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

NHTSA

DOT HS 813 228

December 2021

Special Crash Investigations: On-Site Crash Avoidance Technology Investigation; Vehicle: 2019 Honda Civic; Location: California; Crash Date: October 2019

DISCLAIMER

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Suggested APA Format Citation:

Dynamic Science, Inc. (2021, December). *Special crash investigations: On-site crash avoidance technology investigation; Vehicle: 2019 Honda Civic; Location: California; Crash date: October 2019* (Report No. DOT HS 813 228). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 813 228	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Special Crash Investigations: On-Site Crash Avoidance Technology Investigation; Vehicle: 2019 Honda Civic; Location: California; Crash Date: October 2019		5. Report Date December 2021 6. Performing Organization Code
7. Author Dynamic Science, Inc.		8. Performing Organization Report No. DS20002
9. Performing Organization Name and Address Dynamic Science, Inc. 26141 Marguerite Parkway, Suite C Mission Viejo, CA 92692		10. Work Unit No. (TRAIS) 11. Contract or Grant No. 693JJ918C000012
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered Technical Report October 2019 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 vehicle(s) 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.

16. Abstract

This report documents the investigation of a crash involving a 2019 Honda Civic equipped with standard crash avoidance technology. The crash occurred at night in October 2019 in a rural area of California. Conditions were dark without illumination, clear, and dry. A belted 25-year-old male was driving the 2019 Civic southbound. A belted 52-year-old male was driving a 1995 Civic northbound. The 2019 Civic crossed over the centerline into the northbound lane where it struck the 1995 Civic head-on. The 2019 Civic's event data recorder report indicated the crash avoidance systems were on but only the antilock braking system and electronic stability control system activated prior to impact. Following the crash both vehicles departed the roadway on the east edge. The 2019 Civic driver sustained police-reported "A" (incapacitating) injuries that were determined to be of moderate severity and was transported to a hospital where he was admitted for 8 days and released. The driver of the 1995 Civic sustained "K" (fatal) injuries and was declared deceased on-scene.

17. Key Words crash avoidance, lane departure, deployment, injury, fatality	18. Distribution Statement Document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, rosap.ntl.bts.gov.

19 Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21 No. of Pages 40	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Table of Contents

Special Crash Investigations
On-Site Crash Avoidance Technology Investigation
Case Number: DS20002
Vehicle: 2019 Honda Civic
Location: California
Crash Date: October 2019

Background

This report documents the investigation of a fatal crash involving a 2019 Honda Civic (Figure 1) equipped with standard crash avoidance technology including lane keeping assist system (LKAS), road departure mitigation (RDM) system, collision mitigating braking system (CMBS), adaptive cruise control (ACC), blind spot detection, rear visibility system, vehicle stability assist (VSA), and antilock braking system (ABS). The 2019 Honda Civic was traveling southbound when, for unknown reasons, it crossed over the centerline and entered a northbound lane, where it struck a northbound 1995 Honda Civic head-on, killing its driver.

Figure 1. 2019 Honda Civic

The investigation was intended to determine what role, if any, the crash avoidance technology played in the crash. According to the 2019 Honda Civic owner's manual, the RDM system alerts and helps to assist the driver when the system detects a possibility of the vehicle unintentionally crossing over detected lane markings and/or leaving the roadway altogether. The LKAS provides steering input to help keep the vehicle in the middle of a detected lane and provides tactile and visual alerts if the vehicle is detected drifting out of its lane. The investigation determined that the vehicle's RDM and LKAS were "On" at the time of the crash but due to the driver's active braking and steering input they did not activate. According to the 2019 Civic owner's manual, the RDM system does not activate when the driver is actively braking, accelerating or steering, and the LKAS operation may be automatically suspended if the steering wheel is quickly turned or the brake pedal is depressed. In response to the driver's active braking input, the vehicle's ABS and electronic stability control (ESC) did activate.

The investigation was initiated by the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration in response to a notification from the Fatality Analysis Reporting System (FARS). SCI assigned the case to Dynamic Science, Inc., and field inspections

were completed in February 2020. The 2019 Civic's air bag control module (ACM) with event data recorder (EDR) capability was supported by the Bosch Crash Data Retrieval (CDR) system and was imaged during the inspection. The EDR report did include data relating to crash avoidance technology discussed later in this report. The complete EDR report is included in this technical report as Appendix A. The SCI team conducted a partial exterior inspection of the 1995 Civic using police photographs. The vehicle was not supported by the Bosch CDR system and its ACM was not imaged.

The crash occurred at night in October 2019 in a rural area of California. Conditions were dark without artificial illumination, clear visibility, and dry. A belted 25-year-old male was driving the 2019 Civic southbound and a belted 52-year-old male was driving the 1995 Civic northbound. The 2019 Civic crossed over the centerline into the northbound lane, where it struck the 1995 Civic head-on. Both vehicles departed the roadway on the east edge, the 2019 Civic coming to rest facing southwest on the roadside and the 1995 Civic facing east on the east shoulder. The 2019 Civic driver sustained police-reported "A" (incapacitating) injuries that were determined to be of moderate severity and was transported by air to a hospital, where he was admitted for 8 days and released. The driver of the 1995 Civic sustained "K" (fatal) injuries and was declared deceased on-scene. Both vehicles were towed due to damage.

Summary

Crash Site

The crash site was on a two-lane, undivided north/south State highway in California (Figure 2). The roadway was paved asphalt and configured with one lane for each direction separated by a dashed yellow painted stripe and bordered by solid white painted fog lines. The centerline striping was configured with dashed lines measuring 3.7 m (12.0 ft) in length and spaces measuring 11.0 m (36.0 ft) in length.

Figure 2. Approach to crash site looking south

Raised yellow reflectorized markers were placed in the spaces midway between the dashed lines. Each lane measured 3.7 m (12.0 ft) wide and the pavement edges were 1.3 m (4.3 ft) wide outside of the fog lines. The centerline and fog lines measured 15 cm (6.0 in) wide. A milled-in type rumble strip in a pattern measuring 30 cm (12.0 in) wide was present on the centerline and milled-in type rumble strips in a pattern measuring 15 cm (6.0 in) wide were present on the left and right fog lines. The asphalt pavement and painted lane striping were in good condition. The roadway was straight and level and was configured with a super-elevation measuring negative 1.0 percent for each lane. The east roadside consisted of a gravel shoulder and unpaved ground having a descending slope of 26 percent. The gravel shoulder measured 3.1 m (10.2 ft) wide and the slope ended at a drainage ditch located 4.5 m (14.8 ft) east of the east fog line. A wire fence with wooden posts was located 4.3 m (14.1 ft) east of the drainage ditch. The posted speed limit was 89 km/h (55 mph). Conditions at the time of the crash were dark without artificial illumination, clear, and dry. A crash diagram is at the end of this report.

Pre-Crash

The 2019 Civic was being driven southbound by the belted 25-year-old male at an EDR-reported vehicle speed of 120 km/h (75 mph) at T-5.0 seconds to algorithm enable (AE). According to the EDR report, the RDM system, LKAS, CMBS, ACC, and cruise control were “On.” The forward collision warning and lane departure warning were “Not Warning,” and CMBS, RDM, ACC, LKAS, and cruise control were “Not Engaged.” Steering input was -5 degrees (right), service brake and ABS activity was "Off."

The EDR data suggests the Honda was drifting slightly to the right for 2 or more seconds until it possibly contacted the right fog line and rumble strip with its right side tires. From T-5.0 seconds

to T-3.5 seconds, the driver was accelerating. At T-3.0 seconds, vehicle speed was 130 km/h (81 mph) and the service brake was "On." The noise and vibration tires on the rumble strip possibly alerted the driver to the situation and during the next 2 seconds he braked and steered slightly left, right, and left. During the final 1 second before impact he steered sharply left while continuing to brake. At T-1.0 seconds the driver's steering input was 65 degrees. He continued to increase his steering to the left to 110 degrees at T-0.5 seconds and 135 degrees at T-0.0 seconds. The vehicle traveled approximately 24 m (79 ft) from the right edge of the roadway, across the centerline, and into the northbound lane. A witness traveling in the northbound lane told police she observed the 2019 Civic make a sharp left turn into the northbound lane prior to impact. Based on EDR data, none of the vehicle's crash avoidance systems initiated a warning or engagement until ABS activity was "On" and Stability Control was "On Engaged" at T-0.5 seconds.

During the SCI interview, the driver of the 2019 Civic had no recollection of the pre-crash scenario and did not recall seeing the other vehicle approaching. He had purchased the 2019 Civic 3 days prior to the crash. He did not change settings for the crash avoidance features since the purchase and did not know if any features had been manually disabled. The EDR captured active steering and braking data prior to impact, suggesting the driver had some level of awareness of the situation. The vehicle's pre-crash speed and distance calculations derived from EDR data are included in the table below.

Time	Vehicle Speed		Distance Traveled			
			Incremental		Cumulative	
-sec	km /h	mph	m	ft	m	ft
5	120	75	NA	NA	NA	NA
4.5	123	76	16.9	55.4	16.9	55.4
4	125	78	17.2	56.5	34.1	111.9
3.5	128	80	17.6	57.9	51.8	169.8
3	130	81	18	59	69.7	228.8
2.5	130	81	18.1	59.4	87.8	288.2
2	126	78	17.8	58.3	105.6	346.5
1.5	115	71	16.6	54.6	122.3	401.1
1	105	65	15.2	49.9	137.5	451
0.5	82	51	13	42.5	150.4	493.5
0	82	51	11.4	37.4	161.8	530.9

The 1995 Civic was being driven northbound at an unknown speed by the belted 52-year-old male. Based on scene evidence, the vehicle appeared to have remained in its lane prior to impact. It was unknown if the driver attempted avoidance actions prior to impact.

Crash

The front of the 2019 Civic struck the front of the 1995 Civic head-on in the northbound lane (Event 1). This event was captured by the 2019 Civic's EDR as a deployment-level event in which the driver's frontal air bag deployed and his seat belt pretensioner actuated. Additionally,

the front right seat-mounted side impact air bag and right inflatable curtain (IC) air bag deployed. Following impact, both vehicles rotated clockwise and departed the roadway on the east edge. The vehicles deposited fluid spills and three scrape marks located between the east fog line and roadway edge with the longest measuring 1.6 m (5 ft) in length. The 2019 Civic traveled 12.0 m (39 ft) and came to rest facing southwest on the roadside. The 1995 Civic traveled 8.0 m (26 ft) east of the roadway and came to rest facing east on the east shoulder (Figure 3). A debris field was located on the east roadside in the area of final rest.

Figure 3. Final rest position, 1995 Honda Civic (police photo)

For the 2019 Civic, the EDR reported a maximum longitudinal delta V of -72 km/h (-45 mph) at 122.5 milliseconds (ms) and a maximum lateral delta V of -12 km/h (-7 mph) at 122.5 ms. The calculated principle direction of force was 10 degrees. The "missing vehicle" algorithm of WinSMASH calculated a total delta V of 62 km/h (39 mph) with a longitudinal delta V of -61 km/h (-38 mph), a lateral delta V of -11 km/h (-7 mph) and a barrier equivalent speed (BES) of 64 km/h (40 mph). The results fit the collision model and appeared reasonable.

For the 1995 Civic, WinSMASH calculated a total delta V of 90 km/h (56 mph) with a longitudinal delta V of -90 km/h (-56 mph), a lateral delta V of 0 km/h, and a BES of 88 km/h (55 mph). The results fit the collision model and appeared reasonable.

Post-Crash

According to the police report and interview, the driver of the 2019 Civic exited the vehicle without assistance through the left front door and laid down on the roadside. When emergency responders arrived he was transported by helicopter to a hospital in a nearby city, where he was hospitalized for 8 days for treatment of moderate severity injuries. The driver of the 1995 Civic was entrapped in his vehicle and pronounced deceased on-scene. Both vehicles were towed due to damage.

2019 Honda Civic

Description

The 2019 Honda Civic was identified by the Vehicle Identification Number (VIN) SHHFK7H47KUxxxxxx. The Civic had an owner-estimated mileage of 4,800 km (3,000 mi) at the time of the crash. The vehicle was a 5-door, 5-passenger, hatchback configured with front-wheel drive and a 4-cylinder, 1.5-liter, turbo-charged gasoline engine. It had crash avoidance systems that are discussed in other sections of this report. The vehicle manufacturer's recommended tire size was P235/35R19 for the front and rear with a cold pressure of 240 kPa (35 psi). It had Firestone Firehawk Indy 500 tires size P225/40R19. The vehicle's interior had two rows for seating five occupants. The front row had two bucket seats and adjustable head restraints. The driver's seat track was set between the forward-most and middle positions and his seat back was upright.

Exterior Damage

The 2019 Civic sustained severe front plane crush damage caused by frontal impact with the other vehicle (Figure 4). The front bumper fascia, grille, and headlamps were displaced, the left front tire was restricted, the left wheelbase was increased by 4 cm (1.6 in), the right front wheel was detached from the axle, the hood and right front fender were crumpled, and the right side view mirror was displaced.

Figure 4. Front plane damage, 2019 Honda Civic

Direct damage to the front plane began at the front right bumper corner and extended 132 cm (52.0 in) to the left. The bumper backing bar was used to measure crush. Fifteen measurements were taken at bumper level by the Nikon Total Station and the Faro Blitz program computed crush measurement in six increments as follows: C1 = 0 cm, C2 = 27 cm (10.6 in), C3 = 45 cm (17.7 in), C4 = 56 cm (22.0 in), C5 = 64 cm (25.2 in), C6 = 76 cm (29.9 in). Maximum crush was located at the front right bumper corner and the Collision Deformation Classification (CDC) was 12FDEW4.

Crash Avoidance Technology Discussion

The 2019 Civic's crash avoidance technology included LKAS, RDM, CMBS, ACC, blind spot detection, rear visibility system, ESC, and ABS. The crash avoidance systems employed a radar sensor located at the lower aspect of the front bumper and a front sensor camera mounted to the interior windshield and located behind the rear view mirror. The vehicle had manual controls on the left IP and steering wheel allowing the user to change settings for LKAS, RDM, CMBS, ACC, and VSA.

The driver had purchased the vehicle from a dealership 3 days prior to the crash, according to a vehicle history report. At the time of purchase the seller had reviewed the crash avoidance features with the driver, who did not change any of the user controlled settings for those systems. The EDR report indicated all crash avoidance systems were "On" but only ABS and VSA engaged prior to the crash. The crash avoidance systems for this vehicle are discussed below.

Lane Keeping Assist System (LKAS)

According to the 2019 Civic owner's manual, LKAS provides steering input to help keep the vehicle in the middle of a detected lane and provides tactile and visual alerts if the vehicle is detected drifting out of its lane. The system is activated by pressing the "MAIN" and "LKAS" buttons on the right steering wheel spoke (Figure 5), and is deactivated by pressing either of the buttons. The front sensor camera monitors lane lines and provides tactile and visual alerts when the vehicle is drifting out of a detected lane. If a lane departure occurs without a turn signal applied, the alerts activate and torque is applied to the steering. The owner's manual states the system is not a substitute for driver control of the vehicle and does not work or may be automatically suspended if the driver's hands are off the steering wheel or not actively steering. The system has limitations including, among others, it may not detect lane lines at night or in dark conditions such as a tunnel. According to the EDR report, this system was "On" and "Not Engaged." The EDR report indicated the driver was actively braking continuously from T-3.0 seconds to T-0.0 seconds. The system will not perform when the brake pedal is depressed.

Figure 5. MAIN, LKAS, and ACC Interval control buttons, steering wheel, 2019 Honda Civic

Road Departure Mitigation (RDM) System

According to the owner's manual, the RDM system alerts and helps to assist the driver when the system determines a possibility of the vehicle unintentionally crossing over detected lane markings and/or leaving the roadway altogether. The RDM system is turned "On" and "Off" by pressing the RDM button on the left instrument panel (Figure 6). Based on EDR data, the system was "On" and "Not Engaged" at the time of the crash. This system has three settings: Normal, Wide, and Warning Only. The setting at the time of the crash was unknown. The front camera behind the rearview mirror monitors left and right lane markings (in white or yellow). The system can apply visual and audible alerts in addition to applying torque to the steering to assist the driver in keeping the vehicle in the lane. Additionally, the system may apply braking but only when the lane markings are solid continuous lines. In this crash, the centerline was a dashed yellow painted stripe with raised reflectorized markers placed between dashes. The accuracy of this system is affected by vehicle speed and lane line condition. According to the owner's manual, the RDM system does not activate during periods of acceleration, braking, or steering. The EDR report indicated the driver was accelerating from T-5.0 seconds to T-3.5 seconds, braking from T-3.0 seconds to T-0.0 seconds, and steering left from T-1.0 to T-0.0 seconds. The system has limitations including environmental conditions such as darkness, sudden changes between dark and light, low contrast between objects and background, strong light reflected onto the roadway, and driving in shadows.

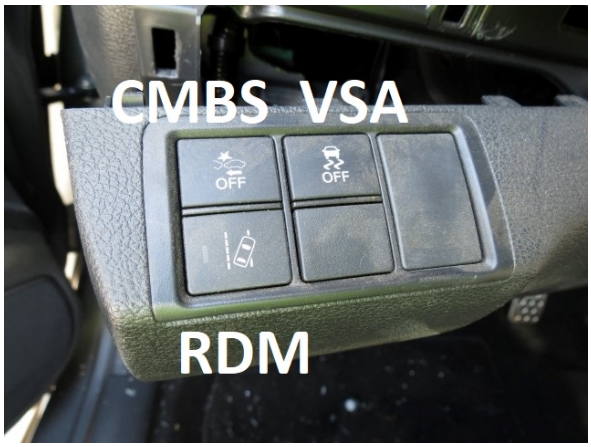


Figure 6. RDM, CMBS, and VSA control buttons, left instrument panel, 2019 Honda Civic

Collision Mitigation Braking System

According to the owner's manual, CMBS is designed to assist the driver when a potential frontal collision exists, as well as to reduce vehicle speed to help minimize collision severity when a collision is deemed unavoidable. It uses a camera located behind the rear view mirror (Figure 7) and a radar sensor in the lower front bumper. The CMBS is turned "On" and "Off" by pressing the CMBS button on the left instrument panel (Figure 6). The system is designed primarily to detect pedestrians and other vehicles in the path of this vehicle. When the system activates, it may automatically apply the brake but it does not automatically stop the vehicle. The system has limitations including environmental conditions such as darkness, sudden changes between dark and light, low contrast between objects and background, strong light reflected onto roadway, and driving in shadows. The system also had detection limitations at times such as approaching a vehicle or pedestrian ahead at high speed, or when the speed difference between this vehicle and

a vehicle or pedestrian in front is significantly large. The system uses three alert stages as follows.

- Risk detected: audible and visual alerts
- Increased risk detected: audible and visual alerts plus light braking
- Unavoidable collision: audible and visual alerts plus forcefully applied braking

According to the EDR report, CMBS was "On" and "Not Engaged" at impact with the other vehicle. Given the limitations of this system, it's this investigator's opinion that it neither contributed to, nor mitigated, the severity of this crash. The driver braked for approximately 3.0 seconds prior to impact and slowed the vehicle speed from 130 km/h (81 mph) at T-3.0 seconds to 82 km/h (51.0 mph) at T-0.0 seconds. The system is designed to function at a maximum vehicle speed of 100 km/h (62 mph) when detecting vehicles traveling in the opposing direction. The Civic did not slow to within that parameter until approximately T-1.0 second and the driver was applying the brakes at that time.

Figure 7. Front camera, 2019 Honda Civic

Adaptive Cruise Control

According to the owner's manual, ACC helps maintain a constant vehicle speed and following interval behind a vehicle detected ahead and, if the detected vehicle comes to a stop, can decelerate and stop this vehicle, without the driver having to keep a foot on the brake or the accelerator. The system is activated or deactivated by pressing the "MAIN" button on the right steering wheel spoke (Figure 5). According to the EDR report, this system was "On" and "Not Engaged" at the time of the crash. The ACC may not have activated in response to the following situations pertinent to this crash and described in the owner's manual as detection limitations.

- An oncoming vehicle suddenly comes in front of this vehicle.
- This vehicle abruptly crosses over in front of an oncoming vehicle.

Vehicle Stability Assist

According to the vehicle owner's manual, VSA helps stabilize the vehicle when turning more or less than intended, and assists in maintaining traction by regulating engine output and selectively applying the brakes. The VSA is activated automatically when the engine is started, and

functionality is partially disabled by pressing the VSA button on the left instrument panel (Figure 6). According to the EDR report, VSA was "Engaged" at T-0.5 seconds when the service brakes and ABS activity were "On," and the steering angle was 110 degrees. The system remained "Engaged" to T-0.0 seconds.

Event Data Recorder

The 2019 Civic was equipped with an air bag control module (ACM) that had EDR capability. The EDR was imaged during the SCI vehicle inspection using Bosch CDR software version 19.3.1 via the direct-to-module method. The data was reported using version 21.2.1. According to the data limitations, the EDR typically records only one event. The frontal impact in this crash was captured as a deployment-level event. The record included pre-crash data in 0.5 second intervals and 250 ms of post-crash data. The report indicated the driver was belted and that his frontal air bag was commanded to deploy in two stages. His seat belt pretensioner was also commanded to actuate. The EDR report included crash avoidance technology data for LKAS, RDM, CMBS, ACC, VSA, and ABS. The data indicated the vehicle's crash avoidance systems were on but did not engage during the crash with the exception of VSA and ABS. The complete EDR report is included in the appendix of this report.

NHTSA Recalls and Investigations

A recall search queried in October 2021 using the vehicle's VIN revealed no unrepaired recalls associated with this VIN.

Interior Damage

The inspection of the interior revealed damage from impact forces, deployed air bags, occupant contacts and post-crash activities. The windshield was fractured and revealed a possible occupant contact evidence in the form a spider web-type fracture located above the left instrument panel (IP). This fracture measured 21 cm (8.3 in) in diameter. The steering column incorporated a collapsible design and it was compressed forward at the time of the inspection. The steering wheel rim was bent forward in the upper and left quadrants. The IP was fractured and the center console was displaced. The front left window glazing was disintegrated. Longitudinal intrusion of the left and right toe pans reduced the space in the front row. Three air bags were deployed and the driver's seat belt pretensioner was actuated locking the belt in the used position. The front row was reduced by the following longitudinal intrusions: left toe pan, 8 cm (3.1 in); right toe pan, 13 cm (5.1 in).

Manual Restraint Systems

The driver's seat position was equipped with a lap and shoulder seat belt configured with a continuous loop webbing, sliding latch plate, emergency locking retractor (ELR) and adjustable shoulder anchor. The D-ring was adjusted to the full up position. The driver was belted at the time of the crash and the seat belt retractor pretensioner actuated during the crash, locking the belt in the used position. The belt webbing revealed scuff marks caused by driver loading at impact.

Supplemental Restraint Systems

The 2019 Honda was equipped with six air bags for supplemental restraint, including driver's and passenger's frontal, seat-mounted side impact, and left and right IC air bags. The driver's frontal, right seat-mounted side impact, and right IC air bags deployed at impact with the other vehicle. The air bags appeared to have deployed normally and were undamaged. The steering wheel mounted frontal air bag revealed driver contact evidence in the form of blood transfers and scuff marks.

2019 Honda Civic Occupant

Driver Demographics

Age/sex:	25 years/male
Height:	165 cm (64 in)
Weight:	79 kg (174 lb)
Eyewear:	None
Seat type:	Bucket
Seat track position:	Forward-most and middle
Manual restraint usage:	Lap and shoulder belt used
Usage source:	Vehicle inspection, EDR report
Air bags:	Frontal air bag deployed, seat-mounted side impact and IC air bags not deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Helicopter to hospital
Type of medical treatment:	Hospitalized for 8 days

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Laceration, duodendum, partial tear (serosal tear)	541022.2	Lap seat belt	Probable
2	Fracture, open, left patella	854501.2	Left lower IP	Probable
3	Contusion, left face	210402.1	Frontal air bag	Probable
4	Abrasions, abdomen	510202.1	Lap seat belt	Probable
5	Abrasion, right hand, wrist	710202.1	Windshield	Possible
6	Abrasion, left hip	810202.1	Lap seat belt	Probable

Driver Kinematics

The belted 25-year-old male driver was seated in an upright posture. Just prior to impact he was braking and steering left. At impact with the other vehicle the driver was displaced sharply forward in response to the 10 degree PDOF loading the pretensioned lap seat belt with his abdomen, causing a laceration to the duodendum and abrasions to his abdomen and left hip. His left knee contacted the left lower instrument panel causing an open fracture to the left patella.

His thorax, neck, and head continued to be displaced forward loading the shoulder seat belt, deployed frontal air bag, and steering wheel collapsing the steering column and bending the steering wheel in the left and upper quadrants, causing a contusion to the left aspect of his face. His right hand possibly continued to be displaced forward contacting and fracturing the

windshield and causing an abrasion 15 cm (5.9 in) in length spanning the right hand and wrist. The vehicle rotated clockwise and departed the roadway on the left edge while the driver remained seated by the pretensioned belt until the vehicle came to rest on the roadside. The driver exited the vehicle without assistance through the left front door and laid down on the roadside until emergency responders arrived. He was flown by helicopter to a nearby hospital and hospitalized for 8 days. He attended physical therapy for approximately 12 weeks.

1995 Honda Civic

Vehicle Description

The 1995 Honda Civic was identified in the police report by the VIN JHMEG865XSSxxxxxx. The vehicle was a 4-door sedan with two rows of seating for five occupants. It had a 4-cylinder, 1.5-liter, gasoline engine, automatic transmission, power steering, power brakes, and power windows.

Exterior Damage

A partial exterior inspection was obtained using police on-scene photos. The vehicle appeared to have sustained crush damage to the front plane extending from bumper corner to bumper corner (Figure 8). The hood, left fender, and right fender were crumpled, and the right front door was displaced rearward. The estimated CDC for the Civic was 12FDEW4.

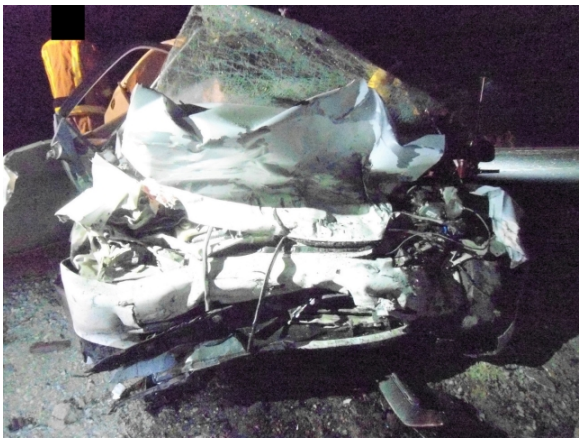
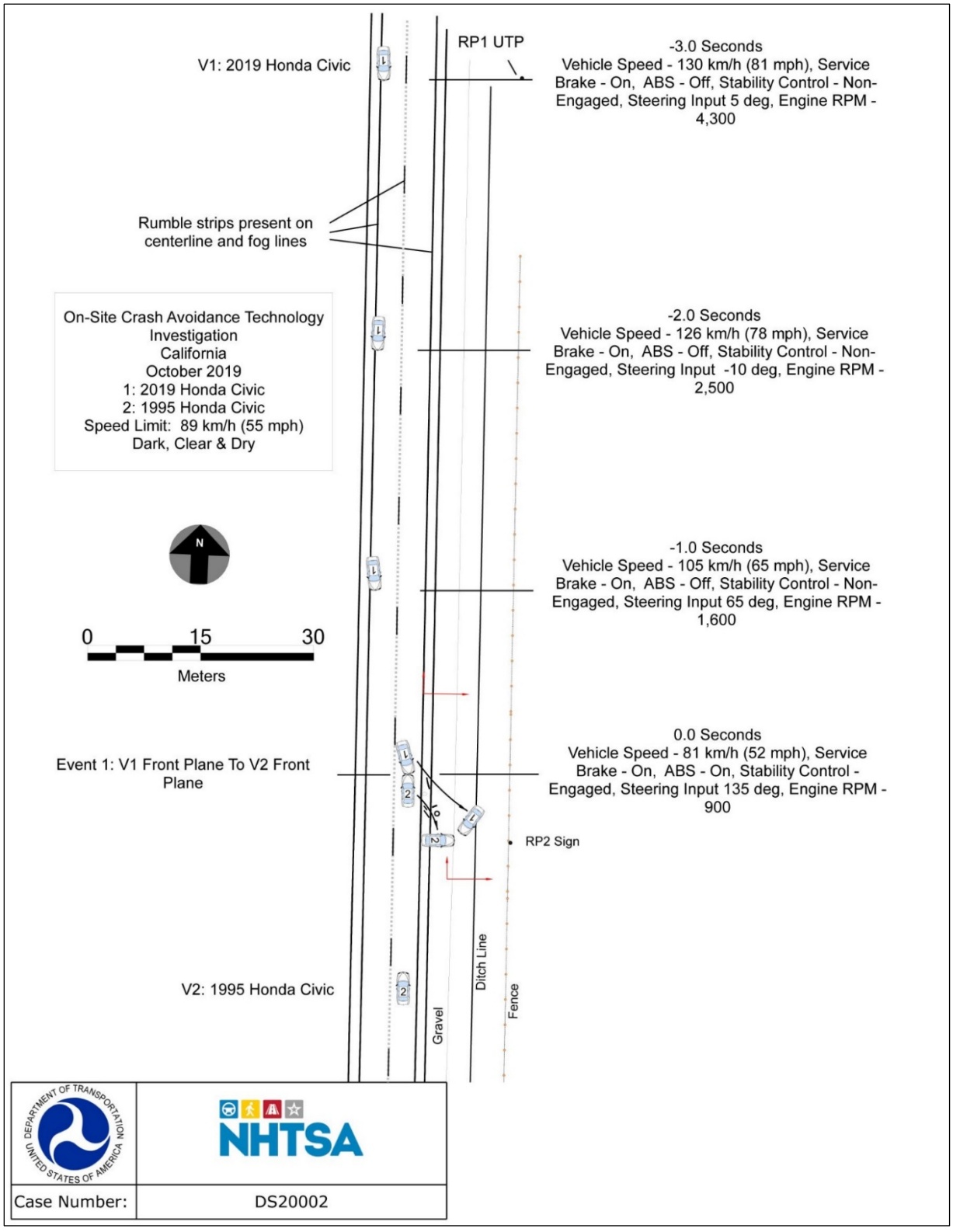


Figure 8. Front plane damage, 1995 Honda Civic (police photo)

Occupant Data

The driver of the Civic was a 52-year-old male. According to the police report he was belted. He sustained fatal injuries of an unknown nature and was declared deceased on-scene.

Crash Diagram



Appendix A: Event Data Recorder Report 2019 Honda Civic[1]

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

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

CDR File Information

User Entered VIN	SHHFK7H47KU******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	DS20002_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.3.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.2.1
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

System Status at Event (Event Record 1)

Multi-Event, Number of Events (1, 2)	1
Complete File Recorded (Yes/No)	Yes
Ignition Cycle, Download	699
Maximum Delta-V, Longitudinal (MPH [km/h])	-45 [-72]
Time, Maximum Delta-V, Longitudinal (msec)	122.5
Maximum Delta-V, Lateral (MPH [km/h])	-7 [-12]
Time, Maximum Delta-V, Lateral (msec)	45.0
Time, Maximum Delta-V, Resultant (msec)	122.5
Time, Accelerometer Range Exceeded, Longitudinal (msec)	24.0
Time, Accelerometer Range Exceeded, Lateral (msec)	5.0
Time, Accelerometer Range Exceeded, Normal (msec)	29.0

Deployment Command Data (Event Record 1)

Pretensioner Deployment, Time to Fire, Driver (msec)	2
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)	23
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)	25
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	698

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

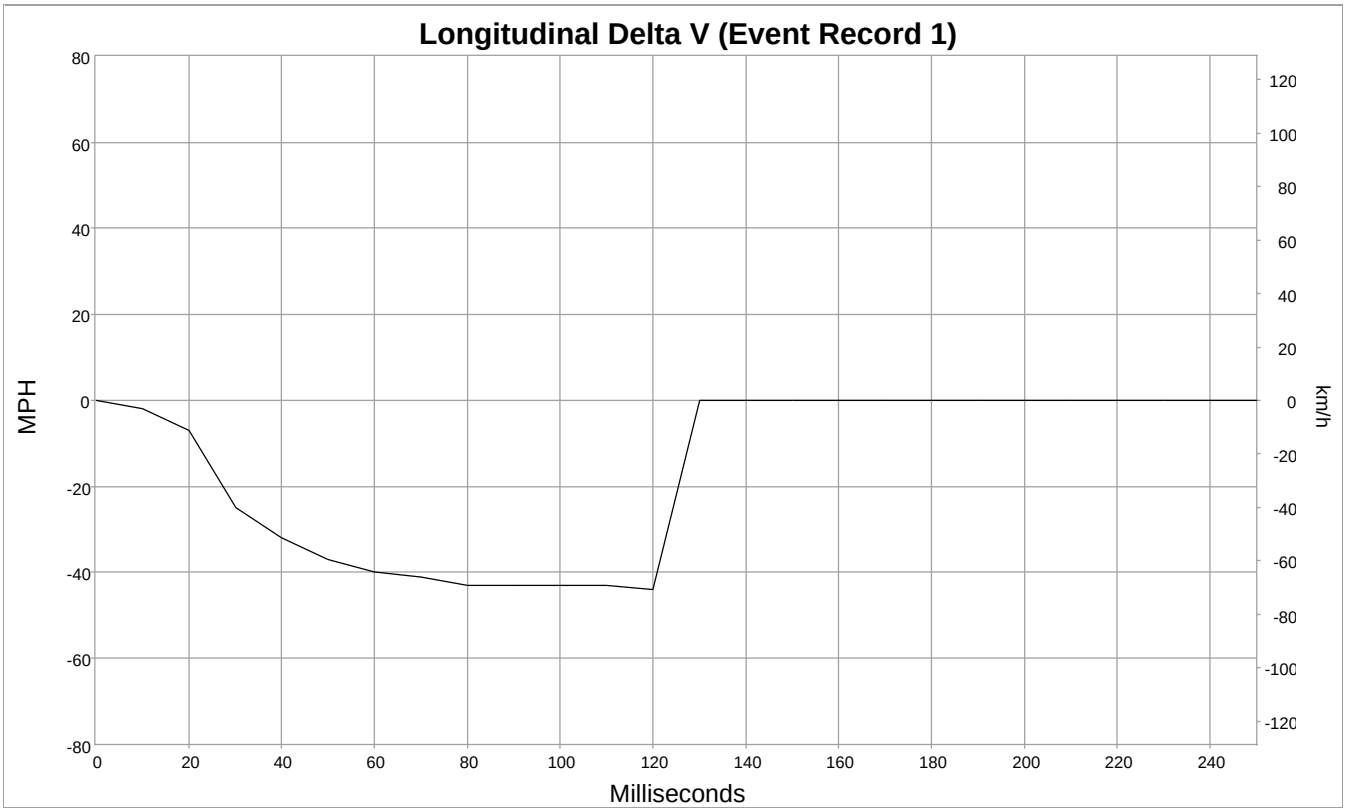
Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal Position, % full	Service Brake (On, Off)	ABS Activity (On, Off)	Stability Control (On, Off, Engaged)	Steering Input (deg)	Engine RPM
-5.0	75 [120]	78	Off	Off	On Non-Engaged	-5	3,700
-4.5	76 [123]	94	Off	Off	On Non-Engaged	-5	4,300
-4.0	78 [125]	94	Off	Off	On Non-Engaged	-5	5,100
-3.5	80 [128]	95	Off	Off	On Non-Engaged	-5	5,100
-3.0	81 [130]	0	On	Off	On Non-Engaged	5	4,300
-2.5	81 [130]	0	On	Off	On Non-Engaged	0	3,200
-2.0	78 [126]	0	On	Off	On Non-Engaged	-10	2,500
-1.5	71 [115]	0	On	Off	On Non-Engaged	5	1,900
-1.0	65 [105]	0	On	Off	On Non-Engaged	65	1,600
-0.5	51 [82]	0	On	On	On Engaged	110	1,000
0.0	51 [82]	0	On	On	On Engaged	135	900

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

Time Stamp (sec)	PCM Derived Accelerator Pedal Position, % full	Forward Collision Warning (Not Warning/ Warning)	Collision Mitigation Braking System (Not Engaged/ Engaged)	Collision Mitigation Braking System, Forward Collision Warning (On/Off)	Lane Departure Warning (Not Warning/ Warning)	Road Departure Mitigation (Not Engaged/ Engaged)	Road Departure Mitigation, Lane Departure Warning (On/Off)
-5.0	78	Not warning	Not engaged	On	Not warning	Not engaged	On
-4.5	94	Not warning	Not engaged	On	Not warning	Not engaged	On
-4.0	94	Not warning	Not engaged	On	Not warning	Not engaged	On
-3.5	95	Not warning	Not engaged	On	Not warning	Not engaged	On
-3.0	0	Not warning	Not engaged	On	Not warning	Not engaged	On
-2.5	0	Not warning	Not engaged	On	Not warning	Not engaged	On
-2.0	0	Not warning	Not engaged	On	Not warning	Not engaged	On
-1.5	0	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

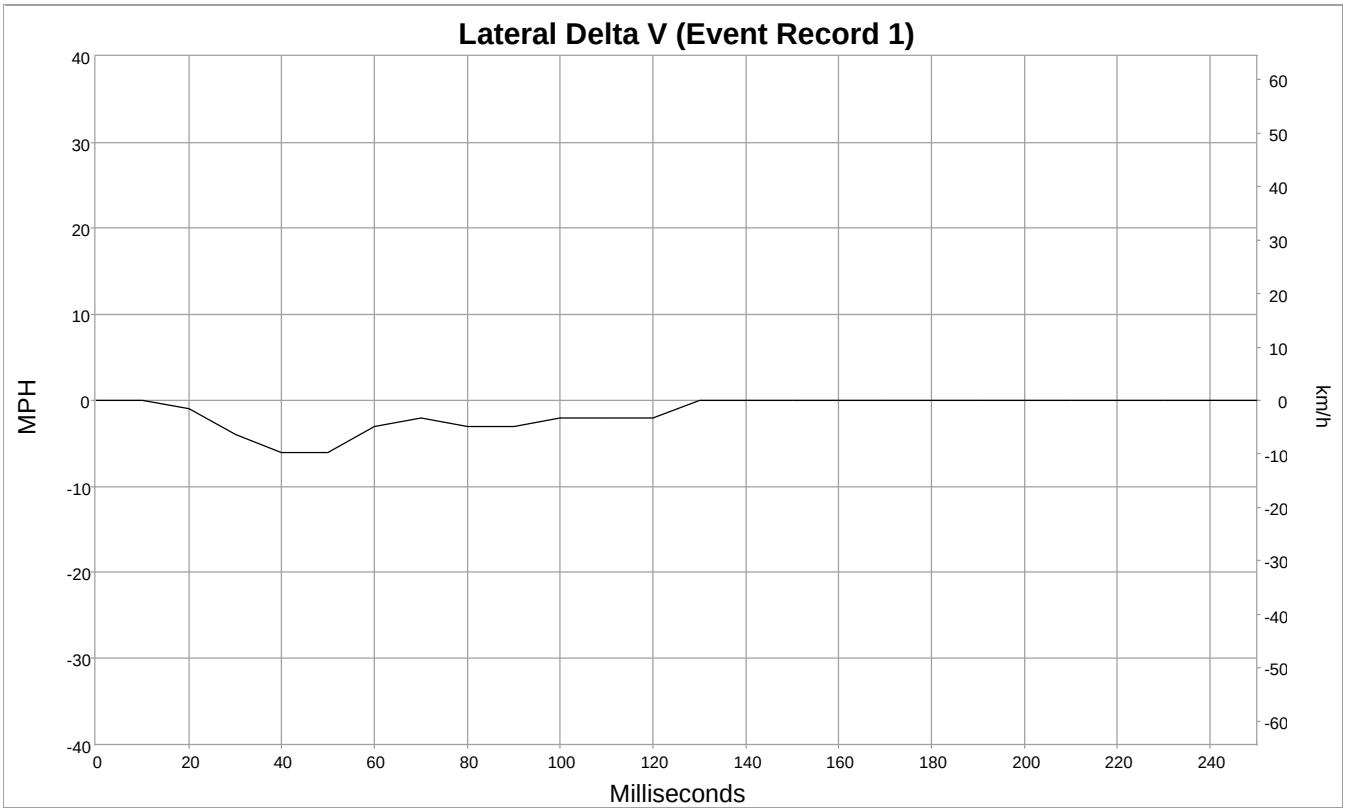
Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1) - Table 3 of 3

Time Stamp (sec)	Adaptive Cruise Control (Not Engaged/ Engaged)	Adaptive Cruise Control (On/Off)	Lane Keeping Assist (Not Engaged/ Engaged)	Lane Keeping Assist (On/Off)	Cruise Control (Not Engaged/ Engaged)	Cruise Control (On/Off)
-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



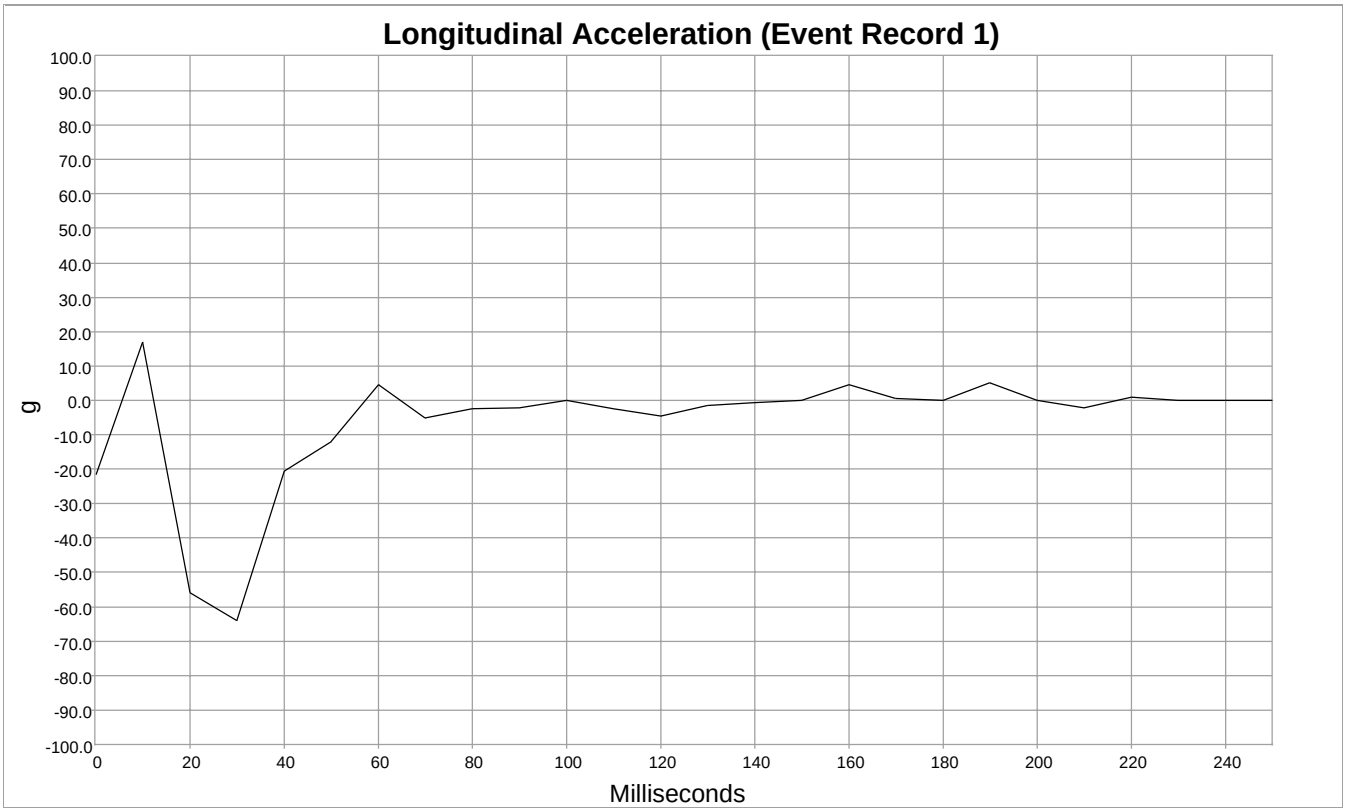
Longitudinal Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	0 [0]
10	-2 [-3]
20	-7 [-11]
30	-25 [-40]
40	-32 [-52]
50	-37 [-59]
60	-40 [-64]
70	-41 [-66]
80	-43 [-69]
90	-43 [-69]
100	-43 [-70]
110	-43 [-70]
120	-44 [-71]
130	0 [0]
140	0 [0]
150	0 [0]
160	0 [0]
170	0 [0]
180	0 [0]
190	0 [0]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	0 [0]



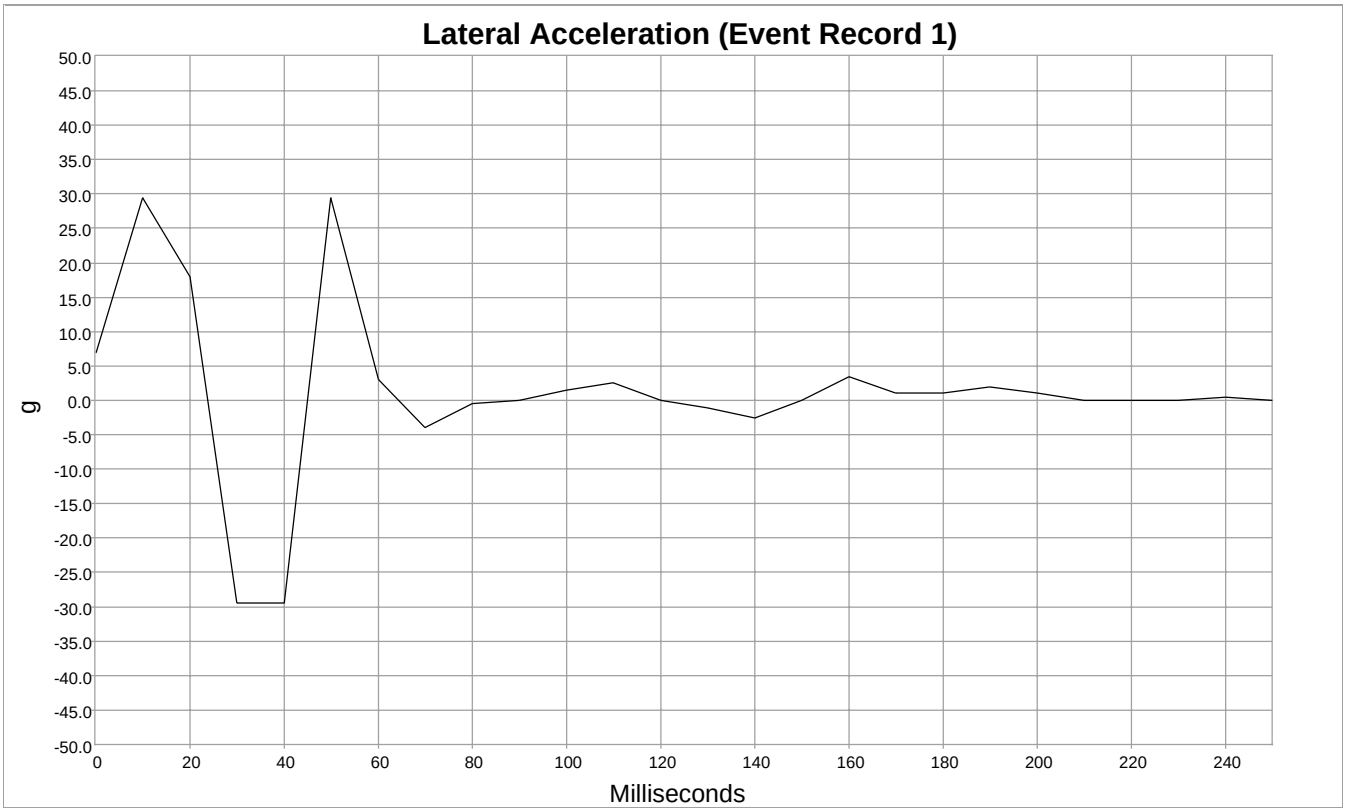
Lateral Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	-1 [-1]
30	-4 [-6]
40	-6 [-9]
50	-6 [-10]
60	-3 [-5]
70	-2 [-4]
80	-3 [-5]
90	-3 [-5]
100	-2 [-4]
110	-2 [-4]
120	-2 [-3]
130	0 [0]
140	0 [0]
150	0 [0]
160	0 [0]
170	0 [0]
180	0 [0]
190	0 [0]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	0 [0]



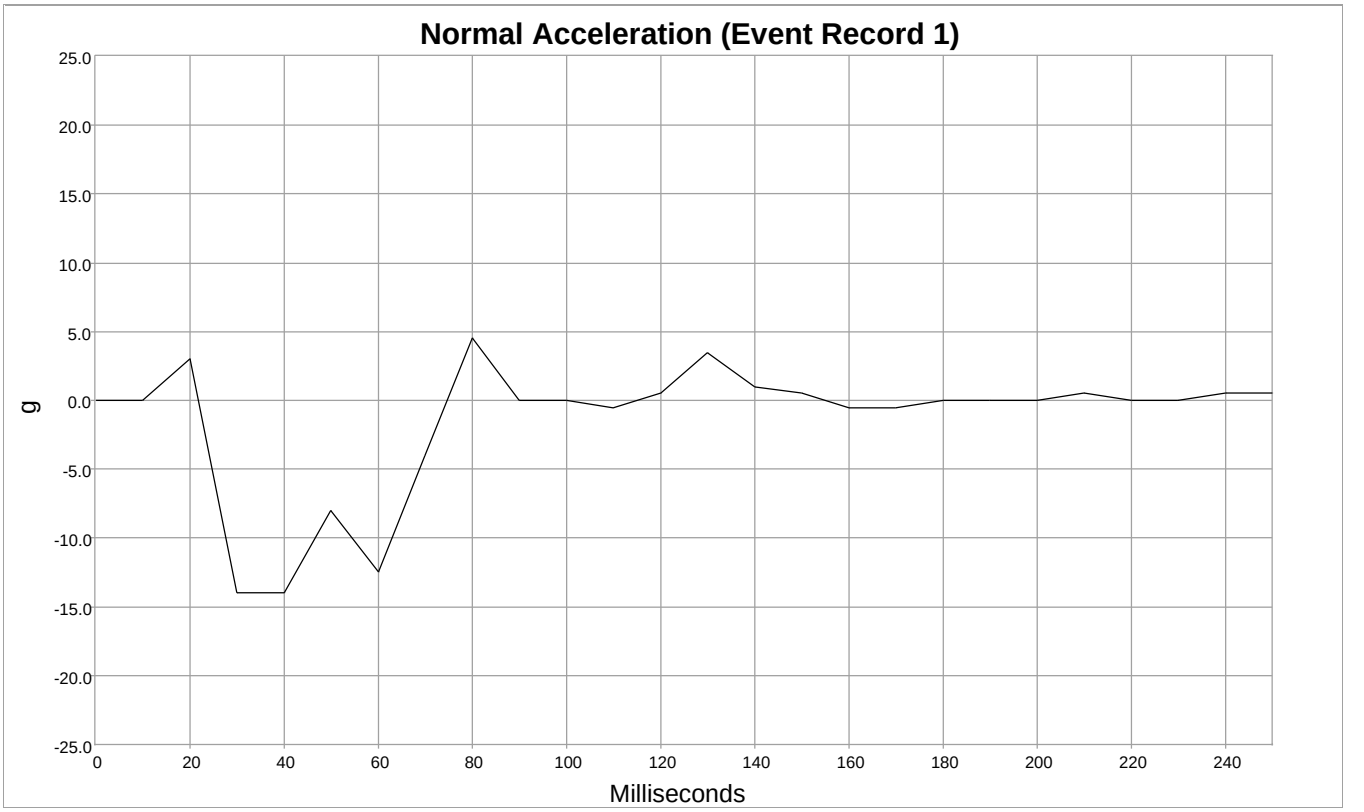
Longitudinal Acceleration (Event Record 1)

Time (msec)	g
0	-21.5
10	17.0
20	-56.0
30	-64.0
40	-20.5
50	-12.0
60	4.5
70	-5.0
80	-2.5
90	-2.0
100	0.0
110	-2.5
120	-4.5
130	-1.5
140	-0.5
150	0.0
160	4.5
170	0.5
180	0.0
190	5.0
200	0.0
210	-2.0
220	1.0
230	0.0
240	0.0
250	0.0



Lateral Acceleration (Event Record 1)

Time (msec)	g
0	7.0
10	29.5
20	18.0
30	-29.5
40	-29.5
50	29.5
60	3.0
70	-4.0
80	-0.5
90	0.0
100	1.5
110	2.5
120	0.0
130	-1.0
140	-2.5
150	0.0
160	3.5
170	1.0
180	1.0
190	2.0
200	1.0
210	0.0
220	0.0
230	0.0
240	0.5
250	0.0



Normal Acceleration (Event Record 1)

Time (msec)	g
0	0.0
10	0.0
20	3.0
30	-14.0
40	-14.0
50	-8.0
60	-12.5
70	-4.0
80	4.5
90	0.0
100	0.0
110	-0.5
120	0.5
130	3.5
140	1.0
150	0.5
160	-0.5
170	-0.5
180	0.0
190	0.0
200	0.0
210	0.5
220	0.0
230	0.0
240	0.5
250	0.5

Hexadecimal Data

DID #	Data
$8000	21 4D 13 14 01 33 00 11 00 55 00 00 11 33 00 00 20 0F 00 E9 02 06 22 00 00 00 00 00 00 00 00 00 11 11 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 29
$8020	01 03 00 00 00 00 00 00 00 00 00 00 00 00 00 FC
$8021	AA 00 01 00 00 00 00 00 00 00 00 55 02 BB AA 00
$8022	AA 00 C0 78 66 00 00 00 02 00 00 00 00 00 00 00 00 12 00 17 00 00 00 00 00 00 19 00 00 00 19 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 11 00 00 00 00 00 00 00 00 00 00 00 00 00 00 4A
$8023	AA 00 C0 78 66 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 11 00 00 00 00 00 00 00 00 00 00 00 00 00 00 A7
$8024	AA 00 FF 00 00 40 43 02 12 12 11 00 02 BA 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 E1
$8025	AA 00 FF 00 00 40 43 00 12 00 11 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 B1
$8026	AA 01 FC D0 35 00 00 77 33 00 30 00 00 00 00 00 78 4E FF 25 4E 00 00 00 00 00 00 00 00 00 00 00 7B 5E FF 2B 5E 00 00 00 00 00 00 00 00 00 00 00 7D 5E FF 33 5E 00 00 00 00 00 00 00 00 00 00 00 80 5F FF 33 5F 00 00 00 00 00 00 00 00 00 00 00 82 00 01 2B 00 01 00 00 00 00 00 00 00 00 00 00 82 00 00 20 00 01 00 00 00 00 00 00 00 00 00 00 7E 00 FE 19 00 01 00 00 00 00 00 00 00 00 00 00 73 00 01 13 00 01 00 00 00 00 00 00 00 00 00 00 69 00 0D 10 00 01 00 00 00 00 00 00 00 00 00 00 52 00 16 0A 00 25 00 00 00 00 00 00 00 00 00 00 52 00 1B 09 00 25 00 00 00 00 00 00 00 00 00 DD
$8027	AA 01 FC D0 35 00 00 77 33 00 30 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 7A
$8028	AA 00 00 FD F5 D8 CC C5 C0 BE BB BB BA BA B9 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 B8 31 00 00 00 00 00 F1
$8029	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 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 56
$802A	AA 00 00 00 FF FA F7 F6 FB FC FB FB FC FC FD 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

```
                00 00 00 00 00 00 00 00 F4 12 00 31 00 00 00 57

$802B           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 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 56

$802C           AA 01 D5 22 90 80 D7 E8 09 F6 FB FC 00 FB F7 FD
                FF 00 09 01 00 0A 00 FC 02 00 00 00 00 F0 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 A9

$802D           AA 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 00 00 00 55

$802E           AA 01 0E 3B 24 C5 C5 3B 06 F8 FF 00 03 05 00 FE
                FB 00 07 02 02 04 02 00 00 00 01 00 00 32 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 E1

$802F           AA 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 00 00 00 55

$8030           AA 01 00 00 06 E4 E4 F0 E7 F8 09 00 00 FF 01 07
                02 01 FF FF 00 00 00 01 00 00 01 01 01 22 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 81

$8031           AA 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 00 00 00 55

$8007           AA 00 00 00 00 00 00 00 0E 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 F2

$803F           AA 01 00 20 00 00 00 00 00 00 00 00 00 00 00 00
                80 34 07 00 00 00 16 00 00 10 00 00 00 03 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8011           AA 01 C4 2F E0 00 00 00 00 01 27 16 00 00 00 10
                00 00 00 00 04 00 10 00 1E FF 06 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 FD

$8012           AA 00 55 04 85 04 C7 02 C9 03 62 00 02 09 53 00
                40 40 00 DF 01 00 40 00 DF 01 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 9F
                02 00 0F 00 00 08 13 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 D4

$8013           AA 01 C4 2F E0 00 00 00 00 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 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 81

$8014           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 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 56
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8015           AA 01 C4 2F E0 00 00 00 00 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 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 81

$8016           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 00 56
```

```
$8017          AA 01 C4 2F E0 00 00 00 00 01 27 16 00 00 00 10
               00 00 00 00 07 00 10 00 1E FF 06 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 FA

$8018          AA 00 01 41 12 B1 21 D5 00 00 00 A1 F9 5F 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62

$8019          AA 01 C4 2F E3 10 BF 80 00 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 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 2F

$801A          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 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$801B          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 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8001          AA 00 C4 18 00 00 00 00 16 16 00 00 00 10 00 00
               00 00 00 07 07 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00

$8002          AA 01 E0 FE F8 FF 00 00 02 80 02 00 00 00 00 00
               80 54 B8 00 F4 00 36 00 00 00 00 06 30 00 00 00
               80 1D 88 71 E7 00 0C 48 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
               11 02 76 CD FF 00 00 00 F5 AF 0C C8 00 00 00 00
               F5 B3 0C C8 00 00 00 00 04 62 09 9E 00 00 00 00
               FF 43 00 FE 6F 00 D3 00 00 00 00 00 00 00 00 7E
               05 8C 00 02 D7 02 B4 00 00 00 00 00 00 00 00 E0
               01 02 26 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 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 FF FF 00 02 00 00 07
               00 00 00 00

$800A          AA 00 00 31 00 00 49 DA 92 26 5D 49 CC 9B 0A 96
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               49 DA 92 26 5D 49 CC 9B 0A 96 00 00 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 00
               AF 80 01 21 05 00 00 00 AF 00 10 51 3F 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 AF 11 11 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
               00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

$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 00 56
$801F	Not Used
$8040	AA 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 00 00 00 00 00 00 00 00 00 00 00 00
$8041	AA 00 FC CC 00 00 00 00 58 58 58 58 58 15 00 00 14 55 00 00 16 55 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$8043	AA 01 00 00 00 00 02 00 02 00 02 00 02 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 62 04 00 9E 09 00 00 00 00 00 00 00 00 00
$8044	AA 00 FF 00 80 8A 7F 7F 80 7F 7F 78 00 00 00 00 00 00 00 00
$8045	AA 00 B4 00 8A 00 77 5C 00 7D 00 00 00 00 00 00 00 00 00 00
$8046	AA 00 C0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$8050	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$8051	B3 11 01 00 98 71 01 00 98 72 01 00 33 31 01 00 C1 11 01 00 83 11 01 00 B2 61 01 00 11 31 01 00
$8052	03 33 05 05 01 15 15 01 01 00 00 00 00 00 00 00
$8053	A8 94 28 00 00 00 00 00 00 00 00 00 00 00 00 00
$8054	AA 00 F5 B3 F5 AA 0C D1 0C C3 00 00 00 00 00 00 00 00 FF FF 00 00 00 00 00 00 00 00 00 00 00 00
$8060	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 00 00
$8061	AA 00 CF 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$8062	AA 01 FF F0 3F 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

```
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8063           AA 00 FF FF 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8064           AA 00 F0 32 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8065           AA 00 FF F0 F0 CC 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
                00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

```
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8070   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 00 00

$8071   AA 00 F3 FF F0 0F 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$8072   AA 00 FF F9 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$E600   35 81

$E604   01 00 00 00

$F100   00 00 00 00

$F110   0E 37 37 39 36 30 54 47 47 41 30 32 30 4D 32 00
        00

$F112   0B 43 31 39 30 30 36 51 39 34 32 51 00 00 00 00
        00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

$F181   37 37 39 35 39 2D 54 47 47 2D 41 30 32 30 00 00
```

Disclaimer of Liability

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

DOT HS 813 228
December 2021

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

15452-120321-v2