NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

August 25, 2016

Light Passenger Vehicle Recorders

Specialist's Factual Report
By George Haralampopoulos

1. EVENT

Location: Northbound Interstate 75 (I-75) in the vicinity of mile marker 11.7, in Hamilton County, Chattanooga, TN

Vehicle #1: 2007 Peterbilt truck-tractor in combination with a 2006 Great Dane refrigerated semitrailer

Operator #1: Cool Runnings Express Inc. of London, KY

Vehicle #2: 2010 Toyota Prius

Vehicle #3: 2010 Scion tC

Vehicle #4: 2003 Mazda SW

Vehicle #5: 2005 GMC Savana

Vehicle #6: 2001 Ford F-150

Vehicle #7: 2007 Chevrolet Uplander

Vehicle #8: 2014 Cadillac CTS

Vehicle #9: 2015 Toyota Tundra

Date: June 25, 2015

Time: Approximately 7:10 p.m. Eastern Daylight Time (EDT)

2. DETAILS OF DEVICE INVESTIGATION

National Transportation Safety Board (NTSB) on-scene investigators identified seven of the eight light passenger vehicles that were equipped with airbag control modules (ACM) that were downloadable by the Bosch Crash Data Retrieval (CDR) toolkit. The 2003 Mazda was the only vehicle not supported by the toolkit. [1,2]

Of the seven ACMs supported, three of which were downloaded through the on-board diagnostic (OBD) port, the 2005 GMC Savana, 2001 Ford F150, and 2015 Toyota

[1] For more information about the CDR kit visit http://www.cdr-system.com/overview/index.html
[2] An ACM refers to any device supported by the CDR toolkit that contains but is not limited to recorded crash pulse and pre- and post-crash data.

Tundra. The remaining four ACMs were removed from their respective vehicle due to damage sustained by the vehicle and downloaded via bench top consistent with CDR download procedures using the recommended interface cable. The ACM from the 2007 Chevrolet Uplander was removed and sent to the NTSB Vehicle Recorder Lab in Washington, DC, for readout with oversight by the NTSB Survival Factors Group Chairman. Table 1 indicates the vehicle information, type of recorder, and download performed.

Table 1: Summary of downloaded light passenger vehicle ACMs.

Make	Model	Year	Type of Recorder	Location	Download Type
Chevrolet	Uplander	2007	ACM	Under RH Seat	Bench-Top at NTSB lab
GMC	Savana	2005	ACM	Under LH Seat	OBD Port
Ford	F-150	2001	ACM	Center Tunnel	OBD Port
Cadillac	CTS	2014	ACM	Center Tunnel	Bench-Top
Toyota	Tundra	2015	ACM	Under Center Stack	OBD Port
Mazda	SW	2003	Unavailable	Unavailable	Not Supported
Toyota	Prius	2010	ACM	Under Center Stack	Bench-Top
Toyota	Scion tC	2010	ACM	Under Center Stack	Bench-Top

2.1. ACM General Description

The ACM is part of an automobile's supplemental restraint system. Depending on vehicle, the module may be capable of recording data when triggered by an airbag event known as a deployment or non-deployment. A non-deployment event involves no airbags firing however the change in velocity was significant enough to initialize the ACM.

Typically, several seconds of pre-collision and post-collision data is recorded when triggered. Parameters recorded vary by manufacturer and manufacturer year but may include vehicle speed, engine speed, brake application, throttle position, seatbelt usage, and airbag performance.

2.2. CDR Software Post Processing

All post processing of the data is performed by the CDR software. The software organizes the downloaded data in a (*.pdf) report that contains the following sections: user information including date and time the device was downloaded, user comments, data limitations, data source, tabular data and plot(s) from event(s), and raw hexadecimal data used in the report.

The software does not correlate time to any standard such as eastern standard time (EST), and is recorded as seconds elapsed based on the start of the event referenced to an ignition cycle.

2.3. 2007 Chevrolet Uplander Data Description

The ACM downloaded normally and the CDR report indicated one non-deployment event. The ignition cycles at non-deployment compared to the ignition cycles during the time of download was such that the non-deployment event could not be related to the accident. The non-deployment event data indicated that it did not complete recording and only four data points were captured. Figure 1 shows the ACM removed from the vehicle before download.

Figure 1: ACM extracted from 2007 Chevy Uplander.

2.4. 2005 GMC Savana Data Description

The ACM downloaded normally and the CDR report indicated one non-deployment event. The recorded event did not appear to be associated to the accident based on the ignition cycles at the non-deployment event compared to the ignition cycles at the download. Five seconds of pre-crash vehicle speed and engine rpm data were recorded and 8 seconds of pre-crash brake status data were recorded. The data indicated the

brake status was “ON”, 5 seconds before the triggered event with a vehicle and engine speed of 37 miles per hour (mph) and 1024 revolutions per minute (RPM), respectively.

2.5. 2001 Ford F-150 Data Description

The ACM downloaded normally and the CDR report indicated one deployment event. The report for this vehicle states: “Once an airbag or other restraint device has been commanded to deploy, the data recorded in connection with that deployment are "locked", and subsequent crashes cannot be recorded.”

The recorded event included the maximum recorded 116 milliseconds of longitudinal acceleration and cumulative change in velocity (delta-V) data.

2.6. 2014 Cadillac CTS Data Description

The ACM downloaded normally and the CDR report indicated an initial non-deployment event and a following deployment event both at 1,464 ignition cycles. The recorded events included longitudinal and lateral acceleration information, including pre-crash data for each event. Additionally, vehicle status information was recorded such as, seatbelt status, seat position, and warning light discretes. The first recorded event included a max delta-V of 37.9 mph. Figure 2 shows the ACM removed from the vehicle before download.

Figure 2: ACM extracted from 2014 Cadillac CTS.

2.7. 2015 Toyota Tundra Data Description

The ACM downloaded normally and the CDR report indicated a non-deployment "Front/Rear Crash" event. The recorded event appeared associated to the accident based on the ignition cycles at the non-deployment event compared to the ignition cycles at the download. The recorded event included longitudinal and lateral acceleration and pre-crash data. At the trigger of the event a vehicle speed of 10 mph was recorded with the accelerator pedal fully engaged (100%).

2.8. 2010 Toyota Prius Data Description

The ACM downloaded normally and the CDR report indicated that the following three events were captured: a most recent "Side Crash", the first prior "Front/Rear Crash", and the second prior "Front/Rear Crash". Pre-crash information was available for all events, although only lateral acceleration information was available for the "Side Crash" and longitudinal acceleration was only available for the "Front/Rear Crash".

Based on the report, the most recent and first prior recorded event were consecutively apart. The Prius's first prior recorded event captured the highest delta-V of all the vehicles at 72.7 mph. The crash pulse for first prior recorded event was a total of 200 milliseconds. Pre-crash data indicated the vehicle's speed was 13.7 mph at the start slowing to 5 mph at the trigger of the event.

Figure 3 shows the ACM removed from the vehicle before download.

Figure 3: 2010 Toyota Prius ACM during bench-top download.

2.9. 2010 Scion tC Device Description

An external examination of the ACM was performed on-scene when removed from the vehicle. The examination showed the casing and connector sustained prolonged fire damage. The circuit board containing the ACM's non-volatile memory was removed from the casing. An internal inspection revealed the circuit board sustained negligible damage and the device was downloaded normally using the CDR recommended procedures for bench-top downloads (figure 4).

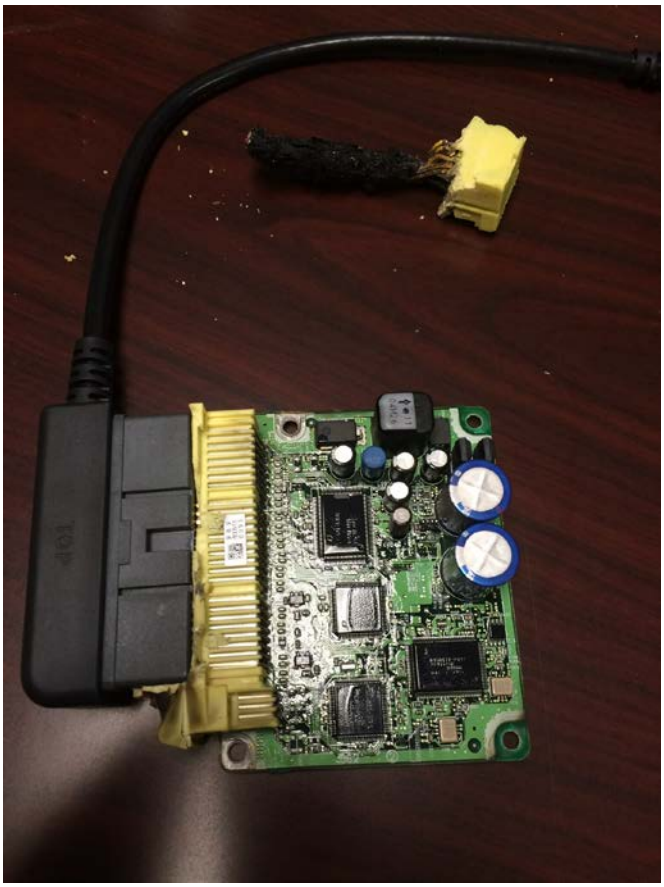

Figure 4: 2010 Scion tC ACM during bench-top download.

2.9.1. Toyota Scion 2010 tC Data Description

The ACM downloaded normally and the CDR report indicated a non-deployment "Frontal/Rear" event. The recorded event indicated both driver and passenger were buckled. A total crash pulse of 150 milliseconds of longitudinal acceleration and delta-V data were captured with a max delta-V of 36.8 mph. No pre-crash information was available.

3. ATTACHMENTS

All reports generated by the CDR software were combined into a single report. That report can be found as Attachment 1 to this report.