Bendix
Aerospace
Systems Division

NO.	REV. NO.
ATM-1055	

PAGE 1 OF 6

DATE 8 Sept 1971

A2 HFE DH15 ANOMALY INVESTIGATION

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Since 219/10/27/56 EGMT, data from A2 HFE probe 2 thermocouple reference bridge Channel DH15 (DH91=1110) has exhibited symptoms that indicate a possible failure within the HFE electronics. At the above time the electronics temperature had been stabilized for over four hours following the August 7th eclipse. This is shown in Figure 1.

Ten days later, at 229/00/07/02, data from Channel DH15 returned to normal, and has remained normal since that time. At the time the data returned to normal, the electronics temperature had been stabilized at lunar night for more than two days.

During the abnormal operation all four of the binary numbers that are combined to derive the probe 2 reference bridge temperature (i. e. DH15-A, B, C and D) were all ones. All other HFE binary numbers (including the four that are combined to derive the probe 1 reference bridge temperature; DH13-A, B, C and D) showed no evidence of malfunction.

The site of a failure that could cause these symptoms is restricted to two components and one circuit path between them; A13 on board P101, A86 on board P100, and the path connecting pin 6 of A13 to pins 2 and 3 of A86. Figure 2 shows the circuitry involved. Any single failure in any other part of the HFE electronics or in either of the probes that could affect DH15 would also have a noticable affect on other HFE scientific data. The fact that DH13-A, B, C and D (probe 1 thermocouple reference bridge data) functioned normally when DH15-A, B, C and D were anomalous is quite significant in this respect. Both sets of data result from identical measurements on the same bridge. The only difference is that DH13 signals pass through switch A12 and DH15 signals pass through switch A13 as they are routed through the multiplexer.

The fact that DH15-A, B, C and D were all ones indicates that the data amplifier output was saturated in a positive direction during the time of these measurements. If either one or both of the inputs to the data amplifier are open circuited, and if there is any slight imbalance in the input bias current compensation circuits, the amplifier output will saturate. The direction of saturation is determined only by the direction of the bias current

compensation imbalance. Since the circuits that provide this compensation are extremely high impedence current sources, the direction of the imbalance, and hence the direction of the amplifier output saturation, will be the same regardless of which input leg is open circuited and regardless of the polarity of the voltage applied to the other input.

The possibilities, then, are as follows:

1. An open in the circuit path from Q1A of A13 thru pin 2 to the first branch point in the P101 board, and/or an open in the circuit path from Q1B of A13 thru pin 4 to the first branch point.

2. An open in the circuit path from Q1A of A13 thru pin 3 to the first branch point and/or an open in the path connecting Q1B of A13 thru pin 5 to the first branch point.

3. FETs Q1A and/or Q1B of A13 failed open (source to drain).

4. FET driver Q3 of A13 failed open (collector to emitter).

5. CR1 of A13 failed short.

6. An open between the emitter of Q3 and the +4V voltage bus within A13.

7. An open in the circuit path connecting the base of Q3 in A13 to pin 2 of A86. This path includes a hardwired connection between board P101 and board P100.

8. A failure within A86 that would prevent the output transistor from pulling pin 2 to ground.

The signals on pins 4, 5, 6 of A86 are not implicated because they are common to gates that are known to be operating properly.

A detailed discussion of the failure modes and an assessment of the relative probabilities of each is given in FIAR No. H-GE-0131. The conclusions reached in the FIAR are repeated here:

The most likely failure modes by decreasing probability are (1) open circuitry due to plated through hole failure on a circuit board, (2) emitter-base metallization shorts on the output transistors of A86 on the drive transistor of A13, (3) open metallization or resistive contact in a silicon window in either A86 or A13.

The loss of DH15 data does not reduce the scientific data acquisition capability of the A2 HFE because DH13 information can be used in place of DH15 information to process the probe 2 thermocouple data. This requires only a minor change to the data reduction program.

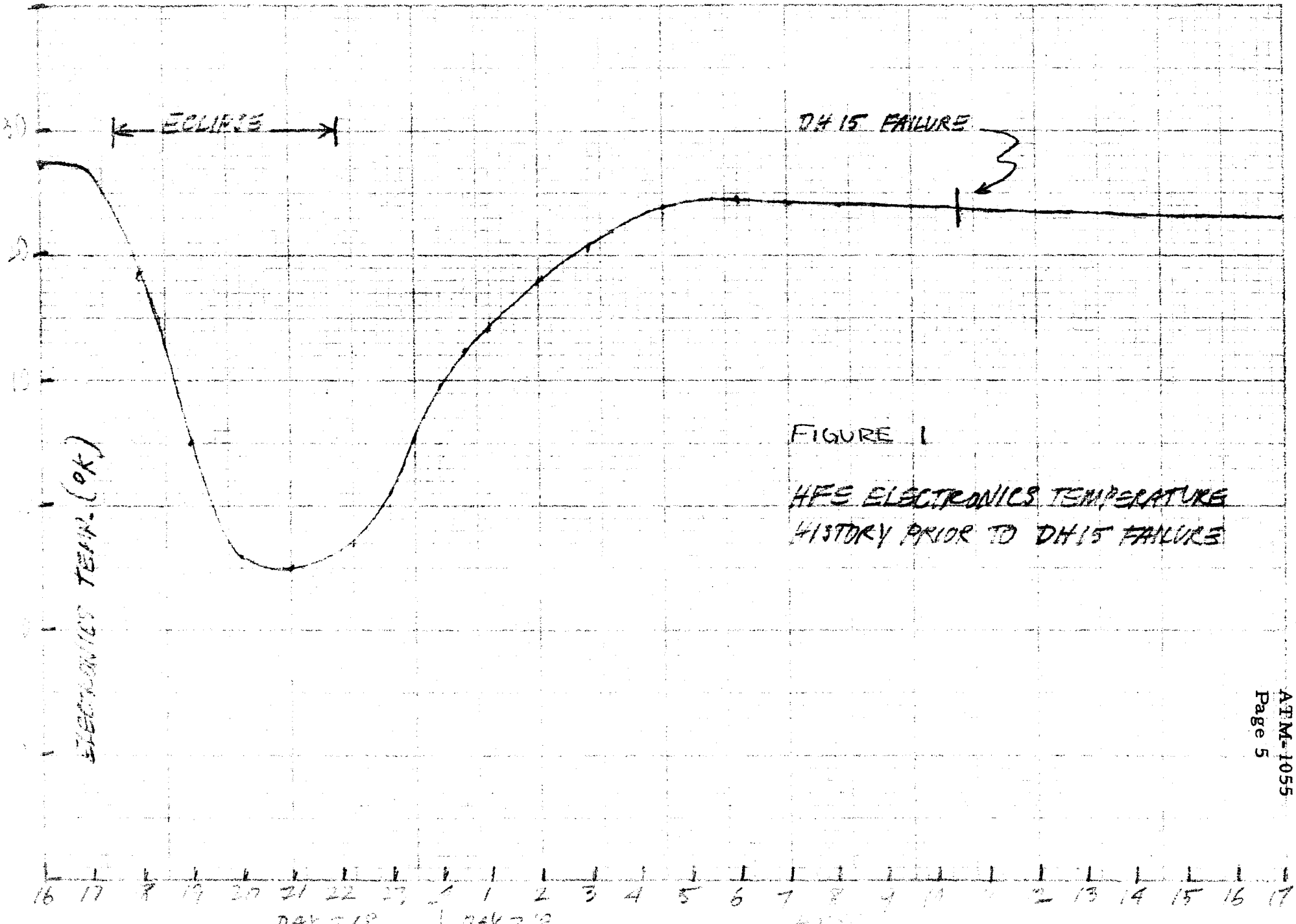

FIGURE 1

HFE ELECTRONICS TEMPERATURE HISTORY PRIOR TO DH15 FAILURE

FIGURE 2

REFERENCE:
GULTON D.S.D. DRAWINGS
13307 S117 SHEETS 1,7,9,11 & 12