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Special Crash Investigations On-Site Rollover Investigation Vehicle: 2016 Toyota Rav4 Location: Texas Crash Date: February 2018

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16. Abstract This report documents the on-site investigation of the crash and rollover of a 2016 Toyota Rav4 equipped with rollover/side impact inflatable curtain (IC) air bags, which were compliant to Federal Motor Vehicle Safety Standard No. 226, Ejection Mitigation. This crash occurred in the intersection of two divided, nine-lane city streets. The Rav4 was a 4-door compact sport utility vehicle (SUV) equipped with multistage frontal air bags, front seat-mounted side impact air bags, and rollover/side impact inflatable curtain (IC) air bags. A belted 48-year-old female drove the vehicle. The Rav4 was traveling south in the center through lane approaching the intersection. A 2005 Toyota Corolla was traveling west in the center through lane and also approaching the intersection. The front plane of the Corolla struck the left plane of the Rav4 (event 1), resulting in deployment of the Rav4's driver seat-mounted side impact air bag and both IC air bags. The Rav4 rotated counterclockwise and rolled over (event 2), right side leading, four quarter turns, coming to final rest on its wheels facing north in the left through lane in the southern leg of the intersection. The Corolla also rotated counterclockwise and came to final rest in the center of the intersection heading east. The Rav4's driver sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital. The belted 40-year old female driver of the Corolla sustained no police-reported injuries. Both vehicles were towed from the crash scene due to damage.			
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Special Crash Investigations
On-Site Rollover Investigation
Case Number - IN18004
Vehicle - 2016 Toyota Rav4
Location - Texas
Crash Date - February 2018

BACKGROUND

This report documents the on-site investigation of the crash and subsequent rollover of a 2016 Toyota Rav4 (**Figure 1**) equipped with rollover/side impact inflatable curtain (IC) air bags, which were compliant to Federal Motor Vehicle Safety Standard No. 226, Ejection Mitigation. This crash investigation was initiated by the National Highway Traffic Safety Administration in March 2018, through the sampling activities of the Crash Investigation Sampling System (CISS) and was assigned to the Special Crash Investigation Team at the Indiana University Transportation Research Center. The crash involved the Rav4 and a 2005 Toyota Corolla. This crash occurred in Texas in March 2018 and was investigated by local police. Both vehicles and the crash scene were inspected in March 2018.

Figure 1: The damaged 2015 Toyota Rav4.

This crash occurred in the intersection of two divided, nine-lane city streets. The Rav4 was a 4-door compact sport utility vehicle (SUV) equipped with multi-stage frontal air bags, front seat-mounted side impact air bags, and rollover/side impact IC air bags compliant with FMVSS 226. A belted 48-year-old female drove the vehicle. The Rav4 was traveling south in the center through lane approaching the intersection. The Corolla was traveling west in the center through lane and also approaching the intersection. The front plane of the Corolla struck the left plane of the Rav4 (event 1), resulting in deployment of the Rav4's driver's seat-mounted side impact air bag and both IC air bags. The Rav4 rotated counterclockwise and rolled over (event 2), right side leading, four quarter turns, coming to final rest on its wheels facing north in the left through lane in the southern leg of the intersection. The Corolla also rotated counterclockwise and came to final rest in the center of the intersection heading east. The Rav4's driver sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital. The belted 40-year old female driver of the Corolla sustained no police-reported injuries. Both vehicles were towed from the crash scene due to damage.

CRASH SUMMARY

Crash Site

This crash occurred at night under artificial light in the intersection of two nine-lane divided city streets. The weather conditions were clear with 16.1 kilometers (9 miles) visibility, southeast winds at 12.9 km/h (8 mph), a temperature of 7.2 °C (45 °F), according to local weather reports. The Rav4's roadway traversed in a northeast-southwest direction. The roadway had three southwest-bound through lanes, two left turn lanes, and a right turn lane. These lanes were separated from the northeast-bound lanes by a 2.1 m (6.9 ft) wide raised concrete median that was 13 cm (5.1 in) high. The center through lane was 3.3 m (10.8 ft) wide. The remaining lanes were approximately 3 m (10 ft) wide. The Corolla's roadway traversed in an east-west direction and had three westbound through lanes, two left turn lanes, and a right turn lane. Each of the through lanes was 3.3 m (10.8) wide. The turn lanes were approximately 3 m (10 ft) wide. These lanes were separated from the eastbound traffic by a 1.0 m (3.3 ft) wide raised median that was 13 cm (5.1 in) high. Both vehicles' roadways were level concrete and the speed limit was 64 km/h (40 mph) for both vehicles. The crash diagram is included at the end of this report.

Figure 2: Southbound approach of the Rav4 to intersection.

Pre-Crash

The Rav4 was traveling south in the center through lane (**Figure 2**) approaching the intersection at an event-data-recorder reported speed range of 63 km/h (39.1 mph) to 60 km/h (37.3 mph) at -4.95 to 0 sec prior to algorithm enable (AE). The steering input was reported as -25.5 degrees[1] at AE, indicating the driver steered right to avoid the crash immediately prior to impact. The vehicle's service brake was reported as "OFF" during the entire pre-crash recording except at 0 sec, where it was reported as "ON." The Rav4's EDR- reported speed, percentage accelerator pedal, percentage throttle, engine rpm, service brake status, yaw rate, and steering input are presented in the table below. The Corolla was traveling west in the center through lane (**Figure 3**) approaching the intersection. According to the police crash report, the Corolla entered the intersection on a red traffic signal.

Figure 3: Westbound approach of the Corolla.

[1] The EDR data limitations states that positive steering values indicate left turn.

Rav4's EDR-reported pre-crash data

Time (sec)	-4.95	-4.45	-3.95	-3.45	-2.95	-2.45	-1.95	-1.45	-0.95	-0.45	0 (TRG)
Vehicle Speed km/h (mph)	63 (39.1)	63 (39.1)	63 (39.1)	64 (39.8)	64 (39.8)	64 (39.8)	63 (39.1)	63 (39.1)	62 (38.5)	61 (37.9)	60 (37.3)
Accel. Pedal, % Full	14.5	28.5	24.0	14.5	1.5	0.0	0.0	0.0	0.0	5.0	0.0
Percent Engine Throttle	4.0	7.5	7.0	4.5	00	0.0	0.0	0.0	0.0	1.5	0.0
Engine RPM	1,300	1,400	1,300	1,300	1,300	1,300	1,300	1,200	1,200	1,300	1,200
Service Brake ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
Steering Input (degrees)	-9.0	-7.5	-4.5	-6.0	-7.5	-9.0	-10.5	-9.0	-6.0	-9.0	-25.5

Crash

The front plane of the Corolla (**Figure 4**) struck the left plane of the Rav4 (**Figure 5**, event 1). The force direction on the Rav4 was in the 10 o'clock sector and the impact activated the driver's seat belt pretensioner, deployment of the driver's seat-mounted side impact air bag, and both IC air bags. The Corolla's driver's frontal air bag also deployed. The damage algorithm of the WinSMASH program calculated the Rav4's total delta V as 14 km/h (8.7 mph). The longitudinal and lateral velocity changes were -10 km/h (-6.2 mph) and 9 km/h (5.6 mph), respectively. The total delta V for the Corolla was 19 km/h (11.8 mph). The longitudinal and lateral velocity changes were -10 km/h (-6.2 mph) and -16 km/h (-9.9 mph), respectively. The results were considered low for both vehicles based on the damage they sustained.

The impact to the left plane of the Rav4 caused the vehicle to rotate counterclockwise and it rolled over (event 2), right side leading, four quarter turns across an estimated distance of 19 m (62 ft). The Rav4 came to final rest on its wheels in the southbound left through lane in the

Figure 4: Front plane damage to the Corolla from impact with left plane of the Rav4.

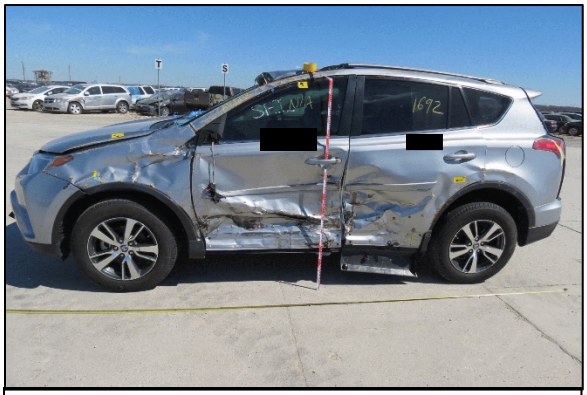


Figure 5: Damage to left plane of the Rav4.

southern leg of the intersection, heading north, based on the police crash schematic. The Corolla came to final rest in the intersection heading east based on the police crash schematic.

Post-Crash

The police were notified of the crash at 2033 hours and arrived at the crash scene at 2035 hours. Rescue personnel also responded. The driver of the Rav4 sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital. Efforts to obtain medical records and/or an interview were unsuccessful. The driver of the Corolla did not sustain any police-reported injuries and refused transport to a medical facility. Both vehicles were towed from the crash scene due to damage.

2016 TOYOTA RAV4

Description

The Rav4 was a front-wheel drive, 5-occupant, 4-door, SUV with the VIN 2T3WFREV1GWxxxxxx), manufactured in April 2016. The vehicle was equipped with a 2.5-liter, L-4 engine, 6-speed automatic transmission with sport shift, 4-wheel antilock brakes with electronic brake force distribution, brake assist, traction control, and electronic stability control. The vehicle's specified wheelbase was 266 cm (104.7 in).

The vehicle manufacturer's recommended tire size was P225/65R17. The vehicle was equipped with Michelin Latitude Touring tires of the recommended size. The vehicle manufacturer's recommended cold tire pressure for the front and rear tires was 241 kPa (35 psi). The tire data for the Rav4 are presented in the table below.

Position	Measured Tread Depth	Restricted	Damage
LF	7 mm (9/32 in)	No	None
LR	7 mm (9/32 in)	No	None
RR	6 mm (8/32 in)	No	None
RF	7 mm (9/32 in)	No	None

The front row was equipped with driver and front right passenger cloth-covered bucket seats with adjustable head restraints. The back row was equipped with a cloth-covered split bench seat with folding backs and adjustable head restraints at the outboard seat positions. The driver's seat track was adjusted between the middle and rearmost positions and the seat back was reclined 30 degrees aft of vertical. The top of the driver's head restraint was located 26 cm (10.2 in) above the top of the seat back. The remaining seating positions were unoccupied at the time of the crash.

Exterior Damage

Exterior Damage Event 1: The Rav4 sustained damage to the left fender and left doors during the impact with the front plane of the Corolla. The direct damage began 53 cm (20.9 in) forward of the left rear axle and extended 165 cm (65.0 in) forward. The Field L was 170 cm (66.9 in) beginning 49 cm (19.3 in) forward of the right rear axle. Crush measurements were taken at the lower-door level and the maximum residual crush was 10 cm (3.9 in) occurring 186 cm (73.2 in) forward of the left rear axle. The crush values were: C_1 = 2 cm (0.8 in), C_2 = 6 cm (2.4 in), C_3=10 cm (3.9 in), C_4 = 6 cm (2.4 in), C_5 = 9 cm (3.5 in), C_6 = 0 cm. The sill height was 36 cm (14.2 in) and the height of the maximum crush was 70 cm (27.6 in). The sill height was 42 cm (16.5 in) and the height of the maximum crush was 48 cm (18.9 in). The Door Sill Differential (DSD) was 8 cm (3.1 in)

Damage Classification Event 1: The collision deformation classification (CDC) was 10LYEW1 (310 degrees). The severity of the damage was considered moderate based on damage to the fender and doors.

Exterior Damage Event 2: The top plane and both side planes were damaged during the rollover. The direct damage on the left plane began at the front of the fender and extended rearward onto both doors, the roof side rail, and quarter panel. The direct damage on the right plane began the front bumper corner and extended rearward on the fender, A-pillar, and the roof side rail. The direct damage on the top plane was limited to both roof side rails. The maximum vertical crush was 3 cm (1.2 in) and occurred at the left windshield header. The maximum lateral crush was 2 cm (0.8 in) and occurred at the right roof side rail adjacent B-pillar.

Damage Classification Event 2: The CDC was 00TDDO2. The severity of the damage was minor based on the extent of the crush to the top plane

Event Data Recorder

The Rav4's EDR was imaged with version 17.6.1 of the Bosch Crash Data Retrieval software via direct connection to the air bag control module (DLC) and reported with version 19.1.1 The EDR reported a side event and a rollover. Each event recording was complete and the driver's seat belt status was reported as "ON." No diagnostic trouble codes were reported for either event. The EDR report is attached to the end of this report as **Appendix A**.

The EDR was capable of storing deployment and non-deployment events. Data from deployment and pretensioner actuation events cannot be overwritten. Data from non-deployment events can be overwritten if the subsequent event is a deployment or pretensioner actuation.

System Status at Event (1st Prior Event, TRG 1): This event was recorded during the vehicle's left plane impact with the Corolla. The EDR reported the "Time to Fire" for actuation of the seat belt pretensioner as 5 msec after AE. The EDR also reported the "Time to Deploy" for deployments of the side impact and IC air bags as 5 msec after AE. No maximum longitudinal or lateral delta Vs were reported in the record.

System Status at Event (Most Recent Event, TRG2): This event was reported as a rollover. The "Time to Deploy" for the ICs was reported as 845 msec after AE. The "Time to Fire" for both front row seat belt pretensioners was reported as 845 msec after AE. Again, no maximum longitudinal or lateral delta Vs were reported in the record. The roll angle peak was reported as 365.4 degrees and the Roll Angle at the Time of TRG was -2.0 degrees.

Interior Damage
The interior of the Rav4 sustained minor damage from intrusion. There were a total of four intrusions of the occupant compartment. The most severe intrusions to the driver's seating area included the rear lower quadrant of the left front door, the left A-pillar, and left B-pillar, which intruded laterally 6 cm (2.4 in), 5 cm (2 in), and 3 cm (1.2 in), respectively.

Inspection of the interior revealed cuts on the interior of the left IC air bag from an unknown source, but no discernable evidence of occupant contact. Both left doors were jammed shut. The right doors and hatch remained closed and operational.

Manual Restraint Systems
The front row seating positions were equipped with lap and shoulder seat belts with sliding latch plates and adjustable upper anchors. The driver's upper anchor was adjusted to the full-up position. The front row seat belts were also equipped with retractor-mounted pretensioners, both of which actuated during the crash. The second row was equipped with lap and shoulder seat belts with sliding latch plates and fixed upper anchors.

The driver was restrained by the lap and shoulder seat belt as evidenced by load marks from the belt webbing on the latch plate belt guide. There was also a 10 cm (3.9 in) long scuff on the belt webbing near the D-ring located 144 cm (5.5 in) from the floor anchor. The vehicle's EDR also reported the status of the driver's seat belt switch circuit as "On." The remaining seating positions were unoccupied at the time of the crash.

Supplemental Restraint Systems
The Rav4 was equipped with multi-stage frontal air bags, front seat-mounted side impact air bags, and side impact IC air bags with roll sensors. The driver's seat-mounted side impact air bag and both IC air bags deployed during the crash.

The driver's side impact air bag was located in the outboard side of the seat back and deployed through a tear seam. The deflated air bag was 20 cm (7.9 in) wide and 58 cm (22 in) in height. Inspection of the air bag revealed no discernable evidence of occupant contact and no damage.

Figure 6: Rear of left IC air bag, not fully extended from roof liner.

The IC air bags were located along the roof side rails behind the headliner and the deflated IC air bags extended from the A-pillar to the D-pillar. The left IC air bag was 185 cm (72.8 in) wide, 47 cm (18.5 in) high, and extended 17 cm (6.7 in) below the beltline. There was a 6 cm (2.4 in) gap between the front of the IC and the base of the A-pillar. There was no discernable evidence of occupant contact to the IC, though there were 5 cm (2 in) and 3 cm (1.9 in) cuts in the interior fabric of the IC, starting 7 cm (2.8 in) forward of the B-pillar and 13 cm (5.1 in) above the belt line. Also, the rear portion of the air bag near the left C-pillar did not fully deploy as indicated by condition of the air bag material at the roof side rail (**Figure 6**). The right IC air bag was of the same approximate dimensions as the left. The front portion of the IC had been cut by emergency responders.

Rollover Mitigation

The Rav4's rollover mitigation features consisted of ESC and roll sensing. The ESC uses sensors to detect a loss of steering control and selectively applies the brakes to minimize the control loss and keep the vehicle on the intended path. The driver was unable to regain control of the vehicle after the impact with the Corolla.

In general, the design of a vehicle's rollover sensing considers a proprietary combination of that particular platform's roll angle, rate of roll, and speed to determine an impending rollover situation and the deployment timing for the IC air bags. The specific IC air bag deployment parameters for the Toyota Rav4 under investigation remain unknown. However, it is clear after analysis and review of the Rav4's EDR data that the IC air bags deployed 5 milliseconds after the side impact trigger (prior to the development of the rollover dynamics). The Rav4's rollover criteria would have commanded IC air bag deployment 845 milliseconds after trigger.

Based on testing, NHTSA has given this vehicle model a 4-star rollover rating on a 5-star scale. The rollover star rating is determined based on a static measurement and a dynamic test for rollover. The static measurement is a mathematical calculation considering the vehicle's weight, track width, and height of the center of gravity and is referred to as the static stability factor. The dynamic test is conducted with a weighted vehicle that simulates a load of five occupants and a full tank of fuel. The test vehicle enters a left steering avoidance maneuver of 270 degrees at 56 to 81 km/h (35 to 50 mph), and then a right steering over-correction of 540 degrees is initiated. If instruments detect two tires that lift at least 5 cm (2 in), then the vehicle is considered to have "tipped up," which is the precursor to a rollover. The "Dynamic Test Results" for the 2015 Rav4 were reported as "No Tip," and the vehicle was reported to have a 16.9 percent risk of a rollover.

Rollover Discussion

The rollover of the Rav4 was initiated following the impact with the Corolla as the Rav4 rotated counterclockwise due to the impact. There was no physical evidence of the impact with the Corolla or of the Rav4's rollover at the crash scene. It was estimated that the Rav4 traveled 9 m (30 ft) prior to rolling over, right side leading, four quarter turns. The rollover distance was estimated to be 19 m (62 ft). The rollover initiation type was classified as "turn-over" since there were no gouge marks from the vehicle's right side wheel rims located at the crash site. And the only damage to the right side wheels where minor abrasions on the rims and tire side walls from the rollover. The roll path of the vehicle was confined to the southbound roadway. The vehicle came to final rest upright and facing northeast on the left southbound through lane in the southern leg of the intersection.

The vehicle's IC air bags were certified to FMVSS No. 226, Ejection Mitigation. They provided full coverage of the side window glazing in the front and second rows. The driver was restrained by the lap and shoulder seat belt and remained in the vehicle throughout the crash.

2016 TOYOTA RAV4 OCCUPANT

Driver Demographics

Age/Sex:	48 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Between middle and rear-most
Manual restraint usage:	Lap and shoulder seat belt
Usage source:	Vehicle inspection, EDR
Air bags:	Frontal, not deployed; seat-mounted side impact and IC air bags, deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Unknown
Transport from scene:	Transported by ambulance to hospital
Medical treatment:	Unknown

Driver Injuries

No injury information was available for the driver.

Driver Kinematics

The driver was restrained by the lap and shoulder seat belt. The seat track was adjusted between the middle and rearmost positions and the seat back was reclined 30 degrees aft of vertical. The top of the head restraint was located 26 cm (10.2 in) above the top of the seat back. The left plane impact to the Rav4 resulted in actuation of the driver's seat belt pretensioner and deployments of the driver's side impact and both IC air bags. The driver was displaced to the left and forward and she loaded the side impact and IC air bags. The driver was then redirected in multiple directions as the vehicle rolled over, right side leading. The driver sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a hospital. Efforts to obtain medical records and/or an interview were unsuccessful.

2005 TOYOTA COROLLA

Description

The Corolla was a front-wheel-drive, 5-occupant, 4-door sedan with theVIN 1NXBR30E55Zxxxxxx equipped with a 1.8-liter, L-4 engine, and a 4-speed automatic transmission.

Exterior Damage

The Corolla sustained damage to the front plane (**Figure 7**). The bumper, bumper fascia, grille, hood, fenders, and both headlamp/turn signal assemblies were directly damaged. The crush measurements were taken on the front bumper and the maximum residual crush was 19 cm (7.5 in), occurring at 68 cm (26.8 in) right of the left bumper corner. The Field L was 113 cm (44.5 in). The crush values were: C_1 = 2 cm (0.8 in), C_2 = 8 cm (3.1 in), C_3 =15 cm (5.9 in), C_4 = 19 cm (7.5 in), C_5 = 18 cm (7.1 in), C_6 = 17 cm (6.7 in).

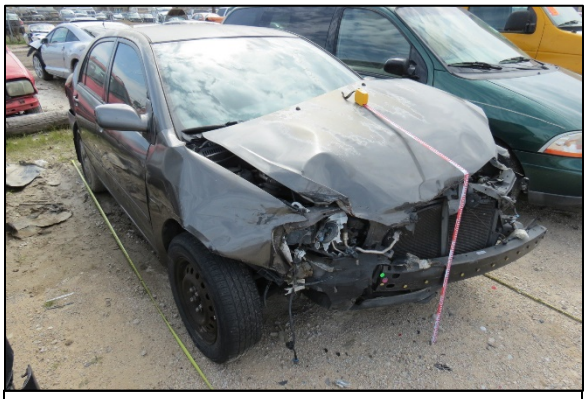


Figure 7: Front plane damage to the Corolla

Damage Classification, Event 1: The CDC was 02FDEW1 (60 degrees).

Event Data Recorder

The Corolla's EDR was imaged with version 17.6.1 of the Bosch Crash Data Retrieval software and reported with version 19.1.1. The EDR was imaged with external electrical power via connection to the DLC. The EDR reported two front/rear events. Each event recording was complete and the driver's belt status was reported as "BUCKLED." The EDR report is attached to the end of this report as Appendix B.

The EDR was capable of storing deployment and non-deployment events. Data from deployment and pretensioner actuation events cannot be overwritten. Data from non-deployment events can be overwritten if the subsequent event is a deployment or pretensioner actuation.

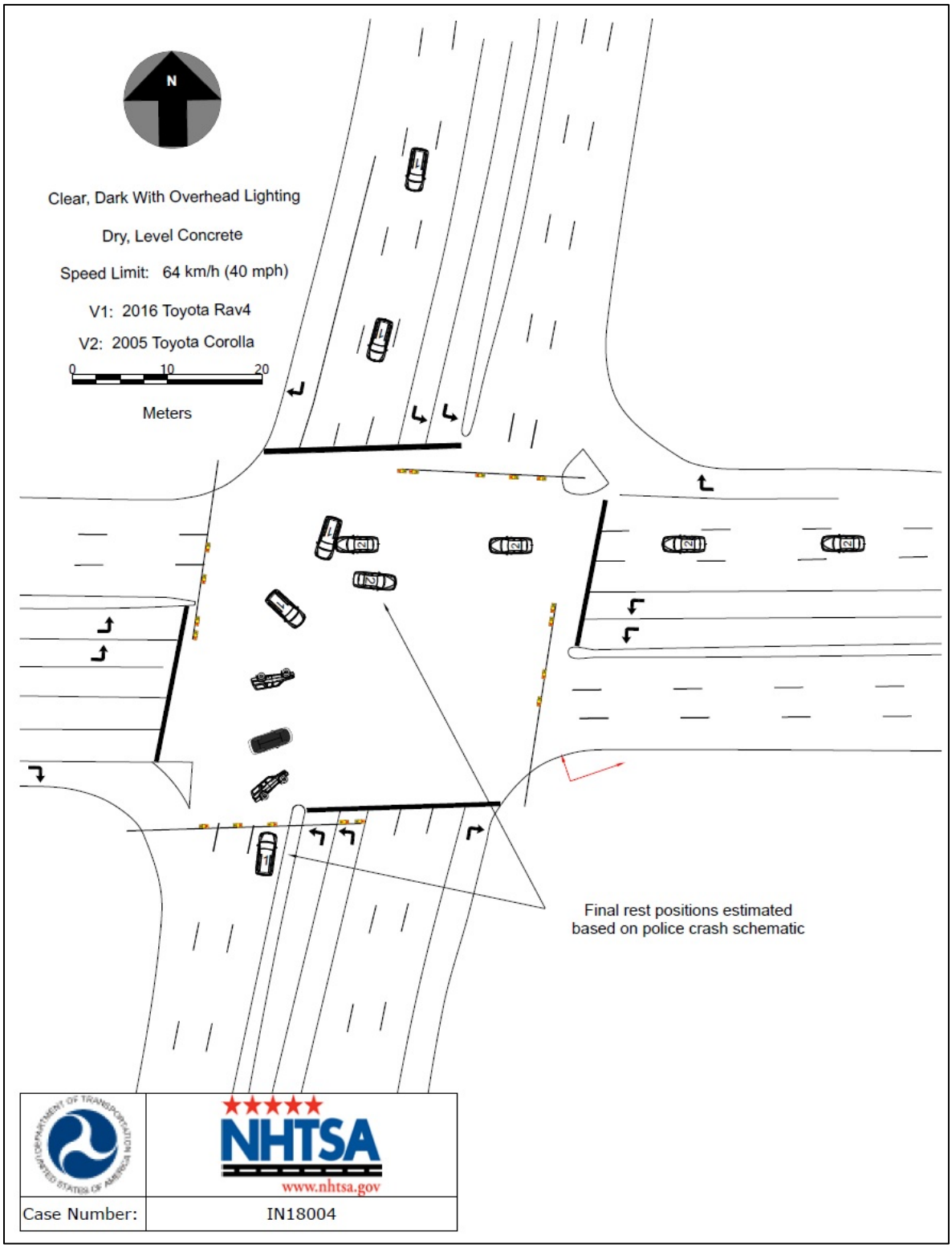
1st Prior Frontal/Rear Event, TRG): This event was recorded during the vehicle's front plane impact with the left plane of the Rav4. This record did not include any pre-crash or air bag deployment timing data. The record reported the maximum longitudinal delta-V as -3.1 km/h (-1.9 mph) occurring at 153.6 msec, which was the end of the reported air bag timing data.

Most Recent Frontal/Rear Event, TRG 2: This record was for a frontal/rear event yet there was no discernable impact damage noted on the vehicle that this event can be correlated to. This record did not include any pre-crash or air bag data.

Occupant Data

The 40-year old female driver was restrained by her lap and shoulder seat belt. She did not sustain any police reported injuries and was not transported for treatment.

CRASH DIAGRAM



APPENDIX A: 2016 TOYOTA RAV4 EVENT DATA RECORDER (EDR) REPORT[2]

[2] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the vehicle inspection. The CDR report contained in the associated Crash Viewer application may differ relative to this report.

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN/Frame Number User	2T3WFREV1GW******
Case Number EDR Data Imaging Date	
Crash Date Filename	IN18004_V1_ACM.CDRX
Saved on Imaged with CDR version	Crash Data Retrieval Tool 17.6.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 19.1.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Side (1), Rollover (1)

Comments

No comments entered.

Data Limitations

CDR Record Information:

- Due to limitations of the data recorded by the airbag ECU, such as the resolution, data range, sampling interval, time period of the recording, and the items recorded, the information provided by this data may not be sufficient to capture the entire crash.
- Pre-Crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may not be synchronous to each other.
- Airbag ECU data should be used in conjunction with other physical evidence obtained from the vehicle and the surrounding circumstances.
- If any of the front passenger seat airbags, side airbags, or Curtain Shield Airbags have deployed, data will not be overwritten or deleted by the airbag ECU following that event. If none of the airbags have deployed, the data of that event may be overwritten by a following event even if other airbags (pretensioner, rear seat airbag, etc.) have deployed.
- If power supply to the airbag ECU is lost during an event, all or part of the data may not be recorded.
- "Diagnostic Trouble Codes" are information about faults when a recording trigger is established. Various diagnostic trouble codes could be set and recorded due to component or system damage during an accident.
- The airbag ECU records only diagnostic information related to the airbag system. It does not record diagnostic information related to other vehicle systems.
- The TaSCAN, Global Tech Stream, or Intelligent Tester II devices (or any other Toyota genuine diagnostic tool) can be used to obtain detailed information on the diagnostic trouble codes from the airbag system, as well as diagnostic information from other systems. However, in some cases, the diagnostic trouble codes of the airbag system recorded by the airbag ECU when the event occurred may not match the diagnostic trouble codes read out when the diagnostic tool is used.

General Information:

- The data recording specifications of Toyota's airbag ECUs are divided into the following categories. The specifications for 12EDR or later are designed to be compatible with NHTSA's 49CFR Part 563 rule.
  - 00EDR / 02EDR / 04EDR / 06EDR / 10EDR / 12EDR / 13EDR / 15EDR / 17EDR / 19EDR
- The airbag ECU records data for all or some of the following accident types: frontal crash, rear crash , side crash, and rollover events. Depending on the installed airbag ECU, data for side crash and/or rollover events may not be recorded.
- This airbag ECU records record pre-crash data and post-crash data.
  - If a single event occurs independently, the data for that event is recorded on a one-to-one basis.
  - If multiple events occur successively (within a period of approximately 500ms), the establishment of the recording trigger for the first event is defined as the "pre-crash recording trigger". Pre-crash data for the first event and post-crash data for each successive event is then recorded.
- The airbag ECU has two recording pages (memory maps) to store pre-crash data. Additionally, to store post-crash data, the airbag ECU has two recording pages for each accident type: two pages for frontal and rear crash, two pages for a side crash, and two pages for rollover event.
- The data recorded by the airbag ECU includes correlating information between each previously occurring event (i.e., information that

clarifies the collision event sequence. This correlation information consists of the following items.
- Time from Previous Pre-Crash TRG
- Linked Pre-Crash Page
- Time from Pre-Crash TRG
- TRG Count
- Previous Crash Type

- In frontal and rear collision events, the first point where a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached is regarded as time zero for the recorded data. In side impact collision and rollover events, the point in time at which the recording trigger is established is regarded as time zero for the recorded data.
- The recording trigger judgment threshold value differs depending on the collision type (i.e., frontal crash, rear crash, side crash, or rollover event).
- Some of the data recorded by the airbag ECU is transmitted to the airbag ECU from various vehicle control modules by the vehicle's Controller Area Network (CAN).
- In some cases, the airbag ECU part number printed on the ECU label may not match the airbag ECU part number that the CDR tool reports. The part number retrieved by the CDR tool should be considered as the official ECU part number.
- In frontal and rear collision events, the record time varies depending on the period during which a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached, and time series data is recorded for up to 250 ms. The record time described above is indicated as "Length of Delta-V". "Delta-V, Longitudinal" outside the record time is indicated by area shaded in the table, and not indicated in the graph.

Data Element Sign Convention:
The following table provides an explanation of the sign notation for data elements that may be included in this CDR report.

Data Element Name	Positive Sign Notation Indicates
Maximum Delta-V, Longitudinal	Forward
Delta-V, Longitudinal	Forward
Lateral Acceleration for Frontal/Rear Crash, Floor Sensor	Left to Right
Lateral Acceleration, Side Satellite Sensor 1	Left to Right
Lateral Acceleration, Side Satellite Sensor 2	Left to Right
Lateral Acceleration, Side Satellite Sensor 3	Left to Right
Lateral Acceleration, Side Satellite Sensor 4	Left to Right
Lateral Acceleration for Side Crash, Floor Sensor	Left to Right
Roll Angle Peak	Clockwise Rotation
Roll Angle at the Time of TRG	Clockwise Rotation
Roll Rate	Clockwise Rotation
Lateral Acceleration for Rollover, Floor Sensor	Left to Right
Longitudinal Acceleration , VSC Sensor	Forward
Yaw Rate	Left Turn
Steering Input	Left Turn

Data Definitions:

- The "ON" setting for the "Freeze Signal" indicates a state in which the non-volatile memory can not be overwritten or deleted by the airbag ECU. After "Freeze Signal" has been turned ON, subsequent events will not be recorded.
- "Recording Status" indicates a state in which all recorded event data has been written into the non-volatile memory, or a state in which this process was interrupted and not fully written into the non-volatile memory. If "Recording Status" is "Incomplete", recorded event data may not be valid.
- If the "Occupant Size Classification, Front Passenger" displays "Child" or "Not Occupied", "Side Air Bag Deployment, Time to Deploy" and "Pretensioner Deployment, Time to Fire" may indicate a time even if deployment did not occur on the for following part no's:
  - 89170-07280, 35400, 35410, 35470, 42660, 0R120, 0R080, 0R081, 0R150
- "Engine RPM" indicates the number of engine revolutions, not the number of motor revolutions. The recorded value has an upper limit of 12,800 rpm. Resolution is 100 rpm and the value is rounded down and recorded. For example, if the actual engine speed is 799 rpm, the recorded value will be 700 rpm.
- If the electric vehicle is using a calculated/virtual engine RPM for drivetrain control, "Engine RPM" may be recorded, but should not be used during data analysis.
- The upper limit for the recorded "Vehicle Speed" value is 200 km/h (125mph). Resolution is 1km/h (0.6mph) and the value is rounded down and recorded. The accuracy of the "Vehicle Speed" value can be affected by various factors. These include, but not limited, to the following.
  - Significant changes in the tire's rolling radius
  - Wheel lock and wheel slip
- "Accelerator Pedal" has two recording specifications. Both the recorded value increases as the driver depresses the accelerator.
  - Percentage of accelerator pedal depressed (recorded as 0-100(%)).
  - Output voltage of accelerator pedal module (recorded as 0-5(V)).
- If M/T transmission vehicle of some limited model, "Shift Position" may display "Drive" regardless of the actual shift position.
- Depending on the type of occupant sensor installed in the vehicle, one of the following three recording formats for "Occupant Size Classification, Front Passenger" will be utilized.
  - Occupied / Not Occupied
  - AM50 / AF05 / Child / Not Occupied
  - AM50 / AF05 / Child or Not Occupied

- "Cruise Control Status" indicates whether the cruise control system is actuated or not. OFF indicates that the cruise control system is not actuated, but can also indicates that the vehicle is not equipped with the system.
- "Air Bag Warning Lamp, On/Off", "Ignition Cycle, Crash", "Seat Track Position Switch, Foremost, Status, Driver", "Occupant Size Classification, Front Passenger", "Safety Belt Status, Driver", "Safety Belt Status, Front Passenger", "Frontal Air Bag Suppression Switch Status, Front Passenger", and "RSCA Disable Switch" indicate the state approximately 1 second before time zero. They may not always indicate the state at the moment of collision.
- The upper and lower limits for the recorded value of "Motor RPM" is 17,500 rpm and -7,500 rpm respectively. Resolution is 100 rpm and the value is rounded down and recorded.
- "Brake Oil Pressure" has an upper limit of 12.14 Mpa. In the case of the vehicle that has not VSC system, "0 Mpa" or "Invalid" may be displayed.
- "Longitudinal Acceleration , VSC Sensor" has upper and lower limits for the recorded value of 8.973 m/s^2 and -8.973 m/s^2 respectively. This acceleration sensor does not sense collisions.
- "Sequential Shift Range" displaying "Undetermined" indicates the shift range is undetermined or was not being used.
- Some vehicles will not be equipped with all "Drive Mode" types indicated in the "Drive Mode" table. If some or all drive modes are not applicable to vehicle, "OFF" or "Invalid" may be displayed. The item in the "Drive Mode" table may not match the name of switch or indicator that equipped the vehicle.
- The upper and lower limits for the recorded value of "Steering Input" is 375 deg and -375 deg respectively. Resolution is 1.5 deg and the value is rounded down and recorded.
- Resolution of the "Air Bag Warning Lamp ON Time Since DTC was Set" is 15 minutes, and the value is rounded down and recorded.
- "Delta-V, Longitudinal" indicates the change in forward speed after time zero. This does not refer to vehicle speed, and it does not include the change in speed during the period from the start of the actual collision to establishment of the time zero.
- "Location of Side Satellite Sensor" shows the outline of a typical sensor position. Sensory location can be confirmed using the repair manual.
- "Time from Previous Pre-Crash TRG" indicates the time between the establishment of an event's pre-crash recording trigger to the establishment of a more recent event's pre-crash recording trigger. The upper limit for the recorded value is 16,381 milliseconds. In the event of establishment of the first pre-crash recording trigger after the ignition is switched ON, the upper limit value(max value) is recorded.
- "TRG Count" indicates a calculated value of the number of times recording triggers have been established for all crash types. The sequence in which each event occurred can be verified from the "TRG Count". The smaller the "TRG Count" value, the older the data. The upper limit for the recorded value is 65,533 times. When more than one event reaches the upper limit, the actual "TRG Count" may be greater than what is displayed for that event.
- "Linked Pre-Crash Page" is used to link 'paged" pre-crash data with 'paged" post-crash data. When old pre-crash data is overwritten by new pre-crash data, the "Linked Pre-Crash Page" value may record a page number that is not actually linked.
- Resolution of the "Time from Pre-Crash to TRG" is 50 [ms], and the value is rounded up and recorded.
- "Roll Angle at the Time of TRG" and "Roll Angle Peak" do not represent the actual roll angle of the vehicle. These values are used internally by the airbag ECU for sensing a rollover.

05013_ToyotaS00std_r027

System Status at Time of Retrieval

ECU Part Number	89170-0R191
EDR Generation	13EDR
Complete File Recorded	Yes
Freeze Signal	ON
Freeze Signal Factor	Side Airbag Deployment, Left Side
Diagnostic Trouble Codes Exist	No
Ignition Cycle ,Download (times)	3150
Multi-event, number of events (times)	2 or greater
Time from event 1 to 2 (s)	0.052
Time from Previous Pre Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No

Event Record Summary at Retrieval

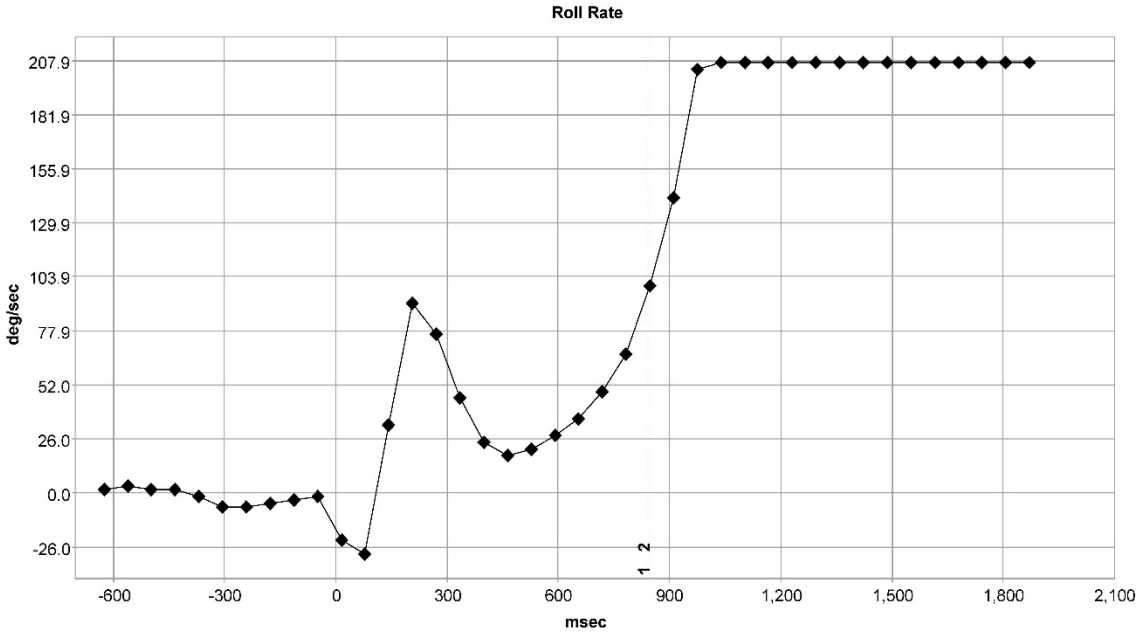
Events Recorded	TRG Count	Crash Type	Time (msec)	Pre-Crash & DTC Data Recording Status	Event & Crash Pulse Data Recording Status
Most Recent Event	2	Rollover	0	Complete (Page 0)	Complete (Rollover Page 0)
1st Prior Event	1	Side Crash	-52	Complete (Page 0)	Complete (Side Page 0)

System Status at Event (Most Recent Event, TRG 2)

Recording Status, Rollover Crash Info.	Complete
Crash Type	Rollover
TRG Count (times)	2
Previous Crash Type	Side Crash
Time from Pre-Crash TRG (msec)	52
Linked Pre-Crash Page	0
Side Curtain Airbag Deployment, Time to Deploy (msec)	845
Pretensioner Deployment, Time to Fire, Driver (msec)	845
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	845

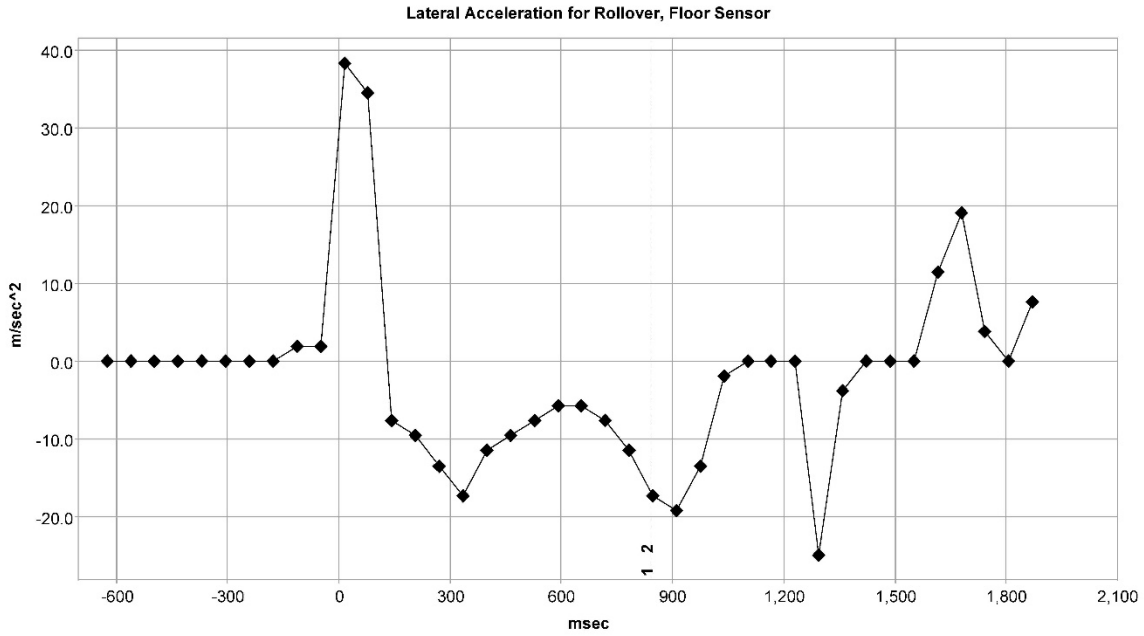
Rollover Crash Pulse (Most Recent Event, TRG 2 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from TRG to Next Sample (msec)	15
Roll Angle Peak (degrees)	365.4
Roll Angle at the Time of TRG (degrees)	-2.0



Deployment Time Marker Key

1	Driver/Passenger CSA
2	Driver/Passenger Pretensioner



Deployment Time Marker Key

1	Driver/Passenger CSA
2	Driver/Passenger Pretensioner

Rollover Crash Pulse (Most Recent Event, TRG 2 - table 2 of 2)

Time (msec)	Roll Rate (deg/sec)	Lateral Acceleration for Rollover, Floor Sensor (m/sec^2)
-625	1.6	0.0
-561	3.3	0.0
-497	1.6	0.0
-433	1.6	0.0
-369	-1.6	0.0
-305	-6.5	0.0
-241	-6.5	0.0
-177	-4.9	0.0
-113	-3.3	1.9
-49	-1.6	1.9
15	-22.8	38.3
79	-29.3	34.5
143	32.6	-7.7
207	91.2	-9.6
271	76.6	-13.4
335	45.6	-17.2
399	24.4	-11.5
463	17.9	-9.6
527	21.2	-7.7
591	27.7	-5.7
655	35.8	-5.7
719	48.9	-7.7
783	66.8	-11.5
847	99.4	-17.2
911	141.7	-19.2
975	203.6	-13.4
1039	206.9	-1.9
1103	206.9	0.0
1167	206.9	0.0
1231	206.9	0.0
1295	206.9	-24.9
1359	206.9	-3.8
1423	206.9	0.0
1487	206.9	0.0
1551	206.9	0.0
1615	206.9	11.5
1679	206.9	19.2
1743	206.9	3.8
1807	206.9	0.0
1871	206.9	7.7

DTCs Present at Time of Event (Most Recent Event, TRG 2)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (Most Recent Event, TRG 2)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	450
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Child or Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	3148

BOSCH

Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 2)

Time (sec)	-4.95	-4.45	-3.95	-3.45	-2.95	-2.45	-1.95	-1.45	-0.95	-0.45	0 (TRG)
Vehicle Speed (MPH [km/h])	39.1 [63]	39.1 [63]	39.1 [63]	39.8 [64]	39.8 [64]	39.8 [64]	39.1 [63]	39.1 [63]	38.5 [62]	37.9 [61]	37.3 [60]
Accelerator Pedal, % Full (%)	14.5	28.5	24.0	14.5	1.5	0.0	0.0	0.0	0.0	5.0	0.0
Percentage of Engine Throttle (%)	4.0	7.5	7.0	4.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0
Engine RPM (RPM)	1,300	1,400	1,300	1,300	1,300	1,300	1,300	1,200	1,200	1,300	1,200
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-1.364	0.072	0.359	0.072	-0.287	-0.431	-0.431	-0.144	-0.933	0.000	-2.728
Yaw Rate (deg/sec)	-3.42	-2.44	-1.46	-1.46	-2.44	-2.93	-3.42	-3.42	-1.95	-1.95	-9.27
Steering Input (degrees)	-9.0	-7.5	-4.5	-6.0	-7.5	-9.0	-10.5	-9.0	-6.0	-9.0	-25.5
Shift Position	D	D	D	D	D	D	D	D	D	D	D
Sequential Shift Range	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined
Cruise Control Status	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, PWR	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, ECO	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Drive Mode, Sport	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, Snow	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

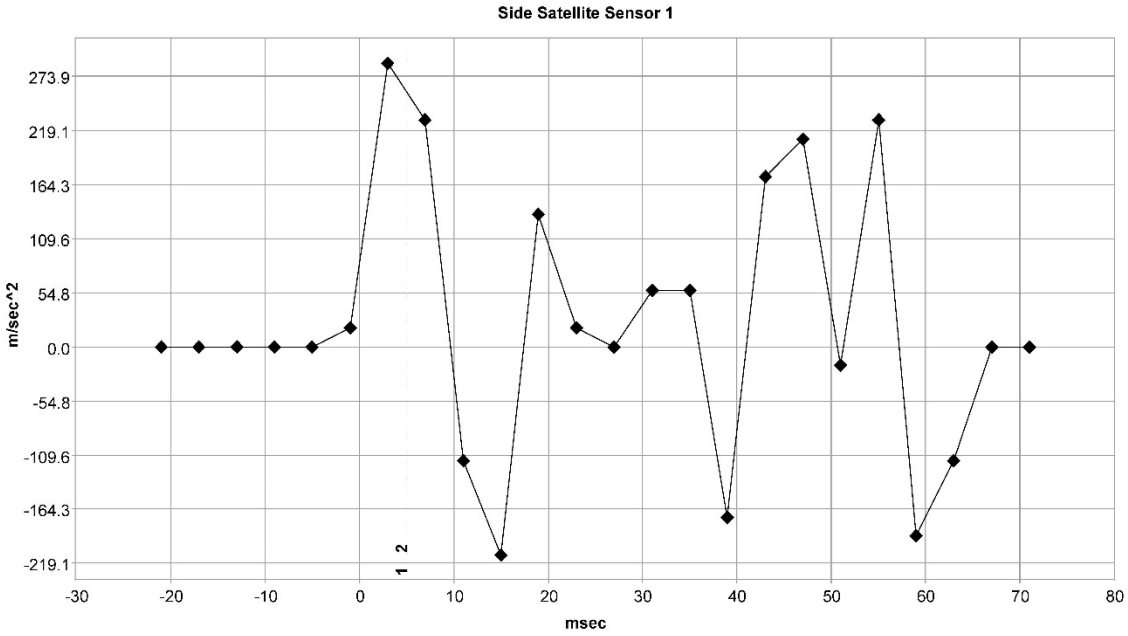
Drive Mode, EV	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Fuel Injection Quantity (mm3/st)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

System Status at Event (1st Prior Event, TRG 1)

Recording Status, Side Crash Info.	Complete
Crash Type	Side Crash
TRG Count (times)	1
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	0
Side Airbag Deployment, Time to Deploy (If Equipped) (msec)	5
Side Curtain Airbag Deployment, Time to Deploy (If Equipped) (msec)	5
Pretensioner Deployment, Time to Fire (msec)	5
Rear Window Airbag Deployment, Time to Deploy (msec)	SNA

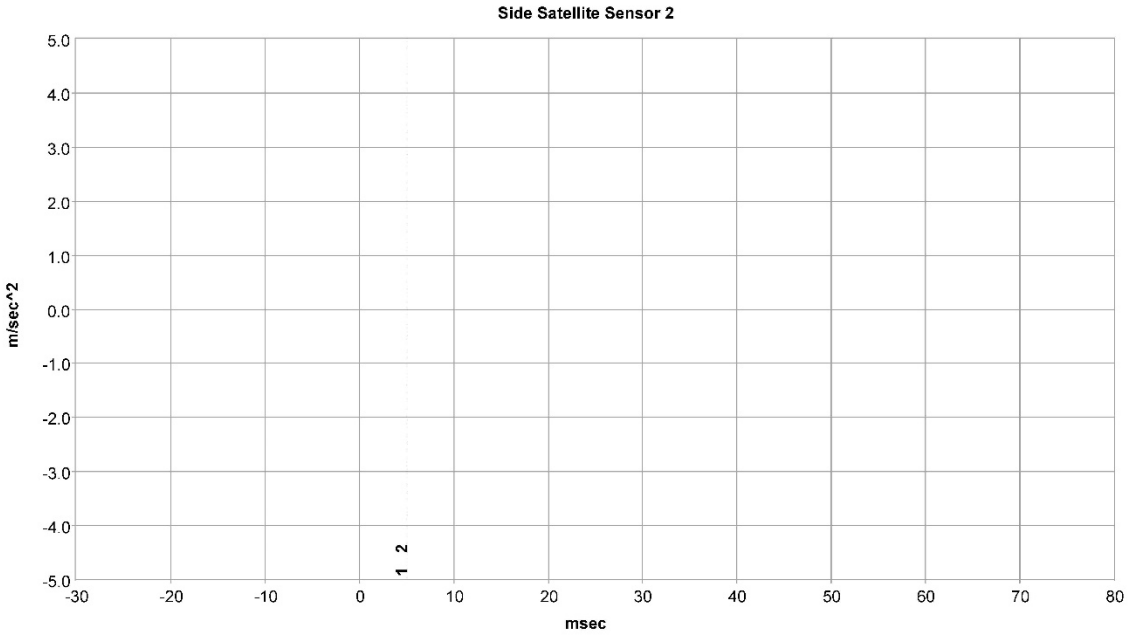
Lateral Crash Pulse (1st Prior Event, TRG 1 - table 1 of 2)

Recording Status, Time Series Data	Complete
Recorded Side	Left Side
Time from TRG to Next Sample (msec)	3
Location of Side Satellite Sensor 1	Front Door
Location of Side Satellite Sensor 2	Not Equipped
Location of Side Satellite Sensor 3	Not Equipped
Location of Side Satellite Sensor 4	C-Pillar
Location of Floor Sensor	Airbag ECU
Clipping Time of Lateral Acceleration, Side Satellite Sensor 1 (msec)	No
Clipping Time of Lateral Acceleration, Side Satellite Sensor 2 (msec)	SNA
Clipping Time of Lateral Acceleration, Side Satellite Sensor 3 (msec)	SNA
Clipping Time of Lateral Acceleration, Side Satellite Sensor 4 (msec)	No
Clipping Time of Lateral Acceleration, Floor Sensor (msec)	No



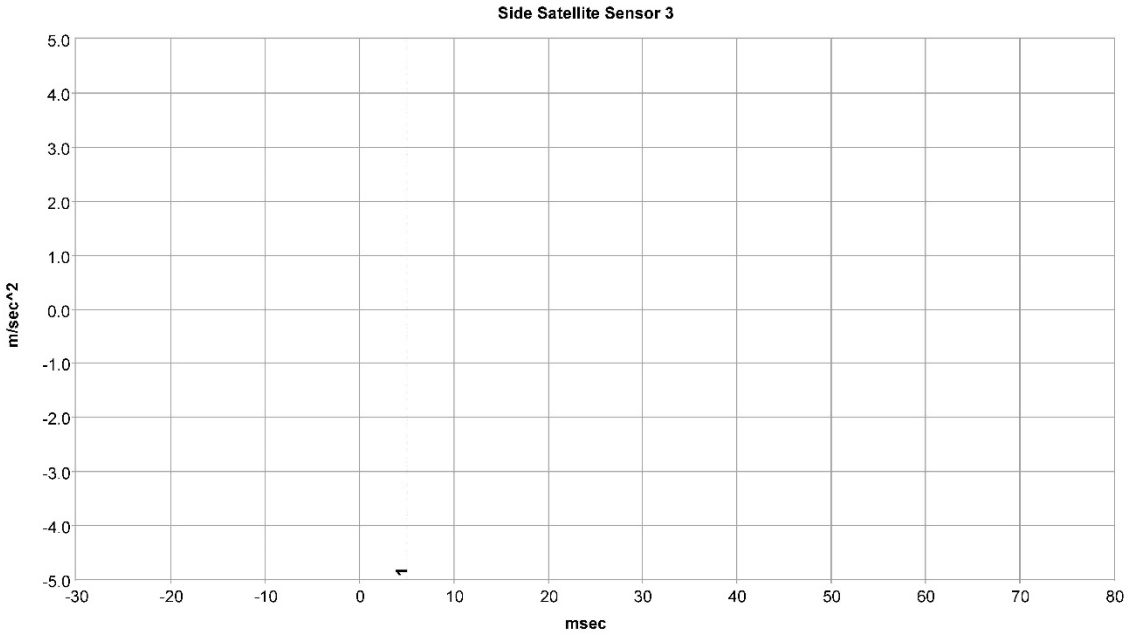
Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time



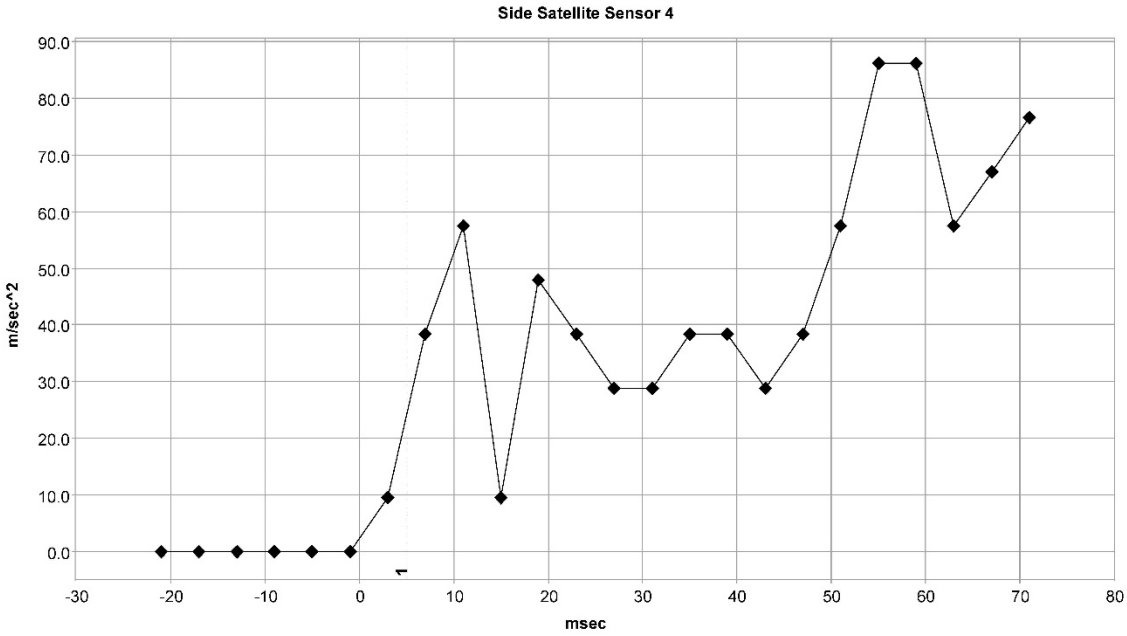
Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time



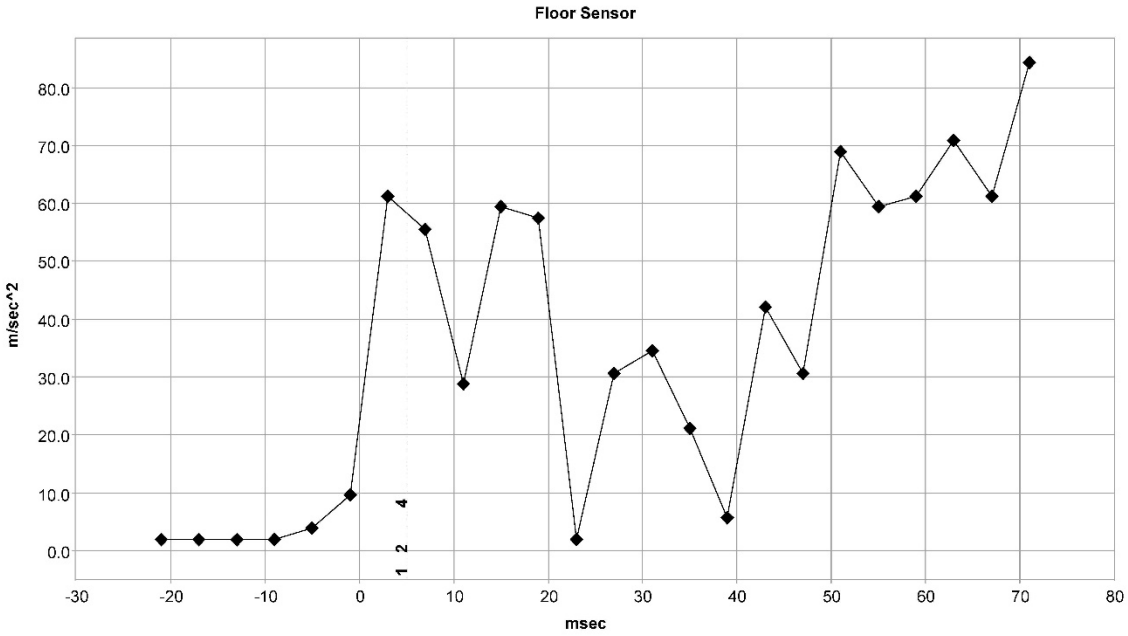
Deployment Time Marker Key

1	Side Curtain Airbag



Deployment Time Marker Key

1	Side Curtain Airbag



Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time
4	Side Curtain Airbag

Lateral Crash Pulse (1st Prior Event, TRG 1 - table 2 of 2)

Time (msec)	Lateral Acceleration, Side Satellite Sensor 1 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 2 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 3 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 4 (m/sec^2)	Lateral Acceleration for Side Crash, Floor Sensor (m/sec^2)
-21	0.0	SNA	SNA	0.0	1.9
-17	0.0	SNA	SNA	0.0	1.9
-13	0.0	SNA	SNA	0.0	1.9
-9	0.0	SNA	SNA	0.0	1.9
-5	0.0	SNA	SNA	0.0	3.8
-1	19.2	SNA	SNA	0.0	9.6
3	287.3	SNA	SNA	9.6	61.3
7	229.8	SNA	SNA	38.3	55.5
11	-114.9	SNA	SNA	57.5	28.7
15	-210.7	SNA	SNA	9.6	59.4
19	134.1	SNA	SNA	47.9	57.5
23	19.2	SNA	SNA	38.3	1.9
27	0.0	SNA	SNA	28.7	30.6
31	57.5	SNA	SNA	28.7	34.5
35	57.5	SNA	SNA	38.3	21.1
39	-172.4	SNA	SNA	38.3	5.7
43	172.4	SNA	SNA	28.7	42.1
47	210.7	SNA	SNA	38.3	30.6
51	-19.2	SNA	SNA	57.5	69.0
55	229.8	SNA	SNA	86.2	59.4
59	-191.5	SNA	SNA	86.2	61.3
63	-114.9	SNA	SNA	57.5	70.9
67	0.0	SNA	SNA	67.0	61.3
71	0.0	SNA	SNA	76.6	84.3

DTCs Present at Time of Event (1st Prior Event, TRG 1)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (1st Prior Event, TRG 1)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	450
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	OFF
Occupant Size Classification, Front Passenger	Child or Not Occupied
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	3148

BOSCH

Pre-Crash Data, -5 to 0 seconds (1st Prior Event, TRG 1)

Time (sec)	-4.95	-4.45	-3.95	-3.45	-2.95	-2.45	-1.95	-1.45	-0.95	-0.45	0 (TRG)
Vehicle Speed (MPH [km/h])	39.1 [63]	39.1 [63]	39.1 [63]	39.8 [64]	39.8 [64]	39.8 [64]	39.1 [63]	39.1 [63]	38.5 [62]	37.9 [61]	37.3 [60]
Accelerator Pedal, % Full (%)	14.5	28.5	24.0	14.5	1.5	0.0	0.0	0.0	0.0	5.0	0.0
Percentage of Engine Throttle (%)	4.0	7.5	7.0	4.5	0.0	0.0	0.0	0.0	0.0	1.5	0.0
Engine RPM (RPM)	1,300	1,400	1,300	1,300	1,300	1,300	1,300	1,200	1,200	1,300	1,200
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.44
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-1.364	0.072	0.359	0.072	-0.287	-0.431	-0.431	-0.144	-0.933	0.000	-2.728
Yaw Rate (deg/sec)	-3.42	-2.44	-1.46	-1.46	-2.44	-2.93	-3.42	-3.42	-1.95	-1.95	-9.27
Steering Input (degrees)	-9.0	-7.5	-4.5	-6.0	-7.5	-9.0	-10.5	-9.0	-6.0	-9.0	-25.5
Shift Position	D	D	D	D	D	D	D	D	D	D	D
Sequential Shift Range	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined
Cruise Control Status	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, PWR	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, ECO	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Drive Mode, Sport	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, Snow	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Drive Mode, EV	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Fuel Injection Quantity (mm3/st)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

```
PIDs      PID   Data
           00   BC 64 00 01
           01   00
           03   30 52 31 39 31 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30
                30 30 30 30 30 30 30 30 30 30 30 30 30
           04   FF FF FF FF
           05   01
           06   02
           0A   03
           0B   00
           20   80 00 00 01
           21   02 A0
           40   00 00 00 01
           60   FF FF F0 01
           61   02 05 E8 00 C0 E0 05 00 02 80 02 80 00 00 00 00 00 00 00 00 05 00
                05 00 19 00 29 B1 85 5F C8 00
           62   A5 02 3F FD 0C 4E 00 00 00 00
           63   55 20 0C 4C 11 10 00 00 11 11 11 11 11 10 3F 3F 3F 40 40 40 3F 3F
                3E 3D 3C 1D 39 30 1D 03 00 00 00 00 0A 00 00 00 04 0D 0E 0D 0D 0D
                0D 0D 0C 0C 0D 0C 00 00 00 00 00 00 00 01
           64   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           65   55 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
           66   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
           67   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00
           68   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00
           69   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           6A   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           6B   55 E0 00 00 01 05 52 04 51 55 03 00 00 00 00 00 01 0F 0C FA F5 07
                01 00 03 03 F7 09 0B FF 0C F6 FA 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           6C   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           6D   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 01 04 06 01 05 04 03 03 04 04 03 04 06 09
                09 06 07 08 00 FE 01 FE 01 FE 01 FE 01 FE
           6E   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00
           6F   55 03 4D 10 34 00 02 55 CF 01 02 01 01 FF FC FC FD FE FF F2 EE 14
                38 2F 1C 0F 0B 0D 11 16 1E 29 3D 57 7D 7F 7F 7F 7F 7F 7F 7F 7F 7F
                7F 7F 7F 7F 7F FF DA 1B 68
           70   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00
           71   00 00 00 00 00 00 00 00 FF FF EC EE 04 05 07 09 06 05 04 03 03 04
                06 09 0A 07 01 00 00 00 0D 02 00 00 00 FA F6 FE 00 FC
           72   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
           73   00 00 00 00 00 00 00 00 00 00 1E 00 00 00 00 00 00 00 00 00 00 00
                F9 FB FD FD FB FA F9 F9 FC FC ED ED 01 05 01 FC FA FA FE F3 00 DA
```

```
        08 0F 0E 09 00 00 00 00 00 03 00 00 00 00
74      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00
80      00 00 00 01
A0      0C 00 DF 81
A5      00 42 00 42 00 42 00 42 00 42 00 42 00 42 00 42 00 42 00 42 00 42 00 42
        FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE FE
        FE FE FE FE FE FE FE FE FE FE
A6      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00
B4      FF FF FF FF FE FB E0 E3 F1 E1 E2 FF F0 EE F5 FD EA F0 DC E1 E0 DB
        E0 D4 01 FE
B5      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00
B6      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00
B7      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00
B8      03 FA 03 FB 03 FD 03 FC 03 FB 03 FA 03 F9 03 FA 03 FC 03 FA 03 EF

B9      00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

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APPENDIX B: 2005 TOYOTA COROLLA EVENT DATA RECORDER (EDR) REPORT[3]

[3] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the vehicle inspection. The CDR report contained in the associated Crash Viewer application may differ relative to this report.

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN/Frame Number	1NXBR30E55Z******
User	
Case Number	
EDR Data Imaging Date	03/08/2018
Crash Date	
Filename	IN18004_V2_ACM.CDRX
Saved on	Thursday, March 8 2018 at 14:37:13
Imaged with CDR version	Crash Data Retrieval Tool 17.6.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 19.1.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Front/Rear (2)

Comments

No comments entered.

Data Limitations

CDR Record Information:

- Due to limitations of the data recorded by the airbag ECU, such as the resolution, data range, sampling interval, time period of the recording, and the items recorded, the information provided by this data may not be sufficient to capture the entire crash.
- Pre-Crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may not be synchronous to each other.
- Airbag ECU data should be used in conjunction with other physical evidence obtained from the vehicle and the surrounding circumstances.
- If the airbags did not deploy or the pretensioners did not operate during an event that meets a specified recording threshold, it is called a Non-Deployment Event. Data from a Non-Deployment Event can be overwritten by a succeeding event that meets the specified recording threshold. If the airbag(s) deploy or the pretensioners are operated, it is called a Deployment Event. Deployment Event data cannot be overwritten or deleted by the airbag ECU following that event.
- If power supply to the airbag ECU is lost during an event, all or part of the data may not be recorded.
- "Diagnostic Trouble Codes" are information about faults when a recording trigger is established. Various diagnostic trouble codes could be set and recorded due to component or system damage during an accident.
- The airbag ECU records only diagnostic information related to the airbag system. It does not record diagnostic information related to other vehicle systems.
- The TaSCAN, Global Tech Stream, or Intelligent Tester II devices (or any other Toyota genuine diagnostic tool) can be used to obtain detailed information on the diagnostic trouble codes from the airbag system, as well as diagnostic information from other systems. However, in some cases, the diagnostic trouble codes of the airbag system recorded by the airbag ECU when the event occurred may not match the diagnostic trouble codes read out when the diagnostic tool is used.

General Information:

- The data recording specifications of Toyota's airbag ECUs are divided into the following categories. The specifications for 12EDR or later are designed to be compatible with NHTSA's 49CFR Part 563 rule.
  - 00EDR / 02EDR / 04EDR / 06EDR / 10EDR / 12EDR / 13EDR / 15EDR / 17EDR / 19EDR
- The airbag ECU records data for all or some of the following accident types: frontal crash, rear crash , side crash, and rollover events. Depending on the installed airbag ECU, data for side crash and/or rollover events may not be recorded.
- The airbag ECU records post-crash data and may record pre-crash data in the event of a frontal/rear crash. In addition, it may record post-crash data in the event of a side crash or rollover.
- The airbag ECU has the following recording pages (memory maps) for each accident type to store event data: three pages for frontal or rear crash, one page for a side crash (if airbag ECU is applicable) , and one page for rollover events. (if airbag ECU is applicable)
- The data recorded by the airbag ECU in the event of a frontal/rear crash includes information that indicates the sequence and interval of each previously-occurring frontal/rear crash event.
  - Time from Previous TRG
  - TRG Count

- The point in time at which the recording trigger is established is regarded as time zero for the recorded data. For the time indicated in "Lateral Delta-V", "Roll Angle" or "Lateral Acceleration", the first sampling point after the recording trigger establishment is regarded as time zero. The time zero of the data and the recording trigger establishment do not always occur simultaneously.
- The recording trigger judgment threshold value differs depending on the collision type (i.e., frontal crash, rear crash, side crash, or rollover event).
- Some of the data recorded by the airbag ECU is transmitted to the airbag ECU from various vehicle control modules by the vehicle's Controller Area Network (CAN).
- In some cases, the airbag ECU part number printed on the ECU label may not match the airbag ECU part number that the CDR tool reports. The part number retrieved by the CDR tool should be considered as the official ECU part number.
- The sampling interval of "Roll Angle" and "Lateral Acceleration" is 8 [ms] or 128 [ms]. A field indicating the sampling interval is not provided. The graph scaling can assist with derterming the sample rate. The time zero is indicated by count (0).
- The data sampling interval and data recording period may be 1.024 times depending on the ECU specifications.
- "Prior Event" is the event that occurred before the "1st Prior Event" that reached the greatest MAX Delta-V. Therefore, "Prior Event" is not always the prior event of "1st Prior Event".

Data Element Sign Convention:
The following table provides an explanation of the sign notation for data elements that may be included in this CDR report.

Data Element Name	Positive Sign Notation Indicates
Max. Longitudinal Delta-V	Forward
Longitudinal Delta-V	Forward
Max. Lateral Delta-V , B-Pillar Sensor	Outside to Inside
Max. Lateral Delta-V , C-Pillar Sensor	Outside to Inside
Lateral Delta-V , B-Pillar Sensor	Outside to Inside
Lateral Delta-V , C-Pillar Sensor	Outside to Inside
Lateral Delta-V , Airbag ECU Sensor	Left to Right
Roll Angle Peak	Clockwise Rotation
Roll Angle	Clockwise Rotation
Lateral Acceleration , Airbag ECU Sensor *	Right to Left

* For sensing a rollover

Data Definitions:

- The "ON" setting for the "Freeze Signal" indicates a state in which the non-volatile memory can not be overwritten or deleted by the airbag ECU. After "Freeze Signal" has been turned ON, subsequent events will not be recorded.
- "Recording Status" indicates a state in which all recorded event data has been written into the non-volatile memory, or a state in which this process was interrupted and not fully written into the non-volatile memory. If "Recording Status" is "Incomplete", recorded event data may not be valid.
- "Recording Status, All Pages" does not consider the recording state of the side crash. Even if the side crash page writing process is interrupted, "Recording Status, All Pages" may display "Complete". If the writing of the frontal/rear crash page or rollover page is interrupted, "Recording Status, All Pages" may be displayed as "Incomplete".
- "Time to Deployment Command" indicates the time between recording trigger establishment and the determination of airbag deployment. This value may differ from the actual time it takes for the airbag to fully deploy. In the case of multiple crash, this item records the information of the first airbag which had been determined to deploy from Frontal/Rear impact TRG. It is necessary to confirm this record with an actual vehicle state.
- Even if an airbag/pretensioner did not deploy due to the "front passenger airbag disable switch and/or "RSCA Disable Switch" in the ON position or other disabling criteria are met, the "Time to deployment command" data element for that airbag/pretensioner may still be recorded.
- "Engine RPM" indicates the number of engine revolutions, not the number of motor revolutions. The recorded value has an upper limit of 6,000 rpm. Resolution is 400 rpm and the value is rounded down and recorded. For example, if the actual engine speed is 799 rpm, the recorded value will be 400 rpm.
- The upper limit for the recorded "Vehicle Speed" value is 126 km/h (78.3mph). Resolution is 2km/h (1.2mph) and the value is rounded down and recorded. The accuracy of the "Vehicle Speed" value can be affected by various factors. These include, but not limited, to the following.
  - Significant changes in the tire's rolling radius
  - Wheel lock and wheel slip
- The "Accelerator Rate" value is recorded as a voltage or level. In the case of voltage, the voltage increases as the driver depresses the accelerator. In case of the level, the following three levels are recorded.
  - FULL / MIDDLE / OFF
- "Accelerator Rate" may be recorded as "OFF" even if the accelerator pedal is depressed lightly. In addition, "FULL" may be recorded when the accelerator pedal is depressed strongly but not fully.
- The "Drive" setting for the "Shift Position" value indicates the shift position state is other than "R,"(Reverse), "N" (Neutral), or "P" (Park). It also includes communication disruption. Regardless of an actual shift position, "Drive" is always set for M/T vehicles because the shift position signal is not available.
- Depending on the type of occupant sensor installed in the vehicle, one of the following three recording formats for "Occupancy Status, Passenger" will be utilized.
  - Occupied / Not Occupied
  - Adult / Child / Not Occupied
  - AM50 / AF05 / Child / Not Occupied

- Resolution of the "Air Bag Warning Lamp ON Time Since DTC was Set" is 15 [min] or 15.36[min] for ECUs with 1.024 data sampling intervals, and the value is rounded down and recorded.
- "Longitudinal Delta-V" indicates the change in forward speed after establishment of the recording trigger. This does not refer to vehicle speed, and it does not include the change in speed during the period from the start of the actual collision to establishment of the recording trigger.
- "Roll Angle peak" may not always match the peak value within the "Roll Angle" sampling points due to differences in data calculation method.
- For "Lateral Delta-V", the sensor location (B-pillar, front door, C-pillar, and slide door) shows the outline of a typical sensor position. Sensory location can be confirmed using the repair manual.
- "TRG Count" indicates the number of frontal/rear recording triggers that have been established. The calculated value does not include the number of times side or rollover recording triggers have been established. The sequence in which each frontal/rear event occurred can be verified from the "TRG Count". The lesser the "TRG Count" value, the older the data. The upper limit for the recorded value is 254 times. When more than one event reaches the upper limit, the actual "TRG Count" may be greater than what is displayed for that event.
- Resolution of the "Time from Pre-Crash to TRG" is 100[ms] or 102.4[ms] for ECUs with 1.024 data sampling intervals, and the value is rounded down and recorded.
- For "Time from Previous TRG", the recording trigger of side crash and rollover is not considered. The upper limit for the recorded value is 5000 [ms] or 5120 [ms] for ECUs with 1.024 data sampling intervals. Resolution is 20 [ms] or 20.48 [ms] and the value is rounded down and recorded.
- If 2 or more frontal/rear events occur successively within a period of 5000ms (or 5120ms for ECUs with 1.024 data sampling intervals), the actual sample time before the trigger is not displayed for subsequent events. The sample time before trigger will only be displayed for the first event of the successive events. For subsequent events (i.e second event or later events), the pre-crash "Time (sec)" data is replaced by integers -5 through -1 and the heading "Time (sec)" is replaced with "Sample Count". The time between "Sample Count" integers (-5 through -1) cannot be determined. The time between the last integer and TRG cannot be determined.
- "Pre-Crash Data Status" indicates data communication status of the vehicle. If communication disruption or other failure is occur, "Invalid" is set. Moreover, "Invalid" is set for some M/T vehicles because the shift position signal is not transmitted for them even if the other data is valid.

05002_ToyotaTRW_r027

System Status at Time of Retrieval

ECU Part Number	89170-02420
ECU Generation	02EDR
Recording Status, All Pages	Complete
Diagnostic Trouble Codes Exist	Yes
Total Number of Front/Rear Crash Events	2
Freeze Signal	ON

Front/Rear Event Record Summary at Retrieval

Events Recorded	TRG Count	Crash Type	Time (msec)	Event & Crash Pulse Data Recording Status
Most Recent Frontal/Rear Event	2	Front/Rear Crash	0	Complete (Front/Rear Page 1)
1st Prior Frontal/Rear Event	1	Front/Rear Crash	-5120 or greater	Complete (Front/Rear Page 0)

System Status at Front Airbag Deployment

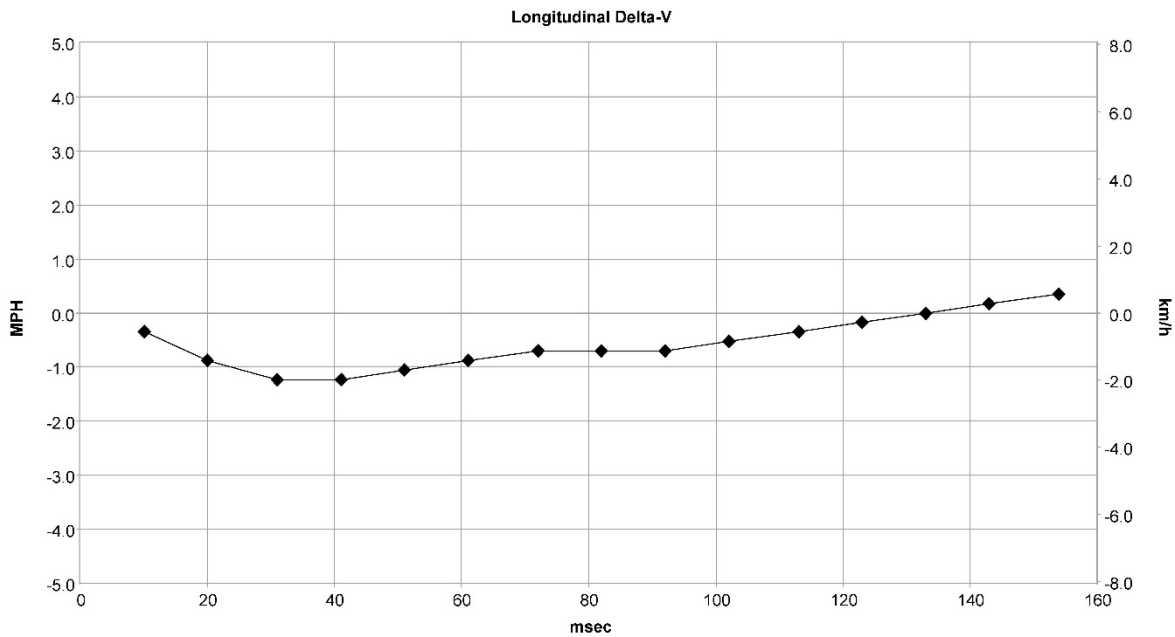
Time to Deployment Command, Front Airbag, Driver (msec)	129
Time to Deployment Command, Front Airbag, Passenger (msec)	129
Event Severity Status, Driver	N/A
Event Severity Status, Passenger	N/A

System Status at Event (Most Recent Frontal/Rear Event, TRG 2)

Recording Status, Front/Rear Crash Info.	Complete
TRG Count	2
Time From Previous TRG (msec)	5120 or greater
Buckle Switch, Driver	Buckled
Buckle Switch, Passenger	Buckled
Occupancy Status, Passenger	AM50
Seat Position, Driver	Rearward

Longitudinal Crash Pulse (Most Recent Frontal/Rear Event, TRG 2 - table 1 of 2)

Max Longitudinal Delta-V (MPH [km/h]) -1.2 [-2.0]



Longitudinal Crash Pulse (Most Recent Frontal/Rear Event, TRG 2 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])
10.24	-0.4 [-0.6]
20.48	-0.9 [-1.4]
30.72	-1.2 [-2.0]
40.96	-1.2 [-2.0]
51.20	-1.1 [-1.7]
61.44	-0.9 [-1.4]
71.68	-0.7 [-1.1]
81.92	-0.7 [-1.1]
92.16	-0.7 [-1.1]
102.40	-0.5 [-0.8]
112.64	-0.4 [-0.6]
122.88	-0.2 [-0.3]
133.12	0.0 [0.0]
143.36	0.2 [0.3]
153.60	0.4 [0.6]

DTCs Present at Start of Event (Most Recent Frontal/Rear Event, TRG 2)

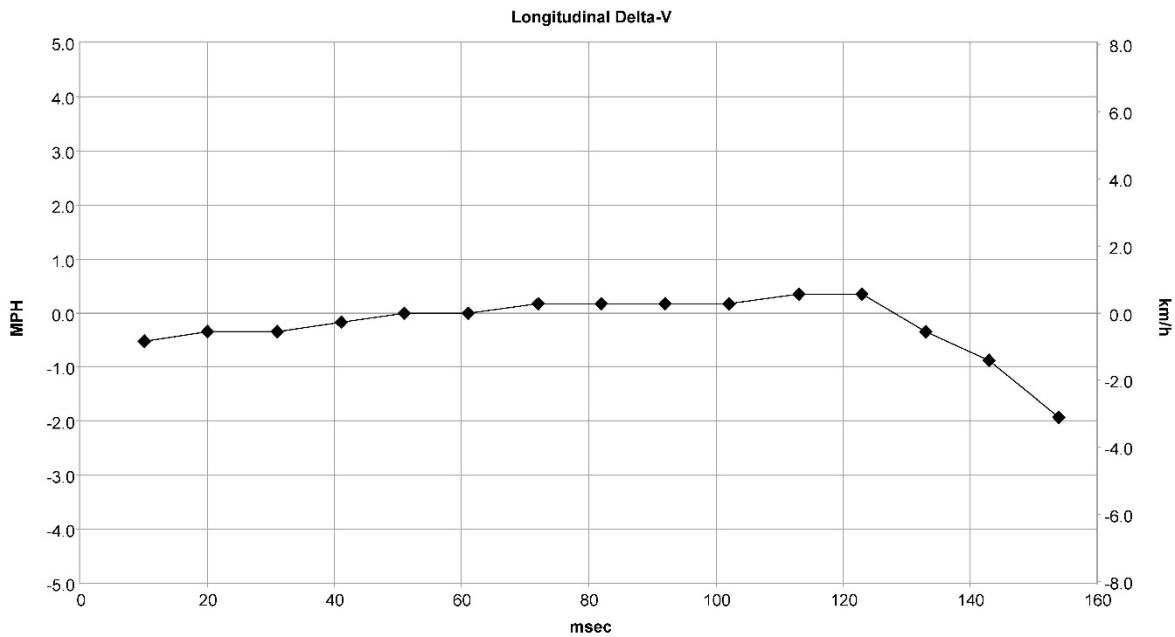
Ignition Cycle Since DTC was Set (times)	2047
Airbag Warning Lamp ON Time Since DTC was Set (min)	31,442
Diagnostic Trouble Code (1)	31
Diagnostic Trouble Code (2)	53
Diagnostic Trouble Code (3)	73

System Status at Event (1st Prior Frontal/Rear Event, TRG 1)

Recording Status, Front/Rear Crash Info.	Complete
TRG Count	1
Time From Previous TRG (msec)	5120 or greater
Buckle Switch, Driver	Buckled
Buckle Switch, Passenger	Buckled
Occupancy Status, Passenger	AF05
Seat Position, Driver	Forward

Longitudinal Crash Pulse (1st Prior Frontal/Rear Event, TRG 1 - table 1 of 2)

Max Longitudinal Delta-V (MPH [km/h]) -1.9 [-3.1]



Longitudinal Crash Pulse (1st Prior Frontal/Rear Event, TRG 1 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])
10.24	-0.5 [-0.8]
20.48	-0.4 [-0.6]
30.72	-0.4 [-0.6]
40.96	-0.2 [-0.3]
51.20	0.0 [0.0]
61.44	0.0 [0.0]
71.68	0.2 [0.3]
81.92	0.2 [0.3]
92.16	0.2 [0.3]
102.40	0.2 [0.3]
112.64	0.4 [0.6]
122.88	0.4 [0.6]
133.12	-0.4 [-0.6]
143.36	-0.9 [-1.4]
153.60	-1.9 [-3.1]

DTCs Present at Start of Event (1st Prior Frontal/Rear Event, TRG 1)

Ignition Cycle Since DTC was Set (times)	2047
Airbag Warning Lamp ON Time Since DTC was Set (min)	31,442
Diagnostic Trouble Code (1)	31
Diagnostic Trouble Code (2)	53
Diagnostic Trouble Code (3)	73

Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

PIDs	PID	Data
	00	BC 00 00 01
	01	00
	03	30 32 34 32 30 30 30 30 30 32 30 30 30 30 32 30 30 30 30 35 30 30 30 30 35 30 30 30 30 30 30 30 30 30 31
	04	02 02 01 01
	05	02
	06	02
	20	80 00 00 01
	21	00 01
	40	C0 00 E0 01
	41	54 57
	42	73
	51	FF
	52	AA FF E2
	53	A5
	60	00 00 00 01
	80	00 00 00 01
	A0	00 00 00 01
	C0	00 00 00 01
	E0	C0 10 00 00
	E1	08 08
	E2	00 5B 1F 11 00
	EC	FF

EEPROM	Address	Data (-- = data not imaged from ECU) (** = no response from ECU)
	0	-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
	10	-- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
	20	-- -- -- -- -- -- -- -- -- -- -- -- -- -- 07 FF
	30	00 00 FF FF 00 00 07 FF A5 FF 00 02 FD 00 FF FF
	40	AA 03 28 FF 00 00 00 FF 00 FF 00 00 00 FF 00 00
	50	00 00 00 00 00 FF 00 00 00 04 00 03 00 06 00 00
	60	00 FA 00 01 00 70 31 53 73 00 00 00 00 00 00 00
	70	00 00 07 FF 07 FF AA AA AA 02 44 03 00 02 00 00
	80	00 FF 00 FF 00 FF 00 00 00 00 00 FF 00 FF 00 FF
	90	00 FF 00 FF 00 FF 00 FF 00 FA 00 02 00 70 31 53
	A0	73 00 00 00 00 00 00 00 00 00 07 FF 07 FF AA AA
	B0	FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
	C0	FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
	D0	FF FF FF 00 FF FF FF FF FF FF FF FF FF FF FF FF
	E0	FF FF FF FF FF FF FF FF

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U.S. Department
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**National Highway
Traffic Safety
Administration**

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