

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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**VERIDIAN ON-SITE AIR BAG RELATED CHILD
FATALITY INVESTIGATION**

VERIDIAN CASE NO. CA02-020

VEHICLE - 1995 CHEVROLET LUMINA

LOCATION - STATE OF MICHIGAN

CRASH DATE - MAY, 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

1. <i>Report No.</i> CA02-020	2. <i>Government Accession No.</i>	3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Veridian On-Site Air Bag Related Child Fatality Investigation Vehicle - 1995 Chevrolet Lumina Location - State of Michigan		5. <i>Report Date:</i> November, 2002	
		6. <i>Performing Organization Code</i>	
7. <i>Author(s)</i> Crash Data Research Center		8. <i>Performing Organization Report No.</i>	
9. <i>Performing Organization Name and Address</i> Veridian Engineering Transportation Sciences Crash Data Research Center P.O. Box 400 Buffalo, New York 14225		10. <i>Work Unit No.</i> C00410.0000.0040	
		11. <i>Contract or Grant No.</i> DTNH22-01-C-17002	
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. <i>Type of Report and Period Covered</i> Technical Report Crash Date - May, 2002	
		14. <i>Sponsoring Agency Code</i>	
15. <i>Supplementary Notes</i> On-site investigation of an acute angle collision that involved a 1995 Chevrolet Lumina 4-door sedan equipped with frontal air bags for the driver and front right passenger positions.			
16. <i>Abstract</i> <p>This on-site investigation focused on the injury mechanisms that caused the death of a 6 year old male front right child passenger of a 1995 Chevrolet Lumina 4-door sedan. The Chevrolet Lumina was equipped with frontal air bags for the driver and front right passenger positions which deployed as a result of an acute angle collision with a 1995 Dodge Ram 2500 Laramie SLT 4x4 pickup truck. The driver of the Dodge pickup truck was operating the vehicle eastbound on the inboard lane of a multi-lane urban roadway when he failed to observe the westbound Chevrolet Lumina as he attempted to turn left (north) onto an intersecting roadway. As the Dodge pickup truck crossed the westbound lanes, the right rear side surface was impacted by the frontal area of the Chevrolet resulting in moderate damage to both vehicles. The unrestrained 49 year old male driver of the 1995 Chevrolet Lumina initiated a forward trajectory in response to the 11 o'clock impact force and loaded the knee bolster and deployed driver air bag. He complained to police of a sore chest and refused transport to a local hospital for treatment. The unrestrained 6 year old male front right child passenger of the 1995 Chevrolet Lumina was kneeling on the seat and facing to the right. He was displaced forward due to the pre-crash braking actions of the driver. At impact, the child passenger was within the path of the expanding air bag which struck his left face and neck resulting in multiple soft tissue injury. Bag expansion against the child resulted in additional soft tissue injury to the left arm and abdomen. At this point, he was accelerated vertically into the right A-pillar and roof/side rail areas. Head loading of the right A-pillar resulted in extensive skull fractures and underlying brain trauma. He also sustained multiple soft tissue injury to the back of the torso and head from subsequent contact to the right roof and side rail. The front right child passenger was transported to a local trauma center where he was pronounced deceased shortly after arrival.</p>			
17. <i>Key Words</i> Collision Deformation Classification (CDC): 11-FDEW-2 WinSMASH damage algorithm: 24.4 km/h (15.2 mph) Occupant out-of-position Vault and basilar skull fractures		18. <i>Distribution Statement</i> General Public	
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified	21. <i>No. of Pages</i> 15	22. <i>Price</i>

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CRASH DATE - MAY, 2002**

BACKGROUND

This on-site investigation focused on the injury mechanisms that caused the death of a 6 year old male front right child passenger of a 1995 Chevrolet Lumina 4-door sedan. The Chevrolet Lumina was equipped with frontal air bags for the driver and front right passenger positions which deployed as a result of an acute angle collision with a 1995 Dodge Ram 2500 Laramie SLT 4x4 pickup truck. The driver of the Dodge pickup truck was operating the vehicle eastbound on the inboard lane of a multi-lane urban roadway when he failed to observe the westbound Chevrolet Lumina as he attempted to turn left (north) onto an intersecting roadway. As the Dodge pickup truck crossed the westbound lanes, the right rear side surface was impacted by the frontal area of the Chevrolet resulting in moderate damage to both vehicles. The unrestrained 49 year old male driver of the 1995 Chevrolet Lumina initiated a forward trajectory in response to the 11 o'clock impact force and loaded the knee bolster and deployed driver air bag. He complained to police of a sore chest and refused transport to a local hospital for treatment. The unrestrained 6 year old male front right child passenger of the 1995 Chevrolet Lumina was kneeling on the seat and facing to the right. He was displaced forward due to the pre-crash braking actions of the driver. At impact, the child passenger was within the path of the expanding air bag which struck his left face and neck resulting in multiple soft tissue injury. Bag expansion against the child resulted in additional soft tissue injury to the left arm and abdomen. At this point, he was accelerated vertically into the right A-pillar and roof/side rail areas. Head loading of the right A-pillar resulted in extensive skull fractures and underlying brain trauma. He also sustained multiple soft tissue injury to the back of the torso and head from subsequent contact to the right roof and side rail. The front right child passenger was transported to a local trauma center where he was pronounced deceased shortly after arrival.

The crash notification was provided to NHTSA by the University of Michigan Transportation Research Institute (UMTRI) and immediately assigned to the Veridian SCI team as an on-site investigative effort on Friday, May 31, 2001. The Veridian SCI Team established cooperation with the local law enforcement agency and completed field activities on Tuesday, June 12, 2002.

SUMMARY

Crash Site

This two vehicle crash occurred during the afternoon hours of May, 2002. At the time of the crash, it was daylight with rainy conditions as the roads were wet. The crash occurred at the junction of a main thoroughfare and local street, 45.0 meters (147.6 feet) west of an interchange area; in the westbound lanes of a four lane east/west urban roadway which had a negative grade and curved left for westbound traffic (see **Figure 14 - page 15**). The travel lanes were divided to the east by a raised curbed median and to the west by a center turning lane which provided access to local businesses. No traffic control was present at the crash site which had a posted speed limit of 72 km/h (45 mph).

Pre-Crash

The 49 year old male driver of the 1995 Dodge Ram 2500 pickup truck was operating the vehicle eastbound (**Figure 1**) on the inboard lane of the multi-lane urban roadway at a (police reported) unknown speed when he maneuvered the vehicle into the center turn lane and failed to observe the westbound Chevrolet as he attempted to turn left (north) onto the intersecting roadway.

The 49 year old male driver of the 1995 Chevrolet Lumina was delivering newspaper bundles to local carriers, and operating the vehicle westbound (**Figure 2**) in the outboard lane of the multi-lane urban roadway at a (police reported) unknown speed when he observed the 1995 Dodge Ram pickup truck cross his path of travel. Upon recognition of the impending harmful event, he braked in avoidance and remained in the outboard (westbound) lane prior to the collision.



Figure 1. Eastbound approach for the 1995 Dodge Ram pickup truck.



Figure 2. Westbound approach for the 1995 Chevrolet Lumina.

Crash

As the Dodge Ram pickup truck crossed the westbound lanes of the multi-lane urban roadway, the right rear side surface was impacted by the frontal area of the Chevrolet Lumina (**Figure 3**) which resulted in moderate damage to both vehicles. The pre-impact braking actions of the Chevrolet driver produced an underride configuration as the bumper and hood structures underrode the bed portion of the Dodge pickup truck. The impact induced deceleration was sufficient to deploy the Chevrolet's frontal air bag system. Impact speeds and velocity changes were calculated utilizing the WinSMASH reconstruction program. The trajectory algorithm computed speeds *at impact* of 50.2 km/h (31.2 mph) for the subject vehicle and 50.3 km/h (31.3 mph) for the struck Dodge. The damage algorithm computed overall velocity changes of 24.4 km/h (15.2 mph) for the subject vehicle and 15.4 km/h (9.6 mph) for the Dodge pickup truck. Respective longitudinal components were -22.9 km/h (-14.2 mph) and -7.7 km/h (-4.8 mph). The Chevrolet's Event Data Recorder (EDR) recorded a deployment event with a longitudinal velocity change of 35.1 km/h (21.8 mph) at the 300 millisecond interval (see **Figures 12 & 13 - pages 13 and 14**).

At this point, the Chevrolet Lumina rotated 80 degrees clockwise and traveled 7.4 meters (24.3 feet) to final rest in the outboard (westbound) lane perpendicular to the north fog line facing north. The Dodge pickup truck rotated clockwise 85 degrees and continued 16.7 meters (54.8 feet) in a northeasterly direction. The Dodge traversed an intersecting street (and mountable curbed median) coming to rest perpendicular to the east curbline facing southeast. This trajectory was evidenced by a 4.8 meter (15.7 feet) scuff mark documented at the scene and attributed to the vehicle's left rear tire. In addition, final rest positions of both vehicles were well marked by the local investigating police agency and documented during the SCI scene inspection.

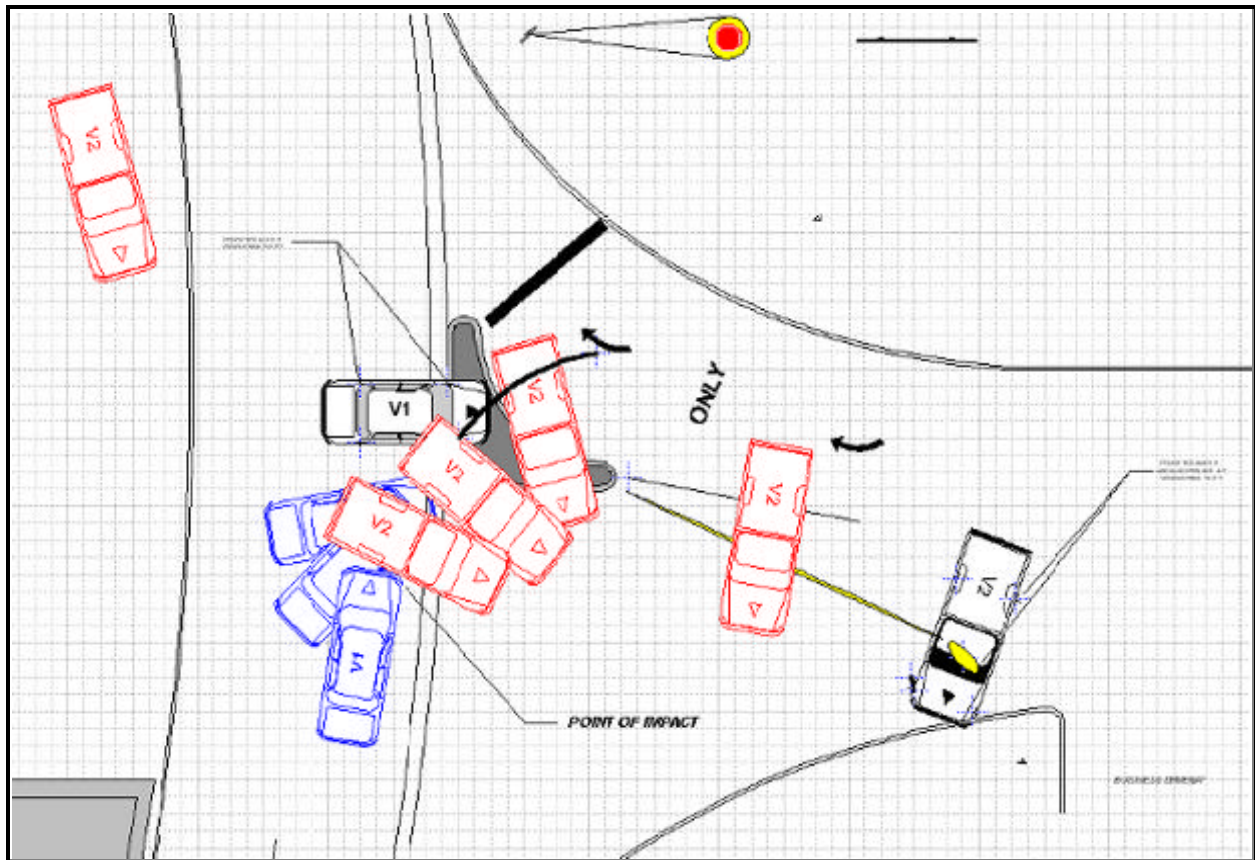


Figure 3. Crash schematic.

Post-Crash

Treatment was rendered at the scene by fire department personnel and emergency medical technicians (EMTs). The exit status of both drivers were unknown. The Dodge pickup driver was reported by police as uninjured in the crash as the Chevrolet driver refused transport to a local medical facility for unspecified complaints of chest pain. The 6 year old male front right child passenger the 1995 Chevrolet Lumina was removed from the vehicle through the right front door by rescue personnel and transported by ambulance to a local trauma center where he was pronounced deceased shortly after arrival. Both vehicles were towed from the crash site due to disabling damage.

VEHICLE DATA

The 1995 Chevrolet Lumina (date of manufacture unknown) was identified by the vehicle identification number (VIN): 2G1WL52M4S9 (production number deleted). The driver was reported by police as the owner of the vehicle which was a 4-door sedan equipped with a power windows, door locks, front-wheel drive, and a 3.1 liter, V6 engine. The odometer reading at the time of the crash was 249,786 km (155,214 miles). The seating was configured with front (split) and rear bench seats. The SCI interview was not obtained, therefore, previous crashes or maintenance on the Chevrolet's frontal air bag system were unknown.

VEHICLE DAMAGE

Exterior

The 1995 Chevrolet Lumina sustained moderate frontal damage as a result of the impact with the 1995 Dodge Ram pickup truck (**Figure 4**). The direct contact damage encompassed the entire front end width resulting in a combined direct and induced damage length (Field L) of 98.0 cm (38.6 in). Six crush measurements were documented at the level of the reinforcement bar (*bumper fascia separation*): C1= 8.0 cm (3.1 in), C2= 32.0 cm (12.6 in), C3= 50.0 cm (19.7 in), C4= 42.0 cm (16.5 in), C5= 22.0 cm (8.7 in), C6= 0. The Collision Deformation Classification (CDC) for this impact to the Chevrolet was 11-FDEW-2 with a principal direction of force of (-)20 degrees. Red paint and black rubber transfers were documented across the direct contact damage, and extended 68.0 cm (26.8 in) rearward on the hood surface; indicative of a side underride configuration. Although the direct contact damage encompassed the entire front end width, a narrow crush pattern or circular indentation was noted to the center section and attributed to the right rear wheel/tire on the opposing Dodge. The windshield was fractured along the lower center section from exterior impact forces and the right mid-windshield from (interior) passenger air bag module cover flap contact. The right fender was deformed rearward which partially restricted the right front door opening. The left rear door was inoperable (“stuck”) and attributed as pre-existing. No wheelbase reduction or induced roof buckle was identified.



Figure 4. Frontal damage to the 1995 Chevrolet Lumina.

The 1995 Dodge Ram 2500 Laramie SLT 4x4 conventional cab pickup truck sustained moderate right rear side surface damage as a result of the impact with the 1995 Chevrolet Lumina (**Figure 5**). The direct contact damage began 21.0 cm (8.3 in) forward of the right rear bed corner and extended 197.0 cm (77.6 in) forward. The combined direct and induced damage length (Field L) also began 21.0 cm (8.3 in) forward of the right rear bed corner and extended 239.0 cm (94.1 in) forward. Six crush measurements were documented at the level of the mid-body panel: C1= 0 cm, C2= 14.0 cm (5.5 in), C3= 15.0 cm (5.9 in), C4= 21.0 cm (8.3 in), C5= 24.0 cm (9.4 in), C6= 0 cm. A maximum crush value of 30.0 cm (11.8 in) was identified 5.0 cm (2.0 in) forward of the C4 position. Although the crush exhibited a sloped pattern vertically towards the lower edge, crush values were obtained at the level of the mid-body panel to conform to WinSMASH vehicle stiffness coefficients. The CDC for this impact to the Dodge was 02-RBEW-3 with a principal direction of force of (+)60 degrees. The right rear wheel was displaced 27.5 cm (10.8 in) rearward and restricted (not deflated) against the bed. Extensive right wheelbase elongation indicated the heaviest concentration of forces at this area, and may account for the wide variance between the WinSMASH calculated velocity change and the Chevrolet’s EDR summary. Loose cargo stowed in the bed area included a large steel toolbox and table saw. The



Figure 5. Right side surface damage to the 1995 Dodge Ram pickup truck.

combined weight of these items were approximately 317.5 kg (700.0 lb). Pre-existing damage consisted of miscellaneous rust spots and small indentations.

Interior

Interior damage to the Chevrolet was moderate and was attributed to occupant contacts (**Figure 6**). A scuff mark was documented on the left knee bolster. Steering wheel rim deformation measured 2.0 cm (0.8 in) at the top section, along with 1.0 cm (0.4 in) of shear capsule movement. Small abrasions and scratches were identified on the forward portion of the right headliner, sunvisor, and roof. Smudge marks and hair strands were also documented on the right sunvisor (vanity mirror undamaged) adjacent to the right A-pillar. This contact pattern extended vertically down the A-pillar into a concentrated area of head interaction. The cover panel was fractured as a deep indentation was noted to the underlying structure with skin tissue and hair strands surrounding the contact site. Blood pooling was found on the front left seat back and cushion, indicative of the child passenger's final rest position. Small areas of abrading and indentations were also documented on the rear aspect of the seat back from loose cargo (newspaper bundles) stowed in the backseat. No intrusions were identified in the vehicle.



Figure 6. Interior view of the front right space.

MANUAL RESTRAINT SYSTEMS

The interior of the Chevrolet Lumina consisted of a six passenger seating configuration with front (split) and rear bench seats. The driver seating position was equipped with a 3-point manual lap and shoulder belt system which consisted of a continuous loop belt webbing with a sliding latchplate and a dual mode retractor (inertial lock/belt sensitive). The front right and rear outboard seating positions were equipped with a 3-point manual lap and shoulder belt system which consisted of a continuous loop belt webbing with a sliding latchplate and a retractor equipped with an inertial and switchable lock mechanism. The front and rear center seats were equipped with a 2-point manual lap belt system and a locking latchplate. There was no loading evidence identified on the D-ring, latchplate, or webbing of the front restraints to suggest belt usage by either occupant in this moderate severity crash. Furthermore, the Chevrolet's EDR recorded the driver's belt switch status as "unbuckled".

SUPPLEMENTAL RESTRAINT SYSTEMS

The 1995 Chevrolet Lumina was equipped with frontal air bags for the driver and front right passenger positions which deployed as a result of the crash (**Figure 7**). The driver air bag was identified by the General Motors part number: *P16756616* with a bar coded lot number of: *TTM000369604*, and housed in the center of the steering wheel with a vertically oriented flap tear seam (I-configuration). The flaps were symmetrical in shape and measured 9.0 cm (3.5 in) in width and 11.3 cm (4.4 in) in height. No contact evidence was identified on the exterior surface of the



Figure 7. 1995 Chevrolet Lumina deployed frontal air bags.

module cover flaps. Although the surface of the air bag seemed lightly abraded and discolored from driver interaction, small areas of facial smudging were documented at the right upper and centered sections. The diameter of the driver air bag measured 53.5 cm (21.1 in) in its deflated state. The bag was vented by two 3.0 cm (1.2 in) ports located at the 10 o'clock and 2 o'clock sectors on the rear aspect of the air bag. No internal tether straps were present. Air bag excursion measured 54.0 cm (21.3 in) from the steering wheel hub.

The front right passenger air bag deployed from the right top instrument panel area with a single cover module cover flap design hinged at the forward aspect. The flap was rectangular in shape and measured 40.0 cm (15.7 in) in width and 25.0 cm (9.8 in) in height. No contact evidence was identified on the exterior surface of the cover flap, however, the forward edges were slightly deformed from the noted windshield fractures. Concentrated areas of abrading were identified along the top and upper sections of the membrane along with dark colored fabric transfers to the mid-face. Tissue transfers were identified at the left lower quadrant and right mid-portion of the air bag face. The passenger air bag measured 70.0 cm (27.6 in) in width and 64.0 cm (25.2 in) in height in its deflated state (**Figure 8**). The bag was vented by two 2.3 cm (0.9 in) diameter ports located at the 11 o'clock and 1 o'clock sectors on the side aspect of the air bag. No internal tether straps were present. Air bag excursion measured 41.0 cm (16.1 in) from the aft portion of the mid-instrument panel.



Figure 8. Contact evidence to the 1995 Chevrolet Lumina deployed front right passenger air bag.

Event Data Recorder (EDR)

The 1995 Chevrolet Lumina Sensing and Diagnostic Module (SDM) was located under the front right seat as the module was harvested for subsequent event data retrieval with the assistance of General Motors. The J1962 connector was found in the typical location to the left of the steering column. The EDR records deployment and near-deployment events for the frontal air bag system. In this crash, the EDR recorded a near deployment event at ignition cycle number 15,954 (ignition cycles at investigation: 15,961). The system status at near deployment reflected the driver's belt switch circuit status as "unbuckled". As the vehicle and engine speed decreased during the five second pre-crash interval, the brake switch circuit status went from "off" to "on" three seconds prior to algorithm activation.

DRIVER DEMOGRAPHICS

Age/Sex: 49 year old male
Height: 183 cm (72 in)
Weight: 91 kg (200 lb)
Seat Track Position: Full rearward position
Manual Restraint Use: None
Usage Source: Vehicle inspection, police report
Eyeware: Unknown
Type of Medical Treatment: Refused treatment.

Driver Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
#None (complaint of chest soreness only)	N/A	N/A

Source: police#

Driver Kinematics

The unrestrained 49 year old male driver of the 1995 Chevrolet Lumina was presumed to be seated in an upright posture with the seat track adjusted to the full rearward position (**Figure 9**). The lack of belt use was determined by the absence of loading evidence on the front left restraint system. Furthermore, the Chevrolet's EDR reflected the driver's belt status switch as "unbuckled".

At impact, the driver initiated a forward and slightly lateral trajectory in response to the 11 o'clock impact force and loaded the knee bolster and deployed driver air bag. Loading of the knee bolster was confirmed by the scuff mark documented on this component, however, no injury was reported as a result. Interaction with the deployed driver frontal air bag was evidenced by the facial smudging documented across the face of the air bag. Possible injury information is unknown as the SCI interview was not obtained. The driver of the Chevrolet Lumina complained to police of unspecified chest soreness, however, he refused subsequent transport to a local medical facility for diagnosis and possible treatment.

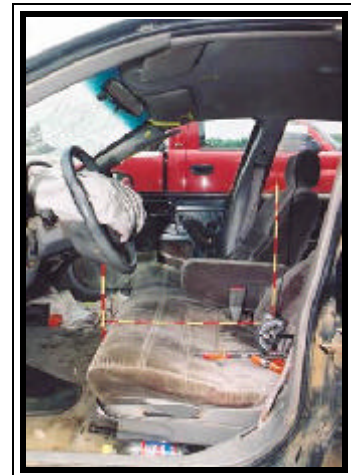


Figure 9. Interior view of the driver space.

FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex: 6 year old male
 Height: 117 cm (46 in)
 Weight: 18 kg (40 lb)
 Seat Track Position: Full rearward position
 Manual Restraint Use: None
 Usage Source: Vehicle inspection, police report
 Eyeware: None
 Type of Medical Treatment: Transported to a local trauma center and pronounced deceased shortly after arrival.

Front Right Passenger Injuries

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
<i>Brain/Cranial:</i>		
*Brain stem contusions (focal pontine: posterior aspect - right side)	Critical (140204.5,8)	Right A-pillar (air bag related injury)
*Cerebral laceration (3/4" cortical right frontal lobe - deep)	Severe (140688.4,1)	Right A-pillar (air bag related injury)
*Acute cerebral subdural hemorrhage	Severe (140652.4,1)	Right A-pillar (air bag related injury)
*Acute cerebral subarachnoid hemorrhages (heaviest right frontal lobe)	Serious (140684.3,1)	Right A-pillar (air bag related injury)
*Basilar skull fracture (right anterior cranial fossa into sphenoid bone)	Serious (150202.3,8)	Right A-pillar (air bag related injury)
*Global cerebral edema - right	Serious (140660.3,1)	Right A-pillar (air bag related injury)
*Global cerebral edema - left	Serious (140660.3,2)	Right A-pillar (air bag related injury)
*Cerebral cortical contusions (superior/lateral aspects right frontal lobe, lateral aspect right temporal lobe. gyri are flattened, sulci are narrowed)	Serious (140612.3,1)	Right A-pillar (air bag related injury)

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
*Linear vault fracture right frontal skull (2 1/4" long, depressed 1/16")	Moderate (150402.2,5)	Right A-pillar (air bag related injury)
<i>Head Soft Tissue:</i>		
*Contusion right scalp - deep 8" x 6"	Minor (190402.1,1)	Right roof and side rail (air bag related injury)
*Contusion left temporal scalp - deep 1" x 3/4"	Minor (190402.1,2)	Right windshield header (air bag related injury)
*Lacerations right side and back of head	Minor (190602.1,1)	Right roof and side rail (air bag related injury)
*Abrasions right side and back of head (a. 2 1/2 x 1/8" right temple area b. 1/2 x 1/2" right parietal scalp above the ear c. 1 1/4" x 1/4" posterior right parietal scalp)	Minor (190202.1,1)	Right roof and side rail (air bag related injury)
<i>Face/Neck Soft Tissue:</i>		
*Abrasions right lateral forehead/eyebrow	Minor (290202.1,7)	Right A-pillar (air bag related injury)
*Laceration right forehead - deep 3/4"	Minor (290602.1,7)	Right A-pillar (air bag related injury)
*Abrasions left side of face (a. 2.5"x 3/4" under chin/left mandible b. 1 1/4" x 1/4" lower midline above chin, c. 3/4" x 3/16" left earlobe)	Minor (290202.1,2)	Expanding front right passenger air bag
*Contusion lower left pre-orbital face (1 1/2" x 3/4")	Minor (290402.1,2)	Expanding front right passenger air bag
*Laceration internal surface lower lip (tear)	Minor (290602.1,8)	Expanding front right passenger air bag (indirect air bag contact injury)

<i>Injury</i>	<i>Severity (AIS 90)</i>	<i>Injury Mechanism</i>
*Contusion internal surface lower lip (1.5" x .5")	Minor (290402.1,8)	Expanding front right passenger air bag (<i>indirect air bag contact injury</i>)
*Abrasions front and left side neck {a. 6" x 2" lower anterior and left neck b. (2) 1/8" lateral left upper neck below mandible }	Minor (390202.1,2)	Expanding front right passenger air bag
<i>Thorax/Abdomen Soft Tissue:</i>		
*Abrasion right upper back - 1/8"	Minor (490202.1,6)	Right roof (<i>air bag related injury</i>)
*Contusions back	Minor (490402.1,6)	Right roof (<i>air bag related injury</i>)
*Abrasion left upper abdomen - 1" x 1/4" (multiple closely spaced/horizontal)	Minor (590202.1,2)	Expanding front right passenger air bag
*Contusions abdomen - NFS	Minor (590402.1,2)	Expanding front right passenger air bag
<i>Upper Extremity Soft Tissue:</i>		
*Contusions anterior left upper arm (3 separate 1/4" to 1/2" contusions)	Minor (790402.1,2)	Expanding front right passenger air bag
*Abrasions anterior left upper arm	Minor (790202.1,2)	Expanding front right passenger air bag

*Source: autopsy report**

Front Right Passenger Kinematics

The unrestrained 6 year old male front right child passenger of the 1995 Chevrolet Lumina was kneeling on the seat and facing to the right. The lack of belt use was determined by the trajectory of the occupant, contact points within the vehicle, and the absence of loading evidence on the front right restraint system. Clothing worn at the time of the crash was unknown.

The front right child passenger was displaced forward due to the pre-crash braking actions of the driver. At impact, he was forward within the path of the expanding air bag which struck his left neck, face, and chin areas resulting in multiple soft tissue injury. This injury pattern extended into the *anterior* regions of the neck, left arm, and abdomen; indicative of membrane expansion against the child, and confirmed the child passenger's abnormal pre-impact posture.



Figure 10. Contact evidence to the right A-pillar.

He was propelled vertically into the right A-pillar, windshield header, and roof side rail areas; evidenced by the indentations, hair strands, and tissue documented on these components (**Figure 10**). This distinct upward trajectory was further evidenced by the abrading and dark colored fabric transfers identified across the top/upper face of the front right air bag. Head contact to the right A-pillar resulted in a linear depressed fracture of the right frontal bone (vault), and a basilar fracture of the right anterior cranial fossa which extended into the sphenoid bone. Associated underlying trauma included focal pontine contusions and a multitude of extensive cerebral trauma. Cerebral trauma involved a deep laceration of the right frontal lobe, subdural/subarachnoid hemorrhages, and multiple cortical contusions. He continued the kinematic pattern into the right roof/side rail area resulting in additional lacerations, abrasions, and contusions to the right and posterior aspects of the scalp. This injury pattern also extended into the posterior regions of the right upper back. These injury mechanisms were evidenced by the abrasions and scratch marks documented on the right roof and side rail areas. A separate abrasion was identified to the left scalp area and attributed to the right sunvisor.

At this point, the vehicle began to rotate clockwise as it began its post-impact trajectory to final rest. The child passenger initiated movement to the left as he rebounded rearward into both front seat backs. He came to rest with his torso against the front seat backs and his face/head in the driver's seat, evidenced by the rotational occupant kinematic relative to the blood pooling documented on the front driver's seat back/cushion. Following the collision, the child passenger was removed from the vehicle through the right front door by rescue personnel in an unconscious state, and transported by ambulance to the emergency room of a local trauma center where he arrived in cardio-pulmonary arrest with no vital signs present. Although death was probably immediate, the front right child passenger of the 1995 Chevrolet Lumina was pronounced deceased shortly after arrival. Multiple organs were procured after death in accordance with family wishes.

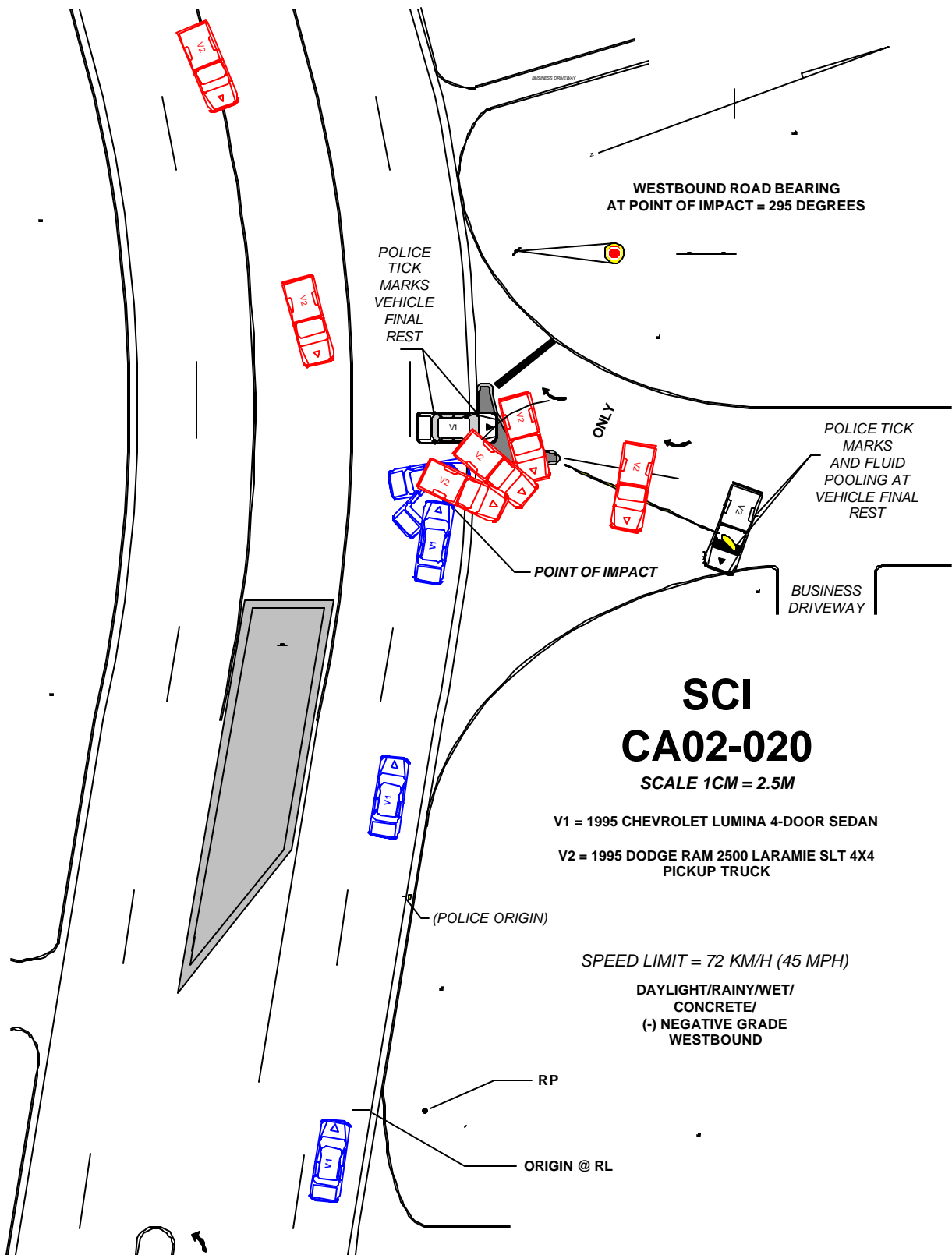


Figure 11. Scene Diagram

EDR REPORT

CDR File Information

Vehicle Identification Number	2G1WL52M4S9xxxxxx
Investigator	burke
Case Number	ca02-020
Investigation Date	6/11/02
Crash Date	
Filename	CA02-020_EDR NO SEQ.CDR
Saved on	6/12/02 11:16:39 AM
Data check information	BOE3BB0F
Collected with CDR version	Crash Data Retrieval Tool 1.5015
Collecting program verification number	1BEB632C
Reported with CDR version	Crash Data Retrieval Tool 2.24
Reporting program verification number	70CD83DD
Interface used to collected data	Block number: 00 Interface version: 30 Date: 06-10-02 Checksum: 6000
Event(s) recovered	Crash 1 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). The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 125 times.

The second type of SDM recorded crash event is the Deployment Event. The SDM can store up to two different Deployment Events. The first deployment event will be stored in the #1 Deployment file (this would have been the event that deployed the air bag) and the second Deployment Event will be stored in the #2 Deployment file. Deployment events can not be overwritten or cleared from the SDM. Once the SDM has two deployments recorded, the SDM must be replaced.

The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 7.65 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. SDM Recorded Vehicle Forward Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. 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 records the first 300 milliseconds of Vehicle Forward Velocity Change after Algorithm Enable. The maximum value that can be recorded for Vehicle Forward Velocity Change is 28 MPH.

-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt 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. An indication of a loss of power would be if the ignition cycles at Deployment or Non-Deployment is recorded as zero. Data recorded after that may not be reliable, such as Time Between Non-Deployment and Deployment Events and Driver Belt Switch Circuit Status.

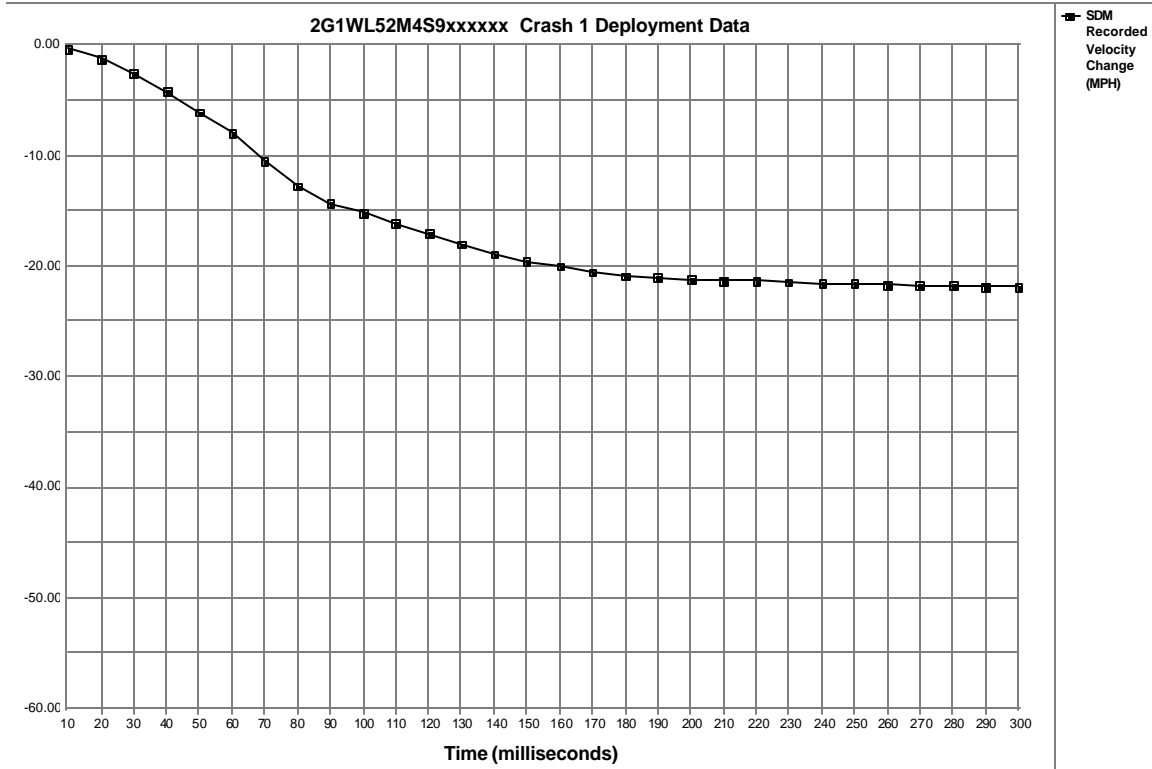
SDM Data Source:

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

-The Driver's Belt Switch Circuit is wired directly to the SDM.

System Status At Crash 1

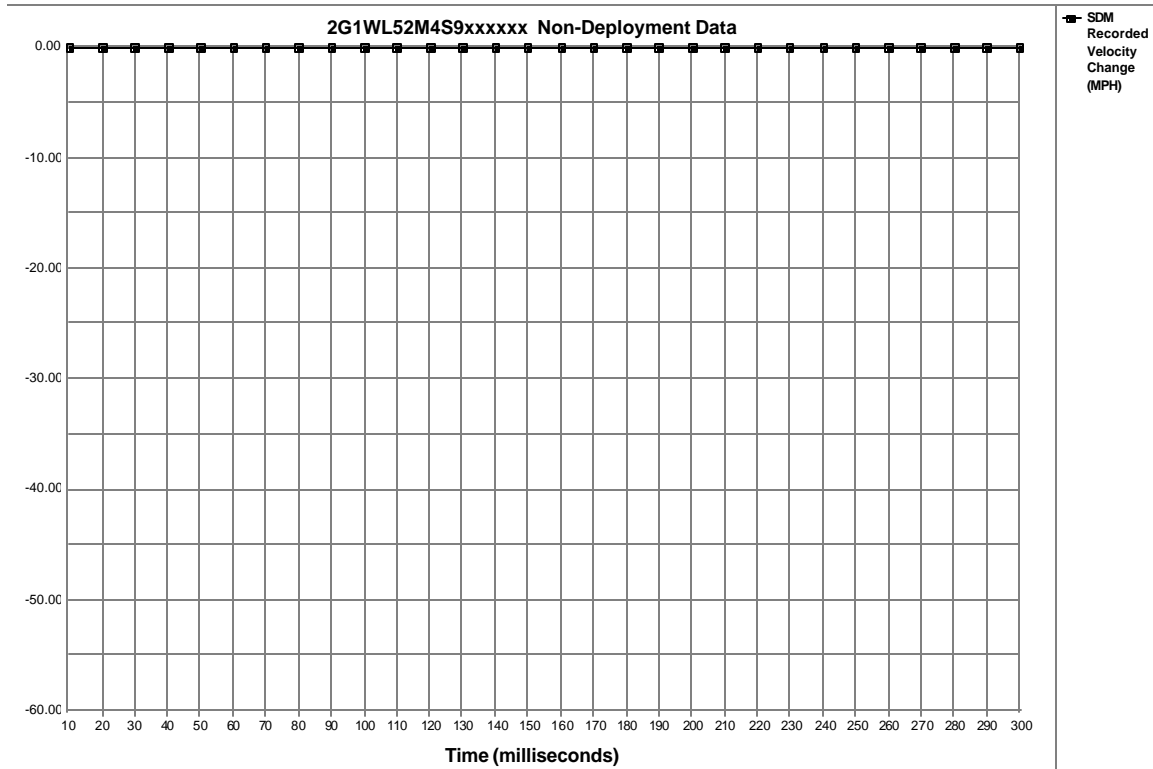
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Deployment	15954
Ignition Cycles At Investigation	15961
Time From Algorithm Enable to Deployment Command Criteria Met (msec)	46.25
Time Between Non-Deployment And Deployment Events (sec)	N/A



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.33	-1.21	-2.52	-4.17	-6.03	-7.90	-10.42	-12.73	-14.26	-15.14	-16.13	-17.00	-17.99	-18.87	-19.53
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	-19.97	-20.51	-20.84	-20.95	-21.17	-21.28	-21.28	-21.39	-21.50	-21.50	-21.61	-21.72	-21.72	-21.83	-21.83

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Non-Deployment	15902
Ignition Cycles At Investigation	15961
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	3.75
Maximum SDM Recorded Velocity Change (MPH)	-0.11
A Deployment was Commanded Prior to this Event	No



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hexadecimal Data

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

```
B600: 25 09 80 01 00 55 00 00
B608: 00 00 00 00 00 3F F9 F9
B610: F9 F9 F9 F9 F9 D3 00 64
B618: 02 75 FD 00 00 00 00 00
B620: AA AA 00 00 00 00 81 00
B628: 08 00 25 03 0B 17 26 37
B630: 48 5F 74 82 8A 93 9B A4
B638: AC B2 B6 BB BE BF C1 C2
B640: C2 C3 C4 C4 C5 C6 C6 C7
B648: C7 3E 52 29 FF 00 00 55
B650: AA 55 55 AA 00 00 00 00
B658: 00 00 00 00 00 00 00 00
B660: 00 00 00 00 00 00 00 00
B668: 00 00 00 00 00 00 00 00
B670: 00 00 00 00 00 00 00 00
B678: 00 00 00 00 00 00 00 00
B680: 00 00 00 00 00 00 00 00
B688: 7D 00 00 00 03 01 00 00
B690: 00 00 00 00 00 00 00 00
B698: 00 00 00 00 00 00 00 00
B6A0: 00 00 00 00 00 00 00 00
B6A8: 00 00 00 00 3E 1E 00 00
B6B0: 55 AA AA AA AA 00 00 FD
B6B8: 87 00 00 00 00 00 81 00
B6C0: 4C 82 00 6E 83 00 A1 84
B6C8: 00 B7 85 00 DA 86 00 00
B6D0: 00 00 00 37 10 43 75 05
B6D8: 30 00 70 41 53 23 71 4B
B6E0: 00 00 00 31 57 03 00 00
B6E8: 00 00 00 00 00 00 10 20
B6F0: 89 28 18 F0 05 50 2D 64
B6F8: FF FF FF FF FF FF FF FF
B700: FF FF FF 5F 5F 60 61 65
B708: 65 66 6A 6D 71 76 79 7B
B710: 8F 95 96 9B A2 A4 AA AE
B718: B3 BA BC C3 CC D0 D9 E0
B720: E7 EC F7 FD 41 43 45 47
B728: 49 4A 4C 4F 50 52 54 56
B730: 58 5A 5B 5D 5F 60 62 62
B738: 64 66 66 68 69 6A 6C 6C
B740: 6D 6E 6F 70 71 72 73 73
B748: 74 74 75 76 76 76 77 77
B750: 77 77 77 78 78 79 79 79
B758: 79 79 79 79 10 28 29 00
B760: 00 00 00 00 00 00 00 00
B768: 00 00 00 00 00 00 10 11
B770: 12 13 15 17 18 1A 1D 1F
B778: 21 23 26 2A 2D 2F 32 35
B780: 37 3A 3C 3E 3F 40 43 00
B788: 00 00 00 00 00 00 00 00
B790: 00 00 00 00 00 00 00 AA
B798: 00 64 00 C8 04 20 30 2C
B7A0: 18 18 01 04 AA 02 34 35
```

2G1WL52M4S9xxxxxx

```
B7A8:  FF FF FF FF FF FF FF FF
B7B0:  FF FF FF 59 5D 61 63 65
B7B8:  69 6C 6D 6F 71 73 74 75
B7C0:  76 77 79 7D 7E 80 82 84
B7C8:  85 86 88 89 89 89 89 89
B7D0:  89 89 89 89 89 89 89 89
B7D8:  89 89 89 89 FF FF FF FF
B7E0:  FF FF FF FF FF FF FF FF
B7E8:  FF FF FF FF FF FF FF FF
B7F0:  FF FF FF FF FF FF FF FF
B7F8:  D1 3C B8 6C 47 93 00 00
```