OCAS-DRI-CIB-19-19
NEW CAR ASSESSMENT PROGRAM
CRASH IMMINENT BRAKE SYSTEM CONFIRMATION TEST

2019 Nissan Kicks

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22 July 2019

Final Report

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U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
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Washington, DC 20590

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16. Abstract These tests were conducted on the subject 2019 Nissan Kicks in accordance with the specifications of the Office of Crash Avoidance Standards most current Test Procedure in docket NHTSA-2015-0006-0025; CRASH IMMINENT BRAKE SYSTEM PERFORMANCE EVALUATION FOR THE NEW CAR ASSESSMENT PROGRAM, October 2015. The vehicle failed the requirements for all test scenarios except the false positive cases, thus failing the overall test.			
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Section I
OVERVIEW AND TEST SUMMARY

Crash Imminent Brake (CIB) systems are a subset of Automatic Emergency Braking (AEB) systems. CIB systems are designed to avoid, or mitigate rear-end crashes, by automatically applying subject vehicle brakes when the system determines that, without intervention, a rear-end crash will occur. CIB systems typically work as an extension of Forward Collision Warning (FCW) systems, which alert the driver to the possibility of a collision unless driver action is taken. CIB systems employ sensors capable of detecting vehicles in the forward path. Current CIB technology typically involves RADAR, LIDAR, or vision-based (camera) sensors, and measurement of vehicle operating conditions such as speed, driver steering and brake application, etc. Algorithms in the system's Central Processing Unit (CPU) use this information to continuously monitor the likelihood of a rear-end crash and command a brake actuator to apply the brakes when necessary.

The method prescribed by the National Highway Traffic Safety Administration (NHTSA) to evaluate CIB performance on the test track[1] involves three rear-end type crash configurations and a "false positive" test. In the rear-end scenarios, a subject vehicle (SV) approaches a stopped, slower-moving, or decelerating principal other vehicle (POV) in the same lane of travel. For these tests, the POV is a strikeable object with the characteristics of a compact passenger car. The false positive scenarios are used to evaluate the propensity of a CIB system to inappropriately activate in a non-critical driving scenario that does not involve a forward vehicle or present a safety risk to the SV occupant(s).

The purpose of the testing reported herein was to objectively quantify the performance of a Crash Imminent Brake system installed on a 2019 Nissan Kicks. This test is part of the New Car Assessment Program to assess Crash Imminent Brake Systems sponsored by the National Highway Traffic Safety Administration under Contract No. DTNH22-14-D-00333.

[1] NHTSA-2015-0006-0025; Crash Imminent Brake System Performance Evaluation for the New Car Assessment Program, October 2015.

Section II
DATA SHEETS

CRASH IMMINENT BRAKE

DATA SHEET 1: TEST RESULTS

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2019 Nissan Kicks

SUMMARY RESULTS

VIN: *3N1CP5CU5KL5xxxx*

Test Date: *5/6/2019*

Test 1 - Subject Vehicle Encounters Stopped Principal Other Vehicle

SV 25 mph: *Fail*

Test 2 - Subject Vehicle Encounters Slower Principal Other Vehicle

SV 25 mph POV 10 mph: *Fail*

SV 45 mph POV 20 mph: *Fail*

Test 3 - Subject Vehicle Encounters Decelerating Principal Other Vehicle

SV 35 mph POV 35 mph: *Fail*

Test 4 - Subject Vehicle Encounters Steel Trench Plate

SV 25 mph: *Pass*

SV 45 mph: *Pass*

Overall: *Fail*

Notes:

CRASH IMMINENT BRAKE

DATA SHEET 2: VEHICLE DATA

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2019 Nissan Kicks

TEST VEHICLE INFORMATION

VIN: *3N1CP5CU5KL5xxxx*

Body Style: *Passenger Car* Color: *Blue Pearl / Fresh Powder*

Date Received: *4/15/2019* Odometer Reading: *66 mi*

Engine: *1.6 L Inline 4*

Transmission: *CVT*

Final Drive: *FWD*

Is the vehicle equipped with:

ABS	**X**	Yes	____	No
Adaptive Cruise Control	**X**	Yes	____	No
Collision Mitigating Brake System	**X**	Yes	____	No

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *NISSAN MOTOR CO.,LTD.*

Date of manufacture: *02/19*

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: *205/55R17*

Rear: *205/55R17*

Recommended cold tire pressure: Front: *220 kPa (32 psi)*

Rear: *220 kPa (32 psi)*

CRASH IMMINENT BRAKE

DATA SHEET 2: VEHICLE DATA

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2019 Nissan Kicks

TIRES

Tire manufacturer and model: *Firestone FT140*

Front tire size: *205/55R17*

Rear tire size: *205/55R17*

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle:

X All options listed on the "window sticker" are present on the test vehicle

X Tires and wheel rims are the same as listed.

X There are no dents or other interior or exterior flaws.

X The vehicle has been properly prepared and is in running condition.

X Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.

CRASH IMMINENT BRAKE

DATA SHEET 3: TEST CONDITIONS

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2019 Nissan Kicks

GENERAL INFORMATION

Test date: *5/6/2019*

AMBIENT CONDITIONS

Air temperature: *18.3 C (65 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.

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: *220 kPa (32 psi)*

Rear: *220 kPa (32 psi)*

CRASH IMMINENT BRAKE

DATA SHEET 3: TEST CONDITIONS

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2019 Nissan Kicks

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*420.9 kg (928 lb)*	Right Front	*381.9 kg (842 lb)*
Left Rear	*276.2 kg (609 lb)*	Right Rear	*265.8 kg (586 lb)*
		Total:	*1344.8 kg (2965 lb)*

CRASH IMMINENT BRAKE

DATA SHEET 4: CRASH IMMINENT BRAKE SYSTEM OPERATION

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2019 Nissan Kicks

Name of the CIB option, option package, etc.

Automatic Emergency Braking

System setting used for test (if applicable): *Nominal (no alternate settings)*

What is the minimum vehicle speed at which the CIB system becomes active?

5 km/h (Per manufacturer supplied information)

What is the maximum vehicle speed at which the CIB system functions?

For moving vehicles: 200 km/h

For stationary vehicles: 80 km/h (Per manufacturer supplied information)

Does the vehicle system require an initialization sequence/procedure?

No

Will the system deactivate due to repeated AEB activations, impacts or near-misses?

The system becomes unavailable after activating three times during the same ignition cycle.

How is the Forward Collision Warning presented to the driver? (Check all that apply)

X	Warning light
X	Buzzer or audible alarm
	Vibration
	Other

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

In the center of the instrument panel there is a display of a vehicle with an outlined area immediately in front of the vehicle. When the system detects risk of a forward collision the area immediately in front of the vehicle flashes yellow in conjunction with audible beeps that have a frequency of approximately 1800 Hz. As the gap between the SV and POV decreases the alert changes to a triangle enclosing a rear view of a vehicle, alternating rapidly between a white background with red graphics and a red background with white graphics.

Is there a way to deactivate the system? **X** Yes

____ No

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

Controls on the left side of the steering wheel are used to interact with menus displayed in the instrument panel. The sequence is:

-Settings

-Driver Assistance

-Emergency Brake

-System On/Off

Is the vehicle equipped with a control whose purpose is to adjust the range setting or otherwise influence the operation of CIB? ____ Yes

X No

If yes, please provide a full description.

CRASH IMMINENT BRAKE

DATA SHEET 4: CRASH IMMINENT BRAKE SYSTEM OPERATION

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2019 Nissan Kicks

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

X Yes

____ No

If yes, please provide a full description.

The AEB system cannot detect all vehicles under all conditions.

The radar sensor does not detect the following objects:

- *Pedestrians, animals or obstacles in the roadway*
- *Oncoming vehicles*
- *Crossing vehicles*

The radar sensor has some performance limitations. If a stationary vehicle is in the vehicle's path, the AEB system will not function when the vehicle is driven at speeds over approximately 50 mph (80 km/h).

The radar sensor may not detect a vehicle ahead in the following conditions:

- *Dirt, ice, snow or other material covering the radar sensor*
- *Interference by other radar sources*
- *Snow or road spray from traveling vehicles*
- *If the vehicle ahead is narrow (e.g., motorcycle.*
- *When driving on a steep downhill slope or roads with sharp curves*

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Four test scenarios were used, as follows:

Test 1. Subject Vehicle (SV) Encounters Stopped Principal Other Vehicle (POV)
Test 2. Subject Vehicle Encounters Slower Principal Other Vehicle
Test 3. Subject Vehicle Encounters Decelerating Principal Other Vehicle
Test 4. Subject Vehicle Encounters Steel Trench Plate

An overview of each of the test procedures follows.

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

This test evaluates the ability of the CIB system to detect and respond to a stopped lead vehicle in the immediate forward path of the SV, as depicted in Figure 1.

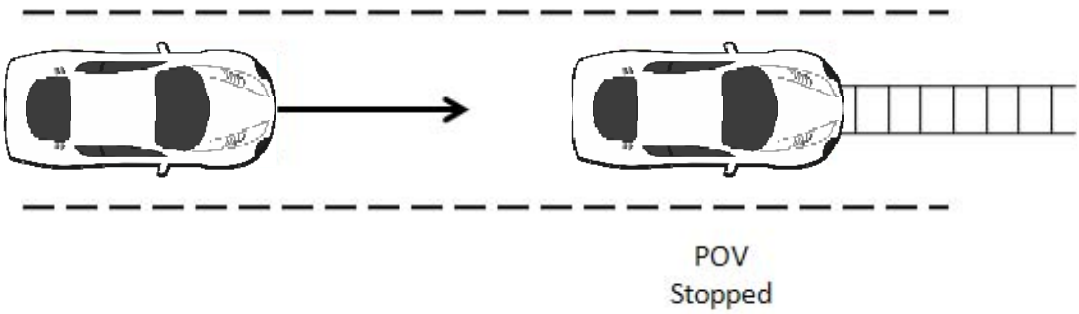


Figure 1. Depiction of Test 1

a. Procedure

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

The SV ignition was cycled prior to each test run. The SV was driven at a nominal speed of 25 mph (40.2 kph) in the center of the lane of travel, toward the parked POV. The SV throttle pedal was released within 500 ms after t_{FCW} , i.e. within 500 ms of the FCW alert. The test concluded when either:

- The SV came into contact with the POV or
- The SV came to a stop before making contact with the POV.

In addition to the general test validity criteria described below, for an individual test trial to be valid, the following was required throughout the test:

- The SV speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) during an interval defined by a Time to Collision (TTC) = 5.1 seconds to t_{FCW}. For this test, TTC = 5.1 seconds is taken to occur at an SV-to-POV distance of 187 ft (57 m).

b. Criteria

In order to pass the test, the magnitude of the SV speed reduction attributable to CIB intervention must have been ≥ 9.8 mph (15.8 km/h) for at least five of seven valid test trials.

The magnitude of the SV speed reduction attributable to CIB intervention was calculated in one of two ways, depending on whether a test trial concluded with the SV colliding with the POV.

- If SV-to-POV contact occurred during a test trial, the CIB speed reduction was calculated by subtracting the SV speed at the time of SV-to-POV contact (i.e., when longitudinal range became zero) from the average SV speed calculated from t_{FCW}-100 ms to t_{FCW}.
- If SV-to-POV contact did not occur during a test trial (i.e., CIB intervention prevented the crash), the SV speed at a time of SV-to-POV contact was taken to be zero. The speed reduction is therefore equal to the SV speed at t_{FCW}.

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

This test evaluates the ability of the CIB system to detect and respond to a slower-moving lead vehicle traveling at a constant speed in the immediate forward path of the SV, as depicted in Figure 2.

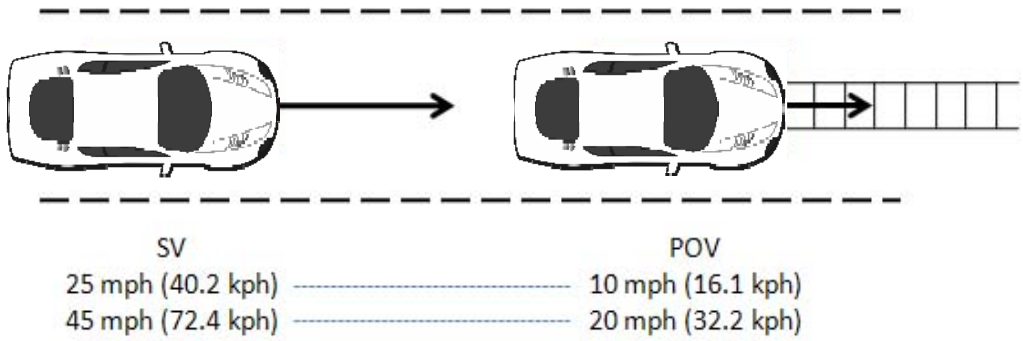


Figure 2. Depiction of Test 2

a. Procedure

The SV ignition was cycled prior to each test run. The tests were conducted two ways. In the first, the POV was driven at a constant 10.0 mph (16.1 kph) in the center of the lane of travel while the SV was driven at 25.0 mph (40.2kph), in the center lane of travel, toward the slower-moving POV. In the second, the POV was driven at a constant 20.0 mph (32.2 kph) in the center of the lane of travel while the SV was driven at 45.0 mph (74.4 kph), in the center lane of travel, toward the slower-moving POV. In both cases, the SV throttle pedal was released within 500 ms after t_{FCW} , i.e. within 500 ms of the FCW alert. The test concluded when either:

- The SV came into contact with the POV or
- 1 second after the speed of the SV becomes less than or equal to that of the POV.

The SV driver then braked to a stop.

In addition to the general test validity criteria described below, for an individual test trial to be valid, the following was required throughout the test:

- The lateral distance between the centerline of the POV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The lateral distance between the centerline of the SV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The SV speed could not deviate more than ±1.0 mph (±1.6 km/h) during an interval defined by TTC = 5.0 seconds to t_{FCW}.

- The POV speed could not deviate more than ±1.0 mph (±1.6 km/h) during the validity period.

b. Criteria

For the test series in which the initial SV speed was 25 mph, the condition for passing was that there be no SV-POV impact for at least five of the seven valid test trials.

In order to pass the test series for which the initial speed of the SV was 45 mph, the magnitude of the SV speed reduction attributable to CIB intervention must have been ≥ 9.8 mph (15.8 km/h) for at least five of seven valid test trials. The magnitude of the SV speed reduction attributable to CIB intervention was calculated in one of two ways, depending on whether a test trial concluded with the SV colliding with the POV.

1. If SV-to-POV contact occurred during a test trial, the CIB speed reduction was calculated by subtracting the SV speed at the time of SV-to-POV contact (i.e., when longitudinal range became zero) from the average SV speed calculated from t_{FCW}-100 ms to t_{FCW}.

2. If SV-to-POV contact did not occur during a test trial (i.e., CIB intervention prevented the crash), the CIB speed reduction was calculated by subtracting the SV speed at the minimum longitudinal SV-POV range during the validity period from the SV speed at t_{FCW}.

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

This test evaluates the ability of the CIB system to detect and respond to a lead vehicle slowing with a constant deceleration in the immediate forward path of the SV, as depicted in Figure 3.

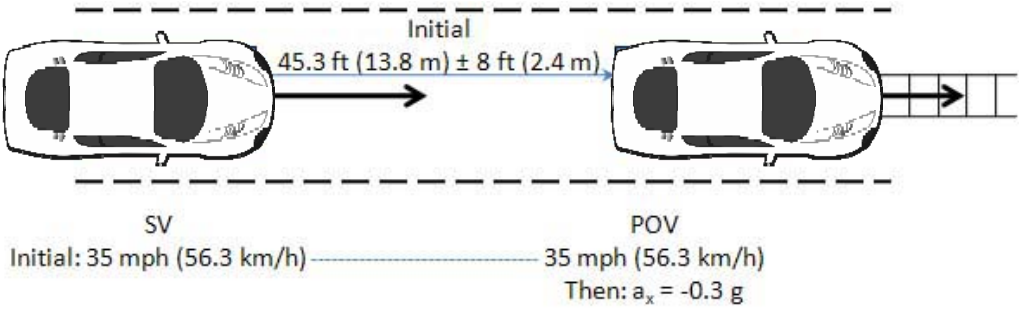


Figure 3. Depiction of Test 3 with POV Decelerating

a. Procedure

The SV ignition was cycled prior to each test run. For this test scenario, both the POV and SV were driven at a constant 35.0 mph (56.3 kph) in the center of the lane, with a headway of 45.3 ft (13.8 m) ± 8 ft (2.4 m). Once these conditions were met, the POV tow vehicle brakes were applied to achieve 0.3 ± 0.03 g of deceleration. The test concluded when either:

- The SV came into contact with the POV or
- For the decelerating POV, 1 second after minimal longitudinal SV-POV distance occurred or
- For the POV decelerating to stop case, 1 second after the velocity of the SV became less than or equal to that of the POV.

The SV driver then braked to a stop.

In addition to the general test validity criteria described below, for an individual test trial to be valid, the following was required throughout the test:

- The lateral distance between the centerline of the POV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The lateral distance between the centerline of the SV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The headway between the SV and POV must have been constant from the onset of the applicable validity period to the onset of POV braking.

- The SV and POV speed could not deviate more than ±1.0 mph (1.6 km/h) during an interval defined by the onset of the validity period to the onset of

POV braking.

- The SV- POV headway distance could not deviate more than ±8 ft (2.4 m) during an interval defined by the onset of the validity period to the onset of POV braking.

- The average POV deceleration could not deviate by more than ±0.03 g from the nominal 0.3 g deceleration during the interval beginning at 1.5 seconds after the onset of POV braking and ending either 250 ms prior to the POV coming to a stop or the SV coming into contact with the POV.

b. Criteria

In order to pass the decelerating POV test series the magnitude of the SV speed reduction attributable to CIB intervention must have been ≥ 10.5 mph (16.9 kph) for at least five of seven valid test trials. The magnitude of the SV speed reduction attributable to CIB intervention was calculated in one of two ways, depending on whether a test trial concluded with the SV colliding with the POV.

1. If SV-to-POV contact occurred during a test trial, the CIB speed reduction was calculated by subtracting the SV speed at the time of SV-to-POV contact (i.e., when longitudinal range becomes zero) from the average SV speed calculated from t_{FCW} - 100 ms to t_{FCW}.

2. If SV-to-POV contact did not occur during a test trial (i.e., CIB intervention prevents the crash), the CIB speed reduction was calculated by subtracting the SV speed at the minimum longitudinal SV-to-POV range during the applicable validity period from the SV speed at t_{FCW}.

4. TEST 4 – FALSE POSITIVE SUPPRESSION

The false positive suppression test series evaluates the ability of a CIB system to differentiate a steel trench plate (STP) from an object presenting a genuine safety risk to the SV. Although the STP is large and metallic, it is designed to be driven over without risk of injury to the driver or damage to the SV. Therefore, in this scenario, the automatic braking available from CIB is not necessary and should be suppressed. The test condition is nearly equivalent to that previously defined for Test 1, the stopped POV condition, but with an STP in the SV forward path in lieu of a POV.

a. Procedure

This test was conducted at two speeds, 25 mph (40.2 km/h) and 45 mph (72.4 km/h). The SV was driven directly towards, and over, the STP, which was positioned in the center of a travel lane, with its longest sides parallel to the road edge.

In addition to the general test validity criteria described below, for an individual test trial to be valid, the following was required throughout the test:

- The SV speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) during an interval defined by a Time to Collision (TTC) = 5.1 seconds to t_{FCW} where:
    - For SV test speed of 25 mph, TTC = 5.1 seconds is taken to occur at an SV-to-STP distance of 187 ft (57 m).
    - For SV test speed of 45 mph, TTC = 5.1 seconds is taken to occur at an SV-to-STP distance of 337 ft (106 m).

- If the SV did not present an FCW alert before the end of the validity period, SV speed could not deviate more than ±1.0 mph (±1.6 km/h) from TTC = 5.1 s to the end of the validity period.

If an FCW alert was presented, the driver released the throttle pedal within 500 ms of the alert. If no alert was presented, the driver did not release the throttle pedal until the end of the validity period. The SV driver then braked to a stop.

b. Criteria

In order to pass the False Positive test series, the magnitude of the SV deceleration reduction attributable to CIB intervention must have been ≤ 0.50 g for at least five of seven valid test trials.

B. General Information

1. t_{FCW}

The time at which the Forward Collision Warning (FCW) activation flag indicates that the system has issued an alert to the SV driver is designated as t_{FCW}. FCW alerts are typically either haptic or audible, and the onset of the alert was determined by post-processing the test data.

For systems that implement audible or haptic alerts, part of the pre-test instrumentation verification process was to determine the tonal frequency of the

audible warning or the vibration frequency of the tactile warning through use of the PSD (Power Spectral Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible or tactile warning data so that the beginning of such warnings can be programmatically determined. The bandpass filter used for these warning signal types was a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 1.

Table 1. Audible and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Pass-Band Frequency Range
Audible	5th	3 dB	60 dB	Identified Center Frequency ± 5%
Tactile	5th	3 dB	60 dB	Identified Center Frequency ± 20%

2. 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.
- The SV was driven at the nominal speed in the center of the travel lane, toward the POV or STP.
- The driver used the least amount of steering input necessary to maintain SV position in the center of the travel lane during the validity period; use of abrupt steering inputs or corrections was avoided.
- The yaw rate of the SV did not exceed ±1.0 deg/s from the onset of the validity period to the instant SV deceleration exceeded 0.25g.
- The SV driver did not apply any force to the brake pedal during the applicable validity period.
- The lateral distance between the centerline of the SV and the centerline of the POV or STP did not deviate more than ±1 ft (0.3 m) during the applicable validity period.

3. Validity Period

The valid test interval began:

Test 1: When the SV-to-POV TTC = 5.1 seconds

Test 2: When the SV-to-POV TTC = 5.0 seconds

Test 3: 3 seconds before the onset of POV braking

Test 4: When the SV-to-STP TTC = 5.1 seconds

The valid test interval ended:

Test 1: When either of the following occurred:

- The SV came into contact with the POV (SV-to-POV contact was assessed by using GPS-based range data or by measurement of direct contact sensor output); or
- The SV came to a stop before making contact with the POV.

Tests 2 and 3: When either of the following occured:

- The SV came into contact with the POV; or
- 1 second after the velocity of the SV became less than or equal to that of the POV.
- 1 second after minimal longitudinal SV-POV distance occurred.

Test 4: At the instant the front most part of SV reached a vertical plane defined by the leading edge of the STP first encountered by the SV (i.e., just before it was driven onto the STP).

4. Static Instrumentation Calibration

To assist in resolving uncertain test data, static calibration data was collected prior to each of the test series.

For Tests 1, 2, and 3, the SV, POV, and POV moving platform and tow vehicle were centered in the same travel lane with the same orientation (i.e., facing

the same direction). For Test 4, the SV and STP were centered in the same travel lane.

For Tests 1, 2, and 3, the SV was positioned such that it just contacted a vertical plane that defines the rearmost location of the POV. For Test 4, the front-most location of the SV was positioned such that it just reached a vertical plane defined by the leading edge of the STP first encountered by the SV (i.e., just before it is driven onto the STP). This is the "zero position."

The zero position was documented prior to, and immediately after, conduct of each test series.

If the zero position reported by the data acquisition system was found to differ by more than ±2 in (±5 cm) from that measured during collection of the pre-test static calibration data file, the pre-test longitudinal offset was adjusted to output zero and another pre-test static calibration data file was collected. If the zero position reported by the data acquisition system was found to differ by more than ±2 in (±5 cm) from that measured during collection of the post-test static calibration data file, the test trials performed between collection of that post-test static calibration data file and the last valid pre-test static calibration data file were repeated.

Static data files were collected prior to, and immediately after, conduct each of the test series. The pre-test static files were reviewed prior to test conduct to confirm that all data channels were operational and were properly configured.

5. Number of Trials

A target total of seven (7) valid trials were performed for each scenario. In cases where the test driver performed more than seven trials, the first seven trials satisfying all test tolerances were used to assess the SV performance.

6. Transmission

All trials were performed with SV automatic transmissions in ''Drive'' or with manual transmissions in the highest gear capable of sustaining the desired test speed. Manual transmission clutches remained engaged during all maneuvers. The brake lights of the POV were not illuminated.

C. Principal Other Vehicle

CIB 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 NHTSA developed Strikeable Surrogate Vehicle (SSV).

The SSV system was designed specifically for common rear-end crash scenarios which AEB systems address. The key elements of the SSV system are:

- POV element, whose requirements are to:
  - Provide an accurate representation of a real vehicle to CIB sensors, including cameras, radar and lidar.
  - Be resistant to damage and inflict little or no damage to the SV as a result of repeated SV-to-POV impacts.

- POV delivery system whose requirements are to:
  - Accurately control the nominal POV speed up to 35 mph (56 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.

The key components of the SSV system are:

- A POV shell which is a visually and dimensionally accurate representation of a passenger car
- A slider and load frame assembly to which the shell is attached
- A two-rail track on which the slider operates
- A road-based lateral restraint track
- A tow vehicle

Operationally, the POV shell is attached to the slider and load frame which includes rollers that allows the entire assembly to move longitudinally along the guide rail. The guide rail is coupled to a tow vehicle and guided by the lateral restraint track secured to the test track surface. The rail includes a provision for restraining the shell and roller assembly in the ward direction. In operation, the shell and roller assembly engage the rail assembly through detents to prevent relative motion during run-up to test speeds and deceleration of the tow vehicle. The combination of rearward stops and forward motion detents allows the test conditions, such as relative POV-SV headway distance, speed, etc., to be achieved and adjusted as needed in the preliminary part of a test. If during the test, the SV strikes the rear of the POV shell, the detents are overcome and the entire shell/roller assembly moves forward in a two-stage manner along the rail away

from the SV. The forward end of the rail has a cushioned stop to restrain forward motion of the shell/roller assembly. After impacting the SSV, the SV driver uses the steering wheel to maintain SV position in the center of the travel lane, thereby straddling the two-rail track. The SV driver must manually apply the SV brakes after impact. The SSV system is shown in Figures A6 through A8 and a detailed description can be found in the NHTSA report: NHTSA'S STRIKEABLE SURROGATE VEHICLE PRELIMINARY DESIGN + OVERVIEW, May 2013.

D. Automatic Braking System

The POV was equipped with an automatic braking system, which was used in Test 3. The braking system consisted of the following components:

- Electronically controlled linear actuator, mounted on the seat rail and attached to the brake pedal. The actuator can be programmed for control of stroke and rate.
- PC module programmed for control of the stroke and rate of the linear actuator.
- Switch to activate actuator.

In some cases, the subject vehicle is also equipped with an automatic braking system (E-brake) for the purpose of slowing the subject vehicle before impact with the SSV in cases where the subject vehicle is likely to fail a test. The system fires when TTC is below 0.7 sec. It is typically enabled when an SV has already impacted the SSV one or two times.

E. Instrumentation

Table 2 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

TABLE 2. TEST INSTRUMENTATION AND EQUIPMENT

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and	Omega DPG8001	17042707002	By: DRI Date: 6/21/2018 Due: 6/21/2019
Platform Scales	Vehicle Total, Wheel, and Axle Load	1200 lb/platform 5338 N/	0.5% of applied load	Intercomp SWI	1110M206352	By: DRI Date: 1/3/2019 Due: 1/3/2020
Linear (string) encoder	Throttle pedal travel	10 in 254 mm	0.1 in 2.54 mm	UniMeasure LX-EP	45050091	By: DRI Date: 5/10/2019 Due: 5/10/2020
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	NA
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities;	Accels ± 10g, Angular Rat	Accels .01g, Angular Rate	Oxford Inertial +		By: Oxford Technical Solutions
					2182	Date: 10/16/2017 Due: 10/16/2019

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
	Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles				2176	Date: 4/11/2018 Due: 4/11/2020

TABLE 2. TEST INSTRUMENTATION AND EQUIPMENT

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
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	NA
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	NA	NA
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	NA	NA
Accelerometer	Acceleration (to measure time at alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	NA	NA

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Coordinate Measurement Machine	Inertial Sensing System Coordinates	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm, Fusion	U08-05-08-06636	By: DRI Date: 1/2/2019 Due: 1/2/2020

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. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (listed above).	D-Space Micro-Autobox II 1401/1513	
		Base Board	549068
		I/O Board	588523

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle

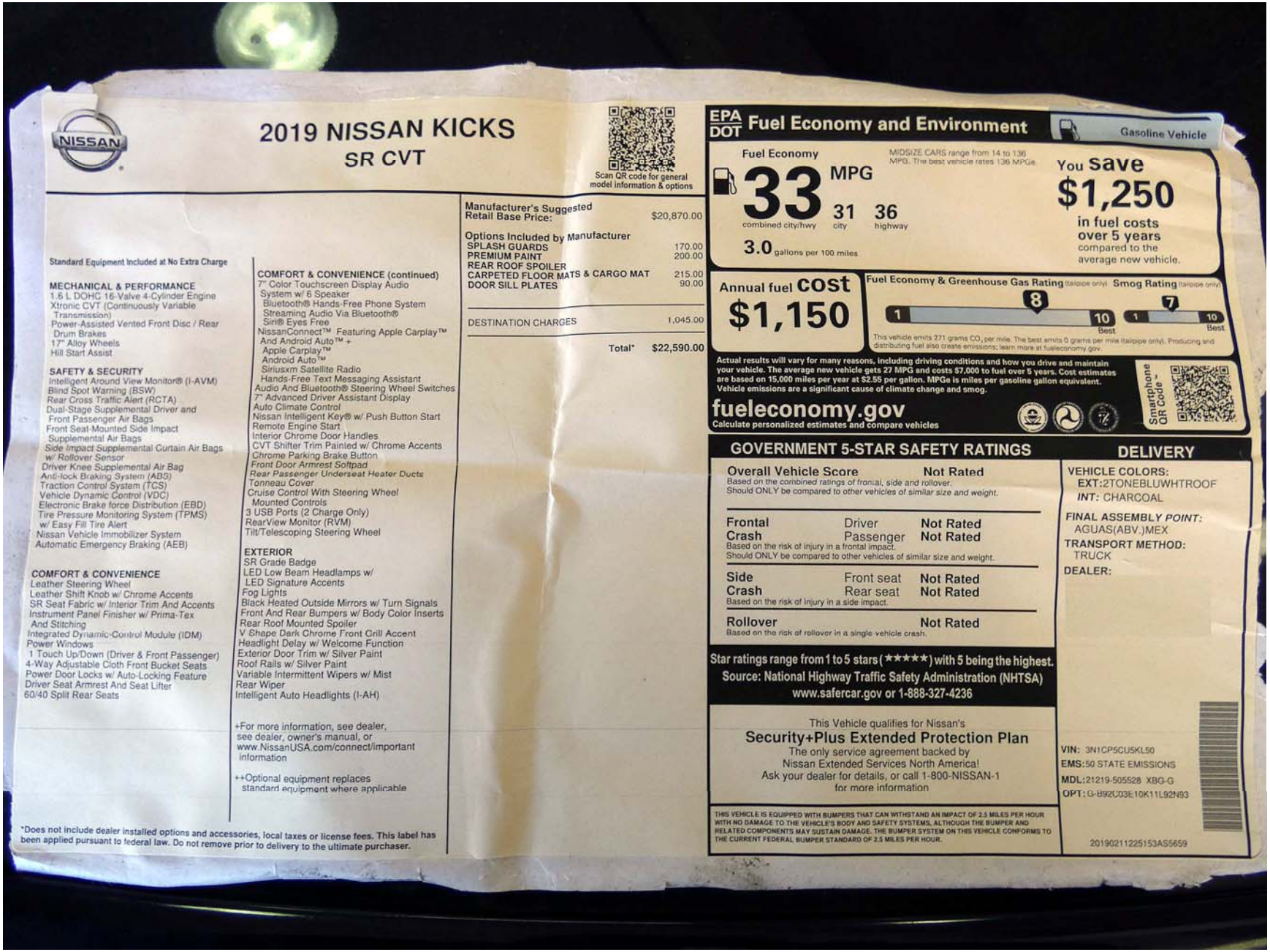


Figure A3. Window Sticker (Monroney Label)

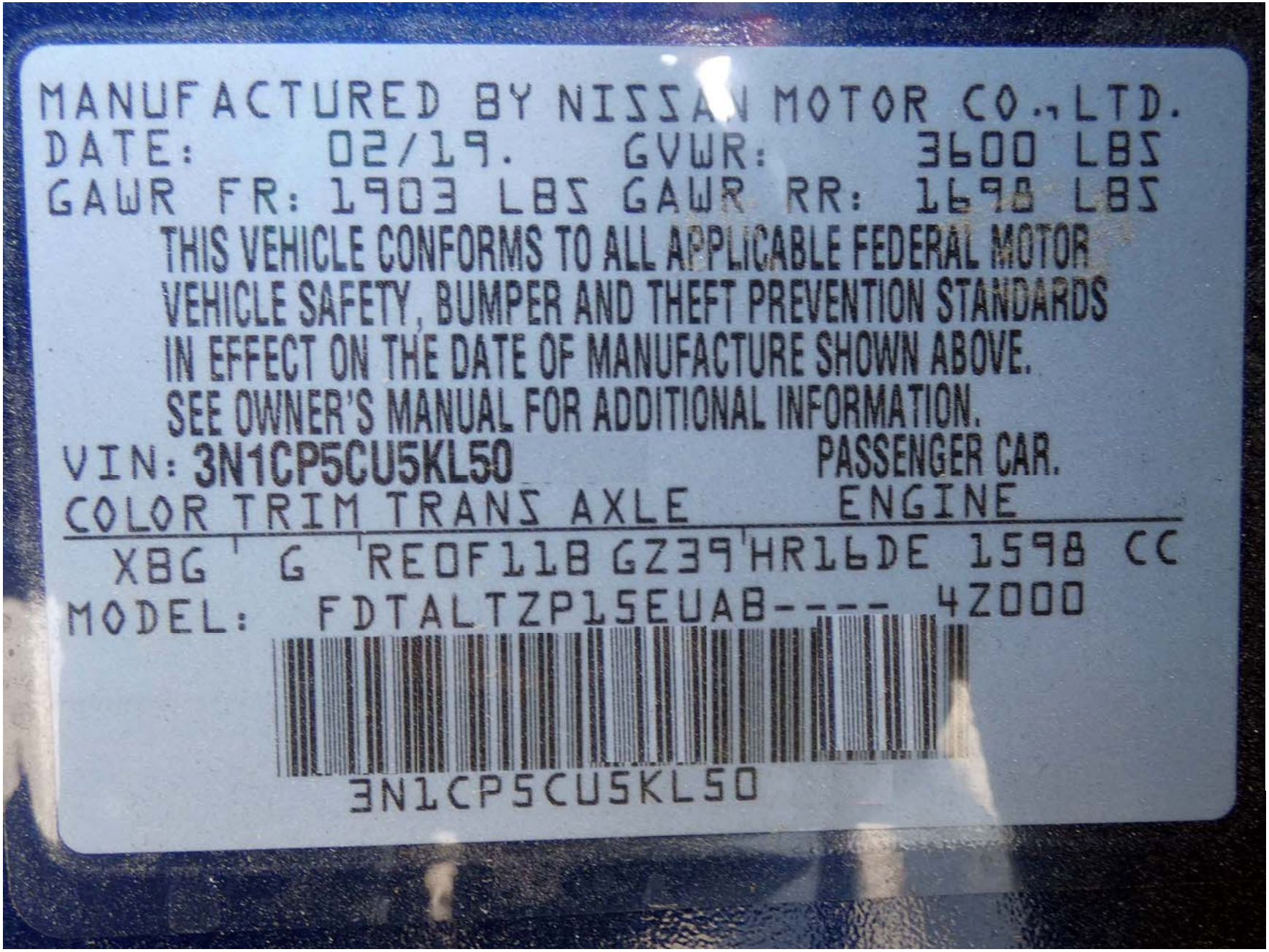


Figure A4. Vehicle Certification Label

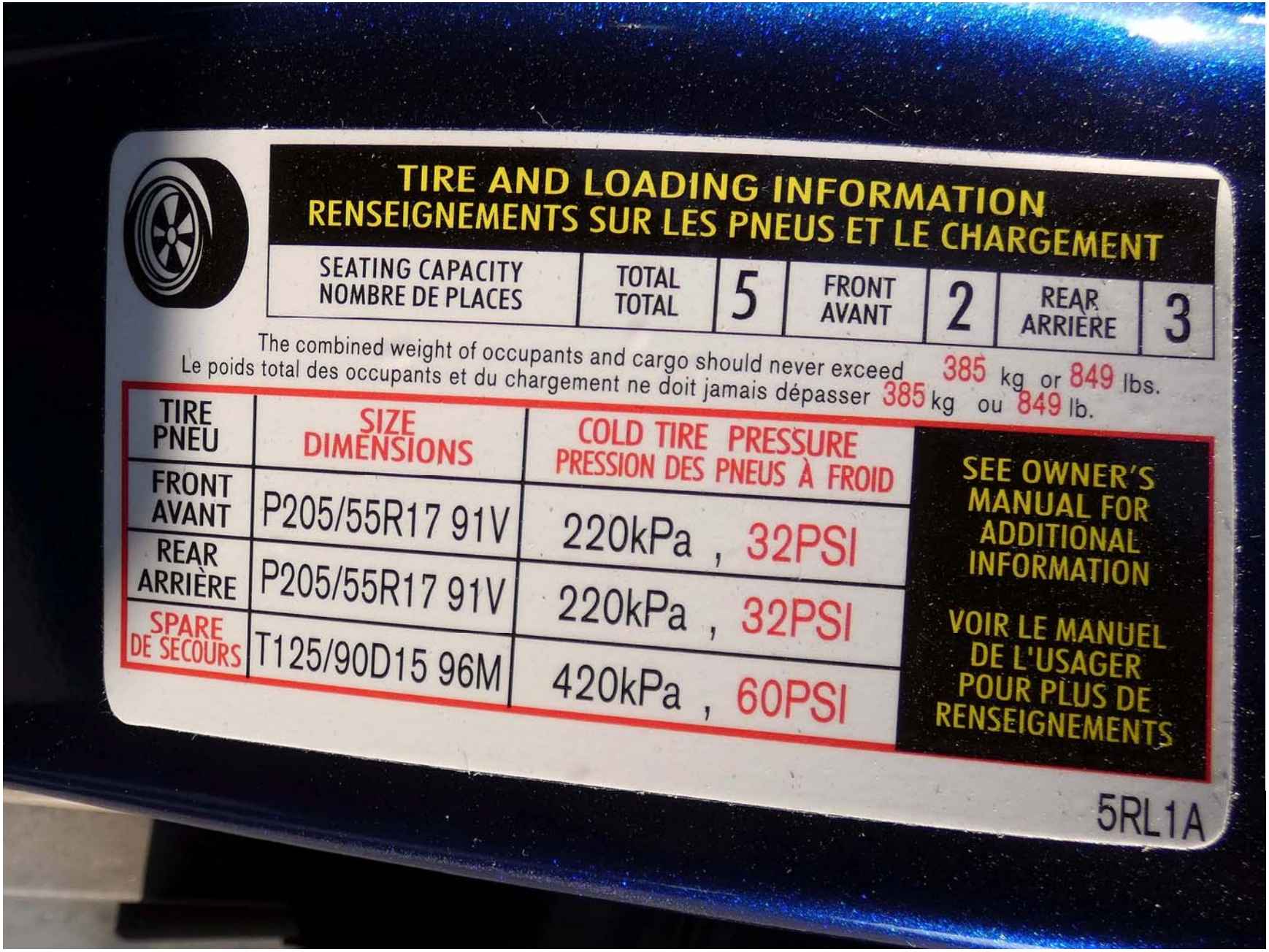


Figure A5. Tire Placard

Figure A6. Rear View of Principal Other Vehicle (SSV)

Figure A7. Load Frame/Slider of SSV

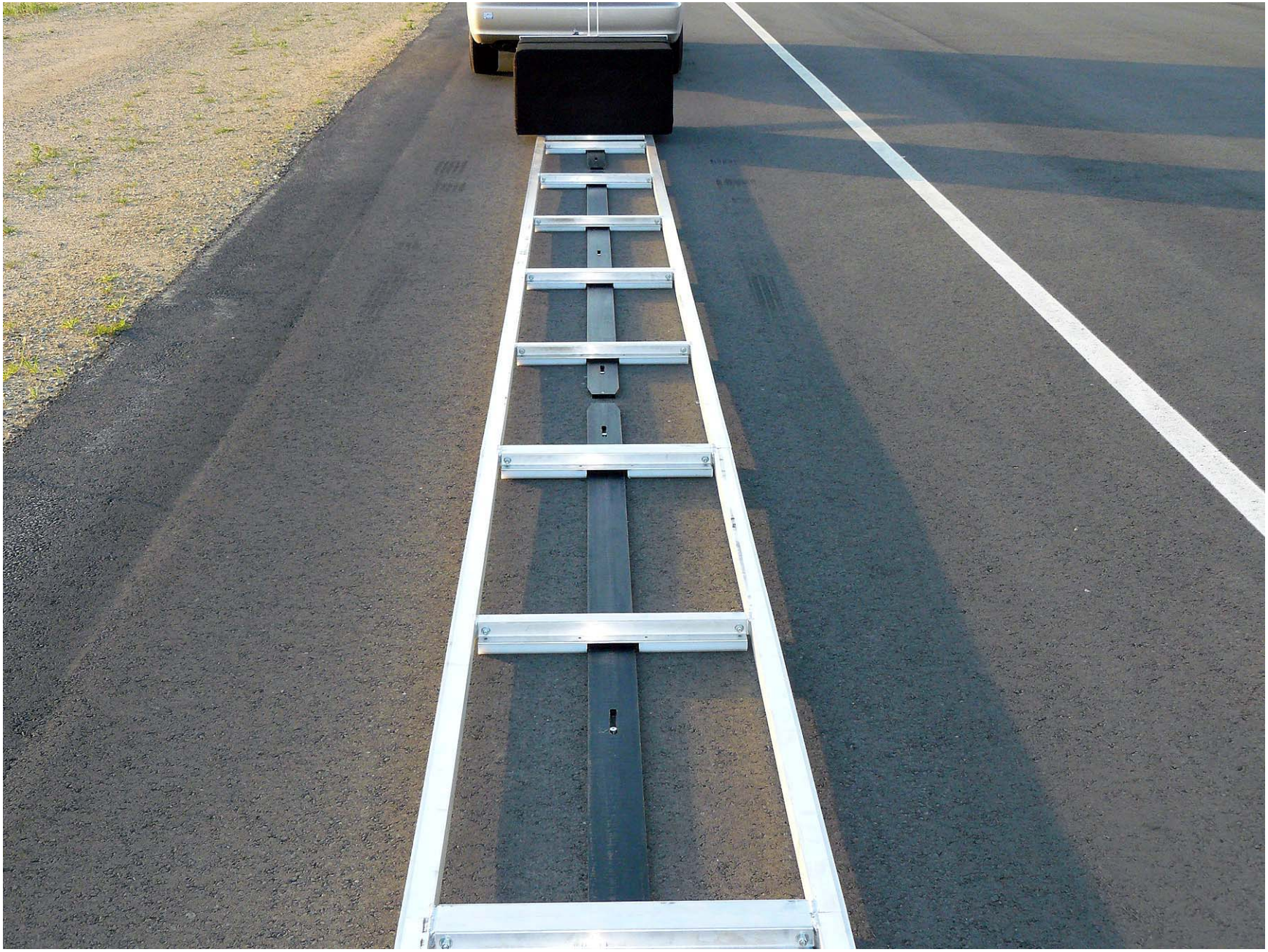


Figure A8. Two-Rail Track and Road-Based Lateral Restraint Track

Figure A9. Steel Trench Plate

Figure A10. DGPS, Inertial Measurement Unit and MicroAutoBox Installed in Subject Vehicle

Figure A11. Sensors for Detecting Visual and Auditory Alerts

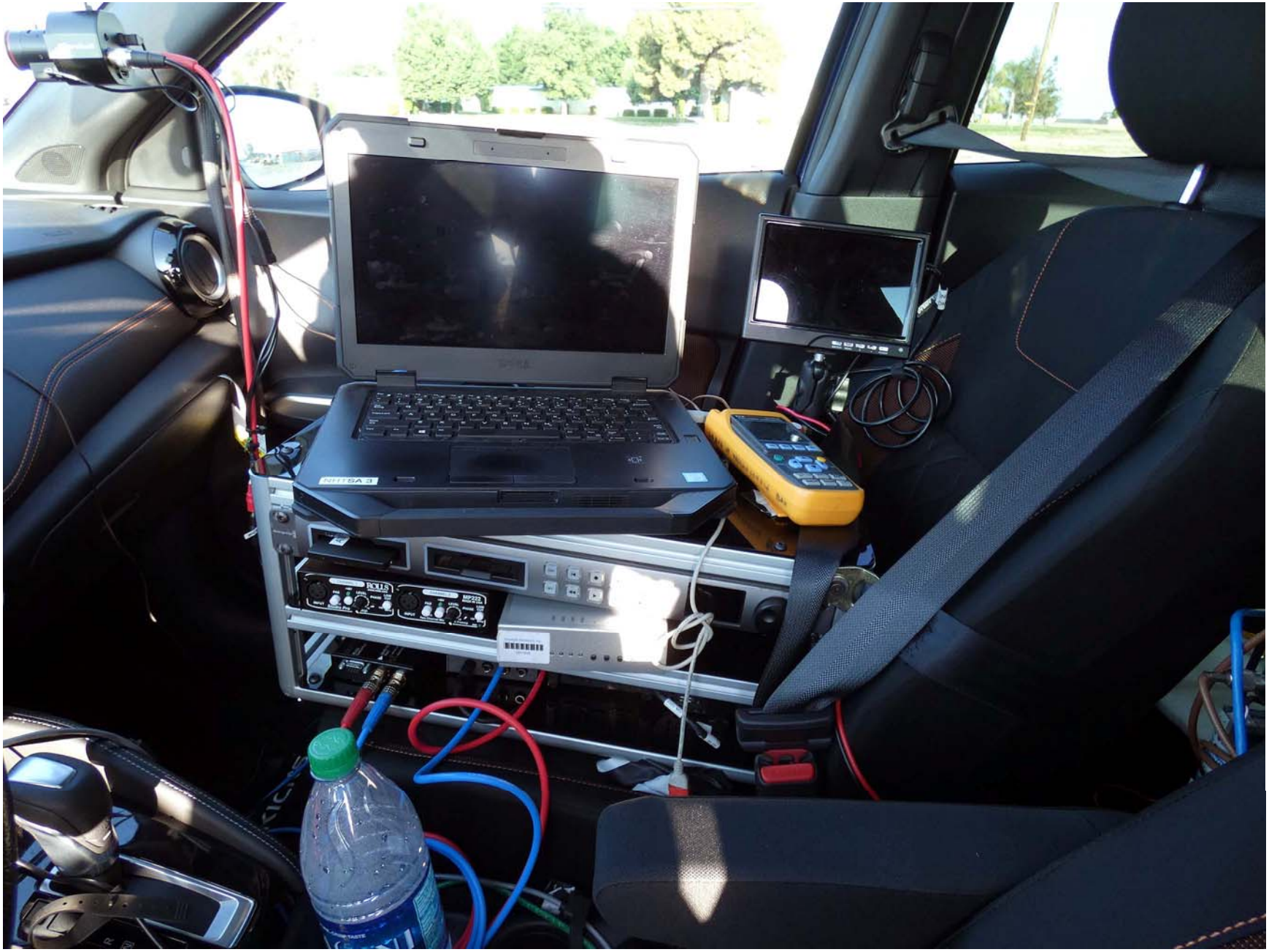


Figure A12. Computer Installed in Subject Vehicle

Figure A13. Brake Actuator Installed in POV System

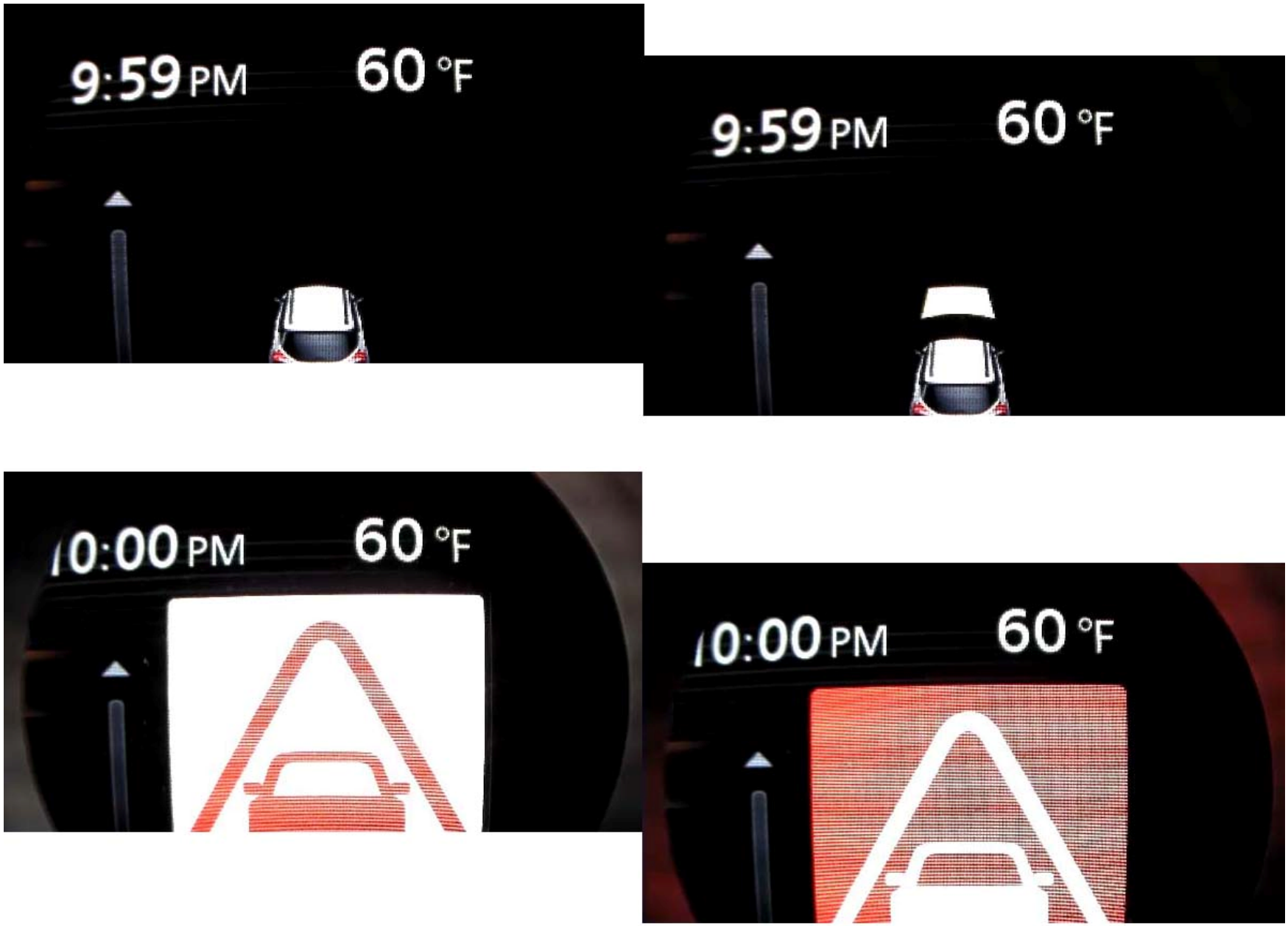


Figure A14. AEB Visual Alert

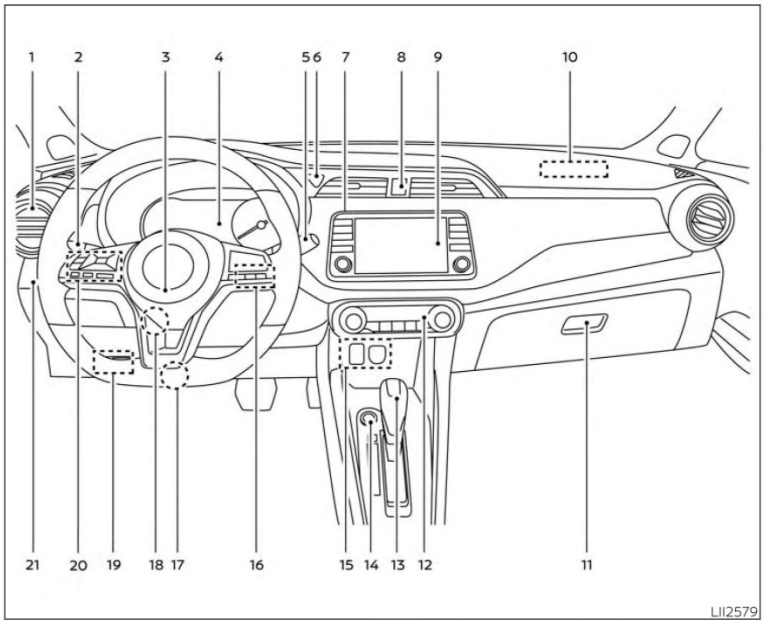
Figure A15. AEB Setup Menus

Figure A16. Steering Wheel Mounted Controls for Changing Parameters

APPENDIX B

Excerpts from Owner's Manual

INSTRUMENT PANEL



1. Vents (P. 4-30)
2. Headlight/fog light (if so equipped)/turn signal switch (P. 2-42)
3. Driver's supplemental air bag (P. 1-42)
   Horn (P. 2-47)
4. Meters and gauges (P. 2-4)
   Warning and indicator lights (P. 2-11)
   Trip computer (if so equipped) (P. 2-9)
   Vehicle information display (if so equipped) (P. 2-22)
5. Wiper and washer switch (P. 2-39)
6. Front passenger airbag status light (P. 1-42)
7. Center display controls (if so equipped) (P. 4-2, 4-3, 4-42)
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8. Hazard warning flasher switch (P. 6-2)
9. Center display (P. 4-2, 4-3, 4-42)
10. Passenger's supplemental air bag (P. 1-42)
11. Glove box (P. 2-51)

12. Climate controls (P. 4-31, 4-39)
    Heated seat switches
    (if so equipped) (P. 2-47)
13. Shift lever (P. 5-15)
14. Push-button ignition switch
    (P. 5-9)
15. Power outlet (P. 2-49)
    USB connection port (P. 4-2, 4-42)
    AUX jack (P. 4-2, 4-42)
16. Bluetooth® Hands-Free Phone
    System (P. 4-2, 4-67)
    Cruise control switches (P. 5-39)
17. Driver supplemental knee air bag
    (P. 1-42)
18. Tilt and telescopic steering wheel
    lock lever (P. 3-26)
19. Hood release (P. 3-21)
    Fuel-filler door release (P. 3-24)
    Automatic Emergency Braking
    (AEB) switch (if so equipped)
    (P 2-48)
20. Steering wheel switches for audio
    control (P. 4-2, 4-62)
    Control panel and vehicle informa-
    tion display switches
    (if so equipped) (P. 2-22)
21. Vehicle Dynamic Control (VDC) OFF
    switch (P. 2-48)
    Enter/select switch for trip com-
    puter (if so equipped) (P. 2-9)

* Refer to the separate NissanConnect® Owner's Manual (if so equipped).

Refer to the page number indicated in parentheses for operating details.

WARNING AND INDICATOR LIGHTS

Warning light	Name	Page
ABS or 	Anti-lock Braking System (ABS) warning light	2-12
	Automatic Emergency Braking (AEB) system warning light (if so equipped)	2-12
BRAKE or 	Brake warning light	2-12
	Charge warning light	2-13
	Door open warning light (if so equipped)	2-13

Warning light	Name	Page
	Engine oil pressure warning light	2-13
	High temperature warning light (red) (if so equipped)	2-14
	Low fuel warning light (if so equipped)	2-14
	Low tire pressure warning light	2-14
	Low windshield-washer fluid warning light (if so equipped)	2-16
	Master warning light (if so equipped)	2-16
KEY 	NISSAN Intelligent Key® warning light (if so equipped)	2-16

Warning light	Name	Page
	Power steering warning light	2-17
	Seat belt warning light	2-17
P SHIFT	Shift P (Park) warning light (if so equipped)	2-17
	Supplemental air bag warning light	2-17

Indicator light	Name	Page
CRUISE	CRUISE indicator light (if so equipped)	2-18
SPORT	DRIVE SPORT mode indicator light (if so equipped)	2-18

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CHECKING LIGHTS

With all doors closed, apply the parking brake, fasten the seat belts and place the ignition switch in the ON position without starting the engine. The following lights (if so equipped) will come on:

, ABS or , , , , , ,

The following lights (if so equipped) will come on briefly and then go off:

BRAKE or , , , , , , O/D OFF

If any light does not come on or operate in a way other than described, it may indicate a burned-out bulb and/or a system malfunction. Have the system checked. It is recommended that you visit a NISSAN dealer for this service.

WARNING LIGHTS

For additional information on warnings and indicators, refer to "Vehicle information display" in this section.

ABS or Anti-lock Braking System (ABS) warning light

When the ignition switch is placed in the ON position, the ABS warning light illuminates and then turns off. This indicates the ABS is operational.

If the ABS warning light illuminates while the engine is running or while driving, it may indicate the ABS is not functioning properly. Have the system checked. It is recommended that you visit a NISSAN dealer for this service.

If an ABS malfunction occurs, the anti-lock function is turned off. The brake system then operates normally but without anti-lock assistance. For additional information, refer to "Brake system" in the "Starting and driving" section of this manual.

Automatic Emergency Braking (AEB) system warning light (if so equipped)

This light comes on when the ignition switch is placed in the ON position. It turns off after the engine is started.

This light illuminates when the AEB system is set to OFF on the vehicle information display.

If the light illuminates when the AEB system is on, it may indicate that the system is unavailable. For additional information, refer to "Automatic Emergency Braking (AEB)" in the "Starting and driving" section of this manual.

BRAKE or Brake warning light

This light functions for both the parking brake and the foot brake systems.

Parking brake indicator

When the ignition switch is placed in the ON position, this light comes on when the parking brake is applied.

Low brake fluid warning light

When the ignition switch is placed in the ON position, the light warns of a low brake fluid level. If the light comes on while the engine is running with the parking brake not applied, stop the vehicle and perform the following:

1. Check the brake fluid level. Add brake fluid as necessary. For additional information, refer to "Brake fluid" in the "Do-it-yourself" section of this manual.

Driver Assistance

The driver assistance menu allows the user to change the various driving aids and assistance options.

Menu item		Result
Blind Spot (if so equipped)		Displays the available Blind Spot options.
	Blind Spot Warning	Allows user to turn the emergency brake on or off. For additional information, refer to "Automatic Emergency Braking (AEB)" in the "Starting and driving" section of this manual.
Emergency Brake		Displays the available emergency brake options.
	System	Allows user to turn the emergency brake on or off. For additional information, refer to "Automatic Emergency Braking (AEB)" in the "Starting and driving" section of this manual.
Parking Aids (if so equipped)		Displays the available parking aids options.
	Moving Object (if so equipped)	Allows user to turn moving object detection on or off. For additional information, refer to "Moving Object Detection (MOD)" in the "Monitor, climate, audio, phone and voice recognition systems" section of this manual.
	Rear Cross Traffic Alert (if so equipped)	Allows user to turn rear cross traffic alert on or off. For additional information, refer to "Rear Cross Traffic Alert (RCTA)" in the "Starting and driving" section of this manual.
Timer Alert		Allows user to set or reset an alert at a specific time interval.
Low Temperature Alert		Allows user to turn the low temperature alert on or off.
Chassis Control (if so equipped)		Displays the available chassis control options.
	Active Trace Control	Allows the user to turn the Intelligent Trace Control (I-TC) feature on or off. For additional information, refer to "Chassis Control" in the "Starting and driving" section of this manual.
	Active Engine Brake	Allows the user to turn the Intelligent Engine Brake (I-EB) feature on or off. For additional information, refer to "Chassis Control" in the "Starting and driving" section of this manual.

TPMS Error: See Owner's Manual (if so equipped)

This warning appears when there is an error with your TPMS. If this warning comes on, have the system checked. It is recommended that you visit a NISSAN dealer for this service.

Alarm - Time for a break? (if so equipped)

This indicator appears when the driver enables the Timer Alert function within the Driving Assistance settings and the selected set time is expired. The time is based on ignition on time and can be set up to six hours.

Power will turn off to save the battery

This message appears in the vehicle information display after a period of time if the ignition switch is in the ON position and if the vehicle is in P (Park). For additional information, refer to "Push-button ignition switch positions" in the "Starting and driving" section of this manual.

Power turned off to save the battery

This message appears after the ignition switch is automatically turned off. For additional information, refer to "Push-button ignition switch positions" in the "Starting and driving" section of this manual.

Reminder: Turn OFF Headlights

This warning appears when the headlights are left in the ON position when exiting the vehicle. Place the headlight switch in the OFF or AUTO position. For additional information, refer to "Headlight and turn signal switch" in this section.

Headlight System Error: See Owner's Manual

This warning illuminates when there is an error with the system. For additional information, refer to "Headlight and turn signal switch" in this section.

Cruise control indicator (if so equipped)

This indicator shows the cruise control system status.

For additional information, refer to "Cruise control" in the "Starting and driving" section of this manual.

Blind Spot Warning (BSW) indicator (if so equipped)

This indicator shows when the BSW system is engaged.

For additional information, refer to "Blind Spot Warning (BSW)" in the "Starting and driving" section of this manual.

Malfunction (if so equipped)

This warning appears when one or more of the following systems (if so equipped) is not functioning properly:

- Automatic Emergency Braking (AEB)
- Blind Spot Warning (BSW)
- Rear Cross Traffic Alert (RCTA)

If one or more of these warning appears, have the system checked. It is recommended that you visit a NISSAN dealer for this service.

Shipping Mode On Push Storage Fuse

This warning may appear if the extended storage switch is not pushed in. When this warning appears, push in the extended storage switch to turn off the warning. For additional information, refer to "Extended storage switch" in this section.

Other

This indicator appears when the customer set distance is reached for checking or replacing maintenance items other than the engine oil, oil filter and tires. Other maintenance items can include such things as air filter or tire rotation. The distance for checking or replacing the items can be set or reset.

Front Radar Obstruction (if so equipped)

This warning appears when there is a radar obstruction detected. For additional information, refer to "Automatic Emergency Braking (AEB)" in the "Starting and driving" section of this manual.

Side Radar Obstruction (if so equipped)

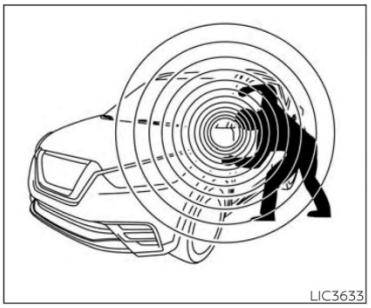
This message appears when the Blind Spot Warning (BSW) or Rear Cross Traffic Alert (RCTA) systems become unavailable because a radar blockage is detected. For additional information, refer to "Blind Spot Warning (BSW)" or "Rear Cross Traffic Alert (RCTA)" in the "Starting and driving" section of this manual.

Drive Sport mode indicator (if so equipped)

A small "S" appears to the right of the Transmission Shift Position indicator in the vehicle information display when the Drive Sport mode is engaged.

Activate the Drive Sport mode by pressing the switch on the shift lever while the shift lever is in the D (Drive) position.

For additional information, refer to "Driving the vehicle" in the "Starting and driving" section of this manual.


LIC3633

Your vehicle may have three types of security systems:

- Vehicle security system
- NISSAN Anti-Theft System
- NISSAN Vehicle Immobilizer System

VEHICLE SECURITY SYSTEM

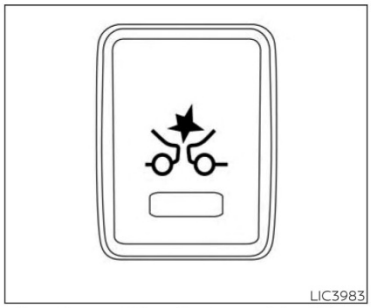
The vehicle security system provides visual and audible alarm signals if someone opens the doors, hood or liftgate when the system is armed. It is not, however, a motion detection type system that activates when a vehicle is moved or when a vibration occurs.

The front seats are warmed by built-in heaters.

1. Place the ignition switch in the ON position.
2. Push the switch once for the high (2 indicators illuminated) setting. Push the switch again for the low (1 indicator illuminated) setting.

   The heater is controlled by a thermostat, automatically turning the heater on and off. The indicator light(s) will remain on as long as the switch is on.
3. Push the switch again to turn it off (no indicators illuminated).
4. When the seat is warmed or before you leave the vehicle, be sure to push the switch to turn it off.

AUTOMATIC EMERGENCY BRAKING (AEB) SWITCH (if so equipped)


LIC3983

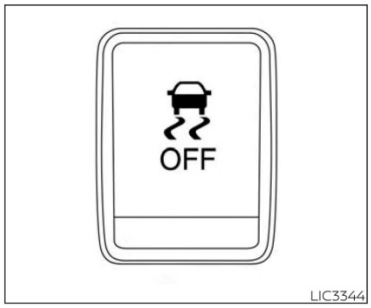
When this switch is illuminated, the following system is activated.

- Automatic Emergency Braking (AEB)

To turn the systems on, push the AEB switch. The light will illuminate. To turn the systems off, push the switch again. The light will go off, and the Automatic Emergency Braking (AEB) system warning light will illuminate in the meter.

For additional information, refer to "Automatic Emergency Braking (AEB)" in the "Starting and driving" section of this manual.

VEHICLE DYNAMIC CONTROL (VDC) OFF SWITCH



LIC3344

The vehicle should be driven with the VDC system on for most driving conditions.

If the vehicle is stuck in mud or snow, the VDC system reduces the engine output to reduce wheel spin. The engine speed will be reduced even if the accelerator is depressed to the floor. If maximum engine power is needed to free a stuck vehicle, turn the VDC system off.

To turn off the VDC system, push the VDC OFF switch. The indicator and the Automatic Emergency Braking (AEB) system warning light will come on.

- Push and release the SET– switch. Each time you do this, the set speed decreases by about 1 mph (1.6 km/h).

To resume the preset speed, push and release the RES+ switch. The vehicle returns to the last set cruising speed when the vehicle speed is over 25 mph (40 km/h).

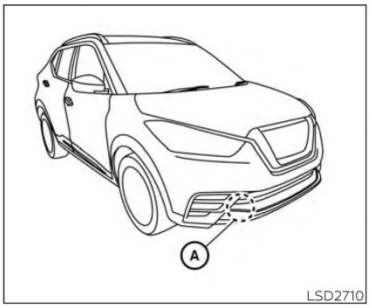
AUTOMATIC EMERGENCY BRAKING (AEB) (if so equipped)

⚠ WARNING

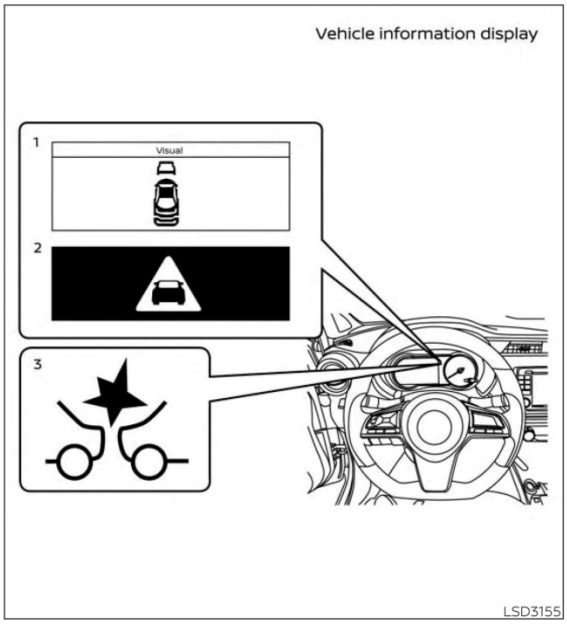
Failure to follow the warnings and instructions for proper use of the AEB system could result in serious injury or death.

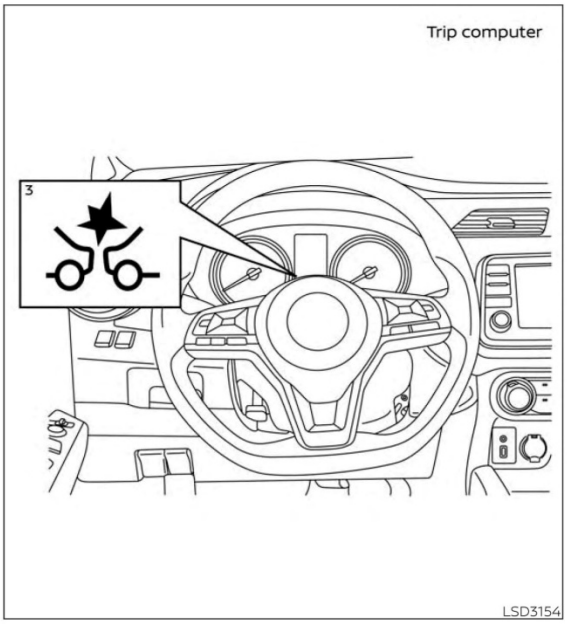
- **The AEB system is a supplemental aid to the driver. It is not a replacement for the driver's attention to traffic conditions or responsibility to drive safely. It cannot prevent accidents due to carelessness or dangerous driving techniques.**
- **The AEB system does not function in all driving, traffic, weather and road conditions.**

The AEB system can assist the driver when there is a risk of a forward collision with the vehicle ahead in the traveling lane.



The AEB system uses a radar sensor Ⓐ located on the front of the vehicle to measure the distance to the vehicle ahead in the same lane.


Vehicle information display
1
Visual
2
3
LSD3155


Trip computer
3
LSD3154

1. Vehicle ahead detection indicator (if so equipped)
2. AEB emergency warning indicator (if so equipped)
3. AEB system warning light

AEB SYSTEM OPERATION

The AEB system will function when your vehicle is driven at speeds above approximately 3 mph (5 km/h).

If a risk of a forward collision is detected, the AEB system will provide an initial warning to the driver by both a visual (if so equipped) and audible alert.

If the driver applies the brakes quickly and forcefully after the warning, and the AEB system detects that there is still the possibility of a forward collision, the system will automatically increase the braking force. If the driver does not take action, the AEB system issues the second visual warning (red) (if so equipped) and audible warning and also applies partial braking.

If the risk of a collision becomes imminent, the AEB system applies harder braking automatically.

NOTE:

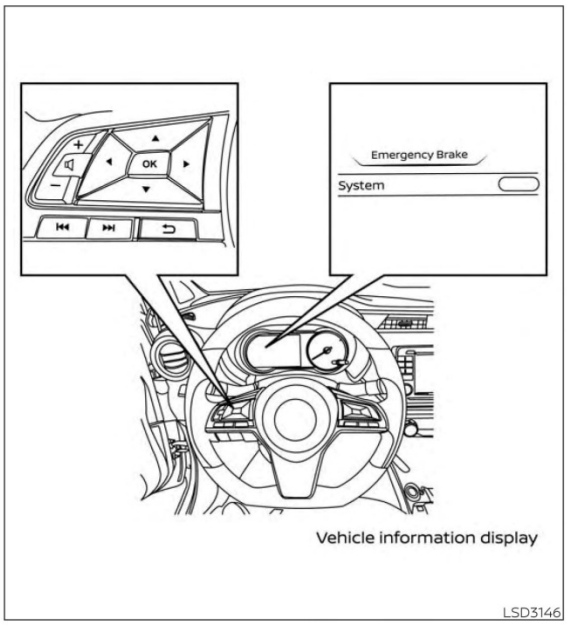
The vehicle's brake lights come on when braking is performed by the AEB system.

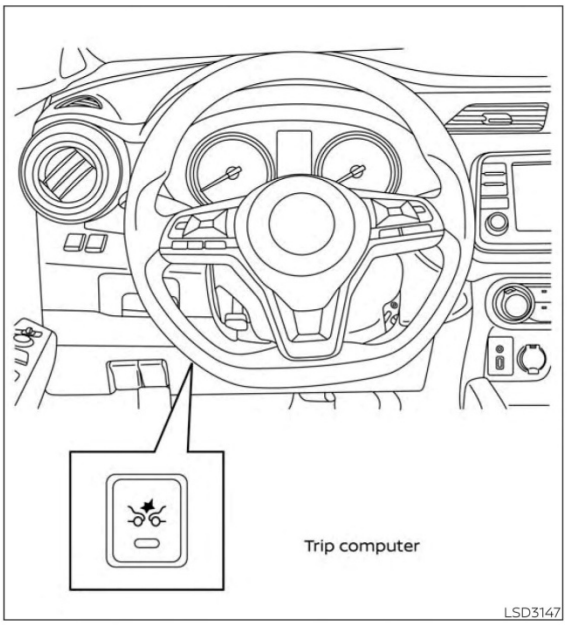
Depending on vehicle speed and distance to the vehicle ahead, as well as driving and roadway conditions, the system may help the driver avoid a forward collision or may help mitigate the consequences of a collision, should one be unavoidable. If the driver is handling the steering wheel, accelerating or braking, the AEB system will function later or will not function.

The automatic braking will cease under the following conditions:

- When the steering wheel is turned as far as necessary to avoid a collision.
- When the accelerator pedal is depressed.
- When there is no longer a vehicle detected ahead.

If the AEB system has stopped the vehicle, the vehicle will remain at a standstill for approximately 2 seconds before the brakes are released.


OK
Emergency Brake
System
Vehicle information display
LSD3146


Trip computer
LSD3147

TURNING THE AEB SYSTEM ON/OFF

Perform the following steps to turn the AEB system on or off in the vehicle information display (if so equipped).

1. Press the ◀▶ button until "Settings" displays in the vehicle information display. Use the ▲▼ button to select "Driver Assistance." Then press the OK button.
2. Select "Emergency Brake" and press the OK button.
3. Select "System" and press the OK button.

Perform the following steps to turn the AEB system on or off using the Automatic Emergency Braking (AEB) switch (if so equipped) for models with a trip computer.

1. Push the AEB switch to turn the AEB system on and the switch illuminates.
2. Push the AEB switch again to turn the AEB system off.

When the AEB system is turned off, the AEB system warning light illuminates.

NOTE:

The AEB system will be automatically turned on when the engine is restarted.

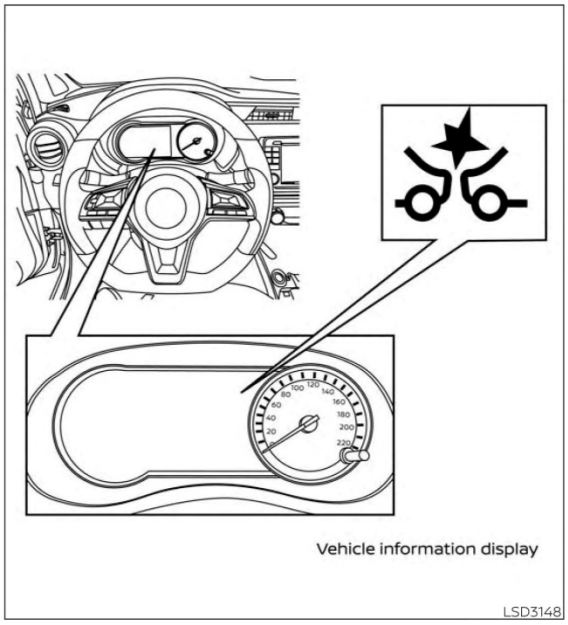
AEB SYSTEM LIMITATIONS

⚠WARNING

Listed below are the system limitations for the AEB system. Failure to operate the vehicle in accordance with these system limitations could result in serious injury or death.

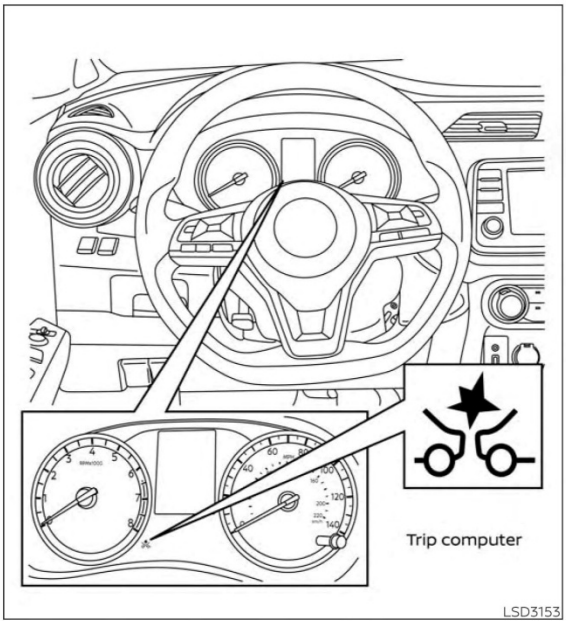
- **The AEB system cannot detect all vehicles under all conditions.**
- **The radar sensor does not detect the following objects:**
  - **Pedestrians, animals or obstacles in the roadway.**
  - **Oncoming vehicles.**
  - **Crossing vehicles.**
- **The radar sensor has some performance limitations. If a stationary vehicle is in the vehicle's path, the AEB system will not function when the vehicle is driven at speeds over approximately 50 mph (80 km/h).**
- **The radar sensor may not detect a vehicle ahead in the following conditions:**
  - **Dirt, ice, snow or other material covering the radar sensor.**
  - **Interference by other radar sources.**
  - **Snow or road spray from traveling vehicles.**
  - **If the vehicle ahead is narrow (e.g., motorcycle).**
  - **When driving on a steep downhill slope or roads with sharp curves.**
- **In some road or traffic conditions, the AEB system may unexpectedly apply partial braking. When acceleration is necessary, continue to depress the accelerator pedal to override the system.**
- **Braking distances increase on slippery surfaces.**

- **The system is designed to automatically check the sensor's functionality, within certain limitations. The system may not detect some forms of obstructions of the sensor area such as ice, snow, stickers, etc. In these cases, the system may not be able to warn the driver properly. Be sure that you check, clean and clear the sensor area regularly.**
- **Excessive noise will interfere with the warning chime sound, and the chime may not be heard.**



Vehicle information display

LSD3148



SYSTEM TEMPORARILY UNAVAILABLE

Condition A

When the radar sensor picks up interference from another radar source, making it impossible to detect a vehicle ahead, the AEB system is automatically turned off.

The AEB system warning light (orange) will illuminate.

Action to take

When the above conditions no longer exist, the AEB system will resume automatically.

Condition B

When the sensor area of the front bumper is covered with dirt or is obstructed, making it impossible to detect a vehicle ahead, the AEB system is automatically turned off.

The AEB system warning light (orange) will illuminate and the "Front Radar Obstruction" warning message will appear in the vehicle information display.

Action to take

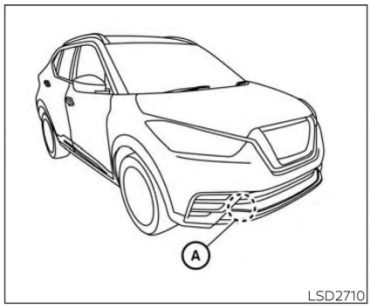
If the warning light (orange) comes on, stop the vehicle in a safe place, place the shift lever in the P (Park) position and turn the engine off. Clean the radar cover on the lower grille with a soft cloth, and restart the engine. If the warning light continues to illuminate, have the AEB system checked. It is recommended that you visit a NISSAN dealer for this service.

SYSTEM MALFUNCTION

If the AEB system malfunctions, it will be turned off automatically, a chime will sound, the AEB warning light (orange) will illuminate and the warning message [Malfunction] will appear in the vehicle information display.

Action to take

If the warning light (orange) comes on, stop the vehicle in a safe location, turn the engine off and restart the engine. If the warning light continues to illuminate, have the AEB system checked. It is recommended that you visit a NISSAN dealer for this service.



LSD2710

SYSTEM MAINTENANCE

The sensor Ⓐ is located on the front of the vehicle.

To keep the system operating properly, be sure to observe the following:

- Always keep the sensor area of the front bumper clean.
- Do not strike or damage the areas around the sensor.
- Do not cover or attach stickers or similar objects on the front bumper near the sensor area. This could cause failure or malfunction.
- Do not attach metallic objects near the sensor area (brush guard, etc.). This could cause failure or malfunction.
- Do not alter, remove or paint the front bumper. Before customizing or restoring the front bumper, it is recommended that you visit a NISSAN dealer.

FCC Notice

For USA

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.

FCC Warning

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Radio Frequency Radiation Exposure Information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body.

The transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

For Canada

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

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

L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage,

   et

2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnnement.

⚠ CAUTION

During the first 1,200 miles (2,000 km), follow these recommendations to obtain maximum engine performance and ensure the future reliability and economy of your new vehicle. Failure to follow these recommendations may result in shortened engine life and reduced engine performance.

- Avoid driving for long periods at constant speed, either fast or slow, and do not run the engine over 4,000 rpm.
- Do not accelerate at full throttle in any gear.
- Avoid quick starts.
- Avoid hard braking as much as possible.

APPENDIX C

Run Log

Subject Vehicle: **2019 Nissan Kicks** Test Date: **5/6/2019**

Principal Other Vehicle: **SSV**

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Pass/Fail	Notes
1	Static Run								
2	**Stopped POV**	N							Yaw Rate
3	Static Run								
4	**Slower POV, 25 vs 10**	Y	1.67	0.00	8.2	0.55	0.67	Fail	
5		Y	1.67	0.00	7.5	0.54	0.63	Fail	
6		Y	1.64	0.00	7.0	0.55	0.58	Fail	
7	Static Run								
8	**Slower POV, 45 vs 20**	Y	2.43	0.00	8.4	0.71	0.64	Fail	
9		Y	2.51	0.00	8.7*	0.47	0.60	Fail	E-brake fired
10		Y	2.51	0.00	8.9*	0.51	0.73	Fail	E-brake fired
11	Static run								

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Pass/Fail	Notes
12	**Braking POV, 35**	Y	1.76	0.00	8.6	0.62	0.87	Fail	
13		Y	1.86	0.00	8.6	0.62	0.85	Fail	
14		Y	1.82	0.00	7.7	0.49	0.85	Fail	
15	Static Run								
16	**Stopped POV**	Y	1.96	0.00	4.0*	0.06	0.20	Fail	No AEB, E-brake fired
17		Y	1.85	0.00	7.4*	0.43	0.73	Fail	E-brake fired
18		Y	N/A	0.00	3.4*	0.05	0.20	Fail	No Warning, E-brake fired
19	Static Run								
20	STP - Static Run								
21	**STP False Positive, 25**	Y				0.01		Pass	
22		N							Throttle release
23		Y				0.01		Pass	
24		Y				0.01		Pass	
25		Y				0.00		Pass	
26		Y				0.01		Pass	
27		Y				0.02		Pass	
28		Y				0.01		Pass	

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Pass/Fail	Notes
29	STP - Static Run								
30	**STP False Positive, 45**	N							Yaw
31		Y				0.01		Pass	
32		Y				0.03		Pass	
33		Y				0.01		Pass	
34		Y				0.02		Pass	
35		Y				0.01		Pass	
36		Y				0.02		Pass	
37		Y				0.03		Pass	
38	STP - Static Run								

*Speed reduction calculated with assistance from E-brake

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 the Principal Other Vehicle (POV), as well as pass/fail envelopes and thresholds. The following is a description of data types shown in the time history plots, as well as a description of the color codes indicating to which vehicle the data pertain.

Time History Plot Description

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:

- Stopped POV (SV at 25 mph)
- Slower POV, 25/10 (SV at 25 mph, POV at 10 mph)
- Slower POV, 45/20 (SV at 45 mph, POV at 20 mph)
- Braking POV 35 mph (Both vehicles at 35 mph with 13.8 m gap, POV brakes at 0.3 g)
- False Positive STP 25 mph (Steel trench plate run over at 25 mph)
- False Positive STP 45 mph (Steel trench plate run over at 45 mph)

Time history figures include the following sub-plots:

- FCW Warning – displays the Forward Collision Warning alert (which can be audible, visual, or haptic). Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any combination of the following:

    - Filtered, rectified, and normalized sound signal. The vertical scale is 0 to 1.
    - Filtered, rectified, and normalized acceleration (i.e., haptic alert, such as steering wheel vibration). The vertical scale is 0 to 1.
    - Normalized light sensor signal. The vertical scale is 0 to 1.

    As only the audible or haptic alert is perceptible by the driver during a test run, the earliest of either of these alerts is used to define the onset of the FCW alert. A vertical black bar on the plot indicates the

TTC (sec) at the first moment of the warning issued by the FCW system. The FCW TTC is displayed to the right of the subplot in green.

- Headway (ft) – longitudinal separation (gap) between the frontmost point of the Subject Vehicle and the rearmost point of the Strikeable Surrogate Vehicle (SSV) towed by the Principal Other Vehicle. The minimum headway during the run is displayed to the right of the subplot.

- SV/POV Speed (mph) – speed of the Subject Vehicle and Principal Other Vehicle (if any). For CIB tests, the speed reduction experienced by the Subject Vehicle is displayed to the right of the subplot.

- Yaw Rate (deg/sec) – yaw rate of the Subject Vehicle and Principal Other Vehicle (if any).

- Lateral Offset (ft) – lateral offset within the lane of the Subject Vehicle to the center of the lane of travel. Note that for tests involving the Strikeable Surrogate Vehicle (SSV), the associated lateral restraint track is defined to be the center of the lane of travel. If testing is done with a different POV which does not have a lateral restraint track, lateral offset is defined to be the lateral offset between the SV and POV.

- Ax (g) – longitudinal acceleration of the Subject Vehicle and Principal Other Vehicle (if any). For CIB tests, the TTC (sec) at the moment of first CIB activation is displayed to the right of the subplot in green. Also, the peak value of Ax for the SV is shown on the subplot.

- Accelerator Pedal Position (0-1) – normalized position of the accelerator pedal. A green dot is displayed if the accelerator pedal was released within 0.5 seconds of the onset of the FCW warning.

Note that 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.

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 AEB 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. 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, in order for the test to be valid, the time-varying data must not exceed the envelope at the beginning (left edge of the boundary) and/or end (right edge), but may exceed the boundary during the time between the left and right edges. Exceedances at the left or right extent of a yellow envelope are indicated by red asterisks.

For the headway plot, a dashed black threshold line indicating a relative headway of zero is displayed. If no impact occurs, a green circle is displayed at the moment of minimum distance. If impact occurs, a red asterisk is displayed at the moment of impact.

For the Ax plot, if the scenario is an AEB brake to stop scenario, a vertical dashed black line is displayed for all plots indicating the moment of first POV braking. The yellow envelope in this case is relevant to the POV braking only. The left edge of the envelope is at 1.5 seconds after the first POV braking. A solid black threshold line extends horizontally 0.5 seconds to the left of the envelope. This threshold line represents the time during which the Ax of the Principal Other Vehicle must first achieve 0.27 g (the upper edge of the envelope). A green circle or red asterisk is displayed at the moment the POV brake level achieves 0.27 g. A green circle indicates that the test was valid (the threshold was crossed during the appropriate interval) and a red asterisk indicates that the test was invalid (the threshold was crossed outside of the appropriate interval). Additionally, for the CIB tests, a dashed black threshold line indicating an Ax of -0.15 g is given to define the onset of CIB activation. When the Subject Vehicle's Ax crosses this threshold, the CIB TTC is calculated and displayed.

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 offset and headway distance)

2. Validation envelope and threshold color codes:
   - Green envelope = time varying data must be within the envelope at all times in order to be valid
   - Yellow envelope = time varying data must be within limits at left and/or right ends
   - Black threshold (Solid) = time varying data must cross this threshold in the time period shown in order to be valid
   - Black threshold (Dashed) = for reference only – this can include warning level thresholds, TTC thresholds, and acceleration thresholds

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

Examples of time history plots for each test type (including passing, failing and invalid runs) are shown in Figure 1 through Figure 9. Figures 1 through 6 show passing runs for each of the 6 test types. Figures 7 and 8 show examples of invalid runs. Figure 9 shows an example of a valid test that failed the CIB requirements.

Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure 10.

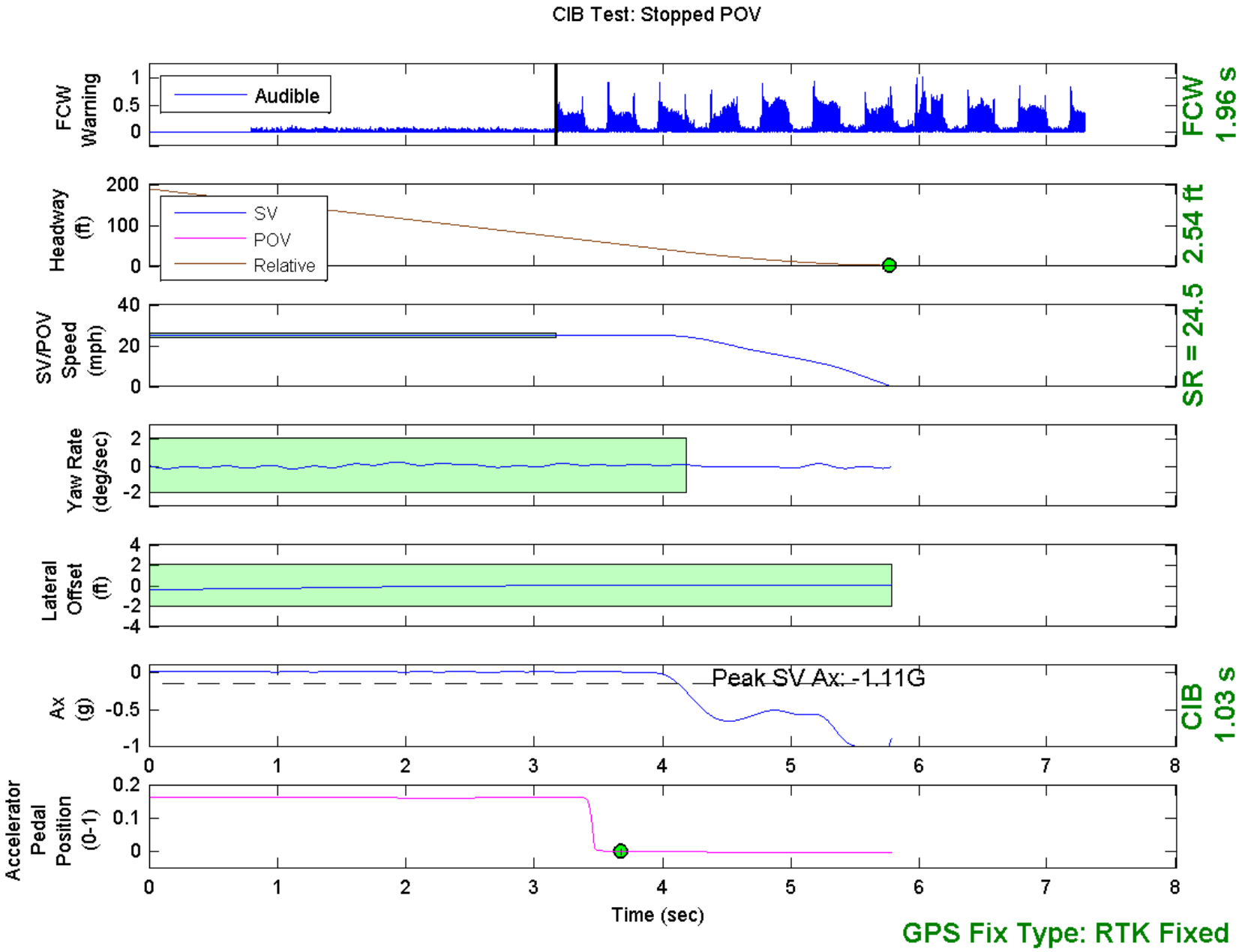


Figure D1. Example Time History for Stopped POV, Passing

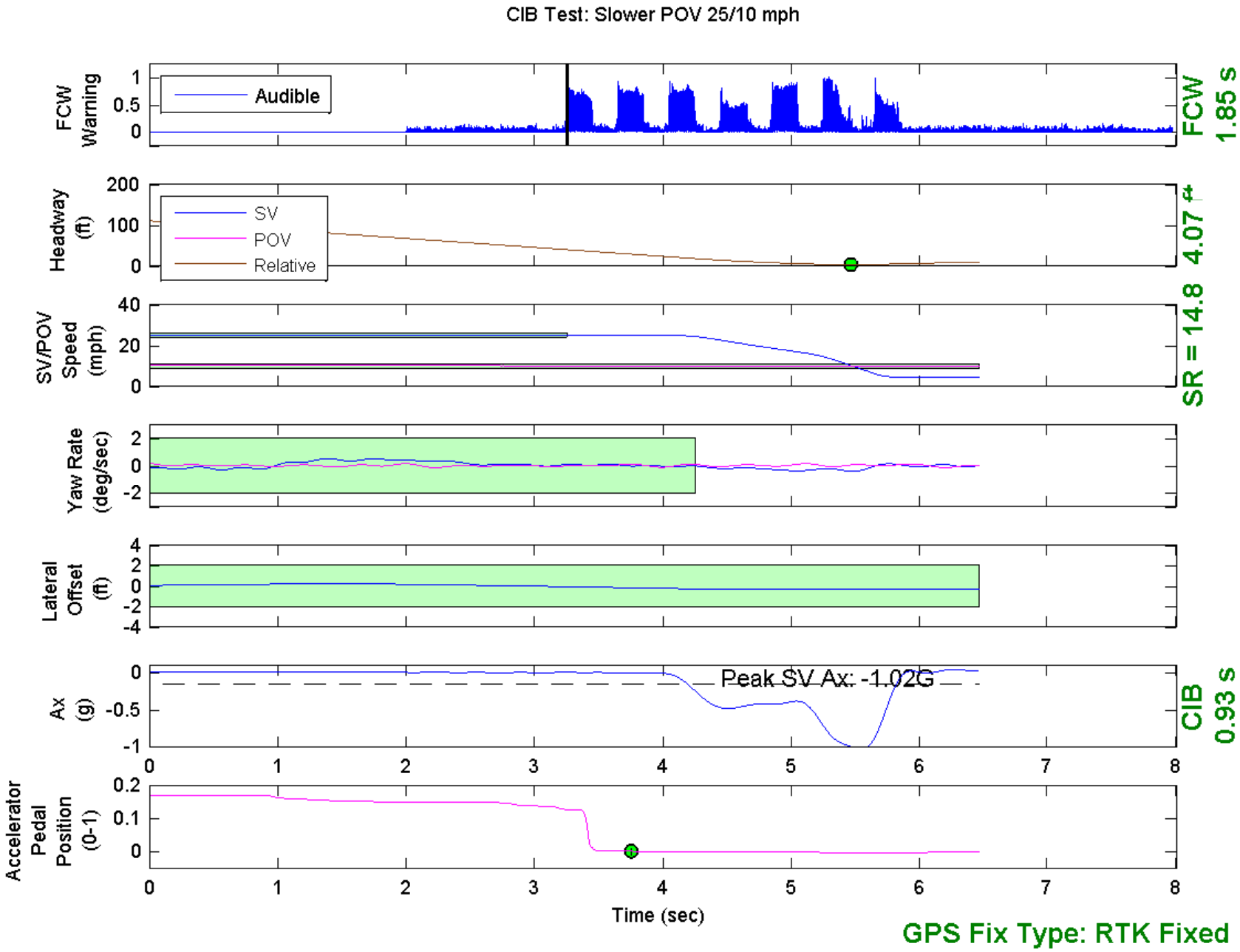


Figure D2. Example Time History for Slower POV 25 vs. 10, Passing

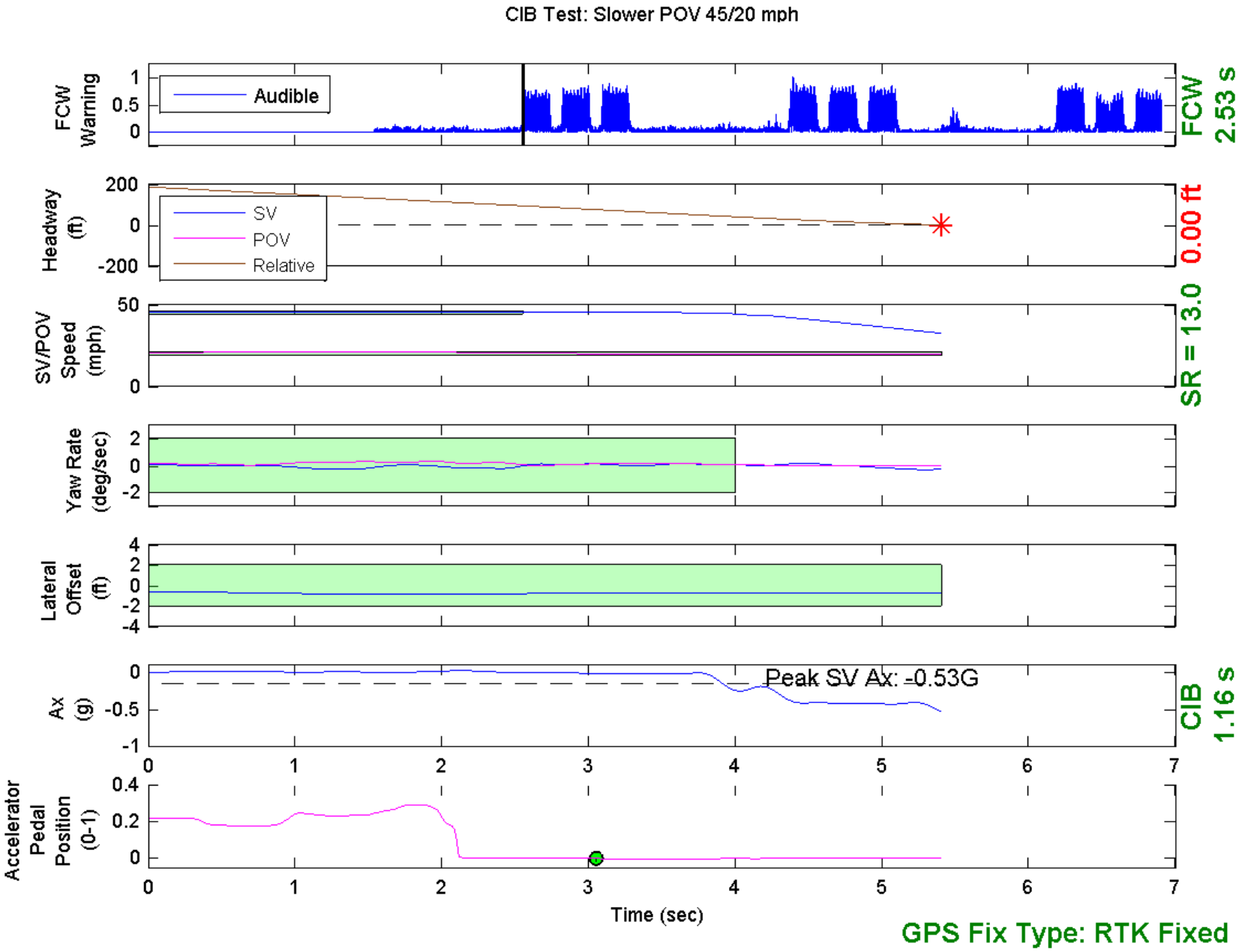


Figure D3. Example Time History for Slower POV 45 vs. 20, Passing

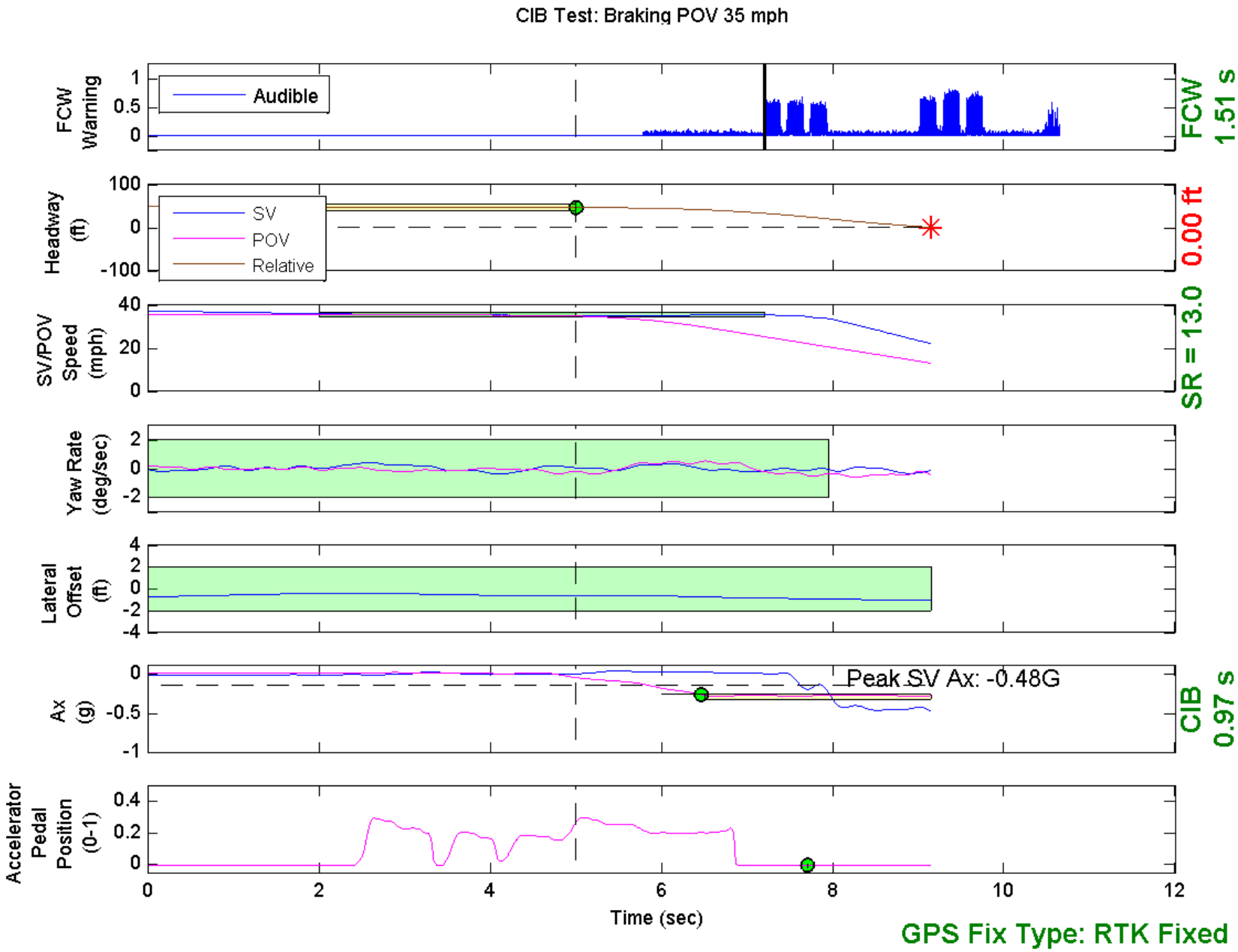


Figure D4. Example Time History for Braking POV 35, Passing

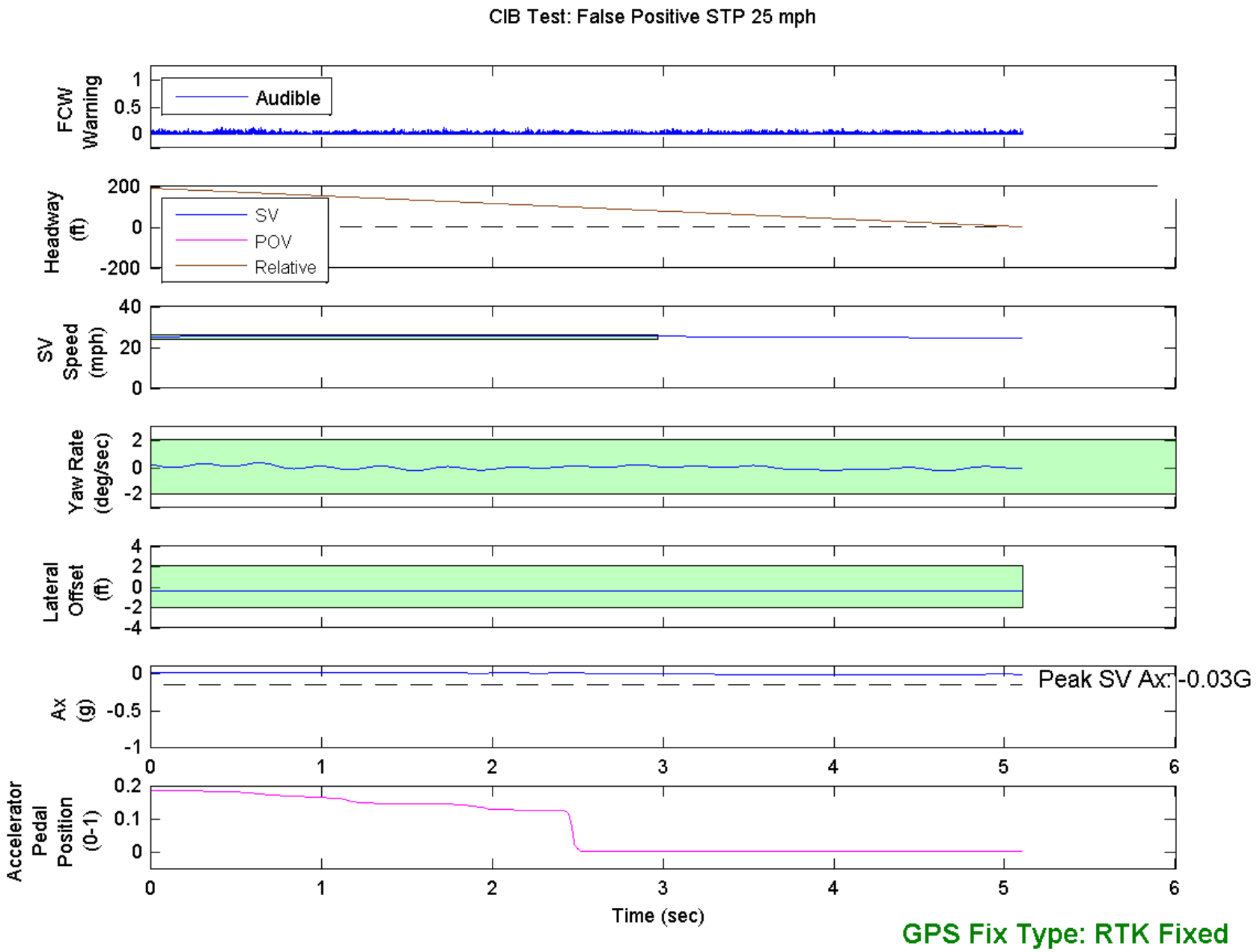


Figure D5. Example Time History for False Positive STP 25, Passing

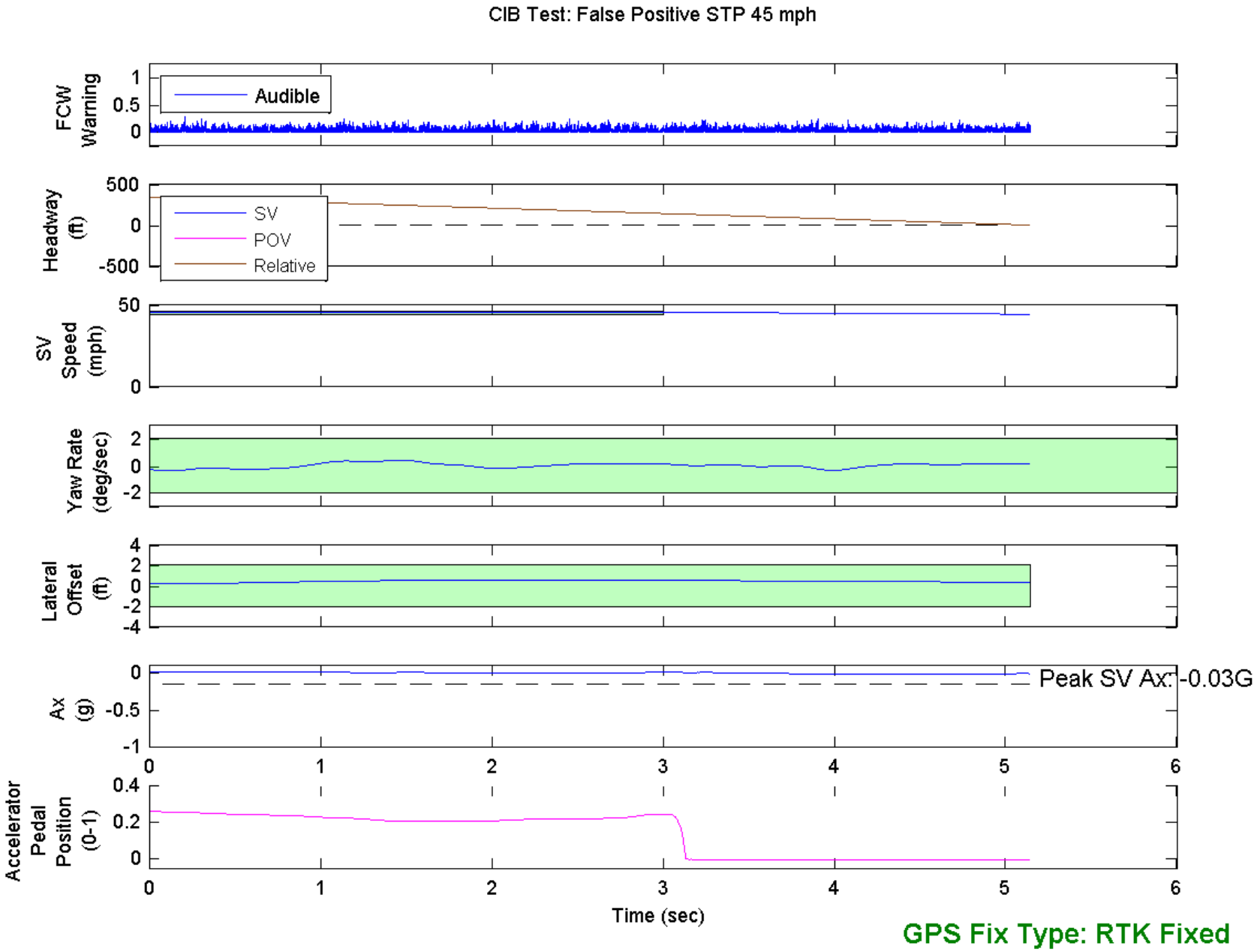


Figure D6. Example Time History for False Positive STP 45, Passing

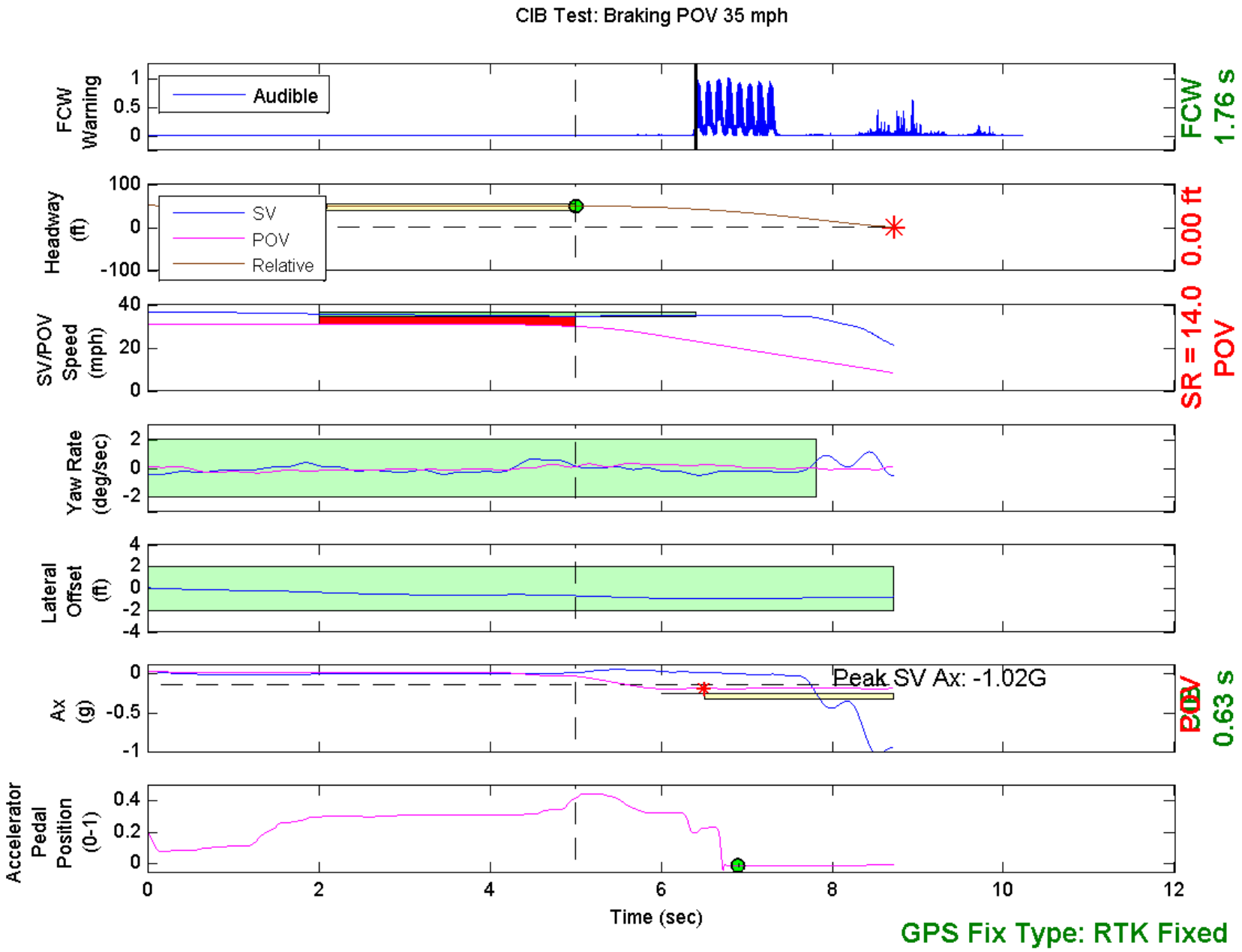


Figure D7. Example Time History Displaying Various Invalid Criteria

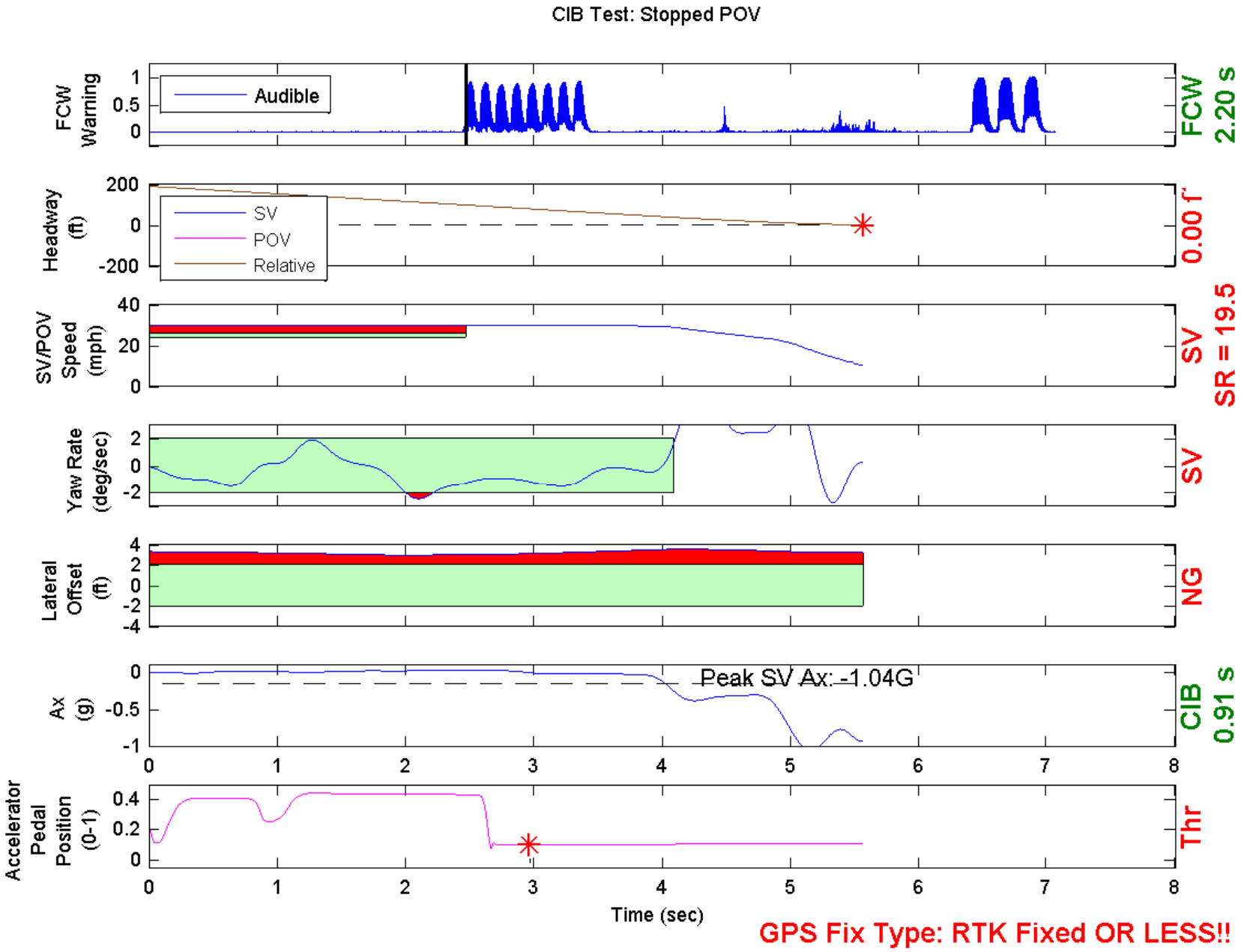


Figure D8. Example Time History Displaying Various Invalid Criteria

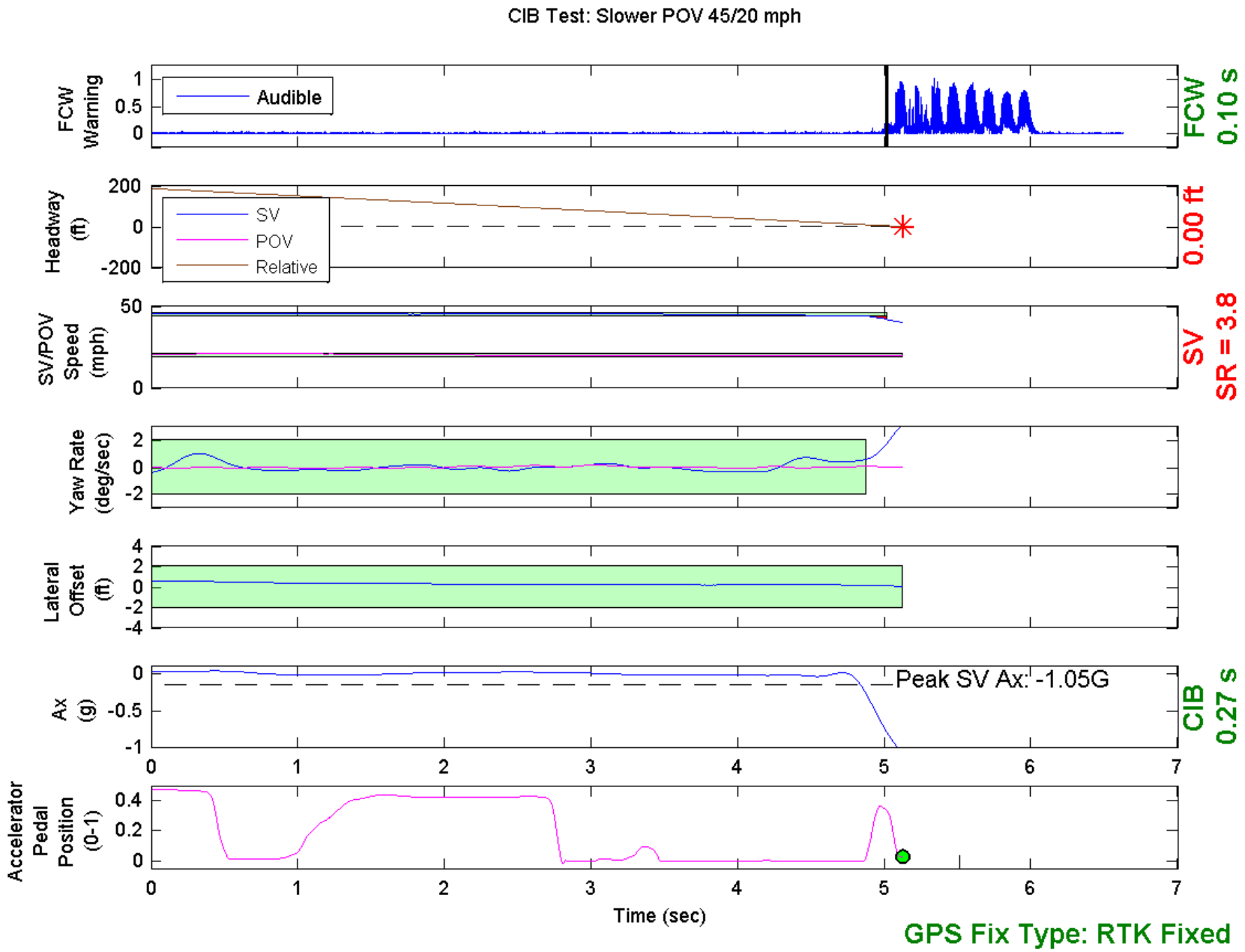


Figure D9. Example Time History for a Failed Run

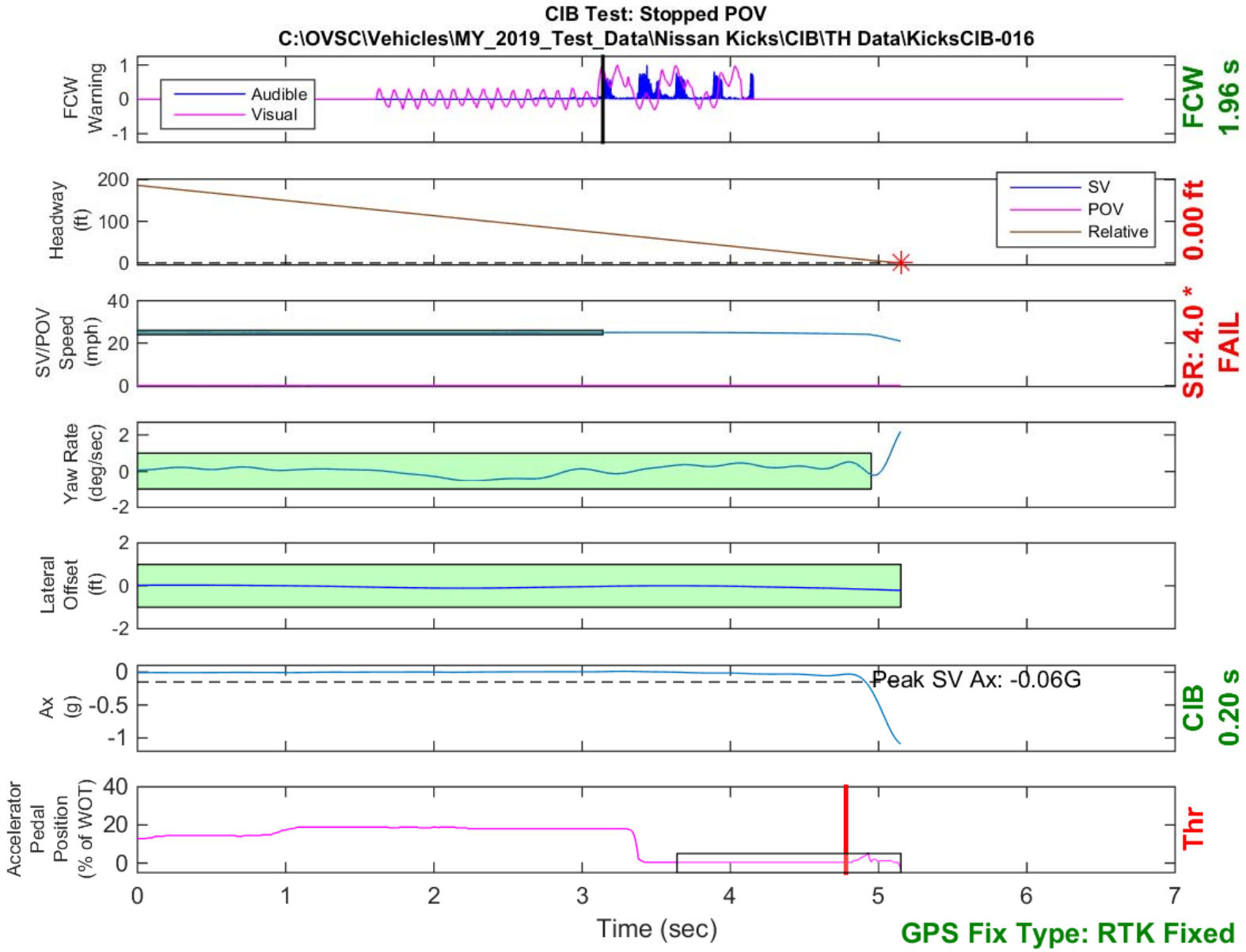


Figure D10. Time History for CIB Run 16, SV Encounters Stopped POV

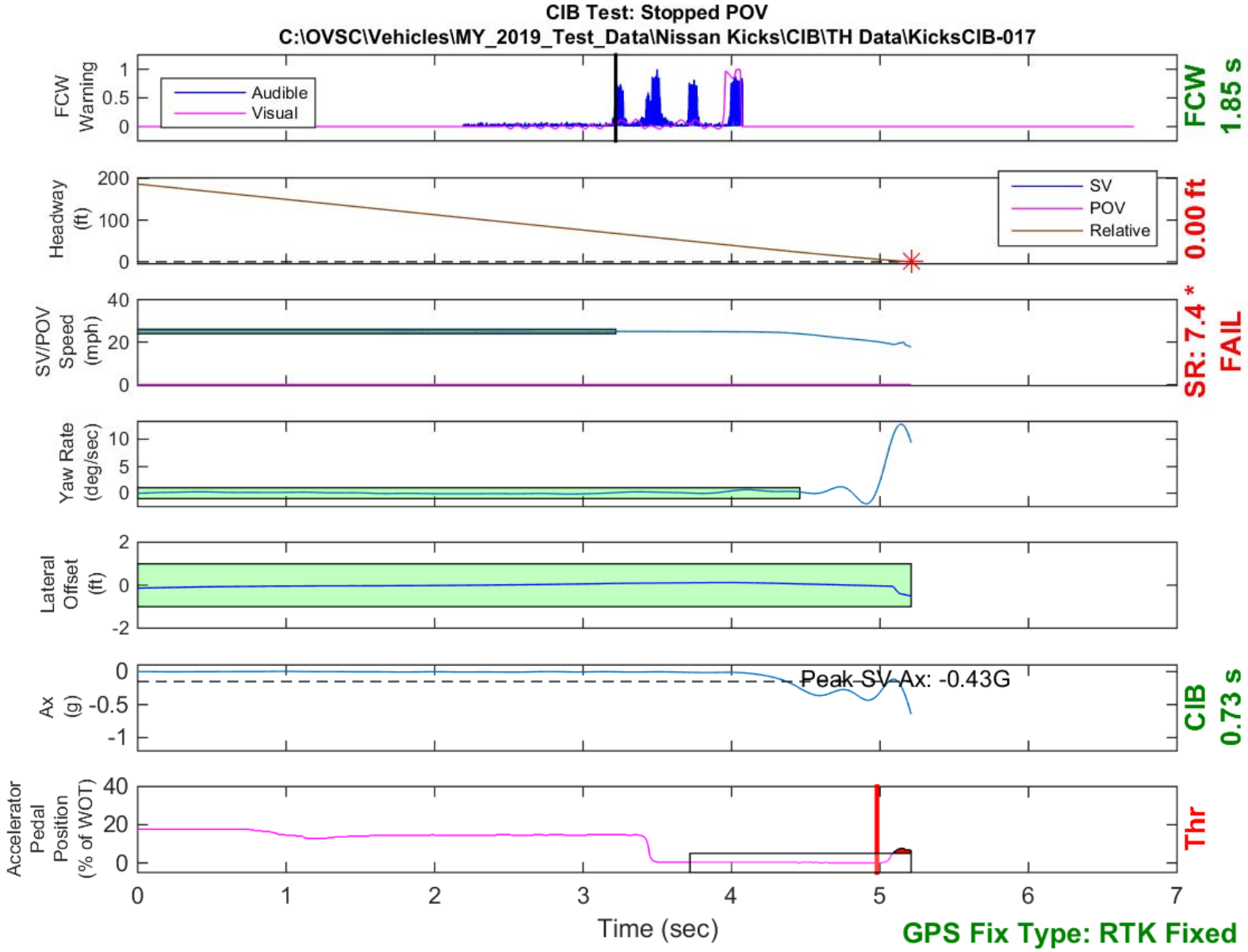


Figure D11. Time History for CIB Run 17, SV Encounters Stopped POV

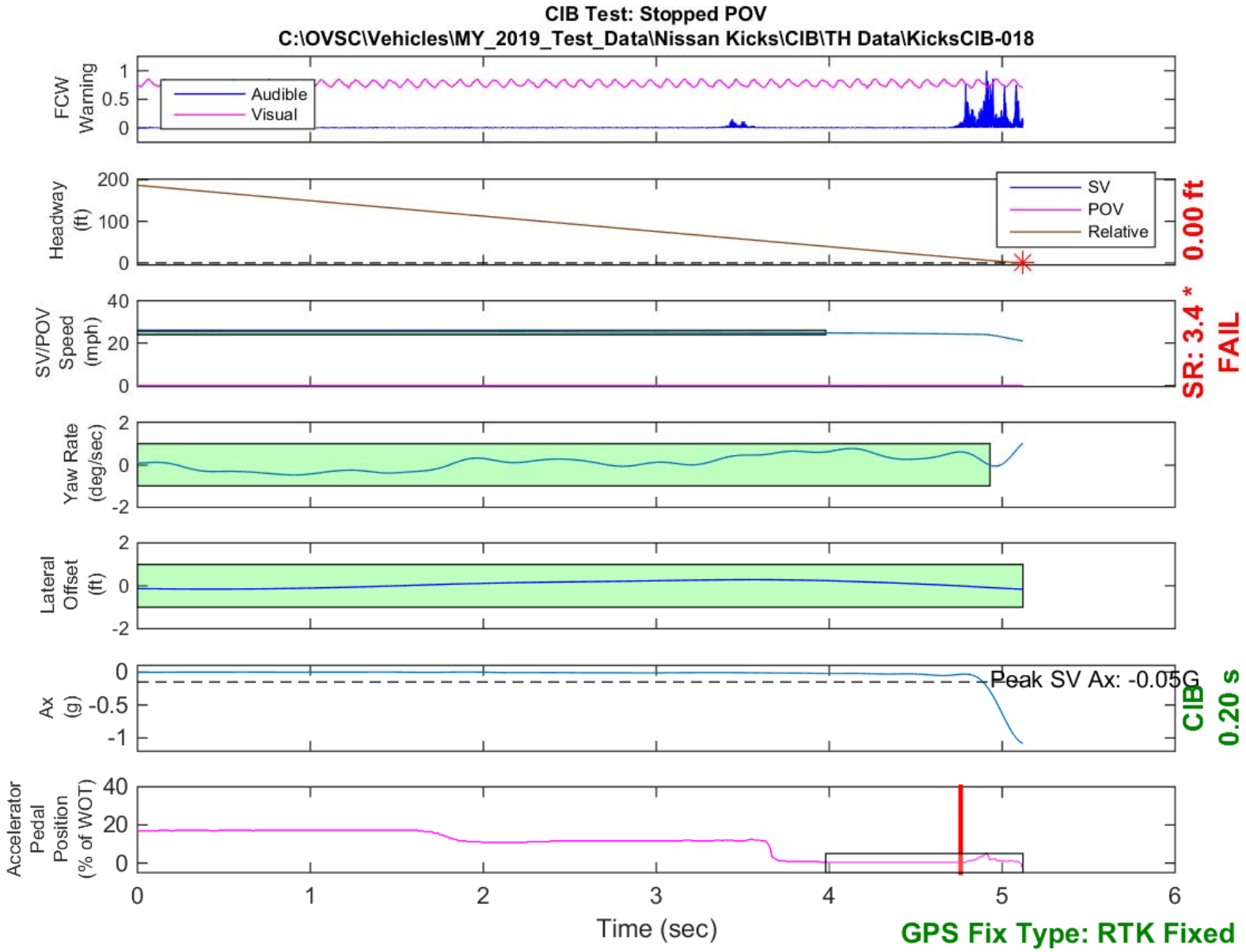


Figure D12. Time History for CIB Run 18, SV Encounters Stopped POV

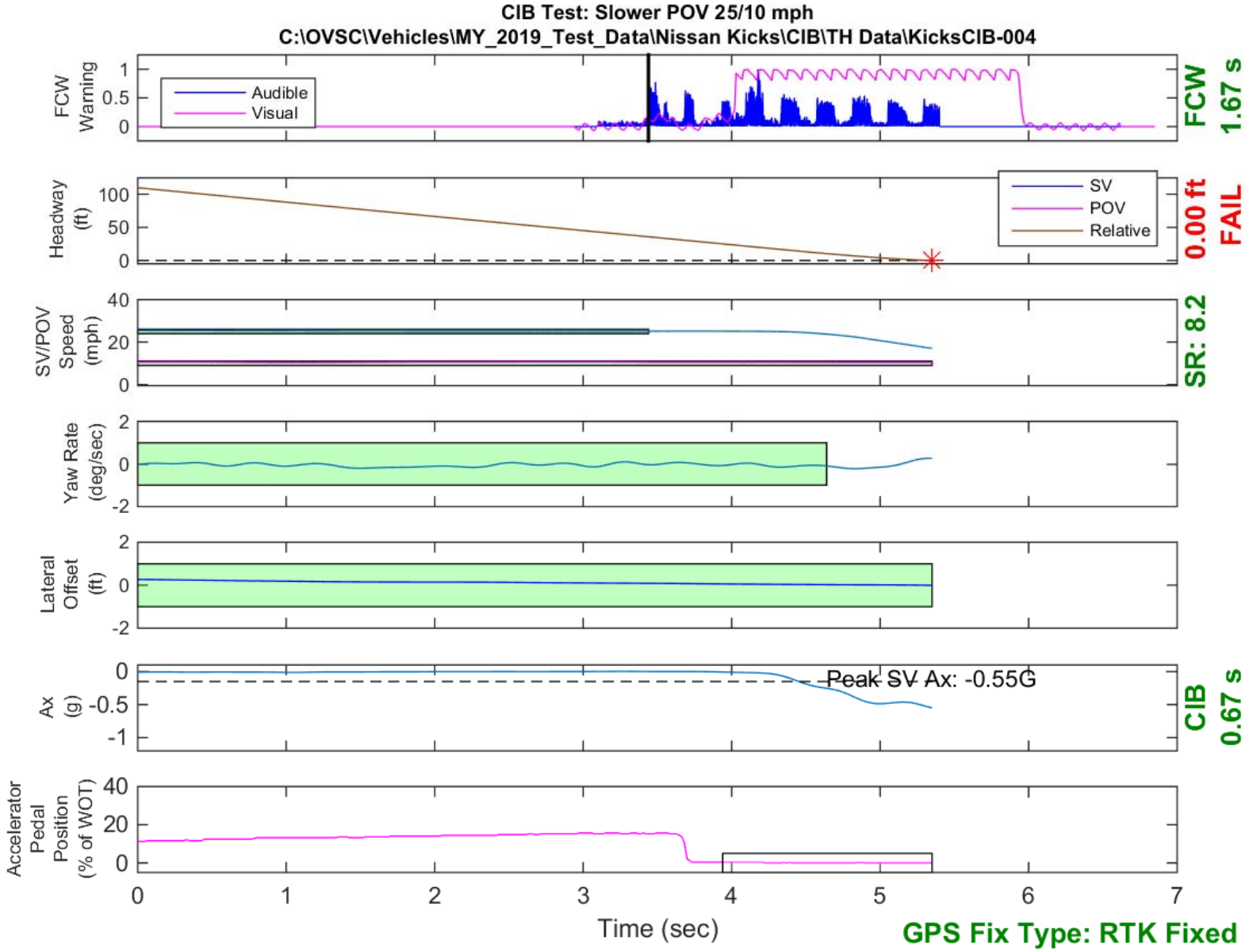


Figure D13. Time History for CIB Run 4, SV Encounters Slower POV, SV 25 mph, POV 10 mph

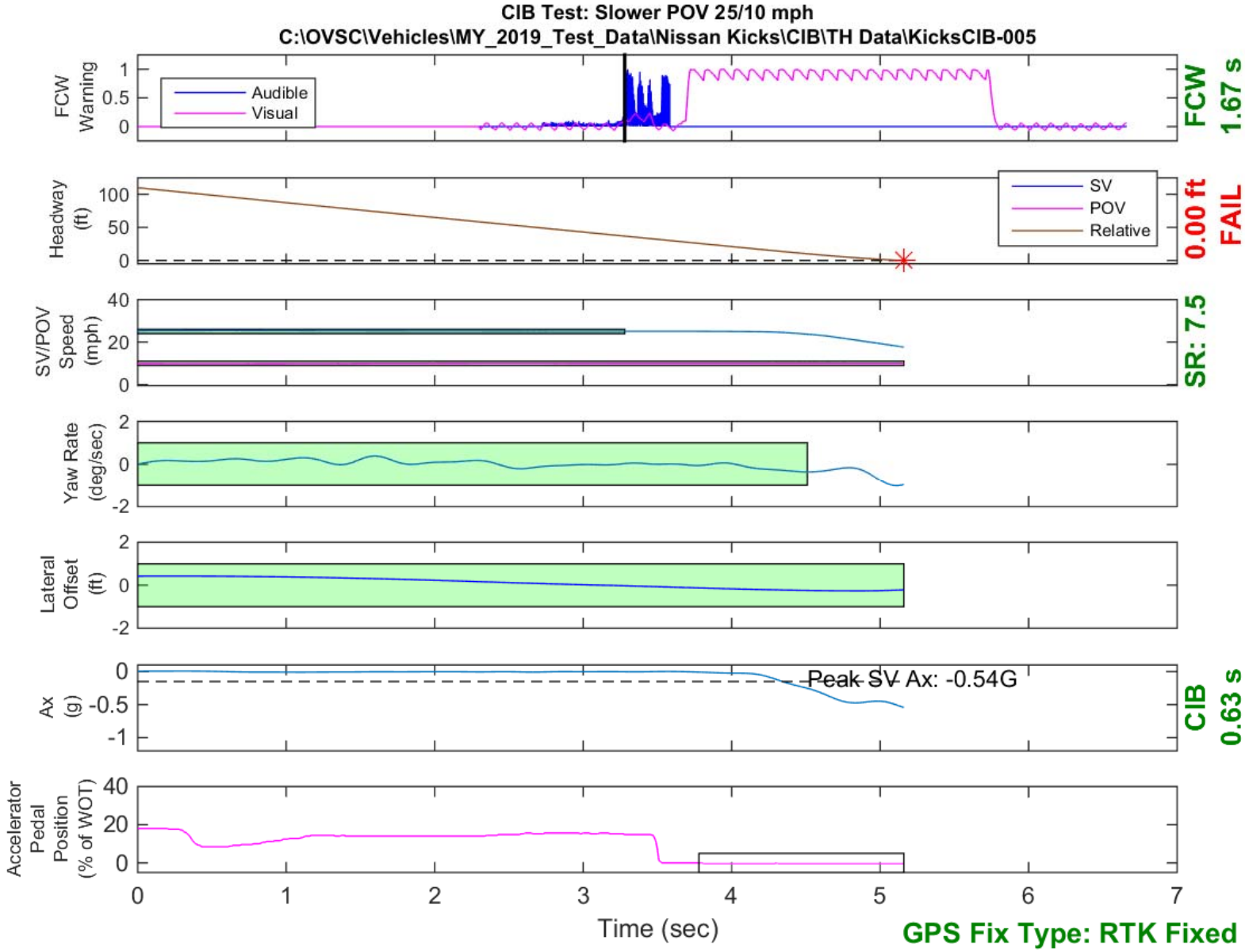


Figure D14. Time History for CIB Run 5, SV Encounters Slower POV, SV 25 mph, POV 10 mph

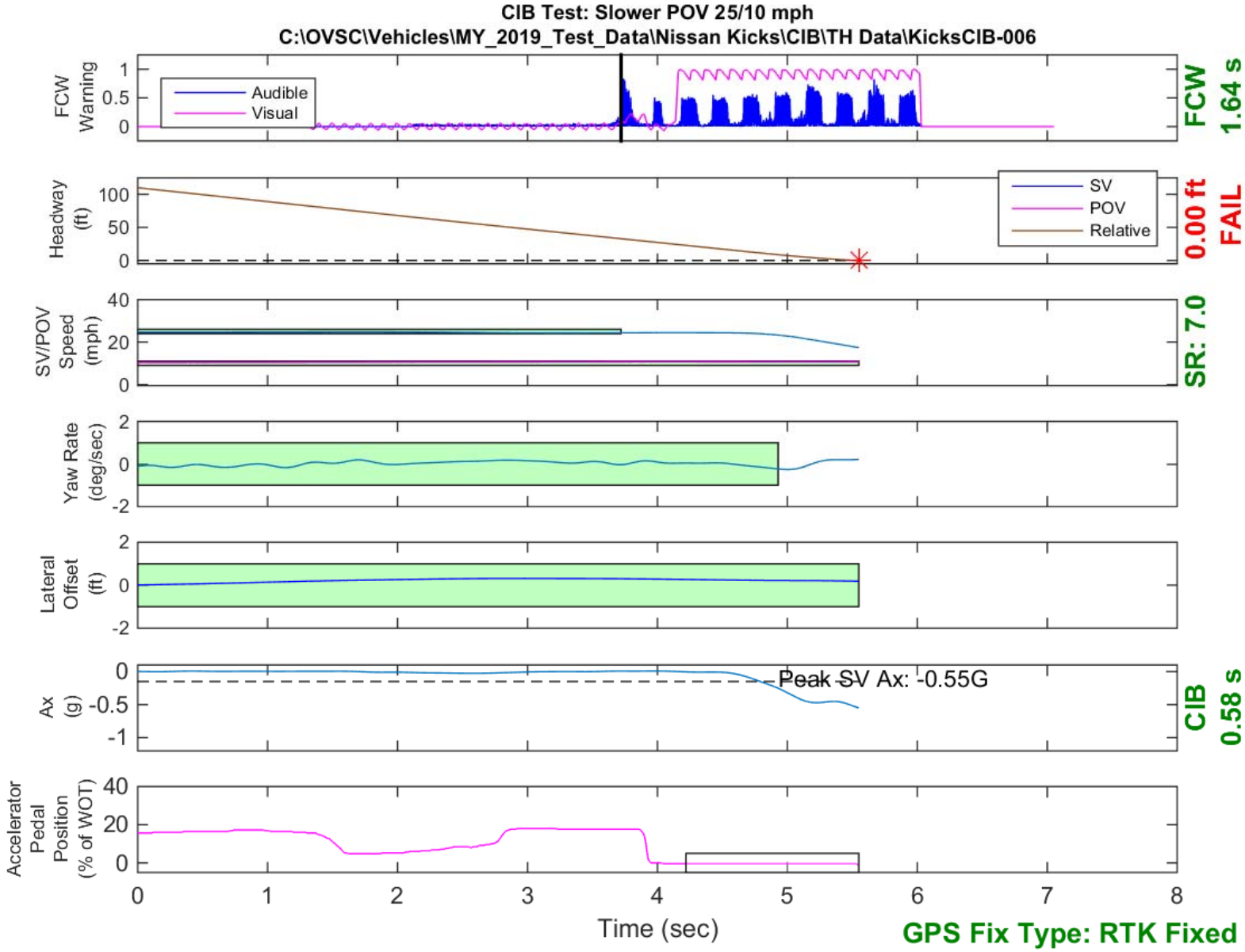


Figure D15. Time History for CIB Run 6, SV Encounters Slower POV, SV 25 mph, POV 10 mph

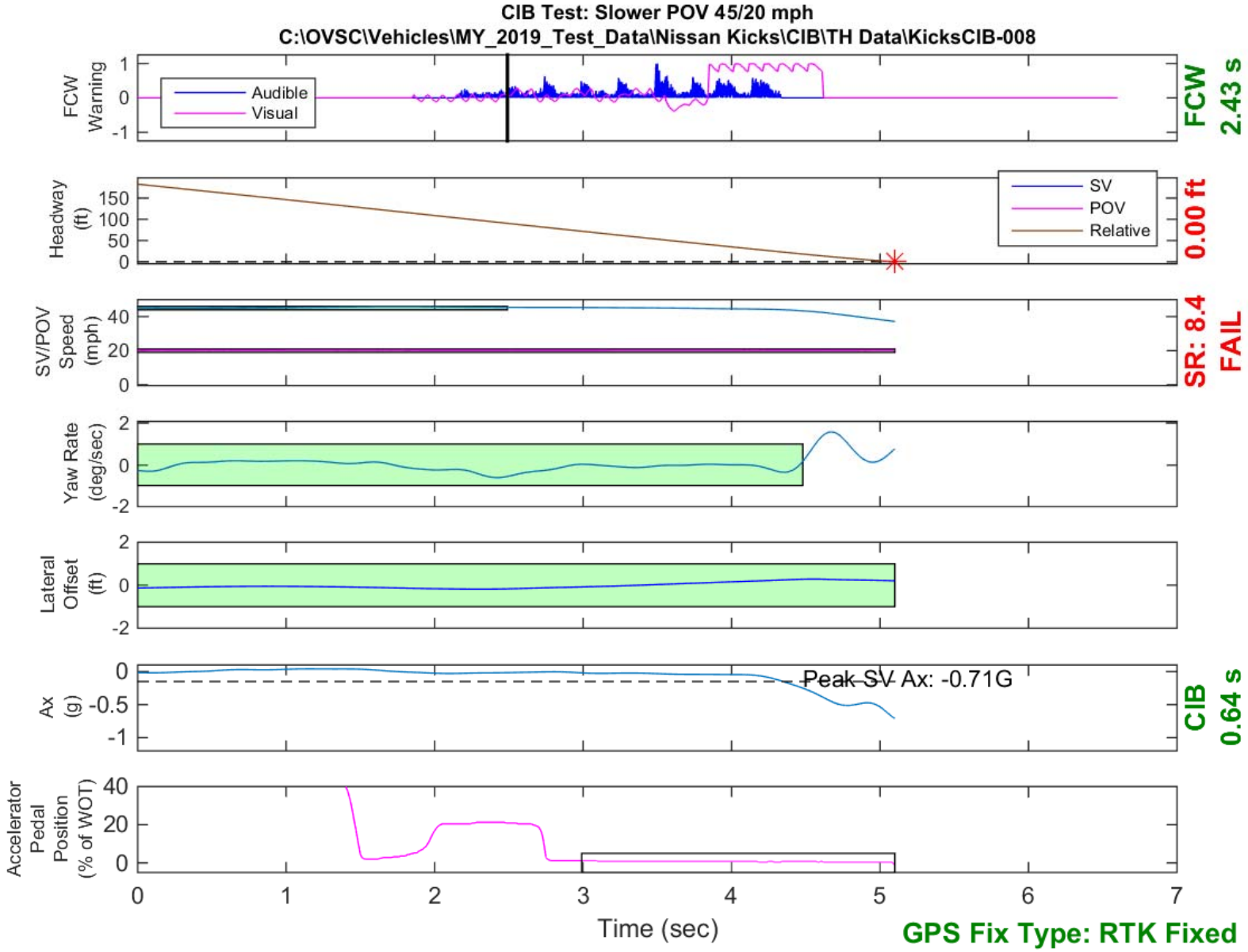


Figure D16. Time History for CIB Run 8, SV Encounters Slower POV, SV 45 mph, POV 20 mph

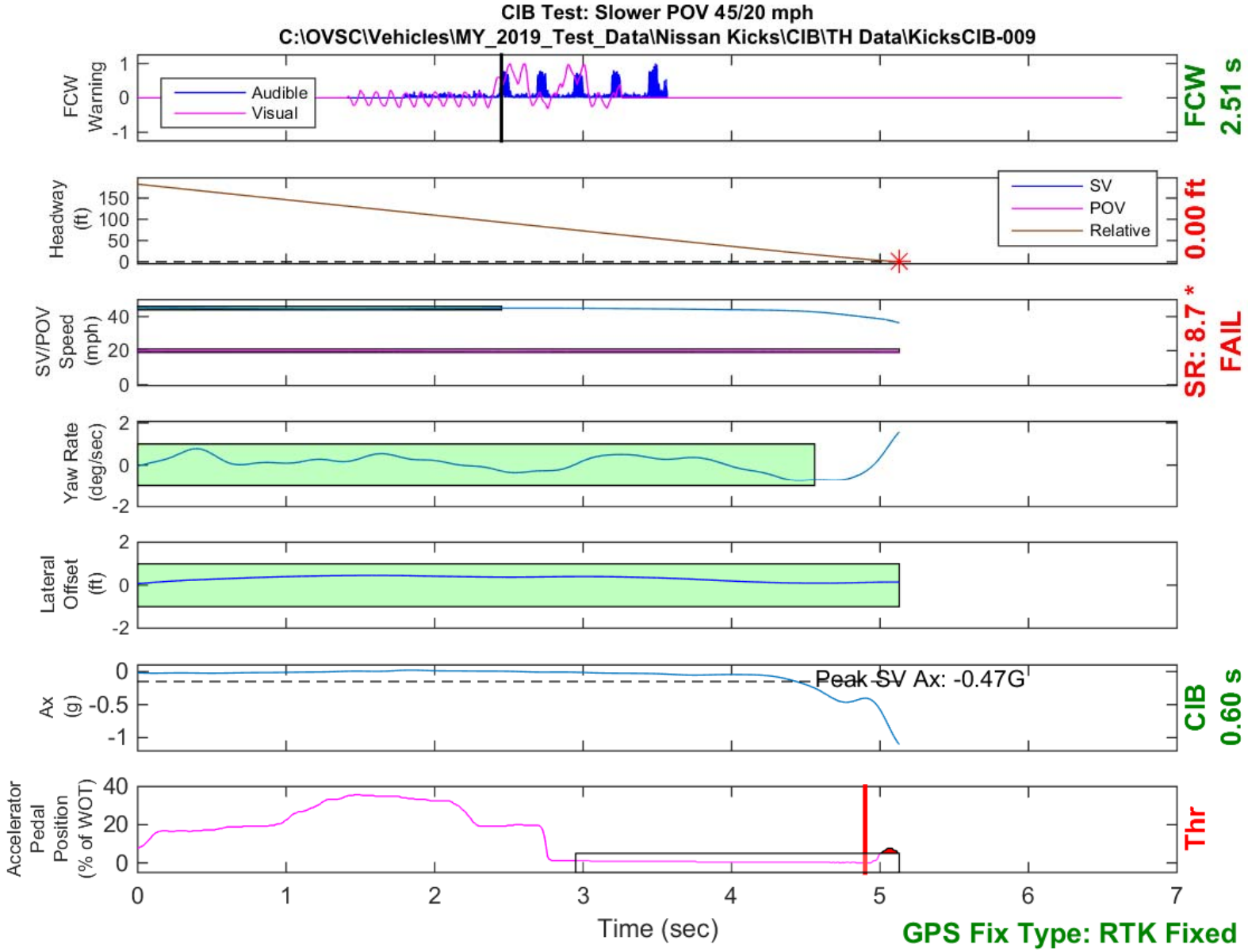


Figure D17. Time History for CIB Run 9, SV Encounters Slower POV, SV 45 mph, POV 20 mph

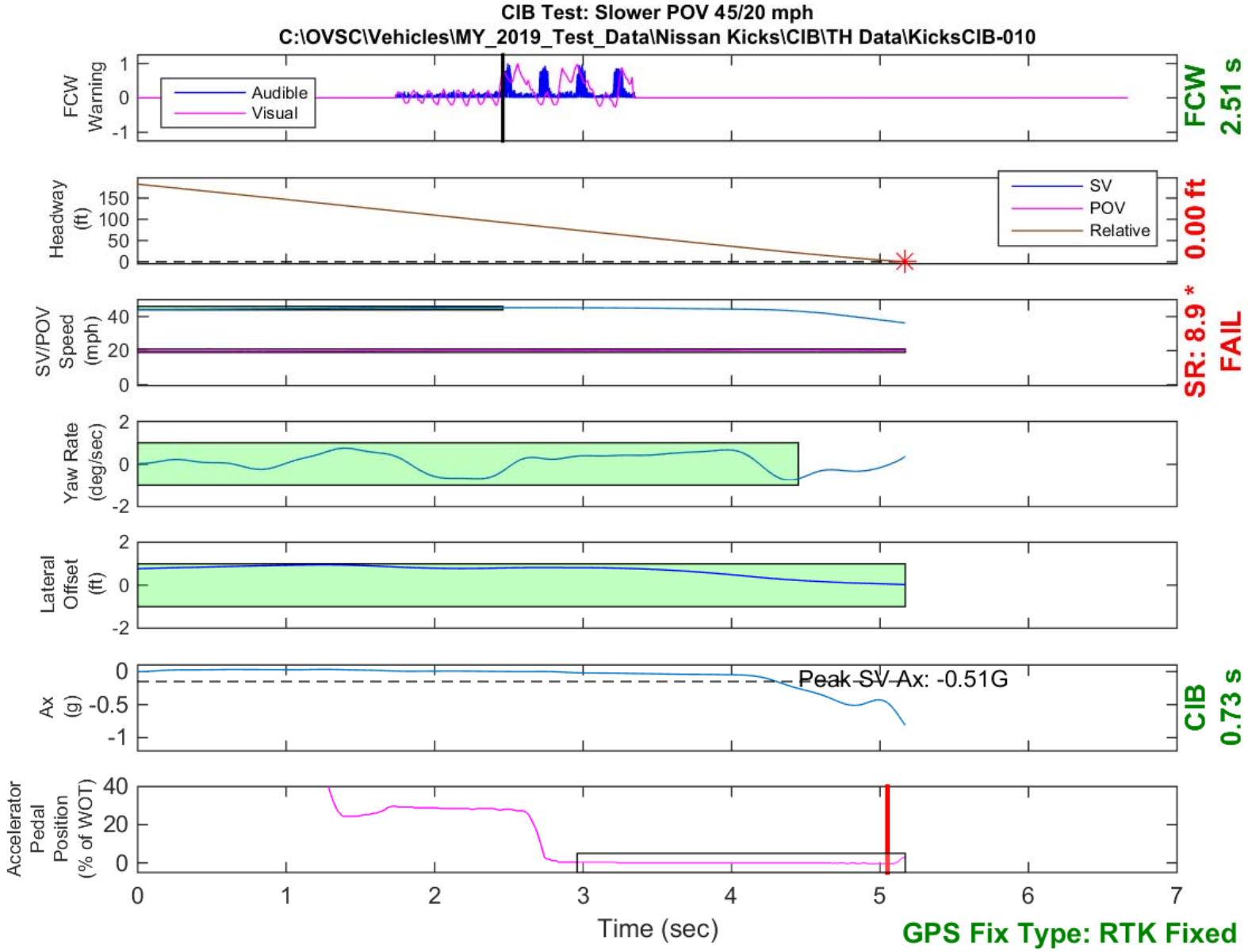


Figure D18. Time History for CIB Run 10, SV Encounters Slower POV, SV 45 mph, POV 20 mph

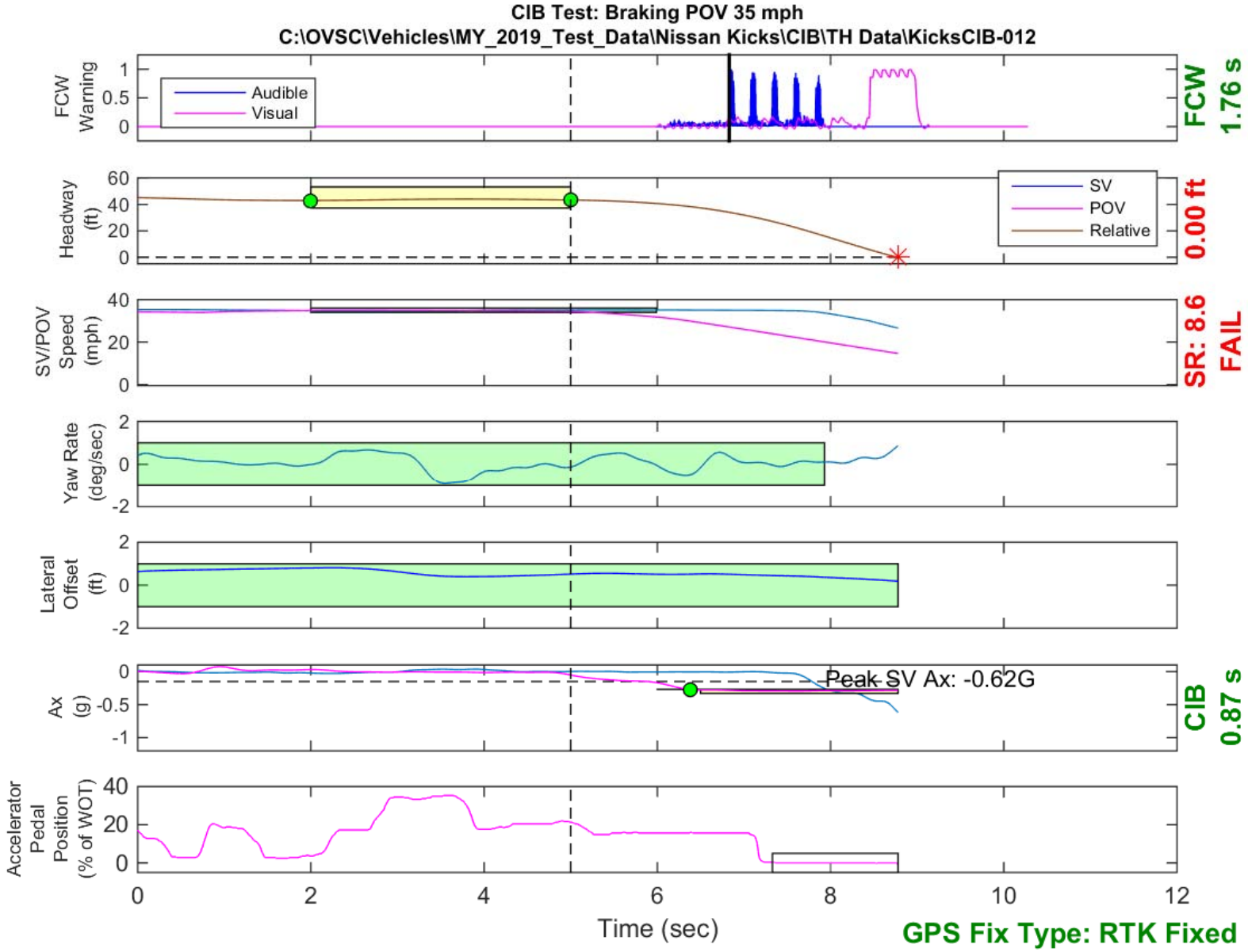


Figure D19. Time History for CIB Run 12, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

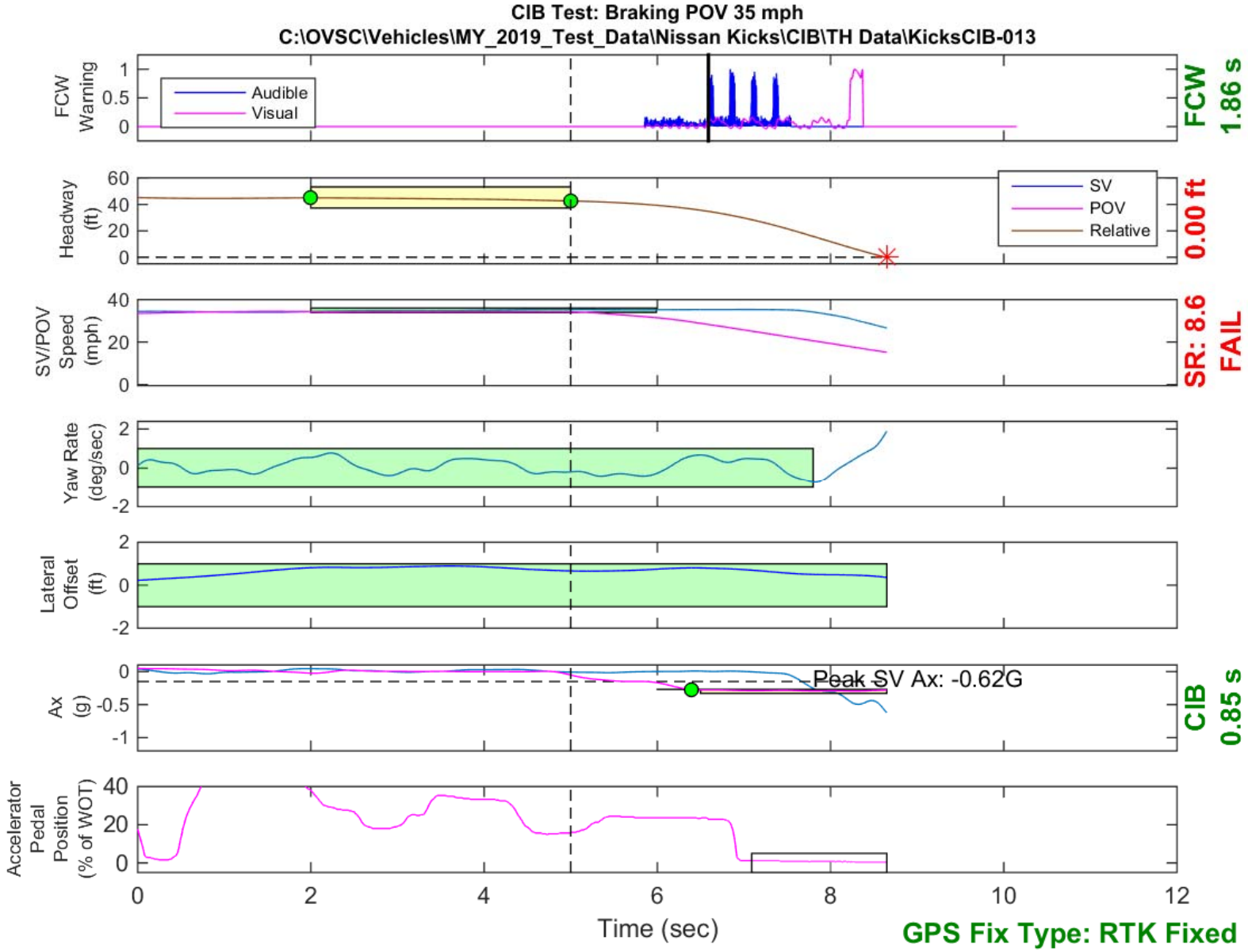


Figure D20. Time History for CIB Run 13, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

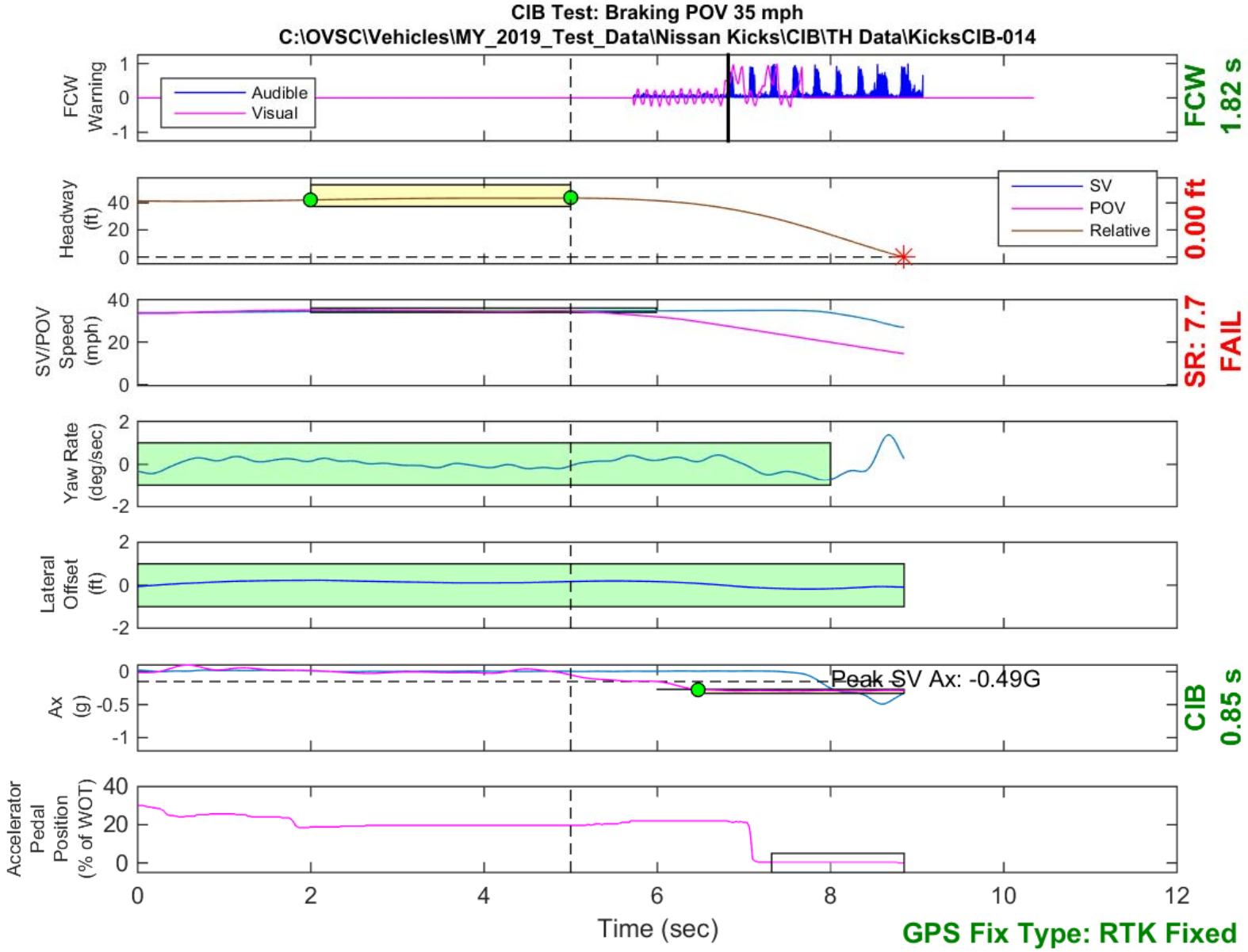


Figure D21. Time History for CIB Run 14, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

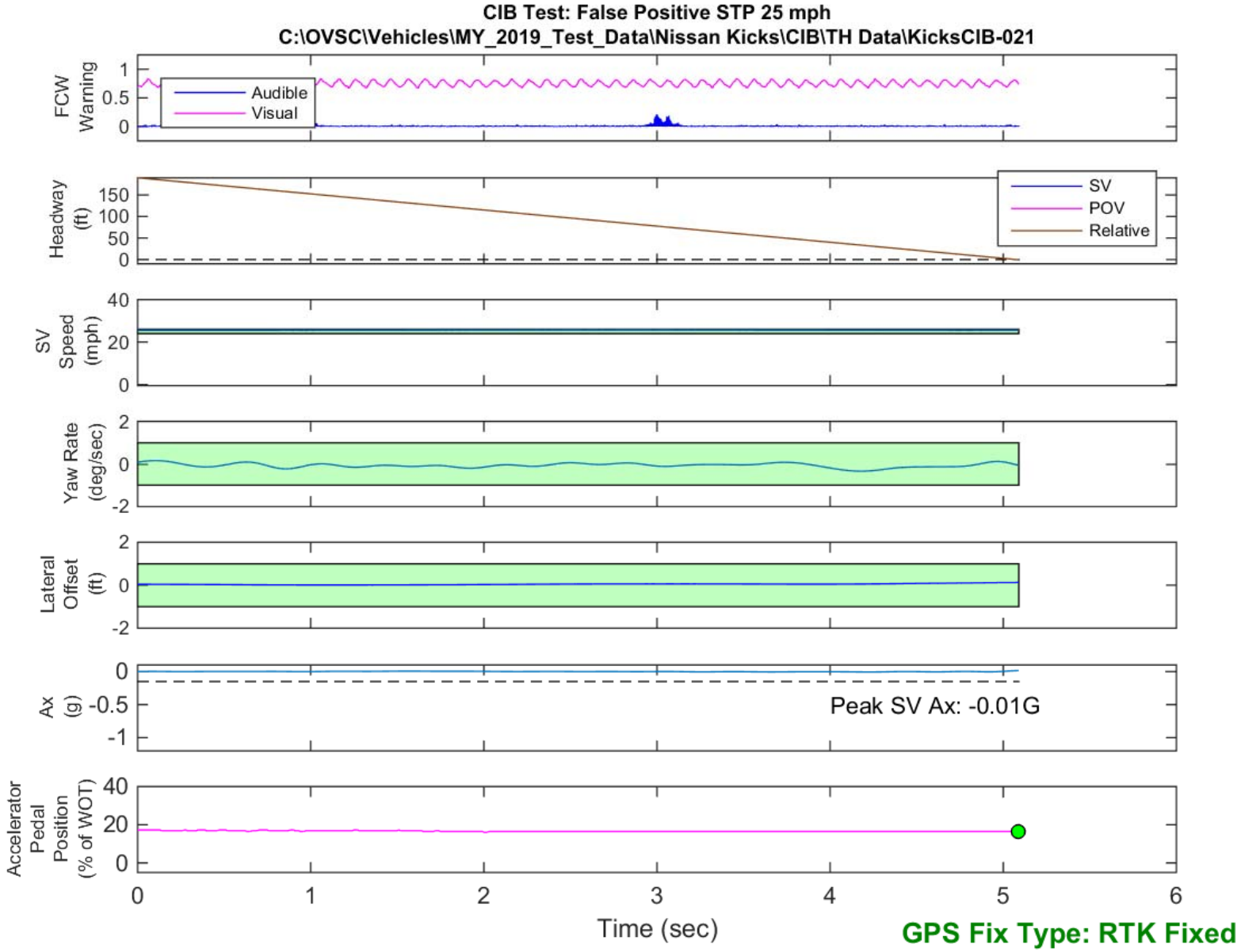


Figure D22. Time History for CIB Run 21, SV Encounters Steel Trench Plate, SV 25 mph

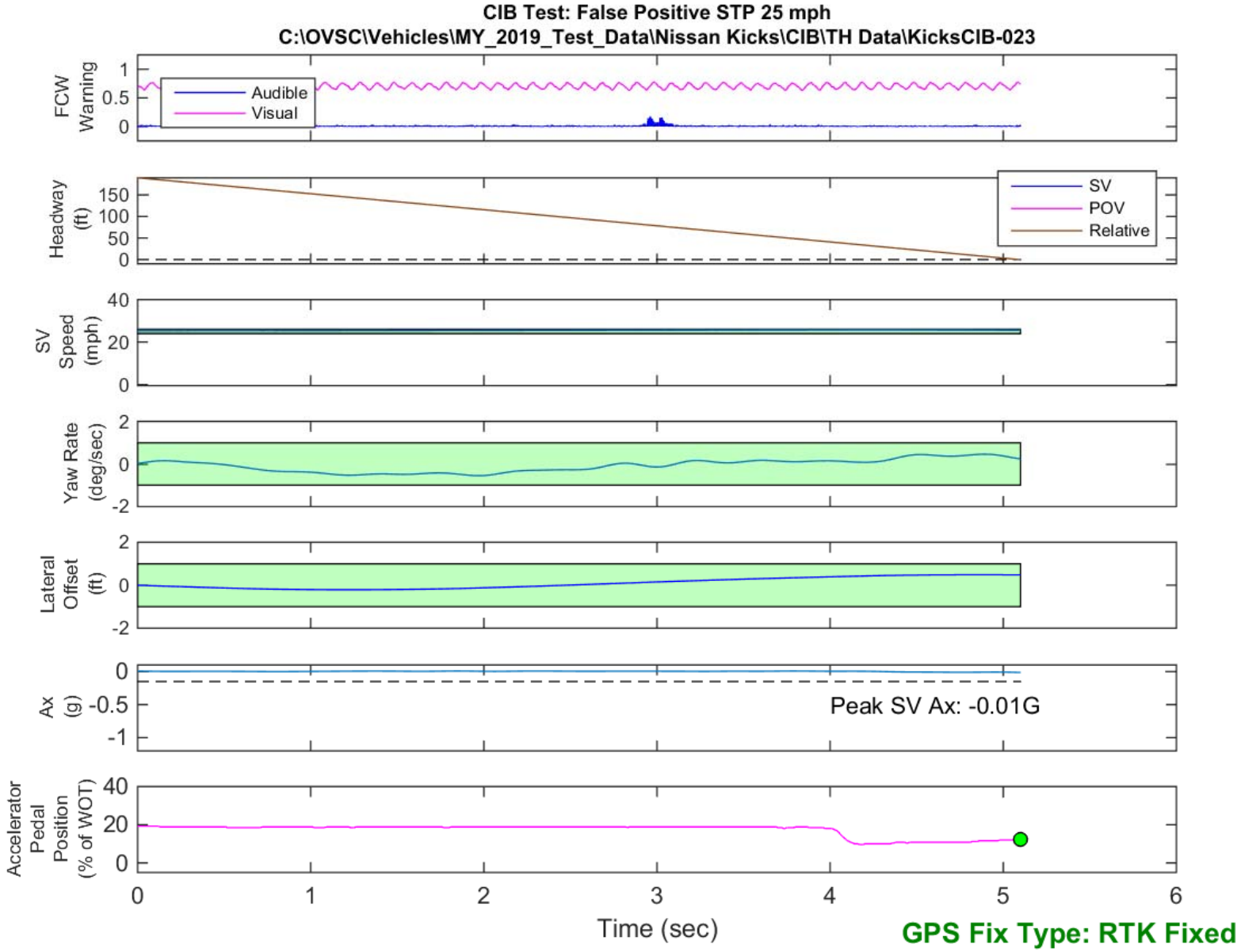


Figure D23. Time History for CIB Run 23, SV Encounters Steel Trench Plate, SV 25 mph

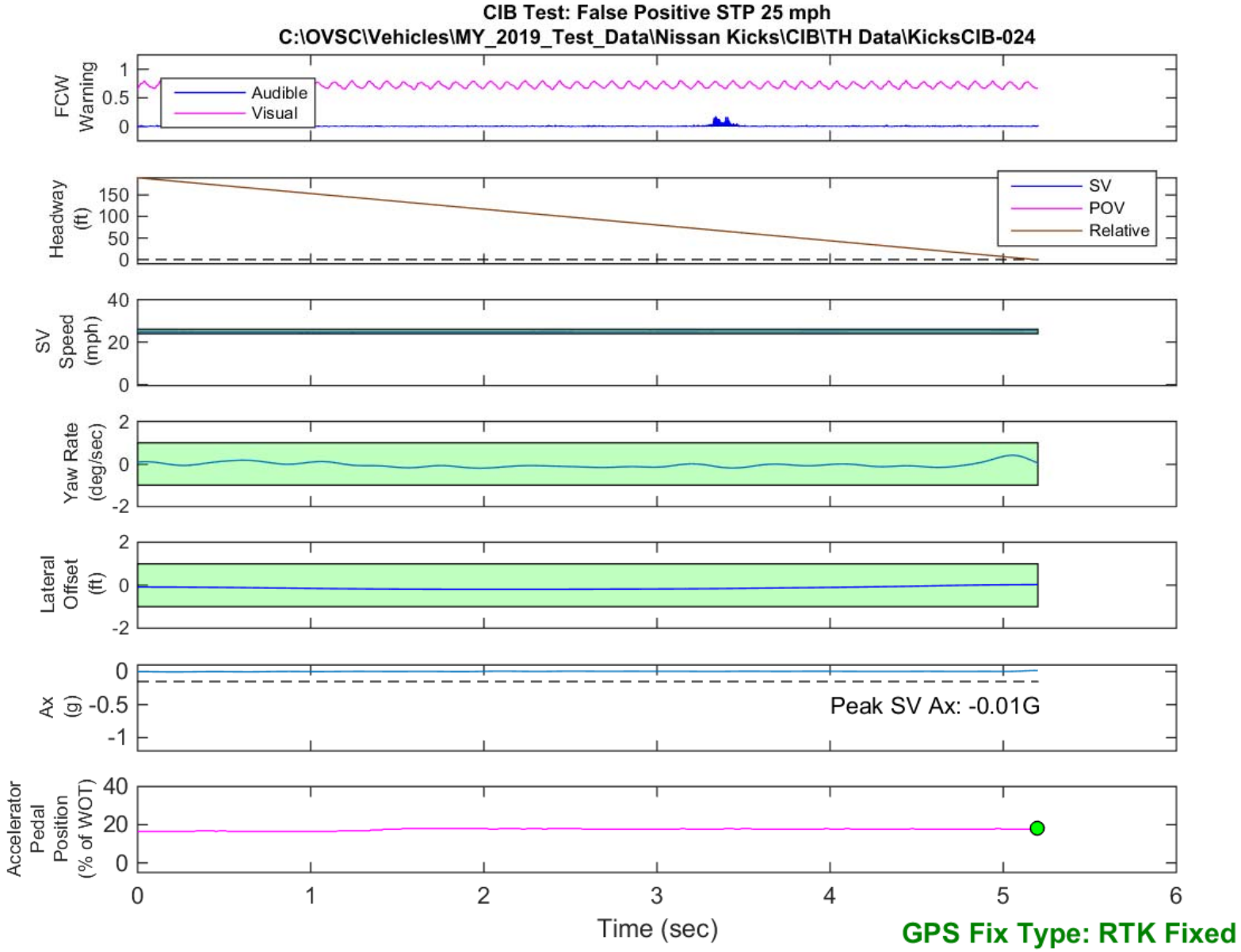


Figure D24. Time History for CIB Run 24, SV Encounters Steel Trench Plate, SV 25 mph

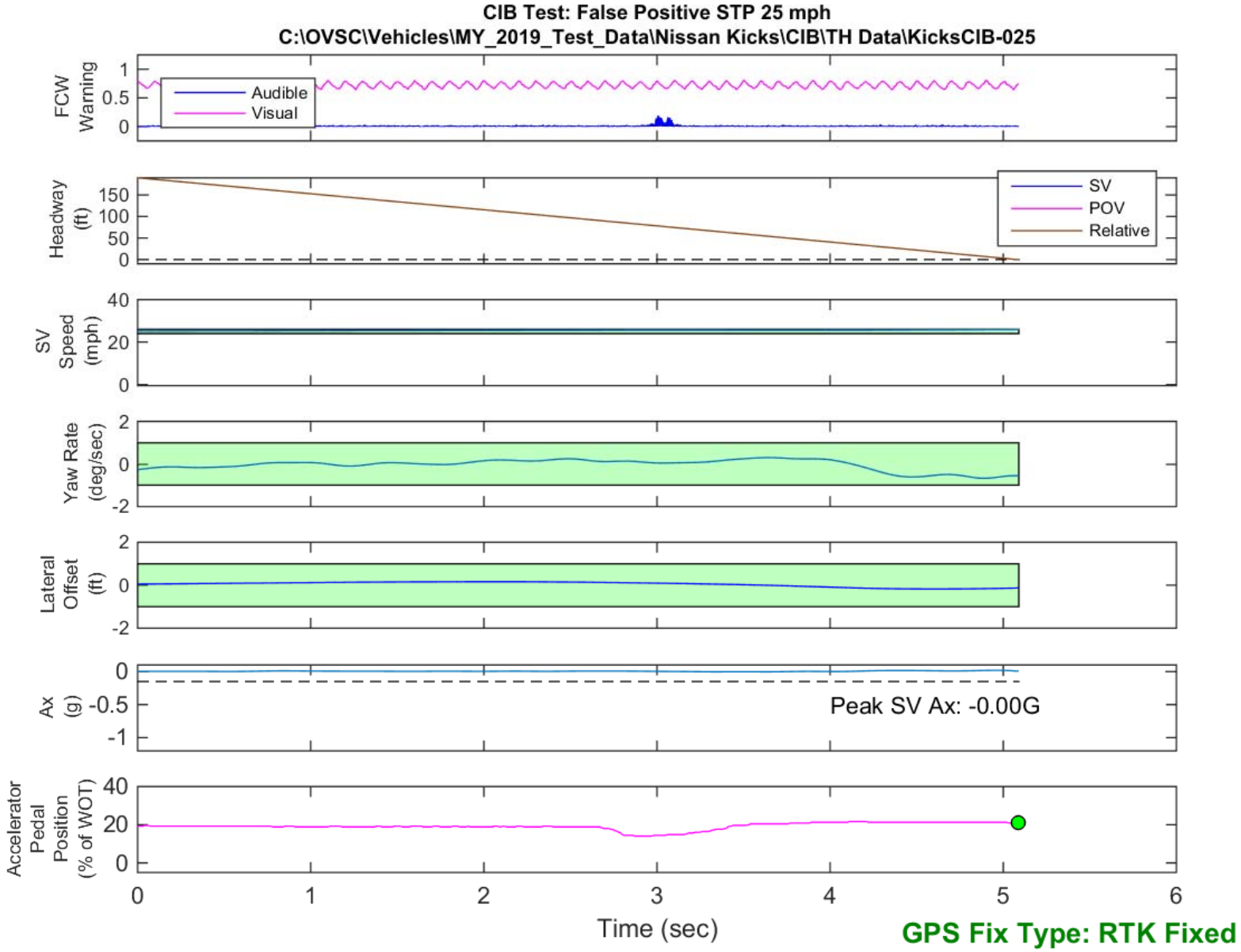


Figure D25. Time History for CIB Run 25, SV Encounters Steel Trench Plate, SV 25 mph

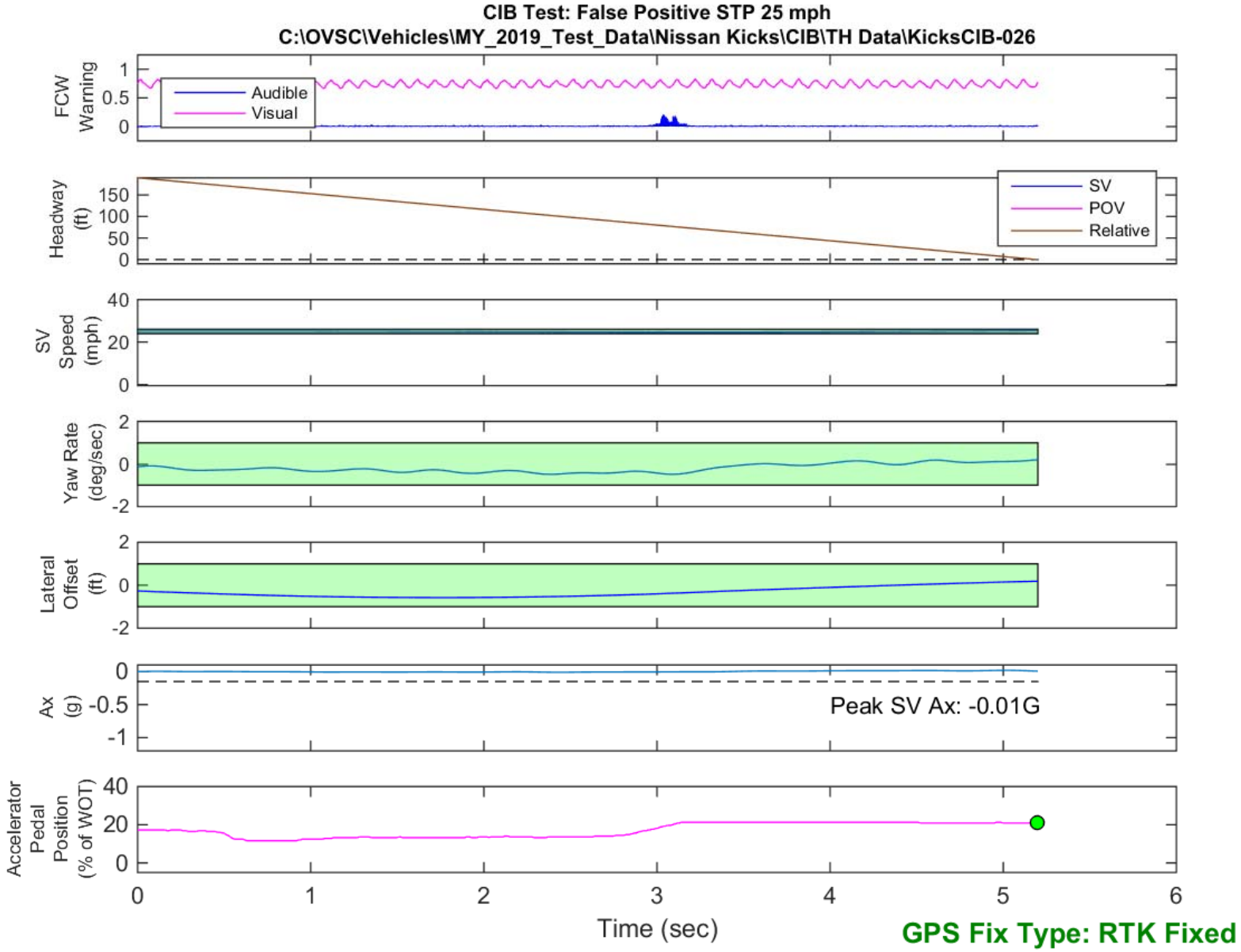


Figure D26. Time History for CIB Run 26, SV Encounters Steel Trench Plate, SV 25 mph

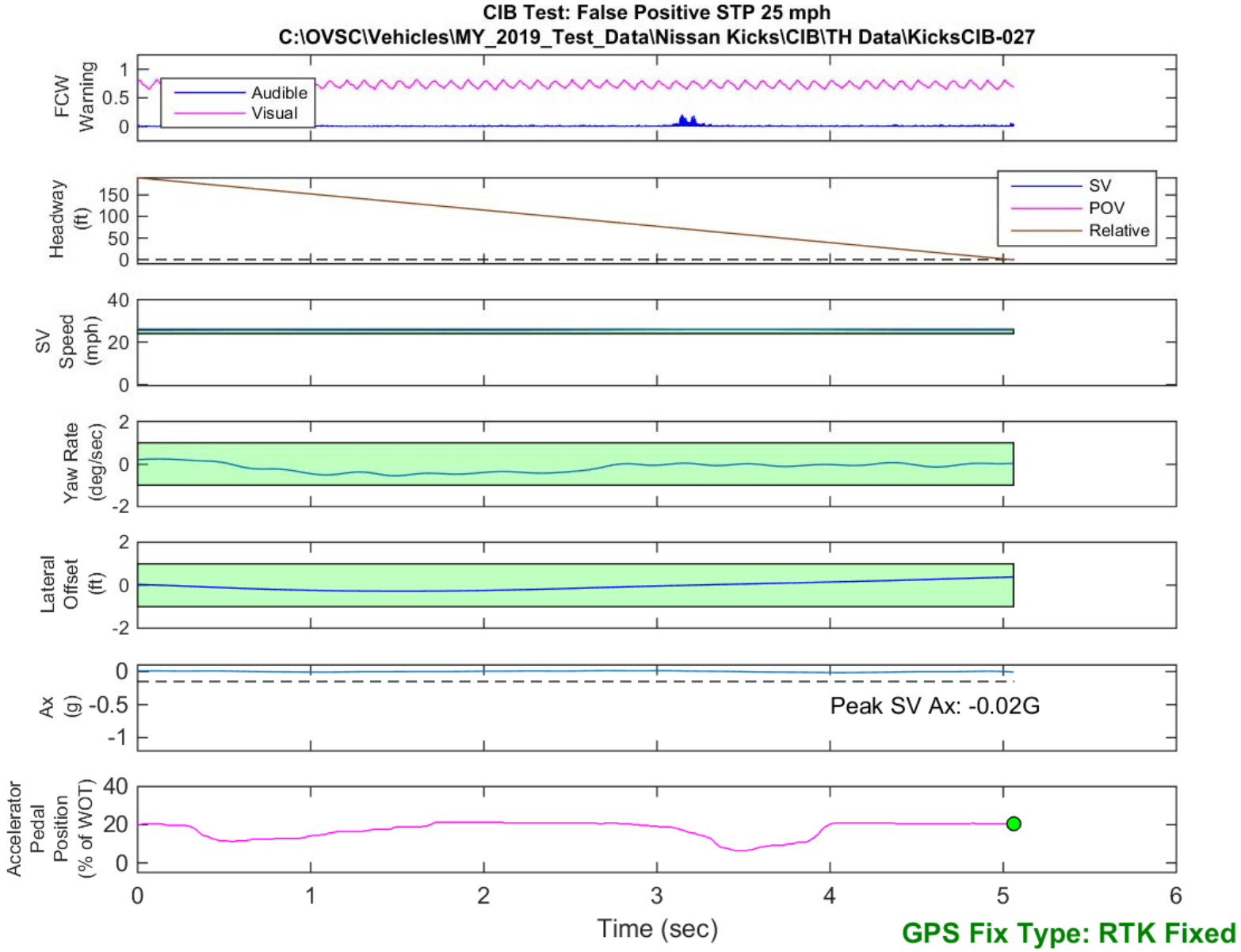


Figure D27. Time History for CIB Run 27, SV Encounters Steel Trench Plate, SV 25 mph

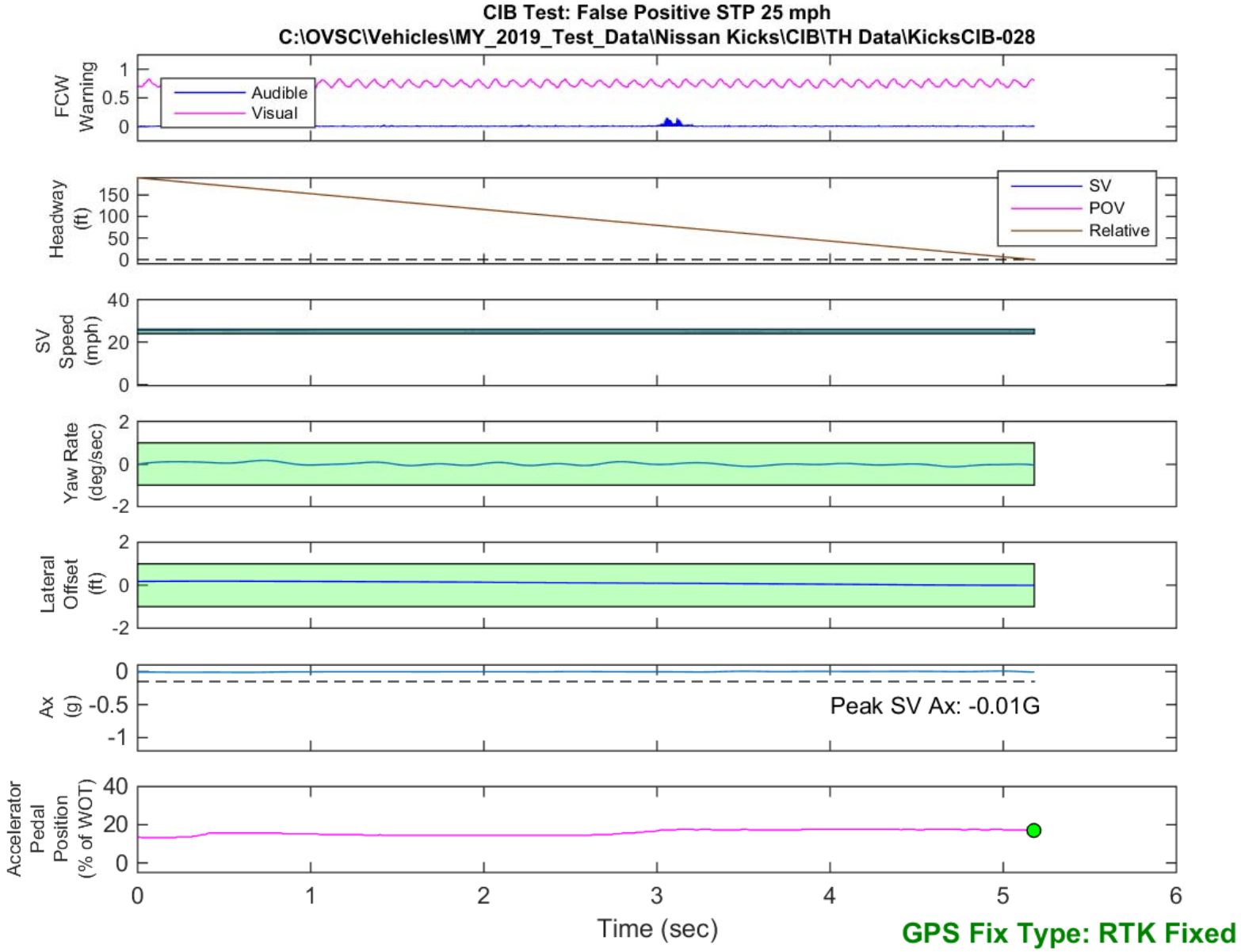


Figure D28. Time History for CIB Run 28, SV Encounters Steel Trench Plate, SV 25 mph

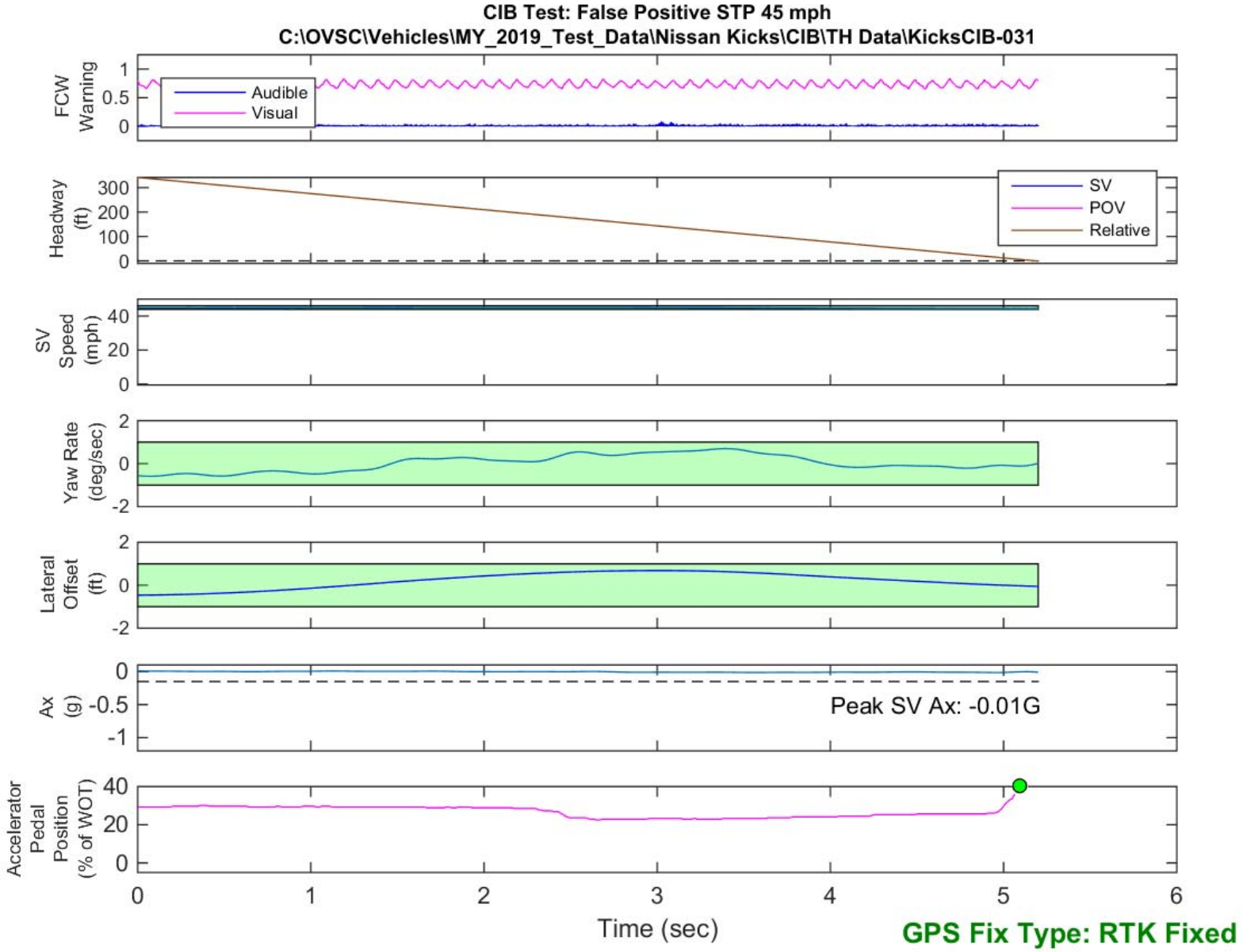


Figure D29. Time History for CIB Run 31, SV Encounters Steel Trench Plate, SV 45 mph

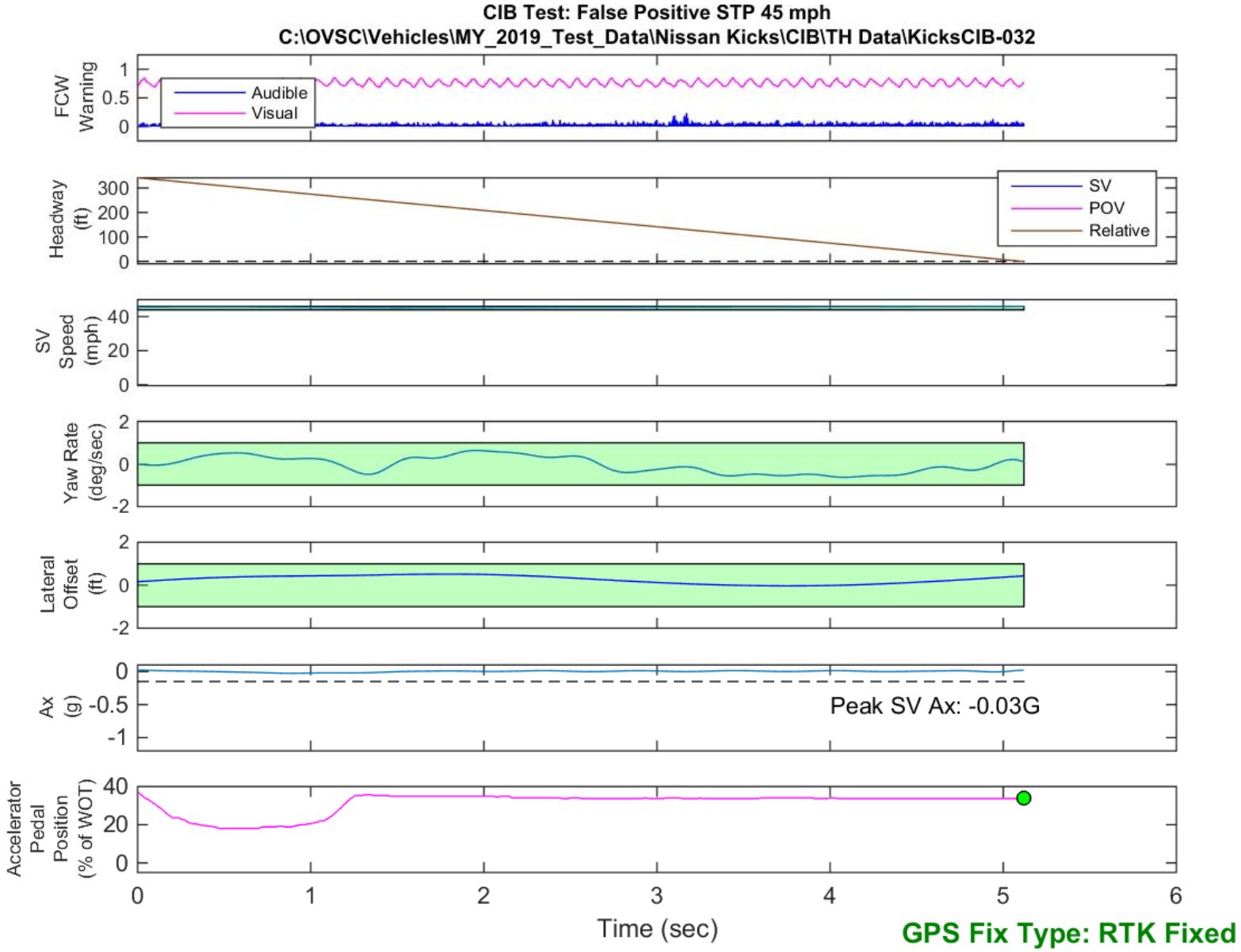


Figure D30. Time History for CIB Run 32, SV Encounters Steel Trench Plate, SV 45 mph

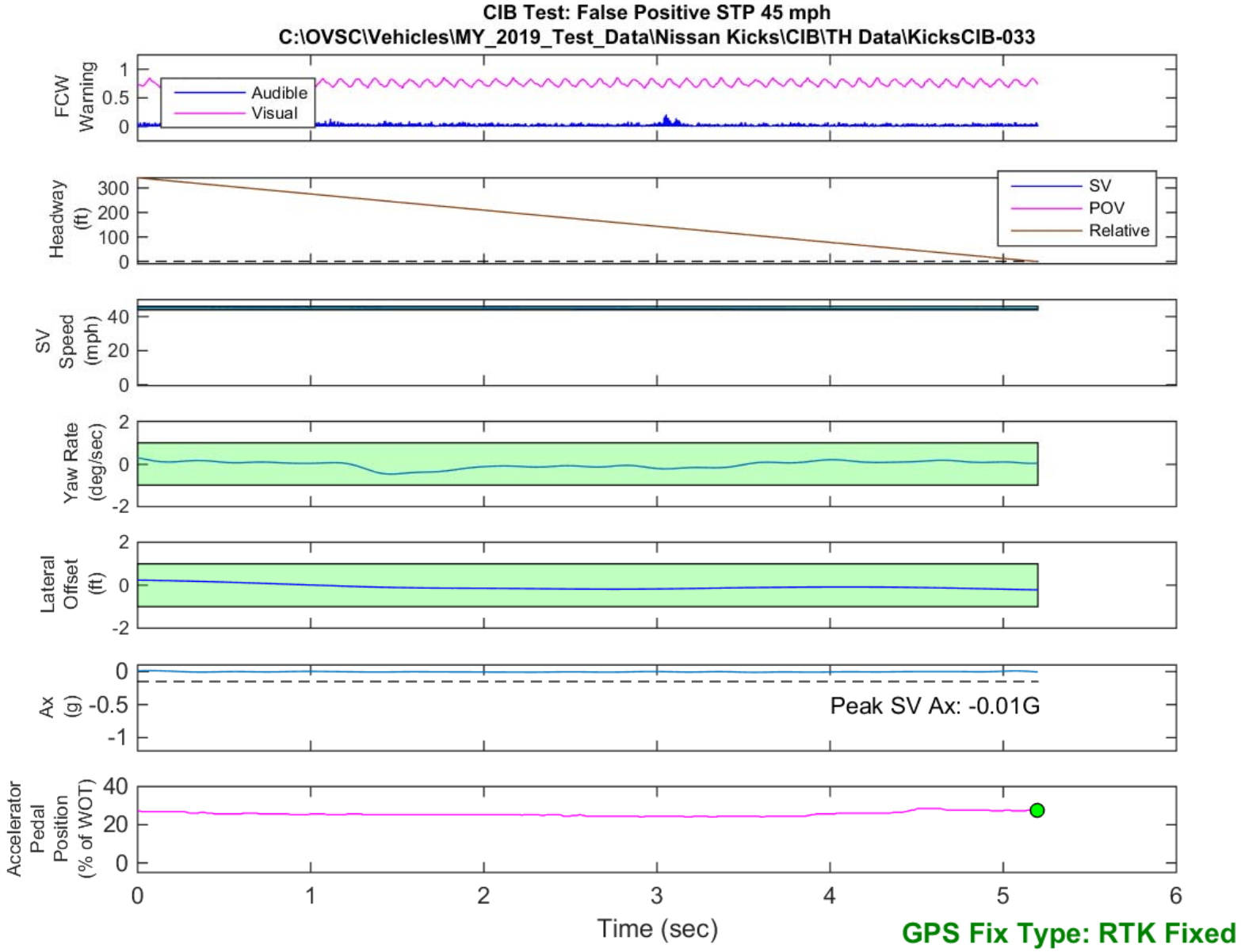


Figure D31. Time History for CIB Run 33, SV Encounters Steel Trench Plate, SV 45 mph

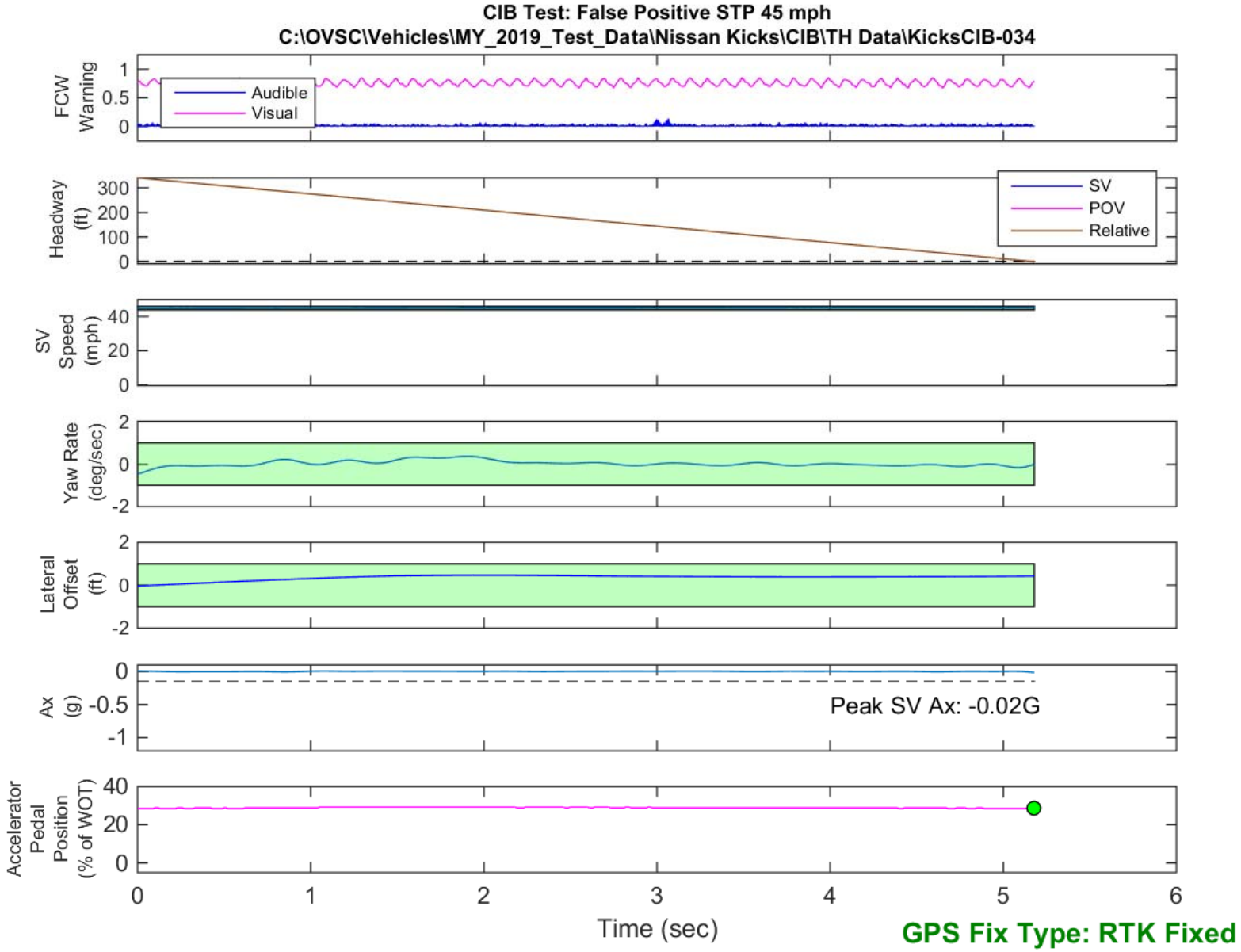


Figure D32. Time History for CIB Run 34, SV Encounters Steel Trench Plate, SV 45 mph

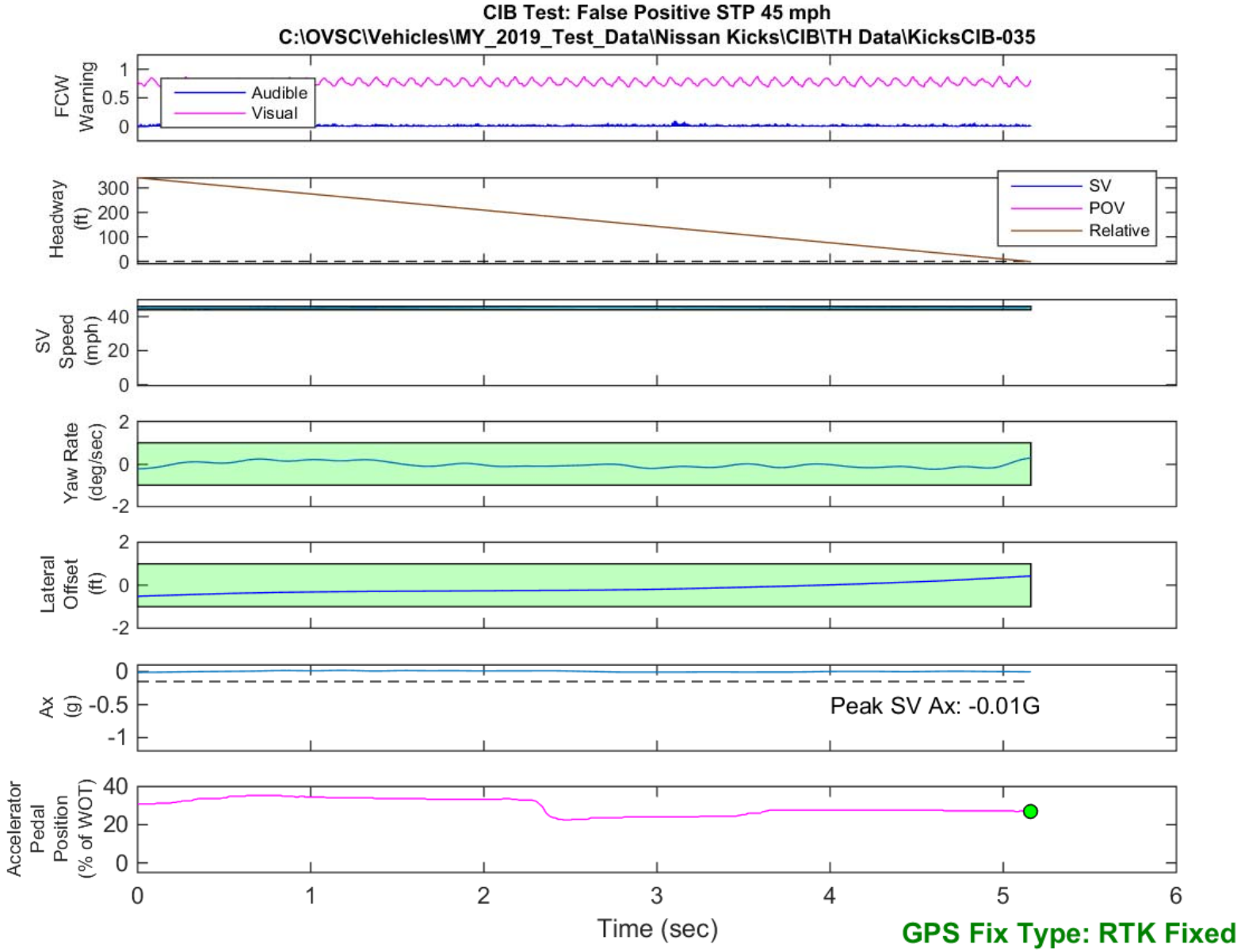


Figure D33. Time History for CIB Run 35, SV Encounters Steel Trench Plate, SV 45 mph

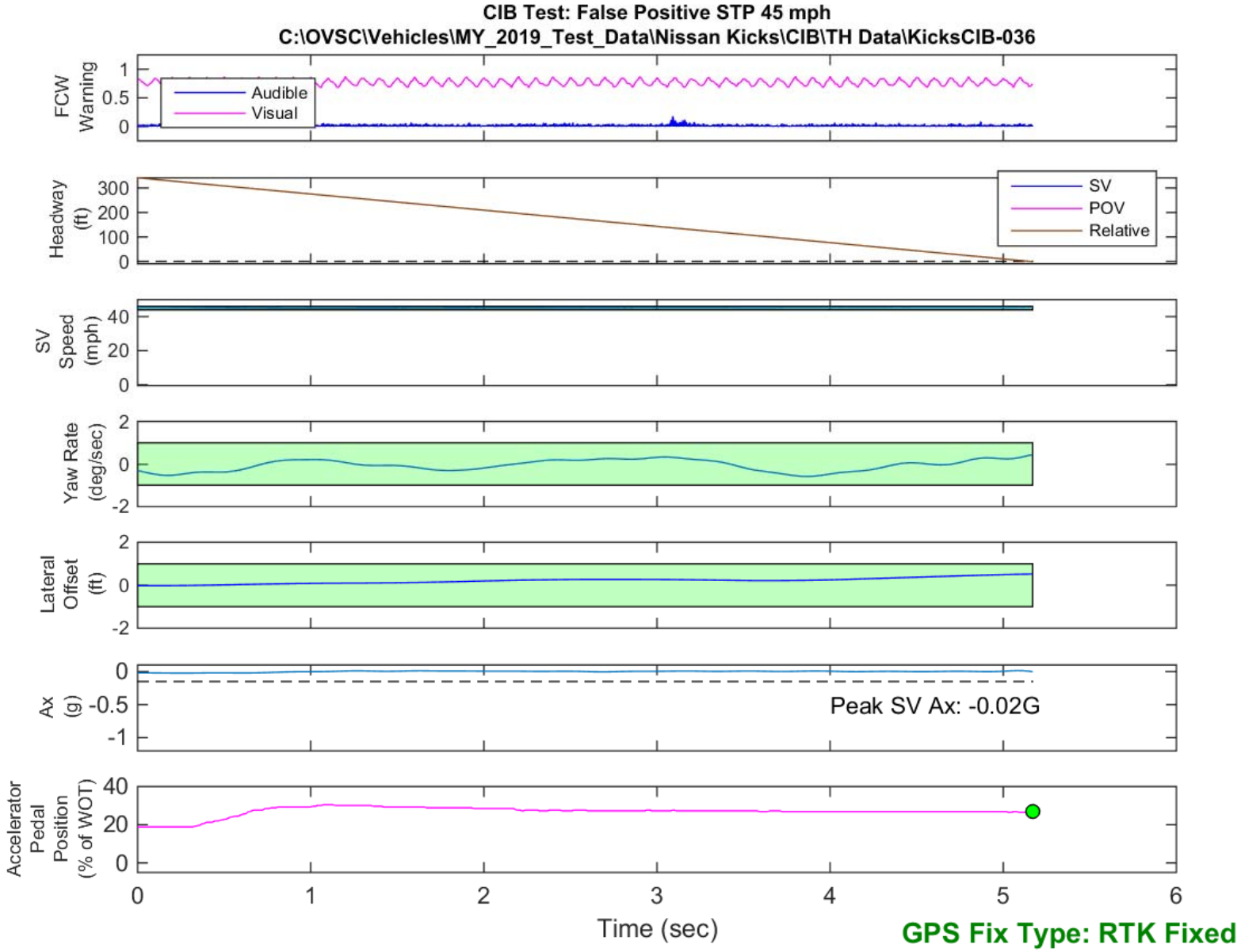


Figure D34. Time History for CIB Run 36, SV Encounters Steel Trench Plate, SV 45 mph

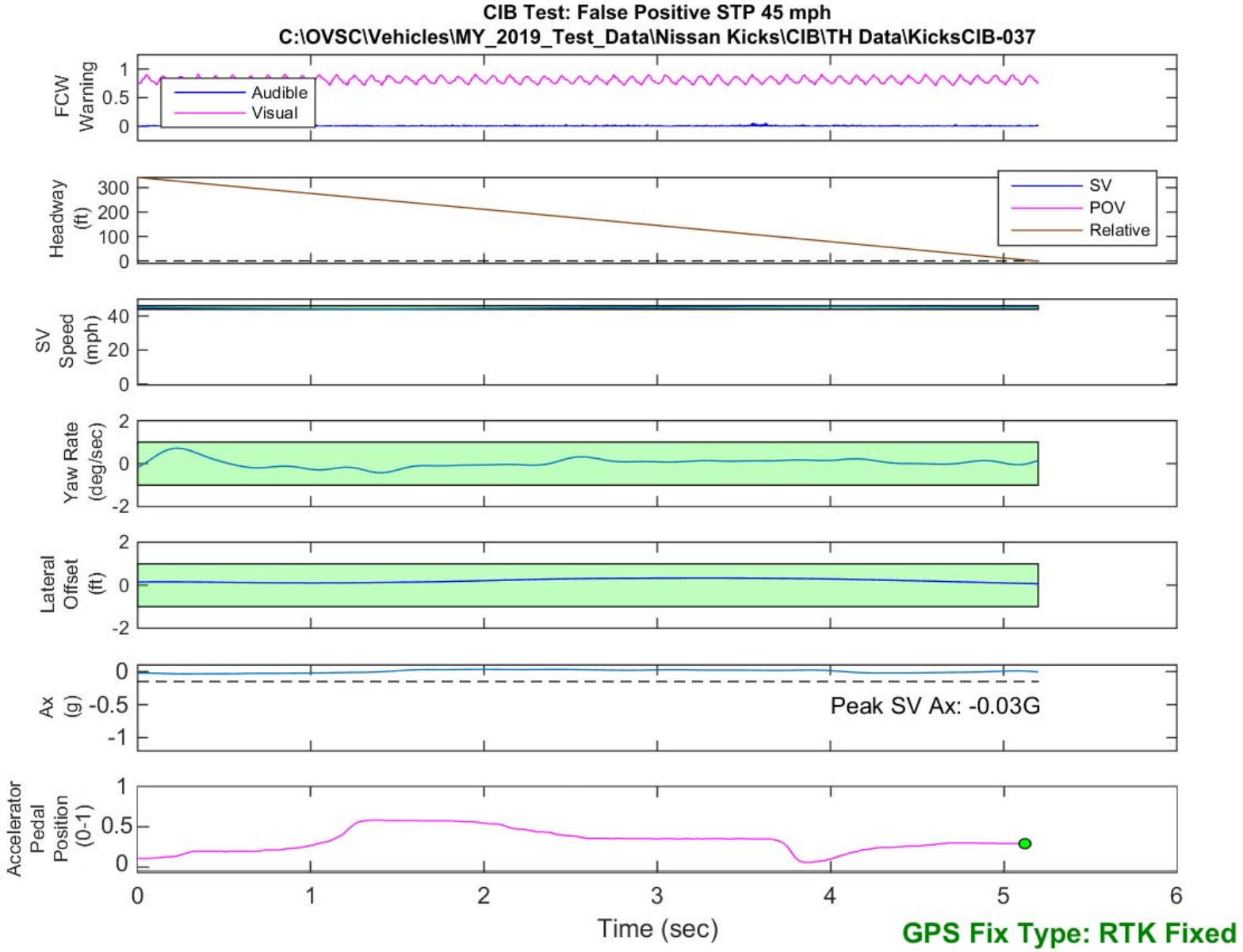


Figure D35. Time History for CIB Run 37, SV Encounters Steel Trench Plate, SV 45 mph