OCAS-DRI-DBS-19-17
NEW CAR ASSESSMENT PROGRAM
DYNAMIC BRAKE SUPPORT CONFIRMATION TEST

2019 Nissan Kicks

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22 July 2019

Final Report

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15. Supplementary Notes

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-2015-0006-0026; DYNAMIC BRAKE SUPPORT PERFORMANCE EVALUATION CONFIRMATION TEST FOR THE NEW CAR ASSESSMENT PROGRAM**,** October 2015. The vehicle failed the requirements of the test for all scenarios except the false positive cases, thus failing the overall test.

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Section I
OVERVIEW AND TEST SUMMARY

Dynamic Brake Support (DBS) systems are a subset of Automatic Emergency Braking (AEB) systems. DBS systems are designed to avoid or mitigate consequences of rear-end crashes by automatically applying supplemental braking on the subject vehicle when the system determines that the braking applied by the driver is insufficient to avoid a collision.

DBS systems intervene in driving situations where a rear-end collision is expected to be unavoidable unless additional braking is realized. Since DBS interventions are designed to occur late in the pre-crash timeline, and the driver has already initiated crash-avoidance braking, DBS systems are not required to alert the driver that a DBS intervention has occurred. In addition to sensors monitoring vehicle operating conditions, such as speed, brake application, etc., DBS systems employ RADAR, LIDAR, and/or vision-based sensors capable of detecting surrounding vehicles in traffic. Algorithms in the system's Central Processing Unit (CPU) use this information to continuously monitor the likelihood of a rear-end crash, and command additional braking as needed to avoid or mitigate such a crash.

The method prescribed by the National Highway Traffic Safety Administration (NHTSA) to evaluate DBS performance on the test track involves three longitudinal, 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 fourth scenario is used to evaluate the propensity of a DBS system to inappropriately activate in a non-critical driving scenario that does not present a safety risk to the SV occupant(s).

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

Section II
DATA SHEETS

<u>DYNAMIC BRAKE SUPPORT</u>

<u>DATA SHEET 1: TEST RESULTS</u>

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2019 Nissan Kicks

<u>SUMMARY RESULTS</u>

VIN: *3N1CP5CU5KL5xxxx*

Test Date: *5/7/2019*

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:

2019 Nissan Kicks

TEST VEHICLE INFORMATION

VIN: *3N1CP5CU5KL5xxxx*

Body Style: *Passenger Car* Color: *Deep 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)*

DYNAMIC BRAKE SUPPORT

DATA SHEET 2: VEHICLE DATA

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2019 Nissan Kicks

TIRES

Tire manufacturer and model: *Firestone FT140*

Front tire size: *P205/55R17*

Rear tire size: *P205/55R17*

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.

<u>DYNAMIC BRAKE SUPPORT</u>

<u>DATA SHEET 3: TEST CONDITIONS</u>

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2019 Nissan Kicks

GENERAL INFORMATION

Test date: *5/7/2019*

AMBIENT CONDITIONS

Air temperature: *21.1 C (70 F)*

Wind speed: *0.0 m/s (0.0 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)*

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)*

DYNAMIC BRAKE SUPPORT

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

2019 Nissan Kicks

Name of the DBS option, option package, etc.: *Automatic Emergency Braking*

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

Brake application mode used for test: *Hybrid control*

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

5 km/h (Per manufacturer supplied information)

What is the maximum vehicle speed at which the DBS 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 DBS activations, impacts or near-misses?

The system becomes unavailable after activating three times during the same ignition cycle. Recommend ignition OFF and ON after each test.

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 Subject Vehicle (SV) and Principal Other Vehicle (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 DBS?

____ Yes

X No

If yes, please provide a full description.

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

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Are there other driving modes or conditions that render DBS 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 DBS system to detect and respond to a stopped lead vehicle in the immediate forward path of the SV, as depicted in Figure 1.

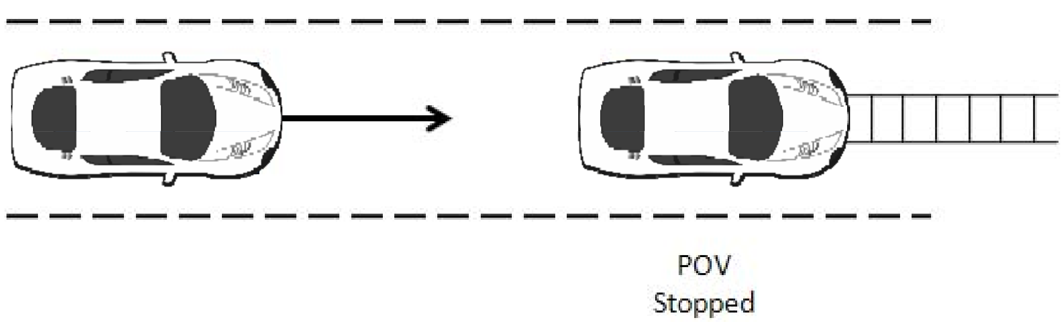


Figure 1. Depiction of Test 1

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 approaches 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 SV brakes were applied at TTC = 1.1 seconds (SV-to-POV distance of 40 ft (12 m)).

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).

Table 1. Nominal Stopped POV DBS Test Choreography

Test Speeds		SV Speed Held Constant		SV Throttle Fully Released By		SV Brake Application Onset (for each application magnitude)	
SV	POV	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway
25 mph (40.2 kph)	0	5.1 → t_{FCW}	187 ft (57 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.1	40 ft (12 m)

b. Criteria

The performance requirement for this series of tests is that there be no SV-POV impact for at least five of the seven valid test trials.

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

This test evaluates the ability of the DBS 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.

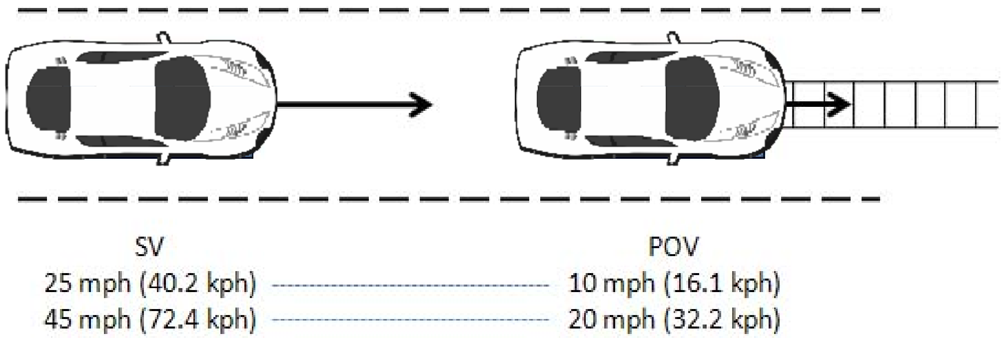


Figure 2. Depiction of Test 2

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 (40.2 kph), 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 SV brakes were applied at TTC = 1.0 seconds, assumed to be SV-to-POV distance of 22 ft (7 m) for an SV speed of 25 mph and 37 ft (11 m) for an SV speed of 45 mph.

The test concluded when either:

- The SV came into contact with the POV or
- 1 second after the speed 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 SV speed could not deviate more than ±1.0 mph (±1.6 kph) 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 kph) during the validity period.

Table 2. Nominal Slower Moving POV DBS Test Choreography

Test Speeds		SV Speed Held Constant		SV Throttle Fully Released By		SV Brake Application Onset (for each application magnitude)	
SV	POV	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway
25 mph (40 kph)	10 mph (16 kph)	5.0 → t_{FCW}	110 ft (34 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.0	22 ft (7 m)
45 mph (72 kph)	20 mph (32 kph)	5.0 → t_{FCW}	183 ft (56 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.0	37 ft (11 m)

b. Criteria

The performance requirement for this series of tests is that there be no SV-POV impact for at least five of the seven valid test trials.

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

This test evaluates the ability of the DBS 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. Should the SV foundation brake system be unable to prevent an SV-to-POV impact for a given test condition, the DBS system should automatically provide supplementary braking capable of preventing an SV-to-POV collision.

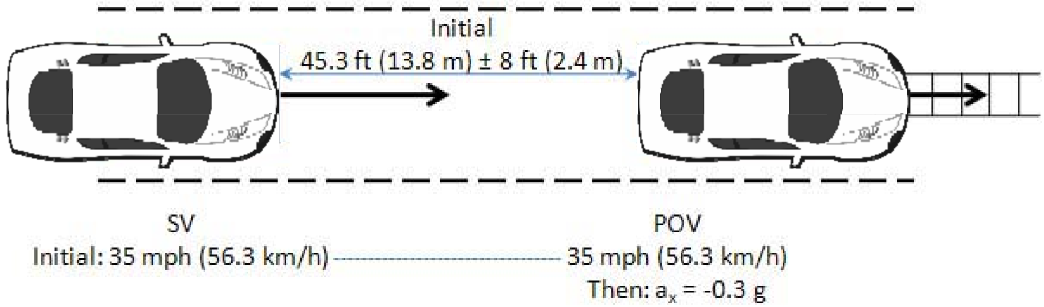


Figure 3. Depiction of Test 3 with POV Decelerating

a. Procedure

The SV ignition was cycled prior to each test run. For this scenario both the POV and SV were driven at a constant 35.0 mph (56.3 kph) in the center of the lane, with headway of 45 ft (14 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. The SV throttle pedal was released within 500 ms of $t_{FCW,}$ and the SV brakes were applied when TTC was 1.4 seconds (31.5 ft (9.6 m)).

The test concluded when either:

- 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.

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 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 kph) 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.

Table 3. Nominal Decelerating POV DBS Test Choreography

Test Speeds		SV Speed Held Constant		SV Throttle Fully Released By		SV Brake Application Onset (for each application magnitude)	
SV	POV	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway	TTC (seconds)	SV-to-POV Headway
35 mph (56 kph)	35 mph (56 kph)	3.0 seconds prior to POV braking → t_{FCW}	45 ft (14 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.4	32 ft (10 m)

b. Criteria

The performance requirement for this series of tests is that no SV-POV contact occurs for at least five of the seven valid test trials.

4. TEST 4 – FALSE POSITIVE SUPPRESSION

The false positive suppression test series evaluates the ability of a DBS 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 DBS 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 kph) and 45 mph (72.4 kph). 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. The SV was driven at constant speed in the center of the lane toward the STP. If the SV did not present an FCW alert during the approach to the STP by TTC = 2.1 s, the SV driver initiated release of the throttle pedal at TTC = 2.1 s and the throttle pedal was fully released within 500 ms of TTC = 2.1 s. The SV brakes were applied at TTC of 1.1 seconds, assumed to be 40 ft (12.3 m) from the edge of the STP at 25 mph or 73 ft (22.1 m) at 45 mph. The test concluded when the front most part of the SV reached a vertical plane defined by the edge of the STP first encountered by the SV.

b. Criteria

In order to pass the False Positive test series, the magnitude of the SV deceleration reduction attributable to DBS intervention must have been less than or equal to 1.25 times the average of the deceleration experienced by the baseline command from the braking actuator 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 haptic, visual, or audible, and the onset of the alert is determined by post-processing the test data.

For systems that implement audible or haptic alerts, part of the pre-test instrumentation verification process is 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 is accomplished in order to identify the center frequency around which a band-pass filter is 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 is a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 4.

Table 4. Audible and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Pass-Band Frequency Range
Audible	5^{th}	3 dB	60 dB	Identified Center Frequency ± 5%
Tactile	5^{th}	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 0.25 g.
- The SV driver did not apply any force to the brake pedal during the during the applicable validity period. All braking shall be performed by the programmable brake controller.
- 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: 2 seconds prior to the SV throttle pedal being released

The valid test interval ended:

Test 1: When either of the following occurred:

- The SV came in 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.

Test 2: When either of the following occurred:

- 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.

Test 3: When either of the following occurred:

- The SV came in contact with the POV; or
- 1 second after minimum SV-to-POV range occurred.

Test 4: When the SV stopped.

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 defining 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

DBS 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).

This 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 DBS 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.

- POV delivery system, whose requirements are to:
    - Accurately control the nominal POV speed up to 35 mph (56 kph).
    - 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 rearward direction. In operation, the shell and roller assembly engages the rail assembly through detents to prevent relative motion during run-up to test speeds and minor 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 and 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 and away from the SV. The forward end of the rail has a soft 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. FOUNDATION BRAKE SYSTEM CHARACTERIZATION

Data collected and analyzed from a series of pre-test braking runs were used to objectively quantify the response of the vehicle's foundation brake system without the contribution of DBS. The results of these analyses were used to determine the brake pedal input magnitudes needed for the main tests.

This characterization was accomplished by recording longitudinal acceleration and brake pedal force and travel data for a variety of braking runs. For three initial brake characterization runs, the vehicle was driven at 45 mph, and the brakes were applied at a rate of 1 inch/sec up to the brake input level needed for at least 0.7 g. Linear regressions were performed on the data from each run to determine the linear vehicle deceleration response as a function of both applied brake pedal force and brake pedal travel. The brake input force or displacement level needed to achieve a vehicle deceleration of 0.4 g was determined from the average of the three runs. Using the 0.4 g brake input force or displacement level found from the three initial runs, subsequent runs were performed at 25 mph, 35 mph, and 45 mph, with the brakes applied at a rate of 10 inch/sec to the determined 0.4 g brake input force or displacement level. For each of the three test speeds, if the average calculated deceleration level was found to be within 0.4 ± 0.025 g, the resulting force or displacement was recorded and used. If the average calculated deceleration level exceeded this tolerance, the brake input force or displacement levels were adjusted and retested until the desired magnitude was realized. Prior to each braking event, the brake pad temperatures were required to be in the range of 149° - 212°F.

E. BRAKE CONTROL

1. Subject Vehicle programmable brake controller

To achieve accurate, repeatable, and reproducible SV brake pedal inputs, a programmable brake controller was used for all brake applications. The controller has the capability to operate in one of two user-selectable, closed-loop, control modes:

- Constant pedal displacement. By maintaining constant actuator stroke, the position of the vehicle's brake pedal remains fixed for the duration of the input. To achieve this, the brake controller modulates application force.

- Hybrid control. Hybrid control uses position-based control to command the initial brake application rate and actuator position, then changes to force-based control to command a reduction of applied force to a predetermined force. This force is maintained until the end of the braking maneuver by allowing the brake controller to modulate actuator displacement.

2. Subject Vehicle brake parameters

- Each test run began with the brake pedal in its natural resting position, with no preload or position offset.

- The onset of the brake application was considered to occur when the brake actuator had applied 2.5 lbf (11 N) of force to the brake pedal.

- The magnitude of the brake application was that needed to produce 0.4 g deceleration, as determined in the foundation brake characterization.

- The SV brake application rate was between 9 to 11 in/s (229 to 279 mm/s), where the application rate is defined as the slope of a linear regression line applied to brake pedal position data over a range from 25% to 75% of the commanded input magnitude.

3. POV Automatic Braking System

The POV was equipped with an automatic braking system, which was used in Test Type 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.

F. INSTRUMENTATION

Table 5 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

TABLE 5. 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
Load Cell	Force applied to brake pedal					By: DRI
		0 - 250 lb 0 -1112 N	0.1% FS	Honeywell 41A	1464391	Date: 8/28/2018 Due: 8/28/2019
		0-250 lb 1112 N	0.05% FS	Stellar Technology PNC700	1607338	Date: 8/28/2018 Due: 8/28/2019
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 kph	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	NA

TABLE 5. TEST INSTRUMENTATION AND EQUIPMENT (continued)

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
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 Rat	Accels .01g, Angular Rate	Oxford Inertial +		By: Oxford Technical Solutions
					2182	Date: 10/16/2017 Due: 10/16/2019
					2176	Date: 4/11/2018 Due: 4/11/2020
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	UO8-05-08-06636	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

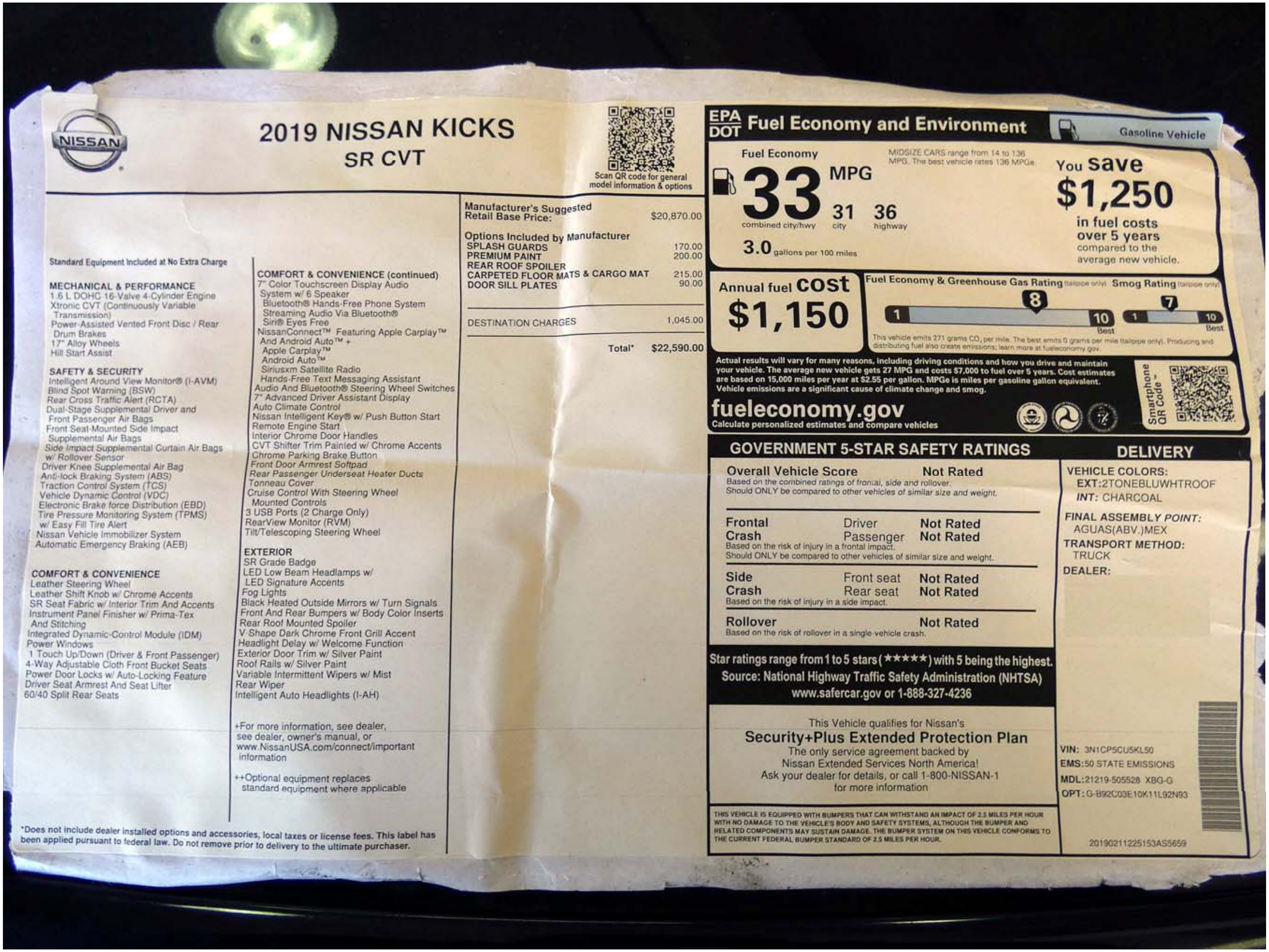


Figure A3. Window Sticker (Monroney Label)

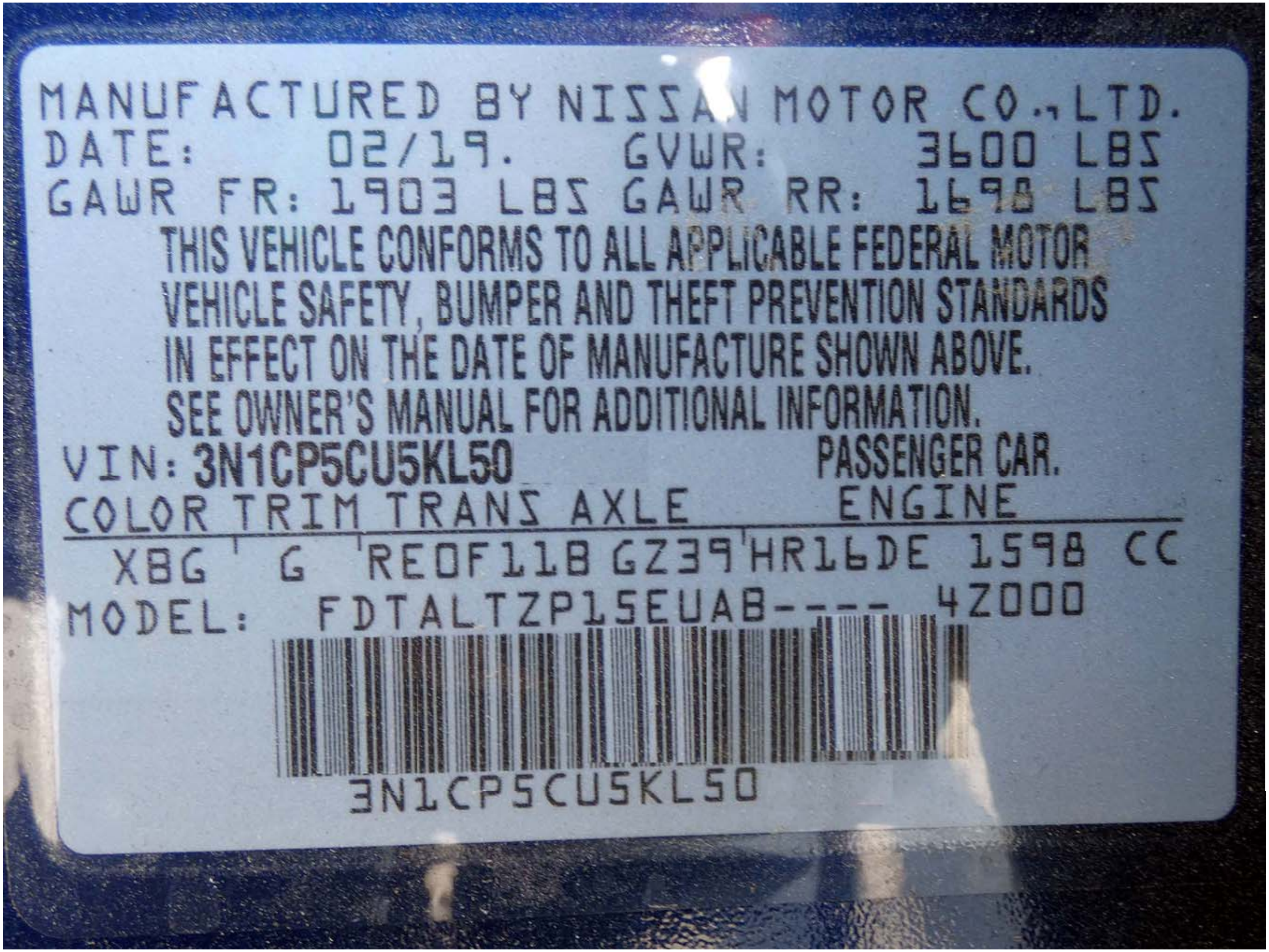


Figure A4. Vehicle Certification Label

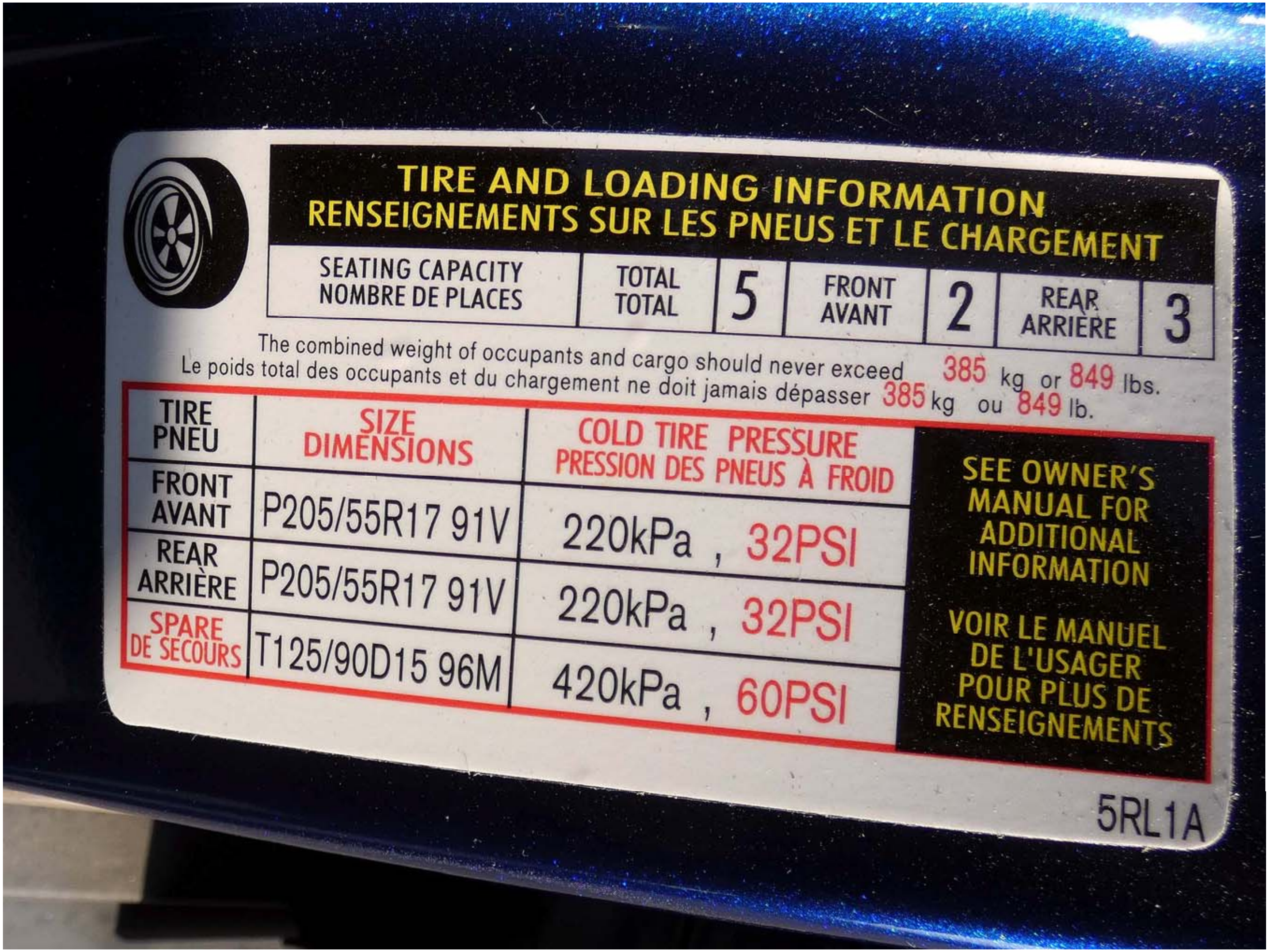


Figure A5. Tire Placard

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

Figure A7. Load Frame/Slider of SSV

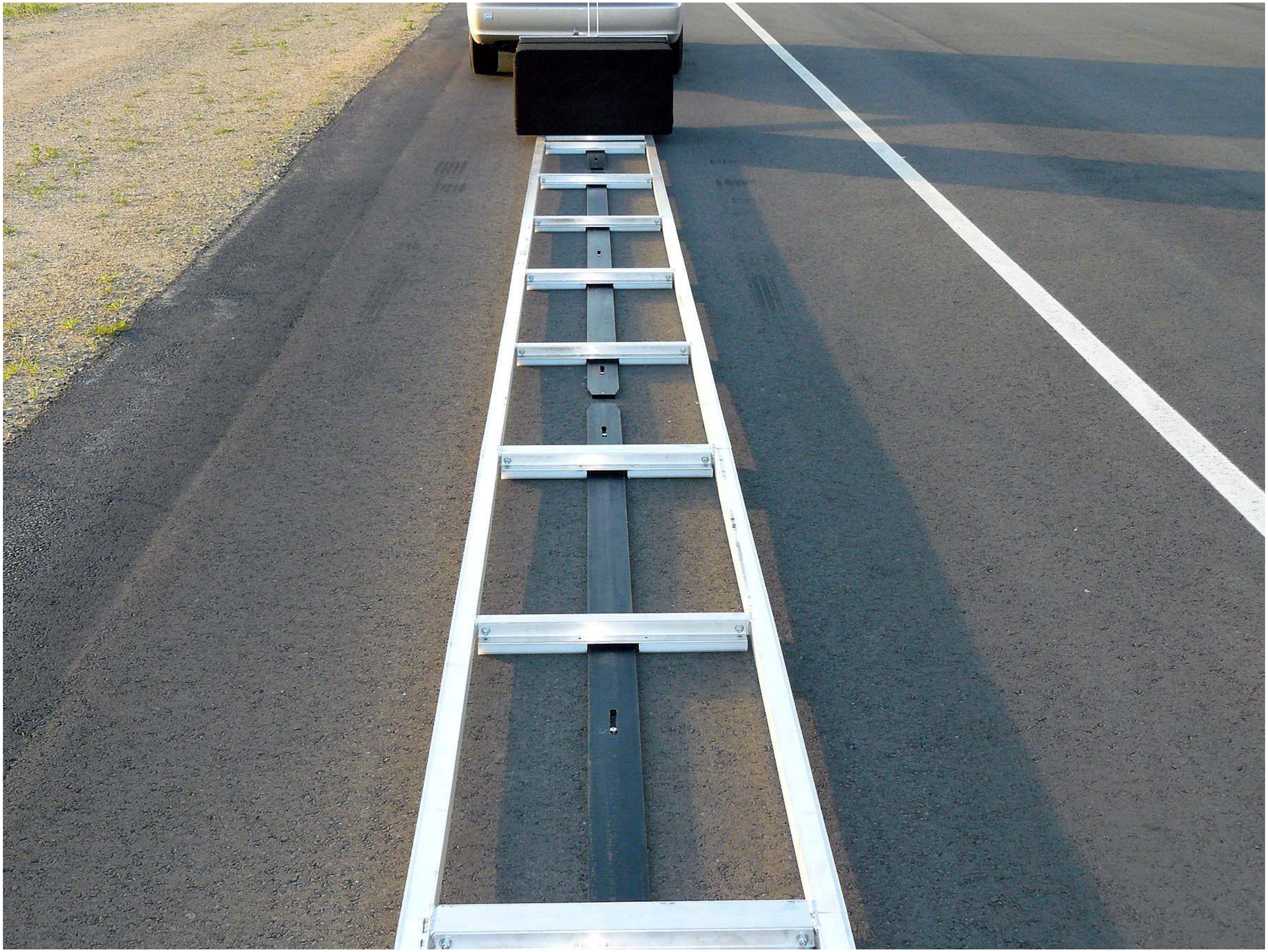


Figure A8. Two-Rail Track and Road-Based Lateral Restraint Track

Figure A9. Steel Trench Plate

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

Figure A11. Sensors for Detecting Auditory and Visual Alerts

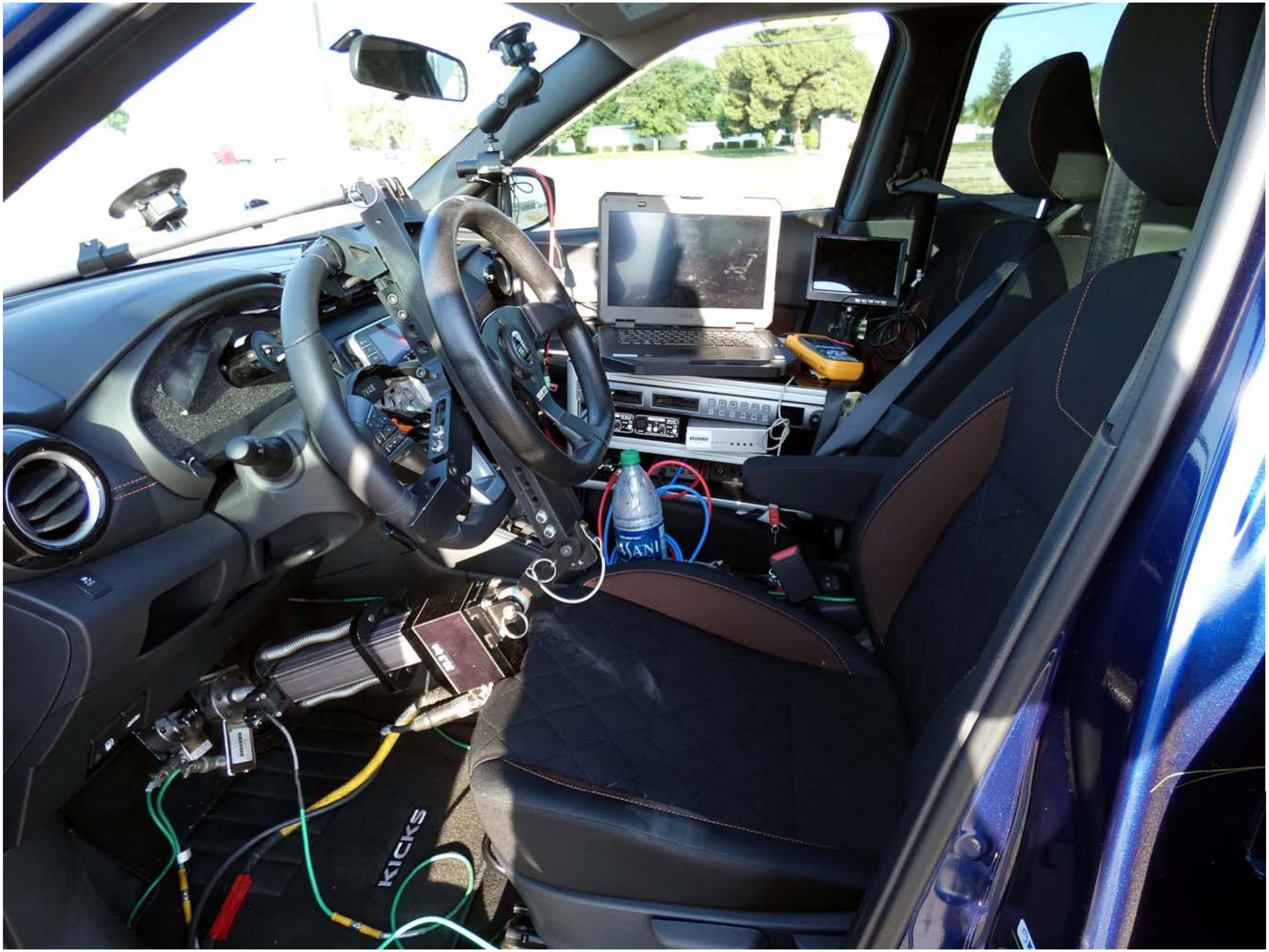


Figure A12. Computer and Brake Actuator Installed in Subject Vehicle

Figure A13. Brake Actuator Installed in POV System

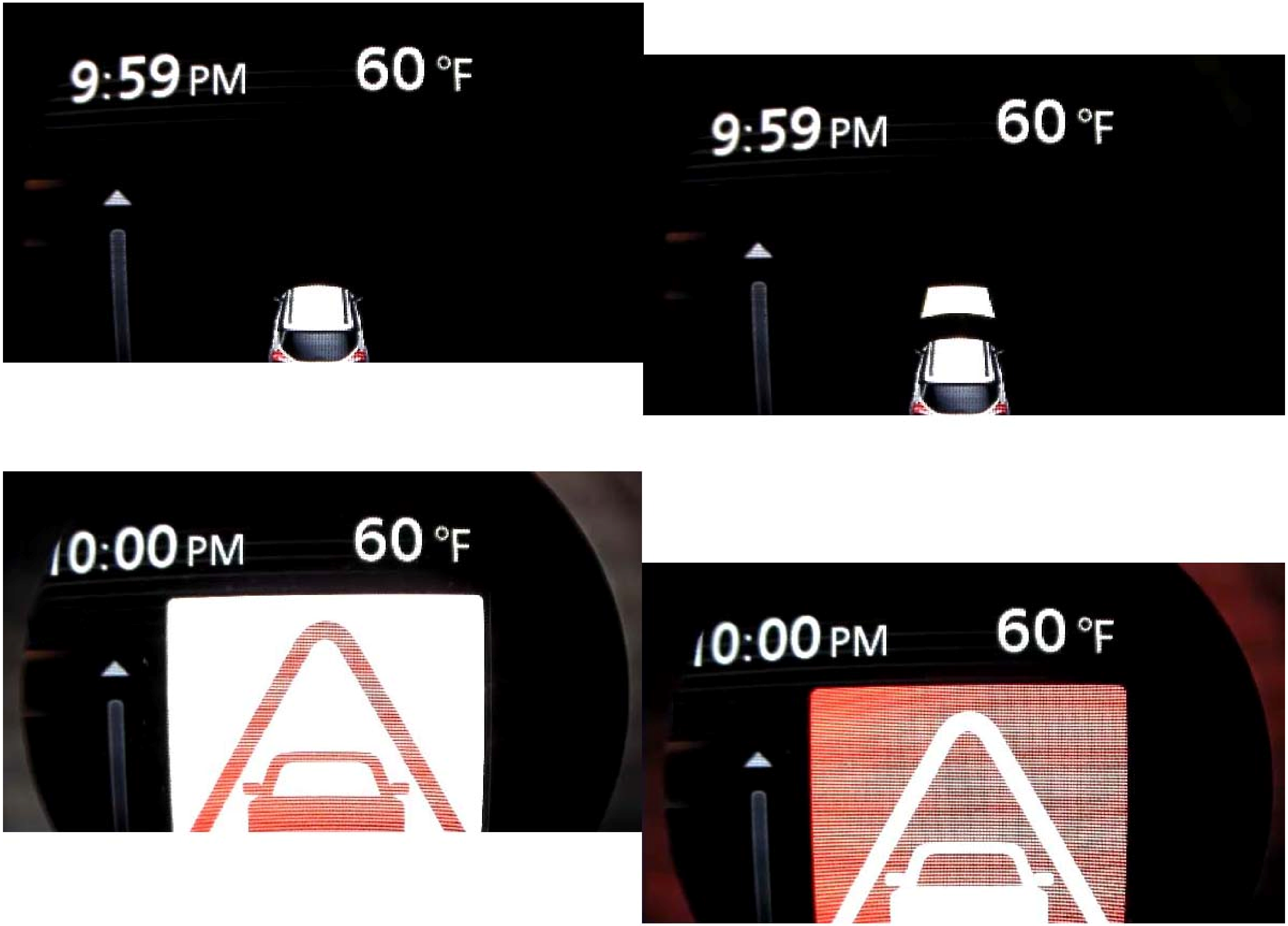


Figure A14. Collision Warning Visual Alert

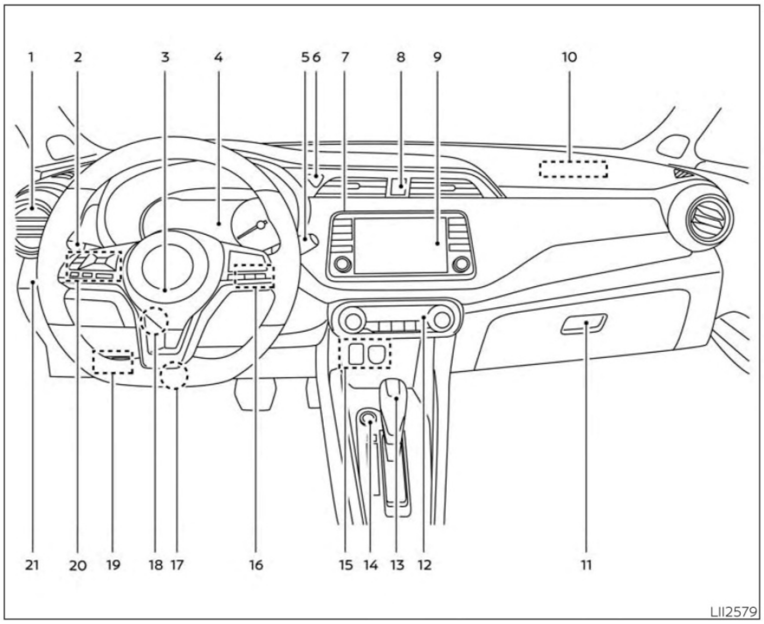
Figure A15. AEB Setup Menus

Figure A16. Steering Wheel Mounted Control Buttons 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)
   Audio controls (P. 4-2, 4-3, 4-42)
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 information display switches
    (if so equipped) (P. 2-22)
21. Vehicle Dynamic Control (VDC) OFF
    switch (P. 2-48)
    Enter/select switch for trip computer (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 (ABS)	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

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)

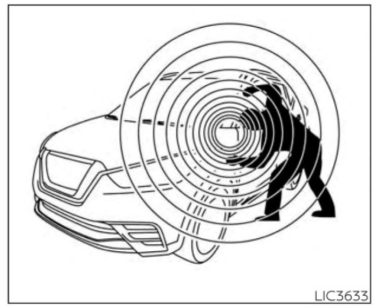
This message appears when the Blind Spot Warning (BSW) or Rear Cross Traffic Alert (RCTA) systems become unavailable because a radar blockage is detected. For additional information, refer to "Blind Spot Warning (BSW)" or "Rear Cross Traffic Alert (RCTA)" in the "Starting and driving" section of this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

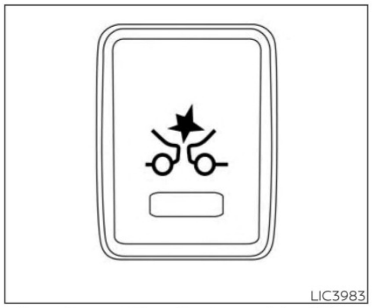
The vehicle security system provides visual and audible alarm signals if someone opens the doors, hood or liftgate when the system is armed. It is not, however, a motion detection type system that activates when a vehicle is moved or when a vibration occurs.

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

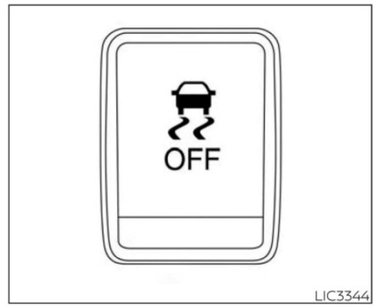
When this switch is illuminated, the following system is activated.

- 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).

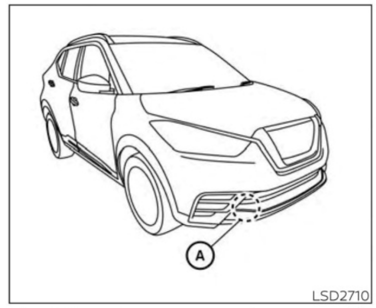
AUTOMATIC EMERGENCY BRAKING (AEB) (if so equipped)

⚠WARNING

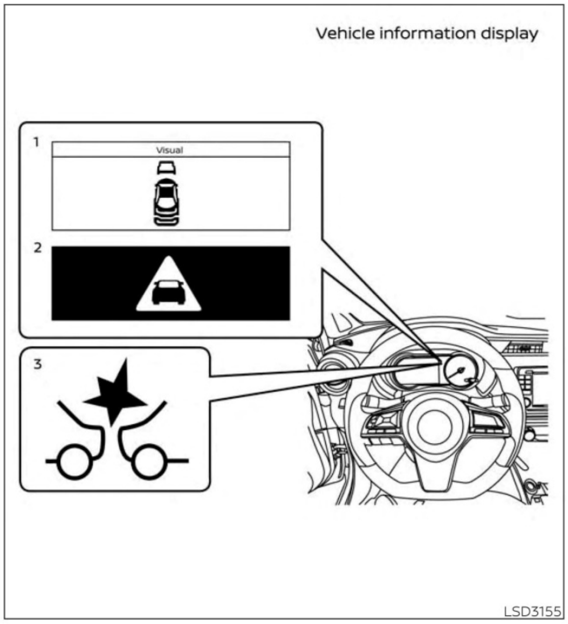
Failure to follow the warnings and instructions for proper use of the AEB system could result in serious injury or death.

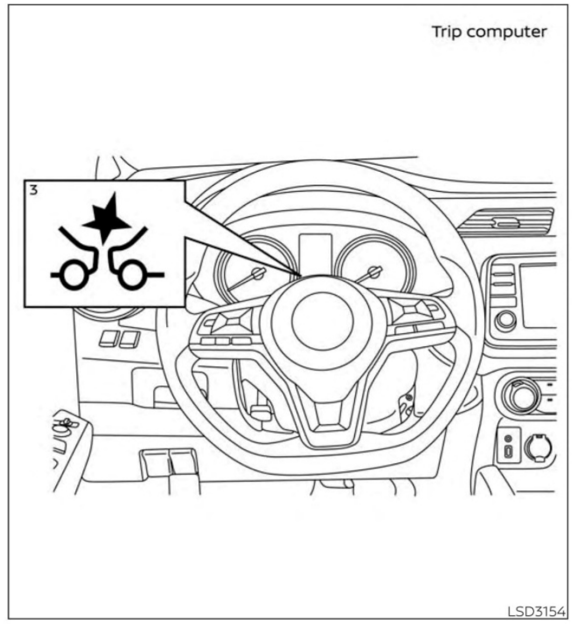
- **The AEB system is a supplemental aid to the driver. It is not a replacement for the driver's attention to traffic conditions or responsibility to drive safely. It cannot prevent accidents due to carelessness or dangerous driving techniques.**
- **The AEB system does not function in all driving, traffic,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

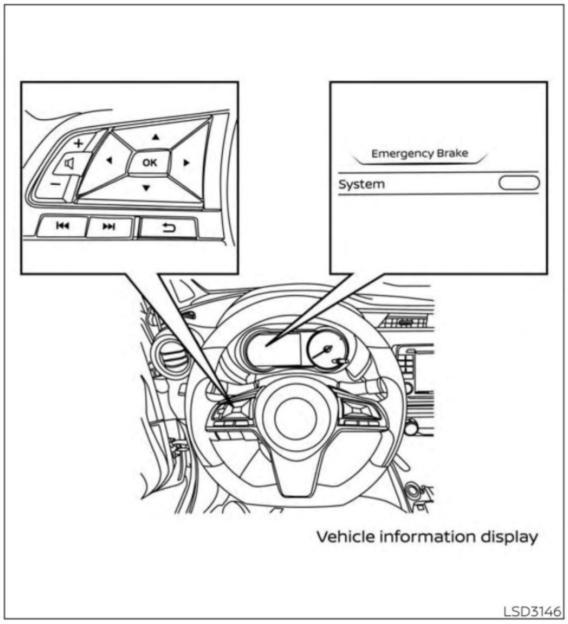
The vehicle's brake lights come on when braking is performed by the AEB system.

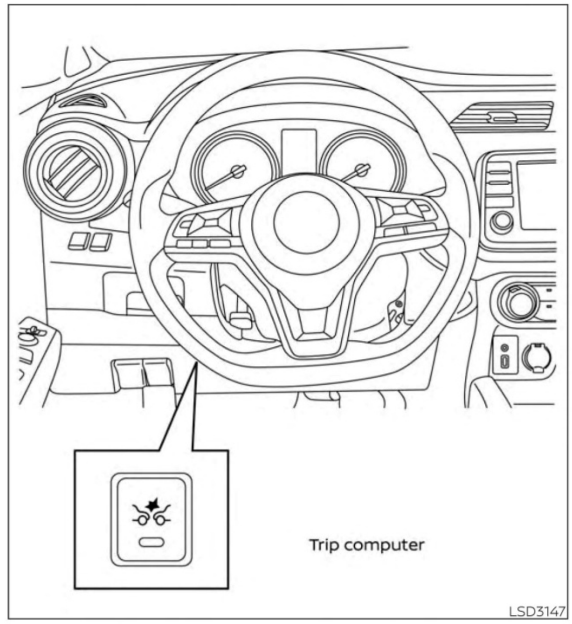
Depending on vehicle speed and distance to the vehicle ahead, as well as driving and roadway conditions, the system may help the driver avoid a forward collision or may help mitigate the consequences of a collision, should one be unavoidable. If the driver is handling the steering wheel, accelerating 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.


Emergency Brake
System
OK
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.

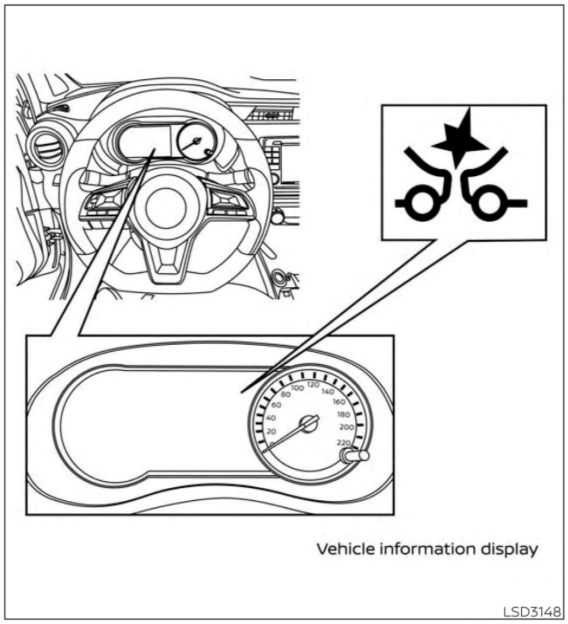
AEB SYSTEM LIMITATIONS

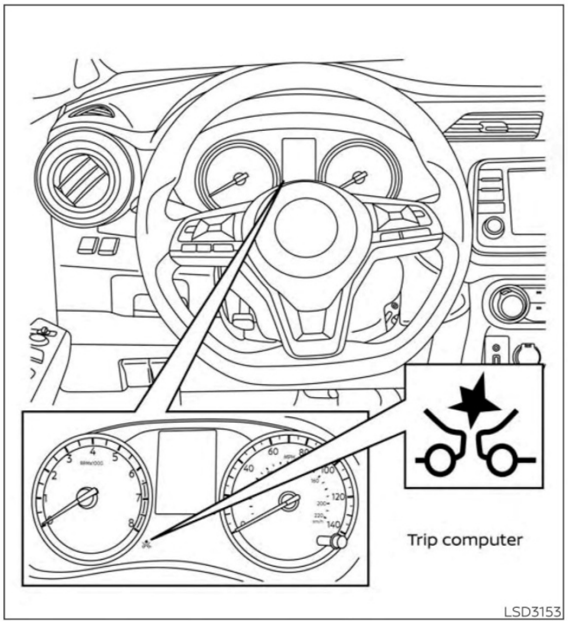
⚠WARNING

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.





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

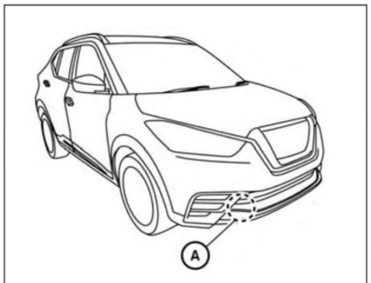
If the warning light (orange) comes on, stop the vehicle in a safe place, place the shift lever in the P (Park) position and turn the engine off. Clean the radar cover on the lower grille with a soft cloth, and restart the engine. If the warning light continues to illuminate, have the AEB system checked. 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 fonctionnement.

BREAK-IN SCHEDULE

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: 5/7/2019

Principal Other Vehicle: SSV

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
	Brake characterization and confirmation						See Appendix D
13	Static Run						
14	**Slower POV, 25 vs 10**	Y	1.70	0.00	0.44	Fail	
15		Y	1.54	0.00	0.42	Fail	
16		Y	1.68	0.00	0.47	Fail	
17	Static run						
18	**Slower POV, 45 vs 20**	Y	2.52	0.00	0.66	Fail	
19		Y	2.36	0.00	0.52	Fail	
20		Y	2.43	0.00	0.54	Fail	
21	Static run						

Subject Vehicle: **2019 Nissan Kicks** Test Date: 5/7/2019

Principal Other Vehicle: SSV

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
22	**Braking POV, 35**	N					Brake overshoot
23		N					Brake Force
24		Y	1.90	0.00	0.63	Fail	
25		N					Yaw Rate
26		Y	1.75	0.00	0.62	Fail	
27		N					Brake Force
28		N					Brake Force
29		N					Actuator Fired early
30		N					Yaw Rate
31		Y	N/A	0.00	0.63	Fail	No FCW
32	Static run						
33	**Stopped POV**	Y	N/A	0.00	0.61	Fail	No FCW
34		Y	2.07	0.00	0.65	Fail	
35		Y	N/A	0.00	0.61	Fail	No FCW

Subject Vehicle: **2019 Nissan Kicks** Test Date: 5/7/2019

Principal Other Vehicle: SSV

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
36	Static Run						
37	**Baseline, 25**	N					Brake profile has large peak. Re-characterize brakes
38-45	Characterization check runs						
46	**Baseline, 25**	Y			0.65		
47		Y			0.63		
48		Y			0.61		
49		Y			0.62		
50		Y			0.61		
51		Y			0.65		
52		Y			0.63		
53	STP - Static run						

Subject Vehicle: **2019 Nissan Kicks** Test Date: 5/7/2019

Principal Other Vehicle: SSV

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
54	**Baseline, 45**	Y			0.64		
55		Y			0.65		
56		Y			0.60		
57		Y			0.62		
58		Y			0.65		
59		Y			0.61		
60		Y			0.65		
61	STP - Static run						
62	**STP False Positive, 25**	Y			0.64	Pass	
63		Y			0.61	Pass	
64		Y			0.67	Pass	
65		Y			0.63	Pass	
66		Y			0.58	Pass	
67		Y			0.64	Pass	

Subject Vehicle: **2019 Nissan Kicks** Test Date: 5/7/2019

Principal Other Vehicle: SSV

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
68		Y			0.64	Pass	
69	STP - Static run						
70	**STP False Positive, 45**	Y			0.63	Pass	
71		Y			0.62	Pass	
72		Y			0.62	Pass	
73		Y			0.60	Pass	
74		Y			0.63	Pass	
75		Y			0.62	Pass	
76		Y			0.60	Pass	
77	STP - Static run						

APPENDIX D

Brake Characterization

Subject Vehicle: **2019 Nissan Kicks** Test Date: 5/7/2019

DBS Initial Brake Characterization				
Run Number	**Stroke at 0.4 g (in)**	**Force at 0.4 g (lb)**	**Slope**	**Intercept**
1	3.691848	21.81441	0.525497	-0.33476
2	3.627041	21.39611	0.521579	-0.35193
3	3.540602	20.72716	0.540419	-0.40438

DBS Brake Characterization Confirmation								
Run	**DBS Mode**	**Speed**	**Valid Run**	**Average Decel. (g)**	**0.4 g Stroke Value (in)**	**0.4 g Force Value (lb)**	**Stroke/Force Calculator (in)**	**Notes**
4	**Displacement**	35	Y	0.447	3.62		3.24	4
5			Y	0.426	3.50		3.29	5
6			Y	0.388	3.35		3.45	6
7		25	Y	0.410	3.35		3.27	7
8		45	Y	0.410	3.35		3.27	8
9	**Hybrid**	35	Y	0.494		21.31	17.26	9
10			Y	0.403		16.00	15.88	10
11		25	Y	0.397		16.00	16.12	11

DBS Brake Characterization Confirmation								
Run	**DBS Mode**	**Speed**	**Valid Run**	**Average Decel. (g)**	**0.4 g Stroke Value (in)**	**0.4 g Force Value (lb)**	**Stroke/Force Calculator (in)**	**Notes**
12		45	Y	0.414		16.00	15.46	12
ADDITIONAL BRAKE CONFIRMATION RUNS: Re-characterized due to large overshoot								
38	**Displacement**	25	N					
39			Y	0.345	3.35		3.88	
40			Y	0.397	2.65		2.67	
41		45	Y	0.403	2.65		2.63	
42	**Hybrid**	25	Y	0.336		16.00	19.05	
43			Y	0.383		16.85	17.60	
44		45	Y	0.436		16.85	15.46	
45			Y	0.424		16.75	15.80	

Appendix E

TIME HISTORY PLOTS

LIST OF FIGURES

Page

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. 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.

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 Baseline 25 mph (Baseline run at 25 mph)
- False Positive Baseline 45 mph (Baseline run at 45 mph)
- 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)
- DBS Brake Characterization, Initial
- DBS Brake Characterization Determination

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.

- o 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 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 the Principal Other Vehicle (if any). For DBS tests, in the case of an impact, the speed reduction experienced by the Subject Vehicle up until the moment of impact 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). The peak value of Ax for the SV is shown on the subplot.

- Pedal Position – position of the accelerator pedal and brake pedal. The units for the brake pedal are inches and the units for the accelerator pedal are percent of full scale divided by 10.

- Brake Force (lb) – force on the brake pedal as applied by the DBS controller. The TTC at the onset of the brake by the DBS controller is shown on the subplot. Additionally, the average force at the brake pedal while the DBS controller is active is displayed.

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 or red 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 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, 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 given. 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 0.27g (the upper edge of the envelope, i.e., 0.30 g $\pm$ 0.03 g). A green circle or red asterisk is displayed at the moment the POV brake level achieves 0.27g. 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 out of the appropriate interval).

For the pedal position plot, a thick black bar appears on the brake pedal position data over the DBS controller brake onset period to signify the time over which the brake application rate is determined. The calculated brake application rate is also displayed on the figure.

If the tests are done in Hybrid mode, the brake force plot shows a dashed black threshold line indicating a brake force of 2.5 lbs. For the time period where the DBS controller is active, the brake force at the pedal must not fall below this 2.5 lb threshold. Exceedances of this threshold are indicated by red shading in the area between the measured time-varying data and the dashed threshold line. The yellow envelope in this case is used only to visualize the target average brake force necessary for the test to be valid. If the tests are done in displacement mode there are no relevant brake force level thresholds or average brake force calculations.

In the instance of the “last second” braking applied by the brake robot, a thick vertical red line will appear on the plots at the moment brake robot activates. Note that last second braking is only done when it has been determined by the onboard computer that test failure cannot be avoided. It is done simply to reduce the collision speed, to minimize the likelihood of damage to the SSV and to the Subject Vehicle. Therefore, data validity checks are not performed after the red line, and certain values such as minimum distance or peak deceleration may not be accurate.

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.
   - Red threshold (Solid) = for reference only – indicates the activation of last minute braking by the brake robot. Data after the solid red line is not used to determine test validity.

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 valid or passing time history plots for each test type (including passing, failing, and invalid runs) are shown in Figure E1 through E12. Figures E1 through E8 show passing runs for each of the 8 test types. Figure E9 shows an example of a passing brake characterization run. Figures E10 and E11 show examples of invalid runs. Figure E12 shows an example of a valid test that failed the DBS requirements.

Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure E13.

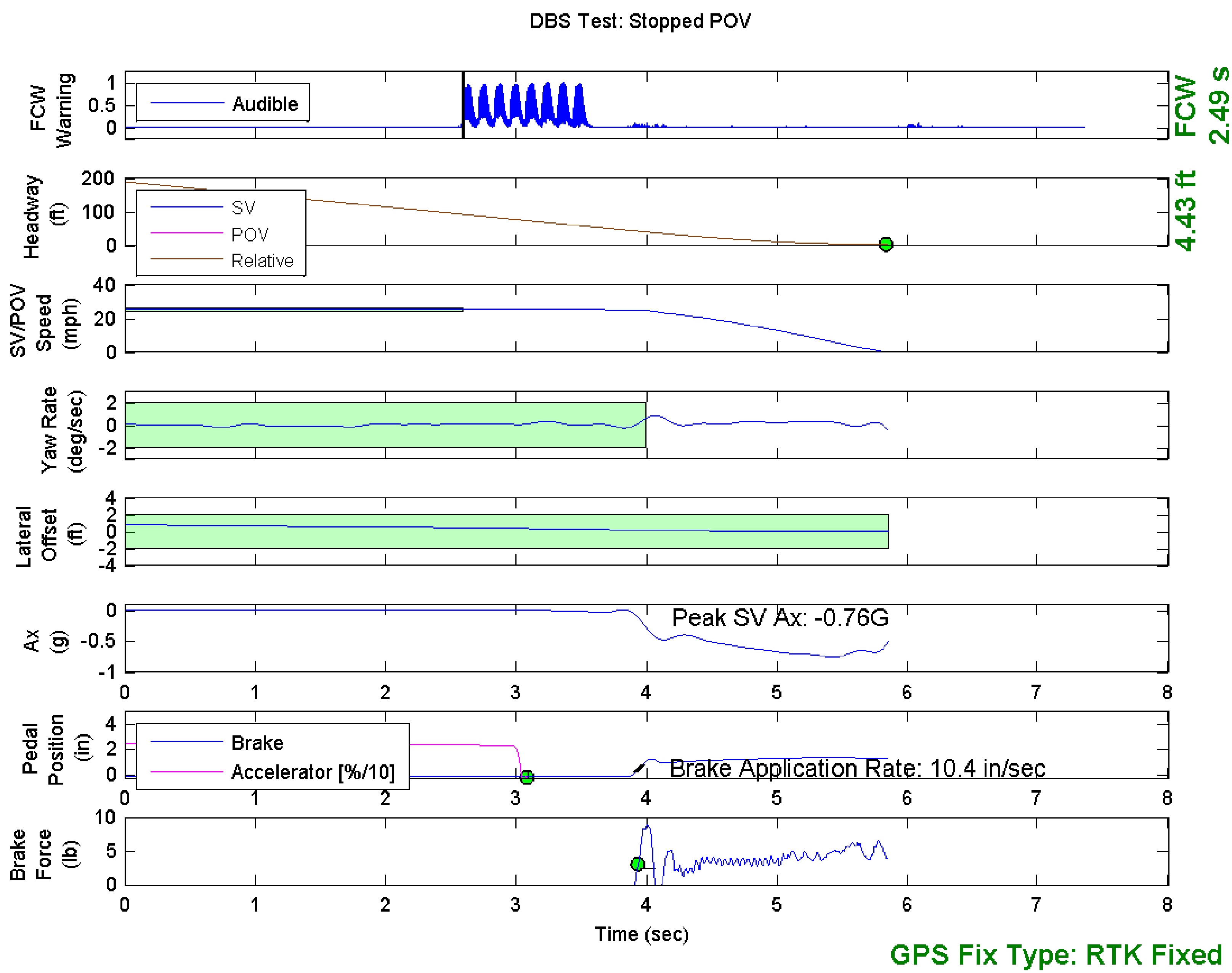


Figure E1. Example Time History for Stopped POV, Passing

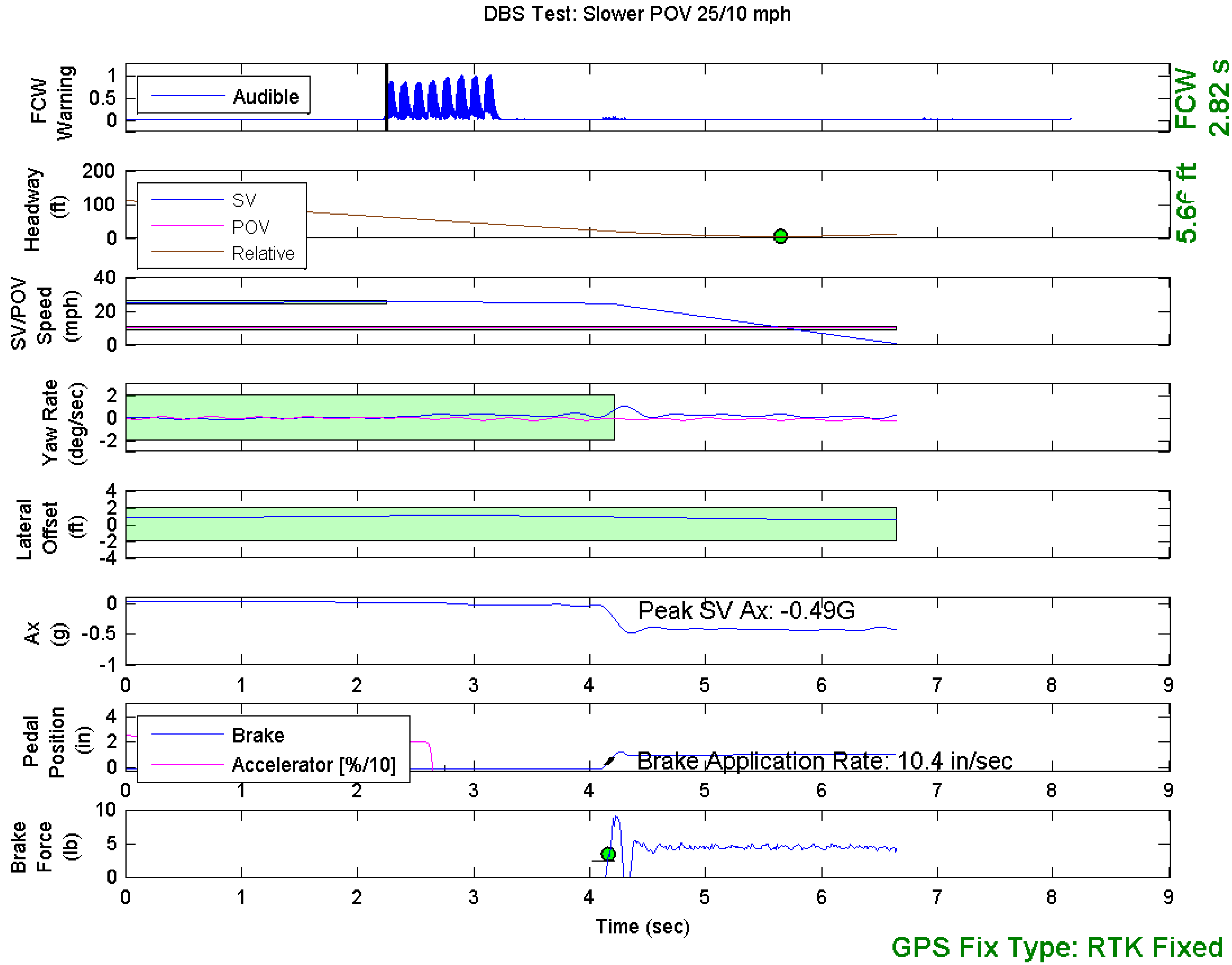


Figure E2. Example Time History for Slower POV 25 vs. 10, Passing

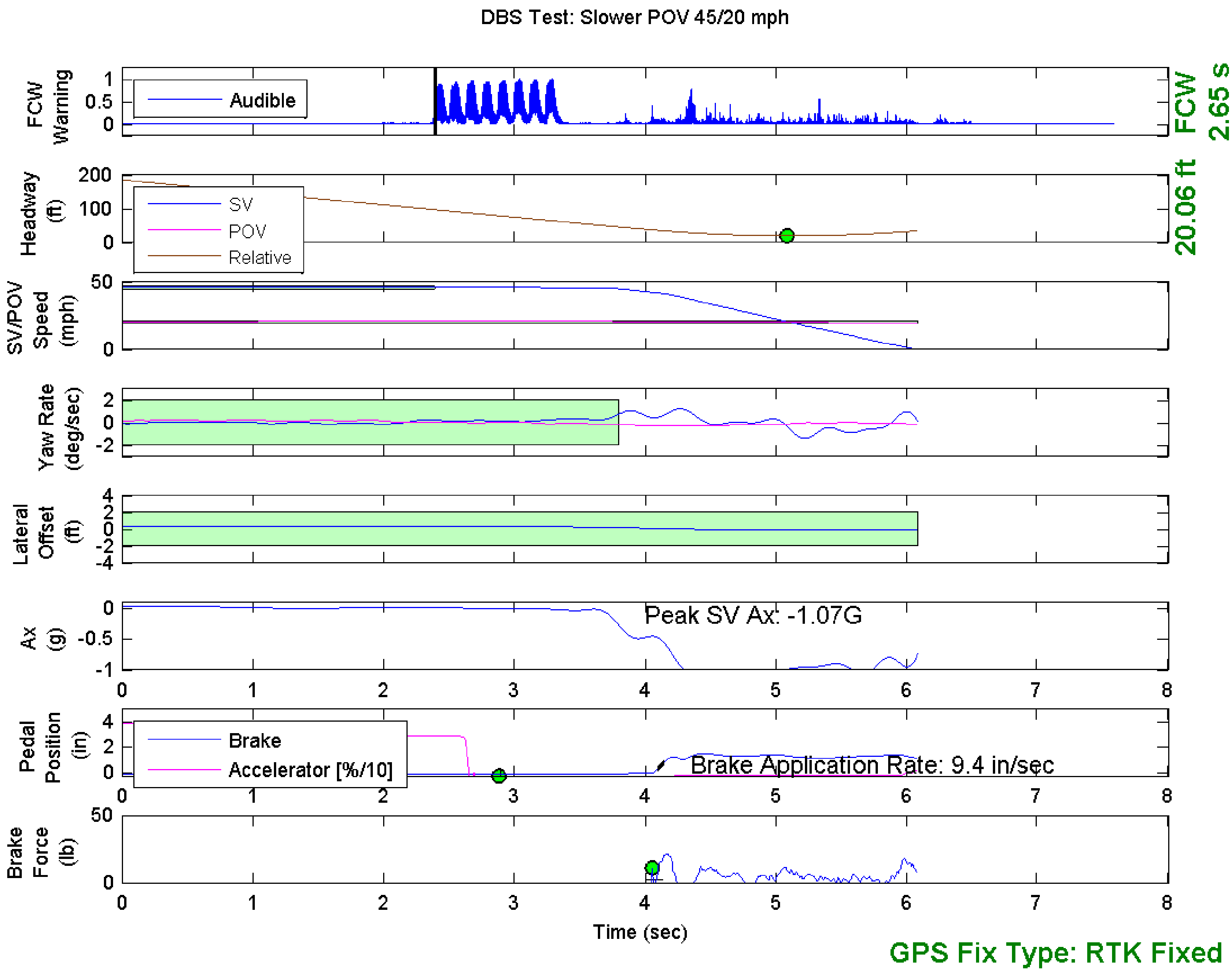


Figure E3. Example Time History for Slower POV 45 vs. 20, Passing

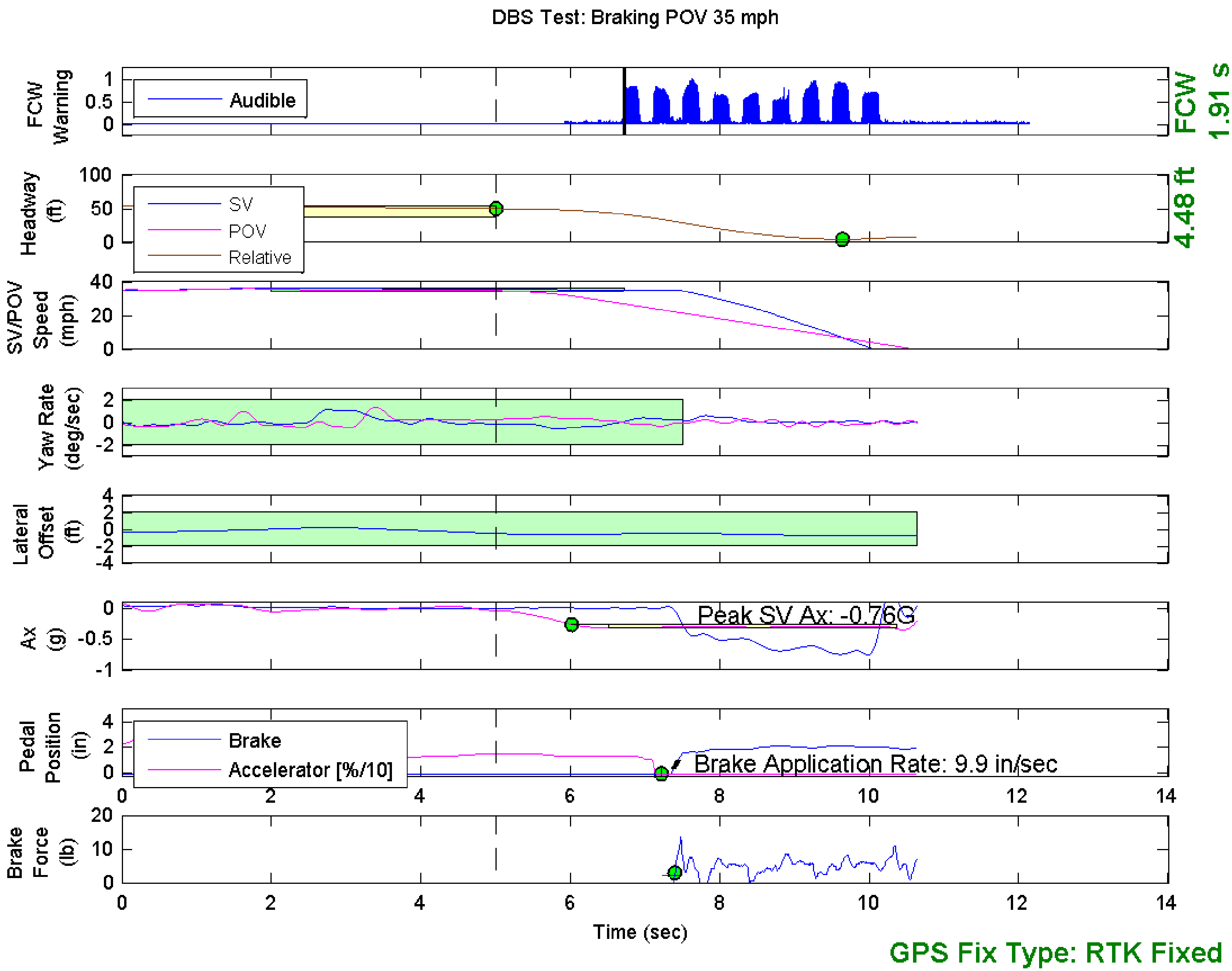


Figure E4. Example Time History for Braking POV 35, Passing

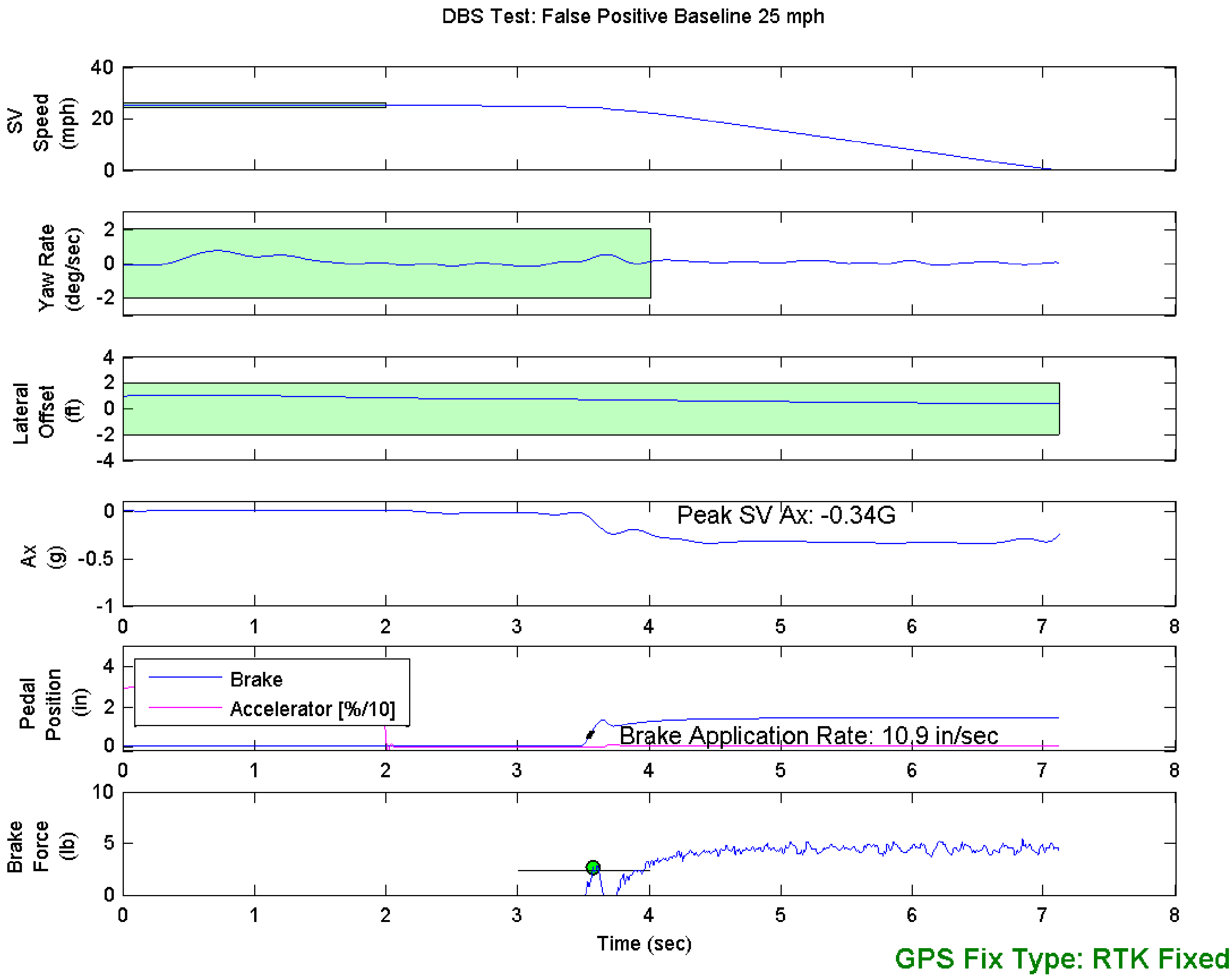


Figure E5. Example Time History for False Positive Baseline 25, Passing

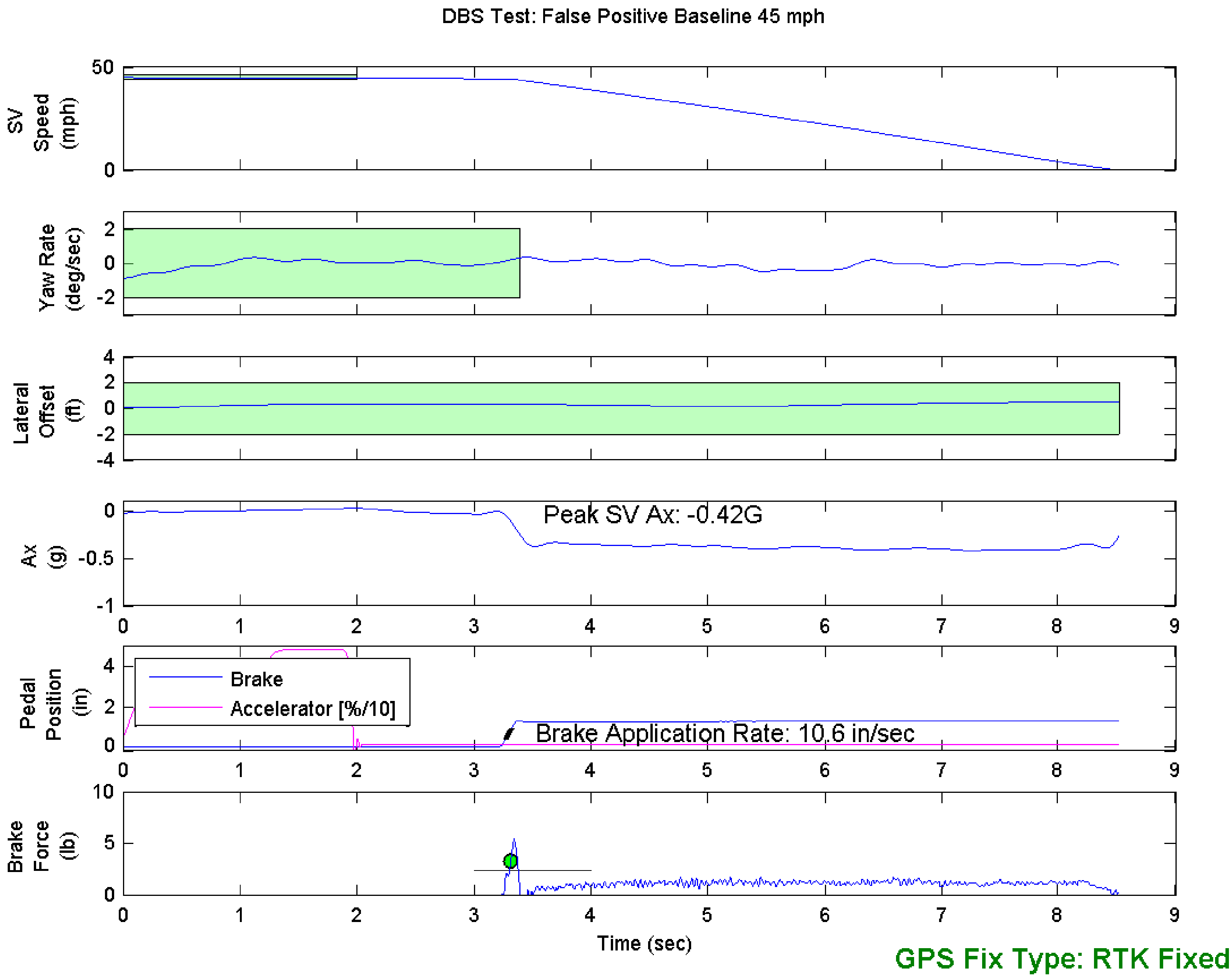


Figure E6. Example Time History for False Positive Baseline 45, Passing

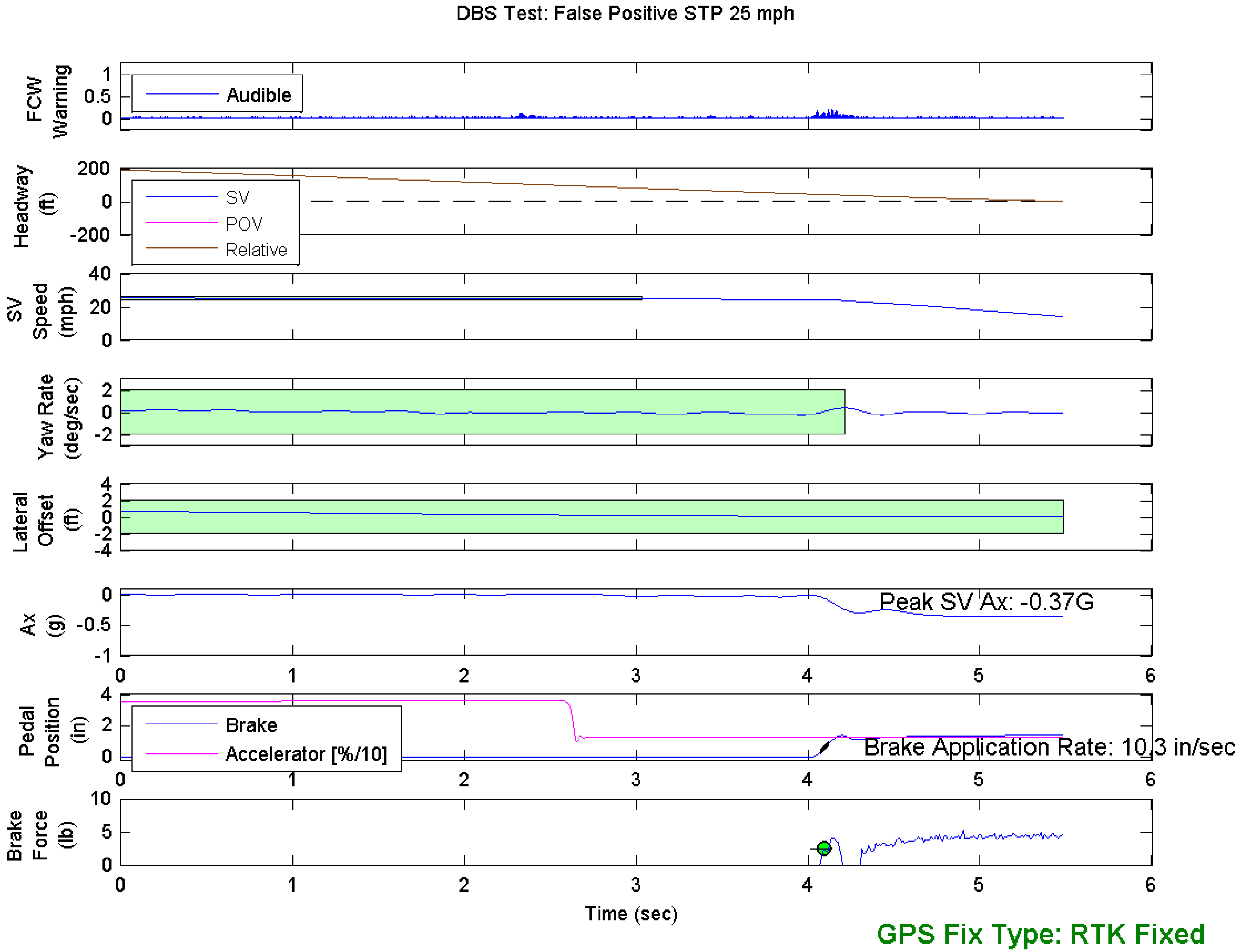


Figure E7. Example Time History for False Positive Steel Plate 25, Passing

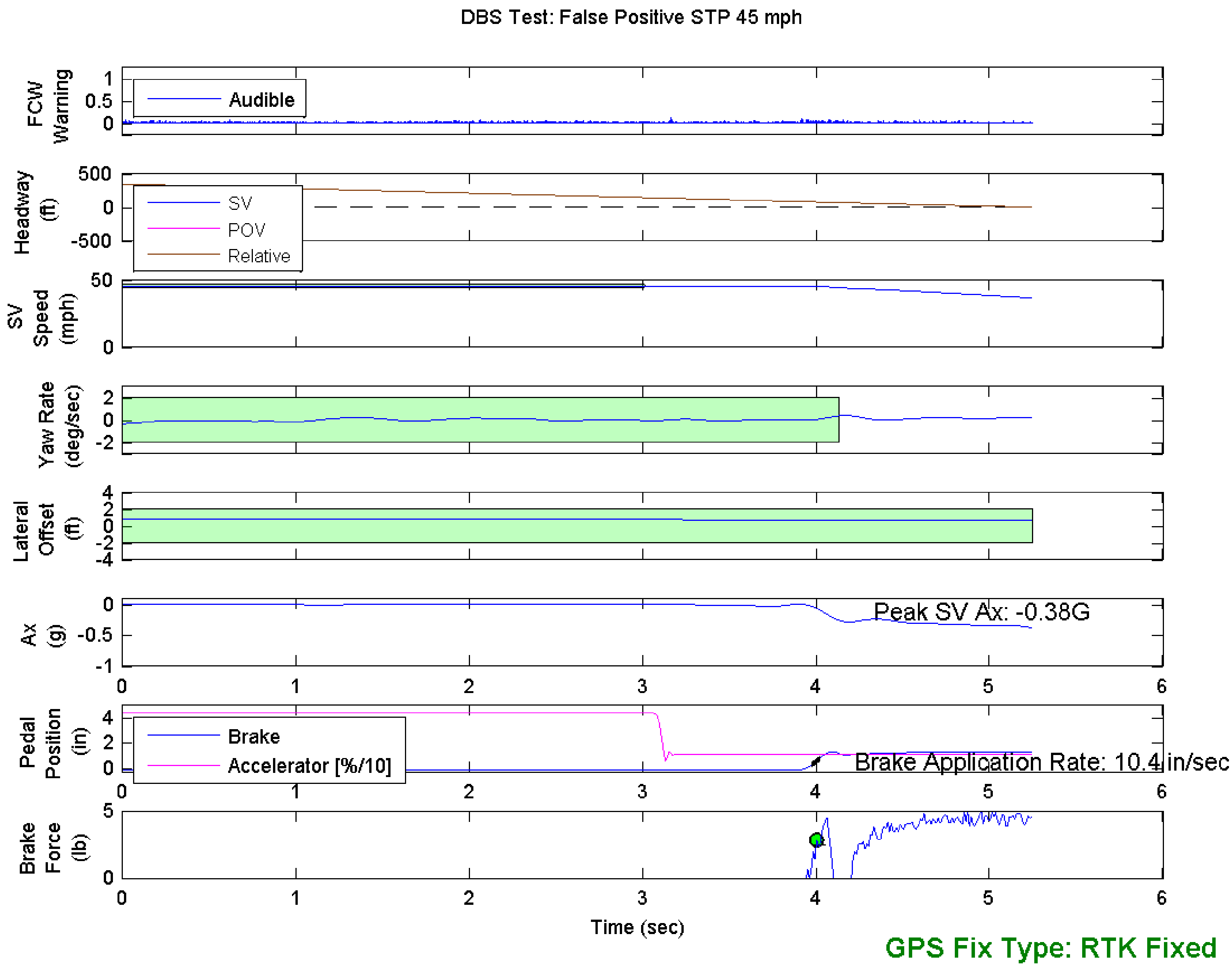


Figure E8. Example Time History for False Positive Steel Plate 45, Passing

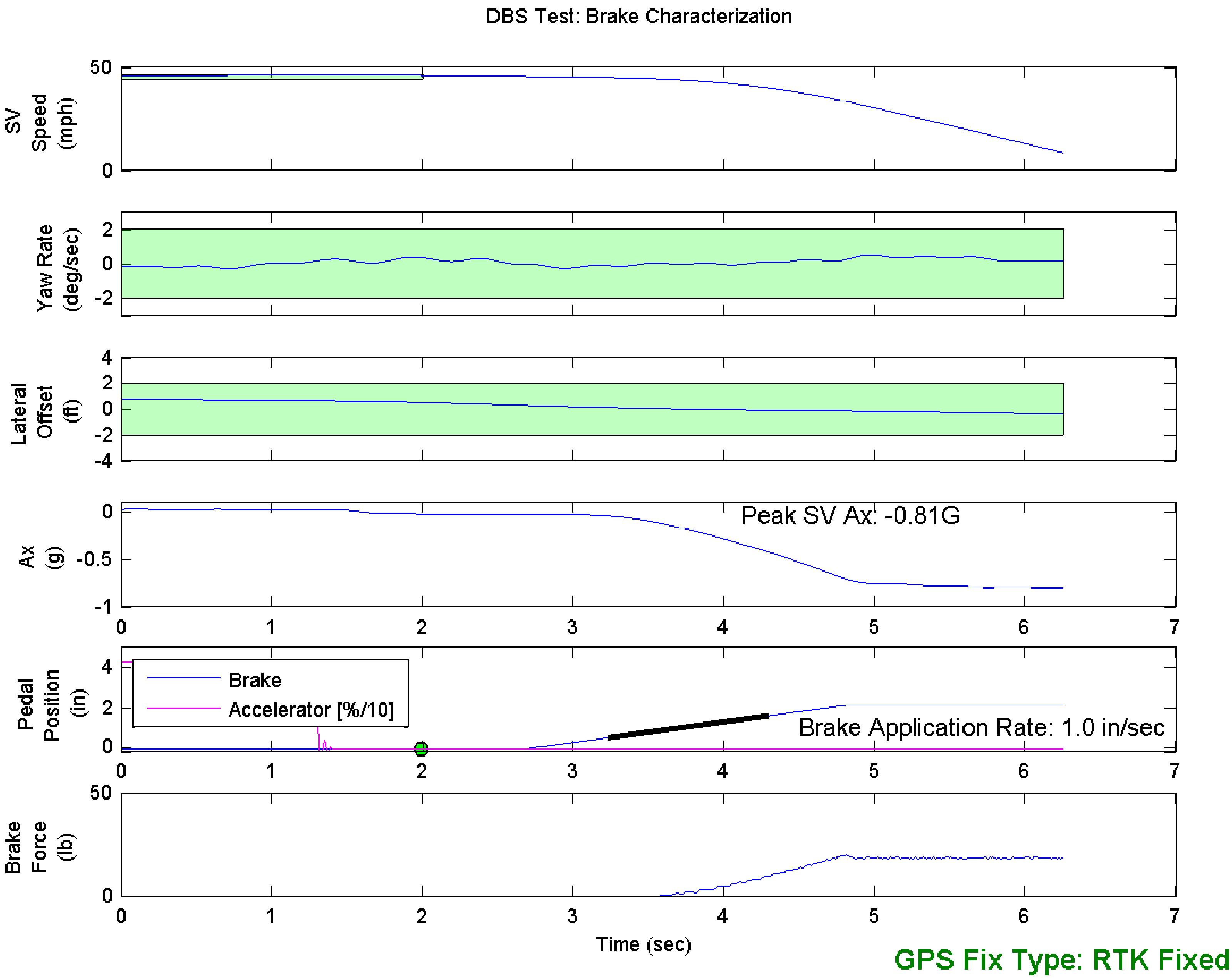


Figure E9. Example Time History for DBS Brake Characterization, Passing

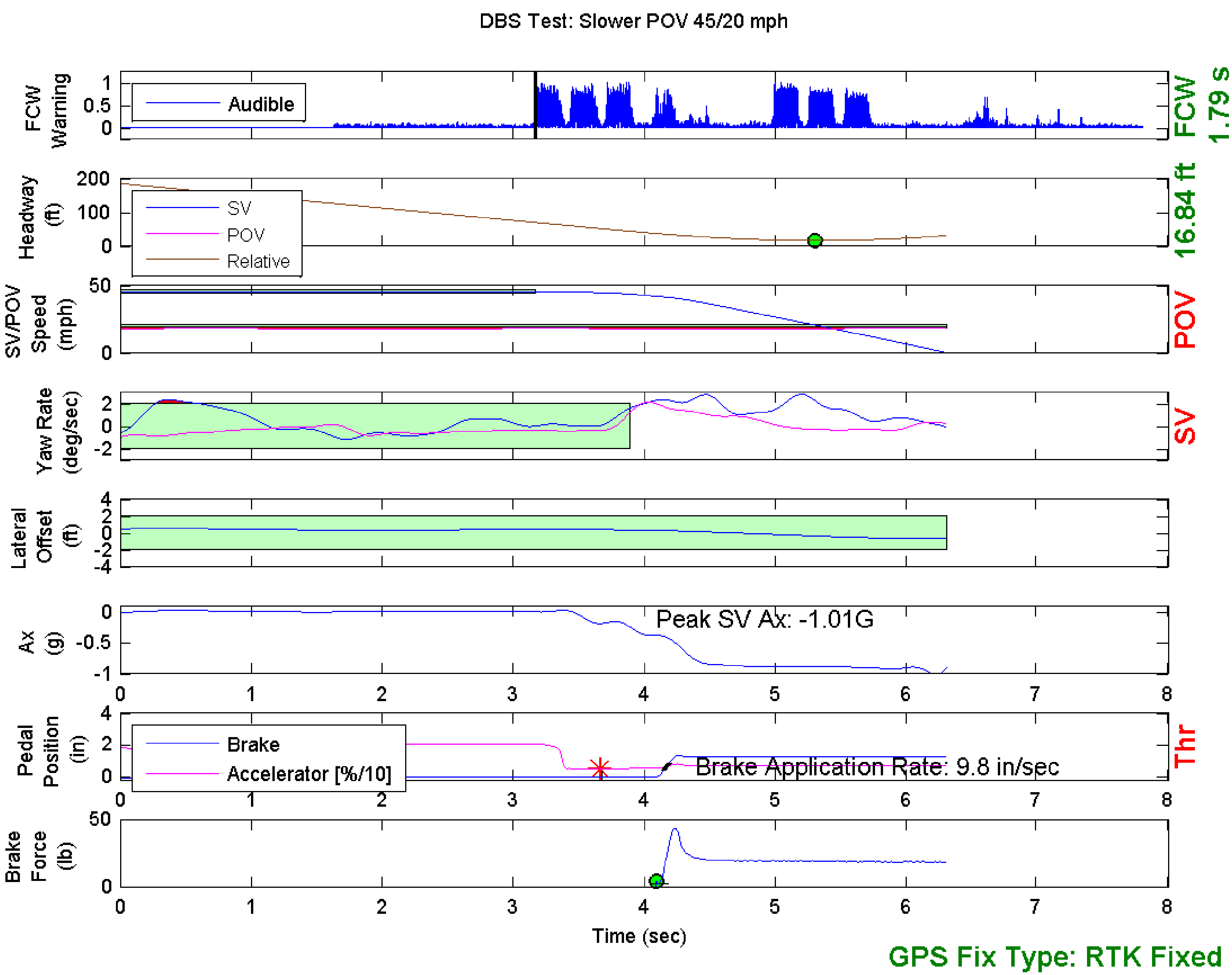


Figure E10. Example Time History Displaying Various Invalid Criteria

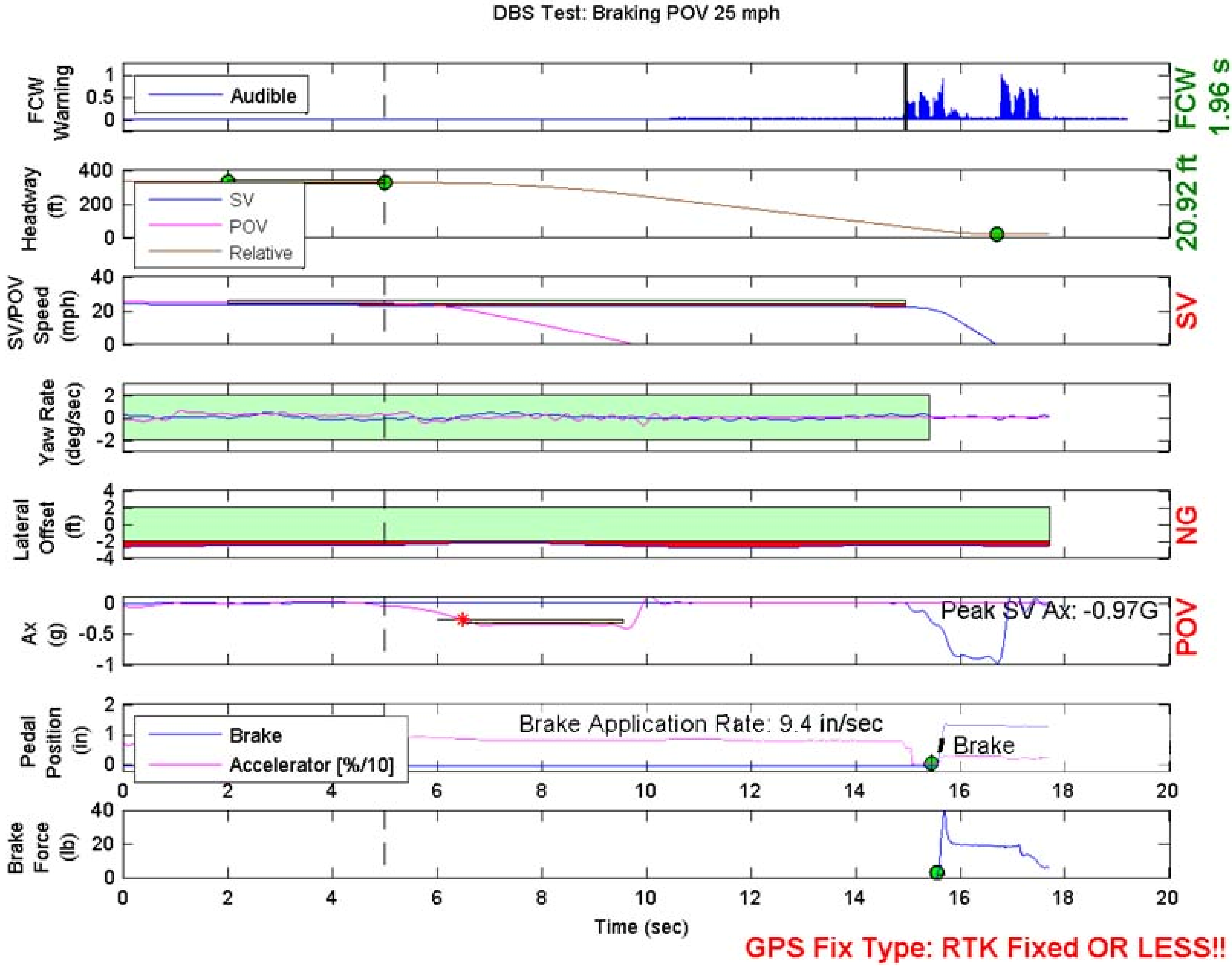


Figure E11. Example Time History Displaying Various Invalid Criteria

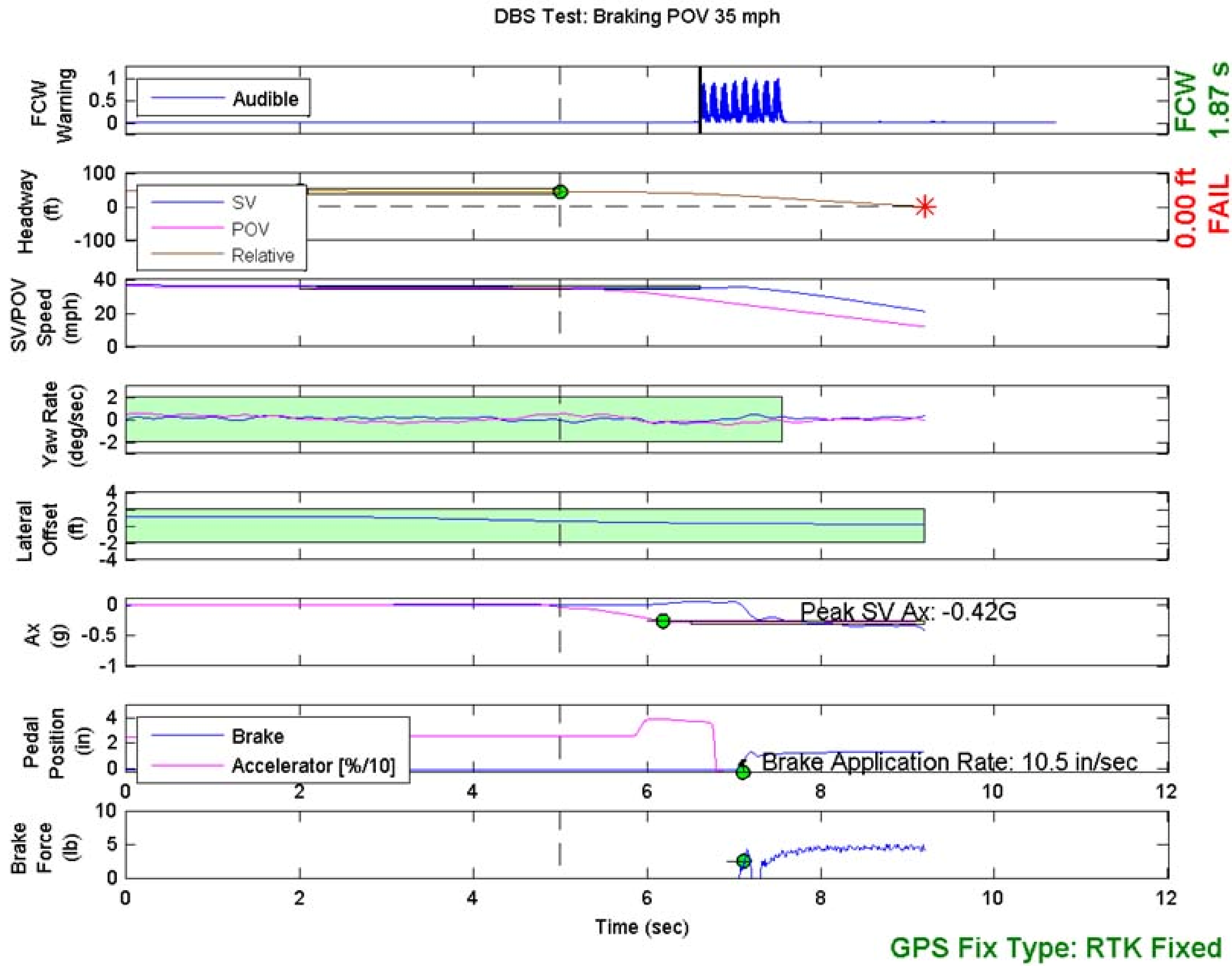


Figure E12. Example Time History for a Failed Run

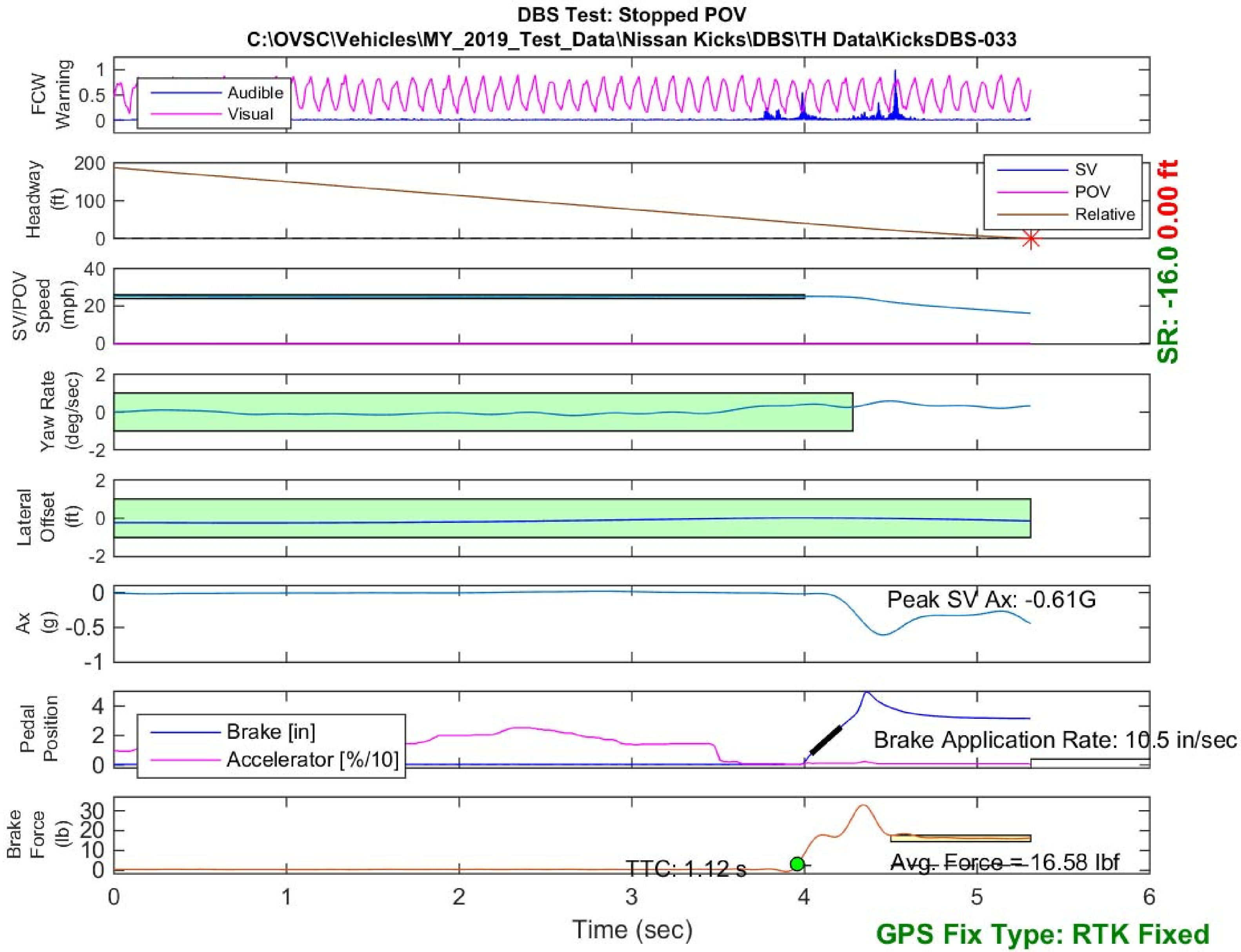


Figure E13. Time History for DBS Run 33, SV Encounters Stopped POV

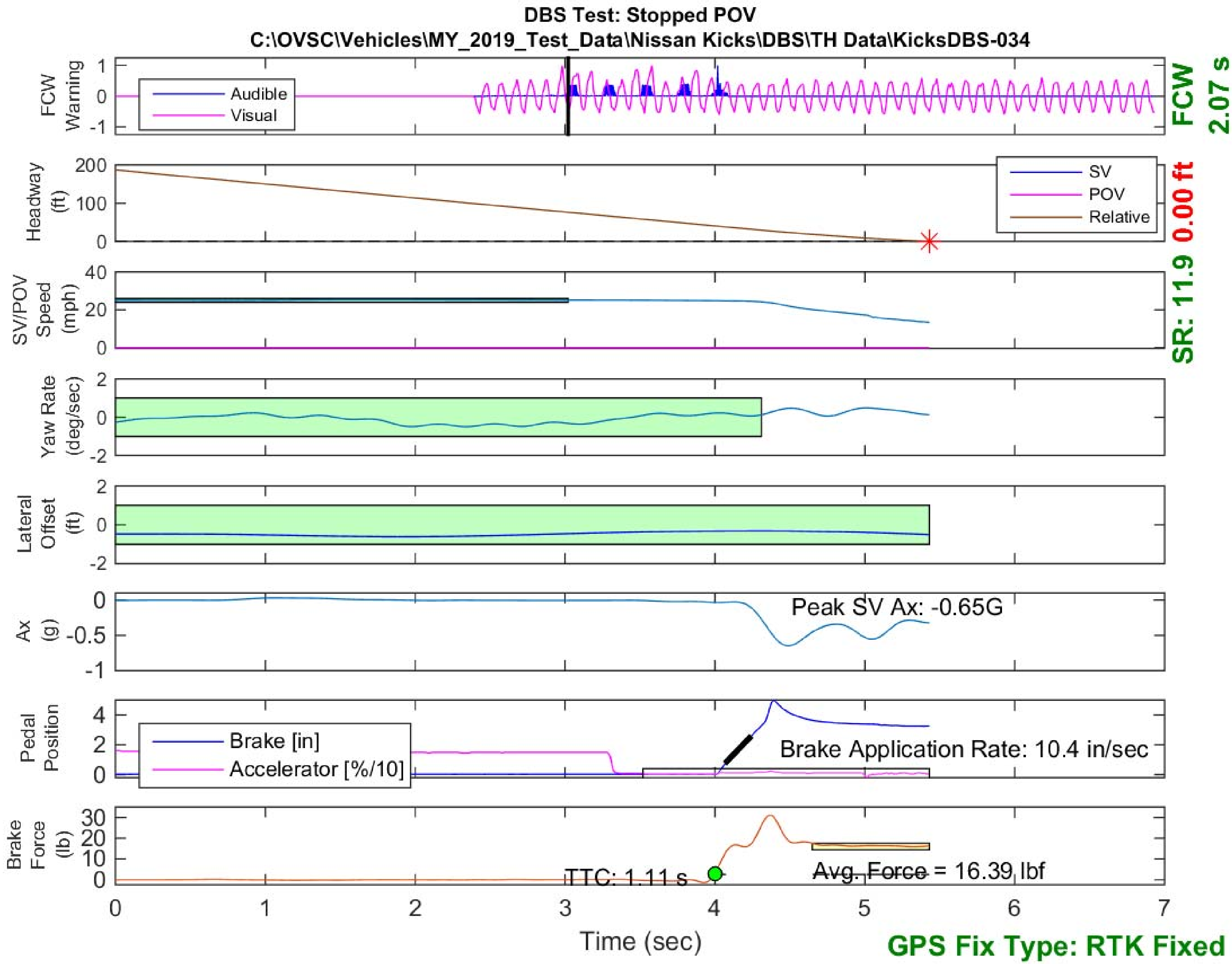


Figure E14. Time History for DBS Run 34, SV Encounters Stopped POV

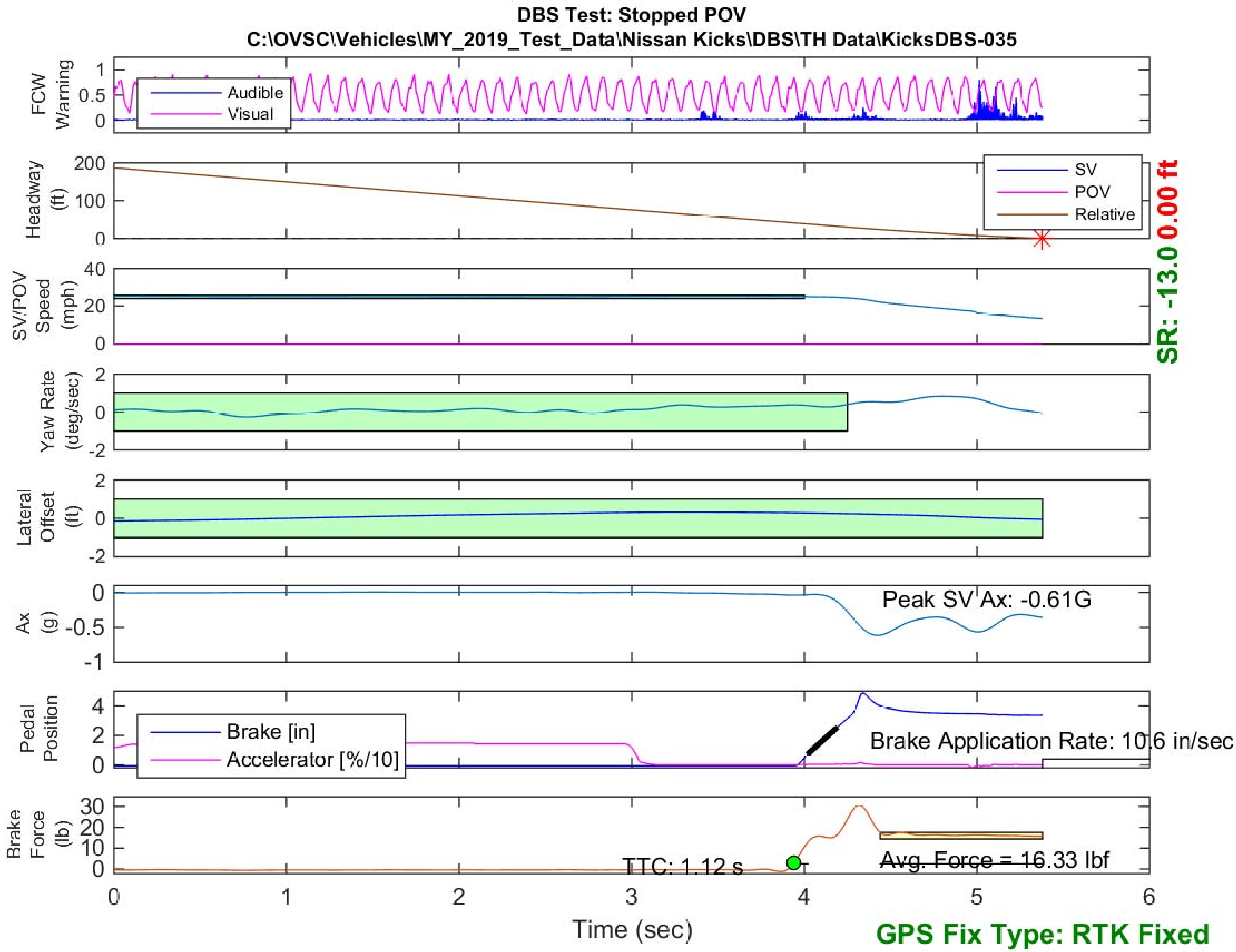


Figure E15. Time History for DBS Run 35, SV Encounters Stopped POV

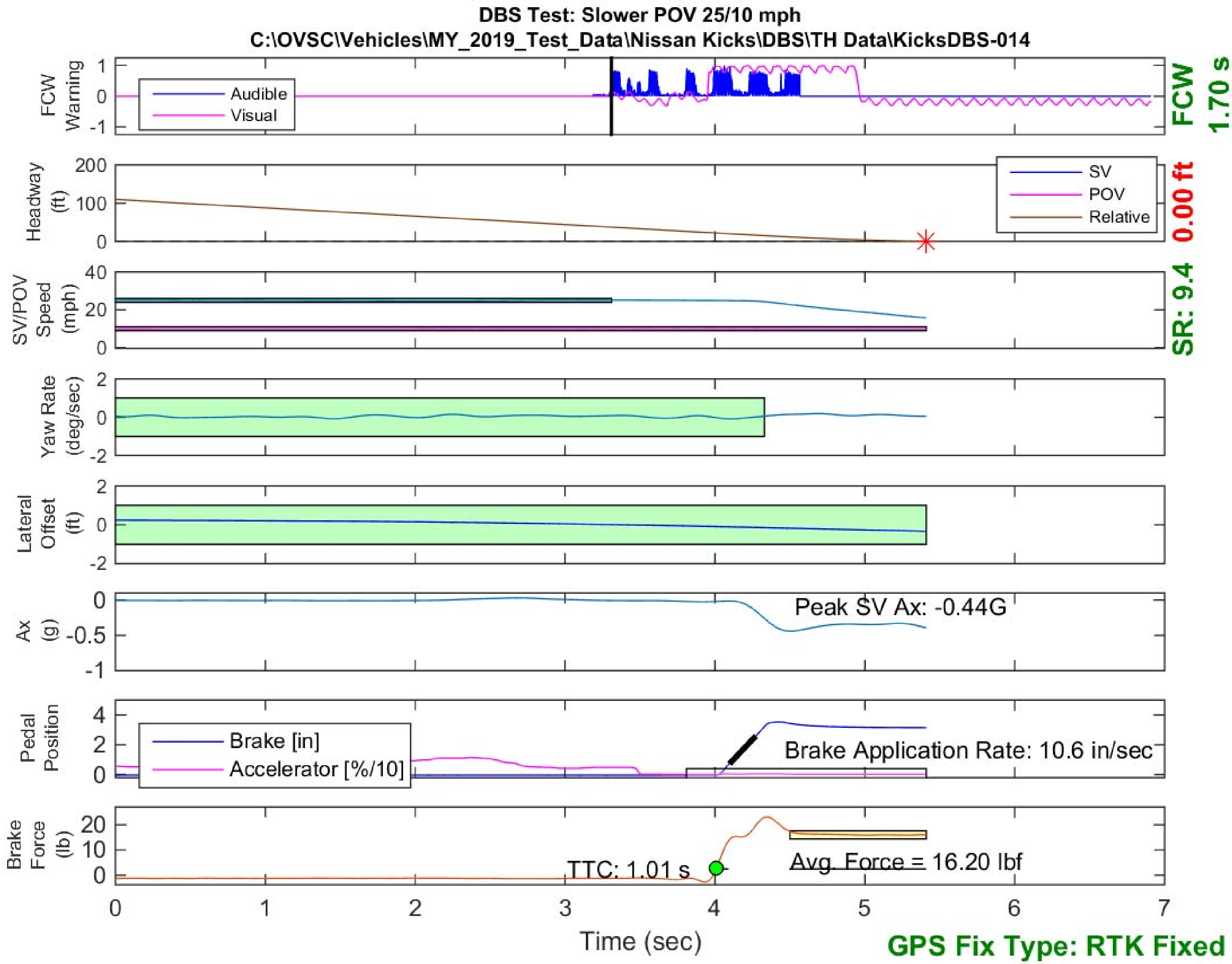


Figure E16. Time History for DBS Run 14, SV Encounters Slower POV, SV 25 mph, POV 10 mph

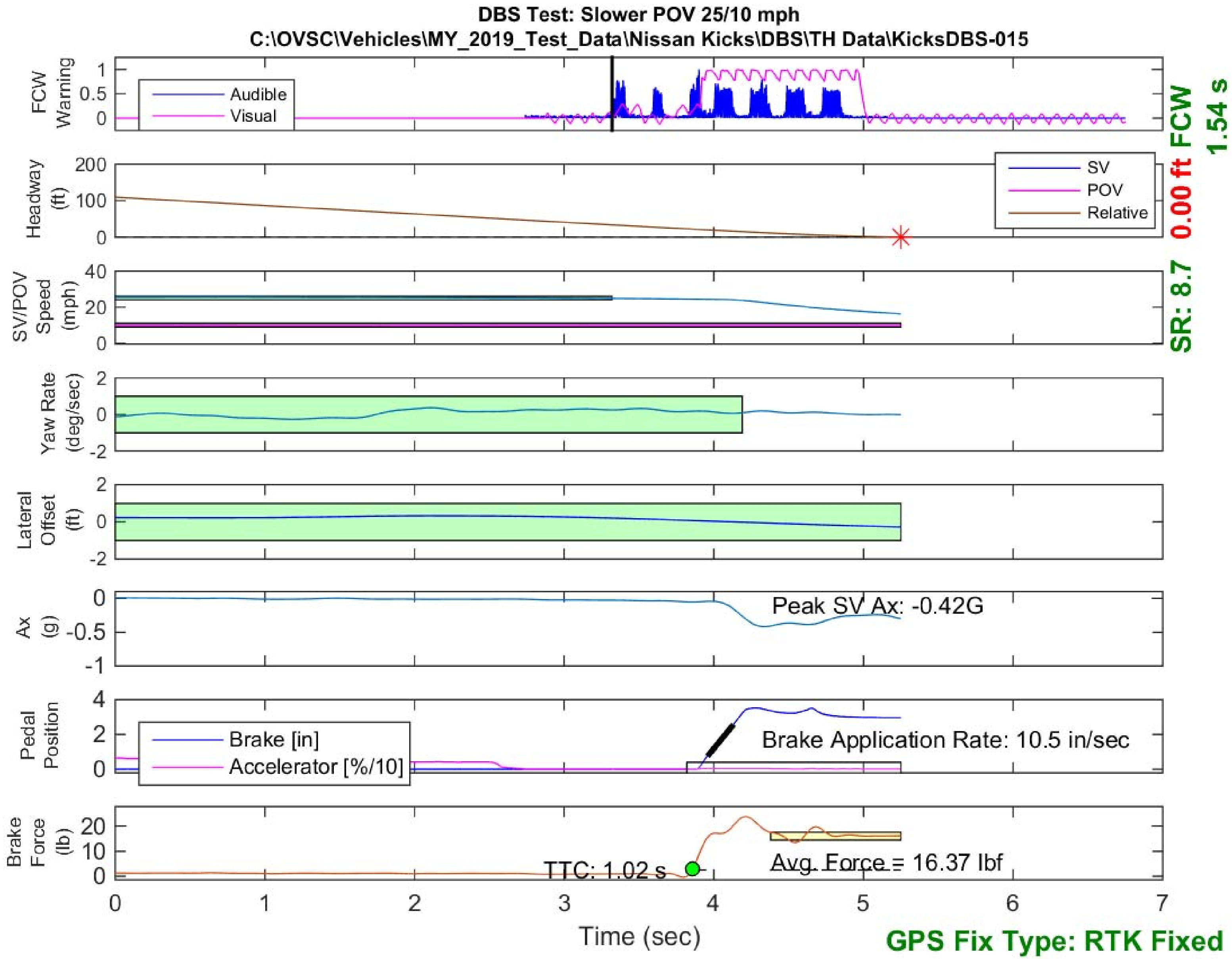


Figure E17. Time History for DBS Run 15, SV Encounters Slower POV, SV 25 mph, POV 10 mph

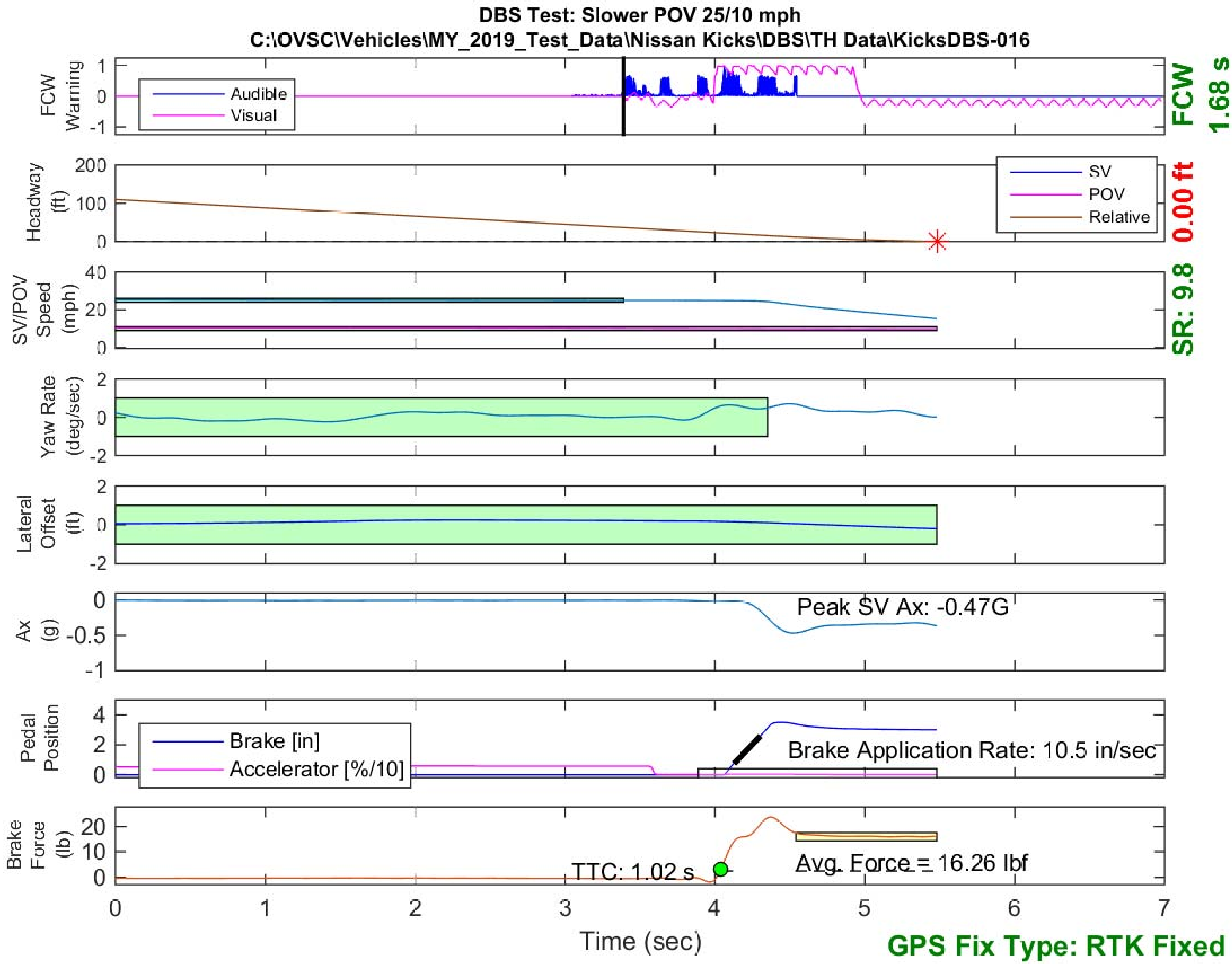


Figure E18. Time History for DBS Run 16, SV Encounters Slower POV, SV 25 mph, POV 10 mph

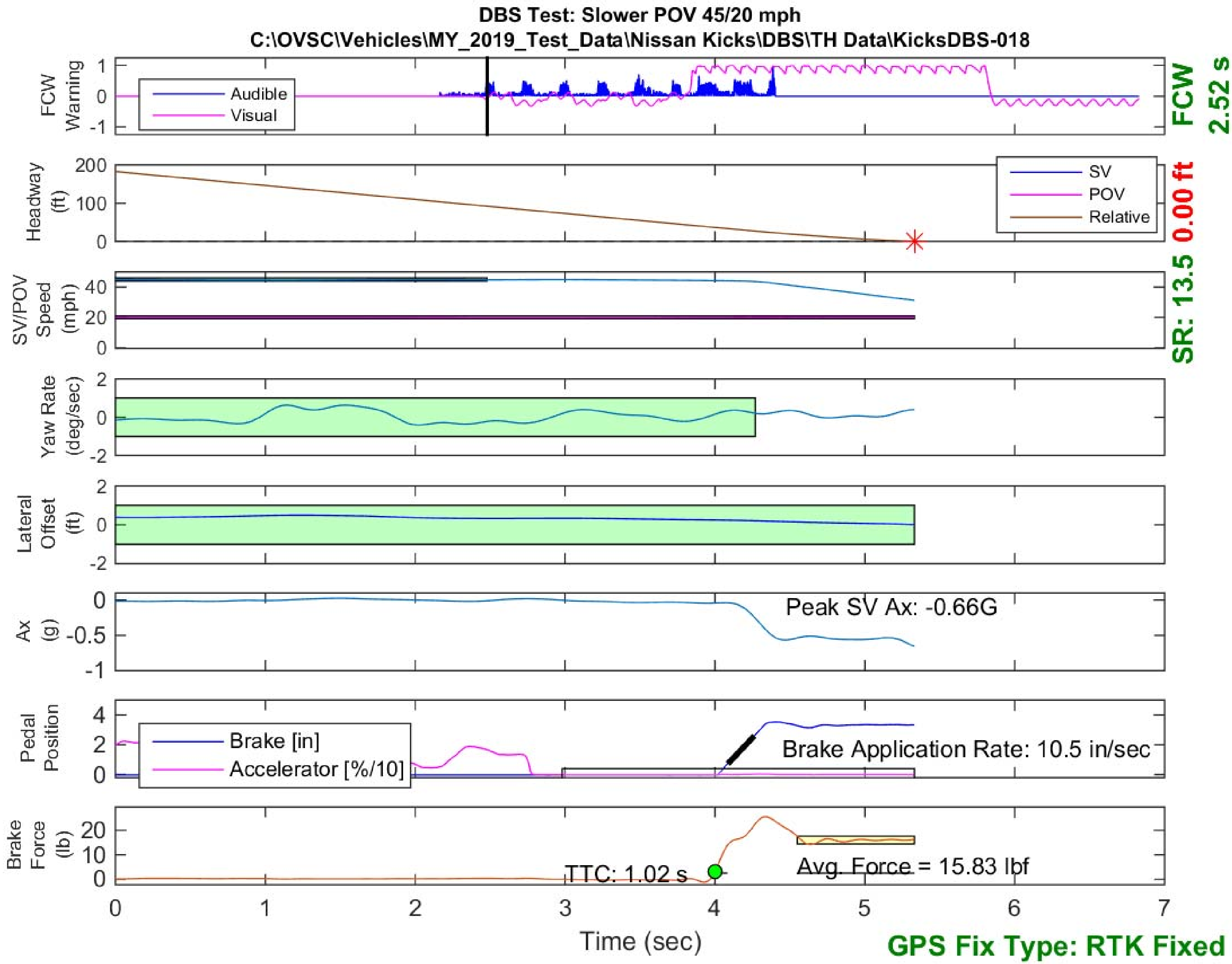


Figure E19. Time History for DBS Run 18, SV Encounters Slower POV, SV 45 mph, POV 20 mph

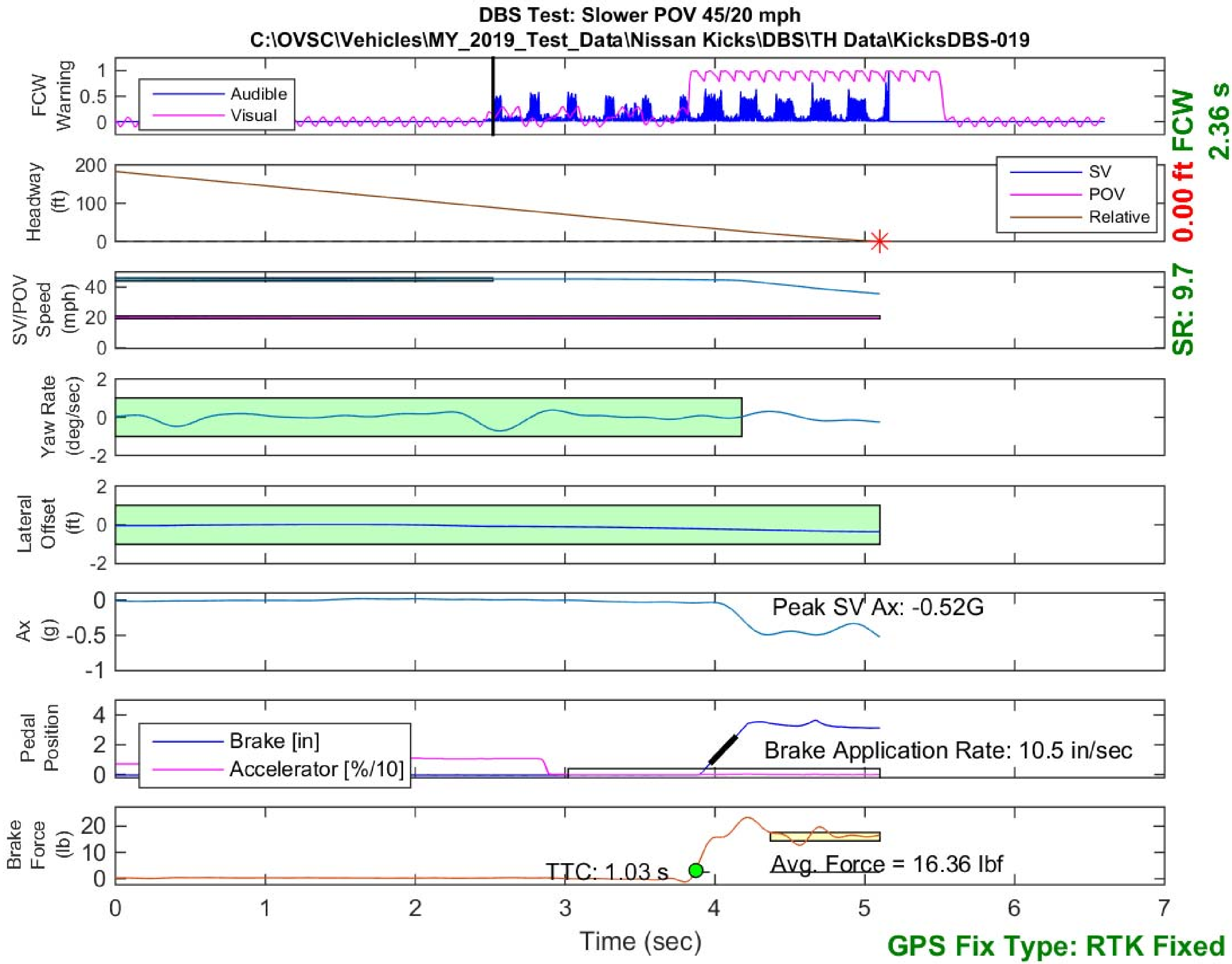


Figure E20. Time History for DBS Run 19, SV Encounters Slower POV, SV 45 mph, POV 20 mph

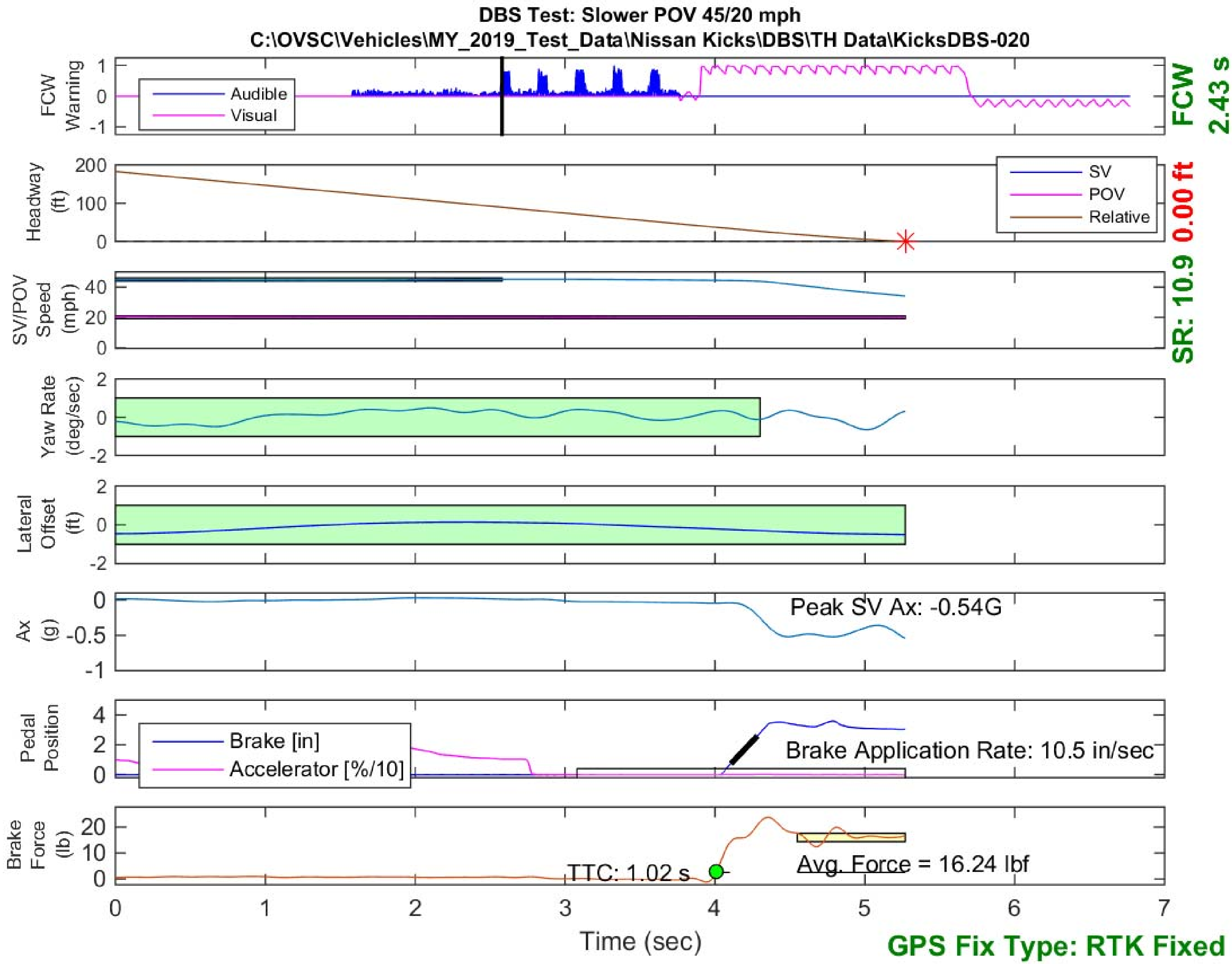


Figure E21. Time History for DBS Run 20, SV Encounters Slower POV, SV 45 mph, POV 20 mph

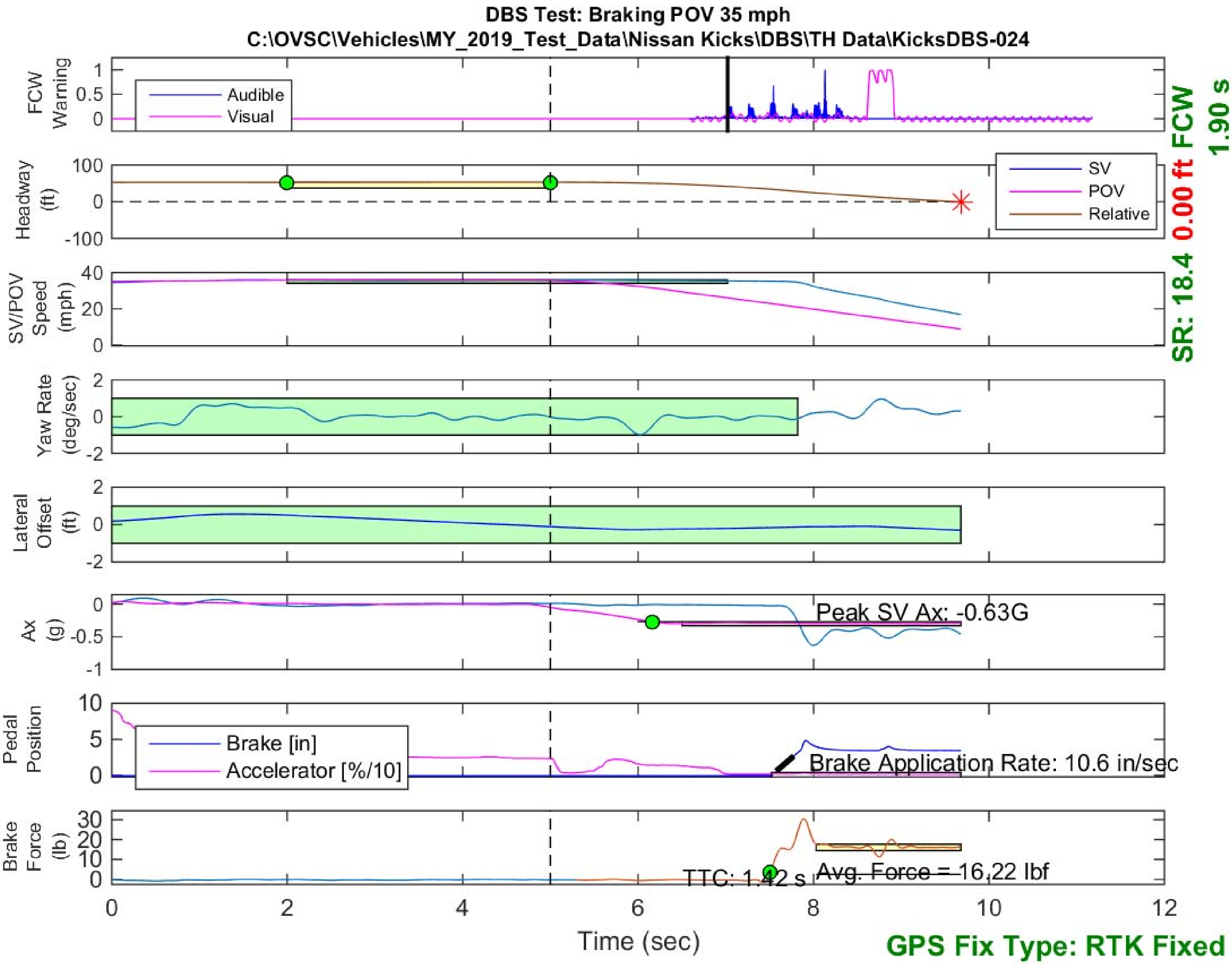


Figure E22. Time History for DBS Run 24, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

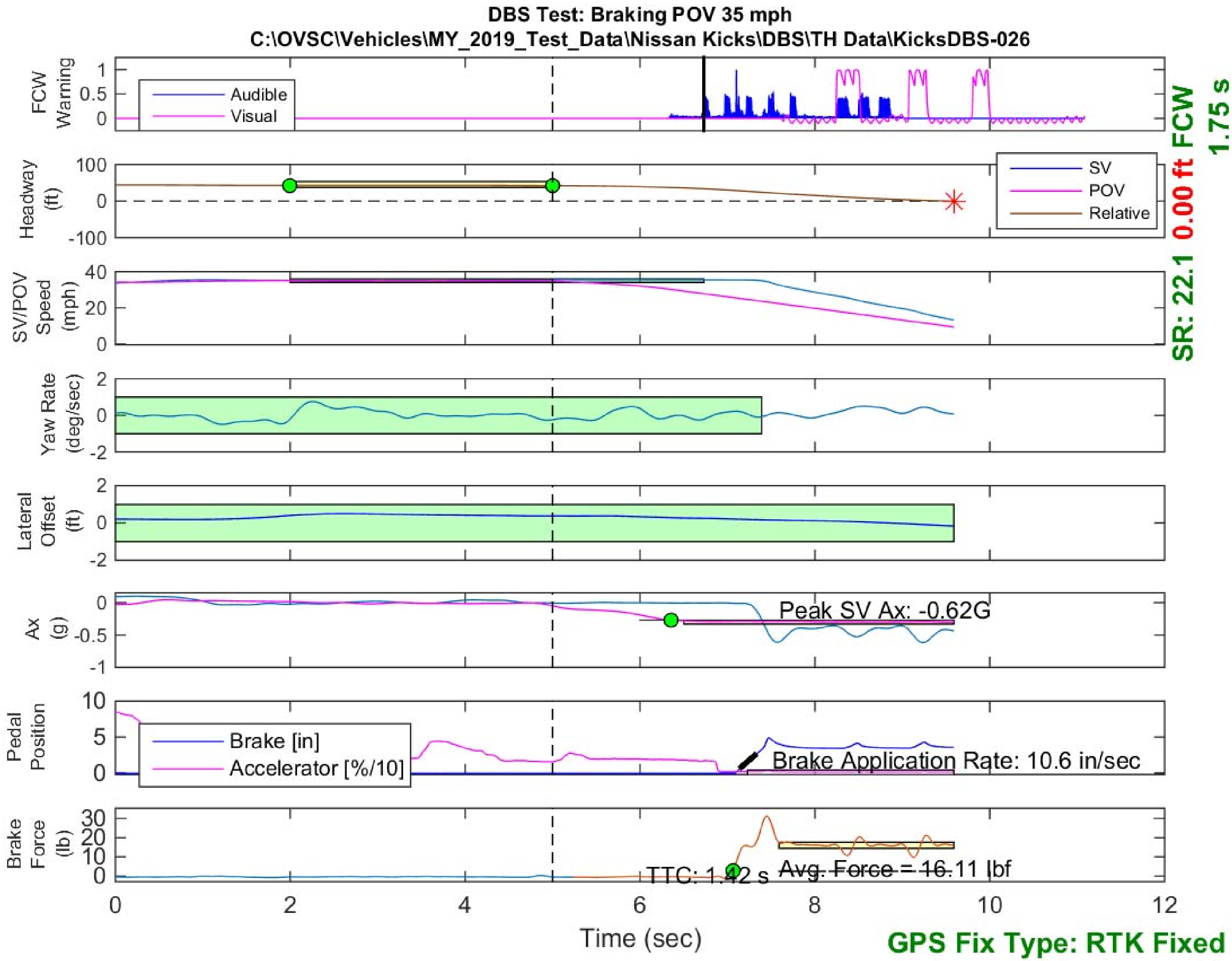


Figure E23. Time History for DBS Run 26, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

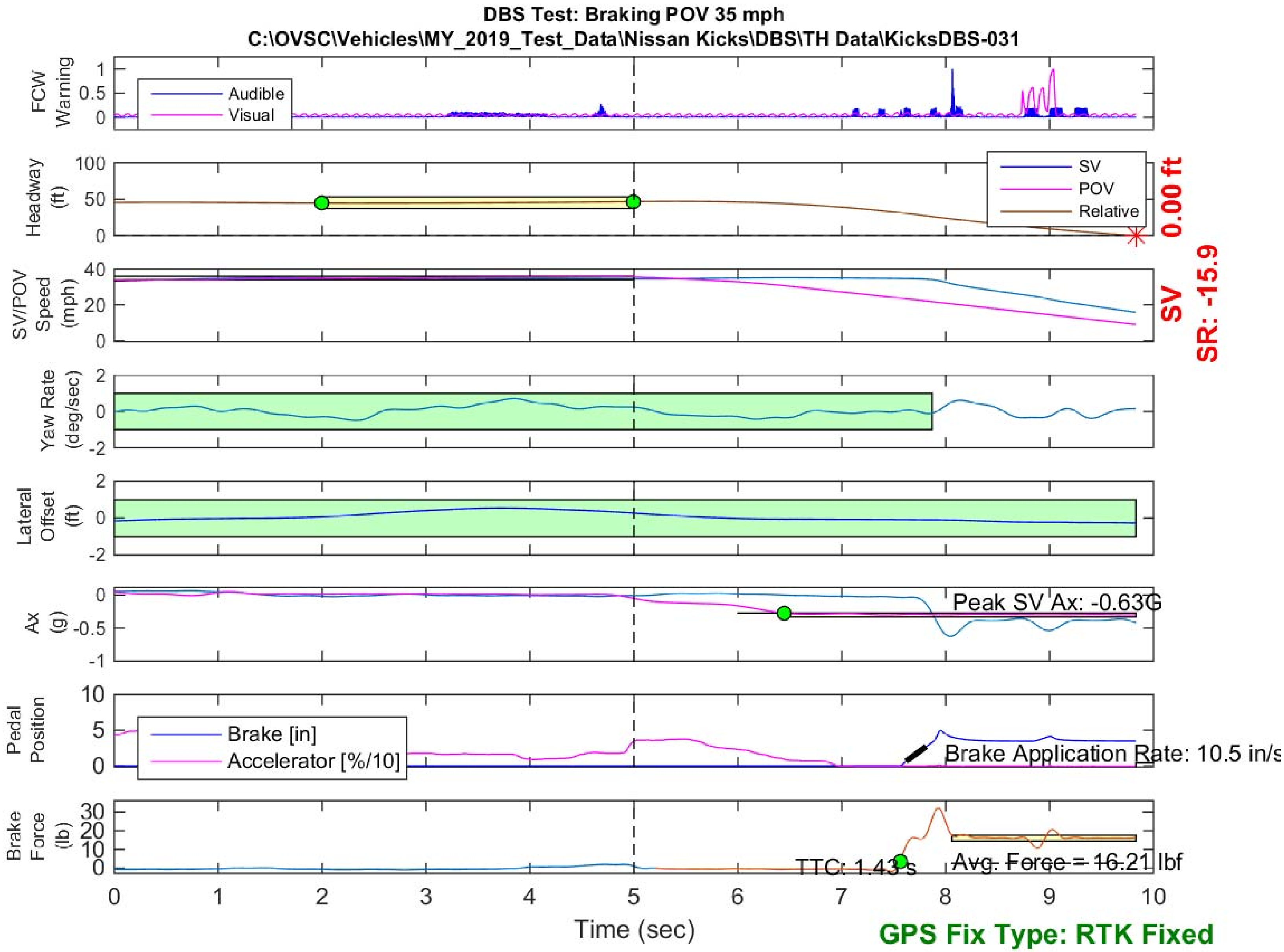


Figure E24. Time History for DBS Run 31, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

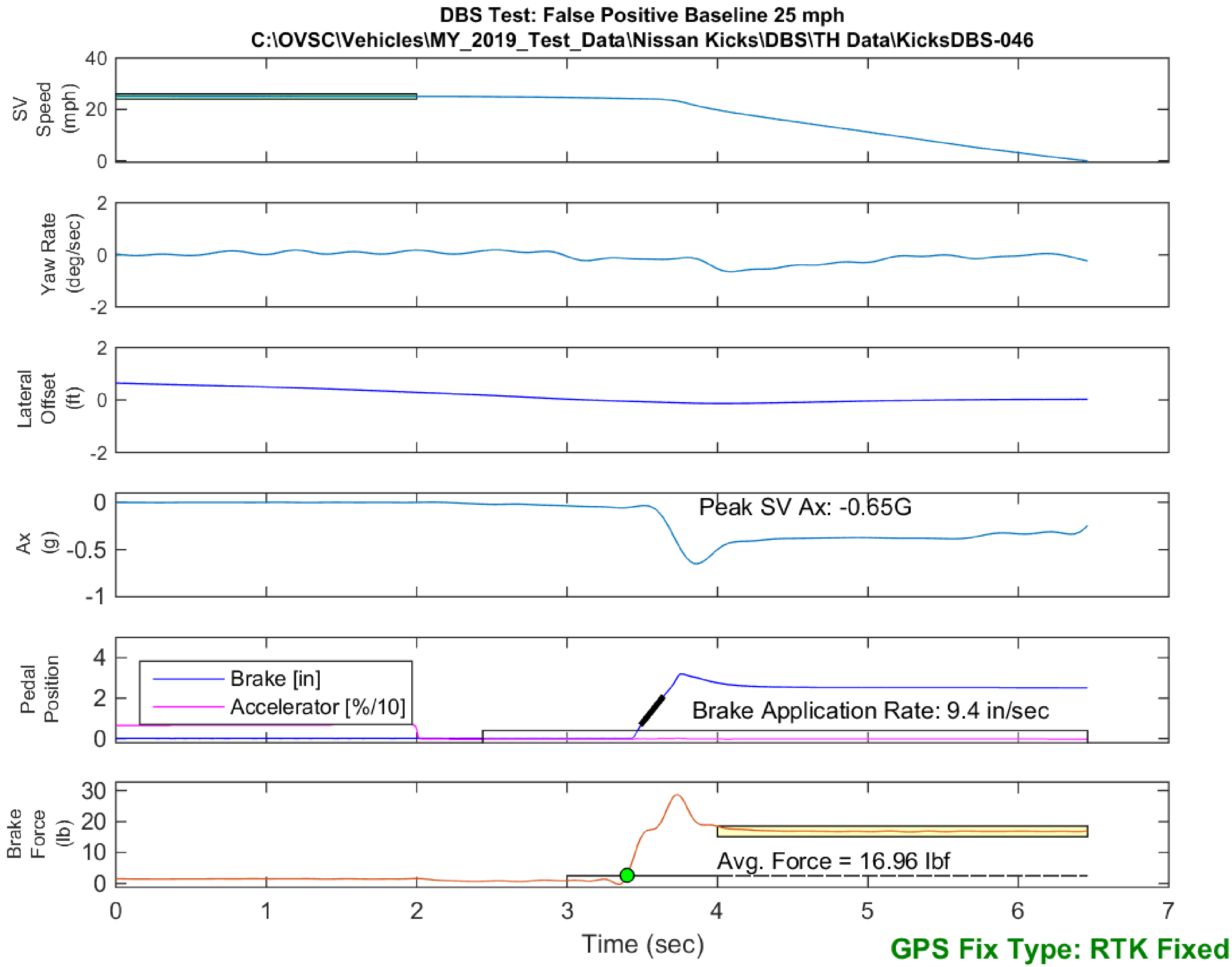


Figure E25. Time History for DBS Run 46, False Positive Baseline, SV 25 mph

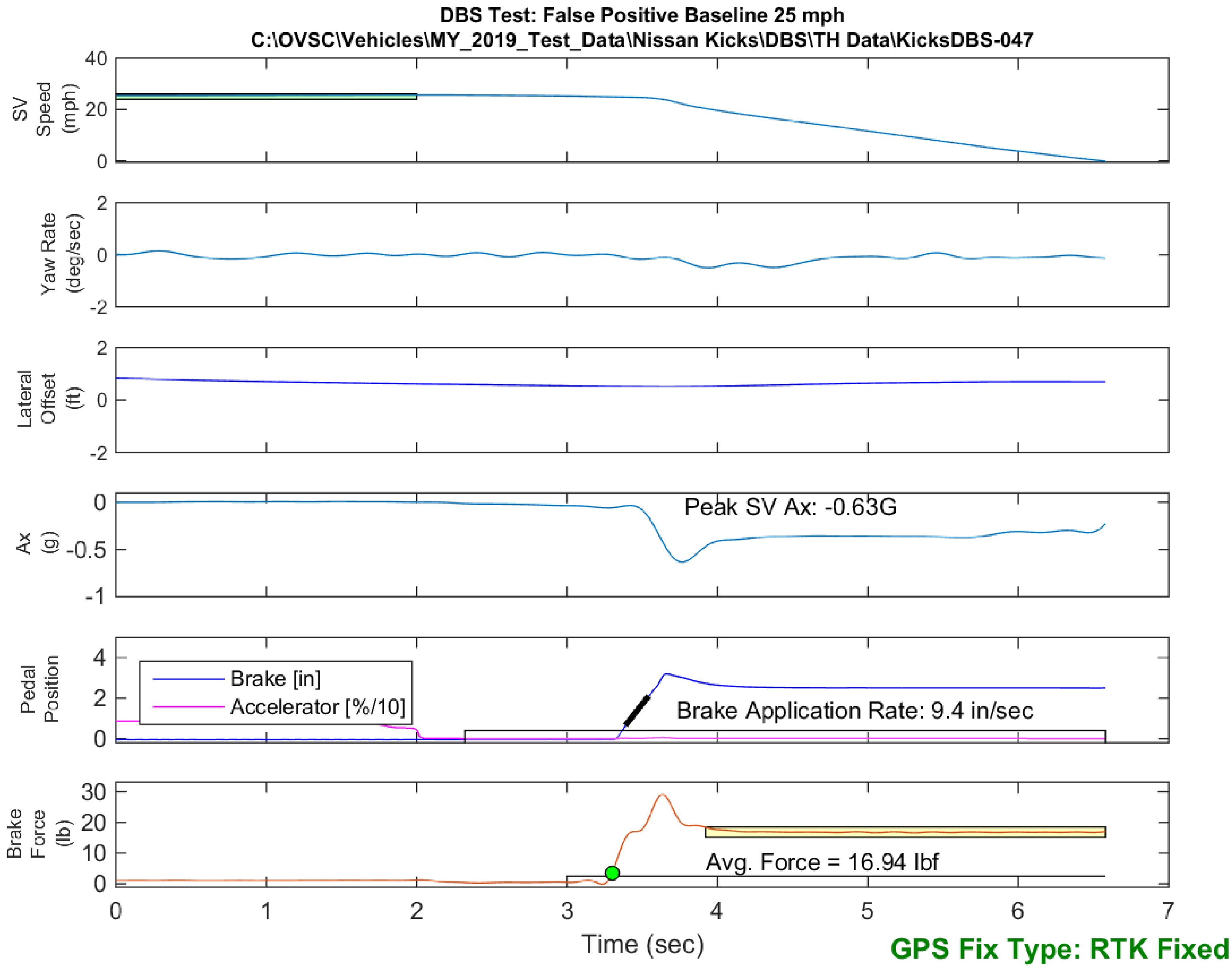


Figure E26. Time History for DBS Run 47, False Positive Baseline, SV 25 mph

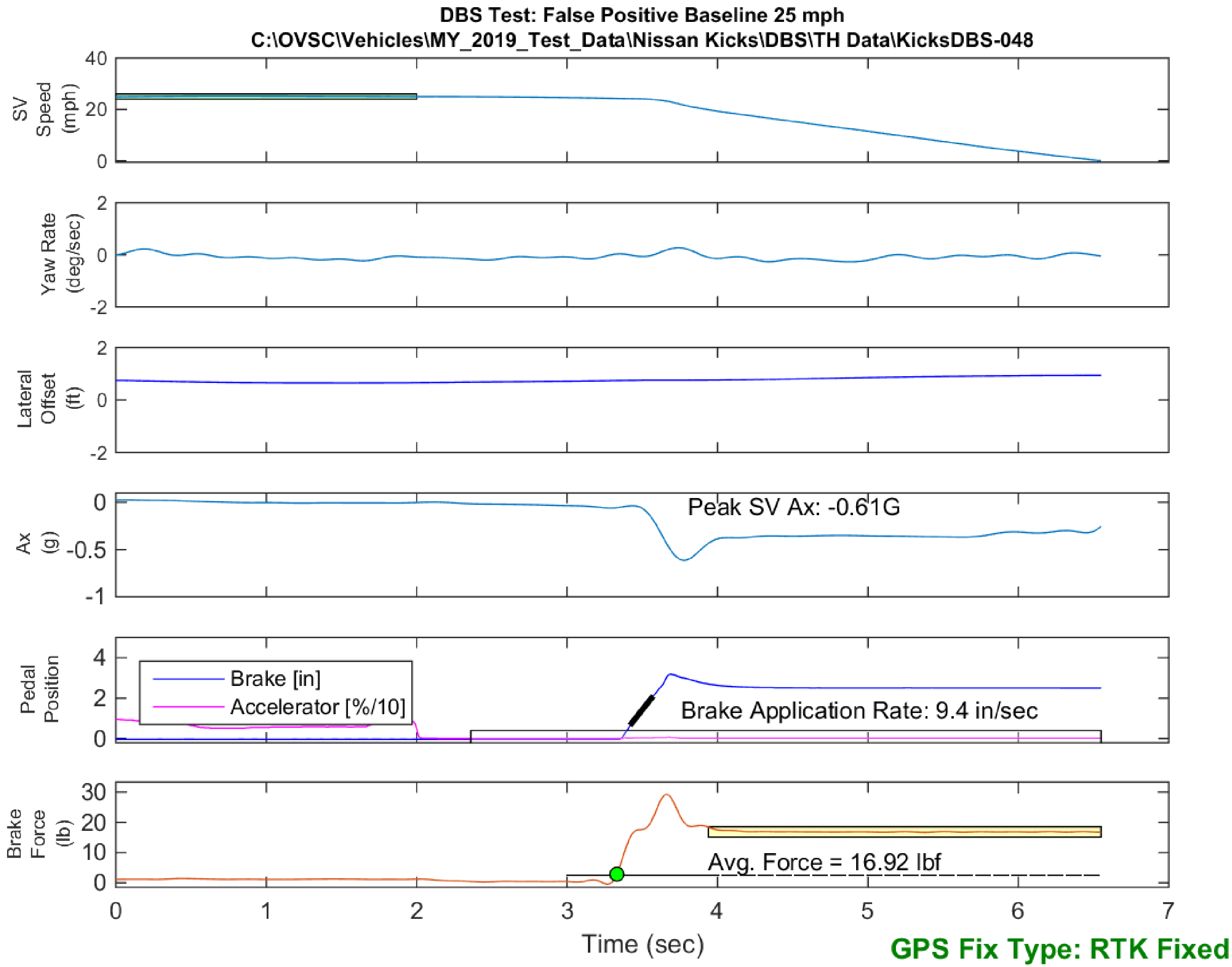


Figure E27. Time History for DBS Run 48, False Positive Baseline, SV 25 mph

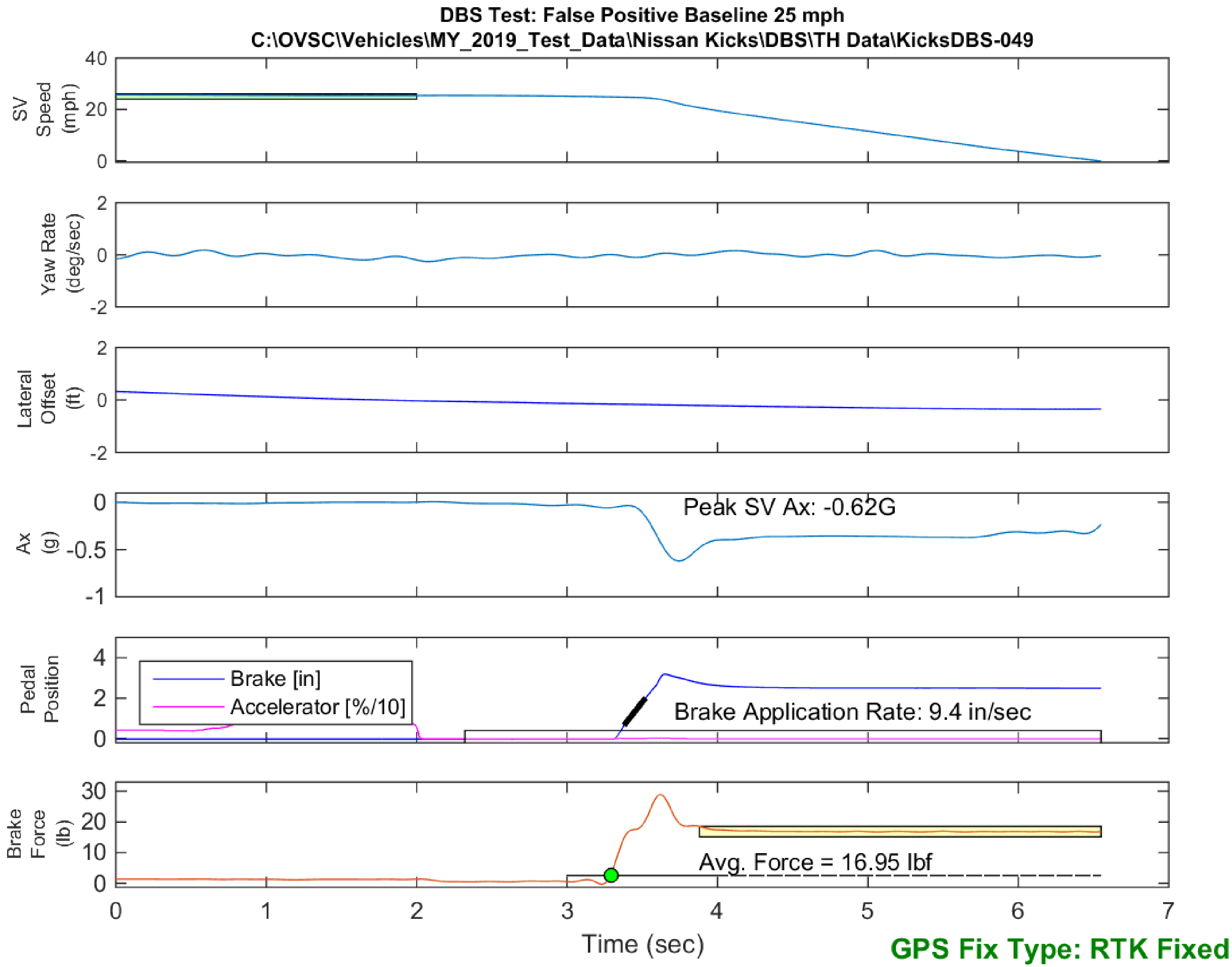


Figure E28. Time History for DBS Run 49, False Positive Baseline, SV 25 mph

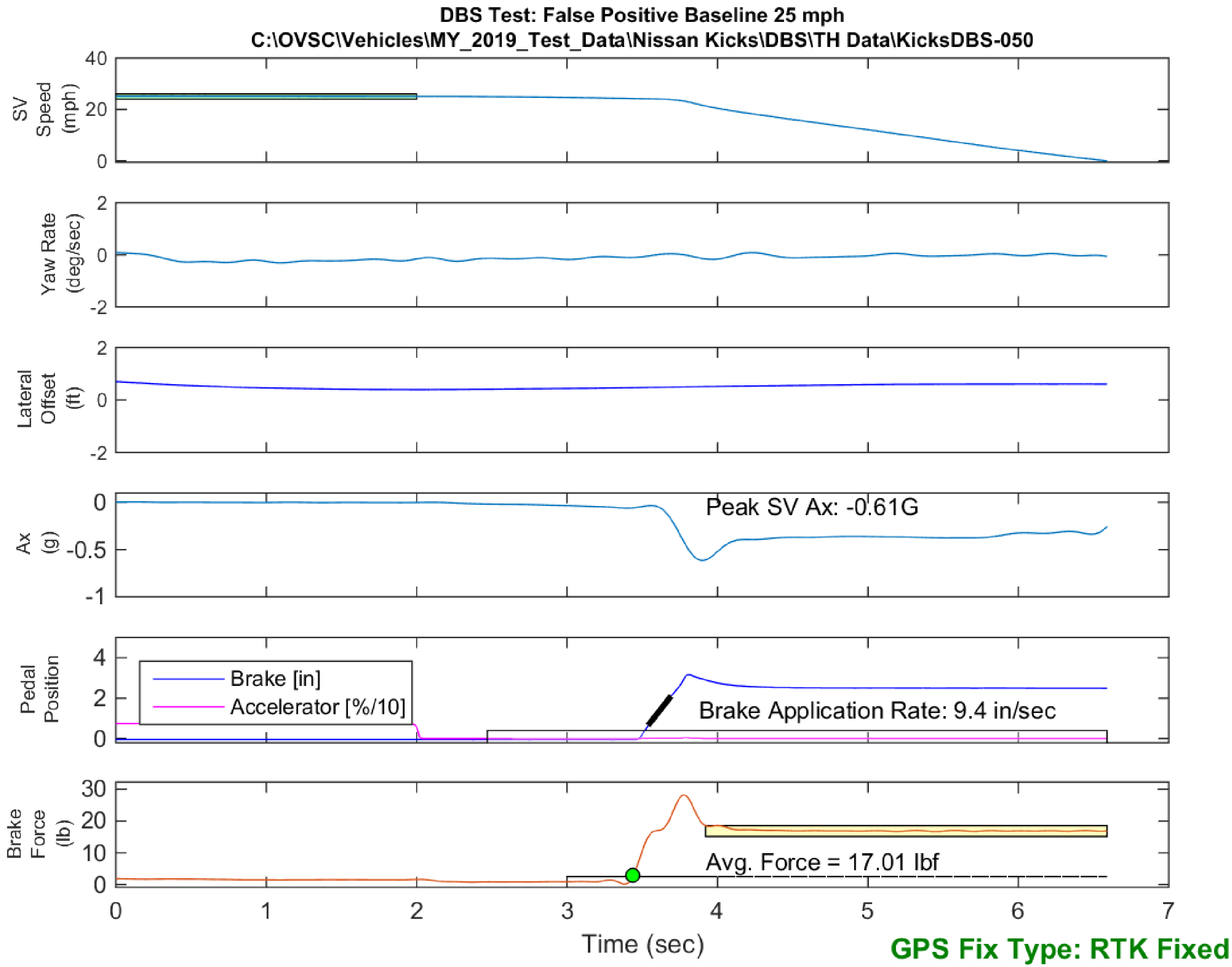


Figure E29. Time History for DBS Run 50, False Positive Baseline, SV 25 mph

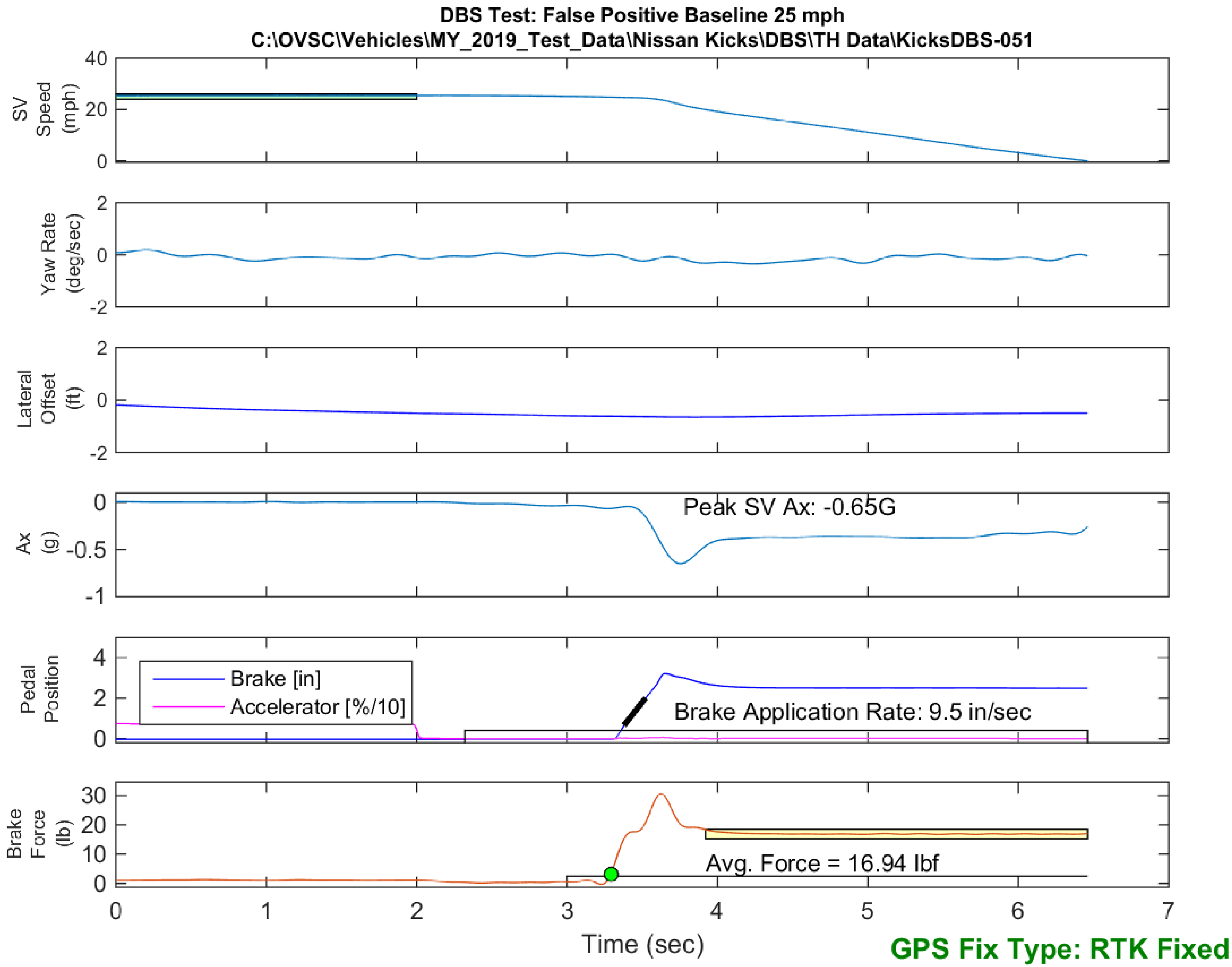


Figure E30. Time History for DBS Run 51, False Positive Baseline, SV 25 mph

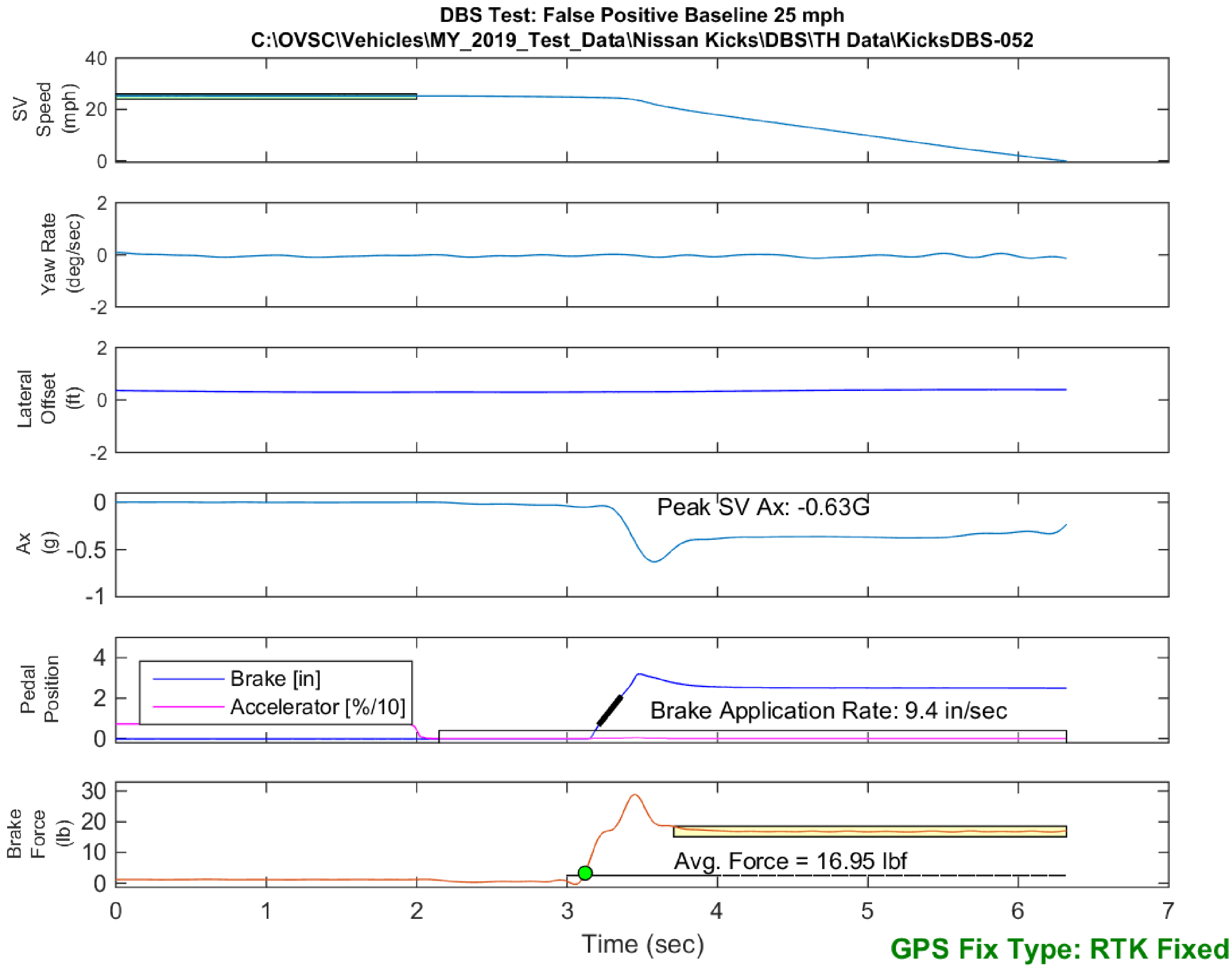


Figure E31. Time History for DBS Run 52, False Positive Baseline, SV 25 mph

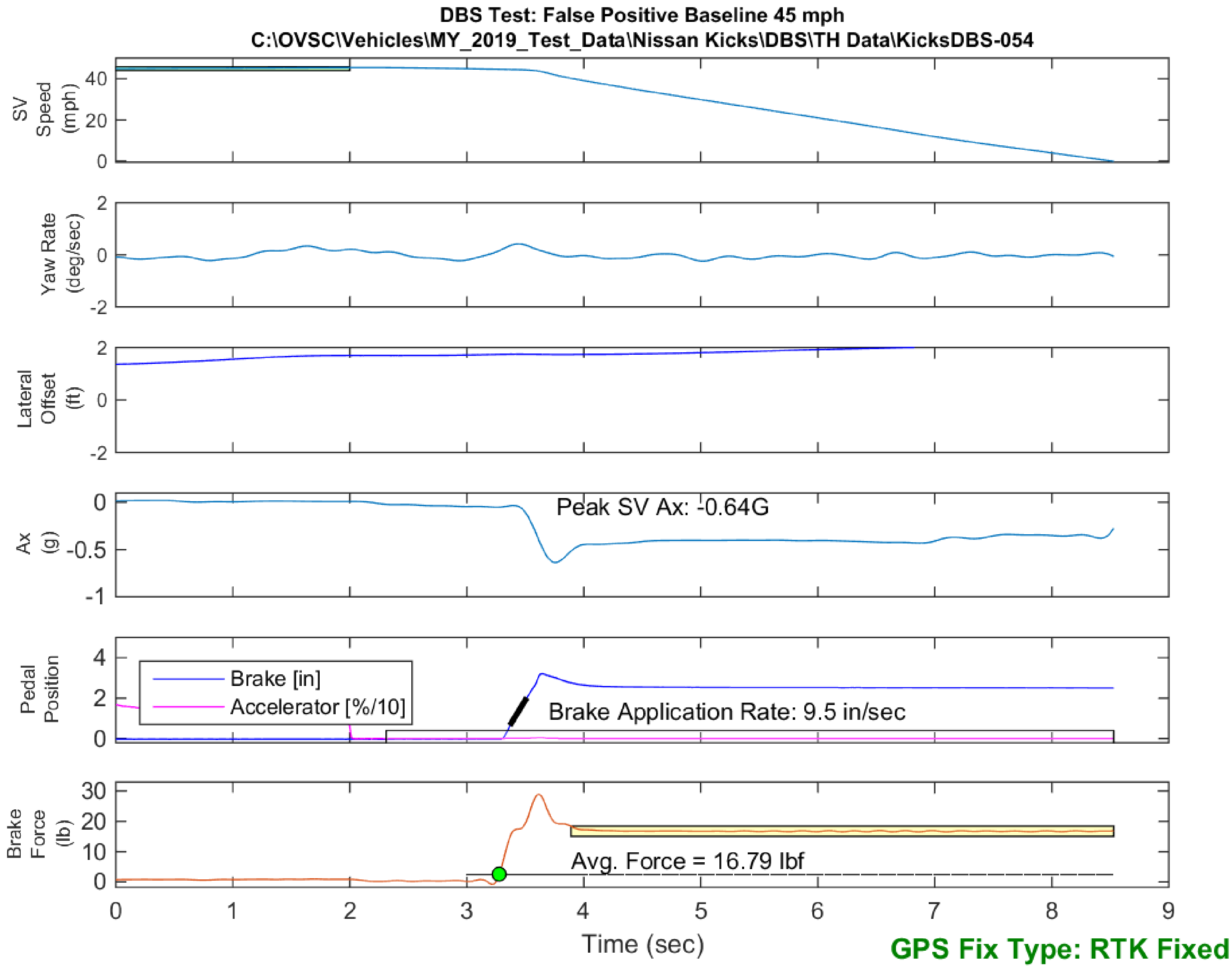


Figure E32. Time History for DBS Run 54, False Positive Baseline, SV 45 mph

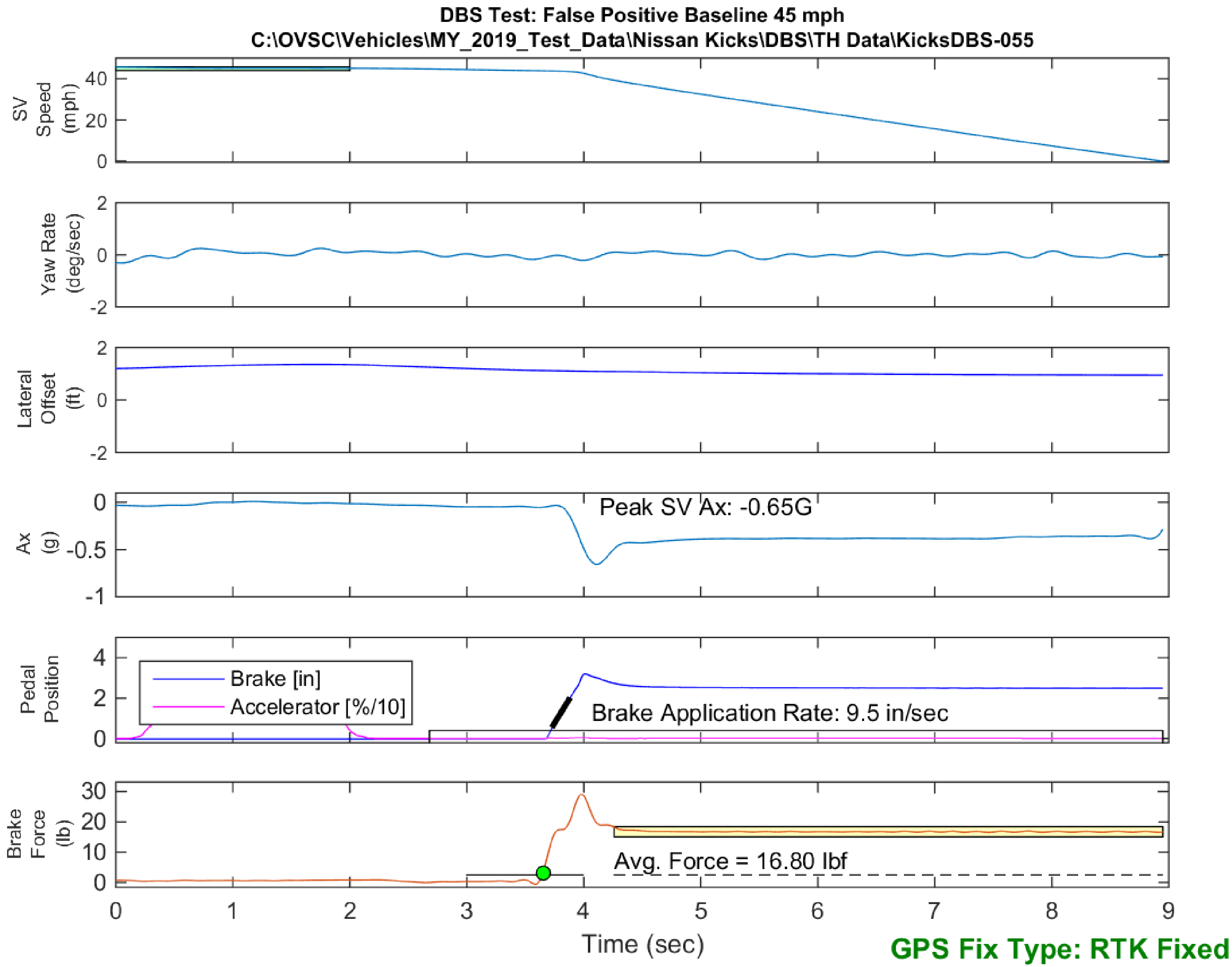


Figure E33. Time History for DBS Run 55, False Positive Baseline, SV 45 mph

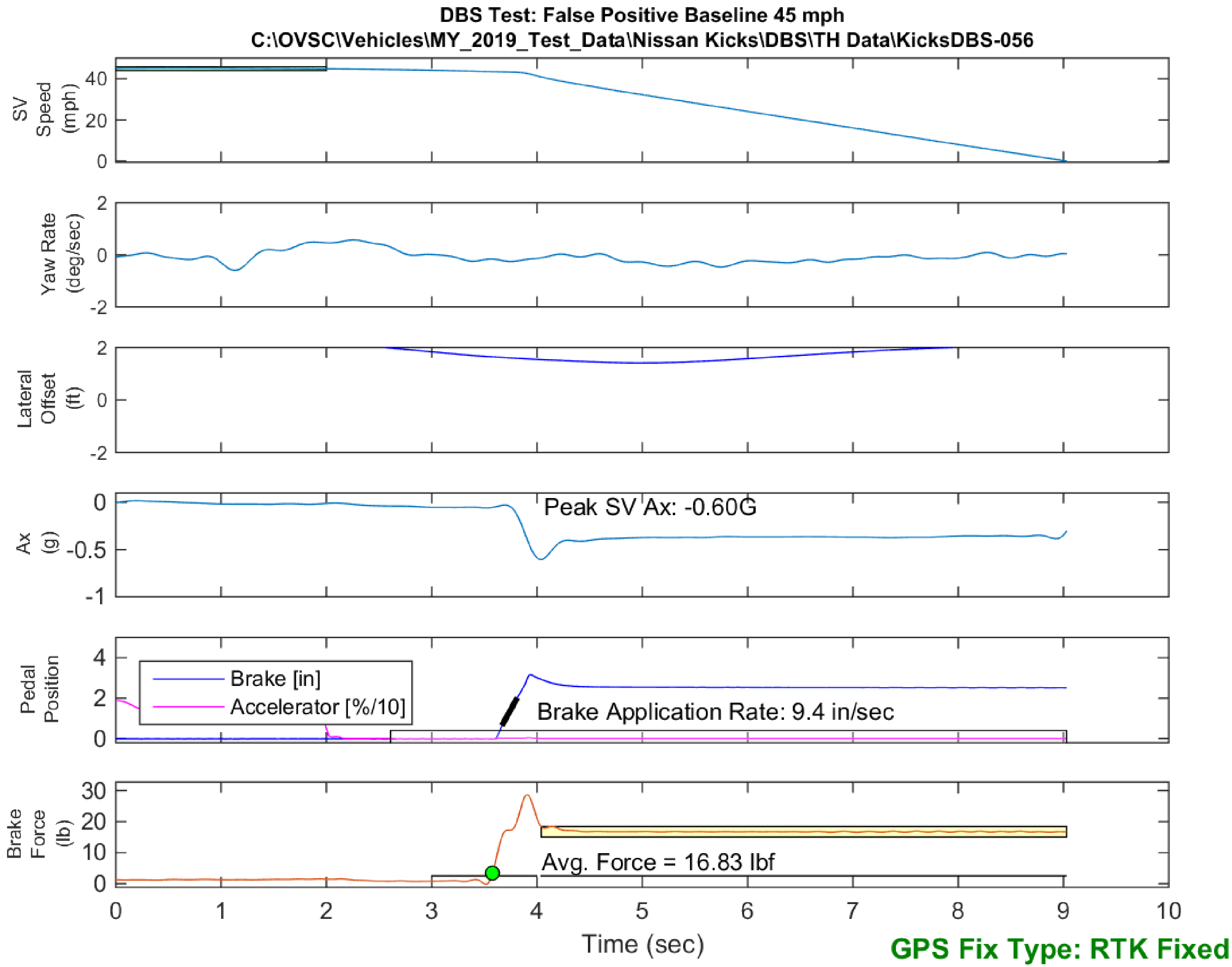


Figure E34. Time History for DBS Run 56, False Positive Baseline, SV 45 mph

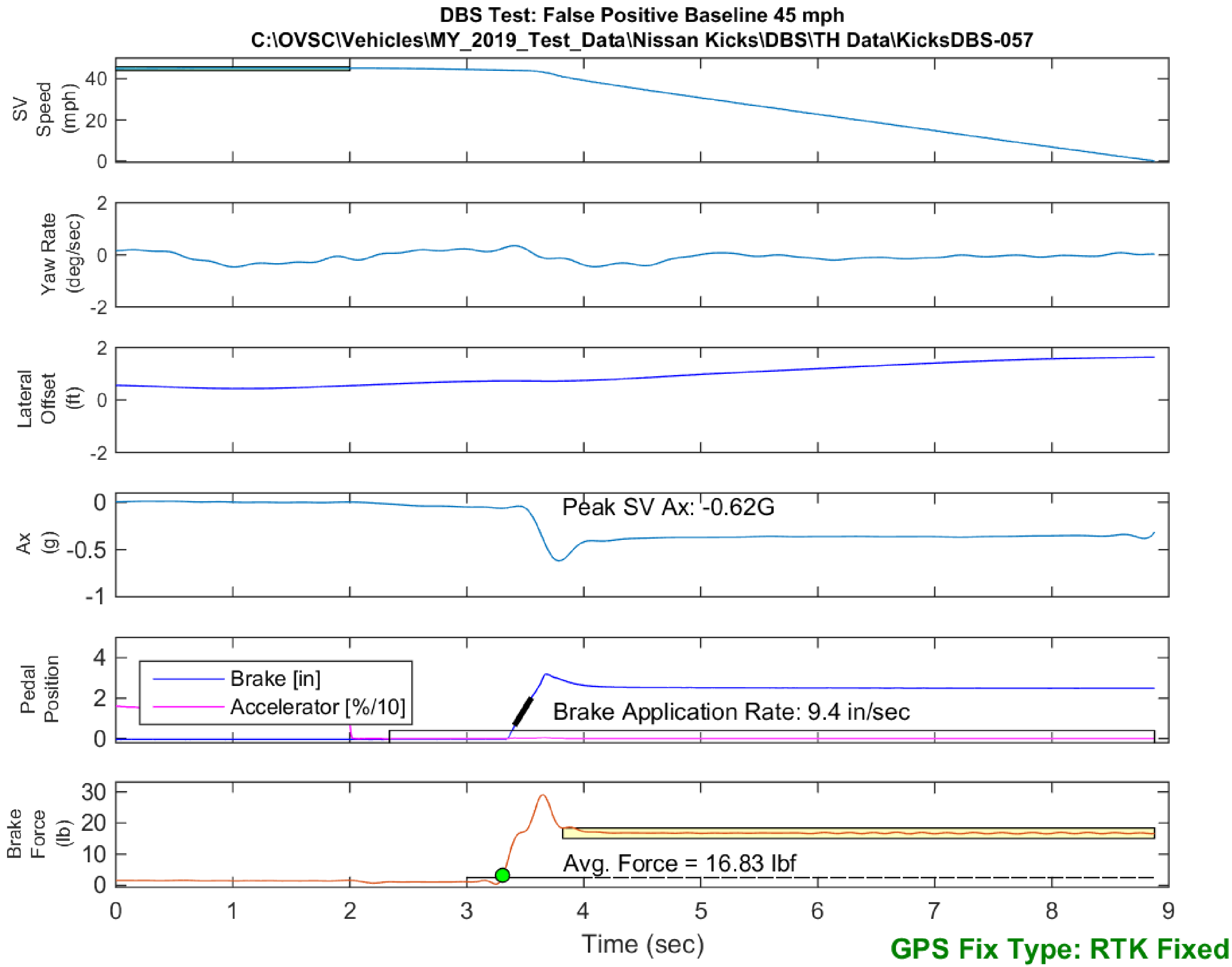


Figure E35. Time History for DBS Run 57, False Positive Baseline, SV 45 mph

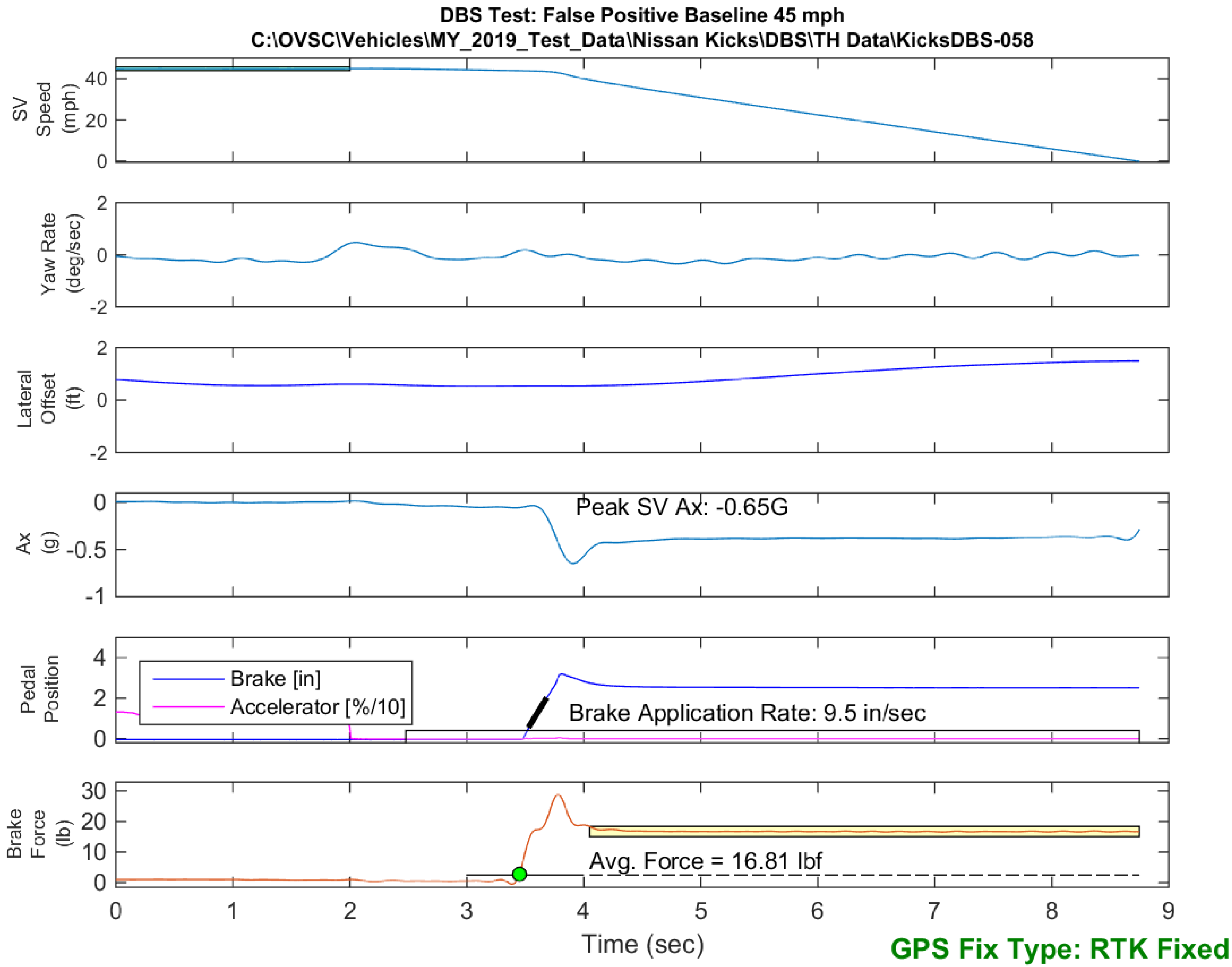


Figure E36. Time History for DBS Run 58, False Positive Baseline, SV 45 mph

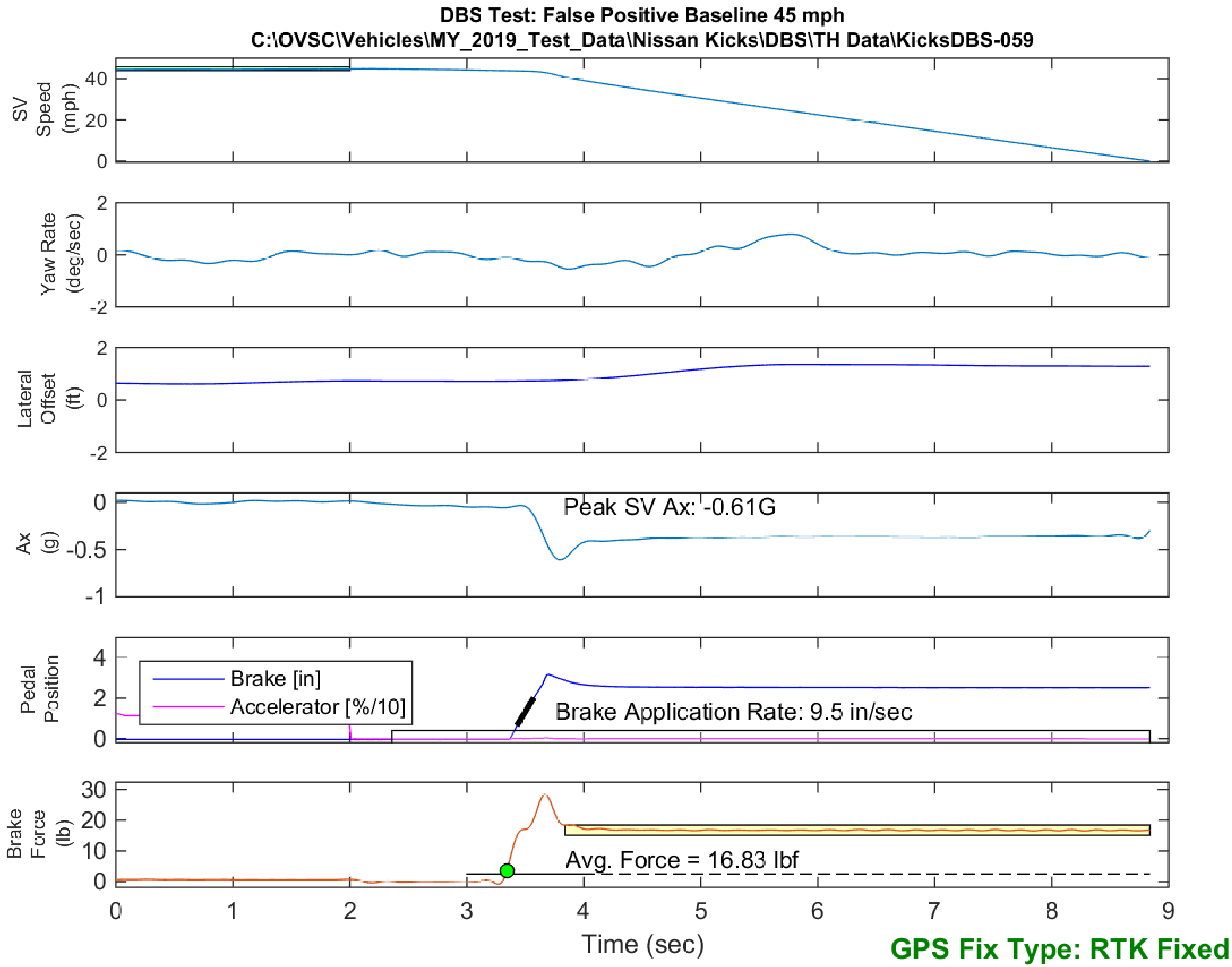


Figure E37. Time History for DBS Run 59, False Positive Baseline, SV 45 mph

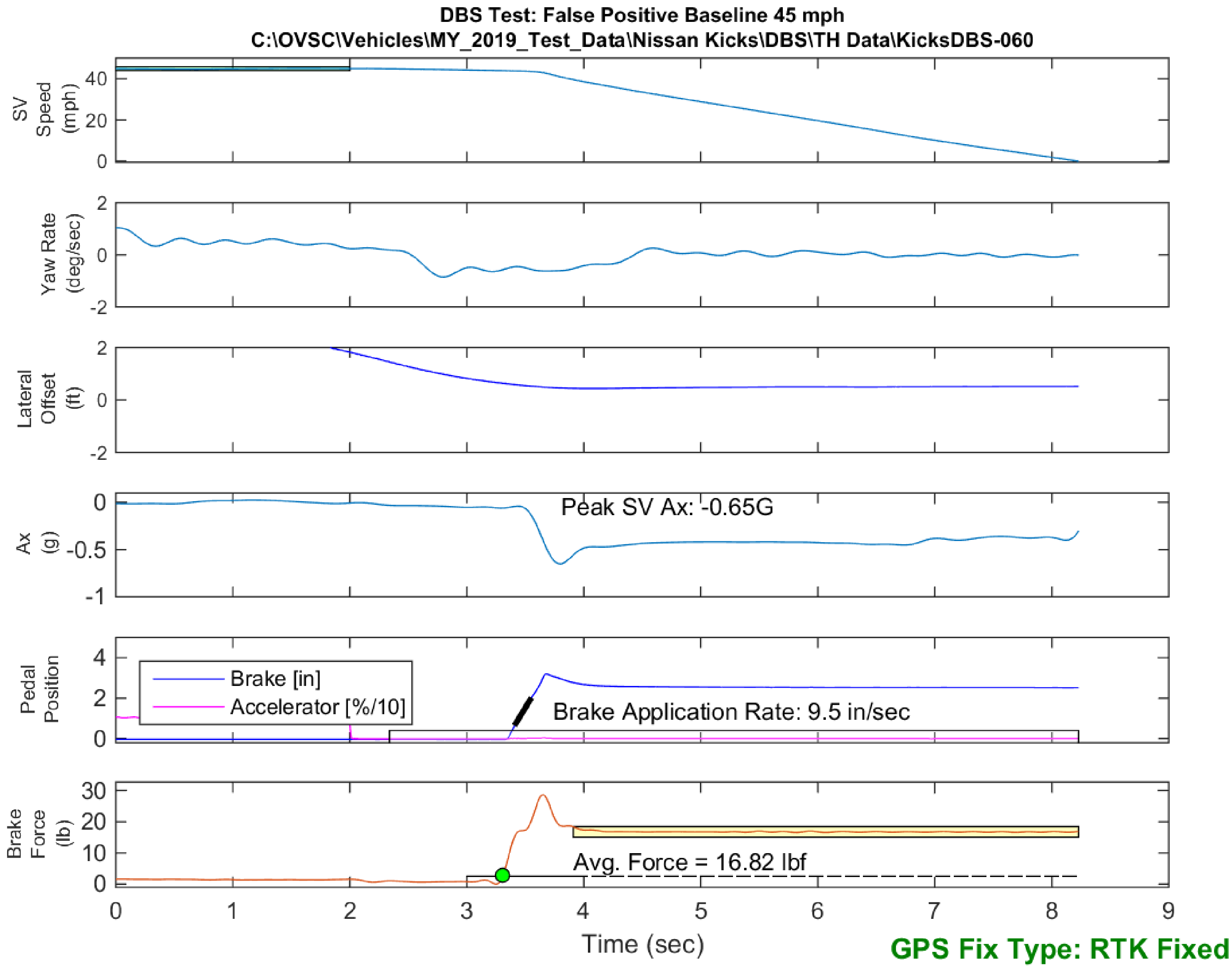


Figure E38. Time History for DBS Run 60, False Positive Baseline, SV 45 mph

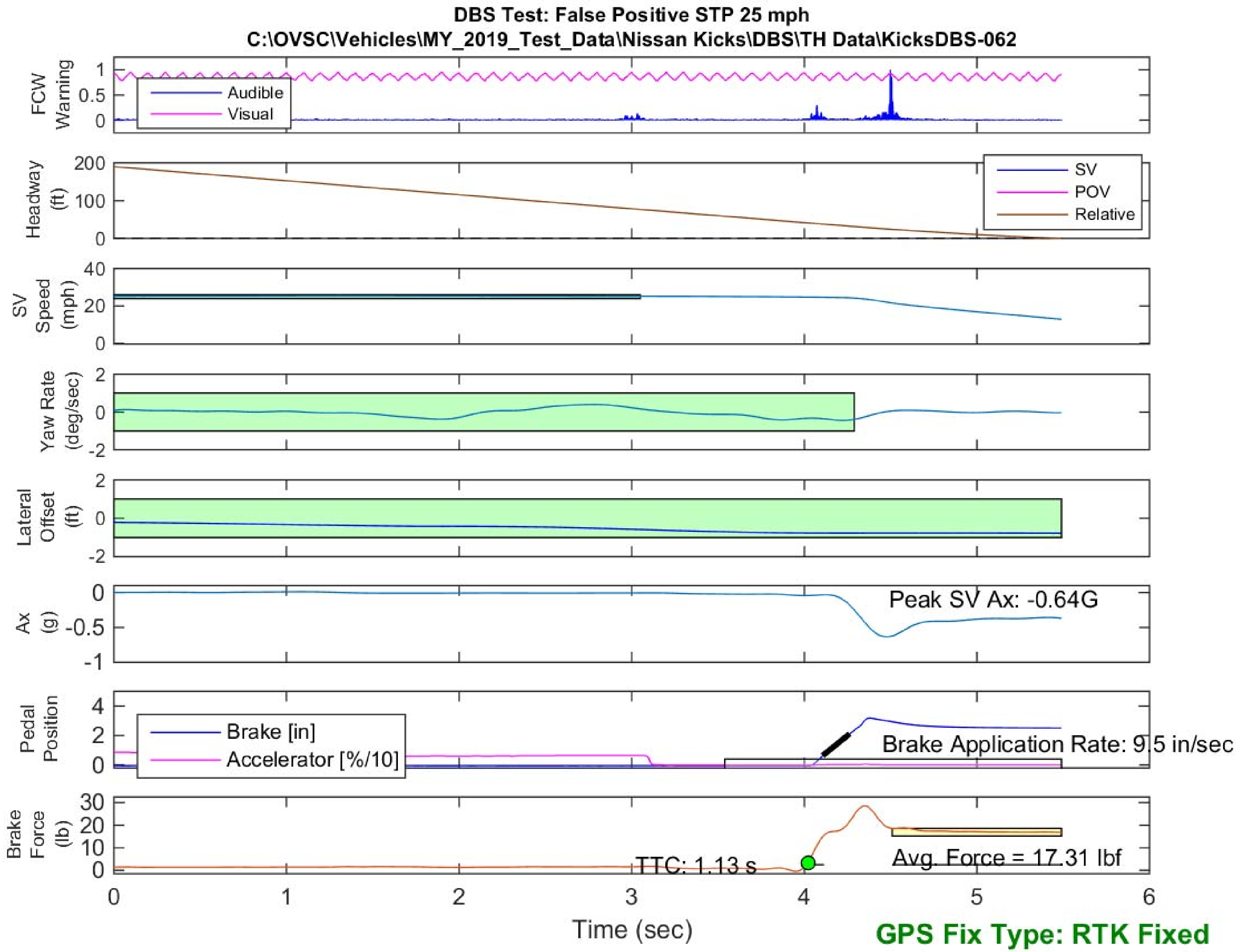


Figure E39. Time History for DBS Run 62, SV Encounters Steel Trench Plate, SV 25 mph

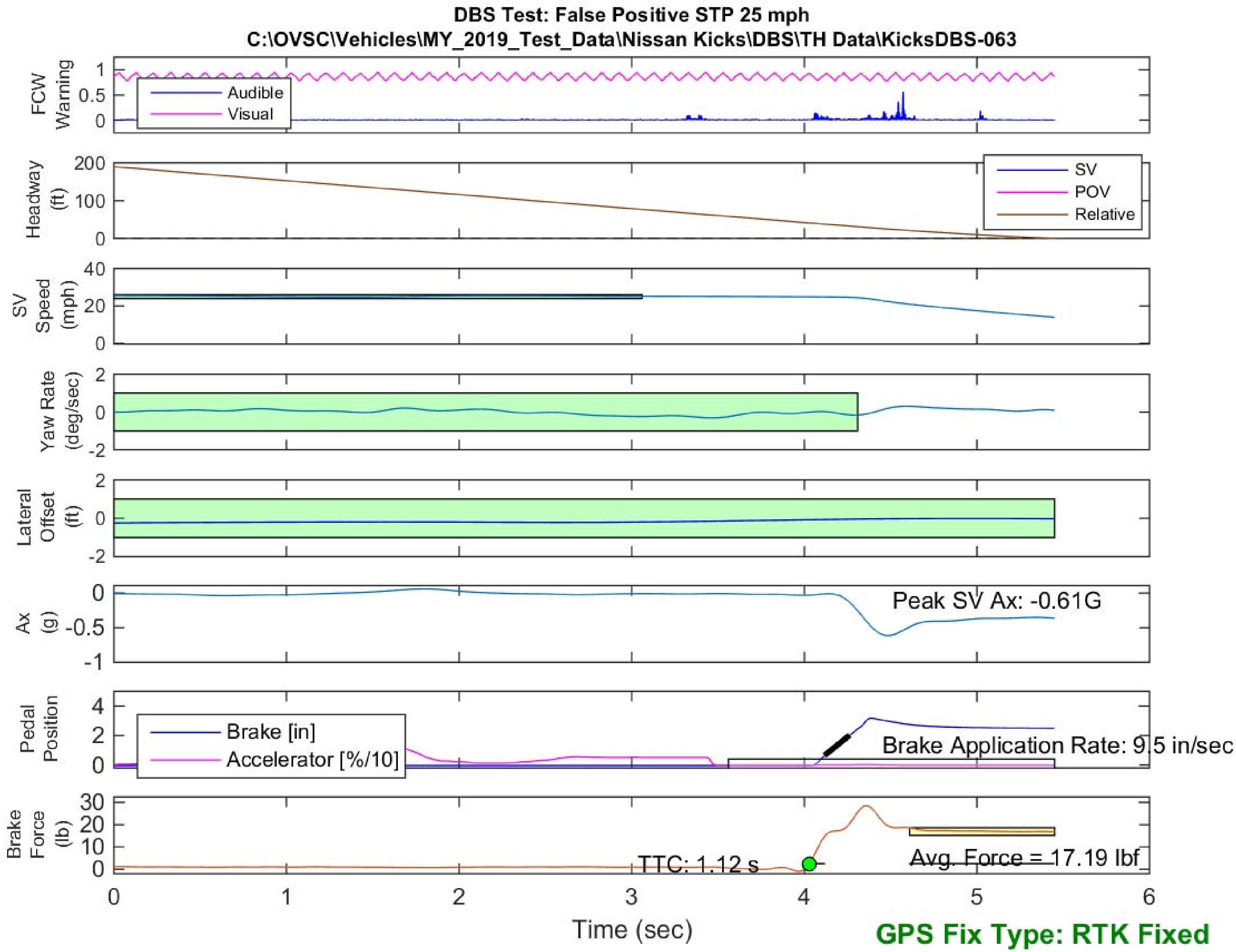


Figure E40. Time History for DBS Run 63, SV Encounters Steel Trench Plate, SV 25 mph

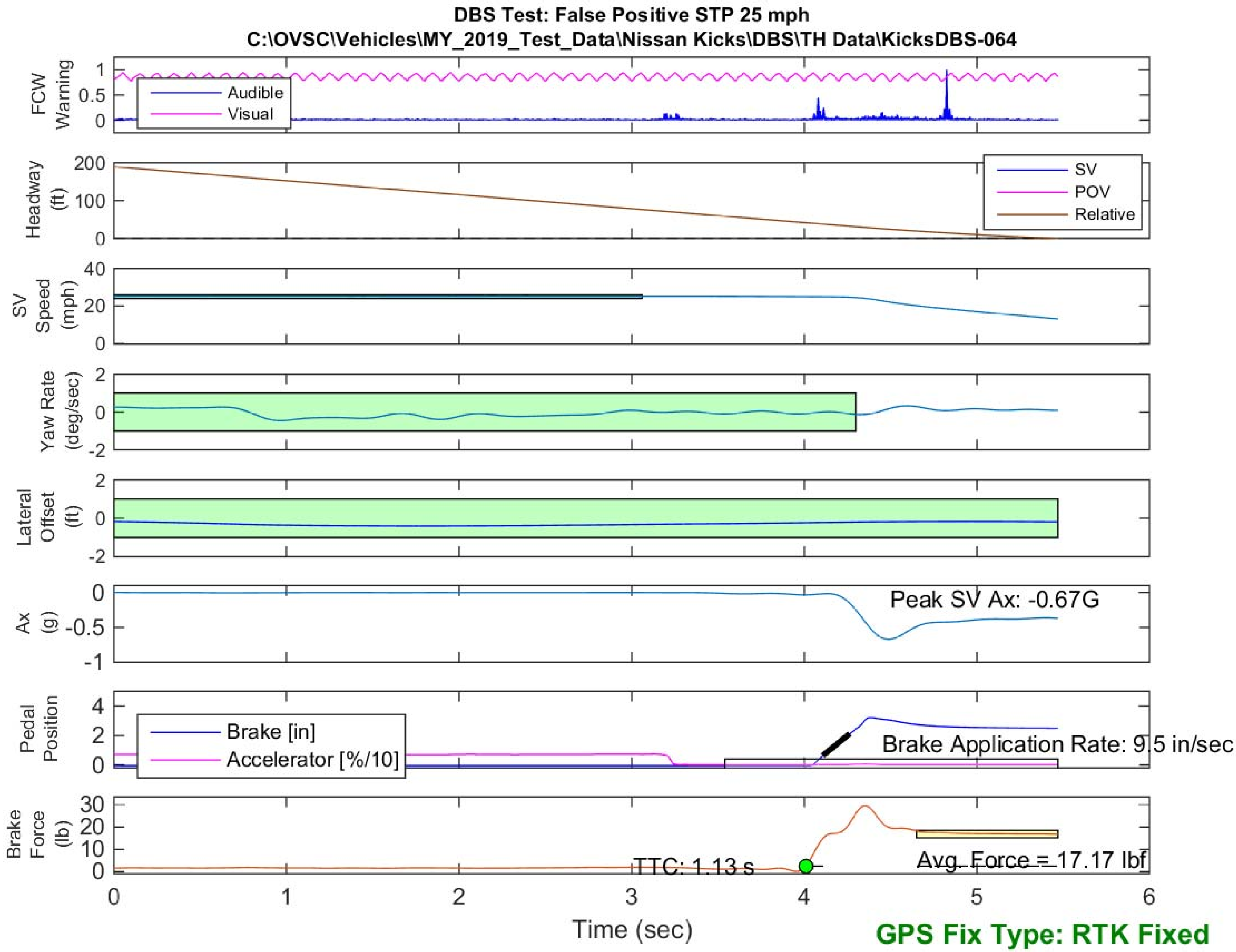


Figure E41. Time History for DBS Run 64, SV Encounters Steel Trench Plate, SV 25 mph

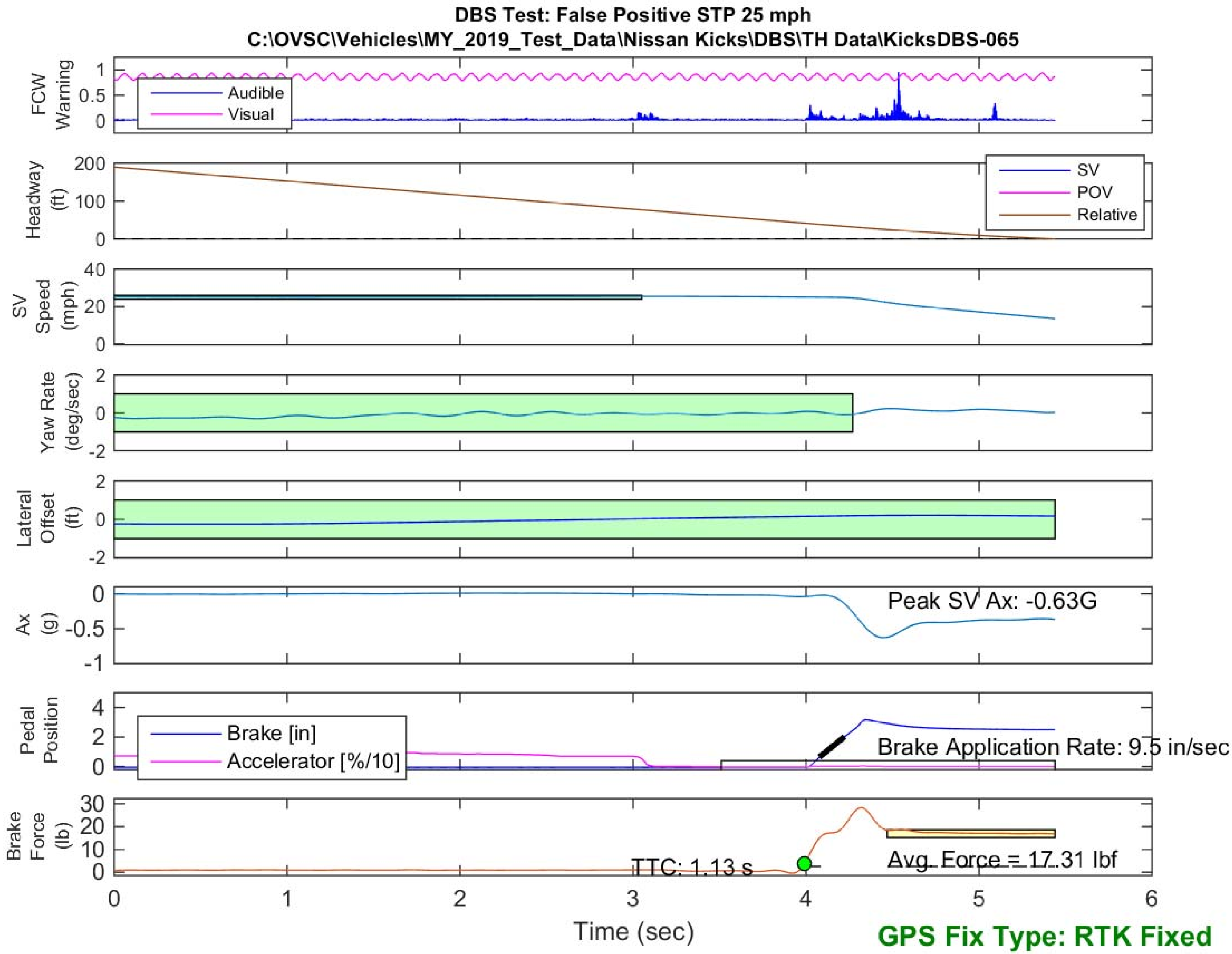


Figure E42. Time History for DBS Run 65, SV Encounters Steel Trench Plate, SV 25 mph

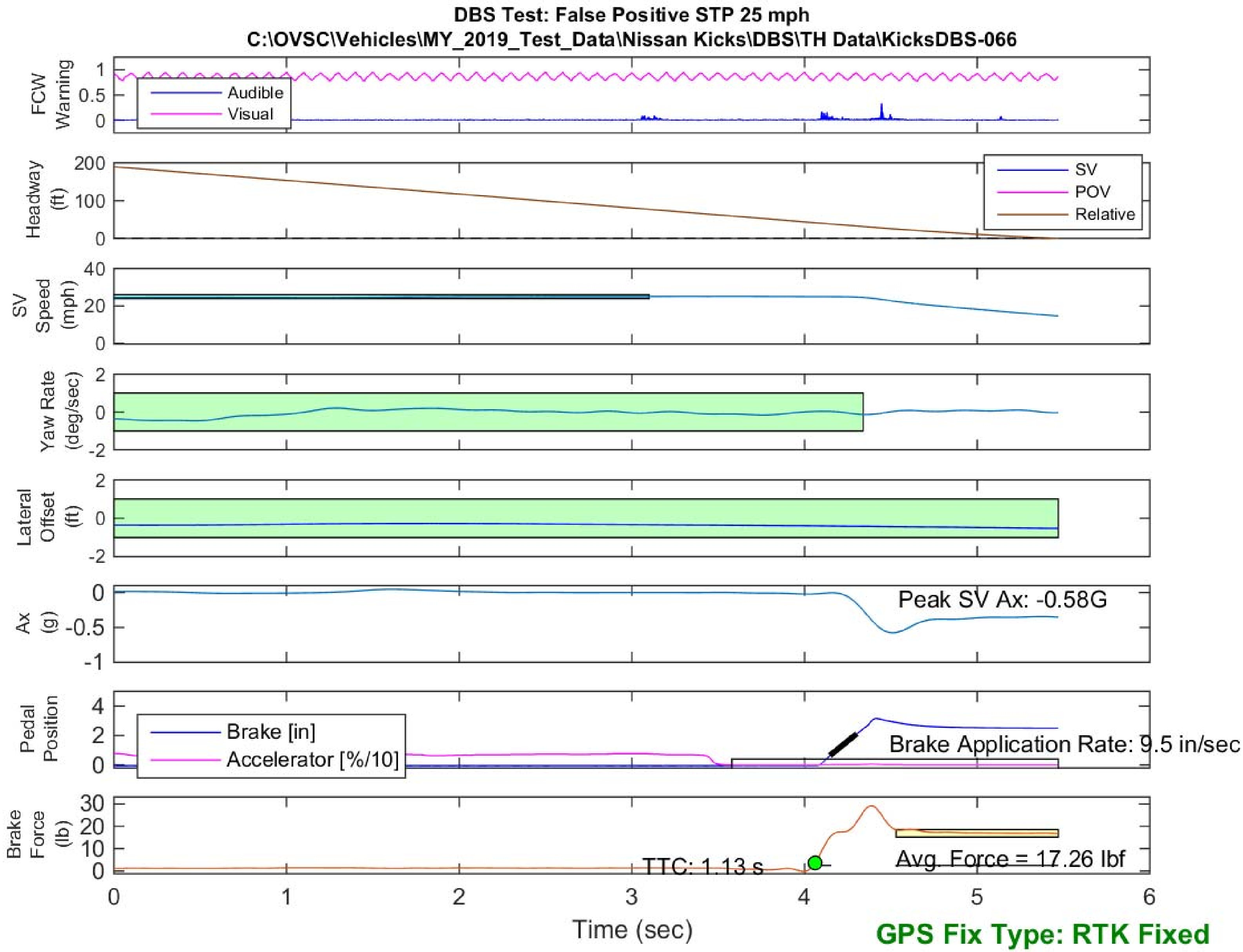


Figure E43. Time History for DBS Run 66, SV Encounters Steel Trench Plate, SV 25 mph

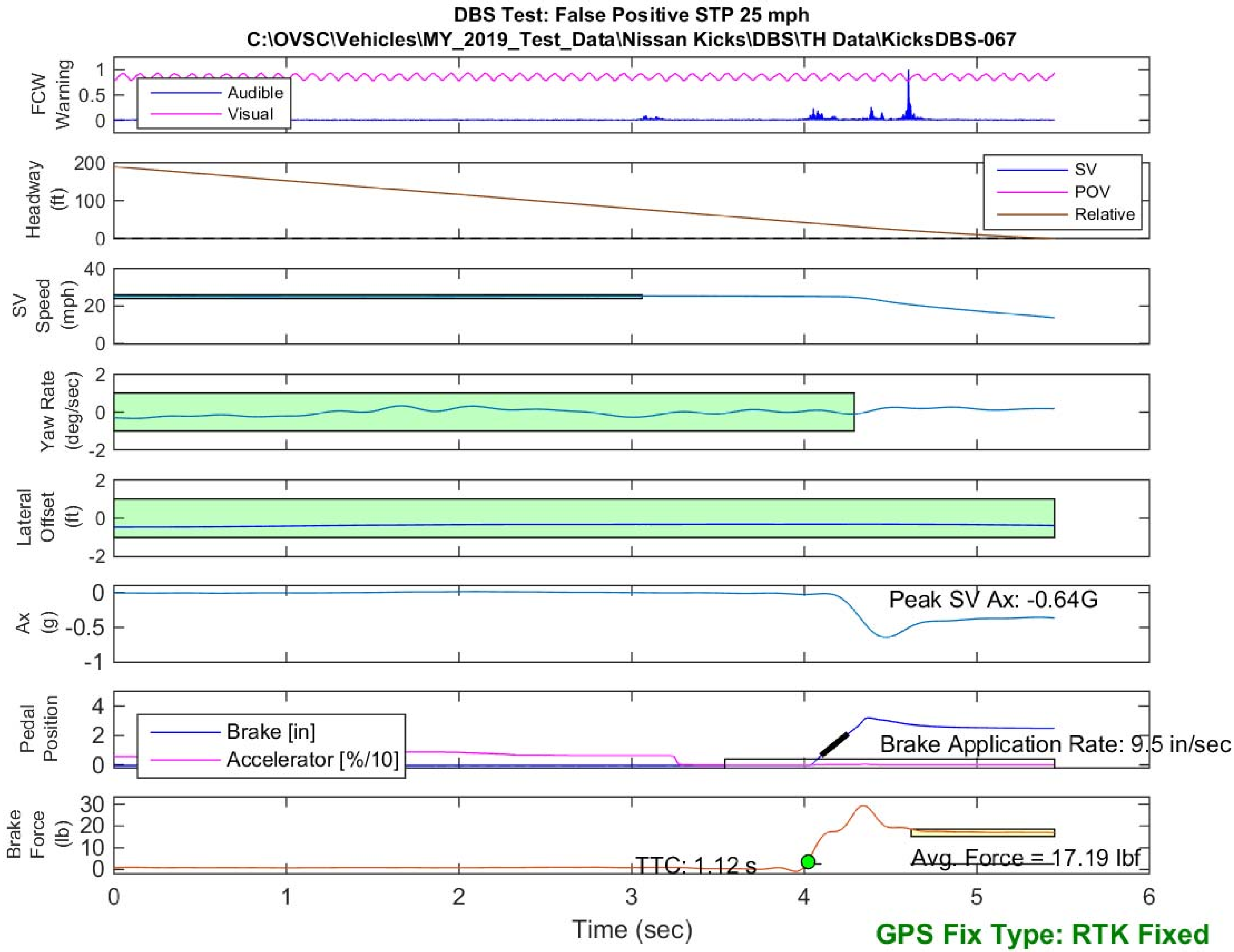


Figure E44. Time History for DBS Run 67, SV Encounters Steel Trench Plate, SV 25 mph

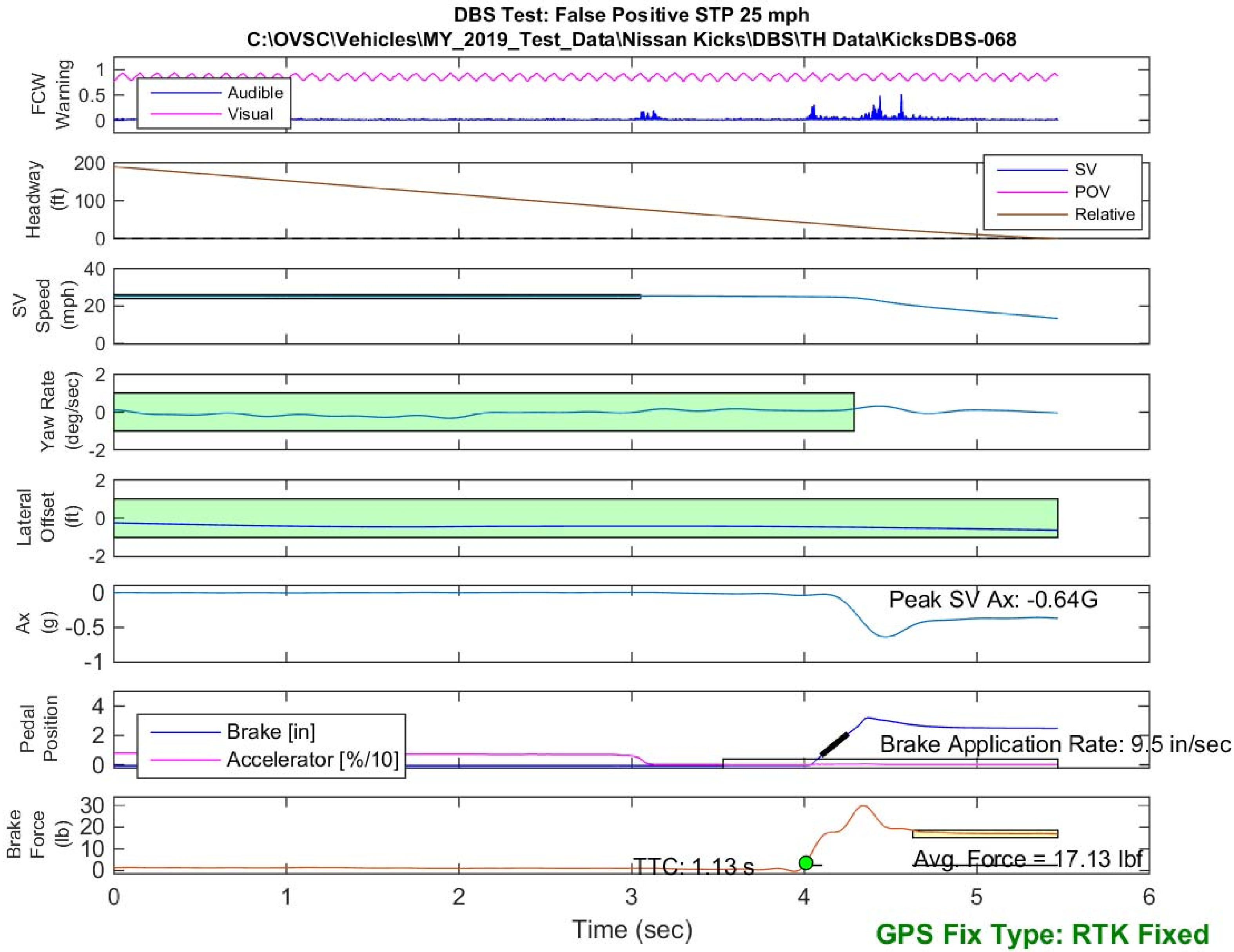


Figure E45. Time History for DBS Run 68, SV Encounters Steel Trench Plate, SV 25 mph

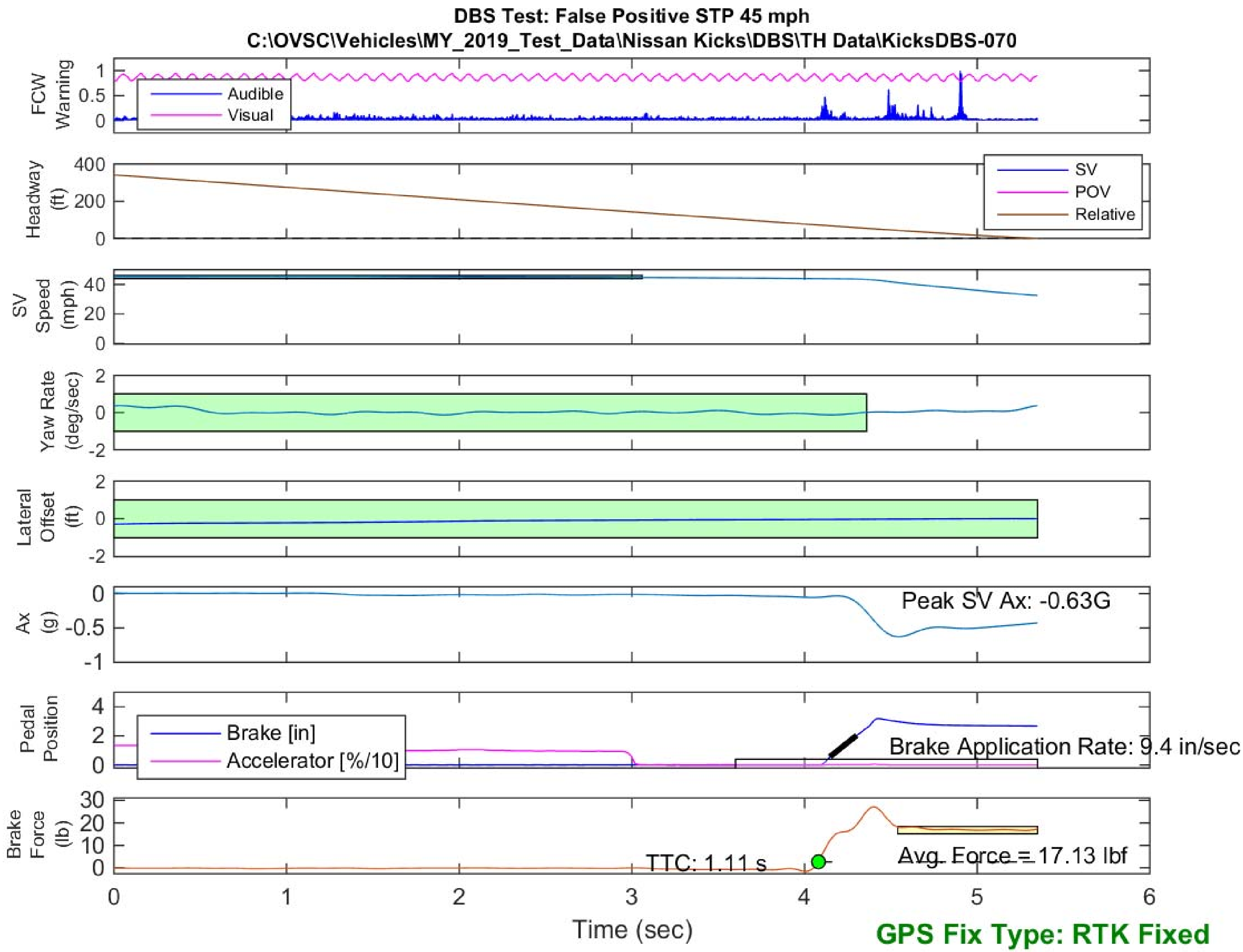


Figure E46. Time History for DBS Run 70, SV Encounters Steel Trench Plate, SV 45 mph

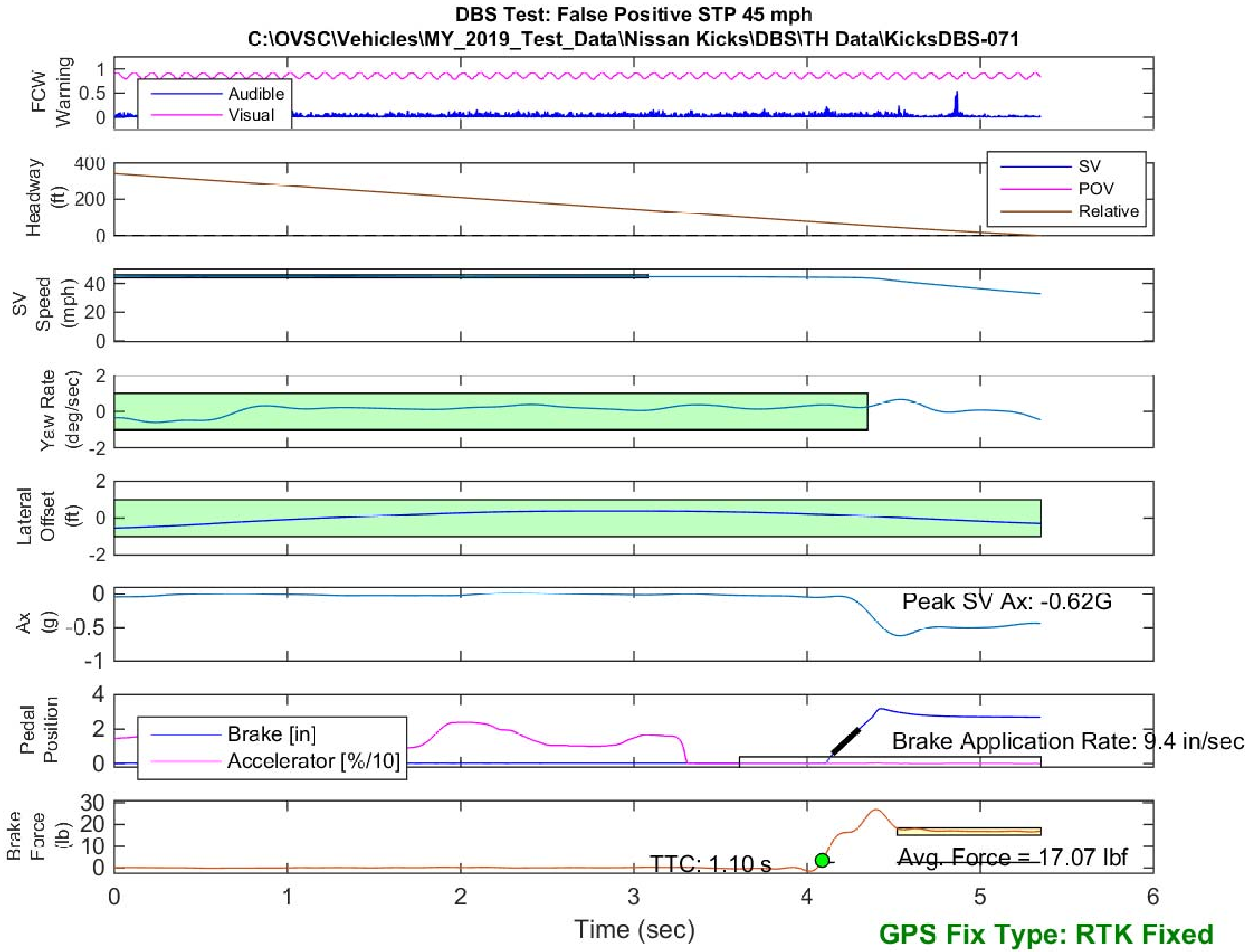


Figure E47. Time History for DBS Run 71, SV Encounters Steel Trench Plate, SV 45 mph

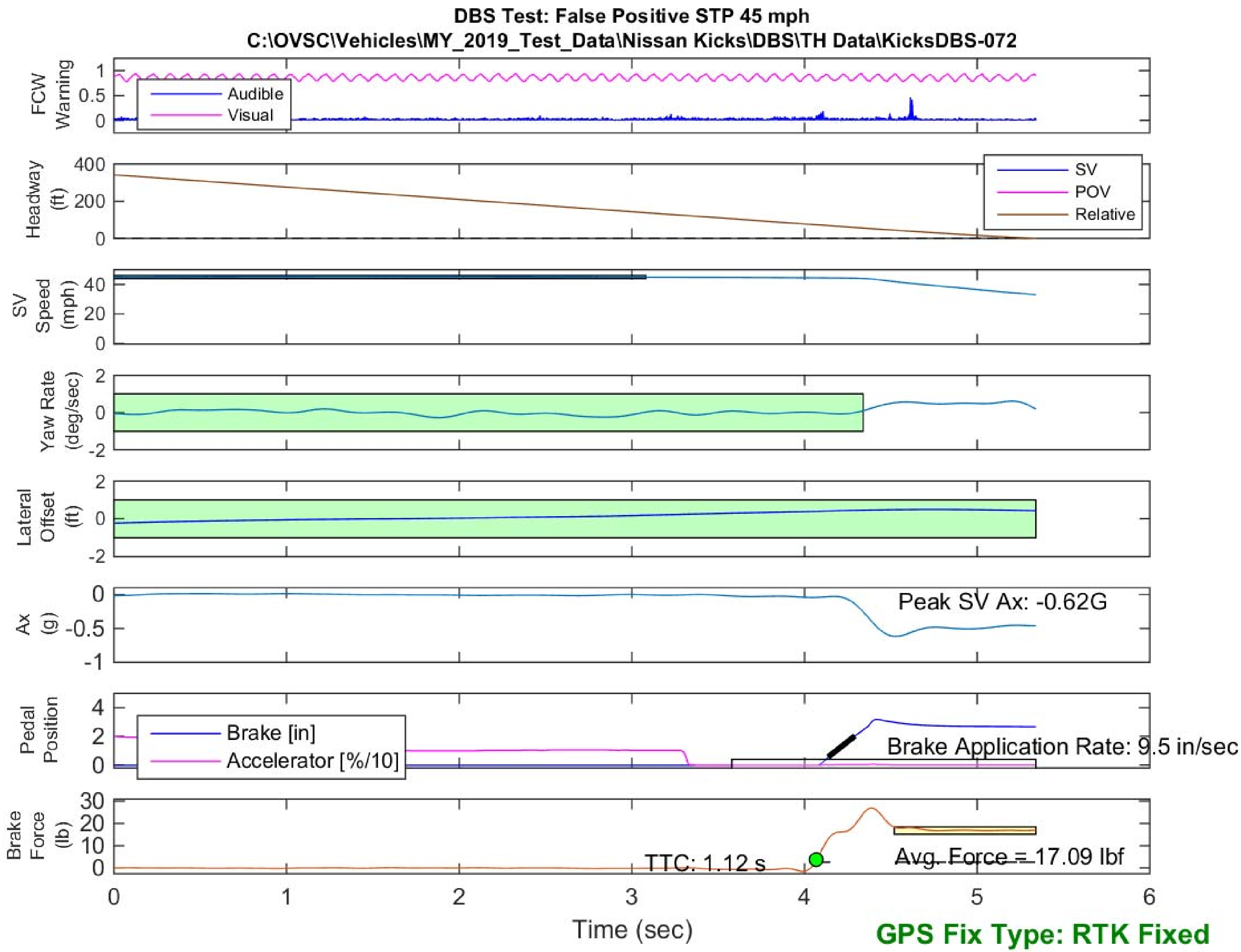


Figure E48. Time History for DBS Run 72, SV Encounters Steel Trench Plate, SV 45 mph

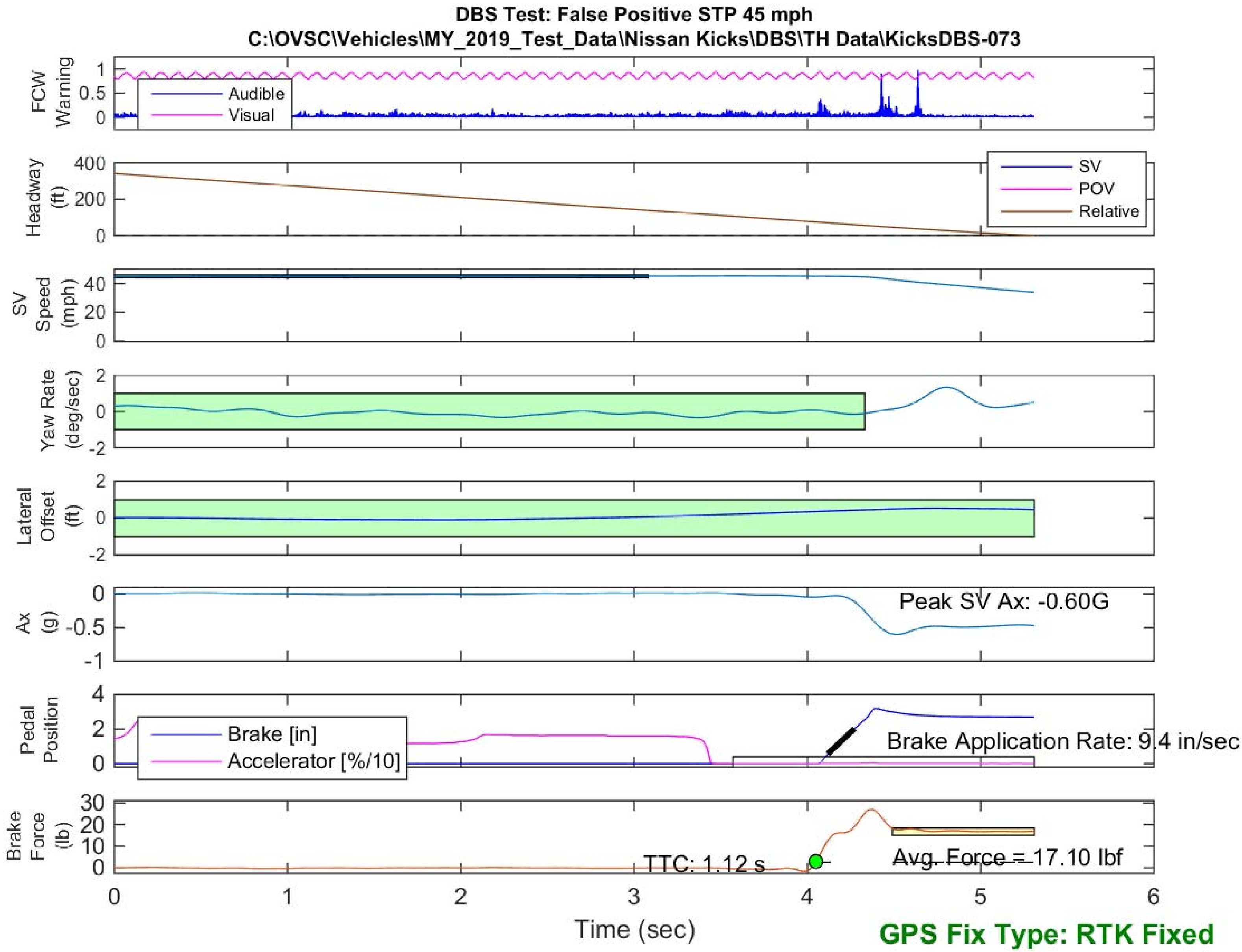


Figure E49. Time History for DBS Run 73, SV Encounters Steel Trench Plate, SV 45 mph

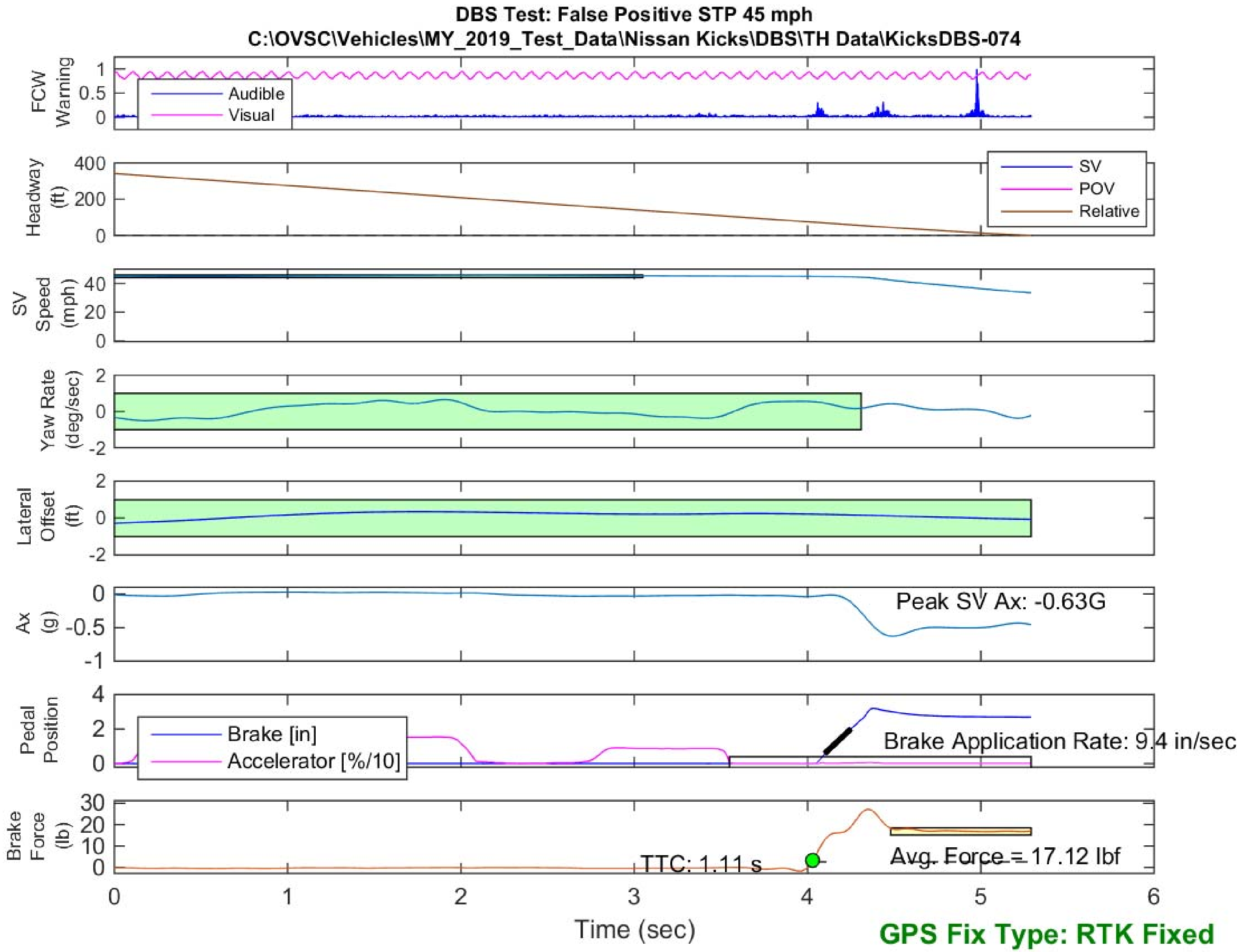


Figure E50. Time History for DBS Run 74, SV Encounters Steel Trench Plate, SV 45 mph

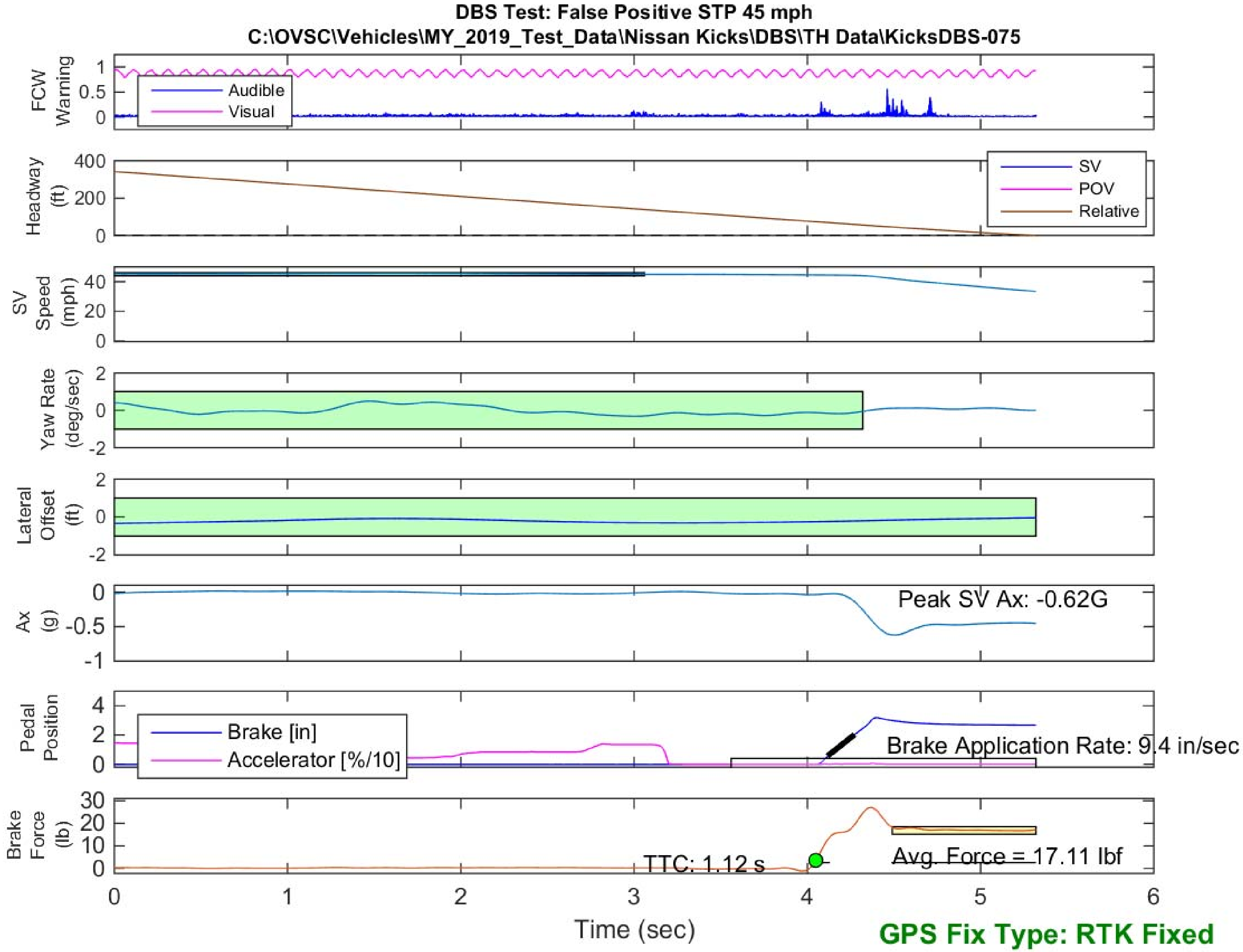


Figure E51. Time History for DBS Run 75, SV Encounters Steel Trench Plate, SV 45 mph

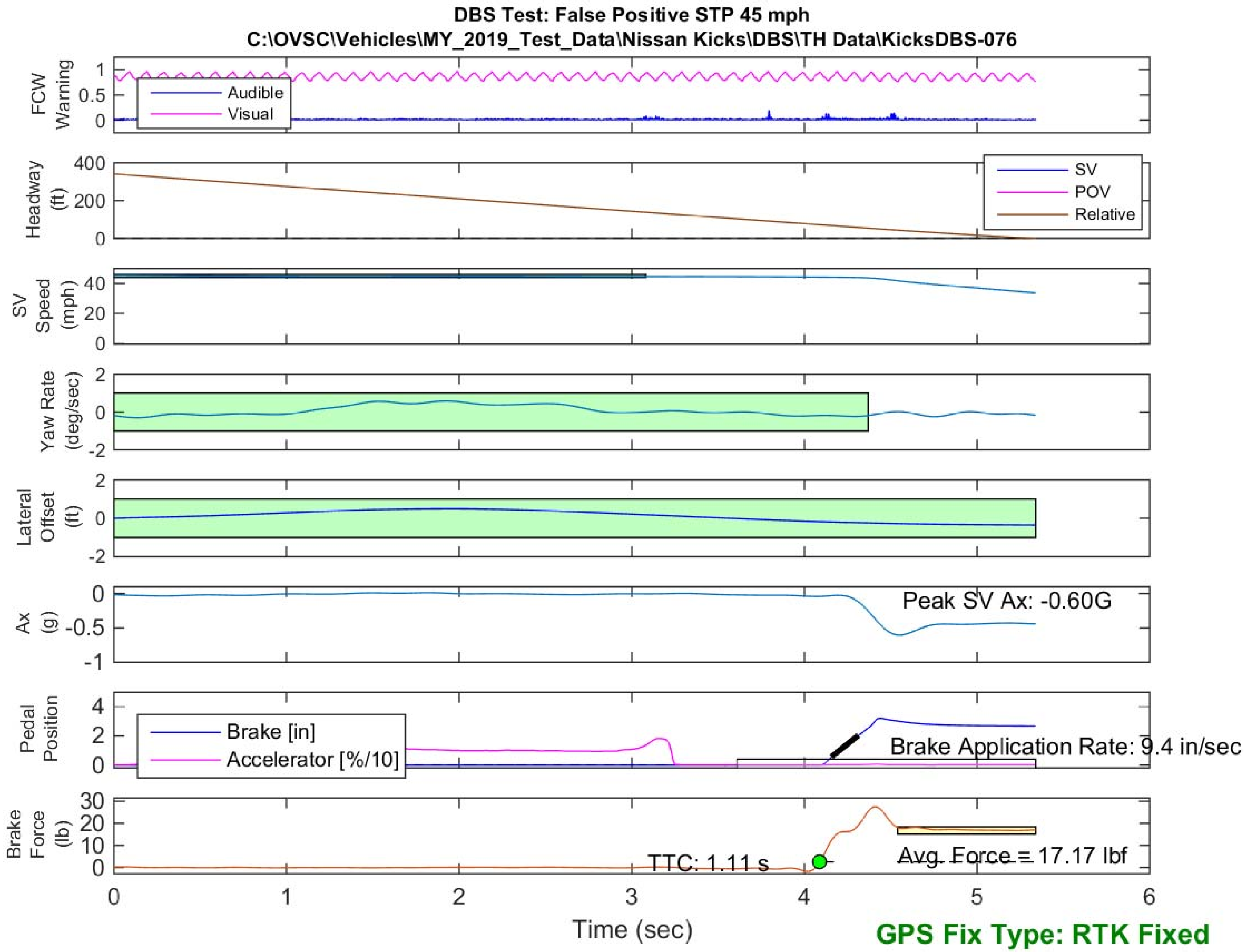


Figure E52. Time History for DBS Run 76, SV Encounters Steel Trench Plate, SV 45 mph

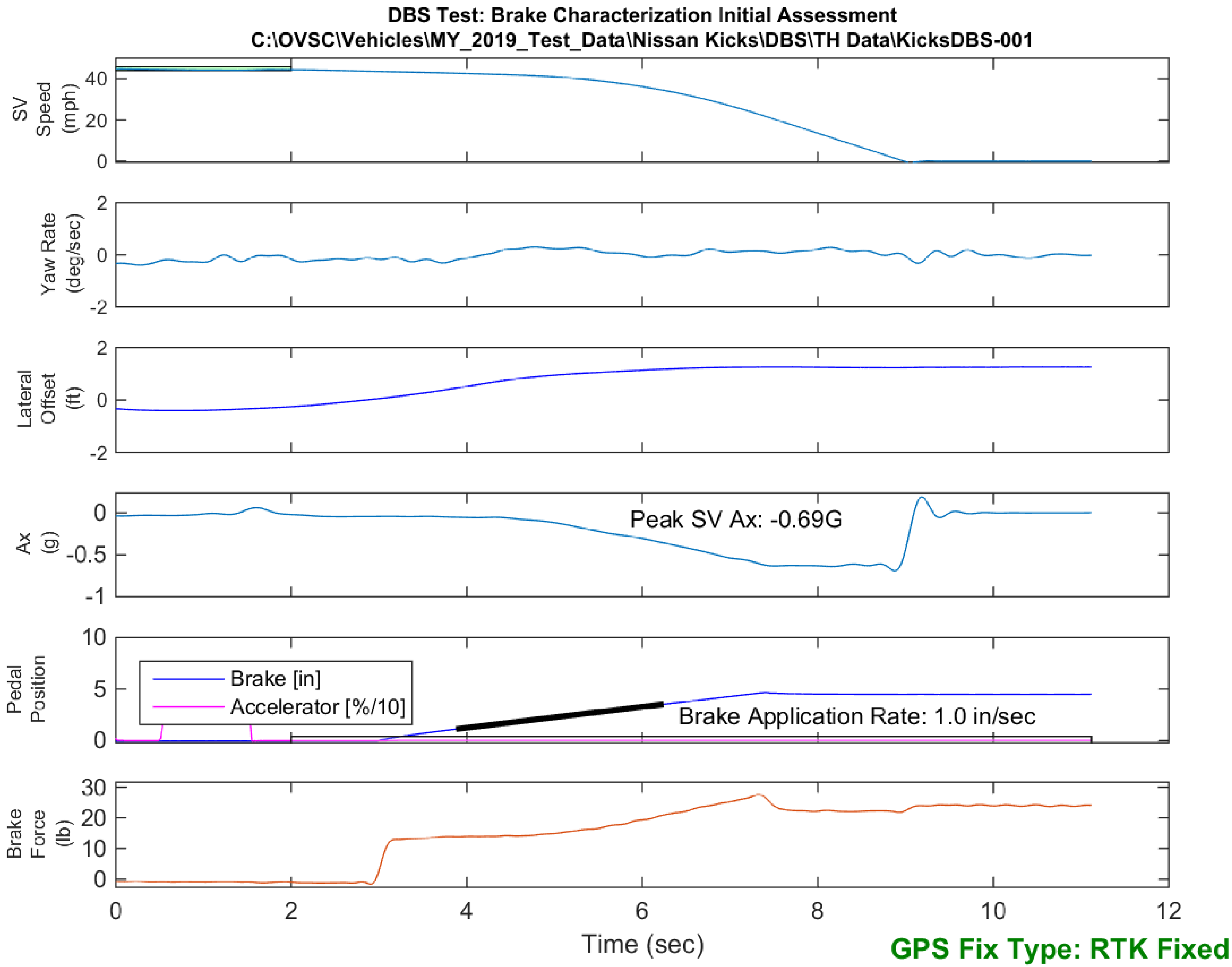


Figure E53. Time History for DBS Run 1, Brake Characterization Initial

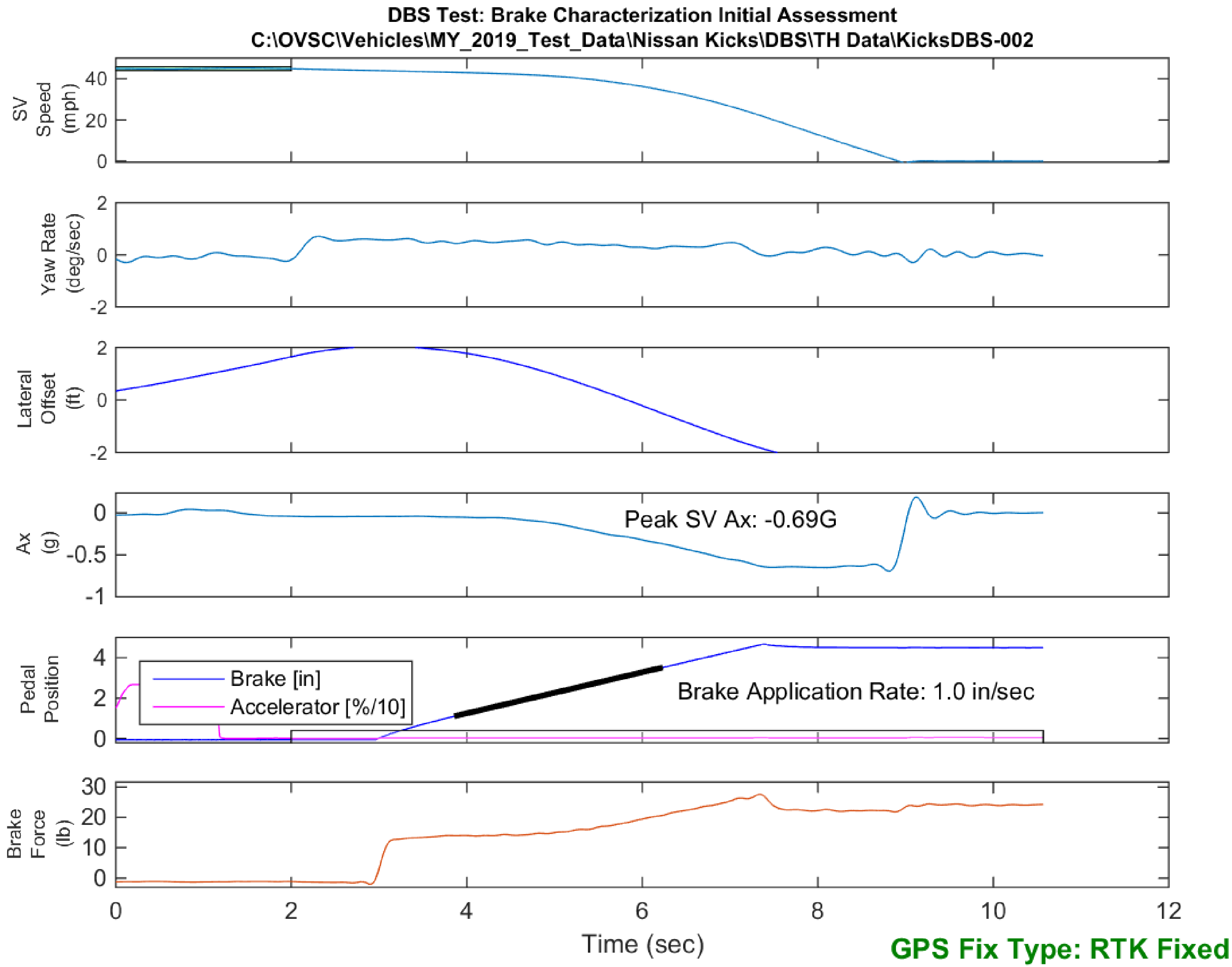


Figure E54. Time History for DBS Run 2, Brake Characterization Initial

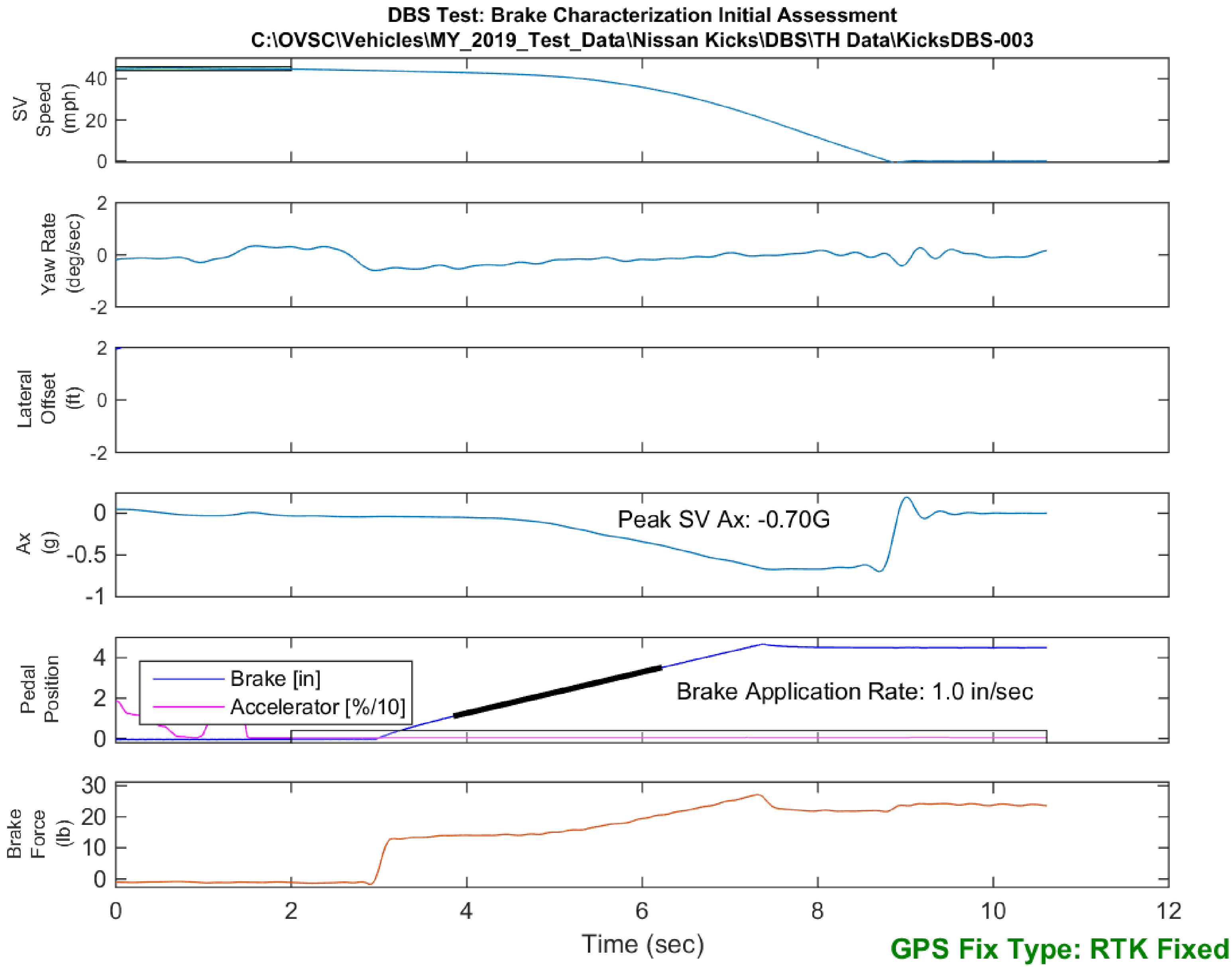


Figure E55. Time History for DBS Run 3, Brake Characterization Initial

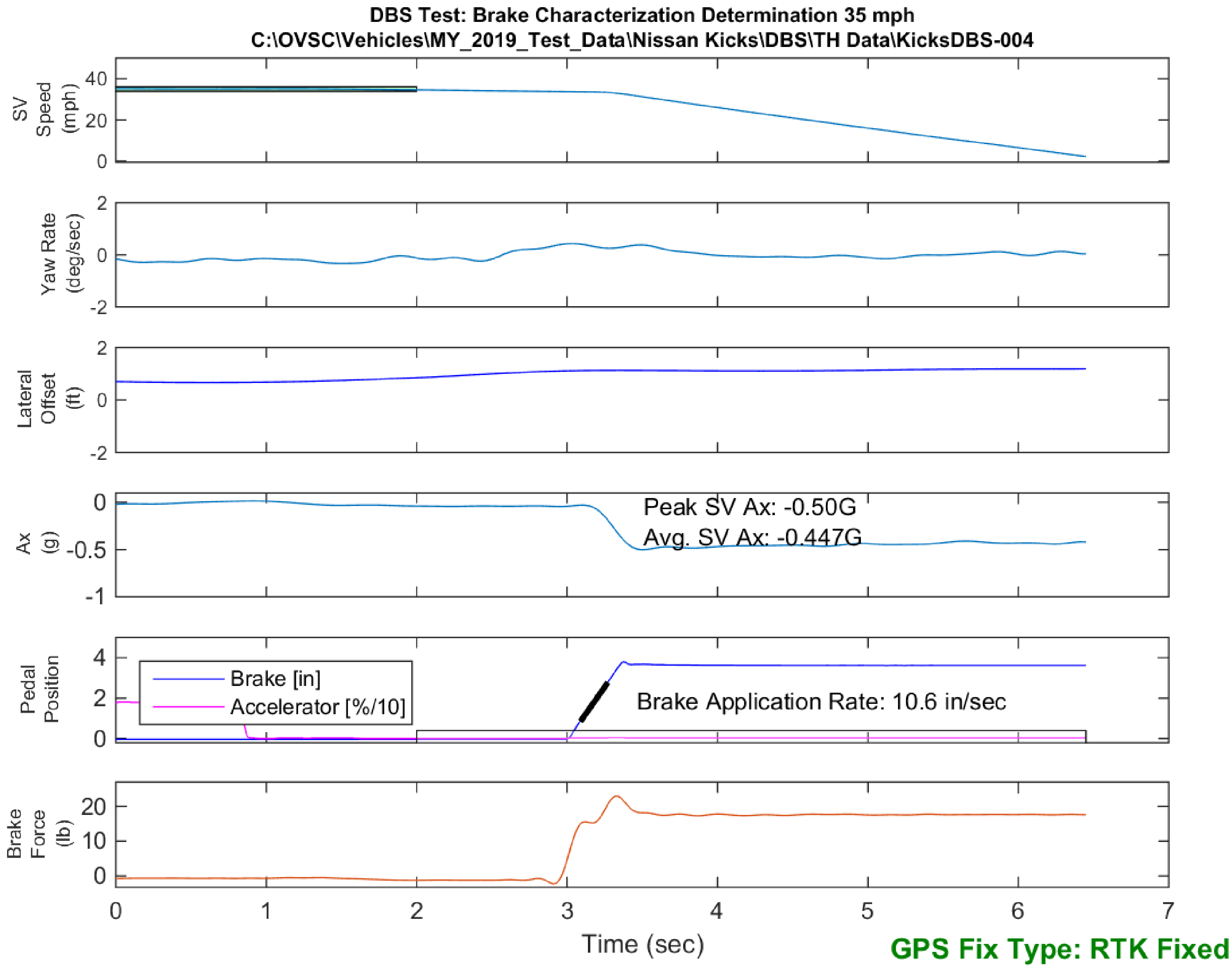


Figure E56. Time History for DBS Run 4, Brake Characterization Determination 35 mph

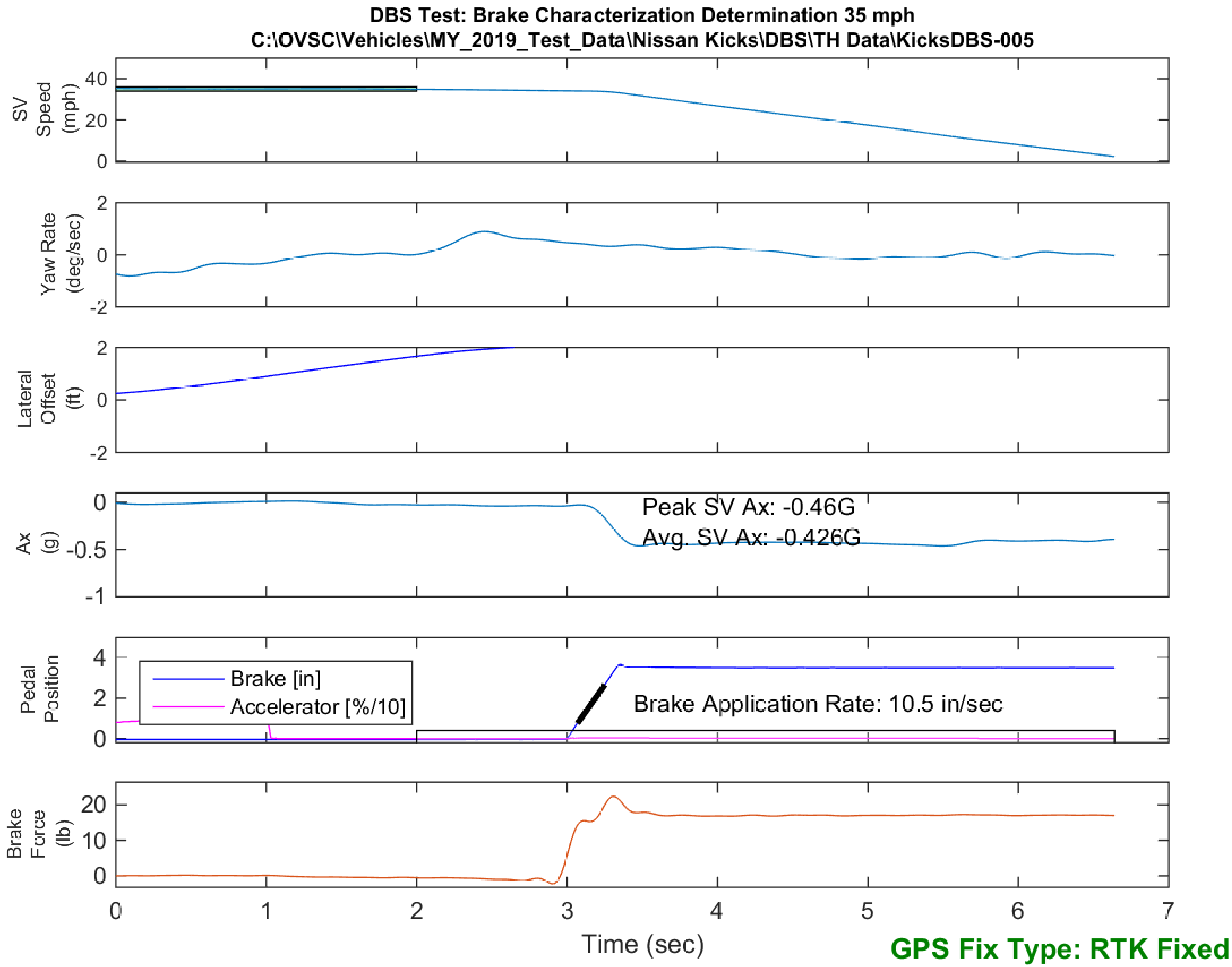


Figure E57. Time History for DBS Run 5, Brake Characterization Determination 35 mph

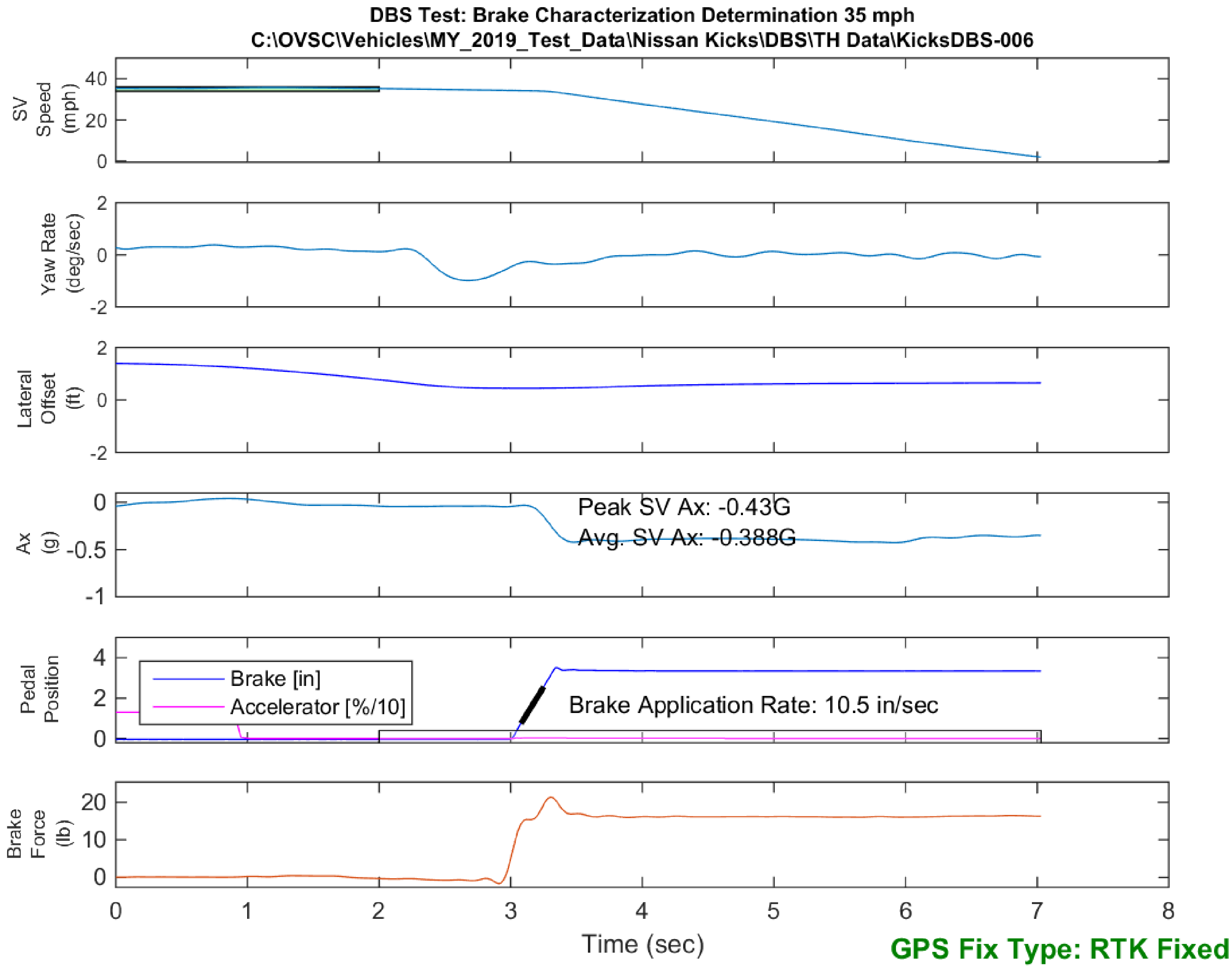


Figure E58. Time History for DBS Run 6, Brake Characterization Determination 35 mph

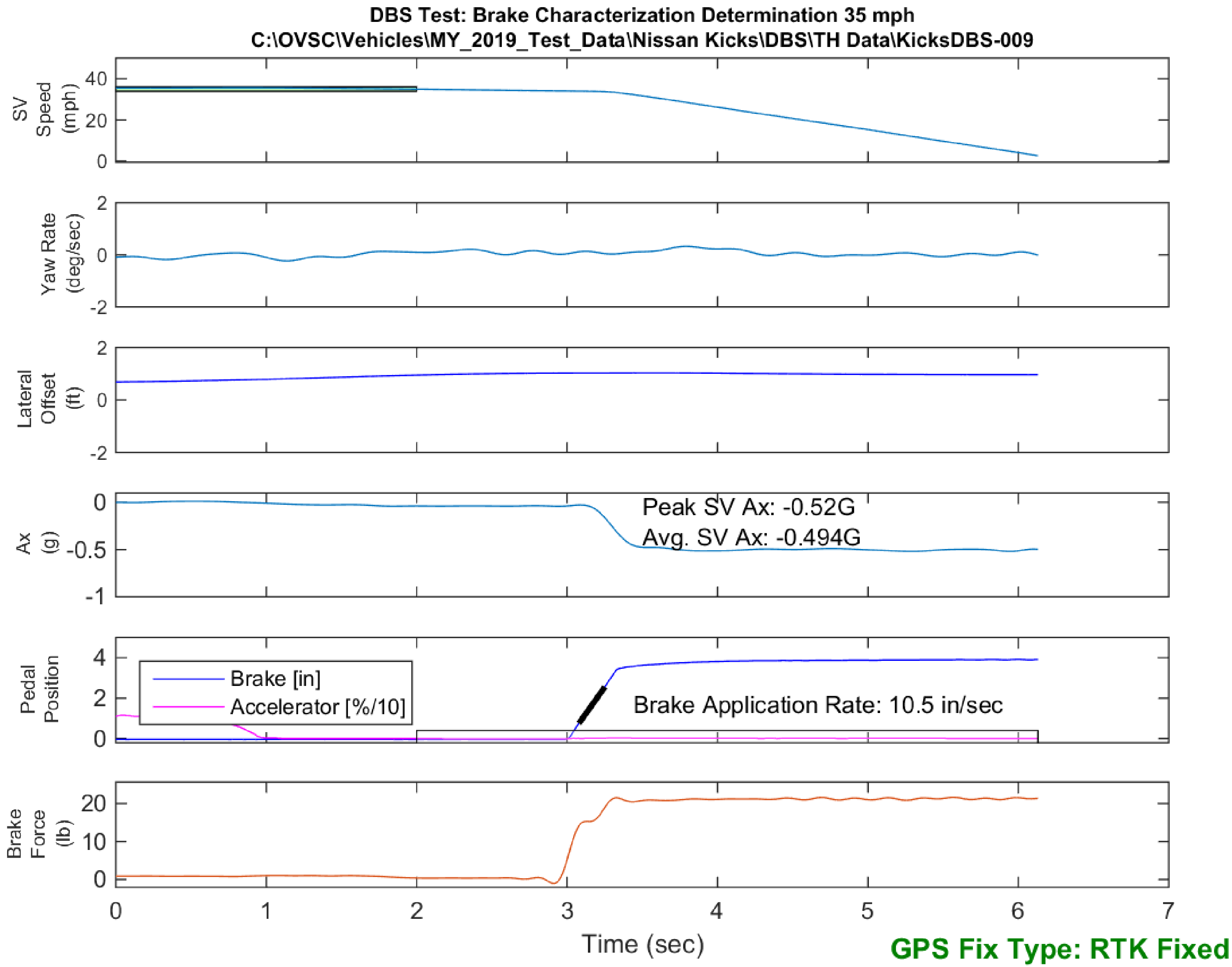


Figure E59. Time History for DBS Run 9, Brake Characterization Determination 35 mph

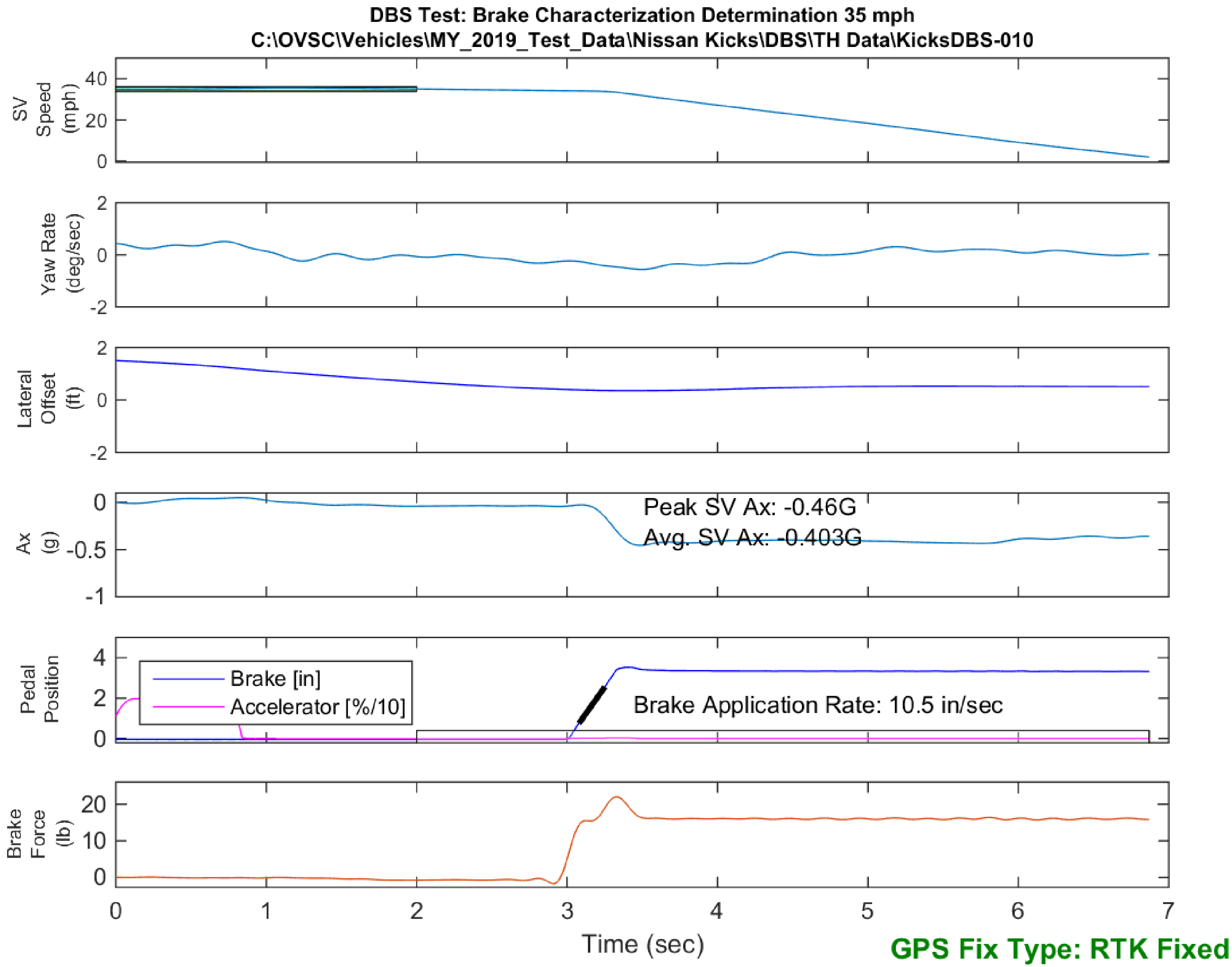


Figure E60. Time History for DBS Run 10, Brake Characterization Determination 35 mph

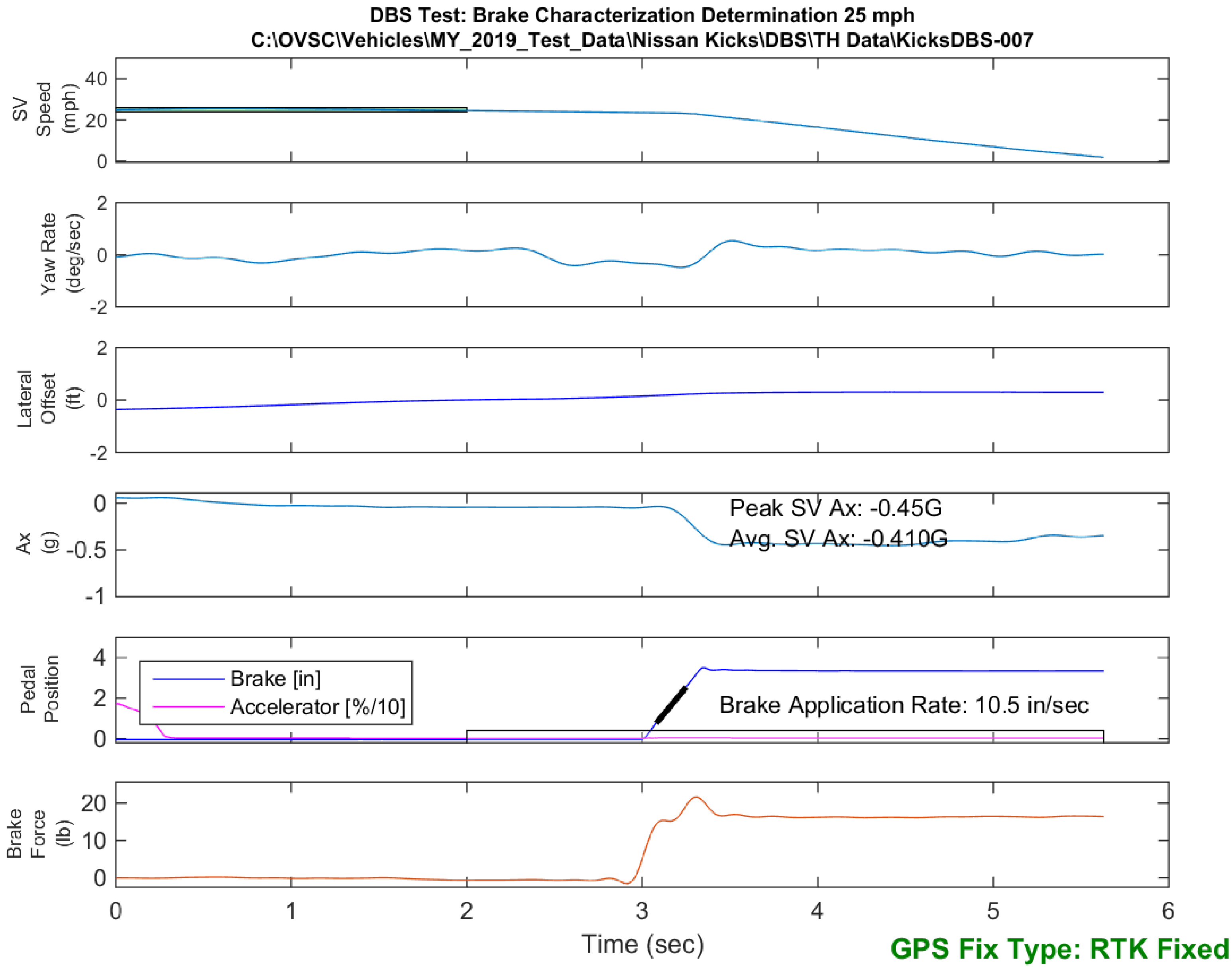


Figure E61. Time History for DBS Run 7, Brake Characterization Determination 25 mph

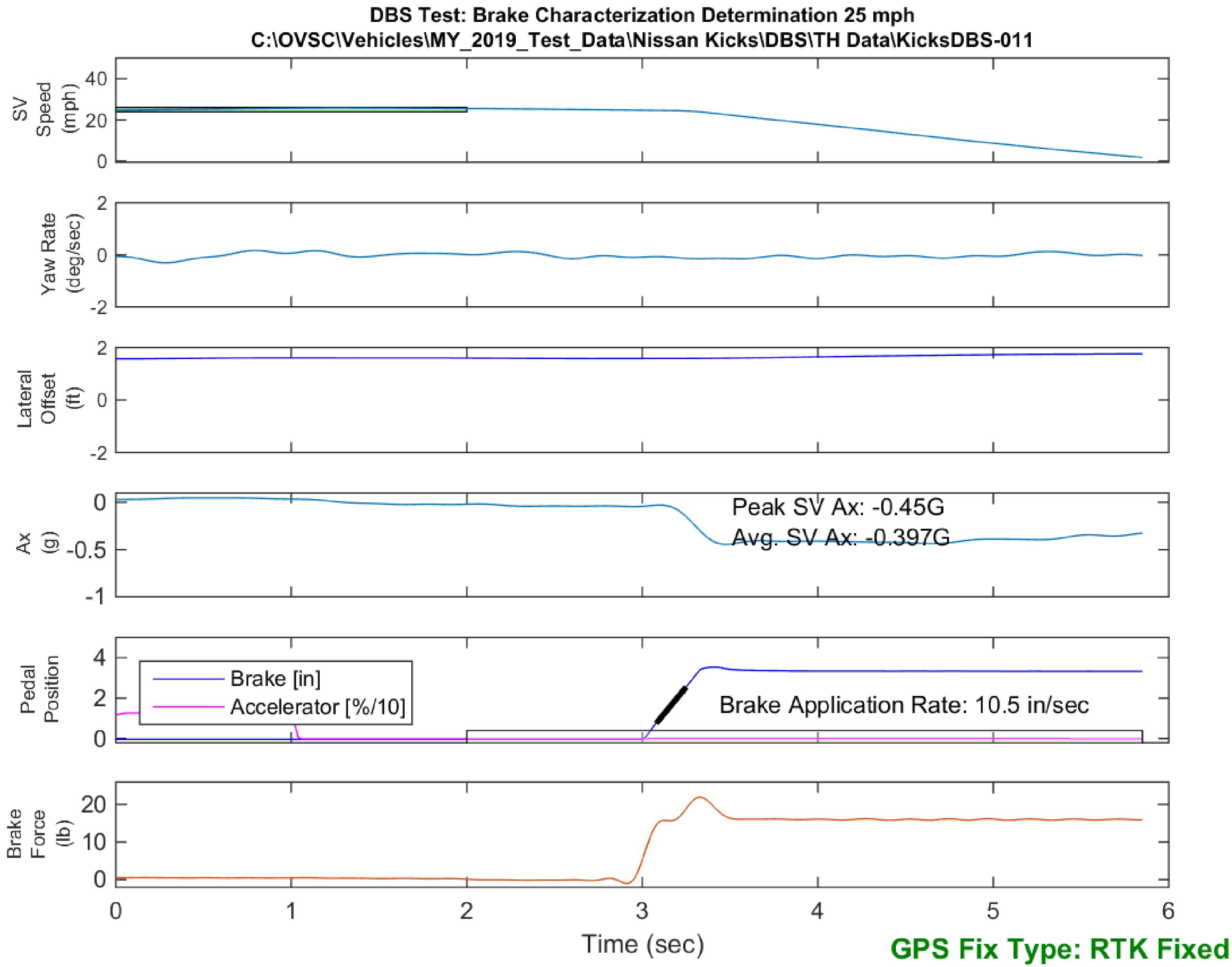


Figure E62. Time History for DBS Run 11, Brake Characterization Determination 25 mph

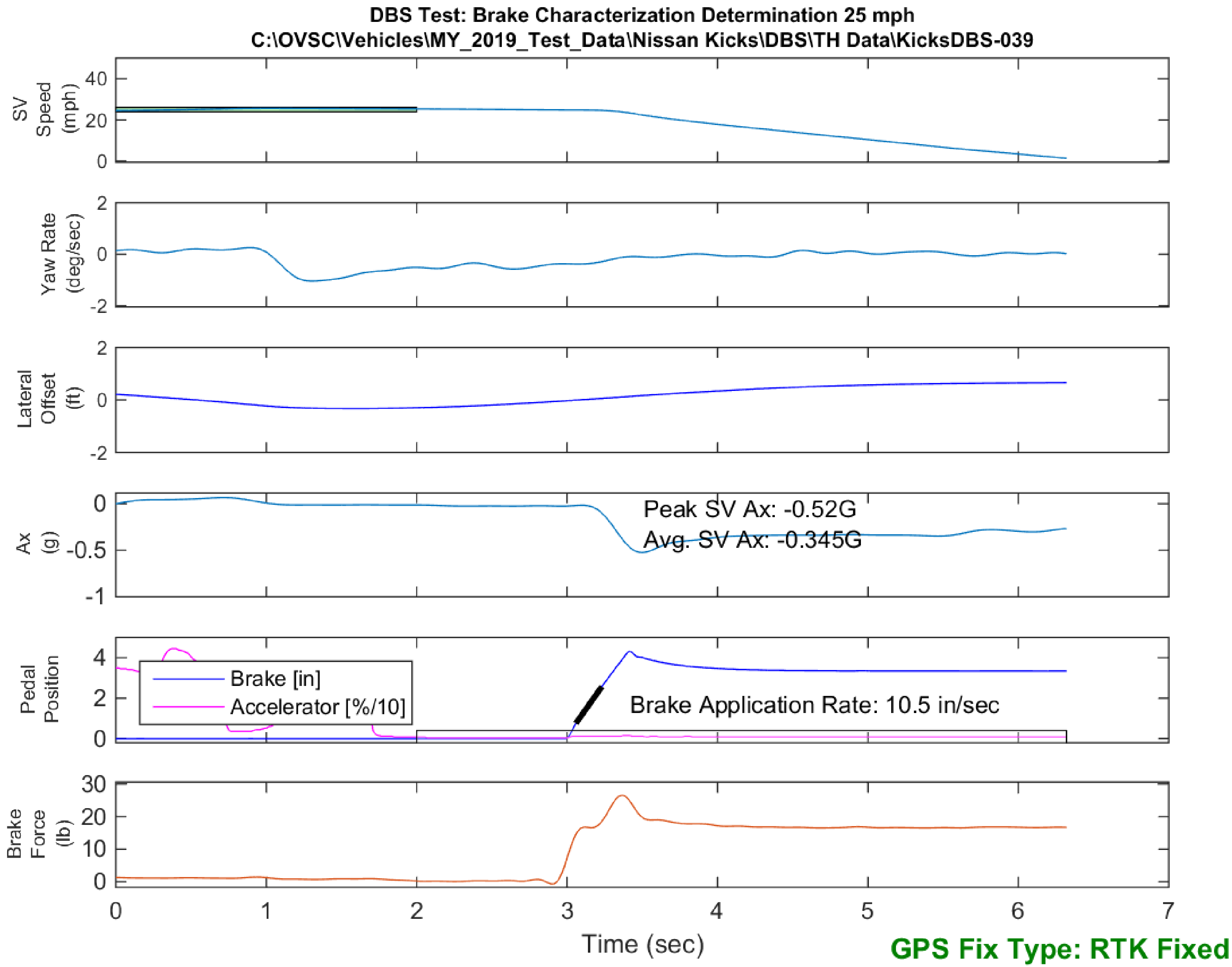


Figure E63. Time History for DBS Run 39, Brake Characterization Determination 25 mph

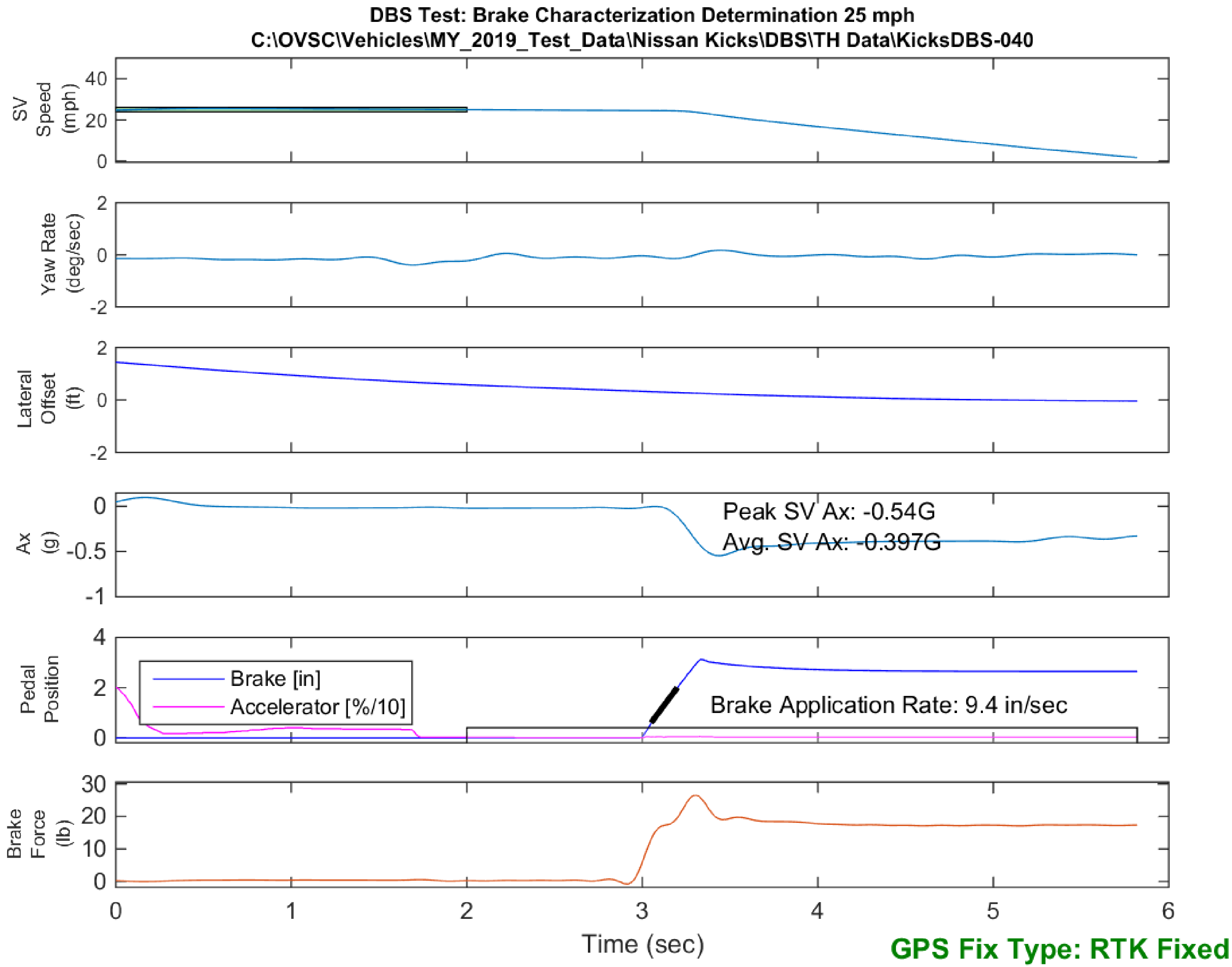


Figure E64. Time History for DBS Run 40, Brake Characterization Determination 25 mph

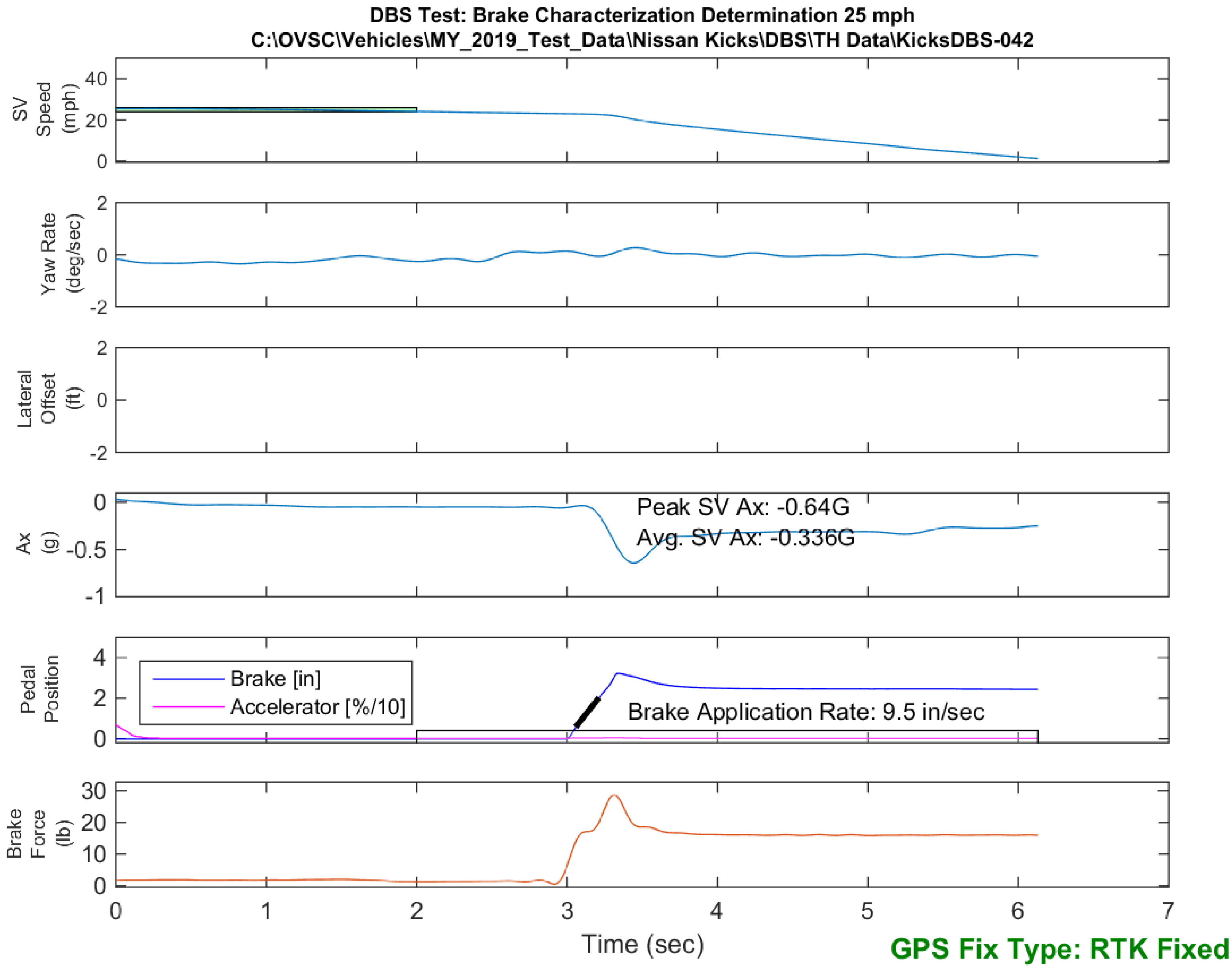


Figure E65. Time History for DBS Run 42, Brake Characterization Determination 25 mph

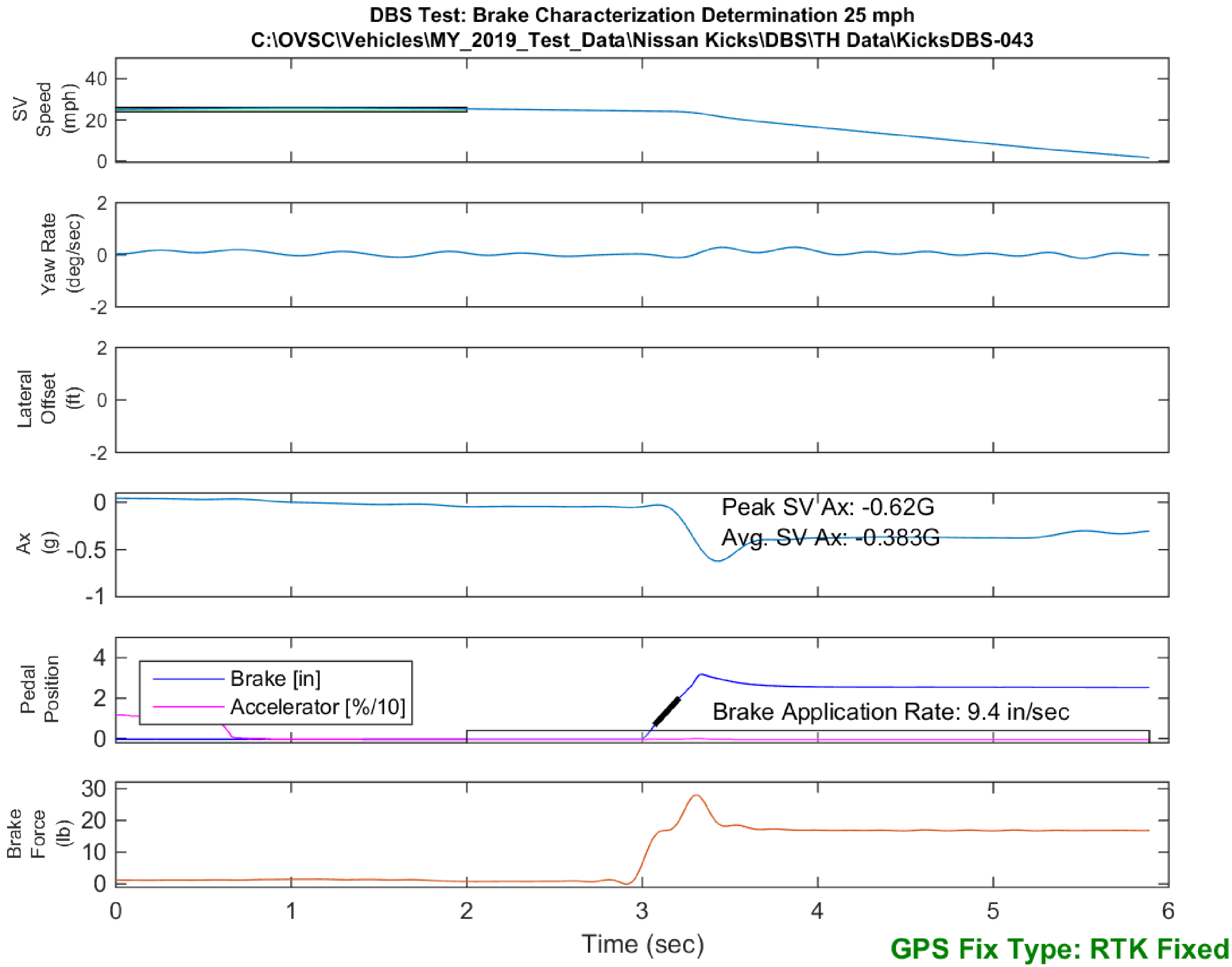


Figure E66. Time History for DBS Run 43, Brake Characterization Determination 25 mph

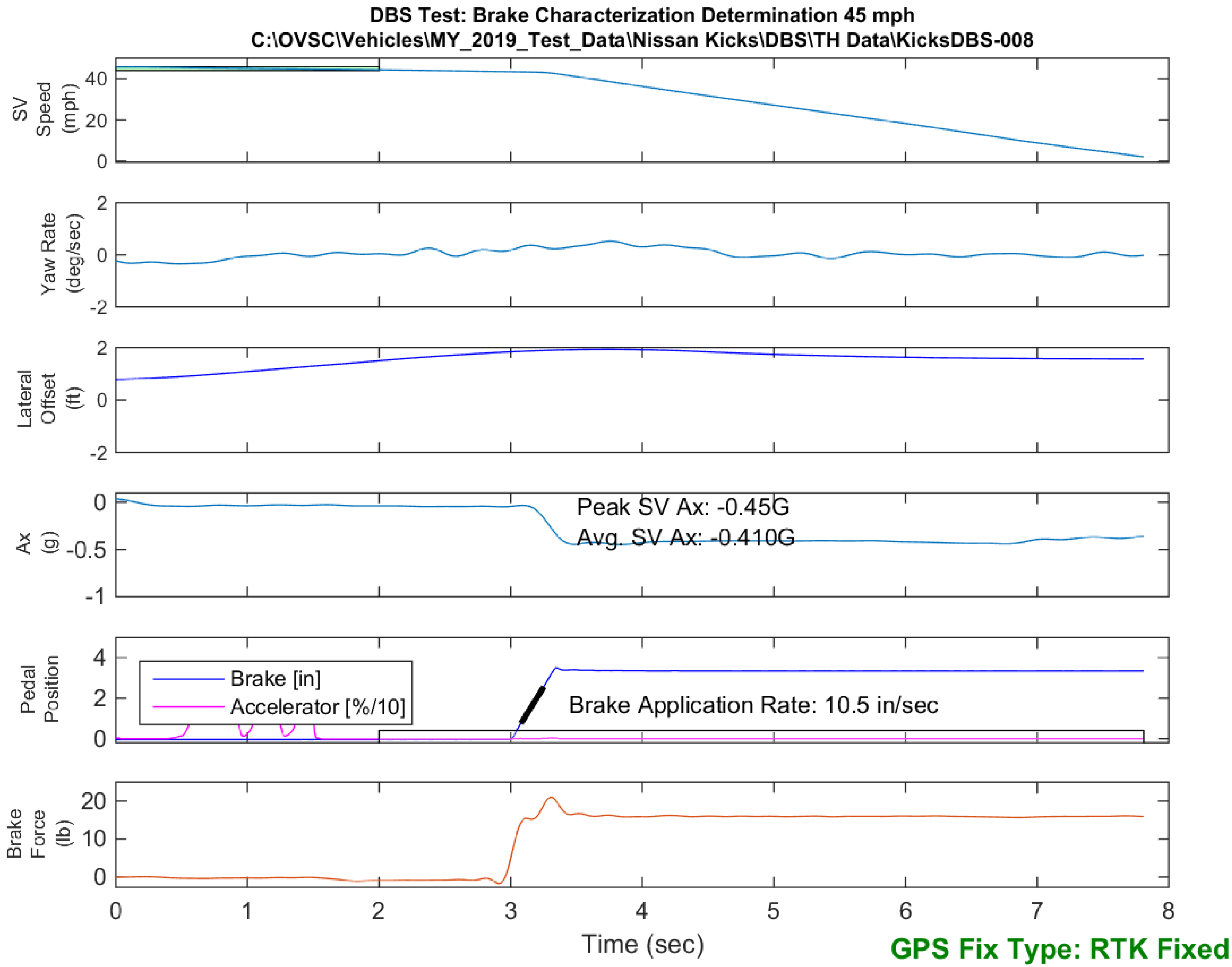


Figure E67. Time History for DBS Run 8, Brake Characterization Determination 45 mph

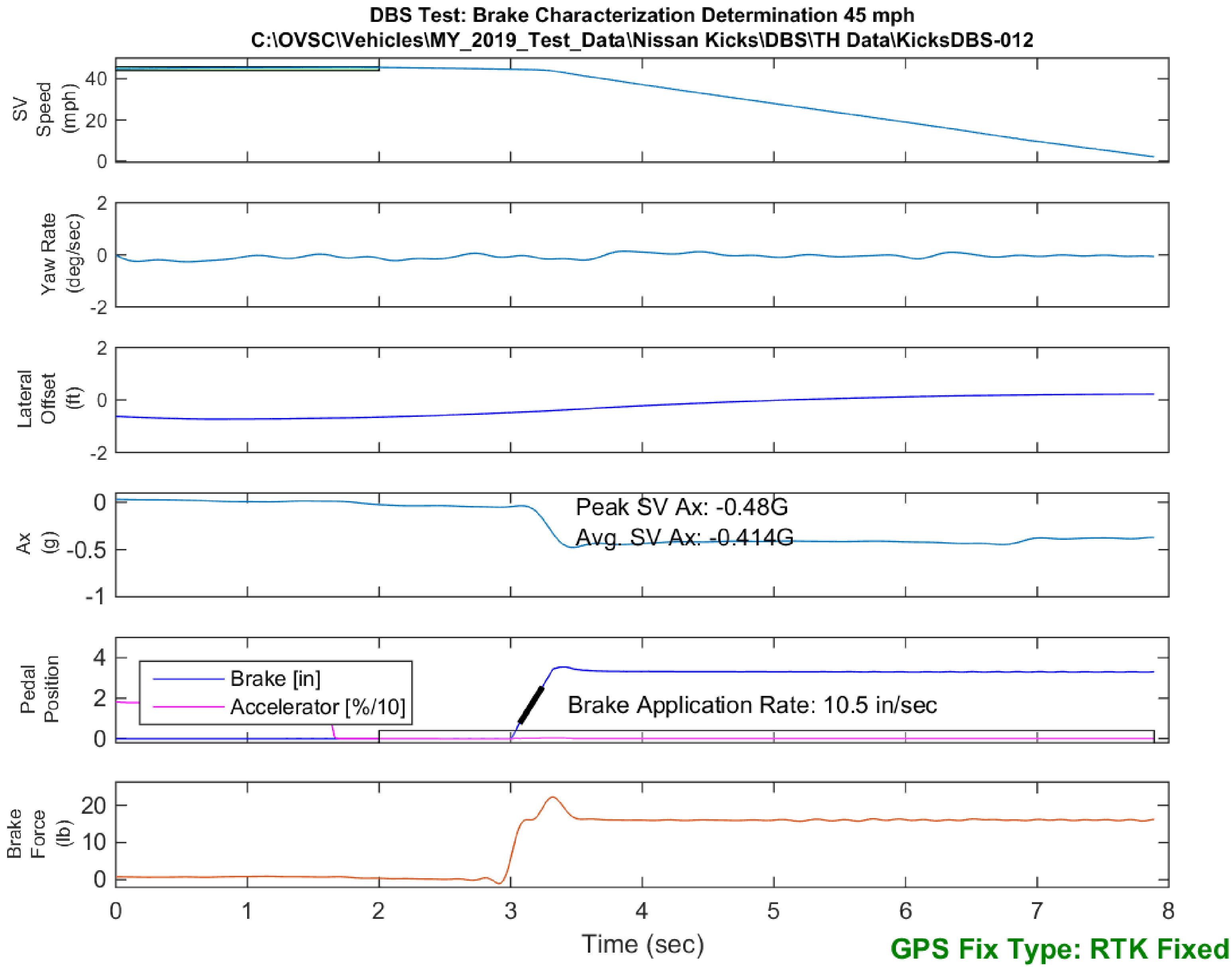


Figure E68. Time History for DBS Run 12, Brake Characterization Determination 45 mph

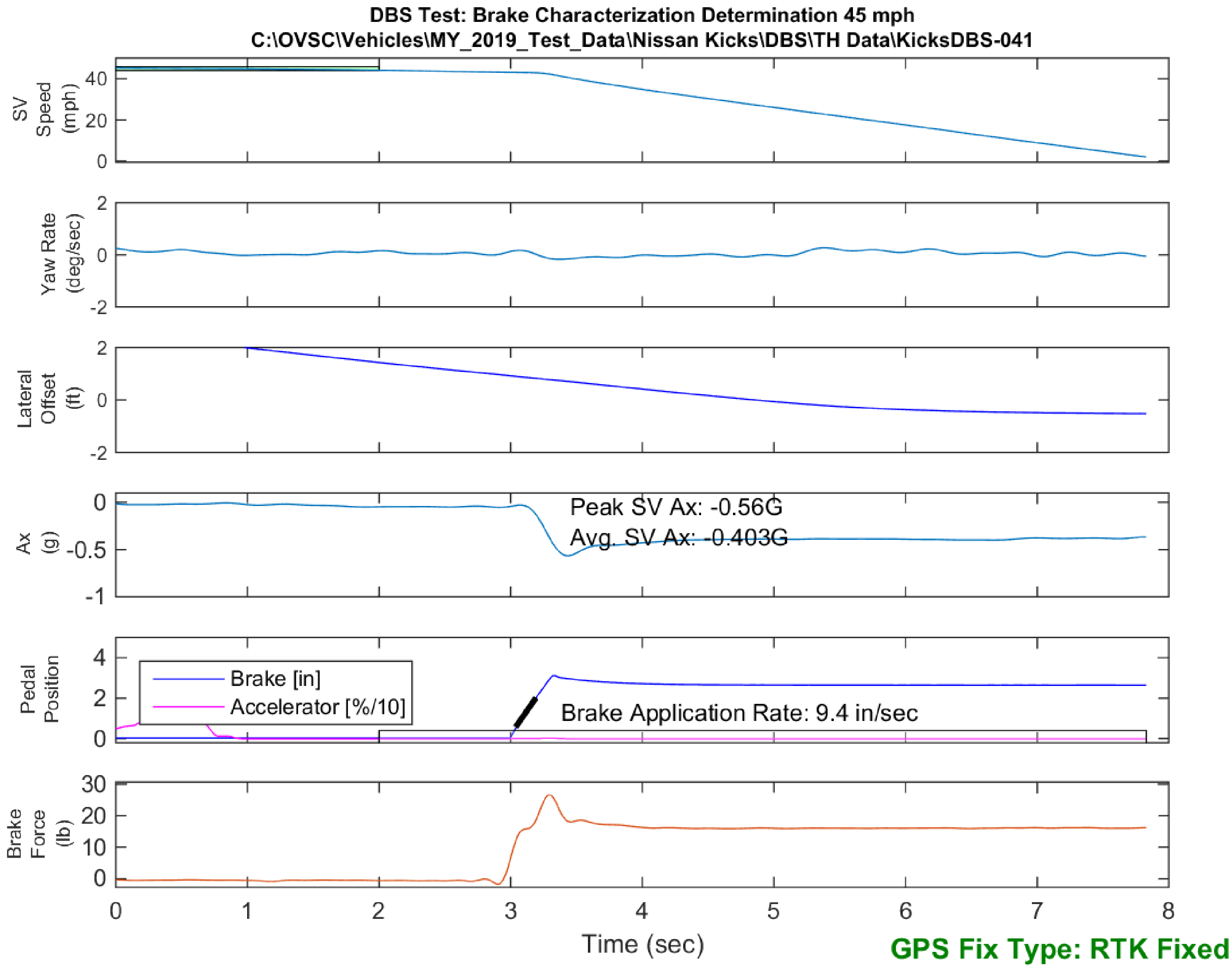


Figure E69. Time History for DBS Run 41, Brake Characterization Determination 45 mph

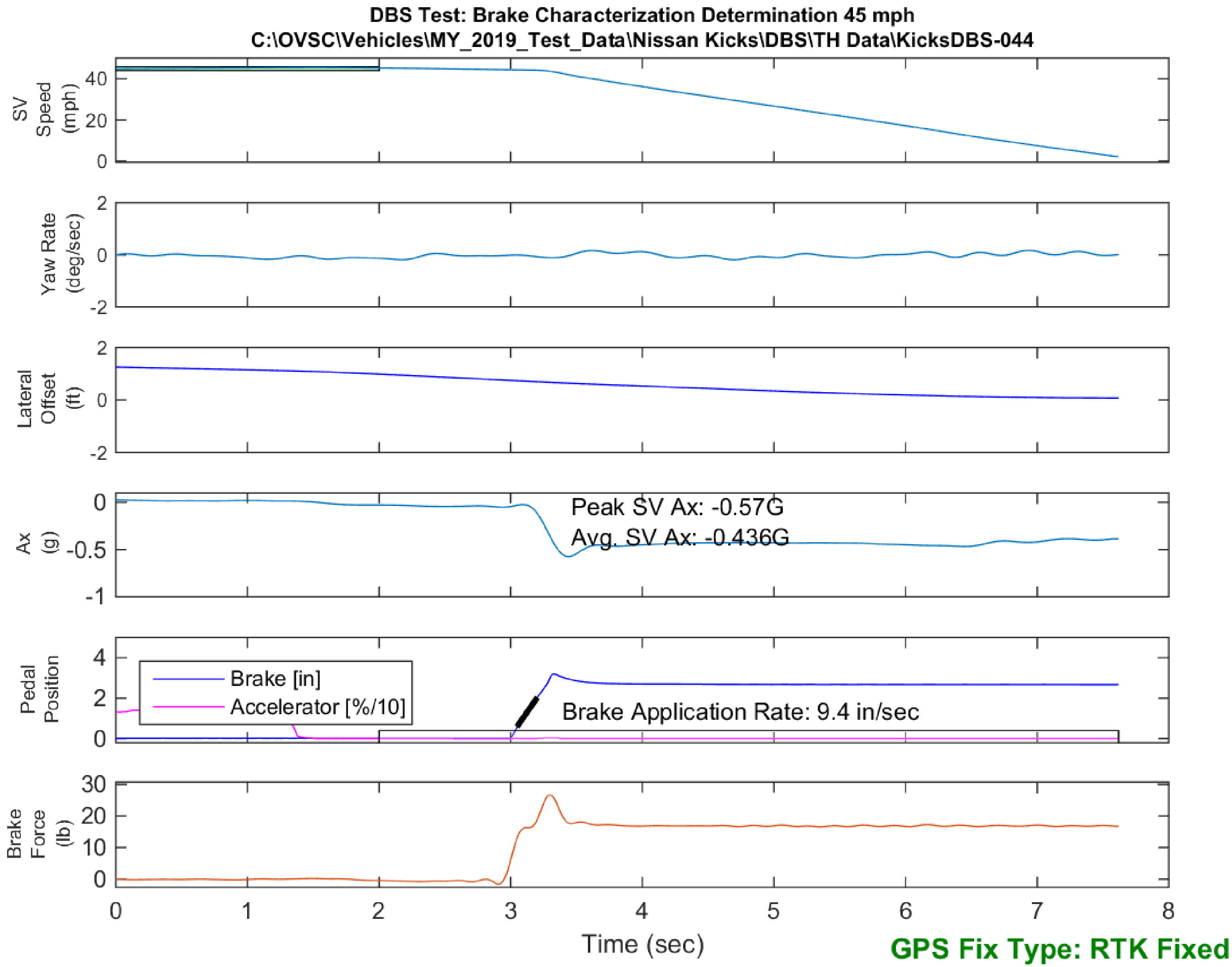


Figure E70. Time History for DBS Run 44, Brake Characterization Determination 45 mph

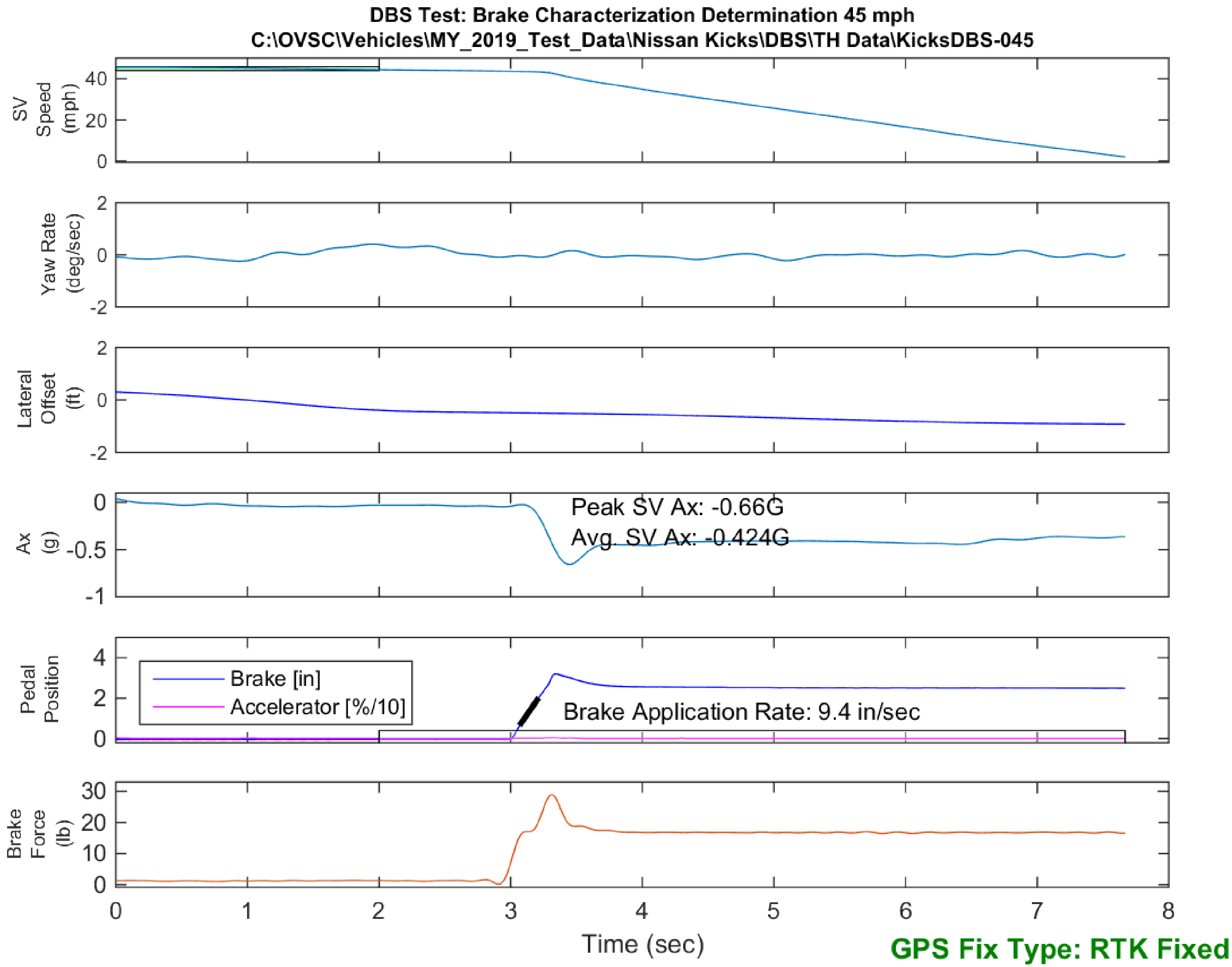


Figure E71. Time History for DBS Run 45, Brake Characterization Determination 45 mph