CRASH IMMINENT BRAKING SYSTEM RESEARCH TEST
NCAP-DRI-CIBHS-20-09

2020 Mercedes-Benz GLC 300 4Matic SUV

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Final Report

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16. Abstract These research tests were conducted on the subject 2020 Mercedes-Benz GLC 300 4Matic SUV in accordance with the specifications of the New Car Assessment Program's most current Test Procedure in docket NHTSA-2015-0006-0025; CRASH IMMINENT BRAKE SYSTEM PERFORMANCE EVALUATION FOR THE NEW CAR ASSESSMENT PROGRAM, October 2015, with modifications to include use of Global Vehicle Target (GVT) and additional test speeds or deceleration rates to assess system performance and point of failure. The system met the acceptability criteria for 56 out of 58 valid test runs.			
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Section I

INTRODUCTION

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

The method prescribed by the National Highway Traffic Safety Administration (NHTSA) in the New Car Assessment Program's (NCAP's) Crash Imminent Brake System Test Procedure (dated October 2015)[1] to evaluate CIB performance on the test track involves three rear-end type crash configurations and a "false positive" test. In the rear-end scenarios, a subject vehicle (SV) approaches a stopped, slower-moving, or decelerating principal other vehicle (POV) in the same lane of travel. For these tests, the POV is a strikeable object with the characteristics of a compact passenger car. The false positive scenarios are used to evaluate the propensity of a CIB system to inappropriately activate in a non-critical driving scenario that does not involve a forward vehicle or present a safety risk to the SV occupant(s).

This report describes the results of research tests conducted in accordance with the NHTSA test procedure, but several modifications were made to the specified test matrix and an alternative POV was used.

The modified test matrix replaces the "false positive" test condition in the standard CIB confirmation test with additional test speeds or deceleration rates, as indicated in Table 1.

The NHTSA test procedure does not specify a particular strikeable POV, but the New Car Assessment Program (NCAP) has been using the Strikeable Surrogate Vehicle (SSV) for the CIB confirmation tests.[2] However, the Global Vehicle Target (GVT) system, which is in general use worldwide, was used in these research tests instead of the SSV. A detailed description of the GVT system is given in Section III C.

[1] NHTSA-2015-0006-0025; Crash Imminent Brake System Performance Evaluation for the New Car Assessment Program, October 2015.
[2] A detailed description of the SSV system can be found in the NHTSA report: NHTSA'S STRIKEABLE SURROGATE VEHICLE PRELIMINARY DESIGN+OVERVIEW, May 2013.

Table 1. Comparison of NCAP CIB Confirmation Test and Research Test Conditions

Test Scenario	Initial SV Speed mph (km/h)	Initial POV Speed mph (km/h)	POV Deceleration (g)	Standard NCAP CIB Confirmation Test Condition	Research Test Condition (Evaluated Herein)
1. Stopped POV	25 (40.2)	0	0	Yes	Yes
	30 (48.3)	0	0	Not Applicable	Yes
	35 (56.3)	0	0	Not Applicable	Yes
	40 (64.4)	0	0	Not Applicable	Yes
	45 (72.4)	0	0	Not Applicable	Yes
2. Slower Moving POV	25 (40.2)	10 (16.1)	0	Yes	Yes
	45 (72.4)	20 (32.2)	0	Yes	Yes
3. Decelerating POV	35 (56.3)	35 (56.3)	0.3	Yes	Yes
	35 (56.3)	35 (56.3)	0.5	Not Applicable	Yes
	45 (72.4)	45 (72.4)	0.3	Not Applicable	Yes
4. Steel Trench Plate	25 (40.2)	Not Applicable	Not Applicable	Yes	No
	45 (72.4)	Not Applicable	Not Applicable	Yes	No

Section II

DATA SHEETS

CRASH IMMINENT BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

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2020 Mercedes-Benz GLC 300 4Matic SUV

VIN: *WDC0G8EB8LF72xxxx* Test Date: *6/11/2020*

Crash Imminent Braking System setting: *Early*

		Number of valid test runs for which acceptability[3] criteria were:		
Test 1 –	**Subject Vehicle Encounters Stopped Principal Other Vehicle**	**Met**	**Not met**	**Valid Runs**
	SV 25 mph:	*6*	*1*	*7*
	SV 30 mph:	*5*	*0*	*5*
	SV 35 mph:	*5*	*0*	*5*
	SV 40 mph:	*5*	*0*	*5*
	SV 45 mph:	*5*	*0*	*5*
Test 2 –	**Subject Vehicle Encounters Slower Principal Other Vehicle**			
	SV 25 mph POV 10 mph:	*7*	*0*	*7*
	SV 45 mph POV 20 mph:	*7*	*0*	*7*
Test 3 –	**Subject Vehicle Encounters Decelerating Principal Other Vehicle**			
	SV 35 mph POV 35 mph, 0.3 g decel:	*7*	*0*	*7*
	SV 35 mph POV 35 mph, 0.5 g decel:	*5*	*0*	*5*
	SV 45 mph POV 45 mph, 0.3 g decel:	*4*	*1*	*5*
	Overall:	***56***	***2***	***58***

Notes:
The system met the acceptability criteria for 56 out of 58 valid test runs.

[3] The acceptability criteria listed herein are used only as a guide to gauge vehicle performance and are identical to the Pass/Fail criteria given in the of the New Car Assessment Program's most current Test Procedure in docket NHTSA-2015-0006-0025; CRASH IMMINENT BRAKE SYSTEM PERFORMANCE EVALUATION FOR THE NEW CAR ASSESSMENT PROGRAM, October 2015,

CRASH IMMINENT BRAKING

DATA SHEET 2: VEHICLE DATA

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2020 Mercedes-Benz GLC 300 4Matic SUV

TEST VEHICLE INFORMATION

VIN: *WDC0G8EB8LF72xxxx*

Body Style: *SUV* Color: *Brilliant Blue Metallic*

Date Received: *6/1/2020* Odometer Reading: *94 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Daimler AG Stuttgart*

Date of manufacture: *09/19*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *235/60R18*

Rear: *235/60R18*

Recommended cold tire pressure: Front: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

TIRES

Tire manufacturer and model: *Pirelli Scorpion Verde All Season*

Front tire designation: *235/60R18 103H*

Rear tire designation: *235/60R18 103H*

Front tire DOT prefix: *93 K3 T899*

Rear tire DOT prefix: *93 K3 T899*

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DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Mercedes-Benz GLC 300 4Matic SUV

GENERAL INFORMATION

Test date: *6/11/2020*

AMBIENT CONDITIONS

Air temperature: *36.7 C (98 F)*

Wind speed: *2.1 m/s (4.6 mph)*

X Windspeed ≤ 10 m/s (22 mph)

X Tests were not performed during periods of inclement weather. This includes, but is not limited to, rain, snow, hail, fog, smoke, or ash.

X Tests were conducted during daylight hours with good atmospheric visibility (defined as an absence of fog and the ability to see clearly for more than 5000 meters). The tests were not conducted with the vehicle oriented into the sun during very low sun angle conditions, where the sun is oriented 15 degrees or less from horizontal, and camera “washout” or system inoperability results.

VEHICLE PREPARATION

Verify the following:

All non-consumable fluids at 100% capacity: **X**

Fuel tank is full: **X**

Tire pressures are set to manufacturer's recommended cold tire pressure: **X**

Front: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

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DATA SHEET 3: TEST CONDITIONS

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2020 Mercedes-Benz GLC 300 4Matic SUV

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*514.8 kg (1135 lb)*	Right Front:	*509.4 kg (1123 lb)*
Left Rear:	*469.0 kg (1034 lb)*	Right Rear:	*469.9 kg (1036 lb)*
		Total:	*1963.1 kg (4328 lb)*

CRASH IMMINENT BRAKING

DATA SHEET 4: CRASH IMMINENT BRAKING SYSTEM OPERATION

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2020 Mercedes-Benz GLC 300 4Matic SUV

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

Active Brake Assist w/ Cross-Traffic Function; a component of option package DA2, Driver Assistance Package

Type and location of sensors the system uses:

Radar located behind the star emblem in the front grille.

Stereo camera located behind the windshield near the rearview mirror.

System setting used for test (if applicable): *Early*

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

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

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

Per manufacturer supplied information:

250 km/h (155 mph) for vehicles travelling in front

100 km/h (63 mph) for stationary vehicles

80 km/h (50 mph) for moving pedestrians, cyclists travelling in front

70 km/h (43 mph) for crossing vehicles, stationary pedestrians, and stationary cyclists

80 km/h (50 mph) for moving pedestrians and cyclists travelling in front

See Appendix B, Page B-6 (Owner's Manual, Page 193).

Does the vehicle system require an initialization sequence/procedure? **X** Yes ____ No

If yes, please provide a full description.

Manufacturer specified proprietary calibration procedure (confidential).

Will the system deactivate due to repeated CIB activations, impacts or near-misses? **X** Yes ____ No

If yes, please provide a full description.

In the event that system function is temporarily limited, the multifunction display will present a message stating "Active Brake Assist Function Currently Limited". If the system function is compromised and needs repair, the message will state "Active Brake Assist Functions Limited".

If the system function is temporarily limited, stop the vehicle and restart the engine. If the system function is compromised due to impact that alters alignment of the radar, then the vehicle must be serviced at the dealership.

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

X Warning light

X Buzzer or audible alarm

____ Vibration

____ Other ____

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

If Active Brake Assist has detected a risk of collision, a warning tone sounds and the distance warning lamp lights up in the instrument cluster. The distance warning light is shown in the upper portion of the speedometer and depicts a front view of a vehicle inside a triangle. See the Owner's Manual, Pages 10 and 562, shown in Appendix B, Pages B-2 and B-14.

The auditory warning is a 2000 Hz tone having a pulse width of approximately 1/3 second.

Is there a way to deactivate the system? **X** Yes ____ No

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

Controls on the right side of the steering wheel or a touch pad located in the center console can be used to interact with the multimedia system menus. The hierarchy is:

Settings

Assistance

Active Brake Assist.

Select "Off" to disable

See Appendix A, Figures A11 and A12.

Is the vehicle equipped with a control whose purpose is to adjust the range setting or otherwise influence the operation of CIB? **X** Yes ____ No

If yes, please provide a full description.

The sensitivity of the system can be adjusted. Controls on the right side of the steering wheel or a touch pad located in the center console can be used to interact with the multimedia system menus. The hierarchy is:

Settings

Assistance

Active Brake Assist

Select Early – Medium (default) – Late – Off

See Appendix A, Figures A11 and A12.

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DATA SHEET 4: CRASH IMMINENT BRAKING SYSTEM OPERATION

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2020 Mercedes-Benz GLC 300 4Matic SUV

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

If yes, please provide a full description.

The system may be impaired or may not function in the following situations:

- *In snow, rain, fog, heavy spray, if there is glare, in direct sunlight or in greatly varying ambient light.*
- *If the sensors are dirty, fogged up, damaged or covered.*
- *If the sensors are impaired due to interference from other radar sources, e.g. strong radar reflections in parking garages.*
- *If a loss of tire pressure or a faulty tire has been detected and displayed.*
- *If Downhill Speed Regulation (DSR) is activated.*
- *In complex traffic situations where objects cannot always be clearly identified.*
- *If pedestrians or vehicles move quickly into the sensor detection range.*
- *If pedestrians are hidden by other objects.*
- *If the typical outline of a pedestrian cannot be distinguished from the background.*
- *If a pedestrian is not detected as such, e.g. due to special clothing or other objects.*
- *On bends with a tight radius.*

See Appendix B, Pages B-9 through B-10 (Owner's Manual, Pages 196-197).

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Three 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

An overview of each of the test procedures follows.

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

This test evaluates the ability of the CIB system to detect and respond to a stopped lead vehicle in the immediate forward path of the SV, as depicted in Figure 1. Test conditions for Test 1 are shown in Table 2.

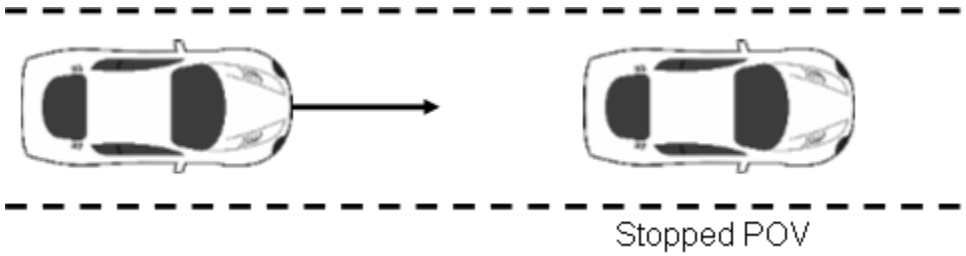


Figure 1. Depiction of Test 1

Table 2. Test Conditions for Stopped POV

Initial SV Speed mph (km/h)	**Initial POV Speed** mph (km/h)	**POV Deceleration** g
25 (40.2)	0	0
30 (48.3)	0	0
35 (56.3)	0	0
40 (64.4)	0	0
45 (72.4)	0	0

a. Procedure

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

The SV ignition was cycled prior to each test run. The tests were conducted at five different SV nominal speeds. The nominal speeds were 25 mph (40.2 km/h), 30 mph (48.3 km/h), 35 mph (56.3 km/h), 40 mph (64.4 km/h), and 45 mph (72.4 km/h). The guideline for test speed was to start at the lowest speed and increase the test speed incrementally until a speed was reached at which the system performance was no longer acceptable. If the system performance became unacceptable before all the nominal speeds were completed, an additional series of tests was then conducted at a speed 2.5 mph less than the speed at which unacceptable performance was observed. The SV was driven at the nominal speed in the center of the lane of travel, toward the parked POV. The SV throttle pedal was released within 500 ms after t_{FCW} , i.e. within 500 ms of the FCW alert. The test concluded when either:

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

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

- The SV speed could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) during an interval defined by a Time to Collision (TTC) = 5.1 seconds to t_{FCW}.

b. Criteria

If, at each nominal speed, the magnitude of the SV speed reduction attributable to CIB intervention was ≥ 9.8 mph (15.8 km/h) for at least three of five valid test trials the system performance was considered acceptable.

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

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

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

This test evaluates the ability of the CIB system to detect and respond to a slower-moving lead vehicle traveling at a constant speed in the immediate forward path of the SV, as depicted in Figure 2. Test conditions for Test 2 are shown in Table 3.

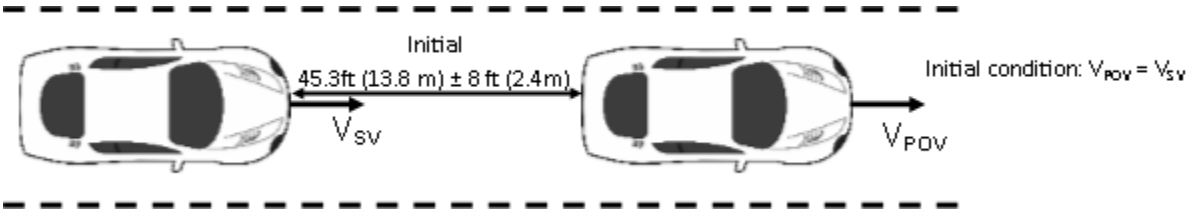


Figure 2. Depiction of Test 2

Table 3. Test Conditions for Slower POV

Initial SV Speed mph (km/h)	Initial POV Speed mph (km/h)	POV Deceleration g
25 (40.2)	10 (16.1)	0
45 (72.4)	20 (32.2)	0

a. Procedure

The SV ignition was cycled prior to each test run. The tests were conducted two ways. In the first, the POV was driven at a constant 10.0 mph (16.1 km/h) in the center of the lane of travel while the SV was driven at 25.0 mph (40.2 km/h), in the center lane of travel, toward the slower-moving POV. In the second, the POV was driven at a constant 20.0 mph (32.2 km/h) in the center of the lane of travel while the SV was driven at 45.0 mph (72.4 km/h), in the center lane of travel, toward the slower-moving POV. In both cases, the SV throttle pedal was released within 500 ms after t_{FCW}, i.e. within 500 ms of the FCW alert. The test concluded when either:

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

The SV driver then braked to a stop.

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

- The lateral distance between the centerline of the POV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.
- The lateral distance between the centerline of the SV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.
- The SV speed could not deviate more than ±1.0 mph (±1.6 km/h) during an interval defined by TTC = 5.0 seconds to t_{FCW}.
- The POV speed could not deviate more than ±1.0 mph (±1.6 km/h) during the validity period.

b. Criteria

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

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

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

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

This test evaluates the ability of the CIB system to detect and respond to a lead vehicle slowing with a constant deceleration in the immediate forward path of the SV, as depicted by the example in Figure 3. Test conditions for Test 3 are shown in Table 4.

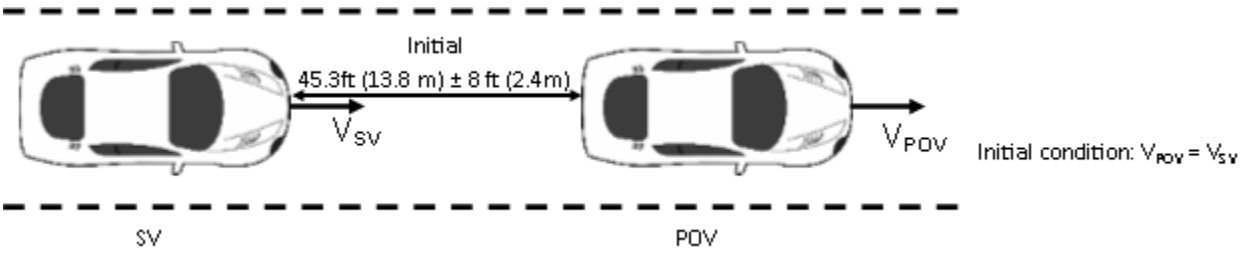


Figure 3. Depiction of Test 3 with POV Decelerating with V_0 =35 mph (56.3 km/h)

Table 4. Test Conditions for Decelerating POV

Initial SV Speed mph (km/h)	Initial POV Speed mph (km/h)	POV Deceleration g
35 (56.3)	35 (56.3)	-0.3
35 (56.3)	35 (56.3)	-0.5
45 (72.4)	45 (72.4)	-0.3

a. Procedure

The SV ignition was cycled prior to each test run. This test scenario was conducted at three different combinations of nominal initial speeds (V_0) and deceleration levels ($-a_x$). The first two combinations comprised V_0 = 35.0 mph (56.3 km/h) with a_x = -0.3 ± 0.03 g and -0.5 ± 0.03 g respectively. The third combination comprised V_0 = 45 mph (72.4 km/h) and a_x = 0.3 ± 0.03 g. Both the POV and SV were driven at a constant V_0 in the center of the lane, with a headway of 45.3 ft (13.8 m) ± 8 ft (2.4 m). Once these conditions were met for at least three seconds, the POV (GVT) brakes were applied to achieve the nominal level of deceleration ($-a_x$). The test concluded when either:

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

The SV driver then braked to a stop.

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

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

- The lateral distance between the centerline of the SV and the center of the travel lane could not deviate more than ±1 ft (0.3 m) during the validity period.
- The headway between the SV and POV must have been constant from the onset of the applicable validity period to the onset of POV braking.
- The SV and POV speed could not deviate more than ±1.0 mph (1.6 km/h) during an interval defined by the onset of the validity period to the onset of POV braking.
- The SV- POV headway distance could not deviate more than ±8 ft (2.4 m) during an interval defined by the onset of the validity period to the onset of POV braking.
- The average POV deceleration could not deviate by more than ±0.03 g from the nominal 0.3 g deceleration or 0.5 g deceleration, during the interval beginning at 1.5 seconds after the onset of POV braking and ending either 250 ms prior to the POV coming to a stop or the SV coming into contact with the POV.

b. Criteria

For the decelerating POV test series, in order to be considered acceptable, the magnitude of the SV speed reduction attributable to CIB intervention must have been ≥ 10.5 mph (16.9 km/h) for at least three of five valid test trials, for each combination of initial speeds and deceleration levels. The magnitude of the SV speed reduction attributable to CIB intervention was calculated in one of two ways, depending on whether a test trial concluded with the SV colliding with the POV.

- If SV-to-POV contact occurred during a test trial, the CIB speed reduction was calculated by subtracting the SV speed at the time of SV-to-POV contact (i.e., when longitudinal range becomes zero) from the average SV speed calculated from t_{FCW} - 100 ms to t_{FCW}.
- If SV-to-POV contact did not occur during a test trial (i.e., CIB intervention prevents the crash), the CIB speed reduction was calculated by subtracting the SV speed at the minimum longitudinal SV-to-POV range during the applicable validity period from the SV speed at t_{FCW}.

B. General Information

1. T_{FCW}

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

For systems that implement audible or haptic alerts, part of the pre-test instrumentation verification process was to determine the tonal frequency of the audible warning or the vibration frequency of the tactile warning through use of the PSD (Power Spectral

Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible or tactile warning data so that the beginning of such warnings can be programmatically determined. The band-pass filter used for these warning signal types was a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 5.

Table 5. Audible and Tactile Warning Filter Parameters

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

2. GENERAL VALIDITY CRITERIA

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

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

3. VALIDITY PERIOD

The valid test interval began:

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

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

Test 3: 3 seconds before the onset of POV braking

The valid test interval ended:

Test 1: When either of the following occurred:

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

Tests 2 and 3: When either of the following 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.
- 1 second after minimal longitudinal SV-to-POV distance occurred.

4. STATIC INSTRUMENTATION CALIBRATION

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

For Tests 1, 2, and 3, the SV and POV (i.e., GVT and LPRV) were centered in the same travel lane with the same orientation (i.e., facing the same direction).

For these tests, the SV was also positioned such that it just contacted a vertical plane that defines the rearmost location of the POV. This is the “zero position.”

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

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

between collection of that post-test static calibration data file and the last valid pre-test static calibration data file were repeated.

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

5. NUMBER OF TRIALS

A target total of five (5) valid trials were performed for each scenario. In cases where the test driver performed more than five trials, the first five trials satisfying all test tolerances were used to assess the SV performance.

6. TRANSMISSION

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

C. Principal Other Vehicle

CIB testing requires a POV that realistically represents typical vehicles, does not suffer damage or cause damage to a test vehicle in the event of collision, and can be accurately positioned and moved during the tests. The tests reported herein made use of the Global Vehicle Target (GVT) secured to a low profile robotic vehicle (LPRV).

This GVT system was designed for a wide range of crash scenarios including scenarios that AEB systems address. The key components of the GVT system are:

- A soft GVT, which is visually and dimensionally similar to a 2013 Ford Fiesta hatchback. It is designed to appear realistic to the sensors used by automotive safety systems and automated vehicles: radar, camera, and lidar. Appropriate radar characteristics are achieved by using a combination of radar-reflective and radar-absorbing material enclosed within the GVT’s vinyl covers. Internally, the GVT consists of a vinyl-covered foam structure. If a test vehicle impacts the GVT at low speeds, it is designed to separate, and is typically pushed off and away from the supporting LPRV platform. At higher impact speeds, the GVT breaks apart as the SV essentially drives through it. The GVT can be repeatedly struck from any approach angle without harm to those performing the tests or the vehicles being evaluated. Reassembly of the GVT occurs on top of the robotic platform and takes a team of 3 to 5 people approximately 7 to 10 minutes to complete.
- An LPRV platform that supports the GVT and provides for precisely controlled GVT motion. The LPRV contains the batteries, drive motors, GPS receiver, and the control electronics for the system. It has a top speed of 50 mph (80 km/h); a maximum longitudinal acceleration and deceleration of 0.12 g (1.18 m/s^2) and

0.8g (7.8 m/s^2), respectively; and a maximum lateral acceleration of 0.5 g (4.9 m/s^2). The LPRV is preprogrammed and allows the GVT's movement to be accurately and repeatedly choreographed with the test vehicle and/or other test equipment required by a pre-crash scenario using closed-loop control. The LPRV is designed to be safely driven over by the SV without damage if the GVT is struck by the SV.

The key requirements of the POV element are to:

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

The key requirements of the POV delivery system are to:

- Accurately control the nominal POV speed up to 45 mph (72.4 km/h).
- Accurately control the lateral position of the POV within the travel lane.

Operationally, the GVT body is attached to LPRV using Velcro hook and loop fasteners. The GVT and LPRV are designed to separate if the GVT is struck by the SV. The GVT/LPRV system is shown in Figures A6 and A7 in Appendix A and a detailed description can be found in the NHTSA report: "A Test Track Comparison of the Global Vehicle Target (GVT) and NHTSA's Strikeable Surrogate Vehicle (SSV)".[4]

D. Automatic Braking System

The LPRV includes an automatic braking system, which was used in Test 3. The braking system can provide for pre-programmed controlled deceleration up to 0.5 g (4.9 m/s^2).

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

E. Instrumentation

Table 6 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

[4] Snyder, A.C., Forkenbrock, G.J., Davis, I.J., O'Harra, B.C., and Schnelle, S.C., A Test Track Comparison of the Global Vehicle Target (GVT) and NHTSA's Strikeable Surrogate Vehicle (SSV), DOT HS 812 698, Vehicle Research and Test Center, National Highway Traffic Safety Administration, Washington, DC, July 2019.

Table 6. Test Instrumentation and Equipment

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and	Omega DPG8001	17042707002	By: DRI Date: 7/3/2019 Due: 7/3/2020
Platform Scales	Vehicle Total, Wheel, and Axle Load	2200 lb/platform	0.1% of reading	Intercomp SW wireless	0410MN20001	By: DRI Date: 4/20/2020 Due: 4/20/2021
Linear (string) encoder	Throttle pedal travel	10 in 254 mm	0.1 in 2.54 mm	UniMeasure LX-EP	49041189	By: DRI Date: 5/22/2020 Due: 5/22/2021
Differential Global Positioning System	Position, Velocity	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots	Horizontal Position: ±1 cm Vertical Position: ±2 cm Velocity: 0.05 km/h	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	NA
SV Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Accels ± 10g, Angular Rat	Accels .01g, Angular Rate	Oxford Inertial +	2258	By: Oxford Technical Solutions Date: 5/3/2019 Due: 5/3/2021
POV Multi-Axis Inertial Sensing System		Latitude: ±90º Longitude	Position: ±2 cm Velocity	Oxford PinPoint 2G	24504	By: Oxford Technical Solutions Date: 7/18/2019 Due: 7/18/2021

Table 6. Test Instrumentation and Equipment (continued)

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: 1/6/2020 Due: 1/6/2021
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec Longitudinal Range to POV: ±200 m Longitudinal Range Rate: ±50 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec Longitudinal Range: ±3 cm Longitudinal Range Rate: ±0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	NA
Microphone	Sound (to measure time at alert)	Frequency Response: 80 Hz – 20 kHz	Signal-to-noise: 64 dB, 1 kHz at 1 Pa	Audio-Technica AT899	NA	NA
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	NA	NA
Accelerometer	Acceleration (to measure time at alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	NA	NA

Type	Description	Mfr, Model	Serial Number
Data Acquisition System	Data acquisition is achieved using a dSPACE MicroAutoBox II. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the MicroAutoBox. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (listed above).	dSPACE Micro-Autobox II 1401/1513	
		Base Board	549068
		I/O Board	588523

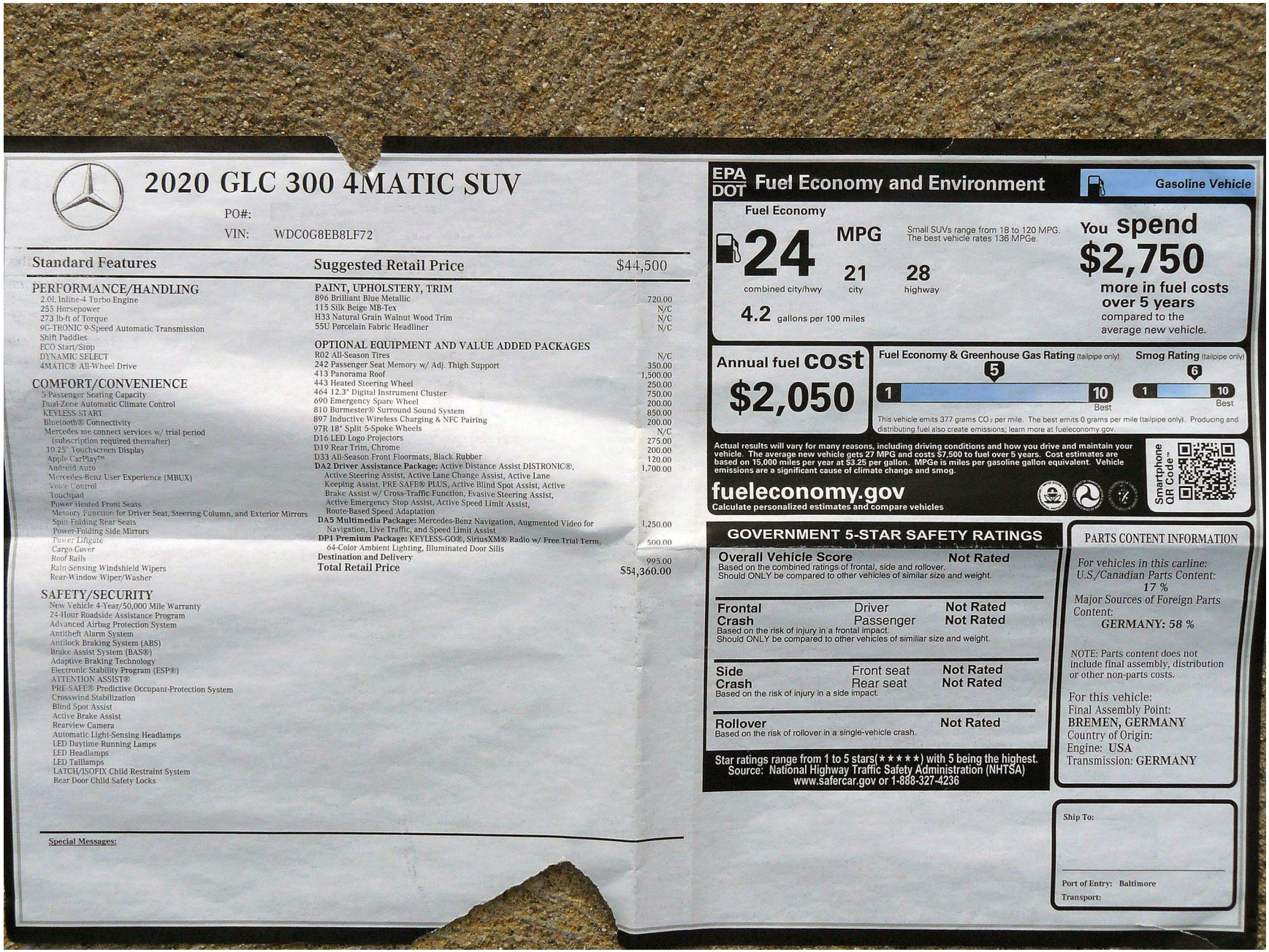
APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle



2020 GLC 300 4MATIC SUV

PO#:

VIN: WDC0G8EB8LF72

Standard Features

PERFORMANCE/HANDLING
- 2.0L Inline-4 Turbo Engine
- 255 Horsepower
- 273 lb-ft of Torque
- 9G-TRONIC 9-Speed Automatic Transmission
- Shift Paddles
- ECO Start/Stop
- DYNAMIC SELECT
- 4MATIC® All-Wheel Drive

COMFORT/CONVENIENCE
- 5-Passenger Seating Capacity
- Dual-Zone Automatic Climate Control
- KEYLESS-START
- Bluetooth® Connectivity
- Mercedes me connect services w/ trial period (subscription required thereafter)
- 10.25" Touchscreen Display
- Apple CarPlay™
- Android Auto
- Mercedes-Benz User Experience (MBUX)
- Voice Control
- Touchpad
- Power Heated Front Seats
- Memory Function for Driver Seat, Steering Column, and Exterior Mirrors
- Split Folding Rear Seats
- Power-Folding Side Mirrors
- Power Liftgate
- Cargo Cover
- Roof Rails
- Rain-Sensing Windshield Wipers
- Rear-Window Wiper/Washer

SAFETY/SECURITY
- New Vehicle 4-Year/50,000 Mile Warranty
- 24-Hour Roadside Assistance Program
- Advanced Airbag Protection System
- Antitheft Alarm System
- Antilock Braking System (ABS)
- Brake Assist System (BAS®)
- Adaptive Braking Technology
- Electronic Stability Program (ESP®)
- ATTENTION ASSIST®
- PRE-SAFE® Predictive Occupant-Protection System
- Crosswind Stabilization
- Blind Spot Assist
- Active Brake Assist
- Rearview Camera
- Automatic Light-Sensing Headlamps
- LED Daytime Running Lamps
- LED Headlamps
- LED Taillamps
- LATCH/ISOFIX Child Restraint System
- Rear Door Child Safety Locks

Suggested Retail Price $44,500

PAINT, UPHOLSTERY, TRIM

896 Brilliant Blue Metallic	720.00
115 Silk Beige MB-Tex	N/C
H33 Natural Grain Walnut Wood Trim	N/C
55U Porcelain Fabric Headliner	N/C

OPTIONAL EQUIPMENT AND VALUE ADDED PACKAGES

R02 All-Season Tires	N/C
242 Passenger Seat Memory w/ Adj. Thigh Support	350.00
413 Panorama Roof	1,500.00
443 Heated Steering Wheel	250.00
464 12.3" Digital Instrument Cluster	750.00
690 Emergency Spare Wheel	200.00
810 Burmester® Surround Sound System	850.00
897 Inductive Wireless Charging & NFC Pairing	200.00
97R 18" Split 5-Spoke Wheels	N/C
D16 LED Logo Projectors	275.00
D19 Rear Trim, Chrome	200.00
D33 All-Season Front Floormats, Black Rubber	120.00
DA2 Driver Assistance Package: Active Distance Assist DISTRONIC®, Active Steering Assist, Active Lane Change Assist, Active Lane Keeping Assist, PRE-SAFE® PLUS, Active Blind Spot Assist, Active Brake Assist w/ Cross-Traffic Function, Evasive Steering Assist, Active Emergency Stop Assist, Active Speed Limit Assist, Route-Based Speed Adaptation	1,700.00
DA5 Multimedia Package: Mercedes-Benz Navigation, Augmented Video for Navigation, Live Traffic, and Speed Limit Assist	1,250.00
DP1 Premium Package: KEYLESS-GO®, SiriusXM® Radio w/ Free Trial Term, 64-Color Ambient Lighting, Illuminated Door Sills	500.00
Destination and Delivery	995.00
Total Retail Price	$54,360.00

Special Messages:

EPA DOT Fuel Economy and Environment

Gasoline Vehicle

Fuel Economy

24 MPG combined city/hwy

21 city

28 highway

Small SUVs range from 18 to 120 MPG. The best vehicle rates 136 MPGe.

4.2 gallons per 100 miles

You **spend $2,750** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost $2,050

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 – 10, Best)

Smog Rating (tailpipe only): 6 (1 – 10, Best)

This vehicle emits 377 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create 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 costs $7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $3.25 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score — Not Rated
Based on the combined ratings of frontal, side and rollover.
Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash — Driver: Not Rated; Passenger: Not Rated
Based on the risk of injury in a frontal impact.
Should ONLY be compared to other vehicles of similar size and weight.

Side Crash — Front seat: Not Rated; Rear seat: Not Rated
Based on the risk of injury in a side impact.

Rollover — Not Rated
Based on the risk of rollover in a single-vehicle crash.

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

PARTS CONTENT INFORMATION

For vehicles in this carline:
U.S./Canadian Parts Content:
17 %
Major Sources of Foreign Parts Content:
GERMANY: 58 %

NOTE: Parts content does not include final assembly, distribution or other non-parts costs.

For this vehicle:
Final Assembly Point:
BREMEN, GERMANY
Country of Origin:
Engine: **USA**
Transmission: **GERMANY**

Ship To:

Port of Entry: **Baltimore**
Transport:

Figure A3. Window Sticker (Monroney Label)

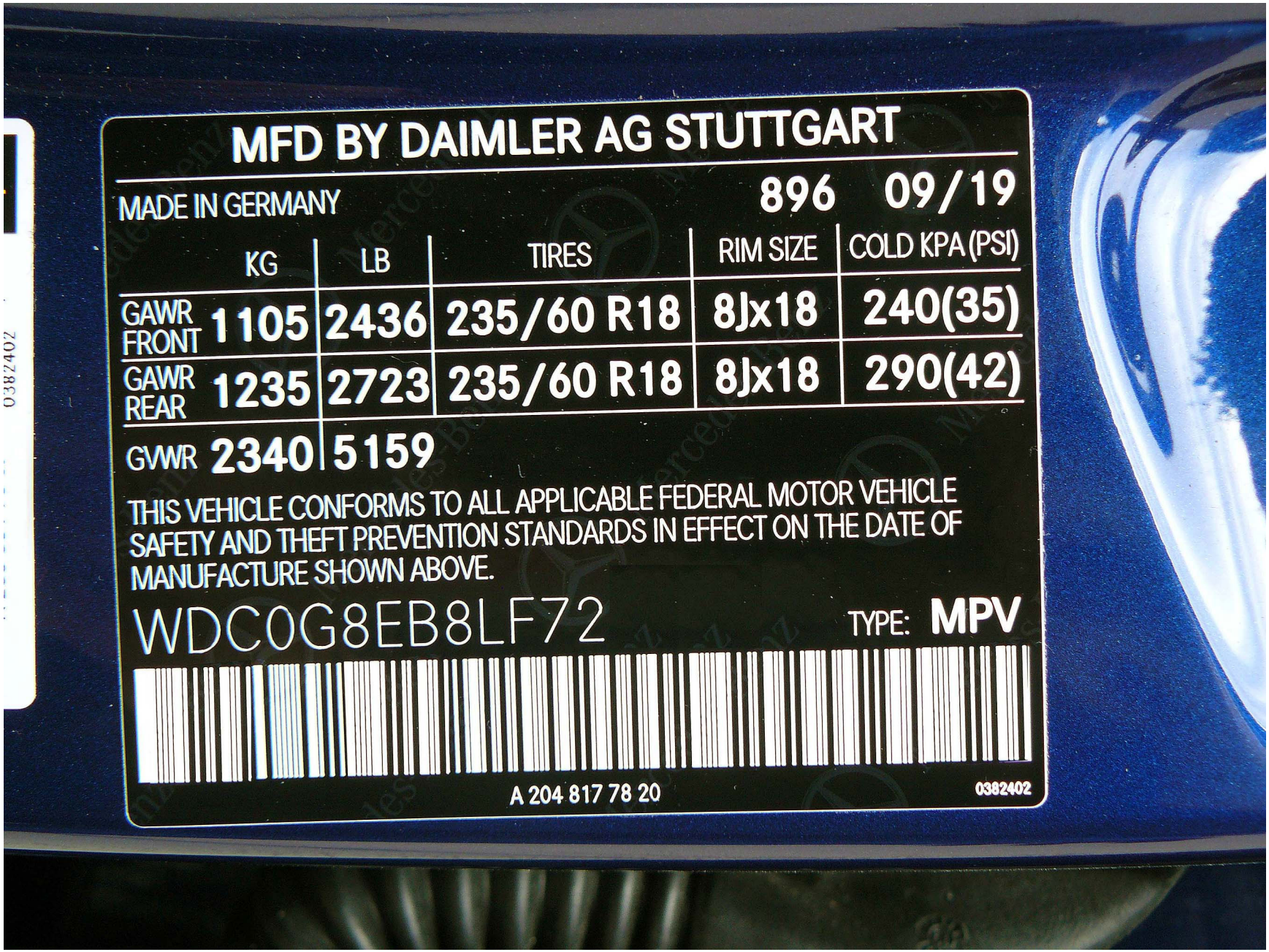


Figure A4. Vehicle Certification Label

Figure A5. Tire Placard

Figure A6. Front View of Principal Other Vehicle: Global Vehicle Target

Figure A7. Rear View of Principal Other Vehicle: Global Vehicle Target

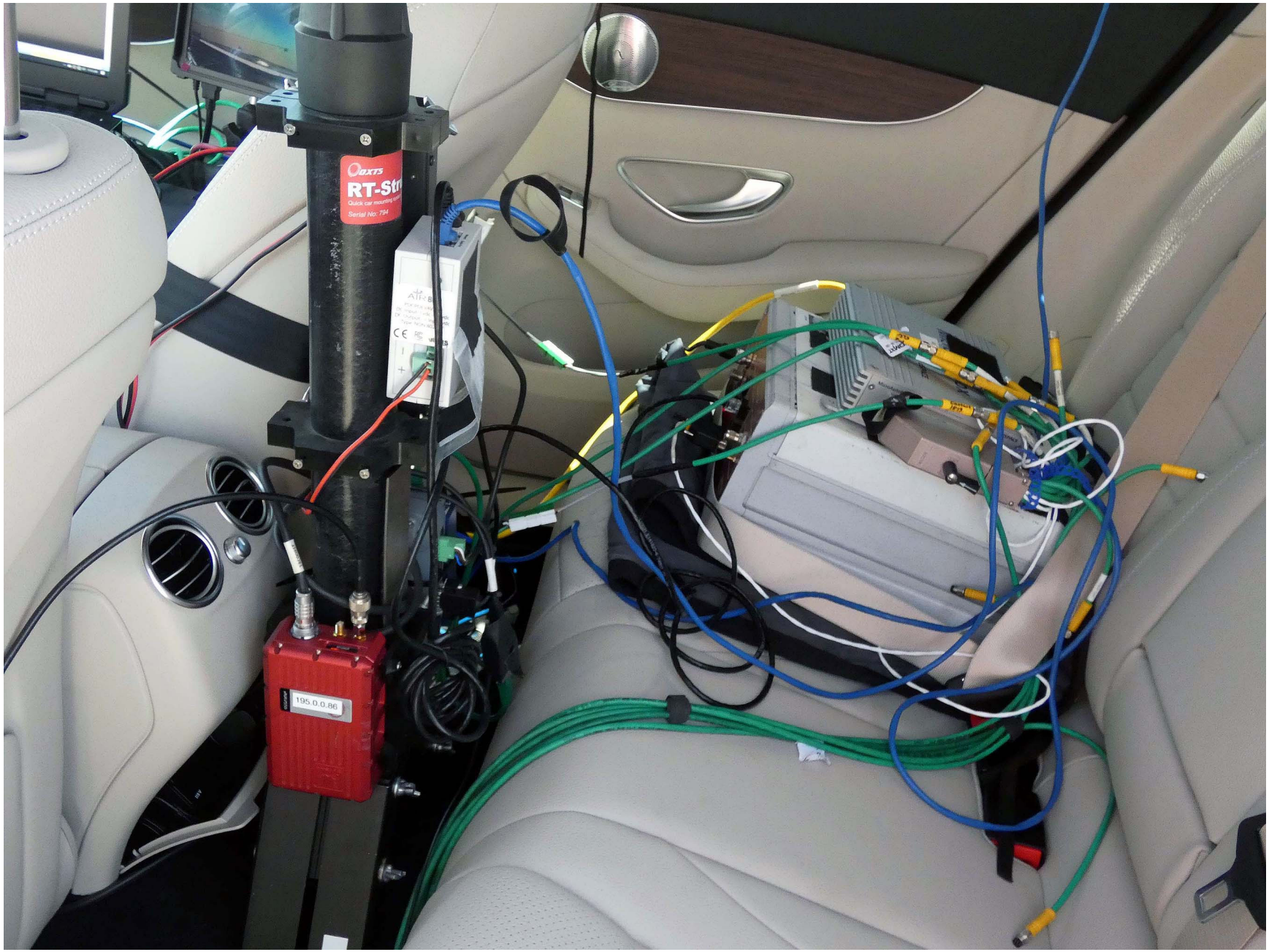


Figure A8. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A9. Sensors for Detecting Auditory and Visual Alerts

Figure A10. Computer Installed in Subject Vehicle

Figure A11. System Setup Menus

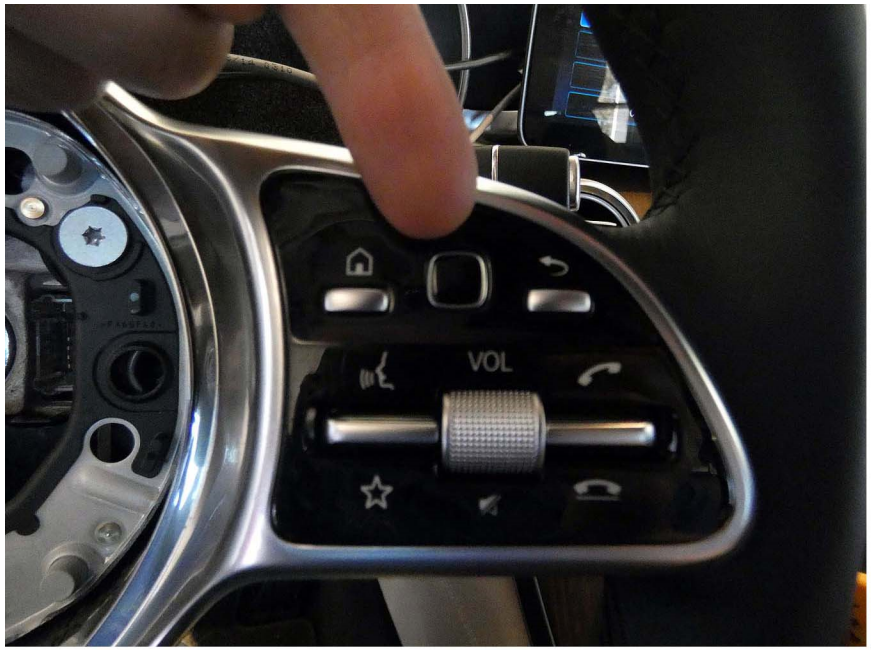


Figure A12. Controls for System Setup

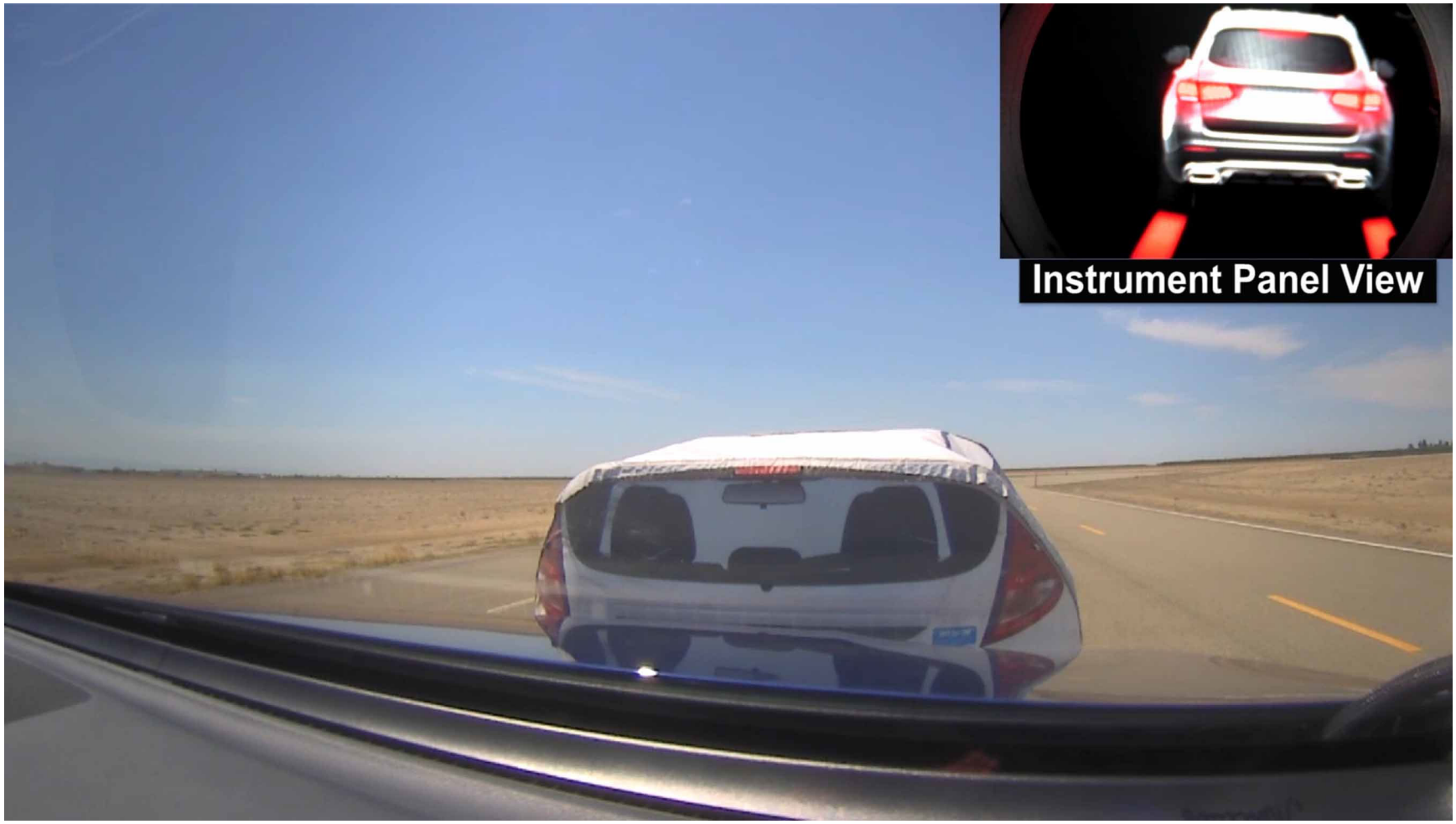
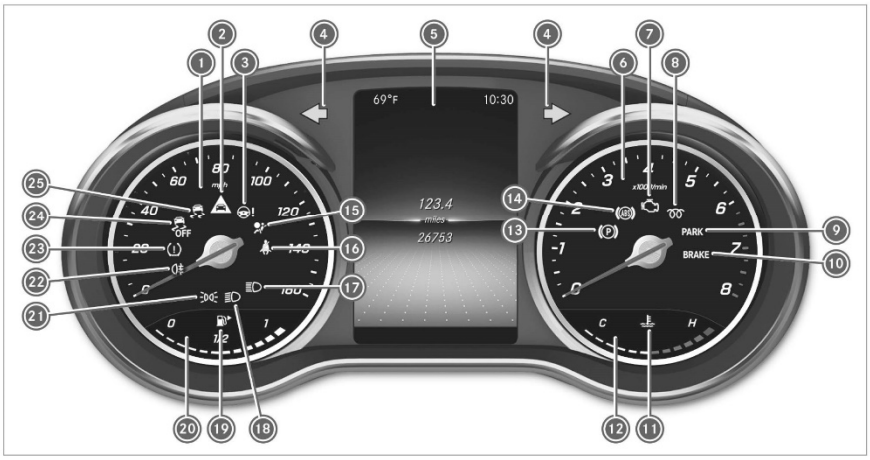


Figure A13. Visual Alert (inset)

APPENDIX B

Excerpts from Owner’s Manual



Instrument Display (standard)

- The engine is switched off.

Multimedia system:

→ ⌂ ▸▸ Settings ▸▸ Vehicle

▶ Switch Standby Mode on or off.
When you activate the function, a prompt appears.

▶ Select Yes.
Standby mode is activated.

Driving and driving safety systems

Driving systems and your responsibility

Your vehicle is equipped with driving systems which assist you in driving, parking and maneuvering the vehicle. The driving systems are aids and do not relieve you of your responsibility pertaining to road traffic law. Pay attention to the traffic conditions at all times and intervene when necessary. Be aware of the limitations regarding the safe use of these systems.

Information on radar and ultrasonic sensors

Some driving and driving safety systems use radar or ultrasonic sensors to monitor the area in front of, behind or next to the vehicle (depending on the vehicle's equipment).

Depending on the vehicle's equipment, the radar sensors are integrated behind the bumpers and/or behind the Mercedes star. The ultrasonic sensors are located in the front and rear bumpers. Keep these parts free of dirt, ice and slush (→ page 433). The sensors must not be covered, for example by bicycle racks, overhanging loads, stickers, foil or foils to protect against stone chipping. Additional license plate brackets can likewise impair the function of the ultrasonic sensors. In the event of damage to the bumpers or radiator grill, or following a collision impacting the bumpers or radiator grill, have the function of the sensors checked at a qualified specialist workshop. If the sensors are damaged, some driving systems and driving safety systems may no longer function properly.

Overview of driving systems and driving safety systems

In this section, you will find information about the following driving systems and driving safety systems:

- 360° Camera (→ page 228)
- ABS (**A**nti-lock **B**raking **S**ystem) (→ page 185)
- Active Distance Assist DISTRONIC (→ page 201)
- AIR BODY CONTROL (→ page 214)
- Active Brake Assist (→ page 191)
- Active Lane Keeping Assist (→ page 245)
- ATTENTION ASSIST (→ page 238)
- BAS (**B**rake **A**ssist **S**ystem) (→ page 186)
- Hill Start Assist (→ page 213)
- DSR (**D**ownhill **S**peed **R**egulation) (→ page 199)
- EBD (**E**lectronic **B**rakeforce **D**istribution) (→ page 191)

Function of ESP® trailer stabilization

WARNING Risk of accident in poor road and weather conditions

In poor road and weather conditions, the trailer stabilization cannot prevent lurching of the vehicle/trailer combination. Trailers with a high center of gravity may tip over before ESP® detects this.

▶ Always adapt your driving style to suit the current road and weather conditions.

When driving with a trailer, ESP® can stabilize your vehicle if the trailer begins to swerve from side to side:

- ESP® trailer stabilization is active above speeds of 40 mph (65 km/h).
- Slight swerving is reduced by means of a targeted, individual brake application on one side.
- In the event of severe swerving, the engine output is also reduced and all wheels are braked.

ESP® trailer stabilization may be impaired or may not function if:

- The trailer is not connected correctly or is not detected properly by the vehicle.

Function of EBD (electronic brake force distribution)

EBD is characterized by the following:

- Monitoring and regulating the brake pressure on the rear wheels.
- Improved driving stability when braking, especially on bends.

Function of STEER CONTROL

STEER CONTROL helps you by transmitting a noticeable steering force to the steering wheel in the direction required for vehicle stabilization.

This steering recommendation is given particularly in the following situations:

- Both right wheels or both left wheels are on a wet or slippery road surface when you brake
- The vehicle starts to skid

System limits

STEER CONTROL may be impaired or may not function in the following situations:

- ESP® is deactivated.
- ESP® is malfunctioning.
- The steering is malfunctioning.

If ESP® is malfunctioning, you will be assisted further by the electric power steering.

Function of Active Brake Assist

Active Brake Assist consists of the following functions:

- Distance warning function
- Autonomous braking function

- Situation-dependent braking assistance
- **Vehicles with Driving Assistance Package:** Evasive Steering Assist and cornering function

Active Brake Assist can help you to minimize the risk of a collision with vehicles, cyclists or pedestrians, or reduce the effects of such a collision.

If Active Brake Assist has detected a risk of collision, a warning tone sounds and the distance warning lamp lights up in the instrument cluster.

If you do not react to the warning, autonomous braking can be initiated in critical situations.

In especially critical situations, Active Brake Assist can initiate autonomous braking directly. In this case, the warning lamp and warning tone occur simultaneously with the braking application.

If you apply the brake yourself in a critical situation or apply the brake during autonomous braking, situation-dependent braking assistance occurs. The brake pressure increases up to maximum full-stop braking if necessary.

If autonomous braking or situation-dependent braking assistance has occurred, display ⓘ appears in the multifunction display and then automatically goes out after a short time.

If the autonomous braking function or the situation-dependent braking assistance is triggered, additional preventive measures for occupant protection (PRE-SAFE®) may also be initiated.

⚠ **WARNING** Risk of an accident caused by limited detection performance of Active Brake Assist

Active Brake Assist cannot always clearly identify objects and complex traffic situations.

In such cases, Active Brake Assist might:

- Give a warning or brake without reason
- Not give a warning or not brake

▶ Always pay careful attention to the traffic situation; do not rely on Active Brake Assist alone. Active Brake Assist is only an aid. The driver is responsible for maintaining a suitable distance to the vehicle in front, vehicle speed and for braking in good time.

▶ Be prepared to brake or swerve if necessary.

ⓘ If the system is unavailable, the OFF display appears in the multifunction display.

Also observe the system limits of Active Brake Assist.

The individual subfunctions are available in the following speed ranges:

The distance warning function issues a warning in the following situations:

- From approximately 4 mph (7 km/h), if your vehicle is critically close to a vehicle or pedestrian, you will hear an intermittent warning tone and the distance warning lamp lights up in the instrument cluster.

Brake immediately or take evasive action, provided it is safe to do so and the traffic situation allows this.

The distance warning function can aid you in the following situations with an intermittent warning tone and a warning lamp:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

The autonomous braking function may intervene at speeds starting from approximately 4 mph (7 km/h) in the following situations:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 124 mph (200 km/h)	Up to approx. 31 mph (50 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

Situation-dependent braking assistance may intervene at speeds starting from approximately 4 mph (7 km/h) in the following situations:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

Canceling a brake application of Active Brake Assist

You can cancel a brake application of Active Brake Assist at any time by:

- Fully depressing the accelerator pedal or with kickdown.
- Releasing the brake pedal.

Active Brake Assist may cancel the brake application when one of the following conditions is fulfilled:

- You maneuver to avoid the obstacle.
- There is no longer a risk of collision.
- An obstacle is no longer detected in front of your vehicle.

Evasive Steering Assist (only vehicles with Driving Assistance Package)

Evasive Steering Assist has the following characteristics:

- The ability to detect stationary or moving pedestrians.
- Assistance through power-assisted steering if it detects a swerving maneuver.

- Activation by an abrupt steering movement during a swerving maneuver.
- Assistance during swerving and straightening of the vehicle.
- Reaction from a speed of approximately 12 mph (20 km/h) up to a speed of approximately 43 mph (70 km/h).

You can prevent the assistance at any time by actively steering.

Cornering function (only vehicles with Driving Assistance Package)
If a danger of collision from an oncoming vehicle is detected when turning across an oncoming lane, autonomous braking can be initiated at speeds below 9 mph (15 km/h) before you have left the lane in which you are driving.

⚠ **WARNING** Risk of an accident despite Evasive Steering Assist

Evasive Steering Assist cannot always clearly identify objects and complex traffic situations.

In addition, the steering support of Evasive Steering Assist is generally not sufficient to avoid a collision.

In such cases Evasive Steering Assist can:

- give an unnecessary warning or provide assistance
- not give a warning or not provide assistance

▶ Always pay careful attention to the traffic situation; do not rely on Evasive Steering Assist alone.
▶ Be ready to brake and take evasive action if necessary.
▶ Prevent the assistance by actively steering in non-critical driving situations.
▶ Drive at an appropriate speed if pedestrians are close to the path of your vehicle.

System limits
Full system performance is not available for a few seconds after switching on the ignition or after driving off.

The system may be impaired or may not function in the following situations:

- In snow, rain, fog, heavy spray, if there is glare, in direct sunlight or in greatly varying ambient light.
- If the sensors are dirty, fogged up, damaged or covered.
- If the sensors are impaired due to interference from other radar sources, e.g. strong radar reflections in parking garages.
- If a loss of tire pressure or a faulty tire has been detected and displayed.
- If DSR is activated.
- In complex traffic situations where objects cannot always be clearly identified.
- If pedestrians or vehicles move quickly into the sensor detection range.
- If pedestrians are hidden by other objects.

- If the typical outline of a pedestrian cannot be distinguished from the background.
- If a pedestrian is not detected as such, e.g. due to special clothing or other objects.
- On bends with a tight radius.

ⓘ The Active Brake Assist sensors adjust automatically while a certain distance is being driven after the vehicle has been delivered. Active Brake Assist is unavailable or only partially available during this teach-in period.

Setting Active Brake Assist

Requirements:

- The ignition is switched on.

Multimedia system:

→ ⌂ ▸▸ Settings ▸▸ Assistance ▸▸ Active Brake Assist

The following settings are available:

- Early
- Medium
- Late

▶ Select a setting.
The setting is retained when the engine is next started.

Deactivating Active Brake Assist

ⓘ It is recommended that you always leave Active Brake Assist activated.

▶ Select Off.
The distance warning function, the autonomous braking function and the Evasive Steering Assist are deactivated.
When the vehicle is next started, the middle setting is automatically selected.

ⓘ If Active Brake Assist is deactivated, the symbol appears in the status bar of the multifunction display.

Speed control cruise control

Function of cruise control
Cruise control regulates the speed to the value selected by the driver.

If you accelerate to overtake, for example, the stored speed is not deleted. If you remove your foot from the accelerator pedal after overtaking, cruise control will resume speed regulation back to the stored speed.

Cruise control is operated using the corresponding steering wheel buttons. You can store any speed above 15 mph (20 km/h) up to the maximum speed.

If you fail to adapt your driving style, cruise control can neither reduce the risk of an accident nor override the laws of physics. It cannot take into account road, weather or traffic conditions. Cruise control is only an aid. The driver is responsible for the distance to the vehicle in front, for vehicle speed, for braking in good time and for staying in lane.

Mercedes-AMG vehicles: Cruise control is available up to a maximum speed of 155 mph (250 km/h).

Displays on the multifunction display
The status of cruise control and the stored speed are shown in the multifunction display.

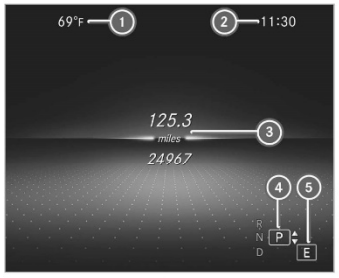
The following display content can be selected in the Classic and Sport designs:

- Tachometer
- Navigation
- ECO display
- Consumption
- G-meter

The following content can be selected in the Progressive design:

- date
- Navigation
- ECO display
- Consumption
- G-meter

Overview of displays on the multifunction display



1. Outside temperature
2. Time
3. Display section
4. Transmission position
5. Drive program

Further displays on the multifunction display:

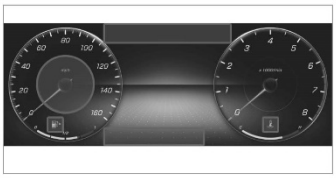
- Gearshift recommendation (→ page 171)
- Active Parking Assist activated (→ page 234)
- Parking Assist PARKTRONIC deactivated (→ page 224, 223, 224)
- Cruise control (→ page 197)
- DSR (→ page 199)
- Active Distance Assist DISTRONIC (→ page 201)
- Active Brake Assist(→ page 197)
- Active Steering Assist (→ page 207)
- Active Lane Keeping Assist (→ page 245)
- Active Lane Change Assist (→ page 209)
- ECO start/stop function (→ page 162)
- HOLD function (→ page 213)
- Adaptive Highbeam Assist (→ page 133)

Vehicles with Traffic Sign Assist: Detected instructions and traffic signs (→ page 240).

Display messages	Possible causes/consequences and ▶ Solutions
	▶ Drive on carefully. ▶ Consult a qualified specialist workshop immediately.
Active Brake Assist Functions Currently Limited See Operator's Manual	* **Vehicles with the Driving Assistance Package:** Active Brake Assist with cross-traffic function, Evasive Steering Assist or PRE-SAFE® PLUS are temporarily unavailable or only partially available. **Vehicles without the Driving Assistance Package:** Active Brake Assist is temporarily unavailable or only partially available. The ambient conditions are outside the system limits (→ page 191). ▶ Drive on. As soon as the ambient conditions are within the system limits, the system will become available again. ▶ If the display message does not disappear, stop the vehicle in accordance with the traffic conditions and restart the engine.
Active Brake Assist Functions Limited See Operator's Manual	* **Vehicles with Driving Assistance Package:** Active Brake Assist with cross-traffic function, Evasive Steering Assist or PRE-SAFE® PLUS is malfunctioning. **Vehicles without Driving Assistance Package:** Active Brake Assist is malfunctioning. ▶ Consult a qualified specialist workshop.
Radar Sensors Dirty See Operator's Manual	* The radar sensor system is malfunctioning. Possible causes: • Dirt on the sensors • Heavy rain or snow • Extended country driving without other traffic, e.g. in the desert

Instrument Display (standard)

Widescreen Cockpit Instrument Display



Depending on the display setting, the positions of the indicator lamps on the Instrument Display may differ from the example shown.

Indicator and warning lamps:

- Low beam (→ page 130)
- Parking lamps (→ page 130)
- High beam (→ page 131)
- Turn signal lights (→ page 131)
- Rear fog lamp (→ page 130)
- Restraint system (→ page 555)
- Seat belt not fastened (→ page 555)
- BRAKE USA: brakes (red) (→ page 560)
- Canada: brakes (red) (→ page 560)
- Electric parking brake (yellow) (→ page 560)
- PARK USA: electric parking brake applied (red) (→ page 560)
- Canada: electric parking brake applied (red) (→ page 560)
- ABS malfunction (→ page 563)
- ESP® (→ page 563)
- ESP® OFF (→ page 563)
- Distance warning (→ page 562)
- Electric power steering malfunction (→ page 556)
- AIR BODY CONTROL malfunction (→ page 562)
- Check Engine (→ page 557)
- Electrical malfunction (→ page 557)
- Fuel reserve with fuel filler cap location indicator (→ page 557)
- Coolant too hot/cold (→ page 557)
- Tire pressure monitor (→ page 566)

Warning/indicator lamp	Possible causes/consequences and ▶ Solutions
	▶ Observe the messages on the multifunction display. ▶ Consult a qualified specialist workshop.

Driving systems

Warning/indicator lamp	Possible causes/consequences and ▶ Solutions
 Warning lamp for distance warning function	The red distance warning lamp lights up while the vehicle is in motion. * The distance to the vehicle in front is too small for the speed selected. If there is an additional warning tone, you are approaching an obstacle at too high a speed. ▶ Be prepared to brake immediately. ▶ Increase the distance. Function of Active Brake Assist (→ page 191).
 Suspension warning lamp	The yellow AIR BODY CONTROL warning lamp is lit. * A malfunction has occurred in the AIR BODY CONTROL. ▶ Note the messages on the multifunction display.

APPENDIX C

Run Log

Subject Vehicle: **2020 Mercedes-Benz GLC 300 4Matic SUV** Test Date: **6/11/2020**

Principal Other Vehicle: **GVT**

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
36	**Stopped POV, 25 mph**	Y	1.79	0.98	25.5	0.98	0.92	Yes	
37		Y	N/A	0.00	0.2	0.13	N/A	No	
38		Y	1.78	1.73	25.2	0.96	0.95	Yes	
39		Y	1.77	1.11	25.2	0.95	0.95	Yes	
40		Y	1.79	1.54	24.8	0.94	0.93	Yes	
41		Y	1.78	1.39	24.7	0.95	0.85	Yes	
42		Y	1.80	1.48	25.1	0.92	0.94	Yes	
47	**Stopped POV, 30 mph**	Y	2.02	1.21	29.7	0.99	0.99	Yes	
48		Y	2.04	0.98	29.5	0.95	0.99	Yes	
49		Y	2.00	1.26	29.8	0.95	0.97	Yes	
50		Y	1.99	2.75	29.7	0.96	1.00	Yes	
51		Y	2.01	0.36	30.0	0.98	1.01	Yes	
52	Static Run								
53	**Stopped POV, 35 mph**	Y	2.13	0.40	34.7	1.00	1.14	Yes	
54		Y	2.09	0.00	28.6	0.96	1.16	Yes	
55		Y	2.14	0.00	28.1	0.94	1.15	Yes	

5 The acceptability criteria listed herein are used only as a guide to gauge vehicle performance, and are identical to the Pass/Fail criteria given in the New Car Assessment Program's most current Test Procedure in docket NHTSA-2015-0006-0025; CRASH IMMINENT BRAKE SYSTEM PERFORMANCE EVALUATION FOR THE NEW CAR ASSESSMENT PROGRAM, October 2015.

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
56		Y	2.08	0.19	34.9	0.96	1.16	Yes	
57		Y	2.10	0.00	29.7	0.96	1.15	Yes	
58	Static Run								
59	**Stopped POV, 40 mph**	Y	2.19	0.00	31.5	0.95	1.34	Yes	
60		Y	2.20	0.00	35.1	0.96	1.36	Yes	
61		Y	2.22	0.00	31.8	0.94	1.36	Yes	
62		Y	2.21	0.00	30.2	0.94	1.35	Yes	
63		Y	2.18	0.00	28.8	0.91	1.32	Yes	
64	Static Run								
65	**Stopped POV, 45 mph**	Y	2.26	0.00	36.2	0.97	1.49	Yes	
66		Y	2.25	0.00	35.6	0.95	1.46	Yes	
67		Y	2.26	0.00	36.2	0.97	1.49	Yes	
68		Y	2.27	0.00	37.3	1.01	1.49	Yes	
69		Y	2.25	0.00	37.0	0.97	1.46	Yes	
70	Static Run								
1	Static Run								
2	**Slower POV, 25 mph**	N							GPS Fix Type
3		N							POV Speed
4		N							POV Speed
5		N							POV Speed

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
6		N							Bad Headway Zero
7		N							Bad Headway Zero
8		N							Bad Headway Zero
9		N							Bad Headway Zero
10		N							Bad Headway Zero
11		N							Bad Headway Zero
12		N							Bad Headway Zero
13		Y	1.65	2.28	14.9	0.61	0.78	Yes	
14		Y	1.61	1.23	14.8	0.90	0.74	Yes	
15		Y	1.63	3.99	15.2	1.02	0.74	Yes	
16		Y	1.61	4.00	14.9	1.03	0.73	Yes	
17		Y	1.62	3.17	15.1	0.62	0.80	Yes	
18		Y	1.58	2.85	15.0	0.62	0.79	Yes	
19		Y	1.63	4.28	15.0	0.99	0.76	Yes	
20	Static Run								
21	**Slower POV, 45 mph**	N							POV Speed, Throttle
22		Y	2.34	3.36	24.2	0.99	1.06	Yes	
23		Y	2.32	3.39	25.1	0.64	1.16	Yes	
24		N							POV Speed
25		Y	2.36	1.86	24.7	0.64	1.08	Yes	
26		Y	2.36	1.26	25.1	0.64	1.08	Yes	
27		Y	2.30	4.10	25.0	0.64	1.16	Yes	

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
28		Y	2.27	4.69	25.1	0.63	1.17	Yes	
29		Y	2.32	2.98	24.5	0.96	1.06	Yes	
30	Static Run								
31	Static Run								
32	**Decelerating POV, 35 mph, 0.3g**	N							POV Lateral Position, Throttle
33		N							POV Lateral Position, Speed, Braking
34		N							POV Lateral, Speed, Braking
35	Static Run								
43	Static Run								
44	**Decelerating POV, 35 mph, 0.3g**	Y	1.85	4.04	20.7	0.96	0.96	Yes	
45		N							POV Speed, Lateral, Braking
46	Static Run								
71	Static Run								
72	**Decelerating POV, 35 mph, 0.3g**	N							POV Lateral, Speed
73		N							POV Braking, Speed
74		N							Braking System Light, POV Lateral, POV Braking
75	Static Run								
76	**Decelerating POV, 35 mph, 0.3g**	N							POV did not get up to speed
77		N							POV Braking, Lateral
78		N							POV Braking
79		N							POV Braking

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
80		Y	1.84	7.82	22.1	0.99	0.92	Yes	
81		Y	1.87	0.00	21.8	0.98	0.60	Yes	
82		Y	1.88	7.43	22.5	1.00	0.95	Yes	
83		Y	1.89	7.33	22.8	1.00	0.97	Yes	
84		Y	1.98	5.45	23.2	0.95	0.84	Yes	
85		N							POV Braking
86		N							POV Braking
87		N							POV Lateral
88		N							POV Lateral
89		N							POV Lateral
90		N							POV Lateral
91		Y	1.83	3.99	24.2	0.99	1.20	Yes	
92	Static Run								
93	**Decelerating POV, 35 mph, 0.5g**	N							POV Lateral
94		N							POV Lateral
95		Y	1.79	6.50	33.7	1.05	1.06	Yes	
96		N							POV Speed
97	Static Run								

Run	Test Type	Valid Run?	FCW TTC (s)	Min. Distance (ft)	Speed Reduction (mph)	Peak Decel. (g)	CIB TTC (s)	Acceptability Criteria met [5]	Notes
98	**Decelerating POV, 35 mph, 0.5g**	Y	1.83	5.72	33.0	1.10	1.04	Yes	
99		Y	1.76	5.55	35.2	1.10	1.03	Yes	
100		N							POV Braking
101		Y	1.78	0.00	14.2	0.61	1.04	Yes	
102		Y	1.72	3.71	35.1	1.05	1.03	Yes	
103	**Decelerating POV, 45 mph, 0.3g**	N							POV Braking
104		Y	1.99	0.00	21.3	0.93	0.93	Yes	
105		Y	1.97	6.52	22.6	1.07	0.80	Yes	
106		N							POV Braking
107		N							POV Lateral
108		Y	1.95	4.21	24.2	1.04	1.18	Yes	
109		Y	1.96	0.00	11.4	0.59	0.77	Yes	
110		N							POV Lateral
111		Y	2.00	0.00	1.0	0.09	N/A	No	

APPENDIX D

Time History Plots

LIST OF FIGURES

Description of Time History Plots

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from both the Subject Vehicle (SV) and the Principal Other Vehicle (POV), as well as pass/fail envelopes and thresholds. The following is a description of data types shown in the time history plots, as well as a description of the color codes indicating to which vehicle the data pertain.

Time History Plot Description

Each time history plot consists of data relevant to the test type under consideration, and therefore the data channels plotted vary according to test type. The test types (shown in the plot titles) include:

Stopped POV (SV at 25 mph)
Stopped POV (SV at 30 mph)
Stopped POV (SV at 35 mph)
Stopped POV (SV at 40 mph)
Stopped POV (SV at 45 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)
Decelerating POV 35 mph (Both vehicles at 35 mph with 13.8 m gap, POV brakes at 0.5 g)
Decelerating POV 45 mph (Both vehicles at 45 mph with 13.8 m gap, POV brakes at 0.3 g)

Time history figures include the following sub-plots:

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

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

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

- Headway (ft) – Longitudinal separation (gap) between the front-most point of the Subject Vehicle and the rearmost point of the Global Vehicle Target (GVT). The minimum headway during the run is displayed to the right of the subplot.

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

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

- Lateral Offset (ft) – Lateral offset within the lane of the Subject Vehicle to the center of the lane of travel. The lateral offset is defined to be the lateral distance between the centerline of the SV and the centerline of the POV.

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

- Accelerator Pedal Position (0-1) – Normalized position of the accelerator pedal.

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

Envelopes and Thresholds

Some of the time history plot figures contain either green or yellow envelopes and/or black threshold lines. These envelopes and thresholds are used to programmatically and visually determine the validity of a given test run. Envelope and threshold exceedances are indicated with either red shading or red asterisks, and red text is placed to the right side of the plot indicating the type of exceedance. Such exceedances indicate either that the test was invalid or that the requirements of the test were not met (i.e., failure of the AEB system).

For plots with green envelopes, in order for the test to be valid, the time-varying data must not exceed the envelope boundaries at any time. Exceedances of a green envelope are indicated by red shading in the area between the measured time-varying data and the envelope boundaries.

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

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

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

For the accelerator pedal position plot, a green envelope is given starting 500 ms after the onset of the FCW warning to ensure that the accelerator pedal was released at the correct time and remained off for the duration of the CIB event.

Color Codes

Color codes have been adopted to easily identify which data correspond to which vehicle, as well as to indicate the types of envelopes and thresholds used in the plots.

Color codes can be broken into four categories:

1. Time-varying data
2. Validation envelopes and thresholds
3. Individual data points
4. Text

1. Time-varying data color codes:
   - Blue = Subject Vehicle data
   - Magenta = Principal Other Vehicle data
   - Brown = Relative data between SV and POV (i.e., TTC, lateral offset and headway distance)

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

3. Individual data point color codes:
   - Green circle = passing or valid value at a given moment in time
   - Red asterisk = failing or invalid value at a given moment in time

4. Text color codes:
   - Green = passing or valid value
   - Red = failing or invalid value

Other Notations

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

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

Examples of time history plots for each test type (including passing, failing and invalid runs) are shown in Figures D1 through Figure D7. Figures D1 through D4 show passing runs for each of the 4 test types. Figures D5 and D6 show examples of invalid runs. Figure D7 shows an example of a valid test that failed the CIB requirements.

Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure D8.

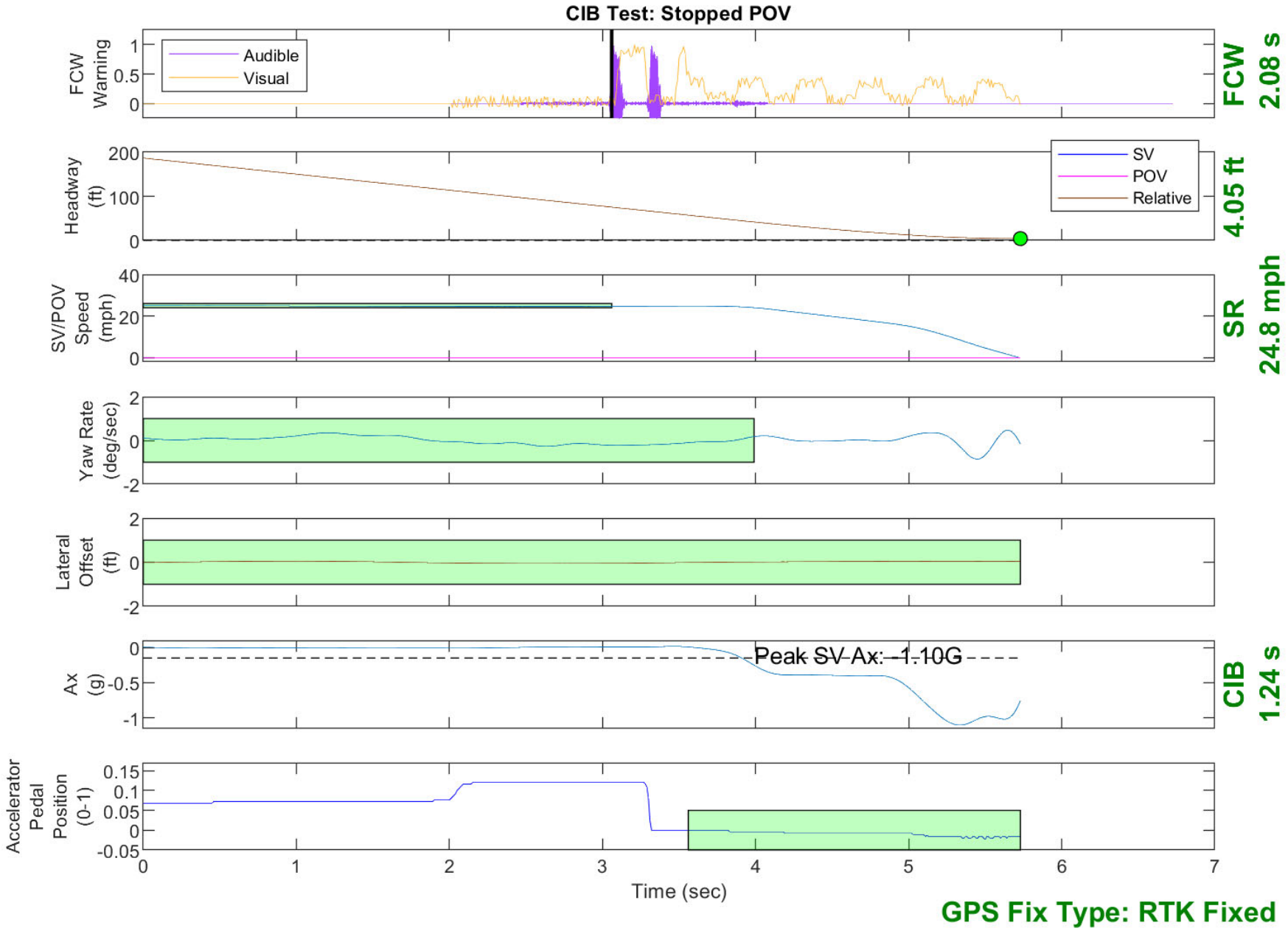


Figure D1. Example Time History for Stopped POV, Passing

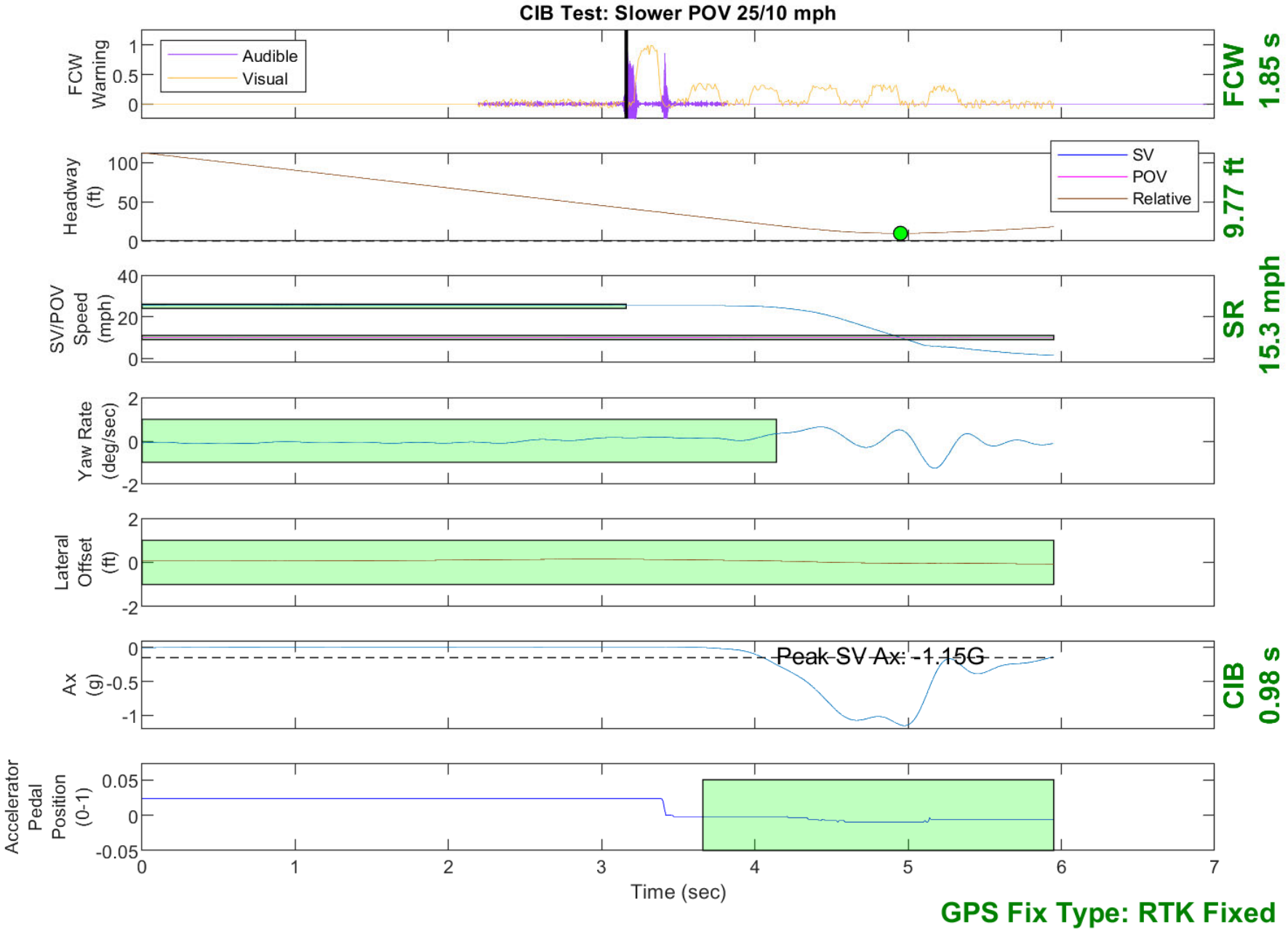


Figure D2. Example Time History for Slower POV 25 vs. 10, Passing

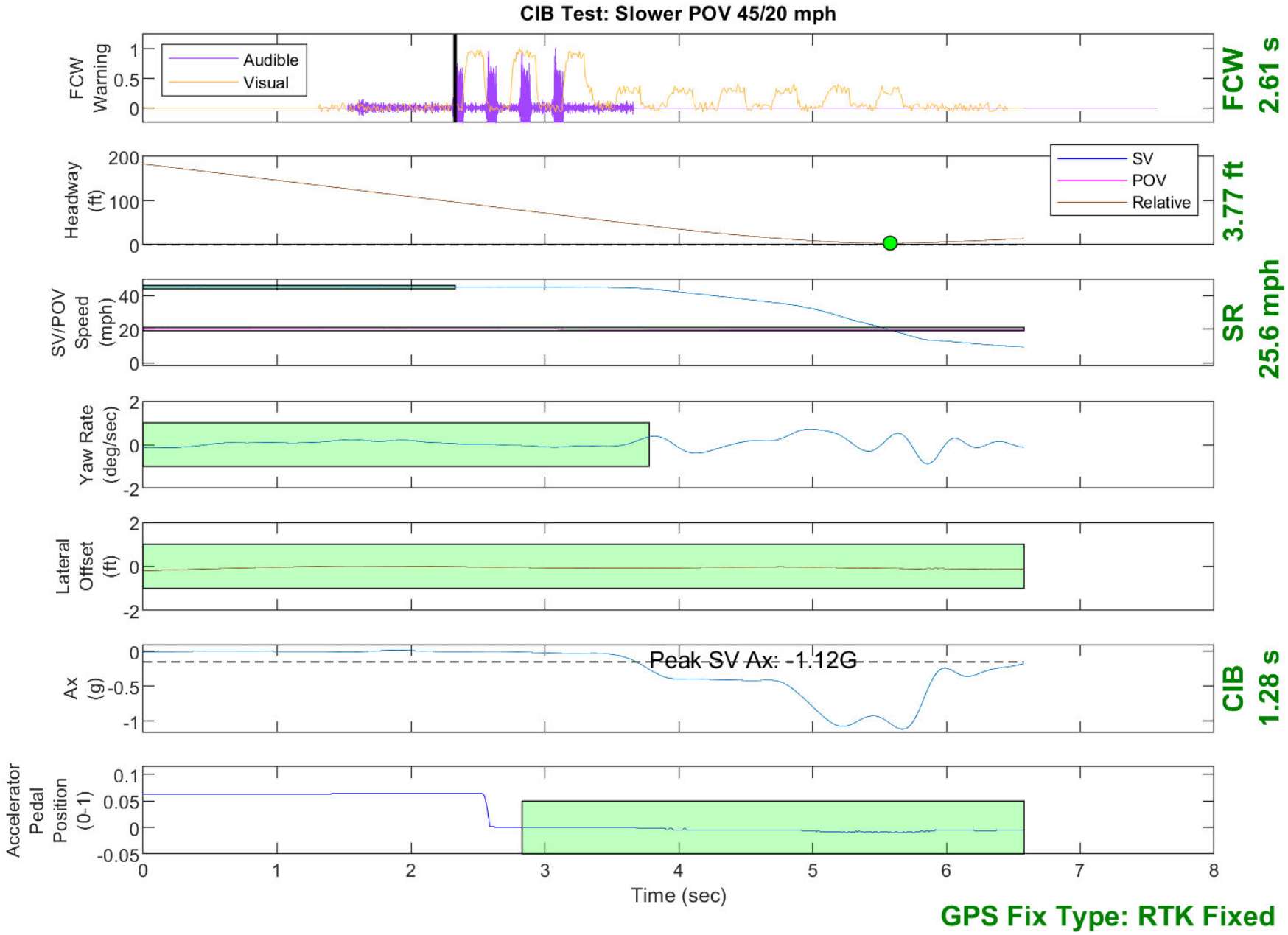


Figure D3. Example Time History for Slower POV 45 vs. 20, Passing

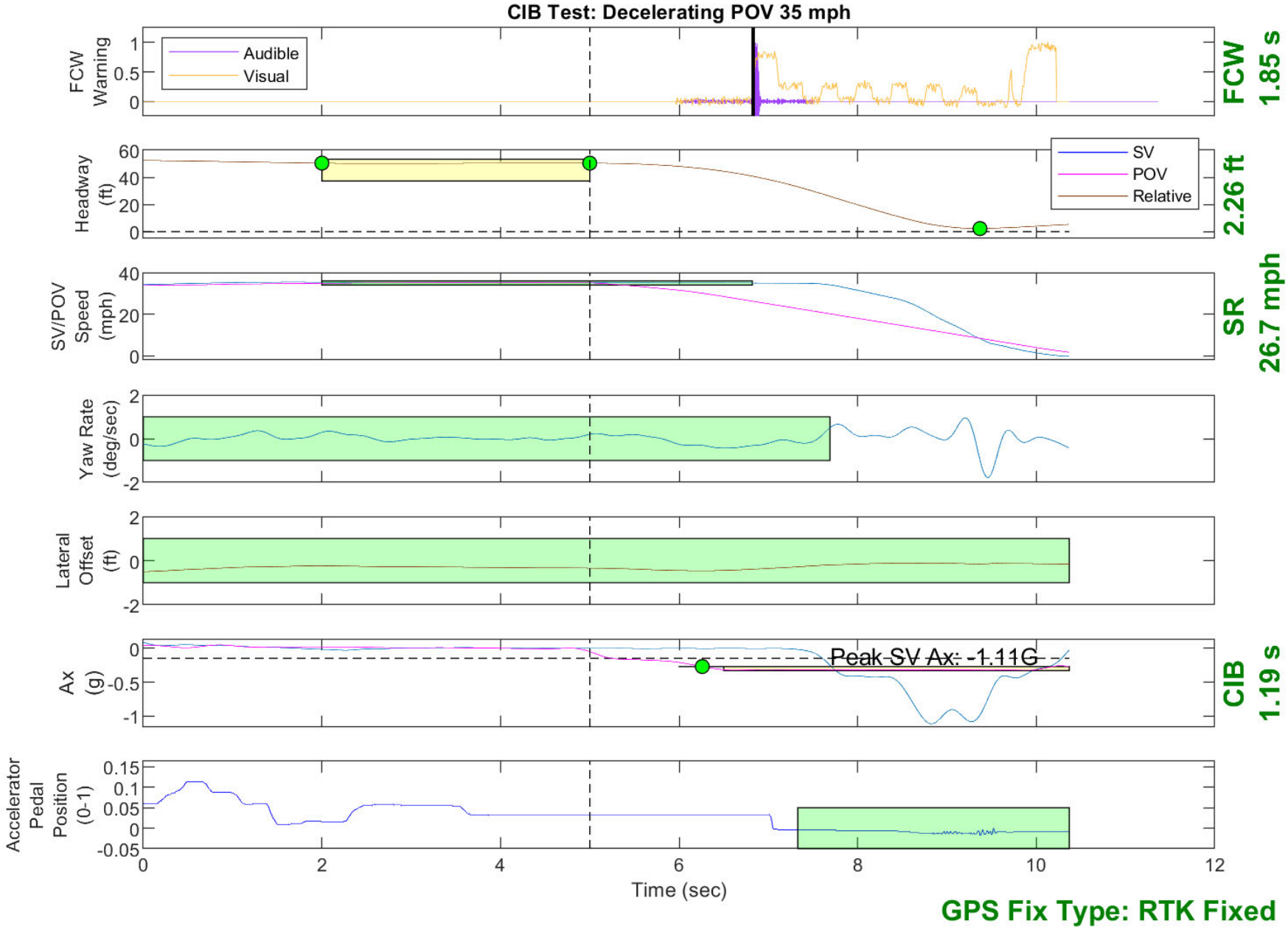


Figure D4. Example Time History for Decelerating POV 35, Passing

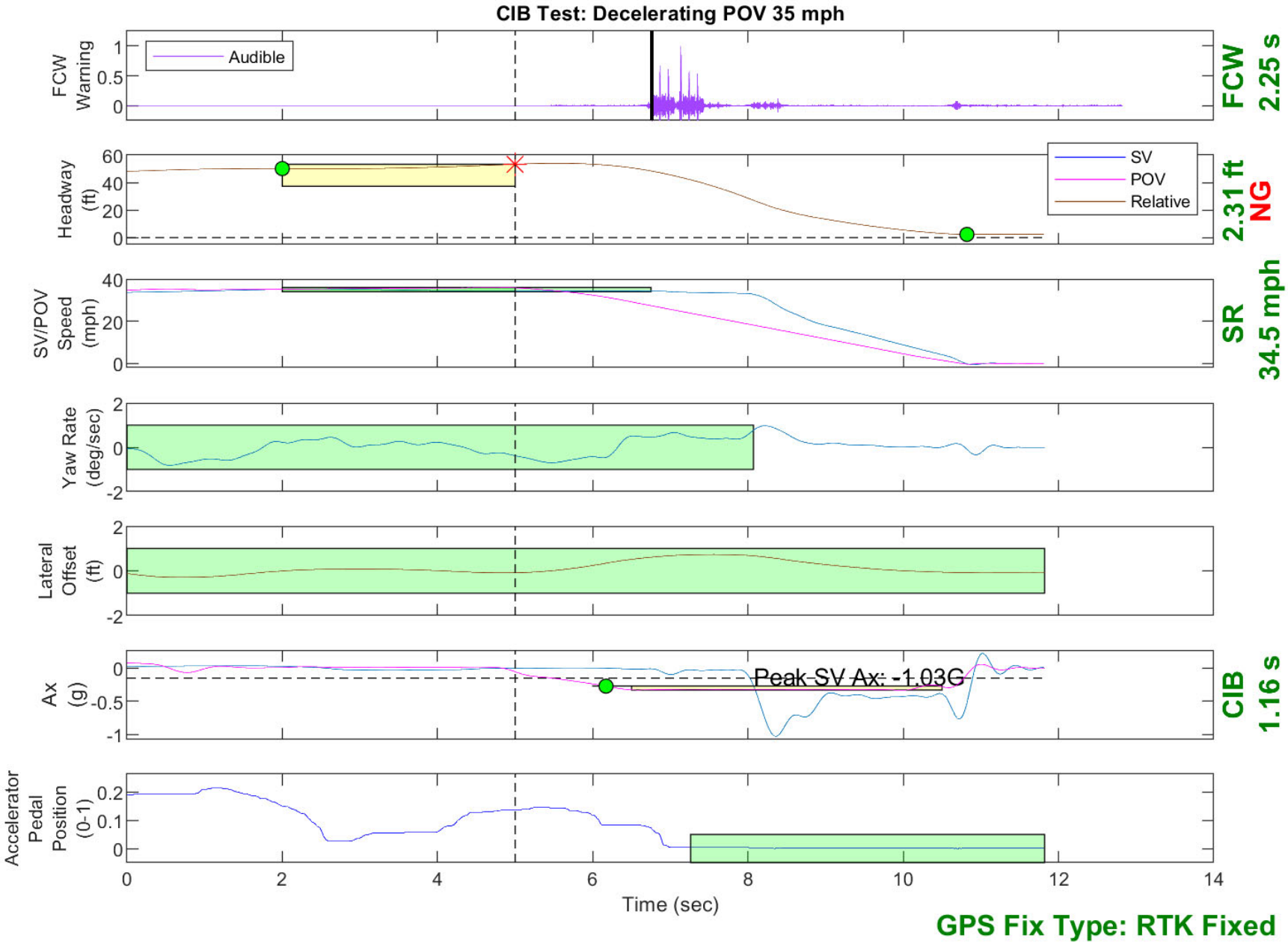


Figure D5. Example Time History Displaying Invalid Headway Criteria

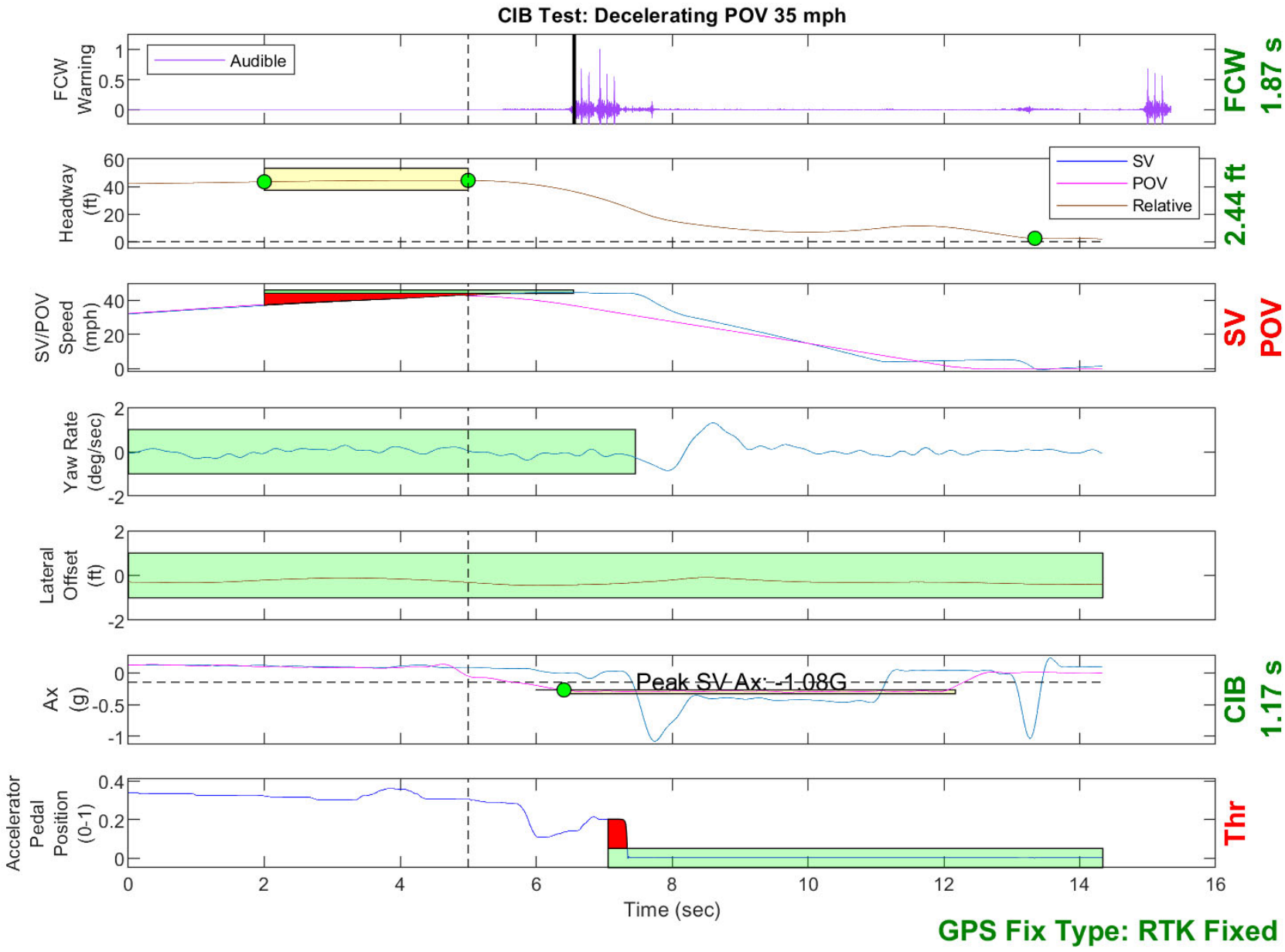


Figure D6. Example Time History Displaying Various Other Invalid Criteria

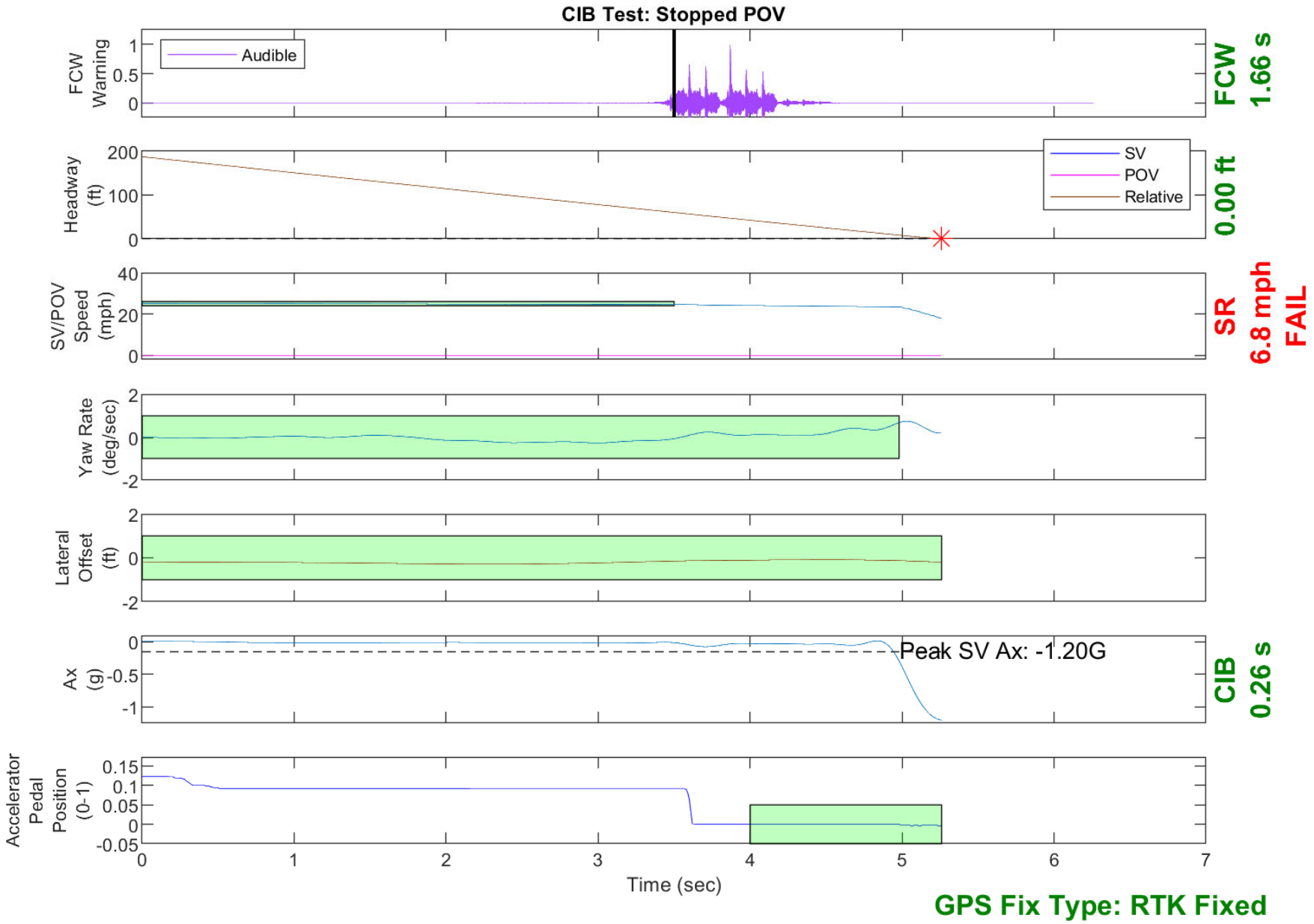


Figure D7. Example Time History for a Failed Run

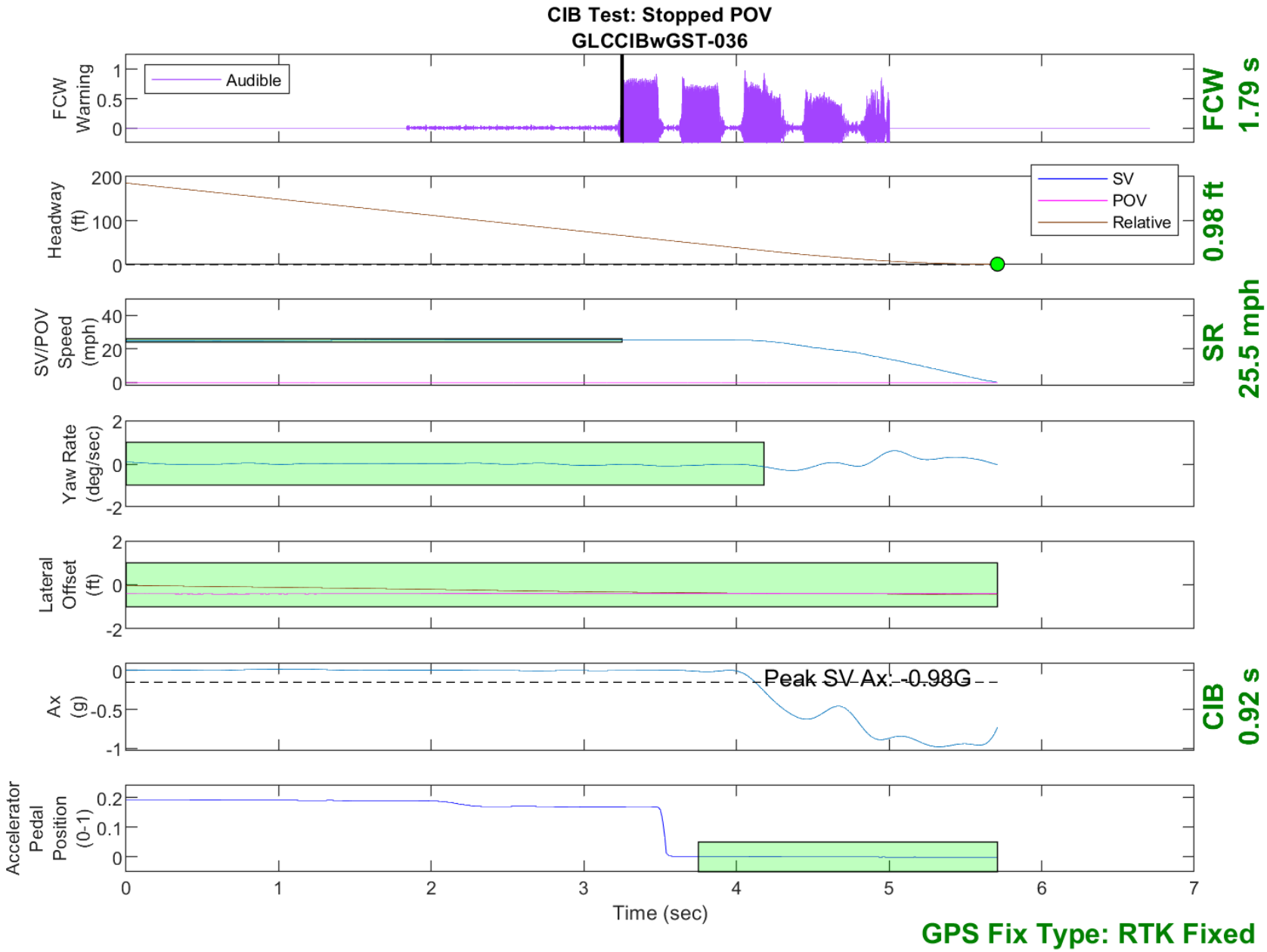


Figure D8. Time History for CIB Run 36, Stopped POV, 25 mph

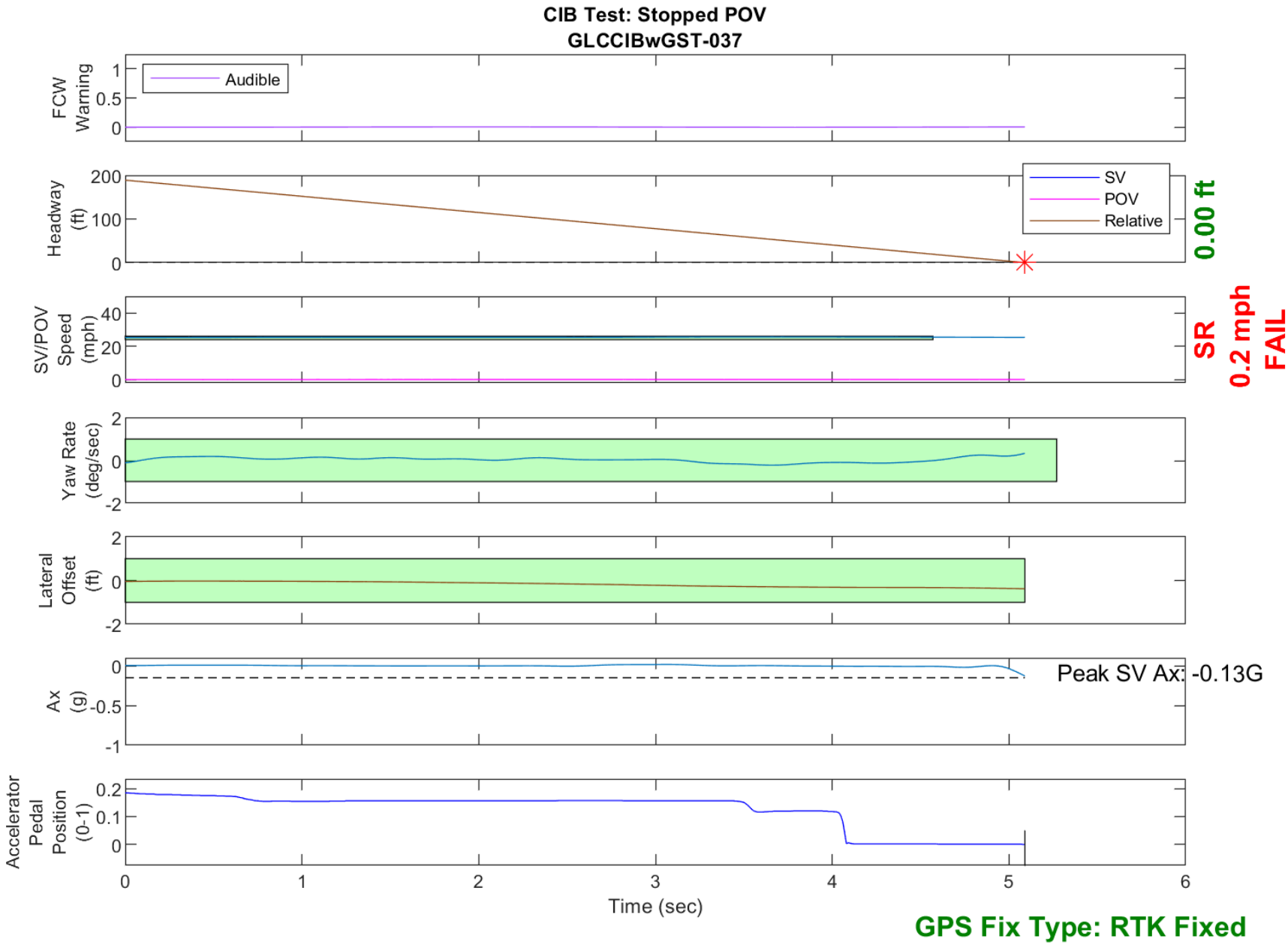


Figure D9. Time History for CIB Run 37, Stopped POV, 25 mph

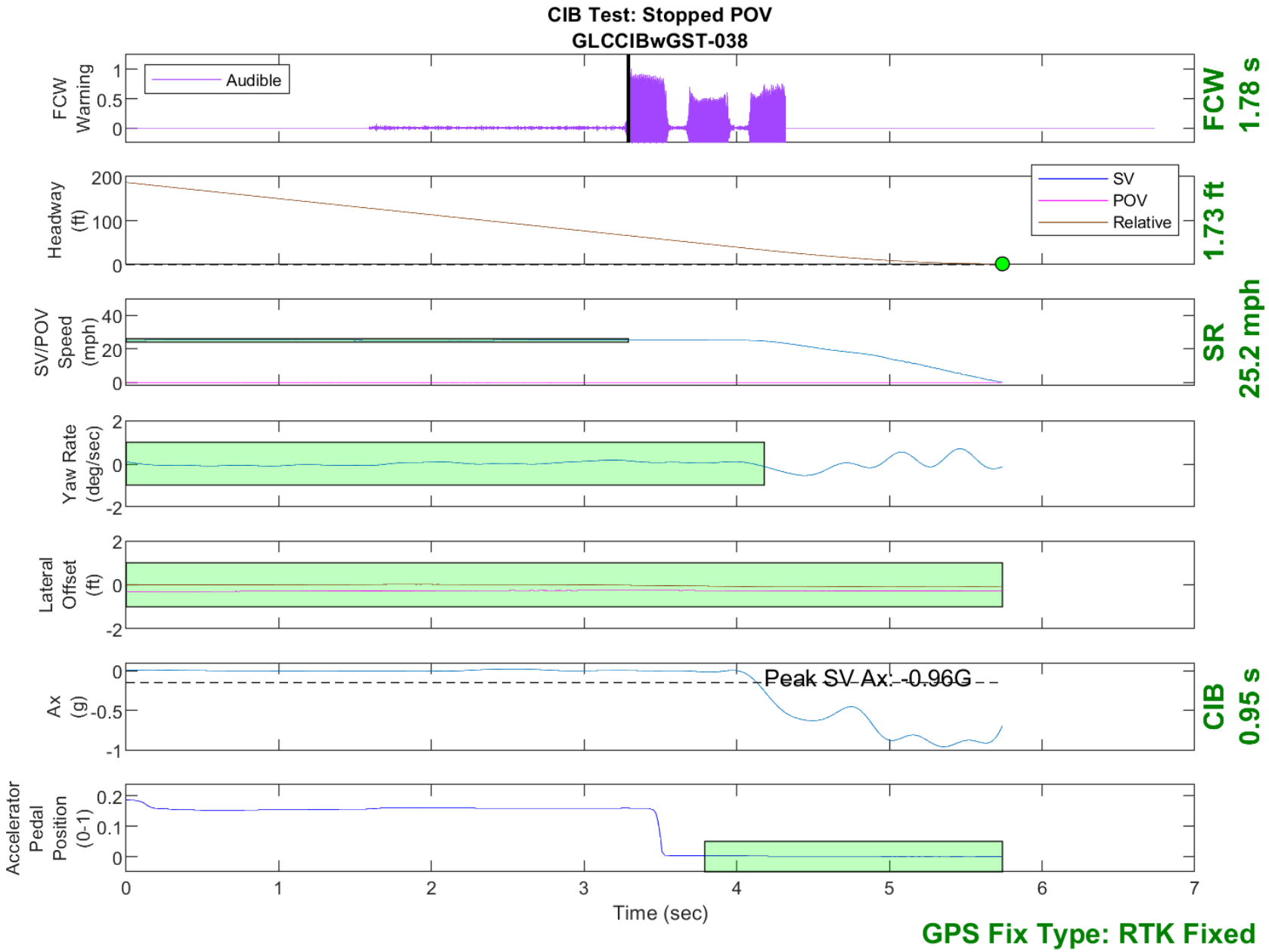


Figure D10. Time History for CIB Run 38, Stopped POV, 25 mph

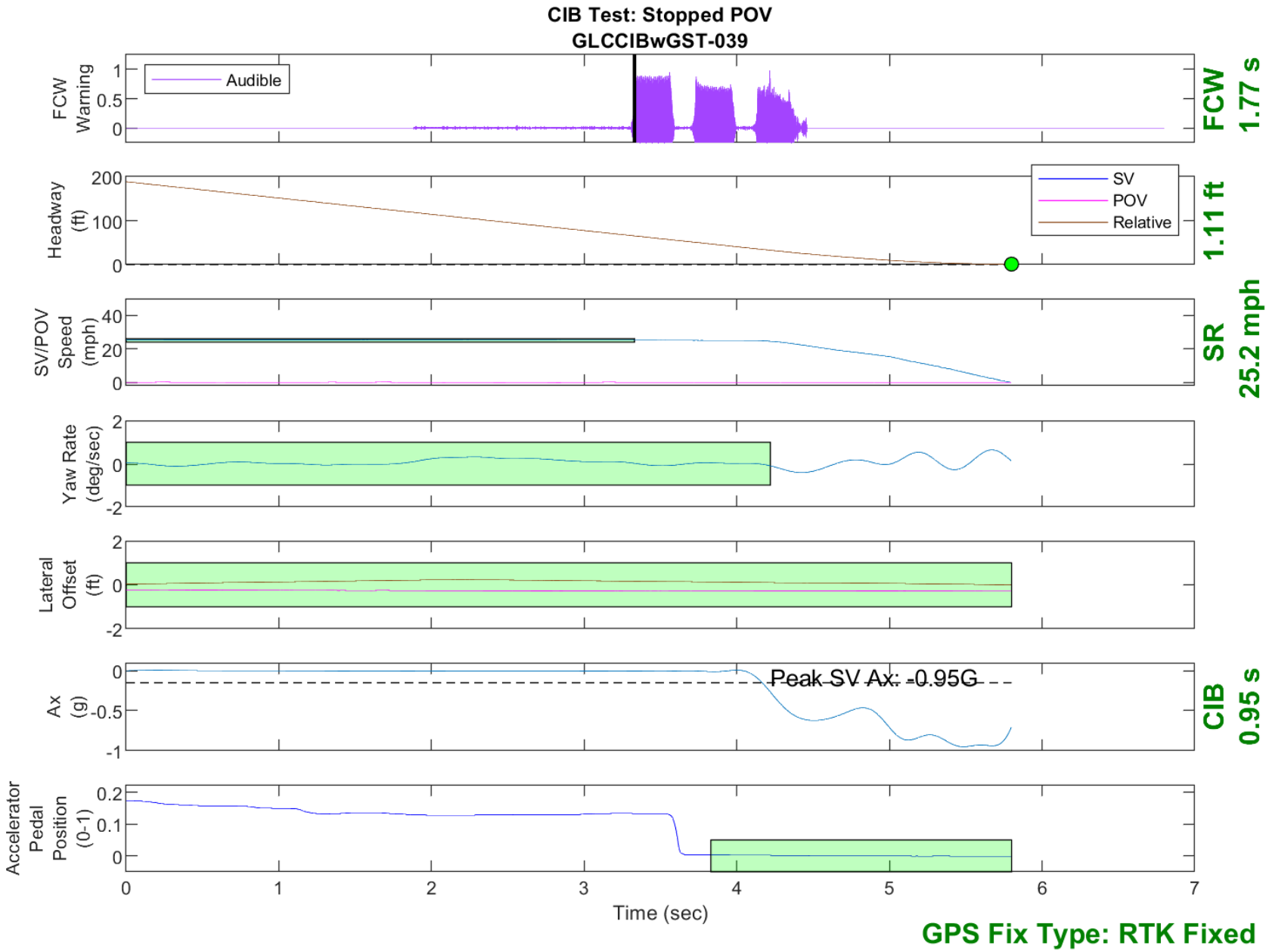


Figure D11. Time History for CIB Run 39, Stopped POV, 25 mph

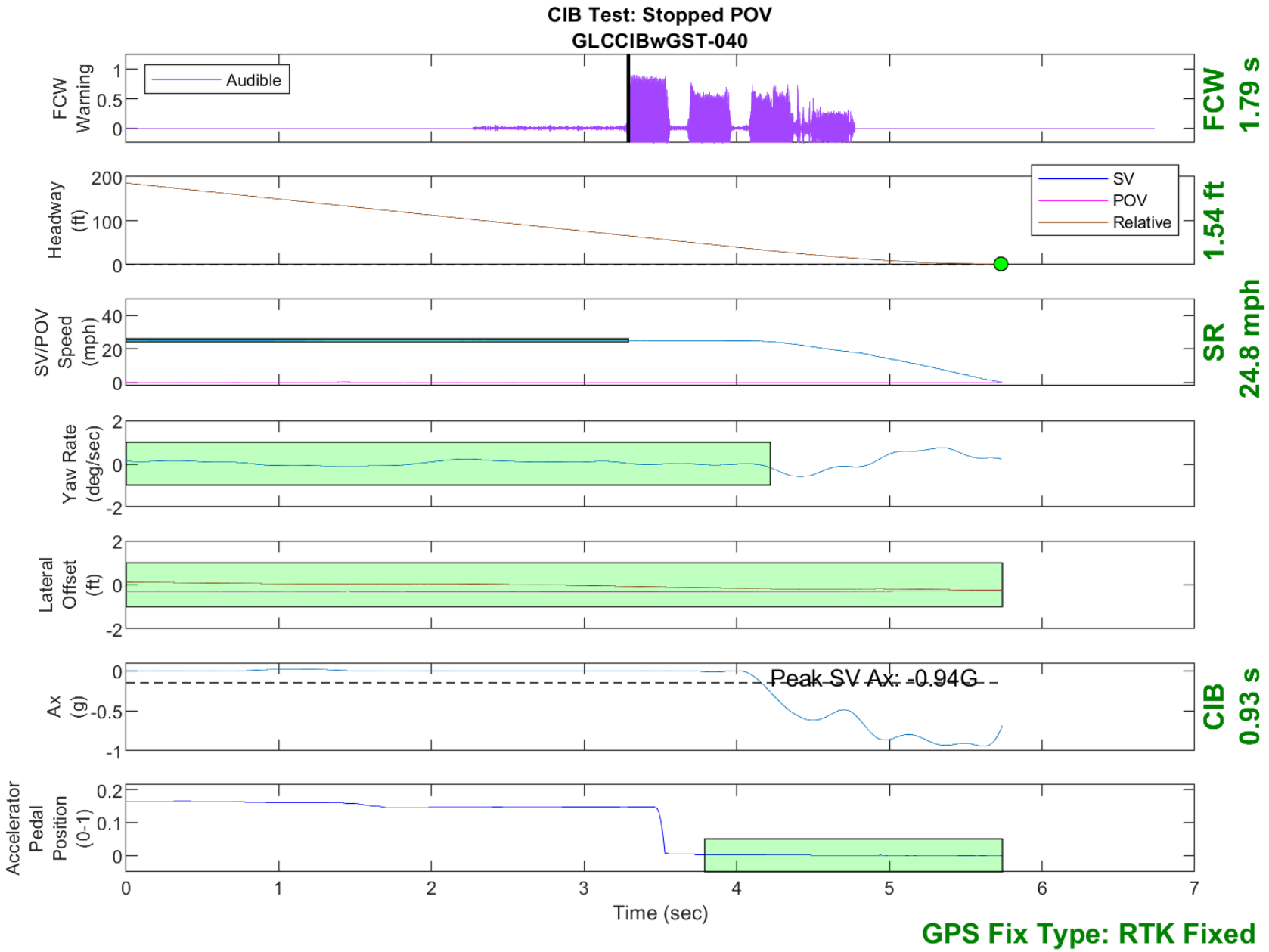


Figure D12. Time History for CIB Run 40, Stopped POV, 25 mph

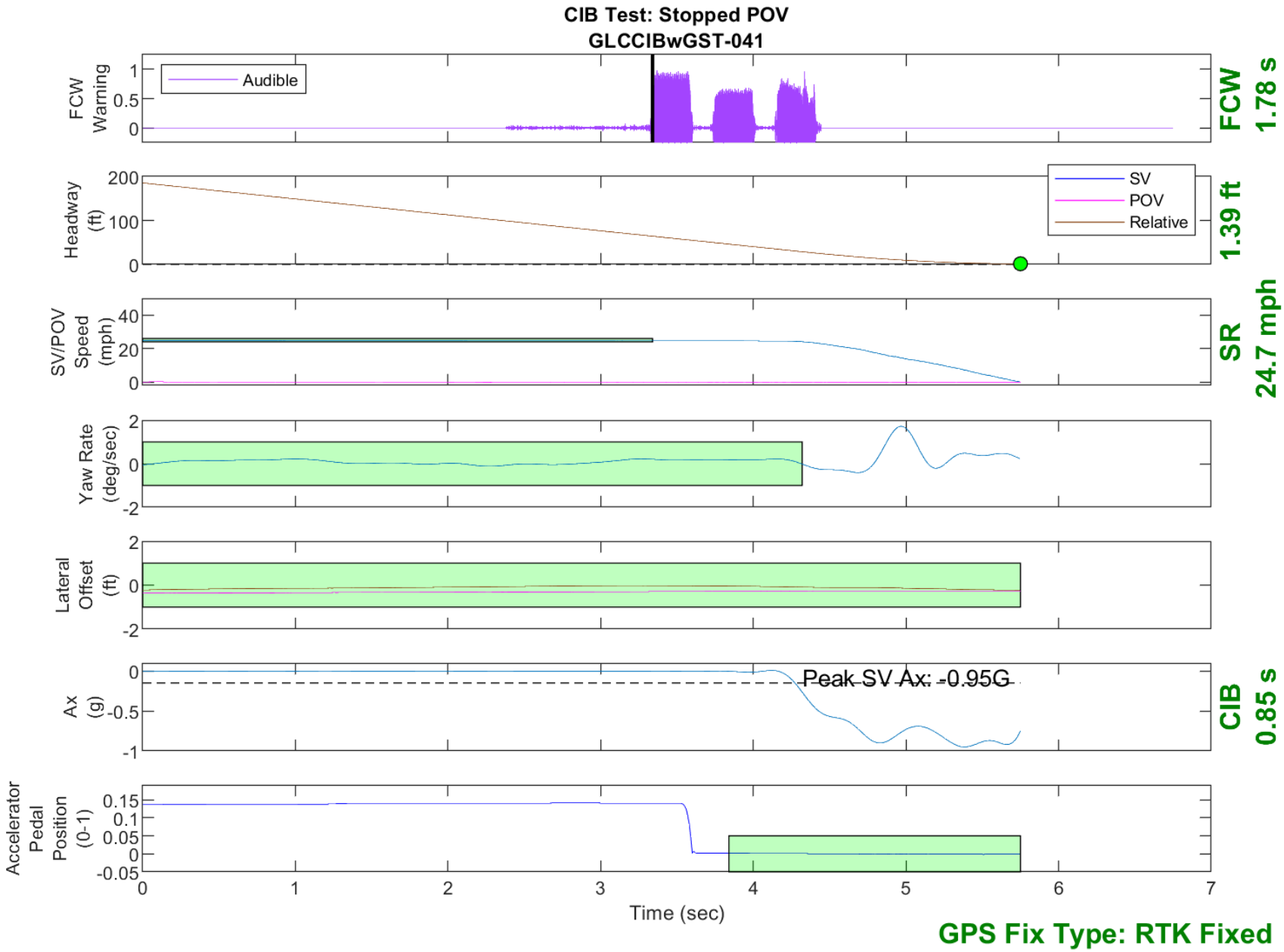


Figure D13. Time History for CIB Run 41, Stopped POV, 25 mph

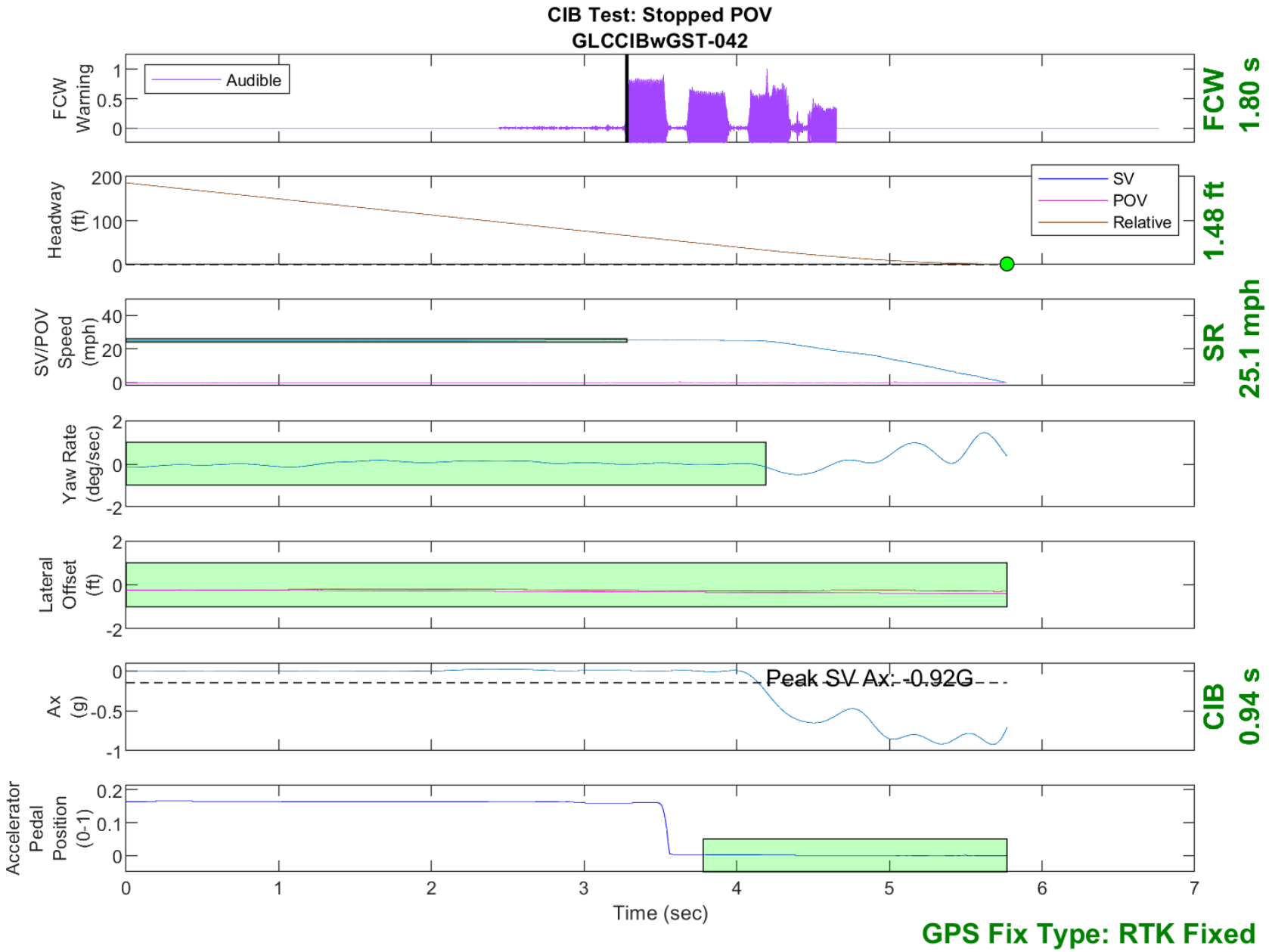


Figure D14. Time History for CIB Run 42, Stopped POV, 25 mph

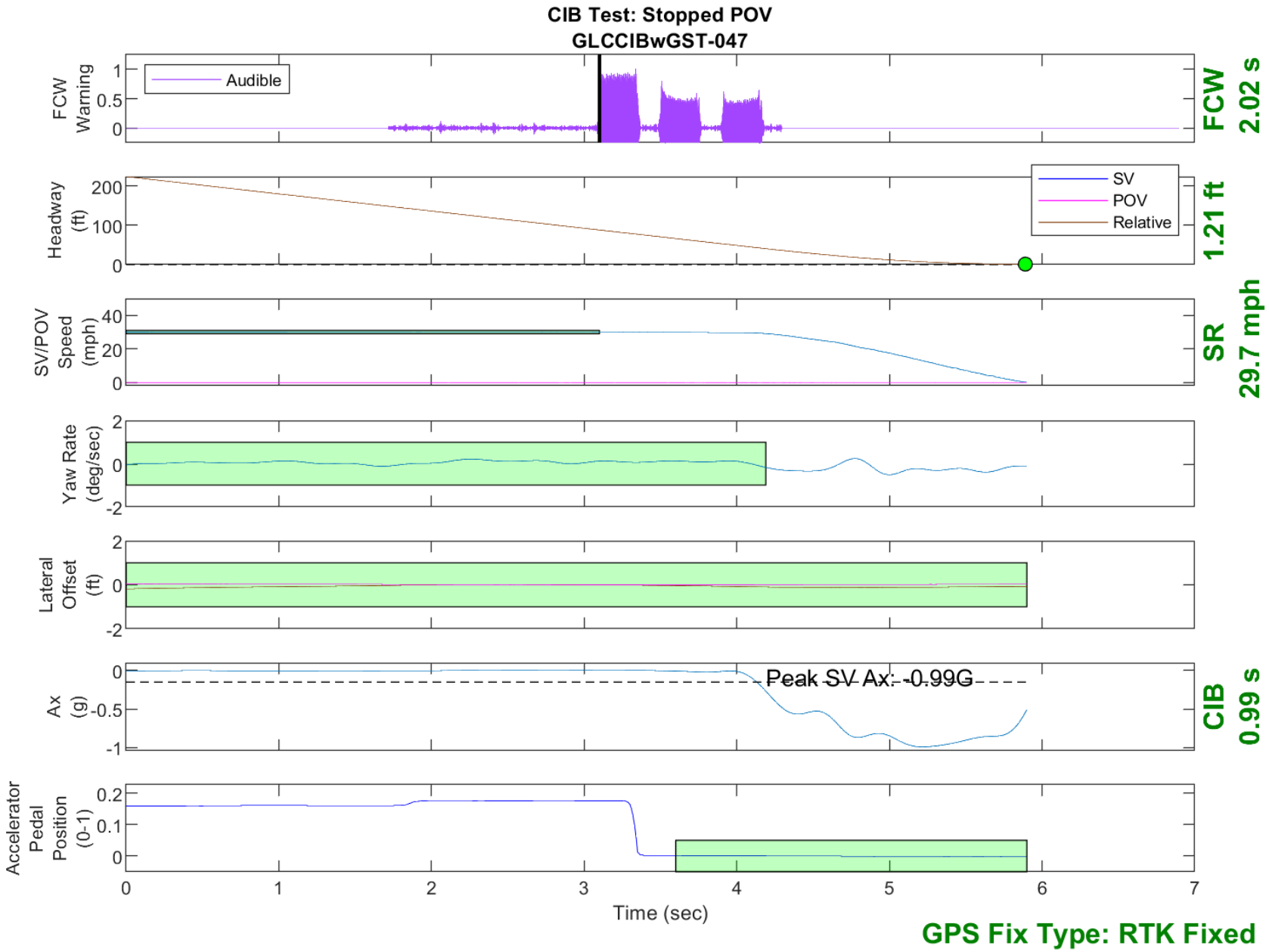


Figure D15. Time History for CIB Run 47, Stopped POV, 30 mph

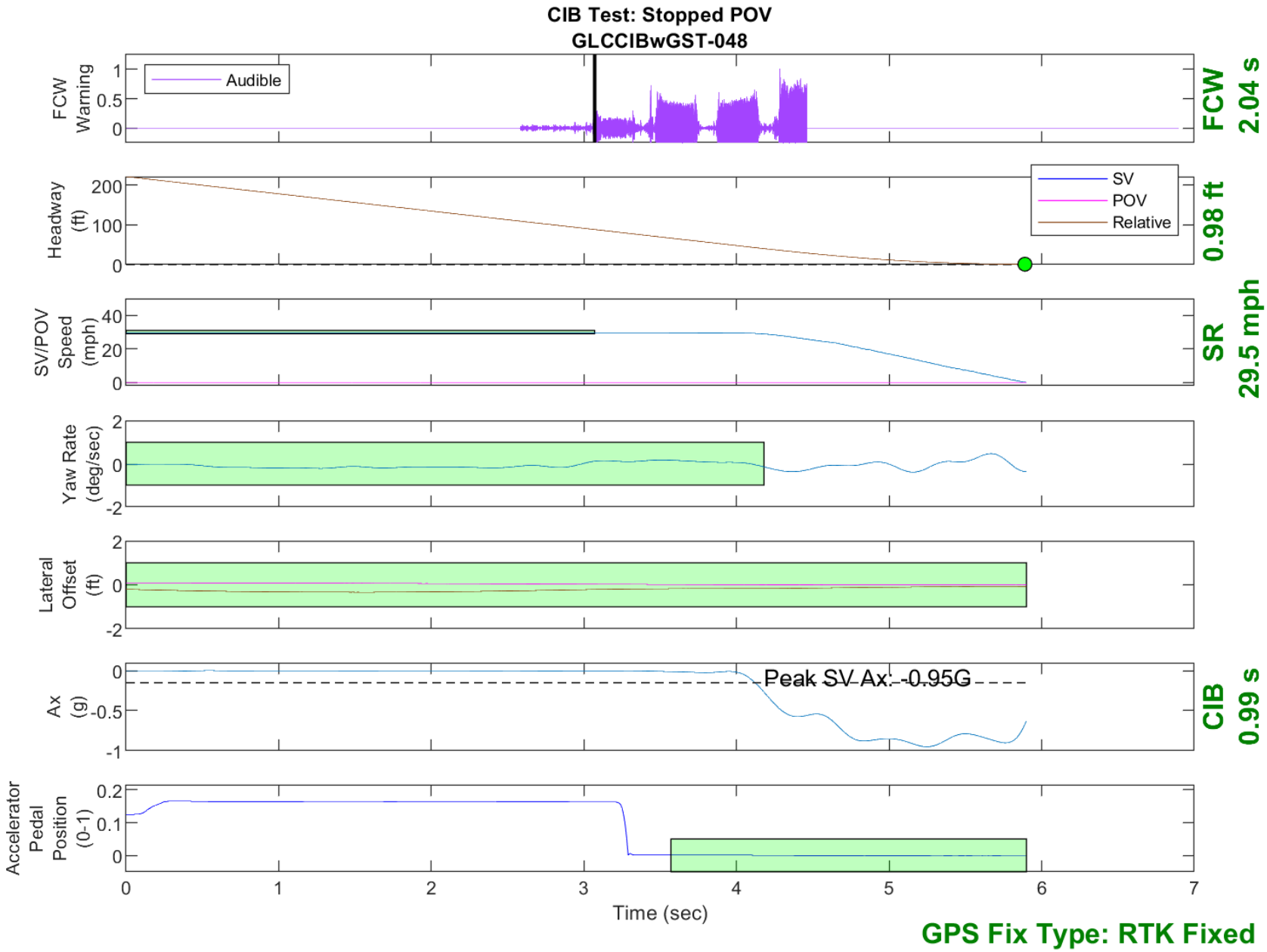


Figure D16. Time History for CIB Run 48, Stopped POV, 30 mph

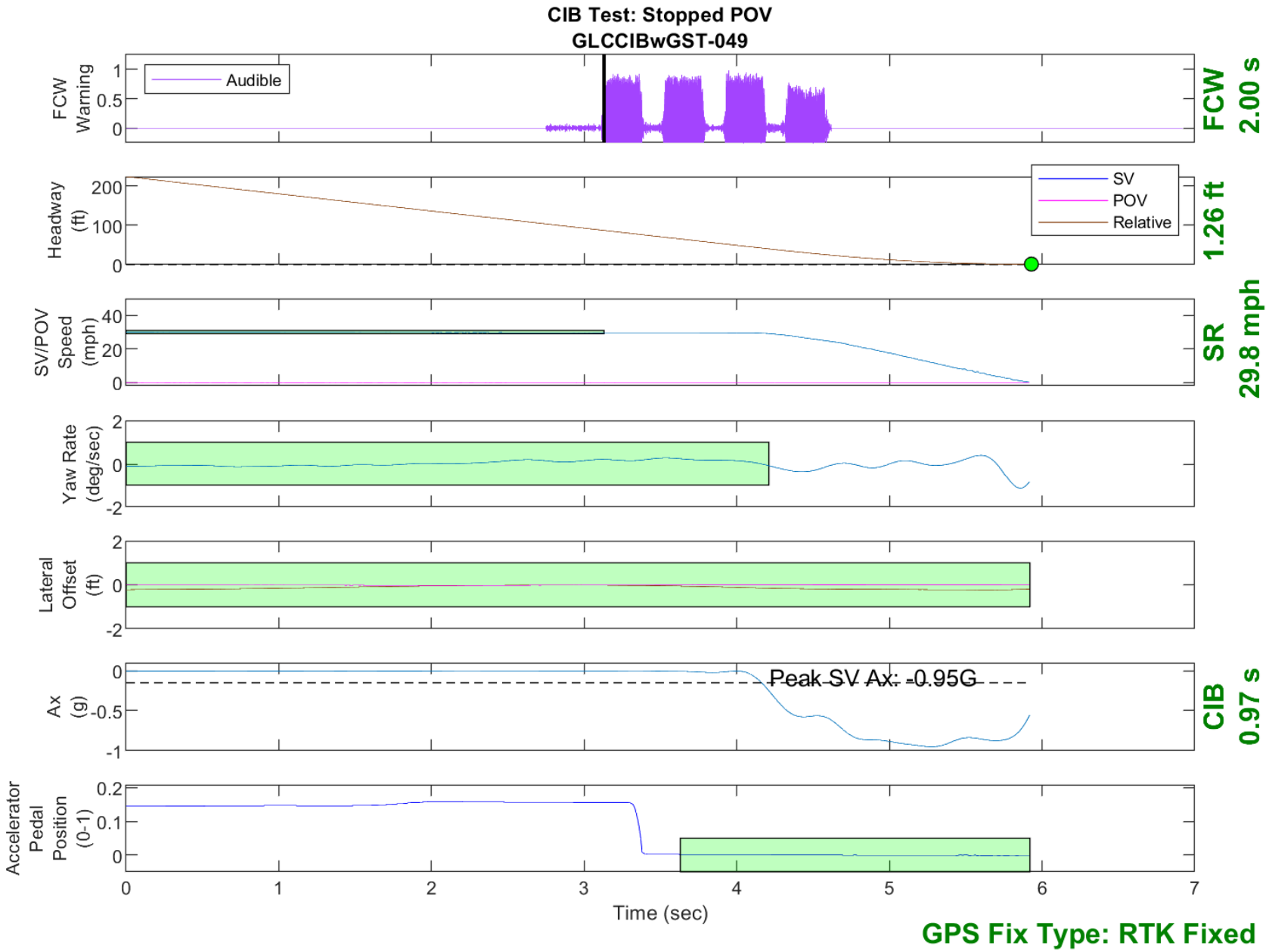


Figure D17. Time History for CIB Run 49, Stopped POV, 30 mph

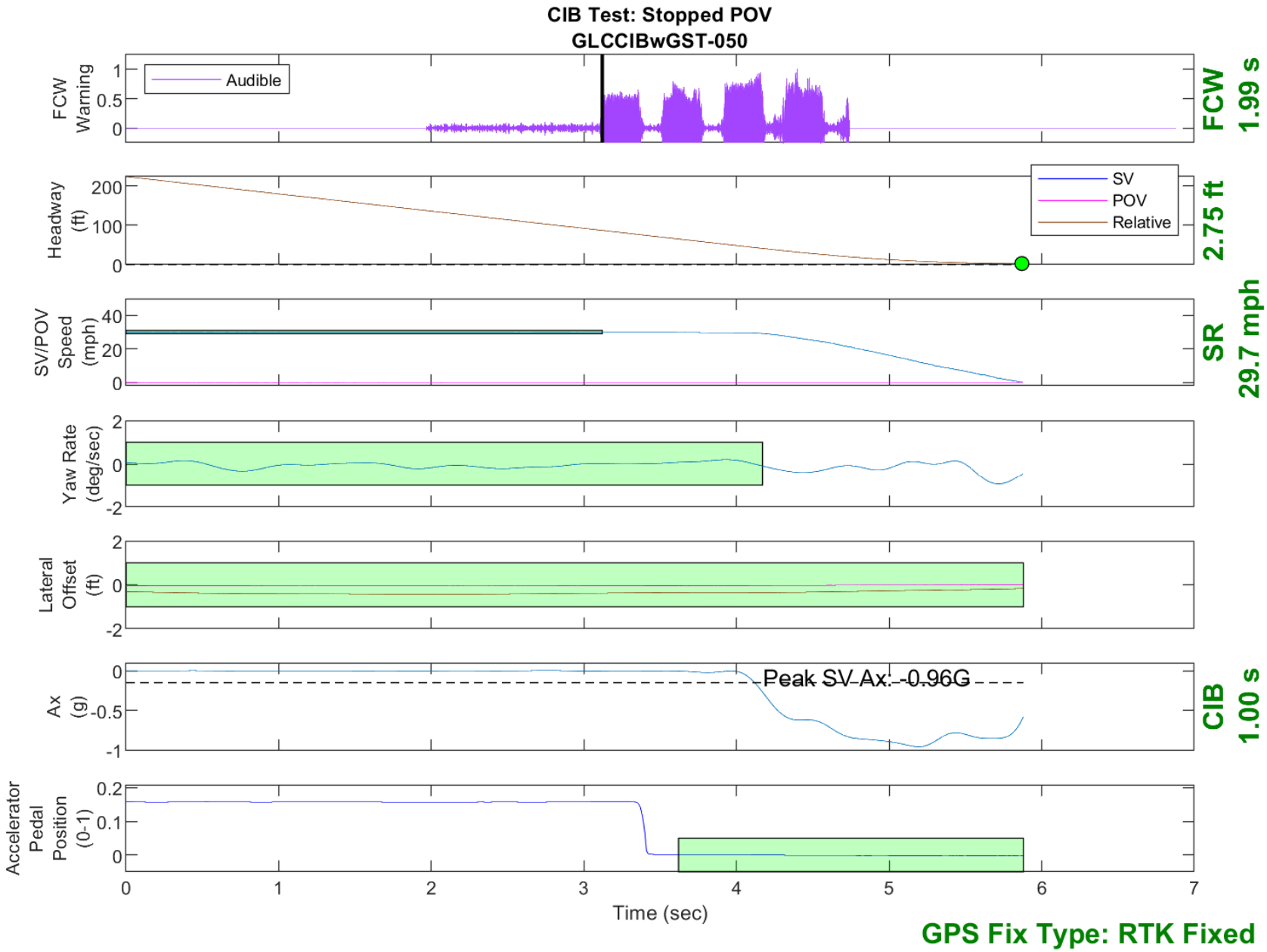


Figure D18. Time History for CIB Run 50, Stopped POV, 30 mph

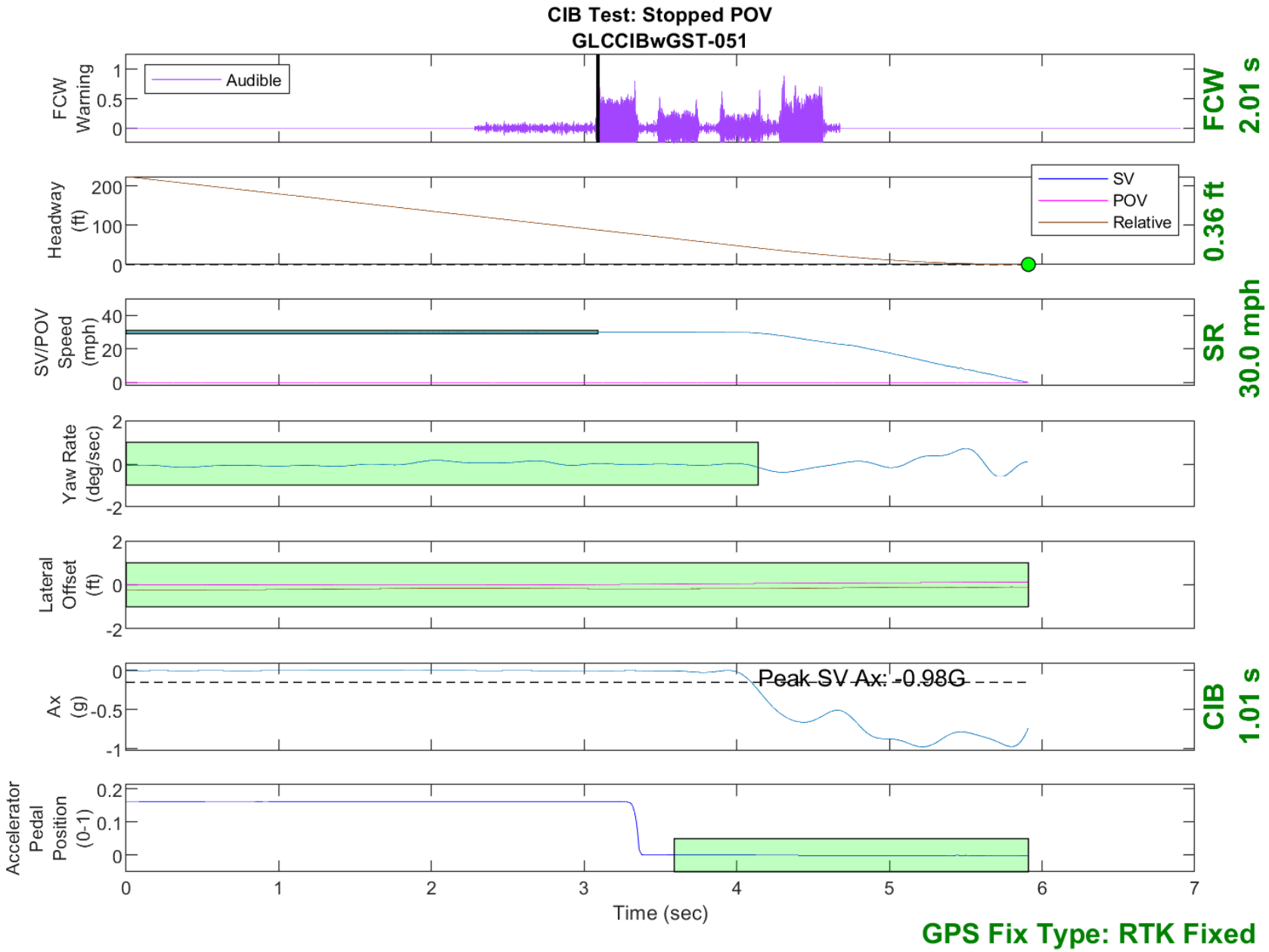


Figure D19. Time History for CIB Run 51, Stopped POV, 30 mph

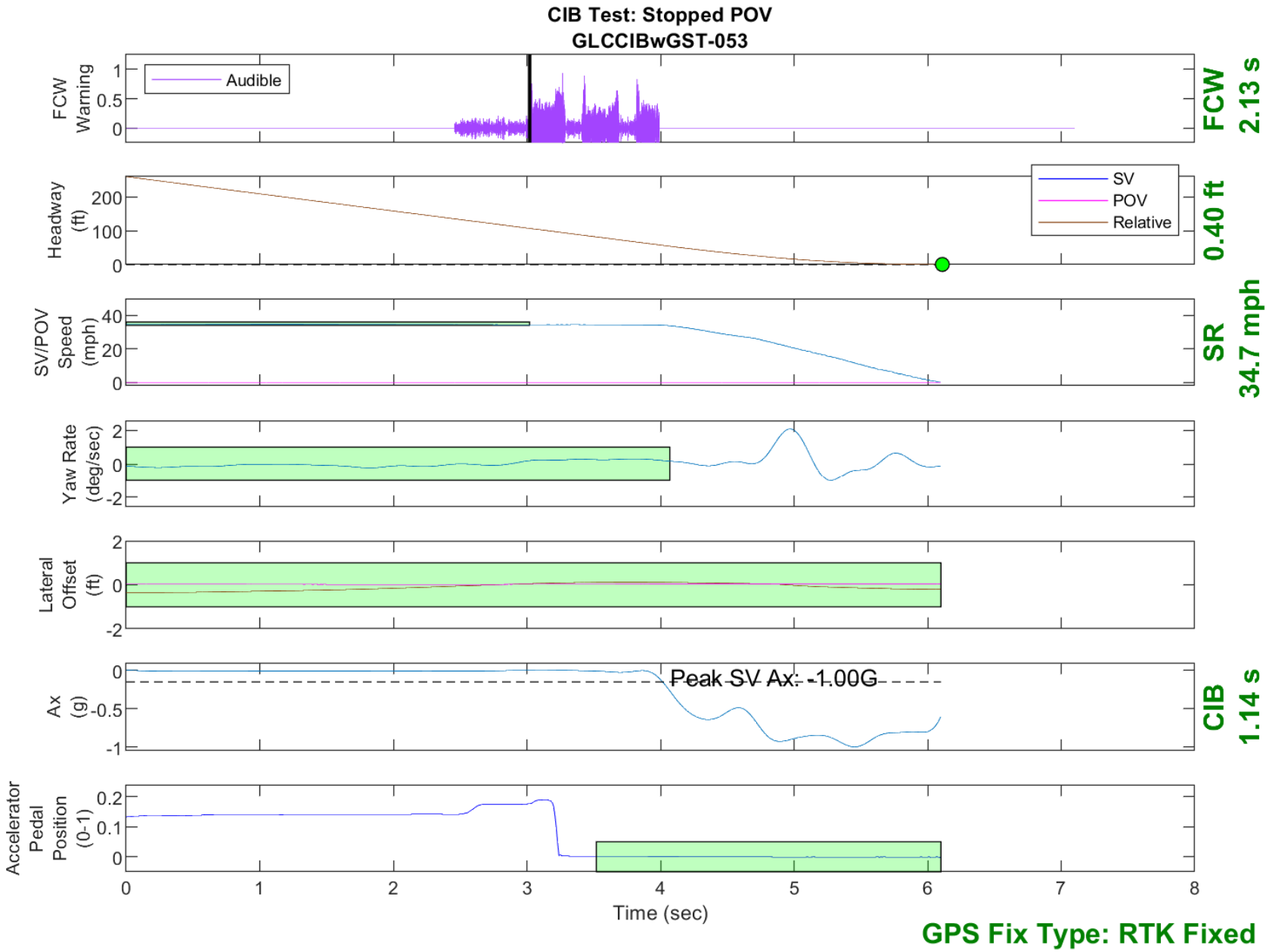


Figure D20. Time History for CIB Run 53, Stopped POV, 35 mph

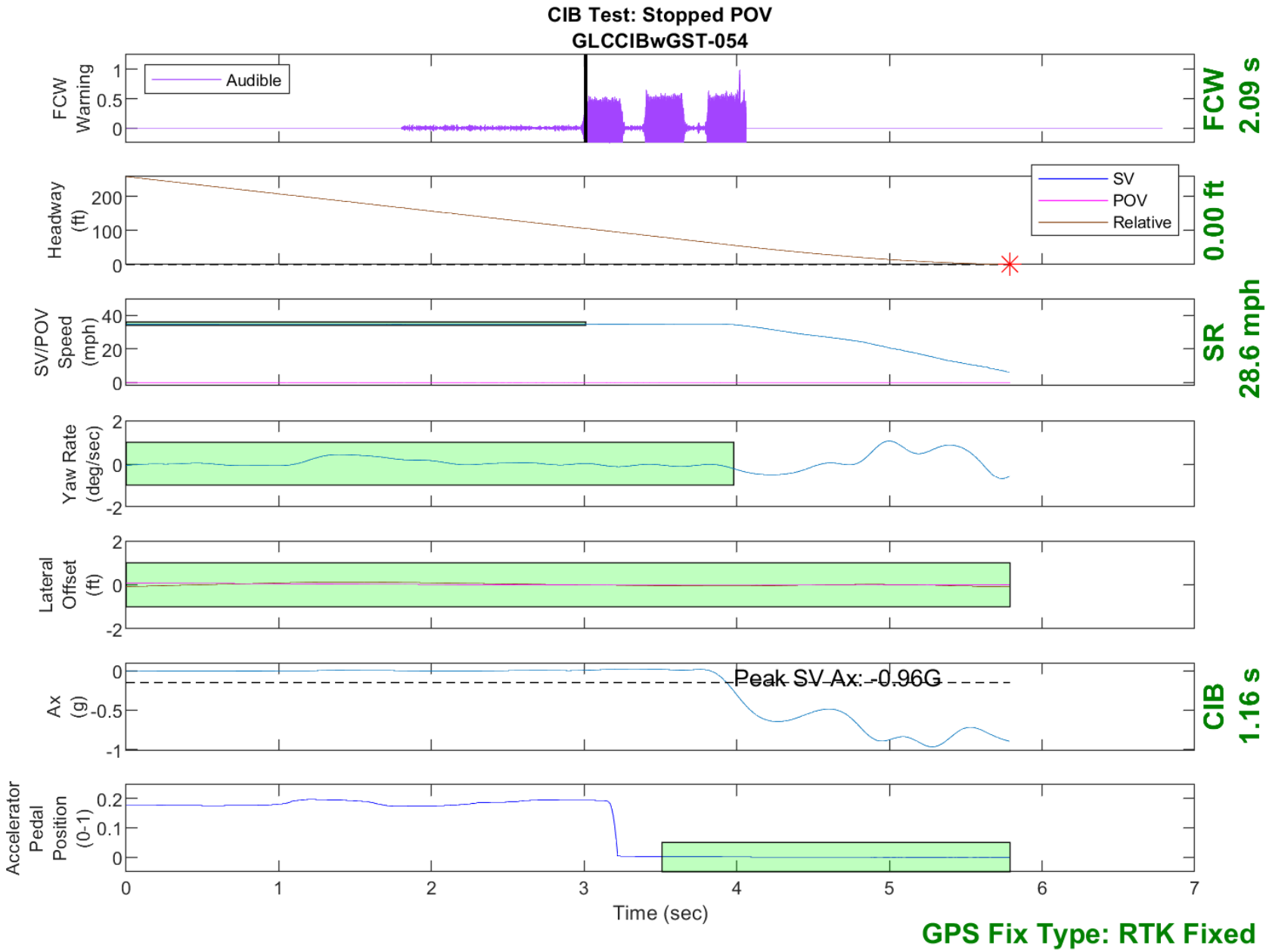


Figure D21. Time History for CIB Run 54, Stopped POV, 35 mph

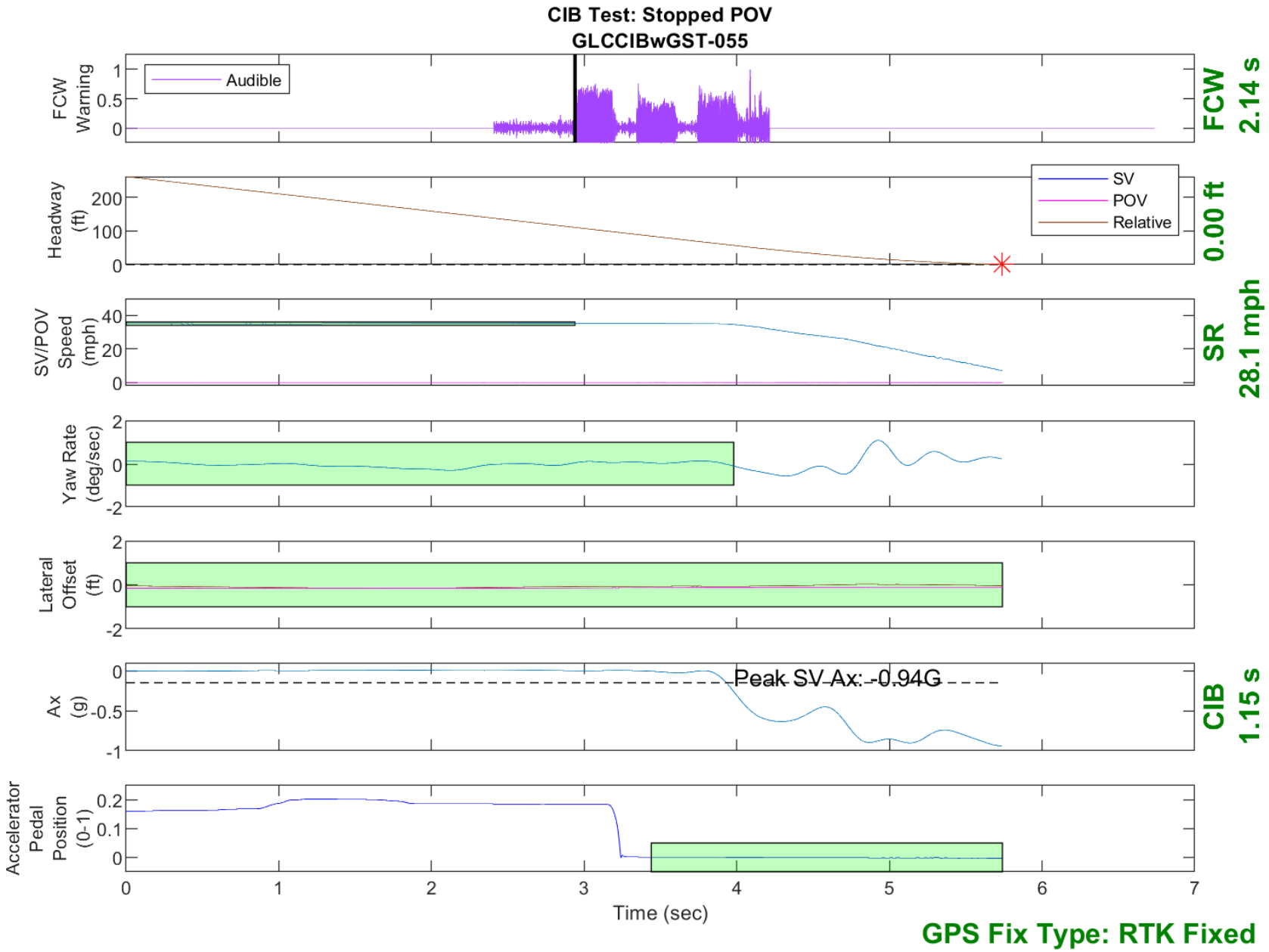


Figure D22. Time History for CIB Run 55, Stopped POV, 35 mph

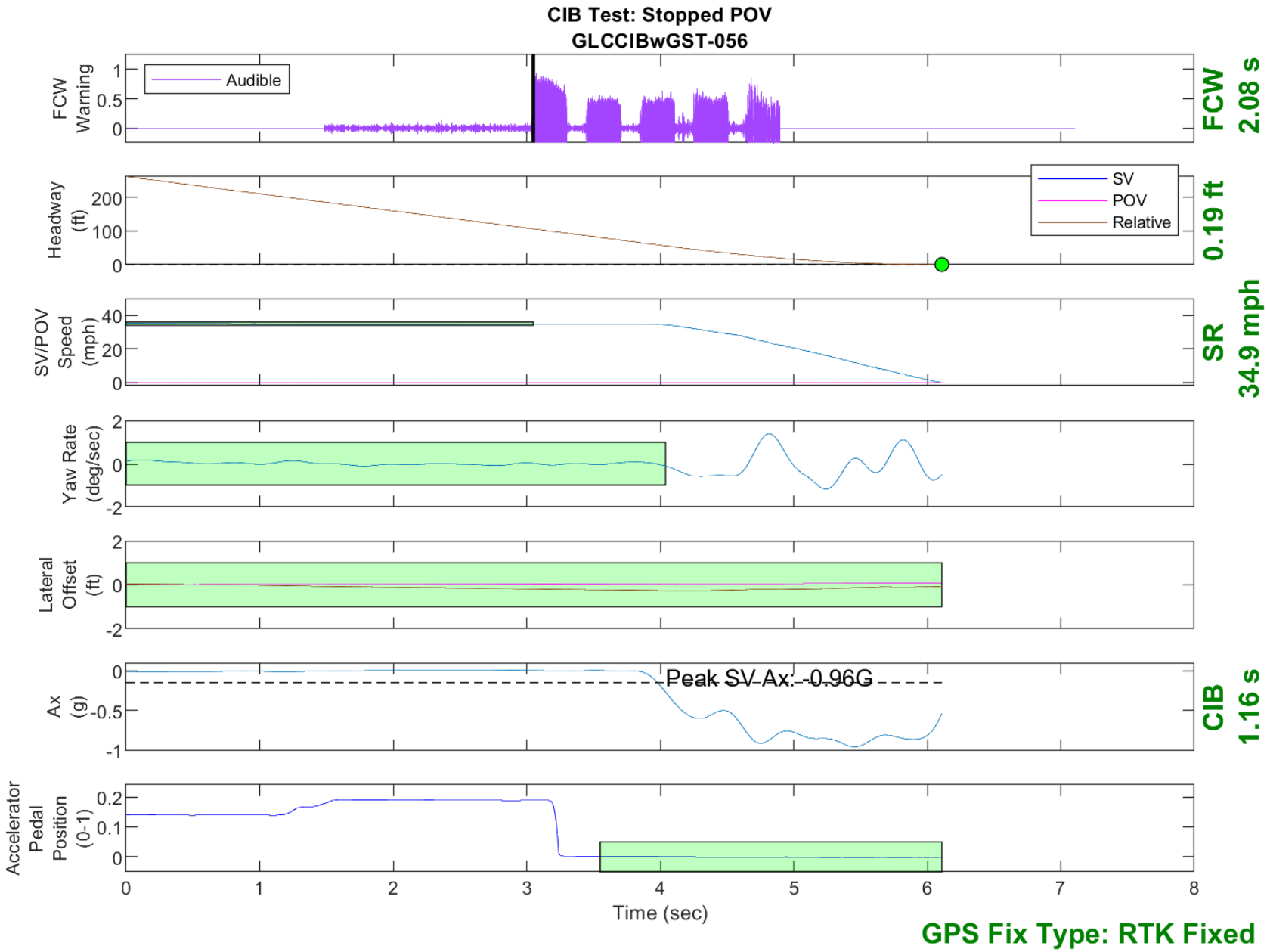


Figure D23. Time History for CIB Run 56, Stopped POV, 35 mph

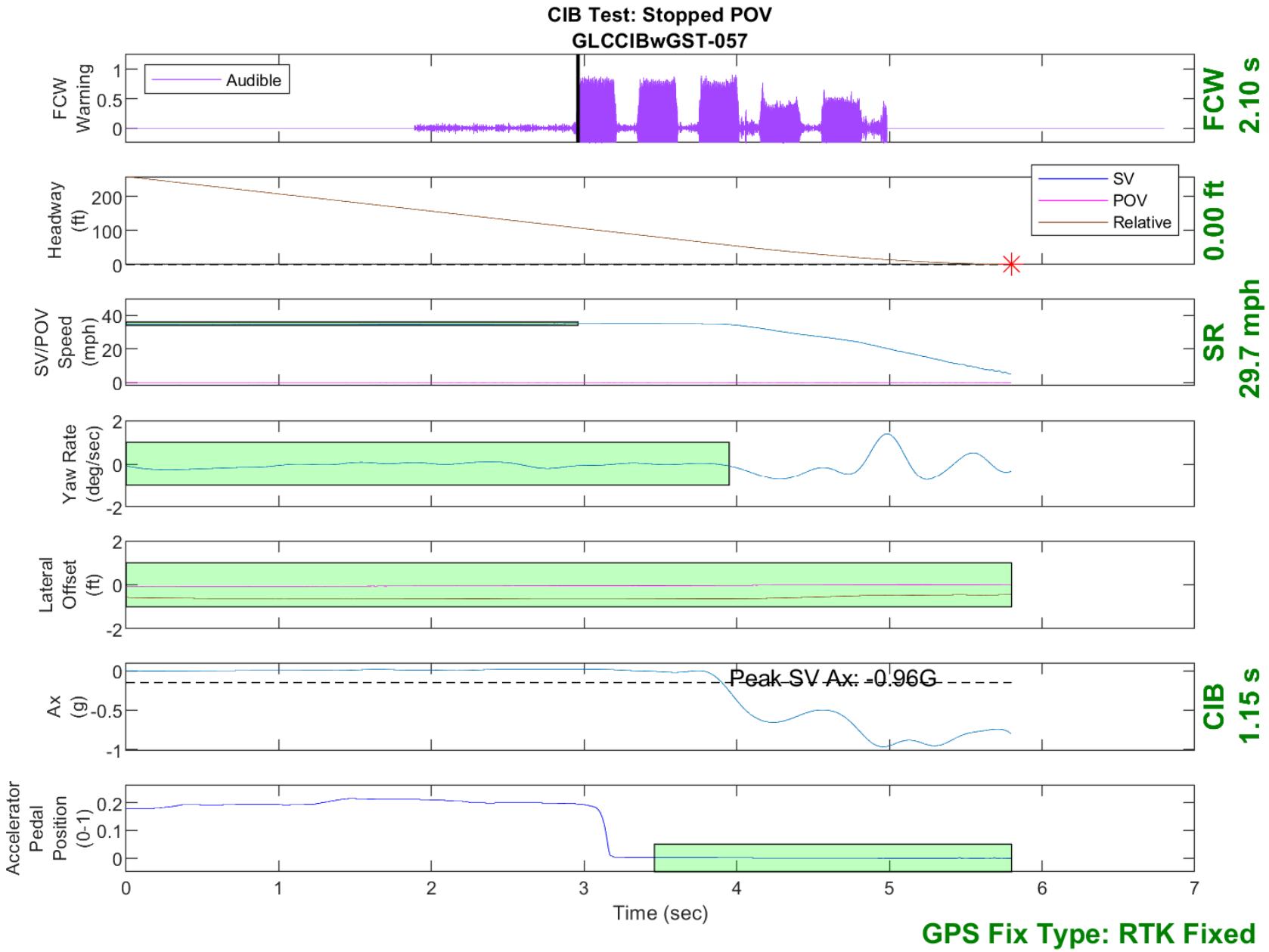


Figure D24. Time History for CIB Run 57, Stopped POV, 35 mph

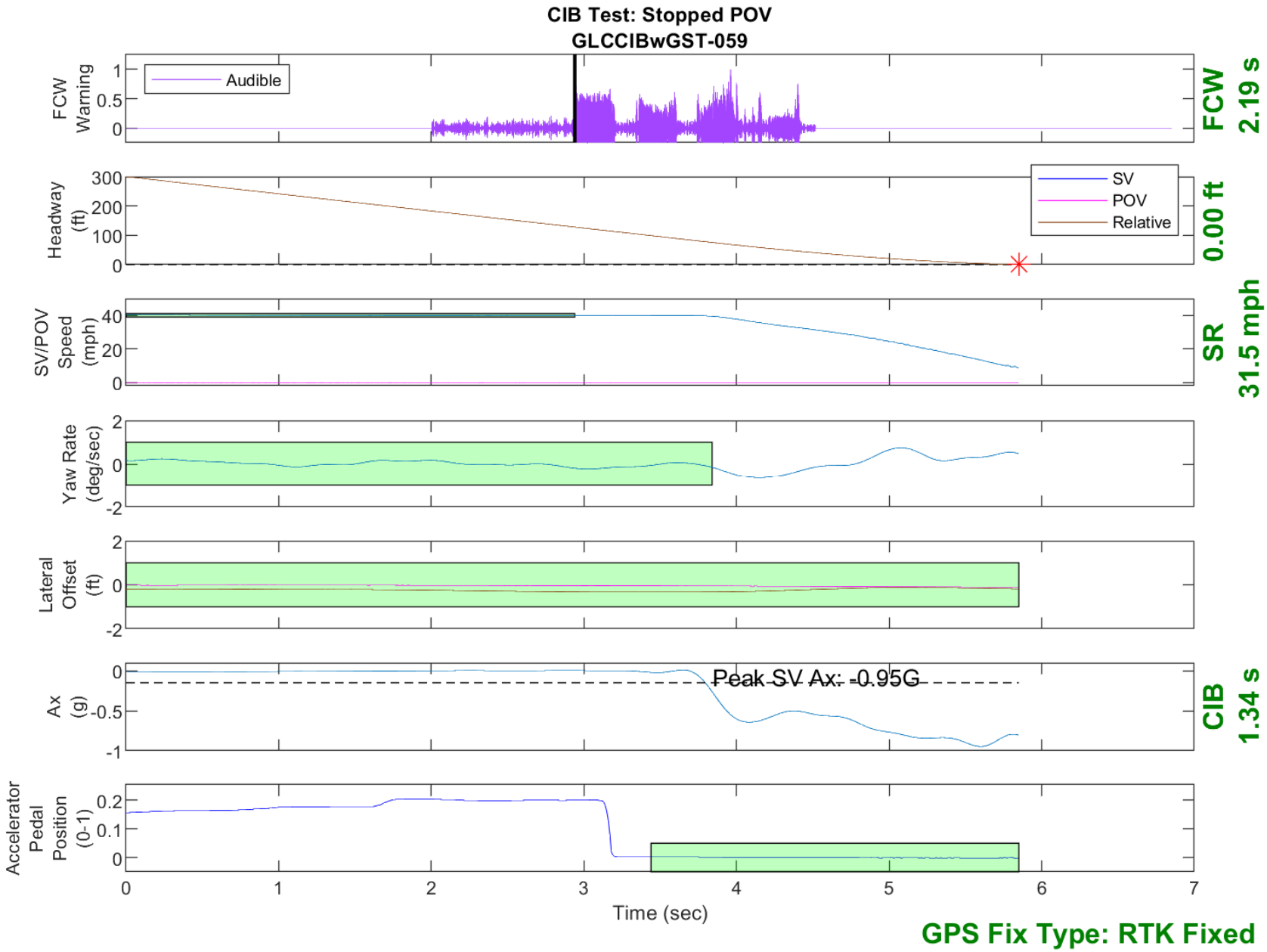


Figure D25. Time History for CIB Run 59, Stopped POV, 40 mph

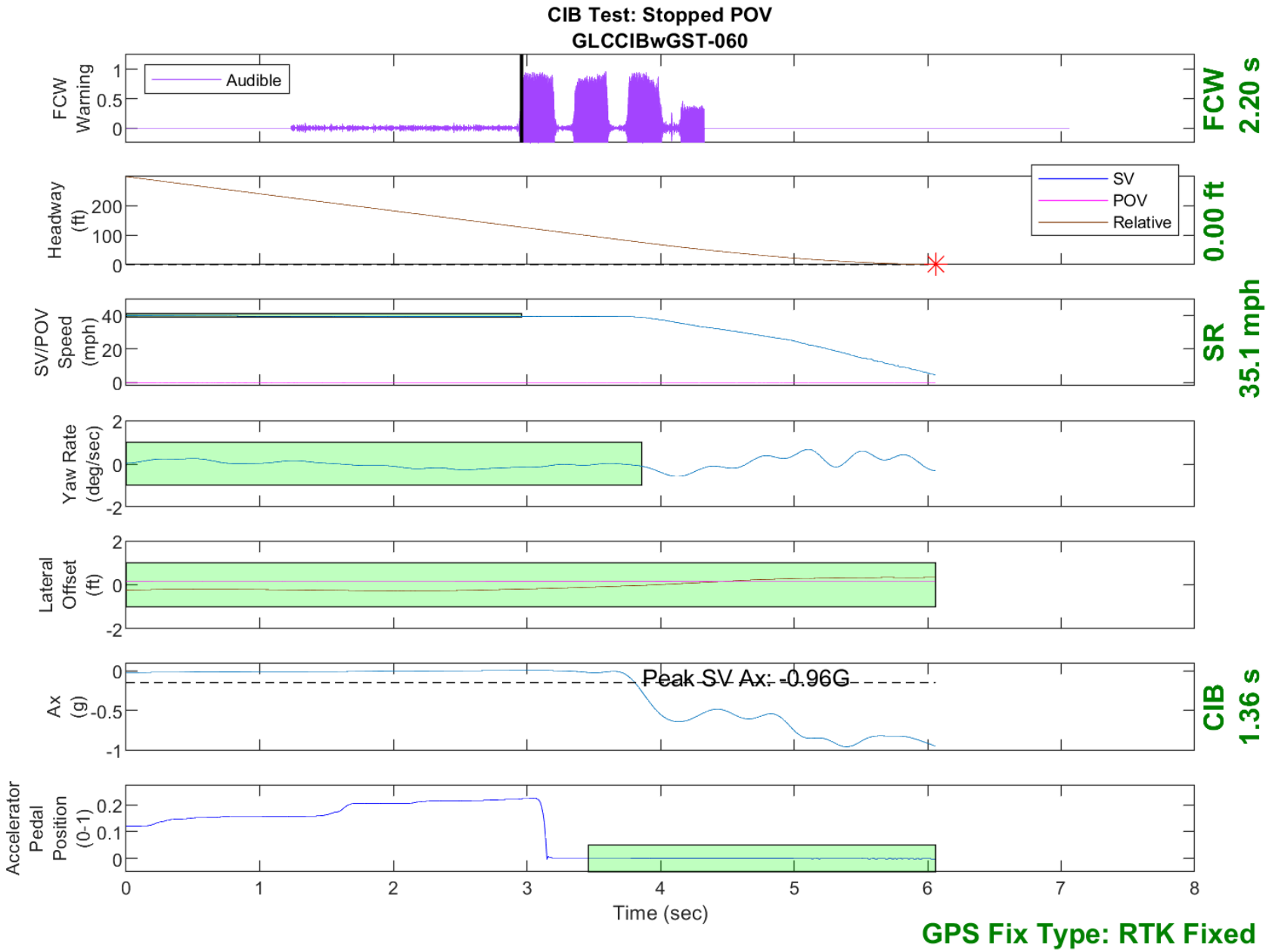


Figure D26. Time History for CIB Run 60, Stopped POV, 40 mph

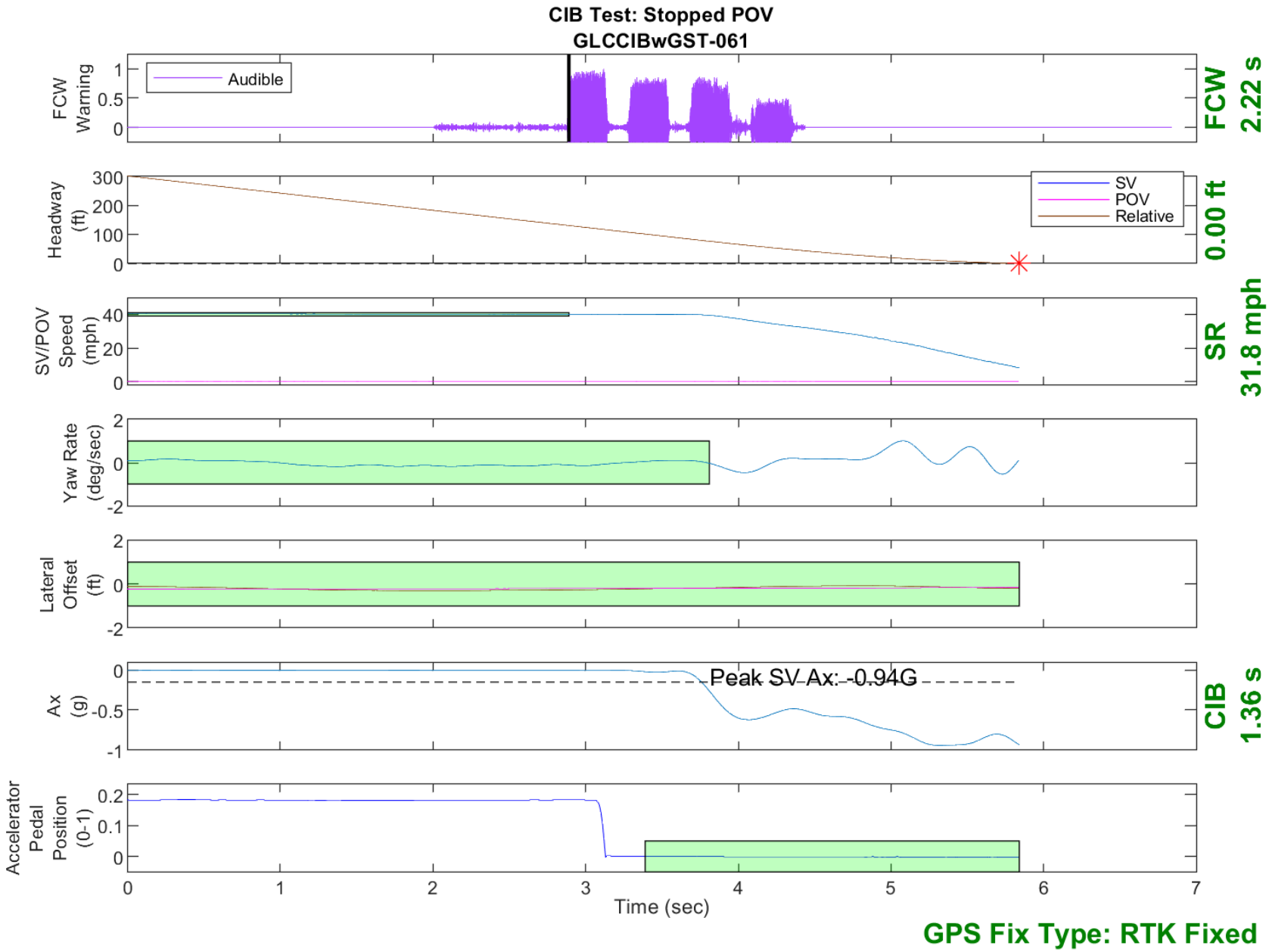


Figure D27. Time History for CIB Run 61, Stopped POV, 40 mph

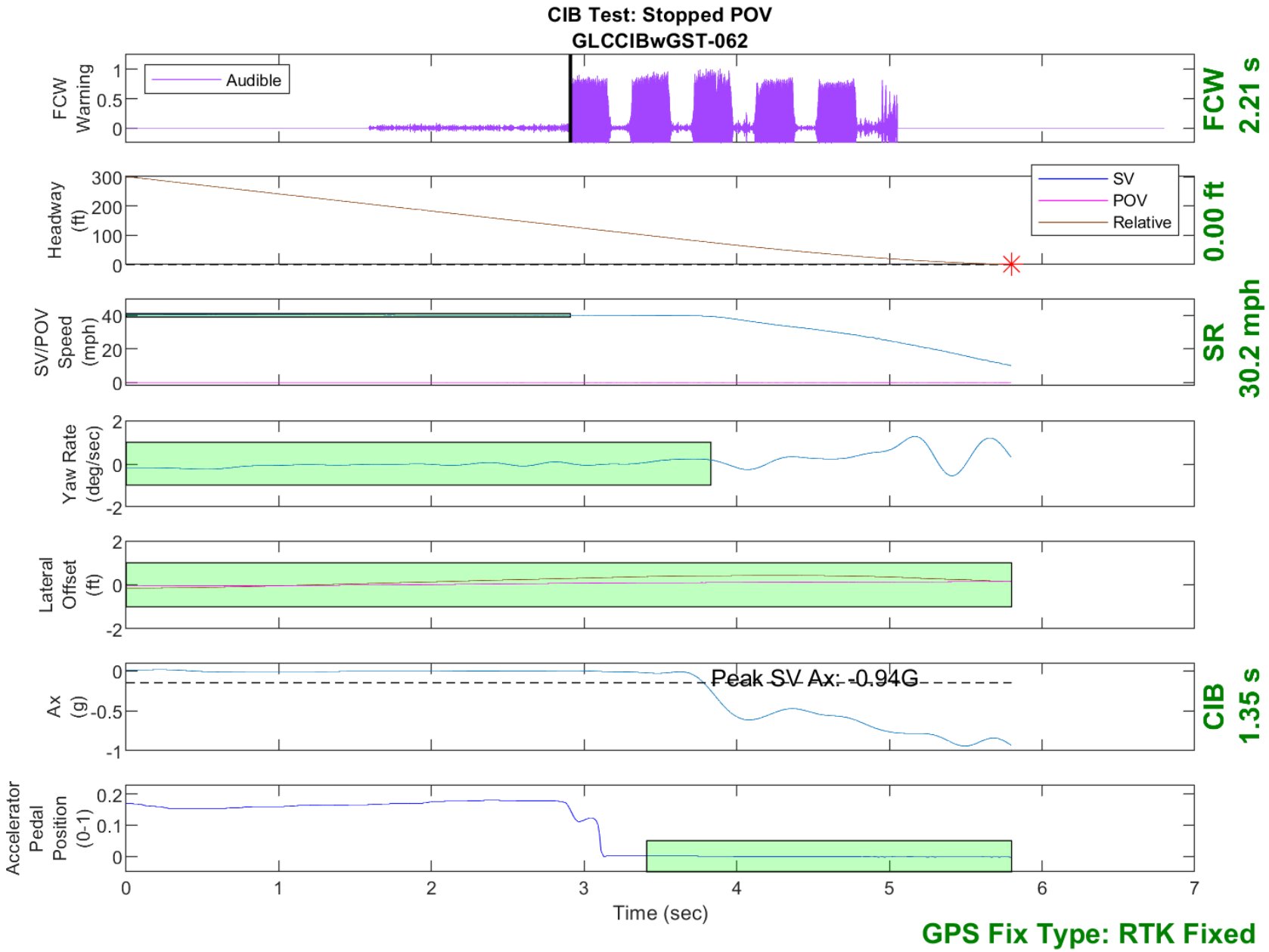


Figure D28. Time History for CIB Run 62, Stopped POV, 40 mph

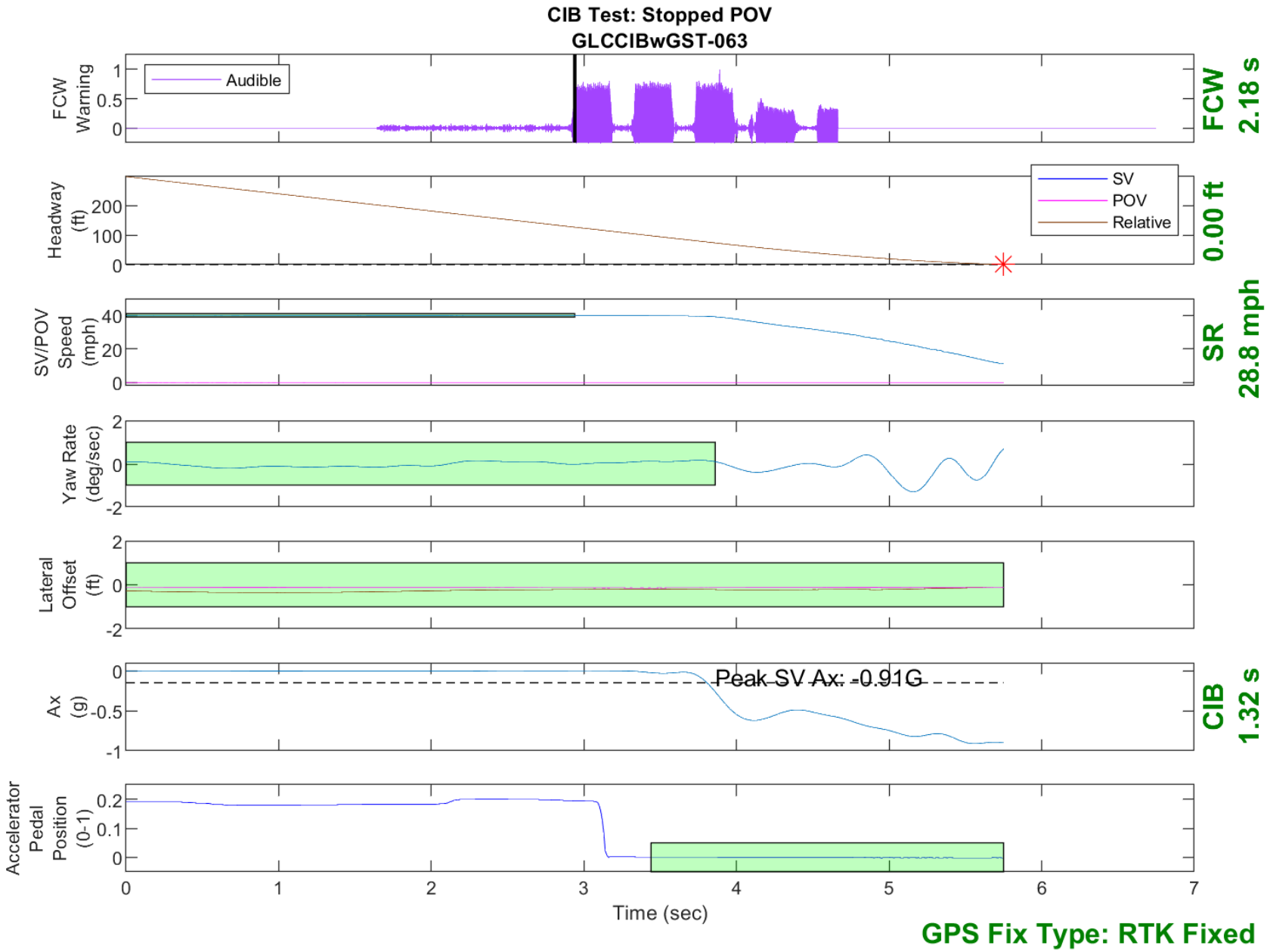


Figure D29. Time History for CIB Run 63, Stopped POV, 40 mph

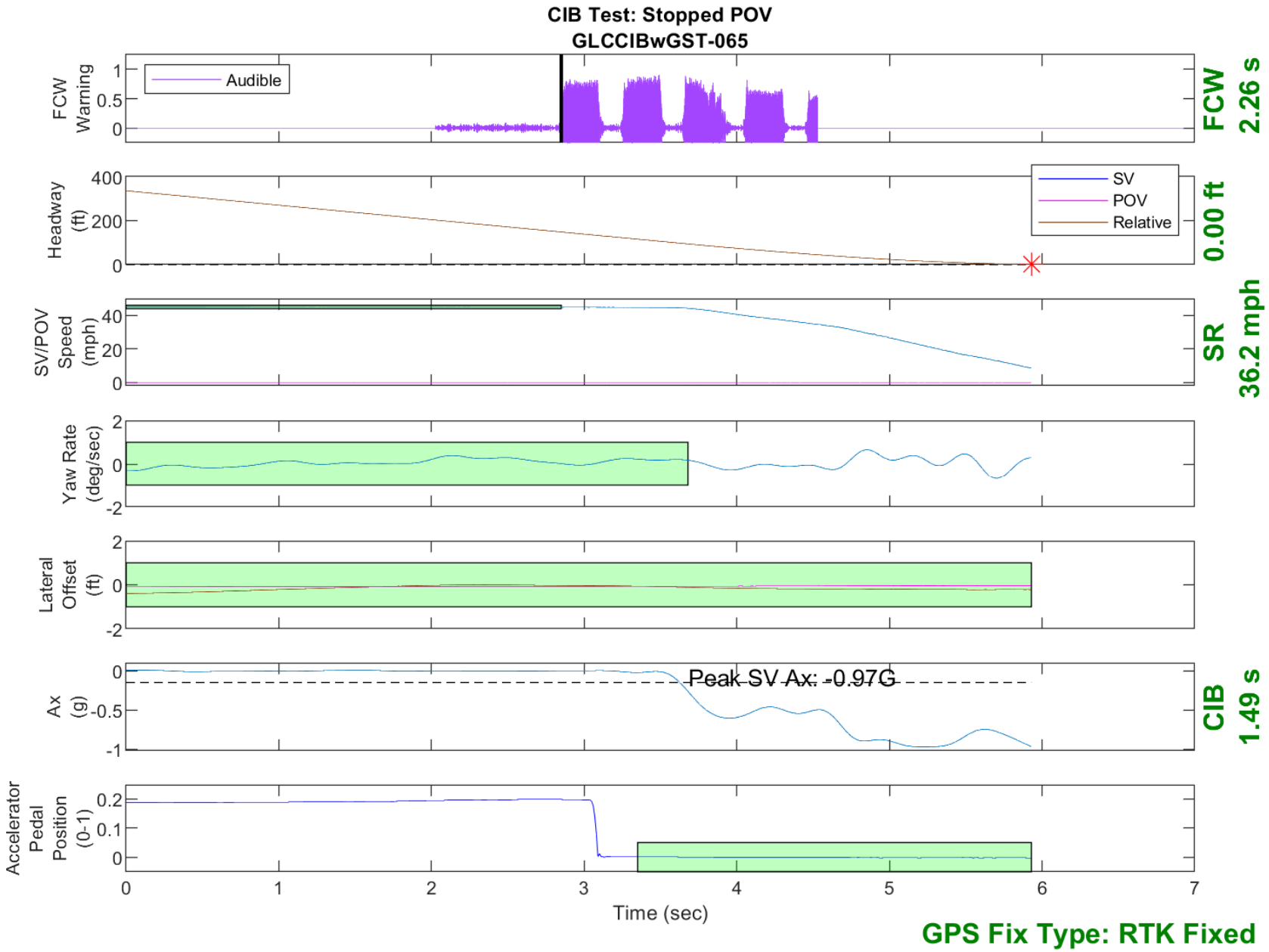


Figure D30. Time History for CIB Run 65, Stopped POV, 45 mph

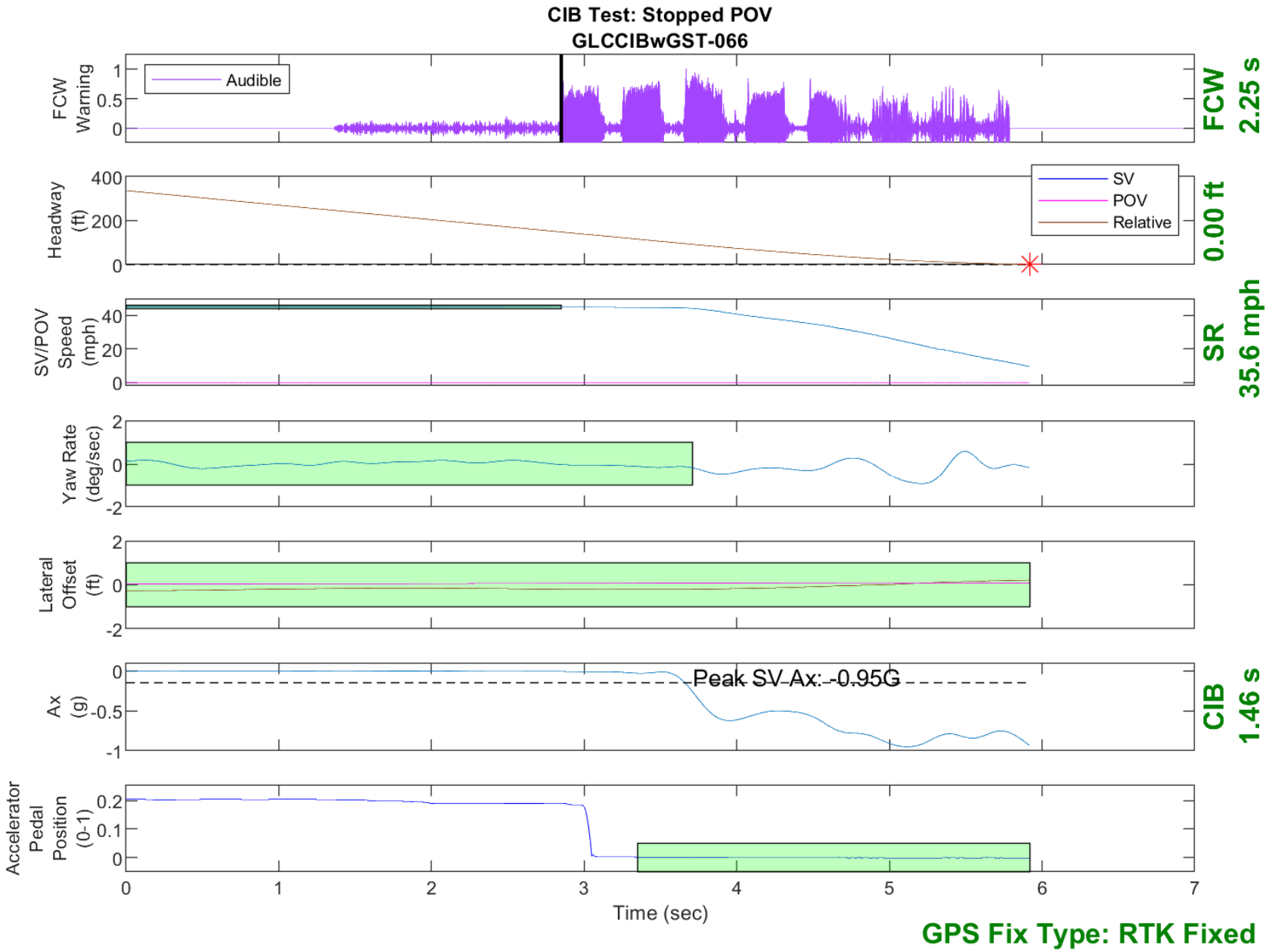


Figure D31. Time History for CIB Run 66, Stopped POV, 45 mph

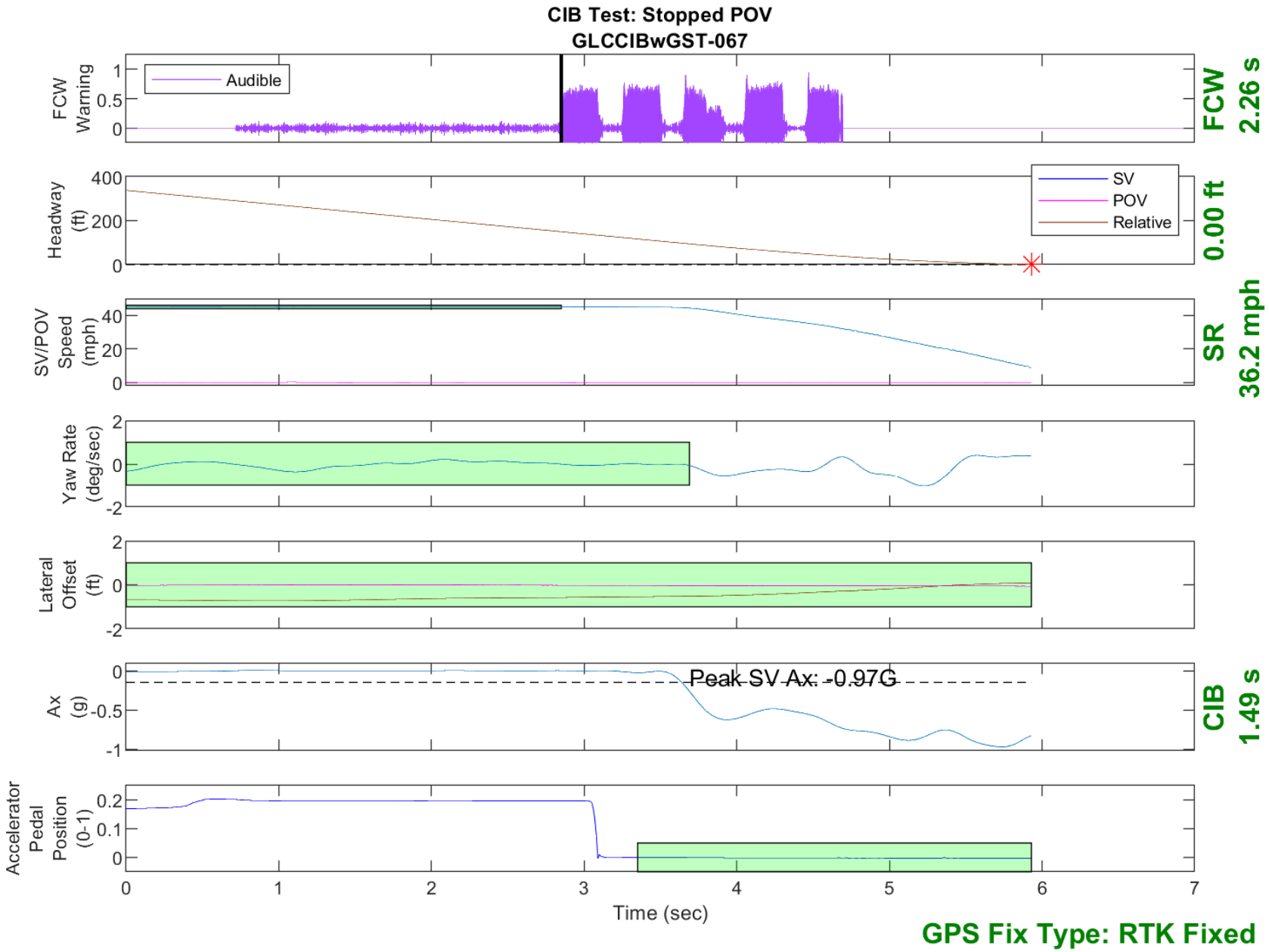


Figure D32. Time History for CIB Run 67, Stopped POV, 45 mph

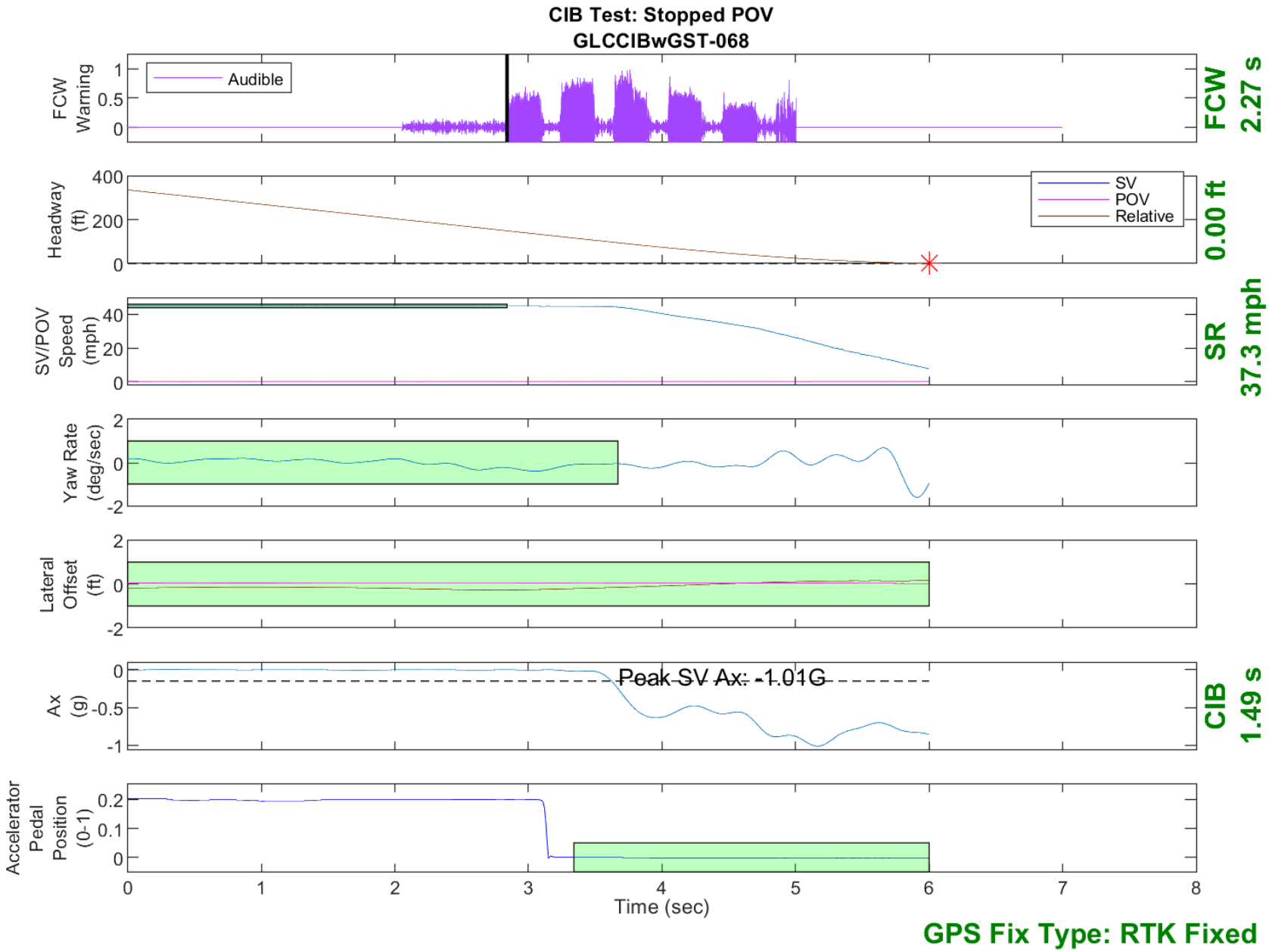


Figure D33. Time History for CIB Run 68, Stopped POV, 45 mph

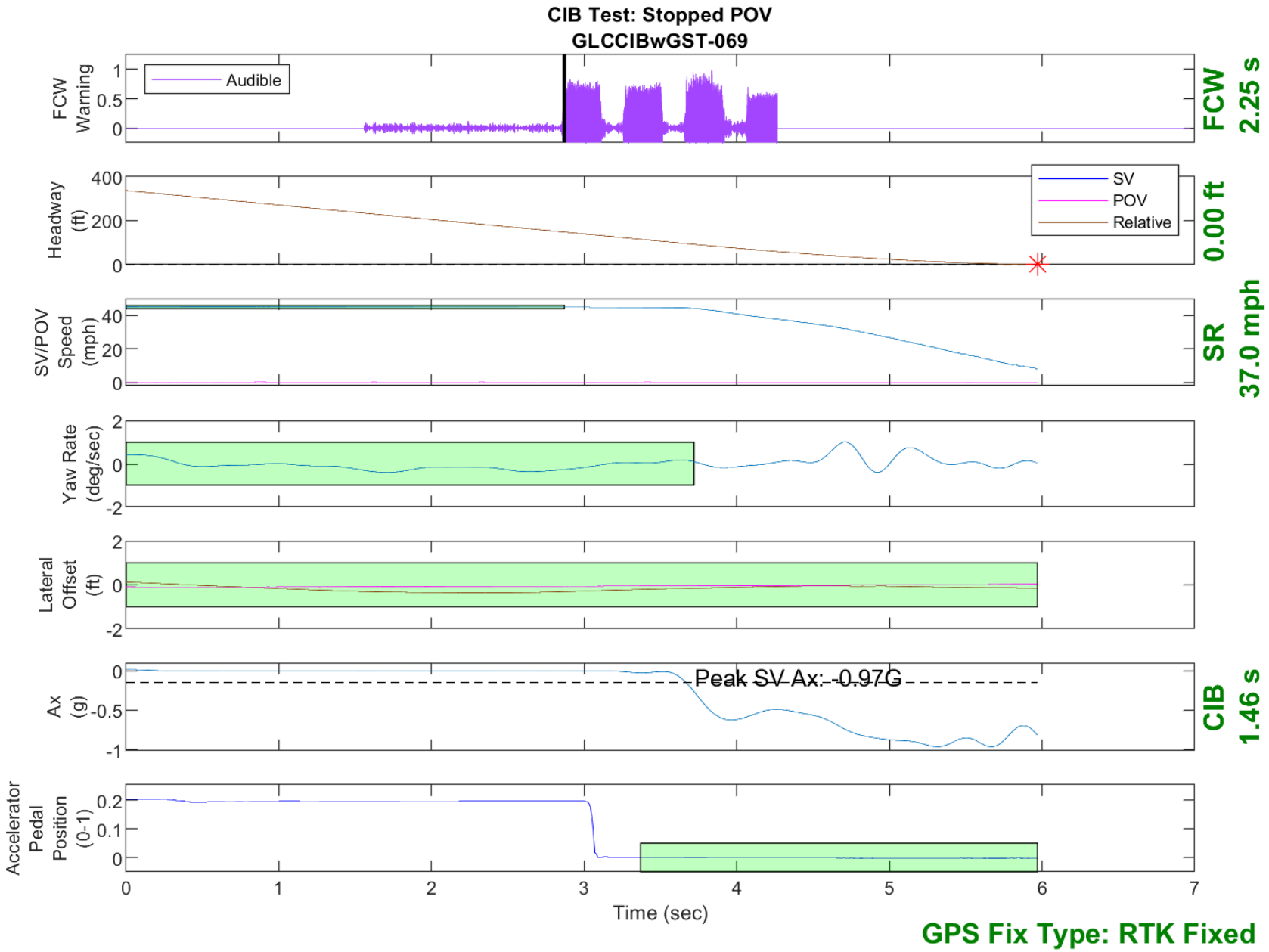


Figure D34. Time History for CIB Run 69, Stopped POV, 45 mph

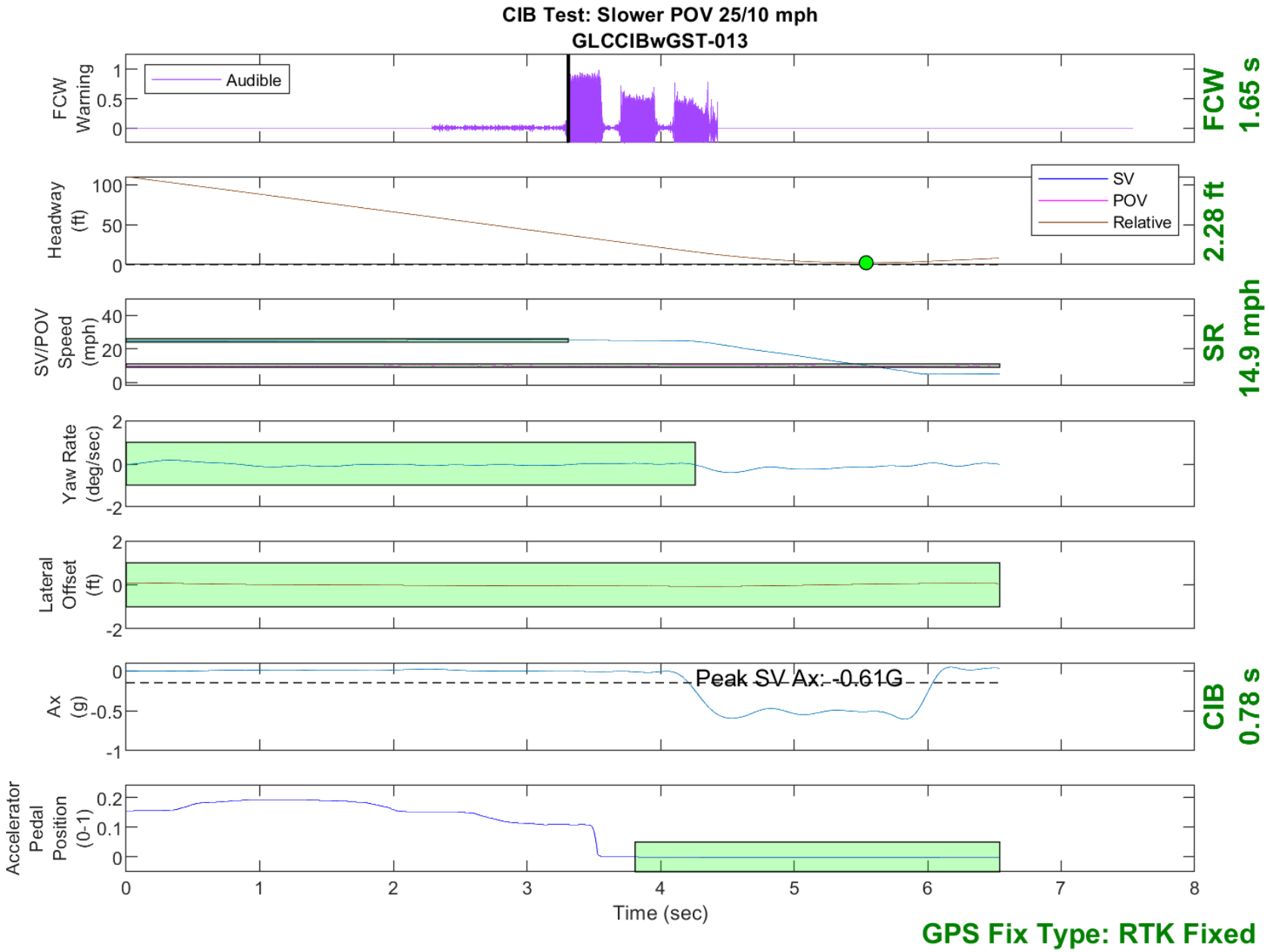


Figure D35. Time History for CIB Run 13, Slower POV, 25/10 mph

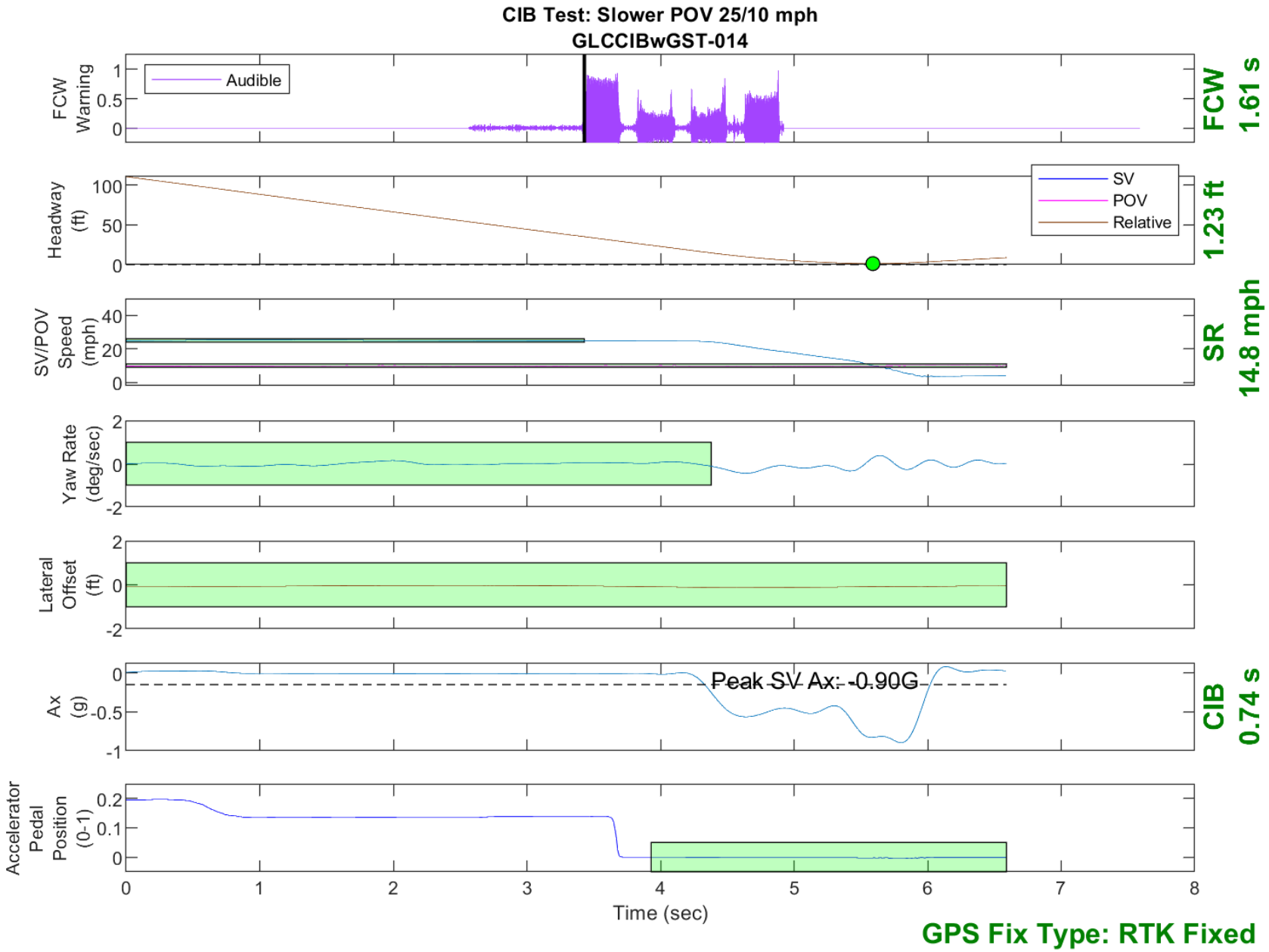


Figure D36. Time History for CIB Run 14, Slower POV, 25/10 mph

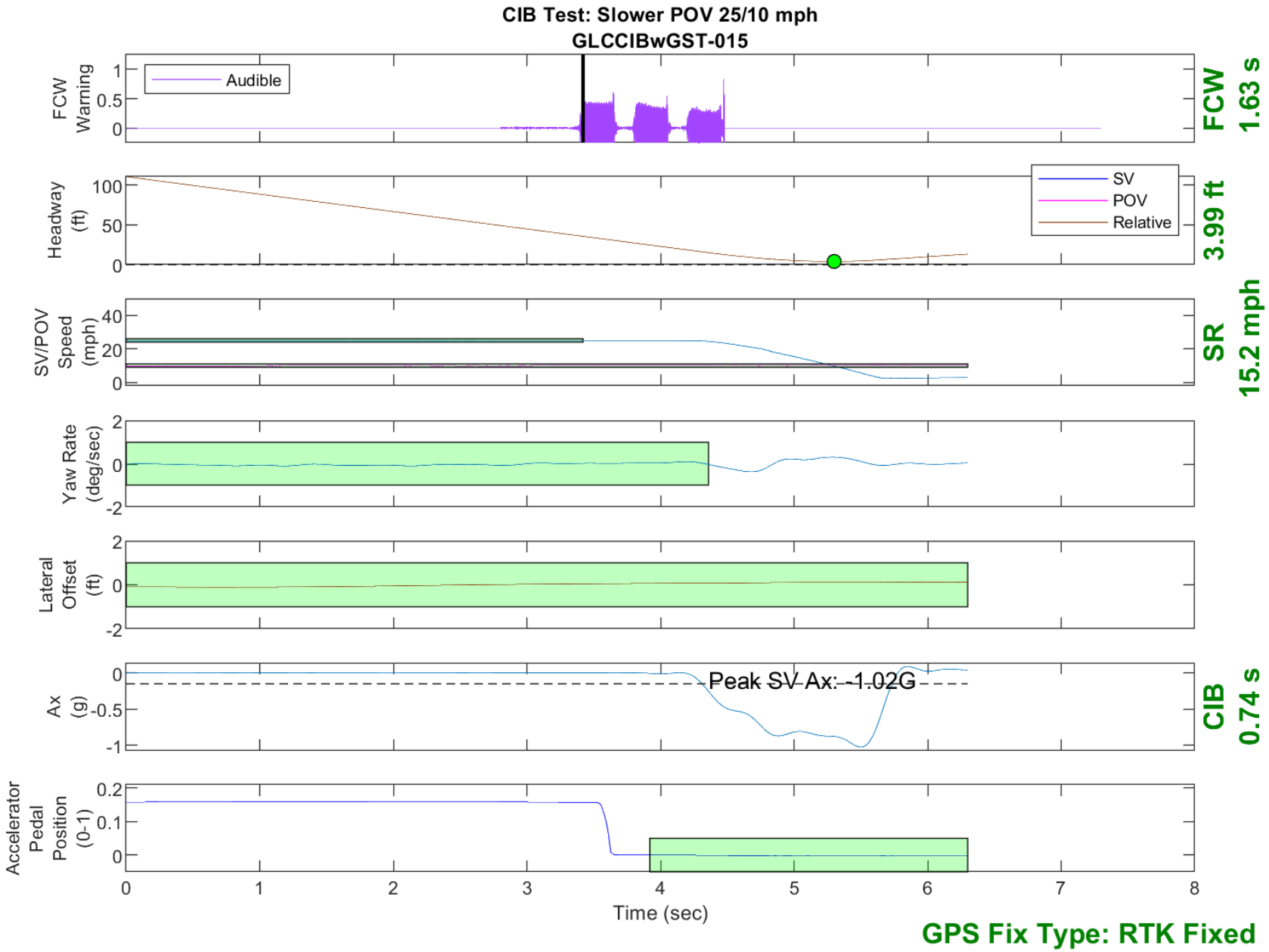


Figure D37. Time History for CIB Run 15, Slower POV, 25/10 mph

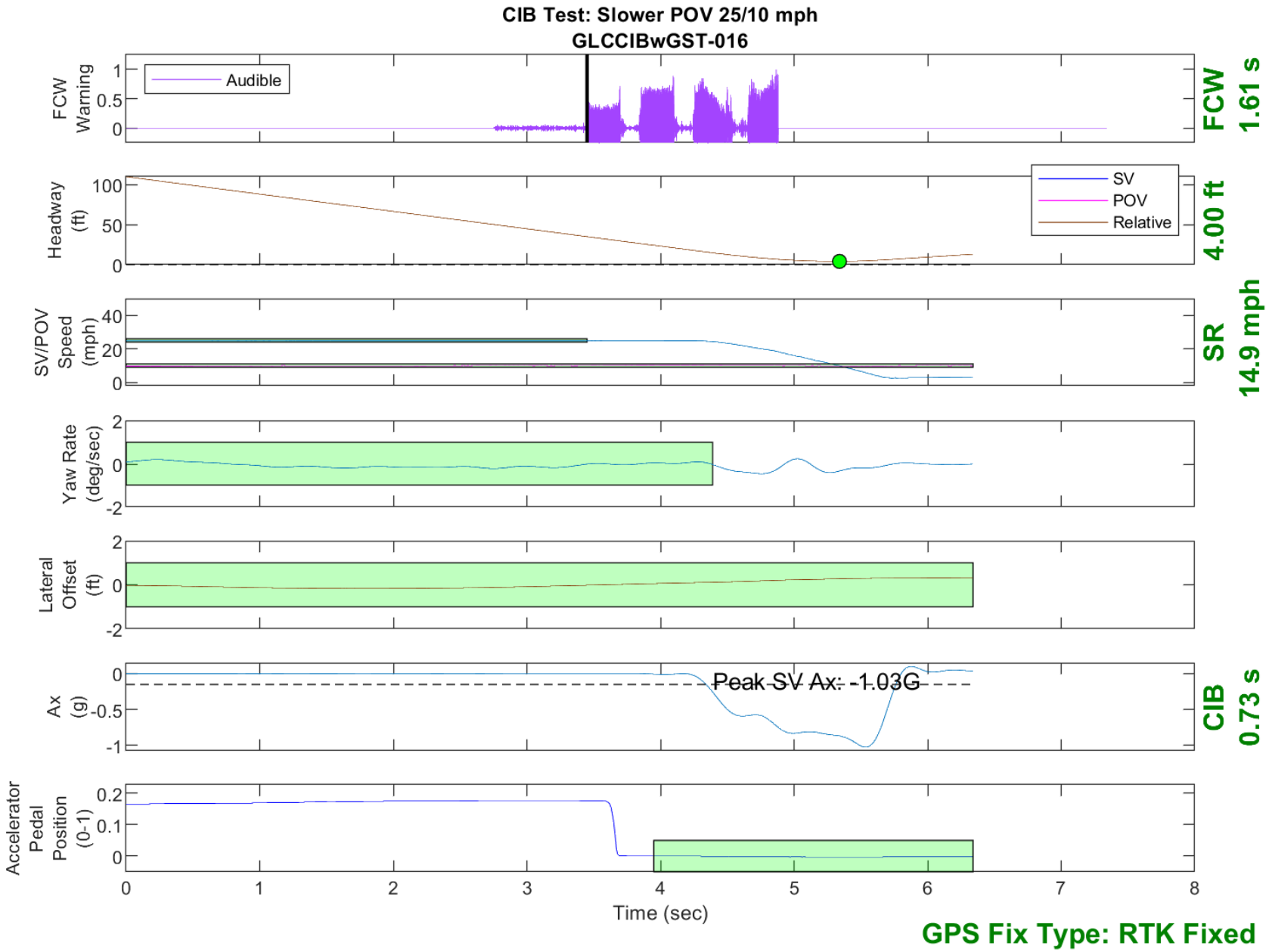


Figure D38. Time History for CIB Run 16, Slower POV, 25/10 mph

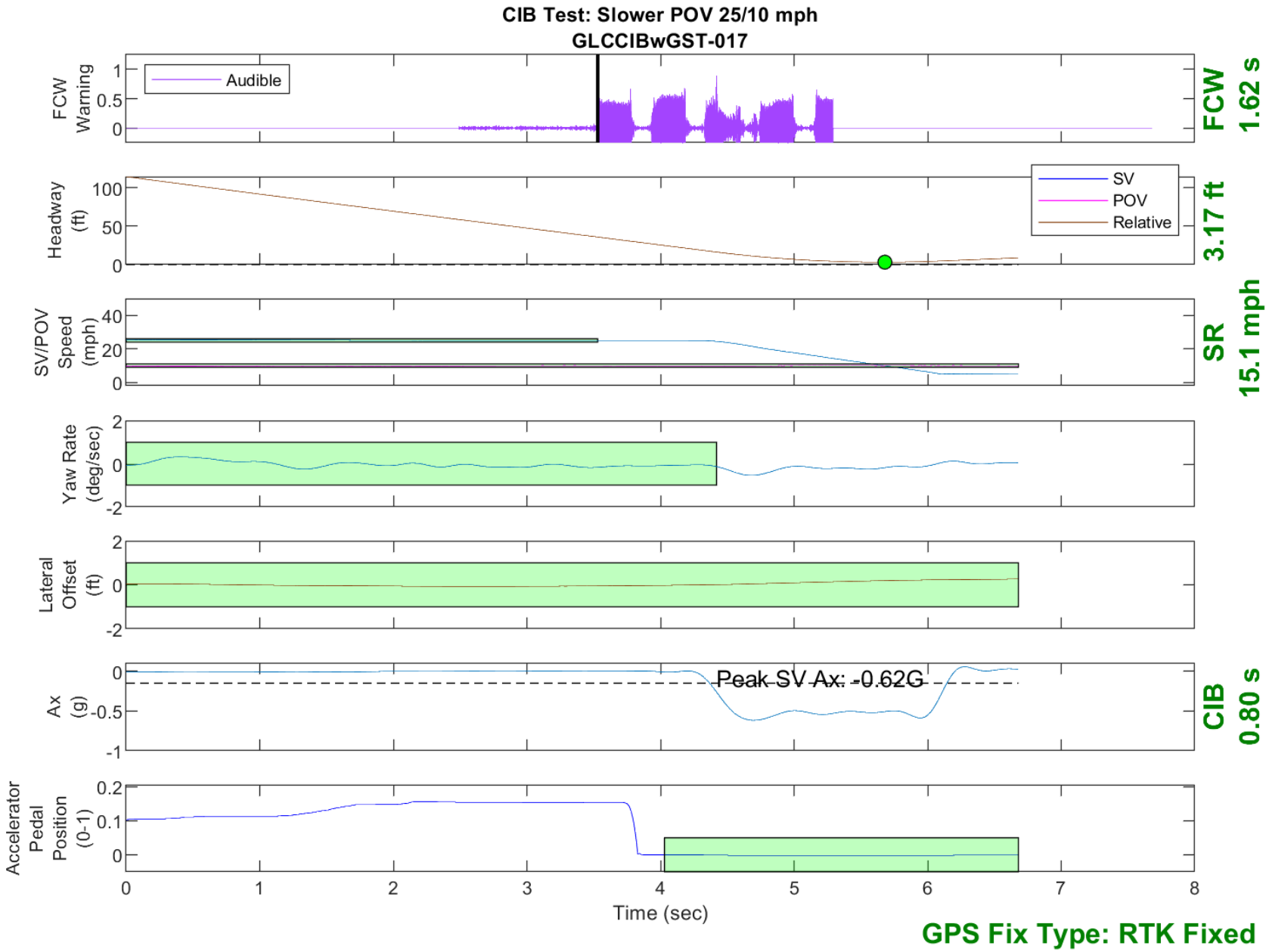


Figure D39. Time History for CIB Run 17, Slower POV, 25/10 mph

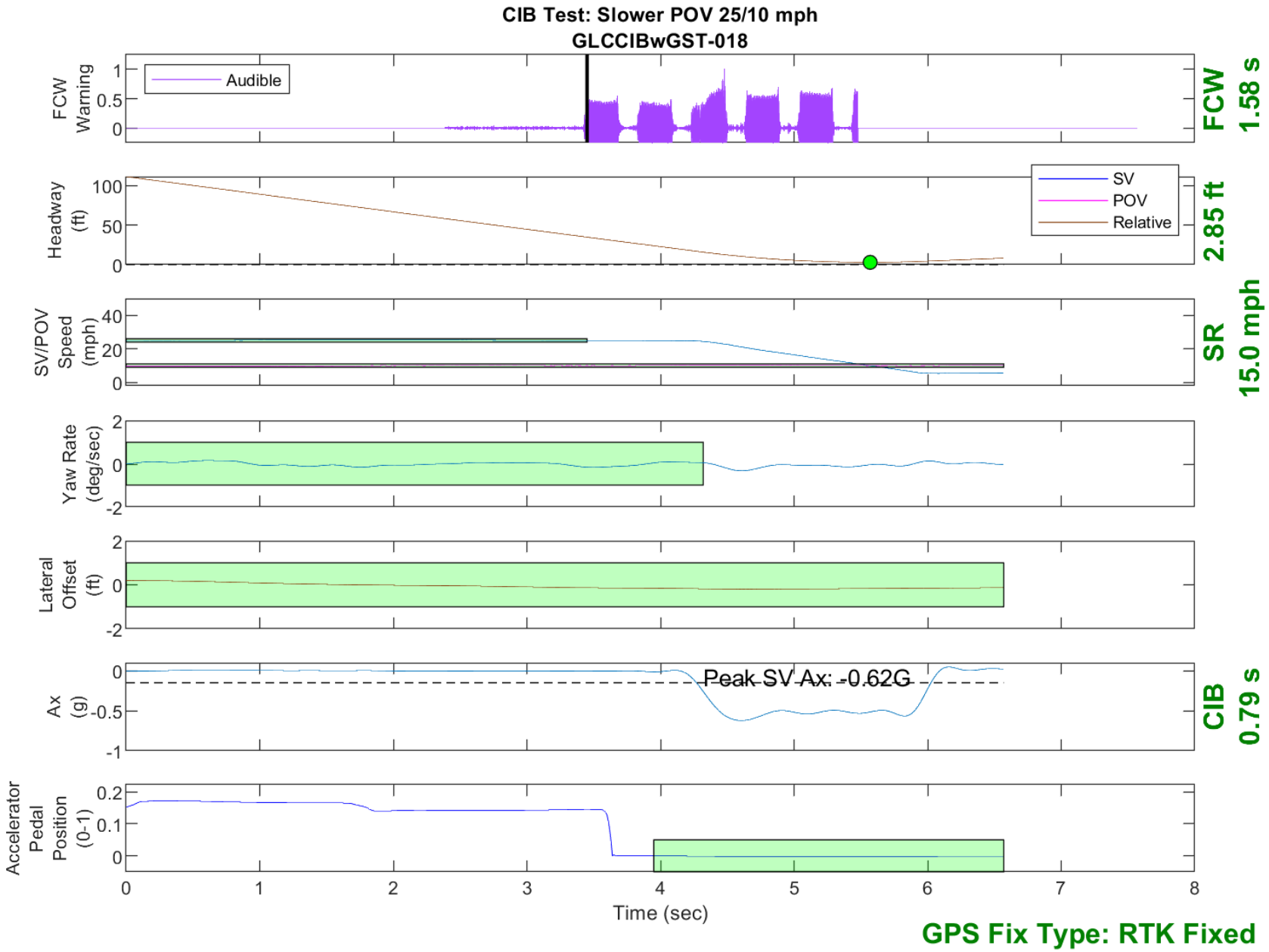


Figure D40. Time History for CIB Run 18, Slower POV, 25/10 mph

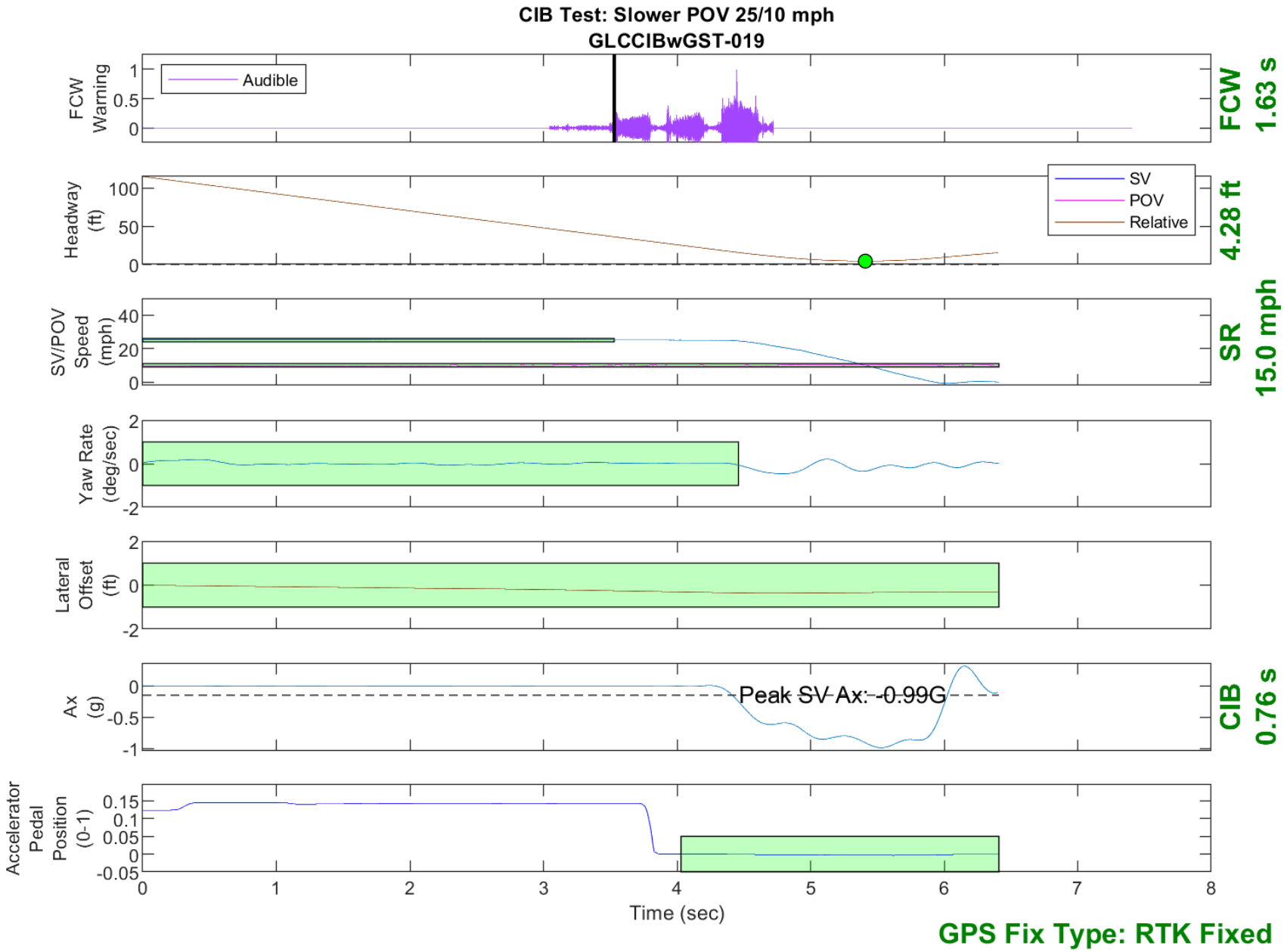


Figure D41. Time History for CIB Run 19, Slower POV, 25/10 mph

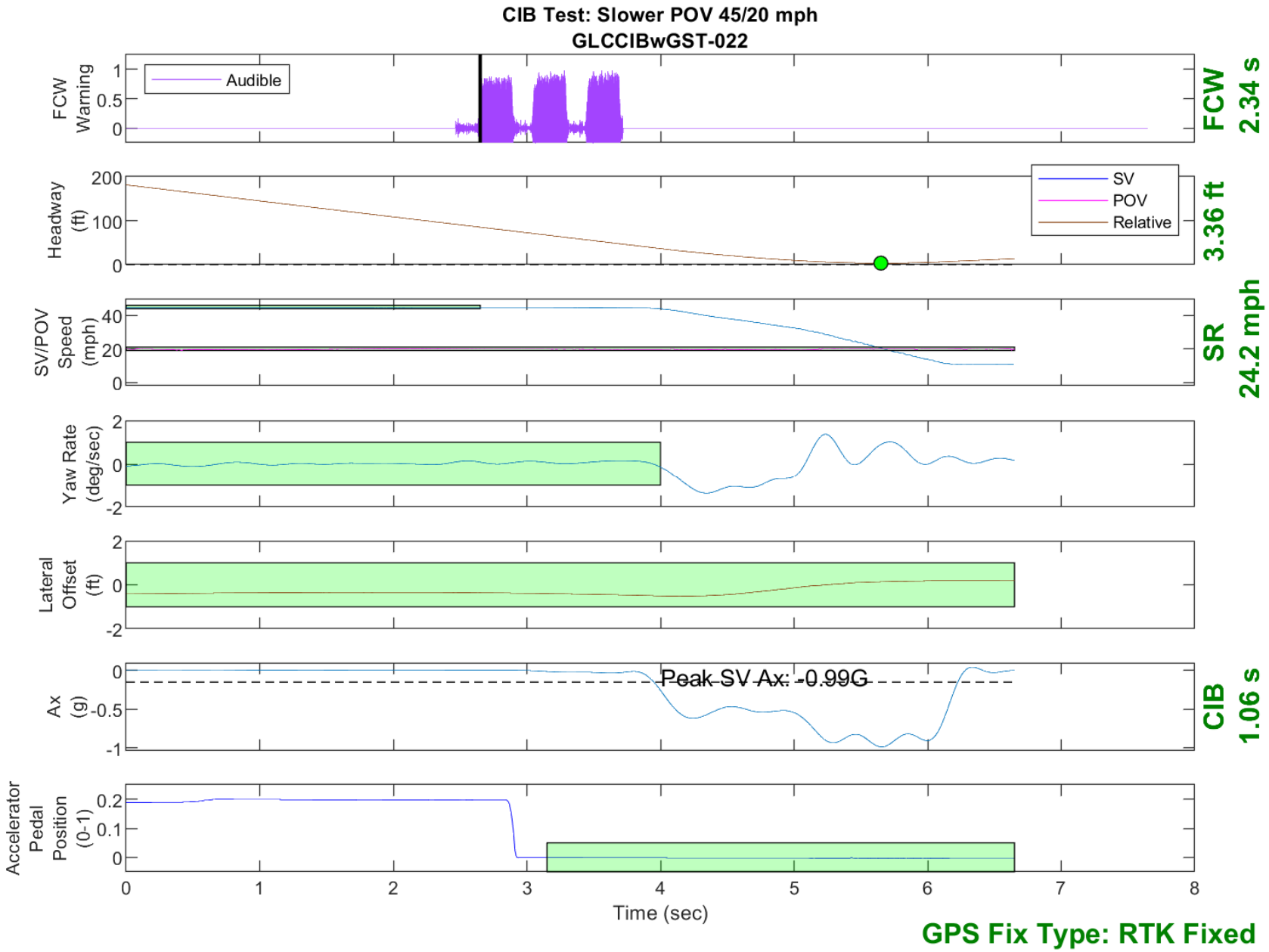


Figure D42. Time History for CIB Run 22, Slower POV, 45/20 mph

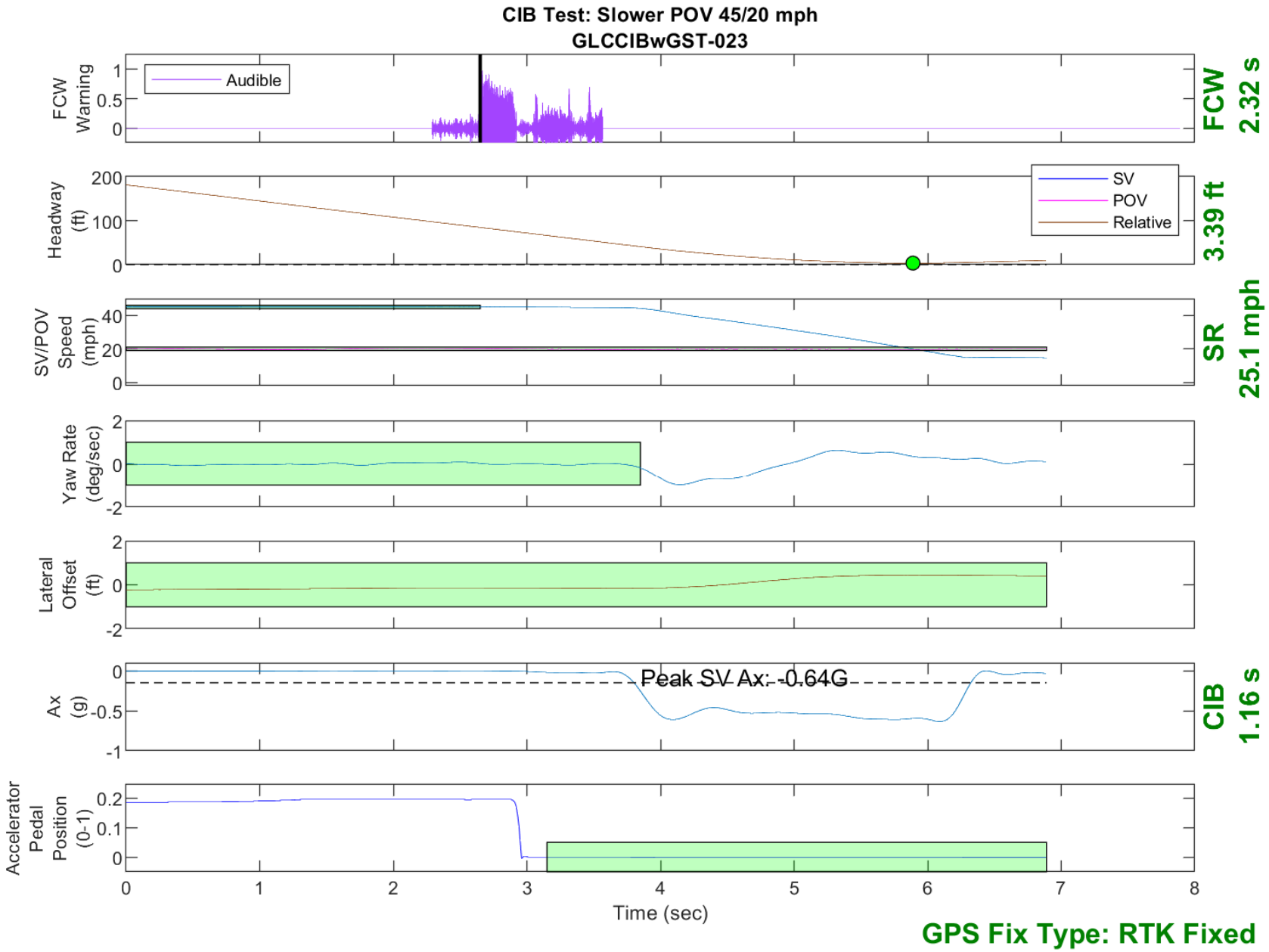


Figure D43. Time History for CIB Run 23, Slower POV, 45/20 mph

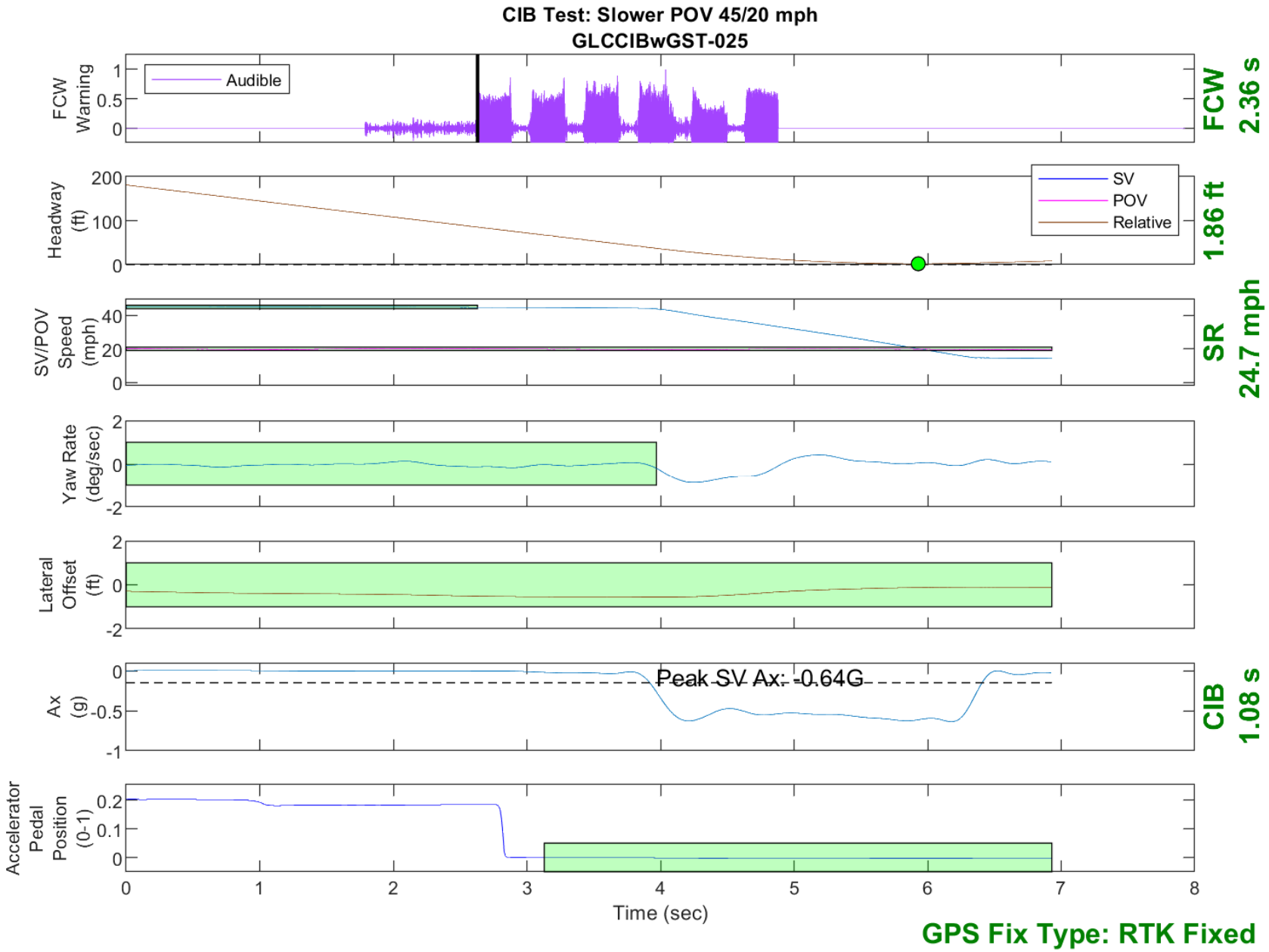


Figure D44. Time History for CIB Run 25, Slower POV, 45/20 mph

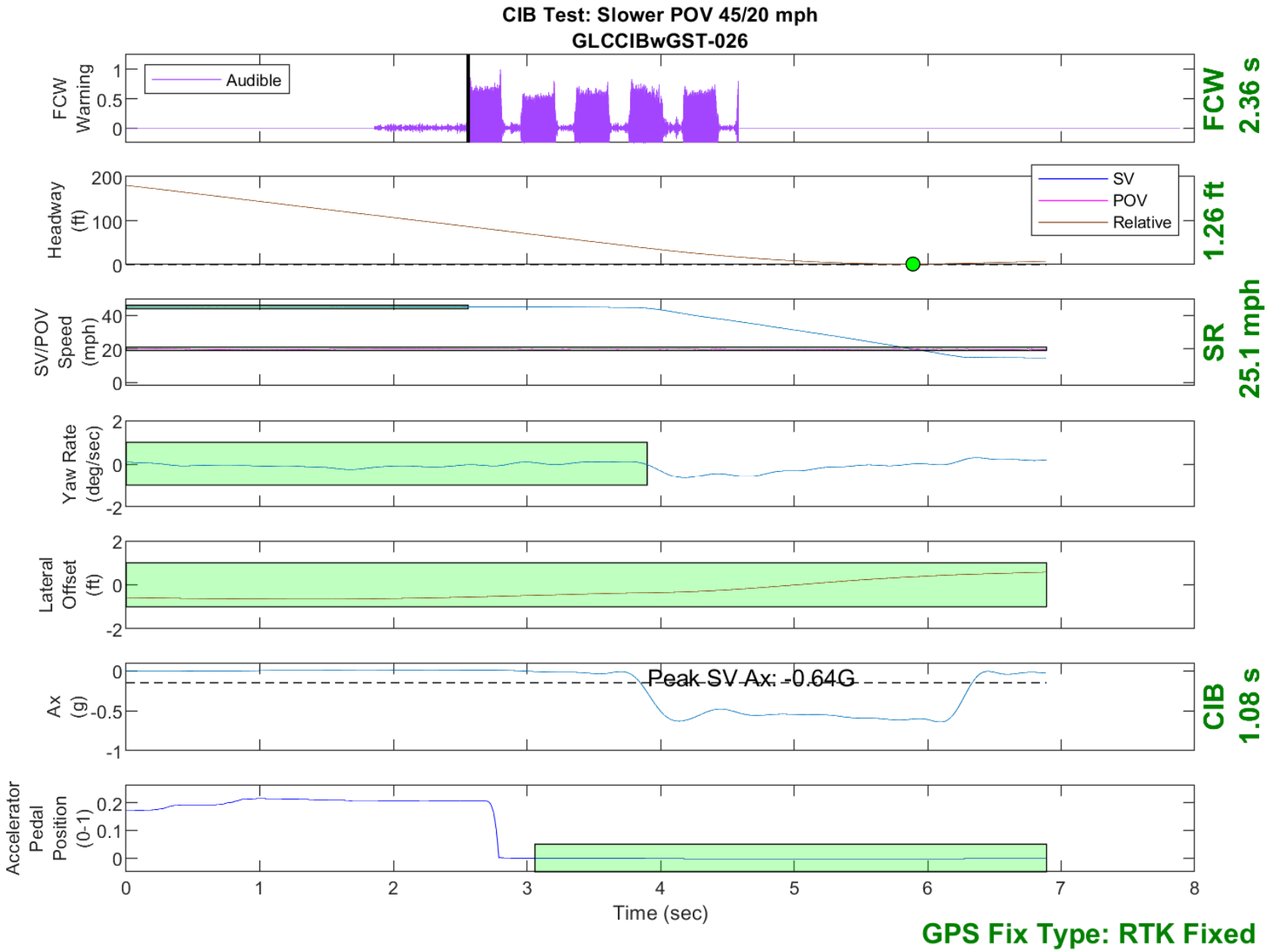


Figure D45. Time History for CIB Run 26, Slower POV, 45/20 mph

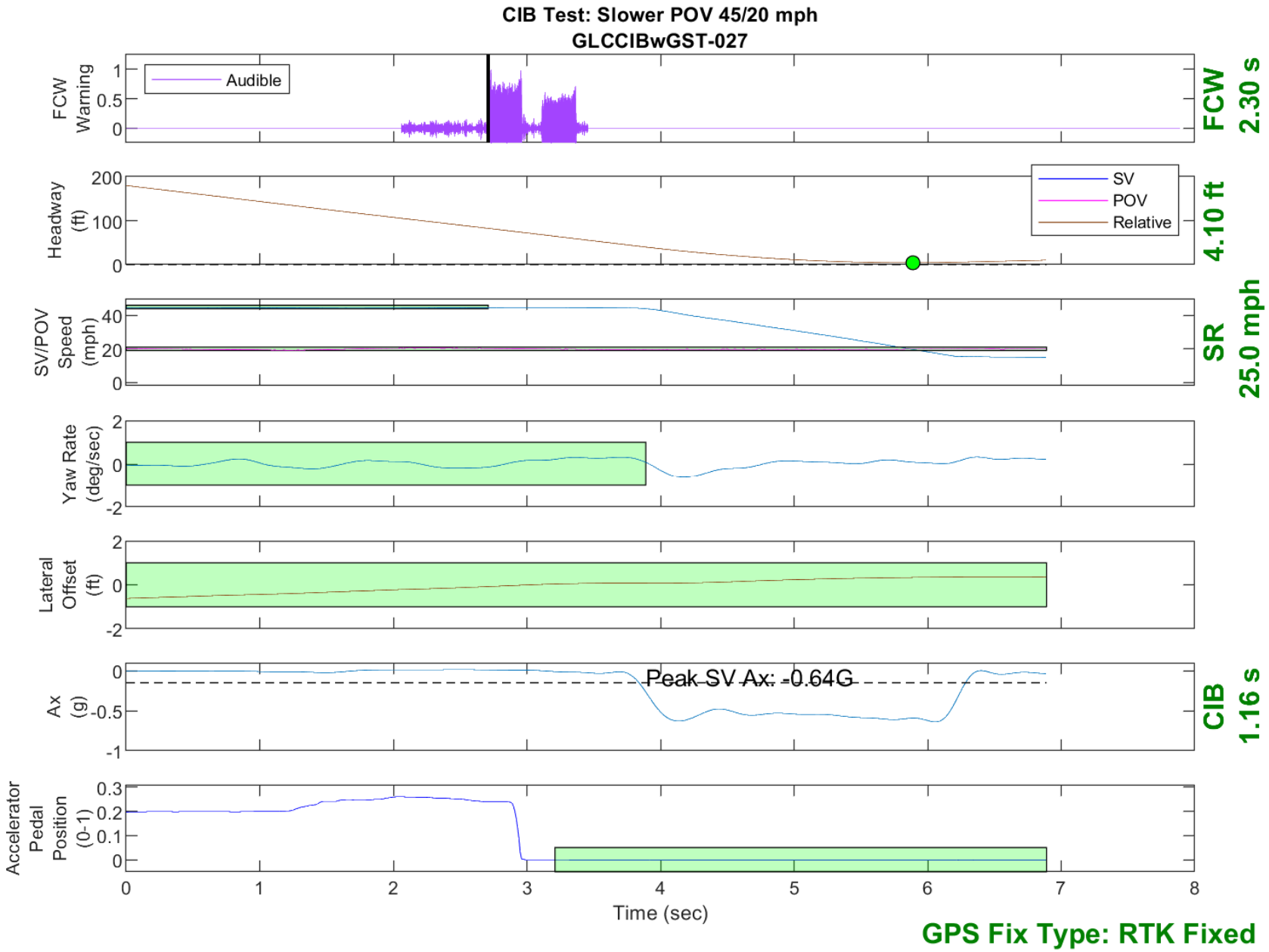


Figure D46. Time History for CIB Run 27, Slower POV, 45/20 mph

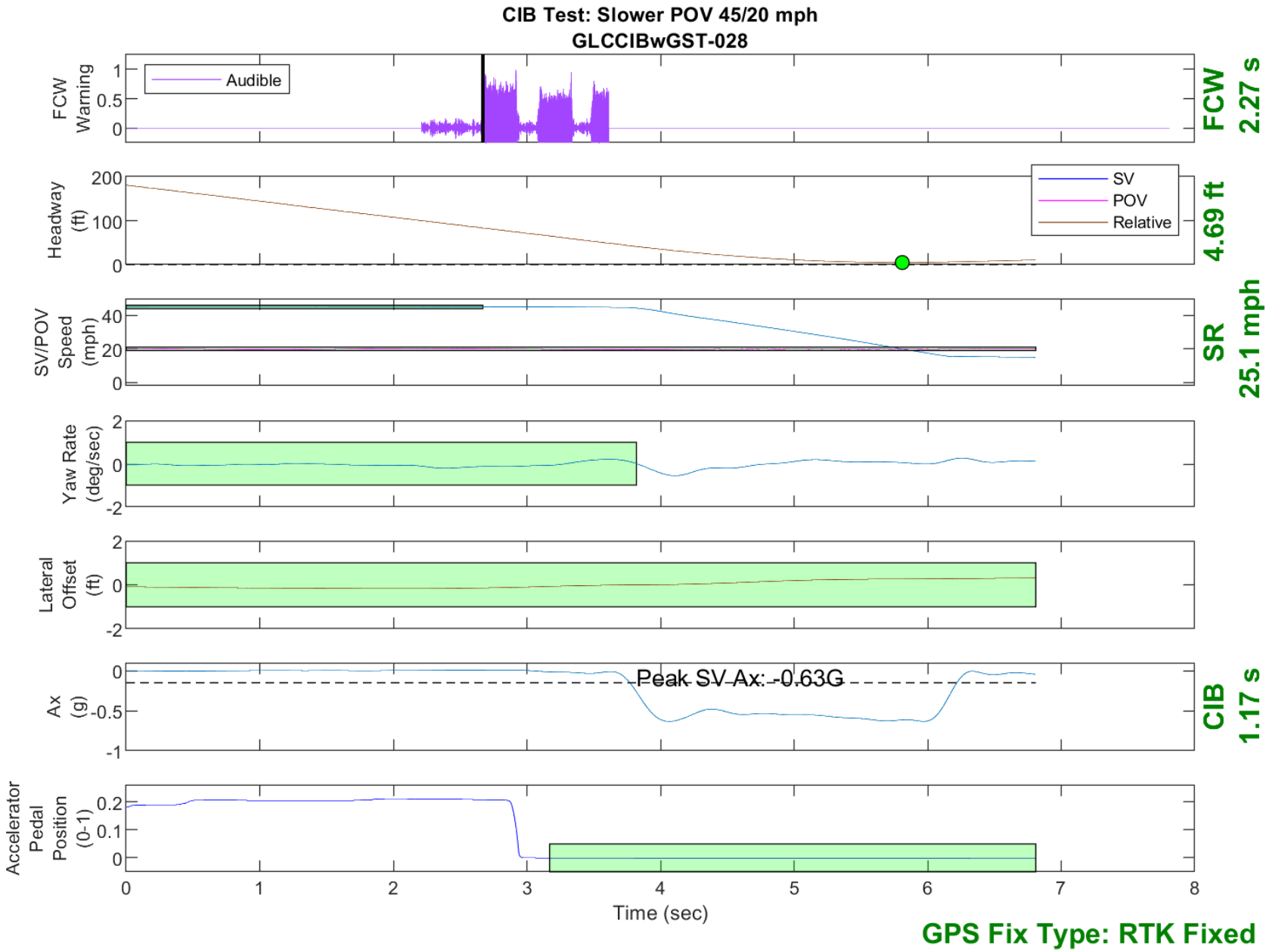


Figure D47. Time History for CIB Run 28, Slower POV, 45/20 mph

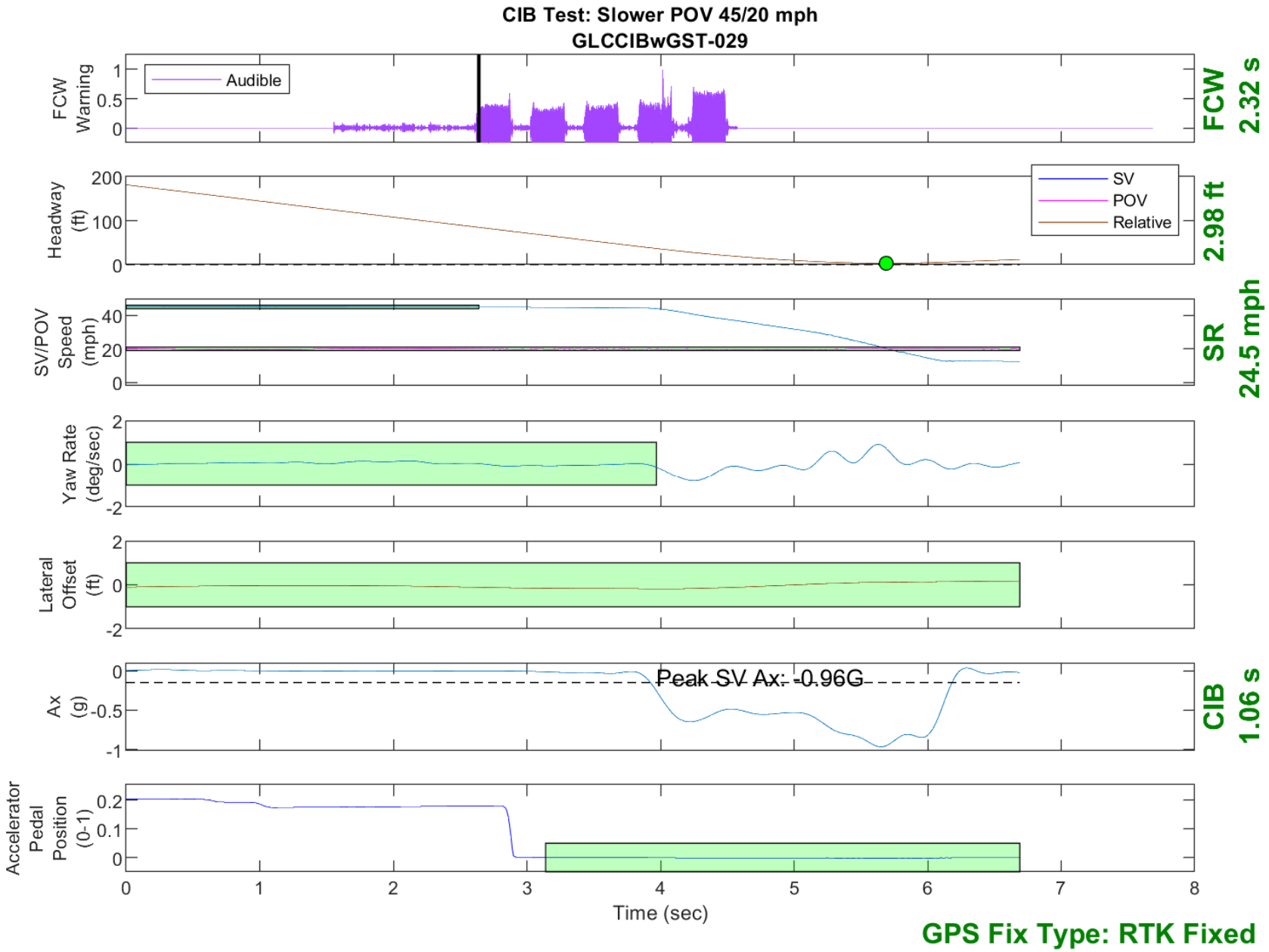


Figure D48. Time History for CIB Run 29, Slower POV, 45/20 mph

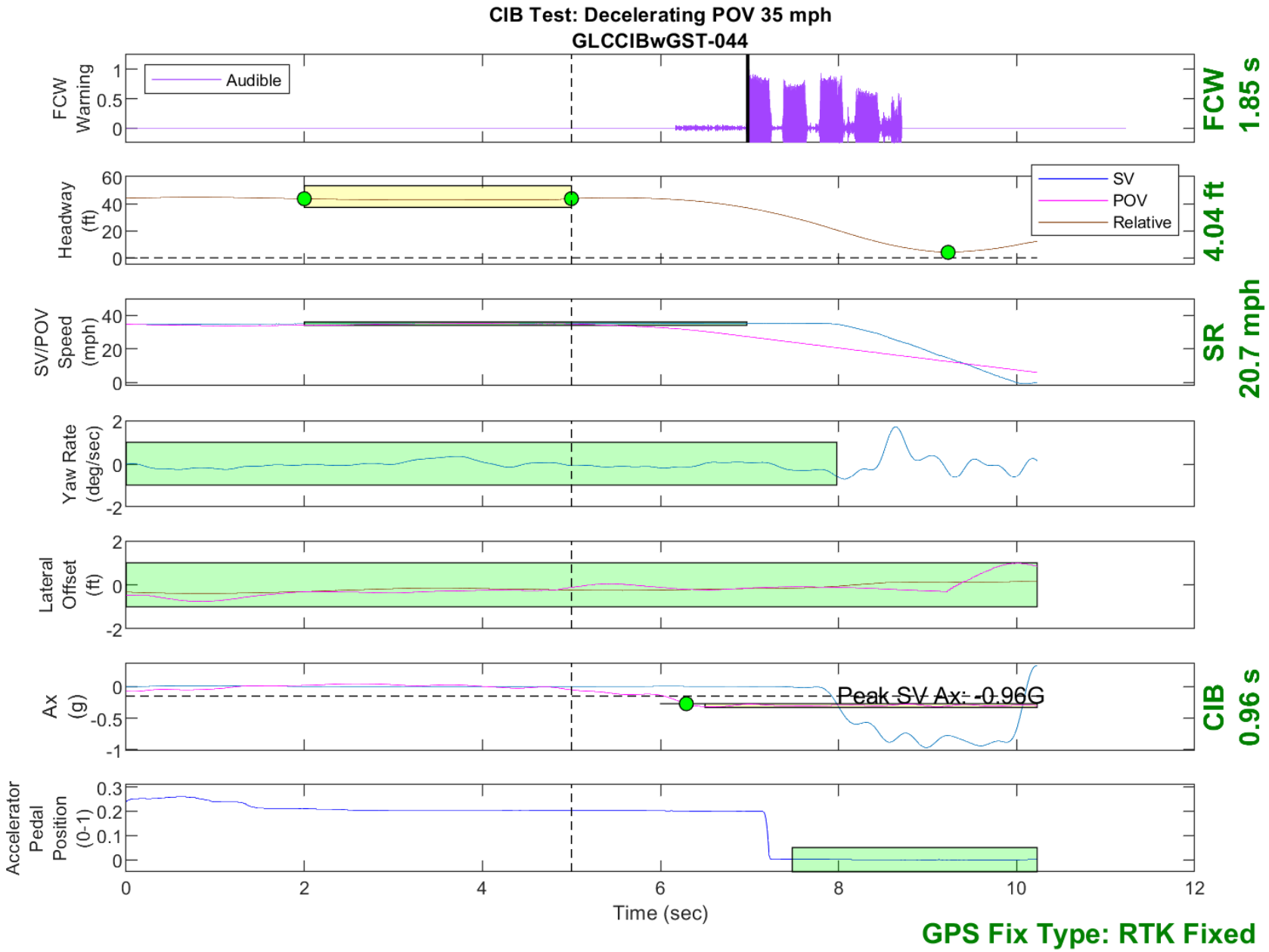


Figure D49. Time History for CIB Run 44, Decelerating POV, 35 mph 0.3g

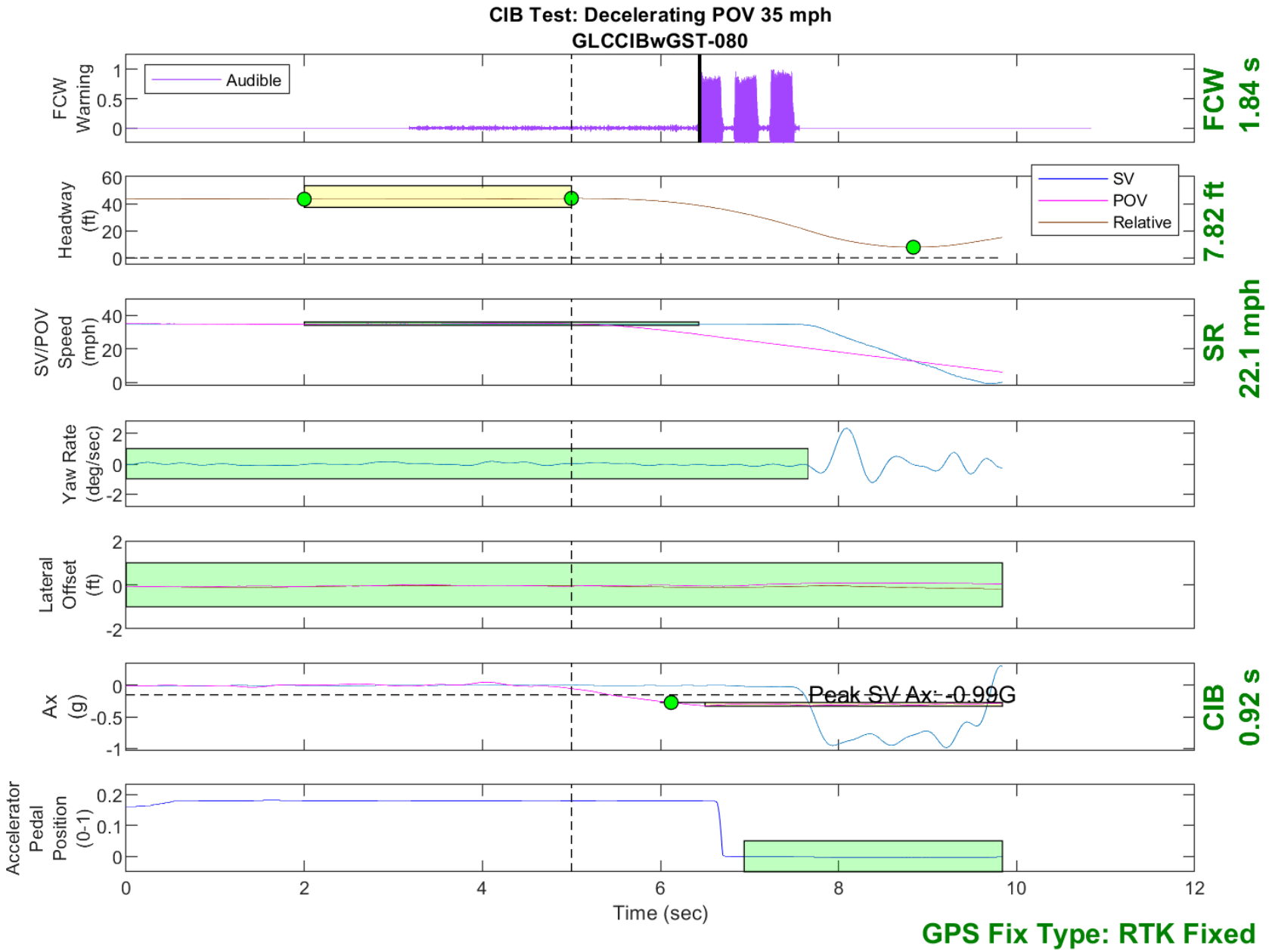


Figure D50. Time History for CIB Run 80, Decelerating POV, 35 mph 0.3g

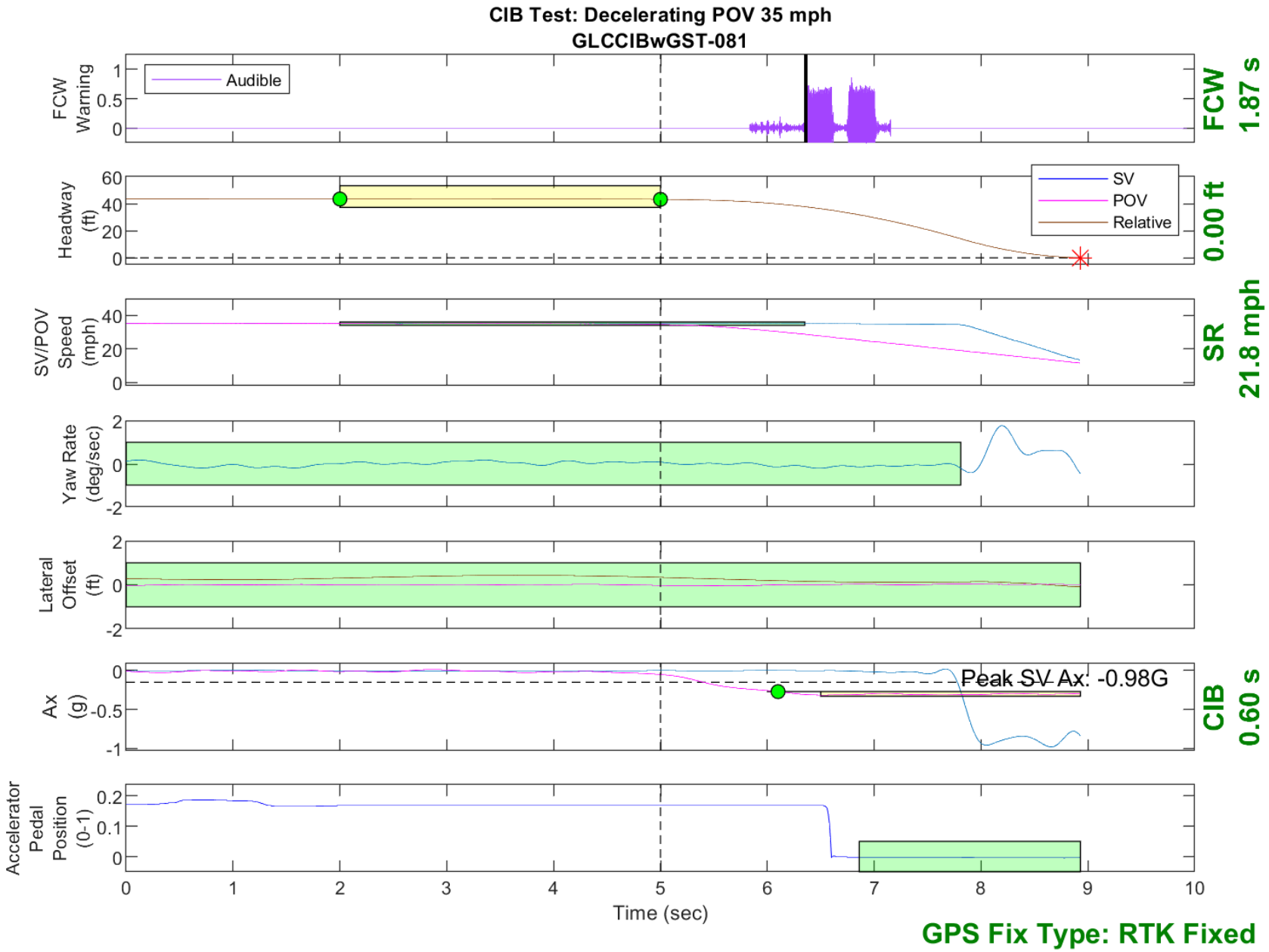


Figure D51. Time History for CIB Run 81, Decelerating POV, 35 mph 0.3g

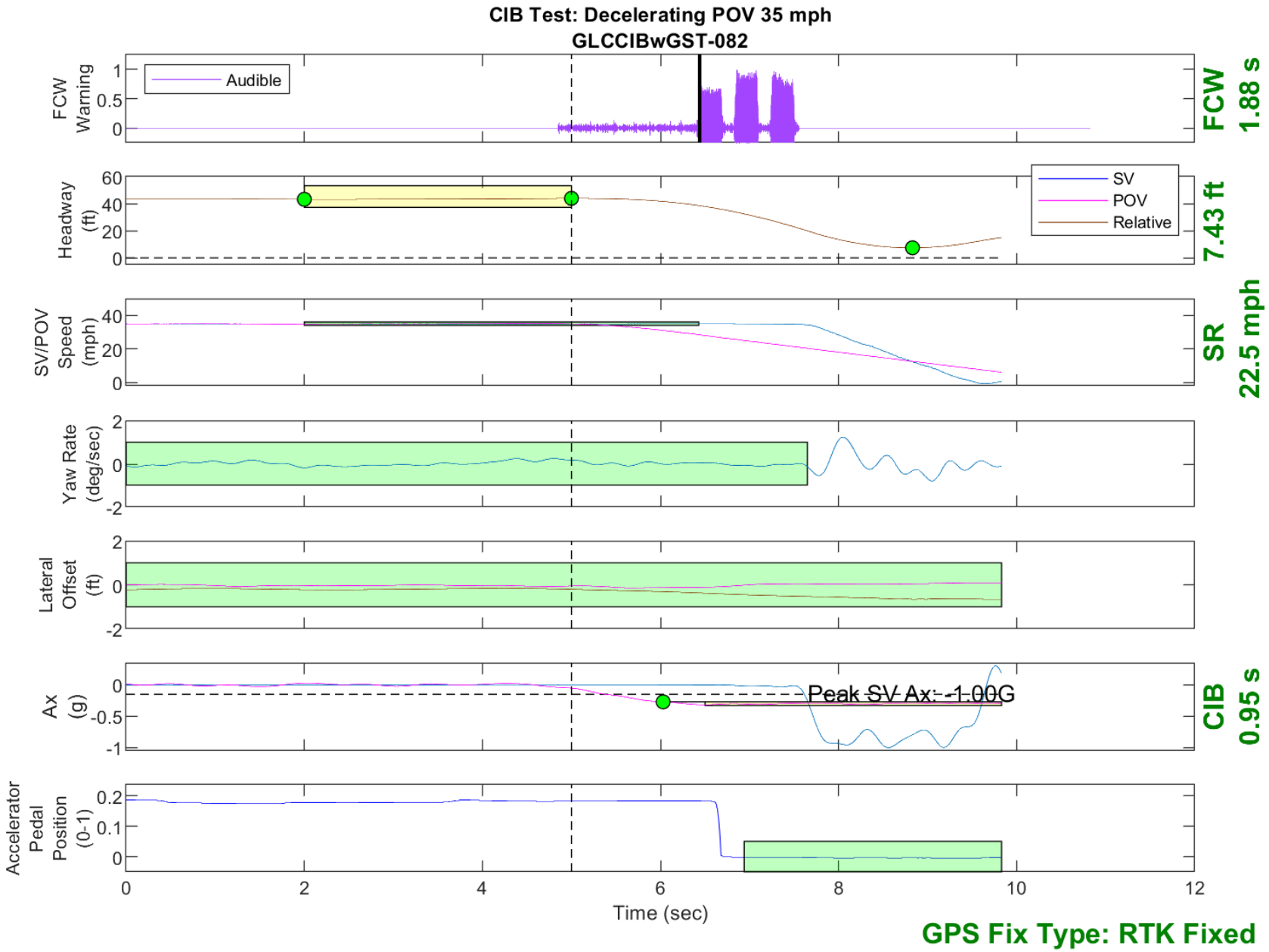


Figure D52. Time History for CIB Run 82, Decelerating POV, 35 mph 0.3g

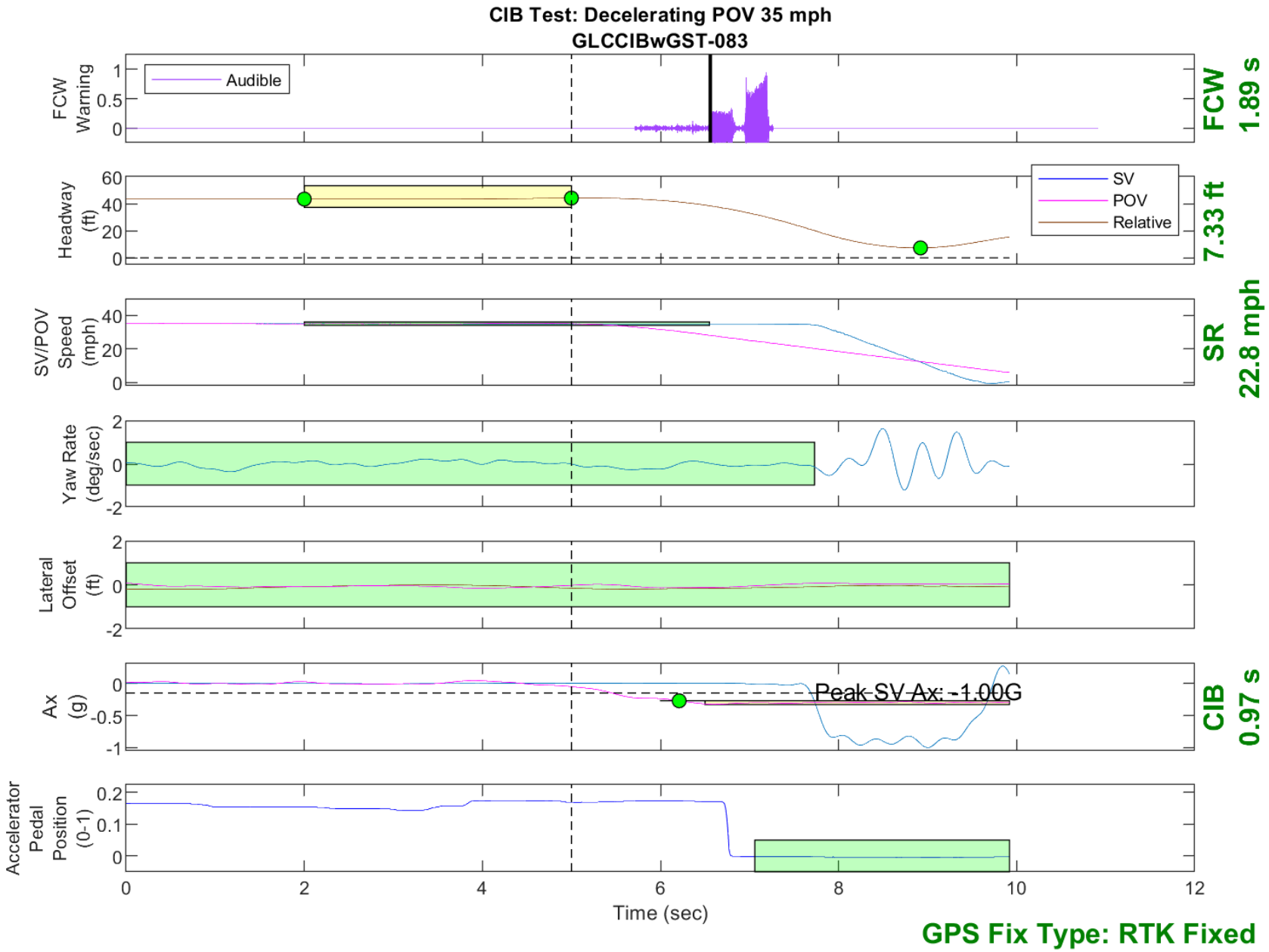


Figure D53. Time History for CIB Run 83, Decelerating POV, 35 mph 0.3g

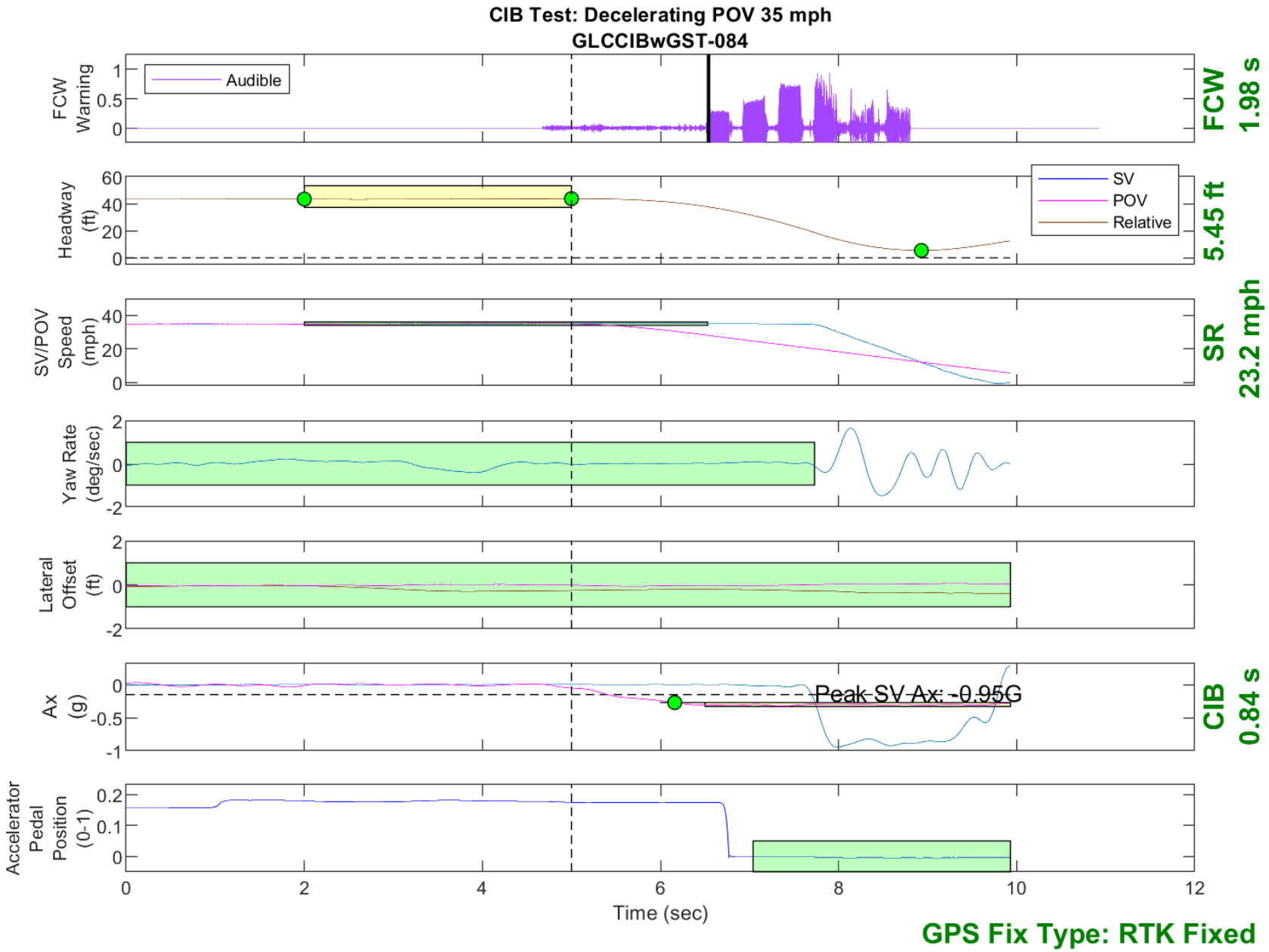


Figure D54. Time History for CIB Run 84, Decelerating POV, 35 mph 0.3g

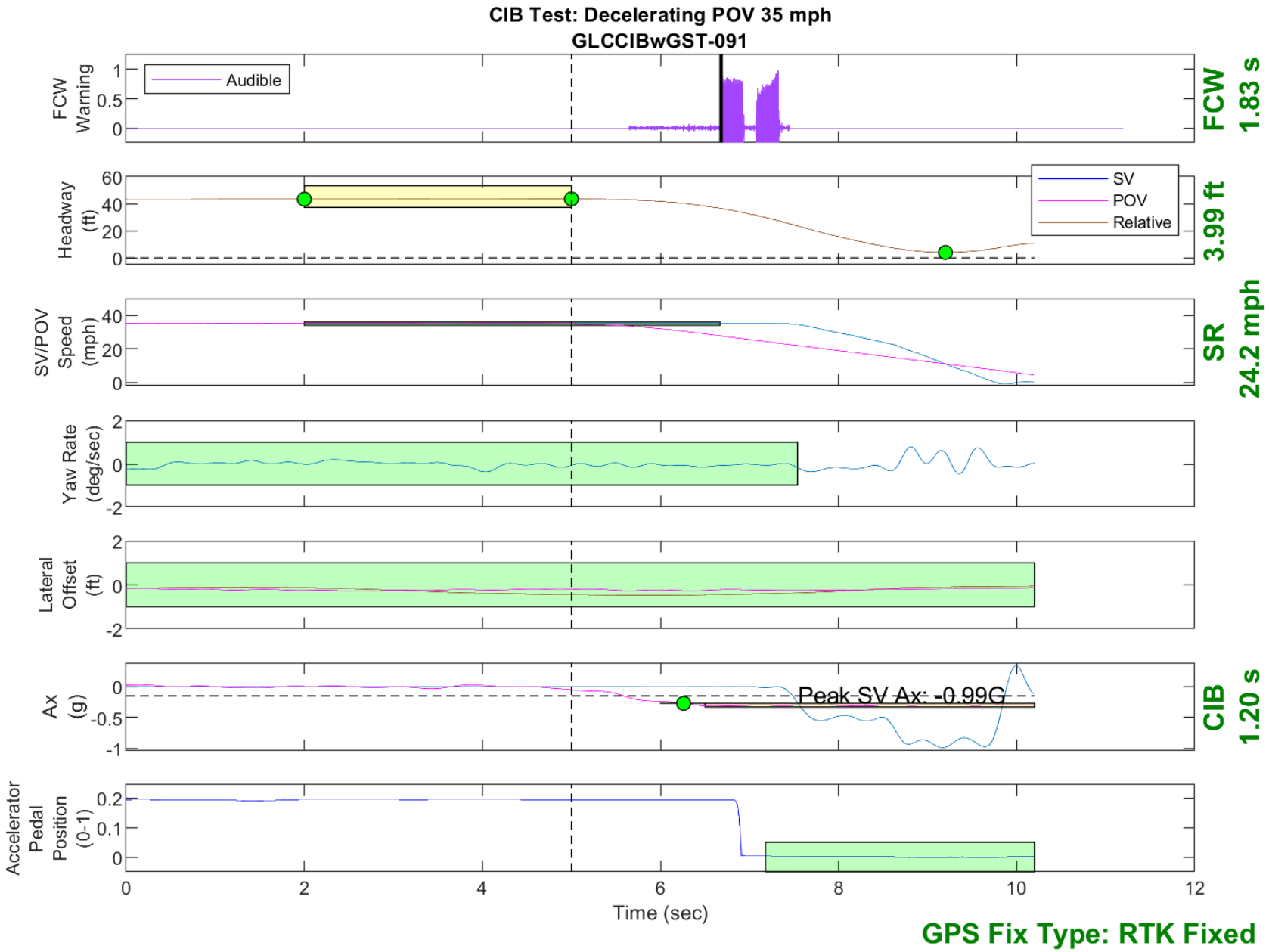


Figure D55. Time History for CIB Run 91, Decelerating POV, 35 mph 0.3g

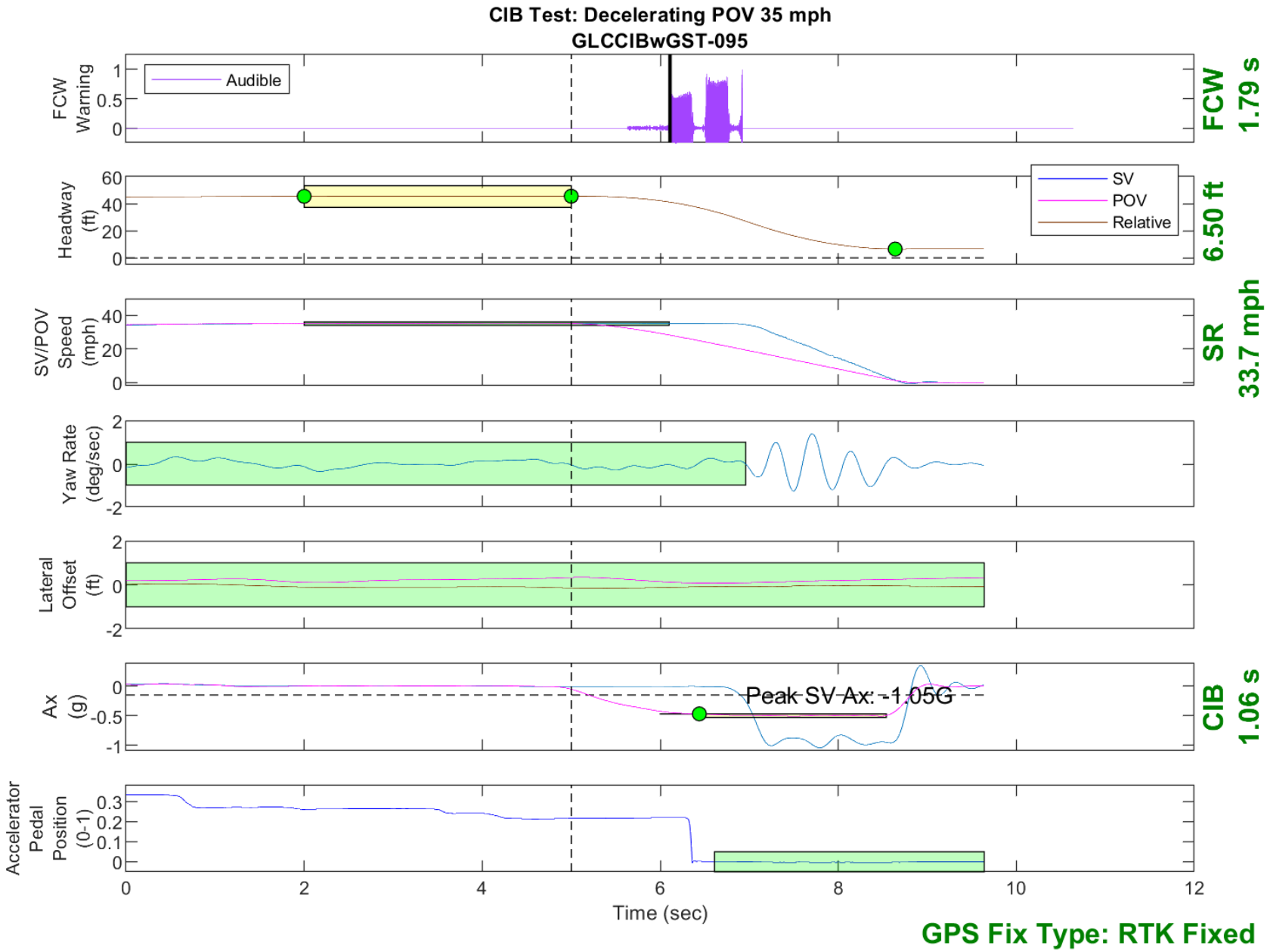


Figure D56. Time History for CIB Run 95, Decelerating POV, 35 mph 0.5g

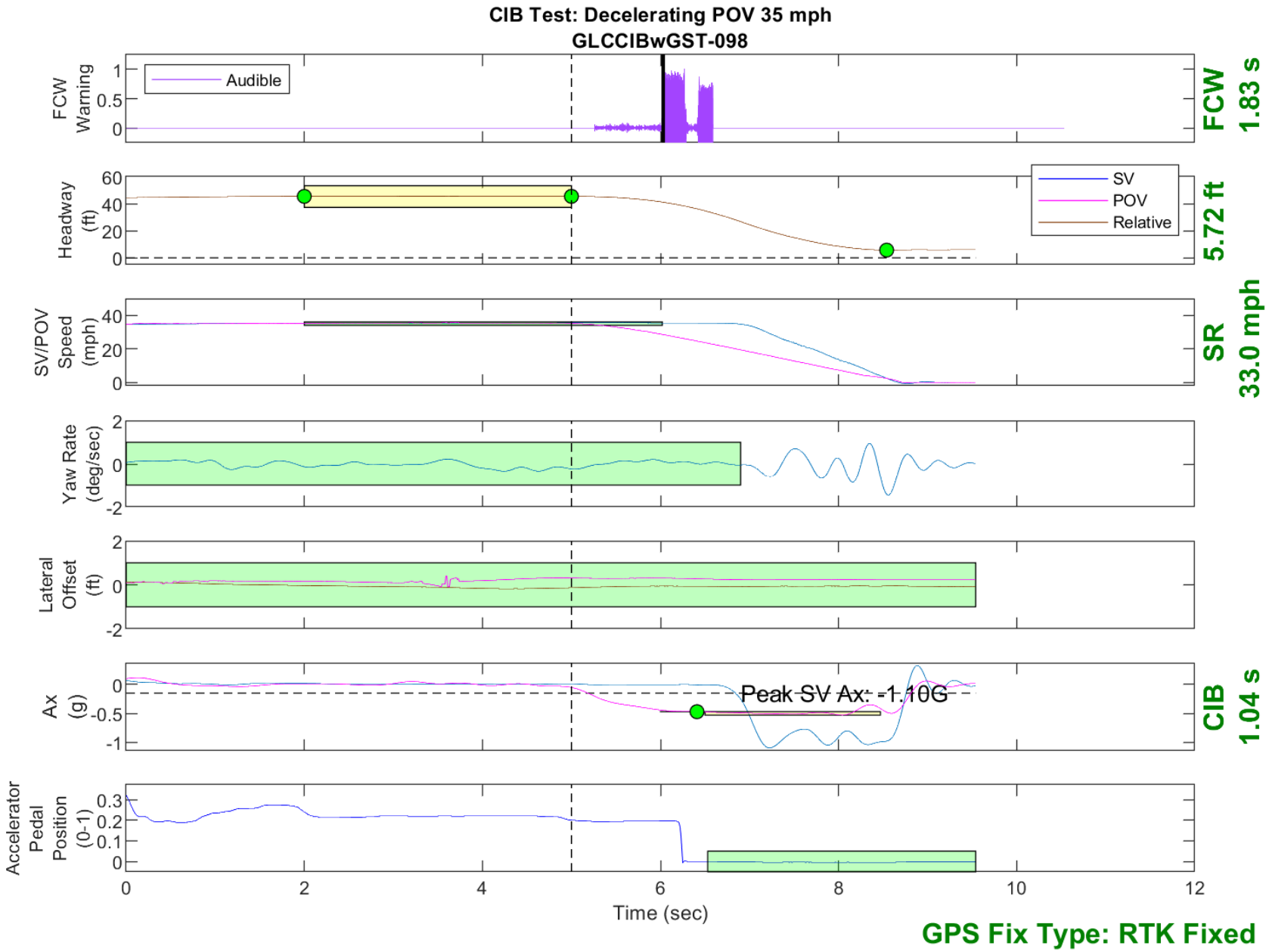


Figure D57. Time History for CIB Run 98, Decelerating POV, 35 mph 0.5g

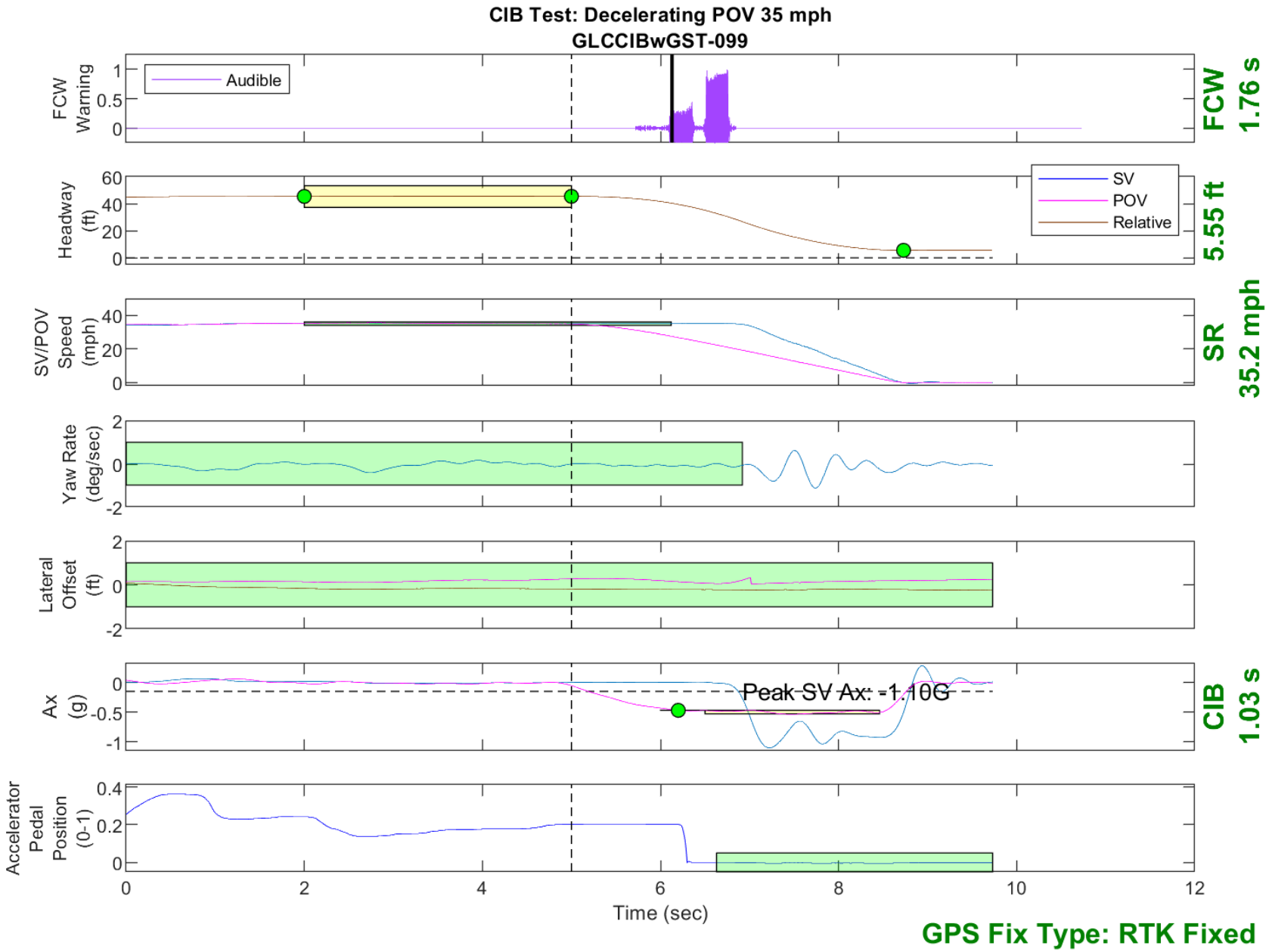


Figure D58. Time History for CIB Run 99, Decelerating POV, 35 mph 0.5g

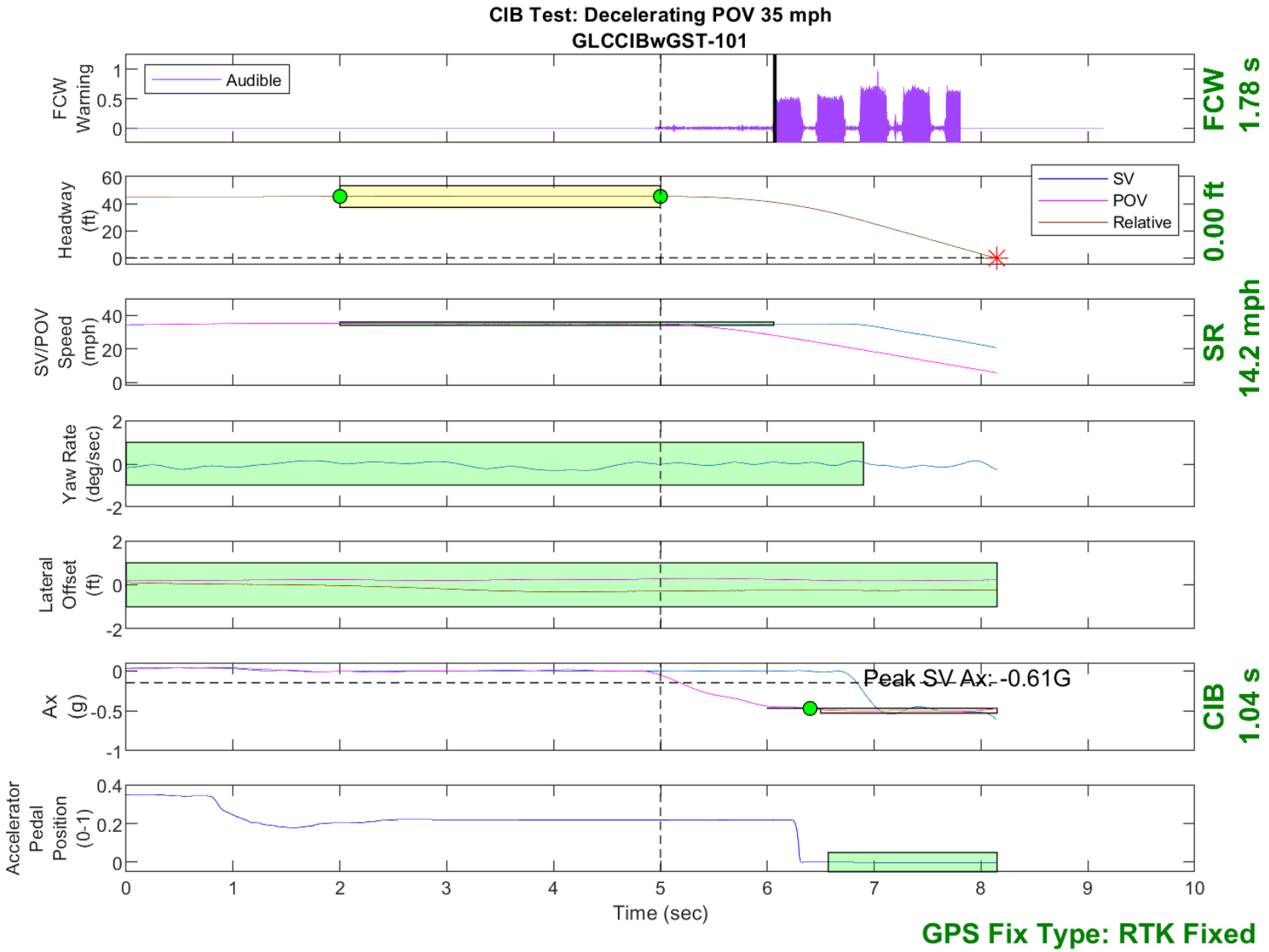


Figure D59. Time History for CIB Run 101, Decelerating POV, 35 mph 0.5g

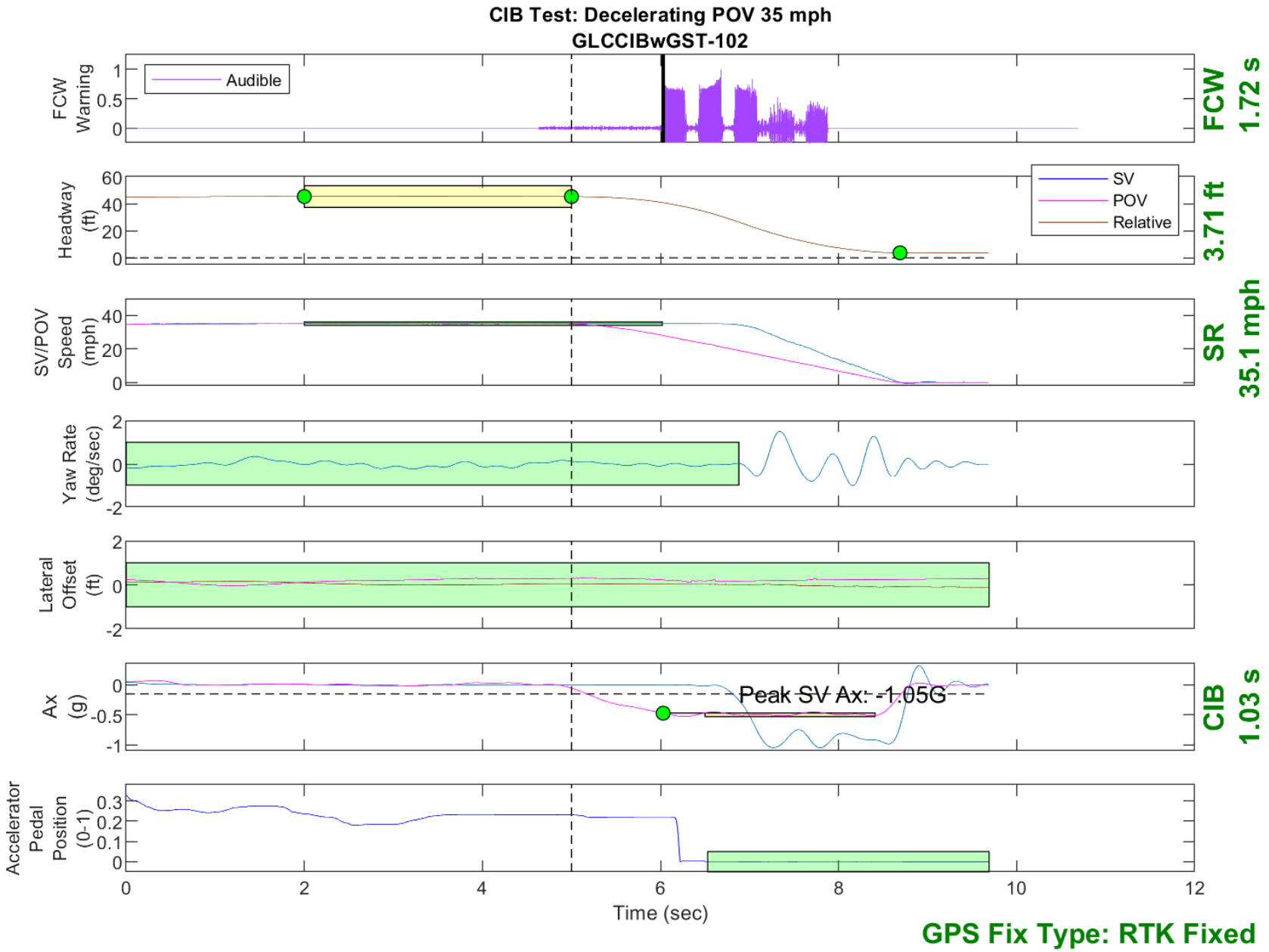


Figure D60. Time History for CIB Run 102, Decelerating POV, 35 mph 0.5g

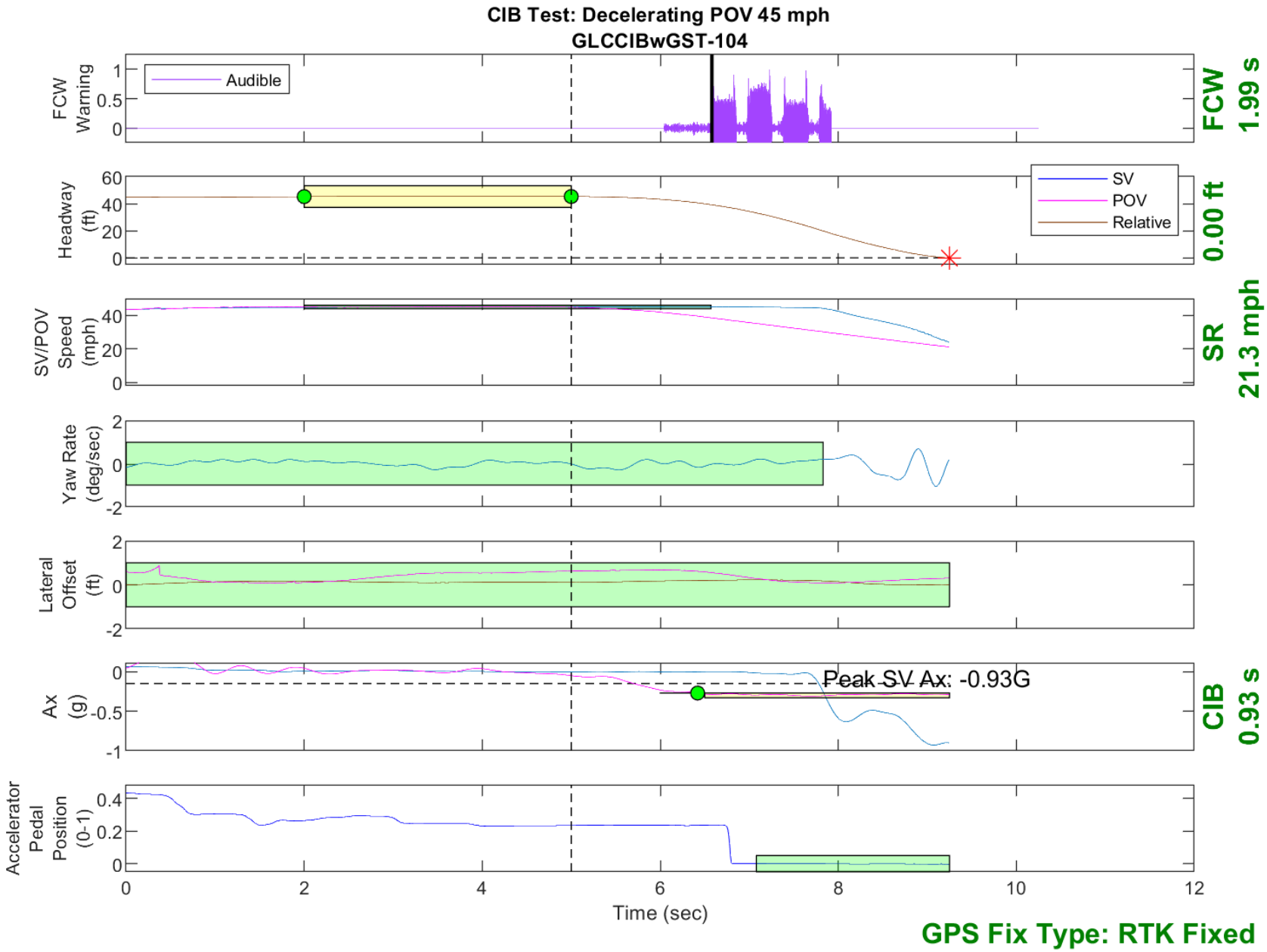


Figure D61. Time History for CIB Run 104, Decelerating POV, 45 mph 0.3g

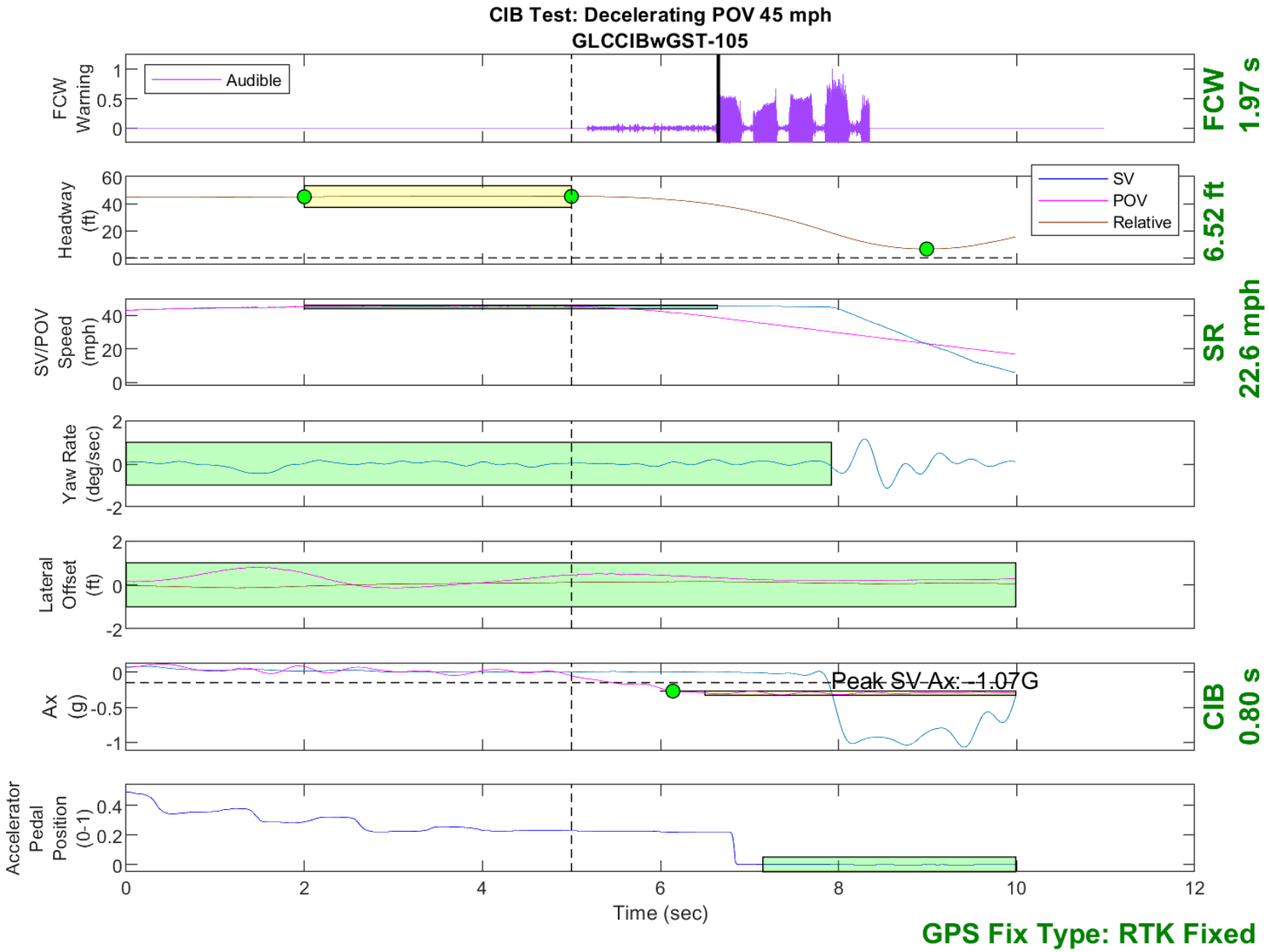


Figure D62. Time History for CIB Run 105, Decelerating POV, 45 mph 0.3g

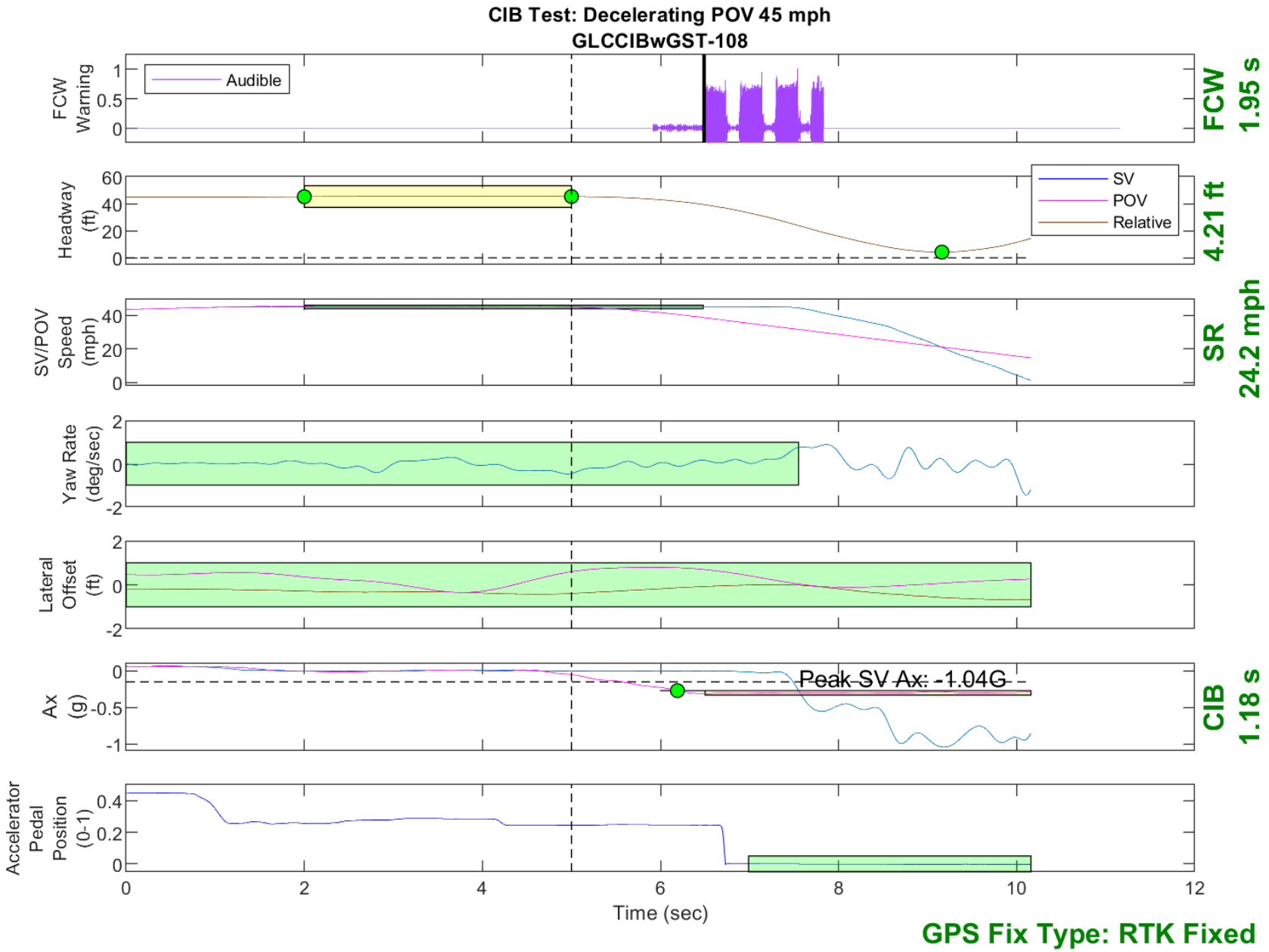


Figure D63. Time History for CIB Run 108, Decelerating POV, 45 mph 0.3g

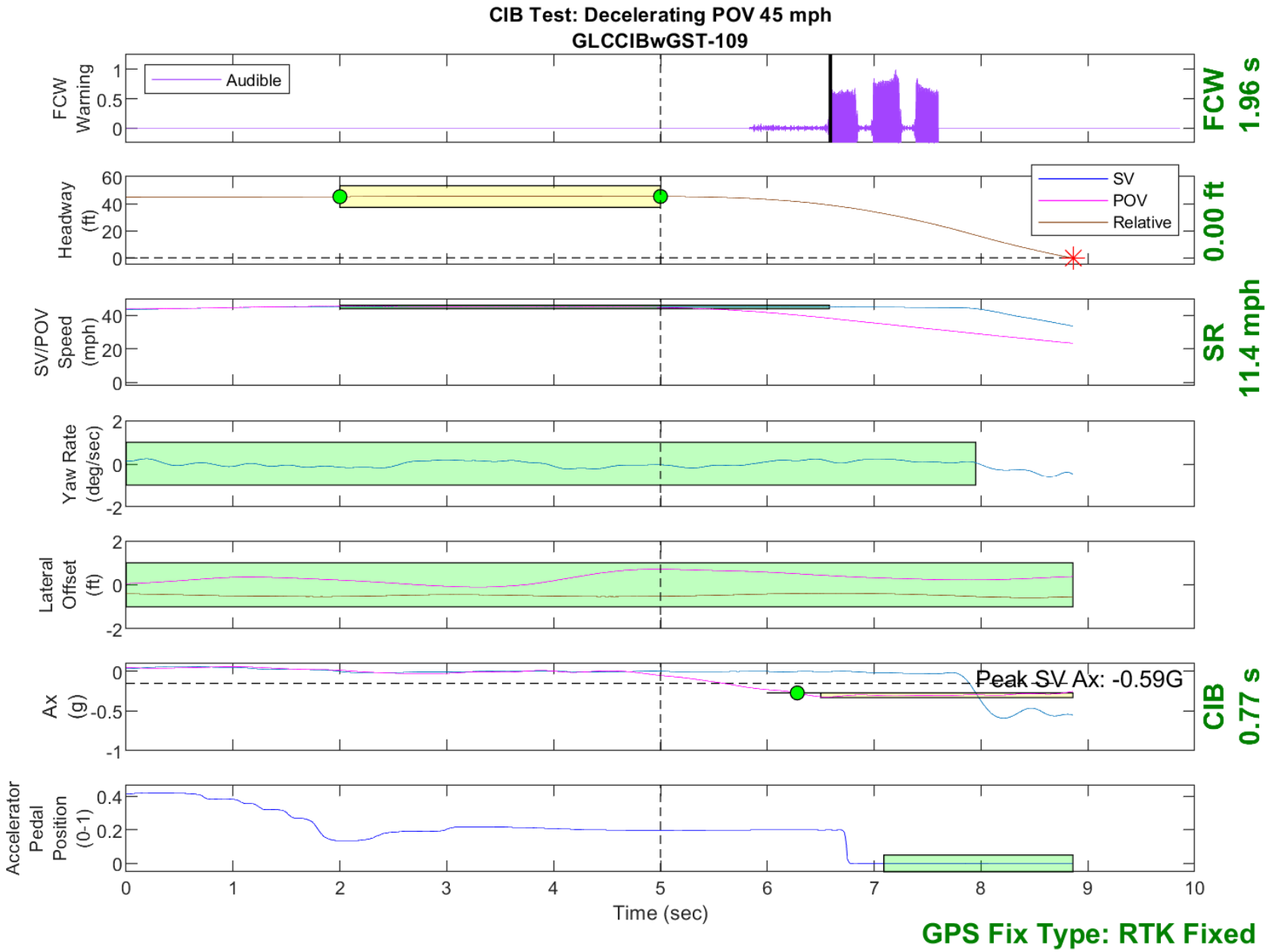


Figure D64. Time History for CIB Run 109, Decelerating POV, 45 mph 0.3g

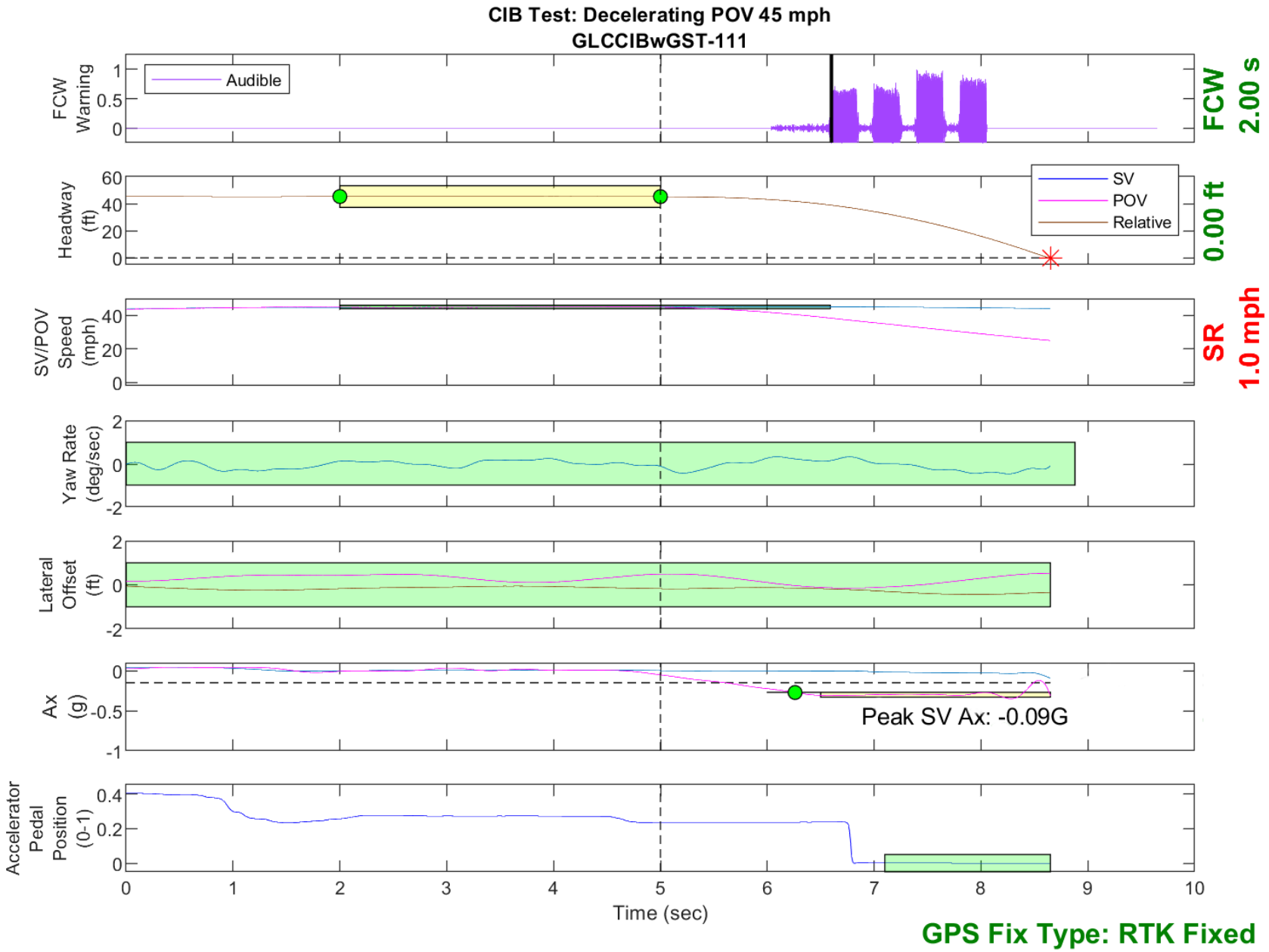


Figure D65. Time History for CIB Run 111, Decelerating POV, 45 mph 0.3g