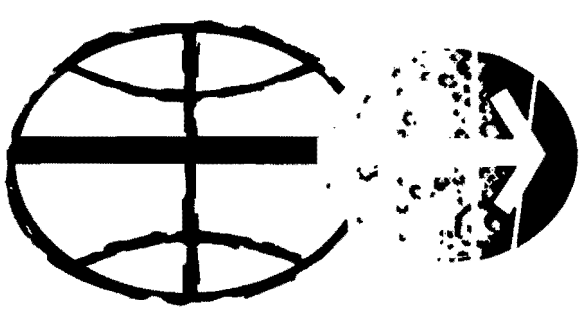
MSC-07489

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 16 MISSION

ANOMALY REPORT NO. 11

MALFUNCTION OF TELEVISION CAMERA MONITOR ON COMMAND MODULE



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
OCTOBER 1972

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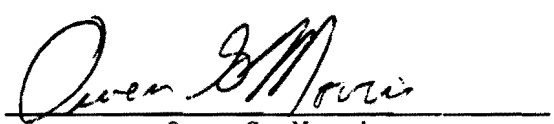
PREPARED BY

Mission Evaluation Team

APPROVED BY



Owen G. Morris
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
October 1972

MALFUNCTION OF TELEVISION CAMERA MONITOR ON COMMAND MODULE

STATEMENT OF ANOMALY

The command module television camera monitor exhibited loss of horizontal synchronization during the initial usage. This condition cleared and performance of the monitor was normal until the press conference telecast during the transearth coast phase. At that time, the monitor had the same horizontal synchronization problem reported during the initial usage. The horizontal hold control adjustment would not correct the condition. The monitor was turned off for approximately 5 minutes, then turned back on, after which the monitor's picture was normal.

DISCUSSION

Since the downlink television video signal was not affected, the malfunction was isolated to the monitor and associated cable.

Thermal testing from minus 30° F to plus 132° F and vacuum testing from 10^{-3} mm Hg to 10^{-6} mm Hg did not disclose any failures in the unit. However, ambient, thermal, and vacuum testing all showed an angular shift of 30° in the stable range of the horizontal control knob during the warm-up period. This condition is inherent in all the monitors.

Another monitor exhibited a noisy picture and horizontal-hold instability during acceptance testing. The source of the problem was the low-voltage power supply (plus 10 volts dc) which has multiple uses in the monitor. A high ripple on the supply voltage results in a noisy picture. It also causes synchronization loss in the horizontal hold circuit since this voltage is applied across the horizontal hold potentiometer. These are the same characteristic failures noted in the Apollo 16 flight unit.

The problem was isolated to the precision voltage regulator which is a linear integrated circuit. The circuit assembly was removed and opened for inspection. It had the following defects:

1. There was general contamination and scoring on the chip face (fig. 1a).

2. Multiple attempts had been made in welding leads to the bonding posts and bonding pads on the chip (fig. 1b).

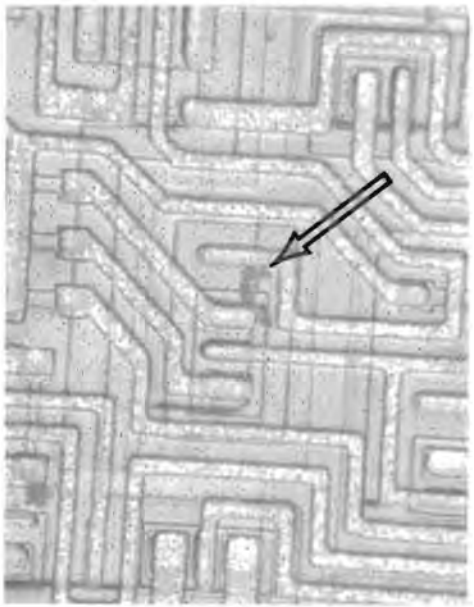
3. The lead on bonding post number 1 was loose (fig. 1c). As a result, the current sensing loop of the voltage regulator was open and the output ripple increased sufficiently to desynchronize the horizontal hold circuit.

Five other integrated circuits from the same lot were opened and two were defective. A new lot of twelve circuits was purchased, four of which were examined and tested with satisfactory results.

The precision voltage regulator with the television monitor low voltage power supply on Apollo 16 will be replaced and the regulator on Apollo 17 has been replaced. The replaced components will be opened, inspected, and tested.

CONCLUSION

The loss of horizontal synchronization was most likely caused by either an intermittent condition in the precision voltage regulator circuit assembly in the low voltage power supply, or the shift of the stable range of the horizontal potentiometer setting when warming up after turn-on.



(a) Contamination and scoring on chip face.

(b) Evidence of multiple attempts to weld lead to bonding pad.

(c) Loose lead on bonding post.

Figure 1.- Defects in circuit assembly.

CORRECTIVE ACTION

1. Television monitor controls will have warm optimum-setting marks applied to the television monitor case .

2. The low-voltage power supply precision voltage regulator (linear integrated circuits) will be replaced on the seven remaining unmodified flight units.