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LUMINARY Memo #167 Revision 1

To: Distribution
From: B. McCoy, P. Rye
Date: 17 September 1970
Subject: Luminary 1D: Which One, What Kind, How Many?

Luminary 1D will be released for the third time on 19 September 1970; its revision # is 178. The new changes incorporated are PCRs 322, 1056 and 1058. Herewith are the descriptions.

PCR 322: One of the major causes of the predatory "throttle castellations" was the response time of the DPS throttle (THROTLAG). The previous value was 0.2 seconds; the new value is 0.08 seconds.

PCR 1056: The required ullage time for a very light Ascent Stage burn using 2 jets is 14 seconds before ignition. The previous Luminary 1D had assumed 3.5 seconds of ullage before ignition causing 2-3 fps overburn. The Apollo 14 crew will be using 4 jet ullage and this would contribute another 2-3 fps to the overburn. Luminary 178 will turn on ullage at 6 seconds prior to ignition. For 4 jet ullage, the required ullage time is 30 seconds. Since, the LGC turns it on at TIG -6 seconds, the astronaut can release the ACA when V99 appears (at TIG -5 seconds). Specifically, "P42TABLE +6" was changed to 2390 (-29.9 +6 seconds) and S40.13 uses "FRCS4" instead of "FRCS2" to assume 4 jet ullage, and also it uses "6.5 SECS" to assume 6.5 seconds of ullage (ullage is turned off at TIG +0.5 seconds). The value of K1VAL (total APS impulse in one second) was 2800 lbf·sec which is based on a "dry" (not yet fired) APS engine. The TPI impulsive burn and most conceivable burns on the APS (except lunar ascent) will be done on a "wet" engine. The value of 2800 lbf·sec caused an overburn of roughly 2 fps. This value was changed to 3150 lbf·sec (extrapolation of data from LM Data Book).

PCR 1058: When it was found that the Landing Analog Displays Routine (R10) gave results with errors up to 3.5 fps in the cross pointer display, a new R10 was suggested to effectively eliminate these errors. In the process the altitude-rate glitch was eliminated. The word saving was 119 words; the new R10 takes 1% longer. The main cause of the errors was the single precision dot products; these were changed to double precision. Also, some computational simplifications were made to the dot products, knowing that the IMU is aligned to the landing site. A PIPA bias correction term is added to increase accuracy; computation of VBIAS formerly done in P66 is now done in SERVICER. Altitude is based on a simpler extrapolation than before. R10 now computes altitude and Alt-Rate every pass (every 1/4 second) outputting Alt-Rate before a 12 cs pause, Altitude immediately after the pause. Flag bit SWANDISP is now set immediately after SERVICER computes the parameters necessary for R10 so that R10 may start near TIG -30 rather than at ignition. The DIDFLAG definition remains the same; just DID the initialization. IMODES33 bit 7 is no longer used. ACB L-11 and Anomaly L-1B-04 were not incorporated into the new R10 as originally conceived, but they are in Luminary 178: The forward velocity for NOUN 60 will be computed if the MODE SELECT switch is not in PGNCS (and incidentally accurate to 0.1 fps); R10 will be initialized if the RR CDU ENABLE bit is removed by e. g. moving the RR MODE switch into and out of LGC.

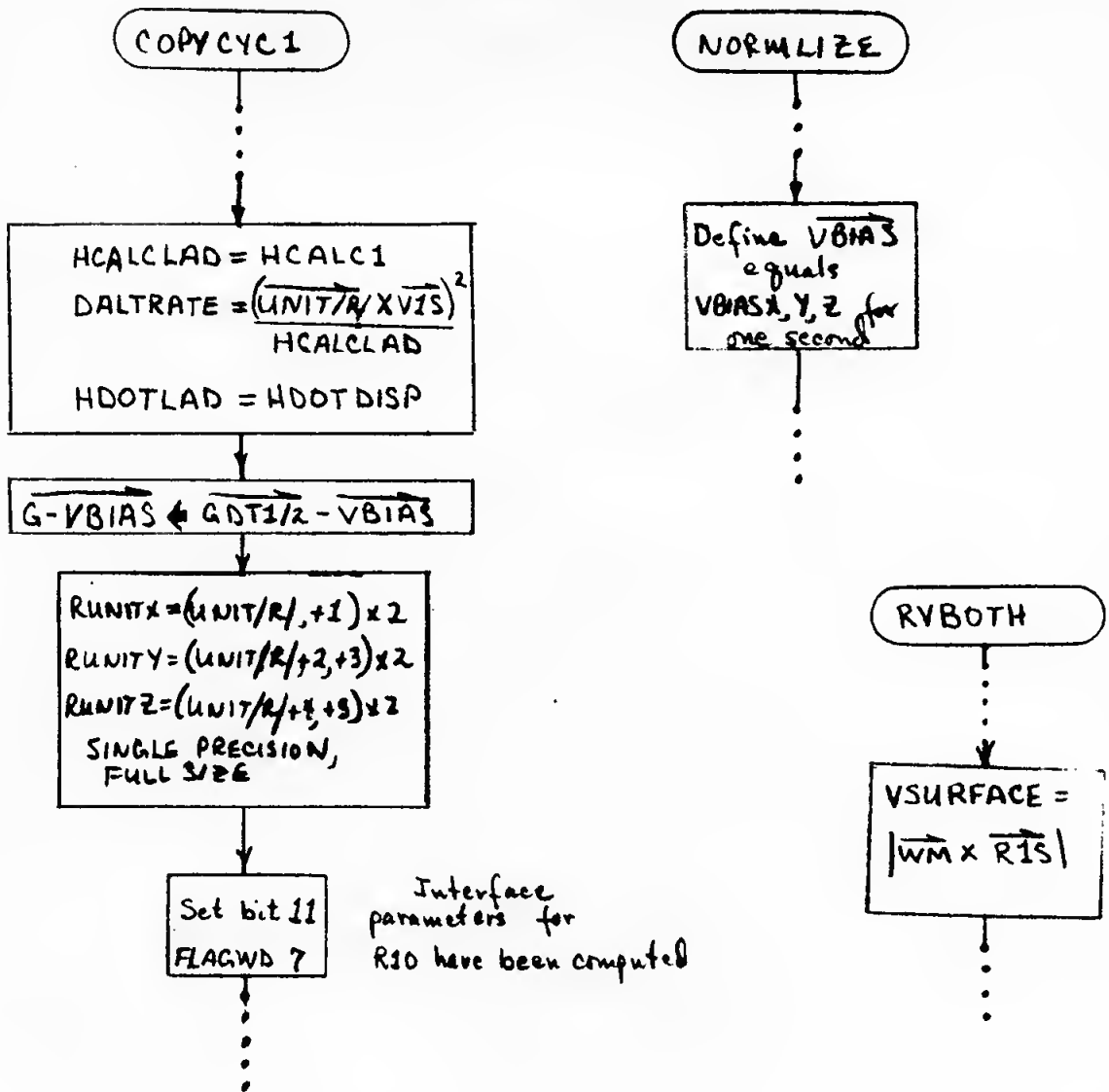
The R10FLAG has been redefined. When it's set by P12, P70, P71, the inertial Y velocity will be displayed on the lateral velocity cross pointer while the forward velocity crosspointer is set to be zero.

Flow Charts for R10 and its interface parameter computation are attached. For more details see Luminary Memo #162 by Don Eyles. This memo superceeds Memo #162 where differences occur.

Changes to other areas due to R10 design:

1. downlist mnemonics changes
 LATVEL to LATVMETR
 FORVEL to FORVMETR
2. VBIAS calculation moved from STRTP66A into NORMLZE;
3. For erasable overlay purposes ZAXIS computation moved to Ascent Guidance from P12 initialization.
4. The erasable ACSAVE, used in ascent, was moved to avoid conflict with the new configuration of R10 erasables.
5. New scaling was implemented to accommodate the double precision value used in R1 of Noun 60.

R10 COMPUTATIONS in SERVICER



LANADISP

$PIPCTR \leftarrow PIPCTR1$
 $TBASE2 \leftarrow -(TIME1)$

Bit 11
 FLAG 7

CLEAR: SERVICEZ completed

DISPRSET+1
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SET: SERVICEZ not completed

$\vec{VVECT} \leftarrow \vec{V} - \vec{VSURFACE}$

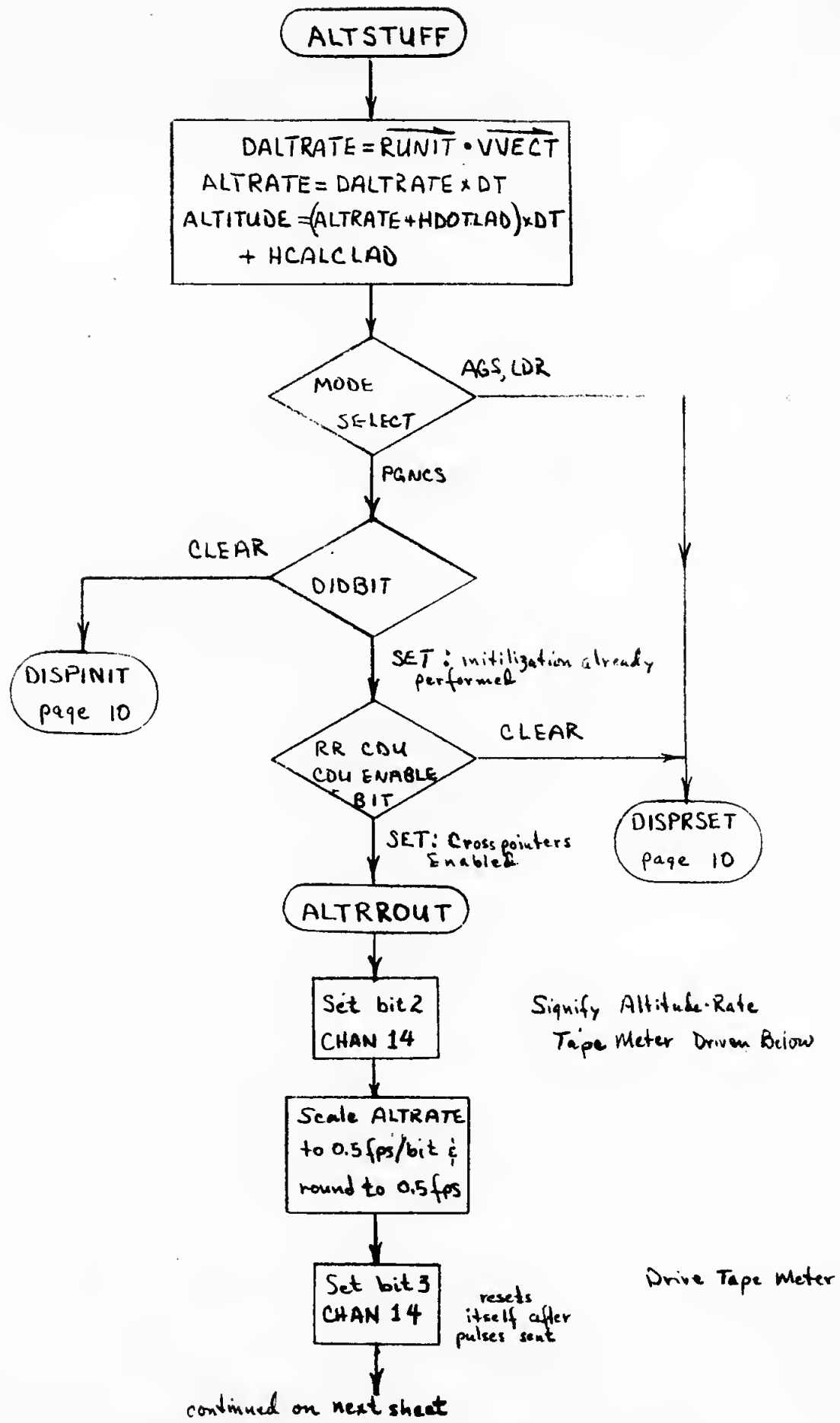
$DT \leftarrow TIME1 - PIPTIME + 1$

$\vec{VVECT} \leftarrow \vec{VVECT} +$
 $(\vec{PIPA} + \vec{PIPATMP}) \times$
 $LANAKPIP$

$\vec{VVECT} \leftarrow \vec{VVECT} +$
 $(G - VBIAS) \times DT$

ALTSTUFF

continued on next sheet



continued on next sheet

from preceeding sheet

PAUSE
12 cs.

ALTROUT

Reset bit 2
CHAN 14

Signify Altitude
Tape Meter

Scale ALTITUDE
to 2.345 ft/bit

Lower limit
+ ZERO

Set bit 3
CHAN 14

resets
itself after
pulses sent

Drive Tape Meter

CROSCOMP

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limit FORVTEMP command to
198 fps. Scale in units of
0.5571 fps and round to
nearest 0.5571 fps.

$CDUSCMD = FORVTEMP -$
 $FORVMETR + (-ZERO)$
 $FORVMETR = FORVMETR$
 $+ CDUSCMD$

continued on next sheet

from preceding sheet

limit LATVEL command to
198 fps. Scale in units of
0.5571 fps and round to
nearest 0.5571 fps.

$CDUTCMD = LATVEL -$
 $LATVMETR + (-ZERO)$
 $LATVMETR = LATVMETR +$
 $CDUTCMD$

Set bits 11 & 12 of CHAN 14

Drive Cross Pointers

TASKOVER

