BY EXTENDED VERB 61, AUTOPILOT FOLLOWING ERRORS USED AS A MONITOR OF THE DAP'S ABILITY TO TRACK AUTOMATIC STEERING COMMANDS.
MODE II - SELECTED BY EXTENDED VERB 62, TOTAL ATTITUDE ERRORS USED TO ASSIST CREW IN MANUALLY MANEUVERING THE VEHICLE.
PGACS-DERIVED VEHICLE ATTITUDE RATES MAY ALSO BE DISPLAYED VIA SELECTION BY EXTENDED VERB 60.
MODE II ATTITUDE ERROR DISPLAYS ARE AUTOMATICALLY SELECTED AT THE BEGINNING OF R60. (SEE ASSUMPTION (12) BELOW).
DISPLAY SELECTION IS ALWAYS BASED UPON THE LAST ENTRY MADE IN THE DSKY. FOR A MORE DETAILED DESCRIPTION OF THESE DISPLAYS, REFER TO SECTION 3 OF R567, PARA. 3.2.6.

(5) THE DAP DATA LOAD ROUTINE (R03) HAS BEEN PERFORMED PRIOR TO THIS ROUTINE.

(6) THE ATTITUDE DEADBAND USED BY THIS ROUTINE WILL BE THAT MOST RECENTLY SELECTED BY THE ASTRONAUT VIA R03, UNLESS THAT DEADBAND HAS BEEN OVERRIDEN IN THE PROGRAM IN PROCESS IN WHICH CASE THE PROGRAM-SPECIFIED DEADBAND WILL BE USED.

(7) THE ATTITUDE MANEUVER RATE FOR AN AUTOMATIC MANEUVER WILL BE THAT WHICH WAS LAST SPECIFIED BY THE ASTRONAUT VIA R03.

(8) THE X-AXIS OVERRIDE OPTION IS NOT INHIBITED DURING THIS ROUTINE, BUT IT SHOULD NOT BE EXERCISED WHEN THE LGC IS SPECIFYING A DESIRED YAW ATTITUDE, I.E.: DURING AN AUTOMATIC LGC-CONTROLLED MANEUVER.

(9) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE PROGRAM OR ROUTINE REQUIRING THE ATTITUDE MANEUVER.

(10) IF THIS ROUTINE WAS SELECTED BY THE PREFERRED TRACKING ATTITUDE ROUTINE (R61) OR THE FINE PREFERRED TRACKING ATTITUDE ROUTINE (R65), THE VSN18 AND THE VSN18 IN THIS ROUTINE ARE PRIORITY DISPLAYS. THE VSN18 DISPLAY WILL REPAIR IF A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

(11) WHEN THIS ROUTINE IS SELECTED BY A PROGRAM OTHER THAN R20 OR R25, ALL DISPLAYS ARE NORMAL.

(12) WHEN THIS ROUTINE IS SELECTED, THE ATTITUDE ERROR NEEDLE DRIVE IS AUTOMATICALLY SET TO MODE 2 ATTITUDE ERRORS, AND IS NOT SUBSEQUENTLY RESET BY THIS ROUTINE.
START ATTITUDE MANEUVER ROUTINE (R6G)

SPECIFY MODE 2 ATTITUDE ERROR DISPLAY TO DAP

SET NEEDLE FLAG

RESET NEED2FLG

OBTAIN DESIRED ATTITUDE SPECIFICATION FROM THE CALLING PROGRAM
IS THE 3-AXIS FLAG SET?

- **N**
- **Y**

CALCULATE FINAL VEHICLE ATTITUDE (CDU/GIMBAL ANGLES) TO MEET THE DESIRED ATTITUDE SPECIFICATION (VECPNT ROUTINE). THIS FINAL VEHICLE ATTITUDE WILL BE CALCULATED TO MEET THE ATTITUDE SPECIFICATION IN SUCH A WAY AS TO CONSERVE RCS FUEL AND NOT CONSTRAINT ANY UNSPECIFIED DEGREE OF FREEDOM.

- **SELECT CDU/GIMBAL ANGLES CORRESPONDING TO FINAL VEHICLE ATTITUDE AND PRESENT IMF ORIENTATION**

TRANSFORM FINAL CDU/GIMBAL ANGLES TO
**FINAL FDAI BALL ANGLES**

---

**FLASH VERB-NOUN TO REQUEST PLEASE PERFORM AUTO MANEUVER AND DISPLAY FINAL FDAI BALL ANGLES:**
- V50 N18
- R1-RCLL
- R2-PITCH
- R3-YAW

**ROLL, PITCH, YAW - FINAL FDAI BALL ANGLES, IN DEGREES TO NEAREST .01 DEGREE.**
- **NOTE:** IF THE FINAL FDAI BALL ANGLES COMPELTE RESULT IN 180 - 90 DEGREES YAW, THE TRANSFORMATION FROM THE FDAI IN ROLL AND PITCH IS INDETERMINATE, AND R1 AND R2 WILL BE SET TO ZERO. FOR YAW ANGLES NEAR 180 - 90 DEGREES, THE VALUES OF R1 AND R2 MAY NOT BE RELIABLE.

---

**REVIEW THE DISPLAYED FINAL FDAI BALL ANGLES AND THE PRESENT ATTITUDE, ARE I WITHIN THE PRESENT RCS CAP DEADBAND LIMITS IN EACH AXIS?**

- Y

---

**WAIT FOR KEYBOARD ENTRY**

---

**DO I WISH TO FURTHER**
VIA RE2 (R RE3), Y

RESET THE 3-AXIS FLAG

EXIT R60

1) IS THE CURRENT PROGRAM P20 OR P25? (R60 MUST THEN HAVE BEEN CALLED BY R61 OR R65).

Y

DO THE FINAL AUTOMATIC REQUEST TERMINATE ROUTINE (R00)

EXIT R60

2) THE TERMINATE TRACKING ROUTINE

SHALL I HAVE THE LGT RE- COMPUTE THE DESIRED ATTITUDE?

Y

PLACE MODE CONTROL SWITCH IN ATT HOLD

SHALL I HAVE THE PGNC'S PERFORM THE MANEUVER AUTOMATICALLY?

Y

N
(R56)

EXIT
R60

IS THE 3-AXIS FLAG SET?

N  Y

SELECT PGN CONTROL MODE AND SELECT THE AUTO MODE.

SHALL I HAVE THE PGN'S RECOMPUTATE THE DESIRED ATTITUDE WITHOUT PERFORMING THE AUTOMATIC MANEUVER?
(NOT POSSIBLE FOR ALL CASES. SEE ASSUMPTION 1)

Y  N

CALCULATE FINAL VEHICLE ATTITUDE (COL/L/GIMBAL ANGLES) TO MEET THE DESIRED ATTITUDE SPECIFICATION (VECPNT ROUTINE). THIS FINAL VEHICLE ATTITUDE WILL BE CALCULATED TO MEET THE
TRANSFORM FINAL CDL/ GIMBAL ANGLES TO FINAL FOAI BALL ANGLES

---

HAS RCS CONTROL MODE BEEN SELECTED?

- N
- Y

---

HAS THE AUTOG ATTITUDE CONTROL MODE BEEN SELECTED?

- Y
- N

---

TEMP HOLD SNAP

DISPLAY FINAL FOAI BALL ANGLES
- V06A18
- R1-RCIL
- R2-PITCH
- R3-YAW

ALL ANGLES IN DEGREES TO THE NEAREST .1 DEGREE

---

MONITOR DSky:
- OBSERVE NON-FLASING VERB- NOUN DISPLAY OF FINAL FOAI BALL ANGLES UNTIL COMPLETION OF THE AUTOMATIC MANEUVER.

---

#350

#360

#370

#380

#390

1195 R60/LUMINARY R60/COLOSSUS
DO MANEUVER
CALCULATION
(KACMANU) AND
ICDU DRIVE
ROUTINE TO
ACHIEVE FINAL
CDU/GIMBAL
ANGLES. THE
MANEUVER RATE
WILL BE THAT
LAST DEFINED
TO THE LP BY DSKY
ENTRY. THIS
PROCESS WILL
INCLUDE A MONI-
TORY OF THE
ACA INPUTS TO
THE LMS ANY
INPUT FROM THE
ACA WILL BE
INTERPRETED AS
A MANUAL OVER-
RIDE AND WILL
CAUSE IMMEDI-
ATE TERMINA-
TION OF THIS
MANEUVER CAL-
CULATION AND
ICDU DRIVE
ROUTINE.

MONITOR ATTITUDE
MANEUVER BY
REFERENCE TO FCAI
BALL AND ATTI-
ITUDE ERROR
NEEDLESS TO AVOID
GIMBAL LOCK.

SHALL I OVERRIDE
THE PGNCS AND
COMPLETE THE MAN-
EUVER MANUALLY?

PERFORM ATTITUDE
MANEUVER MANUALLY
USING ACA AND BY
REFERENCE TO THE
OUT-OF-WINDOW
VIEW AND/OR THE

\#400
\#410
\#420
\#430
\#440
CHANGE CONTROL NOTES

LOGIC REV 01 PCB 5, 86, 164, 236, 234, 423, 446, 637
REV 02 (LUM 1E) PCB 841, EDITORIAL
REV 03 EDITORIAL
PREPARED TRACKING ATTITUDE ROUTINE (R61) REV 03 12/03/69

PURPOSE:
1. To perform a single automatic trim maneuver to the preferred tracking attitude if maneuver required is less than a specified function or, if not, to notify the crew that an attitude maneuver to the preferred tracking attitude is required via R60.
2. To compute the preferred tracking attitude of the LM which enables RR tracking of the CSM, and CSM tracking of the LM beacon.

ASSUMPTIONS:
1. The preferred tracking attitude is defined as follows:
   - LM +Z axis is aligned along the LGS to the CSM.
   - Roll attitude (about LM +Z axis) is undefined, but maintained at the orientation resulting from the R60 maneuver, or from manual crew adjustment.
2. The routine is automatically called by the rendezvous navigation program (P20), the RR manual acquisition routine (R23), and the RR search routine (R24).

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* LGC
  * ROUTINE
  * SELECTION
  *

--------------
START PREFERRED
TRACKING ATTITUDE
ROUTINE (R61)
--------------

--------------
SET R61 FLAG
--------------

#10

#20

R61/LUMINARY
IS TRACK FLAG SET?

V
N
++
+03
+EDIT
++

EXTRAPOLATE LM AND CSM STATE VECTORS TO PRESENT TIME PLUS 3 SECONDS USING LAGRANGE EQUATIONS

CALCULATE LUS VECTOR FROM LM TO CSM.
USING VELPOINT, COMPUTE THE DESIRED IMU
GIMBAL ANGLES TO ALIGN THE LM +Z AXIS
ACROSS THE LCS TO THE CSM (BASED ON
CURRENT DESIRED IMU GIMBAL ANGLES).

HAVE GNSS CONTROL AND ALTIMETRIC ATTITUDE
CONTROL MODES BEEN SELECTED?

TRANSFORM
DESIRED IMU ANGLES TO FINAL FCAI
BALL ANGLES AND STORE AS N10

GO TO "AN" BELOW

IS THE LM/CSM LCS LOS
GREATER THAN 15 DEGREES FROM THE LM
+Z AXIS?
ISSUE DESIRED IMC GIMBAL ANGLES DIRECTLY TO THE RCS CAP.

RESET 3-AXIS FLAG

SET PRIORITY DISPLAY FLAG

COMMAND ZERO ATTITUDE ERRORS

SET 0.3 DEGREE CEILING.

DO ATTITUDE MANEUVER ROUTINE (R60).

DO ATTITUDE MANEUVER ROUTINE (R60).
SET DEADBAND TO PREVIOUS VALUE DEFINED BY RC3

---

RESET PRIORITY DISPLAY FLAG

---

"A" FROM ABOVE

---

IS R61 FLAG SET?

- Y
- N

---

EXIT R61/R65

---

IS NZ ZERC?

- Y
- N

---

EXIT

---
CREW-DEFINED MANEUVER ROUTINE (R62)

PURPOSE:
(1) To provide the crew with the ability to specify a final vehicle attitude for use by an LGC-controlled attitude maneuver.

ASSUMPTIONS:
(1) The routine is manually selected by the astronaut by DSKY entry.
(2) The DAP deadband during this routine is as defined by the DAP data load routine (R03).
(3) This routine can only be entered from the LGC idling program (POD).

PROG CONT

LGC GROUND CREW

* CREW
  * ROUTINE
  * SELECTION

START CREW-DEFINED MANEUVER ROUTINE (R62)

---

IS THE LGC IDLING PROGRAM (POD) IN PROGRESS?

Y  N

---

TURN ON OPERATOR ERRACK LIGHT

---

MONITOR DSKY:
DOES OPERATOR ERROR LIGHT COME ON INDICATING THAT THIS ROUTINE CAN NOT BE SELECTED AT THIS
ALL GIMBAL ANGLES IN DEGREES TO NEAREST 0.1 DEGREE.

WAIT FOR KEYBOARD ENTRY

TERMINATE, FLUSH UPON RECEIPT OF PROCEED, TERMINATE, OR NEW DATA.

STORE DATA

GO TO "A" BELG.

SET 3-AXIS FLAG

DO I WISH TO KEY IN NEW GIMBAL ANGLES TO BE USED BY ROUTINE R607?

KEY IN V25E AND LOAD NEW GIMBAL ANGLES

KEY IN PROCEED

TERMINATE, OR NEW DATA.
DO ATTITUDE MANEUVER Routines (R60)

\[ \text{"A" FROM ABOVE} \]

RESET EXTENDED VERB ACTIVE FLAG AND NO MARKS ALL ZERO FLAG

EXIT R62

CHANGE CONTROL NOTES

REV 01 EDITORIAL
REV 02 EDITORIAL
REV 03 EDITORIAL
RENDEZVOUS FINAL ATTITUDE ROUTINE (R63)

PURPOSE:
1. TO CALCULATE AND DISPLAY THE FINAL FDLI BALL ANGLES REQUIRED TO POINT THE LM +Z OR +X AXIS AT THE CSM.
2. TO CALL THE ATTITUDE MANEUVER ROUTINE (R60) FOR AUTOMATIC MANEUVER CAPABILITY.

ASSUMPTIONS:
1. THE LM ATTITUDE CONTROL MODE SHOULD BE PRESELECTED FOR AUTOMATIC MANEUVERS; R03 SHOULD HAVE BEEN DONE AND THE AUTO MODE SELECTED.
2. THIS ROUTINE CAN ONLY BE SELECTED DURING THE LGC IDLING PROGRAM (POO).
3. THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY CSM INPUT.

PROG CONT

LGC GROUND CREW

---

START RENDEZVOUS

FINAL ATTITUDE ROUTINE (R63)

---

IS THE LGC IDLING PROGRAM (POO) IN PROCESS?

---

TURN ON OPERATOR ERROR LIGHT

---

MONITOR CSM: DOES OPERATOR ERROR LIGHT COME ON INDICATING THAT THIS ROUTINE CAN NOT BE SELECTED AT THIS
TIMEF? (Note: to enable selection of this routine the LGC IDLING program (POO) must be in process.)

Y

N

Press alarm reset

Y

N

Do extended verb interlock routine (R76)

Do extended verb interlock routine (R76)

Do IMU status check routine (R02)

Do IMU status check routine (R02)

Set LGC assumed option to CCO1

EXIT R63
GO TO "AN ANALYSIS" BELOW

EXTRAPOLATE LM AND CSM STATE VECTORS FORWARD TO THE PRESENT TIME PLUS 1 MINUTE USING CONIC EQUATIONS

CALCULATE THE LINE OF SIGHT VECTOR LCS FROM LM TO CSM

IS THE TRACKING ATTITUDE OPTION =
**EDIT**

**#3**

CALCULATE THE SELECTED ATTITUDE AT THE ATTITUDE LIMITS.

**#4**

SELECTS (PREFER) THE SELECTED ATTITUDE AT THE LIMITS.

**#5**

LIMITS OF THE SELECTED ATTITUDE AT THE LIMITS.

**#6**

LIMITS OF THE SELECTED ATTITUDE AT THE LIMITS.

**#7**

LIMITS OF THE SELECTED ATTITUDE AT THE LIMITS.

**#8**

LIMITS OF THE SELECTED ATTITUDE AT THE LIMITS.
SCORE ATTITUDE
SPECIFICATION FOR
SELECTED AXIS (+2 OR
+A) TRACKING ATTITUDE FOR USE BY THE
ATTITUDE MANEUVER
ROUTINE (REG).

-----------------------------

HOLD

FLASH VERB-NOUN
TO REQUEST RESPONSE
AND DISPLAY COMPUTED
FDAA BALL ANGLES:
V=0, N=18
R1-ROLL
R2-PITCH
R3-YAW

ALL FDAA BALL ANGLES
IN DEGREES TO THE
NEAREST .01 DEGREE

-----------------------------

SNAP

MONITOR OXY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
COMPLETED FDAA BALL
ANGLES.

-----------------------------

SHALL I ALLOW
THE LGC TO
DRIVE THE LM
TO THE DESIRED
ATTITUDE?

Y   N

-----------------------------

DO I WISH TO
UPDATE THIS
DISPLAY?

N   Y
WAIT FOR KEYBOARD ENTRY

---------

KEY IN RECYCLE V32E

---------

KEY IN TERMINATE V34E

---------

TERMINATE FLASH UPDA RECEIPT OF PROCEED.
RECYCLE CR TERMINATE

---------

R  P  T
E  R  E
C  D  R
Y  C  M
C  E  I
L  E  N
E  D  A

.... EXIT R63

....

GO TO "A"

BETWE

---------

RESET 3-AXIS FLAG

---------
DO ATTITUDE MANEUVER ROUTINE R60

"A" FROM ABOVE

EXIT R63

RESET EXTENDED VERB ACTIVE AND NC MARKS ALLOWED FLAGS.

EXIT R63

CHANGE CONTROL NOTES

REV 01 PCR 45C, 498, 531
REV 02 EDITORIAL
REV 03 EDITORIAL

1220
K63/LUMINARY
R63/SUNDANCE

#330

#340

#350
FINE PREFERRED TRACKING ATTITUDE ROUTINE (R65)

PURPOSE:
1. To perform a continuous series of automatic trim maneuvers to the preferred tracking attitude if each maneuver required is less than a specified function or, if not, to notify the crew that an attitude maneuver to the preferred tracking attitude is required via R60.

2. To compute the preferred tracking attitude of the LM which enables RR tracking of the CSM and CSM tracking of the LM beacon.

ASSUMPTIONS:
1. The preferred tracking attitude is defined as follows:
   a. The LM +Z axis is aligned along the LOS to the CSM.
   b. The roll attitude (about LM +Z axis) is undefined, but maintained at the orientation resulting from the R60 maneuver, or from manual crew adjustment.

2. This routine will iterate N2 times, where N2 is defined by the calling program/routine.

3. The routine is automatically called by the preferred tracking attitude program (P25), and the RR data read routine (R12).

PROG CONT LGC GROUND CREW

* LGC
* ROLTOE
* SELECTION
* ...

START PREFERRED TRACKING ATTITUDE ROUTINE (R65)

RESET R61 FLAG

R65/LUMINARY

GIMBAL ANGLES TO
ALIGN THE LM +Z AXIS
ALONG THE LOS TO THE
CSM BASED OA
+02 CURRENT DESIRED
+EDIT IMU GIMBAL
ANGLES

HAVE FGAS CONTROL
AND ALT ALTITUDE
CONTROL MODES BEEN
SELECTED?

N Y

TRANSFER
DESIRED IMU
ANGLES TO
FINAL FAIR
BALL ANGLES
AND STORE AS
NIB

GO TO
MAN
BELOW

IS THE LM/CSM LOS
GREATER THAN 15
DEGREES FROM THE LM
+Z AXIS?

N Y

IS THE LM/CSM LOS
GREATER THAN 15
DEGREES FROM THE LM
+Z AXIS?

Y N
ISSUE DESIRE
IMU GIMBAL
ANGLES DIRECTLY
to the RCS DAP.

RESET THE 3-AXIS
FLAG

SET PRIORITY
DISPLAY FLAG

COMMAND ZERO
ATTITUDE ERRORS

SET -3 DEGREE
DEADBAND

DO ATTITUDE MANEUVER ROUTINE
(RR41).

DO ATTITUDE MANEUVER ROUTINE
(RR60).
SET DEADBAND TO PREVIOUS VALUE DEFINED BY R03.

RESET PRIORITY DISPLAY FLAG

"N" FROM ABOVE

IS R61 FLAG SET?

EXIT R61/R65

IS NZ ZERO?
CHANGE CONTROL NOTES

LOGIC REV 01 PCR 39,634
LOGIC REV COLUUM 1A PCR 642,716
LOGIC REV 01(LUM 1B) PCR 76C
REV 02 EDITORIAL
EXTENDED VERB INTERLOCK ROUTINE (R76)

REV 02 12/03/69

PURPOSE: (1) TO INHIBIT SELECTION OF EXTENDED VERBS UNDER CERTAIN CIRCUMSTANCES.

ASSUMPTIONS: (1) THIS ROUTINE IS CALLED BY THE FOLLOWING EXTENDED VERBS: V41R2C, V41R7?, V42, V43, V47(R47), V48(R03), V49(R62), V55, V57, V63(R04), V64(R05), V67, V70(P27), V71(P27), V72(P27), V73(P27), V82(R30), V83(R31), V85, V89(R63), V90(R36), V91, V92

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---
START EXTENDED VERB INTERLOCK ROUTINE (R76) #10

---

IS THE EXTENDED VERB ACTIVE FLAG SET? #20

---

IS THE NO MARKS ALLOWED FLAG SET? #30

---
TURN ON OPERATOR ERROR LIGHT

EXIT R76 AND EXTENDED VERB SELECTED.

SET AC PARKS ALLOWEE FLAG

SET THE EXTENDED VERB ACTIVE FLAG

DISPLAY CURRENT MAJOR MODE AND CALLED VERB ON DSKY-BLANK NCLA, R1, R2, AND R3

EXIT R76

EXIT R76

AND EXTENDED VERB SELECTED
CHANGE CONTROL NOTES

REV 01 (ND PKS)
REV 02 EDITICIAL
LR SPURIOUS TEST ROUTINE (R77)  

PURPOSE:  
(1) TO READ OUT THE RANGE AND VELOCITY DATA FROM THE LANDING RADAR (LR) AND PUT IT ON THE LGC DOWNSINK DURING LR SPURIOUS RETURN TESTS.

ASSUMPTIONS:  
(1) THE LR DATA IS PLACED ON THE DOWNSINK REGARDLESS OF THE STATUS OF THE LR RANGE DATA GOOD AND VELOCITY DATA GOOD DISCRETESS.

++
**03**
*EDIT
+03
++

(2) THIS ROUTINE IS MANUALLY SELECTED BY DSKY ENTRY (V79E) AND MAY BE CALLED ONLY WHEN NO OTHER PROGRAM OR ROUTINE IS USING EITHER RADAR. THE ROUTINE MUST BE TERMINATED BY MANUAL DSKY ENTRY (V79E).

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START LR SPURIOUS TEST ROUTINE (R77)  

---

KEY IN V79E  

---

IS THE NO R29 FLAG SET?  

---

Y  N  

---

IS THE R77 FLAG SET?  

---

N  Y  

---

IS THE V37 FLAG SET?  

---

N  Y  

---

IS THE LR  

---

R77/LUMINARY
BYPASS FLAG SET?
  ----------------
  Y N

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

++ +03 +EDIT +03 ++

IS THE R04 FLAG SET?

TLRAC OA OPERATOR ERROR LIGHT

MONITOR DSKY: DOES OPERATOR ERROR LIGHT INDICATE THAT THIS ROUTINE CANNOT BE SELECTED AT THIS TIME?
  -------------
  Y N

++ +03 +EDIT + +03 ++

TERMINATE PROGRAM OR ROUTINE WHICH IS PREVENTING SELECTION OF R77, THEN RESELECT THIS ROUTINE BY KEYING IN V78E.

---

SET THE R77 FLAG

---

EXIT R77
SAMPLING
----------------------

----------------------

WAIT 0.32 SECONDS
----------------------

----------------------

RESET R77 FLAG
----------------------

CHANGE CONTROL NOTES

LOGIC REV 01 PCB 225
REV 02 EDITORIAL
REV 03 EDITORIAL

109F

R77/LUMINARY
4.4.11 EXTENDED VERB LUM (V36)

---

TITLE

V36 REQUEST FRESH START
V40N20 ZERG IMU CCDU
V40N72 ZERO RR CDLS
V41N20 COARSE ALIGN IMU CCDU
V41N72 COARSE ALIGN RR CDUS
V42 FINE ALIGN IMU
V43 LCAC FCAI ERRMR MEELES
V44 TERMINATE RR CONTINUOUS DESIGNATE
V47 INITIALIZE AGS, R47
V48 START CAP DATA LOAD, RO3
V49 START CREW-DEFINED MANEUVER, R62
V50 PLEASE PERFORM
V52 MARK X-RETICLE
V53 MARK Y-RETICLE
V54 MARK X-OR Y-RETICLE
V55 INCREMENT LOC TIME (CIRCULAR)
V56 REQUEST TERMINATE TRACKING ROUTINE
V57 PERMIT LANDING KODAR UPDATE
V58 INHIBIT LANDING KODAR UPDATE
V59 COMMAND LR TO POSITION 2
V60 DISPLAY VEHICLE RATES
V61 DISPLAY CAP ATTITUDE ERROR
V62 DISPLAY TOTAL ATTITUDE ERROR

EXTVERBS/LUM
4.4.11

REV 01 08/07/69
V63 START RR/LR SELF TEST ROUTINE, R04
V64 START S-BAND ANTENNA ROUTINE, R05
V65 DISABLE U,V JETS DURING DPS BURNS
V66 VEHICLES ATTACHED, MOVE THIS VEHICLE STATE VECTOR TO OTHER VEHICLE STATE VECTOR
V67 W MATRIX RMS ERROR DISPLAY

V69 RESTART

V70 START LGC UPDATE: LIFTOFF TIME
V71 START LGC UPDATE: BLOCK ADDRESS
V72 START LGC UPDATE: SINGLE ADDRESS
V73 START LGC UPDATE: LGC TIME (OCTAL)
V74 INITIALIZE ERASABLE DUMP VIA DOWNLINK
V75 ENABLE L,V JETS DURING DPS BURNS
V76 MINIMUM IMPULSE COMMAND MODE
V77 RATE COMMAND AND ATTITUDE HOLD MODE
V78 START LR SPURIOUS TEST, R77
V79 STOP LR SPURIOUS TEST, R77
V80 ENABLE LM STATE VECTOR UPDATE
V81 ENABLE CSM STATE VECTOR UPDATE
V82 REQUEST ORBIT PARAMETER DISPLAY, R30
V83 REQUEST RENDEZVOUS PARAMETER DISPLAY, R31
V85 DISPLAY RR LOS AZIMUTH AND ELEVATION
V89 START RENDEZVOUS FINAL ATTITUDE MANEUVER, R63
V90 REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY, R36
V91 DISPLAY BANKS
V92 START IMU PERFORMANCE TESTS (GROUND USE)
V93 ENABLE W MATRIX INITIALIZATION
V95 NO UPDATE OF EITHER STATE VECTOR
V96 INTERRUPT INTEGRATION AND GO TO PCC
V97 PERFORM ENGINE FAIL PROCEDURE
V99 ENABLE ENGINE IGNITION
THIS PAGE INTENTIONALLY LEFT BLANK
V36, REQUEST FRESH START

PURPOSE:
(1) TO INITIATE A COMPUTER FRESH START.

ASSUMPTION:
(1) THIS PROCESS MAY BE SELECTED AT ANY TIME.

(2) FRESH START CAN BE INITIATED IN ANY OF THE FOLLOWING WAYS:
   (A) VIA PROGRAM IF PHASE TABLE DISAGREEMENT IS DETECTED FOLLOWING A RESTART (ALARM CODE 01107).
   (B) VIA PROGRAM IF SELF CHECK IS INTERRUPTED BY A RESTART DURING ITS ERASABLE MEMORY CHECK AND ERASABLE MEMORY IS SUSPECT.
   (C) BY SIMULTANEOUS DEPRESSING OF THE MARK REJECT AND ERROR RESET BUTTONS DURING A RESTART.
   (D) CSKY ENTRY OF V36E.

NOTE: A COMMANDED FRESH START (V36) WILL TURN OFF THE ENGINE, AS WILL PRESSING "MARK REJECT" AND "ERROR RESET" DURING A RESTART.
   Thus: "A" and "B" do NOT shut OFF the DPS OR APS, "C" and "D" WILL shut OFF the DPS or APS.

(3) IF FRESH START INTERRUPTS STATE VECTOR INTEGRATION, THE STATE VECTOR MAY BE INVALIDATED.

NOTE: LGC FRESH START INITIALIZES ALL FLAGWORDS (SEE EXCEPTIONS BELOW), CLEARS ALL JOB CORE SET AND VAC AREAS, SETS WAITLIST TASKS TO ENDDTASK, INITIALIZES ALL OUTPUT CHANNELS, INITIALIZES DAP IDLING PROGRAM, INITIALIZES DOWNSHIFT TO DOWNSHIFT, DOWNSHIFT, BLANKS THE DSKY, AND EXITS TO AN IDLING STATE (DUMMY JOB).

LGC FRESH START DOES NOT ALTER THE STATE OF THE FOLLOWING FLAG BITS:
(1) APSFLAG, WHICH INDICATES IF THE DESCENT STAGE IS ATTACHED.
(2) SURFACE FLAG, WHICH INDICATES IF THE LM STATE IS ON THE LUNAR SURFACE.
(3) LMOONFLAG, WHICH INDICATES IF THE LM STATE IS EARTH OR LUNAR CENTERED.
(4) CMOONFLAG, WHICH INDICATES IF THE CSM STATE IS EARTH OR LUNAR CENTERED.
(5) REFSSMAT FLAG, WHICH INDICATES IF REFSSMAT IS VALID.

PROG CONT

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<td>FRESH START</td>
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KEY IN V36E

---

#10

V36/LUMINARY
INITIALIZE DOWNLIST
POINTER TO KITRANS-
PUT CURRENT DOWNLIST
AT NEXT 2C MS
DOWNRPT.

UPDATE STATUS OF LR
POSITION FLAG.
SET RR ALTC RCDE AND
CUD NOT FAILED FLAGS

SET TIME 3 = 37777,
TIME 4 = 37775,
TIME 5 = 37774

RESET I/ACC JOB
CONTROL EIT IN
RC6FLAGS.

DISABLE TIME 6 CLOCK

RESTORE STATUS OF
CHANNEL 13 BITS
RESET ACCSUKAY FLAG

INITIALIZE TSRLPT FOR EARPIER PROGRAM

ZERO CLTBIT CHANNEL 11 (EXCEPT ENGINE ON CR OFF, AND ISS WARNING)

RESET REAC R FLAG

IS NO R-29 FLAG SET?

V

RESET DESIGNATE FLAG

RESET REMODE, RR CDL ZERG, REPOSITION, AND RR TURN-ON FLAGS
ZERG CLIBIT CHANNEL 12 (EXCEPT RR LUCKEN, GIMBAL, TRIM DRIVES, ENABLE IMU ERROR COUNTERS, ZERG IMU CDUS, AND COARSE ALIGN ENABLE).
ENABLE

---

---

TERMINATE ALL WAIT-LISTED TASKS

---

---

CLEAR ALL EXECUTIVE REGISTER SETS

---

---

INDICATE NO ACTIVE JOBS

---

---

MAKE ALL VAC AREAS AVAILABLE

++

03

EDIT

++

BLANK DSKY REGISTERS

(PROGRAM, VERB,
NOUN R1, R2, R3).

---

---

PERMIT ACT MARK
ACTIVITY

---
RESET EXTENDED VERB ACTIVITY INTERLOCK

INITIALIZE IPL FLAGS

RESET DISPLAY/ASTRAL INTERFACE FLAGS

INITIALIZE RACAR READ

INITIALIZE MODE 33 FLAG: SET NC PIPA FAIL BIT; SET DOWN-LINK AND UPLINK CK BITS; RESET ALL OTHER BITS

CLEAR SELF CHECK ERROR REGISTERS

SET ENGINE OFF (BIT 14 IN CHANNEL 11)
INITIALIZE ATTITUDE ERROR DISPLAY FLAGS

INITIALIZE DAP

INITIALIZE DOWNLINK WITH POO DOWNLIST

PERMIT AGS INITIALIZATION

ZERO UPDATE STATE VECTOR INDICATOR

ZERO OUTBIT CHANNELS 5, 6, 12, 13, AND 14

IS ISS IN COARSE ALIGN MODE AND IN GIMBAL LOCK?

N

Y
ENABLE CCWSE
ALIGN MODE

CLEAR PHASE TABLE

LOAD -O INTO MUCKREG

INITIALIZE IMU
(INHIBIT IMU FAIL)

SET MAXIMUM DEADBAND,
KALMAN RATE AND
CAP FLAG WORDS

INHIBIT CAP TURM CN
AND ERROR NEEDLE
DISPLAY UNTIL ICUS
ARE ZEROED

RESET ALL FLAG WORDS
(EXCEPT REFSPMT)
SURFACE, CMDONFLG, LMDONFLG, AND APS FLAGS. SET THE NO R25, IDLE, AND LR BYPASS FLAGS.

* * *
* * *
* *
EXIT

CHANGE CONTROL NOTES

LOGIC REV 00 PCR 496
REV 01 EDITORIAL
REV 02 EDITORIAL
REV 03 EDITORIAL
V4CN2C, ZERC IMC COLS

PURPOSE:
1. To assure synchronization of the IMU CDU counters and the ICDO counters in the LGC.
2. To terminate the IMU coarse align mode and enter the inertial mode.

ASSUMPTIONS:
1. This extended verb (V4ON20) may be crew-selected by DSKY entry. A valid IMU zero (synchronization of CDU counters) can be achieved only if the ISS is energized (no alarm 0021). This process may be selected even if another extended verb is being processed, aside from the ICDO zero procedure which forms a normal part of the ISS turn-on. The astronaut can command ICDO zero procedures only by calling R47 (via V47).
2. V40 may not be selected if IMU mode switching is in progress, nor if gyro torquing is in progress, nor if the IMU is in the coarse align mode and in gimbal lock.
3. This verb disables the DAP for approximately 10 seconds.

PROG CONT LGC GROUND CREW
CREW SELECTION
START CREW INITIATED
ICDO ZERO

IS MODE SWITCHING OR
GYRO TORQUING IN
PROGRESS?

TURN ON OPER-
ATCR ERROR
LIGHT

OBSERVE OPERATOR
ERROR LIGHT FOR
INDICATION OF IMPRO-
PER PROCEDURE

V4ON20/LUM

#10
#20
#30
ENTER ICGU ZERO MODE

----

TURN OFF NO ATT LAMP

----

OBSERVE THAT NO ATT LAMP IS OFF, INDICATING THAT THE ISS IS NOT IN COARSE ALIGN MODE.

----

COMMAND CAP OFF.

----

SET ICGU ZERO DISCRETE

----

CLEAR COARSE ALIGN AND ICGL ERRER COUNTER ENABLE DISCRETES
SET IMU IMU FAIL DISCRETE

SET IMU IMU FAIL DISCRETE

ZEKE LGC LGC COUNTERS

IS IMU UNIT

Y
N

TURN ON PROGRAM
ALARM AND SPEKE
ALARM CODE
(C0210)

MONITOR DSky:
DOES PROGRAM ALARM
LIGHT INDICATE
ABNORMALITY?

Y
N

CALL PROGRAM
ALARM DISPLAY
(C05409) TO
IDENTIFY ABNORMALITY
WHEN FINISHED, PUSH
KEY RELEASE TO
RECALL PREVIOUS
PLAY (VC5N09) TO IDENTIFY THE FAILURE. THERE ARE SIX POSSIBLE CAUSES FOR ISS WARNING. (SEE SEC. 4.4.7 OF THIS DOCUMENT FOR DEFINITION OF ALARM CODES). WHEN FINISHED, PUSH KEY RELEASE TO RECALL PREVIOUS DISPLAY.

PRESS ALARM TO RESET TO RESET PROGRAM ALARM

CHANGE CONTROL ACTES

LGIC REV 00 PCB 496
REV 01 EDITORIAL
REV 02 EDITORIAL
REV 03 EDITORIAL
V40N72, ZERU RR CDUs

PURPOSE:
1. TO ZERO THE RR CDULS.
2. TO DETERMINE THE RR ANTENNA MODE.

ASSUMPTIONS:
1. THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
2. THIS PROCESS MAY BE SELECTED AT ANY TIME EXCEPT WHEN A READ SEQUENCE OF EITHER RADAR OR A RR DESIGNATE IS IN PROGRESS.
3. EXCEPT FOR THE RESTRICTIONS NOTED IN (2) ABOVE, THIS PROCESS CAN BE SELECTED AT ANY TIME IN COMBINATION WITH ANY OTHER EXTENDED VERB.
---

**IS THE V17 FLAG SET?**

- **Y**
- **N**

---

**IS THE LR BYPASS FLAG SET?**

- **Y**
- **N**

---

**IS THE TRACK FLAG SET?**

- **N**
- **Y**

**03**

**EDIT**

**03**

---

**TURN ON OPERATOR ERROR LIGHT**

---

**MONITOR OSKY:**
- **DOES OPERATOR ERROR LIGHT COME ON, INDICATING THAT THIS EXTENDED VERB CANNOT BE SELECTED AT THIS TIME?**

- **Y**
- **N**

---

**EXIT**

**V4072**

---

**TERMINATE THE PROGRAM OR ROUTINE**

---

1266

*30

*40

*50

*60

*70

V4072/LUM
SELECTED (RR AUTO) DISCRETE NOT PRESENT. DO I WISH TO OBSERVE THE PROGRAM ALARM CODE?

Y
N

CALL PROGRAM ALARM CODE DISPLAY (005-N091) TO IDENTIFY THE FAILURE. ALARM 00510 WILL INDICATE THAT THE RR IS NOT IN THE AUTO MODE. WHILE THE PROGRAM WILL CONTINUE AFTER THE DISPLAY OF ALARM 00510, THE RR DISCRETE IS CONTINUOUSLY ISSUED BY R25 WHEN THE RR AUTO MODE DISCRETE IS NOT PRESENT. WHEN FINISHED, PUSH KEY RELEASE TO RECALL PREVIOUS DISPLAY

PRESS ALARM RESET TO RE-SET PROGRAM ALARM

RESET RR CDU ZERK FLAG
IS TURRET ANGLE LESS THAN 50 DEGREES?

Y  N

RESET RR SET RR
ANTENNA ANTENNA
MODE FLAG MODE FLAG
(MODE #1) (MODE #2)

UPDATE TRACKER FAIL LIGHT

MONITOR D.SKY?
TRACKER FAIL LIGHT WILL BE TURNED ON IF:
A. THE RR MODE IS AUTO AND THE RR CDUS FAILED
B. RR DATA FAIL

++
+03 EXIT
+EDIT V40
++

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 496
LOGIC REV 01  EDITORIAL
REV 02 (LUM 18)  PCR 848, EDITORIAL
REV 03  EDITORIAL

V40N72/LUM
V4IN20, COARSE ALIGN IMU CDLS

PURPOSE:
(1) TO COARSE ALIGN THE IMU TO GIMBAL ANGLES SPECIFIED BY THE ASTRONAUT.

ASSUMPTIONS:
(1) EXTENDED VERB V41 MAY BE CREW SELECTED ONLY WHEN NO OTHER EXTENDED VERB WHICH HAS SET THE EXTENDED VERB INTERLOCK IS ACTIVE. IT MAY NOT BE SELECTED WHEN AN ICU ZERO IS IN PROGRESS, NOR WHEN GYRO TORQUING IS IN PROGRESS. V4IN20 IS INHIBITED WHILE THE GIMBALS ARE BEING TORQUED TO A DESIRED COARSE ALIGN ATTITUDE, BUT IS NOT INHIBITED WHEN IN THE COARSE ALIGN MODE IF THE GIMBALS ARE NOT BEING TORQUED.

(2) V41 MAY ONLY BE USED WITH N20 (ICU ANGLES) OR WITH N72 (RR CDU ANGLES).

(3) THE ACCURACY OF THE ALIGNMENT IS TESTED TO A TOLERANCE OF ±2 DEGREES. IF THIS TOLERANCE IS EXCEEDED, THE ASTRONAUT IS NOTIFIED VIA A PROGRAM ALARM 000211.

(4) THIS PROCESS RESETS THE TRACK FLAG AND THE REF SHM AT FLAG AND DISABLES IMU COMPENSATION AND THE DAP.

(5) AFTER ACCOMPLISHING COARSE ALIGNMENT, THE COARSE ALIGN MODE MAY BE TERMINATED BY KEYING IN V4ON20E.

PROG CONT

LGC GROUND CREW

CREW SELECTION

START CREW INITIATED
ISS COARSE ALIGN

KEY IN V4IN20E

IS MODE SWITCHING OR GYRO TORQUING IN

V4IN20/LUM
DISABLE CAP AUTO AND HOLD MODES

INHIBIT IML FAIL

RESET TRACK FLAG, DRIFT FLAG AND REFSMMAT FLAG

WAIT .06 SEC

IS ISS TURN-ON OR CAGING IN PROGRESS?

N       Y

   ...

   GET TC 

   MA = 

   BELOW

ENABLE ICDU ERROR COUNTERS

COMPUTE DELTA CDU ANGLES FOR TURULING
IS ISS TURN-ON OR LAGGING IN PROGRESS?

N  Y

* * *

GO TO "A" Below

COARSE ALIGN IMU TO STORED ANGLES (15 SECS MAX)

* * *

WAIT 1.5 SECONDS

* * *

READ PRESENT IMU ORIENTATION W.R.T. THE VEHICLE (GIMBAL ANGLES)

* * *

ARE THE GIMBALS WITHIN 2 DEGREES OF THE DESIRED ANGLES?

Y  N

* * *

TLRA (A PROGRAM ALARM AND STORE ALARM CODE (CO211)

* * *

MONITOR DSKY: DOES PROGRAM ALARM INDICATE THAT THE IMU GIMBALS DID NOT DRIVE TO WITHIN 2 DEGREES OF THE DESIRED ANGLES?

N  Y

* * *
CALL PROGRAM ALARM DISPLAY V05N09 TO IDENTIFY ABNORMALITY. WHEN FINISHED PUSH KEY RELEASE

PRESS ALARM RESET TO RESET PROGRAM ALARM

EXIT

RESELECT COARSE ALIGN

EXIT V41

CHANGE CONTROL NOTES

LOGIC REV 00 PCR 185
REV 01 EDITORIAL
REV 02 EDITORIAL
REV 03 EDITORIAL
V41N72, COARSE ALIGN RR CDVS

PURPOSE:  (1) TO DRIVE THE RENDEZVOUS RADAR SHAFT AND TRUNNION TO ANGLES SPECIFIED BY THE ASTRONAUT.

ASSUMPTIONS:  (1) THE PROCESS IS CANCELLED ON ENTRY TO DSKY.

(2) THE PROCESS MAY NOT BE SELECTED WHEN ANOTHER EXTENDED VERB WHICH ALSO SETS THE EXTENDED VERB INTERLOCK IS ACTIVE.

(3) THE PROCESS MAY NOT BE SELECTED IF P20 OR P22 IS RUNNING.

(4) THE CONTINUOUS DESIGNATE MODE MUST BE TERMINATED BY DSKY ENTRY OF V44.

(5) THE CONTINUOUS DESIGNATE MODE INHIBITS RR GIMBAL MONITOR ROUTINE (R25).

(6) THE RR SHAFT AND TRUNNION LIMITS ARE:

   (A) MODE 1: SHAFT -70 DEG TO +59 DEG, TRUNNION -55 DEG TO +55 DEG.

   (B) MODE 2: SHAFT -25 DEG TO -139 DEG, TRUNNION -125 DEG TO -253 DEG.

   (C) MODE 1, CONTINUOUS DESIGNATE ONLY: SHAFT -85 DEG. TO +59 DEG., TRUNNION -55 DEG. TO +55 DEG.

PROG CONT

LGC GROUND CREW

- CREW
- SELECTION
- ***

START CREW INITIATED
RR COARSE ALIGN

-----

KEY IN V41N72E

-----

#10

V41N72/LUM
IS THE R77 FLAG SET?

N Y

IS THE V37 FLAG SET?

N Y

IS THE LR BYPASS FLAG SET?

Y N

IS THE TRACK FLAG SET?

N Y

++03 EDIT

TURN ON OPERATOR ERROR LIGHT

MONITOR DSky:
DOES OPERATOR ERROR OR LIGHT COME ON; INDICATING THAT THIS EXTENDED VERB CANNOT BE SELECTED AT THIS TIME?

Y N

EXIT

TERMINATE THE PROGRAM OR ROUTINE
TRUIMINATION-360 MINUS
RR TRUIMINATION CUR
VALUE. IN DEGREES TO
NEAREST .01 DEGREE.
(PLUS IS DEFINED AS
A NEGATIVE ROTATION
ABOUT LM +X AXES) IN
MODE 1.

SHAF-RR SHAFT
ANGLE. IN DEGREES TO
NEAREST .01 DEGREE.

WAIT FOR KEYBOARD
ENTRY

DO I WISH TO LOAD
NEW SHAFT AND
TRUIMINATION ANGLES?

Y  N

EXIT

LOAD DESIRED
ANGLES

TERMINATE FLUSH UPON
RECEIPT OF DATA;
+03
*EDIT
V33E, OR TERNI-
ATE (V34E)

+ + .0 +W
.3 A .9

1282
V41N72/LUM

#120
#130
#140
#150
#160

V41N72/LUM
RESET EXTENDED
VERB ACT-
IVE ANC
RC MARKS
ALLOWED
FLAGS

EXIT

SET LGC ASSUMED
OPTION = CCCC2.

HOLD
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED RR DESIGNATE MODE:
W04 R12
R3-CCCC6
R2-GOODX
R3-BLANK
R1 IS THE OPTION
CODE FOR ASSUMED RR DESIGNATE MODE
R2 IS THE LGC AS-

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED RR DESIGNATE
MODE

1283
V4IN72/LUM

$170
$180
$190
$200

V4IN72/LUM
STORE CODE

IS OPTION CODE GOOD?

Y N

RESET LOCK ON FLAG TO INDICATE RR LOCK ON NOT DESIRED

SET THE NO RR Monitor FLAG

SET CONTINUOUS DESIGNATE FLAG

SET LOCK ON FLAG TO INDICATE RR LOCK ON DESIRED

DISPLAY COARSE ALIGN VERB (V41)
RESET EXTENDED VERB
ACTIVE AND NO MARKS
ALLOWED FLAGS.

RESET LOSM FLAG

IS THE DESIRED LOS
WITHIN THE LIMITS OF
THE PRESENT RR MODE?

Y   N

IS THE DESIRED
LOS WITHIN THE
LIMITS OF THE
OTHER MODE?

Y   N

TURN ON PROGRAM ALARM AND
STORE ALARM CODE (0502)

MONITOR DSKY:
PROGRAM ALARM LIGHT
WILL BE LIT IF THE
DESIRED LOS IS NOT
WITHIN THE LIMITS OF
EITHER RR MODE. DO I
WISH TO OBSERVE THE
PROGRAM ALARM CODE?

Y   N

EXIT

SET KEEMOE FLAG

CALL PROGRAM
ALARM CODE DIS-
PLAY (0502) TO
IDENTIFY FAILURE.
ALARM 0502 INC-
SET DESIGNATE FLAG

IS REPOSITION FLAG SET?

Y

IS REMODE FLAG SET?

Y

N

N

INTERUPT REPOSITION

COMPLETE REPOSITION

RESET REMODE REPOSITION FLAG

IS REMODE FLAG SET?

N

Y


gates a bad radar gimb angle input. When finished, push key release to recall previous display.

PRESS ALARM RESET TO RESET PROGRAM ALARM

EXIT W41

V41N72/LUM

#360

#370

#380

#390

#400

#410

#480

#490
SET DESIGNATE COUNTER = 60.

COMPUTE RR SHAFT AND TRUNNION DRIVE COMMANDS

IS CONTINUOUS DESIGNATE FLAG SET?
  Y  N
  
  IS DESIGNATE FLAG SET?
    Y  N
    
    IS RR CDL FAULT DISCRETE PRESENT?
      Y  N
      
      EXIT
TURN ON PROGRAM ALARM AND STORE ALARM CODE (CC503)

MONITOR DSKY: PROGRAM ALARM LIGHT WILL BE LIT IF THERE HAS BEEN A RADAR ANTENNA DESIGNATE FAIL. DO I WISH TO OBSERVE THE PROGRAM ALARM CODE?

Y
N

HAVE 60 ATTEMPTS ELAPSED WITHOUT RECEIVING DATA CC500 DISCRETE?

N
Y

RESET DESIGNATE FLAG

CALL PROGRAM ALARM CODE DISPLAY (V05N09) TO IDENTIFY FAILURE. ALARM 00503 INDICATES RADAR ANTENNA DESIGNATE FAIL. WHEN FINISHED, PUSH KEY RELEASE TO RECALL PREVIOUS DISPLAY.

PRESS ALARM RESET TO RESET PROGRAM ALARM

REMOVE RR TRACK ENABLE DISCRETE FROM RR

CLEAR ERROR COUNTER ENABLE

EXIT V41
MONITOR DSAY: PROGRAM ALARM LIGHT W ILL BE LIT IF THERE HAS BEEN A RADAR ANTENNA DESIGNATE FAIL. DO I WISH TO OBSERVE THE PROGRAM ALARM CODE?

Y N

CALL PROGRAM ALARM CODE DISPLAY (V05NO9) TO IDENTIFY FAILURE (ALARM CODE Q0503). WHEN FINISHED, PUSH KEY RELEASE TO RECALL PREVIOUS DISPLAY.

N Y

PRESS ALARM RESET TO RESET PROGRAM ALARM.

Y N

SEND NR TRACK ENABLE DIS CREEE TO RR

EXIT V41...
**V42, Fine Align IMU**

**Purpose:**
1. To fine align the stable member by torquing the gyros.

**Assumptions:**
1. The process is crew selected by DSKY entry.
2. Verb 42 may not be selected when another extended verb which also sets the extended verb interlock is active, or when another program is torquing the gyros, zeroing the ISS CDUS, or coarse aligning the IMU.
3. This verb is not preprogrammed to accept delta gyro angles larger than 99.999 degrees. A special procedure, for ground use only, makes use of a double precision load combined with V42 when large angle gyro torquing is required.

**Warning:** The delta gyro angles commanded must be limited to such a size as not to drive the middle gimbal into gimbal lock. In practice, this means that the middle gimbal angle should never exceed 70 degrees (point at which gimbal lock warning lamp is lit).

<table>
<thead>
<tr>
<th>Prog</th>
<th>LGC</th>
<th>Ground</th>
<th>Crew</th>
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**Crew Selection**

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<tr>
<th>Start crew initiated</th>
<th>Key in V42E</th>
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**Is a mode switch being gyro torquing in progress?**

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<tr>
<th>N</th>
<th>Y</th>
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**V42/Luminary**
LOAD DESIRED DELTA
GYRO ANGLES.
NOTE: THE LOADING OF
TORQUING ANGLES
GREATER THAN 90 DE-
GREES SHOULD NOT BE
PERFORMED DURING
FLIGHT.

WARNING: THE GYRO
TORQUING ANGLES MUST
BE SMALL ENOUGH SO
THAT THE MIDDLE GIM-
BAL ANGLE DOES NOT
EXCEED 70 DEGREES
(POINT AT WHICH GIM-
BAL LOCK WARNING
LAMP IS ILLUMI-
NATED).

TERMINATE FLASH
UPCA
RECEIPT OF DATA

DISPLAY FINE ALIGH
VERV V42

IS IMC BEING LAGED?

EXIT

ENTER FINE ALIGH
MODE
ENABLE CAP AUTO AND HELD MODES

TURN OFF NO ATT LAMP

LEAVE IML FAIL INHIBIT ON FOR 5 SECONDS

PULSE IRIS THROUGH DESIRED ANGLES

RESET EXTENDED VERB ACTIVE FLAG AND NO MARKS ALLOWED FLAG

EXIT V42

CHANGE CONTROL NOTES

LOGIC REV CC PQR 496
REV 01 EDITORIAL
V43, LOAD FDOA ERROR NEEDLES

REV 03 12/03/69

PURPOSE:
1. TO DISPLAY ASTRONAUT-SPECIFIED ANGLES ON THE FDOA ERROR NEEDLES.

ASSUMPTIONS:
1. THE PROCESS IS CREW SELECTED BY COSY ENTRY.
2. VERB 43 MAY NOT BE SELECTED IF THE IMU IS IN THE COARSE ALIGN OR ZERU IDU MODE.
3. THE MAXIMUM ERROR ANGLE THAT CAN BE DISPLAYED BY THE FDOA IS PLUS OR MINUS 5 DEGREES, LIMITED BY THE NEEDLE STOP.
4. THIS PROCESS MAY BE SELECTED ONLY IN POO.
5. THIS PROCESS MAY BE SELECTED ONLY IF THE MODE CONTROL SWITCH IS OFF.
6. THIS EXTENDED VERB CANNOT BE SELECTED CONCURRENTLY WITH ANY OTHER EXTENDED VERB WHICH ALSO SETS THE EXTENDED VERB INTERLOCK.

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<td>CREW SELECTION</td>
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--------------------------------------------------------------------------
START CREW INITIATED**************************** KEY IN V43E
LOAD OF FDOA ERROR NEEDLES.****************************
--------------------------------------------------------------------------

#10

--------------------------------------------------------------------------
IS MODE CONTROL SWITCH IN
--------------------------------------------------------------------------

#20

V43/LUMINARY
HOLD - FLASH VERB-NOUN TO REQUEST LOAD OF SNAP - FDAI ERROR ANGLES
** (NOTE: THIS IS AN +03 ALTERNATE PERMISSIBLE USAGE OF N22 **
+EDIT FOR THIS PROCEDURE. NORMALLY, N22 IS LABELED "DESIRED ICU ANGLES").

W2 N22
R1 = 0G
R2 = 1G
R3 = MG

ALL ANGLES IN DEGREES TO NEAREST .01 DEG

WAIT FOR KEYBOARD ENTRY

DO I WANT TO LOAD THE SPECIFIED FDAI ERROR ANGLES?

Y  a

LOAD DESIRED ANGLES
RESET EXTENDED VERB
ACTIVE FLAG AND NC MARKS ALLOWED FLAG

CHANGE CONTROL NOTES

LOGIC REV 00 PCF 496
REV C1 EDITORIAL
REV 02 EDITORIAL
REV C3 EDITORIAL
THIS PAGE INTENTIONALLY LEFT BLANK
**V44, TERMINATE RR CONTINUOUS DESIGNATE**

**REV 01  08/09/69**

**PURPOSE:**
1. TO TERMINATE THE CONTINUOUS DESIGNATE OPTION OF V41N72.
2. TO DISABLE THE RR CCL ERRCR COUNTERS.
3. TO ENABLE R25.

**ASSUMPTIONS:**
1. THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
2. V44E IS EFFECTIVE ONLY IF RR CONTINUOUS DESIGNATION (V41N72, COARSE ALIGN RR CDUS, OPTION 2) IS IN PROGRESS.
3. THE PROCESS MAY BE SELECTED AT ANY TIME.

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<td>START CREW INITIATED TERMINATE RR CONTINUOUS DESIGNATE</td>
<td>KEY IN V44E</td>
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<td>IS THE CONTINUOUS DESIGNATE FLAG SET?</td>
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#20

#30
DESIGNATE FLAGS

DISABLE RR CUU ERROR COUNTERS

WAIT 1 SECOND

RESET THE NC RR MONITOR FLAG (ENABLE R25)

EXIT

CHANGE CONTROL NOTES

LOGIC REV CCA PCR 456
V47, INITIALIZE AGS, R47

REV 01  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 47. SEE R47 FOR THE LOGIC SPECIFICATION FLOW FOR AGS INITIALIZATION.

CHANGE CONTROL NOTES

LOGIC REV CC   PCR 184
THIS PAGE INTENTIONALLY LEFT BLANK
V48, START LEP DATA LOAD, R03

REV 01  09/09/69

NOTE: THIS EXTENDED VERS IS USED TO CALL ROUTINE O3. SEE R03 FOR THE LOGIC SPECIFICATION FLOW FOR THE OAP DATA LOAD.

CHANGE CONTROL NOTES

LOGIC REV 00  P0R 184
NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 62. SEE R62 FOR THE LOGIC SPECIFICATION FLOW FOR THE CREW-DEFINED MANEUVER.
V50, PLEASE PERFORM

PURPOSE:
1. TO INTERRUPT A PROGRAM OR ROUTINE AND REQUEST ASTRONAUT RESPONSE TO THE ACTION DEFINED BY THE CHECKLIST CODE DISPLAYED ON THE DSKY.

ASSUMPTIONS:
1. THIS VERB IS ALWAYS INTERNALLY INITIATED BY THE PROGRAM IN PROCESS, AND SHOULD NOT BE SELECTED BY THE CREW.
2. THE VERB ALWAYS APPEARS WITH N25 AS A FLASHING DISPLAY ON THE DSKY.
3. RESPONSES TO THE DSKY DISPLAY OF THIS VERB ARE DESCRIBED IN SECTION 4.2.2.7 OF THIS DOCUMENT.

CHANGE CONTROL NOTES

LOGIC REV 00 FCR 496
NOTE: THIS EXTENDED VERB IS USED IN R57. REFER TO THIS ROUTINE FOR LOGIC DESCRIPTION OF PERFORMING SIGHTING MARKS ON CELESTIAL BODIES.

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 496
NOTE: THIS EXTENDED VERB IS USED IN R57. REFER TO THAT ROUTINE FOR LOGIC DESCRIPTION OF PERFORMING SIGHTING MARKS ON CELESTIAL BODIES.

CHANGE CONTROL NOTES

LOGIC REV 00  PCK 496
THIS PAGE INTENTIONALLY LEFT BLANK
NOTE: THIS EXTENDED VERB IS USED IN R53 AND R57. REFER TO THESE ROUTINES FOR LOGIC DESCRIPTION OF PERFORMING SIGHTING MARKS ON CELESTIAL BODIES.

CHANGE CONTROL NOTES

LOGIC REV C0 OCR 4/70
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V55, INCREMENT LGC TIME (DECIMAL)

REV 03  12/03/69

PURPOSE:  (1) TO CHANGE THE LGC CLOCK TIME USING INCREMENTS (OR DECREMENTS) LOADED BY THE ASTRONAUT.

ASSUMPTIONS:  (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE PROCESS MAY NOT BE SELECTED WHEN ANOTHER EXTENDED VERB WHICH ALSO SETS THE EXTENDED VERB INTERLOCK IS ACTIVE.

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<th>PROG</th>
<th>LGC</th>
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<td>CONTEXT</td>
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<td>START CREW INITIATED</td>
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<td>CHANGE OF LGC CLOCK</td>
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<td>KEY IN V55E</td>
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<td>DO EXTENDED VERB</td>
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<td>INTERLOCK ROUTINE</td>
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<td>HCONT: FLASH VERB-NOcn To</td>
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<td>REQUEST LOAD OF</td>
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<td>DELTA TIME</td>
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<td>V21 HZ4</td>
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<td>R1-HOURS</td>
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<td>R2-MINUTES</td>
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<td>R3-SECONDS</td>
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V55/LUMINARY
NEAREST 01 SECONDS.
POLARITY IS PLUS IF
THE LCL GIVES LUMEN
CLOCK READING

------------------------------

WAIT FOR KEYBOARD ENTRY

------------------------------

LOG DESIREU TIME INCREMENTS

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TERMATE FLASK UPON RECEIPT OF DATA.
+03 EDIT V33E

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KEY IN V33E CR
TERMATE (V34E).

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V55/LUMINARY
CHANGE CONTROL NOTES

LOGIC REV 00 PC4 49b
REV 01 EDITORIAL
REV 02 EDITORIAL
REV 03 EDITORIAL
V56, REQUEST TERMINATE TRACKING ROUTINE

REV 31  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 56. REFER TO R56 FOR THE LOGIC SPECIFICATION FLOW FOR TERMINATING TRACKING.

CHANGE CONTROl NOTES

LOGIC REV CC  PCR 456
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V57, PERMIT LANDING RADAR UPDATE

REV 03 12/03/69

PURPOSE: (1) TO PERMIT THE ASTRONAUT TO MONITOR THE LM DELTA ALTITUDE (PRESENT LM INDICATED ALTITUDE MINUS LGC-CALCULATED ALTITUDE) AND TO ALLOW THE INCORPORATION OF LM DATA DURING STATE VECTOR UPDATING BY SETTING THE LR PERMIT FLAG (SEE LOGIC DESCRIPTION BELOW).

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE PROCESS IS ONLY EFFECTIVE IN R12, DESCENT STATE VECTOR UPDATE ROUTINE.

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CREW SELECTION

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START CREW INITIATED
PERMIT LANDING
RADAR UPDATE

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KEY IN V57E

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#10
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+EDIT DG EXTENDED VERB
+03 INTERLOCK ROUTINE (R76)
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#20

HOLD
MON
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY LM DATA:

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#30

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST RE-
SPONSE AND DISPLAY

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V57/LUMINARY
K1-RANGE
K2-TG
K3-DELTA H

RANGE - SLANT RANGE FROM THE LM TO THE DESIGNATED LANDING SITE. IN NAUTICAL MILES TO NEAREST .1 NM.

TG - THE ESTIMATED TIME OF FLIGHT FROM THE PRESENT TIME TO THE ACCOMPLISHMENT OF THE CURRENT AIM CONDITIONS. IN MIN AND SECS TO NEAREST SEC. MAX READING IS 99855. SIGN IS -.

DELTA H - THE PRESENT LR INDICATED ALTITUDE MINUS THE LGC CALCULATED ALTITUDE OF THE LM ABOVE THE LUNAR RADAR AT THE DESIGNATED LANDING SITE. IN FEET TO THE NEAREST FOOT.

-------------------------------------------------------------------------

WAIT FOR KEYBOARD ENTRY.  ________________________________________

TERMINATE FLASH UPON RECEIPT OF PROCEED OR TERMINATE

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CF LR DATA

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DO I WISH TO INCORPORATE THE LR DATA?

Y  N

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#40

#50

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#70

#80
V58, INHIBIT LANDING RADAR UPDATE

REV 01  08/09/69

PURPOSE: (1) TO INHIBIT THE INCORPORATION OF LANDING RADAR DATA DURING DESCENT STATE VECTOR UPDATE.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY ESKY ENTRY.

(2) THE PROCESS IS ONLY EFFECTIVE IN R12, DESCENT STATE VECTOR UPDATE ROUTINE.

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</table>
CHANGE CONTROL ACTES

LOGIC REV CO  PCH 118
V59, COMMAND LR TO POSITION 2

PURPOSE:

(1) TO DRIVE THE LANDING RADAR TO POSITION 2 (FINAL APPROACH).
(2) TO CAUSE HIGATCHB (HI-GATE) TO OCCUR WITHIN 2 SECONDS IF THE LR IS STUCK IN POSITION #2 DURING P63 POWERED FLIGHT.

ASSUMPTIONS:

(1) THE PROCESS MAY BE SELECTED ANY TIME ANOTHER PROGRAM IS NOT USING EITHER LR OR RR WITH AVERAGE G ON, HOWEVER, IT IS SELECTABLE IN P63 ONLY.
(2) THE PROCESS IS CREW SELECTED BY GSKY ENTRY.

---

**CONT** **LOG** **GREAD** **CREW**

---

**CREW SELECTION**

---

**START CREW INITIATED COMMAND LR TO POSITION 2**

---

**KEY IN V59E**

---

**N**

---

**IS THE AVERAGE G FLAG SET?**

---

**Y**

---

**IS THE BRAKING PHASE PROGRAM (P63) IN PROGRESS?**

---

**N.**

---

V59/LUMINARY
SET "TPEXTIME" TO "FESPAX"
AND CUMPLEMENT BIT 14 OF "WS"
TO CAUSE MIGRATION TO OCCUR IN 2 SECONDS (SEE R12)


--

TURN ON OPERATING ERROR LIGHT
--


EXIT EXIT
02


IS THE AC R2? FLAG SET?
Y N


IS THE R77 FLAG SET?
N Y


IS THE V37 FLAG SET?
N Y
COMMAND LR TO POSITION 2

WAIT 7 SECONDS

SET MAXIMUM SCAN LIMIT TO 15

IS LR IN POSITION 2?

Y

N

HAVE 15 SCANS BEEN MADE?

Y  N

WAIT 2 SECONDS

FOR LR DECREASE TO SET-MENT
INDICATING

THAT LR DID

NOT ACHIEVE

POSITION 2.

WHEN FIN-

ISHED PUSH

KEY RELEASE.

----------------------------------

* 

----------------------------------

PRESS ALARM

RESET TO RESET

PROGRAM ALARM.

----------------------------------

* 

***

EXIT V59

----------------------------------

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 420
LOGIC REV 01  EDITORIAL
LOGIC REV 00 (LUM 18)  PCR 841, EDITORIAL
LOGIC REV 02 (LUM 1C)  PCR 845, EDITORIAL
V60, DISPLAY VEHICLE RATES

REV 01 08/04/69

PURPOSE:
(1) TO DISPLAY ON THE FDAI ERROR NEEDLES THE PGNS DERIVED VEHICLE ATTITUDE RATES.

ASSUMPTIONS:
(1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) THIS PROCESS MAY BE SELECTED AT ANY TIME, IT SHOULD BE NOTED, HOWEVER, THAT VEHICLE RATES ARE AVAILABLE ONLY WHEN THE DAP IS TURNED ON, I. E., GUID CONT IN PGNS AND PGNS MODE CONT NOT OFF.

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<th>CREW</th>
<th>GROUND</th>
<th>LCC</th>
<th>PROG</th>
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</table>

+CREW
SELECTED

START CREW INITIATED
VEHICLE RATES DISPLAY

KEY IN V60E

SET KEEC2FLG

EXIT

CHANGE CONTROL ACTES

REV 01 PRR 841 (ORIGINATED)
**V61, DISPLAY DAP ATTITUDE ERROR**

**REV 02** 08/05/69

**PURPOSE:**
1. To display on the FDAI error needles the difference between the current CDU angles and the DAP commanded angles.

**ASSUMPTIONS:**
1. The process is crew selected by usky entry.
2. This process may be selected at any time.

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<th>PROG</th>
<th>ECC</th>
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---

START CREW INITIATED
MODE 1 ERROR DISPLAY

---

KEY IN V61E

---

RESET NEEDLE FLAG

---

++
02
RESET NEEDLE FLAG

---

V61/LUMINARY
CHANGE CONTROL ACTES

REV 00 PCR 420
REV 01 EDITURAL
REV 02 (LUM 18) PCR 841
V62, DISPLAY TOTAL ATTITUDE ERROR

REV 02 08/05/69

PURPOSE:
(1) TO DISPLAY THE TOTAL ATTITUDE ERROR \( (N22(DESIRED \text{ ICDU ANGLES}) - N20(\text{PRESENT ICDU ANGLES})) \) ON THE FDAI ERROR NEEDLES.

ASSUMPTIONS:
(1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.

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<th>PROG</th>
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* CREW SELECTION
  * * *

START CREW INITIATED
MODE 2 ERROR DISPLAY

* KEY IN V62E
  * * *

SET NEEDLE FLAG

++

+02

+041

RESET NEEDLE

++

* * *

EXIT

EXIT
CHANGE CONTROL NOTES

LOGIC REV CC PCR 154, 420
REV C1 EDITORIAL
REV 02 (LUM 18) PCR 841
V63, START RR/LK SELF TEST ROUTINE, RO4

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 04. SEE RO4 FOR THE LOGIC SPECIFICATION FLOW FOR THE RR/LK SELF TEST.

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 420
V04, START S-BAND ANTENNA ROUTINE, R05

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 05. SEE R05 FOR THE LOGIC SPECIFICATION FLOW FOR THE S-BAND ANTENNA CALCULATIONS.

CHANGE CONTROL NOTES

LOGIC REV CC PCR 496
V65, DISABLE U, V JETS DURING DPS BURNS

PURPOSE: (1) TO INHIBIT U AND V RCS JET FIRINGS DURING DPS POWERED FLIGHT.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY USKY ENTRY.
(12) THE PROCESS MAY BE SELECTED AT ANY TIME.

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<td>START CREW INITIATED</td>
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<td>DISABLE U, V JETS DURING DPS BURNS</td>
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<td>KEY IN V65E</td>
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<td>SET SNUFFER FLAG</td>
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CHANGE CONTROL NOTES

LOGIC REV: 01, PEE: 335
V66, VEHICLES ATTACHED, MOVE THIS VEHICLE STATE VECTOR TO OTHER VEHICLE STATE VECTOR

REV 02 09/07/69

PURPOSE: (1) TO TRANSFER THE LM STATE VECTOR INFORMATION TO THE CSM STATE VECTOR.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
+EDIT
++ (2) THE TRANSFER OF THE STATE VECTOR INFORMATION MAY BE ACCOMPLISHED AT ANY TIME EXCEPT WHEN AVERAGE G IS IN PROCESS OR WHEN THE SURFACE FLAG IS SET.
++

PROG
CONT LGC GROUND CREW

CREW SELECTION

START CREW INITIATED
STATE VECTOR TRANSFER (LM TO CSM)

++ +02 +005 +02 ++

IS SURFACE FLAG SET?

N Y.

TURN ON OPERATOR ERRARK LIGHT

V66/LUMINARY
IS STATE VECTOR INTEGRATION IN PROGRESS?

Y

COMPLETE THE INTEGRATION

TRANSFER THIS VEHICLE STATE VECTOR TO OTHER VEHICLE STATE VECTOR

EXIT

V66/LUMINARY
CHANGE CONTROL ACTES

LOGIC REV 00 PCR 496
REV 01 EDITORIAL
REV 02 LUM 181 PCR 805 EDITORIAL
PURPOSE:
1. To provide a means of displaying W matrix information and reinitializing the W matrix if desired.

ASSUMPTIONS:
1. AC other extended verb which sets the extended verb interlock is active.
2. This process is crew selected by DSky entry.
3. If new values of RMS position, velocity, and bias errors are loaded in this routine, W matrix initialization occurs the next time a navigation measurement is made.

PROG CONT

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START W MATRIX RMS ERROR DISPLAY

KEY IN W67E

DO EXTENDED VERB INTERLOCK ROUTINE (R76)

RES1T W67 FLAG

REV 02 12/03/69

VS7/LUMINARY
CALCULATE RMS POSITION, VELOCITY, AND BIAS ERRORS.

POSS
HOLD
SNAP

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY:

- V06 N99
- R1 POS ERR
- R2 VEL ERR
- R3 BIAS ERR

R1 = POS ERR - RMS VALUE OF POSITION ERROR IN FEET TO NEAREST FOOT.
R2 = VEL ERR - RMS VALUE OF VELOCITY ERROR IN F.P.S. TO NEAREST 1 F.P.S.
R3 = BIAS ERR - RMS VALUE OF BIAS ERROR IN MILLIRADIANS TO NEAREST MILLIRADIAN.

WAIT FOR KEYEDARC ENTRY.

MONITOR DSky.

OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF W MATRIX RMS VALUES OF POSITION, VELOCITY, AND BIAS ERRORS.

AM I SATISFIED WITH THESE VALUES?

Y N

DO I WISH TO LOAD NEW VALUES AND REINITIALIZE THE W-MATRIX?

Y N
++
*02
+EDIT
+ IS THE SURFACE FLAG SET?
+-------------------------------------
+ Y
+ * 
+ -------------------------------------
+ SET UP FOR SURFACE NAVIGATION
+ H-MATRIX INITIALIZATION
+ -------------------------------------
+ -------------------------------------
+ -------------------------------------
+ SET UP FOR RENDEZVOUS
+ NAVIGATIONAL H-MATRIX INITIALIZATION
+ -------------------------------------
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+ -------------------------------------
+ +02
+ RESET H-M FLAG
+-------------------------------------
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+-------------------------------------
+ "A"
+ FRCP
+ ABOVE
+ * *
+ * *
+ **
+ -------------------------------------
+ RESET EXTENDED VERB
+ ACTIVE FLAG AND NO
V69, RESTART

PURPOSE:
(1) TO CAUSE A COMPUTER RESTART.

ASSUMPTIONS:
(1) THE RESTART IS CREW INITIATED BY DSKY ENTRY.
(2) V69E DOES NOT DIRECTLY SELECT RESTART PROCESSING. IT CAUSES A SITUATION WHICH SATISFIES ONE OF THE CONDITIONS FOR AN AUTOMATIC RESTART, I.E.: TOO MANY CONSECUTIVE TC INSTRUCTIONS.
(3) LGC RESTART LOGIC WILL CLEAR ALL JCB CORE SETS AND VAC AREAS, AND SET THE WAITLIST TO CALL ENDTASK.
(4) ALL EXTENDED VERB AND DISPLAY ACTIVITY WILL BE STOPPED. RESTARTABLE TASKS AND JOBS WILL THEN BE RESTARTED BY REFERENCE TO INFORMATION CONTAINED IN THE PHASE TABLE.
(5) A V69E MAY BE SELECTED AT ANY TIME.

PROG CONT LGC GROUND CREW

CREW SELECTION

START CREW INITIATED
COMPUTER RESTART

---

KEY IN V69E

---

MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON INDICATING COMPUTATIONAL

---
DIFFICULTIES?

-Y   -N

...*

EXIT

---

KEY V058909E TO DISPLAY ALARM CODE: 01107-BAD PHASE TABLE IS EXPECTED AT THIS TIME.

---

IS THE ALARM CODE 01107 AS EXPECTED?

-Y   -N

---

PERFORM NECESSARY ACTIONS FOR A FRESH START

---

EXIT EXIT

++
+03
+EDIT
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<td>PCR 496</td>
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<tr>
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<td>EDITORIAL</td>
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<td>REV 02</td>
<td>EDITORIAL</td>
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<td>REV 03</td>
<td>EDITORIAL</td>
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VIG, START LCC UPDATE; LIFTOFF TIME

REV 01 08/09/69

NOTE: THIS EXTENDED VERB IS USED BY UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE LOGIC SPECIFICATION FLOW FOR UPDATING THE LIFTOFF TIME.

CHANGE CONTROL NOTES

LOGIC REV 00 PCR 496
V71: START LOGIC UPDATE; BLOCK ADDRESS

NOTE: THIS EXTENDED VERB IS USED BY UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE LOGIC SPECIFICATION FLOW FOR A BLOCK ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

LOGIC REV 00A  PCR 496
NOTE: THIS EXTENDED VERB IS USED WITH UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE LOGIC SPECIFICATION FLOW FOR A SINGLE ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 496
V73, START LGC UPDATE: LGC TIME (DECIMAL)

NOTE: THIS EXTENDED VER4 IS USED BY THE UPDATE PROGRAM P27 ONLY. SEE P27 FOR THE LOGIC SPECIFICATION FLOW FOR THE DECIMAL UPDATE OF LGC TIME.

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 495
V74: INITIALIZE ERASABLE DUMP VIA DOWNLINK

PURPOSE: (1) TO DUMP ALL EIGHT BANKS OF ERASABLE MEMORY VIA DOWNLINK.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
   (2) THE DUMP OF EACH BANK IS PRECEDED BY AN ID WORD, SYNCH BITS, ECADR, AND TIME.
   (3) THE 8 BANKS ARE DUMPED IN ORDER, STARTING WITH BANK ZERO.
   (4) DUMPING OF ALL EIGHT BANKS IS REPEATED UNTIL 12 COMPLETE DUMPS TO FACILITATE SUCCESSFUL GROUND RECORDING.
   (5) THE TIME REQUIRED FOR 4 COMPLETE DUMPS IS 13.2 SECONDS.
   (6) THIS PROCESS CAN BE SELECTED CONCURRENTLY WITH ANY OTHER EXTENDED VERB, BUT SHOULD NOT BE SELECTED WITH V47 (AGT, AGS INITIALIZATION ROUTINE).

PROG CONT

LGC GROUND CREW

CREW
SELECTICA
...
***

------------------------
START CREW INITIATED
COGNALINK ERASABLE
DUMP
------------------------

------------------------
KEY IN V74E
------------------------
TERMINATE CURRENT DUMP LIST

SET E BANK COUNTER, WORD COUNTER, AND DUMP COUNTER=0

INITIALIZE E BANK
DUMP*, DUMP ID, SYNCH EITS, ECALR AND TIME1.

DUMP E BANK

INCREMENT E BANK
COUNTER AND SET nCRC COUNTER=C.

C3: ARE ALL B BANKS CUMPED IN BANK
CHANGE CONTROL NOTES

LOGIC REV 00 PCR 496
LOGIC REV 01 EDITORIAL

REV G2LUM 181 PCR 277, EDITORIAL
REV 03 EDITORIAL
V75, ENABLE U, V JETS DURING DPS BURNS

REV 01  08/09/69

PURPOSE:
(1) TO ENABLE U AND V RCS JET FIRINGS DURING DPS POWERED FLIGHT.

ASSUMPTIONS:
(1) THE PROCESS IS CREW SELECTED BY GSKY ENTRY.
(2) THE PROCESS MAY BE SELECTED AT ANY TIME.

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START CREW INITIATED
ENABLE U, V JETS DURING DPS BURNS

#10

RESET SNIFTER FLAG

#20

CHANGE CONTROL ACTES

LOGIC REV 01  PCR 539
V76, MINIMUM IMPULSE COMMAND MODE

PURPOSE: (1) TO ENABLE THE MINIMUM IMPULSE MODE OF THE DAP.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) TO OBTAIN THE MINIMUM IMPULSE MODE, THE GUID CONT SWITCH MUST BE AT PGNS AND THE MODE CONTROL SWITCH AT ATT HOLD.
(3) THE MINIMUM IMPULSE MODE WILL REMAIN ENABLED UNTIL CANCELLED BY RATE MODE SELECTION (SEE V77); OR BY FRESH START; OR BY P12, P40, P41, P42, P63, P70 OR P71.
(4) THE PROCESS MAY BE SELECTED AT ANY TIME.

PROG CONT LGC GROUND CREW

CREW SELECTION
...
***

START CREW INITIATED MINIMUM IMPULSE MODE SELECTION

--- KEY IN V76E

SET PULSES FLAG

---

EXIT
CHANGE CONTROL NOTES

LOGIC REV 00 PCR 450
LOGIC REV 01  ELECTRICAL
LOGIC REV 02  ELECTRICAL
REV 03  ELECTRICAL
V77, RATE COMMAND AND ATTITUDE HOLD MODE

REV 02 12/03/69

PURPOSE:
1. To enable the rate command mode of the DAP.
2. To set desired ICDO angles equal to actual ICDO angles.

ASSUMPTIONS:
1. The process is crew selected by OSKY entry.
2. To obtain the rate command mode, the guid cont switch must be at PGNS and the mode control switch at ATT HOLD.
3. The rate command mode will remain enabled until cancelled by minimum impulse mode selection (see V76), or by P68.
4. The process may be selected at any time.

PROG  CONT
       LCC    GROUND    CREW

CREW SELECTION
   *
   *
   *

START CREW INITIATED
RATE COMMAND MODE
SELECTION
   *
   *
   *
RESET PULSES FLAG
   *

SET DESIRED ICDO ANGLES = CURRENT

V77/LUMINARY
V78, START LR SPURIOUS TEST, R77

REV 01  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 77. SEE R77 FOR THE LOGIC SPECIFICATION FLOW FOR THE LR SPURIOUS TEST.

CHANGE CONTROL NOTES

LOGIC REV 00  PCK 229
V75, STOP LR SPLRICLS TEST, R77

REV 01  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO TERMINATE ROUTINE 77. SEE R77 FOR THE LOGIC SPECIFICATION FLOW FOR THE LR SPURIOUS TEST.

CHANGE CONTROL NOTES

LOGIC REV 00    PCR 225
V80, ENABLE LM STATE VECTOR UPDATE

REV 02 08/07/69

PURPOSE:
1. To cause the rendezvous data processing results to update the LM state vector.

ASSUMPTIONS:
1. The process is crew selected by GSKY entry.
2. The process may be selected at any time.

PROG CONT LGC GROUND CREW

CREW SELECTION

* *
*
*
*
*
*

START CREW INITIATED
LM STATE VECTOR UPD-DATE PROCESS

------------

KEY IN V80E

------------

**
RESET VEHICLE UPDATE FLAG

**
+EDIT

**
+

**

++
RESET NU UPDATE FLAG

++
+02

**

**

V80/LUMINARY
CHANGE CONTROL NOTES

REV 02 DEC 498
REV CL EDITORIAL
REV C2 EDITORIAL
V81, ENABLE CSM STATE VECTOR UPDATE

REV 02  08/07/69

PURPOSE:  
(1) TO CAUSE THE RENDEZVOUS DATA PROCESSING RESULTS TO UPDATE THE CSM STATE VECTOR.

ASSUMPTIONS:  
(1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) THE PROCESS MAY BE SELECTED AT ANY TIME.

<table>
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<tr>
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<th>LGC</th>
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---------------------------  ---------------------------
START CREW INITIATED        KEY IN V81E
CSM STATE VECTOR UPDATE PROCESS
---------------------------  --------------------

++
SET VEHICLE UPDATE
FLAG
++
EDIT
++
RESET NC UPDATE FLAG
++

EXIT
V82, REQUEST ORBIT PARAMETER DISPLAY, R30

REV 01  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 30. SEE R30 FOR THE LOGIC SPECIFICATION FLOW FOR REQUESTING THE ORBIT PARAMETER DISPLAY.

CHANGE CONTROL NOTES

LOGIC REV 00  PQR 496
NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE R31. SEE R31 FOR THE LOGIC SPECIFICATION FLOW FOR REQUESTING THE RENDEZVOUS PARAMETER DISPLAY.

CHANGE CONTROL NOTES

LOGIC REV CC  PCR 496
V85. DISPLAY RR LCS AZIMUTH AND ELEVATION

REV 02 12/03/69

PURPOSE:
(1) TO DISPLAY RR ANTENNA AZIMUTH AND ELEVATION.

ASSUMPTIONS:
(1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) THIS PROCESS CAN BE SELECTED ANY TIME ANOTHER EXTENDED VERB OR ROUTINE (SEE R59) WHICH ALSO SETS THE EXTENDED VERB INTERLOCK IS NOT ACTIVE.
(3) IF THE RR IS NOT IN THE AUTO MODE THE ANGLES Displayed BY THIS PROCESS MAY BE INCORRECT BECAUSE THE RR CDU ZERO DISCRETE WILL BE PRESENT AS LONG AS THE RR MODE IS NOT IN AUTO.

PROG

CONT

LGC

GROUND

CREW

+CREW
+SELECTION

###

START CREW INITIATED
DISPLAY OF RR LOS AZIMUTH AND ELEVATION

----

---

DO EXTENDED VERB INTERLOCK ROUTINE (R76)

----

---

CONVERT RR TRUNNION AND SHAFT CDL ANGLES TO A LOS VECTOR IN BODY AXES.

----

---

COMPUTE ANGLE BETWEEN X/Z BODY PLANE

---

---

V85/LUMINARY
AND RK LOS.

---

COMPUTE ANGLE BETWEEN THE LM +Z AXIS AND THE LGS PROJECTION IN THE LM X/Z PLANE.

---

"MAN" FROM BELOW.

IS EXTENDED VERB ACTIVE FLAG SET?

Y N

RESET NU MARKS ALIGNED FLAG

---

HOLD FLASH VERB-NOUN TO REQUEST RESPONSE AND
MON DISPLAY:
MONITOR DSky:
OBSERVE VERB-NOUN
FLASH TO REQUEST RESPONSE AND DISPLAY

---
R1 - RR LOS AZIMUTH
R2 - RR LOS ELEVATION
R3 - BLANK

RR LOS AZIMUTH-ANGLE BETWEEN LOS AND LM X/Z PLANE 4000.00 TO +360.00 DEGREES ABOUT +Y.

RR LOS ELEVATION - ANGLE BETWEEN LM +Z AXIS AND LOS PROJECTED INTO X/Z PLANE, 4000.00 TO +360.00 DEGREES ABOUT +Y.

DO I WISH TO TERMINATE THIS PROCEDURE?

Y  N

RR LOS AZIMUTH AND ELEVATION DISPLAYS WILL CONTINUE.

WAIT FOR KEYBOARD ENTRY

TERMINATE FLASH UPGRADE RECEIPT OF PROCEED,
TERMINATE (V34E), OR RECYCLE,

PROCEED V34E OR V32E

V85/LUMINARY
RESET EXTENDED VERB
ACTIVE FLAG

CHANGE CONTROL ALTERED

LOGIC REV 01  PCB 623
REV 02  EDITORIAL
V89, START RENDEZVOUS FINAL ATTITUDE MANEUVER, R63

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 63. SEE R63 FOR THE LOGIC SPECIFICATION FLOW TO START RENDEZVOUS FINAL ATTITUDE MANEUVER ROUTINE (R63).

CHANGE CONTROL NOTES

LOGIC REV GC  PCR 456
V90, REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY, R36

REV 01  08/09/69

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE 36. SEE R36 FOR THE LOGIC SPECIFICATION FLOW FOR REQUESTING THE RENDEZVOUS OUT-OF-PLANE DISPLAY.

CHANGE CONTROL NOTES

LOGIC REV GC  PCR 456
V91, DISPLAY BANKSUM

PURPOSE: (1) DISPLAY THE SUM OF EACH BANK FOR COMPARISON.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
(2) P00 IS OPERATING, OR A FRESH START CONDITION EXISTS.
(3) NO OTHER EXTENDED VERB WHICH SETS THE EXTENDED VERB INTERLOCK IS ACTIVE.

PROG CONT LGC GROUND CREW

CREW SELECTION

START CREW INITIATED DISPLAY OF THE SUM OF EACH BANK

KEY IN V91E

#10

IS PROGRAM P00 OPERATING, OR DOES A FRESH START CONDITION EXIST?

#20

Y N

#30

TURN ON OPERATOR OR ERR- OR LIGHT

OBSEIVE OPERATOR ERROR LIGHT FOR INICATION OF IMPROPER PROCEDURE.

EXIT

V91/LUMINARY
VSI

DC EXTENDED VERB INTERLOCK ROUTINE (R76)

INITIALIZE BANK NUMBER TO 00

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY

SNAP - VOSN01
  R1 - BANKSUM
  R2 - BANK NUMBER
  R3 - CHECK SUM CONSTANT

R1 - THE OCTAL REPRESENTATION OF BANKSUM, SHOULD BE EQUAL TO (XR THE ONES' COMPLEMENT OF) THE BANK NUMBER IN R2.

R2 - THE OCTAL REPRESENTATION OF THE BANK NUMBER.

R3 - THE OCTAL CHECK

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

DO I WISH TO RECYCLE THE PRESENT BANKSUM DISPLAY?

Y N

DO I WISH TO TERMINATE THE SEQUENCE OF DISPLAYS?
RESET EXTENDED VERB
ACTIVE FLAG AND NO
MARKS ALLOWED FLAG

CHANGE CONTROL NOTES

LOGIC REV 00  PCR 446
NOTE: THIS EXTENDED VERB IS USED TO OPERATE THE IMU PERFORMANCE TEST (P07). A DESCRIPTION OF THIS PROGRAM IS CONTAINED IN SECTION 1 OF H557/1 (PRE-LAUNCH TEST PROGRAMS FOR SUNDANCE AND LUMINARY, FIGURE 1.4.1-1)

CHANGE CONTROL NOTES

LOGIC REV 00   FCR 496
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V93, ENABLE W MATRIX INITIALIZATION

REV 01 08/09/69

PURPOSE:

1. TO REQUEST REINITIALIZATION OF THE RENDEZVOUS W MATRIX.

ASSUMPTIONS:

1. THIS PROCESS RESETS THE RENEFLAG INDICATING THAT THE RENDEZVOUS W MATRIX IS NOT VALID AND MUST BE REINITIALIZED BEFORE BEING USED. THE RENEFLAG IS AUTOMATICALLY SET FOLLOWING W MATRIX INITIALIZATION OR REINITIALIZATION.

2. THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

3. THIS PROCESS MAY BE SELECTED AT ANY TIME.

PROG

CONT

LEG

GROUND

CREM

CREM

SELECTION

.

.

.

START CREW INITIATED

RENDEZVOUS W MATRIX

INITIALIZATION

-----------------------------

RENEW

FLAG

-----------------------------

EXIT

V93
CHANGE CONTROL NOTES

LOGIC REV 00 PGR 496
UPDATE OF EITHER STATE VECTOR

PURPOSE: (1) TO PREVENT LM OR CSM STATE VECTOR UPDATING BY P20 OR P22.

ASSUMPTION: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PRUG CCNT LCC GROUND CREW
CREW SELECTION:
  
START CREW INITIATED: KEY IN V95E
NO UPDATE OF EITHER STATE VECTOR:
  
SET NO UPDATE FLAG:
  
EXIT

CHANGE CONTROL NOTES

LOGIC REV 00 PCR 496
V96, INTERRUPT INTEGRATION AND GO TO PGC

PURPOSE:
(1) TO PROVIDE A MEANS OF SUSPENDING STATE VECTOR INTEGRATION.

ASSUMPTIONS:
(1) IF THE COASTING INTEGRATION ROUTINE IS IN OPERATION, IT IS TERMINATED AT THE END OF THE CURRENT TIME STEP.
(2) THE CURRENT PROGRAM IS TERMINATED.
(3) THE LOG IDLING PROGRAM (PGC) IS ACTIVATED.
(4) PGC STATE VECTOR INTEGRATION IS BYPASSED UNTIL A NEW PROGRAM SELECTION IS MADE.
(5) THIS PROCESS DOES NOT MAINTAIN STATE VECTOR SYNCHRONIZATION, THEREFORE INCORRECT W MATRIX EXTRAPOLATION MAY RESULT.
(6) THE PROCESS IS CANCELLED BY DSKY ENTRY.

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START CREW INITIATED STATE VECTOR INTEGRATION PROCESS

---

SET QUIT FLAG

---

GO TO IDLING PROGRAM (PGC) VIA ROUTINE
CHANGE CONTROL NOTES

LOGIC REV 00 PGR 146
REV 01 PGR 507
REV 02 EDITINAL
V97, PERFORM ENGINE FAIL PROCEDURE

REV. 91  08/09/69

NOTE: EXTENDED VERB 97 IS USED IN THE DPS/APS THRUST FAIL ROUTINE R40. SEE R40 FOR THE LOGIC SPECIFICATION FLOW FOR DISPLAY OF DPS/APS THRUST FAIL.

CHANGE CONTROL NOTES

LOGIC REV 00     PCK 456
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V99, ENABLE ENGINE IGNITION

REV 02  08/07/69

NOTE: EXTENDED VERB 99 IS USED IN PROGRAMS P12, P40, P42, P63 AND ROUTINE R40. SEE P12, P40, P42, P63, AND R40 FOR THE LOGIC SPECIFICATION FLOWS RELATING TO ENGINE IGNITION.

CHANGE CONTROL NOTES

REV 00  PCR 496
REV 01  EDITORIAL
REV 02  EDITORIAL
# Internal Distribution List

**R-567**

*Luminary 1C*

**Section 4 (Rev 7)**

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<th>S. MacDougall</th>
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External Distribution List

MIT Instrumentation Laboratory
P.O. Box 21025
Kennedy Space Center, Florida 32815
Attn: Mr. Robert O'Donnell

MIT Instrumentation Laboratory
Code EG/MIT Building 16
NASA Manned Spacecraft Center
Houston, Texas 77058
Attn: Mr. Thomas Lawton

NASA MSC HW
Building M7-409
Kennedy Space Center, Florida 32815
Attn: Mr. Frank Hughes

Mr. A. Metzger (NASA/RASPO at MIT/IL)

AC Electronics Division
General Motors Corporation
Milwaukee, Wisconsin
Attn: Mr. J. Stridde, Dept. 32-31 (13)
Attn: Mr. Reino Karell (2)

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