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

NHTSA

DOT HS 813 636

November 2024

Special Crash Investigations: On-Site Rollover Crash Investigation; Vehicle: 2021 Hyundai Santa Fe; Location: North Carolina; Date: March 2022

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Suggested APA Format Citation:

Crash Research & Analysis, Inc. (2024, November). *Special Crash Investigations: On-site rollover crash investigation; 2021 Hyundai Santa Fe; Location: North Carolina; Crash Date: March 2022* (Report No. DOT HS 813 636). National Highway Traffic Safety Administration.

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 813 636		

4. Title and Subtitle	5. Report Date
Special Crash Investigations: On-Site Rollover System Crash Investigation; Vehicle: 2021 Hyundai Santa Fe; Location: North Carolina; Crash Date: March 2022	November 2024
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Crash Research & Analysis, Inc.	CR22008

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Crash Research & Analysis, Inc. PO Box 302 Elma, NY 14059	11. Contract or Grant No. 693JJ919C000004

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Technical Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was submitted.

16. Abstract

This on-site investigation documents the roadway departure/rollover crash of a 2021 Hyundai Santa Fe. The Hyundai was driven by a belted 35-year-old female with a belted 13-year-old male front passenger and belted 14-year-old male left rear passenger. The driver failed to maintain lane control and departed the right side of the roadway at a speed of 104 km/h (64.6 mph). When trying to re-enter the roadway, the Hyundai driver steered into the field-side (outboard) of a cable barrier system, and then entered a trip-over type right-side-leading three-quarter-turn rollover event down the embankment, coming to rest on its left side. All occupants of the Hyundai were transported by ambulance to a nearby medical facility. The driver and right-front passenger had police-reported possible (C-level) injuries, and the left rear passenger had police-reported non-incapacitating (B-level) injuries. The driver and the left rear passenger were treated for pain and minor injuries. The right front passenger was not treated by the hospital.

17. Key Words	18. Distribution Statement
rollover, cable barrier system, road departure	This document is available to the public from the National Highway Traffic Safety Administration, National Center for Statistics and Analysis, https://crashstats.nhtsa.dot.gov.

19 Security Classif. (of this report)	20. Security Classif. (of this page)	21 No. of Pages	22. Price
Unclassified	Unclassified	85	

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Special Crash Investigations
On-Site Rollover Crash Investigation
Case Number: CR22008
Vehicle: 2021 Hyundai Santa Fe
Location: North Carolina
Crash Date: March 2022

Background

This report documents the on-site investigation of the roadway departure/rollover crash of a 2021 Hyundai Santa Fe (Figure 1). The crash was identified through the National Highway Traffic Safety Administration's Crash Research Sampling System in March 2022. The Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., was notified of the crash and conducted an on-site investigation in May 2022. The SCI team contacted the insurance adjuster who had custody of the vehicle. An inspection of the Hyundai was conducted to measure exterior deformation, interior damage and intrusion, documentation of interior occupant contact, and assessment of the manual and supplemental restraint systems. The Hyundai had an event data recorder (EDR) that was imaged by the SCI investigator during the inspection with the Global Information Technologies Hyundai EDR tool. The crash site was also photographed, documented, and measured by a Nikon total station. The driver was contacted but refused an interview.

Figure 1. Left front oblique of the Hyundai

The police crash report (PCR) stated that the driver failed to maintain lane control and departed from the right side of the roadway. In an attempt to re-enter the roadway, the driver steered the Hyundai into the field-side (outboard) of a cable barrier system engaging approximately 35 m (115 ft) of the barrier. The Hyundai then entered a trip-over type right-side-leading three-quarter-turn rollover event down the embankment, coming to rest on its left side. The Hyundai was towed from the scene due to disabling damage to a salvage insurance yard where it remained secured for this investigation. The belted 35-year-old female driver, belted 13-year-old male front passenger, and belted 14-year-old male left rear passenger were transported by ambulance to a nearby medical facility. The driver and right-front passenger had police-reported possible (C-level) injuries, and the left rear passenger had police-reported non-incapacitating (B-level) injuries. The driver and the left rear occupant were treated for pain and minor injuries. The right front passenger was not treated by the hospital.

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Crash Summary

Crash Site

The crash occurred at night on an unlit, undivided two-lane north/south roadway. At the time of the crash, the National Weather Service reported foggy conditions with a temperature of 12 °C (53 °F), 100 percent humidity, and southerly directional winds of 10 km/h (6 mph). The wet bituminous roadway curved left with a negative 4.9 percent grade. The posted speed limit was 89 km/h (55 mph). The roadway was 7.5 m (24.6 ft) wide with lanes measuring 3.1 m (10.2 ft) wide. The lanes were separated by a solid double yellow centerline and white edge lines. The east shoulder of the roadway was 1.8 m (5.9 ft) wide and transitioned into an embankment. The embankment had a negative 40 percent grade. A utility pole was 81.0 m (265.7 ft) north from where the vehicle departed the roadway and 5.8 m (19.0 ft) from the roadway edge. Figures 2 and 3 show the roadway and the departure down the embankment.

Figure 2. Facing north and view of path of travel and roadway departure

Figure 3. Facing south and the lookback at final rest and roadway departure. The blue cones represent final rest, and the yellow cones represent path of travel

Three cable barrier systems (CBS) (Figure 4) bordered the right side of the roadway. According to the Federal Highway Administration, "The cable barrier system used by North Carolina consists of three steel 19-millimeter (0.74-inch)-diameter cables with steel supporting posts a maximum of 5 meters (16.4 feet) apart. The bottom cable height is 54 cm (21 inches) from the ground; the top cable height is 84 cm (33.1 inches) from the ground. Anchor post brackets and breakaway anchor angles secure each end of the cable run. The maximum distance between anchors is 600 meters (1,968.5 feet). The cable tension is controlled by spring turnbuckles located near each end of the cable run."[1] The barrier cables were designed to overlap each other. The first CBS was constructed of three offset cable anchor I-beam posts 78 cm (30.7 in) tall with 10 cm (3.9 in) flanges and a 15 cm (5.9 in) web. The posts were positioned with the web perpendicular to the roadway and welded to the top of the cable anchors that were cemented to the ground. The first anchor post was in line with the barrier and was followed by the offset

[1] Stasburg, G., & Crawley Crist, L. (2005). Keeping traffic on the right side of the road (Report No. FHWA-HRT-05-003). Federal Highway Administration. https://highways.dot.gov/public-roads/januaryfebruary-2005/keeping-traffic-right-side-road

second and third anchors. The first CBS measured 13.0 m (42.7 ft) in length and had 12 total support posts and two turnbuckle guards. All three barriers were of the same construction. The first and third barrier were positioned on the outboard field side of the roadway with the second barrier overlapping the two on the inboard side (roadside). The SCI investigator noted that the barriers had been repaired. On further inspection of the barrier tags and crash debris on the shoulder, it was determined that another crash occurred in close proximity to the subject crash area 15 days after the subject crash date. Due to several repairs, the at-crash design of the barrier system is unknown. A crash diagram is attached at the end of this report.

Figure 4. Facing north at the sections of the cable barriers

Pre-Crash

The Hyundai was traveling north along the roadway at an EDR-reported average speed of 104 km/h (64.6 mph). Reconstruction of the crash showed that the Hyundai was traveling straight with the EDR reporting the steering angle of 0° at 5 seconds prior to algorithm enabled (AE) until 1.0 seconds prior to AE when the driver applied a hard left steering input. Based on the crash scene orientation, the Hyundai departed the roadway approximately 1.0 seconds prior to AE and the driver reacted to the roadway departure by steering left. The Hyundai's speed decreased to 93 km/h (57.7 mph) a half second prior to AE.

Crash

The front plane of the Hyundai struck the field side of the first barrier's second anchor post (Event 1, Figure 5). As the vehicle traveled forward and left, the top cable engaged the surface of the hood (Event 2), and the bottom two cables engaged the left side of the Hyundai (Event 3). An estimated 14 posts were displaced from the ground. As the posts gave way and the vehicle continued traveling forward and left, the tension in the cables increased causing the Hyundai to redirect towards the embankment (Figure 6) until tripping over the side into a rollover event (Event 4). The Hyundai rolled three-quarter-turns, coming to rest on its left side with the front facing the northwest.

Figure 5. Facing north and the forward section of the first CBS, the second post from the left is the first object struck for Event 1

Figure 6. Facing north and looking down at the path of travel for Event 4 and separation from the CBS

Post-Crash

Police and EMS personnel were notified and responded to the scene. The windshield was removed by EMS to assist the driver and both passengers from the vehicle. They were transported by ambulance to a nearby hospital where they were evaluated. The PCR reported that the driver and front passenger had C-level (possible) injuries with complaints of pain and minor injuries. The driver was treated for minor non-crash-related injuries. There was no record of treatment for the right front passenger. The left rear passenger was reported to have B-level injuries. After a medical evaluation, there were no codable injuries. The occupants were all released from the hospital.

The Hyundai was towed from the scene and transferred to an insurance salvage yard where it was located for this investigation.

2021 Hyundai Santa Fe

Description

The 2021 Hyundai Santa Fe was a 4-door SUV (Figure 7) manufactured in May 2021, identified by Vehicle Identification Number 5NMS2DAJ6MHxxxxxx. It had a 277 cm (109.1 in) wheelbase and powered by a 2.5-liter, inline 4-cylinder gasoline engine linked to an 8-speed automatic transmission with all-wheel drive. The service brakes were a power-assisted 4-wheel disc system. Steering was a speed-sensitive electric rack and pinion system. It had an antilock braking system, electronic stability control, traction control, automatic crash notification, crash imminent braking, forward collision warning, pedestrian automatic emergency braking, blind spot detection, lane departure warning, lane keeping assistance, lane centering assistance, daytime running lights, and adaptive cruise control. The status of the lane systems is unknown.

Figure 7. Right front oblique of the Hyundai

The vehicle manufacturer's recommended tire size was P235/60R18 front and rear with a recommended cold tire pressure of 240 kPa (35 psi). During the SCI inspection, the Hyundai had Kumho CruGen Premium tires of the recommended size mounted on original equipment manufacturer aluminum alloy wheels. All tire tread depths were 7 mm (9/32 in) or greater.

The Hyundai had two rows of seats for up to five occupants, two in the front and three in the second row. At the time of the SCI inspection, the driver's seat was reclined approximately 15° aft of vertical. All seating surfaces were cloth. All seat positions had three-point-lap and shoulder seat belts for manual restraint. Supplemental restraint was provided by front seat belt retractor and lower anchor pretensioners, driver's and passenger's frontal air bags, outboard seat-mounted side impact air bags, and dual sensing (side impact and rollover) roof rail side inflatable curtain (IC) air bags.

Vehicle History

According to its Carfax report, the Hyundai was purchased new by the driver in July 2021, 9 months before the crash date. It was registered in North Carolina throughout the ownership without any reported crashes until this March 2022 crash. There was no recorded work or alterations done to the vehicle.

NHTSA Recalls and Investigations

A search in NHTSA's recall database using the Hyundai's VIN in May 2022 and again in August 2024 revealed no open or unrepaired recalls.

Exterior Damage

The Hyundai sustained damage across the front plane from the initial contact with the cable barrier posts (Event 1, Figure 8). The direct contact damage was measured across the entire 122 cm (48.0 in) bumper bar. The direct contact damage from Event 1 also involved the bumper fascia, the headlight components, and the front wheel assemblies. Some of the forces associated with this event were absorbed by the front tires and suspension and led to the separation of the left front tire CV joint from the front gear box. The left wheelbase measured 255 cm (100.4 in) and the right 269 cm (105.9 in). The residual crush was measured with a Nikon total station and the resultant profile was: C1= 7 cm (2.8 in), C2= 15 cm (5.9 in), C3= 23 cm (9.1 in), C4= 30 cm (11.8 in), C5= 16 cm (6.3 in), C6= 10 cm (3.9 in). Maximum crush was located 17 cm (6.7 in) right of the center of the bumper and was 30 cm (11.8 in). For comparative purposes, the severity of impact was calculated by the barrier algorithm in the WinSMASH program. The total change in velocity (delta V) was 29 km/h (18 mph). The longitudinal and lateral components were -28 km/h (-17.9 mph) and 5 km/h (3.1 mph). The calculated result was considered borderline due to the yielding properties of the guardrail impact. The Collision Deformation Classification[2] (CDC) assigned to the damage pattern for Event 1 is 12FDEW2.

Figure 8. Damage to the front bumper from the CBS anchor posts

As the Hyundai traveled forward, the top cable of the CBS cut into the hood (Event 2, Figure 9). The cable contacted the centerline of the hood cutting diagonally to the left A-pillar through the sheet metal for 55 cm (21.7 in) with a continued 14 cm (5.5 in) of surface scraping. The CDC assigned to this event is 00TFCN2.

[2] SAE J224_202205 – SAE Recommended Practice describing vehicle collision damage in an alphanumeric format.

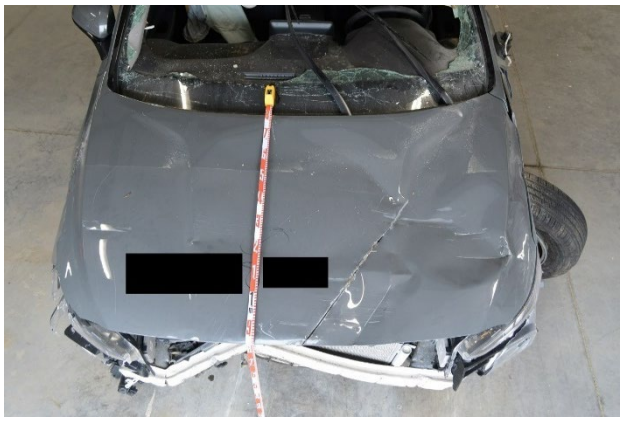

Figure 9. View of the damage to the hood from Event 2

The Hyundai sustained moderate damage during the side impact with the cable barrier (Event 3). The middle and bottom cables contacted the front side panel 57 cm (22.4 in) above and 10 cm (3.9 in) forward of the left front axle and wrapped diagonally 318 cm (125.2 in) across the left side of the Hyundai, breaking the belt line at the C-pillar and ending at the top of the D-pillar (Figure 10) 50 cm (19.7 in) rearward of the left rear axle. Due to the nonlinear nature of the damage, the crush measurements were excluded from this report but are available in the coded data. That maximum crush was 7 cm (2.7 in) and located 80 cm (31.5 in) forward of the left rear axle. There were a mix of deep gouges not associated directly to the cable abrasions linked to the cable posts, still attached to the cables that were pulled across the side sheet metal. The glazing on the left rear and second left rear windows were disintegrated from the cables, cutting across the vehicle. It was also noted during the SCI investigation the rear section of the left IC that covered the left rear window was contacted by the cable/post and punctured. The CDC assigned to this event is 10LDAW2.

Figure 10. Left side of the Hyundai and the damage associated to Event 3

The Hyundai sustained moderate damage during the three-quarter-turn rollover (Event 4). The Hyundai landed on its top roof header, crushing the forward greenhouse space 7 cm (2.8 in) vertically (Figure 11). There were several heavy surface abrasions (Figure 12) across the entire vehicle as well as minor trim damage. The left side mirror was missing from the vehicle, but the right mirror was intact. These abrasions and mirror damages are attributed to the rollover event. The CDC assigned to this event is 00TPDO3.

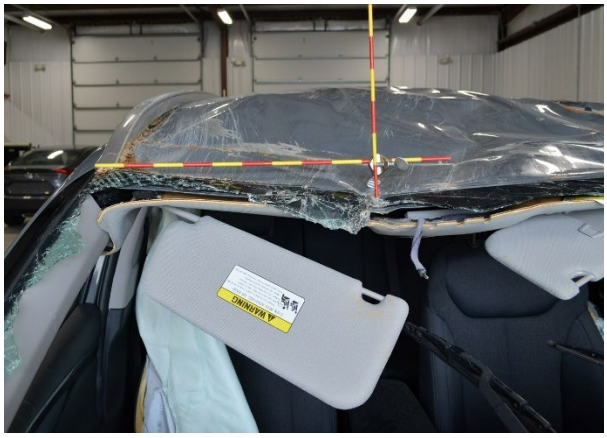

Figure 11. Crush damage to the windshield header

Figure 12. Surface abrasions to the roof

Event Data Recorder

The Hyundai had an air bag control module (ACM) that monitored and controlled the diagnostic, sensing, and deployment commands for the vehicle's supplemental safety systems. The module had EDR capabilities. It was imaged with the tool version E-N-H-01-00-0048 of the GIT Hyundai EDR tool software. During the on-site inspection, the vehicle's key fob was not available. With insurance company approval, the EDR was removed from the Hyundai for a desktop direct-to-module imaging process by the SCI investigator on site. The EDR was placed back into the vehicle after imaging. The imaged data reported with EDR002-R01 is attached as an appendix at the end of this report.

The EDR could store up to two crash events, termed either non-deployment or deployment events. Non-deployment events occur when the recording trigger threshold is met or exceeded. Data from non-deployments can be overwritten by subsequent events. Deployment events cannot be overwritten from the ACM. This ACM also categorizes non-air bag deployment events when there is an event in which non-air bag devices, such as pretensioners, have actuated. This type of event can be overwritten, given a subsequent air bag deployment event. Associative to each reported event was a 5.0-second pre-crash buffer. Multiple data points were recorded regularly every 0.5 seconds, including vehicle speed, engine rpm, engine throttle (% full), accelerator pedal (% full), master cylinder pressure, service brake status, ABS activity, stability control activity, and steering input. Two locked frontal events were recorded by the EDR. It was determined that the data was consistent with the SCI investigation.

First Record

The ignition cycle count at the time of the recording was 922 and 926 at the time of imaging. The air bag warning lamp was off and the driver's and front passenger's seat belt was buckled. A portion of the 5.0-second pre-crash data of the overlapped events is included in Table 1.

Table 1. Pre-Crash data for Event 1 and 2

Time (sec) Ev.1	Time (sec) Ev.2	Vehicle Speed km/h (mph)	Engine rpm	Accelerator Pedal % Full	Master Cylinder Pressure (bar)	Service Brake (on/off)	ABS Activity	Stability Control (on/off/ engaged)	Steering wheel Angle (deg.) (+L)
-5.0	-	101 (62.7)	1900	11	0.0	Off	Off	On	0
-4.5	-	102 (63.3)	1900	11	0.0	Off	Off	On	0
-4.0	-	103 (64.0)	1900	11	0.0	Off	Off	On	0
-3.5	-	103 (64.0)	2000	11	0.0	Off	Off	On	0
-3.0	-5.0	104 (64.4)	2000	11	0.0	Off	Off	On	0
-2.5	-4.5	105 (65.2)	2000	11	0.0	Off	OFF	On	0
-2.0	-4.0	105 (65.2)	2000	11	0.0	Off	Off	On	0
-1.5	-3.5	106 (65.8)	2000	11	0.0	Off	Off	On	0
-1.0	-3.0	107 (66.4)	2000	3	0.0	Off	Off	On	10
-0.5	-2.5	93 (57.7)	1800	54	0.0	Off	Off	Invalid data or not supported	45
0	-2.0	57 (35.4)	1300	0	3.9	On	On	Invalid data or not supported	140
-	-1.5	11 (6.8)	800	0	0.0	Off	Off	Invalid data or not supported	180
-	-1.0	10 (6.2)	800	0	0.0	Off	Off	Invalid data or not supported	105
-	-0.5	12 (7.4)	800	0	0.0	Off	Off	Invalid data or not supported	95

-	0	10 (6.2)	800	0	0.0	Off	Off	Invalid data or not supported	60

The EDR could also capture forward collision alert (FCA) status, warning level, and fail information. For 4.7 seconds of the pre-crash time segment the FCA was on, showed no warnings, and a fail status of normal. At -0.3 seconds prior to AE the FCA status changed to invalid or not supported for undetermined reasons. Additionally, the EDR recorded that the Hyundai's cruise control was off for the duration of the pre-crash time segment.

The EDR reported that the Hyundai, initially traveling at a speed of 101 km/h (62.7 mph), continued to increase speed to 107 km/h (66.4 mph) up until -1.0 seconds where it dropped to 57 km/h (35.4 mph) at AE. The reported speed is underreported due to probable ABS activity. Reconstruction of the crash determined that the Hyundai departed the right side of the roadway approximately 1 second prior to AE. At this time the driver reacted by steering left. The Hyundai's forward plane struck the cable barrier end posts (Event 1) at the 0-second interval and initiated AE. Actuation of the driver's seat-mounted side impact air bag, IC air bag, seat belt pretensioner, as well as the front passenger's seat belt pretensioner occurred 0 ms into AE. The front passenger's seat-mounted side impact air bag, IC air bag, and anchor pretensioner actuated at 354 ms into AE, as did the driver's anchor pretensioner. The maximum longitudinal delta V of this impact was -5 km/h (-3.1 mph) at 267.5 ms with a lateral maximum delta V of 19 km/h (11.8 mph) at 260.0 ms. The increasing lateral delta V pulse appeared to be consistent with the increasing cable tension on the vehicle's left plane (Event 3).

Second Record

This EDR record was consistent with the rollover (Event 4) that occurred approximately 2 seconds after the guardrail impact. The recorded data showed a rollover to the right (positive roll angle). However, it was noted that the reported roll angle was in excess of three-quarter-turns. Table 2 represents the roll angle of the Hyundai for EDR Event 2 in half-second intervals.

Table 2. Roll angle for Event 2

Time (sec)	Roll angle (degree)
-1.0	2
-0.5	77
0	188
0.5	285
1.0	359
1.5	396
2.0	421
2.5	443
3.0	441

Time (sec)	Roll angle (degree)
3.5	431
4.0	430
4.5	428
5.0	424

For undetermined reasons, the roll angle began increasing at the -1.0-second time step of the data (appendix) reaching 188° at 0.0 seconds. The maximum roll angle was 446° at the 2.6-second time step with the angle settling to 424° at the 5.0-second time step. The absolute change in the roll angle from 0.0-seconds to 2.7-seconds was 258° that is consistent with the reconstructed three-quarter-turns of the rollover event. The EDR data limitations section reported that the roll angle is a value calculated internally by the ACU. Although unknown due to the proprietary nature of the algorithms, the vehicle dynamics generated during the guardrail impact may be contributory to the roll angle calculation prior to time zero, thus leading to an inflated value. Actuation of the driver's and front passenger's seat-mounted side impact air bags, both IC air bags, driver's and front passenger's seat belt pretensioners, anchor pretensioners, occurred 0 ms into this AE. However, due to prior deployments in the first recording, there was no actual actuation for Event 2. The maximum longitudinal delta V was -2.0 km/h (-1.2 mph) at 205 ms with a lateral maximum delta V component of -18 km/h (11.1 mph) at 300 ms.

Interior Damage

There was minor interior damage associated to intrusion, air bag deployment, and occupant contacts (Figures 13, 14, 15, and 16). There was a 7 cm (2.8 cm) intrusion of the roof into the front passenger's space (Figure 17). The driver contacts included scuffs to the polymer knee bolster/lower instrument panel areas as well as the left door panel. The front passenger's contacts included scuffs to the lower instrument panel and the right side of the center console. The rear passenger contacts included scuffs to the driver's seatback. Debris and mud from the crash site were evident on the interior of the entire left A-pillar and headliner (Figure 18). The front passenger's IC air bag had been cut by EMS. There was no interior damage to the rear cargo space of the Hyundai.

Figure 13. Contacts to the driver's door

Figure 14. Contacts to the driver's knee bolster

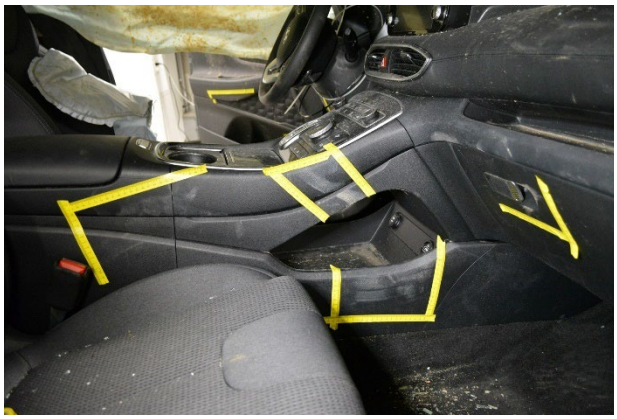

Figure 15. Front passenger's contacts

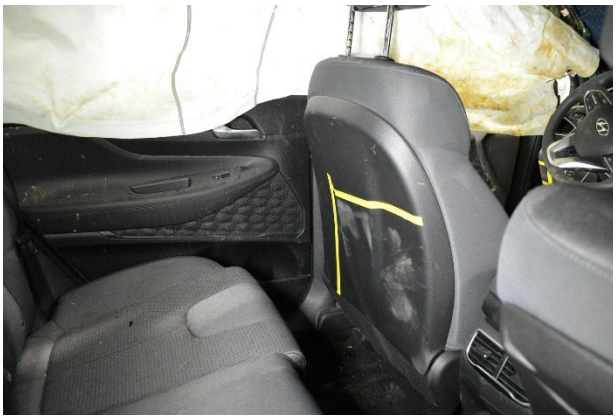

Figure 16. Left rear passenger's contacts

Figure 17. Overview of crush to the first row

Figure 18. Debris on the driver's A-pillar

Manual Restraint Systems

The Hyundai had three-point continuous loop lap and shoulder seat belts for each of the five seat positions. The front row used sliding latch plates and adjustable D-rings. The second row used sliding latch plates. It was determined that all Hyundai occupants were belted at the time of the

crash. The Hyundai had retractor and lower anchor pretensioners for both front positions (Figures 19 and 20) that had actuated.

Figure 19. Driver's actuated anchor pretensioner

Figure 20. Front passenger's actuated anchor pretensioner

At the time of the SCI inspection, it was observed that the driver's seat belt had been cut post-crash by EMS personnel. The cut webbing edges were consistent with being cut while under occupant loading. The webbing and latch plate showed signs of frictional abrasion from occupant loading during the crash events.

The front passenger's seat belt was found with the retractor locked and hanging loose from the D-ring. There was nothing remarkable about the seat belt. Friction burns in the webbing polymer were found on the latch plate.

The left rear passenger's seat belt was found retracted and unremarkable. Friction burns were found in the webbing polymer as well as on the latch plate.

Supplemental Restraint Systems

The Hyundai had dual-stage driver's and passenger's frontal air bags, outboard seat-mounted side impact air bags, and IC air bags. Both outboard seat-mounted side impact air bags and both IC air bags deployed as a result of the crash forces. The frontal air bags did not deploy. At the time of the SCI investigation, it was observed that the left IC air bag that deployed for seating position 11-21 had been penetrated by one of the cable barrier posts in the left rear seating position. There was a deep gouge along the sill of the left door that aligned with the puncture (Figure 21). The puncture did not appear to affect the performance of the air bag, although inflation would have been reduced over time.

Figure 21. Exterior view of the left rear passenger's IC

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2021 Hyundai Santa Fe Occupants

Driver Demographics

Age/sex:	35 years/female
Height:	168 cm (66 in)
Weight:	122 kg (270 lb)
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Seat between middle and rear most track position
Manual restraint usage:	Lap and shoulder belt
Usage source:	Vehicle inspection, EDR, PCR
Air bags:	Driver's frontal, seat-mounted, and IC air bags available; seat-mounted and IC air bags deployed
Alcohol/drug involvement:	No test performed
Egress from vehicle:	Assisted through removed windshield
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	6 cm shallow laceration to posterior left thigh just proximal to knee	810602.1	Egress injury, not crash related	NA
2	Small abrasion to posterior left thigh just proximal to knee	810202.1	Egress injury, not crash related	NA

Source: Emergency room report

Drivers Kinematics

At the time of the crash, the driver was restrained by the lap and shoulder seat belt and the seat track position appeared to be set between the middle and rear-most positions. The initial impact with the cable barrier post nominally displaced her forward and to the left during the side impact with the cables of the barrier system, loading both the IC and seat-mounted air bags. As the Hyundai disengaged from the CBS and initiated the rollover, the driver was displaced to the right. When the Hyundai landed on its roof, the inverted occupant was displaced downwards and loaded the seat belt. The driver remained restrained by the seat belt as the Hyundai came to rest on its left side. The driver loaded the deflated IC and seat-mounted air bags and subsequently loaded the driver's lower door rigid plastic trim. The driver sustained a minor laceration to the back of her left thigh just above the knee. Due to the nature and location of this injury, it was presumed to be not crash-related, but attributed to post-crash vehicle egress. The driver was transported to a local hospital by ambulance. She was treated and released.

Front Right Passenger Demographics

Age/sex:	13 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Seat between middle and rearmost track position
Manual restraint usage:	Lap and shoulder belt
Usage source:	Vehicle inspection, EDR, PCR
Air bags:	Passenger's frontal, seat-mounted, and IC air bags available; seat-mounted and IC deployed
Alcohol/drug involvement:	No test performed
Egress from vehicle:	Assisted through removed windshield
Transport from the scene:	Ambulance to a local hospital
Type of medical treatment:	Unknown

Front Right Passenger Injuries

The medical facility that was recorded in the PCR had no record of treatment for this occupant and his injuries remain unknown.

Front Right Passenger Kinematics

The front passenger was restrained by the lap and shoulder seat belt and the seat track position appeared to be set between the middle and rear-most positions. The initial impact with the cable barrier post nominally displaced him forward and to the left during the side impact with the cables of the barrier system, loading his seat belt and possibly contacting the right side of the center console with his lower and upper extremities. As the Hyundai disengaged from the cable barrier and initiated the rollover, the front passenger was displaced to the right and loaded his seat-mounted and IC air bags. When the Hyundai landed on its roof, the inverted front passenger loaded the seat belt and was displaced downwards. As the Hyundai settled onto its left side, the front passenger remained secured in his seat. The front right passenger was transported by ambulance to a local hospital. He did not receive treatment and there was no record at the hospital.

Left Rear Passenger Demographics

Age/sex:	14 years/male
Height:	175 cm (69 in)
Weight:	104 kg (230 lb)
Eyewear:	Unknown
Seat type:	Split bench with folding back
Seat track position:	Fixed
Manual restraint usage:	Lap and shoulder belt
Usage source:	Vehicle inspection, PCR
Air bags:	IC air bag available; IC air bag deployed
Alcohol/drug involvement:	No test performed
Egress from vehicle:	Assisted through removed windshield
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Treated and released

Left Rear Passenger Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Severe pain in left shoulder	N/A	N/A	N/A

Source: Emergency room report

The left rear passenger complained of severe pain in his left shoulder. It was initially thought that the shoulder was dislocated; however, radiology showed no injury to the shoulder. His left arm was placed in a sling, and he was released.

Left Rear Passenger Kinematics

The left rear passenger was restrained by the lap and shoulder seat belt. The initial impact with the cable barrier post nominally displaced him forward and to the left during the side impact with the cables of the barrier system. During this side impact the left rear passenger, due to his size, possibly loaded the hardened plastic door trim with his left shoulder through the deflated IC air bag. As the Hyundai disengaged from the cable barrier and initiated the rollover, he was displaced to the right. When the Hyundai landed on its roof, he loaded his seat belt and was displaced downwards. As the Hyundai settled onto its left side, he remained secured in his seat and possibly contacted the door trim again with his left shoulder. He was transported by ambulance to a local hospital with complaints of severe pain in his left shoulder but sustained no codable injuries. He received an arm sling and was released.

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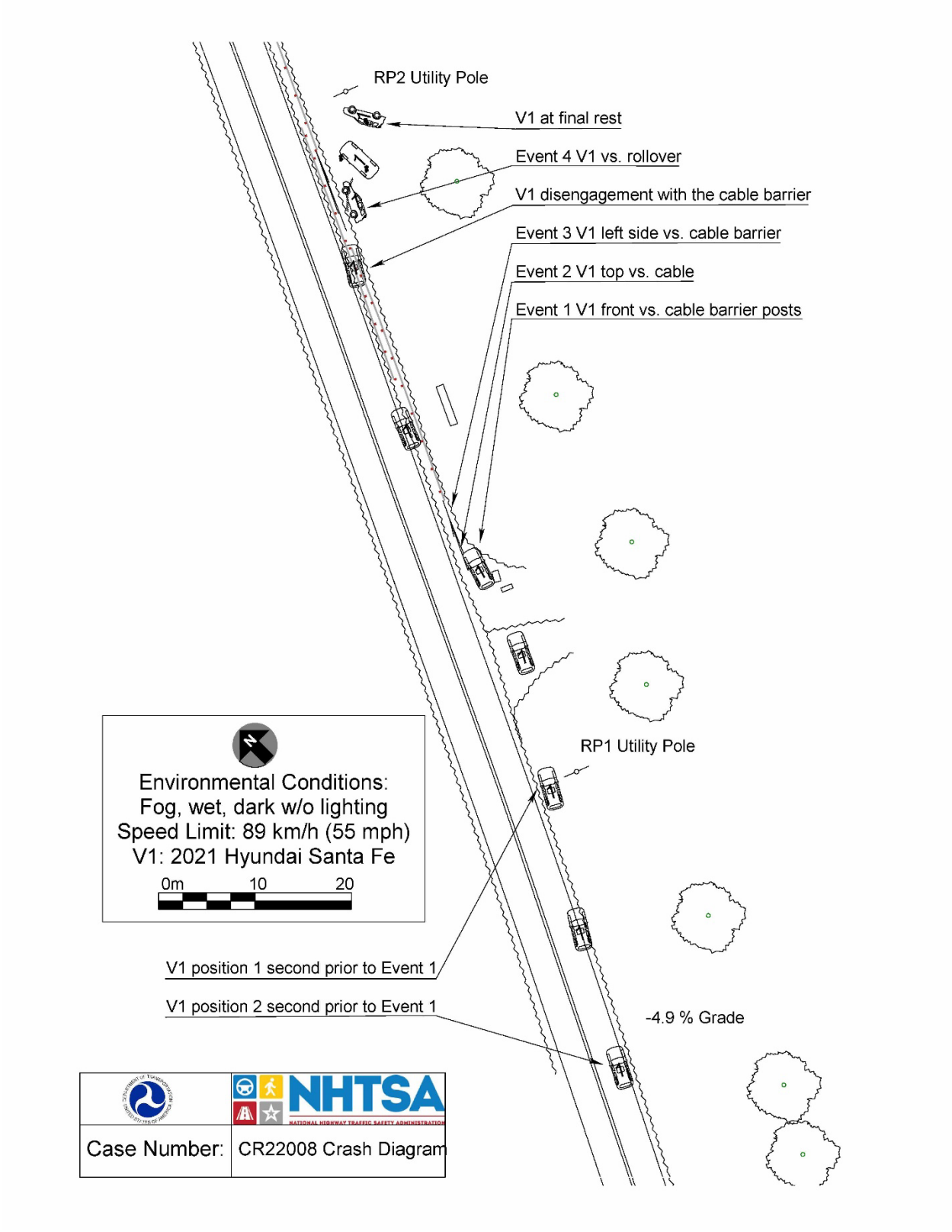
Crash Diagram



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Appendix A: 2021 Hyundai Santa Fe Event Data Recorder Report

The EDR was imaged during the SCI vehicle inspection with the Global Information Technologies Hyundai EDR tool and the current version of the software available at the time of the inspection. The hexadecimal data has been sanitized to remove potential personal identifiable information

Vehicle Information

HYUNDAI | SANTAFE(TMA) | 2021 | AIRBAG SYSTEM	
VIN as Programmed into EMS	5NMS2DAJ6MH

Additional Information

User-entered VIN	5NMS2DAJ6MH
User Name	NHTSA
Case Number	
Crash Date	
Saved-on Date	2022-05-12 09:07
EDR Tool Version	E-N-H-01-00-0048
EDR Report Version	EDR002-R01
Tire Size(s)	
Memo	

Data Limitation

General Information:

Tools for downloading and interpreting the EDRs in Hyundai vehicles have been developed for vehicles produced after September 1, 2012. Currently, there is no tool for downloading and accurate interpreting data from the EDRs in Hyundai vehicles produced prior to this date.

The EDR Report requires Adobe Reader Version 9.00 or higher to open.

EDR(Event Data Recorder):

- The EDR function is part of the Airbag Control Unit(ACU).

- ACU can store up to two events.

- Event means a crash or other physical occurrence that causes the trigger threshold to be met or exceeded, or any non-reversible deployable restraint to be deployed, whichever occurs first:

  1. Deployment Event:
     1) the event which is recorded if an airbag is commanded to deploy.
     2) the event is locked and cannot be overwritten.

  2. Non-deployment Event:
     1) the event which is recorded, but in which an airbag is not commanded to deploy
     2) the event is not locked and can be overwritten by a subsequent event (Deployment or Non-deployment event), for example, Pretensioner(s) only deployment
     3) An example of a non-deployment event is a pretensioner-only deployment with no airbag deployments

- Ignition cycle count will increment by 1 in the following cases

  1. the power mode change from OFF/Accessary to IGN ON/RUN

  2. EDR data download by tools

- The ACU can record data for all or some of the following events. But, depending on the vehicle's configurations, data for side crash and/or rollover crash(event) may not be recorded.

- If power supply to the ACU is lost during an event, all or part of the data may not be recorded.

Data Limitation

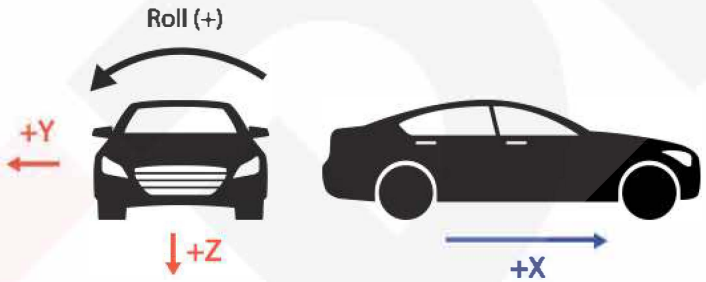
Data Element Sign Convention:

The following table provides an explanation of the sign notation for data elements that may be included in the EDR report. Directional references to sign convention are from the point of view of the driver.

Data element name	Positive sign	Note
* Longitudinal acceleration	Forward direction	+X at the figure 1
Delta V, longitudinal	Forward direction	+X at the figure 1
Lateral acceleration	Left to Right direction	+Y at the figure 1
Delta V, lateral	Left to Right direction	+Y at the figure 1
Normal(vertical) acceleration	Downward direction	+Z at the figure 1
Vehicle roll angle	Clockwise about the longitudinal axis	Roll(+) at the figure 1
Steering input	Counterclockwise rotation	-

* The forward direction of longitudinal acceleration for front side impact sensor may be different for each vehicle

Figure 1. Sign Conventions



Data Sources:

Many EDR data elements are sourced from other control modules in the vehicle.

1. Most of them can be measured and calculated by the ACU. For example, Delta-V and Rollover angle can be calculated from internal sensors in the ACU (if applicable).

2. The following pre-crash data can be transmitted to the ACU via the vehicle's communication network.
   - Vehicle Speed
   - Engine RPM
   - Engine Throttle
   - Acceleration Pedal
   - Service Brake
   - ABS Activity
   - Stability Control
   - Steering Input Angle

   *Note) Depending on the vehicle's configuration and the conditions described above, some items may not be recorded.

3. Pre-crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may be asynchronous to each other.

Data Limitation

Data Definitions:

- Data recorded by the ACU and imaged by the EDR tool is displayed relative to Time zero(T0). Time zero(T0) is not typically the time at which the vehicle made contact with another vehicle or object.
- Time zero (T0) means whichever of the following occurs first

  1. For systems with ''wake-up'' air bag control systems, the time at which the occupant restraint control algorithm is activated; or
  2. For continuously running algorithms,
     1) The first point in the interval where a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 20msec time period; or
     2) For vehicles that record ''delta-V, lateral,'' the first point in the interval where a lateral cumulative delta-V of over 0.8 km/h (0.5 mph) is reached within a 5msec time period; or
  3. Deployment of a non-reversible deployable restraint.
- Multi-event crash means the occurrence of 2 events, the first and last of which begin not more than 5 seconds apart. If an event is not part of a multi-event crash, the value of this data element will be "1".
- Service brake, on or off means the status of the device that is installed in or connected to the brake pedal system to detect whether the pedal was pressed. The device can include the brake pedal switch or other driver-operated service brake control,
- Engine RPM means

  1. For vehicles powered by internal combustion engines, the number of revolutions per minute of the main crankshaft of the vehicle's engine, and
  2. For vehicles not entirely powered by internal combustion engines, the number of revolutions per minute of the motor shaft at the point at which it enters the vehicle transmission gearbox.
- Engine Throttle is a measure of the throttle position.
- Accelerator Pedal is a measure of the accelerator pedal value.
- Seat belt status is determined by whether the buckle switch is open or closed.
- Delta-V means the cumulative change in velocity, and is calculated from internal sensors in the ACU
- 'Invalid data' means
  1. The data sources sent invalid data
  2. The data sources did not send data
  3. The data does not be recorded depending on design standard
  4. The data could not be recorded in some conditions such as the loss of power in vehicle
- 'Not supported' means : The system is not applied in that vehicle

EDR Information

Part No. (EOL Code) as programmed into ACU	95910-S2500(S250)
ECU SW Version as programmed into ACU	1.01
EDR Version as programmed into ACU	0420

< Event 1 >

Event Status at Event

Multi-event, Number of Event (1 or 2)	2 event
Time from Event 1 to 2 [msec]	100
Completed File Recorded (Yes or No)	YES
Ignition cycle, crash [cycle]	922
Ignition cycle, download [cycle]	926

Pre-Crash Information 1(-5 ~ 0 sec)

Time (sec)	Vehicle Speed [kph]	Engine RPM [rpm]	Engine Throttle [%]	Acceleration Pedal [%]	Master cylinder pressure [bar]	Service Brake [on/off]	ABS Activity [on/off]	Stability Control [on/off/engaged]	Steering Input [degree]
-5.0	101	1900	14	11	0.0	OFF	OFF	ON	0
-4.5	102	1900	14	11	0.0	OFF	OFF	ON	0
-4.0	103	1900	14	11	0.0	OFF	OFF	ON	0
-3.5	103	2000	14	11	0.0	OFF	OFF	ON	0
-3.0	104	2000	14	11	0.0	OFF	OFF	ON	0
-2.5	105	2000	14	11	0.0	OFF	OFF	ON	0
-2.0	105	2000	14	11	0.0	OFF	OFF	ON	0
-1.5	106	2000	15	11	0.0	OFF	OFF	ON	0
-1.0	107	2000	14	3	0.0	OFF	OFF	ON	10
-0.5	93	1800	9	54	0.0	OFF	OFF	Invalid data or Not Supported	45
0.0	57	1300	0	0	3.9	ON	ON	Invalid data or Not Supported	140

Pre-Crash Information 2 (-5 ~ 0 sec)

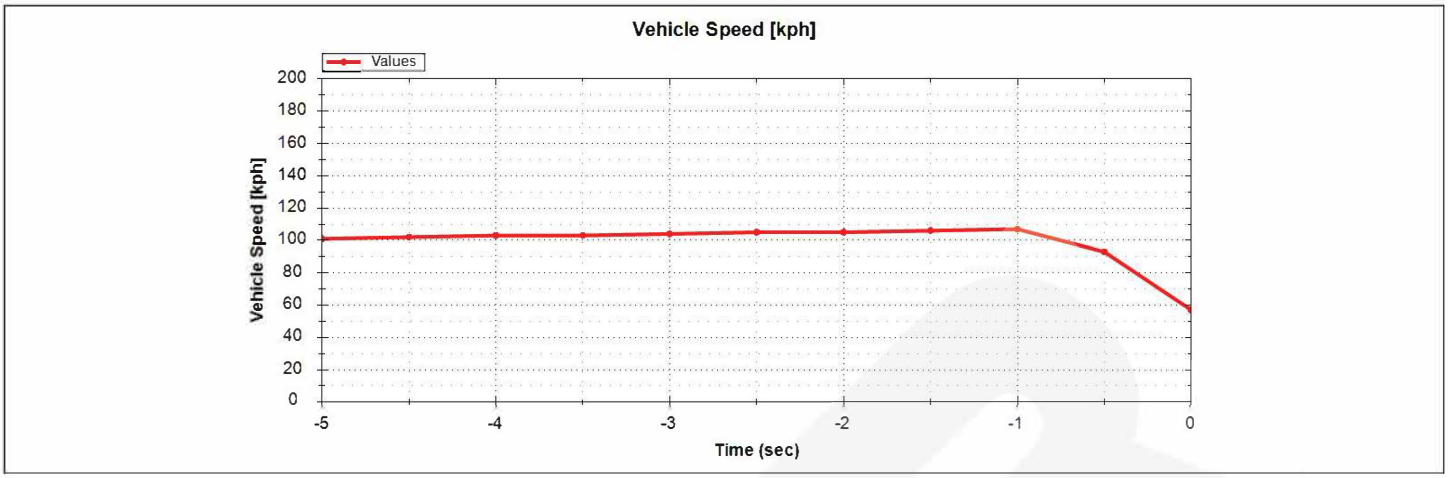
Time (sec)	Gear shift selector display	SCC information (Main switch status)	SCC information (Set Speed)	SCC information (SPEED UNIT)	SCC information (Mode status)	SCC information (Fail info)
-5.0	D	OFF	20	MPH	Ready	System without Error
-4.5	D	OFF	20	MPH	Ready	System without Error
-4.0	D	OFF	20	MPH	Ready	System without Error
-3.5	D	OFF	20	MPH	Ready	System without Error
-3.0	D	OFF	20	MPH	Ready	System without Error
-2.5	D	OFF	20	MPH	Ready	System without Error
-2.0	D	OFF	20	MPH	Ready	System without Error
-1.5	D	OFF	20	MPH	Ready	System without Error
-1.0	D	OFF	20	MPH	Ready	System without Error
-0.5	D	OFF	20	MPH	Ready	System without Error
0.0	D	OFF	20	MPH	Ready	System without Error

Pre-Crash Information 3 (-5 ~ 0 sec)

Time (sec)	FCA (Function status)	FCA (Warning Level)	FCA (Fail info)	Time (sec).	FCA (Function status).	FCA (Warning Level).	FCA (Fail info).
-5.0	ON	No Warning / Invalid or Not supported	Normal	-2.5	ON	No Warning / Invalid or Not supported	Normal
-4.9	ON	No Warning / Invalid or Not supported	Normal	-2.4	ON	No Warning / Invalid or Not supported	Normal
-4.8	ON	No Warning / Invalid or Not supported	Normal	-2.3	ON	No Warning / Invalid or Not supported	Normal
-4.7	ON	No Warning / Invalid or Not supported	Normal	-2.2	ON	No Warning / Invalid or Not supported	Normal
-4.6	ON	No Warning / Invalid or Not supported	Normal	-2.1	ON	No Warning / Invalid or Not supported	Normal
-4.5	ON	No Warning / Invalid or Not supported	Normal	-2.0	ON	No Warning / Invalid or Not supported	Normal
-4.4	ON	No Warning / Invalid or Not supported	Normal	-1.9	ON	No Warning / Invalid or Not supported	Normal
-4.3	ON	No Warning / Invalid or Not supported	Normal	-1.8	ON	No Warning / Invalid or Not supported	Normal
-4.2	ON	No Warning / Invalid or Not supported	Normal	-1.7	ON	No Warning / Invalid or Not supported	Normal
-4.1	ON	No Warning / Invalid or Not supported	Normal	-1.6	ON	No Warning / Invalid or Not supported	Normal
-4.0	ON	No Warning / Invalid or Not supported	Normal	-1.5	ON	No Warning / Invalid or Not supported	Normal
-3.9	ON	No Warning / Invalid or Not supported	Normal	-1.4	ON	No Warning / Invalid or Not supported	Normal
-3.8	ON	No Warning / Invalid or Not supported	Normal	-1.3	ON	No Warning / Invalid or Not supported	Normal
-3.7	ON	No Warning / Invalid or Not supported	Normal	-1.2	ON	No Warning / Invalid or Not supported	Normal
-3.6	ON	No Warning / Invalid or Not supported	Normal	-1.1	ON	No Warning / Invalid or Not supported	Normal
-3.5	ON	No Warning / Invalid or Not supported	Normal	-1.0	ON	No Warning / Invalid or Not supported	Normal
-3.4	ON	No Warning / Invalid or Not supported	Normal	-0.9	ON	No Warning / Invalid or Not supported	Normal
-3.3	ON	No Warning / Invalid or Not supported	Normal	-0.8	ON	No Warning / Invalid or Not supported	Normal
-3.2	ON	No Warning / Invalid or Not supported	Normal	-0.7	ON	No Warning / Invalid or Not supported	Normal
-3.1	ON	No Warning / Invalid or Not supported	Normal	-0.6	ON	No Warning / Invalid or Not supported	Normal
-3.0	ON	No Warning / Invalid or Not supported	Normal	-0.5	ON	No Warning / Invalid or Not supported	Normal
-2.9	ON	No Warning / Invalid or Not supported	Normal	-0.4	ON	No Warning / Invalid or Not supported	Normal
-2.8	ON	No Warning / Invalid or Not supported	Normal	-0.3	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.7	ON	No Warning / Invalid or Not supported	Normal	-0.2	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.6	ON	No Warning / Invalid or Not supported	Normal	-0.1	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.5	ON	No Warning / Invalid or Not supported	Normal	0.0	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported

< Event 1 >

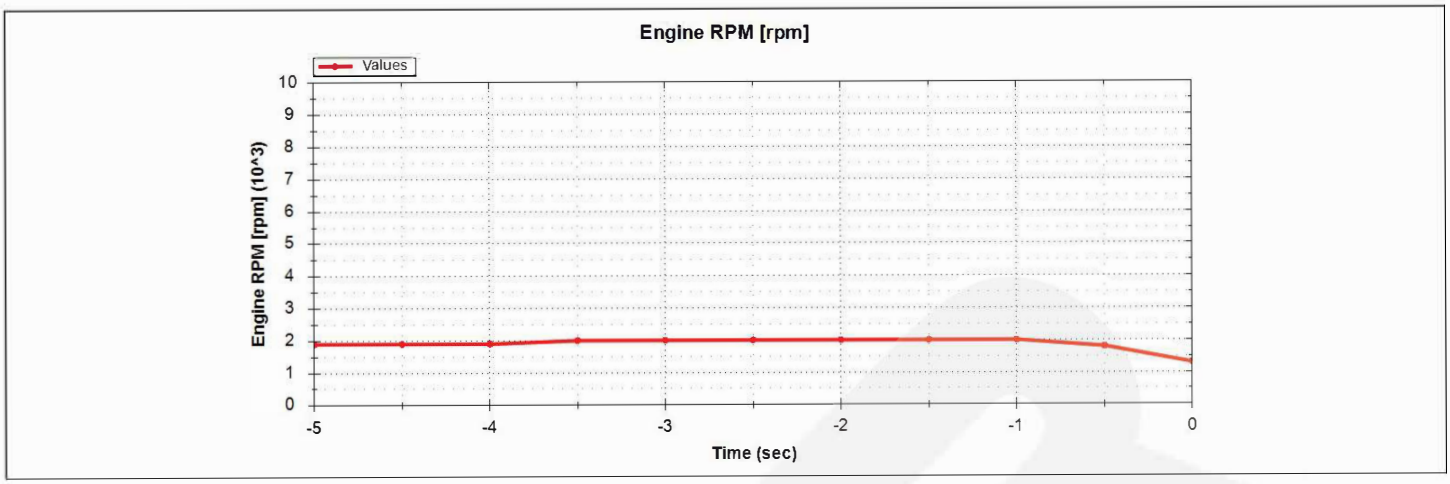
Vehicle Speed



Num	Time (sec)	Vehicle Speed [kph]
1	-5.0	101
2	-4.5	102
3	-4.0	103
4	-3.5	103
5	-3.0	104
6	-2.5	105
7	-2.0	105
8	-1.5	106
9	-1.0	107
10	-0.5	93
11	0.0	57

< Event 1 >

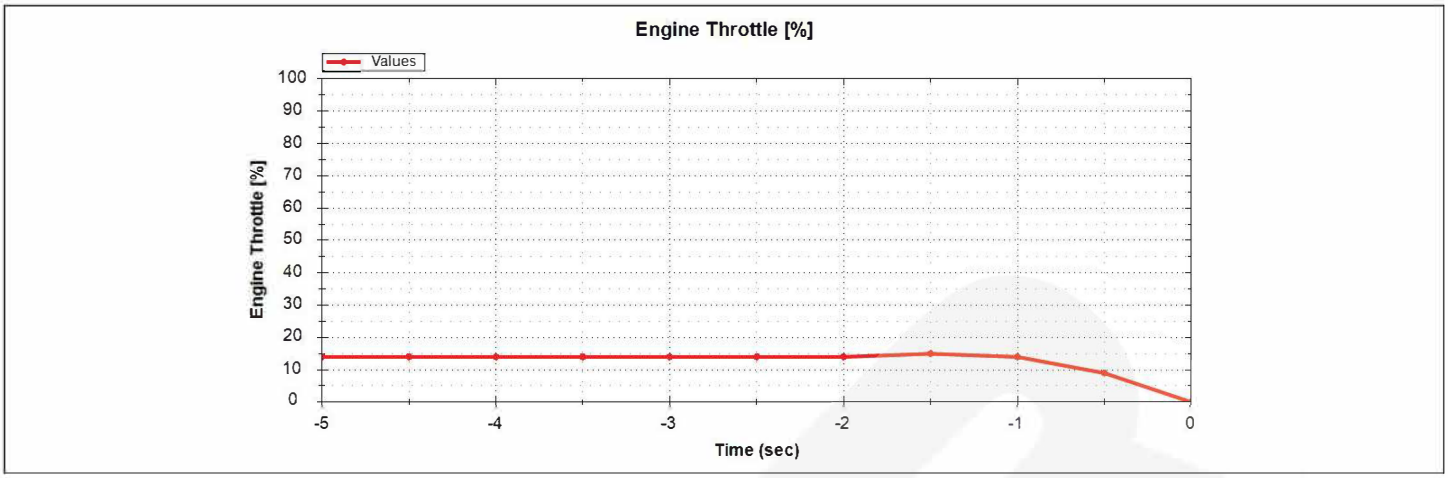
Engine RPM



Num	Time (sec)	Engine RPM [rpm]
1	-5.0	1900
2	-4.5	1900
3	-4.0	1900
4	-3.5	2000
5	-3.0	2000
6	-2.5	2000
7	-2.0	2000
8	-1.5	2000
9	-1.0	2000
10	-0.5	1800
11	0.0	1300

< Event 1 >

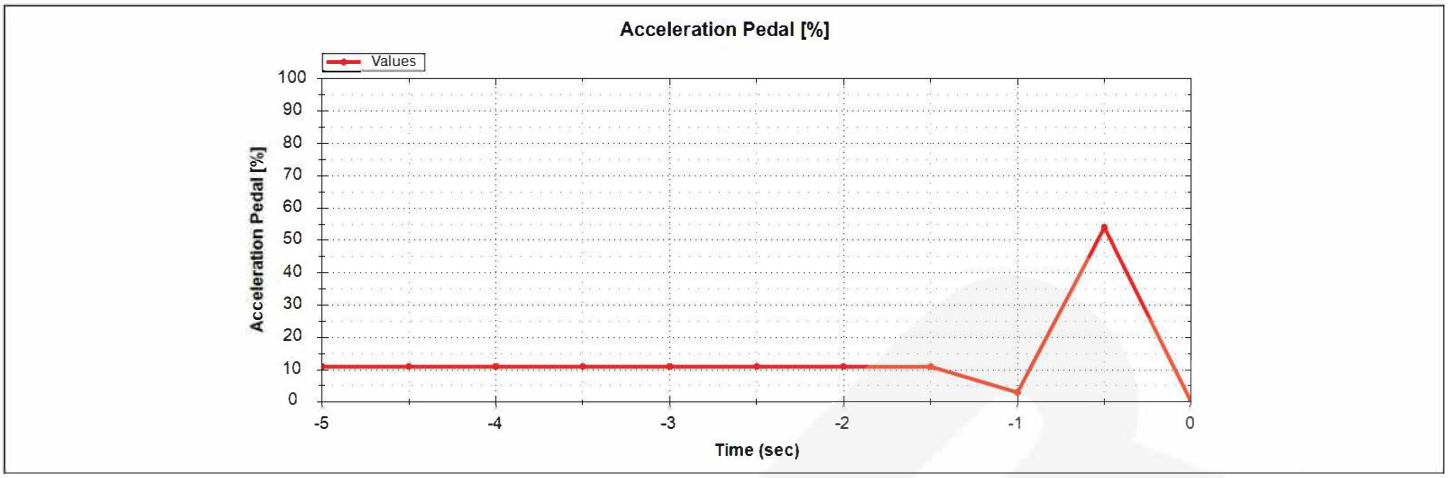
Engine Throttle



Num	Time (sec)	Engine Throttle [%]
1	-5.0	14
2	-4.5	14
3	-4.0	14
4	-3.5	14
5	-3.0	14
6	-2.5	14
7	-2.0	14
8	-1.5	15
9	-1.0	14
10	-0.5	9
11	0.0	0

< Event 1 >

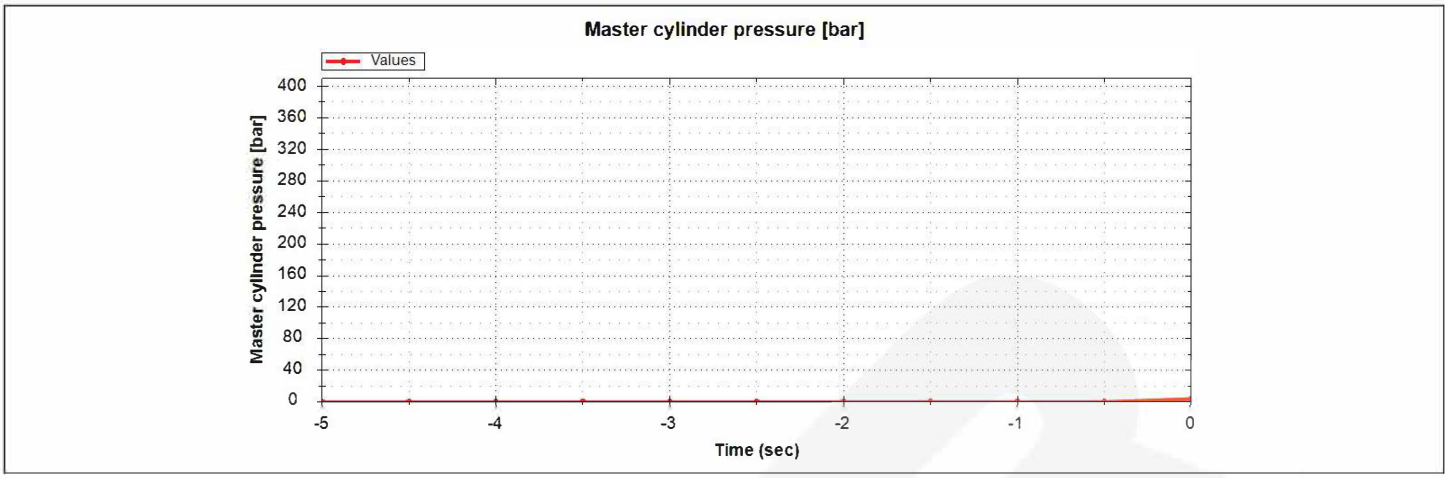
Acceleration Pedal



Num	Time (sec)	Acceleration Pedal [%]
1	-5.0	11
2	-4.5	11
3	-4.0	11
4	-3.5	11
5	-3.0	11
6	-2.5	11
7	-2.0	11
8	-1.5	11
9	-1.0	3
10	-0.5	54
11	0.0	0

‹ Event 1 ›

Master cylinder pressure



Num	Time (sec)	Master cylinder pressure [bar]
1	-5.0	0.0
2	-4.5	0.0
3	-4.0	0.0
4	-3.5	0.0
5	-3.0	0.0
6	-2.5	0.0
7	-2.0	0.0
8	-1.5	0.0
9	-1.0	0.0
10	-0.5	0.0
11	0.0	3.9

< Event 1 >

Service Brake

Num	Time (sec)	Service Brake [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	OFF
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	ON

ABS Activity

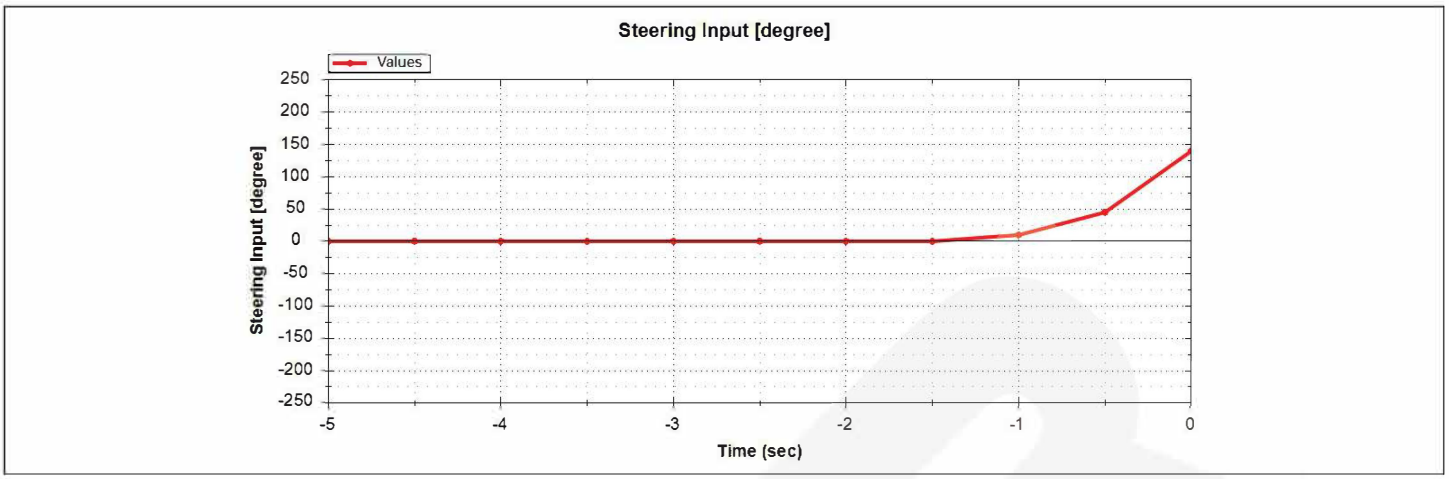
Num	Time (sec)	ABS Activity [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	OFF
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	ON

Stability Control

Num	Time (sec)	Stability Control [on/off/engaged]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	ON
7	-2.0	ON
8	-1.5	ON
9	-1.0	ON
10	-0.5	Invalid data or Not Supported
11	0.0	Invalid data or Not Supported

< Event 1 >

Steering Input



Num	Time (sec)	Steering Input [degree]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	0
6	-2.5	0
7	-2.0	0
8	-1.5	0
9	-1.0	10
10	-0.5	45
11	0.0	140

Note) Positive value(CCW), Negative value(CW)

< Event 1 >

System Status at Event

Airbag warning lamp on/off	OFF
Safety seat belt status, driver	ON
Safety seat belt status, passenger	ON
Seat track position switch foremost status, driver	Not Supported
Seat track position switch foremost status, passenger	Not Supported
Occupant size classification, driver (5% female or larger)	Not Supported
Occupant size classification, passenger (child)	NO

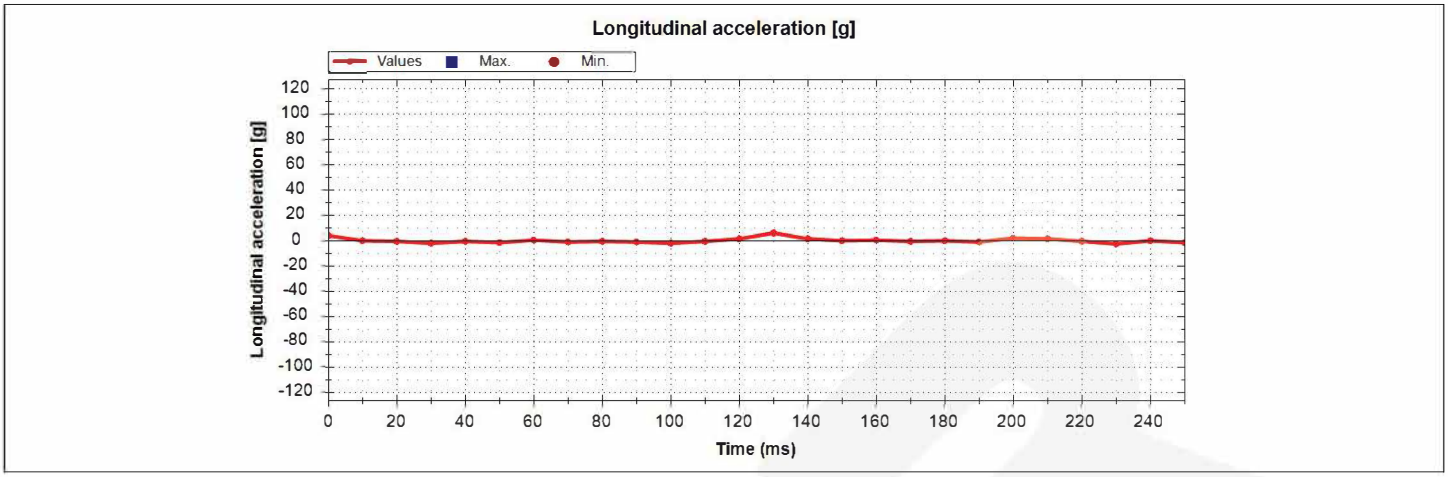
Deployment Command Data at Event

Front airbag deployment time, driver (first stage) [msec]	No deployment
Front airbag deployment time, passenger (first stage) [msec]	No deployment
Front airbag deployment time, driver (second stage) [msec]	No deployment
Front airbag deployment time, passenger (second stage) [msec]	No deployment
Front airbag deployment time, driver (third stage) [msec]	Not supported
Front airbag deployment time, passenger (third stage) [msec]	Not supported
Front airbag deployment time, passenger (4th stage) [msec]	Not supported
Front airbag disposal deployment, driver (second stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (second stage) (Yes or No)	NO
Front airbag disposal deployment, driver (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (4th stage) (Yes or No)	NO
Knee airbag deployment time,driver [msec]	Not supported
Knee airbag deployment time,passenger [msec]	Not supported
Front side airbag deployment time, driver [msec]	0
Front side airbag deployment time, passenger [msec]	354
Rear side airbag deployment time,driver [msec]	Not supported
Rear side airbag deployment time,passenger [msec]	Not supported
Curtain airbag deployment time, driver [msec]	0
Curtain airbag deployment time, passenger [msec]	354
Rear curtain airbag deployment time,driver [msec]	Not supported
Rear curtain airbag deployment time,passenger [msec]	Not supported
Seat belt pretensioner deployment time, driver [msec]	0
Seat belt pretensioner deployment time, passenger [msec]	0
Rear belt pretensioner deployment time,driver [msec]	Not supported

Rear belt pretensioner deployment time,passenger [msec]	Not supported
Anchor pretensioner deployment time,driver [msec]	354
Anchor pretensioner deployment time,passenger [msec]	354
Adaptive load limiter deployment time,driver [msec]	Not supported
Adaptive load limiter deployment time,passenger [msec]	Not supported
Front Center side airbag deployment time [msec]	Not supported

‹ Event 1 ›

Longitudinal crash pulse_acceleration (g, 0 ~ 250msec)

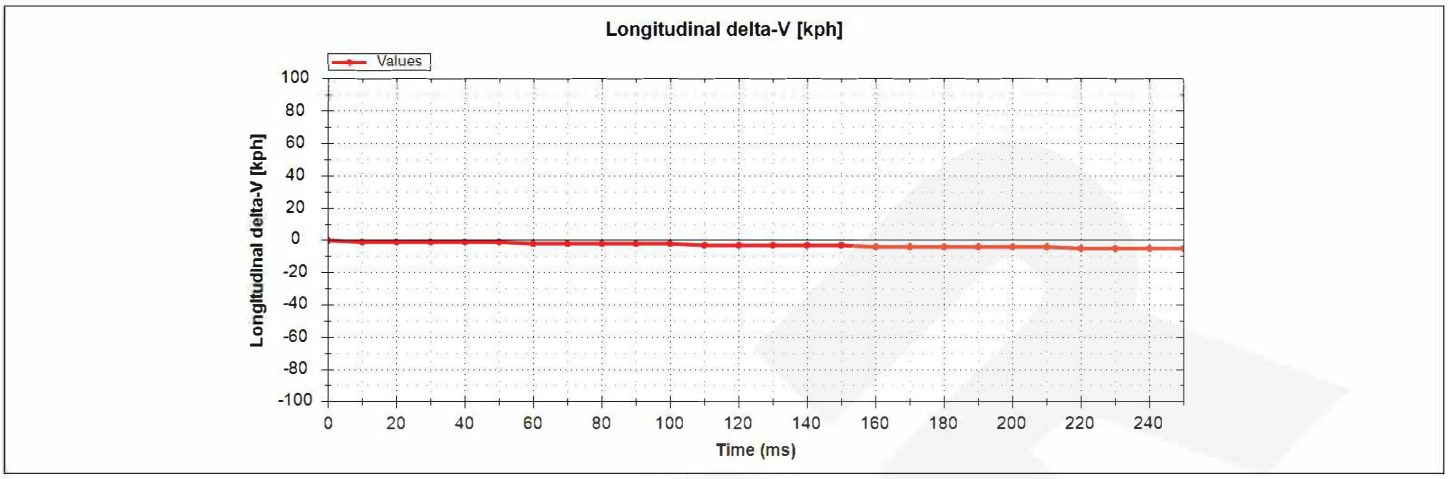


Num	Time (ms)	Longitudinal acceleration [g]
1	0.0	4.0
2	10.0	0.0
3	20.0	-0.5
4	30.0	-2.0
5	40.0	-0.5
6	50.0	-1.5
7	60.0	0.5
8	70.0	-1.0
9	80.0	-0.5
10	90.0	-1.0
11	100.0	-2.0
12	110.0	-0.5
13	120.0	1.5
14	130.0	6.0
15	140.0	1.5
16	150.0	0.0
17	160.0	0.5
18	170.0	-0.5
19	180.0	0.0
20	190.0	-1.0
21	200.0	2.0
22	210.0	1.5
23	220.0	-0.5
24	230.0	-2.5
25	240.0	0.0
26	250.0	-1.5

< Event 1 >

Longitudinal crash pulse_delta-v (kph, 0 ~ 250msec)

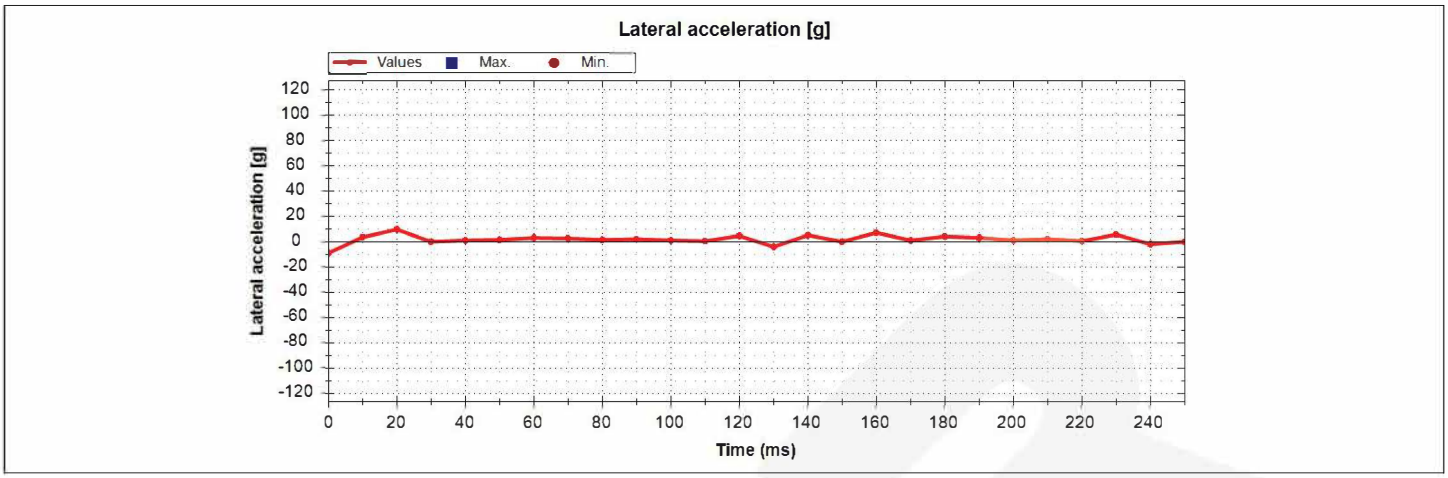
Max. delta-V [kph]	-5
Time, Max. delta-V [msec]	267.5



Num	Time (ms)	Longitudinal delta-V [kph]
1	0.0	0
2	10.0	-1
3	20.0	-1
4	30.0	-1
5	40.0	-1
6	50.0	-1
7	60.0	-2
8	70.0	-2
9	80.0	-2
10	90.0	-2
11	100.0	-2
12	110.0	-3
13	120.0	-3
14	130.0	-3
15	140.0	-3
16	150.0	-3
17	160.0	-4
18	170.0	-4
19	180.0	-4
20	190.0	-4
21	200.0	-4
22	210.0	-4
23	220.0	-5
24	230.0	-5
25	240.0	-5
26	250.0	-5

‹ Event 1 ›

Lateral crash pulse_acceleration (g, 0 ~ 250msec)

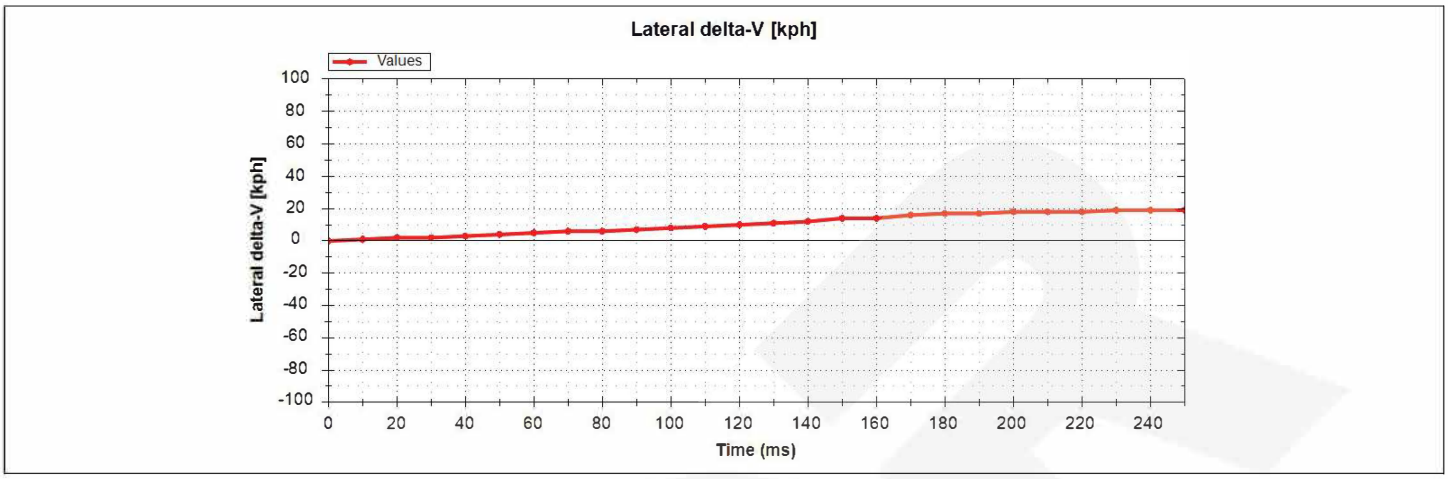


Num	Time (ms)	Lateral acceleration [g]
1	0.0	-9.0
2	10.0	3.5
3	20.0	9.5
4	30.0	0.0
5	40.0	1.0
6	50.0	1.5
7	60.0	3.0
8	70.0	2.5
9	80.0	1.5
10	90.0	2.0
11	100.0	1.0
12	110.0	0.5
13	120.0	4.5
14	130.0	-4.0
15	140.0	5.0
16	150.0	0.0
17	160.0	7.0
18	170.0	1.0
19	180.0	4.0
20	190.0	3.0
21	200.0	1.0
22	210.0	2.0
23	220.0	0.5
24	230.0	5.5
25	240.0	-2.0
26	250.0	0.0

< Event 1 >

Lateral crash pulse_delta-v (kph, 0 ~ 250msec)

Max. delta-V [kph]	19
Time, Max. delta-V [msec]	260.0



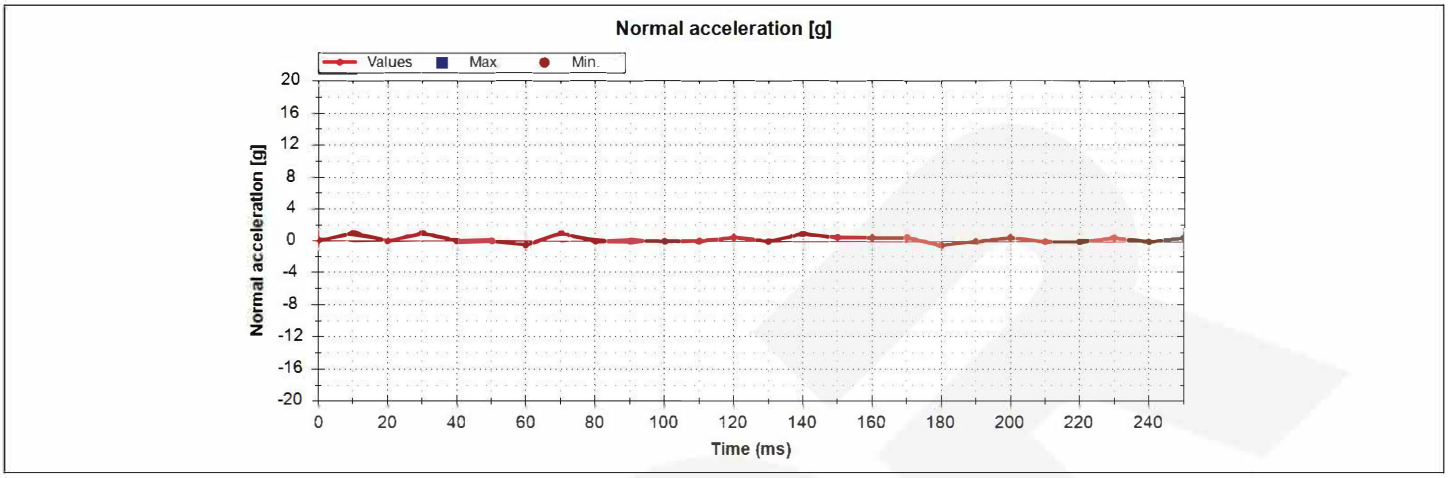
Num	Time (ms)	Lateral delta-V [kph]
1	0.0	0
2	10.0	1
3	20.0	2
4	30.0	2
5	40.0	3
6	50.0	4
7	60.0	5
8	70.0	6
9	80.0	6
10	90.0	7
11	100.0	8
12	110.0	9
13	120.0	10
14	130.0	11
15	140.0	12
16	150.0	14
17	160.0	14
18	170.0	16
19	180.0	17
20	190.0	17
21	200.0	18
22	210.0	18
23	220.0	18
24	230.0	19
25	240.0	19
26	250.0	19

< Event 1 >

Crash pulse Resultant, Time_Max. delta-V resultant (0 ~ 300 msec)

Time, Max. delta-V, resultant [msec]	260.0

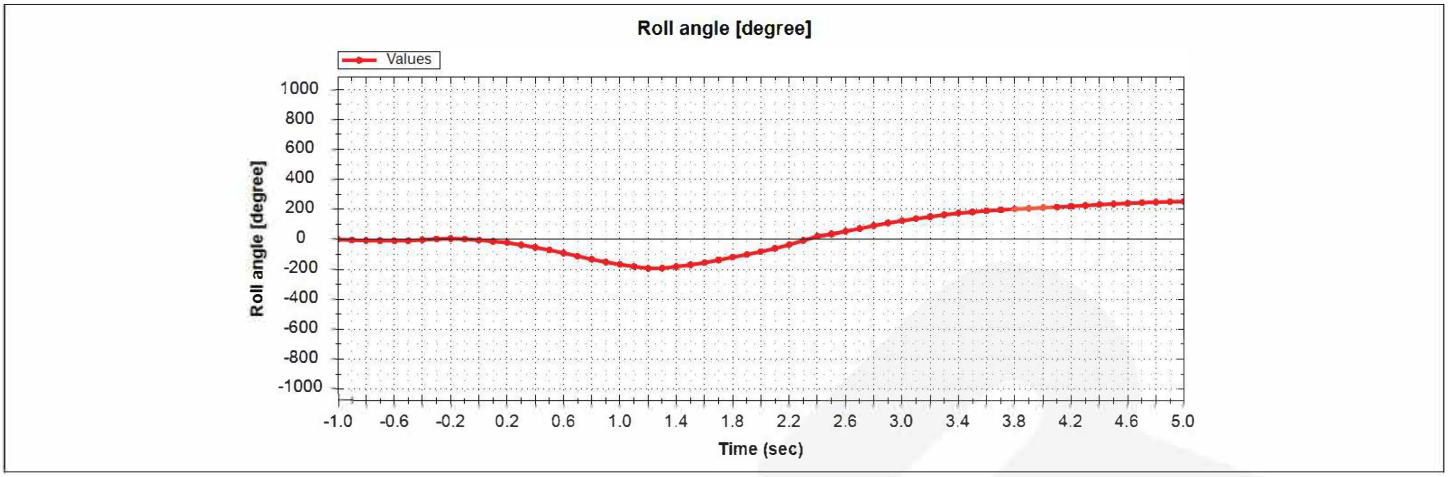
Normal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Normal acceleration [g]
1	0.0	0.0
2	10.0	1.0
3	20.0	0.0
4	30.0	1.0
5	40.0	0.0
6	50.0	0.0
7	60.0	-0.5
8	70.0	1.0
9	80.0	0.0
10	90.0	0.0
11	100.0	0.0
12	110.0	0.0
13	120.0	0.5
14	130.0	0.0
15	140.0	1.0
16	150.0	0.5
17	160.0	0.5
18	170.0	0.5
19	180.0	-0.5
20	190.0	0.0
21	200.0	0.5
22	210.0	0.0
23	220.0	0.0
24	230.0	0.5
25	240.0	0.0
26	250.0	0.5

< Event 1 >

Roll angle (degree, -1 ~ 5sec)

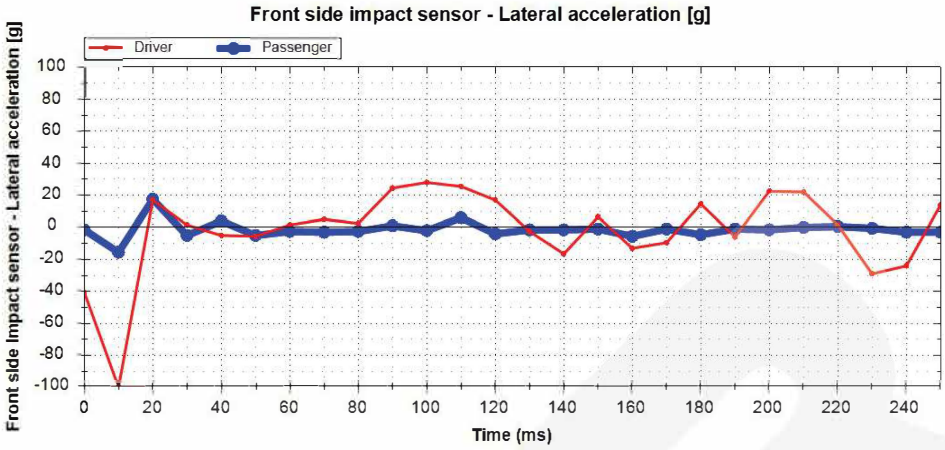


Num	Time (sec)	Roll angle [degree]
1	-1.0	1
2	-0.9	-4
3	-0.8	-7
4	-0.7	-7
5	-0.6	-8
6	-0.5	-8
7	-0.4	-2
8	-0.3	3
9	-0.2	6
10	-0.1	3
11	0.0	-4
12	0.1	-12
13	0.2	-21
14	0.3	-36
15	0.4	-53
16	0.5	-70
17	0.6	-90
18	0.7	-111
19	0.8	-132
20	0.9	-151
21	1.0	-167
22	1.1	-180
23	1.2	-193
24	1.3	-192
25	1.4	-181
26	1.5	-169
27	1.6	-155
28	1.7	-137
29	1.8	-118
30	1.9	-100
31	2.0	-81

32	2.1	-60
33	2.2	-35
34	2.3	-6
35	2.4	20
36	2.5	35
37	2.6	53
38	2.7	71
39	2.8	90
40	2.9	108
41	3.0	123
42	3.1	137
43	3.2	150
44	3.3	163
45	3.4	174
46	3.5	182
47	3.6	190
48	3.7	196
49	3.8	201
50	3.9	205
51	4.0	210
52	4.1	215
53	4.2	220
54	4.3	225
55	4.4	231
56	4.5	236
57	4.6	240
58	4.7	244
59	4.8	248
60	4.9	250
61	5.0	251

‹ Event 1 ›

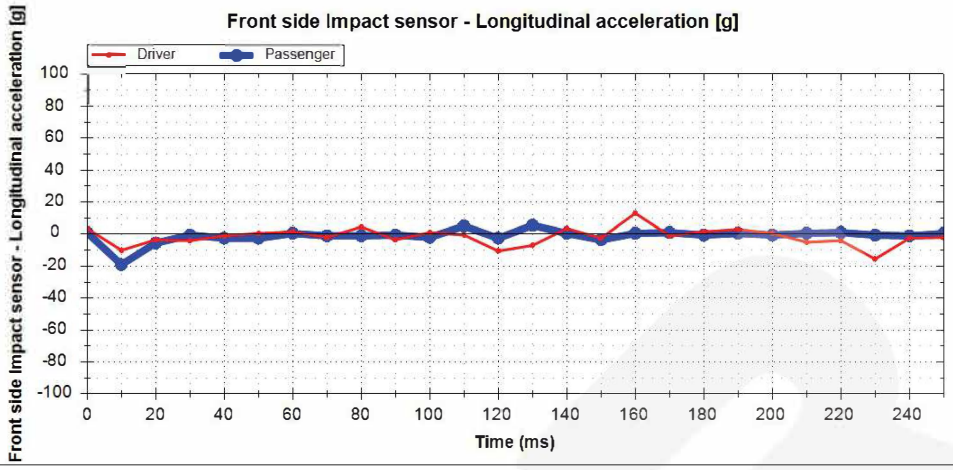
Front side impact sensor - Lateral acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Front driver side impact sensor - Lateral acceleration [g]	Front passenger side impact sensor - Lateral acceleration [g]
1	0.0	-40.5	-1.5
2	10.0	-100.0	-15.5
3	20.0	17.0	17.5
4	30.0	1.5	-5.0
5	40.0	-5.0	4.0
6	50.0	-5.5	-5.0
7	60.0	1.5	-2.5
8	70.0	5.0	-3.0
9	80.0	2.5	-2.5
10	90.0	24.5	1.0
11	100.0	28.0	-2.0
12	110.0	25.5	6.0
13	120.0	17.0	-4.0
14	130.0	-2.5	-1.5
15	140.0	-16.5	-1.5
16	150.0	6.5	-1.0
17	160.0	-13.0	-5.5
18	170.0	-9.5	-1.0
19	180.0	14.5	-4.5
20	190.0	-6.0	-1.0
21	200.0	22.5	-1.5
22	210.0	22.0	0.0
23	220.0	1.5	0.5
24	230.0	-29.0	-0.5
25	240.0	-24.0	-3.0
26	250.0	14.0	-3.0

< Event 1 >

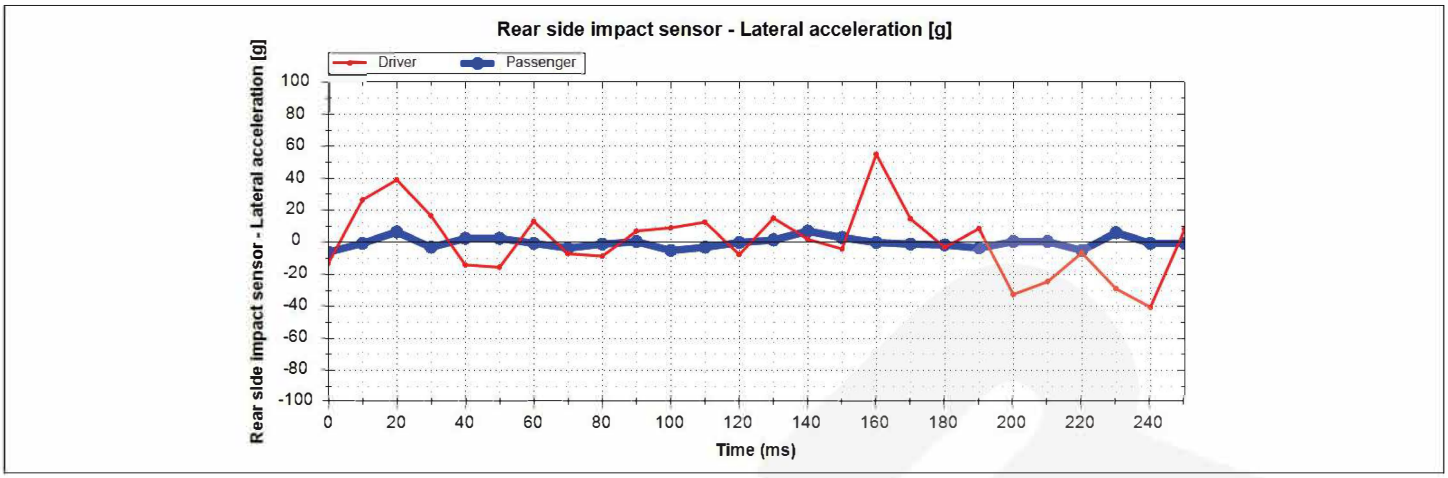
Front side Impact sensor - Longitudinal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Front driver side Impact sensor - Longitudinal acceleration [g]	Front passenger side Impact sensor - Longitudinal acceleration [g]
1	0.0	3.5	1.0
2	10.0	-10.0	-19.0
3	20.0	-3.5	-5.5
4	30.0	-4.0	-0.5
5	40.0	-1.0	-2.5
6	50.0	0.5	-2.5
7	60.0	1.5	0.5
8	70.0	-2.0	-1.0
9	80.0	4.5	-1.0
10	90.0	-3.5	-0.5
11	100.0	1.0	-2.0
12	110.0	-0.5	5.0
13	120.0	-10.5	-2.5
14	130.0	-7.0	5.5
15	140.0	3.5	0.5
16	150.0	-2.5	-3.5
17	160.0	13.0	0.5
18	170.0	-1.0	1.0
19	180.0	1.5	-0.5
20	190.0	3.0	0.5
21	200.0	0.5	-0.5
22	210.0	-5.0	0.5
23	220.0	-4.0	1.0
24	230.0	-15.5	-0.5
25	240.0	-2.5	-1.0
26	250.0	-2.0	0.5

‹ Event 1 ›

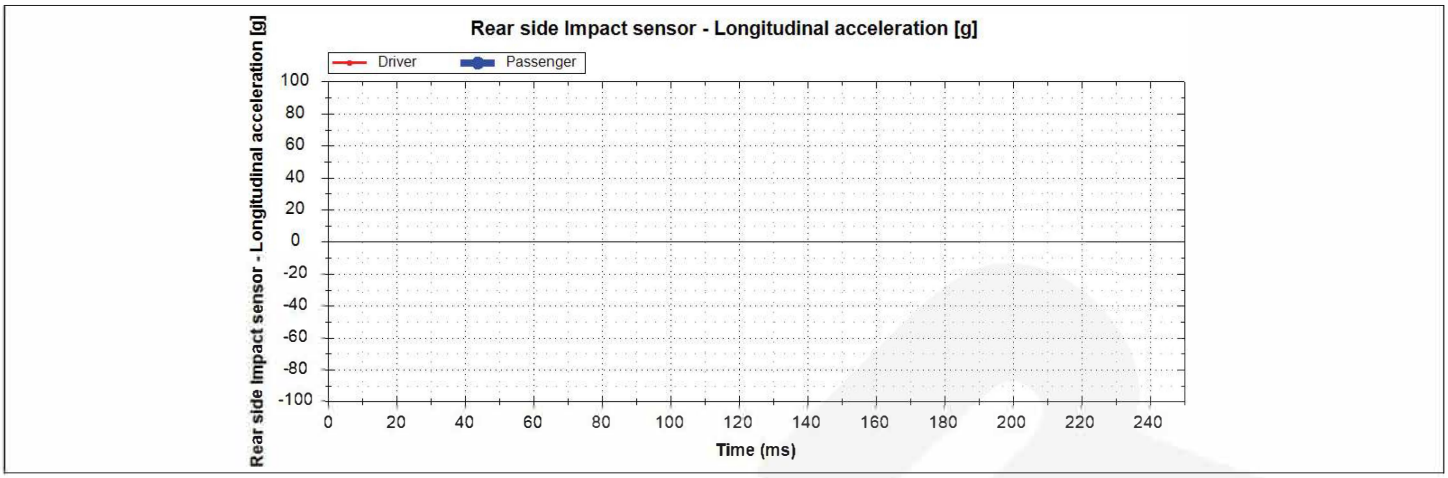
Rear side impact sensor – Lateral acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Rear driver side impact sensor – Lateral acceleration [g]	Rear passenger side impact sensor – Lateral acceleration [g]
1	0.0	-13.0	-6.0
2	10.0	26.5	-0.5
3	20.0	39.0	6.5
4	30.0	16.5	-3.0
5	40.0	-14.0	2.5
6	50.0	-15.5	2.5
7	60.0	13.0	-0.5
8	70.0	-7.0	-3.5
9	80.0	-8.5	-1.0
10	90.0	7.0	0.5
11	100.0	9.0	-5.0
12	110.0	12.5	-3.0
13	120.0	-7.5	0.0
14	130.0	15.0	1.5
15	140.0	2.0	7.0
16	150.0	-4.0	3.0
17	160.0	55.0	0.0
18	170.0	14.5	-1.0
19	180.0	-3.0	-1.5
20	190.0	8.5	-3.5
21	200.0	-32.5	0.5
22	210.0	-24.5	0.5
23	220.0	-6.5	-5.0
24	230.0	-29.0	6.0
25	240.0	-40.5	-0.5
26	250.0	8.0	-0.5

‹ Event 1 ›

Rear side Impact sensor – Longitudinal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Rear driver side Impact sensor – Longitudinal acceleration [g]	Rear passenger side Impact sensor – Longitudinal acceleration [g]
1	0.0	Not supported	Not supported
2	10.0	Not supported	Not supported
3	20.0	Not supported	Not supported
4	30.0	Not supported	Not supported
5	40.0	Not supported	Not supported
6	50.0	Not supported	Not supported
7	60.0	Not supported	Not supported
8	70.0	Not supported	Not supported
9	80.0	Not supported	Not supported
10	90.0	Not supported	Not supported
11	100.0	Not supported	Not supported
12	110.0	Not supported	Not supported
13	120.0	Not supported	Not supported
14	130.0	Not supported	Not supported
15	140.0	Not supported	Not supported
16	150.0	Not supported	Not supported
17	160.0	Not supported	Not supported
18	170.0	Not supported	Not supported
19	180.0	Not supported	Not supported
20	190.0	Not supported	Not supported
21	200.0	Not supported	Not supported
22	210.0	Not supported	Not supported
23	220.0	Not supported	Not supported
24	230.0	Not supported	Not supported
25	240.0	Not supported	Not supported
26	250.0	Not supported	Not supported

< Event 1 >

Hexadecimal data has been removed due to possible personally identifiable information.

Raw Data

< Event 2 >

Event Status at Event

Multi-event, Number of Event (1 or 2)	1 event
Time from Event 1 to 2 [msec]	0
Completed File Recorded (Yes or No)	YES
Ignition cycle, crash [cycle]	922
Ignition cycle, download [cycle]	926

Pre-Crash Information 1(-5 ~ 0 sec)

Time (sec)	Vehicle Speed [kph]	Engine RPM [rpm]	Engine Throttle [%]	Acceleration Pedal [%]	Master cylinder pressure [bar]	Service Brake [on/off]	ABS Activity [on/off]	Stability Control [on/off/engaged]	Steering Input [degree]
-5.0	104	2000	14	11	0.0	OFF	OFF	ON	0
-4.5	105	2000	14	11	0.0	OFF	OFF	ON	0
-4.0	105	2000	14	11	0.0	OFF	OFF	ON	0
-3.5	106	2000	15	11	0.0	OFF	OFF	ON	0
-3.0	107	2000	14	3	0.0	OFF	OFF	ON	10
-2.5	93	1800	9	54	0.0	OFF	OFF	Invalid data or Not Supported	45
-2.0	57	1300	0	0	3.9	ON	ON	Invalid data or Not Supported	140
-1.5	11	800	0	0	0.0	OFF	OFF	Invalid data or Not Supported	180
-1.0	10	800	0	0	0.0	OFF	OFF	Invalid data or Not Supported	105
-0.5	12	800	0	0	0.0	OFF	OFF	Invalid data or Not Supported	95
0.0	10	800	0	0	0.0	OFF	OFF	Invalid data or Not Supported	60

Pre-Crash Information 2 (-5 ~ 0 sec)

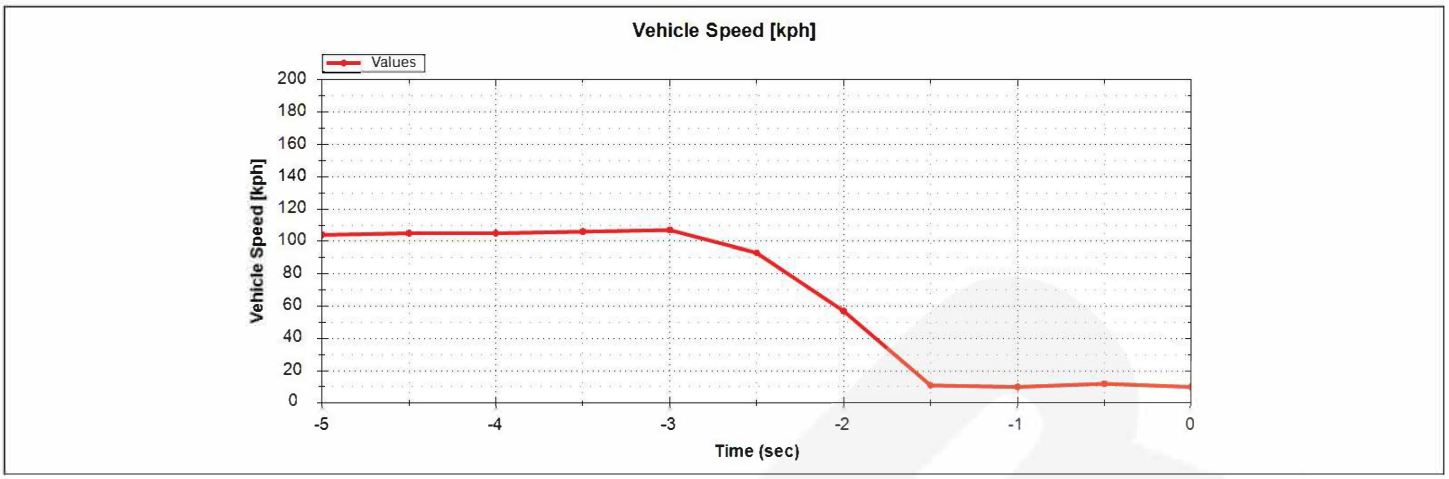
Time (sec)	Gear shift selector display	SCC information (Main switch status)	SCC information (Set Speed)	SCC information (SPEED UNIT)	SCC information (Mode status)	SCC information (Fail info)
-5.0	D	OFF	20	MPH	Ready	System without Error
-4.5	D	OFF	20	MPH	Ready	System without Error
-4.0	D	OFF	20	MPH	Ready	System without Error
-3.5	D	OFF	20	MPH	Ready	System without Error
-3.0	D	OFF	20	MPH	Ready	System without Error
-2.5	D	OFF	20	MPH	Ready	System without Error
-2.0	D	OFF	20	MPH	Ready	System without Error
-1.5	D	Invalid Data or Not Supported	Invalid data or Not Supported	MPH	Invalid or Not Supported	Invalid data or Not Supported
-1.0	D	Invalid Data or Not Supported	Invalid data or Not Supported	MPH	Invalid or Not Supported	Invalid data or Not Supported
-0.5	D	Invalid Data or Not Supported	Invalid data or Not Supported	MPH	Invalid or Not Supported	Invalid data or Not Supported
0.0	D	Invalid Data or Not Supported	Invalid data or Not Supported	MPH	Invalid or Not Supported	Invalid data or Not Supported

Pre-Crash Information 3 (-5 ~ 0 sec)

Time (sec)	FCA (Function status)	FCA (Warning Level)	FCA (Fail info)	Time (sec).	FCA (Function status).	FCA (Warning Level).	FCA (Fail info).
-5.0	ON	No Warning / Invalid or Not supported	Normal	-2.5	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.9	ON	No Warning / Invalid or Not supported	Normal	-2.4	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.8	ON	No Warning / Invalid or Not supported	Normal	-2.3	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.7	ON	No Warning / Invalid or Not supported	Normal	-2.2	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.6	ON	No Warning / Invalid or Not supported	Normal	-2.1	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.5	ON	No Warning / Invalid or Not supported	Normal	-2.0	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.4	ON	No Warning / Invalid or Not supported	Normal	-1.9	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.3	ON	No Warning / Invalid or Not supported	Normal	-1.8	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.2	ON	No Warning / Invalid or Not supported	Normal	-1.7	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.1	ON	No Warning / Invalid or Not supported	Normal	-1.6	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-4.0	ON	No Warning / Invalid or Not supported	Normal	-1.5	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.9	ON	No Warning / Invalid or Not supported	Normal	-1.4	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.8	ON	No Warning / Invalid or Not supported	Normal	-1.3	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.7	ON	No Warning / Invalid or Not supported	Normal	-1.2	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.6	ON	No Warning / Invalid or Not supported	Normal	-1.1	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.5	ON	No Warning / Invalid or Not supported	Normal	-1.0	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.4	ON	No Warning / Invalid or Not supported	Normal	-0.9	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.3	ON	No Warning / Invalid or Not supported	Normal	-0.8	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.2	ON	No Warning / Invalid or Not supported	Normal	-0.7	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.1	ON	No Warning / Invalid or Not supported	Normal	-0.6	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-3.0	ON	No Warning / Invalid or Not supported	Normal	-0.5	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.9	ON	No Warning / Invalid or Not supported	Normal	-0.4	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.8	ON	No Warning / Invalid or Not supported	Normal	-0.3	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.7	ON	No Warning / Invalid or Not supported	Normal	-0.2	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.6	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported	-0.1	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported
-2.5	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported	0.0	Invalid or Not supported	No Warning / Invalid or Not supported	Invalid data or Not Supported

< Event 2 >

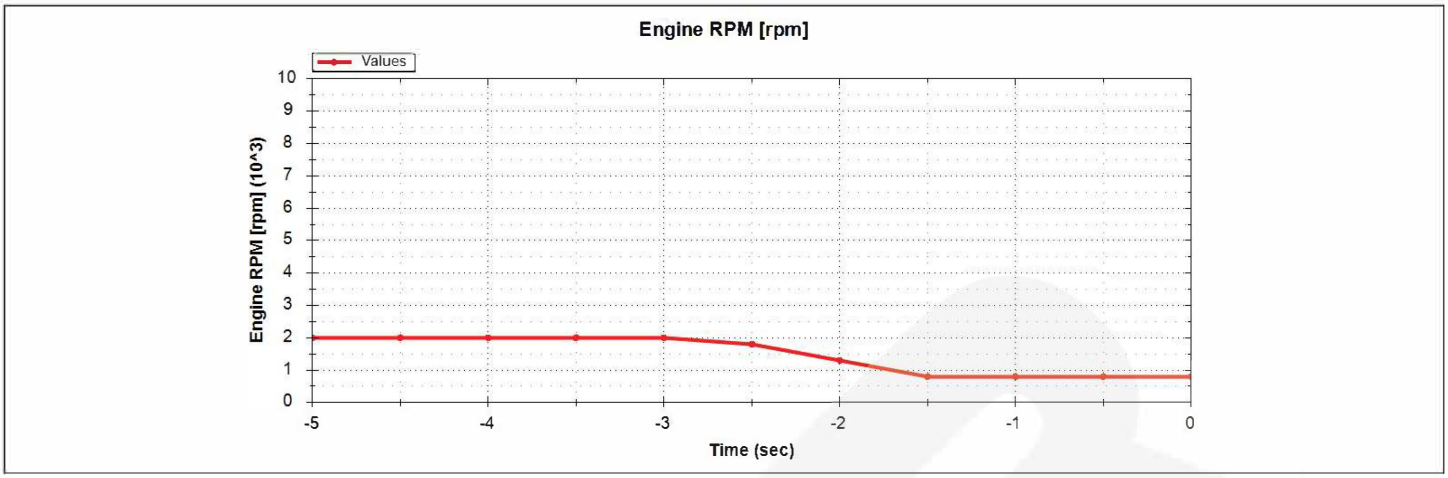
Vehicle Speed



Num	Time (sec)	Vehicle Speed [kph]
1	-5.0	104
2	-4.5	105
3	-4.0	105
4	-3.5	106
5	-3.0	107
6	-2.5	93
7	-2.0	57
8	-1.5	11
9	-1.0	10
10	-0.5	12
11	0.0	10

< Event 2 >

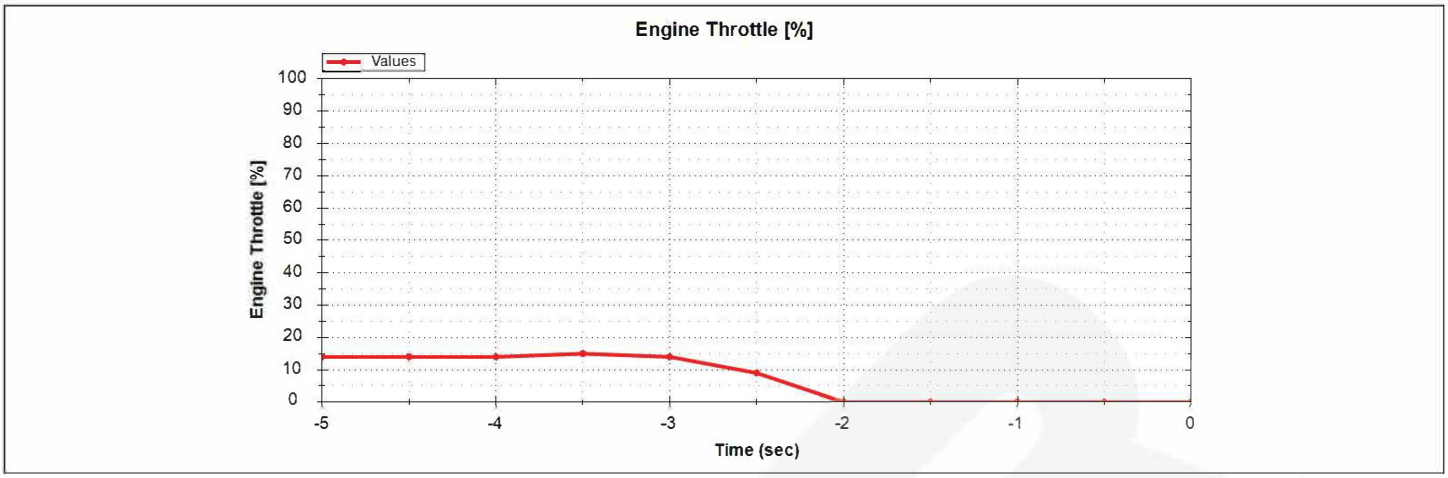
Engine RPM



Num	Time (sec)	Engine RPM [rpm]
1	-5.0	2000
2	-4.5	2000
3	-4.0	2000
4	-3.5	2000
5	-3.0	2000
6	-2.5	1800
7	-2.0	1300
8	-1.5	800
9	-1.0	800
10	-0.5	800
11	0.0	800

< Event 2 >

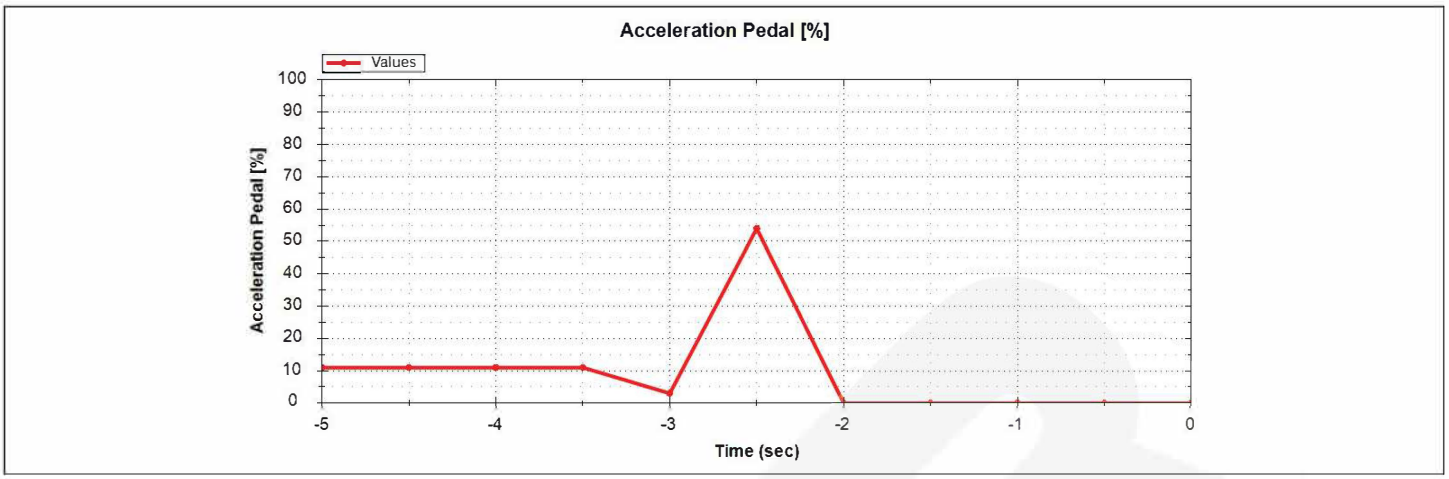
Engine Throttle



Num	Time (sec)	Engine Throttle [%]
1	-5.0	14
2	-4.5	14
3	-4.0	14
4	-3.5	15
5	-3.0	14
6	-2.5	9
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	0

< Event 2 >

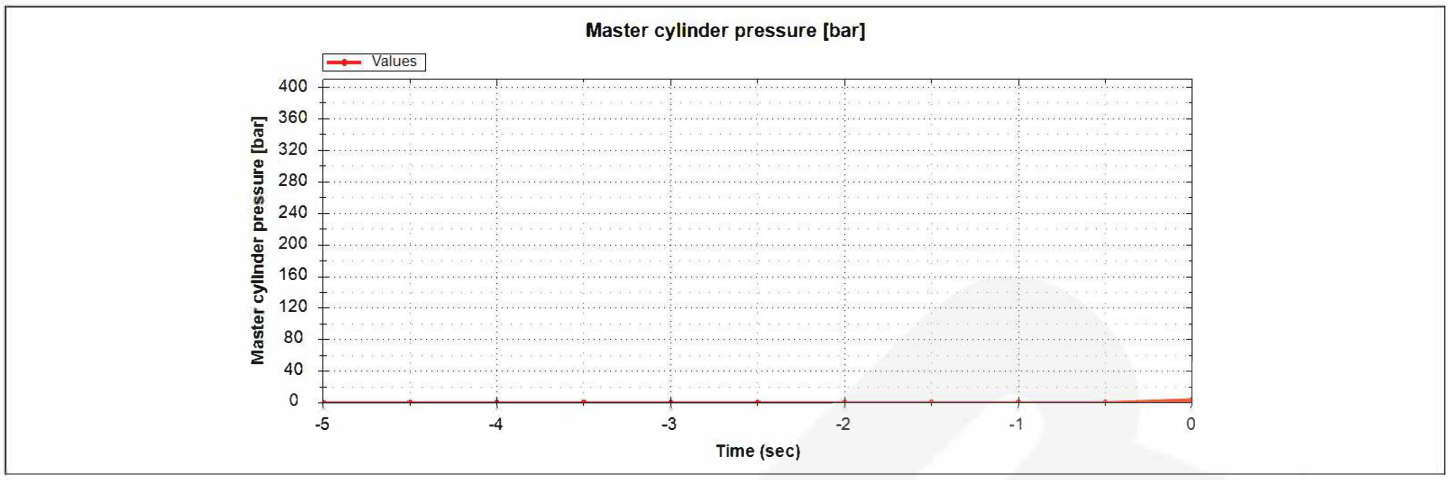
Acceleration Pedal



Num	Time (sec)	Acceleration Pedal [%]
1	-5.0	11
2	-4.5	11
3	-4.0	11
4	-3.5	11
5	-3.0	3
6	-2.5	54
7	-2.0	0
8	-1.5	0
9	-1.0	0
10	-0.5	0
11	0.0	0

‹ Event 2 ›

Master cylinder pressure



< Event 2 >

Service Brake

Num	Time (sec)	Service Brake [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	ON
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	OFF

ABS Activity

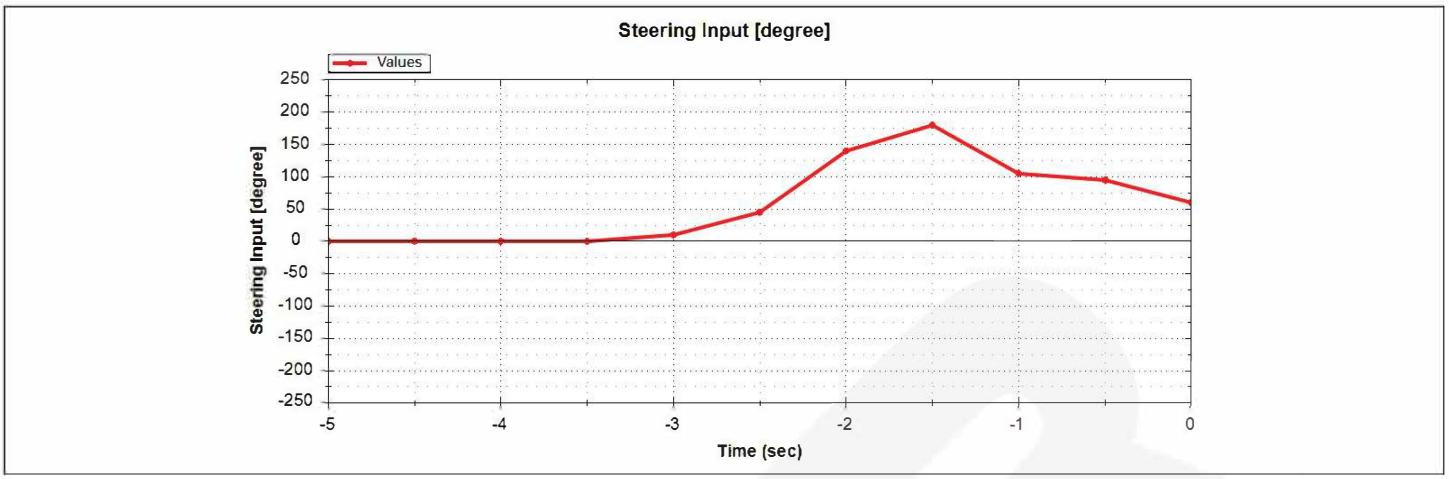
Num	Time (sec)	ABS Activity [on/off]
1	-5.0	OFF
2	-4.5	OFF
3	-4.0	OFF
4	-3.5	OFF
5	-3.0	OFF
6	-2.5	OFF
7	-2.0	ON
8	-1.5	OFF
9	-1.0	OFF
10	-0.5	OFF
11	0.0	OFF

Stability Control

Num	Time (sec)	Stability Control [on/off/engaged]
1	-5.0	ON
2	-4.5	ON
3	-4.0	ON
4	-3.5	ON
5	-3.0	ON
6	-2.5	Invalid data or Not Supported
7	-2.0	Invalid data or Not Supported
8	-1.5	Invalid data or Not Supported
9	-1.0	Invalid data or Not Supported
10	-0.5	Invalid data or Not Supported
11	0.0	Invalid data or Not Supported

< Event 2 >

Steering Input



Num	Time (sec)	Steering Input [degree]
1	-5.0	0
2	-4.5	0
3	-4.0	0
4	-3.5	0
5	-3.0	10
6	-2.5	45
7	-2.0	140
8	-1.5	180
9	-1.0	105
10	-0.5	95
11	0.0	60

Note) Positive value(CCW), Negative value(CW)

< Event 2 >

System Status at Event

Airbag warning lamp on/off	ON
Safety seat belt status, driver	ON
Safety seat belt status, passenger	ON
Seat track position switch foremost status, driver	Not Supported
Seat track position switch foremost status, passenger	Not Supported
Occupant size classification, driver (5% female or larger)	Not Supported
Occupant size classification, passenger (child)	NO

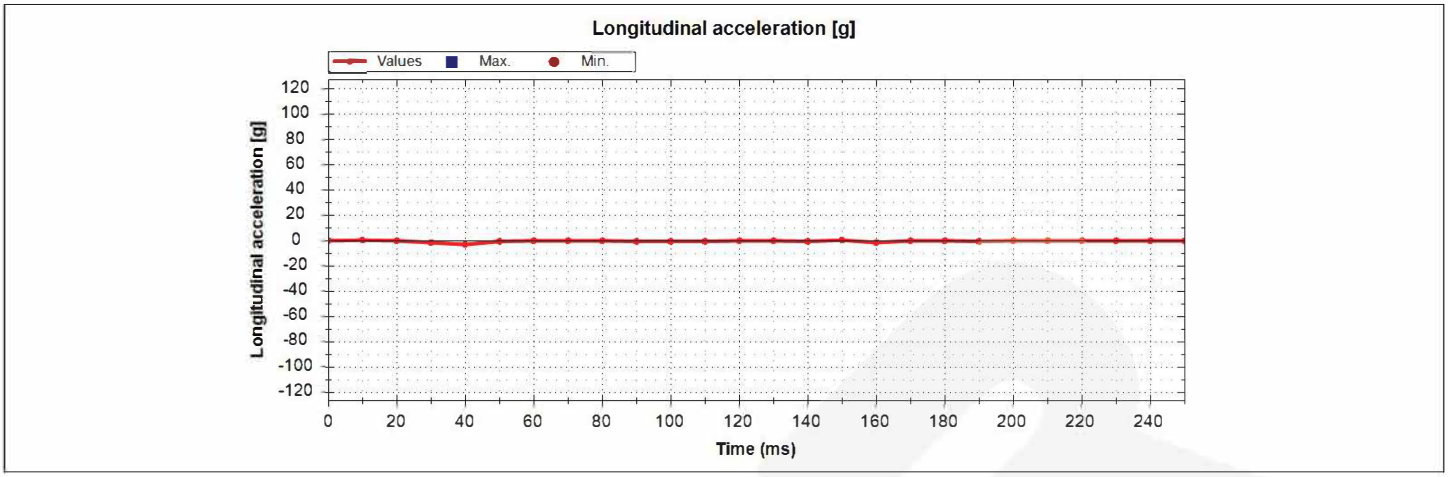
Deployment Command Data at Event

Front airbag deployment time, driver (first stage) [msec]	No deployment
Front airbag deployment time, passenger (first stage) [msec]	No deployment
Front airbag deployment time, driver (second stage) [msec]	No deployment
Front airbag deployment time, passenger (second stage) [msec]	No deployment
Front airbag deployment time, driver (third stage) [msec]	Not supported
Front airbag deployment time, passenger (third stage) [msec]	Not supported
Front airbag deployment time, passenger (4th stage) [msec]	Not supported
Front airbag disposal deployment, driver (second stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (second stage) (Yes or No)	NO
Front airbag disposal deployment, driver (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (third stage) (Yes or No)	NO
Front airbag disposal deployment, passenger (4th stage) (Yes or No)	NO
Knee airbag deployment time,driver [msec]	Not supported
Knee airbag deployment time,passenger [msec]	Not supported
Front side airbag deployment time, driver [msec]	0
Front side airbag deployment time, passenger [msec]	0
Rear side airbag deployment time,driver [msec]	Not supported
Rear side airbag deployment time,passenger [msec]	Not supported
Curtain airbag deployment time, driver [msec]	0
Curtain airbag deployment time, passenger [msec]	0
Rear curtain airbag deployment time,driver [msec]	Not supported
Rear curtain airbag deployment time,passenger [msec]	Not supported
Seat belt pretensioner deployment time, driver [msec]	0
Seat belt pretensioner deployment time, passenger [msec]	0
Rear belt pretensioner deployment time,driver [msec]	Not supported

Rear belt pretensioner deployment time,passenger [msec]	Not supported
Anchor pretensioner deployment time,driver [msec]	0
Anchor pretensioner deployment time,passenger [msec]	0
Adaptive load limiter deployment time,driver [msec]	Not supported
Adaptive load limiter deployment time,passenger [msec]	Not supported
Front Center side airbag deployment time [msec]	Not supported

‹ Event 2 ›

Longitudinal crash pulse_acceleration (g, 0 ~ 250msec)

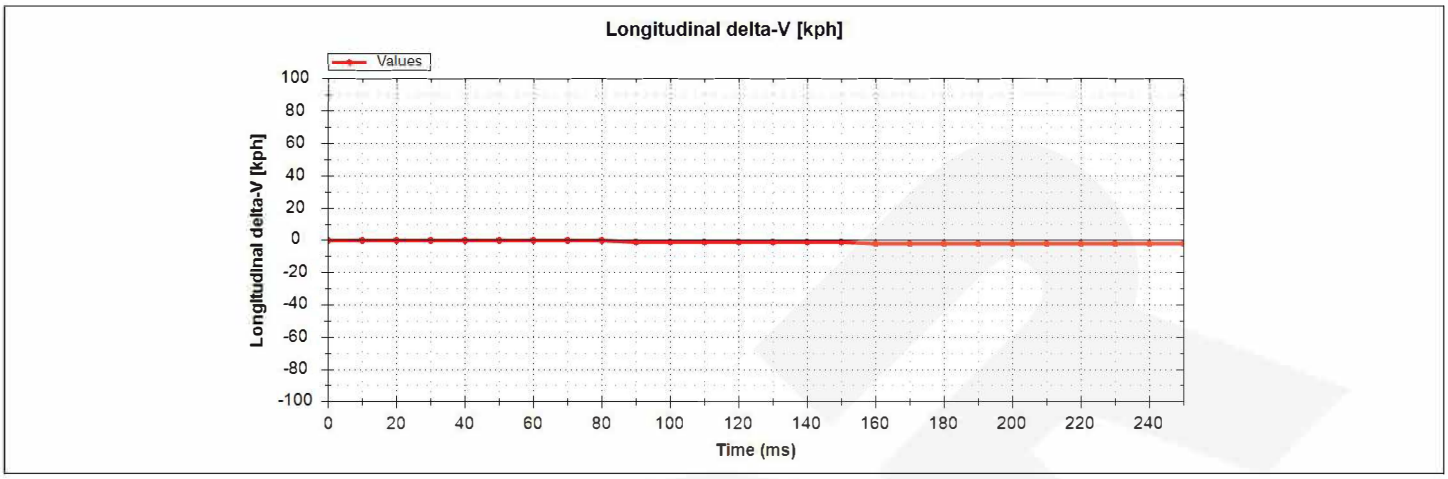


Num	Time (ms)	Longitudinal acceleration [g]
1	0.0	0.0
2	10.0	0.5
3	20.0	0.0
4	30.0	-1.5
5	40.0	-3.0
6	50.0	-0.5
7	60.0	0.0
8	70.0	0.0
9	80.0	0.0
10	90.0	-0.5
11	100.0	-0.5
12	110.0	-0.5
13	120.0	0.0
14	130.0	0.0
15	140.0	-0.5
16	150.0	0.5
17	160.0	-1.5
18	170.0	0.0
19	180.0	0.0
20	190.0	-0.5
21	200.0	0.0
22	210.0	0.0
23	220.0	0.0
24	230.0	0.0
25	240.0	0.0
26	250.0	0.0

‹ Event 2 ›

Longitudinal crash pulse_delta-v (kph, 0 ~ 250msec)

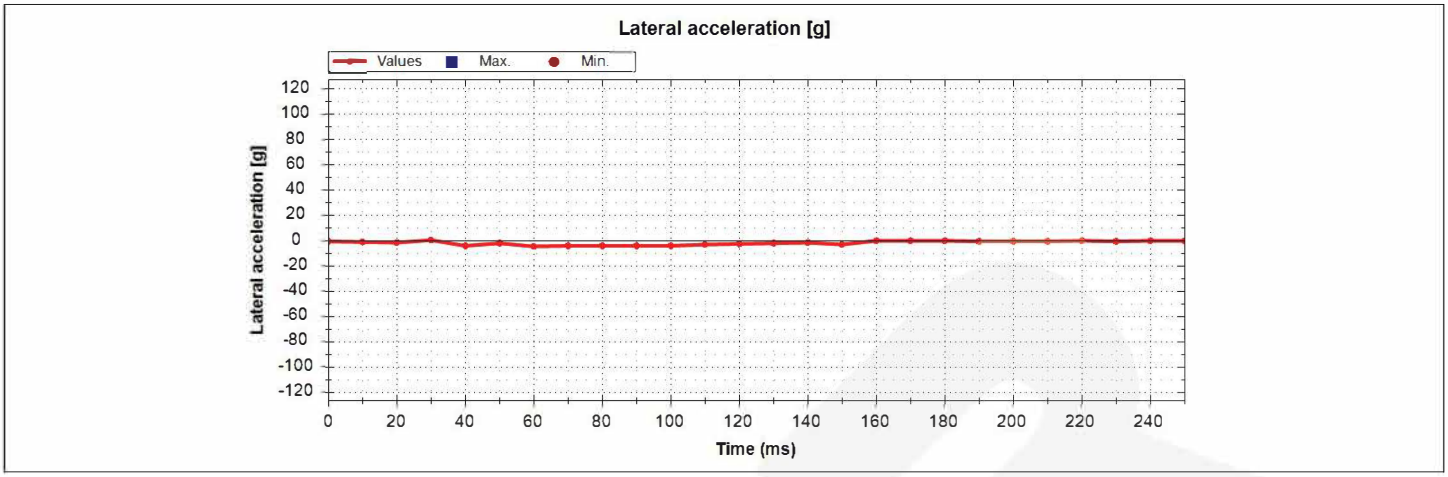
Max. delta-V [kph]	-2
Time, Max. delta-V [msec]	205.0



Num	Time (ms)	Longitudinal delta-V [kph]
1	0.0	0
2	10.0	0
3	20.0	0
4	30.0	0
5	40.0	0
6	50.0	0
7	60.0	0
8	70.0	0
9	80.0	0
10	90.0	-1
11	100.0	-1
12	110.0	-1
13	120.0	-1
14	130.0	-1
15	140.0	-1
16	150.0	-1
17	160.0	-2
18	170.0	-2
19	180.0	-2
20	190.0	-2
21	200.0	-2
22	210.0	-2
23	220.0	-2
24	230.0	-2
25	240.0	-2
26	250.0	-2

‹ Event 2 ›

Lateral crash pulse_acceleration (g, 0 ~ 250msec)

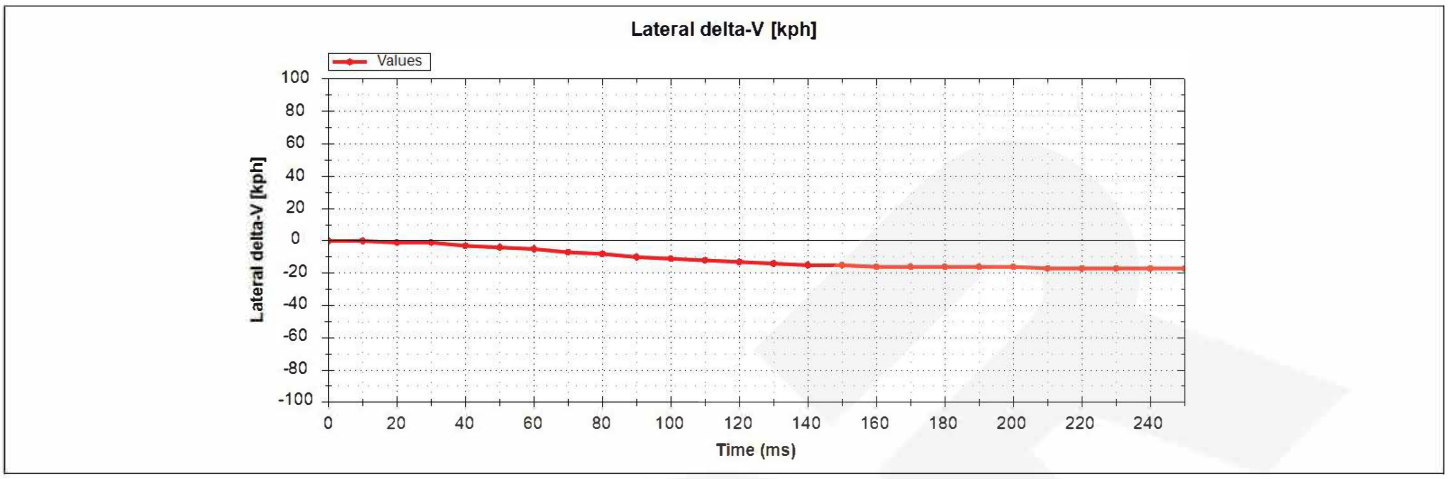


Num	Time (ms)	Lateral acceleration [g]
1	0.0	-0.5
2	10.0	-1.0
3	20.0	-1.5
4	30.0	0.5
5	40.0	-4.0
6	50.0	-2.0
7	60.0	-4.5
8	70.0	-4.0
9	80.0	-4.0
10	90.0	-4.0
11	100.0	-4.0
12	110.0	-3.0
13	120.0	-2.5
14	130.0	-2.0
15	140.0	-1.5
16	150.0	-3.0
17	160.0	0.0
18	170.0	0.0
19	180.0	0.0
20	190.0	-0.5
21	200.0	-0.5
22	210.0	-0.5
23	220.0	0.0
24	230.0	-0.5
25	240.0	0.0
26	250.0	0.0

‹ Event 2 ›

Lateral crash pulse_delta-v (kph, 0 ~ 250msec)

Max. delta-V [kph]	-18
Time, Max. delta-V [msec]	300.0



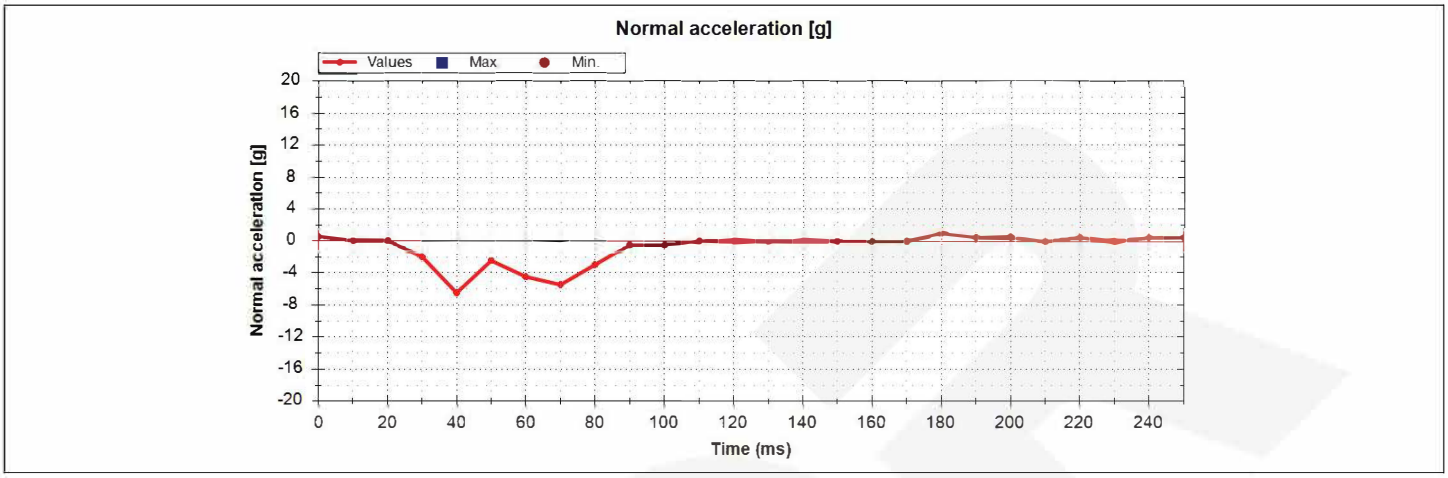
Num	Time (ms)	Lateral delta-V [kph]
1	0.0	0
2	10.0	0
3	20.0	-1
4	30.0	-1
5	40.0	-3
6	50.0	-4
7	60.0	-5
8	70.0	-7
9	80.0	-8
10	90.0	-10
11	100.0	-11
12	110.0	-12
13	120.0	-13
14	130.0	-14
15	140.0	-15
16	150.0	-15
17	160.0	-16
18	170.0	-16
19	180.0	-16
20	190.0	-16
21	200.0	-16
22	210.0	-17
23	220.0	-17
24	230.0	-17
25	240.0	-17
26	250.0	-17

‹ Event 2 ›

Crash pulse Resultant, Time_Max. delta-V resultant (0 ~ 300 msec)

Time, Max. delta-V, resultant [msec]	300.0

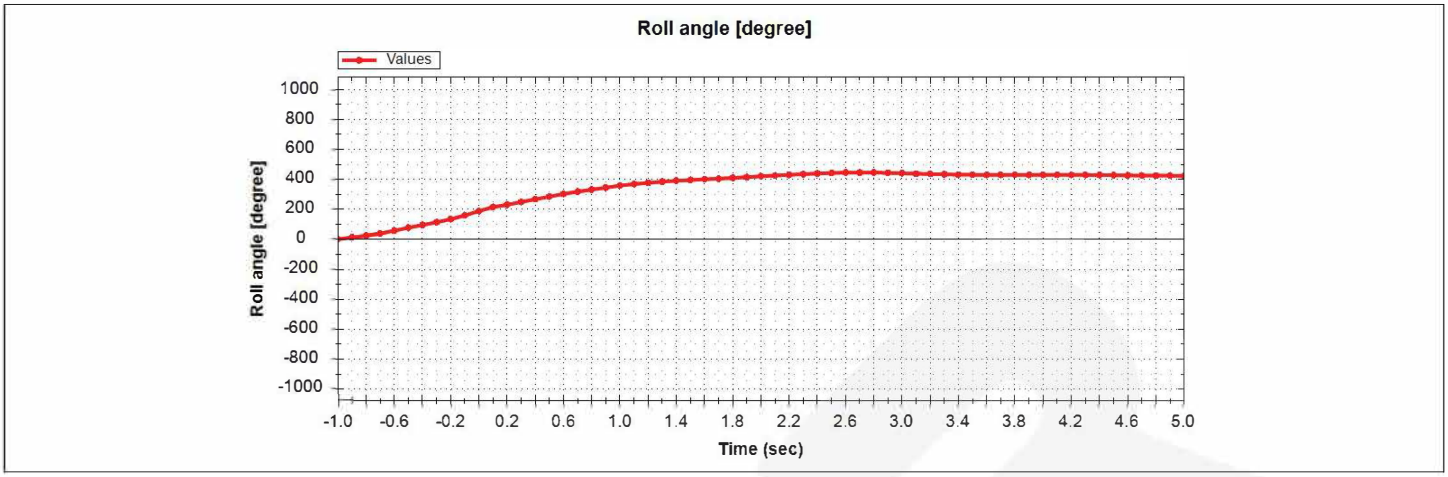
Normal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Normal acceleration [g]
1	0.0	0.5
2	10.0	0.0
3	20.0	0.0
4	30.0	-2.0
5	40.0	-6.5
6	50.0	-2.5
7	60.0	-4.5
8	70.0	-5.5
9	80.0	-3.0
10	90.0	-0.5
11	100.0	-0.5
12	110.0	0.0
13	120.0	0.0
14	130.0	0.0
15	140.0	0.0
16	150.0	0.0
17	160.0	0.0
18	170.0	0.0
19	180.0	1.0
20	190.0	0.5
21	200.0	0.5
22	210.0	0.0
23	220.0	0.5
24	230.0	0.0
25	240.0	0.5
26	250.0	0.5

< Event 2 >

Roll angle (degree, -1 ~ 5sec)

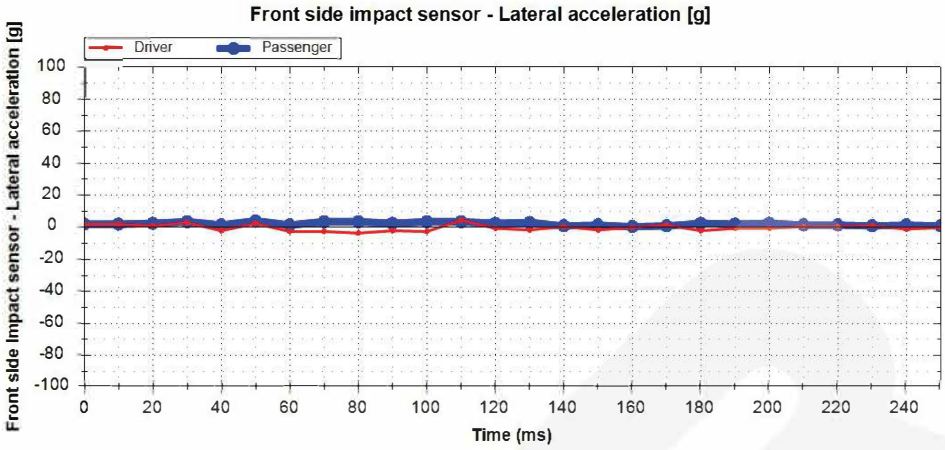


Num	Time (sec)	Roll angle [degree]
1	-1.0	2
2	-0.9	14
3	-0.8	25
4	-0.7	39
5	-0.6	57
6	-0.5	77
7	-0.4	95
8	-0.3	113
9	-0.2	134
10	-0.1	159
11	0.0	188
12	0.1	215
13	0.2	230
14	0.3	249
15	0.4	267
16	0.5	285
17	0.6	303
18	0.7	318
19	0.8	332
20	0.9	345
21	1.0	359
22	1.1	369
23	1.2	377
24	1.3	385
25	1.4	391
26	1.5	396
27	1.6	401
28	1.7	405
29	1.8	410
30	1.9	415
31	2.0	421

32	2.1	426
33	2.2	431
34	2.3	435
35	2.4	440
36	2.5	443
37	2.6	446
38	2.7	446
39	2.8	446
40	2.9	444
41	3.0	441
42	3.1	438
43	3.2	436
44	3.3	434
45	3.4	432
46	3.5	431
47	3.6	430
48	3.7	430
49	3.8	430
50	3.9	430
51	4.0	430
52	4.1	430
53	4.2	430
54	4.3	430
55	4.4	429
56	4.5	428
57	4.6	427
58	4.7	426
59	4.8	425
60	4.9	425
61	5.0	424

‹ Event 2 ›

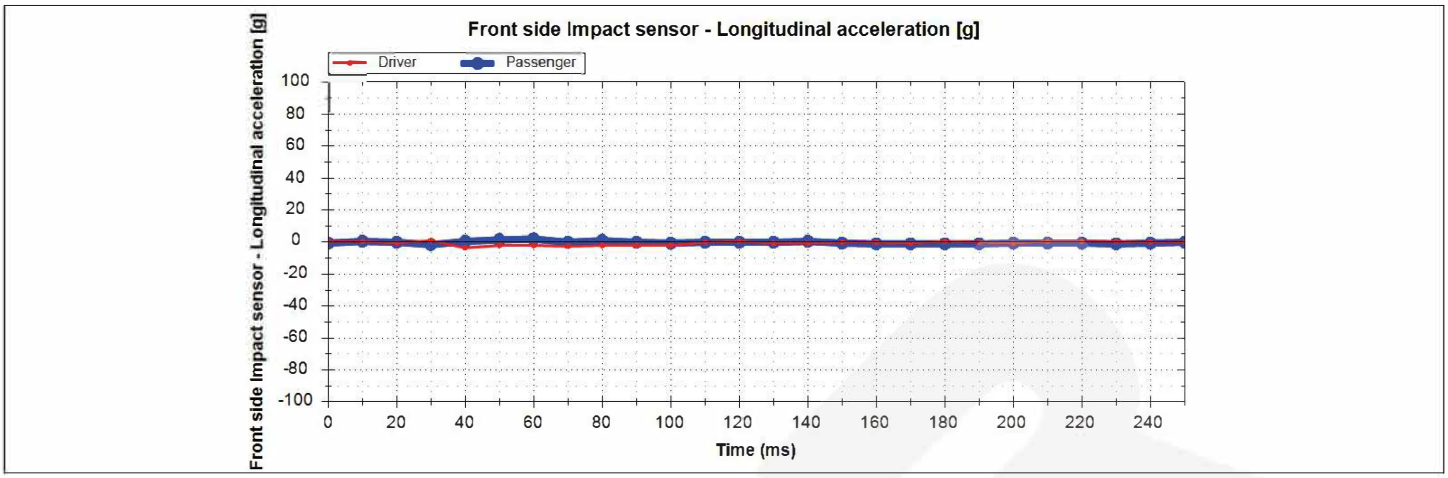
Front side impact sensor - Lateral acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Front driver side impact sensor - Lateral acceleration [g]	Front passenger side impact sensor - Lateral acceleration [g]
1	0.0	2.0	2.0
2	10.0	2.0	2.0
3	20.0	1.0	2.5
4	30.0	3.0	3.5
5	40.0	-2.0	1.5
6	50.0	2.5	4.0
7	60.0	-2.5	1.5
8	70.0	-2.5	3.5
9	80.0	-3.5	3.5
10	90.0	-2.0	2.5
11	100.0	-2.5	3.5
12	110.0	4.5	3.5
13	120.0	-0.5	2.5
14	130.0	-1.5	3.0
15	140.0	0.5	1.0
16	150.0	-1.5	1.5
17	160.0	0.0	0.5
18	170.0	1.5	1.0
19	180.0	-2.0	2.5
20	190.0	-0.5	2.0
21	200.0	-0.5	2.5
22	210.0	0.5	1.5
23	220.0	0.5	1.5
24	230.0	1.0	1.0
25	240.0	-1.0	1.5
26	250.0	0.0	1.0

‹ Event 2 ›

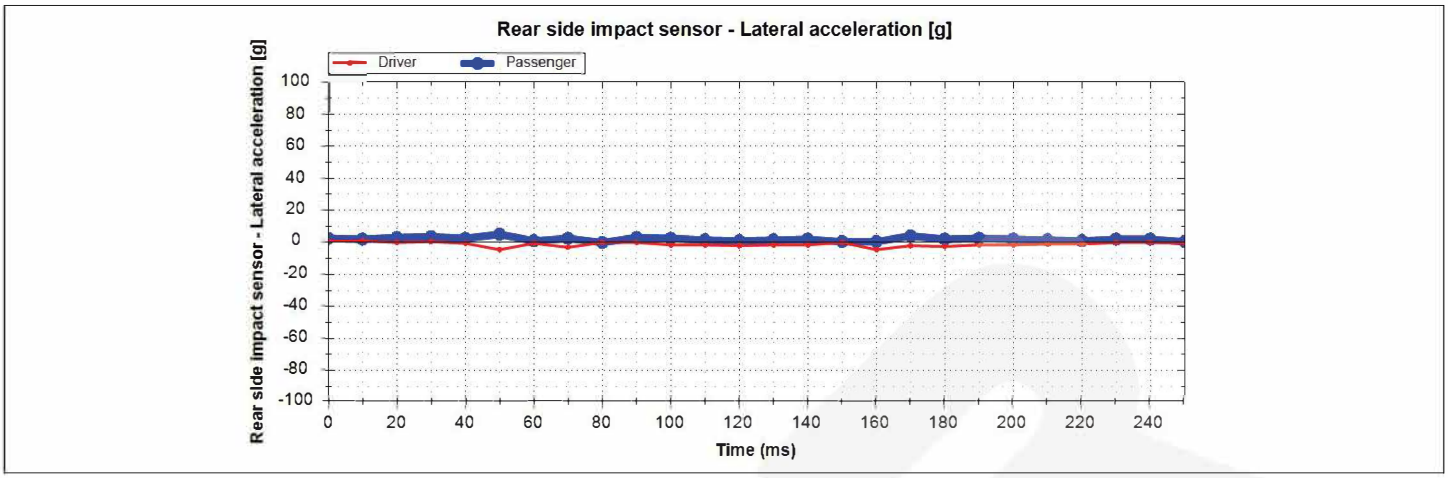
Front side Impact sensor – Longitudinal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Front driver side Impact sensor – Longitudinal acceleration [g]	Front passenger side Impact sensor – Longitudinal acceleration [g]
1	0.0	0.5	-0.5
2	10.0	0.5	0.5
3	20.0	-0.5	0.0
4	30.0	1.0	-1.5
5	40.0	-3.5	0.5
6	50.0	-2.0	1.5
7	60.0	-2.0	2.0
8	70.0	-2.5	0.0
9	80.0	-2.0	1.0
10	90.0	-2.0	0.0
11	100.0	-2.0	-0.5
12	110.0	0.0	0.0
13	120.0	0.5	0.0
14	130.0	-0.5	0.0
15	140.0	-0.5	0.5
16	150.0	0.0	-0.5
17	160.0	0.0	-1.0
18	170.0	-0.5	-1.0
19	180.0	0.5	-1.0
20	190.0	0.0	-1.0
21	200.0	-0.5	-0.5
22	210.0	0.5	-0.5
23	220.0	0.5	-0.5
24	230.0	0.5	-1.0
25	240.0	0.0	-0.5
26	250.0	0.0	0.0

‹ Event 2 ›

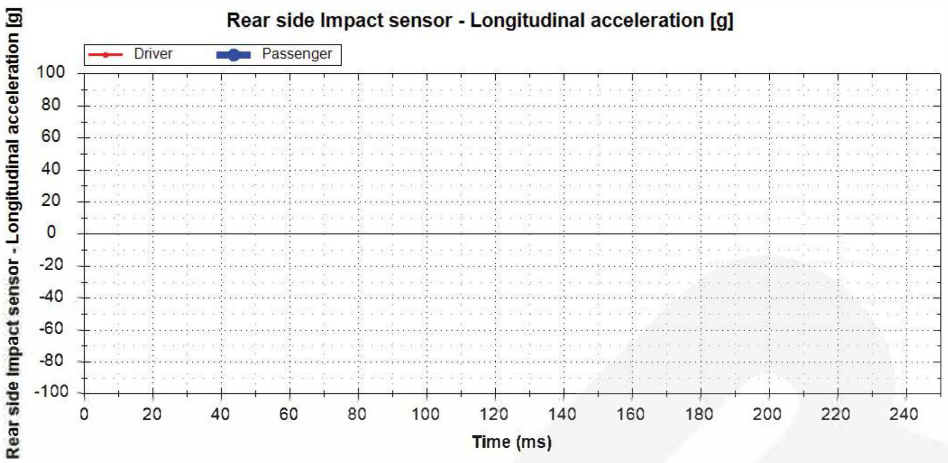
Rear side impact sensor – Lateral acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Rear driver side impact sensor – Lateral acceleration [g]	Rear passenger side impact sensor – Lateral acceleration [g]
1	0.0	1.0	2.5
2	10.0	1.0	2.0
3	20.0	0.0	3.0
4	30.0	0.5	3.5
5	40.0	-0.5	2.5
6	50.0	-4.5	5.0
7	60.0	-0.5	1.0
8	70.0	-3.0	2.5
9	80.0	0.0	0.0
10	90.0	0.0	3.0
11	100.0	-1.5	2.5
12	110.0	-1.5	1.5
13	120.0	-2.0	1.0
14	130.0	-1.5	1.5
15	140.0	-1.5	2.0
16	150.0	0.0	0.5
17	160.0	-4.5	0.5
18	170.0	-2.0	4.0
19	180.0	-2.5	2.0
20	190.0	-1.5	2.5
21	200.0	-1.5	2.0
22	210.0	-1.0	1.5
23	220.0	-1.0	1.0
24	230.0	0.0	2.0
25	240.0	0.0	2.0
26	250.0	-0.5	0.5

‹ Event 2 ›

Rear side Impact sensor – Longitudinal acceleration (g, 0 ~ 250msec)



Num	Time (ms)	Rear driver side Impact sensor – Longitudinal acceleration [g]	Rear passenger side Impact sensor – Longitudinal acceleration [g]
1	0.0	Not supported	Not supported
2	10.0	Not supported	Not supported
3	20.0	Not supported	Not supported
4	30.0	Not supported	Not supported
5	40.0	Not supported	Not supported
6	50.0	Not supported	Not supported
7	60.0	Not supported	Not supported
8	70.0	Not supported	Not supported
9	80.0	Not supported	Not supported
10	90.0	Not supported	Not supported
11	100.0	Not supported	Not supported
12	110.0	Not supported	Not supported
13	120.0	Not supported	Not supported
14	130.0	Not supported	Not supported
15	140.0	Not supported	Not supported
16	150.0	Not supported	Not supported
17	160.0	Not supported	Not supported
18	170.0	Not supported	Not supported
19	180.0	Not supported	Not supported
20	190.0	Not supported	Not supported
21	200.0	Not supported	Not supported
22	210.0	Not supported	Not supported
23	220.0	Not supported	Not supported
24	230.0	Not supported	Not supported
25	240.0	Not supported	Not supported
26	250.0	Not supported	Not supported

< Event 2 >

Hexadecimal data has been removed due to possible personally identifiable information.

Raw Data

DOT HS 813 636
November 2024

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

16409-102824-v3