NEW CAR ASSESSMENT PROGRAM
DYNAMIC BRAKE SUPPORT SYSTEM CONFIRMATION TEST
NCAP-DRI-DBS-22-09

2022 Jeep Wrangler Unlimited Rubicon 392

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8 August 2022

Final Report

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U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
New Car Assessment Program
1200 New Jersey Avenue, SE
West Building, 4th Floor (NRM-110)
Washington, DC 20590

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16. Abstract These tests were conducted on the subject 2022 Jeep Wrangler Unlimited Rubicon 392 in accordance with the specifications of the New Car Assessment Program's (NCAP's) 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 the Stopped POV, Slower Moving POV, and Steel Trench Plate scenarios, but failed 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 2022 Jeep Wrangler Unlimited Rubicon 392. 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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2022 Jeep Wrangler Unlimited Rubicon 392

VIN: _1C4JJXSJ7NW23xxxx_

Test start date: _8/2/2022_   Test end date: _8/3/2022_

Dynamic Brake Support System settings: _Medium_

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

SV 25 mph: _Pass_

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

SV 25 mph POV 10 mph: _Pass_

SV 45 mph POV 20 mph: _Pass_

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

SV 35 mph POV 35 mph: _Fail_

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

SV 25 mph: _Pass_

SV 45 mph: _Pass_

Overall: _Fail_

Notes:

TEST VEHICLE INFORMATION

VIN: _1C4JJXSJ7NW23xxxx_

Body Style: _SUV_   Color: _Limited Edition Gobi_

Date Received: _7/19/2022_   Odometer Reading: _152 mi_

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: _FCA US LLC_

Date of manufacture: _5-22_

Vehicle Type: _MPV_

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: _LT285/70R17C 116Q_

Rear: _LT285/70R17C 116Q_

Recommended cold tire pressure: Front: _255 kPa (37 psi)_

Rear: _255 kPa (37 psi)_

TIRES

Tire manufacturer and model: _BFGoodrich All-Terrain T/A KO2_

Front tire specification: _LT285/70R17 116/113Q_

Rear tire specification: _LT285/70R17 116/113Q_

Front tire DOT prefix: _1BEBF C731_

Rear tire DOT prefix: _1BEBF C731_

2022 Jeep Wrangler Unlimited Rubicon 392

GENERAL INFORMATION

Test start date: _8/2/2022_   Test start date: _8/3/2022_

AMBIENT CONDITIONS

Air temperature: _37.2 C (99 F)_

Wind speed: _4.6 m/s (10.4 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: _255 kPa (37 psi)_

Rear: _255 kPa (37 psi)_

WEIGHT

Weight of vehicle as tested including driver and instrumentation

      Left Front: *644.1 kg (1420 lb)*   Right Front: *674.9 kg (1488 lb)*

      Left Rear: *579.2 kg (1277 lb)*   Right Rear: *574.7 kg (1267 lb)*

                                             Total: *2472.9 kg (5452 lb)*

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

Full Speed Forward Collision Warning Plus (part of the Advanced Safety Group)

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

The AEB system uses a radar/camera fusion system with the radar and camera located in the top center of the windshield.

System settings used for test (if applicable):

Medium

Brake application mode used for test: *Constant pedal displacement*

Over what speed range is the system operational?

The AEB system is operational at a minimum speed of 5 km/h (3 mph) with no maximum speed per manufacturer supplied information.

Does the vehicle system require an initialization sequence/procedure?   Yes

X   No

If yes, please provide a full description.

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

No

If yes, please provide a full description.

The AEB system will deactivate after 4 active braking events within a single key cycle.

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 _____

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

The AEB system alerts the driver with a visual and auditory alert. The visual alert is displayed in the instrument panel and consists of an image of a vehicle between lane lines and the words "BRAKE!". The auditory alert consists of repeated beeps with a primary frequency of 2125 Hz. 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 CIB.

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.

The AEB system can be turned on/off using the Uconnect multimedia system touch screen display on the center dash. The procedure is as follows:

1. Select "Settings" -> "Safety and Driving Assistance" -> "Automatic Emergency Braking".

2. Under "Forward Collision Warning", select between "Off", "Only Warning", and "Warning + Active Braking".

The system will retain the last setting selected by the driver after ignition shutdown.

DYNAMIC BRAKE SUPPORT

DATA SHEET 4: DYNAMIC BRAKE SUPPORT SYSTEM OPERATION

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2022 Jeep Wrangler Unlimited Rubicon 392

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.

The range setting can be adjusted using the Uconnect multimedia system touch screen display on the center dash. The procedure is as follows:

1. Select "Settings" -> "Safety and Driving Assistance" -> "Automatic Emergency Braking".

2. Under "Forward Collision Sensitivity", select between "Near", "Med", and "Far".

The system will retain the last setting selected by the driver after ignition shutdown.

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.

Camera blockage or radar blindness can affect performance. The system is intended for on road use only and should be disabled if the vehicle is taken off road. Refer to the owner's manual pages 312 to 313 shown in Appendix B pages B-3 to B-4 for additional information.

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. <u>TEST 1 – SUBJECT VEHICLE ENCOUNTERS STOPPED PRINCIPAL OTHER VEHICLE ON A STRAIGHT ROAD</u>

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.

Stopped POV
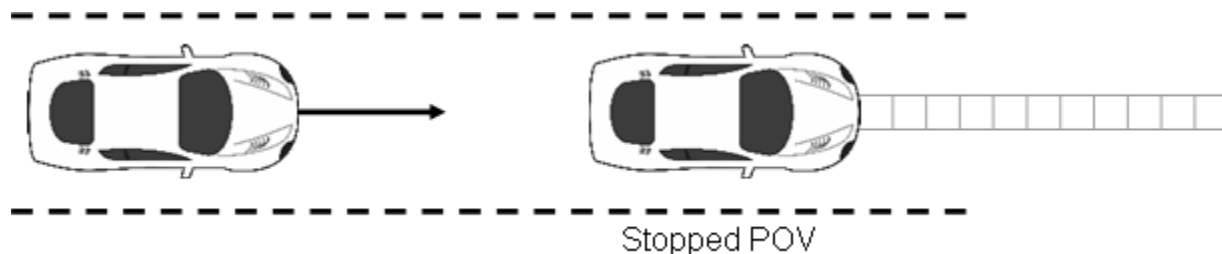
Figure 1. Depiction of Test 1

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 or SV brake application if no FCW alert was given. 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 lateral distance between the centerline of the SV to the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The yaw rate of the SV could not deviate more than ±1 deg/sec during the validity period.

- 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} or impact if no FCW alert was given.

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.
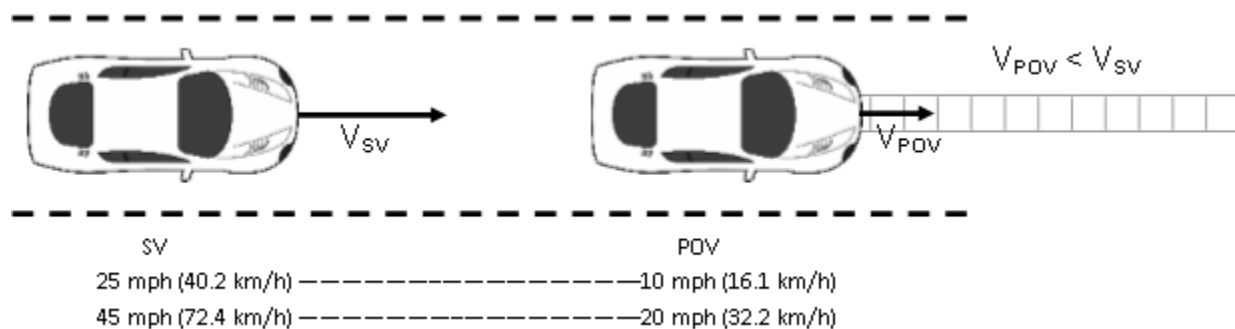
Figure 2. Depiction of Test 2

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 or SV brake application if no FCW alert was given. 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 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 SV and POV to the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The yaw rate of the SV and POV could not deviate more than ±1 deg/sec 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} or impact if no FCW alert was given.

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

Table 2. Nominal Slower-Moving POV DBS Test Choreography

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

b. Criteria

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

3. <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.
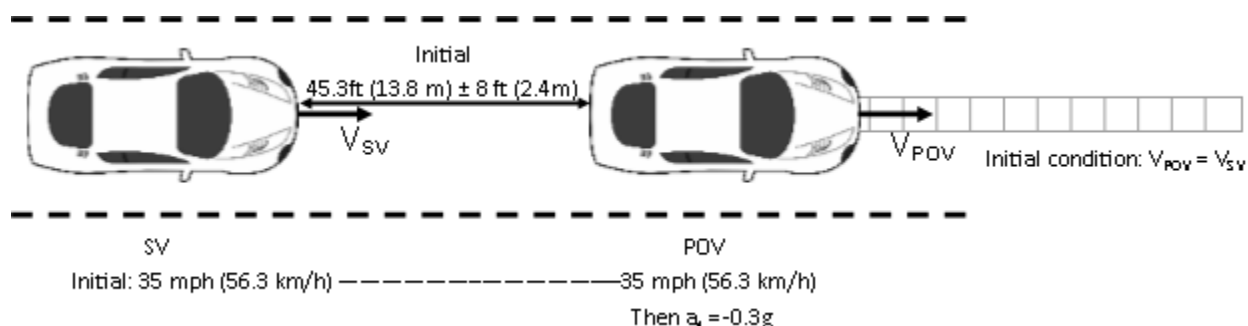
Figure 3. Depiction of Test 3

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 of deceleration within 1.5 ± 0.1 sec. The SV throttle pedal was released within 500 ms of t_{FCW} or SV brake application if no FCW alert was given. 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 SV and POV to the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.
- The yaw rate of the SV and POV could not deviate more than ±1 deg/sec during the validity period.
- The SV speed could not deviate more than ±1.0 mph (1.6 km/h) during an interval defined by 3.0 seconds before the onset of POV braking to t_{FCW} or impact if no FCW alert was given.
- The POV speed could not deviate more than ±1.0 mph (1.6 km/h) during an interval of 3.0 seconds before the onset of POV braking.
- The SV- POV headway distance could not deviate more than ±8 ft (2.4 m) during an interval defined by the onset of the validity period to the onset of POV braking.
- The average POV deceleration could not deviate by more than ±0.03 g from the nominal 0.3 g deceleration during the interval beginning at 1.5 seconds after the onset of POV braking and ending either 250 ms prior to the POV coming to a stop or the SV coming into contact with the POV.

Table 3. Nominal Decelerating POV DBS Test Choreography

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

b. Criteria

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

4. TEST 4 – FALSE POSITIVE SUPPRESSION

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

a. Procedure

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

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 SV to the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.

- The yaw rate of the SV could not deviate more than ±1 deg/sec during the validity period.

- The SV speed could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) during an interval from TTC = 5.1 s to the earlier of t_{FCW} or TTC = 2.1 s.

- The throttle pedal was modulated using smooth inputs until an FCW alert was presented or a TTC = 2.1 s, at which point the SV driver released the throttle pedal within 500 ms.

- The SV brakes were then applied at TTC = 1.1 seconds.
    - For SV test speed of 25 mph, TTC = 1.1 seconds is taken to occur at an SV-to-STP distance of 40 ft (12.3 m).
    - For SV test speed of 45 mph, TTC = 1.1 seconds is taken to occur at an SV-to-STP distance of 73 ft (22.1 m).

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

2. GENERAL VALIDITY CRITERIA

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

- The SV driver seatbelt was latched.
- If any load had been placed on the SV front passenger seat (e.g., for instrumentation), the vehicle's front passenger seatbelt was latched.
- The SV was driven at the nominal speed in the center of the travel lane, toward the POV or STP.
- The driver used the least amount of steering input necessary to maintain SV position in the center of the travel lane during the validity period; use of abrupt

steering inputs or corrections was avoided.

- The yaw rate of the SV did not exceed ±1.0 deg/s from the onset of the validity period to the instant SV deceleration exceeded 0.25 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. <u>VALIDITY PERIOD</u>

The valid test interval began:

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

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

Test 3: 3 seconds before the onset of POV braking

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

The valid test interval ended:

Test 1: When either of the following occurred:

- The SV came into contact with the POV (assessed by using GPS-based range data); or

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

Tests 2 and 3: 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 4: The front of the SV reached the leading edge of the STP.

4. <u>STATIC INSTRUMENTATION CALIBRATION</u>

To assist in resolving uncertain test data, static calibration data was collected prior to, and immediately after 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."

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 offset was adjusted to output zero, another pre-test static calibration data file was collected, and the test series was repeated.

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

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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

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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.

- If the brake application rate could not be achieved due to brake pedal movement during AEB activation, the application rate requirement was removed. Instead, the brakes were applied 1 second after the onset of FCW and the target brake pedal displacement was achieved within 250 ms.

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: 10/5/2021 Due: 10/5/2022
Platform Scales	Vehicle Total, Wheel, and Axle Load	2200 lb/platform	0.1% of reading	Intercomp SW wireless	0410MN20001	By: DRI Date: 2/11/2022 Due: 2/11/2023
Linear (string) encoder	Throttle pedal travel	50 in	0.05 in	TE Connectivity SE1-50	K3161858	By: DRI Date: 1/18/2022 Due: 1/18/2023
Load Cell	Force applied to brake pedal					By: DRI
		0-250 lb	0.05% FS	Stellar Technology PNC700	2002506	Date: 2/25/2022 Due: 2/25/2023
		0-250 lb	0.05% FS	Stellar Technology PNC700	2002505	Date: 3/30/2022 Due: 3/30/2023
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
					2182	Date: 11/19/2021 Due: 11/19/2023
					2258	Date: 4/28/2021 Due: 4/28/2023
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: 1/6/2022 Due: 1/6/2023

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

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Figure A2. Rear View of Subject Vehicle

2022 MODEL YEAR

Jeep WRANGLER UNLIMITED RUBICON 392

For more information visit: www.jeep.com
or call 1–877–IAM–JEEP

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: $77,095

JEEP WRANGLER UNLIMITED RUBICON 392
Exterior Color: Limited Edition Gobi Clear–Coat Exterior Paint
Interior Color: Black Interior Color
Interior: Leather–Trimmed Bucket Seats
Engine: 6.4L V8 SRT® HEMI® MDS Engine
Transmission: 8–Speed Automatic 8HP75 Transmission
STANDARD EQUIPMENT (UNLESS REPLACED BY OPTIONAL EQUIPMENT)
        FUNCTIONAL/SAFETY FEATURES
Jeep Wave Membership (Retail Sales/50 States Only)
Body–Color Rubicon Highline Flare
LED Lighting Group
Cold Weather Group
Safety Group
Advanced Safety Group
Steel–Bumper Group
2.72:1 Selec–Trac® Full–Time 4WD System
3.73 Rear Axle Ratio
Tru–Lok® Front and Rear Axles
Front Door Passive Entry and Lock
Hood with Air Intake Scoop
ParkSense® Rear Park–Assist System
Blind–Spot and Cross–Path Detection
Remote–Start System
Steering–Wheel–Mounted Shift Control
Off–Road Plus Mode
Bronze Tow–Hooks
ParkView® Rear Back–Up Camera
        INTERIOR FEATURES
Leather–Trimmed Bucket Seats
Heated Front Seats
Uconnect® 4C NAV with 8.4–Inch Display
Alpine® Premium Audio System
Cluster 7.0–Inch TFT Color Display
Apple CarPlay®
Google Android Auto™
GPS Navigation
Full Function Media Hub with 2–USB Plus Aux Port
Integrated Voice Command
SiriusXM® with 6–Month Radio Sub Call 800–643–2112
SiriusXM® Traffic Plus with 5–Year Subscription
SiriusXM® Travel Link with 5–Year Subscription
SiriusXM Guardian™ Connected Services w/1–Yr Trial
        EXTERIOR FEATURES
Body–Color 3–Piece Hard Top
17–Inch x 7.5–Inch Beadlock–Capable Wheels
Power–Heated Mirrors
Automatic Headlamps

Tinted Windshield Glass
115–Volt Auxiliary Power–Outlet
Power Front Windows with 1–Touch Down
Air Conditioning with Automatic Temperature Control
Remote Keyless–Entry
Rock–Protection Sill Rails
Transfer Case Skid–Plate Shield
Front LED Fog Lamps
LED Premium Reflector Headlamps

OPTIONAL EQUIPMENT (May Replace Standard Equipment)
Limited Edition Gobi Clear–Coat Exterior Paint $495
Customer Preferred Package 27X
Trailer–Tow Package $350
    Class II Receiver Hitch
    7– and 4–Pin Wiring Harness
Trail Rail™ Management System $195
    Cargo Compartment Floor Mat
Windshield with Corning® Gorilla® Glass $495
Sky One–Touch® Power–Top $2,050
    Removable Rear Quarter Windows
    Power Top Quarter Window Storage Bag
Integrated Off–Road Camera $695

Destination Charge $1,595

TOTAL PRICE: * $82,970

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

EPA DOT Fuel Economy and Environment

Gasoline Vehicle

Fuel Economy These estimates reflect new EPA methods beginning with 2017 models.

14 MPG combined city/hwy

13 city   17 highway

Small SUV 4WD range from 16 to 120 MPGe.
The best vehicle rates 142 MPGe.

You **spend** **$9,250** in fuel costs over 5 years compared to the average new vehicle.

7.1 gallons per 100 miles

Annual fuel cost $3,150

Fuel Economy & Greenhouse Gas Rating (tailpipe only)
1 [2] 10 Best

Smog Rating (tailpipe only)
1 10 Best

This vehicle emits 623 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 $6,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $2.95 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
This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash, or rollover risk.

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

PARTS CONTENT INFORMATION
FOR VEHICLES IN THIS CARLINE:
  U.S./CANADIAN PARTS CONTENT: 61%
MAJOR SOURCES OF FOREIGN PARTS CONTENT:
MEXICO : 21%
NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON–PARTS COSTS.
FOR THIS VEHICLE:
  FINAL ASSEMBLY POINT:
  TOLEDO, OHIO, U.S.A.
COUNTRY OF ORIGIN:
ENGINE: MEXICO
TRANSMISSION: GERMANY

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

Assembly Point/Port of Entry: TOLEDO, OHIO, U.S.A.   S.L.   SHIP TO: SOLD TO:
VIN: 1C4–JJXSJ7NW–23   L4–VON: 6067   0s18–0

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.

Figure A3. Window Sticker (Monroney Label)

MFD BY: FCA US LLC
VIN: 1C4JJXSJ7NW23
VEHICLE MADE IN: U.S.A.

DATE OF MFR (BUILT): 5-22
GAWR FRONT: 3400 LB / 1543 KG   WITH
17X7.5   RIMS
LT285/70R17C 116   TIRES
AT 255 kPa / 37 PSI   COLD
TYPE: MPV   PAINT: PUA

GVWR: 6100 LB / 2767 KG
GAWR REAR: 3550 LB / 1611 KG   WITH
17X7.5   RIMS
LT285/70R17C 116   TIRES
AT 255 kPa / 37 PSI   COLD
MDH: 051808   MKT: 875

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

Figure A4. Vehicle Certification Label

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TIRE AND LOADING INFORMATION

SEATING CAPACITY — TOTAL 5   FRONT   2   REAR   3

THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED 385 KG OR 850 LB

TIRE	FRONT	REAR	SPARE
ORIGINAL TIRE SIZE	LT285/70R17C 116Q	LT285/70R17C 116Q	LT285/70R17C 116Q
COLD TIRE INFLATION PRESSURE	255 kPa / 37 PSI	255 kPa / 37 PSI	255 kPa / 37 PSI

SEE OWNERS MANUAL FOR ADDITIONAL INFORMATION   NW23

Figure A5. Tire Placard

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

Figure A7. Load Frame/Slider of SSV
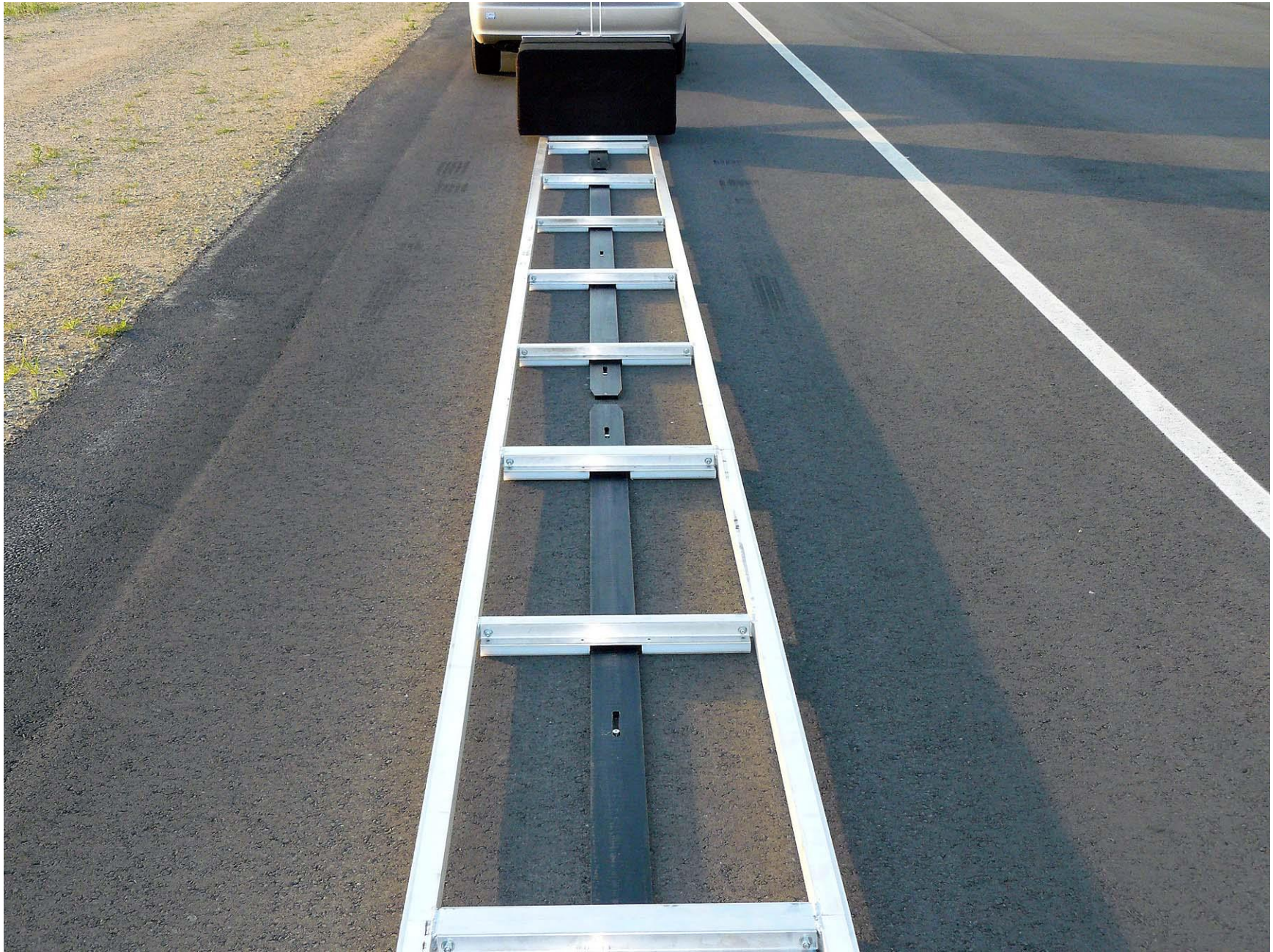
Figure A8. Two-Rail Track and Road-Based Lateral Restraint Track

Figure A9. Steel Trench Plate

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

Figure A11. Sensors for Detecting Visual and Auditory Alerts

Figure A12. Computer Installed in Subject Vehicle

Figure A13. Brake Actuator Installed in Subject Vehicle

Figure A14. Brake Actuator Installed in POV System

Figure A15. AEB On/Off and Alert Sensitivity Menu

Figure A16. Visual Alert

APPENDIX B

Excerpts from Owner's Manual

Blind Spot Alert Lights Only

When operating in Blind Spot Alert mode, the BSM system will provide a visual alert in the appropriate side view mirror based on a detected object. However, when the system is operating in Rear Cross Path (RCP) mode, the system will respond with both visual and audible alerts when a detected object is present. Whenever an audible alert is requested, the radio is muted.

Blind Spot Alert Lights/Chime

When operating in Blind Spot Alert Lights/Chime mode, the BSM system will provide a visual alert in the appropriate side view mirror based on a detected object. If the turn signal is then activated, and it corresponds to an alert present on that side of the vehicle, an audible chime will also be sounded. Whenever a turn signal and detected object are present on the same side at the same time, both the visual and audible alerts will be issued. In addition to the audible alert the radio (if on) will also be muted.

NOTE:

Whenever an audible alert is requested by the BSM system, the radio is also muted.

When the system is in RCP, the system shall respond with both visual and audible alerts when a detected object is present. Whenever an audible alert is requested, the radio is also muted. Turn/ hazard signal status is ignored; the RCP state always requests the chime.

Blind Spot Alert Off

When the BSM system is turned off there will be no visual or audible alerts from either the BSM or RCP systems.

NOTE:

The BSM system will store the current operating mode when the vehicle is shut off. Each time the vehicle is started the previously stored mode will be recalled and used.

Door Removal

When either the front driver or passenger door is removed, the instrument cluster will display "Blind Spot Temporarily Unavailable" and the BSM system will disable. While the system will continue to indicate whatever blind spot mode it was previously in within the Uconnect system, no visual or audible alerts will be provided. As long as the doors are removed, the instrument cluster will provide the "Blind Spot Temporarily Unavailable" pop-up as a reminder that the system is disabled every time the ignition is cycled.

Upon re-installation of both doors, the system will resume functionality based on the personalized mode selected.

FORWARD COLLISION WARNING (FCW) WITH MITIGATION — IF EQUIPPED

The FCW with Mitigation system provides the driver with audible warnings, visual warnings (within the instrument cluster display), and may apply a haptic warning in the form of a brake jerk, to warn the driver when it detects a potential frontal collision. The warnings 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 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 as well as a possible haptic warning in the form of a brake jerk.

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.

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If a FCW with Mitigation event begins at a speed below 32 mph (52 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.

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

NOTE:

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

● The FCW alerts may be triggered on objects other than vehicles such as guardrails 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.

● 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 rate of speed.

● FCW will be disabled like ACC, with the unavailable screens.

WARNING!
Forward Collision Warning (FCW) is not intended to avoid a collision on its own, nor can FCW detect every type of potential collision. In rare situations, the system may react to surrounding objects such as tunnels, bridges, guardrails, etc. The driver has the responsibility to avoid a collision by controlling the vehicle via braking, steering, and acceleration. Unintended braking reactions can always be overridden by pressing down hard on the accelerator. Failure to follow this warning could lead to serious injury or death.

Turning FCW On Or Off

The FCW setting menu can be adjusted through the Uconnect Settings

● To turn the FCW system on, select between "Only Warning" and "Warning and Braking" in the FCW menu.

● Select "OFF" in the FCW menu to turn the FCW system off.

NOTE:

- When the FCW is "on", this allows the system to warn the driver of a possible collision with the vehicle in front.

- When the FCW is "off", this prevents the system from warning the driver of a possible collision with the vehicle in front. If the FCW is set to "off", "FCW OFF" will be displayed in the instrument cluster display.

- When FCW status is set to "Only Warning", this 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.

- When FCW status is set to "Warning and 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.

- The system will retain the last setting selected by the driver after ignition shutdown.

FCW Braking Status And Sensitivity

The FCW Sensitivity and Active Braking status are programmable through the Uconnect system ↪ page 223.

- Far
  - When the sensitivity of FCW is set to the "Far" setting, this allows the system to warn the driver of a possible more distant collision with the vehicle in front using audible/visual warnings.
  - More cautious drivers that do not mind frequent warnings may prefer this setting.

NOTE:

The "Far" setting may result in a greater number of FCW possible collision warnings experienced.

- Medium
  - When the sensitivity of FCW is set to the "Medium" setting, this allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warnings.

- Near
  - When the sensitivity of FCW is set to the "Near" setting, this allows the system to warn the driver of a possible closer collision with the vehicle in front using audible/visual warnings.

  - This setting provides less reaction time than the "Far" and "Medium" settings, which allows for a more dynamic driving experience.

  - More dynamic or aggressive drivers that want to avoid frequent warnings may prefer this setting.

NOTE:

The "Near" setting may result in a lesser number of FCW possible collision warnings experienced.

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.

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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.

TIRE PRESSURE MONITORING SYSTEM (TPMS)

The Tire Pressure Monitoring System (TPMS) will warn the driver of a low tire pressure based on the vehicle recommended cold placard pressure.

NOTE:

The alert warning on the cluster will stay on until the tire is inflated to the placard pressure.

The tire pressure will vary with temperature by approximately 1 psi (7 kPa) for every 12°F (6.5°C). This means that when the outside temperature decreases, the tire pressure will decrease. Tire pressure should always be set based on cold inflation tire pressure. This is defined as the tire pressure after the vehicle has not been driven for at least three hours, or driven less than 1 mile (1.6 km) after a three hour period. The cold tire inflation pressure must not exceed the maximum inflation pressure molded into the tire sidewall.

The tire pressure will also increase as the vehicle is driven. This is normal and there should be no adjustment for this increased pressure.

See ➪ page 420 on how to properly inflate the vehicle's tires.

The TPMS will warn the driver of a low tire pressure if the tire pressure falls below the low-pressure warning limit for any reason, including low temperature effects and natural pressure loss through the tire.

The TPMS will continue to warn the driver of low tire pressure as long as the condition exists, and will not turn off until the tire pressure is at or above the recommended cold placard pressure. Once the low tire pressure warning (Tire Pressure Monitoring System Warning Light) illuminates, you must increase the tire pressure to the recommended cold placard pressure in order for the TPMS Warning Light to turn off.

NOTE:

When filling warm tires, the tire pressure may need to be increased up to an additional 4 psi (28 kPa) above the recommended cold placard pressure in order to turn the TPMS Warning Light off.

The system will automatically update and the TPMS Warning Light will turn off once the system receives the updated tire pressures. The vehicle may need to be driven for up to 20 minutes above 15 mph (24 km/h) in order for the TPMS to receive this information.

For example, your vehicle may have a recommended cold (parked for more than three hours) placard pressure of 33 psi (227 kPa). If the ambient temperature is 68°F (20°C) and the measured tire pressure is 28 psi (193 kPa), a temperature drop to 20°F (-7°C) will decrease the tire pressure to approximately 24 psi (165 kPa). This tire pressure is low enough to turn on the TPMS Warning Light. Driving the vehicle may cause the tire pressure to rise to approximately 28 psi (193 kPa), but the TPMS Warning Light will still be on. In this situation, the TPMS Warning Light will turn off only after the tires are inflated to the vehicle's recommended cold placard pressure value ➪ page 461.

NOTE:

When filling warm tires, the tire pressure may need to be increased up to an additional 4 psi (28 kPa) above the recommended cold placard pressure in order to turn the TPMS Warning Light off.

APPENDIX C

Run Log

| | Subject Vehicle: | **2022 Jeep Wrangler Unlimited Rubicon 392** | | | Test start date: | **8/2/2022** | | |
| | Principal Other Vehicle: | **SSV** | | | Test end date: | **8/3/2022** | | |

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
	Brake characterization and determination						See Appendix D
44	Static Run						
45	**Stopped POV**	Y	1.73	4.93	0.85	Pass	
46		Y	1.78	4.81	0.84	Pass	
47		Y	1.77	5.00	0.85	Pass	
48		Y	1.78	6.40	0.87	Pass	
49		Y	1.69	4.21	0.84	Pass	
50		Y	1.77	4.25	0.84	Pass	
51		Y	1.71	4.52	0.85	Pass	
52	Static Run						
53	**Slower POV, 25 vs 10**	Y	1.61	6.81	0.86	Pass	
54		Y	1.59	6.75	0.84	Pass	
55		Y	1.55	6.52	0.84	Pass	
56		Y	1.63	6.58	0.84	Pass	
57		Y	1.60	6.38	0.83	Pass	
58		Y	1.54	7.27	0.92	Pass	

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
59		Y	1.64	6.77	0.84	Pass	
60	Static run						
61		N					Vehicle Braking Prevented TTC Criteria, Switched to Distance Calculation Method for this scenario ONLY
62		Y	2.42	18.34	0.89	Pass	
63		Y	2.39	19.31	0.95	Pass	
64	**Slower POV, 45 vs 20**	Y	2.43	19.43	0.94	Pass	
65		Y	2.31	17.63	0.87	Pass	
66		Y	2.45	17.06	0.86	Pass	
67		Y	2.38	17.22	0.87	Pass	
68		Y	2.35	19.83	0.84	Pass	
69	Static run						
70		Y	1.64	0.00	0.75	Fail	
71	**Decelerating POV, 35**	Y	1.62	0.00	0.84	Fail	
72		Y	1.66	0.00	0.60	Fail	
73-76	Hybrid Brake Characterization						
77		Y	1.69	0.00	0.79	Fail	Check run in Hybrid mode
78		Y	1.57	0.00	0.82	Fail	Check run in Hybrid mode

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
79	Static run						
27	STP - Static run						
28	**Baseline, 25**	Y			0.46		
29		Y			0.47		
30		Y			0.47		
31		Y			0.46		
32		Y			0.45		
33		Y			0.46		
34		Y			0.46		
35	STP - Static run						
36	**Baseline, 45**	Y			0.45		
37		Y			0.44		
38		Y			0.44		
39		Y			0.44		
40		Y			0.43		
41		Y			0.44		
42		Y			0.45		
43	STP - Static run						

Run	Test Type	Valid Run?	FCW TTC (s)	Minimum Distance (ft)	Peak Deceleration (g)	Pass/Fail	Notes
9	Static						
10	STP False Positive, 25	Y			0.47	Pass	
11		Y			0.47	Pass	
12		N					Throttle Drop
13		Y			0.47	Pass	
14		Y			0.47	Pass	
15		Y			0.47	Pass	
16		Y			0.46	Pass	
17		Y			0.47	Pass	
18	STP - Static run						
19	STP False Positive, 45	Y			0.43	Pass	
20		Y			0.45	Pass	
21		Y			0.45	Pass	
22		Y			0.45	Pass	
23		Y			0.44	Pass	
24		Y			0.43	Pass	
25		Y			0.44	Pass	
26	STP - Static run						

APPENDIX D

Brake Characterization

Subject Vehicle: **2022 Jeep Wrangler Unlimited Rubicon 392**   Test start date: **8/2/2022**

Test end date: **8/3/2022**

DBS Initial Brake Characterization				
Run Number	Stroke at 0.4 g (in)	Force at 0.4 g (lb)	Slope	Intercept
1	2.08	20.44	0.864	-0.245
2	2.10	20.69	0.922	-0.328
3	2.09	20.23	0.922	-0.321

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		35	N					Brake Rate
5		35	N					Brake Rate
6	Displacement	35	Y	0.417	2.09		2.00	
7		25	Y	0.420	2.09		1.99	
8		45	Y	0.408	2.09		2.05	
73	Hybrid	35	Y	0.550	2.09	20.45	14.87	Check run

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
74		35	Y	0.477	2.09	17.00	14.26	Check run
75		35	Y	0.428	2.09	14.50	13.55	Check run
76		35	Y	0.403	2.09	14.00	13.90	Check run

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:

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

As only the 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, green circle, or red asterisk appears on the brake pedal position data over the DBS controller brake onset period. The black bar signifies the time over which the brake application rate is determined, and the calculated brake application rate is displayed on the figure. If instead, a green dot or red asterisk is displayed,

the brake application rate is being assessed under a newly developed requirement. For vehicles that exhibit brake pedal movement during the activation of the brake actuator, the target brake pedal displacement that results in 0.4 g of vehicle deceleration must be achieved within 250 ms of activation. If the target brake pedal displacement was achieved, a green circle is displayed. If not, a red asterisk is displayed.

- If the tests are performed in Displacement mode, the plot shows a short dashed black line above the brake onset period representing the maximum allowable 20% overshoot and 100 ms time period beyond the commanded pedal position.

  Additionally, a green envelope representing ±10% of the target brake pedal position is shown. If the brake pedal position exceeds the boundaries of the envelope, the run is invalid.

- If the tests are performed in Hybrid mode, no other brake pedal position requirements are shown.

For the brake force plots:
- A short, solid black line at 2.5 lbs is displayed representing the required nominal TTC or distance in which the brakes must be applied. If the brakes are applied based on a real-time calculation of TTC (which is standard practice), the tolerance is ±0.05 sec and the TTC of the brake onset is displayed. If the brakes cannot be applied based on a real-time TTC due to regenerative braking or other factors, the brakes are applied based on a distance calculation. The tolerance is ±2 ft and no other values are displayed. If the brakes are applied at the correct TTC or distance, a green dot is displayed. If not, a red asterisk is displayed.

- If the tests are performed in Displacement mode, no other brake force requirements are shown.

- If the tests are performed in Hybrid mode, a long, dashed black line is displayed at 2.5 lbs representing the minimum brake force required while the brake actuator is active. Exceedances of this brake force threshold are indicated by red shading in the area between the measured time-varying data and the dashed threshold line.

  additionally, a blue envelope representing ±10% of the target average brake force is shown along with the calculated average during that time period. Note that the brake force may exceed the boundaries of the envelope as long as the overall average is within tolerance.

In the instance of "last second" braking applied by the brake actuator, a thick vertical red line will appear on the plots at the moment the brake actuator 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.
*   Brk – Indicates that the requirements for the brake application rate 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 Figure E1 through E12. Figures E1 through E8 show passing runs for each of the 8 test types. Figure E9 shows an example of a passing brake characterization run. Figures E10 and E11 show examples of invalid runs. Figure E12 shows an example of a valid test that failed the DBS requirements. Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure E13.

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.
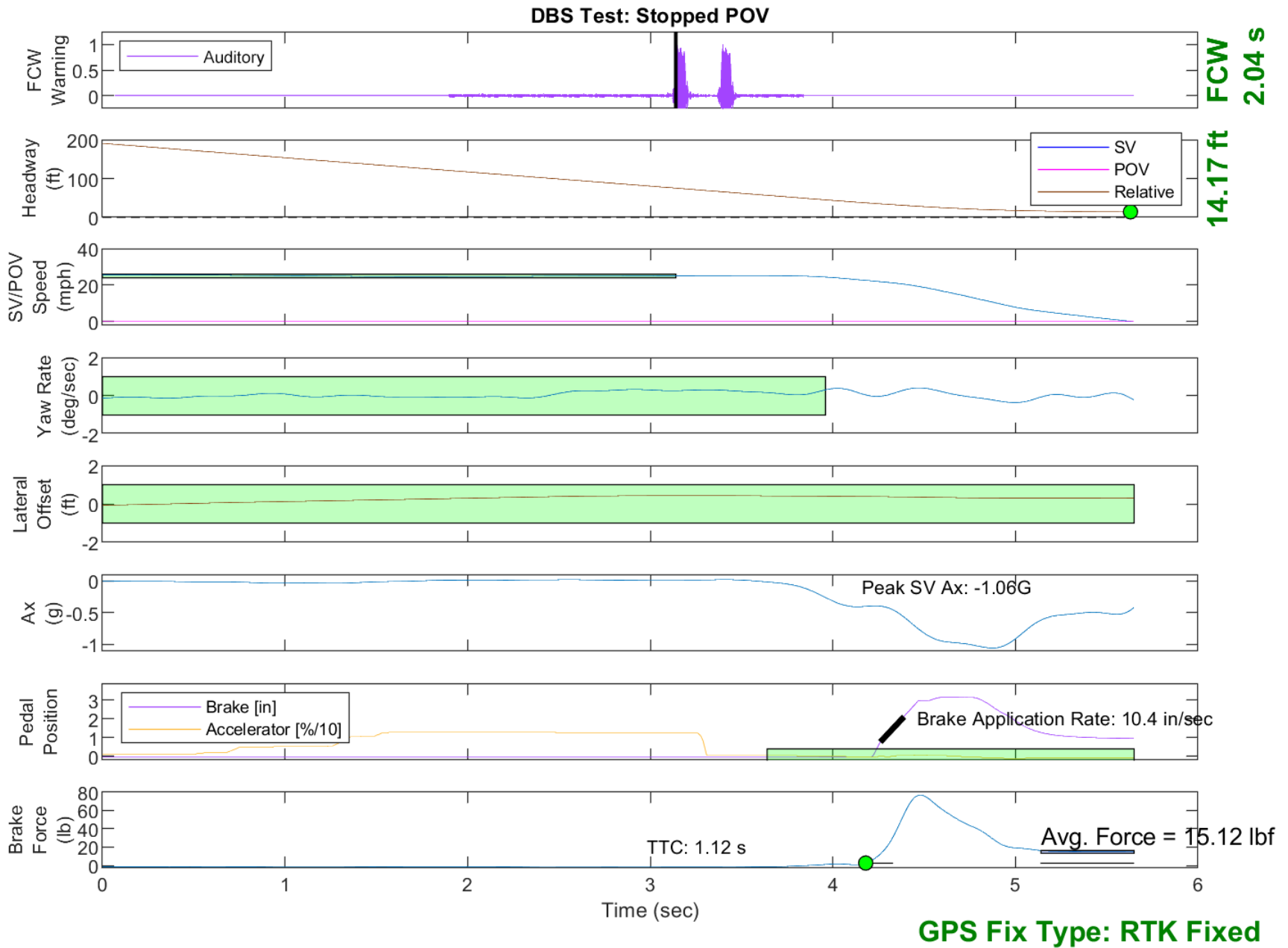
Figure E1. Example Time History for Stopped POV, Passing
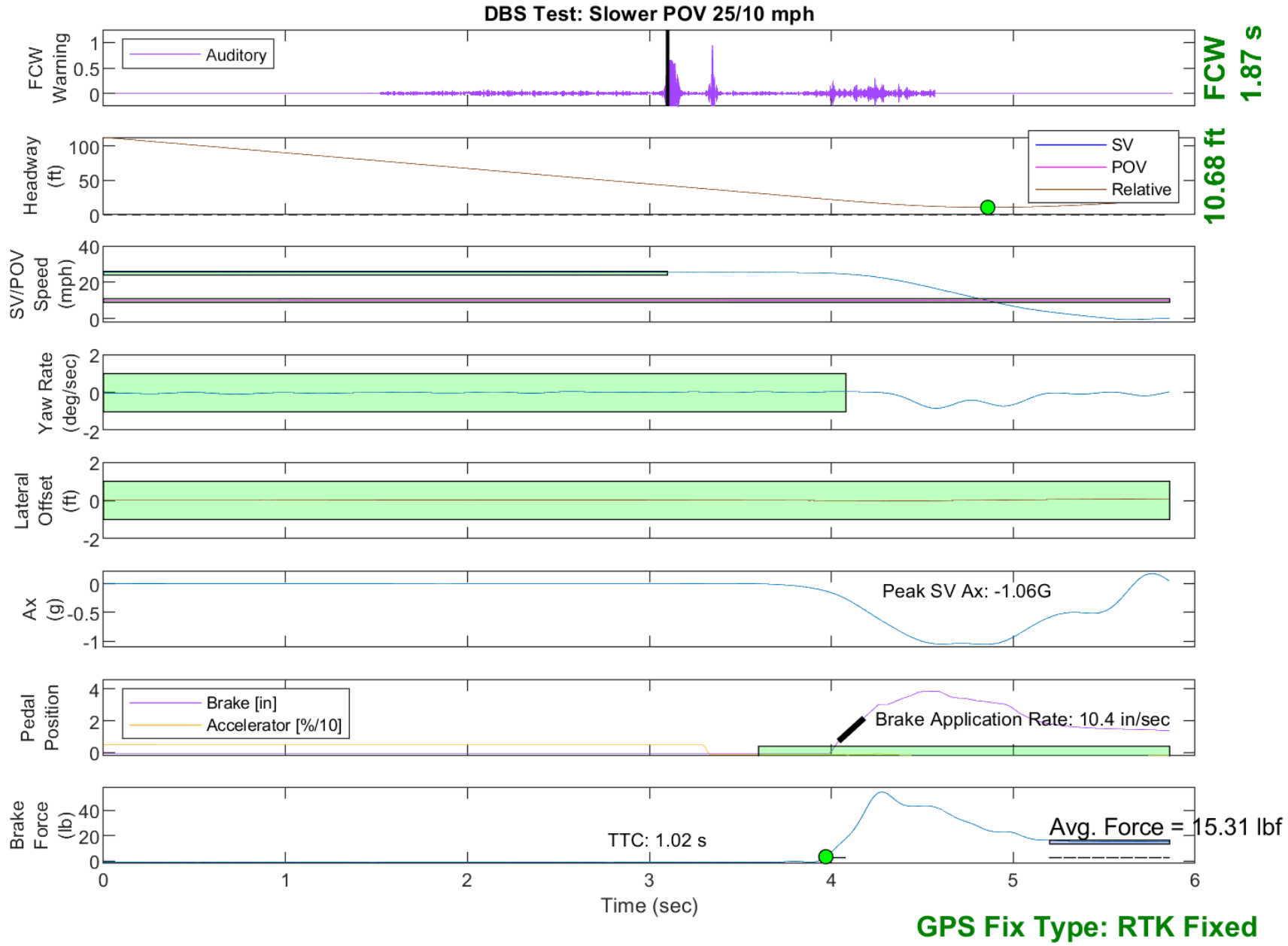
Figure E2. Example Time History for Slower POV 25 vs. 10, Passing
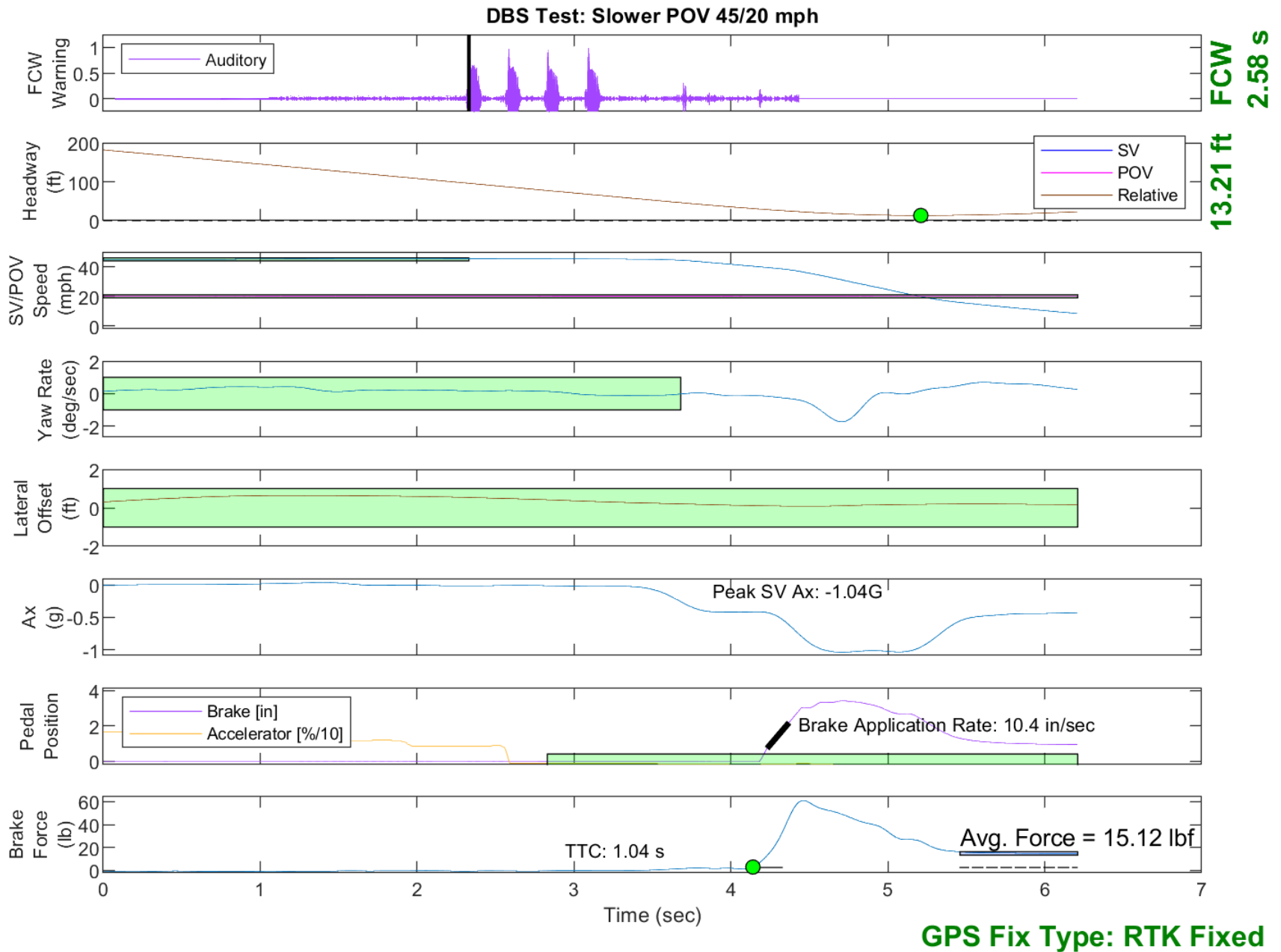
Figure E3. Example Time History for Slower POV 45 vs. 20, Passing
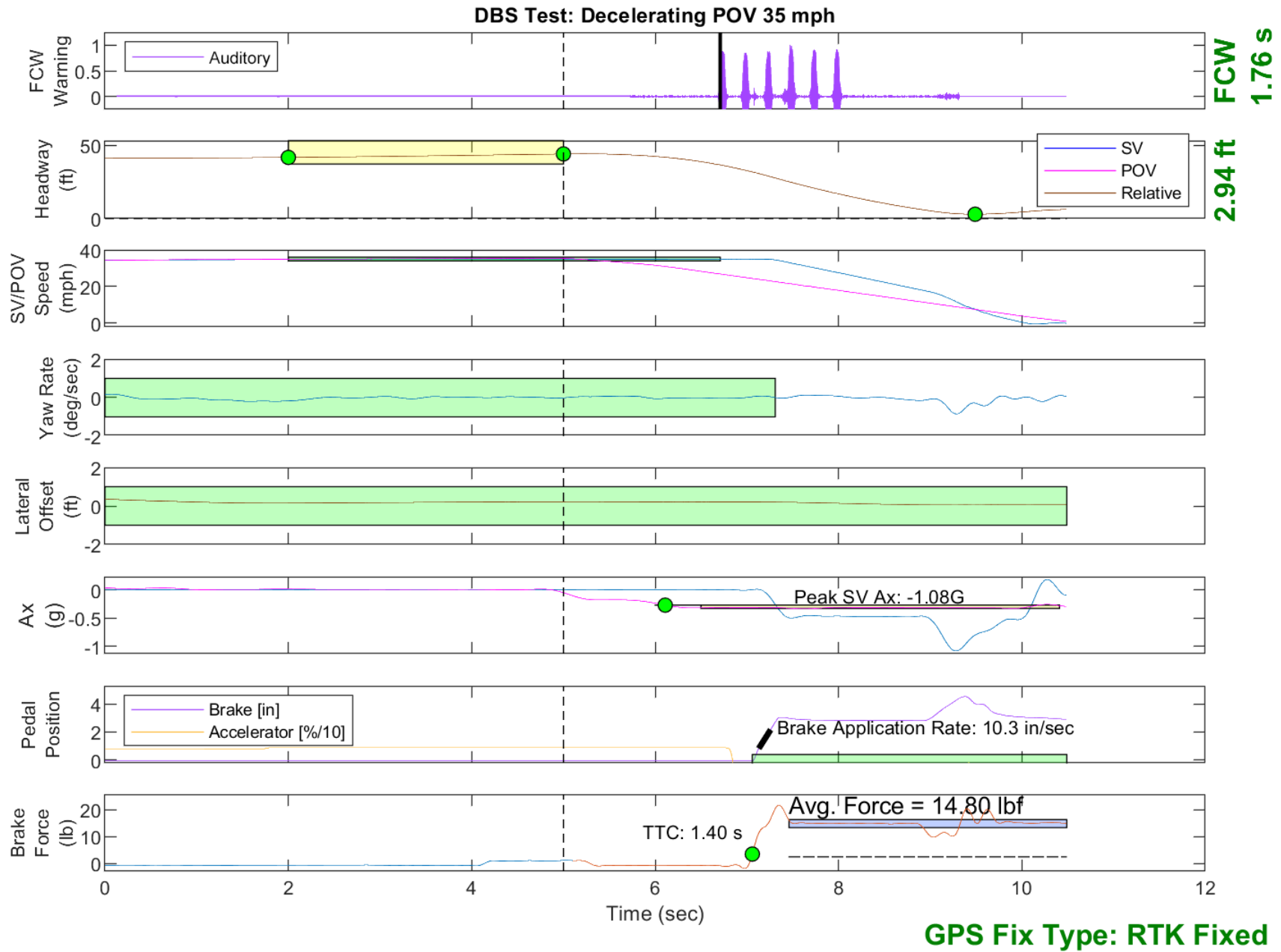
Figure E4. Example Time History for Decelerating POV 35, Passing
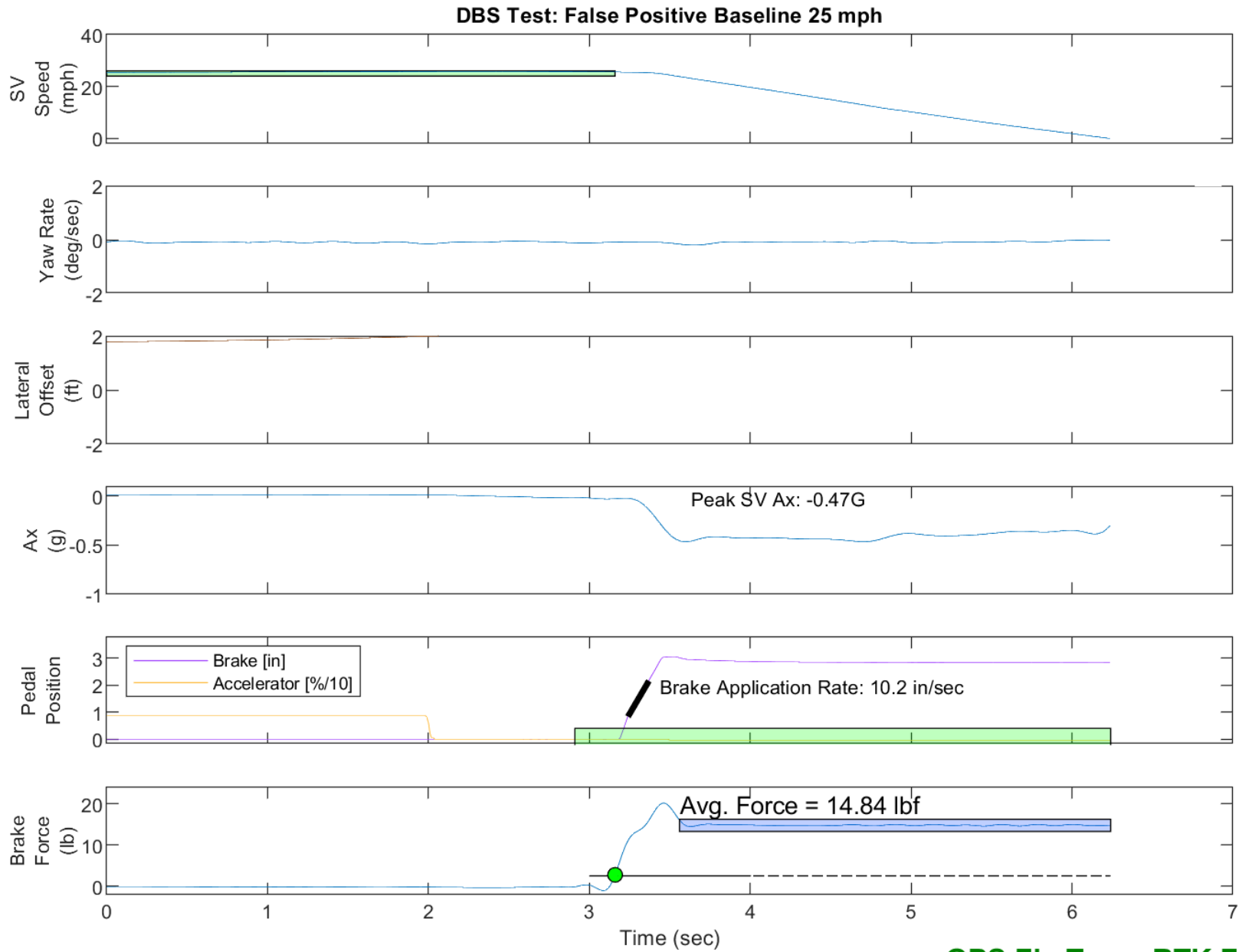
Figure E5. Example Time History for False Positive Baseline 25
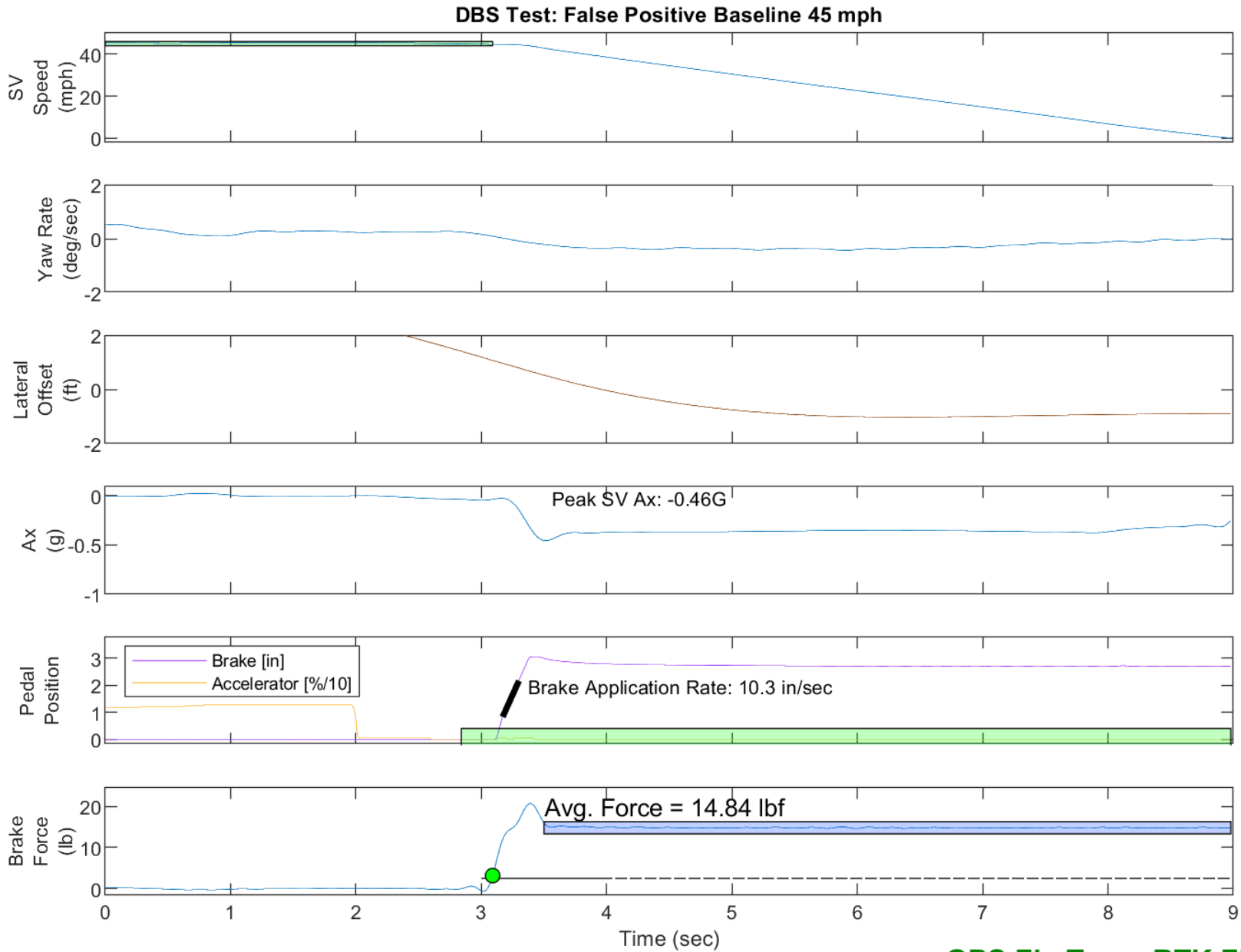
Figure E6. Example Time History for False Positive Baseline 45
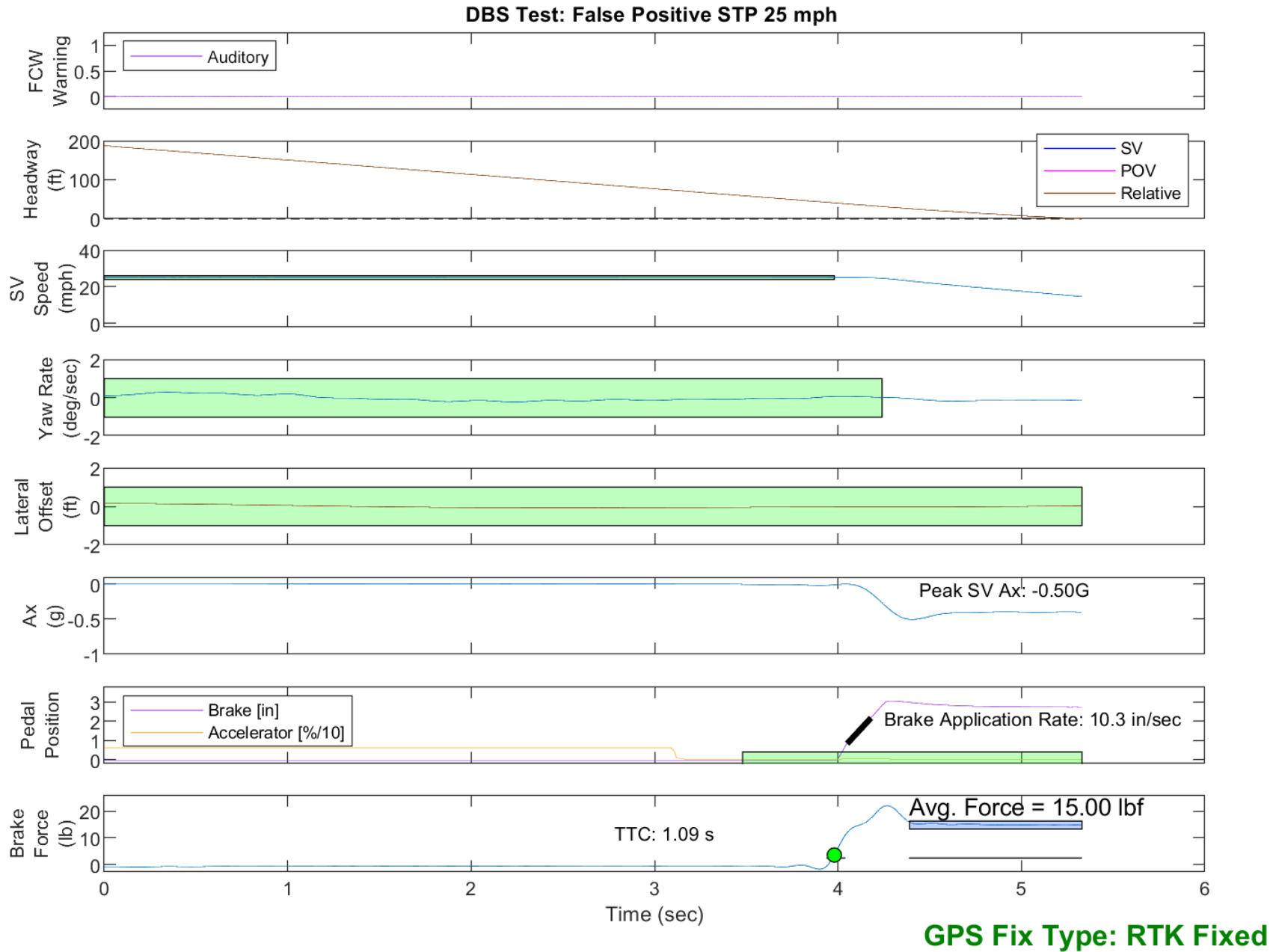
Figure E7. Example Time History for False Positive Steel Plate 25, Passing
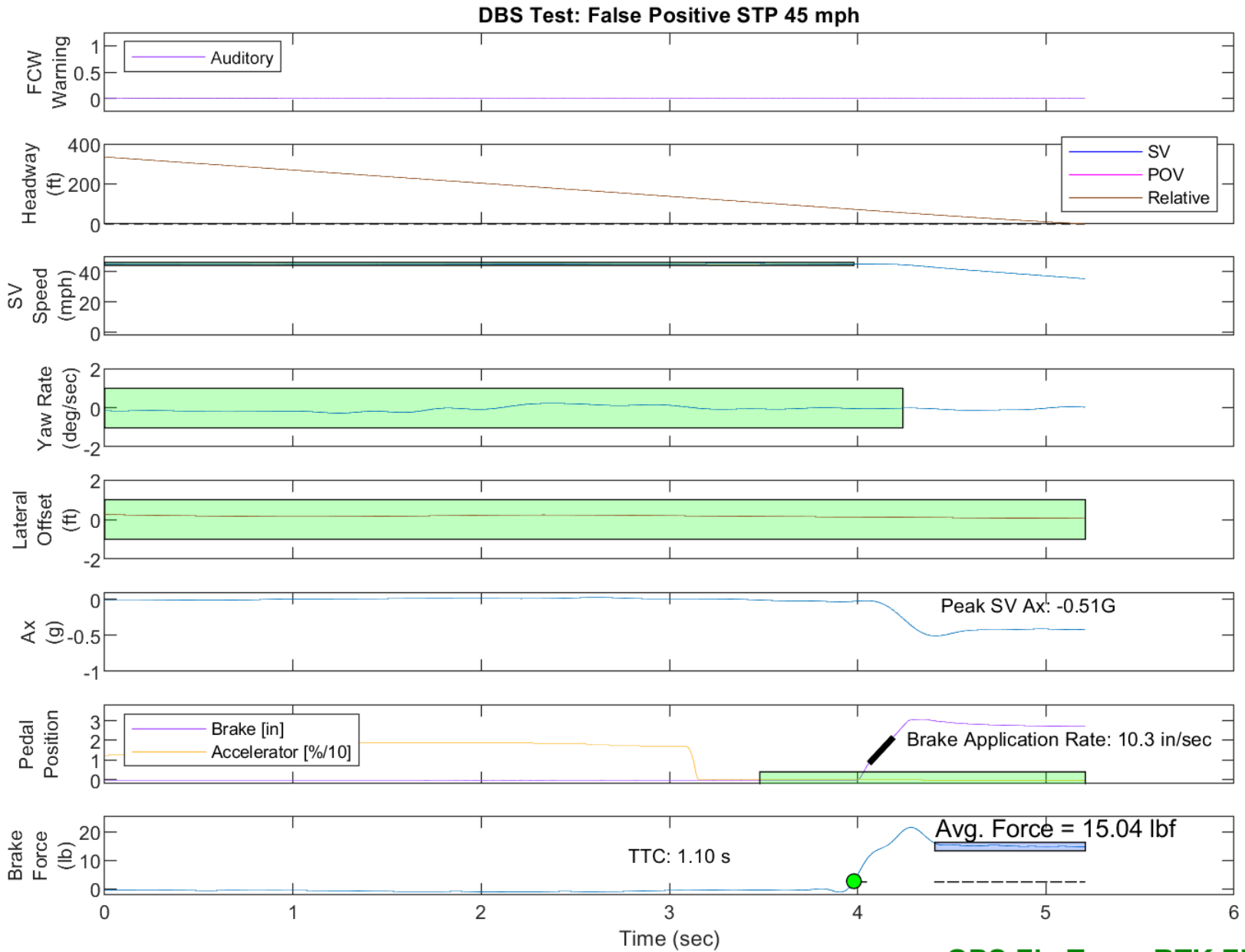
Figure E8. Example Time History for False Positive Steel Plate 45, Passing

DBS Test: Brake Characterization Initial Assessment
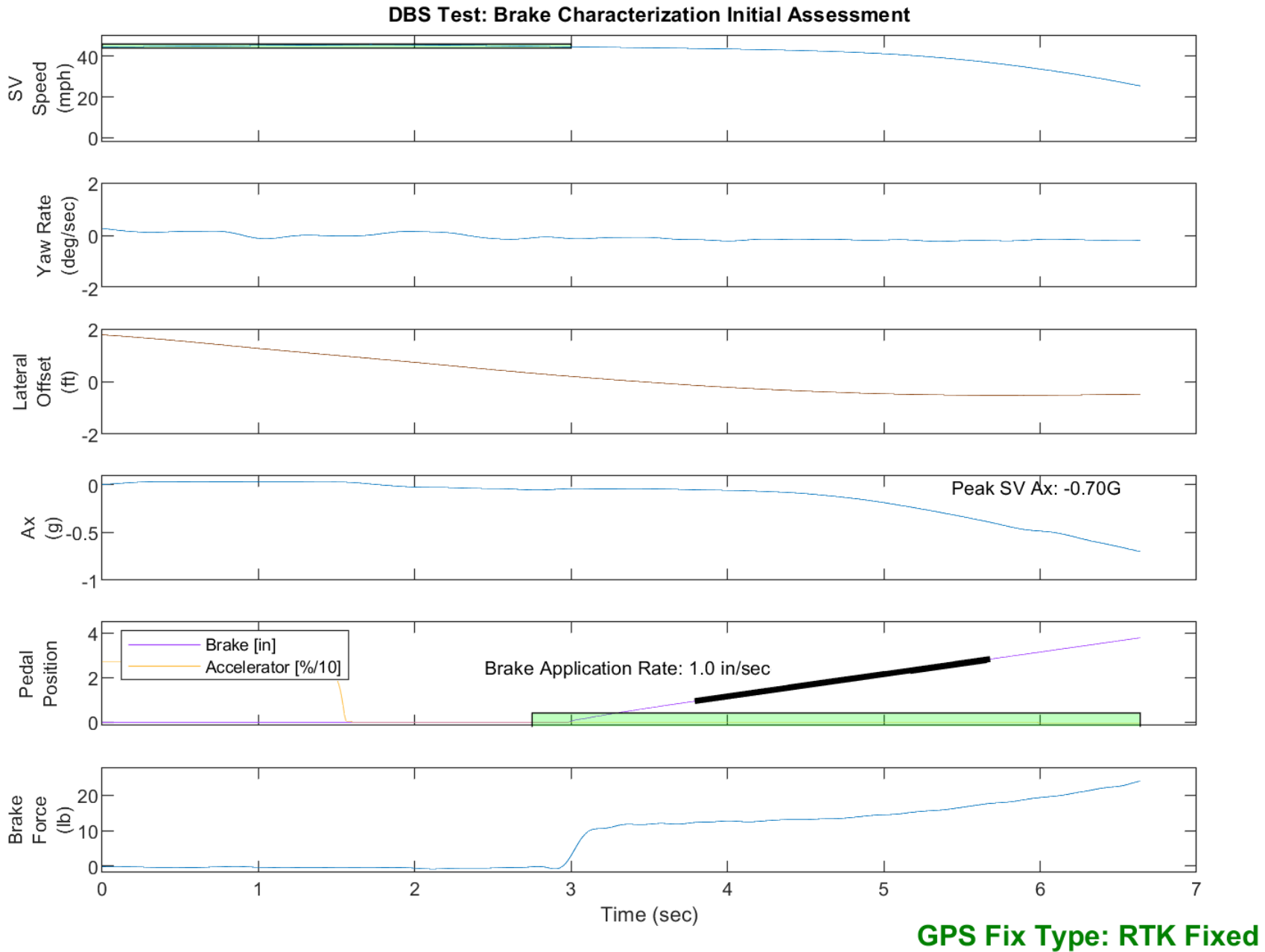
Figure E9. Example Time History for DBS Brake Characterization, Passing
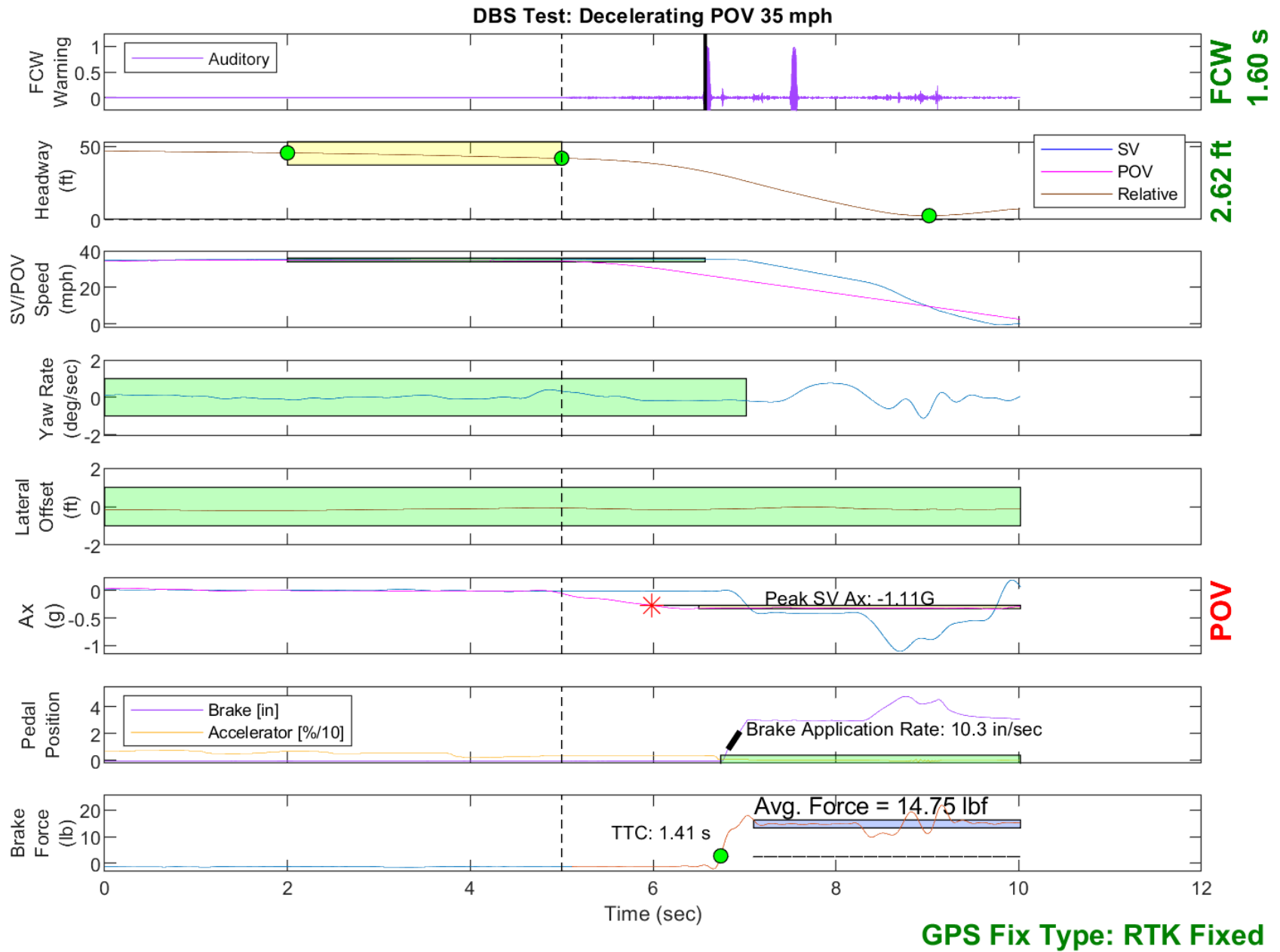
Figure E10. Example Time History Displaying Invalid POV Acceleration Criteria

DBS Test: False Positive Baseline 25 mph

Peak SV Ax: -0.47G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.2 in/sec

Avg. Force = 14.86 lbf

Time (sec)
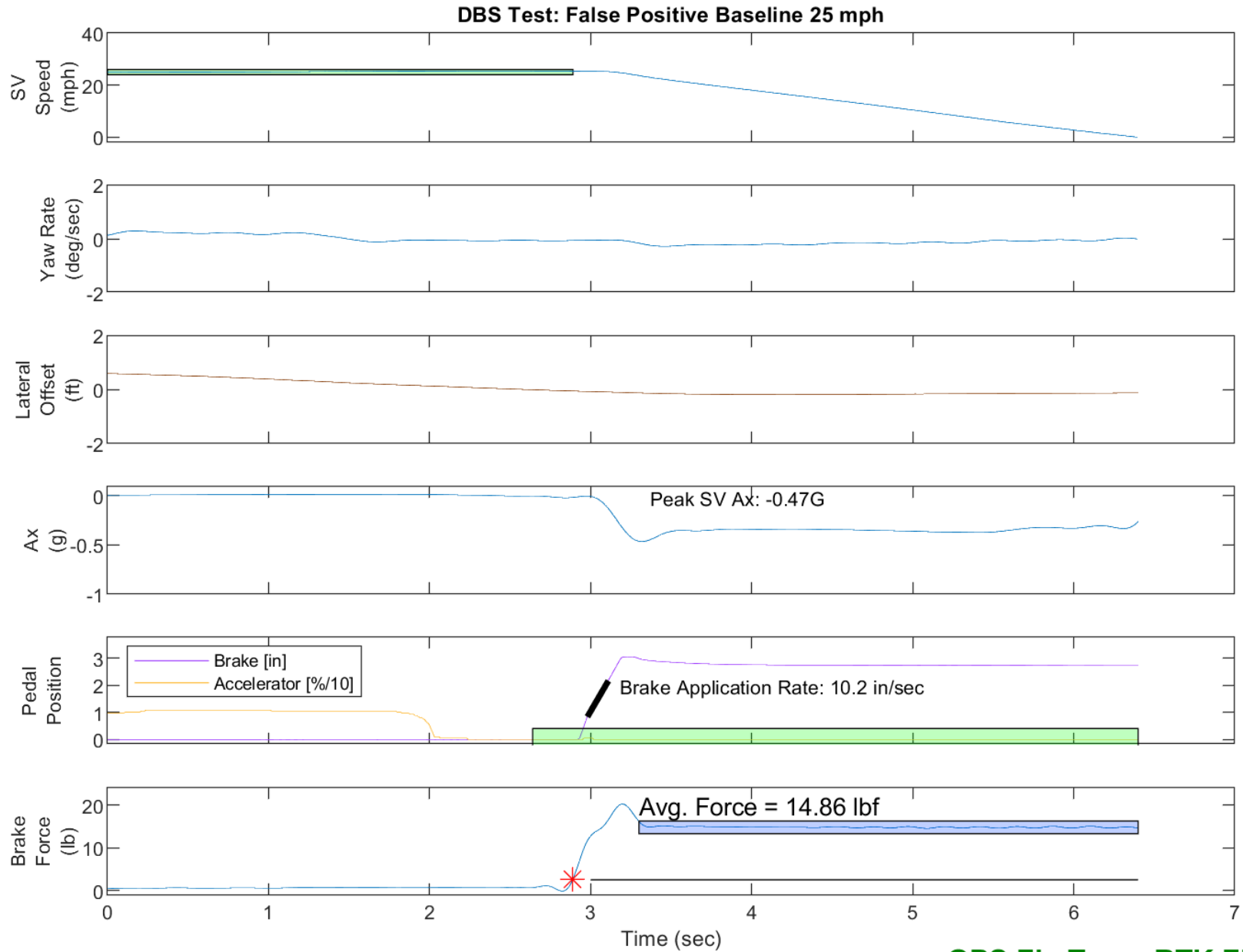
GPS Fix Type: RTK Fixed

Figure E11. Example Time History Displaying Invalid Brake Force Criteria

DBS Test: Stopped POV
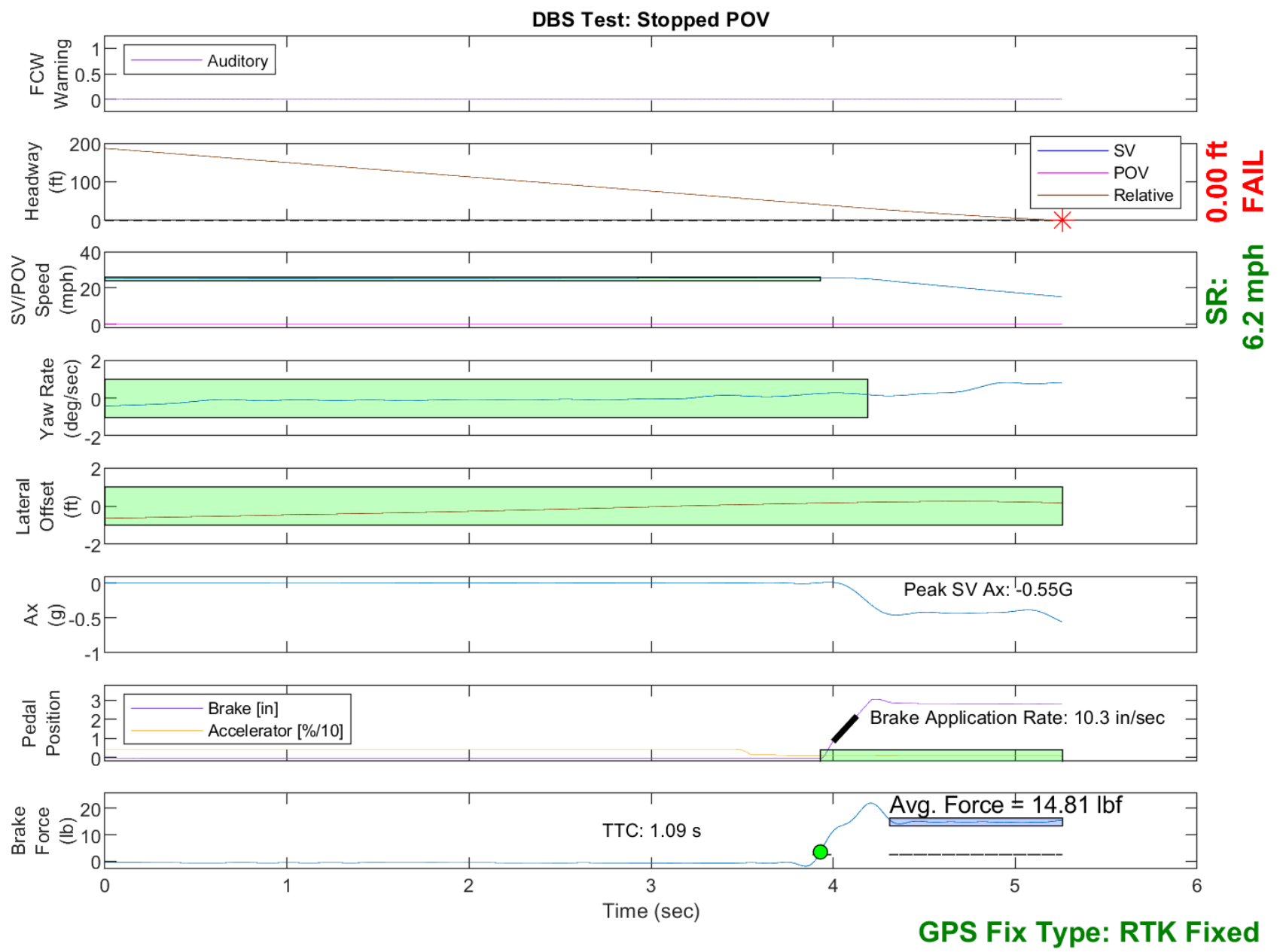
Figure E12. Example Time History for a Failed Run
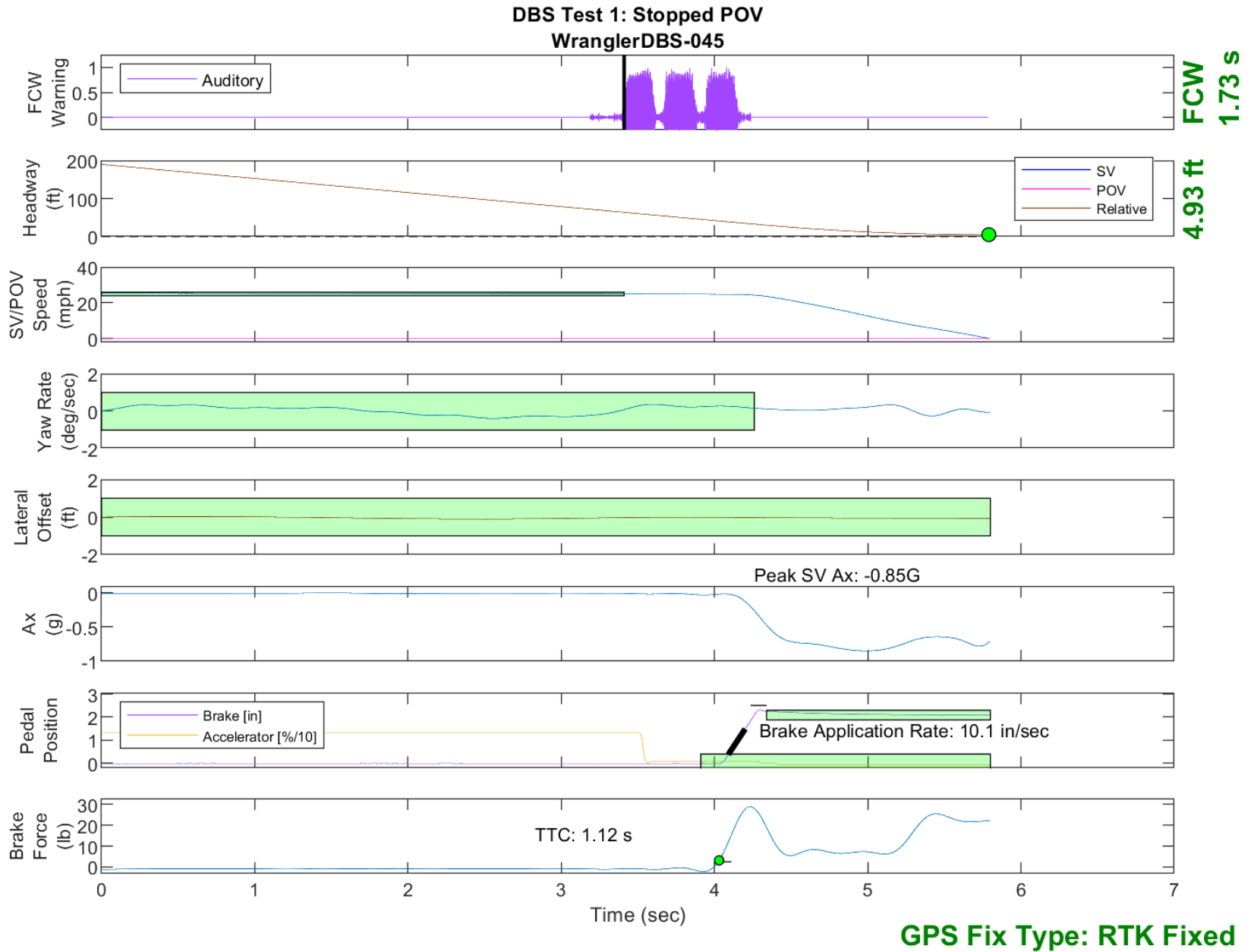
Figure E13. Time History for DBS Run 45, Test 1 - Stopped POV
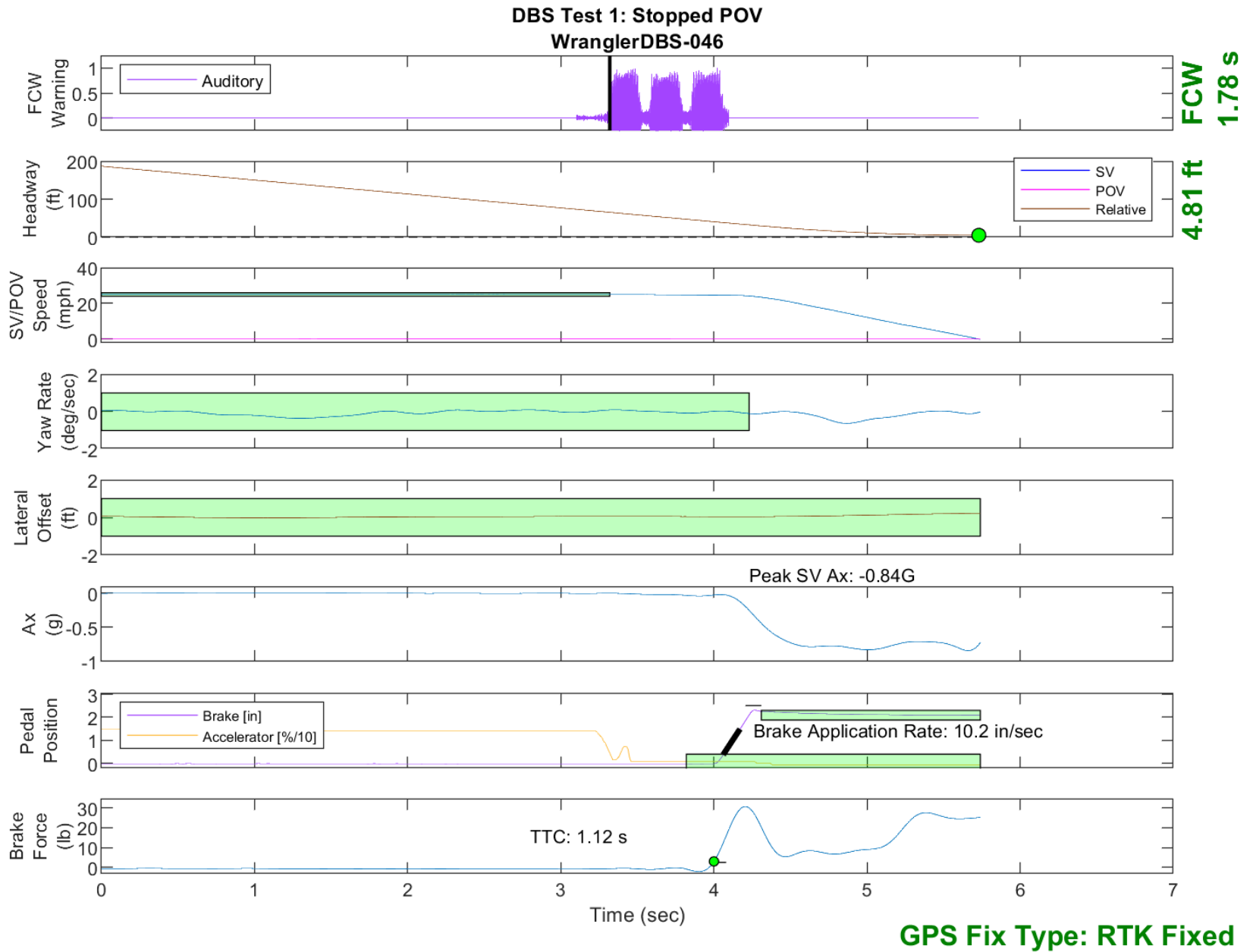
Figure E14. Time History for DBS Run 46, Test 1 - Stopped POV
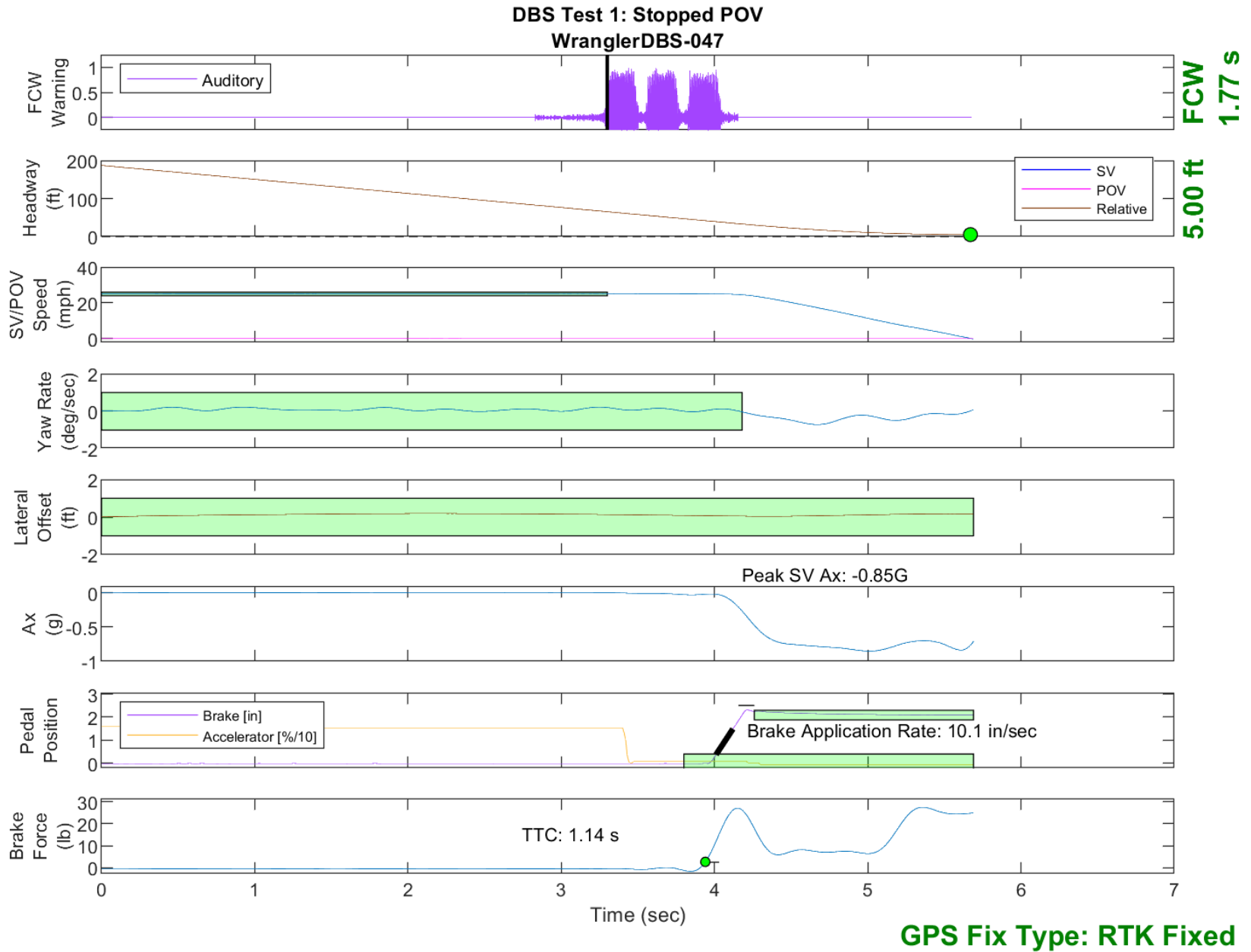
Figure E15. Time History for DBS Run 47, Test 1 - Stopped POV
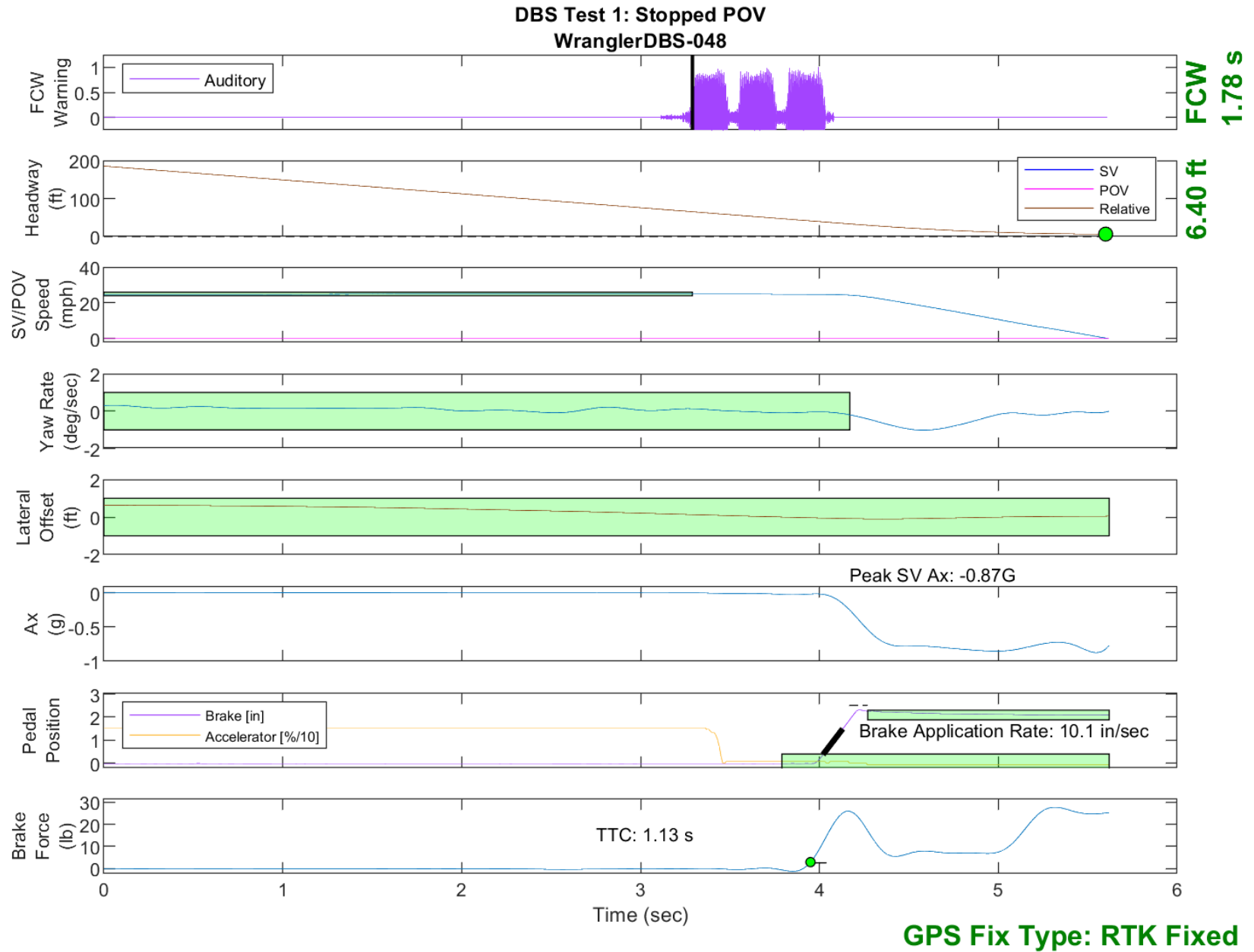
Figure E16. Time History for DBS Run 48, Test 1 - Stopped POV
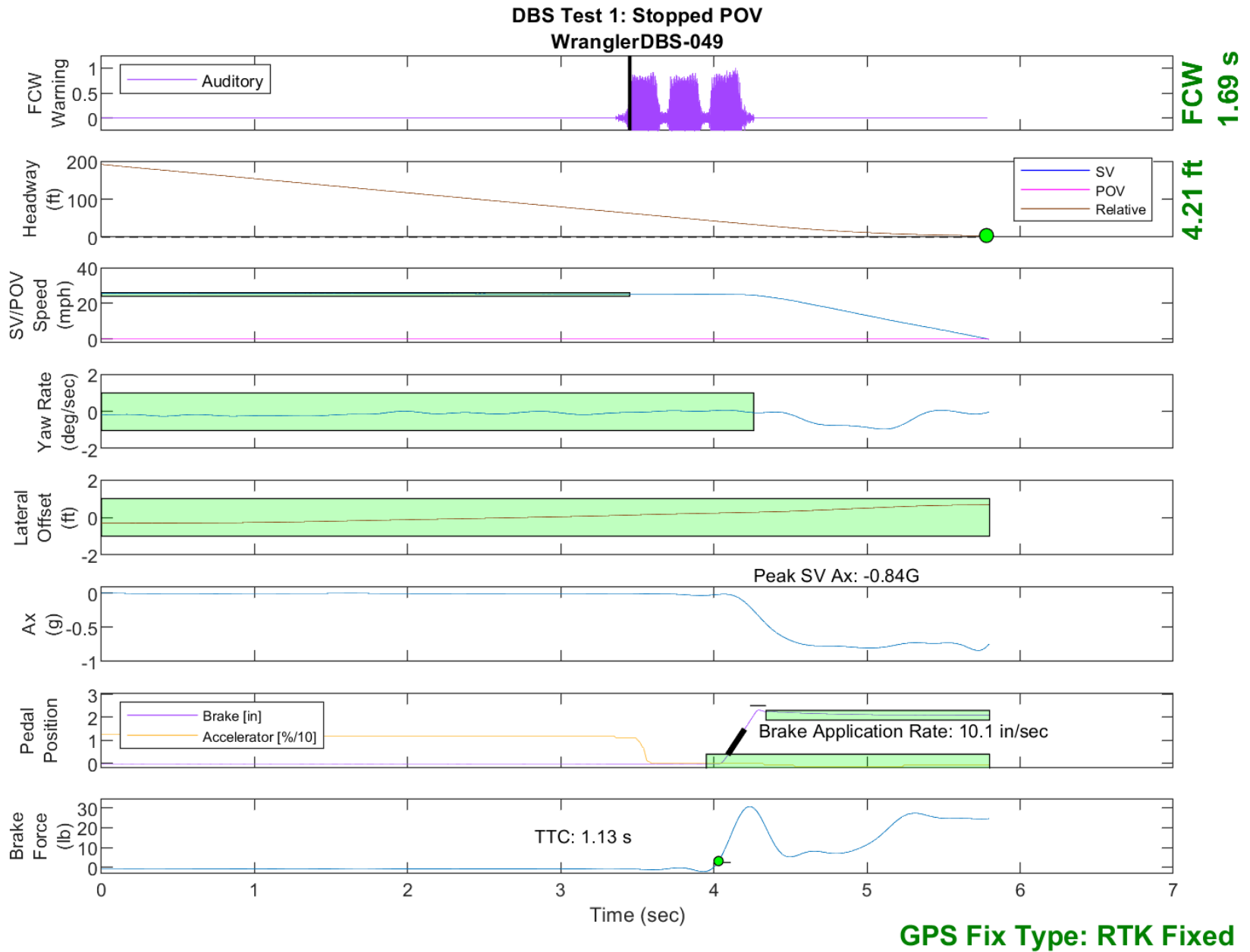
Figure E17. Time History for DBS Run 49, Test 1 - Stopped POV
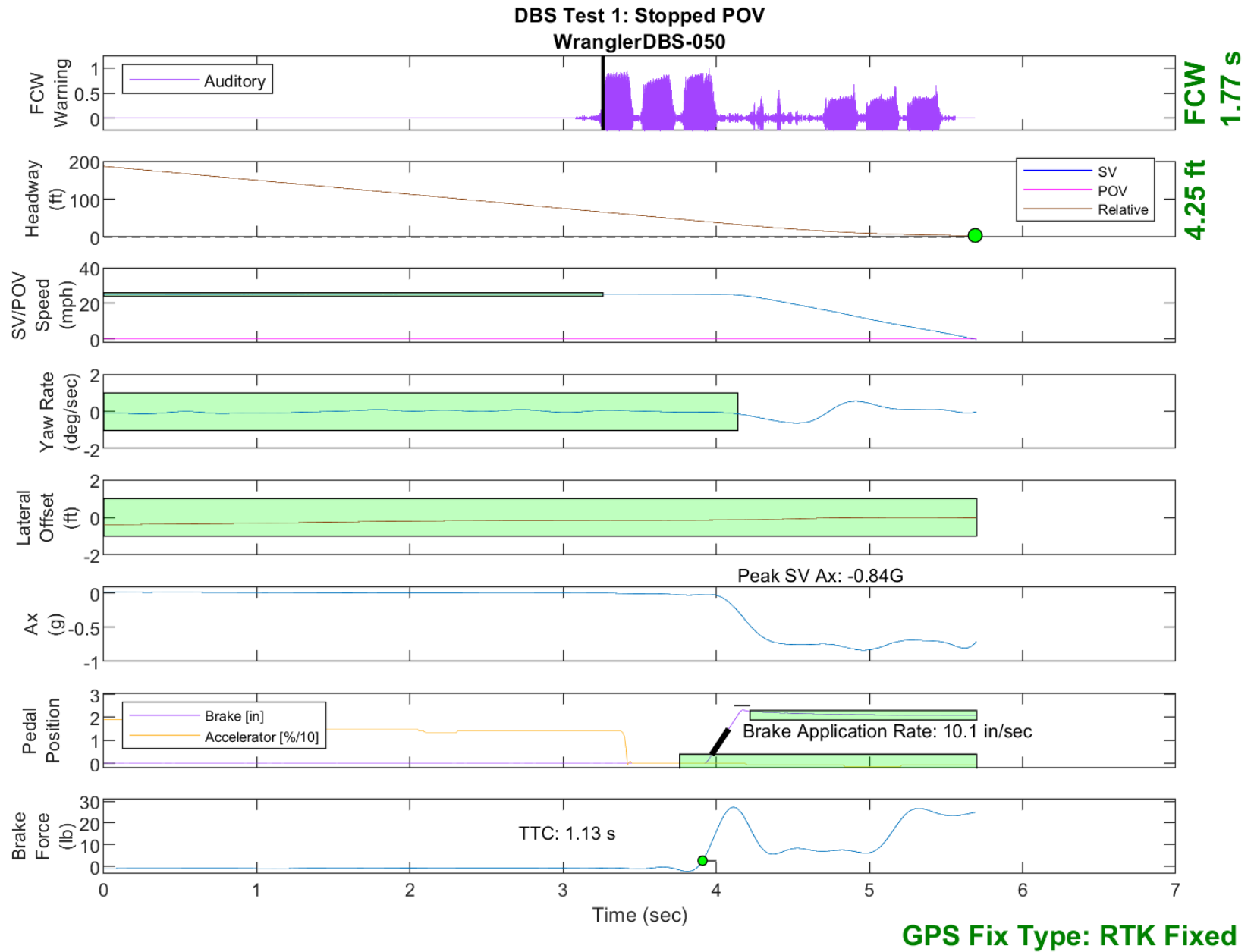
Figure E18. Time History for DBS Run 50, Test 1 - Stopped POV
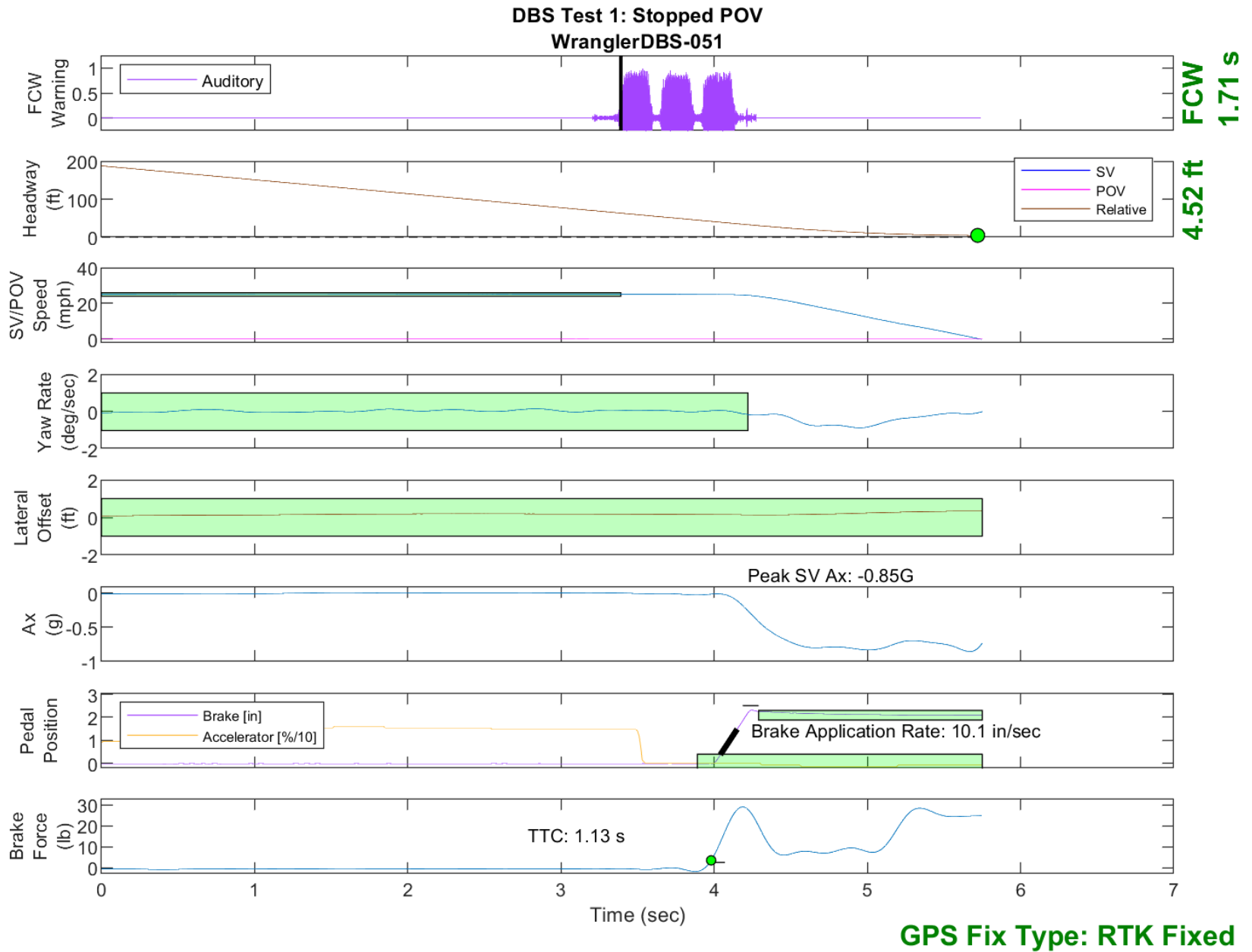
Figure E19. Time History for DBS Run 51, Test 1 - Stopped POV
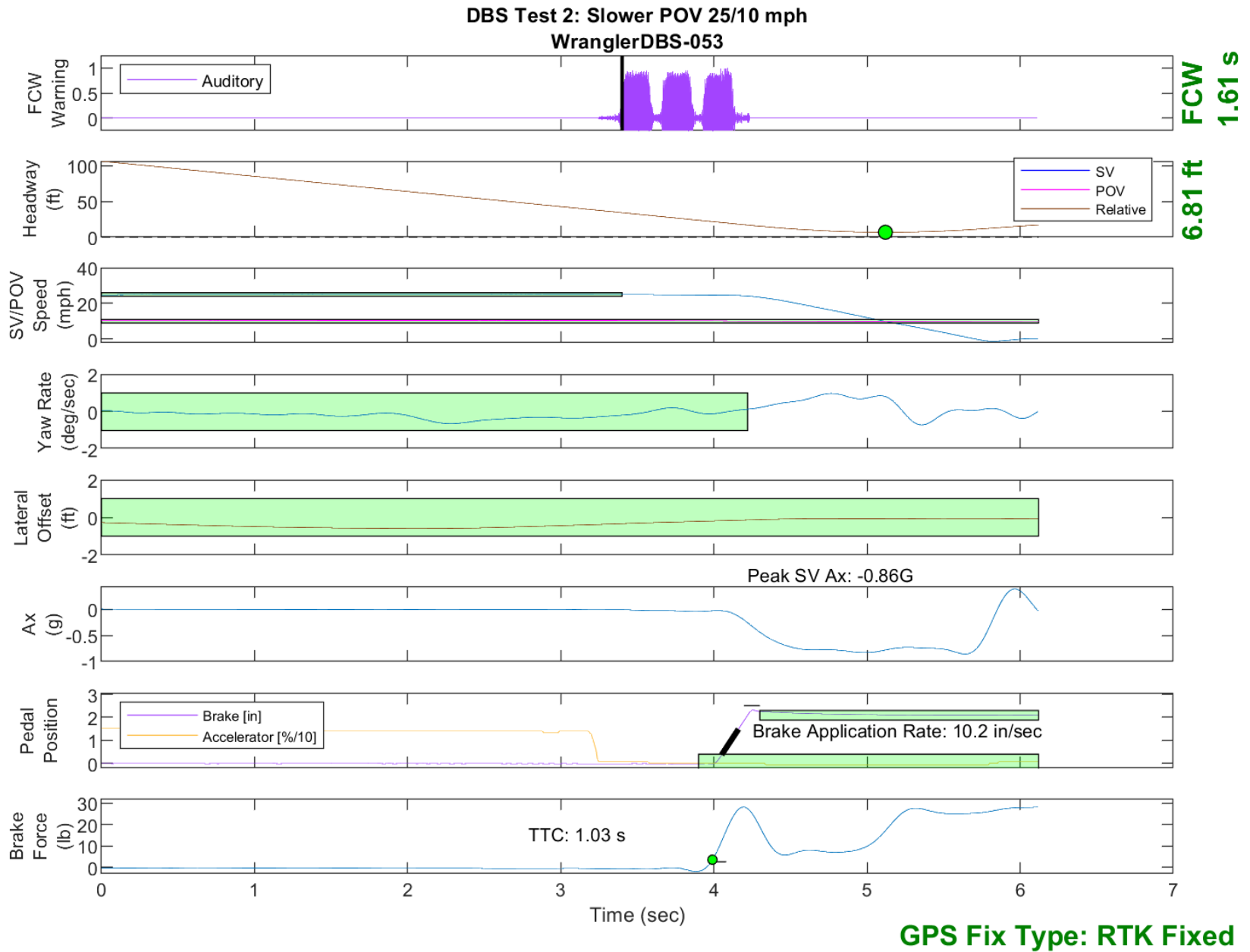
Figure E20. Time History for DBS Run 53, Test 2 - Slower Moving POV 25/10 mph

DBS Test 2: Slower POV 25/10 mph
WranglerDBS-054
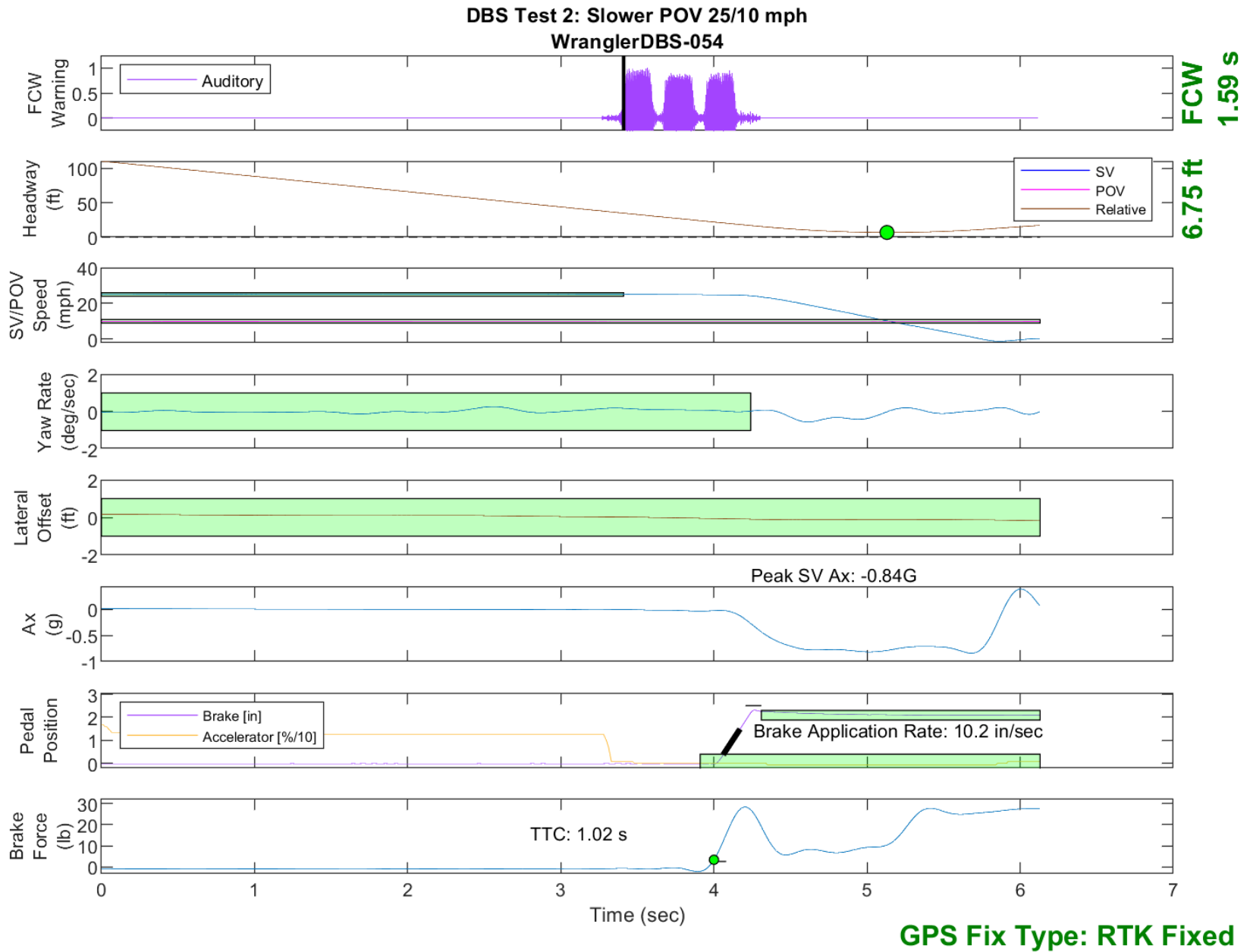
Figure E21. Time History for DBS Run 54, Test 2 - Slower Moving POV 25/10 mph
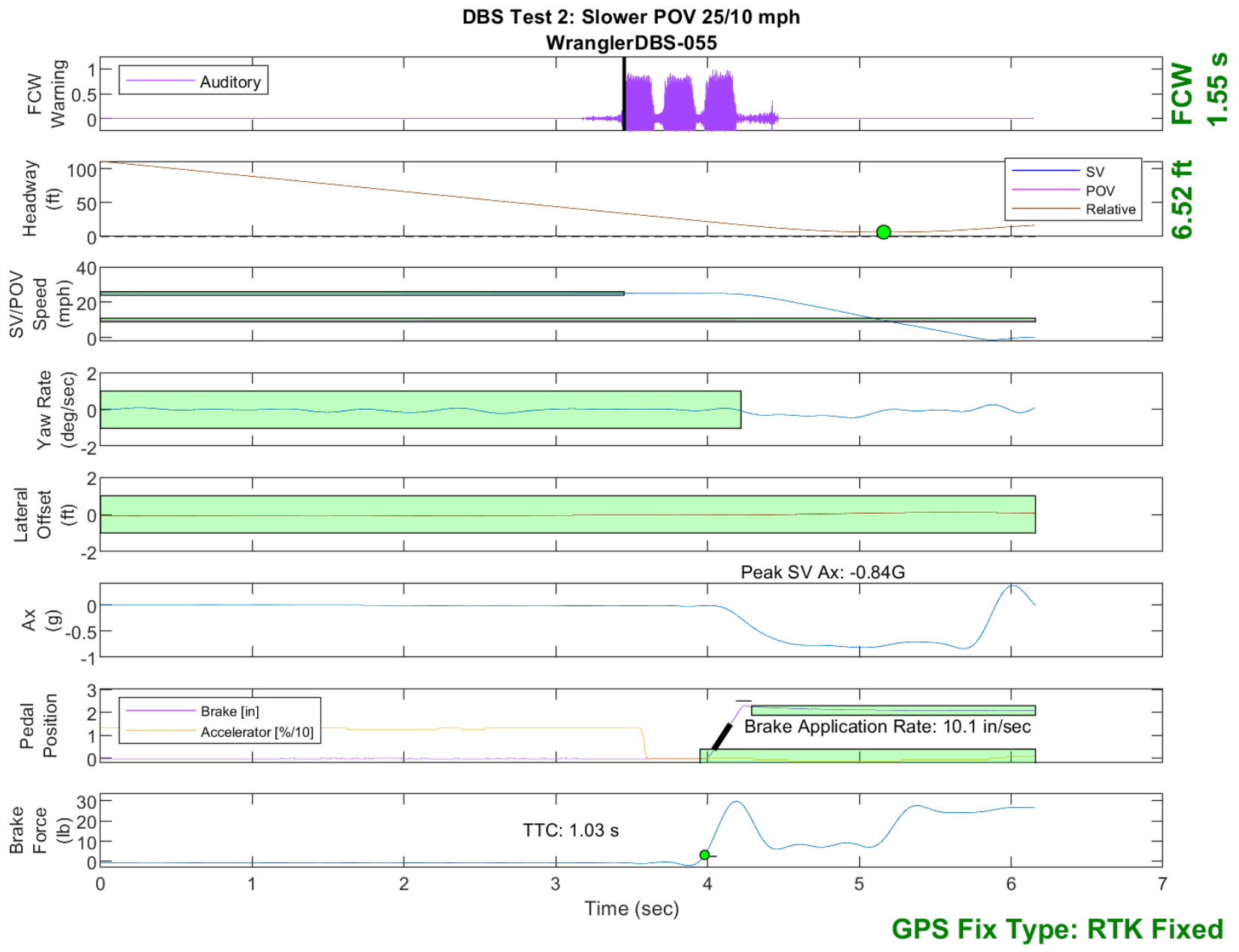
Figure E22. Time History for DBS Run 55, Test 2 - Slower Moving POV 25/10 mph

DBS Test 2: Slower POV 25/10 mph
WranglerDBS-056

FCW 1.63 s

6.58 ft

Peak SV Ax: -0.84G

Brake Application Rate: 10.1 in/sec

TTC: 1.02 s

GPS Fix Type: RTK Fixed
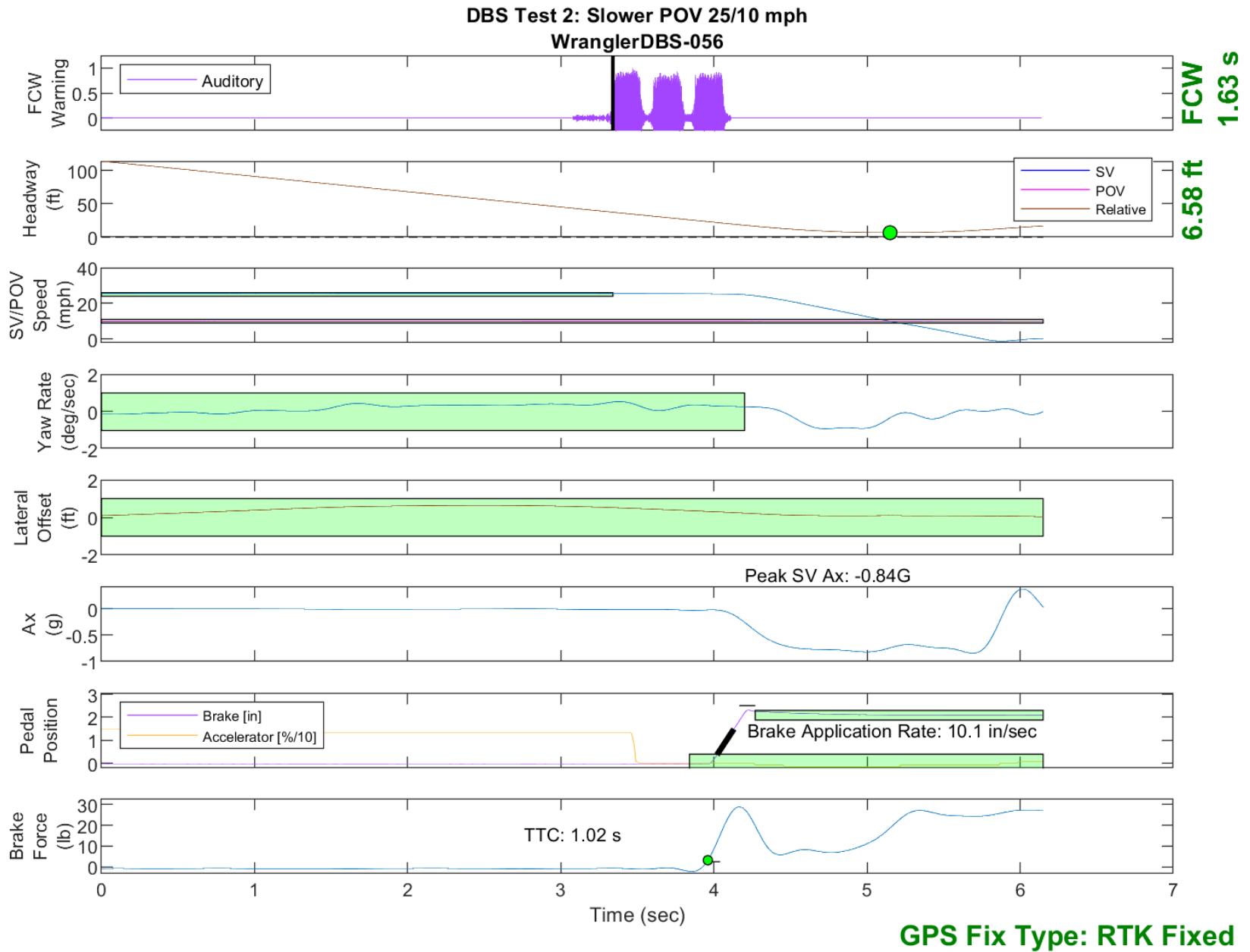
Figure E23. Time History for DBS Run 56, Test 2 - Slower Moving POV 25/10 mph
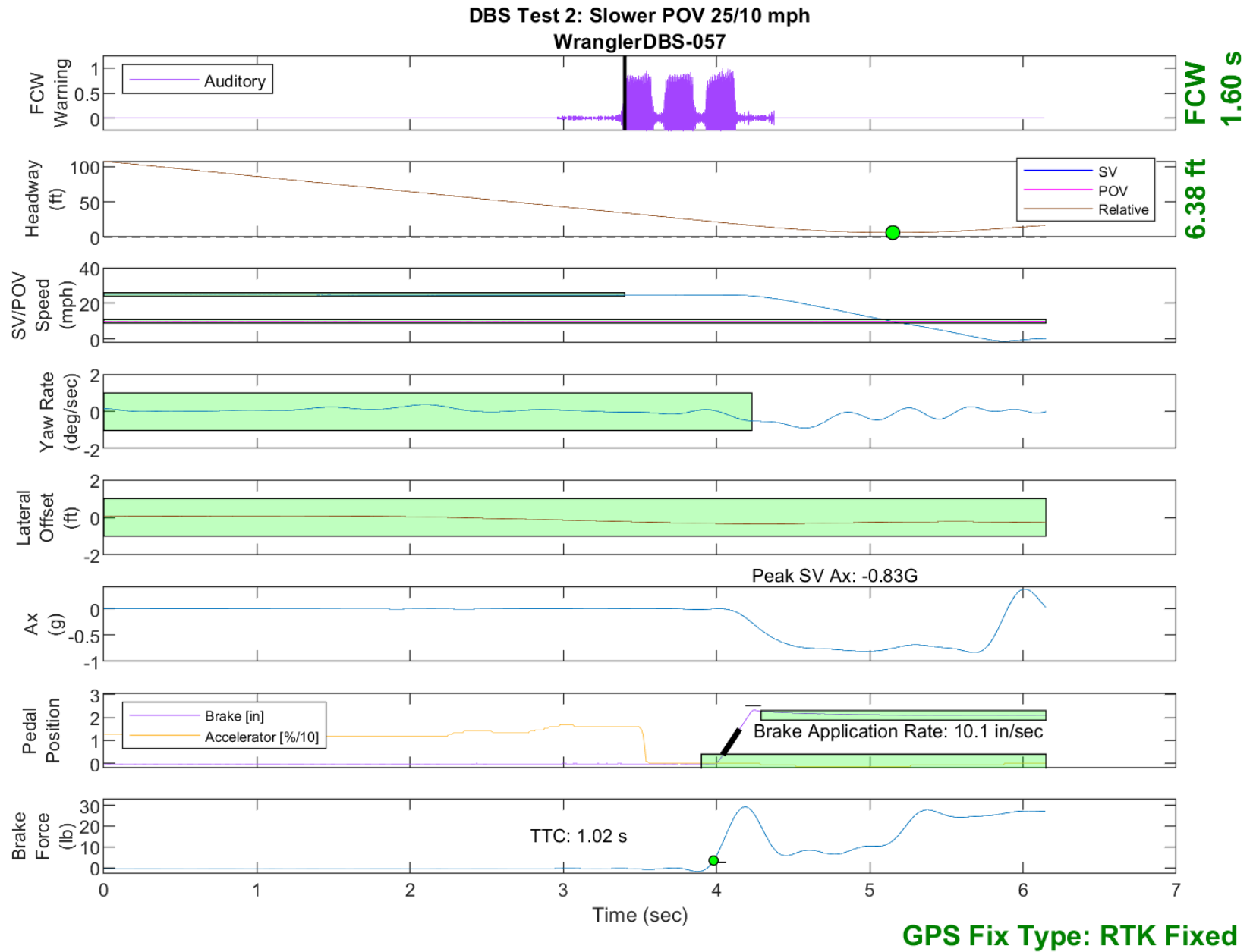
Figure E24. Time History for DBS Run 57, Test 2 - Slower Moving POV 25/10 mph
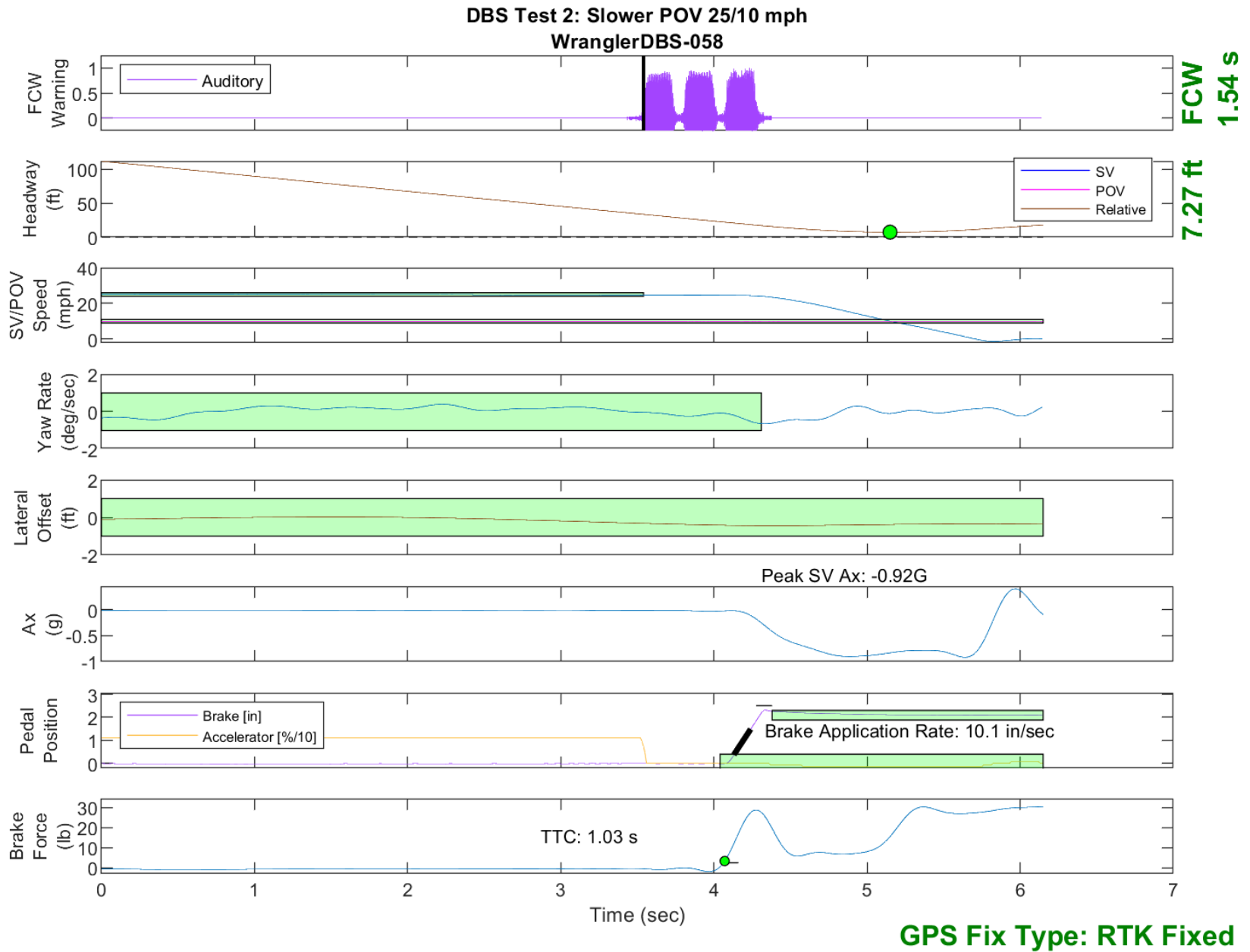
Figure E25. Time History for DBS Run 58, Test 2 - Slower Moving POV 25/10 mph
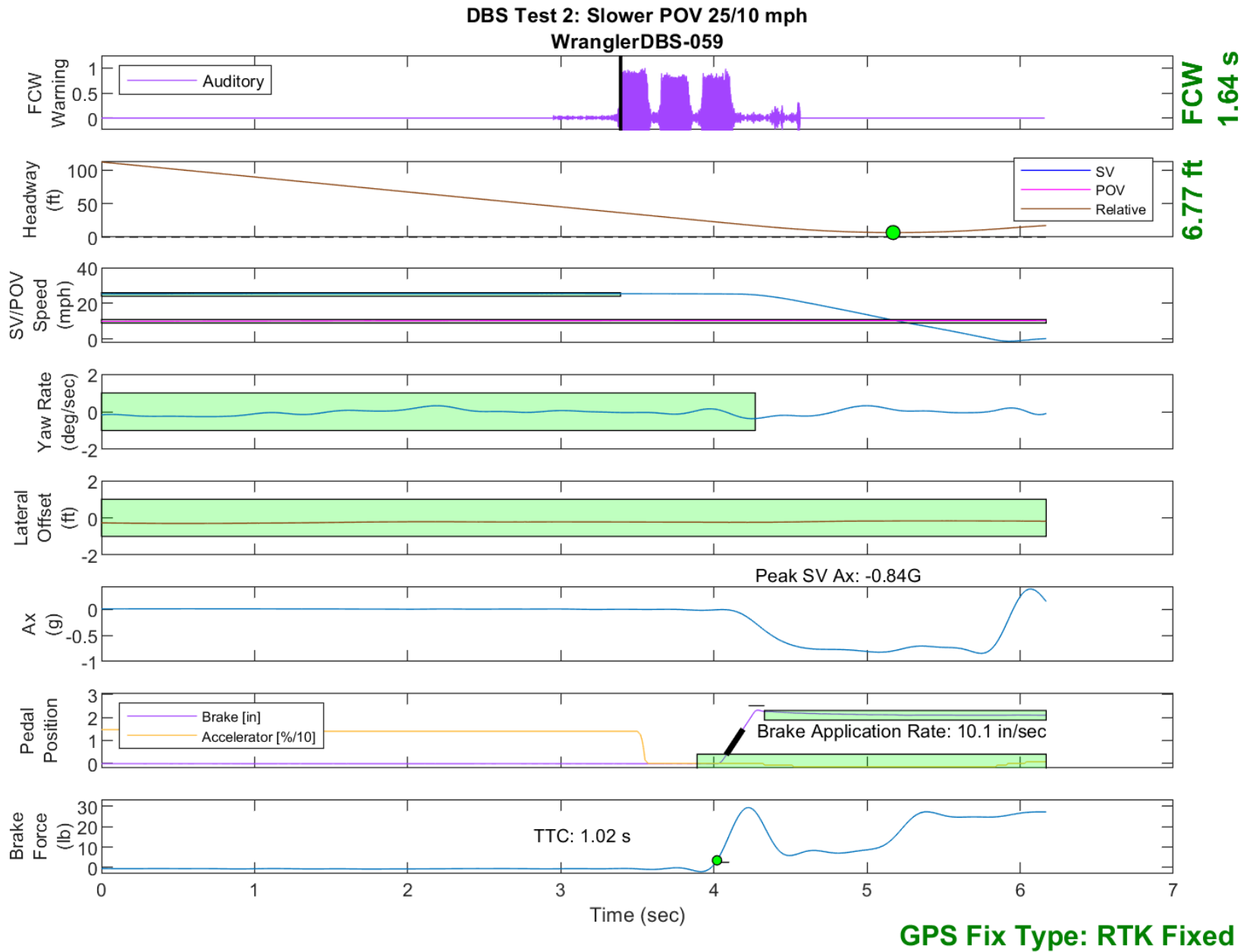
Figure E26. Time History for DBS Run 59, Test 2 - Slower Moving POV 25/10 mph
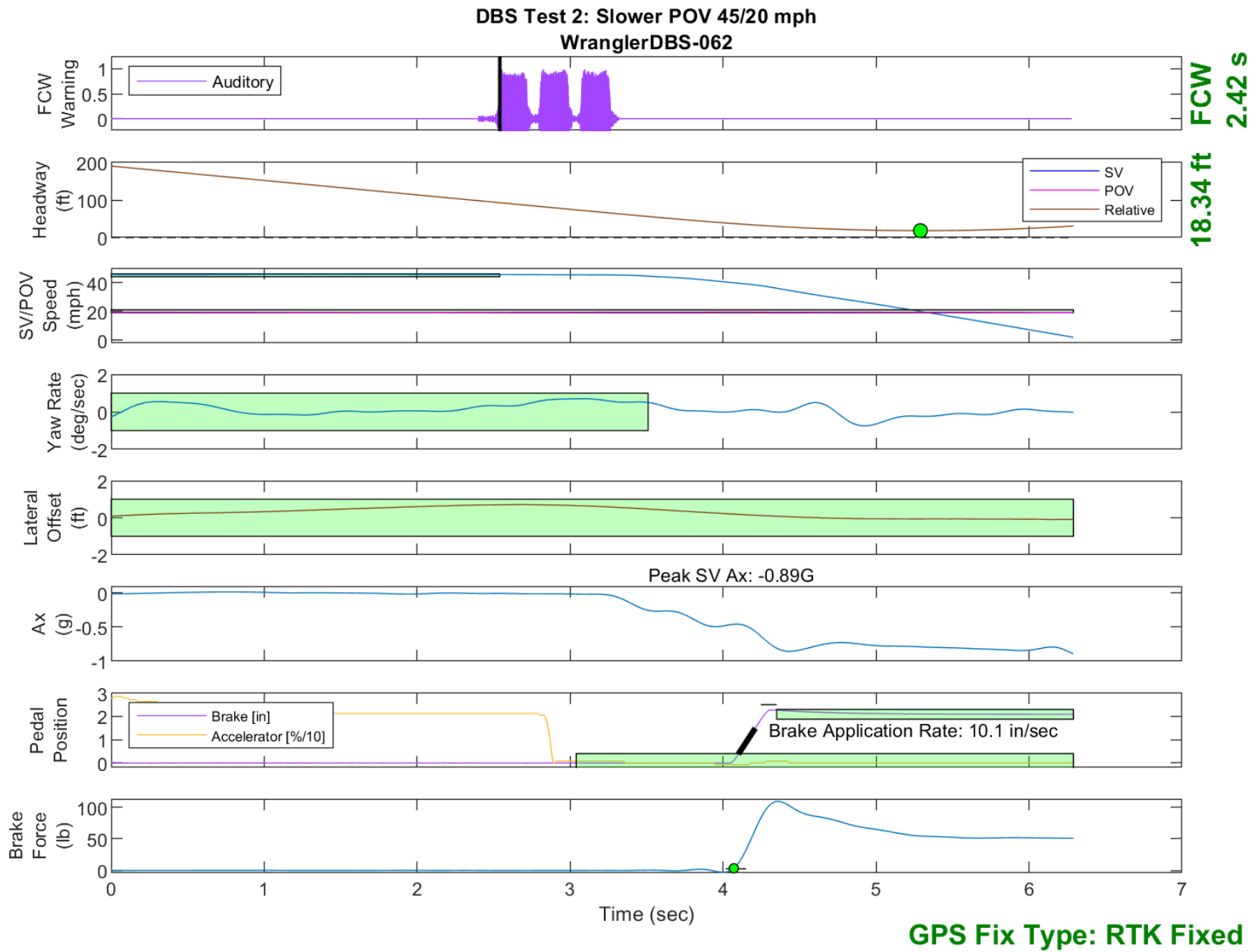
Figure E27. Time History for DBS Run 62, Test 2 - Slower Moving POV 45/20 mph
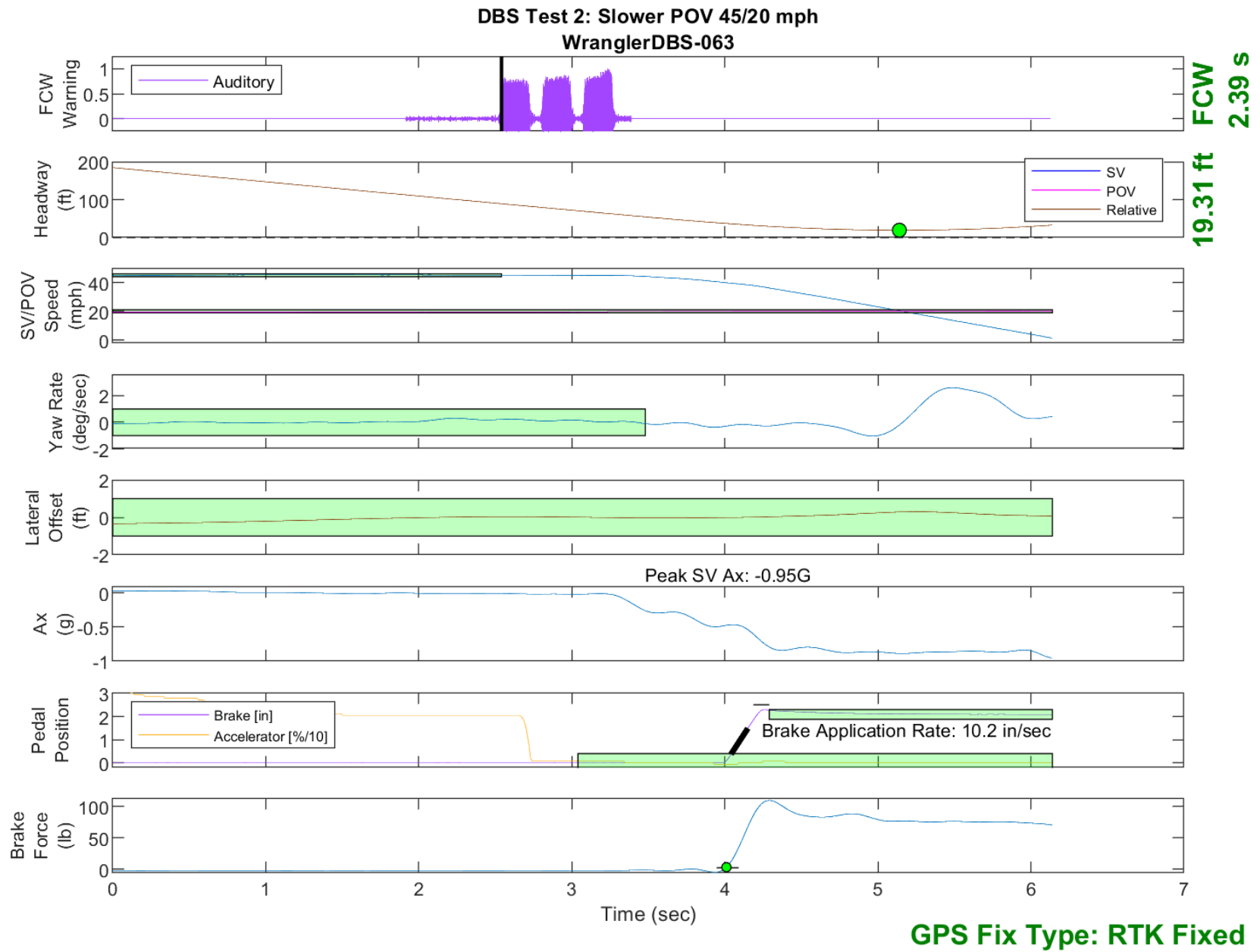
Figure E28. Time History for DBS Run 63, Test 2 - Slower Moving POV 45/20 mph
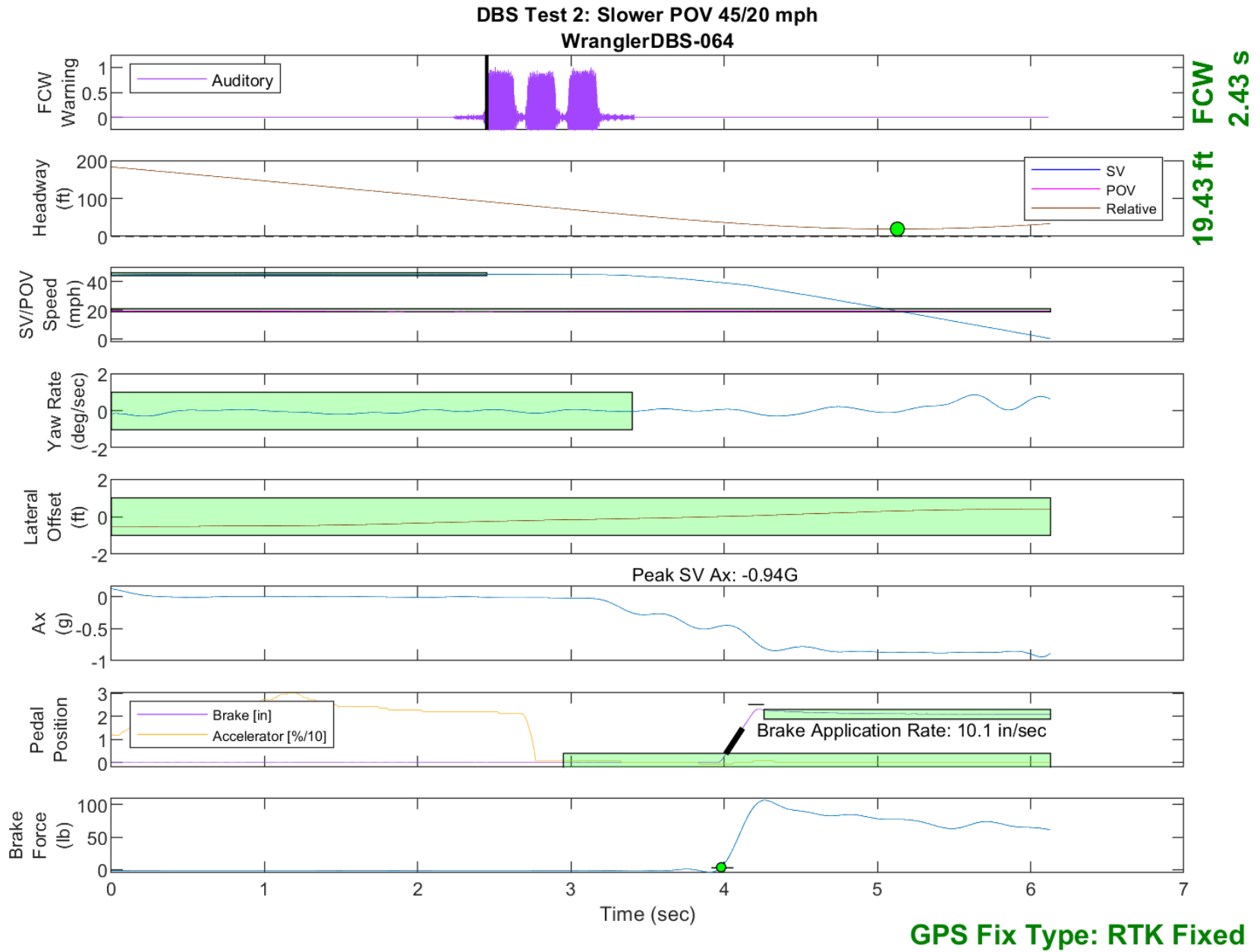
Figure E29. Time History for DBS Run 64, Test 2 - Slower Moving POV 45/20 mph

DBS Test 2: Slower POV 45/20 mph
WranglerDBS-065
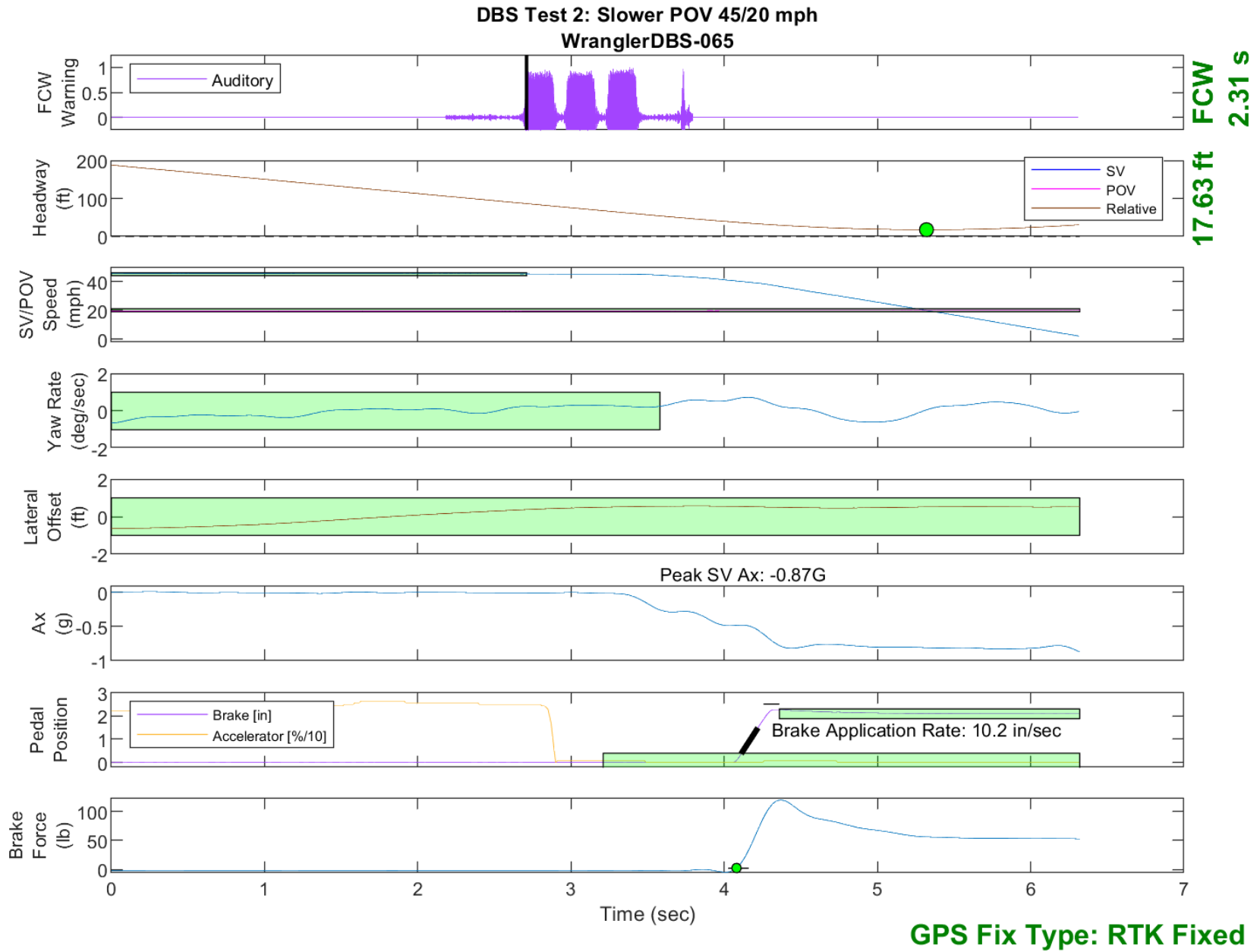
Figure E30. Time History for DBS Run 65, Test 2 - Slower Moving POV 45/20 mph
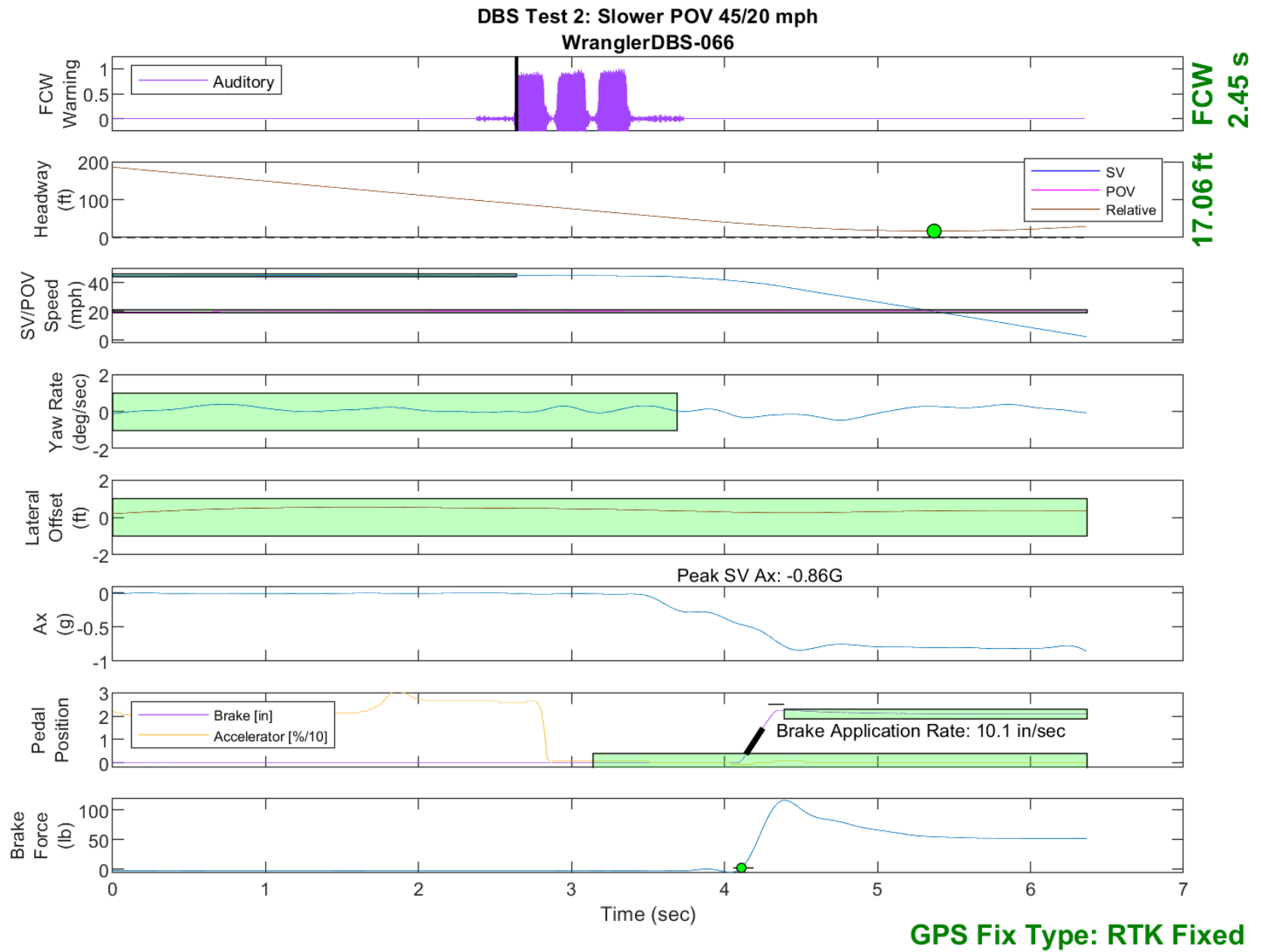
Figure E31. Time History for DBS Run 66, Test 2 - Slower Moving POV 45/20 mph

DBS Test 2: Slower POV 45/20 mph
WranglerDBS-067
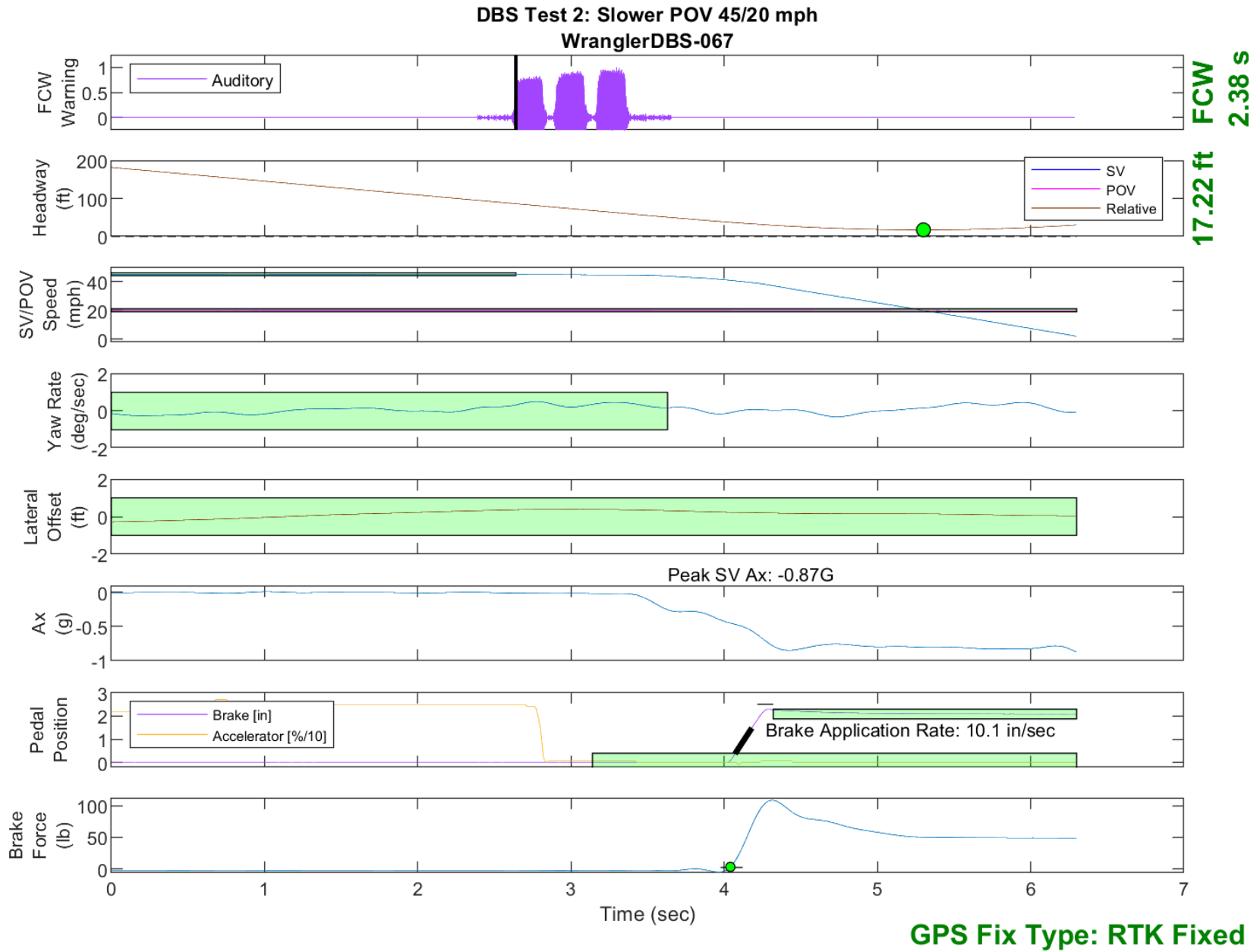
Figure E32. Time History for DBS Run 67, Test 2 - Slower Moving POV 45/20 mph
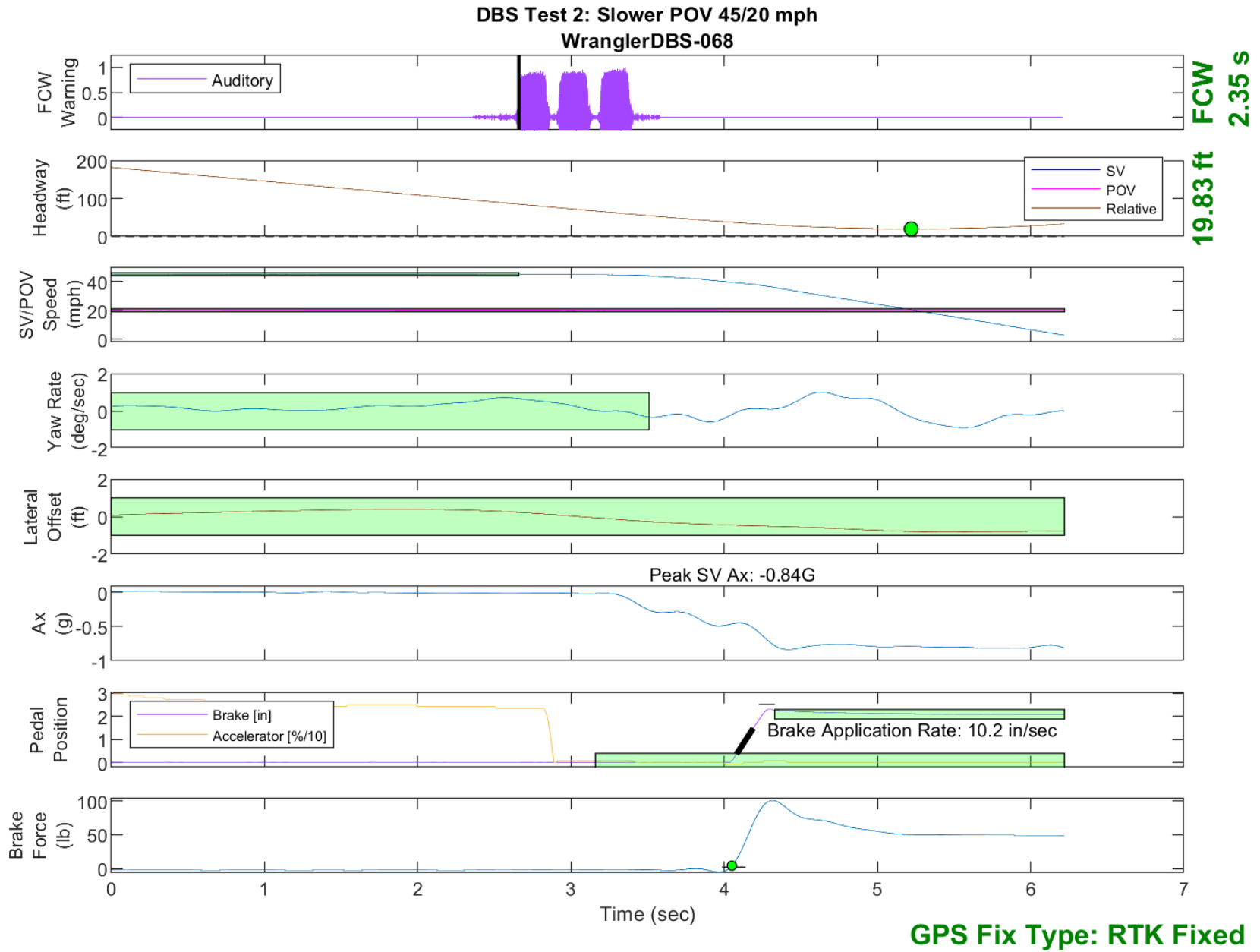
Figure E33. Time History for DBS Run 68, Test 2 - Slower Moving POV 45/20 mph
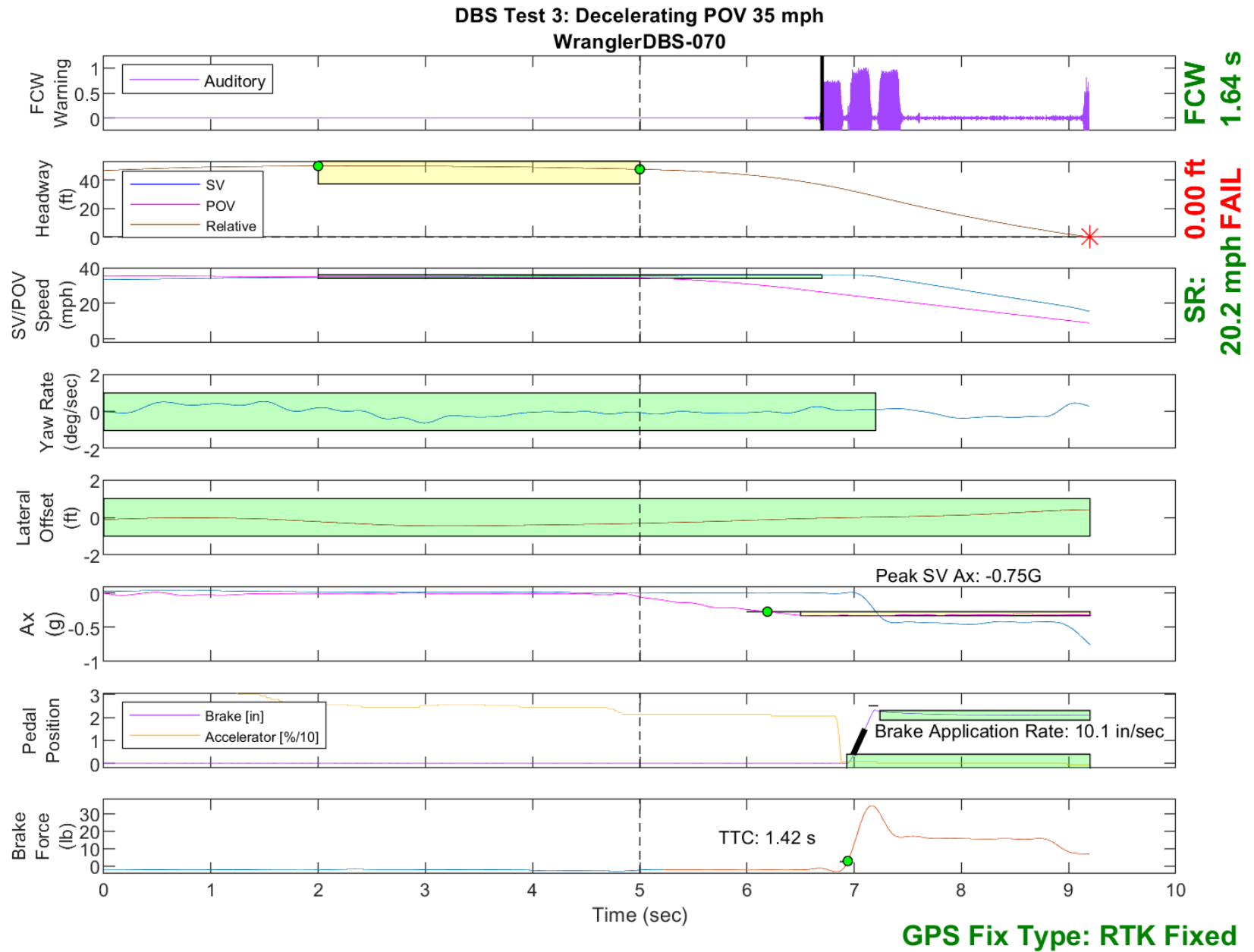
Figure E34. Time History for DBS Run 70, Test 3 - Decelerating POV 35 mph
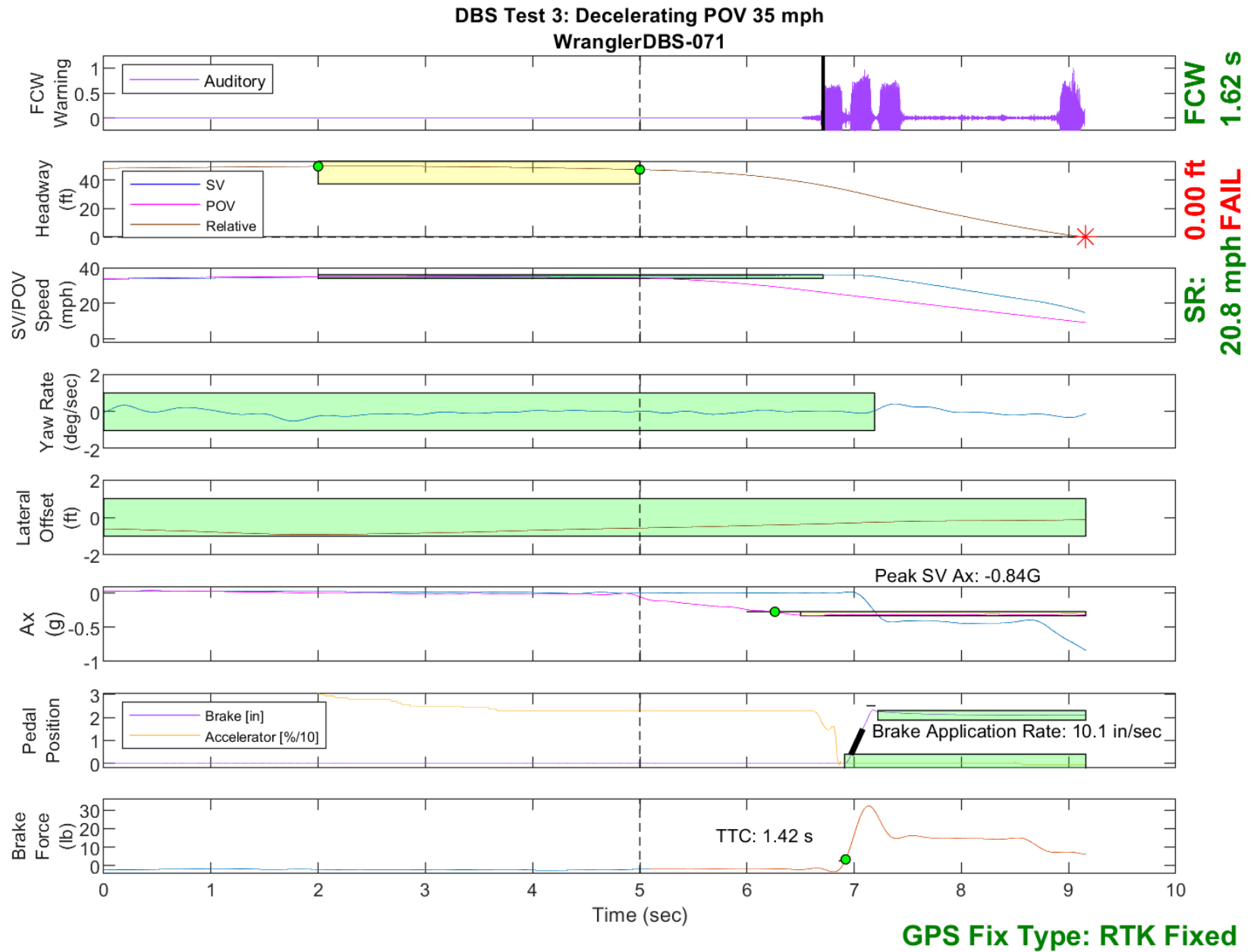
Figure E35. Time History for DBS Run 71, Test 3 - Decelerating POV 35 mph
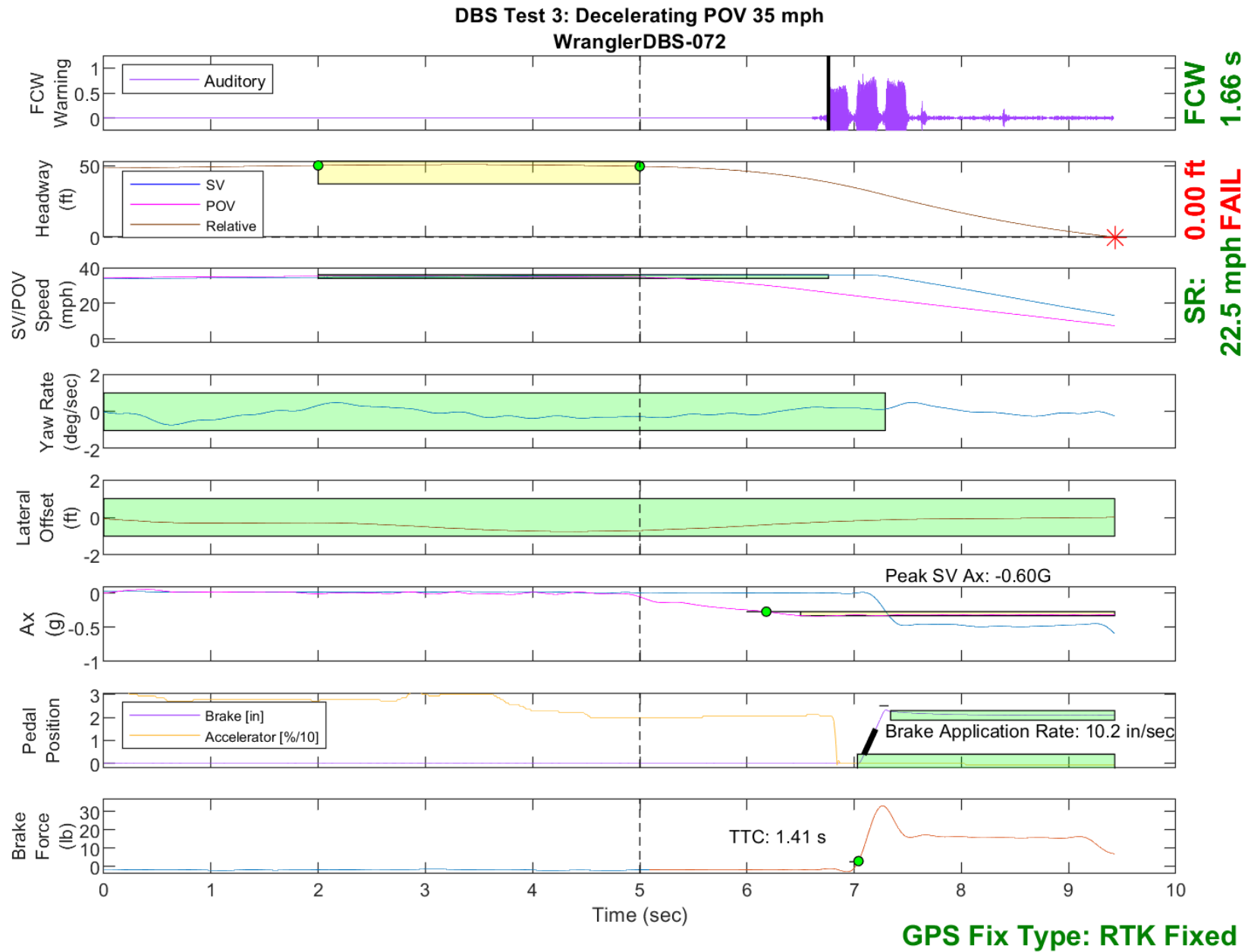
Figure E36. Time History for DBS Run 72, Test 3 - Decelerating POV 35 mph
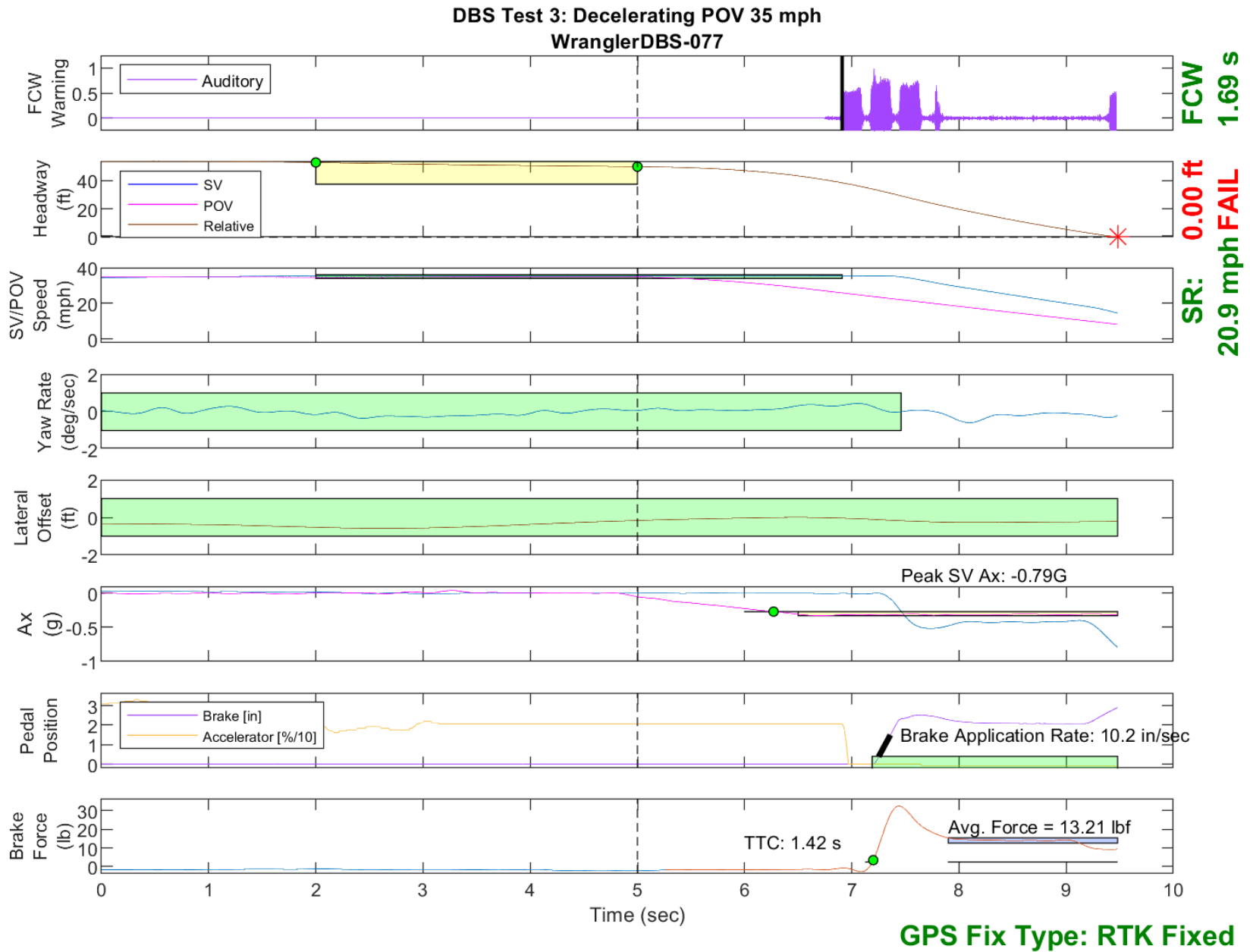
Figure E37. Time History for DBS Run 77, Test 3 - Decelerating POV 35 mph
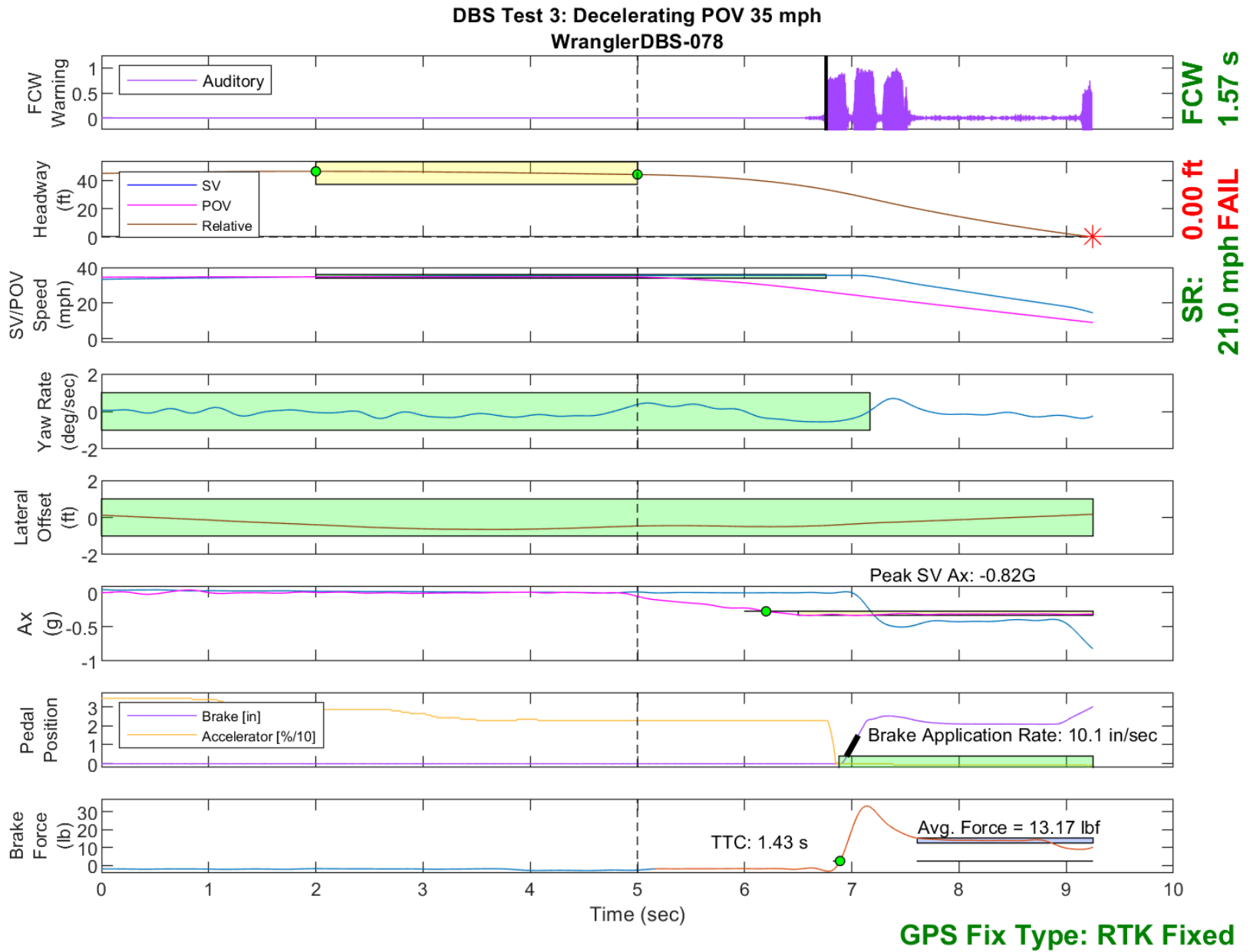
Figure E38. Time History for DBS Run 78, Test 3 - Decelerating POV 35 mph
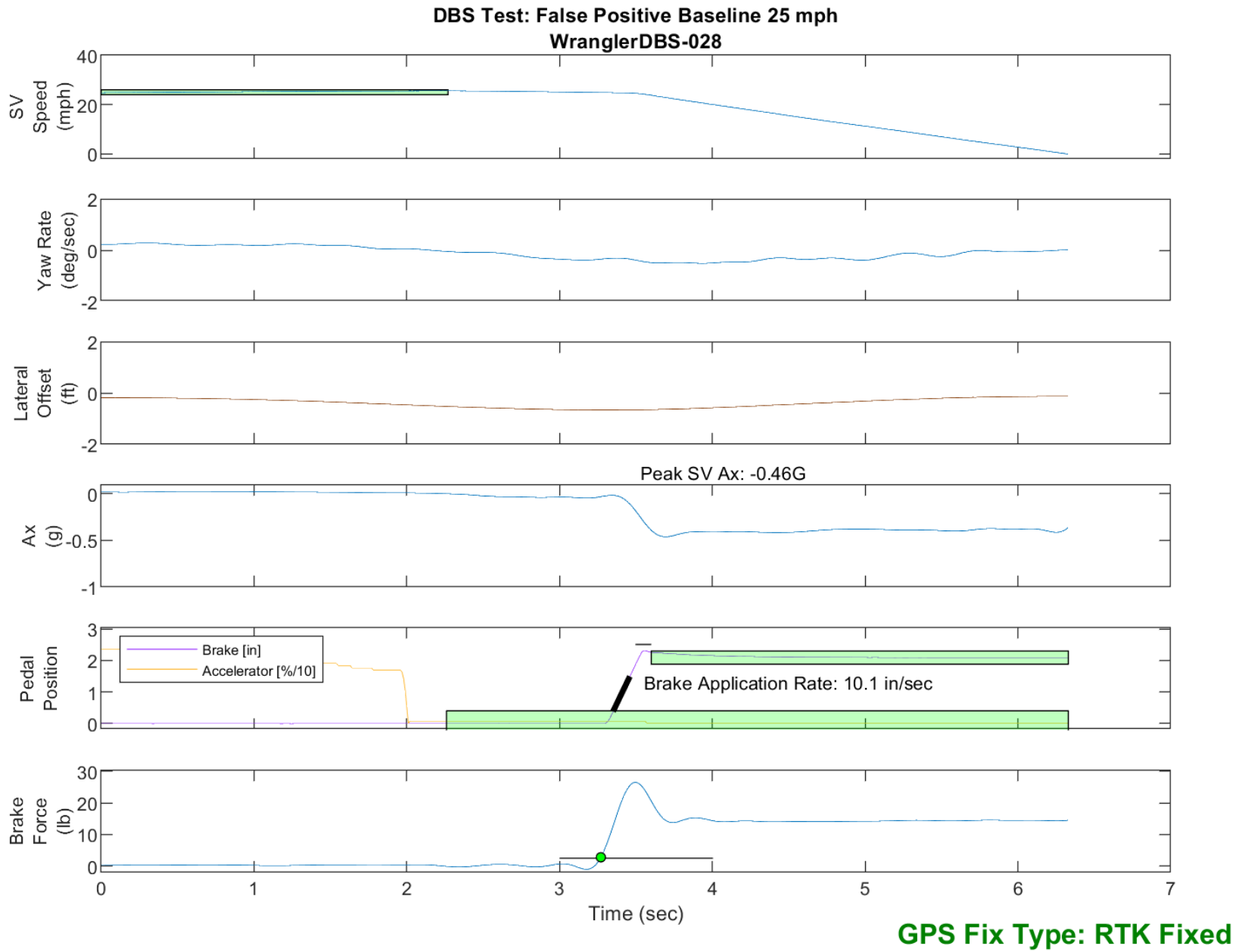
Figure E39. Time History for DBS Run 28, False Positive Baseline, SV 25 mph
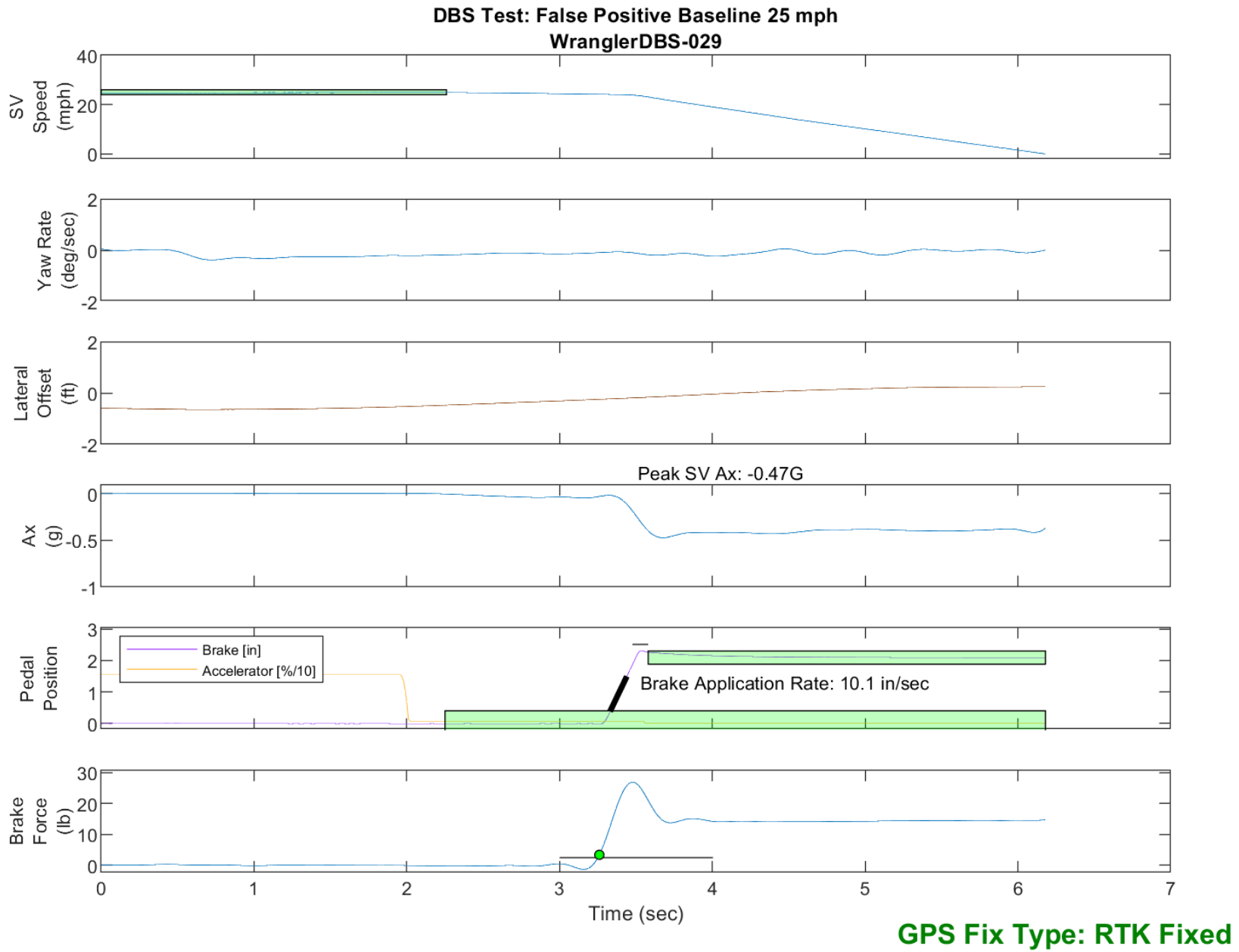
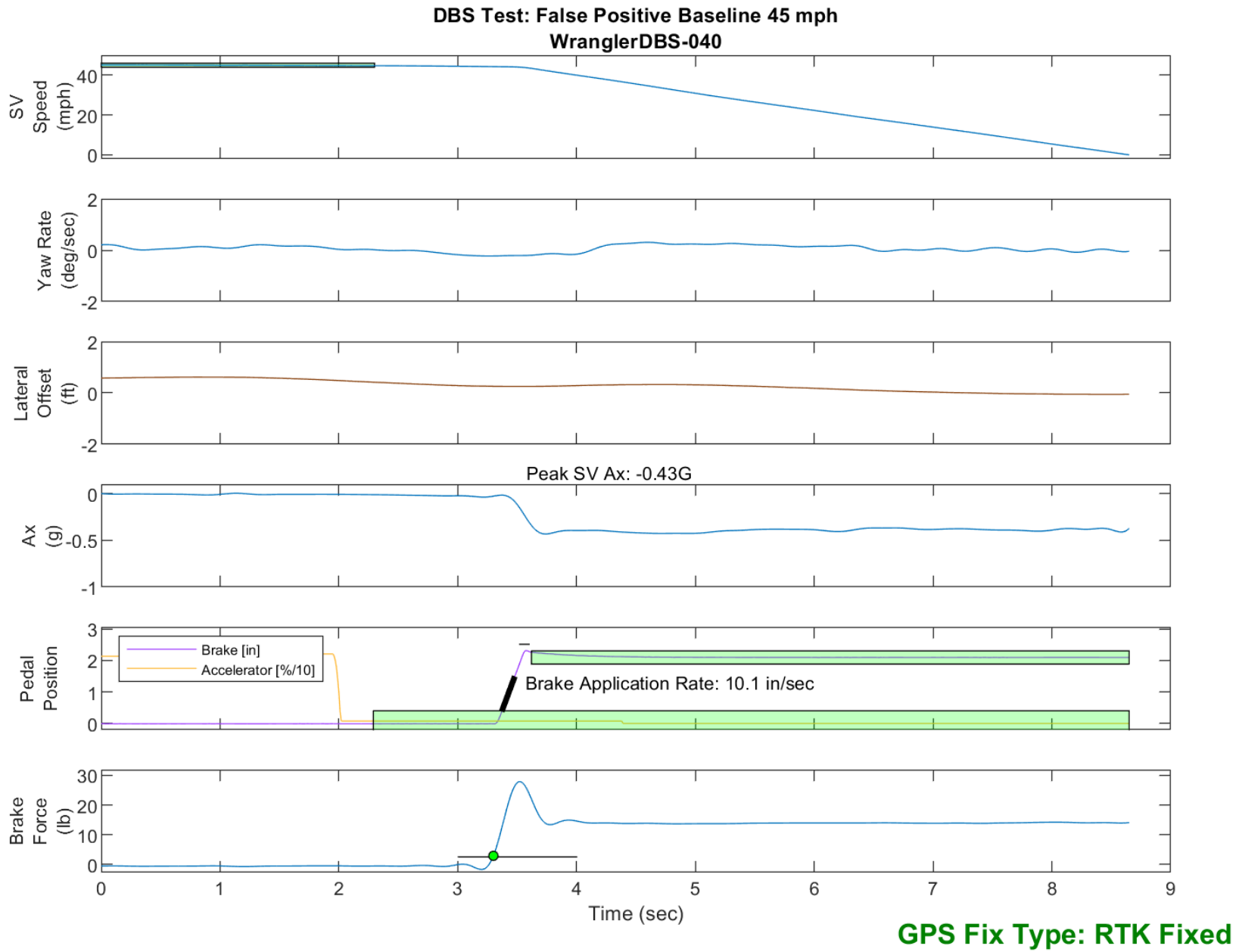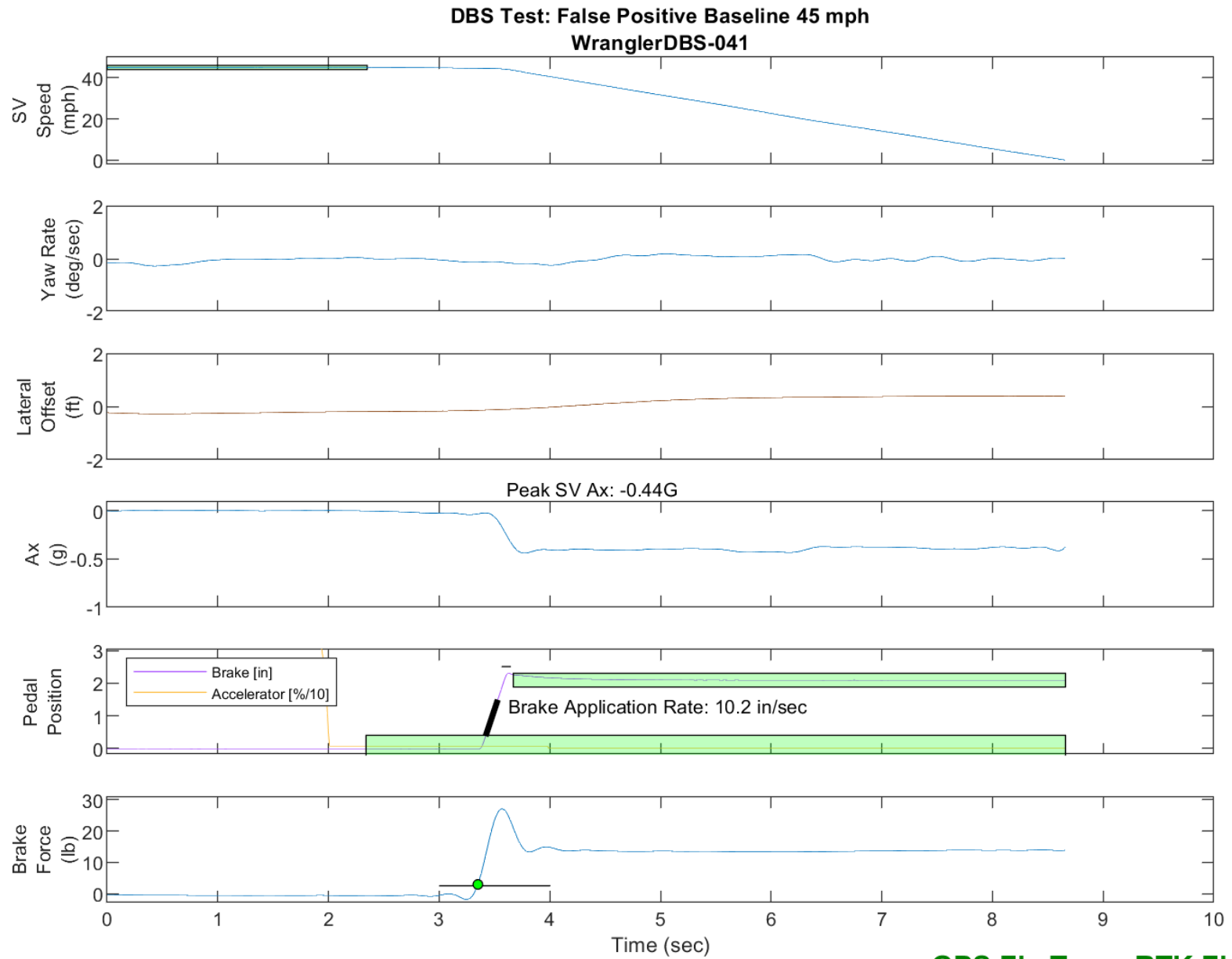Figure E40. Time History for DBS Run 29, False Positive Baseline, SV 25 mph
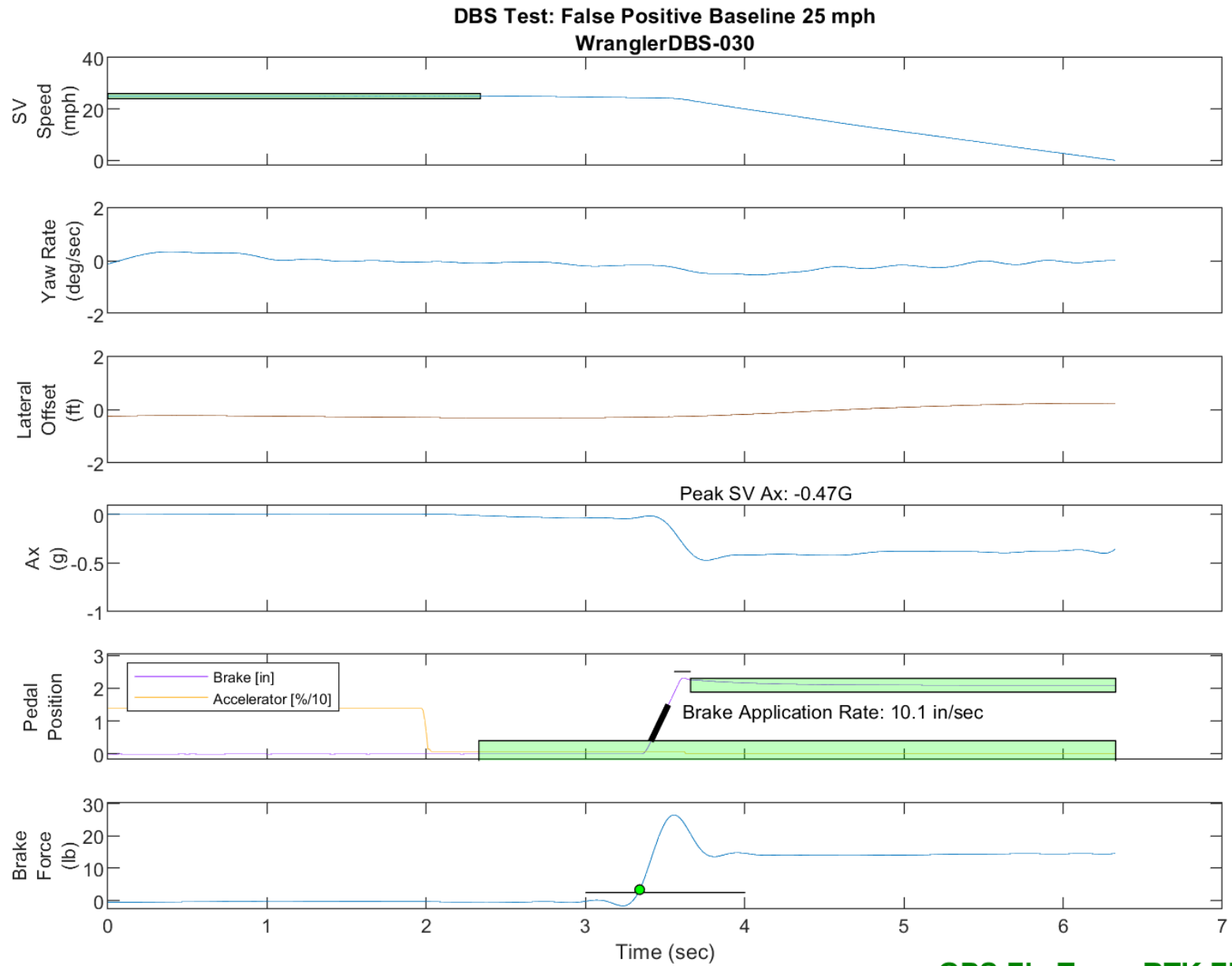
Figure E41. Time History for DBS Run 30, False Positive Baseline, SV 25 mph

DBS Test: False Positive Baseline 25 mph
WranglerDBS-031

Peak SV Ax: -0.46G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.1 in/sec

Time (sec)

GPS Fix Type: RTK Fixed
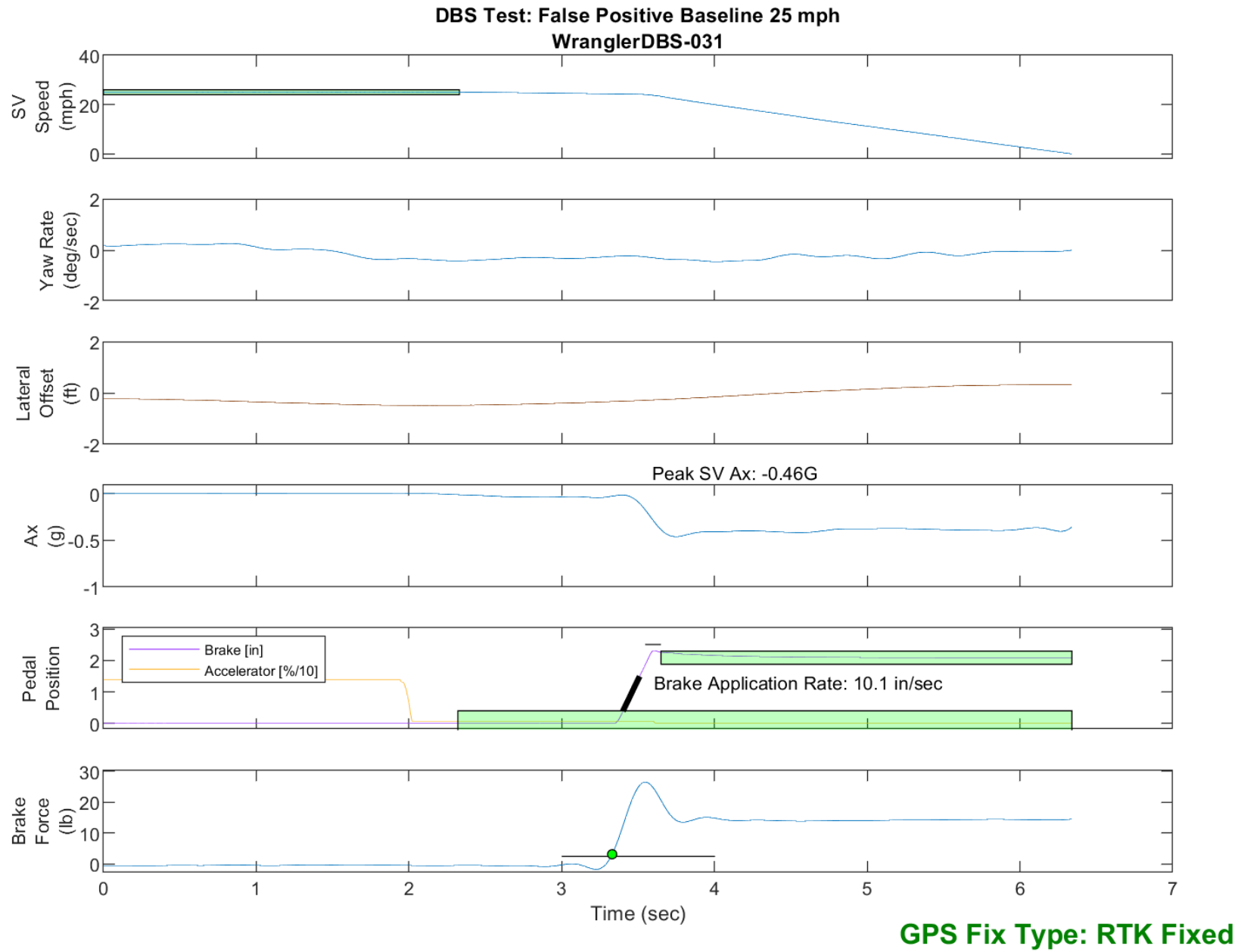
Figure E42. Time History for DBS Run 31, False Positive Baseline, SV 25 mph
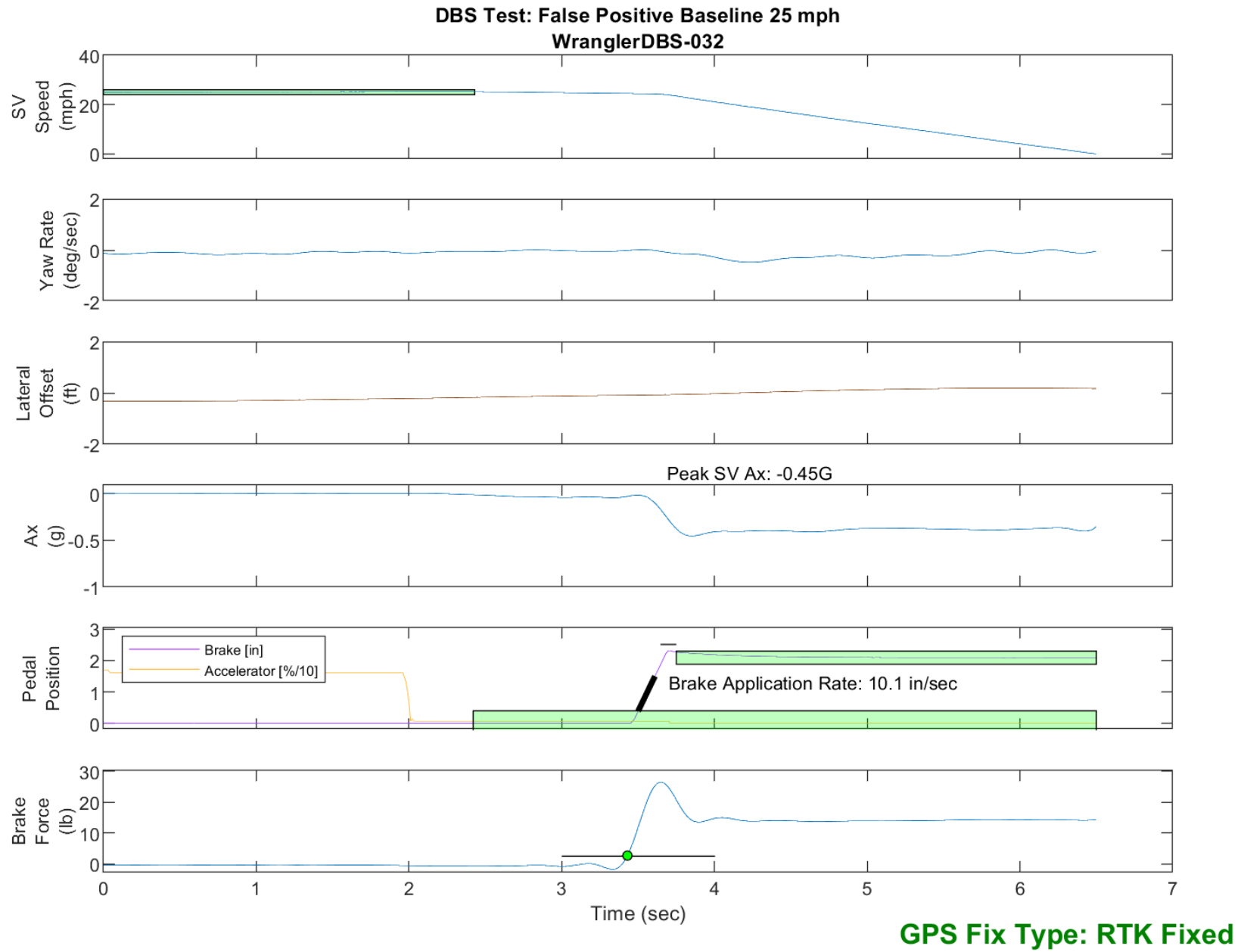
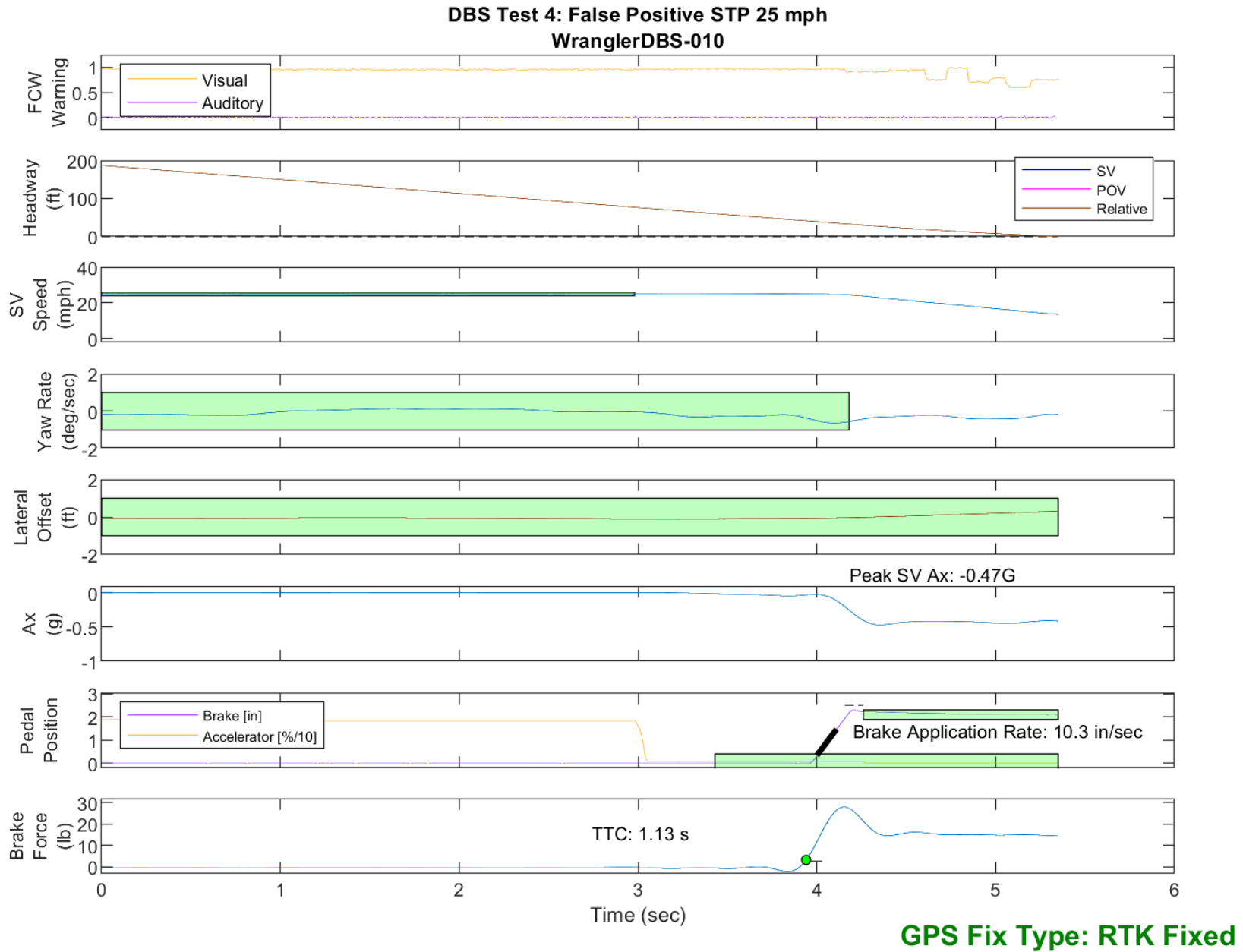Figure E43. Time History for DBS Run 32, False Positive Baseline, SV 25 mph
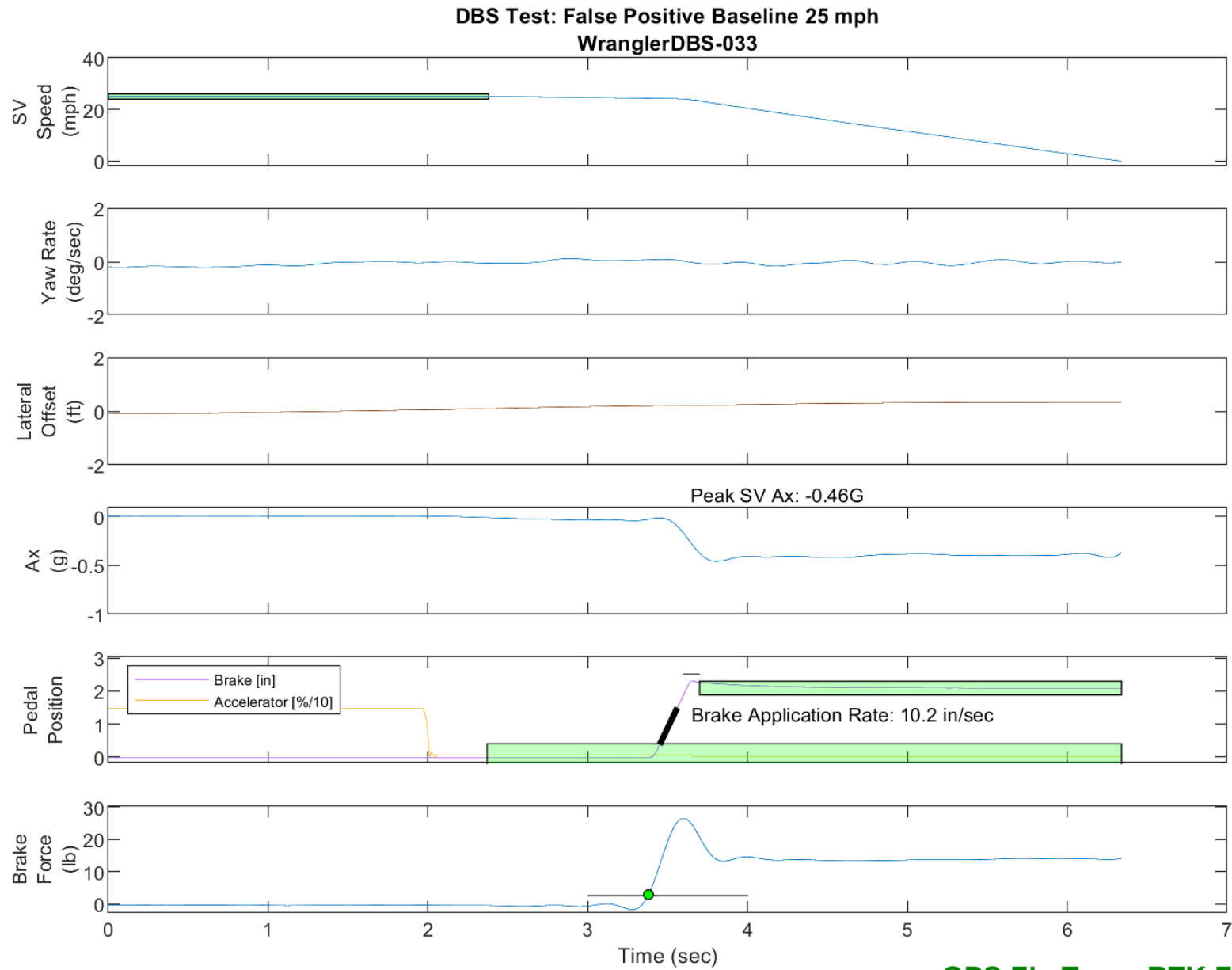
Figure E44. Time History for DBS Run 33, False Positive Baseline, SV 25 mph
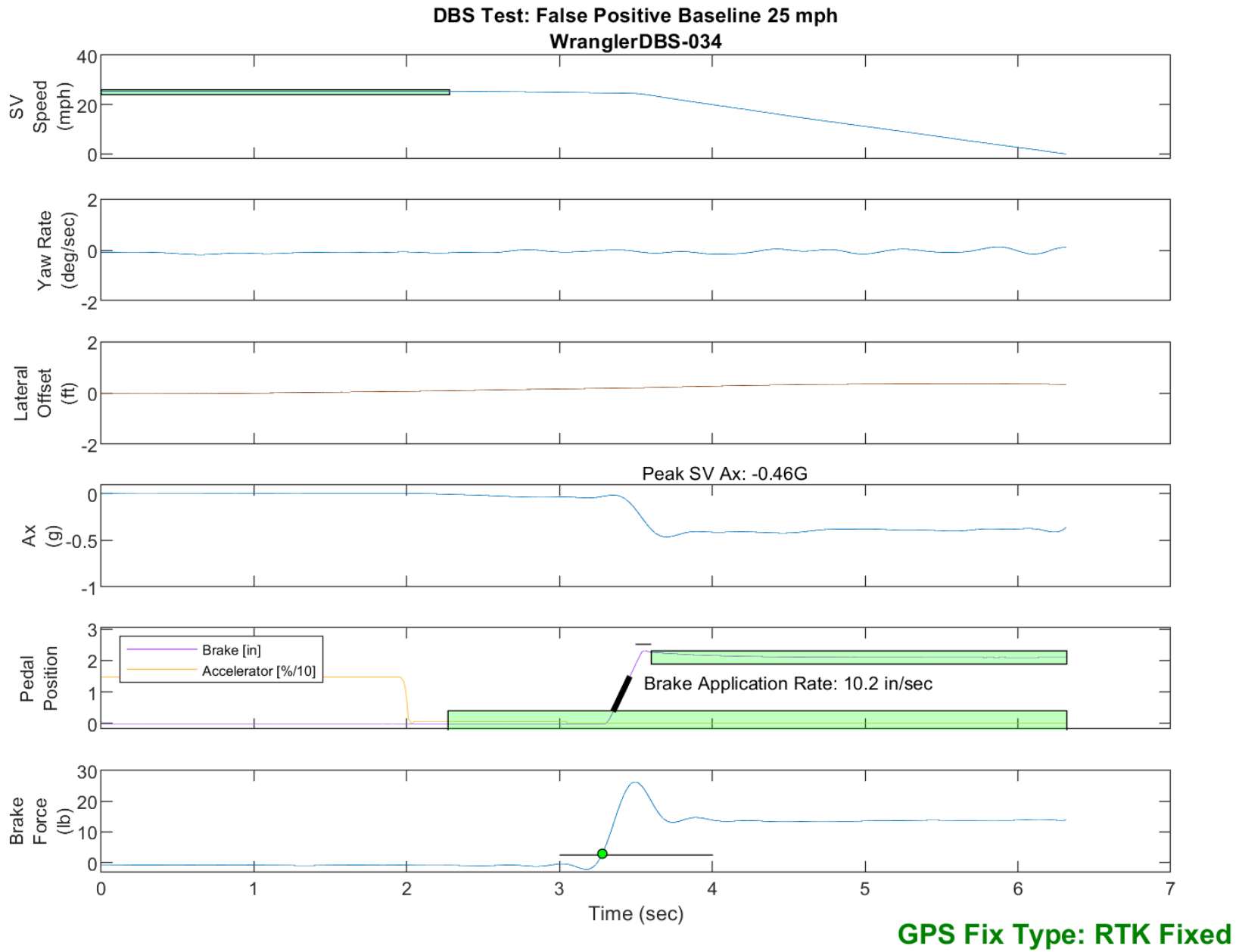
Figure E45. Time History for DBS Run 34, False Positive Baseline, SV 25 mph

DBS Test: False Positive Baseline 45 mph
WranglerDBS-036

Peak SV Ax: -0.45G

Brake Application Rate: 10.1 in/sec

Brake [in]
Accelerator [%/10]

GPS Fix Type: RTK Fixed
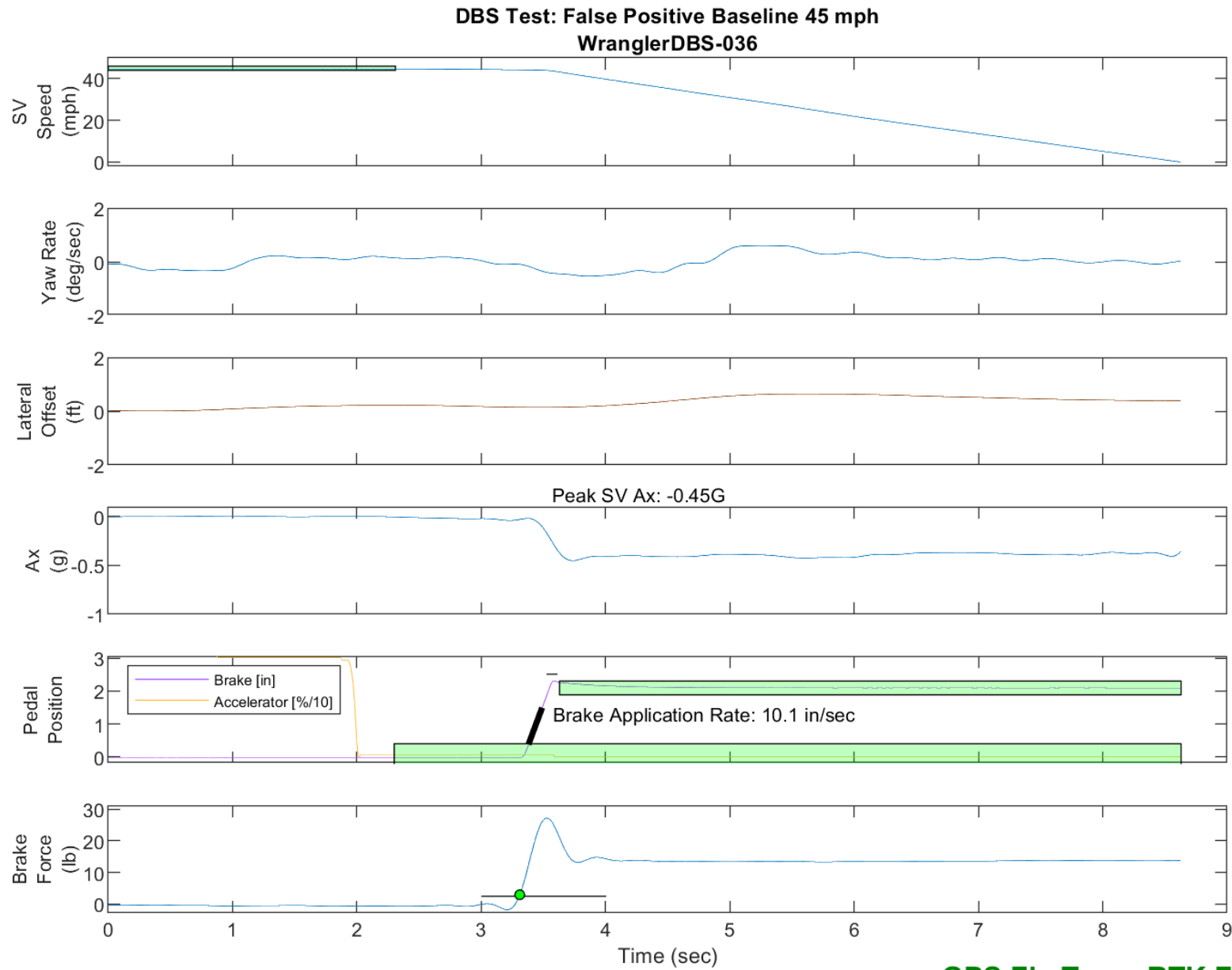
Figure E46. Time History for DBS Run 36, False Positive Baseline, SV 45 mph

DBS Test: False Positive Baseline 45 mph
WranglerDBS-037

Peak SV Ax: -0.44G

Brake Application Rate: 10.1 in/sec

Brake [in]
Accelerator [%/10]

GPS Fix Type: RTK Fixed
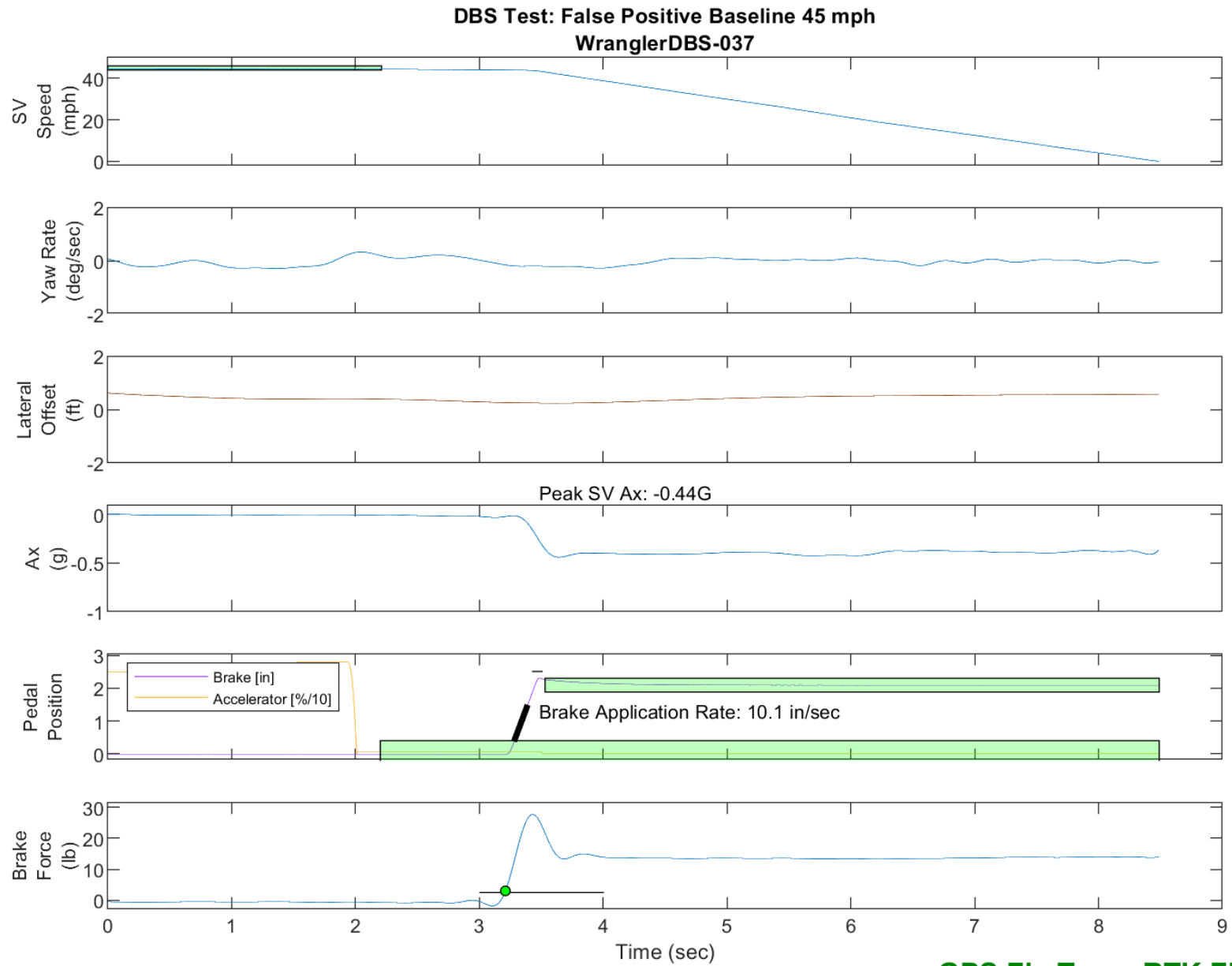
Figure E47. Time History for DBS Run 37, False Positive Baseline, SV 45 mph
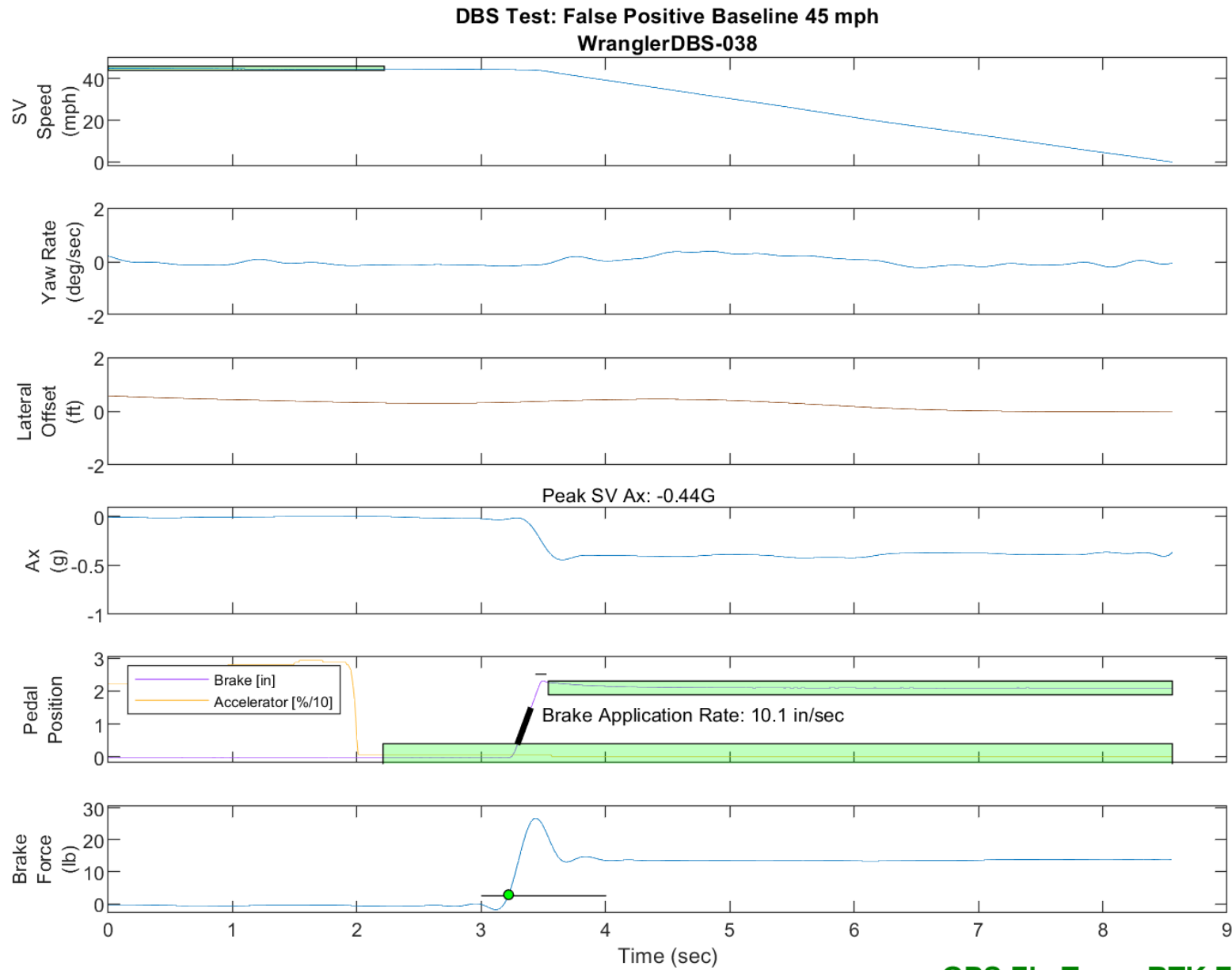
Figure E48. Time History for DBS Run 38, False Positive Baseline, SV 45 mph
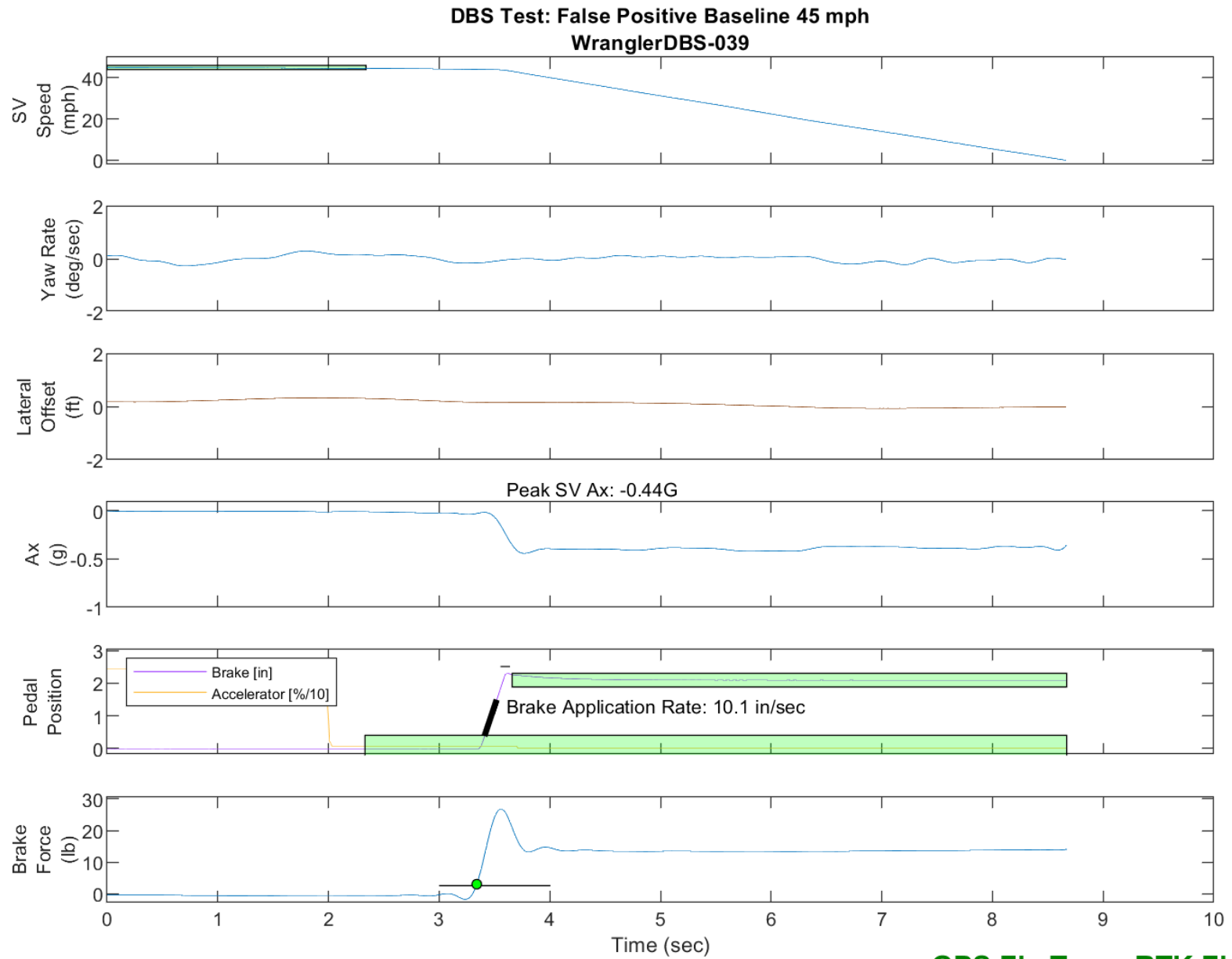
Figure E49. Time History for DBS Run 39, False Positive Baseline, SV 45 mph

DBS Test: False Positive Baseline 45 mph
WranglerDBS-040

Peak SV Ax: -0.43G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.1 in/sec

GPS Fix Type: RTK Fixed

Figure E50. Time History for DBS Run 40, False Positive Baseline, SV 45 mph

DBS Test: False Positive Baseline 45 mph
WranglerDBS-041

Peak SV Ax: -0.44G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.2 in/sec

GPS Fix Type: RTK Fixed

Figure E51. Time History for DBS Run 41, False Positive Baseline, SV 45 mph

DBS Test: False Positive Baseline 45 mph
WranglerDBS-042

GPS Fix Type: RTK Fixed
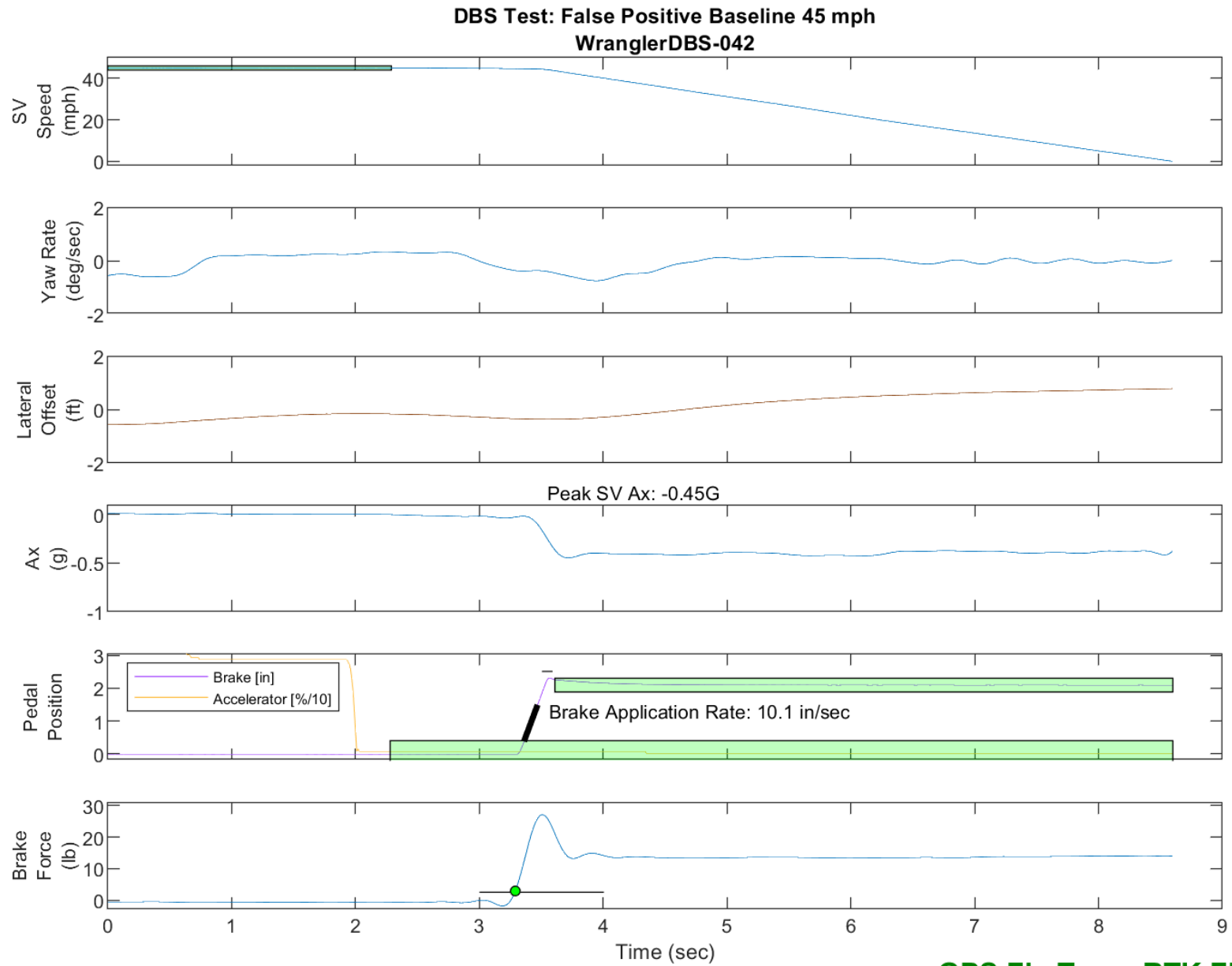
Figure E52. Time History for DBS Run 42, False Positive Baseline, SV 45 mph

DBS Test 4: False Positive STP 25 mph
WranglerDBS-010

GPS Fix Type: RTK Fixed

Figure E53. Time History for DBS Run 10, Test 4 - False Positive STP 25 mph
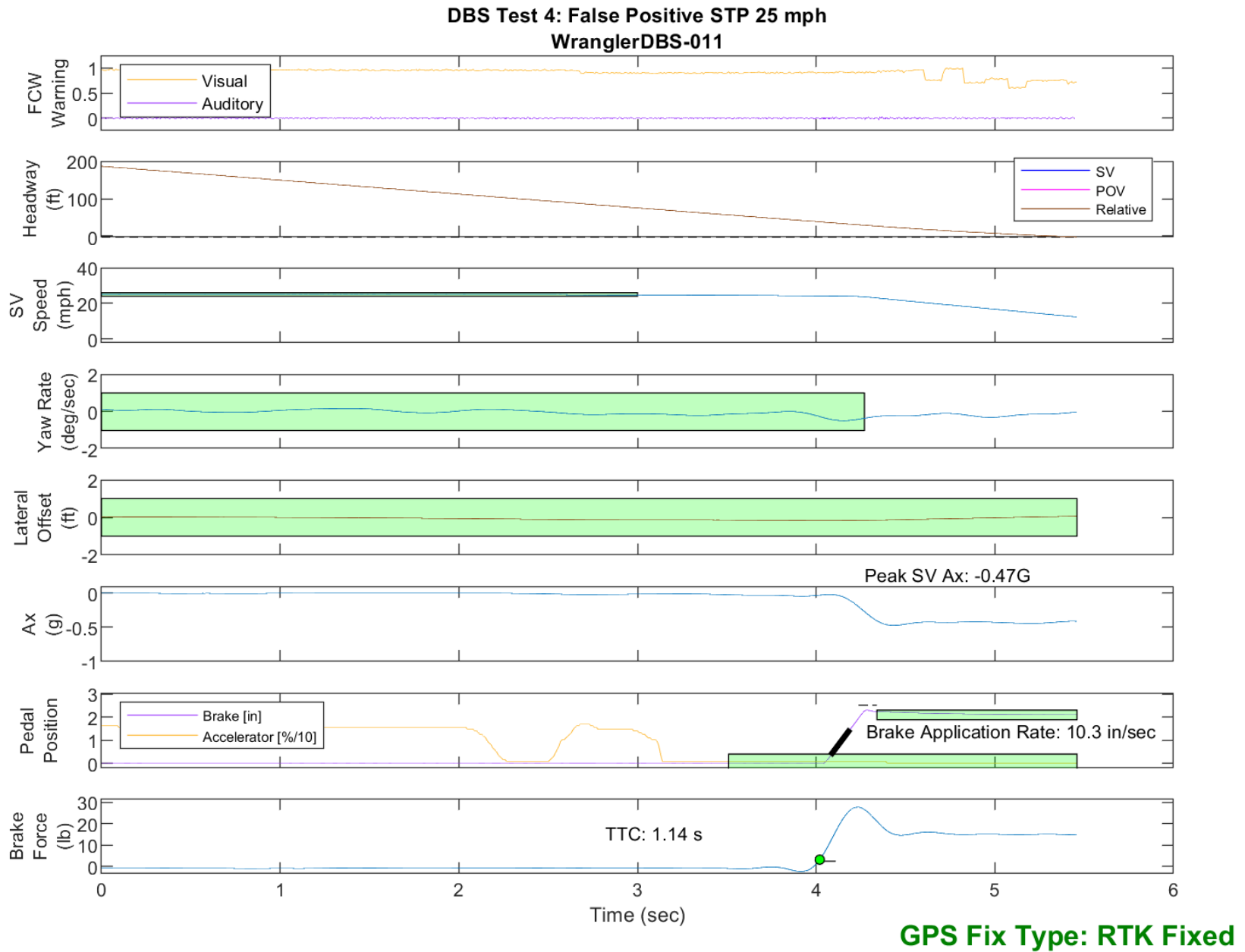
Figure E54. Time History for DBS Run 11, Test 4 - False Positive STP 25 mph
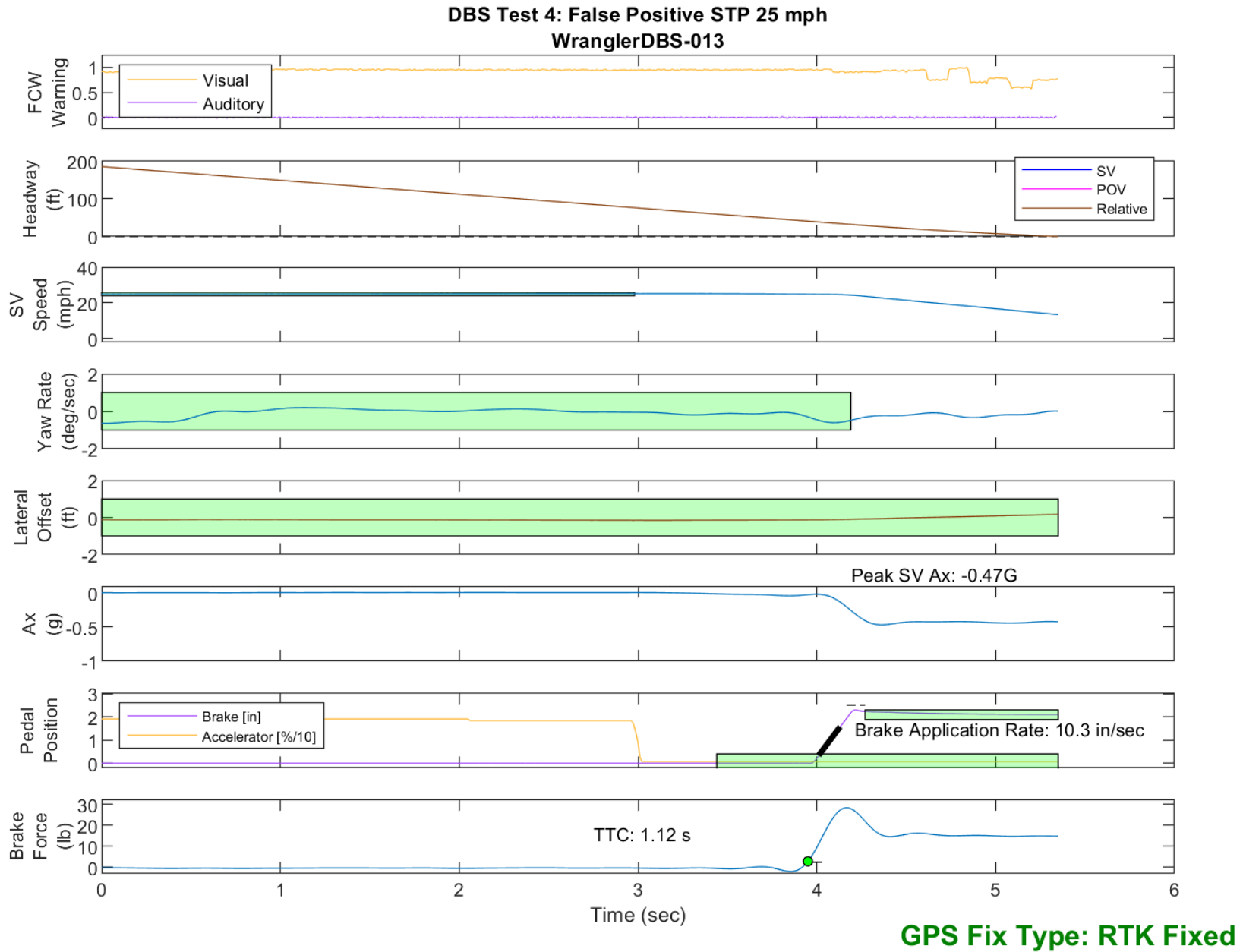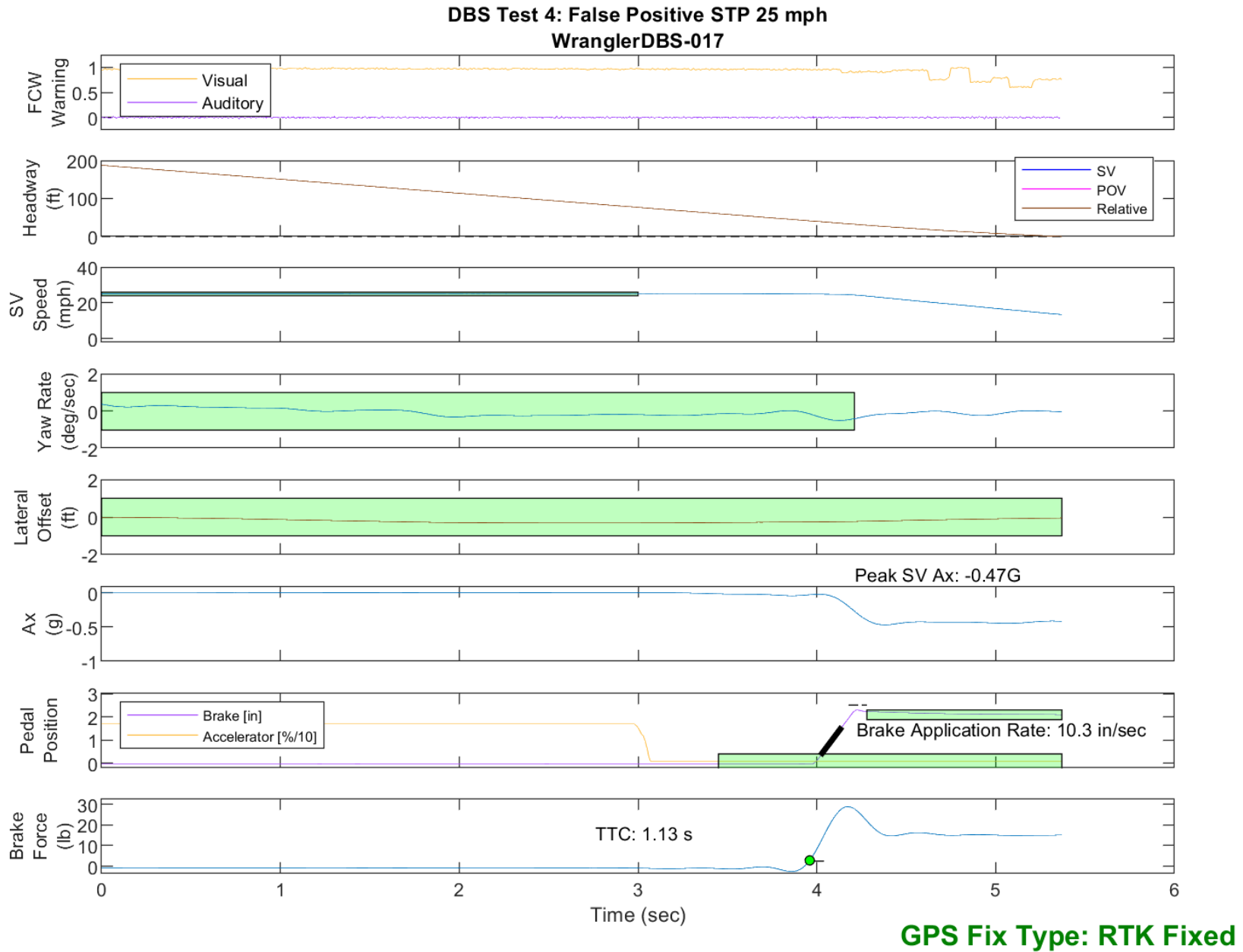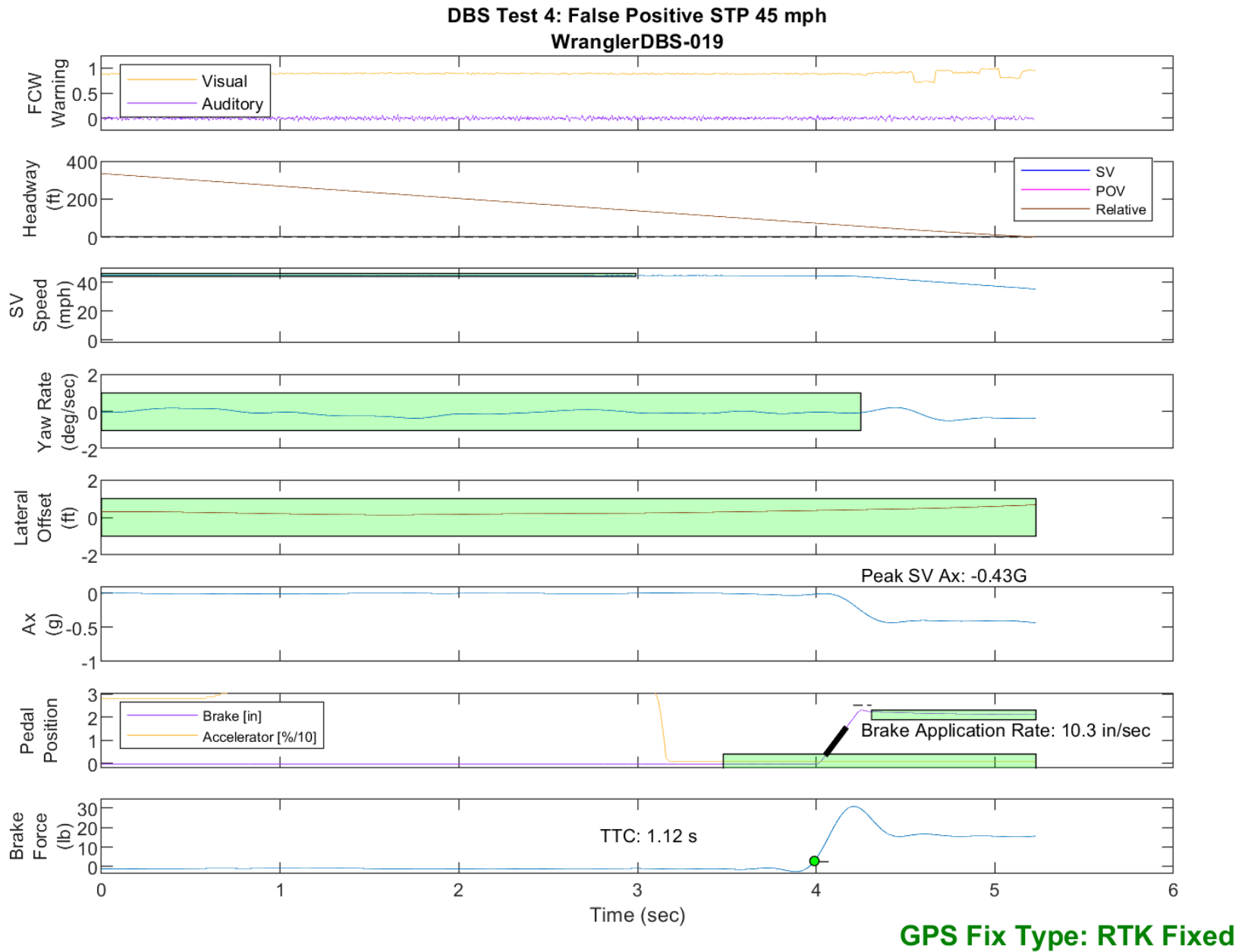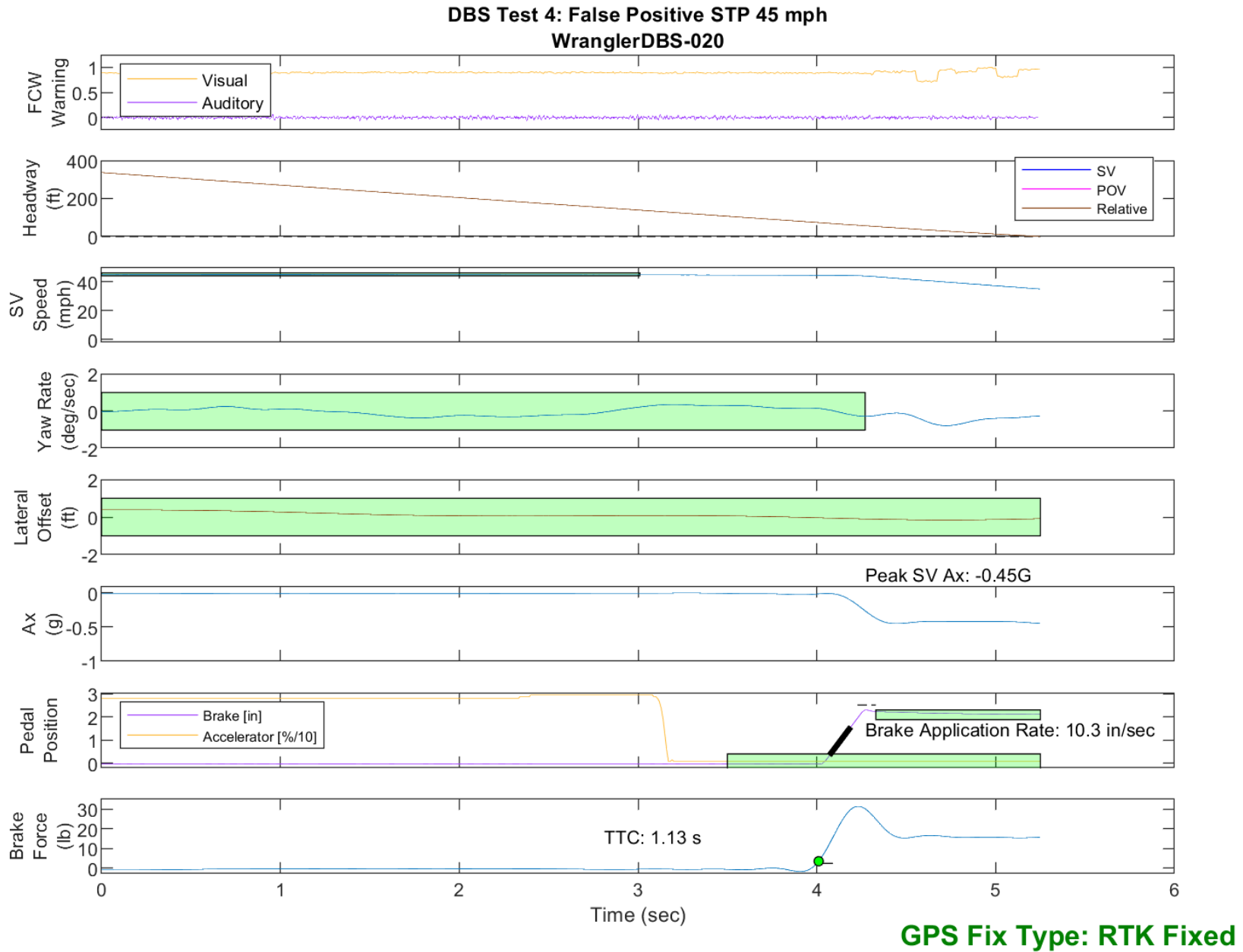
Figure E55. Time History for DBS Run 13, Test 4 - False Positive STP 25 mph

DBS Test 4: False Positive STP 25 mph
WranglerDBS-014

Peak SV Ax: -0.47G

Brake Application Rate: 10.3 in/sec
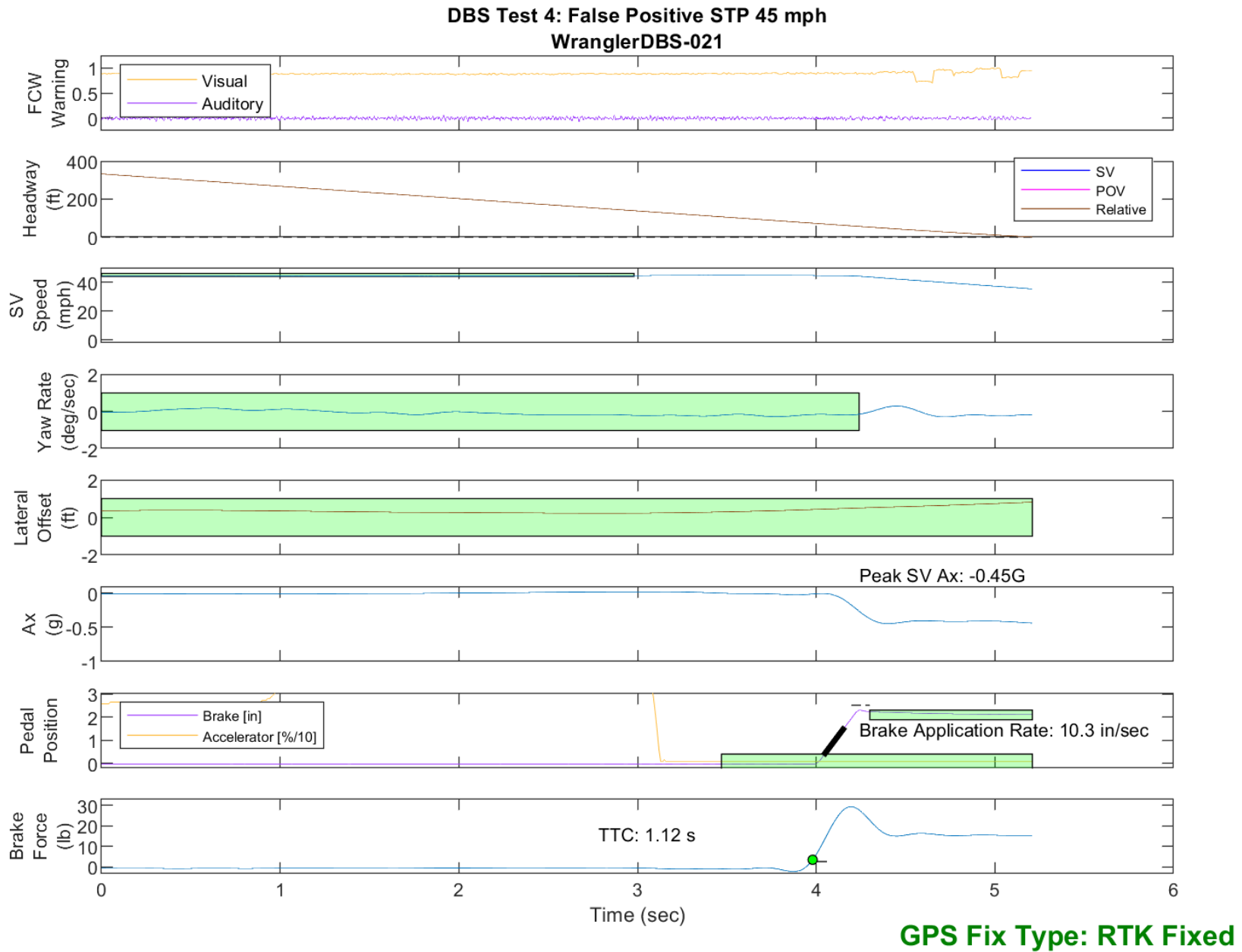
TTC: 1.13 s

GPS Fix Type: RTK Fixed
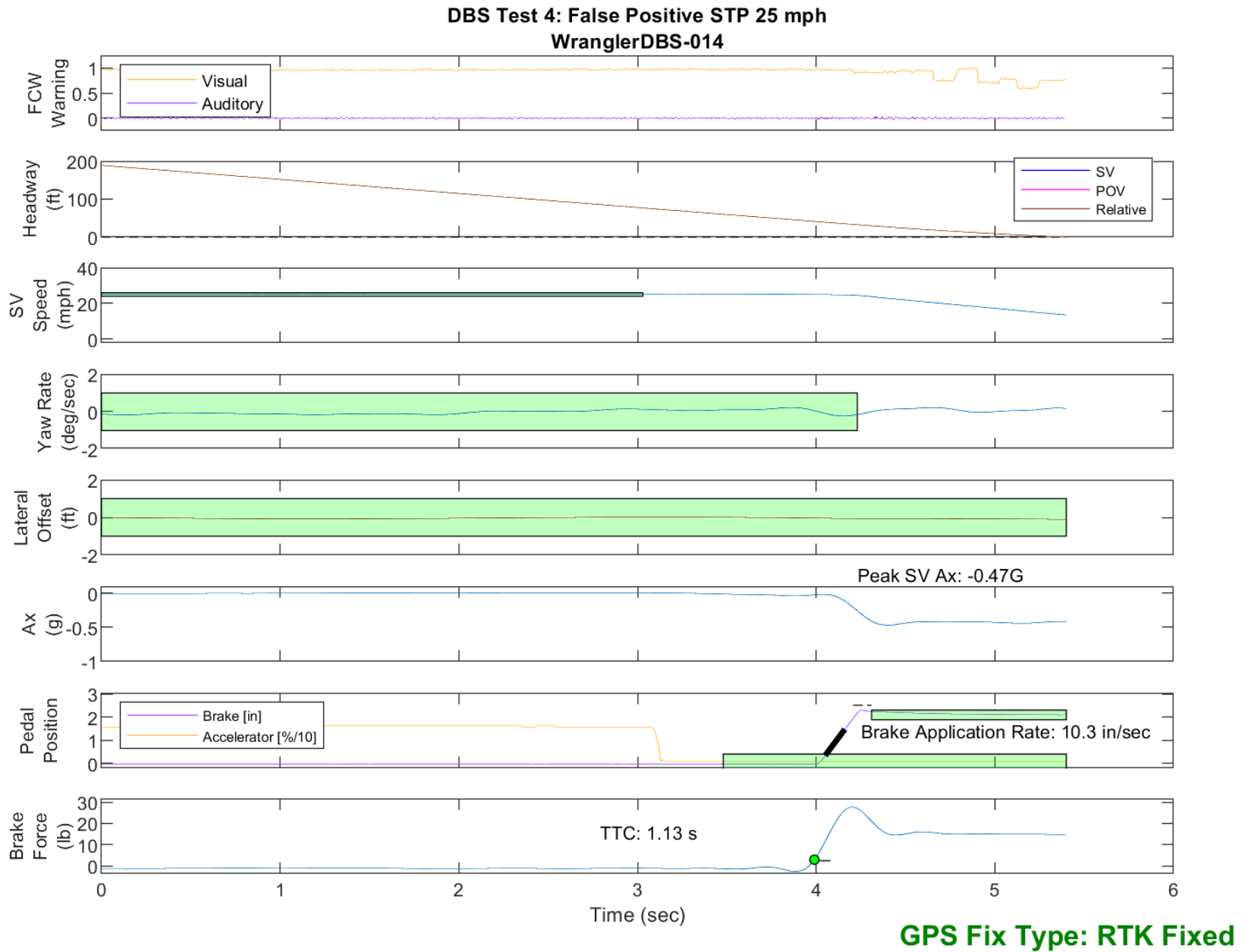
Figure E56. Time History for DBS Run 14, Test 4 - False Positive STP 25 mph
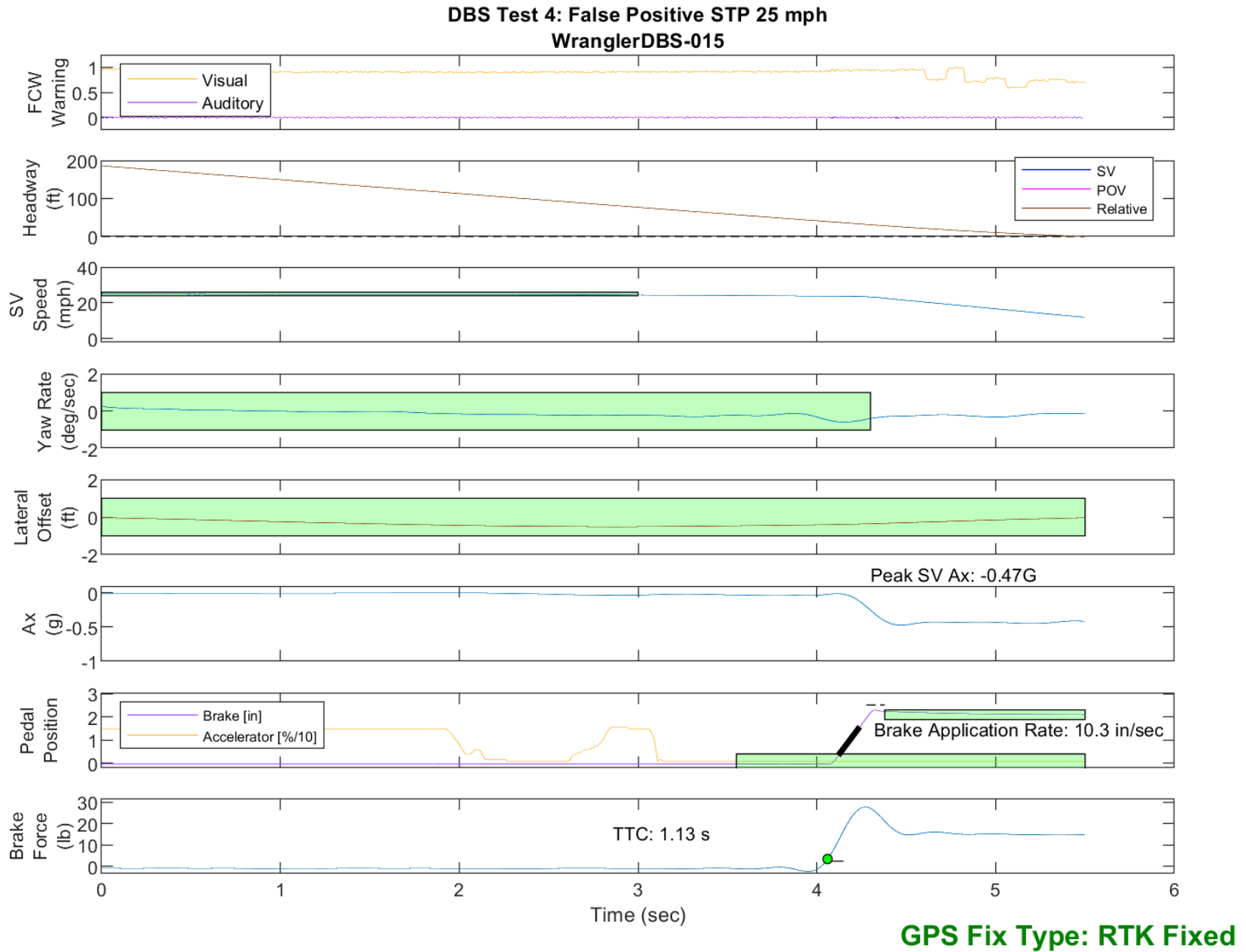
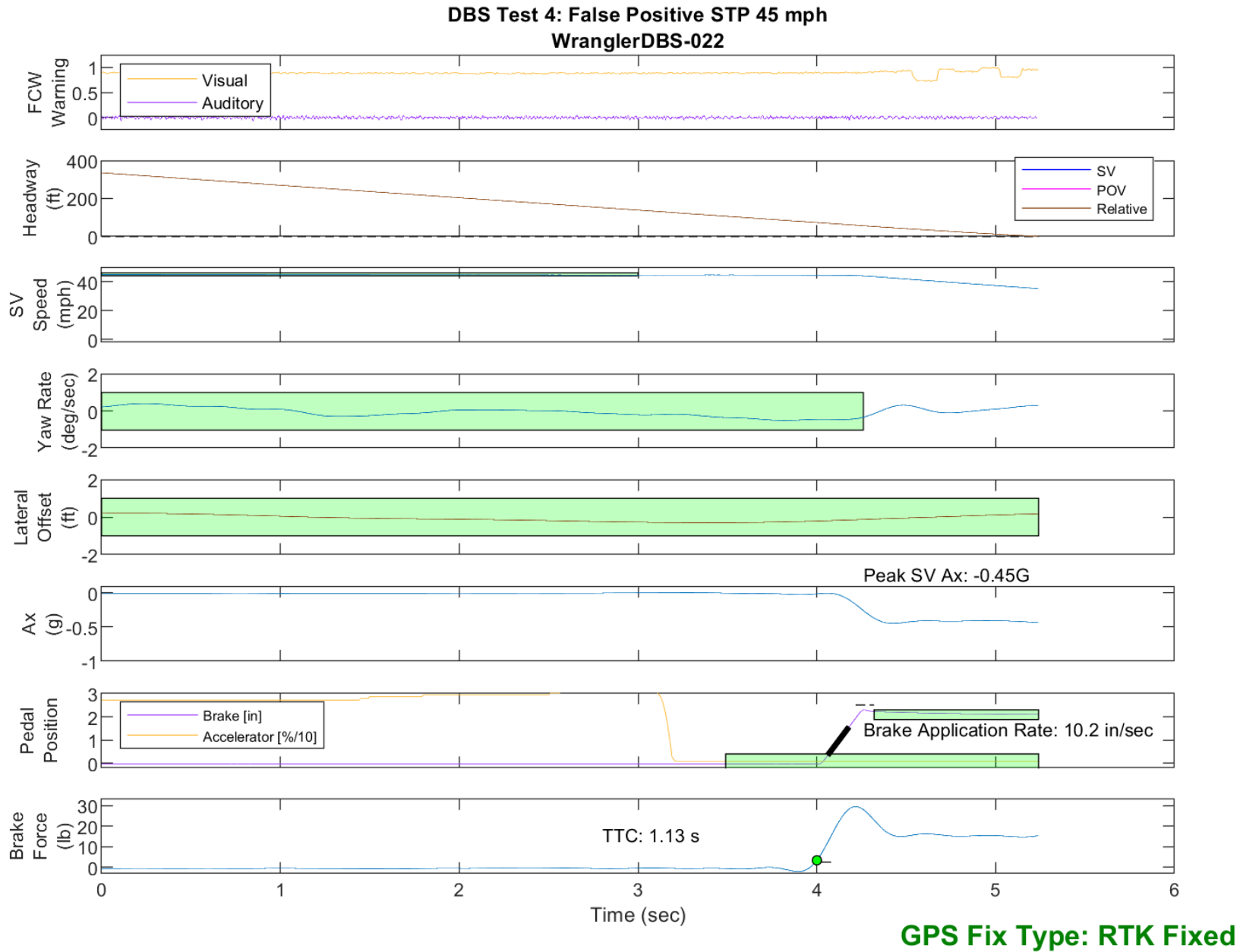Figure E57. Time History for DBS Run 15, Test 4 - False Positive STP 25 mph
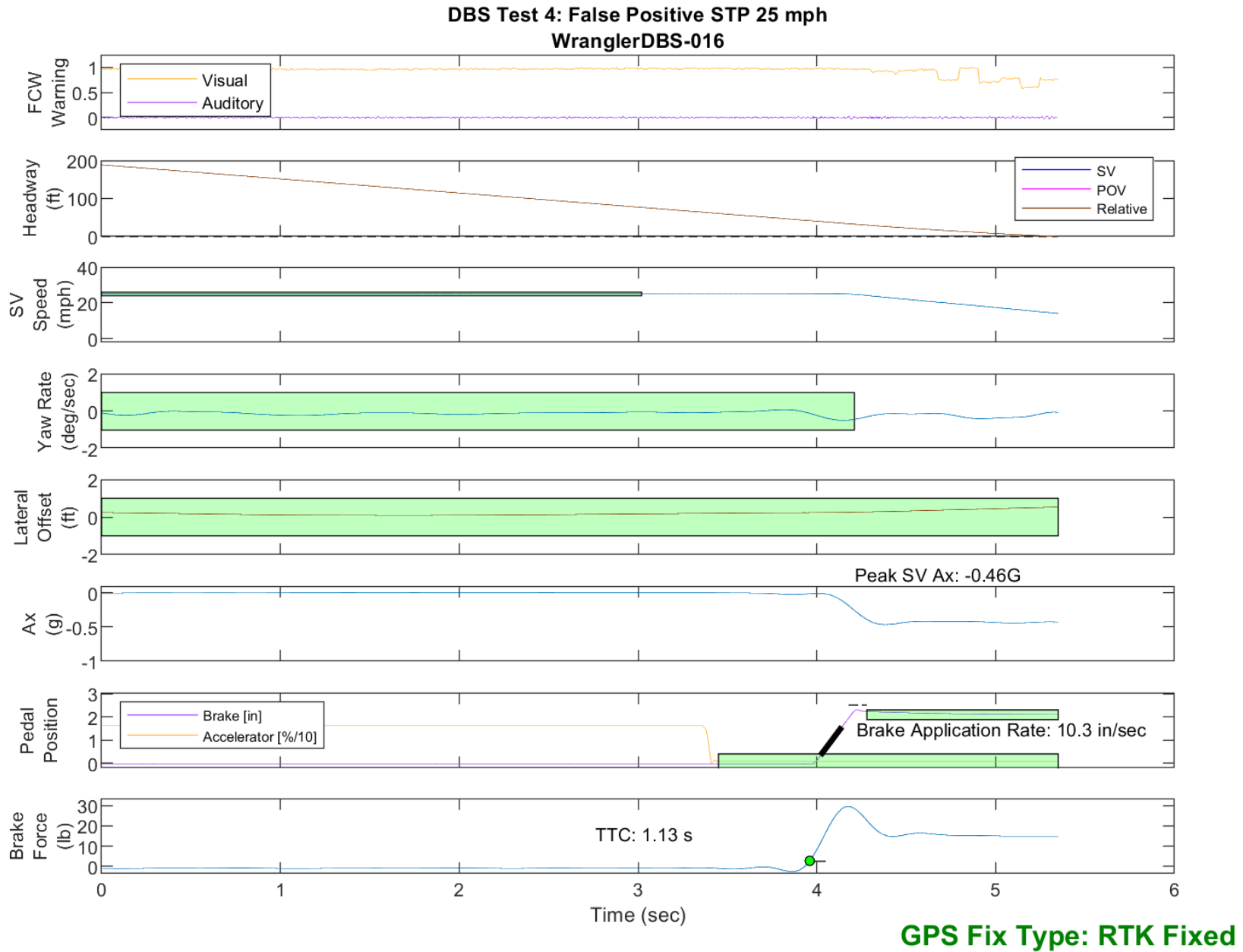
Figure E58. Time History for DBS Run 16, Test 4 - False Positive STP 25 mph

Figure E59. Time History for DBS Run 17, Test 4 - False Positive STP 25 mph

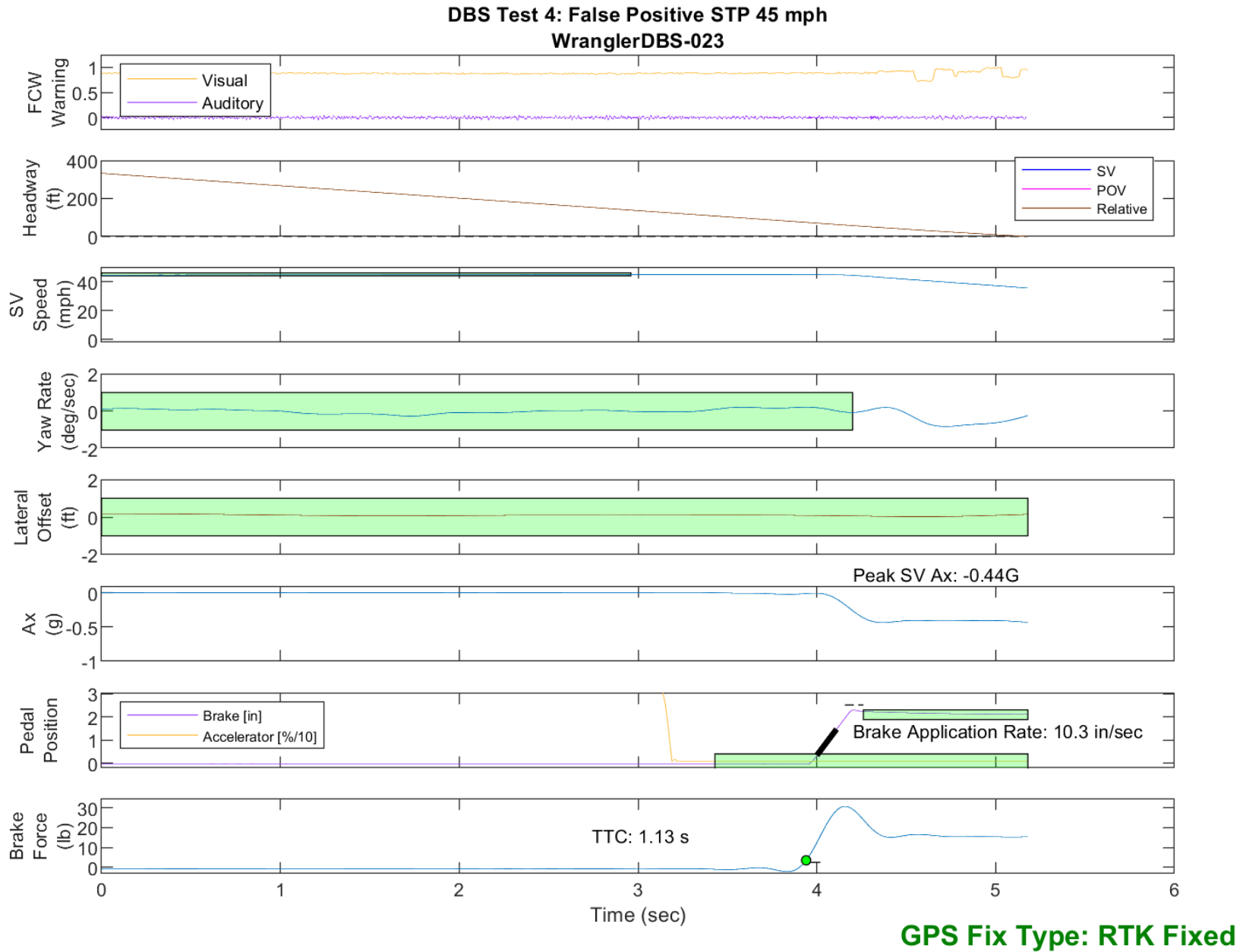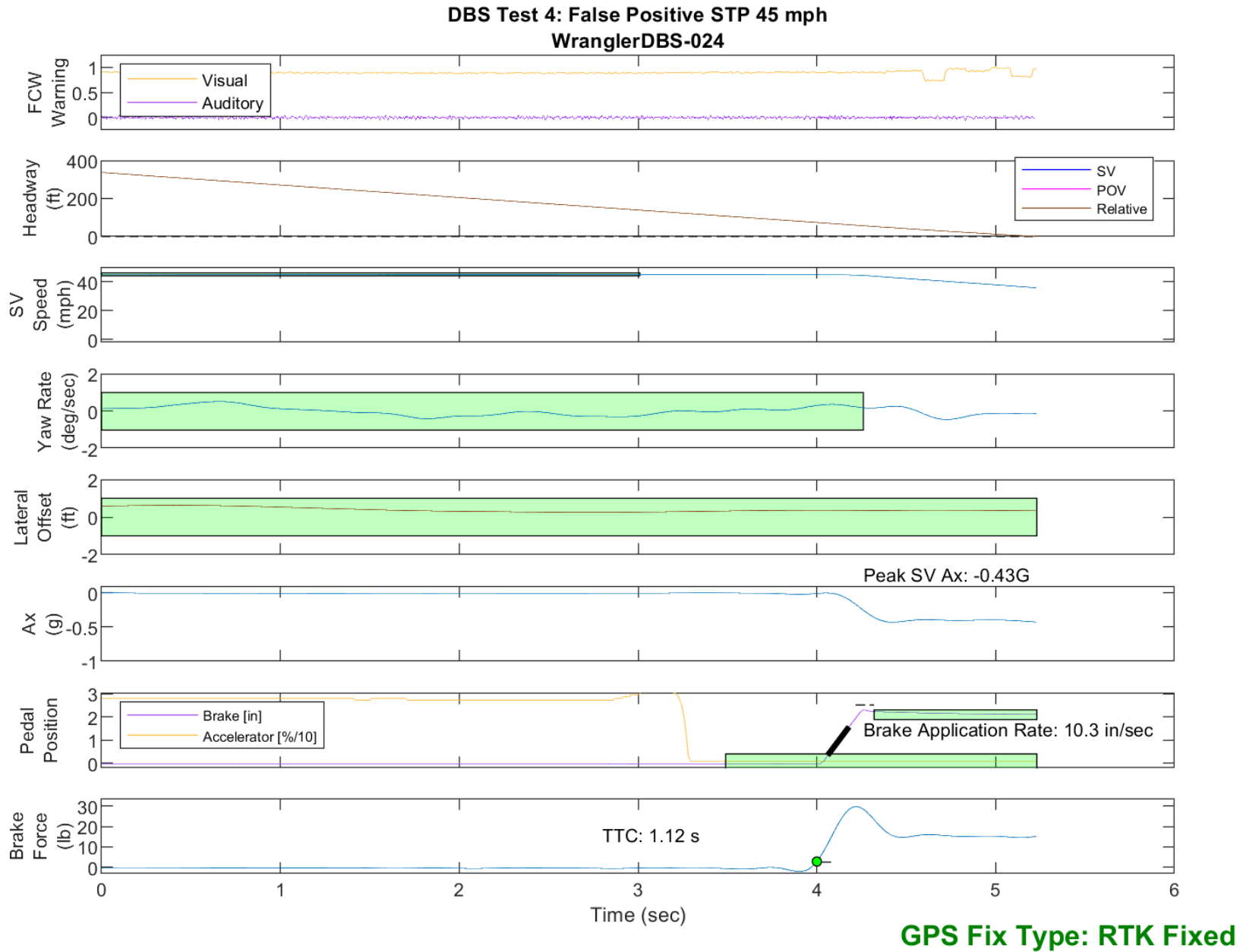Figure E60. Time History for DBS Run 19, Test 4 - False Positive STP 45 mph

DBS Test 4: False Positive STP 45 mph
WranglerDBS-020

GPS Fix Type: RTK Fixed

Figure E61. Time History for DBS Run 20, Test 4 - False Positive STP 45 mph

DBS Test 4: False Positive STP 45 mph
WranglerDBS-021

Peak SV Ax: -0.45G

Brake Application Rate: 10.3 in/sec

TTC: 1.12 s

Time (sec)

GPS Fix Type: RTK Fixed

Figure E62. Time History for DBS Run 21, Test 4 - False Positive STP 45 mph

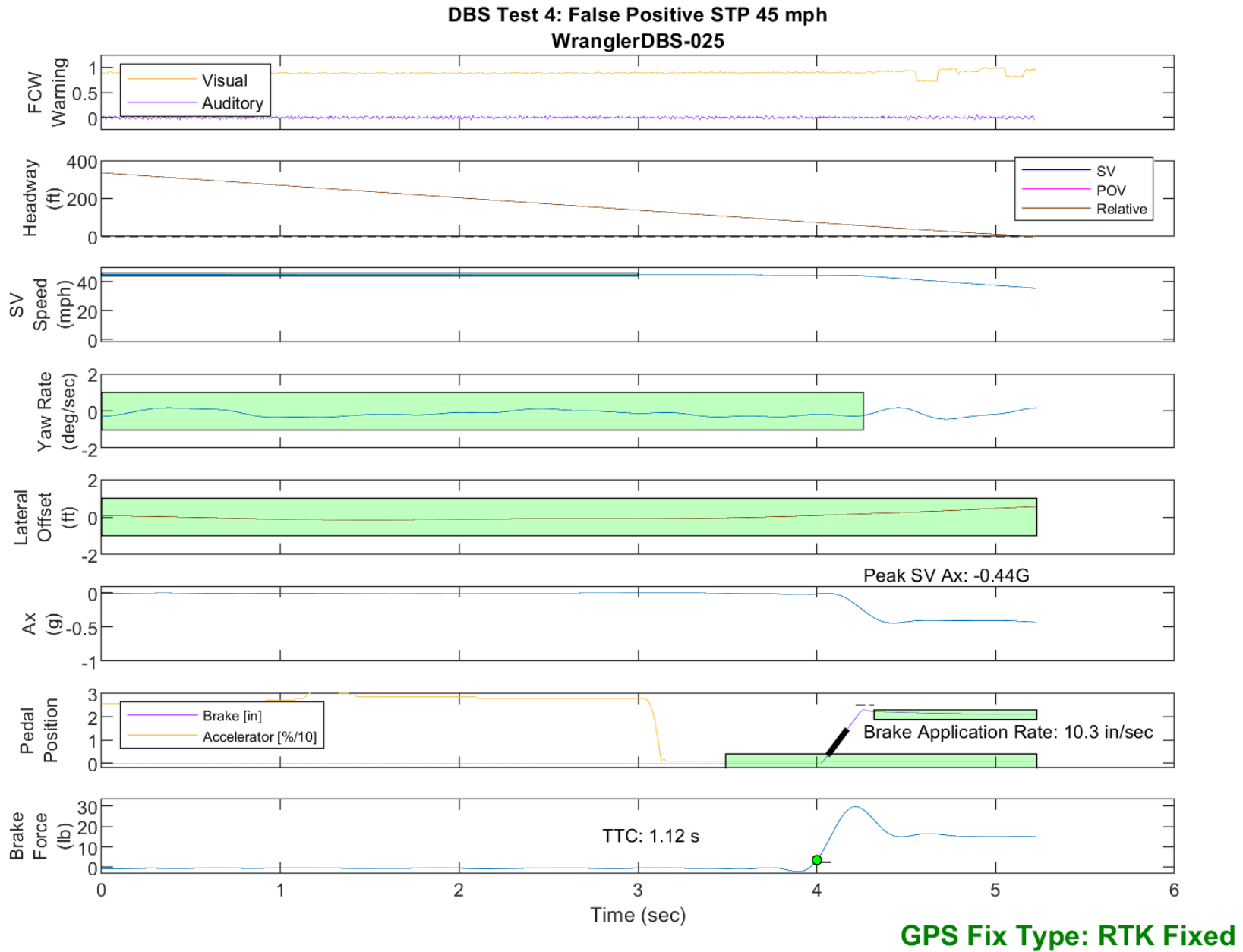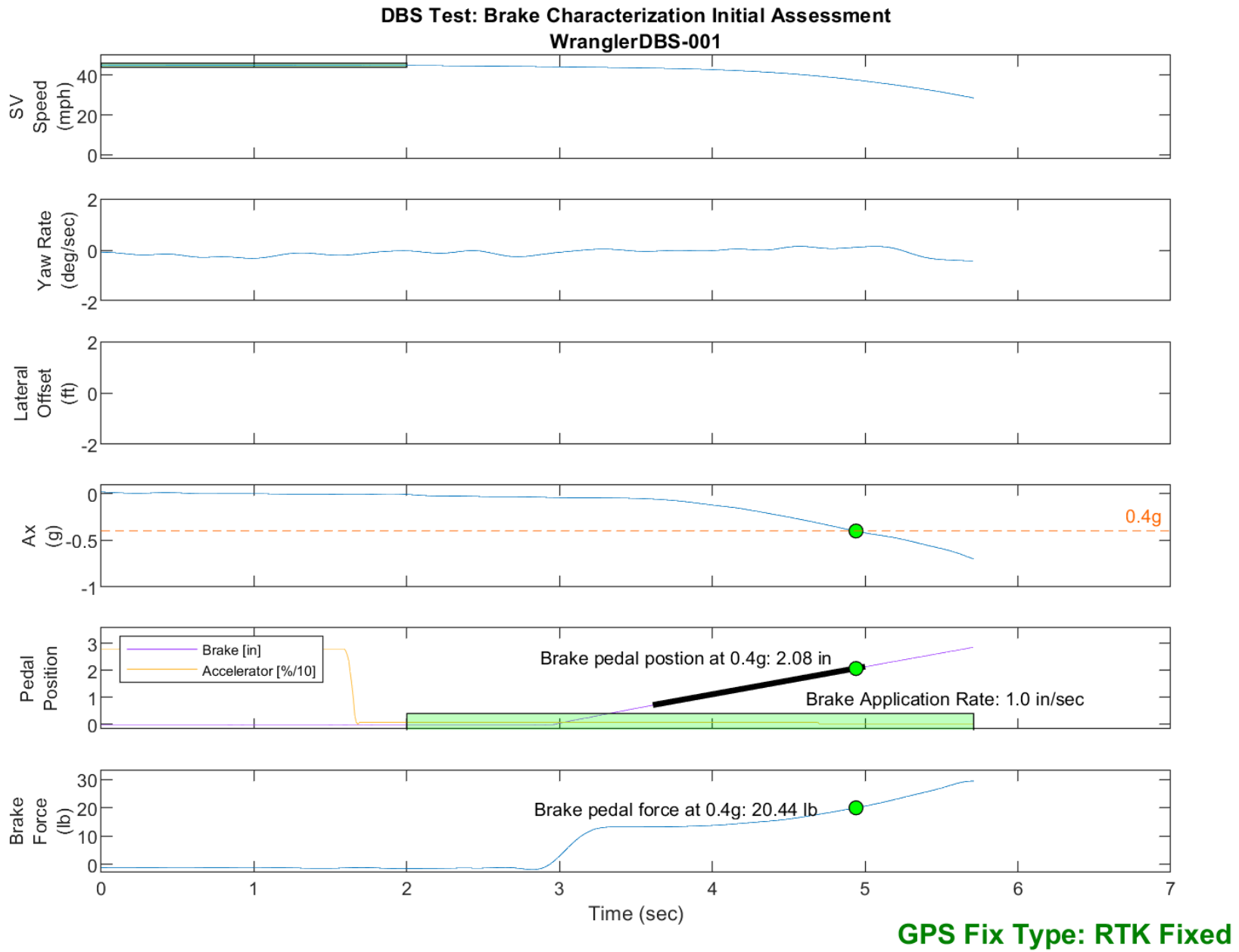Figure E63. Time History for DBS Run 22, Test 4 - False Positive STP 45 mph

DBS Test 4: False Positive STP 45 mph
WranglerDBS-023

GPS Fix Type: RTK Fixed

Figure E64. Time History for DBS Run 23, Test 4 - False Positive STP 45 mph

DBS Test 4: False Positive STP 45 mph
WranglerDBS-024

Figure E65. Time History for DBS Run 24, Test 4 - False Positive STP 45 mph

DBS Test 4: False Positive STP 45 mph
WranglerDBS-025

Figure E66. Time History for DBS Run 25, Test 4 - False Positive STP 45 mph

DBS Test: Brake Characterization Initial Assessment
WranglerDBS-001

Figure E67. Time History for DBS Run 1, Brake Characterization Initial
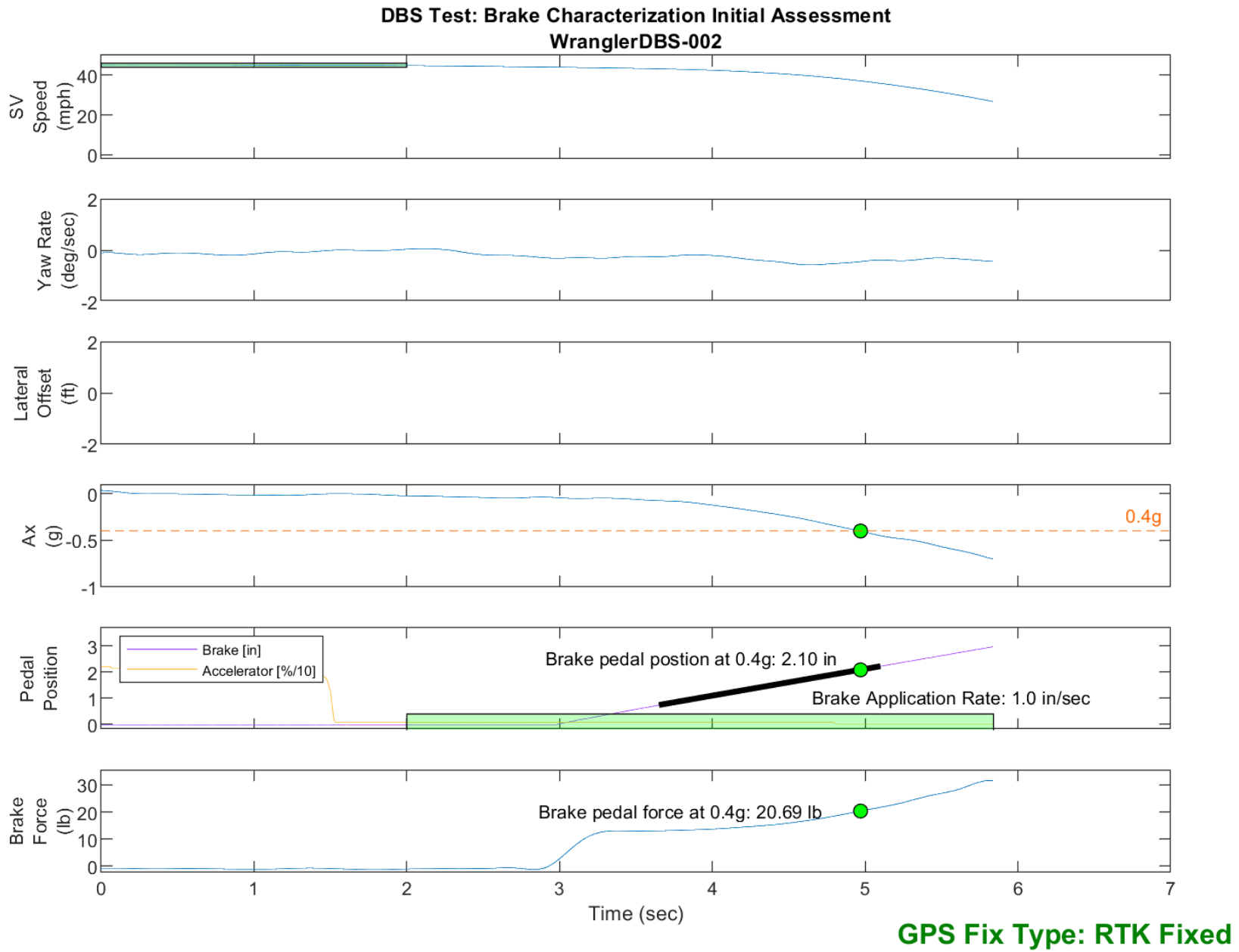
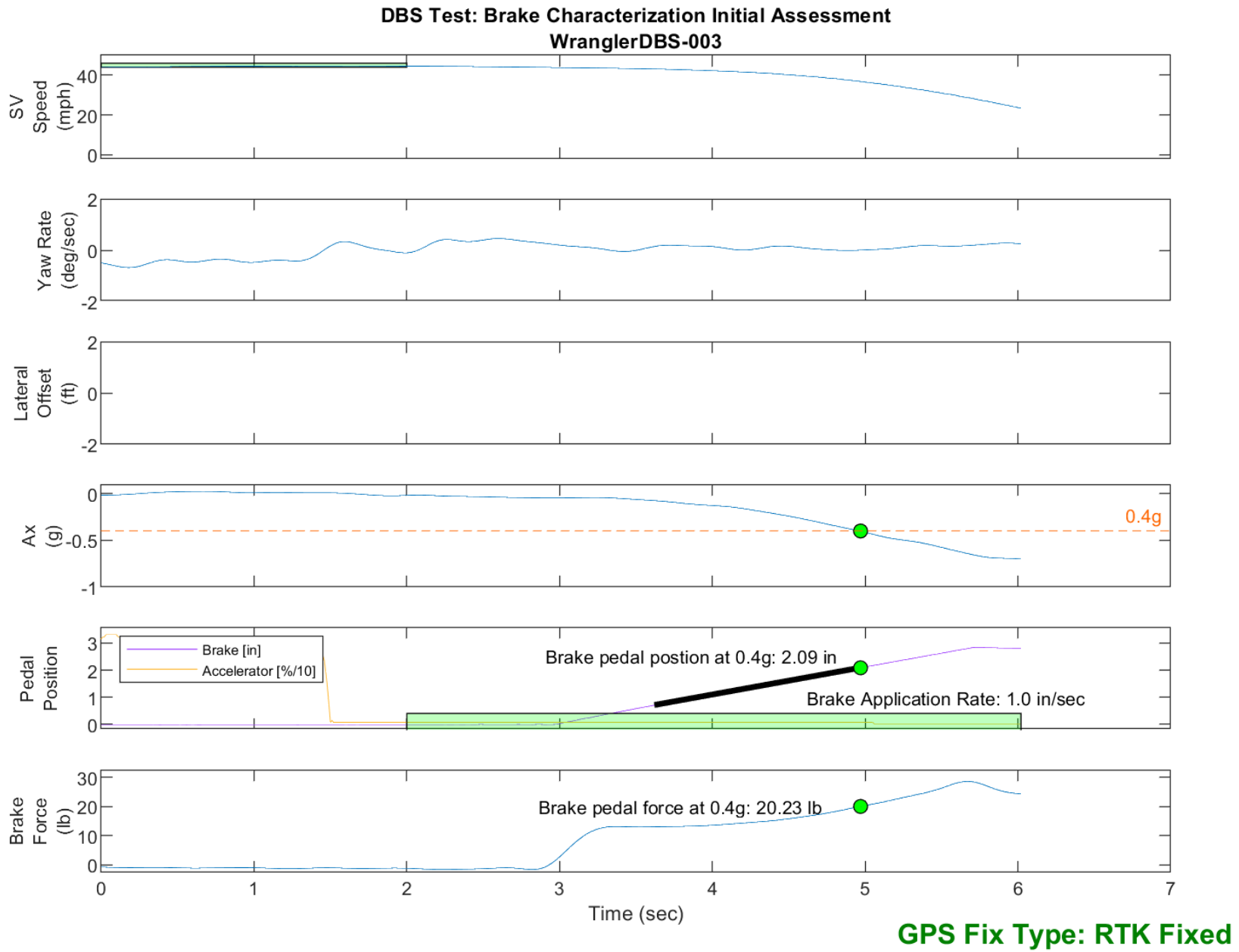Figure E68. Time History for DBS Run 2, Brake Characterization Initial

Figure E69. Time History for DBS Run 3, Brake Characterization Initial
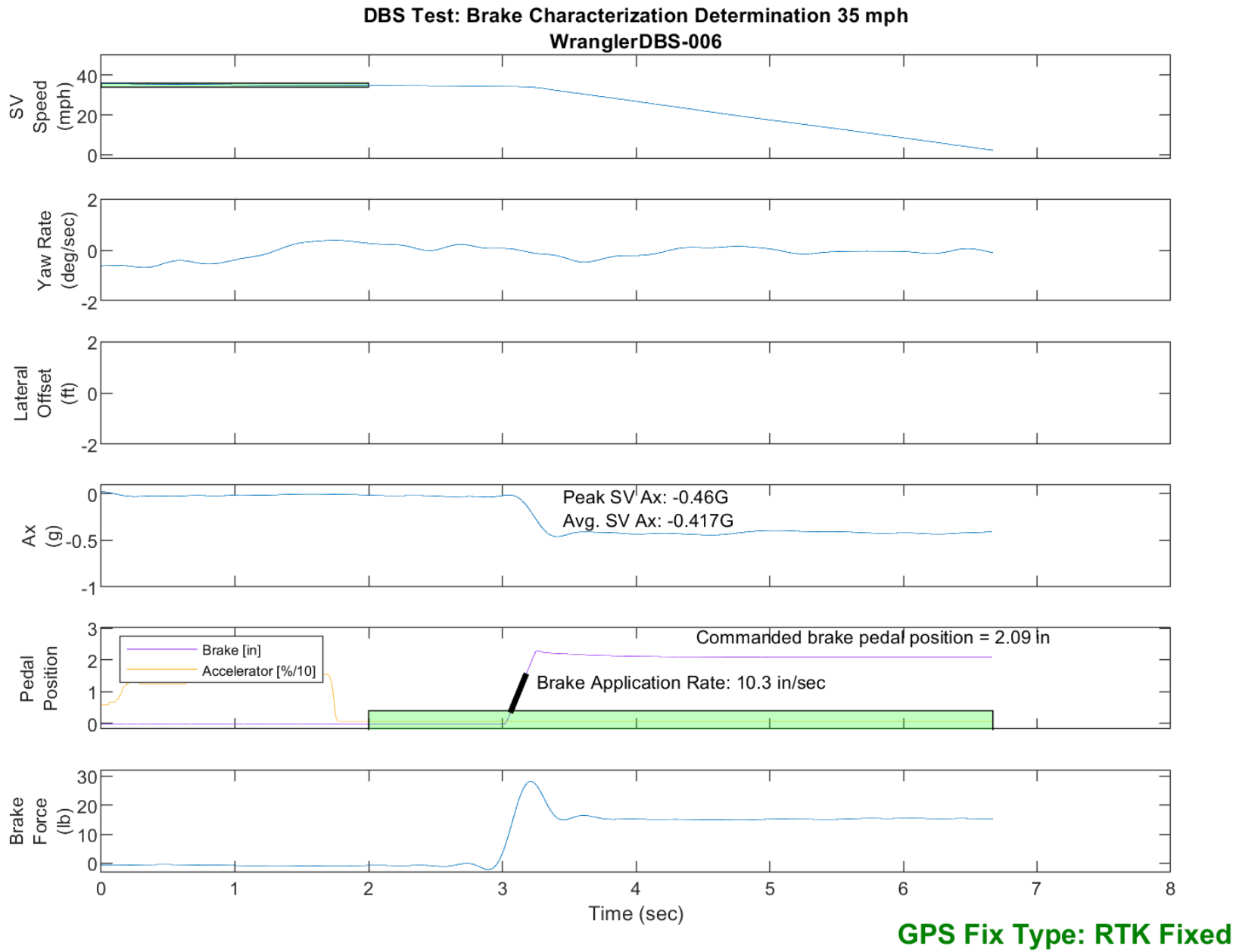
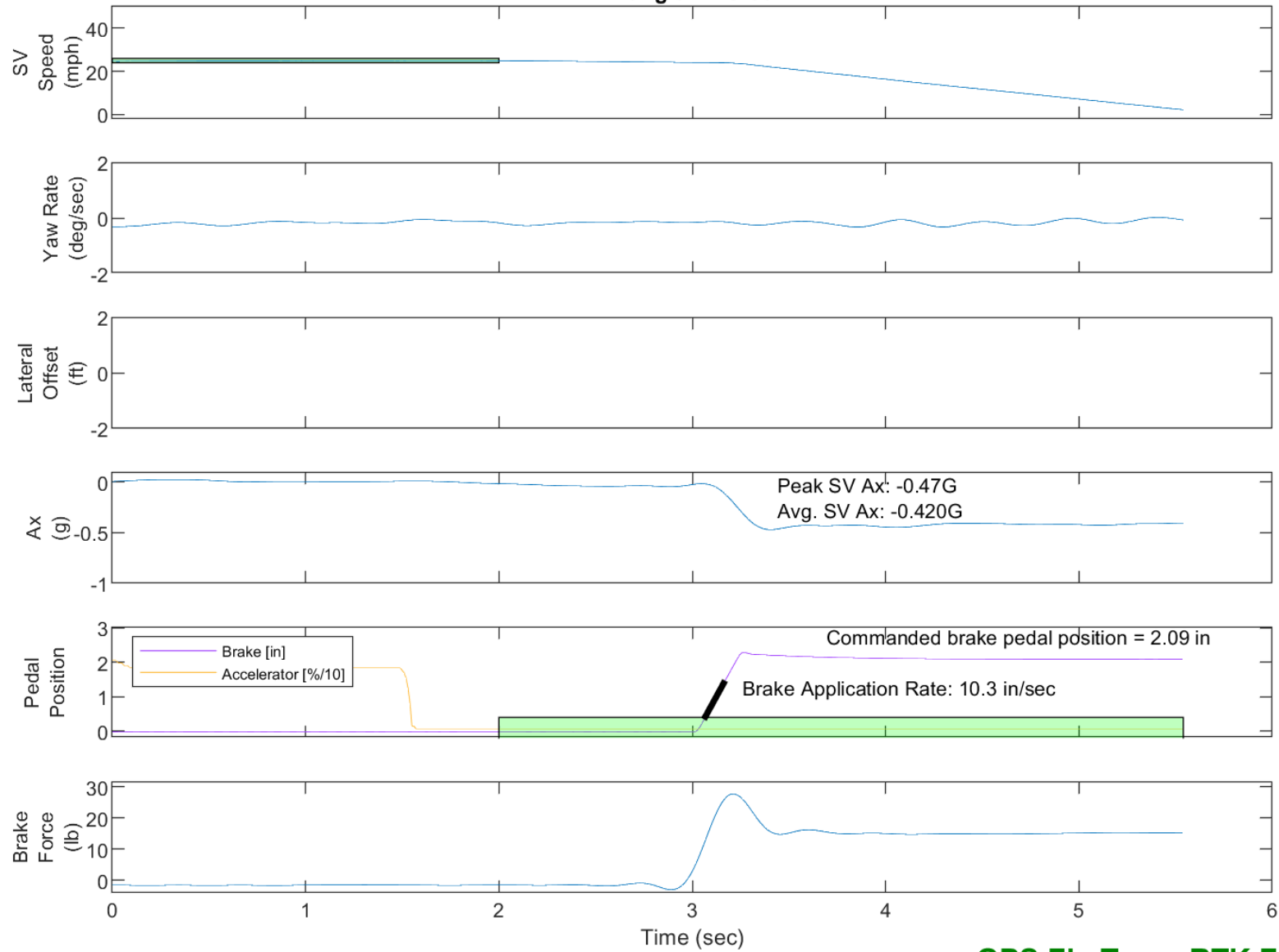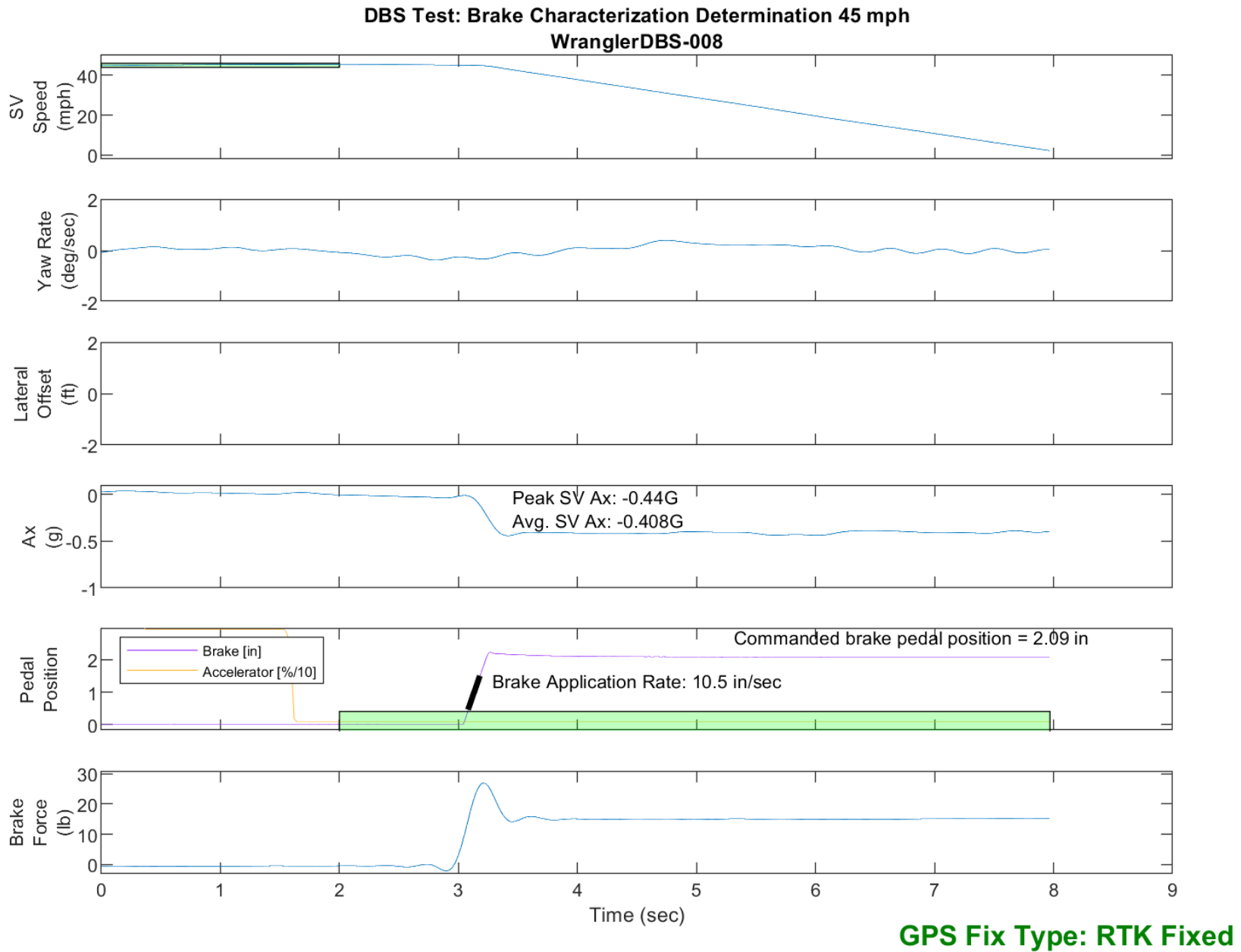Figure E70. Time History for DBS Run 6, Brake Characterization Determination, Displacement Mode, 35 mph

Figure E71. Time History for DBS Run 7, Brake Characterization Determination, Displacement Mode, 25 mph

Figure E72. Time History for DBS Run 8, Brake Characterization Determination, Displacement Mode, 45 mph

DBS Test: Brake Characterization Determination 35 mph
WranglerDBS-073

Peak SV Ax: -0.61G
Avg. SV Ax: -0.550G

Brake Application Rate: 10.2 in/sec

Commanded brake pedal force = 20.45 lbs

Brake [in]
Accelerator [%/10]

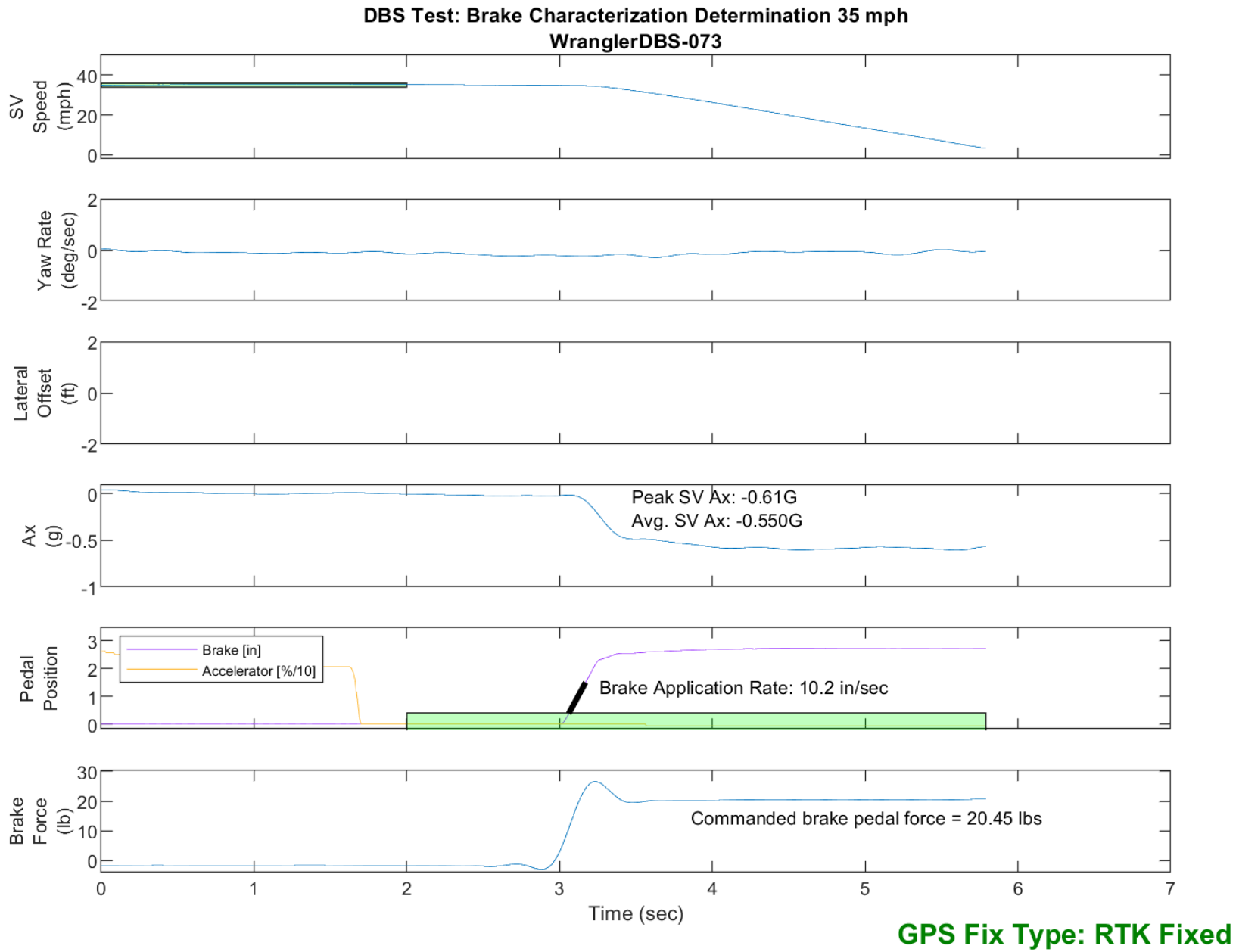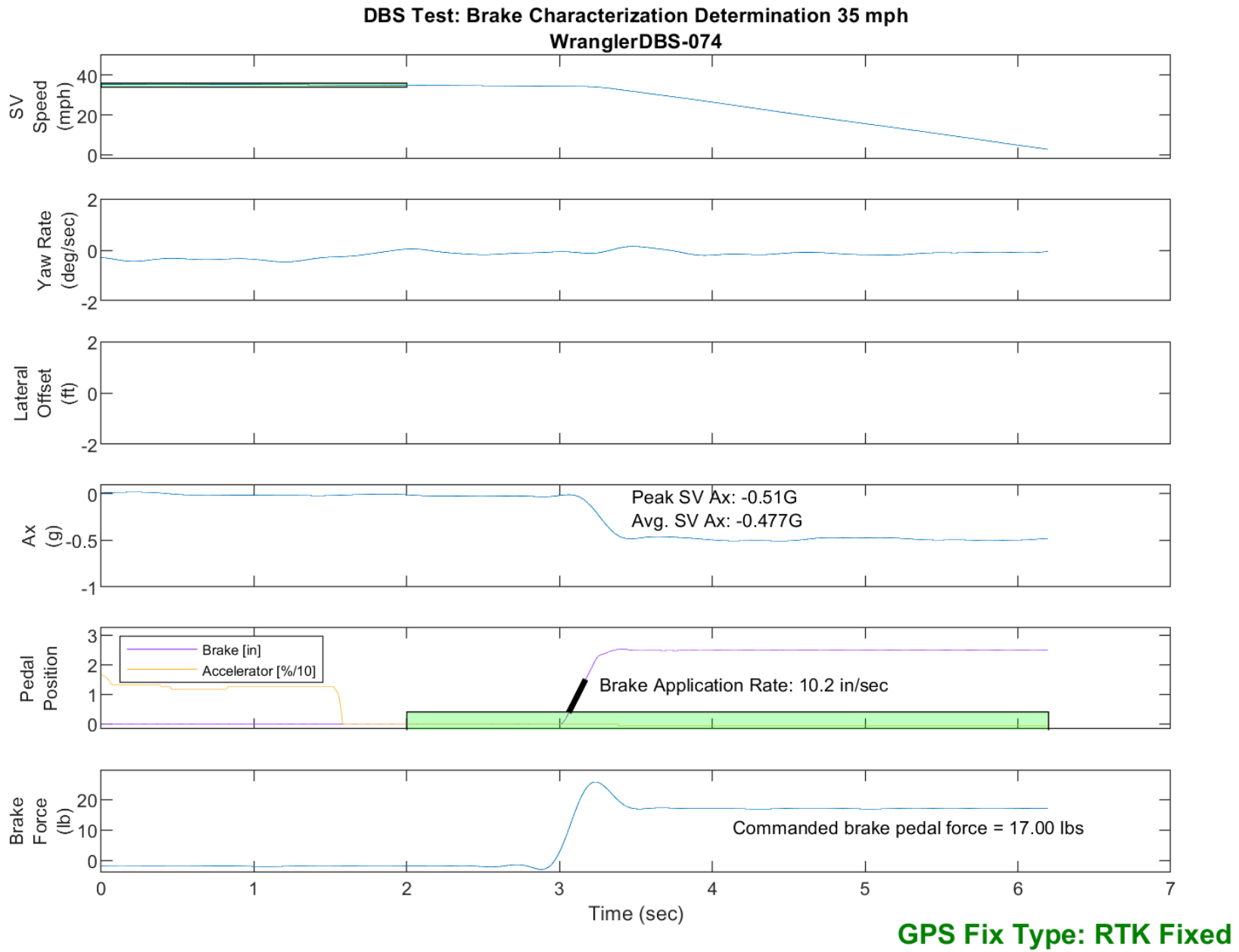Time (sec)

GPS Fix Type: RTK Fixed

Figure E73. Time History for DBS Run 73, Brake Characterization Determination, Hybrid Mode, 35 mph

Figure E74. Time History for DBS Run 74, Brake Characterization Determination, Hybrid Mode, 35 mph
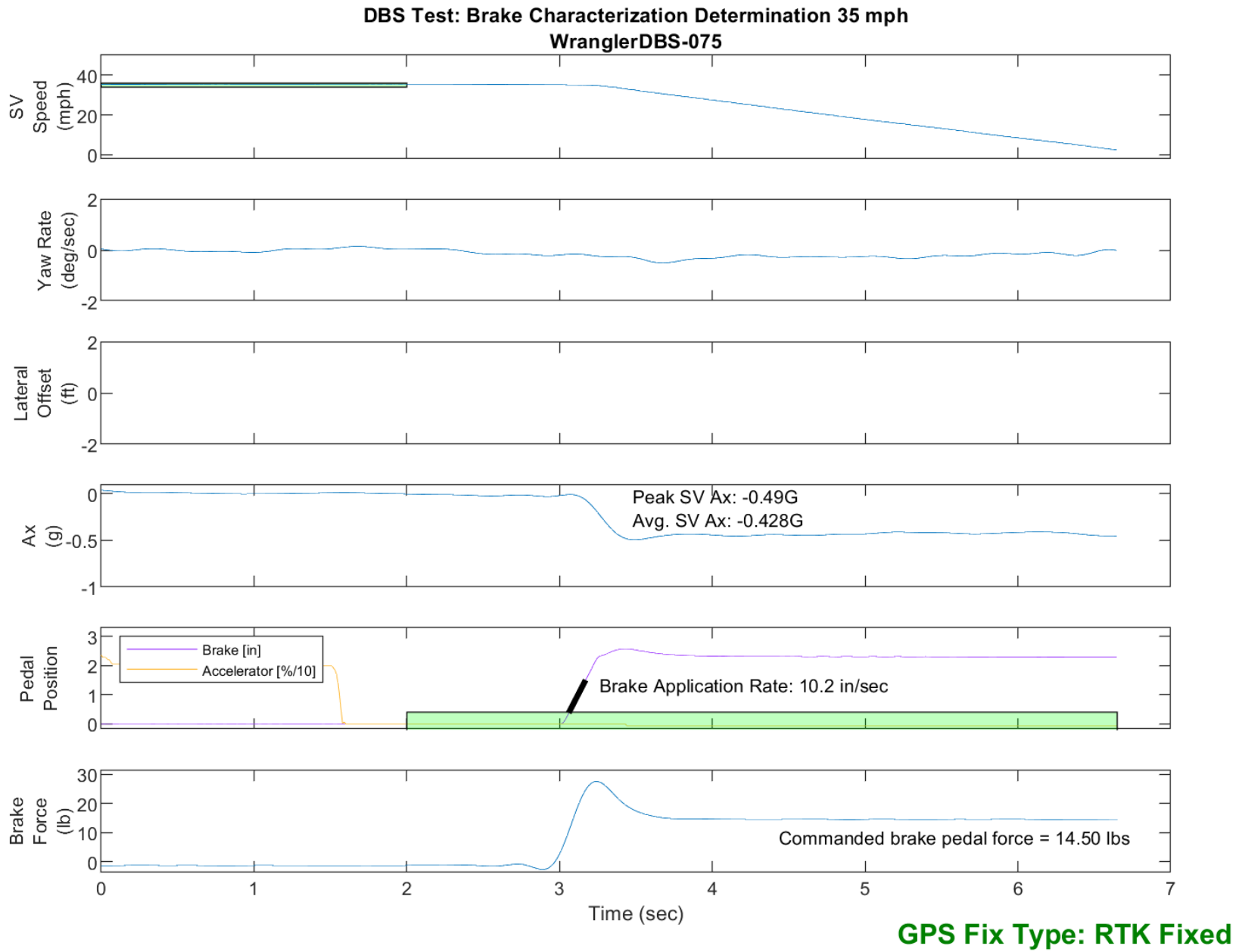
DBS Test: Brake Characterization Determination 35 mph
WranglerDBS-075

Peak SV Ax: -0.49G
Avg. SV Ax: -0.428G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.2 in/sec

Commanded brake pedal force = 14.50 lbs

Time (sec)

GPS Fix Type: RTK Fixed

Figure E75. Time History for DBS Run 75, Brake Characterization Determination, Hybrid Mode, 35 mph

DBS Test: Brake Characterization Determination 35 mph
WranglerDBS-076

Peak SV Ax: -0.51G
Avg. SV Ax: -0.403G

Brake [in]
Accelerator [%/10]

Brake Application Rate: 10.1 in/sec

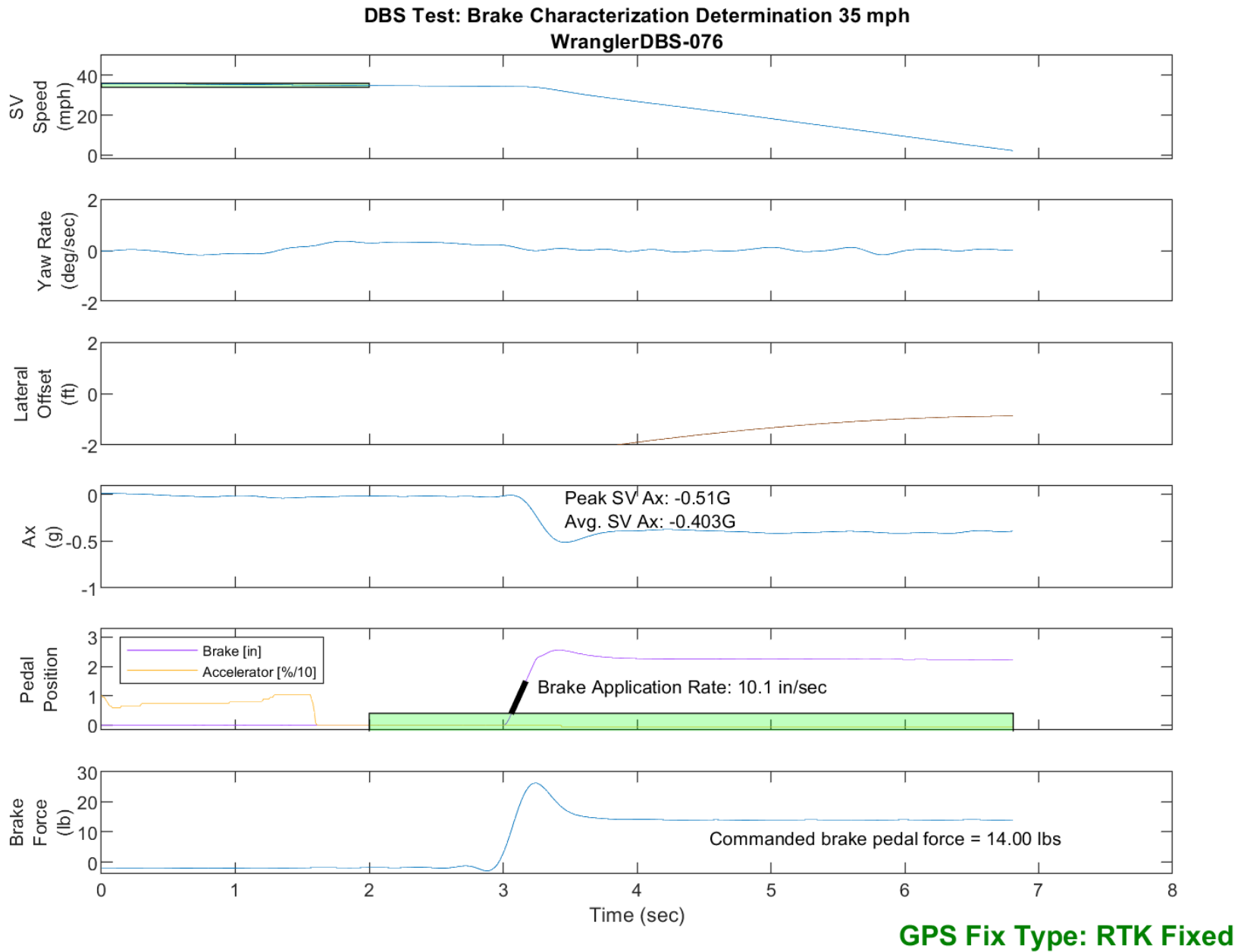Commanded brake pedal force = 14.00 lbs

GPS Fix Type: RTK Fixed

Figure E76. Time History for DBS Run 76, Brake Characterization Determination, Hybrid Mode, 35 mph