

**NEW CAR ASSESSMENT PROGRAM
DYNAMIC BRAKE SUPPORT SYSTEM CONFIRMATION TEST
NCAP-DRI-DBS-21-02**

2021 Chevrolet Tahoe 2WD High Country

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Final Report

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Section I

INTRODUCTION

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 2021 Chevrolet Tahoe 2WD High Country. 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

DYNAMIC BRAKE SUPPORT
DATA SHEET 1: TEST RESULTS SUMMARY

(Page 1 of 1)

2021 Chevrolet Tahoe 2WD High Country

VIN: 1GNSCTKL9MR11xxxx

Test Date: 2/11/2021

Dynamic Brake Support System setting:

Alert and Brake, secondary auditory alert

**Test 1 - Subject Vehicle Encounters
Stopped Principal Other Vehicle**

SV 25 mph: Pass

**Test 2 - Subject Vehicle Encounters
Slower Principal Other Vehicle**

SV 25 mph POV 10 mph: Pass

SV 45 mph POV 20 mph: Pass

**Test 3 - Subject Vehicle Encounters
Decelerating Principal Other Vehicle**

SV 35 mph POV 35 mph: Pass

**Test 4 - Subject Vehicle Encounters
Steel Trench Plate**

SV 25 mph: Pass

SV 45 mph: Pass

Overall: Pass

Notes:

DYNAMIC BRAKE SUPPORT
DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2021 Chevrolet Tahoe 2WD High Country

TEST VEHICLE INFORMATION

VIN: 1GNSCTKL9MR11xxxx

Body Style: SUV

Color: Graywood Metallic

Date Received: 2/1/2021

Odometer Reading: 207 mi

DATA FROM VEHICLE'S CERTIFICATION LABEL

Vehicle manufactured by: General Motors LLC

Date of manufacture: 07/20

Vehicle Type: MPV

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: 275/50R22 H

Rear: 275/50R22 H

Recommended cold tire pressure: Front: 250 kPa (36 psi)

Rear: 250 kPa (36 psi)

TIRES

Tire manufacturer and model: Bridgestone Alenza A/S 02

Front tire specification: 275/50R22 111H

Rear tire specification: 275/50R22 111H

Front tire DOT prefix: 1W2RHAA21

Rear tire DOT prefix: 1W2RHAA21

DYNAMIC BRAKE SUPPORT
DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2021 Chevrolet Tahoe 2WD High Country

GENERAL INFORMATION

Test date: 2/11/2021

AMBIENT CONDITIONS

Air temperature: 18.9 C (66 F)

Wind speed: 2.6 m/s (5.8 mph)

X Wind speed \leq 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: 250 kPa (36 psi)

Rear: 250 kPa (36 psi)

DYNAMIC BRAKE SUPPORT
DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2021 Chevrolet Tahoe 2WD High Country

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front: 684.0 kg (1508 lb)

Right Front: 660.9 kg (1457 lb)

Left Rear: 691.3 kg (1524 lb)

Right Rear: 679.5 kg (1498 lb)

Total: 2715.7 kg (5987 lb)

DYNAMIC BRAKE SUPPORT
DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

(Page 1 of 3)

2021 Chevrolet Tahoe 2WD High Country

Name of the DBS option, option package, etc.:

Enhanced Automatic Emergency Braking. AEB is standard, but the sensor fusion version is only available on Premier or High Country trims.

Type and location of sensor(s) the system uses:

Fusion (radar and mono camera). The camera is located at the top center of windshield. The radar is located behind the lower grille on the passenger side of the vehicle.

System setting used for test (if applicable): Alert and Brake

Brake application mode used for test: Hybrid control

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

4 km/h (2.5 mph) (Per manufacturer supplied information)

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

Maximum vehicle speed (Per manufacturer supplied information)

Does the vehicle system require an initialization sequence/procedure?

____ Yes
X No

If yes, please provide a full description.

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

____ Yes
X No

If yes, please provide a full description.

DYNAMIC BRAKE SUPPORT

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

(Page 2 of 3)

2021 Chevrolet Tahoe 2WD High Country

How is the Forward Collision Warning presented ☒ Warning light
to the driver? _____
(Check all that apply) ☒ Buzzer or auditory 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, auditory, vibration, or combination), etc.

The visual alert is presented in the heads-up display and depicts profile views of two vehicles with a broken star above. See Appendix A, Figure A16.

In addition, either a haptic or auditory alert can be selected as a secondary alert. The auditory alert is a repeated set of beeps that sounds from the front, and the seat bottom vibrates as the haptic alert. Note that it is not possible to select both haptic and auditory secondary alerts.

Is there a way to deactivate the system? ☒ Yes
_____ No

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

System menus are used to interact with the settings. The menu hierarchy is:

Settings

Vehicle

System

Collision/Detection Systems

Forward Collision System

Select from: Off, Alert, Alert and Brake

See Appendix A, Figures A14 and A15.

DYNAMIC BRAKE SUPPORT

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

(Page 3 of 3)

2021 Chevrolet Tahoe 2WD High Country

Is the vehicle equipped with a control whose purpose is to adjust the range setting or otherwise influence the operation of DBS? ☒ Yes
☐ No

If yes, please provide a full description.

The secondary alert can be switched between haptic or auditory. The menu hierarchy is:

Settings

Vehicle

Collision/Detection System

Alert Type

Select from: Beeps and Safety Alert Seat

Are there other driving modes or conditions that render DBS inoperable or reduce its effectiveness? ☒ Yes
☐ No

If yes, please provide a full description.

System limitations are described on pages 269 and 270 of the Owner's Manual, shown in Appendix B, pages B-11 and B-12.

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.

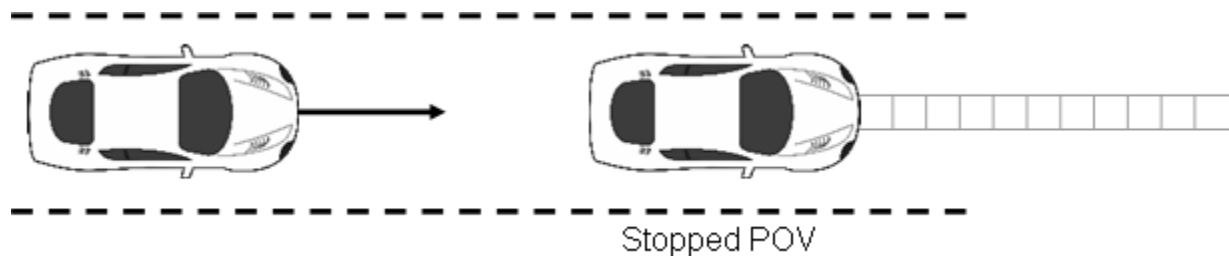


Figure 1. Depiction of Test 1

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 km/h) 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 km/h) 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 km/h) | 0 | 5.1 \rightarrow t_{FCW} | 187 ft (57 m) \rightarrow 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-to-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.

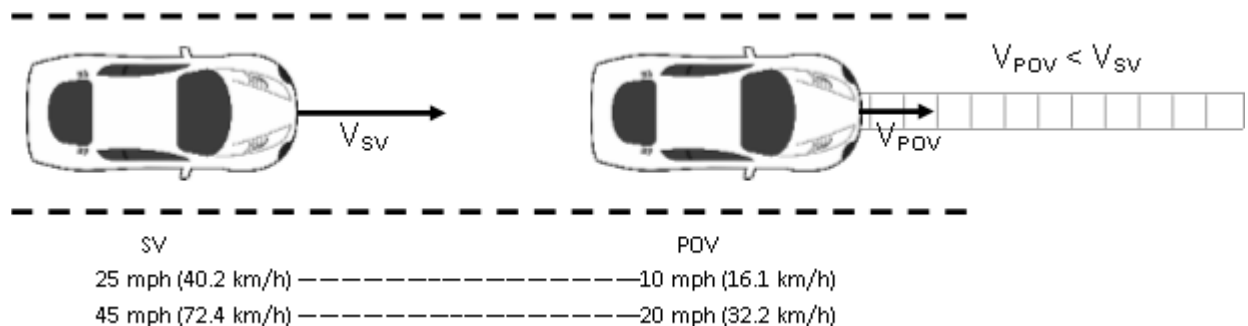


Figure 2. Depiction of Test 2

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 km/h) in the center of the lane of travel while the SV was driven at 25.0 mph (40.2 km/h), 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 km/h) in the center of the lane of travel while the SV was driven at 45.0 mph (72.4 km/h), 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 km/h) during an interval defined by $TTC = 5.0$ seconds to t_{FCW} .
- The POV speed could not deviate more than ± 1.0 mph (± 1.6 km/h) during the validity period.

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 km/h) | 10 mph (16 km/h) | $5.0 \rightarrow t_{FCW}$ | 110 ft (34 m) $\rightarrow t_{FCW}$ | Within 500 ms of FCW1 onset | Varies | 1.0 | 22 ft (7 m) |
| 45 mph (72 km/h) | 20 mph (32 km/h) | $5.0 \rightarrow t_{FCW}$ | 183 ft (56 m) $\rightarrow t_{FCW}$ | 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-to-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.

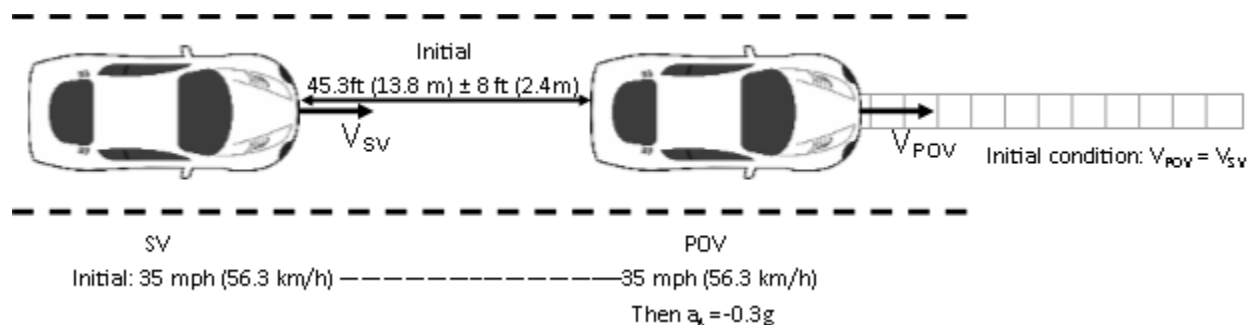


Figure 3. Depiction of Test 3

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 km/h) in the center of the lane, with headway of 45.3 ft (13.8 m) ± 8 ft (2.4 m). Once these conditions were met, the POV tow vehicle brakes were applied to achieve 0.3 ± 0.03 g. 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 km/h) 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 km/h) | 35 mph (56 km/h) | 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-to-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 km/h) and 45 mph (72.4 km/h). The SV was driven directly towards, and over, the STP, which was positioned in the center of a travel lane, with its longest sides parallel to the road edge. 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 1.5 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 auditory, and the onset of the alert is determined by post-processing the test data.

For systems that implement auditory or haptic alerts, part of the pre-test instrumentation verification process is to determine the tonal frequency of the auditory 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 auditory or tactile warning data so that the beginning of such warnings can be programmatically determined. The band-pass 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. Auditory and Tactile Warning Filter Parameters

| Warning Type | Filter Order | Peak-to-Peak Ripple | Minimum Stop Band Attenuation | Passband Frequency Range |
|---------------------|---------------------|----------------------------|--------------------------------------|---------------------------------------|
| Auditory | 5 th | 3 dB | 60 dB | Identified Center Frequency \pm 5% |
| Tactile | 5 th | 3 dB | 60 dB | Identified Center Frequency \pm 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 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 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.

The key requirements of the POV element 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.

The key requirements of the POV delivery system are to:

- Accurately control the nominal POV speed up to 35 mph (56 km/h).
- Accurately control the lateral position of the POV within the travel lane.
- Allow the POV to move away from the SV after an impact occurs.

Operationally, the POV shell is attached to the slider and load frame, which includes rollers that allow 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 SV-to-POV 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 100 psi | Omega DPG8001 | 17042707002 | By: DRI Date: 8/18/2020 Due: 8/18/2021 |
| Platform Scales | Vehicle Total, Wheel, and Axle Load | 2200 lb/platform | 0.1% of reading | Intercomp SW wireless | 0410MN20001 | By: DRI Date: 4/20/2020 Due: 4/20/2021 |
| Linear (string) encoder | Throttle pedal travel | 10 in 254 mm | 0.1 in 2.54 mm | UniMeasure LX-EP | 49041189 | By: DRI Date: 5/22/2020 Due: 5/22/2021 |
| Load Cell | Force applied to brake pedal | | | | | By: DRI |
| | | 0 - 250 lb 0 - 1112 N | 0.1% FS | Stellar Technology PNC700 | 2002505 | Date: 5/11/2020 Due: 5/11/2021 |
| | | 0-250 lb 1112 N | 0.05% FS | Stellar Technology PNC700 | 1607338 | Date: 7/2/2020 Due: 7/2/2021 |
| Differential Global Positioning System | Position, Velocity | Latitude: ± 90 deg Longitude: ± 180 deg Altitude: 0-18 km Velocity: 0-1000 knots | Horizontal Position: ± 1 cm Vertical Position: ± 2 cm Velocity: 0.05 km/h | Trimble GPS Receiver, 5700 (base station and in-vehicle) | 00440100989 | N/A |

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 $\pm 10g$, Angular Rate ± 100 deg/s, Angle >45 deg, Velocity >200 km/h | Accels $.01g$, Angular Rate 0.05 deg/s, Angle 0.05 deg, Velocity 0.1 km/h | Oxford Inertial + | | By: Oxford Technical Solutions |
| | | | | | 2258 | Date: 5/3/2019 Due: 5/3/2021 |
| | | | | | 2182 | Date: 9/16/2019 Due: 9/16/2021 |
| 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: ± 0.02 m/sec Longitudinal Range: ± 3 cm Longitudinal Range Rate: ± 0.02 m/sec | Oxford Technical Solutions (OXTS), RT-Range | 97 | N/A |
| Microphone | Sound (to measure time at alert) | Frequency Response: 80 Hz – 20 kHz | Signal-to-noise: 64 dB, 1 kHz at 1 Pa | Audio-Technica AT899 | N/A | N/A |
| Light Sensor | Light intensity (to measure time at alert) | Spectral Bandwidth: 440-800 nm | Rise time < 10 msec | DRI designed and developed Light Sensor | N/A | N/A |
| Accelerometer | Acceleration (to measure time at alert) | $\pm 5g$ | $\leq 3\%$ of full range | Silicon Designs, 2210-005 | N/A | N/A |

| 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 | ± 0.0020 in. ± 0.051 mm (Single point articulation accuracy) | Faro Arm, Fusion | UO8-05-08-06636 | By: DRI Date: 1/6/2021 Due: 1/6/2022 |
| 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). | | | dSPACE Micro-Autobox II 1401/1513 | | |
| | | | | Base Board | | 549068 |
| | | | | I/O Board | | 588523 |

APPENDIX A

Photographs

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Figure A1. Front View of Subject Vehicle



Figure A2. Rear View of Subject Vehicle



CHEVROLET

2021 TAHOE 2WD HIGH COUNTRY

EXTERIOR: GRAYWOOD METALLIC
INTERIOR: JET BLACK / MOCHA

ENGINE, 6.2L ECOTEC3 V8
TRANSMISSION, 10-SPEED AUTO

Visit us at www.chevy.com

STANDARD EQUIPMENT

ITEMS FEATURED BELOW ARE INCLUDED AT NO EXTRA CHARGE IN THE STANDARD VEHICLE PRICE SHOWN

OWNER BENEFITS

- 3 YEAR/36,000 MILE* BUMPER-TO-BUMPER LIMITED WARRANTY
- 5 YEAR/60,000 MILE* POWERTRAIN LIMITED WARRANTY, ROADSIDE ASSISTANCE & COURTESY TRANSPORTATION
- FIRST MAINTENANCE VISIT
- *WHICHEVER COMES FIRST SEE CHEVROLET.COM OR DEALER FOR TERMS, DETAILS & LIMITS

PERFORMANCE & MECHANICAL

- SUSPENSION, MAGNETIC RIDE CONTROL
- MECHANICAL LIMITED SLIP DIFFERENTIAL
- AUTOMATIC STOP/START ENGINE
- 22" STERLING SILVER PAINTED

WHEELS W/ CHROME INSERTS

- STABILITRAK
- ELECTRONIC PRECISION SHIFT
- TRAILERING EQUIPMENT

CONNECTIVITY & TECHNOLOGY

- 10 SPEAKER BOSE AUDIO SYSTEM
- HEAD-UP DISPLAY
- CHEVROLET INFOTAINMENT 3 PREMIUM WITH NAVIGATION 10.2" DIAG HD COLOR TOUCH-SCREEN, VOICE RECOGNITION, WIRELESS APPLE CARPLAY & WIRELESS ANDROID AUTO CAPABLE BLUETOOTH AUDIO STREAMING, IN-VEHICLE APPS AND PERSONALIZATION CAPABLE
- WIRELESS CHARGING FOR DEVICES
- KEYLESS OPEN, LOCK & START
- ONSTAR (R) SERVICES & 4G LTE WI-FI (R) AVAILABLE; SEE ONSTAR.COM FOR TERMS
- SIRIUSXM RADIO CAPABLE,

ALL ACCESS TRIAL W/ SUBSCRIPTION SOLD SEPARATELY

INTERIOR

- TRI-ZONE AUTOMATIC HVAC
- REAR CAMERA MIRROR
- HEATED AND VENTILATED FRONT POWER BUCKET SEATS W/ LEATHER SEATING SURFACES
- MEMORY SETTINGS, DRIVER SEAT, OUTSIDE MIRRORS, STEERING COLUMN
- SECOND ROW HEATED BUCKET SEATS, POWER RELEASE
- THIRD ROW 60/40 SPLIT BENCH, POWER FOLD

EXTERIOR

- LED HEADLAMPS & TAILLAMPS
- LED DAYTIME RUNNING LAMPS
- HANDS FREE POWER LIFTGATE
- POWER FOLD MIRRORS
- DUAL EXHAUST W/ DUAL TIPS

SAFETY & SECURITY

- AUTOMATIC EMERGENCY BRAKING
- FORWARD COLLISION ALERT
- LANE KEEP ASSIST W/ LANE DEPARTURE WARNING
- LANE CHANGE ALERT WITH SIDE BLIND ZONE ALERT
- HD SURROUND VISION
- FRONT AND REAR PARK ASSIST
- REAR CROSS TRAFFIC ALERT
- FRONT PEDESTRIAN BRAKING
- REAR PEDESTRIAN ALERT
- FOLLOWING DISTANCE INDICATOR
- SAFETY ALERT SEAT
- THEFT DETERRENT SYSTEM

MANUFACTURER'S SUGGESTED RETAIL PRICE

STANDARD VEHICLE PRICE \$69,600.00

OPTIONS & PRICING

OPTIONS INSTALLED BY THE MANUFACTURER (MAY REPLACE STANDARD EQUIPMENT SHOWN)

PREMIUM PACKAGE: 4,605.00

- SUNROOF, POWER PANORAMIC, TILT-SLIDING WITH POWER SUNSHADE
- ASSIST STEPS, POWER RETRACTABLE W/ PERIMETER LIGHTING
- ADAPTIVE CRUISE CONTROL
- ENHANCED AUTOMATIC EMERGENCY BRAKING (REPLACES STANDARD AUTOMATIC EMERGENCY BRAKING)
- TRAILER BRAKE CONTROLLER
- ADVANCED TRAILERING SYSTEM
- HITCH GUIDANCE W/ HITCH VIEW
- TRAILER SIDE BLIND ZONE ALERT
- ENHANCED COOLING RADIATOR

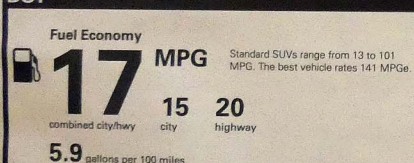
TOTAL OPTIONS \$4,605.00

TOTAL VEHICLE & OPTIONS \$74,205.00

DESTINATION CHARGE 1,295.00

TOTAL VEHICLE PRICE* \$75,500.00

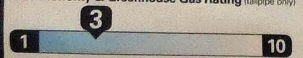
EPA DOT Fuel Economy and Environment



You spend \$6,750 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$2,850

Fuel Economy & Greenhouse Gas Rating (tailpipe only)



Smog Rating (tailpipe only)



Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs \$7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$3.25 per gallon. MPG is miles per gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuelconomy.gov

Calculate personalized estimates and compare vehicles



Equipped with the safety and security of OnStar®. Visit onstar.com for details.

WARNING
Cancer and Reproductive Harm
www.P65Warnings.ca.gov/
passenger-vehicle
SEE OWNER'S MANUAL

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash or rollover risk.

Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 46%
MAJOR SOURCES OF FOREIGN PARTS CONTENT: MEXICO 38%

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT:
ARLINGTON, TX U.S.A.
COUNTRY OF ORIGIN:
ENGINE: UNITED STATES
TRANSMISSION: UNITED STATES

This label has been assigned to the vehicle by the manufacturer. It is not a warranty. The manufacturer's warranty is described in the Owner's Manual. Please read the Owner's Manual for details. Dealer's name and address are listed below. Local taxes or license fees.

© 2020 General Motors LLC. GM, the GM logo, and the GM colors are trademarks of General Motors LLC.

ORDER NO. 1000000000 SALES CODE 8
SALES MODEL CODE 001000
DEALER NO.
FINAL ASSEMBLY:
ARLINGTON, TX U.S.A.
VIN 1GNSCKL9MRT1
DEALER TO WHOM DELIVERED



MU
1AZ0017688



MFD BY GENERAL MOTORS LLC

07/20



634D

GVWR
3357 KG
7400 LB

GAWR FRT
1588 KG
3500 LB

GAWR RR
1950 KG
4300 LB

THIS VEHICLE CONFORMS TO ALL
APPLICABLE U.S. FEDERAL MOTOR
VEHICLE SAFETY STANDARDS IN EFFECT
ON THE DATE OF MANUFACTURE
SHOWN ABOVE.

1GNSCTKL9MR11

TYPE: M.P.V.

| | TIRE SIZE | |
|-----|-----------|---|
| FRT | 275/50R22 | H |
| RR | 275/50R22 | H |
| SPA | 265/70R17 | S |

| RIM |
|-------|
| 22X9J |
| 22X9J |
| 17X7J |

MODEL: 91CC10706

Figure A4. Vehicle Certification Label



TIRE AND LOADING INFORMATION



1GNSCTKL9MR11

SEATING CAPACITY : TOTAL 7 : FRONT 2 : REAR 5

The combined weight of occupants and cargo should never exceed 722 kg or 1590 lbs.

| TIRE | ORIGINAL SIZE | COLD TIRE PRESSURE | SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION |
|-------|---------------|--------------------|--|
| FRONT | 275/50R22 H | 250 kPa, 36 PSI | |
| REAR | 275/50R22 H | 250 kPa, 36 PSI | |
| SPARE | 265/70R17 S | 240 kPa, 35 PSI | |

Figure A5. Tire Placard



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



Figure A7. Load Frame/Slider of SSV

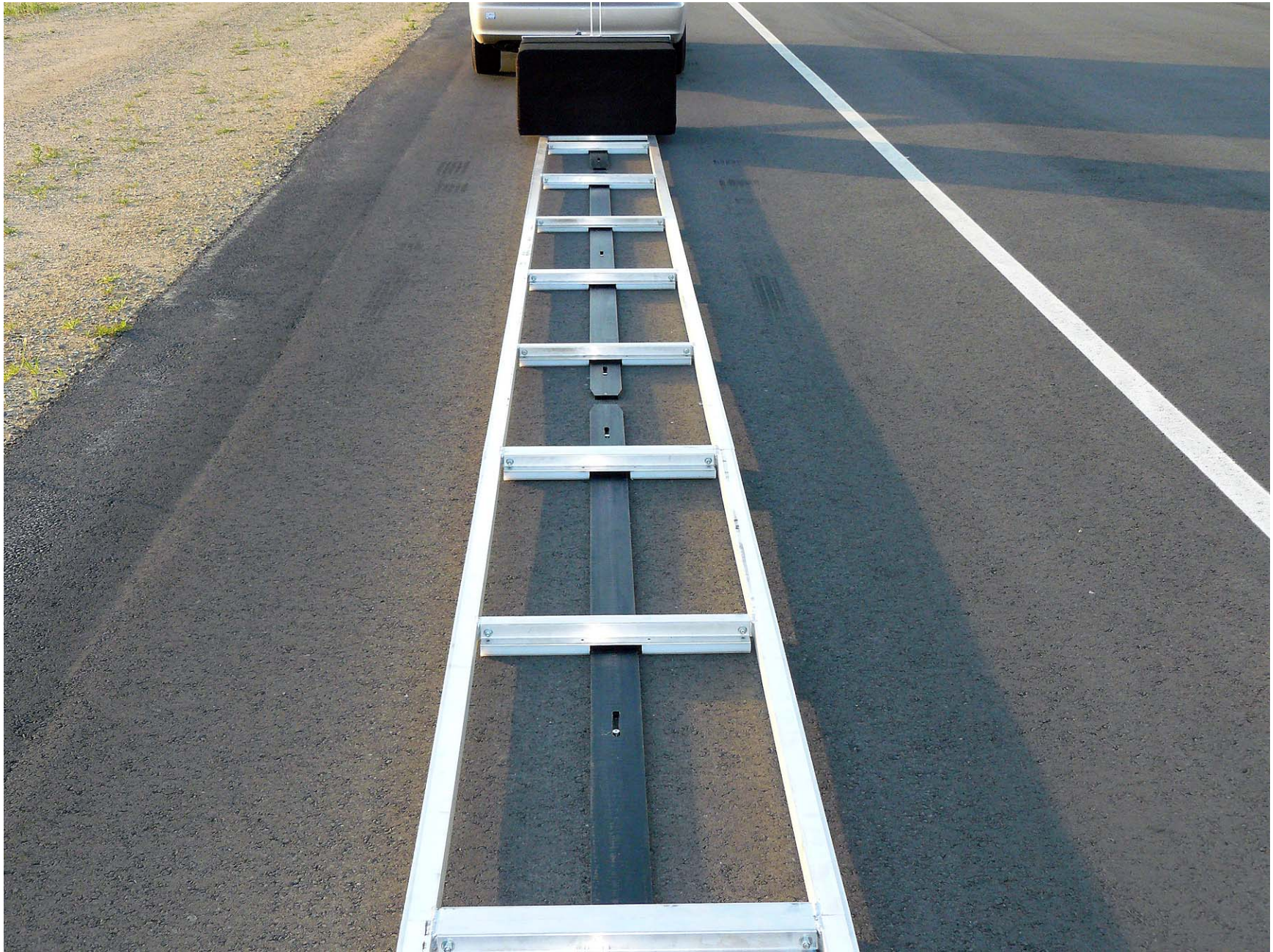


Figure A8. Two-Rail Track and Road-Based Lateral Restraint Track
A-10



Figure A9. Steel Trench Plate
A-11

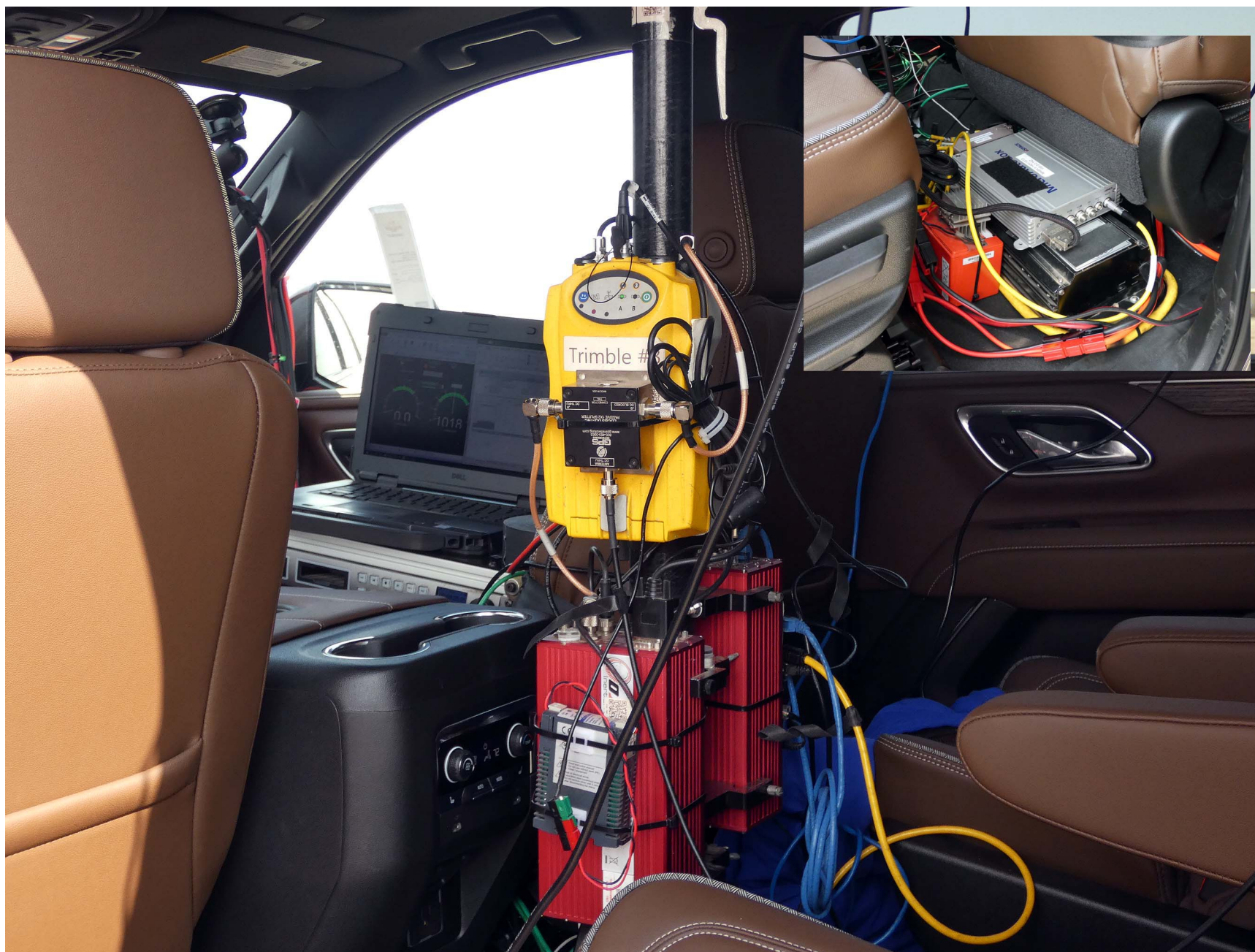


Figure A10. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle



Figure A11. Sensors for Detecting Visual and Auditory Alerts



Figure A12. Computer and Brake Actuator Installed in Subject Vehicle



Figure A13. Brake Actuator Installed in POV System



Figure A14. System Setup Menus (page 1 of 2)

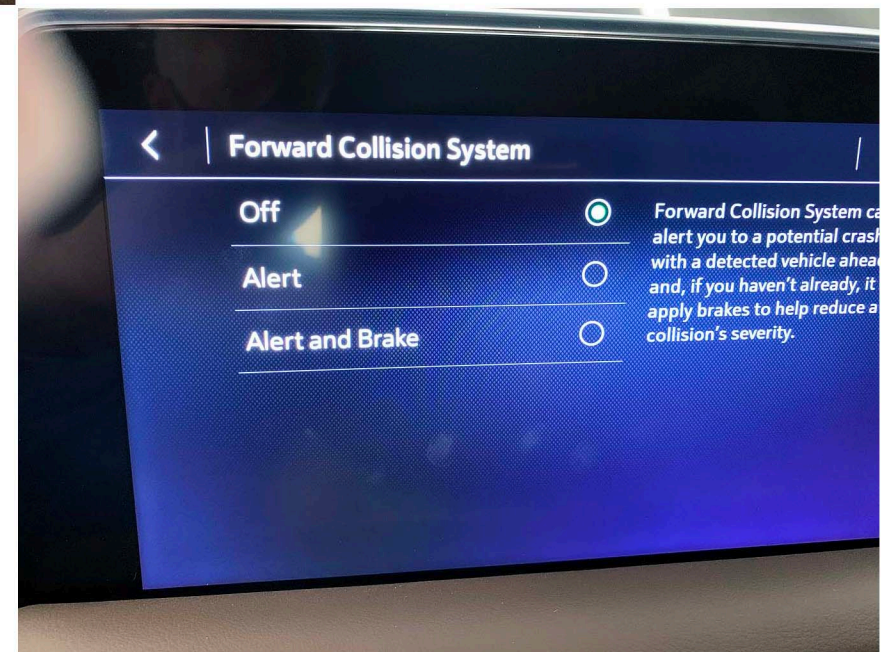
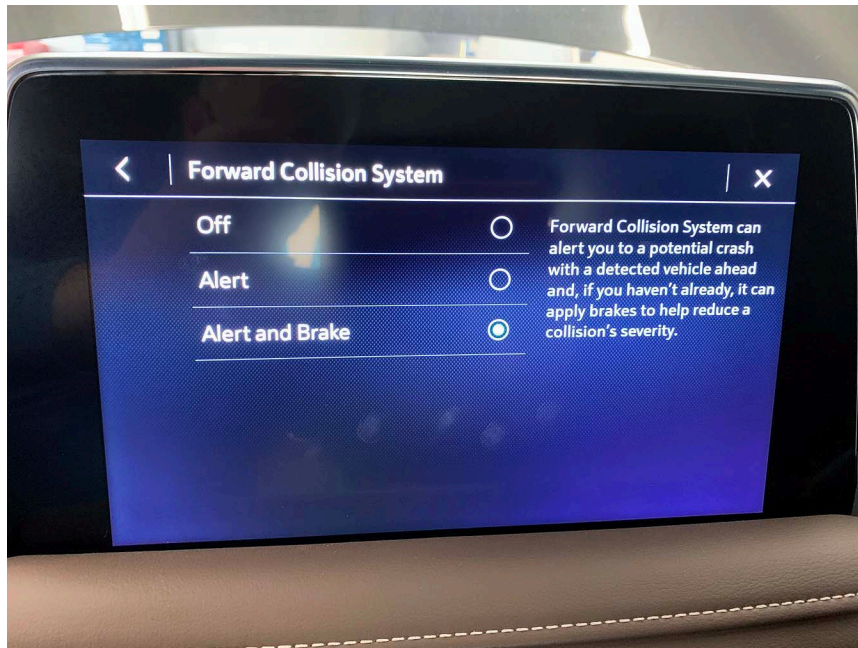


Figure A15. System Setup Menus (page 2 of 2)



Figure A16. Visual Alerts
A-18

APPENDIX B

Excerpts from Owner's Manual

Vehicle Symbol Chart

Here are some additional symbols that may be found on the vehicle and what they mean. See the features in this manual for information.

 : Air Conditioning System

 : Air Conditioning Refrigerant Oil

 : Airbag Readiness Light

 : Antilock Brake System (ABS)

 : Brake System Warning Light

 : Dispose of Used Components Properly

 : Do Not Apply High Pressure Water

 : Engine Coolant Temperature


 : Flame/Fire Prohibited

 : Flammable

 : Forward Collision Alert

 : Fuse Block Cover Lock Location


 : Fuses

 : ISOFIX/LATCH System Child Restraints


 : Keep Fuse Block Covers Properly Installed

 : Lane Change Alert

 : Lane Departure Warning


 : Lane Keep Assist

 : Malfunction Indicator Lamp

 : Oil Pressure


 : Park Assist


 : Pedestrian Ahead Indicator

 : Power

 : Rear Cross Traffic Alert

 : Registered Technician

 : Remote Vehicle Start


 : Risk of Electrical Fire

 : Seat Belt Reminders

 : Side Blind Zone Alert

 : Stop/Start

 : Tire Pressure Monitor

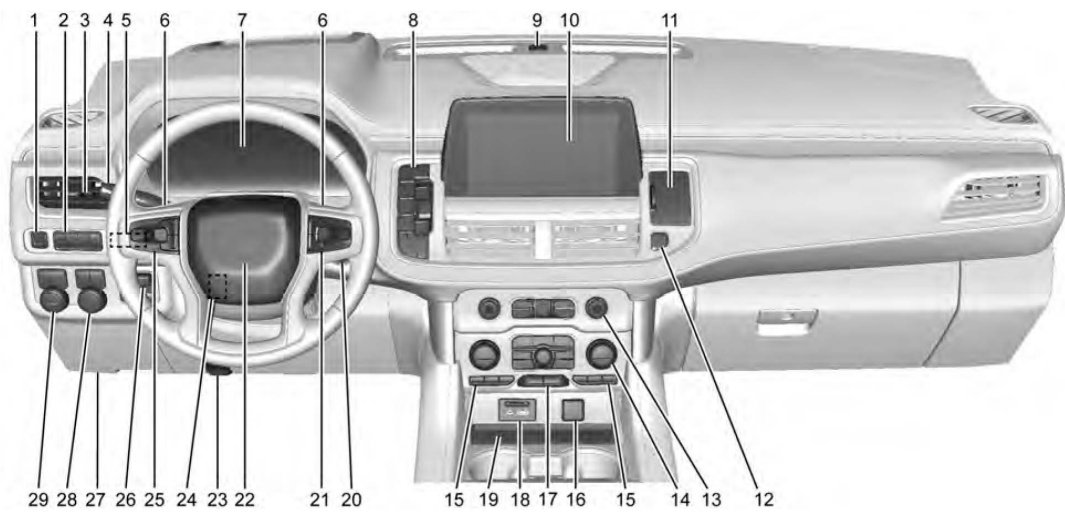
 : Traction Control/StabiliTrak/Electronic Stability Control (ESC)

 : Under Pressure

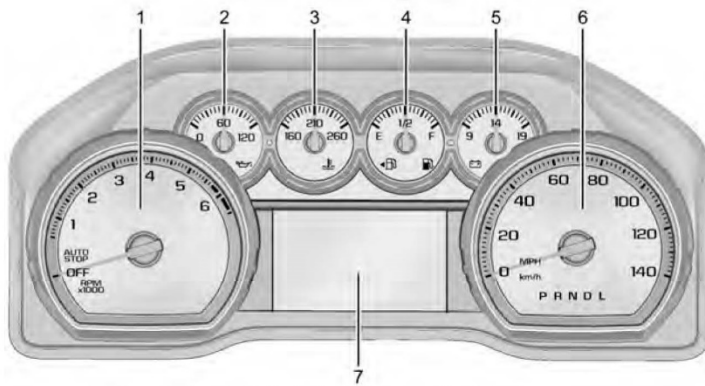
 : Vehicle Ahead Indicator

4 Introduction

Instrument Panel Overview

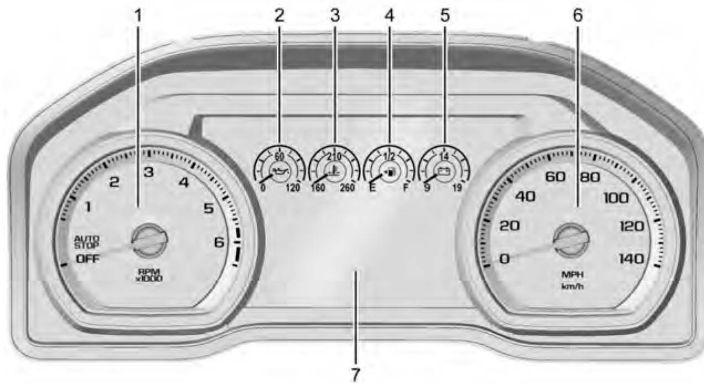


Instrument Cluster



Base Level Cluster English Shown, Metric Similar

- | | |
|---|--|
| 1. Tachometer ⇨ 105 | 5. Voltmeter Gauge ⇨ 107 |
| 2. Engine Oil Pressure Gauge ⇨ 106 | 6. Speedometer ⇨ 105 |
| 3. Engine Coolant Temperature Gauge ⇨ 107 | 7. Driver Information Center (DIC) ⇨ 119 |
| 4. Fuel Gauge ⇨ 105 | |

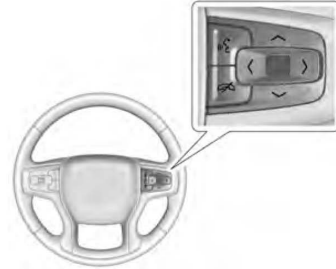


Uplevel Cluster English Shown, Metric Similar

- | | |
|---|--|
| 1. Tachometer ⇨ 105 | 4. Fuel Gauge ⇨ 105 |
| 2. Engine Oil Pressure Gauge ⇨ 106 | 5. Voltmeter Gauge ⇨ 107 |
| 3. Engine Coolant Temperature Gauge ⇨ 107 | 6. Speedometer ⇨ 105 |
| | 7. Driver Information Center (DIC) ⇨ 119 |

Cluster Menu

There is an interactive display area in the center of the instrument cluster.



Use the right steering wheel control to open and scroll through the different items and displays.

Press < or > to access the cluster applications. Use the thumbwheel to scroll through the list of available features. Press the thumbwheel to select. Not all applications will be available on all vehicles.

- Home

If the ABS warning light stays on, or comes on again while driving, the vehicle needs service. A chime may also sound when the light stays on.

If the ABS warning light is the only light on, the vehicle has regular brakes, but ABS is not functioning.

If both the ABS warning light and the brake system warning light are on, ABS is not functioning and there is a problem with the regular brakes. See your dealer for service.

See *Brake System Warning Light* ⇨ 111.

Four-Wheel-Drive Light



Auto Mode Shown, Other Modes Similar

If equipped, the four-wheel-drive light displays what mode the vehicle is in. The light will show each mode: 2WD, 4HI, AUTO (all transfer cases); 4LOW and N (two-speed transfer case only).

The light will flash when a shift is in progress. Once the shift is complete the light will be steady.

If the light turns amber, there may be a malfunction with the four-wheel-drive system. See your dealer.

See *Four-Wheel Drive* ⇨ 236.

Hill Descent Control Light



If equipped, the Hill Descent Control light comes on when the system is ready for use. When the light flashes, the system is active.

See *Hill Descent Control (HDC)* ⇨ 244.

Lane Keep Assist (LKA) Light



After the vehicle is started, this light turns off and stays off if LKA has not been turned on or is unavailable.

If equipped, this light is white if LKA is turned on, but not ready to assist.

This light is green if LKA is turned on and is ready to assist.

LKA may assist by gently turning the steering wheel if the vehicle approaches a detected lane marking. The LKA light is amber when assisting.



This light flashes amber as a Lane Departure Warning (LDW) alert, to indicate that the lane marking has been crossed.


LKA will not assist or alert if the turn signal is active in the direction of lane departure, or if LKA detects that you are accelerating, braking or actively steering.

See *Lane Keep Assist (LKA)* ⇨ 275.

Vehicle Ahead Indicator



4. Touch  or  to turn a feature off or on.

5. Touch  to go to the top level of the Settings menu.

The menu may contain the following:

Rear Seat Reminder

This allows for a chime and a message when the rear door has been opened before or during operation of the vehicle.

Touch Off or On.

Climate and Air Quality

Touch and the following may display:

- Auto Fan Speed
- Auto Cooled Seats
- Auto Heated Seats
- Auto Defog
- Auto Rear Defog

Auto Fan Speed

This setting specifies the amount of airflow when the climate control fan setting is Auto Fan.

Touch Low, Medium, or High.

Auto Cooled Seats

This setting automatically turns on and regulates the ventilated seats when the cabin temperature is warm. See *Heated and Ventilated Front Seats* ⇨ 43.

Touch Off or On.

Auto Heated Seats

This setting automatically turns on and regulates the heated seats when the cabin temperature is cool. The auto heated seats can be turned off by using the heated seat buttons on the center stack. See *Heated and Ventilated Front Seats* ⇨ 43.

If equipped with the auto heated steering wheel, this feature will turn on when the auto heated seats turn on.

Touch Off or On.

Auto Defog

This setting automatically directs air to the windshield to assist in defogging, based on temperature and humidity conditions.

Touch Off or On.

Auto Rear Defog

This setting automatically turns the rear defogger on based on temperature and humidity conditions.

Touch Off or On.

Collision/Detection Systems

Touch and the following may display:

- Alert Type
- Forward Collision System
- Front Pedestrian Detection
- Adaptive Cruise Go Notifier
- Lane Change Alert
- Park Assist
- Rear Camera Park Assist Symbols
- Rear Cross Traffic Alert
- Rear Pedestrian Detection

Alert Type

This feature sets the type of alert from the driver assistance systems to help avoid crashes.

Touch Beeps or Safety Alert Seat.

Forward Collision System

This setting can alert of a potential crash with a detected vehicle ahead and can apply brakes to help reduce a collision's severity.

Touch Off, Alert, or Alert and Brake.

Front Pedestrian Detection

This feature may help avoid or reduce the harm caused by front-end crashes with nearby pedestrians. See *Front Pedestrian Braking (FPB) System* ⇨ 270.

Touch Off, Alert, or Alert and Brake.

Adaptive Cruise Go Notifier

This setting determines if an alert will appear when Adaptive Cruise Control brings the vehicle to a complete stop and the vehicle ahead of you starts moving again. See *Adaptive Cruise Control (Advanced)* ⇨ 253.

Touch Off or On.

Lane Change Alert

This allows the feature to be turned on or off. See *Lane Change Alert (LCA)* ⇨ 272.

Touch Off or On.

Park Assist

This allows the feature to be turned on or off. See *Assistance Systems for Parking or Backing* ⇨ 262.

Select Off or On.

Rear Camera Park Assist Symbols

This setting enables the Rear Camera Park Assist Symbols. See *Assistance Systems for Parking or Backing* ⇨ 262.

Touch Off or On.

Rear Cross Traffic Alert

This allows the Rear Cross Traffic Alert feature to be turned on or off. See *Assistance Systems for Parking or Backing* ⇨ 262.

Touch Off or On.

Rear Pedestrian Detection

This setting specifies if alerts will display when the vehicle detects pedestrians behind when in R (Reverse). See *Rear Pedestrian Alert* ⇨ 266.

Touch Off, Alert, or Alert and Brake.

Comfort and Convenience

Touch and the following may display:

- Automatic Entry/Egress Assist
- Chime Volume
- Hands Free Liftgate/Trunk Control
- Reverse Tilt Mirror
- Remote Mirror Folding
- Rain Sense Wipers

- Auto Wipe in Reverse Gear

Automatic Entry/Egress Assist

This feature specifies if the vehicle will automatically lower to make it easier to enter or exit the vehicle.

Touch Off or On.

Chime Volume

This determines the chime volume level.

Touch the controls on the infotainment display to adjust the volume.

Hands Free Liftgate/Trunk Control

The liftgate may be operated with a kicking motion under the left corner of the rear bumper. See *Liftgate* ⇨ 18.

Touch Off, On-Open and Close, or On-Open Only.

Reverse Tilt Mirror

When on, the driver, passenger, or both driver and passenger outside mirrors will tilt downward when the vehicle is shifted into R (Reverse) to improve visibility of the ground near the rear wheels. They may move from their tilted position when the vehicle is shifted out of R (Reverse) or turned off. See *Reverse Tilt Mirrors* ⇨ 29.

Warning (Continued)

To help avoid death or injury, always check for pedestrians around the vehicle before backing up. Be ready to take action and apply the brakes. See *Defensive Driving* ⇨ 214. Keep the RVC, taillamps, and back-up lamps clean and in good repair.

Rear Pedestrian Alert can be set to Off or Alert. See “Rear Pedestrian Detection” in “Collision/Detection Systems” under *Vehicle Personalization* ⇨ 124. If equipped, alerts can be set to beeps or seat pulses. See “Alert Type” in “Collision/Detection Systems” under *Vehicle Personalization* ⇨ 124.

Assistance Systems for Driving

If equipped, when driving the vehicle in a forward gear, Forward Collision Alert (FCA), Front Pedestrian Braking (FPB), Lane Keep Assist (LKA), Side Blind Zone Alert (SBZA), Lane Change Alert (LCA), and/or Automatic Emergency Braking (AEB) can help to avoid a crash or reduce crash damage.

Forward Collision Alert (FCA) System

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

FCA detects vehicles within a distance of approximately 60 m (197 ft) and operates at speeds above 8 km/h (5 mph). If the vehicle has Adaptive Cruise Control (ACC), it can detect vehicles to distances of approximately 110 m (360 ft) and operates at all speeds. See *Adaptive Cruise Control (Advanced)* ⇨ 253.

Warning

FCA is a warning system and does not apply the brakes. When approaching a slower-moving or stopped vehicle ahead too rapidly, or when following a vehicle too closely, FCA may not provide a warning with enough time to help avoid a crash. It also may not provide any

(Continued)

Warning (Continued)

warning at all. FCA does not warn of pedestrians, animals, signs, guardrails, bridges, construction barrels, or other objects. Be ready to take action and apply the brakes. See *Defensive Driving* ⇨ 214.

FCA can be disabled with either the FCA steering wheel control or, if equipped, through vehicle personalization. See “Collision/Detection Systems” under *Vehicle Personalization* ⇨ 124.

Detecting the Vehicle Ahead



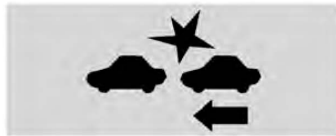
FCA warnings will not occur unless the FCA system detects a vehicle ahead. When a vehicle is detected, the vehicle ahead indicator will display green. Vehicles may not be detected on curves, highway exit ramps, or hills, due to poor visibility; or if a vehicle ahead is partially blocked by

pedestrians or other objects. FCA will not detect another vehicle ahead until it is completely in the driving lane.

Warning

FCA does not provide a warning to help avoid a crash, unless it detects a vehicle. FCA may not detect a vehicle ahead if the FCA sensor is blocked by dirt, snow, or ice, or if the windshield is damaged. It may also not detect a vehicle on winding or hilly roads, or in conditions that can limit visibility such as fog, rain, or snow, or if the headlamps or windshield are not cleaned or in proper condition. Keep the windshield, headlamps, and FCA sensors clean and in good repair.

Collision Alert



With Head-Up Display



Without Head-Up Display

When your vehicle approaches another detected vehicle too rapidly, the red FCA display will flash on the windshield. Also, eight rapid high-pitched beeps will sound from the front, or both sides of the Safety Alert Seat will pulse five times. When this Collision Alert occurs, the brake system may prepare for driver braking to occur more rapidly which can cause a brief, mild deceleration. Continue to apply the brake pedal as needed. Cruise control may be disengaged when the Collision Alert occurs.

Tailgating Alert



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

Selecting the Alert Timing

The Collision Alert control is on the steering wheel. Press  /  to set the FCA timing to Far, Medium, Near, or on some vehicles, Off. The first button press shows the current setting on the DIC. Additional button presses will change this setting. The chosen setting will remain until it is changed and will affect the timing of both the Collision Alert and the Tailgating Alert features. The timing of both alerts will vary based on vehicle speed. The faster the vehicle speed, the farther away the alert will occur. Consider traffic and weather conditions when selecting the alert timing. The range of selectable alert timing may not be appropriate for all drivers and driving conditions.

If your vehicle is equipped with Adaptive Cruise Control (ACC), changing the FCA timing setting automatically changes the ACC following gap setting (Far, Medium, or Near).

Following Distance Indicator

The following distance to a moving vehicle ahead in your path is indicated in following time in seconds on the Driver Information Center (DIC). See *Driver Information Center (DIC)* ⇨ 119. The minimum following time is 0.5 seconds away. If there is no vehicle detected ahead, or the vehicle ahead is out of sensor range, dashes will be displayed.

Unnecessary Alerts

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

Cleaning the System

If the FCA system does not seem to operate properly, this may correct the issue:

- Clean the outside of the windshield in front of the rearview mirror.
- Clean the entire front of the vehicle.
- Clean the headlamps.

For cleaning instructions, see “Washing the Vehicle” under *Exterior Care* ⇨ 376.

System operation may also be limited under snow, heavy rain, or road spray conditions.

Automatic Emergency Braking (AEB)

If the vehicle has Forward Collision Alert (FCA), it also has AEB, which includes Intelligent Brake Assist (IBA). When the system detects a vehicle ahead in your path that is traveling in the same direction that you may be about to crash into, it can provide a boost to braking or automatically brake the vehicle. This can help avoid or lessen the severity of crashes when driving in a forward gear. Depending on the situation, the vehicle may automatically brake moderately or hard. This automatic emergency braking can only occur if a vehicle is detected. This is shown by the FCA vehicle ahead indicator being lit. See *Forward Collision Alert (FCA) System* ⇨ 267.

The system works when driving in a forward gear between 8 km/h (5 mph) and 80 km/h (50 mph), or on vehicles with Adaptive Cruise Control (ACC), above 4 km/h (2 mph). It can detect vehicles up to approximately 60 m (197 ft).

Warning

AEB is an emergency crash preparation feature and is not designed to avoid crashes. Do not rely on AEB to brake the vehicle. AEB will not brake outside of its operating speed range and only responds to detected vehicles.

AEB may not:

- Detect a vehicle ahead on winding or hilly roads.
- Detect all vehicles, especially vehicles with a trailer, tractors, muddy vehicles, etc.
- Detect a vehicle when weather limits visibility, such as in fog, rain, or snow.
- Detect a vehicle ahead if it is partially blocked by pedestrians or other objects.

Complete attention is always required while driving, and you should be ready to take action and apply the brakes and/or steer the vehicle to avoid crashes.

AEB may slow the vehicle to a complete stop to try to avoid a potential crash. The vehicle will only hold at a stop briefly. A firm press of the accelerator pedal will also release AEB.

Warning

AEB may automatically brake the vehicle suddenly in situations where it is unexpected and undesired. It could respond to a turning vehicle ahead, guardrails, signs, and other non-moving objects. To override AEB, firmly press the accelerator pedal, if it is safe to do so.

Intelligent Brake Assist (IBA)

IBA may activate when the brake pedal is applied quickly by providing a boost to braking based on the speed of approach and distance to a vehicle ahead.

Minor brake pedal pulsations or pedal movement during this time is normal and the brake pedal should continue to be applied as needed. IBA will automatically disengage only when the brake pedal is released.

Warning

IBA may increase vehicle braking in situations when it may not be necessary. You could block the flow of traffic. If this occurs, take your foot off the brake pedal and then apply the brakes as needed.

AEB and IBA can be disabled through vehicle personalization. See “Collision/Detection Systems” under *Vehicle Personalization* ⇨ 124.

Warning


Using AEB or IBA while towing a trailer could cause you to lose control of the vehicle and crash. Turn the system to Alert or Off when towing a trailer.

A system unavailable message may display if:

- The front of the vehicle or windshield is not clean.
- Heavy rain or snow is interfering with object detection.
- There is a problem with the StabiliTrak/Electronic Stability Control (ESC) system.

The AEB system does not need service.

Front Pedestrian Braking (FPB) System

If equipped, the FPB system may help avoid or reduce the harm caused by front-end crashes with nearby pedestrians when driving in a forward gear. FPB displays an amber indicator, , when a nearby pedestrian is detected ahead. When approaching a detected pedestrian too quickly, FPB provides a red flashing alert on the windshield and rapidly beeps or pulses the driver seat. FPB can provide a boost to braking or automatically brake the vehicle. This system includes Intelligent Brake Assist (IBA), and the Automatic Emergency Braking (AEB) system may also respond to pedestrians. See *Automatic Emergency Braking (AEB)* ⇨ 269.

The FPB system can detect and alert to pedestrians in a forward gear at speeds between 8 km/h (5 mph) and 80 km/h (50 mph). During daytime driving, the system detects pedestrians up to a distance of approximately 40 m (131 ft). During nighttime driving, system performance is very limited.

APPENDIX C

Run Log

Subject Vehicle: **2021 Chevrolet Tahoe 2WD High Country**

Test Date: **2/11/2021**

Principal Other Vehicle: **SSV**

| Run | Test Type | Valid Run? | FCW TTC (s) | Minimum Distance (ft) | Peak Deceleration (g) | Pass/Fail | Notes |
|------|--|------------|-------------|-----------------------|-----------------------|-----------|--|
| 1-10 | Brake characterization and determination | | | | | | See Appendix D |
| 10 | Static Run | | | | | | Zero SV front bumper to SSV rear bumper and collect data |
| 11 | Stopped POV | Y | 2.73 | 3.06 | 1.10 | Pass | |
| 12 | | Y | 2.25 | 2.65 | 1.07 | Pass | |
| 13 | | Y | 2.33 | 3.35 | 1.11 | Pass | |
| 14 | | Y | 2.24 | 3.17 | 1.11 | Pass | |
| 15 | | Y | 2.31 | 3.36 | 1.08 | Pass | |
| 16 | | Y | 2.30 | 3.47 | 1.12 | Pass | |
| 17 | | Y | 2.26 | 3.22 | 1.13 | Pass | |
| 18 | Static Run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| | | | | | | | |
| 19 | Slower POV, 25 vs 10 | Y | 2.49 | 5.73 | 1.09 | Pass | |
| 20 | | Y | 2.45 | 5.65 | 1.09 | Pass | |
| 21 | | Y | 2.42 | 5.92 | 1.08 | Pass | |
| 22 | | Y | 2.47 | 0.00 | 0.48 | Fail | |
| 23 | | Y | 2.51 | 6.15 | 1.10 | Pass | |
| 24 | | Y | 2.46 | 6.36 | 1.11 | Pass | |
| 25 | | Y | 2.54 | 5.70 | 1.07 | Pass | |

| Run | Test Type | Valid Run? | FCW TTC (s) | Minimum Distance (ft) | Peak Deceleration (g) | Pass/Fail | Notes |
|-----|-----------------------------|------------|-------------|-----------------------|-----------------------|-----------|--|
| 26 | Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| 27 | Slower POV, 45 vs 20 | Y | 3.03 | 9.73 | 1.08 | Pass | |
| 28 | | Y | 2.92 | 10.69 | 1.09 | Pass | |
| 29 | | Y | 3.13 | 10.23 | 1.06 | Pass | |
| 30 | | Y | 2.98 | 9.48 | 1.10 | Pass | |
| 31 | | Y | 3.08 | 9.77 | 1.06 | Pass | |
| 32 | | Y | 2.97 | 10.27 | 1.08 | Pass | |
| 33 | | Y | 3.06 | 10.51 | 1.07 | Pass | |
| 34 | Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| | | | | | | | |
| 35 | Decelerating POV | Y | 2.11 | 0.00 | 0.51 | Fail | |
| 36 | | N | | | | | Brake release early |
| 37 | | Y | 2.28 | 12.61 | 1.06 | Pass | |
| 38 | | Y | 2.14 | 13.56 | 1.09 | Pass | |
| 39 | | N | | | | | SV yaw |
| 40 | | Y | 2.20 | 12.78 | 1.09 | Pass | |
| 41 | | Y | 2.24 | 12.79 | 1.05 | Pass | |
| 42 | | N | | | | | Lost can |
| 43 | | N | | | | | Lost can |
| 44 | | Y | 2.11 | 13.62 | 1.06 | Pass | |
| 45 | | Y | 2.13 | 13.17 | 1.07 | Pass | |
| 46 | Static Run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |

| Run | Test Type | Valid Run? | FCW TTC (s) | Minimum Distance (ft) | Peak Deceleration (g) | Pass/Fail | Notes |
|-----|---------------------|------------|-------------|-----------------------|-----------------------|-----------|---|
| | | | | | | | |
| 47 | STP - Static run | | | | | | Zero SV front bumper to rear edge of steel plate and collect data |
| 48 | Baseline, 25 | N | | | | | Brake force |
| 49 | | Y | | | 0.43 | | |
| 50 | | Y | | | 0.45 | | |
| 51 | | Y | | | 0.42 | | |
| 52 | | Y | | | 0.43 | | |
| 53 | | Y | | | 0.44 | | |
| 54 | | Y | | | 0.45 | | |
| 55 | | Y | | | 0.43 | | |
| 56 | STP - Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| 57 | Baseline, 45 | Y | | | 0.44 | | |
| 58 | | N | | | | | Brake force |
| 59 | | N | | | | | SV speed |
| 60 | | N | | | | | SV speed, brake force |
| 61 | | Y | | | 0.48 | | |
| 62 | | N | | | | | SV speed |
| 63 | | Y | | | 0.47 | | |
| 64 | | Y | | | 0.50 | | |
| 65 | | Y | | | 0.49 | | |
| 66 | | Y | | | 0.53 | | |
| 67 | | N | | | | | Throttle release |

| Run | Test Type | Valid Run? | FCW TTC (s) | Minimum Distance (ft) | Peak Deceleration (g) | Pass/Fail | Notes |
|-----|-------------------------------|------------|-------------|-----------------------|-----------------------|-----------|--|
| 68 | Baseline, 45 | N | | | | | Speed |
| 69 | | Y | | | 0.47 | | |
| 70 | STP - Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| | | | | | | | |
| 71 | Static | | | | | | |
| 72 | STP False Positive, 25 | N | | | | | |
| 73 | | N | | | | | |
| 74 | | Y | | | 0.44 | Pass | |
| 75 | | Y | | | 0.41 | Pass | |
| 76 | | Y | | | 0.42 | Pass | |
| 77 | | Y | | | 0.44 | Pass | |
| 78 | | Y | | | 0.41 | Pass | |
| 79 | | Y | | | 0.41 | Pass | |
| 80 | | Y | | | 0.41 | Pass | |
| 81 | STP - Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |
| 82 | STP False Positive, 45 | Y | | | 0.42 | Pass | |
| 83 | | Y | | | 0.43 | Pass | |
| 84 | | Y | | | 0.47 | Pass | |
| 85 | | Y | | | 0.48 | Pass | |
| 86 | | N | | | | | Brake force, throttle |
| 87 | | N | | | | | accel too high |
| 88 | | Y | | | 0.48 | Pass | |
| 89 | | Y | | | 0.49 | Pass | |

| Run | Test Type | Valid Run? | FCW TTC (s) | Minimum Distance (ft) | Peak Deceleration (g) | Pass/Fail | Notes |
|-----|-------------------------------|------------|-------------|-----------------------|-----------------------|-----------|--|
| 90 | STP False Positive, 45 | N | | | | | Brake force |
| 91 | | N | | | | | Actuator fired early |
| 92 | | Y | | | 0.47 | Pass | |
| 93 | STP - Static run | | | | | | Check zero data is within ± 0.167 ft (± 0.05 m) |

APPENDIX D

Brake Characterization

Subject Vehicle: **2021 Chevrolet Tahoe 2WD High Country**

Test Date: **2/11/2021**

| DBS Initial Brake Characterization | | | | |
|------------------------------------|----------------------|---------------------|----------|-----------|
| Run Number | Stroke at 0.4 g (in) | Force at 0.4 g (lb) | Slope | Intercept |
| 1 | 3.151336 | 17.56142 | 0.554054 | -0.20527 |
| 2 | 3.103046 | 17.36628 | 0.543609 | -0.15895 |
| 3 | 3.020401 | 16.62362 | 0.546051 | -0.17669 |

| DBS Brake Characterization Determination | | | | | | | | |
|--|--------------|-------|-----------|--------------------|-------------------------|------------------------|------------------------------|-------|
| 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 | 0.382 | 3.09 | | 3.24 | |
| 5 | | 25 | Y | 0.391 | 3.09 | | 3.16 | |
| 6 | | 45 | Y | 0.407 | 3.09 | | 3.06 | |
| | | | | | | | | |
| 7 | Hybrid | 35 | Y | 0.404 | 3.09 | 17.18 | 17.01 | |
| 8 | | 25 | N | | | | | |
| 9 | | 25 | Y | 0.410 | 3.09 | 17.18 | 16.76 | |
| 10 | | 45 | Y | 0.403 | 3.09 | 17.18 | 17.05 | |

Appendix E

TIME HISTORY PLOTS

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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)
- Decelerating 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 auditory, visual, or haptic). Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any combination of the following:
 - Filtered, rectified, and normalized sound signal. The vertical scale is 0 to 1.
 - Filtered, rectified, and normalized acceleration (i.e., haptic alert, such as steering wheel vibration). The vertical scale is 0 to 1.
 - Normalized light sensor signal. The vertical scale is 0 to 1.

As only the auditory 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 front-most 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.

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.

With the exception of the brake force plots (see description below), 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 0.27 g (the upper edge of the envelope, i.e., $0.30 \text{ g} \pm 0.03 \text{ g}$). A green circle or red asterisk is displayed at the moment the POV brake level achieves 0.27 g. A green circle indicates that the test was valid (the threshold was crossed during the appropriate interval) and a red asterisk indicates that the test was invalid (the threshold was crossed 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.

For the brake force plots:

- 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. A blue envelope represents the target average brake force necessary 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 the 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 in order 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
- Blue envelope = visualized target range for the time varying data averaged over a period equal to the length of the envelope
- 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

Other Notations

- NG – Indicates that the value for that variable was outside of bounds and therefore “No Good”.
- No Wng – No warning was detected.
- POV – Indicates that the value for the Principal Other Vehicle was out of bounds.
- SV – Indicates that the value for the Subject Vehicle was out of bounds.
- SR – Shows the speed reduction value.
- Thr – Indicates that the requirements for the throttle were not met.

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

Examples of valid or passing time history plots for each test type (including passing, failing, and invalid runs) are shown in Figures 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.

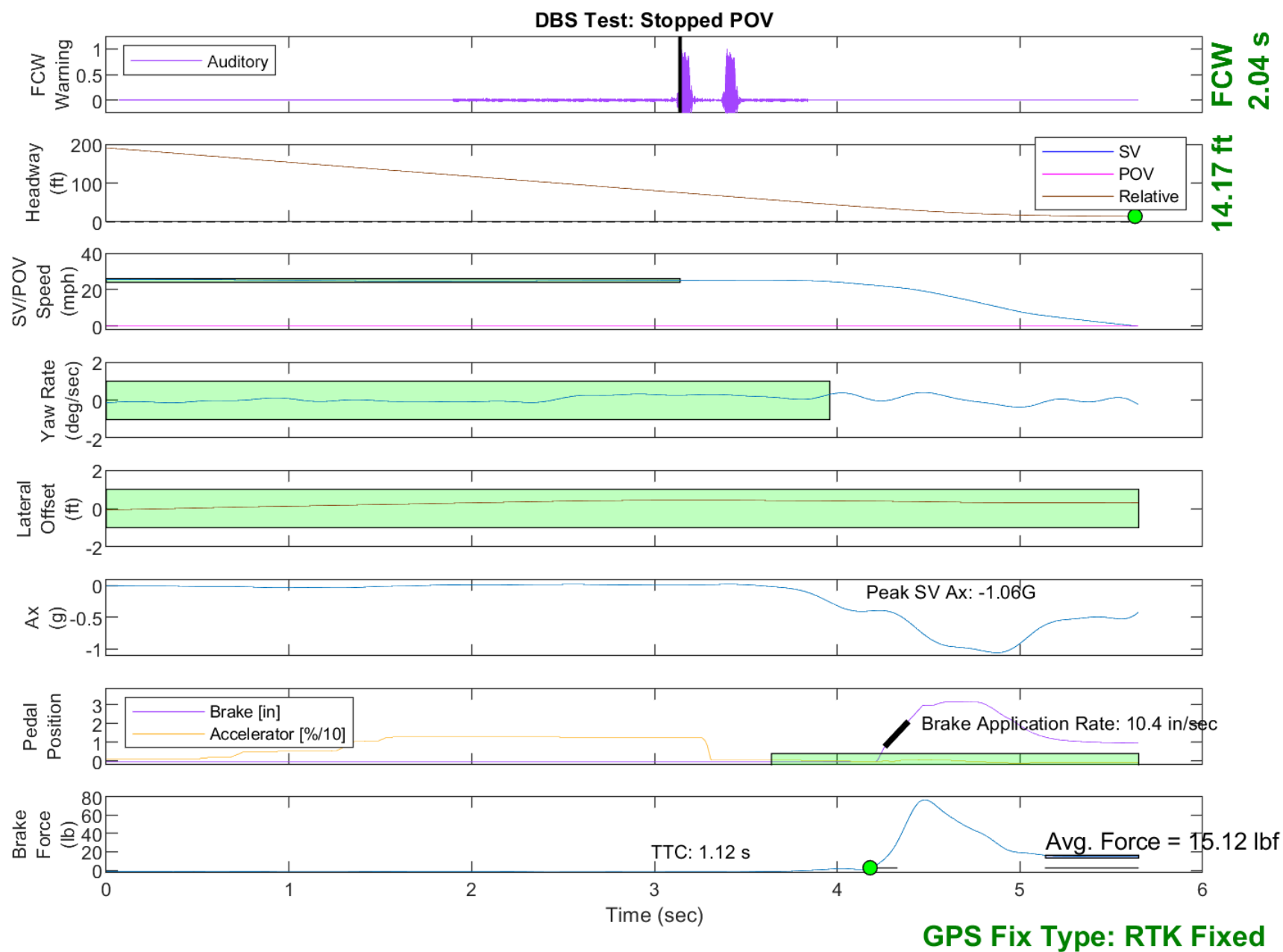


Figure E1. Example Time History for Stopped POV, Passing

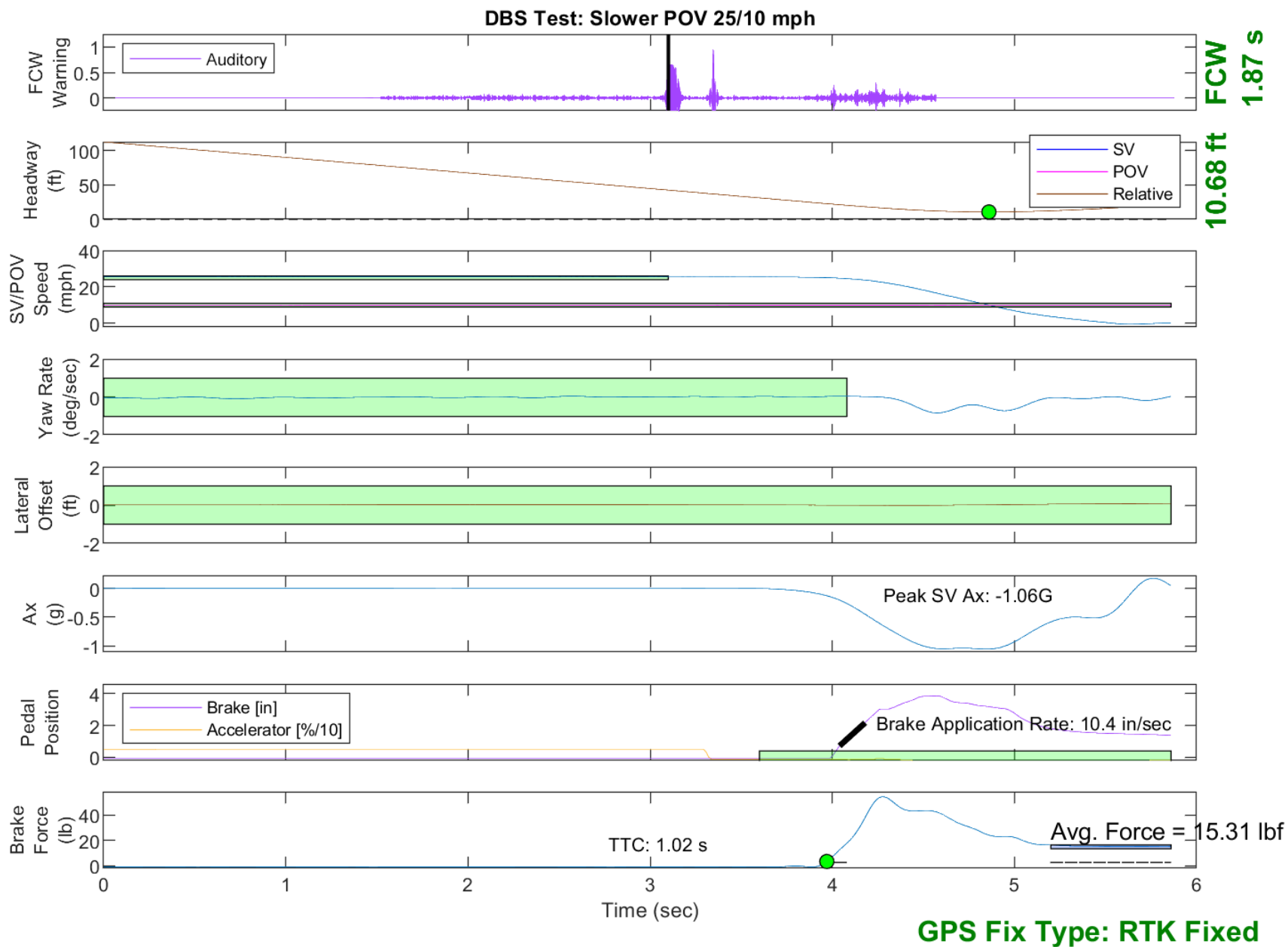


Figure E2. Example Time History for Slower POV 25 vs. 10, Passing

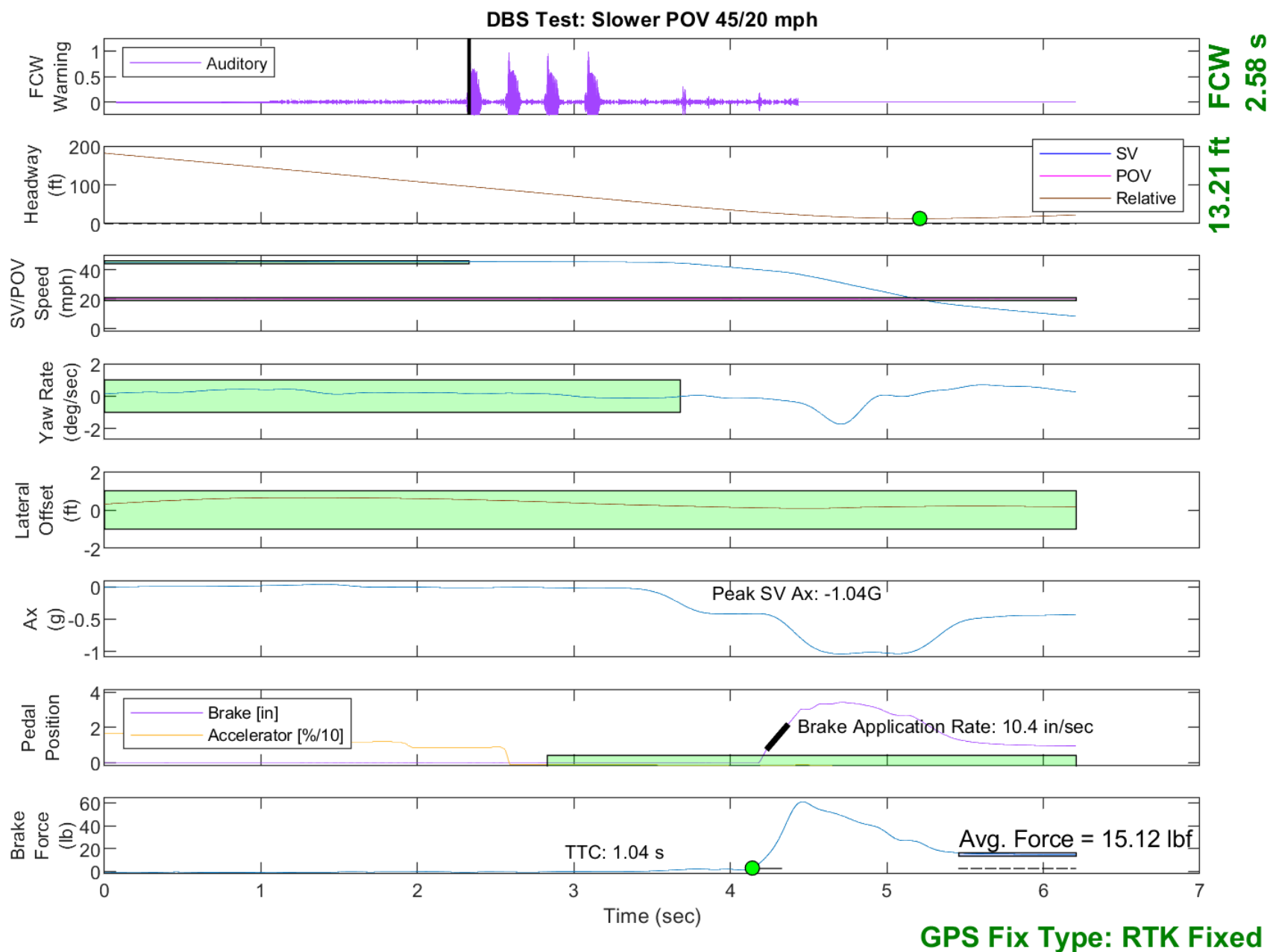


Figure E3. Example Time History for Slower POV 45 vs. 20, Passing

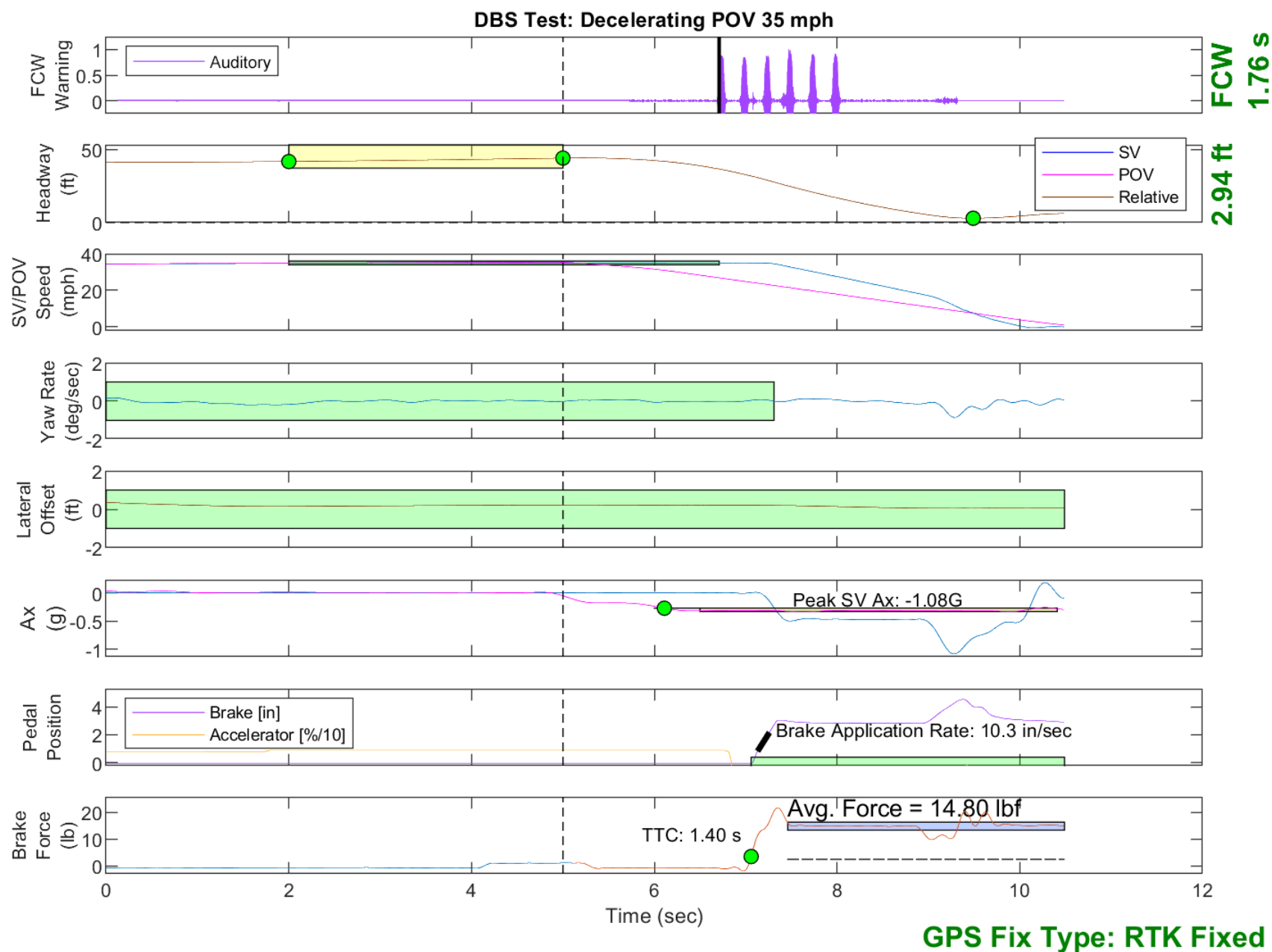
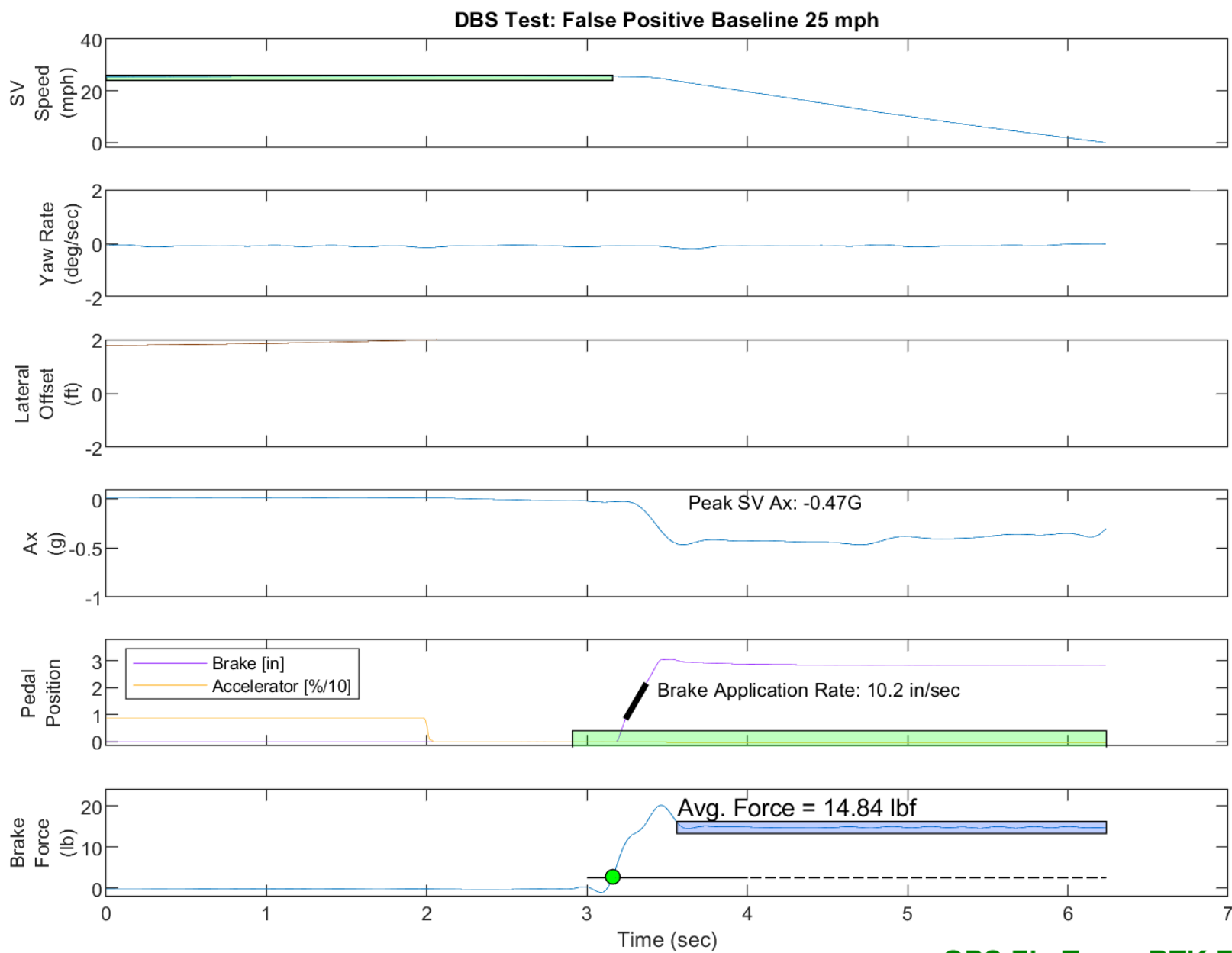


Figure E4. Example Time History for Decelerating POV 35, Passing



GPS Fix Type: RTK Fixed

Figure E5. Example Time History for False Positive Baseline 25

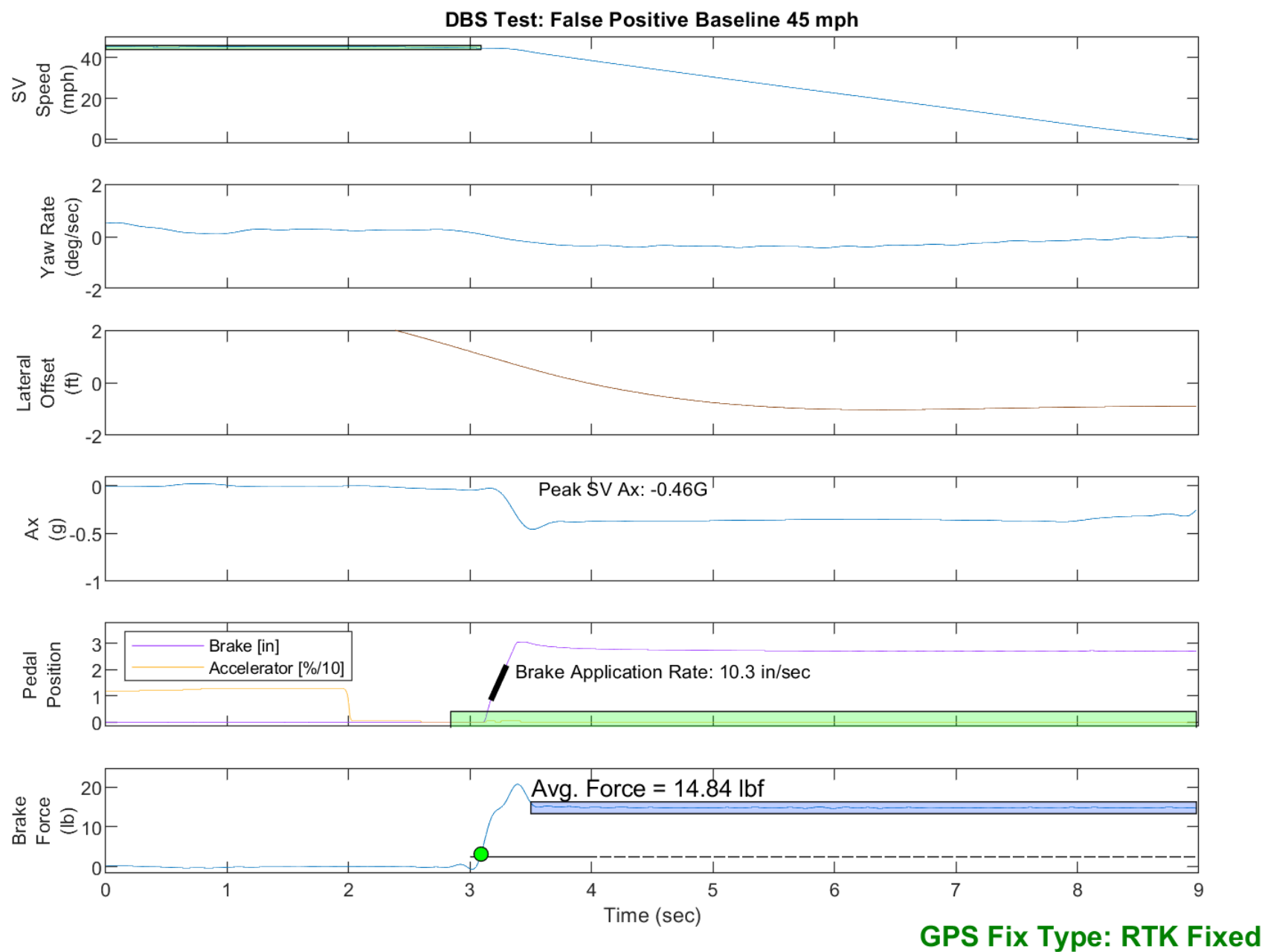


Figure E6. Example Time History for False Positive Baseline 45

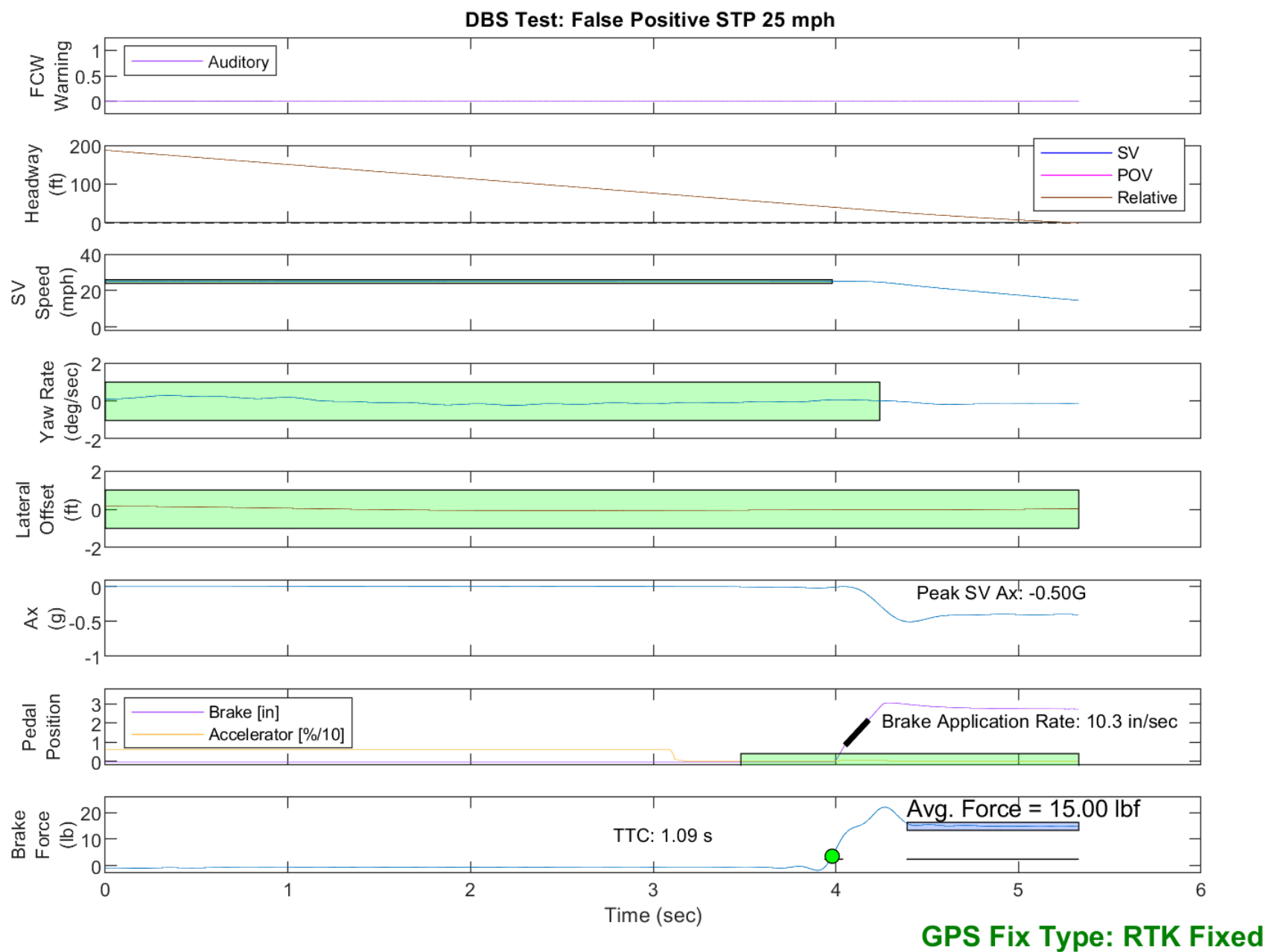


Figure E7. Example Time History for False Positive Steel Plate 25, Passing

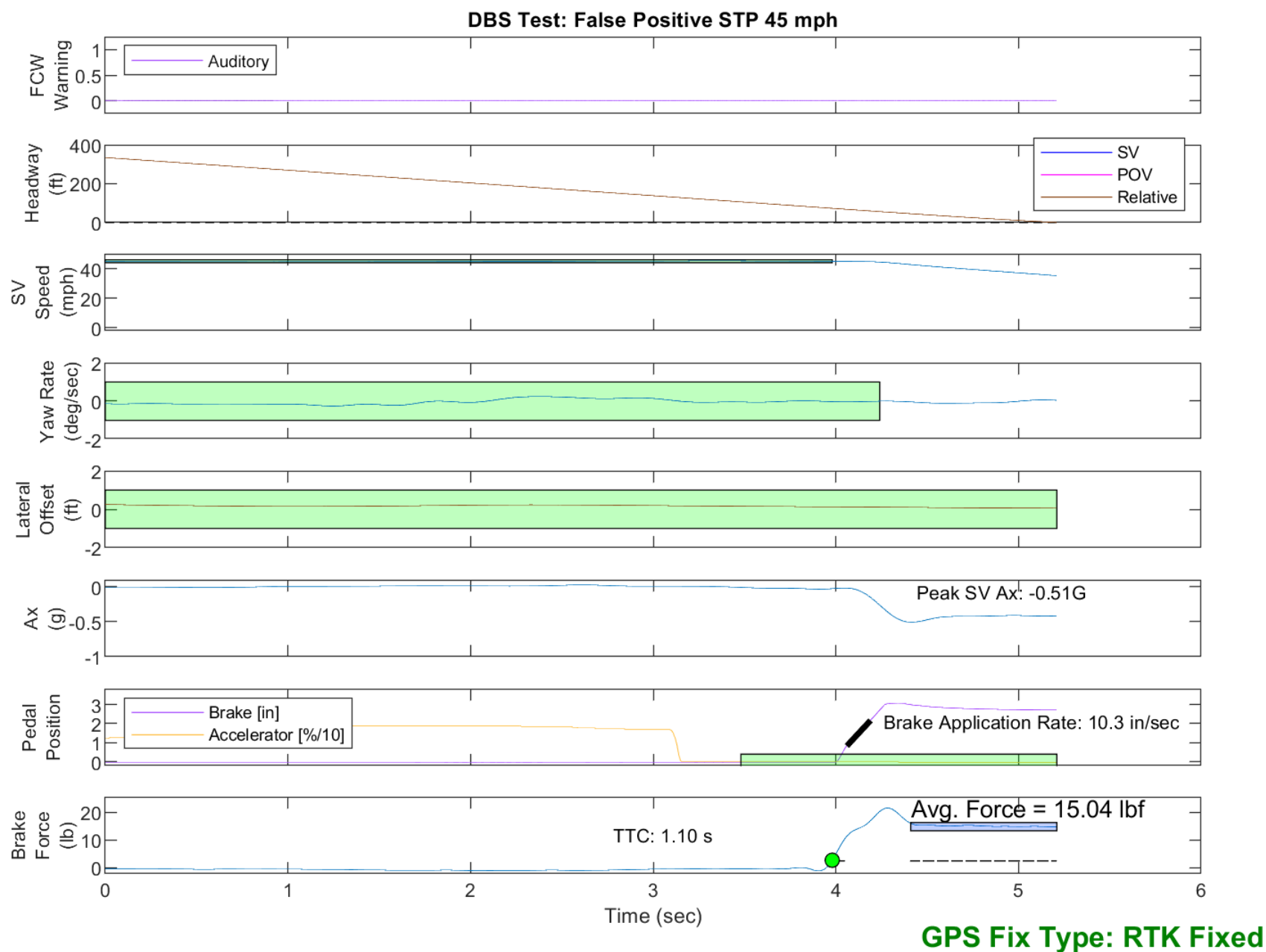


Figure E8. Example Time History for False Positive Steel Plate 45, Passing

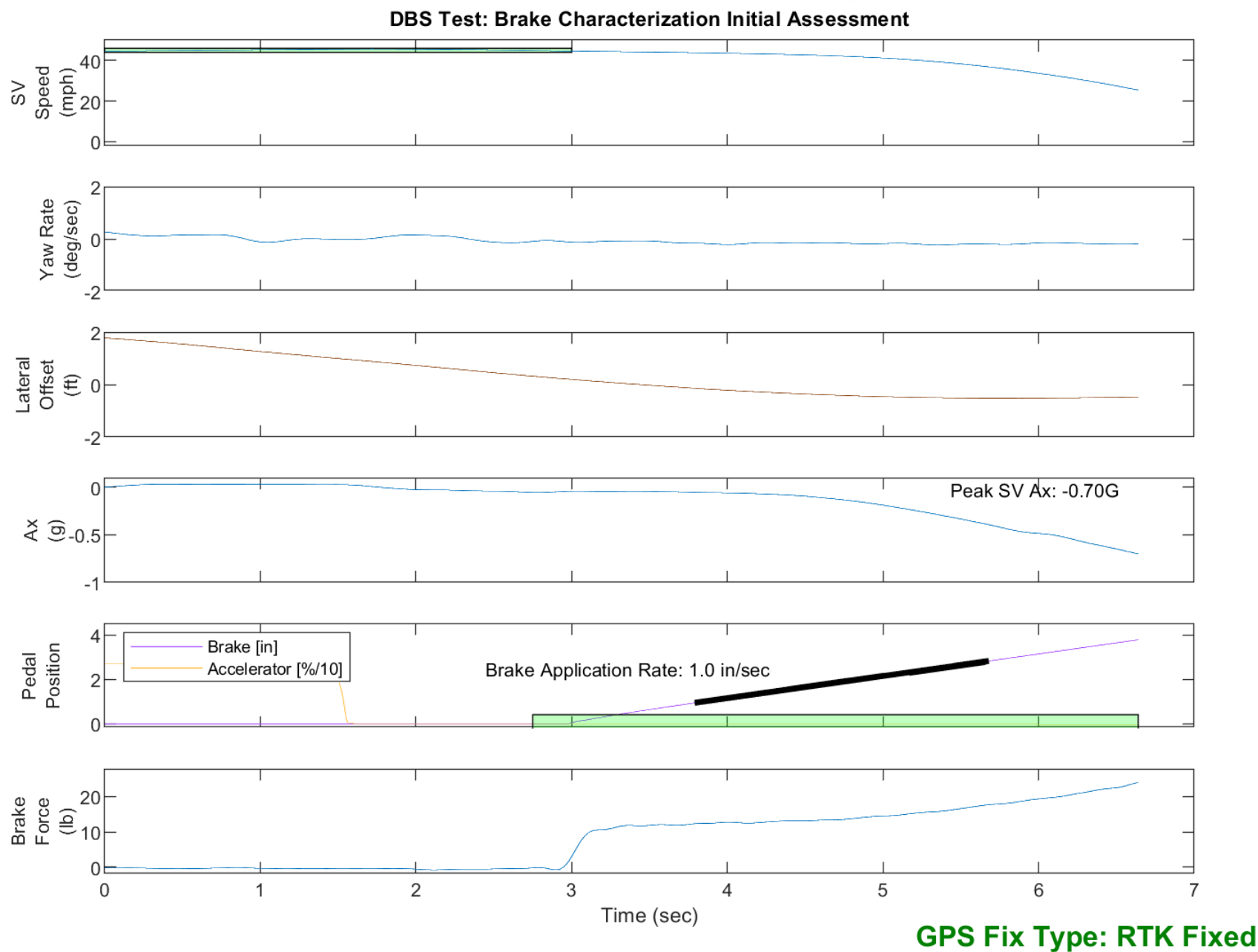


Figure E9. Example Time History for DBS Brake Characterization, Passing

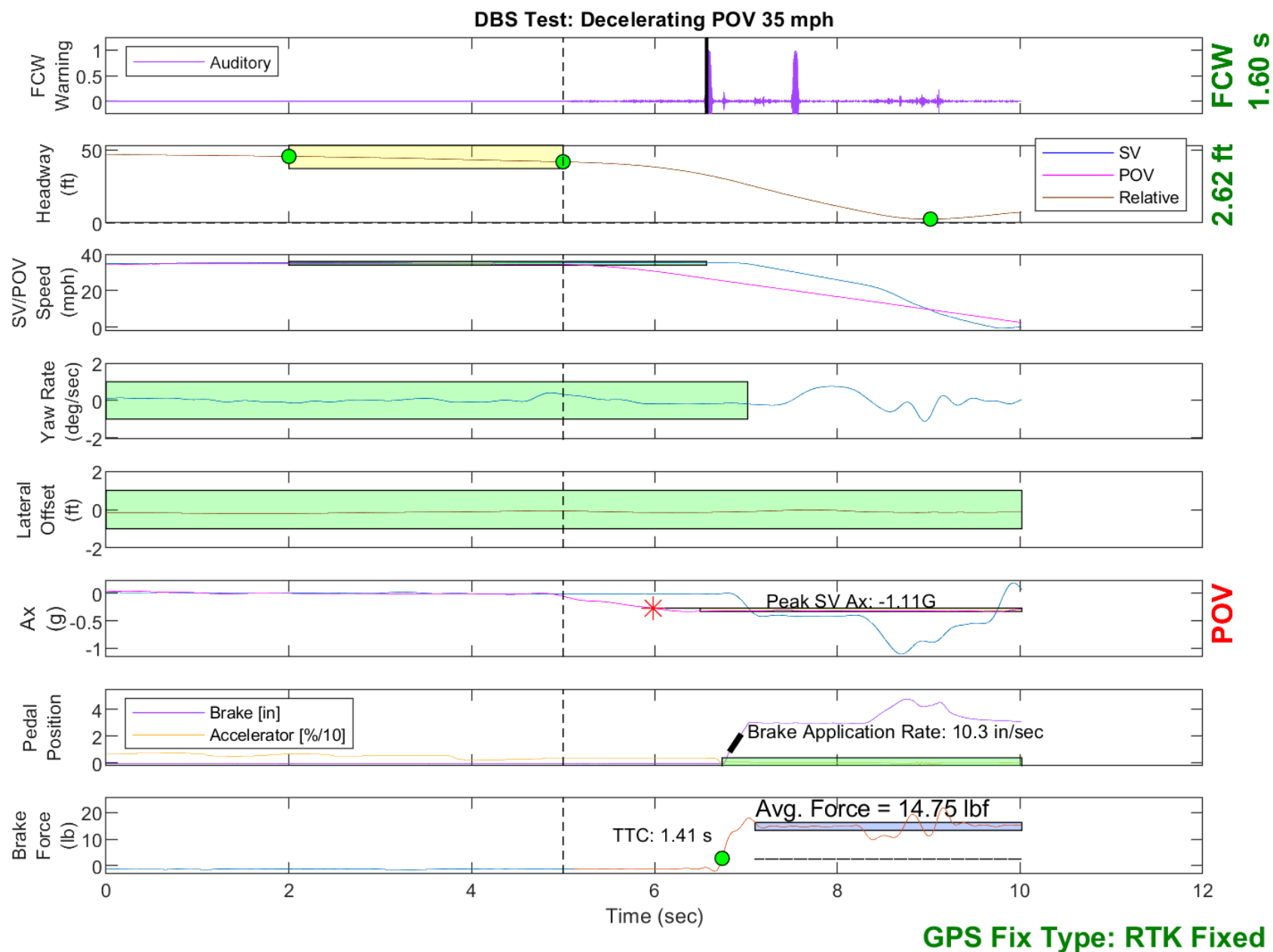


Figure E10. Example Time History Displaying Invalid POV Acceleration Criteria

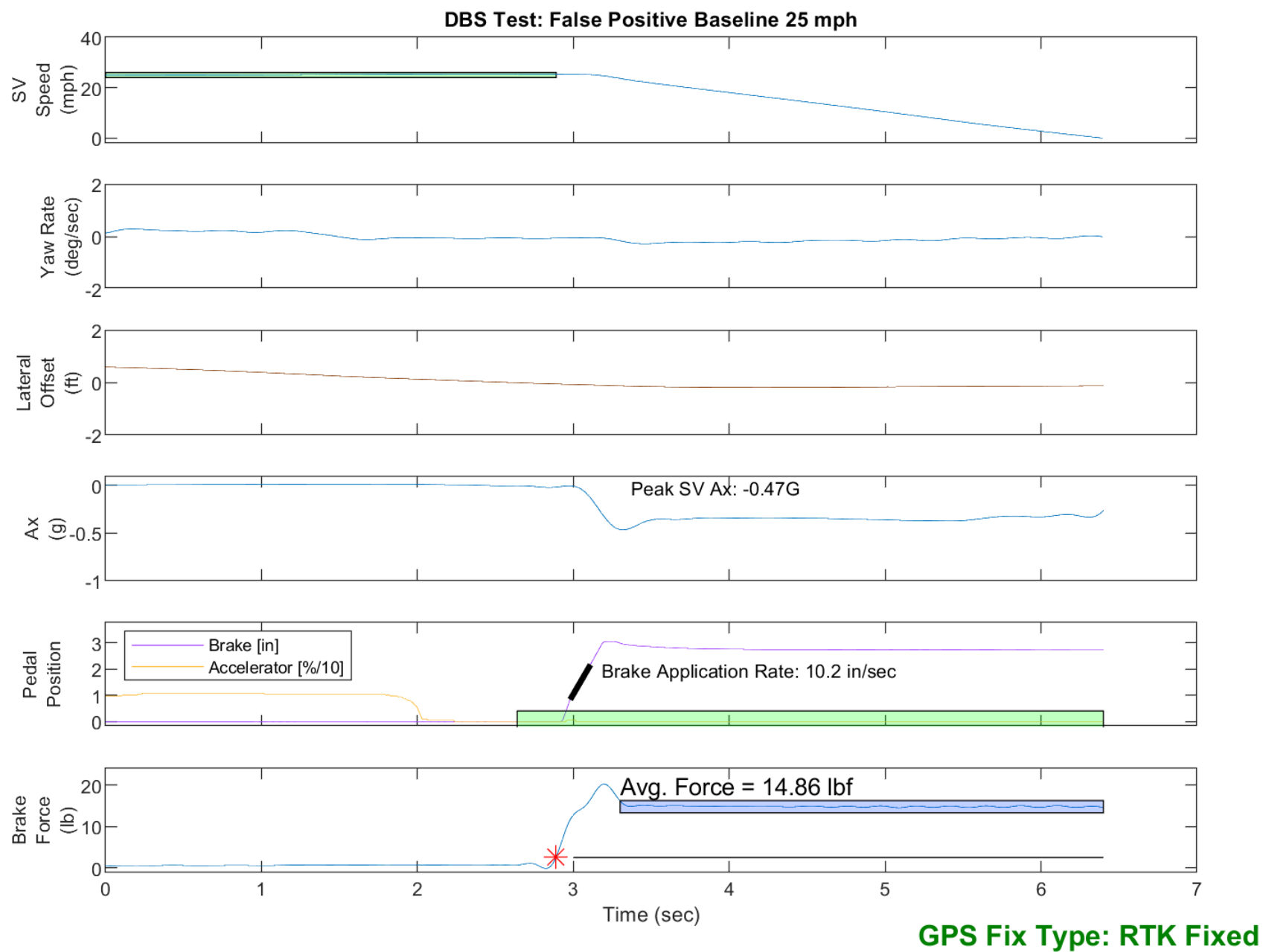


Figure E11. Example Time History Displaying Invalid Brake Force Criteria

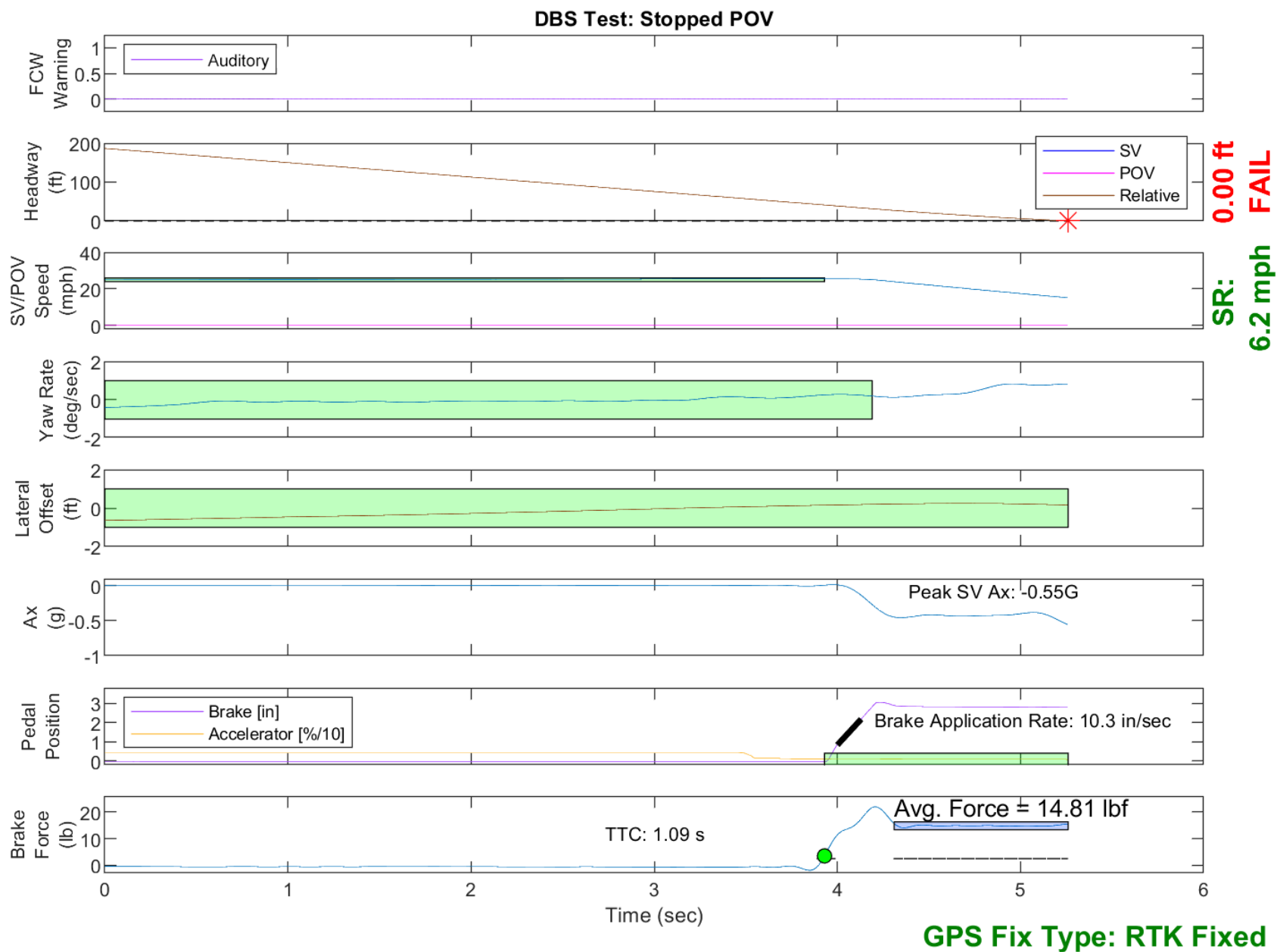


Figure E12. Example Time History for a Failed Run

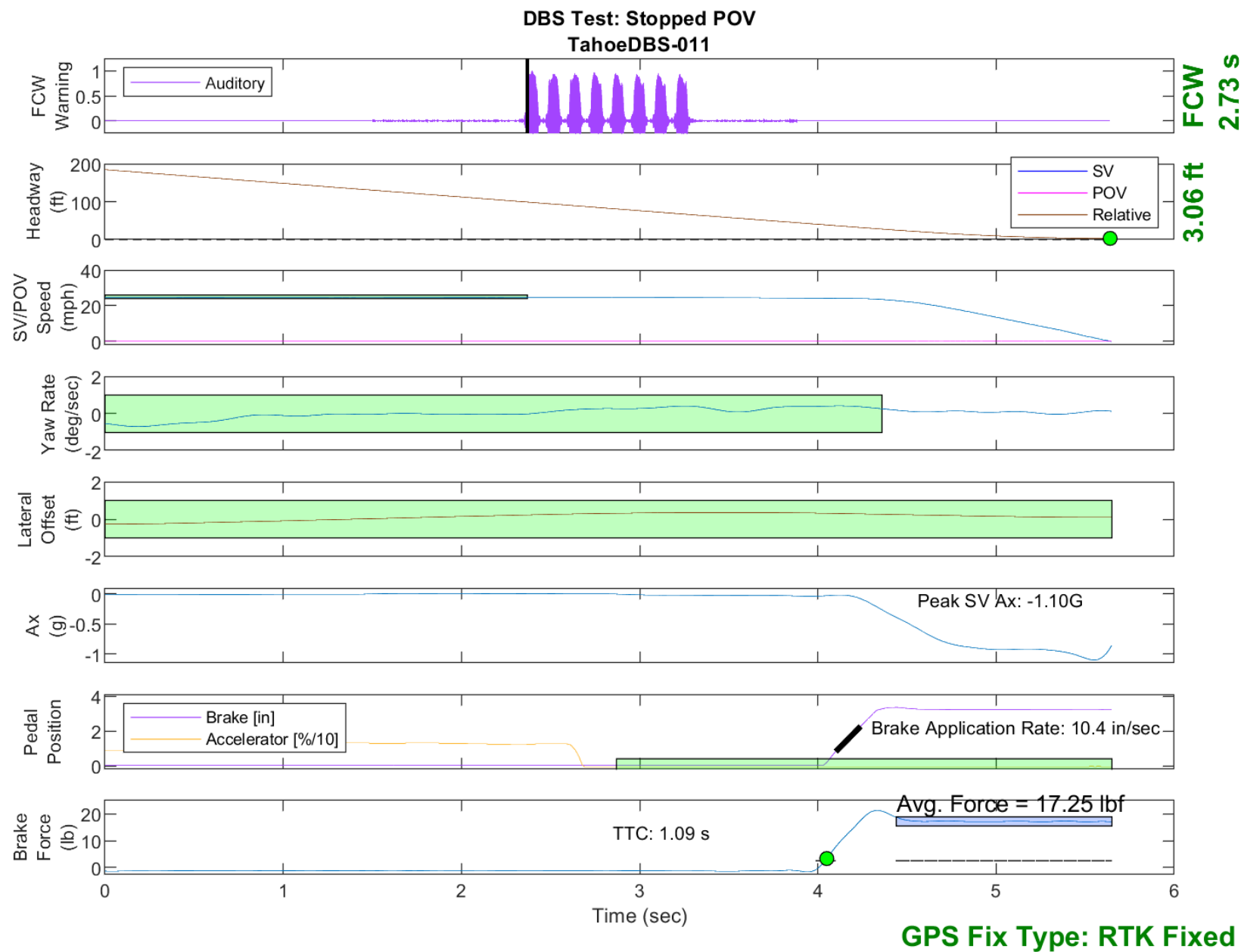


Figure E13. Time History for DBS Run 11, SV Encounters Stopped POV

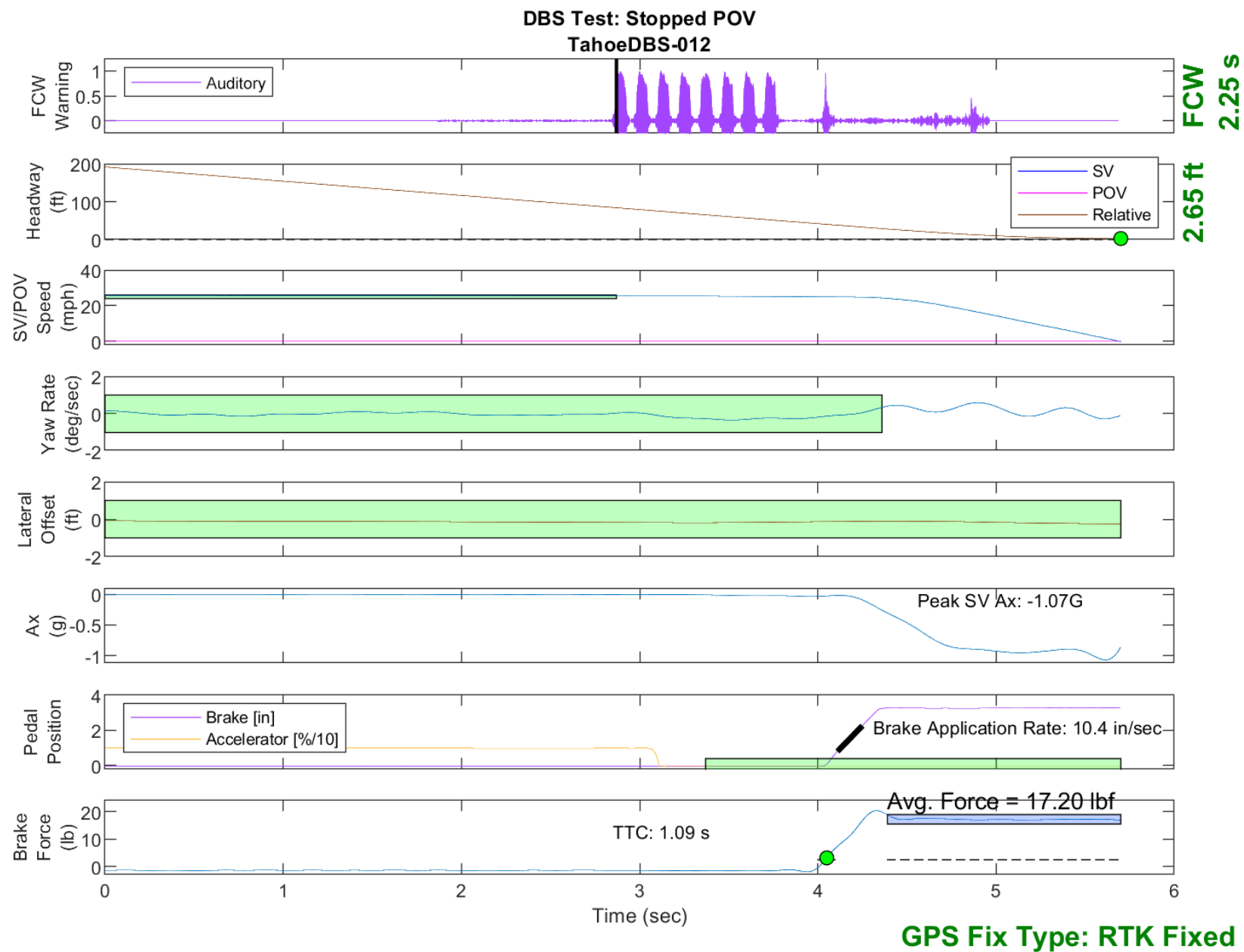


Figure E14. Time History for DBS Run 12, SV Encounters Stopped POV

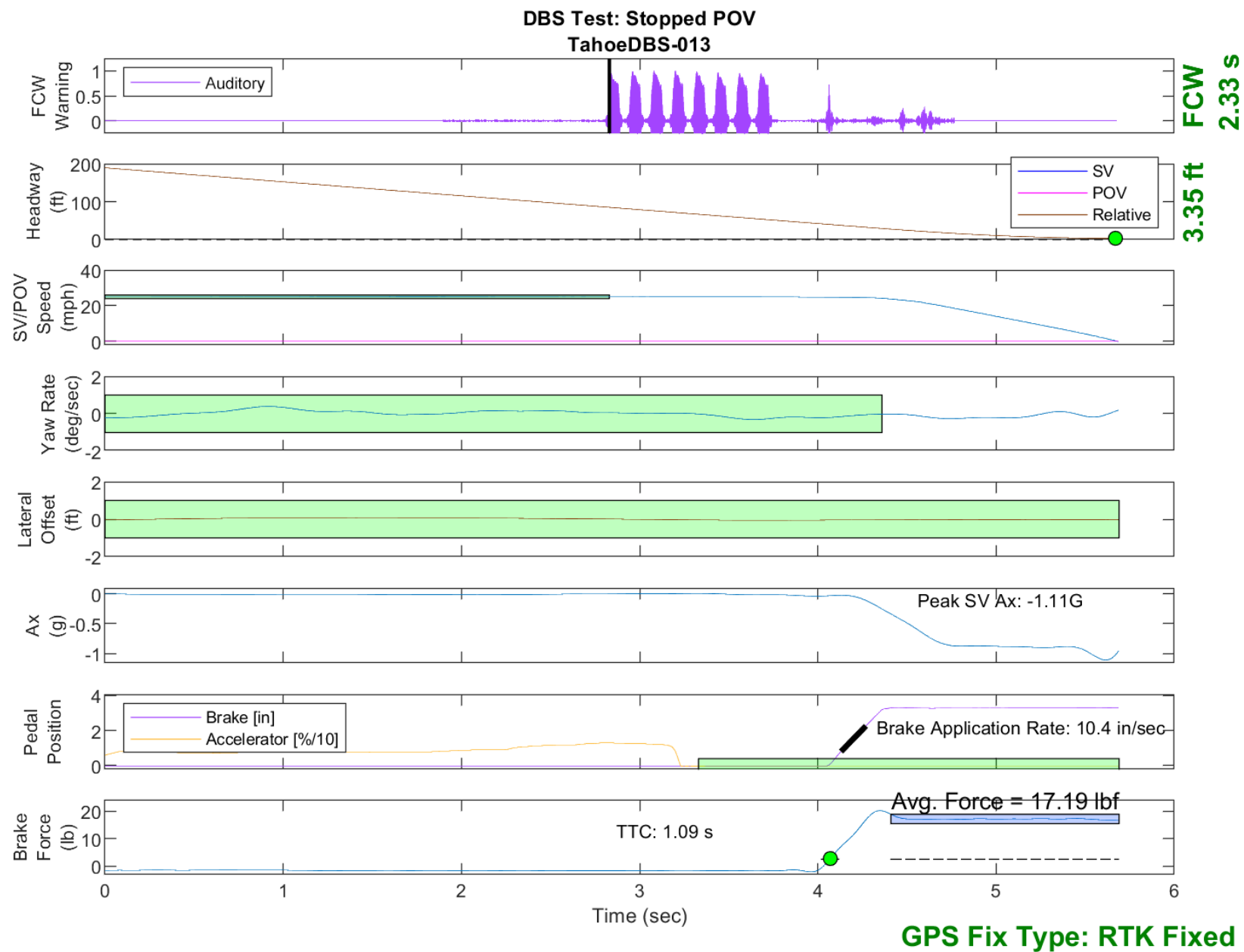


Figure E15. Time History for DBS Run 13, SV Encounters Stopped POV

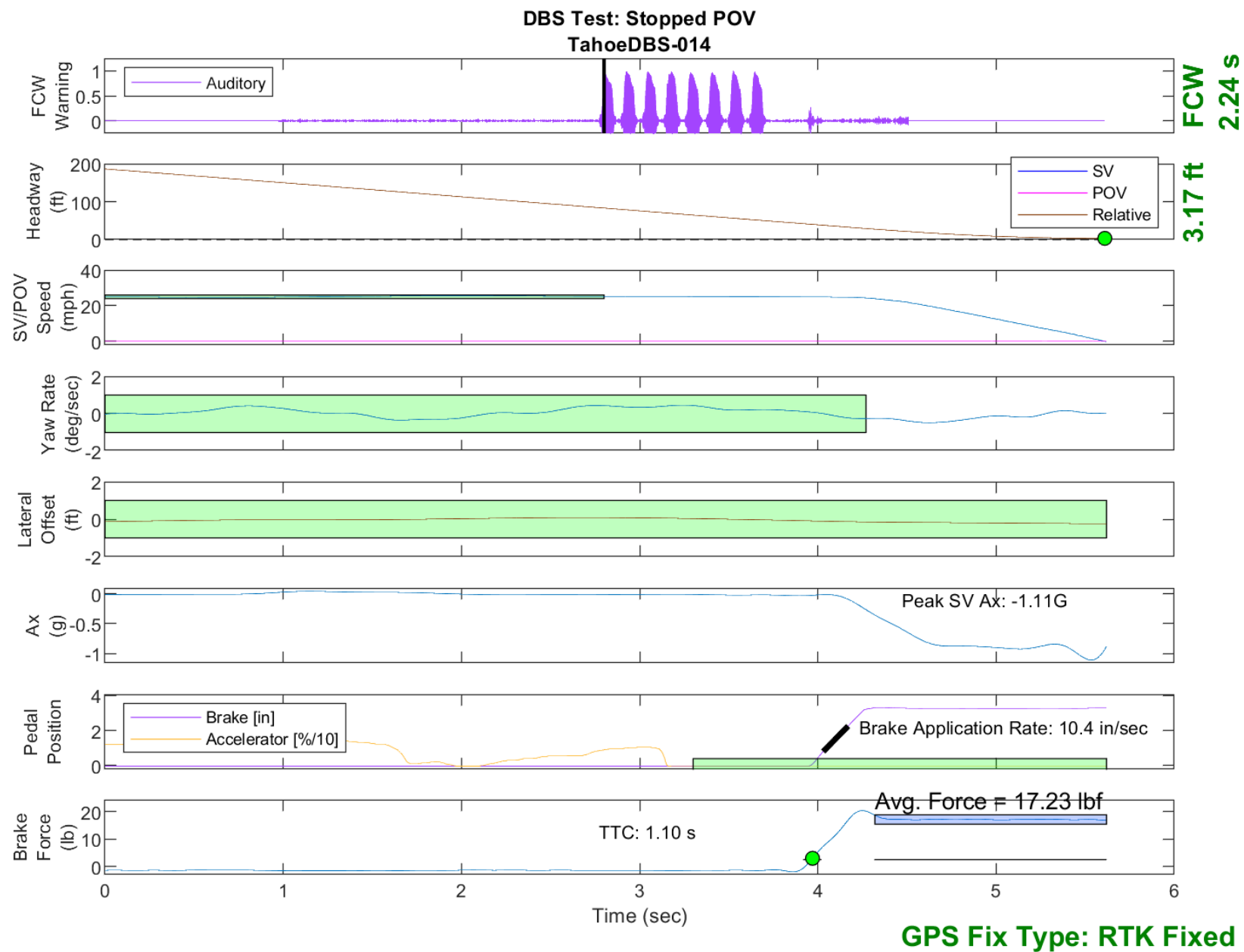


Figure E16. Time History for DBS Run 14, SV Encounters Stopped POV

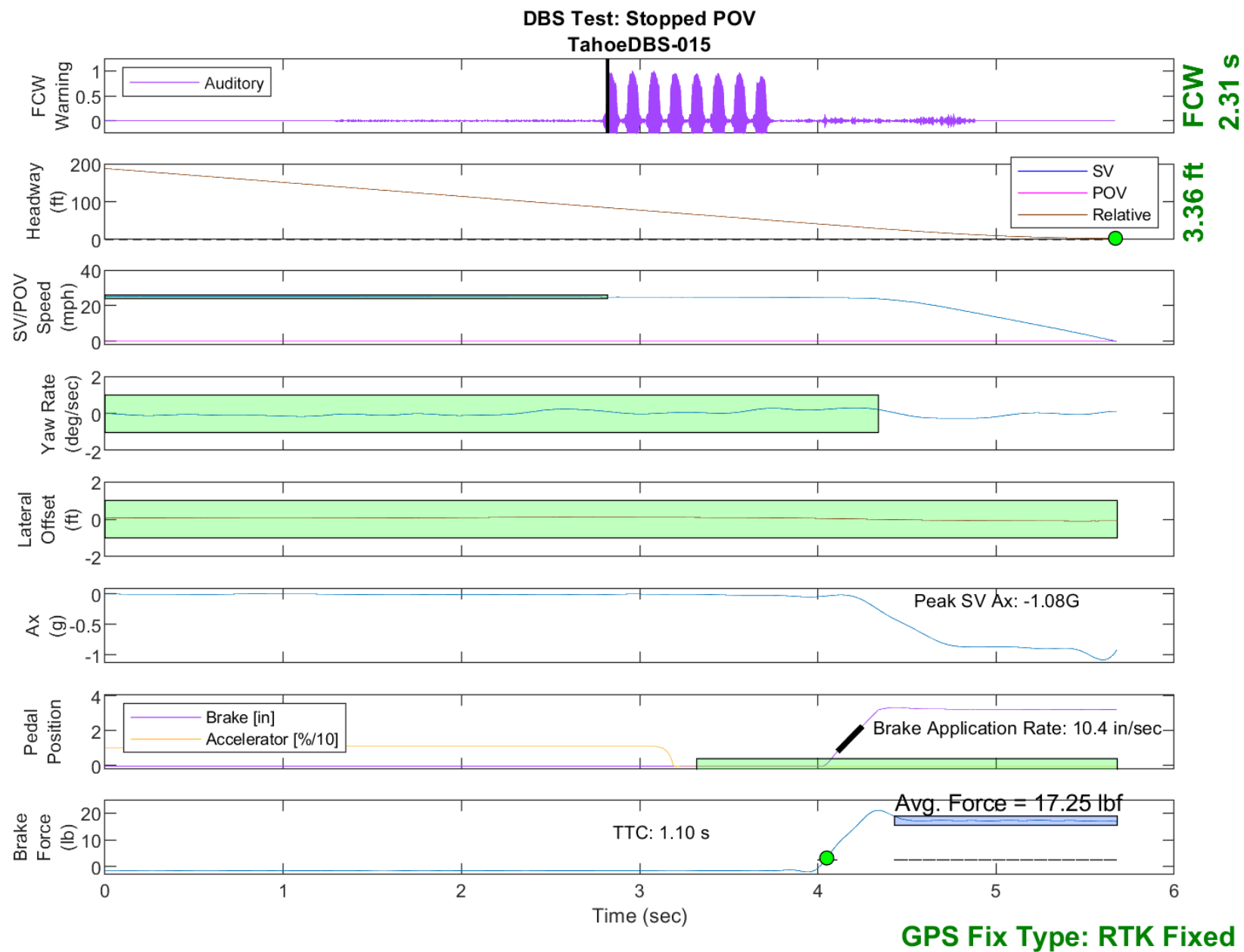


Figure E17. Time History for DBS Run 15, SV Encounters Stopped POV

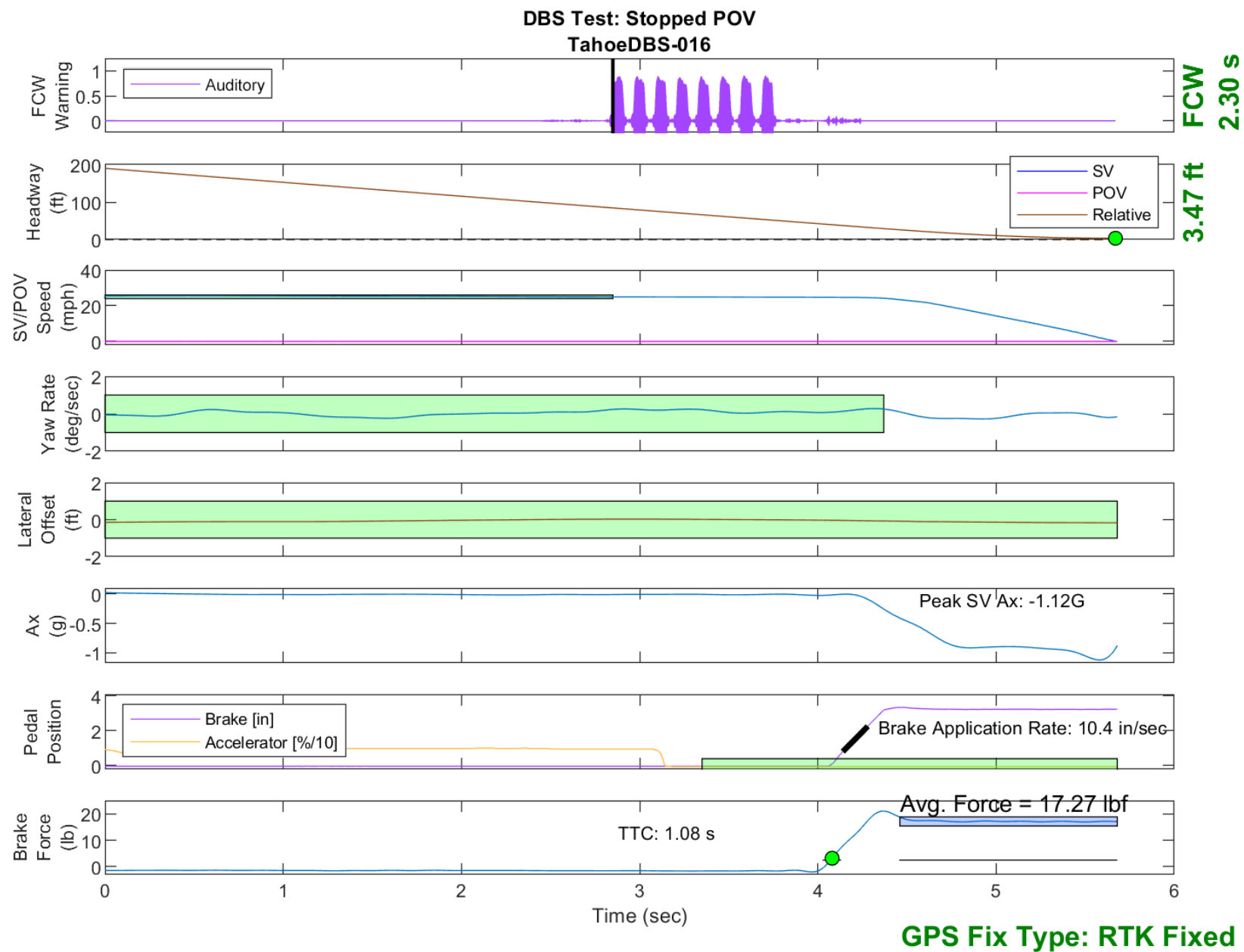


Figure E18. Time History for DBS Run 16, SV Encounters Stopped POV

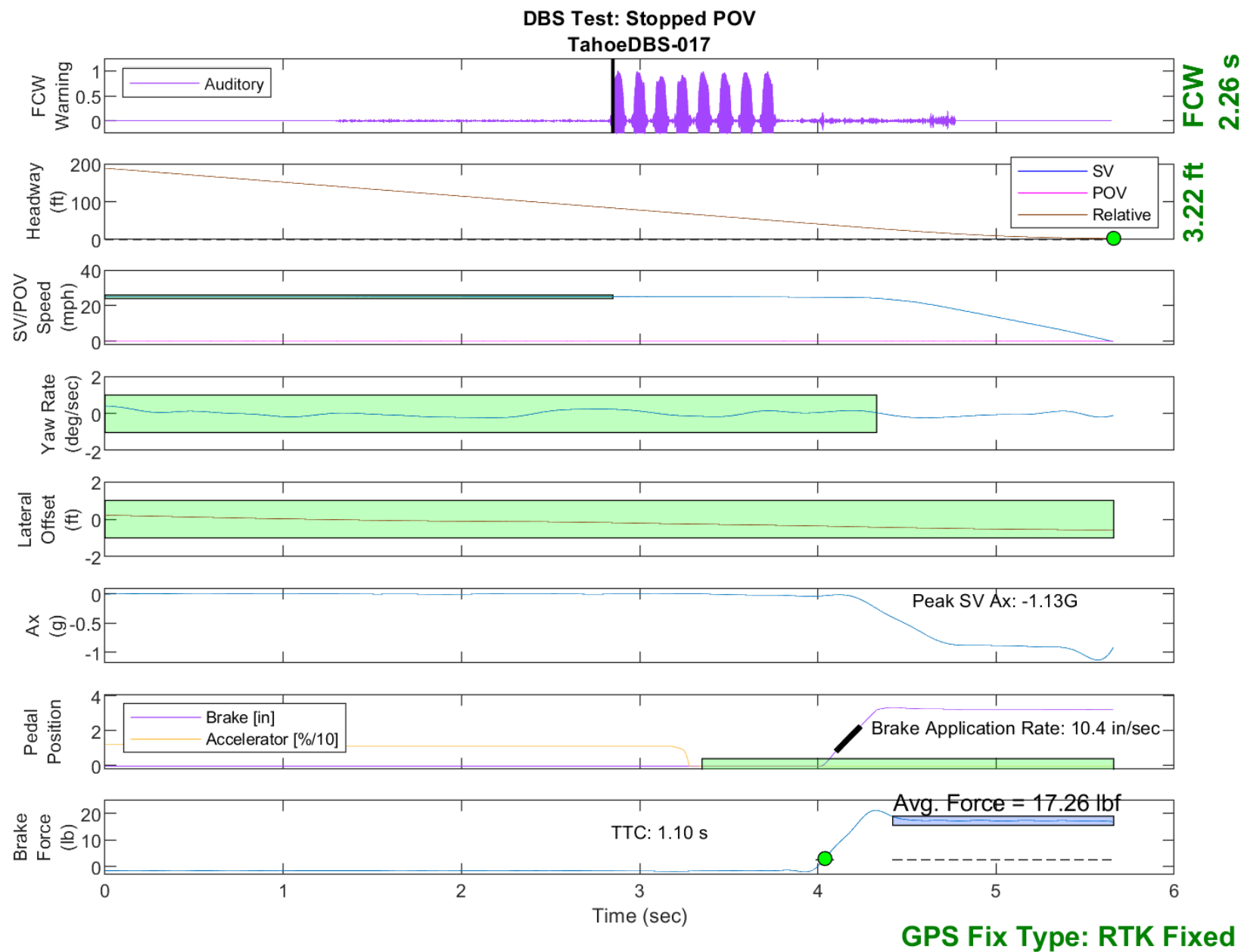


Figure E19. Time History for DBS Run 17, SV Encounters Stopped POV

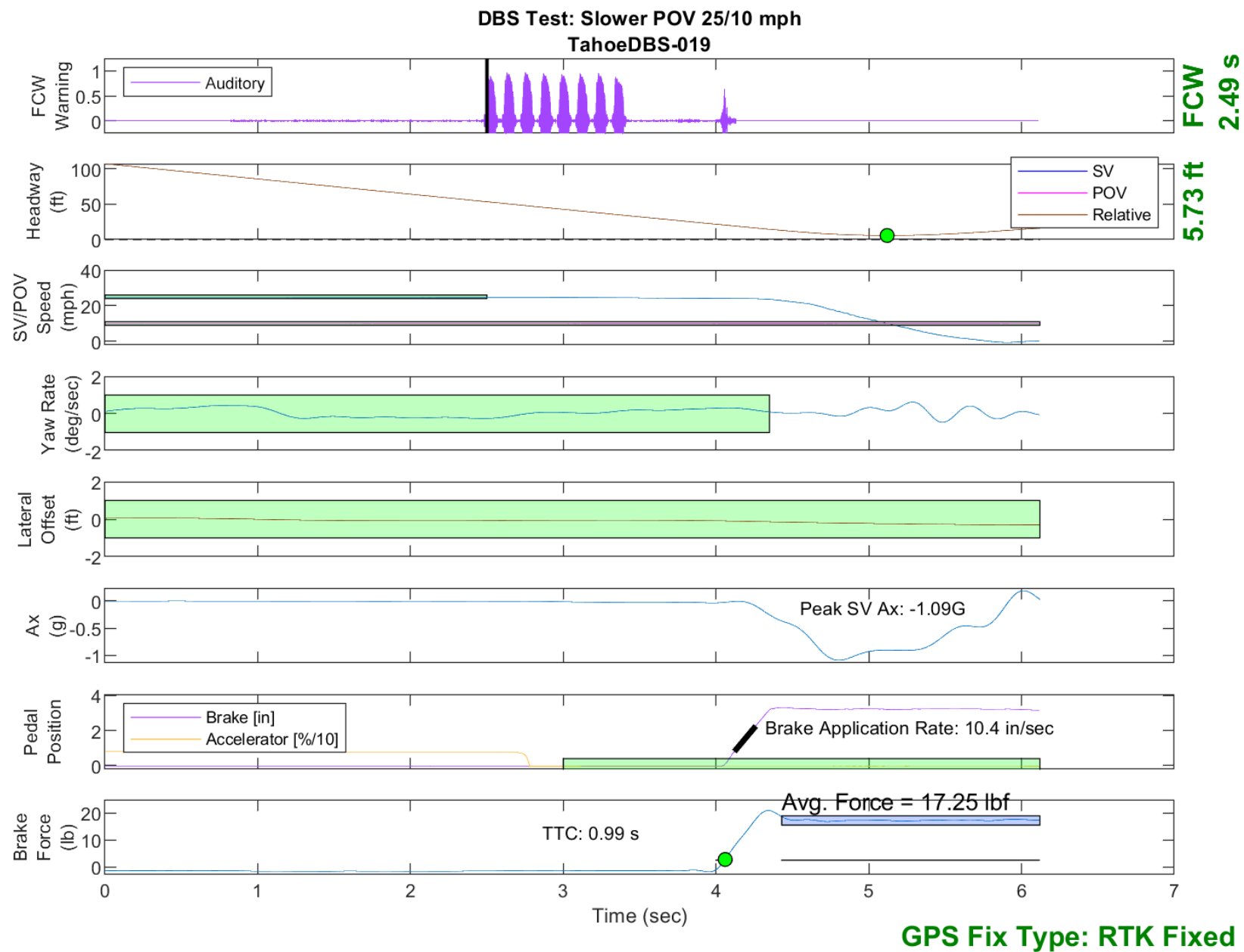


Figure E20. Time History for DBS Run 19, SV Encounters Slower POV, SV 25 mph, POV 10 mph

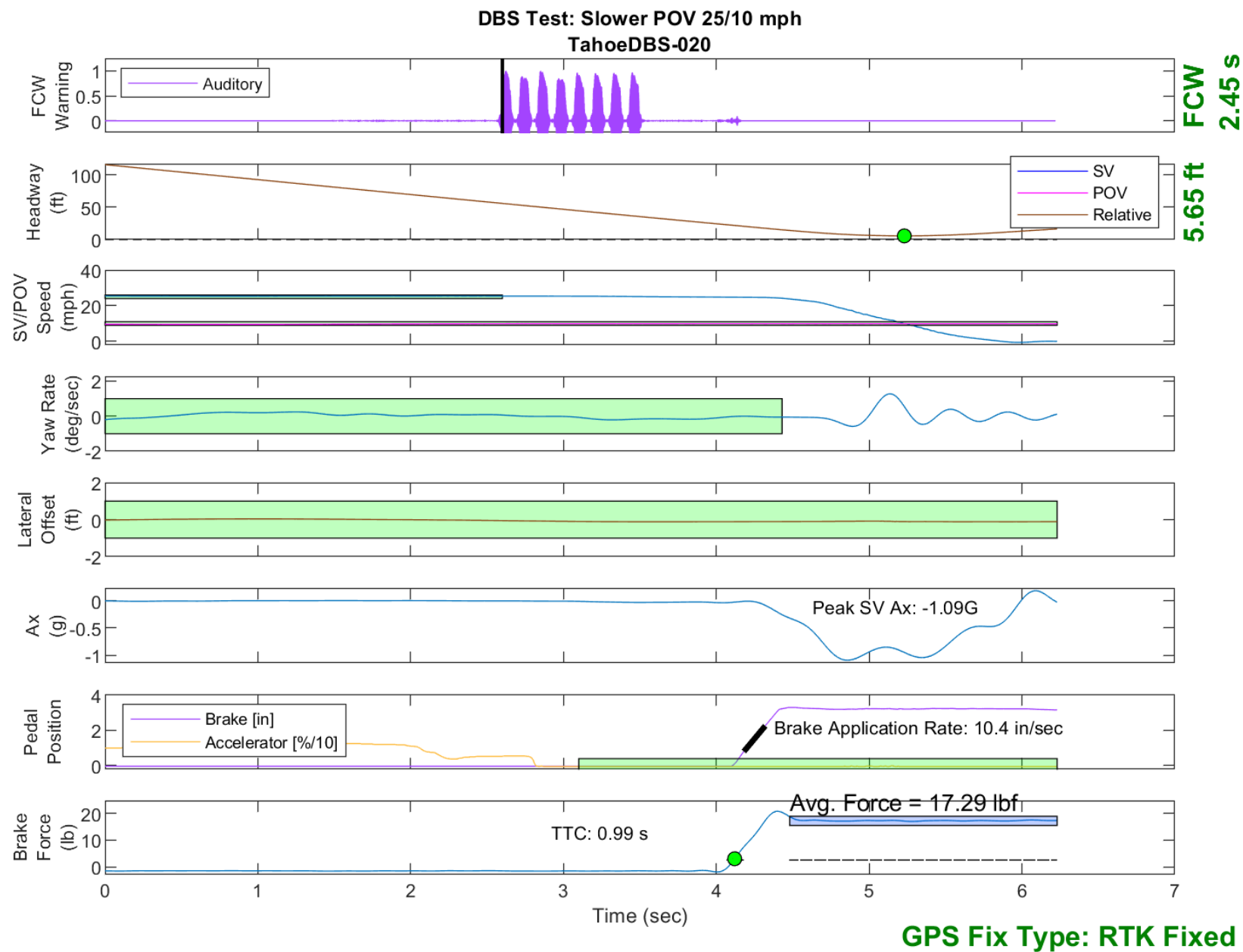


Figure E21. Time History for DBS Run 20, SV Encounters Slower POV, SV 25 mph, POV 10 mph

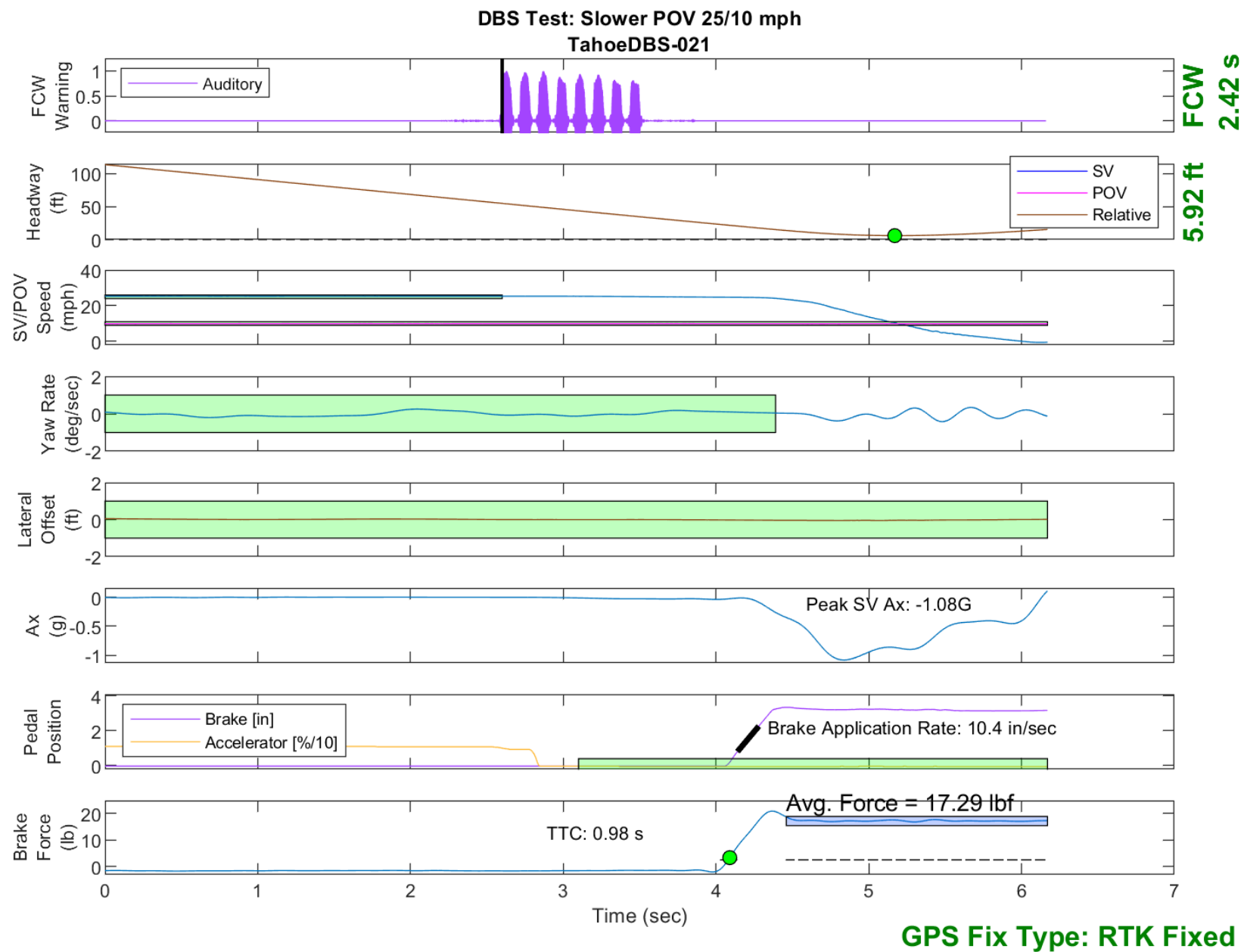


Figure E22. Time History for DBS Run 21, SV Encounters Slower POV, SV 25 mph, POV 10 mph

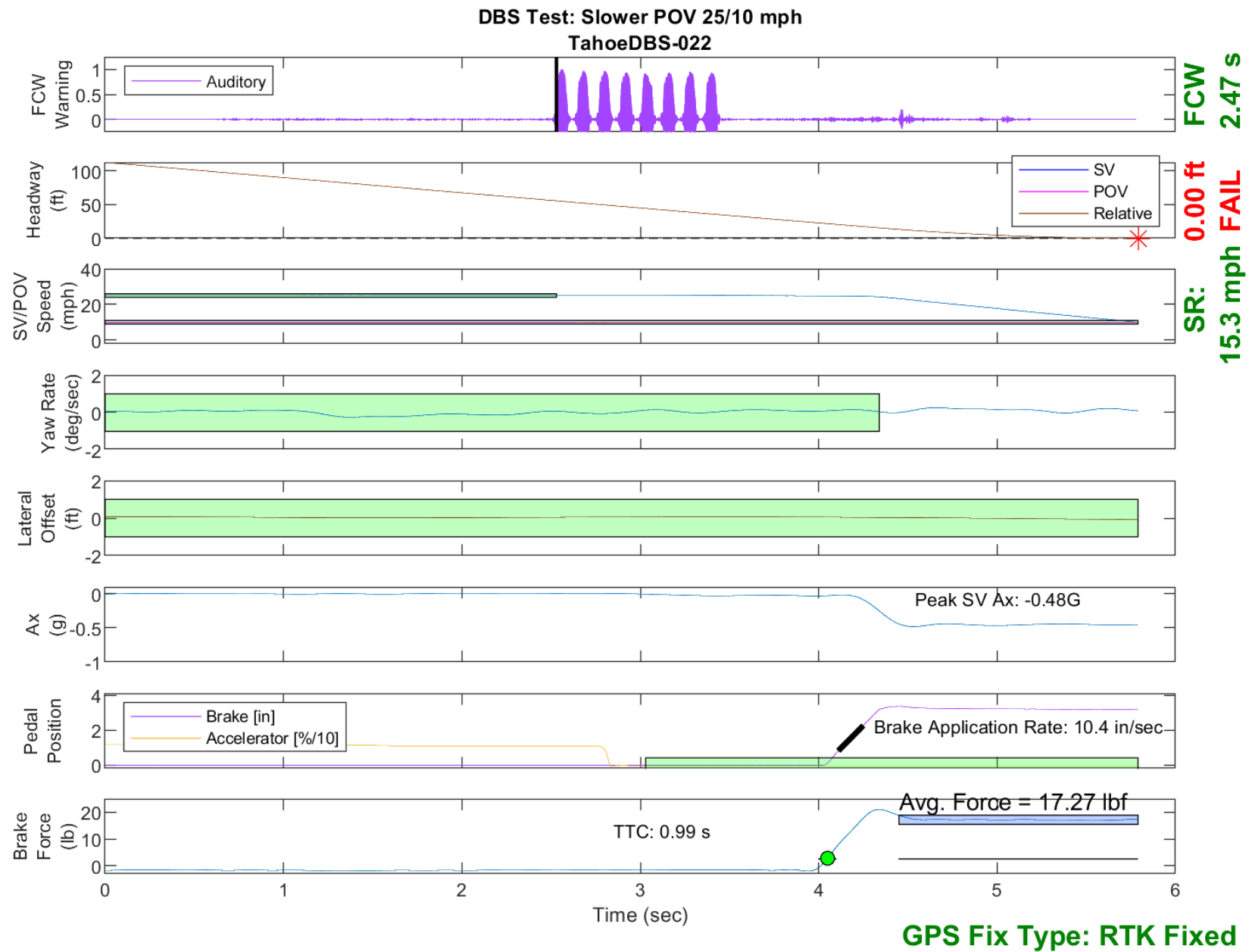


Figure E23. Time History for DBS Run 22, SV Encounters Slower POV, SV 25 mph, POV 10 mph

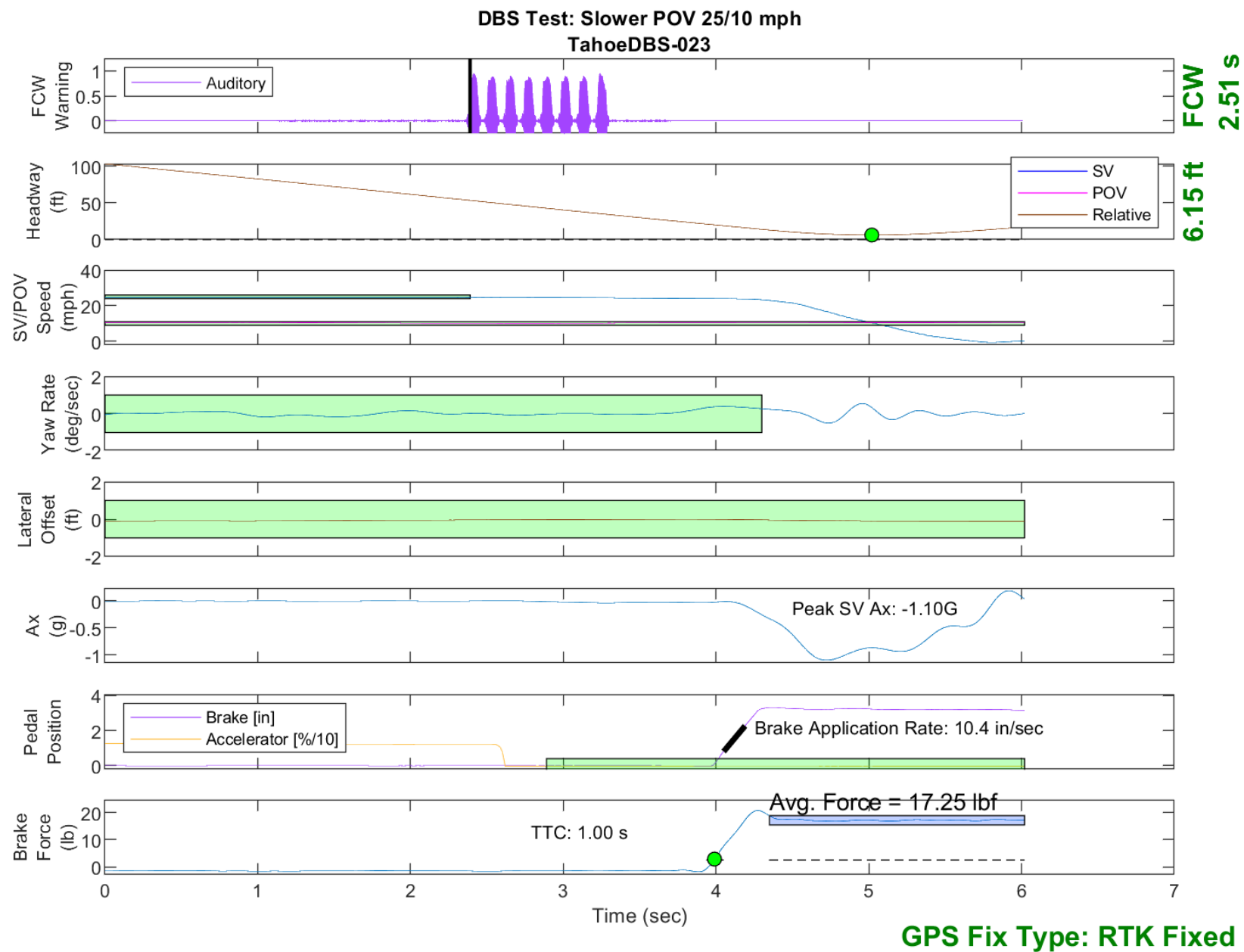


Figure E24. Time History for DBS Run 23, SV Encounters Slower POV, SV 25 mph, POV 10 mph

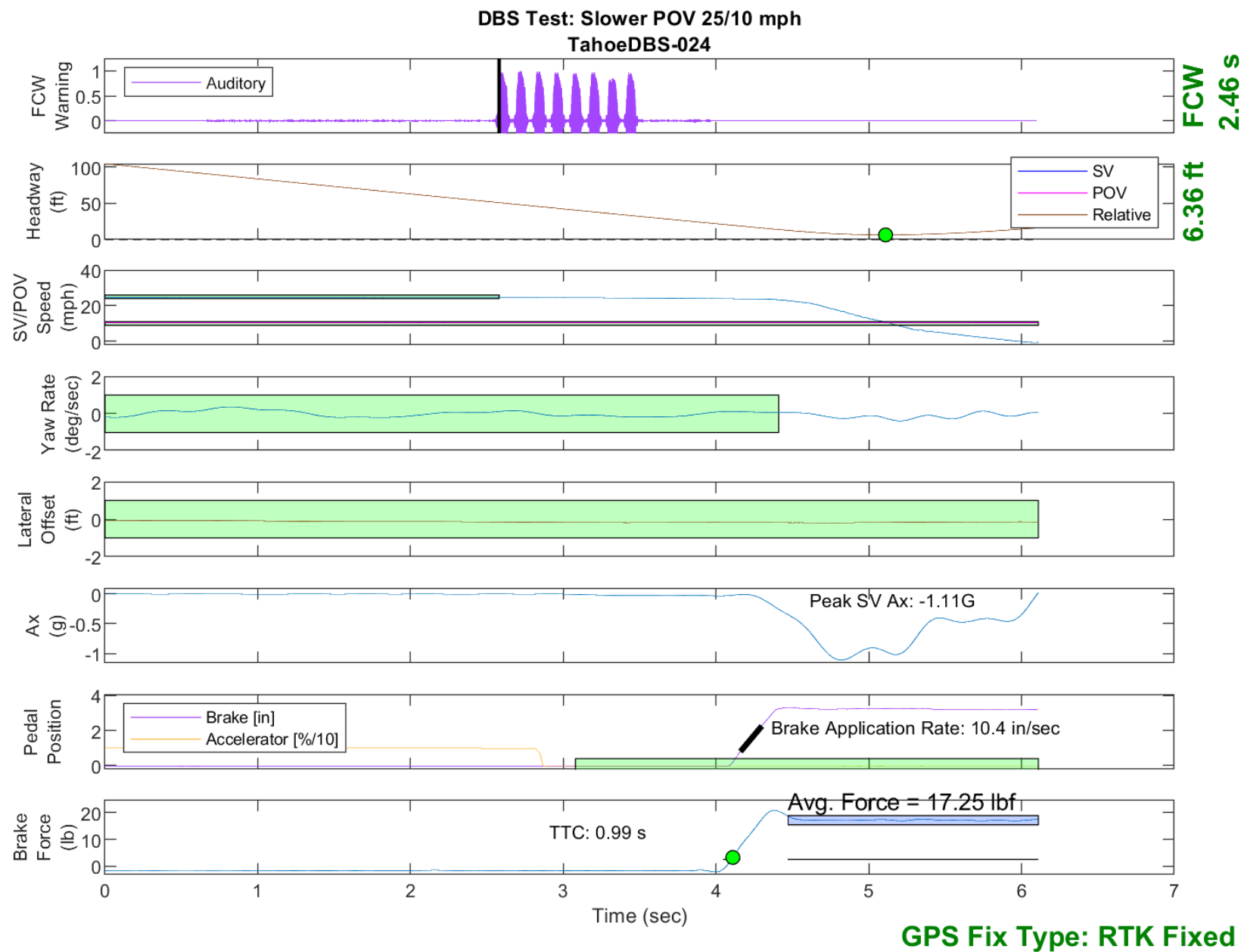


Figure E25. Time History for DBS Run 24, SV Encounters Slower POV, SV 25 mph, POV 10 mph

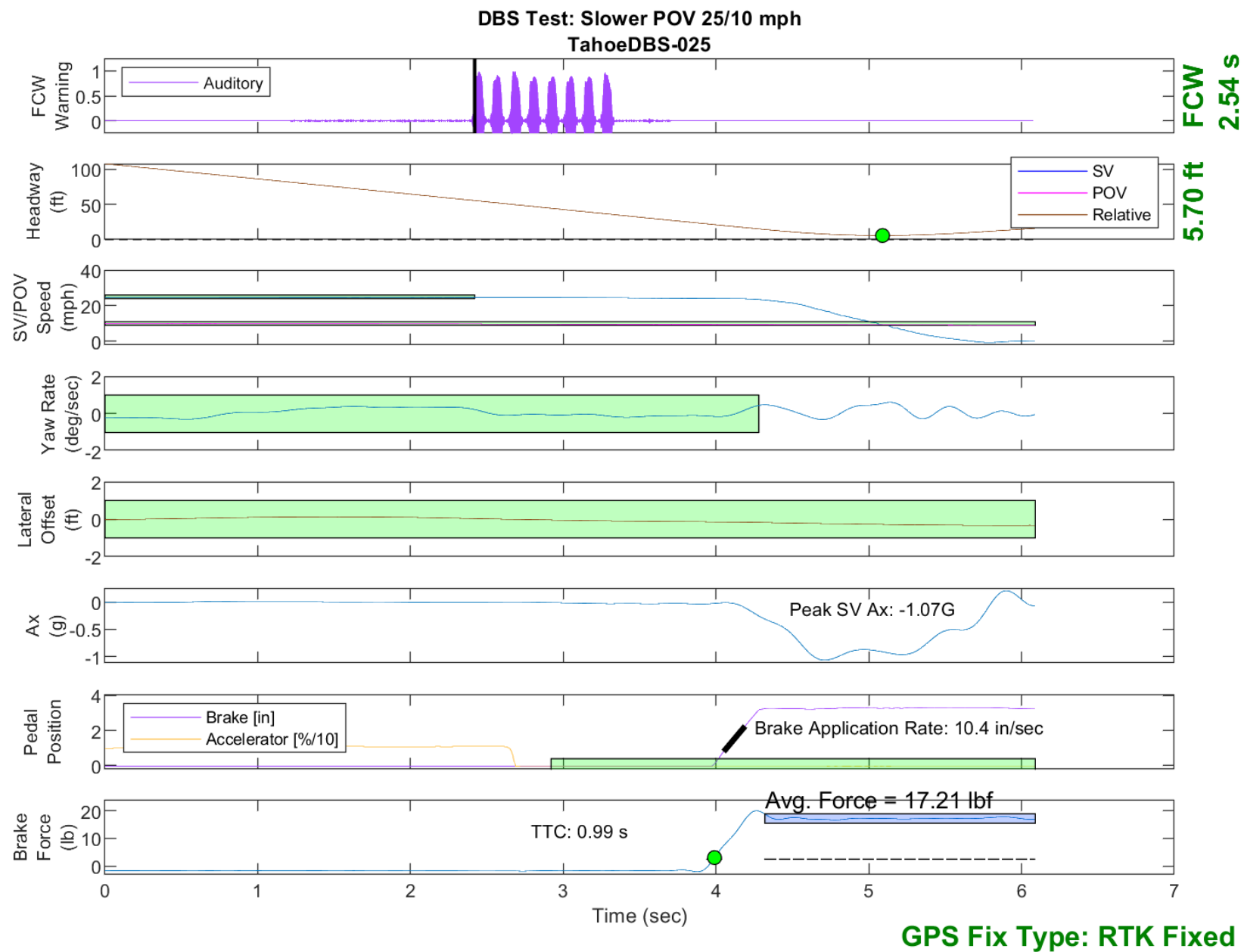


Figure E26. Time History for DBS Run 25, SV Encounters Slower POV, SV 25 mph, POV 10 mph

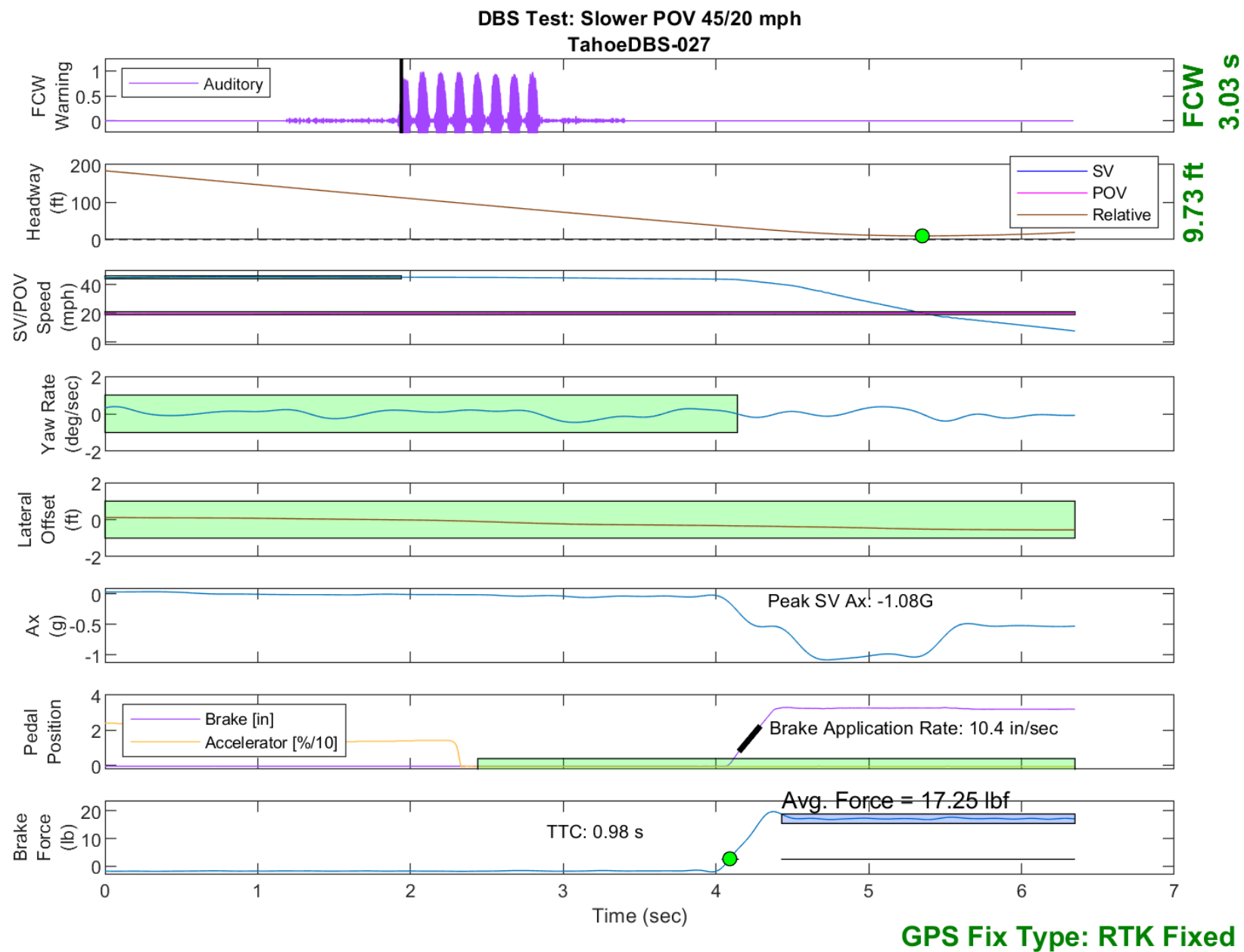


Figure E27. Time History for DBS Run 27, SV Encounters Slower POV, SV 45 mph, POV 20 mph

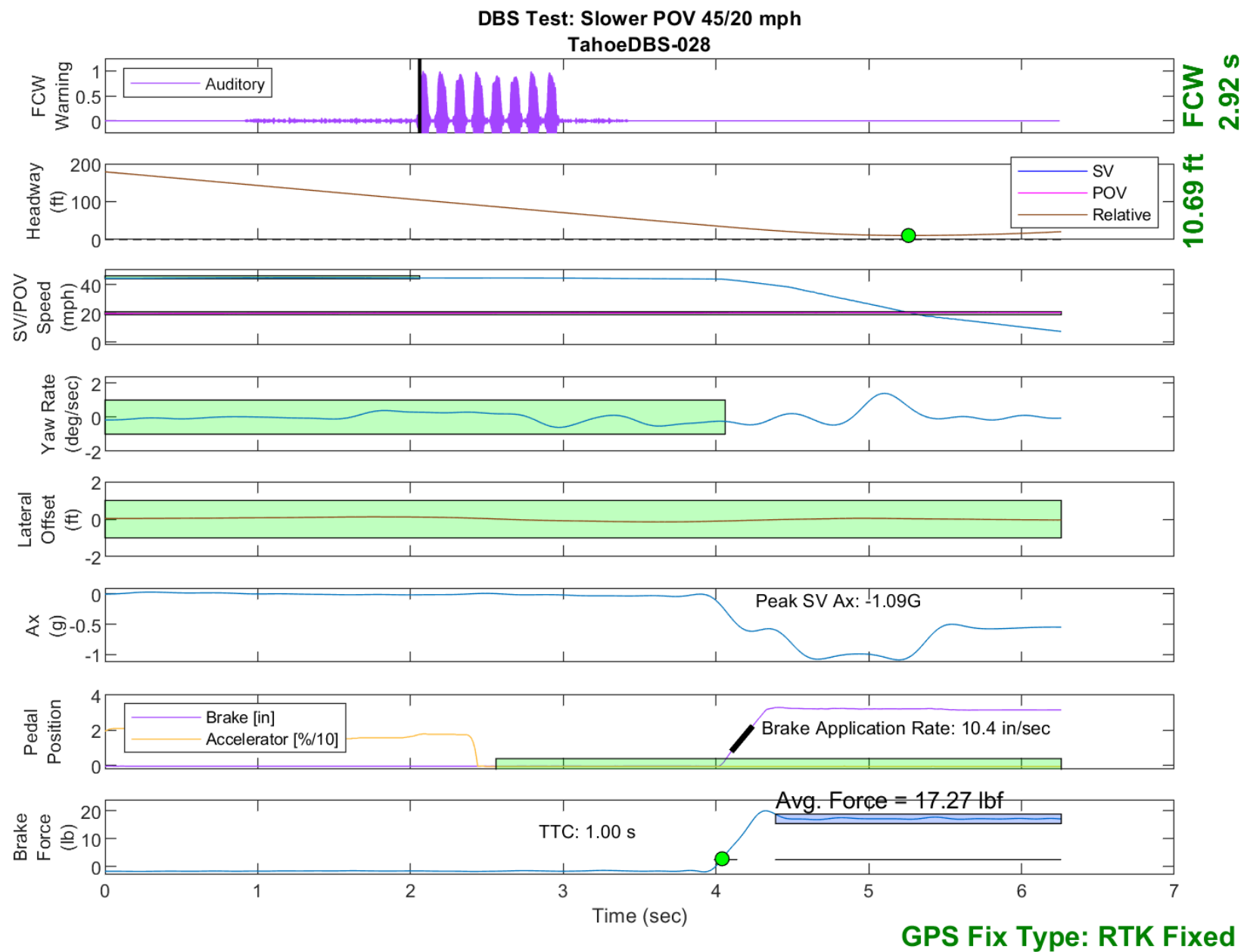


Figure E28. Time History for DBS Run 28, SV Encounters Slower POV, SV 45 mph, POV 20 mph

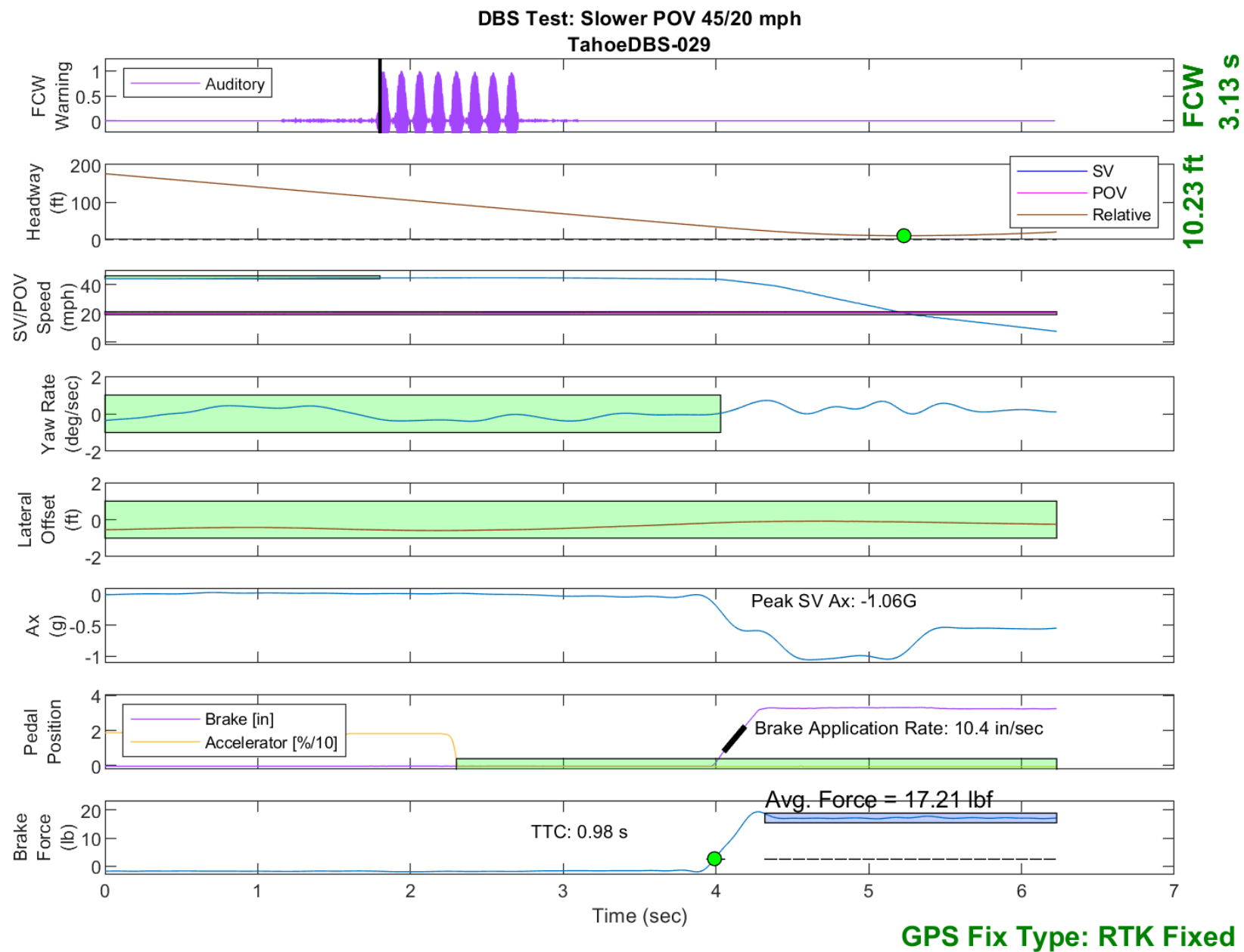


Figure E29. Time History for DBS Run 29, SV Encounters Slower POV, SV 45 mph, POV 20 mph

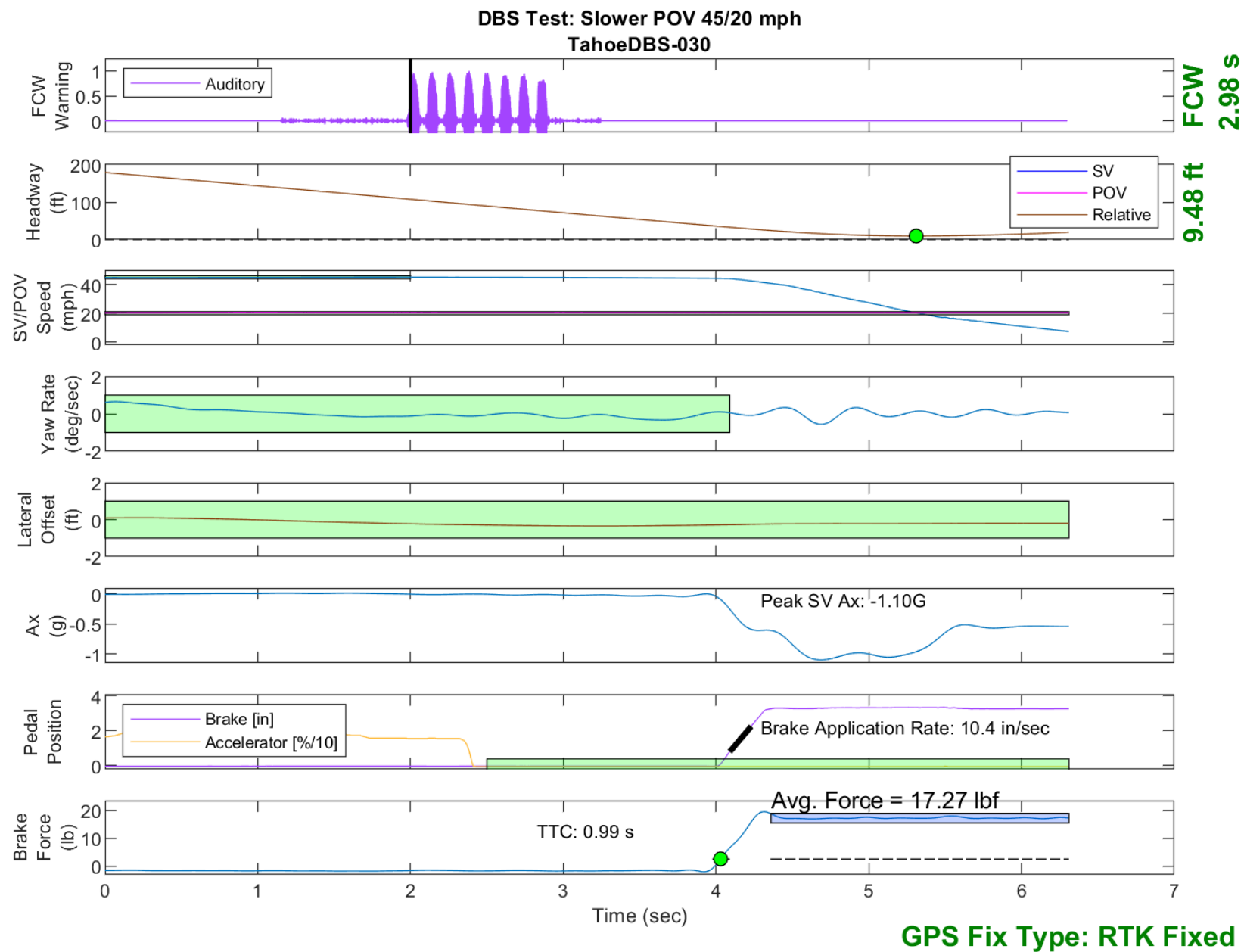


Figure E30. Time History for DBS Run 30, SV Encounters Slower POV, SV 45 mph, POV 20 mph

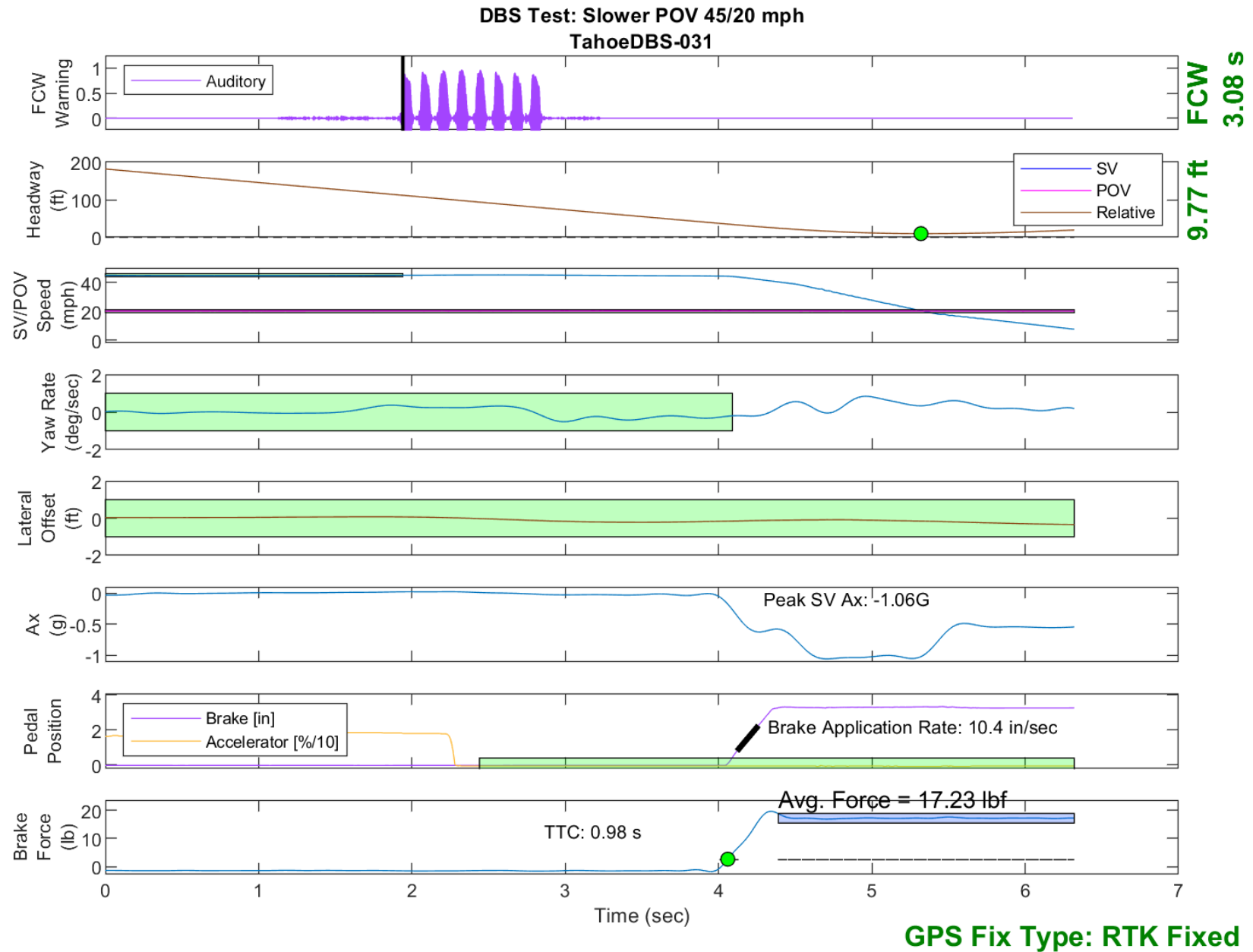


Figure E31. Time History for DBS Run 31, SV Encounters Slower POV, SV 45 mph, POV 20 mph

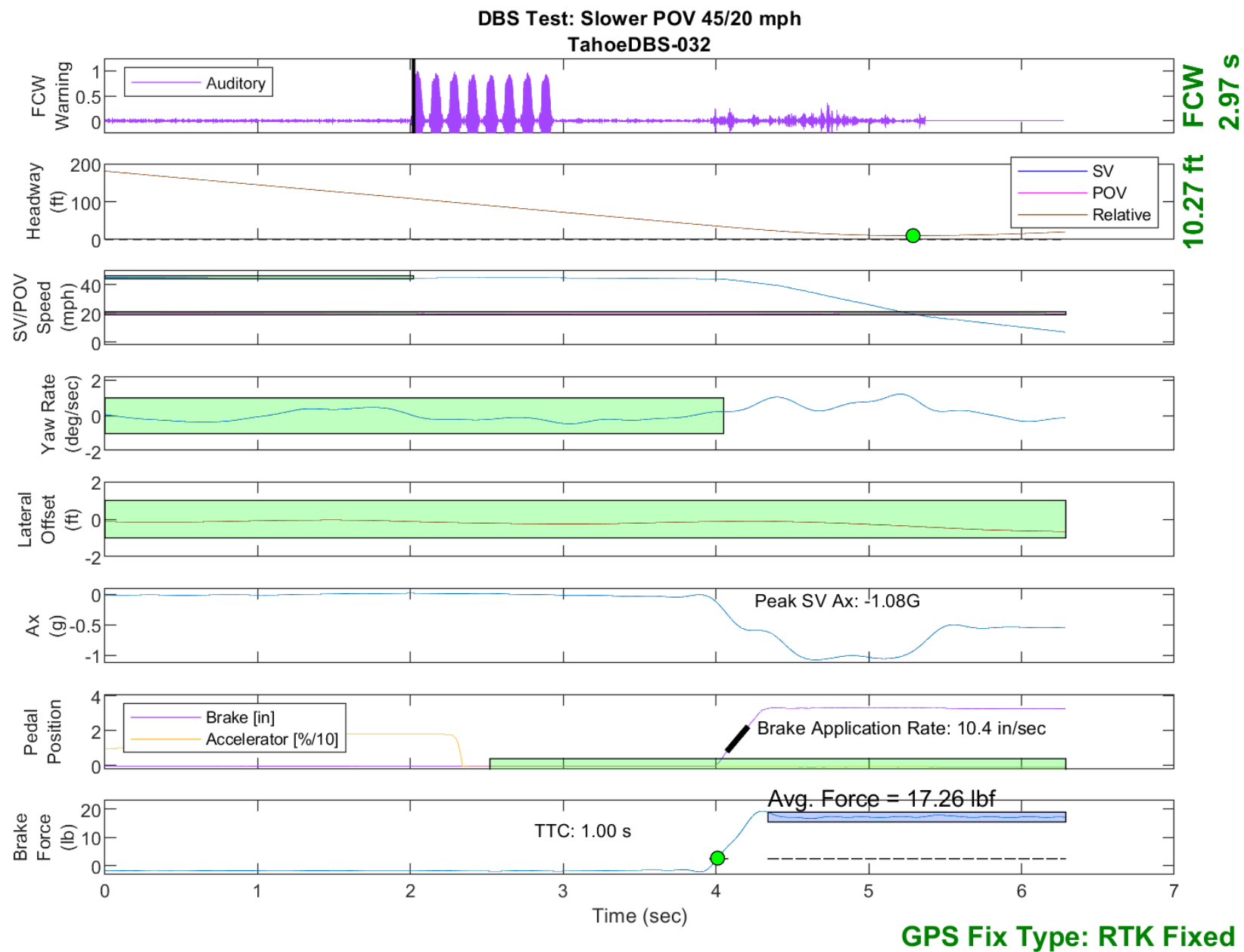


Figure E32. Time History for DBS Run 32, SV Encounters Slower POV, SV 45 mph, POV 20 mph

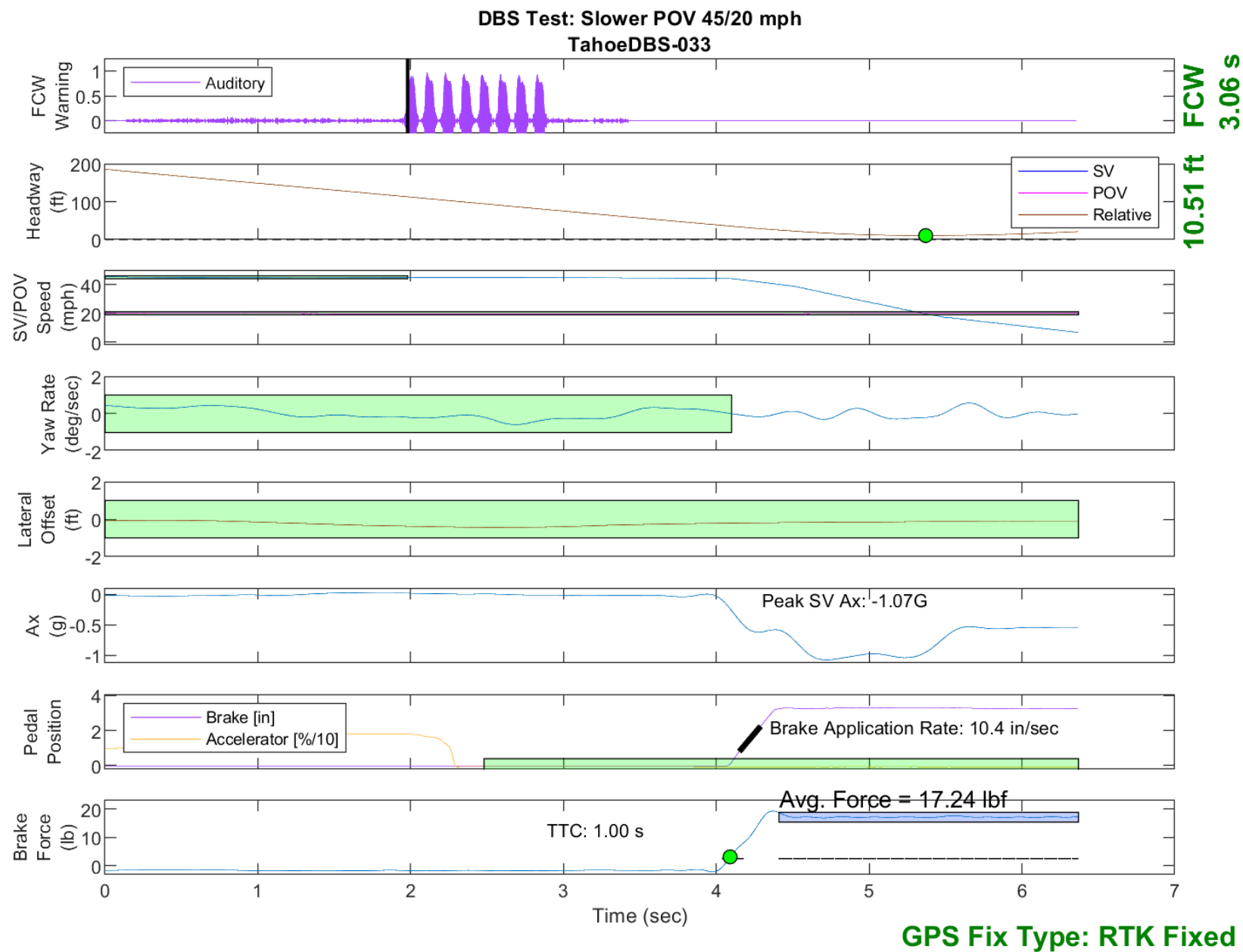


Figure E33. Time History for DBS Run 33, SV Encounters Slower POV, SV 45 mph, POV 20 mph

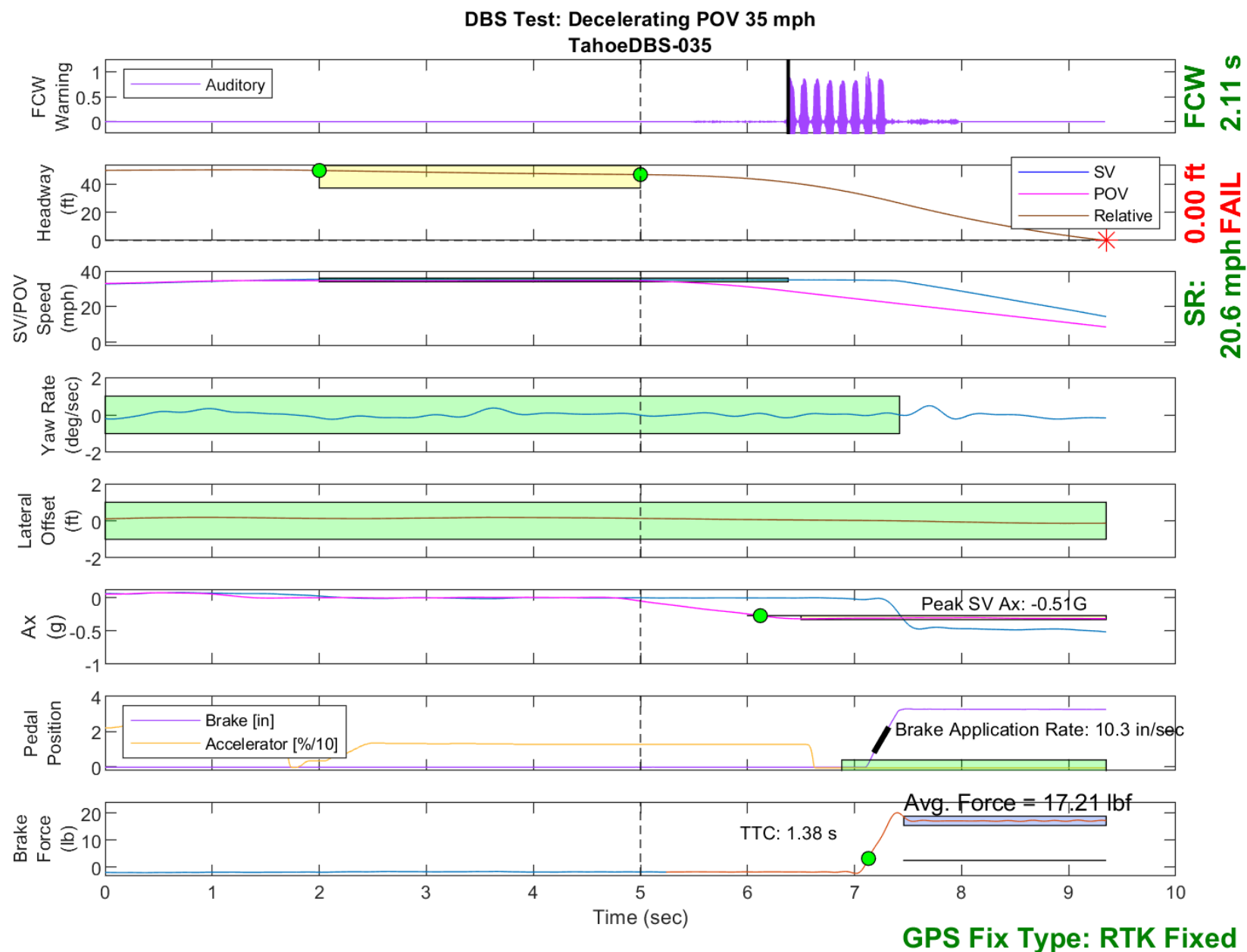


Figure E34. Time History for DBS Run 35, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

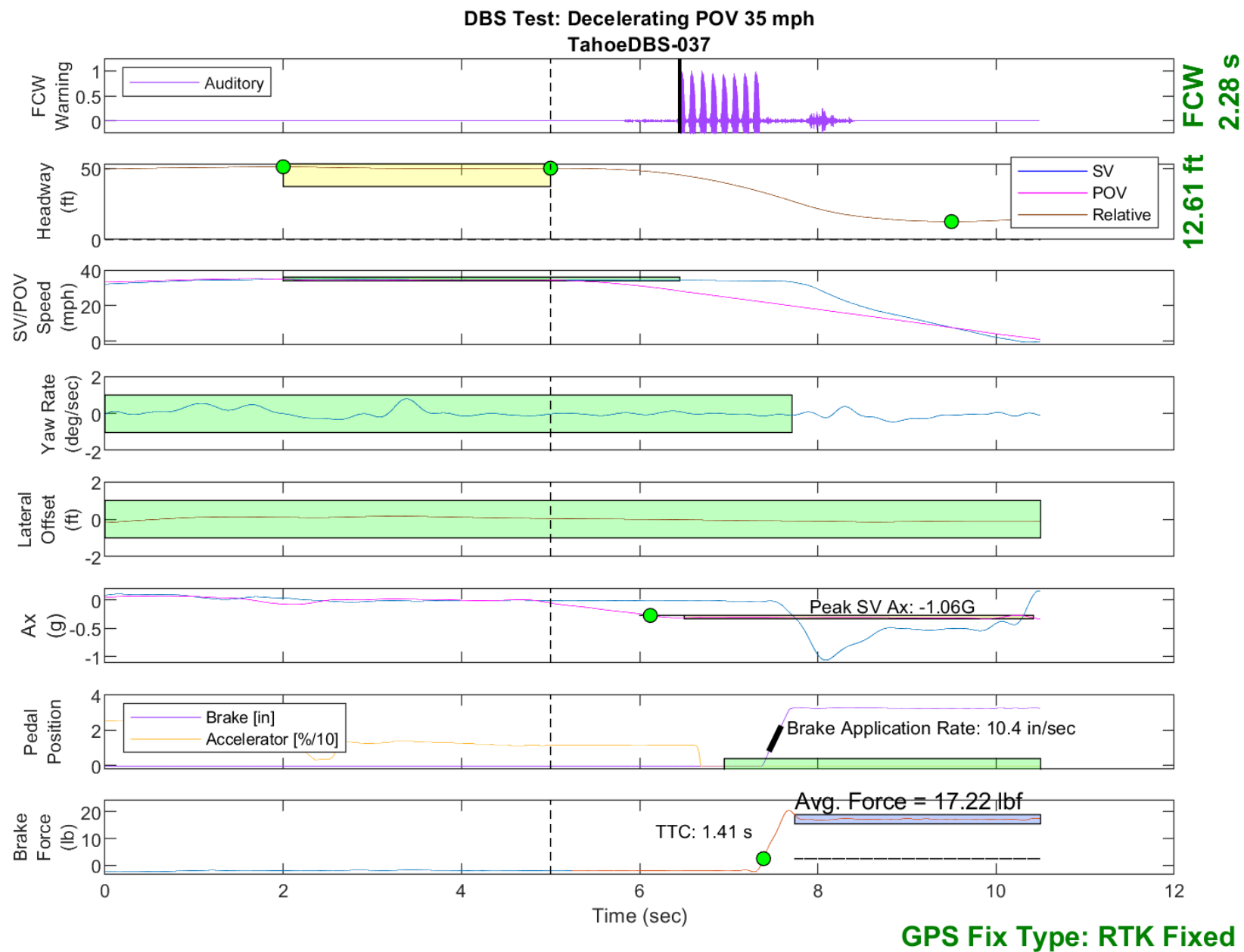


Figure E35. Time History for DBS Run 37, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

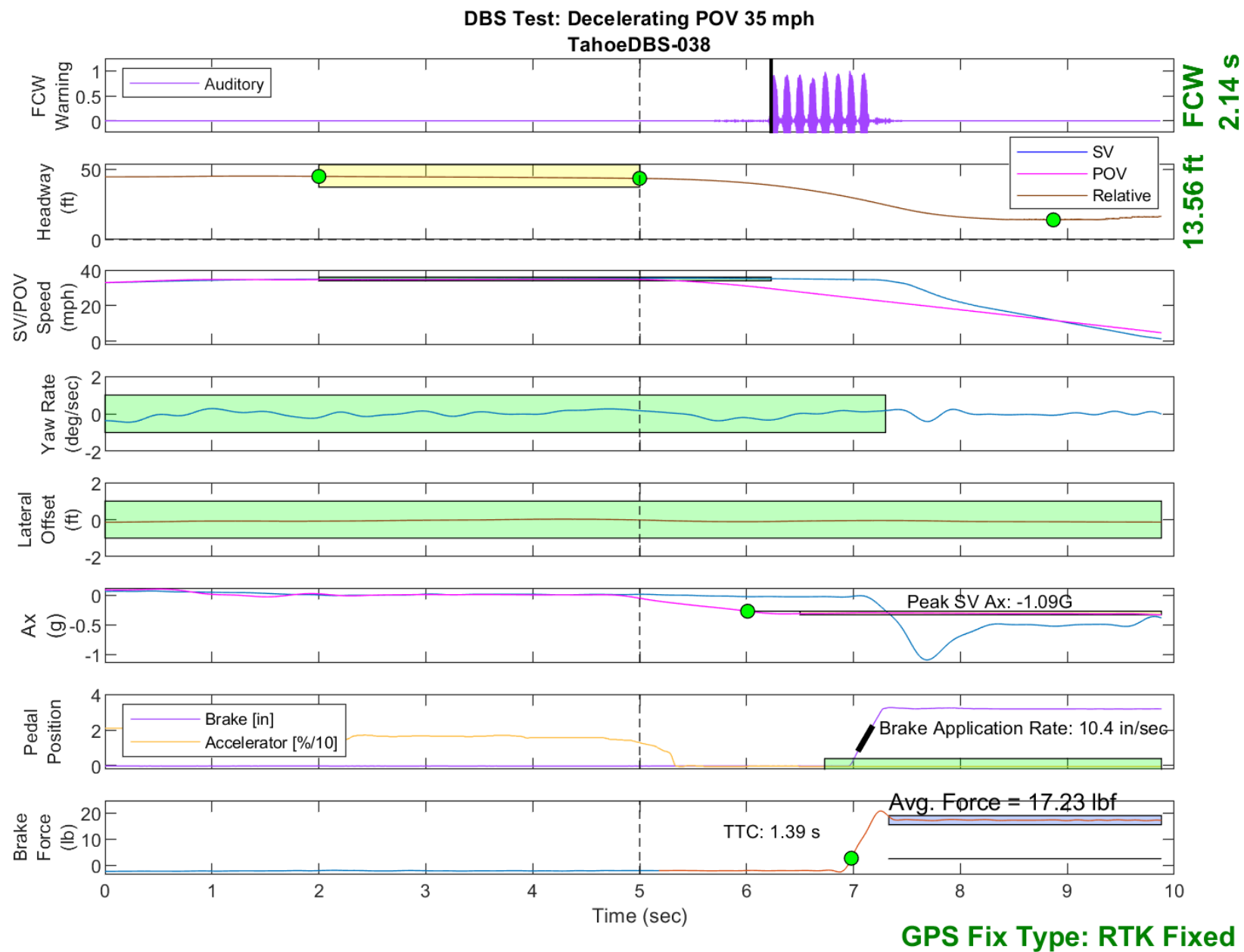


Figure E36. Time History for DBS Run 38, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

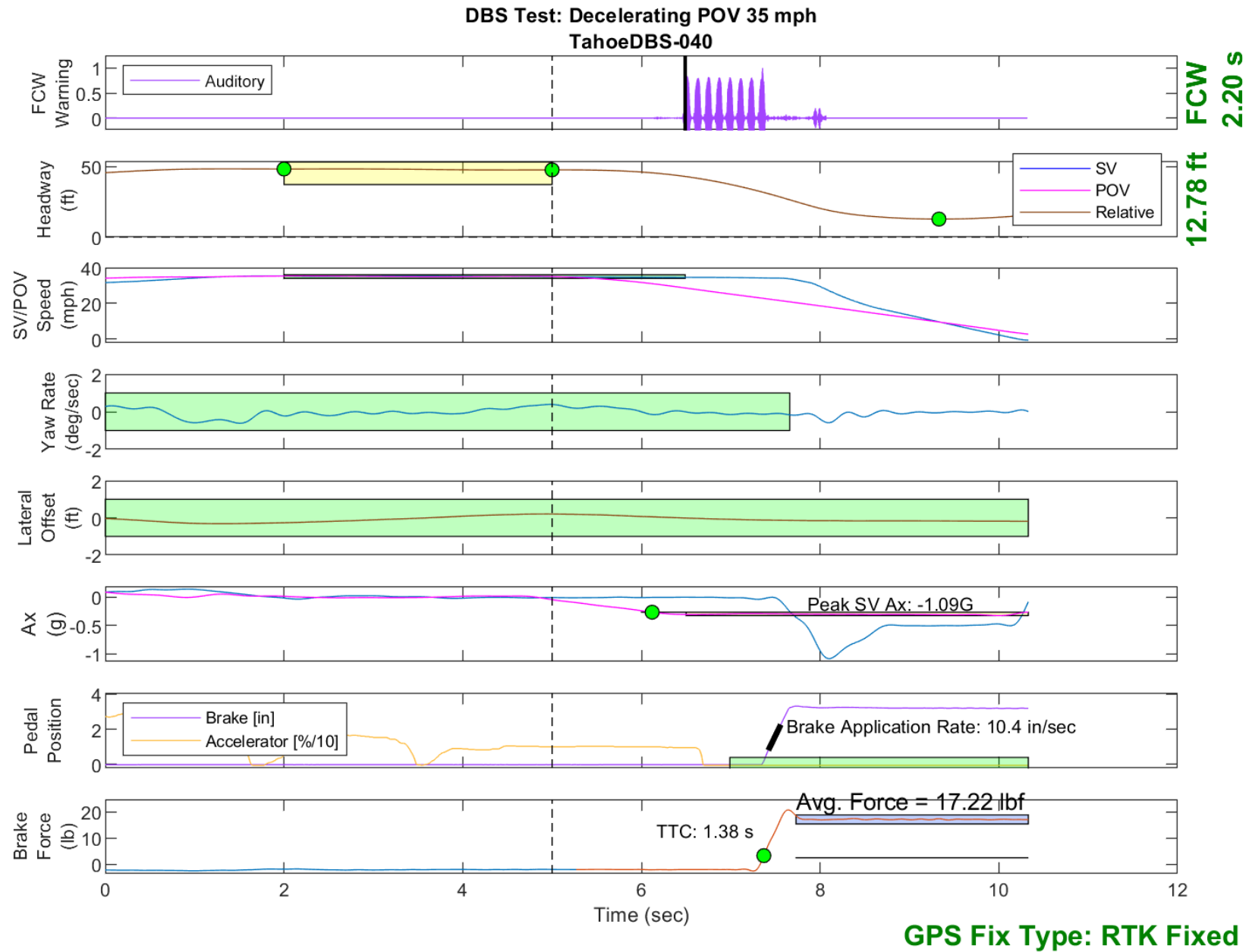


Figure E37. Time History for DBS Run 40, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

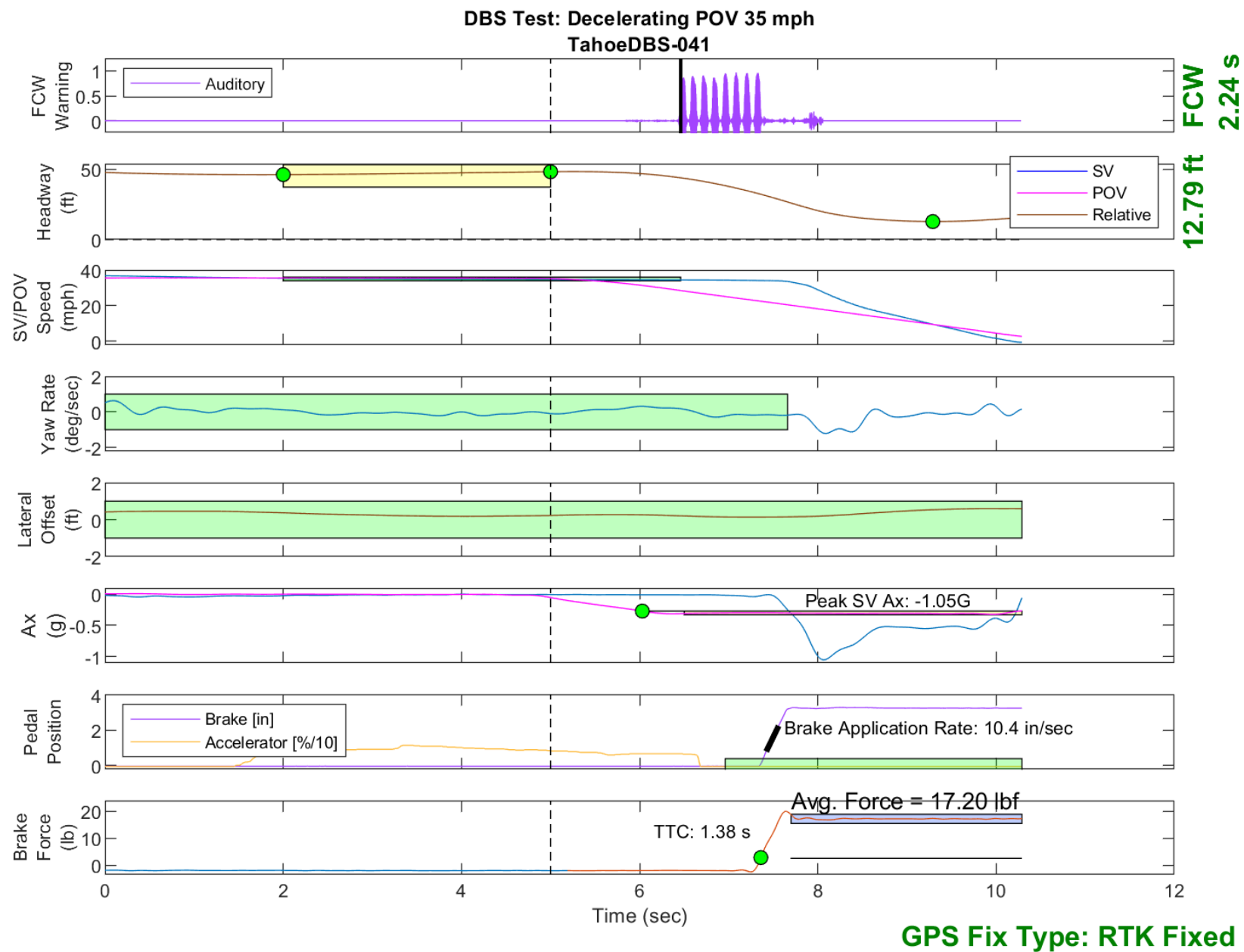


Figure E38. Time History for DBS Run 41, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

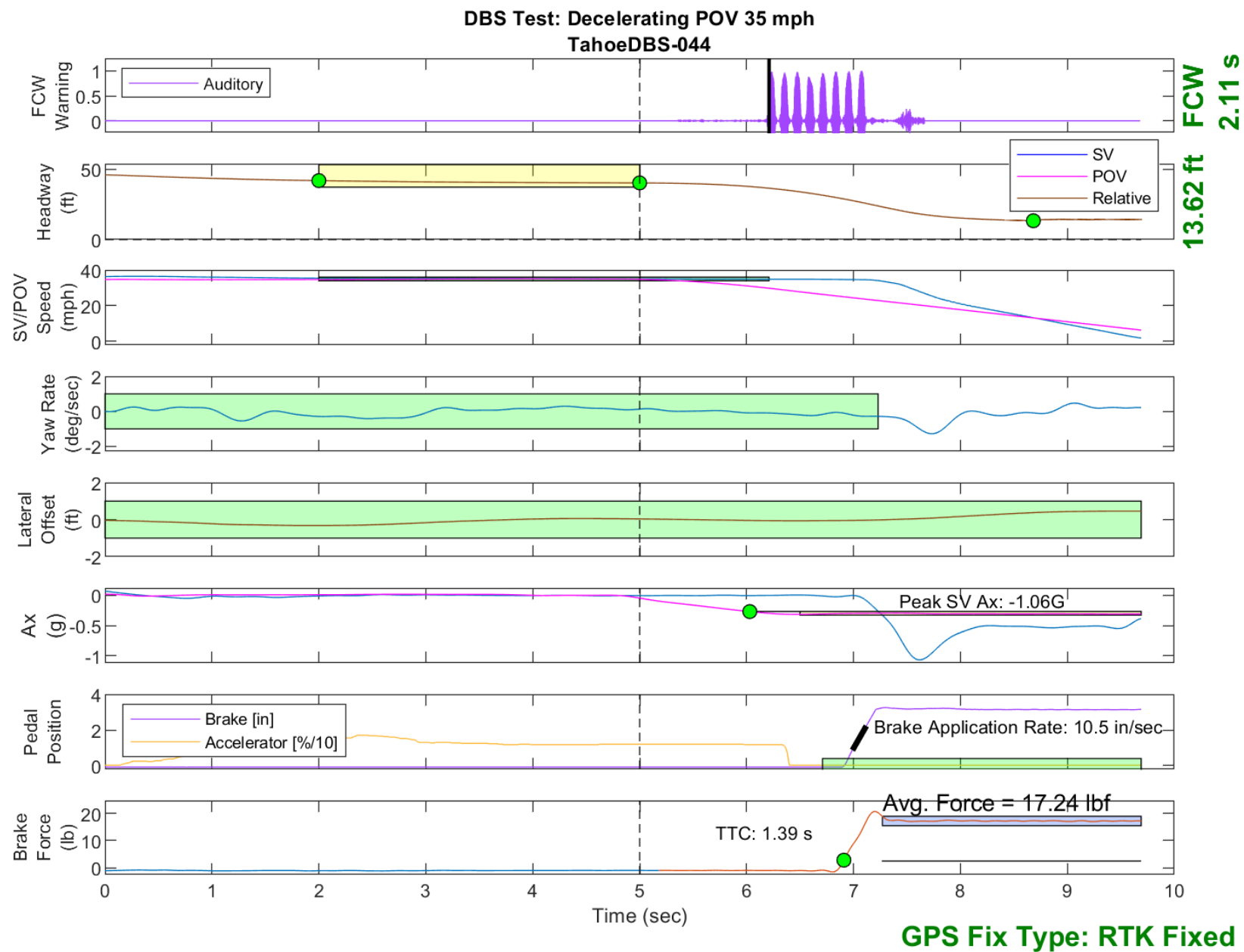


Figure E39. Time History for DBS Run 44, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

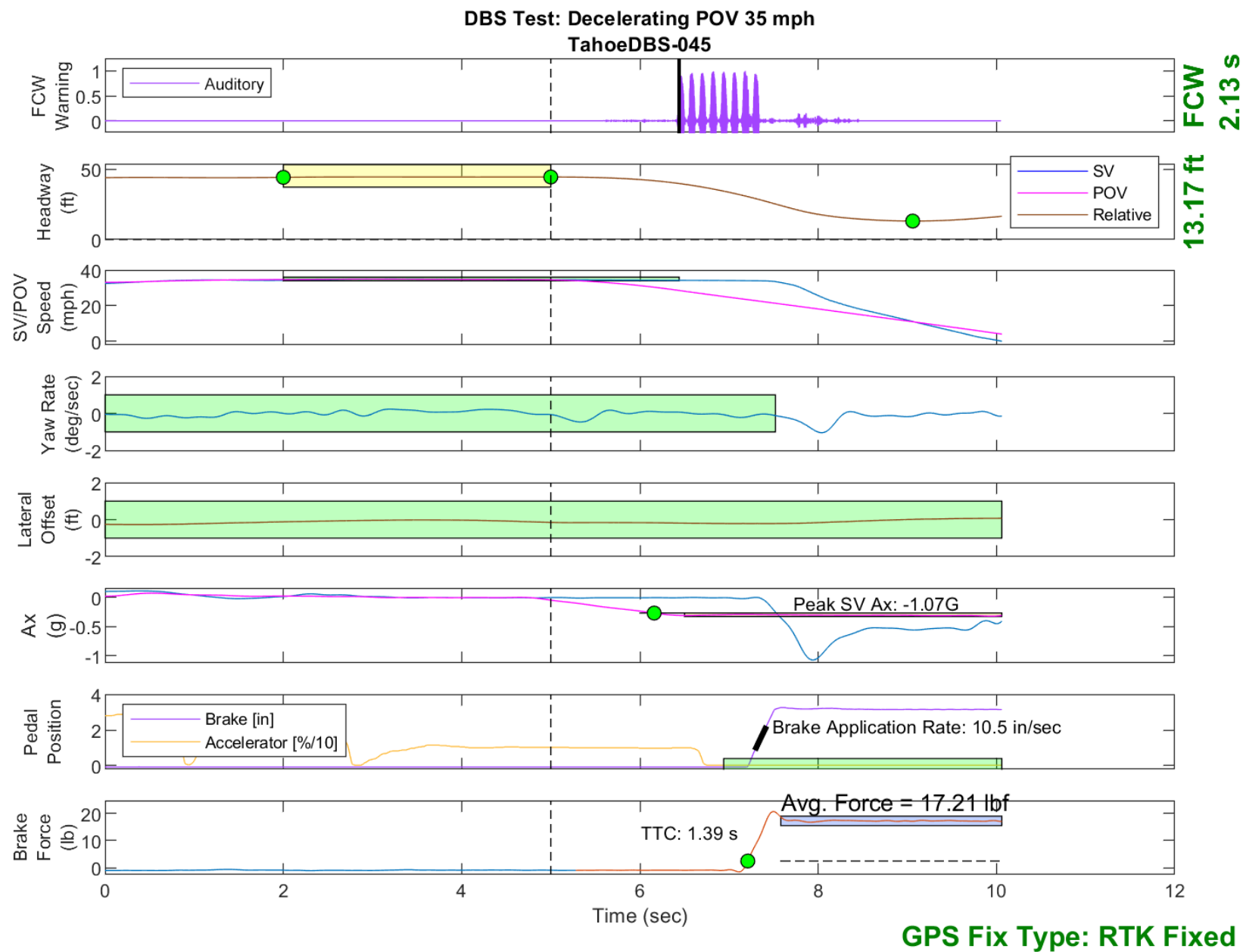


Figure E40. Time History for DBS Run 45, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

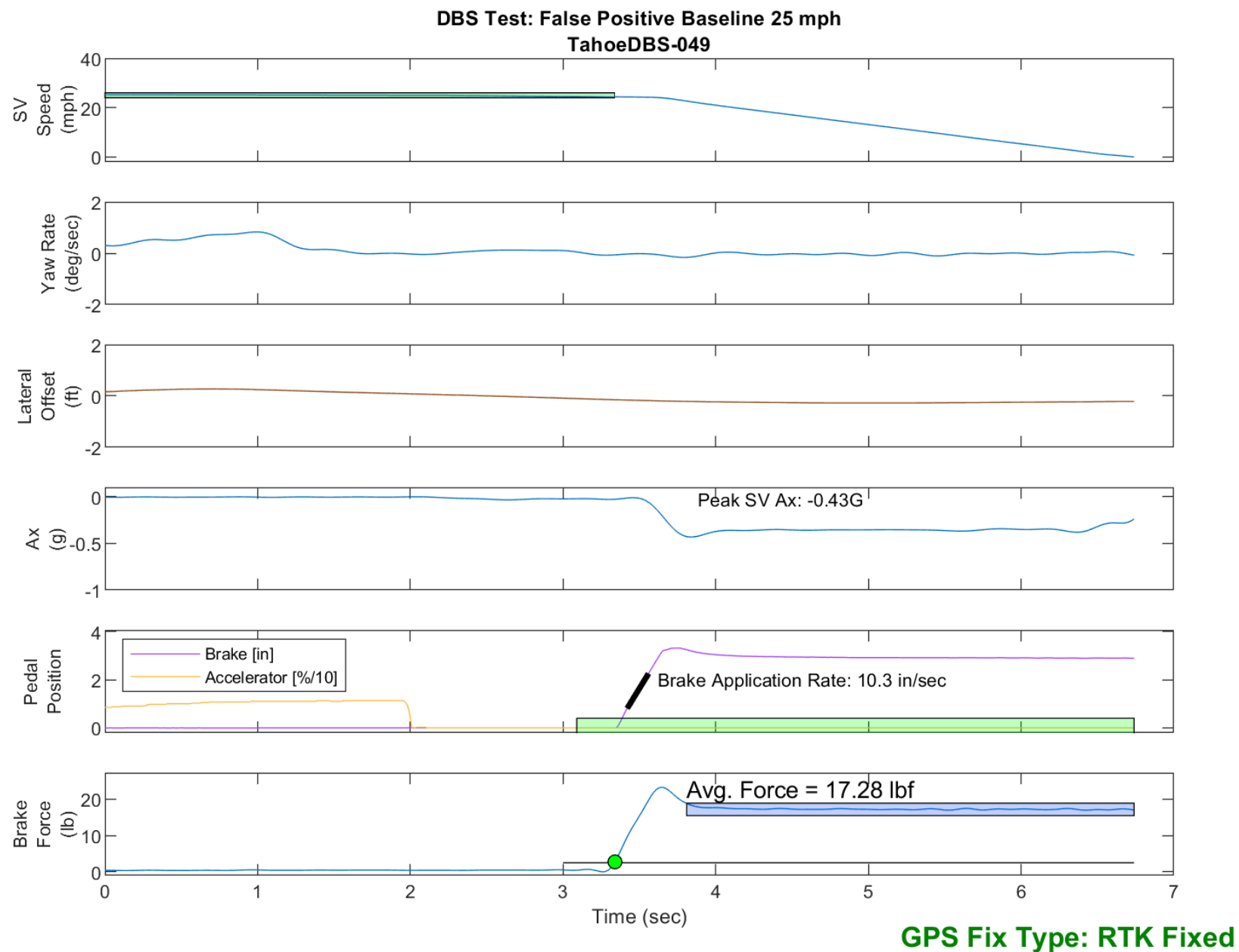


Figure E41. Time History for DBS Run 49, False Positive Baseline, SV 25 mph

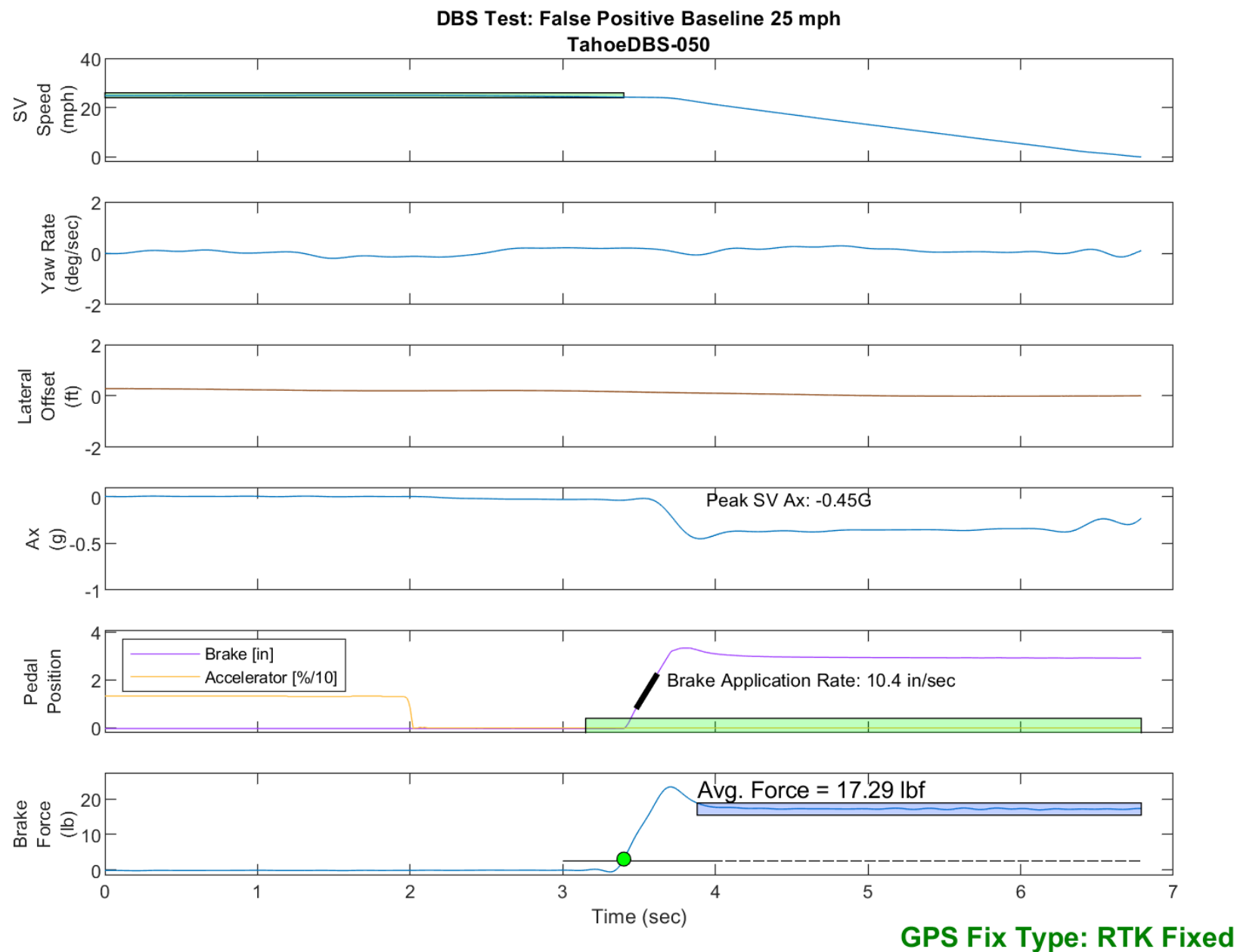


Figure E42. Time History for DBS Run 50, False Positive Baseline, SV 25 mph

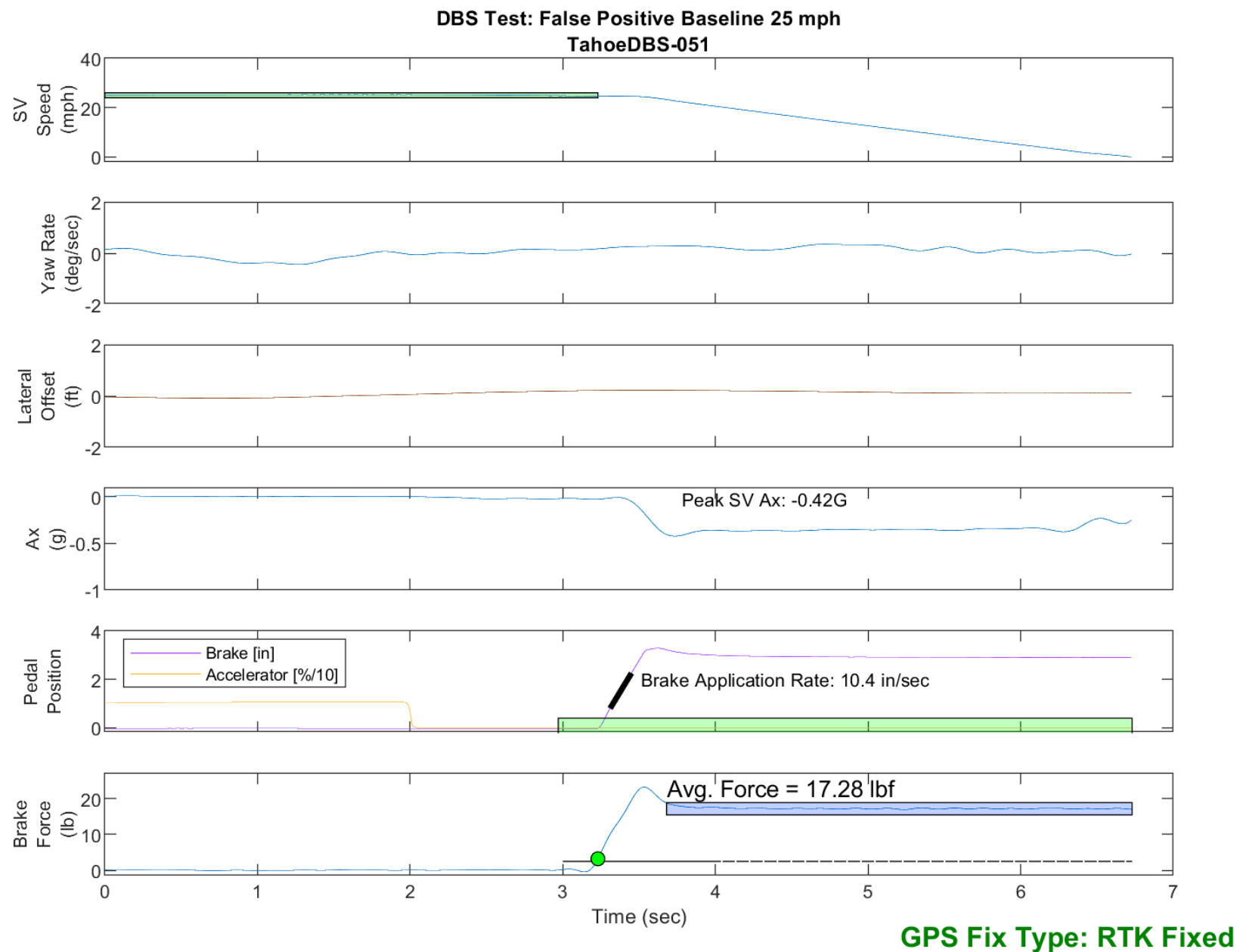


Figure E43. Time History for DBS Run 51, False Positive Baseline, SV 25 mph

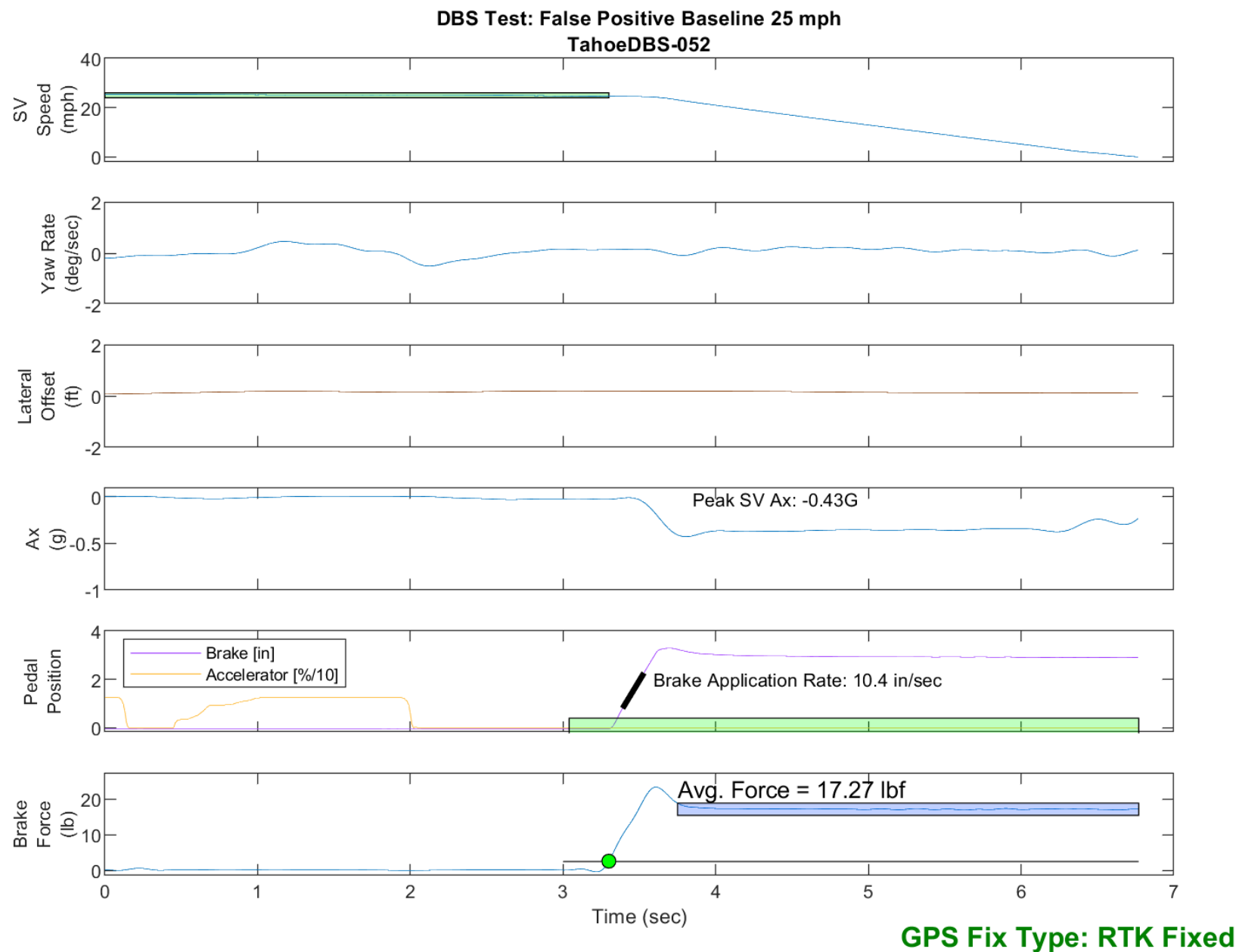


Figure E44. Time History for DBS Run 52, False Positive Baseline, SV 25 mph

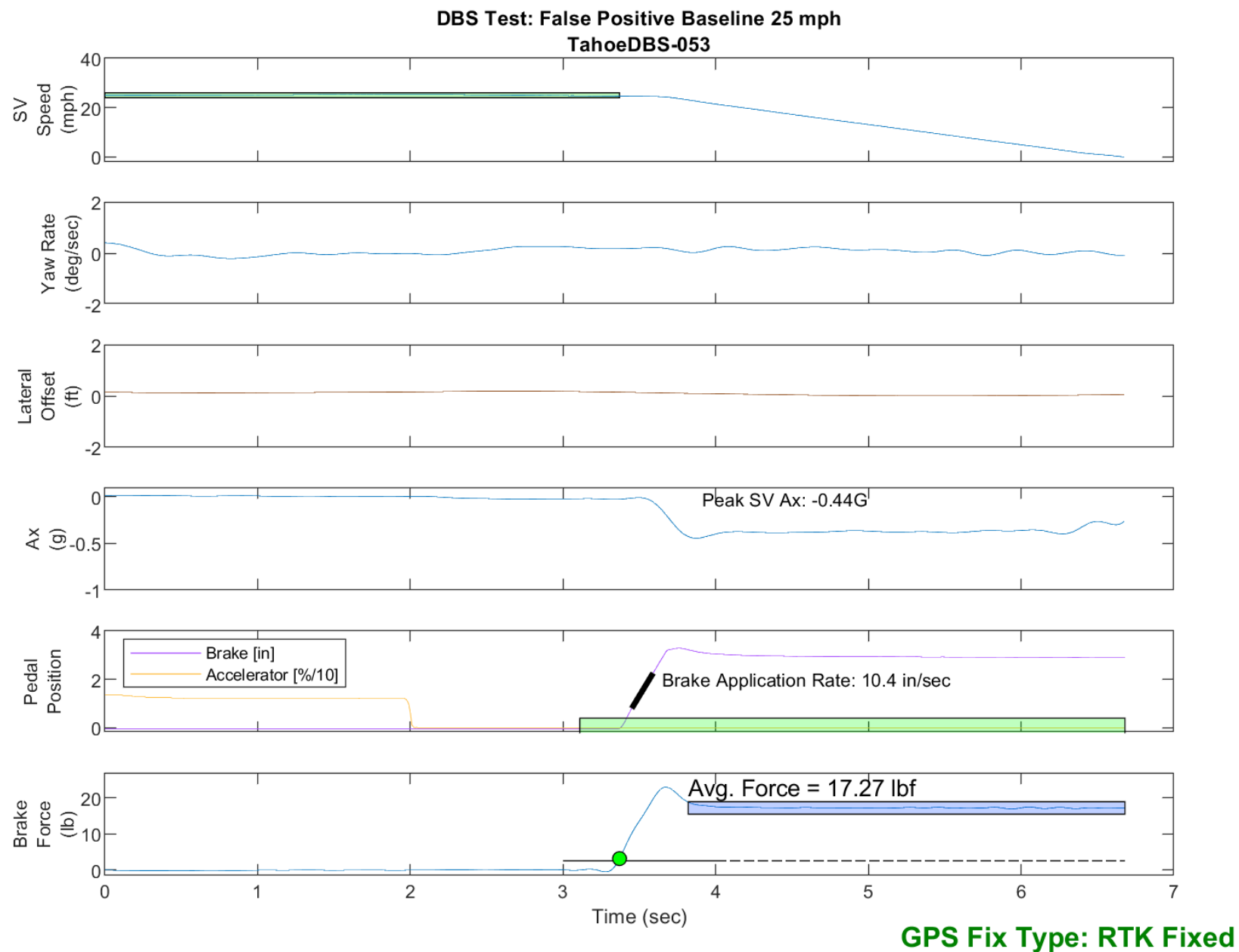


Figure E45. Time History for DBS Run 53, False Positive Baseline, SV 25 mph

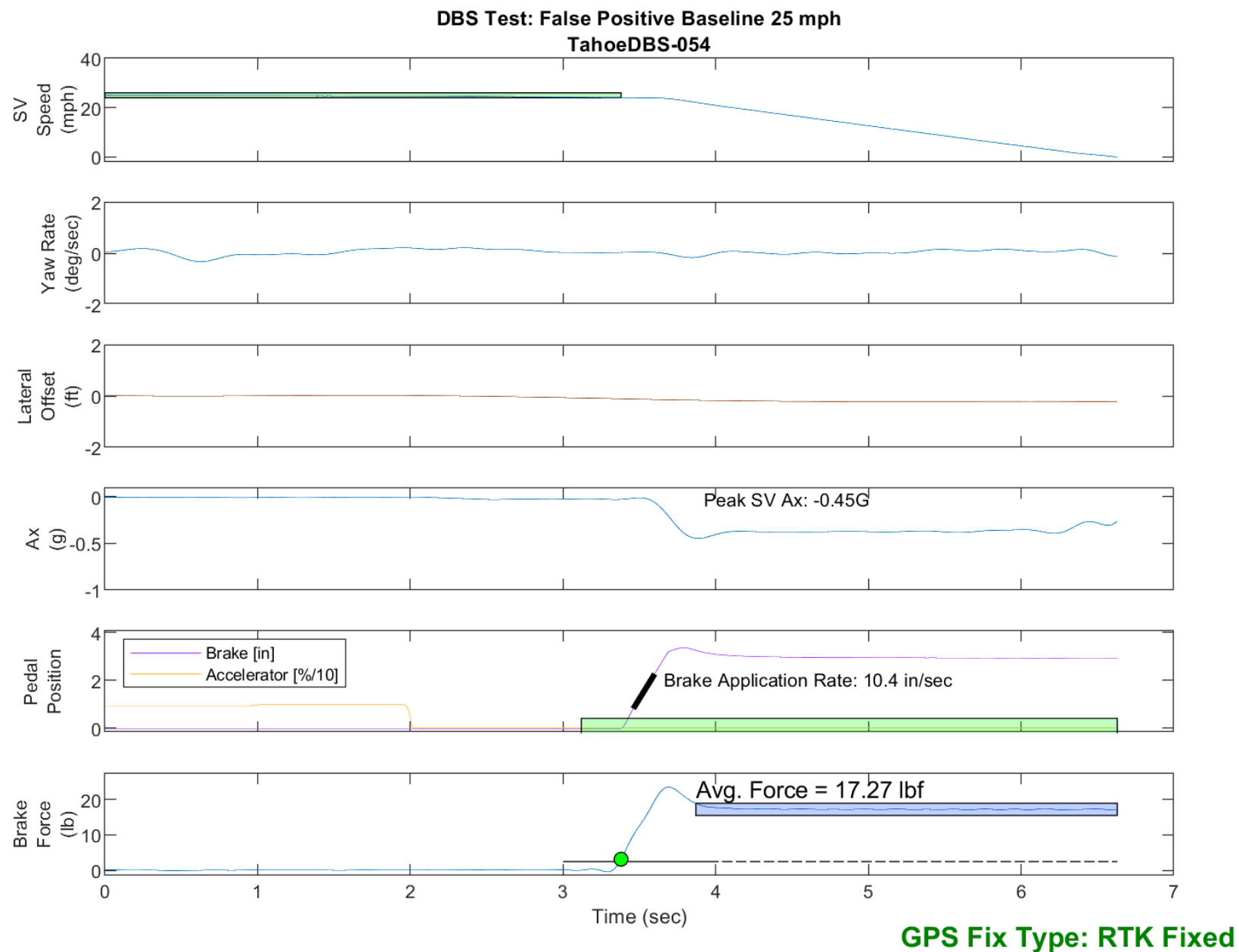


Figure E46. Time History for DBS Run 54, False Positive Baseline, SV 25 mph

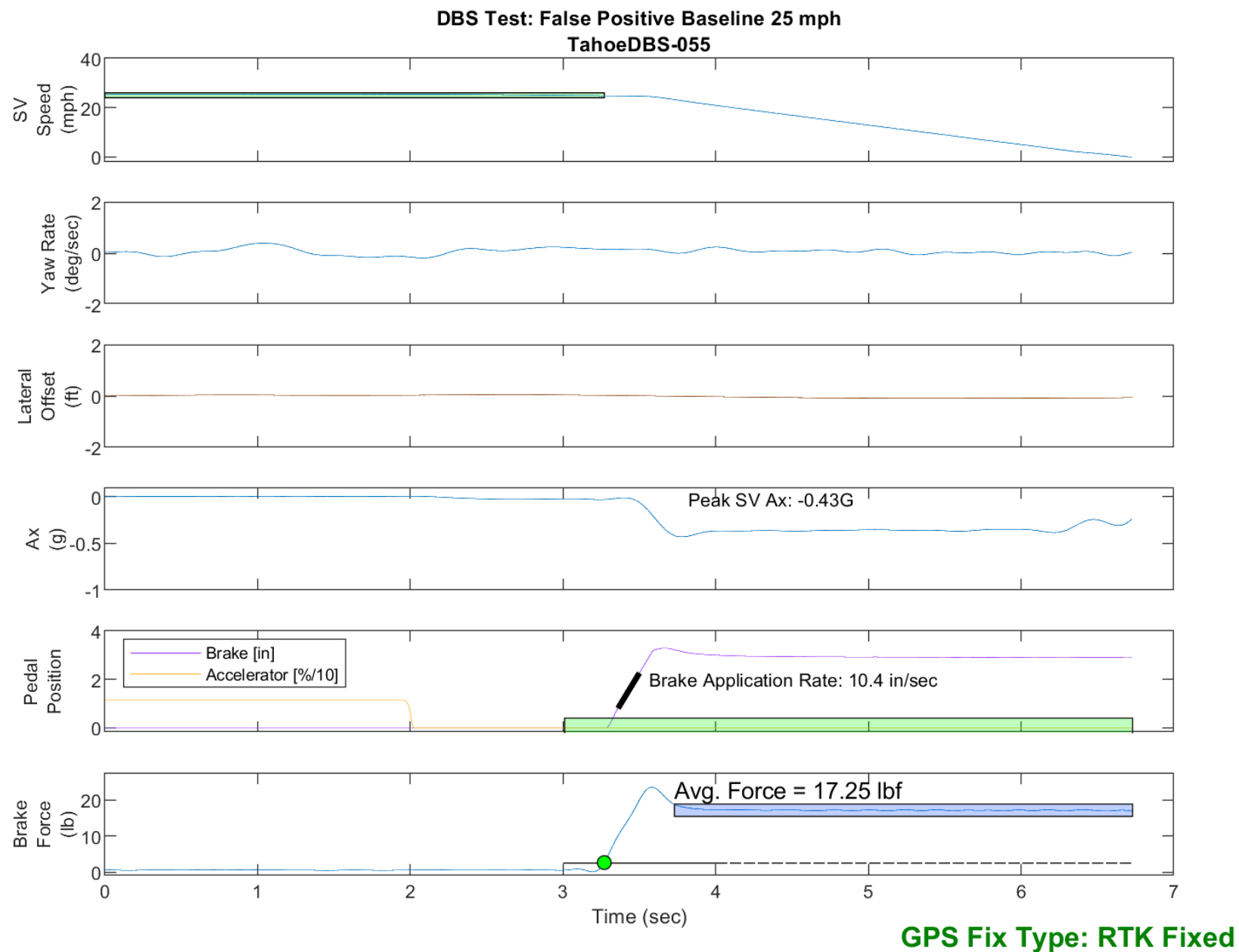


Figure E47. Time History for DBS Run 55, False Positive Baseline, SV 25 mph

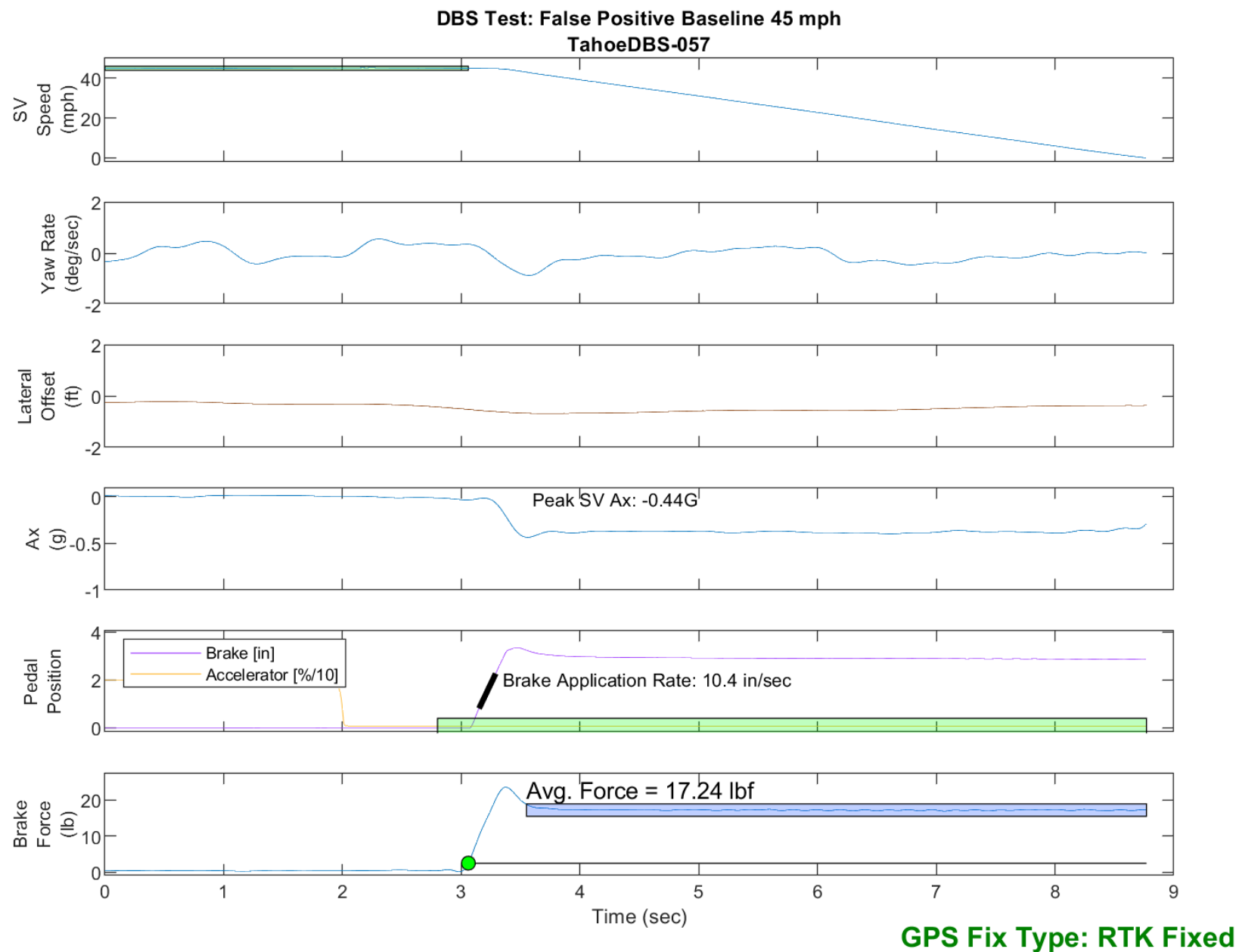


Figure E48. Time History for DBS Run 57, False Positive Baseline, SV 45 mph

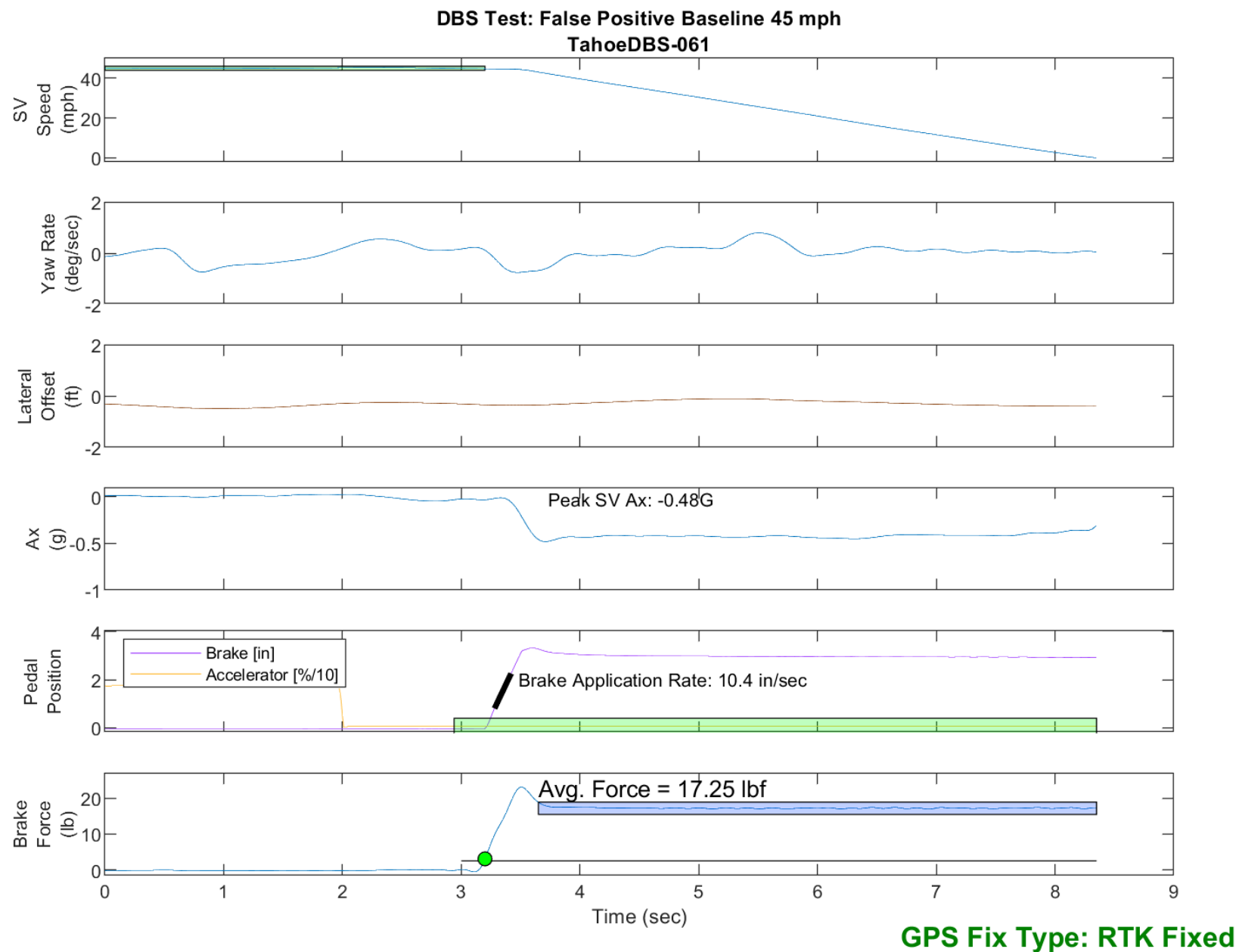


Figure E49. Time History for DBS Run 61, False Positive Baseline, SV 45 mph

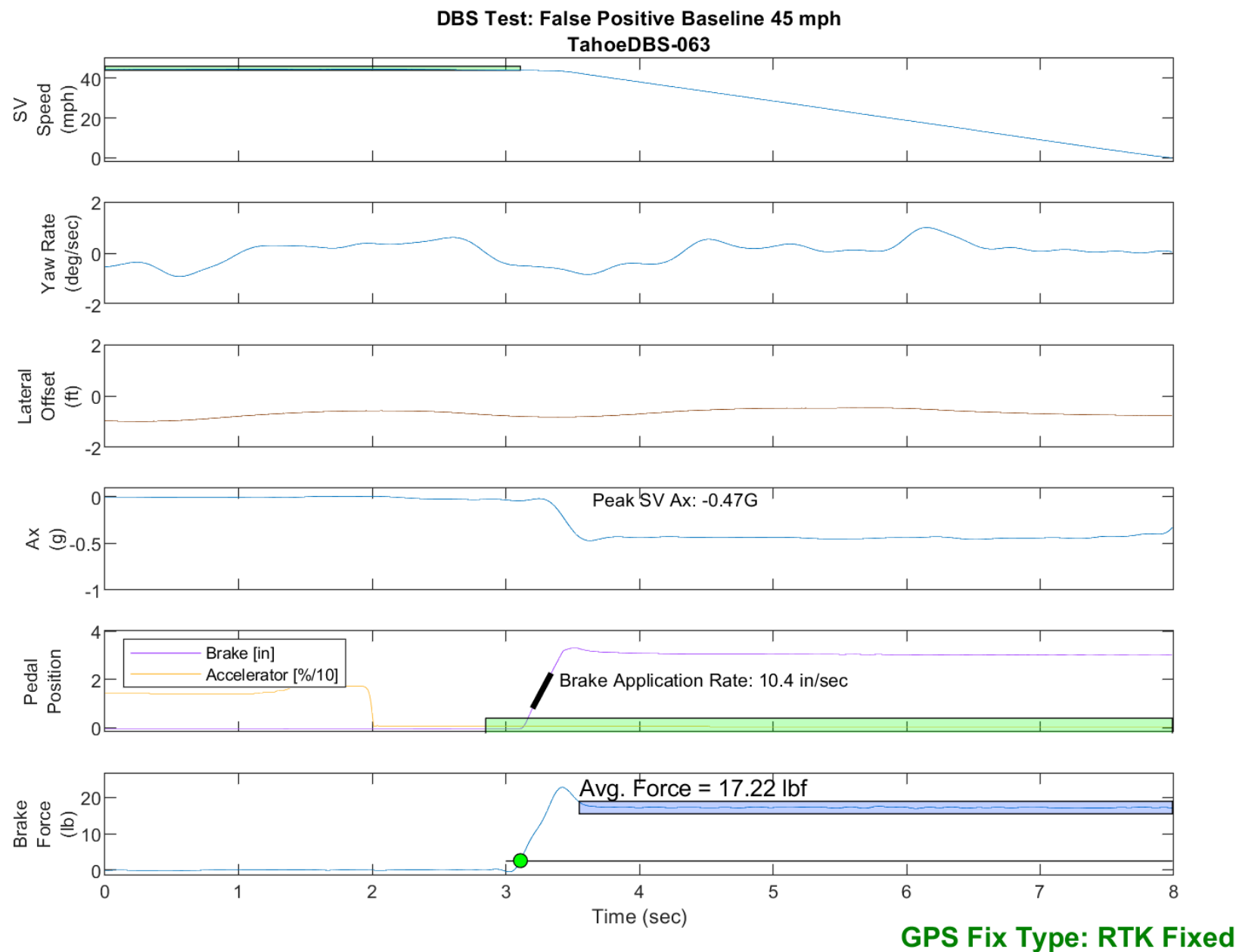


Figure E50. Time History for DBS Run 63, False Positive Baseline, SV 45 mph

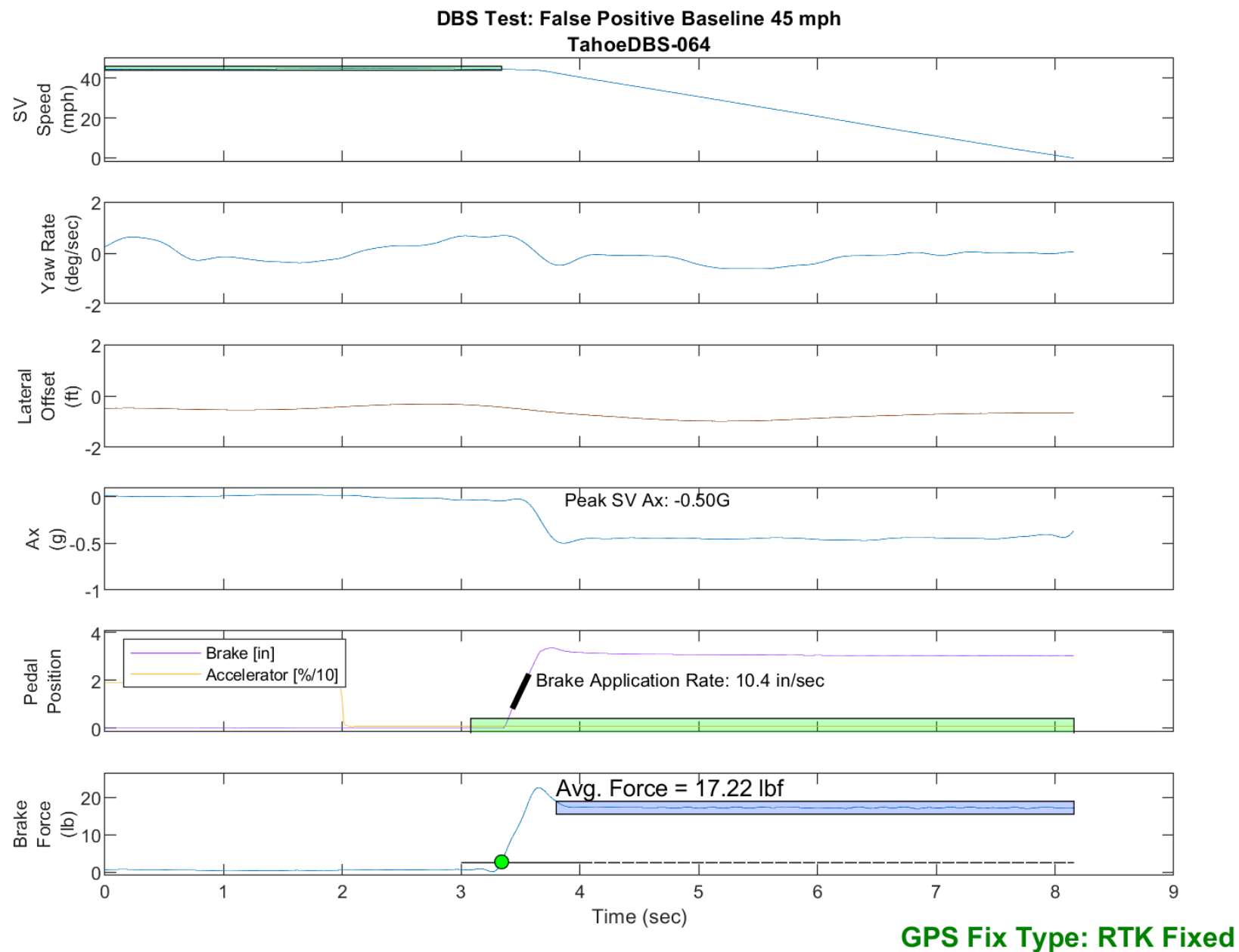


Figure E51. Time History for DBS Run 64, False Positive Baseline, SV 45 mph

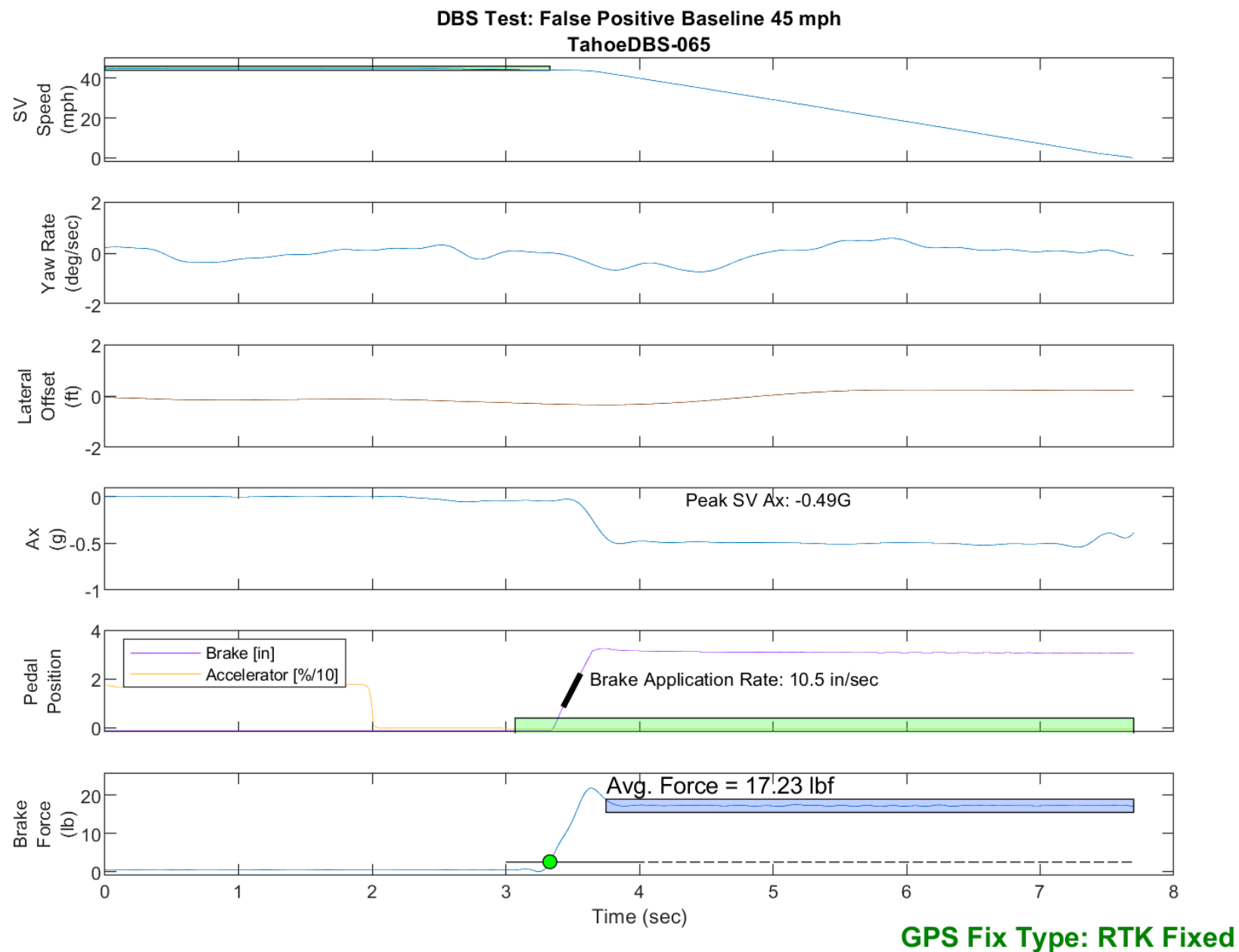


Figure E52. Time History for DBS Run 65, False Positive Baseline, SV 45 mph

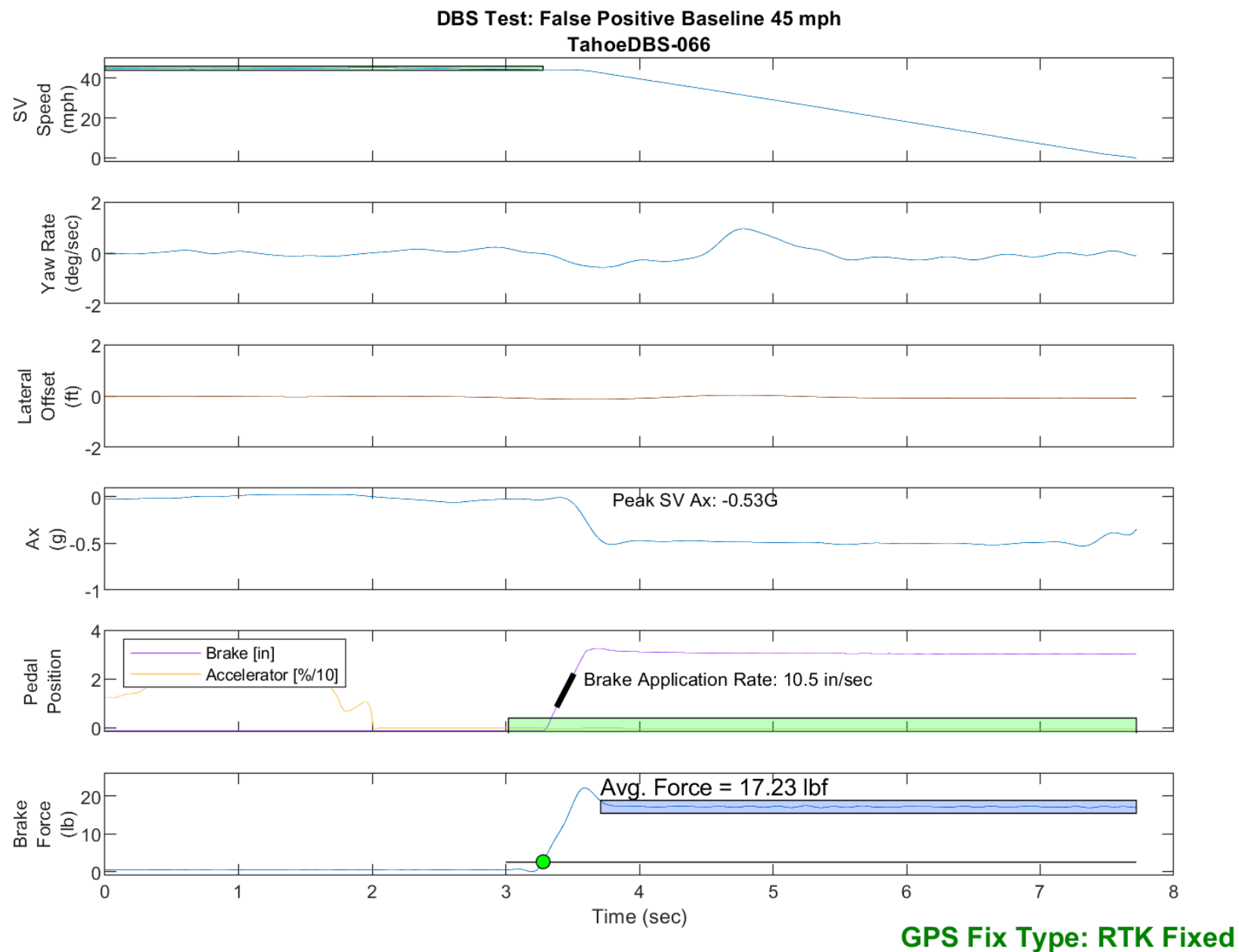


Figure E53. Time History for DBS Run 66, False Positive Baseline, SV 45 mph

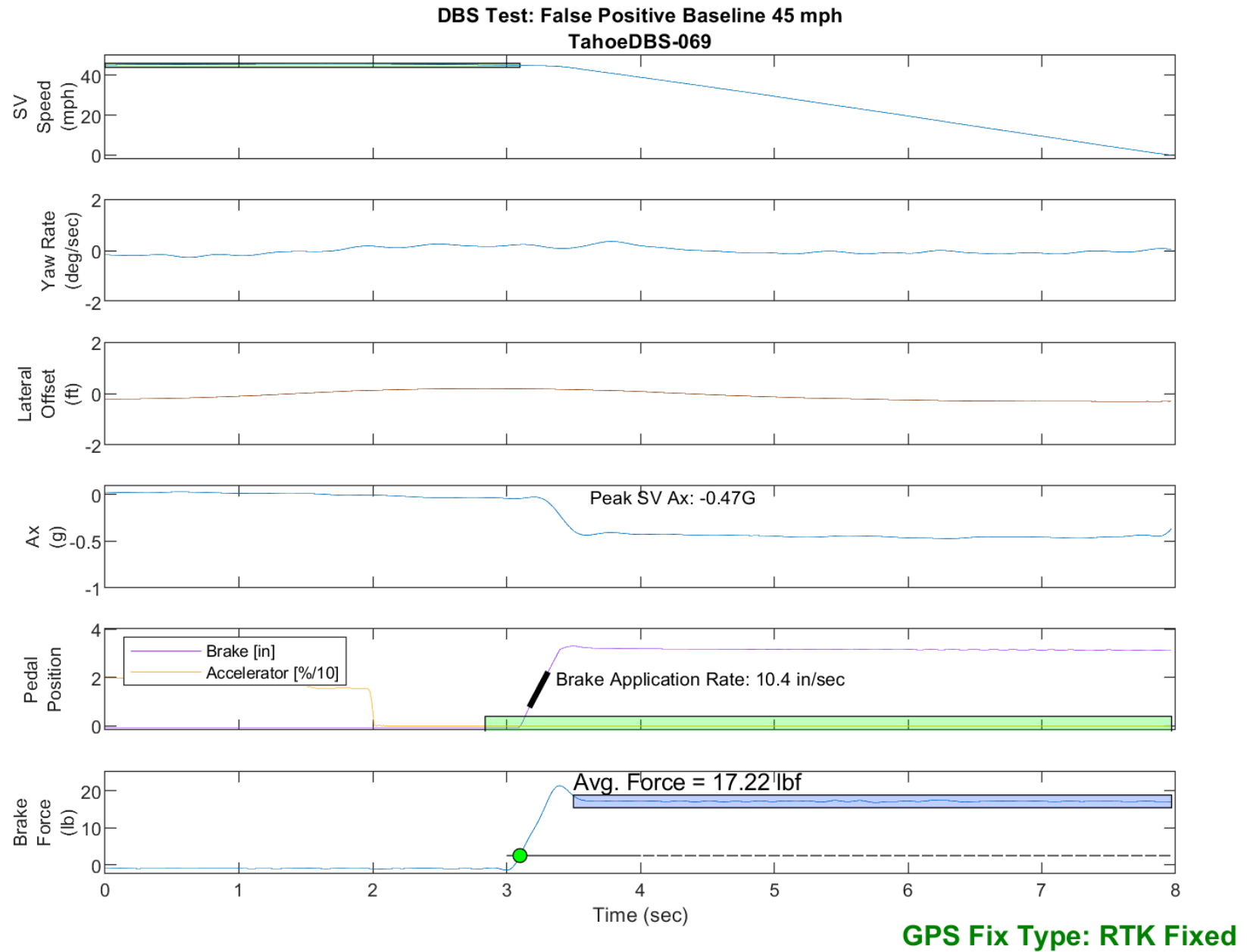


Figure E54. Time History for DBS Run 69, False Positive Baseline, SV 45 mph

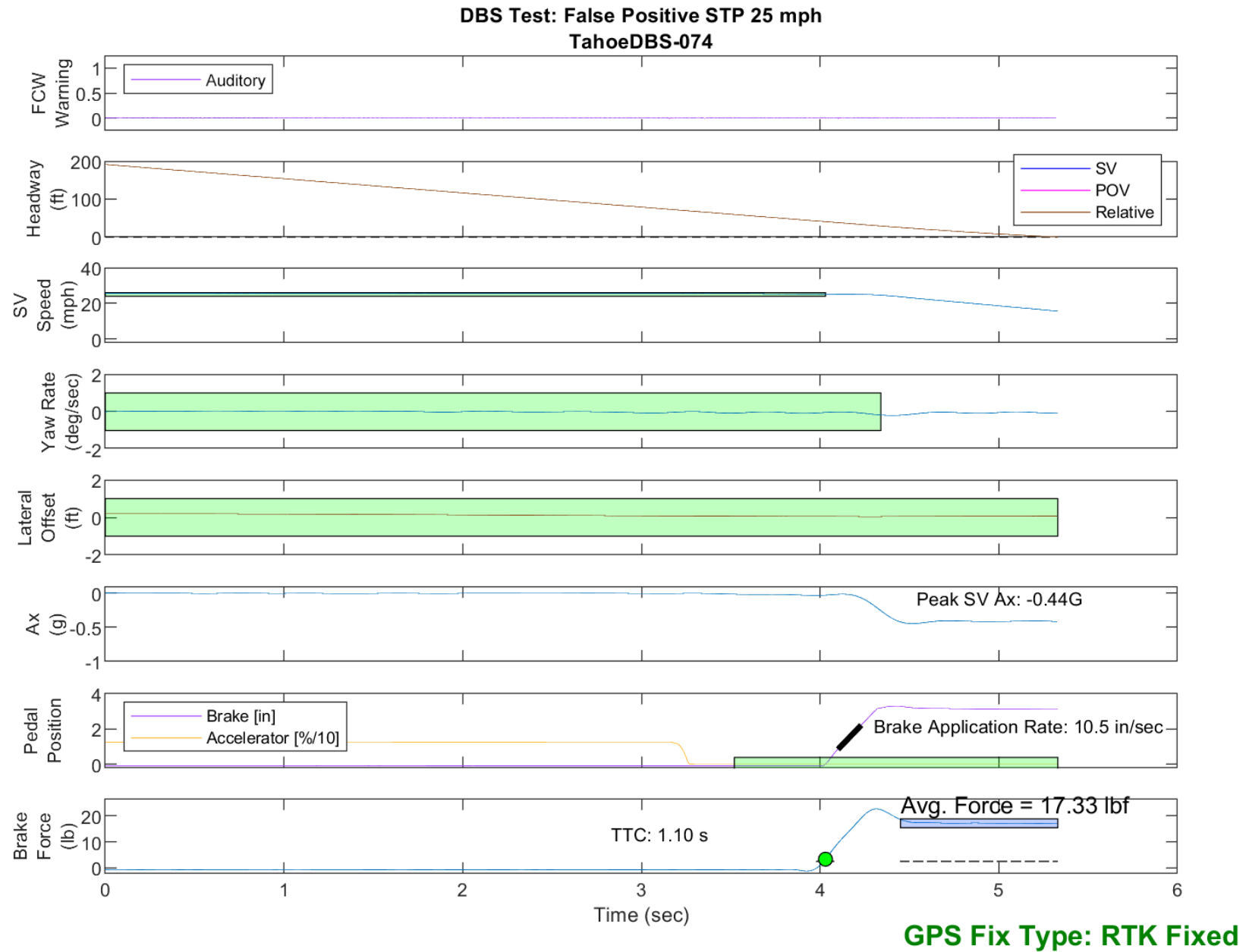


Figure E55. Time History for DBS Run 74, SV Encounters Steel Trench Plate, SV 25 mph

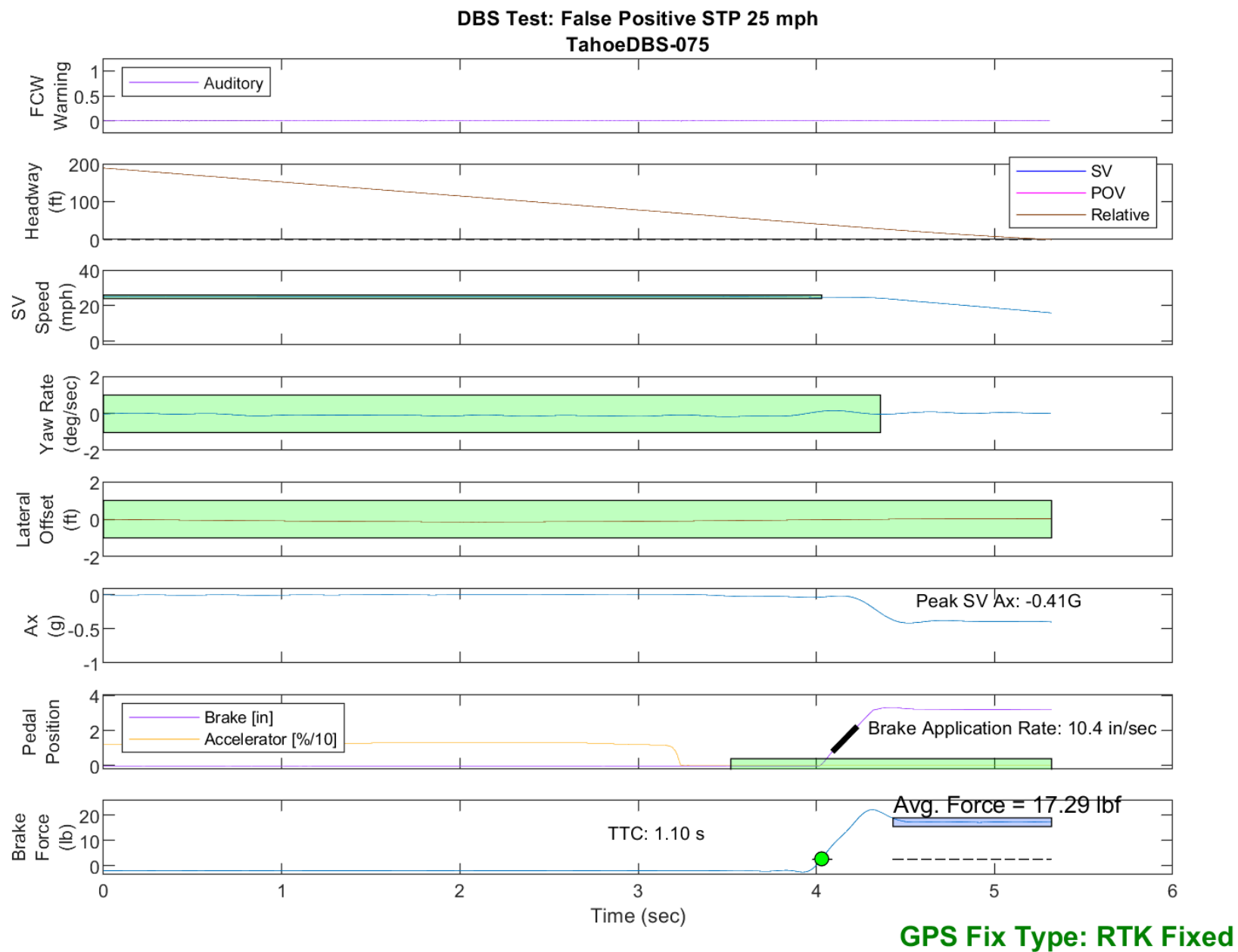


Figure E56. Time History for DBS Run 75, SV Encounters Steel Trench Plate, SV 25 mph

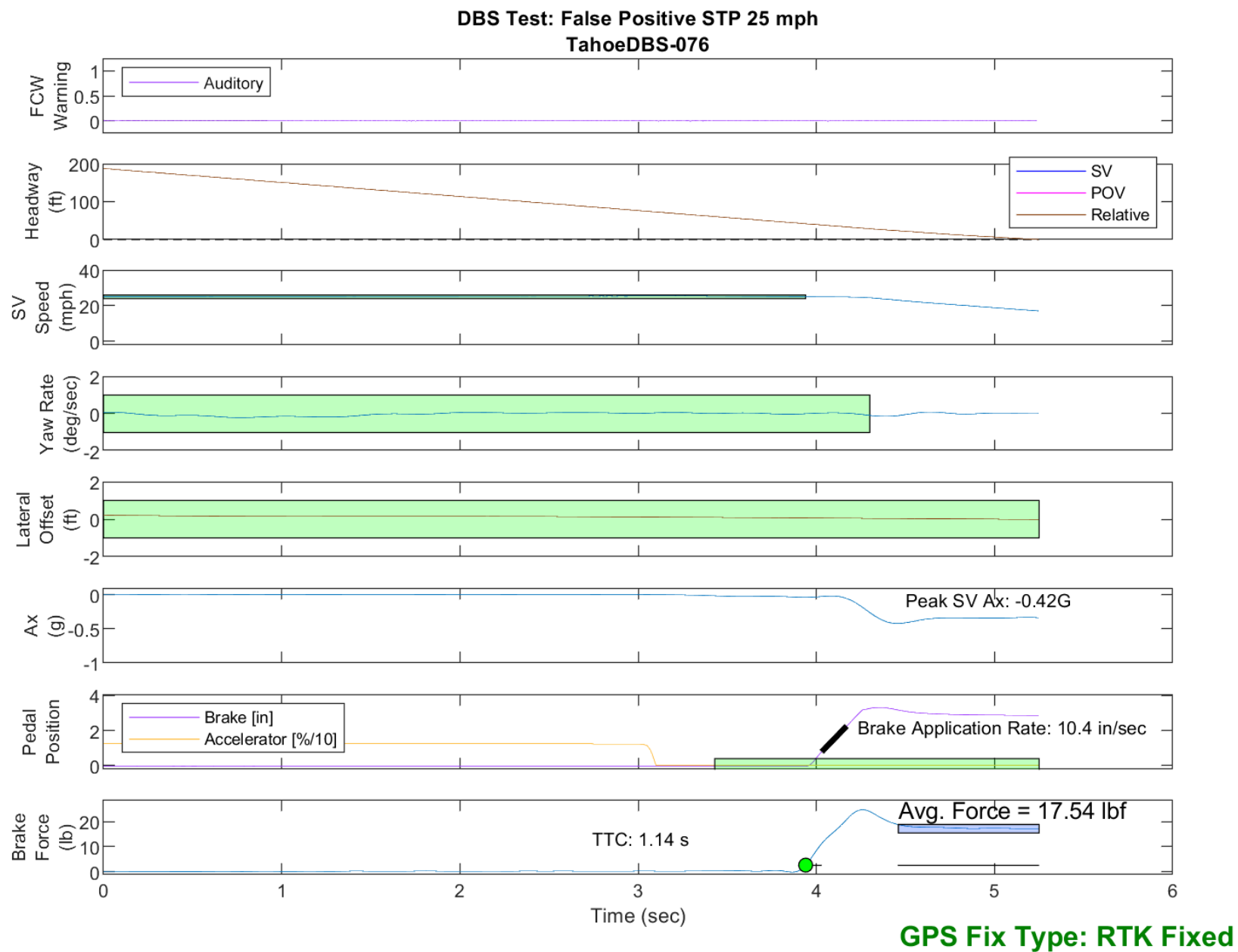


Figure E57. Time History for DBS Run 76, SV Encounters Steel Trench Plate, SV 25 mph

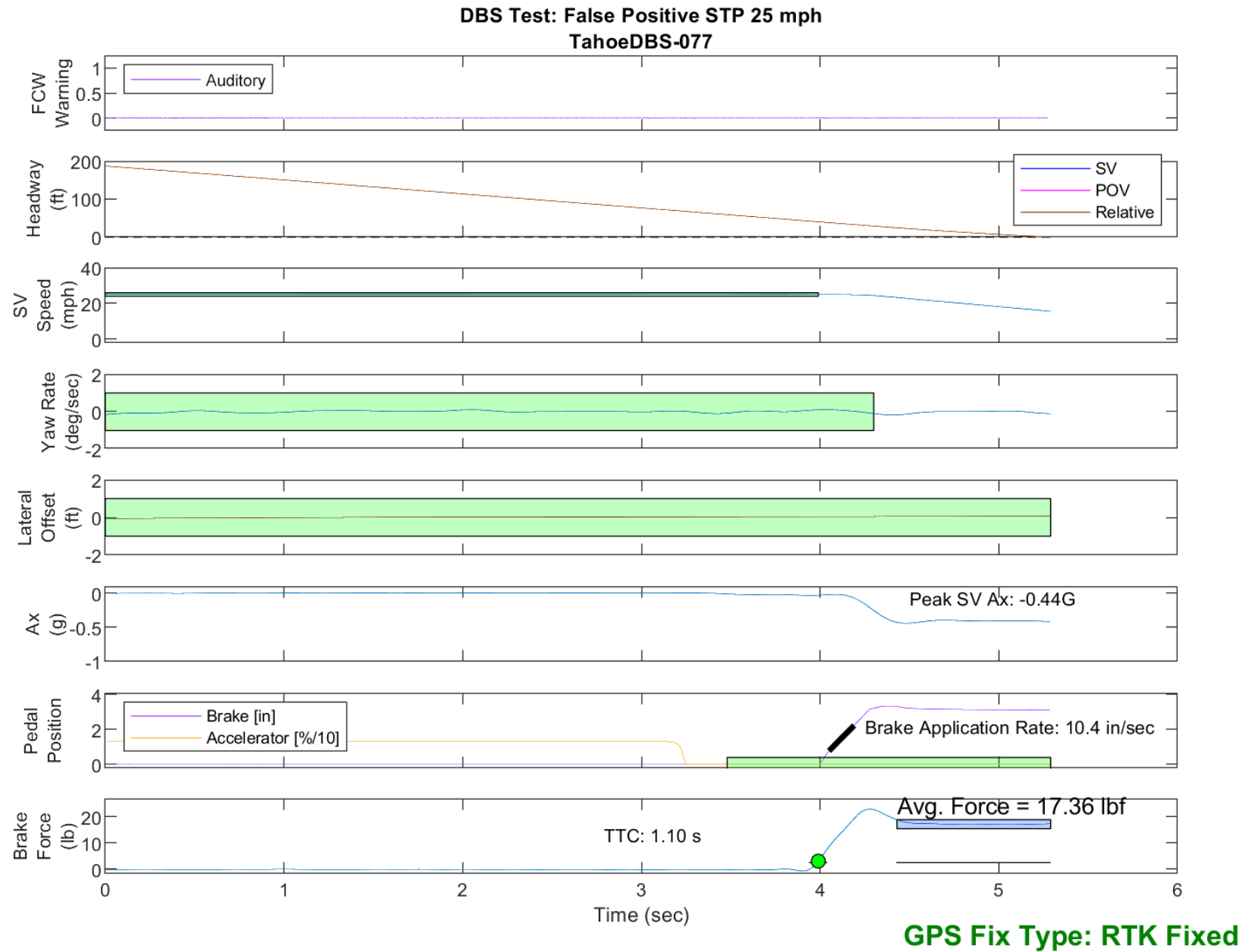


Figure E58. Time History for DBS Run 77, SV Encounters Steel Trench Plate, SV 25 mph

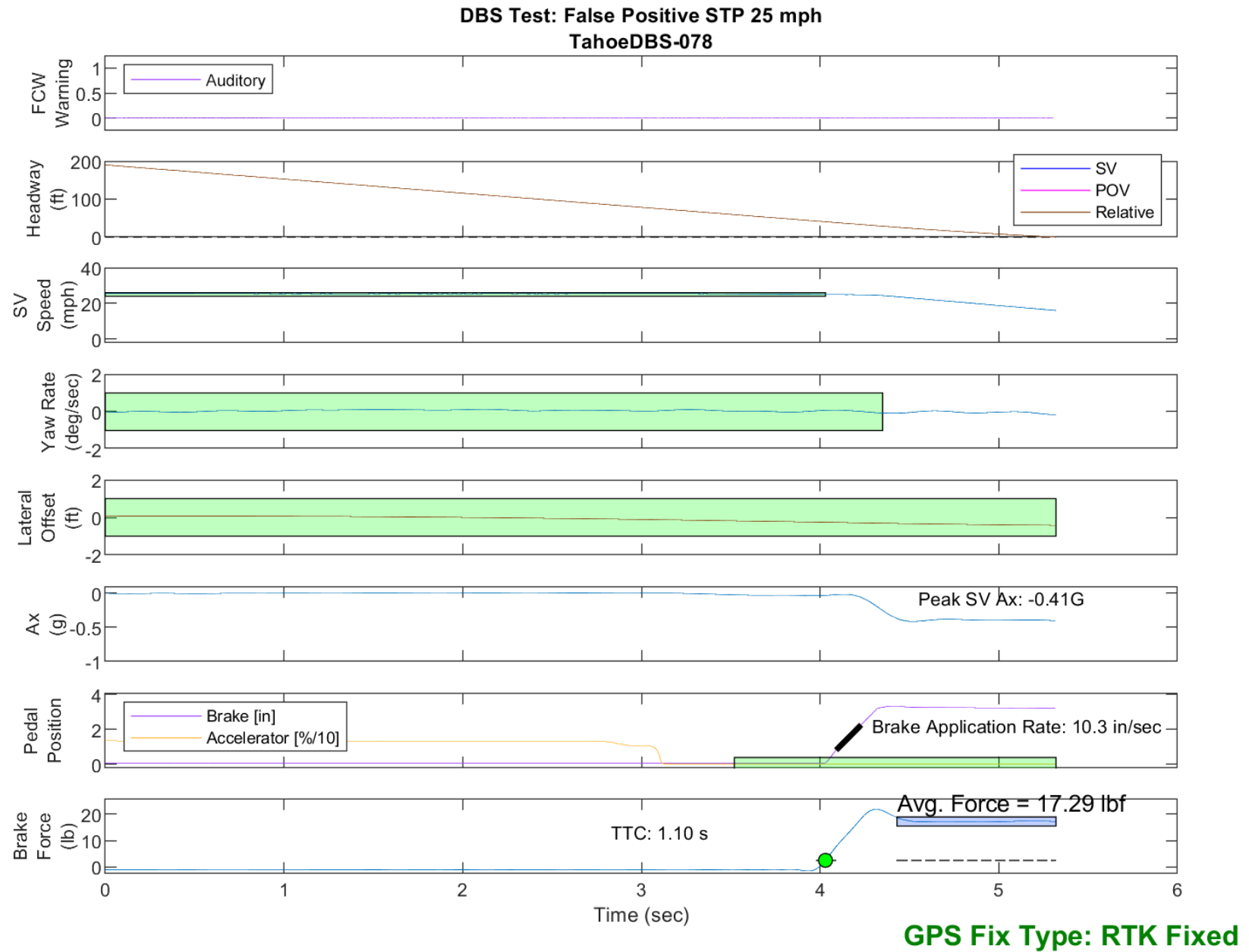


Figure E59. Time History for DBS Run 78, SV Encounters Steel Trench Plate, SV 25 mph

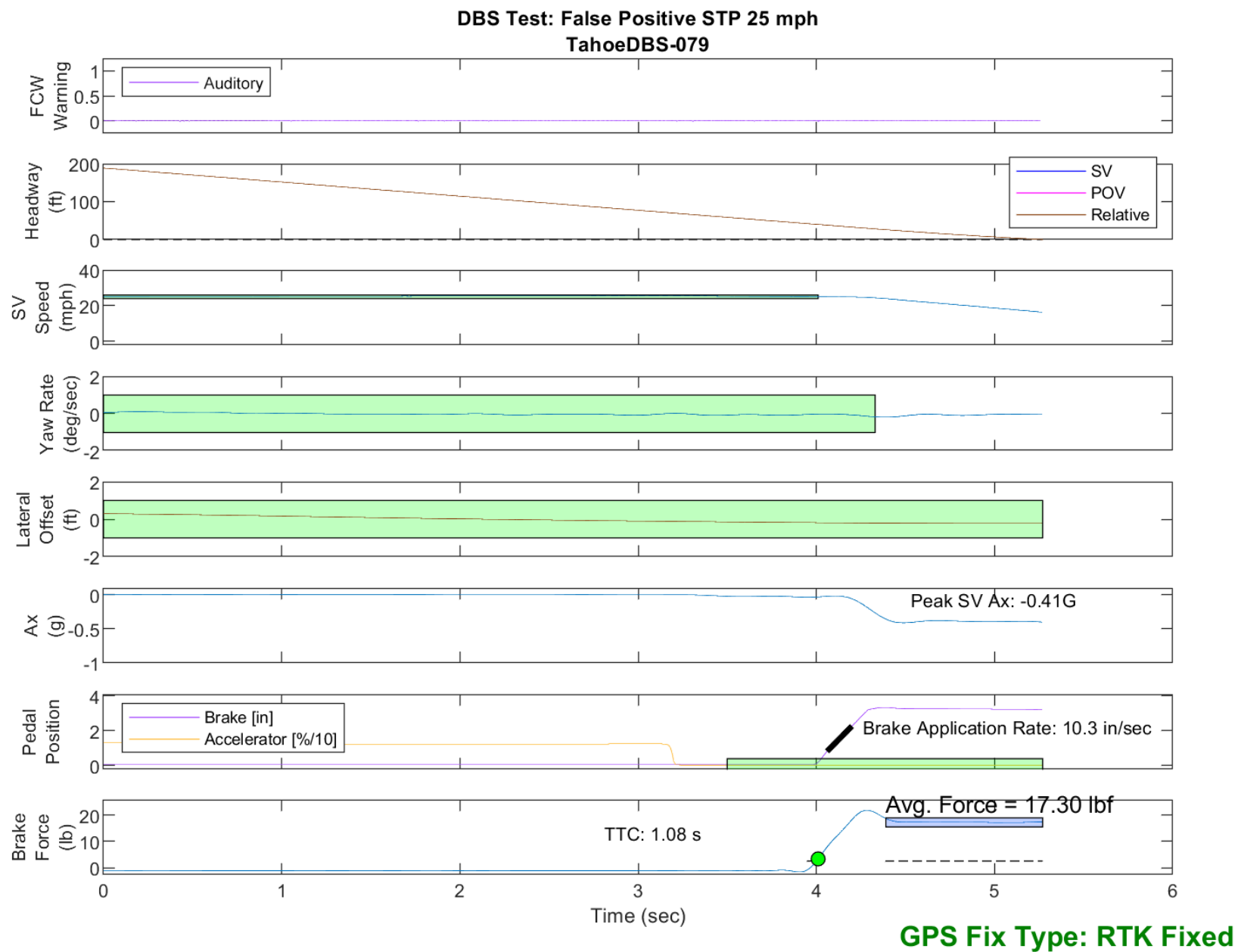


Figure E60. Time History for DBS Run 79, SV Encounters Steel Trench Plate, SV 25 mph

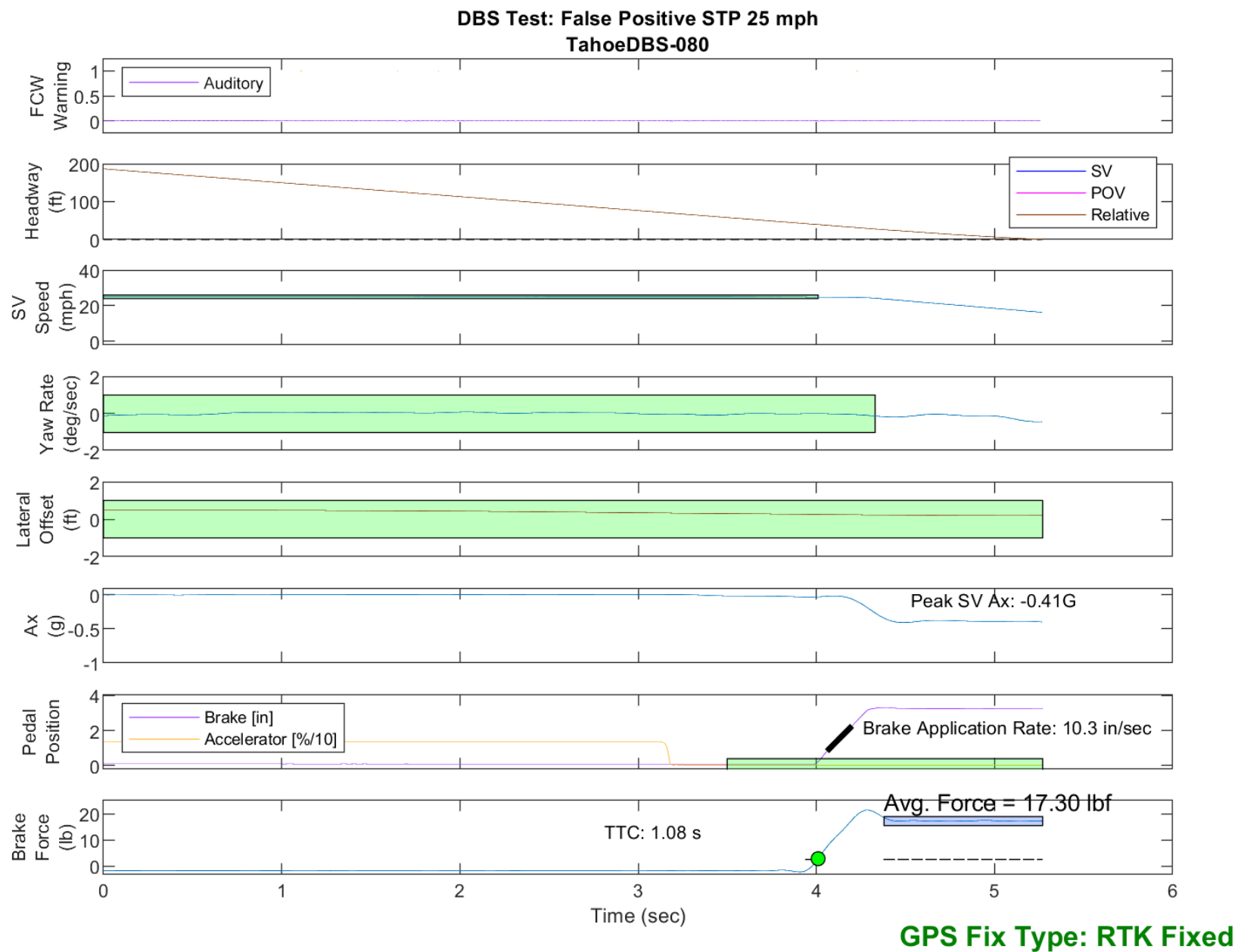


Figure E61. Time History for DBS Run 80, SV Encounters Steel Trench Plate, SV 25 mph

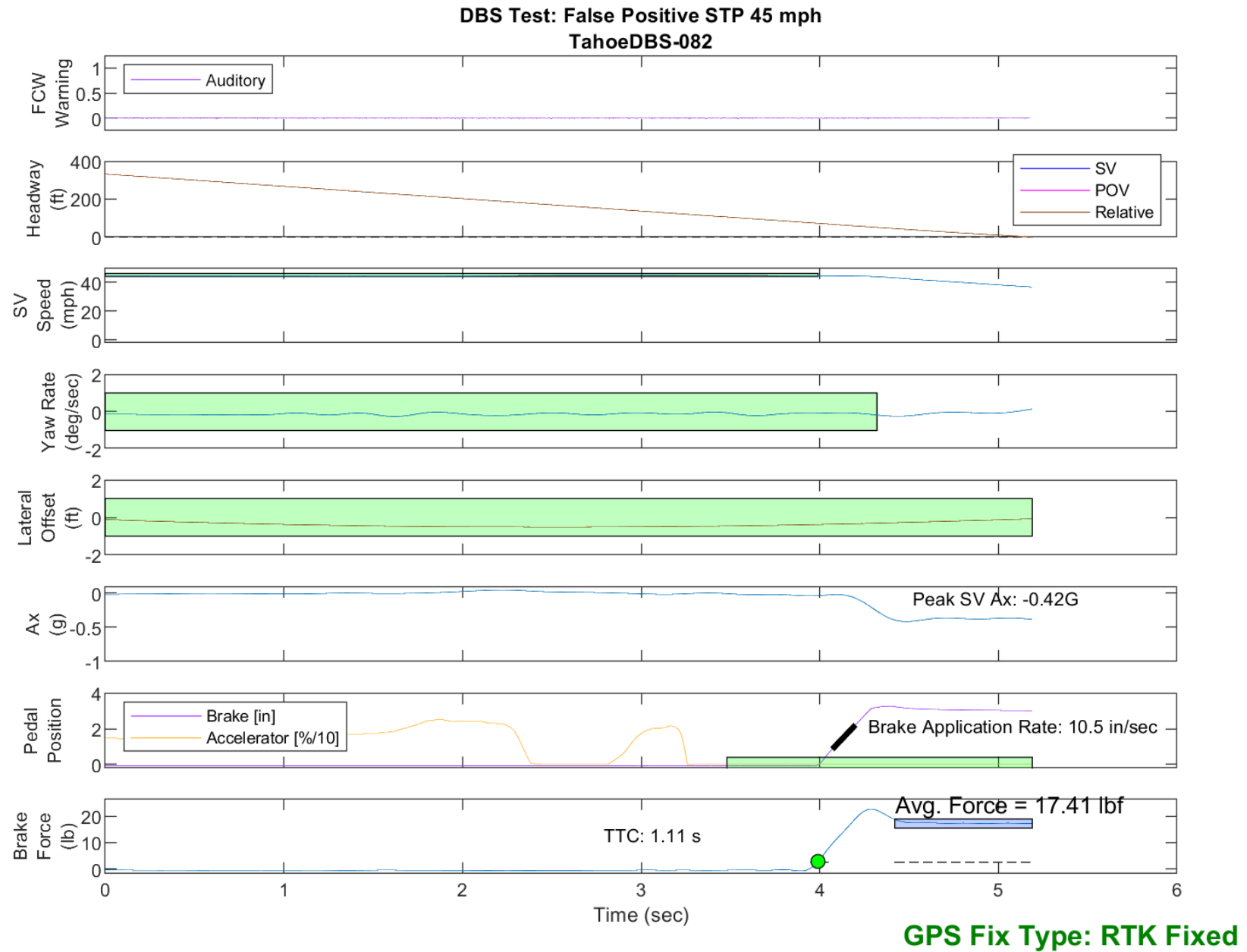


Figure E62. Time History for DBS Run 82, SV Encounters Steel Trench Plate, SV 45 mph

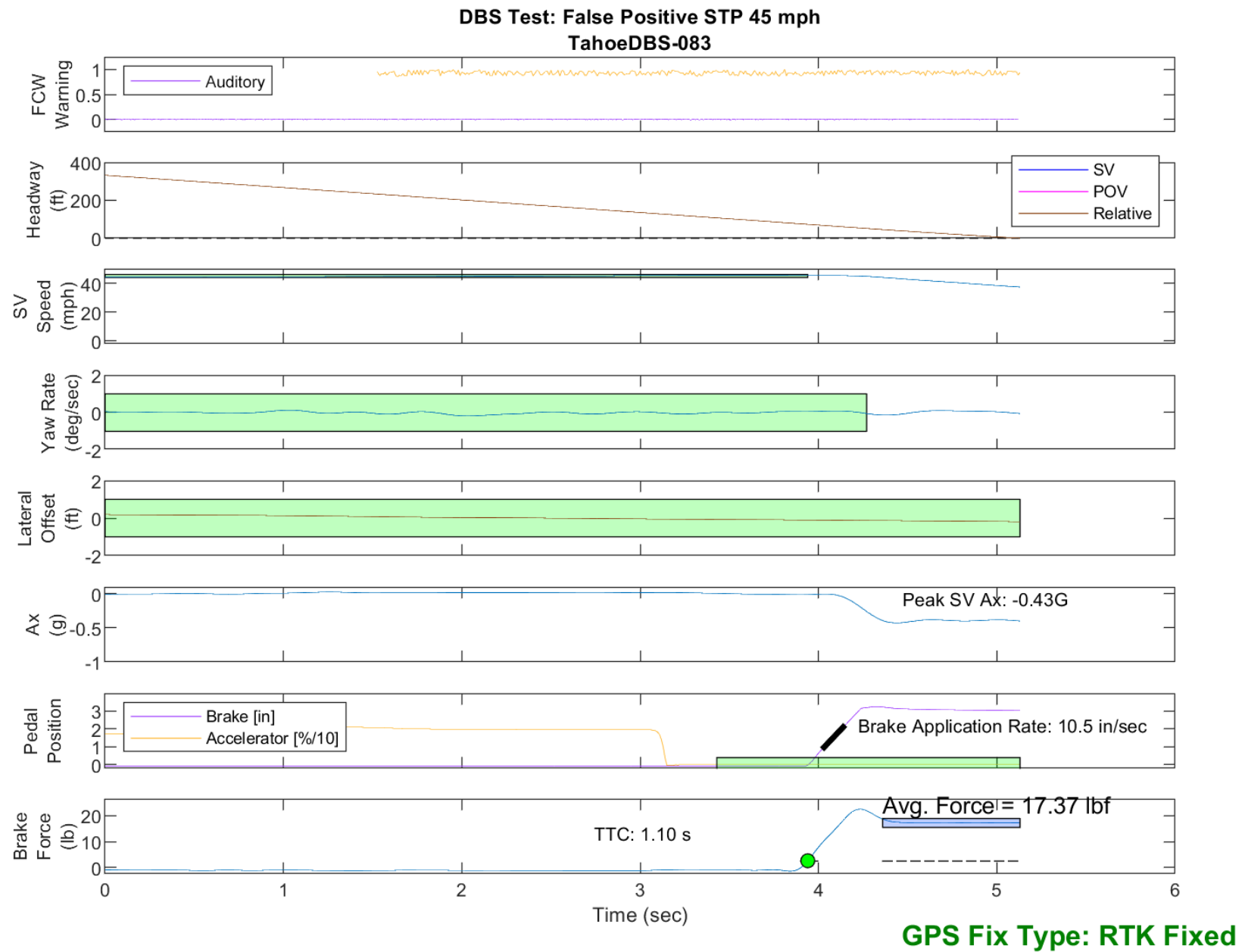


Figure E63. Time History for DBS Run 83, SV Encounters Steel Trench Plate, SV 45 mph

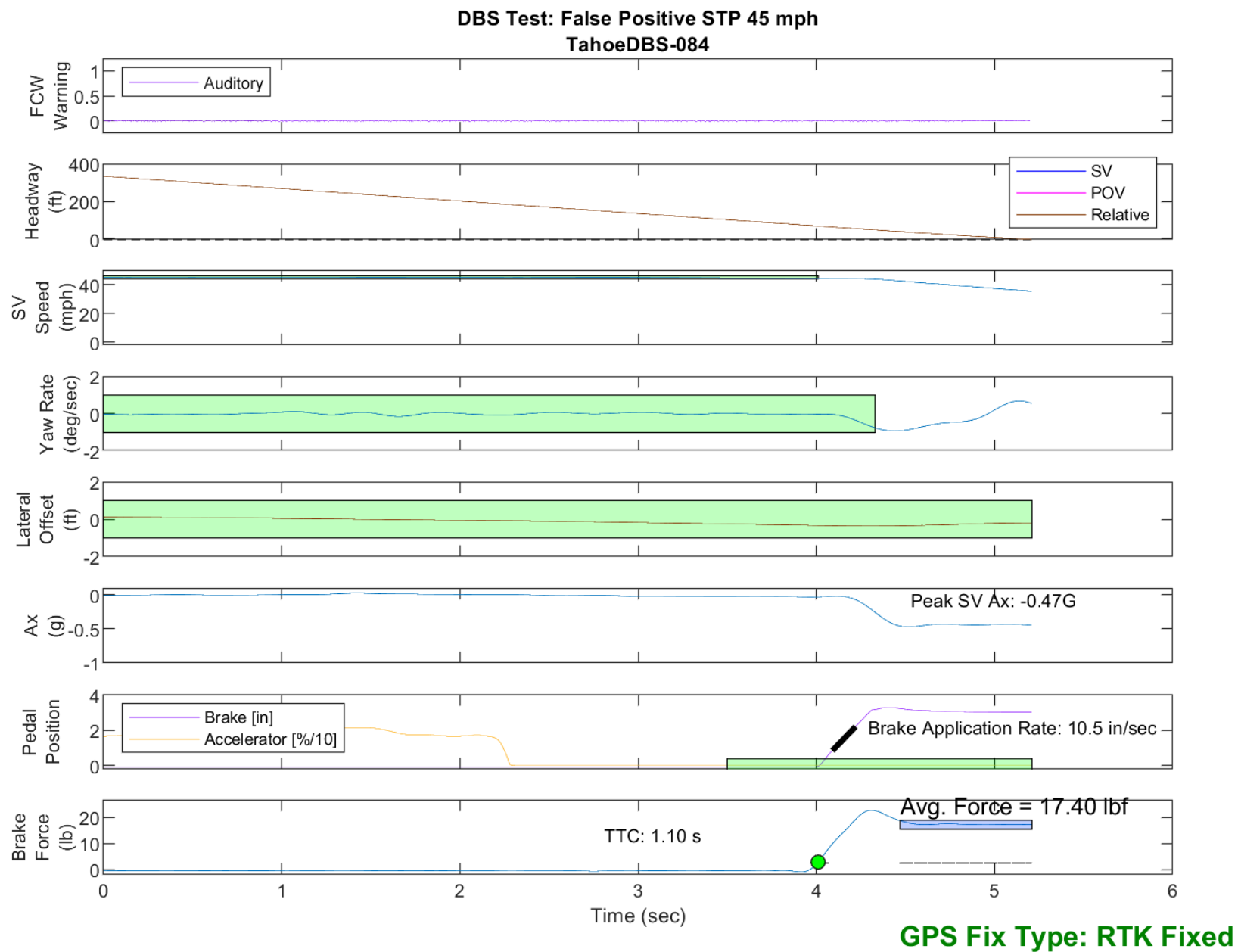


Figure E64. Time History for DBS Run 84, SV Encounters Steel Trench Plate, SV 45 mph

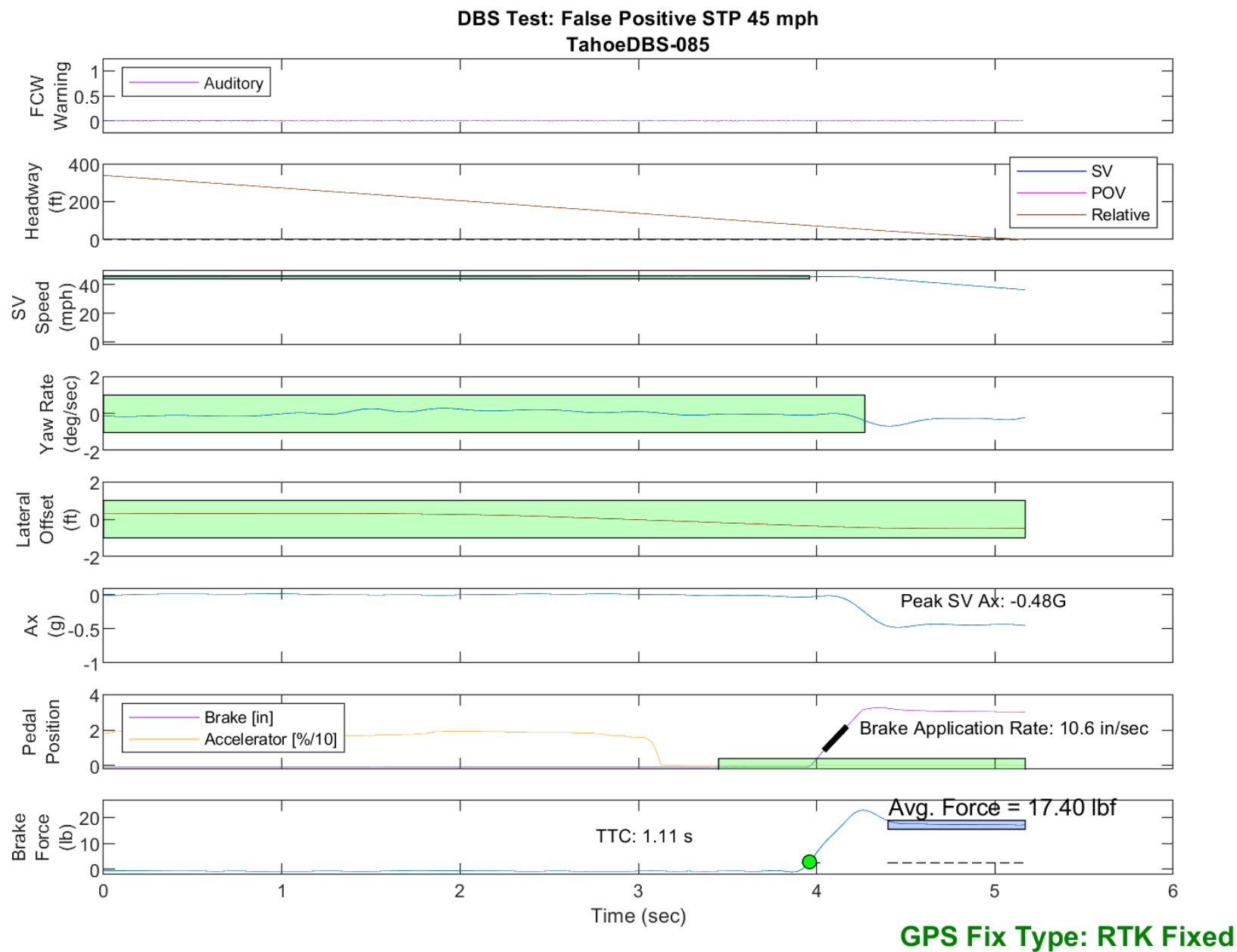


Figure E65. Time History for DBS Run 85, SV Encounters Steel Trench Plate, SV 45 mph

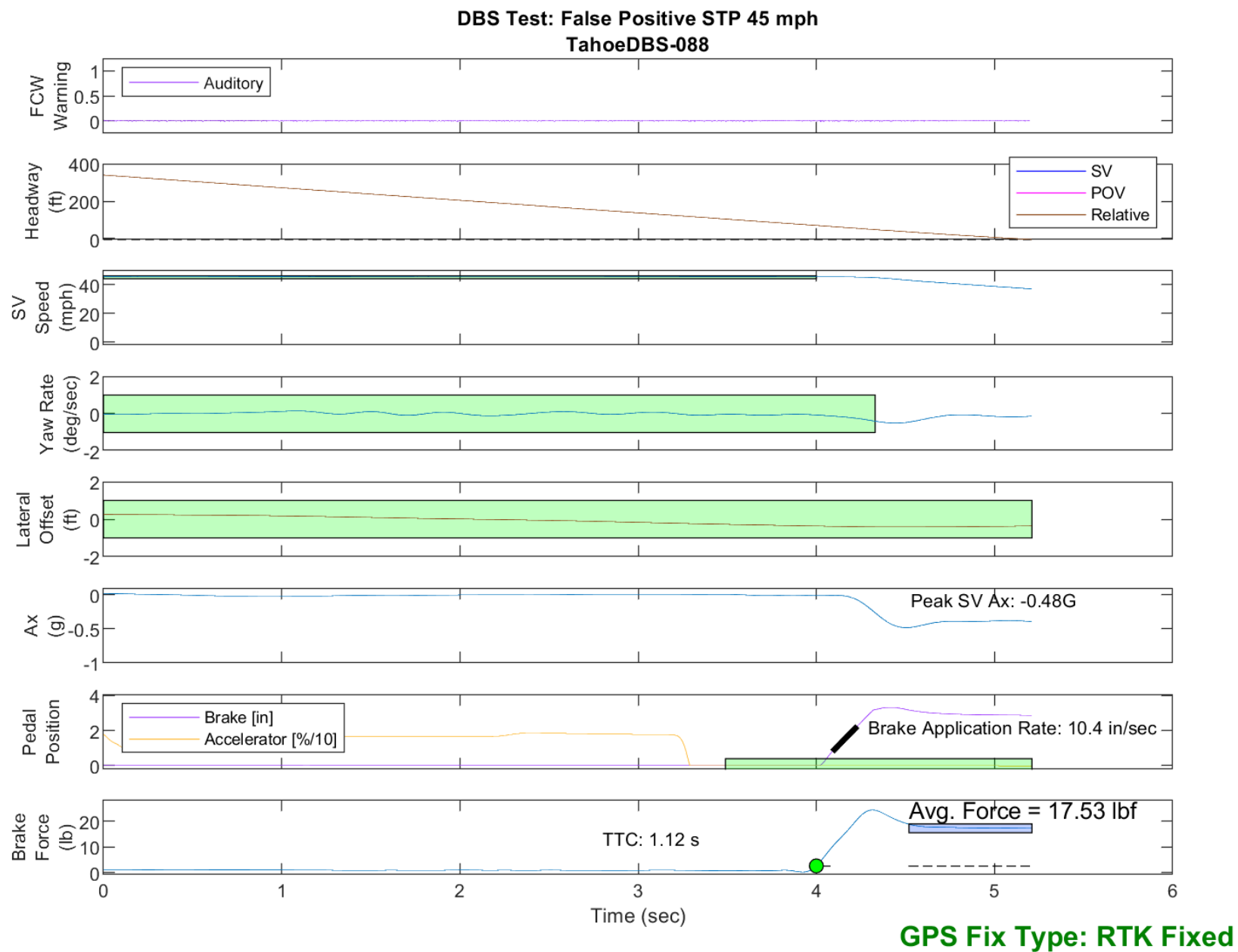


Figure E66. Time History for DBS Run 88, SV Encounters Steel Trench Plate, SV 45 mph

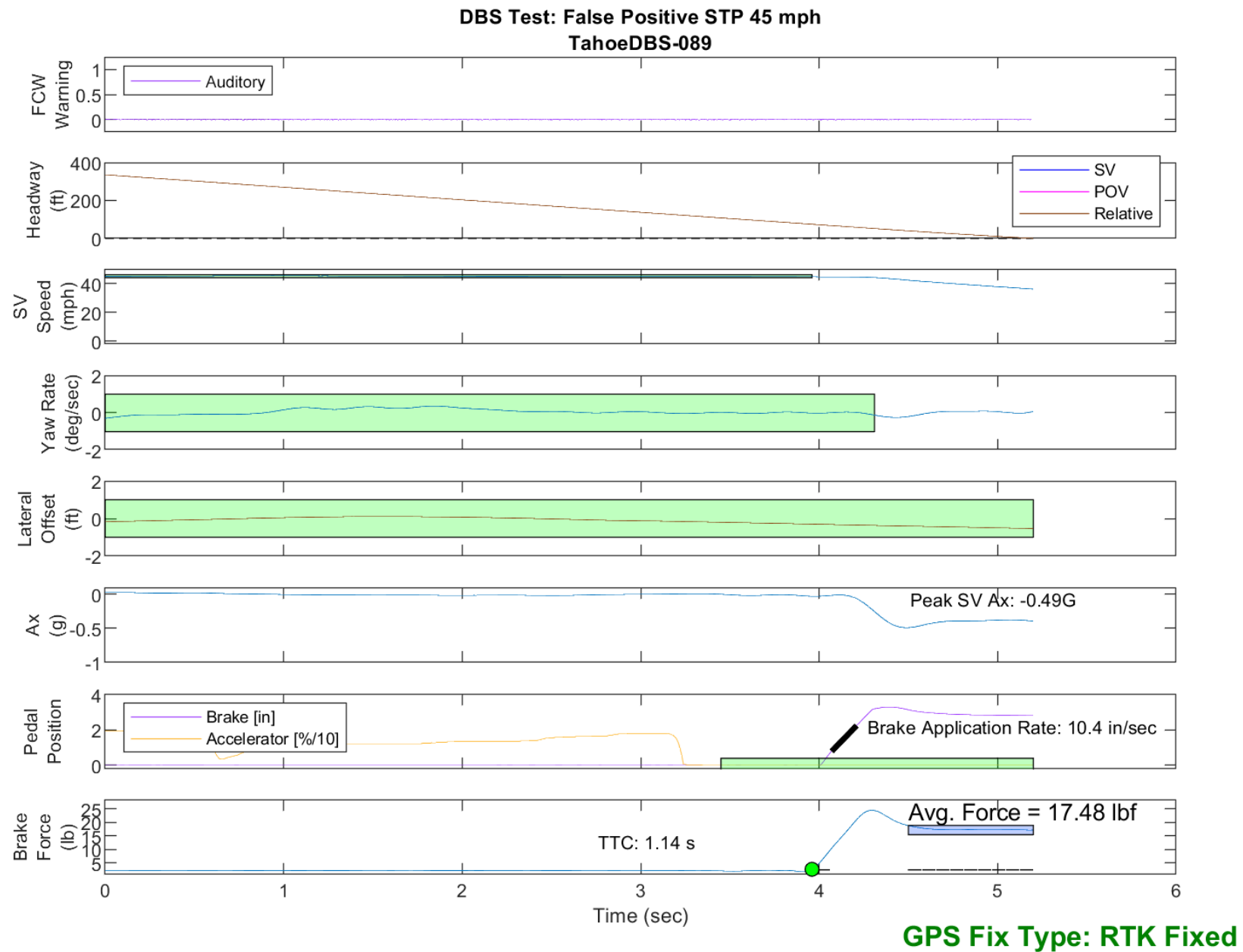


Figure E67. Time History for DBS Run 89, SV Encounters Steel Trench Plate, SV 45 mph

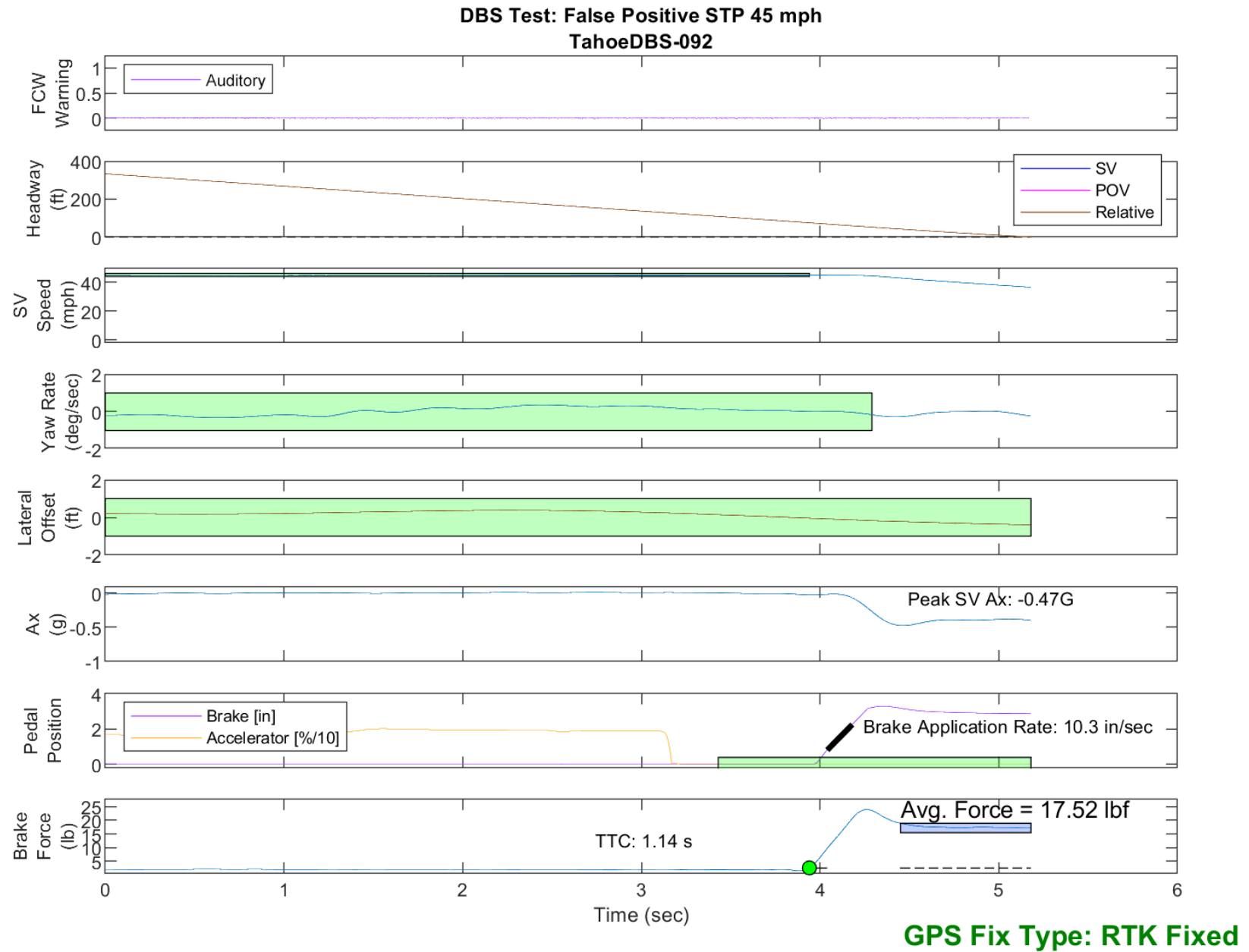


Figure E68. Time History for DBS Run 92, SV Encounters Steel Trench Plate, SV 45 mph

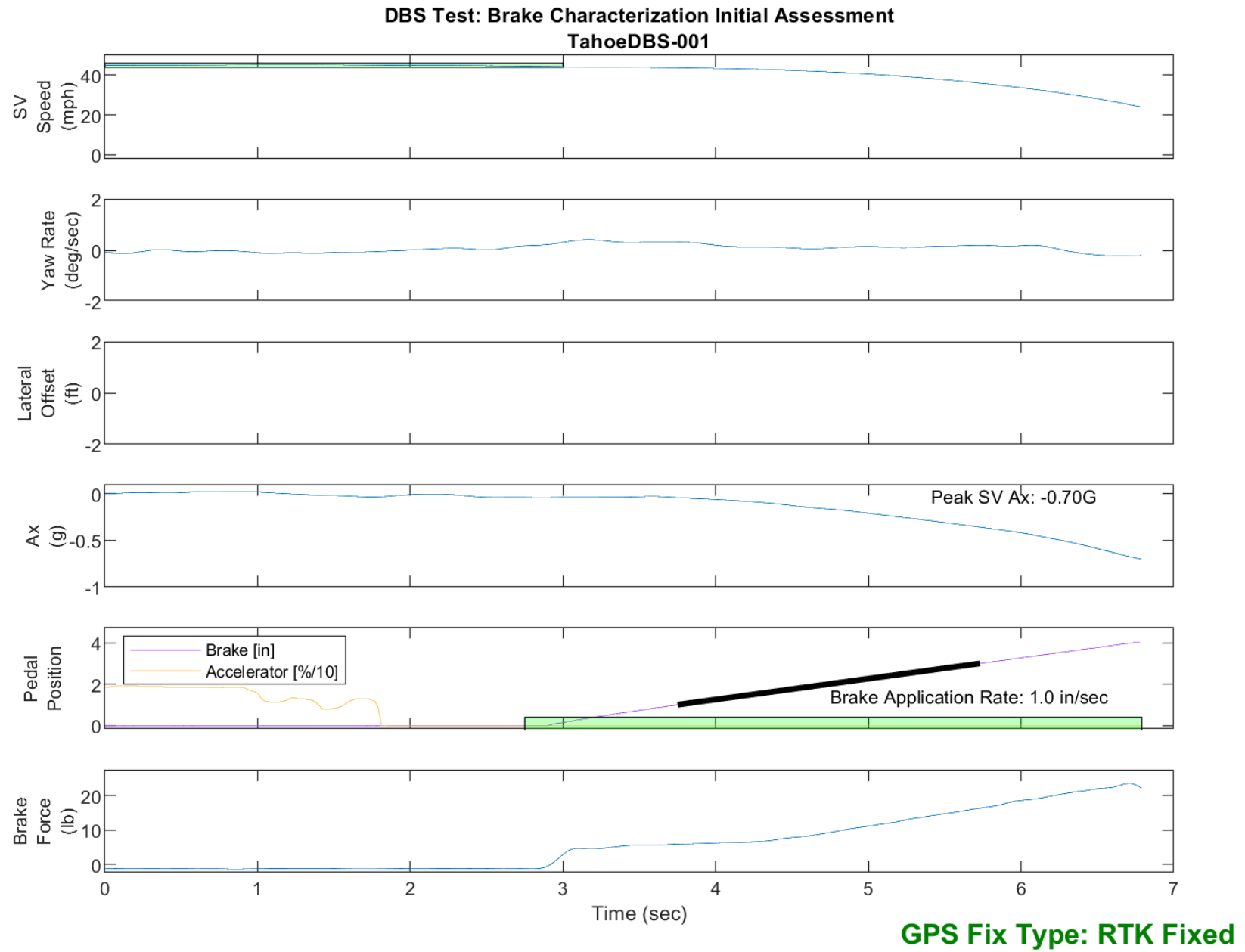


Figure E69. Time History for DBS Run 1, Brake Characterization Initial

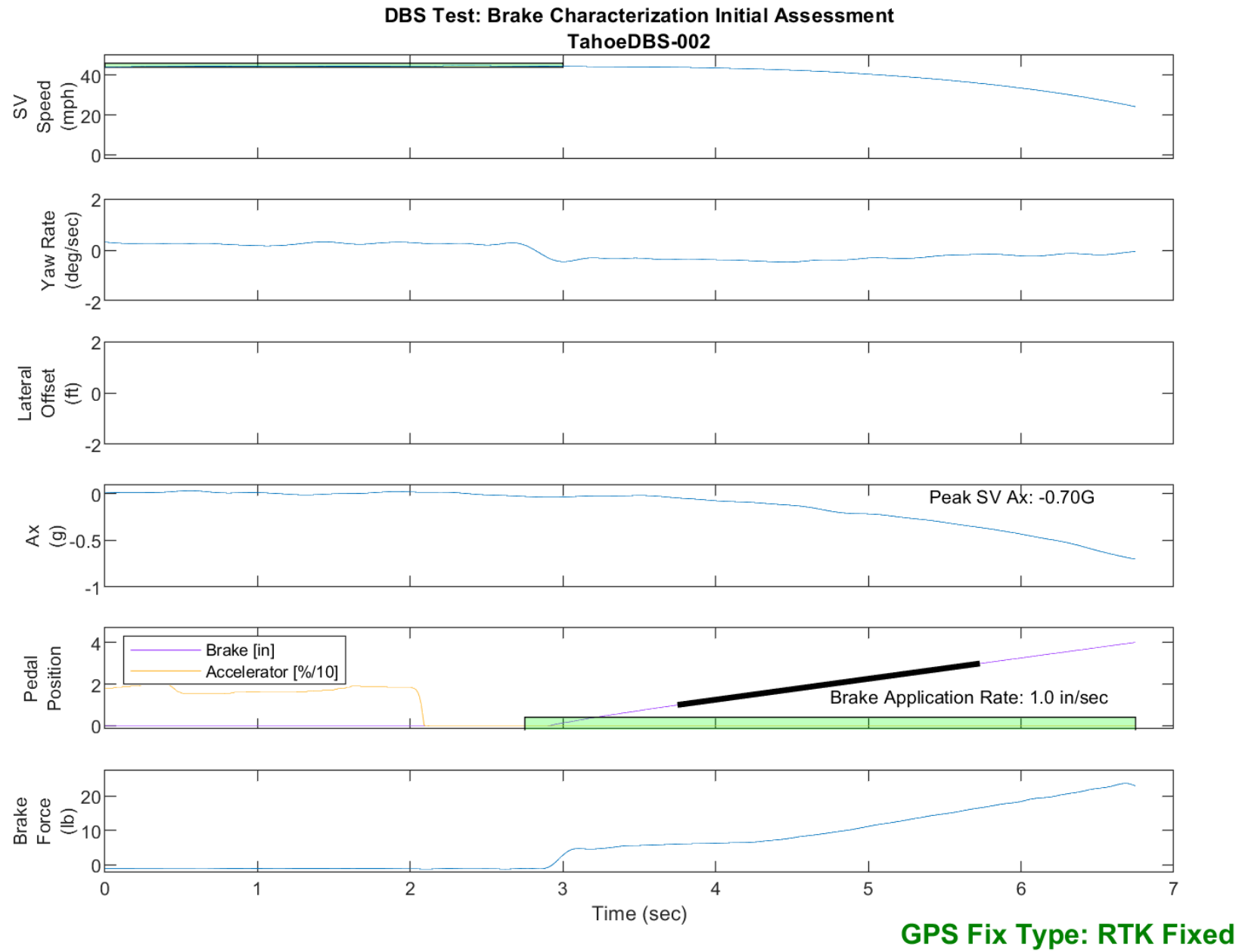


Figure E70. Time History for DBS Run 2, Brake Characterization Initial

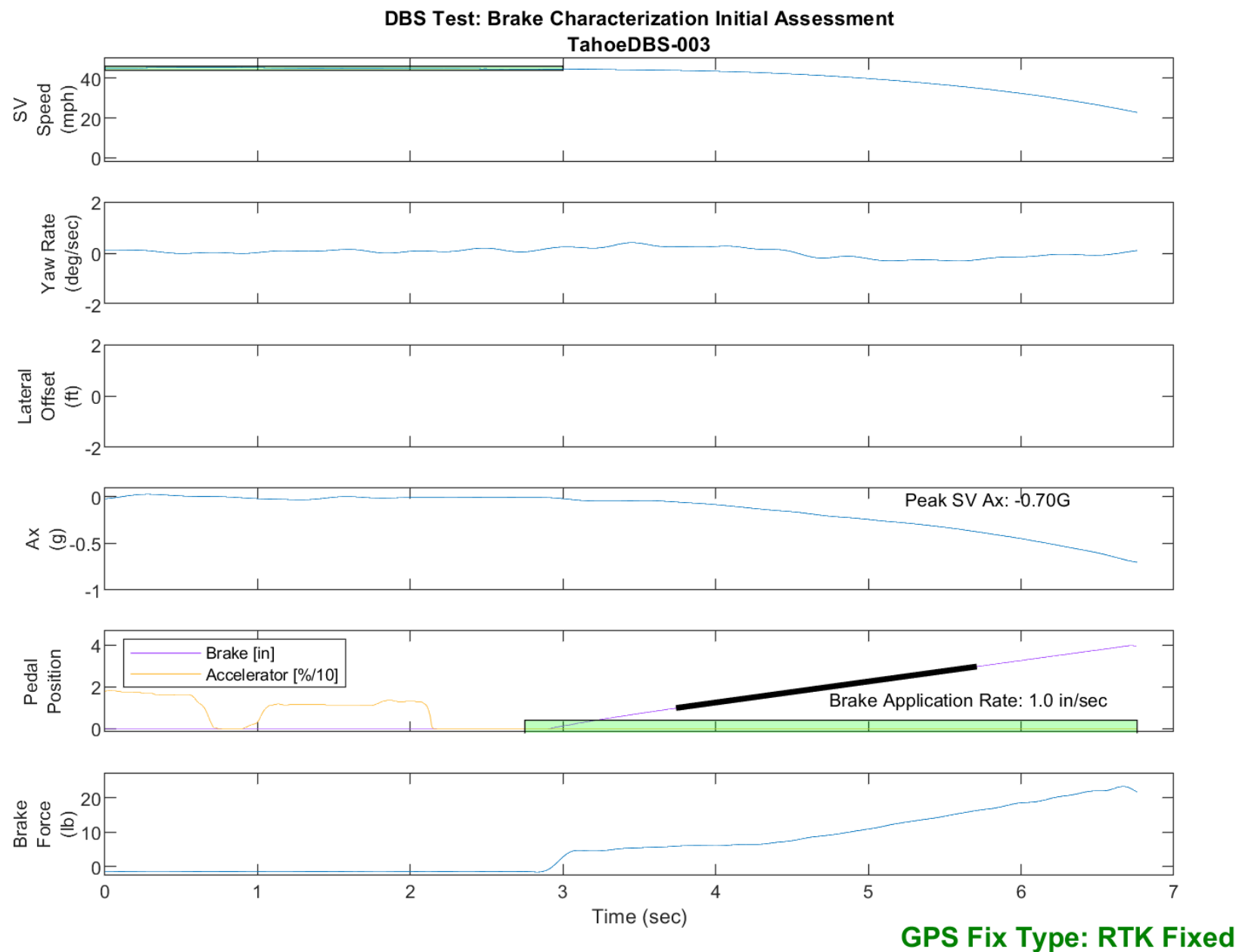


Figure E71. Time History for DBS Run 3, Brake Characterization Initial

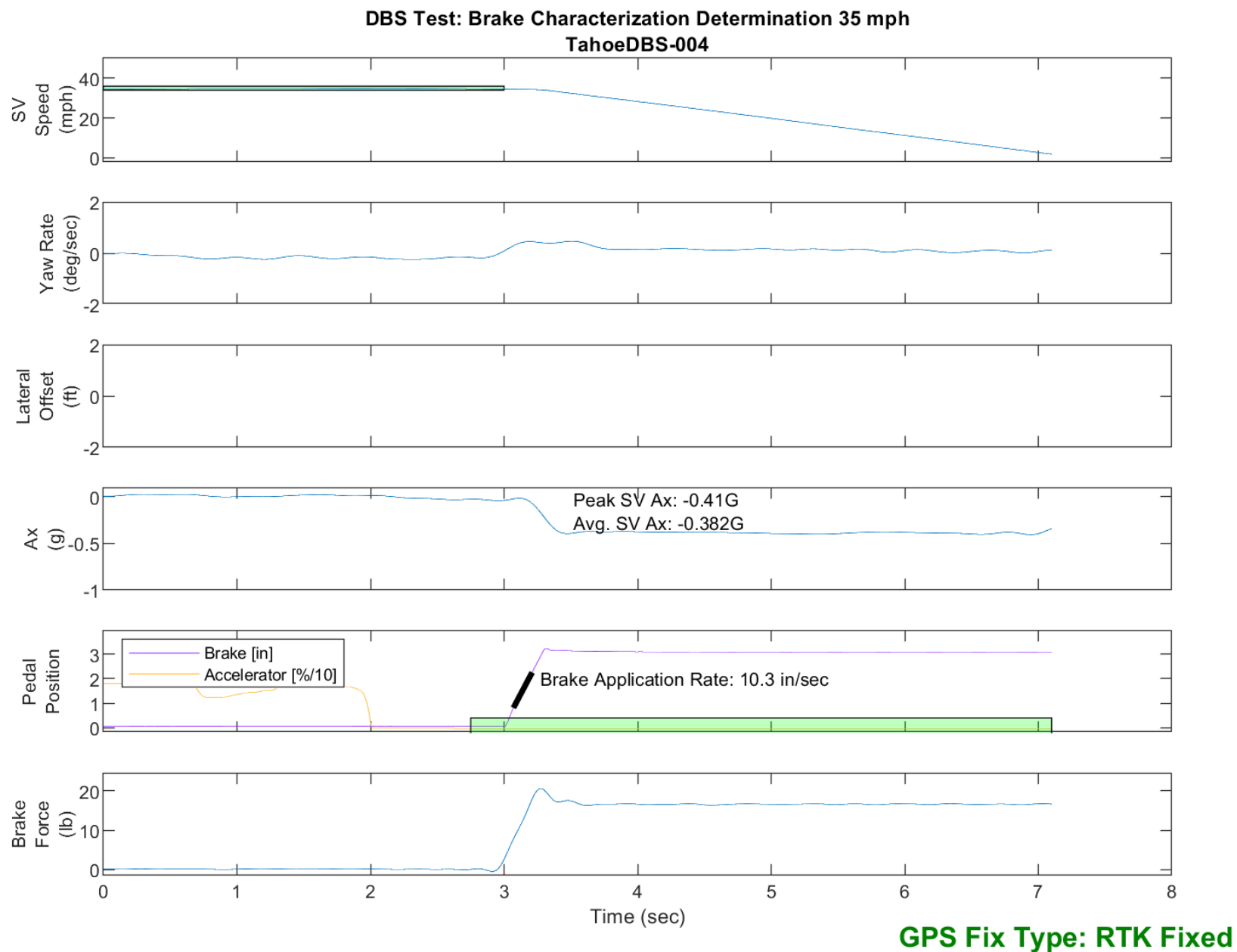


Figure E72. Time History for DBS Run 4, Brake Characterization Determination, Displacement Mode, 35 mph

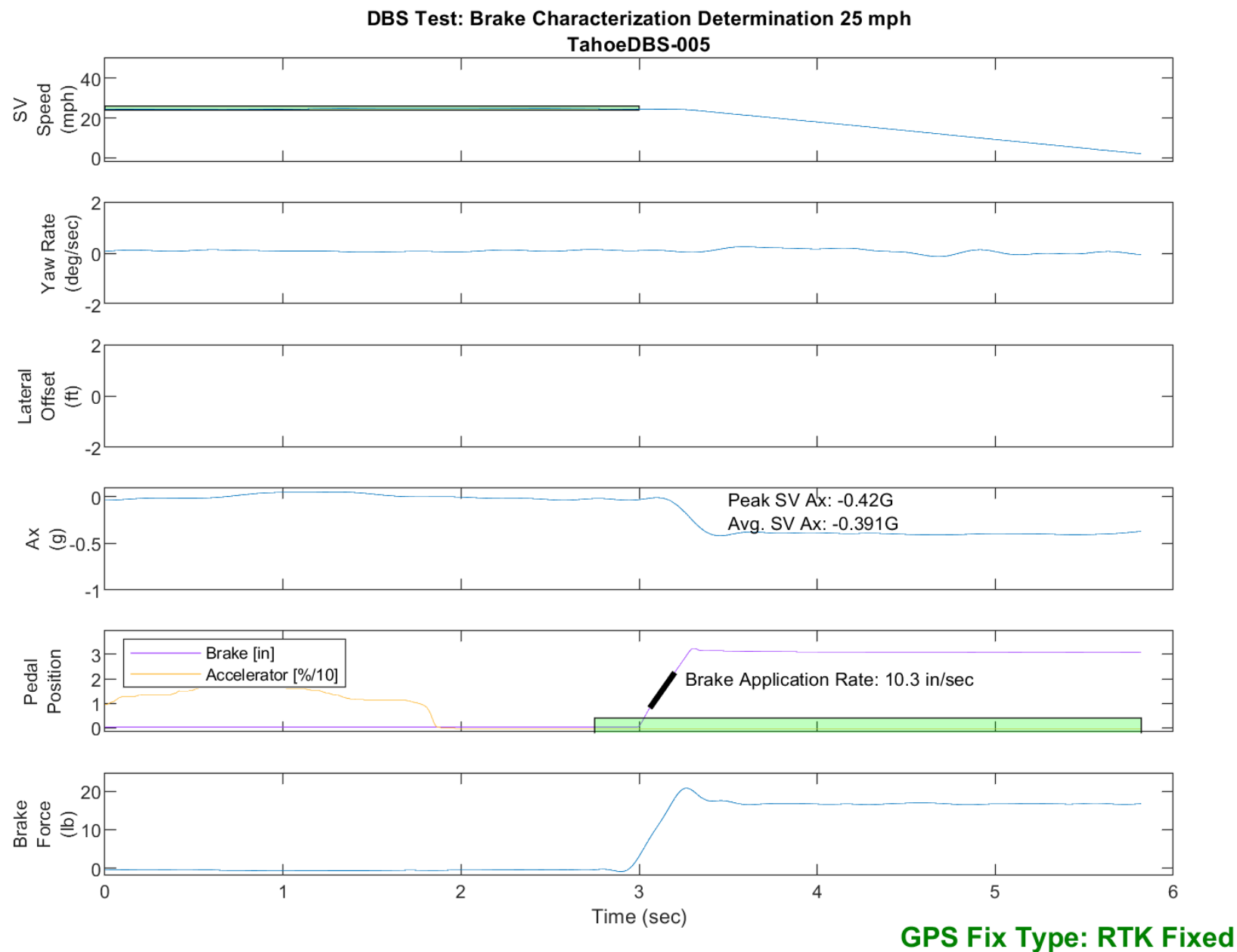


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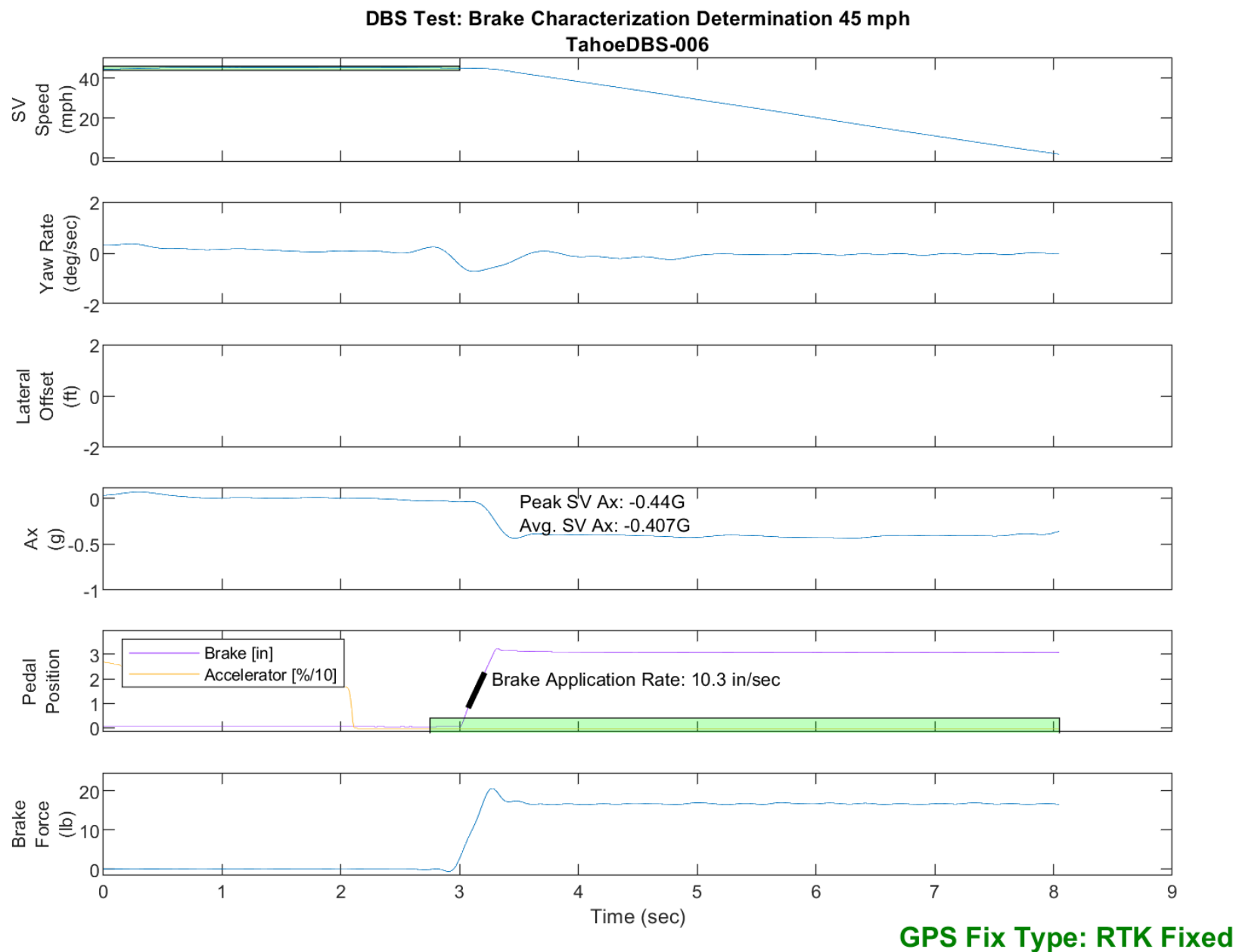


Figure E74. Time History for DBS Run 6, Brake Characterization Determination, Displacement Mode, 45 mph

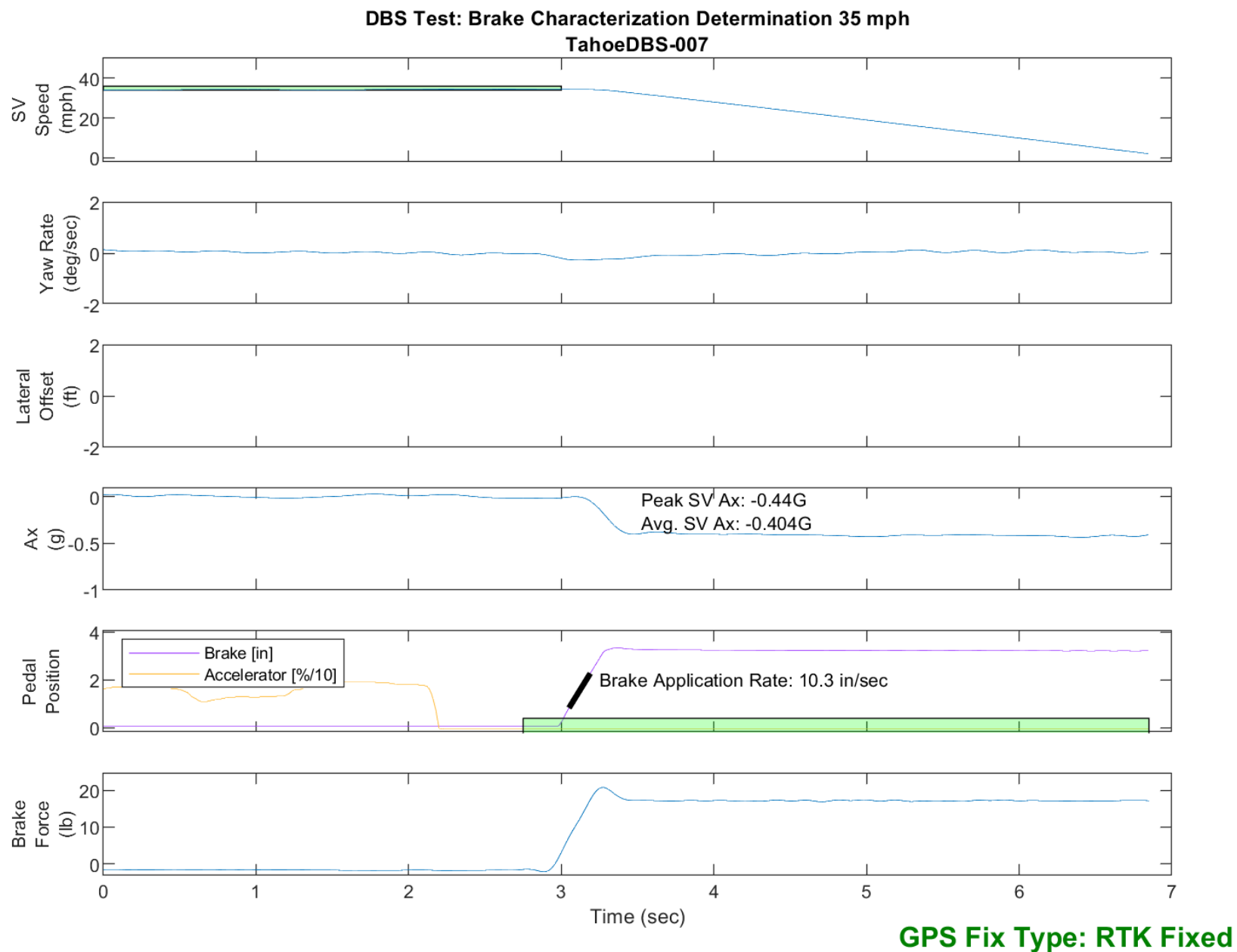


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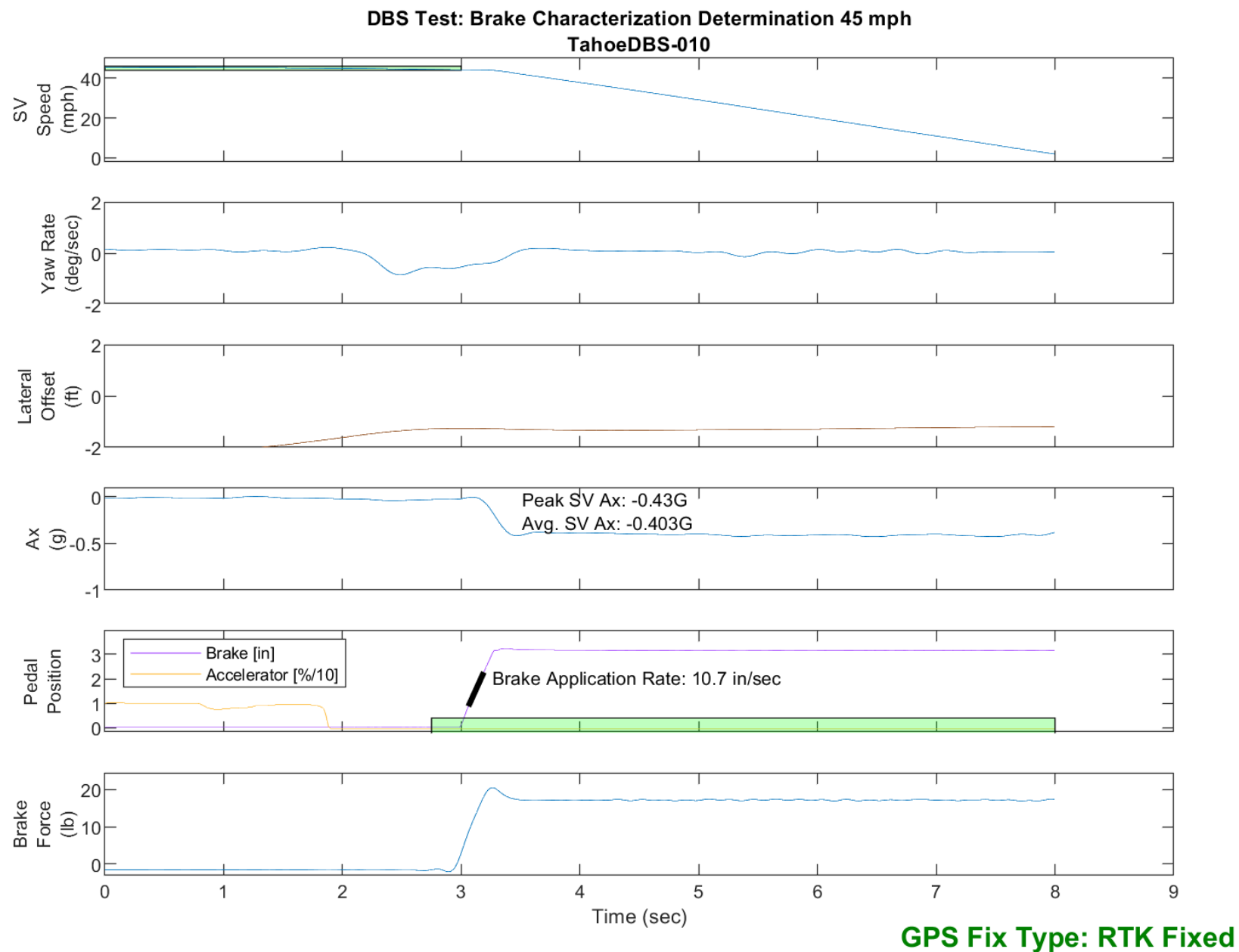


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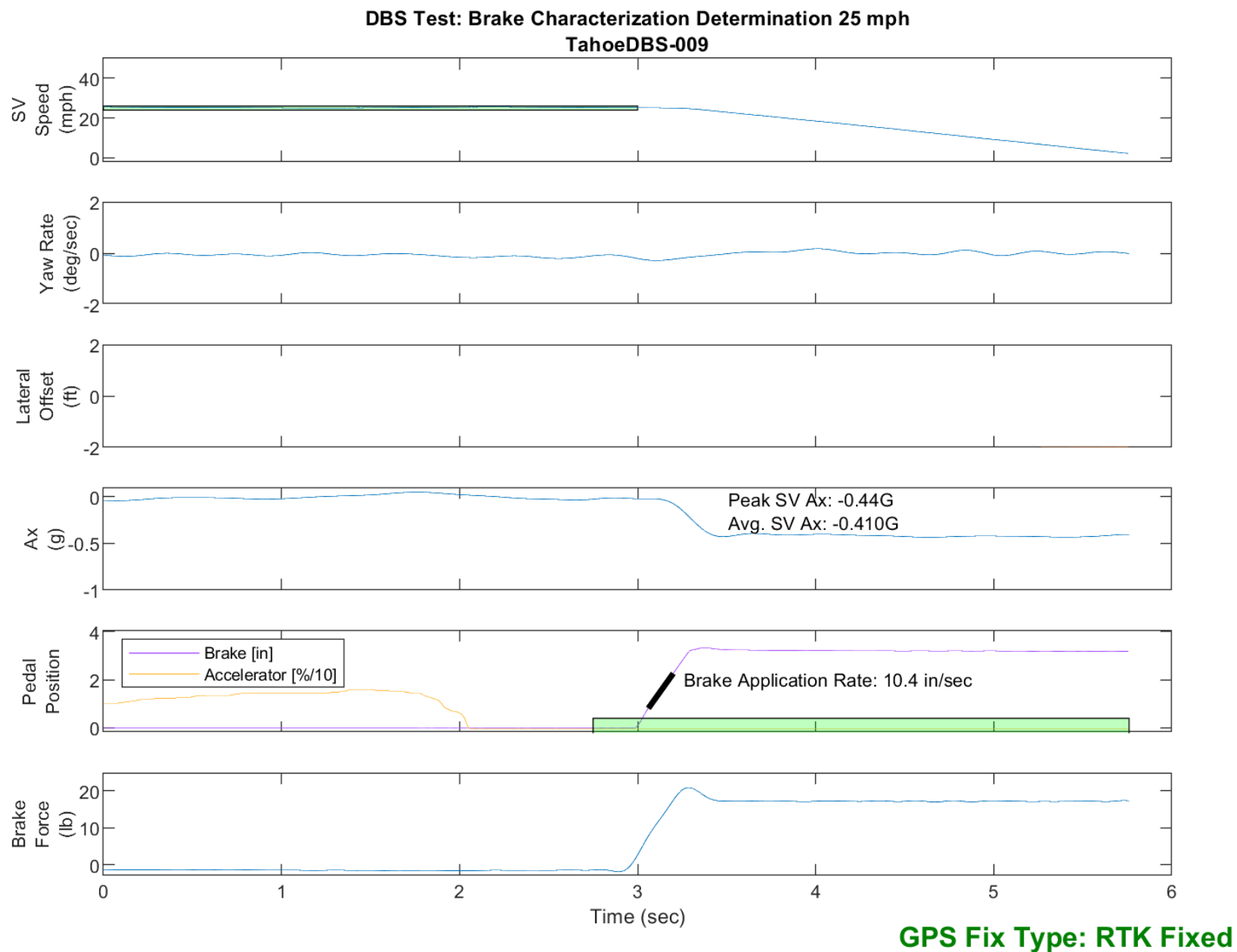


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TIME HISTORY PLOTS

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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)
- Decelerating 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 auditory, visual, or haptic). Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any combination of the following:
 - Filtered, rectified, and normalized sound signal. The vertical scale is 0 to 1.
 - Filtered, rectified, and normalized acceleration (i.e., haptic alert, such as steering wheel vibration). The vertical scale is 0 to 1.
 - Normalized light sensor signal. The vertical scale is 0 to 1.

As only the auditory 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 front-most 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.

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.

With the exception of the brake force plots (see description below), 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 0.27 g (the upper edge of the envelope, i.e., $0.30 \text{ g} \pm 0.03 \text{ g}$). A green circle or red asterisk is displayed at the moment the POV brake level achieves 0.27 g. A green circle indicates that the test was valid (the threshold was crossed during the appropriate interval) and a red asterisk indicates that the test was invalid (the threshold was crossed 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.

For the brake force plots:

- 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. A blue envelope represents the target average brake force necessary 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 the 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 in order 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
- Blue envelope = visualized target range for the time varying data averaged over a period equal to the length of the envelope
- 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

Other Notations

- NG – Indicates that the value for that variable was outside of bounds and therefore “No Good”.
- No Wng – No warning was detected.
- POV – Indicates that the value for the Principal Other Vehicle was out of bounds.
- SV – Indicates that the value for the Subject Vehicle was out of bounds.
- SR – Shows the speed reduction value.
- Thr – Indicates that the requirements for the throttle were not met.

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

Examples of valid or passing time history plots for each test type (including passing, failing, and invalid runs) are shown in Figures 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.

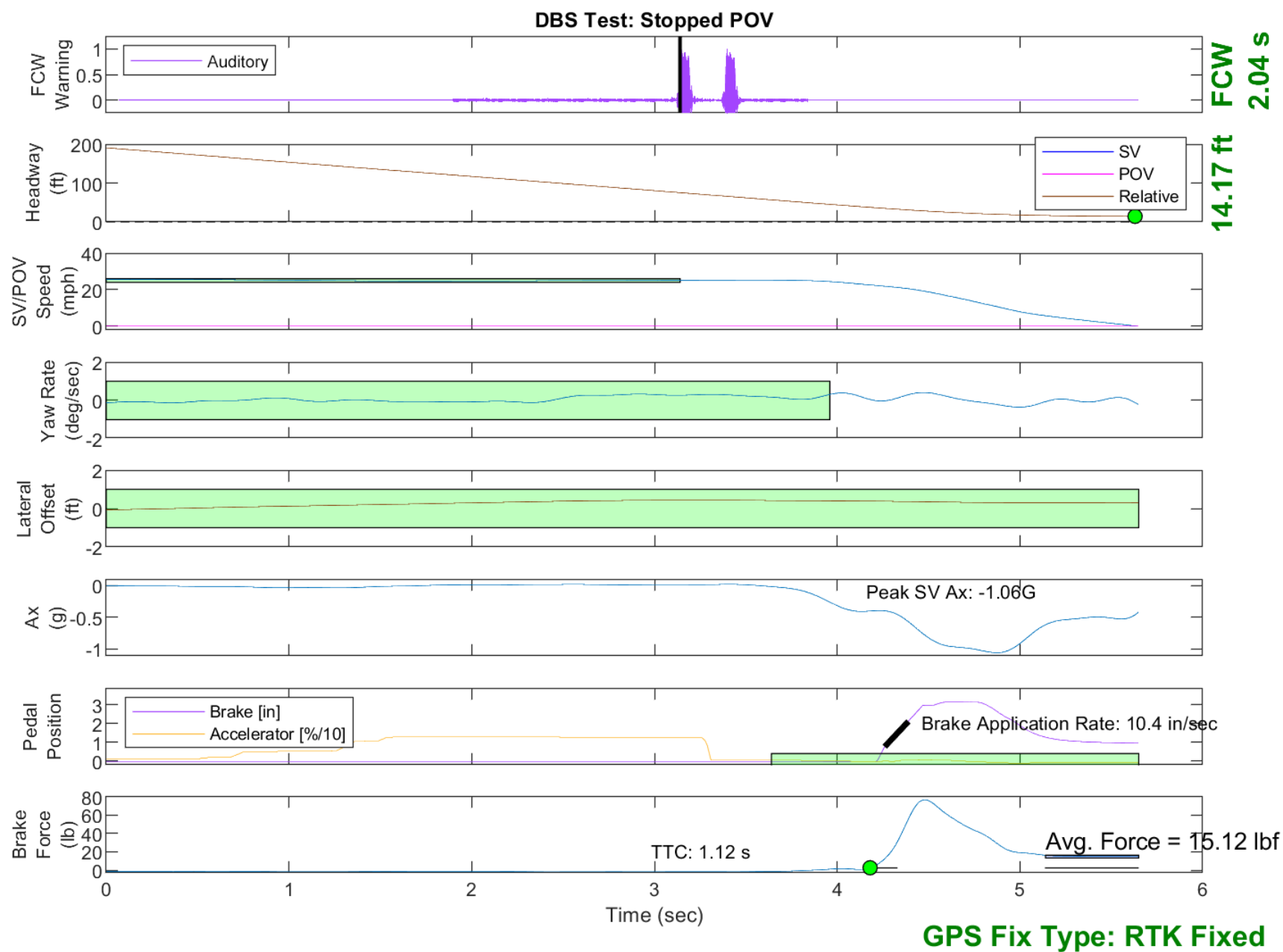


Figure E1. Example Time History for Stopped POV, Passing

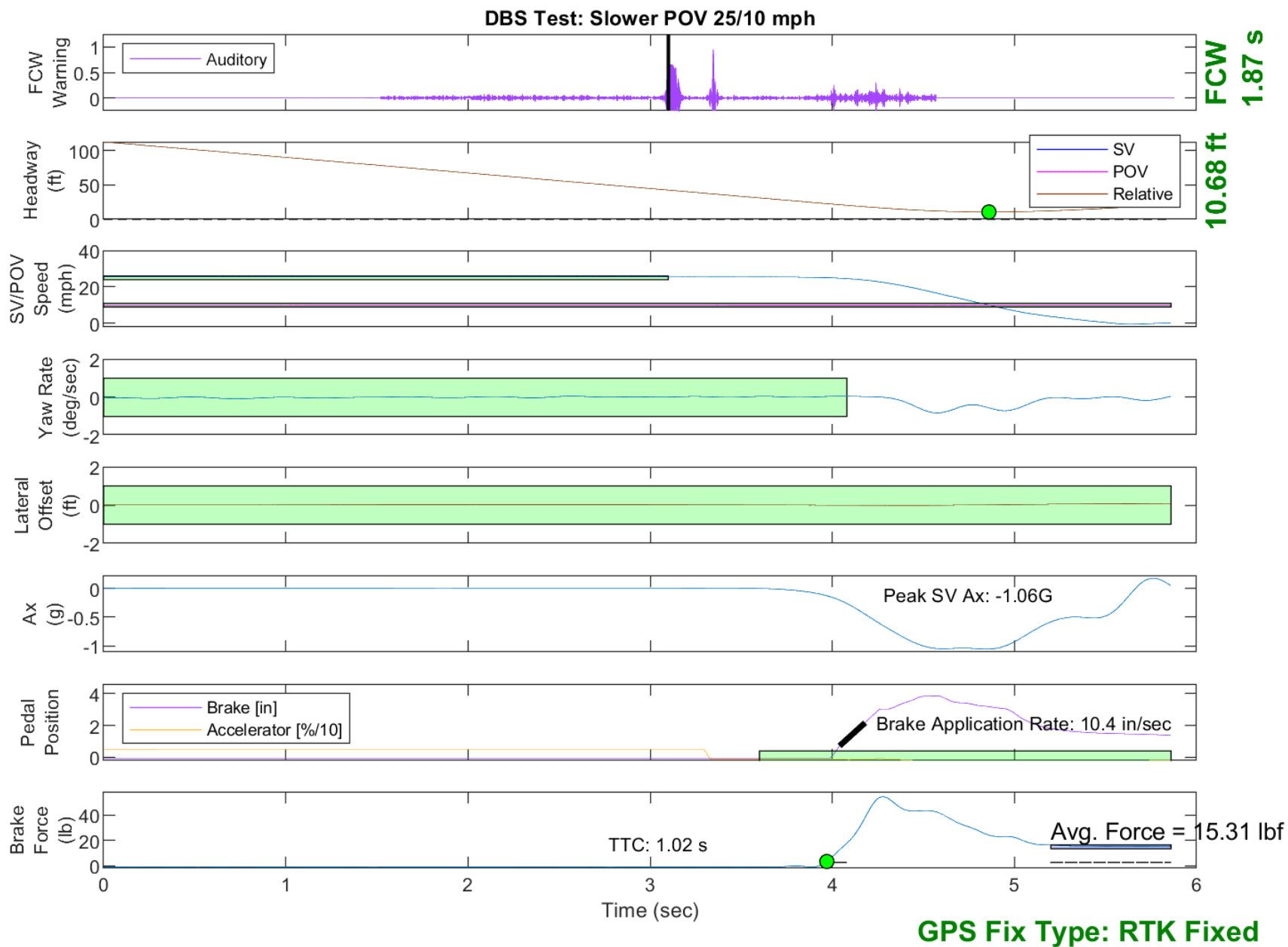


Figure E2. Example Time History for Slower POV 25 vs. 10, Passing

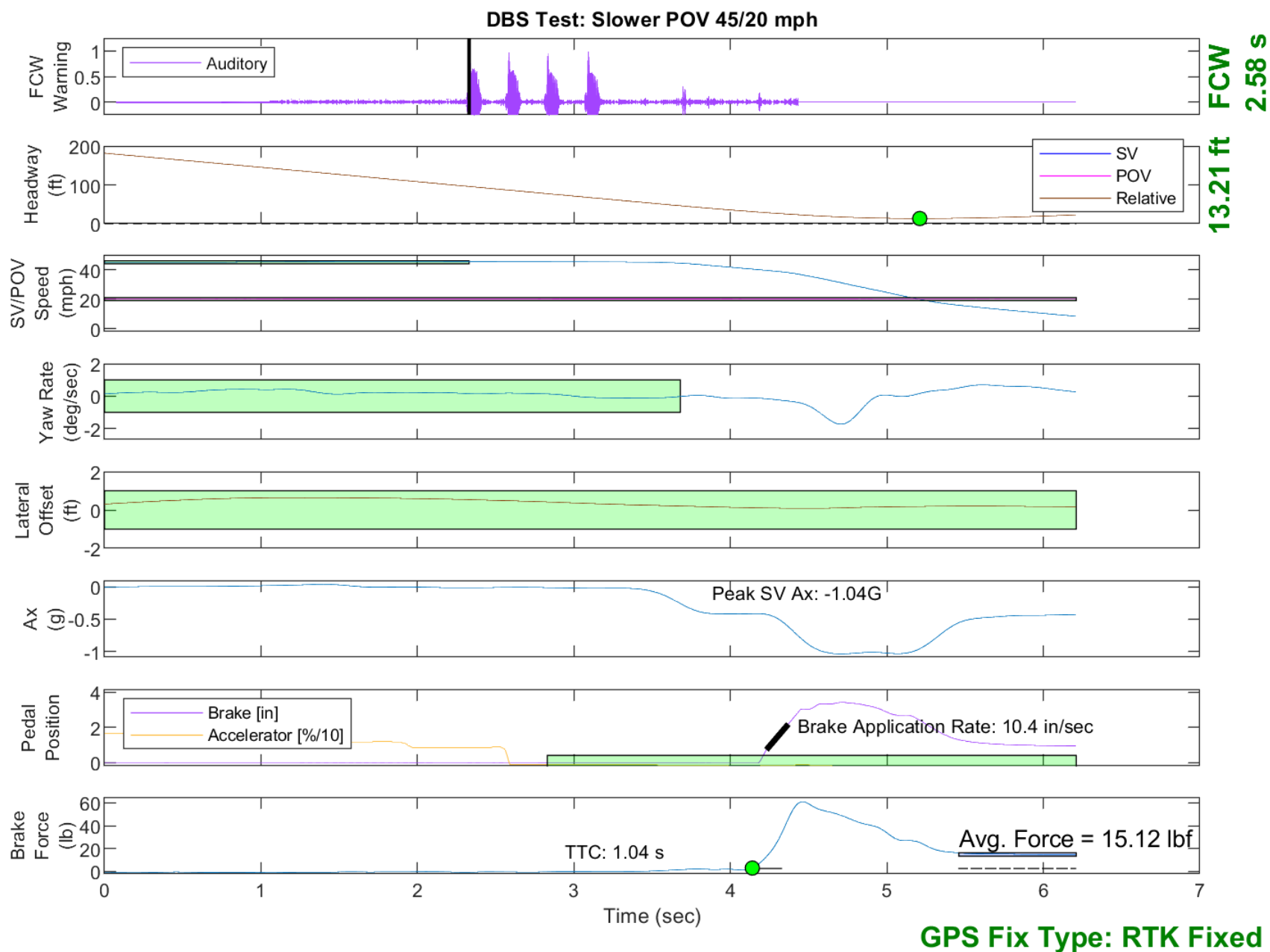


Figure E3. Example Time History for Slower POV 45 vs. 20, Passing

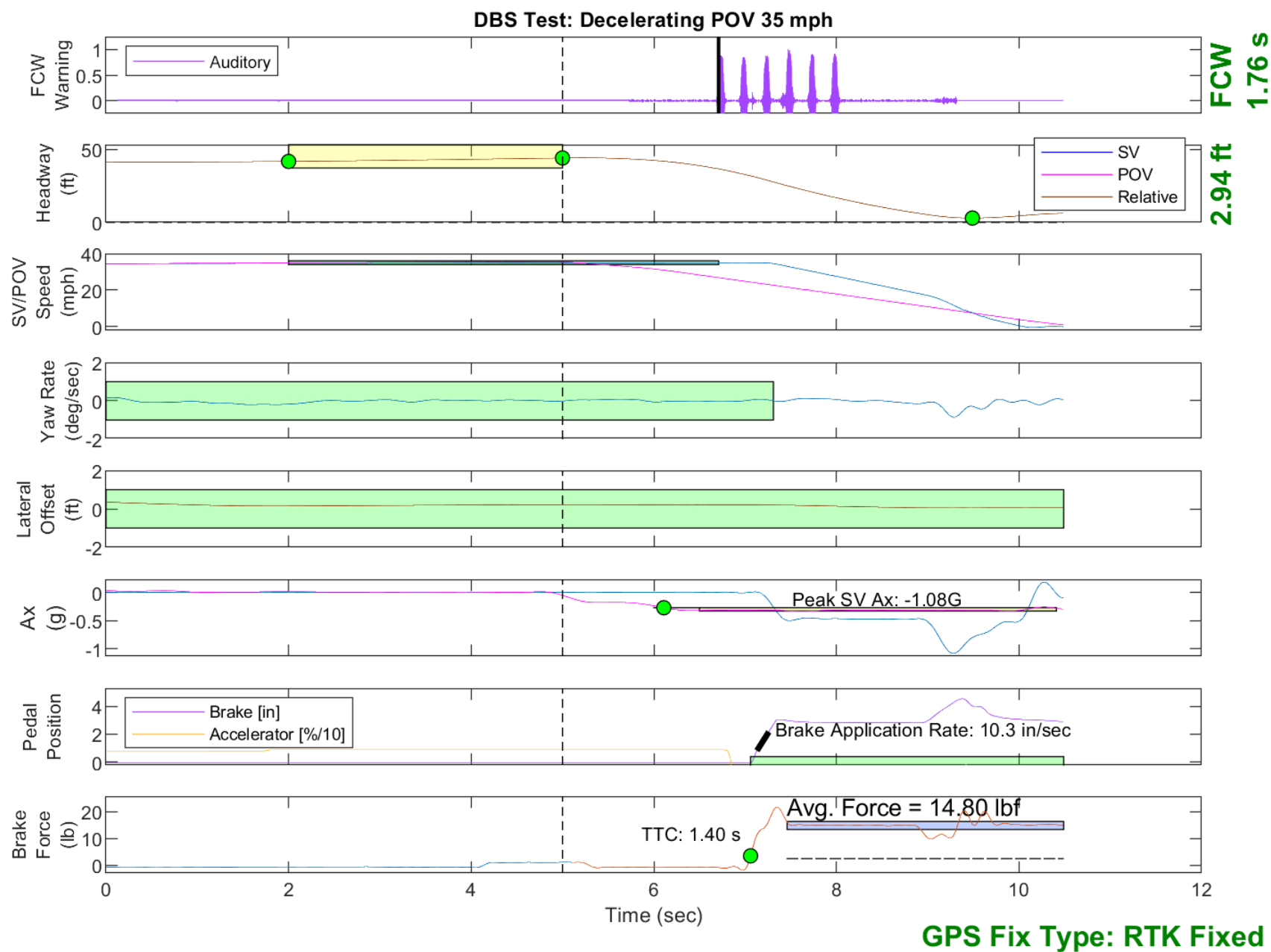
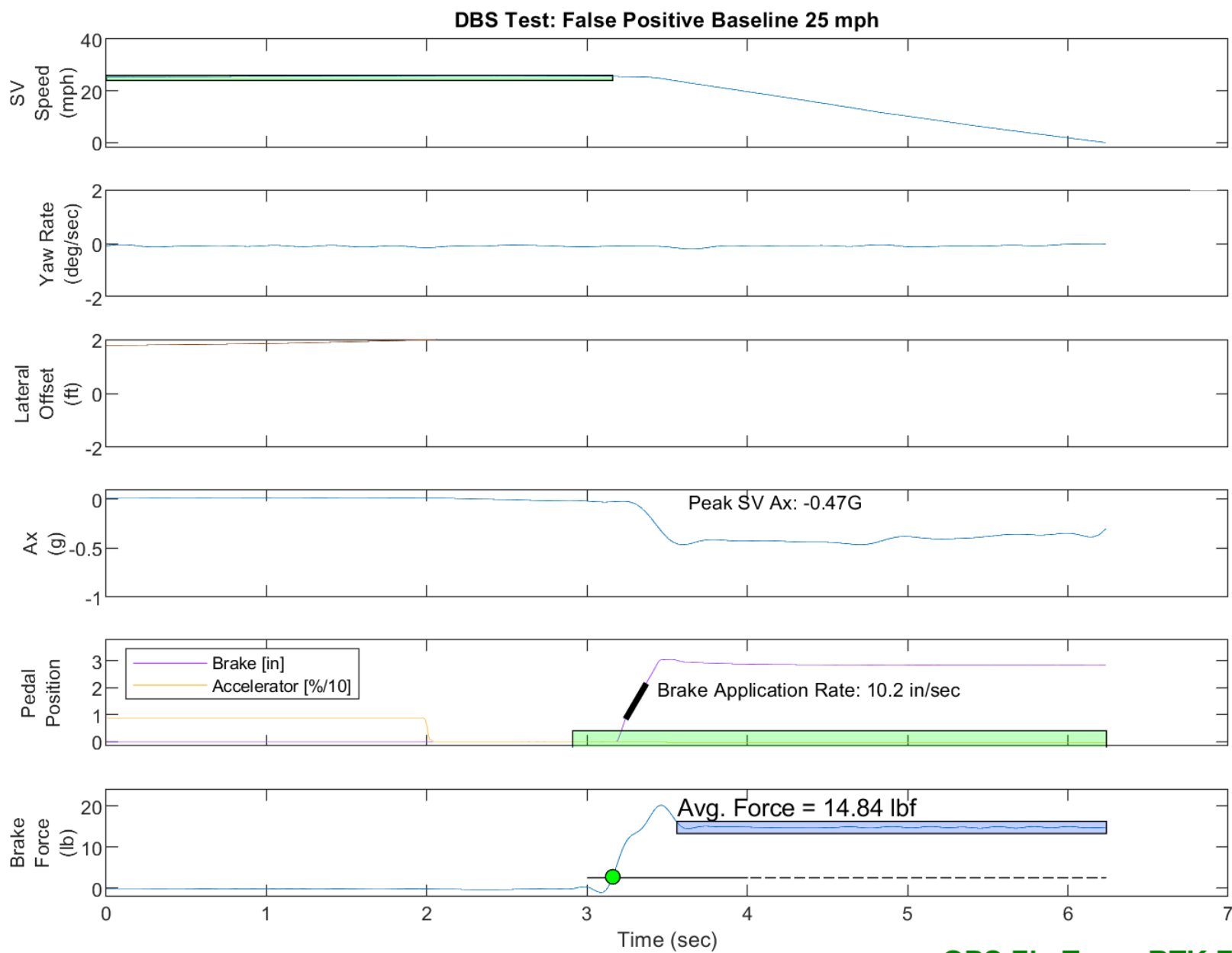


Figure E4. Example Time History for Decelerating POV 35, Passing



GPS Fix Type: RTK Fixed

Figure E5. Example Time History for False Positive Baseline 25

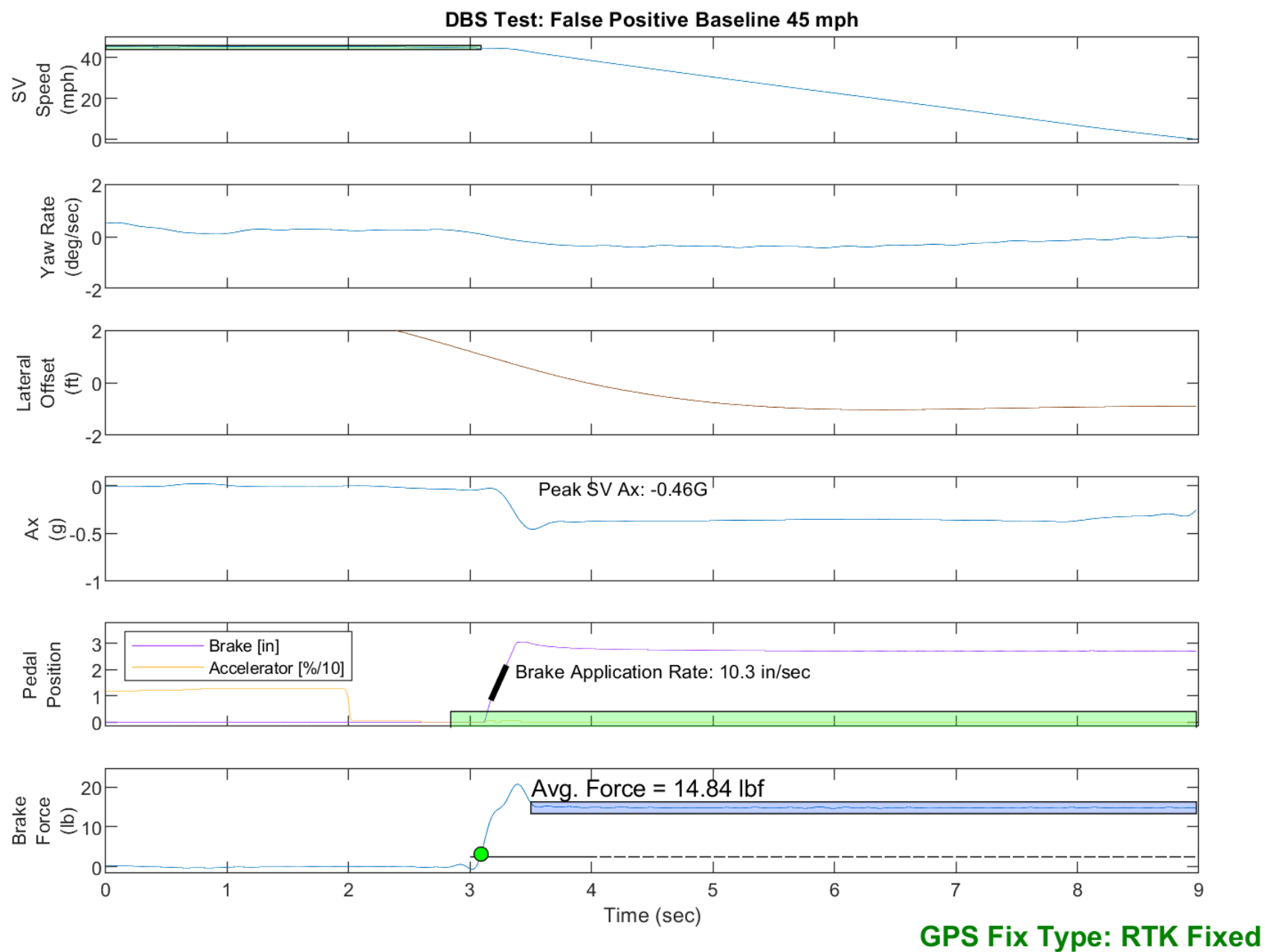


Figure E6. Example Time History for False Positive Baseline 45

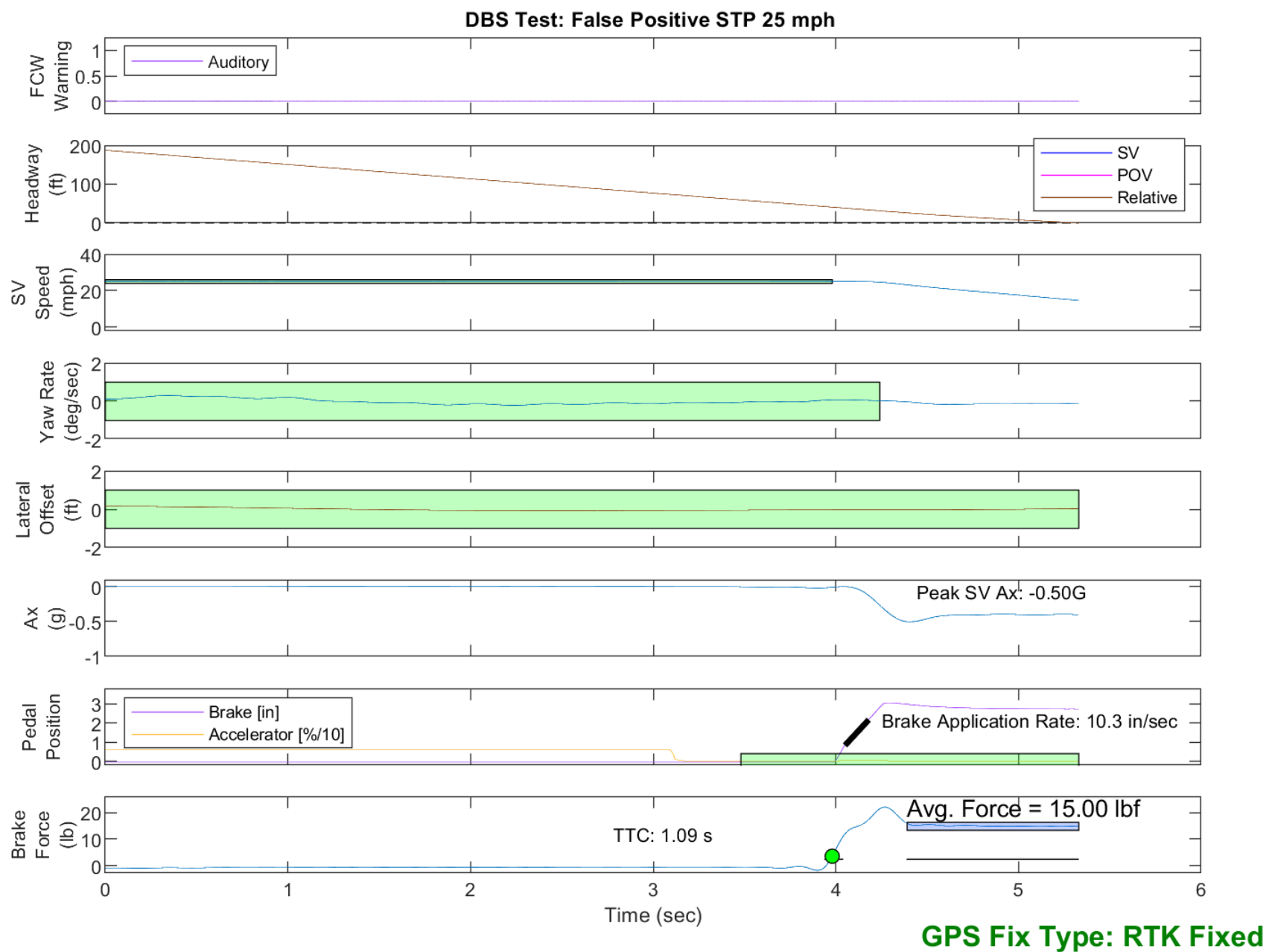


Figure E7. Example Time History for False Positive Steel Plate 25, Passing

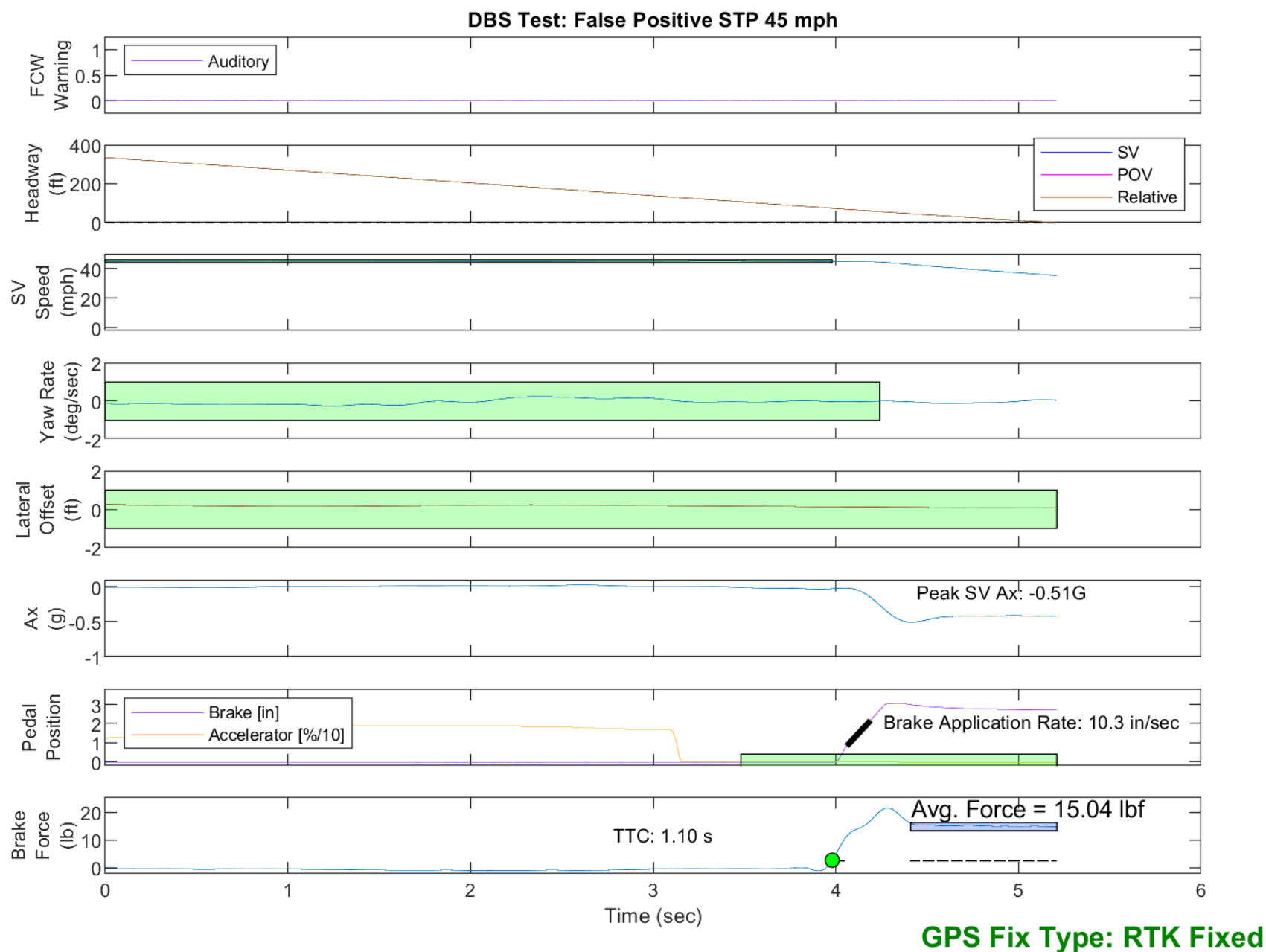


Figure E8. Example Time History for False Positive Steel Plate 45, Passing

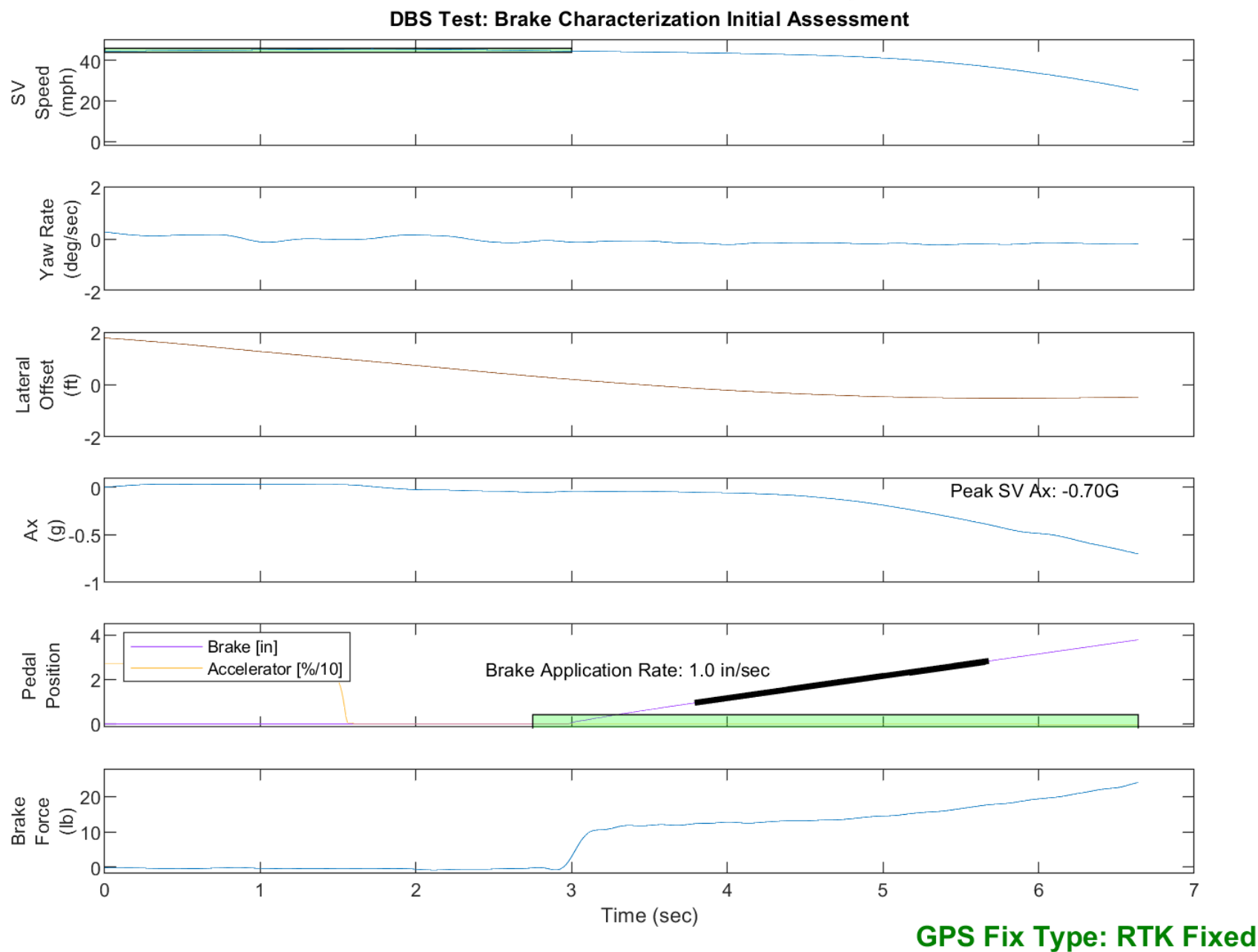


Figure E9. Example Time History for DBS Brake Characterization, Passing

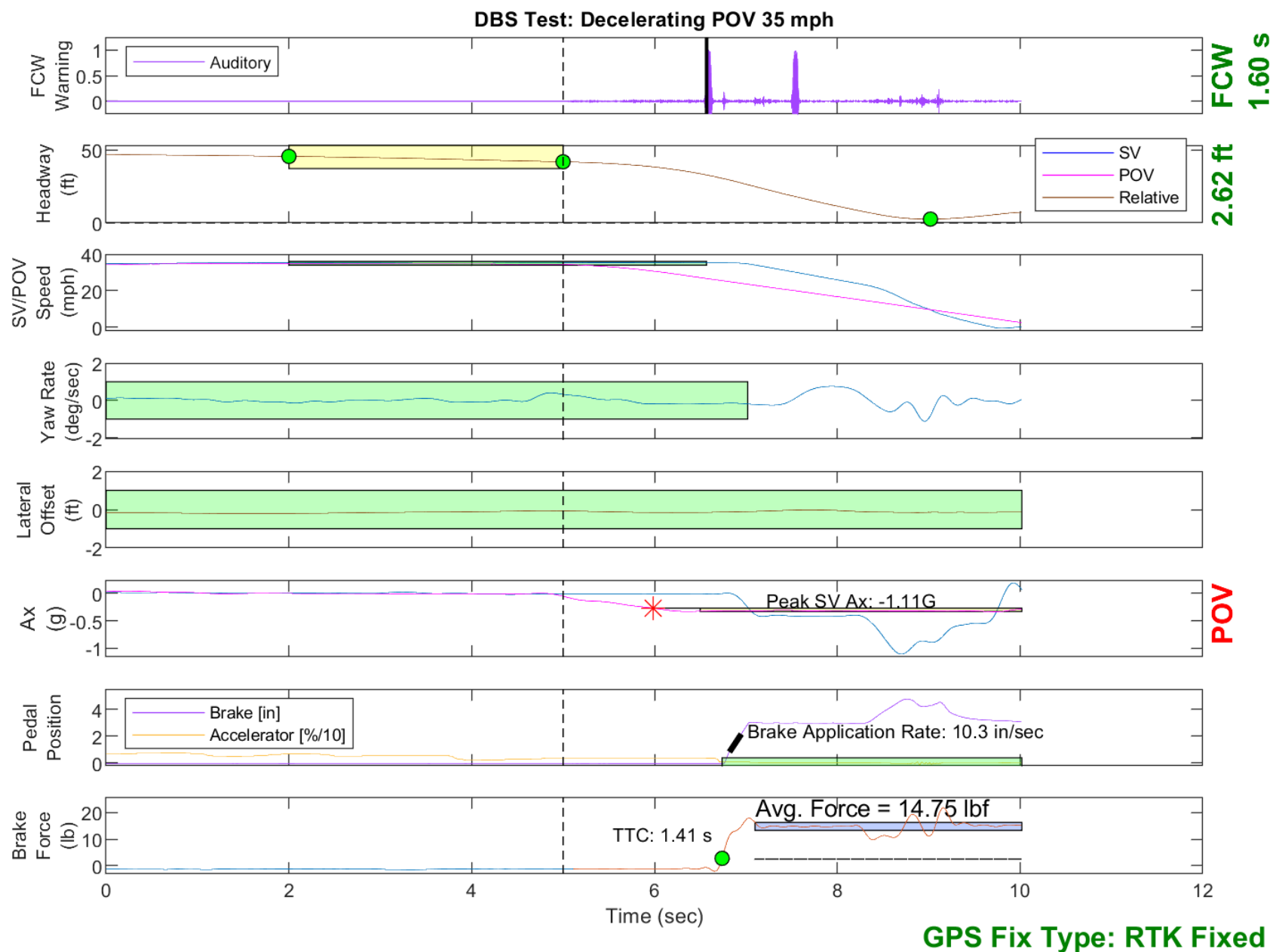


Figure E10. Example Time History Displaying Invalid POV Acceleration Criteria

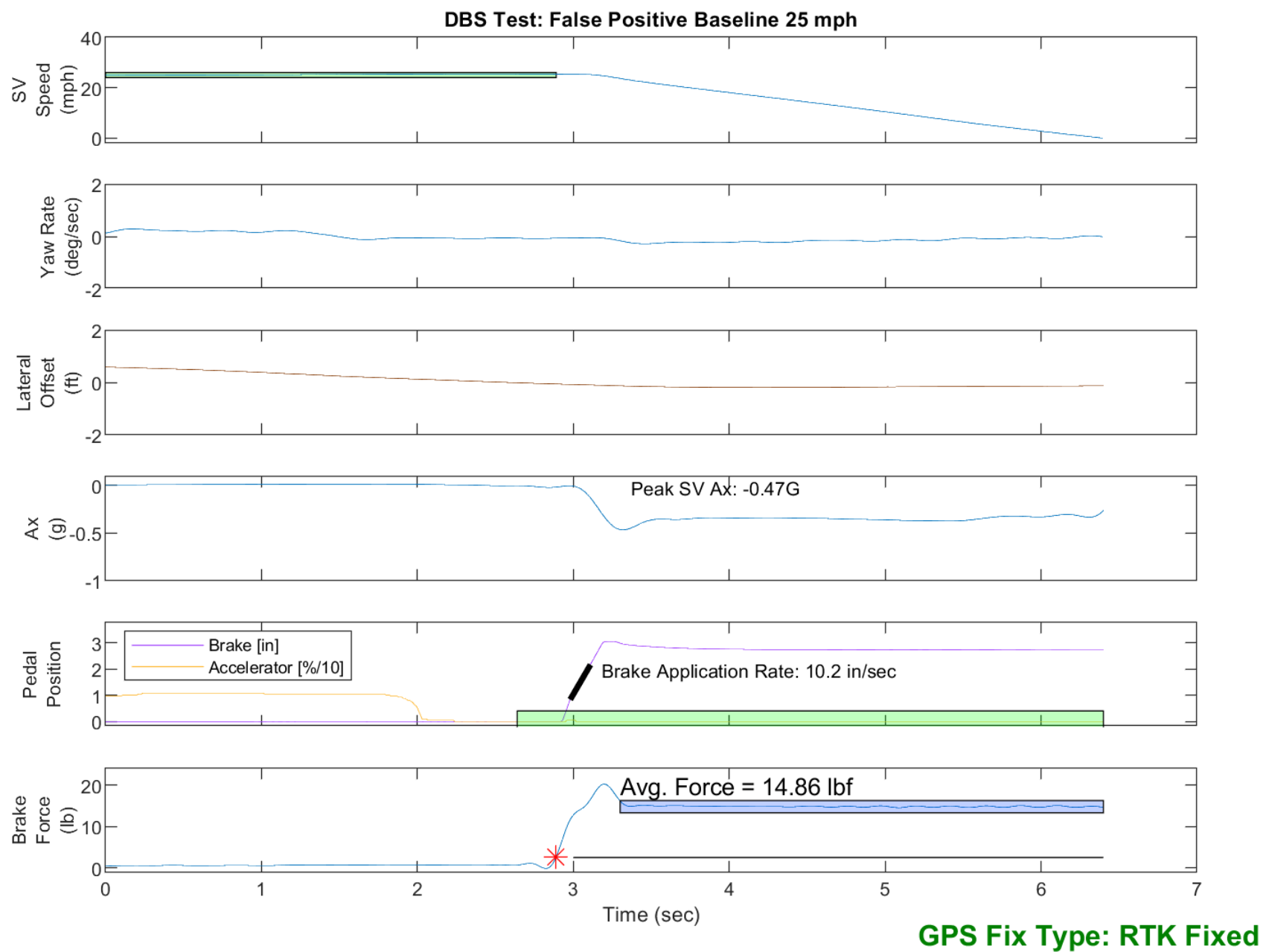


Figure E11. Example Time History Displaying Invalid Brake Force Criteria

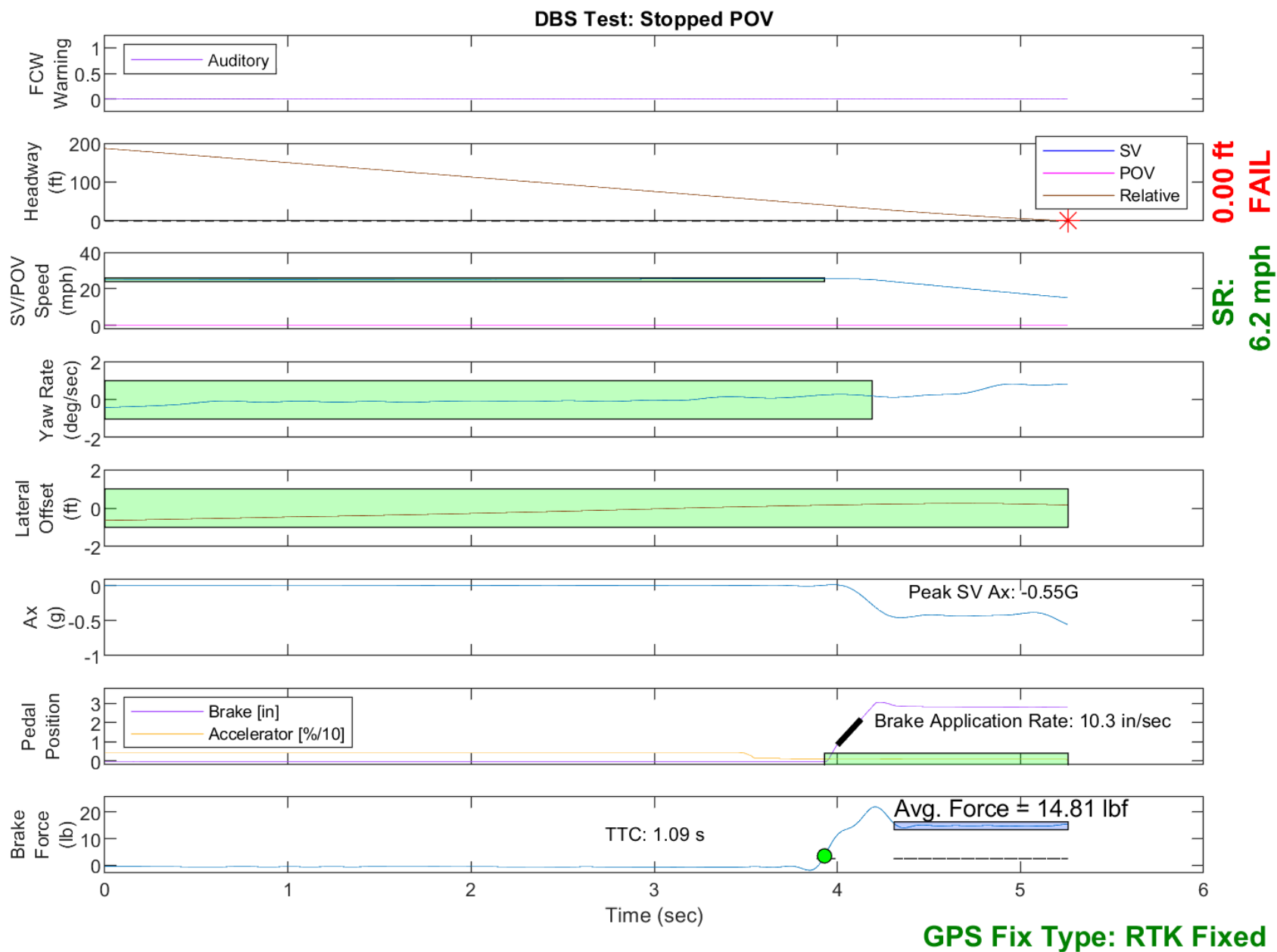


Figure E12. Example Time History for a Failed Run

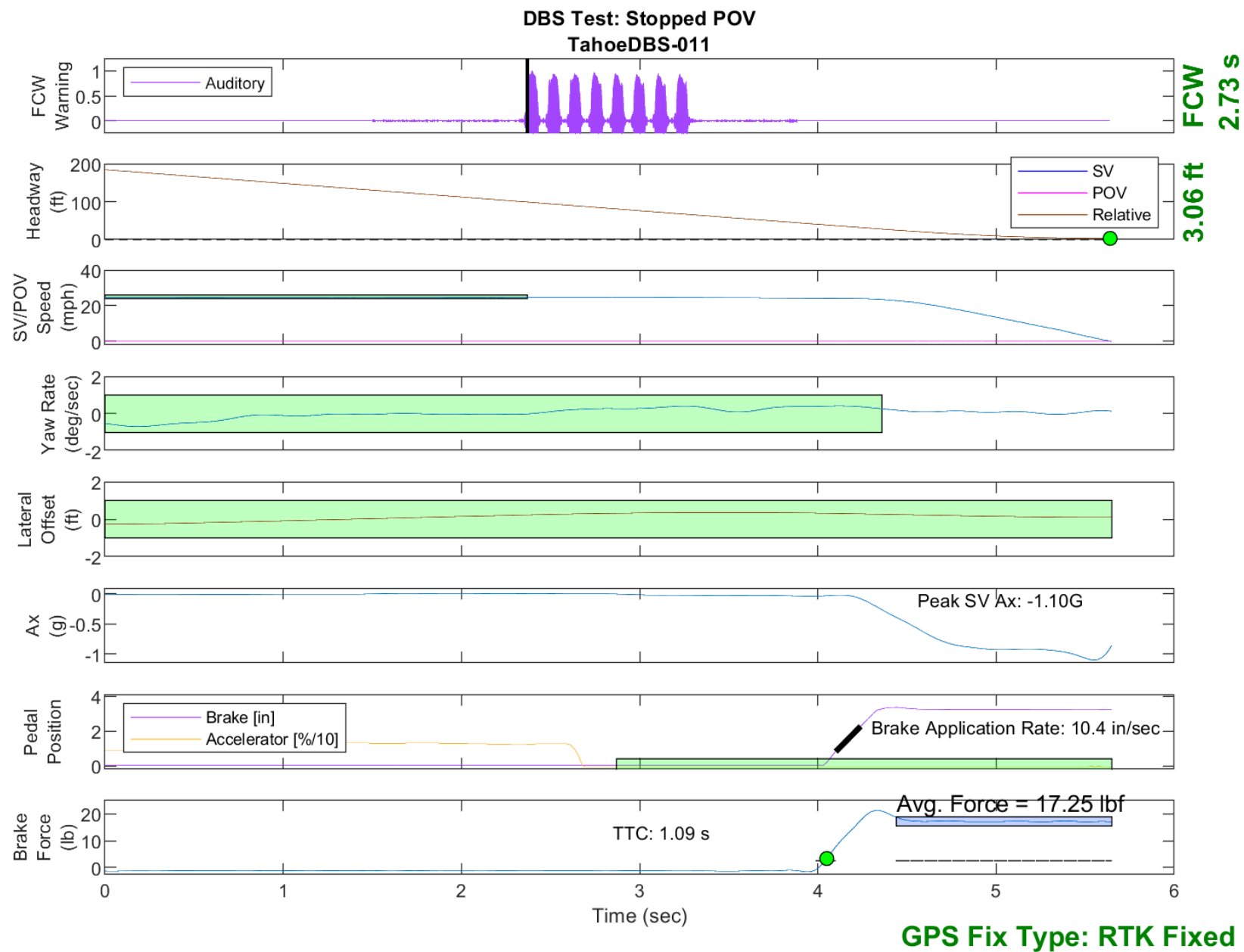


Figure E13. Time History for DBS Run 11, SV Encounters Stopped POV

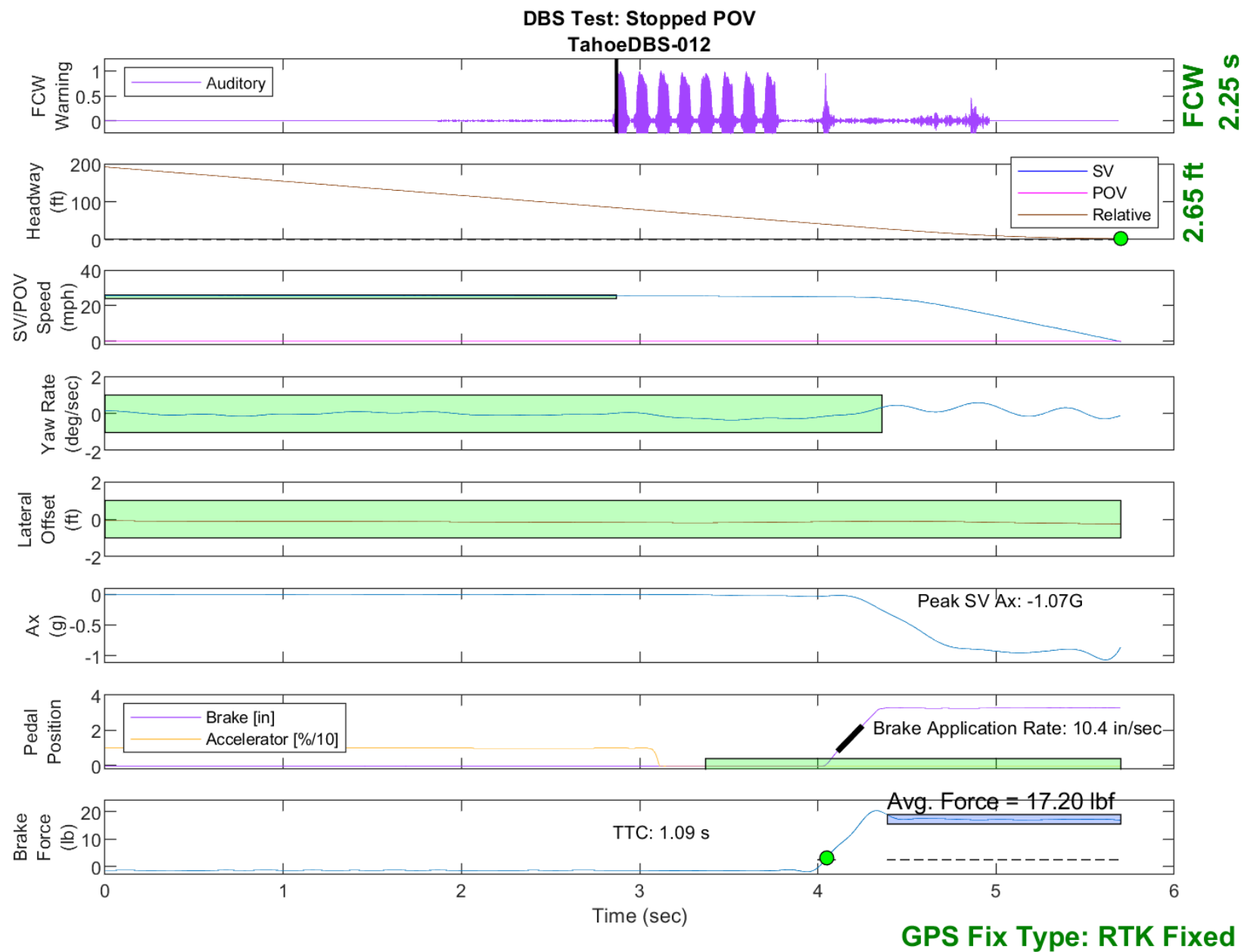


Figure E14. Time History for DBS Run 12, SV Encounters Stopped POV

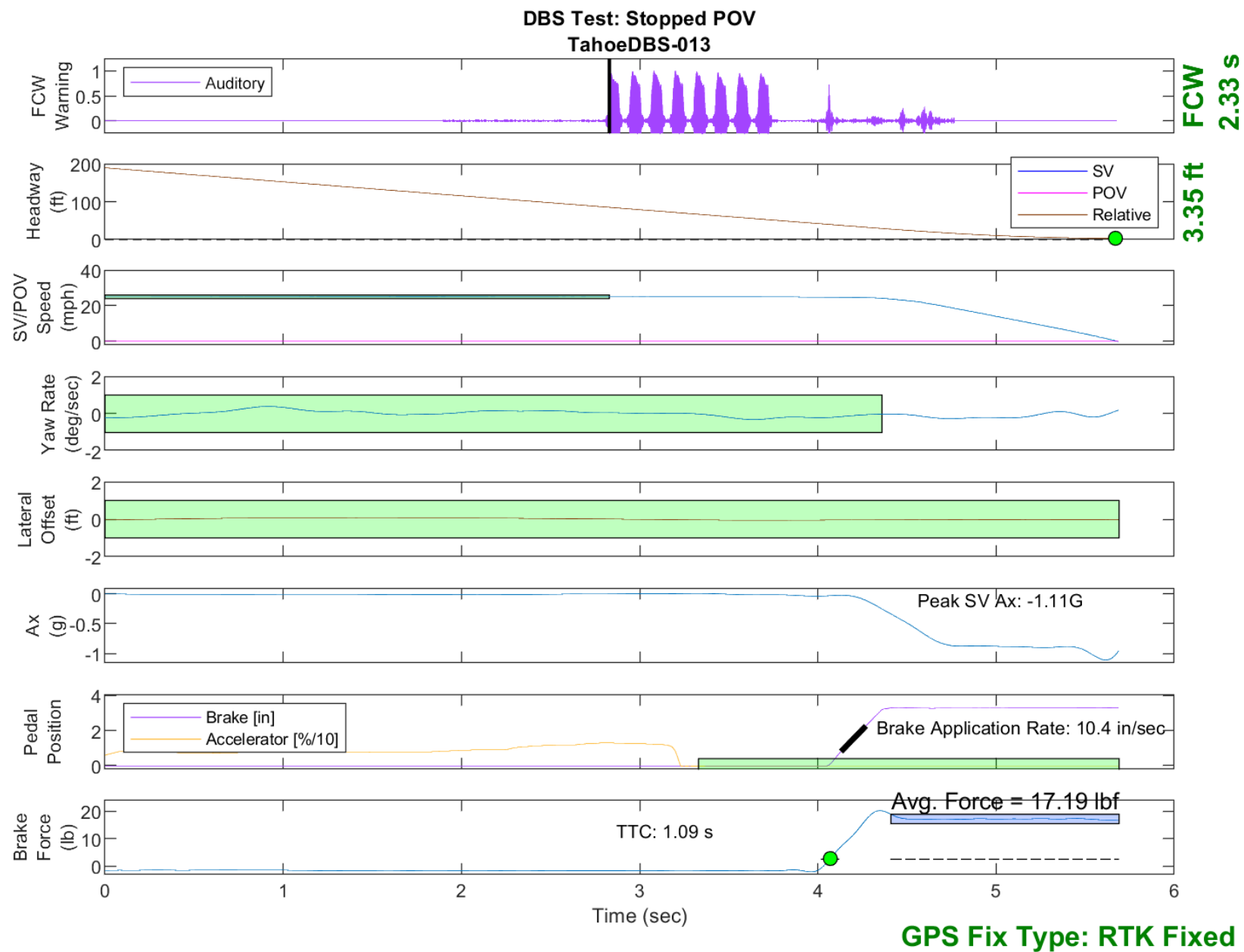


Figure E15. Time History for DBS Run 13, SV Encounters Stopped POV

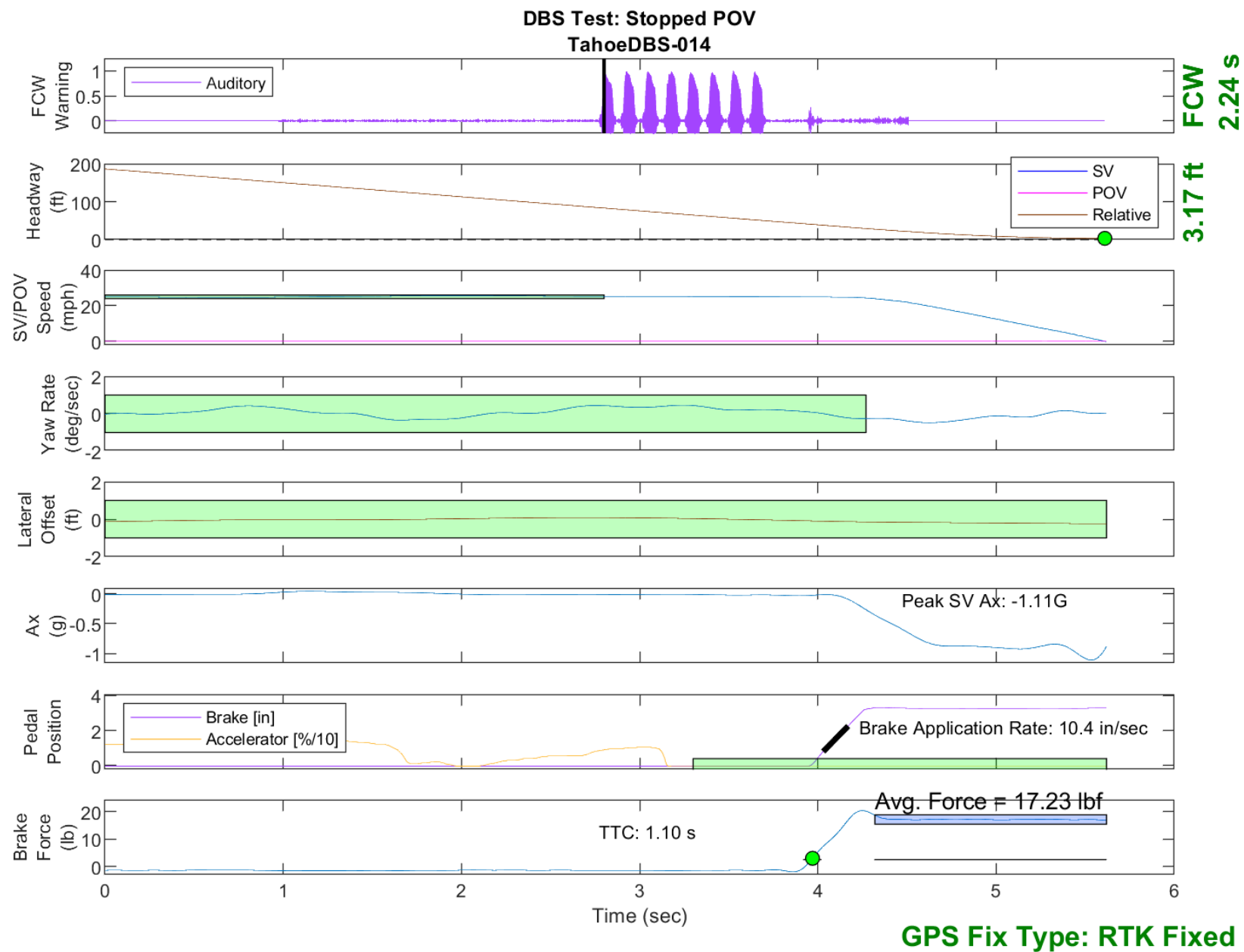


Figure E16. Time History for DBS Run 14, SV Encounters Stopped POV

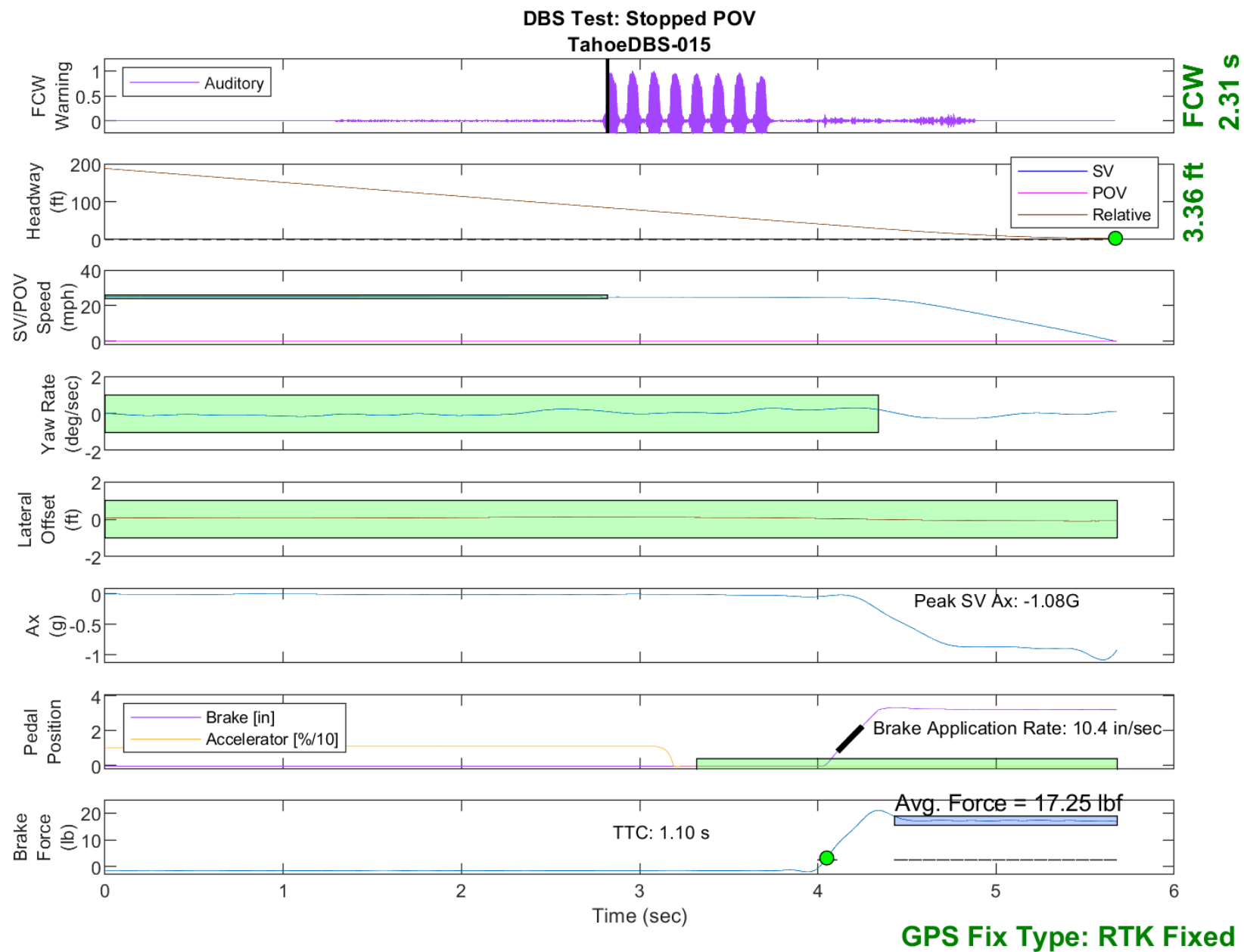


Figure E17. Time History for DBS Run 15, SV Encounters Stopped POV

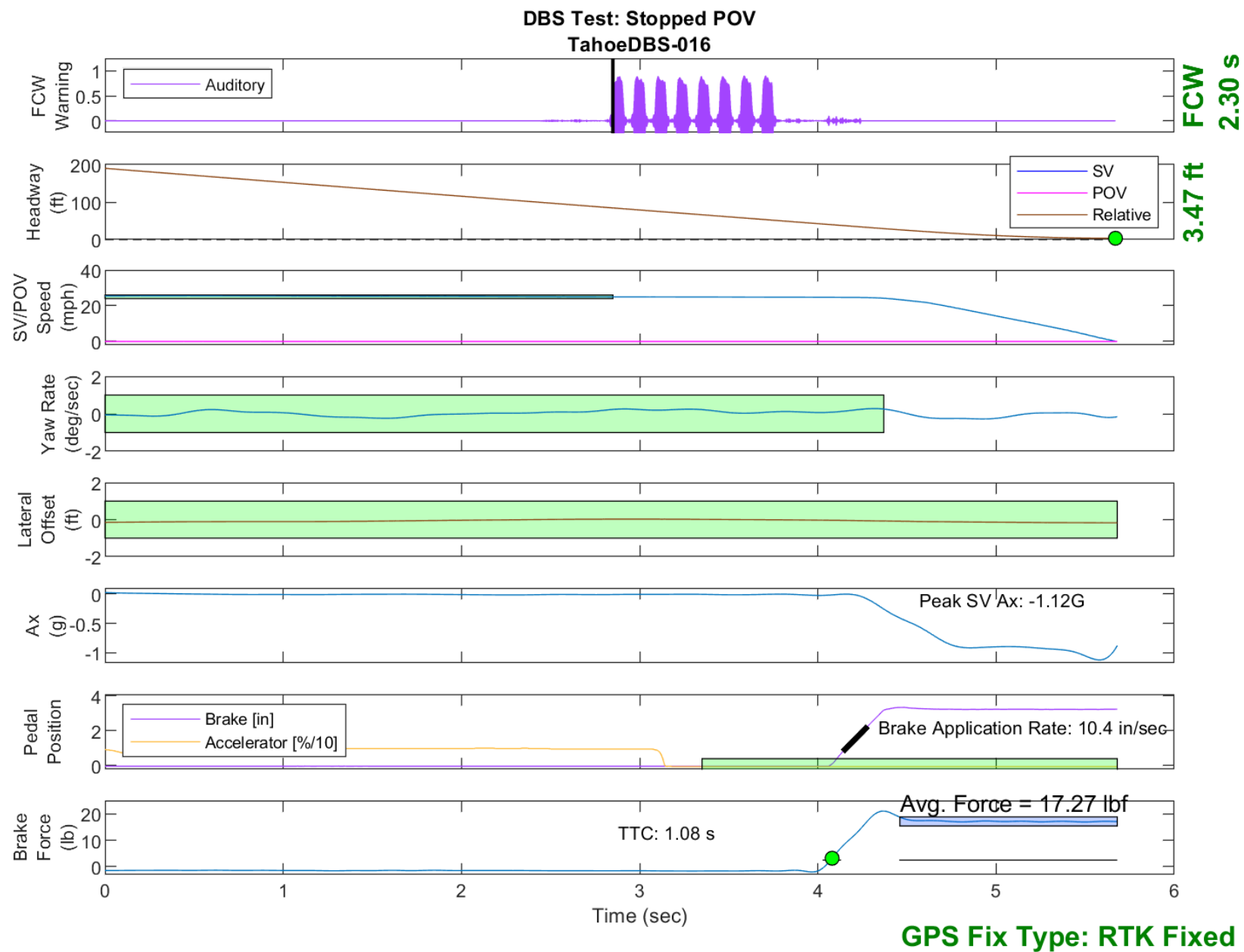


Figure E18. Time History for DBS Run 16, SV Encounters Stopped POV

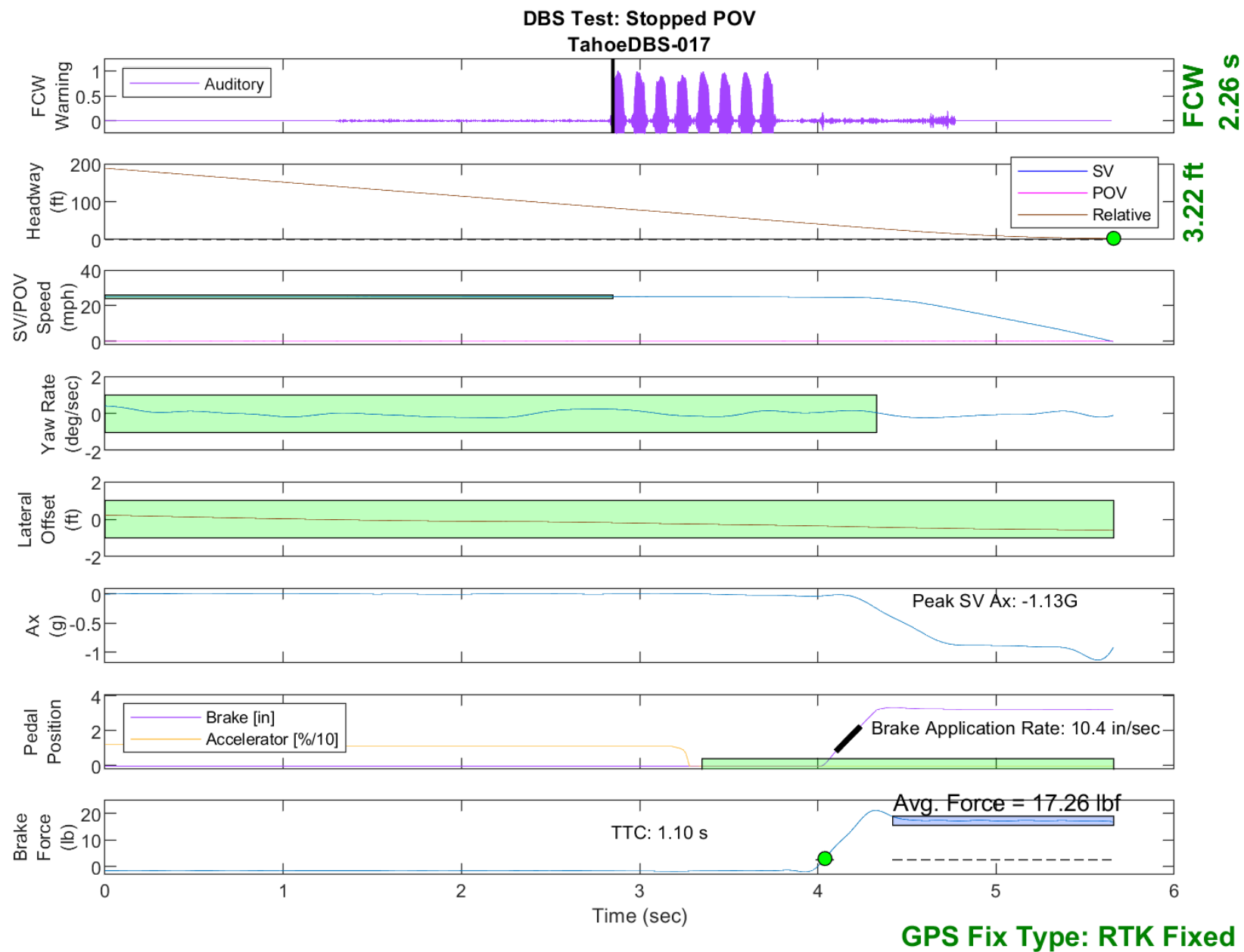


Figure E19. Time History for DBS Run 17, SV Encounters Stopped POV

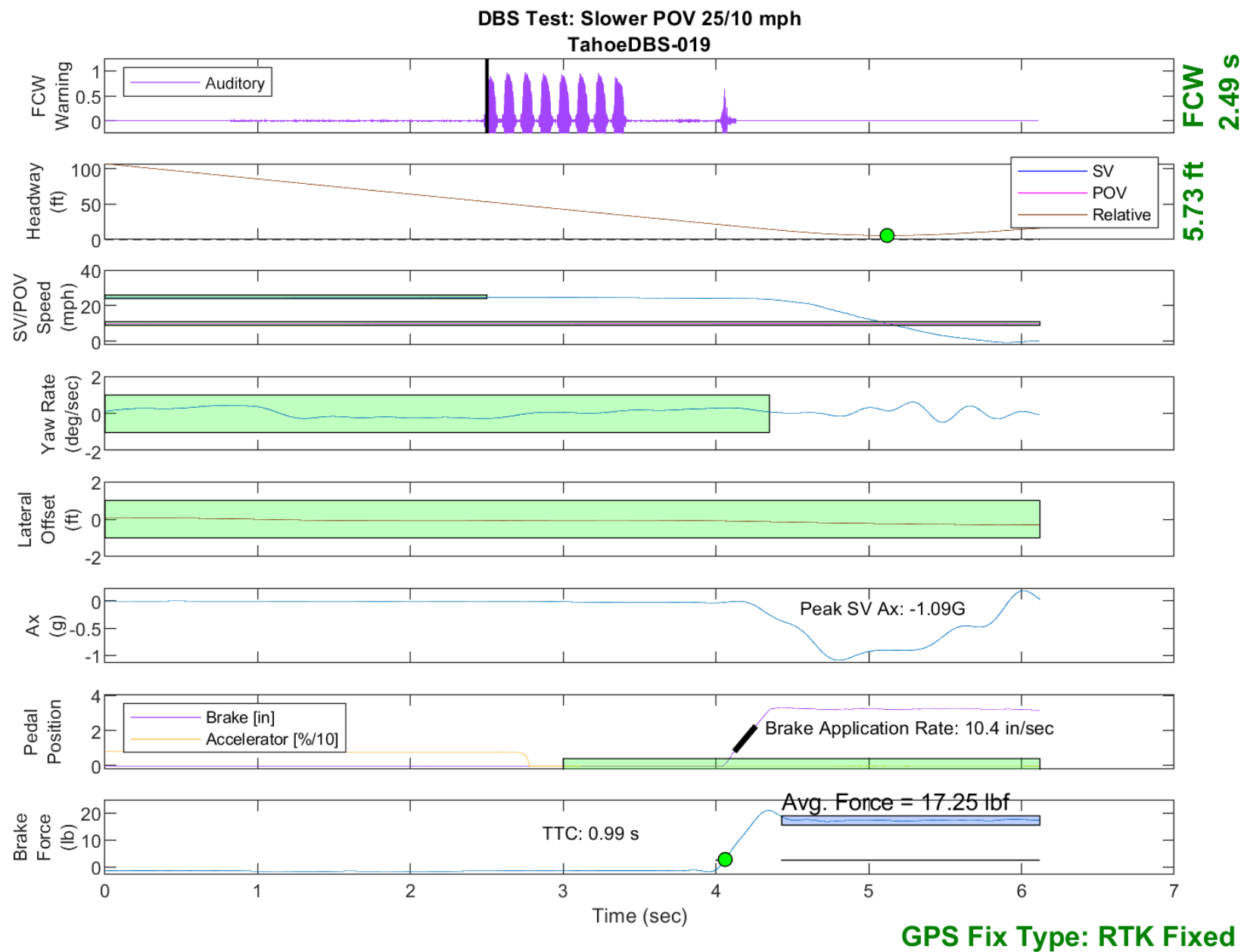


Figure E20. Time History for DBS Run 19, SV Encounters Slower POV, SV 25 mph, POV 10 mph

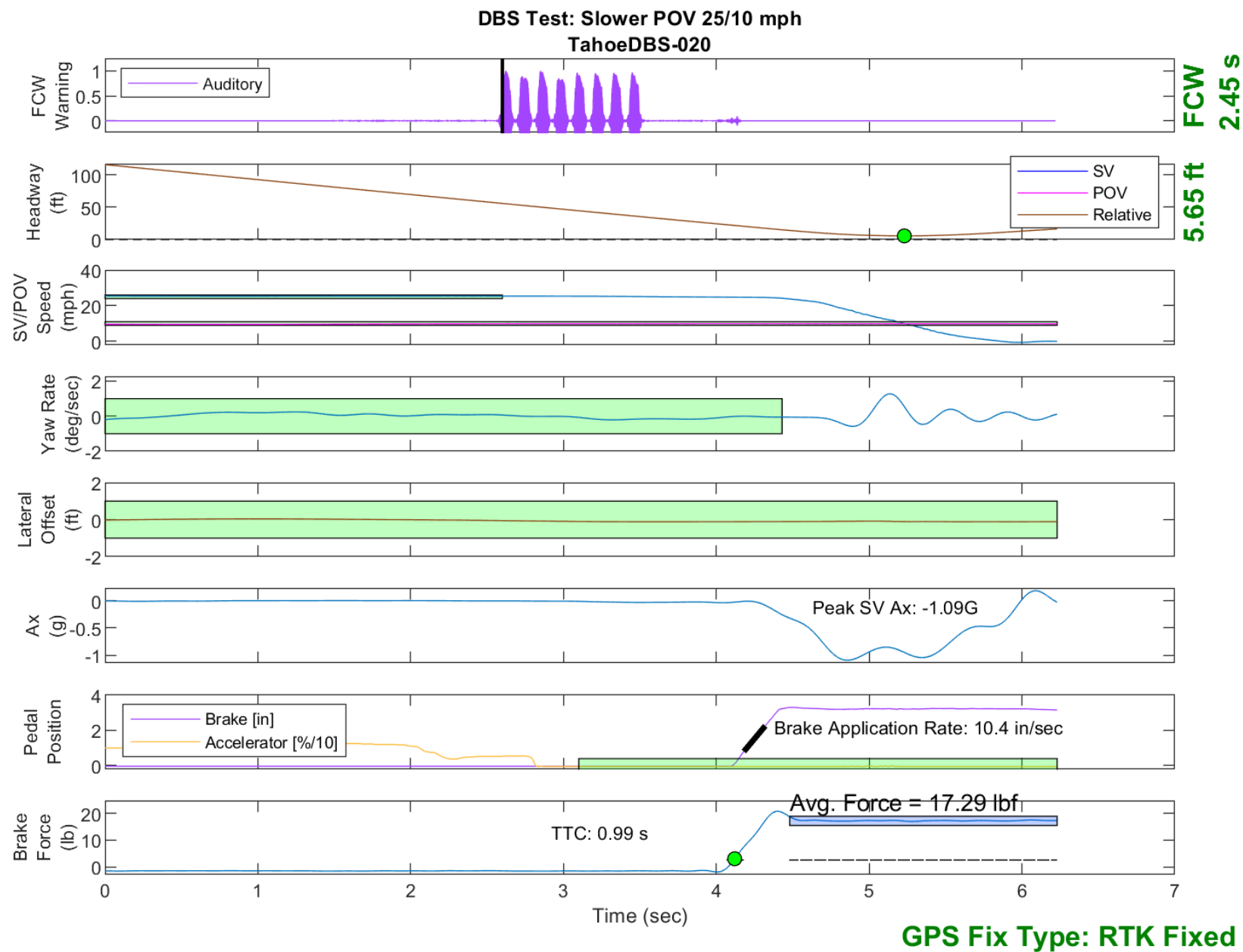


Figure E21. Time History for DBS Run 20, SV Encounters Slower POV, SV 25 mph, POV 10 mph

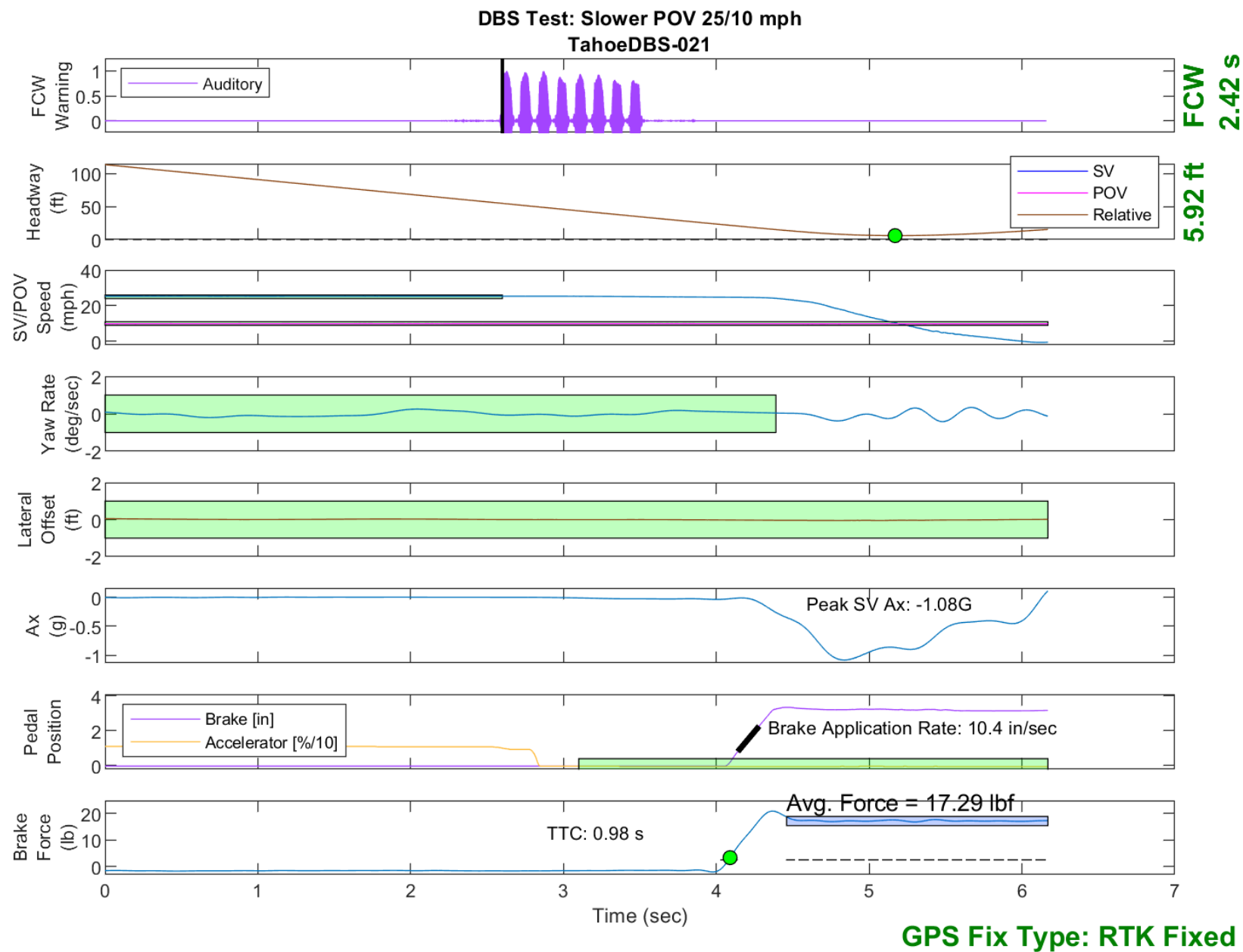


Figure E22. Time History for DBS Run 21, SV Encounters Slower POV, SV 25 mph, POV 10 mph

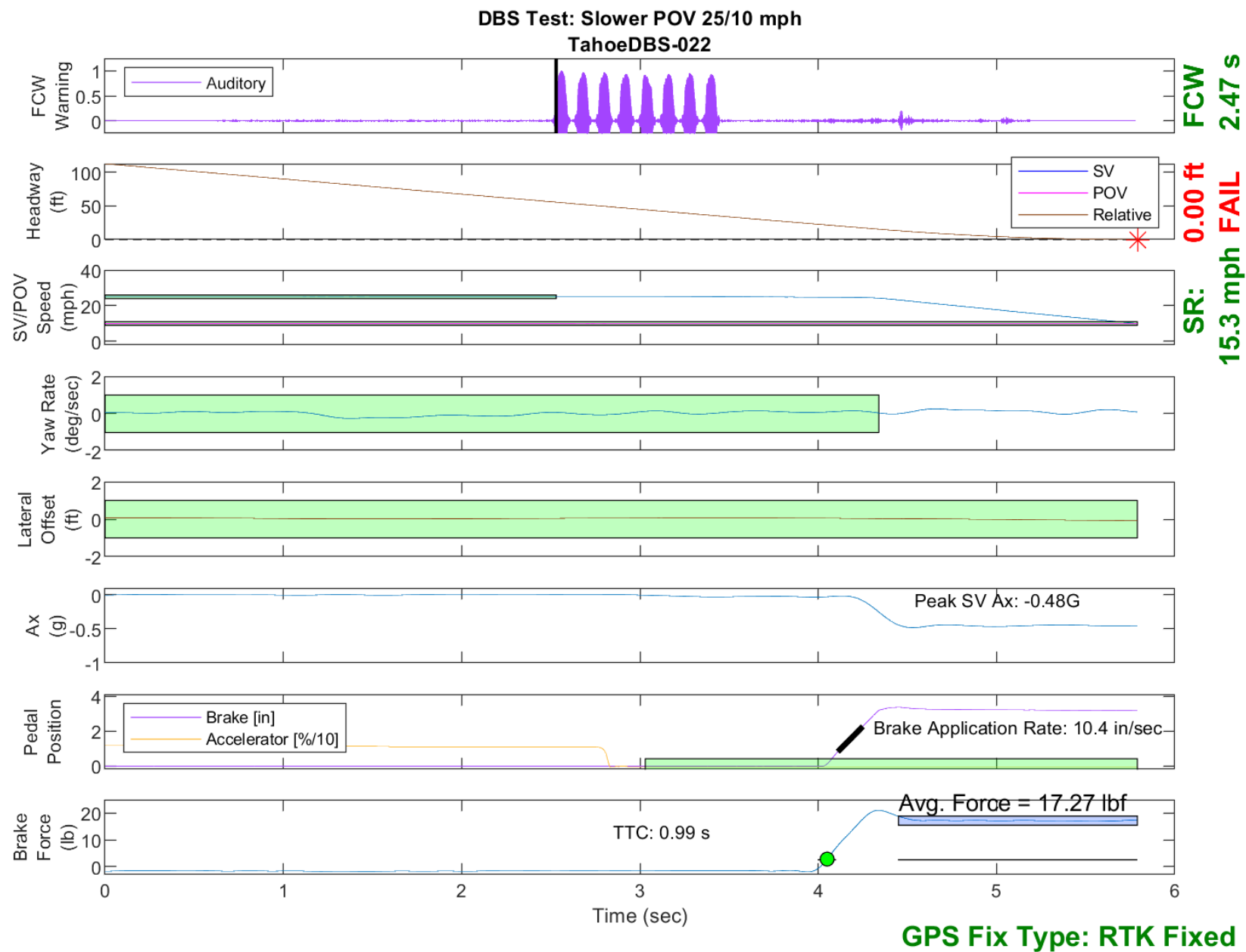


Figure E23. Time History for DBS Run 22, SV Encounters Slower POV, SV 25 mph, POV 10 mph

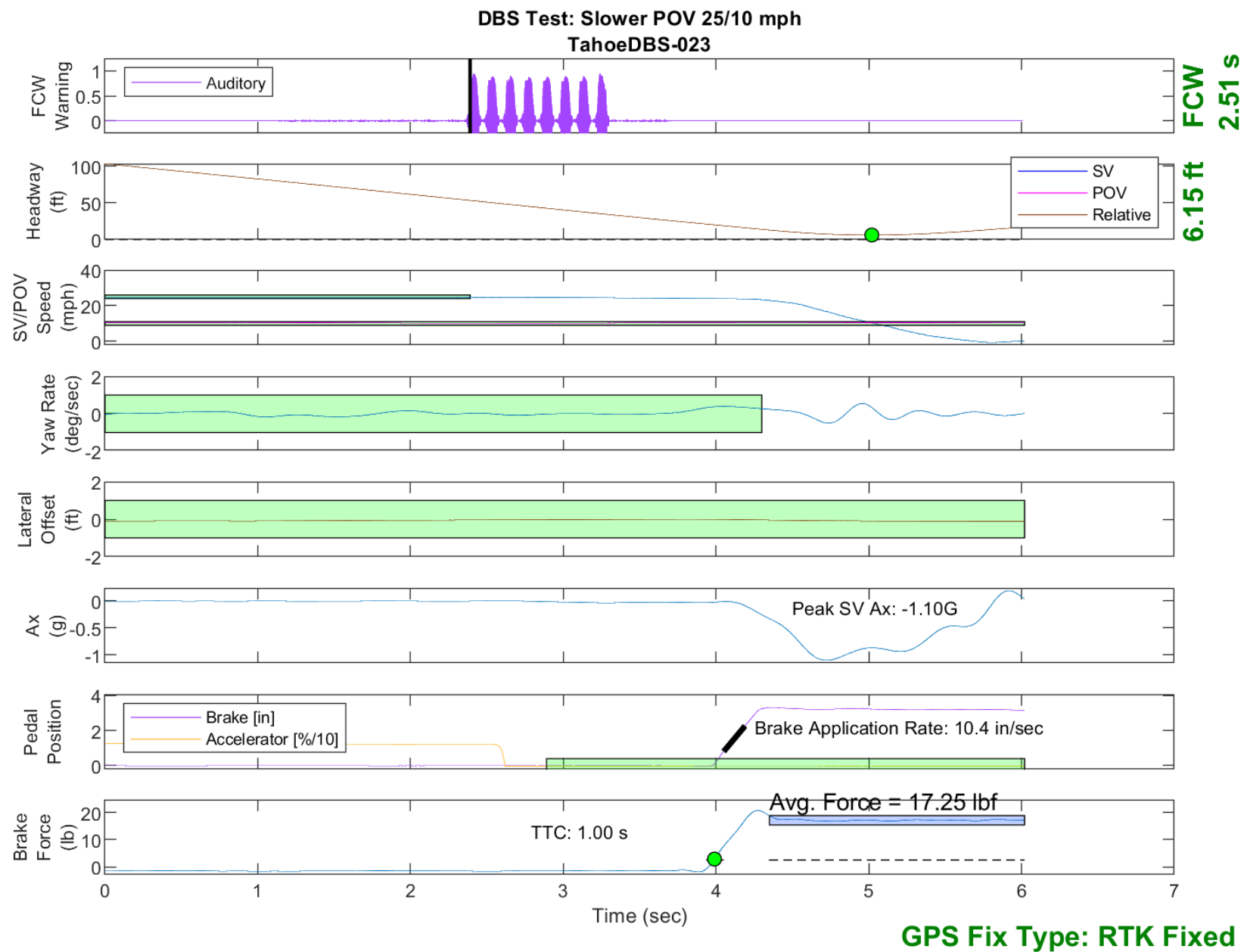


Figure E24. Time History for DBS Run 23, SV Encounters Slower POV, SV 25 mph, POV 10 mph

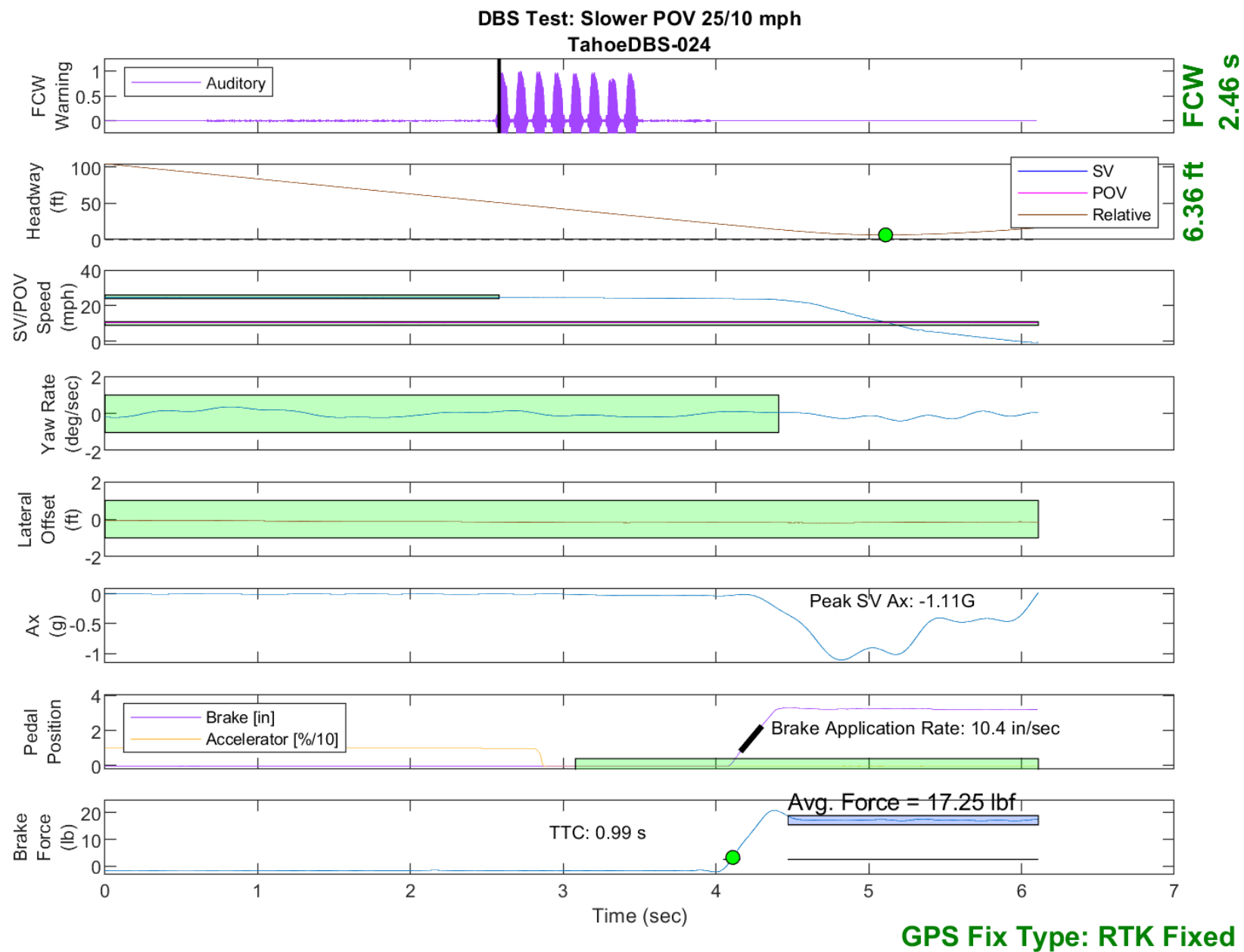


Figure E25. Time History for DBS Run 24, SV Encounters Slower POV, SV 25 mph, POV 10 mph

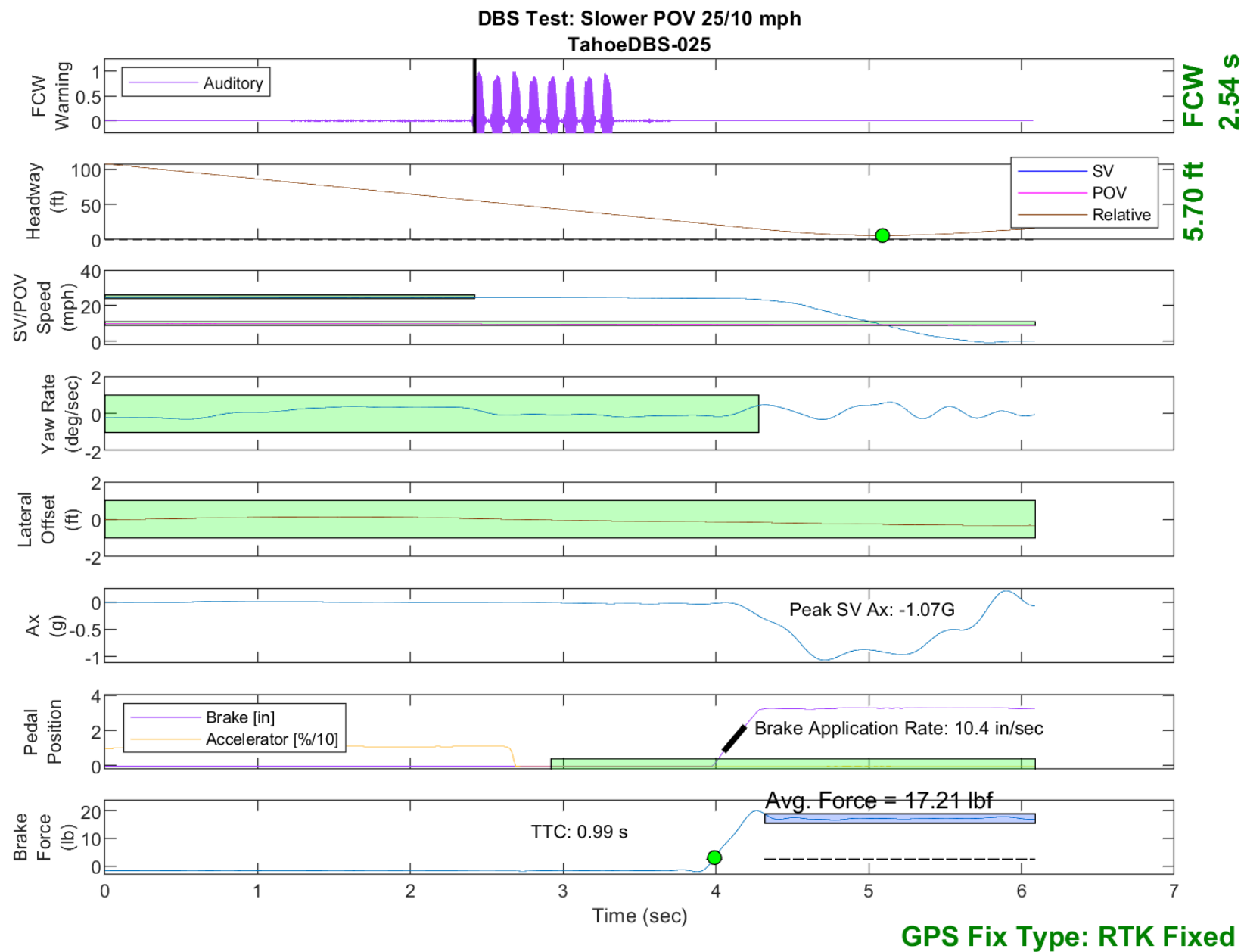


Figure E26. Time History for DBS Run 25, SV Encounters Slower POV, SV 25 mph, POV 10 mph

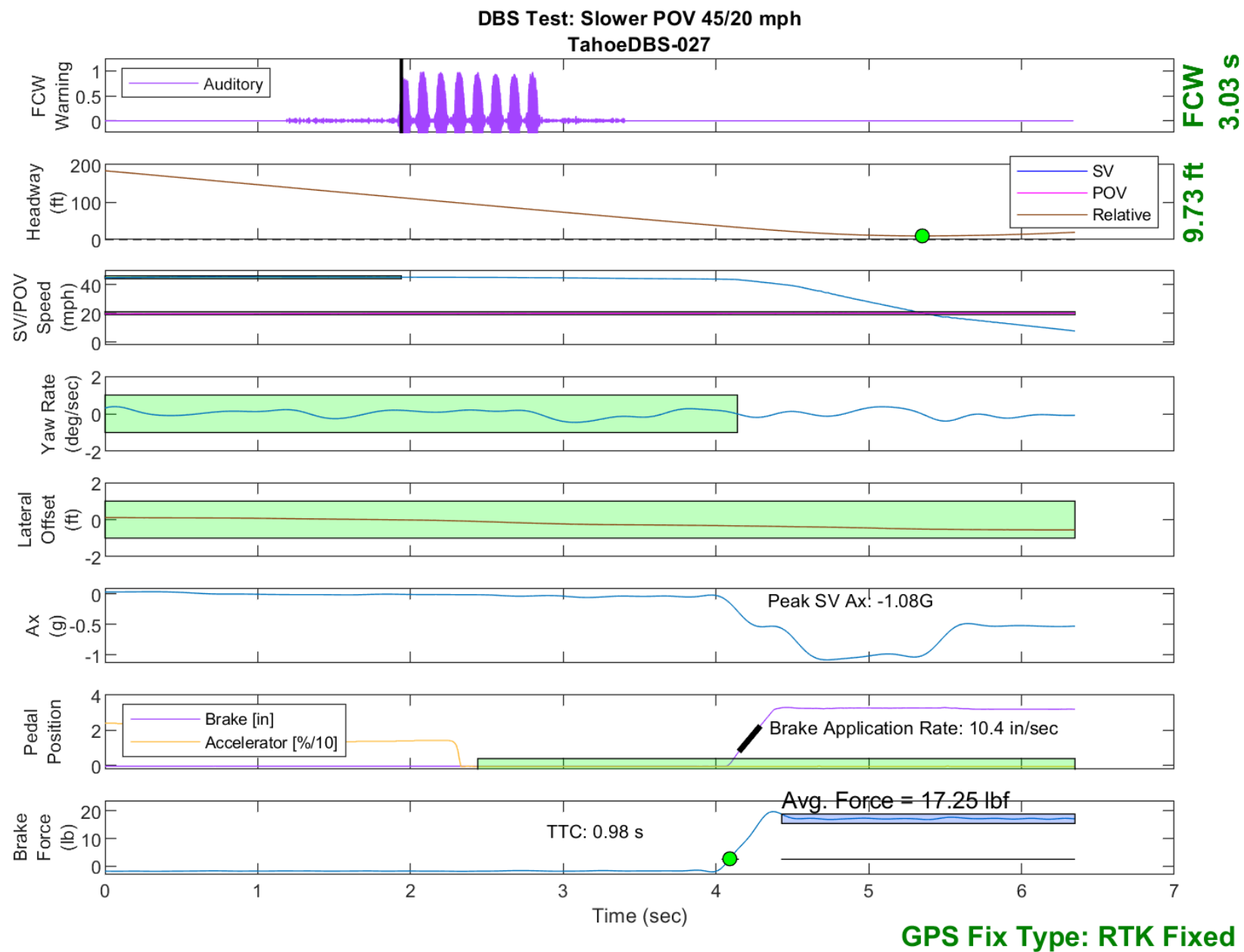


Figure E27. Time History for DBS Run 27, SV Encounters Slower POV, SV 45 mph, POV 20 mph

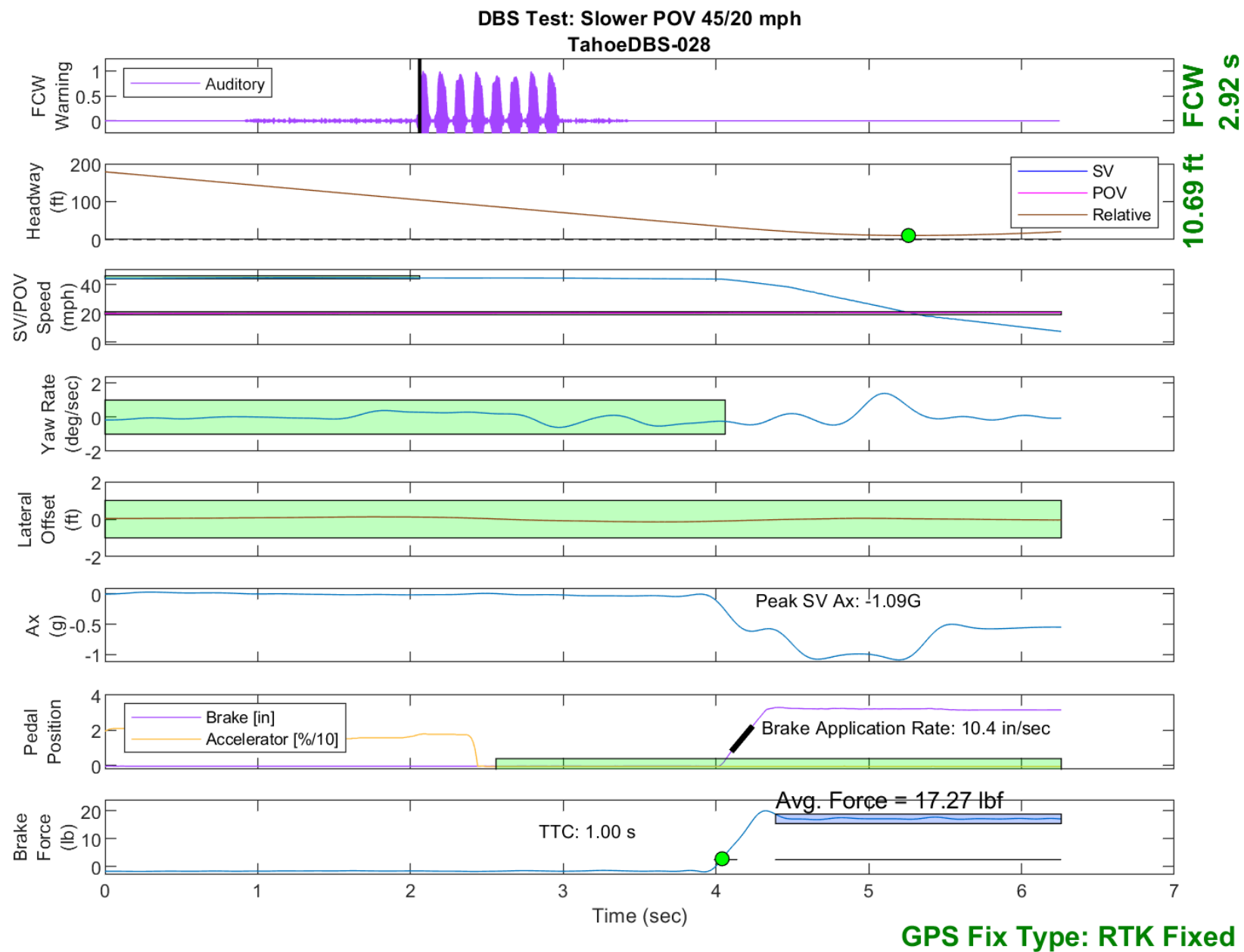


Figure E28. Time History for DBS Run 28, SV Encounters Slower POV, SV 45 mph, POV 20 mph

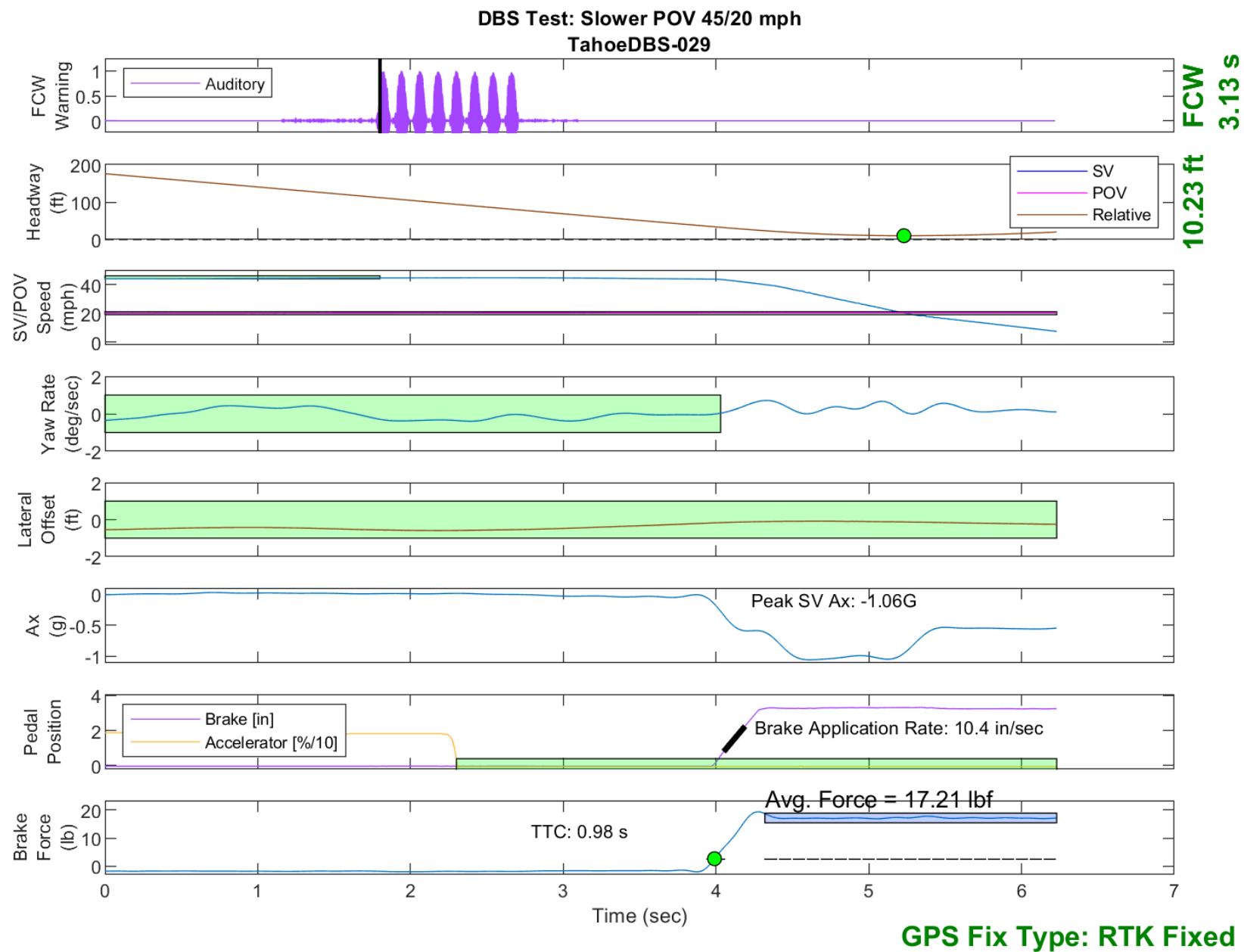


Figure E29. Time History for DBS Run 29, SV Encounters Slower POV, SV 45 mph, POV 20 mph

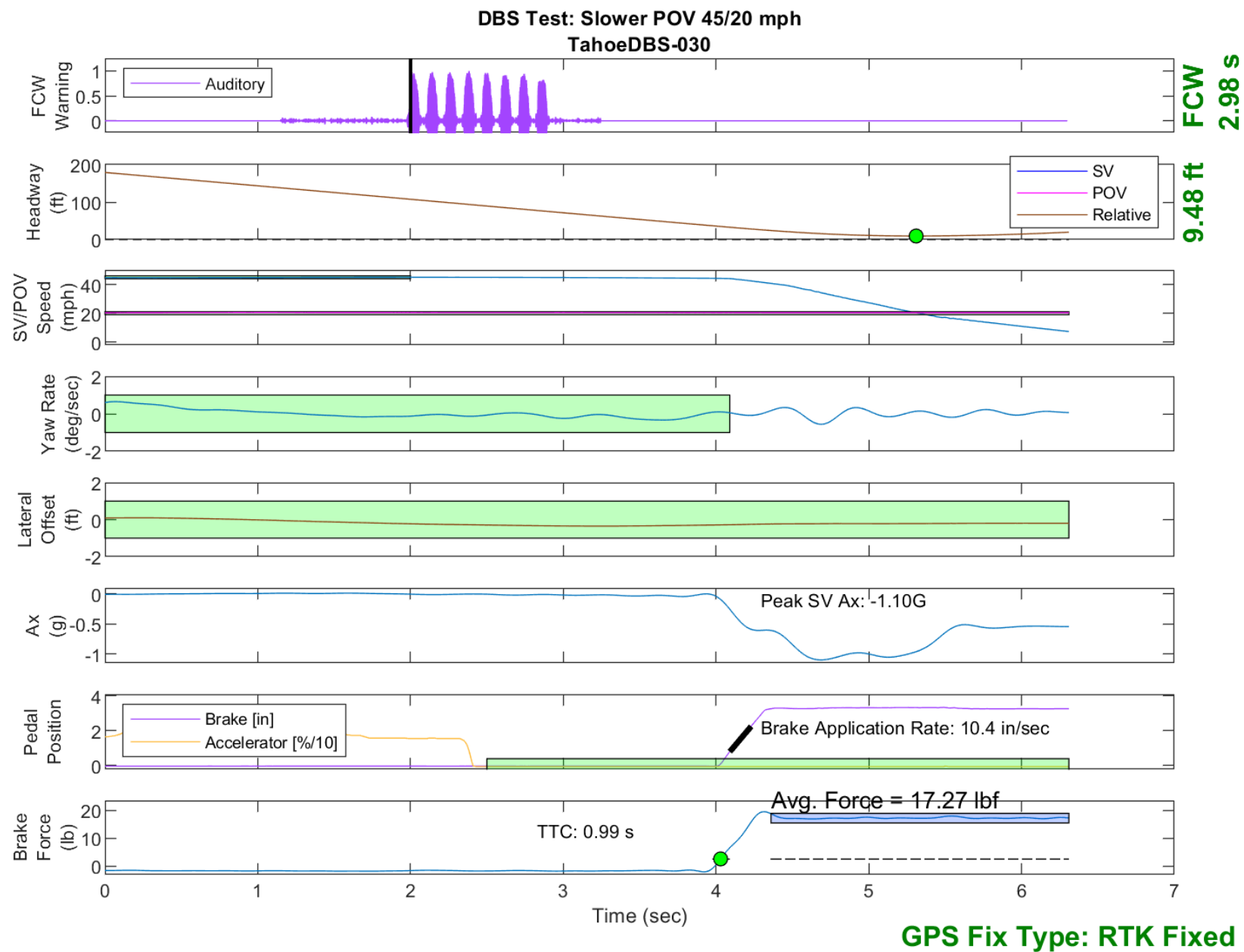


Figure E30. Time History for DBS Run 30, SV Encounters Slower POV, SV 45 mph, POV 20 mph

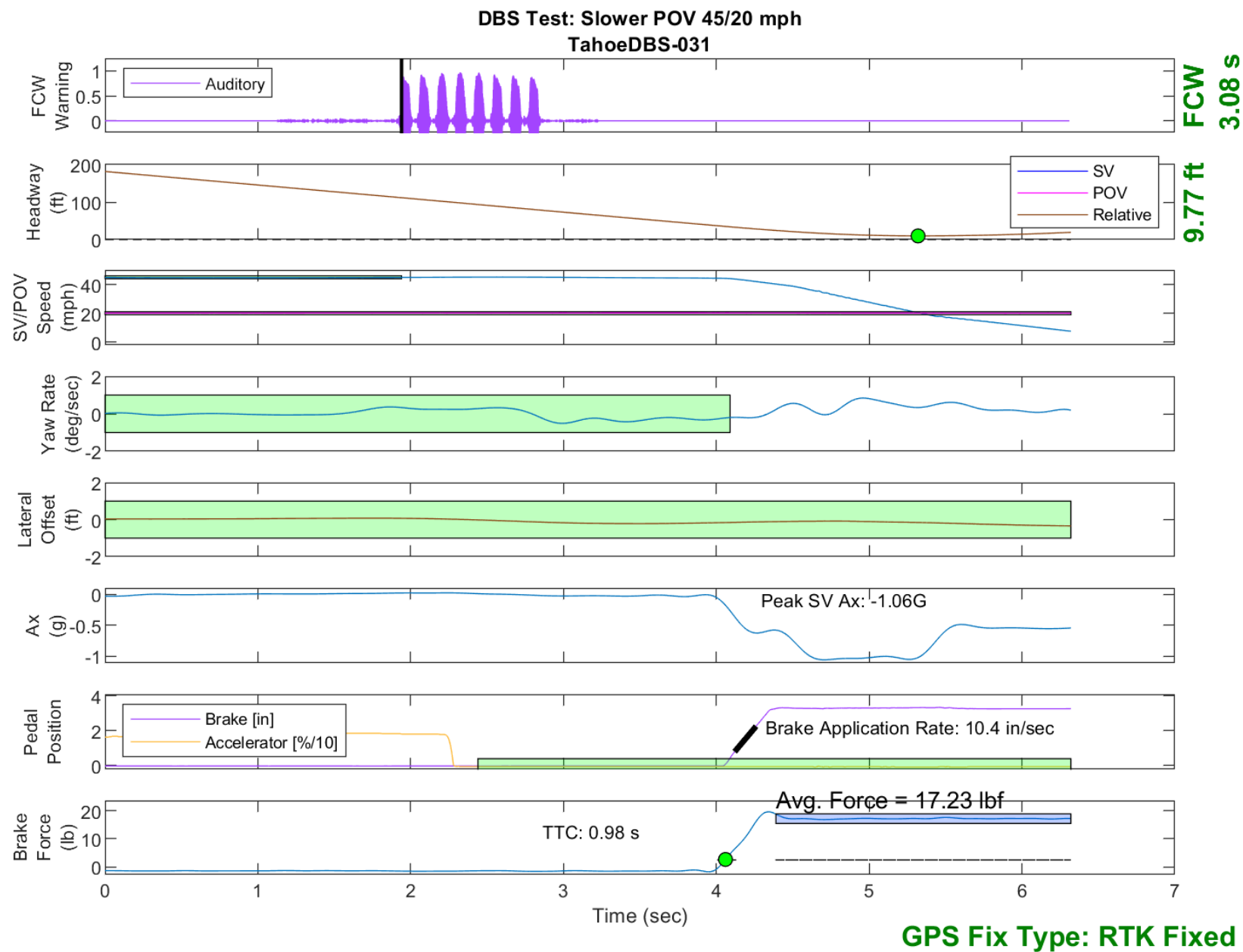


Figure E31. Time History for DBS Run 31, SV Encounters Slower POV, SV 45 mph, POV 20 mph

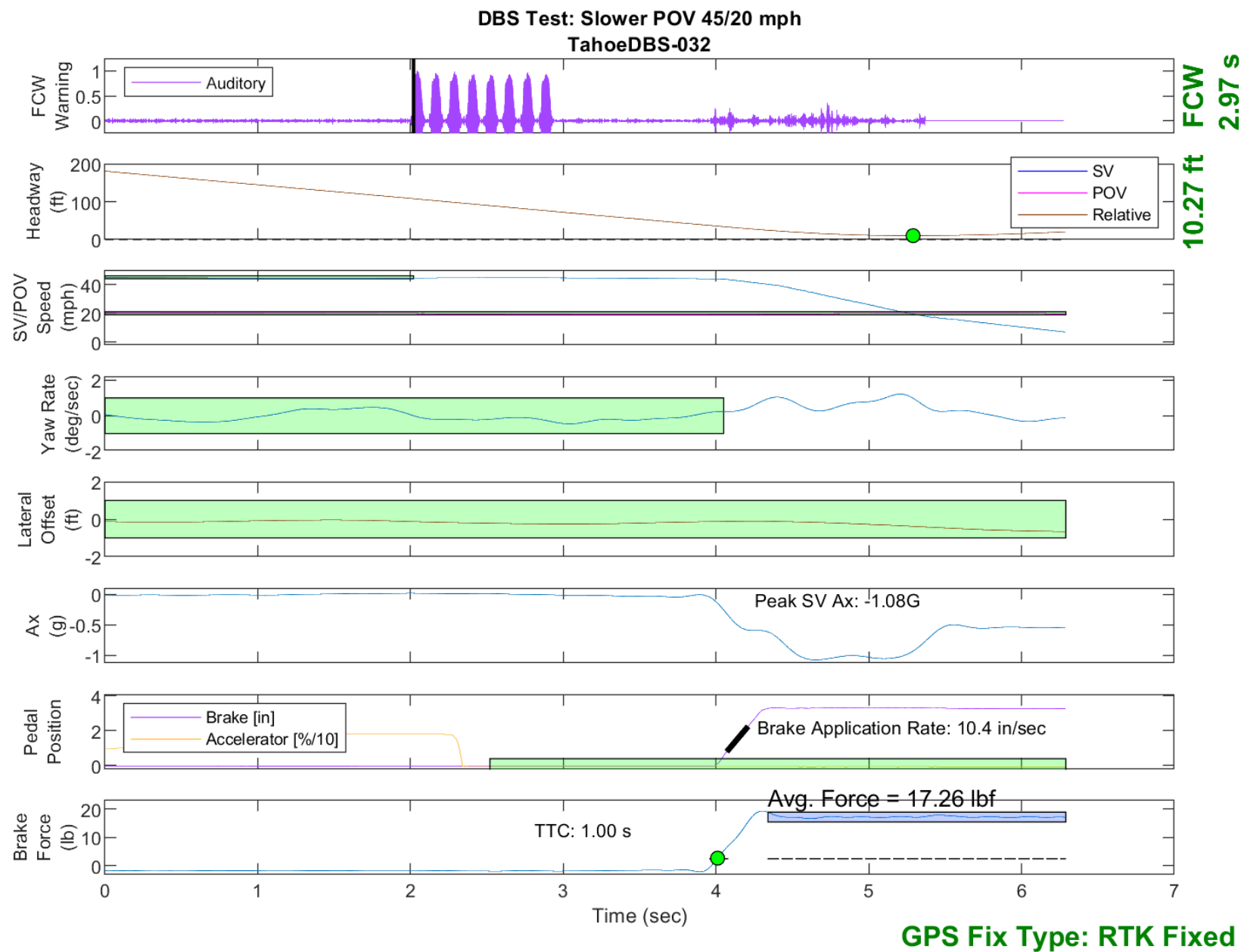


Figure E32. Time History for DBS Run 32, SV Encounters Slower POV, SV 45 mph, POV 20 mph

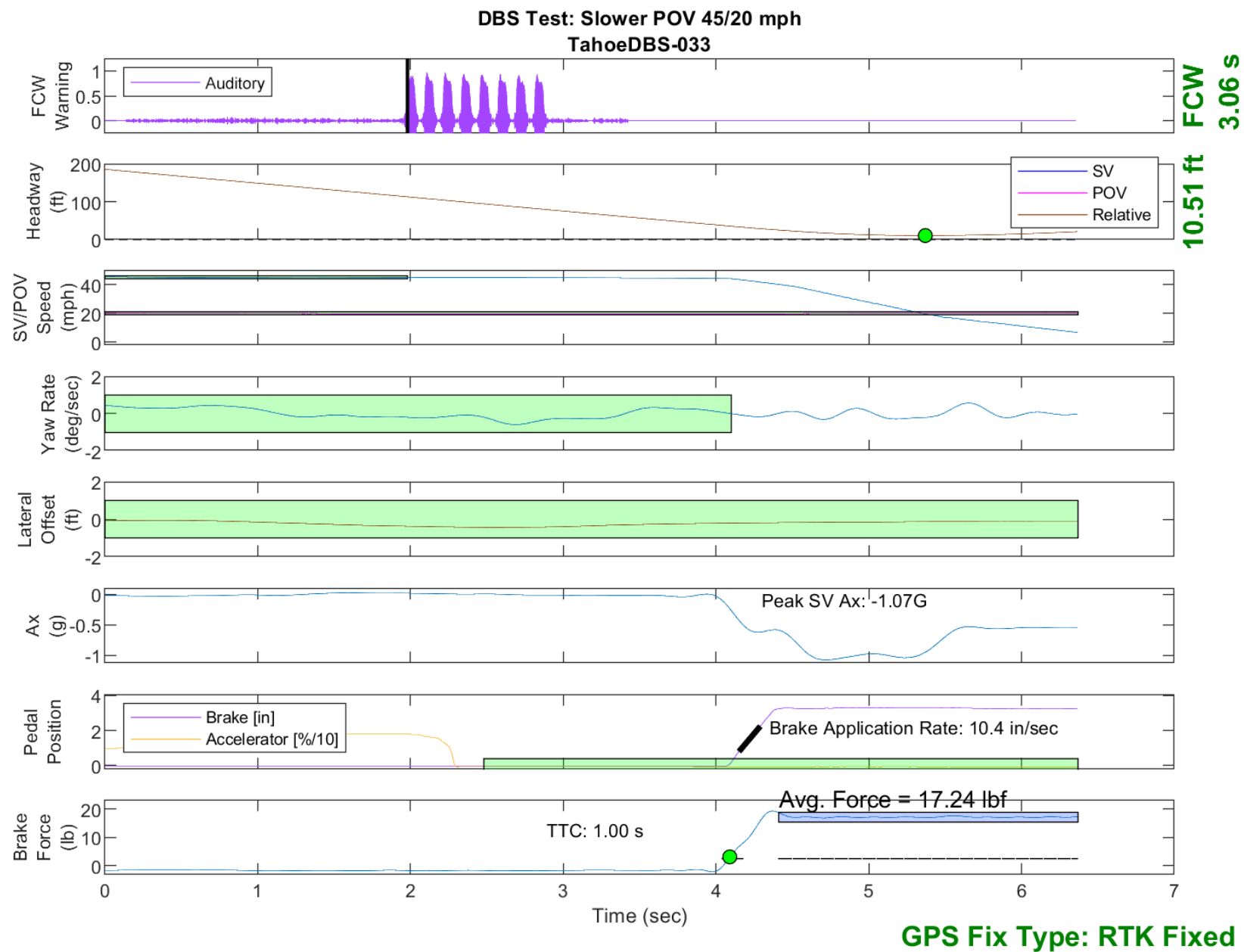


Figure E33. Time History for DBS Run 33, SV Encounters Slower POV, SV 45 mph, POV 20 mph

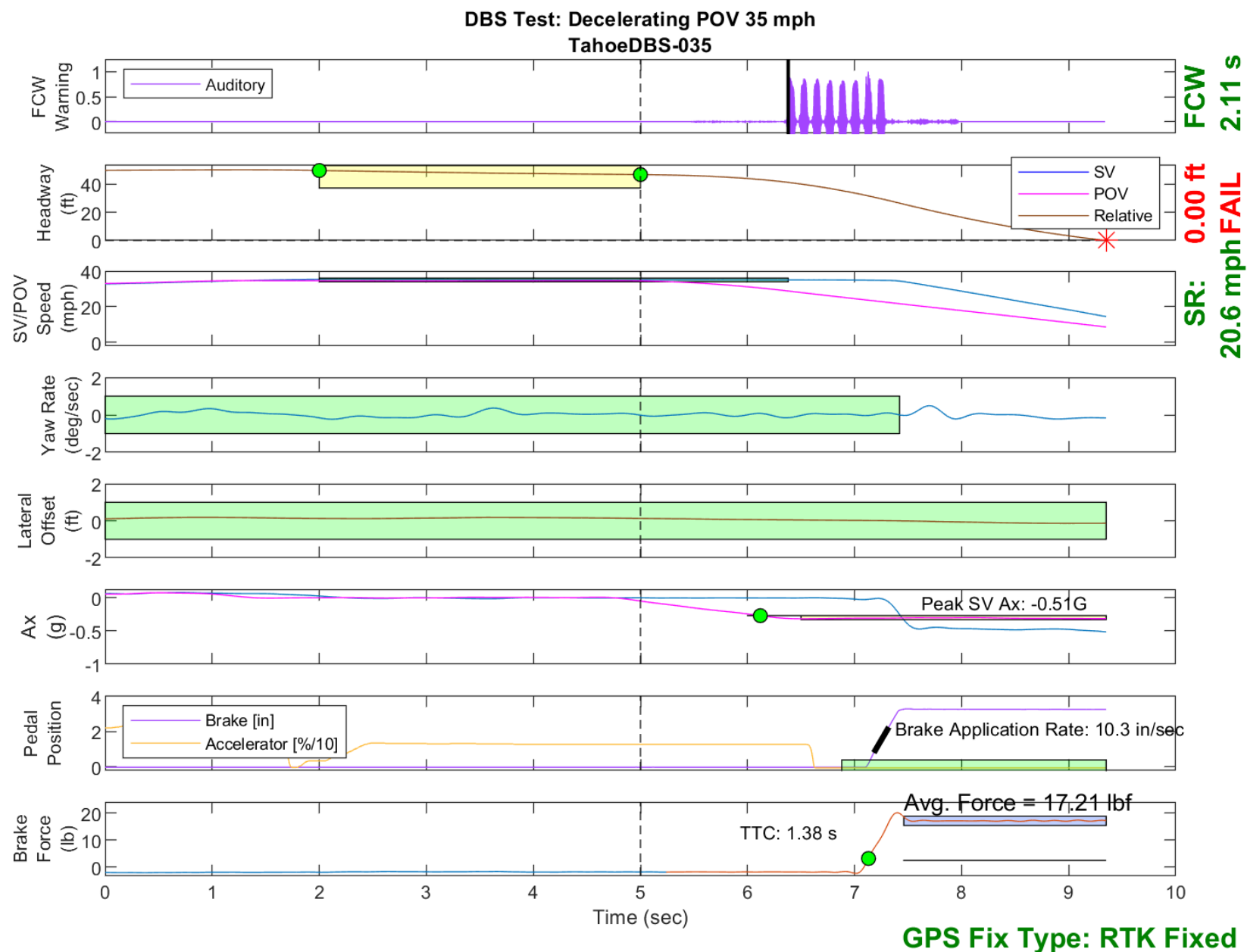


Figure E34. Time History for DBS Run 35, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

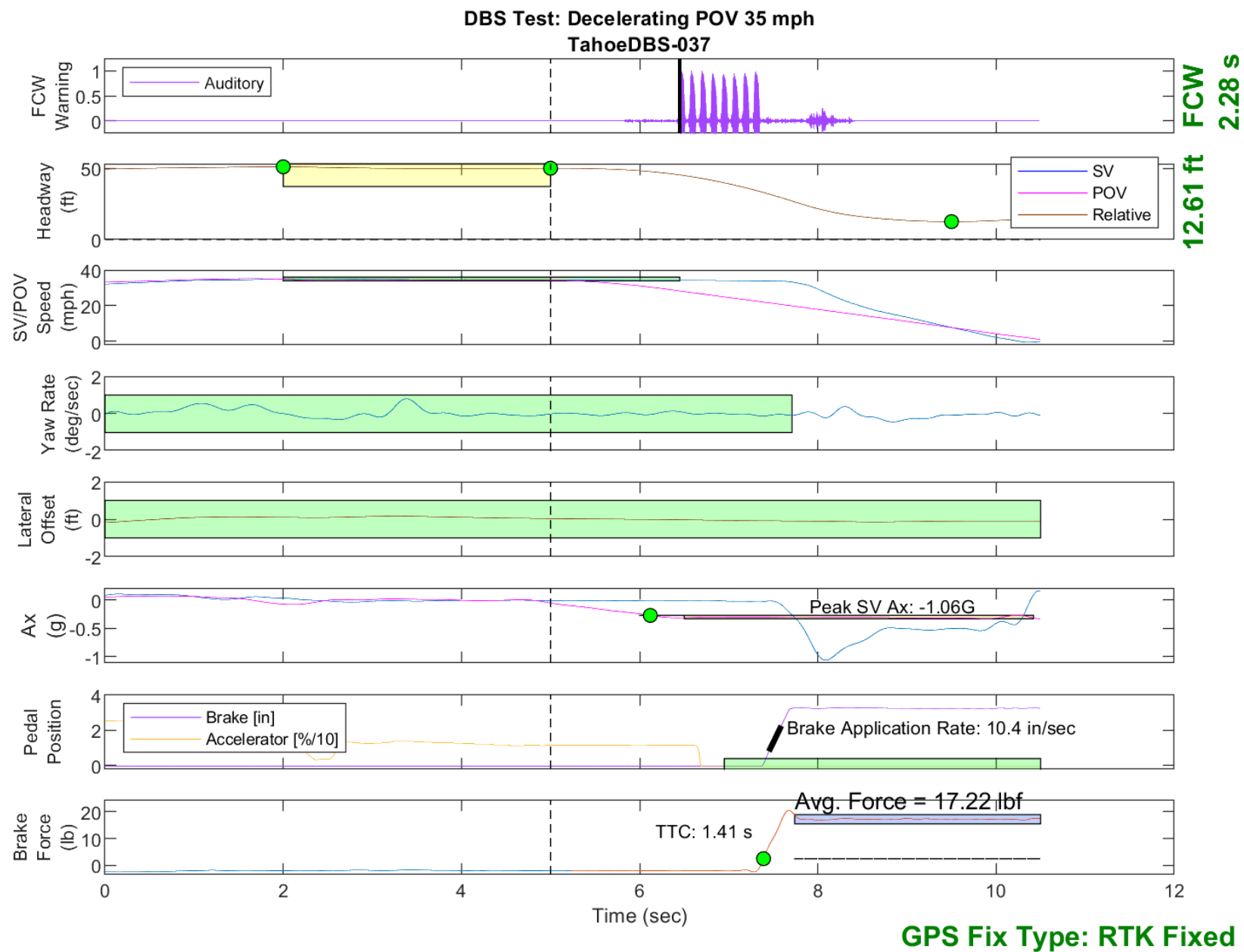


Figure E35. Time History for DBS Run 37, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

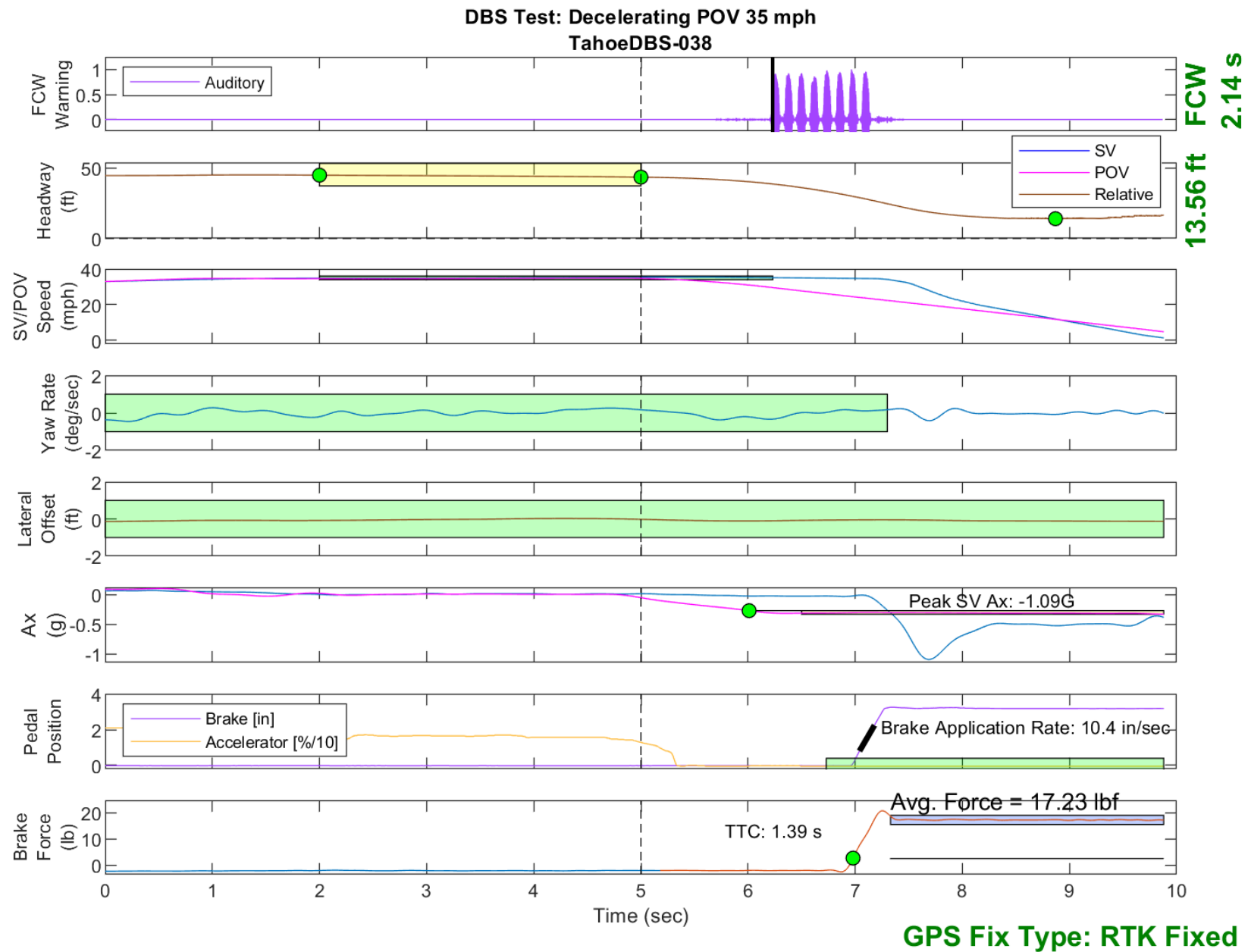


Figure E36. Time History for DBS Run 38, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

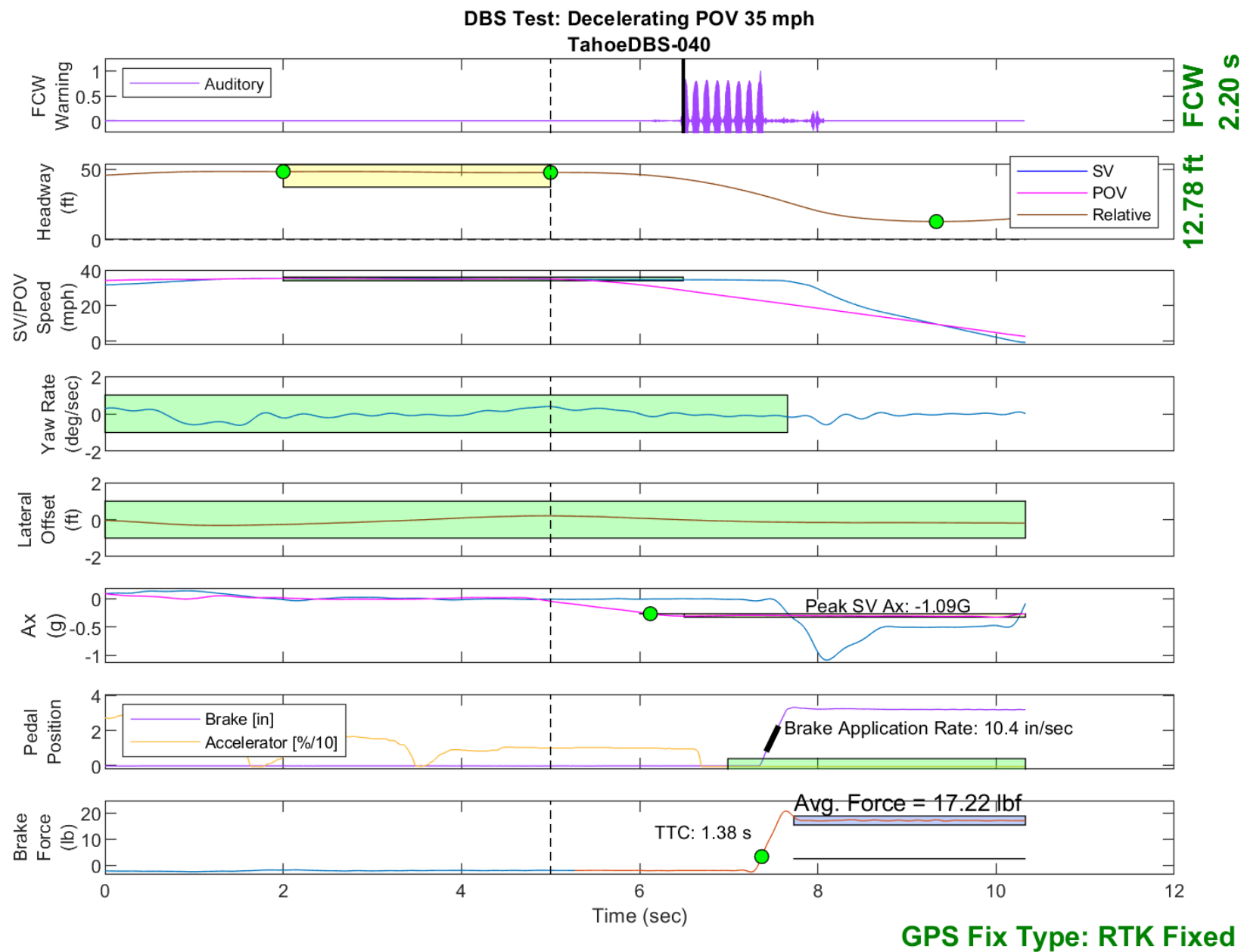


Figure E37. Time History for DBS Run 40, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

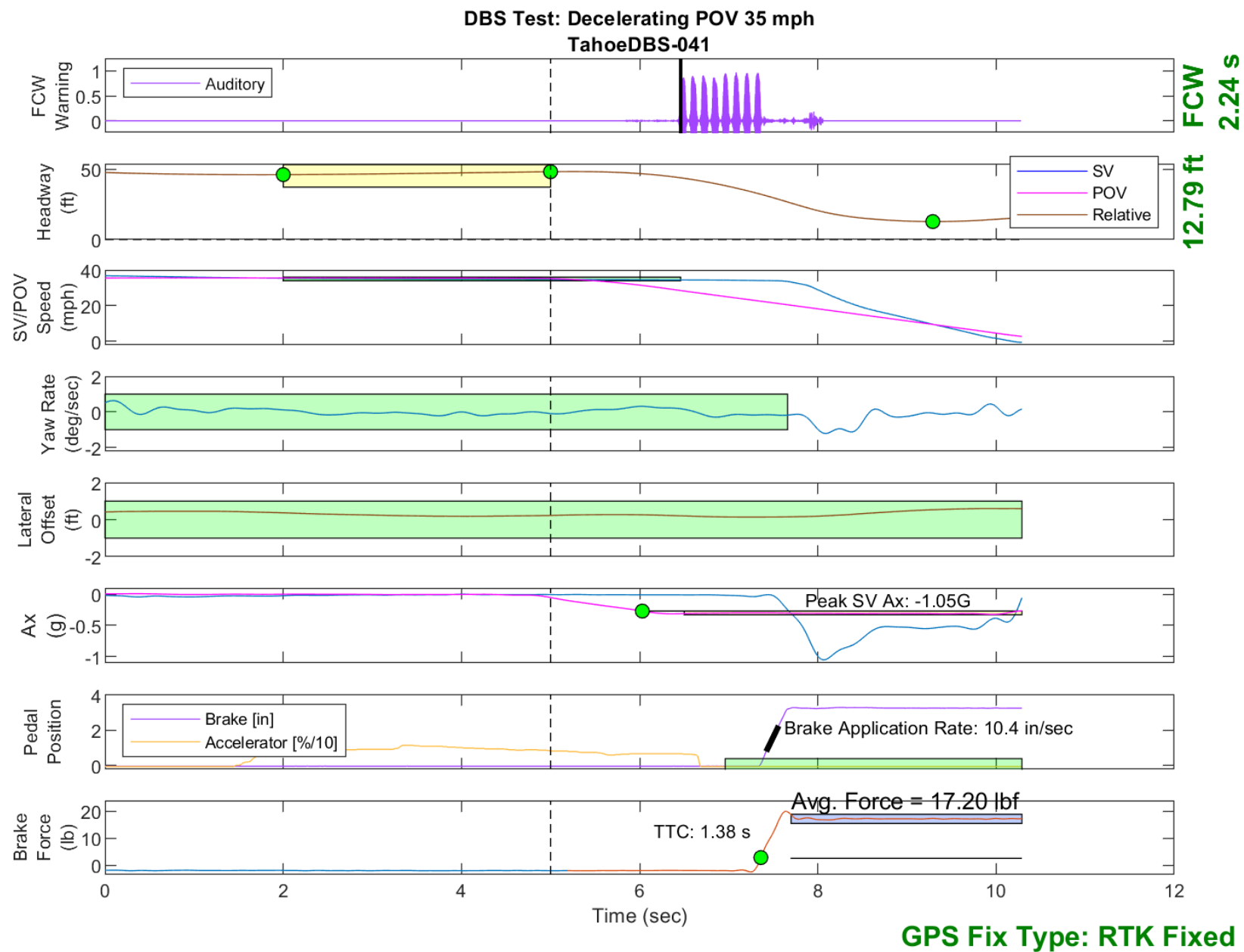


Figure E38. Time History for DBS Run 41, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

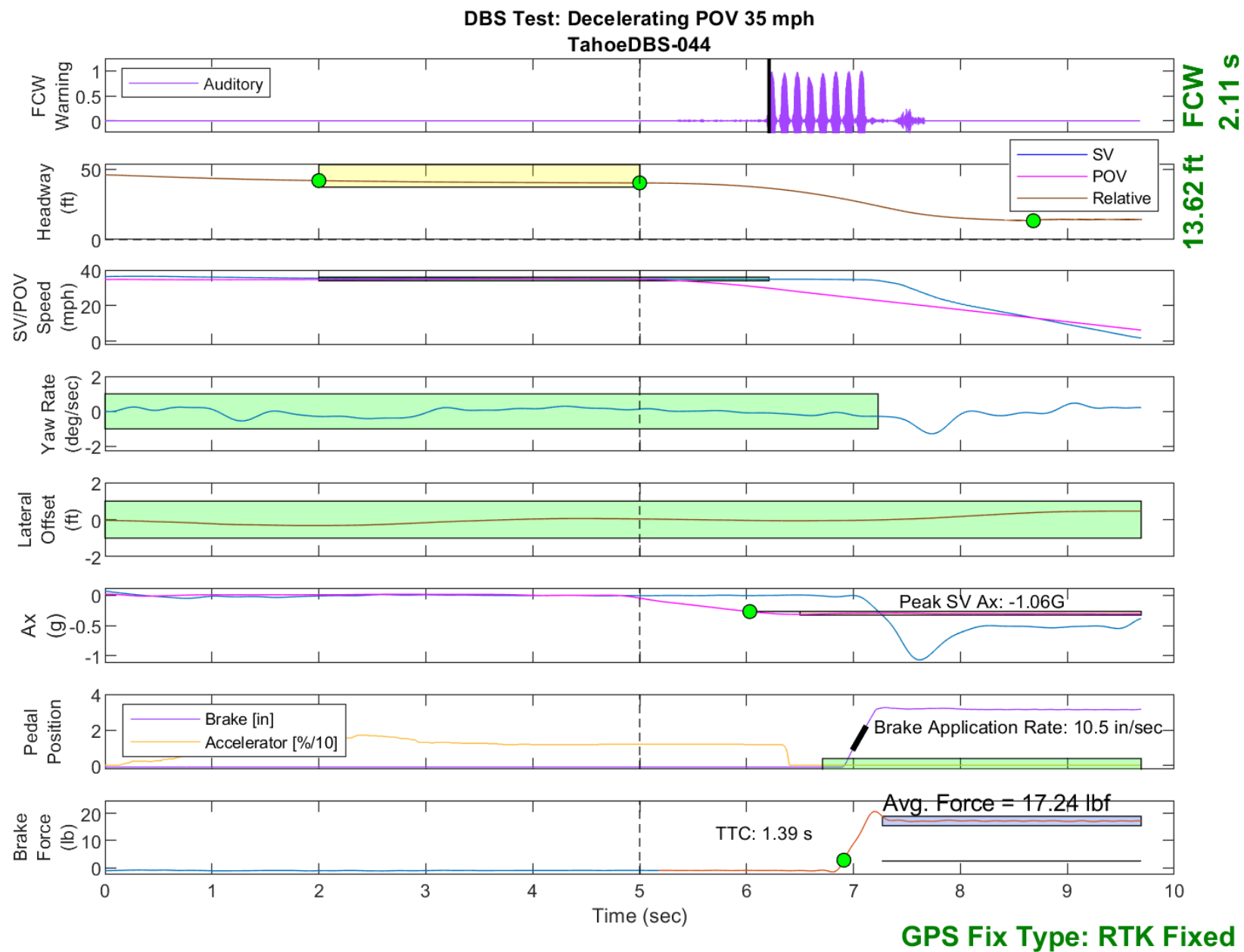


Figure E39. Time History for DBS Run 44, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

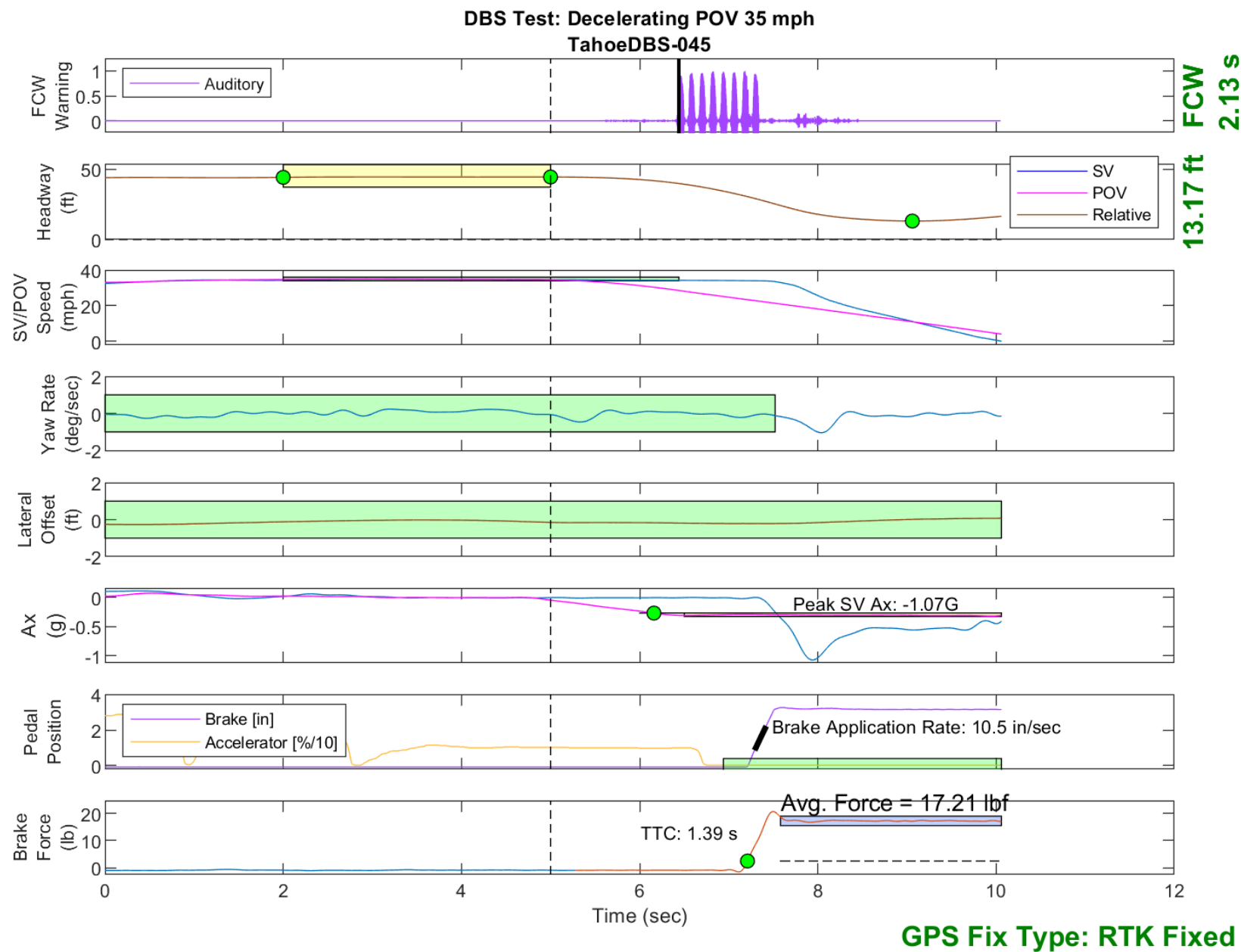


Figure E40. Time History for DBS Run 45, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

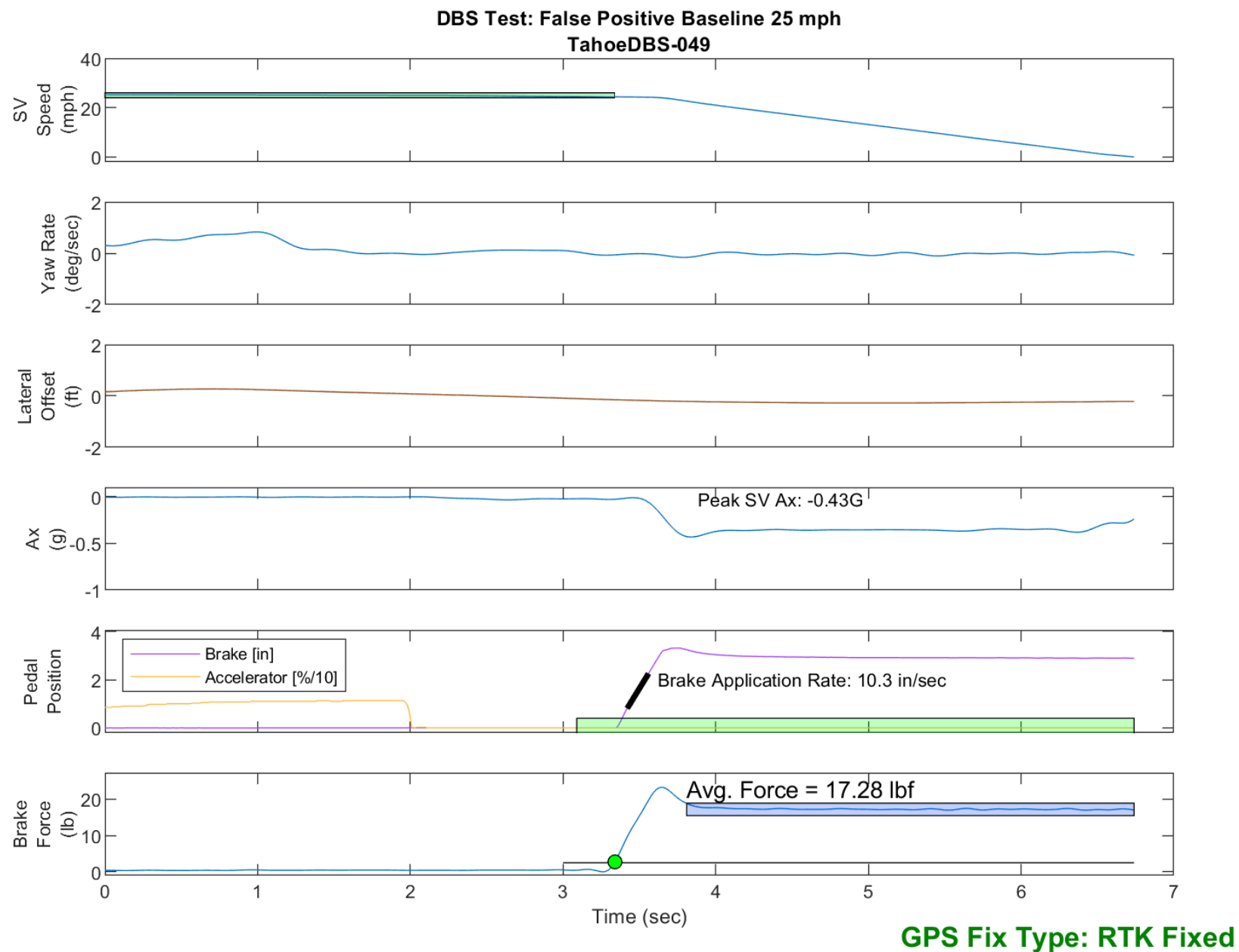


Figure E41. Time History for DBS Run 49, False Positive Baseline, SV 25 mph

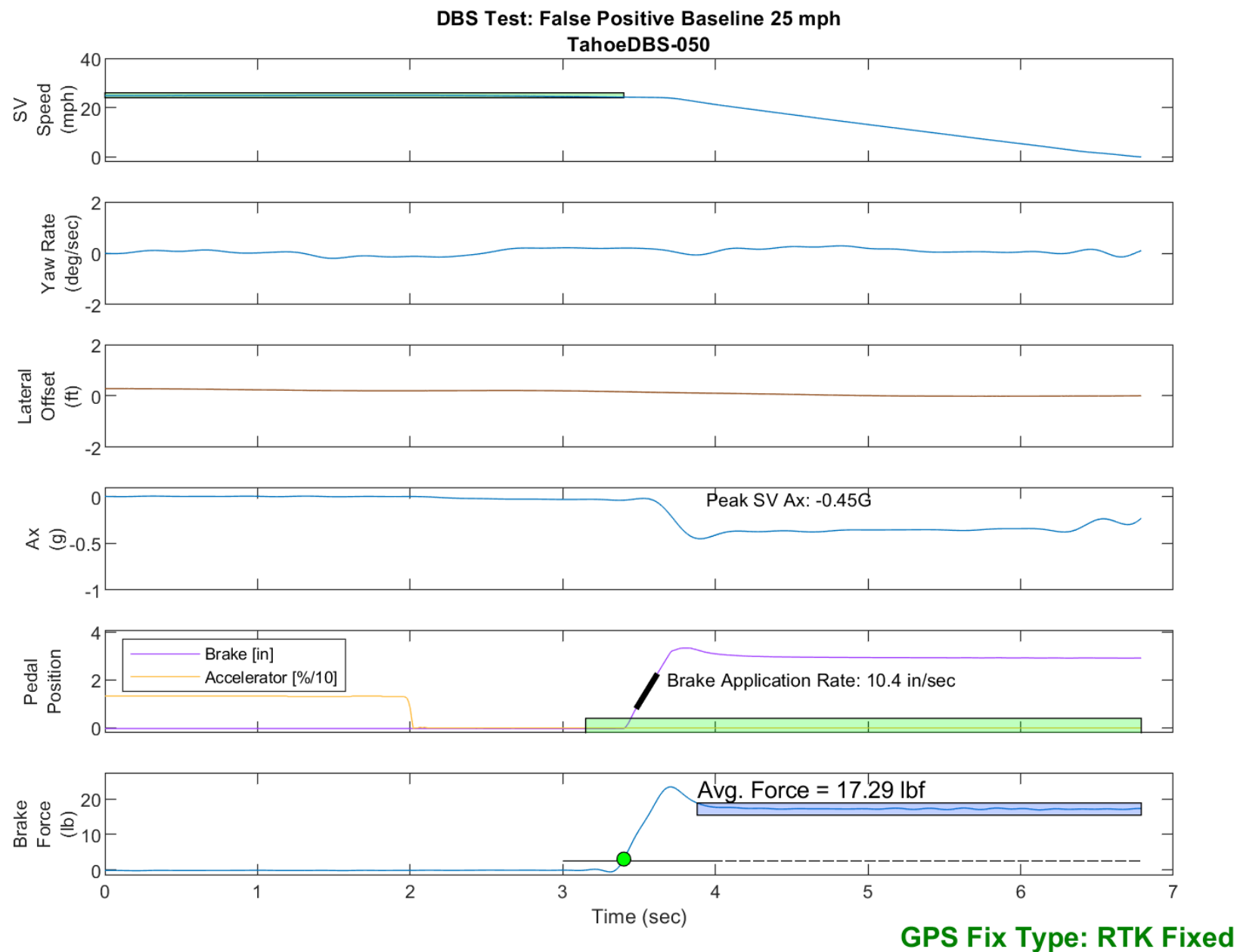


Figure E42. Time History for DBS Run 50, False Positive Baseline, SV 25 mph

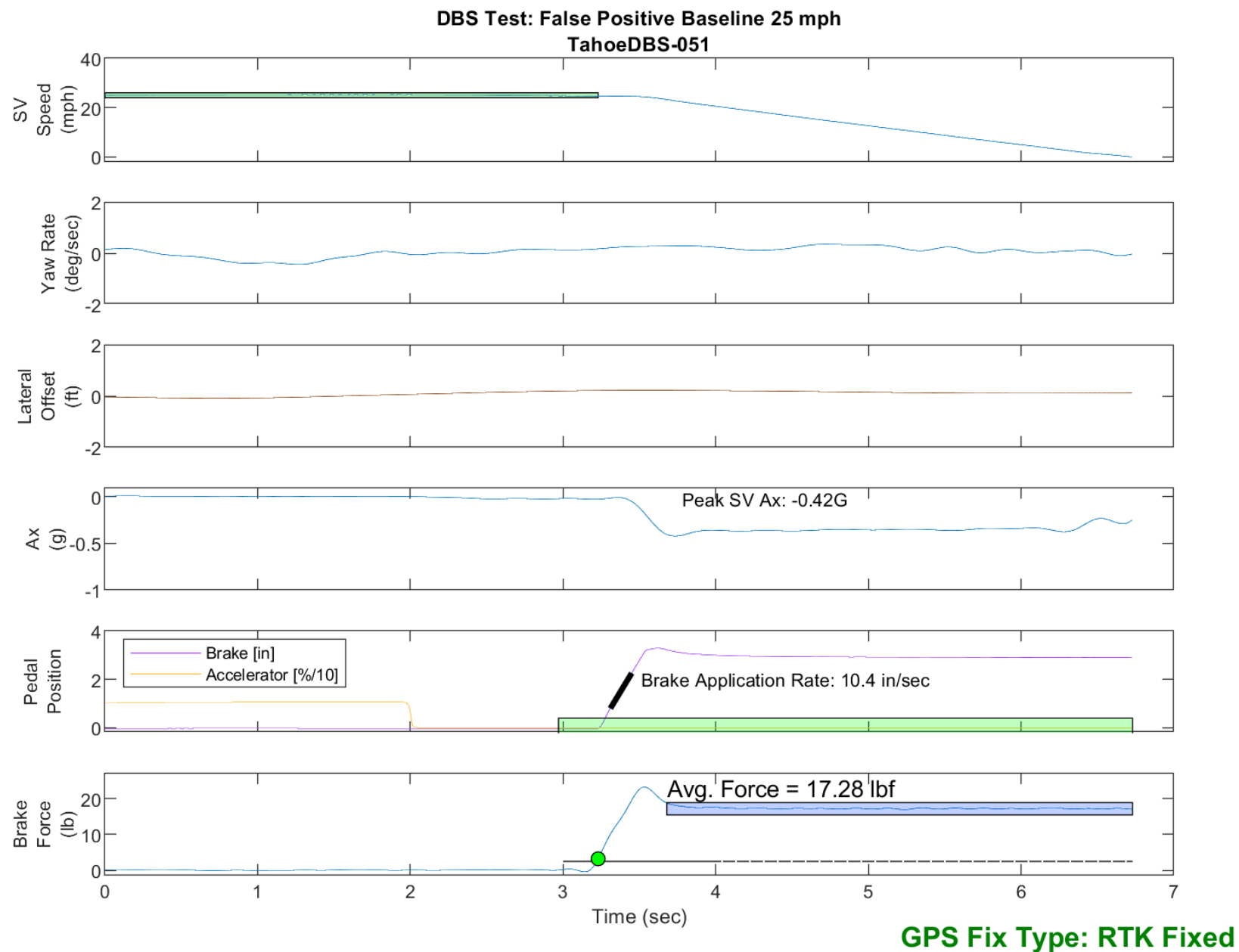


Figure E43. Time History for DBS Run 51, False Positive Baseline, SV 25 mph

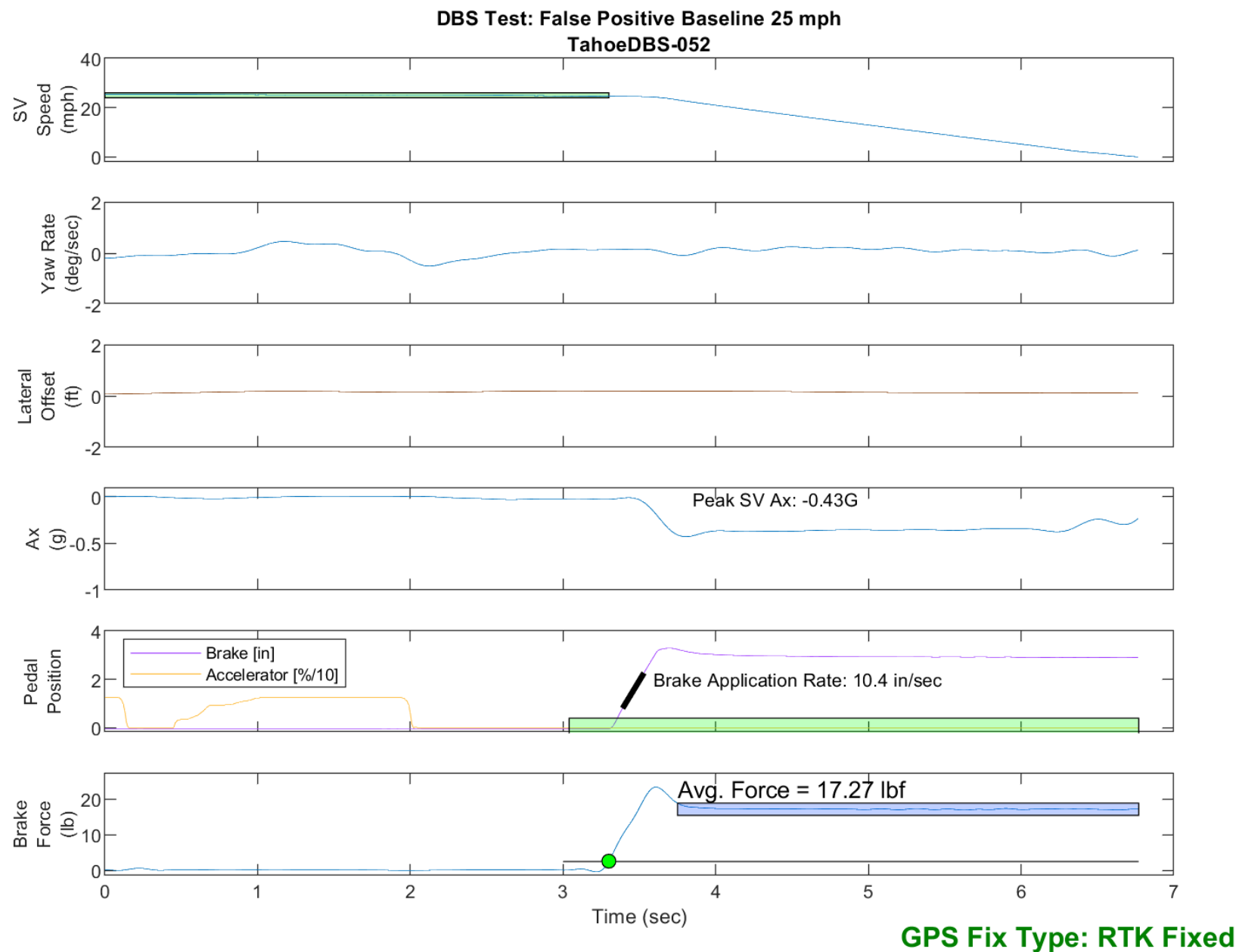


Figure E44. Time History for DBS Run 52, False Positive Baseline, SV 25 mph

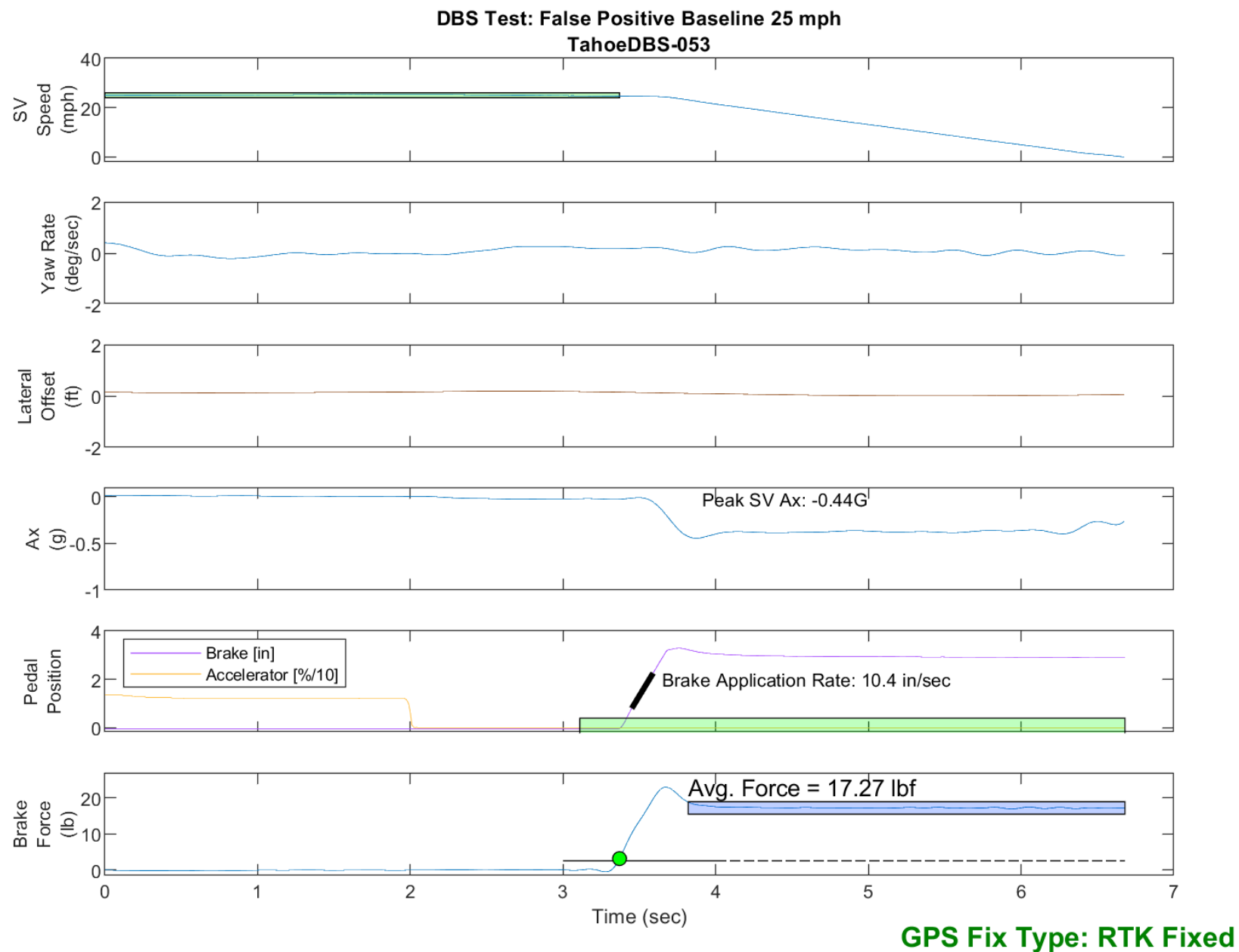


Figure E45. Time History for DBS Run 53, False Positive Baseline, SV 25 mph

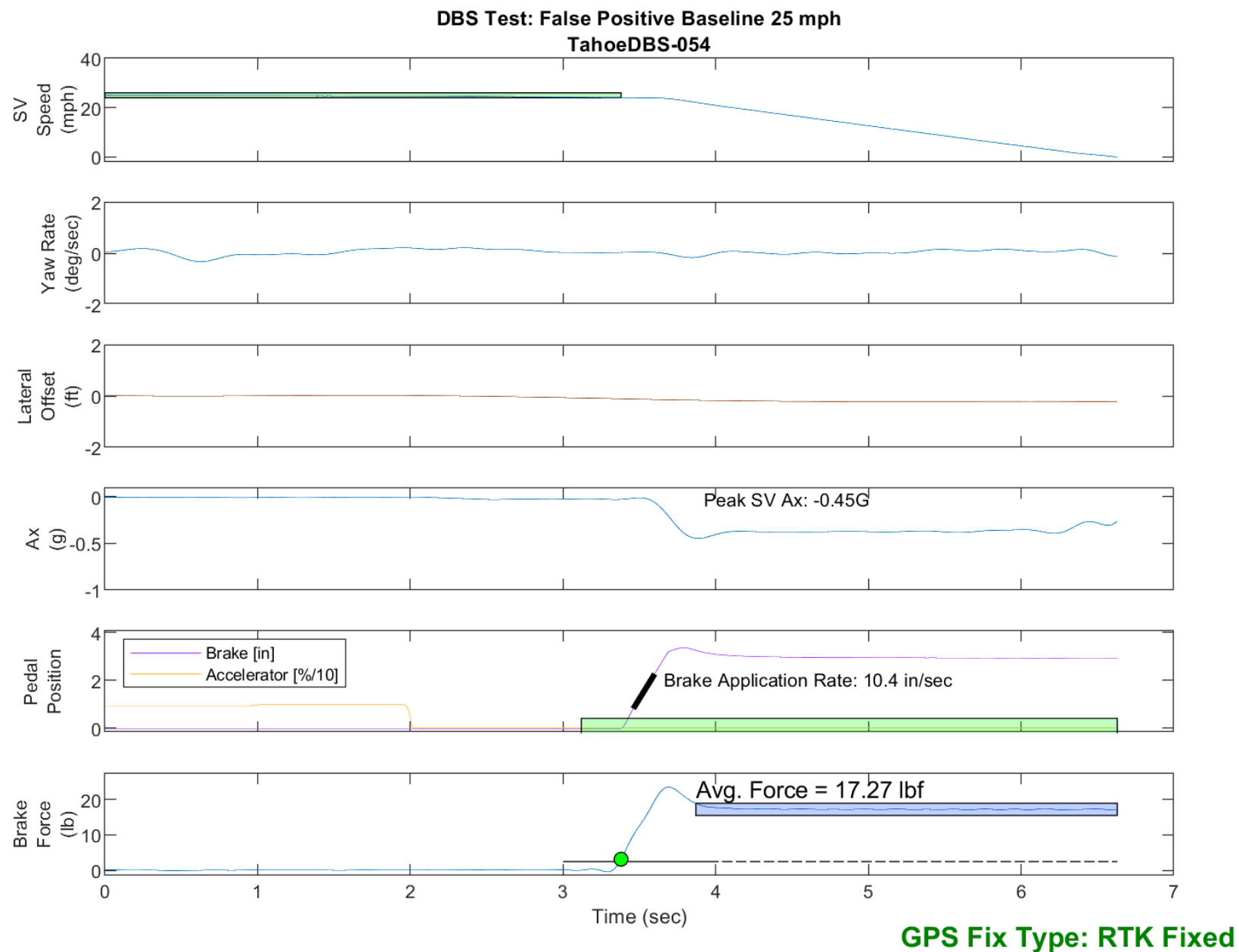


Figure E46. Time History for DBS Run 54, False Positive Baseline, SV 25 mph

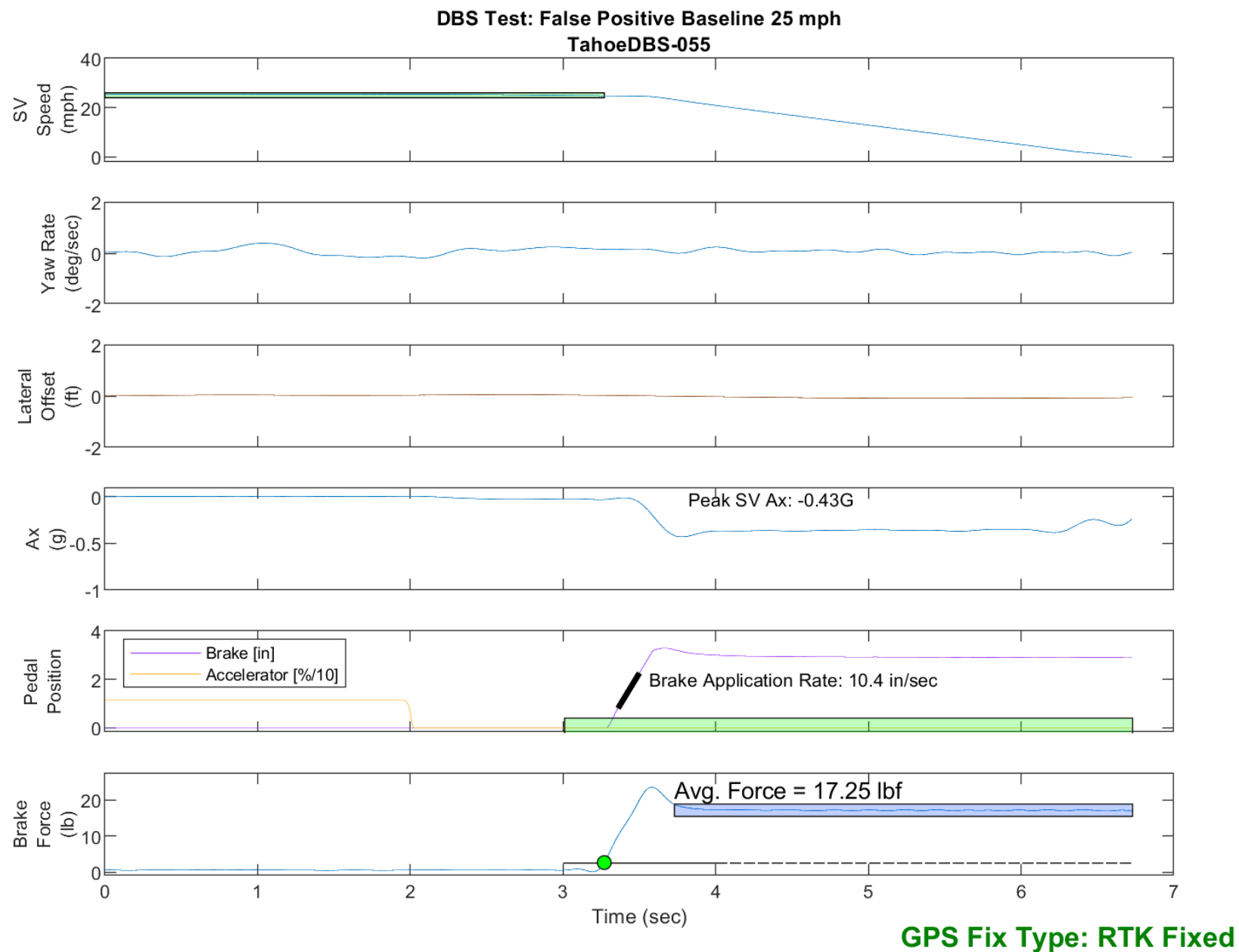


Figure E47. Time History for DBS Run 55, False Positive Baseline, SV 25 mph

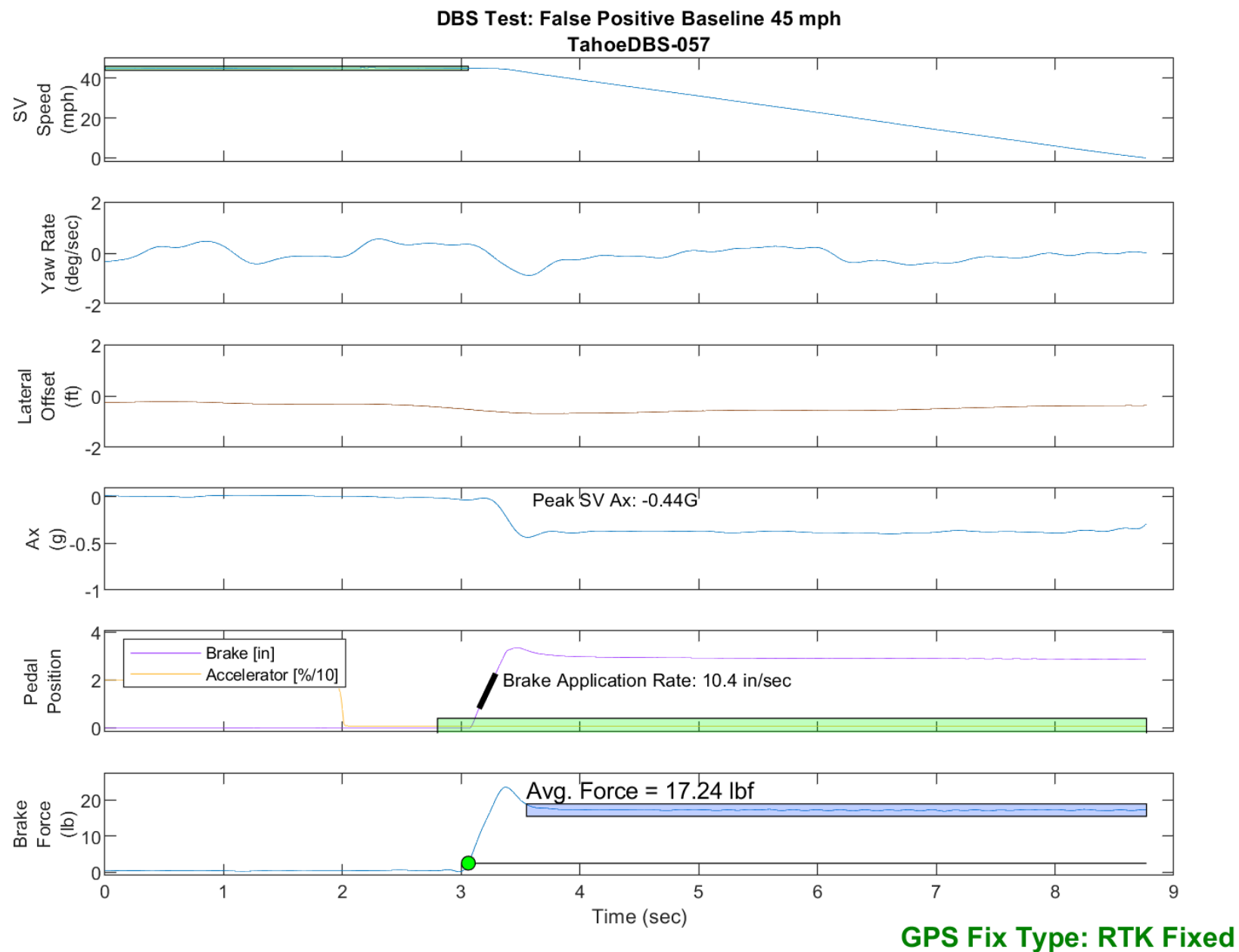


Figure E48. Time History for DBS Run 57, False Positive Baseline, SV 45 mph

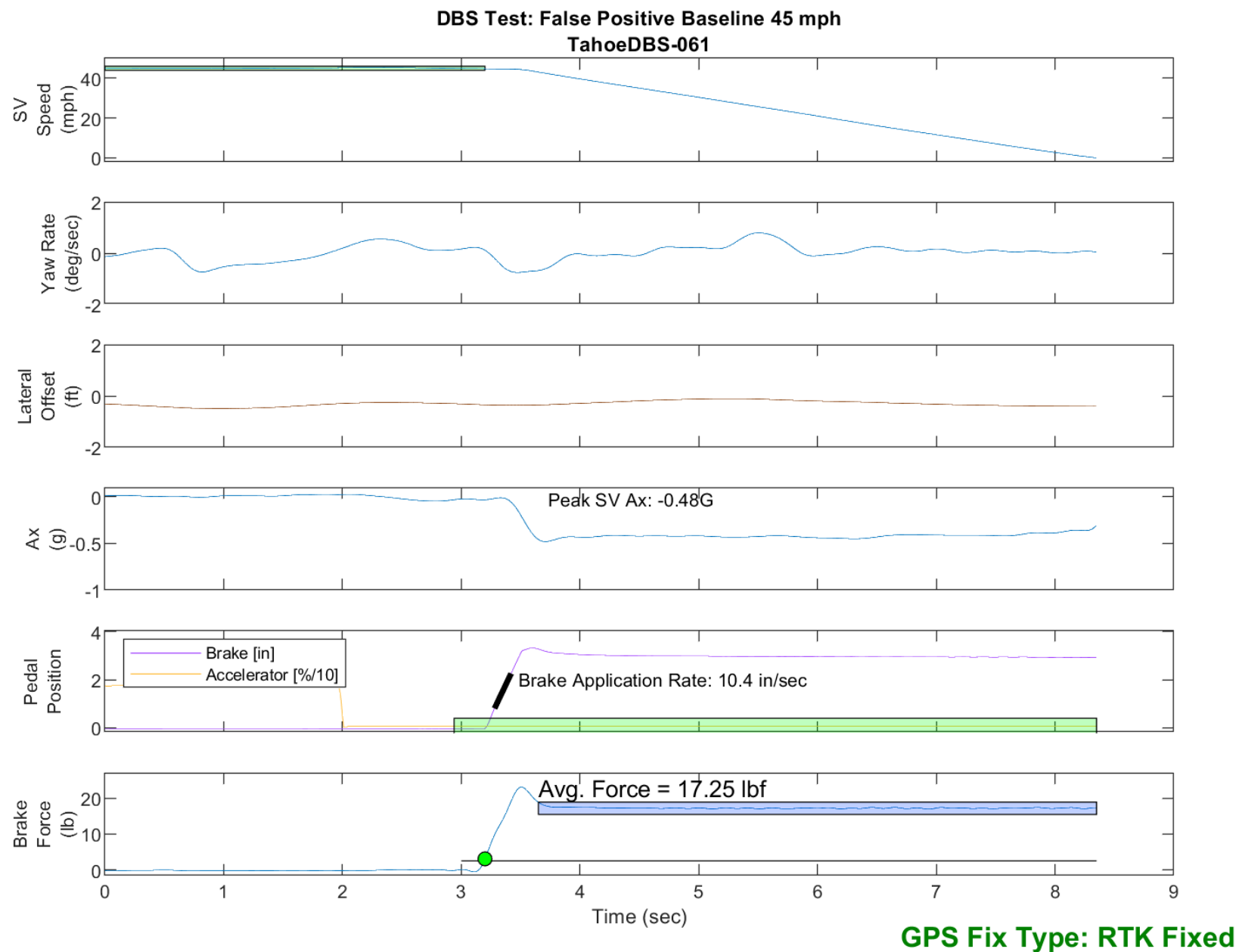


Figure E49. Time History for DBS Run 61, False Positive Baseline, SV 45 mph

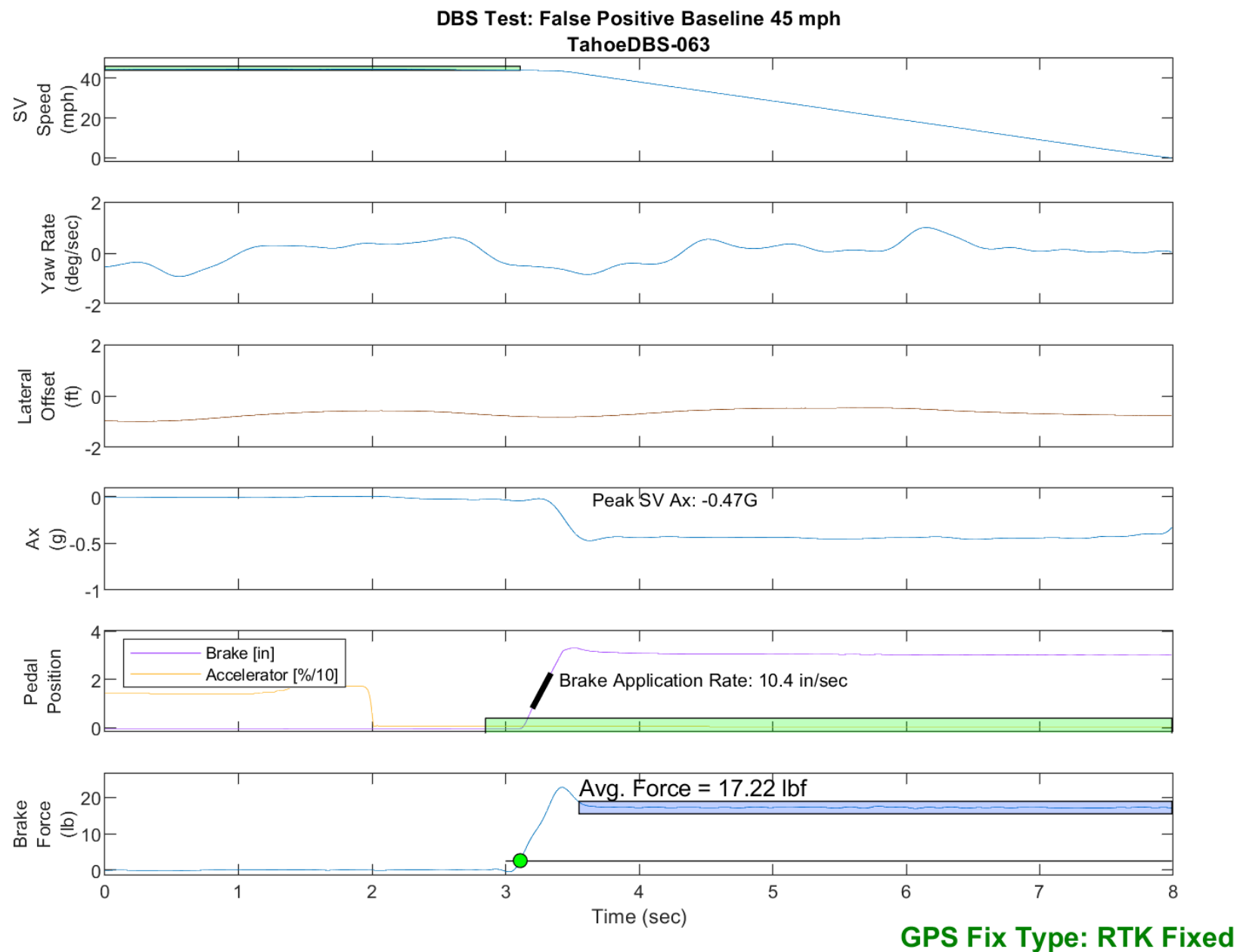


Figure E50. Time History for DBS Run 63, False Positive Baseline, SV 45 mph

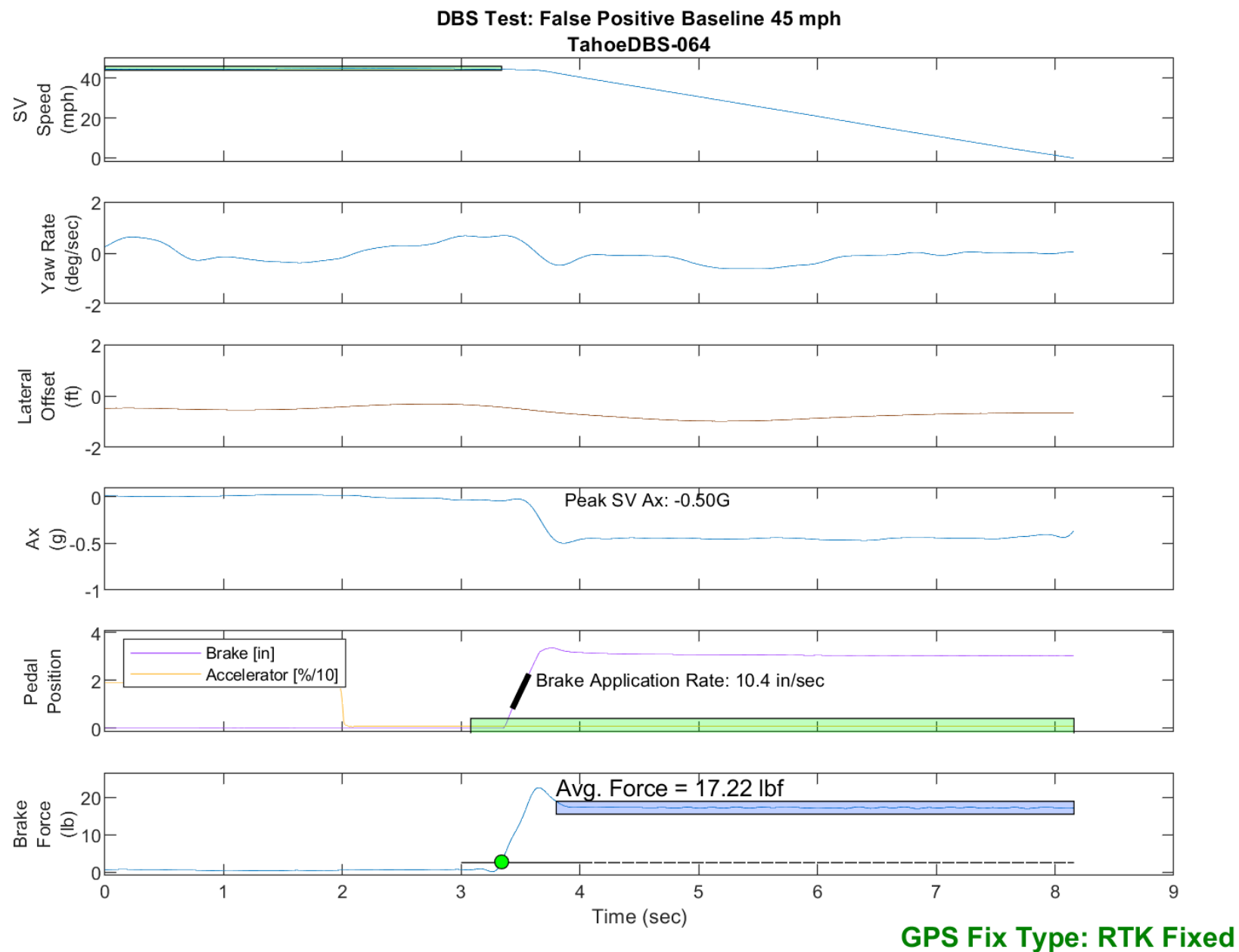


Figure E51. Time History for DBS Run 64, False Positive Baseline, SV 45 mph

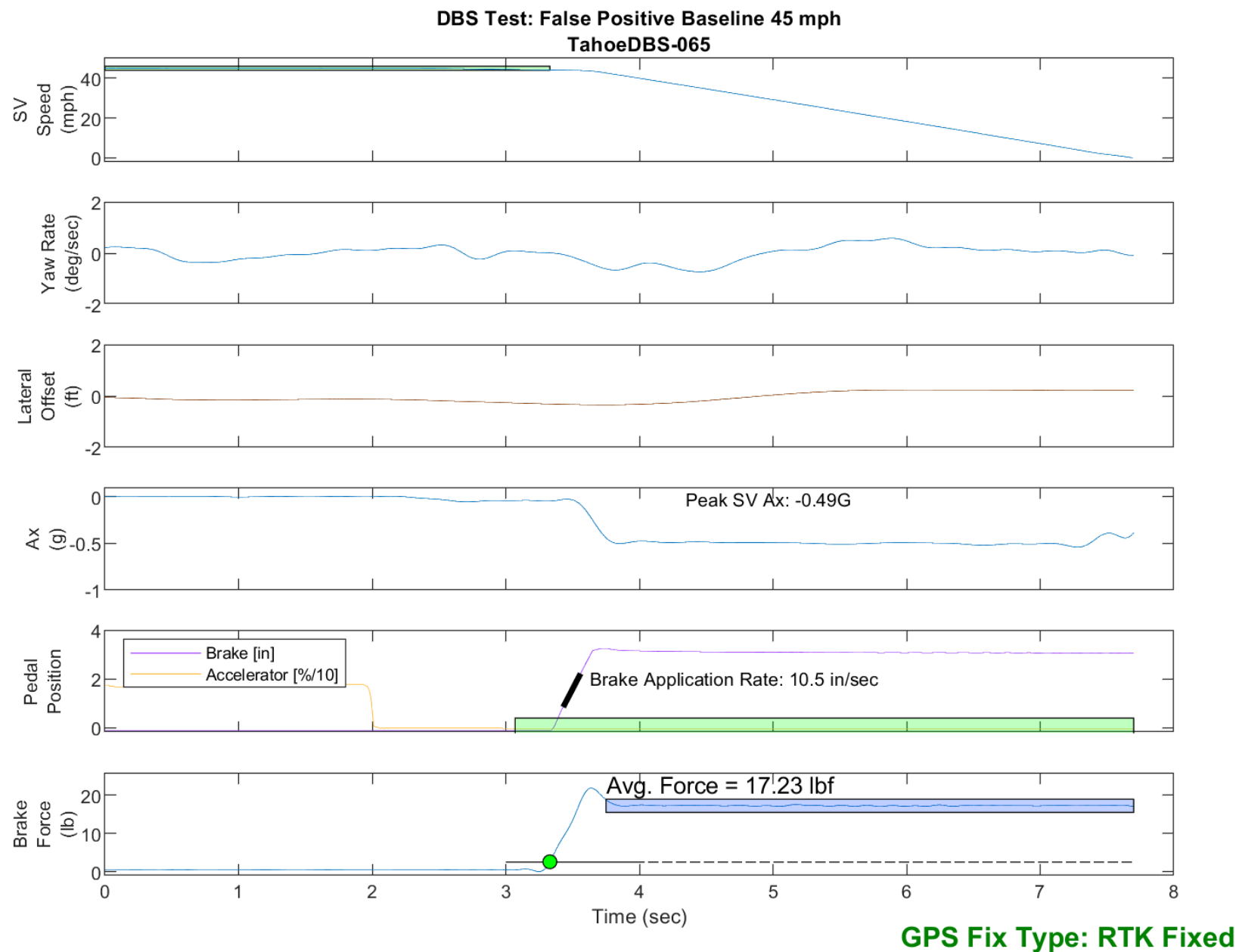


Figure E52. Time History for DBS Run 65, False Positive Baseline, SV 45 mph

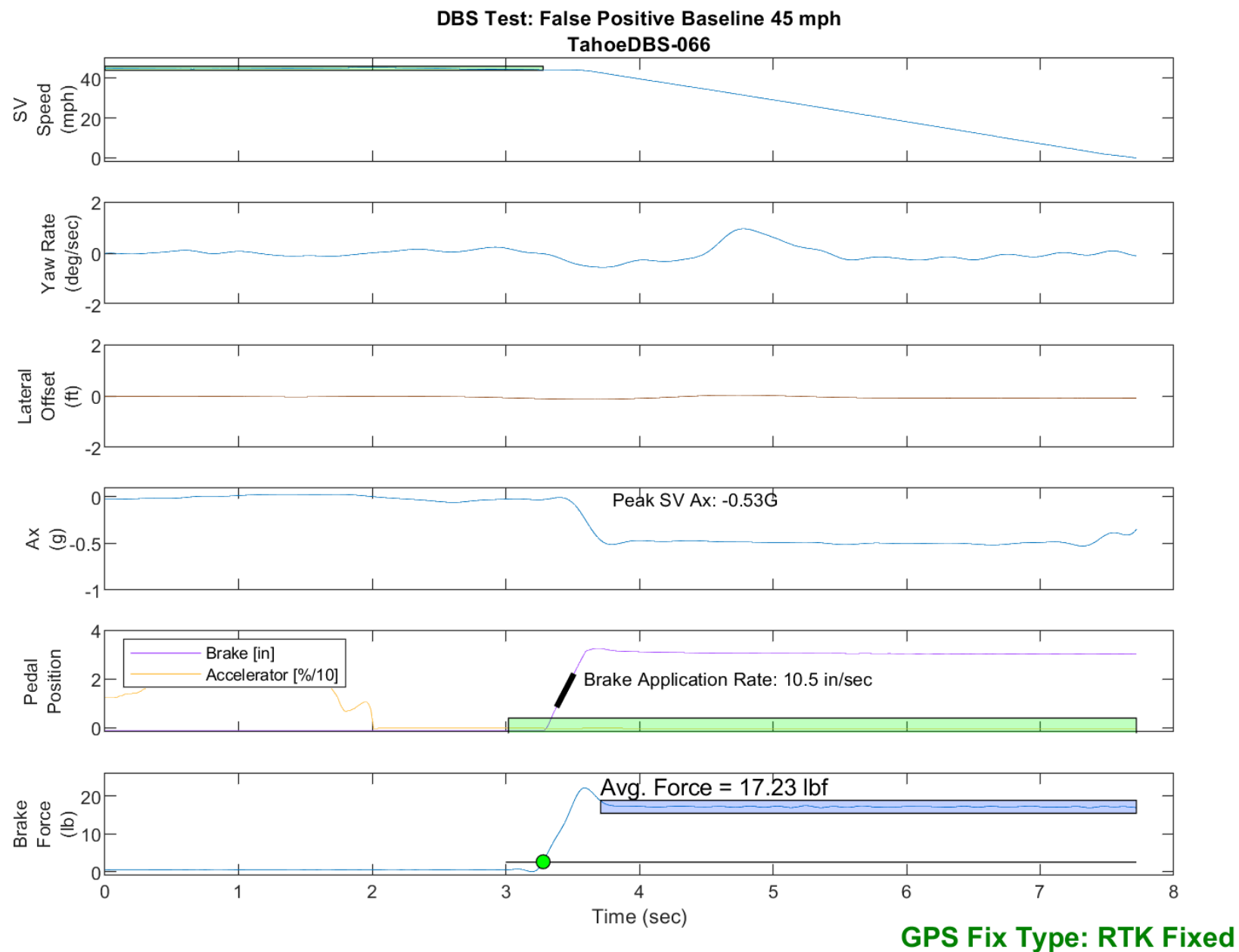


Figure E53. Time History for DBS Run 66, False Positive Baseline, SV 45 mph

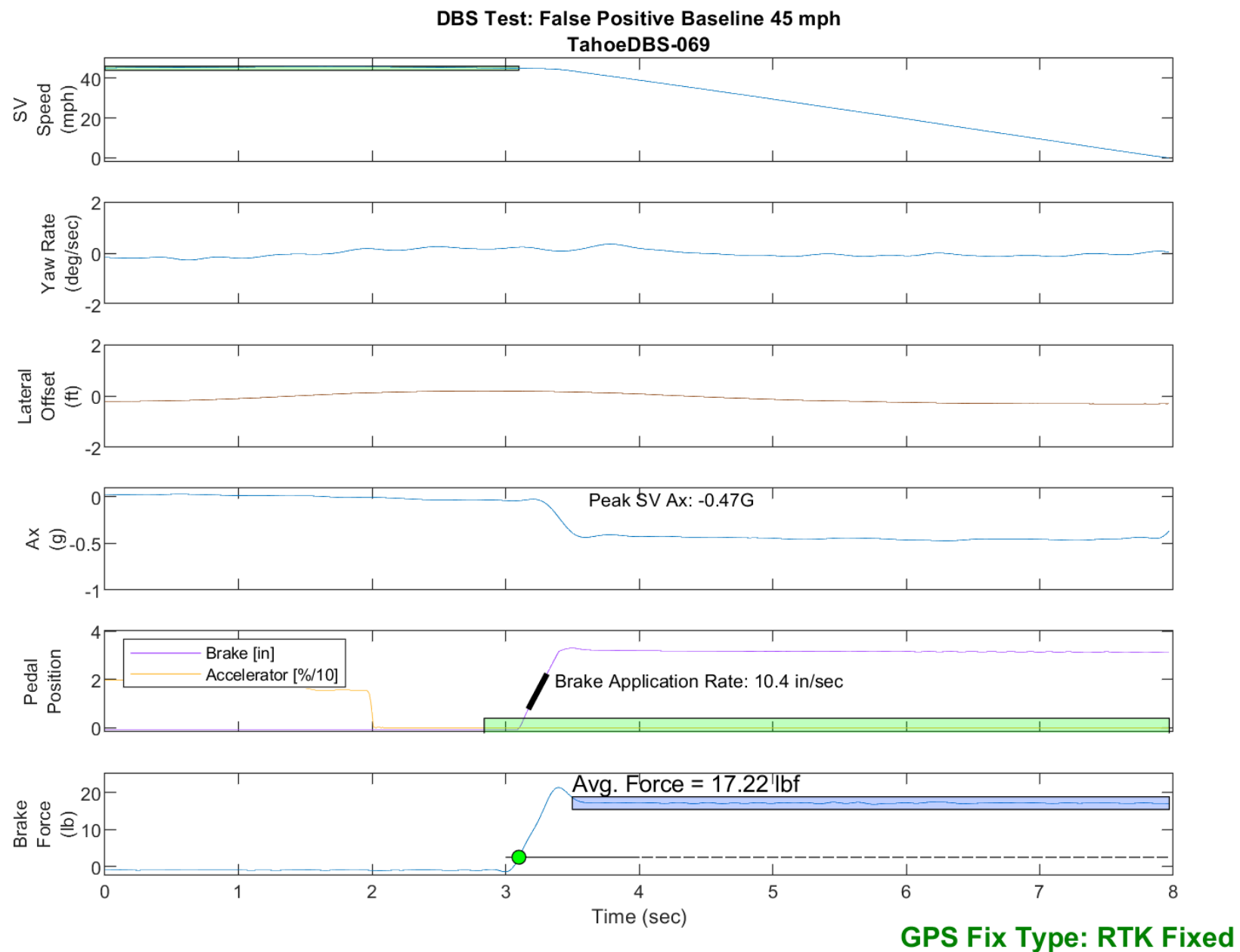


Figure E54. Time History for DBS Run 69, False Positive Baseline, SV 45 mph

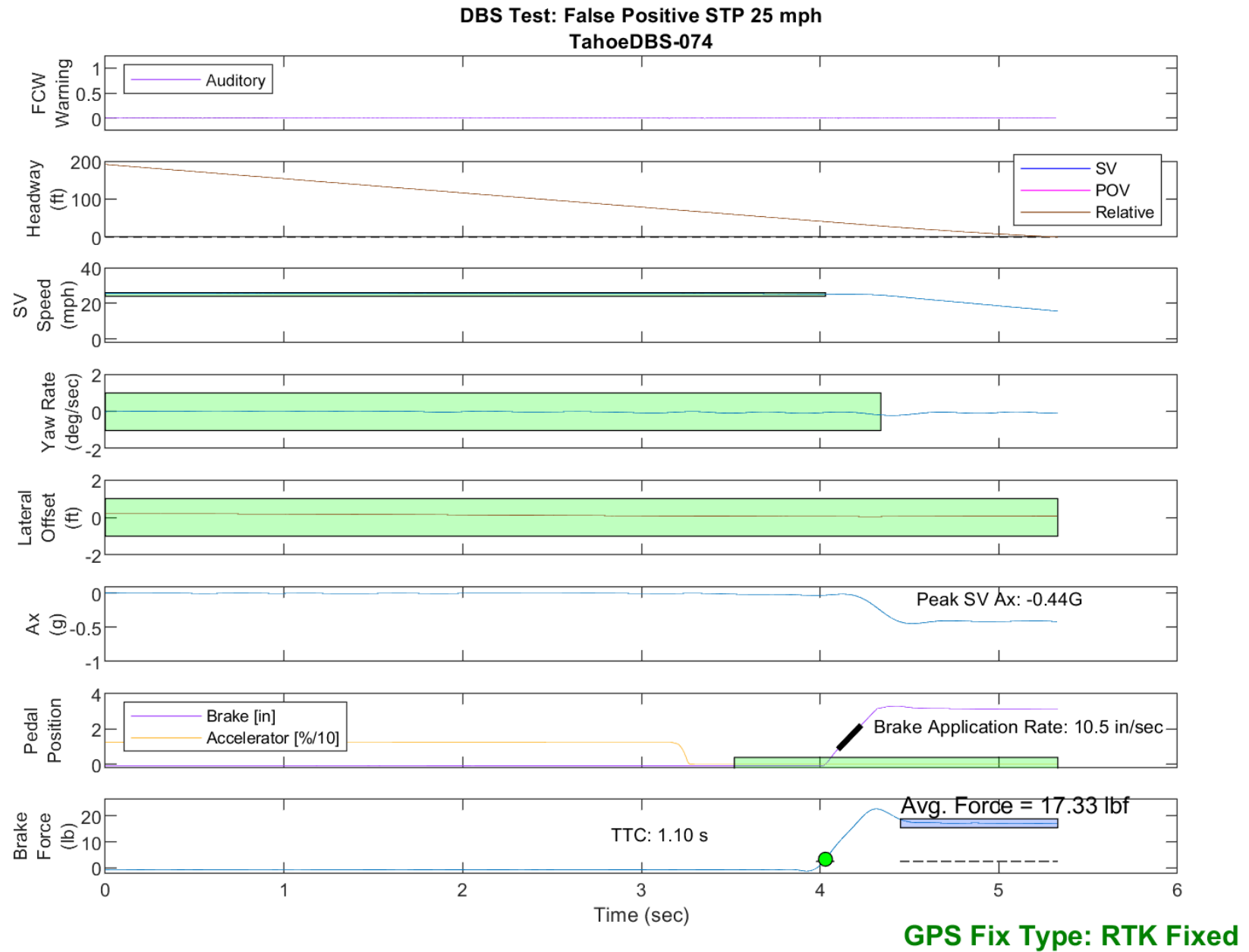


Figure E55. Time History for DBS Run 74, SV Encounters Steel Trench Plate, SV 25 mph

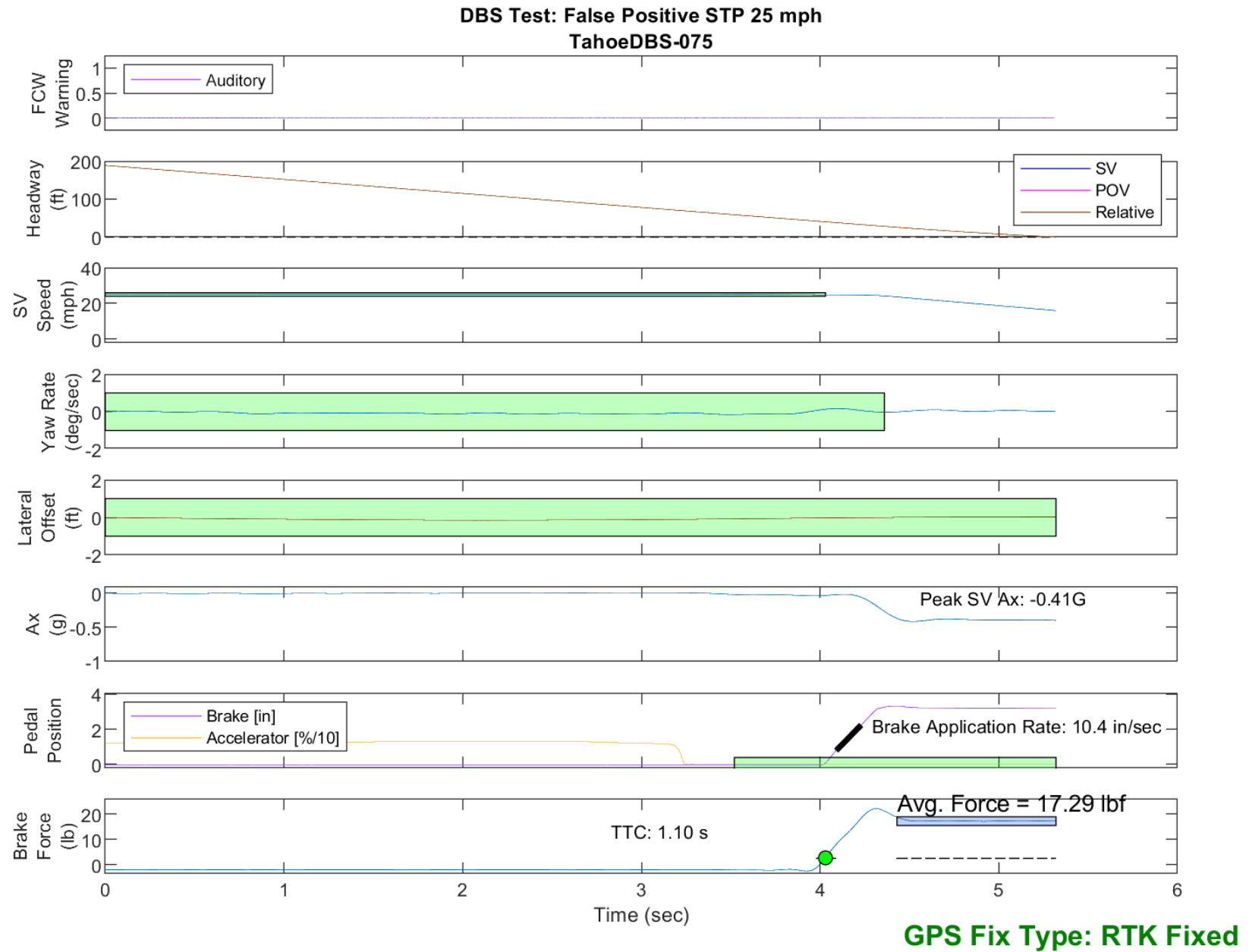


Figure E56. Time History for DBS Run 75, SV Encounters Steel Trench Plate, SV 25 mph

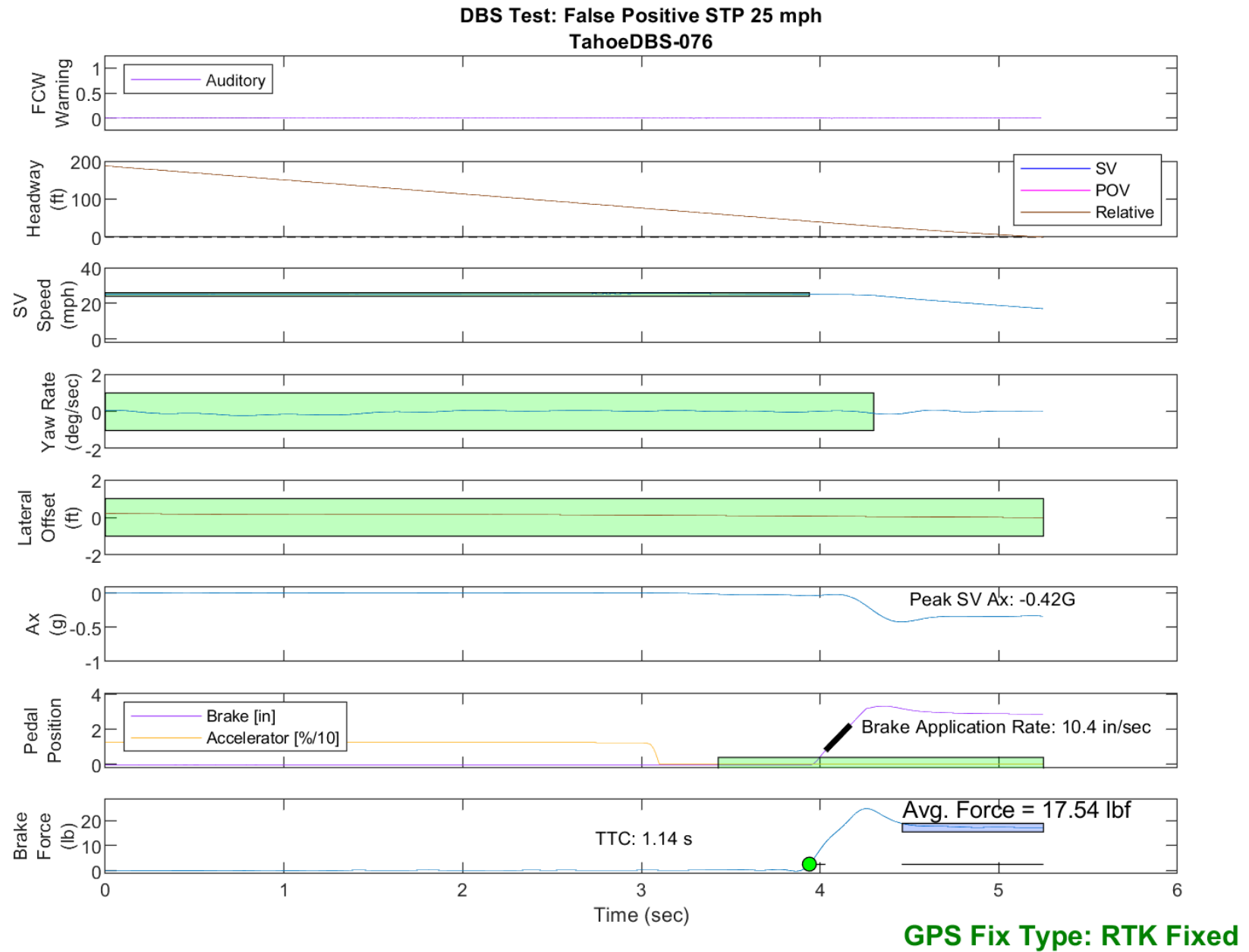


Figure E57. Time History for DBS Run 76, SV Encounters Steel Trench Plate, SV 25 mph

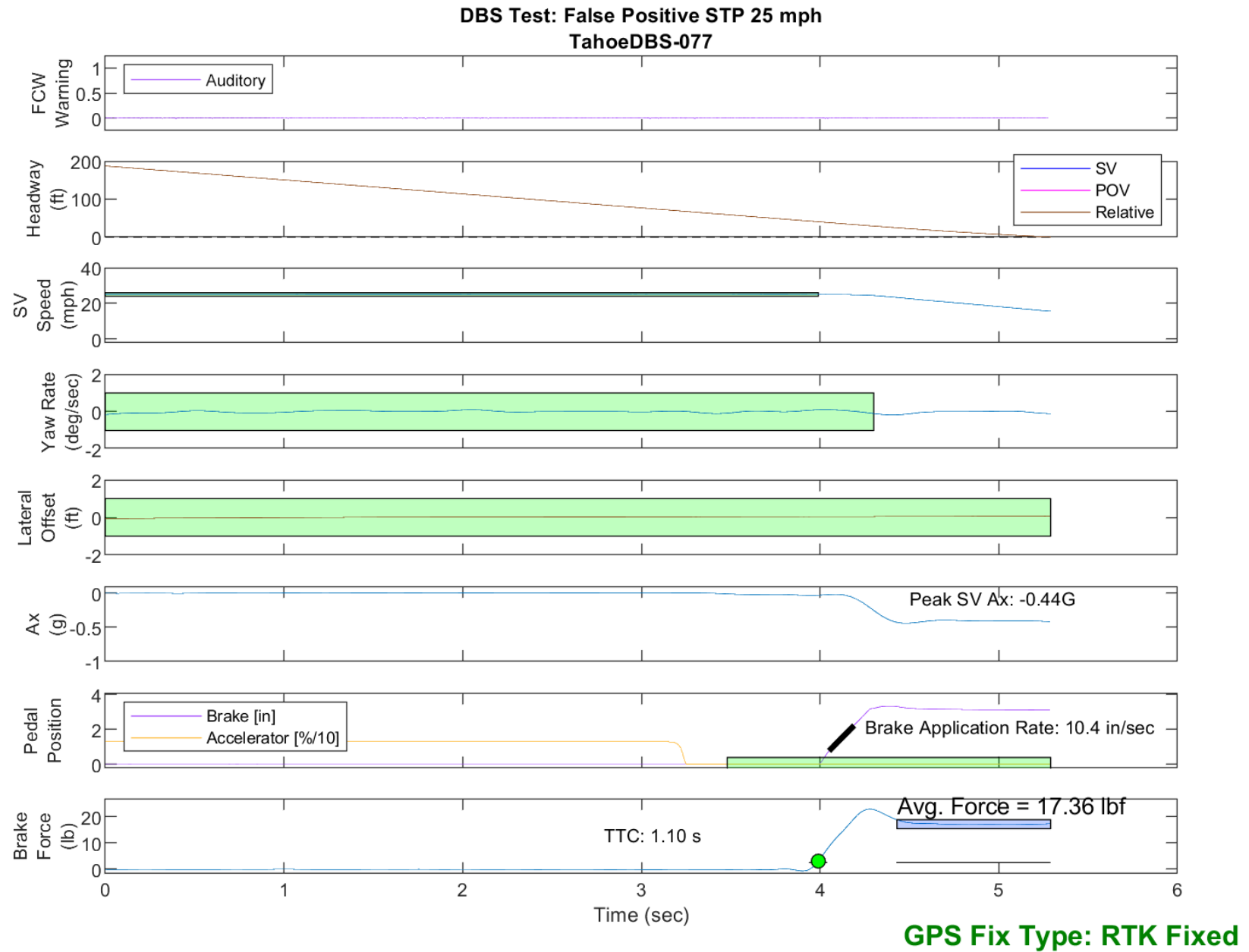


Figure E58. Time History for DBS Run 77, SV Encounters Steel Trench Plate, SV 25 mph

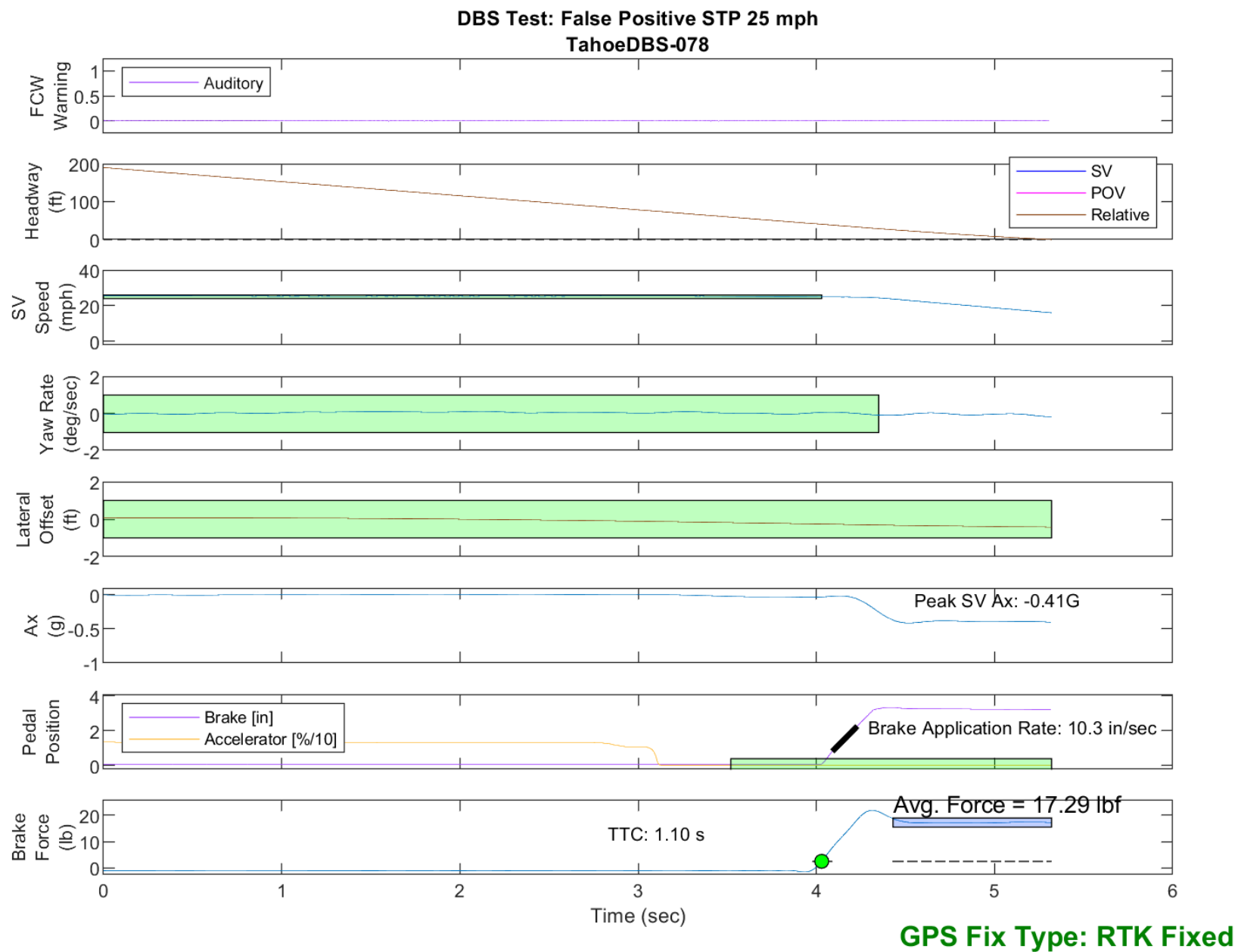


Figure E59. Time History for DBS Run 78, SV Encounters Steel Trench Plate, SV 25 mph

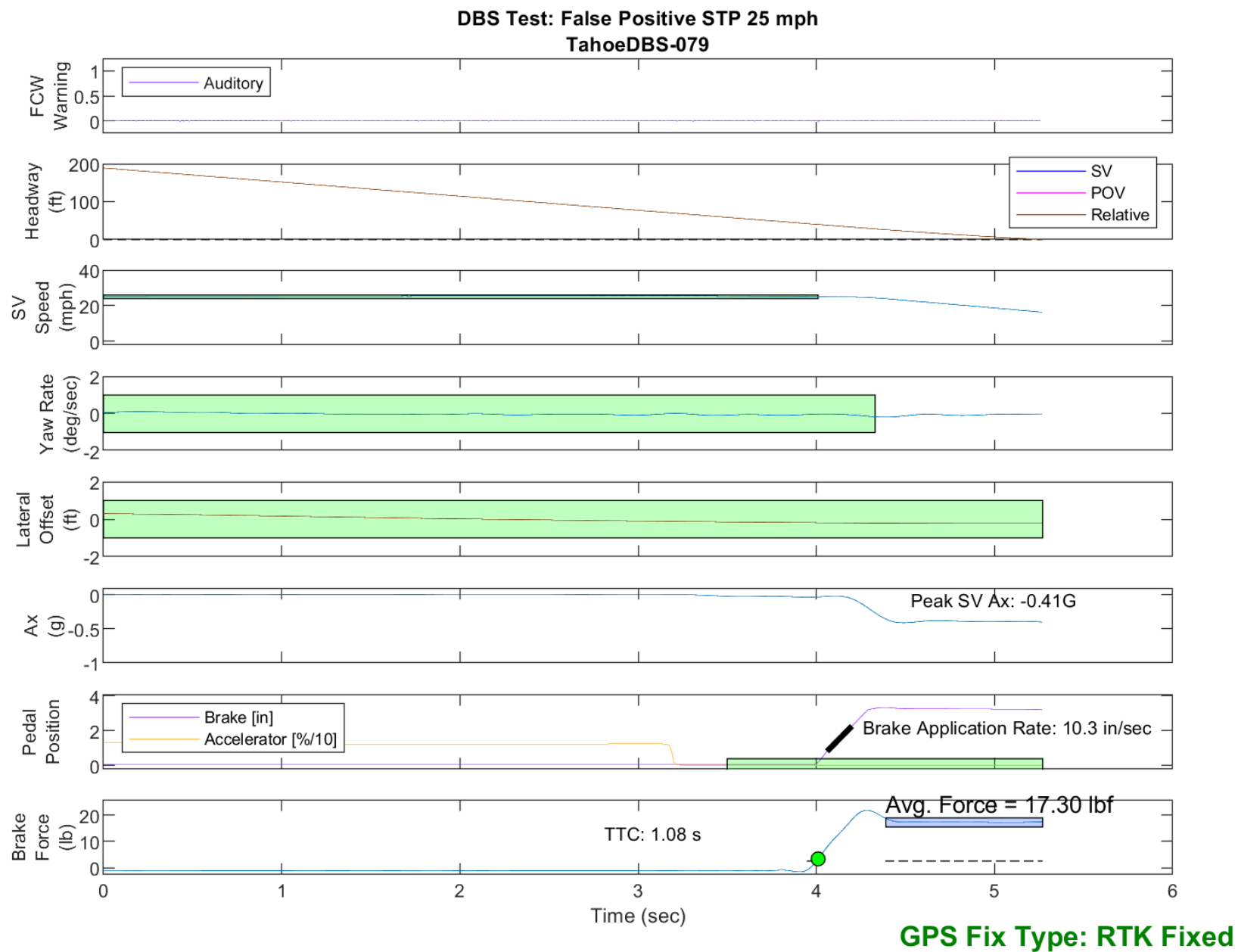


Figure E60. Time History for DBS Run 79, SV Encounters Steel Trench Plate, SV 25 mph

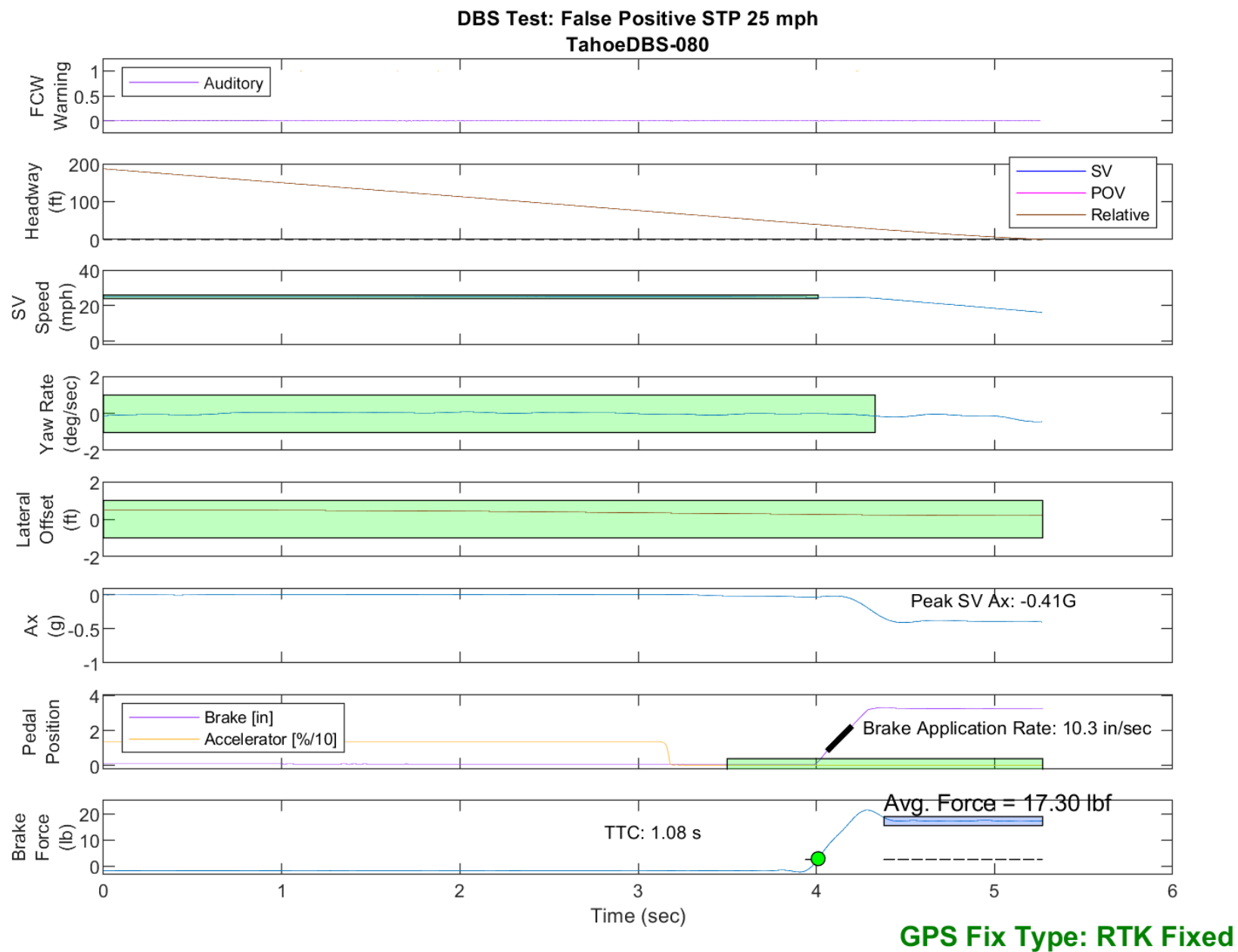


Figure E61. Time History for DBS Run 80, SV Encounters Steel Trench Plate, SV 25 mph

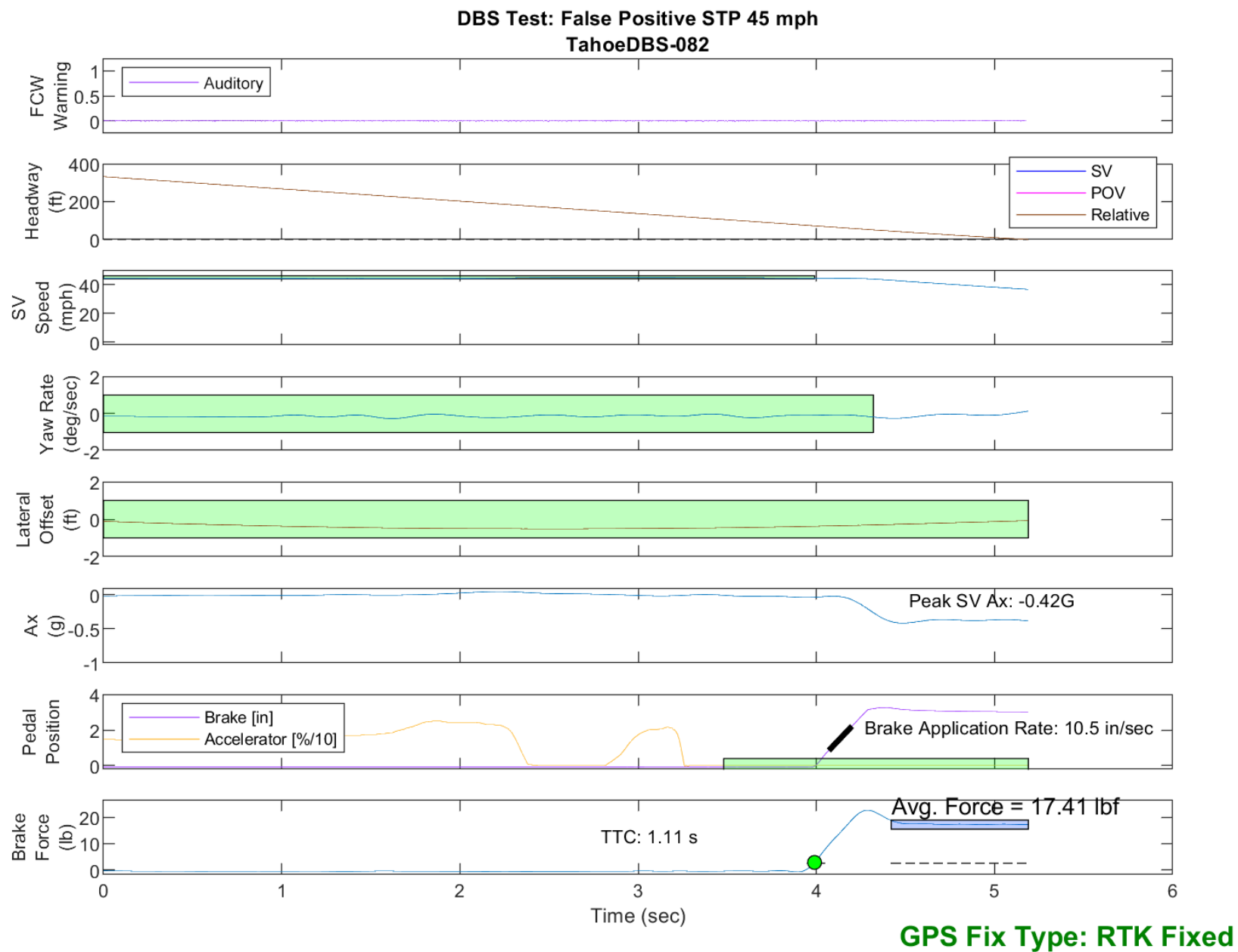


Figure E62. Time History for DBS Run 82, SV Encounters Steel Trench Plate, SV 45 mph

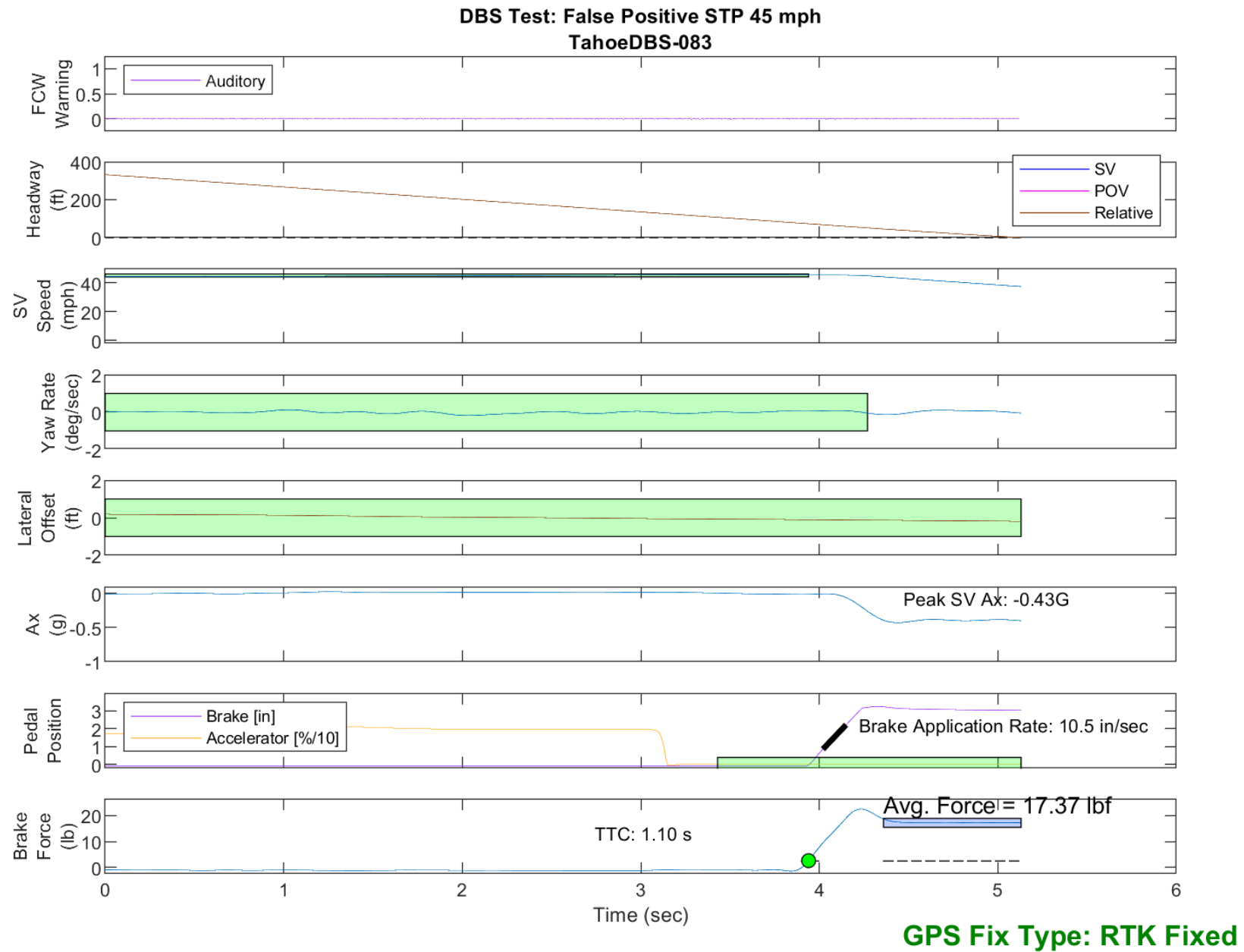


Figure E63. Time History for DBS Run 83, SV Encounters Steel Trench Plate, SV 45 mph

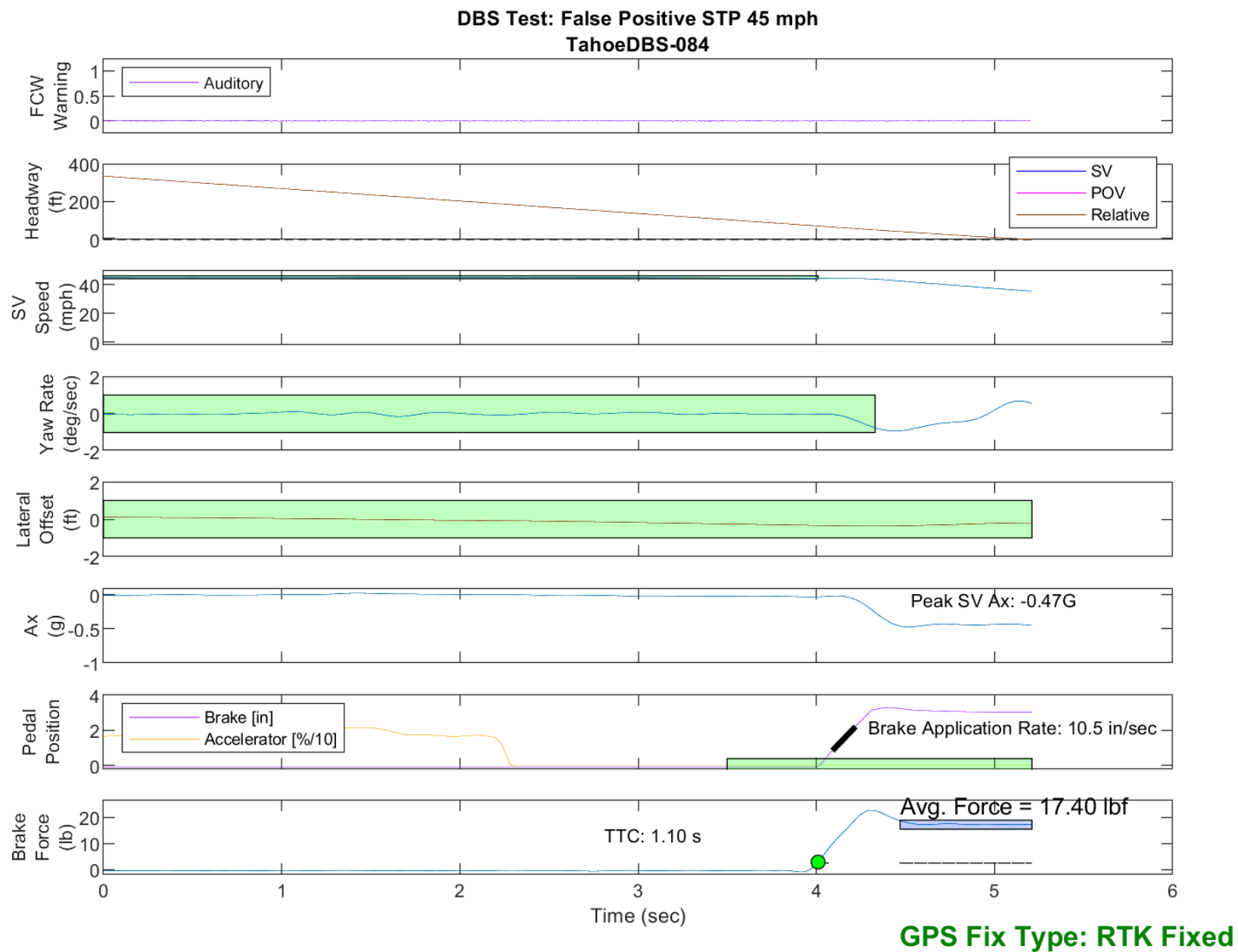


Figure E64. Time History for DBS Run 84, SV Encounters Steel Trench Plate, SV 45 mph

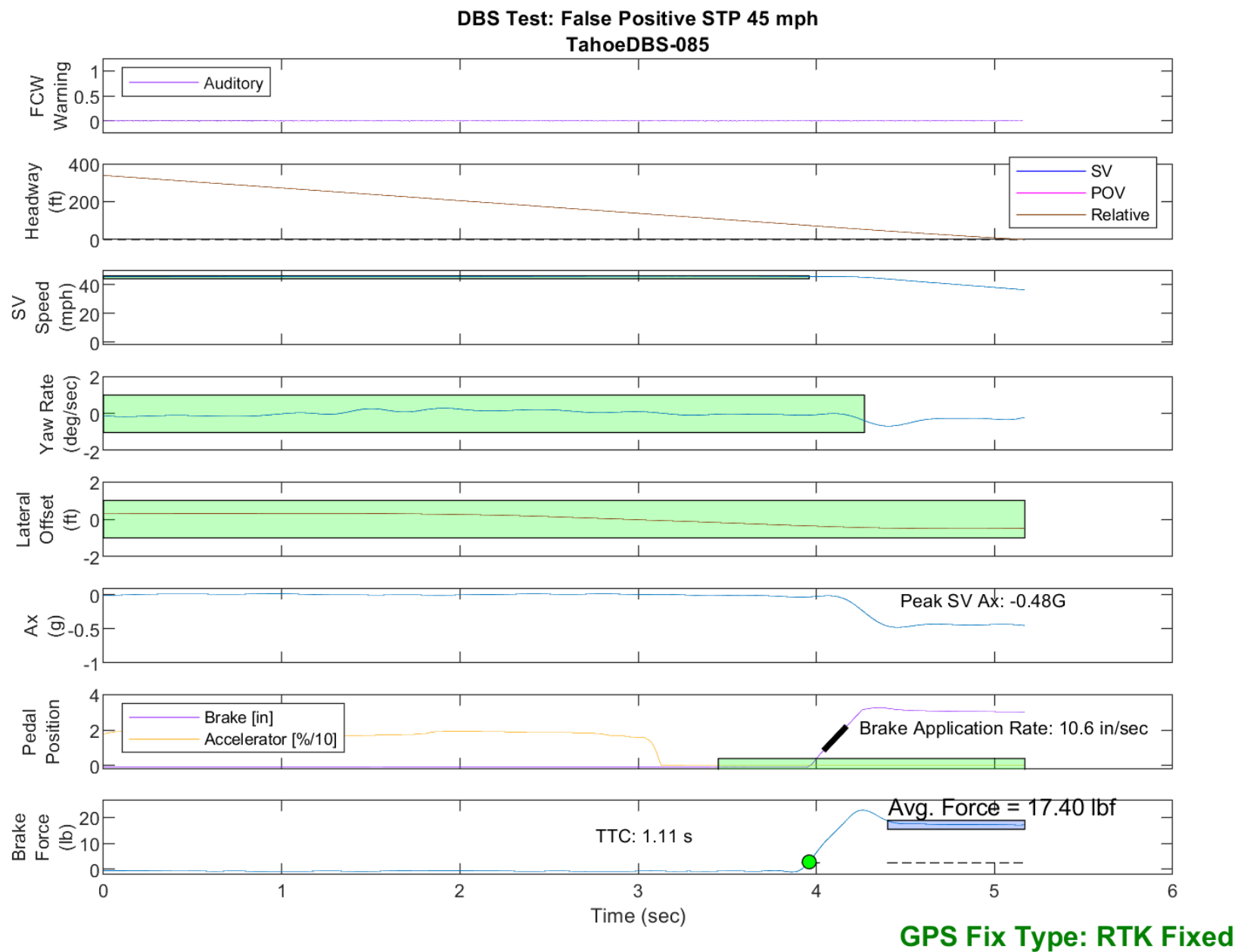


Figure E65. Time History for DBS Run 85, SV Encounters Steel Trench Plate, SV 45 mph

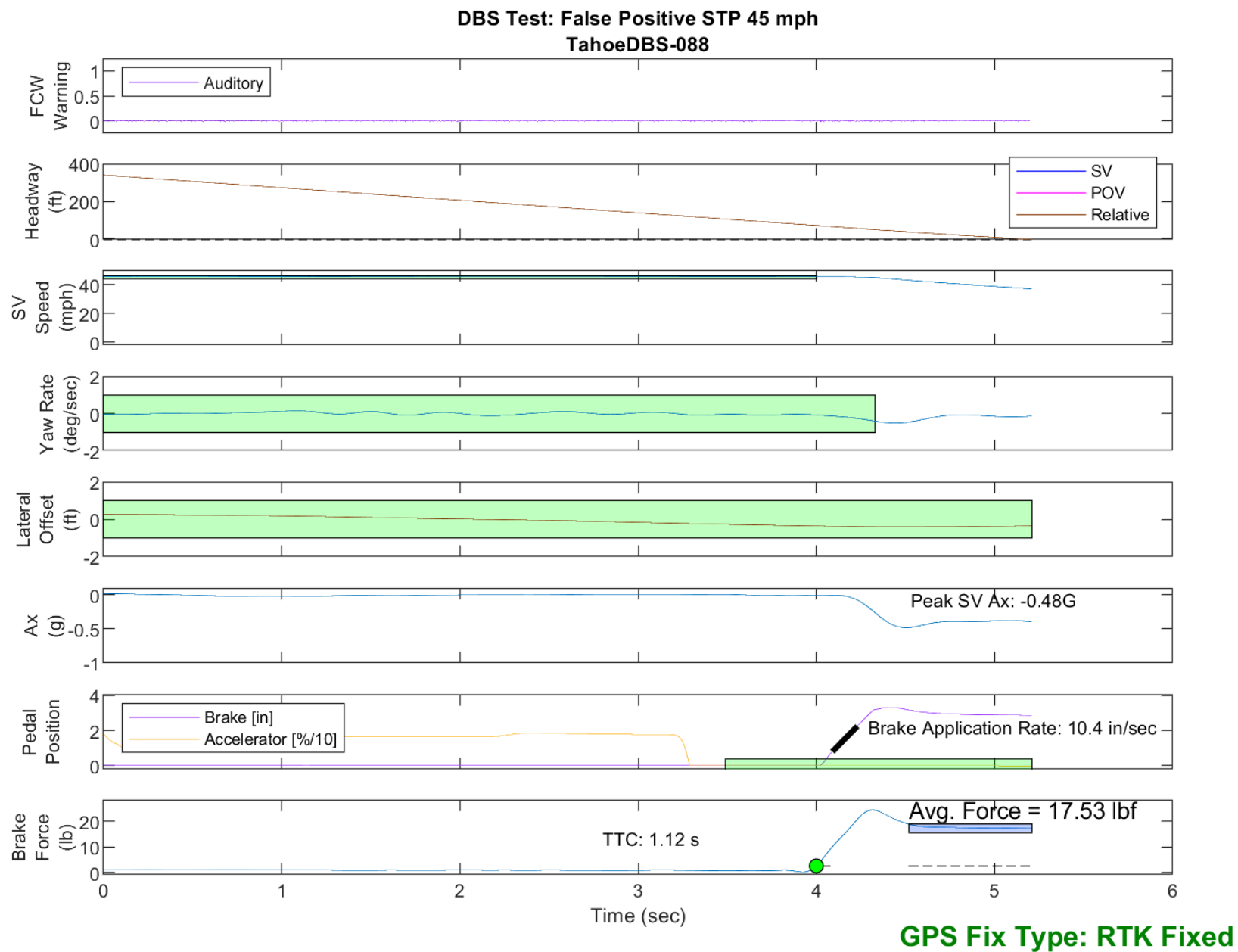


Figure E66. Time History for DBS Run 88, SV Encounters Steel Trench Plate, SV 45 mph

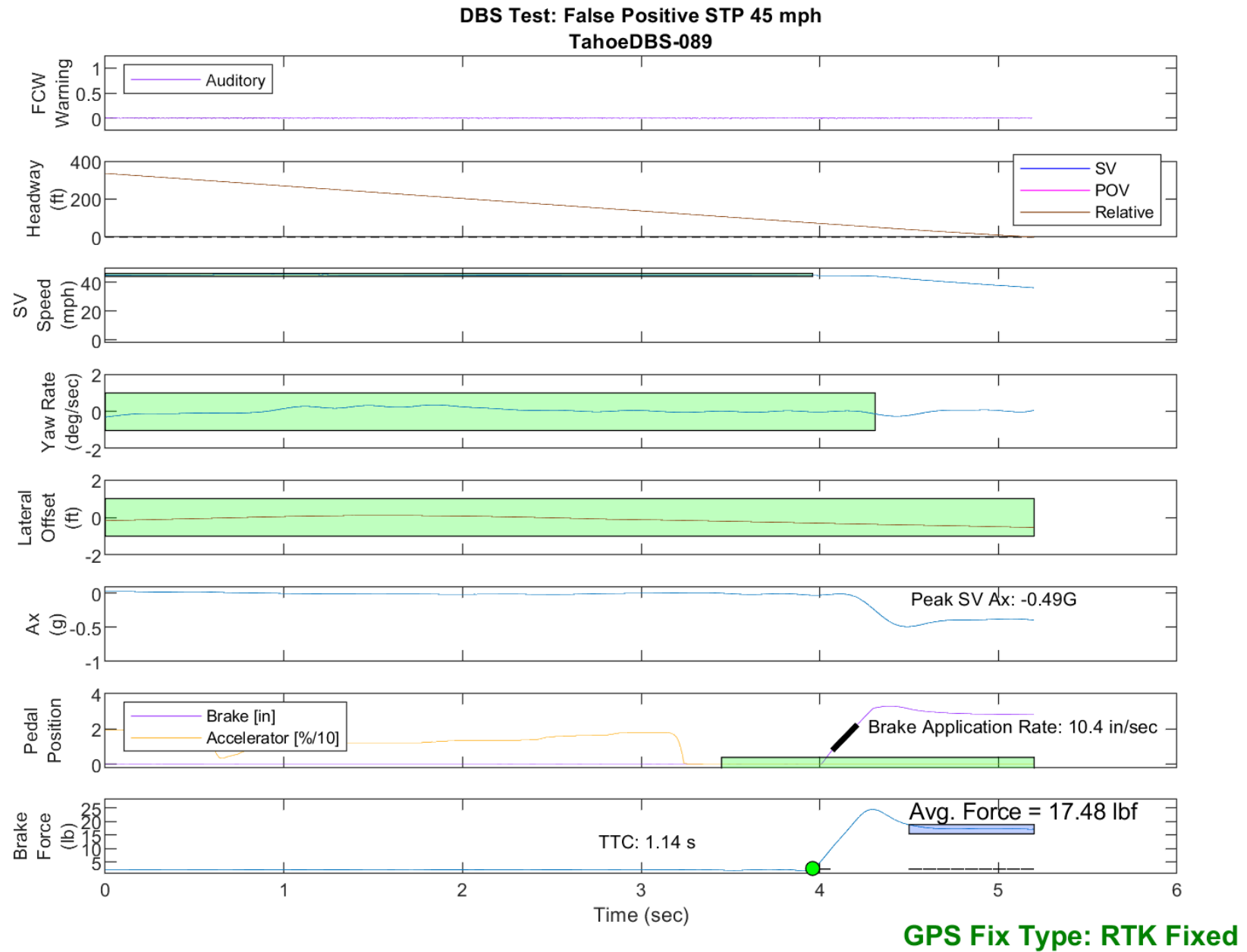


Figure E67. Time History for DBS Run 89, SV Encounters Steel Trench Plate, SV 45 mph

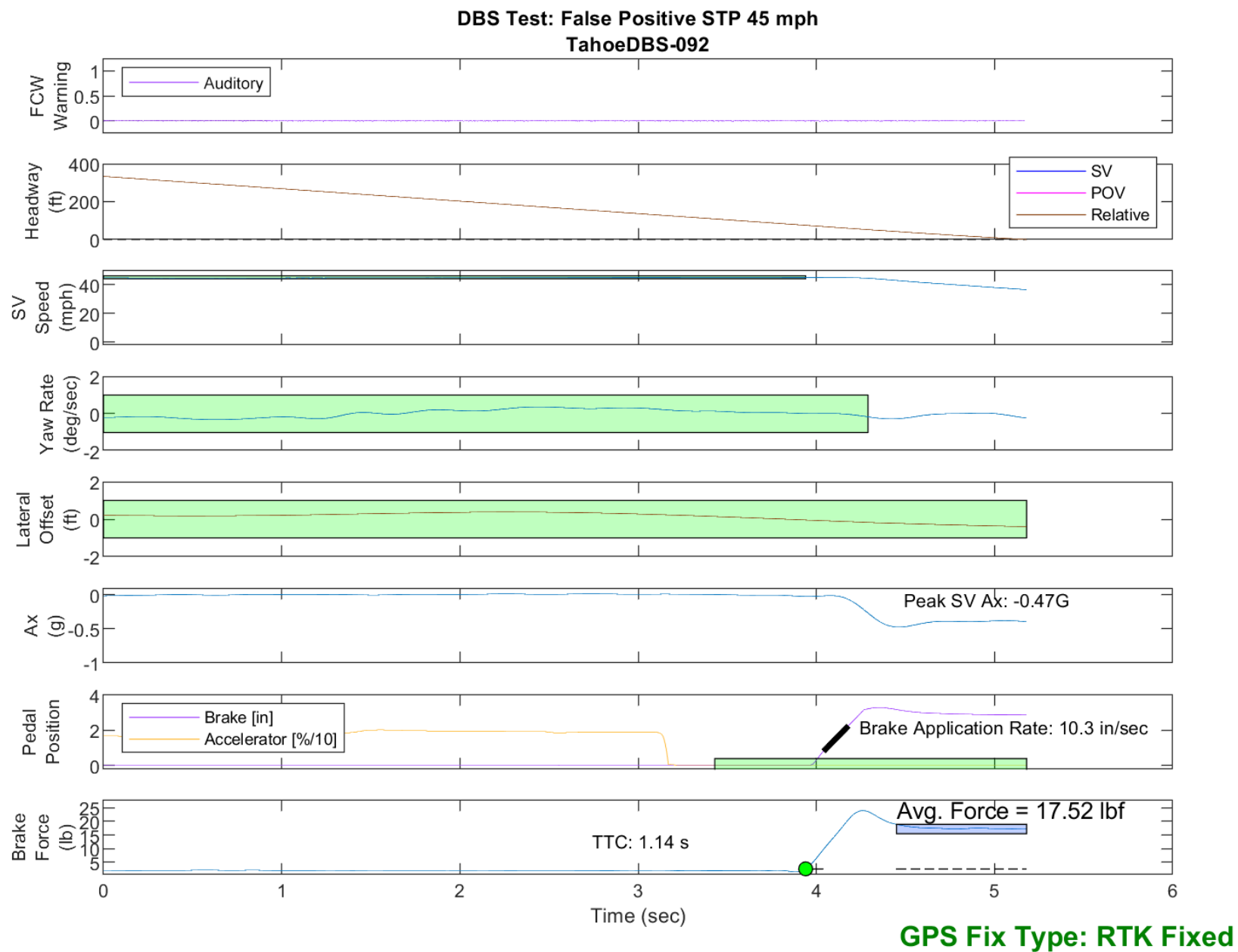


Figure E68. Time History for DBS Run 92, SV Encounters Steel Trench Plate, SV 45 mph

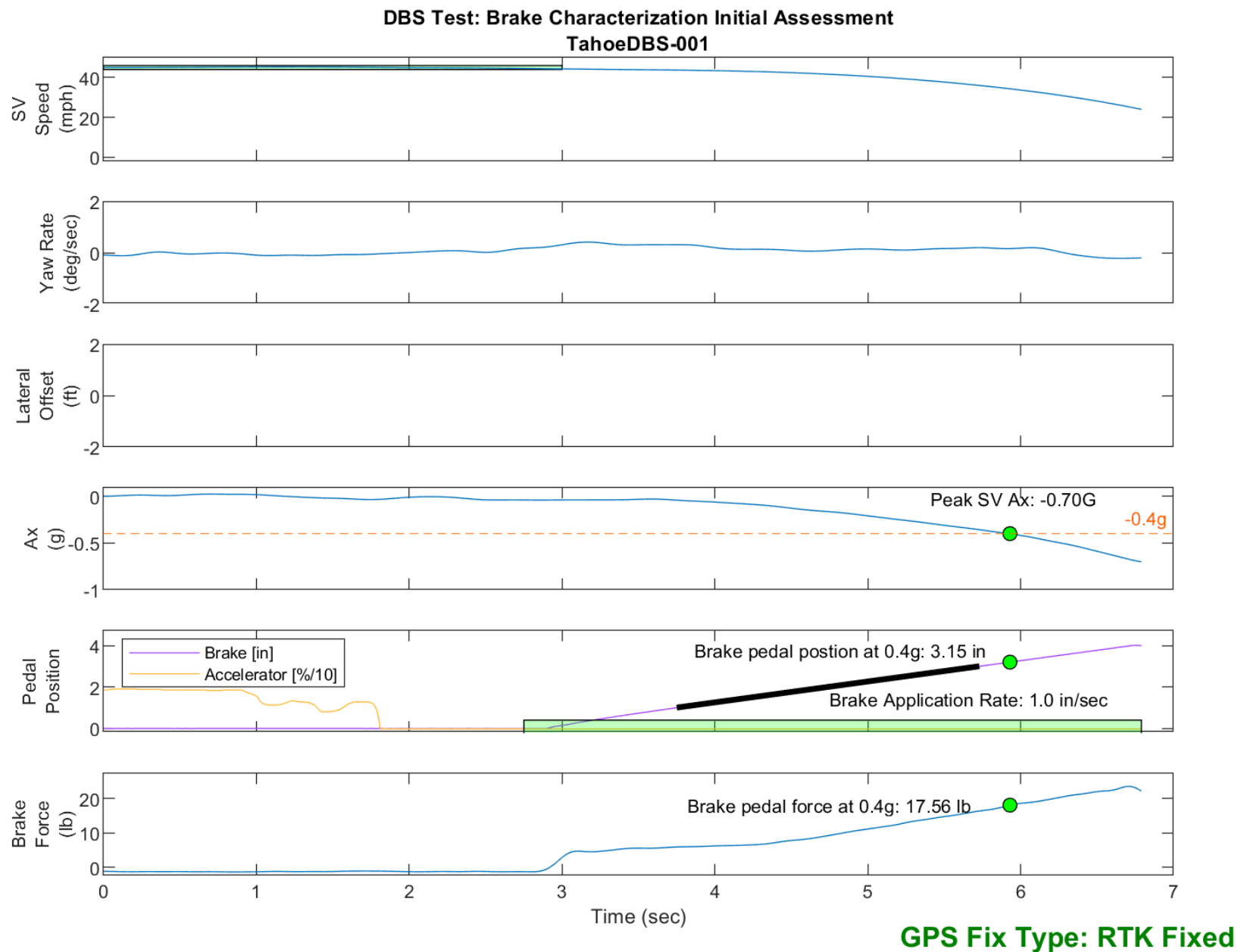


Figure E69. Time History for DBS Run 1, Brake Characterization Initial

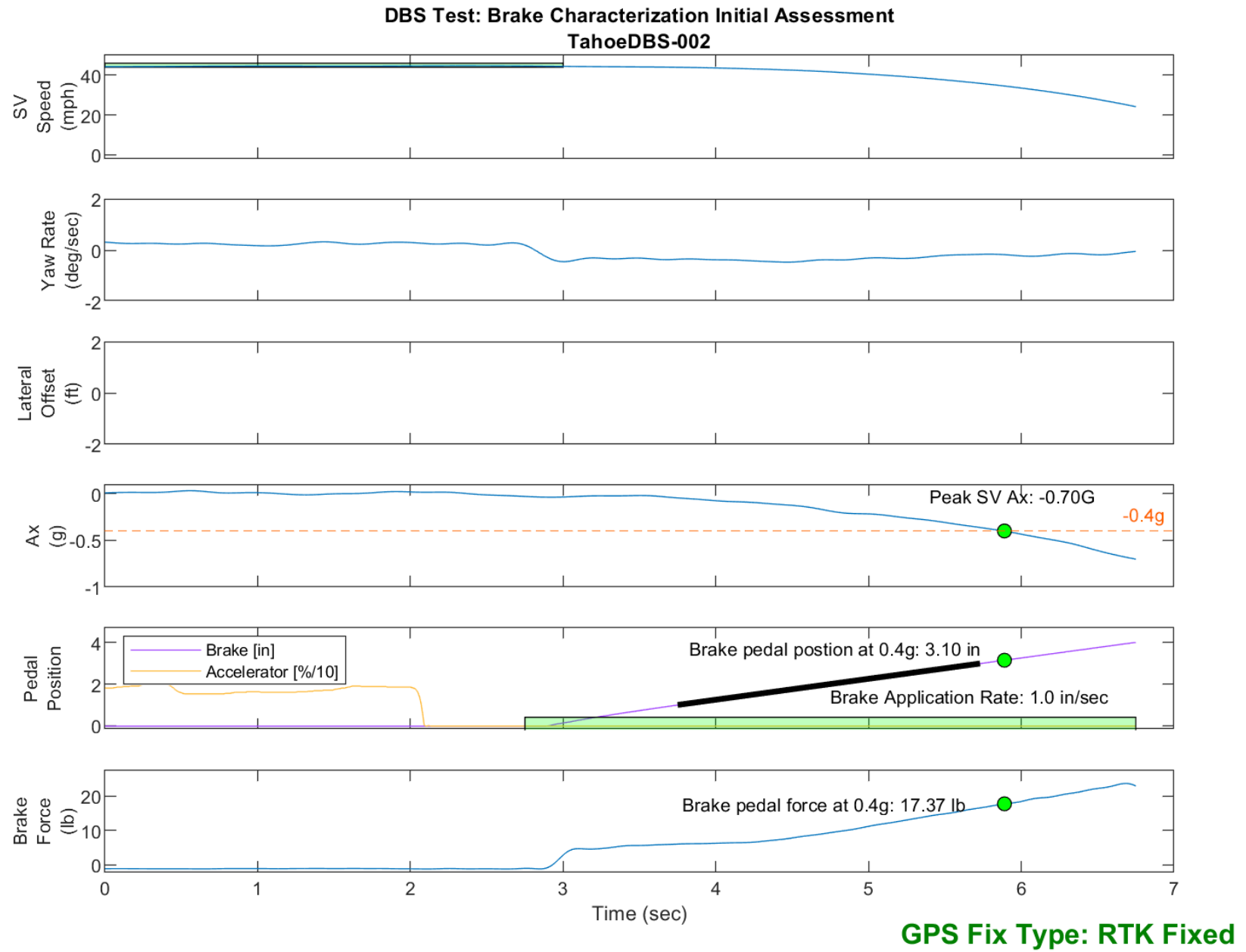


Figure E70. Time History for DBS Run 2, Brake Characterization Initial

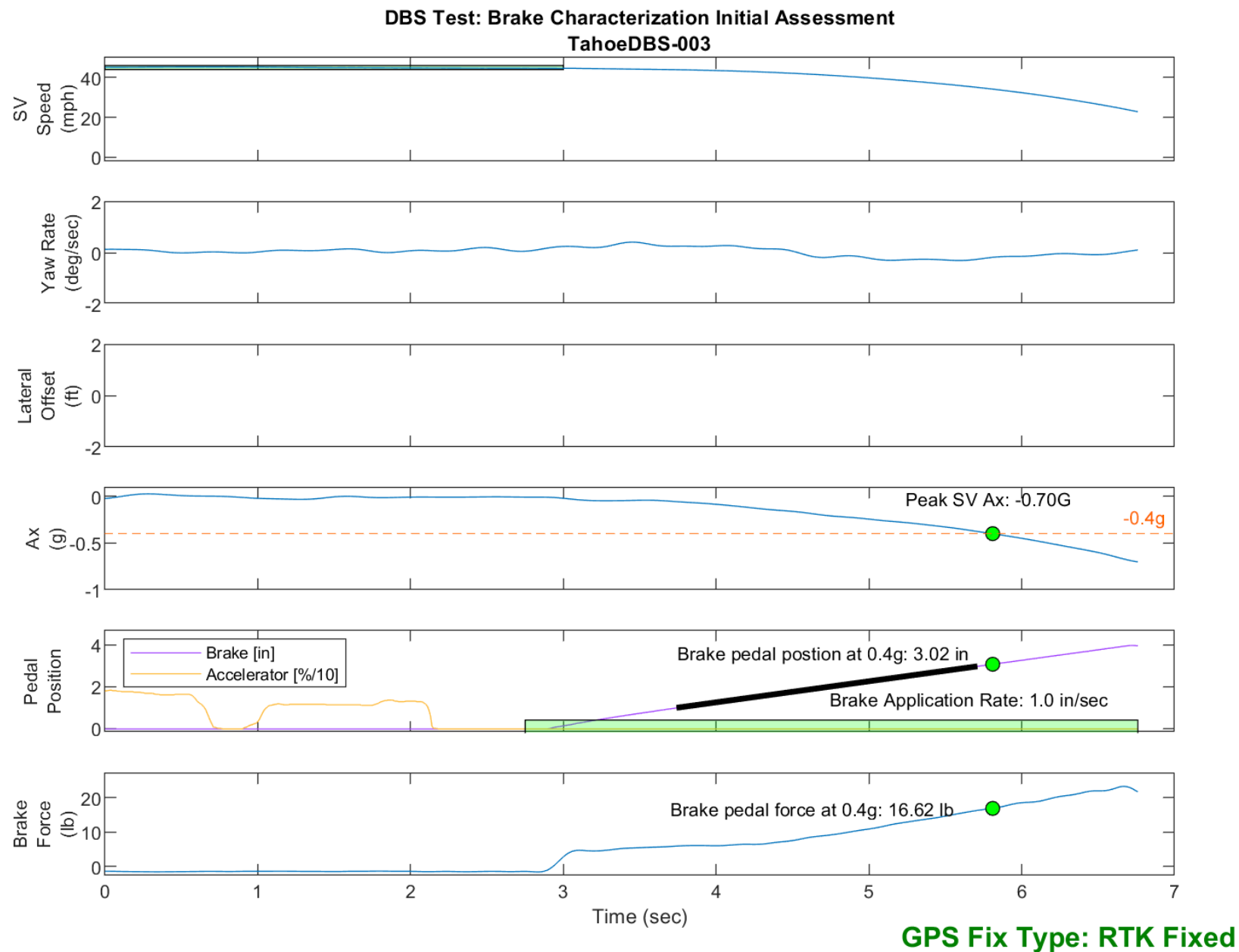


Figure E71. Time History for DBS Run 3, Brake Characterization Initial

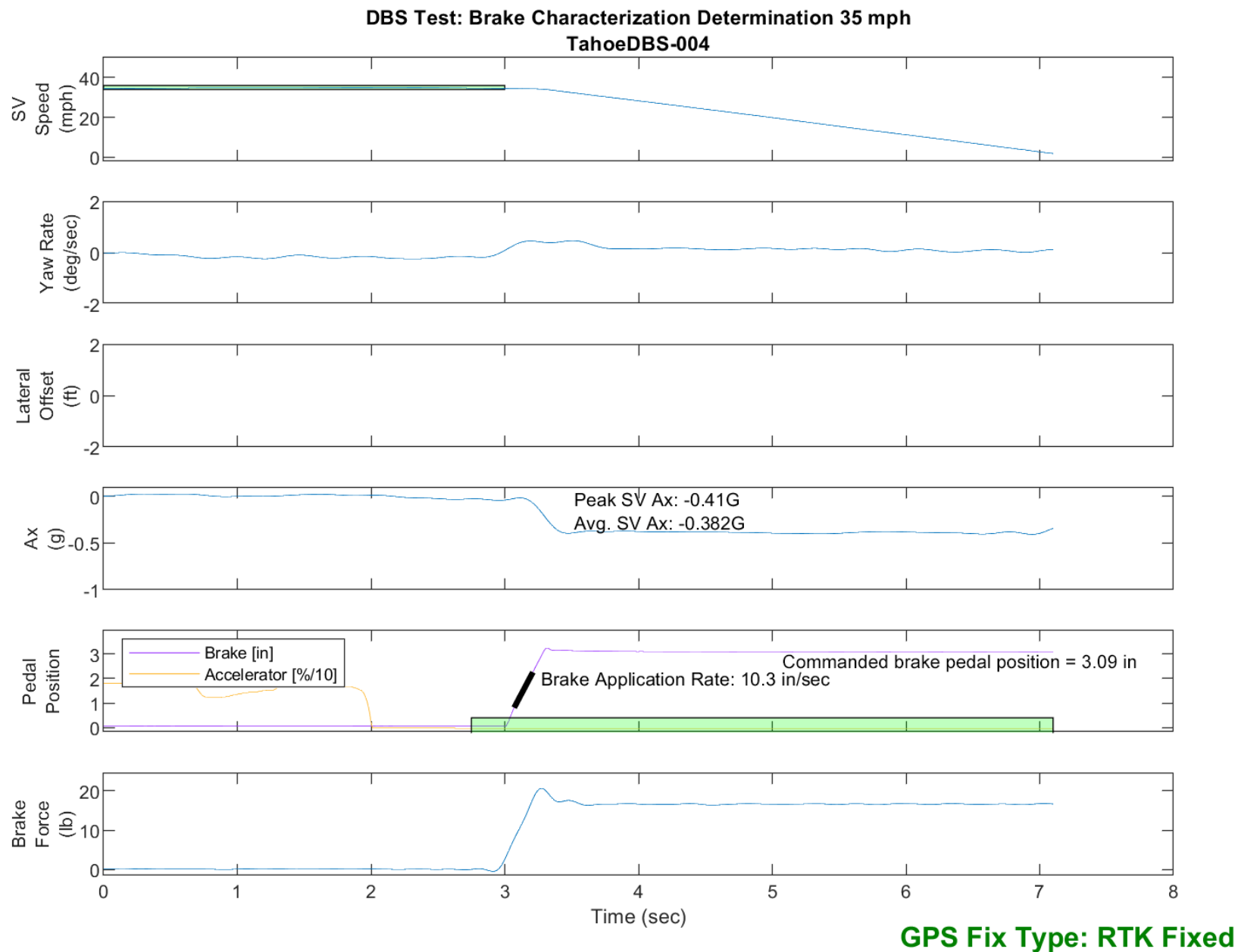


Figure E72. Time History for DBS Run 4, Brake Characterization Determination, Displacement Mode, 35 mph

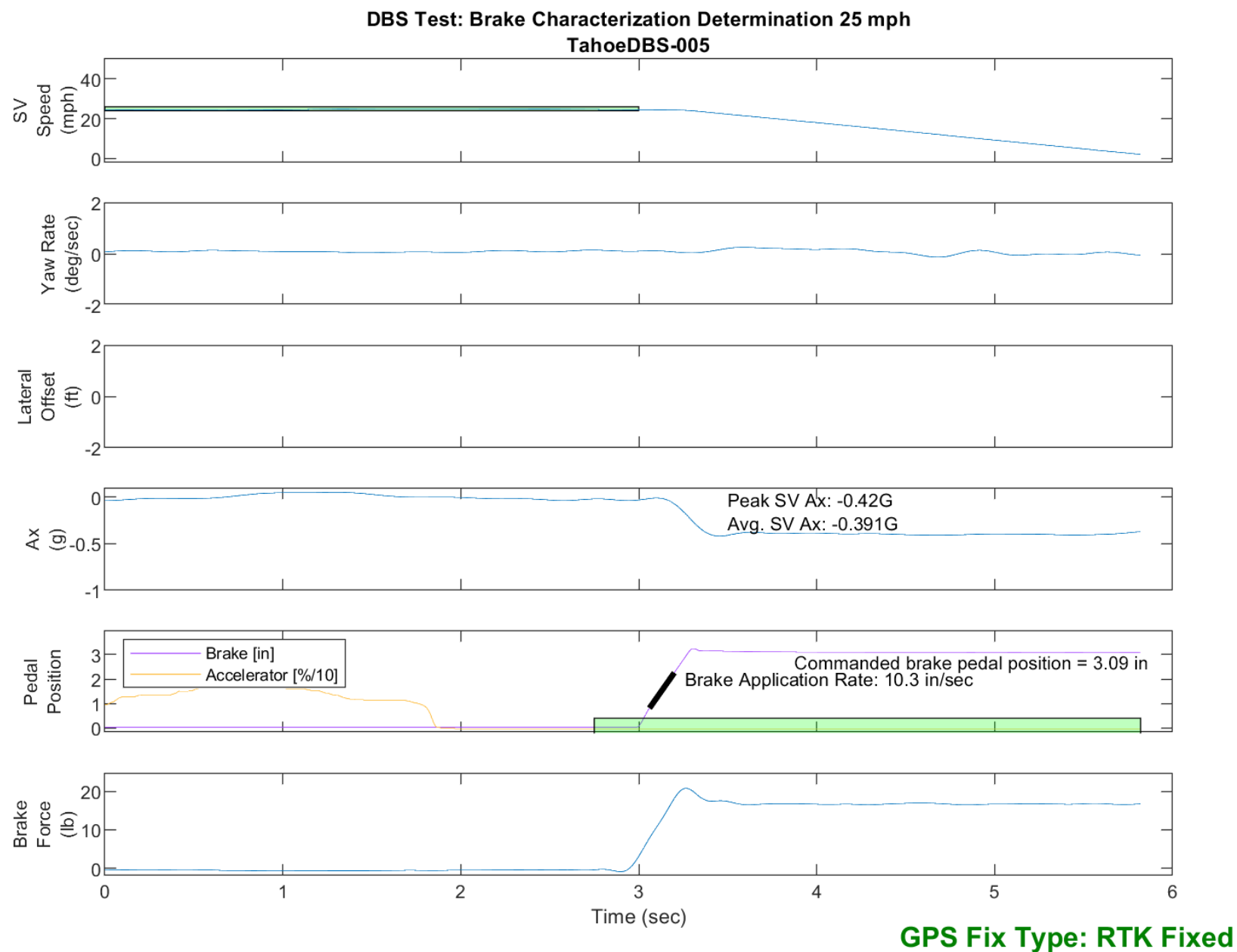


Figure E73. Time History for DBS Run 5, Brake Characterization Determination, Displacement Mode, 25 mph

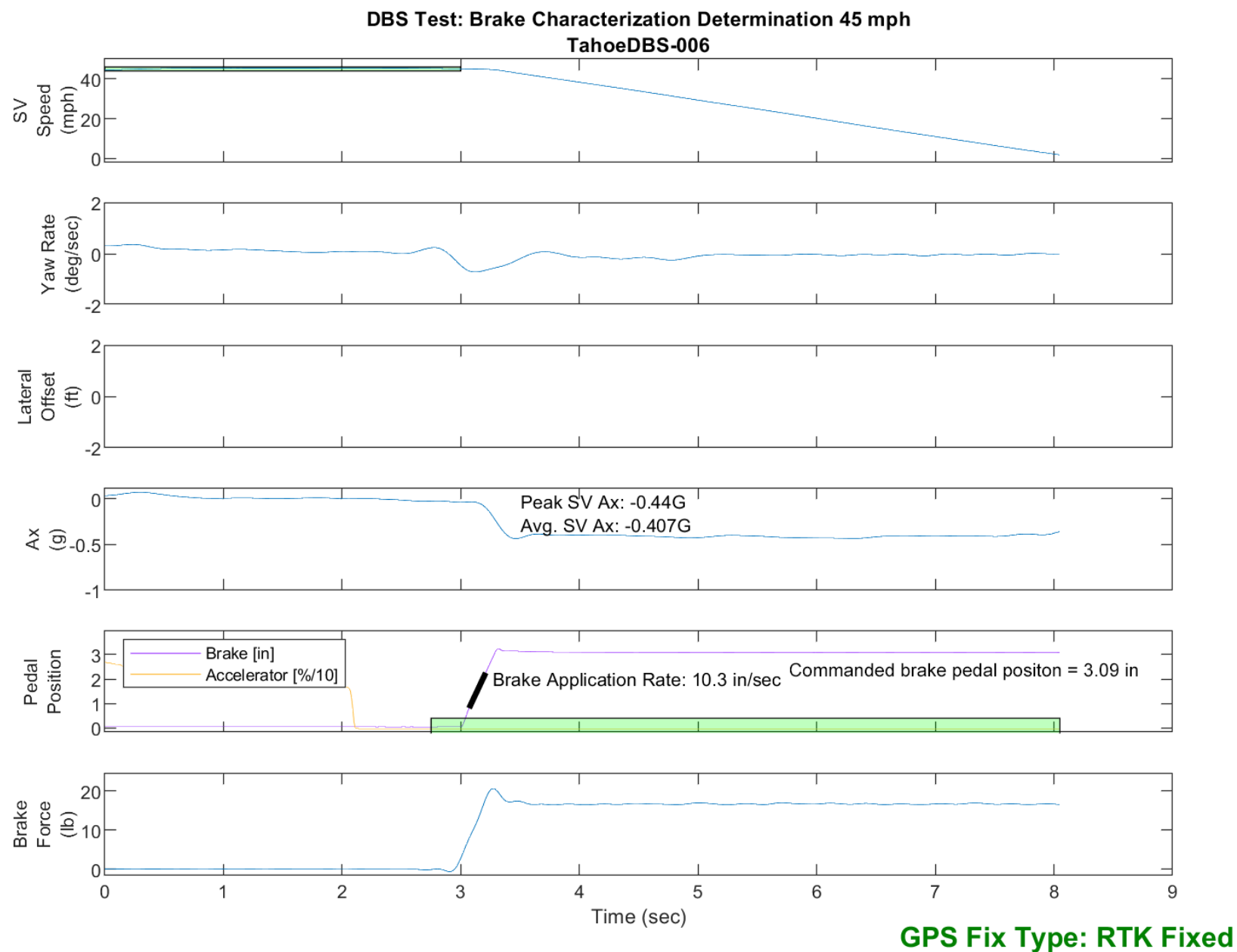


Figure E74. Time History for DBS Run 6, Brake Characterization Determination, Displacement Mode, 45 mph

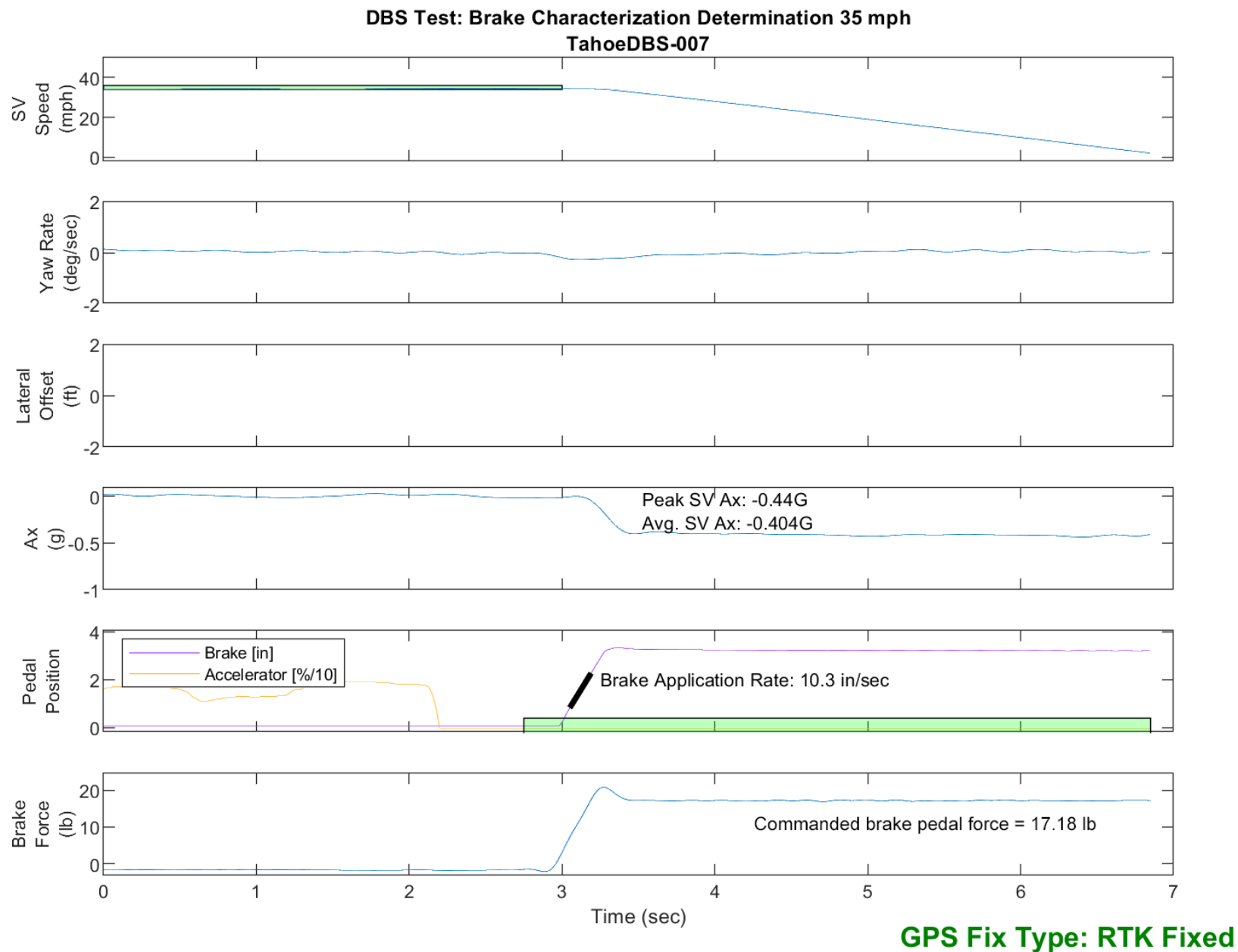


Figure E75. Time History for DBS Run 7, Brake Characterization Determination, Hybrid Mode, 35 mph

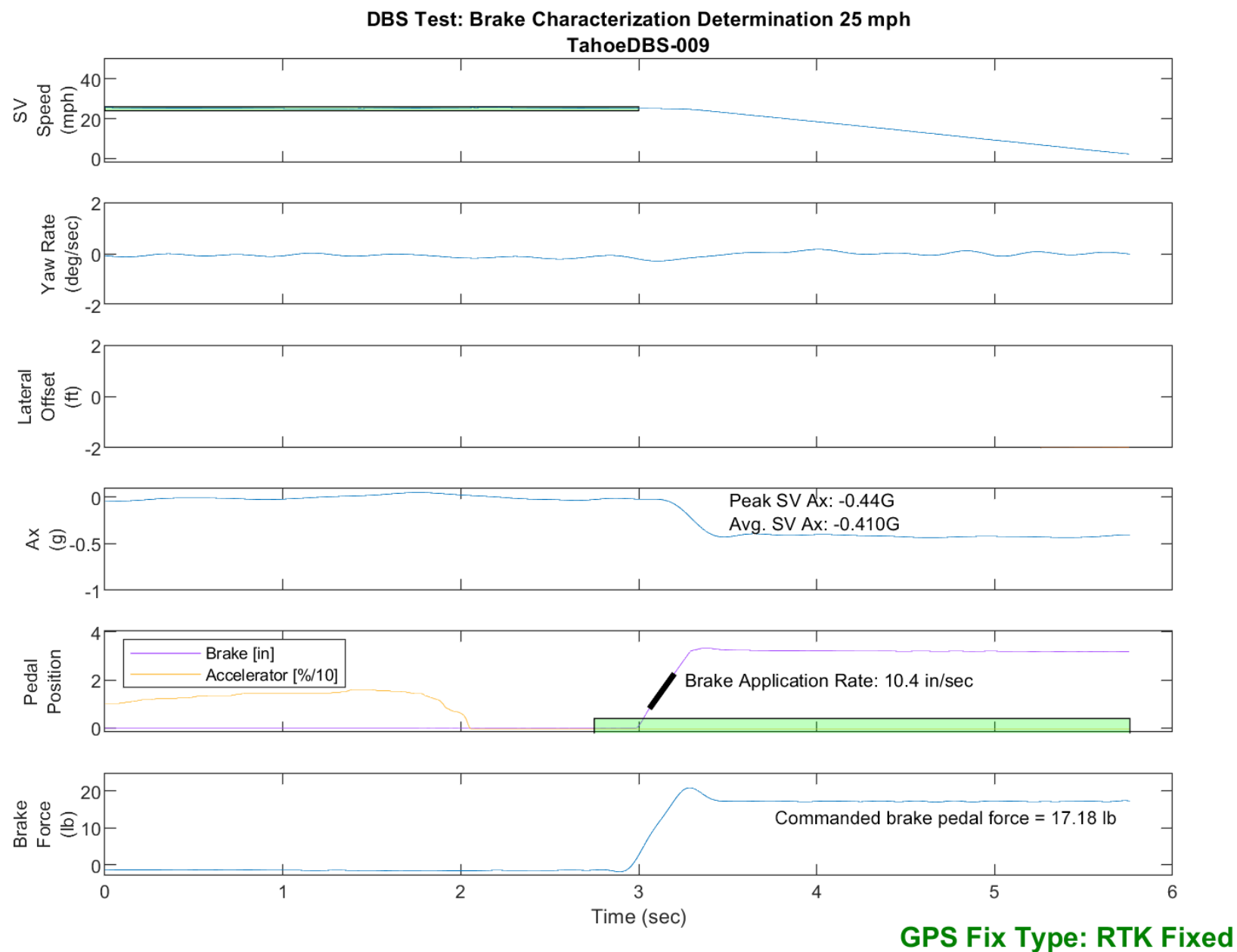


Figure E76. Time History for DBS Run 9, Brake Characterization Determination, Hybrid Mode, 25 mph

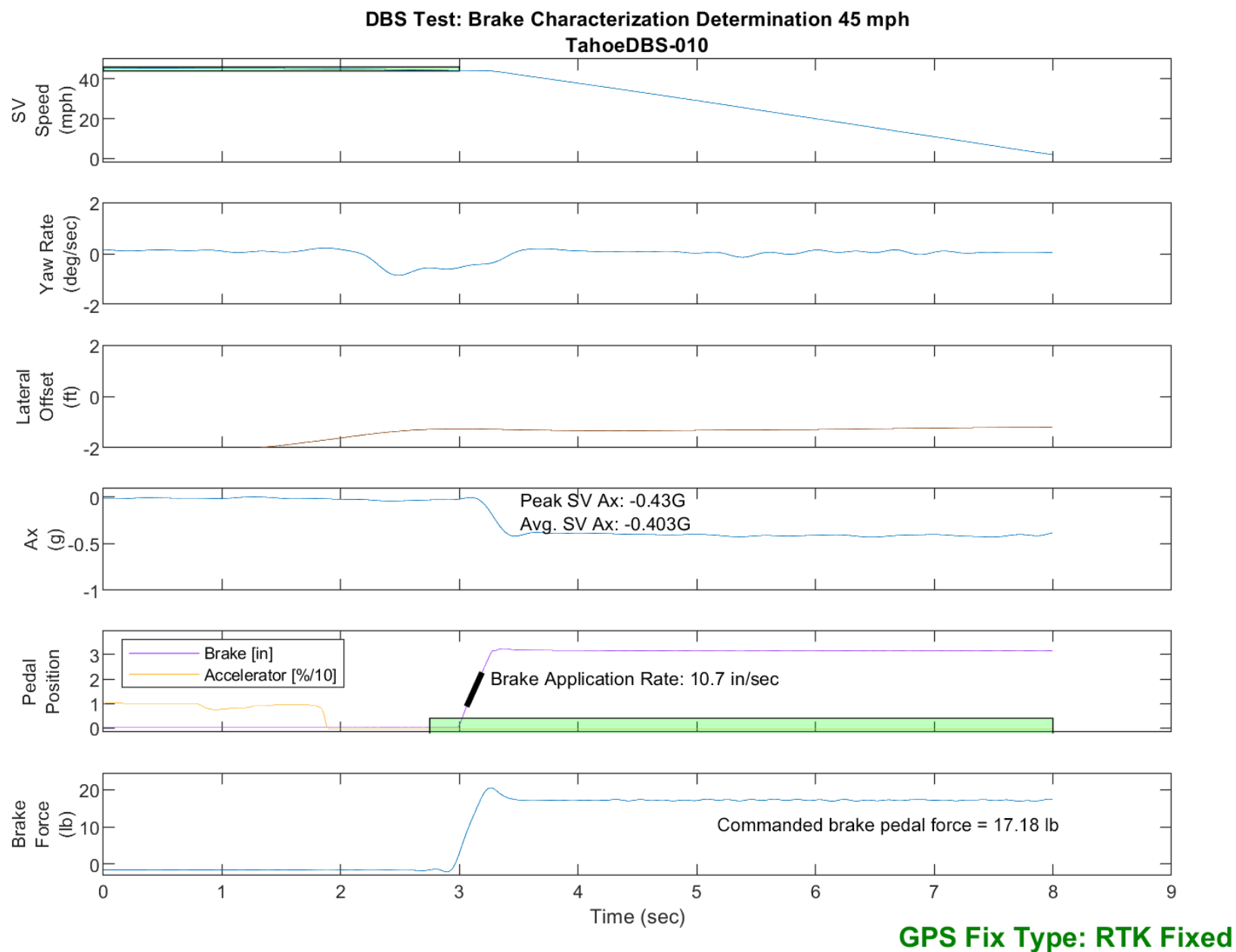


Figure E77. Time History for DBS Run 10, Brake Characterization Determination, Hybrid Mode, 45 mph