

CONTINENTAL AUTOMOTIVE SYSTEMS US, INC.

FIELD EVENT ANALYSIS REPORT

I. Overview

A. General Description – General Motors Corporation has provided the following information to Continental Automotive Systems US, Inc.:

Model Year	2006
Vehicle Type	GMX001 Chevrolet Cobalt
Description of Event	Car left road and struck large tree
Legal action pending (Y or N)	Unknown
Location of event	Lincoln Twp, MI
Date of event	September 13, 2008
Impacted object	Large tree
VIN	1G1AM15B067787193
Mileage	Not provided

B. Module Description

#	Module Type	GM Part Number	MLFB Number	Serial Number	Algorithm Level	Calibration
1	GMX001 – 6 loop	22729011	5WY75930	001103169229	SFA – GM MY05	PFT3210A.par

II. Analysis

A. Multiple Event and Vehicle Data

The multiple event data provides additional information about the overall event:

Event Information from Non Deployment Buffer

S/N: 001103169229

Information	Status
Was Data Locked??	No
Was the Event a Deployment Event?	No
Was the Vehicle Information Associated with this Event?	Yes
Was the Event a Non-Deployment Event?	Yes
Did this Event have the Largest Delta V?	Yes
Was this a frontal event?	Yes
Was this a side event?	No
Was this a rollover event	No

A. Multiple Event and Vehicle Data (cont'd)

Event Information from Deployment Buffer

Information	Status
Was Data Locked??	No
Was the Event a Deployment Event?	No
Was the Vehicle Information Associated with this Event?	No
Was the Event a Non-Deployment Event?	No
Did this Event have the Largest Delta V?	No
Was this a frontal event?	No
Was this a side event?	No
Was this a rollover event	No

Multiple Event Status

Information	Status
Was there an event that preceded the recorded events?	No
Was there an event that was in between the recorded events?	No
Was there an event that followed the recorded events?	No
Was an event not recorded a deployment event?	No
Was an event not recorded a non-deployment event?	No
Multiple Event Counter	0
Time Between Multiple Events (mS)	0

There were no qualified Non-Deploy events preceding or following the recorded event, within 5 seconds of the recorded event. The Multiple Event Counter indicates the number of qualified Non-Deploy events other than the event recorded. The Time Between Multiple Events does not apply to two or more Non-Deploy events.

Additional Information

Information	Status
Rollover Sensor Status	No Rollover
Vehicle Power Mode State	Run
Remote Start State	Inactive
Max Delta V of Event in Non-Deploy Area	115.7374429
Ignition counter for non-deployment	5175

At the start of the recorded event, the vehicle power mode state was "Run".

B. Restraints Buffers

The event was recorded in the Non-Deploy Restraints EEPROM buffer. There was no event stored in the Deploy Restraints EEPROM buffer.

In the Non-Deploy Restraints buffer, there were no faults at the time the event started:

Active Faults at Time of Event		S/N: 001103169229	Mask No.: 0F03092004
Code	Definition	Sub-Type	Definition
N O Codes	None	00	no additional information
N O Codes	None	00	no additional information
N O Codes	None	00	no additional information
N O Codes	None	00	no additional information
N O Codes	None	00	no additional information
N O Codes	None	00	no additional information

Lamp status shows no faults for 10920 minutes of sensing and diagnostic module (SDM) operation:

Lamp Status(Event Enable)	
State of Lamp at Event Enable	
Setting in EE	Indication
0	Lamp Off
Time for Warning Lamp Continuously On/Off at Event Enable	
Hex Value	Time (sec.) Time (minutes)
FFF0	655200 10920

Ignition cycle counters recorded at start of the event:

Ignition Cycle Counters	
Ignition Cycles with Warning Lamp Continuously On/Off	
Hex Value	# of Cycles
0498	1176
Ignition Cycles Since Fault Codes were Cleared	
Hex Value	# of Cycles
FE	254
Ignition Cycles at Event Enable	
Hex Value	# of Cycles
1437	5175

Driver and Passenger Buckle status at start of event:

Seat Belt and Position Switch Data		
Type	Definition	Setting in EE
Driver Seatbelt	buckled	1
	monitored	1
Passenger Seatbelt	unbuckled	0
	monitored	1

At the start of the event, the Passenger Stage 1 and Stage 2 deployment loops were Suppressed:

Loop Suppression		S/N: 001103169229	Mask No.: 0F03092004
Loop	Driver EE Bit	Driver Status	Pass EE Bit Passenger Status
Frontal S1	0	Enabled	1 Suppressed
Frontal S2	0	Enabled	1 Suppressed
Pretentioner	0	Enabled	0 Enabled
Side Curtain	0	Enabled	0 Enabled
Side Thorax-F	0	Enabled	0 Enabled
Side Thorax-R	0	Enabled	0 Enabled

The Suppression System Status at the start of the event indicates the AOS state was invalid or unavailable:

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Suppression System Status at Event Enable	
Setting in EE	Status
1	Enabled
Was the data from the suppression system invalid or unavailable?	
Yes	

B. Restraints Buffers (cont'd)

No deployment was commanded for any loops:

Deployment Commanded		S/N: 001103169229	Mask No.: 0F03092004	
Loop	Driver EE Bit	Driver Status	Pass EE Bit	Passenger Status
Frontal S1	0	No	0	No
Frontal S2	0	No	0	No
Pretentioner	0	No	0	No
Side Curtain	0	No	0	No
Side Thorax-F	0	No	0	No

No algorithm deployment decisions were reached:

Algorithm Timing and Max Delta V				
Time from Event Enable to Deployment				
Loop	Dr Hex Value	Driver Time(mS)	Pass Hex Value	Pass Time (mS)
Frontal S1	00	0	00	0
Frontal S2	00	0	00	0
Side Cur/Thor	00	0	00	0

The maximum delta velocity recorded in the recorded event:

Max Delta V= 115.7374429 kph

Time to max delta velocity:

Time from Event Enable to Max Delta V	
Hex Value	Time (mS)
14	200

Internal algorithm data, indicating no decisions

Algorithm Start Time		
Hex Value	Time (mS)	
00	0	
Algorithm Duration		
Hex Value	Time (mS)	
00	0	
Time from Event Enable to Predicted Displacement Reached		
Hex Value	Time (mS)	
00	0	
Time Trigger Switch Closed		
Hex Value	Time (mS)	
0000	0	
Algorithm Decision for Deployment		
Loop	Hex Value	Time (mS)
No Belt S1	0000	0
No Belt S2	0000	0
With Belt S1	0000	0
With Belt S2	0000	0

At the start of the event, both the front and side algorithms were disabled:

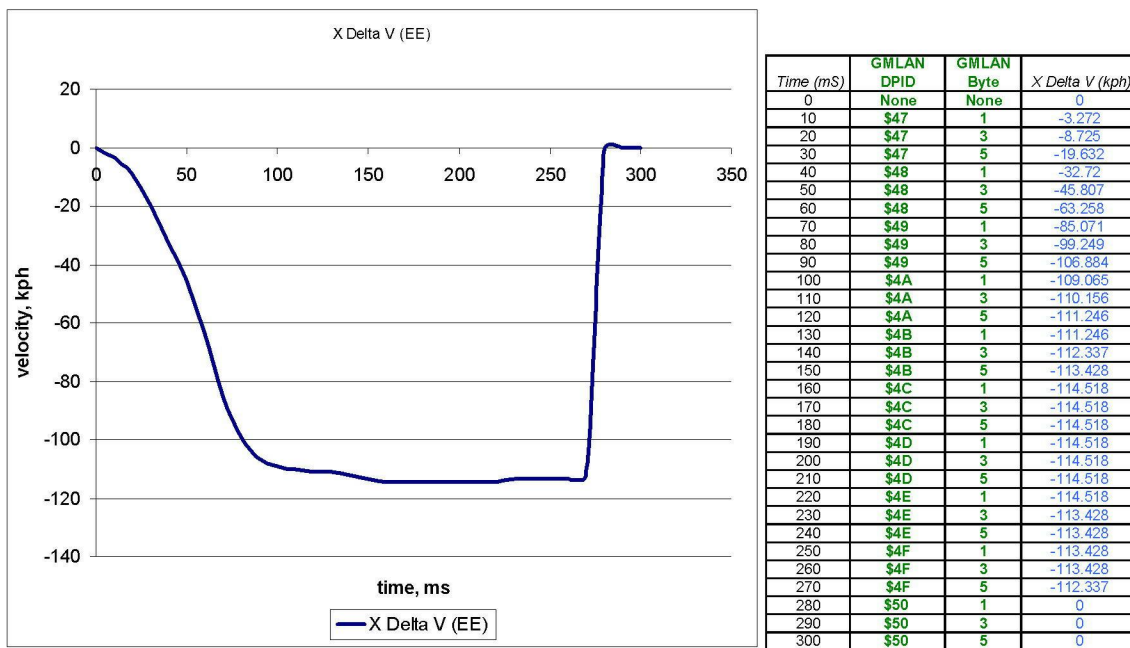
Algorithm Enable		
Algorithm	Setting in EE	Functionality
Front	1	Disabled
Side	1	Disabled

The Sensing and Diagnostic Module (SDM) did not deploy any occupant restraints because the algorithms were disabled at the start of the event. The possible causes for disabling the algorithms are discussed below.

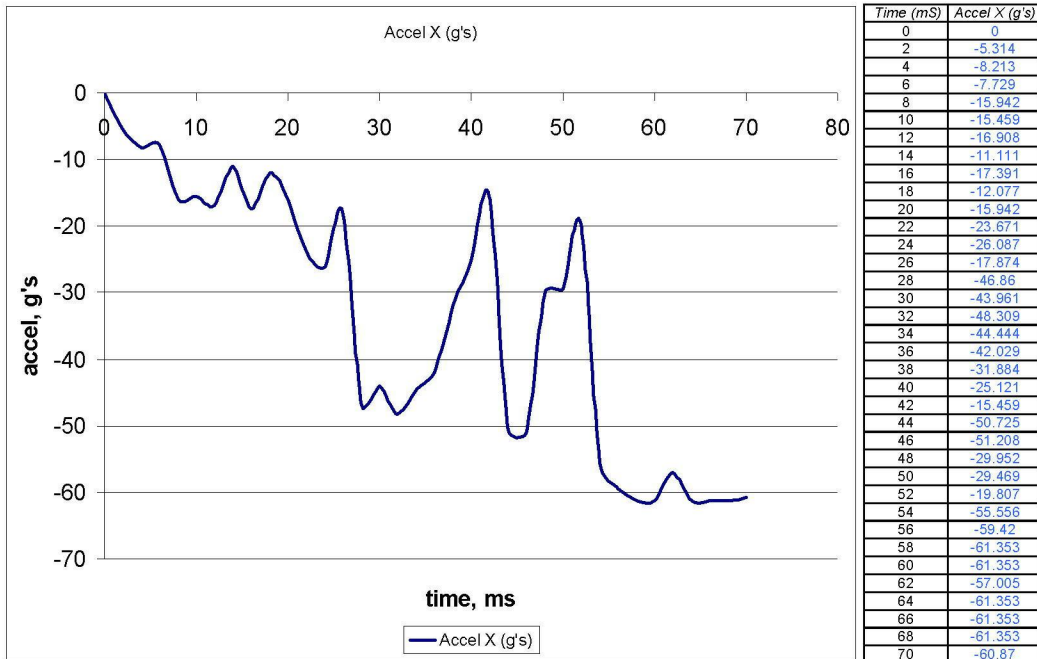
C. EDR graphs:

There was no velocity or acceleration data stored in the Deploy EEPROM buffer. SDM X and Y, and EFS data were stored in the Non-Deploy EEPROM buffer.

SDM X Velocity from start of event until EDR reset:



SDM X Acceleration from start of event to 70ms:

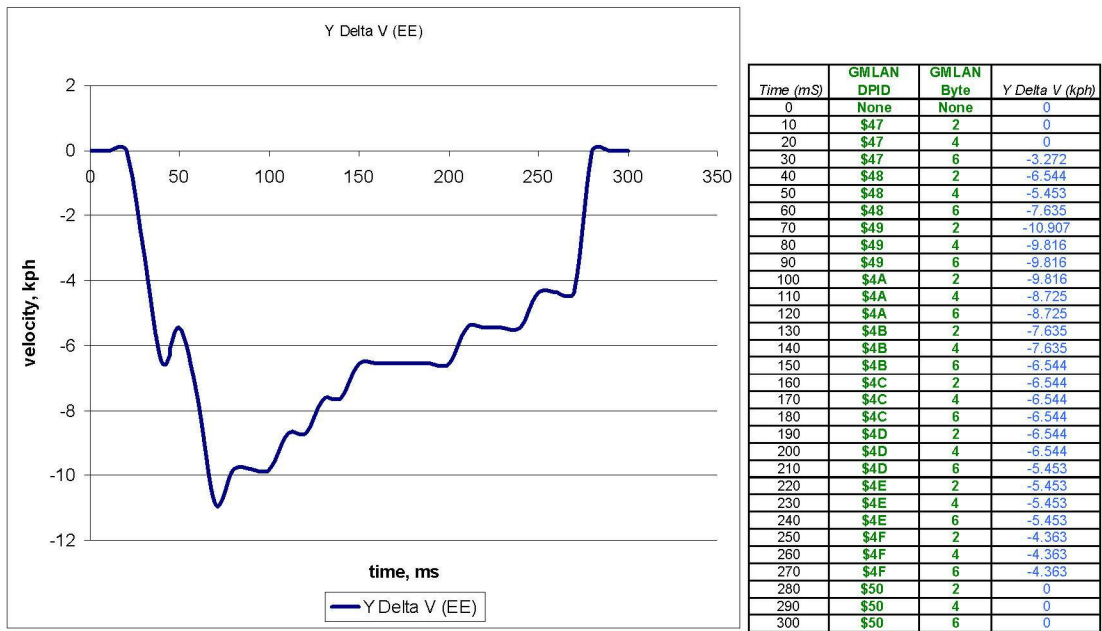


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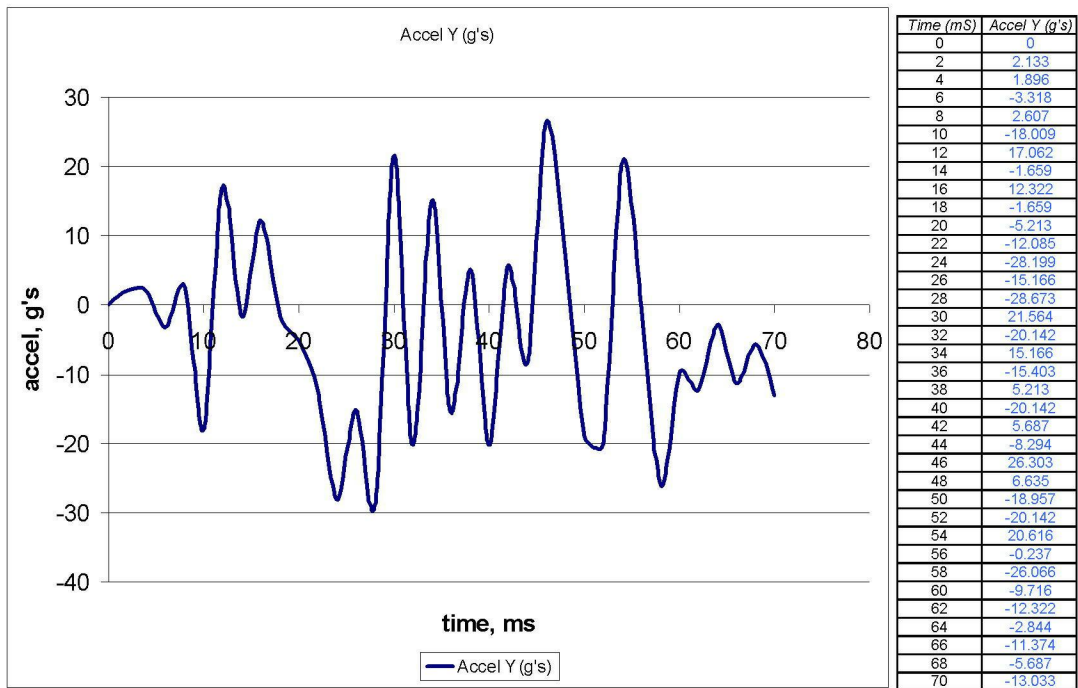
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C. EDR graphs (cont'd)

SDM Y Velocity from start of event until EDR reset:

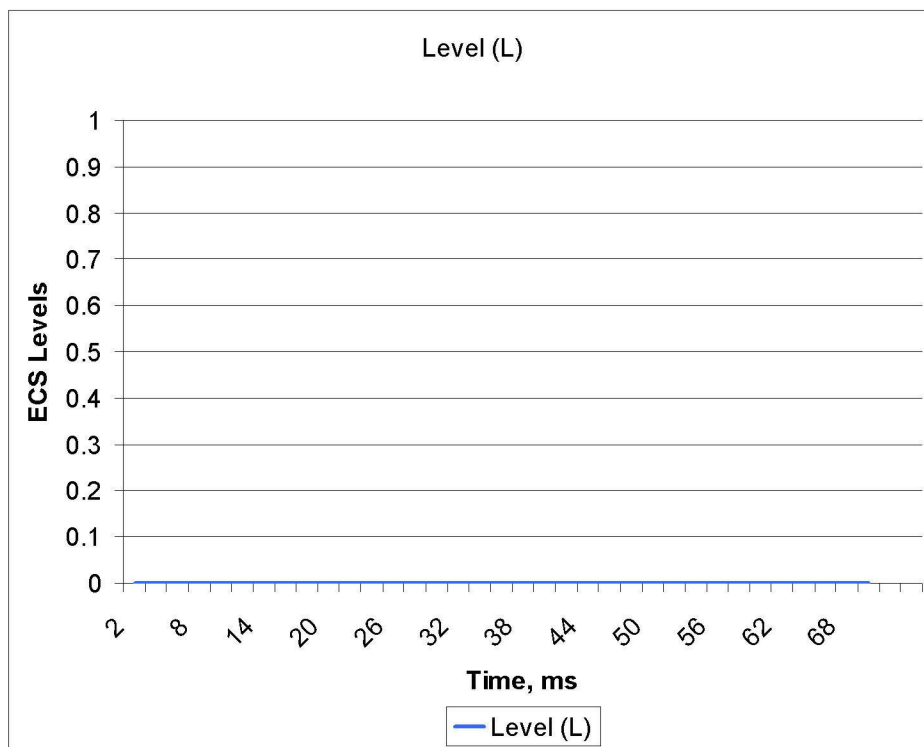


SDM Y Acceleration from start of event to 70ms:



C. EDR graphs (cont'd)

Electronic Crash Sensor (ECS) Acceleration Levels from start of event to 70ms:

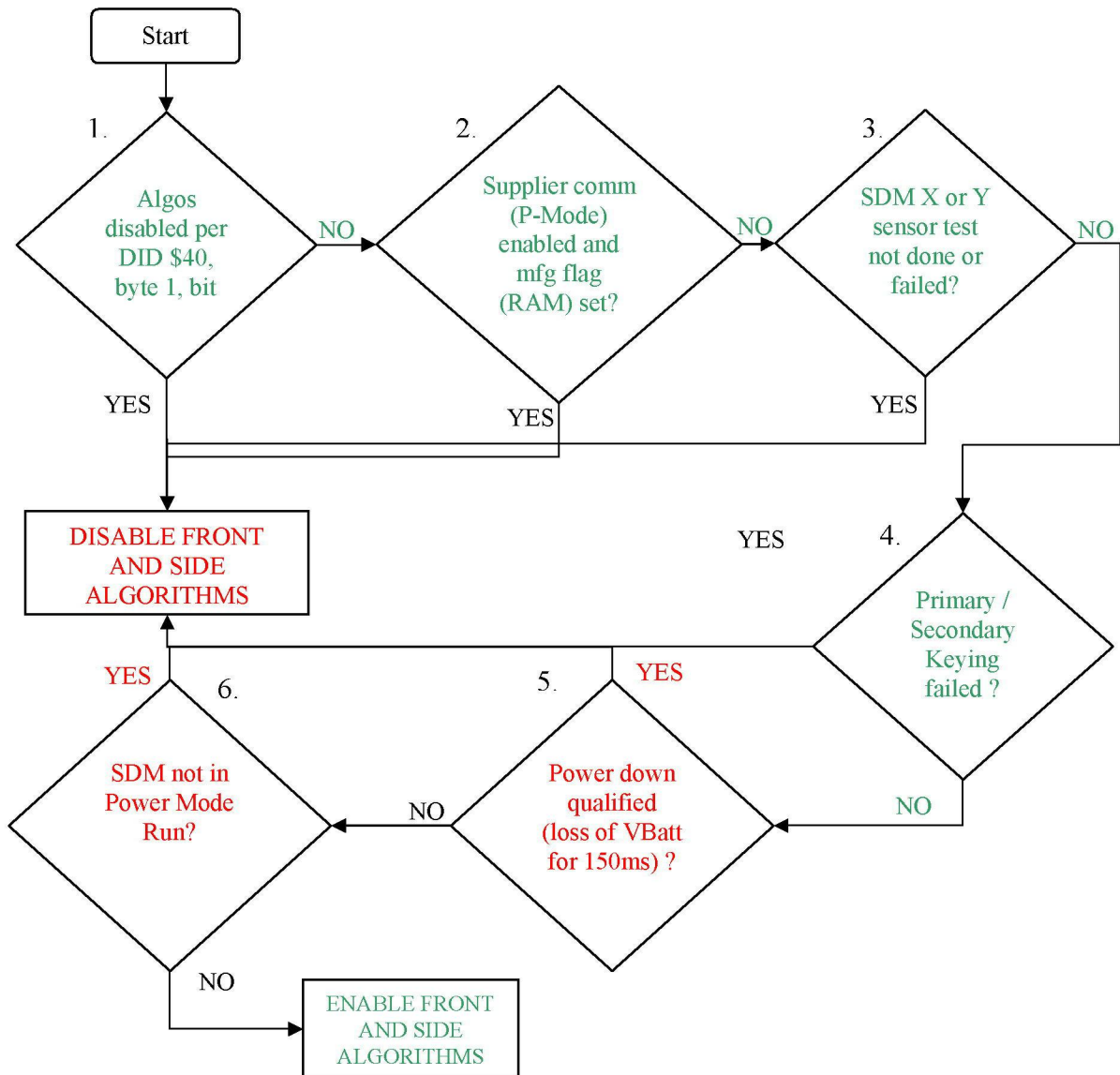


Every ECS level is equal to approximately 8 g's of deceleration.

D. Algorithm Disable Evaluation

As stated in Section B, Restraints Buffers, the front and side algorithms were disabled when the recorded event began. There were no qualified faults when the recorded event began. This section will proceed through the software code to determine under what conditions the front and side algorithm disable condition can occur.

Software logic for algorithm disable:



1. Per the stored EEPROM configuration, DID \$40, byte 1, bit 7, was set to 0, which means algorithms were NOT disabled by configuration.
2. The module was locked and installed in the vehicle, operating without faults. The manufacturing flag is enabled with test equipment at Siemens' manufacturing facility. Therefore, the algorithms were NOT disabled by this path.
3. No faults were recorded at the time of the recorded event. Therefore, the sensors did not fail their sensor test. The SDM X and Y acceleration and velocity as recorded is consistent with the physical event. Therefore, the algorithms were NOT disabled due to an SDM X or Y sensor test failure.
4. A Primary/Secondary key mismatch detected at SDM power up would result in a fault code. There were no faults recorded at time of event. Therefore, the algorithms were NOT disabled by this path.
5. 150ms after the SDM qualifies loss of battery, the front and side algorithms are disabled. This path can not be ruled out and is investigated further below.
6. SDM Power Mode "Run" is set by Ignition Logic Level (ILL) and/or a message from the Body Processor Module (BPM). One message from the BPM indicating SDM Power Mode "Off" will satisfy this check and disable the front and side algorithms. This path can not be ruled out and is investigated further below.

Further Investigation of Step 5.

The Sensing and Diagnostic Module (SDM) constantly monitors the battery voltage while powered up. If the SDM detects loss of battery, it performs qualification. Thus, momentary drops of battery voltage do not result in loss of battery qualification. When loss of battery is qualified, the SDM enters energy reserve mode. At this time, the SDM shuts down the side satellites. The Electronic Crash Sensors (ECS's) are shut down after a minimum of 60ms in energy reserve mode. After 150ms in energy reserve mode, the SDM sets the power down qualified flag, which then sets the front and side algorithm disabled flags.

When the front algorithm disable flag is set, and there is no front algorithm activity, the SDM immediately resets the front algorithm and prevents future calls to the front algorithm.

Testing of SDM using injected signals and creating Loss of Battery at various times from EDR wakeup

This SDM was configured with a Suppression System to detect the presence of an occupant in the passenger seat. As the Restraints Buffer section (B. above) indicates, the Passenger Stage 1 and Stage 2 deployment loops were Suppressed. In addition, the Suppression System status at Event Enable indicated that the Suppression System State was invalid or unavailable, while the System's last known state was Enabled, indicating that the passenger seat was occupied. It can be shown empirically that a Loss of Battery condition can exactly reproduce the recorded result.

Several tests (using GMX001 NCAP acceleration signals) were conducted to determine if qualified Loss of Battery could produce the same EDR as seen in this field event. The following table summarizes the tests:

Description	Memory-AS9011214L5Z	No Loss of Battery (LOB)	LOB @ t0 + 50ms	LOB @ t0 + 0ms	LOB @ t0 - 50ms	LOB @ t0 - 90ms	LOB @ t0 - 110ms	LOB @ t0 - 130ms
SDM result	No Deploy	Deploy	Deploy	Deploy	Deploy	Deploy	No Deploy	No Deploy
Algorithm Enable Status	Disabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Suppr. Status at Event Enable	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Was data unavailable or invalid?	Yes	No	No	No	No	No	No	No
Suppr. Status at Event Deploy	Suppressed	Enabled	Enabled	Enabled	Enabled	Enabled	Suppressed	Suppressed
Was data unavailable or invalid?	No	No	No	No	No	No	No	No
Pass Stage 1 Loop Suppression	N/A	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Pass Stage 2 Loop Suppression	N/A	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
EFS data stored	No	Yes	Yes	Yes	Yes	Yes	No	No

Description	LOB @ t0 - 190ms	LOB @ t0 - 1sec	LOB @ t0 - 2sec	LOB @ t0 - 3sec	LOB @ t0 - 4sec	LOB @ t0 - 4.5sec
SDM result	No Deploy	No Deploy	No Deploy	No Deploy	No Deploy	No Deploy
Algorithm Enable Status	Disabled	Disabled	Disabled	Disabled	Disabled	No Data
Suppr. Status at Event Enable	Enabled	Enabled	Enabled	Enabled	Enabled	No Data
Was data unavailable or invalid?	Yes	Yes	Yes	Yes	Yes	No Data
Suppr. Status at Event Deploy	Suppressed	Suppressed	Suppressed	Suppressed	Suppressed	No Data
Was data unavailable or invalid?	No	No	No	No	No	No Data
Pass Stage 1 Loop Suppression	N/A	N/A	N/A	N/A	N/A	No Data
Pass Stage 2 Loop Suppression	N/A	N/A	N/A	N/A	N/A	No Data
EFS data stored	No	No	No	No	No	No Data

The table above shows that when an event occurs after qualified loss of battery (approx. 150ms), the EDR provides the same output as in the field event. The additional information of the Suppression System behavior provides further evidence that the vehicle experienced a Loss of Battery prior to the impact.

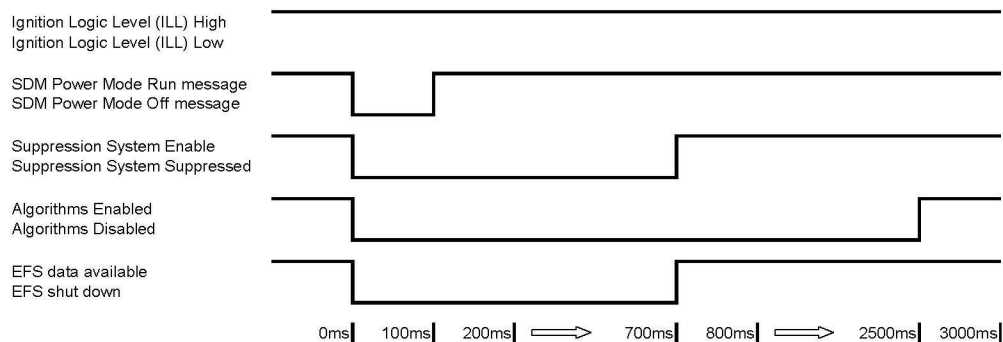
Further Investigation of Step 6.

Another path to disabling front and side algorithms relates to the SDM Power Mode state. When the power mode message published by the Body Processor Module (BPM) on the GMLAN is "Off", the algorithm disable flags are set. Note that only one message of SDM "Off" is required to initiate the SDM power down sequence. When the message is received by the SDM, per requirements (Appendix B (GMW - 3320), 3.2.9.4.1 Power Modes initialization during Power-Up and 3.2.9.17.1.89 System Power Mode), the SDM immediately initiates power down sequence by shutting off the Electronic Crash Sensor (ECS) and dropping its internal phase from Normal operation to a lower phase (but not completely off). In this phase, the X and Y sensors are still active, as is EDR.

Testing confirms that with the SDM ignition state changed from "Run" to "Off" for a single Power Mode message then returned to "Run", the GMLAN message is updated from "Run" to "Off" and the SDM starts shutting down. An event occurring after this resumption of SDM ignition state to "Run" produces an EDR that matches the field event EDR. Further testing indicates that the SDM does not enable algorithms for at least 2.5 seconds after a transition from Power Mode "Off" to "Run". However, after 600ms, the ECS is re-initialized and sending data. This means EDR would show ECS data (but still have algorithms disabled). Thus, the window for experiencing the same EDR as the field event would be approximately 600ms of Power Mode "Run" after at least 100ms of Power Mode "Off" (the "Off" window is variable).

The following timing diagram shows SDM behavior when a Power Mode change of state occurs:

Timing diagram for SDM Power Mode Run to Off to Run Scenario



E. Conclusions

Based on the recorded data, the SDM performed in accordance with specification. The SDM either experienced loss of battery at some point prior to the recorded Non-Deploy event, or received one or more SDM Power Mode "Off" messages from the Body Processor Module prior to the recorded Non-Deploy event. In either case, the front and side algorithms were disabled and the Suppression System indicated suppressed.

