

Massachusetts Institute of Technology
C. S. Draper Laboratory
Cambridge, Massachusetts

LUMINARY Memo #192

To: Distribution
From: D. Densmore
Date: 5 January 1970
Subject: Luminary Revision 196

The following changes were incorporated into Revision 196: PCR 1127, PCR 1107, PCR 1109, PCR 1110, PCR 1122, PCR 1059 (L-1D-10), PCR 348, PCR 1121, PCR 319, ACB L-33, ACB L-41, ACB L-43 and ACB L-45; additional implementation of PCR 1044; and four cosmetic changes.

1) PCR 1127 (Put CHANBKUP on the Downlist).

CHANBKUP is an erasable whose bits dictate override of specific corresponding channel bits for use in the case of channel bit failure. If any of these bits are on, the channel bit setting is ignored and an assumption is made about the true state. This erasable is used by the channel back-up code covered by PCRs 1107, 1109, and 1111.

The following additional changes were made in connection with CHANBKUP.

- a) CHANBKUP was defined in unswitched erasable immediately before FAILREG (for downlink purposes). To make room for it there (374) RESTREG (a display restart erasable) was deleted from location 366, causing the rest of the display erasables including the CADRFLSH registers to move up one. CHANBKUP was then inserted before FAILREG after TEMPFLSH. Comments in this area were improved and expanded. RESTREG was then redefined in location 1265 (unshared still) between the Permanent Dap Storage and the C13STALL erasables. Room was created for RESTREG there by the removal of RCSFLAGS to an unused location in E6 (made possible by PCR 1059; see item 6). RCSFLAGS had been part of the unshared Permanent Dap storage. When it was moved T5ADR (d. p.) moved up one location.

LOCATION	BEFORE	AFTER
366	RESTREG	NVWORD
367	NVWORD	MARKNV
370	MARKNV	NVSAVE
371	NVSAVE	CADRFLSH
372	CADRFLSH	+1
373	+1	+2
374	+2	CHANBKUP
375	FAILREG	FAILREG
376	+1	+1
377	+2	+2
1257	CH5MASK	CH5MASK
1260	CH6MASK	CH6MASK
1261	SPNDX	SPNDX
1262	RCSFLAGS	T5ADR
1263	T5ADR	+1
1264	+1	RESTREG
1265	C13QSAV	C13QSAV

- b) CHANBKUP was put on all the downlists as word 62a. Word 62b is FAILREG, word 63 is FAILREG +1 and FAILREG +2. This was done by replacing CADRFLSH +2 with CHANBKUP on Orbital Maneuvers List sublist #4. All the other downlists include sublists which are equated to that one. No CADRFLSH register appears on the downlink any longer. Channel 77 was put onto that sublist in place of CADRFLSH, +1 in Luminary 1D.
- c) The CHECK= list was updated to ensure that FAILREG = CHANBKUP +1 and no longer check for FAILREG = CADRFLSH +3.
- d) CHANBKUP will be displayed as R2 of N46. This component was formerly a spare. (The third component is still spare.)
- 1) The relevant Pinball Noun Tables were updated: (a) NNADTAB for mixed nouns (component code and relative address in IDADDTAB); (b) NNTYPTAB for mixed nouns (scale factor constant codes for each component); (c) IDADDTAB (ECADRs); (d) RUTMXTAB (scale factor routine for each component).
 - 2) The relevant tables in the Assembly & Operation Section were updated: (a) the mixed noun table with description of the quantity, the # of components, scaling, and restrictions; and (b) the mixed noun table with the component numbers, Mnemonics, and scale routines.

2) PCR 1107 (Backup of Abort Bits - Chan 30 Bits 1 and 4).

A check is made in P70-P71 in P71NOW? on CHANBKUP. If bit 1 is set a branch is made directly to LANADISP, assuming "no abort" and not even checking the channel bits. If bit 1 of CHANBKUP is clear, the channel 30 bits are tested and believed.

3) PCR 1109 (Backup of Off (1) Failure of Auto Throttle Channel 30 Bit 6).

Two checks were made in different areas on bit 4 of CHANBKUP. If the bit is on, channel 30 bit 5 is not tested, and auto throttle is assumed. If CHANBKUP bit 4 is clear the test is made of channel 30.

This is done in LLGE in MANTHRT? and if the CHANBKUP bit is on a direct branch is made to RODCOMPA. In Burn Baby in P40A/P the override test is made and if the override is indicated a direct branch is made to GOBACK.

4) PCR 1110 (Backup for Failure of Inertial Data bit).

The back-up for this bit was to always have the LGC attempt to display the inertial data. If the switch is not in PGNCS the hardware will prevent the data from getting out to the display.

5) PCR 1122 (Turn on a DSKY light when the DAP is not controlling).

a) Implementation of this PCR was begun with the changes required in T4RUPT. The new DSKY light is controlled by bit 2 of DSPTAB +11D. It is set or reset in T4RUPT (beginning of GLOCKOK) based on bit 2 of flagword 10. If the flagbit is set (DAP controlling) and the light is off, no change is made to the light.

If the flag is reset and the light is on, again no change to DSPTAB +11D is made.

If the flag indicates DAP controlling and the light is on it is turned off unless lamp test (V35) is in progress.

If the flag indicates DAP not controlling and the light is off it is turned on.

In all cases the exit sets CONTRLBT (the flag) and then resumes. It is the responsibility of the DAP to reset CONTRLBT when it is not controlling, in DAPIDLER and minimum impulse logic.

- b) The constant TSTCON2 used by V35 lamp test to turn on DSKY lights was changed to include the "DAP not controlling" light, DSPTAB +11D bit 2.
 - c) CONTRLFL and CONTRLBT were defined in the flagword assignments section as bit 2 of flag 10. It was also entered in the alphabetic flag list.
 - d) Interpretive routines GET+MGA, SETMGA, and GET.LVC (28 words) were moved together from Bank 6 into Bank 21. The double precision constant HALFREV was moved from Bank 6 into Bank 22. This was done to make room in Bank 6 for the new T4RUPT coding (see item 5, a). HALFREV was used by GET+MGA in interpretive and had to be moved to remain in the same half of memory as the routine using it. It has no other references.
 - e) The tag assignment section was changed in connection with the bank moving in item 5, d. Tag "MIDDGIM" was deleted from Bank 6 and assigned to Bank 22 to move HALFREV. (There is only that one use of it.) Tag "MIDDGIM1" was defined in Bank 21 for the new SETLOC for GET+MGA etc.
- 6) PCN 1059 (Have major mode changes set up a 1/ACCS).

Implementation of this PCN corrects anomaly L-1D-10 (major mode changes that leave the DAP with improper data).

- a) The clearing of ACCSET (Bit 13 of RCSFLAGS) in STARTSB1 was deleted. This had been there to cause DAPIDLER to call 1/ACCS. STARTSB1 is executed on a fresh start, hardware restart, BAILOUT or POODOO. It is not performed on a V37. In order to cause the 1/ACCS job to be set up in all cases it is set up as a PRIO 27 NOVAC job after the job queue is wiped out in STARTSB2.

- b) The coding to set up the 1/ACCS job in DAPIDLER depending on the value of ACCSET was deleted, now that it is being handled much more simply by STARTSB2. This saved 10 words in Bank 16.
- c) In order to make room in Bank 5 for the change in STARTSB2, the setting of DACFLAG2 (bit 4 of RCSFLAGS) in Fresh Start was deleted. It will be done in the DAP anyway because IMODES33 bit 6 is set. This change was written explicitly into the PCN.
- d) Because RCSFLAGS is no longer referenced in Fresh Start it could be moved out of unswitched erasable into a formerly unused location in E6 (1774). It remains unshared. This makes room for the definition of CHANBKUP in unswitched and the implementation of PCR 1127. See item 1. a.

7) ACB L-33 (Load trap with a number that is one bit off).

This ACB is to make room in Bank 5 for PCN 1059. In Fresh Start (DOFSTR1) DKTRAP was loaded with constant 77001OCT. This constant was only used for this purpose. It was deleted and DKTRAP was loaded with the complement of constant LOW9, which is already defined. This is in error by an insignificant amount, and is overwritten by a padload from the ground following fresh start anyway.

8) PCR 348 (P77 - New target ΔV program for LGC).

A program correlative to P76 was established to allow updating of the LM state vector as P76 allows updating of the CSM state vector. This makes Luminary compatible with Artemis which has P77 (thanks to PCR 325).

- a) A new lead-in for both programs ("P76ER77") was written and where appropriate changes were made in the P76 logic to check for or provide for P77. The lead-in sets a new erasable "OPTFLAG" depending on which program was selected. P77 thus makes use of P76 code. P77 displays delta V via N81.

- b) Entries for P77 were put into the V37 FCADRMM1 table, PREMM1 table, and downlink ADRES table. The entry for P76 the FCADRMM1 table was changed to P76ER77 (identical to the P77 entry FCADR). The number of major modes constant NOV37MM was changed to 26D.
- c) Interpretive routine GRP2PC (7 words) was moved from Bank 4 to Bank 24. Interpretive constants 3CSECS and TIMEDELT (4 words total) were moved from Bank 13 into Bank 4. This made 3 more words in Bank 4 (making room for the V37 changes) and 4 more words in Bank 13 (making room for the P76 changes). A new tag ORBITAL4 was defined in Bank 24 for the SETLOC that moved GRP2PC.
- d) OPTFLAG was defined in unswitched erasable immediately following the d. p. alignment erasable SITIME. This put it in location 1243 sharing with MASS and WEIGHT/G.
- 9) PCR 1121 (Replace Acceleration estimate with RCS Inhibit flags on nonpowered downlist).
- CH5MASK and CH6MASK were put on the Coast and Align list, the Rendezvous and Prethrust test, and the Lunar Surface Align list. It was put in place of ALPHAQ and ALPHAR, the acceleration estimate, which was always zero while these lists were in use. This quantity (needlessly) appeared on all lists in word 89. It formerly was included in the Orbital Maneuvers sublist #5. The other powered flight programs continue to refer to that, and a new sublist #5 was written for the nonpowered lists to include CH5MASK instead of ALPHAQ.
- 10) PCR 319 (Put true delta H on the downlist).
- True $\Delta H (H_{LR} - H_{LGC})$ is needed for monitoring rougher landing sites. It is time-honogeneous with the regular ΔH (which is true ΔH updated by the terrain model when in operation).

a) Two new erasables were defined. TEMDELH is a temporary for holding true delta H during the running of the Terrain Model in order to ensure its time-homogeneity on downlink with the delta H updated by the terrain model. TRUDELH is the permanent downlink location for true delta H. It should remain unshared all through the landing even though it will be the same as DELTAH (also on the downlink) when the terrain model is not running.

E7, 1400	/	/	/	/
	/	/	/	/
E7, 1736	TRUDELH	MDOT	NSRCHPNT	RRSHAFT
1737	+1	+1	SAVLEMV	LRS22, 1X
	/	/	/	/
	/	/	/	/
E7, 1766	TEMDELH	DELVROD	MUSCALE	SCAXIS +2
1767	+1	+1	+1	+3
	/	/	/	/
	/	/	/	/

b) TRUDELH was put on the Descent/Ascent downlist (word 3) in place of a spare. The list was rearranged to snapshot TRUDELH and DELTAH.

1	<u>BEFORE</u>		<u>AFTER</u>
1	ID & Synch		ID & Synch
2	ALMCADR		ALMCADR
3	SPARE		TRUDELH
4	SPARE		DELTAH
5	FC	} snapshot	FC
6	GTCTIME		GTCTIME
7	MKTIME		MKTIME
	/		/
22	DELTAH		SPARE
	/		/
	/		/

c) SERVICER was changed to provide the time-homogeneous true delta H for the downlink. The partial (true) delta H is stored in TEMDELH before entering the terrain model. Formerly it was just left in the push list. After finishing the terrain model, and if the terrain model is skipped, the contents of the push list delta H are put into DELTAH (if the terrain model was active, that value has been updated). Right after the push list value is stored in DELTAH, coding was added to pick up TEMDELH and store into TRUDELH. These two stores were inhibited to prevent a down-rupt from coming in and picking up both quantities for the snapshot after only one had been updated.

- 11) ACB L-41 (Avoid reading the GTS drives bits in 1/ACCS to avoid error in failure case).

The bits were read to determine current GTS drive directions. They are in error if the bits are failed on with the GTS disabled. LRESC in AOSTASK & AOSJOB was changed to use the signum of the current high jerk estimates (Q, RACCDOT) instead.

- 12) ACB L-43 (Delay enabling of redesignator interrupt until PRO on V06N64).

The coding that enables the redesignator interrupt (setting bit 12 of channel 13) was moved from STARTP64 to P64CEED where it goes on the PROCEED response to the V06N64 display. This proceed is the "permit redesignations" response.

Avoiding the proceed in the case of known on-failure of bits 1 or 2 or 5 or 6 of channel 31 would prevent initiation of the redesignation monitor and the automatic loss of about 3% computation time throughout P64. Since redesignations are ignored until after the PRO the trap does not need to be enabled sooner.

- 13) ACB L-45 (Ensure precision integration on a P21 recycle).
INTYPFLG is cleared prior to the INTEGRVS call in the P21 recycle option (P21CONT).
If an extended verb using conic integration were called over the N43 display, P21 could have integrated the base vector with precision integration and then with conic on a recycle.
- 14) PCR 1044 (Redesign R53-R57).
RODCOUNT was zeroed at the start of P63. It might have had left-over information from being used for marks as part of the back-up system.
- 15) PCR 1091 (Priority display DSKY light).
The constant TSTCON2 used by V35 lamp test was changed to turn on Bit 1 of DSPTAB +11D to light the new super key release light.
(see item 5. b).

Cosmetic changes:

- 16) PCR 336 (Delete OG 18 display in R60).
A cosmetic correction was made to the alphabetic flag table entry for PDSPFLAG.
- 17) PCR 1124 (Flag resetting in POODOO abort).
A comment was updated to reflect the change.
- 18) PCR 317.2 (Rescaling nouns containing range and range rate).
A comment in the extended verbs section was updated to reflect the change.
- 19) An incorrect (and useless) "BANK 15" card was deleted from Alarm and Aborts routine.

GSOP Impact:

The following items should be examined for possible impact on the various GSOP sections.

section 2	items 1, 2, 3, 4, 5, 9, 10, 11, 13.
section 3	items 5, 6, 7, 9, 11.
section 4	items 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14.
section 5	items 2, 3, 4, 5, 6, 12.