



LUMINARY MEMO # 252

To: Distribution
From: D. Eyles
Date: 20 November 1972
Subject: EMP to Convert a Bad HMEAS

This memo presents an EMP whose job is to divide HMEAS, containing the landing radar altitude measurement, by a factor of 5 in between the measurement and its use to update the LM state vector. The problem thus confronted would arise from the failure of one of two suspect transistors in the landing radar unit to be flown on Apollo 17. The result of this failure is that radar altitude data does not arrive until about 12000 feet altitude and that, when it does arrive, until the low-scale discrete appears, it is 5 times too big.

The EMP is executed 50 times a second as part of the downrpt. It is prepared, activated, and terminated in the now familiar ways. It is restart protected. The EMP continually examines the RNGEDBIT of FLGWRD11. When this bit is set, indicating that an altitude reading has been stored in HMEAS at STORALT, and when a signal word is zero indicating that the divide has not been done yet on this HMEAS, then the signal word is set positive and the contents of HMEAS are multiplied by .2 and replaced. There is at least a fifth of a second between the loading HMEAS and its use in the update routine. When RNGEDBIT is reset, after the incorporation of HMEAS, the signal word is zeroed again so that the next HMEAS will be corrected.

Operationally, the EMP should be loaded before PDI (because it is too big to be keyed in later), and activated with V 31 E once the problem has declared itself, which happens at 40000 feet or so. Since the data in HMEAS becomes correct once the low-scale point is reached around 500 feet, the EMP must be disabled before this point. The easiest way to do this is to anticipate the low-scale point and do a V 58 E, disabling the landing radar, just before it is reached. Assuming good data since 12000 feet, a manual landing without radar data should be easy from this point. (There was not enough room in the vac arca to include coding to make the EMP disable itself upon receipt of the

low-scale discrete.)

This EMP has been tested sucessfully on the all-digital simulator at MIT.

The EMP itself follows on the next page:

EMP to use if HMEAS is too big by 5...

660	00000	reserves	VAC5
661	10752	CCS	PHASE1
662	00670	TC	670
663	05355	TC	PHASCHNG
664	07011	OCT	07011
665	77777	OCT	77777
666	00676	ADRES	676
667	10100	OCT	10100
670	30107	CA	FLGWRD11
671	74741	MASK	RNGEDBIT
672	10000	CCS	A
673	00710	TC	710
674	54727	TS	signal
675	03532	TC	DNPBASE2
676	34746	CA	ZERO
677	54660	TS	VAC5USE
700	30703	CA	address
701	54335	TS	DNTMGOTO
702	05263	TC	TASKOVER
703	00661	address of	EMP
710	10727	CCS	signal
711	03532	TC	DNPBASE2
712	24727	INCR	signal
713	35007	CA	EBANK7
714	54003	TS	EBANK
715	31655	CA	HMEAS +1
716	00006	EXTEND	
717	70730	MP	factor
720	54001	TS	L
721	34746	CA	ZERO
722	53655	DXCH	HMEAS
723	00006	EXTEND	
724	70730	MP	factor
725	21655	DAS	HMEAS
726	03532	TC	DNPBASE2
727	00001	signal	(initially non-zero)
730	06315	factor	(about .2)

Procedures:

To prepare:

Load EMP.

Key V 5 N 26 E 00001 E
00676 E
10100 E.

To activate:

Key V 31 E.

Description:

The EMP is processed 50 times a second in the downrpt. Using RNGEDBIT and its own signal word the EMP detects when HMEAS has just been stored by the read routine for use by the update routine. Before the update coding grabs it (a window of more than .2 second) the EMP multiplies HMEAS by .2 and puts it back.