BLIND SPOT INTERVENTION SYSTEM CONFIRMATION TEST
NCAP-DRI-BSI-20-06

2020 Land Rover Range Rover Sport HSE

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Final Report

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National Highway Traffic Safety Administration
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16. Abstract These tests were conducted on the subject 2020 Land Rover Range Rover Sport HSE in accordance with the specifications of the National Highway Traffic Safety Administration's most current Test Procedure in docket NHTSA-2019-0102-0001, BLIND SPOT INTERVENTION SYSTEM CONFIRMATION TEST, to confirm the performance of a Blind Spot Intervention system. The preliminary BSI requirements were met for 17 out of 21 valid trials.		
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Section I

INTRODUCTION

There are presently two commercially available crash avoidance technologies designed to directly address the “changing lanes/same direction” pre-crash scenario: Blind Spot Detection (BSD) and Blind Spot Intervention (BSI). BSD is a warning-based passive technology designed to help the driver recognize that another vehicle is approaching, or being operated within, the blind spot of their vehicle in an adjacent lane. Should the driver initiate a lane change towards this other vehicle, the BSD presents an alert before a collision is expected to occur. BSI systems are designed to actively help the driver avoid a collision with another vehicle that is approaching, or being operated within, the blind spot of their vehicle in an adjacent lane.

This research test evaluates BSI systems on light vehicles with SAE automation levels 0, 1, 2, or 3, as specified in the National Highway Traffic Safety Administration’s “Blind Spot Intervention System Confirmation Test”, July 2019. The subject light vehicles have gross vehicle weight ratings (GVWR) under 10,000 pounds. BSI technology uses sensors to detect the presence of other vehicles in the equipped vehicle’s left and right blind spot and then intervene to avoid a collision. The procedures described herein emulate three straight-road, real-world scenarios in which the Subject Vehicle (SV) operating under SAE automation levels 0, 1, 2, or 3 attempts to perform a lane change. The adjacent destination lane is occupied by a single Principal Other Vehicle (POV) in the first two scenarios, and not in the third. Although it is impossible to predict what technologies could be used by future BSI systems, it is believed that minor modifications to these procedures, when deemed appropriate, could be used to accommodate the evaluation of alternative or more advanced BSI systems.

Section II

DATA SHEETS

BLIND SPOT INTERVENTION

DATA SHEET 1: TEST RESULTS SUMMARY

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2020 Land Rover Range Rover Sport HSE

VIN: *SALWR2SU9LA71xxxx*

Test Date: *11/11/2020*

System Setting(s): *Steering Assist*

		Number of valid test runs for which acceptability[1] criteria were:		
		Met	**Not met**	**Valid trials**
Test 1 -	**Subject Vehicle Lane Change, Constant Headway**	*3*	*4*	*7*
Test 2 -	**Subject Vehicle Lane Change, Closing Headway**	*7*	*0*	*7*
Test 3 -	**Subject Vehicle Lane Change, Constant Headway, False Positive**	*7*	*0*	*7*
	Overall:	***17***	***4***	***21***

Notes: *All tests were performed at Level 0 automation.*

[1] The acceptability criteria listed herein are used only as a guide to gauge system performance, and are identical to the Pass/Fail criteria given in NHTSA's most current Test Procedure in docket NHTSA-2019-0102-0001, BLIND SPOT INTERVENTION SYSTEM CONFIRMATION TEST.

BLIND SPOT INTERVENTION

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2020 Land Rover Range Rover Sport HSE

TEST VEHICLE INFORMATION

VIN: *SALWR2SU9LA71xxxx*

Body Style: *SUV* Color: *Portofino Blue*

Date Received: *6/19/2020* Odometer Reading: *62 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Jaguar Land Rover Ltd.*

Date of manufacture: *01/20*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *275/45 R21*

Rear: *275/45 R21*

Recommended cold tire pressure: Front: *250 kPa (37 psi)*

Rear: *300 kPa (44 psi)*

TIRES

Tire manufacturer and model: *Pirelli Scorpion*

Front tire size: *275/45 R21 110Y*

Rear tire size: *275/45 R21 110Y*

Front tire DOT prefix: *XN 8M 325E*

Rear tire DOT prefix: *XN 8M 325E*

BLIND SPOT INTERVENTION

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Land Rover Range Rover Sport HSE

GENERAL INFORMATION

Test date: *11/11/2020*

AMBIENT CONDITIONS

Air temperature: *14.4 C (58 F)*

Wind speed: *1.5 m/s (3.5 mph)*

X Windspeed ≤ 10 m/s (22 mph)

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

X 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.

All tests were also conducted such that there were no overhead signs, bridges, or other significant structures over, or near, the testing site. Except for the POV, each trial shall be conducted with no vehicles, obstructions, or stationary objects within one lane width of either side the SV path.

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: **X**

Front: *250 kPa (37 psi)*

Rear: *300 kPa (44 psi)*

BLIND SPOT INTERVENTION

DATA SHEET 3: TEST CONDITIONS

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2020 Land Rover Range Rover Sport HSE

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*663.6 kg (1463 lb)*	Right Front:	*601.5 kg (1326 lb)*
Left Rear:	*591.5 kg (1304 lb)*	Right Rear:	*669.5 kg (1476 lb)*
		Total:	*2526.1 kg (5569 lb)*

BLIND SPOT INTERVENTION

DATA SHEET 4: BLIND SPOT INTERVENTION SYSTEM OPERATION

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2020 Land Rover Range Rover Sport HSE

General Information

Name of the BSI option, option package, etc., as shown on the Monroney label:

Blind Spot Assist is an available option on all models as part of the 'Drive Pro Pack' and 'Driver Assist Pack' packages.

Type and location of sensors the system uses:

Side Obstacle Detection Control Modules are located in the left rear and right rear, behind the rear bumper. A forward-facing camera system is located in the upper center of the windshield.

System setting used for test (if applicable):

Steering Assist

Method(s) by which the driver is alerted

X Visual

	Type	Location	Description
X	Symbol	*Upper corners of the outside rearview mirrors.*	*Blind spot symbol.*
	Word		
	Graphic		

____ Audible - Description

____ Haptic

	Steering Wheel		Seatbelt
	Pedals		Steering Torque
	Seat		Brake Jerk

Description of alert:

The Blind Spot Monitor system monitors an area adjacent to, and approximately 28 ft (8.5 m) behind the vehicle. When the system detects an overtaking vehicle, the amber warning icon:

- *Flashes if the relevant turn signal is being used.*
- *Illuminates continuously if the relevant turn signal is not being used.*
- *Extinguishes when the system no longer detects a vehicle in the monitored area.*

Please describe the method of intervention for the BSI system. For example, if the intervention is turning of the steering wheel, application of braking to one or more wheels of the vehicle, or a combination. If the intervention has different phases, please describe and provide information for each of these.

The Blind Spot Assist system applies corrective steering inputs if:

- *A vehicle is detected in the blind spot monitor area, and:*
- *A lane change maneuver is attempted.*
- *If a lane change maneuver is initiated while a risk is detected, the relevant door mirror displays a flashing vehicle warning icon.*
- *At the same time, a rotational force is applied to the steering wheel to counter the lane change. The instrument panel displays a warning icon when a rotational force is applied to the steering wheel. The Heads-Up Display (HUD) also displays a warning.*

System Function

What is the speed range over which the system operates?

Minimum: *64 km/h (40 mph)*

Maximum: *180 km/h (112 mph)*

If the system requires an initialization sequence/procedure, please provide a description of the process required to initialize the system.

Drive a few seconds in a straight line (straight steering with not much torque applied) to be sure Electronic Power Assisted Steering (EPAS) and camera are initialized. For failure injection, wait ~10 sec after vehicle starts before injecting failures, allowing all modules & sensor to properly initialize.

If the system requires the driver to operate their turn signal indicator during lane change in order to activate, please provide a description.

BSI works irrespective of direction indicators being activated by the driver. When the BSD system detects object AND side turn indicator is operated, the exterior rearview mirror icon flashes to a solid on state. Blind Spot Assist will seek to steer the vehicle away from the detected hazard.

If the vehicle is equipped with a method to activate/deactivate the system(s) please provide a description of how this is accomplished. If the system is deactivated by this method, does it reactivate upon each ignition cycle?

The system can be switched on and off via the Driver assistance instrument panel menu. Left/Right and Up/Down and Select buttons located on the left side of the steering wheel are used to access the vehicle menus. The menu hierarchy is:

Driver Assistance

Collision Avoidance

Blind Spot assist - Select:

Off

Steering Assist

Alert Only

The selected state remains set until the driver alters the setting. When switched on, the Blind Spot Assist system must then be activated. Press the button located on the steering wheel to activate the Blind Spot Assist system. Press the button a second time to deactivate the system. The button icon illuminates to confirm system status. NOTE: The steering wheel button also controls operation of the lane departure warning and Lane Keep Assist (LKA) systems.

See Appendix A, Figures A13 and A14.

If the vehicle is equipped with a method to adjust the range setting/sensitivity or otherwise influence the operation of BSI, please provide a description.

No range/sensitivity adjustment is provided.

If the system deactivates due to damage to the sensors, how is this indicated to the driver?

The instrument panel and touchscreen display messages to inform the driver of any performance or system issues.

If the system deactivates due to repeated BSI activations:

- How is this indicated to the driver?
- Can deactivation be avoided (e.g., by cycling the ignition after each BSI activation)?
- How can the system be reactivated?

The Blind Spot Assist system continues to operate regardless of the number of activations.

If the system deactivates or its effectiveness is reduced due to periods of inactivity:

- How is this indicated to the driver?
- Can deactivation be avoided?
- How can the system be reactivated?

The system will not deactivate or reduce effectiveness due to periods of inactivity.

If there are other driving modes or conditions (such as weather) that render the system inoperable or reduce its effectiveness please provide a description.

For a more comprehensive list of driving modes or conditions that render the BSI system inoperaple, please see Owner's Manual, pages 201-202 shown on Appendix B, pages B-5 through B-6.

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Three test scenarios were used, as follows:

Test 1. SV Lane Change with Constant Headway
Test 2. SV Lane Change with Closing Headway
Test 3. SV Lane Change with Constant Headway, False Positive

An overview of each of the test procedures follows.

1. TEST 1 – SV LANE CHANGE WITH CONSTANT HEADWAY

The SV Lane Change with Constant Headway (SVLC_Constant_HW) test evaluates the ability of the BSI system to detect and respond to a POV in an adjacent lane blind spot by preventing the SV from changing lanes or colliding with the POV. For this scenario, the POV resides in the SV blind spot with a constant headway. This test scenario is depicted in Figure 1.

The test begins with the POV in the left lane adjacent to the SV. After both vehicles have reached their designated speeds and headway overlap, the SV driver engages the left turn signal indicator and initiates a single lane change maneuver into the lane occupied by the POV. Specific details of the lane change method depended on the automation level as summarized in Table 1. The BSI system was then expected to intervene and prevent the SV from contacting the POV.

This test scenario was performed with the highest available SV automation level (0, 1, 2, or 3).

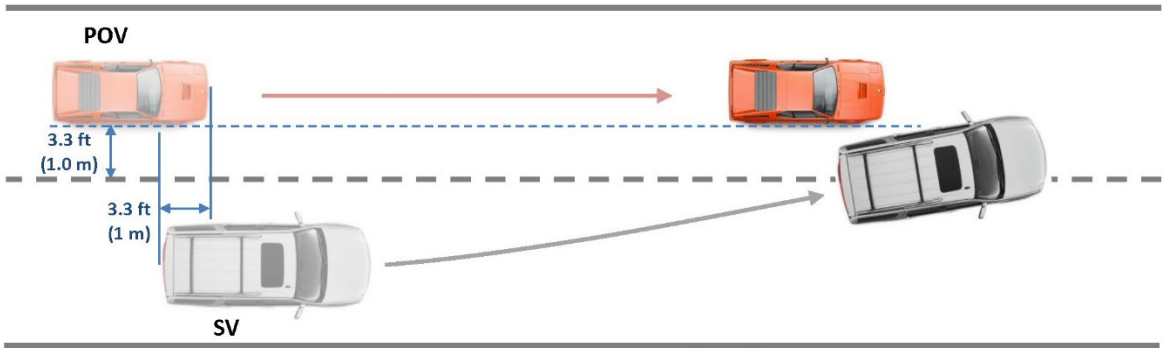


Figure 1. SV Lane Change with Constant Headway Test Scenario

a. Procedure for Automated Vehicle Level 0 or 1 Operation

The tests with SV automated vehicle level 0 or 1 were performed with manual steering input from a robotic steering controller. The SV and POV began in their respective travel lanes with their longitudinal axes oriented parallel to the roadway edge. The initial SV path was offset in the lane as shown in Figure 2 . Both vehicles then accelerated to an initial speed of 45 mph (72.4 km/h). This speed and specified headway overlap between the front-most point of the POV and the rear-most point of the SV were maintained throughout the test. The headway overlap is specified with the front bumper of the POV located 1.0 ± 0.5 m (3.3±1.6 ft) ahead of the rear of the SV (therefore the specified headway distance is a negative value indicating longitudinal overlap).

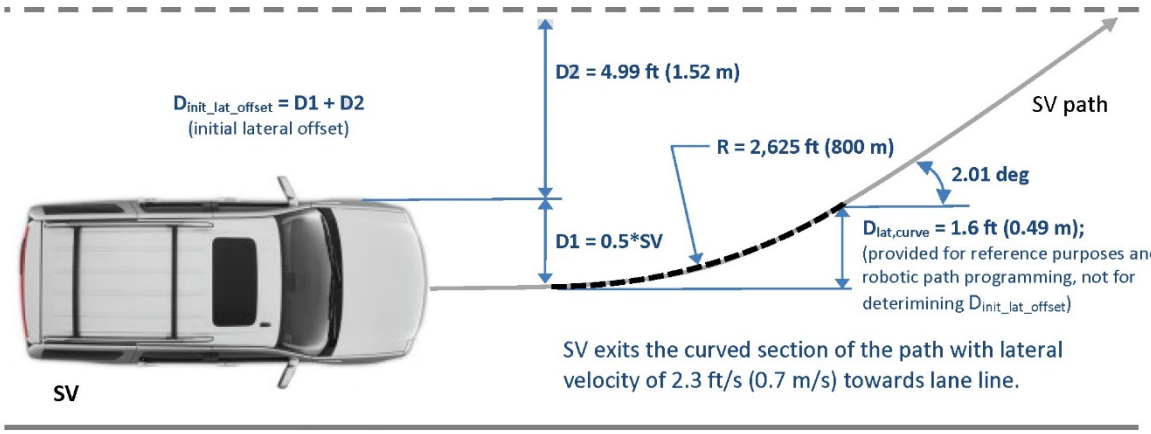


Figure 2. Input Parameters Used to Define the SV Path During the SV Level 0 and 1 Lane Change with Constant Headway Scenario

Once the speeds of both vehicles and the specified headway overlap were stabilized, the vehicles held this formation from the beginning of the test validity period until the SV lane change was initiated, as follows. After at least 3 seconds from the onset of the validity period, the SV driver activated the left turn signal indicator. Then within 1 ± 0.5 seconds after the turn signal was activated, the SV robotic steering controller began the lane change shown in Figure 2. The steer torque applied by the SV robotic steering controller stopped[2] within 250 ms of achieving the desired SV heading angle after the SV exited the 2,625 ft (800 m) radius curve during the lane change. The POV used open loop control to maintain the initial speed indicated in Table 1 (i.e., 45 mph).

[2] To emulate the situation where a human driver is operating the vehicle with their hands removed from the steering wheel.

b. Validity Period

The valid test interval began 3 seconds before the SV driver activated the left turn signal indicator.

For trials where the BSI system intervened, the valid test interval ended when one of the following conditions occurred:

- The SV impacted the POV; or
- five seconds after the SV had established a heading away from the POV and was completely within its original travel lane; or
- one second after the SV traveled ≥ 1 ft (0.3 m) beyond the inboard edge of the lane line separating the SV travel lane from the lane adjacent and to the right of it, as shown in Figure 3.

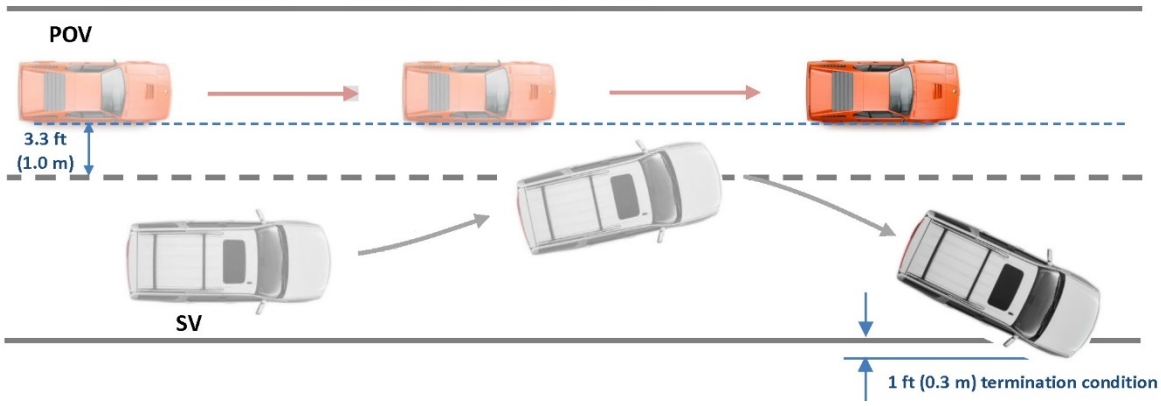


Figure 3. Valid SV Lane Change Intervention Test Interval End Condition 3

For trials where the BSI did not intervene, the valid test interval ended when the SV impacted the POV.

In addition to the procedure and timing described above, for an individual test trial to be valid, the following was required throughout the test:

- The general test validity criteria specified in Section III.B.1 were satisfied.
- The test parameters specified in Table 1 were within the allowable limits specified in Table 1 during the entire test interval or the epoch indicated.
- After initiation of the SV lane change, the POV used open loop control to maintain the constant speed specified in Table 1.

After the test validity period ended, the SV driver manually applied force to the brake pedal, bringing the vehicle to a stop, and placed the transmission in park. The POV also braked to a stop, and the SVLC_Constant_HW test trial was complete.

c. Number of Test Trials

Seven valid SVLC_Constant_HW test trials were performed for the SV automation condition listed in Data Sheet 1.

If no intervention was detected on the first three of the seven valid trials, testing was stopped after three trials in order to mitigate damage to both the POV and SV.

d. Evaluation Criteria

The BSI system performance requirements for the SVLC_Constant_HW tests depended on the level of automation the SV was operating in during that trial. Passing BSI test criteria were:

- The SV did not impact the POV during any valid test performed in automation level 0 or 1 (i.e., those performed with the timing and inputs described in Section III.A.1.a), or

- the SV did not initiate the lane change commanded by the turn signal indicator during any valid test performed with automation level 2 or 3 (i.e., those described in Section III.A.1.b), and

- the SV BSI intervention did not cause the SV to travel ≥ 1 ft (0.3 m) beyond the inboard edge of the lane line separating the SV travel lane from one adjacent and to the right of it within the validity period defined in Section III.A.1.b during any valid test (i.e., with automation level 1, 2, or 3).

Table 1. SV Lane Change with Constant Headway Test Specifications

SV Automation Condition	Initial Speed		Lateral Lane Position		SV-to-POV Longitudinal Orientation	SV Left Turn Signal Activation	SV Lane Change			SV Path Tolerance	Number of Trials
	SV	POV	SV	POV			Initiation Timing	Steering Release Timing	Lateral Velocity		
Manual speed control, LCC off (Level 0)	45 ± 1 mph (72.4±1.6 km/h)	45 ± 1 mph (72.4±1.6 km/h)	Manually offset within travel lane, then manual lane change towards left adjacent lane	Constant; 3.3 ± 0.8 ft (1 ± 0.25 m) from the right side of the POV to the inboard edge of the lane line immediately to its right	Constant; front-most point of the POV 3.3 ± 1.6 ft (1 ± 0.5 m) ahead of the rear-most point of the SV	At least 3 seconds after all pre-SV lane change test validity criteria have been satisfied	1.0 ± 0.5 s after the SV turn signal is activated	Within 250 ms of achieving desired SV heading angle after exiting the 2,625 ft (800 m) radius curve during the lane change	2.3±0.3 ft/s (0.7±0.1 m/s)	±0.8 ft (±0.25 m) until SV steering wheel is released	7
Cruise control, LCC off (Level 0)											7
ACC on, LCC off (Level 1)											7

2. TEST 2 – SV LANE CHANGE WITH CLOSING HEADWAY

The SV Lane Change with Closing Headway (SVLC_Closing_HW) test evaluates the ability of the BSI system to detect a POV approaching a blind spot in an adjacent lane and prevent the SV from changing lanes and colliding with it. The POV is approaching the SV blind spot from the rear, as depicted in Figure 4. In this scenario, the test begins with the POV in the left lane adjacent to the SV. After both vehicles have reached their designated speeds, the SV driver engages the left turn signal indicator and initiates a single lane change maneuver into the lane occupied by the POV. Specific details of the lane change method depended on the automation level as summarized in Table 2. The BSI system was then expected to intervene and prevent the SV from contacting the POV.

This test scenario was performed with the highest available SV automation level (0, 1, 2, and 3).

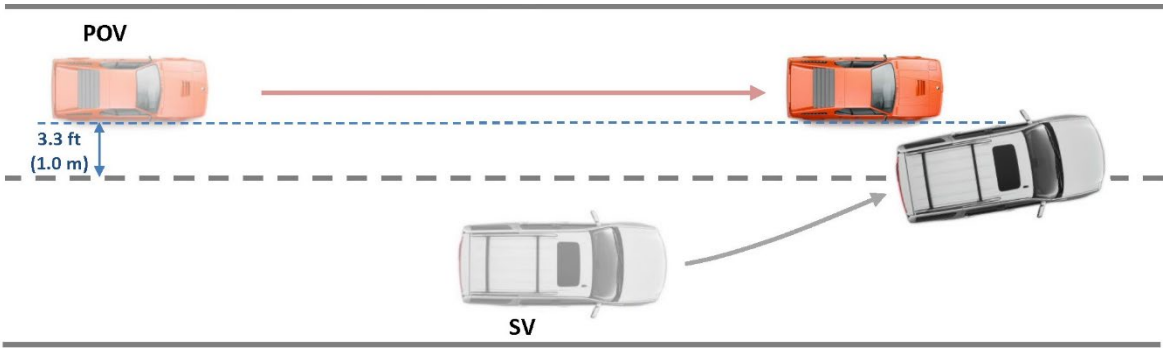


Figure 4. SV Lane Change with Closing Headway Test Scenario

a. Procedure for Automated Vehicle Level 0 or 1 operation

The tests with SV automated vehicle level 0 or 1 were performed with manual steering input from a robotic steering controller. The SV and POV began in their respective travel lanes with their longitudinal axes oriented parallel to the roadway edge, with the POV behind the SV as shown in Figure 4. The initial SV path was offset in the lane as shown in Figure 2 . The SV then accelerated to an initial speed of 45 mph (72.4 km/h) while the POV accelerated to an initial speed of 50 mph (80.5 km/h). These speeds were then maintained throughout the test.

The SV driver then activated the left SV turn signal indicator when the front of the POV was 4.9 ± 0.5 seconds from a vertical plane defined by the rear of the SV and perpendicular to the SV travel lane. This event nominally occurs when the longitudinal SV-to-POV headway is 35.6 ft (10.8 m) if the speed differential is 5 mph (8 km/h).

Then, when the POV is 3.9 ± 0.5 seconds from a vertical plane defined by the rear of the SV and perpendicular to the SV travel lane, the SV robotic steering controller began the lane change shown in Figure 2. This event nominally occurs when the longitudinal SV-to-POV headway is 28.2 ft (8.6 m) if the speed differential is 5 mph (8 km/h). The steer torque applied by the SV robotic steering controller stopped within 250 ms of achieving the desired SV heading angle after the SV exited the 2,625 ft (800 m) radius curve during the lane change. The POV used open loop control to maintain the initial speed indicated in Table 2 (i.e., 50 mph).

b. Validity Period

The valid test interval began 3 seconds before the SV driver activated the left turn signal indicator.

For trials where the BSI system intervened, the valid test interval ended when one of the following conditions occurred:

- The SV impacted the POV; or
- five seconds after the SV had established a heading away from the POV and was completely within its original travel lane; or
- one second after the SV traveled ≥ 1 ft (0.3 m) beyond the inboard edge of the lane line separating the SV travel lane from the lane adjacent and to the right of it, as shown in Figure 3.

For trials where the BSI did not intervene, the valid test interval ended when the SV impacted the POV.

In addition to the procedure and timing described above, for an individual test trial to be valid, the following was required throughout the test:

- The general test validity criterial specified in Section III.B.1 were satisfied.
- After the test validity period ended, the SV driver manually applied force to the brake pedal, bringing the vehicle to a stop, and placed the transmission in park. The POV was also braked to a stop, and the SVLC_Closing_HW test trial was complete.

c. Number of Test Trials

Seven valid SVLC_ Closing _HW test trial were performed for the SV automation condition listed in Data Sheet 1.

If no intervention was detected on the first three of the seven valid trials, testing was stopped after three trials in order to mitigate damage to both the POV and SV.

d. Evaluation Criteria

The BSI system performance requirements for the SVLC_Closing_HW tests depended on the level of automation the SV was operating in during that trial. Passing BSI test criteria were:

- The SV did not impact the POV during any valid test performed in automation level 0 or 1 (i.e., those performed with the timing and inputs described in Section III.A.2.a), or
- the SV did not initiate the lane change commanded by the turn signal indicator during any valid test performed with automation level 2 or 3 (i.e., those described in Section III.A.2.b), and
- the SV BSI intervention did not cause the SV to travel ≥ 1 ft (0.3 m) beyond the inboard edge of the lane line separating the SV travel lane from one adjacent and to the right of it within the validity period defined in III.A.2.b during any valid test (i.e., with automation level 1, 2, or 3).

Table 2. SV Lane Change with Closing Headway Test Specifications

SV Automation Condition	Initial Speed		Lateral Lane Position		SV-to-POV Longitudinal Orientation	SV Left Turn Signal Activation	SV Lane Change			SV Path Tolerance	Number of Trials
	SV	POV	SV	POV			Initiation Timing	Steering Release Timing	Lateral Velocity		
Manual speed control, LCC off (Level 0)	45 ± 1 mph (72.4±1.6 km/h)	50 ± 1 mph (80.5±1.6 km/h)	Manually offset within travel lane, then manual lane change towards left adjacent lane	Constant; 3.3 ± 0.8 ft (1 ± 0.25 m) from the right side of the POV to the inboard edge of the lane line immediately to its right	POV approaches the rear of the SV with a constant 5 mph (8.1 km/h) relative velocity	When the front-most point of the POV is 4.9 ± 0.5 seconds from a vertical plane defined by the rear-most point of the SV and perpendicular to the SV travel lane	When the front-most point of the POV is 3.9 ± 0.5 seconds from a vertical plane defined by the rear-most point of the SV and perpendicular to the SV travel lane	Within 250 ms after exiting the 2,625 ft (800 m) radius curve during the lane change	2.3±0.3 ft/s (0.7±0.1 m/s)	±0.8 ft (±0.25 m) until SV steering wheel is released	7
Cruise control, LCC off (Level 0)											7
ACC on, LCC off (Level 1)											7

Note: Columns 3, 6, 7, and 8 in Table 2 are different from Table 1.

3. TEST 3 – SV LANE CHANGE WITH CONSTANT HEADWAY, FALSE POSITIVE ASSESSMENT

The SV Lane Change with Constant Headway, False Positive (SVLC_Constant_HW_FP) test assesses whether or not a BSI system detects and responds to a non-threatening POV during a single lane change. In this scenario, the POV is two lanes away from the SV, adjacent to the SV blind spot, and traveling with constant headway. This test scenario is depicted in Figure 5. In this scenario the test begins with the POV in the second lane to the left of the SV After both vehicles have reached their designated speeds and headway overlap, the SV driver engages the left turn signal indicator and initiates a single lane change maneuver into the lane between the initial SV and POV travel lanes. Specific details of the lane change method depended on the automation level as summarized in Table 3a and 3b.

This test scenario was performed in two parts comprised of “baseline” and “evaluation” trials, with SV automation level 0, 1, 2, or 3 depending on the highest SAE automation level available on the SV. The main difference between the baseline and evaluation trials is that evaluation trials were performed with the POV present and the baseline trials were performed without the POV. The BSI system was expected to not respond any differently to the presence of the POV compared to a similar baseline test trial without the POV.

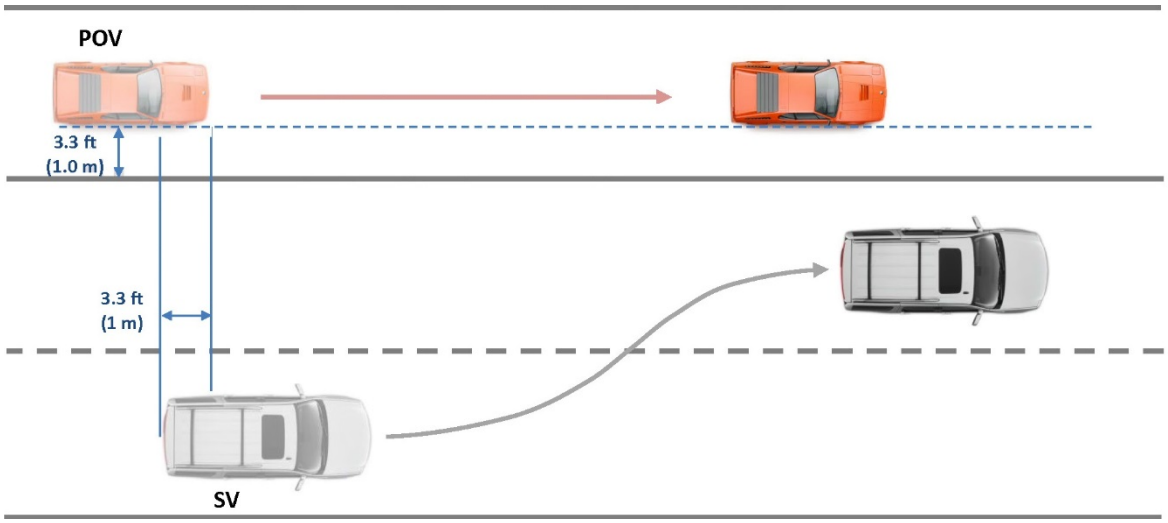


Figure 5. Lane Change with Constant Headway, False Positive Test Scenario

a. Procedure for Automated Vehicle Level 0 or 1 Operation

The SVLC_Constant_HW_FP tests with level 0 and 1 operation were performed in

a similar manner as the SVLC_Constant_HW tests described in Section III.A.1.a with the following exceptions:

- The initial SV and POV lanes of travel were separated by a lane of travel in between them as shown in Figure 5.
- The SV driver did not release the steering wheel (or robotic steering control equivalent) at any time during the baseline test trial.
- The SV driver did not release the steering wheel (or robotic steering control equivalent) at any time during the evaluation test trial unless system intervention was detected.
- The manual steer input included a lane change completion phase as shown in Figure 6.
- The tests were conducted both with and without the POV present.
- There were 3 baseline trials without the POV, as specified in Table 3a. The SV was driven at the initial speed of 45 mph (72.4 km/h) either manually or using the cruise control after it was enabled and initialized. After maintaining this initial speed (there was no initial SV-POV vehicle formation as depicted in Figure 5 during the trial because the POV was not present), the SV driver engaged the left turn signal indicator and initiated the single lane change into the left adjacent lane. No BSI system interventions were expected in the baseline trials because no POV was present.
- There were 7 evaluation trials with the POV, as specified in Table 3b. The SV and POV were both driven at the initial speed of 45 mph (72.4 km/h) and established the initial longitudinal and lateral formation shown in Figure 5. The SV speed was achieved either manually or with the cruise control enabled and initialized. After maintaining the initial formation shown in Figure 5 for 3 seconds, the SV driver engaged the left turn signal indicator and initiated the single lane change into the left adjacent lane. No BSI system interventions were expected in the evaluation trial because a single lane change should not result in a collision with the POV.
- The validity period is defined in Section III.A.3.b.

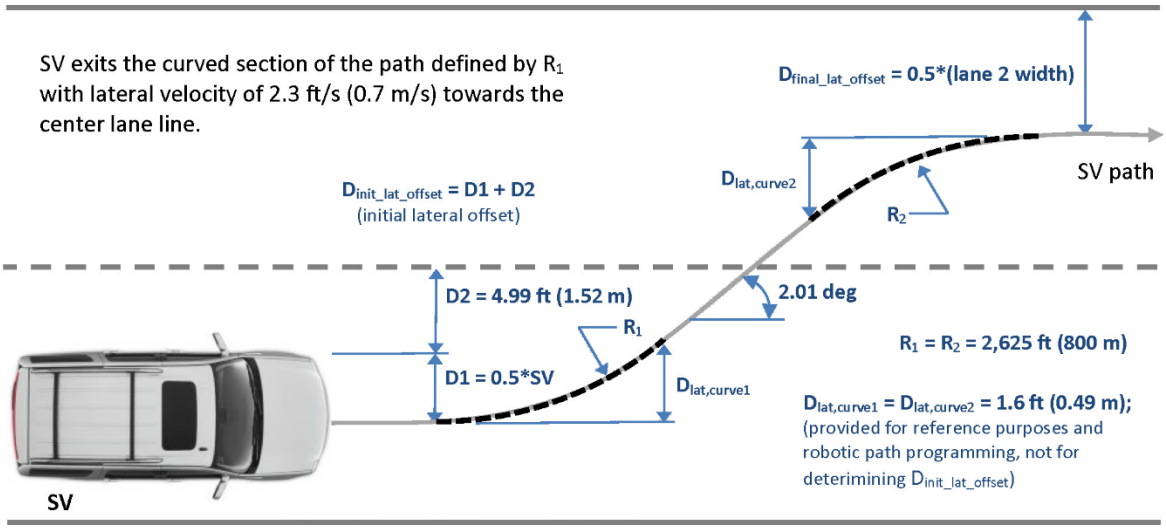


Figure 6. Input Parameters used to define the SV path during the SV Lane Change with Constant Headway, False Positive Scenario

b. Validity Period

The valid test interval began 3 seconds before the SV driver activated the left turn signal indicator.

The valid test interval ended when one of the following conditions occurred:

1. The SV impacted the POV; or

2. Five seconds after the SV had completed the single lane change into the left lane adjacent to the SV's original travel lane without a BSI intervention; or

3. One second after a BSI intervention caused the SV to travel ≥ 1 ft (0.3 m) beyond the inboard edge of the lane line separating the post lane change SV travel lane and the lane adjacent and to the right of it, as shown in Figure 7.

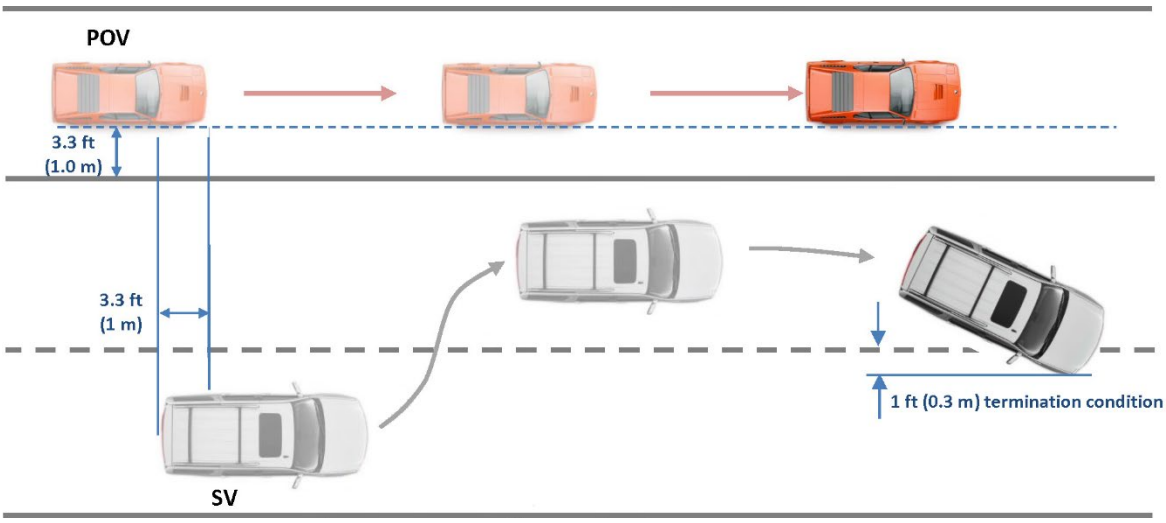


Figure 7. Valid SV Lane Change False Positive Test Interval End Condition 3

In addition to the procedure and timing described above, for an individual test trial to be valid, the following was required throughout the test:

- The general test validity criteria specified in Section III.B.1 were satisfied.
- The test parameters specified in Table 3a and 3b were within the allowable limits specified in Table 3a and 3b during the entire test interval or the epoch indicated.
- For evaluation trials, after initiation of the SV lane change, the POV used open-loop control to maintain the constant speed specified in Table 3b.

After the test validity period ended, the SV driver manually applied force to the brake pedal, bringing the vehicle to a stop, and placed the transmission in park. The POV was also braked to a stop for evaluation trials. The SVLC_Constant_HW_FP test trial was then complete.

c. Evaluation Method and Criteria

Determination of whether a false positive BSI intervention occurred during a SVLC_Closing_HW_FP evaluation required the comparison of the SV yaw rate data collected during the evaluation trial with the acceptability corridor defined by the corresponding composite data from the baseline trials. This was accomplished in two steps.

The first step was to determine an acceptable yaw rate time history corridor for each SV automation condition, as illustrated by the hypothetical example in Figure 8. The

yaw rate time histories for the 3 baseline trials were first synchronized in time so that the onsets of the respective lane changes occurred within 20 ms of each other. The baseline composite yaw rate was then calculated by averaging the yaw rates from the 3 baseline trials, at each time point in the synchronized time history. The acceptability corridor was then the baseline composite yaw rate value ± 1 deg/s.

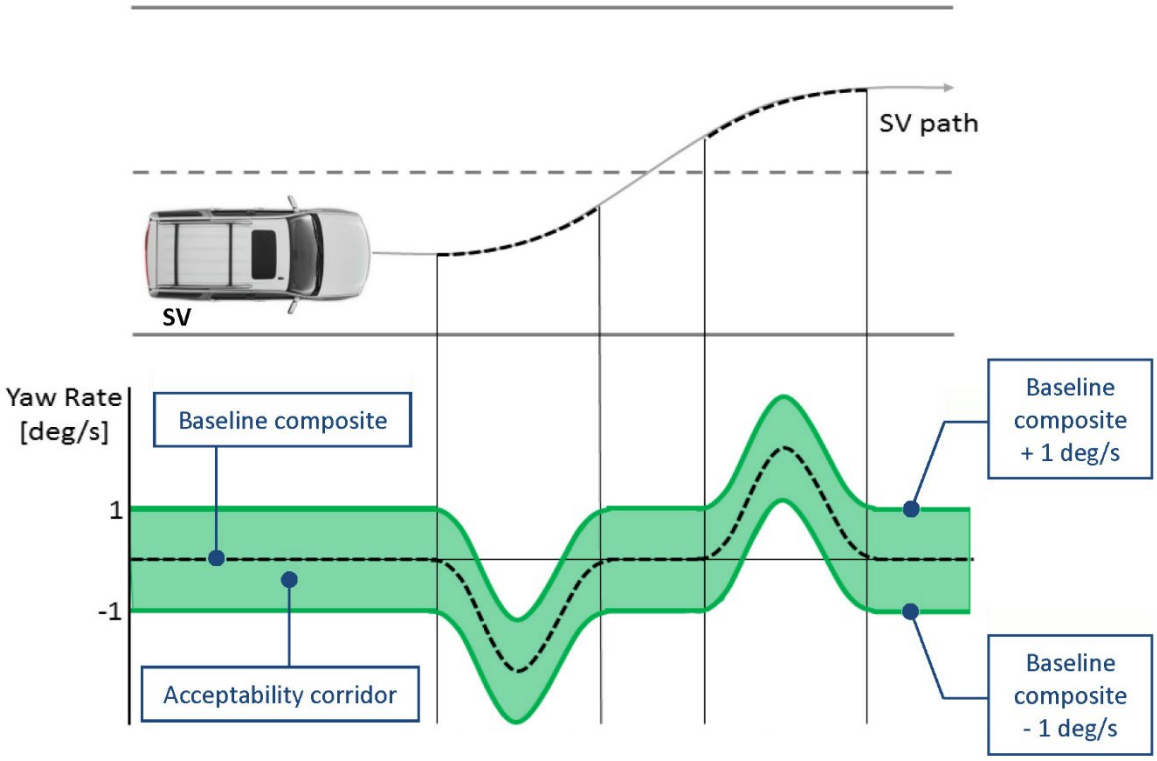


Figure 8. Definition of a Yaw Rate Acceptability Corridor

The second step was to compare the SV yaw rate from each evaluation trial to the acceptable yaw rate time history corridor, as illustrated by the hypothetical example in Figure 9. If, after data synchronization, the SV yaw rate exceeded the acceptability corridor any time during the test validity period defined in Section III.A.3.b, then a false positive intervention test result was determined to have occurred.

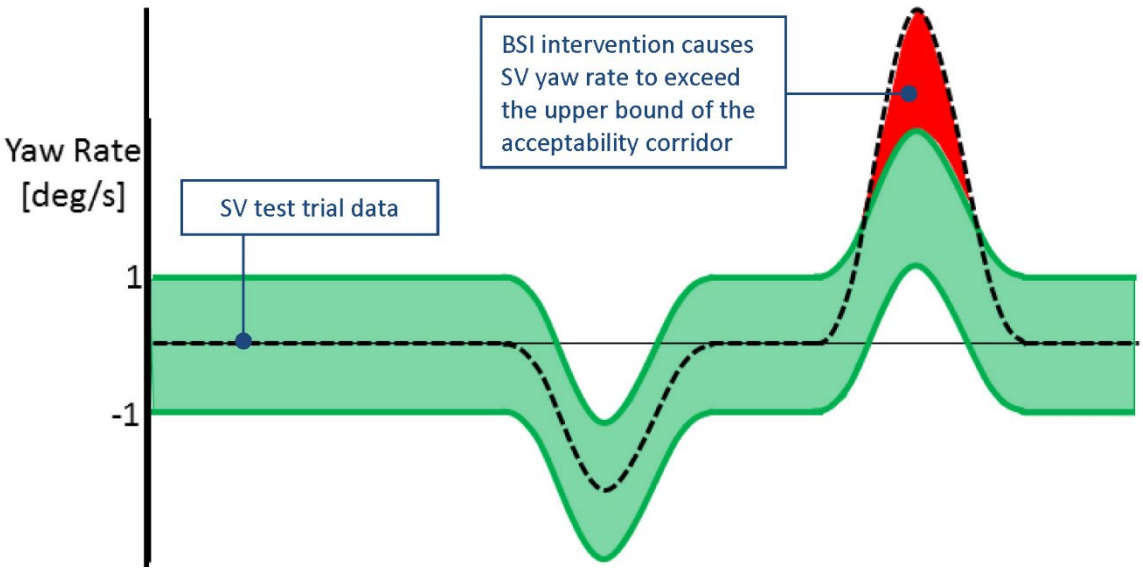


Figure 9. BSI False Positive Example

Table 3a. SV Lane Change with Constant Headway, False Positive Test Specifications (Baseline Trials)

SV Automation Condition	Initial Speed		Lateral Lane Position		SV-to-POV Longitudinal Orientation	SV Left Turn Signal Activation	SV Lane Change			SV Path Tolerance	Number of Trials
	SV	POV	SV	POV			Initiation Timing	Steering Release Timing	Lateral Velocity		
Manual speed control, LCC off (Level 0)	45 ± 1 mph (72.4±1.6 km/h)	N/A	Manually offset within travel lane, then manual lane change into a lane left and adjacent to that of the SV	N/A	N/A	At least 3 seconds after all pre-SV lane change test validity criteria have been satisfied	1.0±0.5 s after the SV turn signal is activated	N/A (the SV driver does not release the steering wheel)	2.3±0.3 ft/s (0.7±0.1 m/s)	±0.8 ft (±0.25 m)	3
Cruise control, LCC off (Level 0)											3
ACC on, LCC off (Level 1)											3

Table 3b. SV Lane Change with Constant Headway, False Positive Test Specifications (Evaluation Trials)

SV Automation Condition	Initial Speed		Lateral Lane Position		SV-to-POV Longitudinal Orientation	SV Left Turn Signal Activation	SV Lane Change			SV Path Tolerance	Number of Trials
	SV	POV	SV	POV			Initiation Timing	Steering Release Timing	Lateral Velocity		
Manual speed control, LCC off (Level 0)	45 ± 1 mph (72.4±1.6 km/h)	45 ± 1 mph (72.4±1.6 km/h)	Manually offset within travel lane, then manual lane change into a lane left and adjacent to that of the SV	Constant; 3.3 ± 0.8 ft (1.0±0.25 m) from the right side of the POV to the inboard edge of the lane line immediately to its right Note the POV travel lane is two lanes to the left of the initial SV travel lane.	Constant; POV front located 3.3 ± 1.6 ft (1 ± 0.5 m) ahead of the SV rear	At least 3 seconds after all pre-SV lane change test validity criteria have been satisfied	1.0 ± 0.5 s after the SV turn signal is activated	N/A (SV driver does not release the steering wheel)	2.3 ± 0.3 ft/s (0.7 ± 0.1 m/s)	± 0.8 ft (± 0.25 m) unless a BSI intervention occurs	7
Cruise control, LCC off (Level 0)											7
ACC on, LCC off (Level 1)											7

B. General Information

1. GENERAL VALIDITY CRITERIA

In addition to any validity criteria described above for the individual test scenarios, for an individual trial to be valid, it must have met the following criteria throughout the test:

- The SV driver seatbelt was latched.
- If any load had been placed on the SV front passenger seat (e.g., for instrumentation), the vehicle's front passenger seatbelt was latched.
- When operating the SV in automation level 0 within the validity period, SV speed was maintained by (1) the SV driver manually modulating the SV accelerator pedal, or (2) use of conventional cruise control unless the SV BSI system automatically terminated its operation.
- Operating the SV in automation level 1 required the SV ACC (i.e., not the vehicle's lane centering system) to be enabled and in operation unless the SV BSI system automatically terminated its operation.
- Operating the SV in automation level 2 or 3 required the SV ACC and lane centering systems both be enabled and in operation.
- The SV driver did not provide manual inputs to the SV accelerator or brake pedals while the SV was being operated in automation level 1 (i.e., while ACC was actively modulating the SV speed), 2, or 3.
- The POV was driven at constant speed.
- The lateral distance between the right side of the POV and the inboard edge of the lane line immediately to its right was 3.3 ± 0.8 ft (1.0 ± 0.25 m).
- When the SV was being operated in automation level 0 or 1, the SV yaw rate did not exceed ± 1.0 deg/s from the onset of the validity period until the initiation of the SV lane change.

2. PRE-TEST INITIALIZATION AND CALIBRATION

A zero calibration was performed to align the lateral and longitudinal zero for the vehicles immediately before and after testing. The "zero position" was determined by positioning the SV and POV such that the centerline of the front-most location of the POV is aligned with the centerline of the rear-most location of the SV. Longitudinally, the front of the front bumper of the POV was placed at the rear of the rear bumper of the SV.

Static calibrations were then performed by placing the SV and POV transmissions in park, or with the system brake enabled, where applicable. Data were then collected for approximately 10 seconds using data from at least six GPS satellites.

C. Principal Other Vehicle

For tests in which a vehicle-to-vehicle collision will not occur, such as the False Positive tests, a high production, mid-sized passenger car was used as the POV. The tests reported herein made use of a 2006 Acura RL.

For tests in which a collision may occur, BSI testing requires a POV that realistically represents typical vehicles, does not suffer damage or cause damage to a test vehicle in the event of collision, and can be accurately positioned and moved during the tests. The tests reported herein made use of the Global Vehicle Target (GVT) secured to a low-profile robotic vehicle (LPRV).

This GVT system was designed for a wide range of pre-crash scenarios including scenarios which BSI systems address. The key components of the GVT system are:

- A soft GVT, which is visually and dimensionally similar to a 2013 Ford Fiesta hatchback. It is designed to appear realistic to the sensors used by automotive safety systems and automated vehicles: radar, camera, and lidar. Appropriate radar characteristics are achieved by using a combination of radar-reflective and radar-absorbing material enclosed within the GVT's vinyl covers. Internally, the GVT consists of a vinyl-covered foam structure. If a test vehicle impacts the GVT at low speeds, it is designed to separate, and is typically pushed off and away from the supporting LPRV platform. At higher impact speeds, the GVT breaks apart as the SV essentially drives through it. The GVT can be repeatedly struck from any approach angle without harm to those performing the tests or the vehicles being evaluated. Reassembly of the GVT occurs on top of the robotic platform and takes a team of 3 to 5 people approximately 7 to 10 minutes to complete.
- An LPRV platform that supports the GVT and provides for precisely controlled GVT motion. The LPRV contains the batteries, drive motors, GPS receiver, and the control electronics for the system. It has a top speed of 50 mph (80 km/h); a maximum longitudinal acceleration and deceleration of 0.12 g (1.18 m/s^2) and 0.8 g (7.8 m/s^2), respectively; and a maximum lateral acceleration of 0.5 g (4.9 m/s^2). The LPRV is preprogrammed and allows the GVT's movement to be accurately and repeatedly choreographed with the test vehicle and/or other test equipment required by a pre-crash scenario using closed-loop control. The LPRV is designed to be safely driven over by the SV without damage if the GVT is struck by the SV.

The key requirements of the POV element are to:

- Provide an accurate representation of a real vehicle to BSI and BSD sensors, including cameras and radar.
- Be resistant to damage and inflict little or no damage to the SV as a result of repeated SV-to-POV impacts.

The key requirements of the POV delivery system are to:

- Accurately control the nominal POV speed up to 50 mph (80 km/h).
- Accurately control the lateral position of the POV within the travel lane.
- Allow the POV to move away from the SV after an impact occurs.

Operationally, the GVT body is attached to LPRV using Velcro hook and loop fasteners. The GVT and LPRV are designed to separate if the GVT is struck by the SV. The GVT/LPRV system is shown in Figures A6 and A7 in Appendix A and a detailed description can be found in the NHTSA report: "A Test Track Comparison of the Global Vehicle Target (GVT) and NHTSA's Strikeable Surrogate Vehicle (SSV)".[3]

D. Throttle Controller

The actual vehicle POV was equipped with a programmable throttle controller, which was used for the False Positive Assessment test scenario to modulate the speed and headway overlap. The throttle controller system consisted of the following components:

- Electronically controlled servo motor, mounted on an aluminum rail system and installed in the vehicle.
- Real time computer (Arduino).

E. Instrumentation

Table 4 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

[3] Snyder, A.C., Forkenbrock, G.J., Davis, I.J., O'Harra, B.C., and Schnelle, S.C., A Test Track Comparison of the Global Vehicle Target (GVT) and NHTSA's Strikeable Surrogate Vehicle (SSV), DOT HS 812 698, Vehicle Research and Test Center, National Highway Traffic Safety Administration, Washington, DC, July 2019.

Table 4. Test Instrumentation and Equipment

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Differential Global Positioning System	Position, Velocity	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots	Horizontal Position: ±1 cm Vertical Position: ±2 cm Velocity: 0.05 km/h	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	N/A
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Accels ± 10g, Angular Rate ±100 deg/s, Angle >45 deg, Velocity >200 km/h	Accels .01g, Angular Rate 0.05 deg/s, Angle 0.05 deg, Velocity 0.1 km/h	SV IMU Oxford Inertial +	2258	By: Oxford Technical Solutions Date: 5/3/2019 Due: 5/3/2021
				POV IMU Oxford Inertial +	2182	Date: 9/16/2019 Due: 9/16/2021
				LPRV IMU Oxford Inertial +	2176	Date: 6/26/2020 Due: 6/26/2022
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec Longitudinal Range to POV: ±200 m Longitudinal Range Rate: ±50 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec Longitudinal Range: ±3 cm Longitudinal Range Rate: ±0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	N/A

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Microphone	Sound (to measure time at alert)	Frequency Response: 80 Hz – 20 kHz	Signal-to-noise: 64 dB, 1 kHz at 1 Pa	Audio-Technica AT899	N/A	N/A
Light Sensor	Light intensity (visual alert)	Spectral Bandwidth: 440 - 800 nm	Rise Time < 10 ms	DRI designed and developed light sensor	N/A	N/A
Accelerometer	Acceleration (to measure time at alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	N/A	N/A
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and 100 psi	Omega DPG8001	17042707002	Date: 8/18/2020 Due: 8/18/2021
Platform Scales	Vehicle Total, Wheel, and Axle Load	2200 lb/platform	0.1% of reading	Intercomp SW wireless	0410MN20001	Date: 4/20/2020 Due: 4/20/2021
Coordinate Measurement Machine	Point x,y,z location	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm, Fusion	UO8-05-08-06636	Date: 1/6/2020 Due: 1/6/2021

Type	Description	Mfr, Model	Serial Number
Data Acquisition System	Data acquisition is achieved using a dSPACE MicroAutoBox II. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the MicroAutoBox.	dSPACE Micro-Autobox II 1401/1513	
		Base Board	549068
		I/O Board	588523
Steering Controller	Precise controlled steering is accomplished using a steering machine designed and constructed by DRI. DRI has used its Automated Vehicle Controller (AVC) steering machine for many vehicle tests including FMVSS 126 tests. It can provide up to 65 ft-lb torque and rates over 1300 deg/sec. The integrated angle encoder has an unlimited range with a resolution of 0.045 degrees and an accuracy of ±0.045 degrees. The steering motor is controlled by a MicroAutoBox II from dSPACE, which also acts as the data acquisition system.	DRI developed	N/A
Throttle Controller	Arduino based, servo actuated controller for managing POV speed	DRI developed	N/A

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle

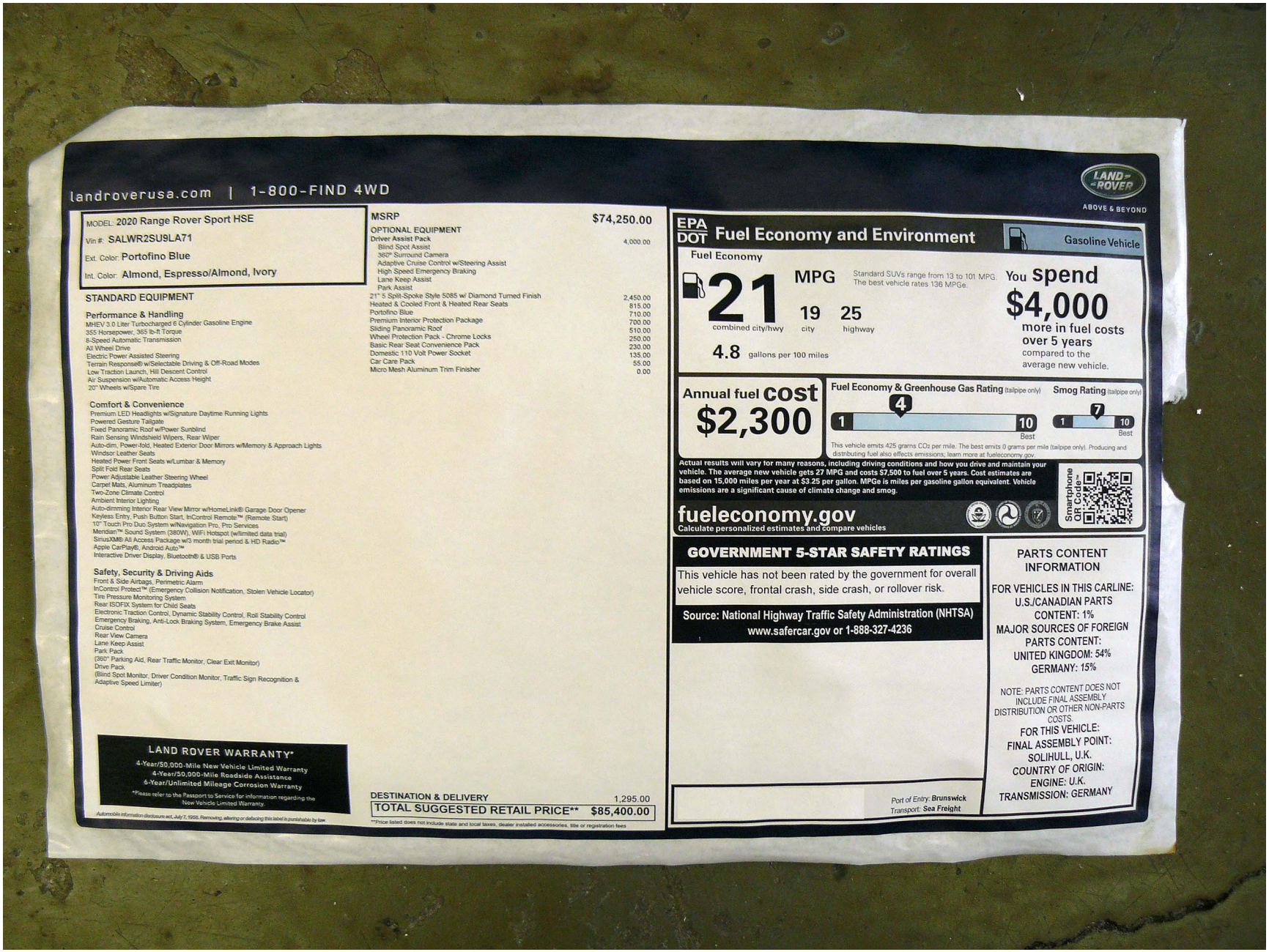


Figure A3. Window Sticker (Monroney Label)

Figure A4. Vehicle Certification Label

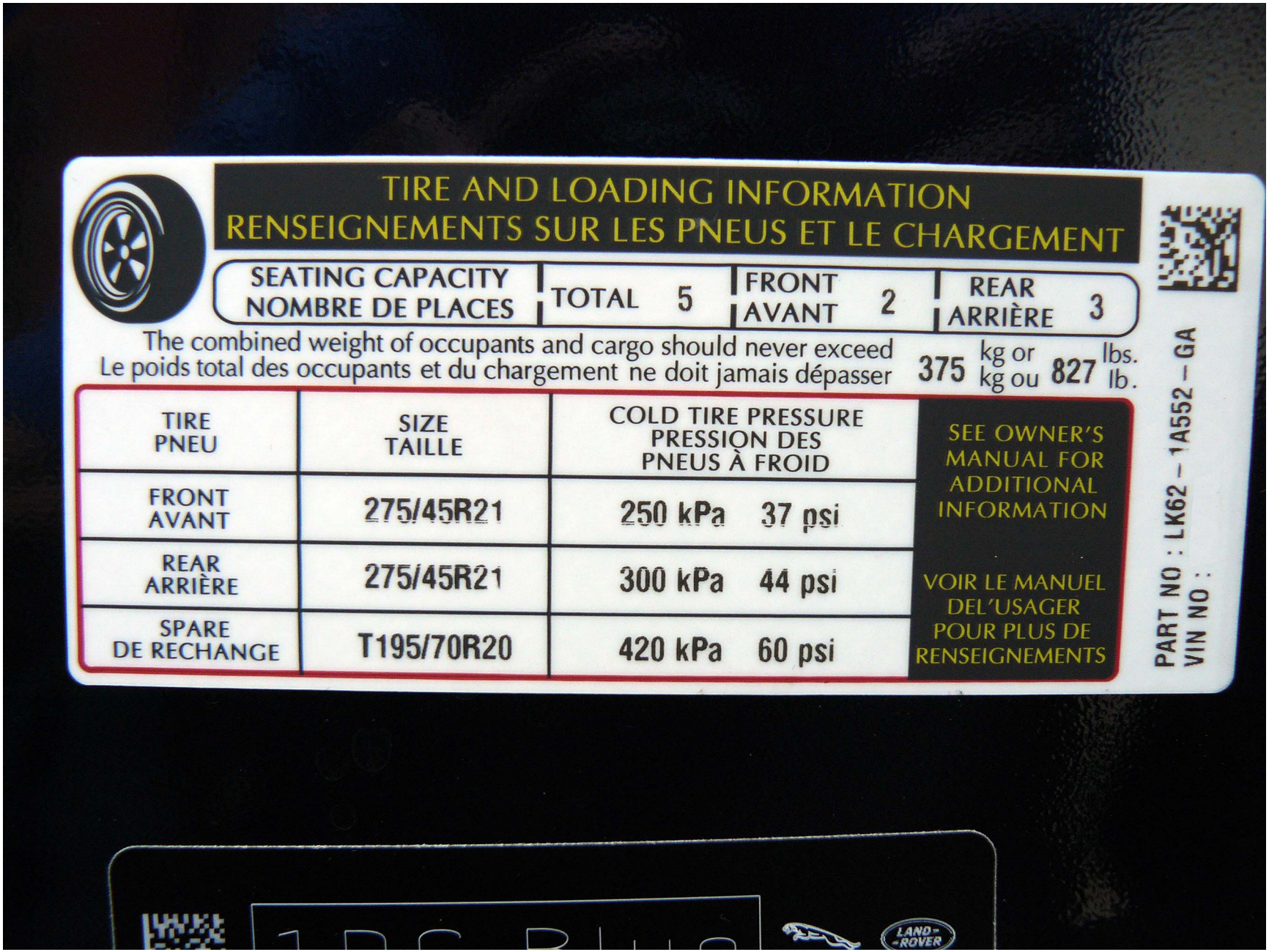


Figure A5. Tire Placard

Figure A6. Front View of Principal Other Vehicle - GVT (Tests 1 and 2)

Figure A7. Rear View of Principal Other Vehicle - GVT (Tests 1 and 2)

Figure A8. Front View of Principal Other Vehicle (Test 3)

Figure A9. Rear View of Principal Other Vehicle (Test 3)

Figure A10. Sensor for Detecting Visual Alerts

Figure A11. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A12. Computer and Steering Controller Installed in Subject Vehicle

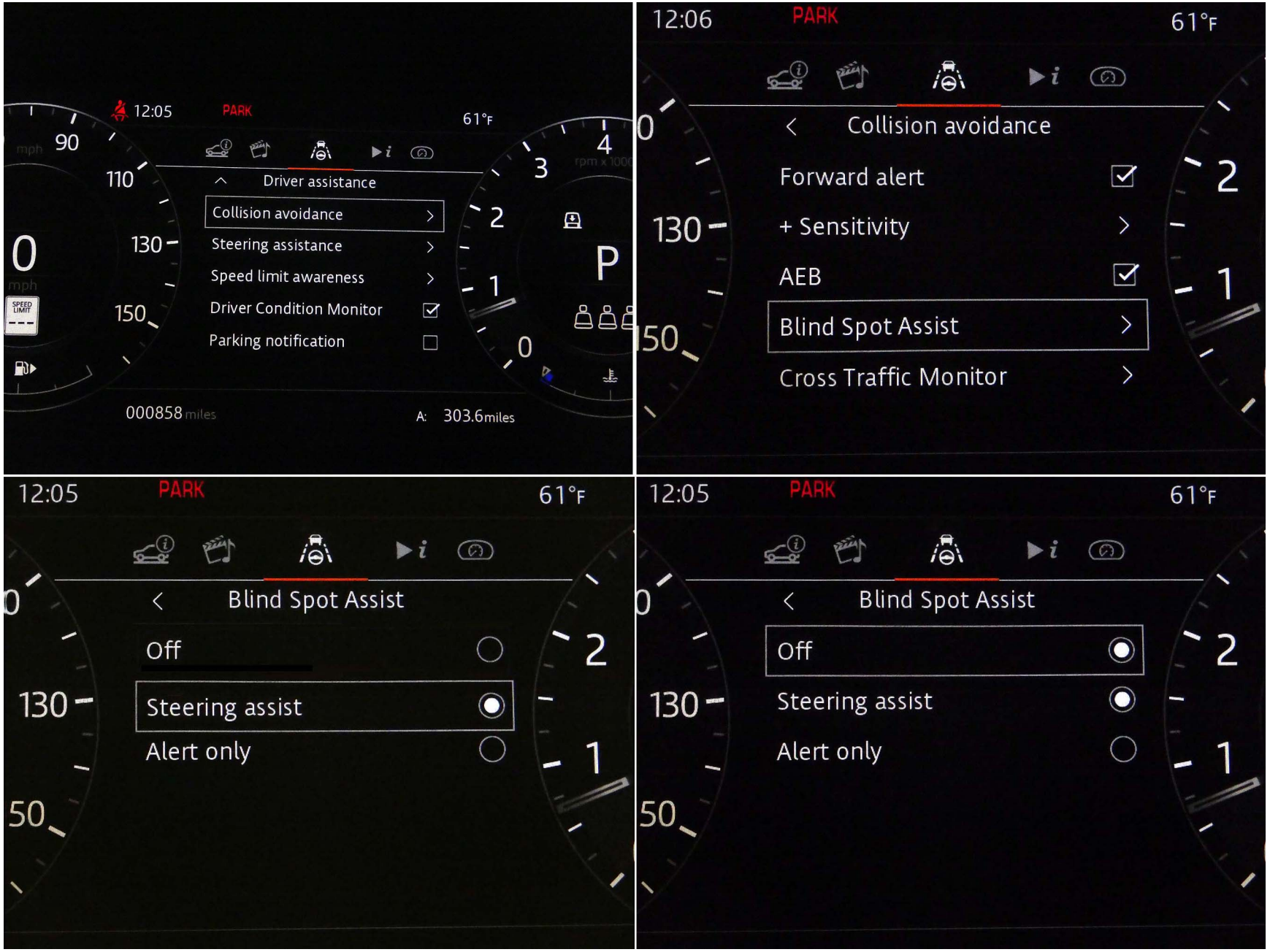


Figure A13. System Setup Menus

Figure A14. Controls for Interacting with System Menus

APPENDIX B

Excerpts from Owner's Manual

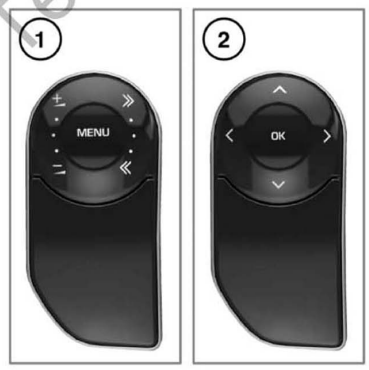
1. **CHARGE** zone: When the vehicle is decelerating during braking or overrun, the electric motor regenerates energy and supplies a charge to the hybrid battery. The charge zone indicates the instantaneous amount of the regenerated energy.
2. **0% POWER**: Indicates when there is no energy being consumed or regenerated.
3. Power gauge marker: Moves to indicate the current power being delivered by the engine and the electric motor.
4. **ECO** zone: Driving in this zone helps to reduce energy consumption.
5. Engine start marker: Displays when the Electric Vehicle (EV) mode is active and indicates the maximum power output of the electric motor. If the current power demand exceeds the start marker position, the engine is started for temporary use. In this event the EV mode is suspended and the engine start marker illuminates gray. If the EV mode is deselected or canceled the engine start marker extinguishes.
6. **READY** or **OFF** status: Indicates when the vehicle is ready to be driven.
7. **EV**: Illuminates to confirm selection of the EV mode via the center console button. See **135, ELECTRIC VEHICLE (EV) MODE**.
   If selected, **SAVE** replaces **EV**. See **138, SAVE**.
8. **100% POWER**: Indicates the maximum power output for the engine.
9. **BOOST** zone: Indicates when the engine and the electric motor are combined to increase the total power output.
10. Gear selector status display.
11. Hybrid battery charge gauge: Indicates the state of charge.

INSTRUMENT PANEL MENU

⚠WARNING

Do not operate the instrument panel controls while the vehicle is moving. Doing so may cause driver distraction, potentially resulting in an accident and causing serious injury or death.

Use the instrument panel menus to configure the instrument panel display and some vehicle features. Use the controls mounted on the left side of the steering wheel to display and navigate through the instrument panel menus.



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Operate the instrument panel menus as follows:

Instrument panel

1. **MENU** button: Press and release to display the instrument panel menus. The **MENU** button extinguishes and the **OK** button illuminates.
   The menus do not display if the instrument panel displays any warning or information messages. In this event, press the **OK** button to clear each message after reading and taking any required action. See **66, WARNING AND INFORMATION MESSAGES**.
2. Operate the buttons as follows:
   - Press the **>** button or the **<** button, to scroll through and highlight the required main menu option, displayed at the top of the information panel. The relevant sub-menu list is automatically displayed.
   - Press the ∧ button or the ∨ button, to scroll through the sub-menu list and highlight the required menu.
   - Press and release the **OK** button, to view the sub-list options for the highlighted sub-menu. Scroll up or down to the required option.
   - Press and release the **OK** button to select or deselect the required sub-list option.
   - Press and release the **<** button to return to the previous menu list.
   - Press and hold the **<** button to close and exit the instrument panel menus. The **OK** button extinguishes and the **MENU** button illuminates to confirm deselection.

The displayed menu options are as follows:

- **Phone**: Only available when a phone is connected.
- **Media**.
- **Driver assistance**.
- **Trip**.
- **Display**. The interactive driver display is configurable. Use the **Display layout** menu to select a **Two dial**, **One dial**, **Full map**, **Media**, or a **Driver assistance** view.
- **Head-up display**.
- **Vehicle settings**.

⚠WARNING

Before making any changes to the Vehicle settings, make sure to read and fully understand the relevant sections and topics of the Owner's Handbook. Failure to do so can lead to serious injury or death.

- **Vehicle info**: Some options are only available before the engine starts.

WARNING AND INFORMATION MESSAGES

⚠WARNING

Do not ignore any warning or information messages displayed in the instrument panel. Take appropriate action as soon as possible. Failure to do so may result in death, serious injury, or serious damage to the vehicle.

The instrument panel displays warning messages if specific driver action is required, or to accompany illuminated warning lamps. For example, in the event that a vehicle system fault is detected.

The instrument panel displays information messages if specific driver action is required, or for driver information. For example, to confirm and assist with the selection or deselection of some vehicle features.

To extinguish an instrument panel warning or information message, press the **OK** button on the steering wheel controls.

Note: *Extinguishing displayed warning and information messages does not clear or rectify a detected fault.*

Note: *If a warning message is manually extinguished, the instrument panel illuminates an amber or red warning lamp until the cause of the message is rectified.*

If a persistent fault is detected, the warning message displays each time the ignition is switched on. In this event, follow any on-screen instructions or seek qualified assistance.

Instrument panel messages are displayed in order of importance. If more than one instrument panel message is active, each message is displayed in turn for 2 seconds. High importance warning messages are displayed first. The displayed warning messages can also be accompanied by an audible tone.

Some warning messages can also display the handbook symbol. For information regarding warning messages and any action required, refer to the warning and information lamps section of the Owner's Handbook. Follow any on-screen instructions, if displayed. The instrument panel displays a warning message until the detected fault is rectified.

USING THE TRIP COMPUTER

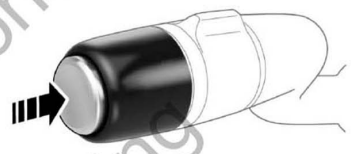
The trip computer displays information and stores data for a series of trips.

A trip is the distance traveled since the last memory reset via the trip computer. The maximum trip distance display is 9 999.9 (km or miles). The trip distance then automatically resets to zero.

Select the **Trip** and **Trip bank** instrument panel menus to display the required trip, i.e., **Trip A**, **Trip B**, or **Trip Auto**. See **65, INSTRUMENT PANEL MENU**.

The trip computer can be configured to display the trip units in miles or km. Select the **Trip** and **Units** instrument panel menus.

To configure the trip content options to be available for display in the instrument panel, select the **Trip** and **Content** instrument panel menus.



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Press and release the trip button to change the trip content option displayed in the instrument panel.

The available trip content options are as follows:

- **Date**.
- **Average speed**.
- **Average economy**.
- **Instantaneous economy**.
- **Range**.
- **Battery range**: Hybrid vehicles only.
- **Trip distance**.

Some of the trip content values can be reset to zero. Select and display the relevant trip content option. Press and hold the trip buttons for 2 seconds.

The distance, average speed, and average fuel economy values for the trips can be reset. Set the trip computer display to show the required trip to reset. Press and hold the trip button until the instrument panel displays the **Resetting** message.

Select the **Trip** and **Trip Auto** instrument panel menus to automatically reset **Trip Auto** each time the ignition is switched on.

Select the **Trip bank** and **Trip Auto** instrument panel menus to add, or remove, another trip figure to the **Trip Auto** figure. Press the trip button for longer than 1 second, when the **Trip Auto** values for distance, average speed, and average fuel economy are displayed. The instrument panel displays either the **Adding last journey** or **Removing last journey** message. Press the trip button for longer than 1 second to select the desired option. The previous trip information is added to, or removed from, the **Trip Auto** value. The new total is displayed. There is no limit to the number of times this can be done before the ignition is switched off.

RANGE

The **Range** and **Battery range** displays show the predicted distance in miles or km that the vehicle can travel. See **67, USING THE TRIP COMPUTER**.

Range: Displays the total predicted driving distance for the current fuel tank level and the amount of charge in the hybrid battery.

Battery range: Displays the predicted driving distance for the amount of charge in the hybrid battery.

SERVICE INTERVAL INDICATOR

The next oil service interval can be displayed via the **Vehicle info** and **Next service** instrument panel menus. See **65, INSTRUMENT PANEL MENU**.

Note: *Dependent on the vehicle's specification, other fluid intervals and capacities may also be displayed.*

The oil service interval displays as a distance left until the service is due. If the distance is exceeded, the display shows a negative (-) value to indicate that a service is overdue.

HEAD-UP DISPLAY (HUD)

⚠WARNING

Do not operate or adjust the Head-Up Display (HUD) system while the vehicle is moving. Doing so may cause driver distraction, potentially resulting in an accident and causing serious injury or death.

Note: *The HUD system may take more time to display in extreme temperatures, allowing the system to operate at the correct temperatures.*

Note: *The full HUD image may not be viewed correctly while wearing polarized sunglasses.*

Note: *Do not place anything over the HUD unit, which is located above the instrument panel, next to the windshield.*

Note: *In the interest of safety, only operate or adjust the HUD system when it is safe to do so.*

The HUD system projects some of the information currently displayed in the instrument panel onto the inside of the windshield.

Use the **Head-up display** and **Enable HUD** instrument panel menus to switch the HUD system **On** or **Off**. See **65, INSTRUMENT PANEL MENU**.

The HUD system also displays some instrument panel warning lamps. See **72, WARNING LAMPS AND INDICATORS**.

Use the **Head-up display** and **HUD content** instrument panel menus to view a list of vehicle features for the HUD system to display. Select the required **On** or **Off** option for each feature. The HUD system only displays the vehicle features that are currently displayed in the instrument panel.

Note: *The position and format of the displayed HUD information varies due to priority and the number of features currently switched on or off.*

Setting the correct HUD position is important. The correct position is dependent on a number of conditions, including the height of the driver and the seat position.

Note: *Before setting the position of the HUD, make sure that the driver's seat is correctly positioned. The HUD level should be set horizontally, within the driver's vision.*

Use the **Head-up display** and **Position** instrument panel menus to set the HUD position. Follow the on-screen instructions to adjust the HUD position using the steering wheel controls. Press the **OK** button to confirm and exit the menu. Preferences are stored using the driver's seat memory store button. See **29, SEAT POSITION MEMORY**.

The brightness of the HUD display is set automatically to suit the current ambient light conditions. To manually adjust the brightness, use the **Head-up display** and **Brightness** instrument panel menus. Follow the on-screen instructions to adjust the HUD brightness using the steering wheel controls. Press the **OK** button to confirm and exit the menu.

The speedometer units displayed in the HUD system are the same as the instrument panel's speedometer units.

If cleaning is required, follow the cleaning instructions. See **375, CLEANING SCREENS AND DISPLAYS**.

The high-speed emergency braking feature attempts to slow the vehicle automatically if it detects that a collision with a slower vehicle ahead is unavoidable. The high-speed emergency braking feature operates at all speeds. The feature also operates if forward alert is switched off.

A warning sounds if the high-speed emergency braking feature detects that a collision is imminent. The high-speed emergency braking feature automatically applies the brakes if it detects that a collision is unavoidable. The instrument panel displays **IEB system not available (was activated)** after the high-speed emergency braking feature has been activated.

Note: *The high-speed emergency braking feature does not work again until the system has been reset by a retailer/ authorized repairer.*

HIGH-SPEED EMERGENCY BRAKING LIMITATIONS

Make sure the following warnings have been read and fully understood before driving the vehicle. The high-speed emergency braking feature does not take away the requirement to always drive with due care and attention. Driving without due care and attention could result in an accident, leading to serious injury or death.

⚠WARNING

The high-speed emergency braking feature may not react to slow-moving vehicles.

⚠WARNING

The high-speed emergency braking feature does not react to stationary vehicles or vehicles traveling in the opposite direction.

The distance required to slow or stop the vehicle is dependent on the condition of the vehicle's tires and the road surface.

BLIND SPOT MONITOR

⚠WARNING

Make sure the relevant safety warnings have been read and understood before driving the vehicle. See 193, COLLISION AVOIDANCE SAFETY.

The blind spot monitor system monitors an area adjacent to, and approximately 28 ft (8.5 m) behind, the vehicle. When the system detects an overtaking vehicle, the amber warning icon (**1**):

- Flashes if the relevant turn signal is being used.
- Illuminates continuously if the relevant turn signal is not being used.
- Extinguishes when the system no longer detects a vehicle in the monitored area.

During initialization, the warning icons flash in both door mirrors.

A warning indicator (**2**) illuminates in the door mirrors when the blind spot monitor system is disabled, not active, or there is a system fault.

The blind spot monitor system can be switched on and off via the **Driver assistance** instrument panel menu. See **65, INSTRUMENT PANEL MENU**.

BLIND SPOT MONITOR LIMITATIONS

The blind spot monitor system does not operate when:

- Reverse (**R**) or Park (**P**) is selected.
- The vehicle's speed is below 6 mph (10 km/h).
- The radar sensors become blocked or stop working.
- The door mirrors stop working.
- An electrical connector is connected to a Jaguar Land Rover approved trailer socket.

  Note: *The blind spot monitor system remains disabled if a trailer is disconnected from the trailer socket while the engine is still running. Switch the vehicle's ignition off, then back on again, to enable the blind spot monitor system.*

The blind spot monitor system:

- Works most effectively on multi-lane highways.
- Monitors an area of approximately 11 ft (3.3 m) from the side of the vehicle, and approximately 28 ft (8.5 m) behind the vehicle.
- May register false targets if traveling along a narrow lane.
- Does not work accurately if the sensors are misaligned due to bumper modifications, impact damage, etc.

The instrument panel and touchscreen display messages to inform the driver of any performance or system issues.

BLIND SPOT MONITOR RADIO FREQUENCY SPECTRUM REGULATION STATEMENTS

United States of America

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

Note: *The manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment. Such modifications could void the user's authority to operate the equipment.*

Canada

This device complies with Industry Canada Standard IC - RSS-210 and IC-RSS-251.

Operation is subject to the following two conditions:

1. this device may not cause interference, and
2. this device must accept any interference, including interference that may cause undesired operation of the device.

Frequency of operation: 24.05GHz - 24.25GHz.

Field strength: Not greater than 2.5V/m peak (0.25V/m average) at a distance of 3 meters.

CLOSING VEHICLE SENSING

⚠WARNING

Make sure the relevant safety warnings have been read and understood before driving the vehicle. See 193, COLLISION AVOIDANCE SAFETY.

The closing vehicle sensing system monitors an area adjacent to, and up to approximately 230 ft (70 m) behind, the vehicle. Closing vehicle sensing is automatically switched on when the blind spot monitor system is switched on. See **198, BLIND SPOT MONITOR**.

An amber warning icon (**1**) is located in each door mirror. The icon:

- Illuminates continuously if the detected vehicle enters the area monitored by the blind spot monitor system, and the relevant turn signal is not being used. See **198, BLIND SPOT MONITOR**.
- Flashes if the detected vehicle enters the area monitored by the blind spot monitor system, and the relevant turn signal is being used. See **198, BLIND SPOT MONITOR**.

A warning indicator (**2**) illuminates in the door mirrors when the closing vehicle sensing system is disabled, not active, or there is a system fault.

CLOSING VEHICLE SENSING LIMITATIONS

The closing vehicle sensing system does not operate when:

- Reverse (**R**) or Park (**P**) is selected.
- The vehicle's speed is below 6 mph (10 km/h).
- The sensors become blocked.
- The blind spot monitor system is not operating.
- The vehicle is traveling around a tight bend.
- An electrical connector is connected to a Jaguar Land Rover approved trailer socket.

Note: *The closing vehicle sensing system remains disabled if a trailer is disconnected from the trailer socket while the engine is still running. Switch the vehicle's ignition off, then back on again, to enable the closing vehicle sensing system.*

The closing vehicle sensing system:

- Works most effectively on multi-lane highways.
- Monitors an area of approximately 11 ft (3.3 m) from the side of the vehicle, and approximately 230 ft (70 m) behind the vehicle.

- May register false targets if traveling along a narrow lane.
- Does not work accurately if the sensors are misaligned due to bumper modifications, impact damage, etc.

The instrument panel and touchscreen display messages to inform the driver of any performance or system issues.

BLIND SPOT ASSIST

⚠WARNING

Make sure the relevant safety warnings have been read and understood before driving the vehicle. See 193, COLLISION AVOIDANCE SAFETY.

The blind spot assist system applies corrective steering inputs if:

- A vehicle is detected in the blind spot monitor area, and:
- A lane change maneuver is attempted.

If a lane change maneuver is initiated while a risk is detected, the relevant door mirror displays a flashing vehicle warning icon.

At the same time, a rotational force is applied to the steering wheel to counter the lane change. The instrument panel displays a warning icon when a rotational force is applied to the steering wheel. The Head-Up Display (HUD) also displays a warning.

Note: *Blind spot assist operates irrespective of the turn signals being used.*

If required, the steering input provided by the blind spot assist system can be overridden in order to complete a lane change maneuver.

The blind spot assist system can be switched on and off via the **Driver assistance** instrument panel menu. See **65, INSTRUMENT PANEL MENU**.

When switched on, the blind spot assist system must then be activated. Press the button located on the steering wheel (**1**) to activate the blind spot assist system. Press the button a second time to deactivate the system. The button icon illuminates to confirm system status.

Note: *The steering wheel button (**1**) also controls operation of the lane departure warning and Lane Keep Assist (LKA) systems. See **211, LANE DEPARTURE WARNING** and **213, LANE KEEP ASSIST (LKA)**.*

BLIND SPOT ASSIST LIMITATIONS

The blind spot assist system does not operate when:

- Reverse (**R**) or Park (**P**) is selected.

Collision avoidance

- The vehicle's speed is below 40 mph (64 km/h) or above 112 mph (180 km/h).
- The sensors in the rear bumper become blocked.
- The camera under the rear-view mirror becomes blocked.
- The blind spot monitor system is not operating.
- An electrical connector is connected to a Jaguar Land Rover approved trailer socket.

The blind spot assist system:

- Works in conjunction with the blind spot monitor and closing vehicle sensing systems.
- May register false targets if traveling along a narrow lane.
- Does not work accurately if the sensors are misaligned due to bumper modifications, impact damage, etc.

The instrument panel displays messages to inform the driver of any performance or system issues.

FORWARD TRAFFIC MONITOR

⚠WARNING

Make sure the relevant safety warnings have been read and understood before driving the vehicle. See 193, COLLISION AVOIDANCE SAFETY.

⚠WARNING

The driver is responsible for detecting obstacles, and estimating the vehicle's distance from them, when maneuvering the vehicle. Failure to drive with due care and attention could cause an accident, leading to serious injury or death.

Note: *The quality of the camera views may vary in different lighting conditions.*

1. **Vehicle warning** icon.
2. Parking aid plan view.
3. **Camera** icon.
4. **Feature disabled** icon.

The forward traffic monitor feature assists the driver when exiting from an intersection or parking space. The feature increases the visibility available to the driver when carrying out a low speed, forward maneuver.

The feature operates when the vehicle is traveling at speeds of up to 4 mph (6 km/h), down to a standstill. Visual and audible alerts are no longer generated once the vehicle reaches a speed of 4 mph (6 km/h). The touchscreen continues to display camera views at speeds above 4 mph (6 km/h).

Note: *The feature is not autonomous.*

Access to the feature is via the **CAMERA** or **PARKING AID** screens.

Switch the feature on by touching the **camera** icon (**3**) shortly before attempting a low speed, forward maneuver.

The touchscreen displays the **vehicle warning** icon (**1**) on the relevant side(s) of the screen if an imminent risk of a side impact is detected. An audible warning also sounds.

The feature detects vehicles from either side, traveling at speeds of up to 40 mph (64 km/h), with a time to collision of 3 seconds.

The touchscreen displays the **feature disabled** icon (**4**) if the feature is not available, or a fault is detected. The instrument panel also displays a message if a camera or sensor is blocked.

If a fault is not rectified when the engine is switched off and then on again, consult a retailer/authorized repairer.

REAR TRAFFIC MONITOR

⚠WARNING

Make sure the relevant safety warnings have been read and understood before driving the vehicle. See 193, COLLISION AVOIDANCE SAFETY.

⚠WARNING

The driver is responsible for detecting obstacles, and estimating the vehicle's distance from them, when maneuvring the vehicle. Failure to drive with due care and attention could cause an accident, leading to serious injury or death.

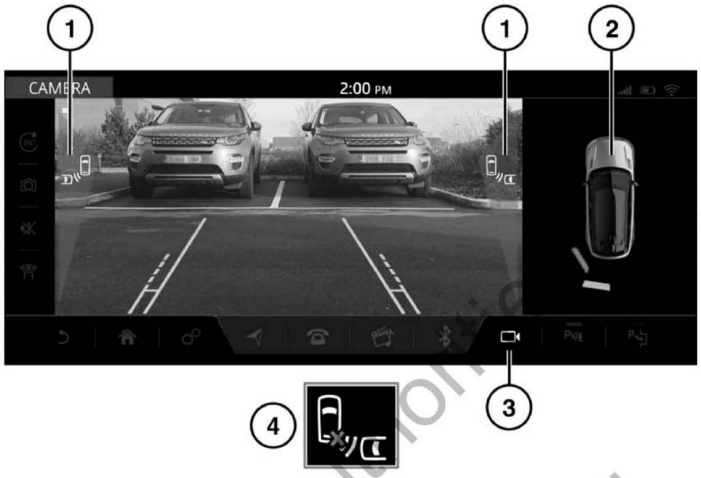
⚠WARNING

The rear camera and bumper must be kept clean and free from debris or obstructions, e.g., ice, frost, snow, leaves, mud, or insects. Failure to keep the rear camera and bumper clear may result in miscalculations, or false indications. Miscalculations and false indications could cause an accident, leading to serious injury or death.

Note: *The quality of the camera views may vary in different lighting conditions.*

Note: *Depending on the vehicle specification and market in which the vehicle is used, an audible and visual warning is provided during a reversing maneuver.*

Collision avoidance



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1. **Vehicle warning** icon.
2. Parking aid plan view.
3. **Camera** icon.
4. **Feature disabled** icon.

The rear traffic monitor feature assists the driver when carrying out a reversing manoeuvre.

The rear traffic monitor feature automatically activates when all the following conditions exist:

- The touchscreen is displaying either the **CAMERA** or **PARKING AIDS** screen.
- Reverse (**R**) gear is selected.
- The vehicle is traveling at speeds of less than 10 mph (16 km/h).

To switch from the **CAMERA** view to the **PARKING AIDS** view, touch the parking aid plan view (**2**). To switch from the **PARKING AIDS** view to the **CAMERA** view, touch the **camera** icon (**3**).

The rear traffic monitor feature detects cross traffic vehicles traveling at speeds of up to 34 mph (55 km/h). If activated, the touchscreen displays the **vehicle warning** icon (**1**) on the relevant side(s) of the screen. The warning icon informs the driver the vehicle is about to reverse into the path of a moving vehicle. An audible warning also sounds.

Note: *For vehicles not fitted with blind spot monitor, the vehicle warning icon (**1**) does not appear.*

The touchscreen or instrument panel may also display warning messages.

If required, the rear traffic monitor feature can be disabled via the **Driver assistance** instrument panel menu. See **65, INSTRUMENT PANEL MENU**.

The touchscreen displays the **feature disabled** icon (**4**) if the feature is not available, or a fault is detected. The instrument panel may also display messages.

Note: *If a fault in a single sensor is detected, the entire rear traffic monitor feature is disabled.*

If a fault is not rectified when the engine is switched off and then on again, consult a retailer/authorized repairer.

APPENDIX C

Run Log

Subject Vehicle: **2020 Land Rover Range Rover Sport HSE** Date: **11/11/2020**

Test Engineer: **N. Watanabe**

Run	Test Type	Valid Run	Minimum Distance to POV (ft)	Minimum Distance to Left Lane Edge (ft)	BSI Activated (Y/N)	Contact (Y/N)	Meets Criteria [4]	Notes
18	**Static Run**							
19	**SV Lane Change Constant Headway**	Y	3.48	0.39		No	Yes	
20		Y	0.00	-3.22		Yes	No	
21		Y	0.00	-3.15		Yes	No	
22		N						POV speed, headway
23		Y	3.25	0.19		No	Yes	
24		Y	0.00	-3.15		Yes	No	
25		Y	2.33	-0.59		No	Yes	Ran out of track
26		N						Headway, GPS
27		Y	0.00	-3.08		Yes	No	

[4] The acceptability criteria listed herein are used only as a guide to gauge system performance, and are identical to the Pass/Fail criteria given in NHTSA's most current Test Procedure in docket NHTSA-2019-0102-0001, BLIND SPOT INTERVENTION SYSTEM CONFIRMATION TEST.

Run	Test Type	Valid Run	Minimum Distance to POV (ft)	Minimum Distance to Left Lane Edge (ft)	BSI Activated (Y/N)	Contact (Y/N)	Meets Criteria [4]	Notes
28	SV Lane Change Closing Headway	Y	3.26	0.17		No	Yes	Ran out of track, vehicle headed towards right lane line appeared no intervention would occur on right lane line
29		Y	2.28	-0.84		No	Yes	Ran out of track, vehicle headed towards right lane line appeared no intervention would occur on right lane line
30		N						GPS
31		Y	2.40	-0.68		No	Yes	Ran out of track, vehicle headed towards right lane line appeared no intervention would occur on right lane line
32		N						SV distance to lane line
33		N						GPS, POV distance to lane line, POV speed
34		Y	2.20	-0.59		No	Yes	Vehicle crossed right lane line
35		N						POV distance to lane line
36		N						POV distance to lane line
37		N						POV distance to lane line
38		Y	2.45	-0.61		No	Yes	Ran out of track
39		Y	1.63	-1.47		No	Yes	Ran out of track, vehicle headed towards right lane line appeared no intervention would occur on right lane line
40		Y	2.73	-0.36		No	Yes	Crossed over left line again

Run	Test Type	Valid Run	Minimum Distance to POV (ft)	Minimum Distance to Left Lane Edge (ft)	BSI Activated (Y/N)	Contact (Y/N)	Meets Criteria [4]	Notes
1	**SV Lane Change Constant Headway False Positive Baseline**	Y						
2		Y						
3		N						Distance to lane line
4		Y						
5	**SV Lane Change Constant Headway False Positive Assessment**	N						MABX issue
6		N						POV speed
7		Y					Yes	
8		N						POV speed, distance to lane line
9		N						POV speed
10		Y					Yes	
11		N						POV speed
12		Y					Yes	
13		Y					Yes	
14		Y					Yes	
15		Y					Yes	
16		N						Distance to lane line
17		Y					Yes	

Appendix D

TIME HISTORY PLOTS

LIST OF FIGURES

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 (SV) and Principal Other Vehicle (POV), as well as pass/fail envelopes and thresholds. Plots shown herein are grouped by test type and are presented sequentially within a given test type. 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.

Each time history plot consists of data relevant to the test type under consideration, and therefore the data channels plotted vary according to test type. The test types (shown in the plot titles) include:

- SV Lane Change with Constant Headway
- SV Lane Change with Closing Headway
- SV Lane Change with Constant Headway, False Positive Assessment – Baseline
- SV Lane Change with Constant Headway, False Positive Assessment – Evaluation

Time history figures include the following sub-plots:

- SV Turn Signal – Displays the cycling of the SV turn signal indicator. The bold vertical line indicates the time at which the turn signal is activated.

- Headway (ft) – Longitudinal separation between the rear of the SV and the front of the POV. A negative value for headway indicates that the front-most point of the POV is forward relative to the rear-most point of the SV.

- SV/POV Speed (mph) – Indicates the speed of the SV and POV.

- SV Ax (g) (Vehicles for which the BSI system operates using a brake intervention.) – Displays the SV lateral acceleration. A vertical bold line marked “BSI Onset” indicates the time at which BSI intervention first occurred.

- SV SWA (deg) (Vehicles for which the BSI system operates using a steering intervention.) – Displays the SV steer wheel angle as measured by a steer wheel encoder. A vertical bold line marked “BSI Onset” indicates the time at which the BSI intervention first occurred.

- Yaw Rate (deg/sec) – Yaw rate of the SV. A vertical bold line marked “SW Release” indicates the point at which the control of the steering wheel by the robotic controller is released allowing for free response of the vehicle. If the BSI system operates using a steering wheel input, a vertical bold line marked “BSI Onset” indicates the time at which BSI intervention first occurred.

- Lateral Velocity (ft/s) – Lateral velocity of the SV. For the False Positive scenario, the average lateral velocity calculated from half a second before the lane line crossing to half a second after the lane line crossing is noted. For the other scenarios, the lateral velocity at the time of steering wheel release is noted.

- Distance to Lane Line (ft) – For both the SV and POV, the distance from the outer-most (not including side mirrors) part of the vehicle to the edge of the lane line. The minimum distance from the left side of the SV to the adjacent left side lane is shown. A negative value indicates that the SV has crossed over the left side lane line.

- Minimum Distance (ft) – Distance between the outer-most (not including side mirrors) parts of the SV and POV. The minimum distance between the SV and POV is shown on the right of the plot. Note that this is not shown for False Positive Baseline cases.

- SV Path Deviation (ft) – The SV deviation from its intended path.

Envelopes and Thresholds

Some of the time history plot figures 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. Such exceedances indicate either that the test was invalid or that the requirements of the test were not met (i.e., failure of the BSI system).

For plots with green envelopes, in order for the test to be valid, the time-varying data must 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.

For plots with yellow envelopes, the yellow envelope is used to signify an area of interest over which the data is being averaged. The data may exceed the envelope at any point during this envelope with no impact on the test validity.

For SV Lane Change with Constant Headway, False Positive – Evaluation tests only, a dashed boundary line is shown on the yaw rate plot. This dashed boundary line indicates the allowable yaw rate threshold used to determine the presence of a BSI intervention as defined in the test procedure. Exceedances of this boundary will display red text to the right of the plot.

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. Individual data points
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 distance 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
   - Black threshold (Solid) = define points of interest during the run (i.e., steering wheel release, BSI onset, etc.)

3. Individual data point 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

Other Notations

- NG – Indicates that the value for that variable was outside of bounds and therefore “No Good”.
- POV – Indicates that the value for the Principal Other Vehicle was out of bounds.
- SV – Indicates that the value for the Subject Vehicle was out of bounds.
- Lane Early – Indicates that the lane change was initiated too early relative to the timing criteria listed for the scenario.
- Lane Late – Indicates that the lane change was initiated too late relative to the timing criteria listed for the scenario.
- Collision – Indicates that the SV and POV collided.

The minimum (worst) GPS fix type is displayed in the lower right corner of each page. The only valid fix type is RTK fixed (displayed in green). If the fix type during any portion of the test was anything other than RTK fixed, then “RTK Fixed OR LESS!!” is displayed in red.

Examples of time history plots for each test type (including passing, failing, and invalid runs) are shown in Figures D1 through D3. Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure D4.

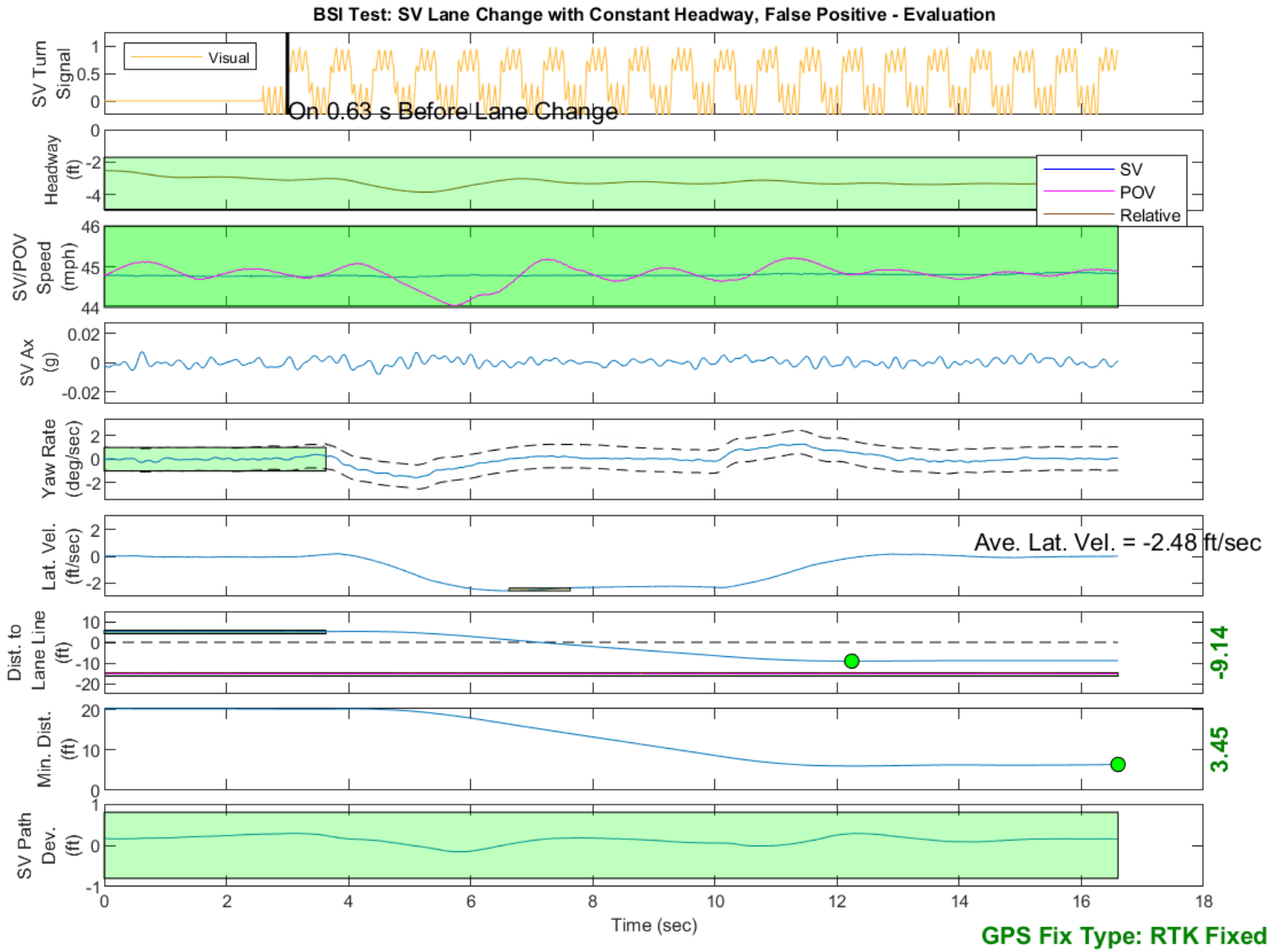

Figure D1. Example Time History for False Positive Evaluation, Passing

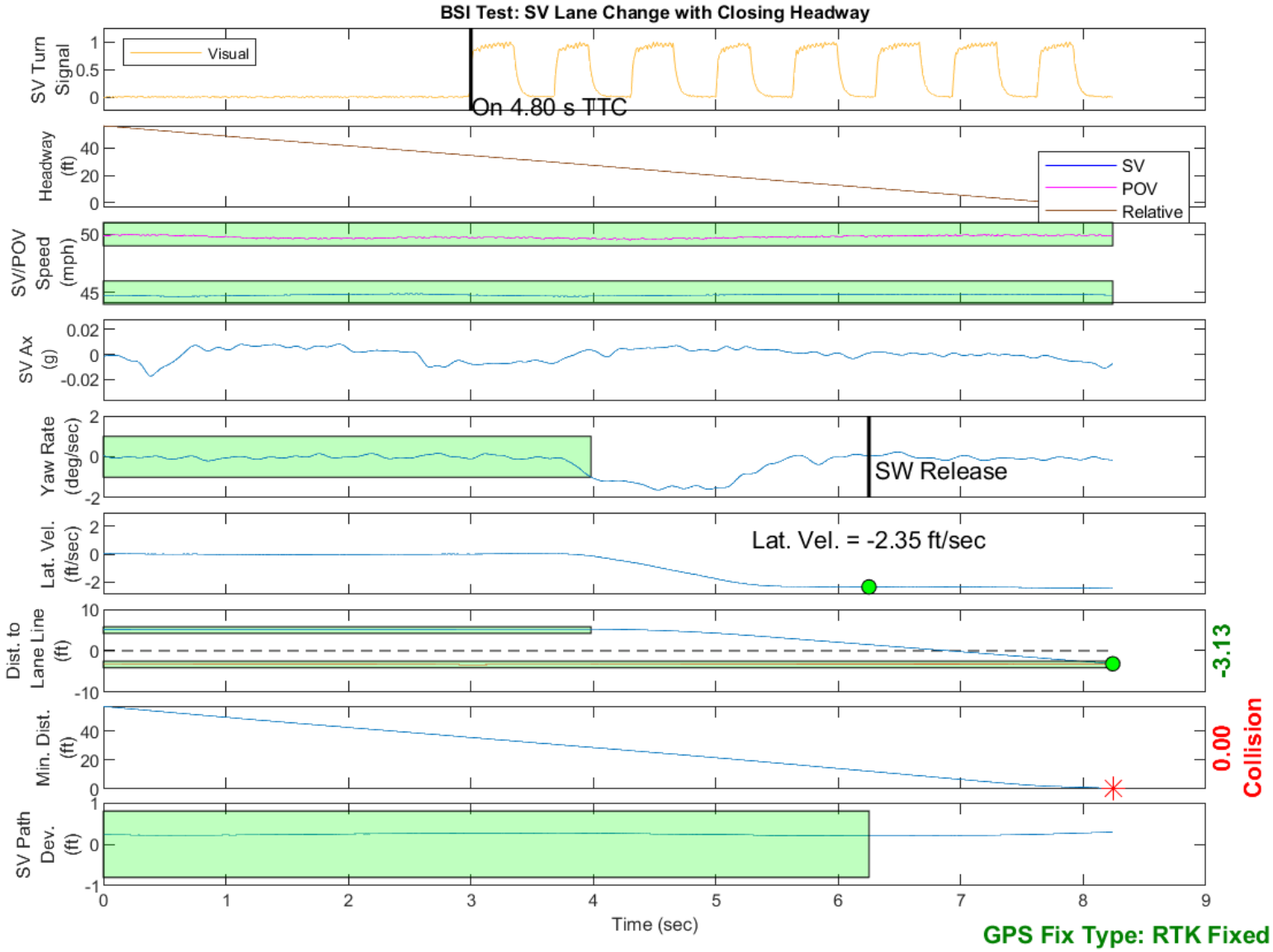

Figure D2. Example Time History for Subject Vehicle with Closing Headway Test, Failing

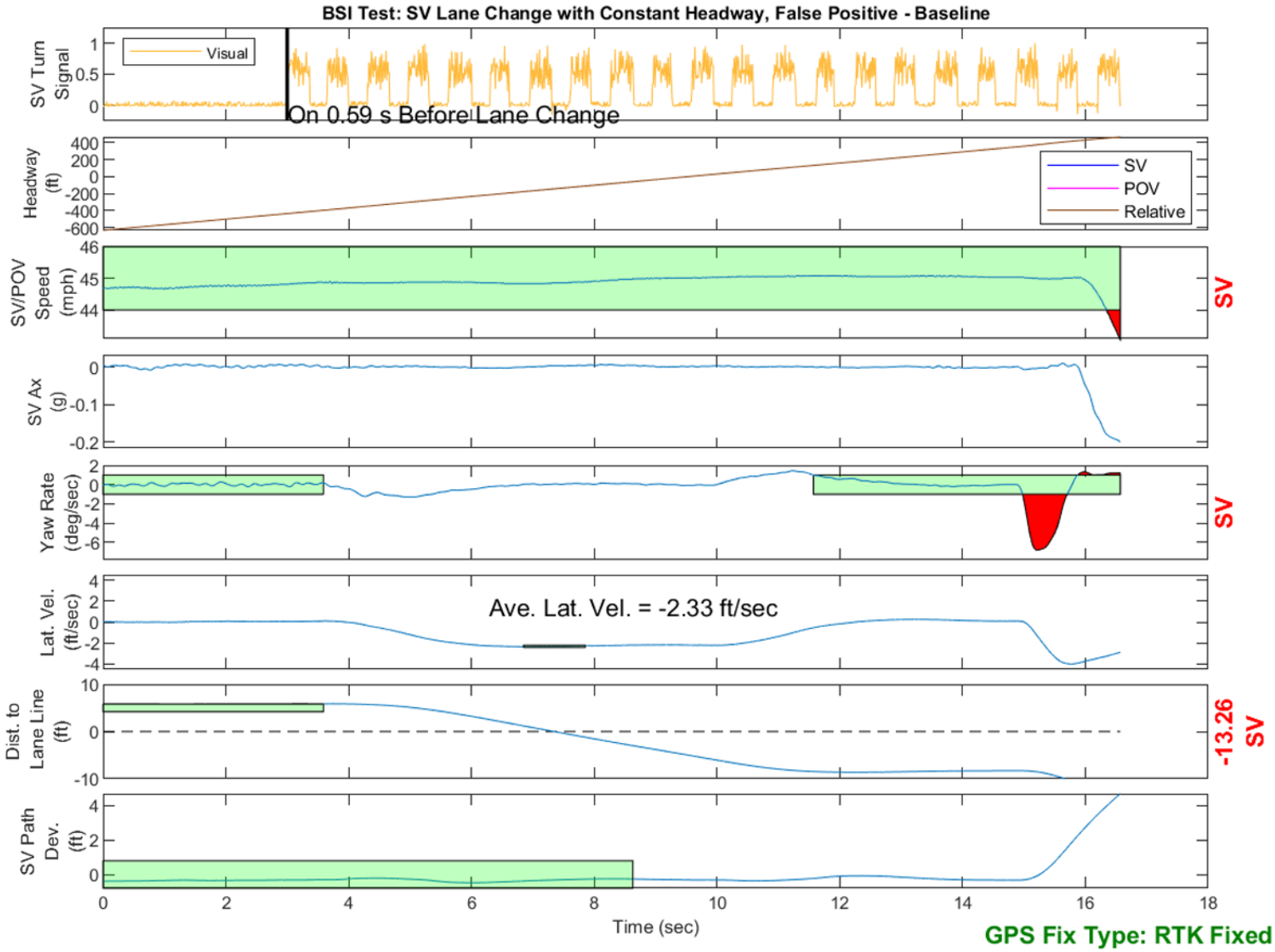

Figure D3. Example Time History for Subject Vehicle with Constant Headway Test, Invalid POV Speed Criteria

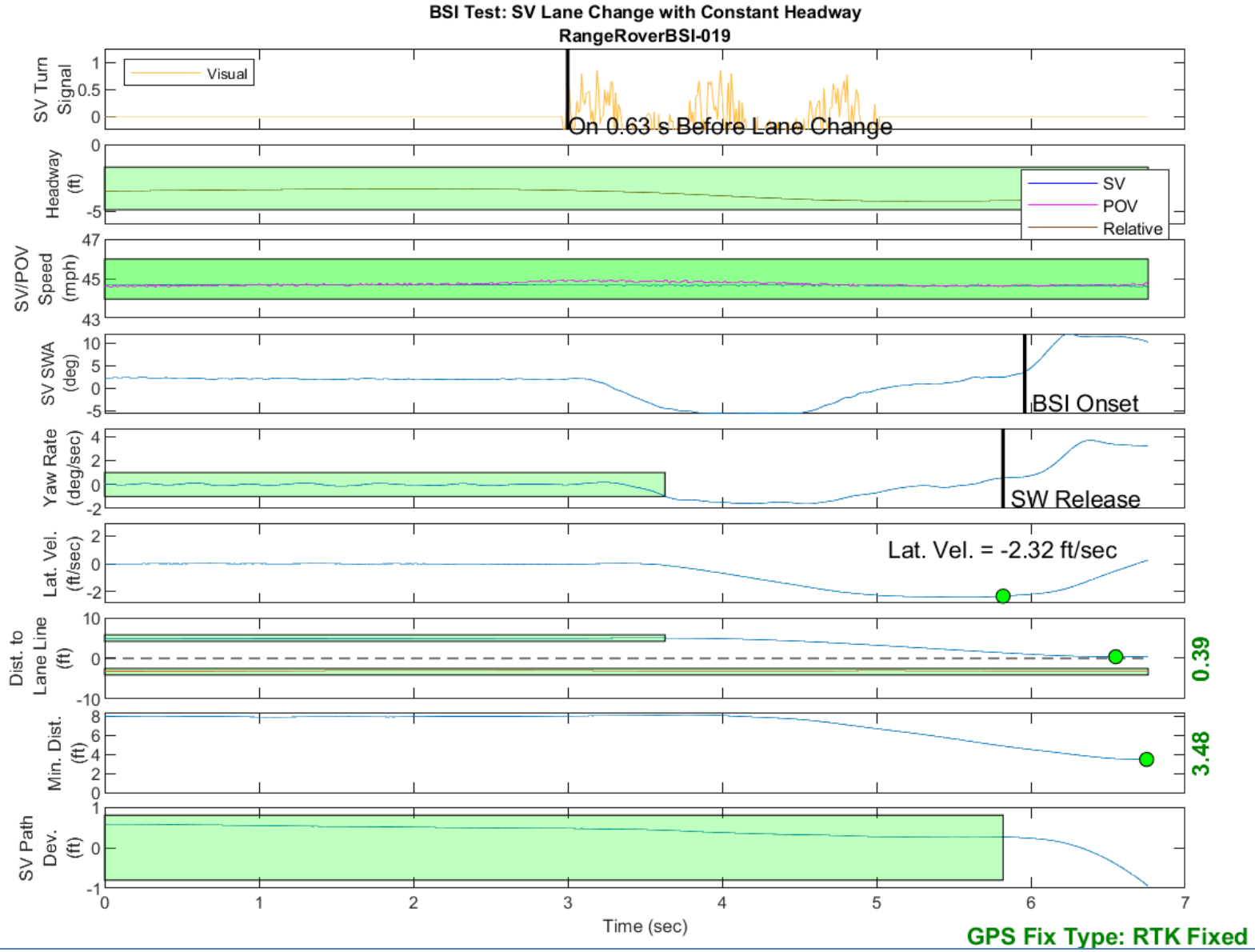

Figure D4. BSI Run 19, Subject Vehicle Lane Change with Constant Headway

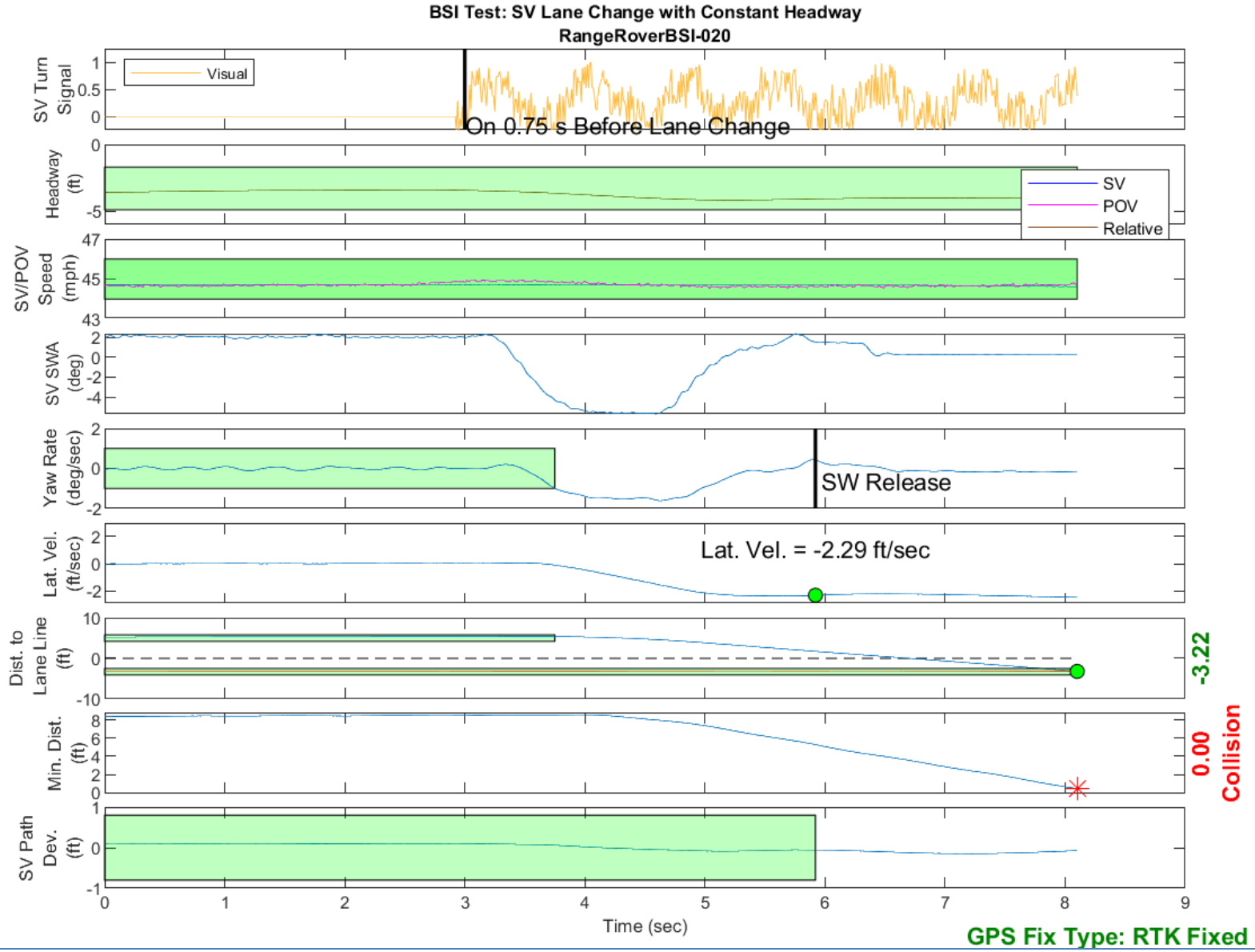

Figure D5. BSI Run 20, Subject Vehicle Lane Change with Constant Headway

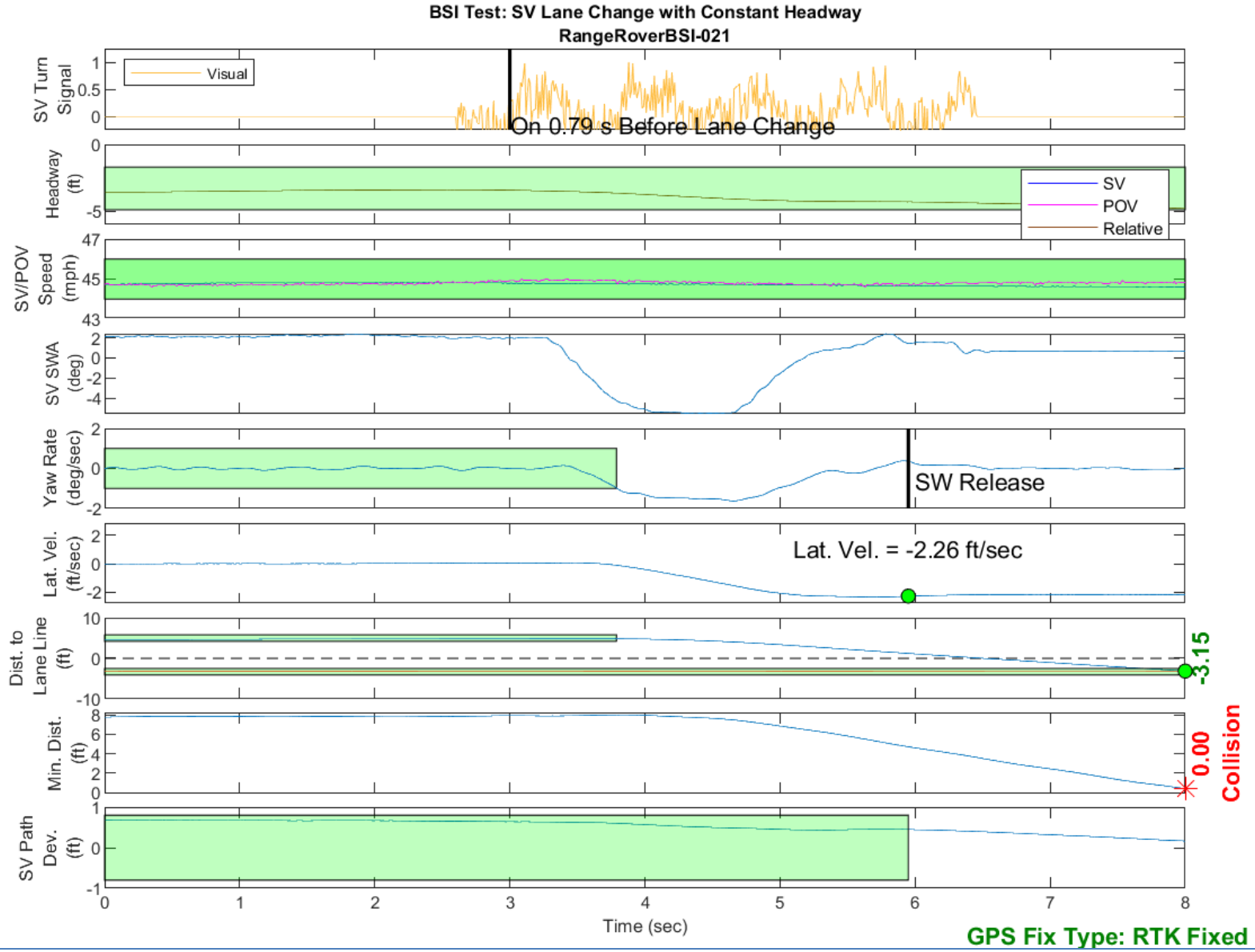

Figure D6. BSI Run 21, Subject Vehicle Lane Change with Constant Headway

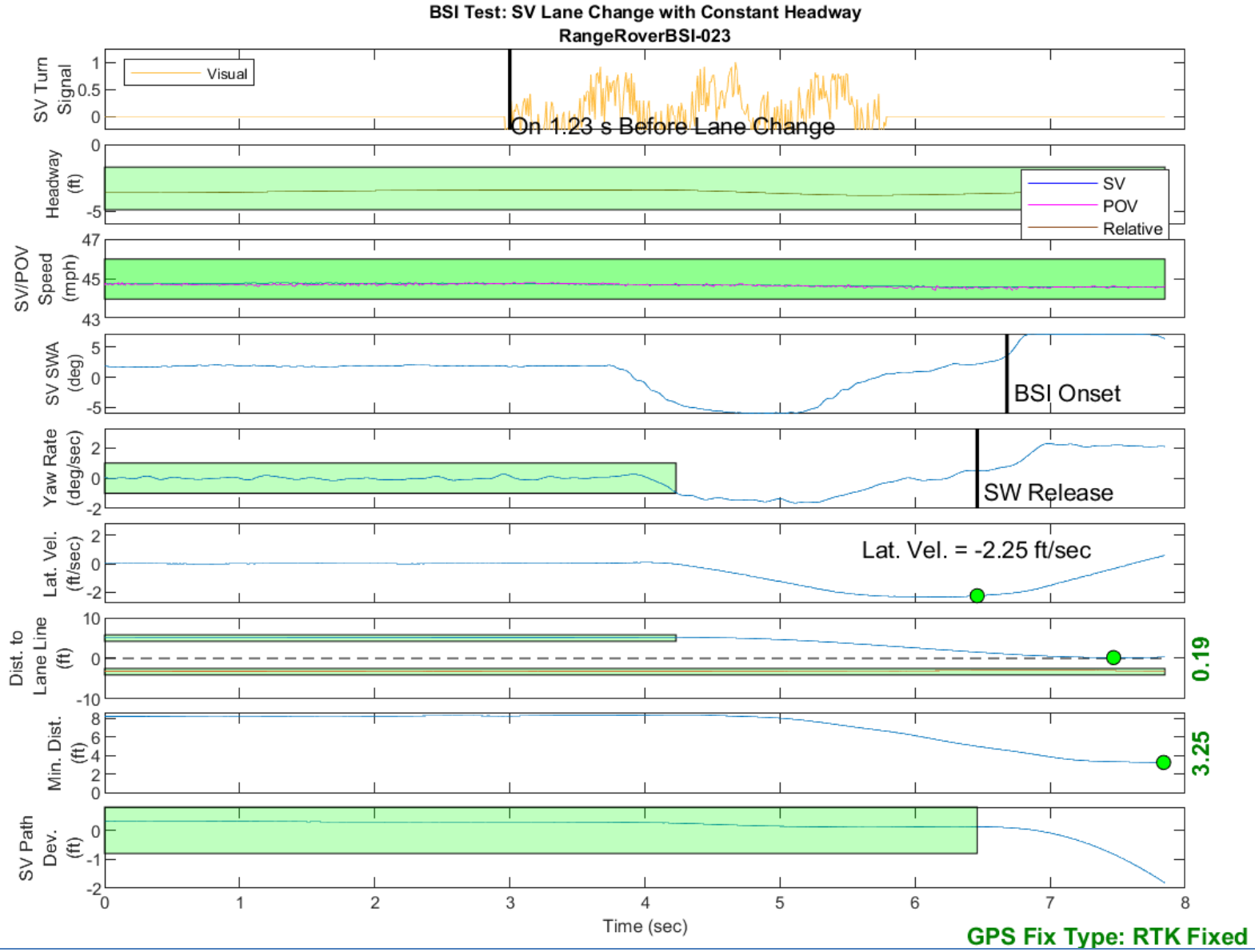

Figure D7. BSI Run 23, Subject Vehicle Lane Change with Constant Headway

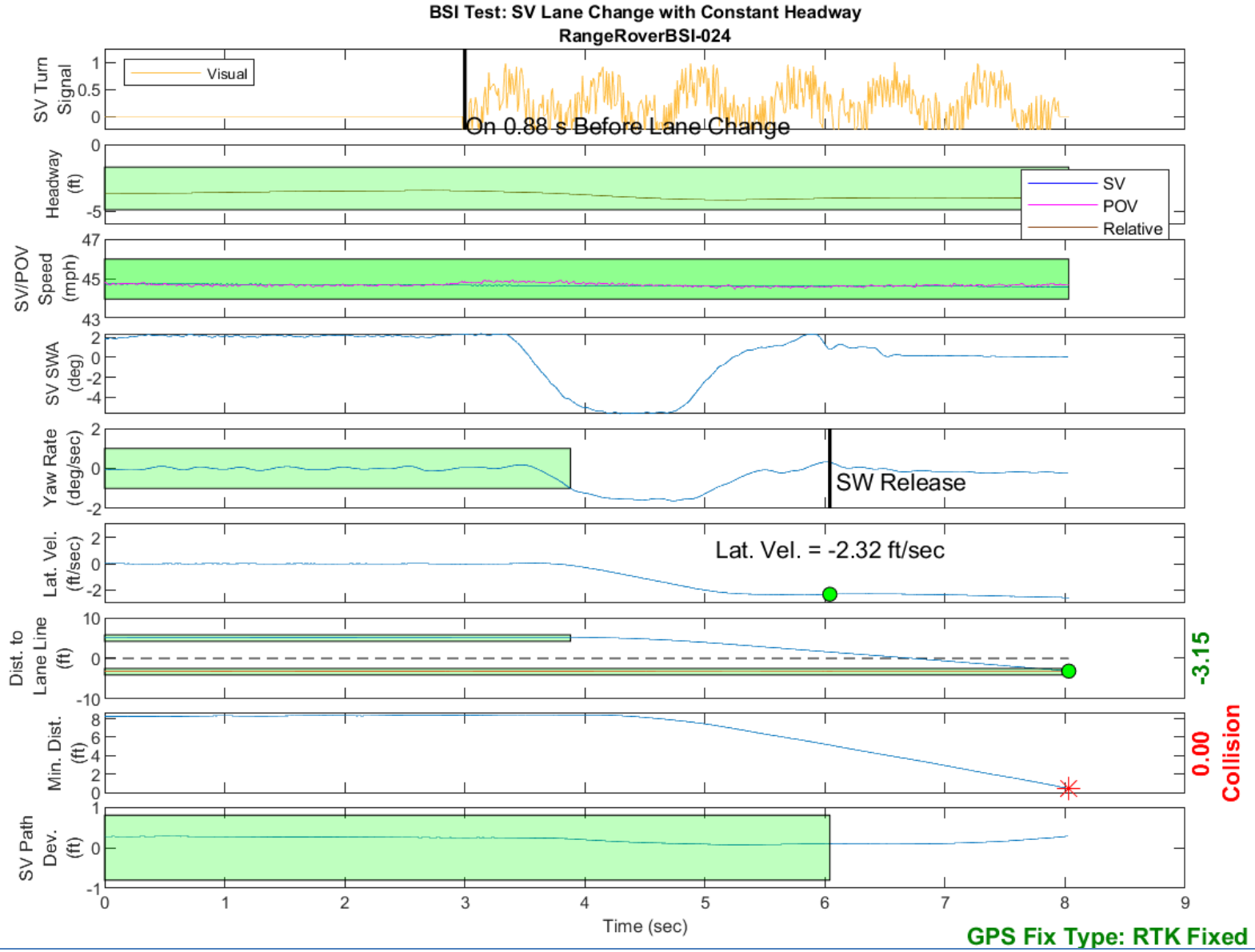

Figure D8. BSI Run 24, Subject Vehicle Lane Change with Constant Headway

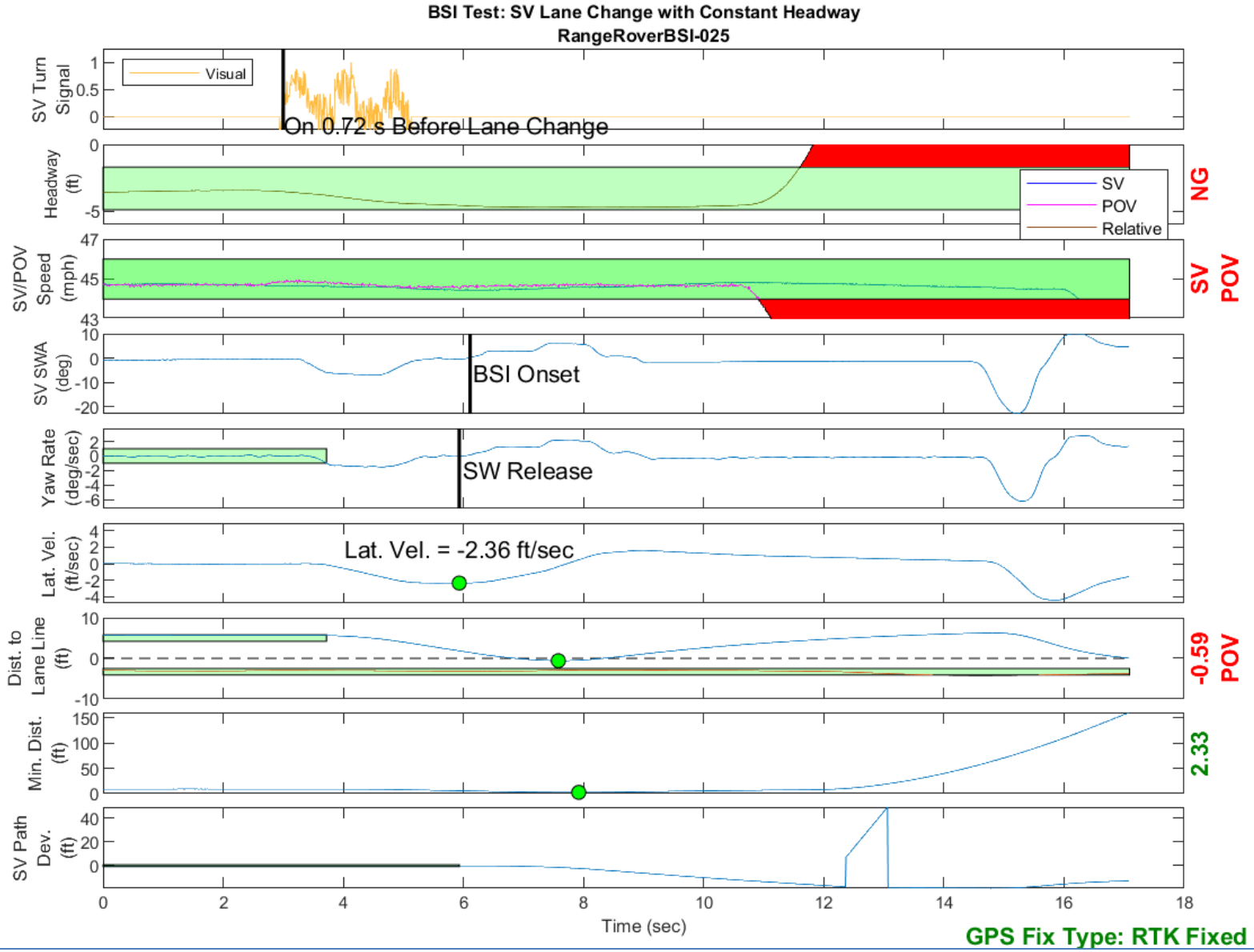

Figure D9. BSI Run 25, Subject Vehicle Lane Change with Constant Headway

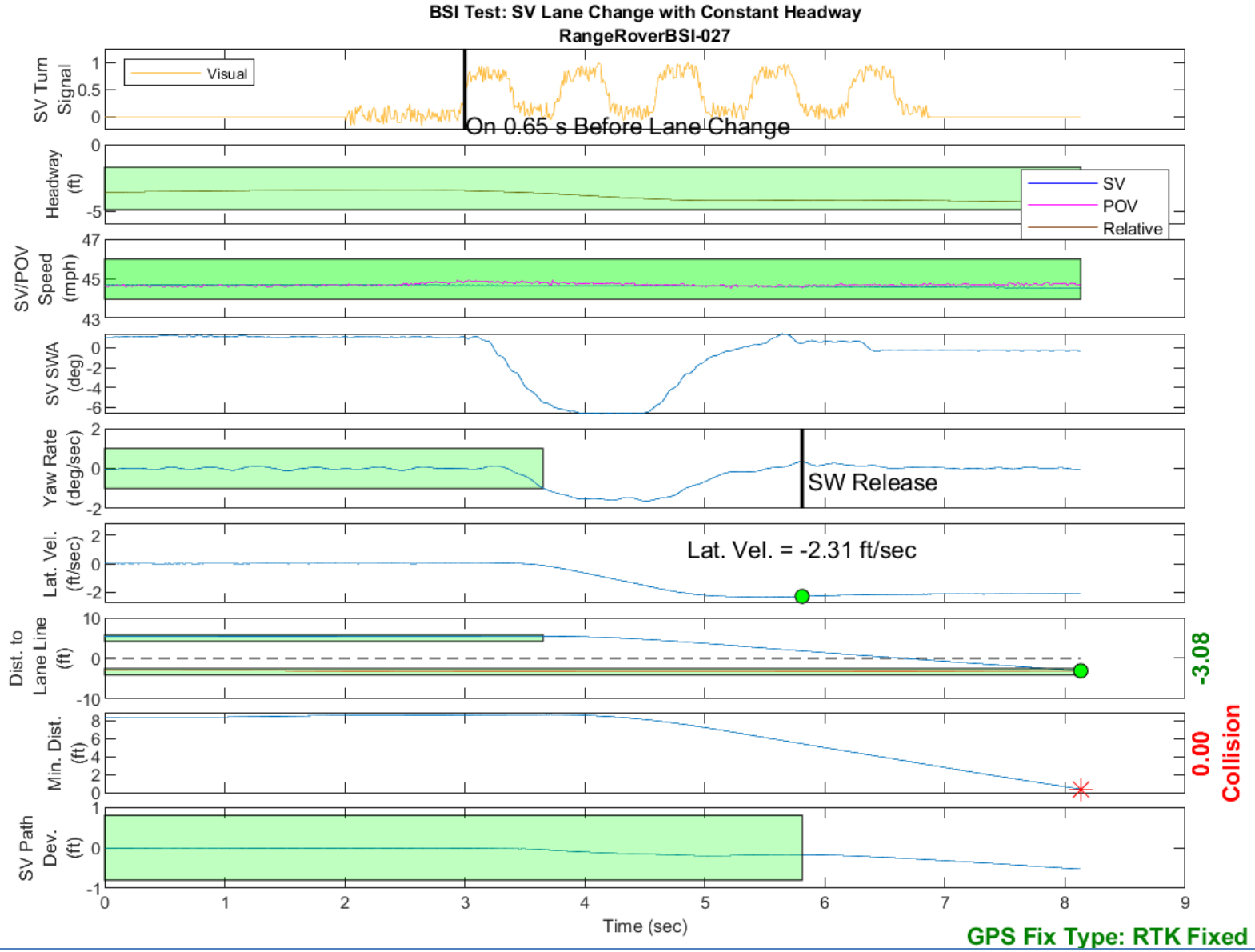

Figure D10. BSI Run 27, Subject Vehicle Lane Change with Constant Headway

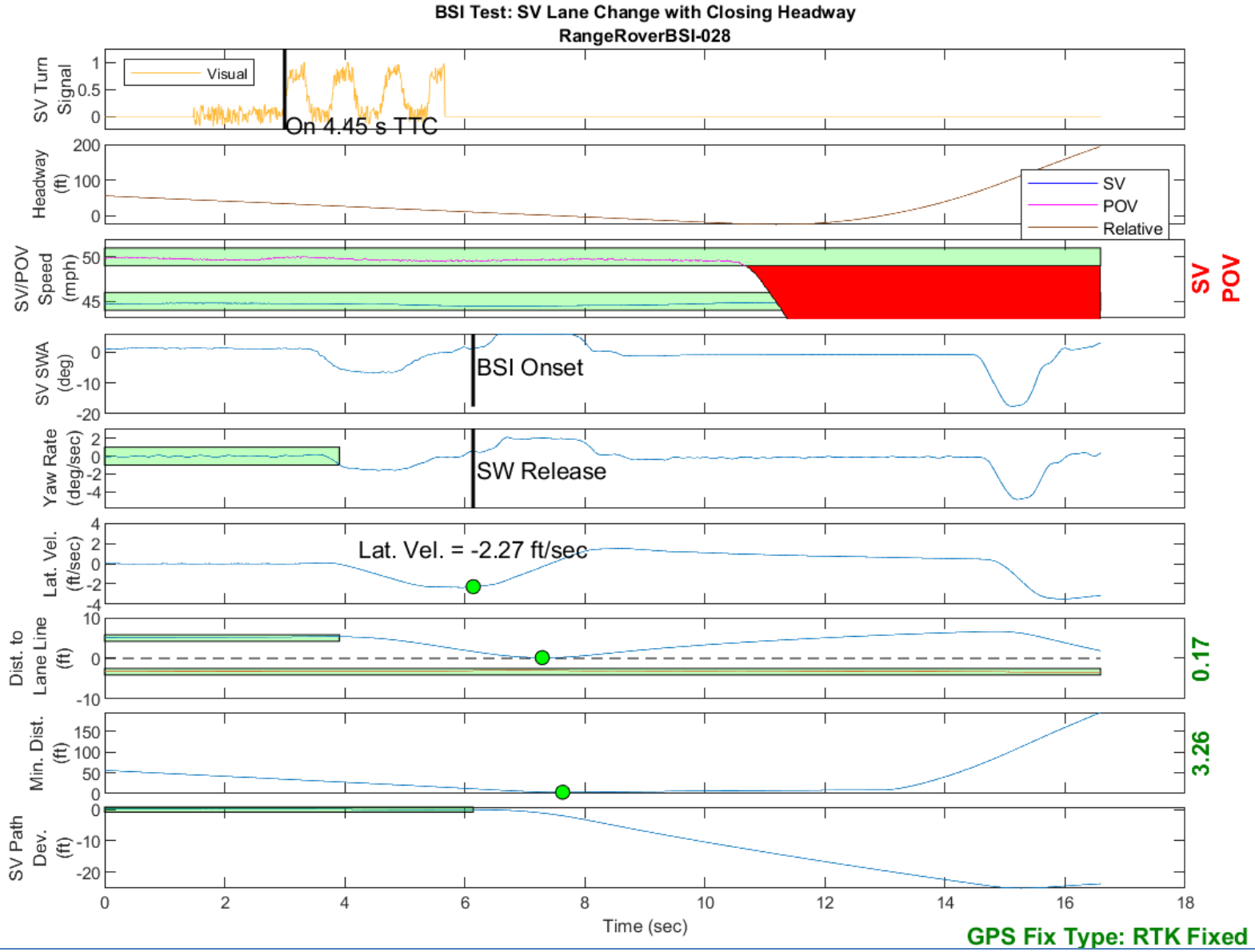

Figure D11. BSI Run 28, Subject Vehicle Lane Change with Closing Headway

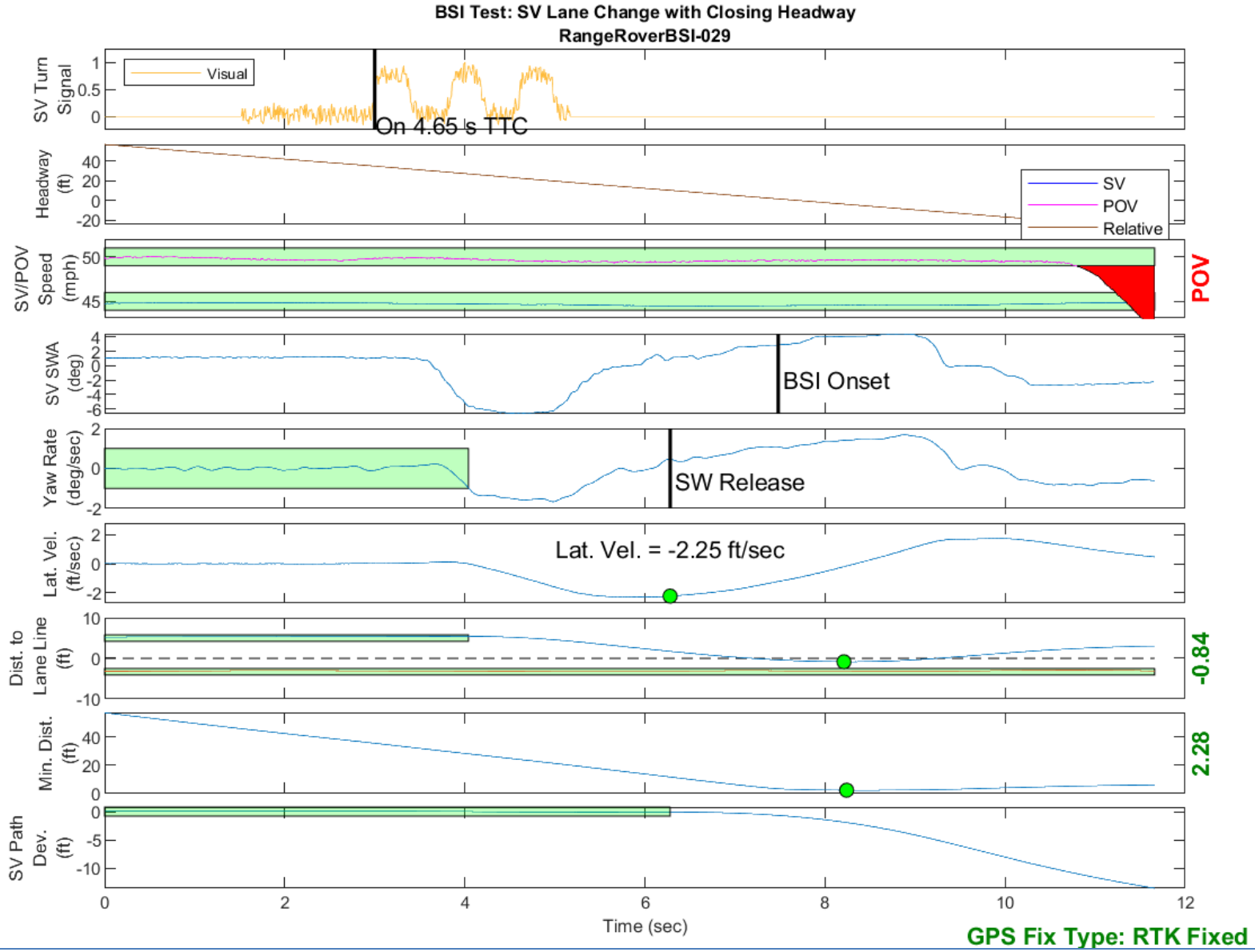

Figure D12. BSI Run 29, Subject Vehicle Lane Change with Closing Headway

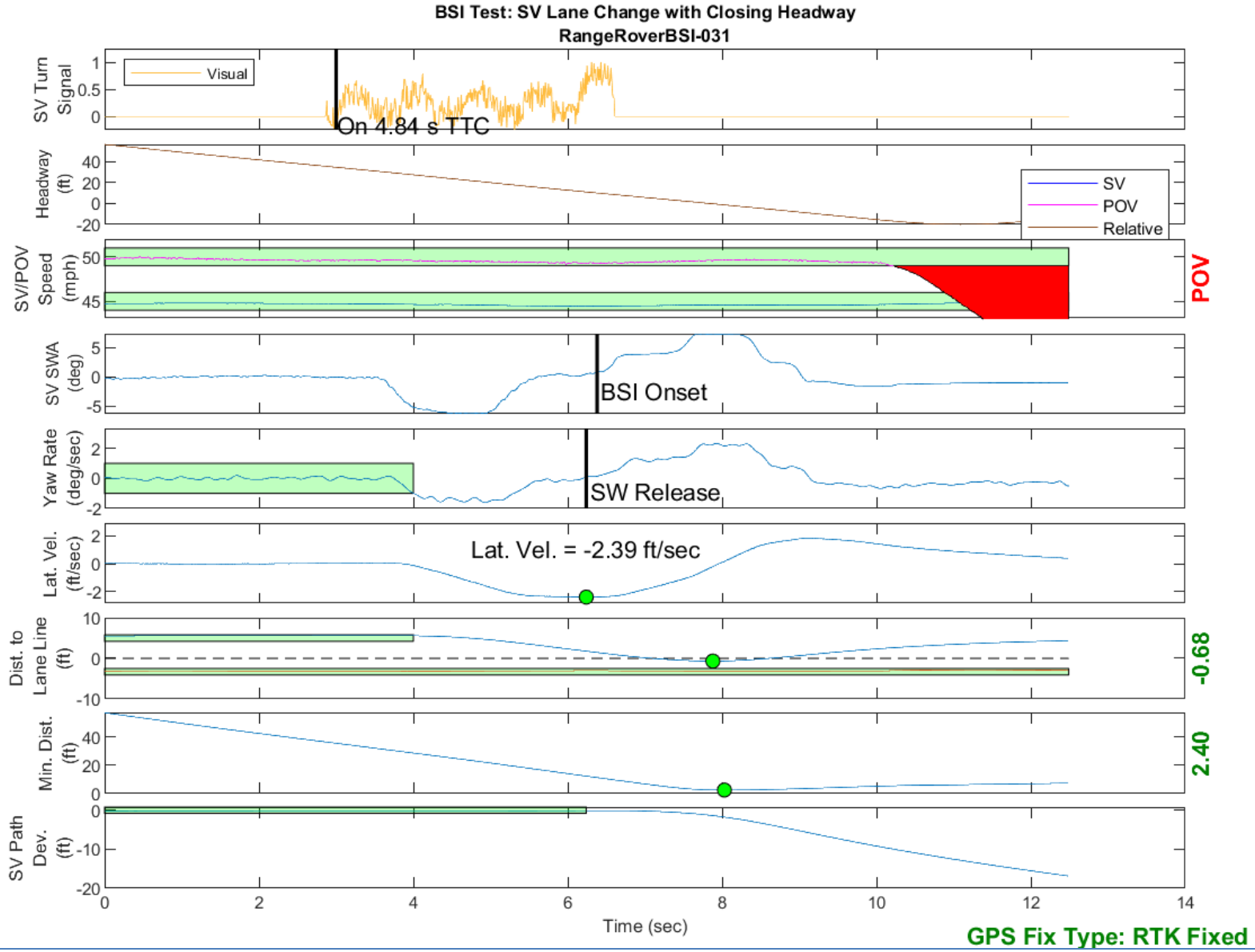

Figure D13. BSI Run 31, Subject Vehicle Lane Change with Closing Headway

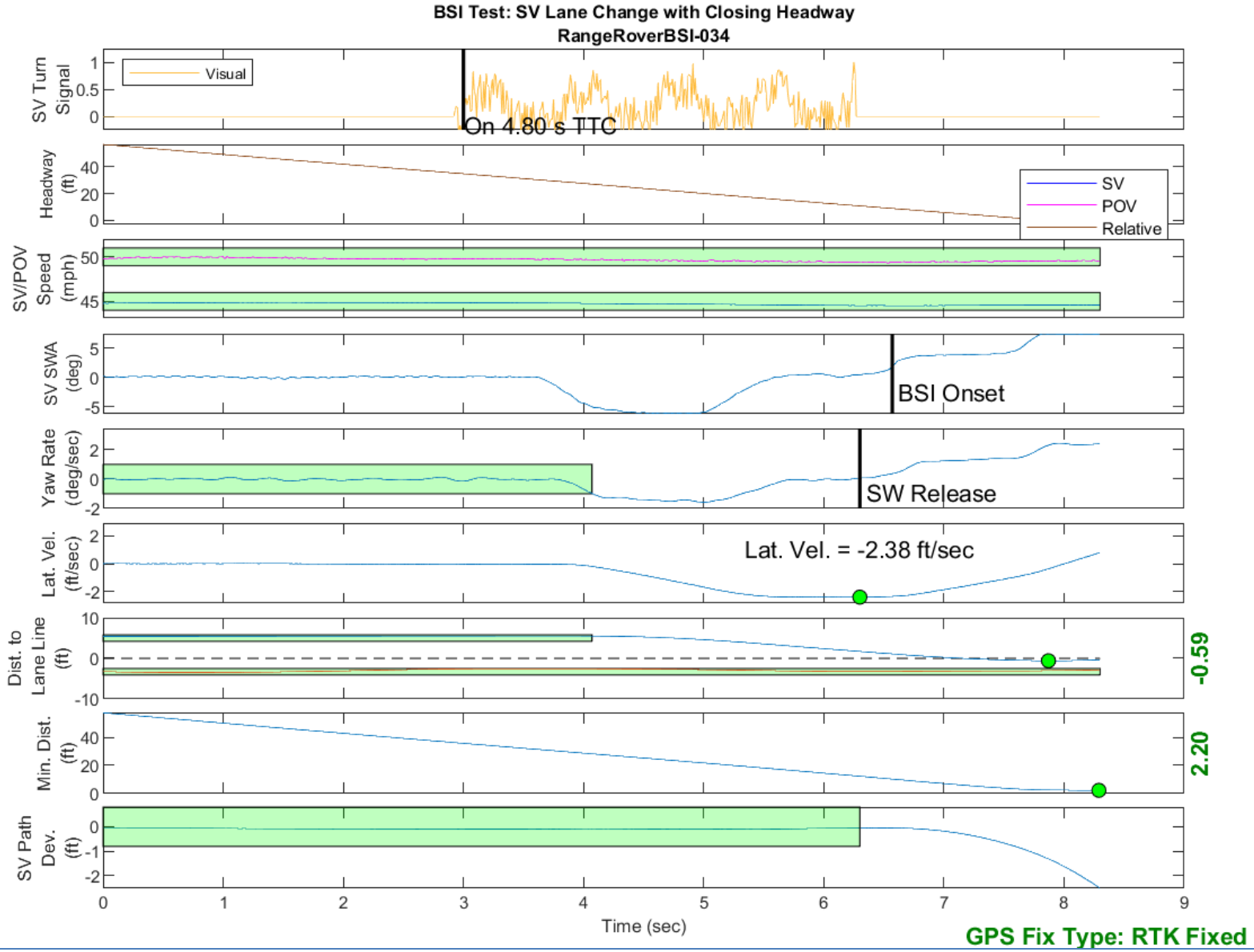

Figure D14. BSI Run 34, Subject Vehicle Lane Change with Closing Headway

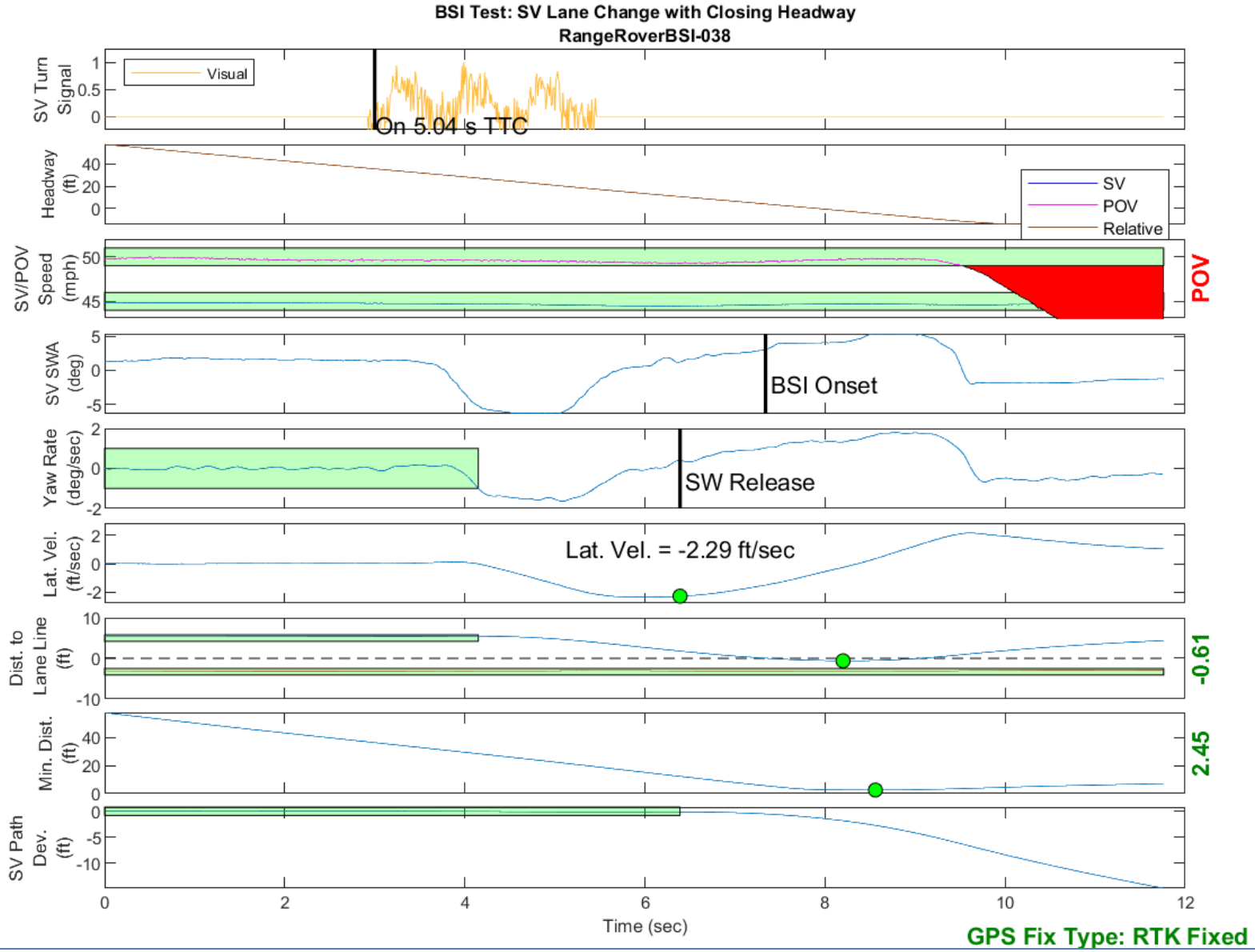

Figure D15. BSI Run 38, Subject Vehicle Lane Change with Closing Headway

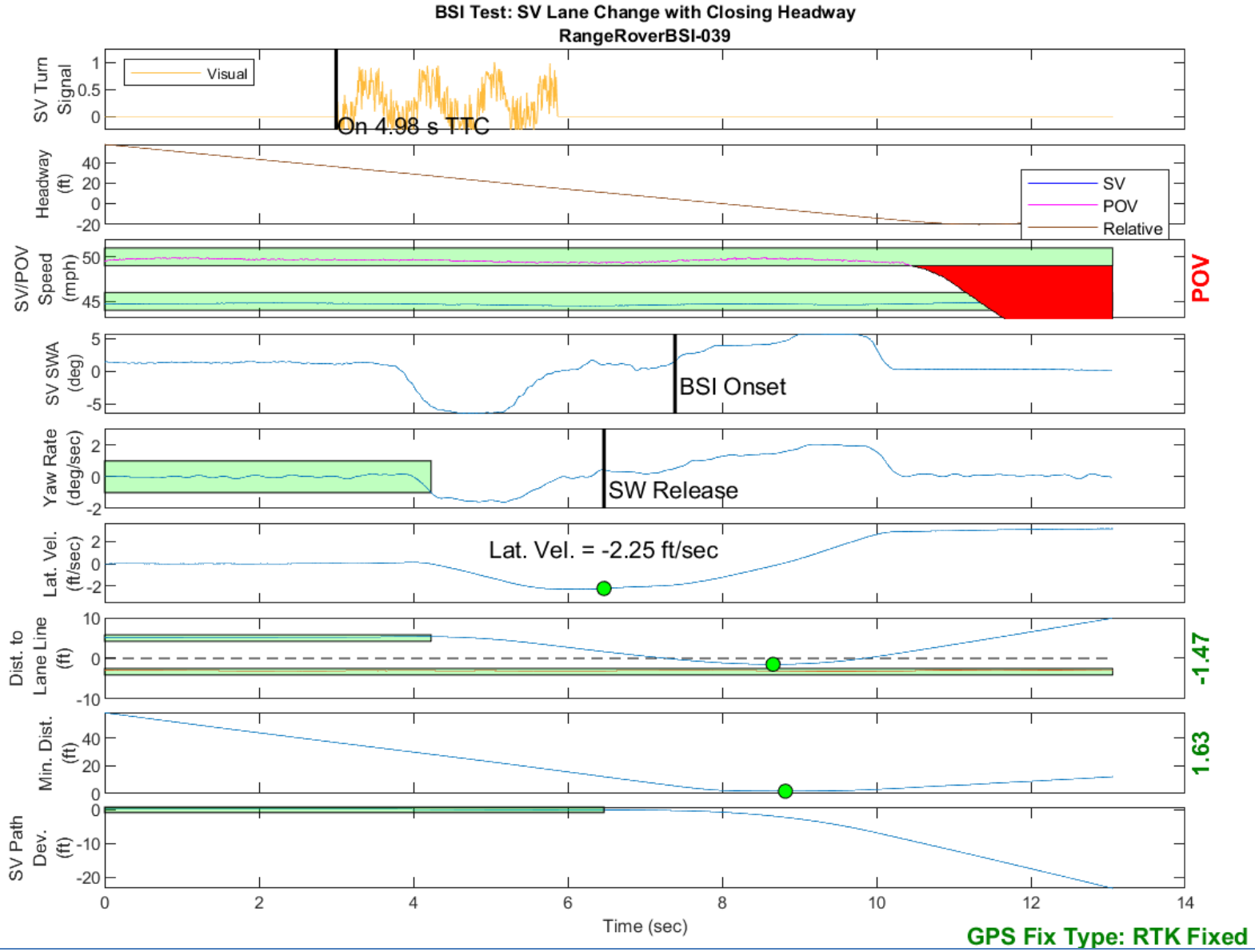

Figure D16. BSI Run 39, Subject Vehicle Lane Change with Closing Headway

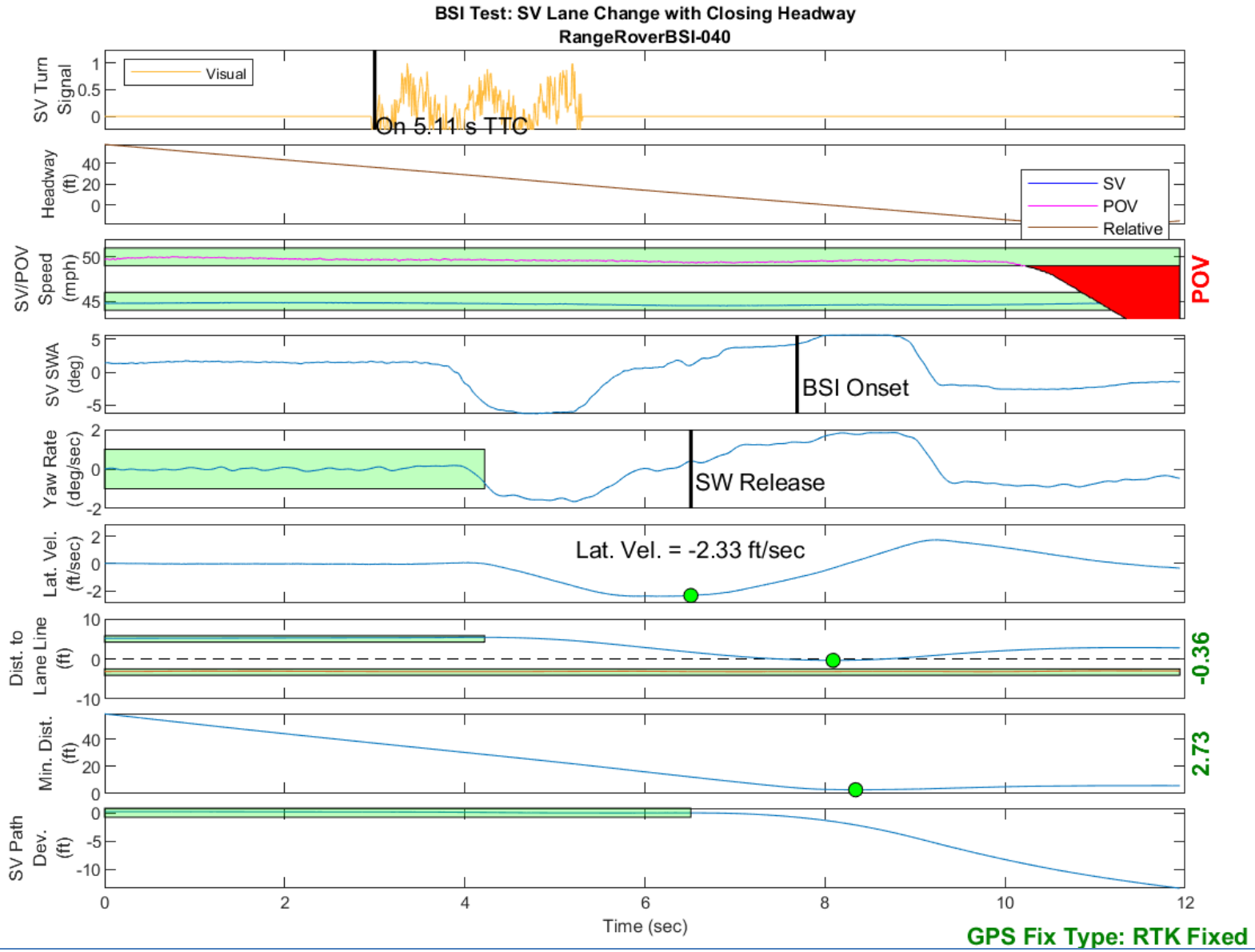

Figure D17. BSI Run 40, Subject Vehicle Lane Change with Closing Headway

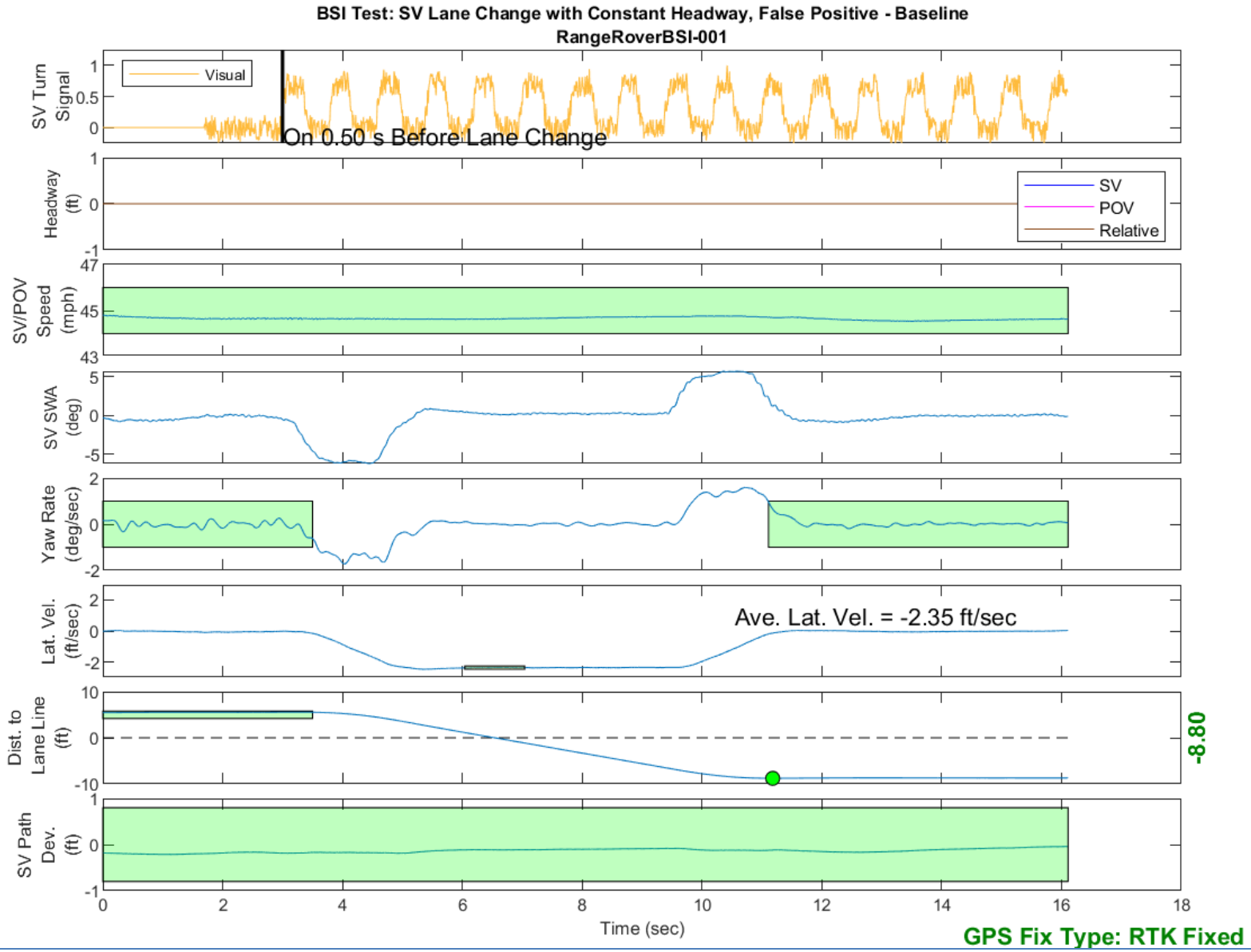

Figure D18. BSI Run 1, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Baseline

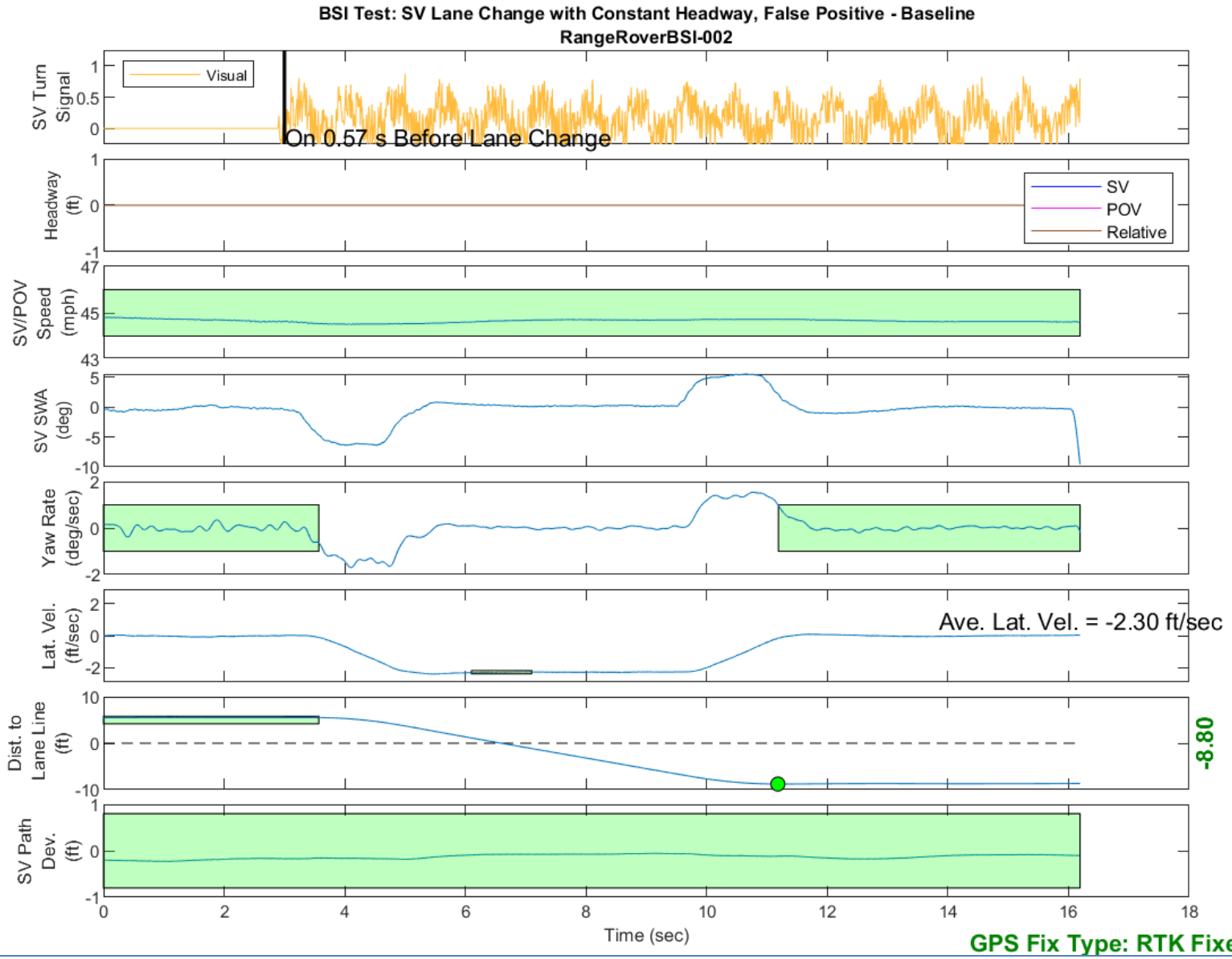

Figure D19. BSI Run 2, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Baseline

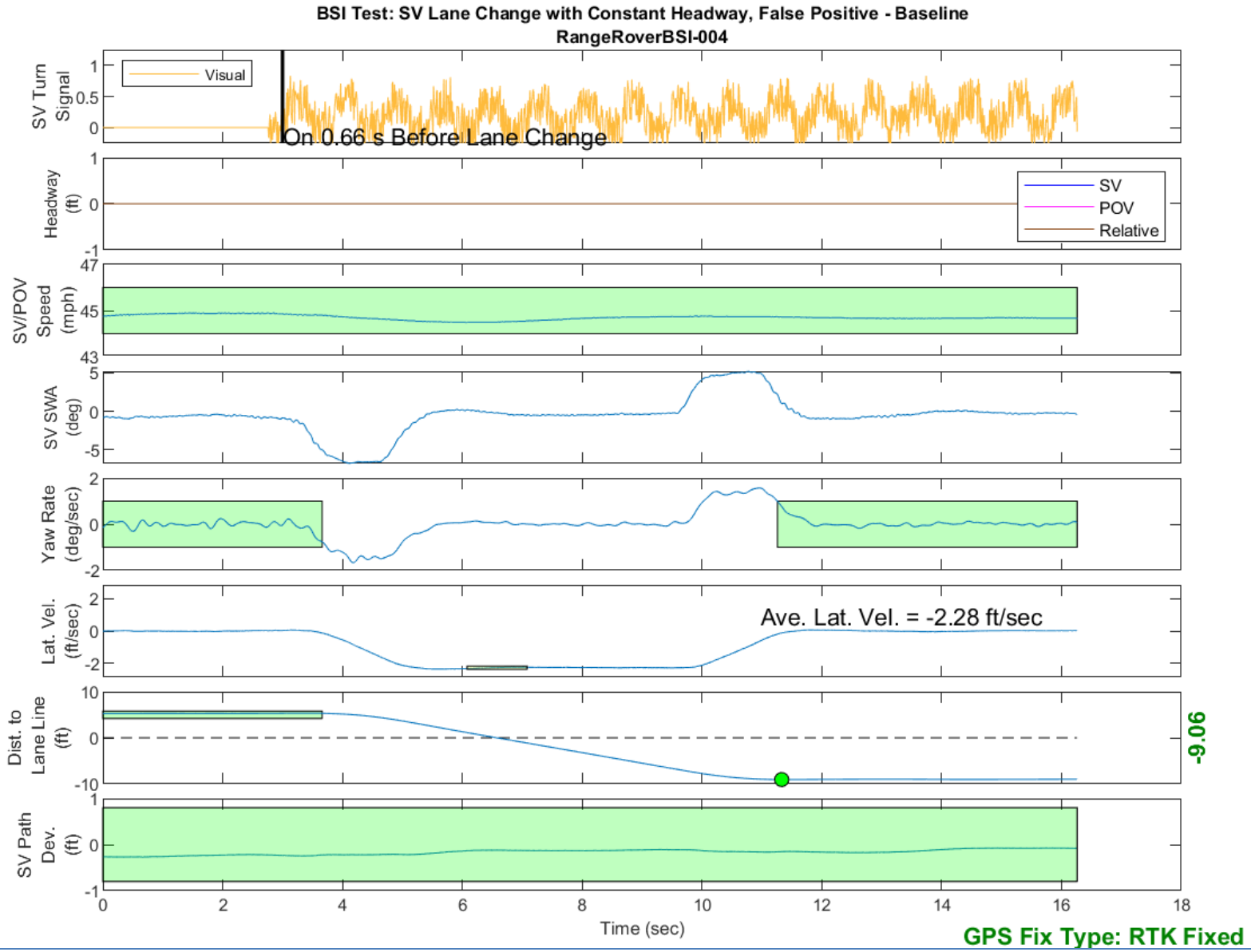

Figure D20. BSI Run 4, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Baseline

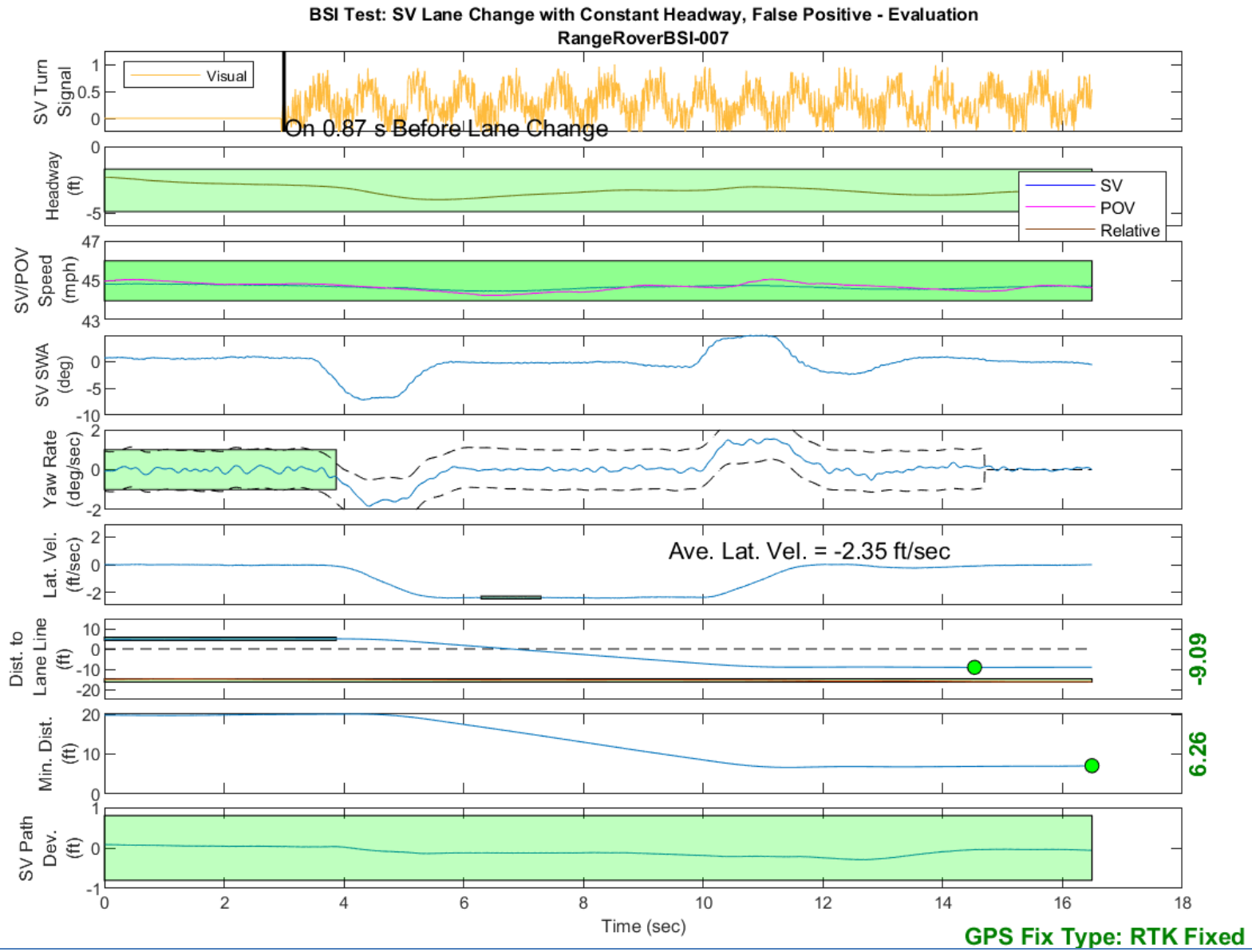

Figure D21. BSI Run 7, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

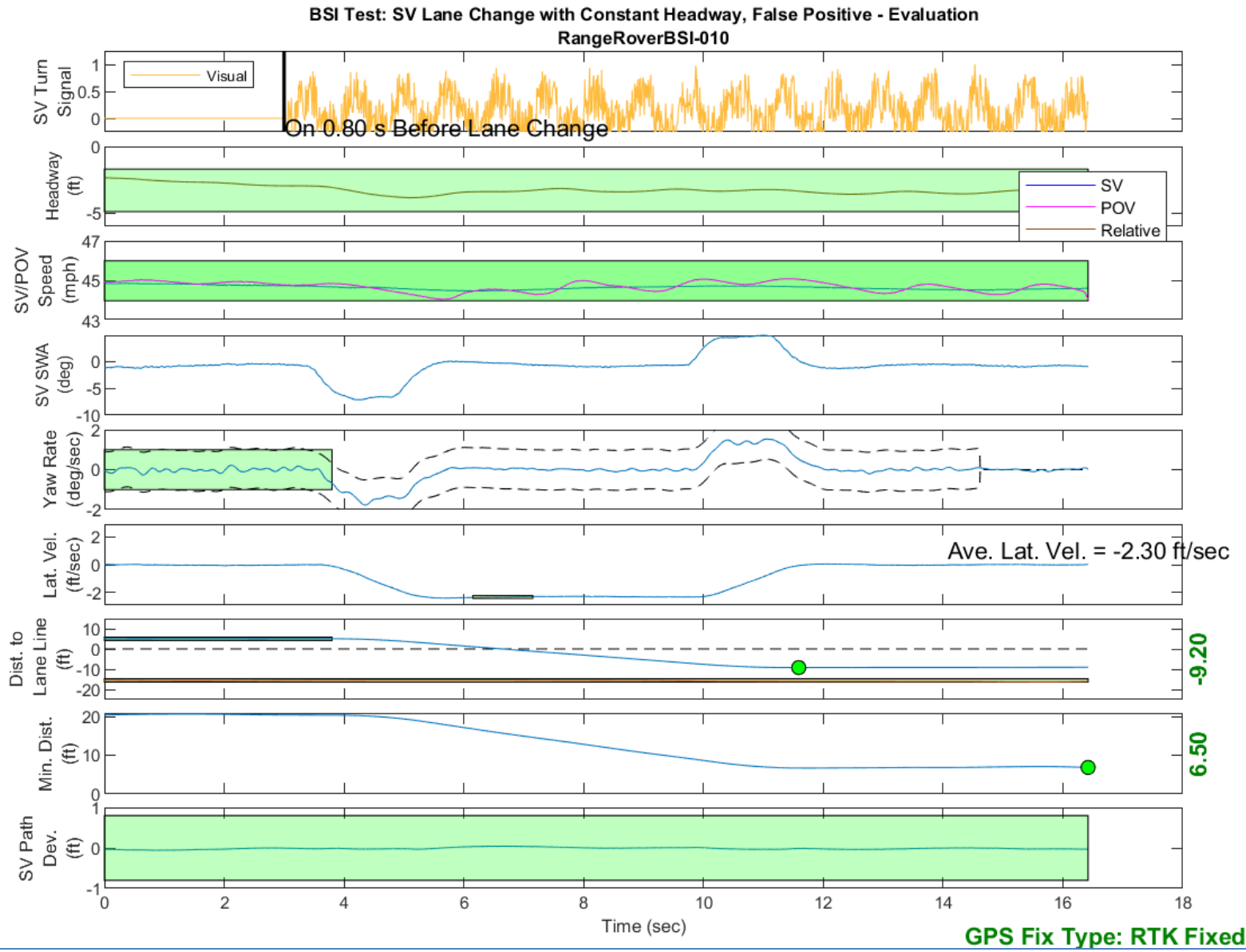

Figure D22. BSI Run 10, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

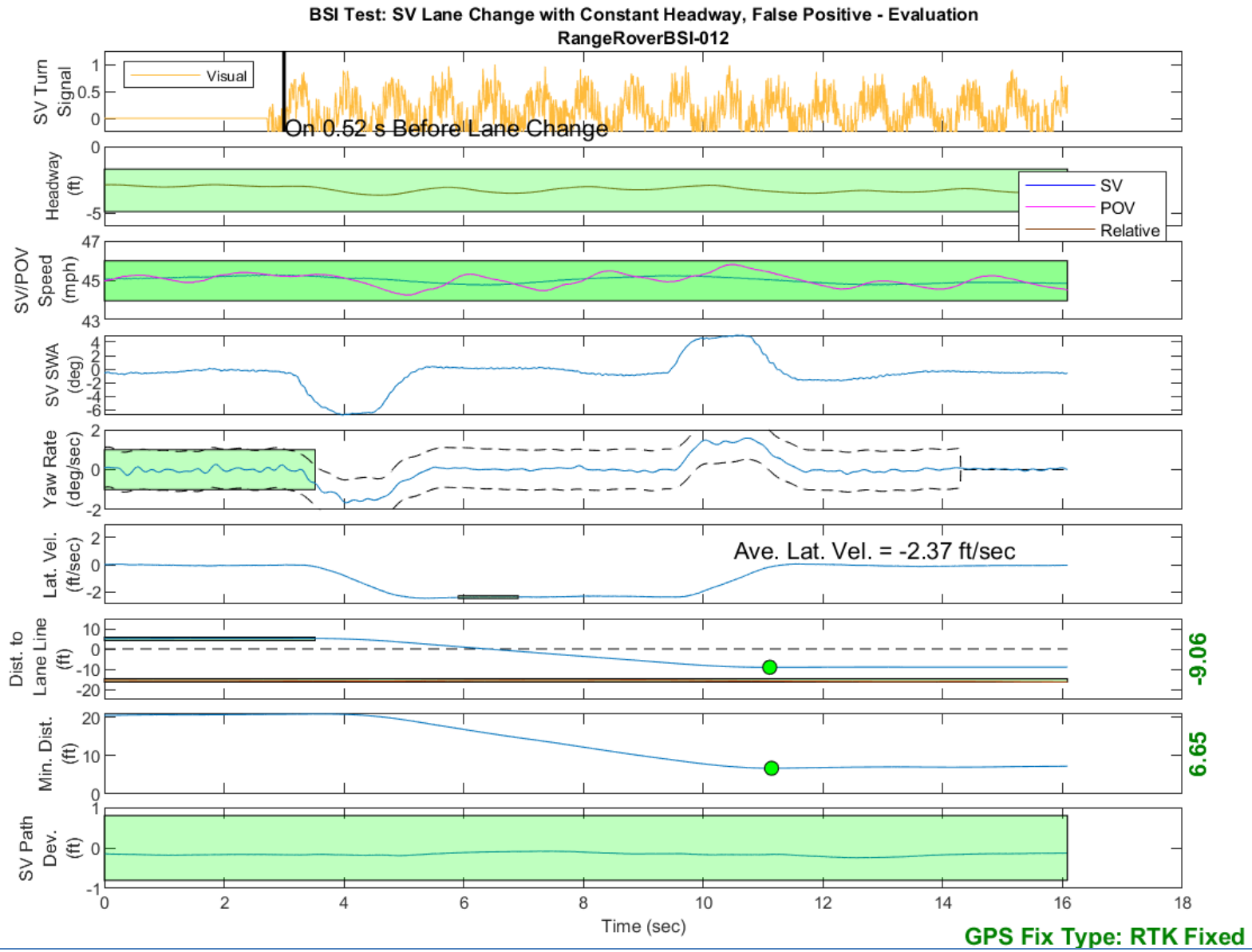

Figure D23. BSI Run 12, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

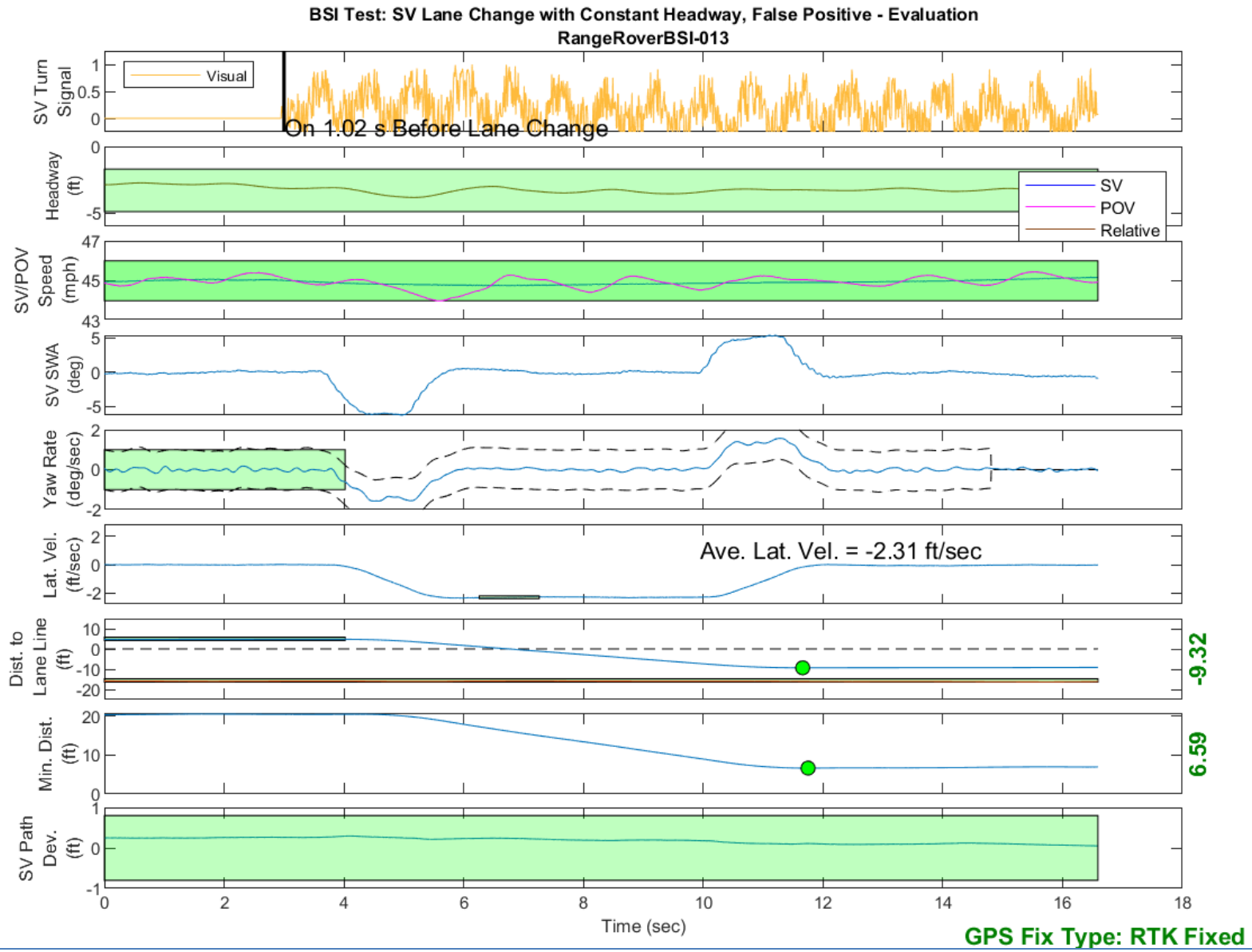

Figure D24. BSI Run 13, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

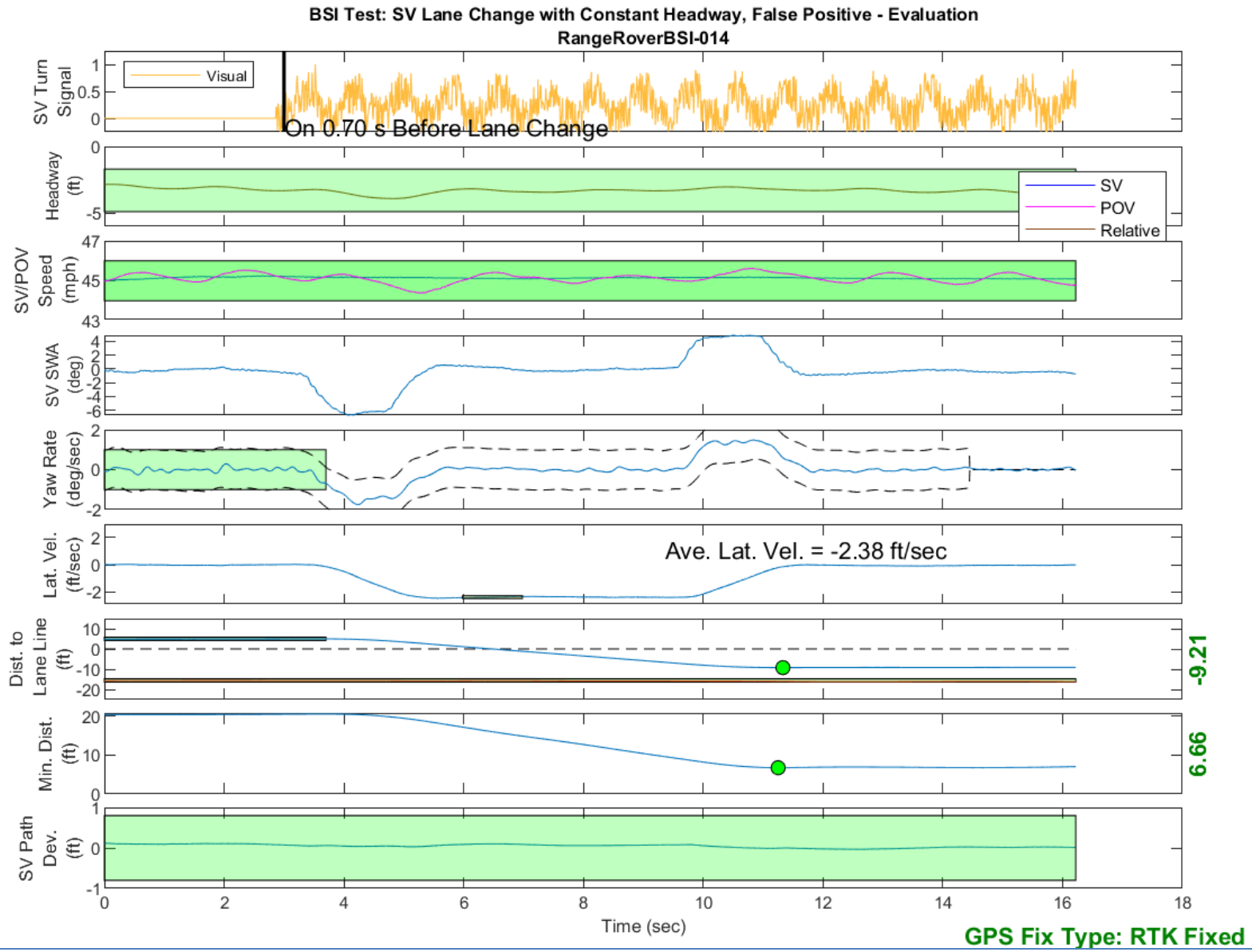

Figure D25. BSI Run 14, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

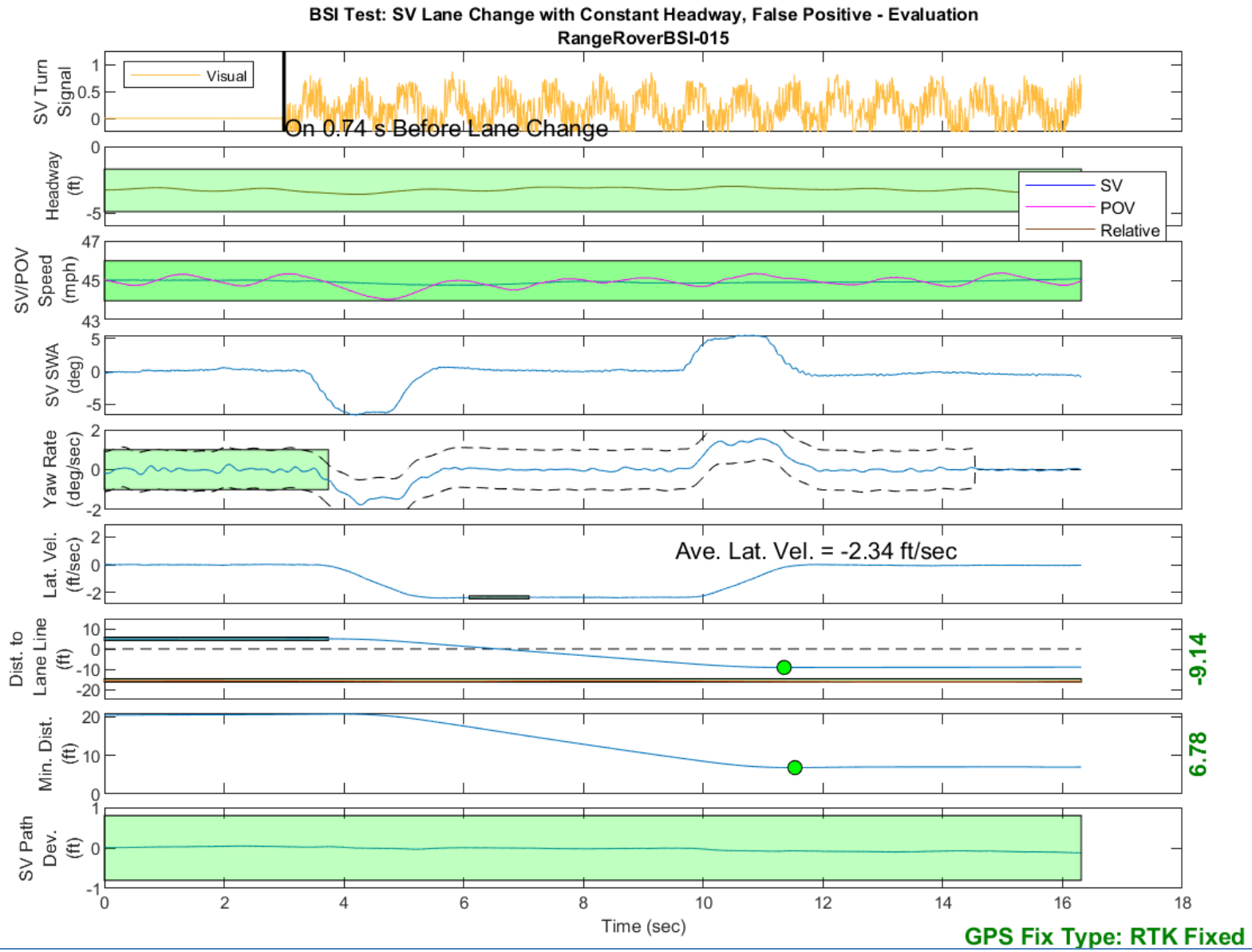

Figure D26. BSI Run 15, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation

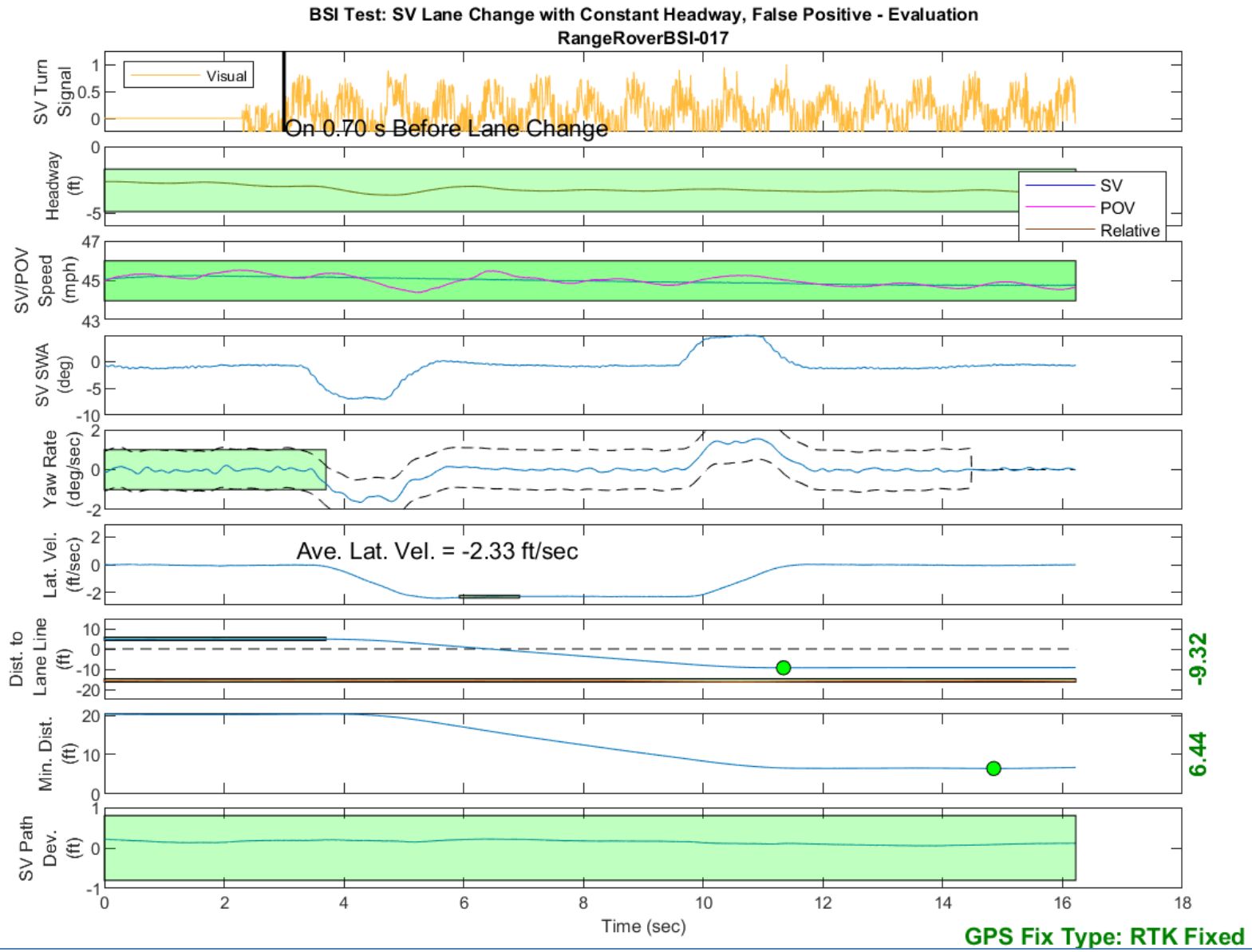

Figure D27. BSI Run 17, Subject Vehicle Lane Change with Constant Headway, False Positive Assessment - Evaluation