NEW CAR ASSESSMENT PROGRAM
DYNAMIC BRAKE SUPPORT SYSTEM CONFIRMATION TEST
NCAP-DRI-DBS-21-04

2021 Chrysler Pacifica Touring L S Appearance

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20 April 2021

Final Report

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National Highway Traffic Safety Administration
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16. Abstract These tests were conducted on the subject 2021 Chrysler Pacifica Touring L S Appearance in accordance with the specifications of the New Car Assessment Program's (NCAP) most current Test Procedure in docket NHTSA-2015-0006-0026; DYNAMIC BRAKE SUPPORT PERFORMANCE EVALUATION CONFIRMATION TEST FOR THE NEW CAR ASSESSMENT PROGRAM, October 2015. The vehicle passed the requirements of the test for both slower moving POV scenarios and both steel trench plate scenarios, but failed the requirements of the test for the stopped POV scenario and the decelerating POV scenario, resulting in an overall failure for the DBS test.		
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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 (SV) 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 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 Chrysler Pacifica Touring L S Appearance. 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

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2021 Chrysler Pacifica Touring L S Appearance

VIN: *2C4RC1BG6MR50xxxx*

Test Date: *4/4/2021*

Dynamic Brake Support System settings:

Forward Collision Warning: Warning + Active Braking
Forward Collision Sensitivity: Med

Test 1 - Subject Vehicle Encounters Stopped Principal Other Vehicle

SV 25 mph: *Fail*

Test 2 - Subject Vehicle Encounters Slower Principal Other Vehicle

SV 25 mph POV 10 mph: *Pass*

SV 45 mph POV 20 mph: *Pass*

Test 3 - Subject Vehicle Encounters Decelerating Principal Other Vehicle

SV 35 mph POV 35 mph: *Fail*

Test 4 - Subject Vehicle Encounters Steel Trench Plate

SV 25 mph: *Pass*

SV 45 mph: *Pass*

Overall: ***Fail***

Notes:

DYNAMIC BRAKE SUPPORT

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2021 Chrysler Pacifica Touring L S Appearance

TEST VEHICLE INFORMATION

VIN: *2C4RC1BG6MR50xxxx*

Body Style: *Minivan* Color: *Ceramic Gray*

Date Received: *3/15/2021* Odometer Reading: *10 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *FCA US LLC*

Date of manufacture: *11-20*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard:	Front:	*235/60R18 103H*
	Rear:	*235/60R18 103H*
Recommended cold tire pressure:	Front:	*250 kPa (36 psi)*
	Rear:	*250 kPa (36 psi)*

TIRES

Tire manufacturer and model:	*Michelin Premier A/S Michelin Total Performance*
Front tire specification:	*235/60R18 103H*
Rear tire specification:	*235/60R18 103H*
Front tire DOT prefix:	*B9XF 01DX*
Rear tire DOT prefix:	*B9XF 01DX*

DYNAMIC BRAKE SUPPORT

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2021 Chrysler Pacifica Touring L S Appearance

GENERAL INFORMATION

Test date: *4/4/2021*

AMBIENT CONDITIONS

Air temperature: *25.0 C (77 F)*

Wind speed: *3.1 m/s (6.9 mph)*

X Wind speed ≤ 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)*

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*645.9 kg (1424 lb)*	Right Front:	*623.2 kg (1374 lb)*
Left Rear:	*489.9 kg (1080 lb)*	Right Rear:	*473.1 kg (1043 lb)*
		Total:	*2232.1 kg (4921 lb)*

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

2021 Chrysler Pacifica Touring L S Appearance

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

Full-Speed Forward-Collision Warning Plus: standard equipment

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

Camera: located in the top-center of the windshield

Radar: located behind the front vehicle fascia along the centerline of the vehicle

System settings used for test (if applicable):

Forward Collision Warning: Warning + Active Braking
Forward Collision Sensitivity: Med

Brake application mode used for test: *Hybrid control*

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

2 km/h (1 mph) (Per manufacturer supplied information)

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

200 km/h (124 mph) (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?

X Yes
___ No

If yes, please provide a full description.

In the event of 4 AEB events with braking within the same key cycle, the cluster will display the message "FCW NOT AVAILABLE AUTOBRAKE DISABLED" and AEB will not be available until the ignition is cycled (vehicle is stopped and restarted).

How is the Forward Collision Warning presented to the driver?

(Check all that apply)

X	Warning light
X	Buzzer or auditory alarm
	Vibration
X	Other *See below*

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.

In the event of an AEB or Forward Collision Warning event, a loud auditory warning will be provided to the driver before the initiation of automated braking. A series of three high-pitched loud beeps will be provided together with a message in the cluster indicating that the driver should brake. The text that will be displayed is: "Brake!" See Appendix A, Figure A15.

In some instances, for speeds above 62 km/h a short duration brake "stab" is provided to the driver as a means of a haptic warning. This is done prior to initiation of AEB.

In the case of DBS, no haptic, visual, or auditory alert is provided to the driver. The driver will, however, feel a stronger response in the brake pedal as the brake pedal will move downward more so than would normally be expected with the amount of pressure that the driver's applying. DBS is not applied until the driver applies some amount of braking force.

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

____ No

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

A center mounted touchscreen display is used to interact with the vehicle system menus. The menu hierarchy is:

Vehicle

Safety & Driving Assistance

Automatic Emergency Braking

Forward Collision Warning

Choose from "Off", "Only Warning", or "Warning + Active Braking"

See Appendix A, Figure A14.

The FCW system state is kept in memory from one key cycle to the next. If the system is turned off, it will remain off when the vehicle is restarted.

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

____ No

If yes, please provide a full description.

A center mounted touchscreen display is used to interact with the vehicle system menus. The menu hierarchy is:

Vehicle

Safety & Driving Assistance

Automatic Emergency Braking

Forward Collision Sensitivity

Choose from "Near", "Med", or "Far"

See Appendix A, Figure A14.

DYNAMIC BRAKE SUPPORT

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

2021 Chrysler Pacifica Touring L S Appearance

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

If yes, please provide a full description.

Radar blindness. If the vehicle is moving and the radar sees no targets for a period of approximately 2 minutes, AEB will become unavailable. An auditory indication will be provided to the driver and the cluster will display the message "FCW Not Available Wipe Front Radar Sensor." This condition can be remedied by restarting the vehicle and letting the radar see stationary objects or moving vehicles.

Camera blindness. Camera blindness can generally be avoided by not attempting to drive for long intervals toward the sun when it is at a low elevation angle in the horizon. In the event that the camera becomes blinded a message stating "ACC/FCW Limited Functionality" will be displayed. In the event that the camera detects a situation of limited visibility because of the dirty windshield a message stating "Clean Front Windshield" will be displayed.

The FCW alerts may be triggered on objects other than vehicles such as guard rails or signposts based on the course prediction.

Avoid driving into the sun for long intervals of time while the sun is at a low elevation angle above the horizon. Also make sure that a significant amount of snow does not accumulate on the fascia in the area that covers the radar (vehicle centerline).

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.

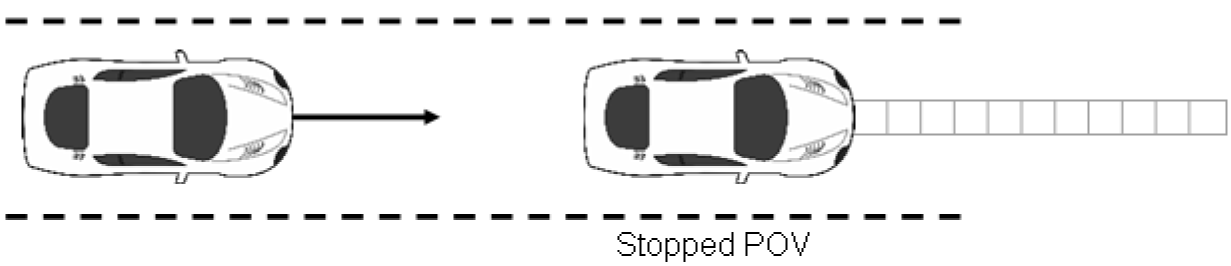


Figure 1. Depiction of Test 1

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 → t_{FCW}	187 ft (57 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.1	40 ft (12 m)

b. Criteria

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

2. <u>TEST 2 – SUBJECT VEHICLE ENCOUNTERS SLOWER PRINCIPAL OTHER VEHICLE</u>

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.

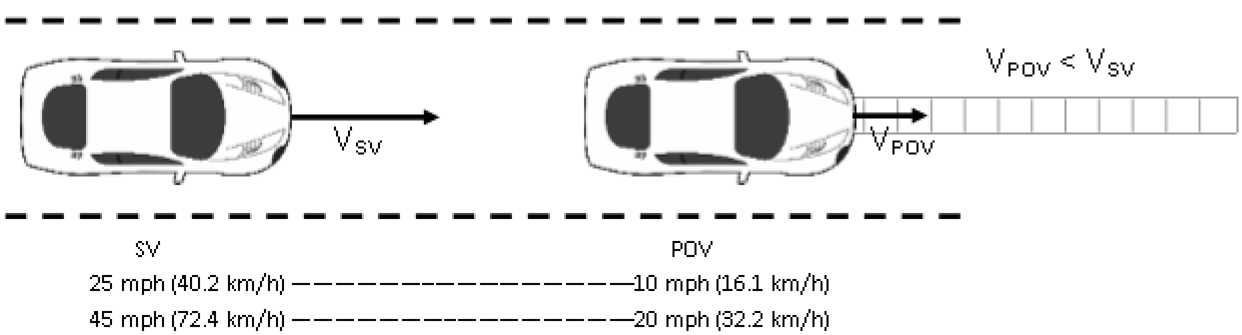


Figure 2. Depiction of Test 2

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 → t_{FCW}	110 ft (34 m) → 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 → t_{FCW}	183 ft (56 m) → t_{FCW}	Within 500 ms of FCW1 onset	Varies	1.0	37 ft (11 m)

b. Criteria

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

3. <u>TEST 3 – SUBJECT VEHICLE ENCOUNTERS DECELERATING PRINCIPAL OTHER VEHICLE</u>

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.

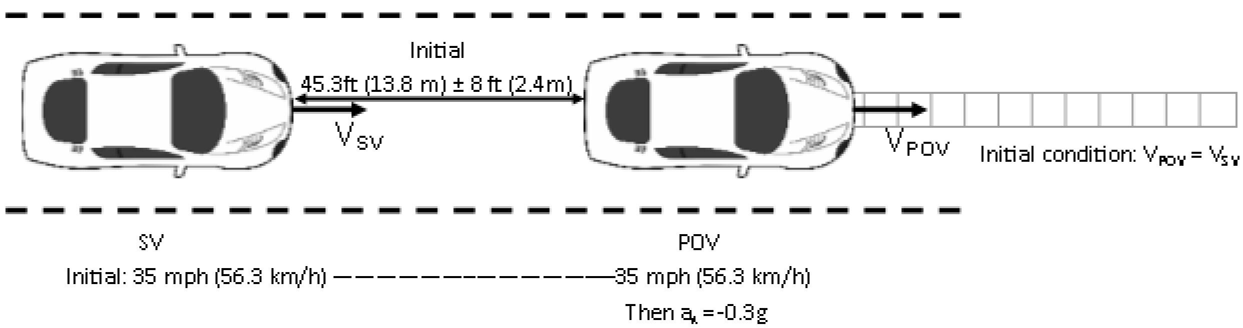


Figure 3. Depiction of Test 3

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. <u>TEST 4 – FALSE POSITIVE SUPPRESSION</u>

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 ± 5%
Tactile	5^{th}	3 dB	60 dB	Identified Center Frequency ± 20%

2. GENERAL VALIDITY CRITERIA

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

- The SV driver seatbelt was latched.
- If any load had been placed on the SV front passenger seat (e.g., for instrumentation), the vehicle's front passenger seatbelt was latched.
- The SV was driven at the nominal speed in the center of the travel lane, toward the POV or STP.
- The driver used the least amount of steering input necessary to maintain SV position in the center of the travel lane during the validity period; use of abrupt steering inputs or corrections was avoided.
- The yaw rate of the SV did not exceed ±1.0 deg/s from the onset of the validity period to the instant SV deceleration exceeded 0.25 g.
- The SV driver did not apply any force to the brake pedal during the during the applicable validity period. All braking shall be performed by the programmable brake controller.
- The lateral distance between the centerline of the SV and the centerline of the POV or STP did not deviate more than ±1 ft (0.3 m) during the applicable validity period.

3. VALIDITY PERIOD

The valid test interval began:

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

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

Test 3: 3 seconds before the onset of POV braking

Test 4: 2 seconds prior to the SV throttle pedal being released

The valid test interval ended:

Test 1: When either of the following occurred:

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

Test 2: When either of the following occurred:

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

Test 3: When either of the following occurred:

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

Test 4: When the SV stopped.

4. STATIC INSTRUMENTATION CALIBRATION

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

For Tests 1, 2, and 3, the SV, POV, and POV moving platform and tow vehicle were centered in the same travel lane with the same orientation (i.e., facing the same direction). For Test 4, the SV and STP were centered in the same travel lane.

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

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

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

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

5. NUMBER OF TRIALS

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

6. TRANSMISSION

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

C. Principal Other Vehicle

DBS testing requires a POV that realistically represents typical vehicles, does not suffer damage or cause damage to a test vehicle in the event of collision, and can be accurately positioned and moved during the tests. The tests reported herein made use of the NHTSA developed Strikeable Surrogate Vehicle (SSV).

This SSV system was designed specifically for common rear-end crash scenarios which AEB systems address. The key 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: 2/10/2021 Due: 2/10/2022
Linear (string) encoder	Throttle pedal travel	10 in	0.1 in	UniMeasure LX-EP	50060726	By: DRI Date: 6/19/2020 Due: 6/19/2021
Load Cell	Force applied to brake pedal					By: DRI
		0 - 250 lb 0 -1112 N	0.1% FS	Honeywell 41A	1464391	Date: 2/4/2021 Due: 2/4/2022
		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 ± 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: ±0.02m/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)	±5g	≤ 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	±.0020 in. ±.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

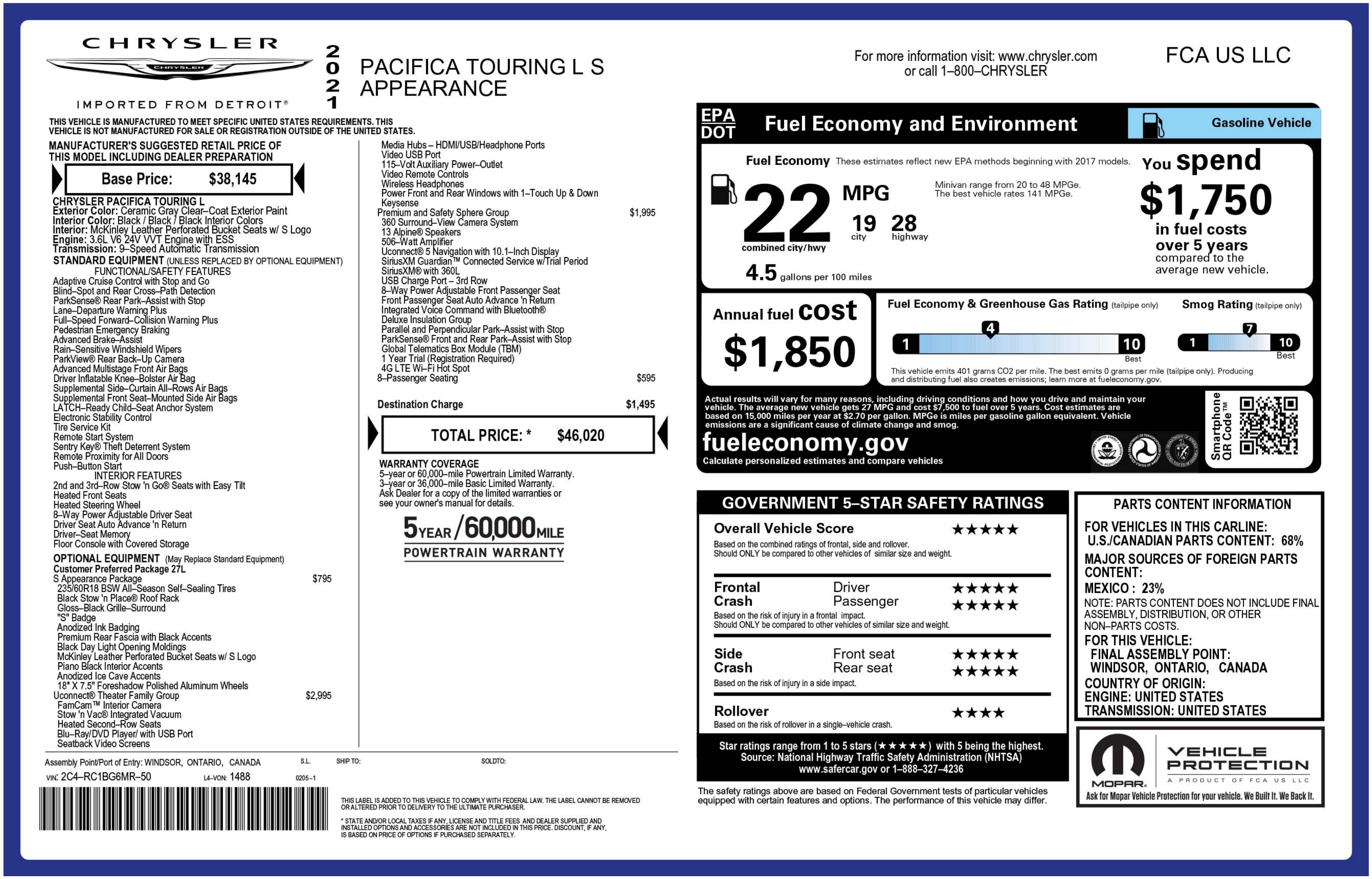
APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle



CHRYSLER

IMPORTED FROM DETROIT®

2021 PACIFICA TOURING L S APPEARANCE

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FCA US LLC

THIS VEHICLE IS MANUFACTURED TO MEET SPECIFIC UNITED STATES REQUIREMENTS. THIS VEHICLE IS NOT MANUFACTURED FOR SALE OR REGISTRATION OUTSIDE OF THE UNITED STATES.

MANUFACTURER'S SUGGESTED RETAIL PRICE OF THIS MODEL INCLUDING DEALER PREPARATION

Base Price: $38,145

CHRYSLER PACIFICA TOURING L
Exterior Color: Ceramic Gray Clear–Coat Exterior Paint
Interior Color: Black / Black / Black Interior Colors
Interior: McKinley Leather Perforated Bucket Seats w/ S Logo
Engine: 3.6L V6 24V VVT Engine with ESS
Transmission: 9–Speed Automatic Transmission

STANDARD EQUIPMENT (UNLESS REPLACED BY OPTIONAL EQUIPMENT)

FUNCTIONAL/SAFETY FEATURES
Adaptive Cruise Control with Stop and Go
Blind–Spot and Rear Cross–Path Detection
ParkSense® Rear Park–Assist with Stop
Lane–Departure Warning Plus
Full–Speed Forward–Collision Warning Plus
Pedestrian Emergency Braking
Advanced Brake–Assist
Rain–Sensitive Windshield Wipers
ParkView® Rear Back–Up Camera
Advanced Multistage Front Air Bags
Driver Inflatable Knee–Bolster Air Bag
Supplemental Side–Curtain All–Rows Air Bags
Supplemental Front Seat–Mounted Side Air Bags
LATCH–Ready Child–Seat Anchor System
Electronic Stability Control
Tire Service Kit
Remote Start System
Sentry Key® Theft Deterrent System
Remote Proximity for All Doors
Push–Button Start

INTERIOR FEATURES
2nd and 3rd–Row Stow 'n Go® Seats with Easy Tilt
Heated Front Seats
Heated Steering Wheel
8–Way Power Adjustable Driver Seat
Driver Seat Auto Advance 'n Return
Driver–Seat Memory
Floor Console with Covered Storage

OPTIONAL EQUIPMENT (May Replace Standard Equipment)
Customer Preferred Package 27L
S Appearance Package $795
235/60R18 BSW All–Season Self–Sealing Tires
Black Stow 'n Place® Roof Rack
Gloss–Black Grille–Surround
"S" Badge
Anodized Ink Badging
Premium Rear Fascia with Black Accents
Black Day Light Opening Moldings
McKinley Leather Perforated Bucket Seats w/ S Logo
Piano Black Interior Accents
Anodized Ice Cave Accents
18" X 7.5" Foreshadow Polished Aluminum Wheels
Uconnect® Theater Family Group $2,995
FamCam™ Interior Camera
Stow 'n Vac® Integrated Vacuum
Heated Second–Row Seats
Blu–Ray/DVD Player/ with USB Port
Seatback Video Screens
Media Hubs – HDMI/USB/Headphone Ports
Video USB Port
115–Volt Auxiliary Power–Outlet
Video Remote Controls
Wireless Headphones
Power Front and Rear Windows with 1–Touch Up & Down
Keysense
Premium and Safety Sphere Group $1,995
360 Surround–View Camera System
13 Alpine® Speakers
506–Watt Amplifier
Uconnect® 5 Navigation with 10.1–Inch Display
SiriusXM Guardian™ Connected Service w/Trial Period
SiriusXM® with 360L
USB Charge Port – 3rd Row
8–Way Power Adjustable Front Passenger Seat
Front Passenger Seat Auto Advance 'n Return
Integrated Voice Command with Bluetooth®
Deluxe Insulation Group
Parallel and Perpendicular Park–Assist with Stop
ParkSense® Front and Rear Park–Assist with Stop
Global Telematics Box Module (TBM)
1 Year Trial (Registration Required)
4G LTE Wi–Fi Hot Spot
8–Passenger Seating $595

Destination Charge $1,495

TOTAL PRICE: * $46,020

WARRANTY COVERAGE
5–year or 60,000–mile Powertrain Limited Warranty.
3–year or 36,000–mile Basic Limited Warranty.
Ask Dealer for a copy of the limited warranties or see your owner's manual for details.

5 YEAR / 60,000 MILE POWERTRAIN WARRANTY

Assembly Point/Port of Entry: WINDSOR, ONTARIO, CANADA S.L. SHIP TO: SOLDTO:
VIN: 2C4–RC1BG6MR–50 L4–VON: 1488 0205–1

THIS LABEL IS ADDED TO THIS VEHICLE TO COMPLY WITH FEDERAL LAW. THE LABEL CANNOT BE REMOVED OR ALTERED PRIOR TO DELIVERY TO THE ULTIMATE PURCHASER.

* STATE AND/OR LOCAL TAXES IF ANY, LICENSE AND TITLE FEES AND DEALER SUPPLIED AND INSTALLED OPTIONS AND ACCESSORIES ARE NOT INCLUDED IN THIS PRICE. DISCOUNT, IF ANY, IS BASED ON PRICE OF OPTIONS IF PURCHASED SEPARATELY.

EPA DOT Fuel Economy and Environment — Gasoline Vehicle

Fuel Economy — These estimates reflect new EPA methods beginning with 2017 models.
22 MPG combined city/hwy; 19 city; 28 highway
Minivan range from 20 to 48 MPGe. The best vehicle rates 141 MPGe.
4.5 gallons per 100 miles

You spend $1,750 in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost $1,850

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 4 (1–10, 10 Best)
Smog Rating (tailpipe only): 7 (1–10, 10 Best)

This vehicle emits 401 grams CO2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also creates emissions; learn more at fueleconomy.gov.

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 cost $7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $2.70 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

GOVERNMENT 5–STAR SAFETY RATINGS

Overall Vehicle Score ★★★★★
Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash — Driver ★★★★★; Passenger ★★★★★
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.

Side Crash — Front seat ★★★★★; Rear seat ★★★★★
Based on the risk of injury in a side impact.

Rollover ★★★★
Based on the risk of rollover in a single–vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA) www.safercar.gov or 1–888–327–4236

The safety ratings above are based on Federal Government tests of particular vehicles equipped with certain features and options. The performance of this vehicle may differ.

PARTS CONTENT INFORMATION
FOR VEHICLES IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 68%
MAJOR SOURCES OF FOREIGN PARTS CONTENT:
MEXICO: 23%
NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON–PARTS COSTS.
FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: WINDSOR, ONTARIO, CANADA
COUNTRY OF ORIGIN:
ENGINE: UNITED STATES
TRANSMISSION: UNITED STATES

MOPAR. VEHICLE PROTECTION — A PRODUCT OF FCA US LLC
Ask for Mopar Vehicle Protection for your vehicle. We Built It. We Back It.

Figure A3. Window Sticker (Monroney Label)

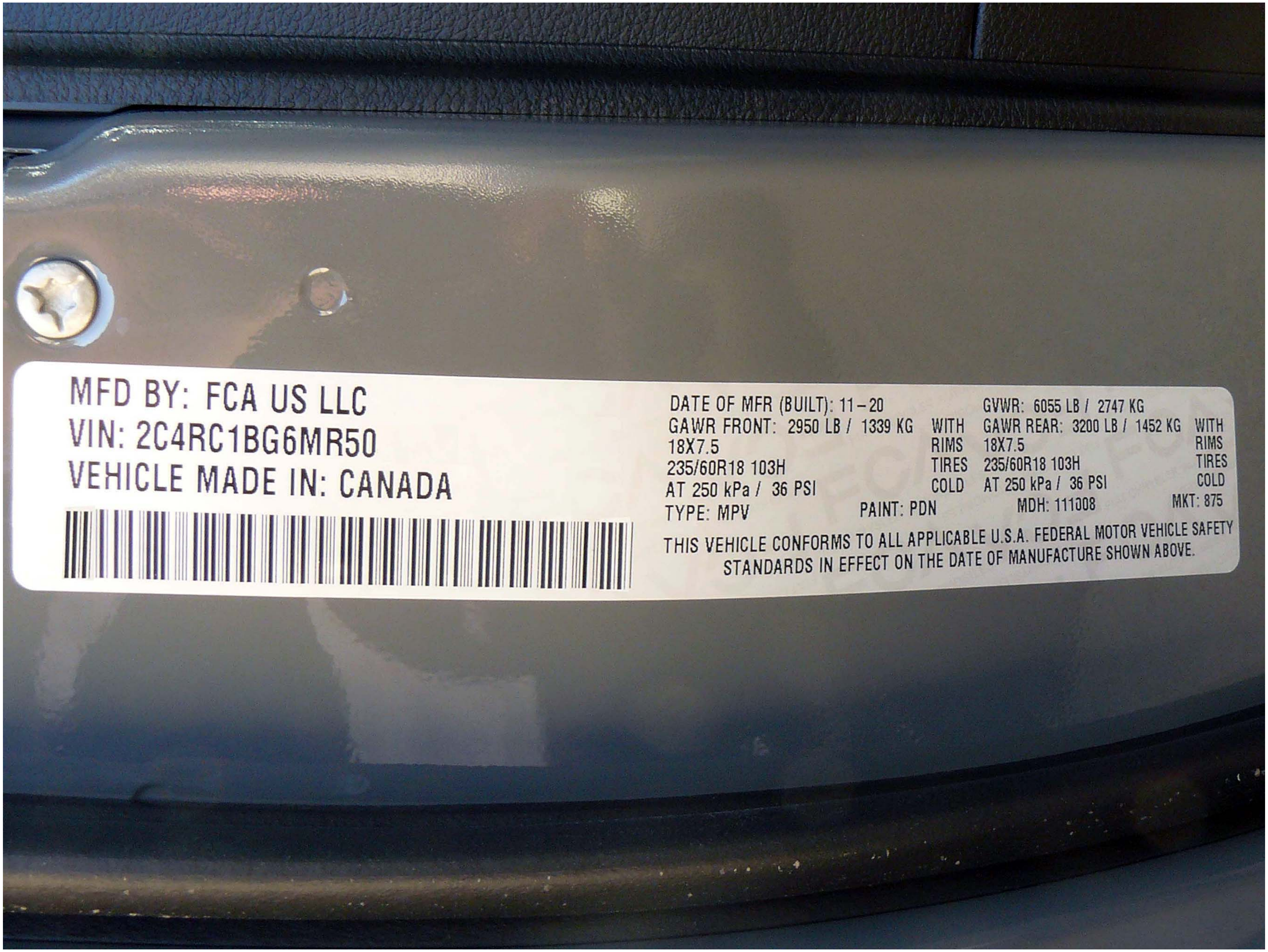

Figure A4. Vehicle Certification Label

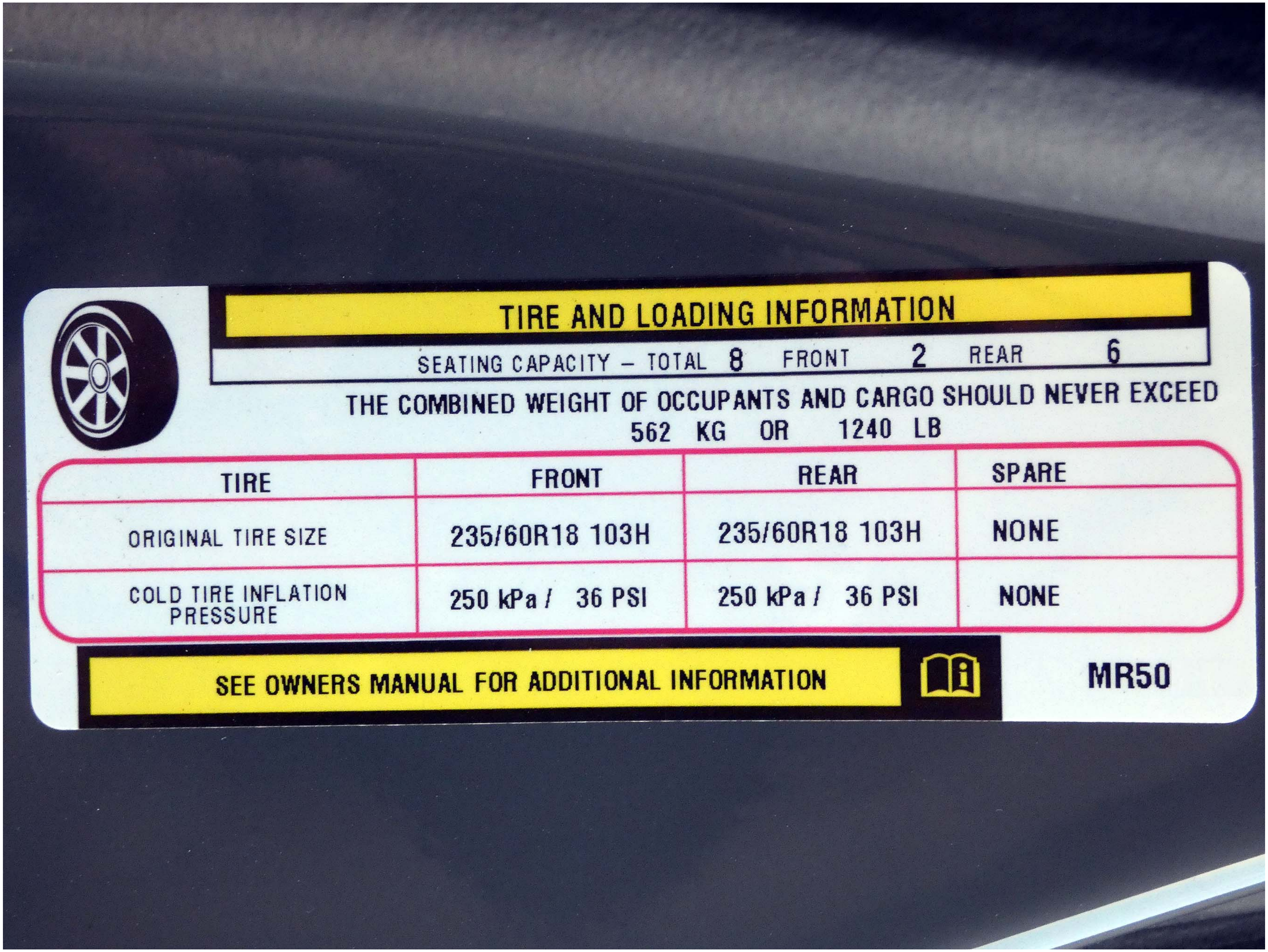

Figure A5. Tire Placard

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

Figure A7. Load Frame/Slider of SSV

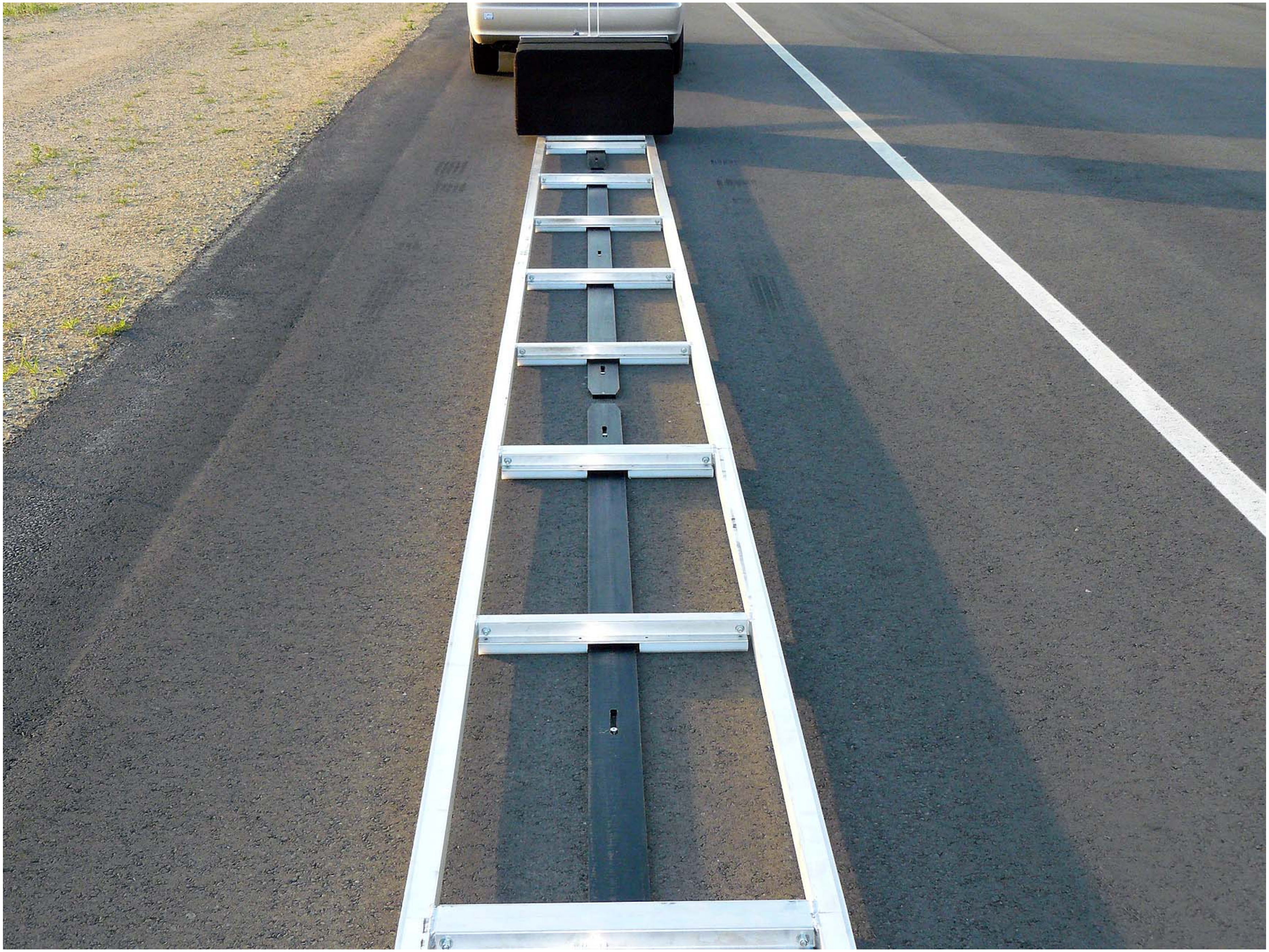

Figure A8. Two-Rail Track and Road-Based Lateral Restraint Track

Figure A9. Steel Trench Plate

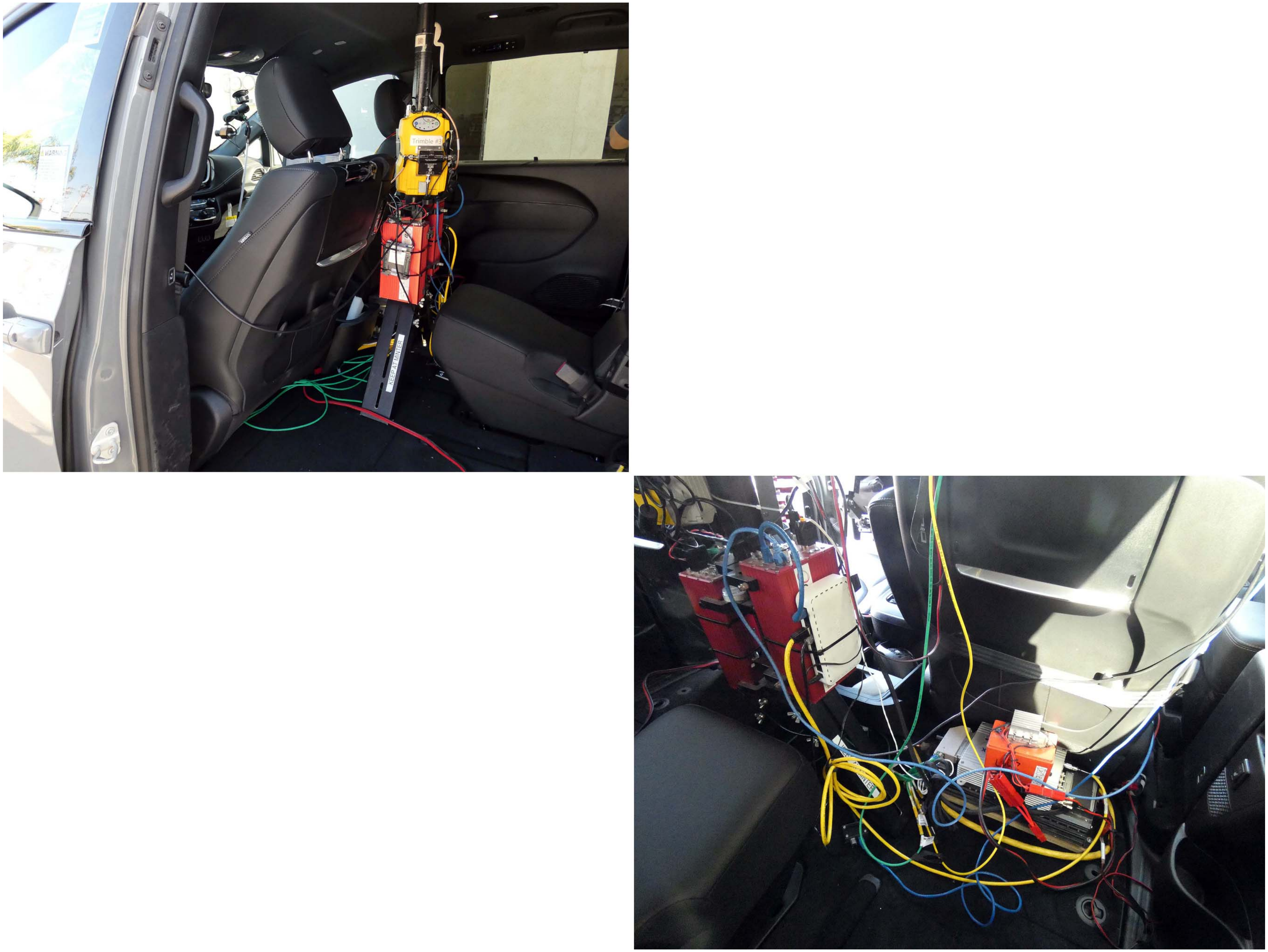

Figure A10. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A11. Sensors for Detecting Visual and Auditory Alerts

Figure A12. Computer and Brake Actuator Installed in Subject Vehicle

Figure A13. Brake Actuator Installed in POV System

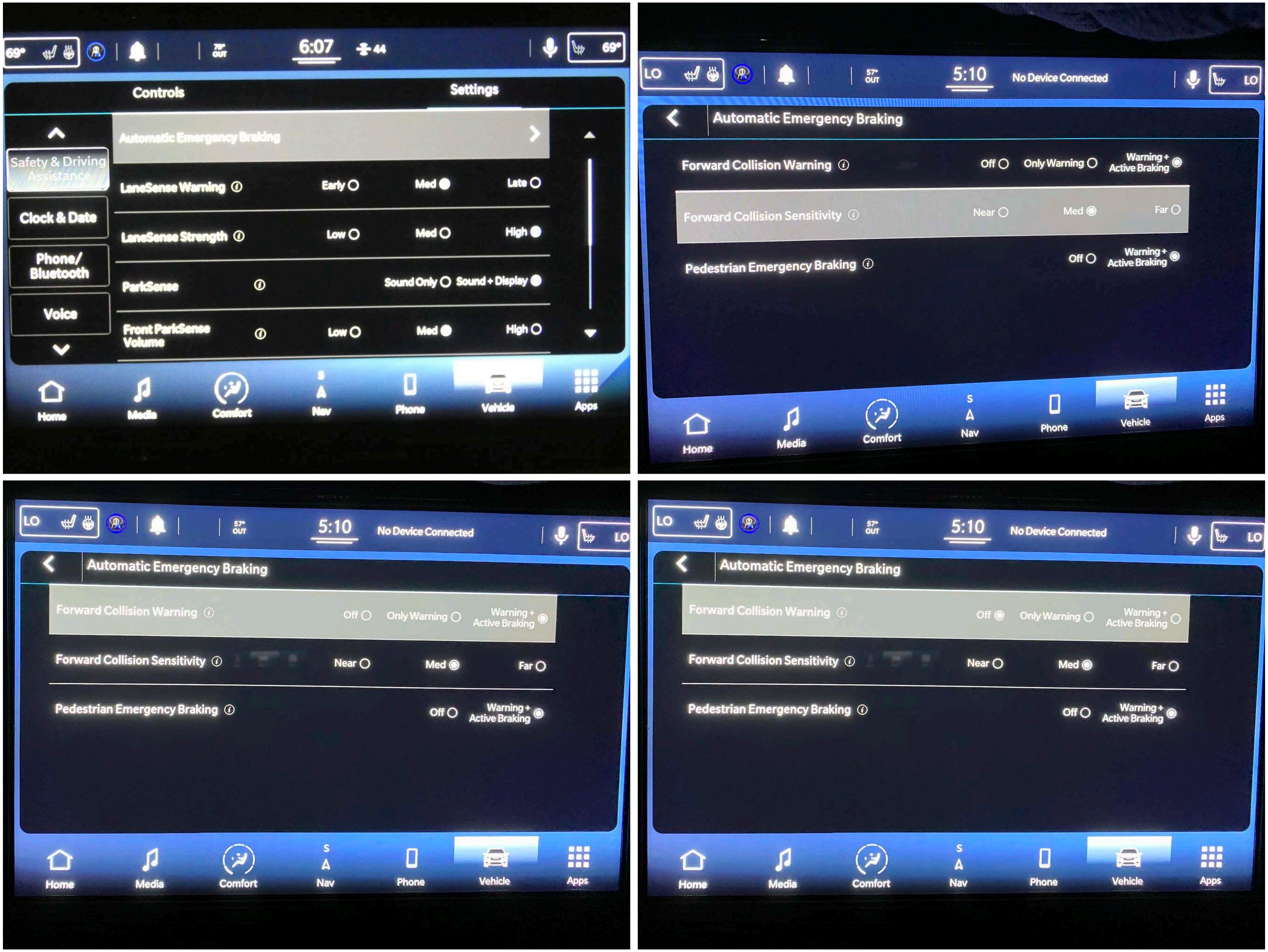

Figure A14. AEB Setup Menus

Figure A15. Visual Alert

APPENDIX B

Excerpts from Owner's Manual

Yellow Indicator Lights

Automatic Emergency Braking (AEB) OFF Indicator Light — If Equipped

This indicator light illuminates to indicate that Forward Collision Warning is off.

Green Indicator Lights

Adaptive Cruise Control (ACC) Set With Target Vehicle Detected Light — If Equipped

This indicator light will illuminate when the Adaptive Cruise Control speed is SET and the vehicle in front is detected ➩ page 165.

Adaptive Cruise Control (ACC) Set With No Target Detected Light — If Equipped

This indicator light will illuminate when the Adaptive Cruise Control speed is SET and there is no vehicle in front detected ➩ page 165.

Cruise Control Set Indicator Light — If Equipped

This indicator light will illuminate when the cruise control is set to the desired speed ➩ page 164.

Front Fog Indicator Light — If Equipped

This indicator light will illuminate when the front fog lights are on.

KeySense Indicator Light — If Equipped

The KeySense indicator is illuminated when a KeySense key is detected upon startup of the vehicle. The indicator will remain lit for the entire key cycle as a reminder that the KeySense key is in use. While the KeySense key is in use, the vehicle will respond to settings associated with the KeySense profile ➩ page 14.

LaneSense Indicator Light — If Equipped

The LaneSense indicator light illuminates solid green when both lane markings have been detected and the system is “armed” and ready to provide visual and torque warnings if an unintentional lane departure occurs ➩ page 187.

Park/Headlight On Indicator Light

This indicator light will illuminate when the park lights or headlights are turned on.

Stop/Start Active Indicator Light — If Equipped

This indicator light will illuminate when the Stop/Start function is in “Autostop” mode ➩ page 161.

Turn Signal Indicator Lights

When the left or right turn signal is activated, the turn signal indicator will flash independently and the corresponding exterior turn signal lamps will flash. Turn signals can be activated when the multifunction lever is moved down (left) or up (right).

NOTE:

- A continuous chime will sound if the vehicle is driven more than 1 mile (1.6 km) with either turn signal on.
- Check for an inoperative outside light bulb if either indicator flashes at a rapid rate.

ACC will allow you to keep Cruise Control engaged in light to moderate traffic conditions without the constant need to reset your Cruise Control. ACC utilizes a radar sensor and a forward facing camera designed to detect a vehicle directly ahead of you.

NOTE:

- If the ACC sensor detects a vehicle ahead, ACC will apply limited braking or accelerate (not to exceed the original set speed) automatically to maintain a preset following distance, while matching the speed of the vehicle ahead.
- Any chassis/suspension or tire size modifications to the vehicle will affect the performance of the Adaptive Cruise Control and Forward Collision Warning system.
- Fixed Speed Cruise Control alone (an ACC distance not set) will not detect vehicles directly ahead of you. Always be aware of the mode selected.

WARNING!

- Adaptive Cruise Control (ACC) is a convenience system. It is not a substitute for active driver involvement. It is always the driver's responsibility to be attentive of road, traffic, and weather conditions, vehicle speed, distance to the vehicle ahead; and, most importantly, brake operation to ensure safe operation of the vehicle under all road conditions. Your complete attention is always required while driving to maintain safe control of your vehicle. Failure to follow these warnings can result in a collision and death or serious personal injury.
- The ACC system:
  - Does not react to pedestrians, oncoming vehicles, and stationary objects (e.g., a stopped vehicle in a traffic jam or a disabled vehicle).
  - Cannot take street, traffic, and weather conditions into account, and may be limited upon adverse sight distance conditions.

(Continued)

WARNING! *(Continued)*

  - Does not always fully recognize complex driving conditions, which can result in wrong or missing distance warnings.
  - Will bring the vehicle to a complete stop while following a target vehicle and hold the vehicle for approximately three minutes in the stop position. If the target vehicle does not start moving within three minutes the parking brake will be activated, and the ACC system will be cancelled.

You should switch off the ACC system:

- When driving in fog, heavy rain, heavy snow, sleet, heavy traffic, and complex driving situations (i.e., in highway construction zones).
- When entering a turn lane or highway off ramp; when driving on roads that are winding, icy, snow-covered, slippery, or have steep uphill or downhill slopes.
- When towing a trailer up or down steep slopes.
- When circumstances do not allow safe driving at a constant speed.

To increase the distance setting, push the Distance Increase button and release. Each time the button is pushed, the distance setting increases by one bar (longer).

To decrease the distance setting, push the Distance Decrease button and release. Each time the button is pushed, the distance setting decreases by one bar (shorter).

If there is no vehicle ahead, the vehicle will maintain the set speed. If a slower moving vehicle is detected in the same lane, the instrument cluster displays the ACC Set With Target Detected Indicator Light, and the system adjusts vehicle speed automatically to maintain the distance setting, regardless of the set speed.

The vehicle will then maintain the set distance until:

- The vehicle ahead accelerates to a speed above the set speed.
- The vehicle ahead moves out of your lane or view of the sensor.
- The distance setting is changed.
- The system disengages ➪ page 168.

The maximum braking applied by ACC is limited; however, the driver can always apply the brakes manually, if necessary.

NOTE:
The brake lights will illuminate whenever the ACC system applies the brakes.

A Proximity Warning will alert the driver if ACC predicts that its maximum braking level is not sufficient to maintain the set distance. If this occurs, a visual alert “BRAKE” will flash in the instrument cluster display and a chime will sound while ACC continues to apply its maximum braking capacity.

NOTE:
The “BRAKE!” screen in the instrument cluster display is a warning for the driver to take action and does not necessarily mean that the Forward Collision Warning system is applying the brakes autonomously.

Overtake Aid

When driving with Adaptive Cruise Control (ACC) engaged and following a vehicle, the system will provide an additional acceleration up to the ACC set speed to assist in passing the vehicle. This additional acceleration is triggered when the driver utilizes the left turn signal and will only be active when passing on the left hand side.

ACC Operation At Stop

In the event that the ACC system brings your vehicle to a standstill while following the vehicle in front, your vehicle will resume motion, without the need for any driver action, if the vehicle in front starts moving within two seconds.

If the vehicle in front does not start moving within two seconds of your vehicle coming to a standstill, the driver will either have to push the RES button, or press the accelerator to reengage the ACC to the existing set speed.

NOTE:
After the ACC system holds your vehicle at a standstill for approximately three consecutive minutes, the parking brake will be activated, and the ACC system will be cancelled.

While the ACC system is holding your vehicle at a standstill, if the driver seat belt is unbuckled or the driver door is opened, the parking brake will be activated, and the ACC system will be cancelled.

KeySense

The vehicle’s KeySense settings are protected by a unique four-digit PIN, which the vehicle owner creates when accessing the specific settings for the first time. This four-digit PIN can only be reset by an authorized dealer.

After pressing the KeySense button on the touchscreen, and entering the KeySense PIN, the following settings will be available:

Setting Name	Description
Forward Collision Warning Sensitivity — If Equipped	This setting will change the distance at which the Forward Collision Warning (FCW) alert sounds. The “Medium” setting will have the FCW system signal when an object is in view, and the possibility of a collision is detected. The “Near” setting will have the FCW system signal when the object is closer to the vehicle. The “Far” setting will have the FCW system signal when an object is at a far distance from the vehicle.
Forward Collision Warning — If Equipped	This setting will turn the Forward Collision Warning (FCW) system on or off. The “Warning Only” setting will provide only an audible chime when a collision is detected. The “Warning + Active Braking” setting will provide an audible chime and apply some brake pressure when a collision is detected.
ParkSense — If Equipped	This setting will change the type of ParkSense alert when a close object is detected. The “Sound Only” setting will provide an audible chime when an object is detected. The “Sound and Display” setting will provide both an audible chime and a visual display when an object is detected.
Front ParkSense Volume — If Equipped	This setting adjusts the volume of the Front ParkSense system. The available settings are “Low”, “Medium”, and “High”.

Safety & Driving Assistance

After pressing the Safety & Driving Assistance button on the touchscreen, the following settings will be available:

Setting Name	Description
Forward Collision Warning Sensitivity — Located In Automatic Emergency Braking Sub-Menu	This setting will change the distance at which the Forward Collision Warning (FCW) alert sounds. The “Medium” setting will have the FCW system signal when an object is in view, and the possibility of a collision is detected. The “Near” setting will have the FCW system signal when the object is closer to the vehicle. The “Far” setting will have the FCW system signal when an object is at a far distance from the vehicle.
Forward Collision Warning — Located In Automatic Emergency Braking Sub-Menu	This setting will turn the Forward Collision Warning system on or off. The “Off” setting will deactivate the FCW system. The “Warning Only” setting will provide only an audible chime when a collision is detected. The “Warning + Active Braking” setting will provide an audible chime and apply some brake pressure when a collision is detected.
Pedestrian Emergency Braking — Located In Automatic Emergency Braking Sub-Menu	This setting will turn the pedestrian emergency braking system on or off.
LaneSense Warning	This setting will change the distance at which the steering wheel will provide lane departure feedback. The available settings are “Early”, “Medium”, and “Late”.
LaneSense Strength	This setting will change the strength of the steering wheel feedback during a lane departure. The available setting are “Low”, “Medium”, and “High”.

Forward Collision Warning (FCW) With Mitigation — If Equipped

FCW with Mitigation provides the driver with audible warnings, visual warnings (within the instrument cluster display), and may apply a brake jerk to warn the driver when it detects a potential frontal collision. The warnings and limited braking are intended to provide the driver with enough time to react, avoid or mitigate the potential collision.

NOTE:
FCW monitors the information from the forward looking sensors as well as the Electronic Brake Controller (EBC), to calculate the probability of a forward collision. When the system determines that a forward collision is probable, the driver will be provided with audible and visual warnings and may provide a brake jerk warning.

If the driver does not take action based upon these progressive warnings, then the system will provide a limited level of active braking to help slow the vehicle and mitigate the potential forward collision. If the driver reacts to the warnings by braking and the system determines that the driver intends to avoid the collision by braking but has not applied sufficient brake force, the system will compensate and provide additional brake force as required.

If a FCW with Mitigation event begins at a speed below 37 mph (60 km/h), the system may provide the maximum braking possible to mitigate the potential forward collision. If the Forward Collision Warning with Mitigation event stops the vehicle completely, the system will hold the vehicle at standstill for two seconds and then release the brakes. If a pedestrian is encountered in the path at the same speed threshold, the system will attempt to bring the vehicle to a stop.

FCW Message

When the system determines a collision with the vehicle in front of you is no longer probable, the warning message will be deactivated ➩ page 417.

NOTE:

- The minimum speed for FCW activation is 1 mph (2 km/h).
- The FCW alerts may be triggered on objects other than vehicles such as guard rails or sign posts based on the course prediction. This is expected and is a part of normal FCW activation and functionality.
- It is unsafe to test the FCW system. To prevent such misuse of the system, after four Active Braking events within a key cycle, the Active Braking portion of FCW will be deactivated until the next key cycle.
- The FCW system is intended for on-road use only. If the vehicle is taken off-road, the FCW system should be deactivated to prevent unnecessary warnings to the surroundings.

6

WARNING!

Forward Collision Warning (FCW) is not intended to avoid a collision on its own, nor can FCW detect every type of potential collision. The driver has the responsibility to avoid a collision by controlling the vehicle via braking and steering. Failure to follow this warning could lead to serious injury or death.

Turning FCW On Or Off

The Forward Collision menu setting is located in the Uconnect settings.

NOTE:
The default status of FCW is “on”, this allows the system to warn you of a possible collision with the vehicle in front of you.

Changing the FCW status to “off” deactivates the system, so no warning or active braking will be available in case of a possible collision.

NOTE:

- The FCW system state is kept in memory from one key cycle to the next. If the system is turned off, it will remain off when the vehicle is restarted.
- FCW can work in conjunction with the KeySense function of the vehicle (if equipped) ➩ page 124.

FCW Braking Status And Sensitivity

The FCW Sensitivity and Active Braking status are programmable through the Uconnect system ➩ page 210.

The default sensitivity of FCW is the “Medium” setting and the system status is “Warning & Braking”. This allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warnings and it applies autonomous braking.

By changing the FCW status setting to "Far", the system provides possible collision warnings on objects farther away. This results in earlier warnings and provides the most reaction time to avoid possible collisions

By changing the FCW status setting to "Near", the system provides possible collision warnings on objects closer to the vehicle. This results in later warnings and provides less reaction time than the "Far" and "Medium" settings, which allows for a more dynamic driving experience.

NOTE:

- Changing the FCW status to “Only Warning” prevents the system from providing limited active braking, or additional brake support if the driver is not braking adequately in the event of a potential frontal collision, but maintains the audible and visual warnings.
- Changing the FCW status to “Off” prevents the system from providing autonomous braking, or additional brake support if the driver is not braking adequately in the event of a potential frontal collision.
- The system will retain the last setting selected by the driver after ignition shut down.
- FCW may not react to irrelevant objects such as overhead objects, ground reflections, objects not in the path of the vehicle, stationary objects that are far away, oncoming traffic, or leading vehicles with the same or higher rates of speed.
- FCW will be disabled like ACC, with the unavailable screens.

FCW Limited Warning

If the instrument cluster displays “ACC/FCW Limited Functionality” or “ACC/FCW Limited Functionality Clean Front Windshield” momentarily, there may be a condition that limits FCW functionality. Although the vehicle is still drivable under normal conditions, the active braking may not be fully available. Once the condition that limited the system performance is no longer present, the system will return to its full performance state. If the problem persists, see an authorized dealer.

Service FCW Warning

If the system turns off, and the instrument cluster displays:

- ACC/FCW Unavailable Service Required
- Cruise/FCW Unavailable Service Required

This indicates there is an internal system fault. Although the vehicle is still drivable under normal conditions, have the system checked by an authorized dealer.

Pedestrian Emergency Braking (PEB) — If Equipped

The Pedestrian Emergency Braking (PEB) is a subsystem of the FCW system which provides the driver with audible and visual warnings in the instrument cluster display, and may apply automatic braking when it detects a potential frontal collision with a pedestrian.

If a PEB event begins at a speed below 37 mph (60 km/h), the system may provide braking to mitigate the potential collision with a pedestrian. If the PEB event stops the vehicle completely, the system will hold the vehicle at a standstill for two seconds and then release the brakes. When the system determines a collision with the pedestrian in front of you is no longer probable, the warning message will be deactivated.

The minimum speed for PEB activation is 3 mph (5 km/h).

WARNING!

Pedestrian Emergency Braking (PEB) is not intended to avoid a collision on its own, nor can PEB detect every type of potential collision with a pedestrian. The driver has the responsibility to avoid a collision by controlling the vehicle via braking and steering. Failure to follow this warning could lead to serious injury or death.

Turning PEB On Or Off

NOTE:
The default status of PEB is “On.” This allows the system to warn you of a possible frontal collision with the pedestrian.

The PEB button is located in the Uconnect display in the Controls settings ➩ page 210.

To turn the PEB system off, push the Pedestrian Emergency Braking button once.

APPENDIX C

Run Log

Subject Vehicle: **2021 Chrysler Pacifica Touring L S Appearance** Test Date: **4/4/2021**

Principal Other Vehicle: **SSV**

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
1-14	Brake characterization and determination						See Appendix D
15	Static Run						Zero SV front bumper to SSV rear bumper and collect data
16	**Stopped POV**	N					Brake application rate
17		N					Brake application rate
18		Y	1.60	0.20	1.09	Pass	
19		N					Brake zero
20		Y	1.60	0.00	0.90	Fail	
21		Y	1.58	3.88	1.12	Pass	
22		Y	1.60	0.00	0.83	Fail	
23		Y	1.50	0.00	0.82	Fail	
24		Y	1.64	0.00	0.89	Fail	
25		Y	1.32	0.00	0.46	Fail	
26	Static Run						
27	**Slower POV, 25 vs 10**	Y	1.98	1.11	0.56	Pass	
28		Y	1.82	1.73	0.59	Pass	
29		Y	1.81	1.49	0.59	Pass	
30		Y	1.94	1.42	0.59	Pass	
31		Y	1.93	1.48	0.60	Pass	
32		Y	1.98	1.31	0.58	Pass	

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
33	**Slower POV, 25 vs 10**	Y	1.94	1.71	0.60	Pass	
34	Static run						Check zero data is within ± 0.167 ft (±0.05m)
35	Static run						Check zero data is within ± 0.167 ft (±0.05m)
36	**Slower POV, 45 vs 20**	Y	1.99	0.34	1.10	Pass	
37		N					Brake zero
38		N					Foot touched throttle encoder string
39		N					Brake force zero
40		Y	2.03	1.39	1.02	Pass	
41		Y	2.13	0.16	0.99	Pass	
42		N					Average pedal force
43		Y	1.96	0.00	0.98	Fail	
44		Y	2.07	2.43	1.06	Pass	
45		N					Average pedal force
46		N					SV speed
47		N					Average pedal force
48		Y	2.09	1.92	1.06	Pass	
49		Y	2.17	4.61	1.04	Pass	
50	Static run						Check zero data is within ± 0.167 ft (±0.05m)

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
51	**Decelerating POV**	Y	1.65	0.00	0.53	Fail	
52		Y	1.56	0.00	0.49	Fail	
53		Y	1.42	0.00	0.51	Fail	
54		Y	1.77	0.00	0.56	Fail	
55		Y	1.57	0.00	0.51	Fail	
56		N					Lateral offset
57		Y	1.49	0.00	0.48	Fail	
58		N					Brake force zero
59		Y	1.75	0.00	0.59	Fail	
60	Static run						Check zero data is within ± 0.167 ft (±0.05m)
61	STP - Static run						Zero SV front bumper to rear edge of steel plate and collect data
62	**Baseline, 25**	Y			0.43		
63		Y			0.43		
64		Y			0.41		
65		Y			0.43		
66		Y			0.41		
67		Y			0.41		
68		Y			0.40		
69	STP - Static run						Check zero data is within ± 0.167 ft (±0.05m)
70	**Baseline, 45**	Y			0.50		
71		Y			0.53		

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
72	**Baseline, 45**	Y			0.53		
73		Y			0.52		
74		Y			0.50		
75		Y			0.51		
76		Y			0.51		
77	STP - Static run						Check zero data is within ± 0.167 ft (±0.05m)
78	**STP False Positive, 25**	Y			0.49	Pass	
79		Y			0.50	Pass	
80		N					Lateral offset
81		Y			0.47	Pass	
82		Y			0.45	Pass	
83		Y			0.48	Pass	
84		Y			0.47	Pass	
85		Y			0.46	Pass	
86	STP - Static run						Check zero data is within ± 0.167 ft (±0.05m)
87	**STP False Positive, 45**	Y			0.46	Pass	
88		Y			0.50	Pass	
89		Y			0.53	Pass	
90		Y			0.48	Pass	
91		Y			0.53	Pass	
92		Y			0.53	Pass	
93		Y			0.53	Pass	

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
94	STP - Static run						Check zero data is within ± 0.167 ft (±0.05m)

APPENDIX D

Brake Characterization

Subject Vehicle: **2021 Chrysler Pacifica Touring L S Appearance** Test Date: **4/4/2021**

DBS Initial Brake Characterization				
Run Number	**Stroke at 0.4 g (in)**	**Force at 0.4 g (lb)**	**Slope**	**Intercept**
1	3.88	26.08	0.48	-0.02
2	3.64	24.23	0.49	-0.04
3	3.51	23.06	0.50	-0.05

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	0.456	3.67		3.22	
5		35	Y	0.358	3.30		3.69	
6		35	Y	0.405	3.50		3.46	
7		25	Y	0.404	3.50		3.47	
8		45	Y	0.417	3.50		3.36	
9	**Hybrid**	35	Y	0.546		24.45	17.91	
10		35	Y	0.455		19.00	16.70	
11		35	Y	0.388		17.50	18.04	

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**
12	**Hybrid**	35	Y	0.422		18.00	17.06	
13		25	Y	0.424		18.00	16.98	
14		45	Y	0.408		18.00	17.65	

Appendix E

TIME HISTORY PLOTS

LIST OF FIGURES

Description of Time History Plots

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from both the Subject Vehicle (SV) and the Principal Other Vehicle (POV), as well as pass/fail envelopes and thresholds. 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 g ± 0.03 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 fore 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.

Notes

For valid runs, plots are shown for all warning types. In some cases, one of the plots may indicate that a run was invalid, but if the run was valid for either warning type it is considered valid. The companion plots are shown for the sake of completeness.

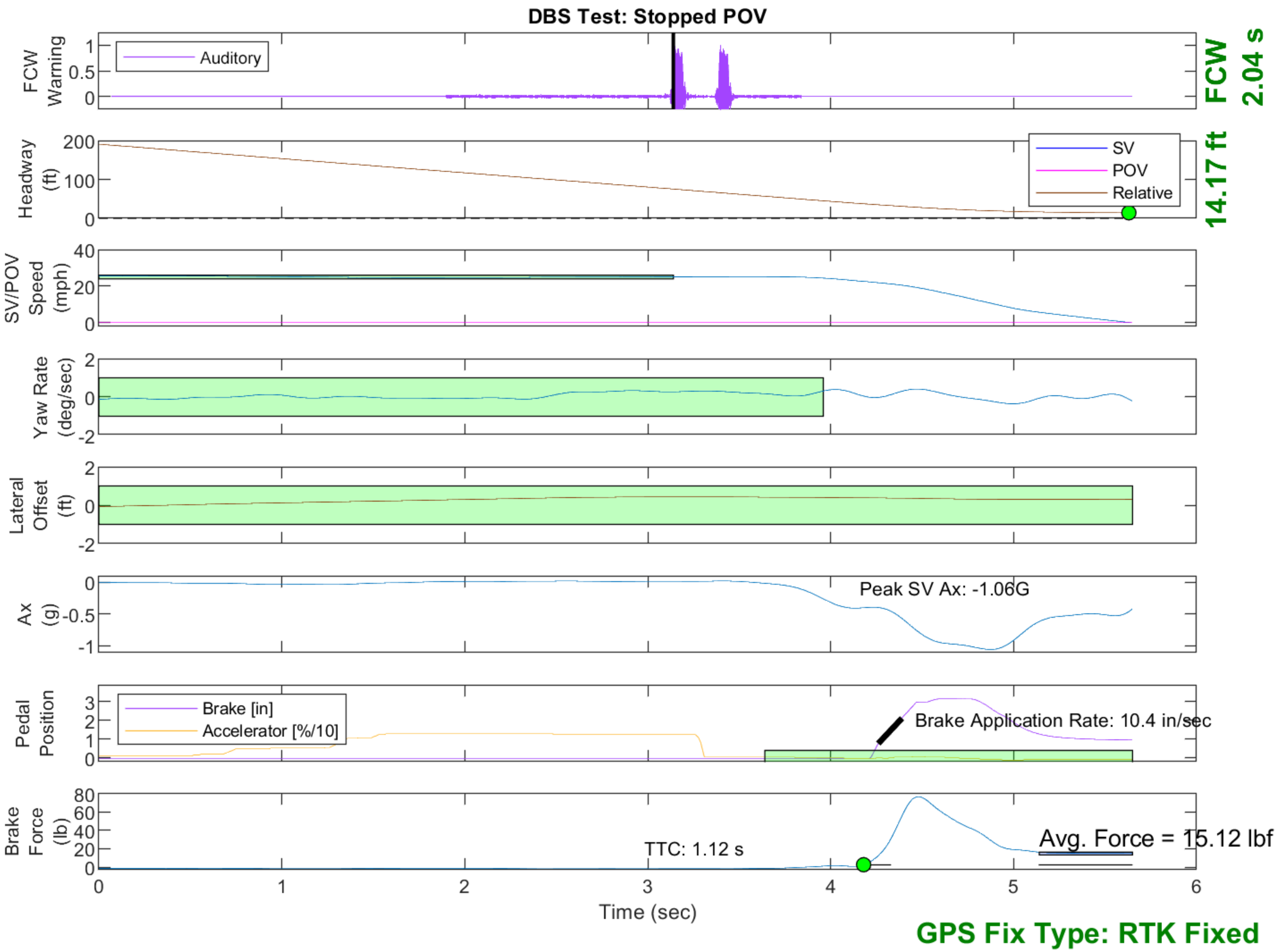

Figure E1. Example Time History for Stopped POV, Passing

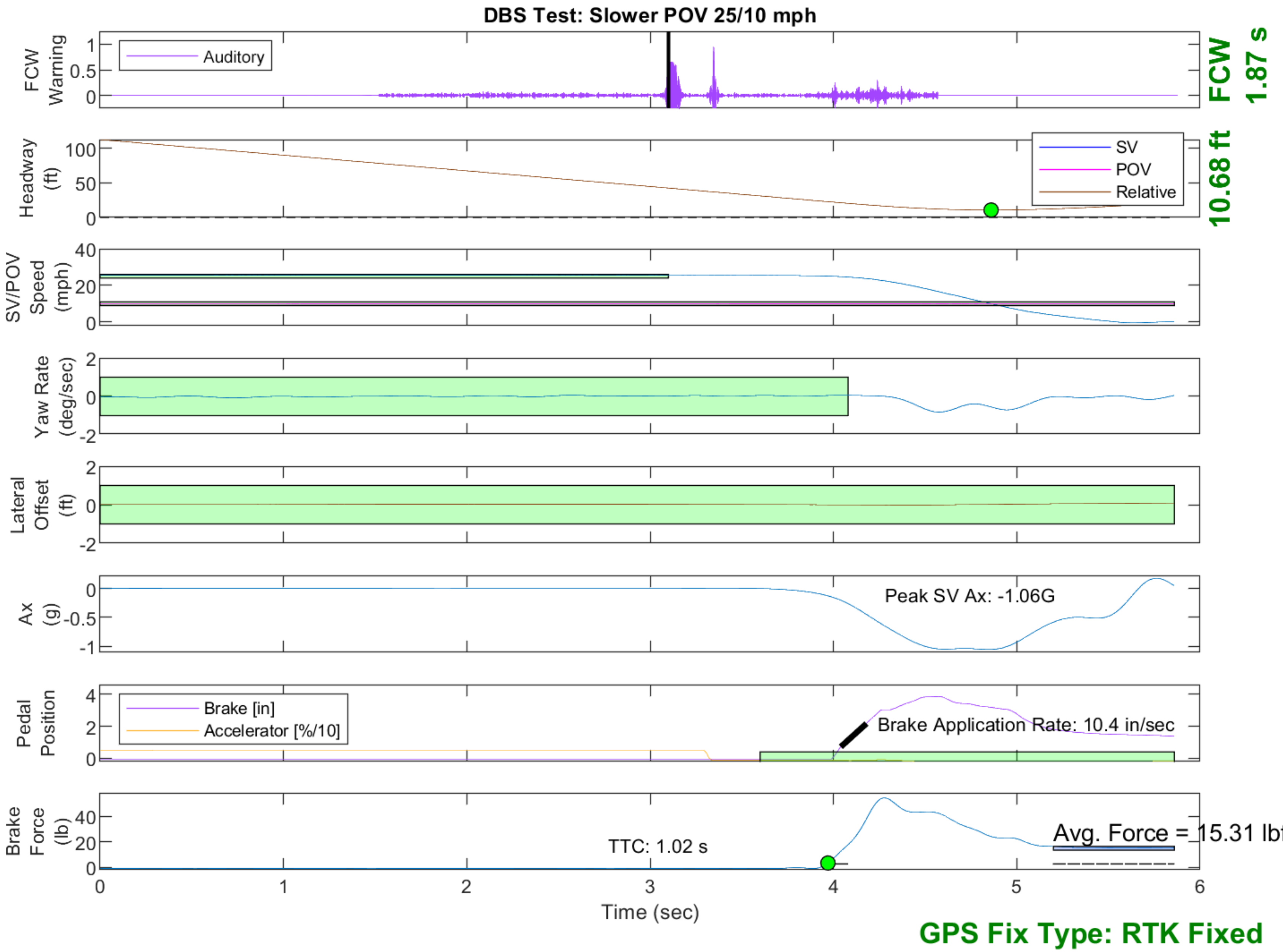

Figure E2. Example Time History for Slower POV 25 vs. 10, Passing

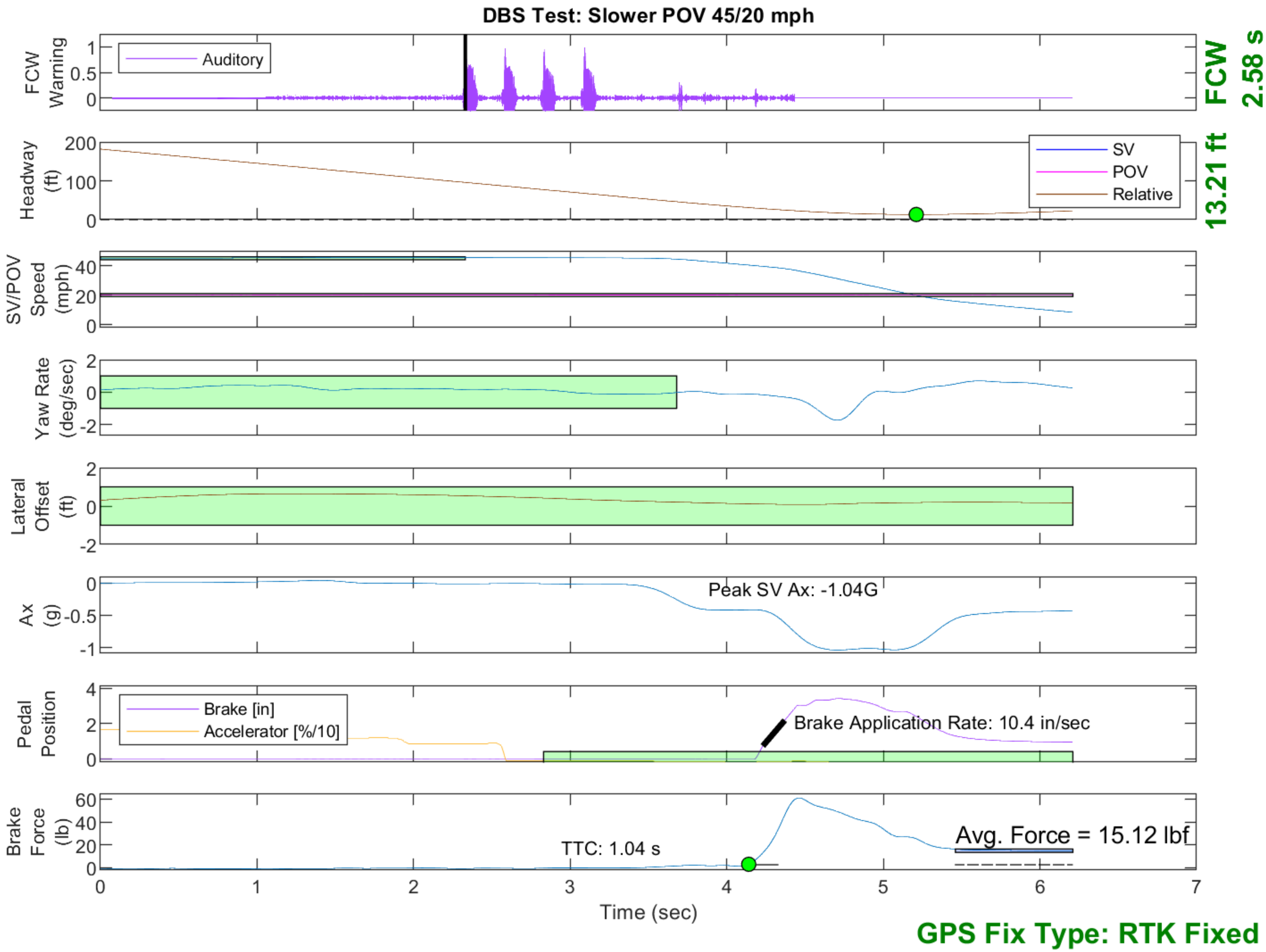

Figure E3. Example Time History for Slower POV 45 vs. 20, Passing

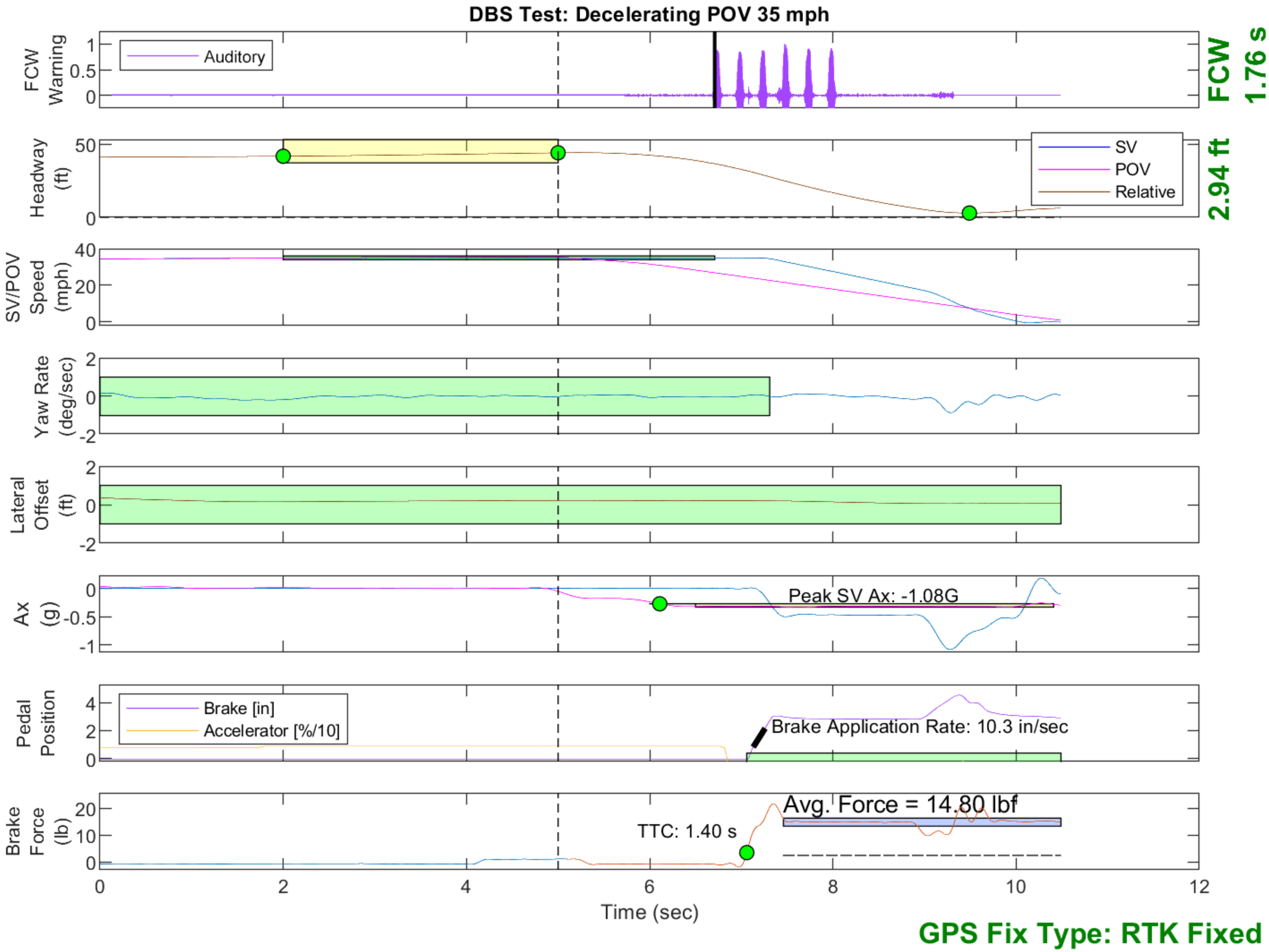

Figure E4. Example Time History for Decelerating POV 35, Passing

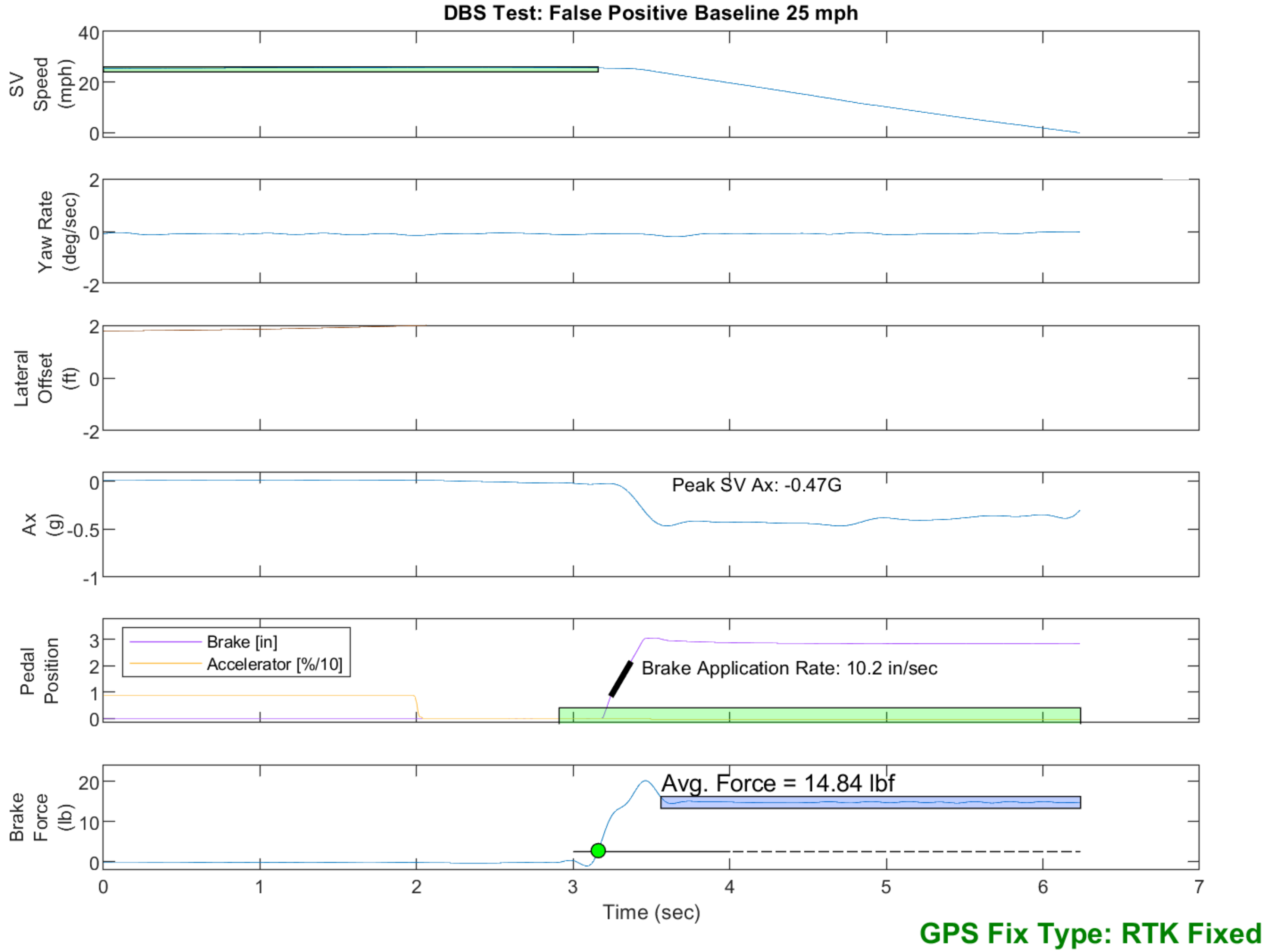

Figure E5. Example Time History for False Positive Baseline 25

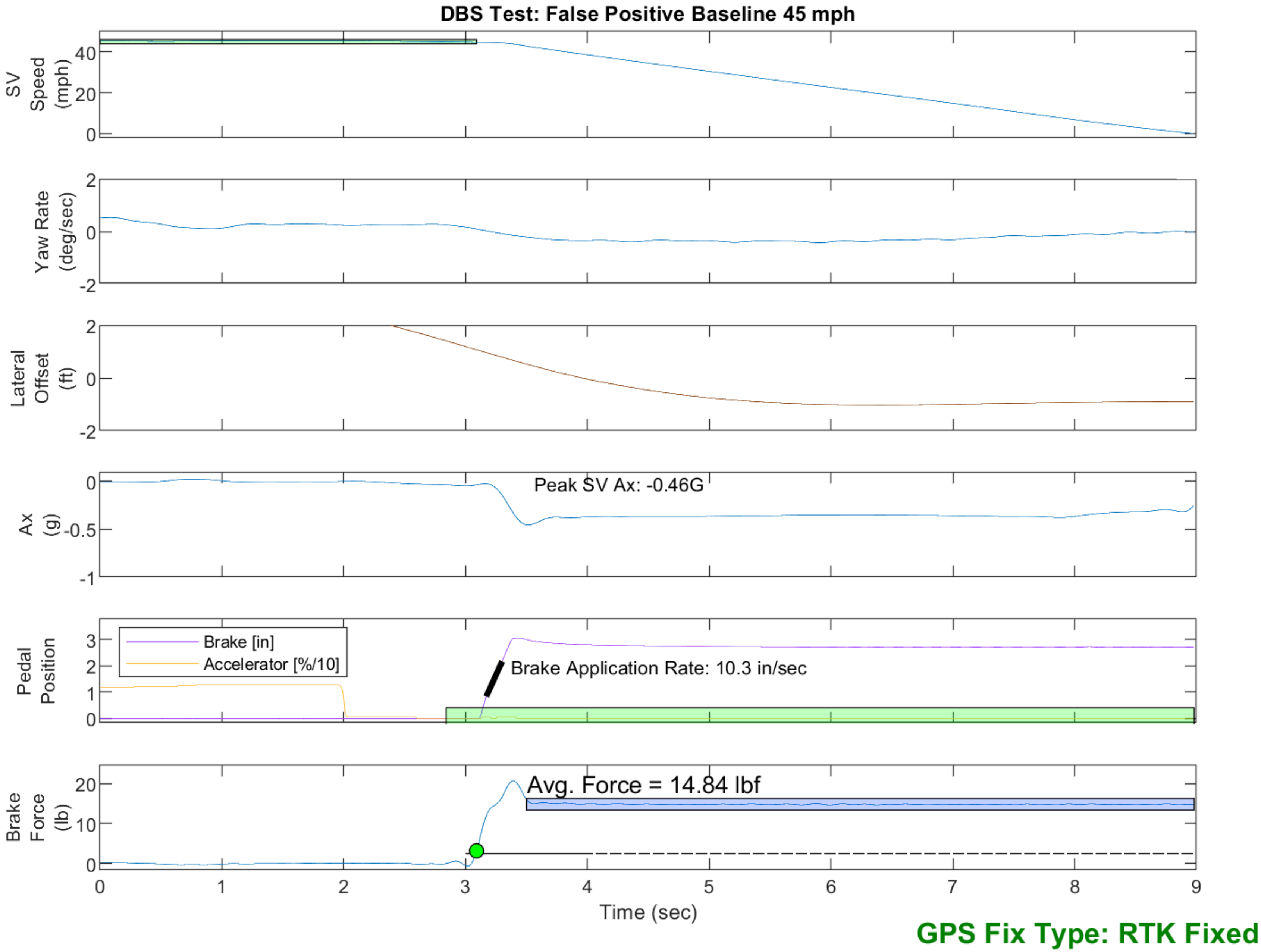

Figure E6. Example Time History for False Positive Baseline 45

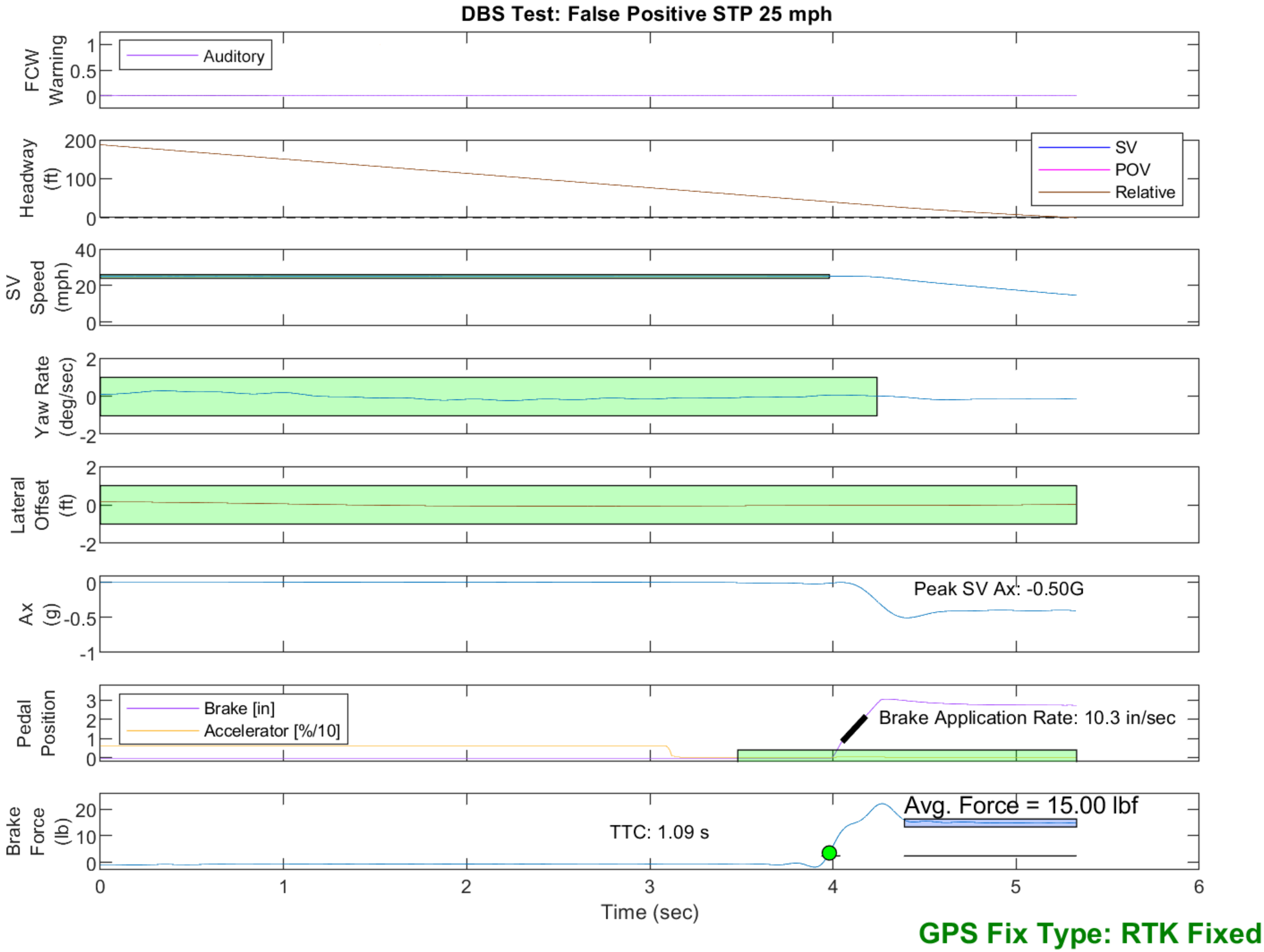

Figure E7. Example Time History for False Positive Steel Plate 25, Passing

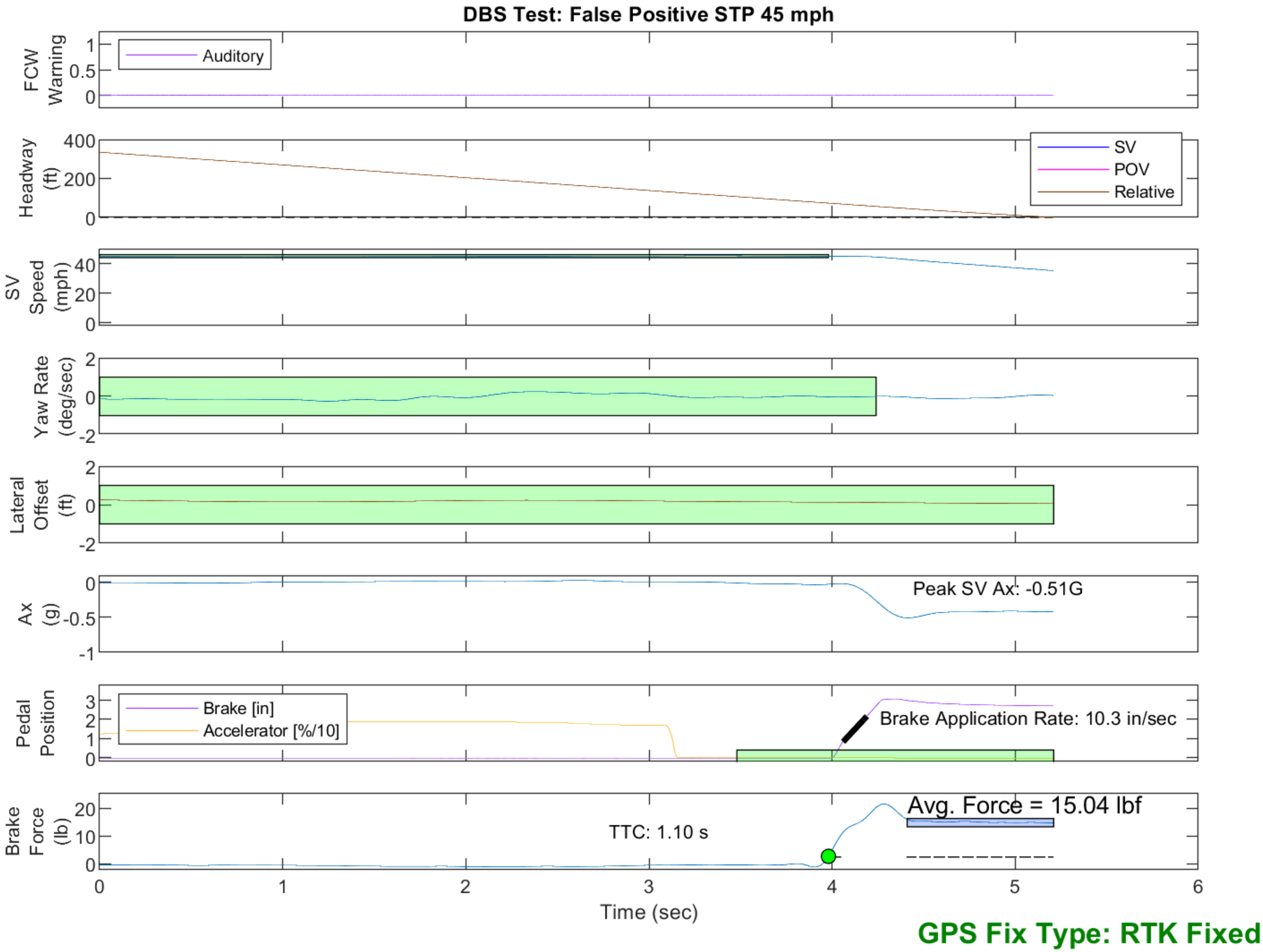

Figure E8. Example Time History for False Positive Steel Plate 45, Passing

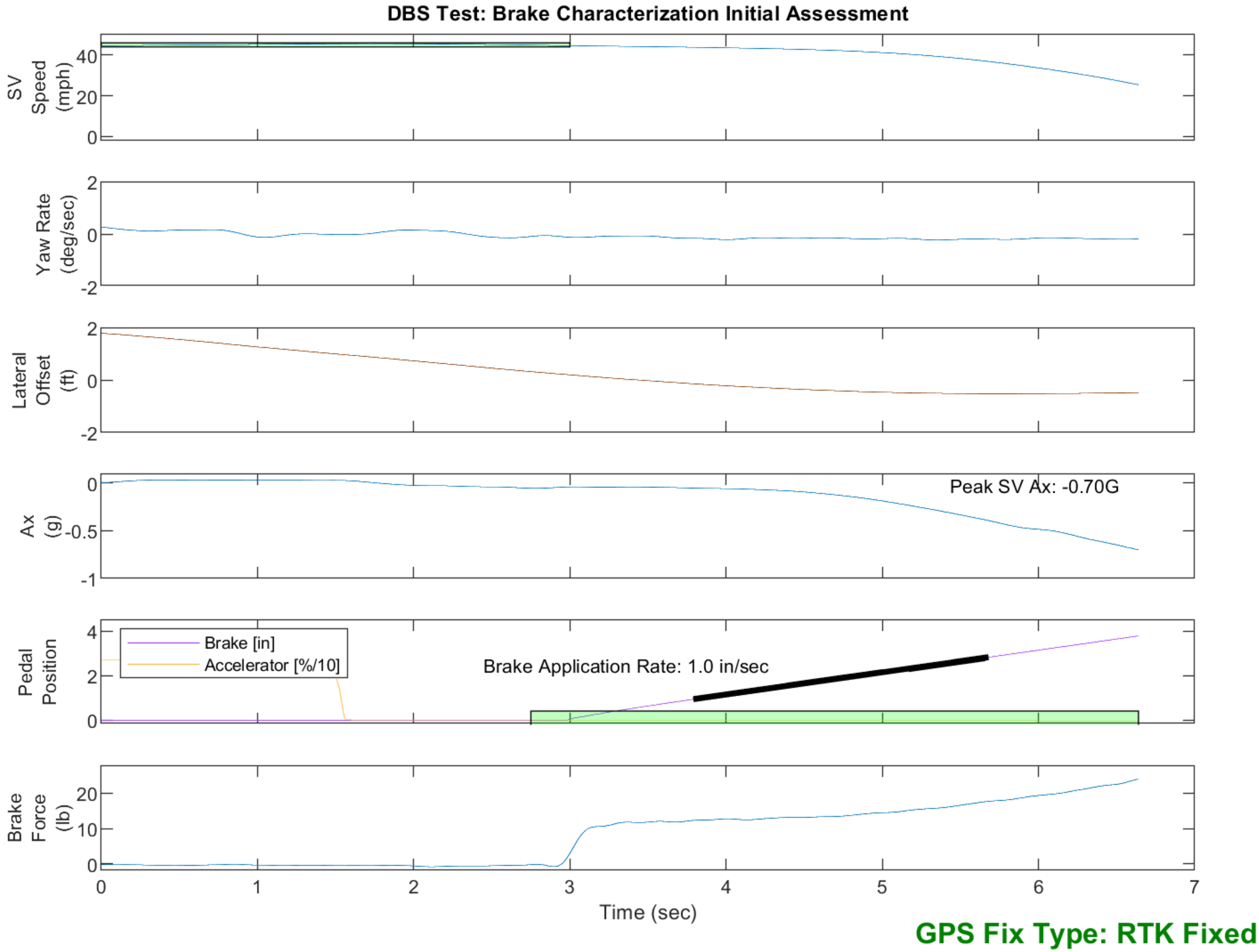

Figure E9. Example Time History for DBS Brake Characterization, Passing

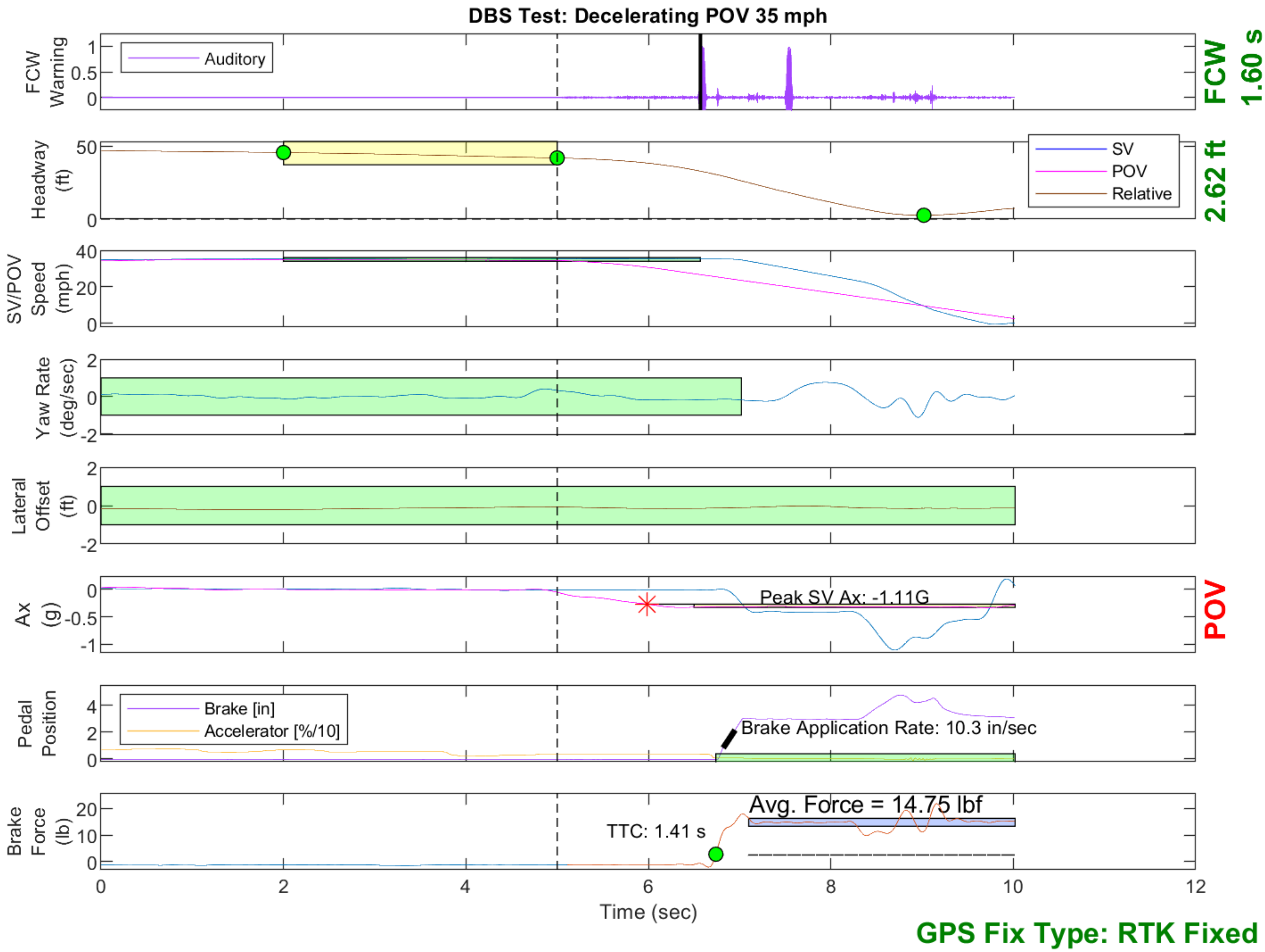

Figure E10. Example Time History Displaying Invalid POV Acceleration Criteria

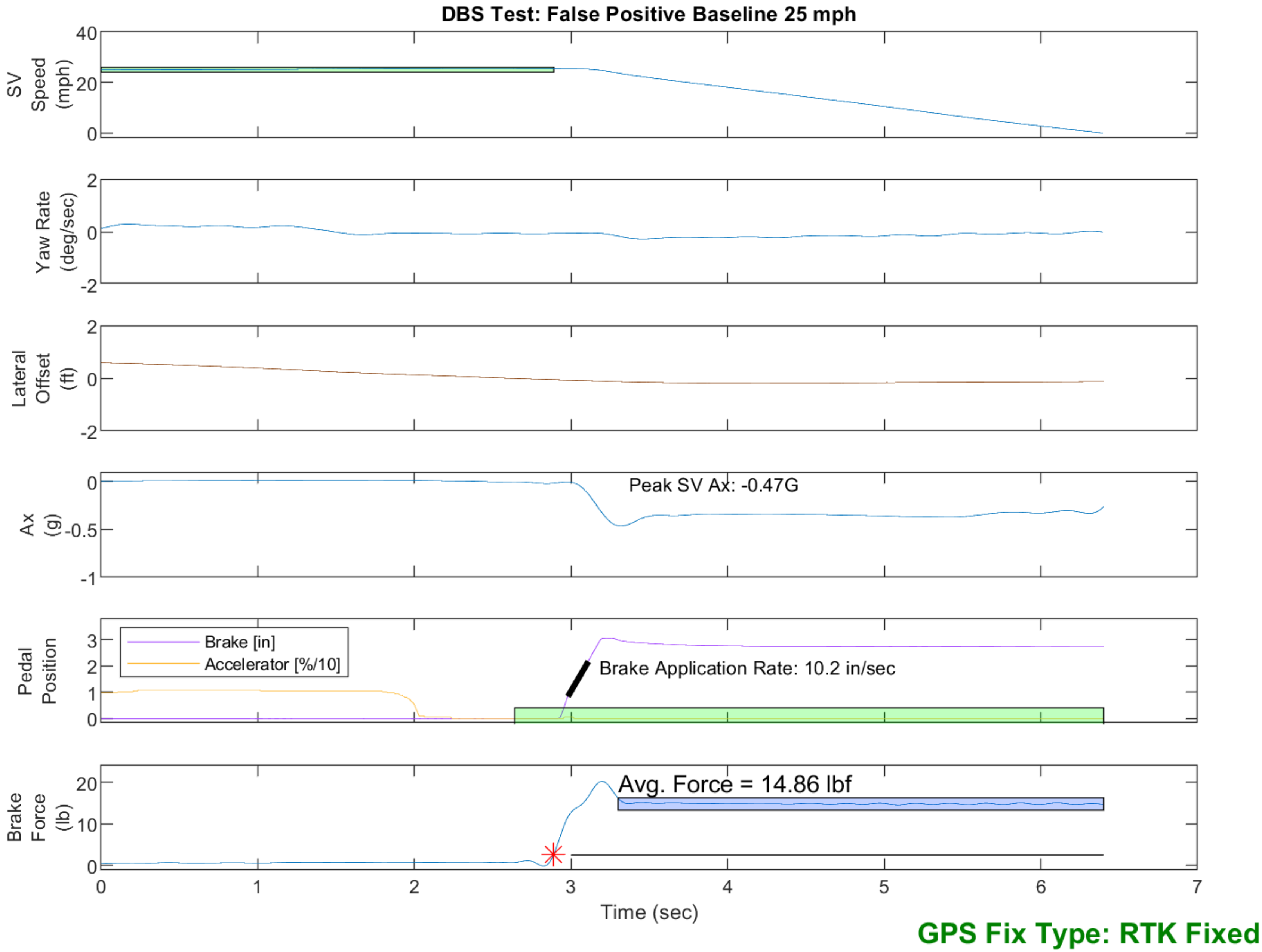

Figure E11. Example Time History Displaying Invalid Brake Force Criteria

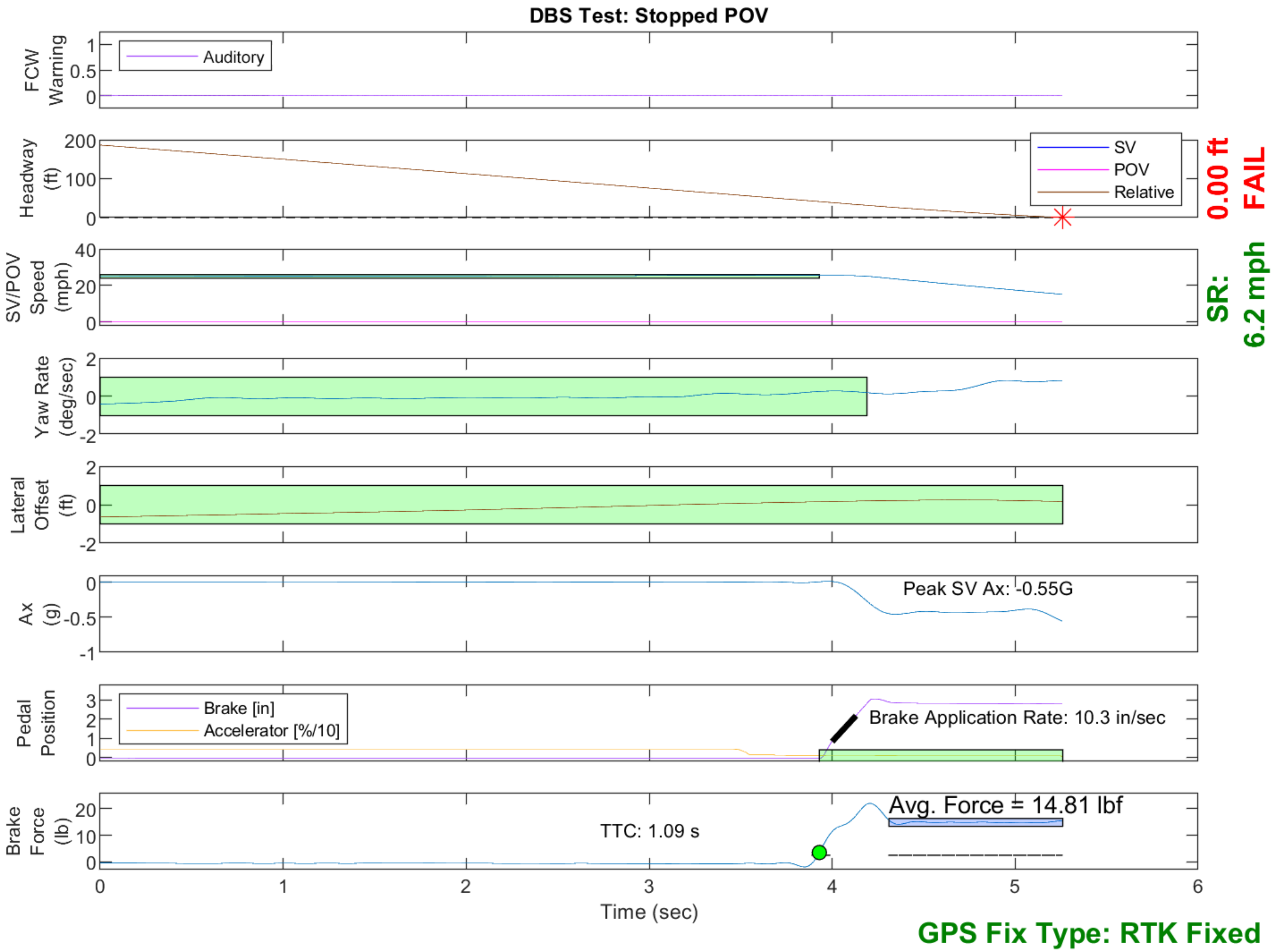

Figure E12. Example Time History for a Failed Run

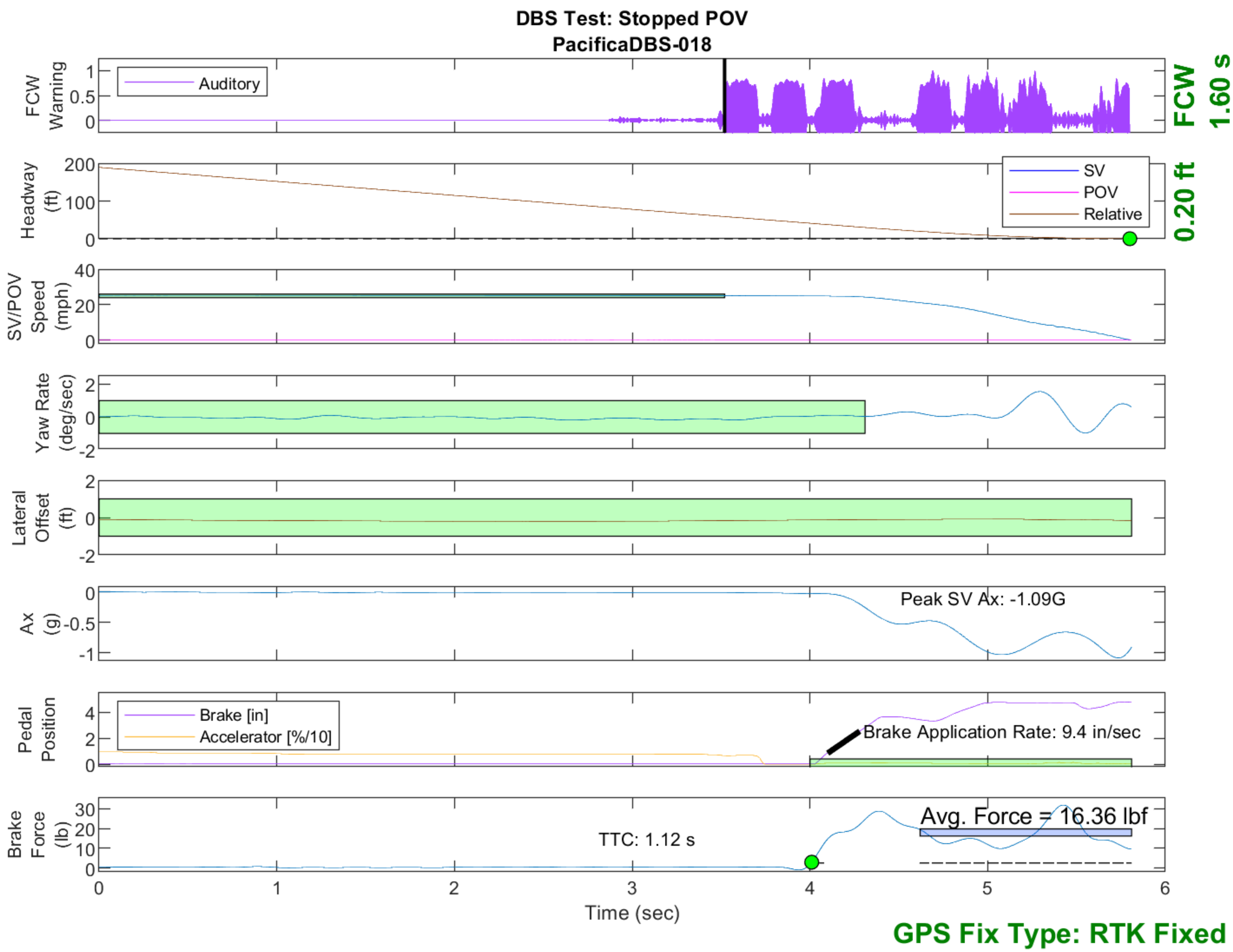

Figure E13. Time History for DBS Run 18, SV Encounters Stopped POV

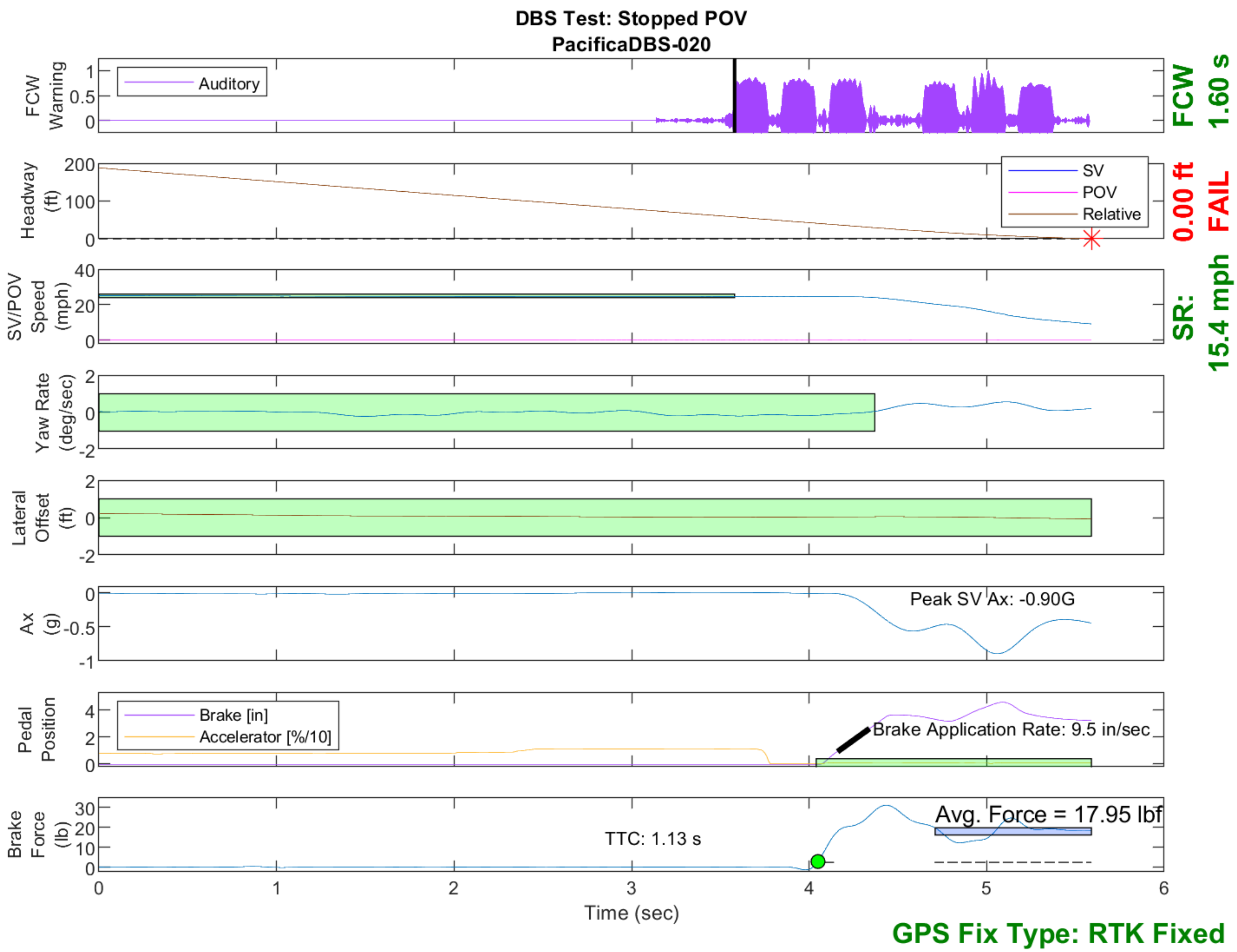

Figure E14. Time History for DBS Run 20, SV Encounters Stopped POV

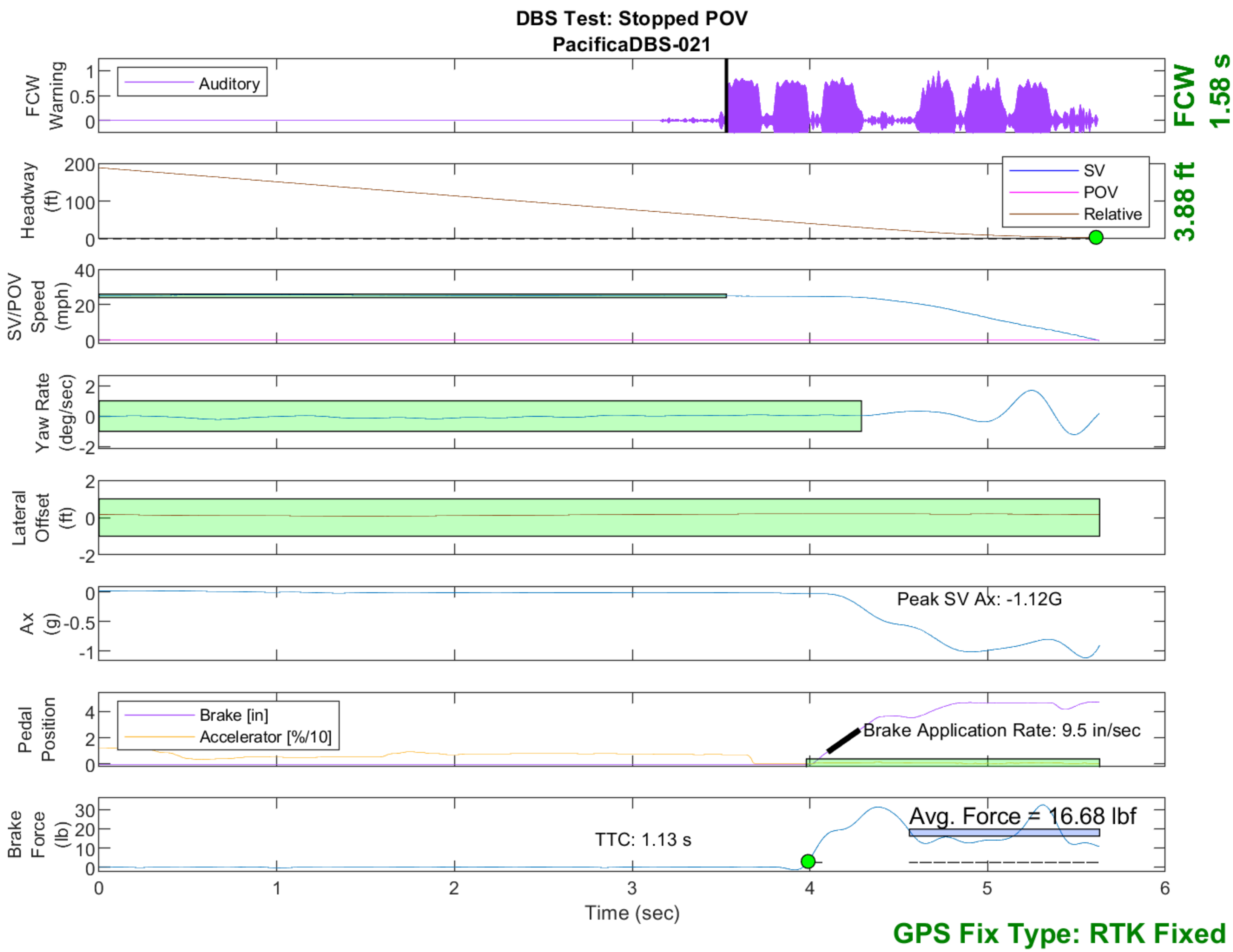

Figure E15. Time History for DBS Run 21, SV Encounters Stopped POV

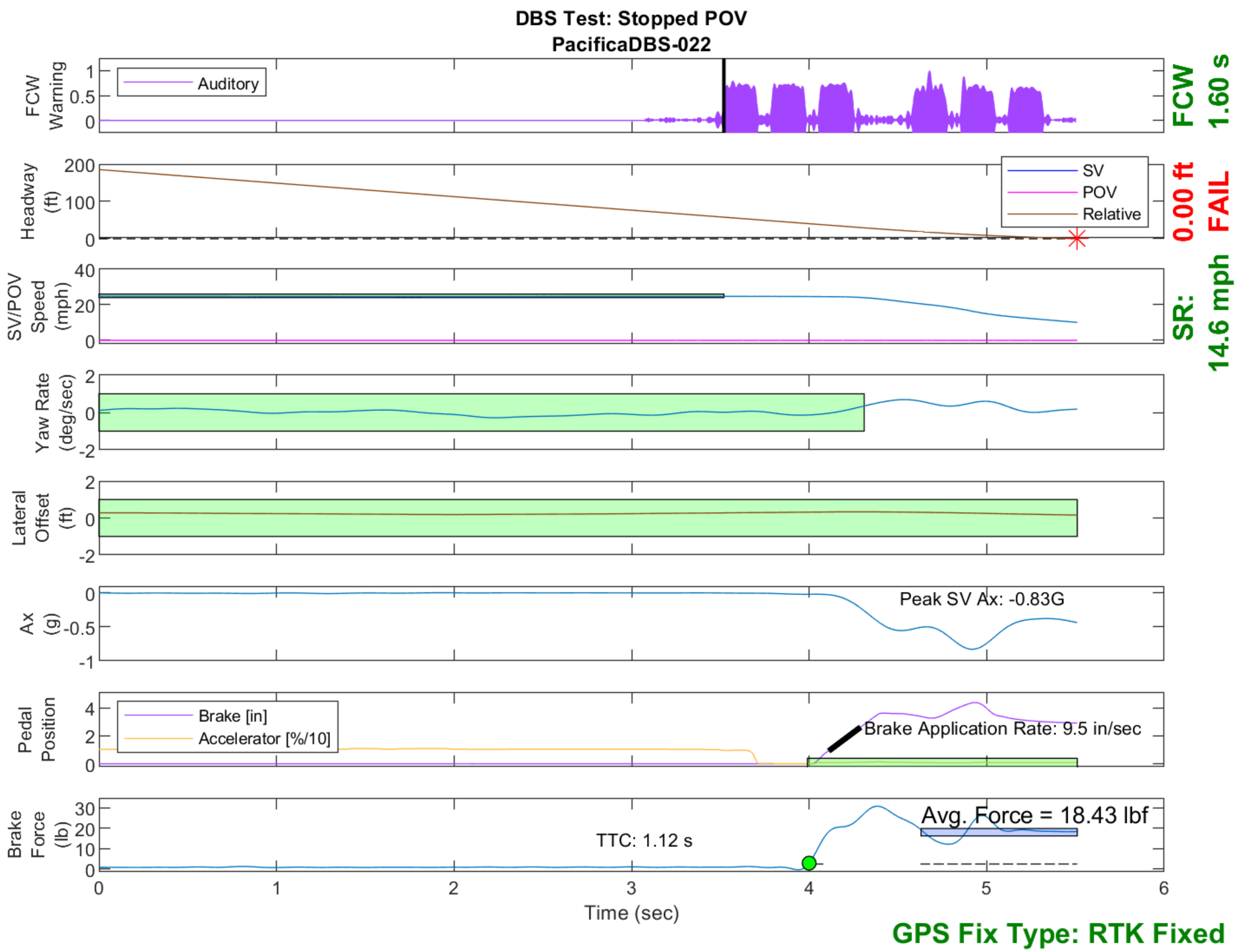

Figure E16. Time History for DBS Run 22, SV Encounters Stopped POV

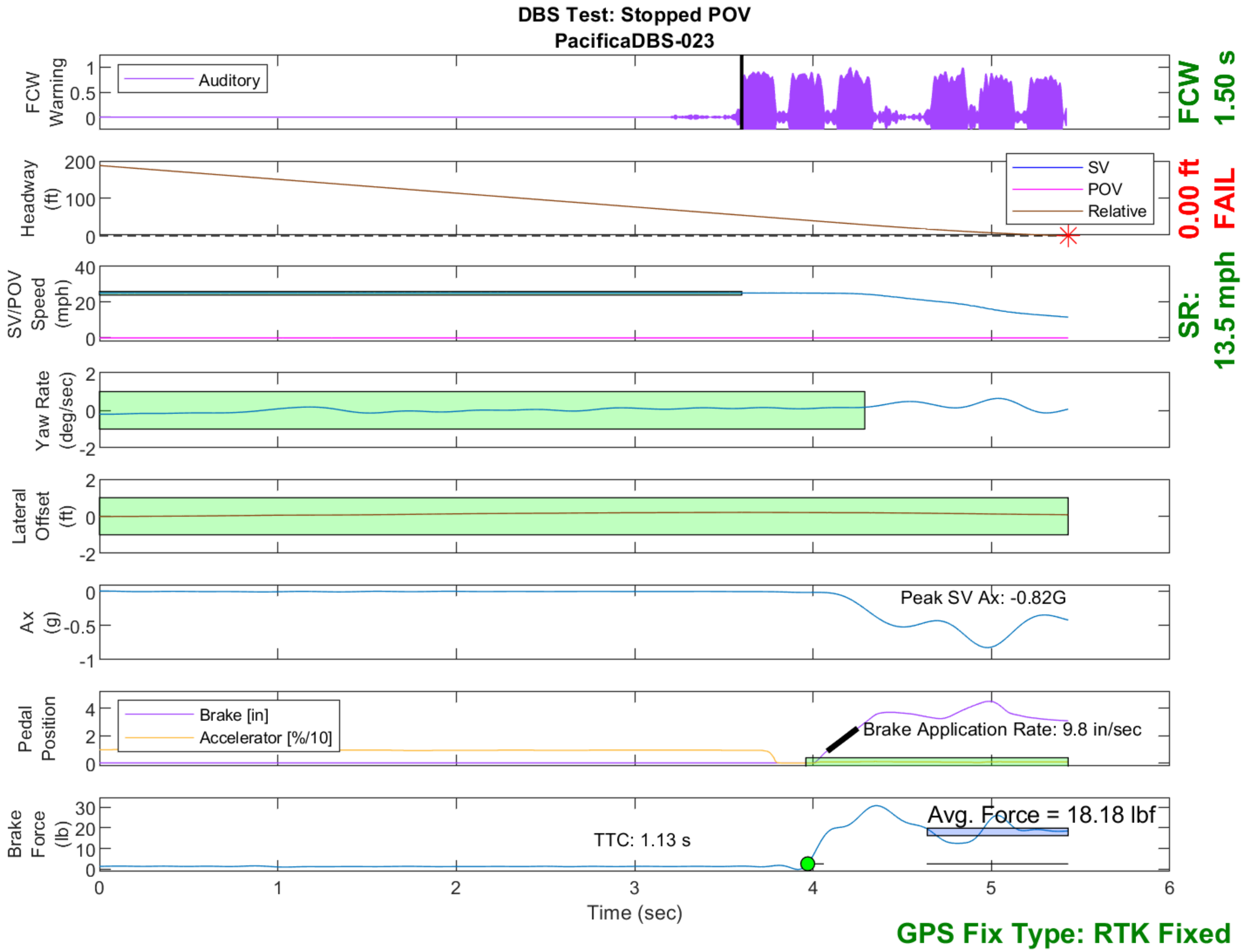

Figure E17. Time History for DBS Run 23, SV Encounters Stopped POV

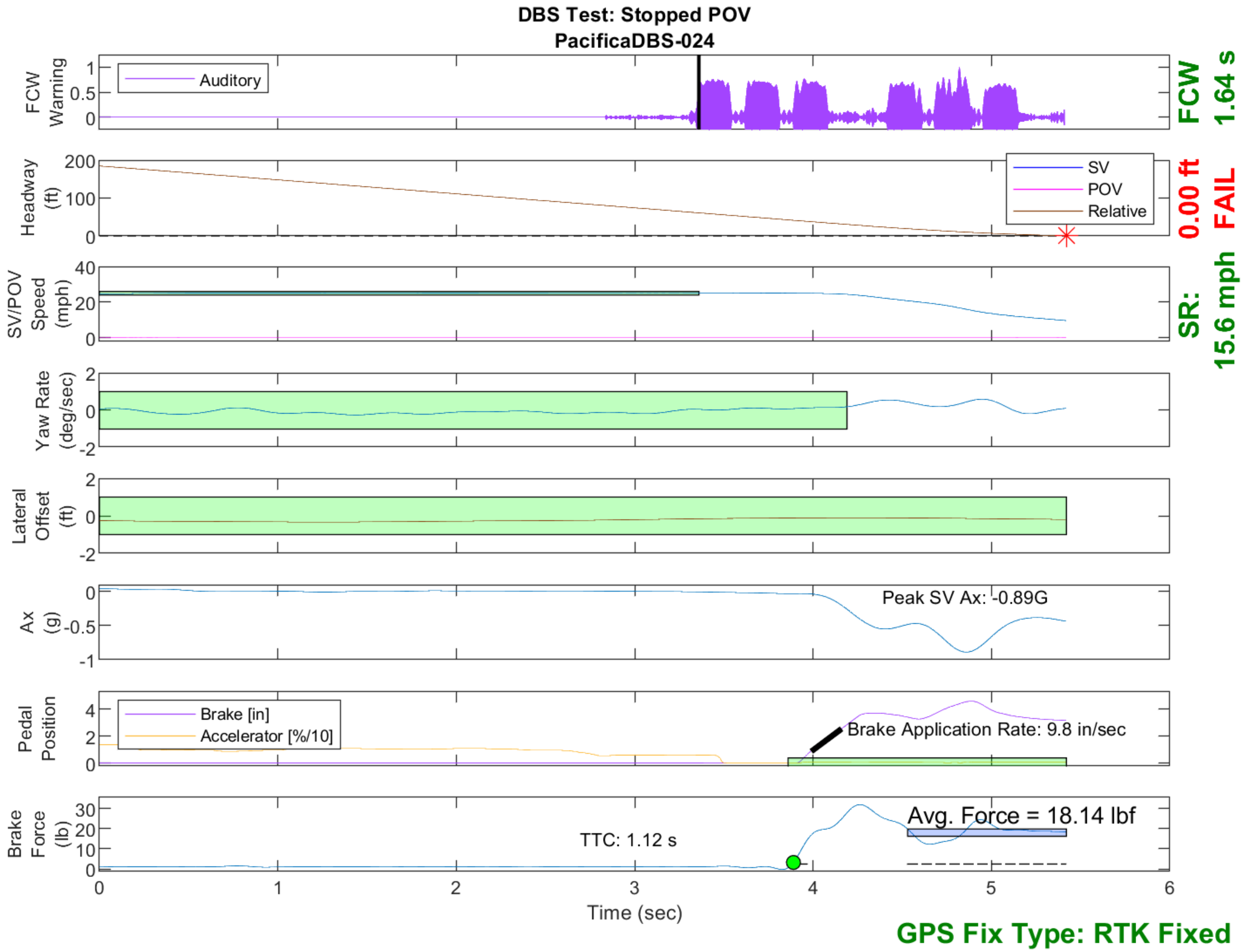

Figure E18. Time History for DBS Run 24, SV Encounters Stopped POV

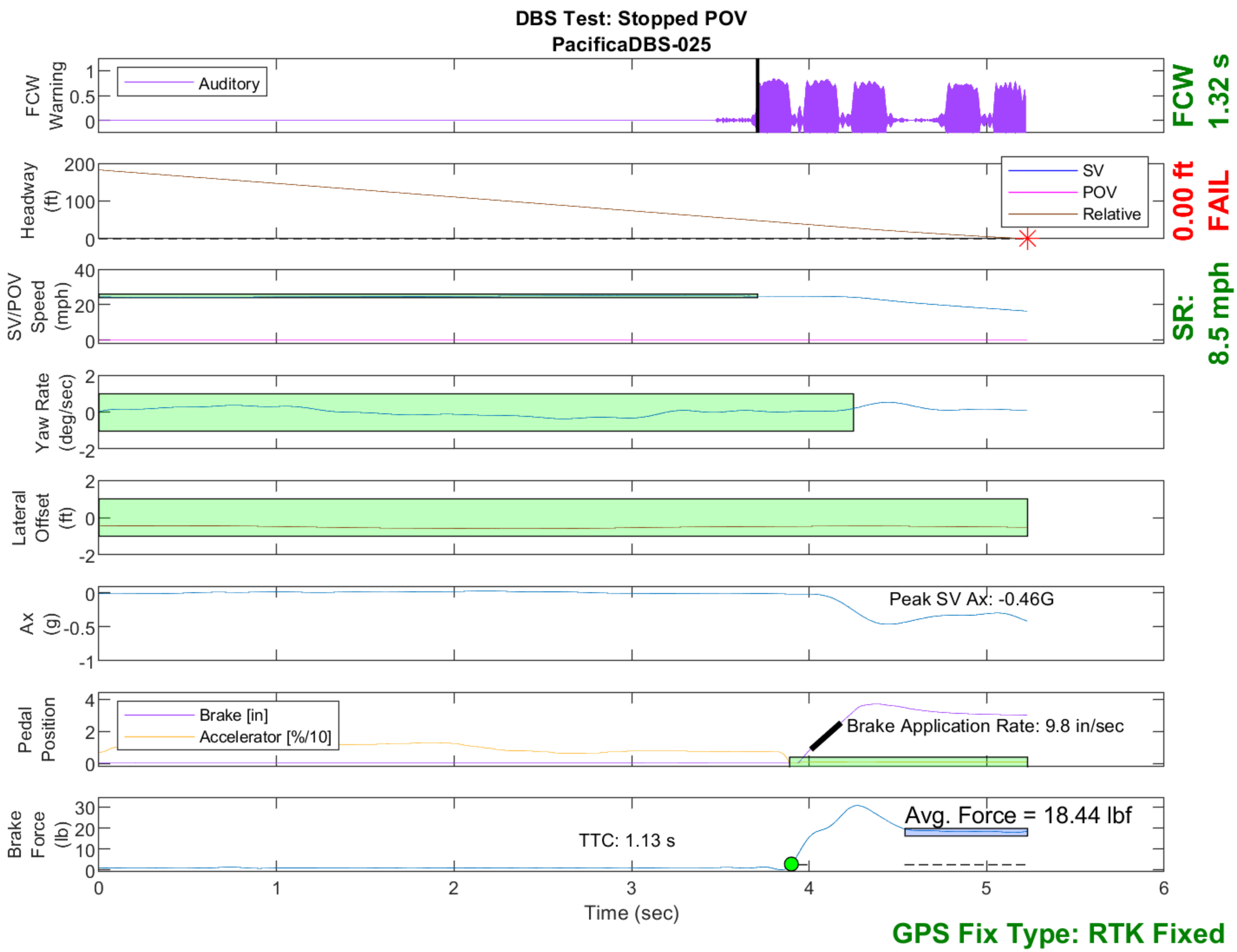

Figure E19. Time History for DBS Run 25, SV Encounters Stopped POV

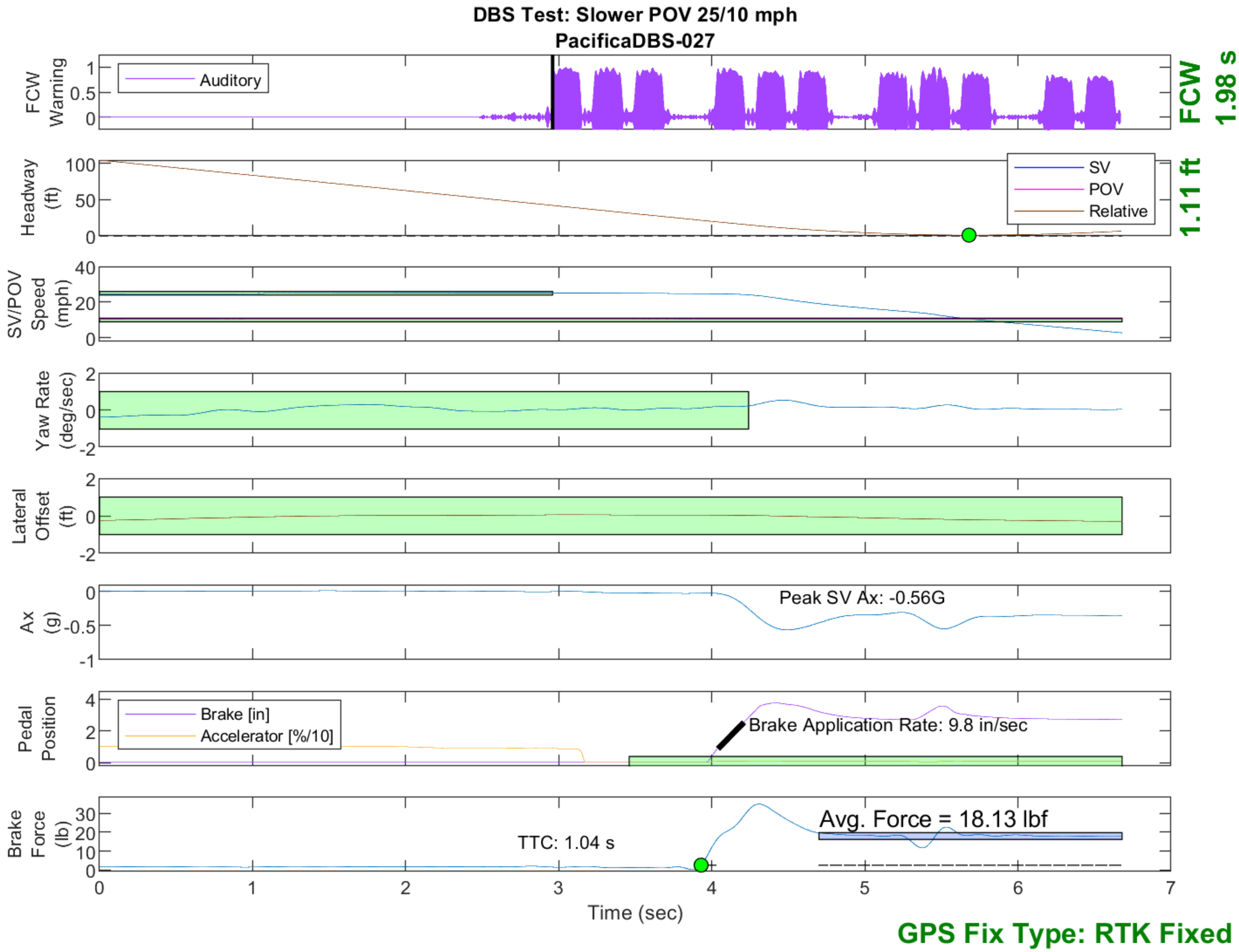

Figure E20. Time History for DBS Run 27, SV Encounters Slower POV, SV 25 mph, POV 10 mph

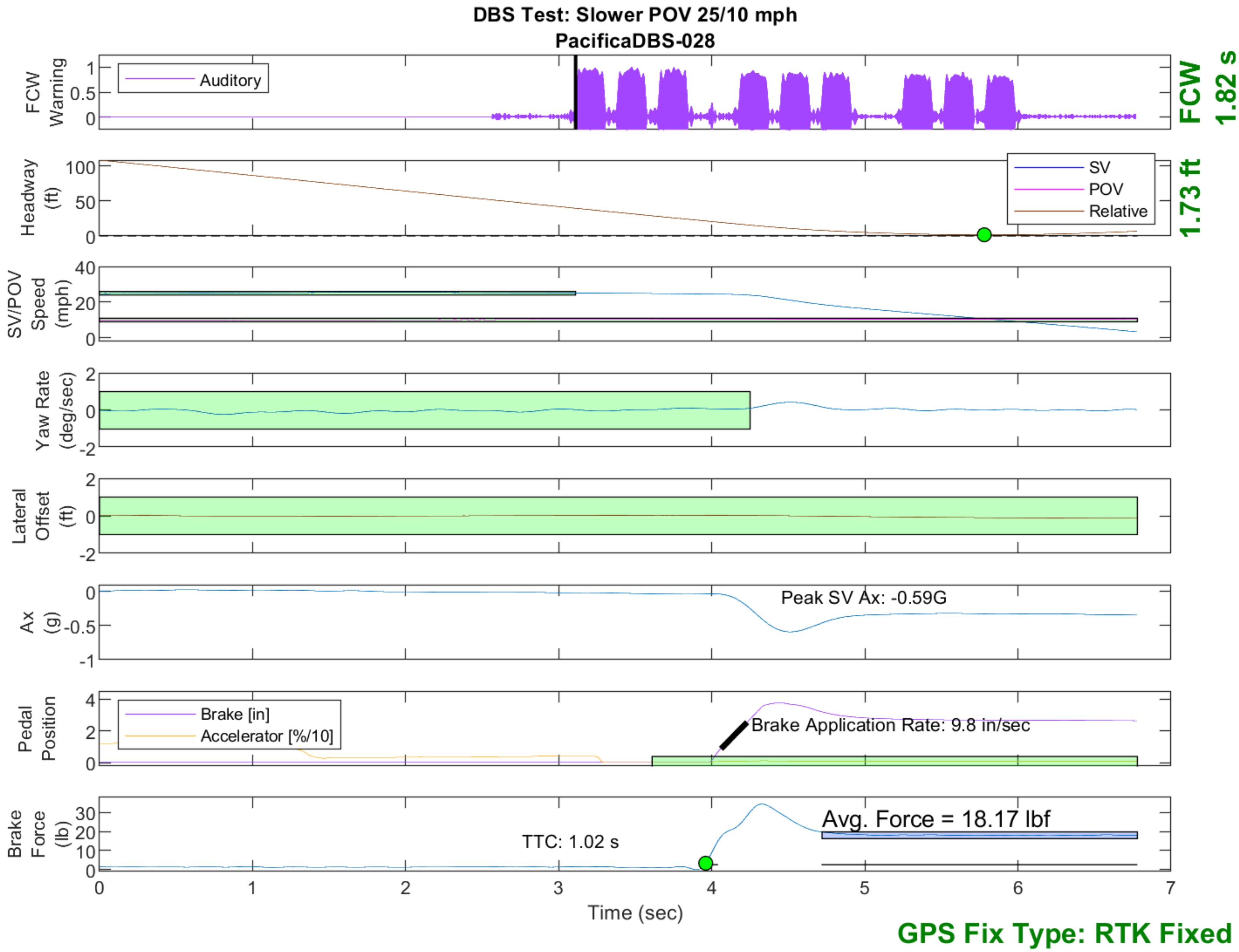

Figure E21. Time History for DBS Run 28, SV Encounters Slower POV, SV 25 mph, POV 10 mph

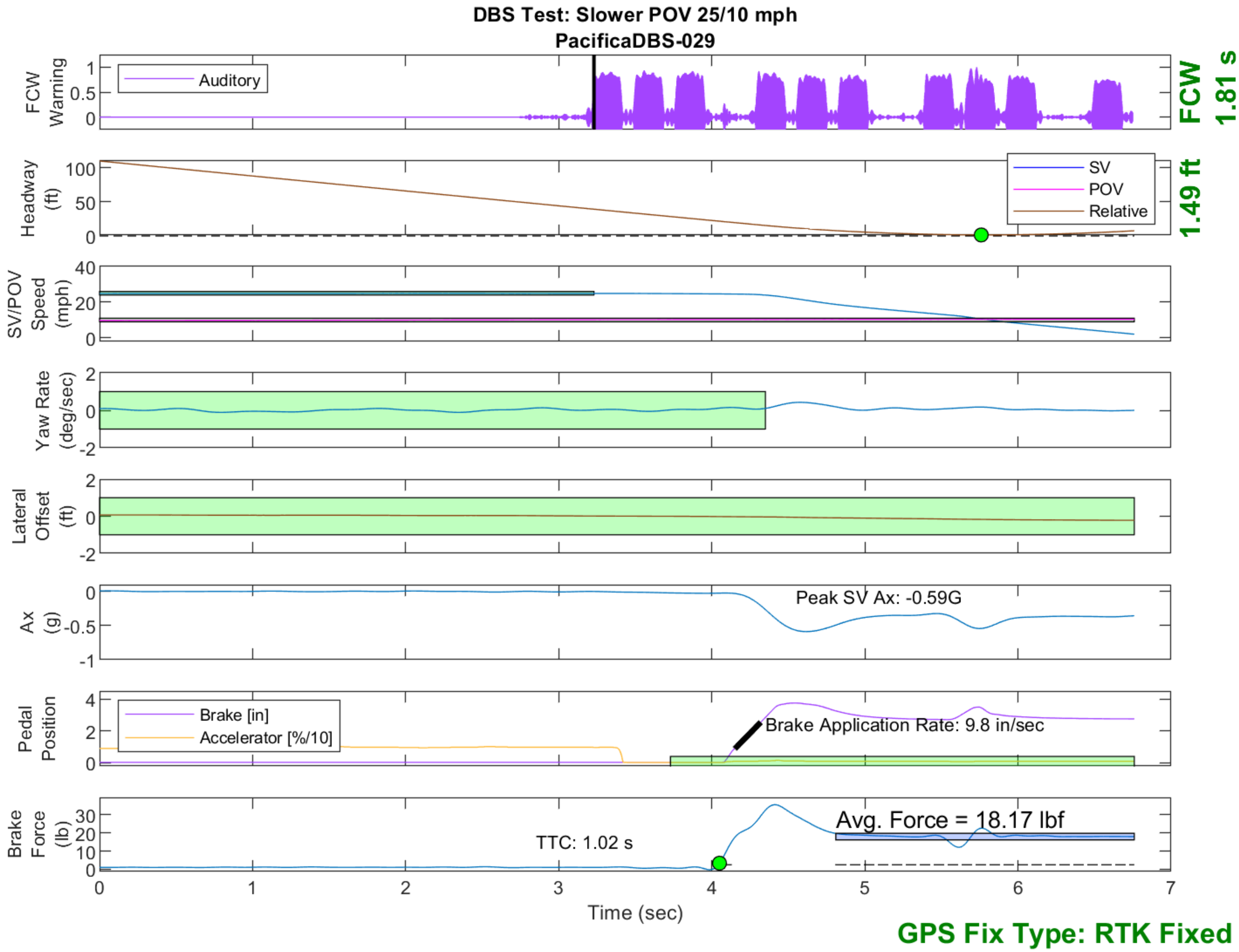

Figure E22. Time History for DBS Run 29, SV Encounters Slower POV, SV 25 mph, POV 10 mph

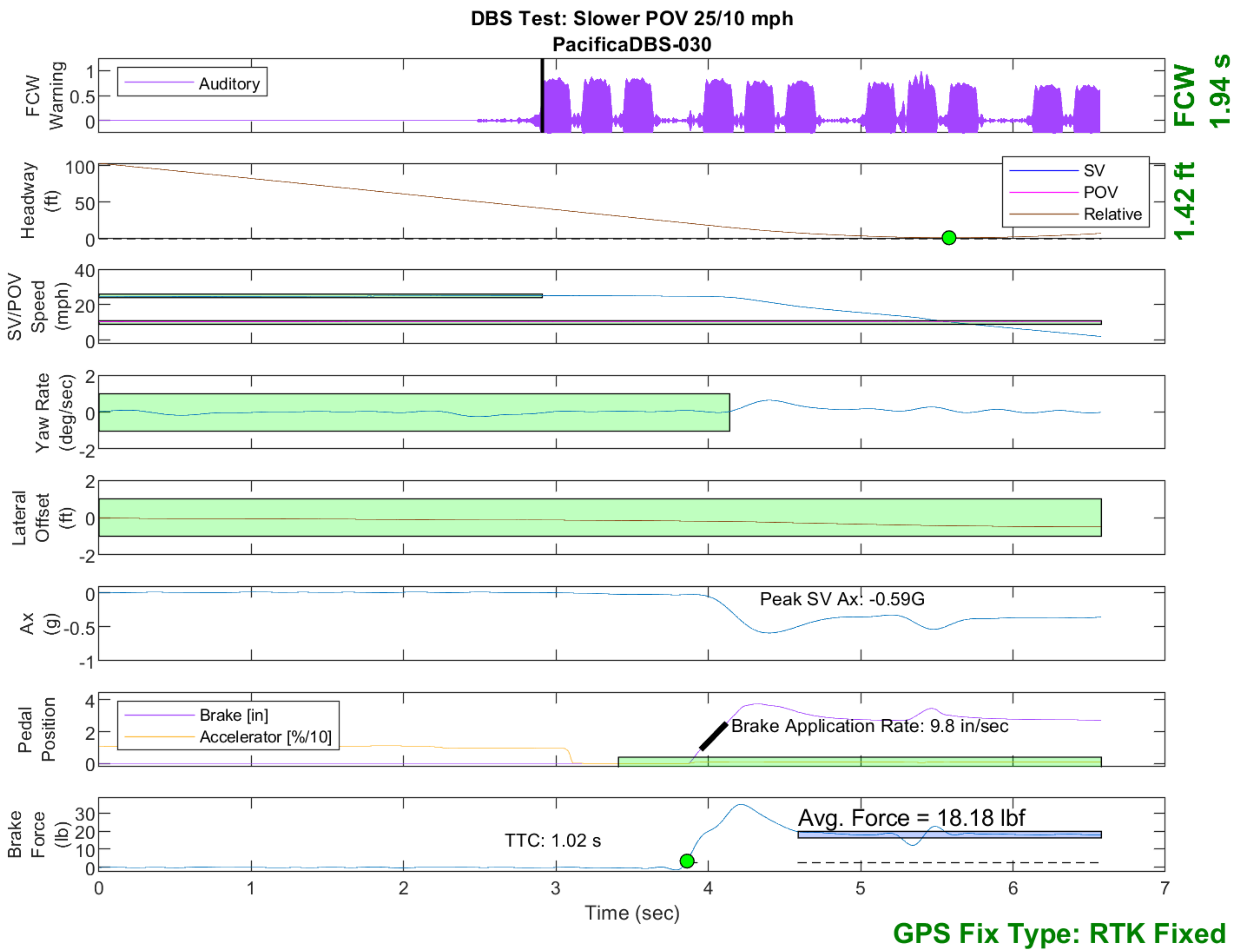

Figure E23. Time History for DBS Run 30, SV Encounters Slower POV, SV 25 mph, POV 10 mph

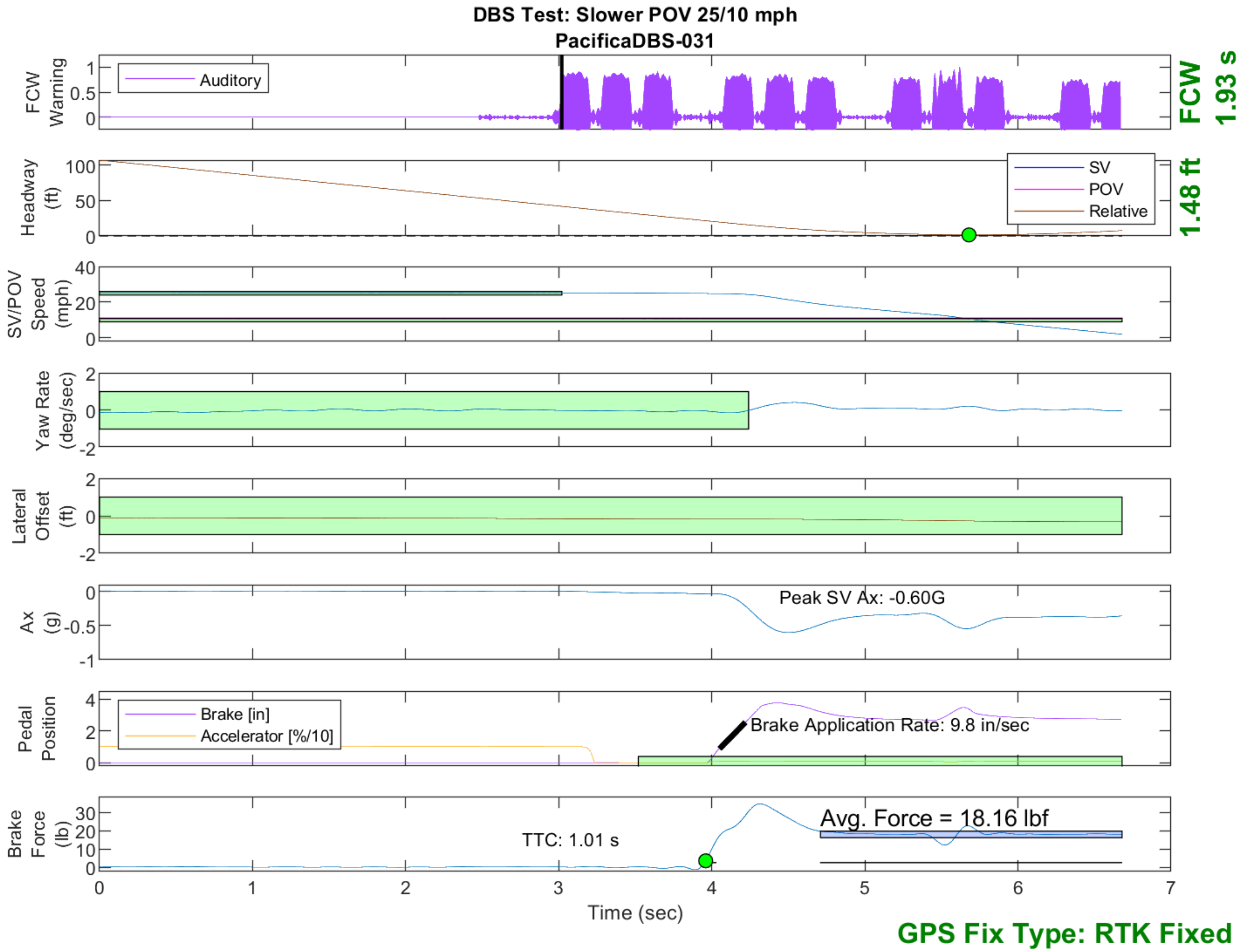

Figure E24. Time History for DBS Run 31, SV Encounters Slower POV, SV 25 mph, POV 10 mph

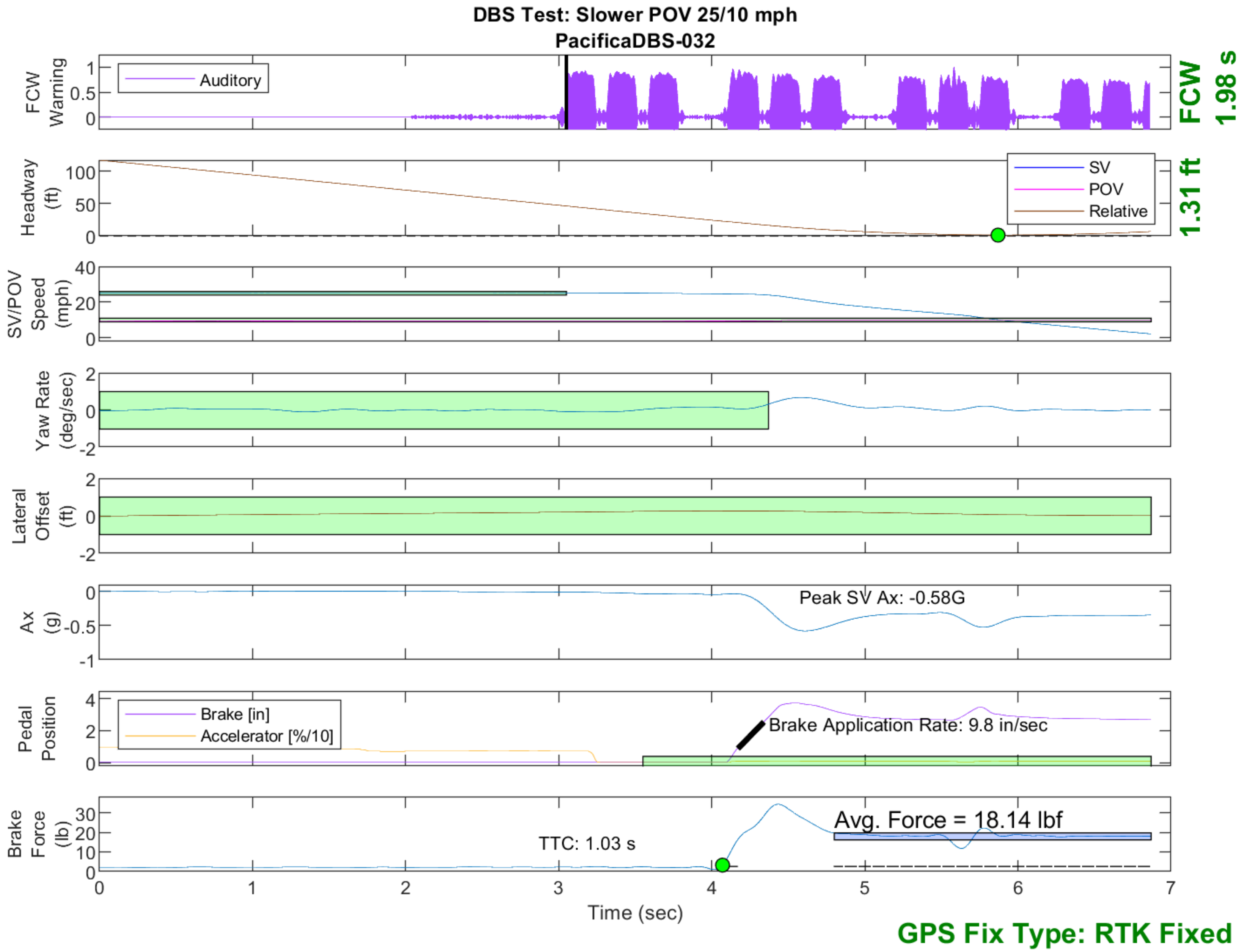

Figure E25. Time History for DBS Run 32, SV Encounters Slower POV, SV 25 mph, POV 10 mph

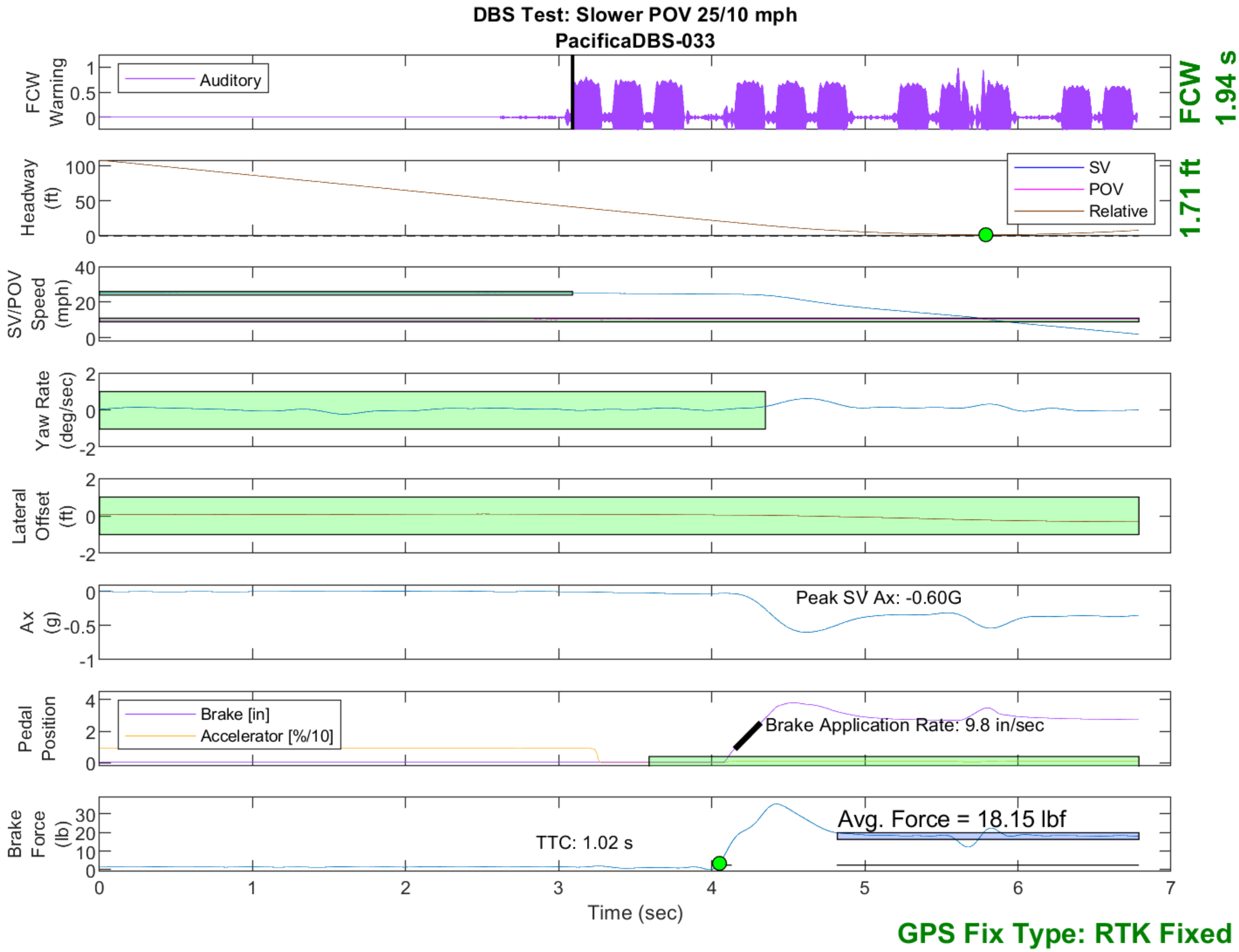

Figure E26. Time History for DBS Run 33, SV Encounters Slower POV, SV 25 mph, POV 10 mph

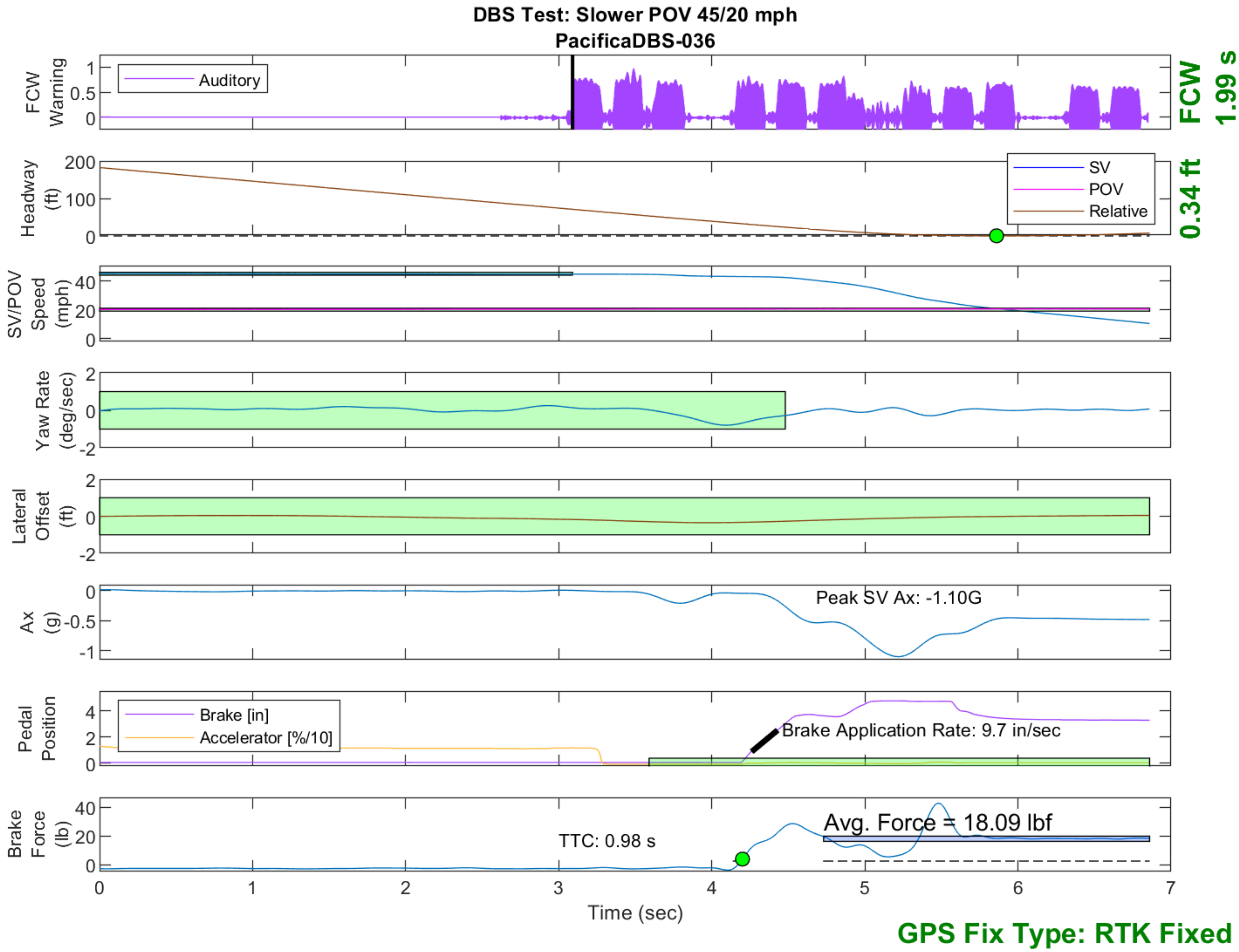

Figure E27. Time History for DBS Run 36, SV Encounters Slower POV, SV 45 mph, POV 20 mph

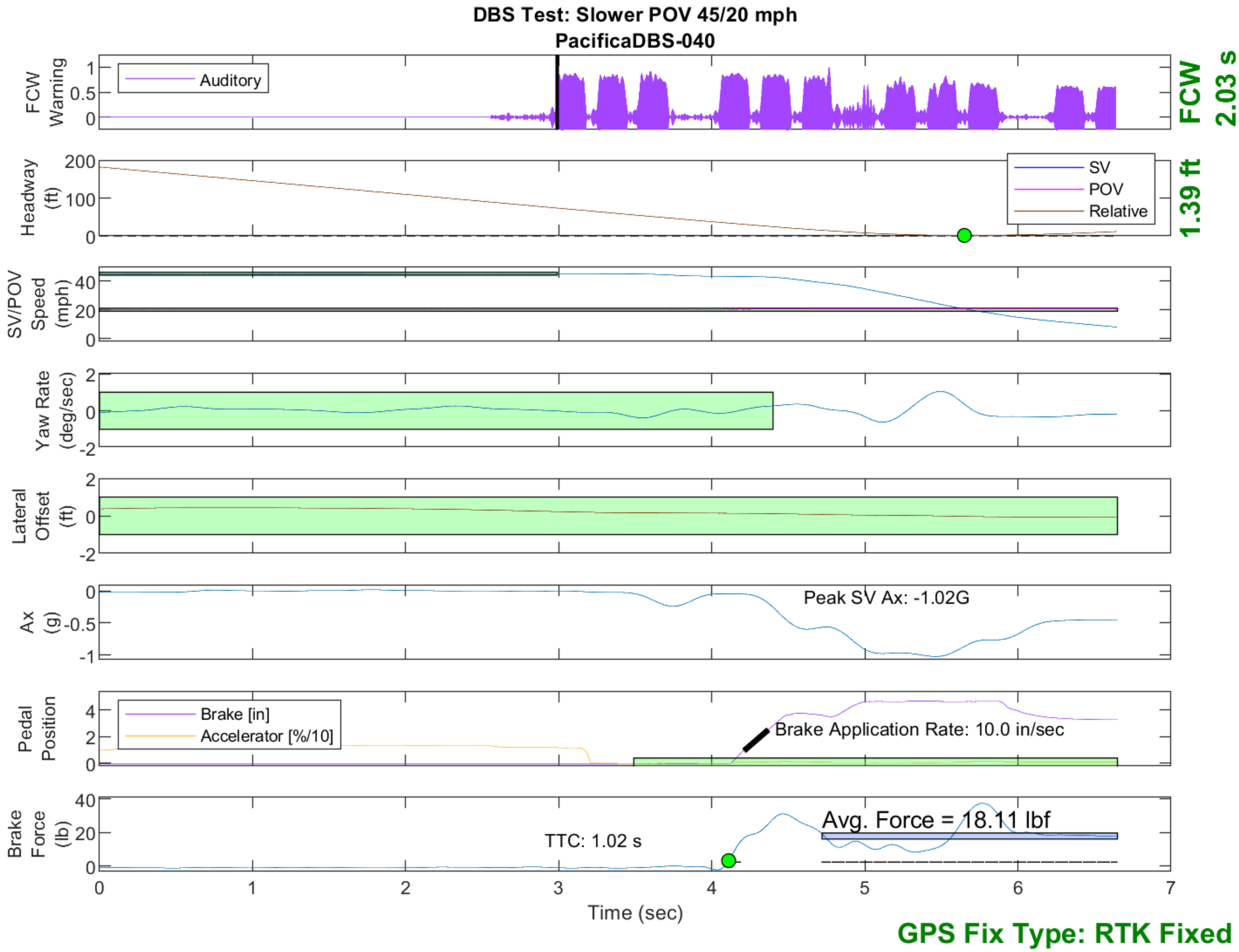

Figure E28. Time History for DBS Run 40, SV Encounters Slower POV, SV 45 mph, POV 20 mph

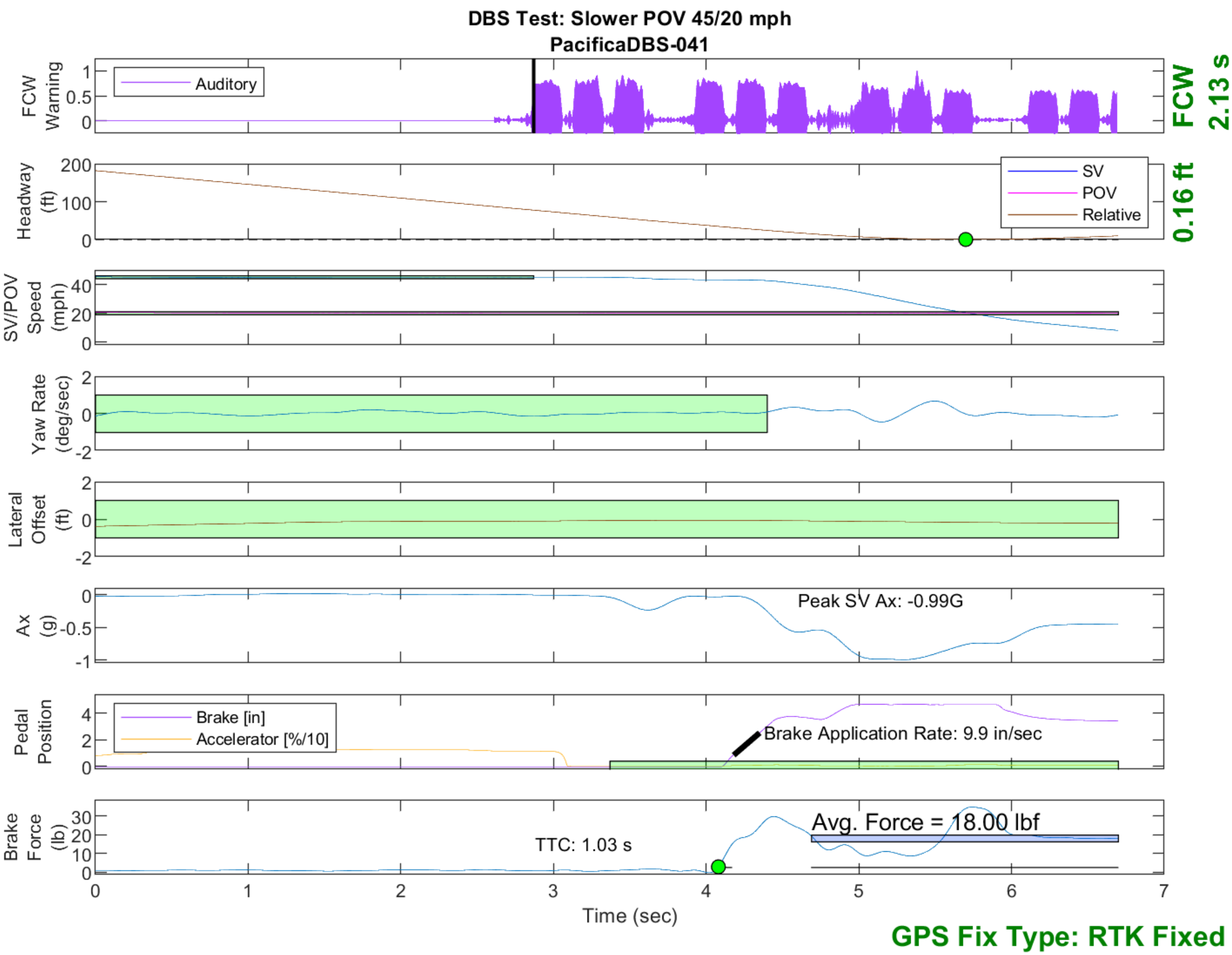

Figure E29. Time History for DBS Run 41, SV Encounters Slower POV, SV 45 mph, POV 20 mph

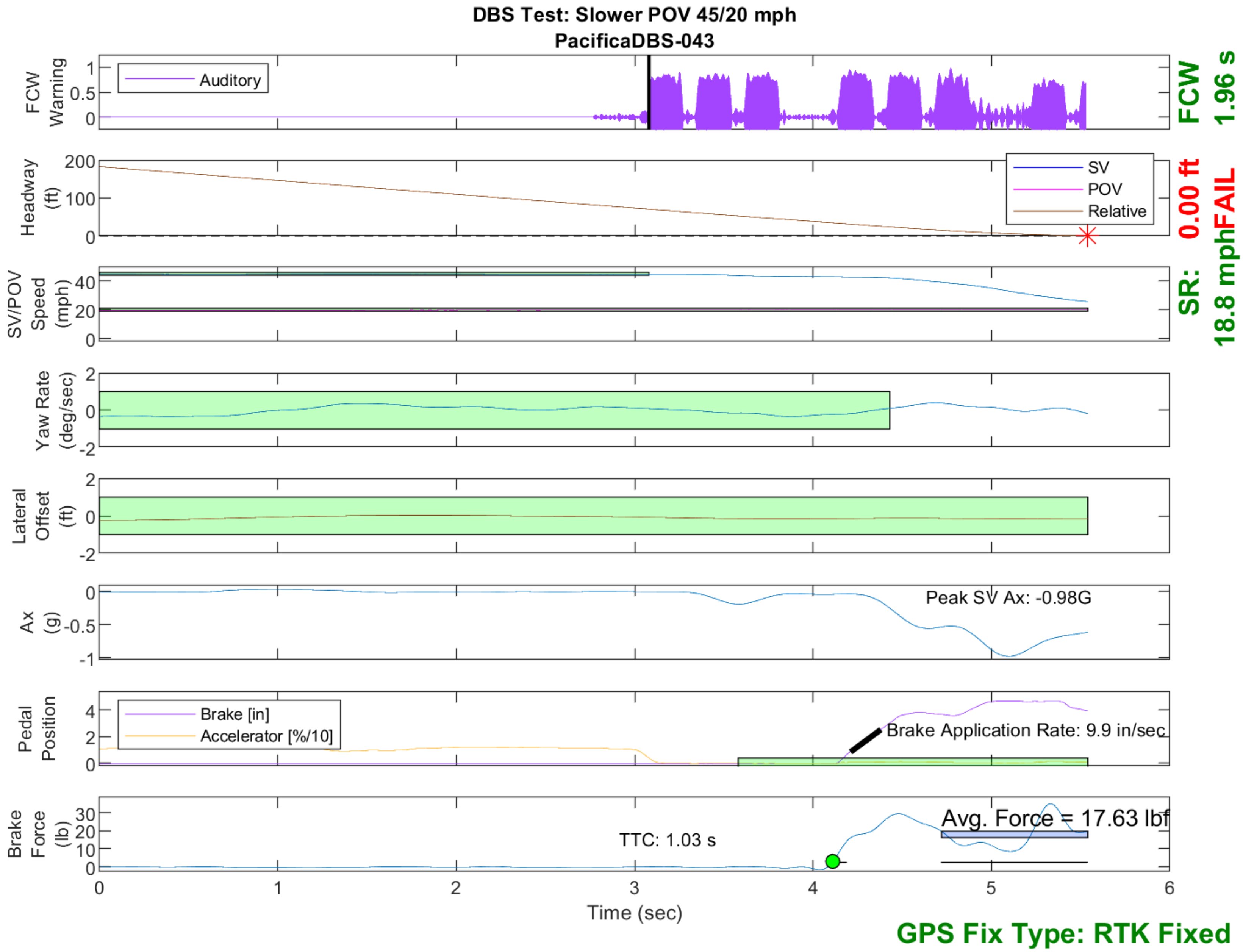

Figure E30. Time History for DBS Run 43, SV Encounters Slower POV, SV 45 mph, POV 20 mph

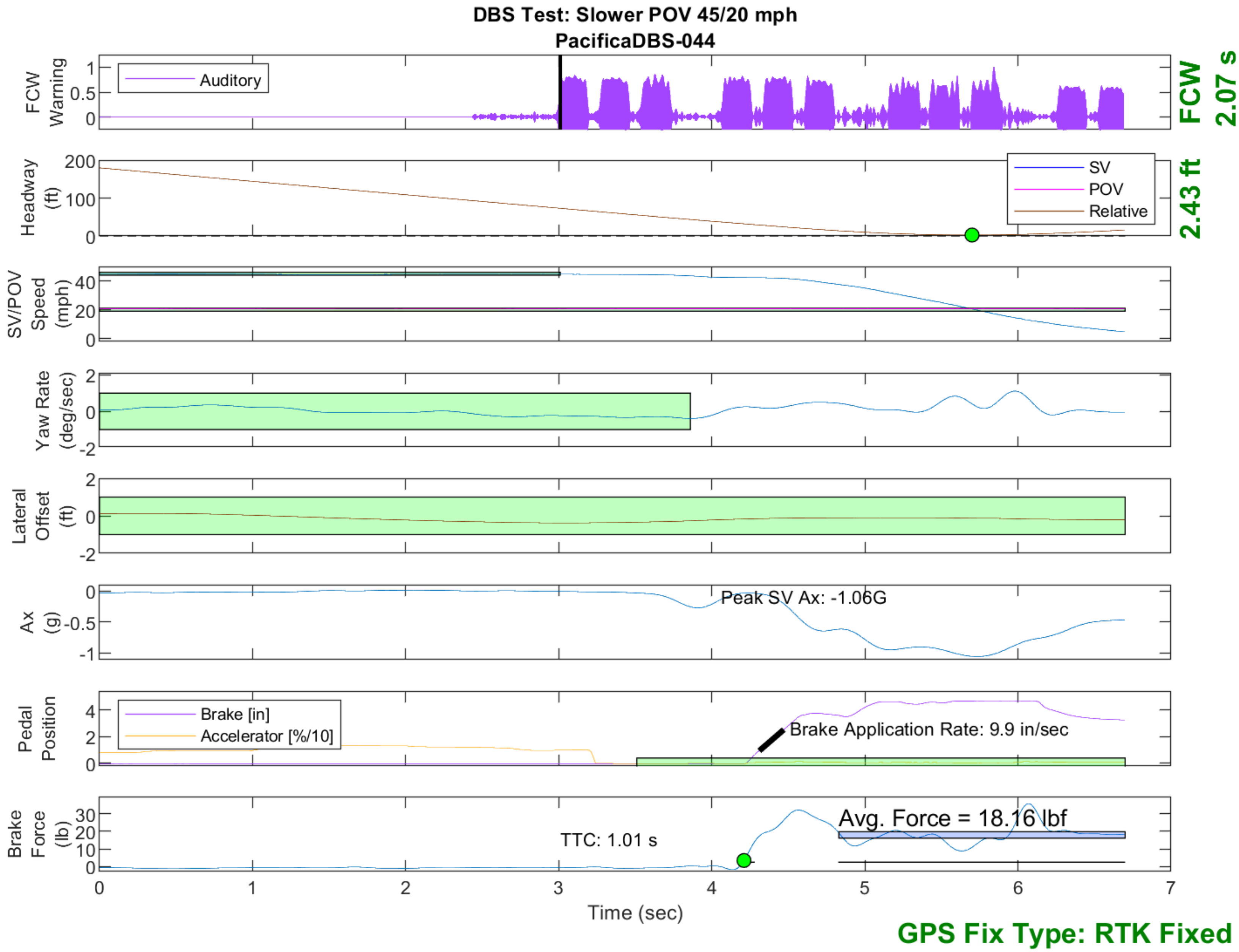

Figure E31. Time History for DBS Run 44, SV Encounters Slower POV, SV 45 mph, POV 20 mph

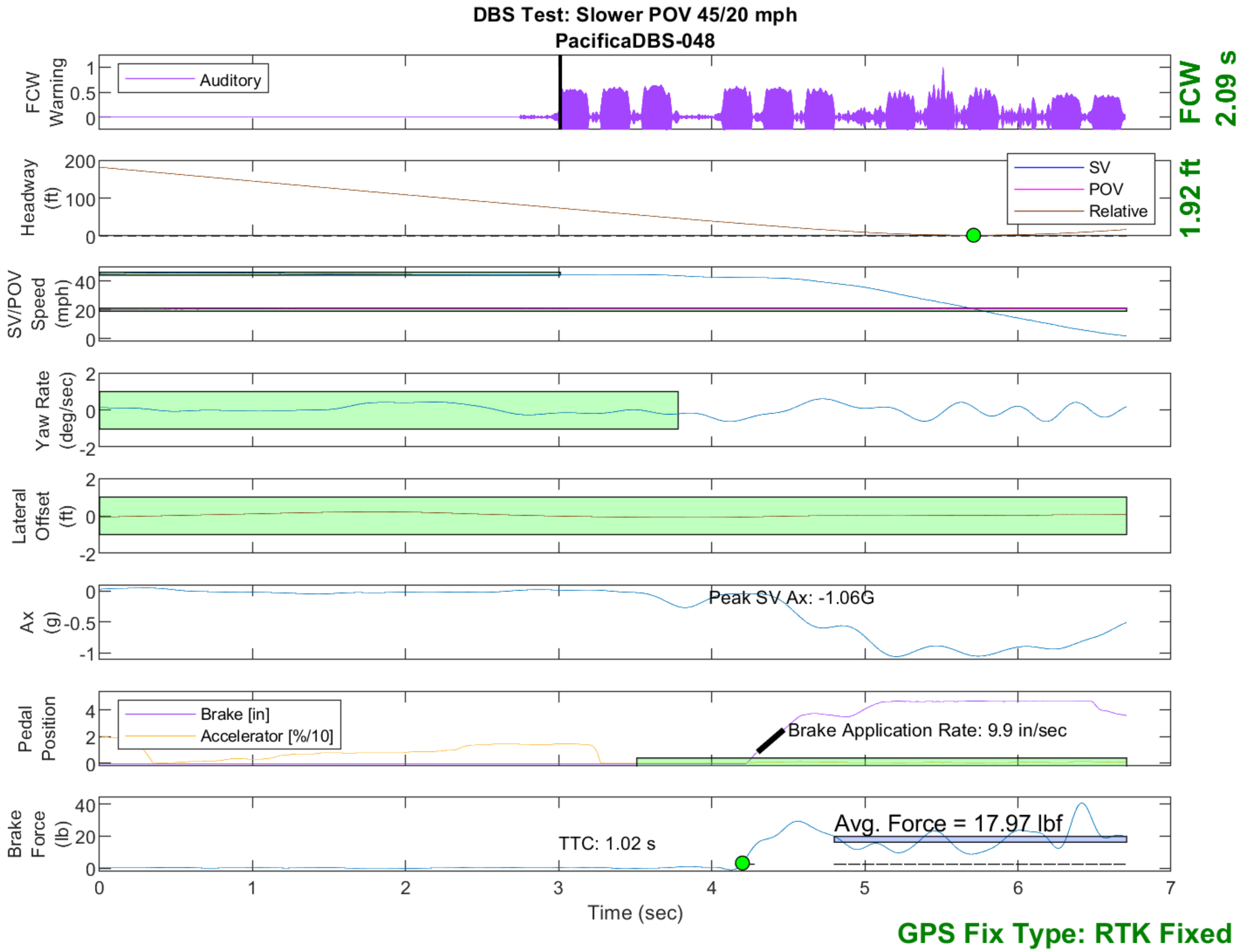

Figure E32. Time History for DBS Run 48, SV Encounters Slower POV, SV 45 mph, POV 20 mph

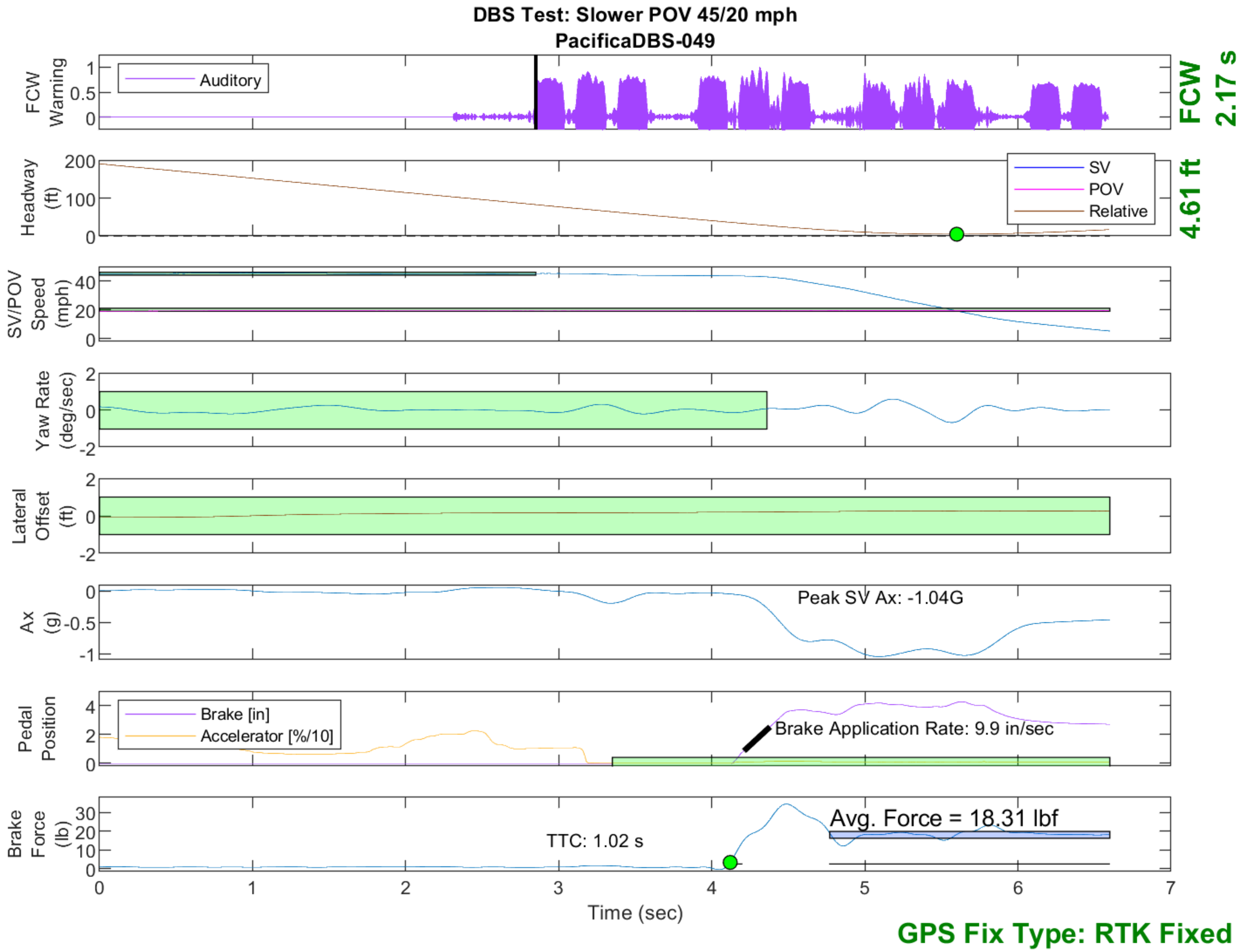

Figure E33. Time History for DBS Run 49, SV Encounters Slower POV, SV 45 mph, POV 20 mph

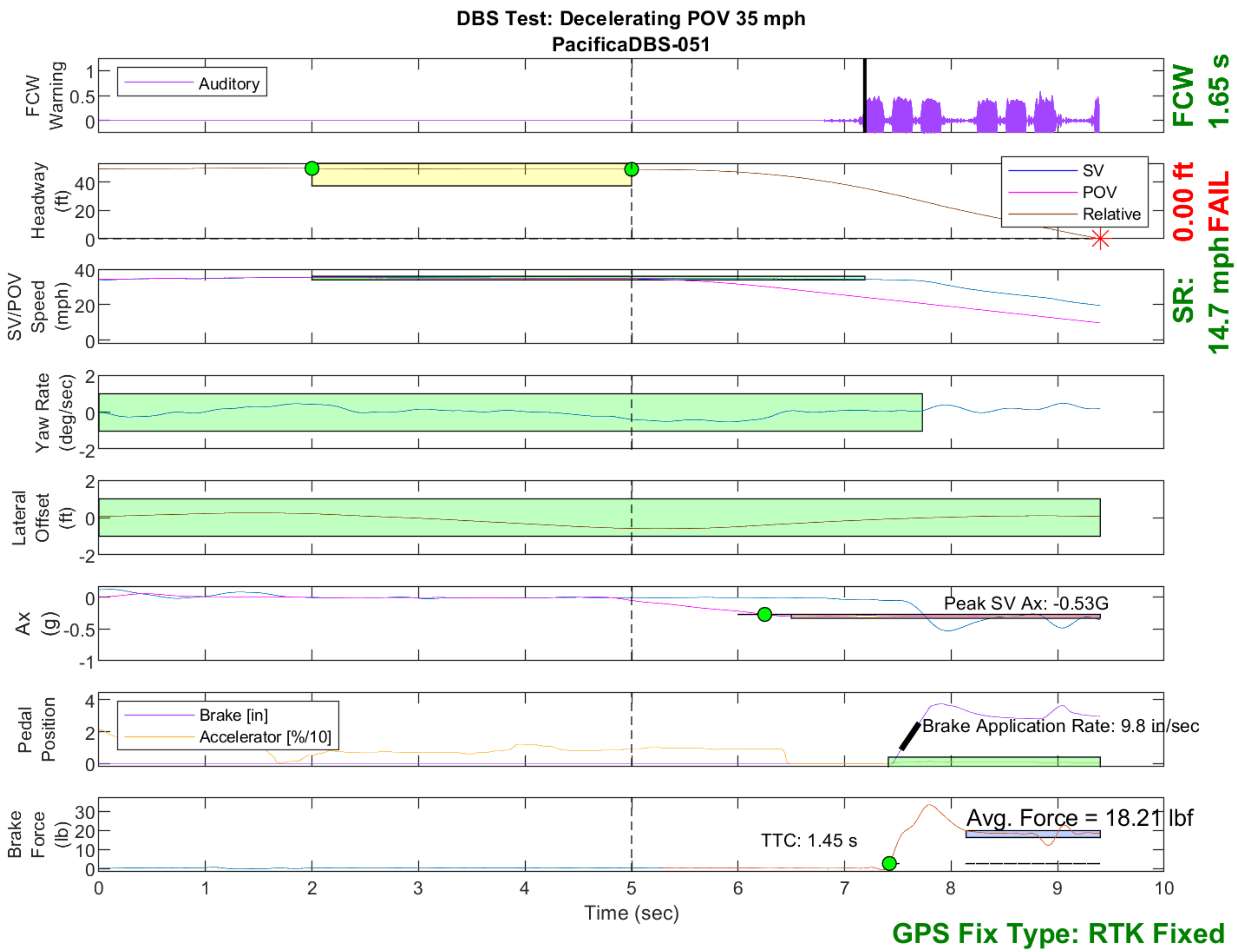

Figure E34. Time History for DBS Run 51, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

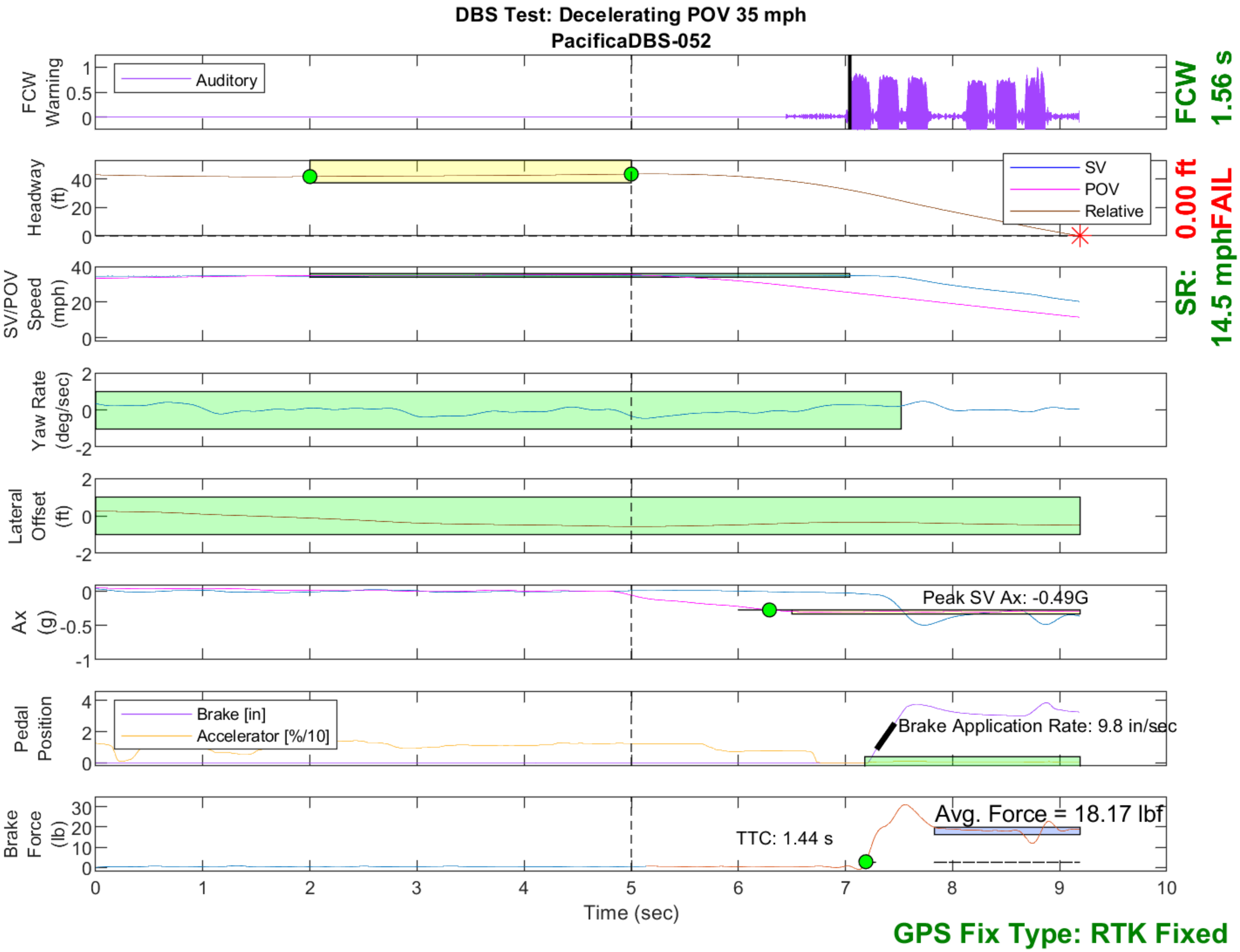

Figure E35. Time History for DBS Run 52, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

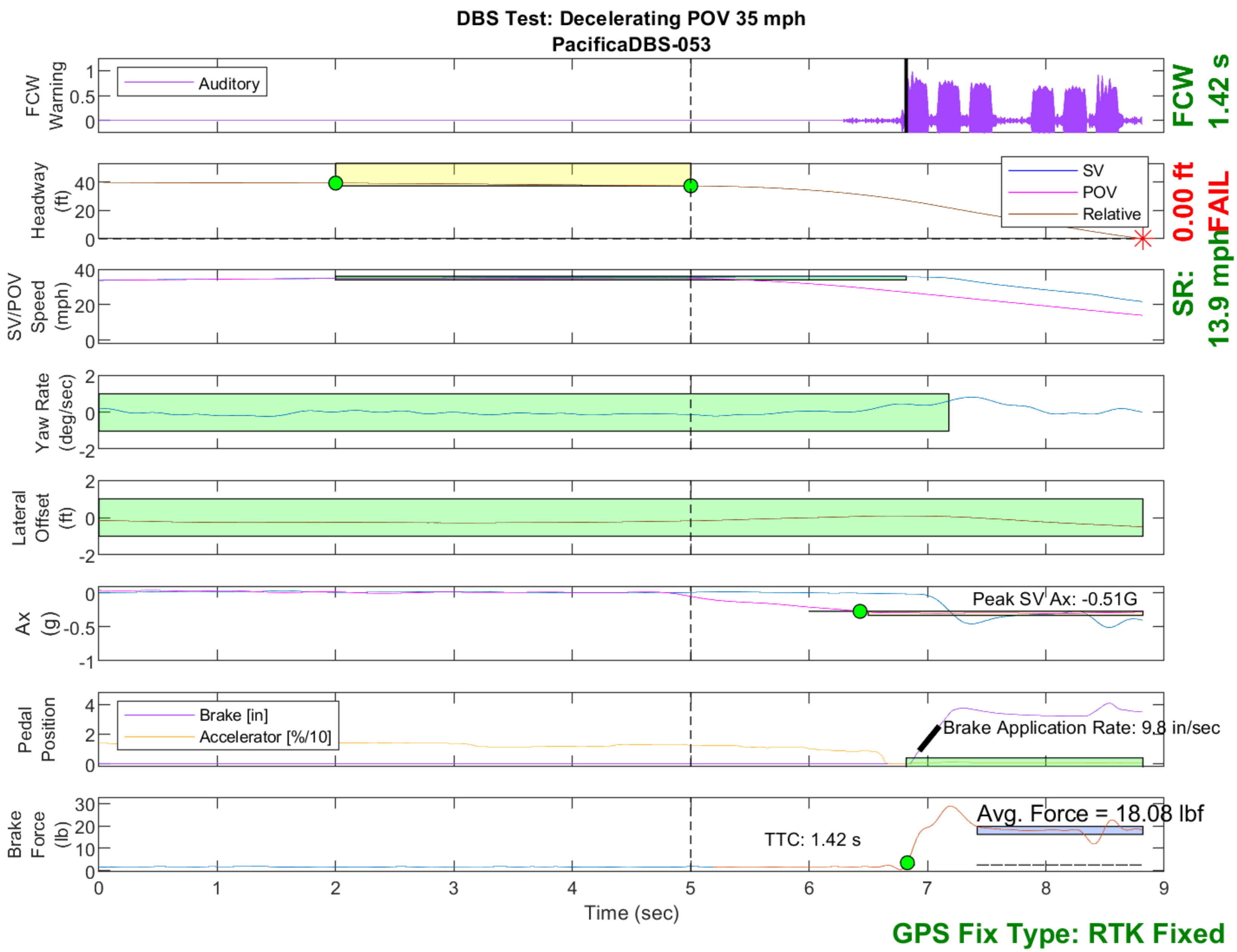

Figure E36. Time History for DBS Run 53, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

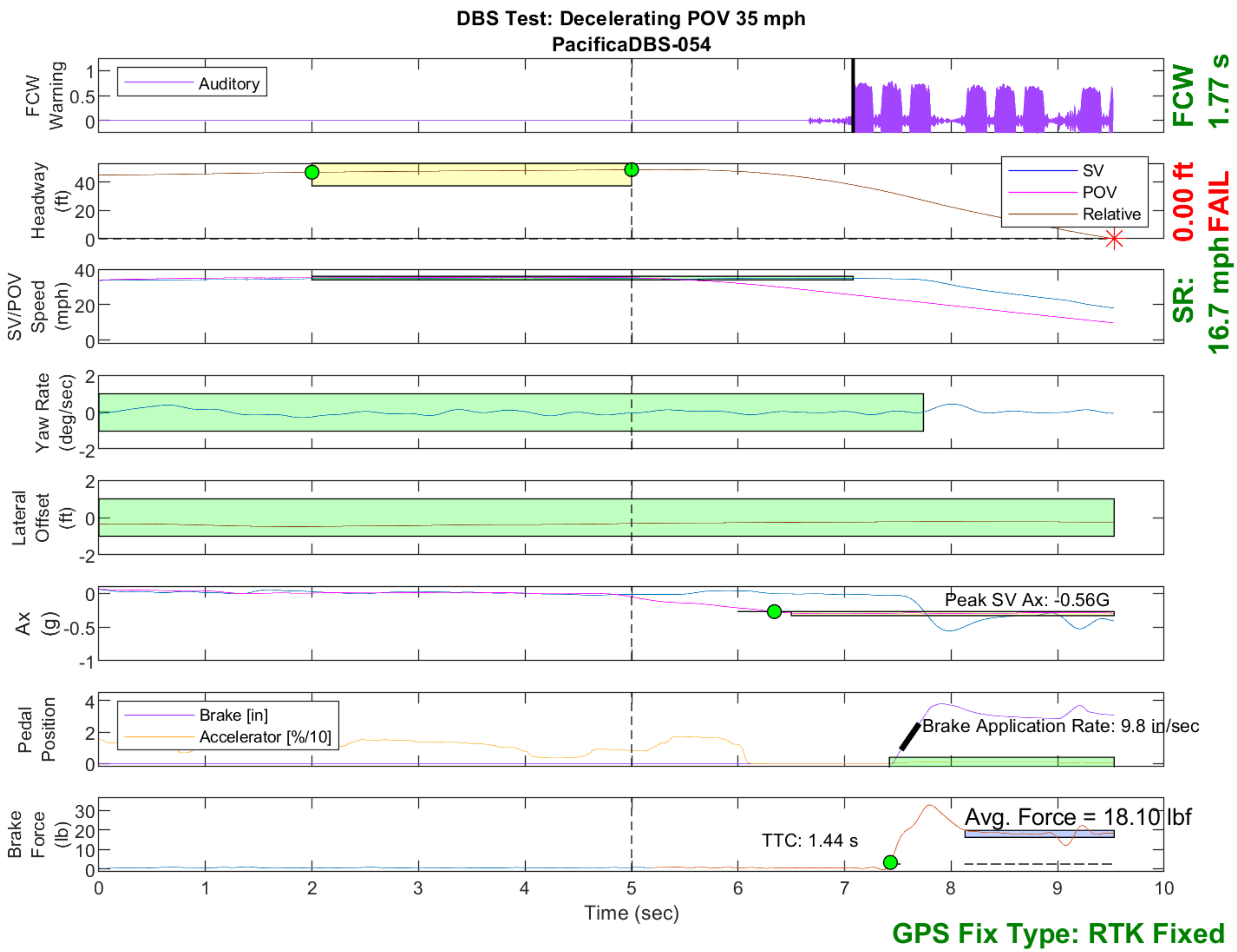

Figure E37. Time History for DBS Run 54, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

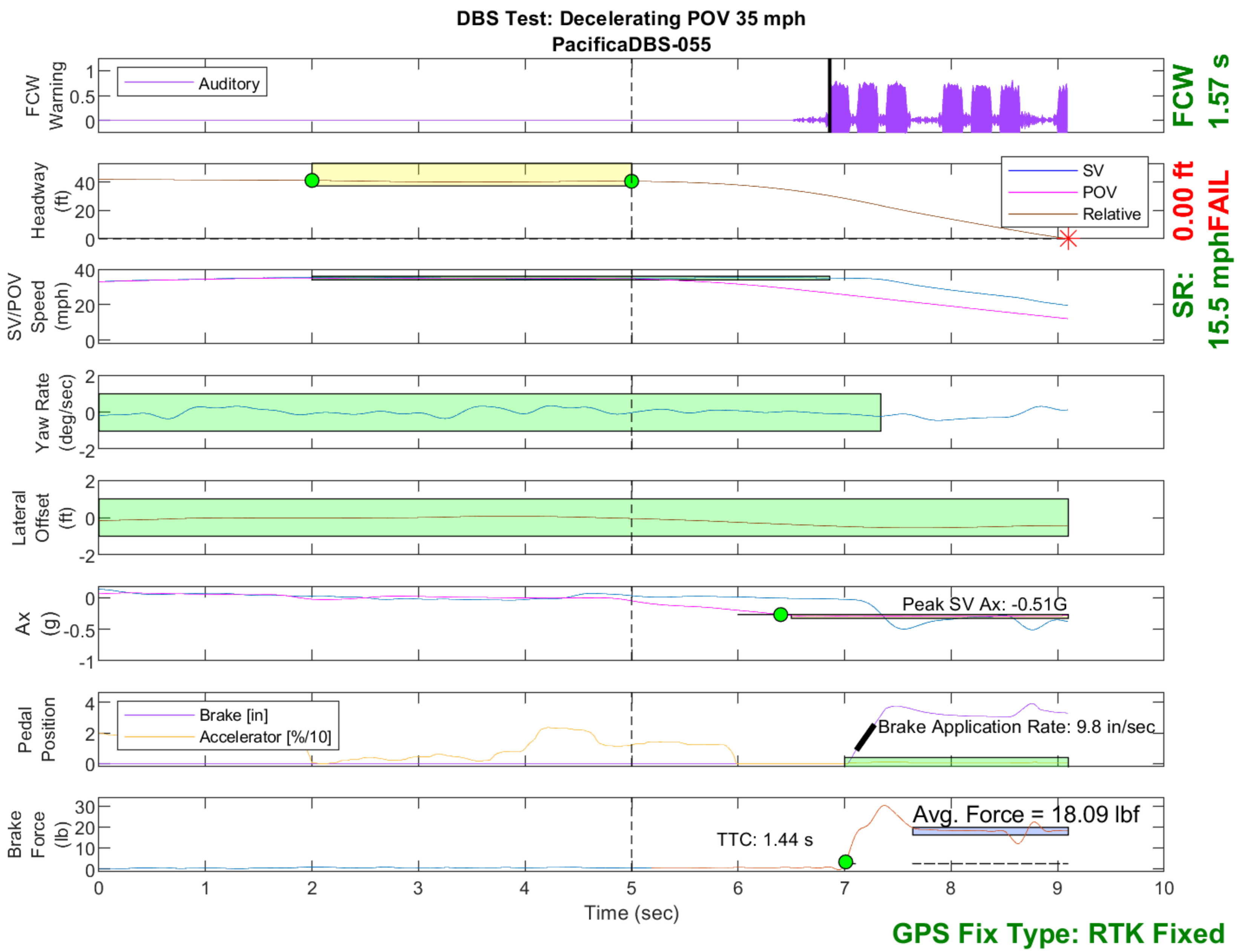

Figure E38. Time History for DBS Run 55, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

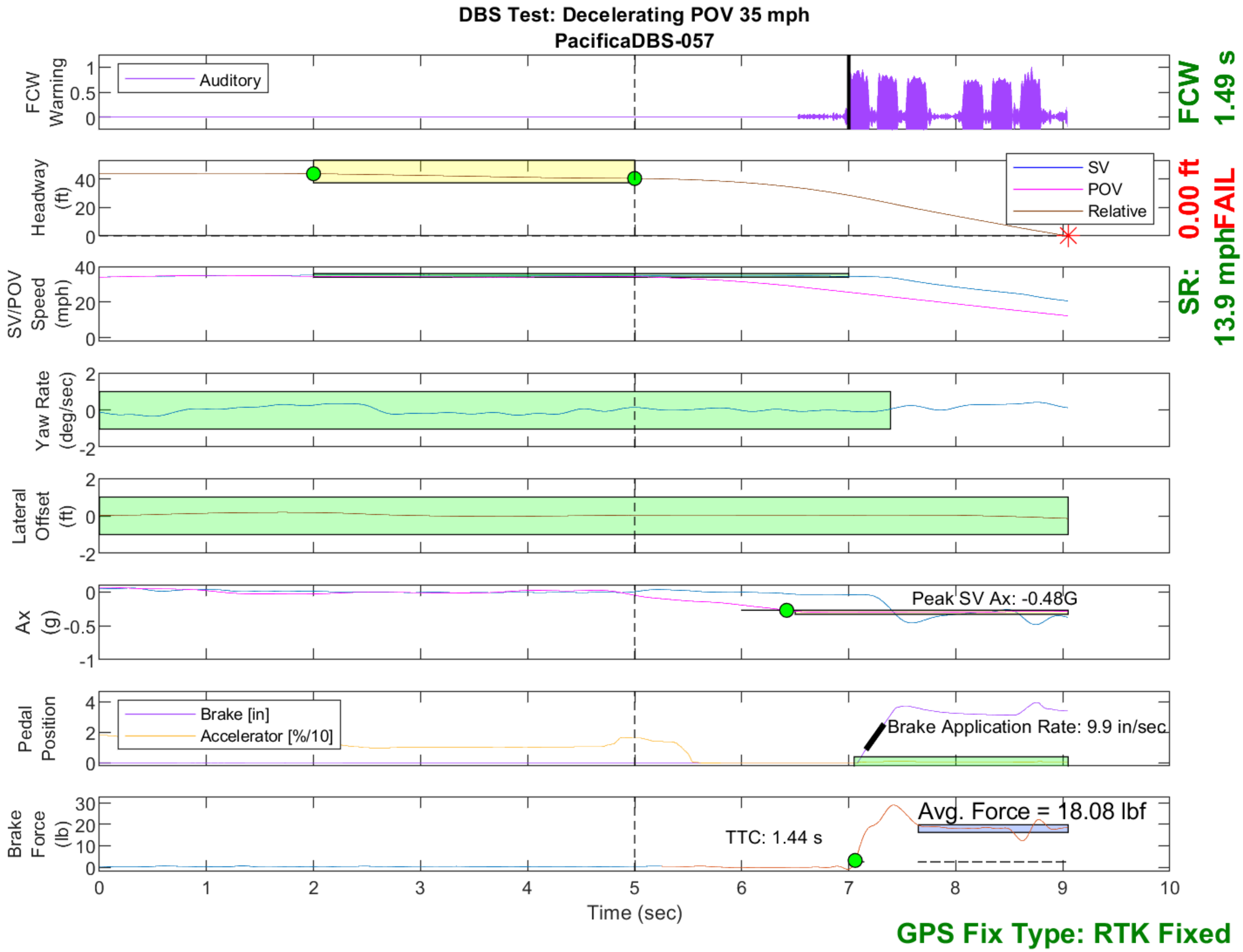

Figure E39. Time History for DBS Run 57, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

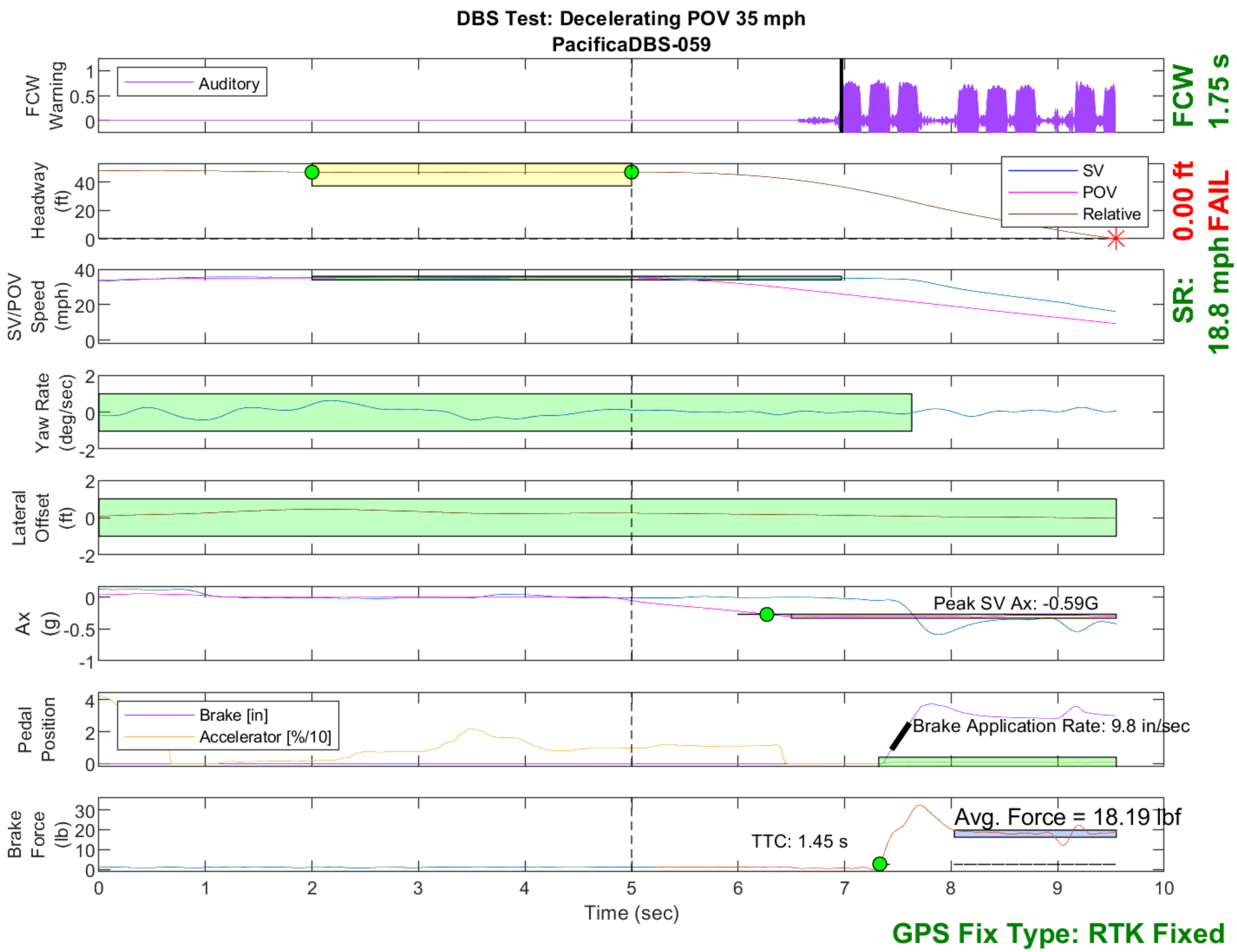

Figure E40. Time History for DBS Run 59, SV Encounters Decelerating POV, SV 35 mph, POV 35 mph

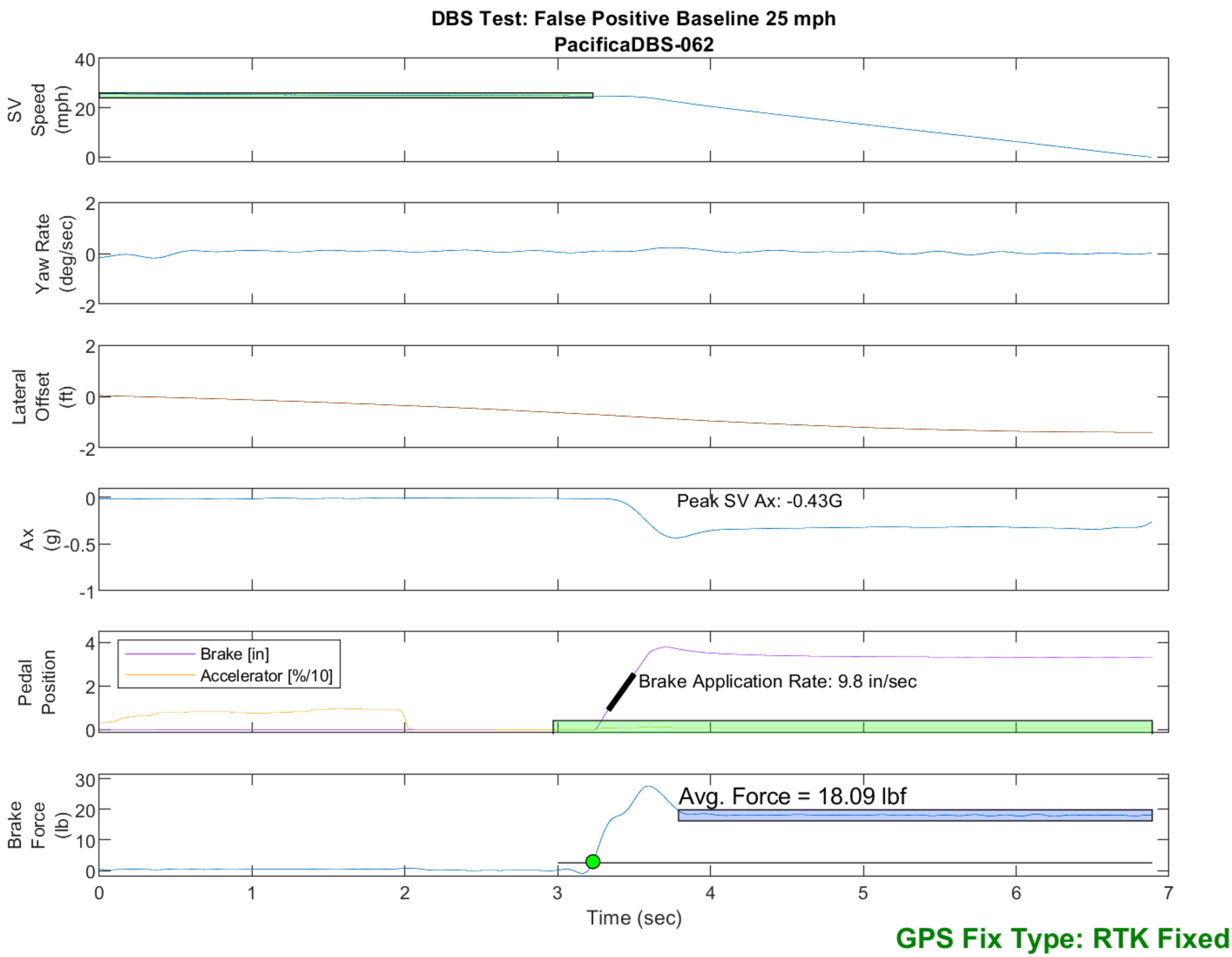

Figure E41. Time History for DBS Run 62, False Positive Baseline, SV 25 mph

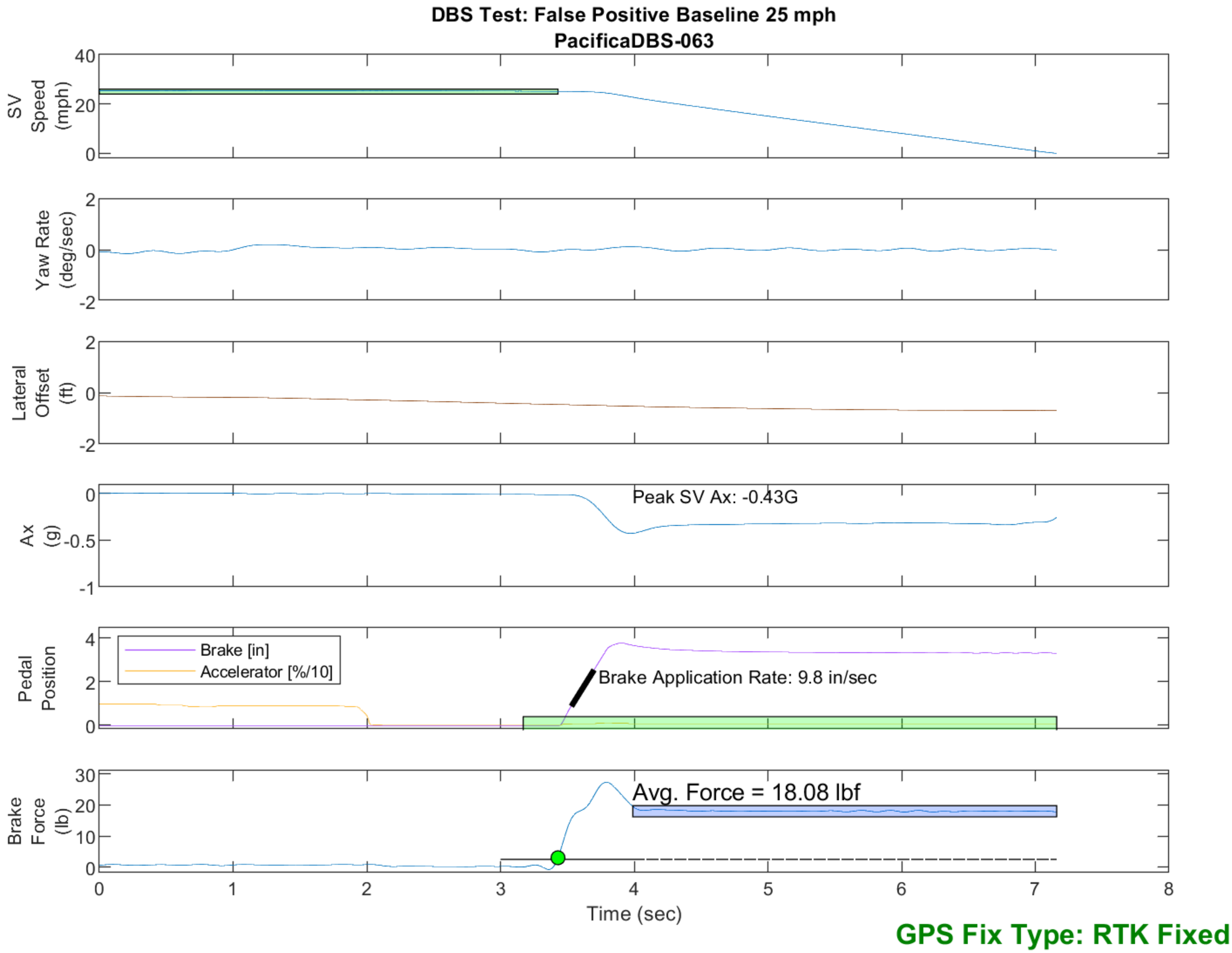

Figure E42. Time History for DBS Run 63, False Positive Baseline, SV 25 mph

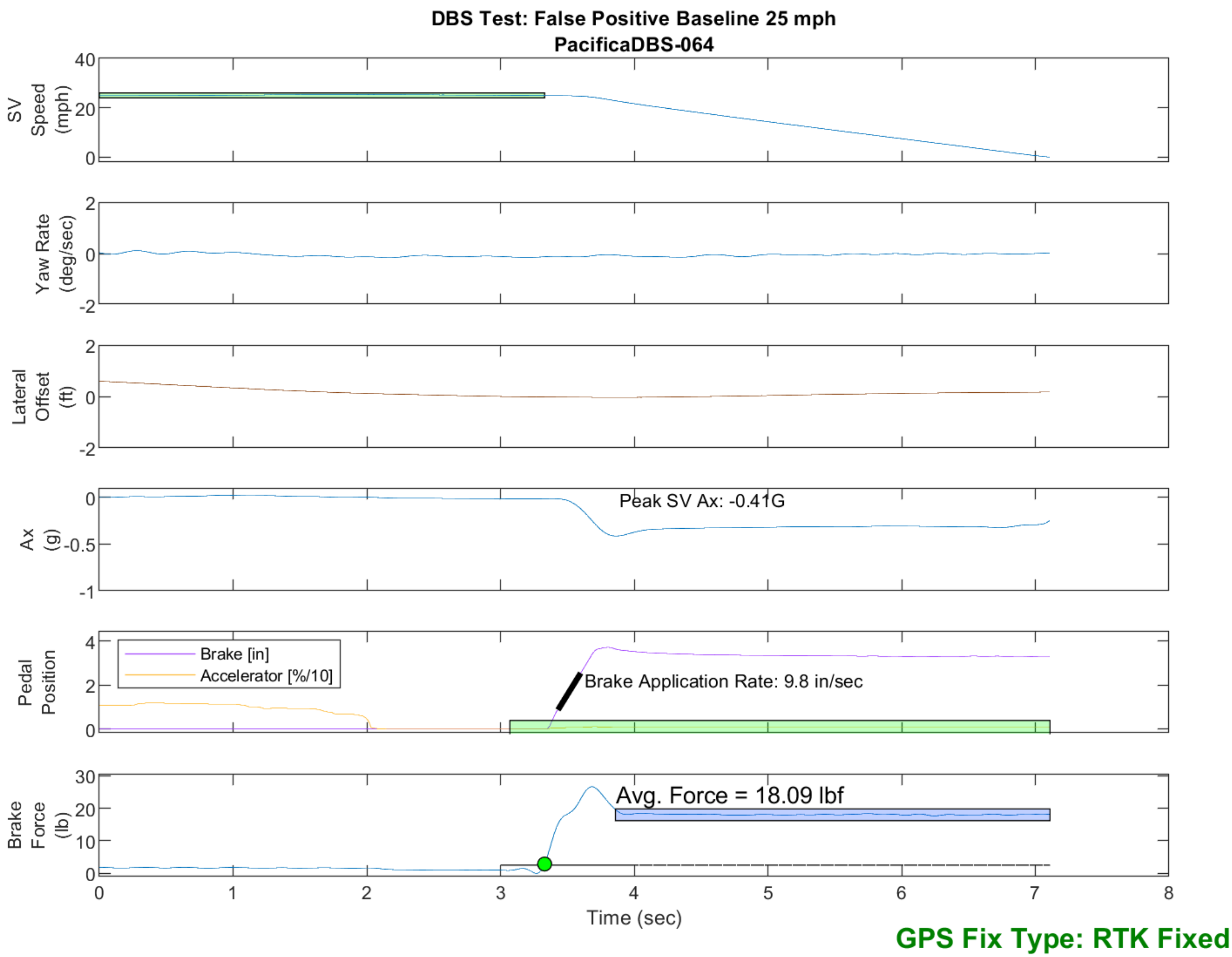

Figure E43. Time History for DBS Run 64, False Positive Baseline, SV 25 mph

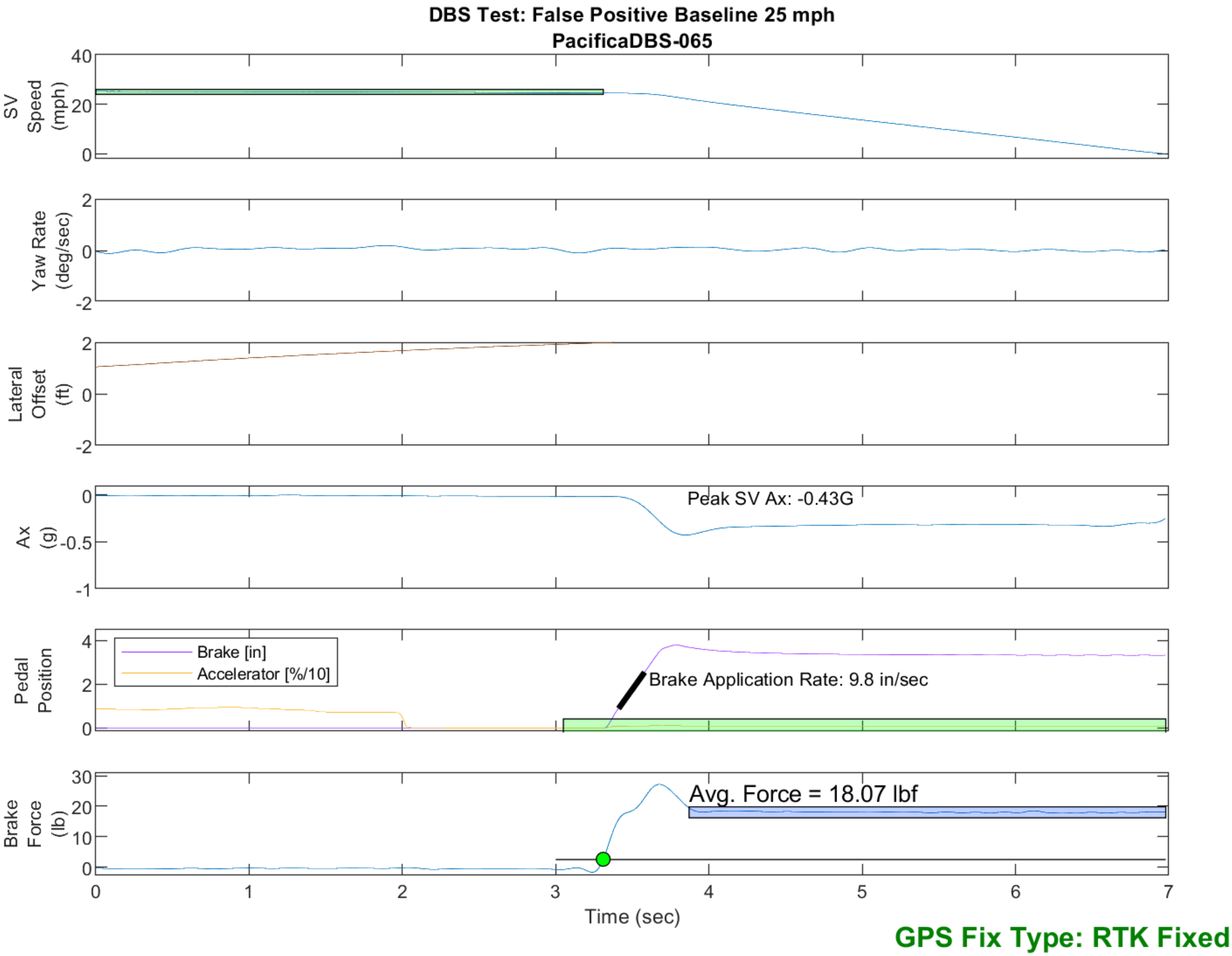

Figure E44. Time History for DBS Run 65, False Positive Baseline, SV 25 mph

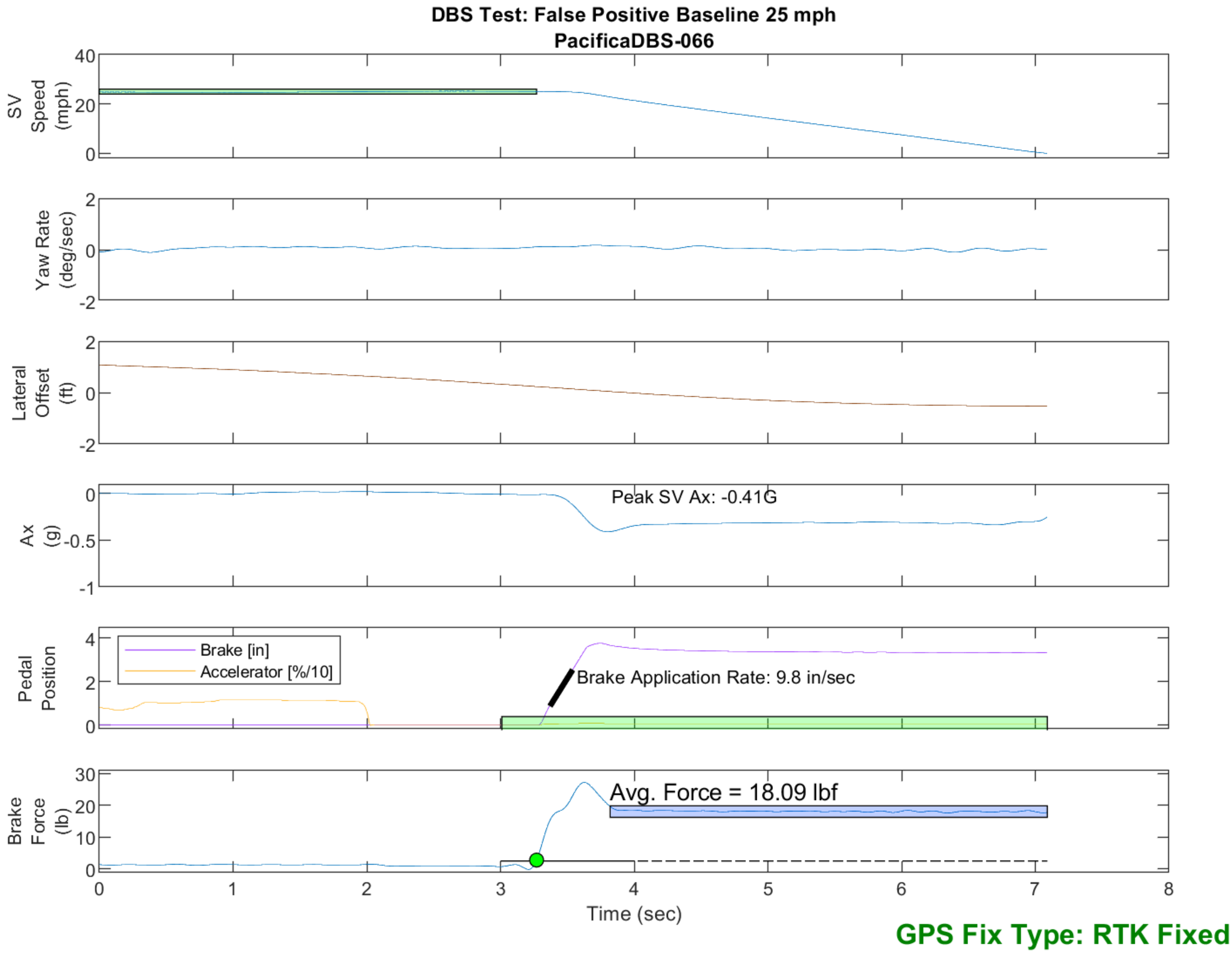

Figure E45. Time History for DBS Run 66, False Positive Baseline, SV 25 mph

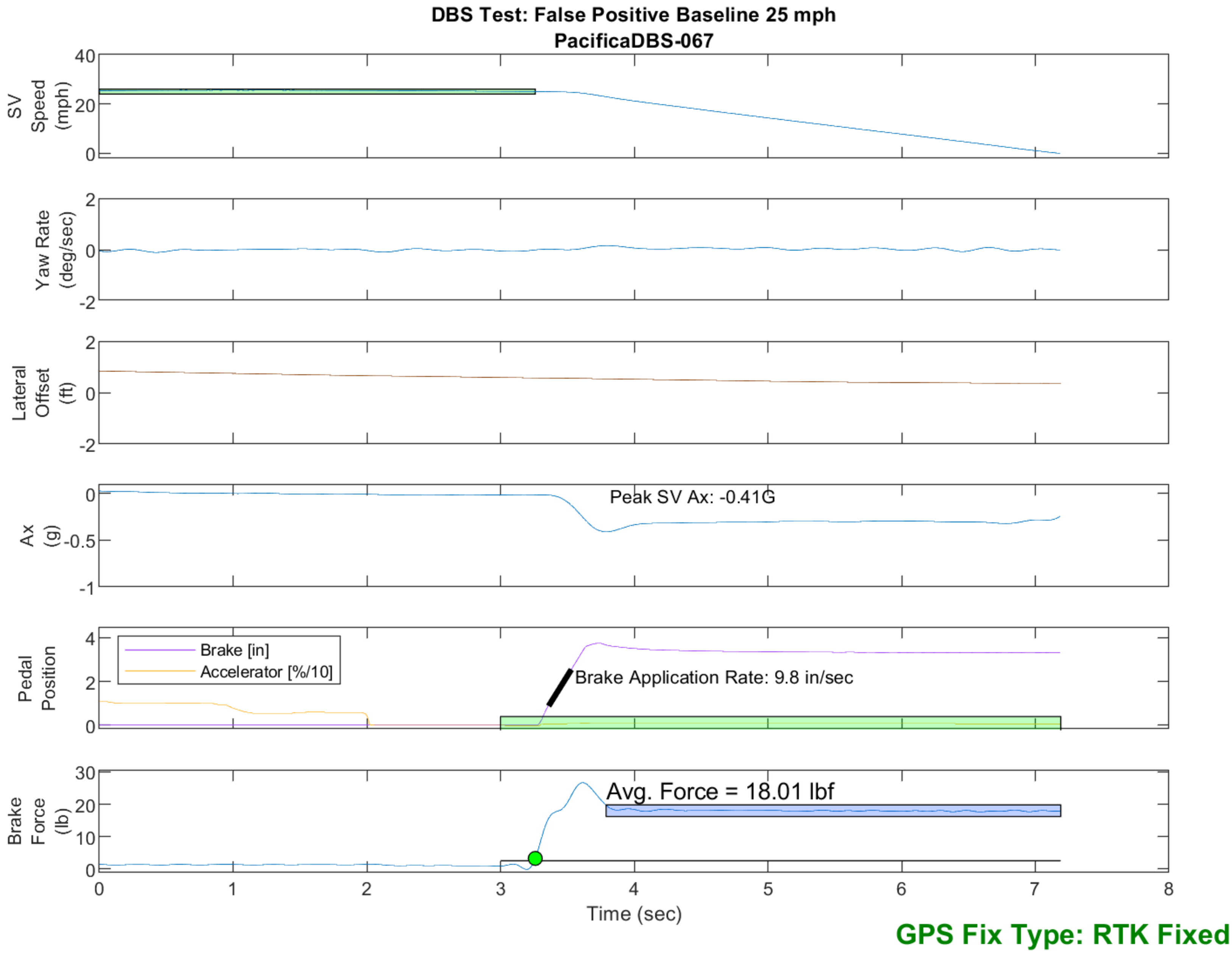

Figure E46. Time History for DBS Run 67, False Positive Baseline, SV 25 mph

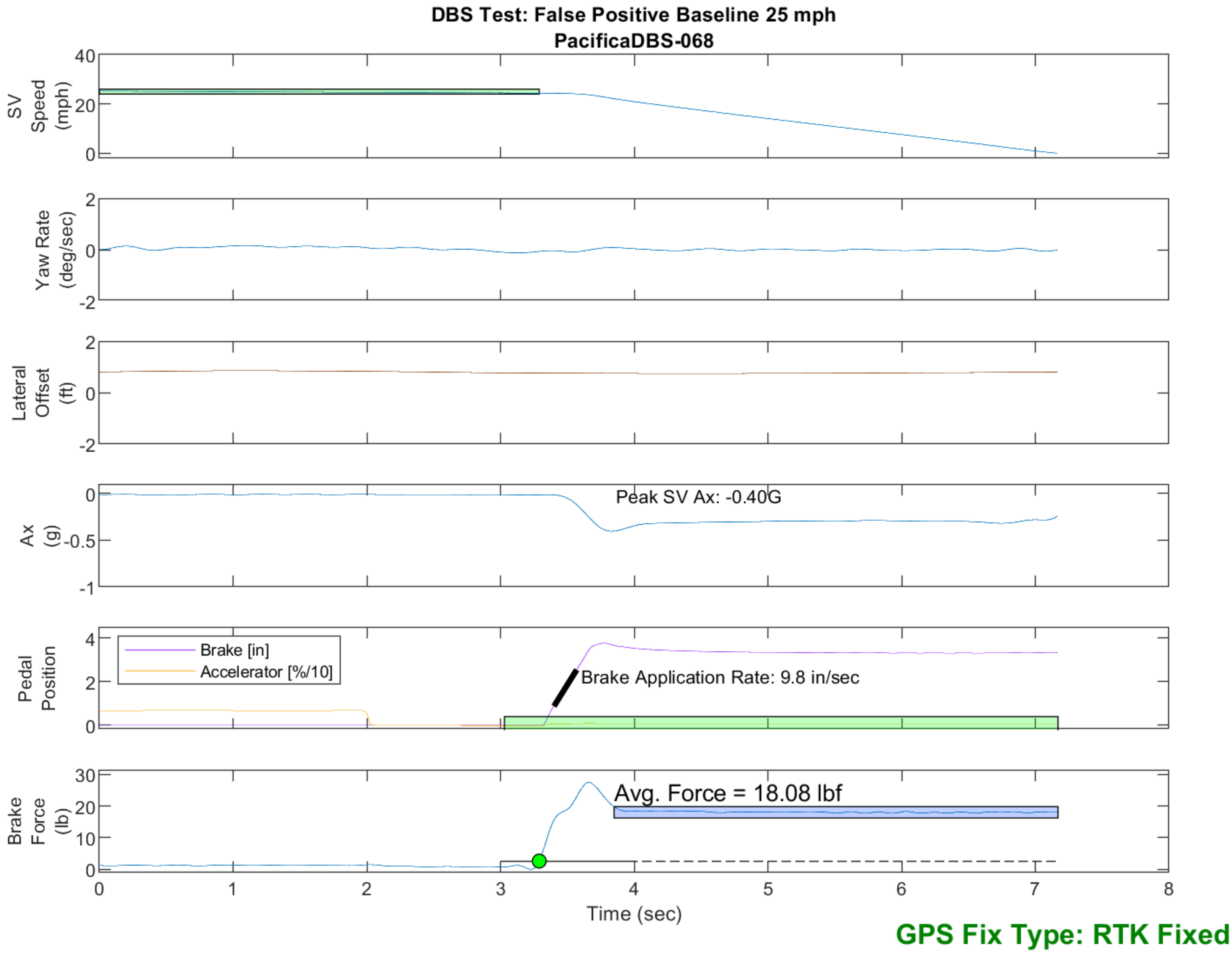

Figure E47. Time History for DBS Run 68, False Positive Baseline, SV 25 mph

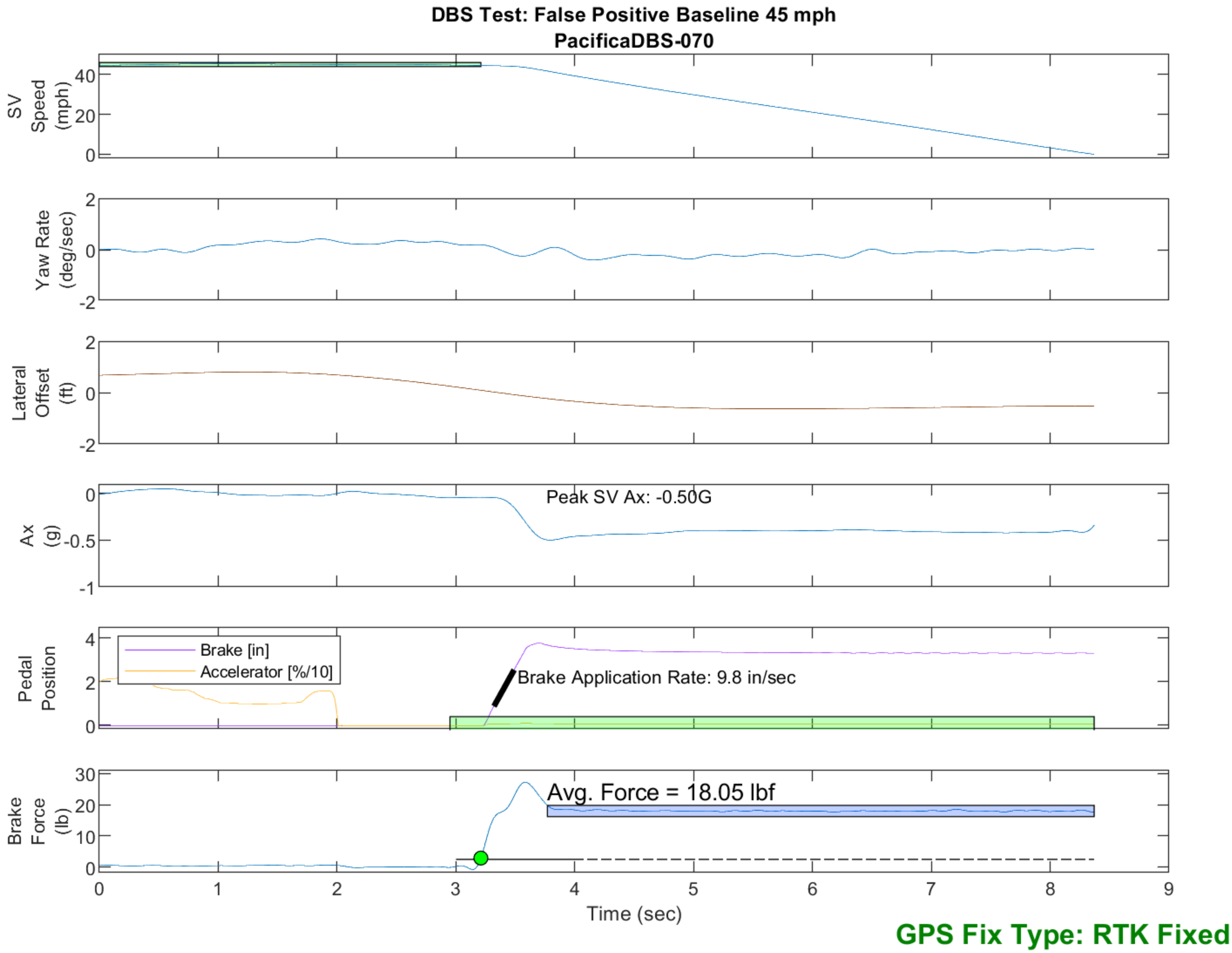

Figure E48. Time History for DBS Run 70, False Positive Baseline, SV 45 mph

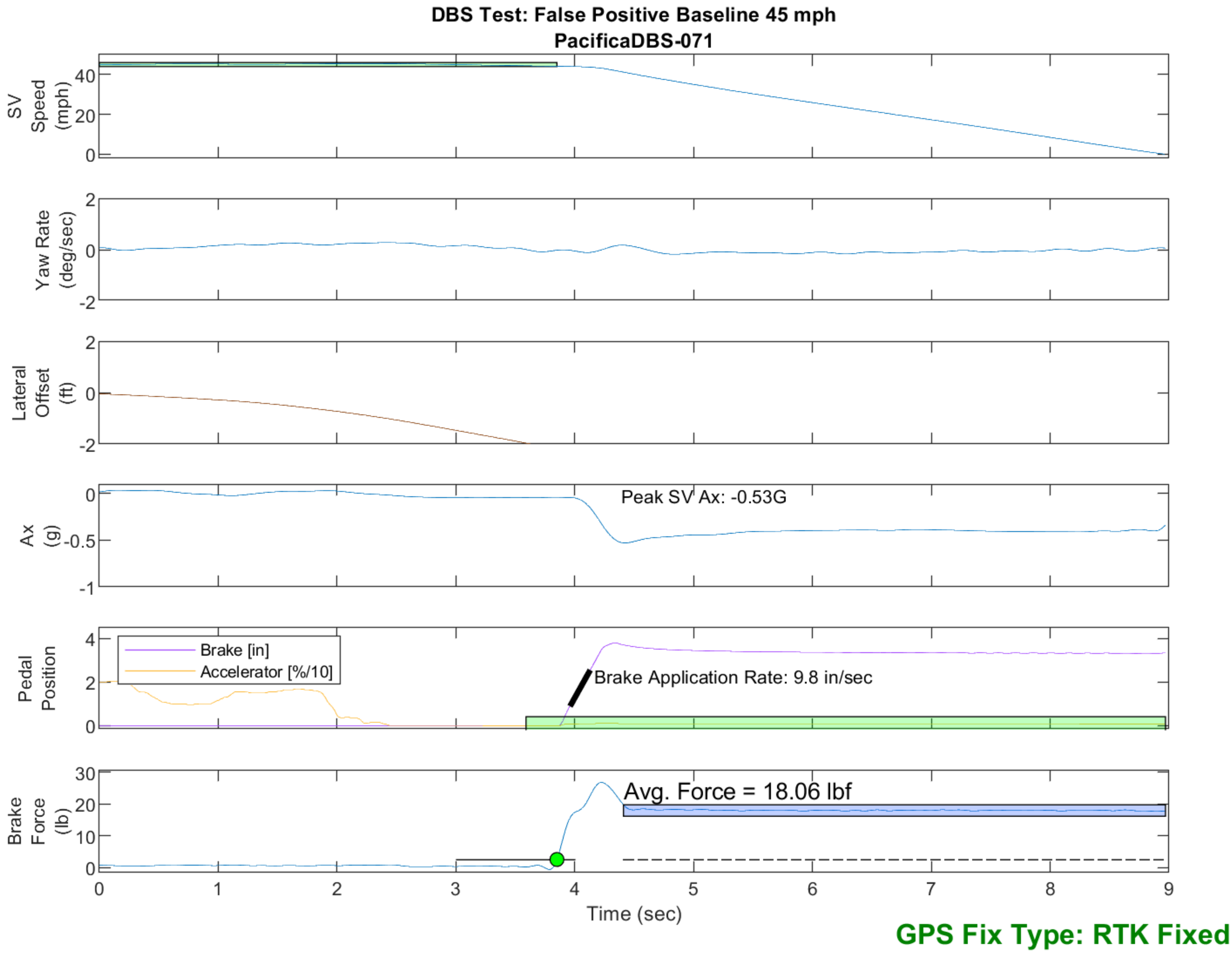

Figure E49. Time History for DBS Run 71, False Positive Baseline, SV 45 mph

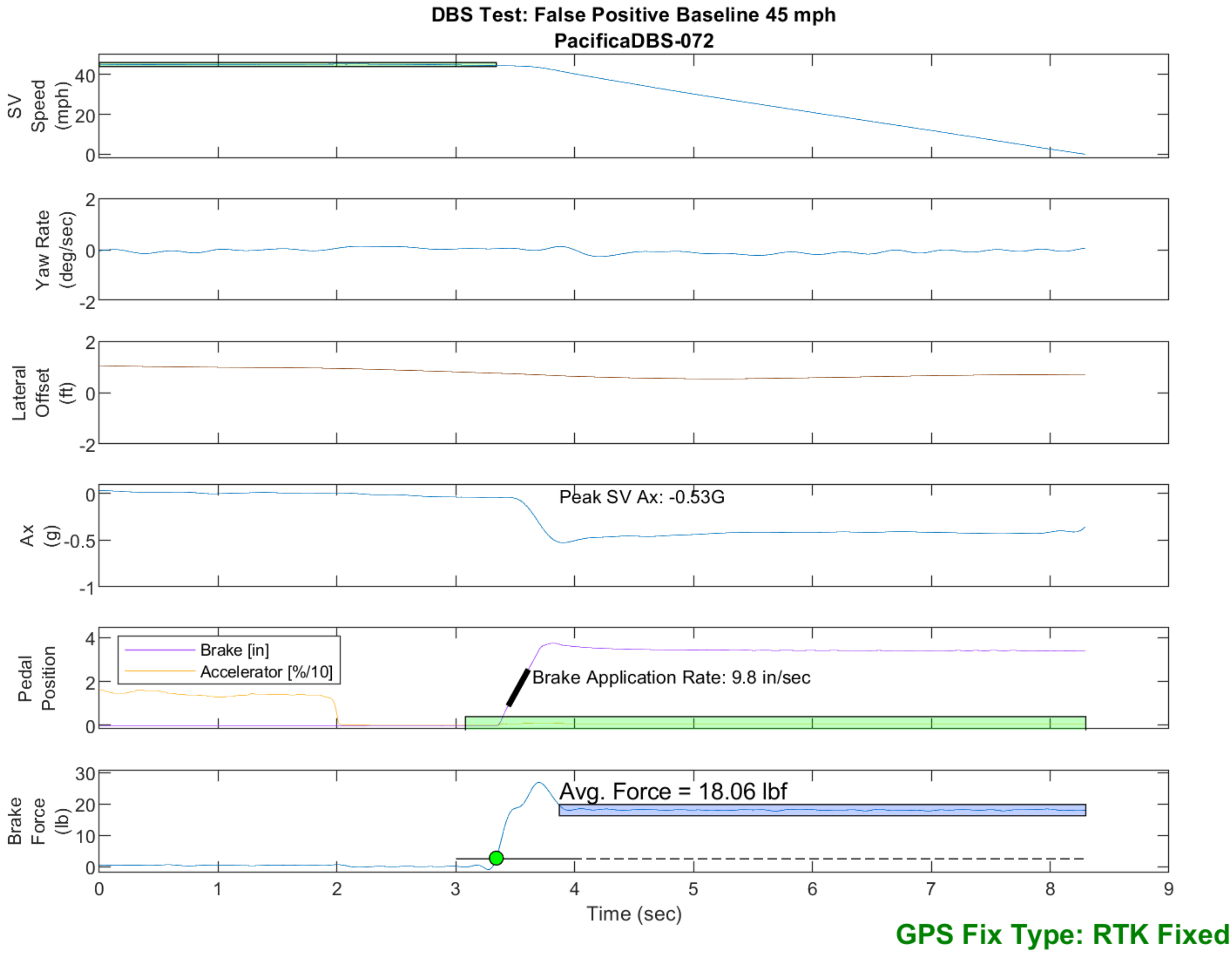

Figure E50. Time History for DBS Run 72, False Positive Baseline, SV 45 mph

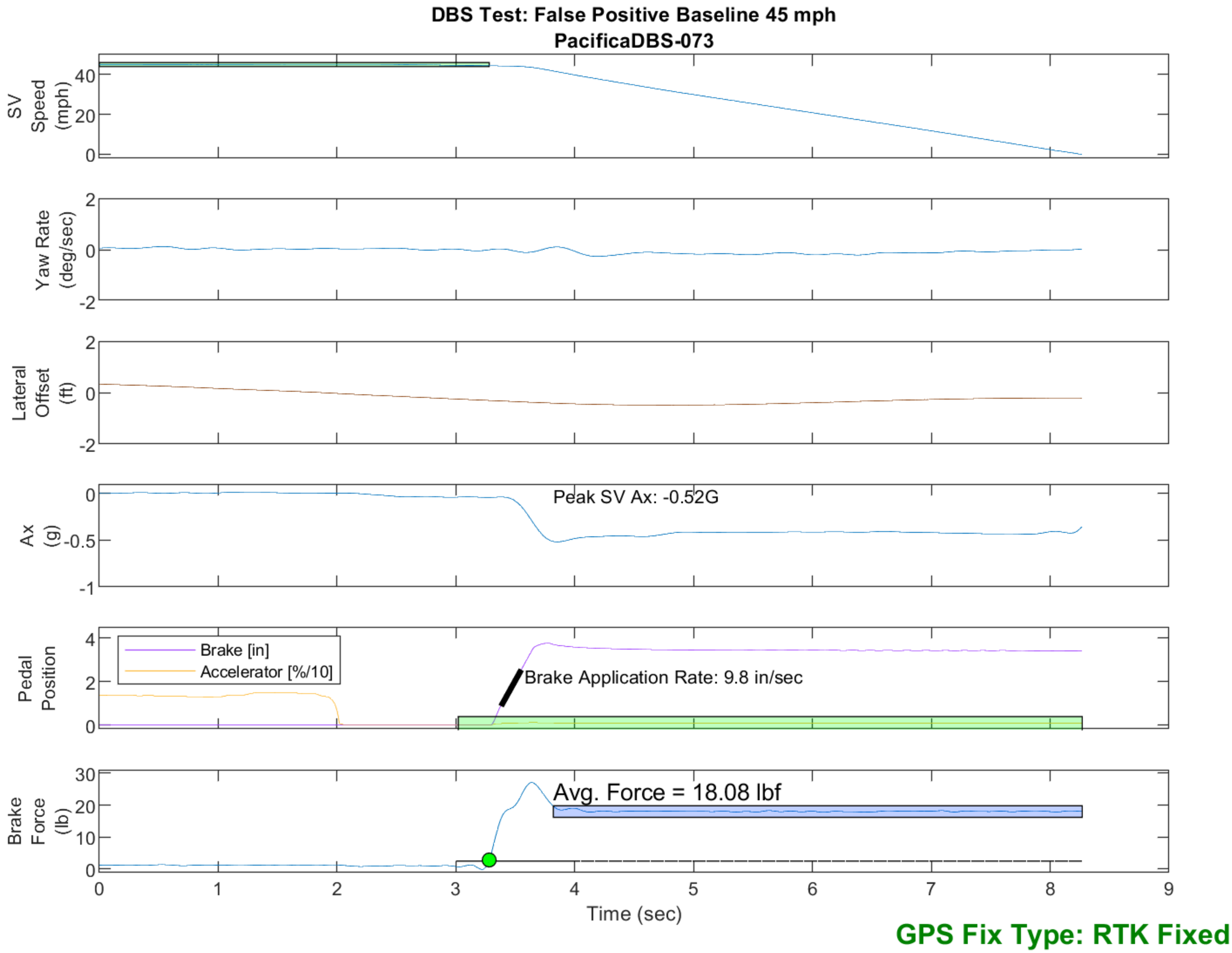

Figure E51. Time History for DBS Run 73, False Positive Baseline, SV 45 mph

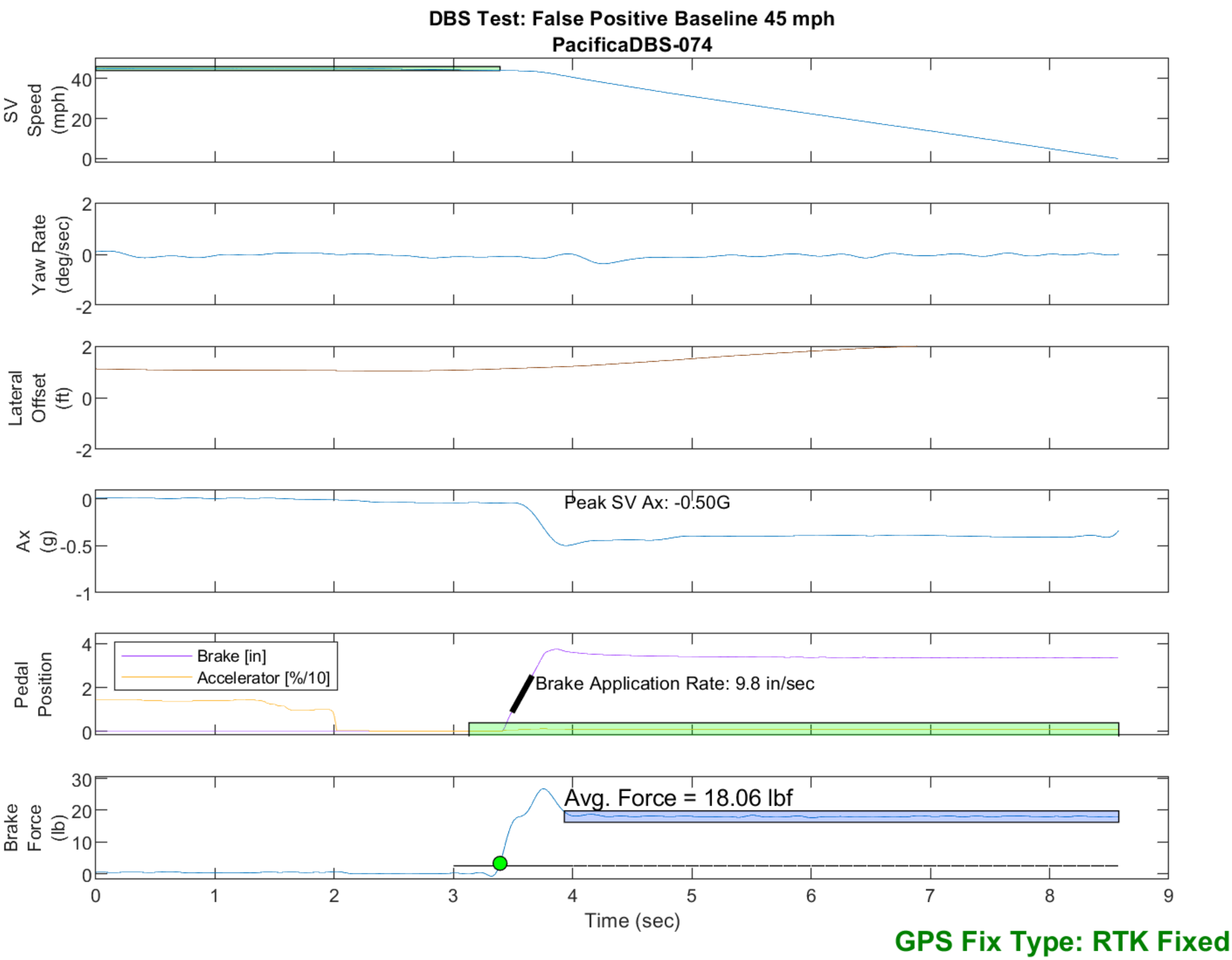

Figure E52. Time History for DBS Run 74, False Positive Baseline, SV 45 mph

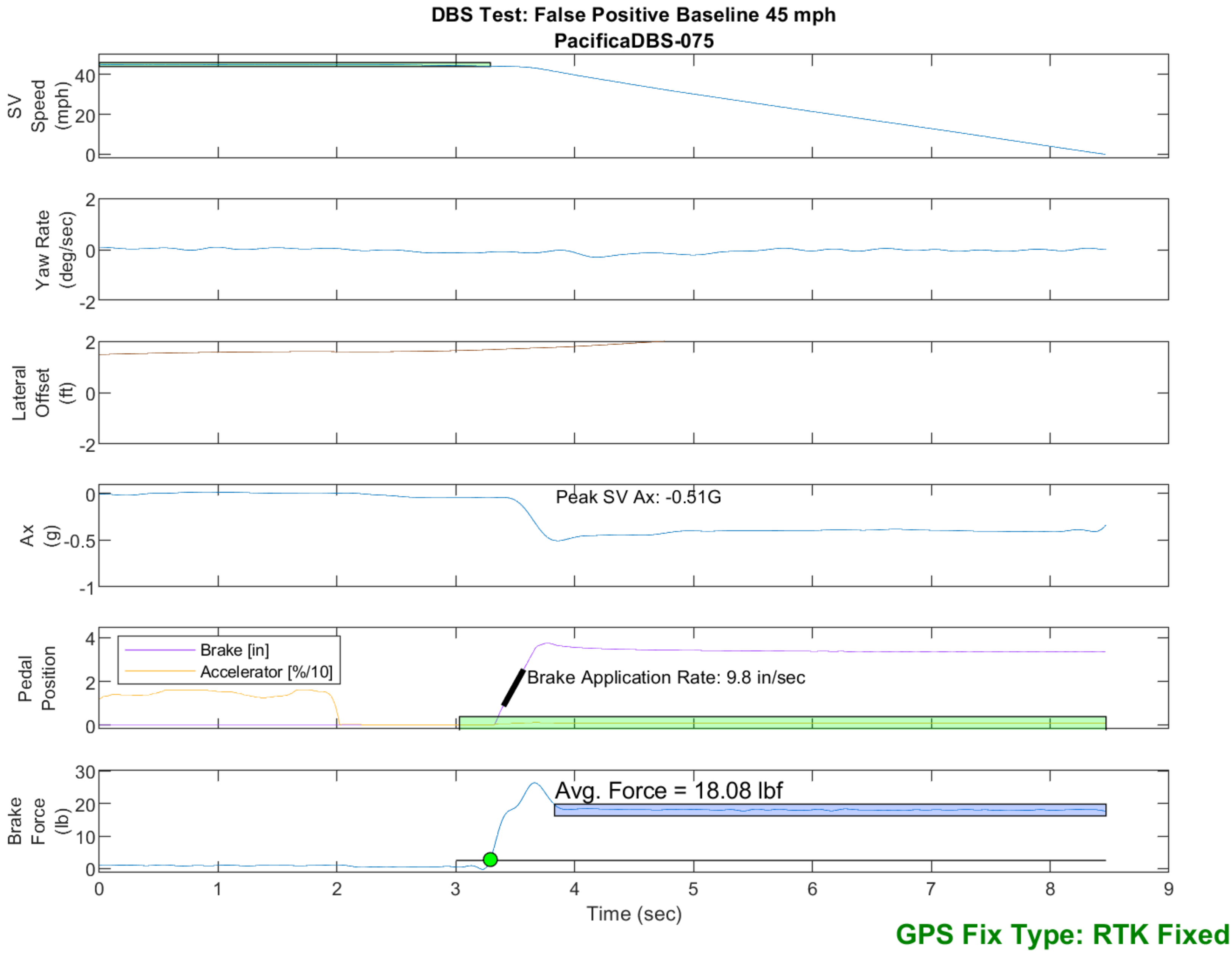

Figure E53. Time History for DBS Run 75, False Positive Baseline, SV 45 mph

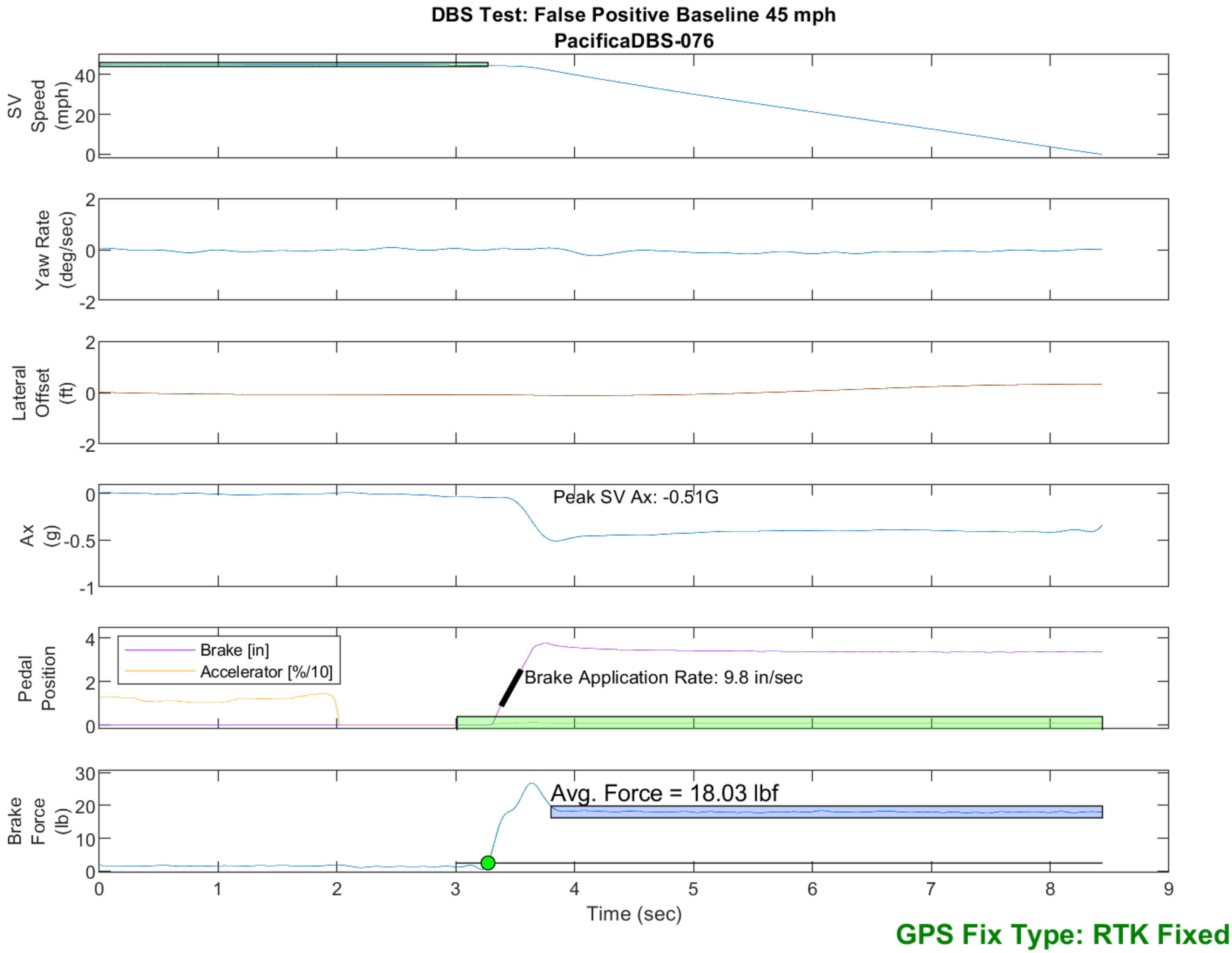

Figure E54. Time History for DBS Run 76, False Positive Baseline, SV 45 mph

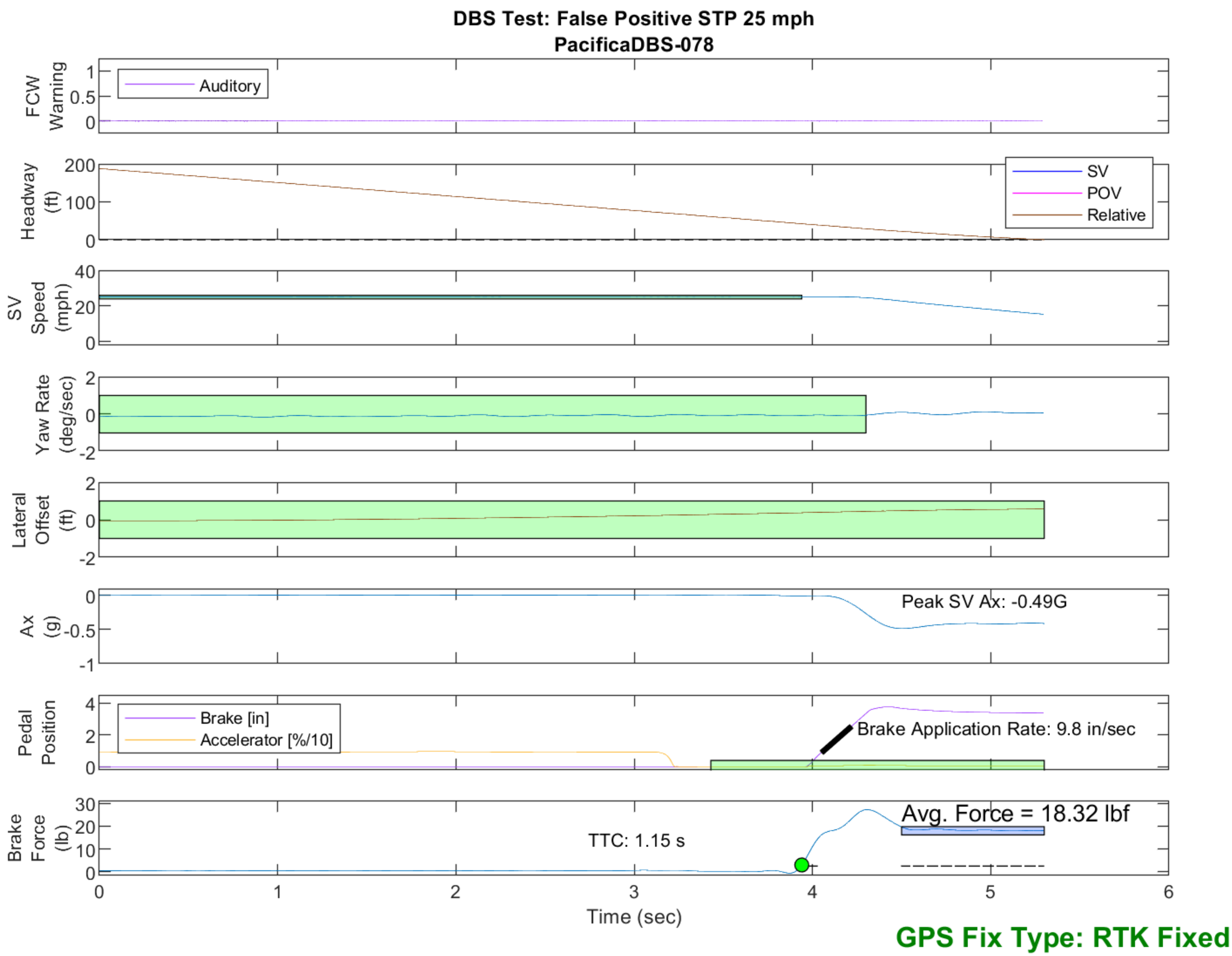

Figure E55. Time History for DBS Run 78, SV Encounters Steel Trench Plate, SV 25 mph

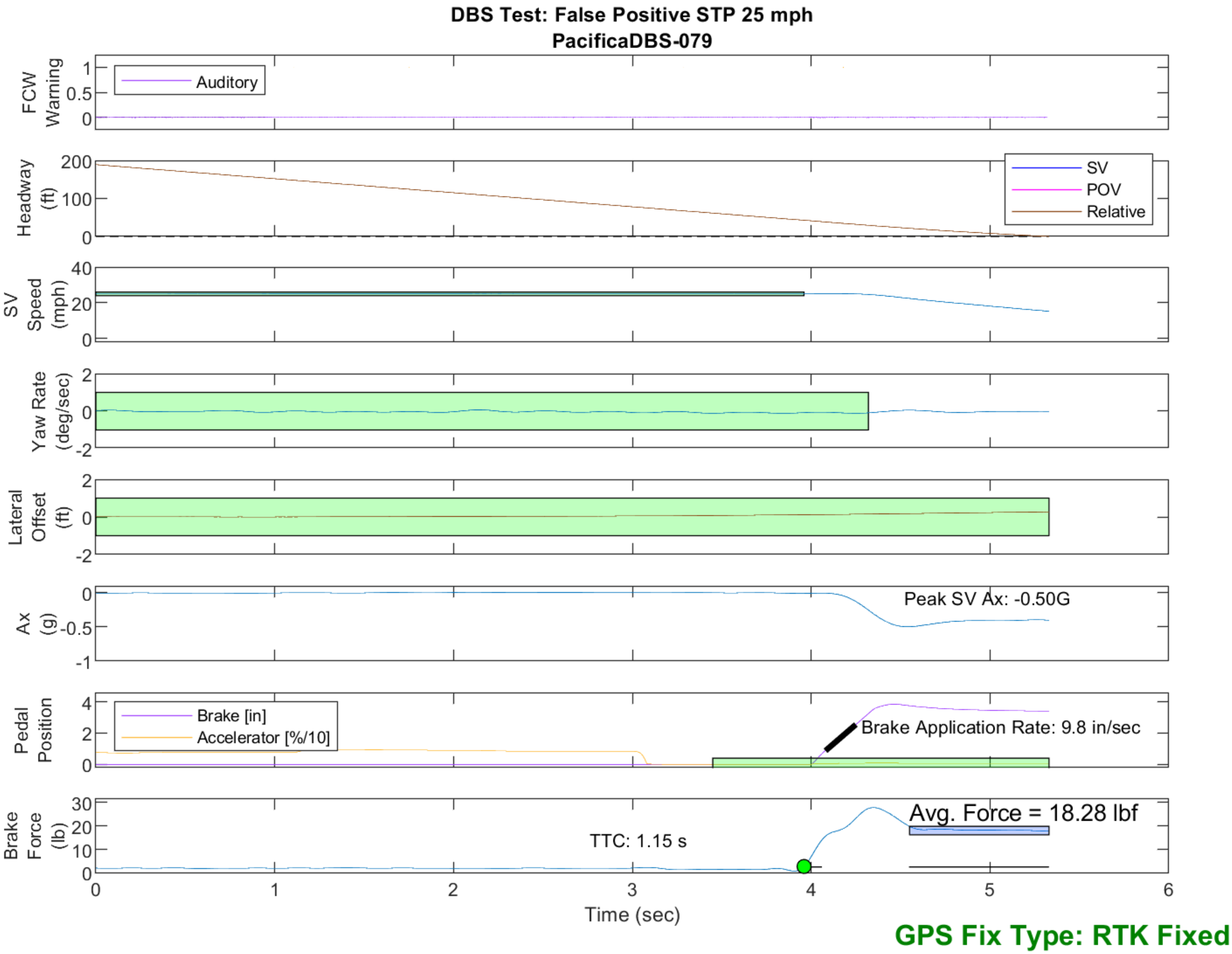

Figure E56. Time History for DBS Run 79, SV Encounters Steel Trench Plate, SV 25 mph

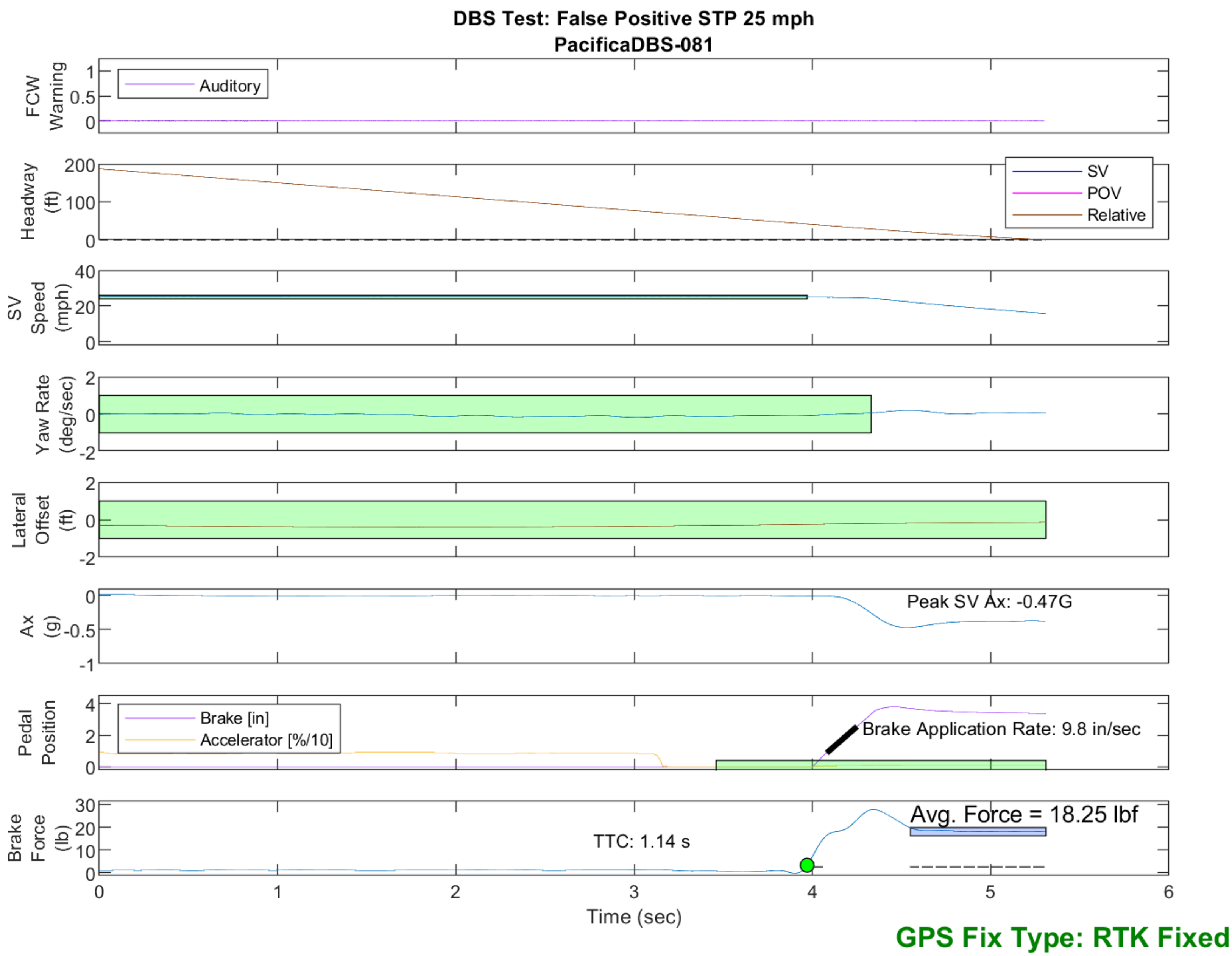

Figure E57. Time History for DBS Run 81, SV Encounters Steel Trench Plate, SV 25 mph

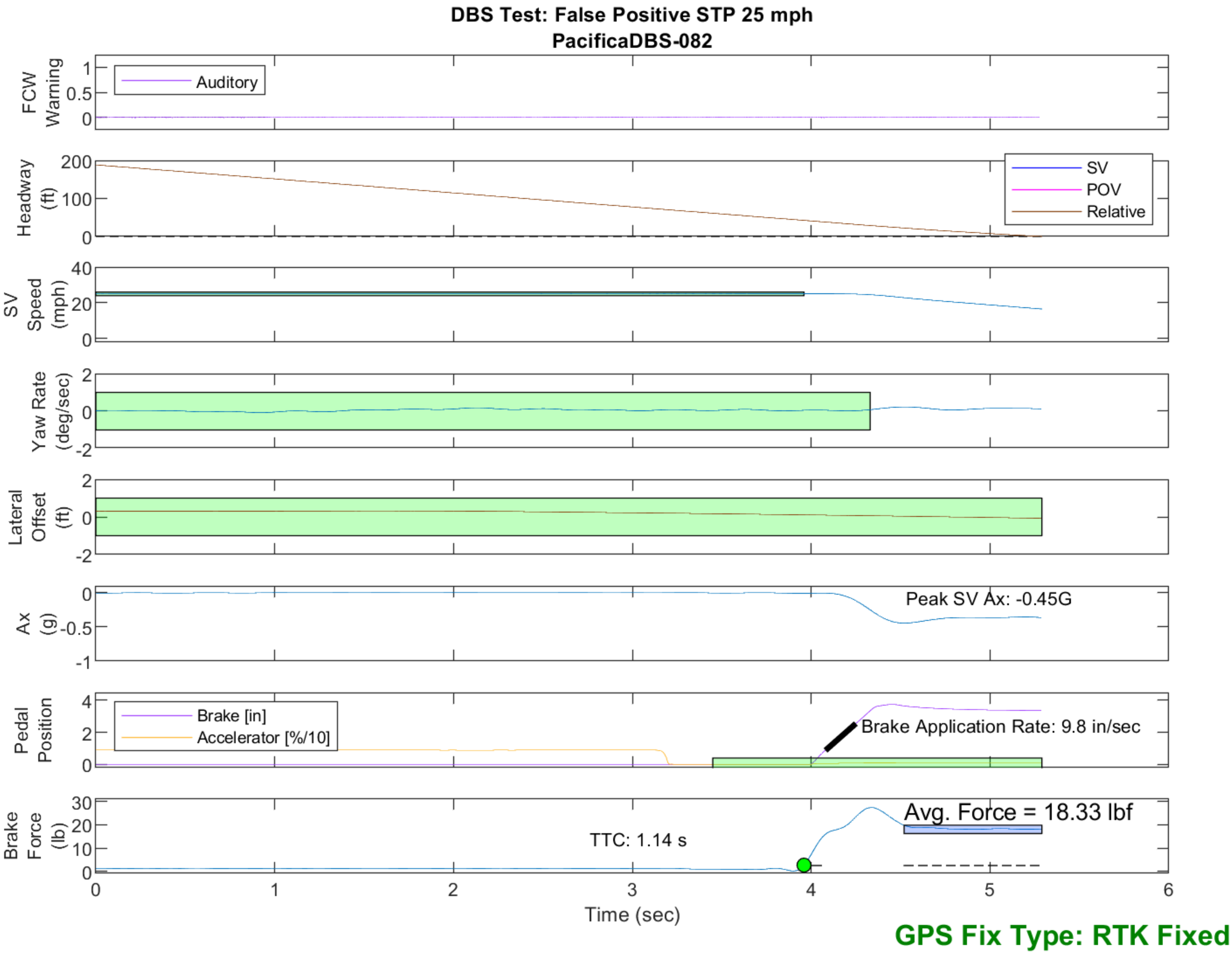

Figure E58. Time History for DBS Run 82, SV Encounters Steel Trench Plate, SV 25 mph

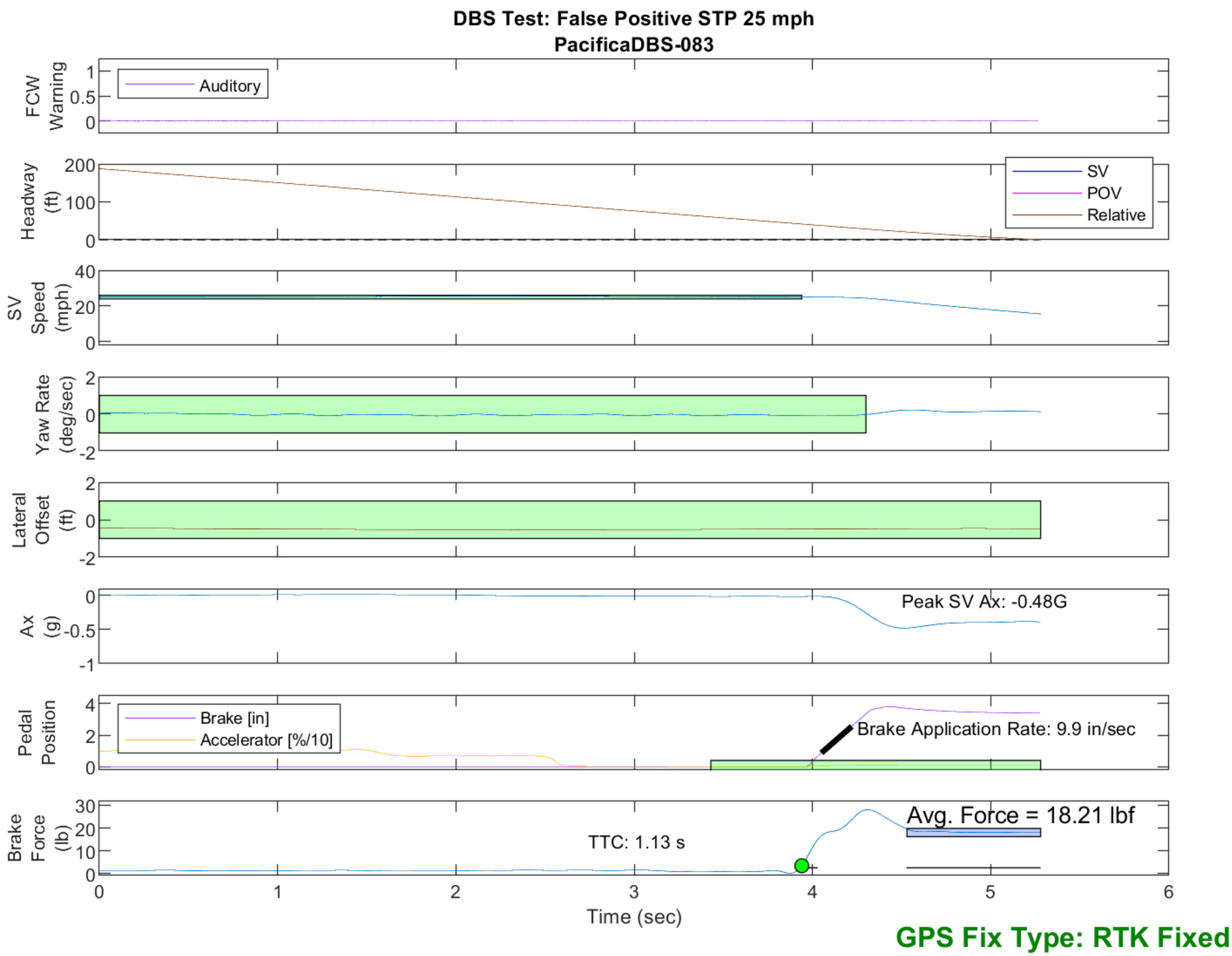

Figure E59. Time History for DBS Run 83, SV Encounters Steel Trench Plate, SV 25 mph

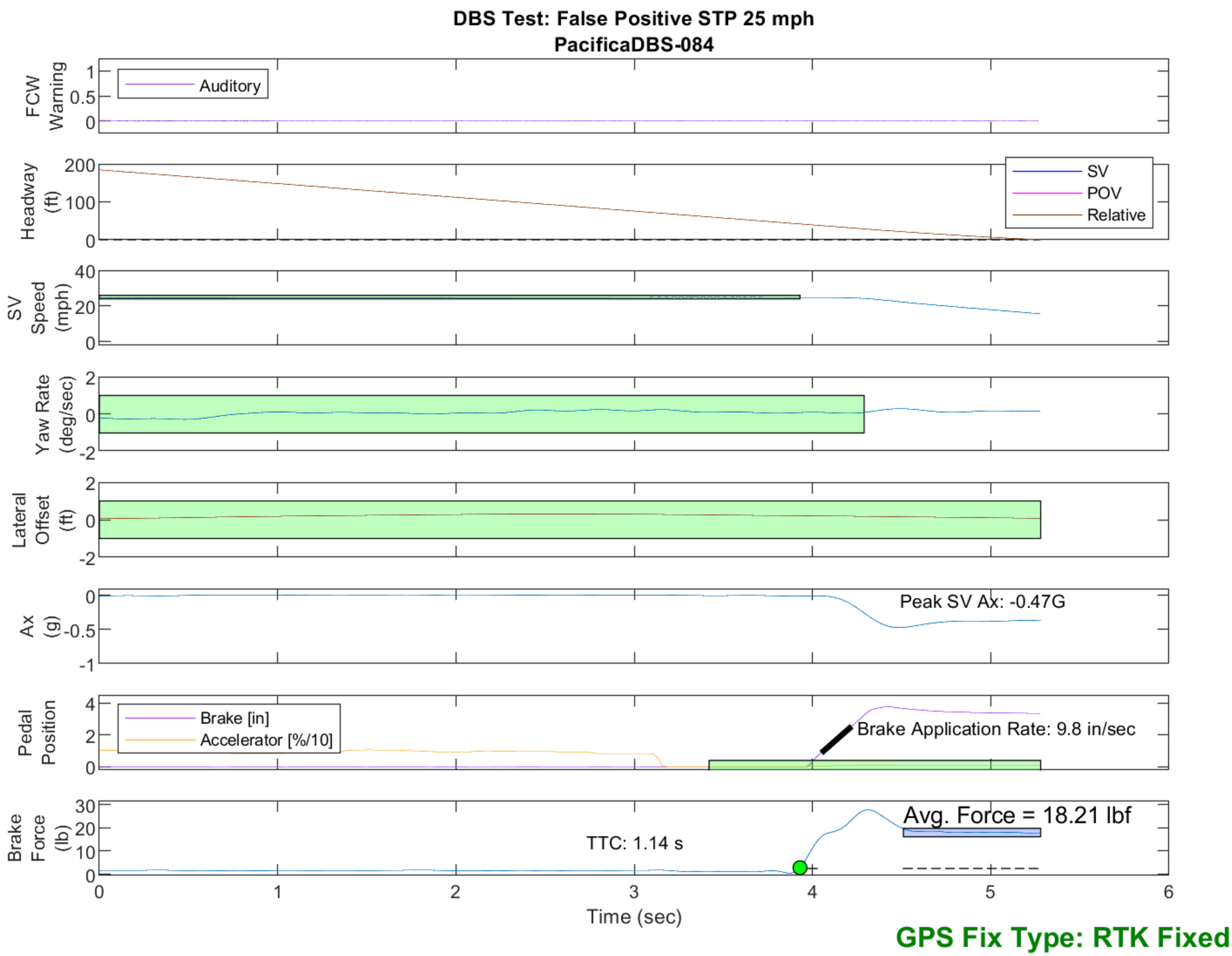

Figure E60. Time History for DBS Run 84, SV Encounters Steel Trench Plate, SV 25 mph

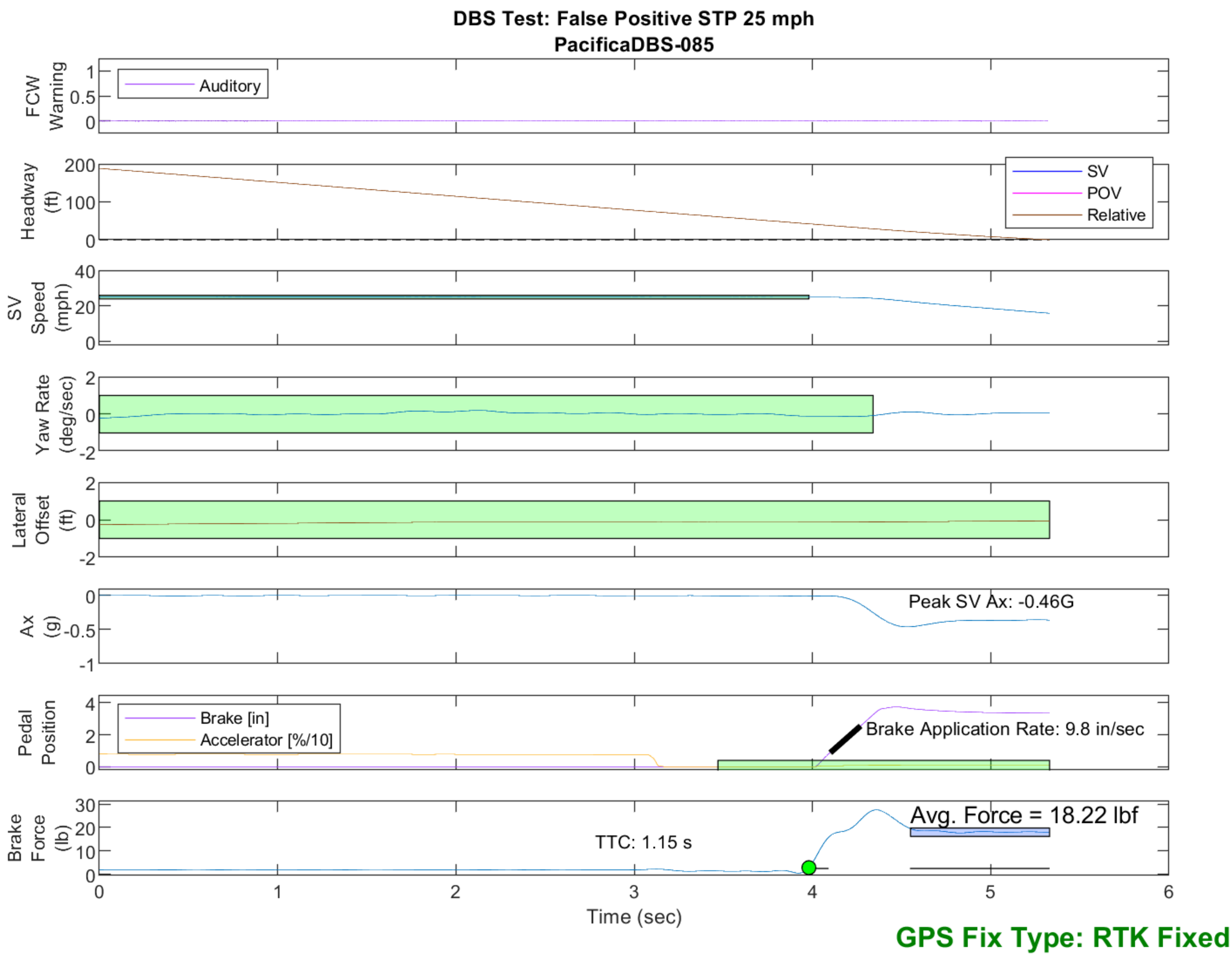

Figure E61. Time History for DBS Run 85, SV Encounters Steel Trench Plate, SV 25 mph

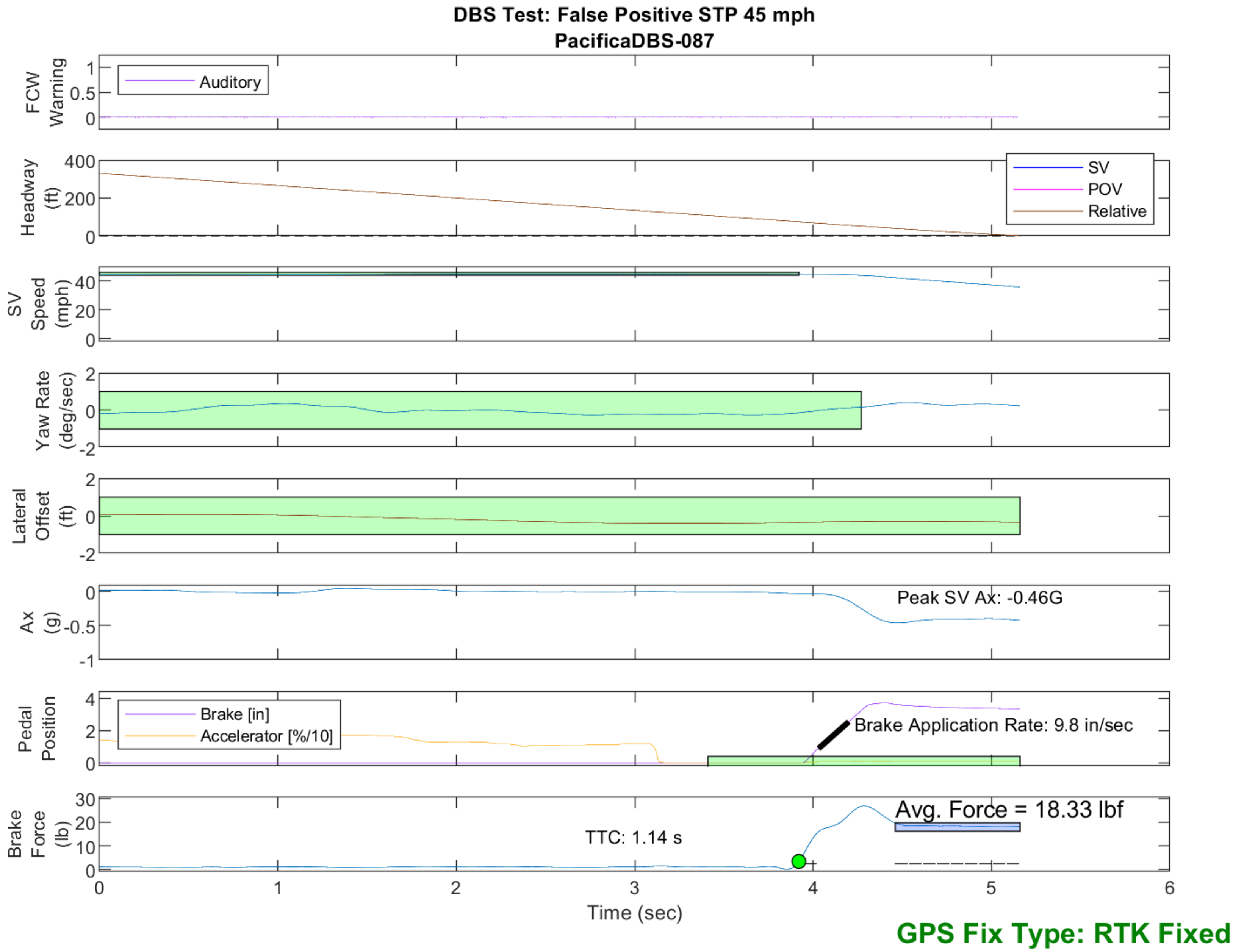

Figure E62. Time History for DBS Run 87, SV Encounters Steel Trench Plate, SV 45 mph

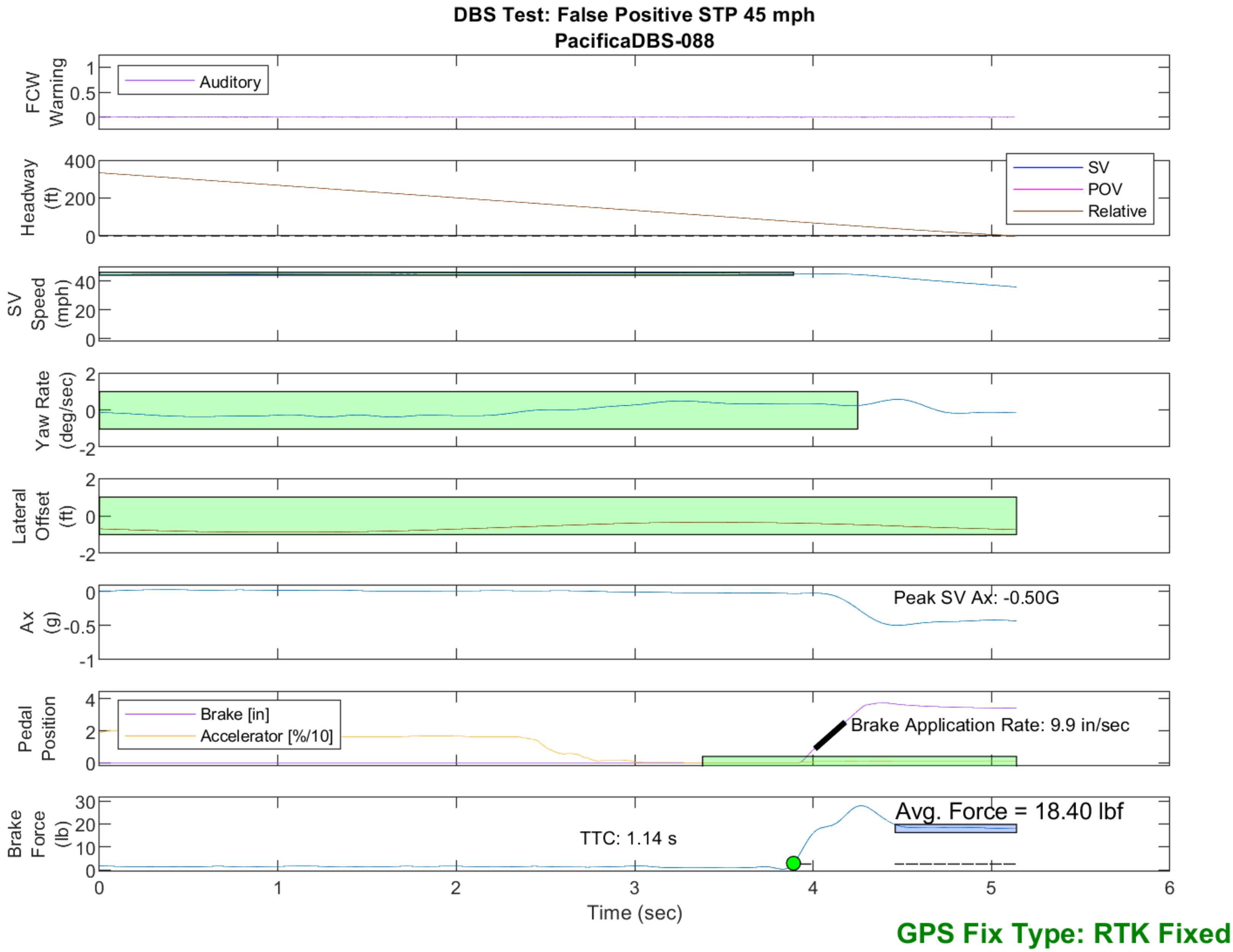

Figure E63. Time History for DBS Run 88, SV Encounters Steel Trench Plate, SV 45 mph

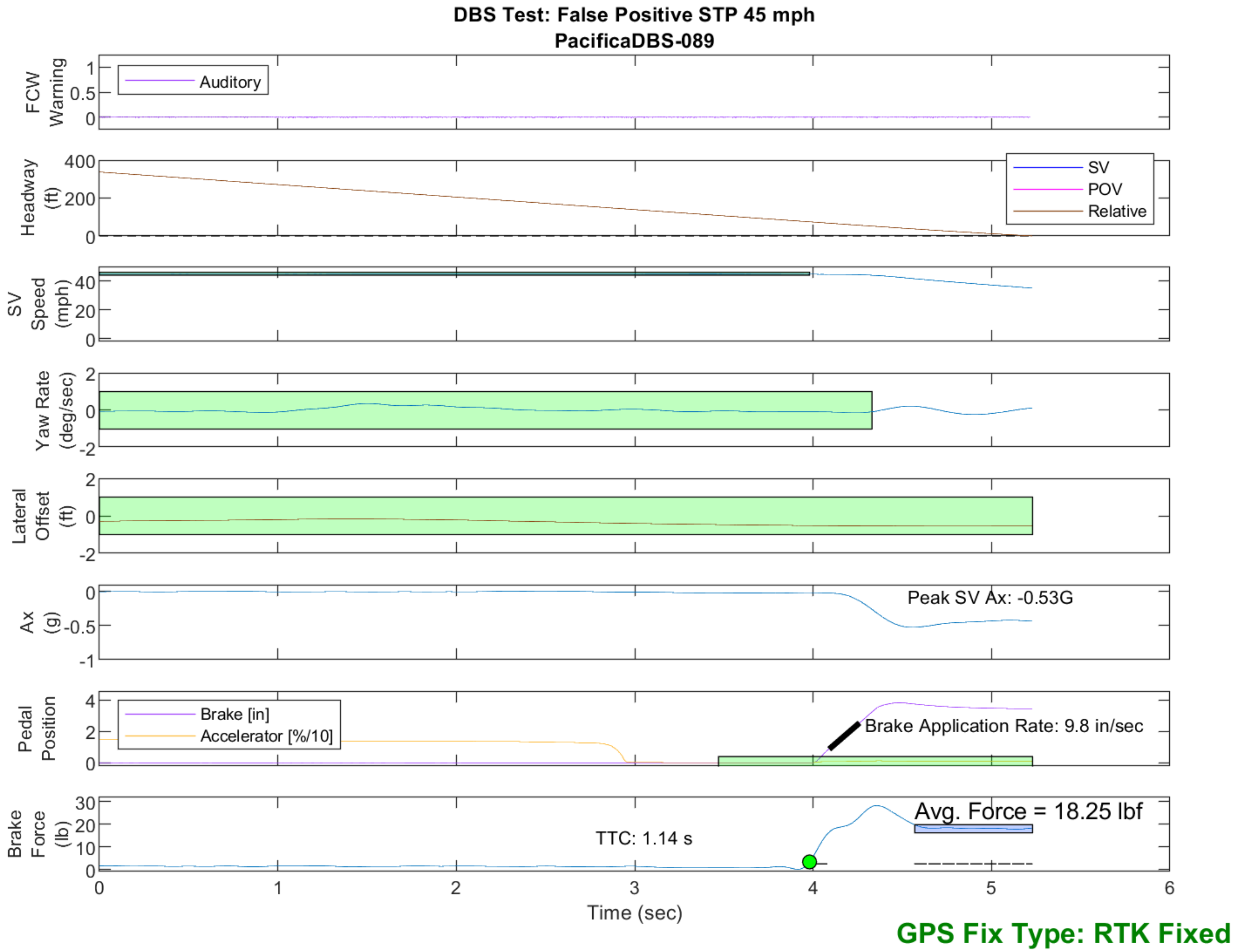

Figure E64. Time History for DBS Run 89, SV Encounters Steel Trench Plate, SV 45 mph

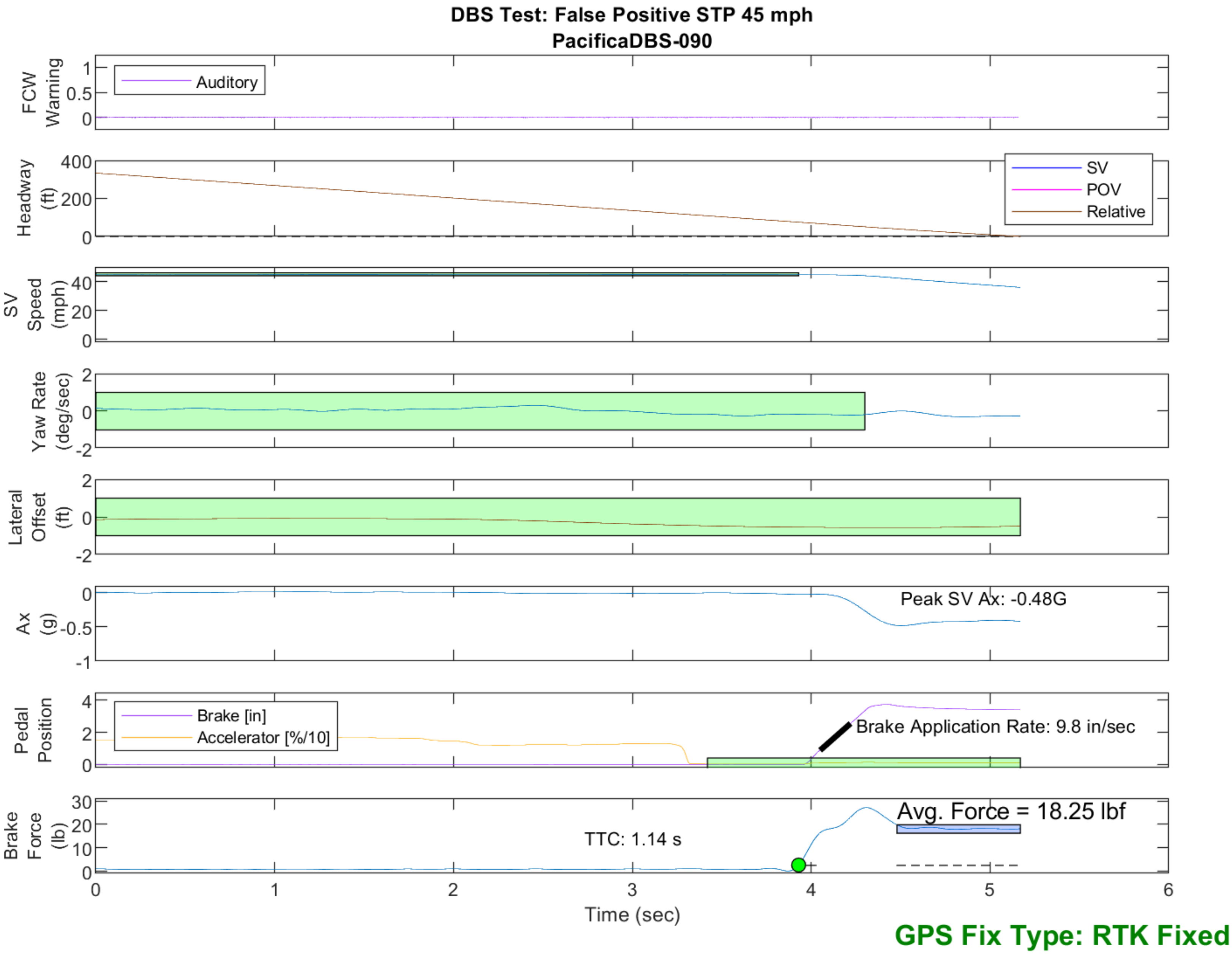

Figure E65. Time History for DBS Run 90, SV Encounters Steel Trench Plate, SV 45 mph

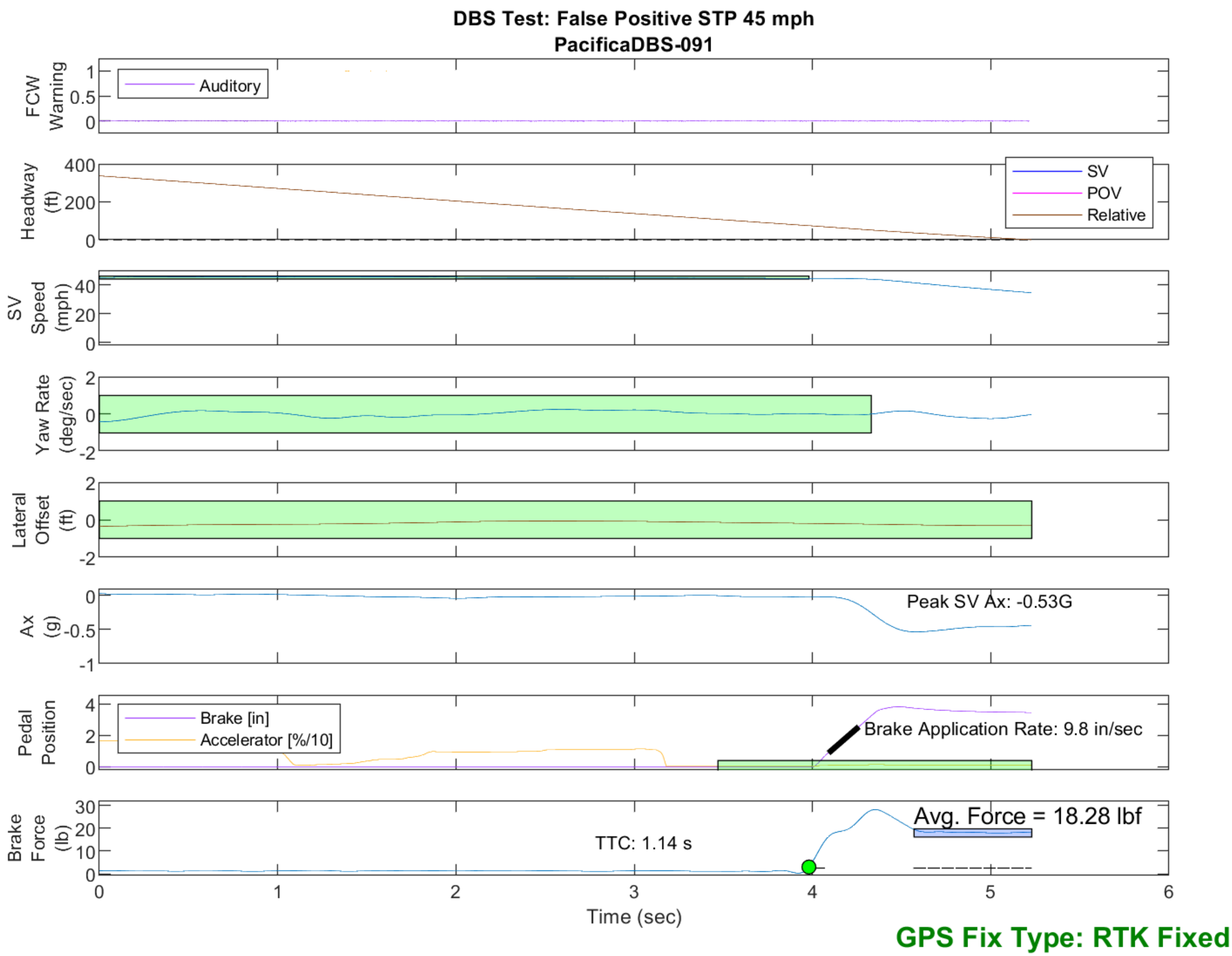

Figure E66. Time History for DBS Run 91, SV Encounters Steel Trench Plate, SV 45 mph

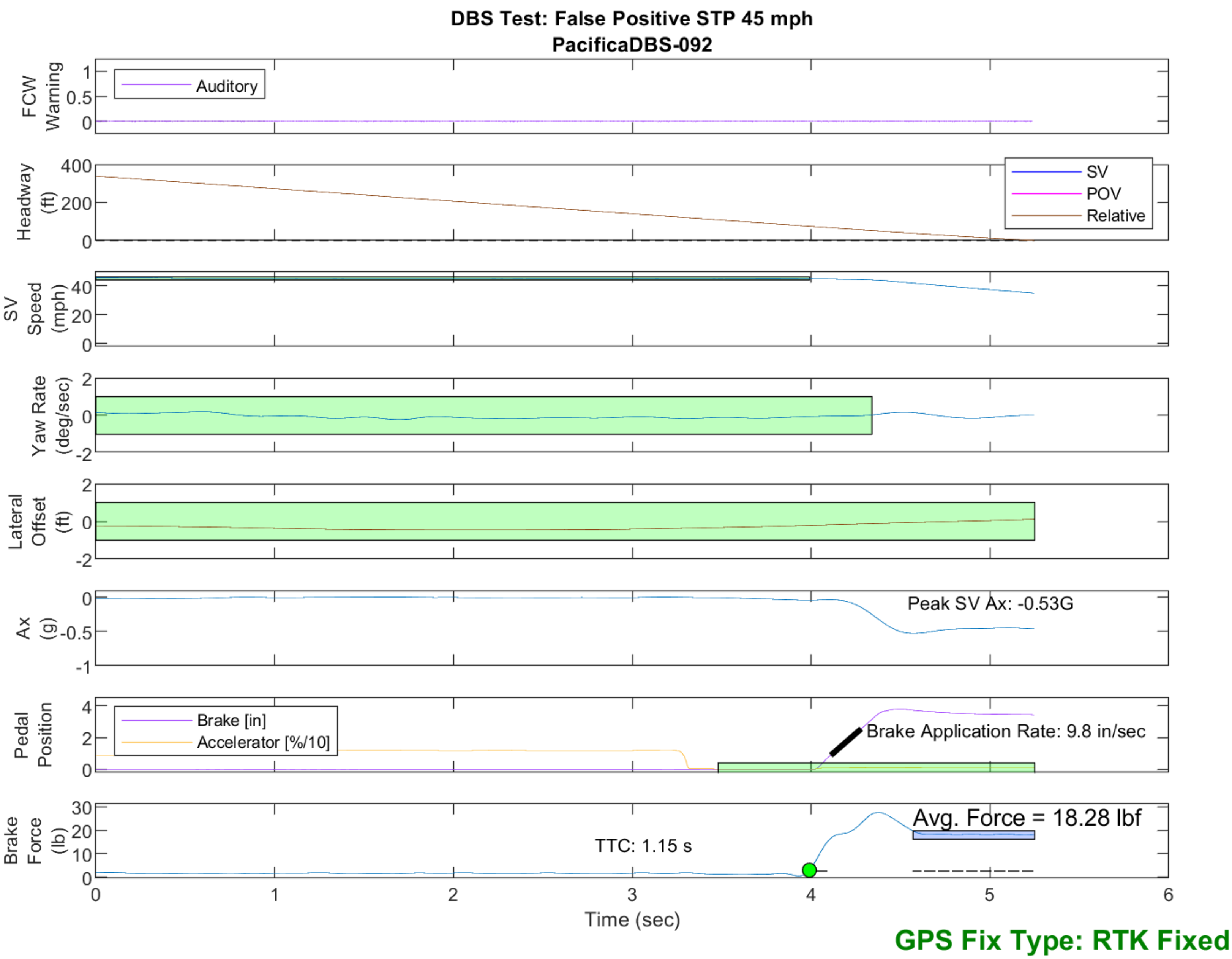

Figure E67. Time History for DBS Run 92, SV Encounters Steel Trench Plate, SV 45 mph

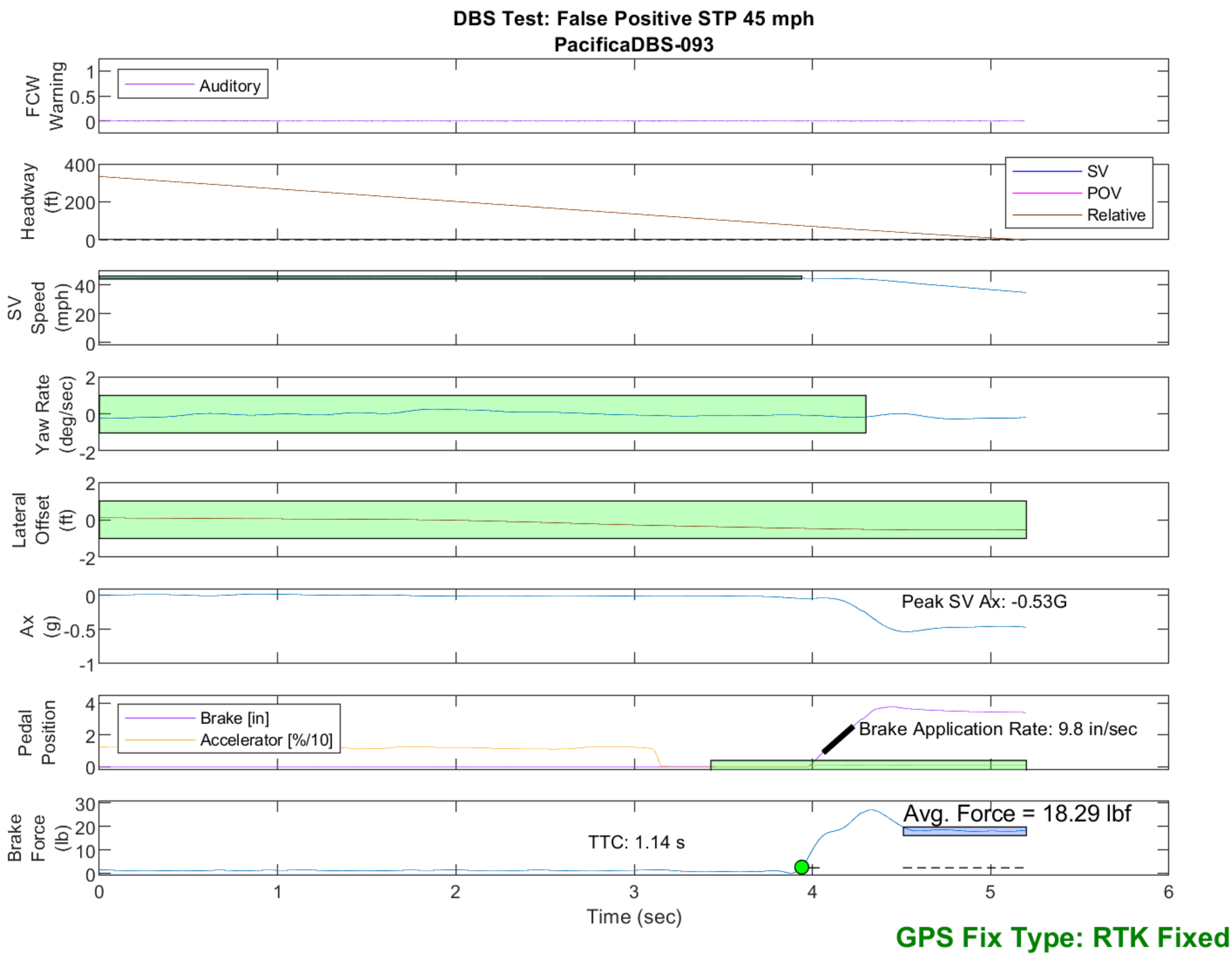

Figure E68. Time History for DBS Run 93, SV Encounters Steel Trench Plate, SV 45 mph

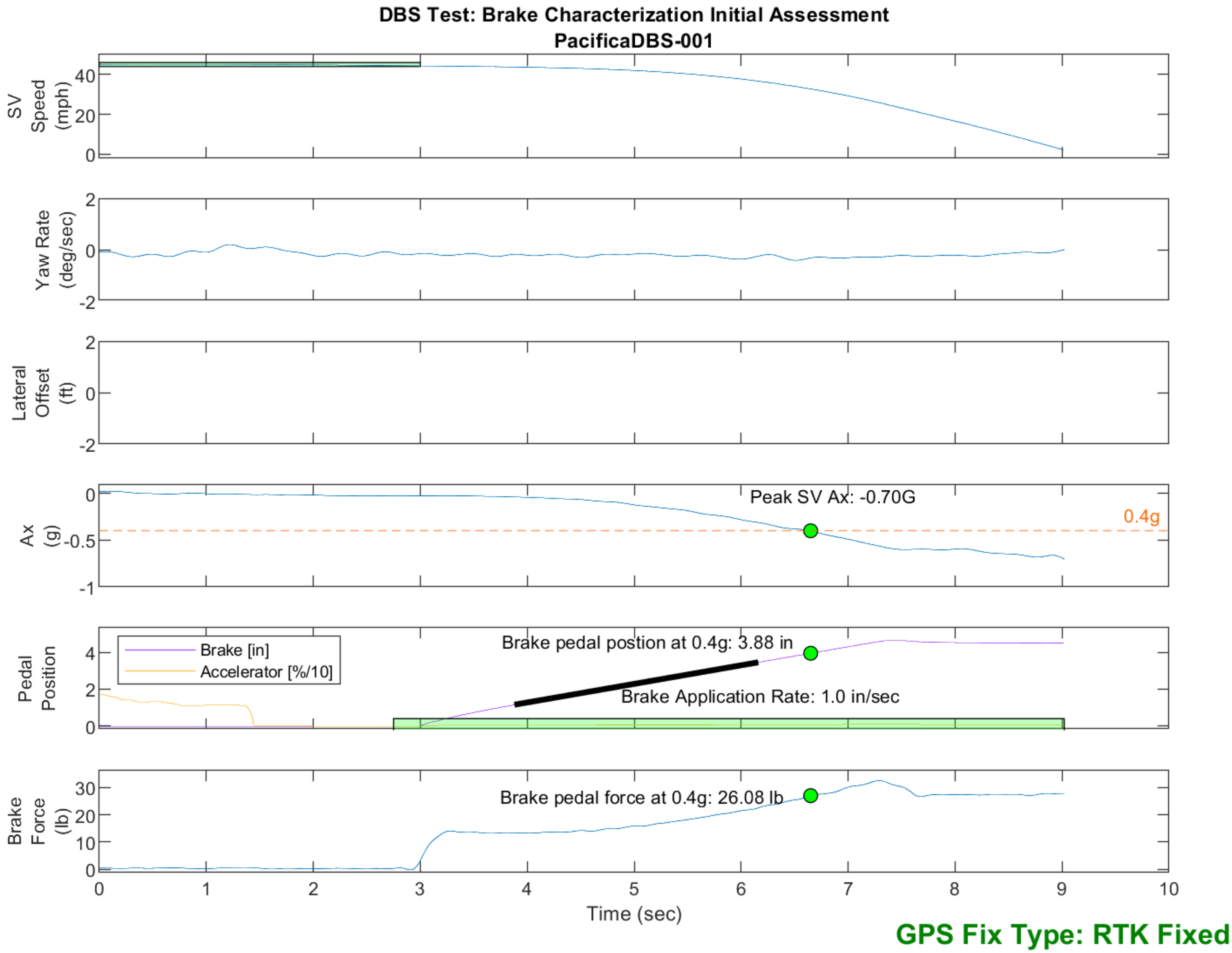

Figure E69. Time History for DBS Run 1, Brake Characterization Initial

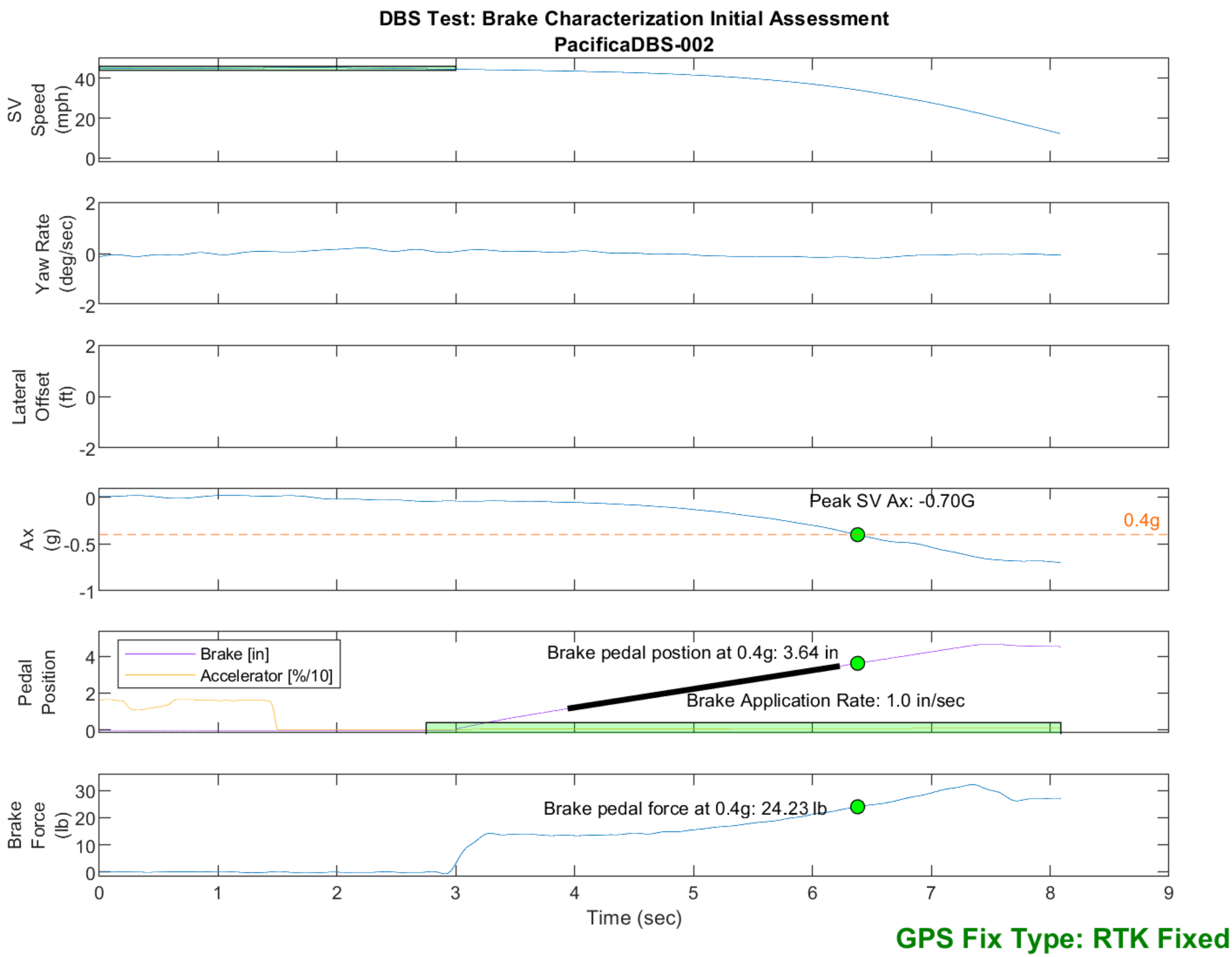

Figure E70. Time History for DBS Run 2, Brake Characterization Initial

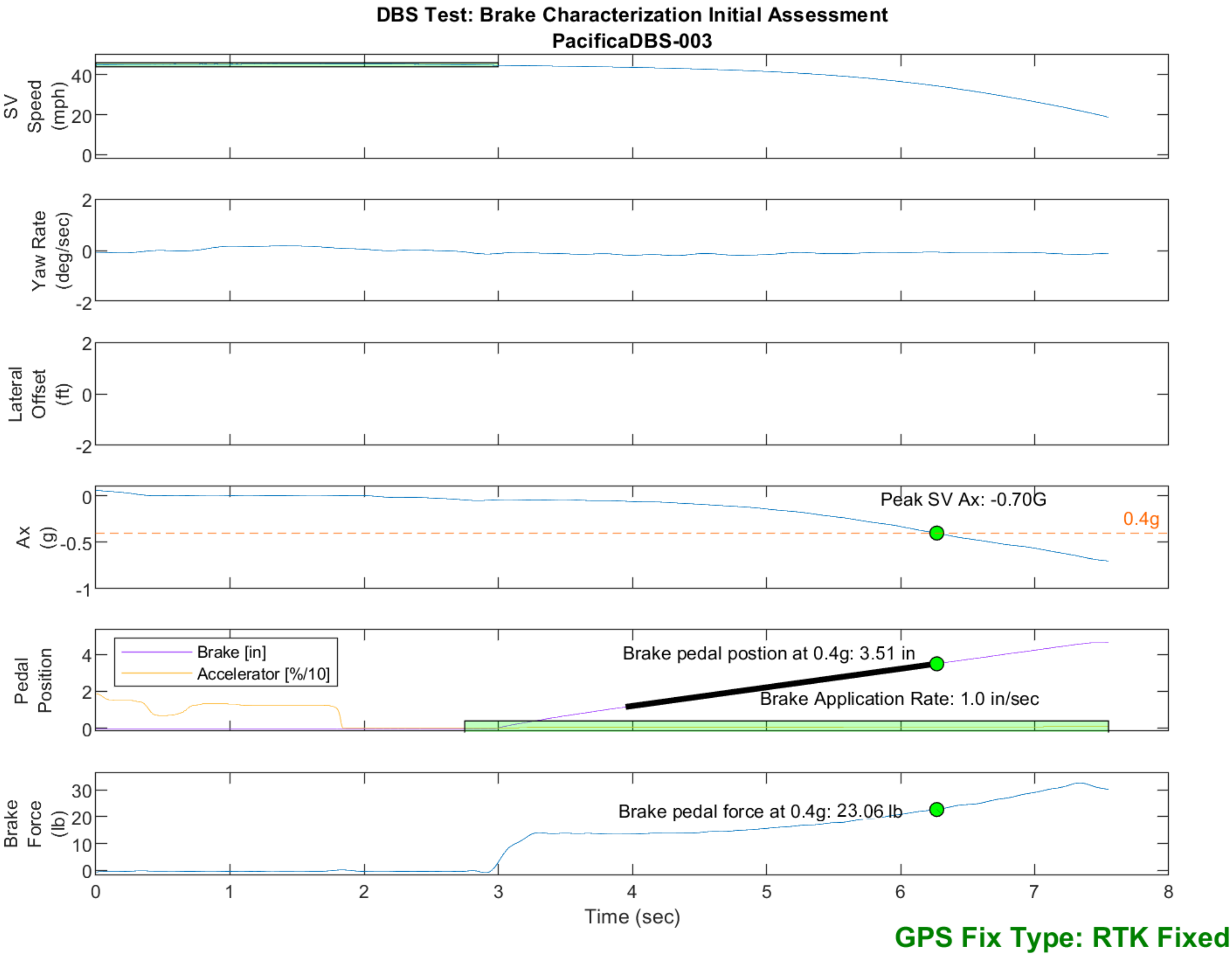

Figure E71. Time History for DBS Run 3, Brake Characterization Initial

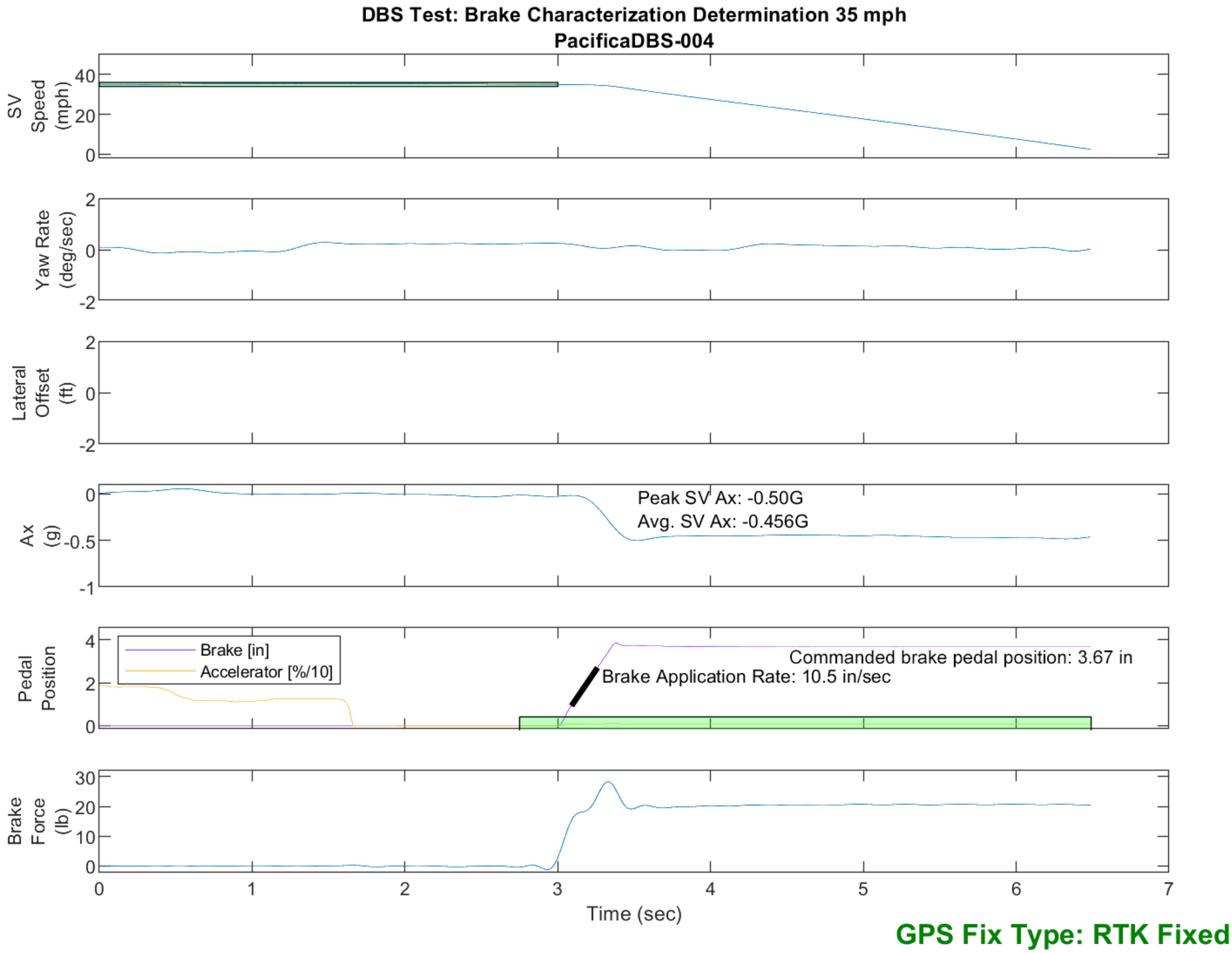

Figure E72. Time History for DBS Run 4, Brake Characterization Determination, Displacement Mode, 35 mph

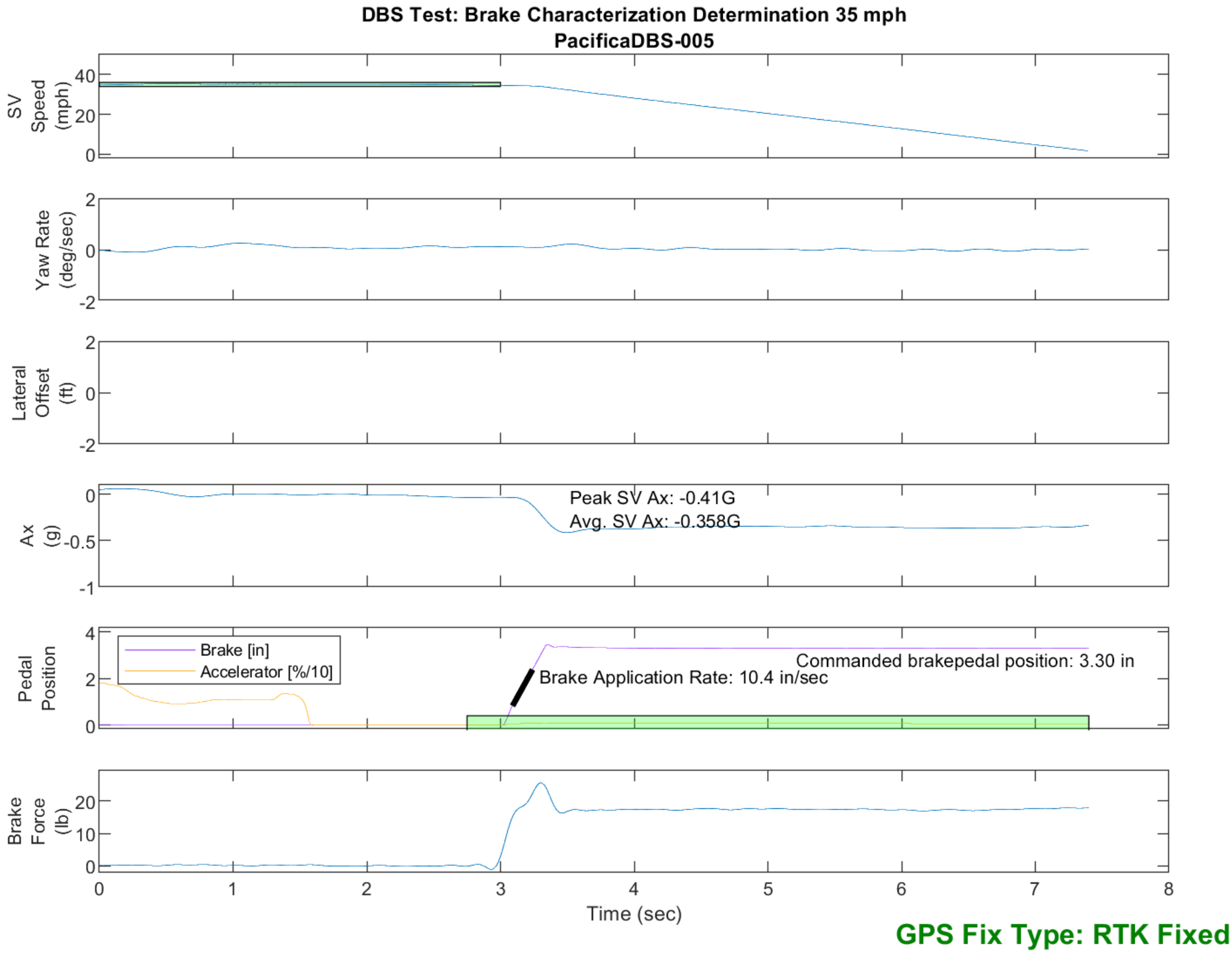

Figure E73. Time History for DBS Run 5, Brake Characterization Determination, Displacement Mode, 35 mph

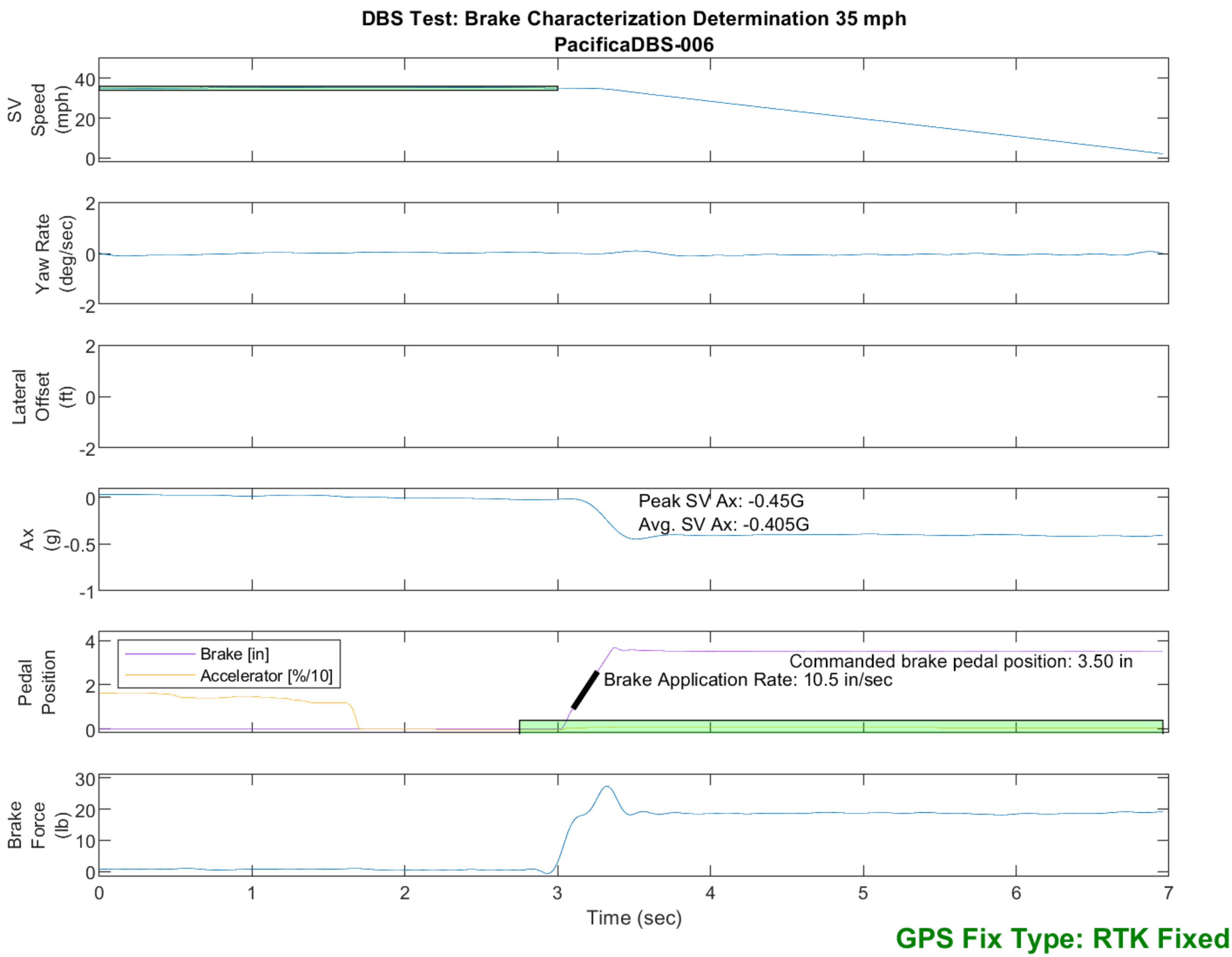

Figure E74. Time History for DBS Run 6, Brake Characterization Determination, Displacement Mode, 35 mph

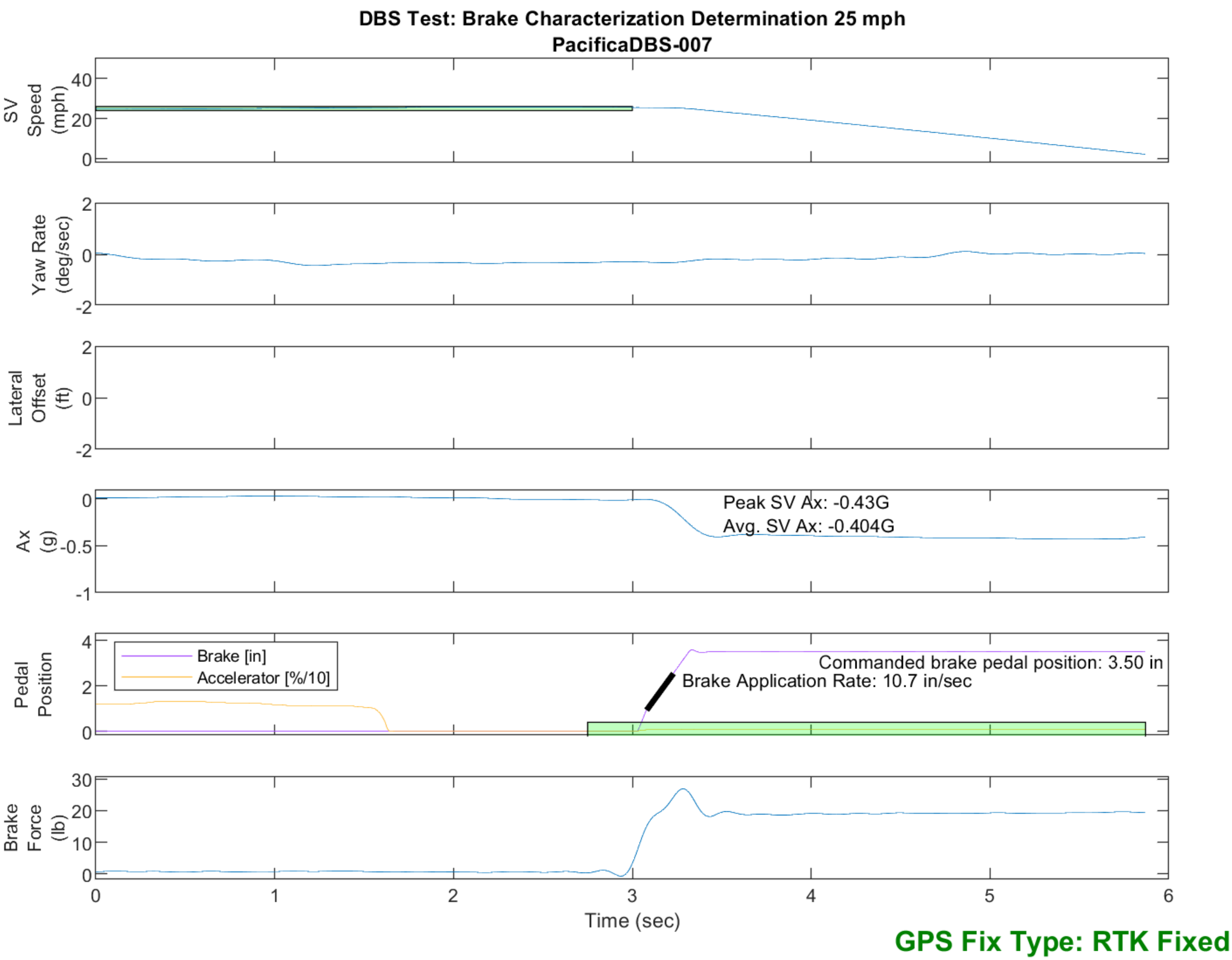

Figure E75. Time History for DBS Run 7, Brake Characterization Determination, Displacement Mode, 25 mph

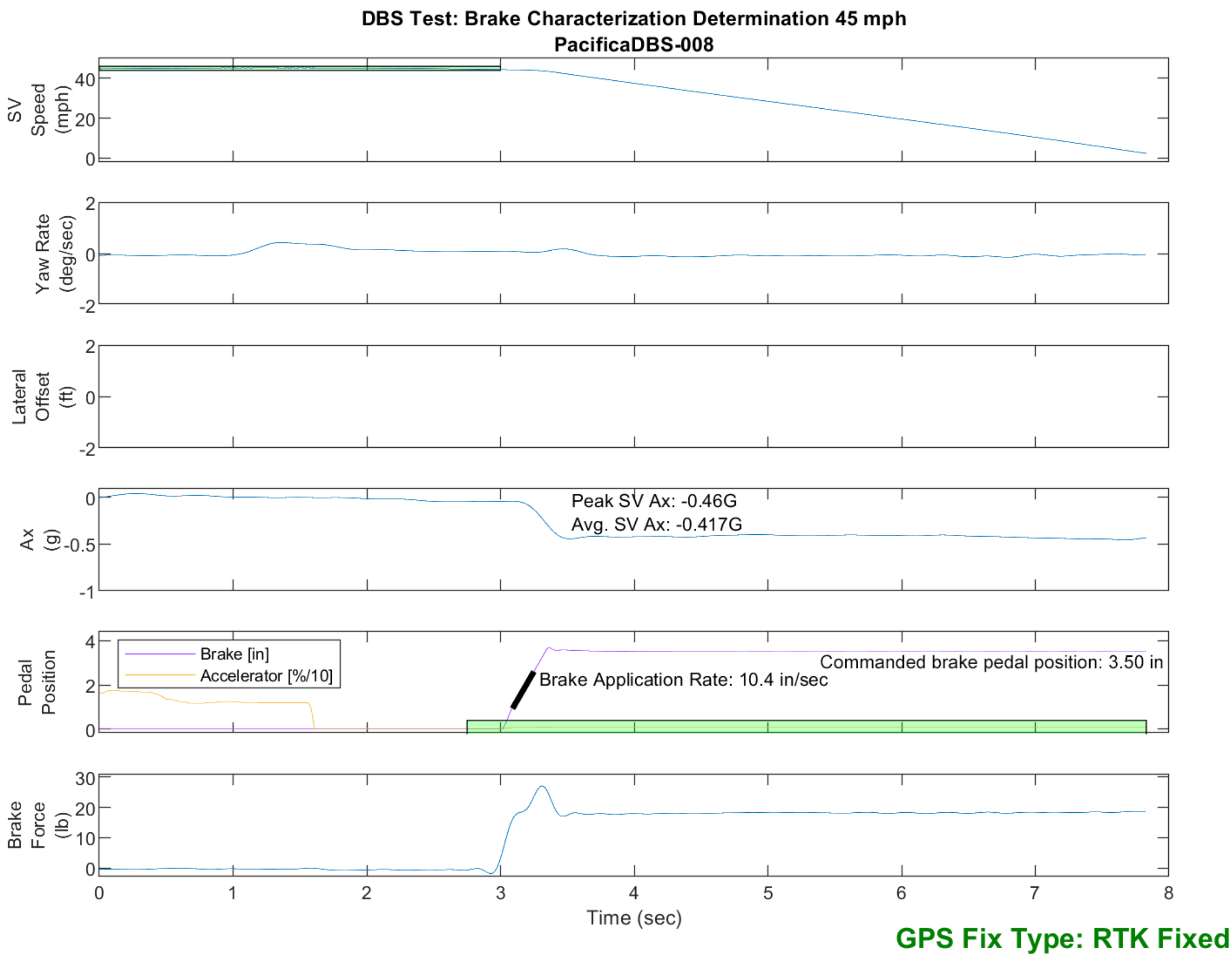

Figure E76. Time History for DBS Run 8, Brake Characterization Determination, Displacement Mode, 45 mph

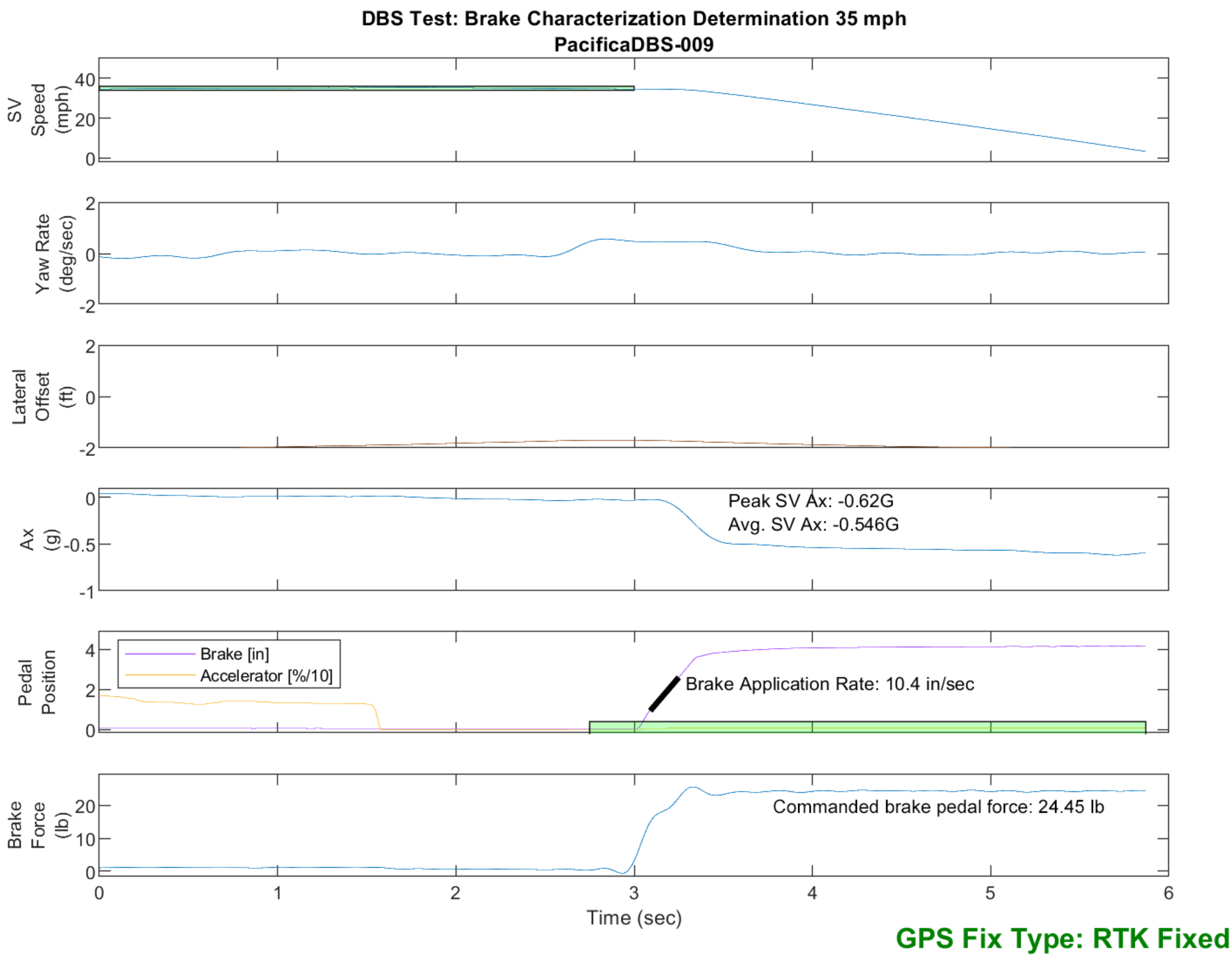

Figure E77. Time History for DBS Run 9, Brake Characterization Determination, Hybrid Mode, 35 mph

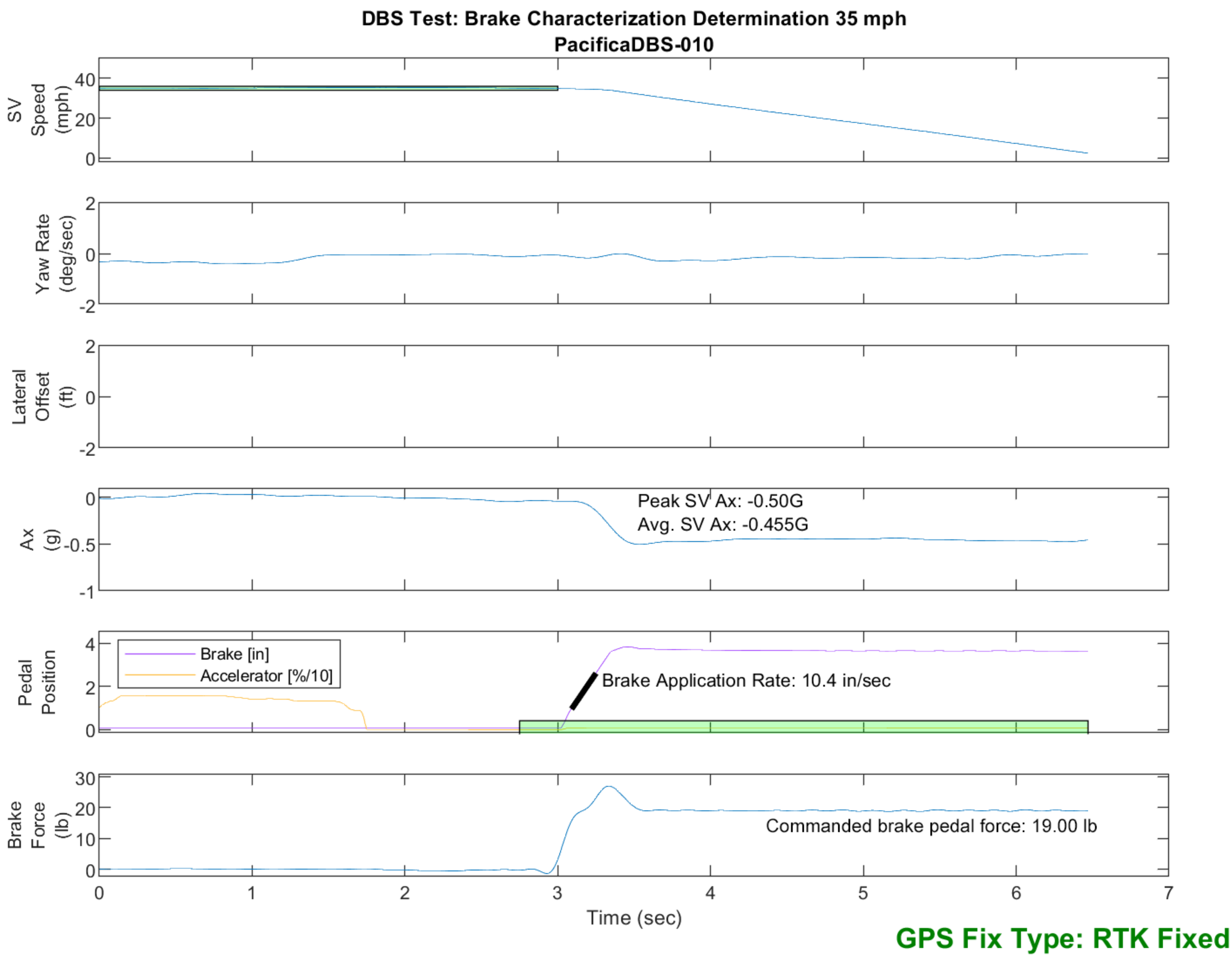

Figure E78. Time History for DBS Run 10, Brake Characterization Determination, Hybrid Mode, 35 mph

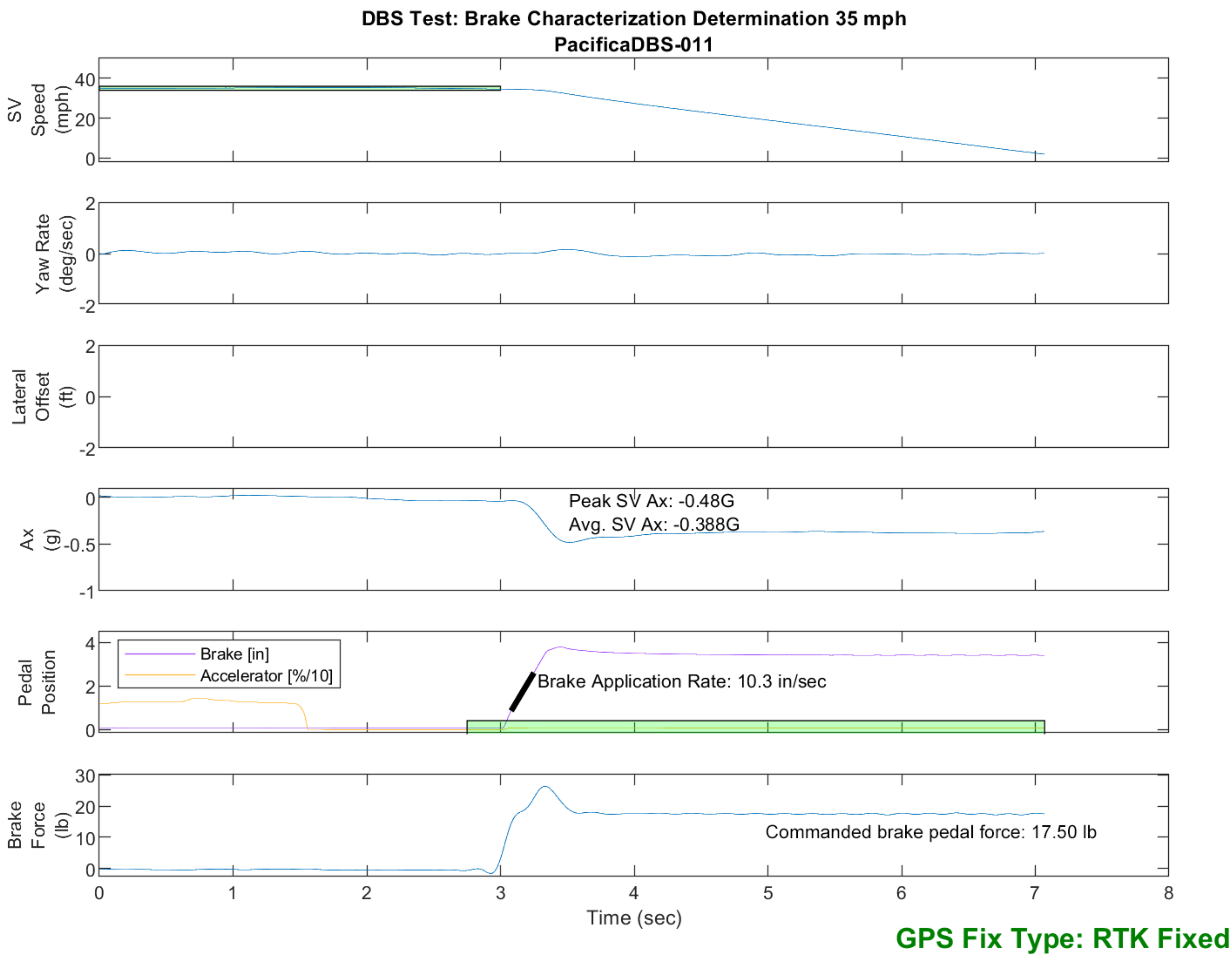

Figure E79. Time History for DBS Run 11, Brake Characterization Determination, Hybrid Mode, 35 mph

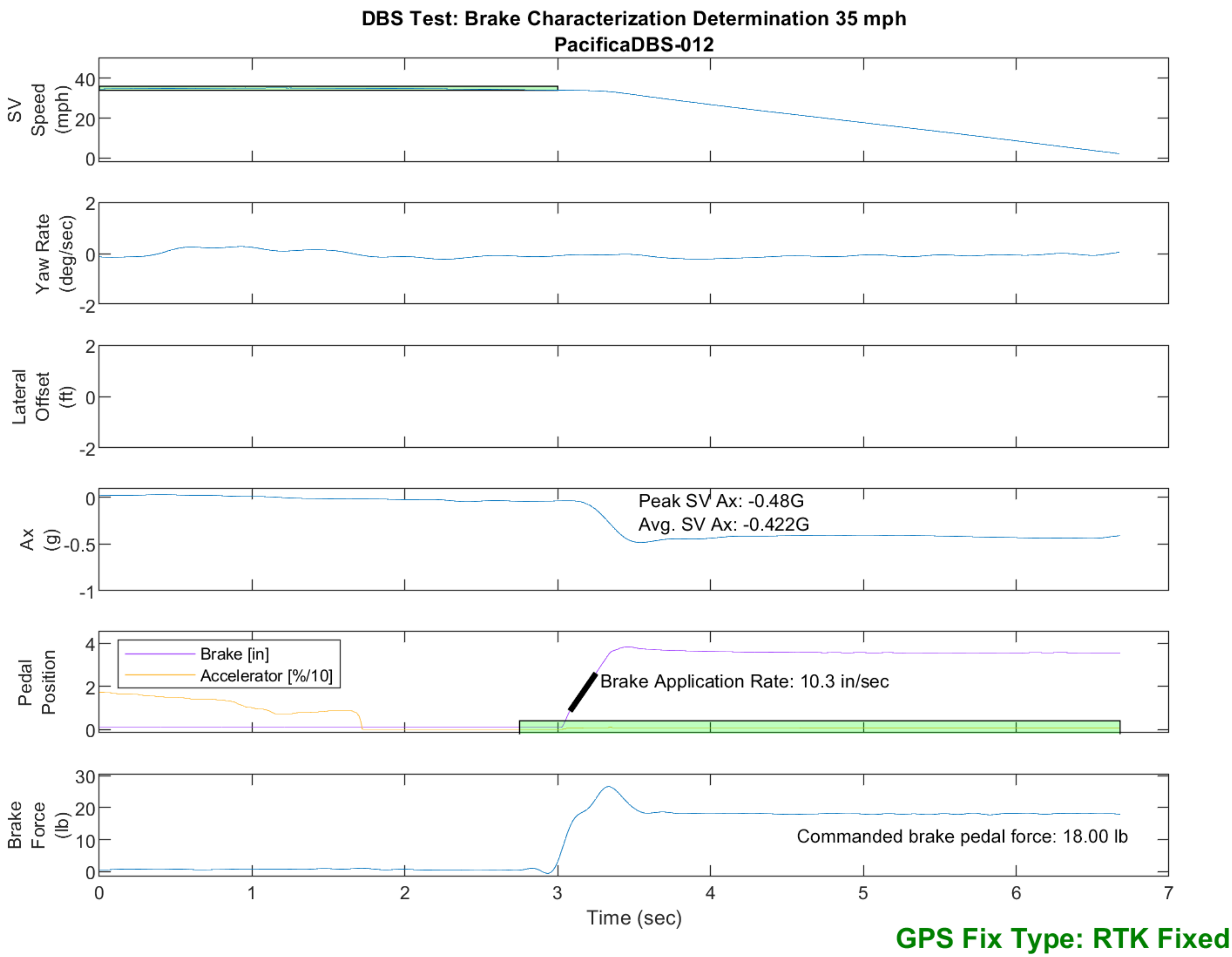

Figure E80. Time History for DBS Run 12, Brake Characterization Determination, Hybrid Mode, 35 mph

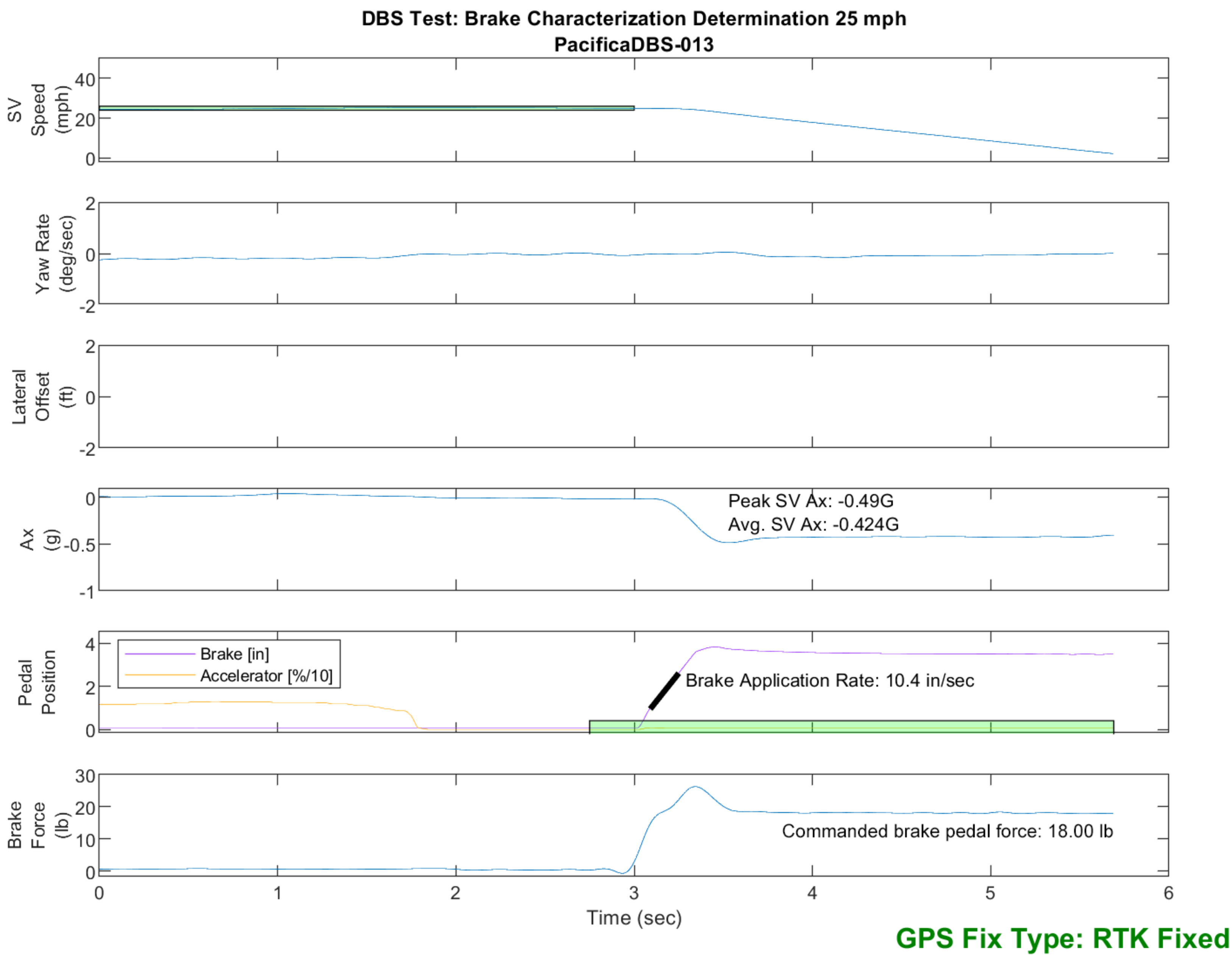

Figure E81. Time History for DBS Run 13, Brake Characterization Determination, Hybrid Mode, 25 mph

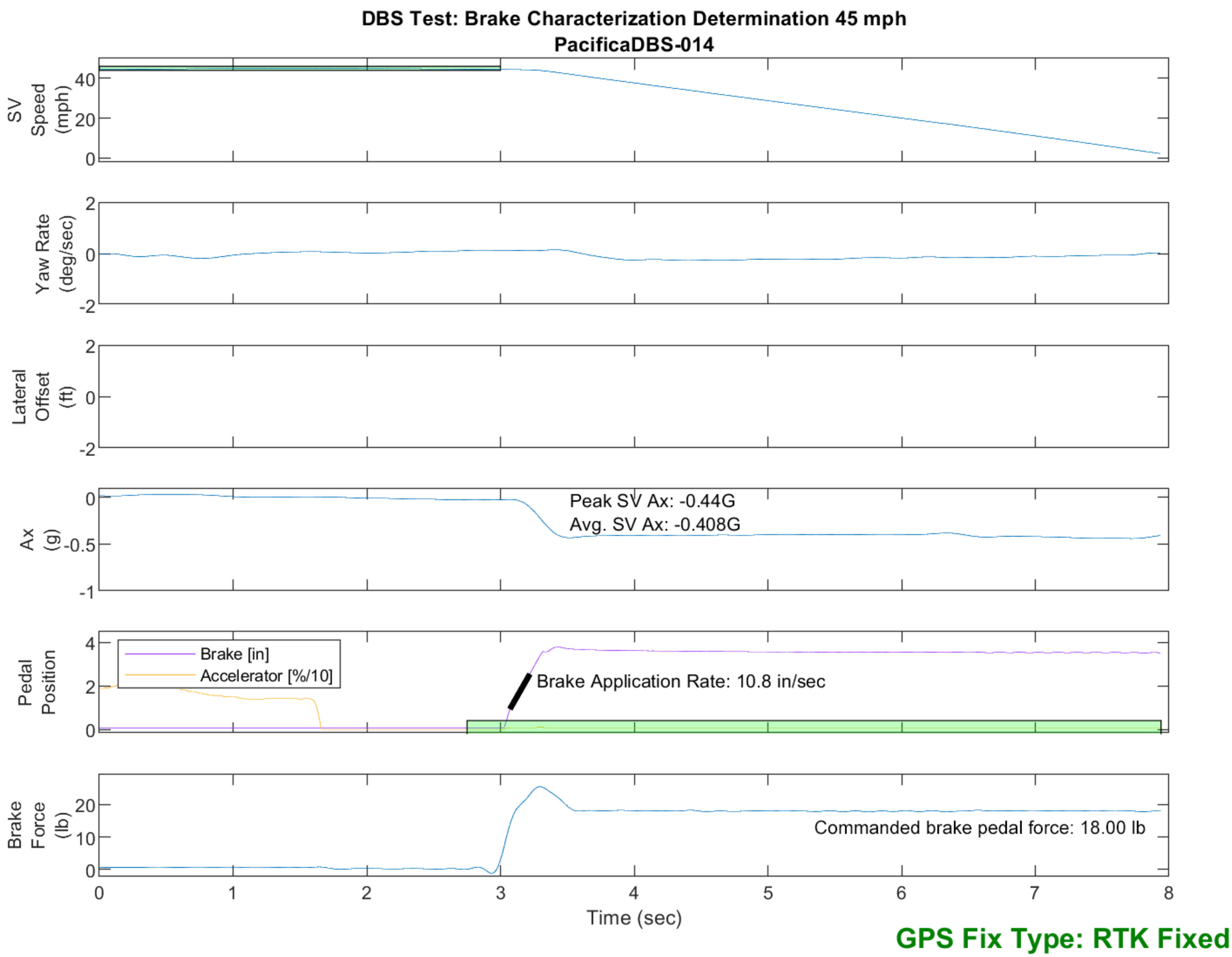

Figure E82. Time History for DBS Run 14, Brake Characterization Determination, Hybrid Mode, 45 mph