NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST
NCAP-DRI-FCW-22-10

2022 Subaru Forester Premium/NFF

DYNAMIC RESEARCH, INC.
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20 January 2022

Draft Report

Prepared Under Contract No. DTNH22-14-D-00333

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

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16. Abstract These tests were conducted on the subject 2022 Subaru Forester Premium/NFF in accordance with the specifications of the New Car Assessment Program's (NCAP's) most current Test Procedure in docket NHTSA-2006-26555-0134 to confirm the performance of a Forward Collision Warning system. The vehicle passed the requirements of the test for all three FCW test scenarios.			
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Section I

INTRODUCTION

This test evaluates the ability of a Forward Collision Warning (FCW) system to detect and alert drivers to potential hazards in the path of the vehicle as specified in the New Car Assessment Program's "Forward Collision Warning Confirmation" test procedure, dated February 2013. Three driving scenarios are utilized to assess this technology. In the first test, a Subject Vehicle (SV) approaches a stopped Principal Other Vehicle (POV) in the same lane of travel. The second test begins with the SV initially following the POV at the same constant speed. After a short while, the POV stops suddenly. The third test consists of the SV, traveling at a constant speed, approaching a slower moving POV, which is also being driven at a constant speed.

Section II

DATA SHEETS

FORWARD COLLISION WARNING

DATA SHEET 1: TEST RESULTS SUMMARY

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2022 Subaru Forester Premium/NFF

VIN: *JF2SKADC7NH41xxxx*

Test start date: *1/12/2022*

Test end date: *1/12/2022*

Forward Collision Warning setting: *No range settings available.*

Test 1 –	Subject Vehicle Encounters Stopped Principal Other Vehicle:	***Pass***
Test 2 –	Subject Vehicle Encounters Decelerating Principal Other Vehicle:	***Pass***
Test 3 –	Subject Vehicle Encounters Slower Principal Other Vehicle:	***Pass***

Overall: ***Pass***

Notes:

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2022 Subaru Forester Premium/NFF

TEST VEHICLE INFORMATION

VIN: *JF2SKADC7NH41xxxx*

Body Style: *SUV* Color: *Autumn Green Metallic*

Date Received: *1/3/2022* Odometer Reading: *5 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Subaru Corporation*

Date of manufacture: *11/21*

Vehicle Type: *MPV/VTUM*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *225/60R17*

Rear: *225/60R17*

Recommended cold tire pressure: Front: *230 kPa (33 psi)*

Rear: *220 kPa (32 psi)*

TIRES

Tire manufacturer and model: *Bridgestone Ecopia H/L 422 Plus*

Front tire specification: *225/60R17 99H*

Rear tire specification: *225/60R17 99H*

Front tire DOT prefix: *EL FC DMM*

Rear tire DOT prefix: *EL FC DMM*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

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2022 Subaru Forester Premium/NFF

GENERAL INFORMATION

Test start date: *1/12/2022* Test end date: *1/12/2022*

AMBIENT CONDITIONS

Air temperature: *5.0 C (41 F)*

Wind speed: *1.5 m/s (3.5 mph)*

X Wind speed ≤ 10 m/s (22 mph).

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

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

VEHICLE PREPARATION

Verify the following:

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

Fuel tank is full: **X**

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

Front: *230 kPa (33 psi)*

Rear: *220 kPa (32 psi)*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

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2022 Subaru Forester Premium/NFF

WEIGHT

Weight of vehicle as tested including driver and instrumentation:

Left Front:	*526.2 kg (1160 lb)*	Right Front:	*479.0 kg (1056 lb)*
Left Rear:	*376.9 kg (831 lb)*	Right Rear:	*371.9 kg (820 lb)*
		Total:	*1754.0 kg (3867 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2022 Subaru Forester Premium/NFF

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

EyeSight Driver-Assist System

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

Stereo camera located at the top center of the windshield

Forward Collision Warning Setting used in test: *N/A*

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

- [X] Warning light
- [X] Buzzer or auditory alarm
- [ ] Vibration
- [ ] Other _____

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

The EyeSight system alerts the driver with a visual and auditory alert. The visual alert is displayed in the center of the instrument panel and consists of an image of two vehicles, one behind the other, lane lines, and the words "Obstacle Detected" above. The vehicle shown in front flashes on/off. The auditory alert consists of repeated beeps followed by a long continuous beep with a primary frequency of 2215 Hz.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2022 Subaru Forester Premium/NFF

Is the vehicle equipped with a switch whose purpose is to render FCW inoperable?

X Yes

____ No

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

A button to deactivate the EyeSight system is located on the front center ceiling control panel. Press and hold the button for approximately 2 seconds and the system will emit a single audible beep and illuminate a Pre-Collision Braking System Off indicator light when it is deactivated. If the engine is turned off and then restarted, the Pre-Collision Braking System will be turned on. The system default setting when the vehicle is restarted is on. Refer to the Subaru EyeSight Manual pages 61-62 shown in Appendix B pages B-14 to B-15.

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

____ Yes

X No

If yes, please provide a full description.

There are no range settings available for the EyeSight system.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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

If yes, please provide a full description.

Refer to the Subaru EyeSight Manual pages 30- 41 shown in Appendix B pages B-2 to B-13.

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Three test procedures were used, as follows:

Test 1. Subject Vehicle (SV) Encounters Stopped Principal Other Vehicle (POV)

Test 2. Subject Vehicle Encounters Decelerating Principal Other Vehicle

Test 3. Subject Vehicle Encounters Slower Principal Other Vehicle

With the exception of trials associated with Test 1, all trials were performed with SV and POV 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. Except for Test 2, the brake lights of the POV were not illuminated.

In order to pass the test, if the FCW system provides a warning timing adjustment for the driver, at least one setting must meet the criterion of the test procedure. Therefore, if the vehicle was equipped with a warning timing adjustment, only the most “conservative” (earliest warning) setting was tested.

An overview of each of the test procedures follows.

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

This test evaluates the ability of the FCW function to detect a stopped lead vehicle, as depicted in Figure 1.

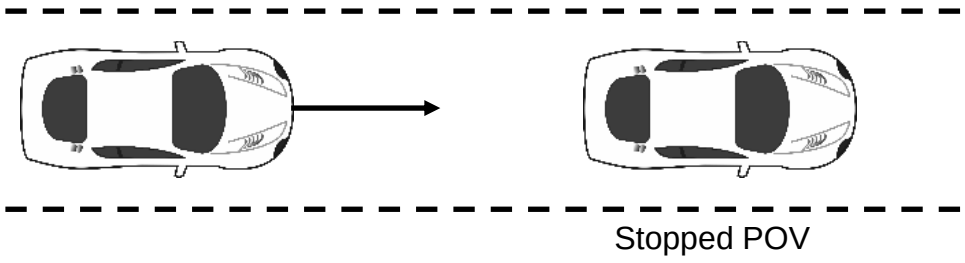

Figure 1. Depiction of Test 1

a. Alert Criteria

In order to pass the test, the FCW alert must be issued when the time-to-collision (TTC) is at least 2.1 seconds. The TTC for this test was calculated by considering the speeds of the SV and the POV at the time of the FCW alert (i.e., when the SV and POV speeds are nominally equal to 45 and 0 mph (72.4 and 0 km/h), respectively).

b. Procedure

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

The SV was driven at a nominal speed of 45 mph (72.4 km/h) in the center of the lane of travel, toward the parked POV. The test began when the SV was 492 ft (150 m) from the POV and ended when either of the following occurred:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90% of the minimum allowable range (i.e., TTC = 1.9 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

For an individual test trial to be valid, the following was required throughout the test:

- The SV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) for a period of three seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.
- The SV driver could not apply any force to the brake pedal before (1) the required FCW alert occurred or (2) the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rate of the SV could not exceed ±1 deg/sec during the test.

Nominally, the Test 1 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

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

The SV in this test initially followed the POV at a constant time gap and then the POV suddenly decelerated, as depicted in Figure 2. The test evaluates the ability of the FCW to recognize a decelerating lead vehicle and to issue an alert to SV driver in a timely manner.

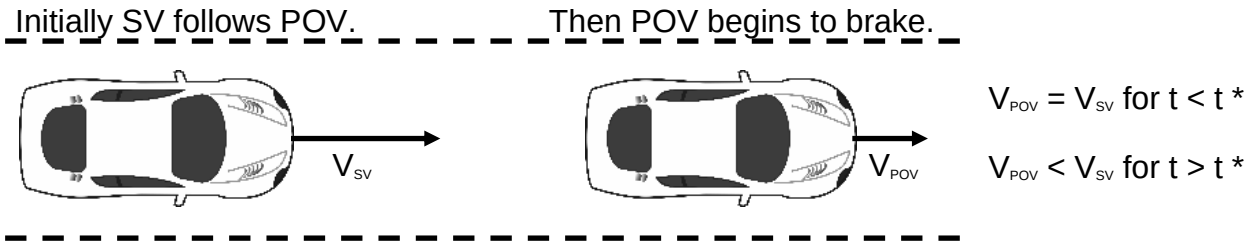

Figure 2. Depiction of Test 2

a. Alert Criteria

In order to pass the test, the FCW alert must be issued when TTC is at least 2.4 seconds. The TTC for this test, a prediction of the time it would take for the SV to collide with the POV, was calculated by considering three factors at the time of the FCW alert: (1) the speed of the SV, (2) the speed of the POV, and (3) the deceleration of the POV[1].

b. Procedure

Test 2 began with the SV and the POV traveling on a straight, flat road at a constant speed of 45.0 mph (72.4 km/h), in the center of the lane of travel. The headway from the SV to the POV was nominally maintained at 98.4 ft (30 m) until the POV braking was initiated.

The test began approximately 7 seconds before the driver of the POV started a braking maneuver in which the POV brakes were rapidly applied and modulated such that a constant deceleration of 0.3 g was achieved within 1.5 seconds after braking is initiated. The test ended when either of the following conditions was satisfied:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90% of the minimum allowable range (i.e., TTC = 2.2 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

[1]To simplify calculation of the TTC for Test 2, the deceleration of the POV is assumed to remain constant from the time of the FCW alert until the POV comes to a stop (i.e., a “constant” rate of slowing is assumed).

For an individual test trial to be valid, the following was required throughout the test:

- The initial POV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) for a period of 3 seconds prior to the initiation of POV braking.
- The speed of the SV could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) for a period of 3 seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rates of the SV and POV could not exceed ±1 deg/sec during the test.
- The POV deceleration level was nominally required to be 0.3 g within 1.5 seconds after initiation of POV braking. The acceptable error magnitude of the POV deceleration was ±0.03 g, measured at the time the FCW alert first occurred. An initial overshoot beyond the deceleration target was acceptable, however the first local deceleration peak observed during an individual trial could not exceed 0.375 g for more than 50 ms. Additionally, the deceleration could not exceed 0.33 g over a period defined from 500 ms after the first local deceleration peak occurs, to the time when the FCW alert first occurred.
- The tolerance for the headway from the SV to the POV was ±8.2 ft (±2.5 m), measured at two instants in time: (1) three seconds prior to the time the POV brake application was initiated and (2) at the time the POV brake application was initiated.
- SV driver could not apply any force to the brake pedal before (1) the required FCW alert occurred or (2) the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.

Nominally, the Test 2 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

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

This test examines the ability of the FCW system to recognize a slower lead vehicle being driven with a constant speed and to issue a timely alert. As depicted in Figure 3, the scenario was conducted with a closing speed equal to 25.0 mph (40.2 km/h).

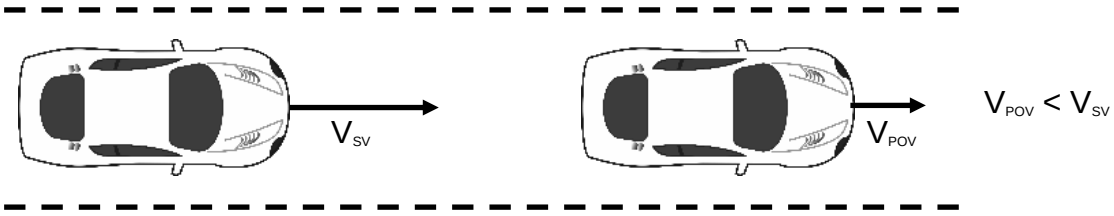

Figure 3. Depiction of Test 3

a. Alert Criteria

In order to pass the test, the FCW alert must be issued when TTC is at least 2.0 seconds. The TTC for this test, a prediction of the time it would take for the SV to collide with the POV, was calculated by considering the speeds of the SV and POV at the time of the FCW alert.

b. Procedure

Throughout the test, the POV was driven at a constant 20.0 mph (32.2 km/h) in the center of the lane of travel.

The SV was driven at 45.0 mph (72.4 km/h), in the center lane of travel, toward the slow-moving POV.

The test began when the headway from the SV to the POV was 329 ft (100 m) and ended when either of the following occurred:

- The required FCW alert occurred.
- The TTC to the POV fell to less than 90% of the minimum allowable range (i.e., TT = 1.8 sec) for the onset of the required FCW alert.

The SV driver then steered and/or braked to keep the SV from striking the POV.

For an individual test trial to be valid, the following was required throughout the test:

- The SV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) for a period of 3 seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.
- Speed of the POV could not deviate from the nominal speed by more than 1.0 mph (1.6 km/h) during the test.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rates of the SV and POV could not exceed ±1 deg/sec during the test.
- SV driver could not apply any force to the brake pedal before (1) the required

FCW alert occurred or (2) before the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.

Nominally, the Test 3 series was comprised of seven individual trials. The FCW system must satisfy the TTC alert criteria for at least five of the seven test trials.

B. Principal Other Vehicle

The vehicle used as the Principal Other Vehicle (POV) was a 2006 Acura RL. This satisfied the test requirement that the POV be a mid-size sedan. The vehicle had a rear license plate in order to provide a suitable representative radar profile. Vehicle loading consisted of the driver plus equipment and instrumentation.

C. Automatic Braking System

The POV was equipped with an automatic braking system, which was used in Test 2. The braking system consisted of the following components:

- Electronically controlled linear actuator, mounted on the seat rail and attached to the brake pedal. The actuator can be programmed for control of stroke and rate.
- PC module programmed for control of the stroke and rate of the linear actuator.
- Switch to activate actuator.

D. Instrumentation

Table 1 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

Table 1. Test Instrumentation and Equipment

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and 100 psi	Omega DPG8001	17042707002	By: DRI Date: 10/5/2021 Due: 10/5/2022
Platform Scales	Vehicle Total, Wheel, and Axle Load	2200 lb/platform	0.1% of reading	Intercomp SW wireless	0410MN20001	By: DRI Date: 2/10/2021 Due: 2/10/2022
Differential Global Positioning System	Position, Velocity	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots	Horizontal Position: ±1 cm Vertical Position: ±2 cm Velocity: 0.05 km/h	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	N/A
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Accels ± 10g, Angular Rate ±100 deg/s, Angle >45 deg, Velocity >200 km/h	Accels .01g, Angular Rate 0.05 deg/s, Angle 0.05 deg, Velocity 0.1 km/h			By: Oxford Technical Solutions
				SV: Oxford Inertial +	2176	Date: 6/26/2020 Due: 6/26/2022
				POV:	2258	Date: 4/28/2021 Due: 4/28/2023
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec Longitudinal Range to POV: ±200 m Longitudinal Range Rate: ±50 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec Longitudinal Range: ±3 cm Longitudinal Range Rate: ±0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	N/A

Table 1. Test Instrumentation and Equipment (continued)

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Microphone	Sound (to measure time at auditory alert)	Frequency Response: 80 Hz – 20 kHz	Signal-to-noise: 64 dB, 1 kHz at 1 Pa	Audio-Technica AT899	N/A	N/A
Light Sensor	Light intensity (to measure time at visual alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	N/A	N/A
Accelerometer	Acceleration (to measure time at haptic alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	N/A	N/A
Coordinate Measurement Machine	Inertial Sensing System Coordinates	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm, Fusion	UO8-05-08-06636	By: DRI Date: 1/6/2022 Due: 1/6/2023

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

For systems that implement auditory or haptic alerts, part of the pre-test instrumentation verification process is to determine the tonal frequency of the auditory warning or the vibration frequency of the tactile warning through use of the PSD (Power Spectral Density) function in Matlab. This is accomplished in order to identify the center frequency around which a band-pass filter is applied to subsequent auditory or tactile warning data so that the beginning of such warnings can be programmatically determined. The band-pass filter used for these warning signal types is a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 2.

Table 2. Auditory and Tactile Warning Filter Parameters

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

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle

Figure A3. Window Sticker (Monroney Label)

Figure A4. Vehicle Certification Label

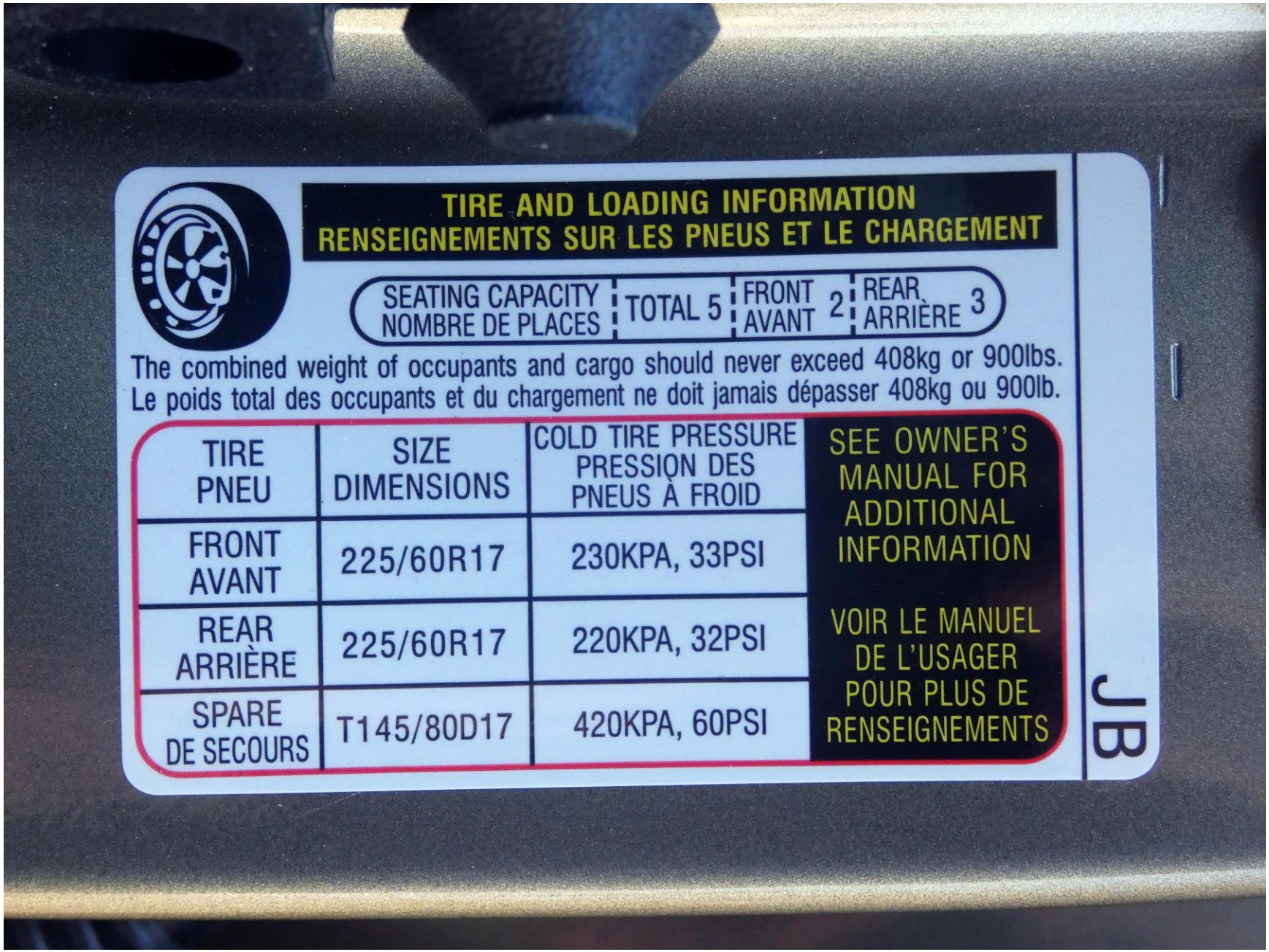

Figure A5. Tire Placard

Figure A6. Front View of Principal Other Vehicle

Figure A7. Rear View of Principal Other Vehicle

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

Figure A9. Sensors for Detecting Auditory and Visual Alerts

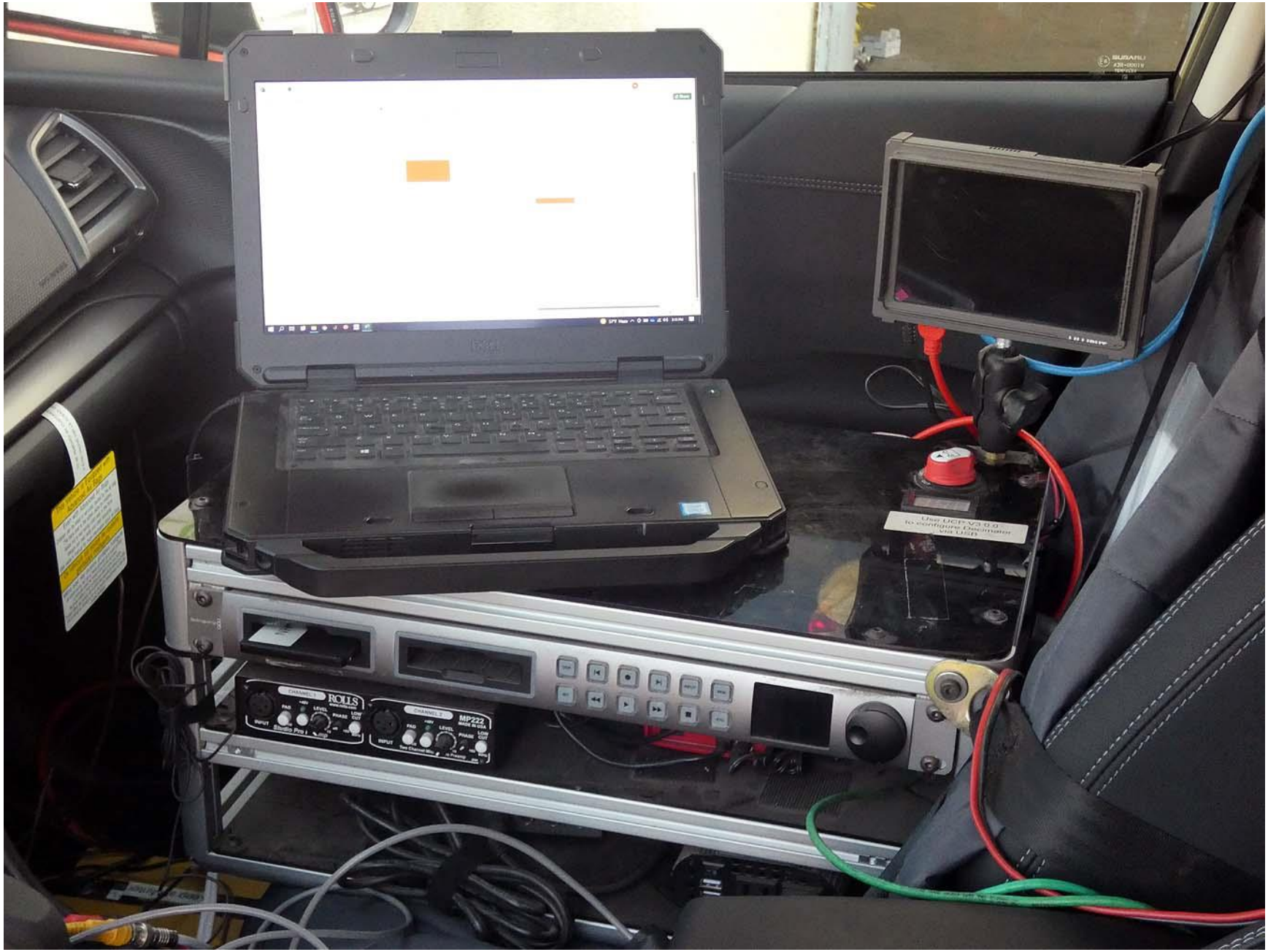

Figure A10. Computer Installed in Subject Vehicle

Figure A11. Brake Actuation System Installed in Principal Other Vehicle

Figure A12. FCW (CMBS) On/Off Switch

Figure A13. FCW Visual Alert

APPENDIX B

Excerpts from Owner’s Manual

Pre-Collision Braking System

When there is a risk of a collision with an obstacle in front (a vehicle, pedestrian, cyclist, etc.), the EyeSight system helps to prevent or minimize a collision by warning the driver. If the driver still does not take evasive action to avoid a collision, the brakes can be automatically applied just before the collision in order to reduce impact damage, or if possible, prevent the collision. If the driver takes evasive action to avoid a collision, Pre-Collision Braking Assist will operate in order to help the driver to prevent or minimize the collision.
This system can be effective not only with direct rear-end collisions, but also with offset rear-end collisions. In addition to rear-end collisions, this system can be effective for avoiding collisions with crossing pedestrians and cyclists and with oncoming vehicles and pedestrians when turning. This function can be activated when the select lever is in the “D”, “M” (models with manual mode), “L” (models with “L” position) or “N” position.

⚠ WARNING

Pre-Collision Braking System operation

- Never use Pre-Collision Braking System and Pre-Collision Braking Assist to stop your car or avoid a collision under ordinary conditions. These functions cannot prevent collisions under all conditions. If the driver relies only on Pre-Collision Braking System for Brake operation, collisions may occur.
- When a warning is activated, pay attention to the front of the vehicle and its surroundings, and operate the brake pedal and/or take other actions if necessary.
- The EyeSight Pre-Collision Braking System is primarily designed to prevent rear-end collisions with other vehicles when possible or to minimize damage and injuries in the event of a collision. In addition to other vehicles, things such as motorbikes, cyclists and pedestrians can also be treated as obstacles. However, there may be cases when detection is not possible depending on a variety of conditions[*2]. For example, when a vehicle is viewed from the side, oncoming vehicle, vehicles approaching in reverse, small animals or children, or walls or doors are not likely to be detected.
- Pre-Collision Braking System will operate at the point when it determines that a collision cannot be avoided and is designed to apply strong braking force just before a collision. The result of this varies depending on a variety of conditions[*2]. Because of this, performance of this function will not always be the same.
- When Pre-Collision Braking System is activated, it will continue to operate even if the accelerator pedal is partially depressed. However, it will be canceled if the accelerator pedal is suddenly or fully depressed.

- If the driver depresses the brake pedal or turns the steering wheel, the system may determine that this constitutes evasive action by the driver, and the automatic braking control may not activate in order to allow the driver full control.
- If the speed difference with the obstacle is greater than approximately 37 mph (60 km/h), collisions cannot be avoided due to performance limitations of EyeSight. However, even if the speed difference is approximately 37 mph (60 km/h) or less, if an obstacle cuts in front of you or moves outside the camera's field of view, the vehicle might not be able to stop or the system might not activate when the visibility, road slipperiness, etc. do not meet the following conditions.*

*: Conditions in which Pre-Collision Braking System cannot detect obstacles:

- Distance to obstacle in front of you, speed difference, proximity conditions, lateral displacement (the amount of offset)
- Vehicle conditions (amount of load, number of occupants, etc.)
- Road conditions (grade, slipperiness, shape, bumps, etc.)
- Visibility ahead is poor (rain, snow, fog or smoke, etc.).
- The detected object is something other than a vehicle, motorcycle, cyclist or pedestrian.
  - A domestic animal or other animal (a dog or deer, etc.)
  - A guardrail, telephone pole, tree, fence or wall, etc.
- Even if the obstacle is a motorcycle, cyclist or pedestrian, depending on the brightness of the surroundings, its relative movement, its aspect, and the direction it is facing, there may be cases when the system cannot detect it.
- The system determines that operation by the driver (based on accelerator pedal operation, braking, steering wheel angle, etc.) is intended as evasive action.
- Vehicle maintenance status (brake systems, tire wear, tire pressure, whether a temporary spare tire is being used, etc.)
- A trailer or another vehicle, etc. is being towed.
- The brakes are cold due to the outside temperature being low or just after starting the engine.
- The brakes are overheated on downhill grades (braking performance is reduced).
- In rain or after washing the vehicle (the brakes are wet and braking performance is reduced.)
- Recognition conditions of the stereo camera
  In particular, the function may be unable to stop the vehicle or may not activate in the following cases.

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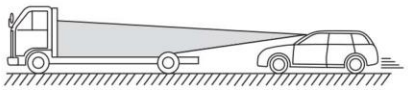
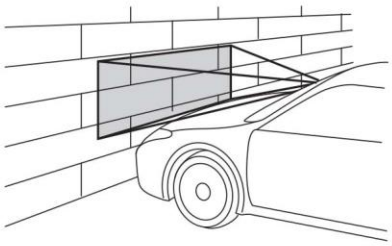
- The object moves outside the camera's field of view.
- Bad weather (for example heavy rain, a blizzard or thick fog)
- Visibility is poor due to sand, smoke or water vapor blowing in the wind, or the front vision is obscured due to water splashes, snow, dirt or dust stir up generated by the vehicle in front or oncoming traffic.
- At night or in a tunnel without the headlights on
- At night or in a tunnel when there is a vehicle in front that does not have its taillights on
- Approaching a motorcycle, cyclist or pedestrian at night
- A vehicle, motorcycle, cyclist or pedestrian is outside the area illuminated by the headlights.
- Strong light is coming from the front (for example, sunlight at dawn, sunset or headlight beams, etc.).
- The windshield has become fogged, scratched or smeared, or snow, dirt, dust or frost has adhered to it, or it is otherwise affected. These will reduce the stereo camera's field of view. Also, light is reflecting off the dirt, etc.
- Fluid has not been fully wiped off the windshield during or after washer use.
- The target cannot be correctly recognized because the stereo camera's view is obstructed by water droplets from rain or the window washer, or by the wiper blades.
- The stereo camera's field of view is obstructed (for example by a canoe on the roof of the vehicle).
- The vehicle is tilted at an extreme angle due to loaded cargo or other factors.
- It is pitch black and there are no objects in the surrounding area.
- The surrounding area is mostly the same color (for example in a snowy location).
- The rear aspect of the vehicle in front is low, small or irregular (the system may recognize another part of the vehicle as its rear and will determine operation from that).
  - There is an empty truck or trailer with no rear and/or side panels on the cargo bed.
  - Vehicles that have cargo protruding from their back ends
  - Non-standard shaped vehicles (vehicle transporters or vehicles with a sidecar fitted, etc.)
  - The height of the vehicle is low, etc.



S02133

- There is a wall, etc. in front of a stopped vehicle.
- There is another object near the vehicle.
- A vehicle, etc. has its side facing you.
- With vehicles that are backing up or with oncoming vehicles, etc.
- The size and height of an obstacle is smaller than the limitations of the stereo camera's recognition capability.
  - With small animals or children, etc.
  - With pedestrians who are sitting or lying down
- The detected object is a fence or wall, etc. with a uniform pattern (a striped pattern or brick pattern, etc.).
- There is a wall or door made of glass or a mirror in front.
- The vehicle in front suddenly swerves, accelerates, or decelerates.
- A vehicle, motorcycle, cyclist or pedestrian suddenly cuts in from the side or suddenly runs in front of you.
- Your vehicle is immediately behind an obstacle after changing lanes.
- There is a vehicle, motorcycle, cyclist or pedestrian in a location close to your vehicle's bumper.
- The speed difference between your vehicle and an obstacle is 4 mph (5 km/h) or less (As braking is performed once the obstacle is in close proximity to your vehicle, depending on the shape and size of the obstacle, there may be some cases when the obstacle is outside the range of the camera's field of view.).
- On sharp curves, steep uphill grades or steep downhill grades
- On a bumpy or unpaved road
- The brightness changes such as at a tunnel entrance or exit or when you drive under an overpass.



S00653

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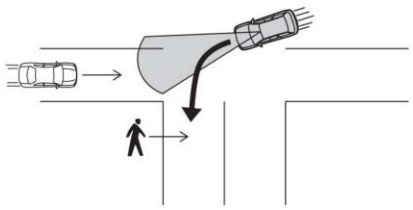
- Do not test Pre-Collision Braking System on its own. It may operate improperly and cause an accident.
- The system may not operate correctly under the conditions listed below. When these conditions occur, turn off Pre-Collision Braking System.
  ⇒ Page 61
  - The tire pressure is not correct.*1
  - The temporary spare tire is installed.*1
  - Tires that are unevenly worn or tires with uneven wear patterns are installed.*1
  - Tires that are the wrong size are installed.*1
  - A flat tire has been fixed temporarily with a tire repair kit.
  - The suspension has been modified (including a genuine SUBARU suspension that has been modified).
  - An object that obstructs the stereo camera's view is installed on the vehicle.
  - The headlights are dirty or they have snow and ice or dirt on them. (Objects are not correctly illuminated and are difficult to detect.)
  - The optical axes are not aligned correctly. (Objects are not correctly illuminated and are difficult to detect.)
  - The lights including headlights and fog lights have been modified.
  - Vehicle operation has become unstable due to an accident or malfunction.
  - The brake system warning light is illuminated.*2
  - The vehicle is tilted at an extreme angle due to loaded cargo or other factors.
  - The maximum number of occupants is exceeded.
  - The combination meter is not operating properly; such as when the lights do not illuminate, the beeps do not sound, the display is different from when it is normal, etc.*3

*1: The wheels and tires have functions that are critically important. Be sure to use the correct ones. For details, refer to the Owner's Manual for your vehicle.

*2: If the brake system warning light does not turn off, immediately pull the vehicle over in a safe place and contact a SUBARU dealer to have the system inspected. For details, refer to the Owner's Manual for your vehicle.

*3: For details about the combination meter, refer to the Owner's Manual for your vehicle.

Activation of Pre-Collision Braking System when turning



S04093

- Operation of the EyeSight Pre-Collision Braking System when making a turn is intended to avoid collisions or reduce the severity of collisions with oncoming vehicles in the neighboring oncoming lane, particularly when you are crossing the oncoming lane to make a turn at an intersection, etc. In addition to oncoming vehicles, pedestrians can also be detected, but your vehicle may not stop or the system may not activate under certain conditions*.
- If your vehicle is moving faster than approximately 16 mph (25 km/h) when you turn, the system will not activate. Also, even if your vehicle is moving approximately 16 mph (25 km/h) or slower, if the obstacle suddenly cuts in front of you or is outside the stereo camera's field of view, your vehicle may not stop or the system may not activate depending on differing conditions* such as visibility or the slipperiness of the road.

*: Conditions

- Speed difference with the oncoming vehicle, distance to the oncoming vehicle, the angle of approach, changes in the actions of the oncoming vehicle and the position of the other vehicle relative to the side of your vehicle.
- Vehicle conditions (amount of load, number of occupants, etc.)
- Road conditions (grade, slipperiness, shape, bumps, etc.)
- Visibility ahead is poor (rain, snow, fog or smoke, etc.).
- The obstacle is something other than an oncoming vehicle or pedestrian.
  - A parked vehicle or a vehicle that is traveling in the same direction as your vehicle
  - An animal, etc.
  - A guardrail, telephone pole, tree, fence or wall, etc.
- Even if an oncoming vehicle has been detected, you are not signaling to move in the direction that your vehicle is actually traveling.
- Even if the obstacle is an oncoming vehicle, it is traveling close to objects on the side of the road.
- Even if the obstacle is an oncoming vehicle, it is stopped or traveling in your lane.

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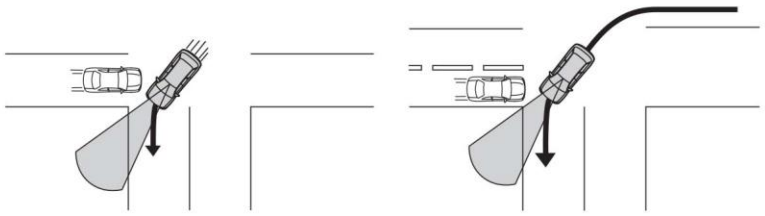
- Even if the obstacle is an oncoming vehicle, the system cannot recognize it as a target obstacle because, for example, the front of the vehicle cannot be seen or the vehicle is difficult to see because it is driving without its headlights on at night.
- Even if the obstacle is an oncoming vehicle, your vehicle moved into the oncoming vehicle's path before the system could recognize it as a target obstacle.
- Even if the obstacle is an oncoming vehicle, your vehicle is in the oncoming lane.



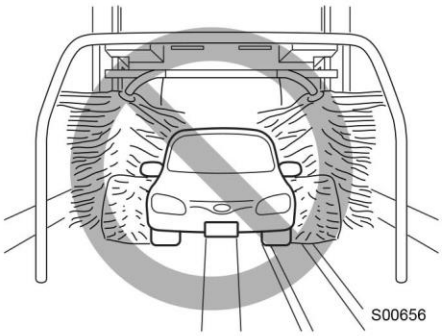
S04094

- Even if the obstacle is a pedestrian, depending on the brightness of the surroundings, its relative movement, its aspect, and the direction it is facing, there may be cases when the system cannot detect it.

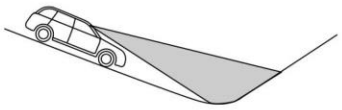
• In particular, there is a high possibility that your vehicle cannot stop or that the system will not activate in the following cases:
- Visibility is poor due to water, snow, dust, etc. kicked up by another vehicle, or due to water vapor, sand, smoke, etc. in the air.
- Approaching a pedestrian at night.
- The oncoming vehicle or pedestrian is outside the area illuminated by the headlights.
- The front aspect of the oncoming vehicle is small, low or irregular.
- The vehicle, etc. has its side facing you.
- The vehicle, etc. is backing up.
- The oncoming vehicle suddenly swerves, accelerates or decelerates.
- The oncoming vehicle or pedestrian suddenly cuts in from the side or suddenly runs in front of you.
- The oncoming vehicle or pedestrian is close to your vehicle's bumper.
- You turn the steering wheel suddenly away or back to your direction of travel.

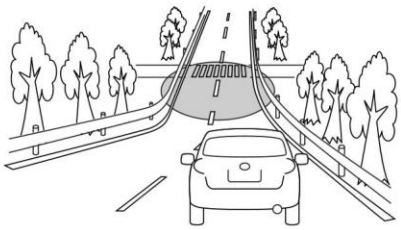
CAUTION

- In the following situations, turn off Pre-Collision Braking System. Otherwise Pre-Collision Braking System may activate unexpectedly.
  ⇒ Page 61
  - The vehicle is being towed.
  - The vehicle is being loaded onto a carrier.
  - A chassis dynamometer, free-rollers or similar equipment is being used.
  - A mechanic lifts up the vehicle, starts the engine and spins the wheels freely.
  - Passing hanging banners, flags or branches
  - Thick/tall vegetation is touching the vehicle.
  - Driving on a race track
  - In a drive-through car wash


S00656

- Pre-Collision Braking System may activate in the following situations. Therefore concentrate on safe driving.
  - Passing through an automatic gate (opening and shutting)
  - Driving close to the vehicle in front, pedestrian or cyclist
  - Driving in a location where the grade of the road changes rapidly




S01264

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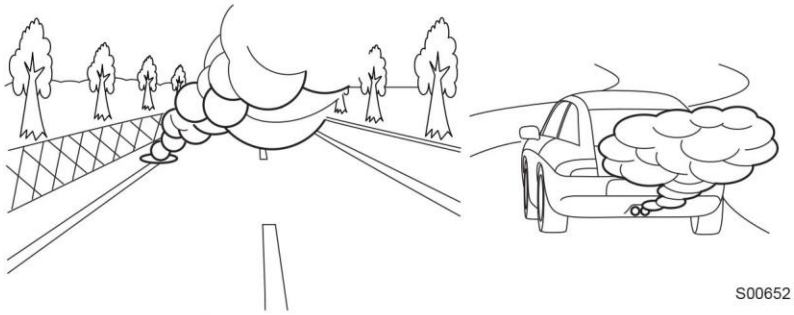
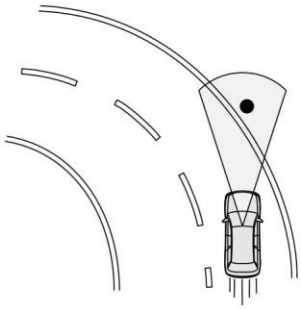
- Visibility is poor due to sand, smoke or water vapor blowing in the wind, or the front vision is obscured due to water splashes, snow, dirt or dust stir up generated by the vehicle in front or oncoming traffic.
- Passing through clouds of steam or smoke, etc.
- In adverse weather, such as heavy snow or snowstorms
- The exhaust gas emitted by the vehicle in front is clearly visible in cold weather, etc.



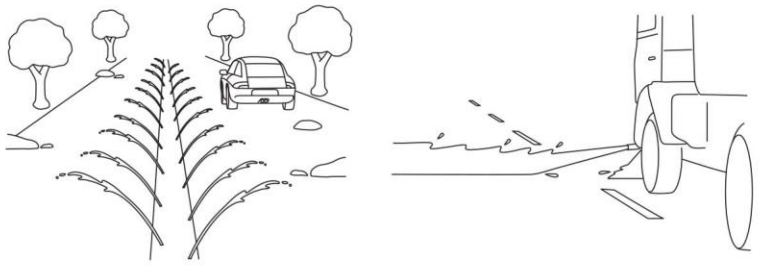
S00652

- There is an obstacle on a curve or intersection.
- You are passing close to the side of a vehicle, an obstacle or vegetation.
- Stopping very close to a wall or a vehicle in front



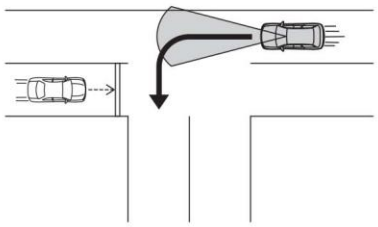
S02669

- Passing through water spray from road sprinklers or snow clearing sprinklers on the road



S02636

- If there is cargo or installed accessories, etc. that are protruding beyond the edge of the front bumper, the vehicle's length will increase and the system may not be able to prevent a collision.
- If you operate the brake pedal during automatic braking, the pedal may feel stiff. The brake pedal may also move on its own during automatic braking. However, this is normal. By depressing the brake pedal further, you can apply more braking force. Apply more braking force as necessary.
- Pre-Collision Braking System may activate in the following situations even when there is no oncoming vehicle or pedestrian approaching.
  - An oncoming vehicle decelerates or stops before an intersection just before you make a turn and enter the oncoming lane.



H00295

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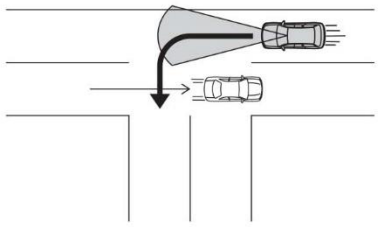
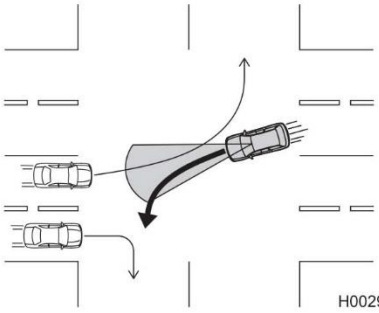
- An oncoming vehicle passes by just before you make a turn and enter the oncoming lane.



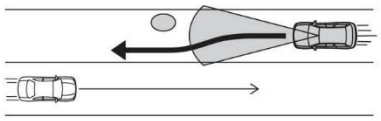
H00296

- Just before you make a turn and enter the oncoming lane, you pass by an oncoming vehicle also making a turn.



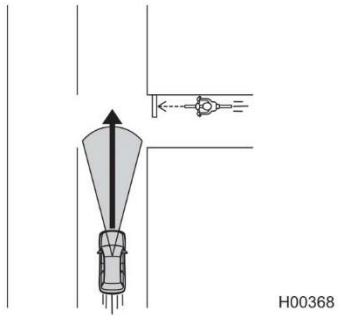
H00297

- You suddenly approach close to an oncoming vehicle while trying to change lanes or avoid an obstacle.
- When you are turning, a pedestrian crosses in front of your vehicle or just before crossing slows down or stops.

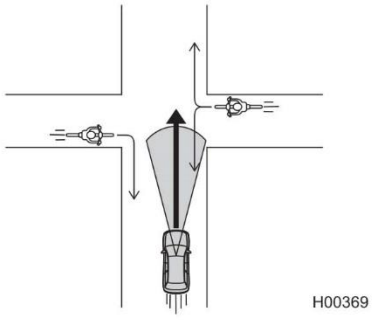


H00298

- A vehicle, motorcycle, cyclist or pedestrian slows down or stops just before crossing in front of you.



- A vehicle, motorcycle, cyclist or pedestrian changes direction to either join your lane or pass by you in the opposite direction just before crossing in front of you.



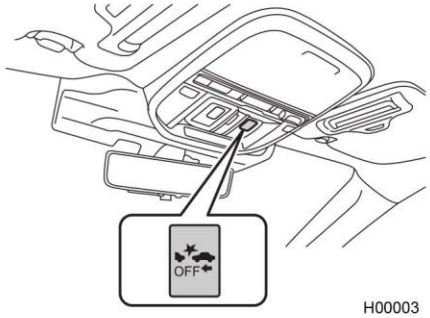
NOTE

Some unusual noises may be audible during automatic braking. This is caused by the braking control and is normal.

Turning off Pre-Collision Braking System

Press and hold the Pre-Collision Braking System OFF switch for approximately 2 seconds or longer to turn off Pre-Collision Braking System (including Pre-Collision Braking Assist and Automatic Emergency Steering (if equipped)). When 1 short beep sound emits, this control is turned off and the Pre-Collision Braking System OFF indicator light on the instrument panel illuminates.

To turn the control back on, press and hold the Pre-Collision Braking System OFF switch for approximately 2 seconds or longer again. When this control is turned on, the Pre-Collision Braking System OFF indicator light turns off.



H00003

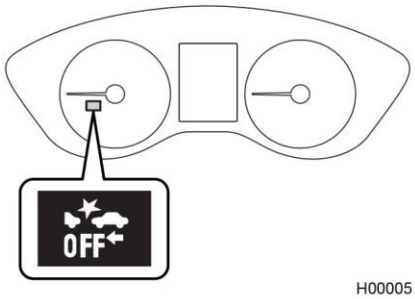
NOTE

- When Pre-Collision Braking System is turned off, the Automatic Emergency Steering (if equipped) and Pre-Collision Throttle Management Control function are also turned off.
- Even when Pre-Collision Braking System is turned off, if the engine is turned off and then restarted, Pre-Collision Braking System will be turned on. The system default setting when the vehicle is restarted is on.

■ Pre-Collision Braking System OFF indicator light

This indicator light illuminates when the ignition switch is turned to the ON position, and remains illuminated for approximately 10 seconds after the engine starts. It turns on when Pre-Collision Braking System, Automatic Emergency Steering (if equipped) and Pre-Collision Throttle Management are turned off.
It also illuminates under the following conditions.

- The EyeSight system has a malfunction.
  ⇒ Page 155
- The EyeSight system has stopped temporarily.
  ⇒ Page 157



H00005

NOTE

- If the Pre-Collision Braking System OFF indicator light illuminates, the Automatic Emergency Steering OFF indicator (if equipped) also illuminates.
  ⇒ Page 60
- When the Pre-Collision Braking System OFF indicator light is turned on, Pre-Collision Braking System (including the Pre-Collision Braking Assist function), Automatic Emergency Steering (if equipped) and Pre-Collision Throttle Management do not operate.
- For models with Automatic Emergency Steering, you cannot use Automatic Emergency Steering when BSD/RCTA is turned off. In this case, the Automatic Emergency Steering OFF indicator illuminates.

APPENDIX C

Run Log

Subject Vehicle: **2022 Subaru Forester Premium/NFF** Test Date: **1/12/2022**

Principal Other Vehicle: **2006 Acura RL**

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	**Stopped POV**	Y	2.64	2.52	0.54	Pass	
2		Y	3.95	3.83	1.85	Pass	
3		Y	3.42	3.30	1.32	Pass	
4		Y	3.74	3.61	1.64	Pass	
5		Y	4.22	4.11	2.12	Pass	
6		Y	4.26	4.15	2.16	Pass	
7		Y	4.26	4.10	2.16	Pass	
15	**Decelerating POV, 45**	N					POV Brakes
16		N					SV Speed
17		Y	2.74	2.56	0.34	Pass	
18		N					Lateral Offset, POV Brakes
19		Y	2.39	2.26	-0.01	Fail	
20		Y	2.48	2.34	0.08	Pass	
21		Y	2.44	2.31	0.04	Pass	
22		Y	2.54	2.38	0.14	Pass	
23		Y	2.40	2.27	0.00	Pass	
24		Y	2.31	2.20	-0.09	Fail	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
8	**Slower POV, 45 vs 20**	Y	3.04	2.84	1.04	Pass	
9		Y	3.18	3.01	1.18	Pass	
10		Y	2.91	2.74	0.91	Pass	
11		Y	3.08	2.91	1.08	Pass	
12		Y	3.14	2.98	1.14	Pass	
13		Y	3.19	3.08	1.19	Pass	
14		Y	3.17	3.01	1.17	Pass	

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 code indicating to which vehicle the data pertain.

Each time history plot consists of data pertinent 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:

- FCW Test 1 – Stopped POV (SV at 45 mph)
- FCW Test 2 – Decelerating POV (Both vehicles at 45 mph with a 30 m gap, POV brakes at 0.3 g)
- FCW Test 3 – Slower Moving POV (SV at 45 mph, POV at 20 mph)

Time history figures include the following sub-plots:

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

- TTC (sec) – Indicates the Time to Collision as calculated up to the point of FCW alert issuance. The value of TTCW (Time to Collision at Warning) is given numerically on the right side of the figure. A passing value is indicated in green, while a failing value is indicated in red.

- SV Speed (mph) – Speed of the Subject Vehicle

- POV Speed (mph) – Speed of the Principal Other Vehicle

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

- Lateral Offset (ft) – Lateral offset within the lane from the Subject Vehicle to the Principal Other Vehicle
- Ax (g) – Longitudinal acceleration of both the Subject Vehicle and Principal Other Vehicle
- Headway (ft) – Longitudinal separation between front of Subject Vehicle to rear of Principal Other Vehicle (Exclusive to test type 2)

Envelopes and Thresholds

Each of the time history plot figures can 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.

Green envelopes indicate that the time-varying data should not exceed the envelope boundaries at any time within the envelope. Exceedances of a green envelope are indicated by red shading in the area between the measured time-varying data and the envelope boundaries.

Yellow envelopes indicate that the time-varying data should not exceed the envelope only at the left and/or right ends. Exceedances at the left or right extent of a yellow envelope are indicated by red asterisks.

For the warning plot, a dashed black threshold line indicates the threshold used to determine the onset of the FCW alert. The alert is considered on the first time the alert signal crosses this threshold line.

For the TTC plot, a dashed black threshold line indicates the minimum allowable TTC for the given test scenario. If the FCW alert occurs before this minimum allowable TTC, a green dot appears. However, if there is no alert or the alert occurs after the minimum allowable TTC, a red asterisk is shown on the plot.

For the Ax plot, a dashed black threshold line is given for at a value of -0.05 g. For a test run to be valid, the longitudinal acceleration of the Subject Vehicle must not fall below this threshold (i.e. the driver cannot apply any brakes). Additionally, for test type 2, the plot indicating the longitudinal acceleration of the Principal Other Vehicle includes a yellow envelope indicating the deceleration (0.3 g ± 0.03 g) allowed while braking. Exceedance of this threshold is indicated with red asterisks at the beginning and/or end of the threshold boundary.

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. Instantaneous samplings
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 not exceed this threshold in order to be valid
   - Black threshold (Dashed) = for reference only – this can include warning level thresholds, TTC thresholds, and acceleration thresholds

3. Instantaneous sampling 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

- ENV – For Ax plots only, indicates that the envelope for the POV braking was exceeded.
- 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 Figure D1 through Figure D6. Actual time history data plots for the vehicle under consideration are provided subsequently.

Notes

When vehicles provide more than one type of alert, and when it is possible to measure the timing of these alerts, plots will be shown of each alert for each run. Because alert timing nearly always differs between alert types, a plot may indicate a valid run for one of the alerts and invalid for another. Test run validity is based on the validity window of the earliest alert, but validity determination for each individual alert is based on the timing of that alert alone. As an example, a vehicle has both visual and auditory alerts. For a particular run, the auditory alert occurs first followed by the visual alert. The validity period for the run ends when the auditory alert occurs, at which time the driver steers and/or brakes to avoid the POV. Since the visual alert occurs after the auditory alert, the run is essentially already over by the time the visual alert occurs. Depending on the relative timing gap between alerts, it may be expected that the validity criteria (yaw rate, speed, etc.) based on the timing of the visual alert could indicate an invalid run.

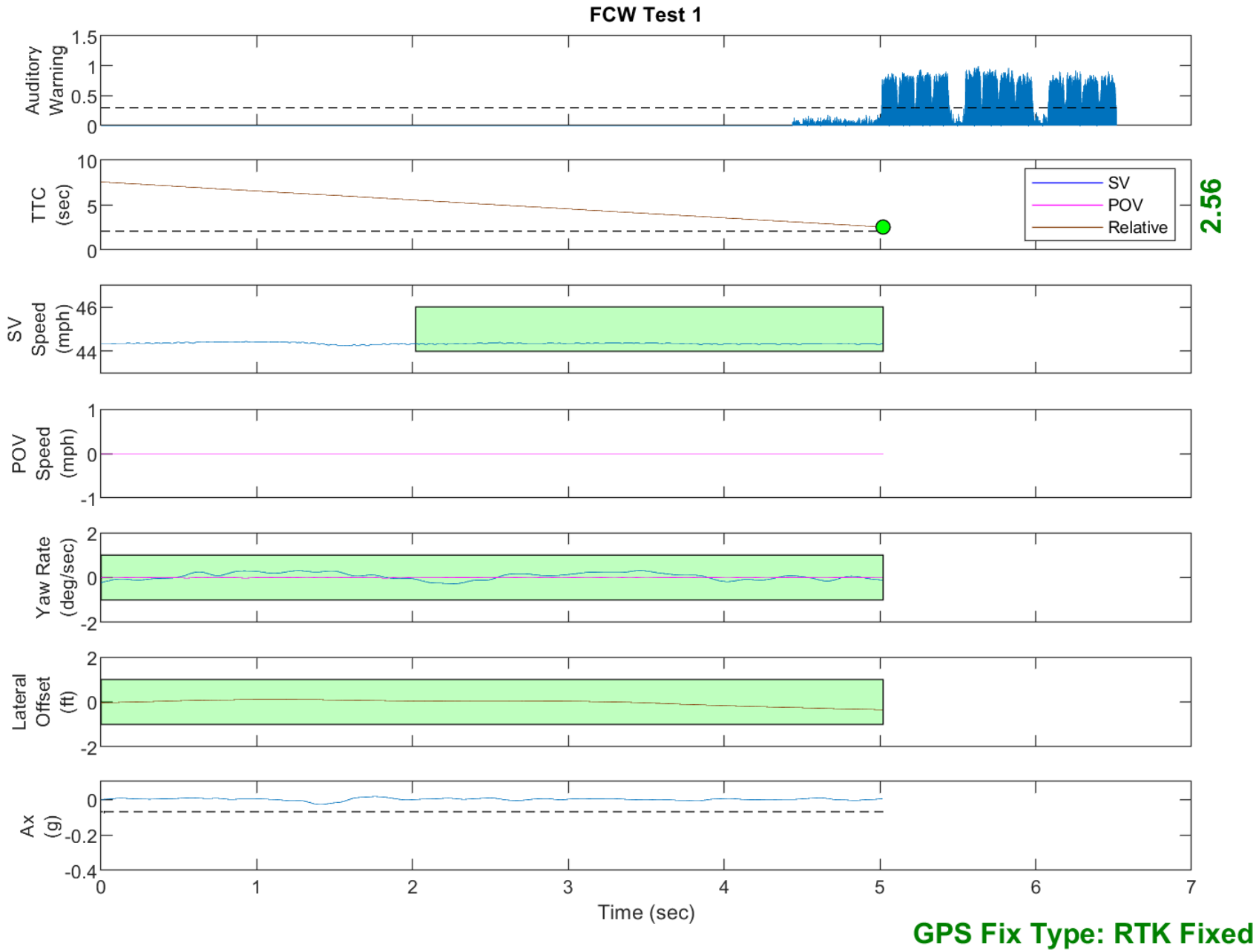


Figure D1. Example Time History for Test Type 1, Passing

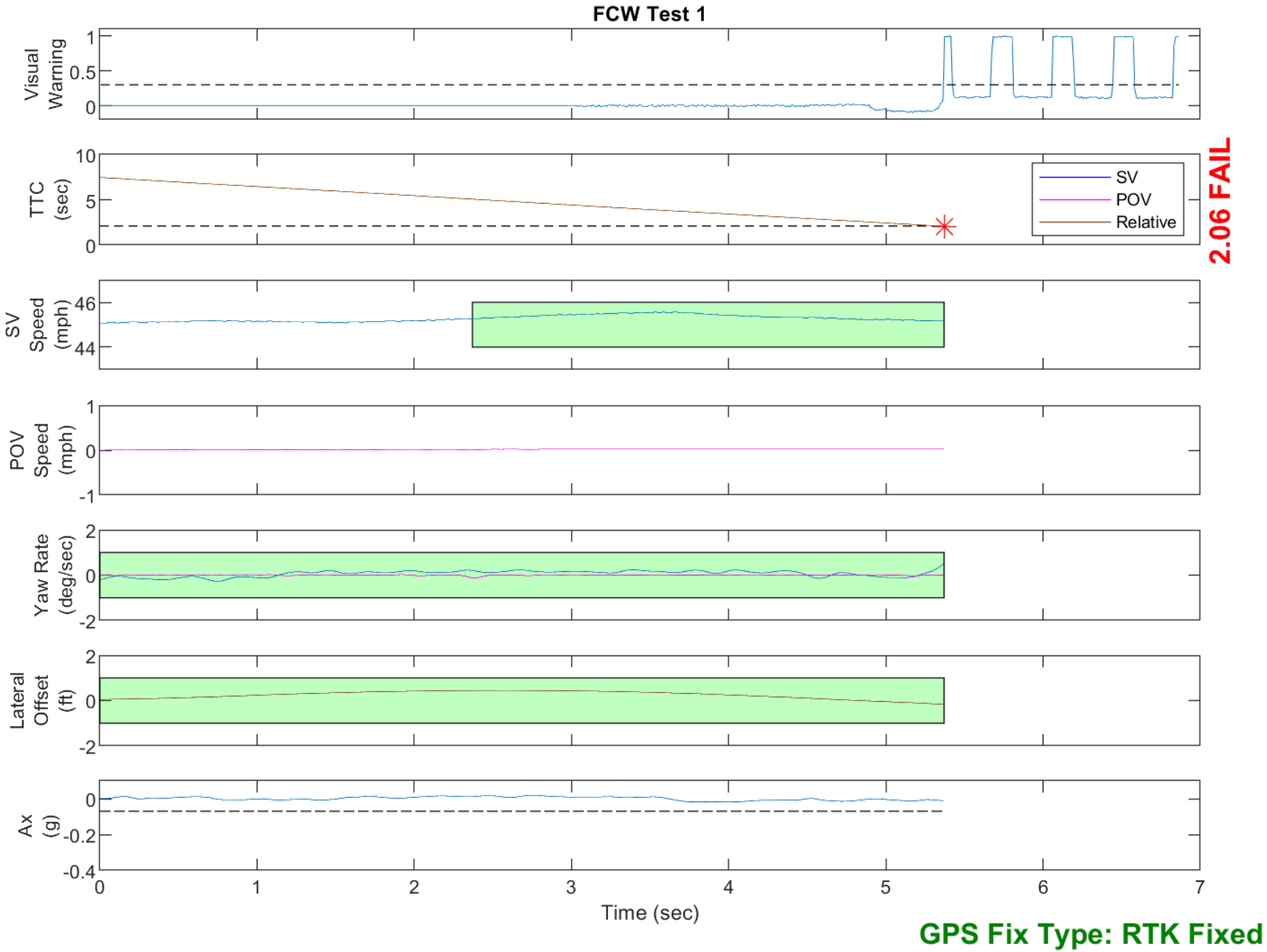


Figure D2. Example Time History for Test Type 1, Failing

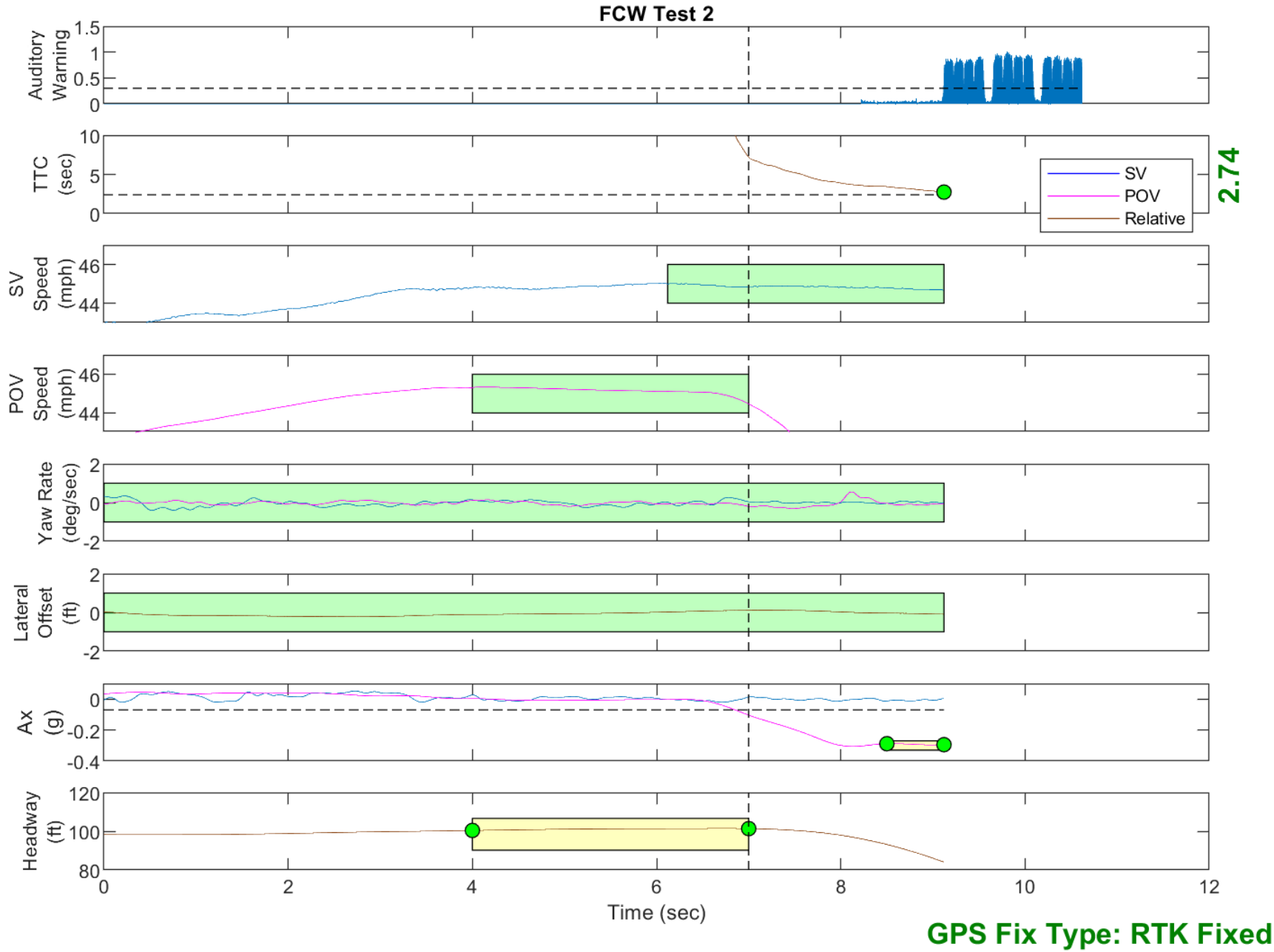


Figure D3. Example Time History for Test Type 2, Passing

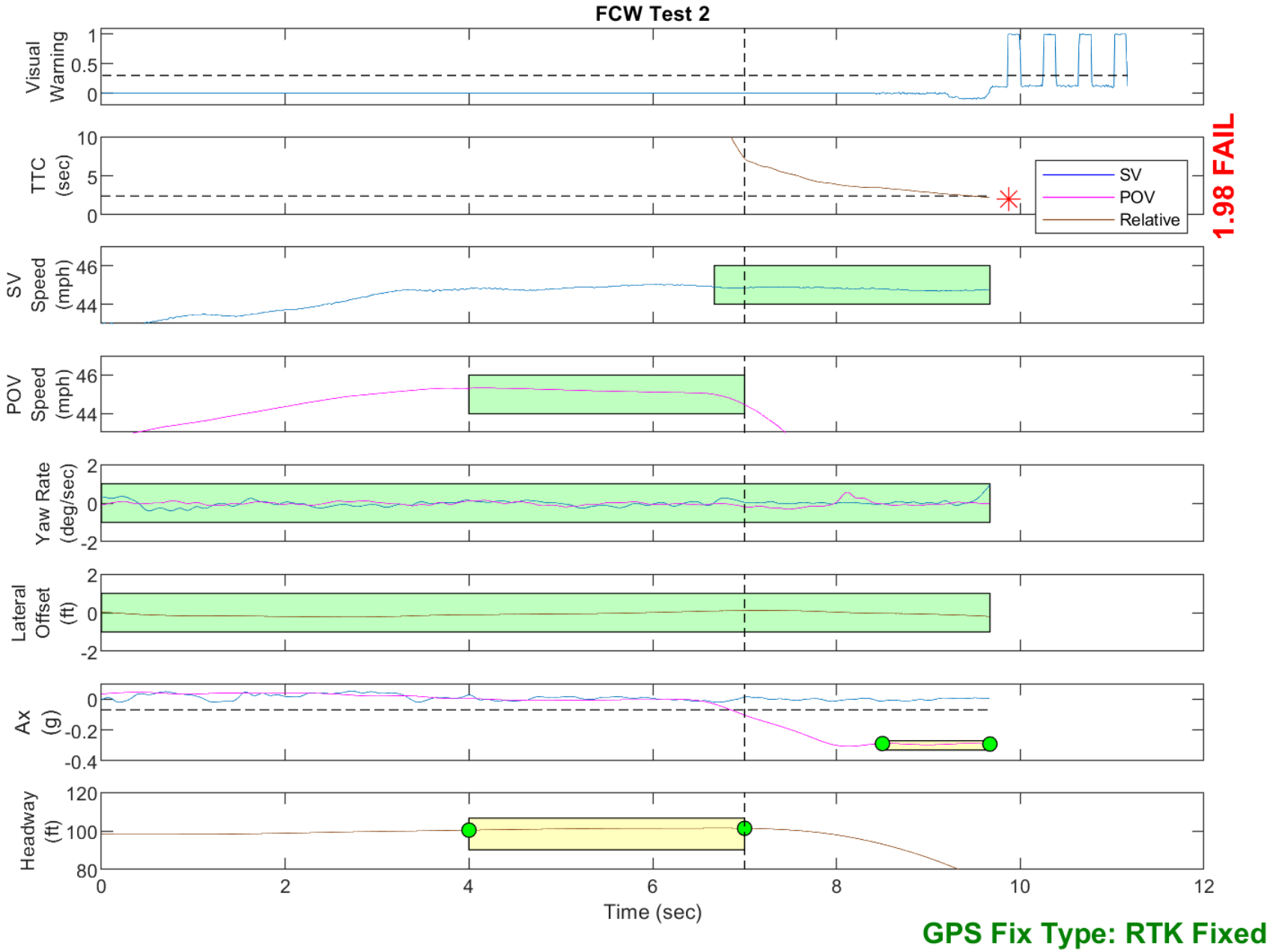


Figure D4. Example Time History for Test Type 2, Failing

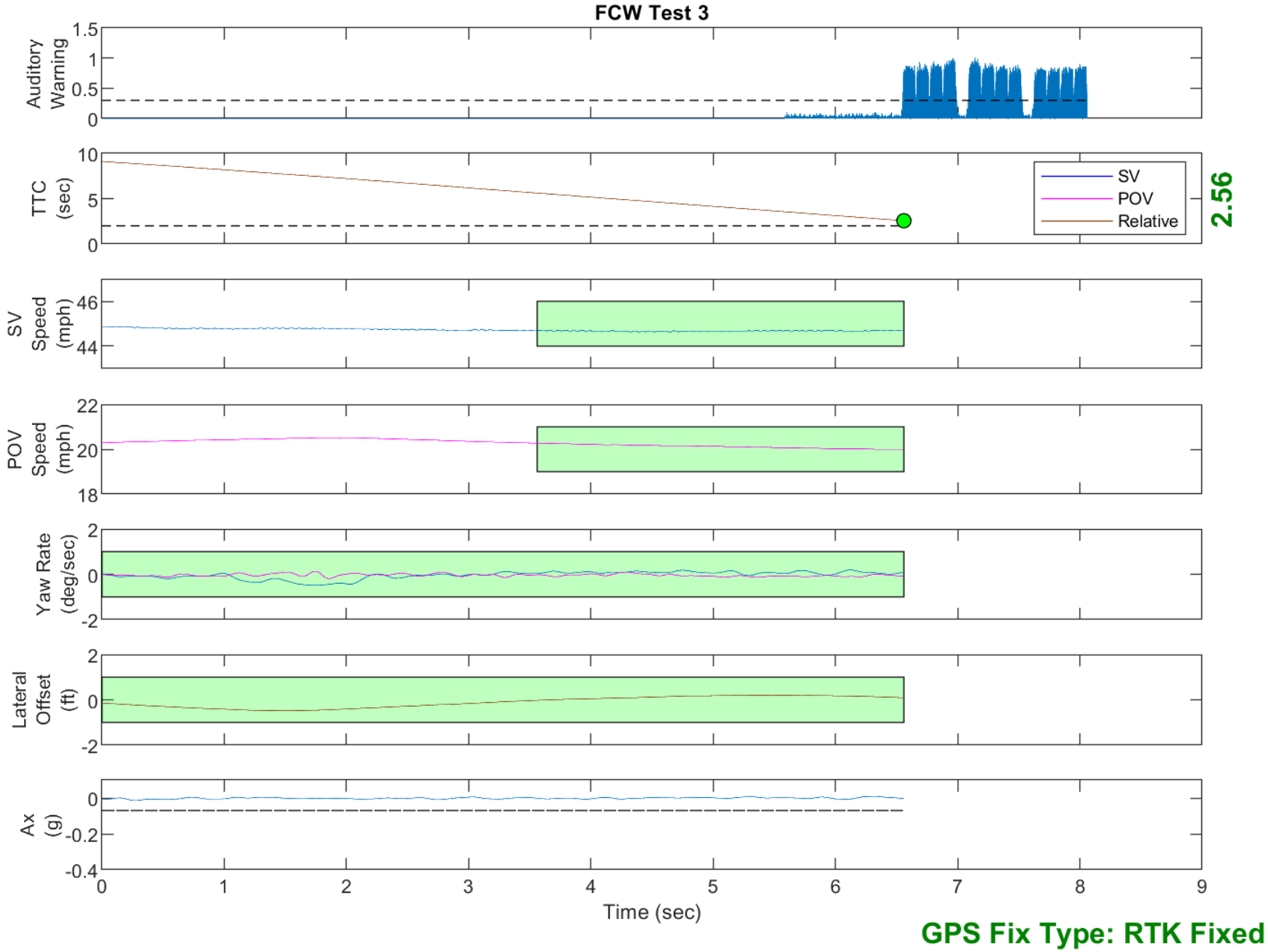


Figure D5. Example Time History for Test Type 3, Passing

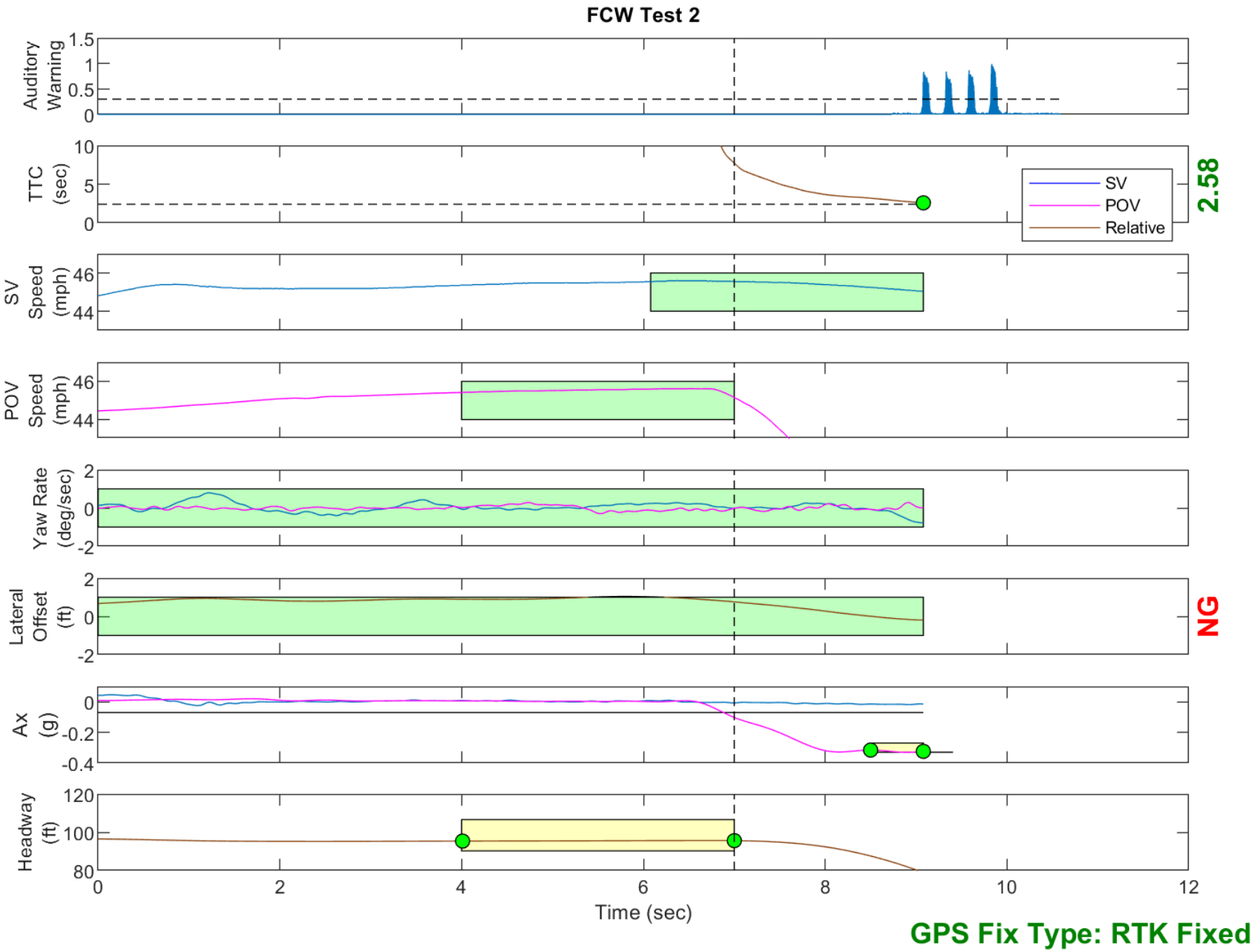


Figure D6. Example Time History Showing Invalid Lateral Offset Criteria

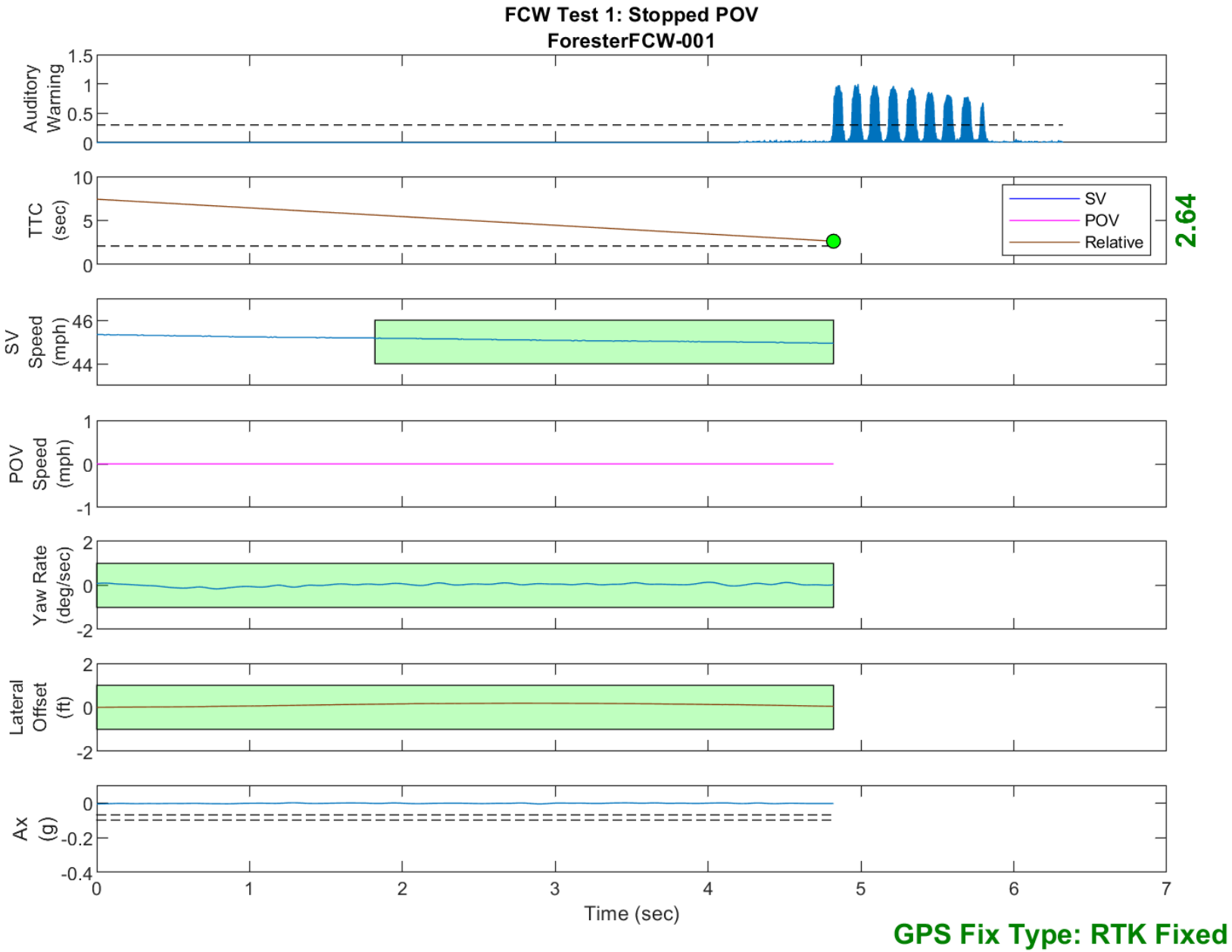


Figure D7. Time History for Run 1, Test 1 - Stopped POV, Auditory Warning

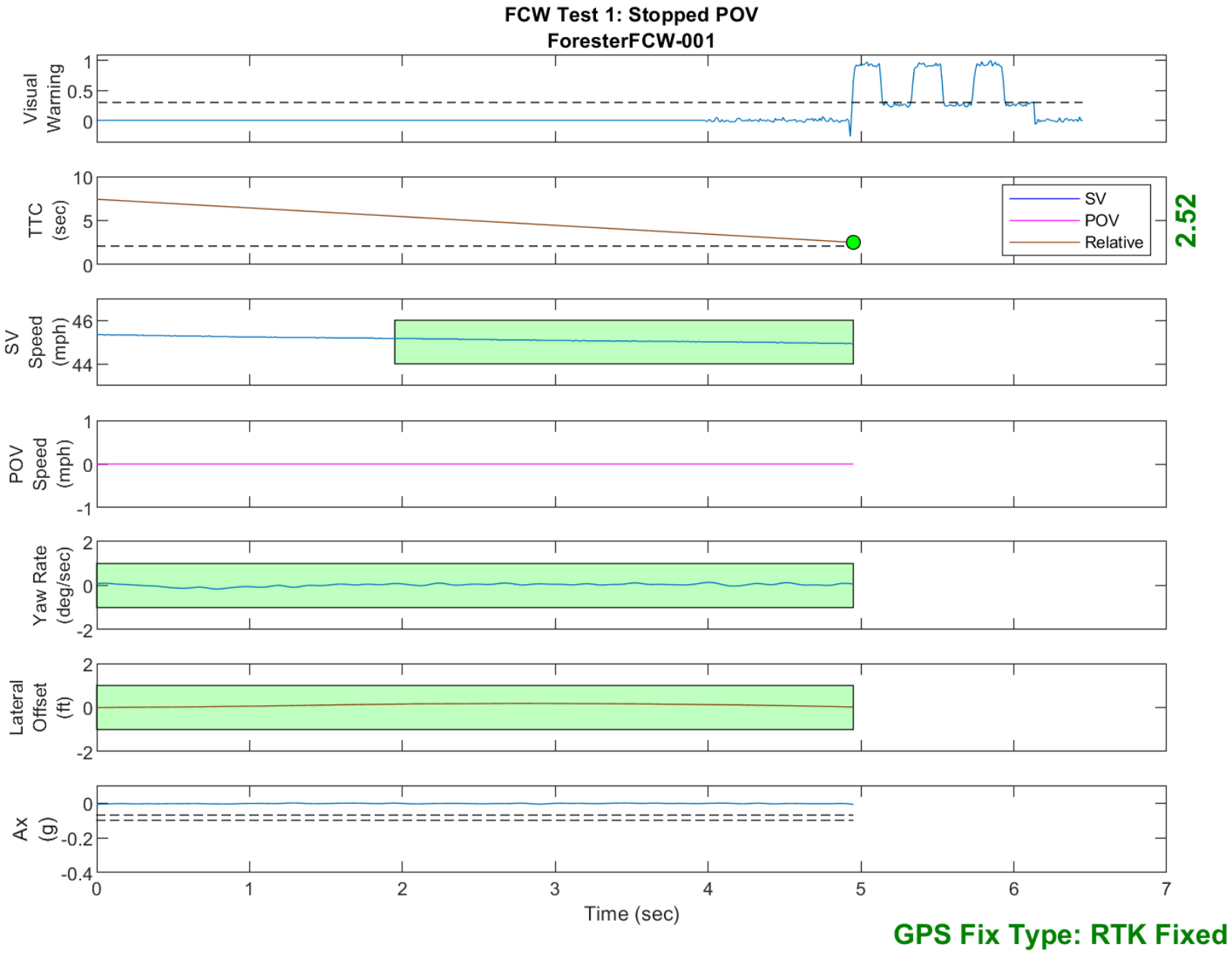


Figure D8. Time History for Run 1, Test 1 - Stopped POV, Visual Warning

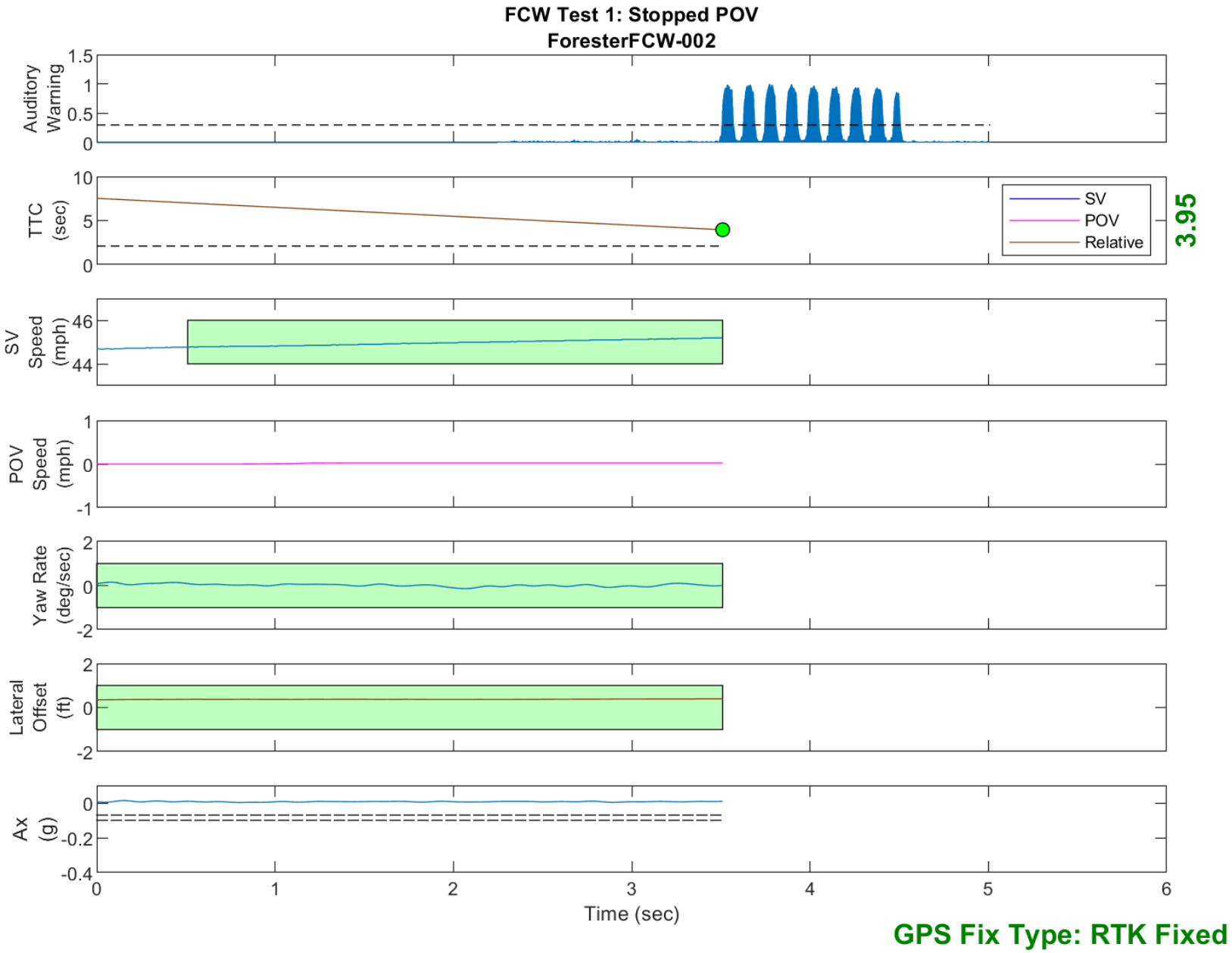


Figure D9. Time History for Run 2, Test 1 - Stopped POV, Auditory Warning

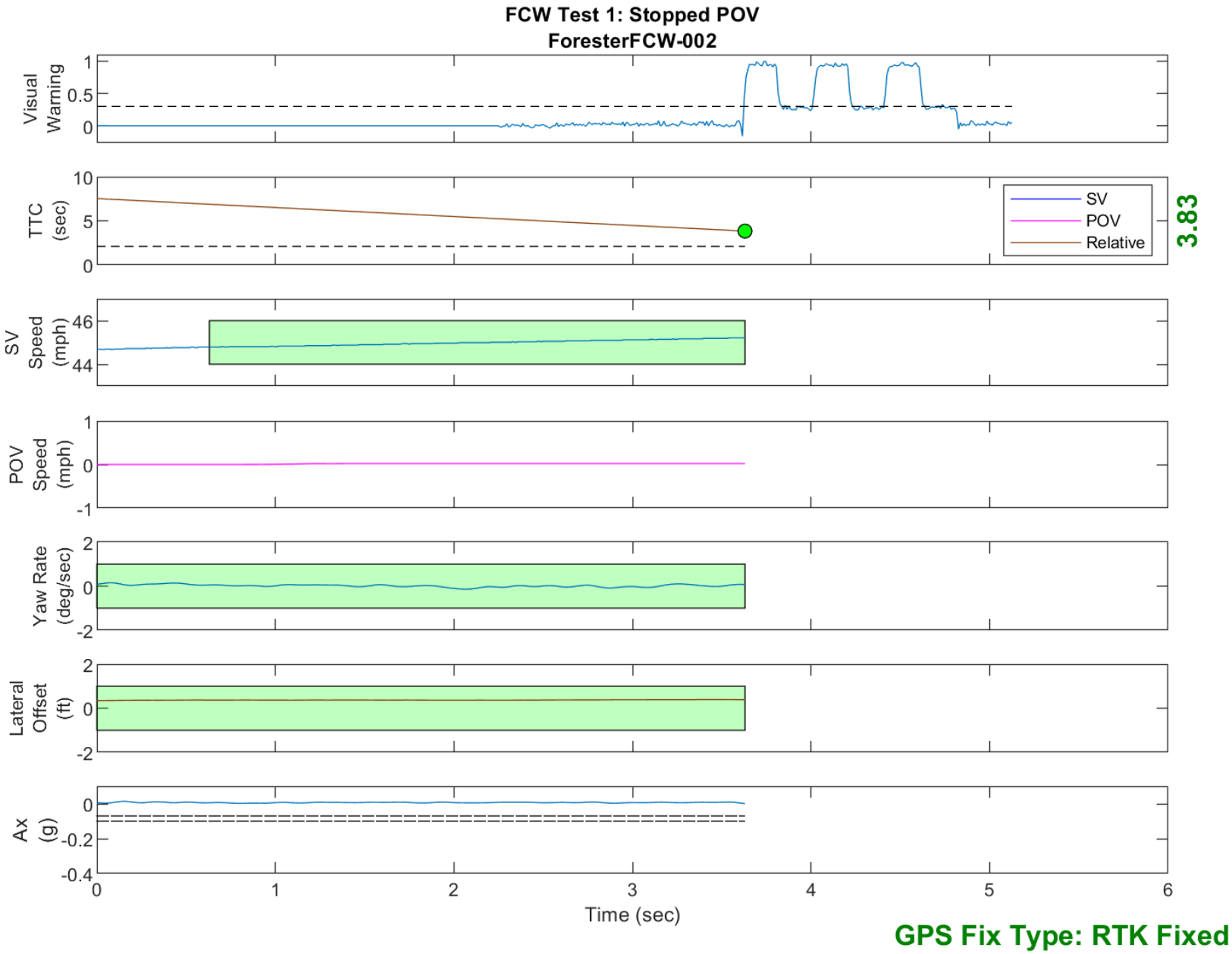


Figure D10. Time History for Run 2, Test 1 - Stopped POV, Visual Warning

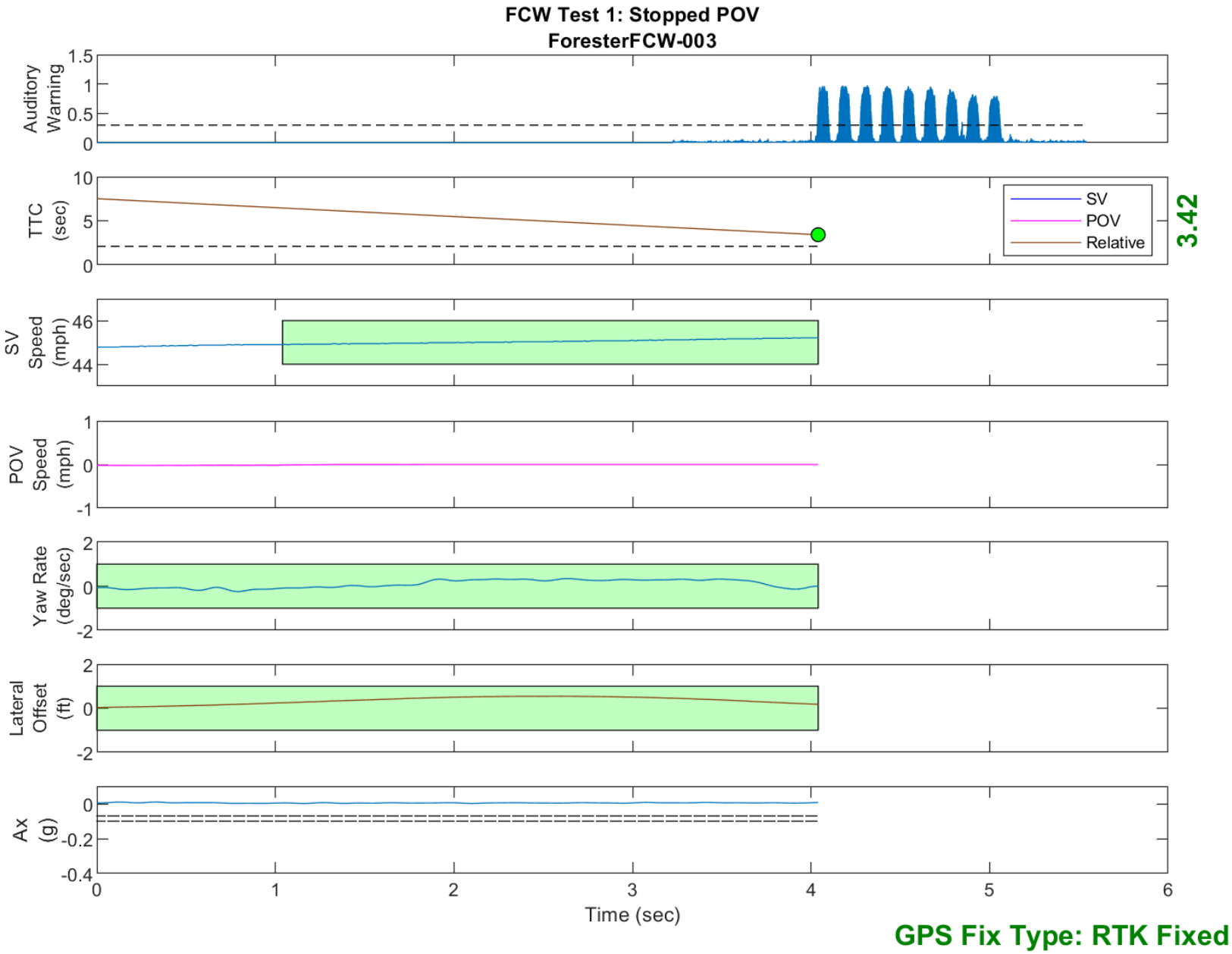


Figure D11. Time History for Run 3, Test 1 - Stopped POV, Auditory Warning

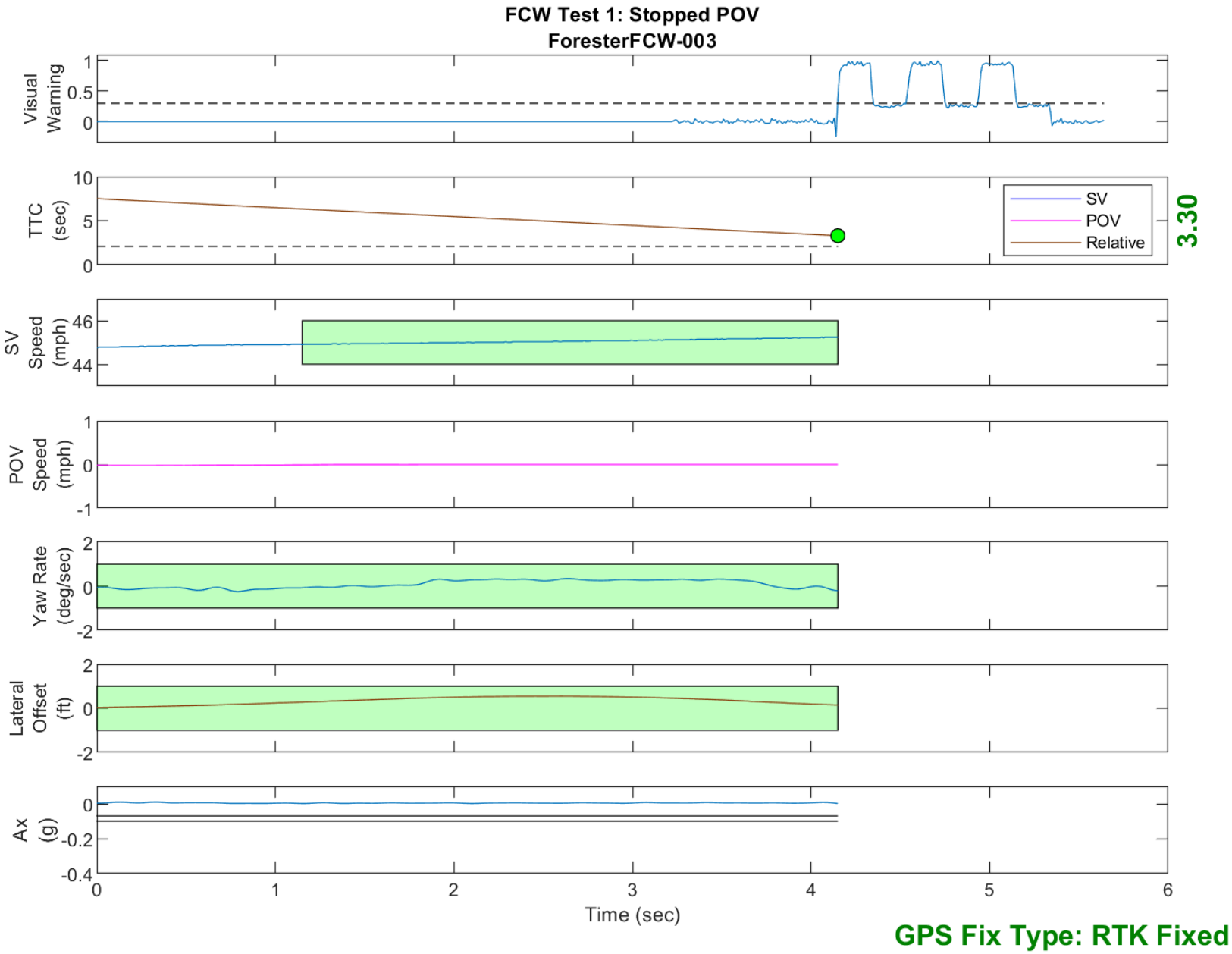


Figure D12. Time History for Run 3, Test 1 - Stopped POV, Visual Warning

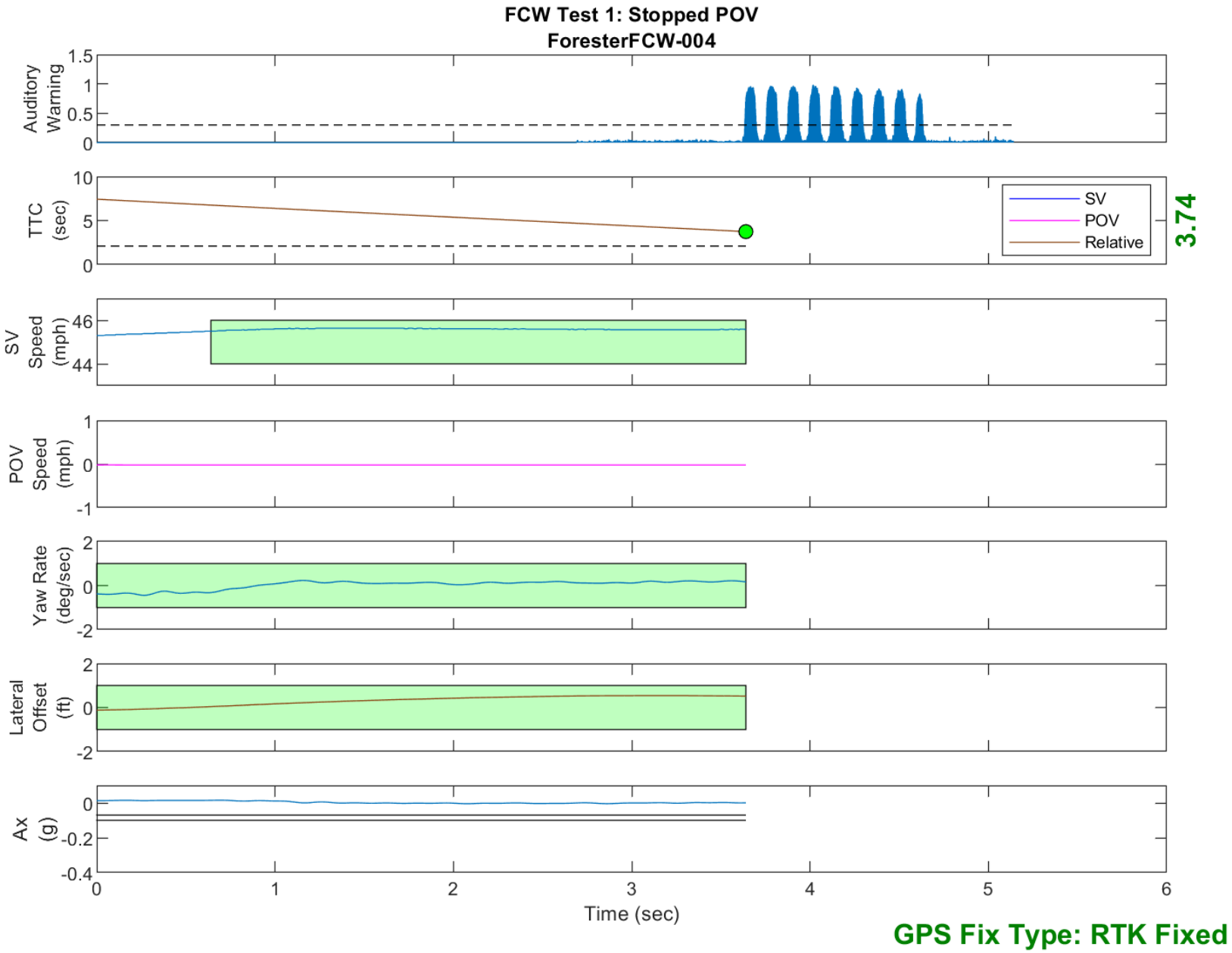


Figure D13. Time History for Run 4, Test 1 - Stopped POV, Auditory Warning

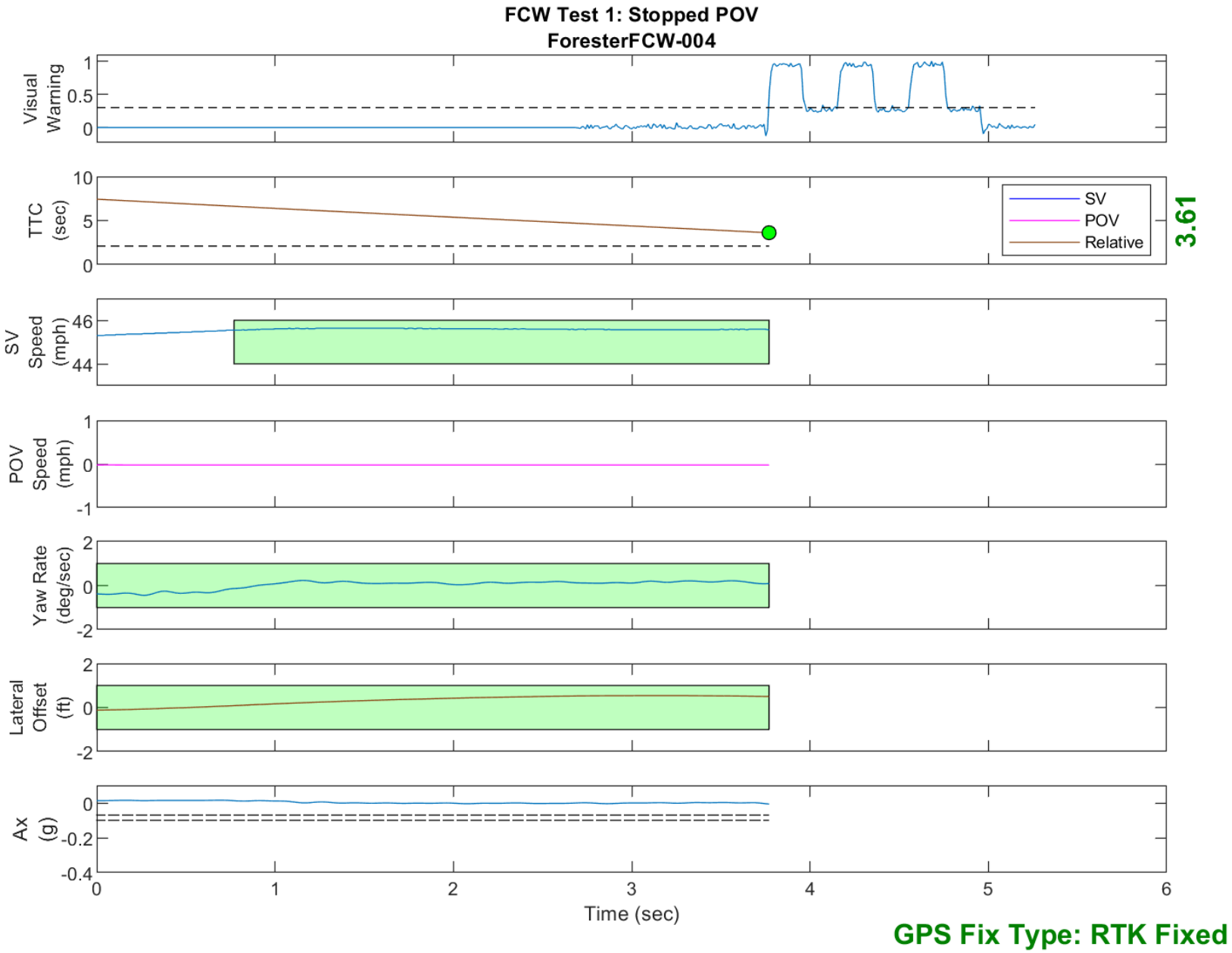


Figure D14. Time History for Run 4, Test 1 - Stopped POV, Visual Warning

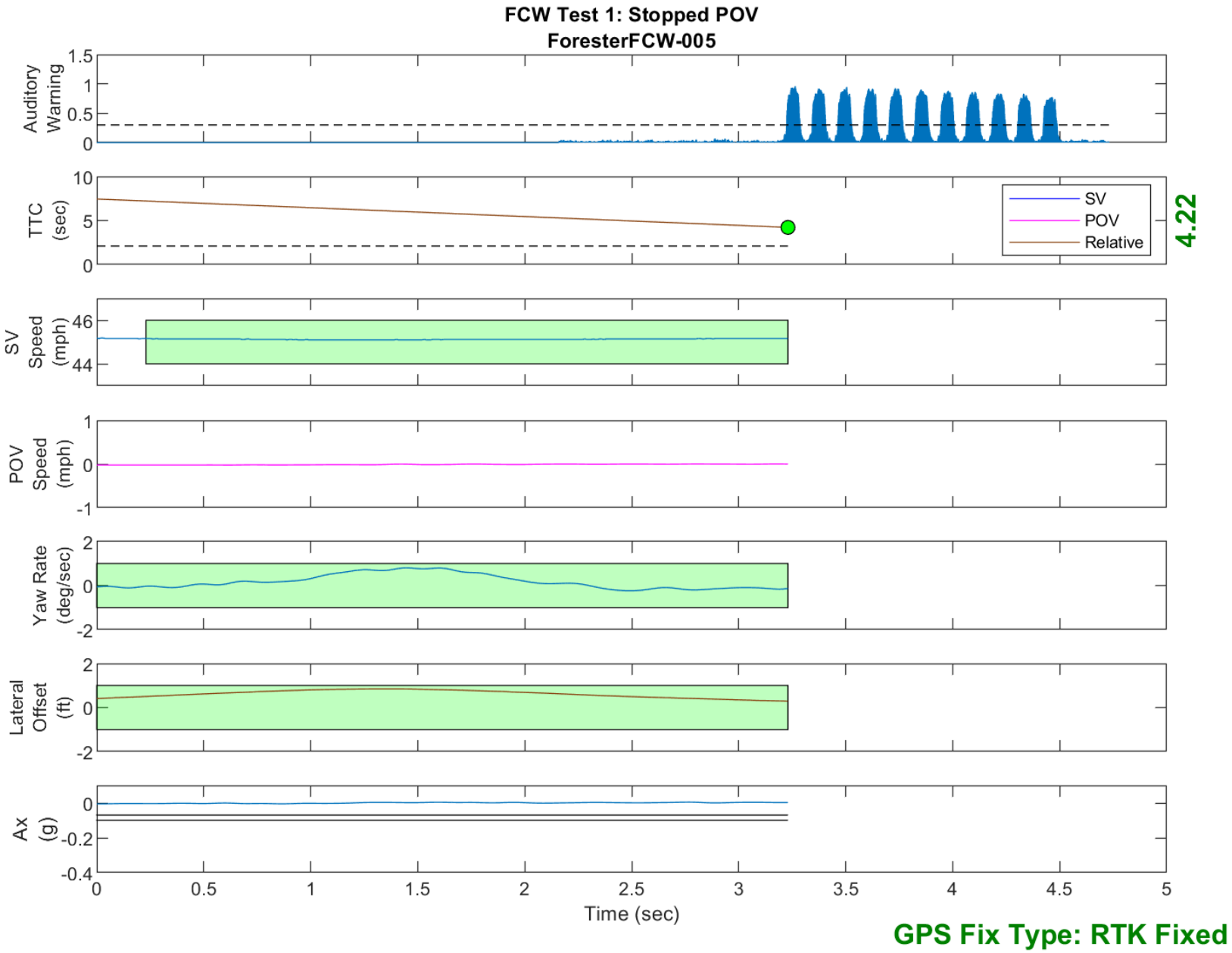


Figure D15. Time History for Run 5, Test 1 - Stopped POV, Auditory Warning

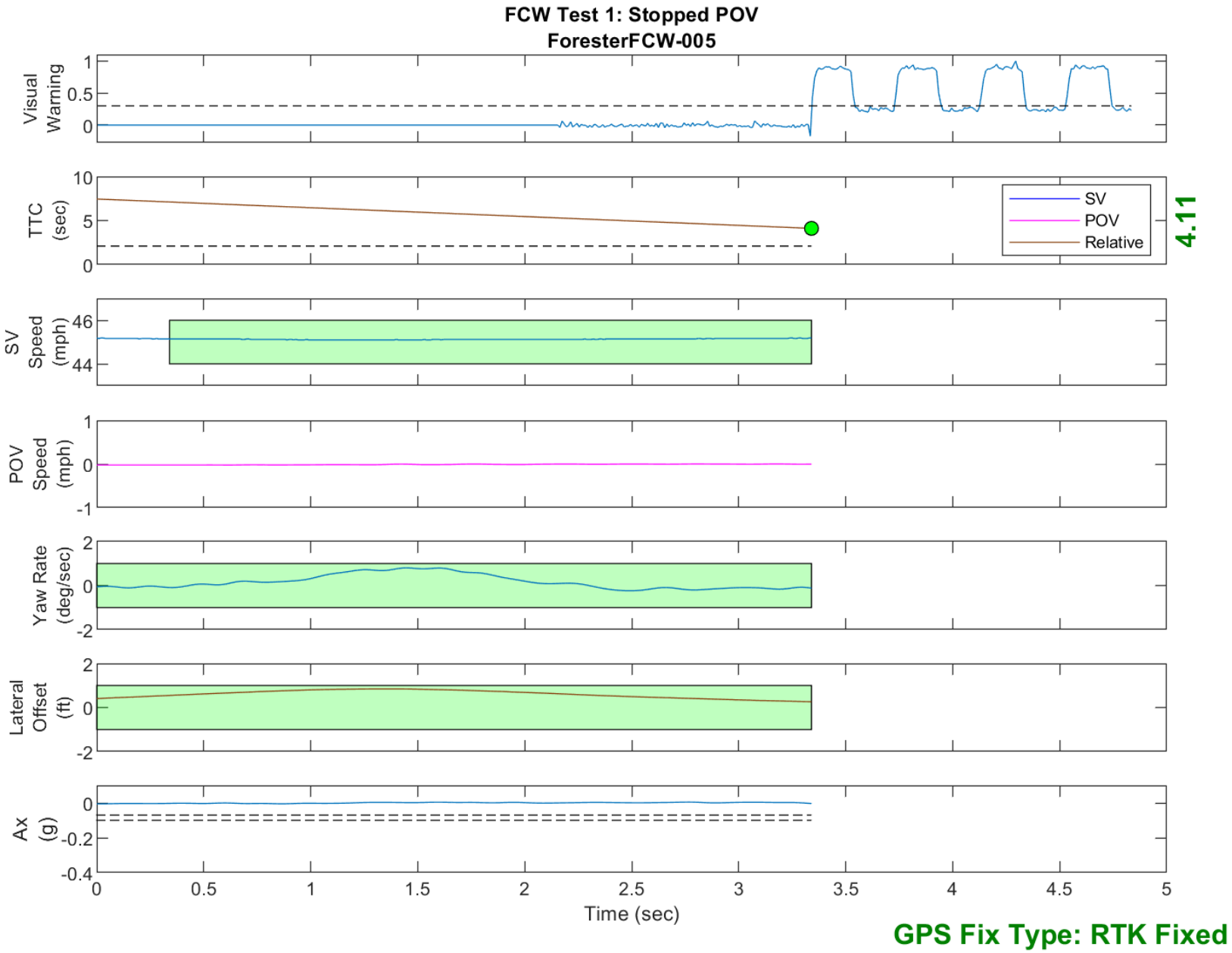


Figure D16. Time History for Run 5, Test 1 - Stopped POV, Visual Warning

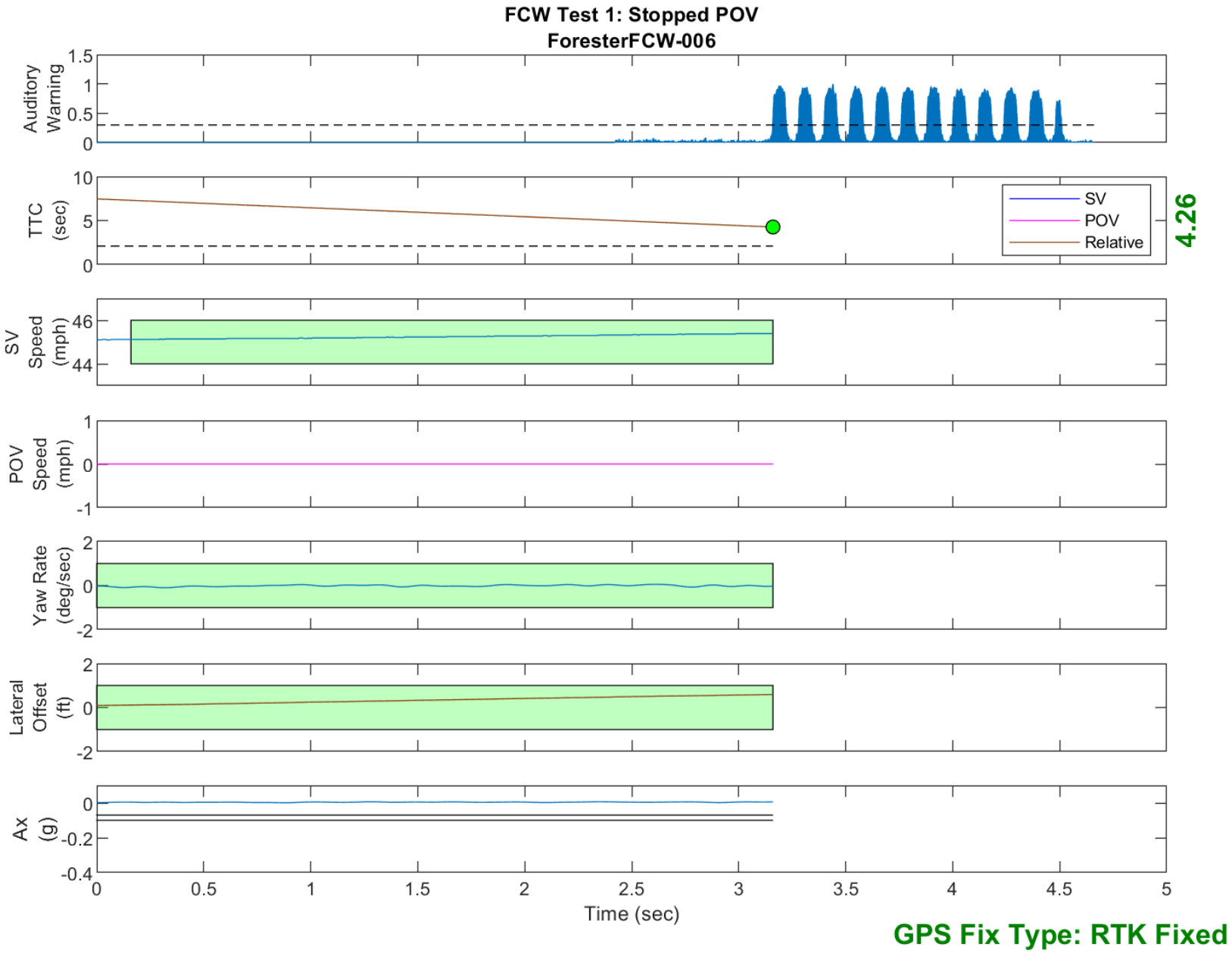


Figure D17. Time History for Run 6, Test 1 - Stopped POV, Auditory Warning

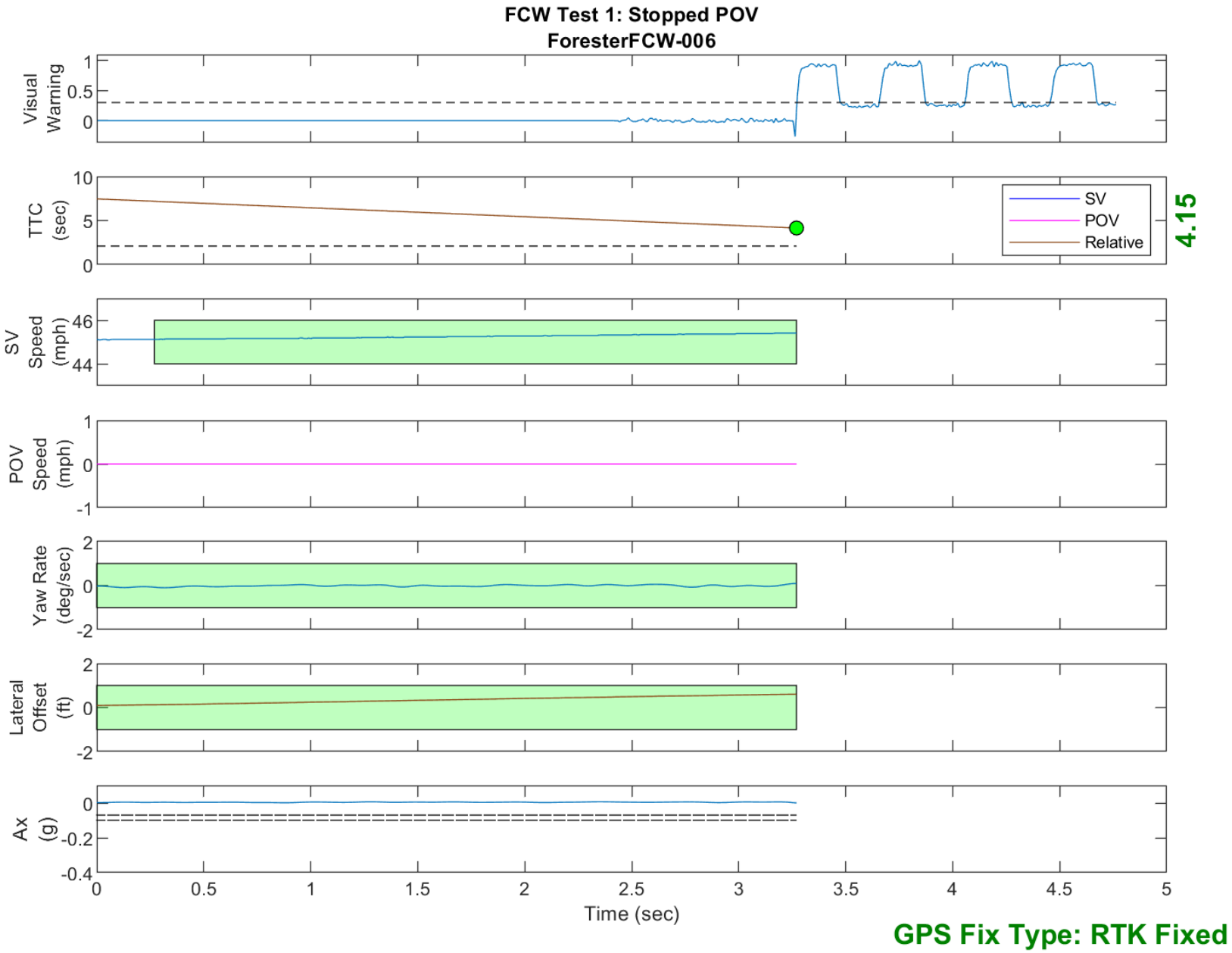


Figure D18. Time History for Run 6, Test 1 - Stopped POV, Visual Warning

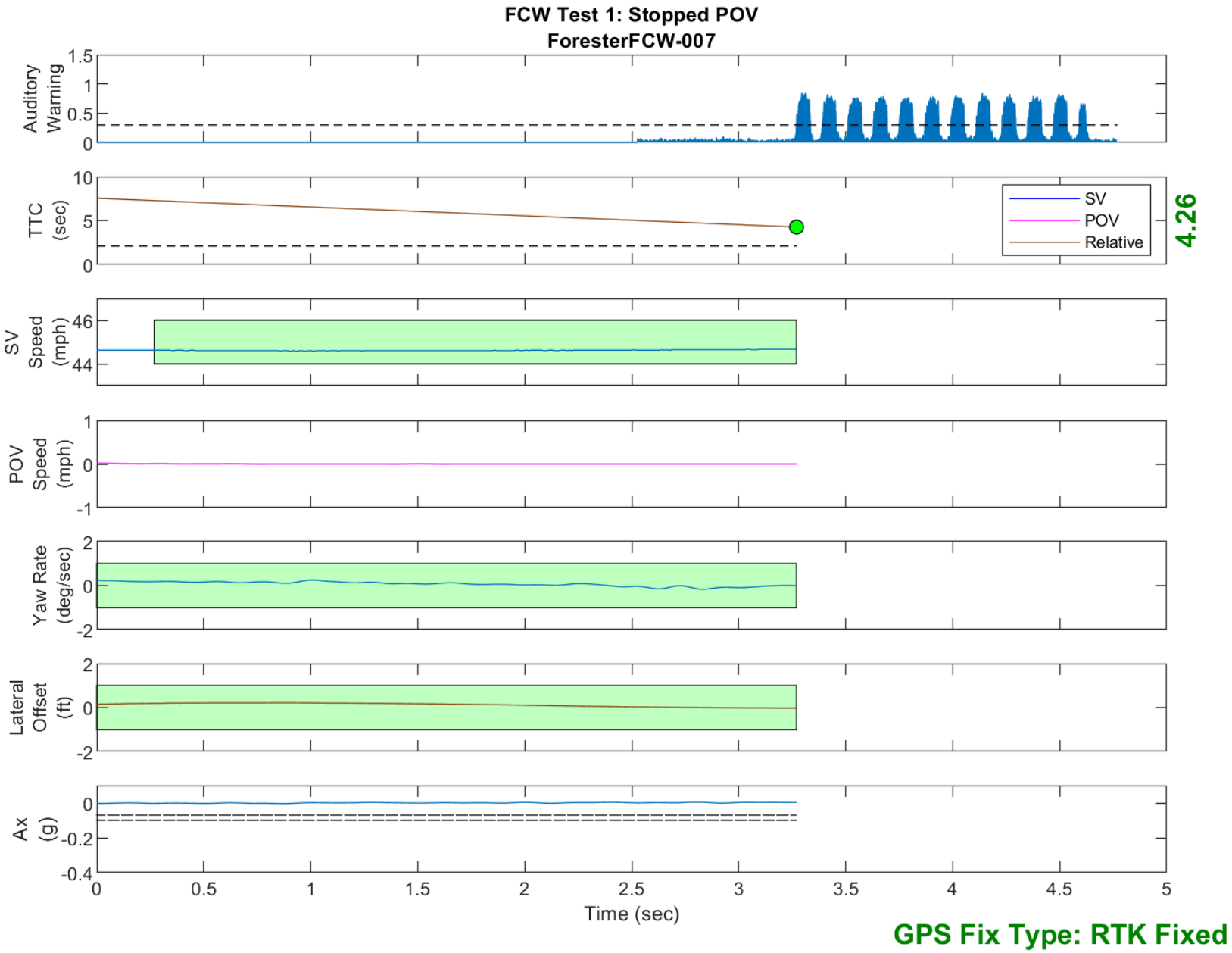


Figure D19. Time History for Run 7, Test 1 - Stopped POV, Auditory Warning

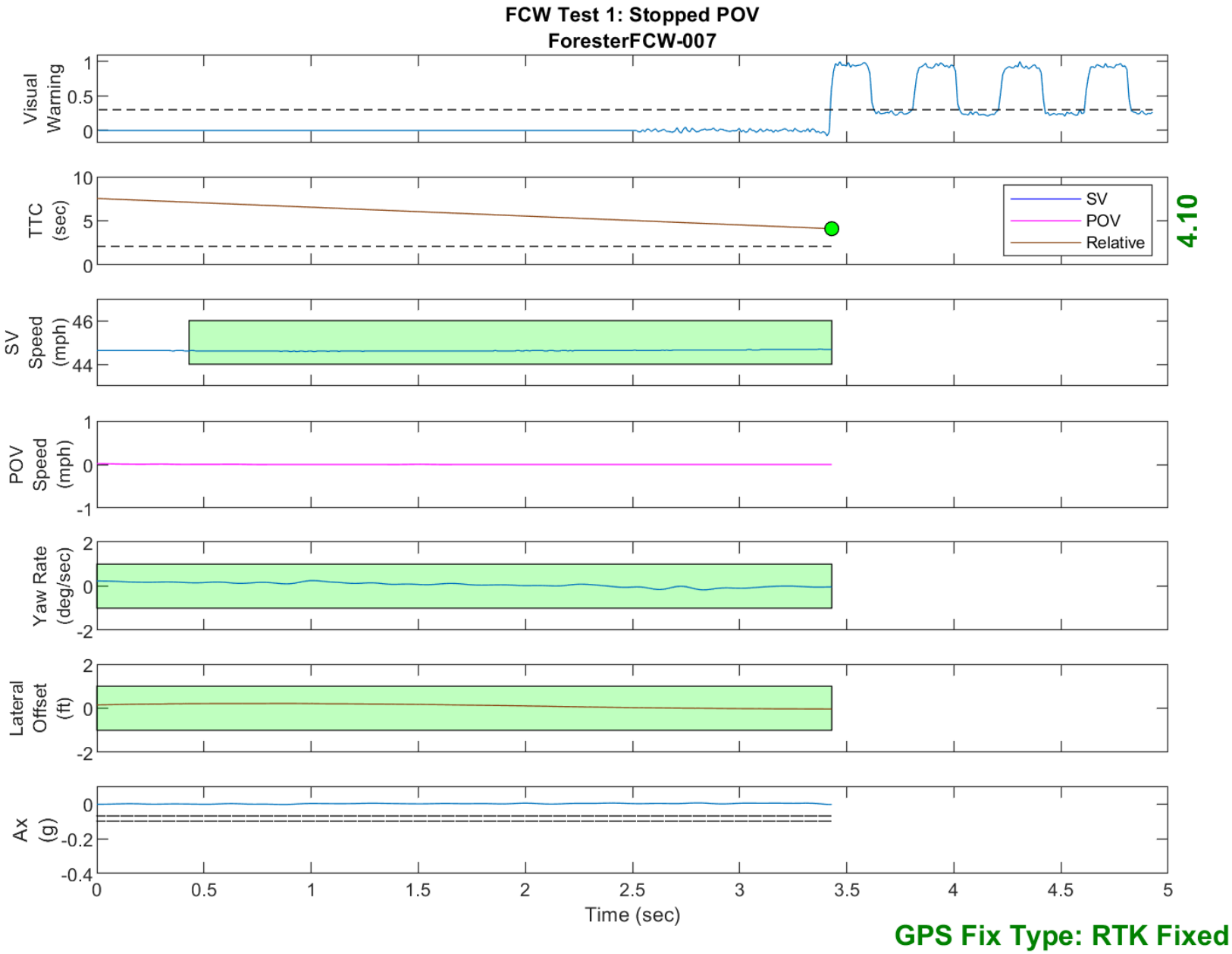


Figure D20. Time History for Run 7, Test 1 - Stopped POV, Visual Warning

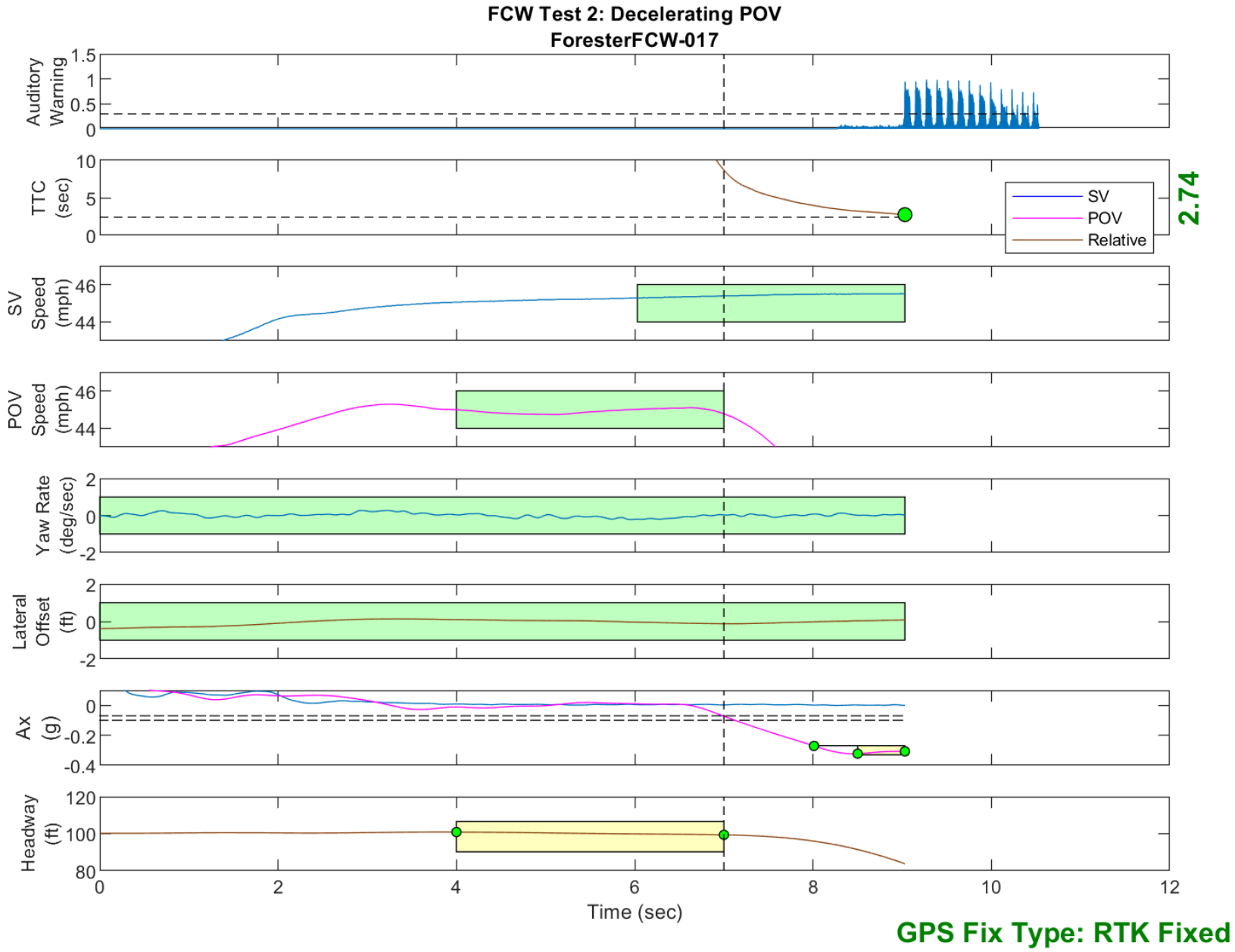


Figure D21. Time History for Run 17, Test 2 - Decelerating POV, Auditory Warning

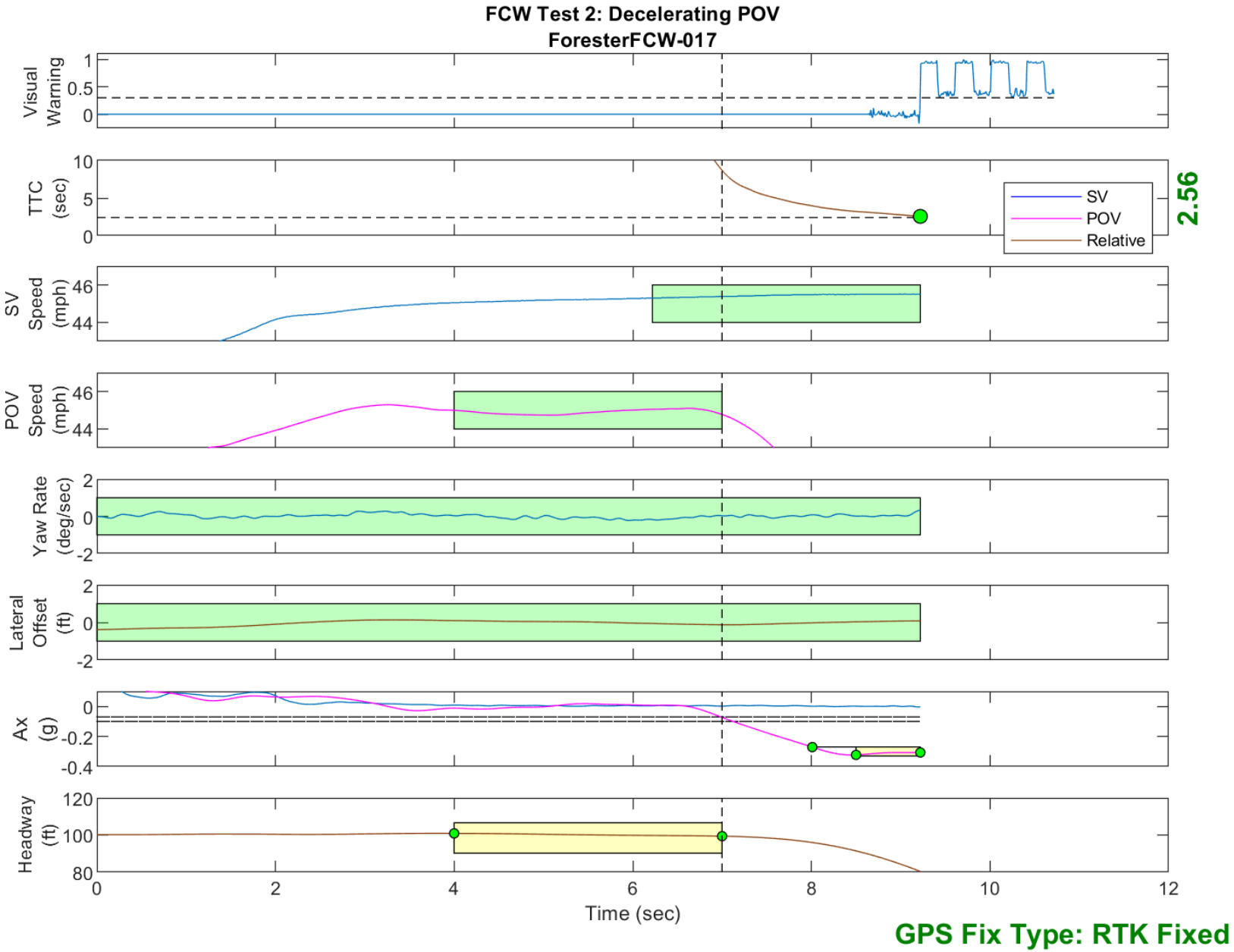


Figure D22. Time History for Run 17, Test 2 - Decelerating POV, Visual Warning

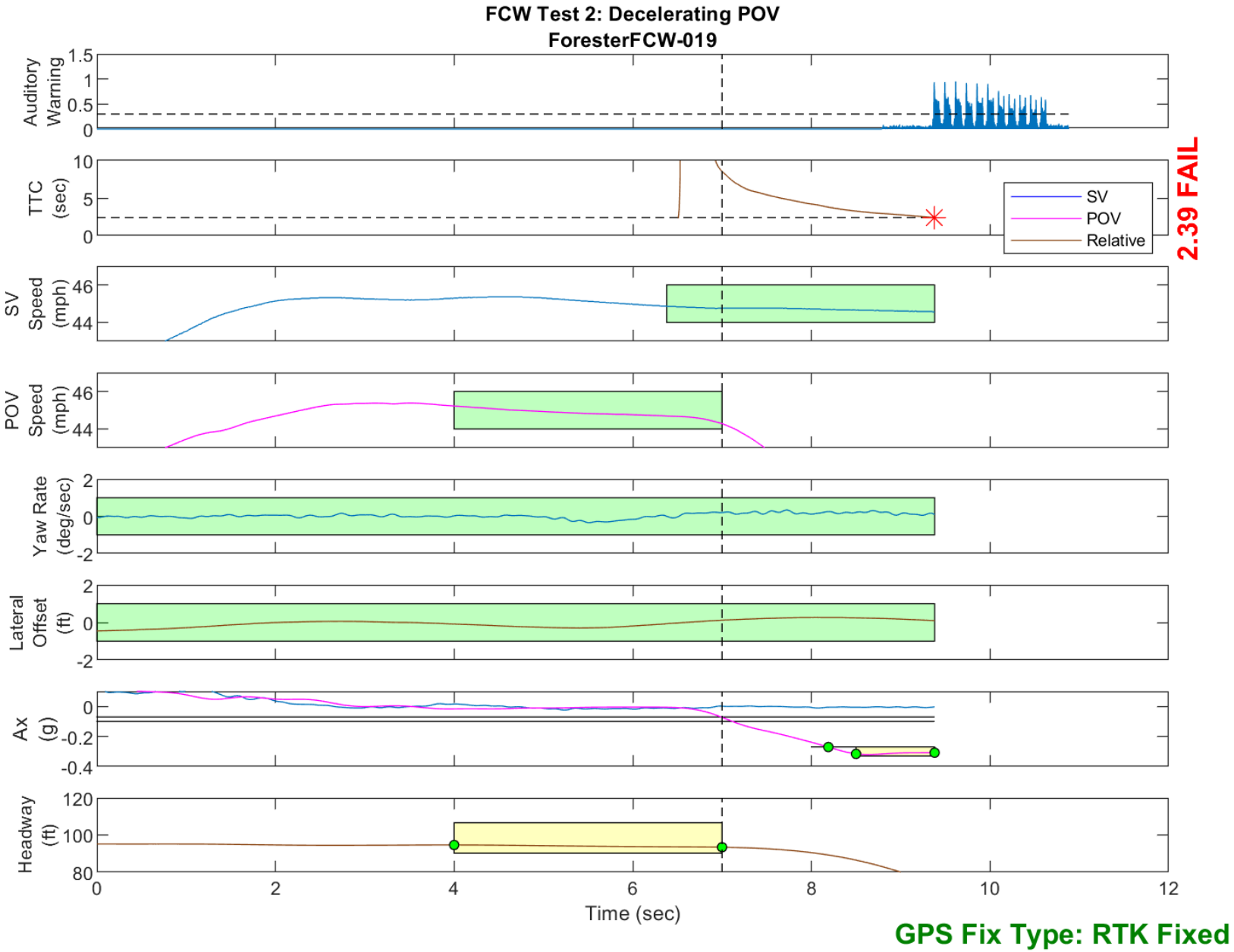


Figure D23. Time History for Run 19, Test 2 - Decelerating POV, Auditory Warning

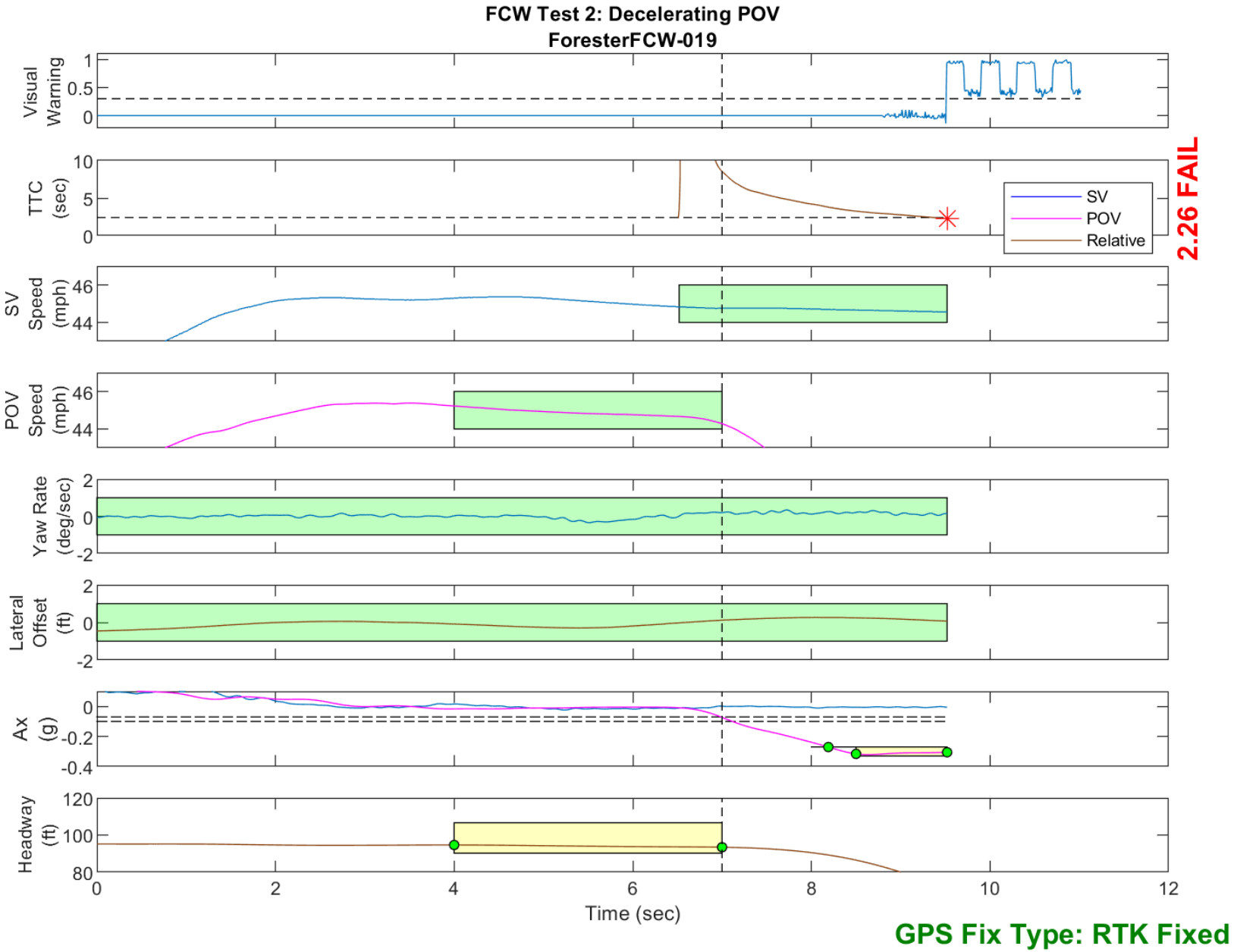


Figure D24. Time History for Run 19, Test 2 - Decelerating POV, Visual Warning

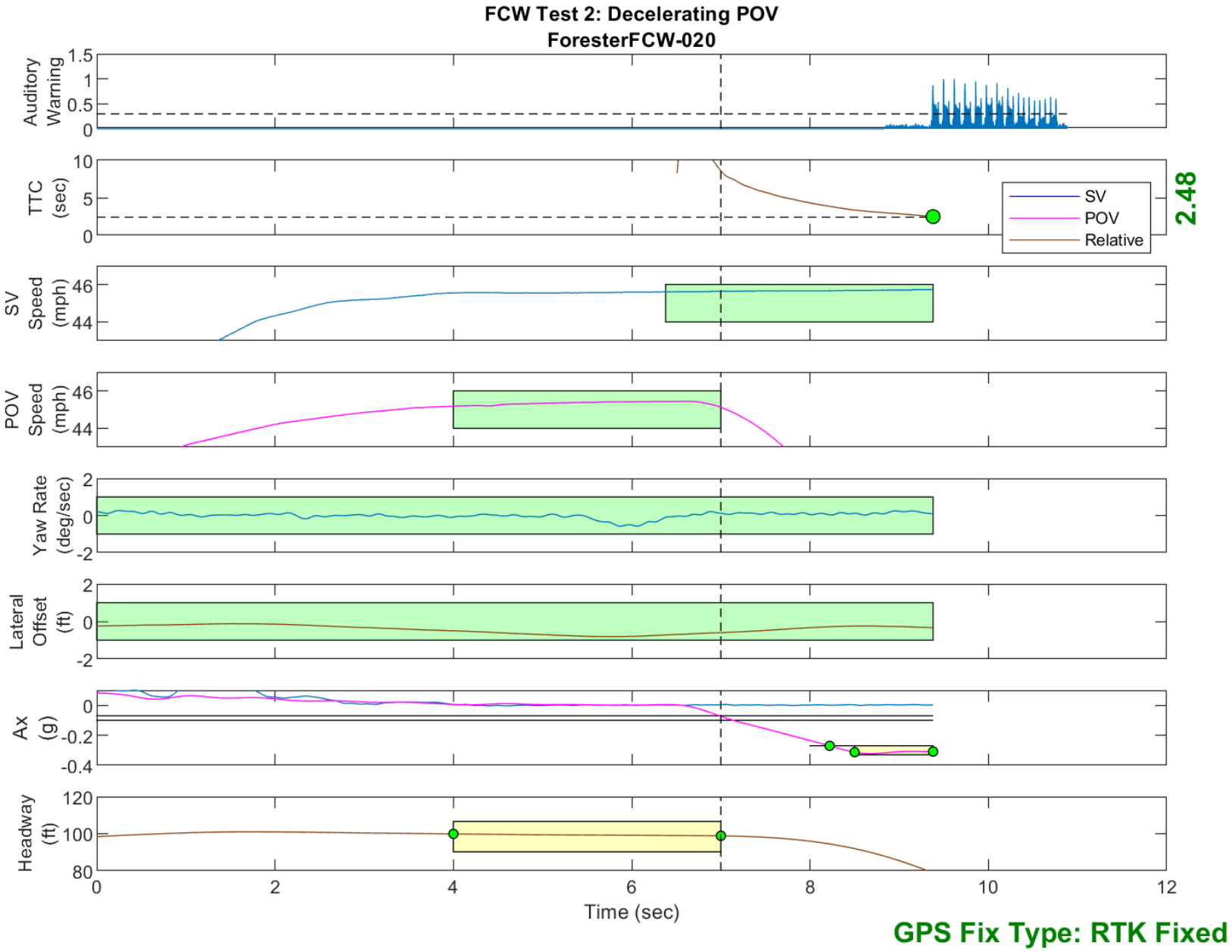


Figure D25. Time History for Run 20, Test 2 - Decelerating POV, Auditory Warning

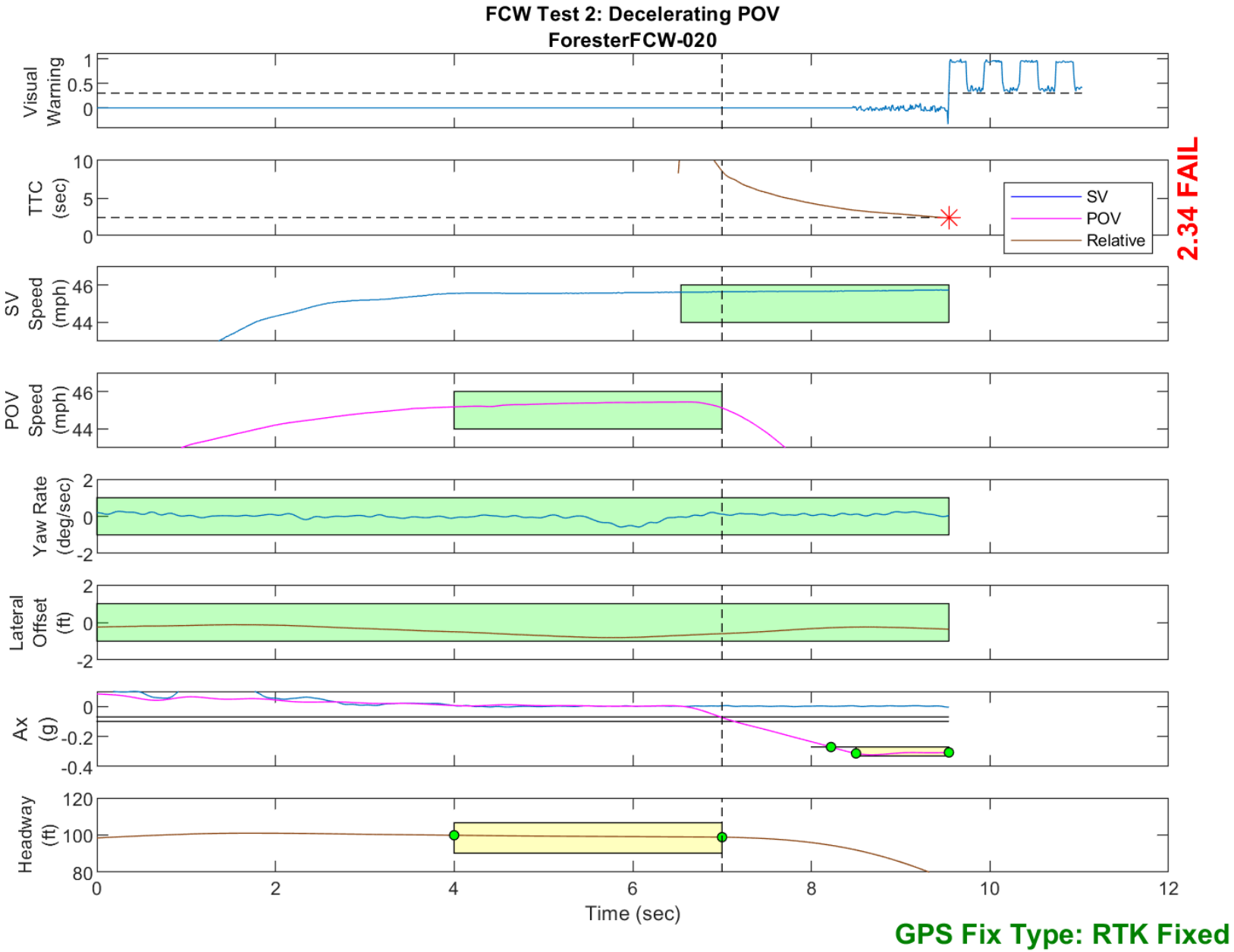


Figure D26. Time History for Run 20, Test 2 - Decelerating POV, Visual Warning

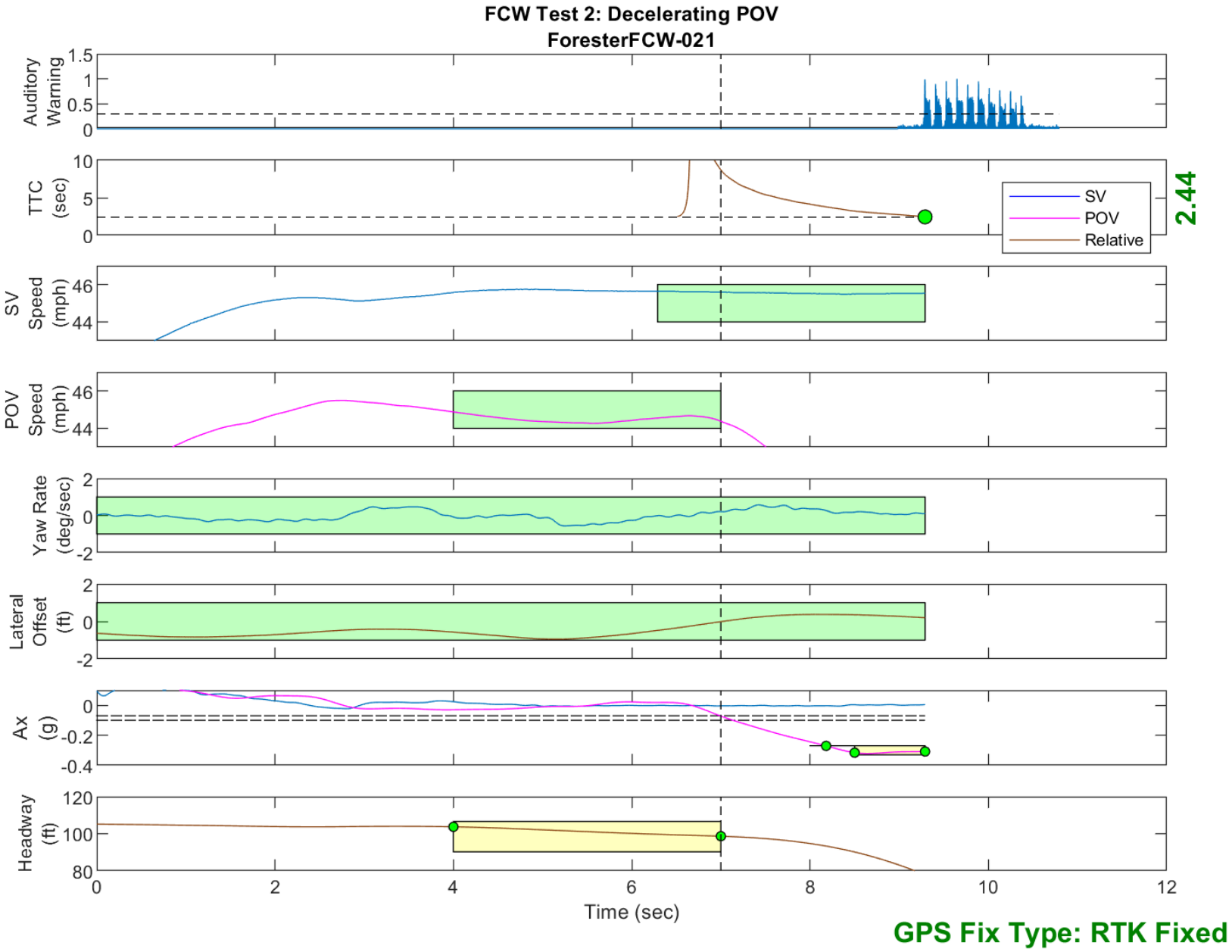


Figure D27. Time History for Run 21, Test 2 - Decelerating POV, Auditory Warning

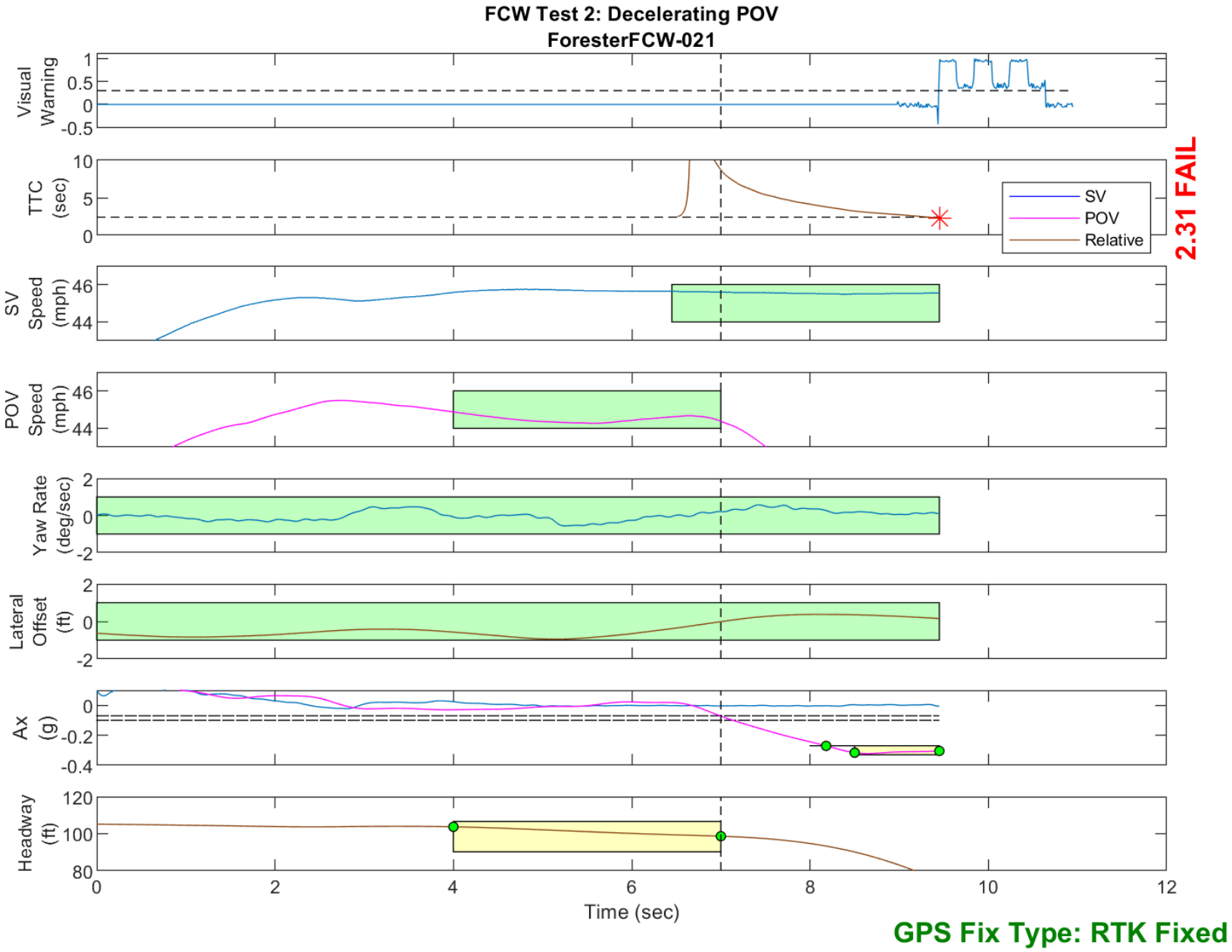


Figure D28. Time History for Run 21, Test 2 - Decelerating POV, Visual Warning

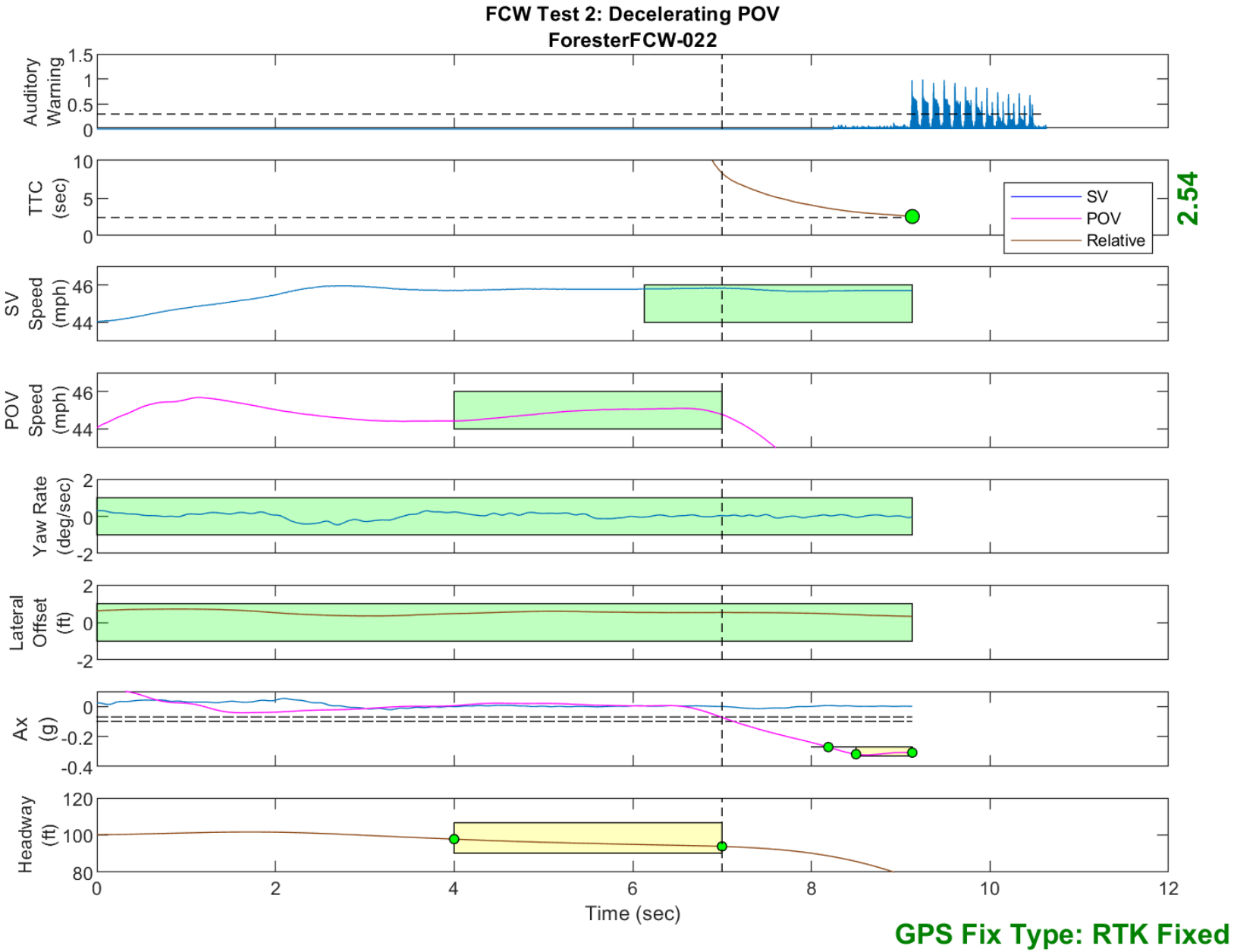


Figure D29. Time History for Run 22, Test 2 - Decelerating POV, Auditory Warning

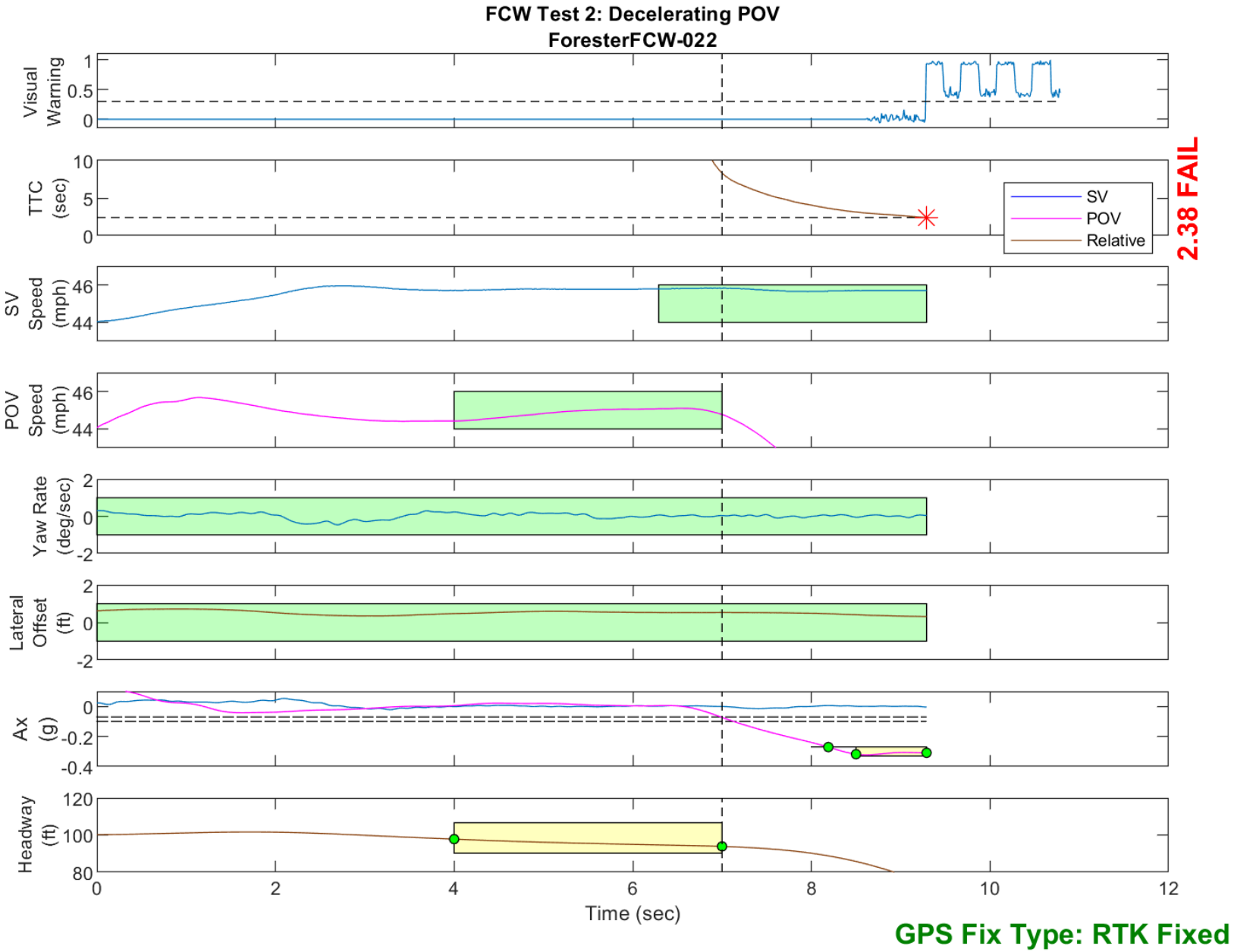


Figure D30. Time History for Run 22, Test 2 - Decelerating POV, Visual Warning

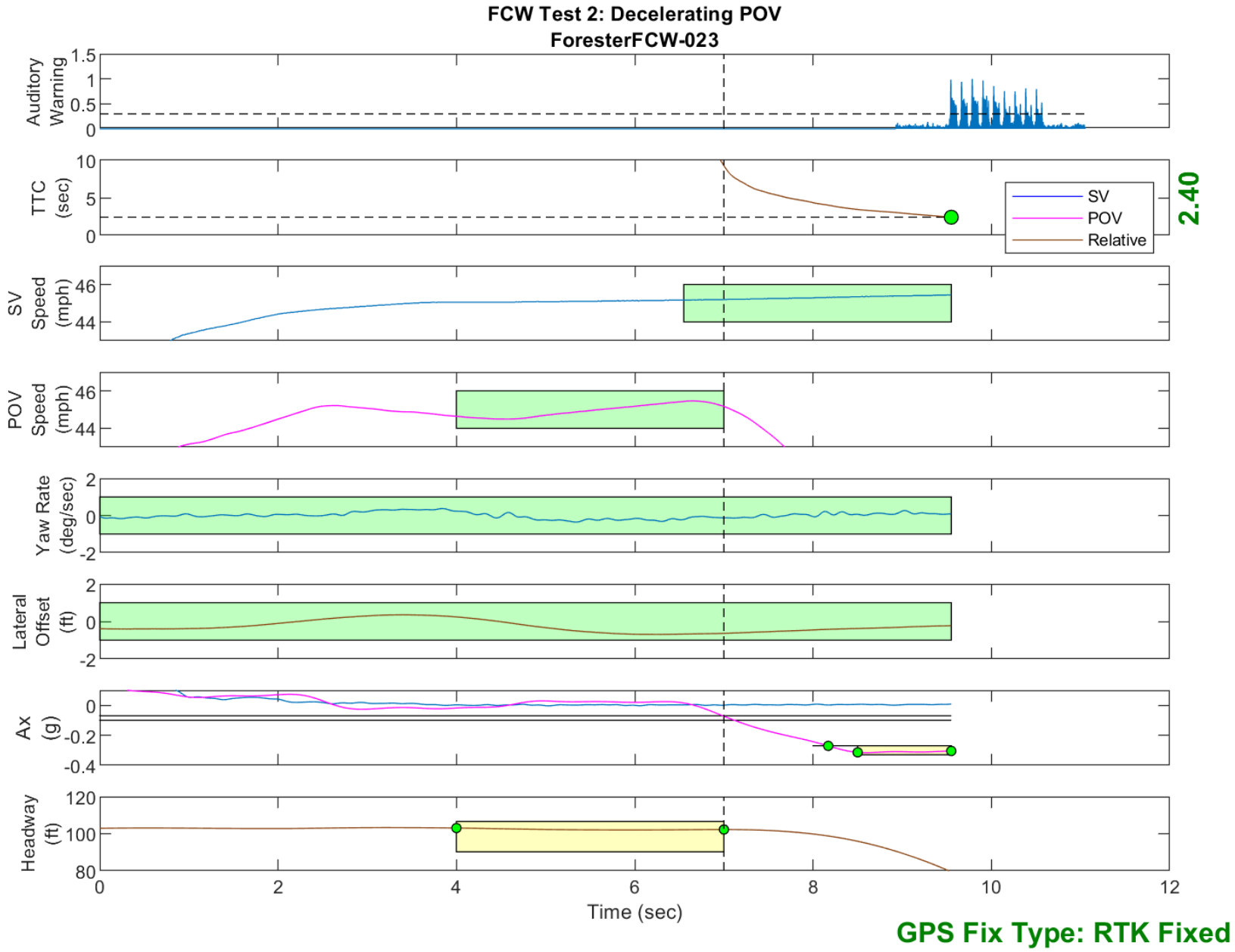


Figure D31. Time History for Run 23, Test 2 - Decelerating POV, Auditory Warning

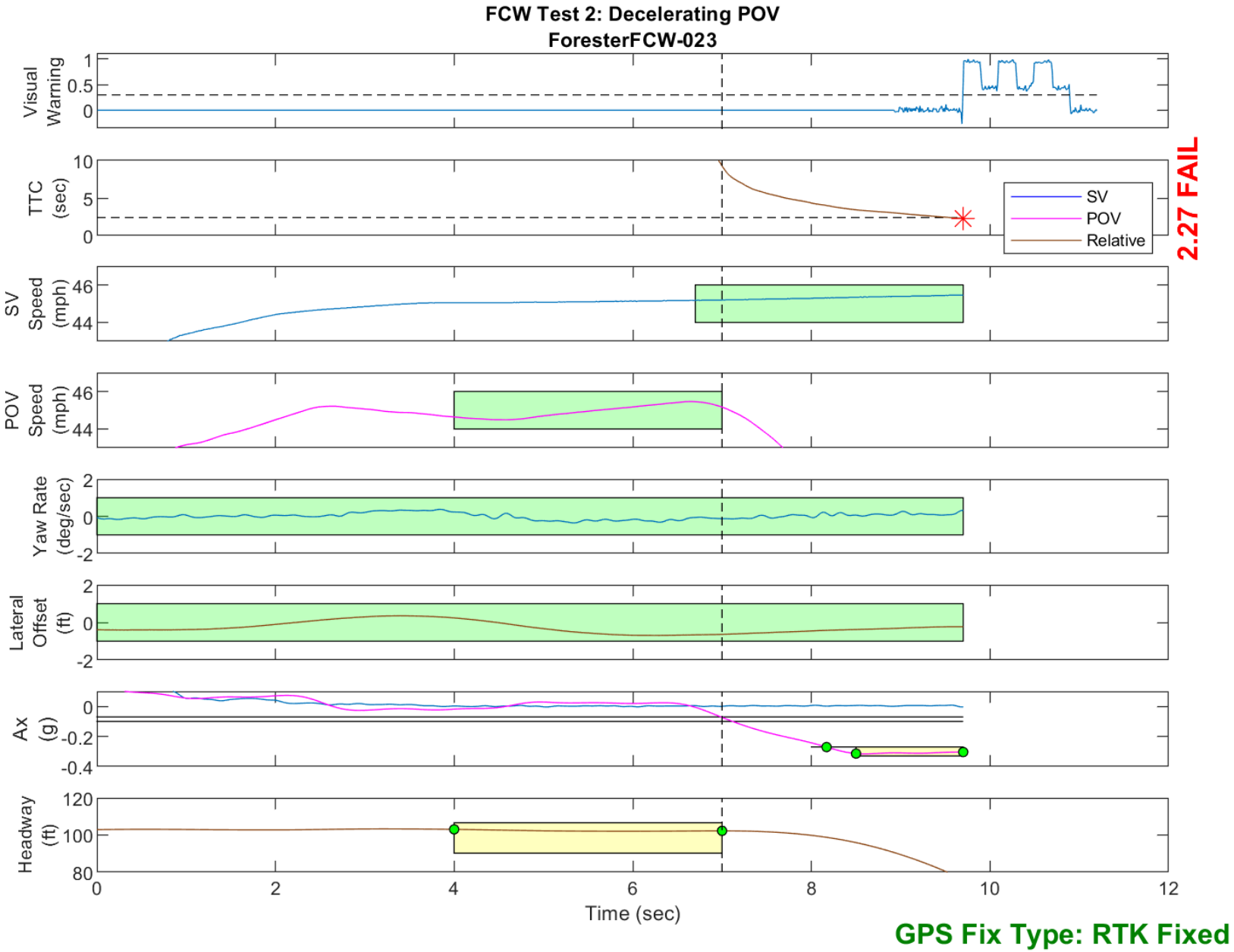


Figure D32. Time History for Run 23, Test 2 - Decelerating POV, Visual Warning

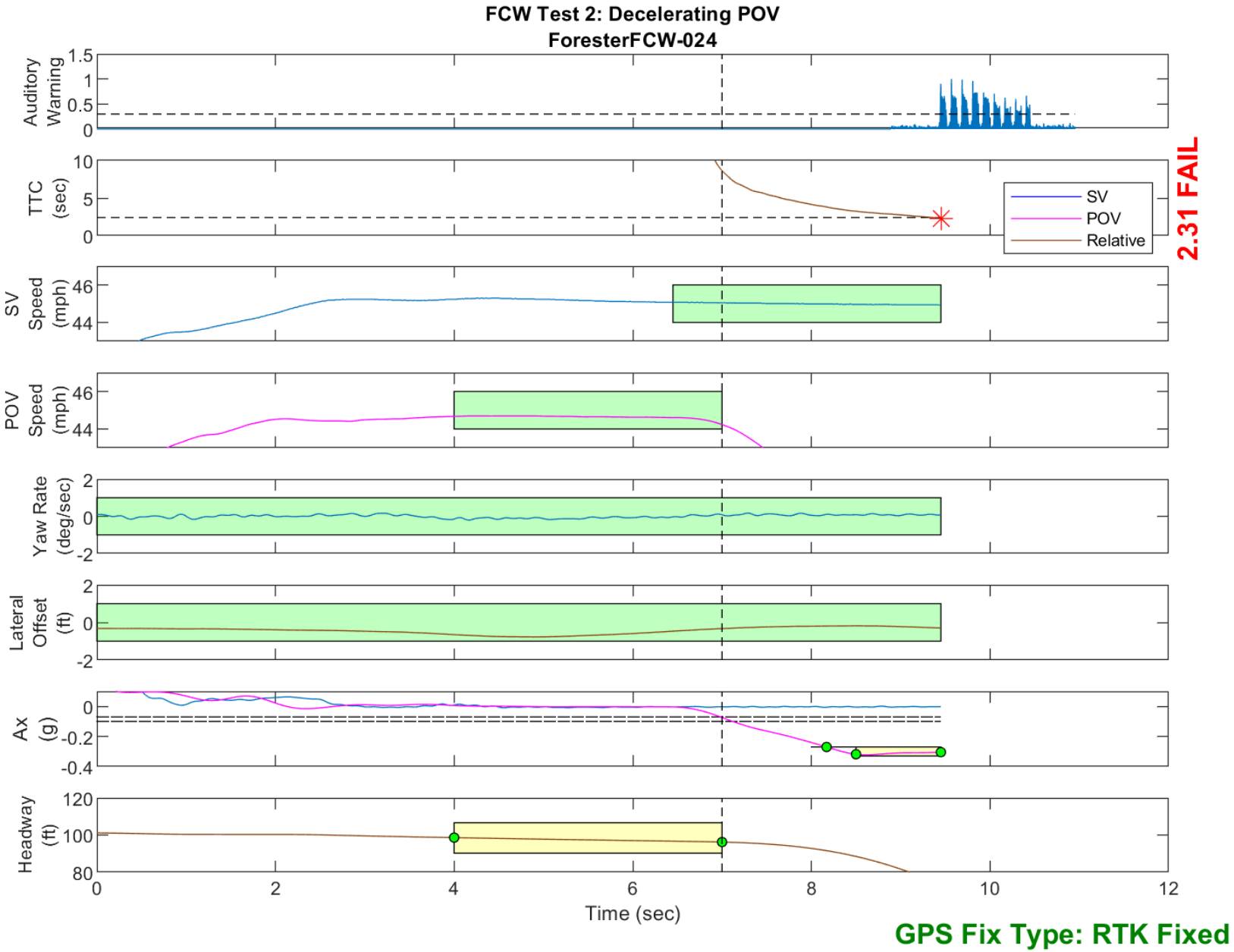


Figure D33. Time History for Run 24, Test 2 - Decelerating POV, Auditory Warning

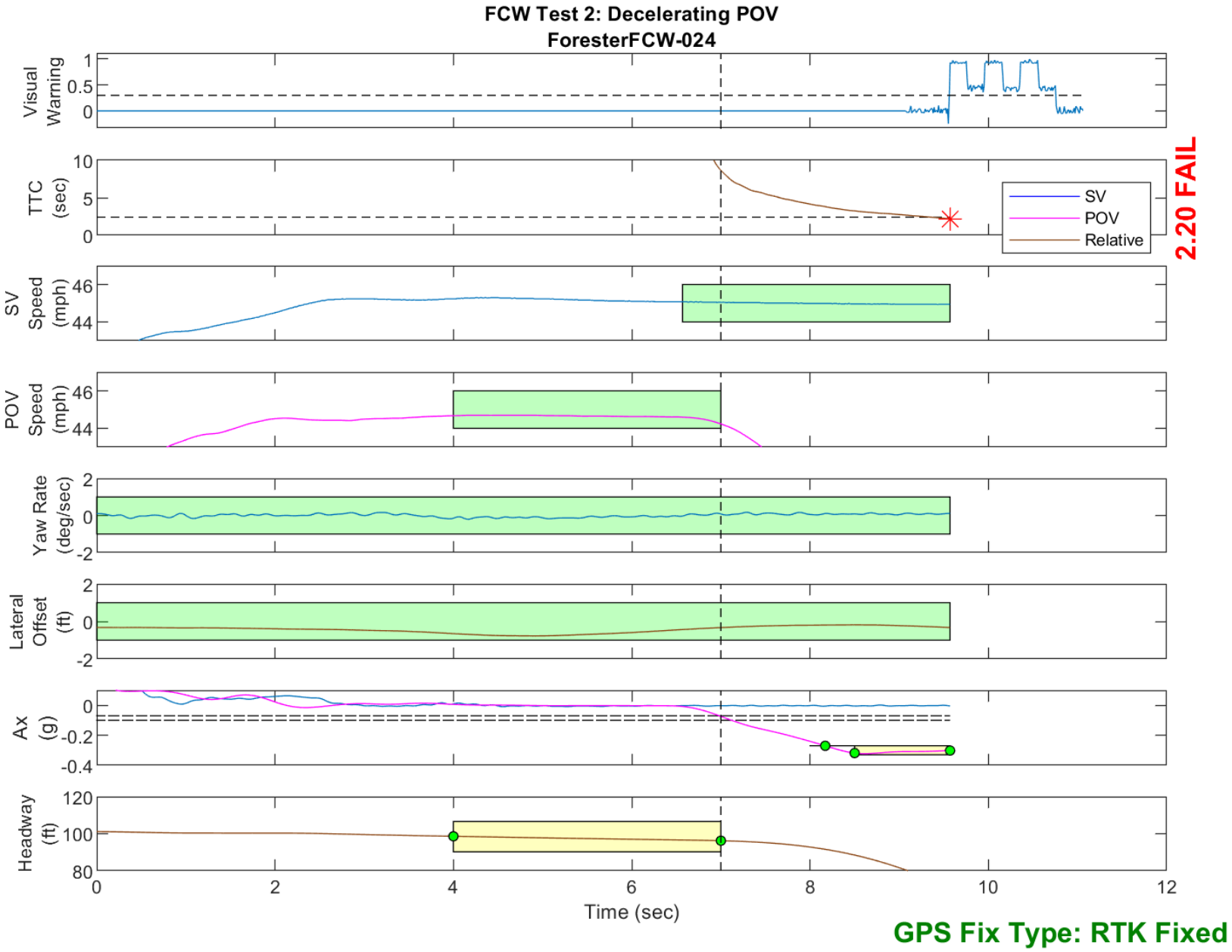


Figure D34. Time History for Run 24, Test 2 - Decelerating POV, Visual Warning

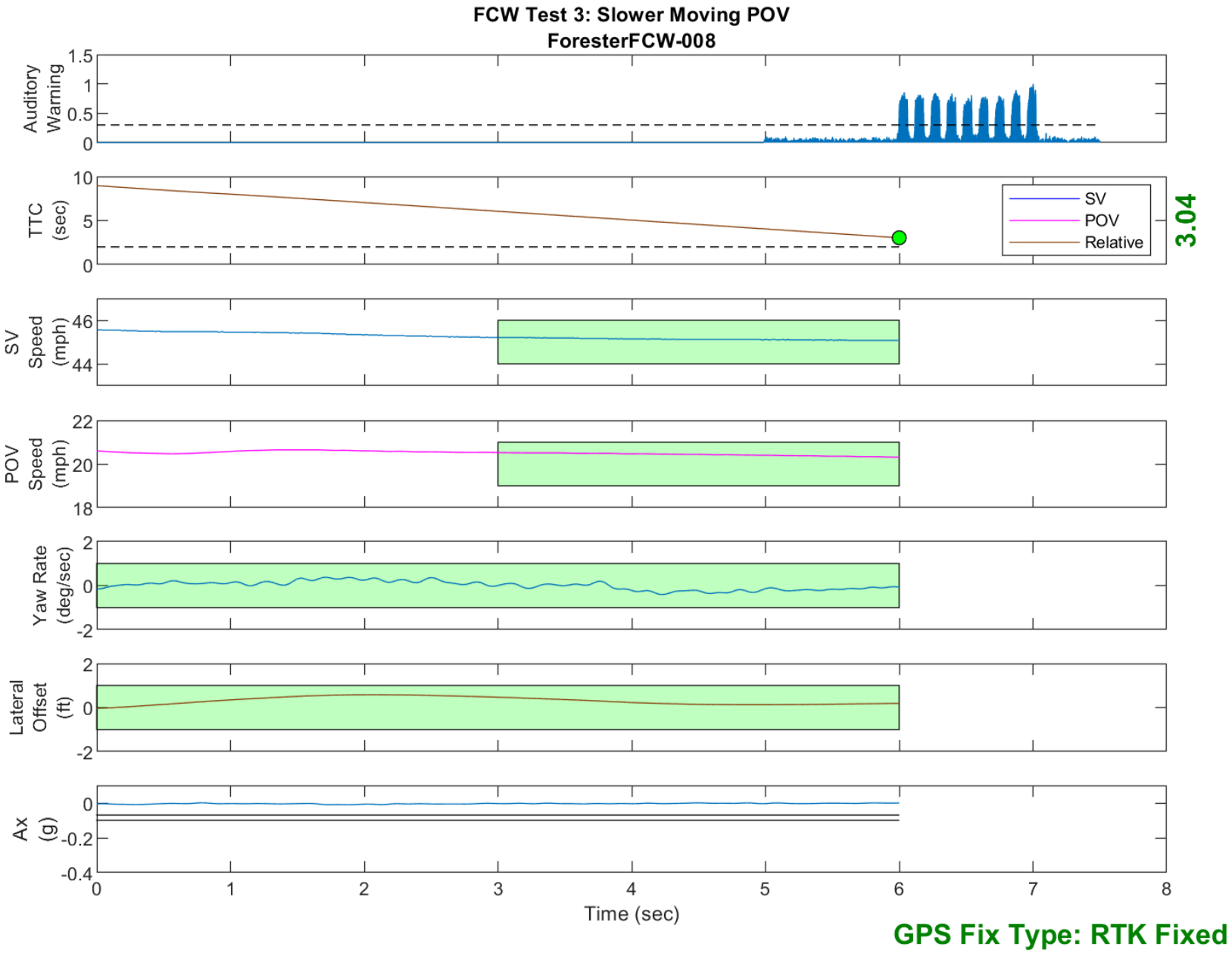


Figure D35. Time History for Run 8, Test 3 - Slower Moving POV, Auditory Warning

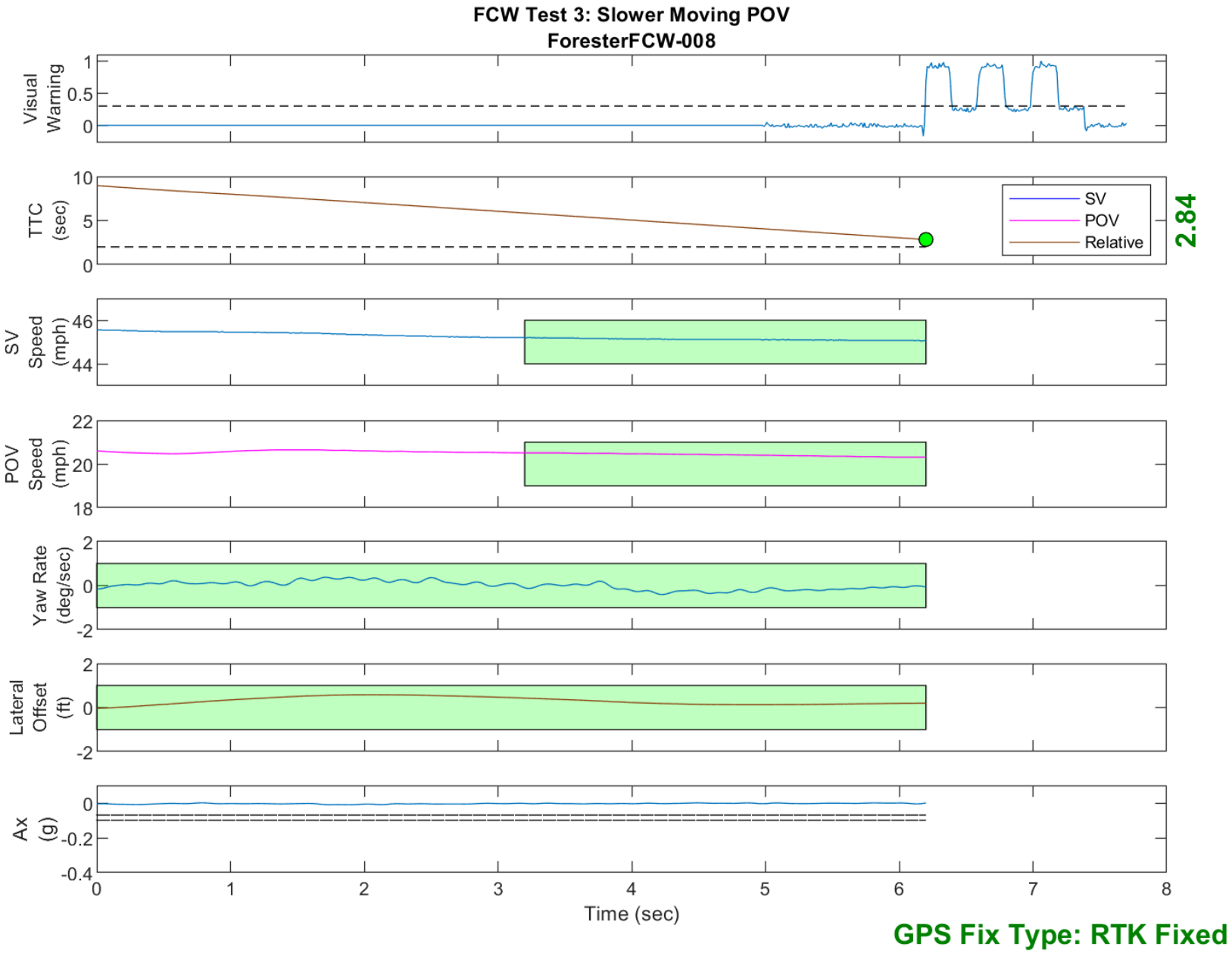


Figure D36. Time History for Run 8, Test 3 - Slower Moving POV, Visual Warning

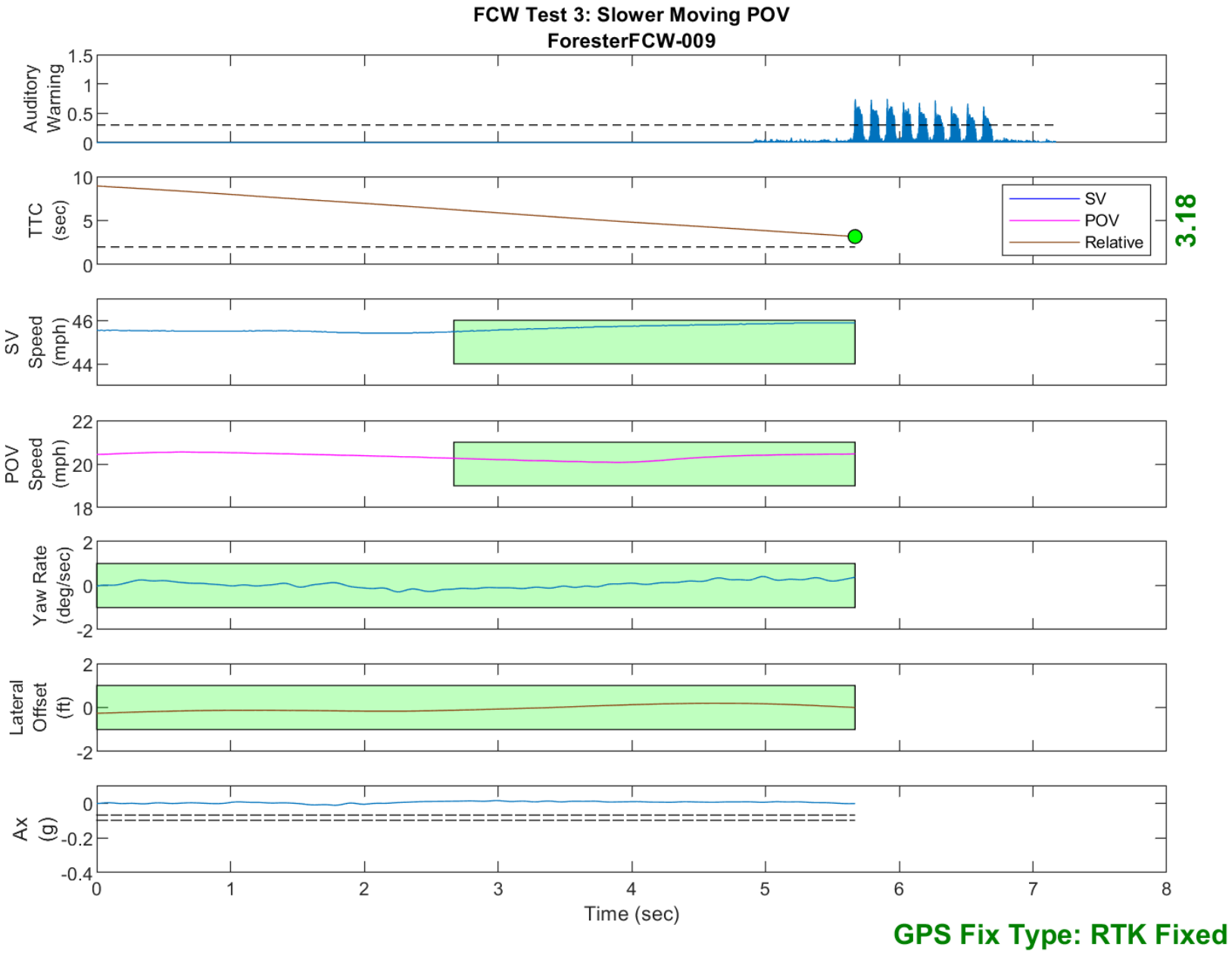


Figure D37. Time History for Run 9, Test 3 - Slower Moving POV, Auditory Warning

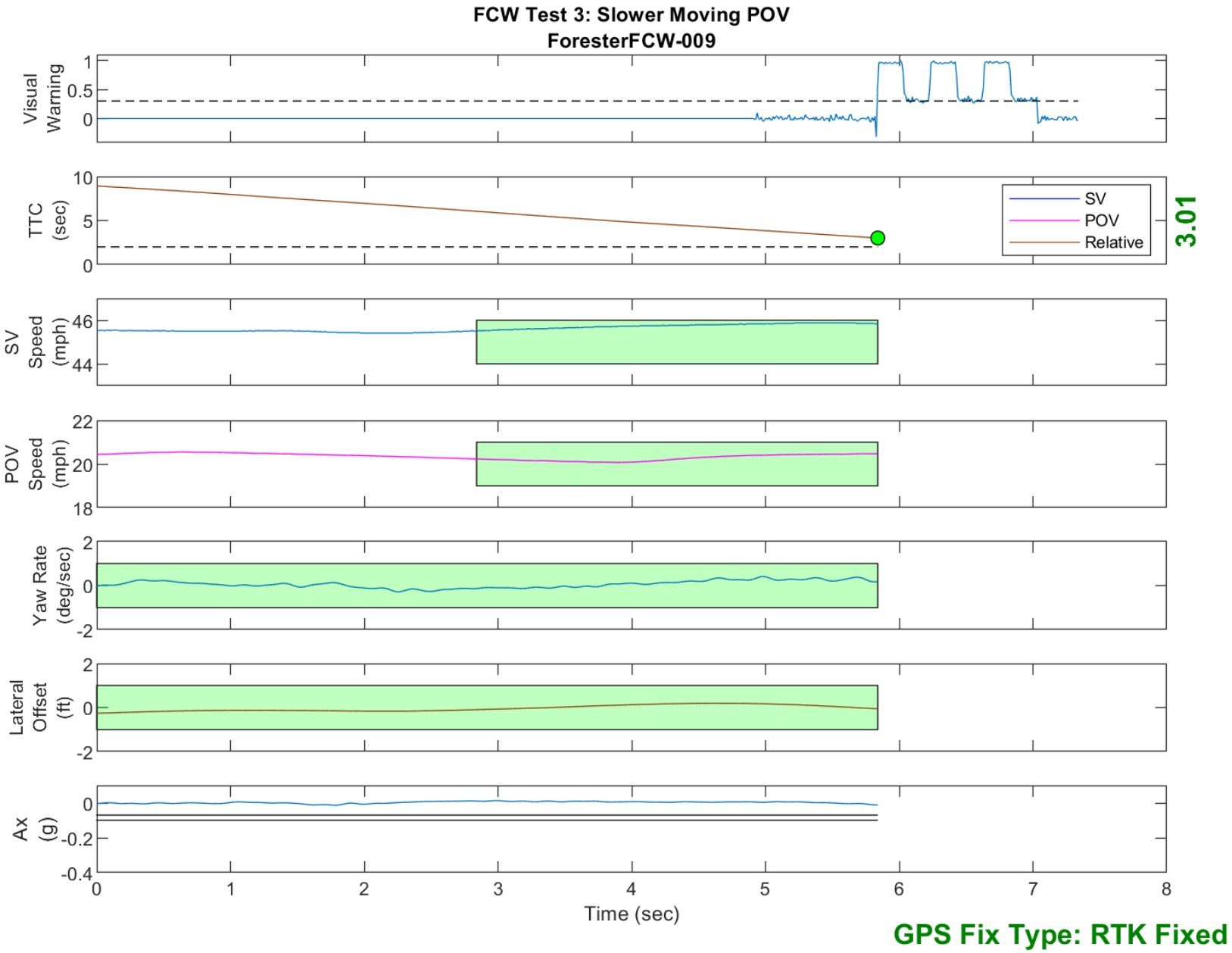


Figure D38. Time History for Run 9, Test 3 - Slower Moving POV, Visual Warning

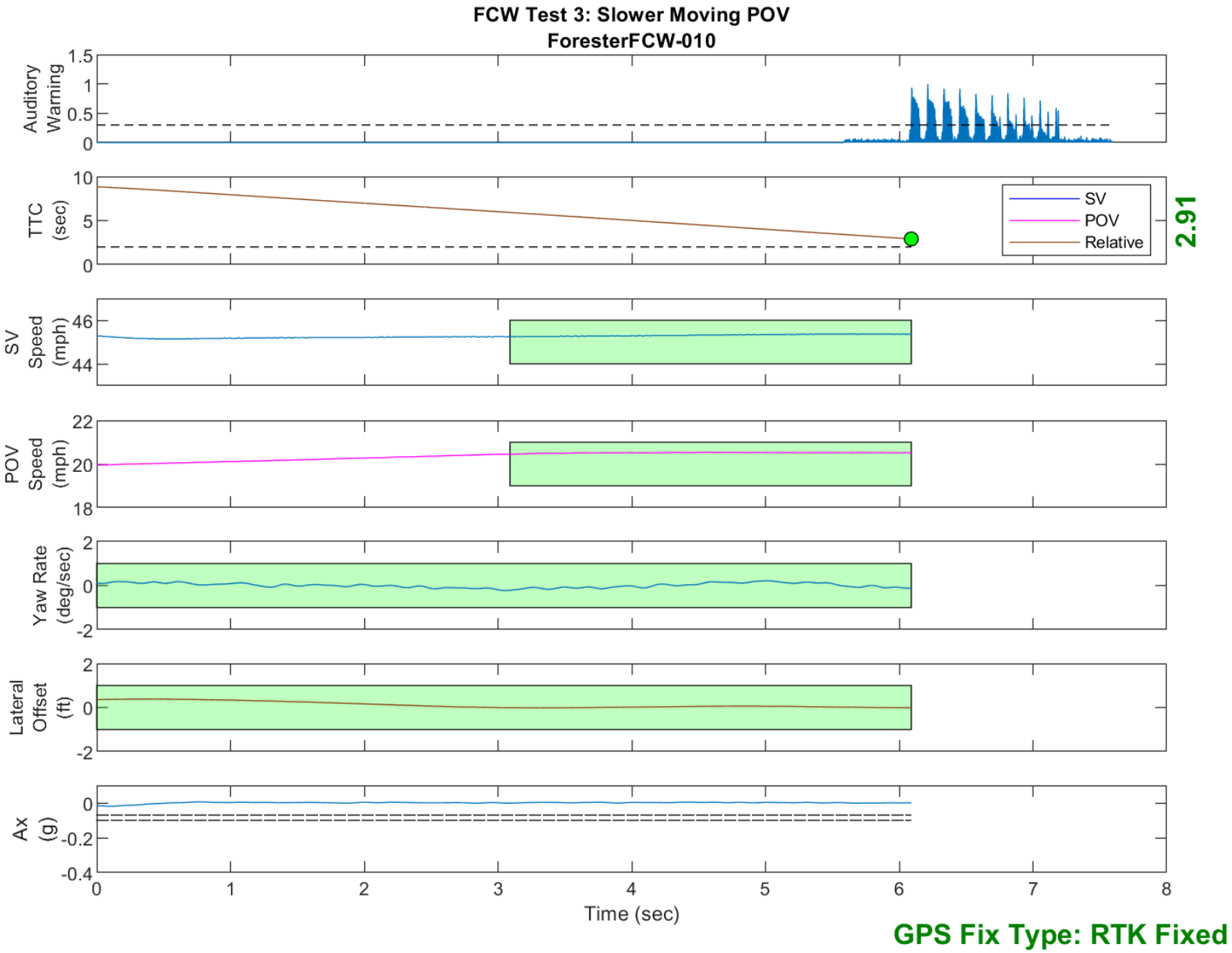


Figure D39. Time History for Run 10, Test 3 - Slower Moving POV, Auditory Warning

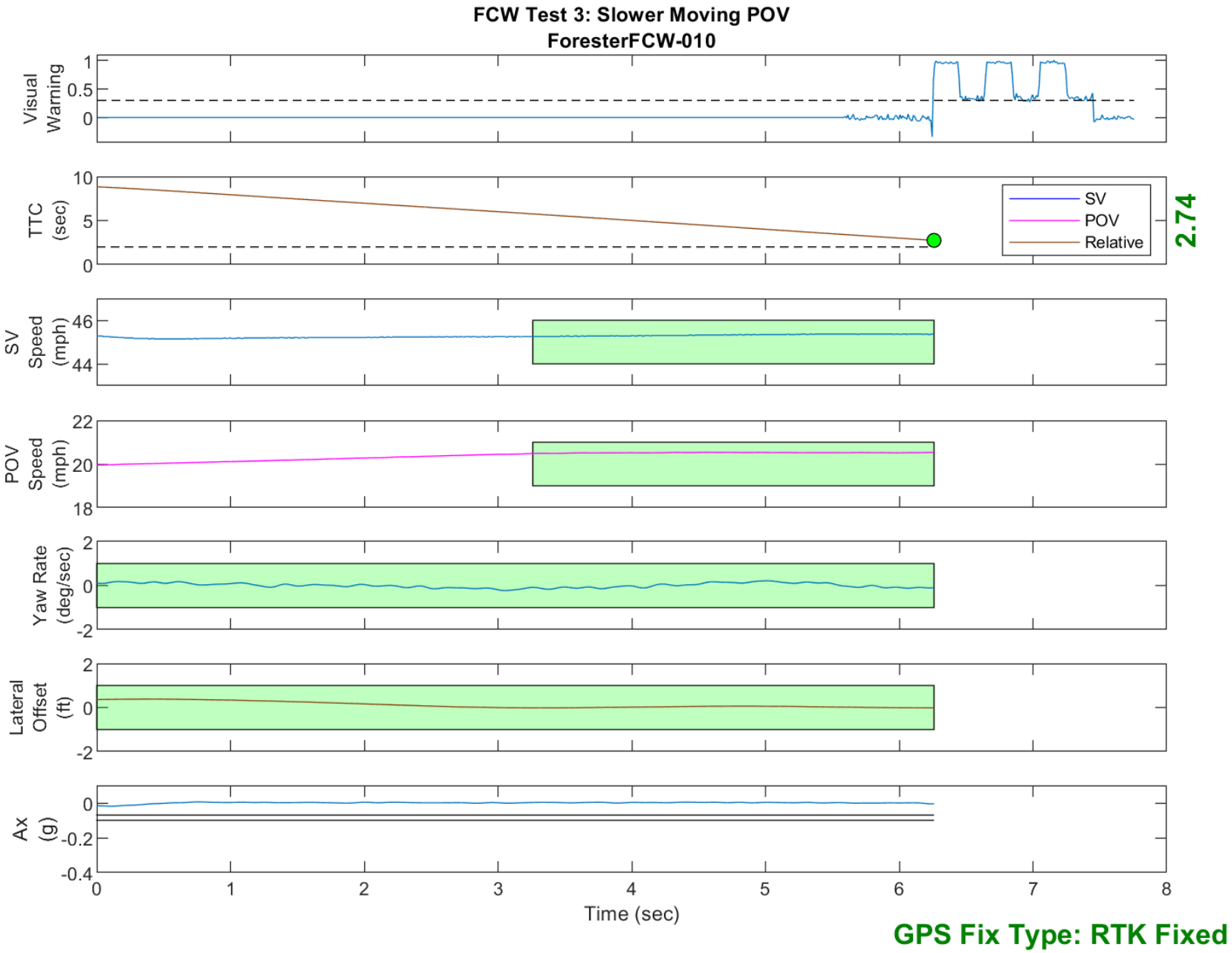


Figure D40. Time History for Run 10, Test 3 - Slower Moving POV, Visual Warning

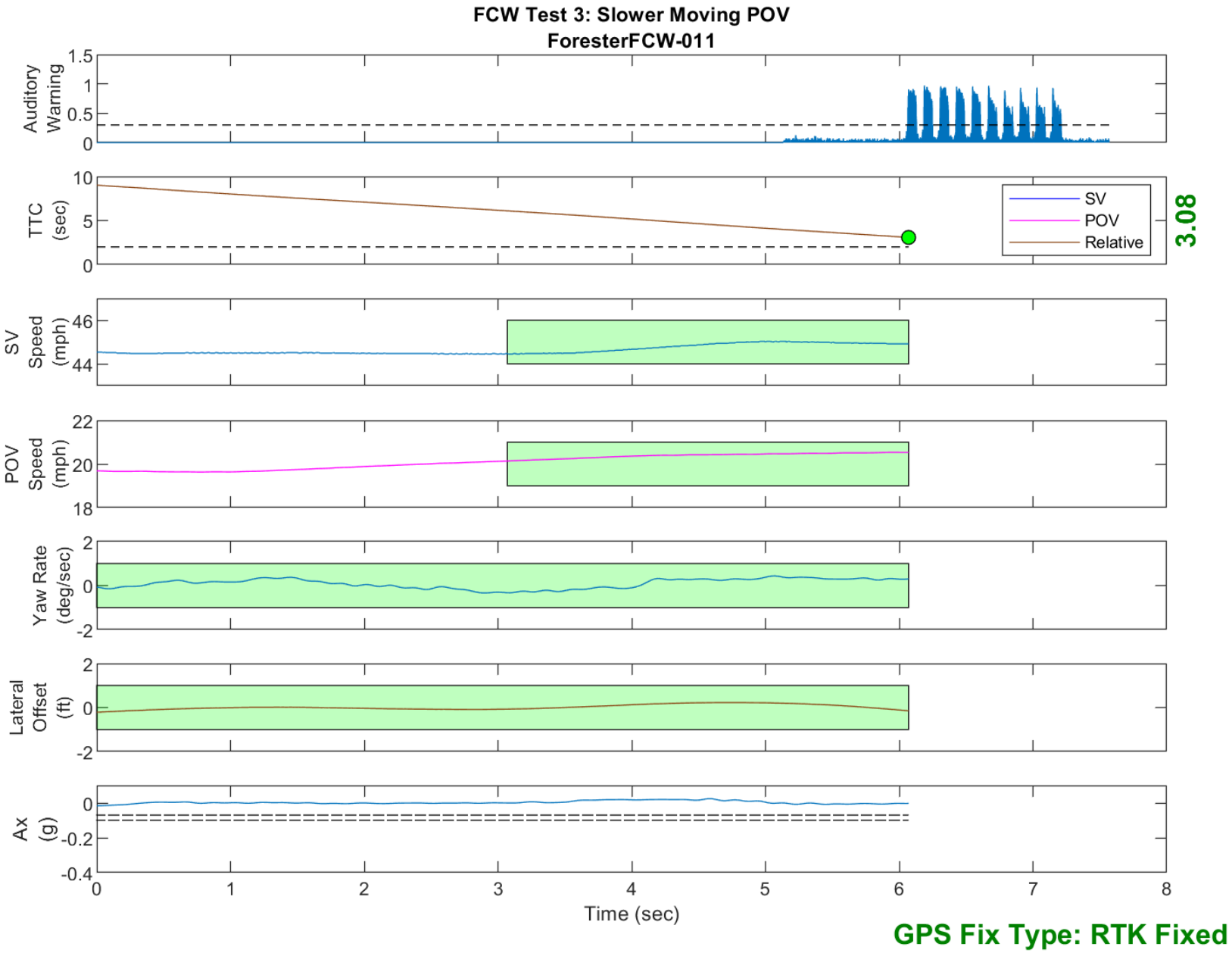


Figure D41. Time History for Run 11, Test 3 - Slower Moving POV, Auditory Warning

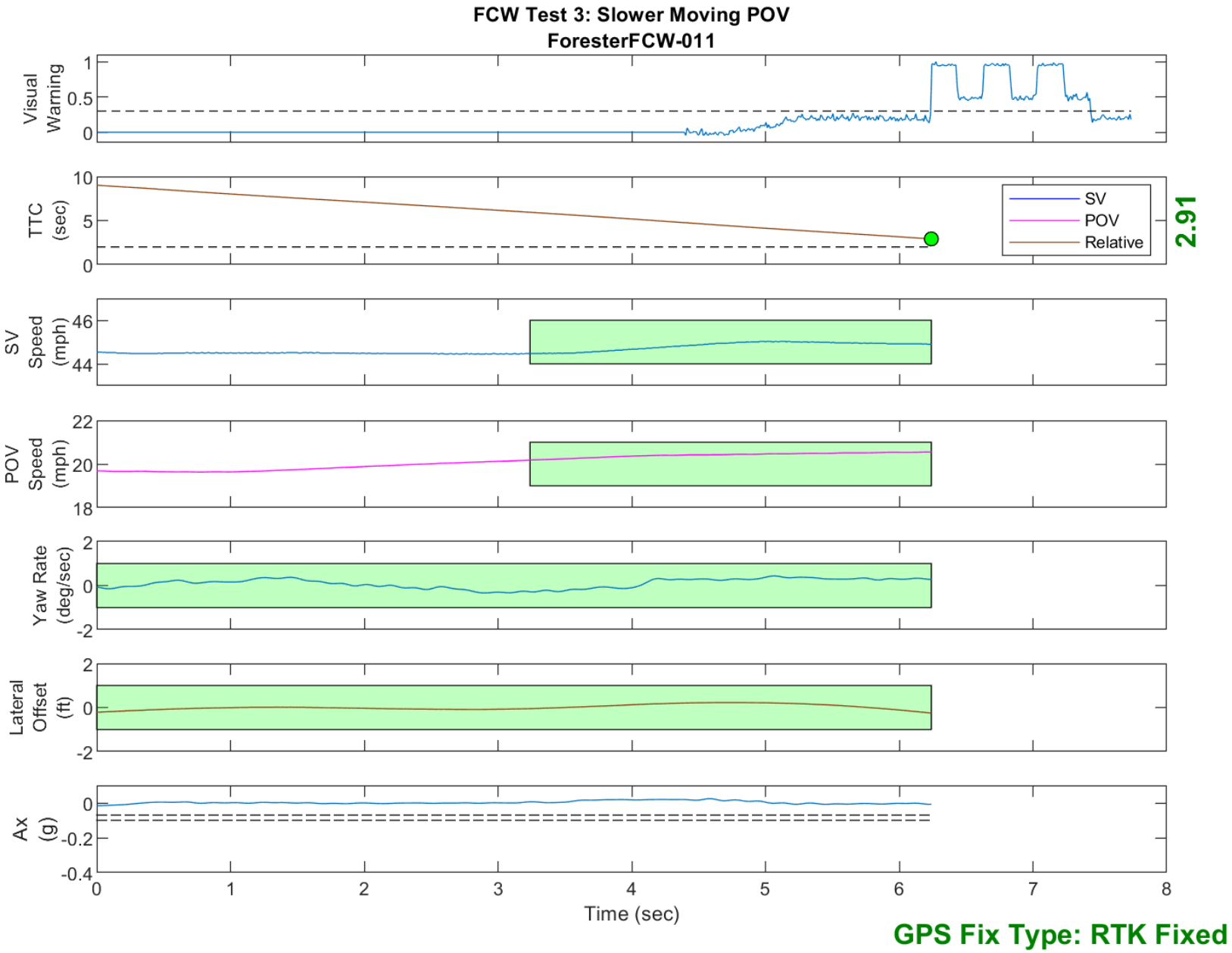


Figure D42. Time History for Run 11, Test 3 - Slower Moving POV, Visual Warning

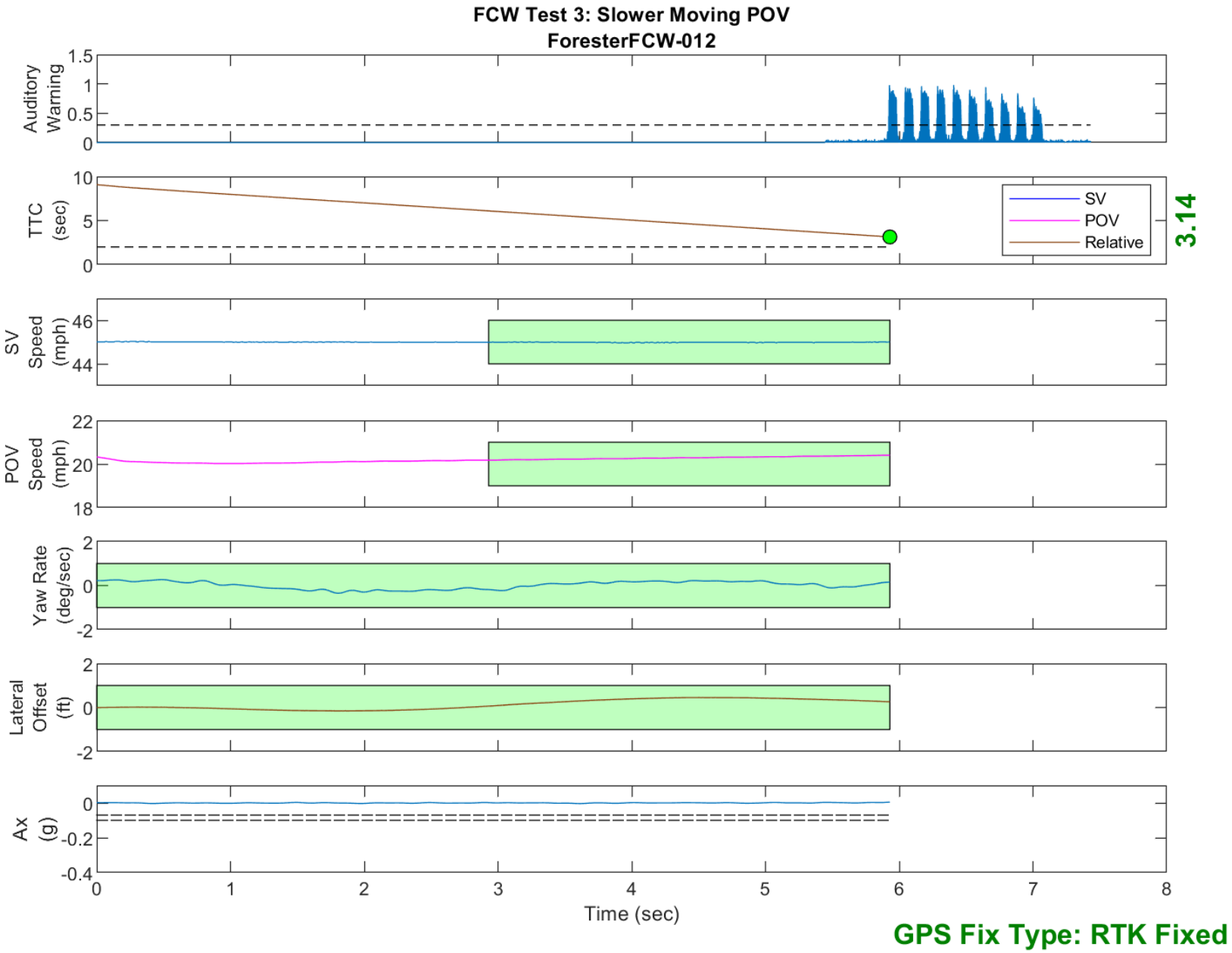


Figure D43. Time History for Run 12, Test 3 - Slower Moving POV, Auditory Warning

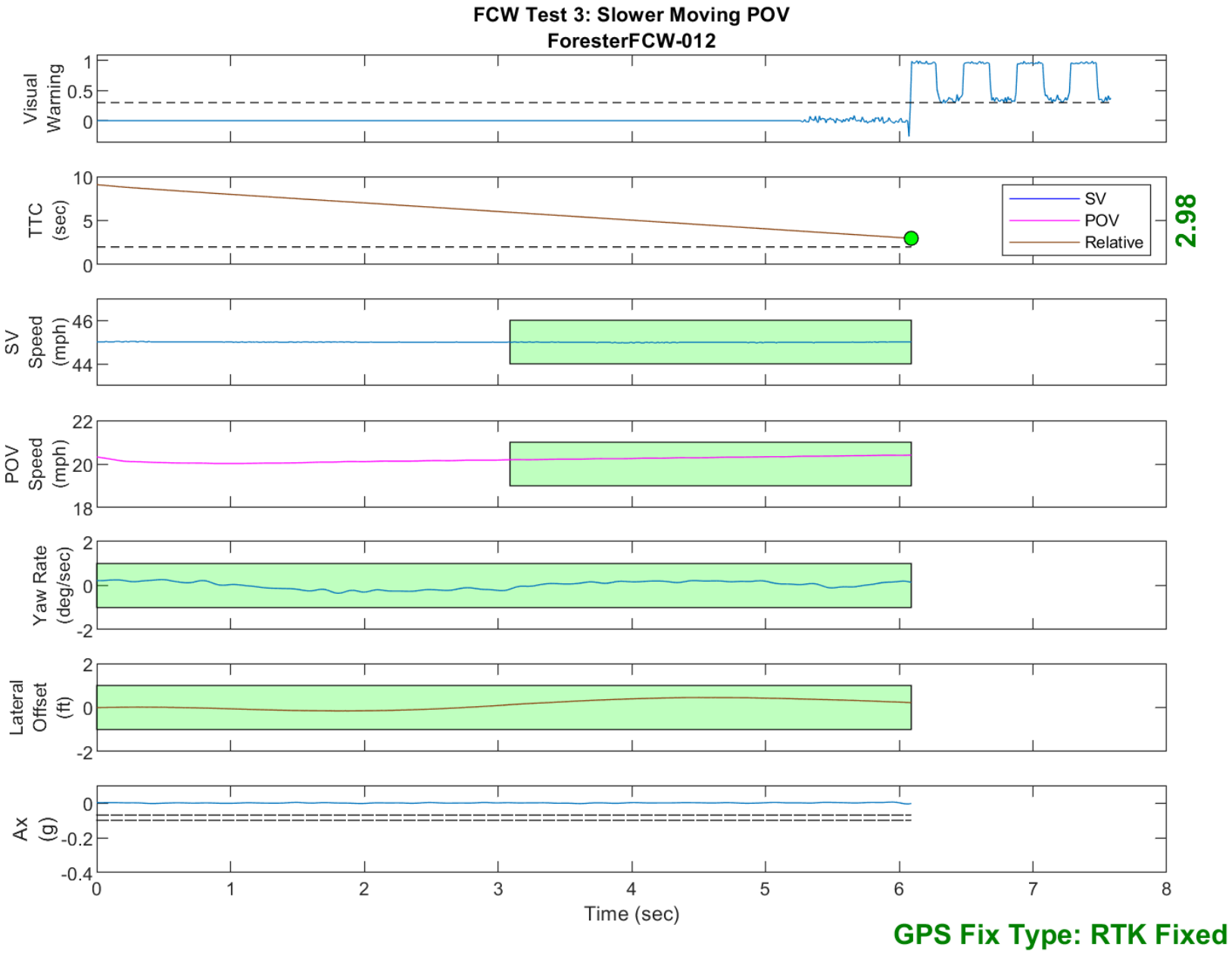


Figure D44. Time History for Run 12, Test 3 - Slower Moving POV, Visual Warning

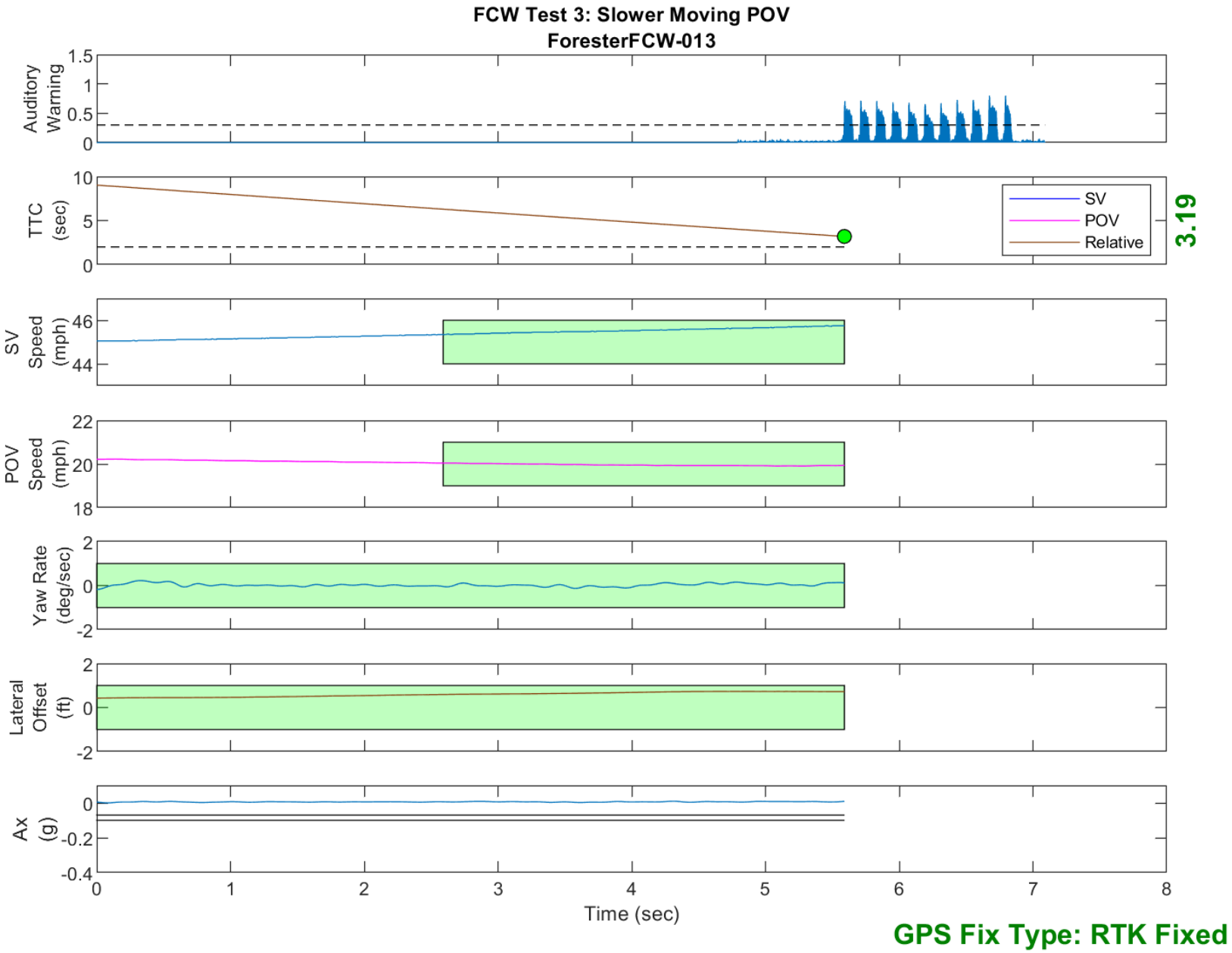


Figure D45. Time History for Run 13, Test 3 - Slower Moving POV, Auditory Warning

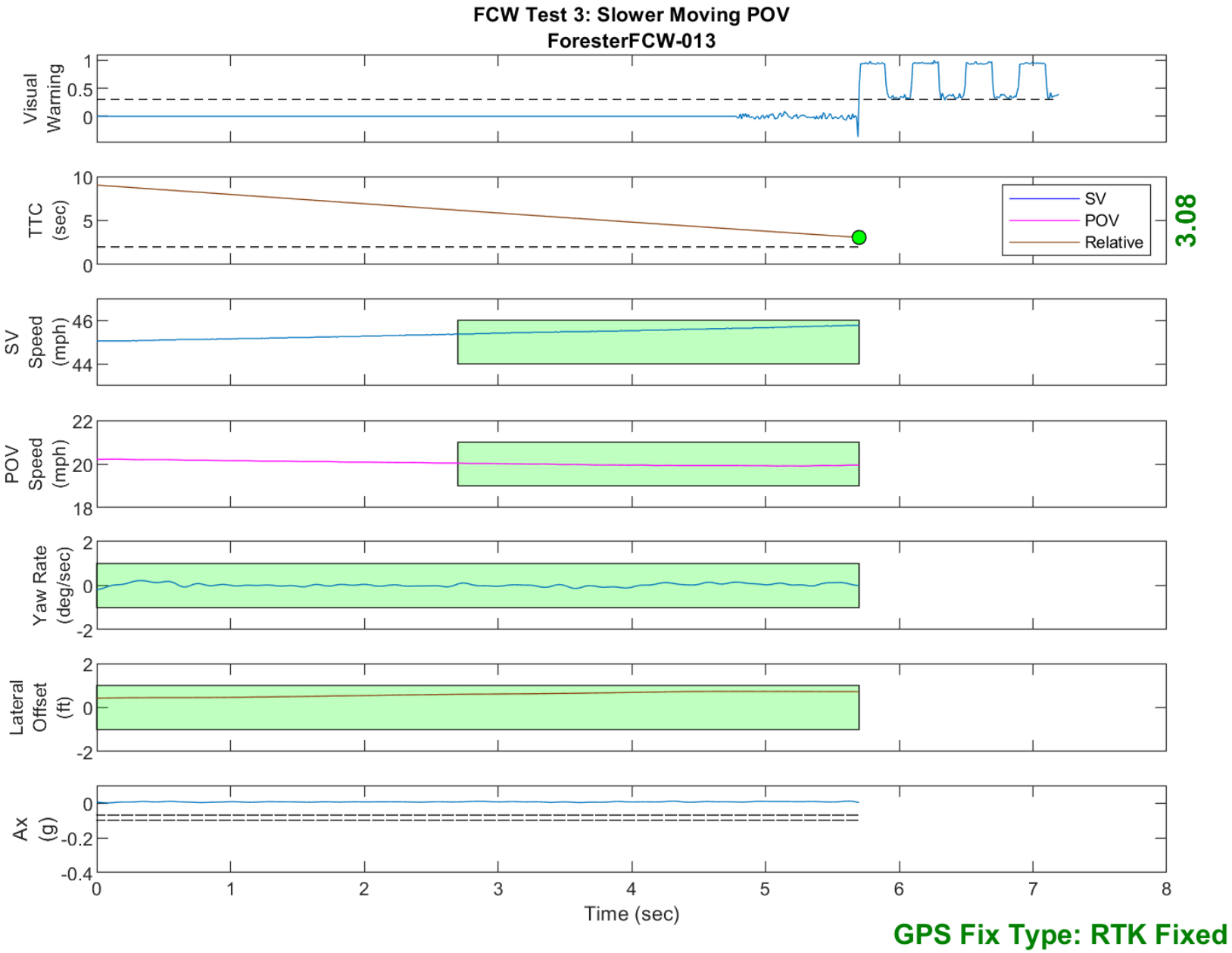


Figure D46. Time History for Run 13, Test 3 - Slower Moving POV, Visual Warning

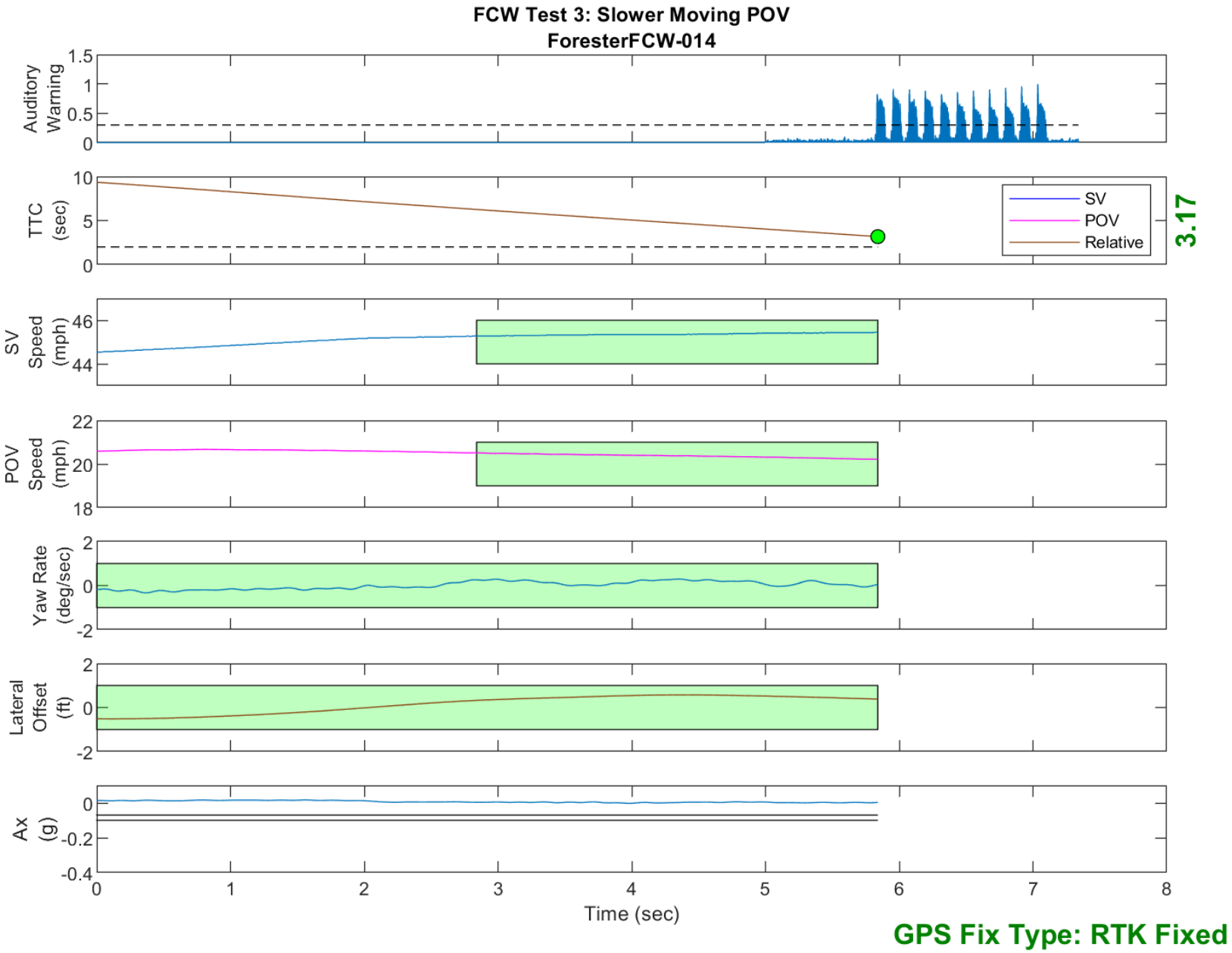


Figure D47. Time History for Run 14, Test 3 - Slower Moving POV, Auditory Warning

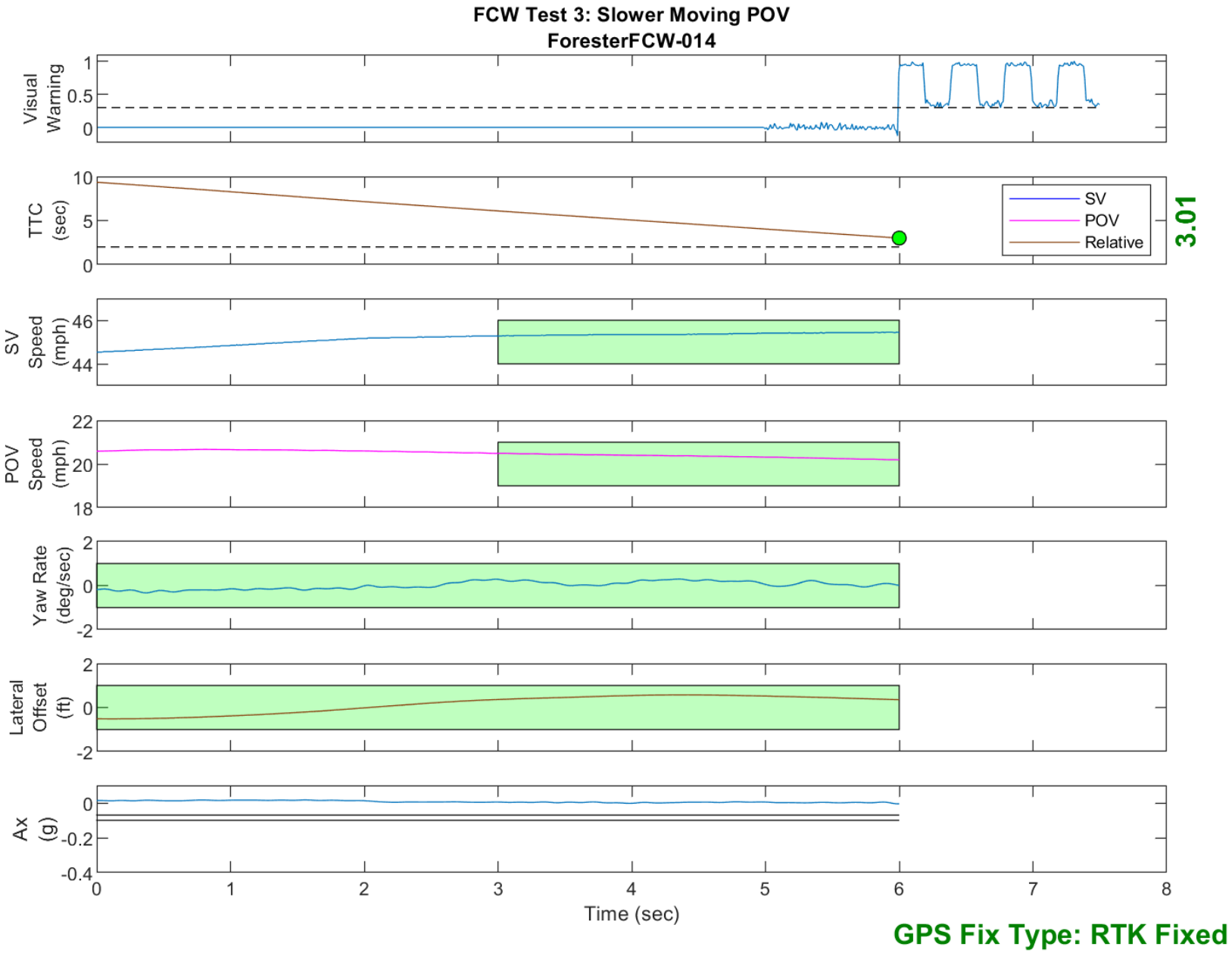


Figure D48. Time History for Run 14, Test 3 - Slower Moving POV, Visual Warning