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Special Crash Investigations Alleged Air Bag Fatality Crash Investigation Vehicle: 2009 Lexus ES350 Location: Texas Crash Date: August 2018

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16. Abstract This single-vehicle crash occurred on a two-lane, undivided roadway in a rural area of Texas in the mid-morning in August 2018. The Lexus was traveling eastbound at an EDR-reported speed of 76 km/h (47 mph). The Lexus was occupied by a belted 28-year-old female driver and an improperly belted 9-year-old female front right occupant. For unknown reasons, the Lexus traveled into the southbound travel lane and then departed the roadway to the left. After departing the roadway the vehicle struck a large tree with its front plane. The driver's frontal and knee air bags deployed and both front row seat belt retractor pretensioners actuated. The front row passenger's frontal air bags did not deploy. Based on the EDR and the owner's manual, it appears that the front passenger air bags were deactivated because the front passenger occupant classification system identified the occupant in that seat position as a child. The driver and front right passenger were transported from the scene with serious injuries. The front right passenger was declared deceased later that day.			
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Special Crash Investigations
Alleged Air Bag Fatality Crash Investigation
Case Number: DS18029
Vehicle: 2009 Lexus ES350
Location: Texas
Crash Date: August 2018

BACKGROUND

This report documents the on-site investigation of an alleged air-bag-related fatality of a 9-year-old female in the front right seat of a 2009 Lexus ES350 involved in a single-vehicle crash (**Figure 1**). This case was initiated in response to a notification from National Highway Traffic Safety Administration’s Fatal Analysis Reporting System (FARS). Dynamic Science, Inc. was notified of the crash by the Special Crash Investigations (SCI) group in November 2018 with instructions to attempt to locate the vehicle. The vehicle was located and permission to inspect the vehicle was obtained in December 2018 and the case was assigned on the same day. The investigation was intended to determine occupant restraint usage, kinematics, injury sources, and air bag deployment parameters for the Lexus. The vehicle is equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the front row occupants, seat-mounted side air bags for the front and second row, front row knee bags, and inflatable curtain (IC) air bags for both rows. The Lexus was supported by the Bosch Crash Data Retrieval (CDR) system and the vehicle’s event data recorder (EDR) was imaged during the vehicle inspection. A representative from the driver’s attorney was present during the inspection.



Figure 1. 2009 Lexus ES350.

This single-vehicle crash occurred on a two-lane undivided, roadway in a rural area of Texas in the mid-morning in August 2018. The Lexus was traveling eastbound at an EDR-reported speed of 76 km/h (47.2 mph). The Lexus was occupied by a belted 28-year-old female driver and an improperly belted 9-year-old female front right occupant. For unknown reasons, the Lexus traveled into the southbound travel lane and then departed the roadway to the left. After departing the roadway the vehicle struck a large tree with its front plane. The driver’s front and knee air bags deployed and both front row seat belt retractor pretensioners actuated. The passenger’s front and knee air bags did not deploy. Based on the EDR and the owner’s manual, it appears that the passenger front air bags were deactivated because the front passenger occupant classification system properly identified the occupant in that seat position as a child. The driver and front right passenger were transported from the scene with serious injuries. The front right passenger was declared deceased later that day.

SUMMARY

Crash Site

The crash site was a two-lane undivided east/west roadway in rural Texas (**Figure 2**). There were no reported defects to the roadway and visibility was unobstructed. The posted speed limit was 89 km/h (55 mph). The asphalt roadway was straight with a negative grade of 2 percent. Pavement markings on the road include solid white fog lines on both roadway edges, and a continuous double yellow centerline. The roadway was bordered on the left by an asphalt shoulder, a grass/dirt ditch, and a barbed wire fence. A 70 cm (27.5 in) diameter tree was located 8.7 m (28.5 ft) to the north of the roadway edge. The weather at the nearest reporting station was 26 degrees C (79 degrees F), 40 percent humidity, fair skies, and the winds were out of the southeast at 19 km/h (12 mph). A crash diagram is attached at the end of this technical report.



Figure 2. Eastbound approach.

Pre-Crash

The Lexus was traveling eastbound at an EDR-reported speed of 76 km/h (47.2 mph) at 4.5 seconds before impact. The brake switch status was OFF throughout the event. Based on EDR report data for accelerator rate voltage and engine rpm, it would appear that the vehicle was possibly in cruise control. The police report indicated that the driver had cannabinoids and benzodiazepines in her system at the time of crash. The vehicle crossed the double yellow center lines into the westbound travel lane and then departed the roadway to the left. As the vehicle departed the roadway and into the ditch, its speed decreased slightly to 72 km/h (44.7 mph). An overview of the vehicle speed and distance traveled as reported by the EDR is shown in the following table.

Time -sec	Vehicle Speed		Distance Traveled			
	km/h	mph	Incremental m	ft	Cumulative m	ft
4.5	76	47.2	NA	NA	NA	NA
3.5	74	46	20.8	68.3	20.8	68.3
2.5	74	46	20.6	67.5	41.4	135.8
1.5	72	44.7	20.3	66.5	61.7	202.3
0.5	72	44.7	20	65.6	81.7	267.9
0	64	39.8	9.4	31	91.1	298.9

Crash

As the vehicle continued forward, the front plane struck the tree (**Figure 3**). The vehicle speed was 64 km/h (39.8 mph). The WinSMASH program calculated a barrier equivalent speed (BES) of 57 km/h (35 mph). The longitudinal and lateral components were -57 km/h (-35 mph) and 0

km/h, respectively. The EDR reported a maximum longitudinal delta-V of -60.4 km/h (-37.5 mph) at 200 ms. The driver's frontal and knee air bags deployed and the front row seat belt pretensioners actuated. The passenger frontal air bags were deactivated because the occupant classification system properly identified the occupant as a child.

Post-Crash

The driver and front right passenger sustained serious injuries. The driver was located in her seat post-crash and was extricated by EMS personnel. She was transported by ambulance to a helipad located 24 km (15 miles) away and was then transported by helicopter to an area trauma center. She underwent right ankle surgery. Post-surgery, she signed an "Against Medical Advice" release and left the hospital because she wanted to see her daughter. Two days later she was transported to a local hospital by a private vehicle complaining of pain to her right leg and foot. She was treated and then released that same day. The front right passenger was transported from the scene to a local hospital where she was declared deceased at 1156 hours due to blunt force trauma to her chest and abdomen. The Lexus was towed from the scene due to damage and was later placed into secure storage by the driver's attorney.



Figure 3. Tree impact, looking north.

2009 LEXUS ES350

Description

The 2009 Lexus ES350 was a 5-passenger, 4-door sedan. The vehicle was identified by the Vehicle Identification Number JTHBJ46G792xxxxxx. The vehicle was equipped with a 3.5-liter, 6-cylinder, gasoline engine coupled to a 6-speed automatic transmission, front-wheel drive, stability control, traction control, and 4-wheel ABS. The vehicle manufacturer's recommended tire size was P215/55R17 with a cold pressure of 207 kPa (30 psi). The vehicle was equipped with P215/50R17 tires for all four wheels. Each tire was from a different manufacturer. The left front tire was restricted. The interior of the Lexus was configured for 5-passenger seating with front bucket seats adjusted to between the forward most and middle track positions and a rear bench with folding backs. The outboard seats were equipped with adjustable head restraints.

Vehicle History

According to a CARFAX report, the driver had owned the Lexus for 7 months prior to the crash and the vehicle had three previous owners. The vehicle had been involved in two previous accidents, one in March 2010 and one in February 2012. Both crashes involved impacts to the rear and there were no reported air bag deployments.

Exterior Damage

The Lexus sustained severe front plane damage from the impact with the tree (**Figure 4**). The direct damage began 22 cm (8.6 in) right of the left bumper corner and extended 46 cm (18.1 in) to the right. Thirteen measurements were taken at the bumper level by the Nikon Total Station

and the Faro Blitz program computed crush measurement in six increments as follows: $C_1 = 20$ cm (7.8 in), $C_2 = 53$ cm (20.8 in), $C_3 = 63$ cm (24.8 in), $C_4 = 57$ cm (22.4 in), $C_5 = 38$ cm (14.9 in), and $C_6 = 13$ cm (5.1 in). The maximum crush was located 70 cm (27.5 in) to the right of the left bumper corner. The collision deformation classification (CDC) was 12FYEW3.

All four doors remained closed and operational. The windshield was fractured from occupant contact from the driver. The remaining glazing was undamaged.

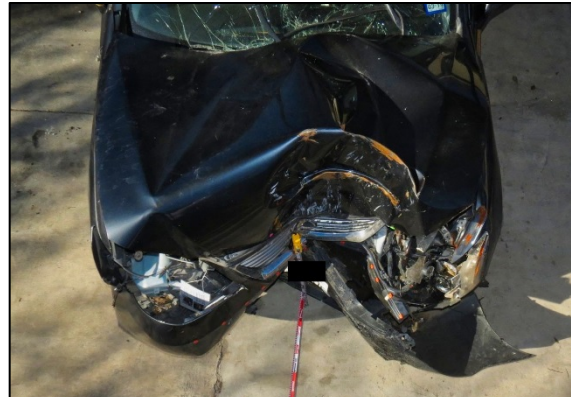


Figure 4. Frontal damage, 2009 Lexus ES350.

Event Data Recorder (EDR)

The Lexus was equipped with an air bag control module (ACM) that had EDR capability to store deployment and non-deployment events. For the pre-crash data there is a 4.5-second buffer that records vehicle speed, brake switch status, acceleration rate, and engine rpm. During the SCI inspection, the Lexus EDR data was imaged using the Bosch Crash Data Retrieval (CDR) scan tool and software version 17.9.1 via a connection to the vehicle’s diagnostic link connector (DLC) and reporting using version 18.0.2. External supplemental power was applied through the fuse block of the vehicle’s low-voltage electrical system. The Bosch CDR report is included as **Appendix A** at the end of this report. The pre-crash data for the first prior event was as follows:

Time (sec)	-4.5	-3.5	-2.5	-1.5	-0.5	0 (TRG)
Vehicle Speed (mph) [km/h])	47.2 [76]	46 [74]	46 [74]	44.7 [72]	44.7 [72]	39.8 [64]
Brake Switch	OFF	OFF	OFF	OFF	OFF	OFF
Accelerator Rate (V)	0.78	0.78	0.78	0.78	0.78	0.78
Engine rpm	1,200	1,200	1,200	1,200	1,200	1,200

The imaged data contained four recorded events. Two of the events were not related to this crash.

The related events, the Most Recent Event and the First Prior Event, were separated by 13 ms and were essentially reporting on the same crash event. The driver’s frontal air bags deployed during the event associated with the First Prior Event. The driver’s side event reported was likely due to rotation. For the First Prior Event, the driver and passenger buckle switch status was “Buckled” and the driver’s seat position was “Rearward.” There were no diagnostic trouble codes. The supplemental restraint system deployment/actuation commands associated with this event are listed in the following table:

Device	Time (ms)
Time to Deployment Command, Front Air Bag, Driver	21
Time to Deployment Command, Front Air Bag, Passenger	21
Time to Deployment Command, Pretensioner	17

NHTSA Recalls and Investigations

Based on the VIN, there was one applicable recall associated with this vehicle. NHTSA Recall Number 16V340 addresses vehicles equipped with front passenger air bag inflators produced by Takata. It is not known if the suggested remedy was undertaken.

Interior Damage

The interior of the Lexus was inspected for crash-related damage and occupant contact. There was no identifiable intrusion into the occupant compartment. Occupant contacts were observed on the windshield, driver's knee air bag, steering wheel, driver's mirror, right instrument panel, and center console. The windshield contact fractured the windshield and was likely caused by the driver's hand (**Figure 5**). The steering wheel was compressed forward due to loading. The top of the rim was located 2 cm (0.8 in) from the top instrument panel and the bottom of the rim was located 27 cm (10.6 in) from the bottom instrument panel. The driver's mirror was scuffed and displaced from the windshield. The center console was displaced, possibly by the driver's hip. A small scuff was observed on the lower right instrument panel. The contact evidence found on the knee air bag is described in the Supplemental Restraint Systems section of this report.



Figure 5. Windshield contact, 2009 Lexus ES350.



Figure 6. Right passenger seat belt latch loading, 2009 Lexus ES350.

Manual Restraint Systems

The Lexus was equipped with 3-point lap and shoulder seat belts for all five seating positions. The driver's belt was equipped with continuous loop belt webbing, a sliding latch plate, an emergency locking retractor (ELR), and an adjustable upper anchor in the full-up position.

The front right passenger's seat belt was equipped the same as the driver, but had a switchable ELR/automatic locking retractor (ALR) and the adjustable upper anchor was in the full-down

position. The EDR reported the seat belt switch status for the driver and passenger seat belt as “Buckled.” Both front row seat belt retractor pretensioners actuated.

The driver’s seat belt was found in the spooled-out position. The retractor was locked in position, resultant from actuation of the retractor pretensioner. There was loading evidence measuring 14 cm (5.5 in) at the D-ring that was located 107 cm (42.1 in) from the stop button and evidence measuring 11 cm (4.3 in) at the latch that was located 21 cm (8.2 in) from the stop button.

The front right passenger’s seat belt was found in the spooled-out position. The retractor was locked in position, resultant from actuation of the retractor pretensioner (**Figure 6**). There were scuffs measuring 5 cm (1.9 in) located 33 cm (12.9 in) from stop button and measuring 8 cm (3.1 in) located 12 cm (4.7 in) from stop button. There was loading evidence in the latch plate (**Figure 7**). There was also loading and scuffing located along the right seat guide area. This seat belt was used improperly by the child occupant.

Supplemental Restraint Systems

The Lexus was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system for the front row occupants, seat-mounted side air bags for the front and second row, front row knee bags, and IC air bags for both rows. The supplemental restraint system included a driver position sensor, front passenger occupant classification sensor, and front air bag sensors. There were two air bag deployments. The driver’s frontal and knee air bags deployed. There were no other air bag deployments.

The driver’s frontal air bag was located in the steering wheel hub. The air bag had a deflated diameter for 52 cm (20.4 in) and was configured with a tether and two vent ports. The cover flaps opened at the designated tear seams and were undamaged. There was no discernible evidence of occupant contact to the air bag and no damage.

The driver’s knee air bag was located in the lower instrument panel. The air bag had a deflated rectangular shape that measured 29 x 52 cm (11.4 x 20.4 in). There were two contacts identified (**Figure 8**). The first scuff measured 2 x 8 cm (0.8 x 3.1 in) and was located 26 cm (10.2 in) from the left edge and 5 cm (1.9 in) from the bottom. The second scuff measured 4 x 4 cm (1.5 x 1.5 in) and located 34 cm (13.3 in) from the left edge and 9 cm (2.5 in) from the bottom.



Figure 7. Right passenger lap and shoulder seat belt loading, 2009 Lexus ES350.



Figure 8. Driver knee air bag, 2009 Lexus ES350.

Air Bag Non-Deployment Discussion

The passenger’s frontal air bags did not deploy. The Lexus was equipped with a front passenger occupant classification system. This system detects the conditions of the front passenger seat and activates or deactivates the devices for front passenger. The event severity status for the driver was Level 2 and NA for the passenger. The occupant status for the passenger was “Child.” Per the owner’s manual, the condition and operation of the front passenger occupant classification system for the child condition is shown in the following table.

Devices	Front passenger’s air bag	Deactivated
	Side air bag on the right-side passenger seats	
	Curtain shield air bag in the front passenger side	Activated
	Front passenger’s knee air bag	Deactivated
	Front passenger’s seat belt pretensioner	Activated

Based on the EDR data and the owner’s manual, it appears that the passenger front air bags were deactivated because the front passenger occupant classification system properly identified the occupant in that seat position as a child.

2009 LEXUS ES350 OCCUPANTS

Driver Demographics

Age/sex: 28 years/female
Height: Unknown
Weight: 63 kg (138 lbs)
Eyewear: Unknown
Seat type: Bucket
Seat track position: Between forward most and middle
Manual restraint usage: Lap and shoulder belt used
Usage source: Vehicle inspection, EDR report
Air bags: Frontal and knee air bags deployed, side and IC air bags did not deploy
Alcohol/drug data: Cannabinoids and benzodiazepines in system, per police
Egress from vehicle: Unknown
Transport from scene: Helicopter
Type of medical treatment: Treated at trauma center, released, and then returned to a different emergency room

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Open, displaced bimalleolar fracture, right lower leg	854464.3	Floor Foot controls	Probable Possible
2	Contusion, front right wall of thorax	410402.1	Shoulder portion, seat belt	Certain
3	Contusion, right foot	810402.1	Floor	Probable
4	Contusion, abdominal wall	510402.1	Lap portion, seat belt	Certain

Source: Emergency Department Records.

Driver Kinematics

The 28-year-old female driver was seated in an unknown posture with the bucket seat adjusted to between forward most and middle track position. She was restrained by the lap and shoulder seat belt. The driver does not appear to have taken any evasive actions prior to leaving the roadway. At impact with the tree, the driver's frontal and knee air bags deployed and the seat belt retractor pretensioner actuated. The driver was displaced forward and loaded the seat belt, causing contusions to her abdomen and chest. Her knees engaged the knee air bag. Her right foot contacted the floor/toe pan area causing the contusion and the indirect ankle fracture. There was contact to the windshield that may have been from the driver's hand.

Front Row Right Passenger Demographics

Age/sex: 9 years/female
Height: 135 cm (53 in)
Weight: 38 kg (84 lbs)
Eyewear: Unknown
Seat type: Bucket
Seat track position: Between forward most and middle
Manual restraint usage: Lap and shoulder belt used incorrectly; shoulder belt worn under arm
Usage source: Vehicle inspection, EDR report, autopsy report
Air bags: Frontal, knee, side impact, and IC air bags did not deploy
Alcohol/drug data: NA
Egress from vehicle: Removed by EMS personnel
Transport from scene: Ambulance
Type of medical treatment: Died before admission

Front Row Right Passenger Injuries

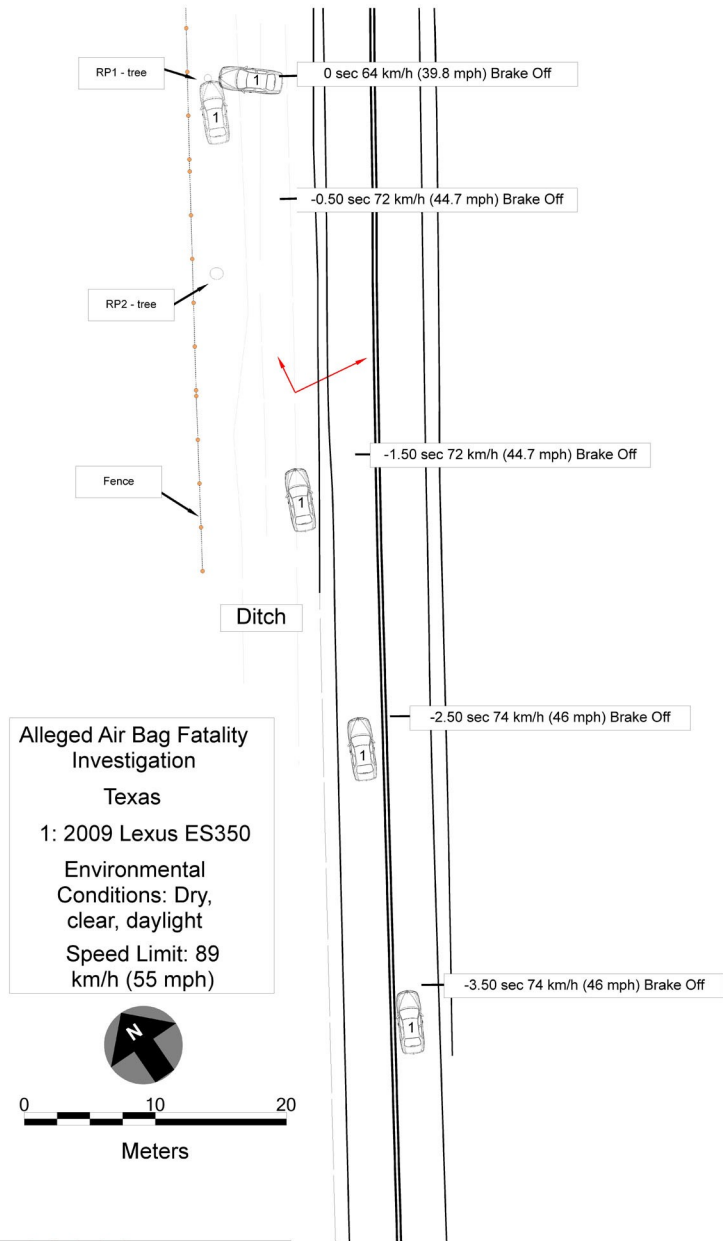
Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Pulpification, right lobe of liver and medial left lobe. Contusions, anterior left lobe and posterior right lobe	541826.4	Lap portion, seat belt	Certain
2	Contusions, both lungs	441410.3	Shoulder portion, seat belt	Certain
3	Multiple tears, intercostal muscles of posterior chest	410102.2	Shoulder portion, seat belt	Probable
4	Contusions, mesentery	542010.2	Lap portion, seat belt	Certain
5	Contusions, serosa of small intestine	541410.2	Lap portion, seat belt	Certain
6 7	Abrasion, 53 x 2.5 cm (21 x 1 in), contusion extending from underneath the right breast diagonally to involve the left upper quadrant of abdomen	410202.1 510202.1	Shoulder portion, seat belt	Certain

Source: Autopsy report.

Front Row Right Passenger Kinematics

The 9-year-old female passenger was seated in an unknown posture. The front right seat was positioned between the forward most and middle track position and her seat back was slightly reclined. She was improperly restrained by her manual three-point lap and shoulder seat belt. Based on medical data and loading evidence to the seat belt, it appears likely that the shoulder portion of the belt had been placed under her right arm. The lap portion of the seat belt was likely not placed along the pelvis but was more likely placed against the abdomen. At impact with the tree, the seat belt pretensioner actuated and locked the webbing. This passenger initiated a forward trajectory in response to the 12 o'clock direction of the frontal impact. She loaded the seat belt system evidenced by the webbing scuffs and latch plate abrasions. The belt webbing produced a heavy load on the child's torso and abdomen. The crash forces were not displaced over a wide area of her body. The thoracic loading of the shoulder belt caused the lung contusions and a diagonal external contusion. The abdominal loading of the lap belt caused the more severe internal injuries.

CRASH DIAGRAM



	 <p>www.nhtsa.gov</p>
<p>Case Number:</p>	<p>DS18029</p>

APPENDIX A :
Event Data Recorder Report 2009 Lexus ES350¹

¹ 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 Crash View 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	JTHBJ46G792*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	18029_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.9.1
Imaged with Software Licensed to (Company Name)	Company Name information was removed when this file was saved without VIN sequence number
Reported with CDR version	Crash Data Retrieval Tool 18.0.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Front/Rear (2), Side (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
- 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 post-crash data, and depending on the airbag ECU, may record pre-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
- 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).
- Time series data for side crash may have 24 or 25 sampling points.
- 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.

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
Max. Lateral Delta-V , Slide Door 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 , Slide Door 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:

- 1)
 - 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.
 - "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.
 - 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 5,200 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 122 km/h (75.8mph). 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
 - "Accelerator Rate" value is recorded as a voltage. The voltage increases as the driver depresses the accelerator.
 - The "Drive" setting for the "Shift Position" value indicates the shift position state is other than "R,"(Reverse), "N" (Neutral), or "P" (Park). If sequential shift had been used, "Invalid" may be displayed.
 - 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 minutes, 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.
 - Depending on the specifications, "Roll Angle peak" can be recorded as absolute value.
 - "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.
 - "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 newpre-crash data, the "Linked Pre-Crash Page" value may record a page number that is not actuallylinked.
 - Resolution of the "Time from Pre-Crash to TRG" is 100 [ms], and the value is rounded down and recorded.

05004_ToyotaDENSO_r026

System Status at Time of Retrieval

ECU Part Number	89170-33550
ECU Generation	04EDR
Recording Status, All Pages	Complete
Freeze Signal	ON
Freeze Signal Factor	Front Pretensioner Deployment
Diagnostic Trouble Codes Exist	No
Time from Previous Pre Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	1
Contains Unlinked Pre-Crash Data	No

Event Record Summary at Retrieval

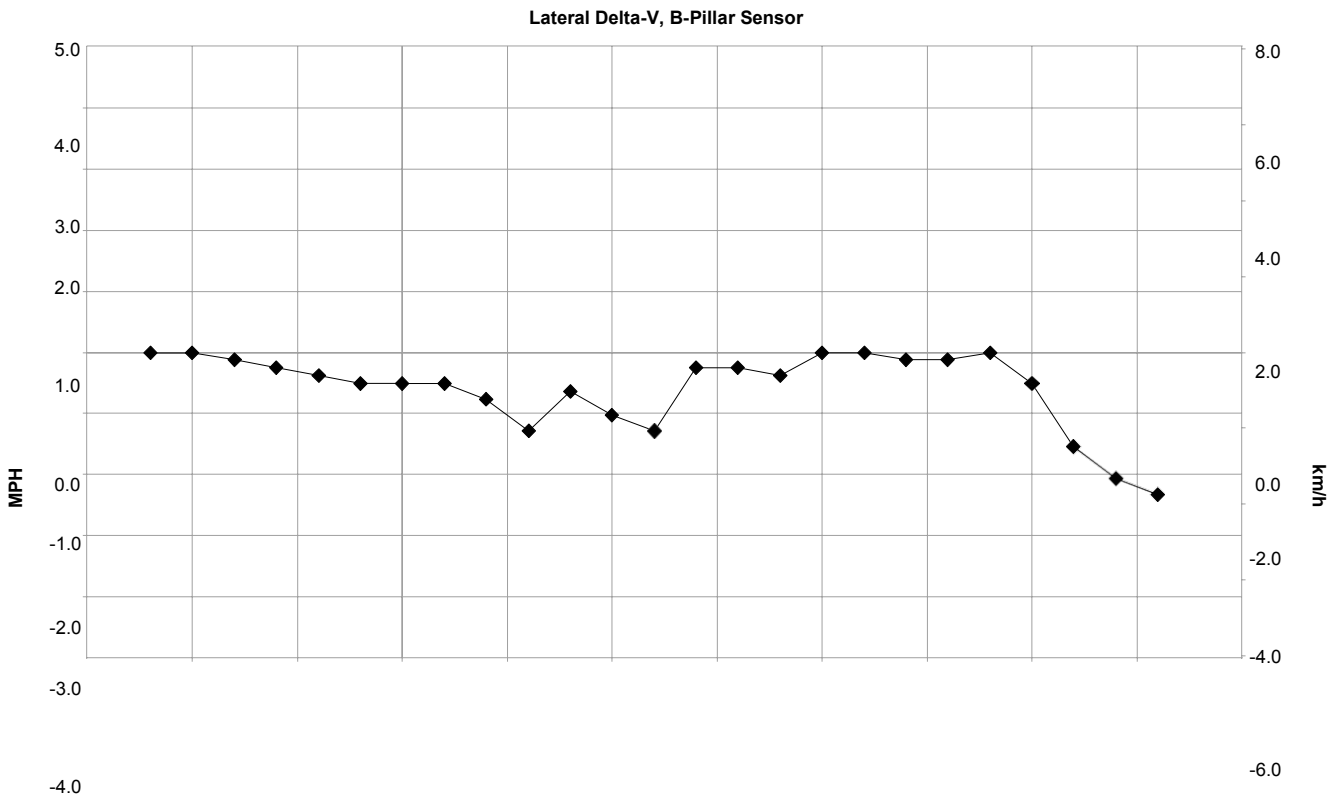
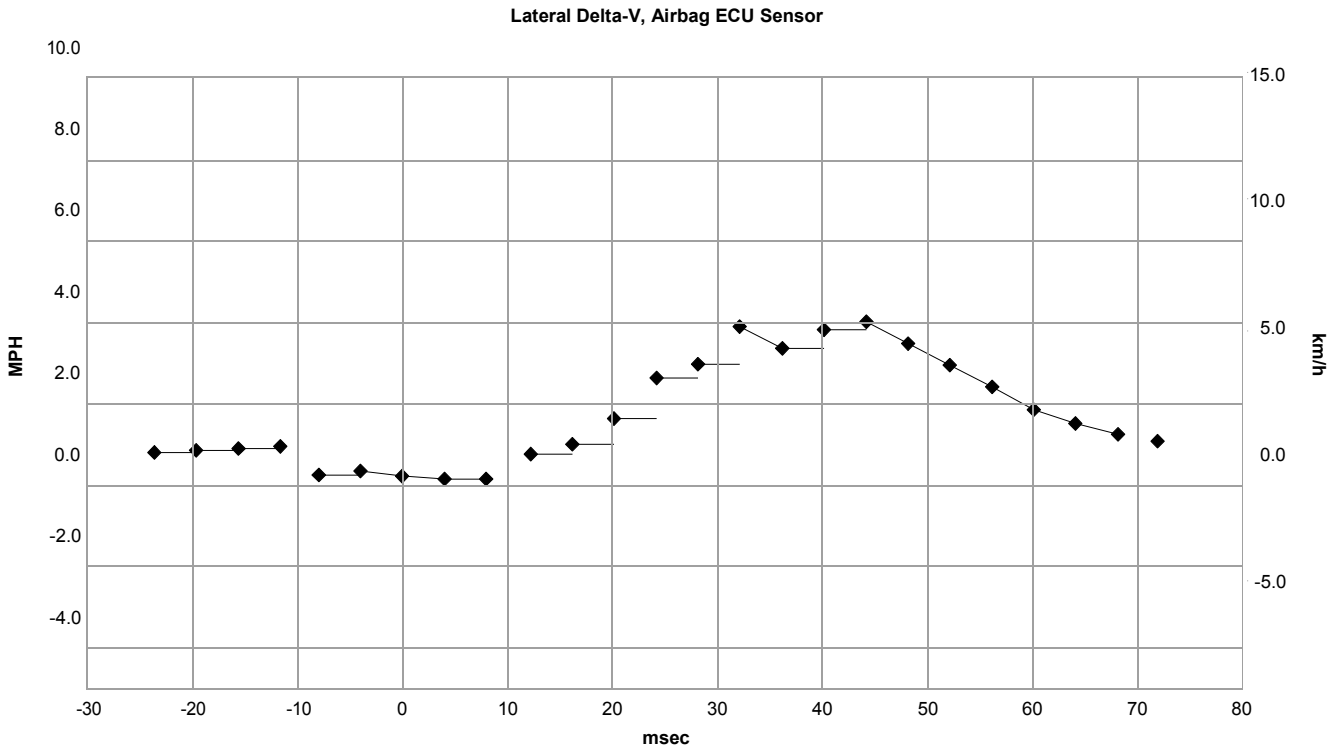
Events Recorded	TRG Count	Crash Type	Time (msec)	Pre-Crash and/or DTC Data Recording Status	Event & Crash Pulse Data Recording Status
Most Recent Event	19	Side Crash	0	Complete (Page 1)	Complete (Side Page 1)
1st Prior Event	18	Front/Rear Crash	-13	Complete (Page 1)	Complete (Front/Rear Page 1)
2nd Prior Event	17	Front/Rear Crash	-16381 or greater	Complete (Page 0)	Complete (Front/Rear Page 0)
3rd Prior Event	15	Side Crash	N/A	N/A	Complete (Side Page 0)

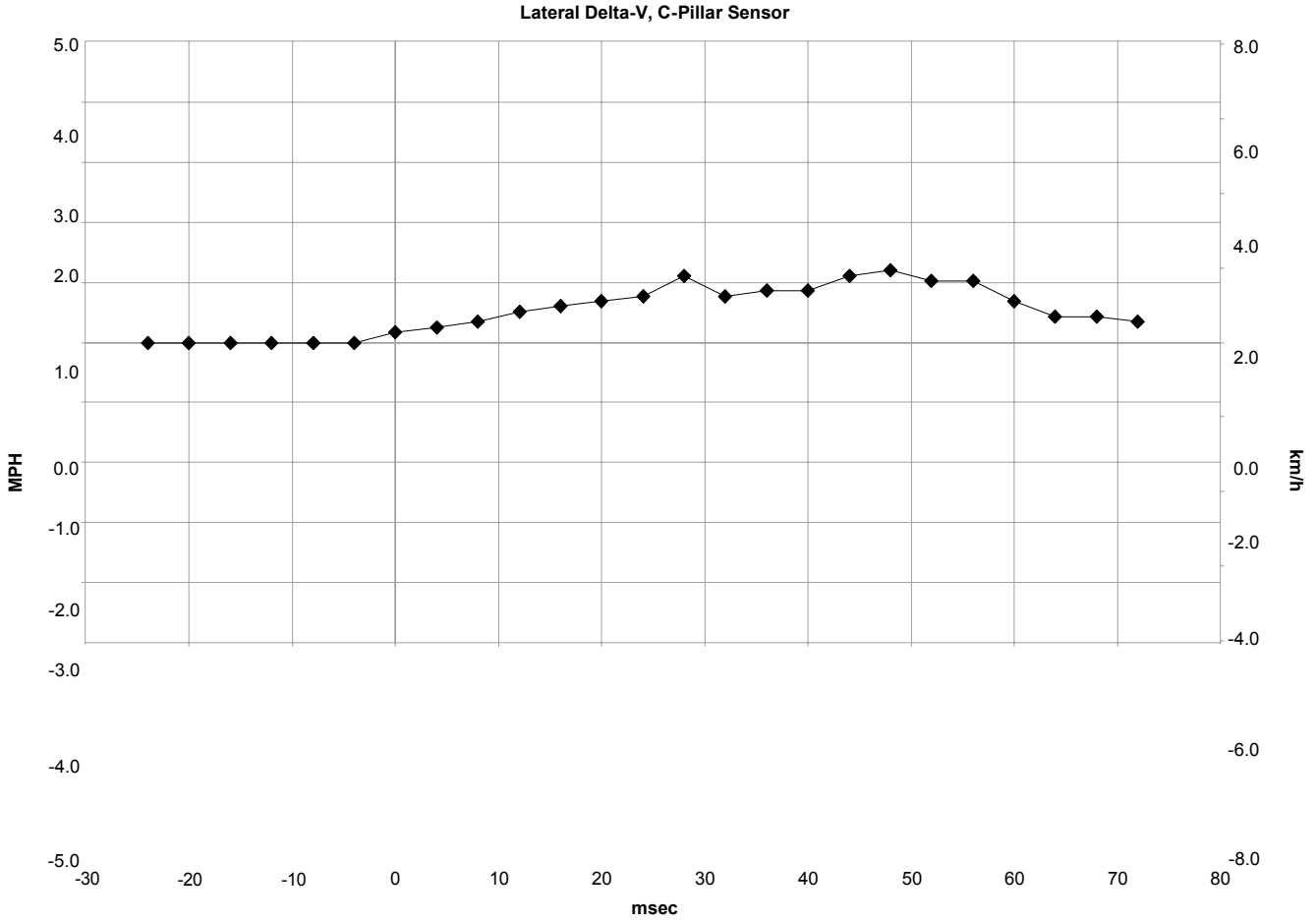
System Status at Event (Most Recent Event, TRG 19)

Recording Status, Side Crash Info.	Complete
Crash Type	Side Crash
TRG Count (times)	19
Recorded Side	Driver's Side
Previous Crash Type	Frontal/Rear
Time from Pre-Crash TRG (msec)	13
Linked Pre-Crash Page	1
Time to Deployment Command, B-Pillar Sensor (msec)	Not Commanded
Time to Deployment Command, C-Pillar Sensor (msec)	Not Commanded

Lateral Crash Pulse (Most Recent Event, TRG 19 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from TRG to Next Sample (msec)	0
Max Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	-2.3 [-3.7]
Max Lateral Delta-V, C-Pillar Sensor (MPH [km/h])	1.2 [1.9]





Lateral Crash Pulse (Most Recent Event, TRG 19 - table 2 of 2)

Time (msec)	Lateral Delta-V, Airbag ECU Sensor (MPH [km/h])	Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	Lateral Delta-V, C-Pillar Sensor (MPH [km/h])
-24	0.1 [0.1]	0.0 [0.0]	0.0 [0.0]
-20	0.1 [0.2]	0.0 [0.0]	0.0 [0.0]
-16	0.2 [0.2]	-0.1 [-0.2]	0.0 [0.0]
-12	0.2 [0.3]	-0.3 [-0.4]	0.0 [0.0]
-8	0.3 [0.4]	-0.4 [-0.6]	0.0 [0.0]
-4	0.4 [0.6]	-0.5 [-0.8]	0.0 [0.0]
0	0.2 [0.4]	-0.5 [-0.8]	0.2 [0.3]
4	0.2 [0.2]	-0.5 [-0.8]	0.3 [0.4]
8	0.2 [0.3]	-0.8 [-1.2]	0.3 [0.6]
12	0.1 [0.1]	-1.3 [-2.1]	0.5 [0.8]
16	0.3 [0.5]	-0.6 [-1.0]	0.6 [1.0]
20	0.9 [1.5]	-1.0 [-1.7]	0.7 [1.1]
24	1.9 [3.1]	-1.3 [-2.1]	0.8 [1.2]
28	2.2 [3.6]	-0.3 [-0.4]	1.1 [1.8]
32	3.2 [5.1]	-0.3 [-0.4]	0.8 [1.2]
36	2.6 [4.2]	-0.4 [-0.6]	0.9 [1.4]
40	3.1 [5.0]	0.0 [0.0]	0.9 [1.4]
44	3.3 [5.3]	0.0 [0.0]	1.1 [1.8]
48	2.8 [4.4]	-0.1 [-0.2]	1.2 [1.9]
52	2.2 [3.6]	-0.1 [-0.2]	1.0 [1.7]
56	1.7 [2.7]	0.0 [0.0]	1.0 [1.7]
60	1.1 [1.8]	-0.5 [-0.8]	0.7 [1.1]
64	0.8 [1.3]	-1.5 [-2.5]	0.4 [0.7]
68	0.5 [0.9]	-2.1 [-3.3]	0.4 [0.7]
72	0.3 [0.4]	-2.3 [-3.7]	0.3 [0.6]

DTCs Present at Time of Event (Most Recent Event, TRG 19)

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 19)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	500
Buckle Switch, Driver	Buckled
Buckle Switch, Passenger	Buckled
Occupancy Status, Passenger	Child
Seat Position, Driver	Rearward
Shift Position	Drive

Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 19)

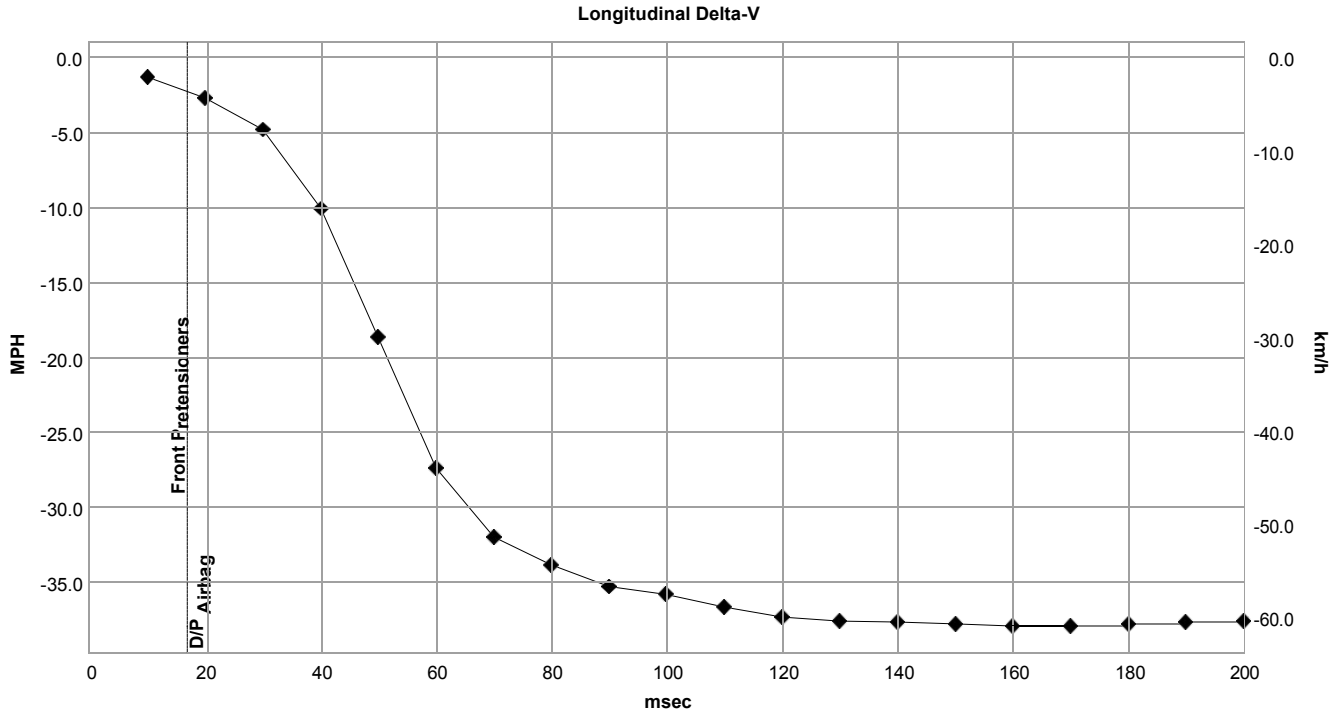
Time (sec)	-4.5	-3.5	-2.5	-1.5	-0.5	0 (TRG)
Vehicle Speed (MPH [km/h])	47.2 [76]	46 [74]	46 [74]	44.7 [72]	44.7 [72]	39.8 [64]
Brake Switch	OFF	OFF	OFF	OFF	OFF	OFF
Accelerator Rate (V)	0.78	0.78	0.78	0.78	0.78	0.78
Engine RPM (RPM)	1,200	1,200	1,200	1,200	1,200	1,200

System Status at Event (1st Prior Event, TRG 18)

Recording Status, Front/Rear Crash Info.	Complete
Crash Type	Front/Rear Crash
TRG Count (times)	18
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	1
Time to Deployment Command, Front Airbag, Driver (msec)	21
Time to Deployment Command, Front Airbag, Passenger (msec)	21
Event Severity Status, Driver	Level 2
Event Severity Status, Passenger	N/A
Time to Deployment Command, Pretensioner (msec)	17

Longitudinal Crash Pulse (1st Prior Event, TRG 18 - table 1 of 2)

Recording Status, Time Series Data	Complete
Max Longitudinal Delta-V (MPH [km/h])	-37.9 [-61.0]



Longitudinal Crash Pulse (1st Prior Event, TRG 18 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])
10	-1.3 [-2.1]
20	-2.7 [-4.3]
30	-4.8 [-7.7]
40	-10.0 [-16.1]
50	-18.6 [-29.9]
60	-27.3 [-44.0]
70	-32.0 [-51.4]
80	-33.8 [-54.3]
90	-35.2 [-56.7]
100	-35.7 [-57.5]
110	-36.6 [-58.9]
120	-37.3 [-60.0]
130	-37.5 [-60.4]
140	-37.6 [-60.5]
150	-37.7 [-60.7]
160	-37.9 [-61.0]
170	-37.9 [-61.0]
180	-37.7 [-60.7]
190	-37.6 [-60.5]
200	-37.5 [-60.4]

DTCs Present at Time of Event (1st Prior Event, TRG 18)

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 18)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	500
Buckle Switch, Driver	Buckled
Buckle Switch, Passenger	Buckled
Occupancy Status, Passenger	Child
Seat Position, Driver	Rearward
Shift Position	Drive

Pre-Crash Data, -5 to 0 seconds (1st Prior Event, TRG 18)

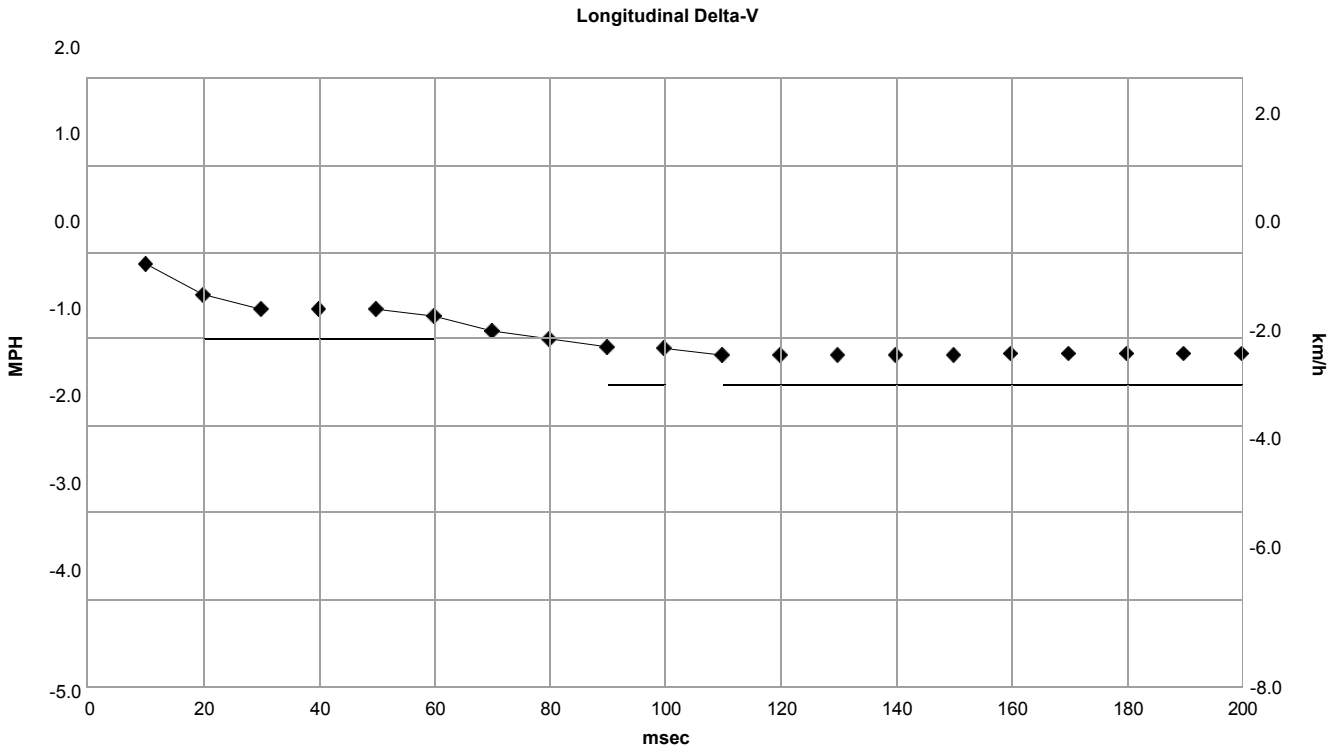
Time (sec)	-4.5	-3.5	-2.5	-1.5	-0.5	0 (TRG)
Vehicle Speed (MPH [km/h])	47.2 [76]	46 [74]	46 [74]	44.7 [72]	44.7 [72]	39.8 [64]
Brake Switch	OFF	OFF	OFF	OFF	OFF	OFF
Accelerator Rate (V)	0.78	0.78	0.78	0.78	0.78	0.78
Engine RPM (RPM)	1,200	1,200	1,200	1,200	1,200	1,200

System Status at Event (2nd Prior Event, TRG 17)

Recording Status, Front/Rear Crash Info.	Complete
Crash Type	Front/Rear Crash
TRG Count (times)	17
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	0
Time to Deployment Command, Front Airbag, Driver (msec)	Not Commanded
Time to Deployment Command, Front Airbag, Passenger (msec)	Not Commanded
Event Severity Status, Driver	N/A
Event Severity Status, Passenger	N/A
Time to Deployment Command, Pretensioner (msec)	Not Commanded

Longitudinal Crash Pulse (2nd Prior Event, TRG 17 - table 1 of 2)

Recording Status, Time Series Data	Complete
Max Longitudinal Delta-V (MPH [km/h])	-1.5 [-2.5]



Longitudinal Crash Pulse (2nd Prior Event, TRG 17 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])
10	-0.5 [-0.8]
20	-0.9 [-1.4]
30	-1.0 [-1.7]
40	-1.0 [-1.7]
50	-1.0 [-1.7]
60	-1.1 [-1.8]
70	-1.3 [-2.1]
80	-1.4 [-2.2]
90	-1.5 [-2.3]
100	-1.5 [-2.3]
110	-1.5 [-2.5]
120	-1.5 [-2.5]
130	-1.5 [-2.5]
140	-1.5 [-2.5]
150	-1.5 [-2.5]
160	-1.5 [-2.5]
170	-1.5 [-2.5]
180	-1.5 [-2.5]
190	-1.5 [-2.5]
200	-1.5 [-2.5]

DTCs Present at Time of Event (2nd Prior Event, TRG 17)

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 (2nd Prior Event, TRG 17)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	900
Buckle Switch, Driver	Unbuckled
Buckle Switch, Passenger	Buckled
Occupancy Status, Passenger	AM50
Seat Position, Driver	Rearward
Shift Position	Drive

Pre-Crash Data, -5 to 0 seconds (2nd Prior Event, TRG 17)

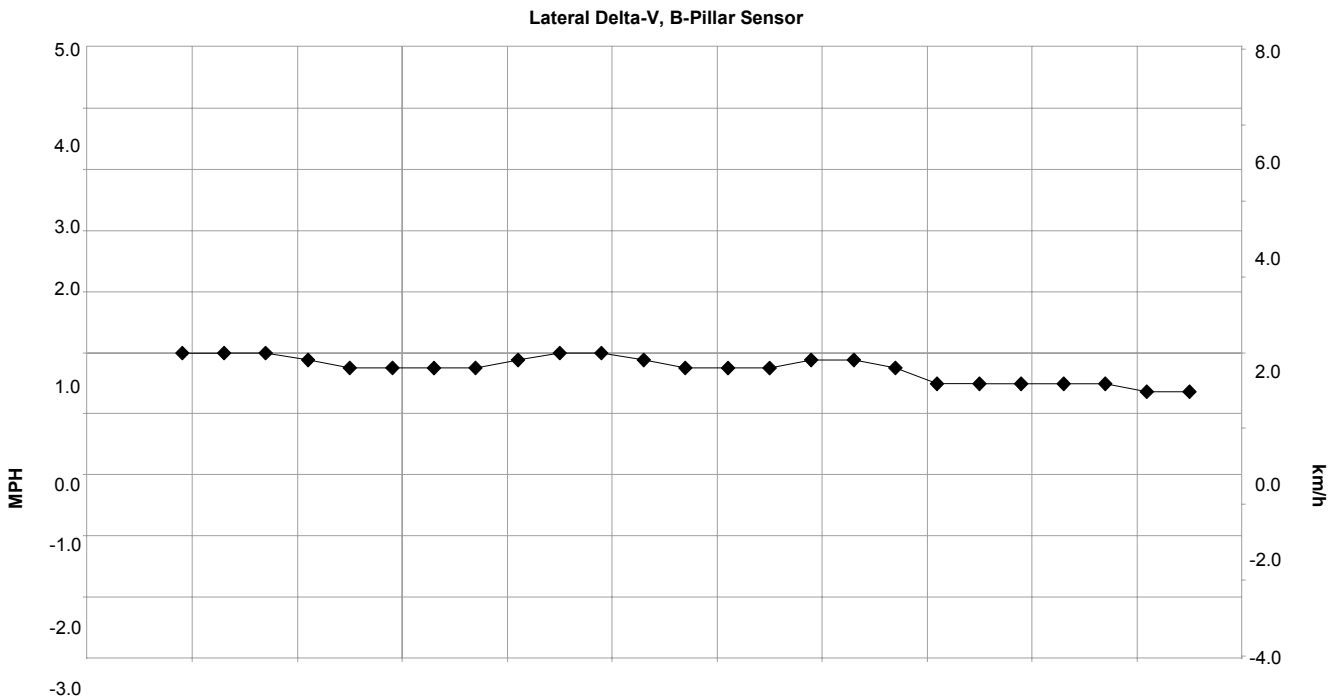
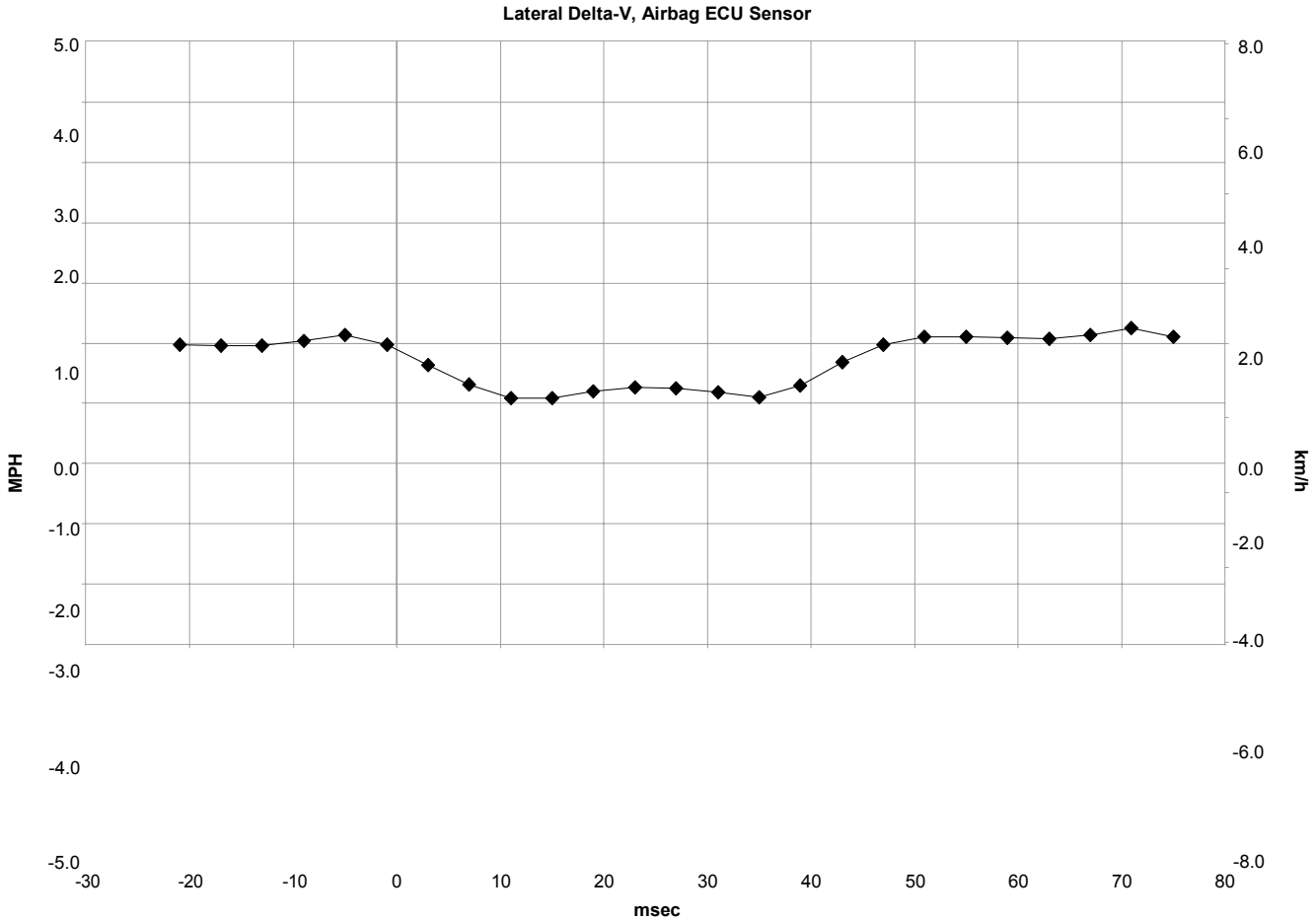
Time (sec)	-4.9	-3.9	-2.9	-1.9	-0.9	0 (TRG)
Vehicle Speed (MPH [km/h])	39.8 [64]	39.8 [64]	39.8 [64]	41 [66]	41 [66]	39.8 [64]
Brake Switch	OFF	OFF	OFF	OFF	OFF	ON
Accelerator Rate (V)	1.17	1.17	1.21	1.21	1.21	0.78
Engine RPM (RPM)	1,200	1,200	1,200	1,200	1,200	1,200

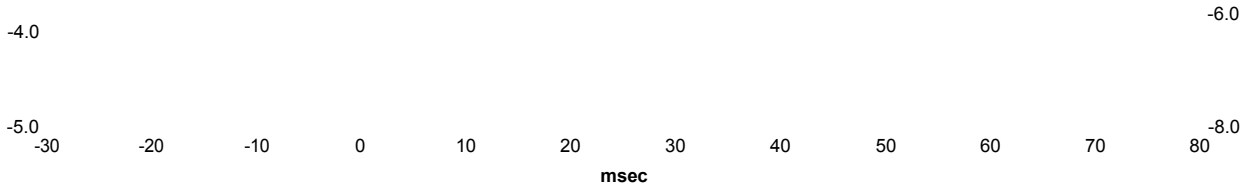
System Status at Event (3rd Prior Event, TRG 15)

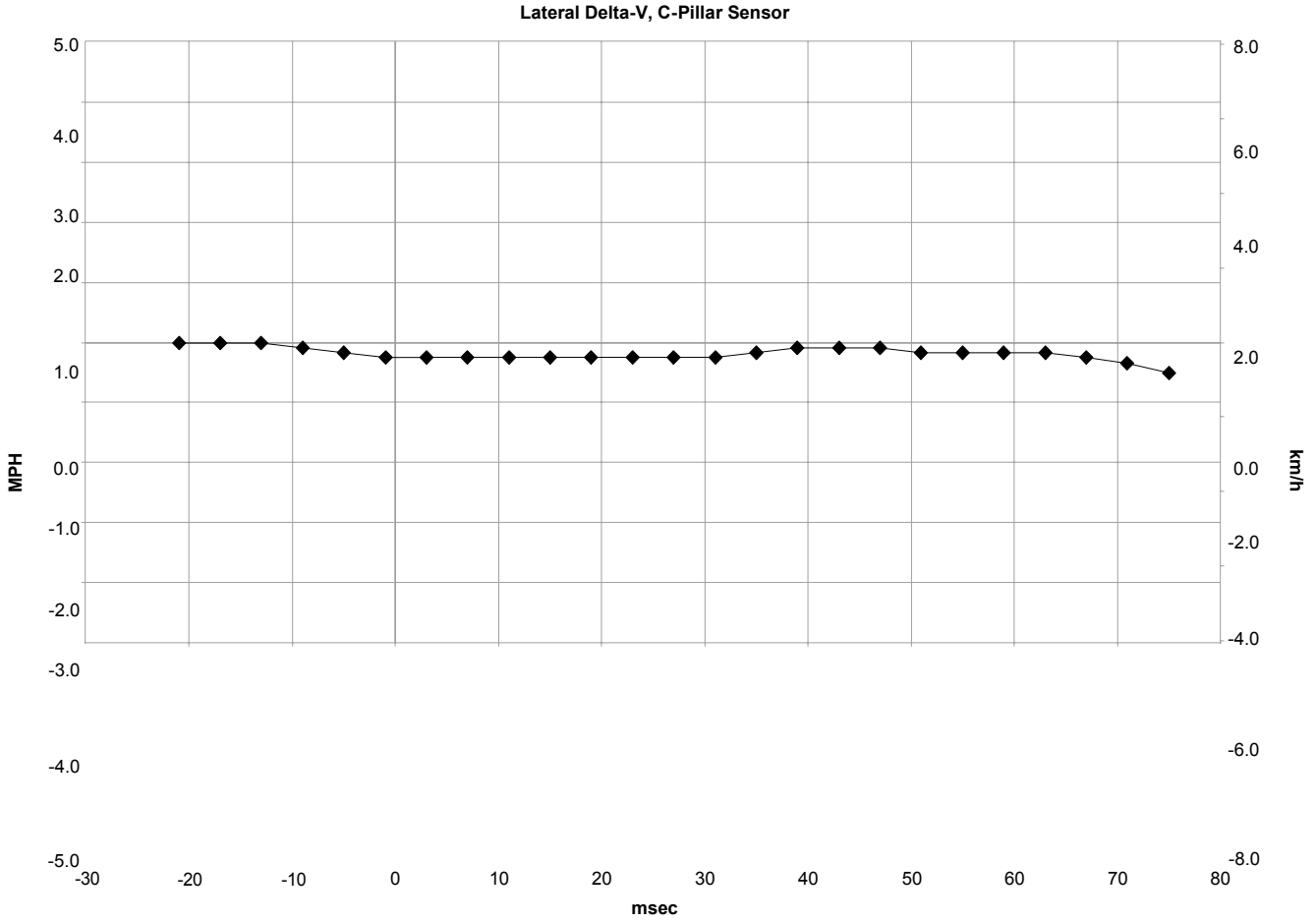
Recording Status, Side Crash Info.	Complete
Crash Type	Side Crash
TRG Count (times)	15
Recorded Side	Passenger's Side
Previous Crash Type	Frontal/Rear
Time from Pre-Crash TRG (msec)	113
Linked Pre-Crash Page	1
Time to Deployment Command, B-Pillar Sensor (msec)	Not Commanded
Time to Deployment Command, C-Pillar Sensor (msec)	Not Commanded

Lateral Crash Pulse (3rd Prior Event, TRG 15 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from TRG to Next Sample (msec)	3
Max Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	-0.6 [-1.0]
Max Lateral Delta-V, C-Pillar Sensor (MPH [km/h])	-0.5 [-0.8]







Lateral Crash Pulse (3rd Prior Event, TRG 15 - table 2 of 2)

Time (msec)	Lateral Delta-V, Airbag ECU Sensor (MPH [km/h])	Lateral Delta-V, B-Pillar Sensor (MPH [km/h])	Lateral Delta-V, C-Pillar Sensor (MPH [km/h])
-21	0.0 [0.0]	0.0 [0.0]	0.0 [0.0]
-17	0.0 [-0.1]	0.0 [0.0]	0.0 [0.0]
-13	0.0 [-0.1]	0.0 [0.0]	0.0 [0.0]
-9	0.0 [0.1]	-0.1 [-0.2]	-0.1 [-0.1]
-5	0.1 [0.2]	-0.3 [-0.4]	-0.2 [-0.3]
-1	0.0 [0.0]	-0.3 [-0.4]	-0.3 [-0.4]
3	-0.4 [-0.6]	-0.3 [-0.4]	-0.3 [-0.4]
7	-0.7 [-1.1]	-0.3 [-0.4]	-0.3 [-0.4]
11	-0.9 [-1.5]	-0.1 [-0.2]	-0.3 [-0.4]
15	-0.9 [-1.5]	0.0 [0.0]	-0.3 [-0.4]
19	-0.8 [-1.3]	0.0 [0.0]	-0.3 [-0.4]
23	-0.7 [-1.2]	-0.1 [-0.2]	-0.3 [-0.4]
27	-0.8 [-1.2]	-0.3 [-0.4]	-0.3 [-0.4]
31	-0.8 [-1.3]	-0.3 [-0.4]	-0.3 [-0.4]
35	-0.9 [-1.4]	-0.3 [-0.4]	-0.2 [-0.3]
39	-0.7 [-1.1]	-0.1 [-0.2]	-0.1 [-0.1]
43	-0.3 [-0.5]	-0.1 [-0.2]	-0.1 [-0.1]
47	0.0 [0.0]	-0.3 [-0.4]	-0.1 [-0.1]
51	0.1 [0.2]	-0.5 [-0.8]	-0.2 [-0.3]
55	0.1 [0.2]	-0.5 [-0.8]	-0.2 [-0.3]
59	0.1 [0.1]	-0.5 [-0.8]	-0.2 [-0.3]
63	0.1 [0.1]	-0.5 [-0.8]	-0.2 [-0.3]
67	0.1 [0.2]	-0.5 [-0.8]	-0.3 [-0.4]
71	0.3 [0.4]	-0.6 [-1.0]	-0.3 [-0.6]
75	0.1 [0.2]	-0.6 [-1.0]	-0.5 [-0.8]

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	BE E0 00 01
	01	00
	03	33 33 35 35 30 30 30 30 43 44 30 30 30 43 44 30 30 30 43 42 30 30
		30 43 42 30 30 30 44 32 30 30 30 44 32
	04	02 02 01 01
	05	02
	06	03
	07	30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30
	09	
	0A	01
	0B	00
	20	80 00 00 01
	21	00 31
	40	00 00 00 01
	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	-- -- -- -- -- -- -- -- -- -- -- -- -- -- 00 00
	30	00 00 01 01 7F FD 00 00 A5 02 00 03 FF FF FF FF
	40	FF FF FF FF FF FF FF FF FF FF FF FF FF FF -- --
	50	-- -- 01 31 01 81 14 33 84 1F 33 84 1F 33 80 1F
	60	80 1E 80 1E 09 00 00 00 00 00 00 00 00 00 00 00
	70	00 00 00 00 00 00 00 00 00 00 11 11 01 80 14 33
	80	90 14 33 90 14 33 94 14 94 14 98 14 05 00 00 00
	90	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
	A0	00 00 -- -- 06 04 02 00 00 01 02 01 01 00 01 00
	B0	00 00 00 00 00 00 00 00 00 28 00 00 00 11 E0 00
	C0	FE FE 00 00 0F 10 19 3D 64 66 36 15 11 06 0A 08
	D0	03 01 01 02 00 FE FF FF 06 C0 00 00 00 12 E4 00
	E0	15 11 20 00 -- -- 00 00 00 FF FF 00 00 00 01 01
	F0	00 FF FF 00 00 01 00 FF FE 00 00 00 00 FF 00 00
	100	00 00 FF FF FF 00 00 00 00 00 00 00 01 01 00
	110	00 FF 00 00 00 FF FF FE 01 01 00 FC FA 09 14 13
	120	0D 00 FA FC 01 04 04 F5 E9 EF F9 00 01 01 FC F9
	130	09 00 30 00 00 0F 04 71 FE FE 40 00 00 00 FF FF
	140	FF FF 00 00 FE FC 05 FD FE 08 00 FF 03 00 FF 00
	150	01 FC F8 FC FE 00 00 00 00 00 00 02 01 01 02 01
	160	01 01 04 FC 01 00 03 01 FE 00 FC FD 00 FF FC FD
	170	FE FD FD FA 08 04 FF 07 F2 DC C6 EC CA 1F E6 F4
	180	1F 1F 20 20 14 0F 10 00 00 00 00 13 04 0D FE FE
	190	00 00

Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.

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December 2019



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



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