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Blind Spot Monitoring in Light Vehicles — System Performance

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16. Abstract

This report summarizes findings of a small population study of blind spot monitoring systems (BSM) installed by original vehicle manufacturers on standard production vehicles. The primary goals of these tests were to simulate real-world driving scenarios within a test track setting to evaluate BSM effectiveness and to develop objective test procedures for future BSM testing.

Three subject vehicles (SV) were subjected to a series of maneuvers that examined the detection capabilities of their BSM. Typical driving scenarios included: lateral converging and diverging lanes; close distance cross-behind; primary other vehicle (POV) passes from behind in same lane; same lane following run-up; SV braking; POV and secondary other vehicle (SOV) pass by, and misapplied opposite turn signal. Typical city and rural driving conditions were simulated by applying numerous vehicle speeds: 0 mph – stopped; 20 mph – school zones; 35 mph – urban and small streets; 55 mph – typical 2-lane highways; and 75 mph – maximum posted limit on limited-access interstate highways and freeways.

Additional tests series included testing for signal aliasing or false-positive alerts as well as BSM sensitivity to close Guard Rail proximity. A broader spectrum test examined sensitivity to BSM alert activation resulting from ghost images (signal multiplexing) bouncing off nearby fences, buildings, or other more distant vehicles.

All three BSMs alerted the drivers to the presence of a vehicle in adjacent lanes and performed mostly as expected during the tests. This research was not sufficient to rank the three BSMs that were tested. Results indicated that increasing only the base speed of the subject vehicle and principal other vehicle did not appear to change the BSM sensitivity. Changing differential speed between the vehicles had a noticeable effect on both BSM onset and extinction points. These BSMs did not detect slower moving traffic traveling in the same direction. The BSM alerts ordinarily remained active for the full 15 seconds of post-trigger sampling time without interruption.

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EXECUTIVE SUMMARY

Blind spot monitoring systems (BSMs) use sensors to detect vehicles in adjacent lanes that may not be directly observed by the driver. The BSM alerts the driver that another vehicle may be present and to use caution if planning a lane change. This report summarizes findings of a small population study of BSMs. Three vehicles equipped with BSMs were used to conduct the following test scenarios designed to replicate real-world driving situations.

- Straight-lane tests
- Dynamic maneuver tests
    1) Converging and diverging
    2) Cross behind
    3) POV makes a pass
    4) Run-up
    5) SV brakes
    6) POV and SOV pass by
    7) Opposite turn signal
- Guard rail detection test

The three systems were evaluated because these BSM-equipped vehicles were vehicles that NHTSA had on hand and available for testing. All three BSMs alerted the driver to the presence of a vehicle in adjacent lanes and performed mostly as expected during the tests. This research was not sufficient to rank order the three BSMs that were tested. Any false-positive alerts that occurred were noted. The test sequences were adequate and only required minor changes as testing went on, such as adjusting lateral or longitudinal spacing.

During data analysis, results indicated that increasing only the base speed of the subject vehicle (SV) and principal other vehicle (POV) did not appear to change the sensitivity of the BSM. However, changing the differential speed between the vehicles made noticeable changes in both the onset and extinction points of the BSM. These BSMs did not detect slower moving traffic traveling in the same direction. The BSM alerts ordinarily remained active for the full 15 seconds of post-trigger sampling time without interruption. Only one false-positive alert occurred during this testing. It occurred during a straight line passing test with the SV traveling at 35 mph and the POV traveling at 20 mph.

1 INTRODUCTION

Each year, passenger vehicles are produced with new innovative mechanical and electronic features installed to enhance drivability and safety. Blind spot monitoring systems are an example of this type of feature. BSMs use sensors to detect one or more vehicles in adjacent lanes that may not be directly observable by the driver. The system warns the driver of the approaching vehicle's presence to help facilitate safe lane changes. A small number of these systems are also equipped to intervene by applying brakes and guiding the vehicle back into the unobstructed lane if the warnings are ignored. BSMs are most effective when the equipped vehicle is passing, being passed, or preparing to make a lane change. Some systems warn when the BSM sensors detect that one or more vehicles have entered either of the driver's two rear blind zones, and some warn only when other vehicles are in a driver's blind zone at a time when the vehicle's turn signal is activated.

Not all BSMs have the same detection capabilities or operating conditions. In vehicle owner's manuals, many automobile manufacturers state that their systems are designed to detect only highway vehicles, not other objects such as bicycles, motorcycles, humans, or animals. Various systems have a threshold speed where if the speed of the equipped vehicle is below the threshold speed, typically ranging from 5 to 20 mph, the system is inactive. Some systems will not detect vehicles passing through blind zones at speeds substantially higher or lower than that of the equipped vehicle. Other systems may not operate when reversing.

The two main goals of the work described in this report were:

- To evaluate the performance of contemporary BSMs, and
- To develop and validate objective test procedures.

In pursuit of these objectives, three vehicles equipped with BSMs were evaluated using a series of tests designed to mimic several common roadway scenarios. A 2007 NHTSA technical report describing the development of pre-crash scenario typology provided information to identify roadway situations in which blind spot monitoring technology could be used to avoid crashes.[1]

2 BACKGROUND

2.1 Technology

Two main types of sensors are used in BSMs: radar and computer vision. Generally, these systems use sensors to detect the presence of other vehicles in the equipped vehicle's left and right blind zones. The BSM processes the sensor information and present it to the driver in the form of visual and audible indicators. Visual indicators are often integrated in the glass of both left and right outside rear-view mirrors, or inside the vehicle on the "A-pillar" or window frame near each outside mirror.

Radar-based BSM for passenger cars use sensors that are usually mounted in left rear and right rear positions on a vehicle, either behind the rear bumper fascia or behind each rear quarter panel. The sensors transmit and receive radio waves to and from the vehicle's left and right blind zones. The systems process the radar signals and provide visual and/or audible information to the driver. Snow, rain, and fog can disrupt the radar signals. Dirt, snow, and ice present on the surfaces through which the radio waves are transmitted and objects mounted on the vehicle near the sensors, such as bicycle and luggage carriers, can cause interference. [2] [3]

Computer-vision-based BSM use digital camera imaging technology to sense the presence of vehicles in blind zones. Cameras mounted on or near the outside rear-view mirror housings on both sides of the vehicle provide views of the blind zones to the system. Images from the cameras are processed by the systems using algorithms that identify image characteristics associated with vehicles. Systems may identify vehicle shapes in daylight, vehicle headlights at night, and/or some combination of shapes and lighting. The systems can be disrupted by snowfall and rainfall, and by snow, ice, and dirt present on the camera lenses. Shadows, light reflected from wet roadways, and sunlight at sunrise and sunset can cause the systems to produce false-positive alerts. [4]

2.2 Market Penetration

An analysis was performed on model year 2013 vehicles to determine the current market penetration of BSM. BSMs were available on 206 different vehicle models from 23 different manufacturers. The average price of a vehicle equipped with BSM was $68,029, and the prices ranged from $20,280 to $213,200. When it was not a standard option, the average cost to add BSM was $4,187. Further details can be seen in Table 2.1.

Table 2.1. Average BSM Market Costs

	Number of Vehicle Models	Price Range w/ BSM	Average Vehicle Price w/ BSM	Average BSM Cost
Standard	22	$47,335 - $213,200	$114,373	$0
Single Option	24	$26,200 - $176,150	$78,273	$806
Trim/Package Upgrade	160	$20,280 - $155,950	$60,120	$4,694

3 METHOD

3.1 Subject Vehicles

This program studied the detection capabilities of currently available BSM on three off-the-lot light vehicles. The subject vehicles (SVs) were a 2008 Volvo S80, a 2008 Buick Lucerne CXL, and a 2010 Mercedes E-350. The three systems were evaluated because these BSM-equipped vehicles were vehicles that NHTSA had on hand and available for testing. In order to maintain comparative detection imaging, a single 2008 BMW 528i was used as the instrumented POV. For one test series involving three vehicles, a 2009 Acura RL was added as the SOV.

Table 3.1 details the vehicles used for testing. The overall vehicle length was measured from the foremost point on the front bumper to the rearmost point on the rear bumper. The lateral centerline of the rear bumper was used as the zero reference point for the SV (referred to as the rear bumper plane) and the forward centerline of the front bumper was the zero reference for the POV (referred to as the front bumper plane). The width was measured laterally between points on the ground vertically beneath the outward-most-points of the vehicle's tires. Table 3.2 provides an overview of specific functions and capabilities of the three BSM.

Table 3.1. Length and Width of Test Vehicles

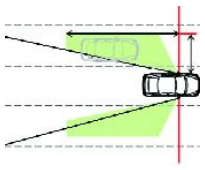
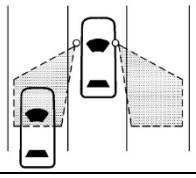
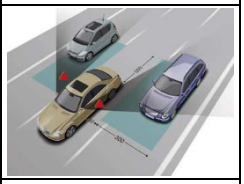
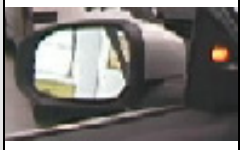
Test Vehicle Measurements			
Vehicle	**Test Role**	**Length (m)**	**Width (m)**
Volvo	SV*	4.85	1.84
Buick	SV	5.18	1.85
Mercedes	SV	4.87	1.85
BMW	POV**	4.87	1.83
Acura	SOV***	4.99	1.80

*Subject Vehicle

**Primary Other Vehicle

***Secondary Other Vehicle

Table 3.2. Overview of Test Vehicles

Vehicle	A	B	C
Year and Make	2008 Volvo	2008 Buick	2010 Mercedes
Model	S80	Lucerne CXL	E-350
Body Style	4-door sedan	4-door sedan	4-door sedan
BSM Illustration[1]			
Trade Name	***Blind spot Information System***	***Side Blind Zone Alert***	***Blind Spot Assist***
Technology	Vision	Radar	Radar
Sensor Location(s)	Compact imaging array camera mounted below each side view mirror	Two sensors mounted one in each corner of the rear bumper	Two sensors mounted one in each corner of the rear bumper
BSM Icon			
Icon Description	LED in a triangular area on the window frame	Lighted warning icon integrated into the side mirror face	Warning lamp integrated into the side mirror face
Audible Warning	None	None	Chimes

3.1.1 Sensor and Alert Warning Indicator Locations

The Volvo was equipped with a vision-based system consisting of two sensors (cameras) mounted one under each side mirror; this is shown in Figures 3.1 and 3.2. The system covered an area of up to 3 meters out to the side, and up to 9.5 meters to the rear, of the mirror positions. It provided coverage at differential speeds of up to 6 mph when passing and 43 mph when being passed.

[1] The BSM illustrations in Table 3.2 are factory representations of the apparent extended field of view gained by adding the BSM to that vehicle. They do not indicate where the sensing hardware is physically located in each vehicle and are not necessarily to scale.

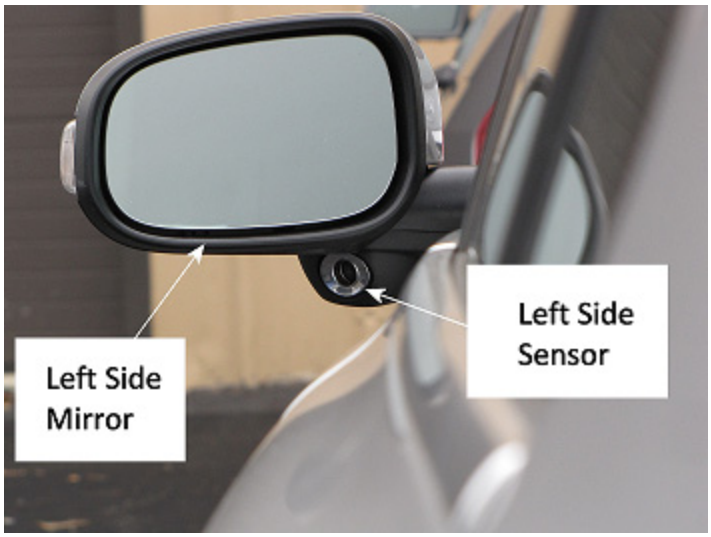


Figure 3-1 Volvo Left BSM Sensor (Camera) Mounted Beneath Mirror (Viewed From Behind the Vehicle)

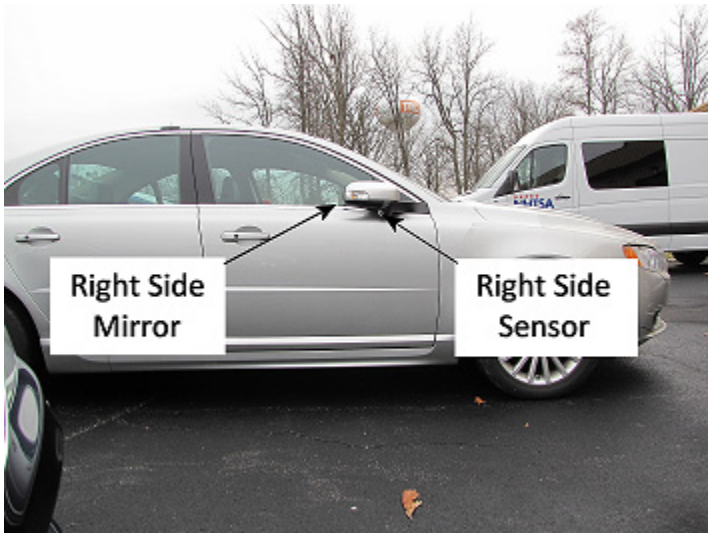


Figure 3-2 Volvo Right BSM Sensor (Camera) Mounted Beneath Mirror

The Volvo indicator of a vehicle within the blind zone consists of a 16 mm square LED in the door panel located just in front of the side window glass. Activating the vehicle's turn signal during an alert did not alter the lighted display. The driver's line of sight to the indicator display was just inboard, and on approximately the same horizontal plane as the side view mirror. The photographic image in Figure 3-3 shows the left lighted display for the Volvo.

Figure 3-3 Photograph of Volvo Left Side "Lighted" Alert Indicator on Inside of Front Door Frame

The Buick was equipped with a radar-based system consisting of two sensors mounted one in each corner of the rear bumper, shown in Figures 3.4 through 3.6. The zone covered by the Buick system started at each mirror and went out to the side 3.5 meters and back 5 meters. A speed range was not listed in the Buick Lucerne's Owner's Manual.

Figure 3-4 Buick BSM Sensor Proximity

Figure 3-5 Buick Left BSM Sensor Behind Rear Bumper Wrap-Around

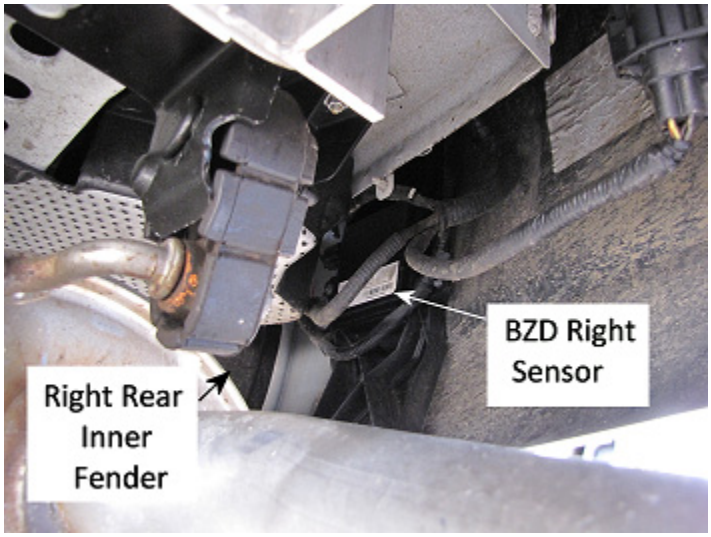


Figure 3-6 Buick Right BSM Sensor Behind Rear Bumper Wrap-Around

The warning indicator for the Buick was an amber colored lighted icon, integrated into each side mirror's face depicting "a vehicle in the blind zone" scenario. The icon blinked if the turn signal was applied and the system sensed another vehicle. Length and width of the display was a square

about 19 mm on a side. The icon was located in the outer fourth of the mirror at the approximate vertical centerline. Figure 3-7 shows a photographic image of the lighted warning icon in the right side mirror on the Buick. The black and yellow dot in the figure marked the approximate center of the mirror.

Figure 3-7 Photographic Image of the Buick Lucerne Warning Icon on the Right Side Mirror

The Mercedes was equipped with a radar-based system consisting of two sensors mounted one in each corner of the rear bumper as shown in Figures 3.8 and 3.9. The owner's manual indicated that the Mercedes system's range is 3 meters to the rear and to both sides of the vehicle at a speed range of greater than 30km/h (20mph).

Figure 3-8 Mercedes BSM Sensor Proximity

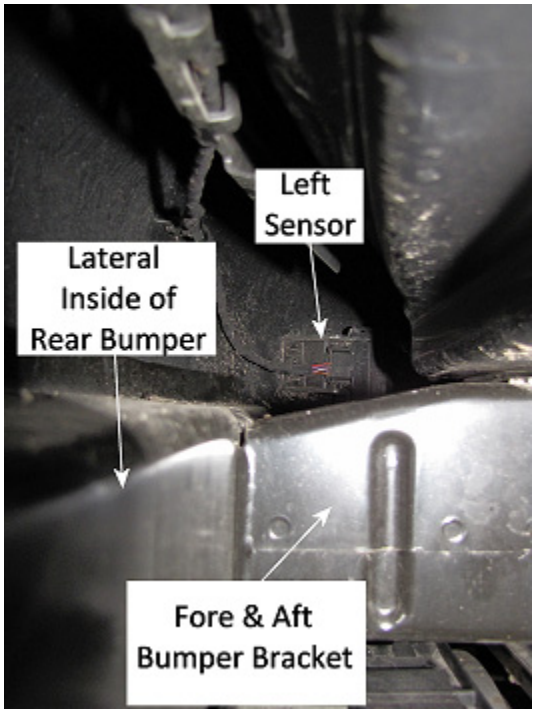


Figure 3-9 Mercedes Left BSM Sensor Behind Rear Bumper Wrap-Around

The warning indicator for the Mercedes was integrated into the mirror face. The lighted warning icon consisted of a red 9.5 mm high triangle located in the outboard lower quarter of the mirror which blinked when the turn signal was applied during an alert. The icon lit up an amber color when the vehicle was traveling at less than 18 mph, which indicated that the system was active but below the speed threshold. Figure 3-10 shows the right side lighted warning indicator for the Mercedes with the center of the mirror marked with a black and yellow dot.

Figure 3-10 Photograph of the Warning Indicator Integrated Into the Right Mirror of the Mercedes

3.2 Test Plan

Each SV was subjected to three types of performance tests: straight-lane, dynamic maneuver, and guardrail detection tests. The straight-lane and the dynamic maneuver tests were performed on a controlled straightaway test facility containing more than three parallel lanes of concrete surface roadway. The guardrail detection tests were performed on an oval track with low-angle super-elevation (lateral banking) and a steel guardrail along one side. All tests were performed during daylight hours, beginning more than an hour after sunrise and ending more than an hour before sunset. The ambient temperatures were above 32 degrees and below 90 degrees Fahrenheit. The roadway surface was dry to slightly damp (when light precipitation occurred during a given test series).

3.2.1 Straight-Lane Tests

In the straight-lane test series, both the SV and POV were driven in separate but parallel, lanes with one vehicle driving longitudinally past another. Initially, the POV was driven two lanes over from the SV, while in a subsequent test sequence, the POV was driven in the lane next to that of the SV as depicted in Figure 3-11 and Figure 3-12, respectively.

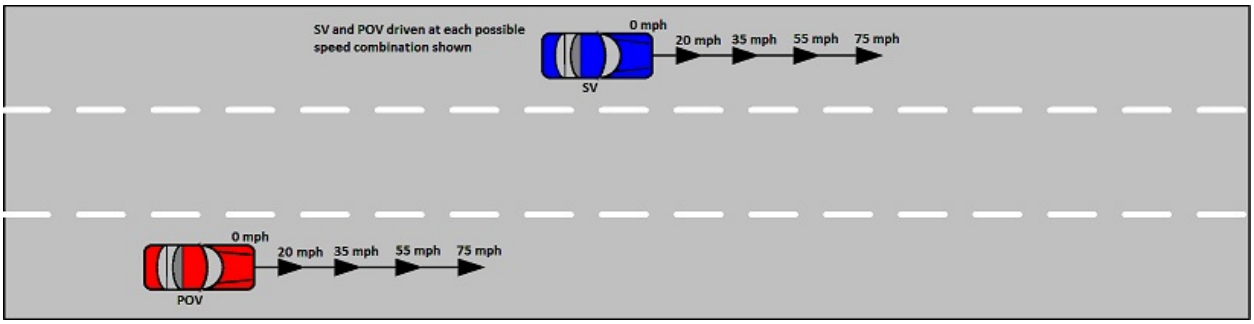


Figure 3-11 Three Lane Straight -Lane Test

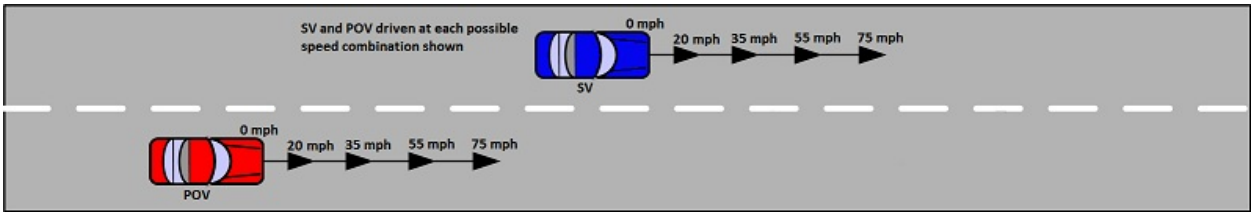


Figure 3-12 Two Lane Straight -Lane Test

The SV and POV were driven at speeds of 0, 20, 35, 55, and 75 mph, with a total of 25 speed combinations. With both vehicles moving, when the POV was in the SV's blind zone and with a speed that either matched or exceeded that of the SV, the expectation was that an alert would be activated. For POV speeds below the SV speed, alerts were not expected to occur. If an alert occurred while the POV was out of range of the SV's sensors, for this test program, the projected alert condition would be termed a "false-positive alert."

Three repetitions of each lane sequence and speed combination were completed to determine sensitivity and repeatability. In order to identify the system's interaction with the application of the SV's turn signals, the series were repeated with the turn signal activated at approximately time zero in the data file (the data system logged 5 seconds of pre-trigger data before time zero occurred to identify the independent turn-on point). Once these measurements were completed for the left side, the entire test array was repeated using the right-side sensor. When the vehicle speeds were the same, the duration of the active alert was surveyed while the data collection system logged each 30-second post-trigger data sample.

3.2.2 Dynamic Maneuver Tests

In the second test series, the SV's were subjected to a mixed array of dynamic maneuver tests. Seven test procedures were conducted to determine the sensitivity of the BSM to POV movement. For each dynamic maneuver test sequence, three tests were performed using the left sensor and three using the right sensor. Once completed, the same series was repeated while hand activating one of the turn signals at the beginning of the test. The left and right turn signals were applied in subsequent test repetitions to determine if there were any interactions between the turn signals and the BSM, such as an altered presentation of the alert signal or a deviation from the normal response that occurs with no turn signal activation.

The seven dynamic maneuver test procedures included:

1) Converging and diverging,
2) Cross behind,
3) POV makes a pass,
4) Run-up,
5) SV brakes,
6) POV and SOV pass by, and
7) Opposite turn signal.

3.2.2.1 Converging and Diverging (Test-1)

The "converging and diverging" (Test-1) maneuver involved the SV (in lane 3) and POV (in lane 1) being driven in formation at 55 mph while centered in their respective lanes as shown in Figure 3-13. The front of the POV was longitudinally spaced between the lateral plane of the SV outside rearview mirror and the SV rear bumper plane, and laterally two lanes over from the SV. Both vehicles were brought up to speed and then the test began by starting the data collection system. While holding the same relative longitudinal range to the SV, the POV was driven into the next lane (lane 2), converging on the SV in lane 1. This close lateral formation was held for a few seconds, and then the POV was driven back out, diverging to the original lane 1, all while maintaining the same relative longitudinal range to the SV. The test ended once the POV had been driven for several more seconds in lane 1. The objective was to determine the sensitivity of the BSM to lateral displacements of a nearby POV by observing if the systems sensed the converging POV (alert onset) and if the alert discontinued (extinguished) as the POV diverged laterally away from it.

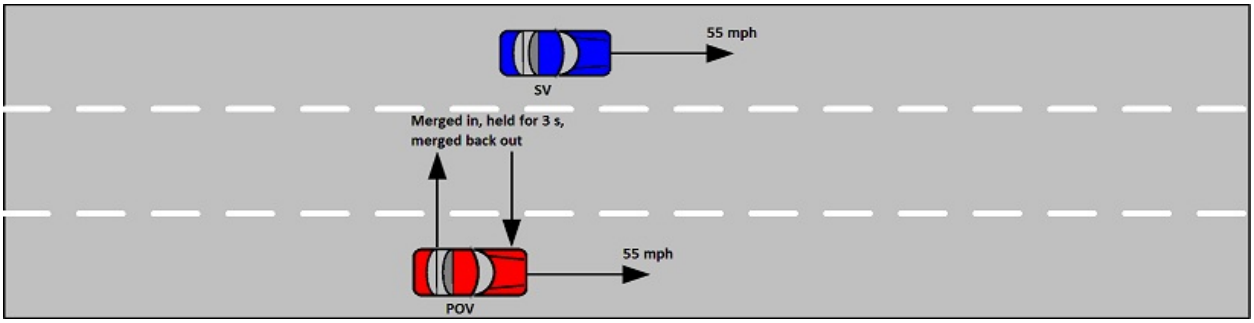


Figure 3-13 Test- 1 - Converge and Diverge

3.2.2.2 Cross-Behind (Test-2)

The "cross-behind" (Test-2) maneuver was similar to Test-1, except there was no longitudinal vehicle overlap for this formation. As seen in Figure 3-14, the lateral movement of the POV was extended to two lanes; therefore, the POV was driven from lane 3 to lane 2, and then from lane 2 to a position behind the SV with a minimum longitudinal gap of 3 meters and with a pause of a few seconds at each lane centerline. Once the vehicles were laterally aligned, the POV was driven back out to lane 2, that relative position held for a few seconds, and then driven back out to the original lane 3. The objective of Test-2 was to determine if the BSM would detect a POV crossing behind the SV.

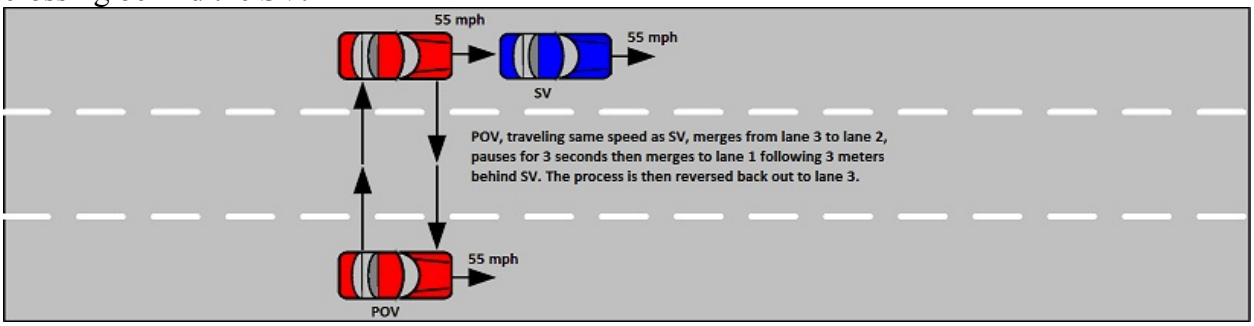


Figure 3-14 Test- 2 – Cross Behind

3.2.2.3 POV Makes a Pass (Test-3)

In Test-3, the "POV makes a pass" from behind the SV as depicted in Figure 3-15. Data was logged once the front of the POV was 20 meters behind the rear bumper of the SV. At a longitudinal spacing of 8 meters, the POV began a mild lane change into lane 2. Upon reaching the centerline of lane 2, the POV continued forward. The test ended after the rear bumper plane of the POV was more than 10 meters in front of the SV's front bumper plane. The objective of Test-3 was to determine if the BSM would identify a POV making a combined lane change and pass by.

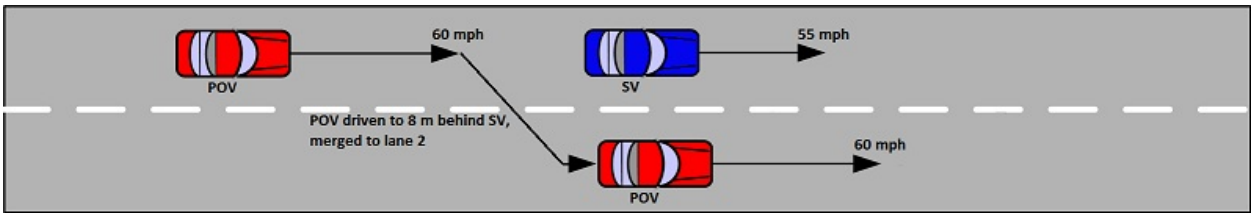


Figure 3-15 Test- 3 - POV Makes a Pass

3.2.2.4 Run-Up (Test-4)

The "run-up" maneuver in Test-4 required only three test repetitions to complete. As depicted in Figure 3-16, the POV was maneuvered to a following distance of 3 meters behind the SV and held for a few seconds. Then, the turn signals were cycled first left, then right, with a few seconds of "on-time" for each direction selected. Next, the turn signal was turned off and the POV backed away from the SV. The objective of Test-4 was to determine if the BSM sensor on either side of the SV would detect a POV that was running-up behind without the POV actually making any lateral lane change effort, such as may occur during an aborted lane change by the POV in heavy multi-lane traffic.

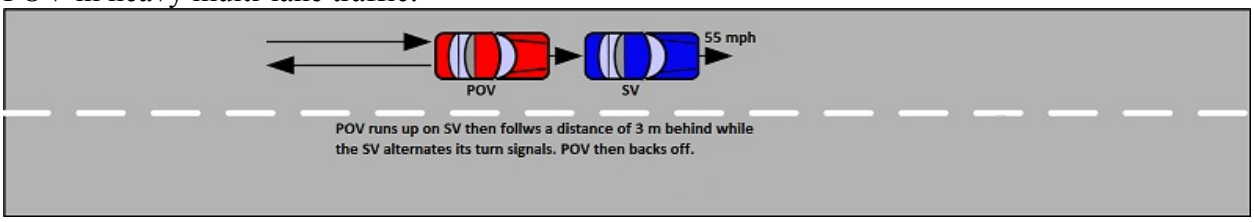


Figure 3-16 Test -4 – Run Up

3.2.2.5 SV Brakes (Test-5)

In Test-5, the "SV brakes," the SV performed the maneuver as depicted in Figure 3-17. The driver of the SV activated a brake machine to precisely control the deceleration of the SV at 0.2 g, the SV brake lights were activated when the brake machine depressed the brake pedal. The objective of Test-5 was to determine if there was any interaction between the BSM and the brake lights, and to determine the sensitivity of the systems to a drive-by POV, while the SV was in braking mode.

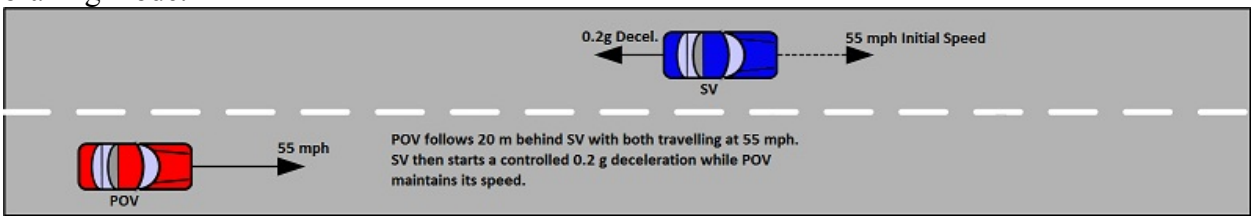


Figure 3-17 Test -5 – SV Brakes

3.2.2.6 POV and SOV Pass by (Test-6)

In Test-6, the "POV and SOV Pass by" the SV on both sides. The SV was driven ahead of the POV and SOV as seen in Figure 3-18. The test started when the planes of the front bumpers of the POV and SOV were 20 meters behind the plane of the SV rear bumper. All vehicles maintained their respective constant speeds until the POV and SOV had cleared the front of the SV by more than 10 meters. The objective of Test-6 was to determine if both the left and the right BSM sensors would activate simultaneously and to determine if there was any interaction when applying a turn signal on only one side of the SV while both BSM sensors may be activating alerts.

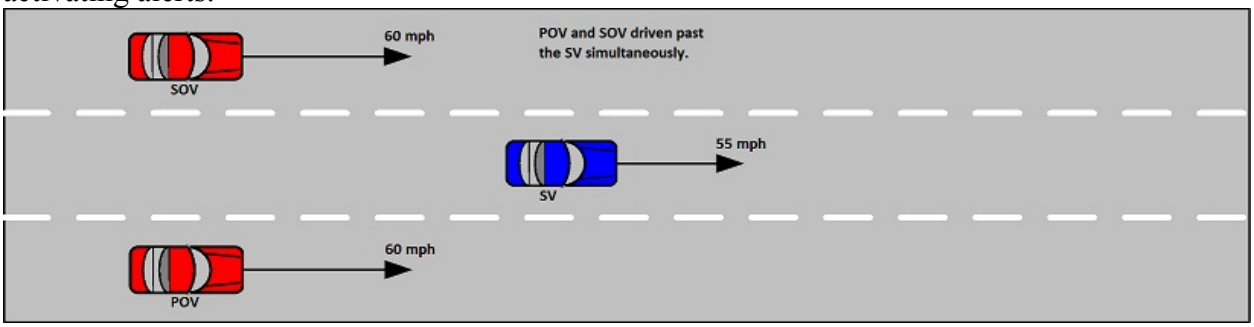


Figure 3-18 Test -6 – POV and SOV Pass by

3.2.2.7 Opposite Turn Signal (Test-7)

In Test-7, the POV was driven past the SV on one side, similar to the straight line tests, while the "opposite turn signal" was applied. The vehicles were driven at 60 and 55 mph, respectively. The objective of Test-7 was to determine if the BSM would correctly sense the passing POV if the opposite turn signal applied.

3.2.3 Guard Rail Detection Tests

Guard rail detection tests were performed on an oval track with low-angle banked curves and a steel guardrail along one side. The test track used required that the SV be driven in a clockwise direction about the pattern; therefore the position of the guard rail was always on the left (driver side) of the vehicle, with a lateral spacing of 4 to 6 feet as shown in Figure 3-19. Each test was started at the beginning of an 1,800 ft straightaway to accelerate to the test speed of 55 mph, which was held constant through the length of the curve. The data file was started as the SV approached the beginning of the curve, close to where the guard rail began; was continued while the SV drove through the curve; and terminated when the SV reached a distance of 200 feet onto the next straightaway. Twelve tests were performed for each vehicle; six with no turn signal applied and six tests with the left turn signal applied. During the test run, the driver and the test technician observed if any audio or visual alerts were made by the BSM.

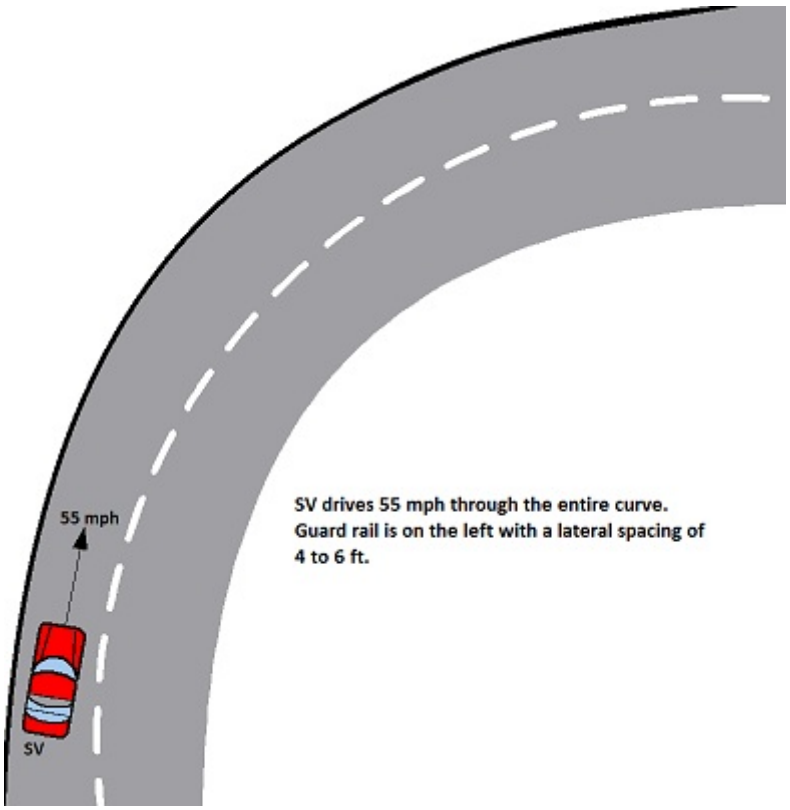


Figure 3-19 Guard Rail Detection Test

3.3 Test Instrumentation

The three SVs and the (POV were tested with a minimal set of instruments for the initial straight-lane tests. The basic measurements included vehicle speed (using GPS-based vehicle speed sensors), SUNX retro-reflective test lane location index, turn signal indicators, and BSM alert signal lamp indicators. For both the Volvo and the Buick, non-intrusive voltage dividers were added to each of the four indicating lamp circuits for measurement with the data system. For the Mercedes, light-sensitive sensors were attached externally to the outside mirrors that could detect whether the system was sending a red alert signal or an amber cautionary signal when the vehicle speed was below 18 mph. Additional ATMEL converters were applied to convert the controller area network (CAN) signal from the Mercedes for both left and right alerts, and for the audible annunciator. Random track tests were videotaped for reference.

When the POV was moved from the third lane to the second lane adjacent to the SV to begin the dynamic maneuver tests, an additional set of ranging equipment was added. For the extended data system applications where the vehicles were driven in very close proximity to one another during a limited set of straight-lane tests and for all dynamic maneuver tests, an RT3000 Inertial and GPS Navigation System from Oxford Technical Solutions Ltd. was installed in the SV and POV under test. The RT "Hunter" system integrated several internally-housed inertial sensors with the data collected from tracking multiple satellites, to produce real-time vehicle speed, position, and vehicle attitude of the SV. A second RT "Target" unit was placed in the POV to measure similar parameters as in the SV. An Oxford RT "Range" unit was also installed in the SV to measure vehicle-to-vehicle spacing and differential speeds. A detailed installation report of the Oxford ranging system is included in APPENDIX A.

For one test series (SV brakes), an electrically-actuated brake controller (made by Heitz Automotive Testing, Inc.) was installed to produce constant rates of deceleration during test replications. It regulated the brake pedal application using feedback from an internally mounted longitudinal accelerometer. Details about this brake controller can be found in an excerpt from a NHTSA report contained in APPENDIX B.

4 RESULTS

Several geometric orientations were used for the relative positioning of the SV and POV during the performance of the test procedures. Figure 4-1 and Figure 4-2 show frequently encountered orientations along with the corresponding terminology.

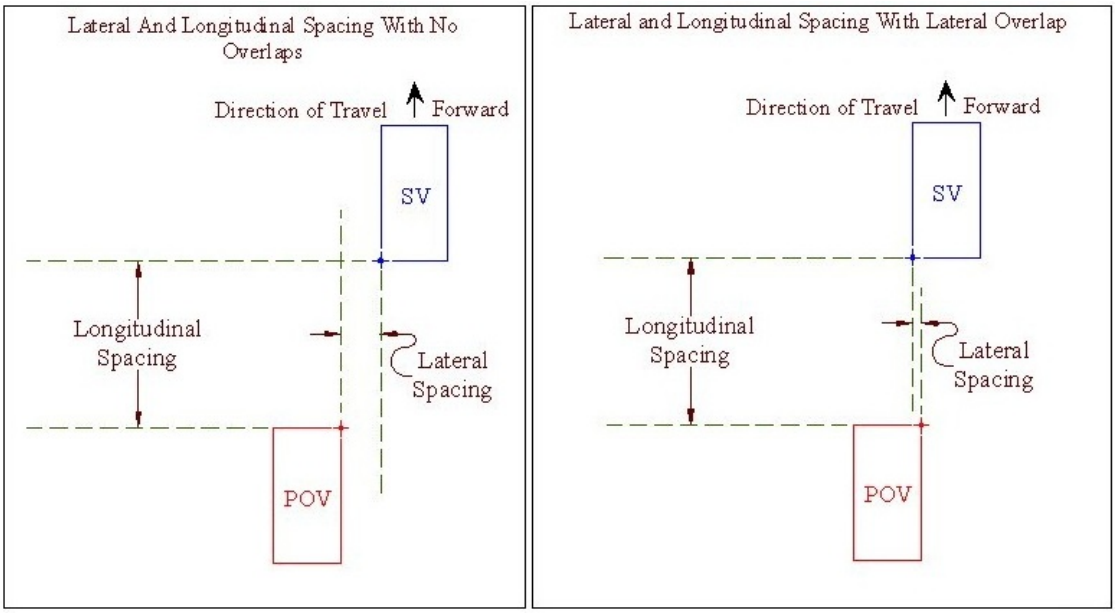


Figure 4-1 Lane Diagrams Showing Free-Spacing Between Vehicles

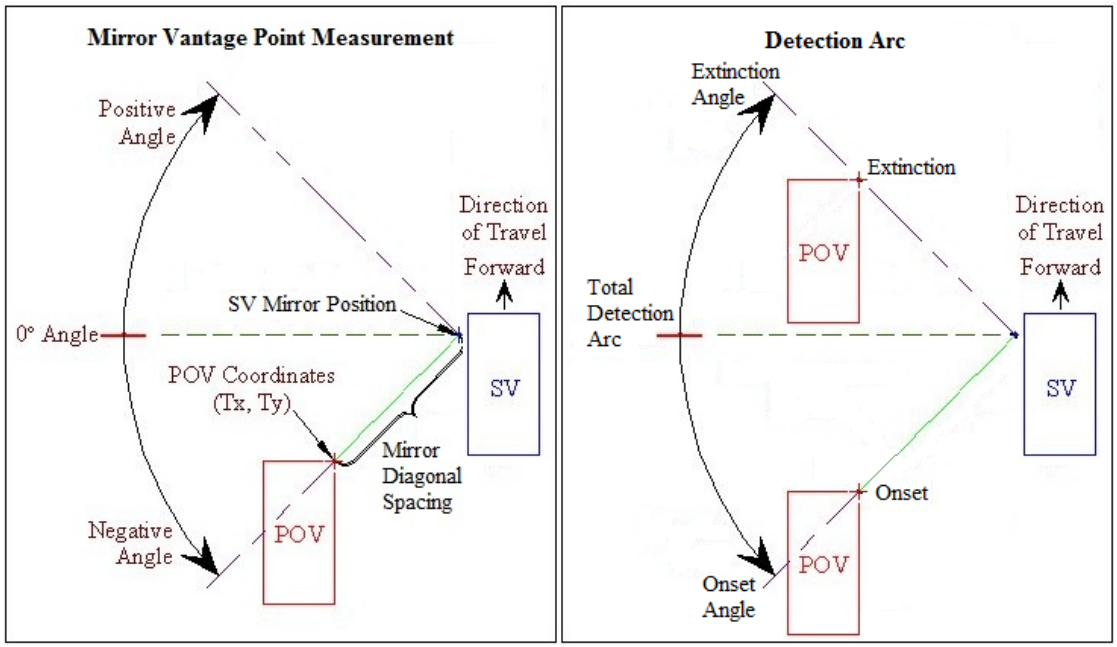


Figure 4-2 Mirror Vantage Point Measurement

4.1 Straight-Lane Test Results

Each SV participated in a set of 600 straight-lane tests. Half of the tests were performed with the POV driving in lane 3 while the SV was driven in lane 1. There were no POV detections for any of the Volvo, Buick, or Mercedes BSM in this two-lane-over set of tests. The tests included observations made while the SV was stationary and the POV was either stationary at a nominal 0 m following distance (the next-lane initial zero position) or was passing by at various driving speeds; or when the SV was driving, even at speeds that exceeded those of the POV. All data for the straight-lane tests can be found in APPENDIX C.

The second group of 300 straight-lane tests was performed with the POV in lane 2 and the SV in lane 1. No blind zone alerts were encountered while both vehicles were stationary at the initial zero position, or when only one of the two vehicles was moving and the other was stationary. For tests performed with the SV driving faster than the POV (the SV was overtaking the POV), no alerts were encountered for the Volvo or the Buick. Increasing the differential speed between the vehicles with the SV overtaking the POV did not cause any false-positive alerts. However, one false-positive alert did occur for the Mercedes during the 35 mph (SV) and 20 mph (POV) test (1 in 120 tests = 0.8 percent false positives).

The remainder of the straight-lane tests in lane 2 produced frequent alert warnings. Four tests included "same-speed" driving rates where both the SV and POV traveled at the same speed and in a continuous formation similar to that applied in the initial-zero-position configuration at zero speed. The same speed tests were performed at four speed ranges: 20, 35, 55, and 75 mph. Six additional tests (referred to as mixed speed tests) were performed at these same speed increments, but with the POV driving at a higher speed and therefore overtaking the SV in each case.

4.1.1 "Same Speed" Straight-Lane Test Results

A special handler was added to the MATLAB program for same-speed side-by-side tests because the BSM alert was already activated before the data file started. If an alert-signal rising or falling edge actually occurred during any of these tests, they were logged as dropouts rather than actual first-activation onsets. In Appendix C, there are four groups of data sets, each pertaining to one of the four speed ranges: 20, 35, 55, and 75 mph. The data files were not triggered to record until both vehicles were at the prescribed test speed (with the SV using cruise control) and in a relative driving formation resembling the next-lane initial zero positions. Once the data file began, all falling and rising edges of the alert channel were labeled as signal dropouts.

For nearly all of the tests, the alert signal activated early (before the data file pre-trigger time began at time = -5 s) and remained active after the 15 s of post trigger time expired. For the Mercedes, the two vehicles were not fully engaged in the final formation at the onset of the pre-trigger time, but were fully formed before the actual time-zero was logged; therefore, the Mercedes logged at least 15 s of continuous blind zone alerts. After reviewing the lateral and longitudinal data for periods of minimal change, an arbitrary data file time period of -2 through +13 seconds was used to identify when the minimum lateral range point occurred between the SV and POV positioning of the vehicles. The lateral range varied by up to 0.2 m and the longitudinal range by plus-or-minus 0.3 m during any one test. No alerts activated for vehicles

traveling in the opposite direction in the next lane (in a lane 2 roadway scenario). This was not a test objective, but when vehicles did pass in the opposite direction and in the next lane, their incident was logged on the data sheets. No reverse-passing false-positive alerts were recorded for any of the tests.

The Volvo was tested first. The nominal following distance range was originally set at 2 m (with the POV in lane 2), similar to the original cross-behind tests. On several same-speed tests, both the longitudinal and lateral positions varied by the limits expressed previously, and encountered numerous alert dropouts over the 15 s test period. While no dropouts were experienced by any vehicles in the 20/20 mph tests (both vehicles at 20 mph), the Volvo experienced three dropouts in the 35/35 mph tests and one each in the 55/55 mph and 75/75 mph tests, all of which were with the left side sensor. After reviewing the lane plots, it was determined that the Volvo left-side-tests were being performed closer to 2.6 m average with several tests seeing maximum following distances (longitudinal bumper spacing) near 5.6 m and simultaneous lateral excursions of 2.2 m (lateral spacing) for a mirror vantage point measurement of 9.6 m at a trailing angle of -78 degrees. The dropouts appeared to be occurring at the far limit of the Volvo sensor. As soon as the POV approached the SV within these distances, the alert re-activated. For the tests where the range was somewhat shorter for the duration of the tests, the alert signal was continuous for the full 20-s observation period.

When the Buick and Mercedes were tested, the following-distance for the POV was moved forward in the relative formation to a point nominally at zero meters following-distance (longitudinal spacing) and in next lane. After this change in the procedure, the Buick and Mercedes alerts activated as soon as the two vehicles were in the revised initial starting formation and remained activated until after the data file had ended. Nominal mirror vantage measurements were similar for these two vehicles with diagonal distances averaging 3.9 m at -55 degrees.

Figure 4-3 shows the lane plot for the Buick (blue rectangle labeled SV) performing the same-speed test maneuver at 20 mph with the POV following at zero meters in lane 1 and on the left side of the SV. The black crosses at the front of the POV show the relative motion of the POV with respect to that of the SV for the arbitrary timing period (-2 to +13 s for this test series). There was no apparent change in relative position for the POV in this time frame.

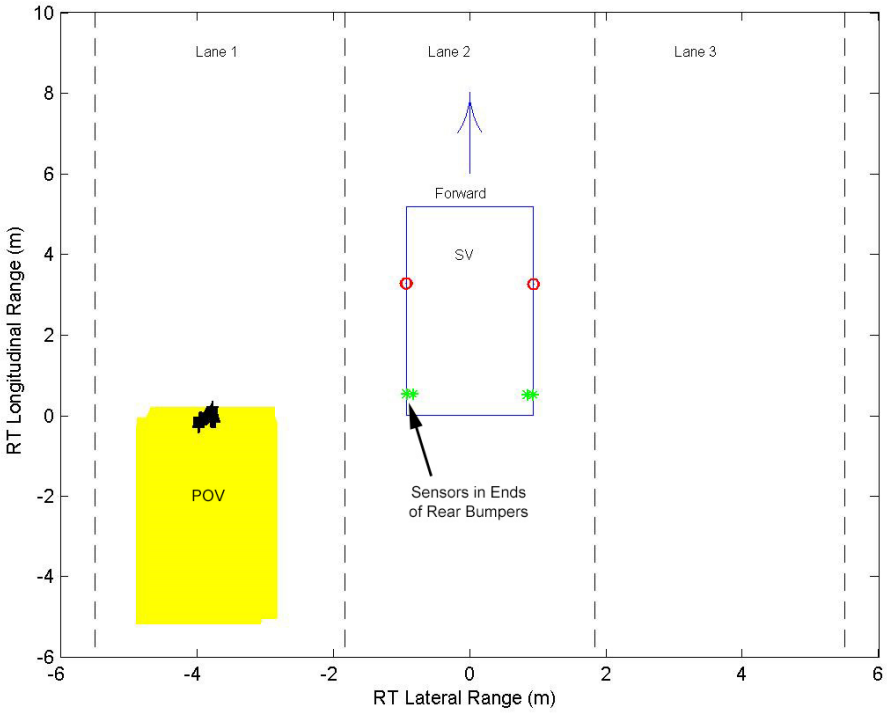


Figure 4-3 BSM Straight-Lane "Same-Speed" - Test No.9 – Left Side Test With Left Turn Signal Applied - Matching Speeds of 20 mph and POV in Next Lane

4.1.2 "Mixed-Speed" Straight-Lane Test Results

After the SVs were tested in the hovering POV-at-Same-Speed configuration in adjacent lanes, the range was extended to include the POV (in one lane) passing the SV (in the next lane). These tests were performed at constant speeds using six paired-speed ranges: 35/20; 55/20; 75/20; 55/35; 75/35; and 75/55 mph. In each case, the SV was driven at the slower test speed. This examined both the SV base speed with respect to passing over the ground and the differential speed between the SV and POV in closing speed rates (differential speeds) of 15, 20, 35, 40, and 55 mph. In performing the tests, both vehicles accelerated up to their respective test speeds and the cruise controls were set for consistency and repeatability. The test file began at a POV following distance of 20 m, while the POV was approaching the SV from the rear. Data was collected until the preset logging time expired at 15 s, which was, for every paired speed range, considerably after the POV had passed the SV.

All three BSMs responded quickly, with no substantial delay from the time the systems detected the overtaking POV and the time when the alert was activated. Detailed data examination revealed that increasing only the base speed of the SV and POV did not change the sensitivity of the BSMs, but changing the differential speed between the vehicles resulted in noticeable changes in both the onset and extinction points of the alerts.

With a differential speed of 55 mph (for the 75/20 mph tests), all three systems experienced at least some longitudinal overlap of the POV to the SV before alert activation. This indicates that the BSMs detect an overtaking POV in the next lane, but that the front of the POV may already be ahead of the rear bumper plane of the SV and nearly into the lateral side-glance field-of-view of the driver at 90 degrees to the left or right of straight forward. This test presented an extreme speed differential, but this condition may be experienced by a driver who stopped along the emergency berm lane of an interstate highway and is preparing to merge back into traffic.

With a lower speed difference of 40 mph (for the 75/35 mph tests) the Volvo alert activated prior to longitudinal overlap. The Buick and the Mercedes experienced overlap on 3 and 4 of 12 tests, respectively. When the speed difference was decreased to 35 mph (for the 55/20 mph tests), the Mercedes experienced an alert activation with longitudinal overlap on one test. The Volvo and Buick activations occurred before any longitudinal overlap. For the two 20 mph and single 15 mph differential speed tests, none of the three BSMs experienced longitudinal overlap before activating an alert.

Figure 4-4 shows that the general trend was for the BSMs to activate with decreasing longitudinal following distance as the differential speeds between the overtaking POV and the SV increased. The Volvo system alerted at the greatest following distance for all differential speeds measured for this test series. The longitudinal spacing values depicted in Figure 4-4 are further summarized in Table 4.1.

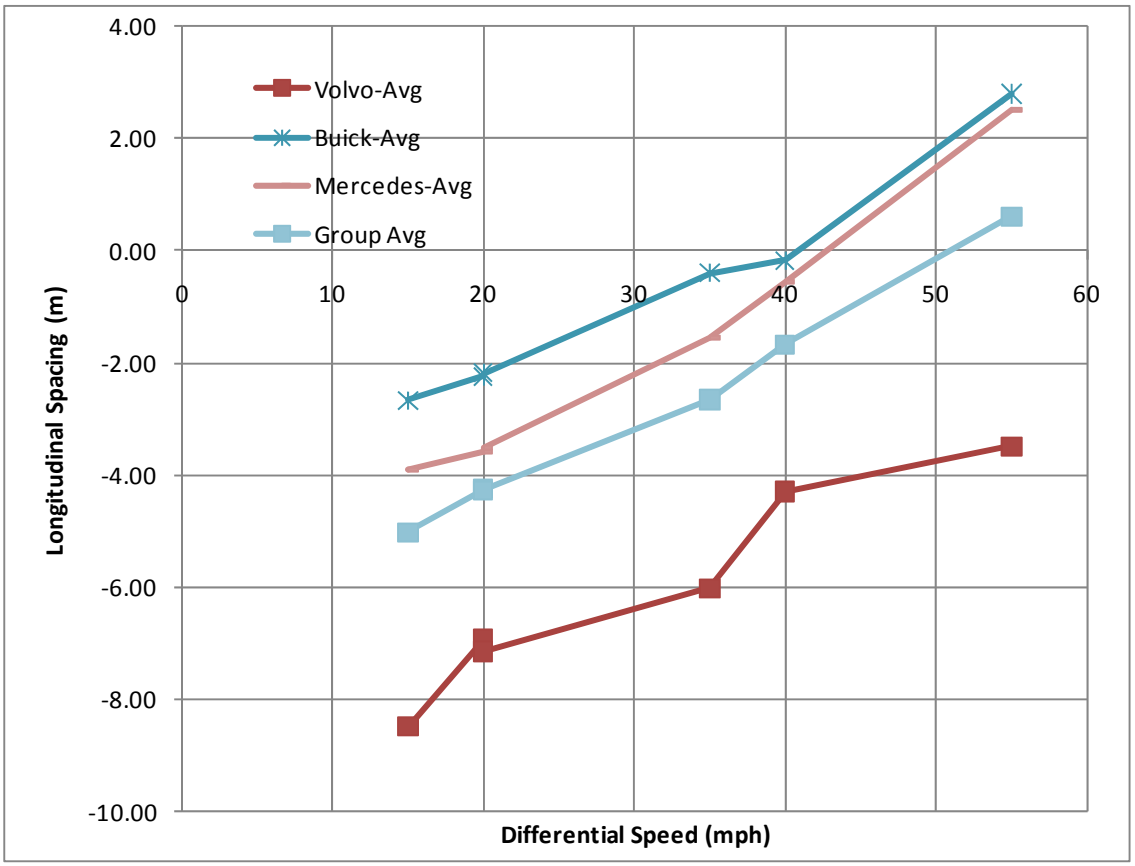


Figure 4-4 Graph of POV Following Distance at BSM Alert Onset for Mixed Speed Tests

Table 4.1. Summary Data for Graph of POV Following Distance for Figure 4-4

Vehicle Speed (mph)			Average Longitudinal Spacing (m)			
POV	SV	Delta	Volvo	Buick	Mercedes	Group Avg.
35	20	15	-8.48	-2.67	-3.91	-5.02
55	35	20	-6.93	-2.24	-3.59	-4.25
75	55	20	-7.14	-2.18	-3.51	-4.28
55	20	35	-6.02	-0.40	-1.56	-2.66
75	35	40	-4.30	-0.18	-0.55	-1.68
75	20	55	-3.49	2.79	2.52	0.61

The blind zone alert extinctions showed a similar trend: As the differential speed between the overtaking POV and SV increases, the resulting alert extinction points move forward with respect to the SV. At higher speeds, the increased delay in extinction allows the POV to better clear the front of the front bumper plane of the SV. This illustrates that the lower speed differentials for extinction are the more critical ranges to observe. The graph of the associated alert extinction distances with respect to the differential speed is shown in Figure 4-5 and the depicted values are summarized in Table 4.2.

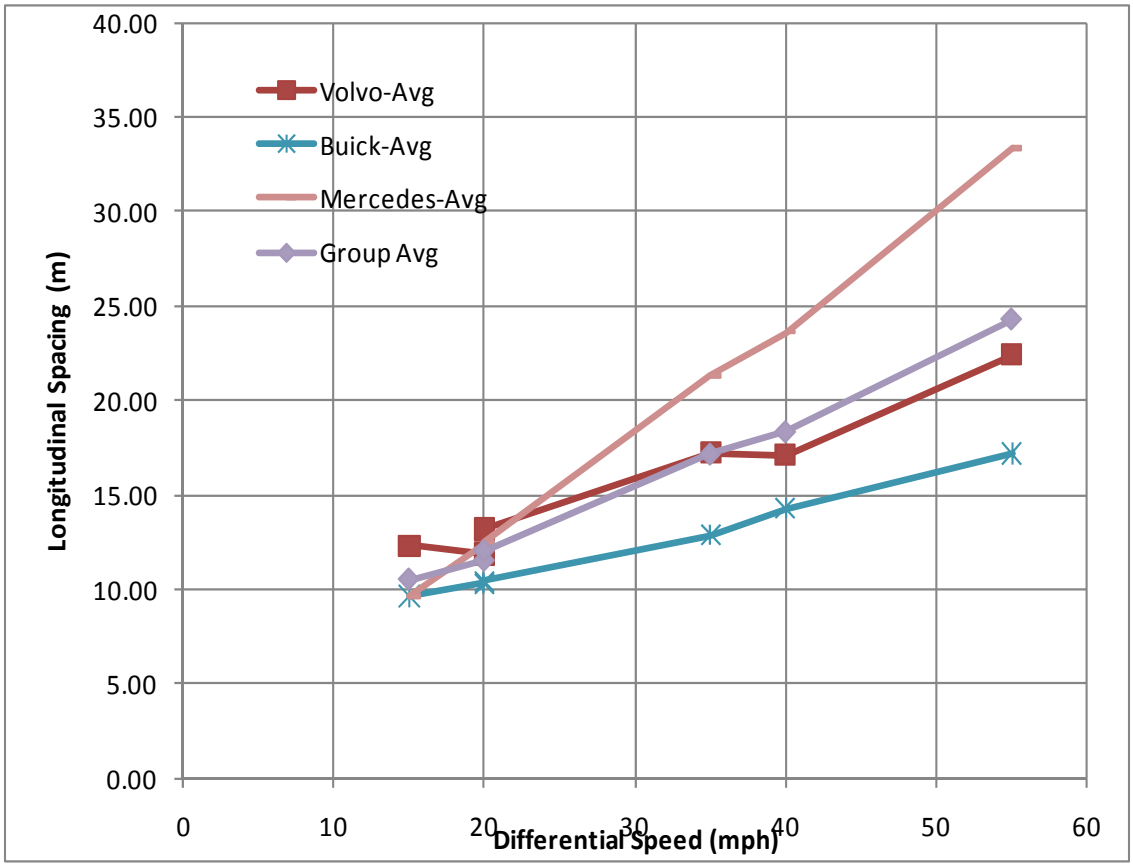


Figure 4-5 Graph of POV Following Distance at BSM Alert Extinction for Mixed Speed Tests

Table 4.2. Summary Data for Graph of POV Following Distance for Figure 4-5

Vehicle Speed (mph)			Average Longitudinal Spacing (m)			
POV	SV	Delta	Volvo	Buick	Mercedes	Group Avg.
35	20	15	12.30	9.65	9.61	8.79
55	35	20	11.90	10.29	12.36	9.18
75	55	20	13.19	10.44	12.46	9.37
55	20	35	17.24	12.88	21.31	11.46
75	35	40	17.09	14.29	23.61	10.28
75	20	55	22.41	17.19	33.36	13.20

The average mirror vantage point following angle of the POV at the moment of onset was -72 degrees at a differential speed of 15 mph, decreasing to -65 degrees at a 35 mph speed differential, and finally to only -31 degrees at the maximum speed differential tested of 55 mph. The corresponding SV mirror to POV near-corner diagonal following distances were 8.5 m, 6.3 m, and 4.2 m for the Volvo, Buick, and Mercedes respectively. For the alert extinction points, the average mirror vantage point (with the POV now leading the SV) angle at the moment of extinction was +71 degrees at a differential speed of 15 mph, +79 degrees at a 35 mph speed delta, and +82 degrees at the maximum delta tested of 55 mph. The corresponding SV mirror to POV near-corner diagonal distances were 7.8 m, 14.3 m, and 21.4 m for the Volvo, Buick, and Mercedes respectively.

Comparing the average onset measurements with the average extinction measurements, the average detection arc was 143 degrees at a differential speed of 15 mph, and 144 degrees at 35 mph. The detection arc decreased at the 55 mph differential speed to only 113 degrees, and the onset starting angle decreased by 41 degrees, from -72 to -31 degrees.

The following two figures show comparative lane plots for one SV. Figure 4-6 shows the SV (the Volvo for this example) driving at 20 mph in lane 2 while the POV was passing at 35 mph in lane 3, for a differential speed of 15 mph. The resulting detection arc was 154 degrees.

Figure 4-7 shows the SV (again the Volvo for this comparison) driving at 20 mph in lane 2 while the POV passed at 75 mph in lane 3, for a differential speed of 55 mph. The resulting detection arc was 162 degrees. In this comparison, the detection arc lengthened by 5 percent, due to the early onset angle experienced by the Volvo. Including the data from the Buick and Mercedes, the average detection arcs reduced at the higher differential speeds.

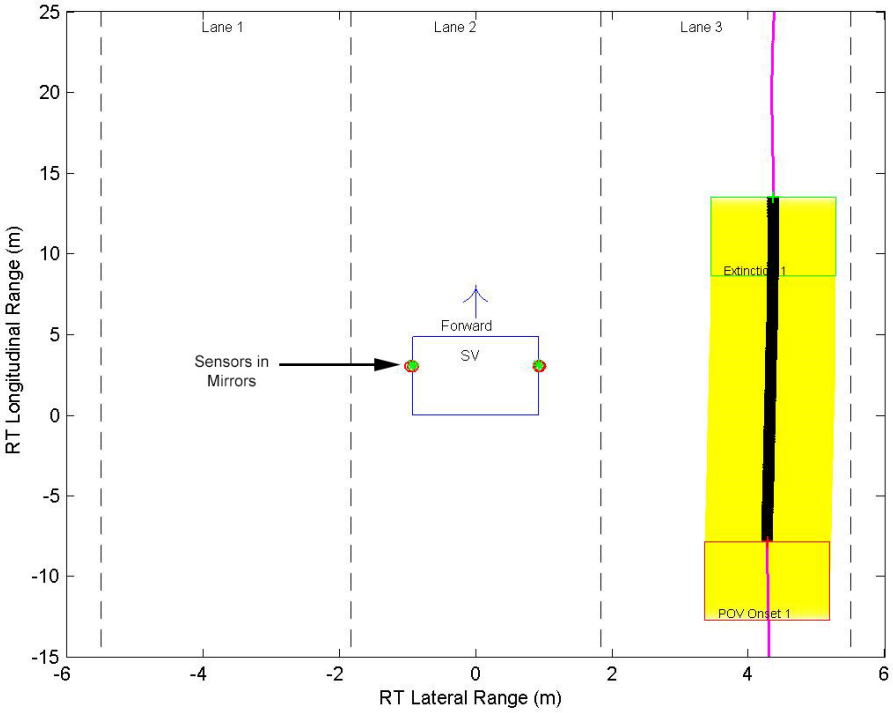


Figure 4-6 BSM Straight-Lane - Test No.9 – Right Side Test With No Turn Signal Applied – SV at 20 mph With POV Driving by in the Next Lane at 35 mph

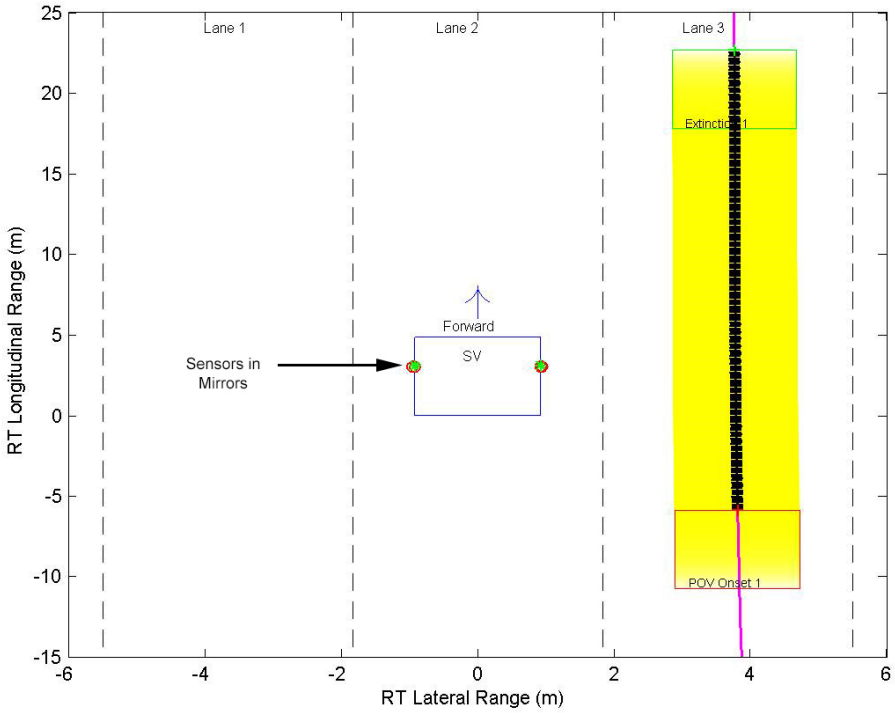


Figure 4-7 BSM Straight-Lane - Test No.9 – Right Side Test With Right Turn Signal Applied – SV at 20 mph With POV Driving by Quickly in the Next Lane at 75 mph

4.2 Dynamic Maneuver Tests

4.2.1 Test-1 Results – The "Converging/Diverging" Maneuver

Test-1 examined lateral activation sensitivity of the systems by seeking a POV, initially traveling in the third lane, as it steered into the second lane (converging) and conversely, lateral extinction sensitivity of an active alert when the POV moved away from the SV and into the third lane (diverging).

For Test-1, the BSMs on all three of the SVs activated 100 percent of the time upon detecting the converging POV on either its left or right side. No difference in activation sensitivity was observed when either the left or right turn signal was applied. The average test speed was 55.2 mph with a tolerance of ±0.5 mph. The data are summarized in Appendix D.1.

The Volvo was tested first. The longitudinal overlap parameter was selected as +2 m, indicating that the front bumper for the POV was 2 meters in front of the rear bumper plane of the SV. This positioned the POV in front of the outward extent of the field of view of the exterior mirrors, as well as out of the driver's field of view with a casual glance of less than 90 degrees to their left or right from forward. As the POV converged and diverged between the second and third lanes, some speed scrubbed off, necessitating the driver of the POV to make slight speed adjustments to maintain the longitudinal overlap range. Periodically, the slight differences in speed during adjustment allowed the POV to move farther forward and into the lateral glance region beside

the driver. It was noted that with these subtle variations in speed and close proximity, the systems may have been acknowledging that the SV was the overtaking vehicle, therefore causing a brief dropout. After the data was reviewed, it was determined that decreasing the overlap in the longitudinal range to 1 meter or less (with the front bumper of the POV at or just in front of the rear bumper plane of the SV) sustained a viable region within which to test lateral sensitivity, while staying back out of the lateral glance range of the driver. The resulting longitudinal overlap range measurements showed the Volvo at 1.97 m, and the Buick and Mercedes at 0.3 and 0.5 m respectively.

The lateral activation distances (the vehicle body side-to-side clearance between the SV and the POV) were 2.7 m for the Volvo, 2.9 m for the Buick, and 3.3 m for the Mercedes. After a short pause, the POV was steered laterally from lane 2 to lane 1. During this lane divergence, the signals extinguished. The lateral spacing between the near sides of the vehicles at the moment of extinction was 3.8 m for the Volvo, 4.8 m for the Buick, and 4.6 m for the Mercedes for their respective longitudinal ranges of 2.2 m, 0.2 m, and 1.1 m.

As a second means of measuring the activation or onset point, by using the centerline of the SV driver's mirror as a measuring vertex, the distance and angle to the forward near-side corner of the POV was determined. The diagonal displacement distances for alert activation were 2.9 m (Volvo), 4.2 m (Buick), and 4.3 m (Mercedes). The diagonal distances for the Volvo were considerably smaller than those for the other vehicles due to the previously described difference in selected longitudinal range distance. The resulting angles (measured as negative if behind the SV outside mirror lateral reference plane) were -21, -45, and -36 degrees respectively (for the Volvo, Buick, and Mercedes).

Figure 4-8 shows the lane plot for a single test-1 run, all the following figures of this sort should be similar to other runs within the respective test but do not represent an average. For this converging/diverging left-side-test series, the thin magenta line approaches the SV from the left side. As soon as the left alert is activated, the POV position is captured on the graph as a red rectangle labeled POV Onset 1. When alert onset occurs, the magenta line segment turns to bold black font and represents the motion of the center of the front bumper during the alert capture period. The expanse of overlapping yellow rectangles portrays the actual path of the POV during the same image capture period. Once the POV diverges and moves laterally outward from the SV, alert extinction occurs (Extinction 1). Extinction is portrayed by a green rectangle showing the moment the POV is declared to be at a safe distance, and no longer a threat to the SV. After extinction, the bold black line returns to a thin magenta line and shows the path of the POV as it continues to diverge to the left into lane 1.

This plot (Figure 4-8) also shows the SV depicted by a blue rectangle, with the rear bumper centerline located at graph position (0, 0), which is the primary reference for all lane plots.

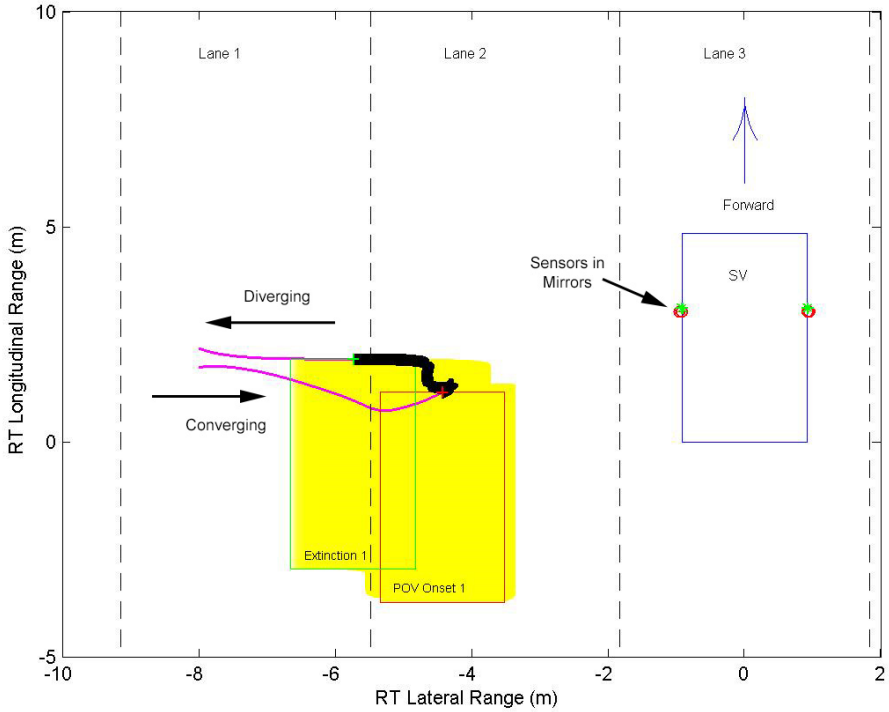


Figure 4-8 BSM Converging-Diverging Left Side - Test No. 1 With Left Turn Signal Applied

4.2.2 Test-2 Results – The Cross Behind Maneuver

The cross behind test expanded upon the basic converging lateral range of Test-1. Instead of overlapping the SV and POV longitudinally (as in Test-1), Test-2 provided a more dynamic lateral range for detection by having the POV drive behind the SV, thus adding the possibility of overextending the longitudinal range past the capability of the individual left or right-side BSM sensors. The Test-2 longitudinal range was initially set at a 2 m following distance, but maintaining this distance proved to be awkward due to the risk of a rear-end collision between the POV and SV. To mitigate this risk, the prescribed longitudinal following distance was expanded to 3 m nominally. All data for this test are summarized in Appendix D.2.

The Volvo and Mercedes systems showed distinctive detection onset and extinction points for both the incursion and excursion events for all tests performed. However, the Buicks system completely missed detecting 3 incursion and 8 excursion events for the 12 tests performed. In two tests, neither event was detected, while seven tests detected only one of the two events. Only 3 of the 12 tests logged correct alert detections for both the incursion and excursion events. Although the measured longitudinal sensing range was longer for the Buick than for the other systems, it was not determined if the Buick was sensitive to the 3 m following distance specification for Test-2, or if it was more sensitive to amount of time that the POV was in proximity.

When detection occurred, Test-2 generally produced good results for identification of the onset and extinction points of the BSM alerts. The nominal lateral spacing for all tests was 2.8 m, with individual vehicle spacing averages of 2.9 m – Volvo; 2.4 m – Buick; and 3.0 m – Mercedes. The longitudinal spacing averages (parallel-lane following distances) at alert onset were 3.0 m; or 3.0, 3.5, and 2.4 m, respectively. The exterior mirror vantage point projections indicated onset typically occurred when the POV front near-side corner was at a diagonal distance of 6.7 m and following angle of 65 degrees. The averages among the three vehicles ranged from 61 to 70 degrees, a relatively narrow range.

The BSM detection alerts continued until the POV was laterally half-overlapped behind the SV. With farther lateral movement of the POV to a position of full overlap behind the SV, the BSMs did not detect the close-following POV for any tests. Full lateral alignment of the POV with the SV concluded the first event.

The second event began as the POV started to move out from behind the SV in lane 1 to a 3 m following distance position in lane 2. The Volvo detected the POV in excursion 12 out of 12 times, with 4 right side detections beginning while the POV was still somewhat laterally overlapped. The Buick detected the POV excursion 4 out of 12 times. In two out of three times that it detected on the left side there was still partial POV overlap. The Mercedes detected the POV excursion 12 out of 12 times and each detection occurred after the POV had laterally cleared the near-side plane of the SV (there was no overlap). For all tests, the average overlap was 0.3 m.

The second extinction concluded the second event with an average lateral spacing of 4.5 m at a following distance of 2.4 m. The mirror vantage angles identified the POV near-side front corner at a distance of 7.1 m and at a following angle of 51 degrees.

Figure 4-9 is a lane plot that shows a full dynamic-lane cross-behind test maneuver. The SV maintained constant speed travel in lane 3. As the POV in lane 1 laterally approached the SV from the left (thin magenta line shows path of POV front bumper centerline), the first point of detection occurred when the POV was just inside the left side of lane 2 (red rectangle labeled POV Onset 1 where thin magenta line turns to bold black line). At this point, a series of overlapping, yellow rectangles began to progress to the right, indicating the path of the POV as it continued to encroach upon the SV in lane 3 (the bold black line continues also). Just after the POV fully entered lane 3, the alert extinguished (green rectangle labeled Extinction 1). From this point, as the POV continued to move farther to the right until in lateral alignment behind the SV, the BSMs did not track the POV (POV path shown as a thin magenta line behind the SV in Figure 4-9).

Next, as the POV drove from lane 3 back into lane 2, the left BSM alert detected the POV (red rectangle labeled POV Onset 2). Again the thin magenta line became the bold black line while the BSM was tracking the POV and the outline of the POV is presented in a series of overlapping cyan (light blue) rectangles. The alert continued until the POV was almost fully into lane 1 (while the POV was moving laterally to the left to a location shown with a green rectangle labeled Extinction 2). As the POV continued its lateral movement to the left, the BSM no longer warned of the POV's proximity and the POV front bumper path is shown by a thin magenta line.

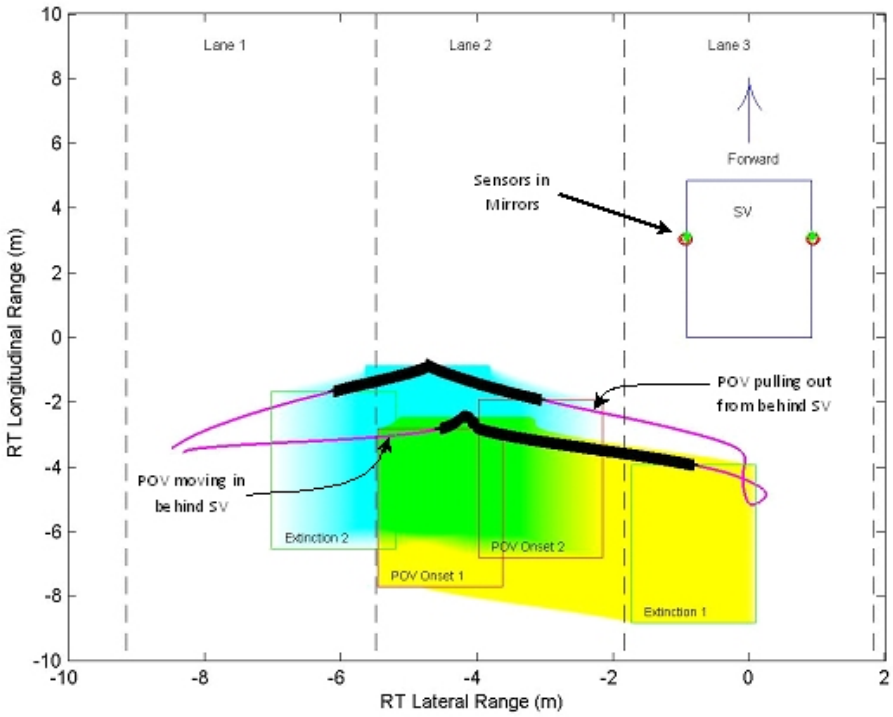


Figure 4-9 BSM Cross-Behind Left Side - Test No. 2 With Left Turn Signal Applied

Each of the three vehicles' BSMs encountered at least one dropout during the Test-2 series. For the Volvo, a single data point width (0.005 s duration) measured a low voltage immediately after the first detection onset during while no turn signal was applied. This dropout and recovery accounted for less than 0.06 percent of the total alert duration of 8.65 s. Two tests experienced dropouts (of 12 total tests performed) for the Mercedes. The first was a left-side test with no turn signal that saw two dropouts in one detection event (6 and 1 percent respectively of the 4.84 s first alert duration) and the second test had one dropout midway through the event period that lasted for 4 percent of the 4.36 s alert time period. The Buick saw a single dropout, for one right-side BSM test. The dropout lasted for 2.64 s of a total alert period of 7.26 s; which was 36 percent of the total alert time. The Buick dropout was the longest dropout recorded for Test 2.

The interaction between blinking signals and BSM alerts was an issue to examine. The turn signal flash frequencies and on-time duty cycles were computed from the time history files using a sample rate of 0.005 seconds per sample. The average values were the same for the left and right side for each vehicle (Figure 4.3). The turn signal and BSM alert appeared to have no effect on one another. Both the Buick and Mercedes algorithms appeared to include modulation of the BSM alert signal if the turn signals were applied, but the frequencies of the two signals were not interdependent. The Volvo BSM alert was not modulated if the turn signal was applied.

Table 4.3. Left and Right Side Blinking Frequencies

Vehicle	Turn Signal		BSM Alert	
	Frequency (Hz)	Duty Cycle (Percent)	Frequency (Hz)	Duty Cycle (Percent)
Volvo	2.80	51	Did not blink	Did not blink
Buick	1.53	53	4.02	50
Mercedes	1.52	52	4.17	51

4.2.3 Test-3 Results – The POV Makes a Pass Maneuver

Test-3 represented a typical real-world highway passing scenario. The SV drove at 55 mph while an overtaking POV made a pass to either side of the SV at 60 mph. The closing distance of the POV to the SV (measured using the RT Range system) was used to determine the point at which the POV would initiate the lane change to pass the SV. At a following distance of 10 meters, the POV initiated the pass and steered from behind the SV in lane 1 into lane 2. Once past the SV, the POV continued at constant speed until 20 meters forward beyond the front bumper plane of the SV. The average SV speed was 55.2 mph and for the POV, it was 60.9 mph. The delta, or average differential speed, ranged from 4.5 to 7.4 mph. All data for Test-3 can be found in Appendix D.3.

The results show that each BSM correctly detected the overtaking and passing of the POV in 12 of 12 attempts. The Volvo and Mercedes had no lateral overlap of vehicles at onset, indicating that the following vehicle will be detected once it moves laterally more than one vehicle width (of the POV) before it causes system activation. However, the Buick detected the passing POV while it was beginning to emerge laterally from behind the SV, but was still partially overlapped. This onset overlap is reflected in the angle values being beyond -90 degrees for the Buick. The sensitivity left to right was comparable as the average onset angles were within 4 degrees of each other.

The large extinction angles indicate the angle that corresponds to the most forward point of a vehicle detectable by the BSMs. For all three vehicles, the average mirror to front-edge-of-POV extinction angle was 66 degrees forward of the SV mirror lateral reference plane, with a variance of plus or minus 3 degrees between the vehicles. This indicates that the alerts extinguish while the passing POV is still partially overlapped longitudinally, but this places the POV well into the forward field of view of the driver. There were no alert dropouts experienced during this test segment.

The lane plot in Figure 4-10 shows the relative path of the POV as it made a pass around the SV to the right. For this test, the yellow sweep area comprises data images generated from front bumper centerline data for the POV while it was lane transitioning in the passing maneuver. Each rectangular figure of the POV was not rotated to exactly show the true heading of the POV, but the bold black line shows the true trajectory of the center of the front bumper during the alert period. For this example - Mercedes file no. 803, there was no lateral or longitudinal overlap of the vehicles at alert onset (red rectangle – POV Onset 1), but there was still longitudinal vehicle overlap at the moment of BSM signal extinction (green rectangle - Extinction 1).

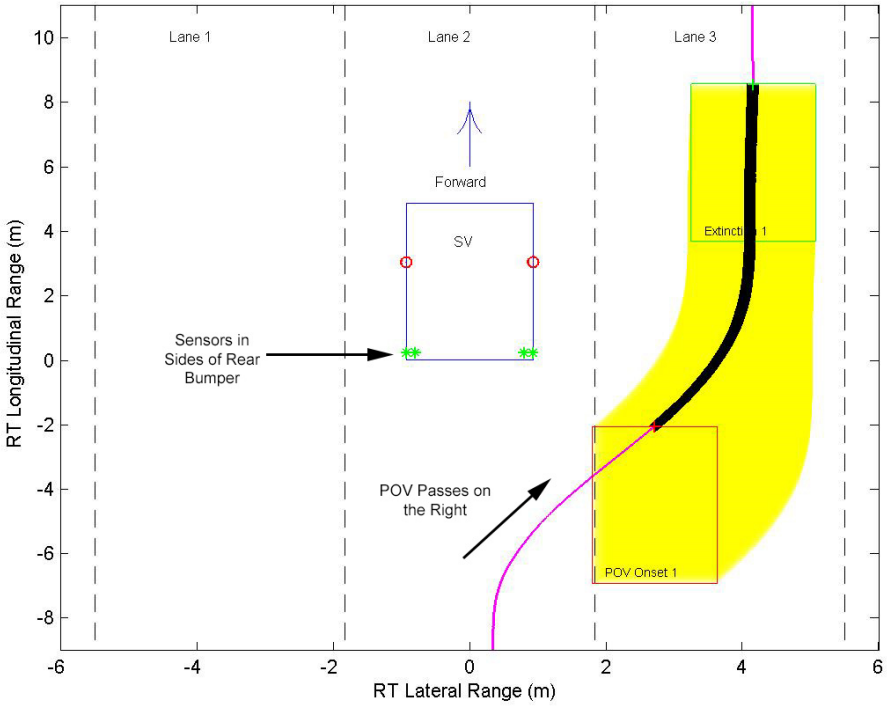


Figure 4-10 BSM POV Makes a Pass - Test No. 3 - SV With No Turn Signal Applied

4.2.4 Test-4 Results - The Run-Up Maneuver

For Test-4, no BSM events were detected for any of the three SVs; therefore, the average test speeds were determined from the data collected for the time period from 0 to 10 seconds. The data file zero reference time was set as soon as the POV had moved into the initial test position, approximately 3 meters behind the SV. The 10-second test period was sufficient time to collect data briefly for the no turn signals, left turn signal, and then right turn signal applications; before decelerating the POV to back away from the SV. Cruise control was used to hold the SV speed constant at 55 mph while the POV performed the maneuver. For all 9 tests combined (3 tests per vehicle), the average speed was 55.3 mph, with a nominal vehicle-to-vehicle speed difference of 0.2 mph. All data for Test-4 can be found in Appendix D.4.

The data files included 5 seconds of pre-trigger and 30 seconds of post-trigger time; therefore, additional observations were made as the POV initially approached the SV prior to the zero starting time and again as the POV decelerated back away from the SV. In these extended observation times, no alerts were activated. This indicated that the systems tested were not configured to identify an overtaking vehicle approaching directly in-line from the rear, as long as the overtaking vehicle did not deviate from the same lane, or one regressing back from a close following proximity.

Figure 4-11 shows a representative run-up test. There is no red POV Onset 1 highlighting rectangle or overlapping yellow boxes (rectangles) plotted, as there were no alert warnings

produced for this test mode. The only representation of the POV is the typical thin magenta line that simply shows the path of the POV relative to the SV (traveling at a constant 55 mph).

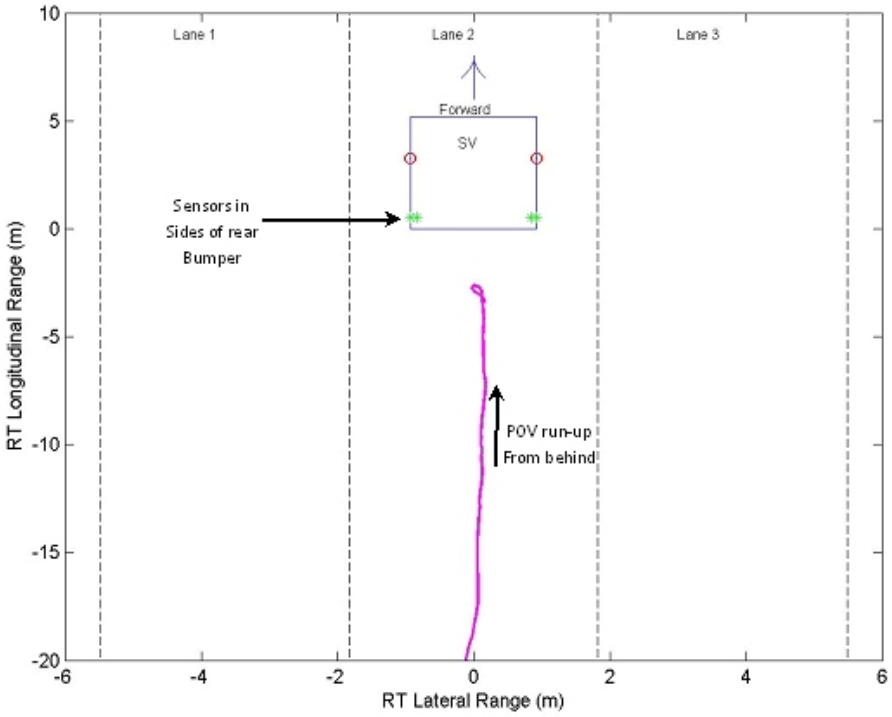


Figure 4-11 BSM POV Run-Up (Same Lane) - Test No. 4 With Alternate Left and Right Turn Signal Applications

4.2.5 Test-5 Results - The SV Brakes Maneuver

In Test-5, both vehicles were driven at 55 mph, with the SV in lane 1 and the POV in lane 2. Initially, the front of the POV was positioned 20 meters behind the rear bumper plane of the SV. The data collection system was started and a Heitz ATI service brake controller (APPENDIX B.) was activated to produce a constant deceleration rate of 0.2 g (6.43 fps^2) in the SV, which was maintained until the POV had passed more than 20 meters ahead of the SV, before releasing the brakes. Activation of the brake controller also applied the SV brake lights, which were studied to identify if they conflicted with, or altered the operation of, the BSMs. Both vehicles were maintained in their respective lanes during this SV braking maneuver. All data for Test-5 can be found in Appendix D.5.

For the alert onset measurement of the SV Brakes tests, the lateral vehicle-to-vehicle side spacing averaged 2.8 m for the entire group, with a variance of ±0.5 m. While the average longitudinal detection following distance was 4.6 m, there was a large variance vehicle-to-vehicle following distance. The Volvo detection distance was considerably longer than the other two units, with a range of 9.6 m. The longitudinal detection distance was 1.9 and 2.7 m respectively for the Buick and Mercedes. The Volvo BSM appeared to be more sensitive to detection during braking than the other two vehicles. For the group, the detection angles

projected from the vantage point of the SV exterior side mirrors averaged 8.2 m diagonal spacing at -69 degrees (69 degrees behind a lateral zero reference plane at the outside mirrors).

The BSM alert extinction points occurred when the SV had decelerated back past the POV (for all vehicle tests, except for one Buick test). The resulting leading edge of the POV at the point of alert extinction produced SV mirror vantage point angles averaging 11.2 m diagonal spacing at +75 degrees (75 degrees forward from the mirrors). This resulted in an effective longitudinal detection arc of 144 degrees. The individual vehicle detection arcs were: 157 degrees – Volvo; 136 degrees – Buick; and 141 degrees – Mercedes. Each system correctly detected the POV during the braking tests. None of the BSMs experienced any dropouts during Test-5 while the SV was pitching slightly from the moderate brake application.

The lane plot in Figure 4-12 shows the relative differences in the positions of the two vehicles during the braking test. This idealized graph shows the world moving about an apparently fixed SV location, when in reality, the SV was actually decelerating at 0.2 g and the POV was moving forward at a constant speed of 55 mph. Therefore, the net effect was that the POV passed the SV, like in a previous straight-lane test, only here, the SV was braking and its brake lights were on. The average speed of the SV during a typical detection period for Test-5 was 33 mph, while the POV maintained at an average speed of 55 mph. The speed differential between the vehicles (for Test No. 0879 shown in Figure 4-12) at the moment of alert onset (detection) was 19.5 mph, and was 26.3 mph at extinction.

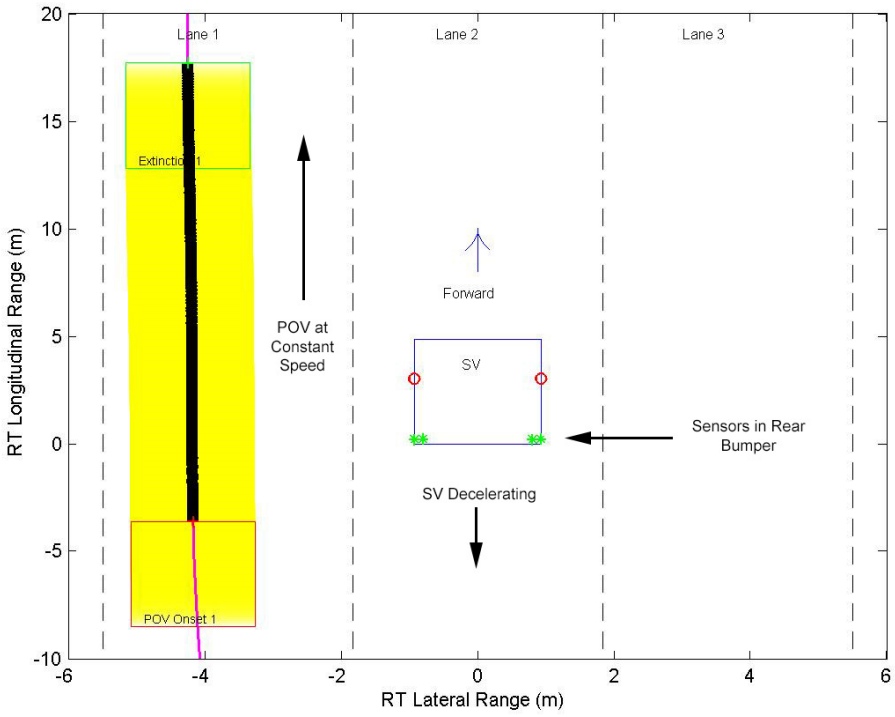


Figure 4-12 SV Brakes Left Side - Test No. 5 With Left Turn Signal Applied

4.2.6 Test-6 Results - POV and SOV Pass by

The scope of Test-6 was to simulate a 3-lane roadway where all traffic flowed in the same direction, similar to one side of a 6-lane divided highway or large city thoroughfare. For this test series, the SV was driven at 55 mph in lane 2, the center of three parallel lanes. The POV and SOV were driven in the adjacent lanes at 60 mph. The POV was instrumented with the second RT Range system and was driven in lane 1. The SOV was not instrumented, and was driven in lane 3.

The SV began driving first, followed by the POV and SOV in their respective lanes. The SV and POV maintained the assigned speeds with cruise control, while the SOV speed was manually adjusted in order to longitudinally track the POV. When the POV and SOV reached a following distance of 20 m behind the SV, the data file commenced. Over the next several seconds, the POV and AV both passed the SV. Data collection continued until the POV and SOV were at least 20 m ahead of the SV. On 6 of the 12 tests, either the left or right turn signal was applied (on the side nearest to the POV) at data file time zero, in order to identify if any signal interactions occurred. After each test repetition, all three vehicles were turned around and headed back in the opposite direction, with each vehicle remaining in its respective lane. This assured that the left and right side sensors on the SV were tested in conjunction with both the POV and SOV. All data for Test-6 can be found in Appendix D.6.

During Test-6, the RT Range system encountered problems in high-precision-synchronization system during the Volvo tests. This did not affect the functionality of the BSM alerts or the recording of them; but it did produce somewhat erroneous lateral and longitudinal positional recordings. Therefore spacing and detection angle data are not included in Table D.6.a and Table D.6.d in the Appendix D.6.

The alerts were continuous and uninterrupted for all 12 tests performed on both the Volvo and Buick. However, for the 12 tests performed on the Mercedes, 4 experienced BSM dropouts. One left side alert dropout (while detecting the SOV) occurred during a POV on-the-right-side test with the right turn signal applied. Two more SOV side dropouts occurred (right side for these tests) while the left turn signal was applied and the left alert was blinking to indicate the overtaking POV on the left side of the SV. The fourth alert dropout occurred during POV detection (on the right side of the SV) with no turn signal applied, and while the SOV was detected on the left side of the SV with a steady BSM warning.

With a nominal SV speed of 55 mph and speeds for the POV and SOV at 60 mph, the pass by speed differential was 5 mph. With this low differential speed, the POV was detected at an average longitudinal following distance of 4.3 m at a lateral spacing of 2.5 m. The detection angle from the outside mirror vantage point was -71 degrees at a diagonal distance of 7.8 m to the front near-side corner of the POV. The alert extinguished while the vehicles were still somewhat longitudinally overlapped, with a mirror vantage point angle of +63 degrees to the front near side corner. This produced an average detection arc of 134 degrees. In comparison to the 144-degree detection arc from the SV brakes Test 5, the Test 6 detection arc was 10 degrees or 7 percent smaller.

For the Buick and Mercedes, when the turn signals were applied during the tests indicating a potential turn into the lane of the POV, the systems alert blinked on that same side. For the Volvo, the alert illuminated and remained steady for the duration of the alert period. For each SV, the alert on the SOV passing side activated with steady detection lamp illuminations (they did not blink or flash).

Figure 4-13 is a typical lane plot that shows the path of the instrumented POV as it passed the SV. The SOV does not appear as a rectangle in the lane plot because it contained no RT Range system; therefore the orange plot is an illustration of the SOV's path. However, the SV's BSM did detect the SOV as it passed.

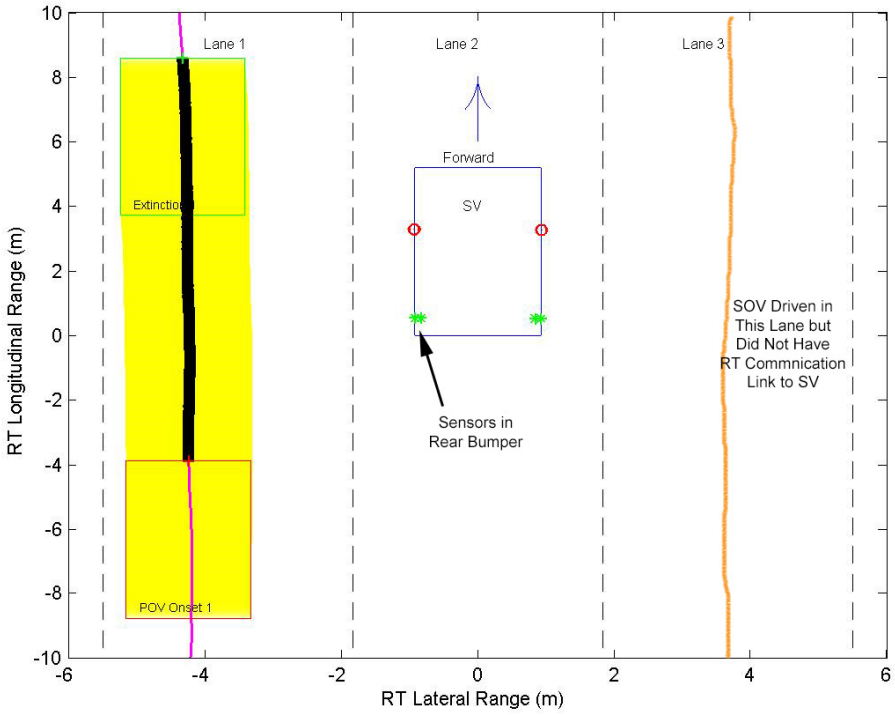


Figure 4-13 BSM Multiple POV's With Range-Monitoring POV on Left Side of SV - Test No. 6 With Left Turn Signal Applied

4.2.7 Test-7 Results – Single POV Detection With SV Opposite Turn Signal Applied

In the opposite turn signal test, the systems correctly identified the passing POV and activated an alert 100 percent of the time. The warning indication was not interrupted or otherwise affected when the SV turn signal on the side opposite of the POV was applied. Each alert lamp remained on and steady for the duration that the POV was in the detection window. The warning indicators did not flash as they did in earlier tests for the Buick and Mercedes when the same side turn signal was applied. The vehicles were traveling at the same speeds as in Test-6 (55 mph - SV and 60 mph – POV), only here, the SV was in lane 2 and the POV was in lane 3 (no vehicle was in lane 1). All data for Test-7 can be found in Appendix D.7.

The ranging data showed that the alert onset occurred before there was any longitudinal overlap between the vehicles. The longitudinal spacing averaged 5.4 m while the lateral spacing averaged 2.3 m. The Volvo's system alerted at the greatest longitudinal spacing of 7.5 m, compared to the 3.8 and 5.0 m respectively for the Buick and Mercedes. From the SV outside mirror vantage point, the nominal sensing angle to the nearest front corner of the POV was -75 degrees with an overall variance of plus or minus 7 degrees.

BSM alert extinction occurred while the SV and POV were still somewhat longitudinally overlapped for all of the tests performed in this group. Again projecting from the mirror vantage point, extinction occurred when the diagonal spacing to the near-side front corner of the POV was 5.9 m away and at a leading angle of +66 degrees. Therefore, the nominal detection arc range was 141 degrees. This was nearly the same as the average detection arc (144 degrees) measured when the SV was braking.

One anomaly did occur during one right-side test with the Mercedes. There was a brief dropout in the alert signal. The dropout occurred 0.12 s after initial detection and lasted for 0.41 s before re-activating the alert signal. The total onset to extinction warning period (including the dropout time) was 4.28 s; therefore, the dropout duration was less than 10 percent of the total activation time. When the dropout occurred, it appeared as a flicker to the driver.

Figure 4.14 shows the path of the POV for a typical right-side test when the left turn signal was applied. The expansive yellow region is the trace of the POV body pattern generated by the multitude of individual ranging samples during a single test run. For this example, the left front corner of the POV (red rectangle labeled POV Onset 1) was 9.1 m diagonally behind the SV mirror at an angle of -74 degrees at alert onset, and was 5.6 m at a leading angle of +63 degrees at extinction. This indicated that total detection arc was 137 degrees.

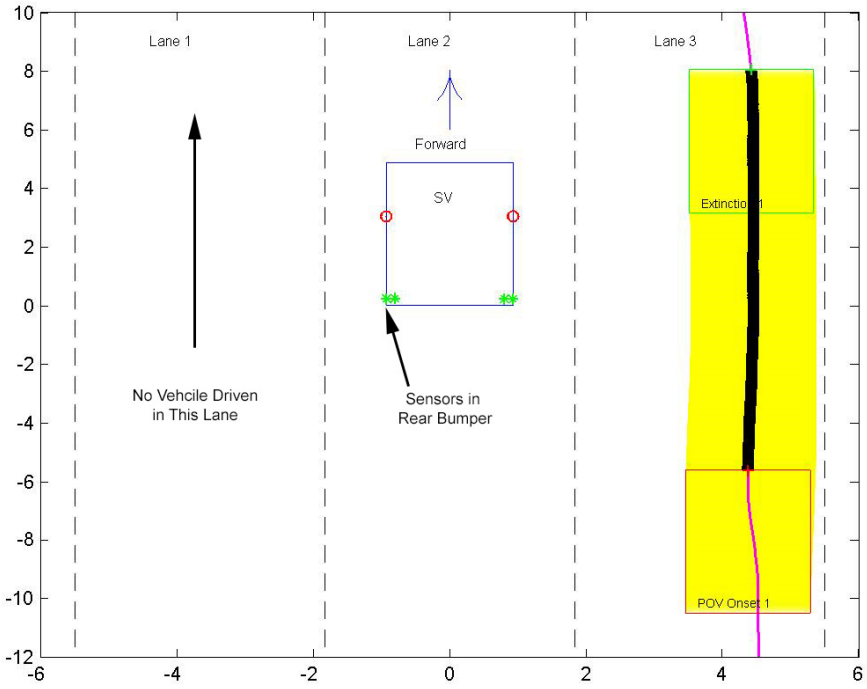


Figure 4-14 Single POV With Opposite Turn Signal Applied - Test No. 7 - POV on Right Side of SV, but With SV Left Turn Signal Applied

4.2.8 Guard Rail Detection

There were no warning alerts in the 36 tests performed by the 3 SV's. The Volvo S80 had a right-side alert after the curve near the end of the test, due to a vehicle passing on the right (this was a valid detection, but of an event beyond the scope of the test procedure). The Mercedes E-350 had no alerts, but amber triangles did light up in the exterior mirrors when it slowed to speeds less than 14 mph indicating that the system was still operational, but that the SV was moving too slowly to properly detect other passing vehicles. The Buick Lucerne CXL had no alerts due to the guard rail, but did produce an audible beeping or a speaker tone at the end of some of the tests. There were no other vehicles in the vicinity of the SV at the time of stopping, and the cause for the Buick's audible beeping was not determined. All data for the guard rail detection test can be found in Appendix E.

5 DISCUSSION AND CONCLUSIONS

The results for each test scenario are summarized below. An evaluation of each scenario is also given that is based on factors such as the complexity, repeatability, and relevance of each scenario. These factors can be considered when planning future BSM evaluations and/or potential rulemaking.

Straight-Lane Tests When the SV was either stopped or moving in lane 1, a stopped or moving POV in lane 3 did not cause any blind zone alerts in a series of 300 tests with POV speeds from 0 to 75 mph and the SV speeds from 0 to 75 mph. There were no false-positive alerts for extended lateral range pass-by tests.

When the SV was stopped in lane 1, neither a stopped nor moving POV in lane 2 caused any alerts in a series of 40 tests where the POV speed ranged from 0 to 75 mph. Increasing the differential speed between the vehicles did not cause an increase in BSM sensitivity or false-positive alert warnings when the SV traveling in lane 1 exceeded the speed of the POV traveling in lane 2.

No alerts were encountered for any of the three test vehicles when the SV was traveling faster than the POV, with one exception for a single Mercedes straight-lane test (35/20 test with the faster POV in lane 2; 1 in 120 tests = 0.8 percent false positives). These BSMs did not appear to detect slower moving traffic traveling in the same direction.

In the straight-lane tests where the SV and POV were both driven at the same speed, each vehicle correctly detected the POV hovering one lane over at a following distance of 0 to 3 m.

The Volvo BSM experienced periodic dropouts in the same speed tests when the POV was driven in a lateral following position and the Volvo was hovering at a range of 9.6 m with a trailing angle of -78 degrees behind the mirror vantage point. This was consistent with the Volvo owner's manual specification of "up to 9.5 m behind the mirrors."

The BSM alerts ordinarily remained active for the full 15s of post-trigger sampling time without interruption.

In the mixed-speed tests, a larger speed differential when the POV was overtaking the SV (in the next lane) created a shorter following distance before the alert activated. Extinction points occurred at POV longitudinal distances much farther ahead of the SV as the differential speed increased.

Increasing the base speed of the SV did not appear to change the sensitivity of the BSMs.

No BSM alerts activated for vehicles traveling in the opposite direction in the next lane (in a lane 2 roadway scenario). This was not a test objective, but when vehicles did pass in the opposite direction and in the next lane, their incident was logged on the data sheets. No reverse-passing false positives were recorded for any of the tests.

When examining the data for other significant findings, it was observed that increasing only the base speed of the SV and POV did not appear to change the sensitivity of the BSMs, but changing the differential speed between the vehicles made noticeable changes in both the onset and extinction points of the BSMs.

Straight-lane scenario testing is of relatively low complexity. This low complexity allows for a high level of repeatability. The straight-lane scenario is also very relevant to BSM testing as it is the scenario that is most likely to be encountered in every day driving. For these reasons, the straight-lane scenario should be considered in future BSM evaluations. However, in future testing, the number of individual test runs completed could be reduced by selecting fewer speed combinations to evaluate.

Test-1 Converge/Diverge: Each of the three BSMs activated warning alerts as the POV laterally approached the SV while the POV converged from lane 3 to lane 2. In general, the alerts remained active with the POV in close proximity to the SV and cleared (extinguished) when the POV diverged from the SV by traveling from lane 2 to lane 3.

The converge/diverge test scenario requires dynamic maneuvers that are more complex than other scenarios. Specifications for lateral velocity and following distances make the repeatability of the tests more difficult without the aid of a steering controller. Due to the relative complexity, converge/diverge would be a less desirable test scenario for further evaluation.

Test-2 Cross-Behind: In 9 of 12 tests performed using the Buick as the SV, its system failed to detect the POV during incursion, excursion, or both. The Volvo and Mercedes detected both incursion and excursion for all 12 tests. When alerts activated, the lateral spacing distances averaged 2.8 m with a longitudinal spacing of 3.0 m.

Cross-behind testing is similar to the converge/diverge scenario with even more complex maneuvering required. The repeatability of this test is low without the use of a steering controller. For these reasons, the cross-behind test scenario would be less desirable for further evaluations.

Test-3 POV Makes a Pass: Each vehicle's BSM correctly detected the overtaking and passing of the POV in all 12 attempts. The nominal identification angle from the SV exterior rearview mirror to the POV side nearest to the SV centerline was -85 degrees, or nearly straight back from the mirror. The Buick BSM responded with some lateral overlap between the SV and the POV, while the Volvo and Mercedes BSMs responded with alerts just after the POV laterally cleared the nearest plane of the SV.

POV Makes a Pass scenario testing is of relatively low complexity and is thus very repeatable. This is a scenario that is more likely encountered in every day driving situations relative to other scenarios. Therefore, POV Makes a Pass is a test scenario that should be considered in future BSM evaluations.

Test-4 Run Up: The three BSMs tested did not activate when a POV traveling in the same lane encroached upon the SV from behind, and reached a minimal following distance of 3 meters. Activating the turn signals on the SV did not cause any apparent changes in BSM functionality. No warning alerts were activated during operation of either left or right turn signals.

The run-up scenario replicates an aborted pass situation and is a situation that can occur often in real-world driving. The maneuver needed to complete this test is relatively non-complex and therefore more repeatable. The run-up scenario should be considered in future BSM evaluations.

Test-5 SV Brakes: In braking mode, the Volvo alert activated at the longest following distance of 9.6m. The Buick and Mercedes BSM alerts activated at 1.9 and 2.7 m, respectively. The general responses were similar to straight-line BSM tests where the POV was overtaking the SV at a differential speed of 20 to 26 mph. The digital video sensors on the Volvo had a higher sensitivity in the braking mode, as the onset distances increased over non-braking modes. The effective detection arc during braking averaged 144 degrees.

The SV brakes scenario, while not a complex maneuver, does require holding a constant deceleration or 0.2g. This can be difficult to maintain, thus making repeatability low without the use of a brake controller. The need for specialized equipment makes the SV brakes scenario less desirable for future evaluations.

Test-6 Multiple POV's: All three BSMs correctly identified both the POV and the SOV in each test. There was no interaction between the two opposing BSM signals on the right or on the left side of the SV. With a closing speed of 5 mph (SV at 55 mph and the POV and AV both at 60 mph), onset activation occurred at an average following distance of 4.3 m and a lateral spacing of 2.5 m. The mirror vantage point projection angle was 134 degrees or 7 percent smaller than the SV Braking tests. The Mercedes experienced 4 out of 12 tests with signal dropout, where the Volvo and Buick had no dropouts.

The Multiple POV's scenario is similar to the Straight-Lane scenario but with the use of a third vehicle. This is a low complexity test with high repeatability and is a scenario that occurs in real world driving. Therefore, Multiple POV's should be considered in future BSM evaluations.

Test-7 Opposite Turn Signal: The three BSMs correctly identified the POV for each test, even when the turn signal was applied to the direction opposite to the side where the POV was passing the SV – the BSMs acted independently of the turn signals. For this test, the BSMs activated alerts before there was any longitudinal overlap between the vehicles, and the average detection arc was 141 degrees, resembling the average SV-braking detection arc.

The opposite turn signal scenario testing is similar to the straight-lane tests but with opposite turn signals applied. The tests are not complex and have a high repeatability. The opposite turn signal scenario should be considered in future BSM evaluations.

Guard Rail Detection: None of the BSMs sensed the approach to, or passing of, a heavy steel guard rail as a false-positive warning condition. No alert warnings were activated whether tested with or without the turn signal activated. Only the left side sensors were tested.

The guard rail detection scenario is relatively non-complex and does have high repeatability. However, the testing requires a specialized test course that may not be readily available for use. The need for a specialized test course is why the guard rail detection scenario is less desirable for further evaluation.

All three BSMs alerted the driver to the presence of a vehicle in adjacent lanes and performed mostly as expected during the tests. This research was not sufficient to rank order the three BSMs that were tested.

A summary of the relative rankings for complexity, repeatability, and specialization of equipment needed for each test scenario used is given in Table 5.1.

Table 5.1 Summary of Test Scenario Evaluation

Test Preferences	Desirable for Future Evaluation		Complex Maneuver		Repeatability		Specialized Equipment Needed	
Test Scenario	**More**	**Less**	**Yes**	**No**	**High**	**Low**	**Yes**	**No**
Straight Lane	x			x	x			x
Converging and Diverging		x	x			x	x	
Cross Behind		x	x			x	x	
POV Makes a Pass	x			x	x			x
Run-up	x			x	x			x
SV Brakes		x		x		x	x	
POV and SOV Pass by	x			x	x			x
Opposite Turn Signal	x			x	x			x
Guard Rail Detection		x		x	x		x	

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APPENDIX A. RT AND RT RANGE

RT Range monitoring systems were installed in the test vehicles to monitor vehicle position, speed, range, as well as many other characteristics of the vehicle motion. A full description of the installation as well as general characteristics and use of the RT system is contained in: Appendix C of *A Test Track Protocol for Assessing Forward Collision Warning Driver-Vehicle Interface Effectiveness*, (Report No. DOT HS 811 501), written by Garrick Forkenbrock of NHTSA, and Andrew Snyder, Mark Heitz, Richard L. (Dick) Hoover, Bryan O'Harra, Scott Vasko, and Larry Smith of TRC Inc., July 2011. The text describes the configuration and operation of the RT system as used for dynamic braking; the details are the same for the dynamic maneuver tests in this report.

APPENDIX B. HEITZ BRAKE CONTROL MACHINE

This section is an excerpt from a NHTSA report titled: "A Test Track Evaluation of Light Vehicle Brake Assist," DOT HS 811 371, written by Garrick J. Forkenbrock of NHTSA, and Andrew Snyder and Robert E. Jones of TRC Inc., September 2010. Although the text describes the configuration and operation of the brake controller as used for a dynamic braking test, the same installation was used for the dynamic maneuver tests in this report.

The excerpt is:

> **PROGRAMMABLE BRAKE CONTROLLER**
>
> Accurately and repeatedly achieving specific combinations of brake pedal force, displacement, and/or application rate is very difficult, even for highly skilled test drivers. For the work performed in this study, use of a programmable brake controller specifically addressed these concerns. This controller uses PID (proportional, integral, derivative) control feedback logic to operate in one of three modes: (1) commanded brake pedal position is achieved and maintained by modulating brake pedal force, (2) commanded brake force is achieved and maintained by modulating brake pedal position, and (3) commanded deceleration is achieved and maintained by modulating brake pedal force and/or displacement. Of these three modes, only the first one was used for the work described in this report.

The brake controller was comprised of four components: an electronically controlled actuator assembly, the mounting apparatus, a driver-operated command module, and an electronics box. The actuator assembly and mounting apparatus were attached to the seat and seat tracks without modification to the vehicle. The electronics box was positioned on the passenger-side floor of the front seat compartment. The command module allowed the driver to specify pedal displacement magnitude and application rate via the use of two rotary dials. A third set of rotary dials, used for selecting feedback mode, was not used. Figure B.1 shows the brake controller installed in the DBS test vehicle.

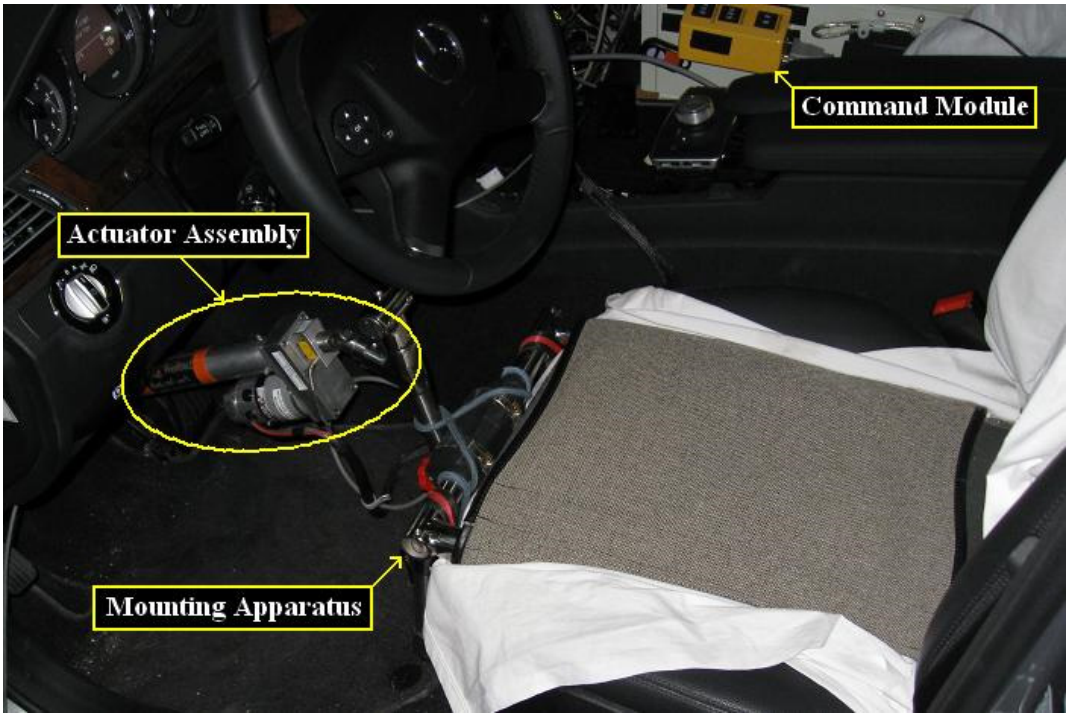

Figure B.1 Brake Controller Components Installed in the Mercedes E350

APPENDIX C. STRAIGHT-LANE TESTS DATA SUMMARIES

Table C. 1 35/20 mph – Summary Table

Test 9 3520 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences									
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1110.00	1408.58	1680.00	1238.00	1692.25	2210.00	1571.00	1704.42	1962.00	1110.00	1601.75	2210.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		1757.00	2030.92	2277.00	1593.00	2061.50	2571.00	1962.00	2100.75	2369.00	1593.00	2064.39	2571.00												
Event1	HSpdAvg	(mph)	20.10	20.16	20.24	19.85	20.47	20.92	20.10	20.22	20.41	19.85	20.28	20.92												
Event1	TSpdAvg	(mph)	34.94	35.15	35.52	34.64	35.44	36.02	35.00	35.53	36.18	34.64	35.37	36.18												
Event1	DeltaSpdAvg	(mph)	14.84	14.99	15.09	14.02	15.00	15.85	14.33	15.34	15.94	14.02	15.11	15.94												
Onset1	Spacing	Lat(m)	2.28	2.51	2.64	2.08	2.42	2.67	2.19	2.56	2.92	2.08	2.50	2.92												
Onset1	Spacing	Long(m)	-10.71	-8.48	-7.28	-3.05	-2.67	-1.77	-5.14	-3.91	-1.74	-10.71	-5.02	-1.74												
Onset1	Corner	Diag(m)	7.69	8.85	10.98	2.96	3.61	3.95	3.26	4.71	5.76	2.96	5.73	10.98												
Onset1	Corner	Angle(deg)	-77.13	-73.25	-70.93	-54.95	-47.69	-36.85	-63.69	-55.85	-32.33	-77.13	-58.93	-32.33												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	10.59	11.77	13.94	5.57	6.41	6.78	5.51	7.41	8.58	5.51	8.53	13.94												
Onset1	Mir	Angle(deg)	-80.00	-77.73	-76.45	-71.71	-67.92	-65.02	-73.70	-69.50	-60.10	-80.00	-71.72	-60.10												
Ext1	Spacing	Lat(m)	2.39	2.59	2.88	2.00	2.40	2.84	2.30	2.52	2.78	2.00	2.50	2.88												
Ext1	Spacing	Long(m)	10.84	12.30	13.49	8.72	9.65	10.67	8.86	9.61	11.87	8.72	10.52	13.49												
Ext1	Corner	Diag(m)	11.14	12.57	13.72	9.17	9.95	10.96	9.21	9.94	12.14	9.17	10.82	13.72												
Ext1	Corner	Angle(deg)	76.30	78.05	79.88	71.96	76.00	78.23	73.61	75.25	77.81	71.96	76.43	79.88												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.83	1.00	0.00	0.75	1.00	0.00	0.53	1.00	0	0	0	5	5	10	5	4	9	3.33	3.00	6.33
Ext1	Mir	Diag(m)	8.21	9.62	10.76	6.12	6.82	7.82	6.34	7.05	9.19	6.12	7.83	10.76												
Ext1	Mir	Angle(deg)	71.78	74.44	77.15	62.60	69.41	72.57	66.24	68.91	73.86	62.60	70.92	77.15												
LeftT/S	hz	0	0.00	0.70	2.82	0.00	0.39	1.56	0.00	0.38	1.52	0.00	0.49	2.82												
RightT/S	hz	0	0.00	0.70	2.82	0.00	0.38	1.54	0.00	0.38	1.52	0.00	0.49	2.82												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	1.02	4.18	0.00	1.04	4.18	0.00	0.69	4.18												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	1.02	4.14	0.00	1.05	4.18	0.00	0.69	4.18												
RightEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Table C. 2. 55/20 mph – Summary Table

Test 9 5520 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences									
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1121.00	1381.00	1632.00	1418.00	1827.25	2182.00	1451.00	1654.33	1920.00	1121.00	1620.86	2182.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		1427.00	1680.33	1935.00	1583.00	1997.83	2345.00	1602.00	1942.83	2279.00	1427.00	1873.67	2345.00												
Event1	HSpdAvg	(mph)	20.10	20.18	20.36	20.17	20.62	21.21	20.14	20.24	20.37	20.10	20.35	21.21												
Event1	TSpdAvg	(mph)	54.29	55.01	55.71	54.85	55.50	57.04	54.59	55.70	56.44	54.29	55.41	57.04												
Event1	DeltaSpdAvg	(mph)	30.55	34.34	35.46	33.65	34.86	36.69	34.47	35.54	36.33	30.55	34.91	36.69												
Onset1	Spacing	Lat(m)	2.13	2.44	2.72	2.11	2.43	2.80	2.04	2.30	2.67	2.04	2.39	2.80												
Onset1	Spacing	Long(m)	-7.46	-6.02	-4.93	-0.71	-0.40	-0.04	-3.03	-1.56	0.46	-7.46	-2.66	0.46												
Onset1	Corner	Diag(m)	5.51	6.51	7.83	2.16	2.47	2.81	2.21	2.94	3.88	2.16	3.97	7.83												
Onset1	Corner	Angle(deg)	-72.41	-67.71	-63.48	-18.10	-9.32	-0.92	-52.24	-30.64	12.01	-72.41	-35.89	12.01												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.00	0.00	0.03	1.00	0	0	0	0	0	0	1	0	1	0.33	0.00	0.33
Onset1	Mir	Diag(m)	8.31	9.36	10.75	4.00	4.39	4.74	3.35	5.16	6.50	3.35	6.31	10.75												
Onset1	Mir	Angle(deg)	-77.42	-75.00	-72.82	-62.00	-56.58	-51.02	-69.24	-62.31	-50.08	-77.42	-64.63	-50.08												
Ext1	Spacing	Lat(m)	2.02	2.46	2.67	2.17	2.44	2.84	2.06	2.35	2.67	2.02	2.42	2.84												
Ext1	Spacing	Long(m)	15.62	17.24	19.19	11.93	12.88	14.01	10.99	21.31	33.24	10.99	17.14	33.24												
Ext1	Corner	Diag(m)	15.83	17.42	19.30	12.23	13.11	14.21	11.24	21.47	33.32	11.24	17.34	33.32												
Ext1	Corner	Angle(deg)	80.65	81.85	83.99	77.15	79.24	80.66	77.54	82.06	86.11	77.15	81.05	86.11												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Mir	Diag(m)	12.86	14.43	16.29	9.07	9.92	11.00	8.29	18.49	30.29	8.29	14.28	30.29												
Ext1	Mir	Angle(deg)	78.62	80.26	82.97	72.76	75.76	77.97	73.22	79.88	85.74	72.76	78.63	85.74												
LeftT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.58	0.00	0.38	1.52	0.00	0.49	2.81												
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.55	0.00	0.38	1.52	0.00	0.49	2.81												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	1.04	4.20	0.00	1.05	4.18	0.00	0.69	4.20												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	1.06	4.51	0.00	1.05	4.18	0.00	0.70	4.51												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.08	1.00	0.00	0.00	0.00	0.00	0.03	1.00	0	0	0	0	1	1	0	0	0	0.00	0.33	0.33

Table C. 3. 75/20 mph – Summary Table

Test 9 7520 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences										
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1196.00	1519.83	1879.00	1353.00	1890.09	2458.00	1816.00	2226.83	2630.00	1196.00	1878.92	2630.00	6	6	12	6	5	11	6	6	12	6.00	5.67	11.67
Ext1	(counts)		1415.00	1728.83	2074.00	1484.00	2007.45	2591.00	1903.00	2475.83	3037.00	1415.00	2070.71	3037.00												
Event1	HSpdAvg	(mph)	20.10	20.13	20.15	20.09	20.54	20.99	20.13	20.20	20.29	20.09	20.29	20.99												
Event1	TSpdAvg	(mph)	75.47	75.61	75.74	75.14	75.56	76.02	74.79	75.55	75.99	74.79	75.57	76.02												
Event1	DeltaSpdAvg	(mph)	55.38	55.47	55.61	54.11	55.10	56.84	54.57	55.39	55.90	54.11	55.32	56.84												
Onset1	Spacing	Lat(m)	1.91	2.35	2.66	2.06	2.35	2.62	1.94	2.35	2.69	1.91	2.35	2.69												
Onset1	Spacing	Long(m)	-6.75	-3.49	0.03	0.99	2.79	6.61	0.50	2.52	6.71	-6.75	0.61	6.71												
Onset1	Corner	Diag(m)	2.65	4.40	7.19	2.81	3.84	6.92	2.23	3.57	7.07	2.23	3.93	7.19												
Onset1	Corner	Angle(deg)	-71.39	-50.76	0.66	20.75	44.37	72.66	12.93	43.02	71.62	-71.39	12.21	72.66												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.08	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	0.69	1.00	1	0	1	6	5	11	6	6	12	4.33	3.67	8.00
Onset1	Mir	Diag(m)	3.97	6.96	10.08	2.11	2.95	3.93	1.97	2.76	4.29	1.97	4.22	10.08												
Onset1	Mir	Angle(deg)	-77.63	-68.74	-48.81	-41.16	-10.22	58.55	-49.49	-12.66	58.82	-77.63	-30.54	58.82												
Ext1	Spacing	Lat(m)	1.89	2.34	2.68	2.04	2.34	2.67	1.92	2.29	2.55	1.89	2.32	2.68												
Ext1	Spacing	Long(m)	18.11	22.41	24.49	14.89	17.19	18.91	11.50	33.36	57.23	11.50	24.32	57.23												
Ext1	Corner	Diag(m)	18.30	22.53	24.61	15.03	17.35	19.04	11.71	33.48	57.28	11.71	24.45	57.28												
Ext1	Corner	Angle(deg)	81.57	83.98	85.13	81.12	82.23	83.64	79.13	83.84	87.74	79.13	83.35	87.74												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Mir	Diag(m)	15.32	19.52	21.60	11.82	14.12	15.81	8.74	30.48	54.24	8.74	21.37	54.24												
Ext1	Mir	Angle(deg)	80.04	83.12	84.45	79.12	80.48	82.32	75.42	82.33	87.61	75.42	81.98	87.61												
LeftT/S	hz	0	0.00	0.70	2.82	0.00	0.38	1.52	0.00	0.38	1.52	0.00	0.49	2.82												
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.55	0.00	0.38	1.53	0.00	0.49	2.81												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	1.01	4.04	0.00	1.05	4.18	0.00	0.68	4.18												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.68	4.08	0.00	1.05	4.18	0.00	0.57	4.18												
RightEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Table C. 4. 55/35 mph – Summary Table

Test 9 5535 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences										
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1108.00	1338.58	1703.00	1524.00	1907.08	2176.00	1379.00	1983.42	2451.00	1108.00	1743.03	2451.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		1495.00	1767.92	2051.00	1829.00	2186.42	2449.00	1657.00	2339.00	2858.00	1495.00	2097.78	2858.00												
Event1	HSpdAvg	(mph)	35.23	35.27	35.39	34.50	35.23	36.11	35.00	35.09	35.24	34.50	35.20	36.11												
Event1	TSpdAvg	(mph)	54.73	54.94	55.49	54.24	55.34	55.97	54.41	55.18	55.89	54.24	55.15	55.97												
Event1	DeltaSpdAvg	(mph)	19.48	19.64	19.95	18.86	20.10	20.99	19.01	19.98	20.79	18.86	19.90	20.99												
Onset1	Spacing	Lat(m)	1.80	2.14	2.60	1.91	2.26	2.80	2.15	2.56	2.88	1.80	2.32	2.88												
Onset1	Spacing	Long(m)	-10.24	-6.93	-2.54	-2.46	-2.24	-1.89	-4.47	-3.59	-2.78	-10.24	-4.25	-1.89												
Onset1	Corner	Diag(m)	3.63	7.29	10.43	3.05	3.19	3.38	3.81	4.42	5.00	3.05	4.97	10.43												
Onset1	Corner	Angle(deg)	-78.89	-71.34	-44.33	-52.11	-44.84	-33.95	-63.30	-54.16	-46.83	-78.89	-56.78	-33.95												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	6.12	10.19	13.40	5.80	5.95	6.08	6.37	7.10	7.83	5.80	7.75	13.40												
Onset1	Mir	Angle(deg)	-81.53	-77.52	-65.26	-71.60	-67.80	-61.64	-73.37	-68.80	-65.48	-81.53	-71.37	-61.64												
Ext1	Spacing	Lat(m)	1.85	2.09	2.43	2.00	2.29	2.83	2.28	2.55	2.90	2.36	2.31	2.90												
Ext1	Spacing	Long(m)	10.13	11.90	13.74	9.24	10.29	11.63	9.12	12.36	15.80	9.12	11.52	15.80												
Ext1	Corner	Diag(m)	10.30	12.08	13.95	9.51	10.55	11.86	9.46	12.63	16.01	9.46	11.75	16.01												
Ext1	Corner	Angle(deg)	79.09	80.00	81.49	74.25	77.45	79.32	73.25	77.87	81.21	73.25	78.44	81.49												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.33	1.00	0.00	0.25	1.00	0.00	0.19	1.00	0	0	0	2	2	4	2	1	3	1.33	1.00	2.33
Ext1	Mir	Diag(m)	7.34	9.11	10.98	6.37	7.39	8.69	6.59	9.69	13.02	6.59	8.73	13.02												
Ext1	Mir	Angle(deg)	75.07	76.81	79.26	67.39	72.01	74.88	66.36	73.65	79.11	66.36	74.16	79.26												
LeftT/S	hz	0	0.00	0.70	2.81	0.00	0.39	1.57	0.00	0.38	1.52	0.00	0.49	2.81												
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.56	0.00	0.38	1.52	0.00	0.49	2.81												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	1.00	4.02	0.00	1.05	4.18	0.00	0.68	4.18												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	1.01	4.03	0.00	1.05	4.18	0.00	0.68	4.18												
RightEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Table C. 5. 75/35 mph – Summary Table

Test 9 7535 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences										
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1087.00	1556.17	2135.00	1473.00	1744.08	2176.00	1972.00	2365.83	2729.00	1087.00	1888.69	2729.00	6	6	12	6	6	12	0	0	0	4.00	4.00	8.00
Ext1	(counts)		1359.00	1793.50	2407.00	1636.00	1906.08	2336.00	2107.00	2632.83	3119.00	1359.00	2110.81	3119.00												
Event1	HSpdAvg	(mph)	35.22	35.25	35.30	35.26	35.58	35.88	34.99	35.05	35.11	34.99	35.30	35.88												
Event1	TSpdAvg	(mph)	75.52	75.63	75.71	74.71	75.57	76.13	75.15	75.62	75.90	74.71	75.61	76.13												
Event1	DeltaSpdAvg	(mph)	40.29	40.38	40.46	39.14	39.97	40.52	40.34	40.65	41.01	39.14	40.33	41.01												
Onset1	Spacing	Lat(m)	1.86	2.13	2.59	2.06	2.32	2.60	1.90	2.36	2.68	1.86	2.27	2.68												
Onset1	Spacing	Long(m)	-7.87	-4.30	-0.59	-0.48	-0.18	0.24	-2.34	-0.55	1.90	-7.87	-1.68	1.90												
Onset1	Corner	Diag(m)	2.65	4.93	8.10	2.09	2.34	2.60	2.31	2.69	3.20	2.09	3.32	8.10												
Onset1	Corner	Angle(deg)	-76.21	-59.61	-12.77	-12.01	-4.52	5.57	-46.96	-11.26	45.00	-76.21	-25.13	45.00												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.25	1.00	0.00	0.33	1.00	0.00	0.19	1.00	0	0	0	2	1	3	3	1	4	1.67	0.67	2.33
Onset1	Mir	Diag(m)	4.42	7.66	11.06	3.87	4.15	4.36	2.21	4.34	5.80	2.21	5.38	11.06												
Onset1	Mir	Angle(deg)	-80.08	-72.72	-54.72	-60.51	-56.13	-50.82	-67.95	-54.41	-30.89	-80.08	-61.09	-30.89												
Ext1	Spacing	Lat(m)	1.79	2.12	2.50	2.08	2.30	2.58	1.85	2.34	2.64	1.79	2.25	2.64												
Ext1	Spacing	Long(m)	14.32	17.09	19.50	13.53	14.29	15.06	7.04	23.61	38.95	7.04	18.33	38.95												
Ext1	Corner	Diag(m)	14.48	17.23	19.63	13.68	14.47	15.23	7.38	23.78	38.99	7.38	18.49	38.99												
Ext1	Corner	Angle(deg)	80.39	82.83	84.45	79.47	80.85	81.45	72.55	81.90	87.28	72.55	81.86	87.28												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	1.00	0.00	0.03	1.00	0	0	0	0	0	0	0	1	1	0.00	0.33	0.33
Ext1	Mir	Diag(m)	11.49	14.23	16.62	10.48	11.26	12.02	4.57	20.80	35.96	4.57	15.43	35.96												
Ext1	Mir	Angle(deg)	78.07	81.38	83.46	76.40	78.27	79.20	61.13	79.21	87.06	61.13	79.62	87.06												
LeftT/S	hz	0	0.00	0.70	2.81	0.00	0.26	1.59	0.00	0.38	1.52	0.00	0.45	2.81												
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.52	0.00	0.38	1.52	0.00	0.49	2.81												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.71	4.29	0.00	1.05	4.18	0.00	0.59	4.29												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	1.06	4.39	0.00	1.05	4.18	0.00	0.70	4.39												
RightEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Table C. 6. 75/55 mph – Summary Table

Test 9 7555 - Straight Lane			Volvo	Volvo	Volvo	Buick	Buick	Buick	Mercedes	Mercedes	Mercedes	For All Vehicles			Number of Tests with Occurrences										
For All Tests			For All Tests									For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		1263.00	1772.25	2190.00	1417.00	1845.25	2212.00	1273.00	2042.00	2997.00	1263.00	1886.50	2997.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		1777.00	2223.25	2628.00	1684.00	2123.83	2485.00	1544.00	2392.33	3404.00	1544.00	2246.47	3404.00												
Event1	HSpdAvg	(mph)	55.30	55.38	55.44	54.56	55.35	55.98	54.88	54.98	55.25	54.56	55.24	55.98												
Event1	TSpdAvg	(mph)	75.46	75.56	75.70	75.02	75.64	76.00	74.75	75.37	76.13	74.75	75.53	76.13												
Event1	DeltaSpdAvg	(mph)	20.09	20.17	20.31	18.85	20.18	21.40	18.46	20.21	21.13	18.46	20.18	21.40												
Onset1	Spacing	Lat(m)	1.82	2.15	2.43	2.21	2.42	2.74	2.12	2.57	2.85	1.82	2.38	2.85												
Onset1	Spacing	Long(m)	-10.54	-7.14	-5.87	-2.40	-2.18	-1.73	-4.35	-3.51	-2.18	-10.54	-4.28	-1.73												
Onset1	Corner	Diag(m)	6.28	7.47	10.74	3.03	3.27	3.52	3.21	4.37	4.99	3.03	5.04	10.74												
Onset1	Corner	Angle(deg)	-78.88	-72.62	-68.09	-46.42	-41.96	-34.44	-63.95	-53.26	-42.87	-78.88	-55.95	-34.44												
Onset1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	9.16	10.39	13.72	5.58	5.96	6.12	5.72	7.03	7.72	5.58	7.79	13.72												
Onset1	Mir	Angle(deg)	-81.42	-77.97	-75.20	-68.47	-66.11	-63.28	-74.00	-68.48	-64.44	-81.42	-70.85	-63.28												
Ext1	Spacing	Lat(m)	2.06	2.20	2.49	2.13	2.42	2.81	2.24	2.57	2.81	2.06	2.40	2.81												
Ext1	Spacing	Long(m)	12.25	13.19	14.43	9.55	10.44	12.64	9.19	12.46	17.06	9.19	12.03	17.06												
Ext1	Corner	Diag(m)	12.42	13.38	14.64	9.81	10.72	12.93	9.52	12.73	17.20	9.52	12.28	17.20												
Ext1	Corner	Angle(deg)	79.11	80.51	81.17	74.01	76.92	78.58	74.44	77.74	82.53	74.01	78.39	82.53												
Ext1	Lateral	Overlap	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.33	1.00	0.00	0.25	1.00	0.00	0.19	1.00	0	0	0	2	2	4	1	2	3	1.00	1.33	2.33
Ext1	Mir	Diag(m)	9.45	10.40	11.67	6.67	7.57	9.75	6.64	9.80	14.20	6.64	9.26	14.20												
Ext1	Mir	Angle(deg)	75.90	77.92	78.77	66.84	71.37	73.90	68.10	73.48	80.96	66.84	74.26	80.96												
LeftT/S	hz	0	0.00	0.70	2.82	0.00	0.39	1.57	0.00	0.38	1.54	0.00	0.49	2.82												
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.38	1.55	0.00	0.38	1.54	0.00	0.49	2.81												
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	1.01	4.04	0.00	1.04	4.18	0.00	0.68	4.18												
LeftEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	0.00	0.00	0.00	1.00	4.02	0.00	1.05	4.18	0.00	0.68	4.18												
RightEvent1	numdrop	downs_BZD	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	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Table C. 7. Number of BSM Alerts During Straight-Lane Testing - Subject Vehicle-Volvo S80

SV: Volvo S80			POV to the Left of the SV				POV to the Right of the SV			
Test Sequence	**POV	*SV	Turn Signal ON		Turn Signal OFF		Turn Signal ON		Turn Signal OFF	
	mph	mph	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane
1	0	0	0	0	0	0	0	0	0	0
2	20	0	0	0	0	0	0	0	0	0
3	35	0	0	0	0	0	0	0	0	0
4	55	0	0	0	0	0	0	0	0	0
5	75	0	0	0	0	0	0	0	0	0
6	20	20	3	0	3	0	3	0	3	0
7	35	20	3	0	3	0	3	0	3	0
8	55	20	3	0	3	0	3	0	3	0
9	75	20	3	0	3	0	3	0	3	0
10	35	35	*1 3	0	*2 3	0	3	0	3	0
11	55	35	3	0	3	0	3	0	3	0
12	75	35	3	0	3	0	3	0	3	0
13	55	55	3	0	*3 3	0	3	0	3	0
14	75	55	3	0	3	0	3	0	3	0
15	75	75	*4 3	0	3	0	3	0	3	0
16	0	20	0	0	0	0	0	0	0	0
17	0	35	0	0	0	0	0	0	0	0
18	0	55	0	0	0	0	0	0	0	0
19	0	75	0	0	0	0	0	0	0	0
20	20	35	0	0	0	0	0	0	0	0
21	20	55	0	0	0	0	0	0	0	0
22	20	75	0	0	0	0	0	0	0	0
23	35	55	0	0	0	0	0	0	0	0
24	35	75	0	0	0	0	0	0	0	0
25	55	75	0	0	0	0	0	0	0	0

Notes: *SV = Subject Vehicle

**POV = Primary Other Vehicle

*1Test Sequence 10 - POV to the left of SV, Turn Signal ON, Next Lane-Alert Dropout on 1 test

*2Test Sequence 10 - POV to the left of SV, Turn Signal OFF, Next Lane-Alert Dropout on 1 test

*3Test Sequence 13 - POV to the left of SV, Turn Signal OFF, Next Lane-Alert Dropout on 1 test

*4Test Sequence 15 - POV to the left of SV, Turn Signal ON, Next Lane-Alert Dropout on 1 test

Table C. 8. Number of BSM Alerts During Straight-Lane Testing - Subject Vehicle-Buick Lucerne

SV: Buick Lucerne			POV to the Left of the SV				POV to the Right of the SV			
Test Sequence	**POV	*SV	Turn Signal ON		Turn Signal OFF		Turn Signal ON		Turn Signal OFF	
	mph	mph	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane
1	0	0	0	0	0	0	0	0	0	0
2	20	0	0	0	0	0	0	0	0	0
3	35	0	0	0	0	0	0	0	0	0
4	55	0	0	0	0	0	0	0	0	0
5	75	0	0	0	0	0	0	0	0	0
6	20	20	3	0	3	0	***	0	3	0
7	35	20	3	0	3	0	3	0	3	0
8	55	20	3	0	3	0	3	0	3	0
9	75	20	3	0	2	0	3	0	3	0
10	35	35	1	0	3	0	3	0	3	0
11	55	35	3	0	3	0	3	0	3	0
12	75	35	3	0	3	0	3	0	3	0
13	55	55	3	0	3	0	3	0	3	0
14	75	55	3	0	3	0	3	0	3	0
15	75	75	3	0	3	0	3	0	3	0
16	0	20	0	0	0	0	0	0	0	0
17	0	35	0	0	0	0	0	0	0	0
18	0	55	0	0	0	0	0	0	0	0
19	0	75	0	0	0	0	0	0	0	0
20	20	35	0	0	0	0	0	0	0	0
21	20	55	0	0	0	0	0	0	0	0
22	20	75	0	0	0	0	0	0	0	0
23	35	55	0	0	0	0	0	0	0	0
24	35	75	0	0	0	0	0	0	0	0
25	55	75	0	0	0	0	0	0	0	0

Notes: *SV = Subject Vehicle

**POV = Primary Other Vehicle

***POV 20 mph and SV 20 mph Right Turn Signal On - No tests run

Table C. 9. Number of BSM Alerts During Straight-Lane Testing - Subject Vehicle-Mercedes E-Class

SV: Mercedes E-Class			POV to the Left of the SV				POV to the Right of the SV			
Test Sequence	**POV	*SV	Turn Signal ON		Turn Signal		Turn Signal ON		Turn Signal OFF	
	mph	mph	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane	Next Lane	3rd Lane
1	0	0	0	0	0	0	0	0	0	0
2	20	0	0	0	0	0	0	0	0	0
3	35	0	0	0	0	0	0	0	0	0
4	55	0	0	0	0	0	0	0	0	0
5	75	0	0	0	0	0	0	0	0	0
6	20	20	3	0	3	0	3	0	3	0
7	35	20	3	0	3	0	3	0	3	0
8	55	20	3	0	3	0	3	0	3	0
9	75	20	3	0	3	0	3	0	3	0
10	35	35	3	0	3	0	3	0	3	0
11	55	35	3	0	3	0	3	0	3	0
12	75	35	3	0	3	0	3	0	3	0
13	55	55	3	0	3	0	3	0	3	0
14	75	55	3	0	3	0	3	0	3	0
15	75	75	3	0	3	0	3	0	3	0
16	0	20	0	0	0	0	0	0	0	0
17	0	35	0	0	0	0	0	0	0	0
18	0	55	0	0	0	0	0	0	0	0
19	0	75	0	0	0	0	0	0	0	0
20	20	35	0	0	0	0	1	0	0	0
21	20	55	0	0	0	0	0	0	0	0
22	20	75	0	0	0	0	0	0	0	0
23	35	55	0	0	0	0	0	0	0	0
24	35	75	0	0	0	0	0	0	0	0
25	55	75	0	0	0	0	0	0	0	0

Notes: *SV = Subject Vehicle

**POV = Primary Other Vehicle

Table C. 10. Straight-Lane Test 9 – Four Ranges of Same-Speed Tests

Test 9 2020 - Straight Lane			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Event1	HSpdAvg	(mph)	20.16	20.15	20.21	19.85	20.17	20.49												
Event1	TSpdAvg	(mph)	20.25	20.15	20.20	19.86	20.20	20.62												
Event1	DeltaSpdAvg	(mph)	0.13	0.09	-0.03	-0.24	0.06	0.83												
MinLat1	Spacing	Lat(m)	2.29	1.97	2.31	1.71	2.19	2.63												
MinLat1	Spacing	Long(m)	-2.19	-0.03	0.08	-3.44	-0.71	0.43												
MinLat1	Corner	Diag(m)	3.19	1.99	2.32	1.73	2.50	4.13												
MinLat1	Corner	Angle(deg)	-42.66	-0.55	1.97	-56.41	-13.74	11.48												
MinLat1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
MinLat1	Longitudinal	Overlap	0.00	0.44	0.75	0.00	0.40	1.00	0	0	0	1	3	4	5	4	9	2.00	2.33	4.33
MinLat1	Mir	Diag(m)	5.68	3.84	3.75	3.43	4.42	6.85												
MinLat1	Mir	Angle(deg)	-66.47	-59.31	-52.00	-70.80	-59.26	-48.16												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Test 9 3535 - Straight Lane			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
Event1	HSpdAvg	(mph)	35.24	35.15	35.15	34.87	35.18	35.51												
Event1	TSpdAvg	(mph)	35.25	35.15	35.18	34.34	35.19	35.70												
Event1	DeltaSpdAvg	(mph)	0.11	0.04	0.12	-0.44	0.09	0.68												
MinLat1	Spacing	Lat(m)	1.66	2.28	2.25	1.22	2.06	2.55												
MinLat1	Spacing	Long(m)	-2.27	0.02	-0.02	-6.31	-0.76	1.76												
MinLat1	Corner	Diag(m)	3.80	2.29	2.27	1.42	2.79	6.61												
MinLat1	Corner	Angle(deg)	-20.00	0.49	-0.43	-72.75	-6.65	55.23												
MinLat1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
MinLat1	Longitudinal	Overlap	0.42	0.67	0.45	0.00	0.51	1.00	0	5	5	4	4	8	2	4	6	2.00	4.33	6.33
MinLat1	Mir	Diag(m)	5.62	3.96	3.80	1.74	4.46	9.53												
MinLat1	Mir	Angle(deg)	-66.18	-55.01	-53.69	-78.35	-58.29	-46.47												
LeftEvent1	numdrop	downs_BZD	0.08	0.00	0.00	0.00	0.03	1.00	3	0	3	0	0	0	0	0	0	1.00	0.00	1.00
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Test 9 5555 - Straight Lane			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
Event1	HSpdAvg	(mph)	55.40	55.19	54.88	54.50	55.16	55.55												
Event1	TSpdAvg	(mph)	55.36	55.26	54.98	54.23	55.20	56.12												
Event1	DeltaSpdAvg	(mph)	0.08	-0.07	-0.07	-0.70	-0.02	1.02												
MinLat1	Spacing	Lat(m)	1.59	2.23	2.25	1.24	2.03	2.73												
MinLat1	Spacing	Long(m)	-2.61	-0.30	-0.14	-6.05	-1.01	1.12												
MinLat1	Corner	Diag(m)	3.70	2.26	2.31	1.24	2.76	6.31												
MinLat1	Corner	Angle(deg)	-29.74	-7.53	-3.60	-73.41	-13.62	38.88												
MinLat1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
MinLat1	Longitudinal	Overlap	0.33	0.08	0.42	0.00	0.28	1.00	0	4	4	1	0	1	0	5	5	0.33	3.00	3.33
MinLat1	Mir	Diag(m)	5.89	4.20	3.90	2.34	4.66	9.24												
MinLat1	Mir	Angle(deg)	-70.37	-58.07	-54.39	-78.98	-60.94	-48.26												
LeftEvent1	numdrop	downs_BZD	0.08	0.00	0.00	0.00	0.03	1.00	1	0	1	0	0	0	0	0	0	0.33	0.00	0.33
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Test 9 7575 - Straight Lane			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
Event1	HSpdAvg	(mph)	75.78	74.84	74.86	74.02	75.16	75.95												
Event1	TSpdAvg	(mph)	75.88	74.82	75.61	73.98	75.44	76.58												
Event1	DeltaSpdAvg	(mph)	-0.03	-0.09	-0.41	-1.20	-0.17	0.44												
MinLat1	Spacing	Lat(m)	1.59	2.21	2.28	1.33	2.03	2.66												
MinLat1	Spacing	Long(m)	-2.64	-0.12	-0.13	-5.61	-0.96	1.19												
MinLat1	Corner	Diag(m)	3.57	2.23	2.34	1.36	2.71	5.94												
MinLat1	Corner	Angle(deg)	-35.86	-2.53	-3.21	-74.29	-13.87	41.78												
MinLat1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
MinLat1	Longitudinal	Overlap	0.17	0.42	0.25	0.00	0.28	1.00	0	2	2	1	4	5	1	2	3	0.67	2.67	3.33
MinLat1	Mir	Diag(m)	5.91	4.04	3.91	2.25	4.62	8.84												
MinLat1	Mir	Angle(deg)	-71.23	-57.08	-53.90	-80.07	-60.74	-39.51												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	1	0	1	0	0	0	0	0	0	0.33	0.00	0.33
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.17	0.00	0.06	1.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Note: *Continuous Alert - signifies that the BZD alert began as the POV came into formation prior to the start of data collection and remained on after the test timed out.

Table C. 11. Comparison of BSM Alert Activation Onset Points for Six Mixed Speed Straight-Lane Tests

Onset Points	Test 9 Straight Lane			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences											
	For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
	Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Test 9 3520 mph	Onset1	(counts)		1408.58	1692.25	1704.42	1110.00	1601.75	2210.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
	Onset1	Spacing	Lat(m)	2.51	2.42	2.56	2.08	2.50	2.92												
	Onset1	Spacing	Long(m)	-8.48	-2.67	-3.91	-10.71	-5.02	-1.74												
	Onset1	Corner	Diag(m)	8.85	3.61	4.71	2.96	5.73	10.98												
	Onset1	Corner	Angle(deg)	-73.25	-47.69	-55.85	-77.13	-58.93	-32.33												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Mir	Diag(m)	11.77	6.41	7.41	5.51	8.53	13.94												
	Onset1	Mir	Angle(deg)	-77.73	-67.92	-69.50	-80.00	-71.72	-60.10												
Test 9 5520 mph	Onset1	(counts)		1381.00	1827.25	1654.33	1121.00	1620.86	2182.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
	Onset1	Spacing	Lat(m)	2.44	2.43	2.30	2.04	2.39	2.80												
	Onset1	Spacing	Long(m)	-6.02	-0.40	-1.56	-7.46	-2.66	0.46												
	Onset1	Corner	Diag(m)	6.51	2.47	2.94	2.16	3.97	7.83												
	Onset1	Corner	Angle(deg)	-67.71	-9.32	-30.64	-72.41	-35.89	12.01												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.00	0.00	0.08	0.00	0.03	1.00	0	0	0	0	0	0	1	0	1	0.33	0.00	0.33
	Onset1	Mir	Diag(m)	9.36	4.39	5.16	3.35	6.31	10.75												
	Onset1	Mir	Angle(deg)	-75.00	-56.58	-62.31	-77.42	-64.63	-50.08												
Test 9 7520 mph	Onset1	(counts)		1519.83	1890.09	2226.83	1196.00	1878.92	2630.00	6	6	12	6	5	11	6	6	12	6.00	5.67	11.67
	Onset1	Spacing	Lat(m)	2.35	2.35	2.35	1.91	2.35	2.69												
	Onset1	Spacing	Long(m)	-3.49	2.79	2.52	-6.75	0.61	6.71												
	Onset1	Corner	Diag(m)	4.40	3.84	3.57	2.23	3.93	7.19												
	Onset1	Corner	Angle(deg)	-50.76	44.37	43.02	-71.39	12.21	72.66												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.08	1.00	1.00	0.00	0.69	1.00	1	0	1	6	5	11	6	6	12	4.33	3.67	8.00
	Onset1	Mir	Diag(m)	6.96	2.95	2.76	1.97	4.22	10.08												
	Onset1	Mir	Angle(deg)	-68.74	-10.22	-12.66	-77.63	-30.54	58.82												
Test 9 5535 mph	Onset1	(counts)		1338.58	1907.08	1983.42	1108.00	1743.03	2451.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
	Onset1	Spacing	Lat(m)	2.14	2.26	2.56	1.80	2.32	2.88												
	Onset1	Spacing	Long(m)	-6.93	-2.24	-3.59	-10.24	-4.25	-1.89												
	Onset1	Corner	Diag(m)	7.29	3.19	4.42	3.05	4.97	10.43												
	Onset1	Corner	Angle(deg)	-71.34	-44.84	-54.16	-78.89	-56.78	-33.95												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Mir	Diag(m)	10.19	5.95	7.10	5.80	7.75	13.40												
	Onset1	Mir	Angle(deg)	-77.52	-67.80	-68.80	-81.53	-71.37	-61.64												
Test 9 7535 mph	Onset1	(counts)		1556.17	1744.08	2365.83	1087.00	1888.69	2729.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
	Onset1	Spacing	Lat(m)	2.13	2.32	2.36	1.86	2.27	2.68												
	Onset1	Spacing	Long(m)	-4.30	-0.18	-0.55	-7.87	-1.68	1.90												
	Onset1	Corner	Diag(m)	4.93	2.34	2.69	2.09	3.32	8.10												
	Onset1	Corner	Angle(deg)	-59.61	-4.52	-11.26	-76.21	-25.13	45.00												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.00	0.25	0.33	0.00	0.19	1.00	0	0	0	2	1	3	3	1	4	1.67	0.67	2.33
	Onset1	Mir	Diag(m)	7.66	4.15	4.34	2.21	5.38	11.06												
	Onset1	Mir	Angle(deg)	-72.72	-56.13	-54.41	-80.08	-61.09	-30.89												
Test 9 7555 mph	Onset1	(counts)		1772.25	1845.25	2042.00	1263.00	1886.50	2997.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
	Onset1	Spacing	Lat(m)	2.15	2.42	2.57	1.82	2.38	2.85												
	Onset1	Spacing	Long(m)	-7.14	-2.18	-3.51	-10.54	-4.28	-1.73												
	Onset1	Corner	Diag(m)	7.47	3.27	4.37	3.03	5.04	10.74												
	Onset1	Corner	Angle(deg)	-72.62	-41.96	-53.26	-78.88	-55.95	-34.44												
	Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
	Onset1	Mir	Diag(m)	10.39	5.96	7.03	5.58	7.79	13.72												
	Onset1	Mir	Angle(deg)	-77.97	-66.11	-68.48	-81.42	-70.85	-63.28												
Test 9 Average of All Six Mixed Speed Tests	Onset1	(counts)		1496.07	1817.67	1996.14	1147.50	1769.96	2533.17	6.00	6.00	12.00	6.00	5.83	11.83	6.00	6.00	12.00	6.00	5.94	11.94
	Onset1	Spacing	Lat(m)	2.29	2.37	2.45	1.92	2.37	2.80												
	Onset1	Spacing	Long(m)	-6.06	-0.81	-1.77	-8.93	-2.88	0.62												
	Onset1	Corner	Diag(m)	6.58	3.12	3.78	2.59	4.49	9.21												
	Onset1	Corner	Angle(deg)	-65.88	-17.33	-27.03	-75.82	-36.74	4.82												
	Onset1	Lateral	Overlap	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	0.00	0.00	0.00
	Onset1	Longitudinal	Overlap	0.01	0.21	0.24	0.00	0.15	0.50	0.17	0.00	0.17	1.33	1.00	2.33	1.67	1.17	2.83	1.06	0.72	1.78
	Onset1	Mir	Diag(m)	9.39	4.97	5.63	4.07	6.66	12.16												
	Onset1	Mir	Angle(deg)	-74.94	-54.13	-56.03	-79.68	-61.70	-34.53												

APPENDIX D. DYNAMIC LANE TESTS – INDIVIDUAL VEHICLE DATA

D.1. DYNAMIC LANE TEST 1 - CONVERGE/DIVERGE – SUMMARY TABLES

Table D.1 a Test 1 – Volvo Summary

Test 1 Converging-Diverging - Volvo													
Filename			For All Tests			For Target on Left			For Target on Right			Occurrences	
TargetSide			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2090.00	2943.58	4468.00	2182.00	2957.50	4468.00	2090.00	2929.67	3722.00	6	6	12
Ext1	(counts)		3926.00	5282.67	6591.00	3926.00	5097.17	6297.00	4700.00	5468.17	6591.00			
Event1	HSpdAvg	(mph)	55.30	55.38	55.47	55.38	55.42	55.47	55.30	55.34	55.39			
Event1	TSpdAvg	(mph)	55.05	55.42	55.71	55.05	55.33	55.58	55.33	55.50	55.71			
Event1	DeltaSpdAvg	(mph)	-0.74	0.14	0.88	-0.74	-0.15	0.40	0.10	0.43	0.88			
Onset1	Spacing	Lat(m)	2.50	2.67	2.80	2.50	2.63	2.80	2.52	2.71	2.78			
Onset1	Spacing	Long(m)	1.16	1.97	3.48	1.16	2.16	3.48	1.45	1.78	2.13			
Onset1	Corner	Diag(m)	2.84	3.36	4.36	2.84	3.47	4.36	2.90	3.25	3.49			
Onset1	Corner	Angle(deg)	24.03	35.49	52.81	24.03	37.90	52.81	29.20	33.07	37.60			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Onset1	Mir	Diag(m)	2.55	2.91	3.26	2.55	2.84	3.26	2.88	2.97	3.08			
Onset1	Mir	Angle(deg)	-36.10	-20.92	9.92	-36.10	-17.04	9.92	-32.34	-24.81	-18.17			
Ext1	Spacing	Lat(m)	3.40	3.84	4.45	3.40	3.64	3.97	3.55	4.04	4.45			
Ext1	Spacing	Long(m)	1.49	2.15	3.55	1.49	1.74	2.01	1.81	2.57	3.55			
Ext1	Corner	Diag(m)	3.71	4.43	5.33	3.71	4.03	4.35	4.06	4.83	5.33			
Ext1	Corner	Angle(deg)	22.10	28.79	45.01	23.63	25.50	29.74	22.10	32.08	45.01			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	3.56	3.96	4.59	3.62	3.83	4.14	3.56	4.09	4.59			
Ext1	Mir	Angle(deg)	-24.55	-12.98	8.47	-24.55	-19.70	-15.91	-18.68	-6.27	8.47			
LeftT/S	hz	0	0.00	0.70	2.82	0.00	1.40	2.82	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.70	2.81	0.00	0.00	0.00	0.00	1.40	2.81			
LeftBZD1	hz	0	0.00	0.05	0.31	0.00	0.10	0.31	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.25	2.00	0.00	0.50	2.00	0.00	0.00	0.00	2	0	2
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.1 b. Test 1 – Buick Summary

Test 1 Converging-Diverging - Buick													
Filename			For All Tests			For Target on Left			For Target on Right			Occurrences	
TargetSide			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2519.00	3068.33	4115.00	2808.00	3327.00	4115.00	2519.00	2809.67	2975.00	6	6	12
Ext1	(counts)		4543.00	5132.92	5832.00	4543.00	5137.50	5832.00	4761.00	5128.33	5425.00			
Event1	HSpdAvg	(mph)	54.85	55.27	55.48	54.85	55.22	55.42	55.09	55.31	55.48			
Event1	TSpdAvg	(mph)	54.56	55.29	55.75	54.56	55.34	55.75	54.92	55.24	55.69			
Event1	DeltaSpdAvg	(mph)	-1.69	-0.41	0.19	-1.69	-0.58	0.08	-0.95	-0.24	0.19			
Onset1	Spacing	Lat(m)	2.59	2.94	3.18	2.59	2.81	3.01	2.92	3.07	3.18			
Onset1	Spacing	Long(m)	-0.47	0.26	1.27	-0.47	-0.13	0.57	0.01	0.64	1.27			
Onset1	Corner	Diag(m)	2.62	3.00	3.43	2.62	2.83	3.01	2.95	3.17	3.43			
Onset1	Corner	Angle(deg)	-9.80	4.32	22.01	-9.80	-2.84	11.13	0.13	11.47	22.01			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.58	1.00	0.00	0.17	1.00	1.00	1.00	1.00	1	6	7
Onset1	Mir	Diag(m)	3.70	4.23	4.60	3.95	4.41	4.60	3.70	4.04	4.52			
Onset1	Mir	Angle(deg)	-55.17	-45.27	-31.97	-55.17	-50.46	-43.16	-45.92	-40.09	-31.97			
Ext1	Spacing	Lat(m)	4.26	4.80	5.24	4.26	4.90	5.24	4.28	4.69	4.92			
Ext1	Spacing	Long(m)	-1.38	0.23	1.51	-1.38	0.29	1.51	-0.75	0.17	1.33			
Ext1	Corner	Diag(m)	4.28	4.88	5.34	4.29	5.01	5.34	4.28	4.75	5.10			
Ext1	Corner	Angle(deg)	-15.74	2.37	16.61	-15.74	2.97	16.61	-8.86	1.76	15.08			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.58	1.00	0.00	0.67	1.00	0.00	0.50	1.00	4	3	7
Ext1	Mir	Diag(m)	5.28	5.72	6.76	5.34	5.80	6.76	5.28	5.65	6.24			
Ext1	Mir	Angle(deg)	-43.57	-31.99	-19.31	-43.57	-30.87	-19.31	-39.90	-33.11	-21.44			
LeftT/S	hz	0	0.00	0.38	1.53	0.00	0.76	1.53	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
LeftBZD1	hz	0	0.00	1.00	4.02	0.00	2.00	4.02	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.00	4.01	0.00	0.00	0.00	0.00	2.00	4.01			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.1 c. Test 1 – Mercedes Summary

Test 1 Converging-Diverging - Mercedes													
Filename			For All Tests			For Target on Left			For Target on Right			Occurrences	
TargetSide			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2556.00	2888.92	3535.00	2556.00	2728.67	2917.00	2587.00	3049.17	3535.00	6	6	12
Ext1	(counts)		3811.00	4452.67	5156.00	3811.00	4343.67	5156.00	4098.00	4561.67	4822.00			
Event1	HSpdAvg	(mph)	54.77	54.89	55.01	54.77	54.89	55.01	54.82	54.90	54.94			
Event1	TSpdAvg	(mph)	54.50	55.08	55.82	54.50	55.17	55.82	54.71	54.98	55.23			
Event1	DeltaSpdAvg	(mph)	-1.58	-0.37	0.21	-1.58	-0.48	0.21	-0.84	-0.26	0.13			
Onset1	Spacing	Lat(m)	3.10	3.31	3.57	3.10	3.23	3.41	3.20	3.39	3.57			
Onset1	Spacing	Long(m)	-1.89	0.47	2.12	-1.89	-0.45	0.46	0.76	1.39	2.12			
Onset1	Corner	Diag(m)	3.10	3.52	4.06	3.10	3.36	3.77	3.40	3.69	4.06			
Onset1	Corner	Angle(deg)	-30.17	7.26	31.57	-30.17	-7.58	7.65	12.85	22.09	31.57			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.67	1.00	0.00	0.33	1.00	1.00	1.00	1.00	2	6	8
Onset1	Mir	Diag(m)	3.44	4.28	5.90	4.21	4.78	5.90	3.44	3.78	4.02			
Onset1	Mir	Angle(deg)	-56.58	-36.04	-14.81	-56.58	-46.45	-37.10	-34.55	-25.64	-14.81			
Ext1	Spacing	Lat(m)	4.27	4.56	4.68	4.27	4.49	4.64	4.53	4.63	4.68			
Ext1	Spacing	Long(m)	-0.53	1.12	2.15	-0.53	0.64	1.57	0.93	1.59	2.15			
Ext1	Corner	Diag(m)	4.30	4.76	5.13	4.30	4.61	4.77	4.70	4.91	5.13			
Ext1	Corner	Angle(deg)	-7.10	13.25	25.07	-7.10	7.70	19.30	11.42	18.81	25.07			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.83	1.00	0.00	0.67	1.00	1.00	1.00	1.00	4	6	10
Ext1	Mir	Diag(m)	4.68	5.00	5.58	4.70	5.14	5.58	4.68	4.86	5.06			
Ext1	Mir	Angle(deg)	-39.88	-22.36	-10.89	-39.88	-27.50	-18.12	-24.57	-17.22	-10.89			
LeftT/S	hz	0	0.00	0.38	1.53	0.00	0.76	1.53	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.53	0.00	0.00	0.00	0.00	0.77	1.53			
LeftBZD1	hz	0	0.00	1.04	4.17	0.00	2.09	4.17	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.04	4.17	0.00	0.00	0.00	0.00	2.09	4.17			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.1 d. BSM Converging-Diverging - Test No. 1 Summary

Test 1 - Converging/Diverging			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences											
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		2943.58	3068.33	2888.92	2090.00	2966.94	4468.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		5282.67	5132.92	4452.67	3811.00	4956.08	6591.00												
Event1	HSpdAvg	(mph)	55.38	55.27	54.89	54.77	55.18	55.48												
Event1	TSpdAvg	(mph)	55.42	55.29	55.08	54.50	55.26	55.82												
Event1	DeltaSpdAvg	(mph)	0.14	-0.41	-0.37	-1.69	-0.21	0.88												
Onset1	Spacing	Lat(m)	2.67	2.94	3.31	2.50	2.97	3.57												
Onset1	Spacing	Long(m)	1.97	0.26	0.47	-1.89	0.90	3.48												
Onset1	Corner	Diag(m)	3.36	3.00	3.52	2.62	3.29	4.36												
Onset1	Corner	Angle(deg)	35.49	4.32	7.26	-30.17	15.69	52.81												
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	1.00	0.58	0.67	0.00	0.75	1.00	6	6	12	1	6	7	2	6	8	3.00	6.00	9.00
Onset1	Mir	Diag(m)	2.91	4.23	4.28	2.55	3.81	5.90												
Onset1	Mir	Angle(deg)	-20.92	-45.27	-36.04	-56.58	-34.08	9.92												
Ext1	Spacing	Lat(m)	3.84	4.80	4.56	3.40	4.40	5.24												
Ext1	Spacing	Long(m)	2.15	0.23	1.12	-1.38	1.17	3.55												
Ext1	Corner	Diag(m)	4.43	4.88	4.76	3.71	4.69	5.34												
Ext1	Corner	Angle(deg)	28.79	2.37	13.25	-15.74	14.80	45.01												
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	1.00	0.58	0.83	0.00	0.81	1.00	6	6	12	4	3	7	4	6	10	4.67	5.00	9.67
Ext1	Mir	Diag(m)	3.96	5.72	5.00	3.56	4.90	6.76												
Ext1	Mir	Angle(deg)	-12.98	-31.99	-22.36	-43.57	-22.44	8.47												
LeftT/S	hz	0	0.70	0.38	0.38	0.00	0.49	2.82												
RightT/S	hz	0	0.70	0.38	0.38	0.00	0.49	2.81												
LeftBZD1	hz	0	0.05	1.00	1.04	0.00	0.70	4.17												
LeftEvent1	numdrop	downs_BZD	0.25	0.00	0.00	0.00	0.08	2.00	2	0	2	0	0	0	0	0	0	0.67	0.00	0.67
RightBZD1	hz	0	0.00	1.00	1.04	0.00	0.68	4.17												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Notes:

1. Onset1 = beginning of first BSM alert. Counts refers to the actual time in the test when the alert initiated; 200 counts = 1 second.
2. Ext1 = the time at which the BSM alert ended or extinguished.
3. Event1 refers to the first BSM detection alert; most tests were only subjected to one event or opportunity to detect an overtaking POV, but Test 2 was subjected to 2 events.
4. HSpdAvg = average speed of the SV as logged with the RT Range system during an event. TSpdAvg is the speed of the POV.
5. Long = Longitudinal spacing in positive if the front of the POV is ahead of the rear bumper plane of the SV.
6. Lat = Lateral Spacing is the distance between the near-side planes of the SV and POV if no overlap is specified (Overlap = 0). When Overlap occurred (Overlap = 1) then the Spacing is the amount of overlap.
7. Corner refers to the diagonal distance and angle from the near-side rear corner of the SV and the near-side front corner of the POV. With overlap, the previous Spacing measurement is smaller than the diagonal Corner measurement.
8. Mir is the ID for the exterior mirrors, whose Diagonal (Diag) distances and Angles are measured to the near-side front corner of the POV. The mirror vantage point is the primary reference used in this report for comparing BSM measurements between vehicles.
9. LeftT/S refers to the left turn signal blinking frequency; RightT/S = right turn signal.
10. LeftBSM1 or RightBSM1 = frequency of the BSM alert signal if it flashed or blinked, rather than was on steadily.
11. LeftEvent1/RightEvent1 = refers to the corresponding left or right BSM alert, here numdrop is the number of dropouts that occurred during a single BSM alert event.

D.2. DYNAMIC LANE TEST 2 - CROSS BEHIND – SUMMARY TABLES

Table D.2 a. Cross Behind Test Results Summary for Volvo BSM

T2		Volvo	For All Tests			For Target on Left			For Target on Right			Occurrences		
Cross Behind			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2893.00	3242.92	4591.00	2893.00	3165.33	3678.00	2897.00	3320.50	4591.00	6	6	12
Ext1	(counts)		4471.00	4926.17	6669.00	4622.00	4805.00	5197.00	4471.00	5047.33	6669.00			
Onset2	(counts)		5508.00	6385.00	7961.00	6149.00	6433.67	6938.00	5508.00	6336.33	7961.00	6	6	12
Ext2	(counts)		7168.00	7913.83	9314.00	7526.00	7832.50	8127.00	7168.00	7995.17	9314.00			
Event1	HSpdAvg	(mph)	55.29	55.42	55.54	55.38	55.49	55.54	55.29	55.36	55.39			
Event1	TSpdAvg	(mph)	54.63	55.17	55.84	54.63	55.12	55.84	54.63	55.22	55.57			
Event1	DeltaSpdAvg	(mph)	-1.52	-0.68	-0.17	-1.52	-0.77	-0.17	-0.71	-0.58	-0.25			
Event2	HSpdAvg	(mph)	55.29	55.38	55.45	55.37	55.41	55.45	55.29	55.36	55.43			
Event2	TSpdAvg	(mph)	54.94	55.47	56.41	54.94	55.44	56.41	54.97	55.50	56.20			
Event2	DeltaSpdAvg	(mph)	-1.53	-0.50	0.35	-1.53	-0.65	0.13	-1.20	-0.36	0.35			
Onset1	Spacing	Lat(m)	2.65	2.86	3.25	2.65	2.73	2.88	2.84	3.00	3.25			
Onset1	Spacing	Long(m)	-4.39	-3.01	-1.62	-4.39	-2.82	-1.62	-3.91	-3.20	-1.80			
Onset1	Corner	Diag(m)	3.31	4.20	5.14	3.31	3.98	5.14	3.54	4.42	4.92			
Onset1	Corner	Angle(deg)	-58.72	-45.35	-29.35	-58.72	-44.67	-29.35	-53.42	-46.03	-30.46			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	5.45	6.68	7.87	5.45	6.45	7.87	5.70	6.91	7.51			
Onset1	Mir	Angle(deg)	-70.45	-64.50	-57.86	-70.45	-64.82	-58.48	-67.48	-64.17	-57.86			
Ext1	Spacing	Lat(m)	0.72	1.05	1.39	0.72	0.91	1.07	1.09	1.19	1.39			
Ext1	Spacing	Long(m)	-5.01	-4.04	-3.35	-5.01	-4.23	-3.41	-4.65	-3.86	-3.35			
Ext1	Corner	Diag(m)	3.49	4.19	5.10	3.49	4.33	5.10	3.62	4.04	4.79			
Ext1	Corner	Angle(deg)	-112.49	-104.85	-100.00	-104.80	-102.26	-100.00	-112.49	-107.43	-103.87			
Ext1	Lateral	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Mir	Diag(m)	6.48	7.15	8.09	6.48	7.31	8.09	6.53	6.99	7.77			
Ext1	Mir	Angle(deg)	-102.49	-98.76	-96.26	-98.81	-97.45	-96.26	-102.49	-100.08	-98.69			
Onset2	Spacing	Lat(m)	0.00	0.51	1.23	0.68	0.97	1.23	0.00	0.05	0.20			
Onset2	Spacing	Long(m)	-4.70	-3.04	-1.93	-4.70	-2.85	-1.93	-4.16	-3.23	-2.46			
Onset2	Corner	Diag(m)	2.28	3.13	4.78	2.28	3.03	4.78	2.47	3.23	4.16			
Onset2	Corner	Angle(deg)	-91.39	-79.65	-57.49	-79.57	-69.76	-57.49	-91.39	-89.55	-85.35			
Onset2	Lateral	Overlap	0.00	0.33	1.00	0.00	0.00	0.00	0.00	0.67	1.00	0	4	4
Onset2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset2	Mir	Diag(m)	5.09	6.10	7.77	5.09	5.95	7.77	5.49	6.26	7.19			
Onset2	Mir	Angle(deg)	-90.92	-85.38	-76.45	-83.87	-80.71	-76.45	-90.92	-90.05	-88.18			
Ext2	Spacing	Lat(m)	4.04	4.81	5.30	4.04	4.41	4.69	5.03	5.21	5.30			
Ext2	Spacing	Long(m)	-4.30	-2.79	-0.75	-3.88	-2.79	-1.53	-4.30	-2.79	-0.75			
Ext2	Corner	Diag(m)	4.58	5.64	6.71	4.58	5.26	6.08	5.35	6.02	6.71			
Ext2	Corner	Angle(deg)	-39.92	-29.44	-8.09	-39.64	-31.55	-19.24	-39.92	-27.33	-8.09			
Ext2	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Mir	Diag(m)	6.30	7.56	8.94	6.30	7.29	8.32	6.49	7.84	8.94			
Ext2	Mir	Angle(deg)	-56.29	-50.12	-35.62	-56.29	-52.66	-46.26	-55.07	-47.59	-35.62			
LeftT/S	hz	0	0.00	0.70	2.81	0.00	1.40	2.81	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.70	2.82	0.00	0.00	0.00	0.00	1.40	2.82			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.08	1.00	0.00	0.17	1.00	0.00	0.00	0.00	1	0	1
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
LeftBZD2	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD2	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.2 b. Cross Behind Test Results Summary for Buick BSM

T2		Buick	For All Tests			For Target on Left			For Target on Right			Occurrences		
Cross Behind			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2829.00	3386.89	4231.00	2829.00	3142.67	3659.00	3197.00	3509.00	4231.00	3	6	9
Ext1	(counts)		4556.00	5008.22	5702.00	4556.00	4922.00	5169.00	4587.00	5051.33	5702.00			
Onset2	(counts)		5849.00	6923.25	7852.00	5849.00	6613.67	7541.00	7852.00	7852.00	7852.00	3	1	4
Ext2	(counts)		7667.00	8375.00	8895.00	7667.00	8295.00	8895.00	8615.00	8615.00	8615.00			
Event1	HSpdAvg	(mph)	54.58	55.01	56.23	54.77	54.89	55.06	54.58	55.13	56.23			
Event1	TSpdAvg	(mph)	54.25	55.08	56.65	54.25	54.89	55.25	54.68	55.28	56.65			
Event1	DeltaSpdAvg	(mph)	-0.92	-0.52	0.20	-0.92	-0.46	0.20	-0.89	-0.57	0.12			
Event2	HSpdAvg	(mph)	54.62	54.94	55.94	54.74	54.87	55.14	54.62	55.02	55.94			
Event2	TSpdAvg	(mph)	54.62	55.16	56.20	54.95	55.15	55.40	54.62	55.17	56.20			
Event2	DeltaSpdAvg	(mph)	-1.07	0.02	0.70	-1.07	-0.18	0.51	-0.50	0.22	0.70			
Onset1	Spacing	Lat(m)	2.11	2.42	2.72	2.11	2.51	2.72	2.16	2.37	2.72			
Onset1	Spacing	Long(m)	-4.56	-3.52	-0.18	-3.98	-2.49	-0.18	-4.56	-4.04	-3.31			
Onset1	Corner	Diag(m)	2.72	4.40	5.10	2.72	3.82	4.81	4.28	4.70	5.10			
Onset1	Corner	Angle(deg)	-63.27	-52.62	-3.74	-57.56	-39.06	-3.74	-63.27	-59.40	-50.56			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	4.38	7.23	8.14	4.38	6.34	7.73	7.10	7.67	8.14			
Onset1	Mir	Angle(deg)	-73.70	-69.56	-51.95	-72.37	-64.68	-51.95	-73.70	-72.01	-67.57			
Ext1	Spacing	Lat(m)	1.07	1.36	1.83	1.23	1.32	1.42	1.07	1.38	1.83			
Ext1	Spacing	Long(m)	-4.40	-3.66	-2.80	-4.28	-3.71	-3.37	-4.40	-3.64	-2.80			
Ext1	Corner	Diag(m)	3.13	3.93	4.55	3.66	3.94	4.45	3.13	3.92	4.55			
Ext1	Corner	Angle(deg)	-119.92	-110.94	-104.65	-112.81	-109.83	-106.10	-119.92	-111.50	-104.65			
Ext1	Lateral	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	6	9
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Mir	Diag(m)	6.21	7.07	7.74	6.80	7.11	7.65	6.21	7.04	7.74			
Ext1	Mir	Angle(deg)	-105.98	-101.37	-98.40	-102.18	-100.89	-99.41	-105.98	-101.61	-98.40			
Onset2	Spacing	Lat(m)	0.29	1.25	2.50	0.29	0.83	1.87	2.50	2.50	2.50			
Onset2	Spacing	Long(m)	-3.85	-3.42	-2.76	-3.85	-3.64	-3.45	-2.76	-2.76	-2.76			
Onset2	Corner	Diag(m)	3.47	3.78	4.28	3.47	3.79	4.28	3.73	3.73	3.73			
Onset2	Corner	Angle(deg)	-95.33	-75.43	-47.79	-95.33	-84.65	-64.06	-47.79	-47.79	-47.79			
Onset2	Lateral	Overlap	0.00	0.50	1.00	0.00	0.67	1.00	0.00	0.00	0.00	2	0	2
Onset2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset2	Mir	Diag(m)	6.51	6.88	7.36	6.73	7.00	7.36	6.51	6.51	6.51			
Onset2	Mir	Angle(deg)	-92.88	-82.07	-67.49	-92.88	-86.94	-75.40	-67.49	-67.49	-67.49			
Ext2	Spacing	Lat(m)	3.71	4.42	4.91	3.71	4.44	4.91	4.36	4.36	4.36			
Ext2	Spacing	Long(m)	-3.21	-2.60	-1.92	-3.21	-2.53	-1.92	-2.81	-2.81	-2.81			
Ext2	Corner	Diag(m)	4.91	5.17	5.31	4.91	5.16	5.31	5.19	5.19	5.19			
Ext2	Corner	Angle(deg)	-40.85	-30.63	-21.31	-40.85	-29.90	-21.31	-32.80	-32.80	-32.80			
Ext2	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Mir	Diag(m)	7.13	7.37	7.47	7.13	7.33	7.47	7.46	7.46	7.46			
Ext2	Mir	Angle(deg)	-60.31	-53.01	-46.67	-60.31	-52.55	-46.67	-54.36	-54.36	-54.36			
LeftT/S	hz	0	0.00	0.38	1.53	0.00	0.76	1.53	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.53	0.00	0.00	0.00	0.00	0.76	1.53			
LeftBZD1	hz	0	0.00	0.45	4.02	0.00	1.34	4.02	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.01	4.09	0.00	0.00	0.00	0.00	2.02	4.09			
RightEvent1	numdrop	downs_BZD	0.00	0.08	1.00	0.00	0.00	0.00	0.00	0.17	1.00	0	1	1
LeftBZD2	hz	0	0.00	0.89	4.01	0.00	2.67	4.01	0.00	0.00	0.00			
LeftEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD2	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.2 c. Cross Behind Test Results Summary for Mercedes BSM

T2		Mercedes	For All Tests			For Target on Left			For Target on Right			Occurrences		
Cross Behind			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2577.00	2866.33	3718.00	2627.00	2893.83	3718.00	2577.00	2838.83	3004.00	6	6	12
Ext1	(counts)		3322.00	4124.75	5438.00	3322.00	4022.33	5438.00	3848.00	4227.17	4547.00			
Onset2	(counts)		5334.00	5916.00	7583.00	5371.00	6021.00	7583.00	5334.00	5811.00	6126.00	6	6	12
Ext2	(counts)		5826.00	6777.08	8286.00	5826.00	6754.67	8286.00	6558.00	6799.50	7291.00			
Event1	HSpdAvg	(mph)	54.76	54.95	55.14	54.76	54.90	55.02	54.93	55.01	55.14			
Event1	TSpdAvg	(mph)	53.80	54.44	54.94	53.80	54.33	54.94	54.12	54.54	54.91			
Event1	DeltaSpdAvg	(mph)	-1.28	-0.70	0.13	-1.28	-0.81	-0.27	-1.13	-0.58	0.13			
Event2	HSpdAvg	(mph)	54.61	54.82	54.95	54.61	54.79	54.87	54.80	54.86	54.95			
Event2	TSpdAvg	(mph)	53.94	54.94	55.84	53.94	54.49	54.87	55.23	55.39	55.84			
Event2	DeltaSpdAvg	(mph)	-1.59	-0.17	1.02	-1.59	-0.59	0.50	-0.30	0.24	1.02			
Onset1	Spacing	Lat(m)	2.63	3.03	3.30	2.63	2.91	3.08	2.76	3.15	3.30			
Onset1	Spacing	Long(m)	-3.77	-2.44	-1.44	-3.77	-2.76	-1.44	-3.06	-2.13	-1.71			
Onset1	Corner	Diag(m)	3.35	3.95	4.60	3.35	4.07	4.60	3.67	3.83	4.12			
Onset1	Corner	Angle(deg)	-55.07	-38.11	-25.39	-55.07	-42.45	-25.39	-47.88	-33.78	-27.79			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	5.39	6.28	7.29	5.39	6.50	7.29	5.75	6.06	6.69			
Onset1	Mir	Angle(deg)	-68.88	-60.72	-55.69	-68.88	-62.95	-55.92	-65.66	-58.49	-55.69			
Ext1	Spacing	Lat(m)	0.22	0.69	1.13	0.26	0.70	1.11	0.22	0.68	1.13			
Ext1	Spacing	Long(m)	-5.01	-3.92	-3.07	-5.01	-4.27	-3.83	-4.11	-3.57	-3.07			
Ext1	Corner	Diag(m)	3.19	3.99	5.03	3.92	4.34	5.03	3.19	3.65	4.12			
Ext1	Corner	Angle(deg)	-109.90	-97.07	-78.06	-105.62	-93.78	-78.06	-109.90	-100.36	-86.95			
Ext1	Lateral	Overlap	0.00	0.75	1.00	0.00	0.67	1.00	0.00	0.83	1.00	4	5	9
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Mir	Diag(m)	6.17	6.99	8.06	6.92	7.34	8.06	6.17	6.65	7.15			
Ext1	Mir	Angle(deg)	-100.44	-93.83	-82.82	-99.05	-92.11	-82.82	-100.44	-95.55	-88.30			
Onset2	Spacing	Lat(m)	0.65	2.01	2.79	2.06	2.44	2.79	0.65	1.58	2.14			
Onset2	Spacing	Long(m)	-3.30	-2.20	-1.33	-2.48	-1.85	-1.33	-3.30	-2.55	-2.20			
Onset2	Corner	Diag(m)	2.45	3.05	3.70	2.45	3.07	3.69	2.57	3.03	3.70			
Onset2	Corner	Angle(deg)	-76.20	-47.71	-30.64	-42.18	-36.92	-30.64	-76.20	-58.49	-50.61			
Onset2	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset2	Mir	Diag(m)	4.82	5.64	6.55	4.82	5.45	6.15	5.40	5.82	6.55			
Onset2	Mir	Angle(deg)	-83.55	-68.94	-59.29	-65.47	-63.55	-59.29	-83.55	-74.33	-69.32			
Ext2	Spacing	Lat(m)	3.46	4.23	4.82	3.46	3.98	4.68	4.30	4.48	4.82			
Ext2	Spacing	Long(m)	-2.87	-1.86	-0.90	-2.87	-2.29	-1.18	-1.86	-1.43	-0.90			
Ext2	Corner	Diag(m)	4.04	4.68	5.06	4.04	4.64	5.06	4.50	4.71	5.06			
Ext2	Corner	Angle(deg)	-37.94	-23.88	-11.49	-37.94	-30.07	-14.11	-23.37	-17.68	-11.49			
Ext2	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext2	Mir	Diag(m)	5.92	6.50	7.02	6.17	6.67	7.02	5.92	6.33	6.65			
Ext2	Mir	Angle(deg)	-58.89	-49.02	-41.67	-58.89	-53.11	-42.00	-48.73	-44.92	-41.67			
LeftT/S	hz	0	0.00	0.38	1.52	0.00	0.76	1.52	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
LeftBZD1	hz	0	0.00	1.04	4.17	0.00	2.09	4.17	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.17	2.00	0.00	0.33	2.00	0.00	0.00	0.00	1	0	1
RightBZD1	hz	0	0.00	1.04	4.17	0.00	0.00	0.00	0.00	2.09	4.17			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
LeftBZD2	hz	0	0.00	1.04	4.18	0.00	2.09	4.18	0.00	0.00	0.00			
LeftEvent2	numdrop	downs_BZD	0.00	0.08	1.00	0.00	0.17	1.00	0.00	0.00	0.00	1	0	1
RightBZD2	hz	0	0.00	1.05	4.21	0.00	0.00	0.00	0.00	2.09	4.21			
RightEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.2 d. BSM Cross Behind - Test No. 2 Summary

Test 2 - Cross Behind			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences											
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		3242.92	3386.89	2866.33	2577.00	3165.38	4591.00	6	6	12	3	6	9	6	6	12	5.00	6.00	11.00
Ext1	(counts)		4926.17	5008.22	4124.75	3322.00	4686.38	6669.00												
Onset2	(counts)		6385.00	6923.25	5916.00	5334.00	6408.08	7961.00	6	6	12	3	1	4	6	6	12	5.00	4.33	9.33
Ext2	(counts)		7913.83	8375.00	6777.08	5826.00	7688.64	9314.00												
Event1	HSpdAvg	(mph)	55.42	55.01	54.95	54.58	55.13	56.23												
Event1	TSpdAvg	(mph)	55.17	55.08	54.44	53.80	54.90	56.65												
Event1	DeltaSpdAvg	(mph)	-0.68	-0.52	-0.70	-1.52	-0.63	0.20												
Event2	HSpdAvg	(mph)	55.38	54.94	54.82	54.61	55.05	55.94												
Event2	TSpdAvg	(mph)	55.47	55.16	54.94	53.94	55.19	56.41												
Event2	DeltaSpdAvg	(mph)	-0.50	0.02	-0.17	-1.59	-0.22	1.02												
Onset1	Spacing	Lat(m)	2.86	2.42	3.03	2.11	2.77	3.30												
Onset1	Spacing	Long(m)	-3.01	-3.52	-2.44	-4.56	-2.99	-0.18												
Onset1	Corner	Diag(m)	4.20	4.40	3.95	2.72	4.18	5.14												
Onset1	Corner	Angle(deg)	-45.35	-52.62	-38.11	-63.27	-45.36	-3.74												
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	6.68	7.23	6.28	4.38	6.73	8.14												
Onset1	Mir	Angle(deg)	-64.50	-69.56	-60.72	-73.70	-64.93	-51.95												
Ext1	Spacing	Lat(m)	1.05	1.36	0.69	0.22	1.03	1.83												
Ext1	Spacing	Long(m)	-4.04	-3.66	-3.92	-5.01	-3.88	-2.80												
Ext1	Corner	Diag(m)	4.19	3.93	3.99	3.13	4.04	5.10												
Ext1	Corner	Angle(deg)	-104.85	-110.94	-97.07	-119.92	-104.29	-78.06												
Ext1	Lateral	Overlap	1.00	1.00	0.75	0.00	0.92	1.00	6	6	12	3	6	9	4	5	9	4.33	5.67	10.00
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Mir	Diag(m)	7.15	7.07	6.99	6.17	7.07	8.09												
Ext1	Mir	Angle(deg)	-98.76	-101.37	-93.83	-105.98	-97.99	-82.82												
Onset2	Spacing	Lat(m)	0.51	1.25	2.01	0.00	1.25	2.79												
Onset2	Spacing	Long(m)	-3.04	-3.42	-2.20	-4.70	-2.89	-1.33												
Onset2	Corner	Diag(m)	3.13	3.78	3.05	2.28	3.32	4.78												
Onset2	Corner	Angle(deg)	-79.65	-75.43	-47.71	-95.33	-67.60	-30.64												
Onset2	Lateral	Overlap	0.33	0.50	0.00	0.00	0.28	1.00	0	4	4	2	0	2	0	0	0	0.67	1.33	2.00
Onset2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset2	Mir	Diag(m)	6.10	6.88	5.64	4.82	6.21	7.77												
Onset2	Mir	Angle(deg)	-85.38	-82.07	-68.94	-92.88	-78.80	-59.29												
Ext2	Spacing	Lat(m)	4.81	4.42	4.23	3.46	4.49	5.30												
Ext2	Spacing	Long(m)	-2.79	-2.60	-1.86	-4.30	-2.42	-0.75												
Ext2	Corner	Diag(m)	5.64	5.17	4.68	4.04	5.16	6.71												
Ext2	Corner	Angle(deg)	-29.44	-30.63	-23.88	-40.85	-27.98	-8.09												
Ext2	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext2	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext2	Mir	Diag(m)	7.56	7.37	6.50	5.92	7.14	8.94												
Ext2	Mir	Angle(deg)	-50.12	-53.01	-49.02	-60.31	-50.72	-35.62												
LeftT/S	hz		0.70	0.38	0.38	0.00	0.49	2.81												
RightT/S	hz		0.70	0.38	0.38	0.00	0.49	2.82												
LeftBZD1	hz		0.00	0.45	1.04	0.00	0.50	4.17												
LeftEvent1	numdrop	downs_BZD	0.08	0.00	0.17	0.00	0.08	2.00	1	0	1	0	0	0	1	0	1	0.67	0.00	0.67
RightBZD1	hz		0.00	1.01	1.04	0.00	0.68	4.17												
RightEvent1	numdrop	downs_BZD	0.00	0.08	0.00	0.00	0.03	1.00	0	0	0	0	1	1	0	0	0	0.00	0.33	0.33
LeftBZD2	hz		0.00	0.89	1.04	0.00	0.64	4.18												
LeftEvent2	numdrop	downs_BZD	0.00	0.00	0.08	0.00	0.03	1.00	0	0	0	0	0	0	1	0	1	0.33	0.00	0.33
RightBZD2	hz		0.00	0.00	1.05	0.00	0.35	4.21												
RightEvent2	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00

Note:

For some tests, the Angle values exceed a magnitude of 90 degrees. This is due to the nearside reference corner of the POV from the Onset 1 measurement becoming the overlapped corner (POV behind SV) at the moment of BSM alert extinction. If overlap occurred during Onset2, this Angle phenomenon repeated. During Overlap, the lateral spacing parameter shows the amount of overlap.

D.3. DYNAMIC LANE TEST 3 - POV MAKES A PASS – SUMMARY TABLES

Table D.3 a. Test 3 – Volvo Summary

T3		Volvo	For All Tests			For Target on Left			For Target on Right			Occurrences		
POV Makes a Pass			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1692.00	2161.58	2606.00	1692.00	2011.50	2314.00	2107.00	2311.67	2606.00	6	6	12
Ext1	(counts)		2623.00	3282.00	4200.00	2623.00	3030.00	3273.00	3121.00	3534.00	4200.00			
Event1	HSpdAvg	(mph)	55.36	55.41	55.47	55.39	55.43	55.47	55.36	55.39	55.42			
Event1	TSpdAvg	(mph)	59.49	61.01	62.88	60.68	61.48	62.88	59.49	60.55	61.37			
Event1	DeltaSpdAvg	(mph)	4.59	5.80	6.76	5.20	5.94	6.76	4.59	5.65	6.50			
Onset1	Spacing	Lat(m)	0.08	0.66	1.34	0.08	0.79	1.34	0.21	0.53	1.29			
Onset1	Spacing	Long(m)	-7.74	-4.68	-2.53	-7.74	-4.66	-2.53	-6.67	-4.69	-3.25			
Onset1	Corner	Diag(m)	2.87	4.75	7.84	2.87	4.78	7.84	3.26	4.73	6.69			
Onset1	Corner	Angle(deg)	-89.35	-80.86	-62.07	-89.35	-77.78	-62.07	-86.33	-83.94	-77.80			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	5.70	7.74	10.83	5.70	7.74	10.83	6.28	7.74	9.71			
Onset1	Mir	Angle(deg)	-89.76	-85.10	-76.76	-89.76	-83.72	-76.76	-88.33	-86.47	-81.99			
Ext1	Spacing	Lat(m)	1.90	2.32	2.86	2.14	2.59	2.86	1.90	2.06	2.24			
Ext1	Spacing	Long(m)	7.87	8.97	9.90	7.87	8.86	9.90	8.62	9.08	9.55			
Ext1	Corner	Diag(m)	8.33	9.28	10.13	8.33	9.25	10.13	8.88	9.31	9.78			
Ext1	Corner	Angle(deg)	70.79	75.36	78.52	70.79	73.52	77.83	75.56	77.20	78.52			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.92	1.00	0.00	0.83	1.00	1.00	1.00	1.00	5	6	11
Ext1	Mir	Diag(m)	5.55	6.39	7.19	5.55	6.40	7.19	5.97	6.39	6.85			
Ext1	Mir	Angle(deg)	60.82	68.65	73.50	60.82	65.94	73.02	68.68	71.37	73.50			
LeftT/S	hz	0	0.00	0.70	2.81	0.00	1.40	2.81	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.70	2.85	0.00	0.00	0.00	0.00	1.40	2.85			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.3 b. Test 3 – Buick Summary

T3		Buick	For All Tests			For Target on Left			For Target on Right			Occurrences		
POV Makes a Pass			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2057.00	2294.00	2879.00	2103.00	2329.67	2879.00	2057.00	2258.33	2556.00	6	6	12
Ext1	(counts)		2819.00	3291.25	3994.00	3126.00	3391.00	3994.00	2819.00	3191.50	3391.00			
Event1	HSpdAvg	(mph)	54.68	55.05	55.92	54.77	55.10	55.92	54.68	55.00	55.17			
Event1	TSpdAvg	(mph)	59.22	60.45	61.99	59.22	60.15	60.80	60.08	60.75	61.99			
Event1	DeltaSpdAvg	(mph)	4.53	5.72	7.42	4.53	5.37	6.35	5.45	6.08	7.42			
Onset1	Spacing	Lat(m)	0.02	0.29	0.83	0.06	0.29	0.50	0.02	0.29	0.83			
Onset1	Spacing	Long(m)	-4.38	-3.63	-1.22	-4.38	-3.93	-3.47	-4.19	-3.34	-1.22			
Onset1	Corner	Diag(m)	1.48	3.67	4.40	3.47	3.94	4.40	1.48	3.39	4.19			
Onset1	Corner	Angle(deg)	-97.31	-87.15	-55.75	-97.31	-92.28	-84.44	-90.26	-82.02	-55.75			
Onset1	Lateral	Overlap	0.00	0.50	1.00	0.00	0.83	1.00	0.00	0.17	1.00	5	1	6
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	4.55	6.91	7.67	6.74	7.21	7.67	4.55	6.61	7.44			
Onset1	Mir	Angle(deg)	-94.11	-89.25	-79.63	-94.11	-91.34	-86.93	-90.24	-87.16	-79.63			
Ext1	Spacing	Lat(m)	1.84	2.21	2.62	2.21	2.37	2.62	1.84	2.05	2.31			
Ext1	Spacing	Long(m)	6.87	8.12	8.60	6.87	7.92	8.51	7.75	8.32	8.60			
Ext1	Corner	Diag(m)	7.23	8.42	8.90	7.23	8.27	8.79	7.97	8.57	8.90			
Ext1	Corner	Angle(deg)	70.73	74.73	77.27	70.73	73.27	75.42	74.99	76.19	77.27			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	4.23	5.34	5.82	4.23	5.22	5.68	4.86	5.46	5.82			
Ext1	Mir	Angle(deg)	58.27	65.49	70.11	58.27	62.85	67.24	66.67	68.12	70.11			
LeftT/S	hz	0	0.00	0.38	1.52	0.00	0.76	1.52	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
LeftBZD1	hz	0	0.00	1.01	4.05	0.00	2.01	4.05	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.00	4.01	0.00	0.00	0.00	0.00	2.00	4.01			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.3 c. Test 3 – Mercedes Summary

T3		Mercedes	For All Tests			For Target on Left			For Target on Right			Occurrences		
POV Makes a Pass			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2070.00	2263.83	2642.00	2132.00	2306.50	2642.00	2070.00	2221.17	2336.00	6	6	12
Ext1	(counts)		2731.00	3014.25	3385.00	2731.00	3032.17	3385.00	2750.00	2996.33	3367.00			
Event1	HSpdAvg	(mph)	54.87	55.01	55.22	54.91	54.97	55.09	54.87	55.05	55.22			
Event1	TSpdAvg	(mph)	59.77	61.35	62.46	60.74	61.32	62.34	59.77	61.37	62.46			
Event1	DeltaSpdAvg	(mph)	5.58	6.34	7.41	5.58	6.33	7.41	5.90	6.35	7.41			
Onset1	Spacing	Lat(m)	0.62	0.88	1.27	0.62	0.80	1.00	0.80	0.95	1.27			
Onset1	Spacing	Long(m)	-3.26	-2.31	-1.61	-2.57	-2.17	-1.61	-3.26	-2.45	-2.11			
Onset1	Corner	Diag(m)	1.84	2.47	3.50	1.84	2.32	2.67	2.27	2.62	3.50			
Onset1	Corner	Angle(deg)	-75.56	-68.96	-61.08	-75.56	-69.06	-61.08	-71.49	-68.87	-66.07			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	4.72	5.41	6.42	4.72	5.26	5.65	5.21	5.56	6.42			
Onset1	Mir	Angle(deg)	-83.59	-80.77	-78.66	-83.59	-81.21	-79.17	-81.67	-80.33	-78.66			
Ext1	Spacing	Lat(m)	1.95	2.46	2.89	2.35	2.66	2.89	1.95	2.27	2.73			
Ext1	Spacing	Long(m)	7.45	8.15	8.65	7.45	8.06	8.46	7.71	8.24	8.65			
Ext1	Corner	Diag(m)	7.94	8.52	8.88	7.94	8.49	8.88	8.18	8.55	8.87			
Ext1	Corner	Angle(deg)	69.71	73.13	77.28	69.71	71.70	74.24	70.49	74.55	77.28			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	5.20	5.69	6.06	5.20	5.69	6.06	5.36	5.68	5.95			
Ext1	Mir	Angle(deg)	58.13	64.25	70.88	58.13	62.10	66.12	59.75	66.40	70.88			
LeftT/S	hz	0	0.00	0.38	1.53	0.00	0.76	1.53	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.53	0.00	0.00	0.00	0.00	0.76	1.53			
LeftBZD1	hz	0	0.00	1.05	4.25	0.00	2.10	4.25	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.04	4.18	0.00	0.00	0.00	0.00	2.09	4.18			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.3 d. BSM POV Makes A Pass - Test No. 3 Summary

Test 3 - POV Makes a Pass			For All Tests			For All Vehicles			Number of Tests with Occurrences												
For All Tests			Volvo	Buick	Mercedes	For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		2161.58	2294.00	2263.83	1692.00	2239.81	2879.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		3282.00	3291.25	3014.25	2623.00	3195.83	4200.00												
Event1	HSpdAvg	(mph)	55.41	55.05	55.01	54.68	55.16	55.92												
Event1	TSpdAvg	(mph)	61.01	60.45	61.35	59.22	60.94	62.88												
Event1	DeltaSpdAvg	(mph)	5.80	5.72	6.34	4.53	5.95	7.42												
Onset1	Spacing	Lat(m)	0.66	0.29	0.88	0.02	0.61	1.34												
Onset1	Spacing	Long(m)	-4.68	-3.63	-2.31	-7.74	-3.54	-1.22												
Onset1	Corner	Diag(m)	4.75	3.67	2.47	1.48	3.63	7.84												
Onset1	Corner	Angle(deg)	-80.86	-87.15	-68.96	-97.31	-78.99	-55.75												
Onset1	Lateral	Overlap	0.00	0.50	0.00	0.00	0.17	1.00	0	0	0	5	1	6	0	0	0	1.67	0.33	2.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	7.74	6.91	5.41	4.55	6.69	10.83												
Onset1	Mir	Angle(deg)	-85.10	-89.25	-80.77	-94.11	-85.04	-76.76												
Ext1	Spacing	Lat(m)	2.32	2.21	2.46	1.84	2.33	2.89												
Ext1	Spacing	Long(m)	8.97	8.12	8.15	6.87	8.41	9.90												
Ext1	Corner	Diag(m)	9.28	8.42	8.52	7.23	8.74	10.13												
Ext1	Corner	Angle(deg)	75.36	74.73	73.13	69.71	74.41	78.52												
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.92	1.00	1.00	0.00	0.97	1.00	5	6	11	6	6	12	6	6	12	5.67	6.00	11.67
Ext1	Mir	Diag(m)	6.39	5.34	5.69	4.23	5.81	7.19												
Ext1	Mir	Angle(deg)	68.65	65.49	64.25	58.13	66.13	73.50												
LeftT/S	hz	0	0.70	0.38	0.38	0.00	0.49	2.81												
RightT/S	hz	0	0.70	0.38	0.38	0.00	0.49	2.85												
LeftBZD1	hz	0	0.00	1.01	1.05	0.00	0.69	4.25												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	1.00	1.04	0.00	0.68	4.18												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00

D.4. DYNAMIC LANE TEST 4 - RUN-UP – SUMMARY TABLES

Table D.4 a. Test 4 – Volvo Summary

T4	Run-Up	Volvo	For All Tests			Occurrences
			Min	Avg	Max	All
Onset1	(counts)		No Alert1	No Alert1	No Alert1	0
Ext1	(counts)		No Alert1	No Alert1	No Alert1	
Event1	HSpdAvg	(mph)	55.44	55.49	55.54	
Event1	TSpdAvg	(mph)	55.45	55.48	55.54	
Event1	DeltaSpdAvg	(mph)	-0.61	-0.37	-0.22	
Onset1	Lateral	Overlap	1.00	1.00	1.00	3
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0
*MinLong1	Spacing	Long(m)	-2.04	-1.62	-1.37	

Note: left and right turn signals were alternately applied during the test

Table D.4 b. Test 4 – Buick Summary

T4	Run-Up	Buick	For All Tests			Occurrences
			Min	Avg	Max	All
Onset1	(counts)		No Alert1	No Alert1	No Alert1	0
Ext1	(counts)		No Alert1	No Alert1	No Alert1	
Event1	HSpdAvg	(mph)	55.16	55.34	55.50	
Event1	TSpdAvg	(mph)	54.88	55.29	55.76	
Event1	DeltaSpdAvg	(mph)	-0.18	-0.09	-0.02	
Onset1	Lateral	Overlap	1.00	1.00	1.00	3
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0
MinLong1	Spacing	Long(m)	-2.93	-2.26	-1.24	

Note: left and right turn signals were alternately applied during the test

Table D.4 c. Test 4 – Mercedes Summary

T4	Run-Up	Mercedes	For All Tests			Occurrences
			Min	Avg	Max	All
Onset1	(counts)		No Alert1	No Alert1	No Alert1	0
Ext1	(counts)		No Alert1	No Alert1	No Alert1	
Event1	HSpdAvg	(mph)	54.93	55.00	55.06	
Event1	TSpdAvg	(mph)	54.79	54.91	54.99	
Event1	DeltaSpdAvg	(mph)	-0.31	-0.12	0.19	
Onset1	Lateral	Overlap	1.00	1.00	1.00	3
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0
*MinLong1	Spacing	Long(m)	-3.04	-2.64	-2.13	

Note: left and right turn signals were alternately applied during the test

Table D.4 d. BSM Run-Up - Test No. 4 Summary

Test 4 - Run-Up			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences			
For All Tests						For All Tests			Volvo	Buick	Mercedes	Avg.
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	All	All	All	All Vehicles
Onset1	(counts)		No Alert1	No Alert1	No Alert1	No Alert1	No Alert1	No Alert1	0	0	0	0
Ext1	(counts)		No Alert1	No Alert1	No Alert1	No Alert1	No Alert1	No Alert1				
Event1	HSpdAvg	(mph)	55.49	55.34	55.00	54.93	55.28	55.54				
Event1	TSpdAvg	(mph)	55.48	55.29	54.91	54.79	55.23	55.76				
Event1	DeltaSpdAvg	(mph)	-0.37	-0.09	-0.12	-0.61	-0.20	0.19				
Onset1	Lateral	Overlap	1	1	1	1.00	1	1.00	3	3	3	3
Onset1	Longitudinal	Overlap	0	0	0	0.00	0	0.00	0	0	0	0

D.5. DYNAMIC LANE TEST 5 - SV BRAKES – SUMMARY TABLES

Table D.5 a. Test 5 – Volvo Summary

T5		Volvo	For All Tests			For Target on Left			For Target on Right			Occurrences		
SV Brakes			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1942.00	2298.17	2710.00	1942.00	2248.50	2523.00	2114.00	2347.83	2710.00	6	6	12
Ext1	(counts)		2563.00	2804.42	3149.00	2563.00	2799.33	3039.00	2611.00	2809.50	3149.00			
Event1	HSpdAvg	(mph)	31.24	33.62	36.21	31.27	34.20	36.21	31.24	33.03	34.15			
Event1	TSpdAvg	(mph)	54.66	55.59	56.30	55.18	55.80	56.30	54.66	55.39	55.63			
Event1	DeltaSpdAvg	(mph)	26.85	27.93	29.45	26.93	28.03	29.45	26.85	27.84	28.77			
Onset1	Spacing	Lat(m)	2.20	2.51	2.83	2.30	2.64	2.83	2.20	2.38	2.53			
Onset1	Spacing	Long(m)	-13.47	-9.27	-6.45	-13.47	-10.85	-8.30	-8.86	-7.69	-6.45			
Onset1	Corner	Diag(m)	6.82	9.61	13.76	8.76	11.17	13.76	6.82	8.05	9.18			
Onset1	Corner	Angle(deg)	-78.14	-74.39	-71.14	-78.14	-76.08	-71.28	-74.83	-72.70	-71.14			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	9.72	12.54	16.72	11.65	14.12	16.72	9.72	10.97	12.12			
Onset1	Mir	Angle(deg)	-80.38	-78.41	-76.22	-80.38	-79.25	-76.22	-78.70	-77.58	-76.55			
Ext1	Spacing	Lat(m)	2.10	2.43	2.78	2.16	2.54	2.78	2.10	2.31	2.52			
Ext1	Spacing	Long(m)	13.47	15.38	16.24	13.47	15.46	16.24	15.00	15.31	15.71			
Ext1	Corner	Diag(m)	13.76	15.58	16.47	13.76	15.67	16.47	15.20	15.48	15.85			
Ext1	Corner	Angle(deg)	78.34	81.01	82.38	78.34	80.60	82.11	80.48	81.42	82.38			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Mir	Diag(m)	10.81	12.59	13.49	10.81	12.69	13.49	12.21	12.49	12.85			
Ext1	Mir	Angle(deg)	75.28	78.98	80.71	75.28	78.51	80.40	78.25	79.46	80.71			
LeftT/S	hz	0	0.00	0.70	2.81	0.00	1.40	2.81	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.70	2.84	0.00	0.00	0.00	0.00	1.41	2.84			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.5 b. Test 5 – Buick Summary

T5		Buick	For All Tests			For Target on Left			For Target on Right			Occurrences		
SV Brakes			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1805.00	2308.00	2517.00	2123.00	2334.50	2448.00	1805.00	2281.50	2517.00	6	6	12
Ext1	(counts)		2144.00	2575.42	2721.00	2434.00	2603.83	2721.00	2144.00	2547.00	2716.00			
Event1	HSpdAvg	(mph)	26.93	33.64	37.60	30.21	33.49	37.60	26.93	33.79	37.53			
Event1	TSpdAvg	(mph)	54.26	55.69	57.43	54.26	55.74	57.43	54.90	55.64	56.33			
Event1	DeltaSpdAvg	(mph)	21.22	25.16	30.37	22.69	25.37	28.90	21.22	24.94	30.37			
Onset1	Spacing	Lat(m)	2.12	2.55	3.09	2.12	2.38	2.56	2.48	2.72	3.09			
Onset1	Spacing	Long(m)	-2.82	-1.94	-0.77	-2.62	-2.30	-2.06	-2.82	-1.58	-0.77			
Onset1	Corner	Diag(m)	2.76	3.27	3.83	3.15	3.31	3.51	2.76	3.22	3.83			
Onset1	Corner	Angle(deg)	-51.02	-36.48	-14.07	-51.02	-43.97	-38.80	-47.50	-28.99	-14.07			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	4.82	5.81	6.60	5.91	6.05	6.26	4.82	5.56	6.60			
Onset1	Mir	Angle(deg)	-70.34	-63.62	-52.60	-70.34	-66.99	-64.49	-67.05	-60.26	-52.60			
Ext1	Spacing	Lat(m)	2.10	2.51	3.00	2.10	2.40	2.73	2.24	2.62	3.00			
Ext1	Spacing	Long(m)	9.64	11.04	13.04	9.64	10.99	11.73	10.32	11.09	13.04			
Ext1	Corner	Diag(m)	10.01	11.32	13.38	10.01	11.25	11.93	10.62	11.40	13.38			
Ext1	Corner	Angle(deg)	74.21	77.13	79.84	74.21	77.57	79.84	74.92	76.68	78.49			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.08	1.00	0.00	0.17	1.00	0.00	0.00	0.00	1	0	1
Ext1	Mir	Diag(m)	6.91	8.17	10.23	6.91	8.08	8.73	7.50	8.26	10.23			
Ext1	Mir	Angle(deg)	66.94	72.05	76.15	66.94	72.60	76.15	69.20	71.50	73.96			
LeftT/S	hz	0	0.00	0.38	1.52	0.00	0.76	1.52	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
LeftBZD1	hz	0	0.00	1.01	4.03	0.00	2.01	4.03	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.01	4.04	0.00	0.00	0.00	0.00	2.02	4.04			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.5 c. Test 5 – Mercedes Summary

T5		Mercedes	For All Tests			For Target on Left			For Target on Right			Occurrences		
SV Brakes			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2008.00	2467.42	2685.00	2334.00	2501.67	2685.00	2008.00	2433.17	2647.00	6	6	12
Ext1	(counts)		2383.00	2805.75	3092.00	2597.00	2831.33	3092.00	2383.00	2780.17	3041.00			
Event1	HSpdAvg	(mph)	26.81	31.66	41.31	26.81	30.67	32.33	28.98	32.65	41.31			
Event1	TSpdAvg	(mph)	54.66	55.86	58.39	54.66	55.45	56.64	55.14	56.27	58.39			
Event1	DeltaSpdAvg	(mph)	21.35	28.20	32.87	25.70	28.66	32.87	21.35	27.73	30.89			
Onset1	Spacing	Lat(m)	2.33	2.67	3.06	2.33	2.57	2.94	2.53	2.78	3.06			
Onset1	Spacing	Long(m)	-4.37	-2.73	-0.56	-3.59	-2.89	-2.28	-4.37	-2.56	-0.56			
Onset1	Corner	Diag(m)	2.88	3.89	5.25	3.31	3.89	4.28	2.88	3.89	5.25			
Onset1	Corner	Angle(deg)	-57.03	-43.81	-11.23	-57.03	-47.86	-37.89	-56.32	-39.76	-11.23			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	4.57	6.36	7.95	5.86	6.46	7.02	4.57	6.27	7.95			
Onset1	Mir	Angle(deg)	-70.67	-64.61	-51.92	-70.67	-66.43	-61.14	-68.58	-62.79	-51.92			
Ext1	Spacing	Lat(m)	2.33	2.68	2.93	2.33	2.61	2.86	2.57	2.76	2.93			
Ext1	Spacing	Long(m)	10.51	15.56	22.30	10.66	15.49	22.30	10.51	15.63	21.00			
Ext1	Corner	Diag(m)	10.89	15.82	22.48	10.99	15.74	22.48	10.89	15.91	21.16			
Ext1	Corner	Angle(deg)	74.86	79.17	83.39	75.57	79.49	83.39	74.86	78.85	82.96			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Mir	Diag(m)	8.00	12.87	19.47	8.08	12.78	19.47	8.00	12.95	18.15			
Ext1	Mir	Angle(deg)	69.21	75.96	82.25	70.56	76.40	82.25	69.21	75.53	81.81			
LeftT/S	hz	0	0.00	0.38	1.54	0.00	0.76	1.54	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.25	1.53	0.00	0.00	0.00	0.00	0.51	1.53			
LeftBZD1	hz	0	0.00	1.05	4.18	0.00	2.09	4.18	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.70	4.18	0.00	0.00	0.00	0.00	1.39	4.18			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.5 d. BSM "SV Brakes" Maneuver - Test No. 5 Summary

Test 5 - SV Brakes			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences											
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		2298.17	2308.00	2467.42	1805.00	2357.86	2710.00	6	6	12	6	6	12	6	6	12	6.00	6.00	12.00
Ext1	(counts)		2804.42	2575.42	2805.75	2144.00	2728.53	3149.00												
Event1	HSpdAvg	(mph)	33.62	33.64	31.66	26.81	32.97	41.31												
Event1	TSpdAvg	(mph)	55.59	55.69	55.86	54.26	55.71	58.39												
Event1	DeltaSpdAvg	(mph)	27.93	25.16	28.20	21.22	27.10	32.87												
Onset1	Spacing	Lat(m)	2.51	2.55	2.67	2.12	2.58	3.09												
Onset1	Spacing	Long(m)	-9.27	-1.94	-2.73	-13.47	-4.64	-0.56												
Onset1	Corner	Diag(m)	9.61	3.27	3.89	2.76	5.59	13.76												
Onset1	Corner	Angle(deg)	-74.39	-36.48	-43.81	-78.14	-51.56	-11.23												
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	12.54	5.81	6.36	4.57	8.24	16.72												
Onset1	Mir	Angle(deg)	-78.41	-63.62	-64.61	-80.38	-68.88	-51.92												
Ext1	Spacing	Lat(m)	2.43	2.51	2.68	2.10	2.54	3.00												
Ext1	Spacing	Long(m)	15.38	11.04	15.56	9.64	13.99	22.30												
Ext1	Corner	Diag(m)	15.58	11.32	15.82	10.01	14.24	22.48												
Ext1	Corner	Angle(deg)	81.01	77.13	79.17	74.21	79.10	83.39												
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	0.00	0.08	0.00	0.00	0.03	1.00	0	0	0	1	0	1	0	0	0	1.00	0.00	0.33
Ext1	Mir	Diag(m)	12.59	8.17	12.87	6.91	11.21	19.47												
Ext1	Mir	Angle(deg)	78.98	72.05	75.96	66.94	75.66	82.25												
LeftT/S	hz	0	0.70	0.38	0.38	0.00	0.49	2.81												
RightT/S	hz	0	0.70	0.38	0.25	0.00	0.45	2.84												
LeftBZD1	hz	0	0.00	1.01	1.05	0.00	0.68	4.18												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0	0.00	1.01	0.70	0.00	0.57	4.18												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00

D.6. DYNAMIC LANE TEST 6 – POV AND SOV PASS BY – SUMMARY TABLES

Table D.6 a. Test 6 – Volvo Summary

T6		Volvo	For All Tests			For Target on Left			For Target on Right			Occurrences		
Multiple POVs			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		2240.00	2800.50	3759.00	2895.00	3079.33	3759.00	2240.00	2521.67	2695.00	6.00	6.00	12.00
Ext1	(counts)		4043.00	4427.50	5335.00	4414.00	4638.33	5335.00	4043.00	4216.67	4493.00			
Event1	HSpdAvg	(mph)	55.30	55.39	55.48	55.30	55.36	55.44	55.35	55.41	55.48			
Event1	TSpdAvg	(mph)	~60	~60	~60	~60	~60	~60	~60	~60	~60			
Event1	DeltaSpdAvg	(mph)	~5	~5	~5	~5	~5	~5	~5	~5	~5			
Onset1	Spacing	Lat(m)	Ranging Data not available due to GPS malfunction in POV			Ranging Data not available due to GPS malfunction in POV			Ranging Data not available due to GPS malfunction in POV			Ranging Data not available due to GPS malfunction in POV		
Onset1	Spacing	Long(m)												
Onset1	Corner	Diag(m)												
Onset1	Corner	Angle(deg)												
Onset1	Lateral	Overlap												
Onset1	Longitudinal	Overlap												
Onset1	Mir	Diag(m)												
Onset1	Mir	Angle(deg)												
Ext1	Spacing	Lat(m)												
Ext1	Spacing	Long(m)												
Ext1	Corner	Diag(m)												
Ext1	Corner	Angle(deg)												
Ext1	Lateral	Overlap												
Ext1	Longitudinal	Overlap												
Ext1	Mir	Diag(m)												
Ext1	Mir	Angle(deg)												
LeftT/S	hz	0.00	0.00	0.70	2.81	0.00	1.40	2.81	0.00	0.00	0.00			
RightT/S	hz	0.00	0.00	0.70	2.82	0.00	0.00	0.00	0.00	1.40	2.82			
LeftBZD1	hz	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RightBZD1	hz	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table D.6 b. Test 6 – Buick Summary

T6		Buick	For All Tests			For Target on Left			For Target on Right			Occurences		
Multiple POVs			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1950.00	2072.67	2347.00	2046.00	2137.20	2347.00	1950.00	1992.00	2014.00	5	4	9
Ext1	(counts)		2935.00	3100.11	3420.00	3011.00	3207.40	3420.00	2935.00	2966.00	2984.00			
Event1	HSpdAvg	(mph)	54.83	55.16	55.43	54.83	55.07	55.30	55.04	55.27	55.43			
Event1	TSpdAvg	(mph)	59.30	60.52	61.36	59.30	60.26	60.84	60.38	60.84	61.36			
Event1	DeltaSpdAvg	(mph)	3.90	5.21	5.72	3.90	5.13	5.59	4.86	5.32	5.72			
Onset1	Spacing	Lat(m)	2.26	2.46	2.63	2.26	2.45	2.63	2.40	2.48	2.45			
Onset1	Spacing	Long(m)	-4.07	-3.86	-3.65	-4.07	-3.90	-3.76	-3.96	-3.82	-3.65			
Onset1	Corner	Diag(m)	4.37	4.58	4.80	4.49	4.61	4.80	4.37	4.55	4.53			
Onset1	Corner	Angle(deg)	-59.80	-57.46	-55.05	-59.80	-57.86	-55.05	-57.57	-56.95	-56.66			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	7.31	7.54	7.77	7.50	7.57	7.77	7.31	7.49	7.47			
Onset1	Mir	Angle(deg)	-72.59	-71.03	-69.63	-72.59	-71.26	-69.63	-70.95	-70.75	-70.91			
Ext1	Spacing	Lat(m)	2.28	2.52	2.74	2.28	2.49	2.74	2.29	2.55	2.69			
Ext1	Spacing	Long(m)	8.04	8.31	8.63	8.13	8.37	8.63	8.04	8.23	8.55			
Ext1	Corner	Diag(m)	8.43	8.68	9.00	8.45	8.74	9.00	8.43	8.62	8.97			
Ext1	Corner	Angle(deg)	71.68	73.16	74.38	71.68	73.45	74.33	71.90	72.80	74.38			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5	4	9
Ext1	Mir	Diag(m)	5.36	5.63	5.94	5.36	5.67	5.92	5.42	5.59	5.94			
Ext1	Mir	Angle(deg)	61.46	63.64	65.21	61.46	64.15	65.02	61.54	63.00	65.21			
LeftT/S	hz	0	0.00	0.51	1.54	0.00	0.92	1.54	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.51	1.52	0.00	0.00	0.00	0.00	1.14	1.52			
LeftBZD1	hz	0	0.00	1.34	4.04	0.00	2.41	4.04	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	1.34	4.06	0.00	0.00	0.00	0.00	3.02	4.01			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.6 c. Test 6 – Mercedes Summary

T6		Mercedes	For All Tests			For Target on Left			For Target on Right			Occurrences		
Multiple POVs			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LTS	RTS	All
Onset1	(counts)		1811.00	2083.50	2288.00	1912.00	2101.00	2288.00	1811.00	2066.00	2268.00	6	6	12
Ext1	(counts)		2812.00	3072.00	3348.00	2812.00	3072.17	3319.00	2832.00	3071.83	3348.00			
Event1	HSpdAvg	(mph)	54.79	54.98	55.14	54.96	55.06	55.14	54.79	54.91	55.00			
Event1	TSpdAvg	(mph)	60.04	60.78	62.13	60.33	60.97	62.13	60.04	60.58	61.55			
Event1	DeltaSpdAvg	(mph)	4.43	5.60	7.34	5.29	5.70	7.34	4.43	5.50	6.72			
Onset1	Spacing	Lat(m)	2.16	2.59	3.11	2.16	2.37	2.54	2.55	2.81	3.11			
Onset1	Spacing	Long(m)	-5.76	-4.65	-3.83	-5.14	-4.57	-3.83	-5.76	-4.73	-4.02			
Onset1	Corner	Diag(m)	4.51	5.34	6.30	4.51	5.16	5.66	4.91	5.52	6.30			
Onset1	Corner	Angle(deg)	-66.09	-60.71	-55.05	-65.18	-62.43	-58.13	-66.09	-58.99	-55.05			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	7.26	8.11	9.16	7.26	7.96	8.50	7.60	8.26	9.16			
Onset1	Mir	Angle(deg)	-74.22	-71.36	-68.33	-74.22	-72.67	-70.91	-73.85	-70.06	-68.33			
Ext1	Spacing	Lat(m)	2.32	2.70	2.91	2.32	2.58	2.76	2.78	2.82	2.91			
Ext1	Spacing	Long(m)	7.67	8.00	8.35	7.78	8.09	8.35	7.67	7.91	8.17			
Ext1	Corner	Diag(m)	8.17	8.45	8.67	8.25	8.50	8.67	8.17	8.40	8.67			
Ext1	Corner	Angle(deg)	69.96	71.35	74.47	70.44	72.31	74.47	69.96	70.39	71.14			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	5.41	5.66	5.90	5.49	5.68	5.82	5.41	5.63	5.90			
Ext1	Mir	Angle(deg)	58.95	61.52	66.51	59.86	63.04	66.51	58.95	60.01	61.46			
LeftT/S	hz	0	0.00	0.38	1.53	0.00	0.76	1.53	0.00	0.00	0.00			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
LeftBZD1	hz	0	0.00	1.05	4.21	0.00	2.09	4.21	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.08	1.00	0.00	0.00	0.00	0.00	0.17	1.00	0	1	1
RightBZD1	hz	0	0.00	1.04	4.17	0.00	0.00	0.00	0.00	2.09	4.17			
RightEvent1	numdrop	downs_BZD	0.00	0.25	1.00	0.00	0.33	1.00	0.00	0.17	1.00	2	1	3

Table D.6 d. BSM "POV and SOV Pass by" - Test No. 6 Summary

Test 6 - Mulitple Targets			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		2800.50	2072.67	2083.50	1811.00	2318.89	3759.00	6	6	12	5	4	9	6	6	12	5.67	5.33	11.00
Ext1	(counts)		4427.50	3100.11	3072.00	2812.00	3533.20	5335.00												
Event1	HSpdAvg	(mph)	55.39	55.16	54.98	54.79	55.18	55.48												
Event1	TSpdAvg	(mph)	~60	60.52	60.78	59.30	60.65	62.13												
Event1	DeltaSpdAvg	(mph)	~5	5.21	5.60	3.90	5.41	7.34												
Onset1	Spacing	Lat(m)		2.46	2.59	2.16	2.53	3.11												
Onset1	Spacing	Long(m)		-3.86	-4.65	-5.76	-4.26	-3.65												
Onset1	Corner	Diag(m)		4.58	5.34	4.37	4.96	6.30												
Onset1	Corner	Angle(deg)		-57.46	-60.71	-66.09	-59.08	-55.05												
Onset1	Lateral	Overlap		0.00	0.00	0.00	0.00	0.00				0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	Ranging Data not available due to RT-GPS malfunction in POV	0.00	0.00	0.00	0.00	0.00	Ranging Data not available due to RT-GPS malfunction in POV			0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)		7.54	8.11	7.26	7.83	9.16												
Onset1	Mir	Angle(deg)		-71.03	-71.36	-74.22	-71.20	-68.33												
Ext1	Spacing	Lat(m)		2.52	2.70	2.28	2.61	2.91												
Ext1	Spacing	Long(m)		8.31	8.00	7.67	8.16	8.63												
Ext1	Corner	Diag(m)		8.68	8.45	8.17	8.57	9.00												
Ext1	Corner	Angle(deg)		73.16	71.35	69.96	72.26	74.47												
Ext1	Lateral	Overlap		0.00	0.00	0.00	0.00	0.00				0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap		1.00	1.00	1.00	1.00	1.00				5	4	9	6	6	12	5.50	5.00	10.50
Ext1	Mir	Diag(m)		5.63	5.66	5.36	5.64	5.94												
Ext1	Mir	Angle(deg)		63.64	61.52	58.95	62.58	66.51												
LeftT/S	hz	0	0.70	0.51	0.38	0.00	0.53	2.81												
RightT/S	hz	0	0.70	0.51	0.38	0.00	0.53	2.82												
LeftBZD1	hz	0	0.00	1.34	1.05	0.00	0.80	4.21												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.08	0.00	0.03	1.00	0	0	0	0	0	0	0	1	1	0.00	0.33	0.33
RightBZD1	hz	0	0.00	1.34	1.04	0.00	0.80	4.17												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.25	0.00	0.08	1.00	0	0	0	0	0	0	2	1	3	0.67	0.33	1.00

Mercedes Notes:

1. LTS = Left Side BSM Test; RTS = Right Side BSM Test; L-T/S = Left Turn Signal; R-T/S = Right Turn Signal
2. POV = instrumented Primary Other Vehicle; AV = non-instrumented Auxiliary Vehicle
3. For LST, 0 L-BSM dropouts;
4. For RST, 1 L-BSM dropout; AV side, R-T/S
5. For LST, 2 R-BSM dropouts; AV side, L-T/S
6. For RST, 1 R-BSM dropout; POV side, no T/S

D.7. DYNAMIC LANE TEST 7 - OPPOSITE TURN SIGNAL – SUMMARY TABLES

Table D.7 a. Test 7 – Volvo Summary

T7		Volvo	For All Tests			For Target on Left			For Target on Right			Occurrences		
Opposite T/S			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1455.00	2059.92	2632.00	1455.00	2101.83	2632.00	1560.00	2018.00	2534.00	6	6	12
Ext1	(counts)		2872.00	3412.75	3912.00	2932.00	3434.50	3912.00	2872.00	3391.00	3903.00			
Event1	HSpdAvg	(mph)	55.38	55.42	55.49	55.40	55.44	55.49	55.38	55.40	55.42			
Event1	TSpdAvg	(mph)	60.76	60.82	60.92	60.78	60.81	60.83	60.76	60.83	60.92			
Event1	DeltaSpdAvg	(mph)	5.21	5.31	5.41	5.21	5.30	5.39	5.22	5.33	5.41			
Onset1	Spacing	Lat(m)	1.74	2.02	2.41	1.85	2.17	2.41	1.74	1.87	2.08			
Onset1	Spacing	Long(m)	-9.01	-7.52	-6.37	-9.01	-7.26	-6.37	-8.47	-7.77	-7.20			
Onset1	Corner	Diag(m)	6.67	7.79	9.28	6.67	7.58	9.28	7.44	8.00	8.64			
Onset1	Corner	Angle(deg)	-78.40	-74.83	-71.12	-75.92	-73.26	-71.12	-78.40	-76.41	-75.32			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	9.59	10.73	12.23	9.59	10.50	12.23	10.39	10.96	11.62			
Onset1	Mir	Angle(deg)	-81.53	-79.26	-76.85	-79.64	-78.24	-76.85	-81.53	-80.27	-79.69			
Ext1	Spacing	Lat(m)	1.69	2.13	2.49	2.08	2.35	2.49	1.69	1.92	2.09			
Ext1	Spacing	Long(m)	8.50	8.83	9.08	8.50	8.73	9.08	8.78	8.93	9.02			
Ext1	Corner	Diag(m)	8.86	9.08	9.31	8.86	9.04	9.31	8.97	9.13	9.22			
Ext1	Corner	Angle(deg)	73.69	76.39	79.36	73.69	74.91	77.12	76.86	77.86	79.36			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	6.01	6.18	6.39	6.01	6.16	6.39	6.04	6.20	6.28			
Ext1	Mir	Angle(deg)	65.91	70.05	74.43	65.91	67.89	71.38	70.80	72.20	74.43			
LeftT/S	hz	0	0.00	0.70	2.82	0.00	0.00	0.00	0.00	1.40	2.82			
RightT/S	hz	0	0.00	0.70	2.82	0.00	1.41	2.82	0.00	0.00	0.00			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.7 b. Test 7 – Buick Summary

T7		Buick	For All Tests			For Target on Left			For Target on Right			Occurrences		
Opposite T/S			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LST	RST	All
Onset1	(counts)		1914.00	2174.60	2688.00	2087.00	2337.33	2688.00	1914.00	1930.50	1947.00	3	2	5
Ext1	(counts)		2750.00	3137.40	3709.00	3022.00	3350.00	3709.00	2750.00	2818.50	2887.00			
Event1	HSpdAvg	(mph)	54.67	54.77	54.92	54.78	54.84	54.92	54.67	54.67	54.67			
Event1	TSpdAvg	(mph)	59.94	60.55	61.25	59.94	60.31	60.82	60.56	60.91	61.25			
Event1	DeltaSpdAvg	(mph)	5.12	5.84	6.30	5.12	5.79	6.30	5.79	5.91	6.03			
Onset1	Spacing	Lat(m)	2.08	2.31	2.50	2.08	2.21	2.32	2.40	2.45	2.50			
Onset1	Spacing	Long(m)	-3.95	-3.83	-3.74	-3.95	-3.86	-3.76	-3.85	-3.79	-3.74			
Onset1	Corner	Diag(m)	4.37	4.48	4.58	4.37	4.45	4.58	4.44	4.51	4.58			
Onset1	Corner	Angle(deg)	-61.68	-58.96	-57.02	-61.68	-60.17	-59.27	-57.30	-57.16	-57.02			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	7.37	7.46	7.58	7.37	7.46	7.58	7.39	7.46	7.52			
Onset1	Mir	Angle(deg)	-73.86	-72.10	-70.72	-73.86	-72.88	-72.29	-71.15	-70.93	-70.72			
Ext1	Spacing	Lat(m)	2.30	2.54	2.79	2.30	2.47	2.61	2.49	2.64	2.79			
Ext1	Spacing	Long(m)	8.43	8.48	8.56	8.43	8.46	8.52	8.45	8.50	8.56			
Ext1	Corner	Diag(m)	8.73	8.85	8.92	8.73	8.82	8.91	8.89	8.91	8.92			
Ext1	Corner	Angle(deg)	71.72	73.35	74.76	72.98	73.75	74.76	71.72	72.76	73.80			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	3	2	5
Ext1	Mir	Diag(m)	5.64	5.79	5.89	5.64	5.74	5.85	5.86	5.87	5.89			
Ext1	Mir	Angle(deg)	61.85	64.21	66.14	63.72	64.73	66.14	61.85	63.42	64.99			
LeftT/S	hz	0	0.00	0.61	1.52	0.00	0.00	0.00	1.52	1.52	1.52			
RightT/S	hz	0	0.00	0.92	1.55	1.52	1.54	1.55	0.00	0.00	0.00			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0

Table D.7 c. Test 7 – Mercedes Summary

T7		Mercedes	For All Tests			For Target on Left			For Target on Right			Occurrences		
Opposite T/S			Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	LTS	RTS	All
Onset1	(counts)		1625.00	1958.08	2524.00	1625.00	1894.50	2157.00	1649.00	2021.67	2524.00	6	6	12
Ext1	(counts)		2504.00	2951.08	3739.00	2592.00	2900.17	3196.00	2504.00	3002.00	3739.00			
Event1	HSpdAvg	(mph)	54.74	55.00	55.19	54.74	54.89	54.96	55.00	55.10	55.19			
Event1	TSpdAvg	(mph)	60.10	60.91	62.21	60.31	60.56	60.98	60.10	61.25	62.21			
Event1	DeltaSpdAvg	(mph)	4.82	5.75	6.52	4.87	5.53	6.10	4.82	5.97	6.52			
Onset1	Spacing	Lat(m)	2.32	2.54	2.89	2.34	2.48	2.59	2.32	2.61	2.89			
Onset1	Spacing	Long(m)	-5.67	-4.96	-4.20	-5.30	-4.78	-4.43	-5.67	-5.13	-4.20			
Onset1	Corner	Diag(m)	5.07	5.58	6.21	5.07	5.39	5.85	5.10	5.77	6.21			
Onset1	Corner	Angle(deg)	-66.96	-62.67	-55.50	-65.34	-62.55	-60.79	-66.96	-62.79	-55.50			
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Onset1	Mir	Diag(m)	7.79	8.39	9.06	7.86	8.19	8.69	7.79	8.58	9.06			
Onset1	Mir	Angle(deg)	-74.75	-72.33	-68.30	-73.98	-72.44	-71.68	-74.75	-72.22	-68.30			
Ext1	Spacing	Lat(m)	2.20	2.55	2.79	2.20	2.51	2.67	2.40	2.59	2.79			
Ext1	Spacing	Long(m)	7.62	8.04	8.36	7.62	7.94	8.27	7.88	8.13	8.36			
Ext1	Corner	Diag(m)	8.04	8.43	8.69	8.04	8.33	8.56	8.31	8.54	8.69			
Ext1	Corner	Angle(deg)	70.93	72.38	75.13	71.24	72.44	75.13	70.93	72.31	73.99			
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12
Ext1	Mir	Diag(m)	5.26	5.62	5.83	5.26	5.52	5.68	5.52	5.72	5.83			
Ext1	Mir	Angle(deg)	60.64	63.02	67.33	60.64	62.95	67.33	61.05	63.09	65.81			
LeftT/S	hz	0	0.00	0.38	1.52	0.00	0.00	0.00	0.00	0.76	1.52			
RightT/S	hz	0	0.00	0.38	1.52	0.00	0.76	1.52	0.00	0.00	0.00			
LeftBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0
RightBZD1	hz	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
RightEvent1	numdrop	downs_BZD	0.00	0.08	1.00	0.00	0.00	0.00	0.00	0.17	1.00	0	1	1

Table D.7 d. BSM "Opposite Turn Signal" Maneuver - Test No. 7 Summary

Test 7 - Opposite T/S			Volvo	Buick	Mercedes	For All Vehicles			Number of Tests with Occurrences												
For All Tests			For All Tests			For All Tests			Volvo			Buick			Mercedes			Avg. All Tests		
Data Channel Headers			Avg	Avg	Avg	Min	Avg	Max	LST	RST	All	LST	RST	All	LST	RST	All	LST	RST	All
Onset1	(counts)		2059.92	2174.60	1958.08	1455.00	2064.20	2688.00	6	6	12	3	2	5	6	6	12	5.00	4.67	9.67
Ext1	(counts)		3412.75	3137.40	2951.08	2504.00	3167.08	3912.00												
Event1	HSpdAvg	(mph)	55.42	54.77	55.00	54.67	55.06	55.49												
Event1	TSpdAvg	(mph)	60.82	60.55	60.91	59.94	60.76	62.21												
Event1	DeltaSpdAvg	(mph)	5.31	5.84	5.75	4.82	5.63	6.52												
Onset1	Spacing	Lat(m)	2.02	2.31	2.54	1.74	2.29	2.89												
Onset1	Spacing	Long(m)	-7.52	-3.83	-4.96	-9.01	-5.44	-3.74												
Onset1	Corner	Diag(m)	7.79	4.48	5.58	4.37	5.95	9.28												
Onset1	Corner	Angle(deg)	-74.83	-58.96	-62.67	-78.40	-65.49	-55.50												
Onset1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Longitudinal	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Onset1	Mir	Diag(m)	10.73	7.46	8.39	7.37	8.86	12.23												
Onset1	Mir	Angle(deg)	-79.26	-72.10	-72.33	-81.53	-74.56	-68.30												
Ext1	Spacing	Lat(m)	2.13	2.54	2.55	1.69	2.41	2.79												
Ext1	Spacing	Long(m)	8.83	8.48	8.04	7.62	8.45	9.08												
Ext1	Corner	Diag(m)	9.08	8.85	8.43	8.04	8.79	9.31												
Ext1	Corner	Angle(deg)	76.39	73.35	72.38	70.93	74.04	79.36												
Ext1	Lateral	Overlap	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
Ext1	Longitudinal	Overlap	1.00	1.00	1.00	1.00	1.00	1.00	6	6	12	3	2	5	6	6	12	5.00	4.67	9.67
Ext1	Mir	Diag(m)	6.18	5.79	5.62	5.26	5.86	6.39												
Ext1	Mir	Angle(deg)	70.05	64.21	63.02	60.64	65.76	74.43												
LeftT/S	hz	0.00	0.70	0.61	0.38	0.00	0.56	2.82												
RightT/S	hz	0.00	0.70	0.92	0.38	0.00	0.67	2.82												
LeftBZD1	hz	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
LeftEvent1	numdrop	downs_BZD	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0.00	0.00	0.00
RightBZD1	hz	0.00	0.00	0.00	0.00	0.00	0.00	0.00												
RightEvent1	numdrop	downs_BZD	0.00	0.00	0.08	0.00	0.03	1.00	0	0	0	0	0	0	0	1	1	0.00	0.33	0.33

Note: only 5 tests were performed for the Buick in this series

APPENDIX E. GUARD RAIL DETECTION TEST DATA

Table E. 1. Volvo S80 - BSM Guard Rail Detection Test

BZD Guard Rail Detection							
Vehicle	Volvo S80, Subject Vehicle-A, Running Clockwise on VDA Oval Lane						
Test Date:	9/2/2010						
Hunter File Number	VDA Loop (N or S)	Hunter Speed	dx3 Veh_Spd avg. (mph)	Lateral Spacing	BZD Warning	Turn Signal L; R; N	Notes
S80VolvoBZD0616	S	55	55.03	4-5 ft.	No	N	
S80VolvoBZD0617	N	55	54.72	4-5 ft.	No	N	
S80VolvoBZD0618	S	55	55.12	4-5 ft.	No	N	
S80VolvoBZD0619	N	55	54.72	4 ft.	No	N	
S80VolvoBZD0620	S	55	55.14	3-4 ft.	No	N	
S80VolvoBZD0621	N	55	54.87	4 ft.	No	N	*1
S80VolvoBZD0622	S	55	55.18	4 ft.	No	L	
S80VolvoBZD0623	N	55	54.79	4 ft.	No	L	
S80VolvoBZD0624	S	55	55.20	3-4 ft.	No	L	
S80VolvoBZD0625	N	55	50.34	4 ft.	No	L	
S80VolvoBZD0626	S	55	55.16	4 ft.	No	L	
S80VolvoBZD0627	N	55	54.83	3-4 ft.	No	L	
Note: Semi tractor on Jennite, 1 car on Profile Lanes, light traffic on oval away from Hunter.							
Note: *1 = Right side BZD alert from another test vehicle last .275 sec. of file, away from guard rail.							

Table E. 2. Buick CXL - BSM Guard Rail Detection Test

BZD Guard Rail Detection							
Vehicle	Buick Lucerne CXL, Subject Vehicle-B, Running Clockwise on VDA Oval Lane						
Test Date:	10/8/2009						
Hunter File Number	VDA Loop (N or S)	Hunter Speed	dx3 Veh_Spd avg. (mph)	Lateral Spacing	BZD Warning	Turn Signal L; R; N	Notes
BuickCXL_BZD0784	S	55	55.40	6 ft.	No	N	6 ft. from guard rail
BuickCXL_BZD0785	N	55	55.28	6 ft.	No	N	
BuickCXL_BZD0786	S	55	55.42	6 ft.	No	N	
BuickCXL_BZD0787	N	55	55.26	5 ft.	No	N	
BuickCXL_BZD0788	S	55	55.23	6 ft.	No	N	
BuickCXL_BZD0789	N	55	55.06	5 ft.	No	N	
BuickCXL_BZD0790	S	55	55.53	6 ft.	No	L	Turn Signal End of test Beeping Left Turn
BuickCXL_BZD0791	N	55	55.00	3 ft.	No	L	
BuickCXL_BZD0792	S	55	55.37	5 ft.	No	L	beeping after out of loop
BuickCXL_BZD0793	N	55	55.01	6 ft.	No	L	
BuickCXL_BZD0794	S	55	55.24	3 ft.	No	L	beeping after out of loop
BuickCXL_BZD0795	N	55	55.27	6 ft.	No	L	
BuickCXL_BZD0797	S	55	55.67	5 ft.	No/Yes	L	stop, Tone Starts as Dash T/S comes on.
BuickCXL_BZD0798	N	55	55.29	6 ft.	No	L	No Tone
BuickCXL_BZD0799	S	55	55.41	5 ft.	No	L	Started DX 100' after GR.No Tone
BuickCXL_BZD0800	S	55	55.56	5 ft.	No	L	mph Tone in left door speaker starts ~35,
BuickCXL_BZD0802	N	55	55.53	6 ft.	No	R	No Alert, No Tone
BuickCXL_BZD0803	S	55	55.52	5 ft.	No/Yes	R	Tone in left door speaker only, Multiple Alert after stop
BuickCXL_BZD0804	S	55	55.69	5 ft.	No	L	Lane Tracking on, Tone @ 12 mph screen
BuickCXL_BZD0805	S	55	55.69	5 ft.	No	L	Lane Tracking on, No Tone; passed paint crew at beginning of curve
BuickCXL_BZD0806	N	55	55.33	6 ft.	No	L	No tone, Lane tracker beeped 3 times quickly crossing lines
BuickCXL_BZD0807	S	55	55.69	5 ft.	No	L	Tone at 34 mph.
BuickCXL_BZD0808	N	55	55.43	6 ft.	No	R	No Alert, No Tone
BuickCXL_BZD0809	S	55	55.67	5 ft.	No	R	Tone~32 mph. After stop tone still on but no click

Table E. 3. Mercedes E-350 - BSM Guard Rail Detection Test

BZD Guard Rail Detection							
Vehicle	Mercedes E-350, Subject Vehicle-C, Running Clockwise on VDA Oval Lane						
Test Date:	8/17/2009						
Hunter File Number	VDA Loop (N or S)	Hunter Speed	dx3 Veh_Spd avg. (mph)	Lateral Spacing	BZD Warning	Turn Signal L; R; N	Notes
Mercedes_E_BZD0419	S	55	55.90	4-6 ft.	No	N	
Mercedes_E_BZD0420	N	55	54.93	4-6 ft.	No	N	
Mercedes_E_BZD0421	S	55	55.16	4-6 ft.	No	N	
Mercedes_E_BZD0422	N	55	54.80	4-6 ft.	No	N	
Mercedes_E_BZD0423	S	55	55.06	4-6 ft.	No	N	Car passed on right=Opps.Dir.=No Alert
Mercedes_E_BZD0424	---	0	0	---	No	N	Sensor Check
Mercedes_E_BZD0425	N	55	54.74	4-6 ft.	No*	N	Amber Triangle ≤14.0 mph
Mercedes_E_BZD0426	S	55	55.04	4-6 ft.	No	L	
Mercedes_E_BZD0427	N	55	55.13	4-6 ft.	No	L	
Mercedes_E_BZD0428	S	55	54.93	4-6 ft.	No	L	
Mercedes_E_BZD0429	N	55	54.85	4-6 ft.	No*	L	Amber Triangle ≤14.0 mph
Mercedes_E_BZD0430	S	55	55.19	4-6 ft.	No	L	
Mercedes_E_BZD0431	N	55	55.01	4-6 ft.	No*	L	Amber Triangle ≤14.1 mph

*Note: Both BZD (L+R) Alert At End (On StraightAway) = Amber, Not Red Alert = On Due to Slow Speed ,13.95 mph

APPENDIX F. VIDEO NOTES FOR SAMPLE STRAIGHT-LANE AND DYNAMIC LANE TESTS

F.1. STRAIGHT-LANE TESTS

The data for the Mercedes E-Class "Third Lane Vehicle Detection" tests performed on July 27 and 28, 2009, were recorded by video camera. This vehicle was not instrumented otherwise at this time. The Mercedes E-Class subject vehicle (SV) was tested simultaneously with the Buick CXL SV, however at a position 400 feet north of the Buick. Both SV's were static as the POV, the BMW528, was driven past each SV to test for BSM alerts. The orientation of the SV's was the same direction as that the POV's direction of travel. Because the exterior side rearview mirrors contained visual BSM alert indicators the video camera was focused on the mirrors to record each test. A technician seated inside the SV operated the video camera, activated the turn signals, and observed each test. In the 97 tests performed, no BSM alerts were observed.

F.2. DYNAMIC LANE TESTS

The Mercedes E-350 SV BSM dynamic lane tests were videotaped with the camera stationed midway between the north and south ends of the test lanes. The position of the SV, POVs, or any other traffic on the test pad that could have influenced the measurements and results were observed and recorded. Other traffic consisted of one tractor-trailer unit, a passenger car, and an ATV, each passing in both directions in the adjacent lane. None of these extraneous vehicles influenced or interfered with the results – no false negatives were recorded. It was observed that during the tests if a BSM alert activated while the SV driver was calling the camera operator on the hand-held radio, the audible Mercedes BSM 2-pulse tone sequence would be recorded on the fixed position video recorder. There were no unexpected events observed through review of the video tape.

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