



U.S. Department  
of Transportation

**National Highway  
Traffic Safety  
Administration**



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DOT HS 813 239

January 2022

**Special Crash Investigations:  
On-Site Crash Avoidance Technology  
Investigation;  
Vehicle: 2017 Honda Civic Touring;  
Location: Florida;  
Crash Date: December 2019**

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Suggested APA Format Citation:

Crash Research & Analysis, Inc. (2022, January). *Special crash investigations: On-site crash avoidance technology investigation; Vehicle: 2017 Honda Civic Touring; Location: Florida; Crash date: December 2019* (Report No. DOT HS 813 239). National Highway Traffic Safety Administration.

## Technical Report Documentation Page

<b>1. Report No.</b> DOT HS 813 239	<b>2. Government Accession No.</b>	<b>3. Recipient's Catalog No.</b>	
<b>4. Title and Subtitle</b> Special Crash Investigations: On-Site Crash Avoidance Technology Investigation; Vehicle: 2017 Honda Civic Touring; Location: Florida; Crash Date: December 2019		<b>5. Report Date</b> January 2022	
		<b>6. Performing Organization Code</b>	
<b>7. Author</b> Crash Research & Analysis, Inc.		<b>8. Performing Organization Report No.</b> CR20007	
<b>9. Performing Organization Name and Address</b> Crash Research & Analysis, Inc. P.O. Box 302 Elma, NY 14059		<b>10. Work Unit No. (TRAIS)</b>	
		<b>11. Contract or Grant No.</b> 693JJ919RQ000616	
<b>12. Sponsoring Agency Name and Address</b> National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		<b>13. Type of Report and Period Covered</b> Technical Report	
		<b>14. Sponsoring Agency Code</b>	
<b>15. Supplementary Notes</b>  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 published.			
<b>16. Abstract</b>  This report documents the on-site investigation of the frontal crash of a 2017 Honda Civic into a QuadGuard II impact attenuator that protected the blunt end of a concrete Jersey barrier. The police crash report stated that the driver fell asleep at the wheel and drifted off the roadway. The Honda had crash avoidance systems, including forward collision warning with crash imminent braking, roadway departure mitigation, lane departure warning with lane keeping assist, blind spot detection, adaptive cruise control, dynamic brake support, daytime running lights, and a rearview video system. The Honda's belted 33-year-old male driver did not detect the vehicle drifting off the roadway, and the front right corner of the Honda struck the impact attenuator. The PCR reported no injuries to the driver.  Through the course of the investigation, it was determined that the imaged EDR data indicated the crash avoidance systems were "On" at the time of the crash; however, no warnings were issued. The SCI crash reconstruction determined that the lane departure occurred at the mouth of an exit ramp in a section of the roadway, where the right lane line had diverged to the right. The Honda did not cross a painted line during its pre-crash travel. It should be noted that the Honda did drive over the painted lane lines at the mouth of the exit and that these lane lines were centered to the front of the vehicle when they were driven over.			
<b>17. Key Words</b>  crash avoidance, impact attenuator, QuadGuard, FCW, CIB, RDM, LDW, LKAS, ACC		<b>18. Distribution Statement</b>  This document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, <a href="https://rosap.ntl.bts.gov">rosap.ntl.bts.gov</a> .	
<b>19 Security Classif. (of this report)</b> Unclassified	<b>20. Security Classif. (of this page)</b> Unclassified	<b>21. No. of Pages</b> 42	<b>22. Price</b>

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**Special Crash Investigations**  
**On-Site Crash Avoidance Technology Investigation**  
**Case Number: CR20007**  
**Vehicle: 2017 Honda Civic Touring**  
**Location: Florida**  
**Crash Date: December 2019**

## **Background**

This report documents the on-site investigation of the frontal crash of a 2017 Honda Civic (Figure 1) into a QuadGuard II impact attenuator that protected the blunt end of a concrete Jersey barrier. The police crash report (PCR) reported that the driver fell asleep at the wheel and drifted off the roadway to the right. The Honda was equipped with multiple crash avoidance (CA) systems, including forward collision warning (FCW) with crash imminent braking (CIB), roadway departure mitigation (RDM), lane departure warning (LDW) with lane keeping assist (LKAS), blind spot detection, adaptive cruise control (ACC), dynamic brake support, daytime running lights, and a rearview video system. The Honda's belted 33-year-old male driver did not detect the vehicle drifting off the roadway, and the front right corner of the Honda struck the impact attenuator. The PCR reported no injuries to the driver.



*Figure 1. Front view of the 2017 Honda during the SCI investigation*

The crash was identified by the Crash Report Sampling System in February 2020, with notification provided to the Crash Investigation Division of the National Highway Traffic Safety Administration. The PCR was forwarded to the Special Crash Investigations (SCI) team at Crash Research and Analysis, Inc., and assigned for an on-site investigation on February 10, 2020. The on-site portion of this investigation took place in February 2020.

On-site activities included the exterior and interior inspections of the Honda to measure the exterior deformation, interior damage, document occupant contacts, examine the manual and supplemental restraint systems, and verify the equipped CA systems. The Honda was equipped with an Event Data Recorder (EDR), which was imaged during the inspection process using the current version of the Bosch Crash Data Retrieval tool and software. The crash site was photographed. The SCI team has been unable to contact the driver.

Through the course of the investigation, it was determined that the imaged EDR data indicated the crash avoidance systems were “On” at the time of the crash; however, no warnings were issued. The SCI crash reconstruction determined that the lane departure occurred at the mouth of an exit ramp in a section of the roadway, where the right lane line had diverged to the right. The Honda did not laterally cross a painted line during its pre-crash travel.

## Summary

### Crash Site

This crash occurred on a multi-lane, limited access roadway in an urban setting during daytime. Reported weather conditions at the locale included cloudy skies, light rain, a temperature of 21.7 °C (71 °F), an 87-percent relative humidity, and calm winds. In the southbound travel direction, the roadway was straight and level with four travel lanes, each approximately 3.7 m (12 ft) wide. They were delineated by broken white lines, with a single solid yellow median line and a single solid white fog line that were clear and visible. A concrete median barrier physically divided the southbound traffic from the northbound traffic. There was an exit off the far-right lane that was separated from the four travel lanes by a Jersey barrier with the impact attenuator on the north end of it. Figure 2 depicts a south-facing view of the roadway on approach to the crash site. Speed was regulated by a posted limited of 113 km/h (70 mph). A crash diagram is included at the end of this report.

### Pre-Crash

The Honda traveled south on the roadway, driven by a belted 33-year-old male. According to the PCR, he fell asleep and drifted right into the impact attenuator. However, during the SCI investigation, it was determined that the vehicle drifted to the right and entered the mouth of an exit lane (Figure 3) approximately seven seconds prior to algorithm enabled (AE). The vehicle began drifting back left at the top of the painted gore (highlighted by red arrows in Figure 3). The vehicle never laterally crossed a painted lane line. Rather, the painted lane line at the top of the painted gore was driven over by the front of the vehicle. Data imaged from the vehicle's EDR indicated that the Honda was traveling at a speed of 84 km/h (52 mph) 5.0 seconds prior to AE and increasing its travel speed to 87 km/h (54 mph) 1.5 seconds prior to AE. The FCW, CIB, roadway departure mitigation/LDW, ACC, and lane keeping assist systems were all "On." No warnings were recorded by the EDR. As the Honda approached the impact attenuator, the EDR indicated that the driver attempted avoidance by steering to the left and braking.



*Figure 2. Southbound view of the Honda's pre-crash approach to the crash site*



*Figure 3. Southbound view of the original travel lane and the exit travel lane lines where they meet*

### Crash

The front plane, right aspect of the Honda struck the impact attenuator. The directions of force were within the 12 o'clock sector (10°) for the Honda. The front right bumper corner of the Honda rode down the left side of the attenuator that transitioned to the Jersey barrier. The Honda

rapidly decelerated as the driver maintained his braking application and came to final rest facing south, with the right plane of the Honda in contact with the Jersey barrier.

### **Post-Crash**

The driver of the Honda exited his vehicle without assistance and called the emergency response system. Law enforcement personnel responded to the crash scene. The Honda's driver denied injury; therefore, no emergency medical services were requested.

A local recovery service towed the Honda from the crash scene to a local yard, where it was deemed a total loss by its insurer and then transferred to a regional insurance vehicle salvage facility, where it was inspected for this investigation.

# Impact Attenuator

## Description

The QuadGuard II impact attenuator (Figure 4), manufactured by Trinity Highway (<https://trinityhighway.com/product/quadguard-ii/>), was originally installed in November 2013. The QuadGuard II, which does not use anchor chains or tension cables, features a self-supporting steel nose (Figure 5), monorail guide shims to stabilize the diaphragms, high strength Quad-Beam panels, and a design tested to speeds from 40 km/h (25 mph) to 100 km/h (62 mph). This impact attenuator is considered a Test Level 3 Five-Bay Unit per the manufacturer's description. According to the QuadGuard manual, during a head-on collision, within criteria, the QuadGuard II is designed to telescope rearward to absorb the energy of the impact, and when impacted from the side, it is designed to redirect the vehicle back toward its original travel path and away from the roadside obstacle. It should be noted that at the time of the inspection, the nose and first bay of the impact attenuator system had been replaced, so there was no evidence at the scene of impact.



Figure 4. QuadGuard II impact attenuator system



Figure 5. Nose section of the QuadGuard II impact attenuator system

## 2017 Honda Civic Touring

### Description

The 2017 Honda Civic (Figure 6), manufactured in September of 2018, was identified by the vehicle identification number 2HGFC1F93HHxxxxxx. The electric odometer reading was 63,221 km (39,284 miles) at the inspection. The Honda was a front-wheel drive platform, powered by a 1.5-liter, 4-cylinder gasoline engine linked to a continuous variable transmission. Its service brakes were power-assisted, 4-wheel disc with antilock. The gross vehicle weight rating was 1,770 kg (3,902 lb), with gross axle weight ratings of 955 kg (2,105 lb) in front and 820 kg (1,808 lb) in rear. The vehicle manufacturer's recommended tire size was P215/50R17, with recommended cold tire pressures of 220 kPa (32 PSI) for all four axle positions. At the time of the SCI inspection, the Honda was equipped with Firestone FT140 tires of the recommended size at the left front, left rear, and right rear positions. The right front tire was not present at the time of inspection. The left front, left rear, and right rear tires had at least 6 mm (7/32) of tread, remained inflated, and were not damaged in the crash.



*Figure 6. View of the 2017 Honda Civic during the SCI vehicle inspection*

The interior of the Honda had seating for five occupants (2/3), with front row bucket seats and a second row bench seat with split forward-folding seat backs. All leather-surfaced seating positions had adjustable head restraints. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all seat positions. Supplemental restraint systems included front seat belt retractor, with six air bags consisting of the driver's and passenger's frontal, front seat-mounted, and inflatable curtain (IC) air bags.

### Exterior Damage

This crash involved the front and right planes of the Honda, and the damage pattern resembled a corner impact configuration. Although the bumper fascia had scratching across the entire front of it, these markings were not representative of the crash and attributed to pre-existing damage. The front reinforcement bar was deformed minimally at the right front corner. Figure 7 depicts the front plane damage pattern, while Figure 8 depicts the front right corner reinforcement bar damage.



*Figure 7. Front plane damage to the Honda as documented during the SCI vehicle inspection*



*Figure 8. Front right corner of the Honda's reinforcement bar damage as documented during the SCI vehicle inspection*

A residual crush profile was documented to the front bumper beam. The corresponding direct damage width was 16 cm (6.2 in) beginning at the right edge of the beam. The field-L was 170 cm (66.9 in). The crush measurements at the bumper level were C1 = 0 cm (0 in), C2 = 0 cm (0 in), C3 = 0 cm (0 in), C4 = 0 cm (0 in), C5 = 0 cm (0 in), and C6 = 9 cm (3.5 in). Maximum crush was observed at the right front bumper corner of the vehicle. The damage pattern extended along the right plane 198 cm (77.9 in). A corresponding collision deformation classification (CDC) of 12FREE06 was assigned to the Honda's damage profile.

This yielding object impact was out-of-scope for analysis by the WinSMASH program. However, a barrier equivalent speed (BES) was calculated using the barrier algorithm of the program for comparison purposes. The calculated BES was 15 km/h (9 mph). Based on SCI expertise and observed vehicle damage, the borderline reconstruction underestimated the severity of the crash.

### **Event Data Recorder**

The 2017 Honda Civic was equipped with an air bag control module (ACM) mounted to the center tunnel of the vehicle, beneath the center instrument stack. The ACM monitored three-dimensional acceleration and commanded the actuation and/or deployment of pretensioners and inflatable supplemental restraint systems. It also had EDR capabilities. During the SCI vehicle inspection, the Honda's EDR data were imaged using the Bosch CDR tool and software version 19.3, via the diagnostic link connector port under the instrument panel on the driver's side. The data, later read using software version 21.2, are included as Appendix A.

The requirements for event recording included a change in longitudinal velocity of 0.8 km/h (0.5 mph) or greater over a 20-millisecond timeframe, a change in lateral velocity of 0.8 km/h (0.5 mph) or greater over a 5-millisecond timeframe, an activation of the occupant restraint control algorithm, or a command deployment of any type of non-reversible deployable restraint

device (air bag). The EDR typically would record only one event unless the time zero values for multiple events occurred within five seconds of one another. In this manner, a non-deployment event could be recorded and locked if it occurred within five seconds of a deployment event. By definition, a deployment event was any recognized event in which the control unit commanded deployment of an air bag system. A non-deployment event would not deploy air bags but could include pretensioner actuation-only commanded events.

Depending on the specific control unit type, it could record approximately 255 milliseconds of data associated with a deployment command. If power supply to the SRS control unit was lost during or following a crash event, all or part of the data may not have been recorded to the EDR's memory.

System status data, inclusive of reported Diagnostic Trouble Codes (DTCs), seat belt usage of front row occupants, and vehicle ignition cycle at the time of the event were recorded. Associated with the recording of each respective event was an asynchronous 5-second, pre-crash buffer that recorded multiple pre-crash parameters in 0.5-second intervals. Data recorded included vehicle speed (mph), accelerator pedal (% Full), service brake (On/Off) status, ABS activity (On/Off), stability control (On, Off, Engaged), steering input (+/- 5 degrees), and engine speed (rpm). Data for the vehicle's multiple crash avoidance systems, also recorded, are discussed in the Crash Avoidance Systems section of this report.

The imaged data contained one recorded event, a deployment event type, recorded as Event Record 1. The data were imaged on ignition cycle counter 3,146, and the ignition cycle at event counter was 3,129. A difference of 17 ignition cycles separates from the time of incident to the time when the data were imaged. This is likely due to transporting the vehicle from the scene to a local tow yard, then to a salvage yard, and insurance inspections. Therefore, the recovered data were related to the crash under investigation.

The following pre-crash data was reported for Event Record 1.

<b>Time (sec)</b>	<b>Speed (km/h [mph])</b>	<b>Accel. Pedal (%)</b>	<b>Service Brake</b>	<b>ABS Activity</b>	<b>Steering Input</b>	<b>Engine rpm</b>
-5.0	52 [84]	30	OFF	OFF	-5	2,000
-4.5	52 [84]	0	OFF	OFF	0	1,700
-4.0	52 [84]	16	OFF	OFF	0	1,400
-3.5	52 [84]	20	OFF	OFF	0	1,600
-3.0	52 [84]	22	OFF	OFF	0	1,800
-2.5	53 [85]	25	OFF	OFF	5	1,900
-2.0	53 [85]	24	OFF	OFF	0	2,000
-1.5	54 [87]	0	OFF	OFF	0	1,900
-1.0	54 [87]	0	OFF	OFF	26	1,900
-0.5	54 [87]	0	ON	OFF	40	1,500
0.0	54 [87]	0	ON	ON	40	1,400

The seat belt status of the driver (sole occupant) was reported “On.” The driver’s seat track position was reported as not in a forward position. There were no DTCs active when the crash occurred, and no supplemental restraint system warning lights were illuminated. A complete file was recorded in association with the deployment event.

The maximum longitudinal delta V reported was -28 km/h (-17 mph) at 190 milliseconds after time zero. The maximum lateral delta V was -6 km/h (-4 mph), which occurred at 100 milliseconds after time zero. Associated with the frontal event were the following supplemental restraint system deployment/actuation commands relative to time zero: driver’s retractor pretensioner at 3 ms, driver’s frontal air bag first stage at 18 ms, driver’s frontal air bag second stage at 58 ms, passenger outboard side air bag at 78 ms, and right IC air bag at 25 ms.

### **Interior Damage**

There was no loss of integrity to the interior occupant compartment of the Honda, relative to the crash. All doors remained closed and were operational post-crash. The windshield was cracked, and the front right side window was disintegrated by the crash forces, relative to the corner impact. All other glazing remained intact, not damaged or contacted by the occupant (driver). The only discernable evidence in the Honda’s interior from occupant contact was the loading of the safety belt, as described in the Manual Restraint Systems section of this report. Figure 9 depicts the front row left (driver’s) position of the Honda and the surrounding components.



*Figure 9. View of the interior of the Honda during the SCI vehicle inspection*

### **Manual Restraint Systems**

The Honda was equipped with 3-point continuous loop lap and shoulder seat belt systems for all five seat positions. All used sliding latch plates, and the front row (driver’s and passenger’s) systems were configured with adjustable D-rings. The driver’s seat belt retracted onto an emergency locking retractor (ELR), while the other systems all used switchable ELR/automatic locking retractors (ALR). Both front seat belt systems were equipped with retractor pretensioners. Data imaged from the Honda’s EDR reported actuation commands for the driver’s retractor pretensioners.

At the time of the inspection, the SCI investigator found the driver’s seat belt system lying loosely in the driver’s seat, with the webbing extended in a used position. The retractor pretensioner was actuated.

An area of polymer transfer and apparent loading (Figure 10) was observed. The SCI investigator also observed a polymer transfer on the webbing from the D-ring. Based on the post-crash condition of the driver's seat belt system, it was apparent that the driver was belted at the time of the crash.



*Figure 10. Latch plate loading evidence on the driver's seat belt system in the Honda*

### **Supplemental Restraint Systems**

The Honda was equipped with multiple supplemental restraints for its occupants. These included a certified advanced 208-compliant (CAC) frontal air bag system, front seat-mounted side impact air bags, and dual-sensing (side impact and rollover) IC air bags. The CAC system consisted of dual-stage driver's and passenger's frontal air bags, front seat track position sensors, front seat belt buckle switch sensors, front retractor pretensioners, and a front right occupant classification sensor. The driver's frontal air bag was mounted in the hub of the four-spoke steering wheel, while the passenger's frontal air bag was a top-mount design in the right instrument panel. The front seat-mounted side impact air bags were mounted in the outboard aspect of each front seat adjacent to the respective B-pillars and provided supplemental protection for lateral (side) crash forces. The IC air bags were mounted to the roof side rails and concealed by the vehicle's head liner, designed to provide outboard protection for both of the Honda's seating rows. Labeling molded into the polymer surfaces of the pillar trim panels identified the presence of the IC air bags. The supplemental restraints (air bags and pretensioners) were controlled and monitored by the ACM. During the investigation, it was determined that the driver's seat belt pretensioners actuated. Additionally, the driver's frontal, right IC, and passenger outboard air bags deployed. The right IC had been cut from the vehicle prior to the SCI inspection.

The driver's frontal air bag deployed from the steering wheel hub-mounted module and through the cover flaps without damage. In its deflated state, the driver's frontal air bag measured approximately 60 cm (23.6 in) in overall diameter. It had an 11 cm (4.3 in) wide circular center stitch pattern, to which internal tethers were affixed. The air bag was vented on its rear aspect by a pair of 4 cm (1.6 in) diameter vent ports, located at the 11 o'clock and 1 o'clock positions. There was no discernable occupant contact evidence or other crash-related damage to the Honda's deployed driver's frontal air bag. The Honda's right IC air bag deployed downward from the roof side rail mounting location through the edge of the headliner. The right IC air bag was cut and removed prior to the SCI inspection of the vehicle.

There was no discernable occupant contact to the right IC air bag. Figure 11 depicts the deployed driver's frontal air bag at the time of the SCI inspection, while Figure 12 depicts the remnants of the deployed right IC air bag.



Figure 11. View of the deployed driver's frontal air bag in the Honda at the time of the SCI inspection



Figure 12. View from the removed deployed right IC air bag in the Honda

### Crash Avoidance Systems

The Honda was equipped with multiple CA systems designed to assist/support the driver in both avoiding a potential crash and/or mitigating the severity of a crash event should a collision become imminent. The driver was able to turn three of the CA systems on or off by pushing a button representative of the CA system located on the instrument panel, left of the steering column. Figure 13 shows the on/off buttons for the FCW (top left), stability control (top right), and LDW (bottom left). The Honda's CA systems used two distinct sensors to support their functionality, including a radar sensor and an optical camera sensor. The radar sensor was located in the front grille, while the optical sensor was located on the interior of the windshield in front of the rearview mirror (Figure 14).



Figure 13. View of the Crash Avoidance System Buttons located on the instrument panel left of the steering column



Figure 14. View of the Honda's optical sensor for the FCW and LDW systems

The Honda's CA systems included FCW with CIB, RDM, LDW with LKAS, blind spot detection, ACC, dynamic brake support, daytime running lights, and a rearview video system. The LKAS and RDM systems were forms of LDW with lane keeping, while the CMBS was a form of FCW with CIB. The information discussed hereafter and concerning the crash avoidance

systems of the 2017 Honda Civic was obtained from the vehicle owner's manual provided with the vehicle by its manufacturer at the time of its original sale/delivery.<sup>1</sup>

The LKAS aids the driver in “maintaining the travel lane and provides visual and tactile alerts when it sensed that vehicle was drifting from the detected lane.” It was functional between speeds of “72-145 km/h (45-90 mph).” It was capable of providing “torque to the steering wheel to allow the vehicle to maintain a detected lane without driver input.” If the system sensed that the vehicle was drifting from a detected lane, it provided “vibrations of the steering wheel and illuminated a warning display.” “Use of the vehicle’s turn signals would suspend functionality of the LKAS, such that the driver could change lanes without receiving the system’s alerts. The alert functionality of the system would return once the turn signal was off.” In addition, the system would not work if the “driver removed their hands from the steering wheel.”

The RDM system functioned similar to the LKAS by providing alerts to prevent the vehicle from “unintentionally departing a detected lane or leaving the roadway.” It also was functional between speeds of “72-145 km/h (45-90 mph).” Should the vehicle get too close to detected lane or roadway markings without activation of the turn signal, the system would provide “visual/vibration alerts and apply torque to the steering wheel” to help the driver maintain the lane/roadway. “Braking was applied if the lane markings were solid/continuous.” The manufacturer warned that “over-reliance on the systems could result in a collision.”

The CMBS could alert the driver of a “potential collision with an object” and was “capable of reducing the vehicle’s speed without driver input” to help reduce the severity if a collision became unavoidable. There were three stages of warnings, which may or may not be progressive dependent upon circumstances and/or settings: (1) “visual and audible warnings,” (2) “visual and audible warnings with light brake application,” and (3) “visual and audible warnings with strong brake application.” A manufacturer warning stated that the system could “reduce the severity of an unavoidable collision but could not prevent collisions or stop the vehicle automatically.”

The EDR component of the Honda’s ACM was capable of recording data concerning the vehicle’s crash avoidance systems and their respective status/functionality. The data were contained in the imaged data (CDR report) only if the vehicle was equipped with the systems and data were recorded. The reported data included FCW (Warning/Not Warning), CMBS (Engaged/Not Engaged), CMBS/FCW status (On/Off), LDW (Warning/Not Warning), RDM (Engaged/Not Engaged), RDM/LDW status (On/Off), ACC (Engaged/Not Engaged), ACC status (On/Off), lane keeping assist (Engaged/Not Engaged), lane keeping assist status (On/Off), cruise control (Engaged/Not Engaged), and cruise control status (On/Off). According to the data, all systems were “On” for all recorded pre-crash intervals. However, all systems indicated that they were all “Not Engaged” and “Not Warning” leading up to the recorded crash event. See the recorded data on the following page.

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<sup>1</sup> “CIVIC: 2017 Owner’s Guide.” Honda Motor Co., Ltd. 2019.

<b>Time (sec)</b>	<b>FCW</b>	<b>CMBS</b>	<b>CMBS/FCW</b>	<b>RDM</b>	<b>RDM</b>	<b>LKAS</b>	<b>LKAS</b>
-5.0	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-4.5	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-4.0	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-3.5	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-3.0	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-2.5	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-2.0	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-1.5	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-1.0	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
-0.5	Not Warning	Not Engaged	On	Not Engaged	On	Not Engaged	On
0.0	Not Warning	Not Engaged	On	Not Engaged	Off	Not Engaged	Off

The imaged data indicate that the Honda's RDM and LKAS systems were turned on by the driver and operational prior to the crash. The RDM and LKAS were recorded as "Off" at AE for unknown reasons. The system never activated to alert/warn the driver prior to the crash. This suggests that the system never detected the lane departure from the initial travel lane. This is due to the pre-crash travel of the vehicle drifting into the opening of the exit ramp and never laterally crossing any lane lines. The lack of warning may stem from the presence of the exit lane at the same location where the drift and lane departure occurred. As the Honda approached the area of the crash, the right line widened from approximately 3 m (12 ft) to greater than 9 m (30 ft) at the mouth of the exit ramp. The Honda did not cross the lane line, but the lane line diverted to the right. The vehicle then drove over the lane lines, likely resulting in confusion in the system and preventing it from warning of a lane departure.

## 2017 Honda Civic Touring Occupant

### Driver Demographics

Age/sex:	33 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Between middle and rearmost track position at the time of SCI inspection
Manual restraint usage:	3-point lap and shoulder seat belt with retractor and pretensioners (actuated)
Usage source:	Vehicle inspection, EDR data
Air bags:	Frontal, seat-mounted side impact, and IC air bags available; frontal air bag deployed
Alcohol/drug data:	No test given
Egress from vehicle:	Unknown
Transport from scene:	Not medically transported
Type of medical treatment:	None; unknown if treatment sought later

### Driver Injuries

No reported injuries.

### Driver Kinematics

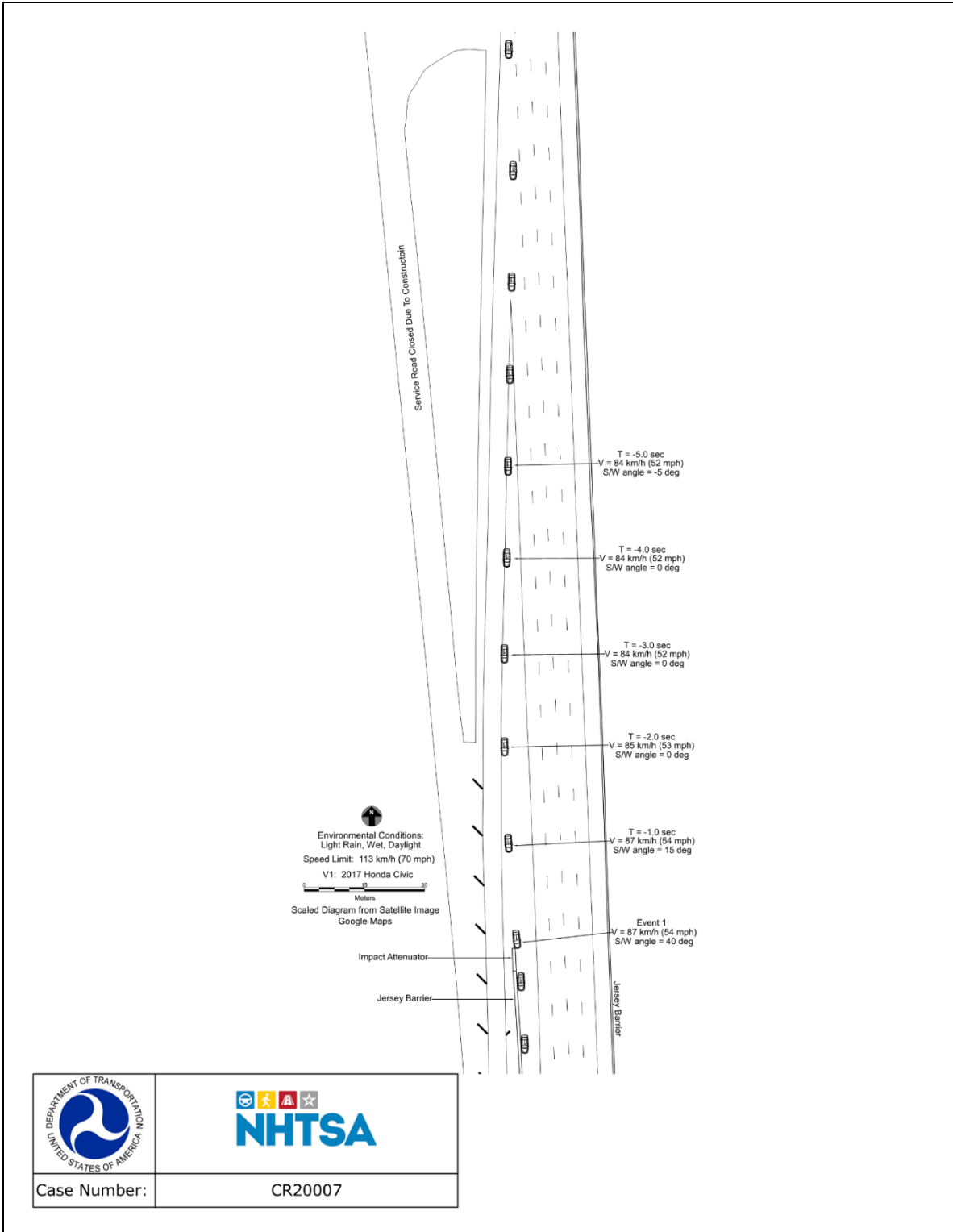
The 33-year-old male driver was seated with the track position adjusted between the middle and rearmost position, with the seat back slightly reclined and the head restraint adjusted 2 cm (0.7 in) upward. The driver used the available 3-point lap and shoulder seat belt system for manual restraint. His use of the seat belt system was determined by frictional polymer abrasions on the webbing latch plate and D-ring engagement and corroborated by the data imaged from the vehicle's EDR.

The driver operated the Honda southbound on the limited access roadway. The driver reported to the police that he "fell asleep" and drifted right out of his initial travel lane and into the mouth of the exit lane. The vehicle began drifting slightly back to the left after the vehicle crossed over the point, where the original right lane line and the left exit ramp lane line met. Despite the available CA equipment, including the RDM and LDW systems which were turned on/operational, the Honda did not detect the lane lines of the original travel lane or the exit ramp travel lane due to the vehicle never laterally crossing a lane line. Rather, the driver detected the pending impact and provided a last-second left steering and braking input in an attempt to avoid the crash.

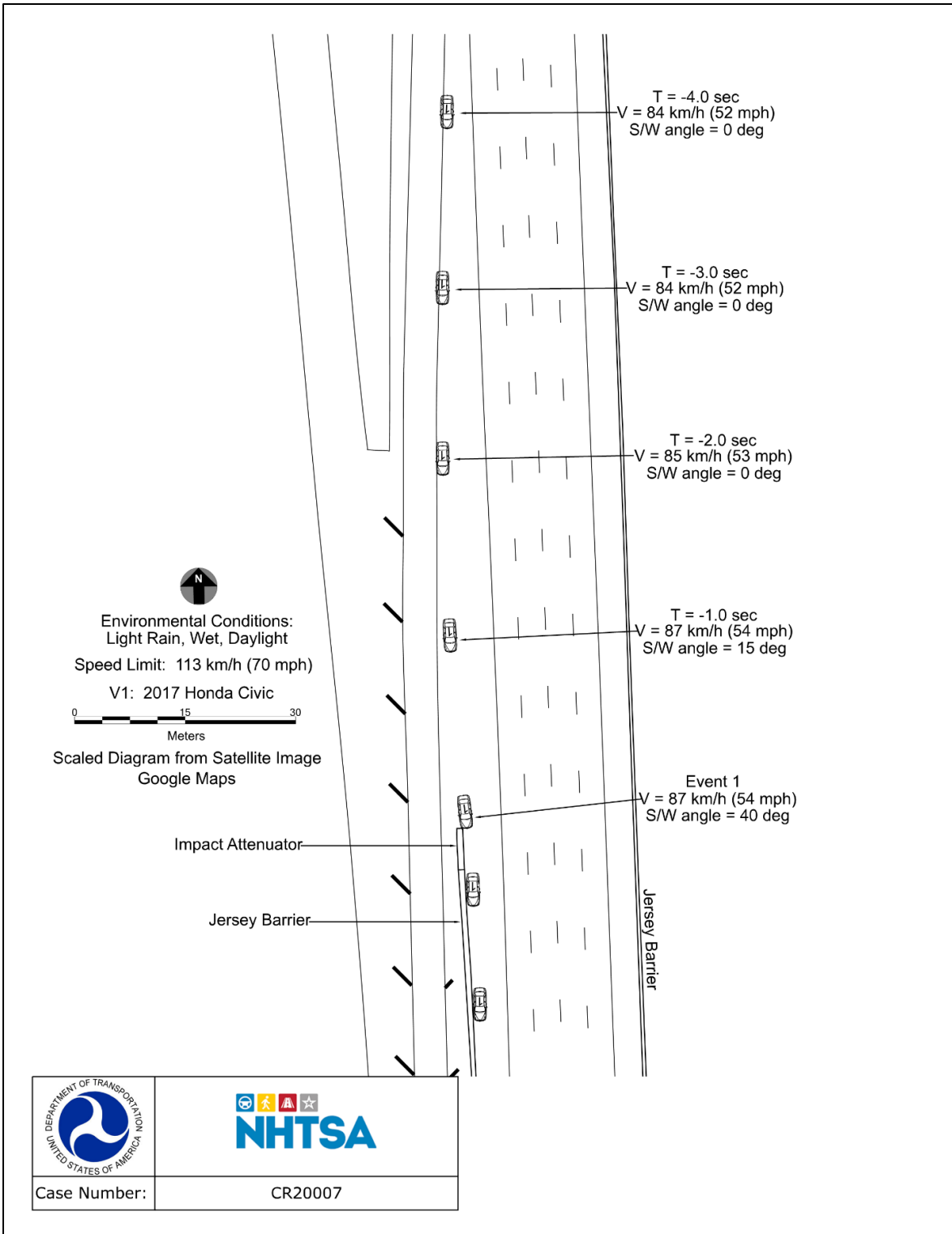
Upon sensing the impact with the attenuator, the ACM commanded the actuation of the driver's retractor pretensioner and the deployment of the driver's frontal air bag. The driver initiated a forward trajectory, and his body loaded the manual restraint system.

His forward movement was restricted by the seat belt system, which provided the driver with a ride-down of the crash forces. It is likely that his head/face and chest contacted the deployed driver's frontal air bag which distributed the crash forces and mitigated injury. The driver remained belted and rebounded in the driver's seat as the vehicle came to final rest. The driver was not medically transported from the scene and did not sustain injury as a result of the crash according to the PCR.

# Crash Diagram



# Crash Diagram: A Detailed View



## **Appendix A: Event Data Recorder Report for 2017 Honda Civic Touring<sup>2</sup>**

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

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

## CDR File Information

User Entered VIN	2HGFC1F93HH*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR20007 V1 ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.3
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 21.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	1

## Comments

No comments entered.

## Data Limitations

### General Information:

These limitations are intended to assist you in reading the event data that has been imaged from the vehicle's SRS control unit. They contain general information and are not specific to this particular event. Event data should be considered in conjunction with other available physical evidence from the vehicle and scene.

Honda and Acura passenger vehicles designated as 2013 or later model year production are designed to be compatible with the Bosch CDR tool. Only some 2012 model year vehicles are compatible with the Bosch CDR tool.

### Recorded Crash Events:

Data for front, side, rear and rollover events can be recorded as either non-deployment or deployment events. Both types of events can contain pre-crash and crash data.

- A non-deployment event is recorded if the change in longitudinal or lateral velocity equals or exceeds 8km/h over a 150ms timeframe or another type of non-reversible deployable restraint device other than a front, side, or side curtain airbag (e.g. seatbelt pretensioner) is commanded to deploy. Except as indicated below, non-deployment events are not locked into memory and can be over-written by subsequent non-deployment or deployment events.
- A deployment event is recorded if front airbag(s), side airbag(s), or side curtain airbag(s) are commanded to deploy. Deployment events are locked into memory and cannot be over-written.

The SRS control unit typically records only one event. Two events can be recorded if the T0 (time zero) values for each event occur within 5 seconds of each other. Therefore, a non-deployment event can be recorded and locked if it occurs within 5 seconds of a deployment event.

T0 is established by whichever of the following occurs first: (1) the change in longitudinal velocity at the SRS control unit equals or exceeds 0.8km/h over a 20ms timeframe; or (2) the change in lateral velocity at the SRS control unit equals or exceeds 0.8km/h over a 5ms timeframe; or (3) the occupant restraint control algorithm is activated; or (4) a commanded deployment of any type of non-reversible deployable restraint device (e.g. airbag or seatbelt pretensioner). If the time to deploy equals 0, then the command to deploy occurred at T0 or the device was not commanded to deploy during the event.

TEnd (end of event) is established by whichever of the following occurs first: (1) the change in longitudinal and lateral Delta V equals or falls below 0.8km/h over a 20ms timeframe; or (2) the occupant restraint control algorithm resets; or (3) time from T0 exceeds 300ms.

### Data:

- Data recorded by the SRS control unit and imaged by the CDR tool is displayed relative to T0, not the time at which the vehicle made contact with another vehicle or object.
- Pre-crash data is recorded at 2 samples per second within the 5 seconds before T0. The sampling point at 0.0 is taken at T0 and is asynchronous with the other sample points. The time between -0.5 and 0.0 is not recorded and is between 1 and 500ms.
- Delta V data is recorded at 100 samples per second from T0 to 250ms or T0 to TEnd plus 30ms.
- Acceleration data is recorded at 100 samples per second from T0 to 250ms.
- Delta V, longitudinal reflects the change in velocity that the SRS control unit experienced in the longitudinal direction during the recorded portion of the event and is not the speed the vehicle was traveling before the event.
- Depending on the severity of the event and the accelerometer characteristics, saturation of the SRS control unit longitudinal or lateral accelerometers may occur, decreasing the recorded Delta V value.

- Time, accelerometer range exceeded is recorded if saturation of the SRS control unit longitudinal, lateral and/or normal (vertical) accelerometer occurs. The recorded data is the time at which the sensor range is first exceeded.
- The maximum recording capability of Deployment Command Data is 254ms or 255ms depending on vehicle model. A recorded value of 254ms or 255ms may indicate that the recording maximum was exceeded. In this case, the deployment command may have occurred between the recorded time and TEnd.
- Speed, vehicle indicated data is the speed indicated to the driver by the speedometer, not actual vehicle ground speed. Data accuracy can be affected by various factors, including but not limited to the following:
  - Significant changes in tire size from the factory setting
  - Wheel lockup or spin
  - Data latency or filtering and hysteresis within the speedometer module
- Accelerator pedal position, percent full is the ratio of accelerator pedal position compared to the fully depressed position.
- PCM (Powertrain Control Module) derived accelerator pedal position, percent full may differ from the accelerator pedal position, percent full under circumstances such as brake override activation or cruise control system engagement. These circumstances are based on vehicle equipment application and vary by model.
- Steering input angle is recorded in 5 degree increments.
- Side air bag suppression system status, right front passenger is recorded when the vehicle is equipped with the Occupant Position Detection System (OPDS).
- Occupant size classification, right front passenger airbag suppressed data is recorded as yes (suppressed) if the front passenger seat weight sensor system determined the passenger seat was empty or occupied by a child-size occupant.
- EV mode data records the vehicle powertrain status, not a driver selected operation mode. EV mode is recorded as On when the vehicle is moving and the internal combustion engine is not operating. EV mode may be recorded as On or Off when the vehicle is stopped.
- If power to the SRS control unit is lost during an event, all or part of the data may not be recorded.

**Roll Rate Data:**

- Vehicle roll rate data is recorded separately from the non-deployment and deployment events as described above. Therefore, the T0 for the roll rate data may differ from the T0 for the other data in this report.
- Roll rate recording trigger (T0) is established by whichever of the following occurs first: (1) a rollover algorithm ON judgment (SRS control unit decision to command deployment); or (2) a change in relative roll angle at the SRS control unit equal to or exceeding 30 degrees (roll angle is not measured, but is calculated from the roll rate data); or (3) the rollover algorithm is activated.
- Once a recording trigger has been met, roll rate data is recorded for one rollover event at 10 samples per second from 1 second before to 2 seconds after T0. If a roll angle trigger is satisfied without a rollover algorithm ON judgment, the recorded roll rate data is unlocked and can be over-written by a subsequent rollover event. Roll rate data triggered by or recorded during a rollover algorithm ON judgment is locked into memory and cannot be over-written.
- If roll rate is detected at the SRS control unit during a non-deployment or deployment event but the recording trigger has not been satisfied, no roll rate data will be recorded. A graph of roll rate data will only be present in this report if roll rate data is recorded.

**Data Element Sign Convention:**

Except as noted below, all data is displayed in SAE J211 sign convention. The following table provides an explanation of the sign notation for data elements that may be included in this CDR report. All directional references to sign notation are from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

Data element name	Positive sign indicates
Longitudinal Acceleration	Forward direction acceleration
Delta-V, Longitudinal	Forward direction acceleration
Lateral Acceleration	Left to right direction acceleration
Delta-V, Lateral	Left to right direction acceleration
Normal (Vertical) Acceleration	Downward direction acceleration
Vehicle Roll Rate*	See roll rate graph and data (if recorded)
Steering Input Angle*	Left Turn

\*Not SAE J211 sign convention

**Data Source:**

All recorded data is measured and calculated within the SRS control unit except for the following parameters (if applicable) which are transmitted via the vehicle's communication network to the SRS control unit:

- Speed, vehicle indicated
- Accelerator pedal position, percent full
- Service brake
- ABS activity
- Stability control
- Steering input angle
- Engine RPM
- PCM derived accelerator pedal position, percent full
- EV mode
- Forward Collision Warning
- Collision Mitigation Braking System information
- Lane Keeping Assist System information
- Lane Departure Warning
- Road Departure Mitigation information
- Cruise Control status
- Adaptive Cruise Control status

Depending on vehicle feature content, capability, or conditions described above, the following items may not be recorded. If these items are not recorded, they will not be present in this document.

- EV mode

- Forward Collision Warning
- Collision Mitigation Braking System information
- Lane Keeping Assist System information
- Lane Departure Warning
- Road Departure Mitigation information
- Cruise Control status
- Adaptive Cruise Control status

**Hexadecimal Data:**

All data that has been specified for imaging is shown in the hexadecimal data section of this report. However, not all of this data is translated by the CDR tool. The SRS control unit may contain additional data that is not retrievable by the CDR tool.

**Data Imaging:**

If the SRS control unit is imaged outside of the vehicle, ensure that it is not moved, tilted or turned while connected to the CDR tool. Also, after imaging is complete, wait 3 minutes after removing the CDR tool before moving the SRS control unit. Not following this guideline could cause current non-deployment event data to be overwritten and a new event to be recorded. Current fault status could also be altered if the SRS control unit is imaged outside of the vehicle.

04002\_HondaSRS\_GEN2\_r002

### System Status at Retrieval

EDR Version	1.3.2.0
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### System Status at Event (Event Record 1)

Multi-Event, Number of Events (1, 2)	1
Complete File Recorded (Yes/No)	Yes
Ignition Cycle, Download	3146
Maximum Delta-V, Longitudinal (MPH [km/h])	-17 [-28]
Time, Maximum Delta-V, Longitudinal (msec)	190.0
Maximum Delta-V, Lateral (MPH [km/h])	-4 [-6]
Time, Maximum Delta-V, Lateral (msec)	95.0
Time, Maximum Delta-V, Resultant (msec)	190.0
Time, Accelerometer Range Exceeded, Longitudinal (msec)	0
Time, Accelerometer Range Exceeded, Lateral (msec)	45.5
Time, Accelerometer Range Exceeded, Normal (msec)	0

### Deployment Command Data (Event Record 1)

Pretensioner Deployment, Time to Fire, Driver (msec)	3
Pretensioner Deployment, Time to Fire, Right Front Passenger (msec)	0
Frontal Air Bag Deployment, Time to Deploy First Stage, Driver (msec)	18
Frontal Air Bag Deployment, Time to Deploy First Stage, Right Front Passenger (msec)	0
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (msec)	58
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (msec)	0
Side Air Bag Deployment, Time to Deploy, Driver (msec)	0
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (msec)	78
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Driver Side (msec)	0
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Right Side (msec)	25
Frontal Air Bag Deployment, 2nd Stage Disposal, Driver (Yes/No)	No
Frontal Air Bag Deployment, 2nd Stage Disposal, Right Front Passenger (Yes/No)	No

### Pre-Crash Data -1 sec (Event Record 1)

Safety Belt Status, Driver	On
Safety Belt Status, Right Front Passenger	Off
Seat Track Position Switch, Foremost, Status, Driver	No
Occupant Size Classification, Right Front Passenger Airbag Suppressed (Yes/No)	Yes
Frontal Air Bag Warning Lamp (On, Off)	Off
Ignition Cycle, Crash	3129

**Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 1 of 3**

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal Position, % full	Service Brake (On, Off)	ABS Activity (On, Off)	Stability Control (On, Off, Engaged)	Steering Input (deg)	Engine RPM
-5.0	52 [84]	30	Off	Off	On Non-Engaged	-5	2,000
-4.5	52 [84]	0	Off	Off	On Non-Engaged	0	1,700
-4.0	52 [84]	16	Off	Off	On Non-Engaged	0	1,400
-3.5	52 [84]	20	Off	Off	On Non-Engaged	0	1,600
-3.0	52 [84]	22	Off	Off	On Non-Engaged	0	1,800
-2.5	53 [85]	22	Off	Off	On Non-Engaged	5	1,900
-2.0	53 [85]	25	Off	Off	On Non-Engaged	0	2,000
-1.5	54 [87]	24	Off	Off	On Engaged	0	1,900
-1.0	54 [87]	0	Off	Off	On Non-Engaged	15	1,900
-0.5	54 [87]	0	On	Off	On Non-Engaged	40	1,500
0.0	54 [87]	0	On	On	On Non-Engaged	40	1,400

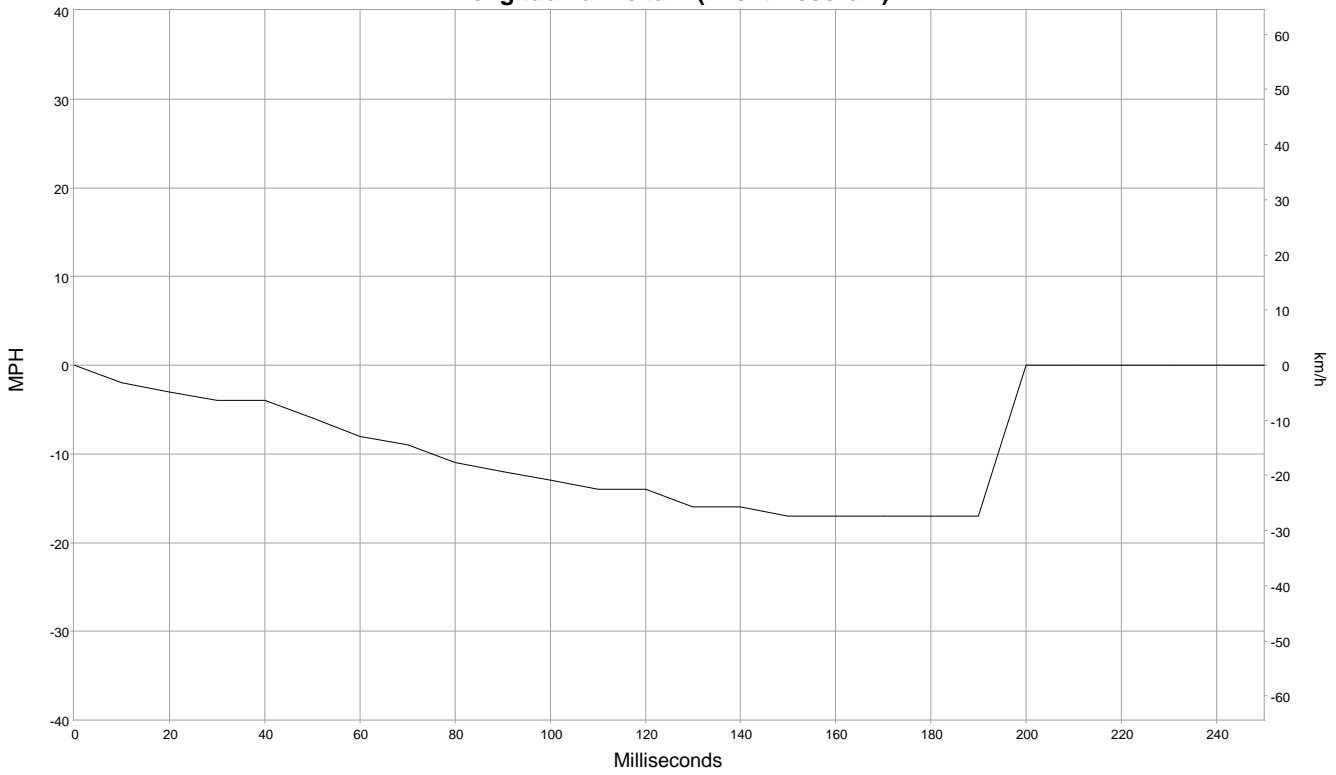
**Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 2 of 3**

<b>Time Stamp (sec)</b>	<b>PCM Derived Accelerator Pedal Position, % full</b>	<b>Forward Collision Warning (Not Warning/ Warning)</b>	<b>Collision Mitigation Braking System (Not Engaged/ Engaged)</b>	<b>Collision Mitigation Braking System, Forward Collision Warning (On/Off)</b>	<b>Lane Departure Warning (Not Warning/ Warning)</b>	<b>Road Departure Mitigation (Not Engaged/ Engaged)</b>	<b>Road Departure Mitigation, Lane Departure Warning (On/Off)</b>
-5.0	30	Not warning	Not engaged	On	Not warning	Not engaged	On
-4.5	0	Not warning	Not engaged	On	Not warning	Not engaged	On
-4.0	16	Not warning	Not engaged	On	Not warning	Not engaged	On
-3.5	20	Not warning	Not engaged	On	Not warning	Not engaged	On
-3.0	22	Not warning	Not engaged	On	Not warning	Not engaged	On
-2.5	22	Not warning	Not engaged	On	Not warning	Not engaged	On
-2.0	25	Not warning	Not engaged	On	Not warning	Not engaged	On
-1.5	24	Not warning	Not engaged	On	Not warning	Not engaged	On
-1.0	0	Not warning	Not engaged	On	Not warning	Not engaged	On
-0.5	0	Not warning	Not engaged	On	Not warning	Not engaged	On
0.0	0	Not warning	Not engaged	On	Not warning	Not engaged	On

**Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 3 of 3**

<b>Time Stamp (sec)</b>	<b>Adaptive Cruise Control (Not Engaged/ Engaged)</b>	<b>Adaptive Cruise Control (On/Off)</b>	<b>Lane Keeping Assist (Not Engaged/ Engaged)</b>	<b>Lane Keeping Assist (On/Off)</b>	<b>Cruise Control (Not Engaged/ Engaged)</b>	<b>Cruise Control (On/Off)</b>
-5.0	Not engaged	On	Not engaged	On	Not Engaged	On
-4.5	Not engaged	On	Not engaged	On	Not Engaged	On
-4.0	Not engaged	On	Not engaged	On	Not Engaged	On
-3.5	Not engaged	On	Not engaged	On	Not Engaged	On
-3.0	Not engaged	On	Not engaged	On	Not Engaged	On
-2.5	Not engaged	On	Not engaged	On	Not Engaged	On
-2.0	Not engaged	On	Not engaged	On	Not Engaged	On
-1.5	Not engaged	On	Not engaged	On	Not Engaged	On
-1.0	Not engaged	On	Not engaged	On	Not Engaged	On
-0.5	Not engaged	On	Not engaged	On	Not Engaged	On
0.0	Not engaged	On	Not engaged	On	Not Engaged	On

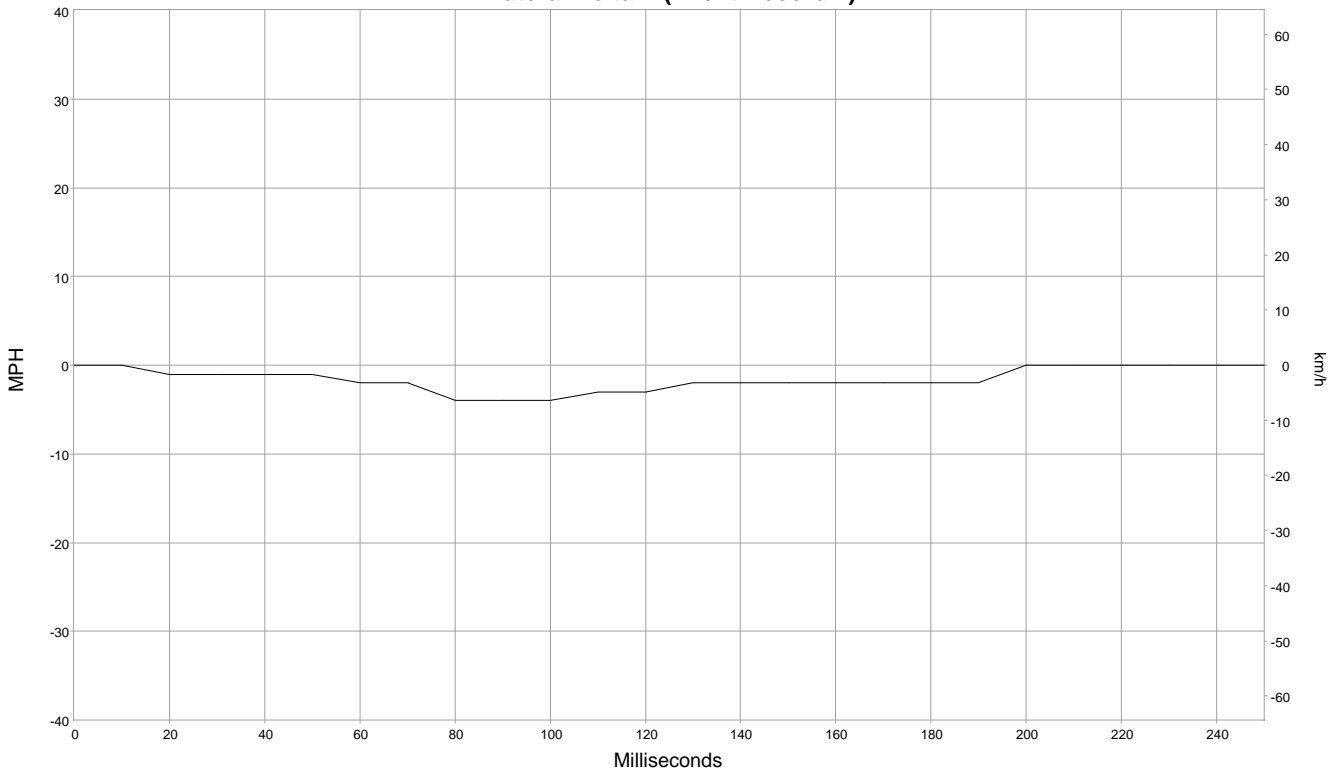
**Longitudinal Delta V (Event Record 1)**



**Longitudinal Delta V (Event Record 1)**

Time (msec)	MPH [km/h]
0	0 [0]
10	-2 [-3]
20	-3 [-5]
30	-4 [-6]
40	-4 [-7]
50	-6 [-10]
60	-8 [-13]
70	-9 [-14]
80	-11 [-18]
90	-12 [-19]
100	-13 [-21]
110	-14 [-22]
120	-14 [-23]
130	-16 [-25]
140	-16 [-26]
150	-17 [-27]
160	-17 [-27]
170	-17 [-27]
180	-17 [-28]
190	-17 [-28]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	0 [0]

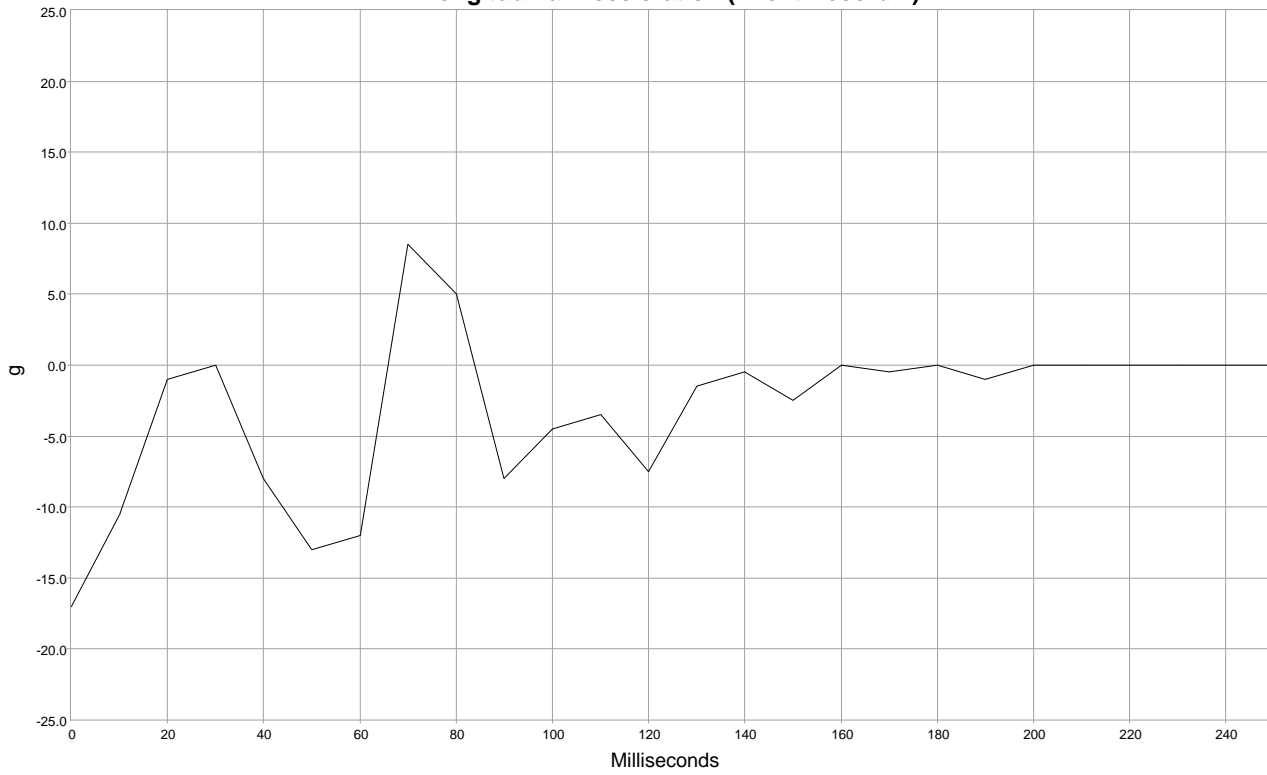
**Lateral Delta V (Event Record 1)**



**Lateral Delta V (Event Record 1)**

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	-1 [-1]
30	-1 [-1]
40	-1 [-2]
50	-1 [-2]
60	-2 [-3]
70	-2 [-4]
80	-4 [-6]
90	-4 [-6]
100	-4 [-6]
110	-3 [-5]
120	-3 [-5]
130	-2 [-4]
140	-2 [-4]
150	-2 [-4]
160	-2 [-4]
170	-2 [-4]
180	-2 [-4]
190	-2 [-3]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	0 [0]

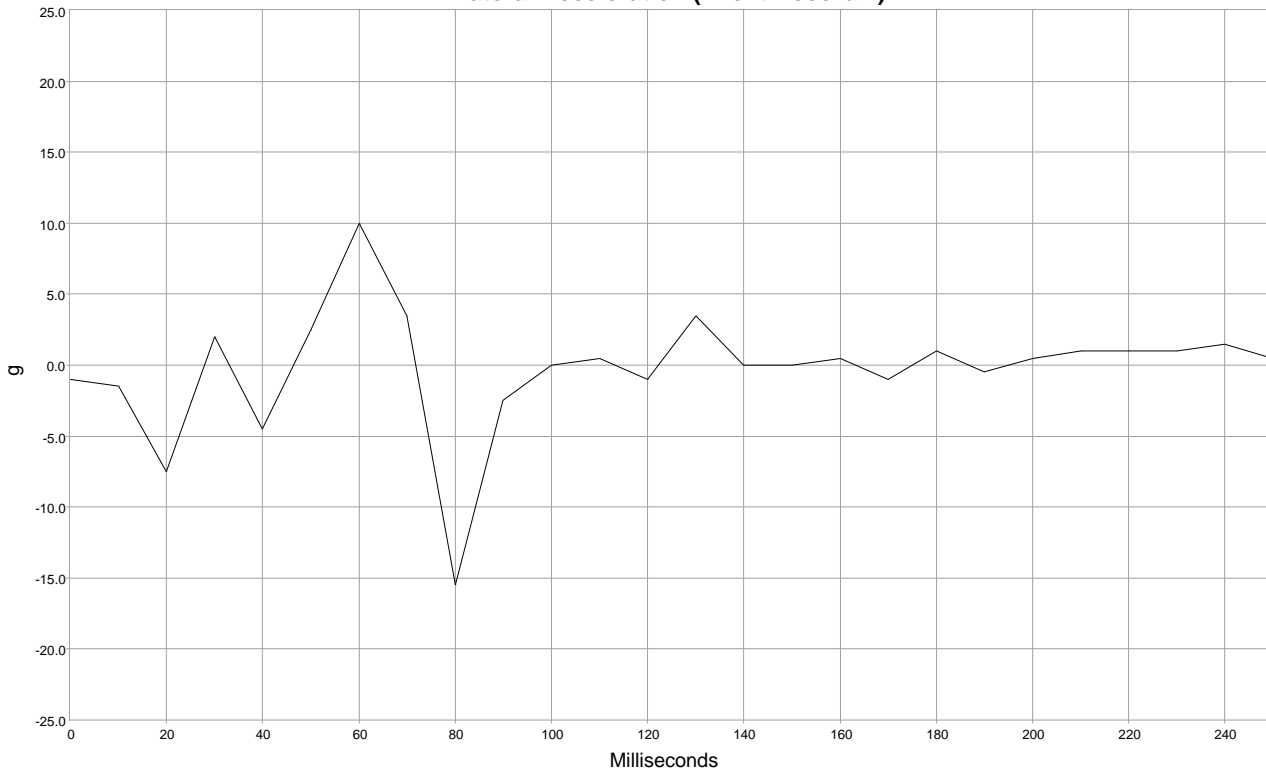
**Longitudinal Acceleration (Event Record 1)**



**Longitudinal Acceleration (Event Record 1)**

Time (msec)	g
0	-17.0
10	-10.5
20	-1.0
30	0.0
40	-8.0
50	-13.0
60	-12.0
70	8.5
80	5.0
90	-8.0
100	-4.5
110	-3.5
120	-7.5
130	-1.5
140	-0.5
150	-2.5
160	0.0
170	-0.5
180	0.0
190	-1.0
200	0.0
210	0.0
220	0.0
230	0.0
240	0.0
250	0.0

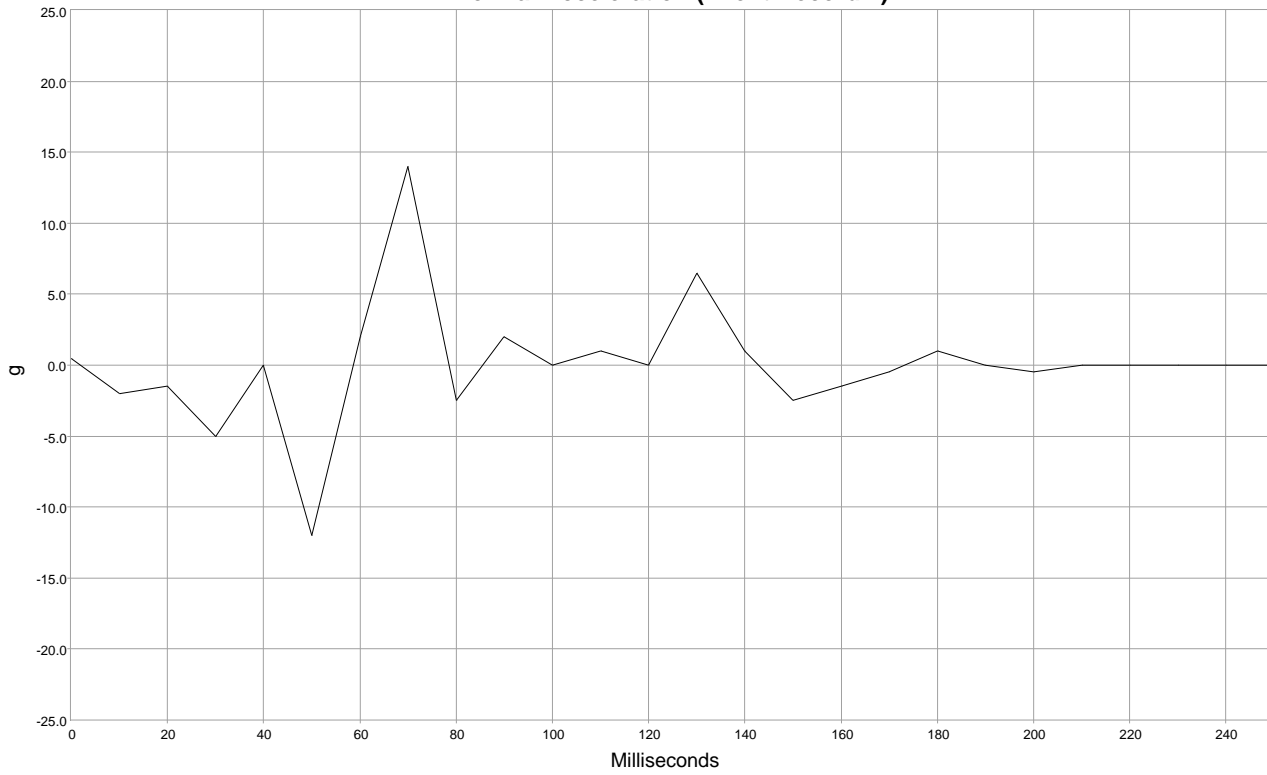
**Lateral Acceleration (Event Record 1)**



**Lateral Acceleration (Event Record 1)**

Time (msec)	g
0	-1.0
10	-1.5
20	-7.5
30	2.0
40	-4.5
50	2.5
60	10.0
70	3.5
80	-15.5
90	-2.5
100	0.0
110	0.5
120	-1.0
130	3.5
140	0.0
150	0.0
160	0.5
170	-1.0
180	1.0
190	-0.5
200	0.5
210	1.0
220	1.0
230	1.0
240	1.5
250	0.5

**Normal Acceleration (Event Record 1)**



**Normal Acceleration (Event Record 1)**

Time (msec)	g
0	0.5
10	-2.0
20	-1.5
30	-5.0
40	0.0
50	-12.0
60	2.0
70	14.0
80	-2.5
90	2.0
100	0.0
110	1.0
120	0.0
130	6.5
140	1.0
150	-2.5
160	-1.5
170	-0.5
180	1.0
190	0.0
200	-0.5
210	0.0
220	0.0
230	0.0
240	0.0
250	0.0



\$802B AA 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
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02 00 0E 00 00 09 12 00 00 00 00 00 00 00 00 00  
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\$801B AA 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
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\$8001 AA 00 C4 18 00 00 00 00 16 16 00 00 00 16 00 00  
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
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\$8002 AA 01 E0 FE F8 FF 00 00 02 80 20 00 00 00 00 00  
80 54 E4 00 FA 00 13 00 00 00 00 06 21 00 00 00  
80 23 C8 02 02 00 0C 46 00 00 00 00 00 00 00 00  
00 00 00 00 00 00 00 00

\$8004 Not Used

\$8005 AA 00 FE F0 F0 F0 DE 01 DE 01 E0 00 00 00 00 00  
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FF F8 00 08 00 00 00 00 06 B6 06 BA 00 00 00 00  
FF D0 00 01 39 FE 97 00 00 00 00 00 00 00 00 62  
02 ED 00 01 ED 00 FF 00 00 00 00 00 00 00 00 24  
01 02 01 00 00 00 00 00 00 00 00 00 00 00 00  
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

\$8008 Not Used

\$8009 AA 01 B7 F8 AA AA AA AA 00 00 03 FF FD FF FD 07  
00 00 00 00

\$800A AA 00 00 31 00 00 44 F0 93 20 45 44 CE 9A 26 A0  
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44 F0 93 20 45 44 CE 9A 26 A0 00 00 00 00 00  
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

\$8010 AA 00 F8 F8 F8 F8 E0 E0 E0 E3 00 00 00 00 00  
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00 00 00 00 00 00 00 00 AF 11 11 00 00 00 00  
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\$801C AA 00 00 00 00 00 00 00 00 00 00 00 00 00 00

00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 56

\$801F Not Used

\$8040 AA 01 00 00 00 00 00 00 00 00 00 0A 00 00 00 00
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64 00 00 00 00 00 00 00

\$8041 AA 00 FC CC 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00

\$8043 AA 01 02 00 02 00 02 00 02 00 02 00 02 00 00 00
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\$8044 AA 00 FF 00 80 80 7F 80 80 7F 80 81 00 00 00 00
00 00 00 00

\$8045 AA 00 B4 00 6C 00 78 5C 00 61 00 00 00 00 00 00
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\$8046 AA 00 C0 00 00 00 00 00 00 00 00 00 00 00 00 00
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\$8050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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\$8051 12 81 01 00 33 31 01 00 00 00 00 00 00 00 00
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\$8053 54 94 24 00 00 00 00 00 00 00 00 00 00 00 00

\$8054 AA 00 FF FC FF F3 00 08 00 00 00 00 00 00 00
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\$8060 AA 00 B2 11 A6 11 A1 11 A2 11 32 11 0A E4 86 00
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\$8061 AA 00 CF 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00
6E 49 00 00 77 63 5C 5C 00 00 00 00 00 00 00
78 6E 00 00 78 77 5C 5C 00 00 00 00 00 00 00
7C 7A 00 00 78 77 5C 5C 00 00 00 00 00 00 00
7C 79 00 00 78 77 5C 5C 00 00 00 00 00 00 00

\$8062 AA 01 FF F0 3F 00 00 00 00 00 00 00 00 00 00
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DOT HS 813 239  
January 2022



U.S. Department  
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