OCAS-DRI-FCW-14-10

NCAP FORWARD COLLISION WARNING CONFIRMATION TEST

2014 Chevrolet SS

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Torrance, California 90501

31 January, 2014

Final Report

Prepared Under Contract No.: DTNH22-08-D-00095

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
1200 New Jersey Avenue, SE
West Building, 4th Floor (NVS-120)
Washington, DC 20590
# Final Report of Forward Collision Warning Testing of a 2014 Chevrolet SS

These tests were conducted on the subject 2014 Chevrolet SS in accordance with the specifications of the Office of Crash Avoidance Standards most current Test Procedure in docket NHTSA-2006-26555 to confirm the performance of a forward collision warning system. The vehicle passed the requirements of the test for all three FCW test scenarios.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. DATA SHEETS</td>
<td>2</td>
</tr>
<tr>
<td>A. Data Sheet 1: Test Summary</td>
<td>3</td>
</tr>
<tr>
<td>B. Data Sheet 2: Vehicle Data</td>
<td>4</td>
</tr>
<tr>
<td>C. Data Sheet 3: Test Conditions</td>
<td>6</td>
</tr>
<tr>
<td>D. Data Sheet 4: Forward Collision Warning System Operation</td>
<td>8</td>
</tr>
<tr>
<td>III. TEST PROCEDURES</td>
<td>11</td>
</tr>
<tr>
<td>A. Test Procedure Overview</td>
<td>11</td>
</tr>
<tr>
<td>B. Principal Other Vehicle</td>
<td>17</td>
</tr>
<tr>
<td>C. Automatic Braking System</td>
<td>17</td>
</tr>
<tr>
<td>D. Instrumentation</td>
<td>17</td>
</tr>
<tr>
<td>Appendix A Photographs</td>
<td>A1</td>
</tr>
<tr>
<td>Appendix B Excerpts from Owner’s Manual</td>
<td>B1</td>
</tr>
<tr>
<td>Appendix C Run Logs</td>
<td>C1</td>
</tr>
<tr>
<td>Appendix D Time Histories</td>
<td>D1</td>
</tr>
</tbody>
</table>
Section I
INTRODUCTION

This test evaluates the ability of a forward collision warning (FCW) system to detect and alert drivers to potential hazards in the path of the vehicle as specified in the New Car Assessment Program “Forward Collision Warning Confirmation”, March 2010. Three driving scenarios are utilized to assess this technology. In the first test, a subject vehicle (SV) approaches a stopped principle other vehicle (POV) in the same lane of travel. The second test begins with the SV initially following the POV at the same constant speed. After a short while, the POV stops suddenly. The third test consists of the SV, traveling at a constant speed, approaching a slower moving POV, which is also being driven at a constant speed.
Section II
DATA SHEETS
VIN: 6G3F15RW6EL9xxxx

Test Date: 12/17/2013

Forward Collision Warning setting: Far

Test 1 - Subject Vehicle Encounters
   Stopped Principal Other Vehicle: Pass

Test 2 - Subject Vehicle Encounters
   Decelerating Principal Other Vehicle: Pass

Test 3 - Subject Vehicle Encounters
   Slower Principal Other Vehicle: Pass

Overall: Pass

Notes:
TEST VEHICLE INFORMATION

VIN:       6G3F15RW6EL9xxxx
Body Style: Sedan       Color: Silver
Date Received: 12/16/2013       Odometer Reading: 21 mi
Engine:     6.2 L V-8
Transmission: Automatic
Final Drive:    RWD

Is the vehicle equipped with:

ABS      X Yes       ___ No
Adaptive Cruise Control ___ Yes      X No
Collision Mitigating Brake System ___ Yes      X No

DATA FROM VEHICLE'S CERTIFICATION LABEL

Vehicle manufactured by:  GM Holden Ltd
Date of manufacture:       8/13

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: 245/40R19
                                                Rear: 275/35R19
Recommended cold tire pressure: Front: 250 kPa (36 psi)
                                          Rear: 250 kPa (36 psi)
TIREs

Tire manufacturer and model: *Bridgestone Potenza RE050A*

Front tire size: **245/40R19**

Rear tire size: **275/35R19**

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle

- [X] All options listed on the “window sticker” are present on the test vehicle
- [X] Tires and wheel rims are the same as listed.
- [X] There are no dents or other interior or exterior flaws.
- [X] The vehicle has been properly prepared and is in running condition.
- [X] Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.
FORWARD COLLISION WARNING
DATA SHEET 3: TEST CONDITIONS (Page 1 of 2)
2014 Chevrolet SS

GENERAL INFORMATION

Test date: 12/17/2013

AMBIENT CONDITIONS

Air temperature: 20.0°C (68°F)

Wind speed: 1.0 m/s (2.3 mph)

Wind speed ≤ 10 m/s (22 mph)

Tests were not performed during periods of inclement weather. This includes, but is not limited to, rain, snow, hail, fog, smoke, or ash.

Tests were conducted during daylight hours with good atmospheric visibility (defined as an absence of fog and the ability to see clearly for more than 5000 meters). The tests were not conducted with the vehicle oriented into the sun during very low sun angle conditions, where the sun is oriented 15 degrees or less from horizontal, and camera “washout” or system inoperability results.

VEHICLE PREPARATION

Verify the following:

All non consumable fluids at 100% capacity: X

Fuel tank is full: X

Tire pressures are set to manufacturer's recommended cold tire pressure:

Front: 250 kPa (36 psi)

Rear: 250 kPa (36 psi)
## WEIGHT

Weight of vehicle as tested including driver and instrumentation

<table>
<thead>
<tr>
<th>Location</th>
<th>Weight</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Front</td>
<td>526.6 kg (1161 lb)</td>
<td></td>
</tr>
<tr>
<td>Right Front</td>
<td>487.6 kg (1075 lb)</td>
<td></td>
</tr>
<tr>
<td>Left Rear</td>
<td>499.4 kg (1101 lb)</td>
<td></td>
</tr>
<tr>
<td>Right Rear</td>
<td>467.2 kg (1030 lb)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1980.8 kg (4367 lb)</td>
<td></td>
</tr>
</tbody>
</table>
How is the Forward Collision Warning presented to the driver? (Check all that apply)

- [X] Warning light
- [X] Buzzer or audible alarm
- ___ Vibration
- ___ Other

Describe the method by which the driver is alerted. For example, if the warning is a light, where is it located, its color, size, words or symbol, does it flash on and off, etc. If it is a sound, describe if it is constant beep or a repeated beep. If it is a vibration, describe where it is felt (e.g., pedals, steering wheel), the dominant frequency (and possibly magnitude), the type of warning (light, audible, vibration, or combination) etc.

_The audible warning consists of a series of 8 repeated beeps whose primary frequency is approximately 2000 Hz._

_The visual warning is shown in the heads up display in front of the driver and consists of an image of a vehicle about to collide with another vehicle with a star in between. The image appears red and remains illuminated on the heads up display without flashing._ (see Figure A12)
Is the vehicle equipped with a switch whose purpose is to render FCW inoperable?  

Yes  

No

If yes please provide a full description including the switch location and method of operation, any associated instrument panel indicator, etc.

* A switch located on the left hand side of the steering wheel toggles the FCW system between "Far", "Medium", "Near", and "Off" modes. An image of a vehicle about to collide with another vehicle with a star in between appears on the switch. The chosen setting is shown to the driver via the heads up display on the windshield. (see Figures A13,A14)

Are there other driving modes or conditions that render FCW inoperable or reduce its effectiveness?  

Yes  

No

If yes please provide a full description

* The Forward Collision Alert System may not detect a vehicle ahead if the sensor is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition.

* The system may provide unnecessary alerts for turning vehicles, vehicles in other lanes, objects that are not vehicles, or shadows.
Is the vehicle equipped with a control whose purpose is to adjust the range setting or otherwise influence the operation of FCW?  

- Yes
- No

If yes please provide a full description.

*A switch located on the left hand side of the steering wheel toggles the FCW system between "Far", "Medium", "Near", and "Off" modes. An image of a vehicle about to collide with another vehicle with a star in between appears on the switch. The chosen setting is shown to the driver via the heads up display on the windshield. (see Figures A13,A14)*

Notes:
Section III

TEST PROCEDURES

A. Test Procedure Overview

Three test procedures were used, as follows:

Test 1. Subject Vehicle (SV) Encounters Stopped Principal Other Vehicle (POV) on a Straight Road
Test 2. Subject Vehicle Encounters Decelerating Principal Other Vehicle
Test 3. Subject Vehicle Encounters Slower Principal Other Vehicle

With the exception of trials associated with Test 1, all trials were performed with SV and POV automatic transmissions in ‘‘Drive’’ or with manual transmissions in the highest gear capable of sustaining the desired test speed. Manual transmission clutches remained engaged during all maneuvers. Except for Test 2, the brake lights of the POV were not illuminated.

In order to pass the test, if the FCW system provides a warning timing adjustment for the driver, at least one setting must meet the criterion of the test procedure. Therefore, if the vehicle was equipped with a warning timing adjustment, only the most “conservative” (earliest warning) setting was tested.

An overview of each of the test procedures follows.

1. TEST 1 - SUBJECT VEHICLE ENCOUNTERS STOPPED PRINCIPAL OTHER VEHICLE ON A STRAIGHT ROAD

This test evaluates the ability of the FCW function to detect a stopped lead vehicle, as depicted in Figure 1.

![Diagram of Test 1](image)

Figure 1. Depiction of Test 1
a. Alert Criteria

In order to pass the test, the FCW alert must be issued when the time-to-collision (TTC) is at least 2.1 seconds. (Note: TTC values were computed in accordance with Ref 1). The TTC for this test was calculated by considering the speeds of the subject vehicle (SV) and the lead vehicle (POV) at the time of the FCW alert (i.e., when the SV and POV speeds are nominally equal to 45 and 0 mph (72.4 and 0 kph), respectively).

b. Procedure

The POV was parked in the center of a travel lane, with its longitudinal axis oriented parallel to the roadway edge, and facing the same direction as the SV, so the SV approaches the rear of the POV.

The SV was driven at a nominal speed of 45 mph (72.4 kph) in the center of the lane of travel, toward the parked POV. The test began when the SV was 492 ft (150 m) from the POV and ended when either of the following occurred:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90 percent of the minimum allowable range (i.e., TTC = 1.9 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

For an individual test trial to be valid, the following was required throughout the test:

- The SV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of three seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.
- The SV driver could not apply any force to the brake pedal before the required FCW alert occurred, or before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).

- The yaw rate of the SV could not exceed ±1 deg/sec during the test.

Nominally, the Test 1 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

2. TEST 2 – SUBJECT VEHICLE ENCOUNTERS DECELERATING PRINCIPAL OTHER VEHICLE

The SV in this test initially followed the POV at a constant time gap, and then the POV suddenly decelerated, as depicted in Figure 2. The test evaluates the ability of the FCW to recognize a decelerating lead vehicle and to issue an alert to the SV driver in a timely manner.

<table>
<thead>
<tr>
<th>Initially, SV follows POV.</th>
<th>Then POV begins to brake.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image-url" alt="Image of initial and decelerating vehicles" /></td>
<td><img src="image-url" alt="Image of initial and decelerating vehicles" /></td>
</tr>
<tr>
<td>$V_{SV}$</td>
<td>$V_{POV} = V_{SV}$, for $t &lt; t^*$</td>
</tr>
<tr>
<td></td>
<td>$V_{POV} &lt; V_{SV}$, for $t &gt; t^*$</td>
</tr>
</tbody>
</table>

Figure 2. Depiction of Test 2

a. Alert Criteria

In order to pass the test, the FCW alert must be issued when TTC is at least 2.4 seconds. The TTC for this test, a prediction of the time it would take for the SV to collide with the POV, was calculated by considering three factors at the time of the FCW alert: (1) the speed of the SV, (2) the speed of the POV, and (3) the deceleration of the POV$^1$.

b. Procedure

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$^1$To simplify calculation of the TTC for Test 2, the deceleration of the POV is assumed to remain constant from the time of the FCW alert until the POV comes to a stop (i.e., a "constant" rate of slowing is assumed).
Test 2 began with the SV and the POV traveling on a straight, flat road at a constant speed of 45.0 mph (72.4 kph), in the center of the lane of travel. The headway from the SV to the POV was nominally maintained at 98.4 ft (30 m) until the POV braking was initiated.

The test began approximately 7 seconds before the driver of the POV started a braking maneuver in which the POV brakes were rapidly applied and modulated such that a constant deceleration of 0.3 g was achieved within 1.5 seconds after braking is initiated. The test ended when either of the following conditions was satisfied:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90% of the minimum allowable range (i.e., TTC = 2.2 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

For an individual test trial to be valid, the following was required throughout the test:

- The initial POV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of 3 seconds prior to the initiation of POV braking.
- The speed of the SV could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of 3 seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rates of the SV and POV could not exceed ±1 deg/sec during the test.
- The POV deceleration level was nominally required to be 0.3 g within 1.5 seconds after initiation of POV braking. The acceptable error magnitude of the POV deceleration was ±0.03g, measured at the time the FCW alert first occurred. An
initial overshoot beyond the deceleration target was acceptable, however the first local deceleration peak observed during an individual trial could not exceed 0.375 g for more than 50 ms. Additionally, the deceleration could not exceed 0.33 g over a period defined from (1) 500 ms after the first local deceleration peak occurs, to (2) the time when the FCW alert first occurred.

- The tolerance for the headway from the SV to the POV was ±8.2 ft (±2.5 m), measured at two instants in time: (1) three seconds prior to the time the POV brake application was initiated, and (2) at the time the POV brake application was initiated.

- SV driver could not apply any force to the brake pedal before the required FCW alert occurred, or before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.

Nominally, the Test 2 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

3. TEST 3 – SUBJECT VEHICLE ENCOUNTERS SLOWER PRINCIPAL OTHER VEHICLE

This test examines the ability of the FCW system to recognize a slower lead vehicle being driven with a constant speed and issue a timely alert. As depicted in Figure 3, the scenario was conducted with a closing speed equal to 25.0 mph (40.2 kph).

![Figure 3. Depiction of Test 3](image)

a. Alert Criteria
In order to pass the test, the FCW alert must be issued when TTC is at least 2.0 seconds. The TTC for this test, a prediction of the time it would take for the SV to collide with the POV, was calculated by considering the speeds of the SV and POV at the time of the FCW alert.

b. Procedure

Throughout the test, the POV was driven at a constant 20.0 mph (32.2 kph) in the center of the lane of travel.

The SV was driven at 45.0 mph (72.4 kph), in the center lane of travel, toward the slow-moving POV.

The test began when the headway from the SV to the POV was 329 ft (100 m) and ended when either of the following occurred:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90% of the minimum allowable range (i.e., TTC = 1.8 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

For an individual test trial to be valid, the following was required throughout the test:

- The SV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of 3 seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.
- Speed of the POV could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) during the test.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rates of the SV and POV could not exceed ±1 deg/sec during the test.
- SV driver could not apply any force to the brake pedal before the required FCW alert occurred, or before the range fell to less than 90 percent of the minimum allowable range for onset of the required FCW alert.

Nominally, the Test 3 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

B. Principal Other Vehicle

The vehicle used as the Principal Other Vehicle (POV) was a 2000 Honda Accord. This satisfied the test requirement of Ref 1 that the POV be a mid-size sedan. The vehicle had a rear license plate in order to provide a suitable representative radar profile. Vehicle loading consisted of the driver plus equipment and instrumentation.

C. Automatic Braking System

The POV was equipped with an automatic braking system, which was used in Test 2. The braking system consisted of the following components:

- High pressure nitrogen bottle, strapped to the front passenger seat, with regulator and pressure gauges.
- Pneumatic piston-type actuator, with solenoid valve
- “Pickle” switch to activate brakes

D. Instrumentation

Table 1 lists the sensors, signal conditioning and data acquisition equipment used for these tests.

As part of the pre-test instrumentation verification process, the tonal frequency of the audible warning was determined through use of the PSD (Power Spectral Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible warning data such that the beginning of the audible warning could be programatically determined. The band-pass filter used for the audible warning signal was a phase-less, forward-reverse pass, 5th order elliptical (Cauer) digital filter, with 3 dB peak-to-peak ripple, minimum stop-band attenuation of 60 dB, and a pass-band of center frequency +/- 5% of the identified center frequency.
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<th>Output</th>
<th>Range</th>
<th>Accuracy, Other Primary Specs</th>
<th>Mfr, Model</th>
<th>Serial Number</th>
<th>Calibration Dates Last Due</th>
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<td>Tire Pressure Gauge</td>
<td>Vehicle Tire Pressure</td>
<td>0-100 psi 0-690 kPa</td>
<td>0.5 psi 3.45 kPa</td>
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<td>1/23/2013 1/23/2014</td>
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<td>Vehicle Total, Wheel, and Axle Load</td>
<td>8000 lb 35.6 kN</td>
<td>± 1.0% of applied load</td>
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<td>Differential Global Positioning System</td>
<td>Position, Velocity</td>
<td>Latitude: ± 90 deg</td>
<td>Horizontal Position: ± 1 cm</td>
<td>Trimble GPS Receiver, 5700</td>
<td>00440100989</td>
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<td>Multi-Axis Inertial Sensing System</td>
<td>Position; Longitudinal, Lateral, and Vertical Accels; Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles</td>
<td>Latitude: ± 90 deg</td>
<td>Velocity: 0.05 km/h</td>
<td>Oxford Technical Solutions (OXTS), Inertial+</td>
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<td></td>
<td></td>
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<td>Position: ± 2 cm Velocit: 0.05 km/h</td>
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<td>Distance and Velocity to lane markings (LDW) and POV (FCW)</td>
<td>Lateral Lane Dist: ± 30 m</td>
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<td>Mfr, Model</td>
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<td>--------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>---------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>Data Acquisition System</td>
<td>Record Time; Position; Velocity; Distance to lane markings; Headway distance; Closing Velocity; Lateral, Longitudinal, and Vertical Accels; Roll, Yaw, and Pitch Rates; Roll, Yaw and Pitch Angles.</td>
<td>Sufficient to meet or exceed individual sensors</td>
<td>Sound digitized at 10 kHz, all other channels digitized at 100 Hz. Accuracy is sufficient to meet or exceed individual sensors</td>
<td>SoMat, eDaq ECPU processor</td>
<td>MSHLB.03-2476</td>
<td>4/24/13 4/24/14</td>
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<tr>
<td></td>
<td></td>
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<td>SoMat, High level Board EHLS</td>
<td>MSHLS.03-3182</td>
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<td>Microphone</td>
<td>Sound (to measure time at alert)</td>
<td>Max SPL: 139 dB/SPL Frequency Response:  40 Hz – 20 kHz</td>
<td>≤ 3 dB over Freq. Resp. Range</td>
<td>Sennheiser, e614</td>
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<td>Light Sensor</td>
<td>Light intensity (to measure time at alert)</td>
<td>Spectral Bandwidth: 440-800 nm</td>
<td>Rise time &lt; 10 msec</td>
<td>DRI designed and developed Light Sensor</td>
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<tr>
<td>Accelerometer</td>
<td>Acceleration (to measure time at alert)</td>
<td>±5 g</td>
<td>≤ 3% of full range</td>
<td>Silicon Designs, 2210-005</td>
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<td>NA</td>
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<tr>
<td>Coordinate Measurement Machine</td>
<td>Inertial Sensing System Coordinates</td>
<td>0-8 ft 0-2.4 m</td>
<td>±.0020 in. ±.051 mm (Single point articulation accuracy)</td>
<td>Faro Arm, Fusion</td>
<td>UO8-05-08-06636</td>
<td>1/4/2013 1/4/2014</td>
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APPENDIX A

Photographs
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Front View of Subject Vehicle</td>
<td>A-3</td>
</tr>
<tr>
<td>A2</td>
<td>Rear View of Subject Vehicle</td>
<td>A-4</td>
</tr>
<tr>
<td>A3</td>
<td>Window Sticker (Monroney Label)</td>
<td>A-5</td>
</tr>
<tr>
<td>A4</td>
<td>Vehicle Certification Label</td>
<td>A-6</td>
</tr>
<tr>
<td>A5</td>
<td>Front View of Principal Other Vehicle</td>
<td>A-7</td>
</tr>
<tr>
<td>A6</td>
<td>Rear View of Principal Other Vehicle</td>
<td>A-8</td>
</tr>
<tr>
<td>A7</td>
<td>DGPS and Inertial Measurement Unit Installed in Subject Vehicle</td>
<td>A-9</td>
</tr>
<tr>
<td>A8</td>
<td>Data Acquisition System Installed in Subject Vehicle</td>
<td>A-10</td>
</tr>
<tr>
<td>A9</td>
<td>Computer Installed in Subject Vehicle</td>
<td>A-11</td>
</tr>
<tr>
<td>A10</td>
<td>Brake Actuation System Installed in Principal Other Vehicle</td>
<td>A-12</td>
</tr>
<tr>
<td>A11</td>
<td>Sensors for Detecting Visual and Audible Alerts</td>
<td>A-13</td>
</tr>
<tr>
<td>A12</td>
<td>Visual Warning Display</td>
<td>A-14</td>
</tr>
<tr>
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</tr>
<tr>
<td>A14</td>
<td>FCW Adjustment Button</td>
<td>A-16</td>
</tr>
</tbody>
</table>
Figure A1. Front View of Subject Vehicle
Figure A2. Rear View of Subject Vehicle
Figure A3. Window Sticker (Monroney Label)
Figure A4. Vehicle Certification Label
Figure A5. Front View of Principal Other Vehicle
Figure A6. Rear View of Principal Other Vehicle
Figure A7. DGPS and Inertial Measurement Unit Installed in Subject Vehicle
Figure A8. Data Acquisition System Installed in Subject Vehicle
Figure A9. Computer Installed in Subject Vehicle
Figure A10. Brake Actuation System Installed in Principal Other Vehicle
Figure A11. Sensors for Detecting Visual and Audible Alerts
Figure A12. Visual Warning Display
Figure A13. FCW Adjustment Display Options
Figure A14. FCW Adjustment Button
APPENDIX B

Excerpts from Owner’s Manual
Instrument Panel

Instrument Panel Overview
1. Air Vents on page 8-6.
2. Turn Signal Lever. See Turn and Lane-Change Signals on page 6-3. Driver Information Center (DIC) Controls. See Driver Information Center (DIC) on page 5-21.
   Lane Departure Warning (LDW) on page 9-44 (If Equipped).
   Forward Collision Alert (FCA) System on page 9-40 (If Equipped).
6. Horn on page 5-3.
7. Steering Wheel Controls on page 5-2.
12. Infotainment. See Overview on page 7-2.
15. Instrument Panel Illumination Control on page 6-4.
16. Head-Up Display (HUD) on page 5-23.
17. Steering Wheel Adjustment on page 5-2.
   Front and Rear Parking Assist Button. See Assistance Systems for Parking or Backing on page 9-36.
   Automatic Parking Assist (APA) Button (If Equipped). See Assistance Systems for Parking or Backing on page 9-36.
22. Power Outlets on page 5-4 (Out of View).
23. Dual Automatic Climate Control System on page 8-1.
25. CD Player Eject Button. See CD Player on page 7-32.
3. **MENU**: Press to display the DIC menus. This button is also used to return to or exit the last screen displayed on the DIC.

See *Driver Information Center (DIC)* on page 5-21.

**Forward Collision Alert (FCA) System**

If equipped, FCA may help avoid or reduce the harm caused by front-end crashes. FCA provides a green indicator when a vehicle is detected ahead. This indicator displays amber if you follow a vehicle much too closely. When approaching a vehicle ahead too quickly, FCA provides a red flashing alert on the windshield and rapidly beeps.

See *Forward Collision Alert (FCA) System* on page 9-40.

**Lane Departure Warning (LDW)**

If equipped, LDW is intended to help avoid unintentional lane departures at speeds of 56 km/h (35 mph) or greater. LDW uses a camera sensor to detect the lane markings. The LDW indicator, ⬋, appears green if a lane marking is detected. If the vehicle departs the lane, the indicator will change to amber and flash. In addition, beeps will sound.

See *Lane Departure Warning (LDW)* on page 9-44.

**Side Blind Zone Alert (SBZA)**

If equipped, SBZA will detect vehicles in the next lane over in the vehicle's side blind zone area. When this happens, the SBZA display will light up in the corresponding outside side mirror and will flash if the turn signal is on.

See *Side Blind Zone Alert (SBZA)* on page 9-42.

**Rear Vision Camera (RVC)**

If equipped, RVC displays a view of the area behind the vehicle, on the center stack display, when the vehicle is shifted into R (Reverse).

See *Assistance Systems for Parking or Backing* on page 9-36.

**Ultrasonic Parking Assist**

If equipped, Ultrasonic Rear Parking Assist (URPA) uses sensors on the rear bumper to assist with parking and avoiding objects while in R (Reverse). It operates at speeds less than 8 km/h (5 mph). URPA uses audible beeps to provide distance and system information. The vehicle may also be equipped with Front Parking Assist.

See *Driver Assistance Systems* on page 9-35.
5-16 Instruments and Controls

Parking Brake on page 9-27. If a message displays in the Driver Information Center (DIC), see Brake System Messages on page 5-26.

Antilock Brake System (ABS) Warning Light

This light comes on briefly when the engine is started.
If it does not, have the vehicle serviced by your dealer.
If the ABS light stays on, turn the ignition off.
If the light comes on while driving, stop as soon as it is safely possible and turn off the vehicle. Then start the engine again to reset the system. If the ABS light stays on, or comes on again while driving, the vehicle needs service. A chime may also sound when the light comes on steady.
If the ABS light is the only light on, the vehicle has regular brakes, but the antilock brakes are not functioning.
If both the ABS and the brake system warning light are on, the vehicle’s antilock brakes are not functioning and there is a problem with the regular brakes. See your dealer for service.

See Brake System Warning Light on page 5-14 and Brake System Messages on page 5-26.

Lane Departure Warning (LDW) Light

This light comes on green when the system is on and ready to operate. When the system determines that the vehicle is leaving its lane without using the turn signal, this light will change to amber and flash.
See Lane Departure Warning (LDW) on page 9-44.

Forward Collision Alert (FCA) Warning Light

The forward collision alert comes on and warns when a vehicle is being rapidly approached.
See Forward Collision Alert (FCA) System on page 9-40 for more information.
Vehicle Ahead Indicator

This light comes on briefly while starting the engine. If it does not, have the vehicle serviced by your dealer. If the system is working normally, the indicator light then turns off.

The traction off light comes on when the Traction Control System (TCS) has been turned off by pressing and releasing the TCS/StabiliTrak button.

This light and the StabiliTrak OFF light come on when StabiliTrak is turned off.

If the TCS is off, wheel spin is not limited. Adjust driving accordingly.


StabiliTrak® OFF Light

This light comes on briefly while starting the engine. If it does not, have the vehicle serviced by your dealer.

This light comes on when the StabiliTrak system is turned off. If StabiliTrak is off, the Traction Control System (TCS) is also off.

If the StabiliTrak and TCS are off, the system does not assist in controlling the vehicle. Turn on the TCS and the StabiliTrak systems and the warning light turns off.

Key and Lock Messages

NO REMOTE DETECTED
This message displays when the transmitter battery is weak on vehicles with Keyless Access. See “Starting the Vehicle with a Low Transmitter Battery” under Remote Keyless Entry (RKE) System Operation on page 2-3.

REPLACE BATTERY IN REMOTE KEY
This message displays when the battery in the Remote Keyless Entry (RKE) transmitter needs to be replaced. See “Battery Replacement” under Remote Keyless Entry (RKE) System Operation on page 2-3.

USE TRANSMITTER POCKET TO START
This message displays when trying to start the vehicle if an RKE transmitter is not detected. The transmitter battery may be weak. See “Starting the Vehicle with a Low Transmitter Battery” under Remote Keyless Entry (RKE) System Operation on page 2-3.

Lamp Messages

AUTOMATIC LIGHT CONTROL ON/OFF
This message is displayed when the automatic light control has been turned on or off. See Automatic Headlamp System on page 6-2.

CHECK XXX TURN SIGNAL LAMP
When one of the turn signals is out, this message displays to show which bulb needs to be replaced. See Bulb Replacement on page 10-24 and Replacement Bulbs on page 10-25.

TURN SIGNAL ON
This message is displayed if the turn signal has been left on. Turn off the turn signal.

Object Detection System Messages

FORWARD COLLISION ALERT OFF
This message displays when the Forward Collision Alert has been turned off.

FRONT CAMERA BLOCKED CLEAN WINDSHIELD
This message displays when the camera is blocked. Cleaning the outside of the windshield behind the rearview mirror may correct the issue. The Lane Departure Warning system will not operate. Forward Collision Alert (FCA) may not work or may not work as well.

LANE DEPARTURE WARNING UNAVAILABLE
This message displays when attempting to activate the Lane Departure Warning (LDW) system.
5-30 Instruments and Controls

when it is temporarily unavailable. The LDW system does not need service.

This message could be due to the camera being blocked. Cleaning the outside of the windshield behind the rearview mirror may correct the issue.

PARK ASSIST OFF
This message displays when the Parking Assist system has been turned off or when there is a temporary condition causing the system to be disabled.

REAR CROSS TRAFFIC ALERT OFF
This message displays when the Rear Cross Traffic Alert has been turned off.

SERVICE FRONT CAMERA
If this message remains on after continued driving, the vehicle needs service. Do not use the Lane Departure Warning (LDW) and Forward Collision Alert (FCA) features. Take the vehicle to your dealer.

SERVICE PARKING ASSIST
This message displays if there is a problem with the Parking Assist system. Do not use this system to help you park. See your dealer for service.

SERVICE SIDE DETECTION SYSTEM
If this message remains on after continued driving, the vehicle needs service. Side Blind Zone Alert (SBZA) and Rear Cross Traffic Alert (RCTA) features will not work. Take the vehicle to your dealer.

SIDE BLIND ZONE ALERT OFF
This message indicates that the driver has turned the Side Blind Zone Alert (SBZA) system off.

SIDE DETECTION SYSTEM UNAVAILABLE
This message indicates that Side Blind Zone Alert (SBZA) and Rear Cross Traffic Alert (RCTA) are disabled either because the sensor is blocked and cannot detect vehicles in the blind zone, or the vehicle is passing through an open area, such as the desert, where there is insufficient data for operation. This message may also activate during heavy rain or due to road spray. The vehicle does not need service. For cleaning, see "Washing the Vehicle" under Exterior Care on page 10-72.
Assistance Systems for Driving

If equipped, when driving the vehicle, Forward Collision Alert (FCA), Lane Departure Warning (LDW), and Side Blind Zone Alert (SBZA) can help to avoid a crash or reduce crash damage.

Forward Collision Alert (FCA) System

If equipped, the FCA system may help to avoid or reduce the harm caused by front-end crashes. When approaching a vehicle ahead too quickly, FCA provides a red flashing alert on the windshield and rapidly beeps. FCA also lights an amber visual alert if following another vehicle much too closely.

FCA detects vehicles within a distance of approximately 60 m (197 ft) and operates at speeds above 40 km/h (25 mph).

⚠️ Warning

FCA is a warning system and does not apply the brakes. When approaching a slower-moving or stopped vehicle ahead too rapidly, or when following a vehicle too closely, FCA may not provide a warning with enough time to help avoid a crash. FCA does not warn of pedestrians, animals, signs, guardrails, bridges, construction barrels, or other objects. Be ready to take action and apply the brakes. For more information, see Defensive Driving on page 9-3.

FCA can be disabled with the FCA steering wheel control.

Detecting the Vehicle Ahead

FCA warnings will not occur unless the FCA system detects a vehicle ahead. When a vehicle is detected, the vehicle ahead indicator will display green. Vehicles may not be detected on curves, highway exit ramps, or hills; or due to poor visibility. FCA will not detect another vehicle ahead until it is completely in the driving lane.

⚠️ Warning

FCA does not provide a warning to help avoid a crash, unless it detects a vehicle. FCA may not detect a vehicle ahead if the FCA sensor is blocked by dirt, snow, (Continued)
Warning (Continued)

or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Keep the windshield, headlamps, and FCA sensors clean and in good repair.

Collision Alert

The vehicle ahead indicator will display amber when you are following a detected vehicle ahead much too closely.

Selecting the Alert Timing

The Collision Alert control is on the steering wheel. Press the FCA timing to Far, Medium, Near, or Off. The first button press shows the current setting on the Head-Up Display (HUD). Additional button presses will change this setting. The chosen setting will remain until it is changed and will affect the timing of both the Collision Alert and the Tailgating Alert features. The timing of both alerts will vary based on vehicle speed. The faster the vehicle speed, the farther away the
9-42 Driving and Operating

alert will occur. Consider traffic and weather conditions when selecting the alert timing. The range of selectable alert timing may not be appropriate for all drivers and driving conditions.

Unnecessary Alerts
FCA may provide unnecessary alerts for turning vehicles, vehicles in other lanes, objects that are not vehicles, or shadows. These alerts are normal operation and the vehicle does not need service.

Cleaning the System
If the FCA system does not seem to operate properly, cleaning the outside of the windshield in front of the camera sensor and the front of the vehicle may correct the issue.

Side Blind Zone Alert (SBZA)
If equipped, the SBZA system is a lane-changing aid that assists drivers with avoiding crashes that occur with vehicles in the side blind zone (or spot) areas. The SBZA warning display will light up in the corresponding outside side mirror and will flash if the turn signal is on.

<table>
<thead>
<tr>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBZA does not alert the driver to vehicles rapidly approaching outside of the side blind zones, pedestrians, bicyclists, or animals. It may not provide alerts when changing lanes under all driving conditions. Failure to use proper care when changing lanes may result in injury, death, or vehicle damage. Before making a lane change, always check mirrors, glance over your shoulder, and use the turn signals.</td>
</tr>
</tbody>
</table>

SBZA Detection Zones
The SBZA sensor covers a zone of approximately one lane over from both sides of the vehicle, or 3.5 m (11 ft). The height of the zone is approximately between 0.5 m (1.5 ft) and 2 m (6 ft) off the ground. This zone starts at approximately the middle of the vehicle and goes back 5 m (16 ft).

How the System Works
The SBZA symbol lights up in the side mirrors when the system detects a vehicle in the next lane.
APPENDIX C

Run Log
Subject Vehicle: 2014 Chevrolet SS  
Principal Other Vehicle: 2000 Honda Accord  
Date: 12/17/2013

<table>
<thead>
<tr>
<th>Run</th>
<th>Test Type</th>
<th>Valid Run?</th>
<th>TTCW Sound (sec)</th>
<th>TTCW Light (sec)</th>
<th>TTCW Margin (sec)</th>
<th>Pass/Fail</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FCW1 (Stopped)</td>
<td>Y</td>
<td>2.44</td>
<td>2.55</td>
<td>0.45</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Data file transfer problem</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Y</td>
<td>2.58</td>
<td>2.68</td>
<td>0.58</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Y</td>
<td>2.45</td>
<td>2.52</td>
<td>0.42</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Y</td>
<td>2.52</td>
<td>2.60</td>
<td>0.50</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Y</td>
<td>2.48</td>
<td>2.59</td>
<td>0.49</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Y</td>
<td>2.70</td>
<td>2.74</td>
<td>0.64</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Data file transfer problem</td>
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<tr>
<td>9</td>
<td></td>
<td>Y</td>
<td>2.66</td>
<td>2.76</td>
<td>0.66</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>FCW3 (Slower)</td>
<td>Y</td>
<td>2.37</td>
<td>2.45</td>
<td>0.45</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>Y</td>
<td>2.54</td>
<td>2.63</td>
<td>0.63</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Y</td>
<td>2.23</td>
<td>2.31</td>
<td>0.31</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Y</td>
<td>2.33</td>
<td>2.44</td>
<td>0.44</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Y</td>
<td>2.41</td>
<td>2.51</td>
<td>0.51</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>POV speed high</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Y</td>
<td>2.52</td>
<td>2.57</td>
<td>0.57</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td>Y</td>
<td>2.98</td>
<td>3.01</td>
<td>1.01</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td>Test Type</td>
<td>Valid Run?</td>
<td>TTCW Sound (sec)</td>
<td>TTCW Light (sec)</td>
<td>TTCW Margin (sec)</td>
<td>Pass/Fail</td>
<td>Notes</td>
</tr>
<tr>
<td>-----</td>
<td>--------------</td>
<td>------------</td>
<td>------------------</td>
<td>------------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>-------------------</td>
</tr>
<tr>
<td>18</td>
<td>FCW2 (Braking)</td>
<td>Y</td>
<td>2.47</td>
<td>2.52</td>
<td>0.12</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>Y</td>
<td>3.34</td>
<td>3.46</td>
<td>1.06</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td>Y</td>
<td>2.90</td>
<td>2.98</td>
<td>0.58</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td></td>
<td>Y</td>
<td>2.94</td>
<td>2.98</td>
<td>0.58</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Y</td>
<td>2.58</td>
<td>2.69</td>
<td>0.29</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Y</td>
<td>2.82</td>
<td>2.88</td>
<td>0.48</td>
<td>Pass</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td>Y</td>
<td>2.87</td>
<td>2.99</td>
<td>0.59</td>
<td>Pass</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX D

Time History Plots
LIST OF FIGURES

Figure D1. Example Time History for Test Type 1, Passing....................................... D-7
Figure D2. Example Time History for Test Type 2, Failing ........................................ D-8
Figure D3. Example Time History for Test Type 2, Passing ....................................... D-9
Figure D4. Example Time History for Test Type 3, Failing ........................................ D-10
Figure D5. Example Time History for Test Type 3, Passing .......................... D-11
Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate ............................................. D-12
Figure D7. Time History for Run 1, FCW Test 1, Audible Warning........................... D-13
Figure D8. Time History for Run 1, FCW Test 1, Visual Warning............................... D-14
Figure D9. Time History for Run 3, FCW Test 1, Audible Warning........................... D-15
Figure D10. Time History for Run 3, FCW Test 1, Visual Warning.............................. D-16
Figure D11. Time History for Run 4, FCW Test 1, Audible Warning......................... D-17
Figure D12. Time History for Run 4, FCW Test 1, Visual Warning............................. D-18
Figure D13. Time History for Run 5, FCW Test 1, Audible Warning......................... D-19
Figure D14. Time History for Run 5, FCW Test 1, Visual Warning............................. D-20
Figure D15. Time History for Run 6, FCW Test 1, Audible Warning........................... D-21
Figure D16. Time History for Run 6, FCW Test 1, Visual Warning............................. D-22
Figure D17. Time History for Run 7, FCW Test 1, Audible Warning........................... D-23
Figure D18. Time History for Run 7, FCW Test 1, Visual Warning............................. D-24
Figure D19. Time History for Run 9, FCW Test 1, Audible Warning......................... D-25
Figure D20. Time History for Run 9, FCW Test 1, Visual Warning............................. D-26
Figure D21. Time History for Run 18, FCW Test 2, Audible Warning......................... D-27
Figure D22. Time History for Run 18, FCW Test 2, Visual Warning......................... D-28
Figure D23. Time History for Run 20, FCW Test 2, Audible Warning......................... D-29
Figure D24. Time History for Run 20, FCW Test 2, Visual Warning......................... D-30
Figure D25. Time History for Run 22, FCW Test 2, Audible Warning......................... D-31
Figure D26. Time History for Run 22, FCW Test 2, Visual Warning........................... D-32
Figure D27. Time History for Run 23, FCW Test 2, Audible Warning......................... D-33
Figure D28. Time History for Run 23, FCW Test 2, Visual Warning........................... D-34
Figure D29. Time History for Run 24, FCW Test 2, Audible Warning......................... D-35
Figure D30. Time History for Run 24, FCW Test 2, Visual Warning........................... D-36
Figure D31. Time History for Run 25, FCW Test 2, Audible Warning......................... D-37
Figure D32. Time History for Run 25, FCW Test 2, Visual Warning........................... D-38
Figure D33. Time History for Run 26, FCW Test 2, Audible Warning......................... D-39
Figure D34. Time History for Run 26, FCW Test 2, Visual Warning........................... D-40
Figure D35. Time History for Run 10, FCW Test 3, Audible Warning......................... D-41
Figure D36. Time History for Run 10, FCW Test 3, Visual Warning........................... D-42
Figure D37. Time History for Run 11, FCW Test 3, Audible Warning......................... D-43
Figure D38. Time History for Run 11, FCW Test 3, Visual Warning........................... D-44
Figure D39. Time History for Run 12, FCW Test 3, Audible Warning......................... D-45
Figure D40. Time History for Run 12, FCW Test 3, Visual Warning........................... D-46
Figure D41. Time History for Run 13, FCW Test 3, Audible Warning......................... D-47
Figure D42. Time History for Run 13, FCW Test 3, Visual Warning........................... D-48
Figure D43. Time History for Run 14, FCW Test 3, Audible Warning......................... D-49
Figure D44. Time History for Run 14, FCW Test 3, Visual Warning
Figure D45. Time History for Run 16, FCW Test 3, Audible Warning
Figure D46. Time History for Run 16, FCW Test 3, Visual Warning
Figure D47. Time History for Run 17, FCW Test 3, Audible Warning
Figure D48. Time History for Run 17, FCW Test 3, Visual Warning
Description of Time History Plots

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from both the Subject Vehicle and the Principal Other Vehicle, as well as pass/fail envelopes and thresholds. The following is a description of data types shown in the time history plots, as well as a description of the color code indicating to which vehicle the data pertain.

Time History Plot Description

Each time history plot consists of data pertinent to the test type under consideration. The data shown in time history plots for test type 2 differs slightly from the data shown in test types 1 and 3, owing to the headway distance criterion which is used exclusively for test type 2.

Time history figures include the following sub-plots:
- Event – indicates timing of warning issued by FCW system. Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any of the following,:
  - Filtered and rectified sound signal
  - Filtered and rectified acceleration (e.g., steering wheel vibration)
  - Light sensor signal
  - Discrete on/off value
- TTC (sec) – indicates the Time to Collision as calculated up to the point of FCW alert issuance. The value of TTCW (Time to Collision at Warning) is given numerically on the right side of the figure. A passing value is indicated in green, while a failing value is indicated in red.
- SV Speed (mph) – speed of the Subject Vehicle
- POV Speed (mph) – speed of the Principal Other Vehicle
- Yaw Rate (deg/sec) – yaw rate of both the Subject Vehicle and Principal Other Vehicle
- Lateral Offset (ft) – lateral offset within the lane from the Subject Vehicle to the Principal Other Vehicle
- Ax (g) – Longitudinal acceleration of both the Subject Vehicle and Principal Other Vehicle
- Headway (ft) – Longitudinal separation between front of Subject Vehicle to rear of Principal Other Vehicle (Exclusive to test type 2)
Envelopes and Thresholds

Each of the time history plot figures can contain either green or yellow envelopes and/or black threshold lines. These envelopes and thresholds are used to programmatically and visually determine the validity of a given test run. Envelope and threshold exceedances are indicated with either red shading or red asterisks, and red text is placed to the right side of the plot indicating the type of exceedance.

Green envelopes indicate that the time-varying data should not exceed the envelope boundaries at any time within the envelope. Exceedances of a green envelope are indicated by red shading in the area between the measured time-varying data and the envelope boundaries.

Yellow envelopes indicate that the time-varying data should not exceed the envelope only at the left and/or right ends. Exceedances at the left or right extent of a yellow envelope are indicated by red asterisks.

For test type 2, the plot indicating the longitudinal acceleration of the Principal Other Vehicle includes a solid black threshold line indicating the maximum deceleration (-0.33 g) allowed while braking. Exceedance of this threshold is indicated with red shading in the area between the measured time-varying data and the threshold boundary.

Color Codes

Color codes have been adopted to easily identify which data correspond to which vehicle, as well as to indicate the types of envelopes and thresholds used in the plots.

Color codes can be broken into four categories:
1. Time-varying data
2. Validation envelopes and thresholds
3. Instantaneous samplings
4. Text

1. Time-varying data color codes:
   • Blue = Subject Vehicle data
   • Magenta = Principal Other Vehicle data
• Brown = Relative data between SV and POV (i.e., TTC, lateral offset and headway distance)

2. Validation envelope and threshold color codes:
   • Green envelope = time varying data must be within the envelope at all times in order to be valid
   • Yellow envelope = time varying data must be within limits at left and/or right ends
   • Black threshold (Solid) = time varying data must not exceed this threshold in order to be valid
   • Black threshold (Dashed) = for reference only – this can include warning level thresholds, TTC thresholds, and acceleration thresholds

3. Instantaneous sampling color codes:
   • Green circle = passing or valid value at a given moment in time
   • Red asterisk = failing or invalid value at a given moment in time

4. Text color codes:
   • Green = passing or valid value
   • Red = failing or invalid value

Examples of time history plots for each test type (including passing, failing and invalid runs) are shown in Figure D1 through Figure D6. Actual time history data plots for the vehicle under consideration are provided subsequently.
Figure D1. Example Time History for Test Type 1, Passing
Figure D2. Example Time History for Test Type 2, Failing
Figure D3. Example Time History for Test Type 2, Passing
Figure D4. Example Time History for Test Type 3, Failing
Figure D5. Example Time History for Test Type 3, Passing
Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate
Figure D7. Time History for Run 1, FCW Test 1, Audible Warning
Figure D8. Time History for Run 1, FCW Test 1, Visual Warning
Figure D9. Time History for Run 3, FCW Test 1, Audible Warning
Figure D10. Time History for Run 3, FCW Test 1, Visual Warning
Figure D11. Time History for Run 4, FCW Test 1, Audible Warning
Figure D12. Time History for Run 4, FCW Test 1, Visual Warning
Figure D13. Time History for Run 5, FCW Test 1, Audible Warning
Figure D14. Time History for Run 5, FCW Test 1, Visual Warning
Figure D15. Time History for Run 6, FCW Test 1, Audible Warning
Figure D16. Time History for Run 6, FCW Test 1, Visual Warning
Figure D17. Time History for Run 7, FCW Test 1, Audible Warning
Figure D18. Time History for Run 7, FCW Test 1, Visual Warning
Figure D19. Time History for Run 9, FCW Test 1, Audible Warning
Figure D20. Time History for Run 9, FCW Test 1, Visual Warning
Figure D21. Time History for Run 18, FCW Test 2, Audible Warning
Figure D22. Time History for Run 18, FCW Test 2, Visual Warning
Figure D23. Time History for Run 20, FCW Test 2, Audible Warning
Figure D24. Time History for Run 20, FCW Test 2, Visual Warning
Figure D25. Time History for Run 22, FCW Test 2, Audible Warning
Figure D26. Time History for Run 22, FCW Test 2, Visual Warning
Figure D27. Time History for Run 23, FCW Test 2, Audible Warning
Figure D28. Time History for Run 23, FCW Test 2, Visual Warning.
Figure D29. Time History for Run 24, FCW Test 2, Audible Warning
Figure D30. Time History for Run 24, FCW Test 2, Visual Warning
Figure D31. Time History for Run 25, FCW Test 2, Audible Warning
Figure D32. Time History for Run 25, FCW Test 2, Visual Warning
Figure D33. Time History for Run 26, FCW Test 2, Audible Warning

GPS Fix Type: RTK Fixed
Figure D34. Time History for Run 26, FCW Test 2, Visual Warning
Figure D35. Time History for Run 10, FCW Test 3, Audible Warning
Figure D36. Time History for Run 10, FCW Test 3, Visual Warning
Figure D37. Time History for Run 11, FCW Test 3, Audible Warning
Figure D38. Time History for Run 11, FCW Test 3, Visual Warning
Figure D39. Time History for Run 12, FCW Test 3, Audible Warning
Figure D40. Time History for Run 12, FCW Test 3, Visual Warning
Figure D41. Time History for Run 13, FCW Test 3, Audible Warning
Figure D42. Time History for Run 13, FCW Test 3, Visual Warning
Figure D43. Time History for Run 14, FCW Test 3, Audible Warning
Figure D44. Time History for Run 14, FCW Test 3, Visual Warning
Figure D45. Time History for Run 16, FCW Test 3, Audible Warning
Figure D46. Time History for Run 16, FCW Test 3, Visual Warning
Figure D47. Time History for Run 17, FCW Test 3, Audible Warning.
Figure D48. Time History for Run 17, FCW Test 3, Visual Warning

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