

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

June 14, 2022

Electronic Devices

Specialist's Factual Report

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1. EVENT SUMMARY

Location: Big Spring, Texas
Date: November 19, 2021
Vehicles: MCI Motorcoach (2005) / Ford F-350 (2016)
Operators: Andrews Independent School District / Private
NTSB Number: HWY22FH001

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Recorder Manufacturer/Model: **DDEC V**
Recorder Serial Number: **SCMAE600YVL**

Recorder Manufacturer/Model: **Airbag Control Module (ACM)**
Recorder Serial Number: **Unknown**

3.1. DDEC V Description

The Detroit Diesel Electronic Controls (DDEC) V is an engine-mounted Electronic Control Unit (ECU) that includes control logic to provide overall engine management. The ECU performs self-diagnostic checks and monitors other system components. System diagnostic checks are made at ignition-on and continue throughout all engine-operating modes.

3.1.1. DDEC V Data Recovery

The DDEC V was recovered from the MCI Motorcoach. Upon arrival at the Vehicle Recorder Laboratory, an external examination revealed the device had sustained minor damage, as shown in Figure 1. The device was evaluated and brought to an external engineering facility for download. The device powered on using laboratory equipment and data were extracted normally using the manufacturer's software.



Figure 1. Front and back of DDEC V as received.

3.1.2. DDEC V Data Description

An XTR binary file was extracted from the device and was opened in the DDEC Reports program to generate a report for viewing data parameters. The raw XTR file is included as Attachment 1 to this report.

Upon powering the DDEC, the internal battery was not functional, therefore, all timestamps recorded to non-volatile memory did not correspond to their actual date and time of recording.¹ Timestamps ranged from the year 2010 through 2030 and data recorded were unable to be correlated to a standard time. Attachment 2 to this report contains the DDEC report generated by the DDEC Reports program.

Due to the non-functioning internal clock battery and the inaccurate timestamps found in the report in Attachment 2, the XTR binary file was examined to identify potential data points excluded from the report. Records are saved to memory but will not appear in the report for timestamps beyond 2038. Timestamps are reverse 4-byte strings in seconds since January 1, 1985. Two of these strings were identified in the XTR binary file and changed such that their values would not produce a date beyond 2038. A second report to include an additional record for “Hard Brake” was generated.

¹ Non-volatile memory (NVM) is semiconductor memory that does not require external power for data retention.

The changed portion of the XTR file is summarized below:

- The locations of the 4-byte strings are highlighted in Figure 2. The hexadecimal values in these locations are B0 AE C2 8B and EB AE C2 8B respectively. The difference between these two values is 59 (in decimal), which corresponds to the length of a “Hard Brake” record.
- B0 AE C2 8B was changed to 00 00 00 00 (Figure 3), as the start of the “Hard Brake” record to begin at 00:00:00 on January 1, 1985, Universal Coordinated Time (UTC).
- EB AE C2 8B was changed to 3B 00 00 00 (Figure 3), as the end of the “Hard Brake” record to end 59 seconds after 00:00:00 on January 1, 1985, UTC.

1004h:	3A 10 0E 00 4B	B0 AE C2 8B	6D EB 15 96 BC 00 6D 09 16 86 B0
1018h:	00 6E 48 13 82 A9 00 6F 57 13 82 A9 00 6F 81 13 81 A9 00 70		
102Ch:	8C 13 81 A9 00 71 BB 13 81 A9 00 71 B9 13 71 9B 00 71 C4 13		
1040h:	71 9B 00 72 E4 13 73 9D 00 72 FE 13 73 9D 00 72 04 14 73 9D		
1054h:	00 73 FF 13 73 9D 00 73 04 14 73 9E 00 73 10 14 99 BD 00 73		
1068h:	2A 14 AC CD 00 74 4B 14 B0 D0 00 75 83 14 B0 D0 00 77 C0 14		
107Ch:	AF D0 00 78 FE 14 AD CF 00 79 2F 15 A9 CC 00 7B 67 15 A5 C7		
1090h:	00 7C 90 15 9C C1 00 7D D2 15 8D B5 00 7D DF 15 81 AD 00 7E		
10A4h:	06 16 9D C2 00 7F 36 16 B3 D4 00 81 85 16 BA DA 00 82 B8 16		
10B8h:	A5 C9 00 83 D9 16 8E B7 00 84 0C 17 89 B4 00 84 27 17 62 96		
10CCh:	00 85 1A 17 4C 85 00 85 25 17 43 7D 00 85 2B 17 43 7D 00 85		
10E0h:	29 17 43 7D 00 85 23 17 40 7C 00 85 2B 17 40 7C 00 84 1A 17		
10F4h:	3D 79 00 84 26 17 3D 79 00 84 15 17 3D 79 00 84 0E 17 38 73		
1108h:	00 84 02 17 38 73 00 83 C0 16 00 00 00 82 9A 16 00 00 00 81		
111Ch:	72 16 00 00 00 7F 3D 16 00 00 00 7F 15 16 00 00 20 7D E4 15		
1130h:	00 00 20 7C A8 15 00 00 20 7B 6F 15 00 00 20 7A 43 15 00 00		
1144h:	20 79 1C 15 00 00 20 78 E9 14 00 00 20 77 B4 14 00 00 20 76		
1158h:	8D 14 00 00 20 71 AE 13 00 00 20 66 CC 11 00 00 20 58 AB 11		
116Ch:	00 00 20 4B FD 0E 00 00 20 3C 11 10 00 00 20 2E C8 0F 00 00		
1180h:	20 20 81 0C 00 00 20 15 C7 0A 2C 00 20 0B FB 0A 39 00 20 05		
1194h:	DB 0A 47 00 20 00 E0 0A 4E 00 20 00 DC 0A 52 00 20 00 E3 0A		
11A8h:	51 00 20 00 EA 0A 50 00 20 00 F0 0A 4F 00 20 00 E8 0A 4B 00		
11BCh:	20 00 EF 0A 49 00 20 00 F3 0A 47 00 20 00 F1 0A 46 00 20 EB		
11D0h:	AE C2 8B 61 0C 01 00 BA D2 0D 00 4B F8 F3 D0 30 9D 6A 1B 73		

Figure 2. Original XTR binary file showing the start and end of a Hard Brake record (red boxes).

1004h:	3A 10 0E 00 4B	00 00 00 00	6D EB 15 96 BC 00 6D 09 16 86 B0
1018h:	00 6E 48 13 82 A9 00 6F 57 13 82 A9 00 6F 81 13 81 A9 00 70		
102Ch:	8C 13 81 A9 00 71 BB 13 81 A9 00 71 B9 13 71 9B 00 71 C4 13		
1040h:	71 9B 00 72 E4 13 73 9D 00 72 FE 13 73 9D 00 72 04 14 73 9D		
1054h:	00 73 FF 13 73 9D 00 73 04 14 73 9E 00 73 10 14 99 BD 00 73		
1068h:	2A 14 AC CD 00 74 4B 14 B0 D0 00 75 83 14 B0 D0 00 77 C0 14		
107Ch:	AF D0 00 78 FE 14 AD CF 00 79 2F 15 A9 CC 00 7B 67 15 A5 C7		
1090h:	00 7C 90 15 9C C1 00 7D D2 15 8D B5 00 7D DF 15 81 AD 00 7E		
10A4h:	06 16 9D C2 00 7F 36 16 B3 D4 00 81 85 16 BA DA 00 82 B8 16		
10B8h:	A5 C9 00 83 D9 16 8E B7 00 84 0C 17 89 B4 00 84 27 17 62 96		
10CCh:	00 85 1A 17 4C 85 00 85 25 17 43 7D 00 85 2B 17 43 7D 00 85		
10E0h:	29 17 43 7D 00 85 23 17 40 7C 00 85 2B 17 40 7C 00 84 1A 17		
10F4h:	3D 79 00 84 26 17 3D 79 00 84 15 17 3D 79 00 84 0E 17 38 73		
1108h:	00 84 02 17 38 73 00 83 C0 16 00 00 00 82 9A 16 00 00 00 81		
111Ch:	72 16 00 00 00 7F 3D 16 00 00 00 7F 15 16 00 00 20 7D E4 15		
1130h:	00 00 20 7C A8 15 00 00 20 7B 6F 15 00 00 20 7A 43 15 00 00		
1144h:	20 79 1C 15 00 00 20 78 E9 14 00 00 20 77 B4 14 00 00 20 76		
1158h:	8D 14 00 00 20 71 AE 13 00 00 20 66 CC 11 00 00 20 58 AB 11		
116Ch:	00 00 20 4B FD 0E 00 00 20 3C 11 10 00 00 20 2E C8 0F 00 00		
1180h:	20 20 81 0C 00 00 20 15 C7 0A 2C 00 20 0B FB 0A 39 00 20 05		
1194h:	DB 0A 47 00 20 00 E0 0A 4E 00 20 00 DC 0A 52 00 20 00 E3 0A		
11A8h:	51 00 20 00 EA 0A 50 00 20 00 F0 0A 4F 00 20 00 E8 0A 4B 00		
11BCh:	20 00 EF 0A 49 00 20 00 F3 0A 47 00 20 00 F1 0A 46 00 20 3B		
11D0h:	00 00 00 61 0C 01 00 BA D2 0D 00 4B F8 F3 D0 30 9D 6A 1B 73		

Figure 3. Changed XTR binary file showing the edited values (red boxes).

Attachment 3 to this report contains the additional “Hard Brake” record generated in the DDEC Reports program. Hard Brake #2 in Attachment 3 corresponds to Hard Brake #1 in Attachment 2. Hard Brake #1 in Attachment 3 is the additional Hard Brake record.

3.2. Airbag Control Module Description

The Airbag Control Module controls the vehicle's airbag deployment and exchanges information with the vehicle's engine.

3.2.1. Airbag Control Module Data Recovery

The Airbag Control Module was recovered from the Ford F-350. Upon arrival at the Vehicle Recorder Laboratory, an external examination revealed the device had sustained extensive fire damage, as shown in Figure 4, rendering it inoperable. Identifying features were damaged and the exact part number and serial number were unidentifiable. Multiple manufacturers were consulted to identify the device and determine potential data that may be contained. Based on the condition of the device, the model year of the vehicle and the system architecture likely contained on the device, it was determined that potential data stored in non-volatile memory would not be usable, thus, further attempts at data recovery were not pursued. No data were recovered from this device.

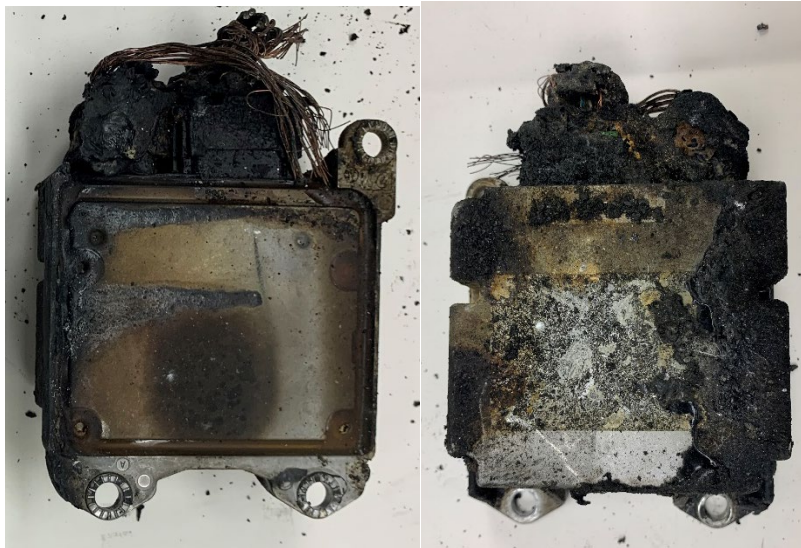


Figure 4. Front and back of Airbag Control Module as received.