

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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SIDE IMPACT AIR BAG NON-DEPLOYMENT/DRIVER FATALITY INVESTIGATION

VERIDIAN CASE NO: CA02-054

VEHICLE: 2001 BUICK REGAL

LOCATION: COLORADO

CRASH DATE: OCTOBER, 2002

Contract No. DTNH22-01-C-17002

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

TECHNICAL REPORT STANDARD TITLE PAGE

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**SIDE IMPACT AIR BAG NON-DEPLOYMENT/DRIVER FATALITY INVESTIGATION
VERIDIAN CASE NO: CA02-054**

**VEHICLE: 2001 BUICK REGAL
LOCATION: COLORADO
CRASH DATE: OCTOBER, 2002**

BACKGROUND

This on-site investigation focused on the crash severity and issues surrounding the non-deployment of the left side impact air bag in a 2001 Buick Regal. The Buick Regal was equipped with a Supplemental Restraint System that consisted of frontal air bags and a seat mounted side impact air bag for the driver. The Buick Regal was struck on the left side by the front of a 2002 Buick Century in an intersection collision. The Buick Century was equipped with a frontal air bag system that deployed as a result of the crash. The 88 year old female driver of the Buick Regal suffered intrusion related fatal injuries. The 25 year old male driver, 25 year old female front right passenger, and 26 year old female rear right passenger in the Buick Century sustained police reported non-incapacitating injuries.

The investigating Colorado State Police notified the Special Crash Investigations team at Veridian Engineering of the crash on November 8, 2002. The Crash Investigation Division (CID) and the Office of Defects Investigation (ODI) of the National Highway Traffic Safety Administration (NHTSA) were subsequently notified. The ODI asked for an on-site investigation, which was assigned by the CID on November 11, 2002. The vehicles were located in an insurance salvage yard and were available for inspection. The on-site portion of this investigation was initiated on November 20, 2002.

SUMMARY

Crash Site

This two-vehicle crash occurred during the daytime hours in October, 2002. At the time of the crash, it was daylight and it was raining. The asphalt road surface was wet. The crash occurred at the four-leg intersection of a two-lane north/south road and a two-lane divided east/west road. **Figure 1** is an eastbound trajectory view 61 m (200 ft) west of the intersection. A 12 m (38 ft) wide depressed earth median separated the eastbound and westbound lanes. A median cross-over allowed the intersecting traffic to cross the divided highway. There was a negative grade (estimated greater than two percent) in the eastbound direction. A stop sign for northbound traffic controlled the intersection. There were no obstructions in the intersection that would have impaired either driver's visibility. The speed limit in the area of the crash was 89 km/h (55 mph).



Figure 1: Eastbound trajectory view 61 m (200 ft) west of the intersection.

CRASH SEQUENCE

Pre-Crash

The 2001 Buick Regal was northbound on the intersecting roadway driven by an 88 year old unrestrained female. The driver had a reported height and weight of 137 cm (54 in) and 57 kg (125 lb). The driver reportedly stopped at the intersection and then accelerated forward intending to cross the eastbound lanes of the highway. A witness was stopped in the median cross-over facing south. She reported, in her statement to the police, that the Buick Regal came to a full stop and then accelerated across the eastbound lanes of the highway. The vehicle accelerated forward approximately 14 m (45 ft) and was traveling approximately 16 to 24 km/h (10 to 15 mph) at impact. Approximately four seconds elapsed during the Regal's acceleration.

The 2002 Buick Century was eastbound in the inboard lane of the highway. The Buick Century was driven by a 25 year old restrained male. A 25 year old restrained female and a 26 year old restrained female were the vehicle's front right and rear right passengers, respectively. The speed of the Buick Century five seconds prior to the crash, as recorded by the vehicle's Event Data Recorder (EDR), was 122 km/h (76 mph). The driver of the Century responded to the acceleration of the Buick Regal across his path of travel by steering counterclockwise (left) and braking. The EDR recorded brake initiation approximately three seconds prior to the impact. The Buick Century decelerated to approximately 79 km/h (49 mph) one second prior to impact. No pre-crash skid marks were identified by the police investigation.

Crash

The front plane of the Buick Century impacted the left side of the Buick Regal in a 12/9 impact configuration. The impact induced deceleration deployed the frontal air bags of the Buick Century. The left side impact air bag of the Buick Regal did not deploy. The total delta V's of the collision calculated by the Damage Algorithm of the WINSMASH model were 45.0 km/h (28.6 mph) and 42.0 km/h (26.7 mph) for the Buick Regal and Buick Century, respectively.

The eastbound momentum and pre-crash left steering input of the Buick Century coupled with the lateral momentum of the Buick Regal redirected the vehicles into the center median. The force of the crash forward of the Buick Regal's center of gravity caused it to rotate approximately 30 degrees clockwise during its post-impact travel. The Buick Regal came to rest facing northeast approximately 23 m (75 ft) northeast of the point of impact. The Buick Century came to rest adjacent to the Regal approximately 24 m (80 ft) northeast of the impact. Tire marks through the median identified during the police investigation defined the vehicles' post-impact trajectory. **Figure 2** is a northeastward view of the vehicles' trajectory to their respective final rest locations. A pattern of gouge marks was identified in the inboard eastbound lane, bordering the inboard edge line and located the area of the impact. The gouges were attributed to the front undercarriage



Figure 2: Northeastward view along the vehicle's trajectory toward their final rest locations

of the Buick Century as it impacted the Regal and Century's suspension was driven down. **Figure 15**, page 12 of this report, is a schematic of the crash developed by the investigating Colorado State police.

Post-Crash

The police and ambulance personnel were dispatched to the crash scene. The first police officer arrived on-scene 11 minutes post-crash. The officer began assessment of the situation and requested a life flight helicopter due to the seriousness of the injuries sustained by the 88 year old driver of the Buick Regal. The ambulance personnel arrived on-scene 16 minutes post-crash and began administering aid to the involved parties. The life flight helicopter arrived on-scene 24 minutes post-crash and took over treatment of the elderly driver. The driver was transported to a local hospital via helicopter and arrived 38 minutes post-crash. Medicals efforts to sustain the driver's life were unsuccessful and she was pronounced deceased 55 minutes post-crash. An autopsy was performed and the cause of death was listed as blunt force trauma to the chest and abdomen. The driver and passengers of the Buick Century were treated for minor injuries and released from the hospital the day of the crash.

2001 BUICK REGAL GS

The 2001 Buick Regal GS, **Figure 3**, was identified by the Vehicle Identification Number (VIN): 2G4WF551211 (production sequence deleted). The vehicle was equipped with a 3.8 liter V6 supercharged engine linked to a 4-speed automatic transmission. The Buick was equipped with a four wheel anti-lock brake system (ABS). The manual restraint system consisted of 3-point lap and shoulder belts in the four outboard seat positions and a center rear lap belt. The Supplemental Restraint System (SRS) consisted of redesigned frontal air bags for the driver and front right passenger and a driver seat-mounted side impact air bag. None of the air bags deployed as a result of the crash. The vehicle was purchased new by the driver in October 2000. The vehicle's date of manufacture and odometer reading were unknown.



Figure 3: Front view of the Buick Regal.

The Buick Regal was equipped with an Event Data Recorder (EDR) capable of recording crash related data. The EDR was designed to capture and store data related to the deployment (or near deployment) of the frontal air bag system. The EDR in the subject vehicle was downloaded, however, the stored near deployment data was not related to this side impact crash.

Exterior Damage

Figures 4 and 5 are left side views of the Buick. The left side plane of the Regal sustained 214.0 cm (84.3 in) of direct contact damage as a result of the impact. The damage began 56.7 cm (22.3 in) forward of the left rear axle and extended forward onto the left front fender. The damage ended 6.4 cm (2.5 in) aft of the left front axle. The maximum crush was located at the mid-aspect

of the left front door and measured 78.0 cm (30.7 in). The residual crush profile at the mid-door elevation was as follows: C1 = 0, C2 = 26.0 cm (10.2 in), C3 = 65.0 cm (25.6 in), C4 = 78.0 cm (30.7 in), C5 = 62.0 cm (24.4 in), C6 = 18.0 cm (7.1 in). The lateral deformation of the left A-pillar fractured the windshield. The left front, right front and backlight glazing disintegrated upon impact. The left doors were jammed shut by the deformation. The right rear door was jammed due to body deformation. The right front door was opened by extrication. The force of the impact deformed the vehicle's unibody structure and caused it to bow. The bowing was reflected in the vehicle's wheelbase measurements. The wheelbase specification was 277.0 cm (109.1 in). The right wheelbase measured 282.0 cm (111.1 in). The left wheelbase measured 261.0 cm (102.8 in). The left front axle was displaced approximately 8 cm (3 in) forward during the impact. The total delta V calculated by the Damage Algorithm of the WINSMASH model was 45.0 km/h (27.9 mph). The longitudinal and lateral components were -7.8 km/h (-4.8 mph) and +44.3 km/h (+27.5 mph), respectively. The Principle Direction of Force (PDOF) was an estimated 280 degrees. The Collision Deformation Classification (CDC) was 09-LPAW-4.



Figure 4: Overall left side view.



Figure 5: Close-up view of the left side damage.

2002 BUICK CENTURY

The 2002 Buick Century was identified by the Vehicle Identification Number (VIN): 2G4W552J721 (production sequence deleted). The vehicle was owned by a rental agency and was operated under a rental agreement at the time of the crash. The vehicle was manufactured in November 2001 and the odometer had recorded 45,828 km (28,477 miles) at the time of the crash. The Buick was equipped with a power train that consisted of 3.1 liter, V6 engine linked to a 4-speed automatic transmission. The brake system was four-wheel ABS. The manual restraint system consisted of 3-point lap and shoulder belts in the four outboard seat positions with center front and center rear lap belts. The Supplemental Restraint System (SRS) consisted of redesigned frontal air bags for the driver and front right passenger that deployed as a result of the crash. The vehicle was equipped with an Event Data Recorder (EDR) capable of recording crash related data. The EDR was downloaded and a summary of the recorded event data is attached to the end of this report, **Attachment A**.

Exterior Damage

Figures 6 and 7 are the front and right lateral views of the frontal damage. The front plane of the Buick Century sustained direct contact damage that extended across the vehicle's entire 147 cm (58 in) frontal end width. The direct contact damage on the hood along the vehicle's centerline extended rearward approximately 25 cm (10 in) from the hood's leading edge, [61.2 cm (24.1 in) from the original baseline]. The residual crush profile measured along the bumper reinforcement bar was as follows: C1 = 10.0 cm (3.9 in), C2 = 19.0 cm (7.5 in), C3 = 20.0 cm (7.9 in), C4 = 19.0 cm (7.5 in), C5 = 17.0 cm (6.7 in), C6 = 7.0 cm (2.8 in). The force of the crash caused both front fenders and the hood to buckle. All the doors remained operational. There was no change in the wheelbase dimensions. The energy of the crash was managed primarily by the vehicle's structures forward of the A-pillars. The Collision Deformation Classification (CDC) was 12-FDEW-1. The delta V calculated by the Damage Algorithm of the WINSMASH model was 42.0 km/h (26.1 mph). The longitudinal and lateral delta V components were -41.4 km/h (-25.7 mph) and -7.3 km/h (-4.5 mph), respectively.



Figure 6: Front view of the Buick Century.



Figure 7: Right lateral view of the damage.

Event Data Recorder

The Buick Century's on-board Event Data Recorder (EDR) was downloaded during the police investigation. The data indicated the vehicle was operating at a speed of 122 km (76 mph), five seconds (T-5) prior to Algorithm Enable (AE). The driver actuated the brakes approximately three seconds (T-3) prior to AE and decelerated to a speed of approximately 79 km/h (49 mph). The EDR recorded delta V was 38.3 (23.8 mph). This recorded value was consistent with the WINSMASH reconstruction. The EDR data indicated the driver seat belt was buckled. The SCI inspection of the Buick Century identified crash related evidence on the manual restraint systems in all three occupied positions. All three occupants of the Buick Century were restrained at the time of the crash.

2001 BUICK REGAL GS

Interior Damage

The Regal's front left and rear left occupant spaces sustained moderate intrusion as a result of the exterior crash forces. **Figure 8** is a view of the right lateral view of the driver's interior. **Figure 9** is a rear interior view through the backlight. The lateral intrusion into the driver's foot well measured 35.1 cm (13.8 in). The left corner of the instrument panel intruded laterally 12.7 cm (5.0 in). The lateral intrusion of the left front door measured at the center aspect of the arm rest was 25.9 cm (9.8 in). The lateral intrusion of the left rear door measured at its center aspect was 27.9 cm (11.0 in). The intrusion of the left B-pillar measured at the D-ring elevation and beltline was 38.4 cm (15.1 in) and 48.9 cm (19.3 in), respectively. The left B-pillar was in contact with the outboard aspect of the driver's seat back. The intruding left side had deformed the seat back laterally approximately 30 cm (12 in). The inboard aspect of the driver's seat contacted and fractured the center console.

The driver was seated in a forward track position consistent with her stature. The seat could not be moved due to the deformation. The driver's safety belt was stowed within the retractor and the webbing was captured between the outboard aspect of the seat back and the intruded B-pillar. The retractor was locked due to deformation. The fact that the webbing was captured indicated the driver was not restrained at the time of the crash. The front right seat was in a full rear track position and the seat back was reclined.

The interior panel of the left front door exhibited two areas of contact with the driver's left flank. A 10 x 13 cm (4 x 5 in) contact area above the arm rest was abraded. The contact began 21.6 cm (8.5 in) forward of the aft edge of the door panel and extended forward. An 8 cm (3 in) long contact was identified on the edge of the arm rest. This contact began 23 cm (9 in) forward of the aft edge of the door panel. The protrusion of the arm rest measured 8.4 cm (3.3 in). Blood transfers were noted on the leading edge of the driver seat cushion and the displaced center console trim panel.



Figure 8: Right interior view.



Figure 9: Interior view through the backlight.

Supplemental Restraint System

The Buick Regal was equipped with a Supplemental Restraint System that consisted of redesigned driver and front right passenger air bags and a seat-mounted side impact air bag for the driver (only). A Sensing and Diagnostic Control Module (SDM) located under the front right seat monitored and controlled the deployment of the system. A satellite sensor in the left lower B-pillars provided input to the SDM regarding lateral crash severity. The SDM had EDR capability. However, the data downloaded during the subject investigation was (frontal) near-deployment event data unrelated to the subject crash.

The driver air bag was located in the center hub of the steering wheel rim and the front passenger air bag was a top-mount design located in the right aspect of the instrumental panel. The frontal air bags were not commanded to deploy in the side impact crash.

The left side impact air bag was housed in a module designed in the outboard aspect of the driver's seat back. **Figure 10** is a close-up view of the module looking rearward. (For orientation: the intruded B-pillar is depicted in the right side of the figure and the left door interior panel is in the lower right foreground. The outboard aspect of the seat and side impact module is in the left center of the figure.)



Figure 10: View of the non-deployed left side impact air bag module.

The side impact air bag (SAB) module was oriented vertically and measured 21.1 cm x 8.4 cm (8.3 in x 3.3 in), height by depth, respectively. Initial inspection revealed the lower forward aspect of the module cover flap had separated at the tear seam due to contact from the intruding B-pillar. The separation measured (4.5 in x 1.5 in), height by depth, along its perimeter.

During the SCI vehicle inspection, the module was opened by the investigator to ascertain the condition of the side air bag. **Figures 11 through 14** are sequential views of the air bag examination. **Figure 11** is a view of the non-deployed side air bag packaged within the module. The non-deployed bag was folded and packaged within a sleeve designed to tear open along a weakened vertical seam. During the deployment sequence, this seam would separate and allow the egress of the expanding bag. **Figure 12** is a view of the folded air bag after separation of the tear seam.

Figures 13 and 14 are views of the side air bag after it was removed from the module and unfolded by the SCI investigator. The air bag was designed to offer head and thorax protection. It was approximately rectangular in shape and measured 66 cm x 30 cm (26 in x 12 in), height by width. The bag was tethered by two straps located in the upper aspect of the chamber. A 6.4 cm (2.5 in) wide strap was located 14.0 cm (5.5 in) below the top of the bag and a 10.2 cm (4.0) wide strap was located 33 cm (13 in) below the top reference. The air bag inflated to a lateral depth of approximately 8 cm (3 in). Inspection of the air bag surface was unremarkable. There were no

visible manufacturer's labels. The air bag was initially folded in an accordion pattern, unfolded without resistance and was not heat stressed. The physical condition of the side air bag indicated that it had not deployed. All the information gathered during the course of this investigation suggested that the side air bag module did not receive a deployment command during the crash sequence. The root cause of the non-deployment could not be determined.



Figure 11: View of the packaged SAB under the cover flap.



Figure 12: View of the folded and undeployed SAB.



Figure 13: Right interior view of the SAB removed and unfolded from the module by the SCI investigator..



Figure 14: Left view of the SAB removed and unfolded from the module by the SCI investigator.

OCCUPANT DEMOGRAPHICS**2001 Buick Regal**

| | <i>Driver</i> |
|-------------------|--------------------------------|
| Age/Sex | 88 year old/Female |
| Height: | 157 cm (62 in) |
| Weight: | 68 kg (149 lb) |
| Restraint Use: | Unrestrained |
| Usage Source | SCI inspection |
| Medical Treatment | None, Fatal prior to admission |

2002 Buick Century

| | <i>Driver</i> | <i>Front Right Passenger</i> | <i>Rear Right Passenger</i> |
|-------------------|----------------------|------------------------------|-----------------------------|
| Age/Sex | 25 year old Male | 25 year old Female | 26 year old Female |
| Height: | 178 cm (70 in) | 175 cm (69 in) | 170 cm (67 in) |
| Weight: | 79 kg (175) | 59 kg (130 lb) | 77 kg (170 lb) |
| Restraint Use: | Restrained | Restrained | Restrained |
| Usage Source | SCI inspection | SCI inspection | SCI inspection |
| Medical Treatment | Treated and released | Treated and released | Treated and released |

BUICK REGAL DRIVER INJURY

| Injury | Injury Severity (AIS 98 update) | Injury Mechanism |
|---|--|---|
| 2 cm abrasion of the lateral left forehead | Minor (290202.1,7) | Intruding left front door panel |
| 3 cm abrasion of the left cheek | Minor (290202.1,2) | Intruding left front door panel |
| 3 cm abrasion of the posterior left scalp | Minor (190202.1,6) | Intruding left front door panel |
| 9 x 6 cm intrascalpular contusion near the vertex | Minor (190402.1,5) | Rebound contact to the right front door panel |
| 7 x 5 cm contusion of the scalp and left temporalis muscle | Minor (190402.1,2) | Intruding left front door panel |
| Lateral fractures of left ribs 4 - 10 Lateral fractures of right ribs 2 - 8 Posterior fractures (near spine) of left ribs 1 - 3 and right ribs 2 - 10; Hemothoraces - 425 ml left, 400 ml right; extensive intramuscular hemorrhage | Critical (450242.5,3) | Intruding left front door panel |
| Mild contusion to lungs, bilaterally | Severe (441410.4,3) | Intruding left front door panel |
| Fracture of the fifth thoracic vertebral body, without cord involvement | Moderate (650416.2,7) | Intruding left front door panel |
| 14 cm vertical tear of the pericardial sac and the heart is out of the sac | Critical (441606.5,4) | Intruding left front door panel |

| | | |
|---|---|---------------------------------|
| 10 cm coronal laceration of the left hemidiaphragm | Serious (440604.3,8) | Intruding left front door panel |
| 6 cm stomach laceration | Moderate (544420.2,7) | Intruding left front door panel |
| 3 cm horizontal laceration of the descending aorta located 3 cm distal to the left subclavian takeoff; Hemoperitoneum, 250 ml | Severe (420208.4,4) | Intruding left front door panel |
| Multiple 2 – 10 cm liver lacerations over both surfaces with the lateral right lobe internally pulped over a 5 cm wide area | Severe (541826.4,1) | Center Console |
| 7 x 3.5 cm laceration of the spleen capsule on the anti-hilar side | Moderate (544222.2,2) | Intruding left front door panel |
| Complex fracture of the inferior and superior left pubic bones just left of the pubic symphysis and a fracture of the left inferior ileum | Serious (852604.3,5) Moderate (852602.2,2) | Intruding left front door panel |
| 6 cm purpuric abraded contusion on the right anterolateral arm | Minor (790402.1,1) | Center console |
| Right medial elbow abraded contusion | Minor (790402.1,1) | Center console |
| 15 cm posterior right forearm contusion | Minor (790402.1,1) | Center console |
| Multiple abrasions and contusions to the dorsal aspect of both hands | Minor (790402.1,1) | Instrument panel |
| 10 x 6 cm abraded purpuric contusion of the lateral left arm | Minor (790402.1,2) | Intruding left front door panel |
| 18 x 7 cm abraded contusion on the dorsal left forearm | Minor (790402.1,2) | Intruding left front door panel |
| 8 cm purpuric contusion on the dorsomedial left hand and wrist | Minor (790402.1,2) | Instrument panel |
| 20 x 10 blue-red contusion on the right medial thigh | Minor (890402.1,1) | Transmission selector |
| Three small oblique linear abrasions on the dorsomedial right foot | Minor (890202.1,1) | Foot controls |
| 17 x 6 cm abraded contusion of the medial left thigh | Minor (890402.1,2) | Intruding left front door panel |
| 12.5 x 2 cm curving abrasion on the anterior left leg | Minor (890402.1,2) | Intruding left front door panel |
| 7 x 3 cm skin avulsion on the distal posterior left leg | Minor (890802.1,2) | Foot well intrusion |
| 2 cm intermittent contusion on the dorsal left foot | Minor (890402.1,2) | Foot controls |
| Multiple contusions of the left toes | Minor (890402.1,2) | Foot controls |

BUICK REGAL DRIVER KINEMATICS

Immediately prior to the crash, the unrestrained driver was seated in a presumed normal posture with her seat adjusted in a forward-to-mid track position. She reportedly came to a stop at the intersection and then accelerated forward, directly into the path of the Buck Century.

Upon impact, the driver responded to the left lateral direction of the impact by moving left into the door panel. Coincident with this kinematic pattern the left side of the vehicle was intruding laterally. The lateral intrusion contacted the left flank of the driver resulting in the multiple blunt force injuries identified above. As her torso contacted the door panel and was accelerated to the right, the unrestrained head and neck rolled to the left (toward the left shoulder). The left side facial injuries resulted in this manner. The door contact then displaced the driver to the right. The driver's right flank contacted the center console and transmission selector resulting in the injuries to the right extremities. The driver's head contacted the right door panel resulting in the intrascapular contusion. She came to rest lying across the center console with her head in the front right seat.

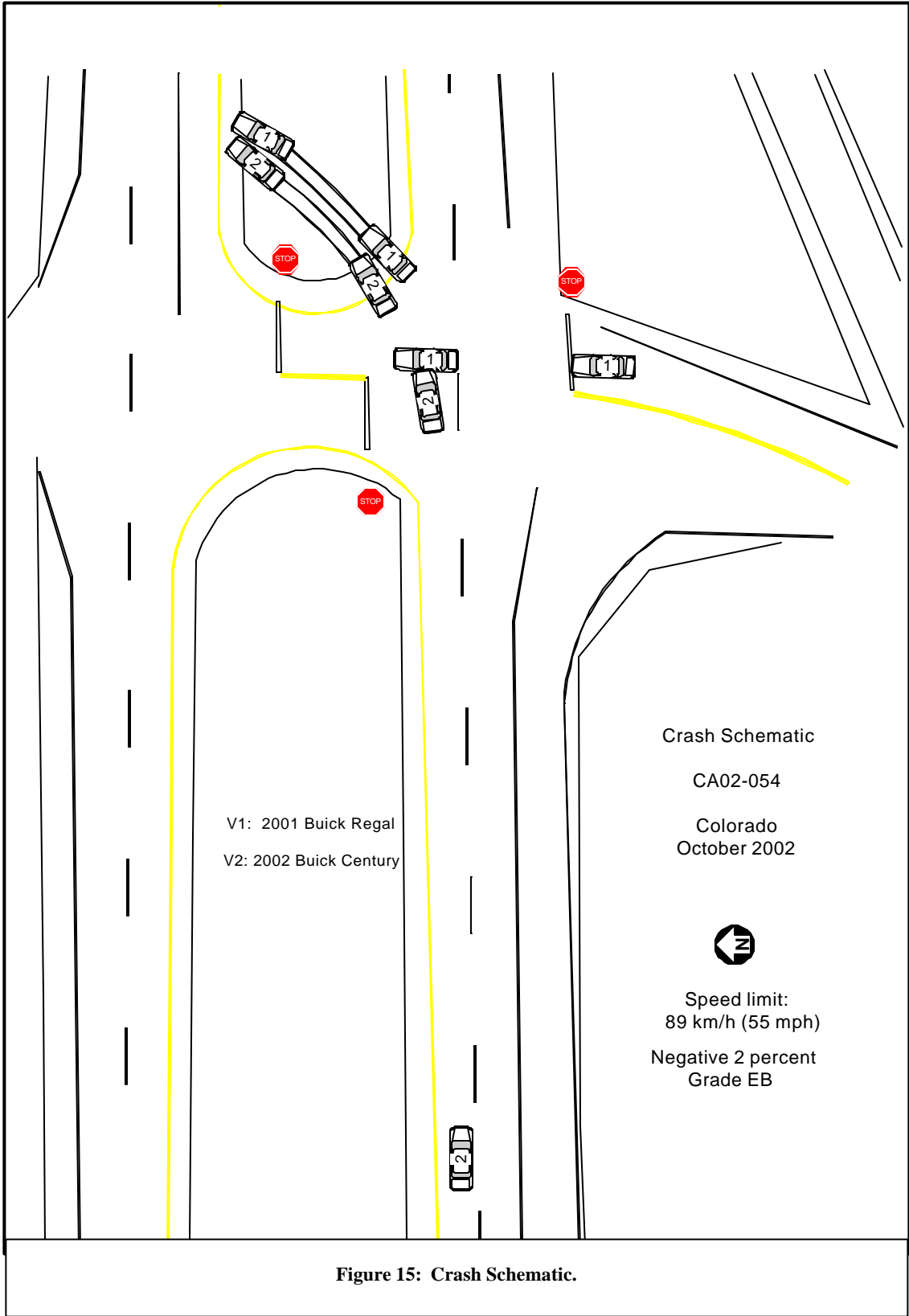


Figure 15: Crash Schematic.

ATTACHMENT A

EDR REPORT: 2002 Buick Century

| | |
|--|---------------------------------|
| Vehicle Identification Number | 2G4WS52J721xxxxxx |
| Investigator | |
| Case Number | |
| Investigation Date | 10/30/02 |
| Crash Date | 10/27/02 |
| Filename | 2G4WS52J721XXXXX.CDR |
| Saved on | 10/30/02 10:30:31 AM |
| Data check information | 123A361B |
| Collected with CDR version | Crash Data Retrieval Tool 1.673 |
| Collecting program verification number | D50959B5 |
| Reported with CDR version | Crash Data Retrieval Tool 1.673 |
| Reporting program verification number | D50959B5 |
| Event(s) recovered | Deployment Non-Deployment |

SDM DATA LIMITATIONS

SDM Recorded Crash Events:

There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.

The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. Deployment events can not be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.

The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 5 seconds before the deployment or a deployment level event occurs within 5 seconds after the deployment.

SDM Data Limitations:

-SDM Recorded Vehicle Forward Velocity Change is one of the measures used to make air bag deployment decisions. SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. The SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. The SDM will also record 150 milliseconds of data after non-deployment criteria is met.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.

-SDM Recorded Vehicle Speed accuracy can be affected if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.

-Brake Switch Circuit Status indicates the status of the brake switch circuit.

-Some of the Pre-Crash data, from the Deployment file, may be recorded after algorithm enable, if the Deployment event has a long crash pulse.

-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM does not receive a valid message for any of the four Pre-Crash data parameters (Vehicle Speed, Engine Speed, Percent Throttle, and Brake Switch Circuit Status).

-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit

-Passenger Front Air Bag Suppression Switch Circuit Status indicates the status of the suppression switch circuit.

-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, "N/A" is displayed in place of the time.

-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.

SDM Data Source:

All SDM recorded data is measured, calculated, and stored internally, except for the following:

-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module (PCM), via the Class 2 data link, to the SDM.

-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the Class 2 data link, to the SDM. Depending on vehicle option content, the Brake Switch Circuit Status data may not be available.

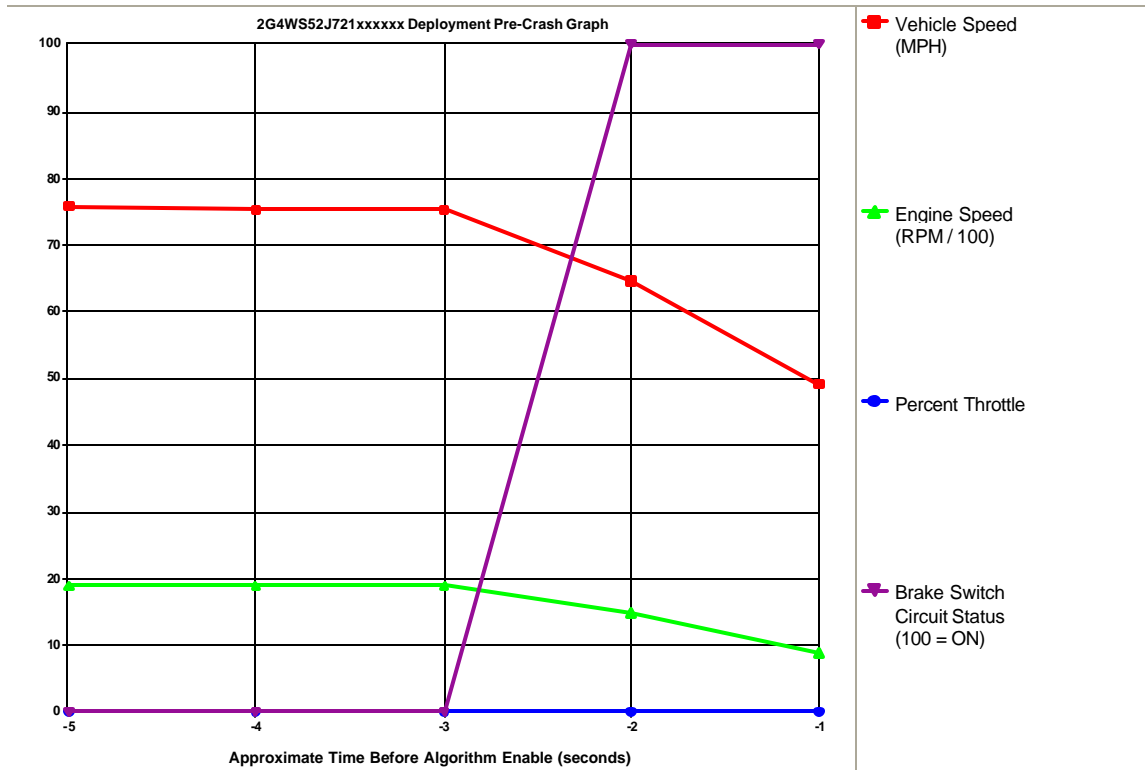
-In most vehicles, the Driver's Belt Switch Circuit is wired directly to the SDM. In some vehicles, the Driver's Belt Switch Circuit



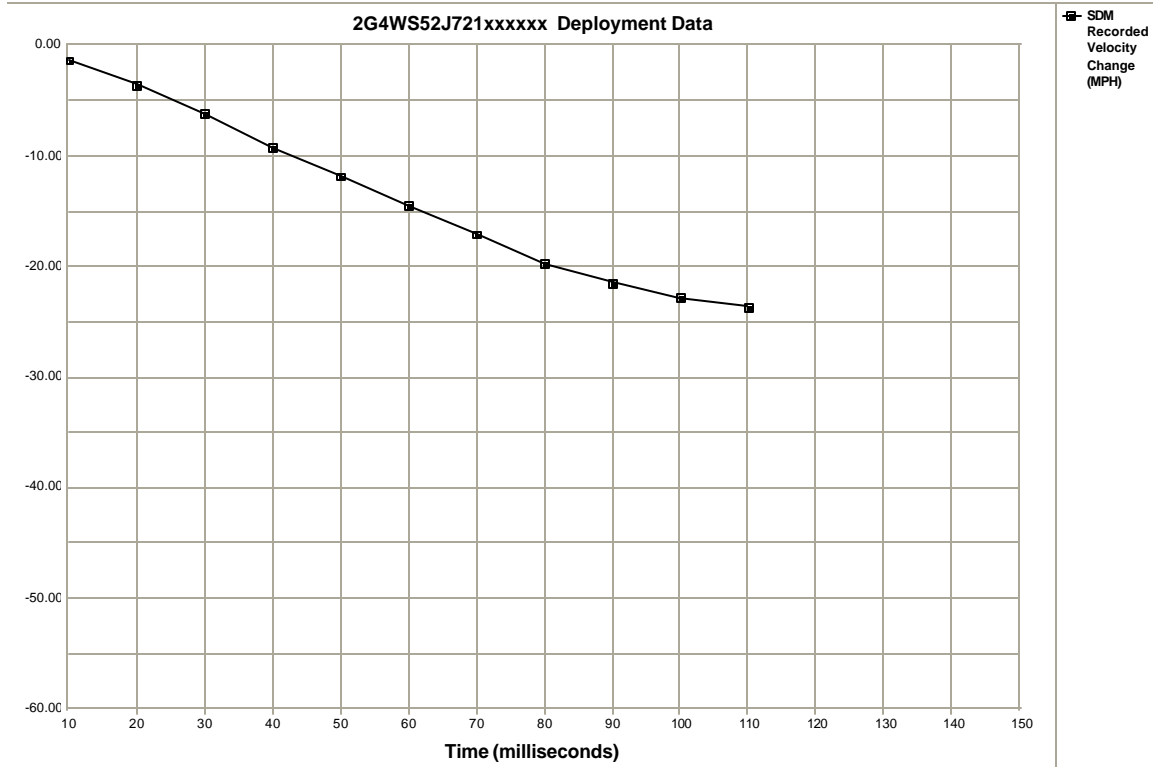
Status data is transmitted from the Body Control Module (BCM), via the Class 2 data link, to the SDM.
-The Passenger Front Air Bag Suppression Switch Circuit is wired directly to the SDM.

System Status At Deployment

| | |
|--|------------------------|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Passenger Front Air Bag Suppression Switch Circuit Status | Air Bag Not Suppressed |
| Ignition Cycles At Deployment | 1999 |
| Ignition Cycles At Investigation | 2001 |
| Maximum SDM Recorded Velocity Change (MPH) | -23.87 |
| Algorithm Enable to Maximum SDM Recorded Velocity Change (msec) | 107.5 |
| Time Between Non-Deployment And Deployment Events (sec) | 1.4 |
| Time From Algorithm Enable to Deployment Command Criteria Met (msec) | 12.5 |



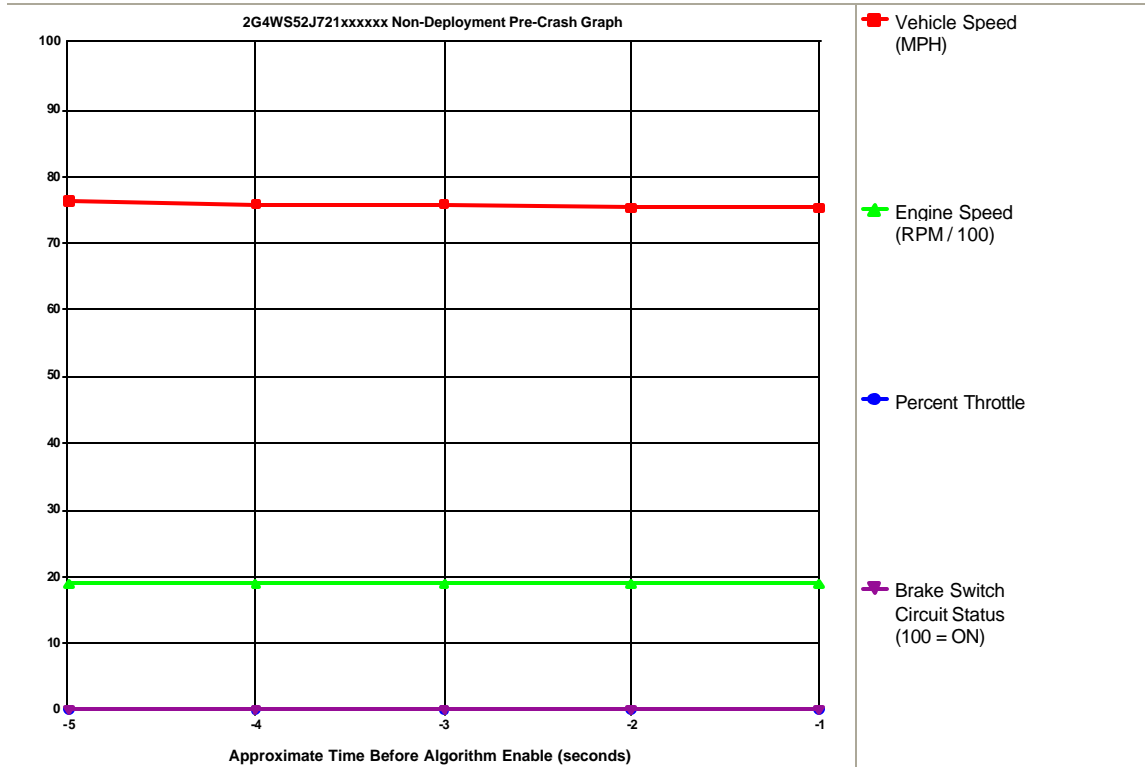
| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle | Brake Switch Circuit Status |
|-------------------|---------------------|--------------------|------------------|-----------------------------|
| -5 | 76 | 1856 | 0 | OFF |
| -4 | 75 | 1856 | 0 | OFF |
| -3 | 75 | 1856 | 0 | OFF |
| -2 | 65 | 1536 | 0 | ON |
| -1 | 49 | 896 | 0 | ON |



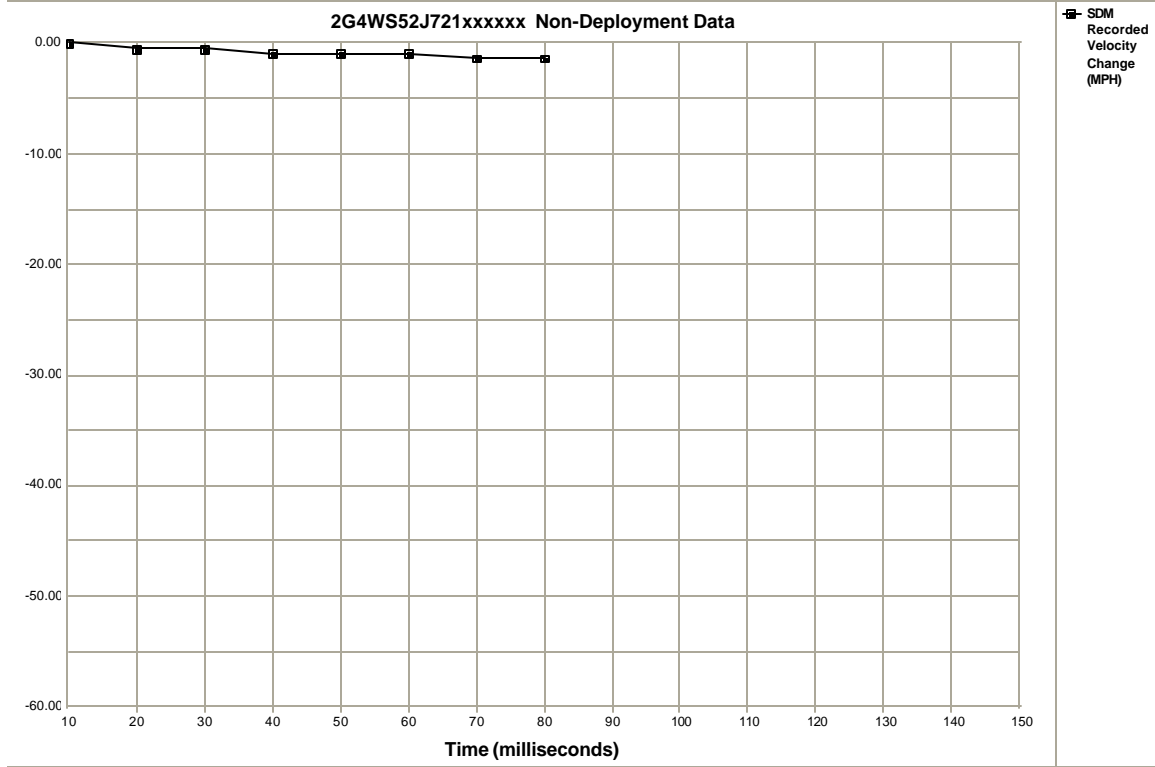
| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|------------------------------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|--------|-----|-----|-----|-----|
| SDM Recorded Velocity Change | -1.32 | -3.51 | -6.14 | -9.21 | -11.85 | -14.48 | -17.11 | -19.75 | -21.50 | -22.82 | -23.70 | N/A | N/A | N/A | N/A |

System Status At Non-Deployment

| | |
|---|------------------------|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Passenger Front Air Bag Suppression Switch Circuit Status | Air Bag Not Suppressed |
| Ignition Cycles At Non-Deployment | 1999 |
| Ignition Cycles At Investigation | 2001 |
| Maximum SDM Recorded Velocity Change (MPH) | -1.49 |
| Algorithm Enable to Maximum SDM Recorded Velocity Change (msec) | 80 |



| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle | Brake Switch Circuit Status |
|-------------------|---------------------|--------------------|------------------|-----------------------------|
| -5 | 76 | 1920 | 0 | OFF |
| -4 | 76 | 1920 | 0 | OFF |
| -3 | 76 | 1856 | 0 | OFF |
| -2 | 75 | 1856 | 0 | OFF |
| -1 | 75 | 1856 | 0 | OFF |



| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|------------------------------|------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|-----|-----|-----|
| SDM Recorded Velocity Change | 0.00 | -0.44 | -0.44 | -0.88 | -0.88 | -0.88 | -1.32 | -1.32 | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Hexadecimal Data

This page displays all the data retrieved from the air bag module.
It contains data that is not converted by this program.

```
$01 08 23 00 00
$02 87 CC
$03 41 53 31 33 32 34
$04 4B 33 34 42 4E 32
$05 00
$06 10 31 06 39
$10 FF 05 FE
$11 83 86 87 E8 8D 00
$14 03 04 2D 80
$18 85 84 85 B3 FF 00
$1C 34 32 57 42 46 53
$1D 59 34 32 57 4B 4C
$1E 4C 4C
$1F FF 02 00 00 00
$20 A0 00 00 FF 7D 80
$21 FF FF FF FF FF FF
$22 FF FF FF FF FF FF
$23 FF 00 00 6D 01 00
$24 01 01 02 02 02 03
$25 03 FF FF FF FF FF
$26 FF FF 08 79 79 7A
$27 7A 7B 00 00 00 00
$28 00 00 00 00 00 1D
$29 1D 1D 1E 1E 00 FF
$2A 06 80 FF FF FF FF
$2B FF FF FF 00 00 00
$2C 00 00 00 00
$2D 20 0C 06 00
$30 A0 00 00 FF 7D 80
$31 FF BF FF FF FF FF
$32 FF FF FF FF FF FF
$33 7C 0A 03 01 03 08
$34 0E 15 1B 21 27 2D
$35 31 34 36 FF FF FF
$36 FF 0B 57 06 CE 4F
$37 68 79 79 7A 00 C0
$38 00 00 00 00 00 00
$39 00 0E 18 1D 1D 1D
$3A 00 FF 06 80 24 00
$3B 00 10 00
$3C 05 2B 57 2B
$40 FF FF FF FF FF FF
$41 FF FF FF FF FF FF
$42 FF FF FF FF FF FF
$43 FF
```




Comments

Vehicle #2