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MEMO TO: R. O'Donnell

FROM: R. Gilbert

SUBJECT: LUMINARY 1E (210) vs LUMINARY 1D (178)

- P12 -

1. FLRCS flag (FLAGWRD9 BIT 10) is set to 0 at the beginning of P12. This flag need not be reset via DSKY if, during a previous P12, ENTER was inserted on a flashing V99. It is still necessary to reset P7071 flag (13F9) if P71 is called on surface prior to P12.

2. ASCENT NOUN Changes -

NOUN 77	R1 XXbXX	M/S	TTOGO	
	R2 XXXX.X	FPS	VGY (BODY)	was XXXX.X FPS YDOT
	R3 XXXX.X	FPS	VI	was SPARE
NOUN 94	R1 XXXX.X	FPS	VGX (BODY)	was SPARE
	R2 XXXX.X	FPS	HDOT	was SPARE
	R3 XXXXX.	FT	H	was SPARE

- P2X -

1. PRIO DISP lamp lights when an internal PRIORITY DISPLAY is on the DSKY or waiting in the background if the DSKY is being used externally. The following are PRIORITY DISPLAYS:

P20, P25	V50N18
P20, P22	V06N05
P20	V06N49
	V50N72
	V05N09 ALARMS 501, 503, 514, 525
	V16N80
P22	V05N09 ALARMS 503, 514, 525, 530

The light is turned off by PRO, V32E, V33E, V34E, V36E, V37EXXE, V56E, or hardware of software restart.

- P2X Continued -

2. RENDEZVOUS NOUN change

NOUN 49	R1	XXX.XX	NM	DELTA R	was R1 XXXX.X NM
	R2	XXXX.X	FPS	DELTA V	
	R3	XXXXX.		SOURCE	

Nouns 49, 54, 78, and 90 now all have R1 scaled XXX.XX NM and R2 scaled XXXX.X FPS.

3. PGNCS/AGS RR DATA TRANSFER - During R22, the LGC sends, via the downlist, RR RANGE, RR RANGE RATE, TRUNNION, and SHAFT angles to the AGS and sets a code word called AGSCODE, also on the downlist, to indicate the validity of the data as well as whether the data is HI or LO SCALE.

AGSCODE	20000	no new data
	57777	new data - RR HI SCALE
	17777	new data - RR LO SCALE

Under normal operating conditions, new data is sent approximately every 65 seconds. (See MIT/KSC Memo 71-5).

4. V06N18 has been deleted from R60 to allow EXTENDED VERBS during an AUTO maneuver. Restrictions on EXTENDED VERBS with displays (e.g. V82, V83) during P20 or P22 include:

   a) If V83, for example, is called during the first maneuver in P20 and the RR MODE switch is not in LGC when E is depressed on V50N18, it will be necessary to exit V83 to allow the V50N25 R1 = 00201 display.

   b) If, in P22, the RANGE is greater than 400 NM and closing and a V83 is displaying RANGE and RANGE RATE in addition to the cyclic display, it will be necessary to exit V83 when the range becomes less than 400 NM. V83 could be recalled almost immediately.

5. V50N72 following LOCK-ON in R21 now updates the RR TRUNNION and SHAFT angle displays in R1 and R2 every second. The V50 is "pasted" over a V16N72 monitor.

6. If P20 is called prior to P63, it is no longer necessary to load the LR weighting function LRWH1, location 1315 in LUMINARY 210, prior to PDI. Thus, as long as the NOUPDATE MODE (V95) is in, no reloading whatsoever is required. W-MATRIX initialization destroys the descent targets if incorporations take place.

7. P25 will control spacecraft attitude even though the range to the CSM is greater than 566 NM.

8. P22 will not flash V37 following the overhead pass of the CSM when RR LOCK-ON is lost. V37E00E, for example, should be inserted to terminate P22.

- P3X -

1. NOUN 81, DELTAV in local vertical coordinates, is displayed on all passes in P34(74) and P35(75). NOUN 59, DELTA V LOS, is no longer displayed during these prethrust programs. NOUN 59 data is calculated following PRO on V06N81 and is callable via DSKY.

- P4X -

1. AUTO THROTTLE (CHANNEL 30 BIT 5) is assumed under conditions as described under P6X. Applicable during PGNCS/AUTO and AUTO THROTTLE check just after R60.

2. If the burn time calculated at TIG - 5 seconds is less than 6 seconds, the NOTHROT flag (FLAGWRD5 BIT 12) is set. Previously the LGC would command maximum throttle at zoomtime even though the engine was off.

3. A V37EXXE prior to ullage coming on will now prevent the LGC from commanding ullage. (P40, 42, 63)

- P5X -

1. ROD INPUTS are handled as follows:

   a) AVERAGEG ON - Valid ROD input
   b) P57 or P52 (surface technique - V32E on V50N25 R1 = 00015) MARK X if V52 flashing and MARK Y if V53 flashing
   c) P51 and P52 - ALARM 113

2. R53 and R57 were re-designed. Among the changes were:

   a) Inflight alignments - X MARKS and Y MARKS need not be taken in pairs.
   b) Surface technique - CURSOR and SPIRAL MARKS need not be taken in pairs.
   c) ALARM 107, more than 5 mark pairs, was deleted. A 6th MARK will replace the 5th MARK.
   d) ALARM 114, MARK made but not desired was deleted. This indicated that 2 X MARKS, or 2 Y MARKS were taken in succession.
   e) Star vector determination equations were re-coded.

   Attached diagram illustrates responses to displays in R53 for MARKING on catalog star.

   NOTE: In R59, if the V06N79 display of the desired CURSOR and SPIRAL angles are for a detent other than the one desired, load V21N1E 373E 32533 and then PRO. As of the date of this memo, this procedure hasn't been formally blessed for flight use.

- P6X -

1. DESCENT NOUN changes.

NOUN 63	R1	XXXXX.	FT	DELTAH	was	R1	XXXX.X	FPS	VI
	R2	XXXX.X	FPS	HDOT					
	R3	XXXXX.	FT	H					

- P6X Continued -

NOUN 68	R1	XXXX.X	NM	HOR.RANGE	was R1 XXXX.X	FPS	SLANT RANGE
	R2	XXbXX	M/S	TGO			
	R3	XXXX.X	FPS	VI	was R3 XXXXX.	FT	DELTAH

2. Alignment option, V50N25 R1 = 00014, deleted. PRO on V06N61 results in R60 with 1 degree deadband.

3. TRUDELH was added to the DESCENT/ASCENT downlist.

Word 3a, 3b $\quad$ TRUDELH = $H_{LR} - H_{PGNCS}$

Word 4a, 4b $\quad$ DELTAH = $H_{LR} - H_{PGNCS} - H_{TERRAIN}$ (N63 R1)

4. LPD scaling is: AZIMUTH $\pm 1^{\circ}$ was $\pm 2^{\circ}$
ELEVATION $\pm 1^{\circ}$ was $\pm 1/2^{\circ}$

5. The slope in the LR reasonability test was increased to .25 from .125. This number will reject updates that cause guidance interference problems but will accept values that won't cause guidance interference problems.

6. ABORT (CHANNEL 30 BIT 1) and ABORT STAGE (CHANNEL 30 BIT 4) INPUT discretes are not checked if BIT 1 of location CHANBKUP is 1. CHANBKUP loaded by V22N46E 1 E (11E if AUTO THROTTLE discrete is to be backed up). Applicable during R11.

7. AUTO THROTTLE (CHANNEL 30 BIT 5) is assumed if BIT 4 of location CHANBKUP is 1. CHANBKUP loaded by V22N46E 10E (11E if ABORT and ABORT STAGE to be backed up). Applicable during PGNCS/AUTO and AUTO THROTTLE check just prior to V06N62 and during P66. (Also P40)

8. ALT/ALT RATE and FORWARD/LATERAL VELOCITY commands are sent from the LGC during AVERAGEG regardless of the position of the MODE SELECT switch. The DISPLAY INERTIAL DATA INPUT discrete (CHANNEL 30 BIT 6) is not checked. For ALT/ALT RATE commands to get to the meters requires MODE SELECT switch in PGNCS and RNG-ALT MON switch in ALT/ALT RATE. For FORWARD/LATERAL VELOCITY commands to get to cross-pointers requires MODE SELECT switch in PGNCS and RATE/ERR MON switch in LDG RDR/CMPTR.

9. V57E results in a flashing V06N63 display while V58 results in a static V06N63 display during P63.

10. The polarity of the LATERAL VELOCITY cross-pointer using data sent via the LGC is reversed. This is a hardware change.

- P77 -

1. P77, LM TARGET DELTA V, updates the LM state vector if, for instance, the LM performs a burn without AVERAGEG on. In P77, the NOUN 33 display is followed by the NOUN 81 display as opposed to the NOUN 84 in P76.

- PXX -

1. ALARM 1520 results if V37EXXE is inserted during

   a) ISS CDU ZERO following V40N20E.
   b) V47 is performed in program other than P12, P20, P22, P4X, P5X, P6X, P70, and P71 and ISS CDU ZERO is in progress.

   The ISS CDU ZERO routine in these cases takes 10.56 seconds. ALARM 1520 results if V37EXXE is inserted, as in previous LUMINARY releases, during

   c) ISS CDU ZERO following V36E or other FRESH START.
   d) TURN-ON SEQUENCE or IMU CAGE.
   e) NODO flag (1F2) is set.

- VERBS -

1. V30 or V31E with R1 of NOUN 26 = 0 results in OPERATOR ERROR. NOUN 26 now uses unshared erasable locations 2371,2,3. NOUN 26 is loaded with V25 and displayed with V05.

2. V35E now lights the PRIO DISP and NO DAP lights on the DSKY. (BITS 1 and 2, respectively, of DSPTAB +11D).

3. V41N72E while a REMODE or REPOSITION is in progress will result in the routine delaying the V21N73 display until the REMODE or REPOSITION is complete. A second V41N72E in the belief that the first one did not get in will result in OPERATOR ERROR. V41N72E may be inserted, without an intervening V44E, after PRO is inserted on the V04N12 R1 = 00006 display. RADMODES, location 110, BITS 14 and 11 indicate that a REMODE and/or REPOSITION is in progress (V11N1E 110E). Patience.

4. V44E plays the same REMODE/REPOSITION game as V41N72 inasmuch as waiting for the completion of the REMODE or REPOSITION. Additional V44's while the routine is looping will eventually lead to ALARM 31202 although no OPERATOR ERROR will result. A V44E while no other displays are active on the DSKY will result in the DSKY blanking when the routine has terminated a CONTINUOUS DESIGNATE presently running. V44E is not necessary if a V41N72E is to be inserted immediately thereafter. V44E is also not necessary if the RR MODE switch is in AUTO TRACK or SLEW and/or the RR CB's are pulled.

5. V47E - The NODO flag (FLAGWRD2 BIT 1) is not set so V37EXXE may be called prior to the V50N16 display, usually when downlink is received by AGS, although ALARM 1520 results if called during the ISS CDU ZERO.

6. V48E has V04N46 displayed instead of V01N46. R2 has CHANBKUP, the location containing the back-up flags for DESCENT. It is desireable to load this location to 00000 when new ropes are installed. V48E need not be called to load NOUN 46. CHANBKUP is on all downlists. (See P6X)

7. V56E was recoded so that it can perform properly if it is necessary to call it again if it was interrupted by a RESTART.

- VERBS Continued -

8. V57E - Sets LR UPDATE flag and results in static V06N63 display in P63.
   V57E has no displays associated with it.
   V58E - Resets LR UPDATE flag and results in flashing V06N63 display in P64.

9. V63E - NOUN change

```
NOUN 78  R1 XXX.XX   NM   RANGE
         R2 XXXX.X   FPS  RANGE RATE    was XXXXX.  FPS
         R3 XXbXX    M/S  TTOTIG
```

The RADSAMP routine calls itself using the word ADRES rather than CADR which caused problems in the LMS but not in the LGC.

- DAP -

1. NO DAP lamp lights when

   a) PGNCS is in PULSE MODE, ATT HOLD and V76E.
   b) PGNCS MODE CONTROL switch is in OFF position.
   c) IMU is OFF or TURN-ON sequence is in progress.
   d) IMU is being caged.
   e) ISS CDU ZERO is in progress or ISS is in COARSE ALIGN.
   f) Ground testing - IMODES33 (location 1300) BIT 6 is set.

2. DAP continues to function and FINDCDUW, powered flight steering routine, issues commands if input discrete from GUID CONT switch (CHANNEL 30 BIT 10) indicates AGS. Exceptions are:

   a) The actual CDU's rather than the desired CDU's (CDUD) will be used to set up the coordinate frame for the thrust direction filter.
   b) The DAP will reinitialize when the GUID CONT input discrete indicates PGNCS.

3. CH5MASK and CH6MASK (locations 1257 and 1260), RCS JET INHIBIT flags, are on the Coast and Align, Rendezvous and Prethrust, and Lunar Surface downlists. They are not on the AGS Initialization and Update, Orbital Maneuvers, and Descent/Ascent downlists.

4. All MAJOR MODE changes and RESTARTS (hardware and software) set up a 1/ACCS job.

5. The ATTITUDE ERROR needles will be reinitialized when the PGNCS MODE CONTROL switch is switched from OFF. The ATTITUDE ERROR needles previously were reinitialized when the IMU became "usable" but not when going to ATT HOLD or AUTO from OFF.

6. The mass-dependent calculations in 1/ACCS were updated for the DESCENT configuration by changing various "constants." The addition of the Rover and associated enlargement of the DPS tanks in LM 10 caused appreciable change in the mass properties.

- DAP Continued -

7. The present bounds on the ASCENT and DESCENT masses are

	R03	minimum unstaged mass in N47	14,462 lbs.
	R03	minimum ASCENT mass in N47	4,850 lbs.
HIASCENT	1/ACCS	maximum ASCENT mass	8,858 lbs.min.(E-load)
LOASCENT	1/ACCS	minimum ASCENT mass	4,850 lbs.
HIDESCENT	1/ACCS	maximum unstaged mass	36,817 lbs.
LODESCENT	1/ACCS	minimum unstaged mass	5,604 lbs. + HIASCENT

8. If inhibit X-AXIS override is removed or the PGNCS MODE CONTROL switch is moved to ATT HOLD after previously been moved from ATT HOLD to AUTO before the MANUAL RATE COMMAND has properly terminated and while X-AXIS override is inhibited, no unexpected jet firings will occur about the YAW AXIS.

9. A hardware or software restart during an ISS CDU ZERO, except the V37EXXE which results in ALARM 1520, requires that the ISS CDU ZERO be again executed, V40N20E, to re-enable the DAP.

- MISCELLANEOUS -

1. Constants in fixed memory were updated for the 1971-72 year. These are the locations that must be changed on LMS when running with previous load tapes.

AZO	(2)	STAR TABLE (222)		KONMAT	(8)
BDOT	(2)			RATESP	(12)
NODIO	(2)			VAL67	(12)
NODDOT	(2)				
FSUBO	(2)				
FDOT	(2)				

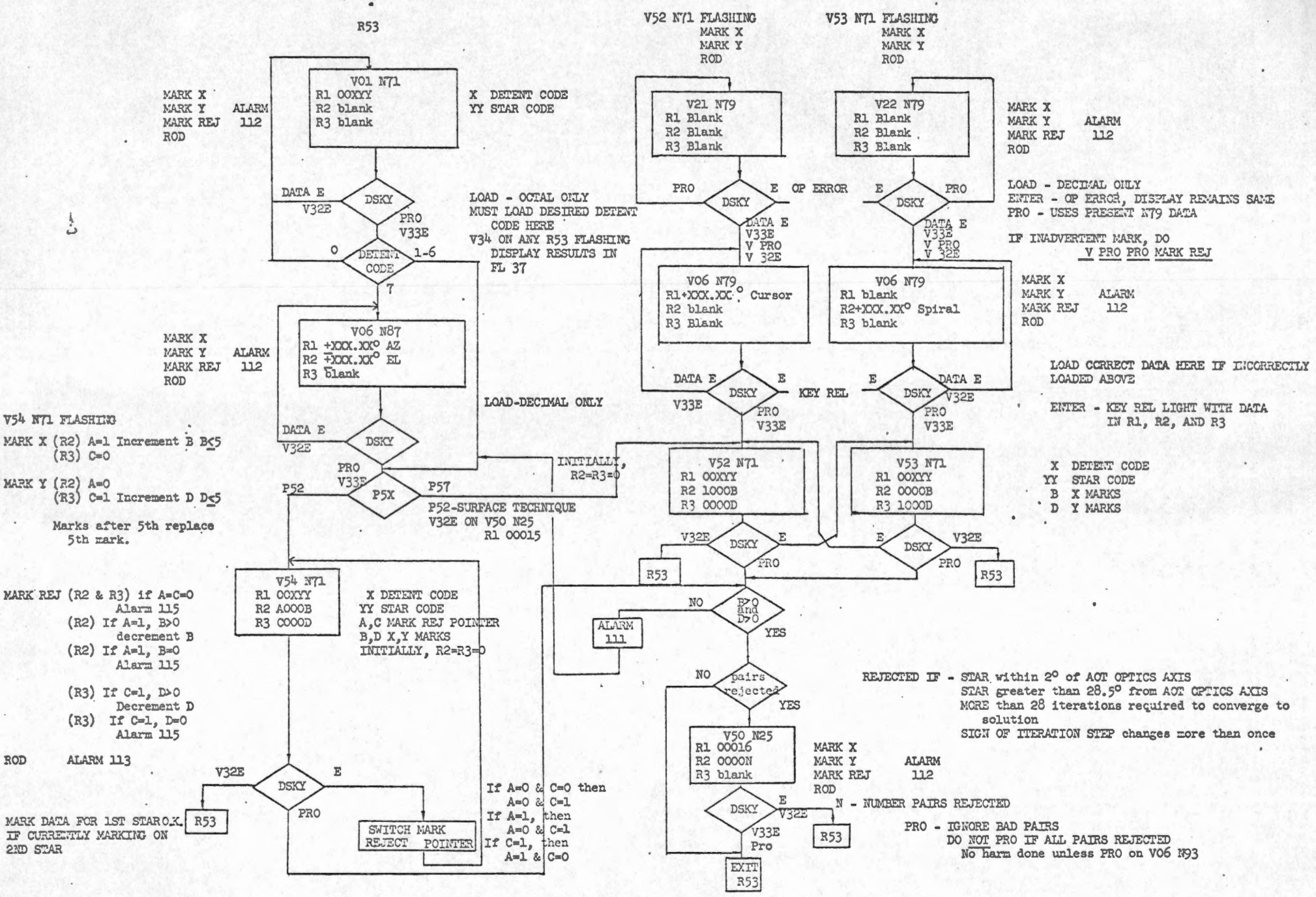
CSTODAY, the number of centiseconds in 24 hours, was rescaled from B33 to B32.

2. ALMCADR and ALMCADR +1 were placed on the AGS Initialization and Update, Rendezvous and Prethrust, Orbital Maneuvers, and Descent/Ascent downlists. V5N8E displays these quantities in R1 and R2. R1 contains the address and R2 the bank information to indicate where the ALARM originated in the program.

3. A POODOO will turn into a BAILOUT, ALARM code remains same, if location EXTVBACT indicates that an EXTENDED VERB may have caused the ALARM. If the ALARM then returns, the POODOO logic will be executed.

4. A POODOO ALARM, not caused while an EXTENDED VERB is running, will now clear the RENDEZVOUS (7F0), TRACK (5F1), and P25 (9F0) flags. This prevents the possibility of P20 being requested but not executed.

5. Gyro torquing is not performed, or is terminated if presently torquing, if the ISS is in COARSE ALIGN or being CAGED.


R53
V52 N71 FLASHING
MARK X
MARK Y
ROD
V53 N71 FLASHING
MARK X
MARK Y
ROD
V01 N71
R1 00XYY
R2 blank
R3 blank
MARK X
MARK Y ALARM
MARK REJ 112
ROD
X DETENT CODE
YY STAR CODE
V21 N79
R1 Blank
R2 Blank
R3 Blank
V22 N79
R1 Blank
R2 Blank
R3 Blank
MARK X
MARK Y ALARM
MARK REJ 112
ROD
DATA E
V32E
DSKY
PRO
V33E
PRO
E OP ERROR
E
PRO
LOAD - DECIMAL ONLY
ENTER - OP ERROR, DISPLAY REMAINS SAME
PRO - USES PRESENT N79 DATA
IF INADVERTENT MARK, DO
V PRO PRO MARK REJ
LOAD - OCTAL ONLY
MUST LOAD DESIRED DETENT CODE HERE
V34 ON ANY R53 FLASHING DISPLAY RESULTS IN FL 37
0
DETENT CODE
1-6
7
DATA E
V33E
V PRO
V 32E
V06 N79
R1+XXX.XX° Cursor
R2 blank
R3 Blank
V06 N79
R1 blank
R2+XXX.XX° Spiral
R3 blank
MARK X
MARK Y ALARM
MARK REJ 112
ROD
V06 N87
R1 +XXX.XX° AZ
R2 ±XXX.XX° EL
R3 blank
MARK X
MARK Y ALARM
MARK REJ 112
ROD
LOAD-DECIMAL ONLY
DATA E
V33E
KEY REL
E
DATA E
V32E
PRO
V33E
LOAD CORRECT DATA HERE IF INCORRECTLY LOADED ABOVE
ENTER - KEY REL LIGHT WITH DATA IN R1, R2, AND R3
V54 N71 FLASHING
MARK X (R2) A=1 Increment B B≤5
(R3) C=0
MARK Y (R2) A=0
(R3) C=1 Increment D D≤5
Marks after 5th replace 5th mark.
INITIALLY, R2=R3=0
P52
P5X
P57
P52-SURFACE TECHNIQUE
V32E ON V50 N25
R1 00015
V52 N71
R1 00XYY
R2 1000B
R3 0000D
V53 N71
R1 00XYY
R2 0000B
R3 1000D
X DETENT CODE
YY STAR CODE
B X MARKS
D Y MARKS
V32E
E
R53
NO
R>0 and D>0
YES
ALARM 111
V54 N71
R1 00XYY
R2 A000B
R3 C000D
X DETENT CODE
YY STAR CODE
A,C MARK REJ POINTER
B,D X,Y MARKS
INITIALLY, R2=R3=0
MARK REJ (R2 & R3) if A=C=0
Alarm 115
(R2) If A=1, B>0
decrement B
(R2) If A=1, B=0
Alarm 115
(R3) If C=1, D>0
Decrement D
(R3) If C=1, D=0
Alarm 115
ROD ALARM 113
NO
pairs rejected
YES
REJECTED IF - STAR within 2° of AOT OPTICS AXIS
STAR greater than 28.5° from AOT OPTICS AXIS
MORE than 28 iterations required to converge to solution
SIGN OF ITERATION STEP changes more than once
V50 N25
R1 00016
R2 0000N
R3 blank
MARK X
MARK Y ALARM
MARK REJ 112
ROD
N - NUMBER PAIRS REJECTED
PRO - IGNORE BAD PAIRS
DO NOT PRO IF ALL PAIRS REJECTED
No harm done unless PRO on V06 N93
V32E
E
PRO
MARK DATA FOR 1ST STAR O.K. IF CURRENTLY MARKING ON 2ND STAR
R53
SWITCH MARK REJECT POINTER
If A=0 & C=0 then A=0 & C=1
If A=1, then A=0 & C=1
If C=1, then A=1 & C=0
V33E
Pro
EXIT R53