

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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POWERPLANTS

Group Chair's Factual Report - Attachment #2

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May 30, 2025

Technical document

ECU #1 examination

Restricted release to the safety investigation members

Accident on **28th August 2023**
near **Pompano Beach (United States)**
to the **helicopter EUROCOPTER > EC135 > T1**
registered **N109BC**

Foreword

This document and the photographs and technical information contained herein are subject to the laws relating to communication and confidentiality embodied in European Regulation 996 of 20 October 2010.

The conclusions of this document are based on the work undertaken by the BEA (Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile). They should not be used to prejudge the final conclusions of the safety investigation.

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1 - EQUIPEMENT EXAMINED

After the readout and decoding of the memory component of the left engine ECU, a simultaneous double N1 and double N2 failure was identified during the flight of the event. The purpose of this examination is to assess the damages on the ECU electronic boards and determine if the identified damages could have led to the identified failures.

ECU #1	
	
Manufacturer	Goodrich
Part number	70EMF01290
Serial number	8ALD0285CE

The document **EMC-35B EECU Potential Failure Modes.pdf** which describes the EMC-35B ECU Failure Modes and Effects Analysis which can lead to a simultaneous double N1 and double N2 failure, provided by Triumph was used as baseline for this examination.

2 - WORK PERFORMED

The CPU board (board 1) from the ECU has already been removed to unsolder the memory component. The 4 other boards were removed from the computer. The boards were visually examined under magnification. The boards were numbered from 1 to 5 from bottom to the top of the computer. The bottom being the side where are located the computer fixation holes.

2.1. Board 1 (CPU)

The board was in good condition. One transistor (circled in red) was found coloured in orange. This coloration was also found on the inner side of the casing in front of the component.

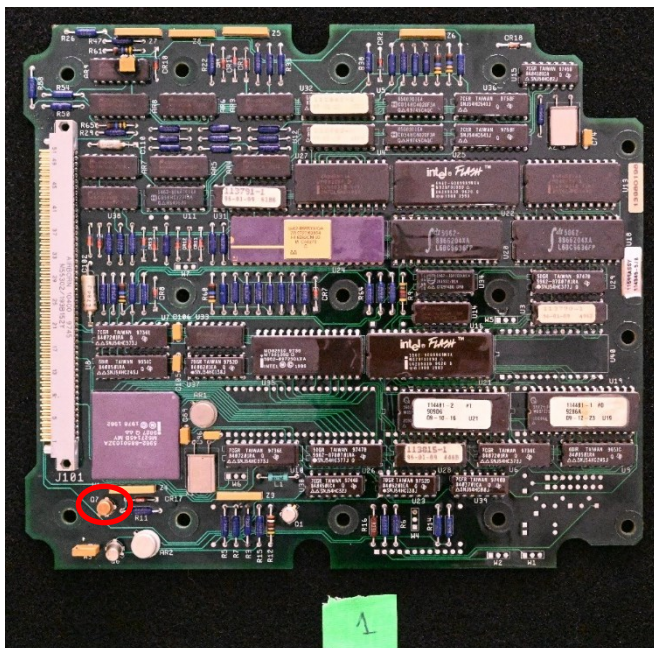


Figure 1 : Board 1 top side

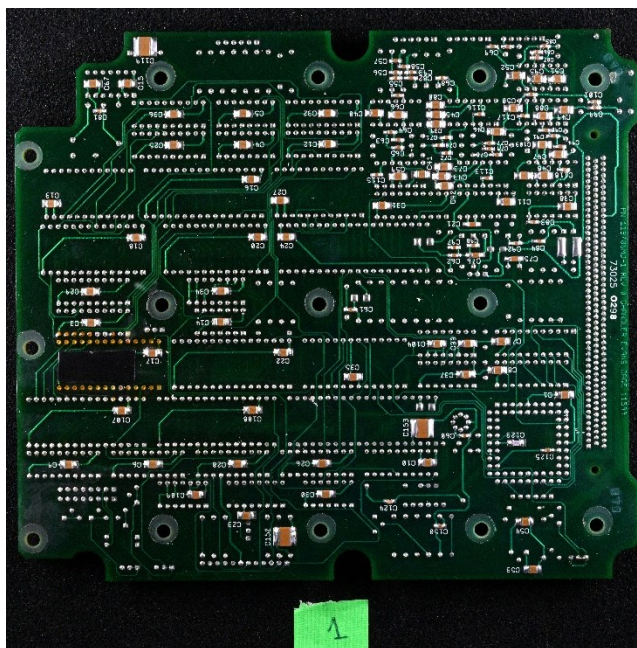
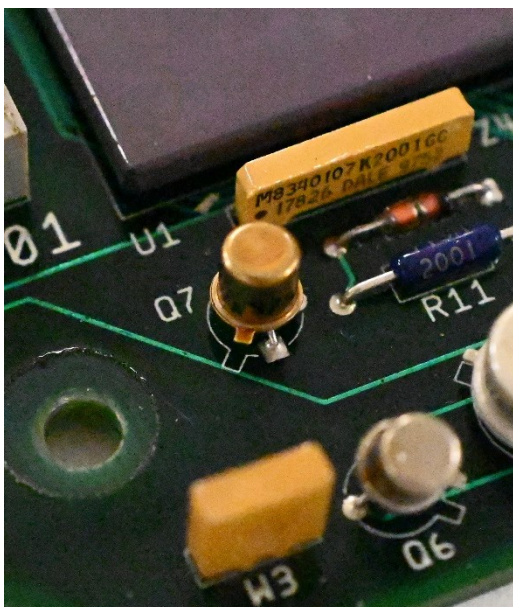


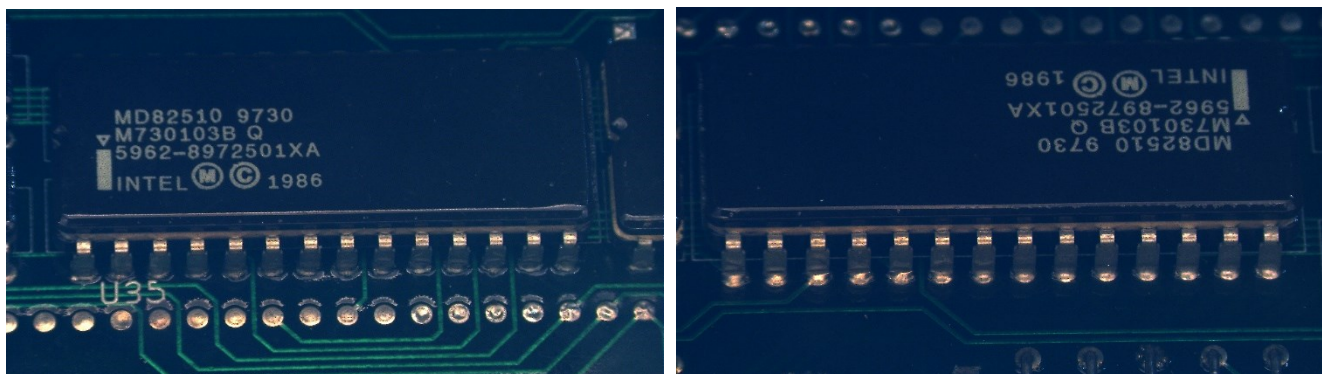
Figure 2 : Board 1 bottom side

2.1.1. Coloured transistor Q7 and casing

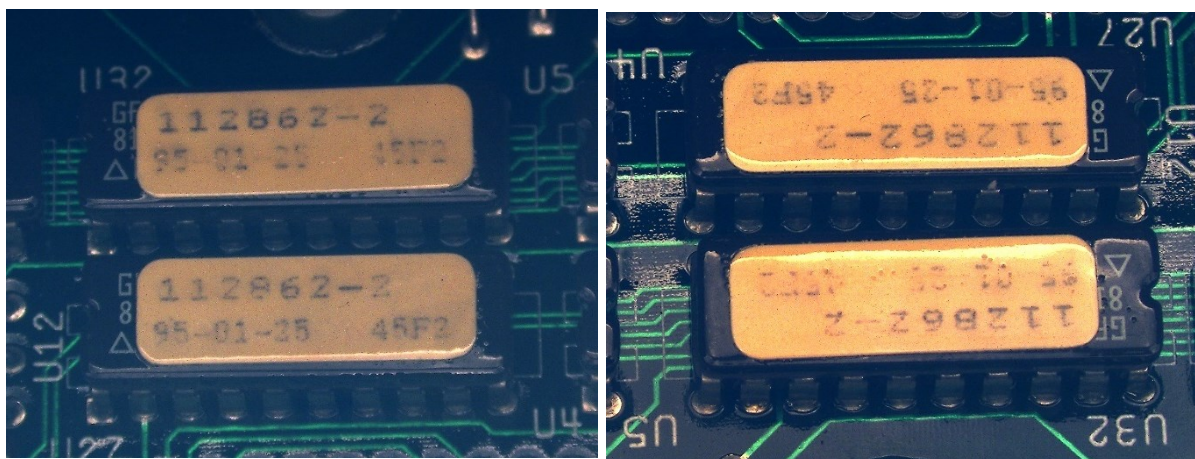


The components mentioned in Triumph **EMC-35B EECU Potential Failure Modes.pdf** were examined more closely.

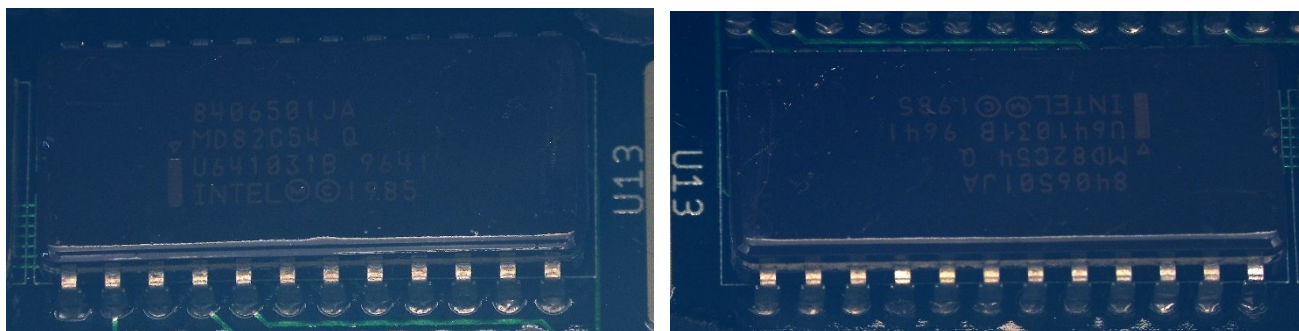
2.1.2. Component U35



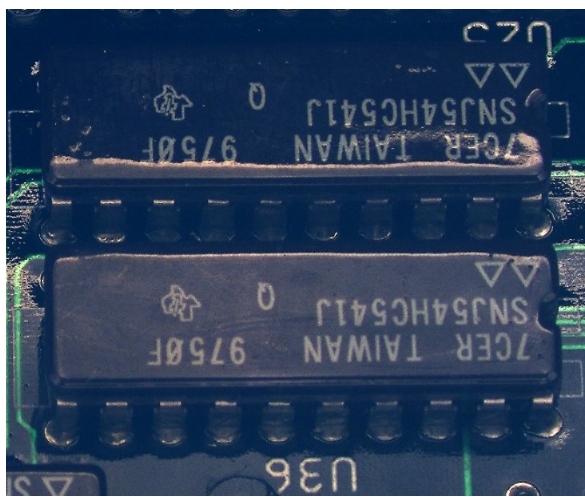
2.1.3. Components U32 and U12



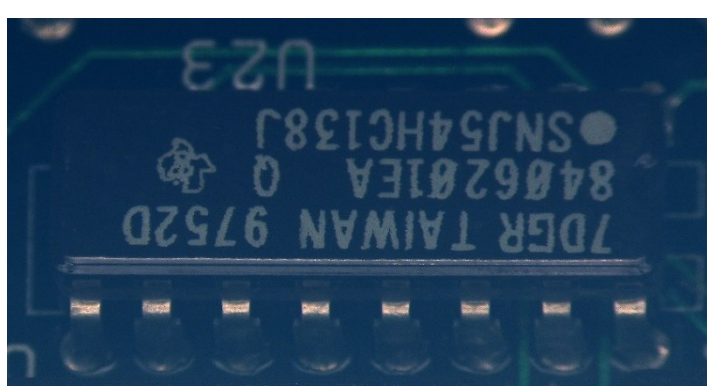
2.1.4. Component U13



2.1.5. Components U25 and U36



2.1.6. Component U23



2.2. Board 2

The board was in good condition. One resistor (circled in red) presented thermal damages. No other damage was identified on this board.

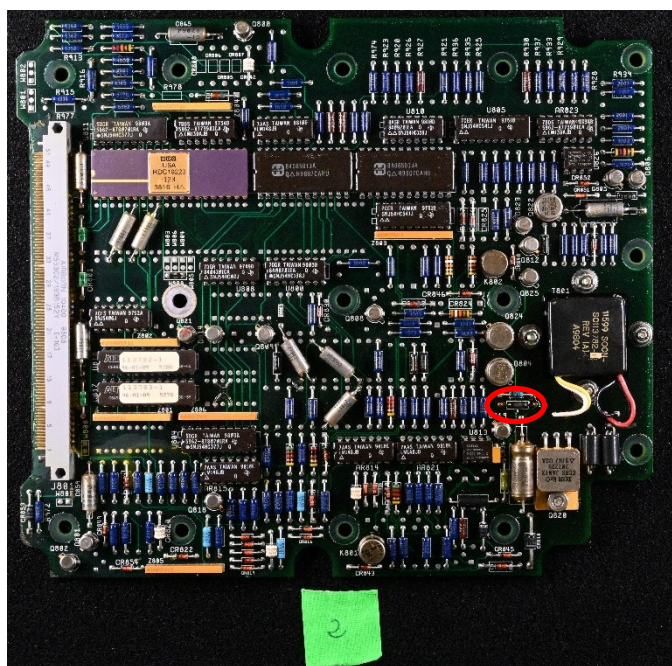


Figure 4 : Board 2 top side

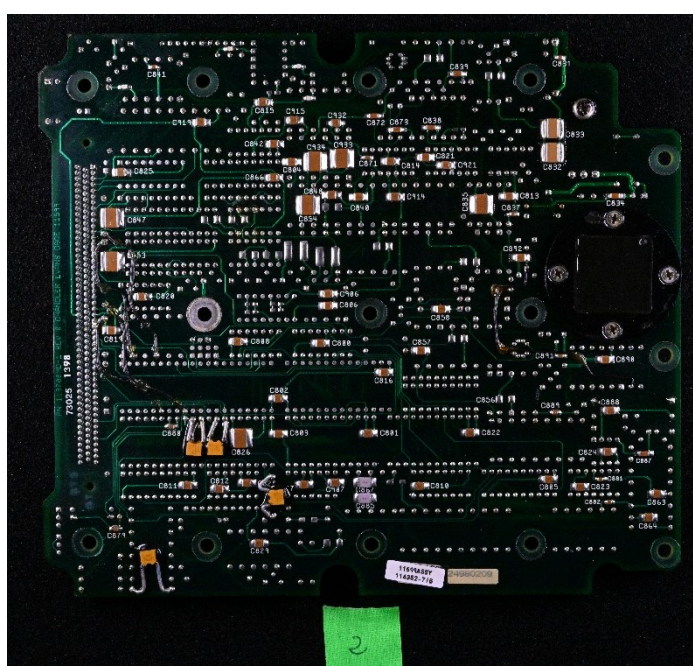
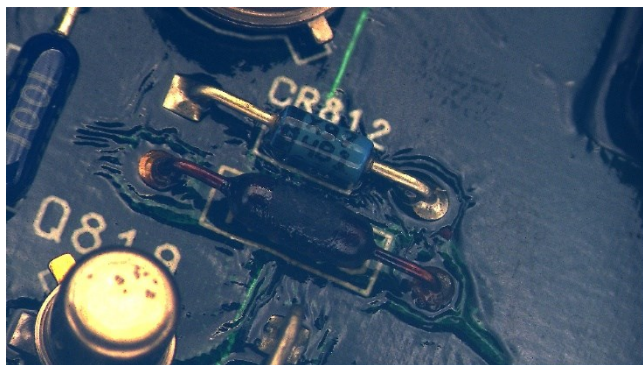


Figure 3 : Board 2 bottom side

2.2.1. Damaged resistor



2.3. Board 3

No discrepancy was found on the board itself or its surface components.

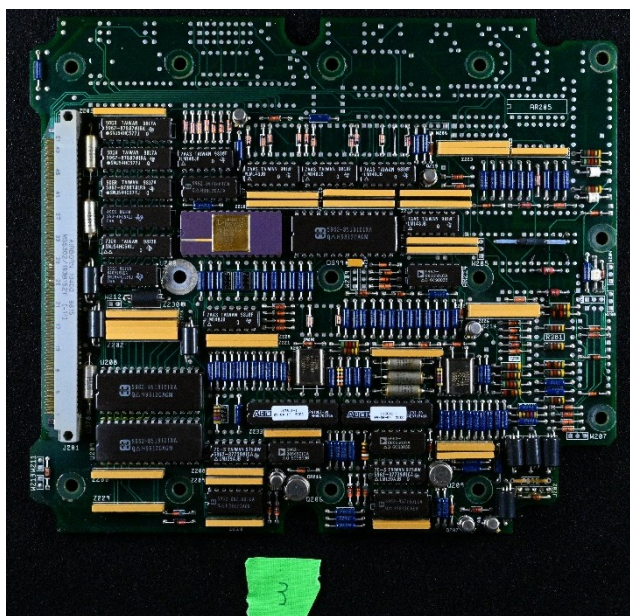


Figure 5 : Board 3 top side

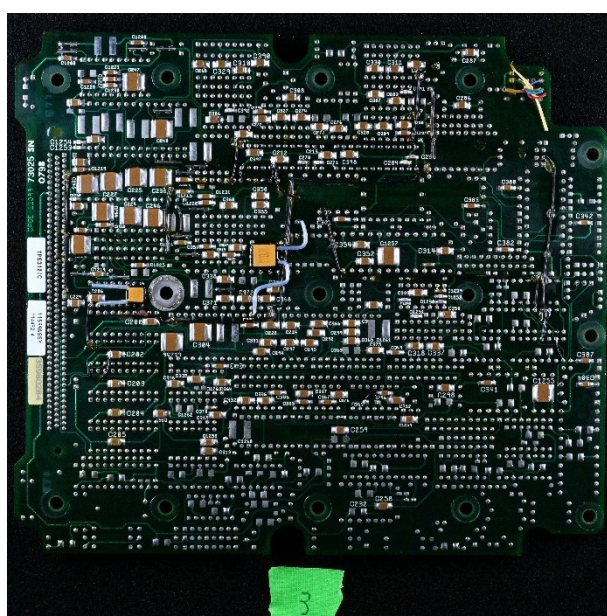


Figure 6 : Board 3 bottom side

2.4. Board 4

The board was in good condition. One transistor (circled in red) was partially unsoldered from the board.

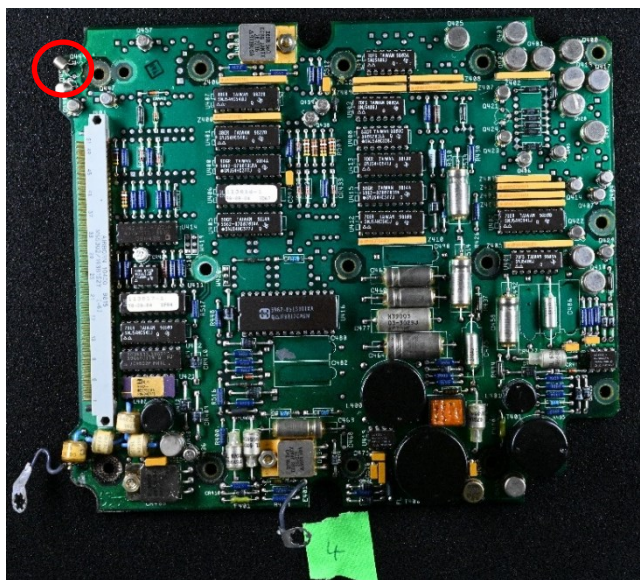


Figure 8 : Board 4 top side

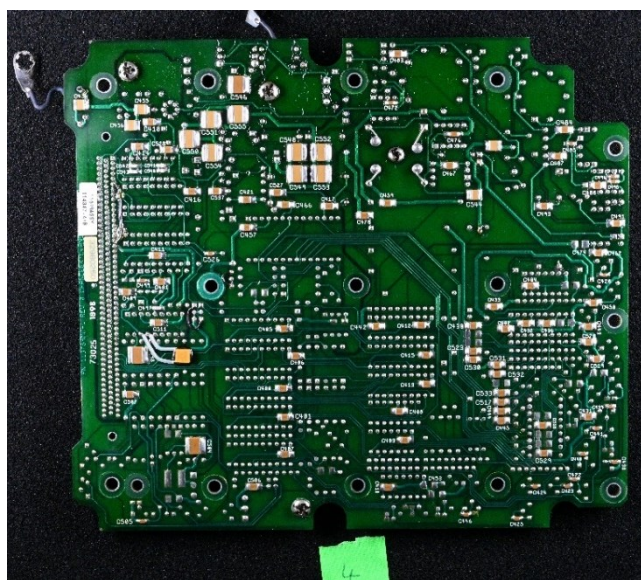
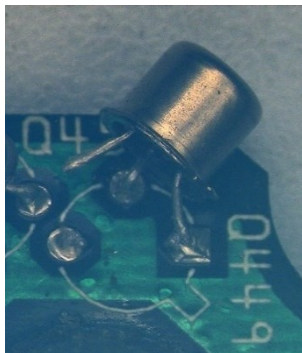


Figure 7 : Board 4 bottom side

2.4.1. Partially unsoldered transistor Q449



2.5. Board 5

To remove the board from the casing, the flex connecting the board to the ECU external connectors was cut. The board was thermally damaged. The damages were localized on the board and not homogeneous.

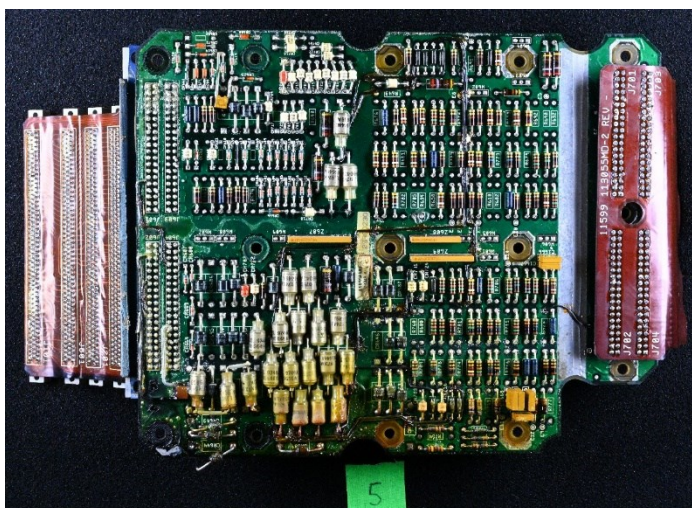


Figure 9 : Board 5 top side

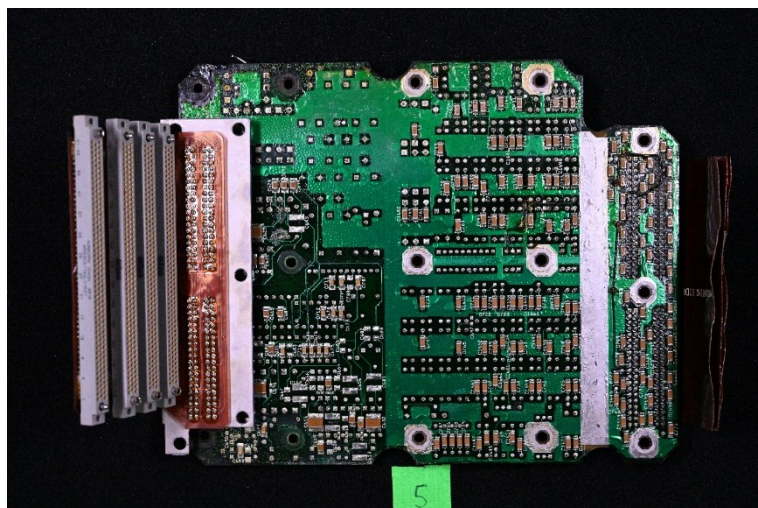


Figure 10 : Board 5 bottom side

The location of the damages on the board was consistent with thermal damages observed on the inner part of the casing.

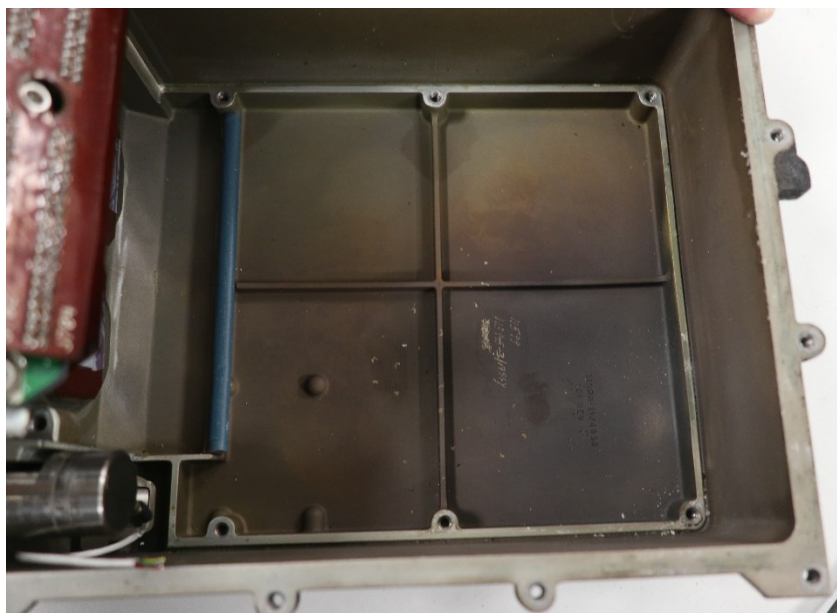


Figure 11 : Thermal damages on the inner side of the casing

The two diodes (CR644 and CR643) found partially unsoldered on the X-ray view were identified.

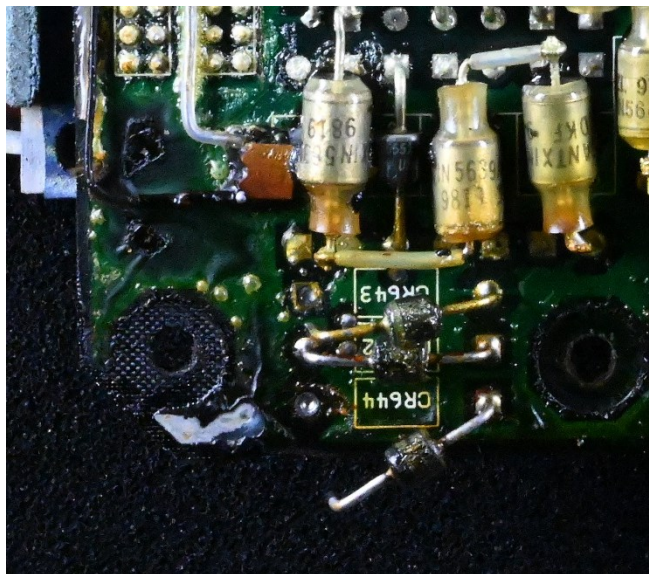


Figure 13 : Damaged diodes on board 5

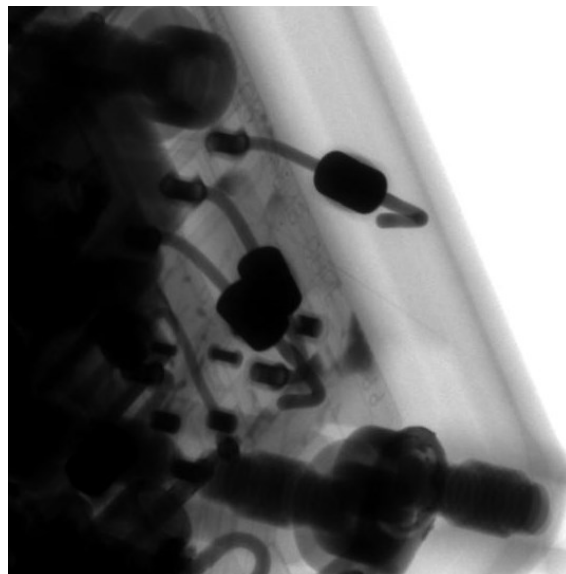


Figure 12 : X-Ray view of the damaged diodes on board 5

3 - RESULTS

Damages were identified on three of the electronic boards of the ECU.

Transistor Q7 was found coloured in orange on the top side of the board number 1. A similar coloration was found at the corresponding location on the casing. The reason of this colouring was not identified.

One resistor was found thermally damaged on the top side of the board number 2. As the damages are only located on the component itself and its solder joint, it is not compatible with the exposure to an external heat source and may be due to an overcurrent. Taking in account the overall damages of the computer boards, a more detailed analysis of the electronics schematics should be performed to assess what could have led to the resistor overheat.

Transistor Q449 was found partially unsoldered on the top side of the board number 4. This damage is not compatible with the exposure to an external heat source and may be due to the impact with the ground.

The board number 5 was found thermally damaged. It is consistent with a consequence of the in-flight fire or post-crash fire. The thermal damages were localised on the board which indicates a localised exposure to the fire.



Figure 14 : ECU Highest thermal exposure area deduced from board 5 damages

None of the observed damages were mentioned in Triumph EMC-35B ECU Potential Failure Modes document. As the two damages of the component from board 2 and 4 cannot be explained directly by the heat exposure, it should be assessed whether these damages could have led to a simultaneous double N1 and double N2 failure.

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