NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST
NCAP-DRI-FCW-20-18

2020 Subaru Outback Premium/LDD

DYNAMIC RESEARCH, INC.
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11 June 2020

Final 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 2020 Subaru Outback Premium/LDD in accordance with the specifications of the New Car Assessment Program's (NCAP) 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 principle 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

(Page 1 of 1)

2020 Subaru Outback Premium/LDD

VIN: *4S4BTACC3L319xxxx*

Test Date: *5/27/2020*

Forward Collision Warning setting: *Pre-Collision Braking On*

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)

2020 Subaru Outback Premium/LDD

TEST VEHICLE INFORMATION

VIN: *4S4BTACC3L319xxxx*

Body Style: *SUV* Color: *Magnetite Gray Metallic*

Date Received: *5/14/2020* Odometer Reading: *114 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Subaru Corporation*

Date of manufacture: *2/20*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *225/65R17*

Rear: *225/65R17*

Recommended cold tire pressure: Front: *240 kPa (35 psi)*

Rear: *230 kPa (33 psi)*

TIRES

Tire manufacturer and model: *Yokohama Avid GT*

Front tire specification: *225/65R17 102H*

Rear tire specification: *225/65R17 102H*

Front tire DOT prefix: *4UF5 6JK*

Rear tire DOT prefix: *4UF5 6JK*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Subaru Outback Premium/LDD

GENERAL INFORMATION

Test date: *5/27/2020*

AMBIENT CONDITIONS

Air temperature: *37.2 C (99 F)*

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

X Wind speed ≤ 10 m/s (22 mph).

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

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

VEHICLE PREPARATION

Verify the following:

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

Fuel tank is full: **X**

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

Front: *240 kPa (35 psi)*

Rear: *230 kPa (33 psi)*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2020 Subaru Outback Premium/LDD

WEIGHT

Weight of vehicle as tested including driver and instrumentation:

Left Front:	*518.9 kg (1144 lb)*	Right Front:	*474.9 kg (1047 lb)*
Left Rear:	*400.1 kg (882 lb)*	Right Rear:	*378.3 kg (834 lb)*
		Total:	*1772.2 kg (3907 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2020 Subaru Outback Premium/LDD

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

The window sticker refers to the option as Driver-Assist System w/Automatic Emergency Braking. Throughout the Eyesight Owner's Manual, the system is referred to a Pre-Collision Braking System, and is a sub-function of Eyesight.

Forward Collision Warning Setting used in test: *Pre-Collision Braking On*

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

Stereo cameras located behind the windshield near the rearview mirror.

How is the Forward Collision Warning 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.

The visual alert alternates between two graphics, shown in Appendix A, Figure A14. The auditory alert is a tone centered at 2200 HZ and pulsed approximately 8 times per second.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2020 Subaru Outback Premium/LDD

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.

System settings are accessed by means of a touch screen center screen. The hierarchy is:

Settings

Driver Assistance

Pre-Collision Braking

Select: Setting On or Setting Off

The system is automatically reactivated after cycling the ignition.

Please see EyeSight Owner's Manual, Pages 126 and 127. These are shown in Appendix B, Pages B-33 and B-34. See also Appendix A, Figure A13.

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.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2020 Subaru Outback Premium/LDD

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.

Limitations of the system are addressed at length in the EyeSight Owner's Manual, Pages 5 through 9 and Pages 27 through 31. These are shown in Appendix B, Pages B-2 through B-6 and Pages B-17 through B-21.

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

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

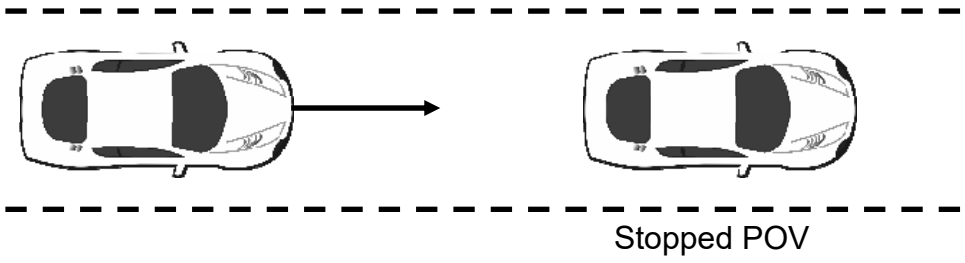


Figure 1. Depiction of Test 1

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.

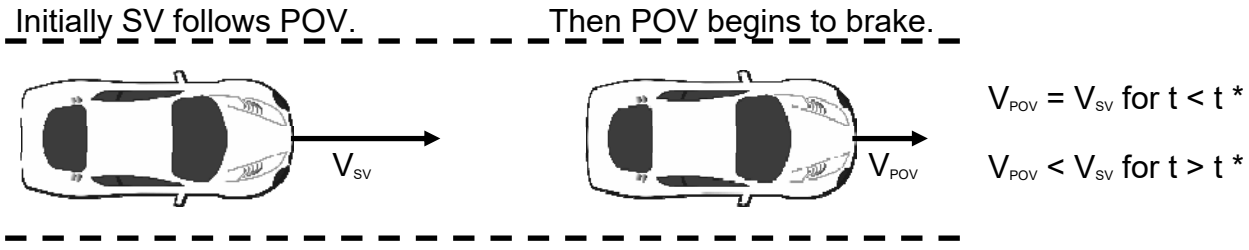


Figure 2. Depiction of Test 2

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 ±0.03g, 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).

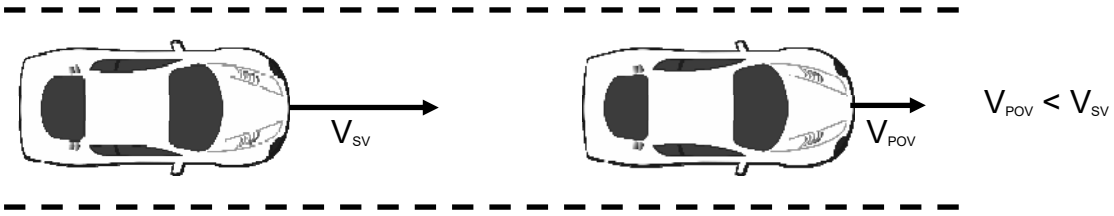


Figure 3. Depiction of Test 3

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:

- High pressure nitrogen bottle, strapped to the front passenger seat, with regulator and pressure gauges
- Pneumatic piston-type actuator, with solenoid valve
- “Pickle” switch to activate brakes

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	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
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
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Accels ± 10g, Angular Rate ±100 deg/s, Angle >45 deg, Velocity >200 km/h	Accels .01g, Angular Rate 0.05 deg/s, Angle 0.05 deg, Velocity 0.1 km/h	Oxford Inertial +	2258	By: Oxford Technical Solutions Date: 5/3/2019 Due: 5/3/2021
					2182	Date: 9/16/2019 Due: 9/16/2021
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec Longitudinal Range to POV: ±200 m Longitudinal Range Rate: ±50 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec Longitudinal Range: ±3 cm Longitudinal Range Rate: ±0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	NA

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	NA	NA
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	NA	NA
Accelerometer	Acceleration (to measure time at haptic alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	NA	NA
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

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 audible or haptic alerts, part of the pre-test instrumentation verification process is 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 is accomplished in order to identify the center frequency around which a band-pass filter is 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 is a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 2.

Table 2. Audible and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Passband Frequency Range
Audible	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

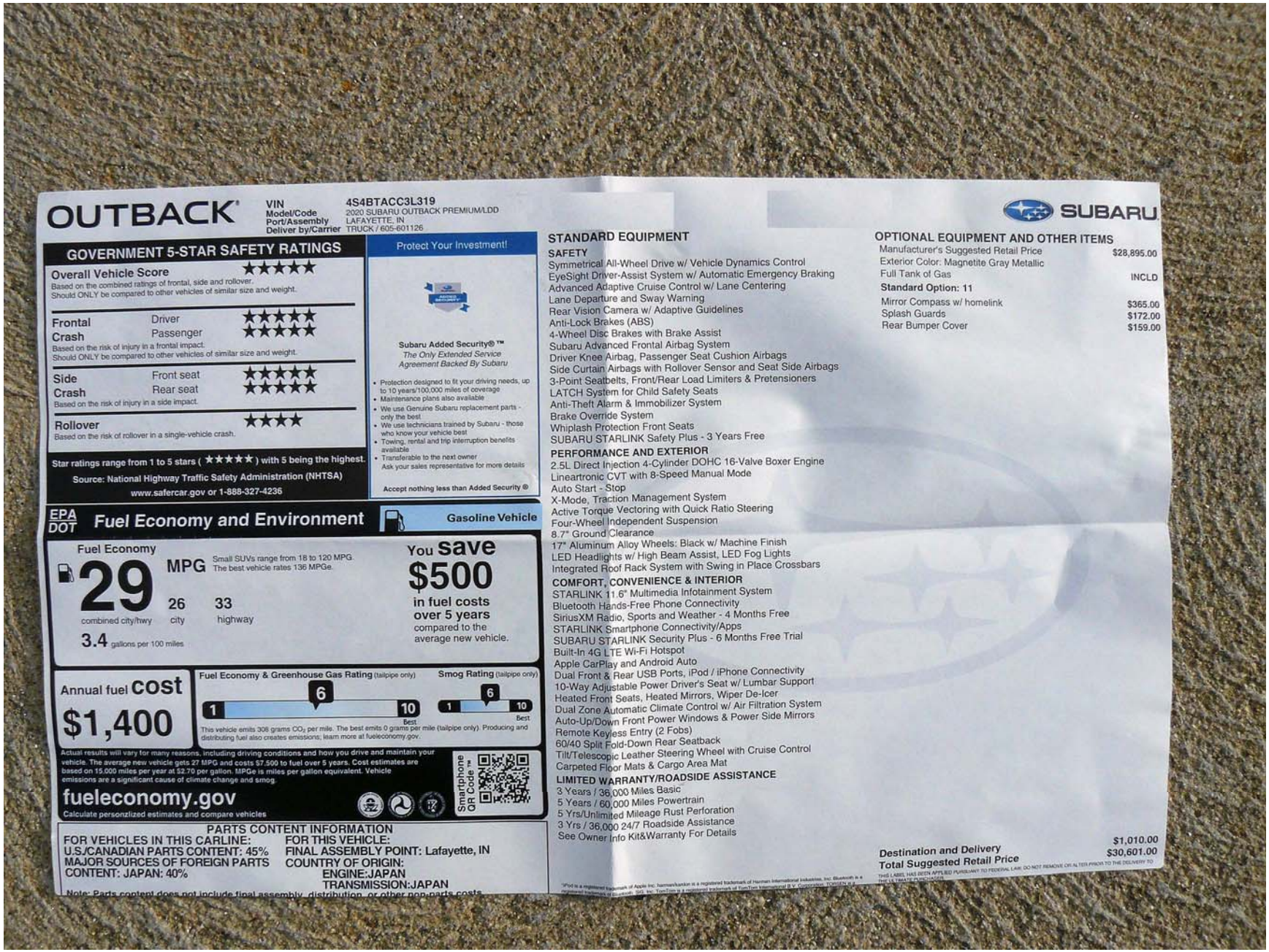


Figure A3. Window Sticker (Monroney Label)

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. Sensor for Detecting Auditory Alerts

Figure A10. Sensor for Detecting Visual Alerts

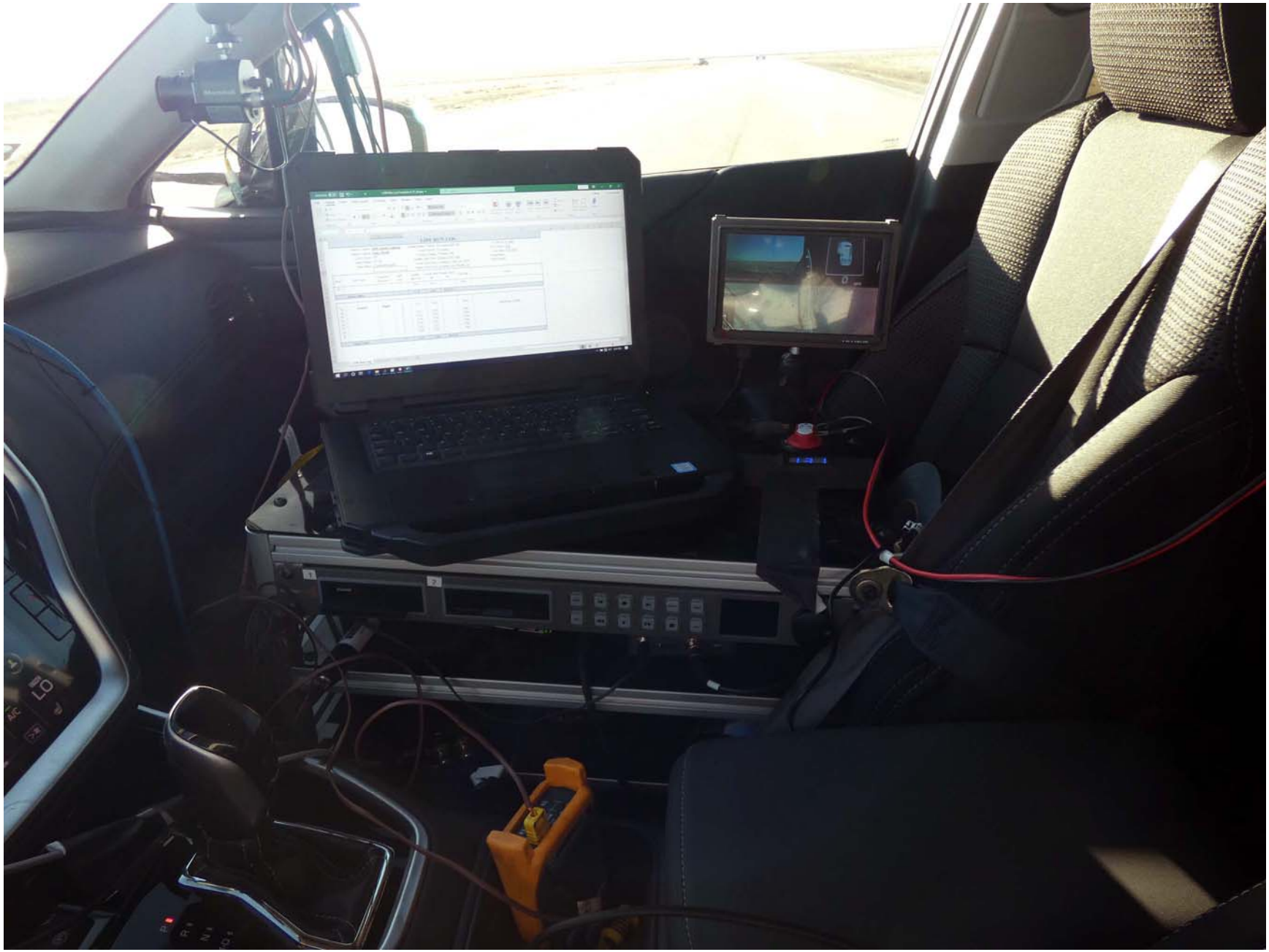


Figure A11. Computer Installed in Subject Vehicle

Figure A12. Brake Actuation System Installed in Principal Other Vehicle

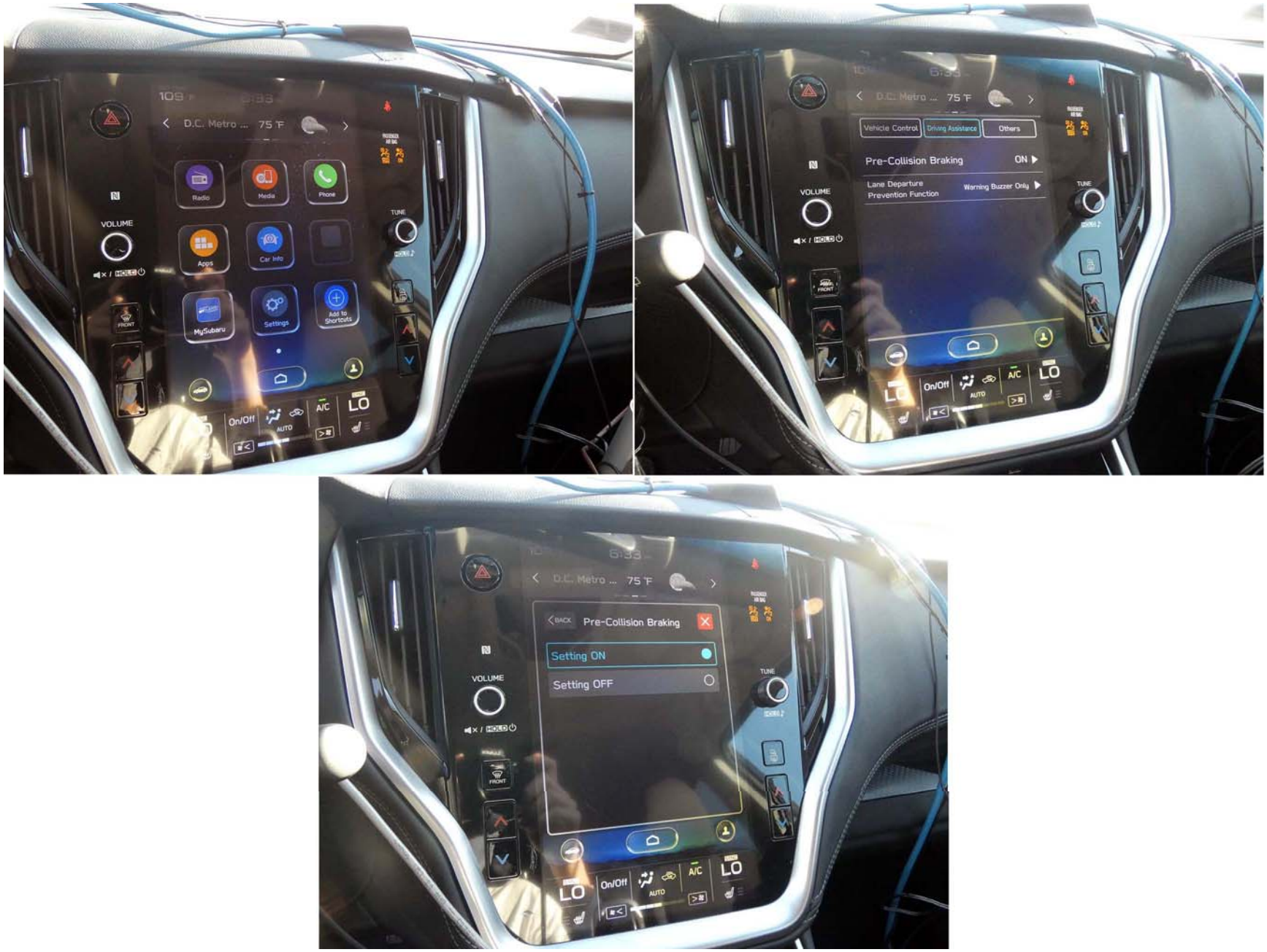


Figure A13. System Setting Menus

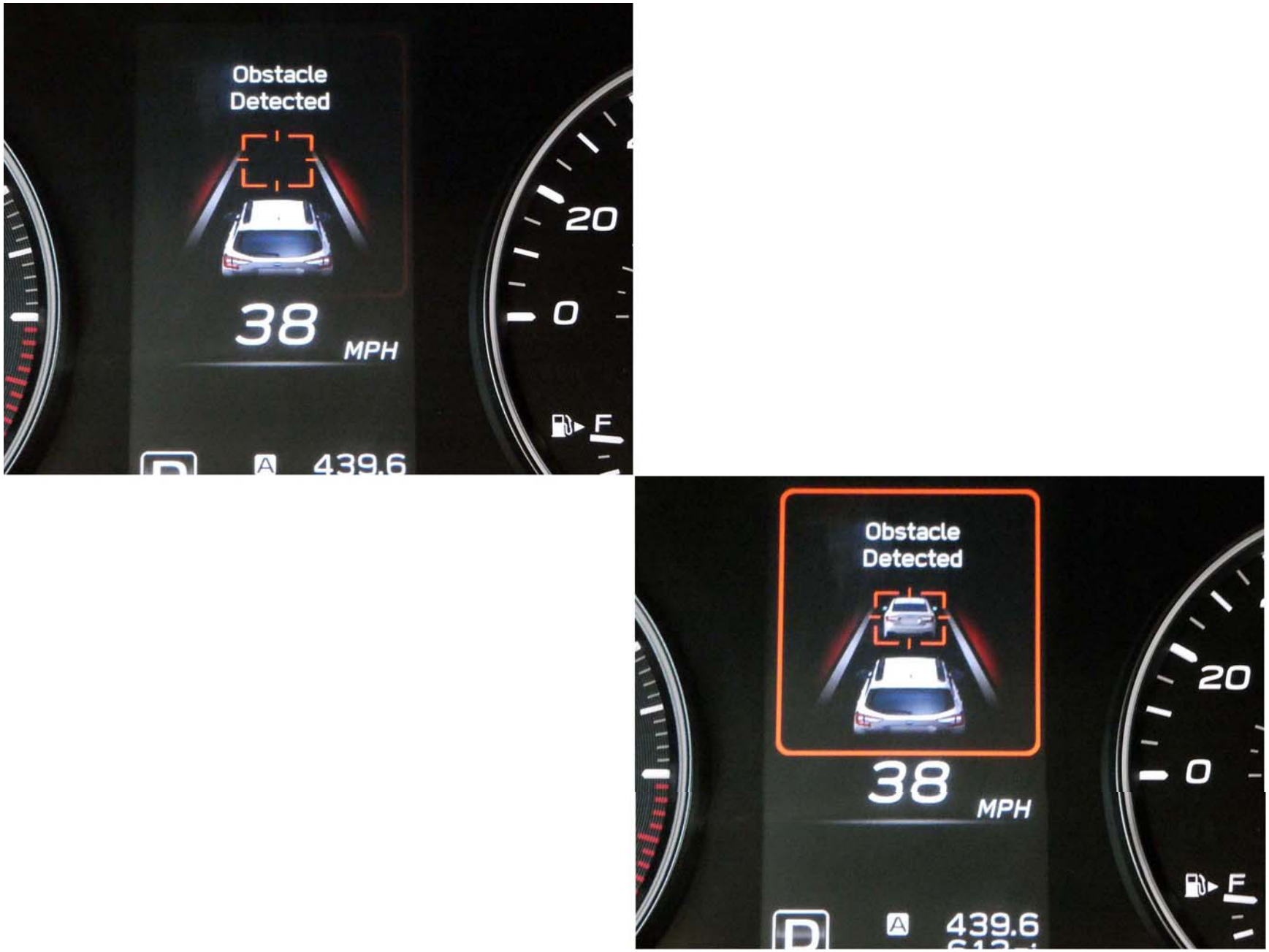


Figure A14. FCW Visual Alerts

APPENDIX B

Excerpts from Owner’s Manual

In LHD vehicles, EyeSight is configured for driving on the right-hand side of the road. However, it can be reconfigured by changing the Driving Lane Customize setting for driving on the left-hand side.*
⇒ **Page 126**
If the setting for the traffic lane (driving side of the road) does not match the traffic lane, full EyeSight performance may not be available.
***: Characteristics and settings that are affected by specific differences between RHD and LHD vehicles cannot be changed.**

- The system may not operate correctly under the conditions listed below. When these conditions occur, turn off the Pre-Collision Braking System. Also, do not use Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function or Conventional Cruise Control.
  - 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 in red.[*2]
  - A heavy cargo is loaded onto or inside the vehicle.
  - 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]

Continued on next page ⇒

⇒ Continued from previous page

- The system will not operate correctly in the following conditions. Do not use Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function or Conventional Cruise Control.
  - The wheels are out of balance (e.g., the balance weight is removed or misaligned).*1
  - The wheels are out of alignment.*1
  - A trailer or another vehicle, etc. is being towed.
- The system may not operate properly under the following conditions. Do not use Lane Centering Function.
  - There is an abnormal vibration in the steering wheel or the steering wheel is heavier than usual.
  - The steering wheel has been replaced with parts other than genuine SUBARU parts.

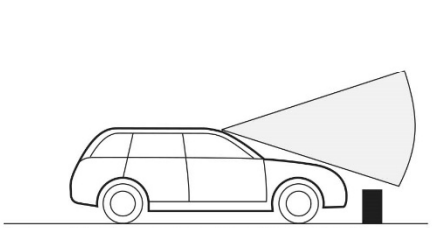
*1: The wheels and tires have functions that are critically important. Be sure to use the correct ones. For details, refer to the Owner's Manual for your vehicle.

*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.

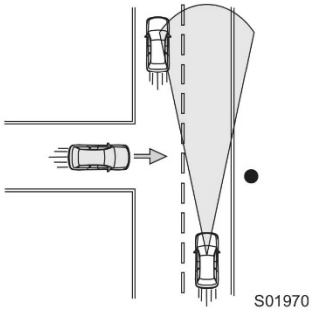
*3: For details about the combination meter, refer to the Owner's Manual for your vehicle.

CAUTION

- The characteristics of the stereo camera are similar to those of human eyes. For this reason, conditions that make it difficult for the driver to see in the forward direction have the same effect on the stereo camera. They also make it difficult for the system to detect vehicles, obstacles, and traffic lanes.
- Detection by the EyeSight system is limited to objects that are within the range of the stereo camera's field of view. Also, after an object enters the range of the camera's field of view, it may take some time for the system to detect it as a controllable target and to warn the driver.



Low objects surrounding the vehicle cannot be detected.



S01970

- Under the conditions listed below, it will become more difficult for the system to detect the vehicle in front, motorcycles, bicycles, pedestrians and obstacles on the road, and lane markers. Also, EyeSight may temporarily stop operating. However, the temporary stop will be canceled once these conditions have improved and the vehicle is driven for a short period of time.
  - Bad weather (for example heavy rain, a blizzard or thick fog). In particular, the system is more likely to temporarily stop operating when there is an oil film adhering to the windshield, a glass coating has been applied, or poorly performing wipers are used.
  - Strong light is coming from the front (sunlight or headlight beams of oncoming traffic, etc.).
  - The windshield washer is in use.
  - Raindrops, water drops, or dirt on the windshield are not wiped off sufficiently.
  - The windshield has become fogged, scratched, 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.
  - The vehicle is tilted at an extreme angle due to loaded cargo or other factors.

Continued on next page ⇒

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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.
- The stereo camera's field of view is obstructed (for example by a canoe on the roof of the vehicle).
- Through the entrance or exit of a tunnel
- The rear aspect of the vehicle in front is low, small or irregular (for example a low bed trailer, etc.).
- The obstacle is a fence, a wall or a shutter, etc. with a uniform pattern (a striped pattern, brick, etc.) or with no pattern in front.
- The obstacle is a wall or door made of glass or a mirror in front.
- Driving at night or in a tunnel when there is a vehicle in front that does not have its taillights on
- Driving through a banner or flag, low branches on a tree or thick/tall vegetation
- On steep uphill or downhill grades
- The stereo camera is obstructed by a hand, etc. (If even one of the lenses is obstructed, the system does not operate properly.)
- It is completely dark and no objects are detected.
- The area around the vehicle has a uniform color (such as when completely covered in snow, etc.).
- Accurate detection is not possible due to reflections in the windshield.

• Under the conditions listed below, EyeSight may temporarily stop operating. If this occurs, EyeSight will resume operating when the conditions improve.
- The temperature inside the vehicle is high, such as after the vehicle was left in bright sunshine, or the temperature inside the vehicle is low, such as after the vehicle was left in an extremely cold environment.
- Immediately after the engine starts

• Under the conditions listed below, it is difficult to recognize vehicles in front, motorcycles, pedestrians, obstacles on the road, traffic lanes, etc. Also, the EyeSight system may temporarily stop operating. If the EyeSight system repeatedly stops operating several times, contact a SUBARU dealer and have the system inspected.
- The stereo camera lenses are smeared such as from fingerprints.
- The stereo camera has become misaligned due to a strong impact.

- When there is a malfunction in the EyeSight system, turn off the Pre-Collision Braking System (⇒ page 41) and the Lane Departure Warning (⇒ page 102), and stop using the Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function and Conventional Cruise Control. Contact a SUBARU dealer and have the system inspected.
- When the Vehicle Dynamics Control warning light is illuminated, the Pre-Collision Braking System may not operate properly. If the indicator light is illuminated, turn off the Pre-Collision Braking System. Also, do not use the Adaptive Cruise Control or Conventional Cruise Control.

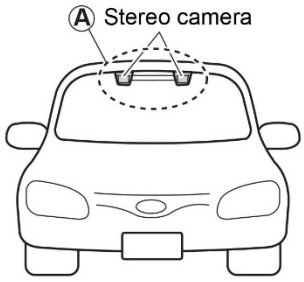
NOTE

EyeSight records and stores the following data when the Pre-Collision Braking System is operated. It does not record conversations or other audio data.

- Stereo camera image data
- Distance from the vehicle in front
- Vehicle speed
- Steering wheel turning angle
- Lateral movement with regards to the direction of travel
- Accelerator pedal operation status
- Brake pedal operation status
- Select lever position
- Odometer reading
- Data related to ABS, Vehicle Dynamics Control and Traction Control Function SUBARU and third parties contracted by SUBARU may acquire and use the recorded data for the purpose of vehicle research and development. SUBARU and third parties contracted by SUBARU will not disclose or provide the acquired data to any other third party except under the following conditions.
  - The vehicle owner has given his/her consent.
  - The disclosure/provision is based on a court order or other legally enforceable request.
  - Data that has been modified so that the user and vehicle cannot be identified is provided to a research institution for statistical processing or similar purposes.

Handling of the Stereo Camera

The stereo camera is located on the front map lights unit.

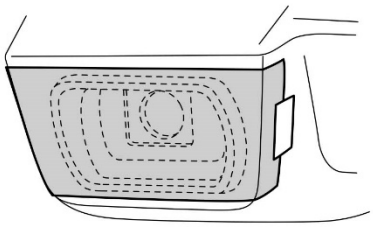


S01107

⚠ CAUTION

- The stereo camera monitors and detects smears or blurs on the front of the camera. However, detection is not 100% accurate.
  Under certain conditions, the function may fail to detect smears or blurs on the front of the stereo camera accurately. In addition, this function may not detect that there is snow or ice on the windshield close to the stereo camera. In such conditions, be sure to keep the windshield clean at all times (indicated by Ⓐ). Otherwise the system may not operate correctly. When this function detects that the front of the stereo camera is smeared or blurred, no EyeSight functions can be activated except for Conventional Cruise Control.
- The stereo camera lenses are precision components. Always observe the following precautions especially when handling them.
  - Never touch the stereo camera lenses, and do not attempt to wipe or clean the lenses. Doing so could damage or soil the lens, and lead to improper system performance.
    If you ever touch a lens for any reason, be sure to contact a SUBARU dealer.

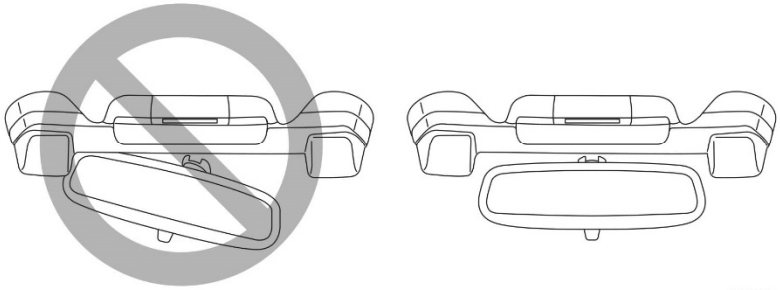
- When cleaning the windshield, cover the front of the camera casing with paper that does not collect dust, such as copy paper. Affix the paper to prevent glass cleaner from getting on the camera lenses. At this point, make sure that the tape's adhesive surface does not come in contact with the windshield or the lens. Be sure to remove the paper after cleaning.



S03066

- When having the inside of windshield cleaned at a service station, etc., be sure to request that the attendant covers the camera covers before washing the vehicle.
- Do not subject the stereo camera to a strong impact.
- Do not remove or disassemble the stereo camera.
- Do not change the positions where the stereo camera is installed or modify any of the surrounding structures.

• Do not install an interior rearview mirror other than a genuine SUBARU rearview mirror (such as a wide-type mirror) and the sun visor. Also, use the rearview mirror so that it does not obstruct the stereo camera. Failure to do so may affect the stereo camera's field of view and could prevent the EyeSight system from functioning properly.



S00509

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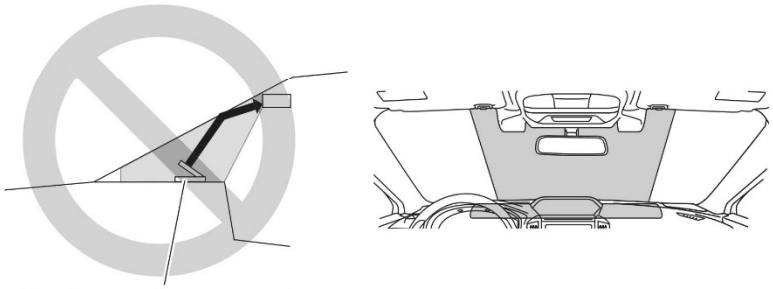
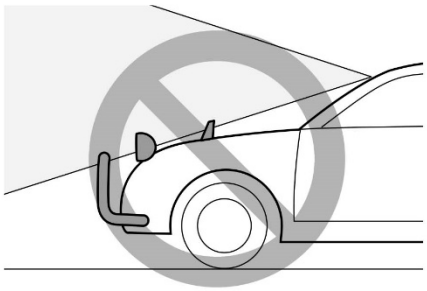
- Do not install any accessories other than the ones designated by SUBARU on the prohibited areas shown in the illustrations (gray zones).
  Even if some accessories are installed on the outside of the prohibited areas, abnormal operation of EyeSight may occur due to the reflection of the light or any objects. In this situation, move the accessories. For details, contact a SUBARU dealer.

Side view **Front view**



- Do not place any objects on top of the instrument panel. The stereo camera may not be able to detect objects accurately and the EyeSight system may not function properly due to reflections in the windshield. For details, contact a SUBARU dealer.
- If the top of the instrument panel is polished with chemicals or other substances, the stereo camera may not be able to detect objects accurately and the EyeSight system may not operate properly due to reflections in the windshield.
- Do not install any wiper blades other than genuine SUBARU wiper blades. Doing so may affect the stereo camera's field of view and could prevent the EyeSight system from functioning properly.
- Replace damaged wiper blades or worn wiper blade rubbers as soon as possible. Using damaged wiper blades or worn wiper blade rubbers may cause streaking on the windshield. The stereo camera may not be able to detect objects accurately and the EyeSight system may not function properly due to streaks or droplets remaining on the windshield.

- Do not install any accessories on the front side such as on the hood or the grille. It may affect the camera view and the system may not operate correctly.
- Make sure that the cargo loaded on the roof does not interfere in the stereo camera's field of view. Obstructing the stereo camera's view may impair the system operation. For details, contact a SUBARU dealer.



S01098

- Keep the windshield (outside and inside) clean at all times. When the windshield has become fogged, or it has a dirt or an oil film on it, the stereo camera may not detect objects accurately and the EyeSight system may not operate correctly. Never mount any device to the center air vent, as any airflow change may impact performance of the EyeSight system.
- Do not place any stickers or accessories on the windshield (outside or inside). If you have to do so (for example, legally required or electronic toll tag), avoid the area directly in front of the camera. Otherwise, it may adversely affect the field of view of the stereo camera and can cause improper operation of the system. For details, contact a SUBARU dealer.
- Do not use any glass coating agents or similar substances on the windshield. Doing so may interfere with the proper operation of the system.
- Do not install any film or an additional layer of glass on the windshield. The system may not operate correctly.
- If there are scratches or cracks on the windshield, contact a SUBARU dealer.
- To have the windshield replaced or repaired, contact a SUBARU dealer. Do not install a windshield other than a genuine SUBARU windshield. The stereo camera may not be able to detect objects accurately and the EyeSight system may not operate properly.

EyeSight Functions

EyeSight includes the following functions.

■ Pre-Collision Braking System

This function uses a following distance warning feature to warn the driver to take evasive action when there is the possibility of a collision with a vehicle or obstacle in front of you. If the driver does not take evasive action, the brakes are applied automatically to help reduce vehicle collision damage or, if possible, help prevent a collision.
⇒ Page 27

■ Advanced Adaptive Cruise Control

Adaptive Cruise Control

This function maintains the set vehicle speed and when there is a vehicle in front in the same traffic lane, it follows the speed of the vehicle in front up to the maximum of the set vehicle speed.
⇒ Page 43

Lane Centering Function

This function helps suppress lane drifting by detecting lane markings (e.g., white lines) and the lead vehicle on expressways, freeways and interstate highways, and by assisting steering operation. Lane Centering Function will work only when the Adaptive Cruise Control is activated.
⇒ Page 71

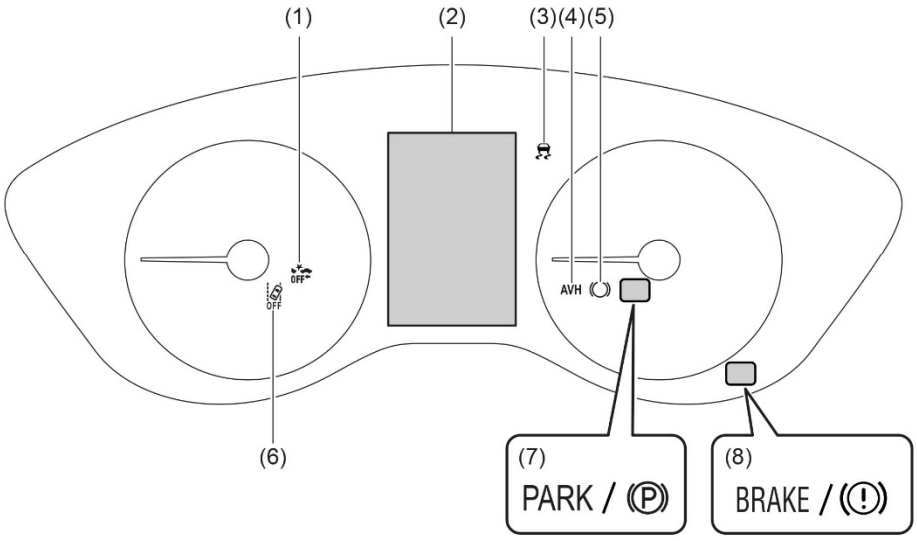
■ Lane Departure Prevention Function

When driving on expressways, freeways, or interstate highways, the system recognizes the lane markings on both sides of the vehicle. If the vehicle appears likely to depart from the lane, the system assists with steering operation in the direction that prevents the lane departure, preventing the vehicle from leaving the lane.
⇒ Page 84

■ Pre-Collision Throttle Management

This function reduces accidental forward movement caused by the select lever being placed in the wrong position or the accelerator pedal being accidentally depressed, or depressed too strongly.
⇒ Page 93

Instrument panel display layout



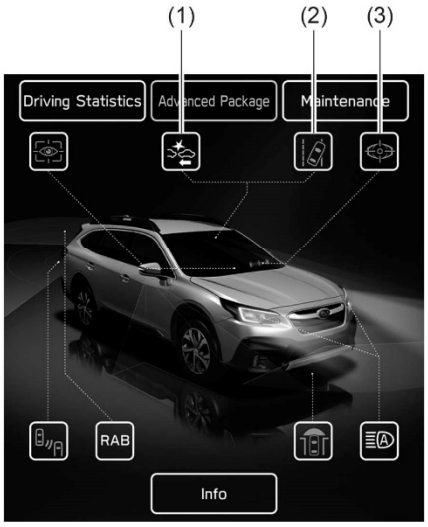
S03537

(1) Pre-Collision Braking System OFF indicator light
(2) Combination meter display
(3) Vehicle Dynamics Control warning light
(4) Auto Vehicle Hold ON indicator light
(5) Auto Vehicle Hold operation indicator light
(6) Lane Departure Warning OFF indicator light
(7) Electronic parking brake indicator light
(8) Brake system warning light

	**Select lever/gear position indicator** This indicator illuminates and shows which position the select lever or the gear is in.
	**EyeSight warning indicator (yellow)** • This indicator illuminates or flashes when a malfunction occurs in the EyeSight system. • When it is illuminated or flashing, none of the EyeSight functions can be used (including Adaptive Cruise Control and the Pre-Collision Braking System, etc.). ⇒ Page 122
	**EyeSight temporary stop indicator (white)** • This indicator illuminates when the EyeSight system is temporarily stopped. • When the ignition switch is placed in the ON position, it will illuminate if the (CRUISE) switch or (Lane Centering) switch is set to ON within approximately 7 seconds of the engine starting. It turns off when approximately 7 seconds have elapsed since the engine started. • When it is illuminated, none of the EyeSight functions can be used except for Conventional Cruise Control. ⇒ Page 124
	**Auto Start Stop indicator (green) (also used as Auto Start Stop warning indicator (yellow))** • This indicator illuminates in yellow when the ignition switch is turned to the ON position, and then it turns off after the engine starts. • It illuminates in green while the Auto Start Stop system operates. It turns off after the engine restarts. • It illuminates in yellow if a malfunction occurs in the Auto Start Stop system.
	**Auto Start Stop OFF indicator** This indicator illuminates when the Auto Start Stop system is turned off. It turns off when the Auto Start Stop system is turned on. ⇒ Refer to the vehicle Owner's Manual for details.
	**Auto Start Stop No Activity Detected indicator light** When a vehicle is stopped, the indicator light illuminates when the operating conditions of the Auto Start Stop system are not met. The light will turn off when the vehicle starts driving.
	**X-MODE indicator (if equipped)** The X-MODE indicator illuminates when the X-MODE is on. ⇒ Refer to the vehicle Owner's Manual for details.

	**Lane Departure Warning OFF indicator light** • This indicator light illuminates when the Lane Departure Warning and Lane Sway Warning are off. • It also illuminates when the ignition switch is turned to the ON position. Approximately 7 seconds after the engine starts, the Lane Departure Warning OFF indicator light will turn off or remain illuminated depending on the current status (ON or OFF). ⇒ Pages 102 and 105
	**Pre-Collision Braking System OFF indicator light** • This indicator light illuminates when the Pre-Collision Braking System and Pre-Collision Throttle Management are off. • It also illuminates when the ignition switch is turned to the ON position, and then turns off approximately 7 seconds after the engine starts. ⇒ Pages 42 and 99
	**Lane indicator** • This indicator illuminates in gray when the Lane Departure Prevention Function is turned on. • It illuminates in white under the following conditions. - The Lane Departure Prevention Function goes into the standby status. - Lane Centering Function is operating by detecting the lane markings. • It illuminates in yellow when the Lane Departure Prevention Function is operating. ⇒ Pages 80 and 89
	**Brake system warning light** If the brake system warning light illuminates when the electronic parking brake is released while driving, turn the Pre-Collision Braking System off. At this time, do not use the Conventional Cruise Control mode or Adaptive Cruise Control mode. If the brake system warning light does not turn off, immediately pull the vehicle over to a safe location. Contact a SUBARU dealer to have the system inspected. ⇒ Refer to the vehicle Owner's Manual for details.
	**Electronic parking brake indicator light** This indicator light illuminates when the electronic parking brake is applied. ⇒ Refer to the vehicle Owner's Manual for details.
	**Your vehicle indicator** When the brake pedal is depressed or the brake control function is activated, the brake indicator light illuminates in red.

Center information display



S03520

(1) Pre-Collision Braking System indicator
(2) Lane Departure/Sway Warning indicator
(3) EyeSight Assist Monitor

The settings of the on-board systems can be changed by operating the center information display.
Warning screens will be displayed on the center information display as needed.

●Pre-Collision Braking System indicator

This indicator illuminates when the Pre-Collision Braking System is on.

●Lane Departure/Sway Warning indicator

This indicator illuminates when the Lane Departure Warning and Lane Sway Warning are on.

●EyeSight Assist Monitor

This indicator illuminates when the EyeSight Assist Monitor is on.

■ Changing settings

The EyeSight settings can be changed by operating the center information display.
⇒ Page 126

The following systems can also be turned ON/OFF by operating the center information display.

- Vehicle Dynamics Control
- X-MODE (if equipped)
- Auto Vehicle Hold (AVH)

⇒ Refer to the vehicle Owner's Manual for details.

■ Warning screens

The following warning screens will be displayed on the center information display.

Item	Displayed screen
Pre-Collision Braking System warning (first braking and secondary braking)	 S03539
"Obstacle Detected" warning	
Lane Centering Function warning (no-operation of the steering wheel)	 S03540
Lane Centering Function cancellation (no-operation of the steering wheel)	 S03541

Pre-Collision Braking System

When there is the risk of a rear-end collision with an obstacle in front, 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. This function can be activated when the select lever is in the D, M or N positions.

⚠ WARNING

- Never use the 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 the 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, bicycles 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.
- The 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 the 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.

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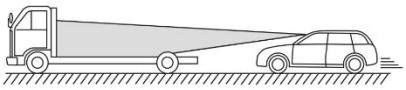
- When the difference in speed with the obstacle in front is the following figure*1 or more, it may not be possible to avoid a collision. Even if the speed difference is the following figure*1 or less, in cases such as when another vehicle cuts in front of you, or in other cases depending on visibility, the condition of road surface and other factors*2, the function may be unable to stop the vehicle or may not activate. Pre-Collision Braking Assist also may not activate depending on the conditions*2 listed below.

*1: For vehicles: approximately 30 mph (50 km/h),
For pedestrians: approximately 21 mph (35 km/h)

*2: Conditions in which the 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, bicycle 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, bicycle or pedestrian, depending on the brightness of the surroundings as well as the relative movement, and aspect or angle of the object, 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.
  - 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, bicycle or pedestrian at night
  - Ambient light is poor in the evening or early morning.
  - A vehicle, motorcycle, bicycle 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 snow, dirt, dust or frost has adhered to it, or it is otherwise affected.
  - 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 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.
    - With vehicles that have cargo protruding from their back ends
    - With non-standard shaped vehicles (vehicle transporters or vehicles with a sidecar fitted, etc.)
    - The height of the vehicle is low, etc.



S02133

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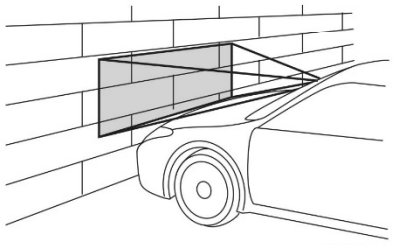
- There is a wall, etc. in front of a stopped vehicle.
- There is another object near the vehicle.
- A vehicle, etc. has its side facing you.
- With vehicles that are backing up or with oncoming vehicles, etc.
- The size and height of an obstacle is smaller than the limitations of the stereo camera's 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, bicycle or pedestrian suddenly cuts in from the side or suddenly runs in front of you.


S00653

- Your vehicle is immediately behind an obstacle after changing lanes.
- There is a vehicle, motorcycle, bicycle 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
- There are changes in brightness, such as at a tunnel entrance or exit.

- 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 the Pre-Collision Braking System.
  - 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 in red.*2
- A heavy cargo is loaded onto or inside the vehicle.
- 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

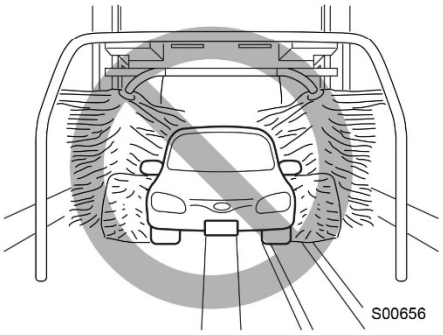
*1: The wheels and tires have functions that are critically important. Be sure to use the correct ones. For details, refer to the Owner's Manual for your vehicle.

*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.

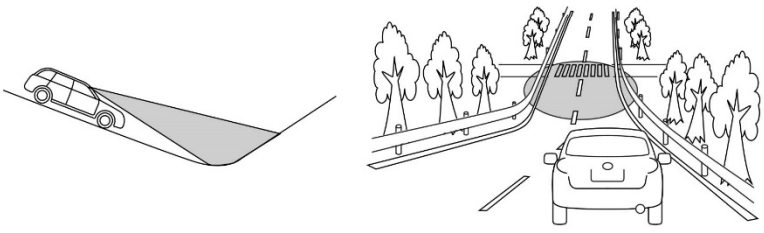
*3: For details about the combination meter, refer to the Owner's Manual for your vehicle.

CAUTION

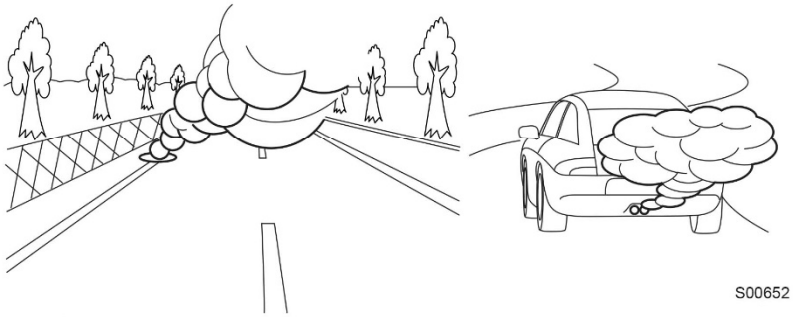
- In the following situations, turn off the Pre-Collision Braking System. Otherwise the Pre-Collision Braking System may activate unexpectedly.
  - The vehicle is being towed.
  - The vehicle is being loaded onto a carrier.
  - A chassis dynamometer, free-rollers or similar equipment is being used.
  - 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



- The 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
  - Driving in a location where the grade of the road changes rapidly

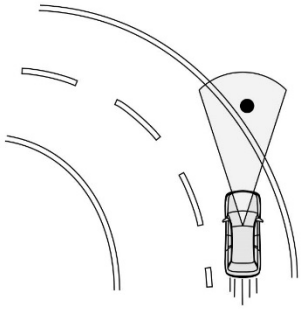


- Visibility is poor due to sand, smoke or water vapor blowing in the wind, or the front vision is obscured due to water splashes, snow, dirt or dust stir up generated by the vehicle in front or oncoming traffic.
- Passing through clouds of steam or smoke, etc.
- In adverse weather, such as heavy snow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

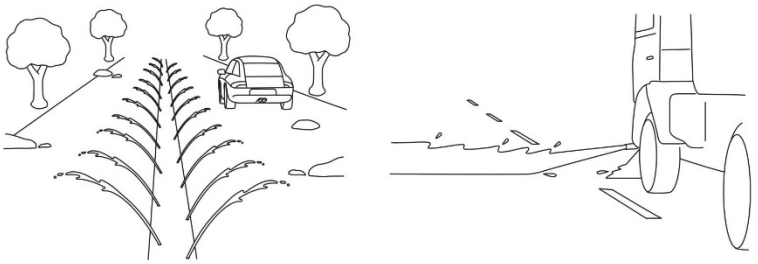


S00652

- There is an obstacle on a curve or intersection.
- A vehicle or an object is being narrowly passed.
- Stopping very close to a wall or a vehicle in front
- Passing through water spray from road sprinklers or snow clearing sprinklers on the road



S02669



S02636

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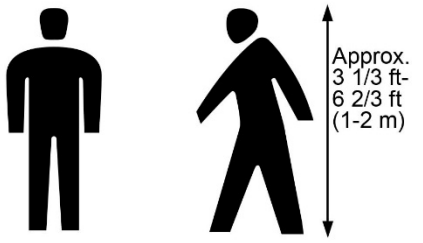
- If there is cargo or installed accessories, etc. that are protruding beyond the edge of the front bumper, the vehicle's length will increase and the system may not be able to prevent a collision.
- If the driver operates the brake pedal during automatic braking, the pedal may feel stiff; however, this is normal. By depressing the brake pedal further you can apply more braking force.

NOTE

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

■ Detection of pedestrians

The EyeSight system can also detect pedestrians. The EyeSight system detects pedestrians from their size, shape and movement. The system detects a pedestrian when the contour of the head and shoulders are clear.



S02846

WARNING

The EyeSight system's Pre-Collision Braking function also identifies pedestrians as obstacles. However, depending on the conditions, there may be cases when the system cannot detect a pedestrian. In the following conditions, the possibility that the system may not be able to detect a pedestrian as an object is particularly high.

- Pedestrians are walking in a group.
- A pedestrian is next to a wall or other obstacle.
- A pedestrian is using an umbrella.
- A pedestrian is wearing clothes that are a similar color to the surrounding environment.
- A pedestrian is carrying bulky luggage.
- A pedestrian is bent over, crouching down or lying down.
- A pedestrian is in a dark location.
- A pedestrian suddenly crosses in front of you from the side or suddenly runs in front of you.

Pre-Collision Braking System operation

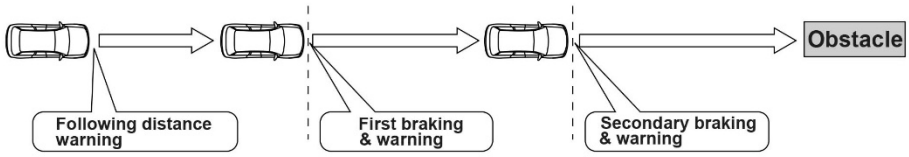
When there is an obstacle in front of you during driving, the system activates in the following sequence in order to warn the driver and to activate braking control and the brake lights.

Following Distance Warning:
When the system determines that there is a risk of collision, an alert sounds repeated short beeps and the indicators on the combination meter display illuminate to warn the driver.
The Following Distance Warning operates when Adaptive Cruise Control is not activated.
When the driver depresses the brake pedal to decelerate and achieves a suitable following distance, the warning is canceled.

First Braking and Warning:
When the system determines that there is a high risk of collision with an obstacle in front, an alert sounds repeated short beeps and the indicators on the combination meter display and the center information display illuminate to warn the driver. Braking control may be activated and in some situations, engine output may also be controlled. If the system determines that the amount of evasive action (braking, steering, etc.) taken by the driver has reduced the risk of collision, braking activation is canceled.

Secondary Braking and Warning:
If the system then determines that the risk of collision is extremely high, the alert changes to a continuous beeping sound and stronger braking control is activated. Despite any evasive action taken by the driver, if the system subsequently determines that a collision is unavoidable, braking and engine output are controlled by the system.

When the vehicle is stopped by secondary braking, the driver should depress the brake pedal in order to ensure that the vehicle stays stopped.



Operating system	Strength of Automatic Braking	Indication on the combination meter display	Alert type
Following distance warning	No brake control		Repeated short beeps
First braking	Moderate		Repeated short beeps
Secondary braking	Strong		Continuous beep

S03559

NOTE

- To release the brake control after the vehicle has come to a stop through Pre-Collision Braking System, perform the following.
  - Depress the brake pedal.
  - Depress the accelerator pedal (except when the select lever is in the N position).
  - Shift the select lever into the P position.
- After stopping with secondary braking, in the following cases, brake control will be released and the electronic parking brake will be applied.
  (For details about how to release the electronic parking brake, refer to the Owner's Manual for your vehicle.)
  - Approximately 2 minutes have elapsed since stopping and the brake pedal is not depressed.
  - Any door (except the rear gate/trunk) is opened.
  - The driver's seatbelt is unfastened.
  - The EyeSight system has a malfunction.
  - The EyeSight system has stopped temporarily.

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- Neither first braking nor secondary braking will operate in the following cases.
  - The vehicle speed is approximately 1 mph (1 km/h) or less (When the select lever is in the [N] position and your vehicle speed is approximately 2 mph (4 km/h) or less) or 100 mph (160 km/h) or more.
  - Vehicle Dynamics Control is active.
- If the system detects the brake lights of the vehicle in front, your vehicle will start decelerating earlier than if it does not.
- There are some cases where the first braking is applied for a longer period of time. One of the reasons for this is due to a large speed difference with an obstacle in front. In those cases, stronger or weaker braking control may be activated.

■ Pre-Collision Braking System operation indicator

After the Pre-Collision Braking System operation, a message appears and stays in the warning screen area of the combination meter display for a certain period of time.

▼If the Pre-Collision Braking System stopped operating before the vehicle came to a stop

The message appears and stays in the warning screen area of the combination meter display to indicate that the Pre-Collision Braking System has activated. This screen will be displayed for 10 seconds.

S03129

▼If the Pre-Collision Braking System continued operating until the vehicle came to a stop

The screen displays the message “Apply Brake To Hold Position” to urge the driver to depress the brake pedal. At this time the alert sounds. This screen will be displayed for approximately 2 minutes until the driver depresses the brake pedal.

S02962

If the brake pedal is depressed or 2 minutes have elapsed, a message changes and stays in the warning screen area of the combination meter display to indicate that the Pre-Collision Braking System has activated. This screen will be displayed for 10 seconds.

S03130

Pre-Collision Braking Assist operation

When the Pre-Collision Braking System is activated (when the system determines that there is a high risk of collision with an obstacle in front), if the driver depresses the brake pedal, the system determines that this is emergency braking and activates braking assist automatically.

CAUTION

If the driver depresses the brake pedal while following distance warning is activated, the Pre-Collision Braking Assist will not work. The vehicle decelerates with the normal braking force operated by the driver.

NOTE

- Pre-Collision Braking Assist function does not operate when the vehicle speed is approximately 7 mph (10 km/h) or less or 100 mph (160 km/h) or more.
- For information about the brake assist function, refer to the Owner's Manual for your vehicle.

Turning on/off the Pre-Collision Braking System

Operate the center information display to turn on/off the Pre-Collision Braking System (including Pre-Collision Braking Assist).
This function is turned on by selecting “Setting ON” on the “Pre-Collision Braking” screen of the EyeSight settings.
This function is turned off by selecting “Setting OFF” on the “Pre-Collision Braking” screen of the EyeSight settings.
⇒ Page 126

The Pre-Collision Braking System on/off setting interlocks with the Pre-Collision Throttle Management setting.

- When this system is turned off, the Pre-Collision Braking System OFF indicator light illuminates.
- When this system is turned on, the Pre-Collision Braking System OFF indicator light turns off.

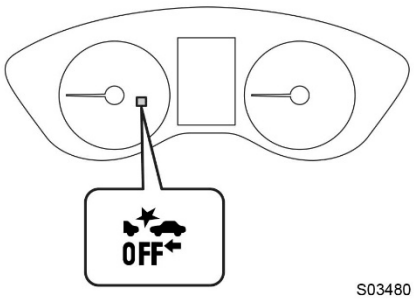
NOTE

Even when the Pre-Collision Braking System is turned off, 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.

■ 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 7 seconds after the engine starts. It turns on when the Pre-Collision Braking System and Pre-Collision Throttle Management are turned off. It also illuminates under the following conditions.

- The EyeSight system has a malfunction.
  ⇒ Page 122
- The EyeSight system has stopped temporarily.
  ⇒ Page 124



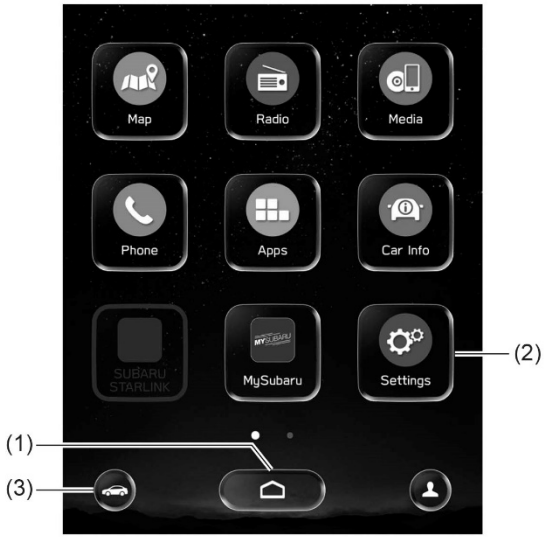
S03480

NOTE

When the Pre-Collision Braking System OFF indicator light is turned on, the Pre-Collision Braking System (including the Pre-Collision Braking Assist function) and Pre-Collision Throttle Management do not operate.

Changing settings

■ 11.6-inch display models (if equipped)



S03581

(1) HOME icon
(2) Settings icon
(3) Car settings icon

Change the EyeSight system setting as follows:
1. Touch (HOME).
2. → (Settings)
3. → “Car”
4. Select the preferred menu.

The setting adjustments to the following items can be manually changed to meet your personal requirements.

Item		Setting
EyeSight	Pre-Collision Braking	Setting ON/Setting OFF
	Lane Departure Prevention Function	All Functions/ Lane Departure Prevention Function Only/ Warning Buzzer Only/ OFF
	Cruise Control Acceleration Characteristics	Lv. 1 (Eco)/ Lv. 2 (Comfort)/ Lv. 3 (Standard)/ Lv. 4 (Dynamic)
	Select Drive on Left/Drive on Right	Right Lane/ Left Lane
	Lead Vehicle Acquisition Sound	ON/OFF
	Lead Vehicle Moving Monitor	ON/OFF
EyeSight Assist Monitor	Red Indicator	ON/OFF
	Yellow Indicator	ON/OFF
	Green Indicator	ON/OFF
Warning Volume	—	Min/Mid/Max

Touch  (Car settings icon) to display the items that are changeable while driving.
Change the EyeSight system setting as follows:
1. Touch  (Car settings icon).
2. Select the preferred menu.

Item		Setting
Driving Assistance	Pre-Collision Braking	Setting ON/Setting OFF
	Lane Departure Prevention Function	All Functions/ Lane Departure Prevention Function Only/ Warning Buzzer Only/ OFF
Others	Cruise Control Acceleration Characteristics	Lv. 1 (Eco)/ Lv. 2 (Comfort)/ Lv. 3 (Standard)/ Lv. 4 (Dynamic)
	Warning Volume	Min/Mid/Max

APPENDIX C

Run Log

Subject Vehicle: **2020 Subaru Outback Premium/LDD** Test Date: **5/27/2020**

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	2.90	2.85	0.80	Pass	
2		Y	2.65	2.55	0.55	Pass	
3		Y	2.72	2.63	0.62	Pass	
4		Y	2.89	2.80	0.79	Pass	
5		Y	2.91	2.82	0.81	Pass	
6		Y	2.95	2.86	0.85	Pass	
7		N					SV Speed
8		Y	2.77	2.72	0.67	Pass	
16	**Decelerating POV, 45**	Y	2.92	2.94	0.54	Pass	
17		N					Lateral Offset
18		Y	2.77	2.72	0.37	Pass	
19		Y	2.38	2.33	-0.02	Fail	
20		Y	2.90	2.79	0.50	Pass	
21		Y	2.88	2.83	0.48	Pass	
22		N					POV Speed
23		Y	2.65	2.60	0.25	Pass	
24		Y	2.99	2.94	0.59	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
9	**Slower POV, 45 vs 20**	Y	3.37	3.18	1.37	Pass	
10		Y	3.28	3.12	1.28	Pass	
11		Y	3.10	3.02	1.10	Pass	
12		Y	2.95	2.88	0.95	Pass	
13		Y	3.05	2.86	1.05	Pass	
14		Y	3.01	2.93	1.01	Pass	
15		Y	3.14	3.07	1.14	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 audible, 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)

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

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.

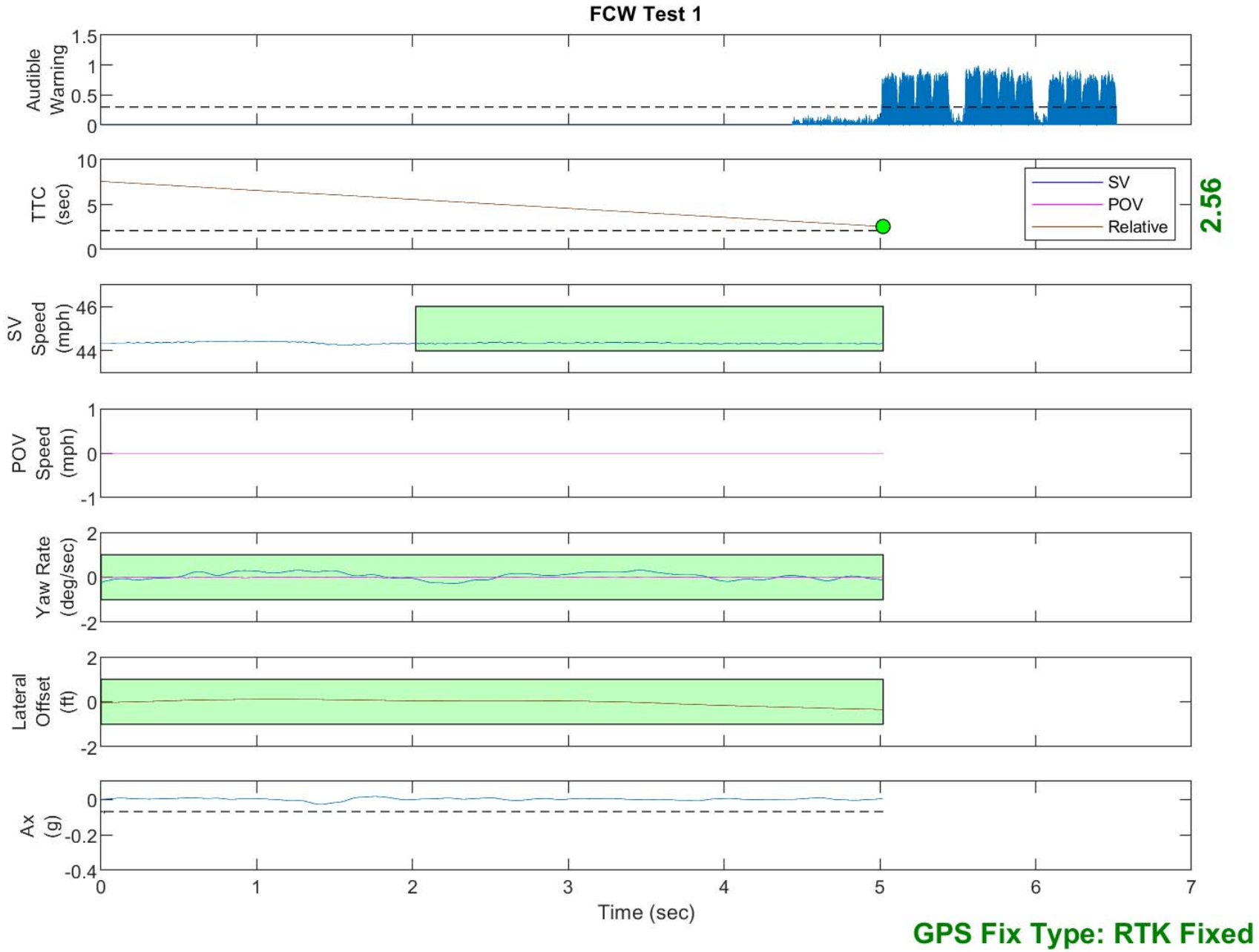


Figure D1. Example Time History for Test Type 1, Passing

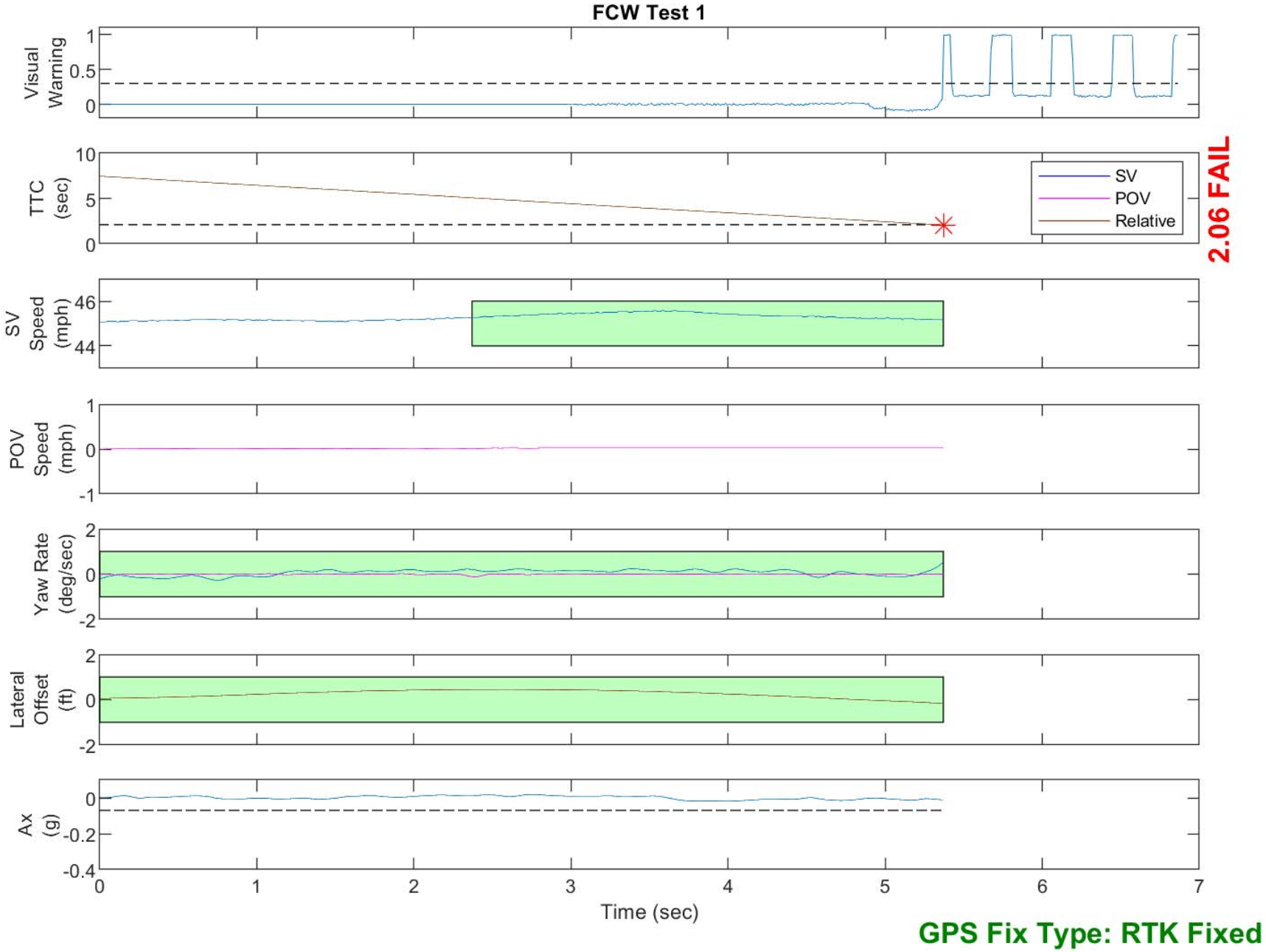


Figure D2. Example Time History for Test Type 1, Failing

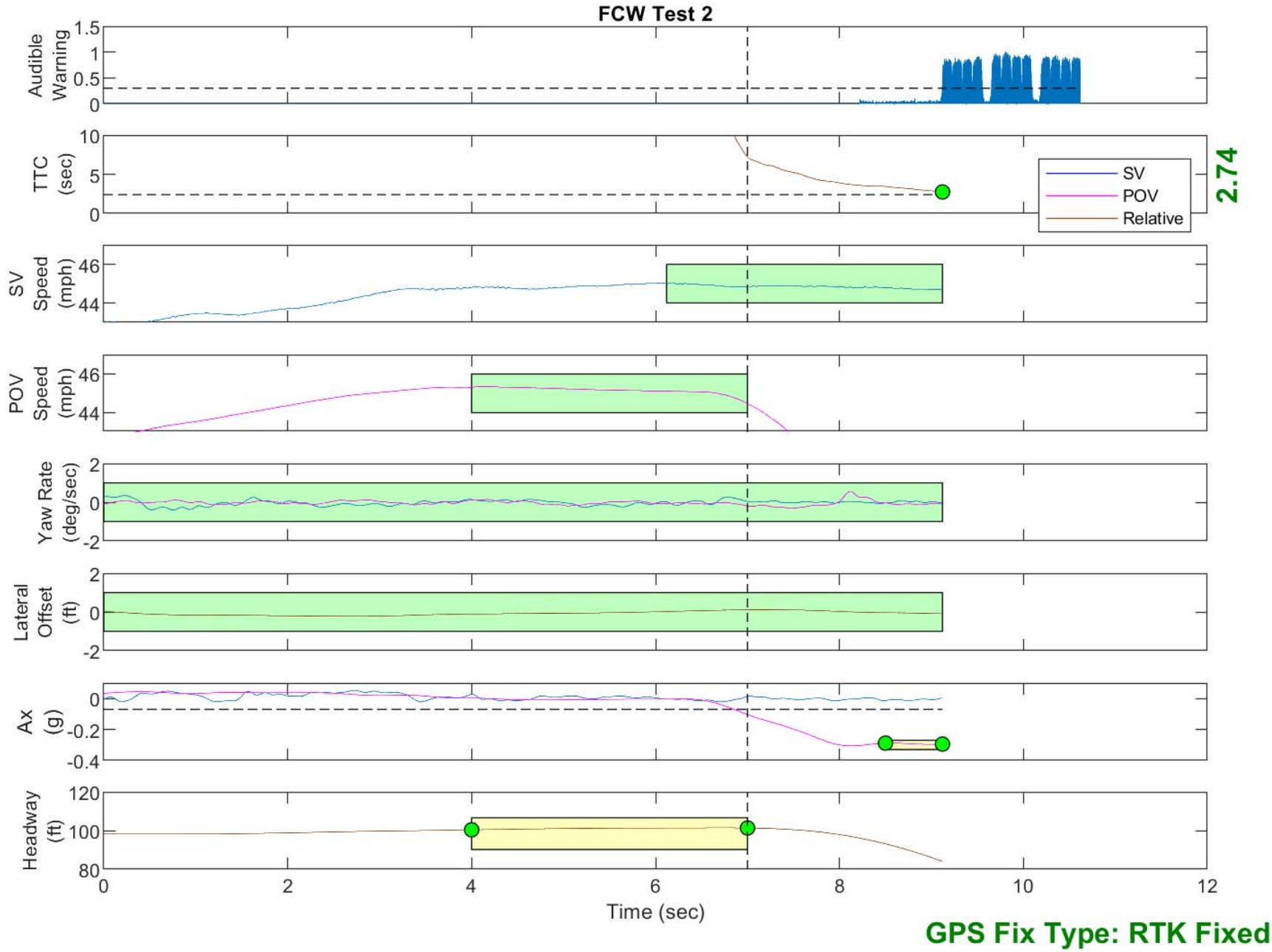


Figure D3. Example Time History for Test Type 2, Passing

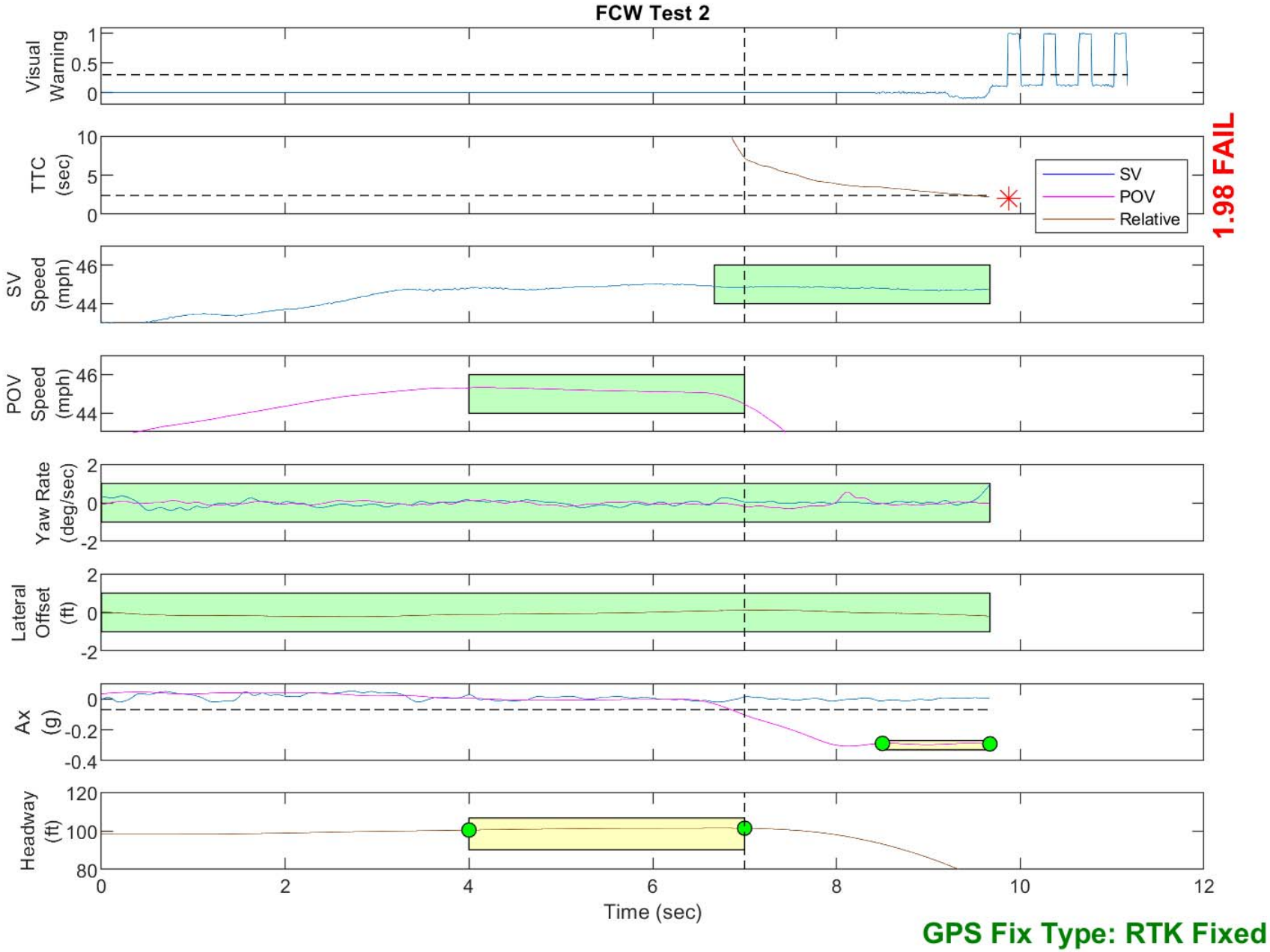


Figure D4. Example Time History for Test Type 2, Failing

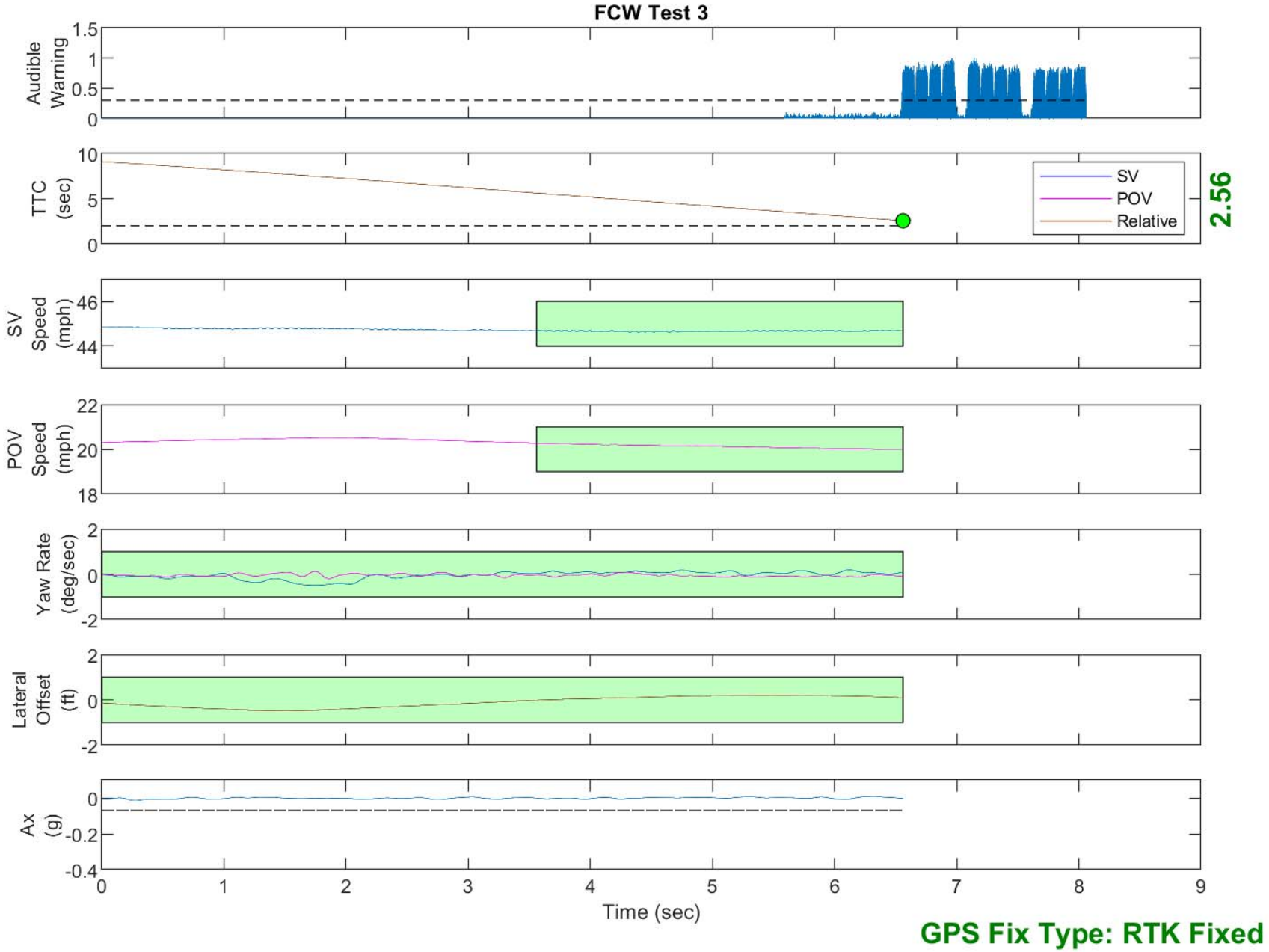


Figure D5. Example Time History for Test Type 3, Passing

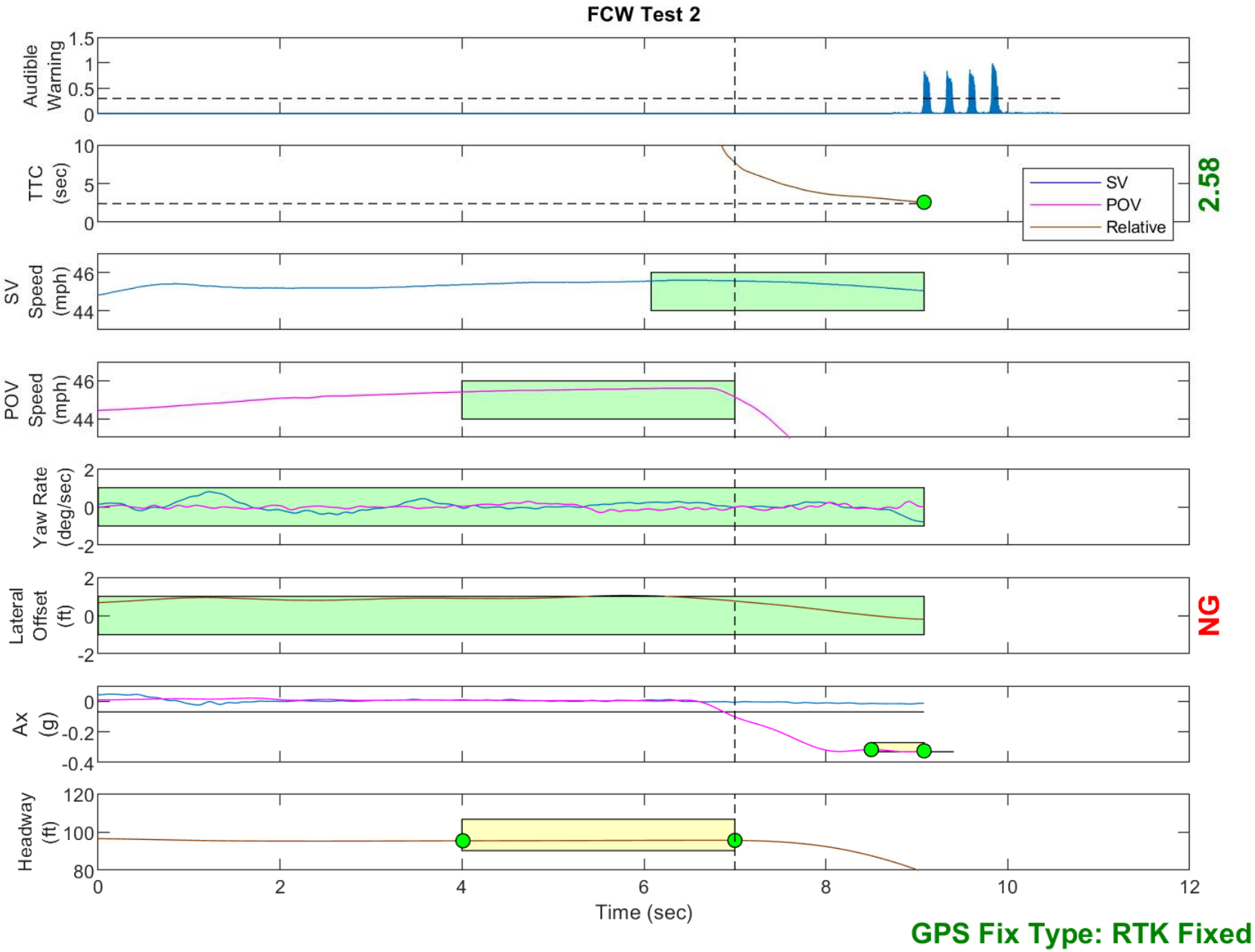


Figure D6. Example Time History Showing Invalid Lateral Offset Criteria

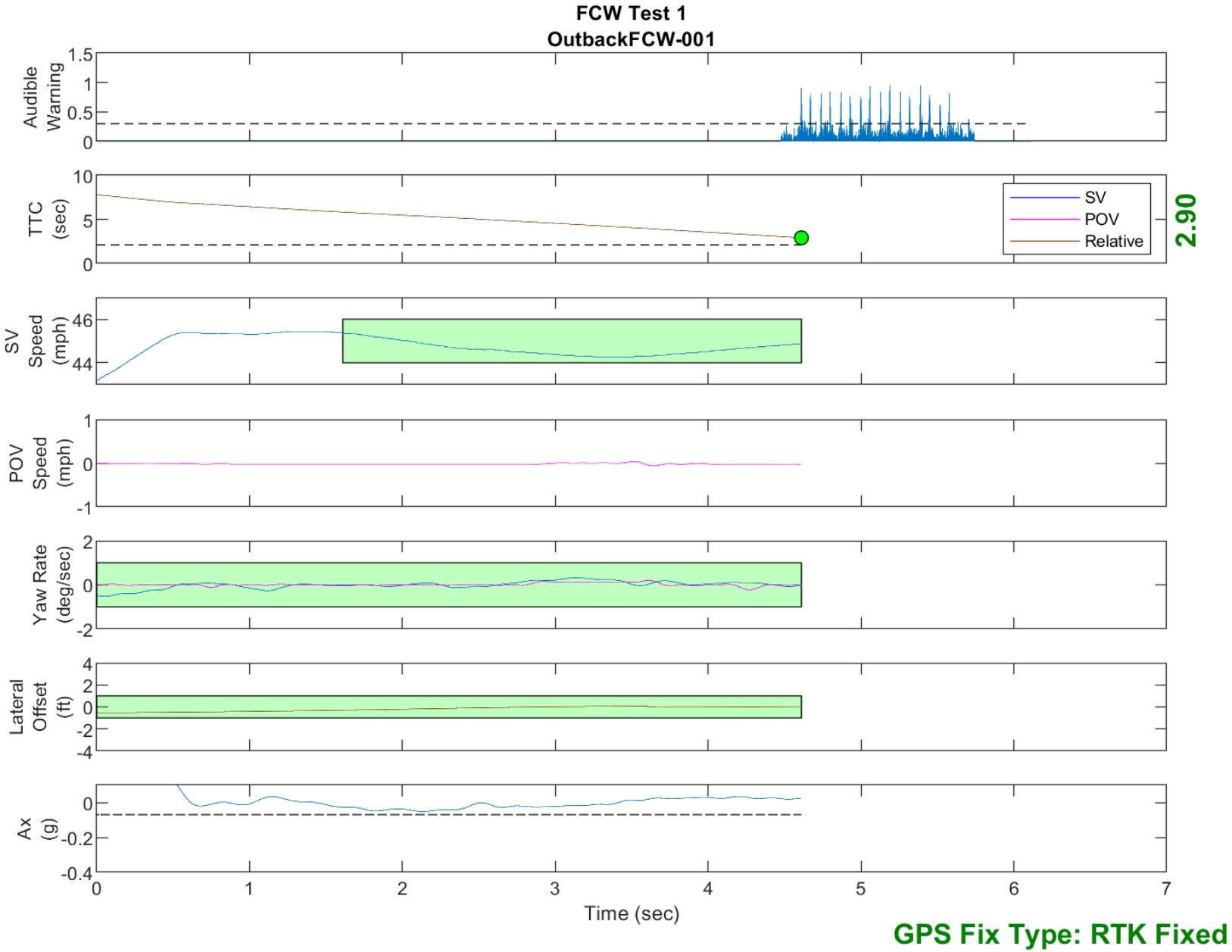


Figure D7. Time History for Run 1, FCW Test 1, Audible Warning

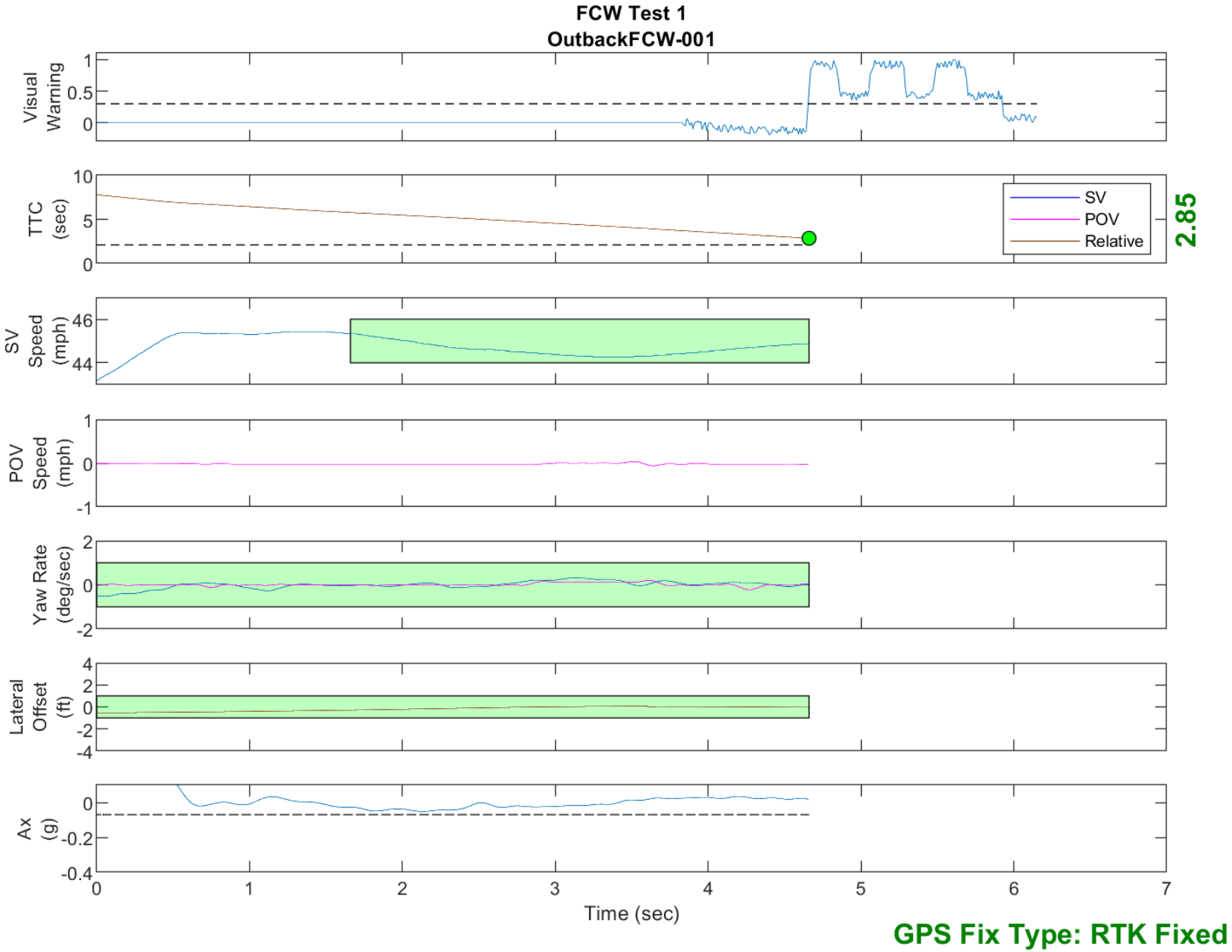


Figure D8. Time History for Run 1, FCW Test 1, Visual Warning

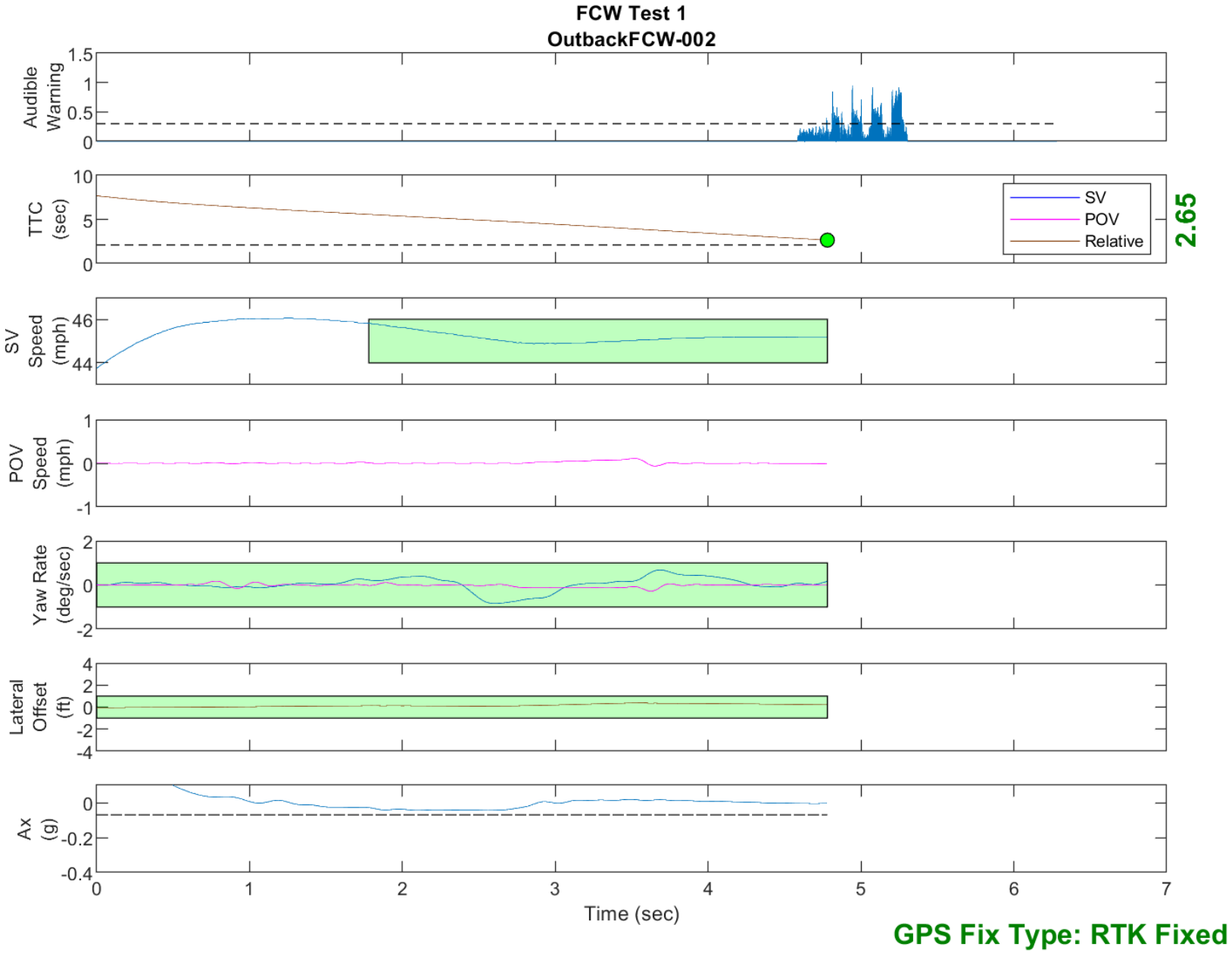


Figure D9. Time History for Run 2, FCW Test 1, Audible Warning

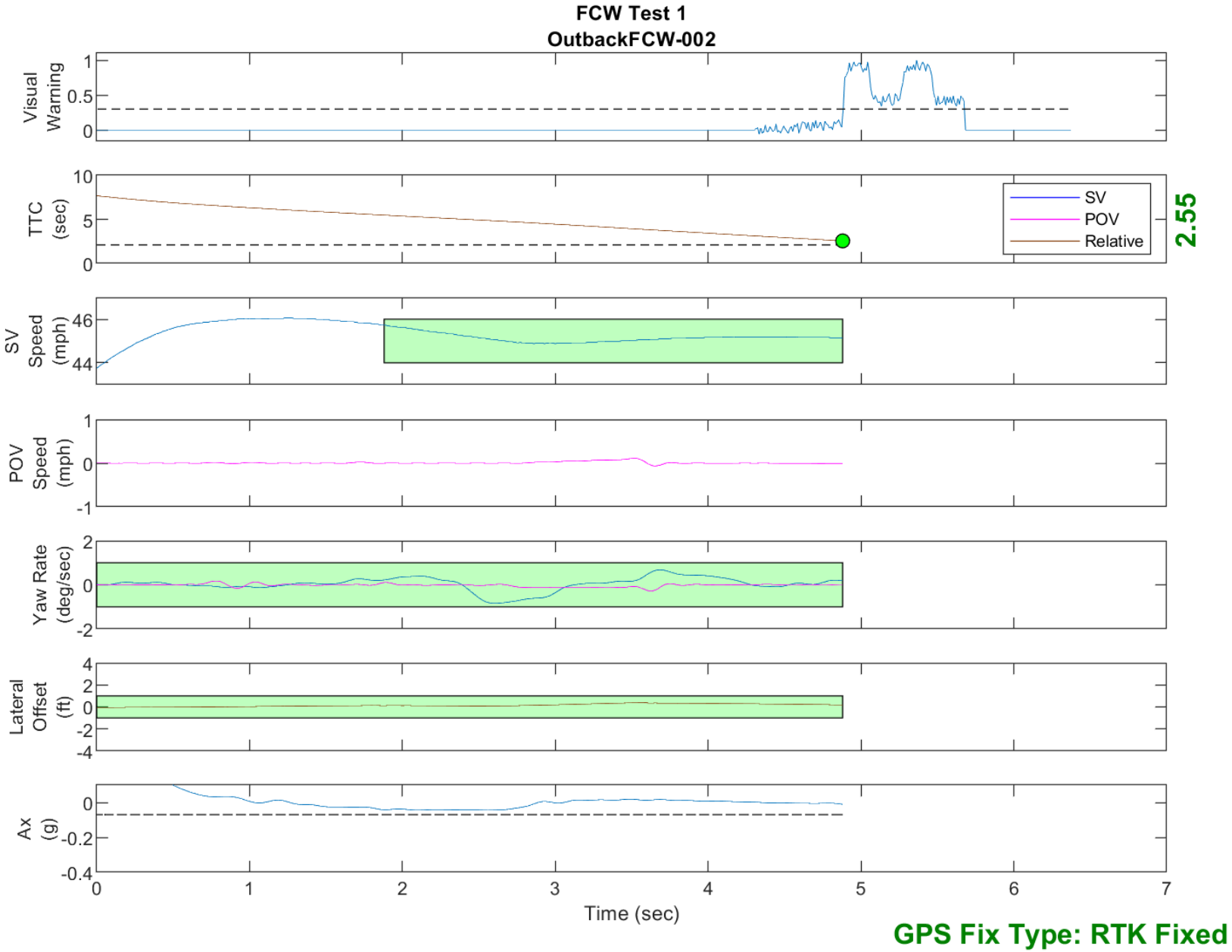


Figure D10. Time History for Run 2, FCW Test 1, Visual Warning

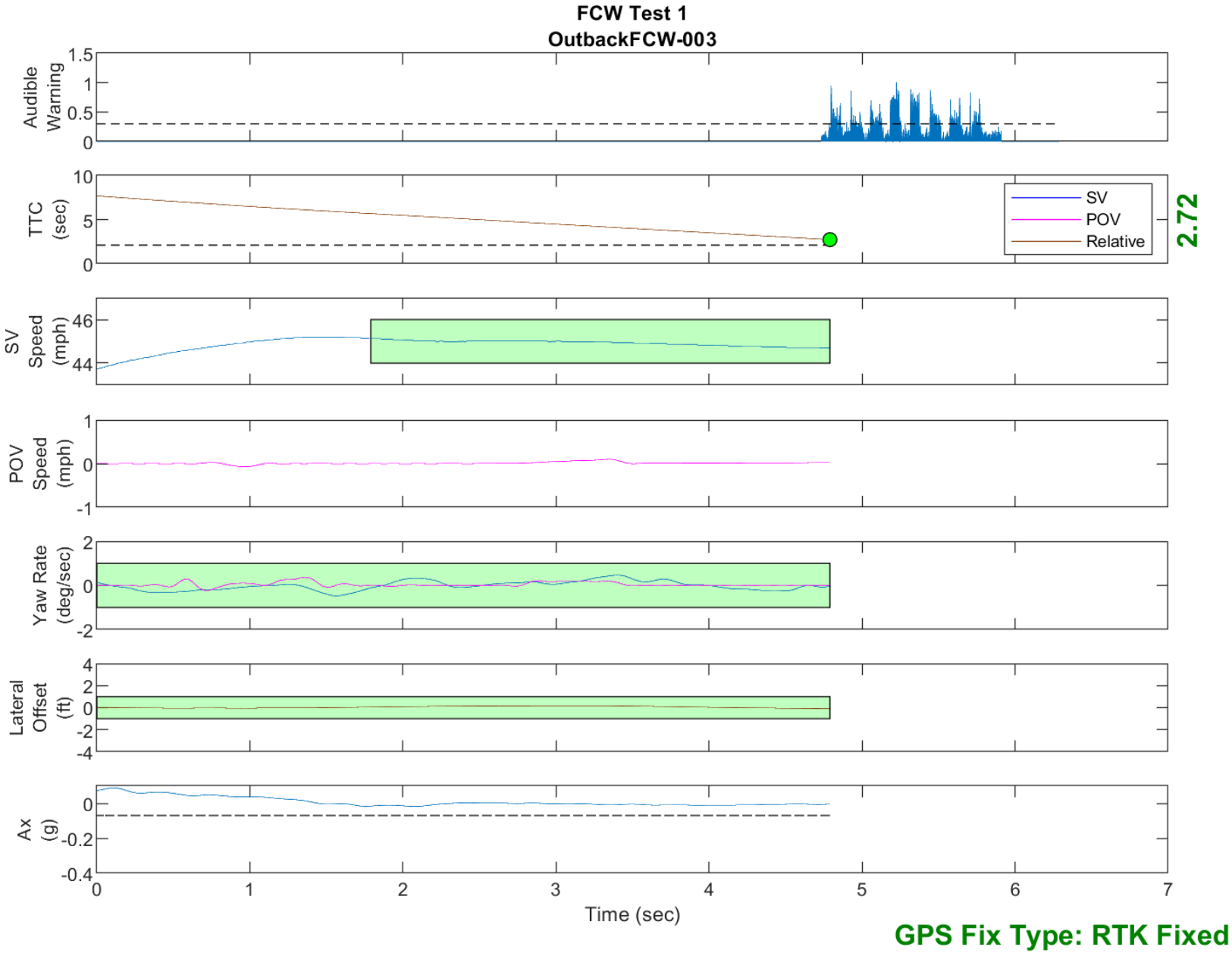


Figure D11. Time History for Run 3, FCW Test 1, Audible Warning

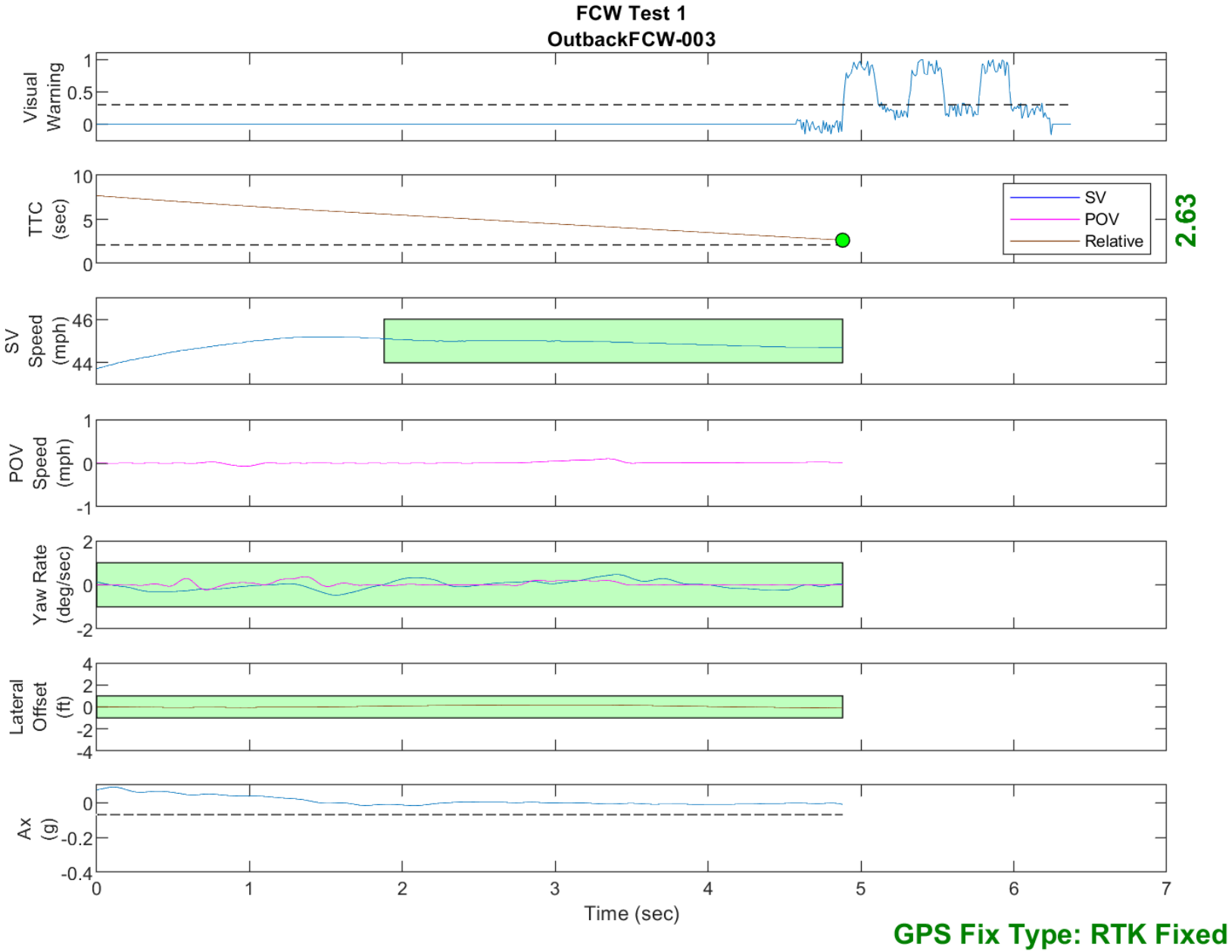


Figure D12. Time History for Run 3, FCW Test 1, Visual Warning

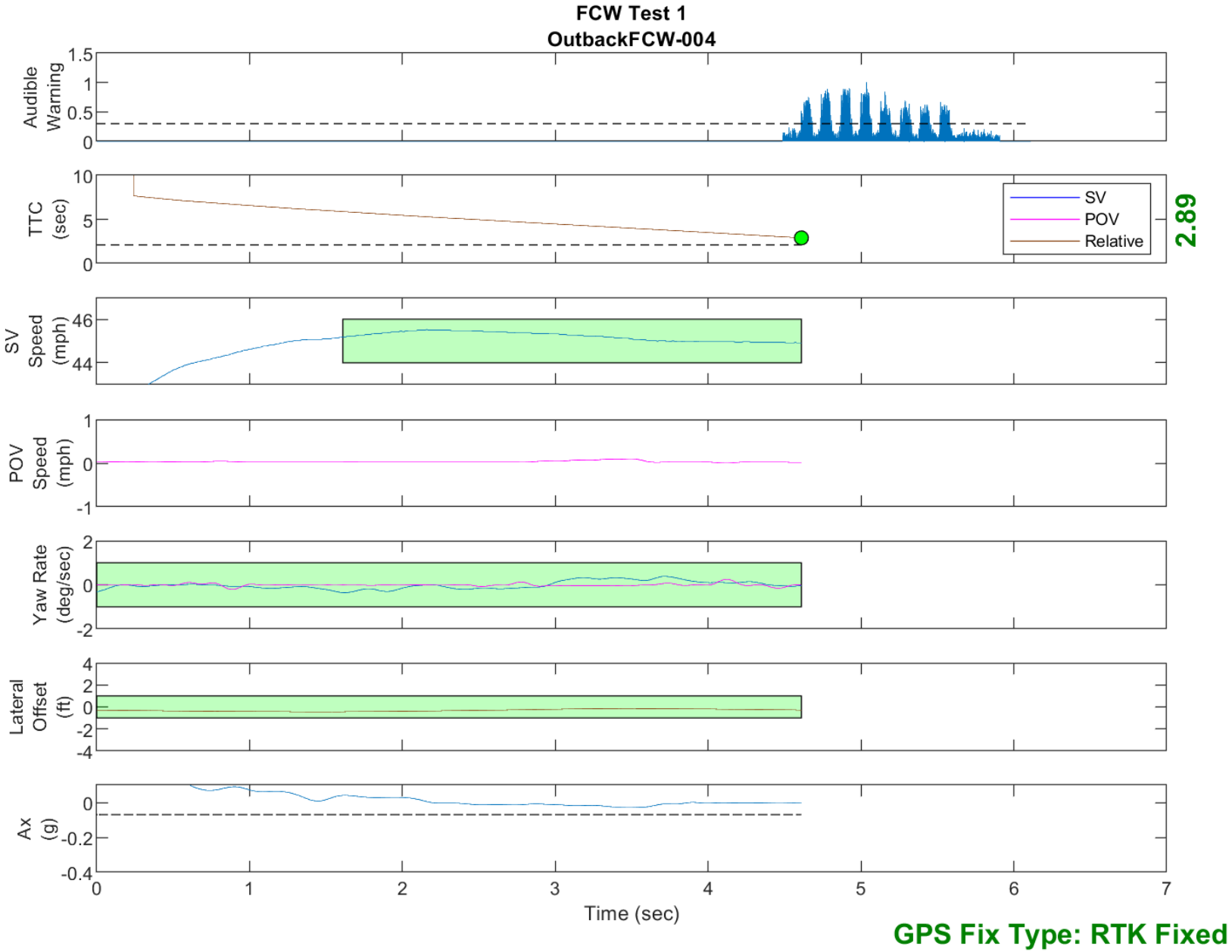


Figure D13. Time History for Run 4, FCW Test 1, Audible Warning

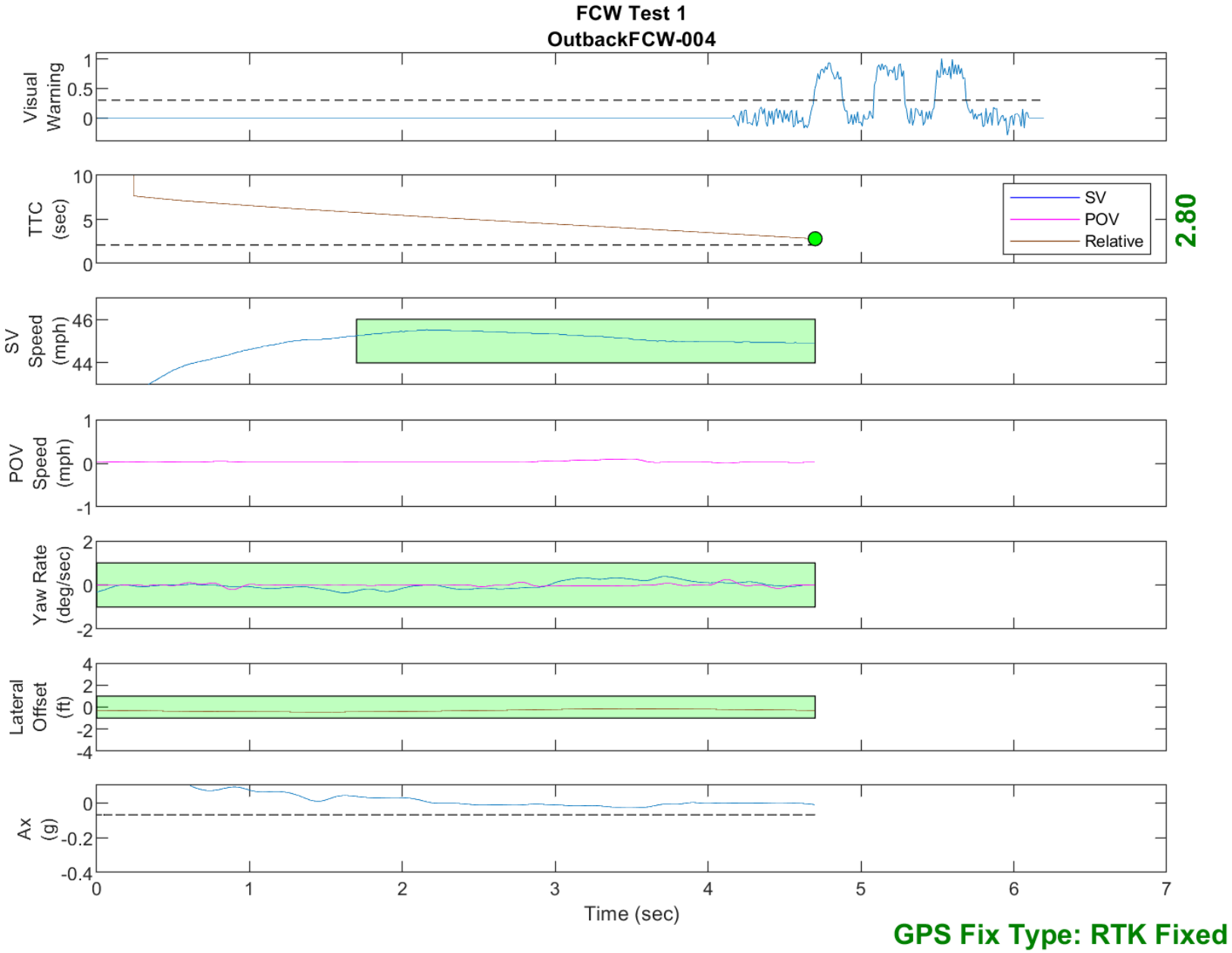


Figure D14. Time History for Run 4, FCW Test 1, Visual Warning

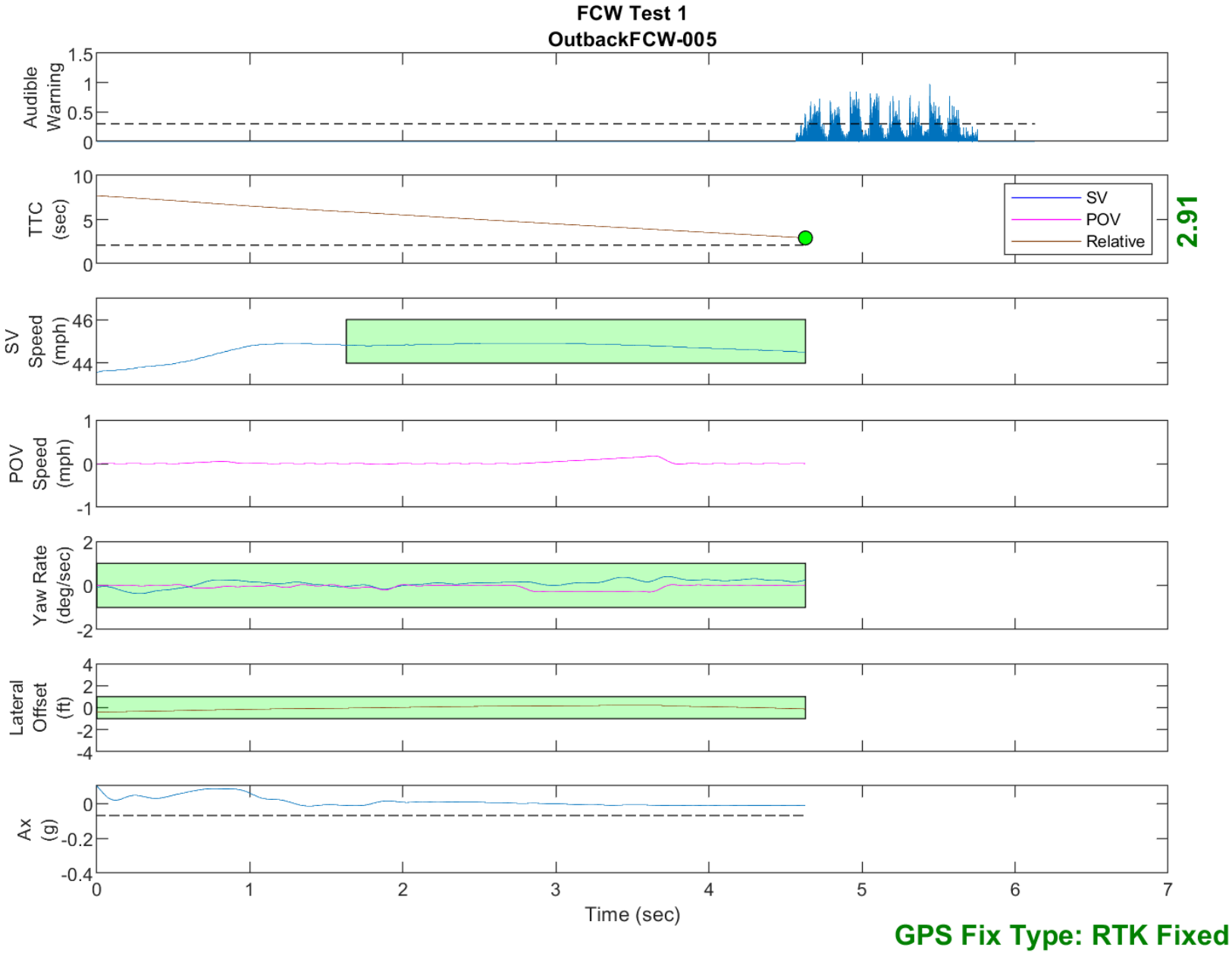


Figure D15. Time History for Run 5, FCW Test 1, Audible Warning

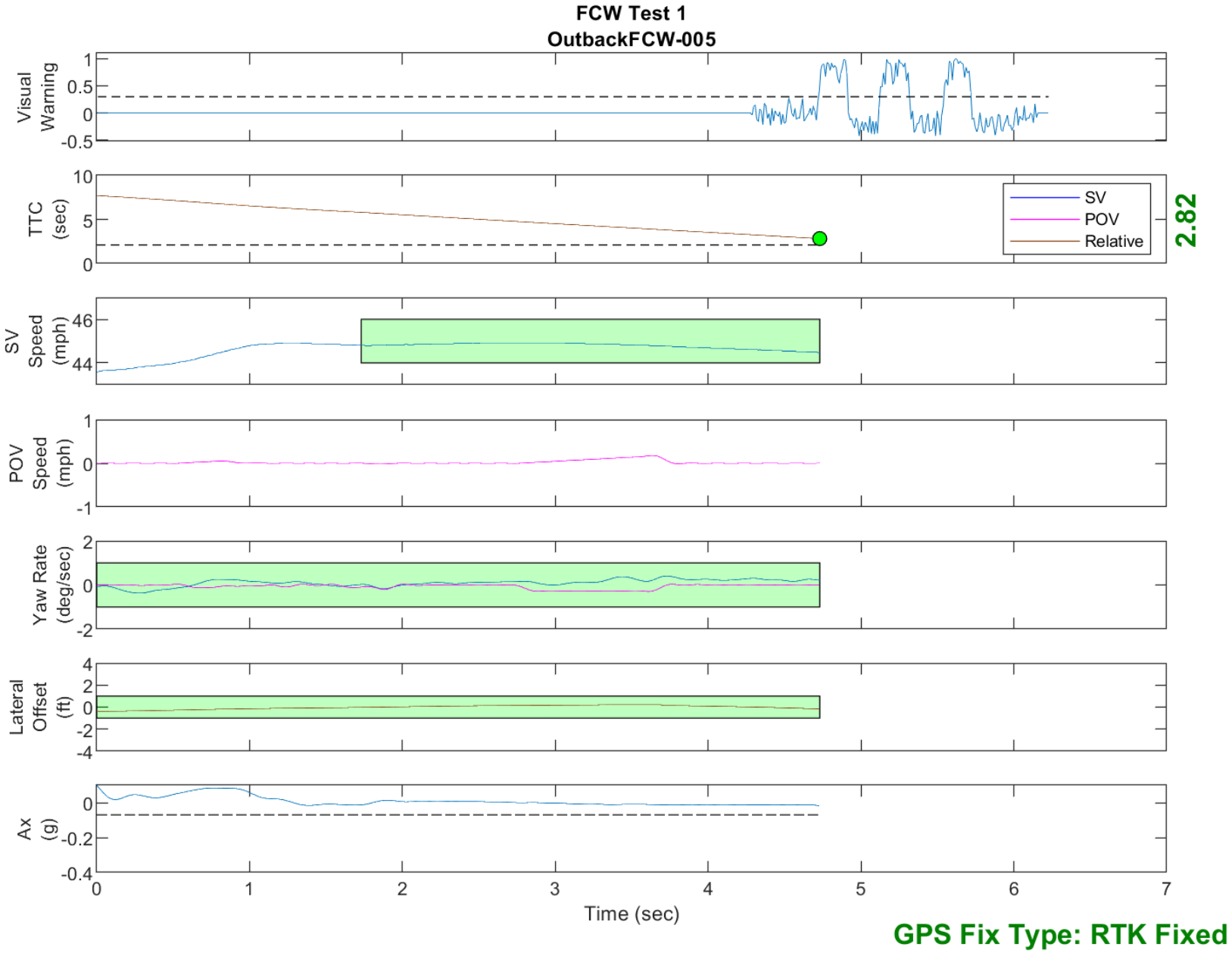


Figure D16. Time History for Run 5, FCW Test 1, Visual Warning

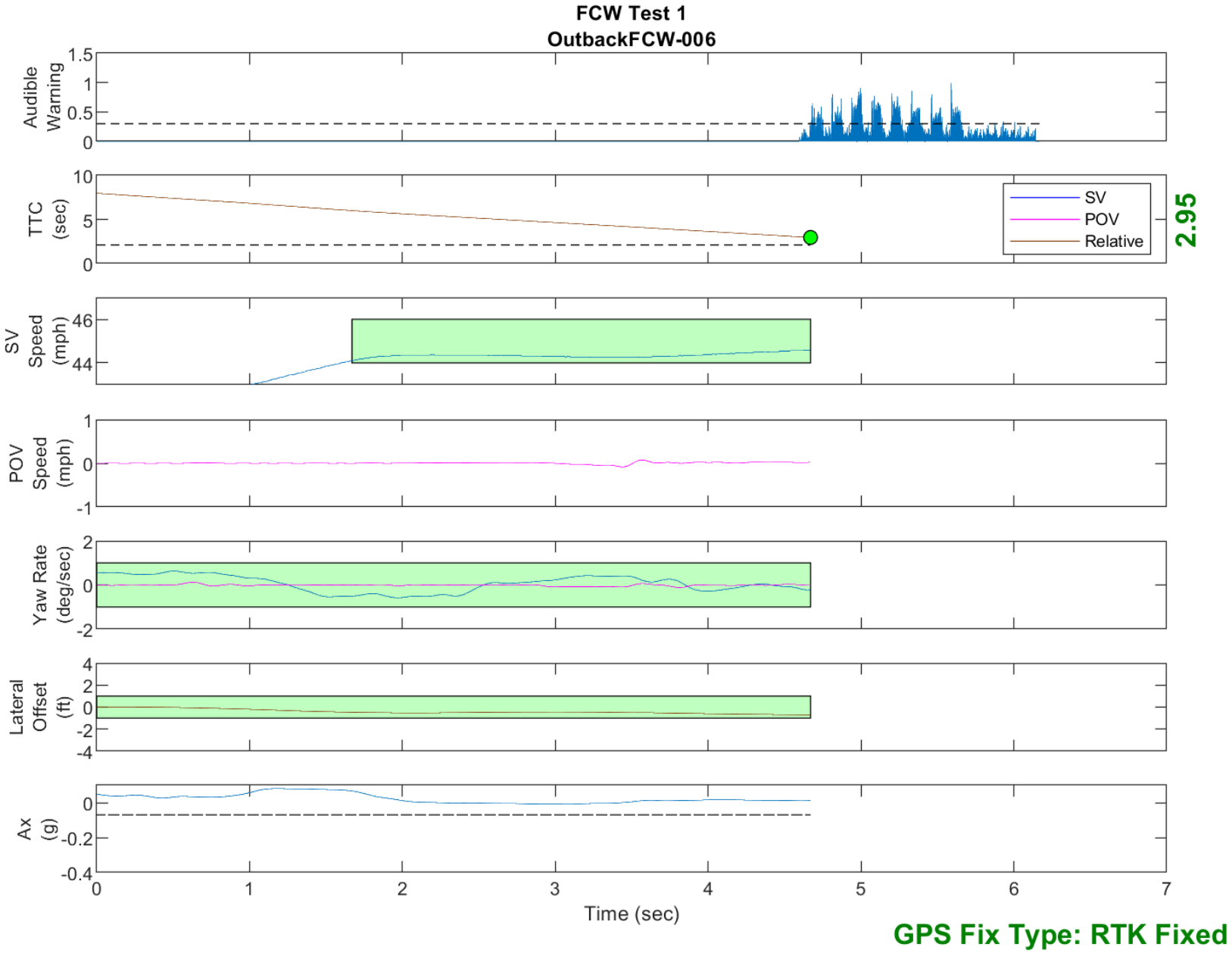


Figure D17. Time History for Run 6, FCW Test 1, Audible Warning

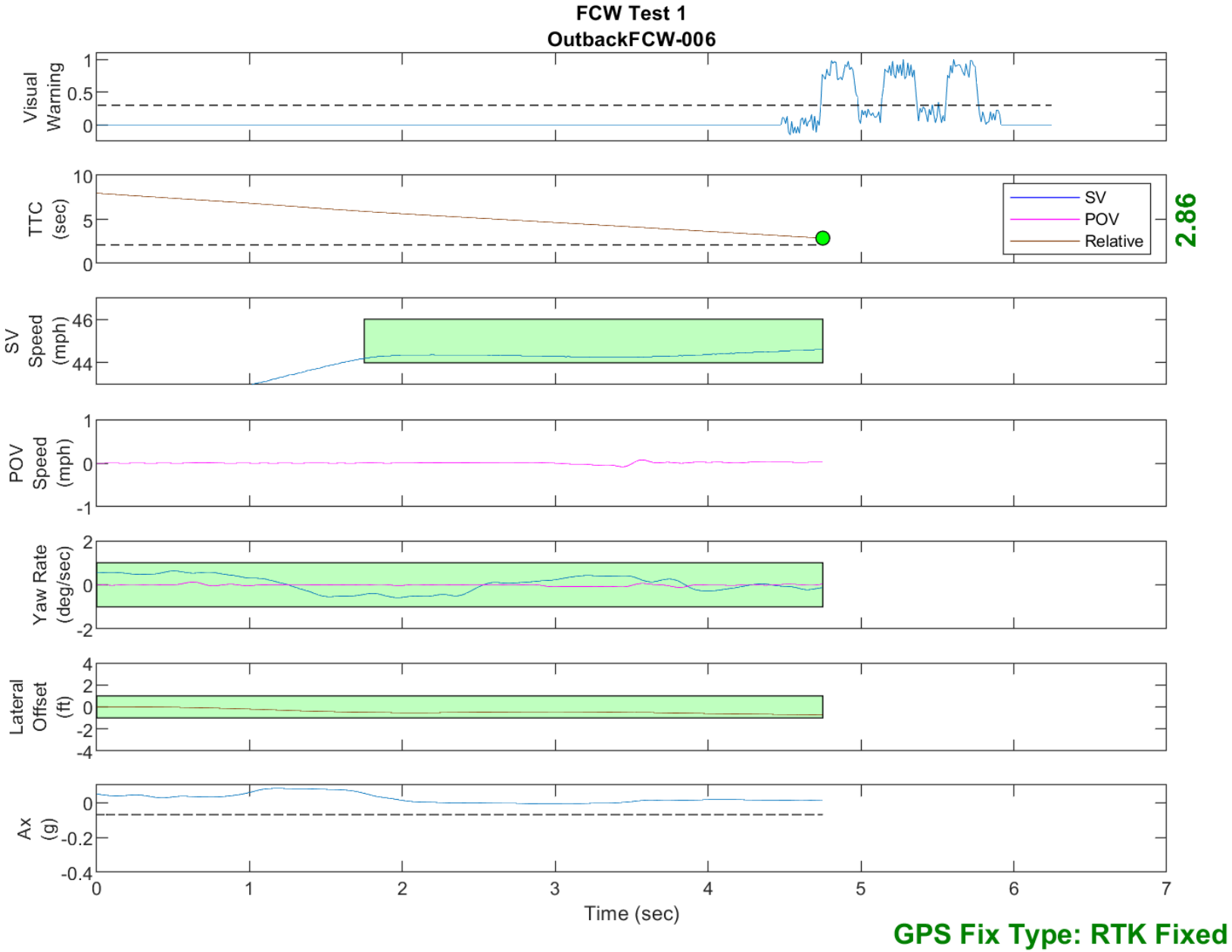


Figure D18. Time History for Run 6, FCW Test 1, Visual Warning

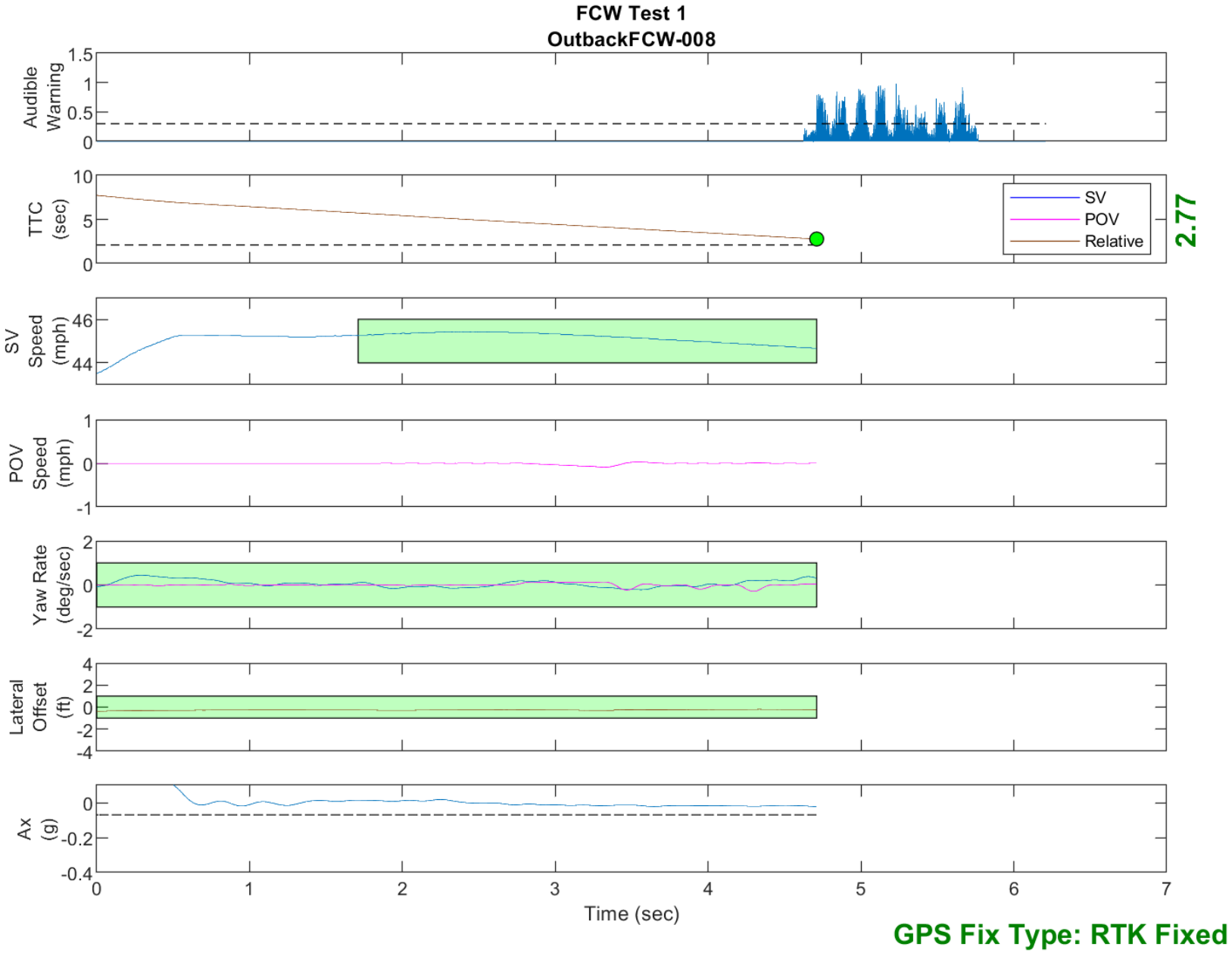


Figure D19. Time History for Run 8, FCW Test 1, Audible Warning

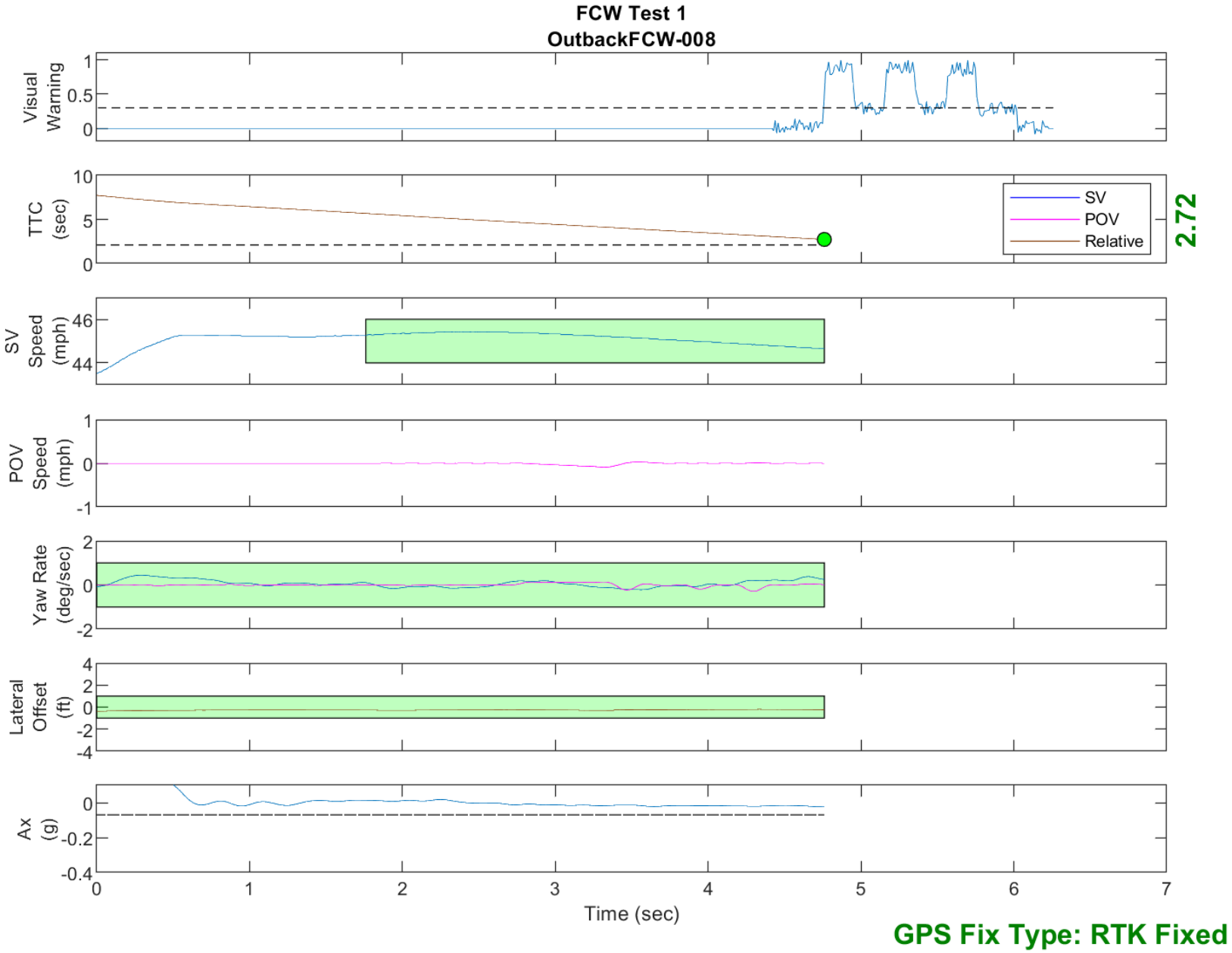


Figure D20. Time History for Run 8, FCW Test 1, Visual Warning

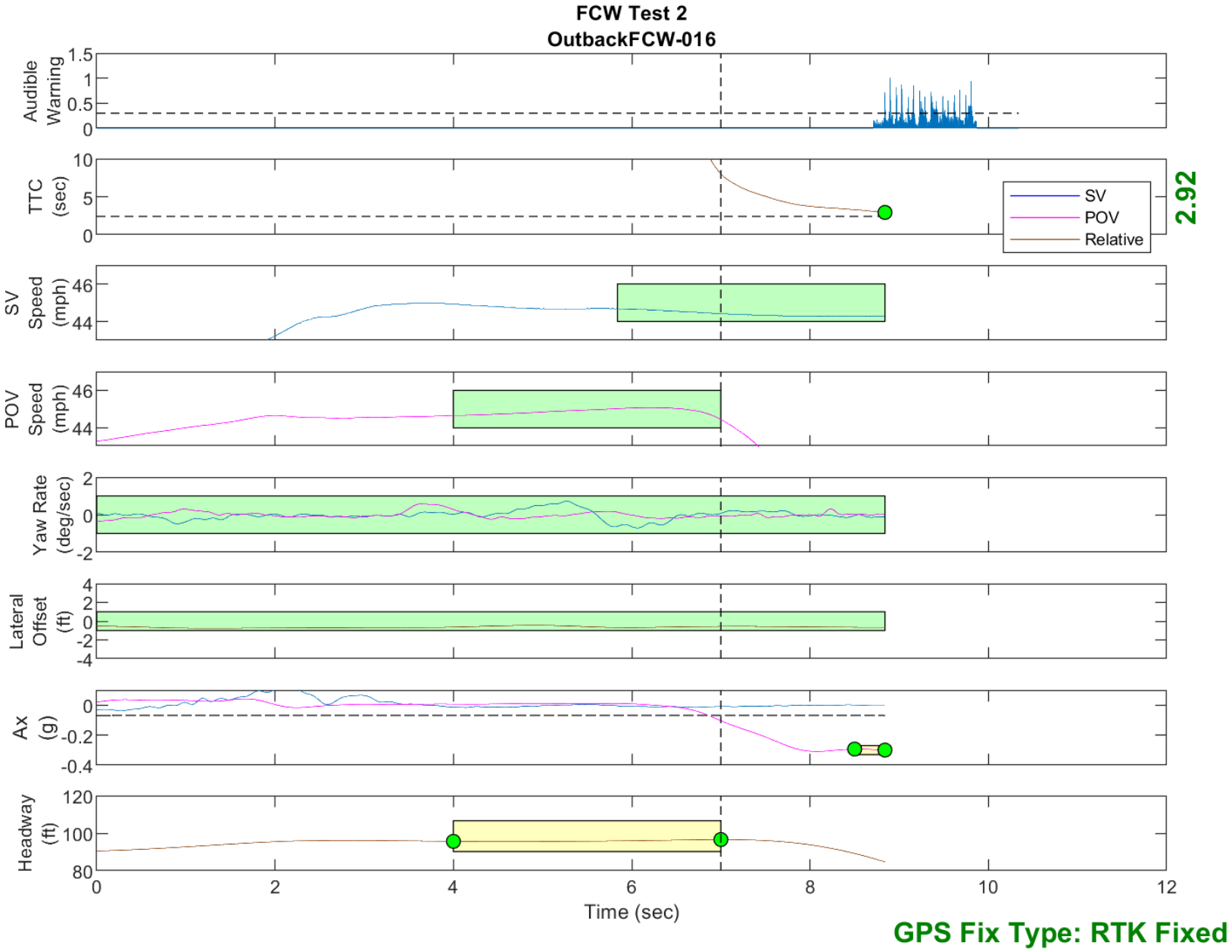


Figure D21. Time History for Run 16, FCW Test 2, Audible Warning

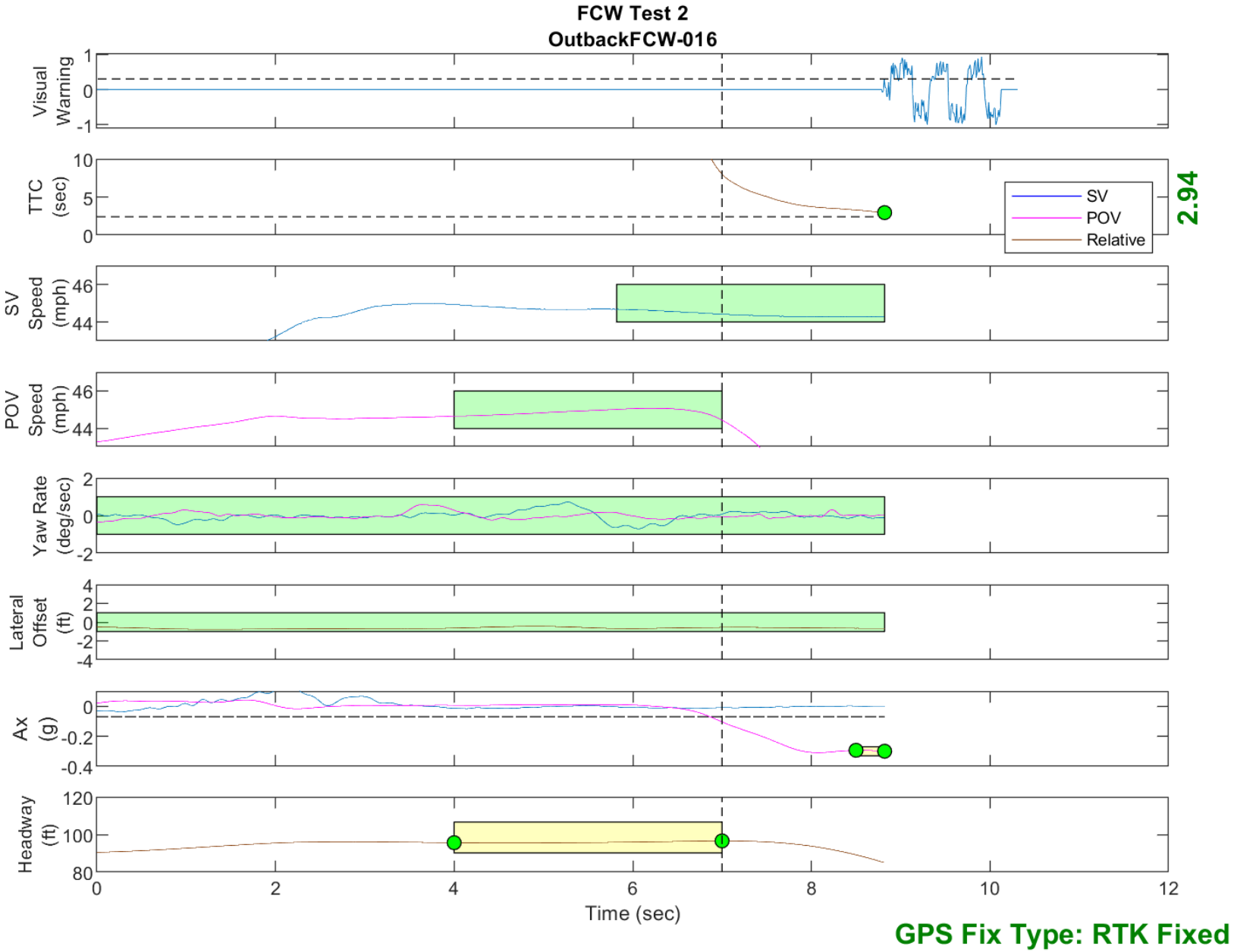


Figure D22. Time History for Run 16, FCW Test 2, Visual Warning

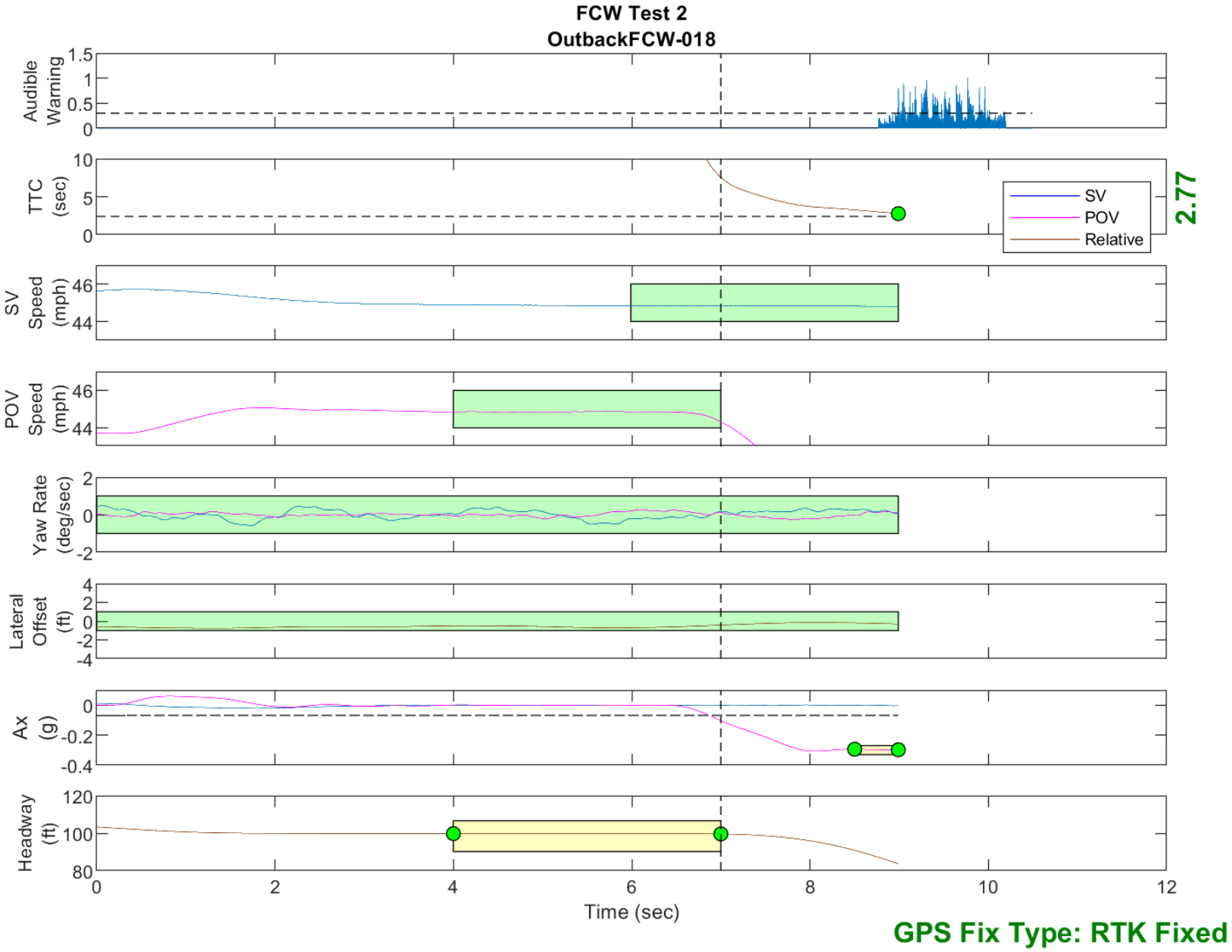


Figure D23. Time History for Run 18, FCW Test 2, Audible Warning

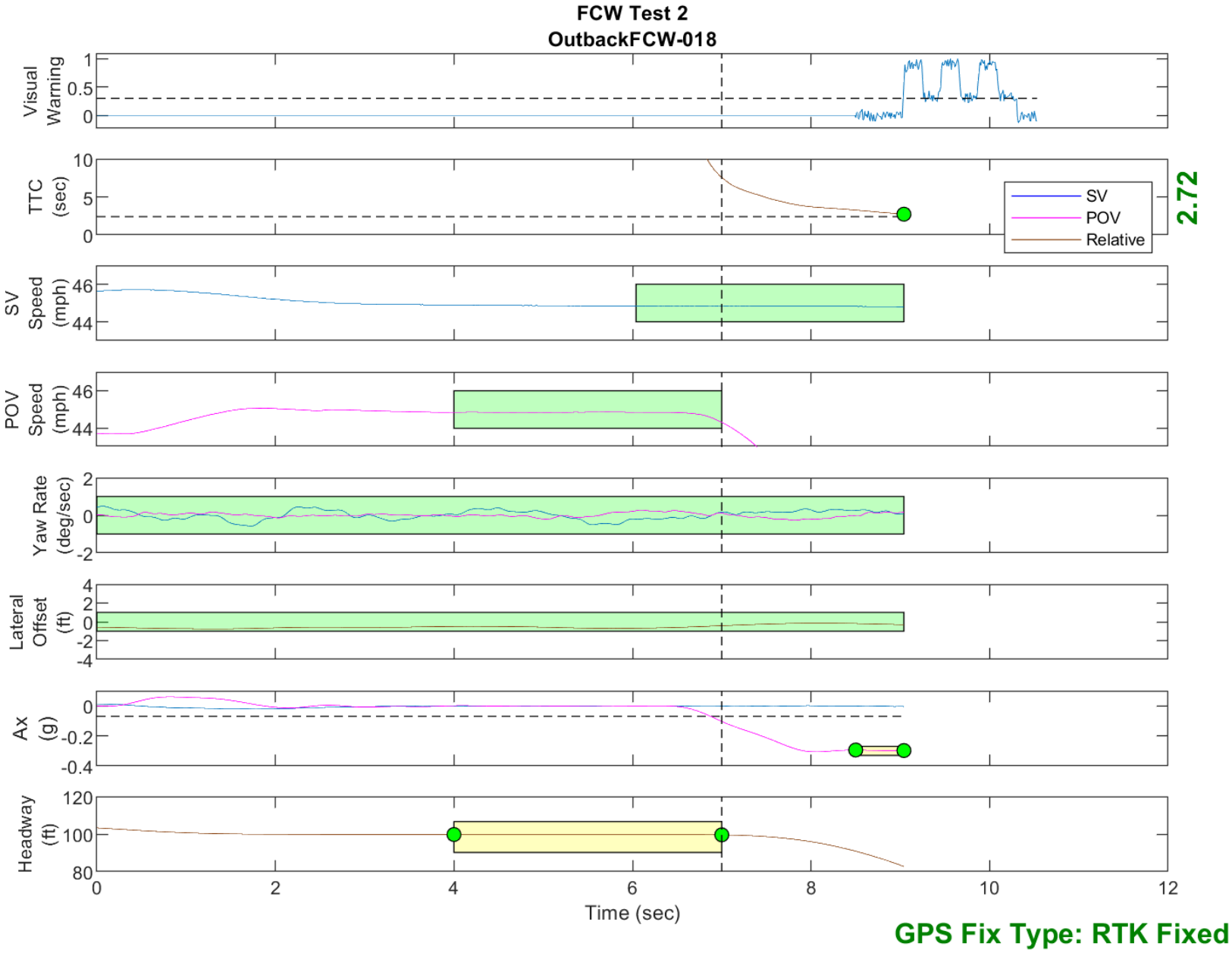


Figure D24. Time History for Run 18, FCW Test 2, Visual Warning

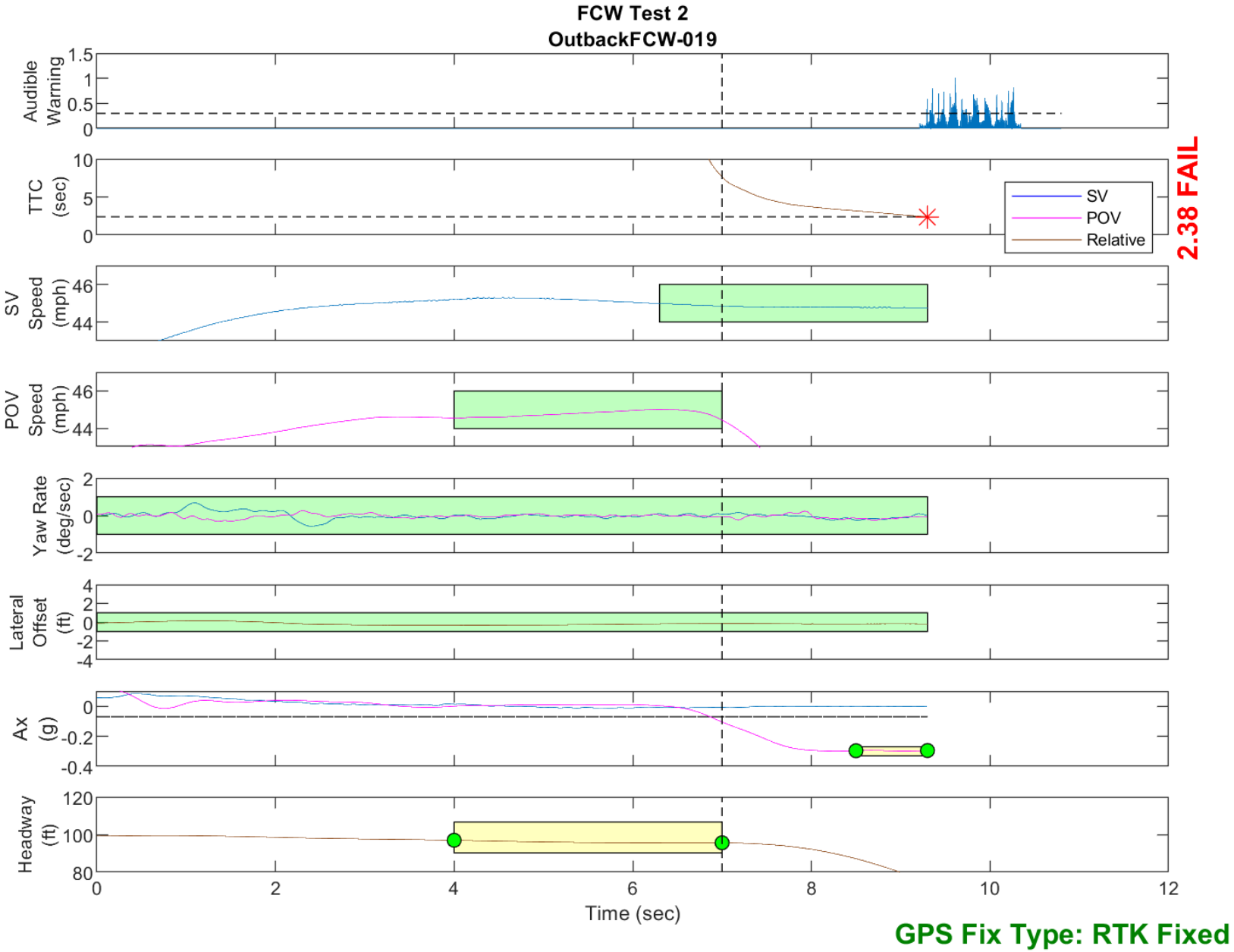


Figure D25. Time History for Run 19, FCW Test 2, Audible Warning

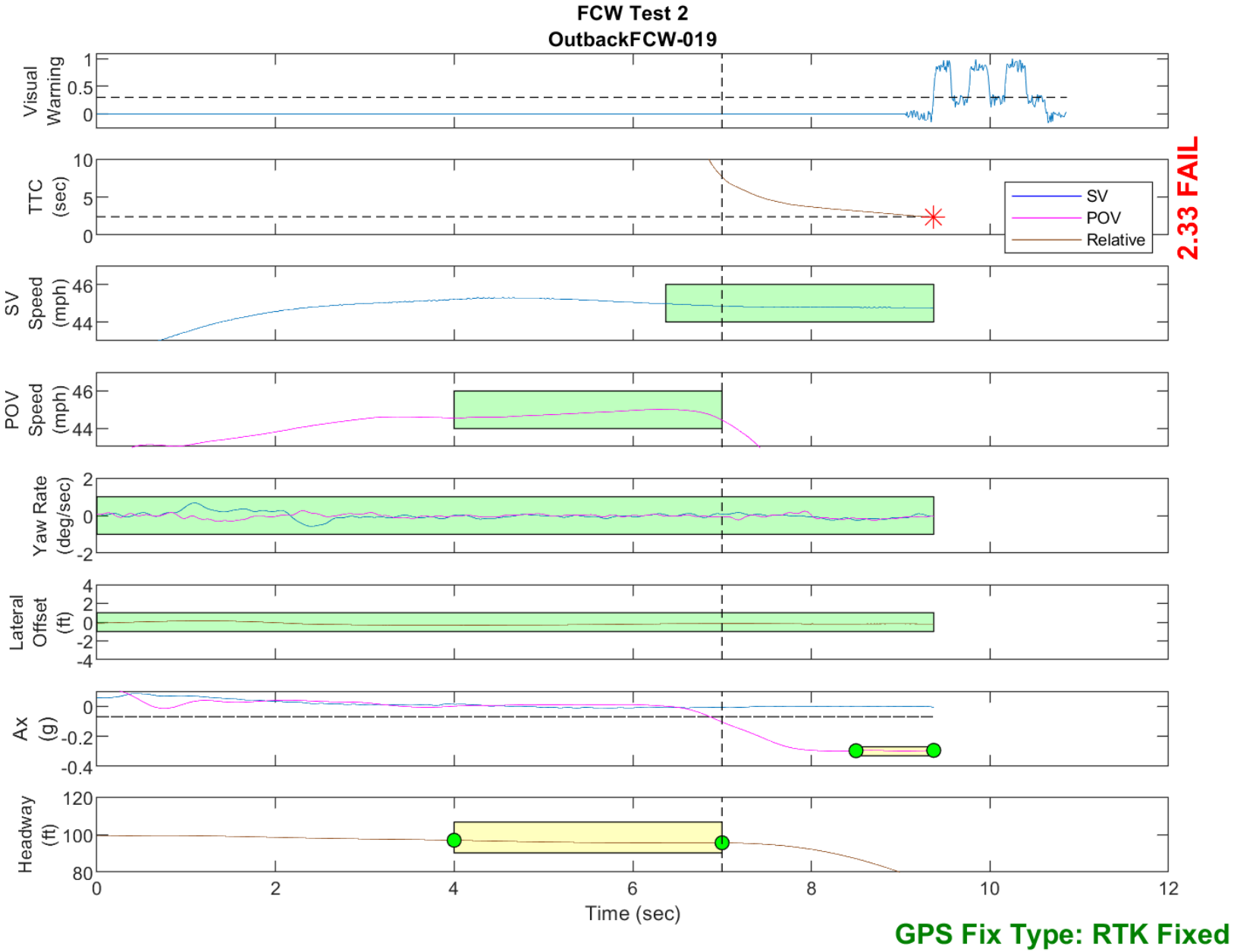


Figure D26. Time History for Run 19, FCW Test 2, Visual Warning

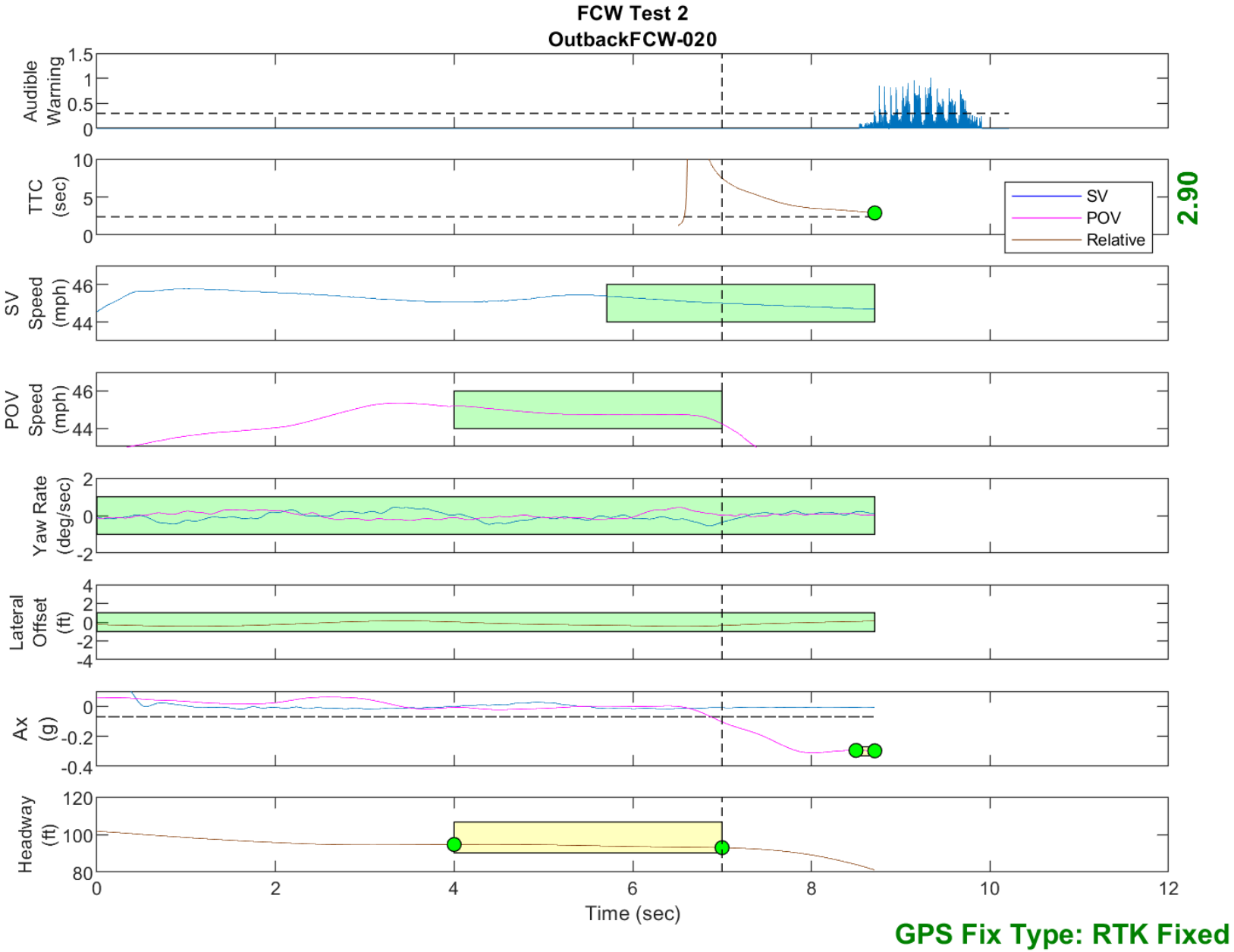


Figure D27. Time History for Run 20, FCW Test 2, Audible Warning

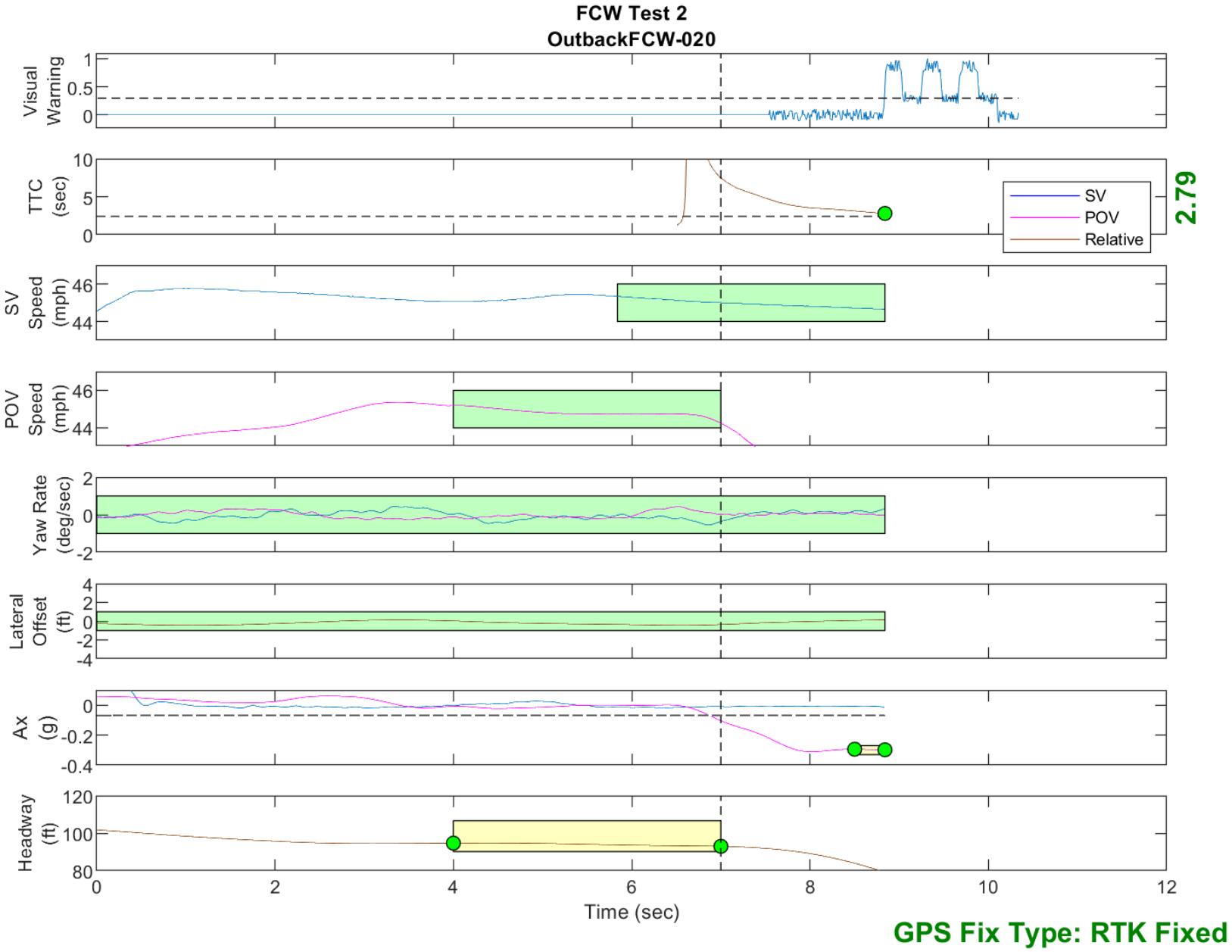


Figure D28. Time History for Run 20, FCW Test 2, Visual Warning

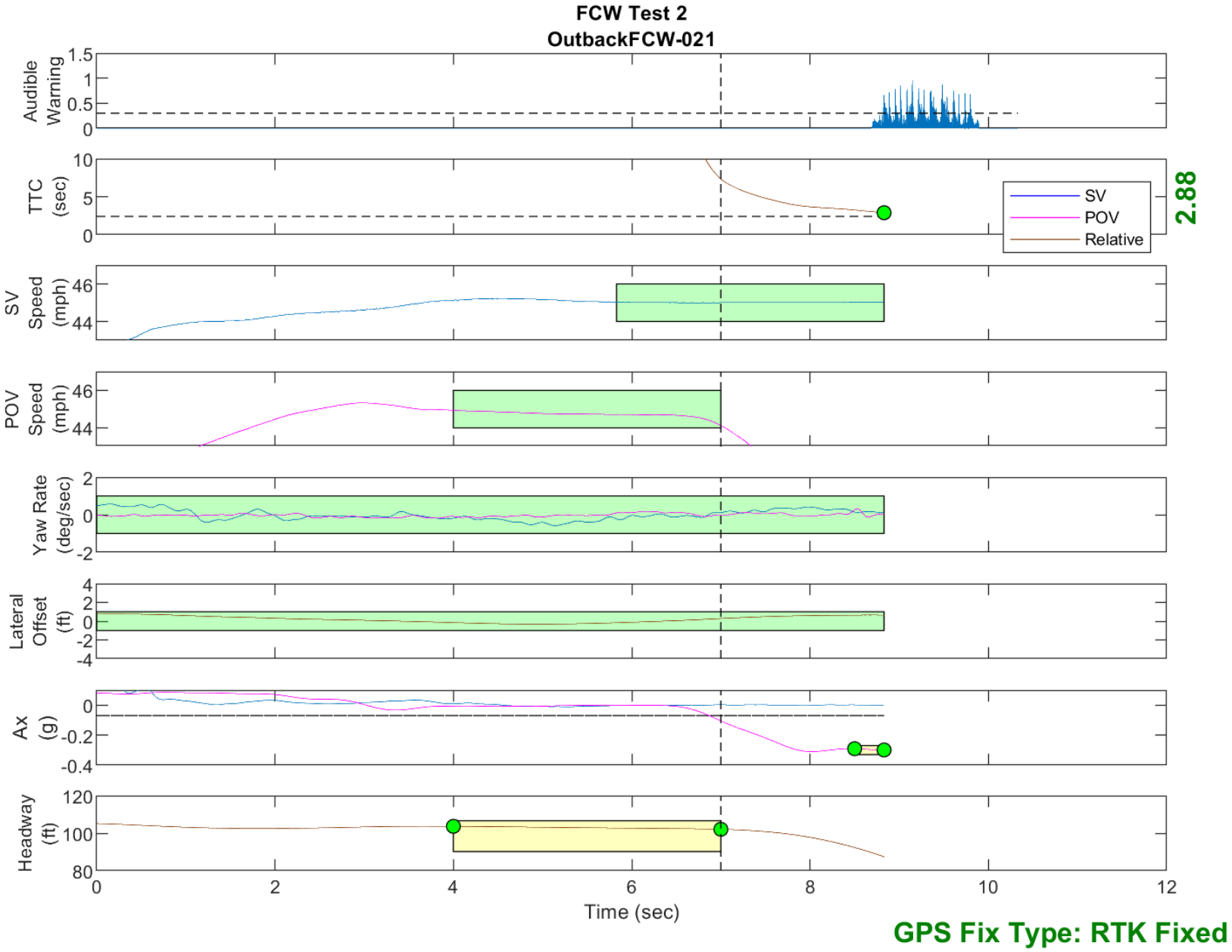


Figure D29. Time History for Run 21, FCW Test 2, Audible Warning

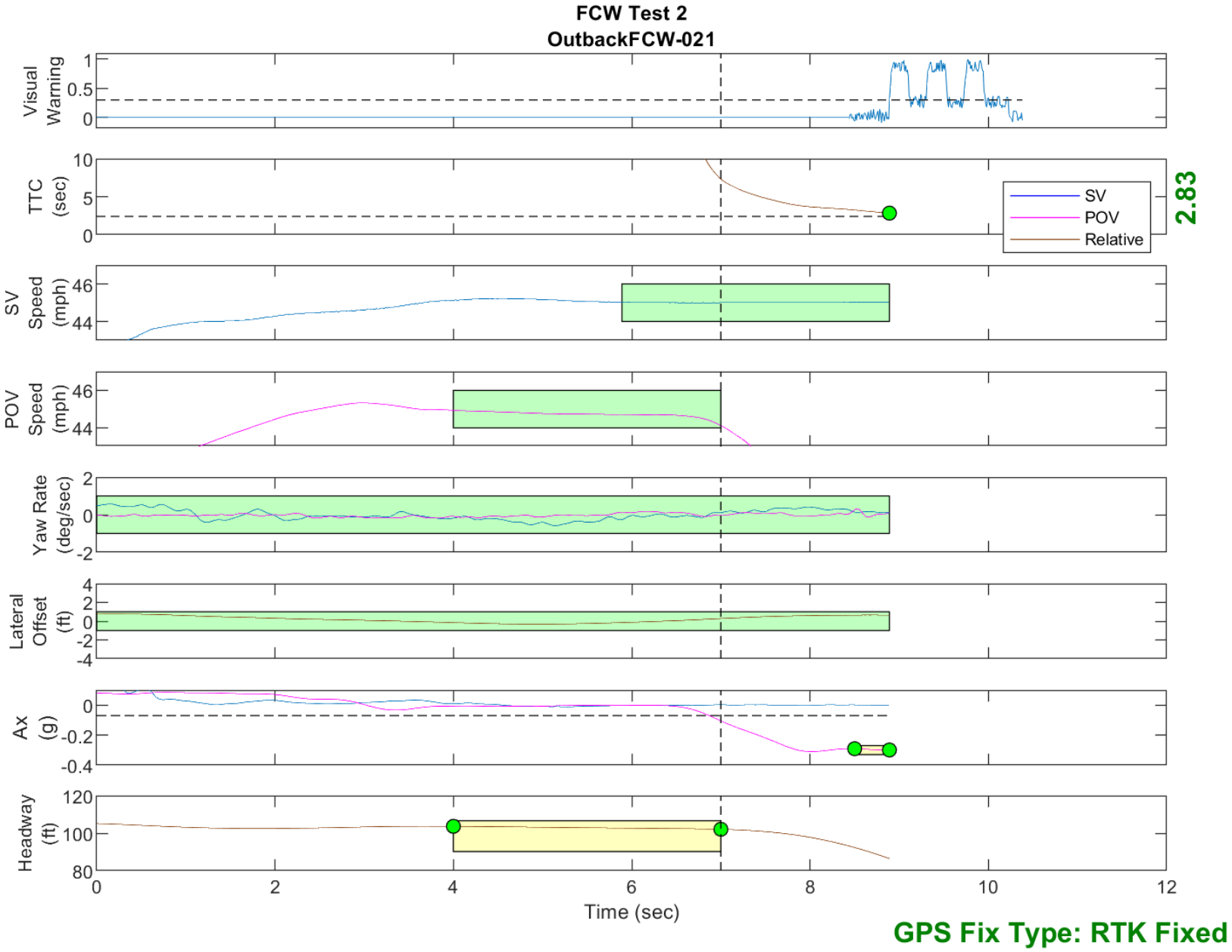


Figure D30. Time History for Run 21, FCW Test 2, Visual Warning

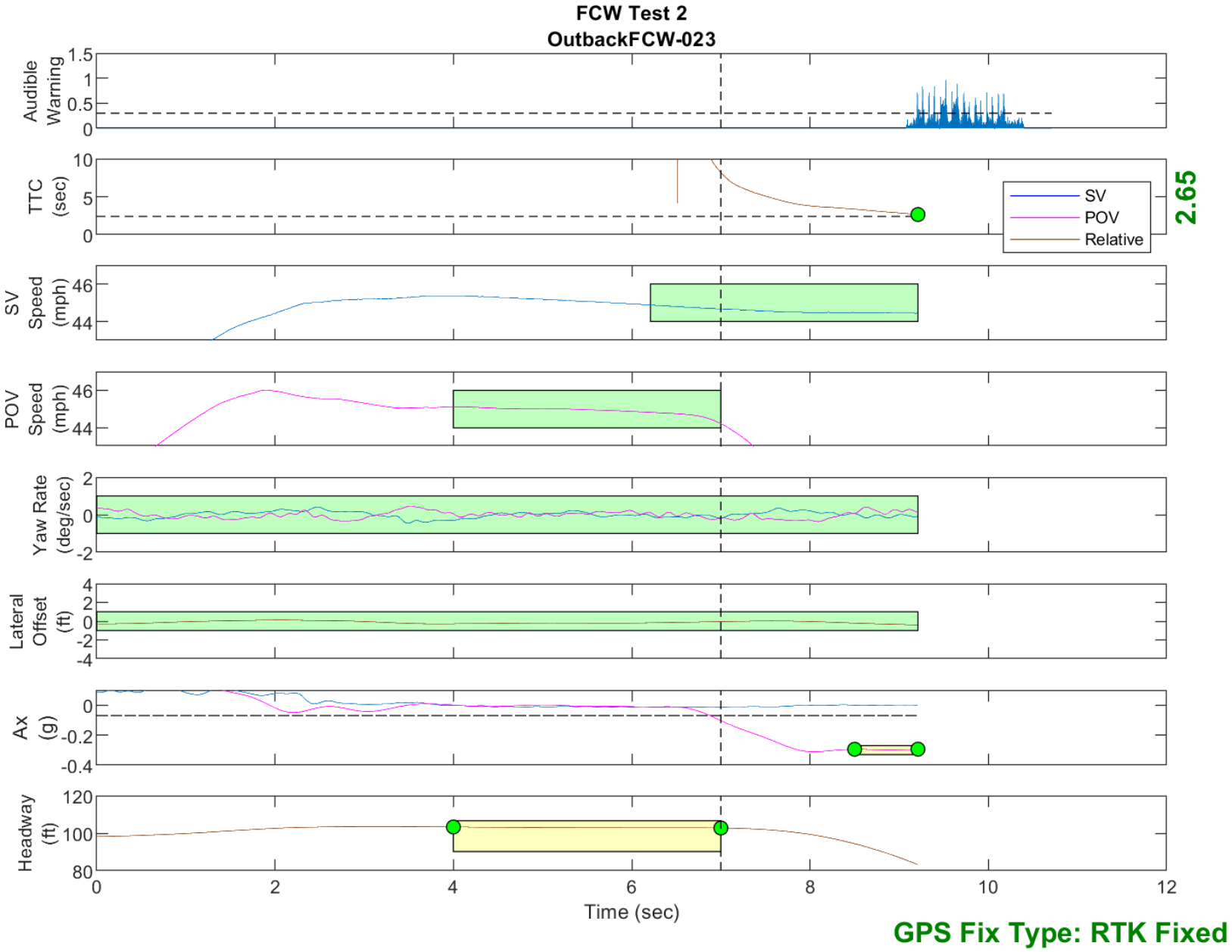


Figure D31. Time History for Run 23, FCW Test 2, Audible Warning

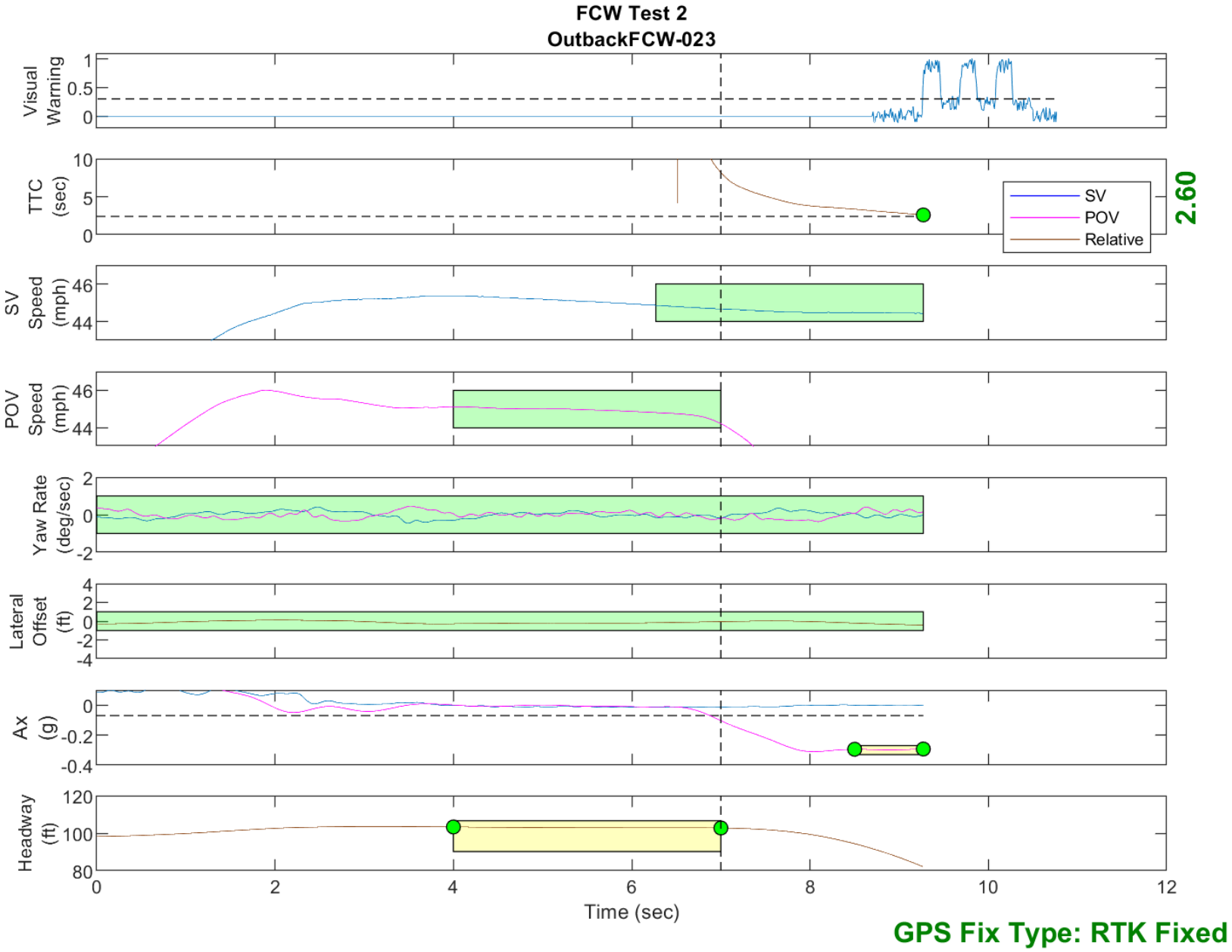


Figure D32. Time History for Run 23, FCW Test 2, Visual Warning

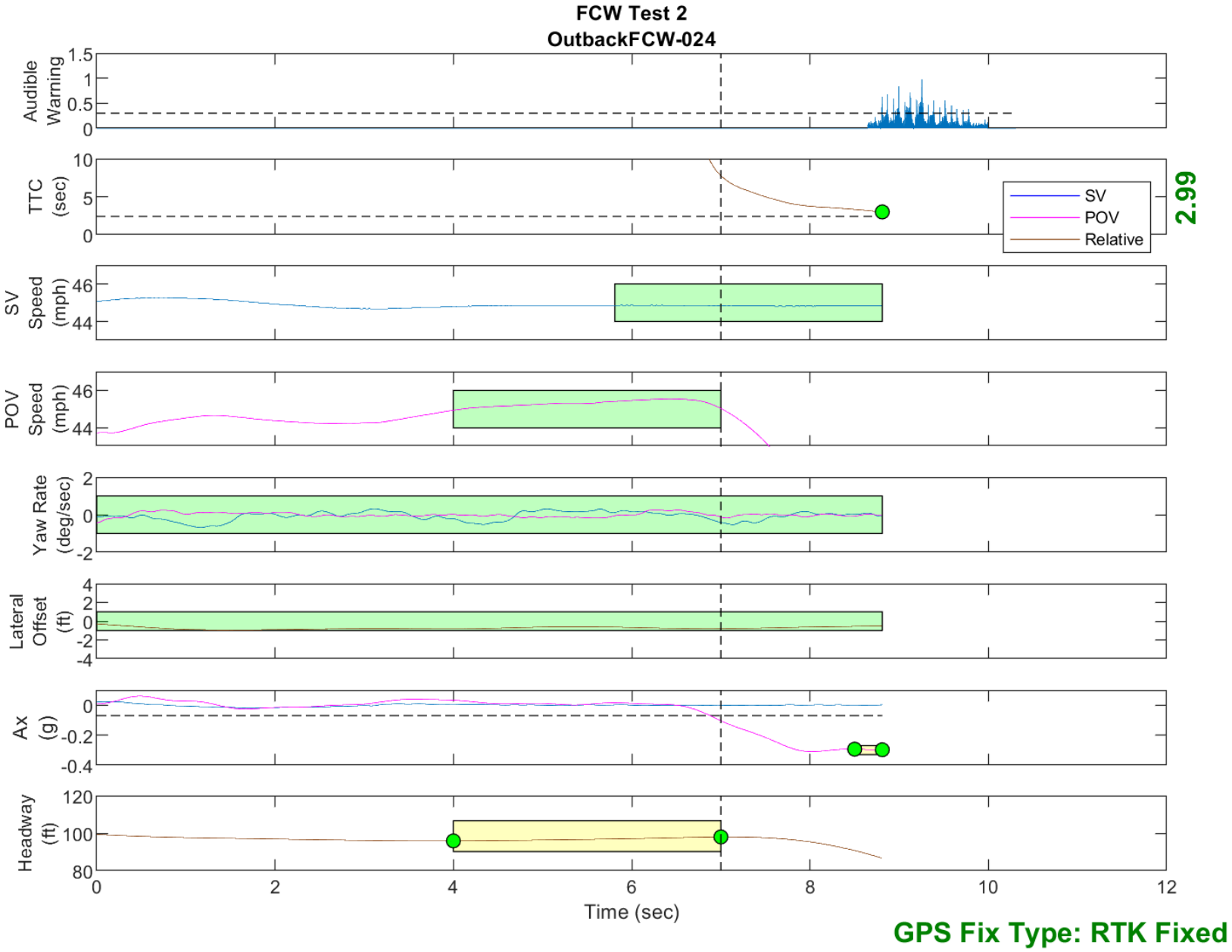


Figure D33. Time History for Run 24, FCW Test 2, Audible Warning

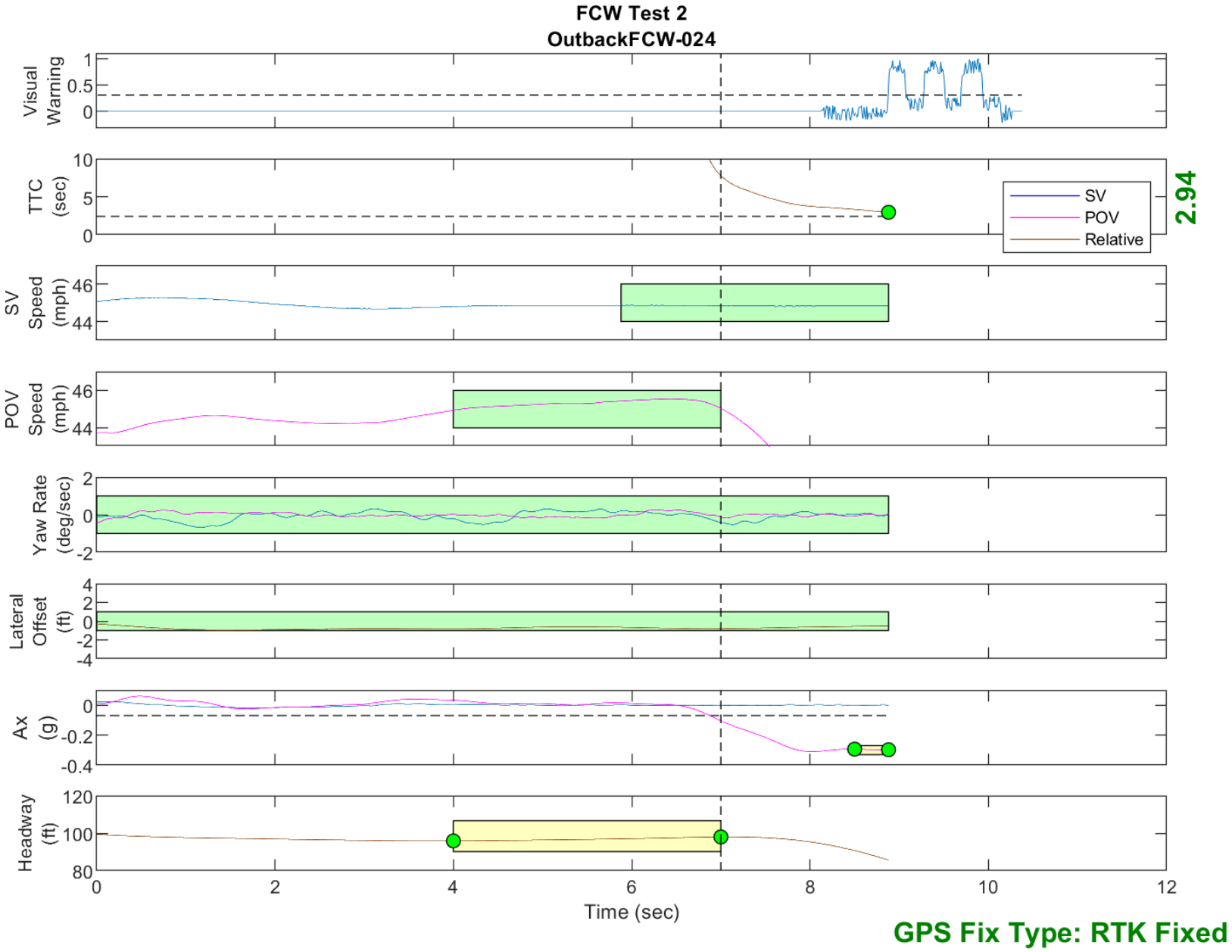


Figure D34. Time History for Run 24, FCW Test 2, Visual Warning

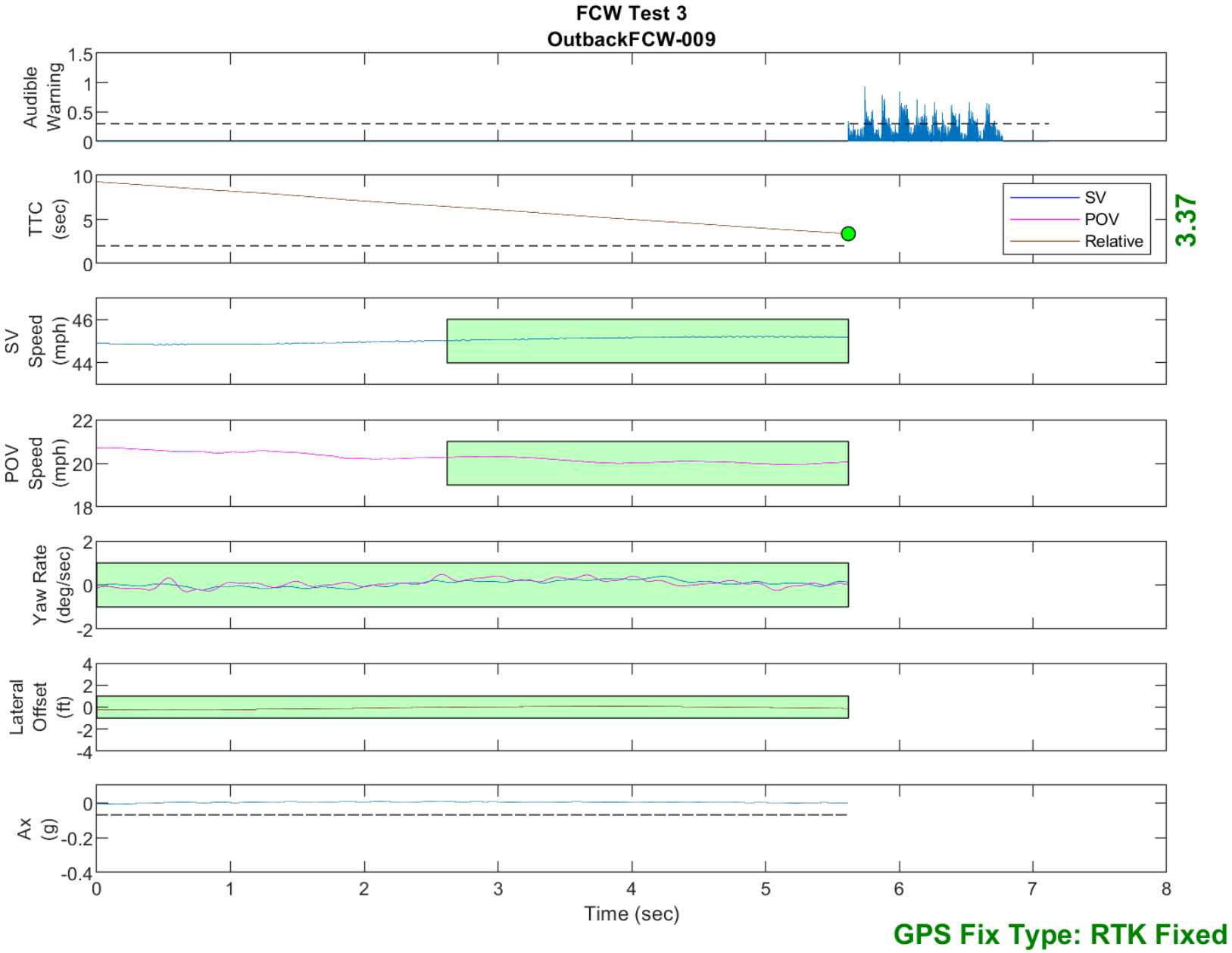


Figure D35. Time History for Run 9, FCW Test 3, Audible Warning

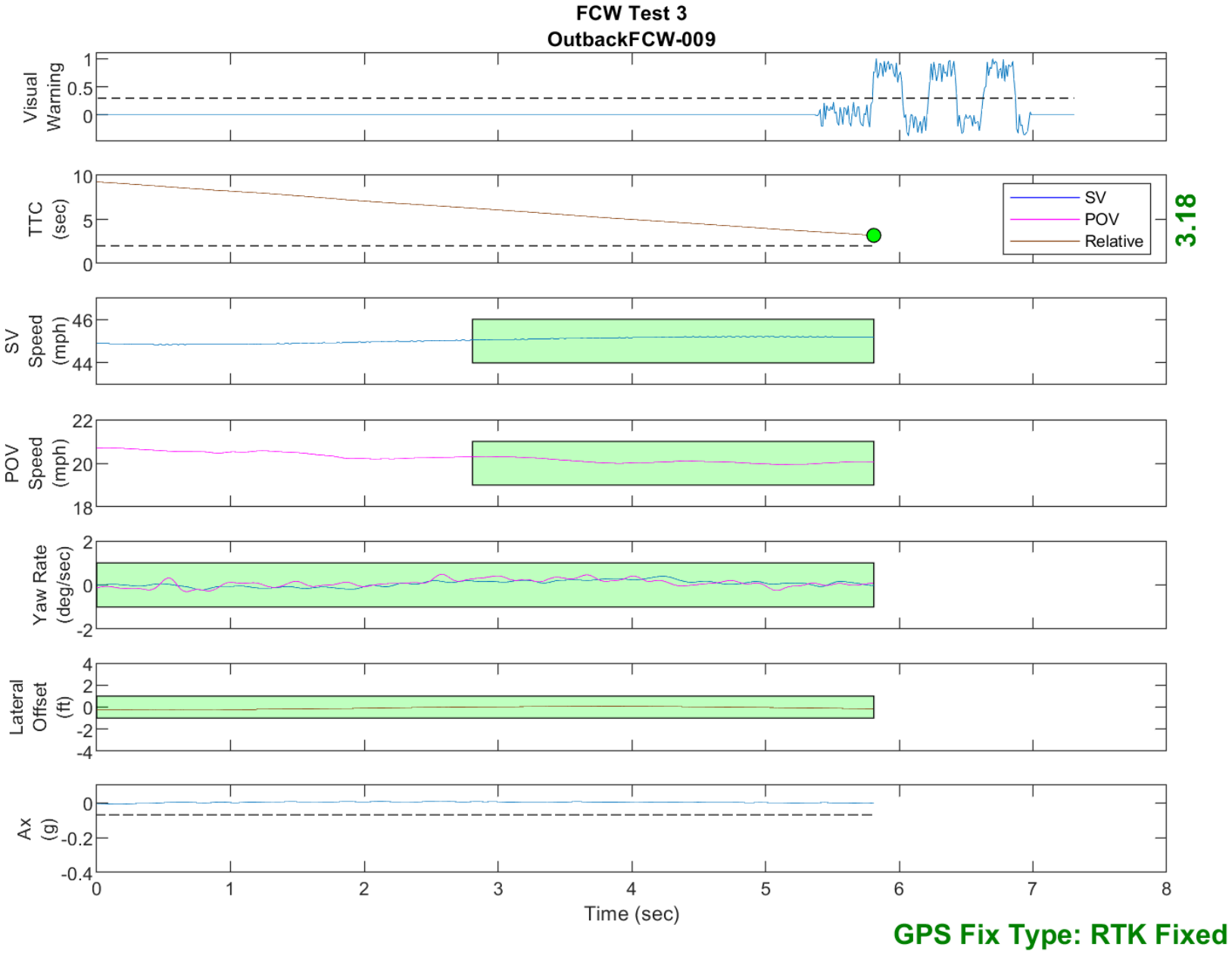


Figure D36. Time History for Run 9, FCW Test 3, Visual Warning

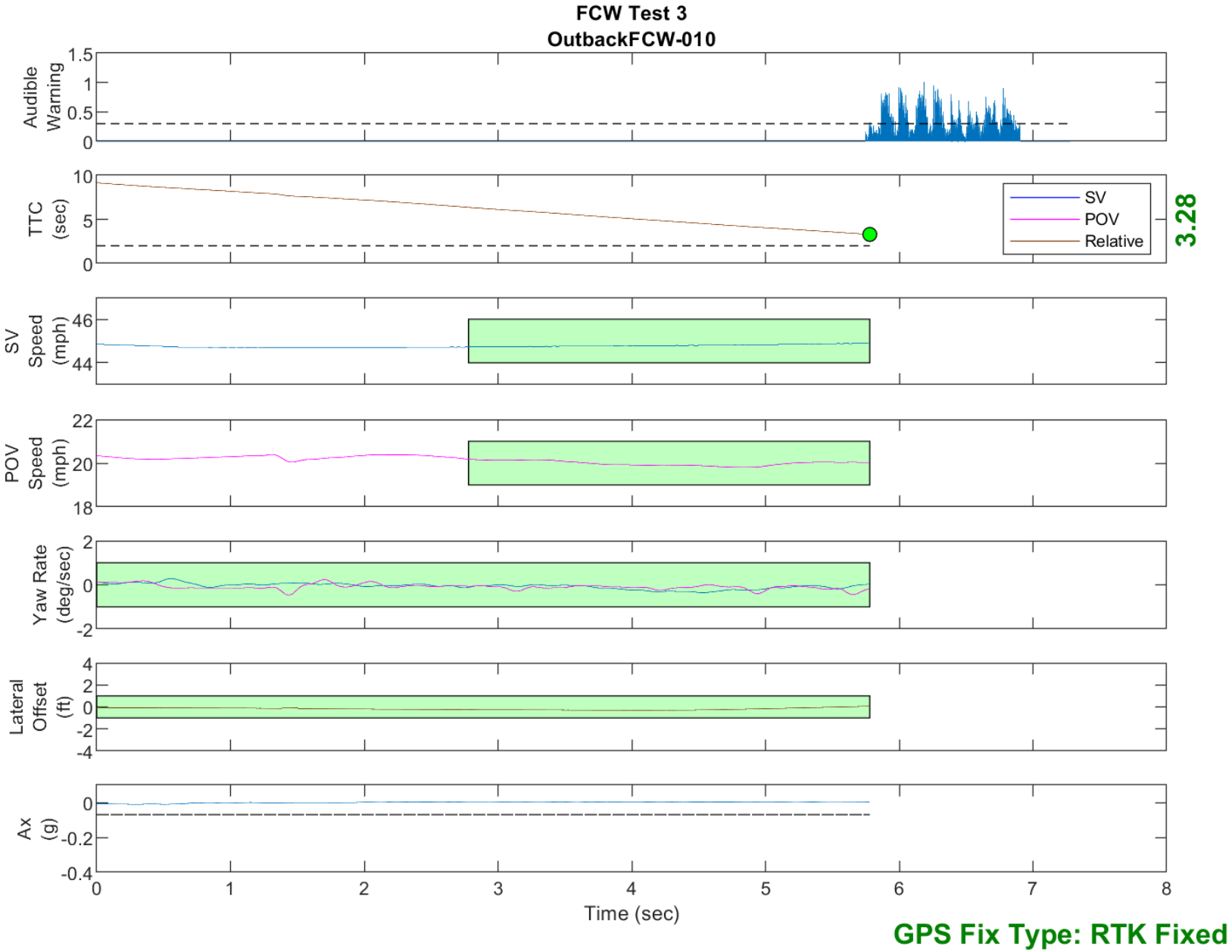


Figure D37. Time History for Run 10, FCW Test 3, Audible Warning

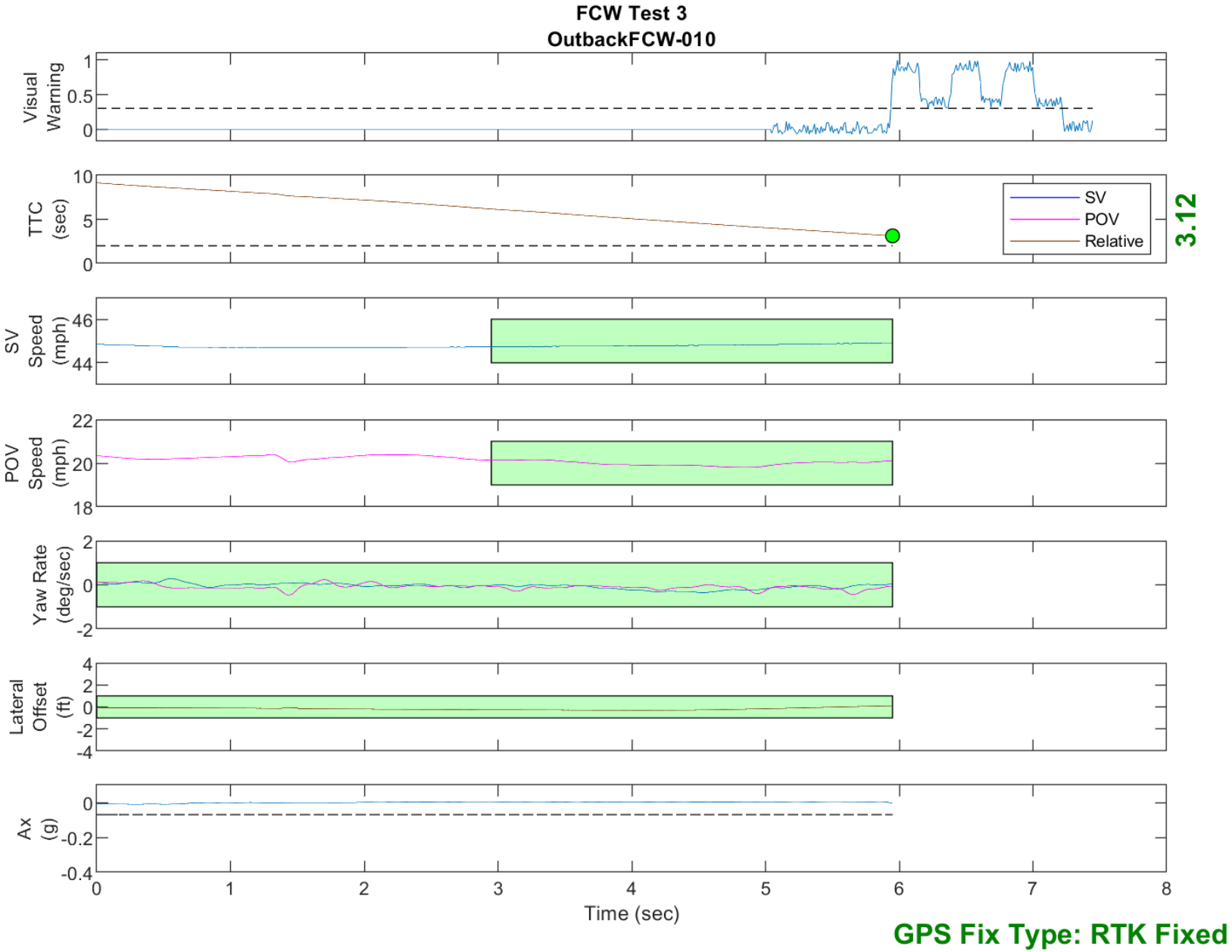


Figure D38. Time History for Run 10, FCW Test 3, Visual Warning

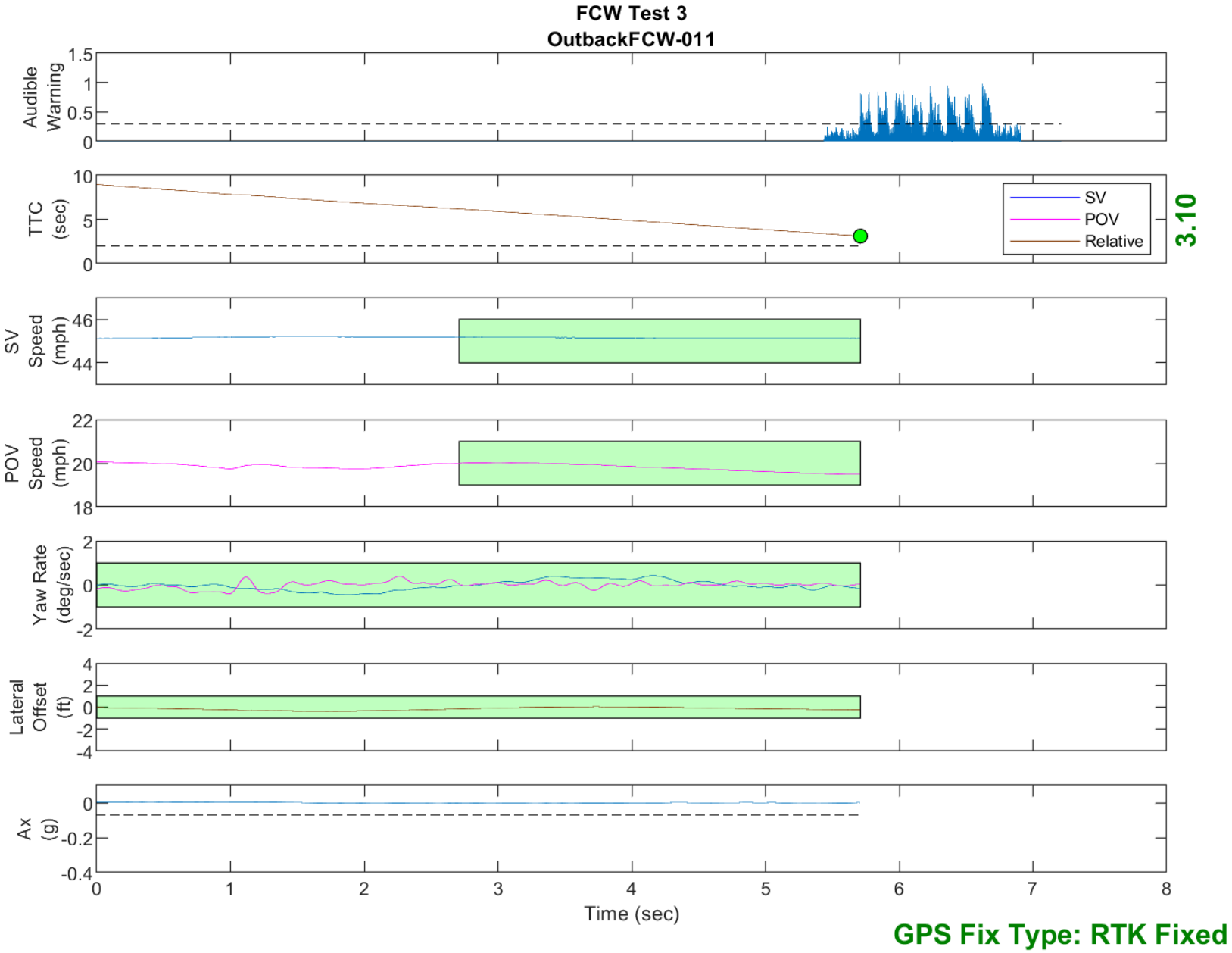


Figure D39. Time History for Run 11, FCW Test 3, Audible Warning

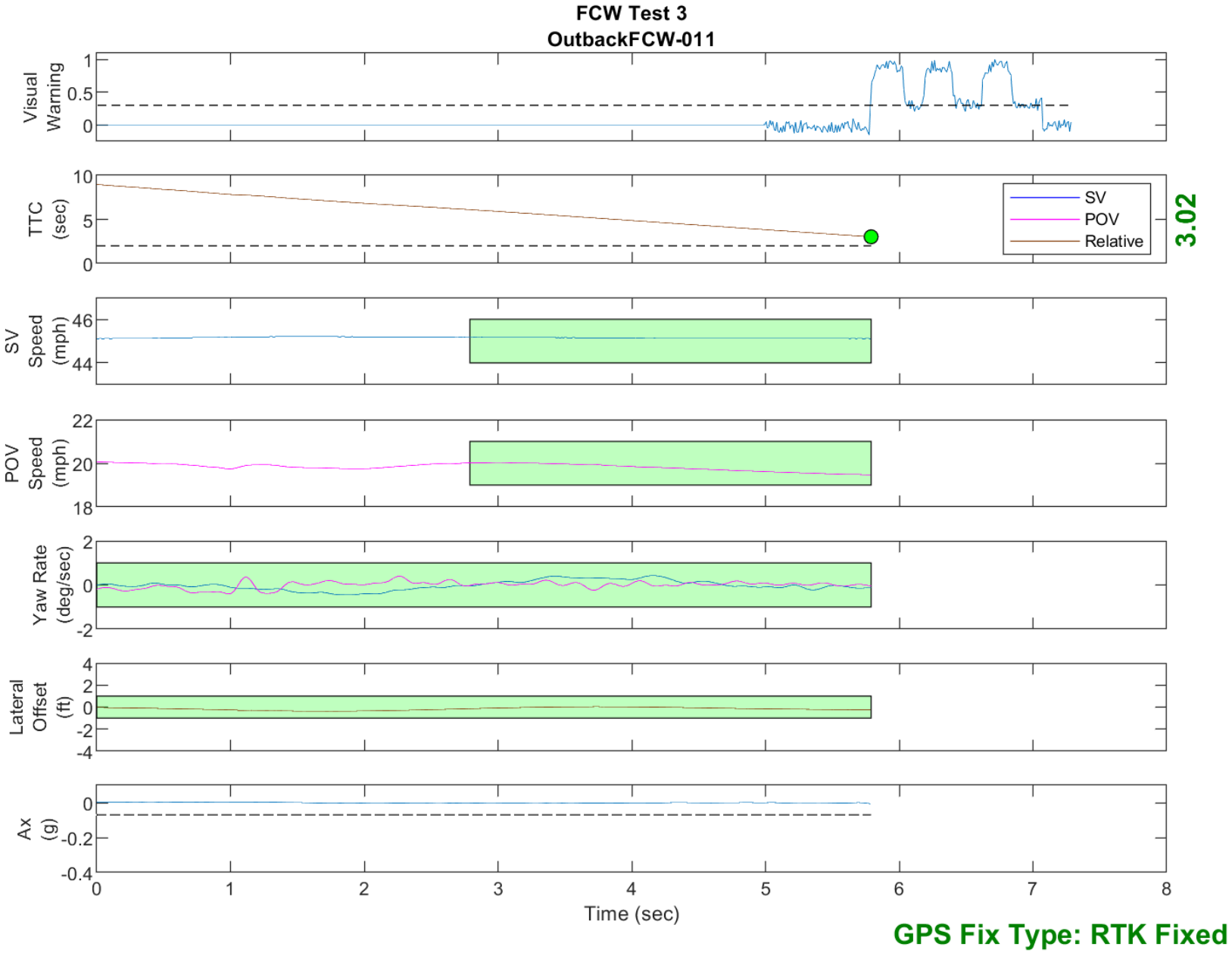


Figure D40. Time History for Run 11, FCW Test 3, Visual Warning

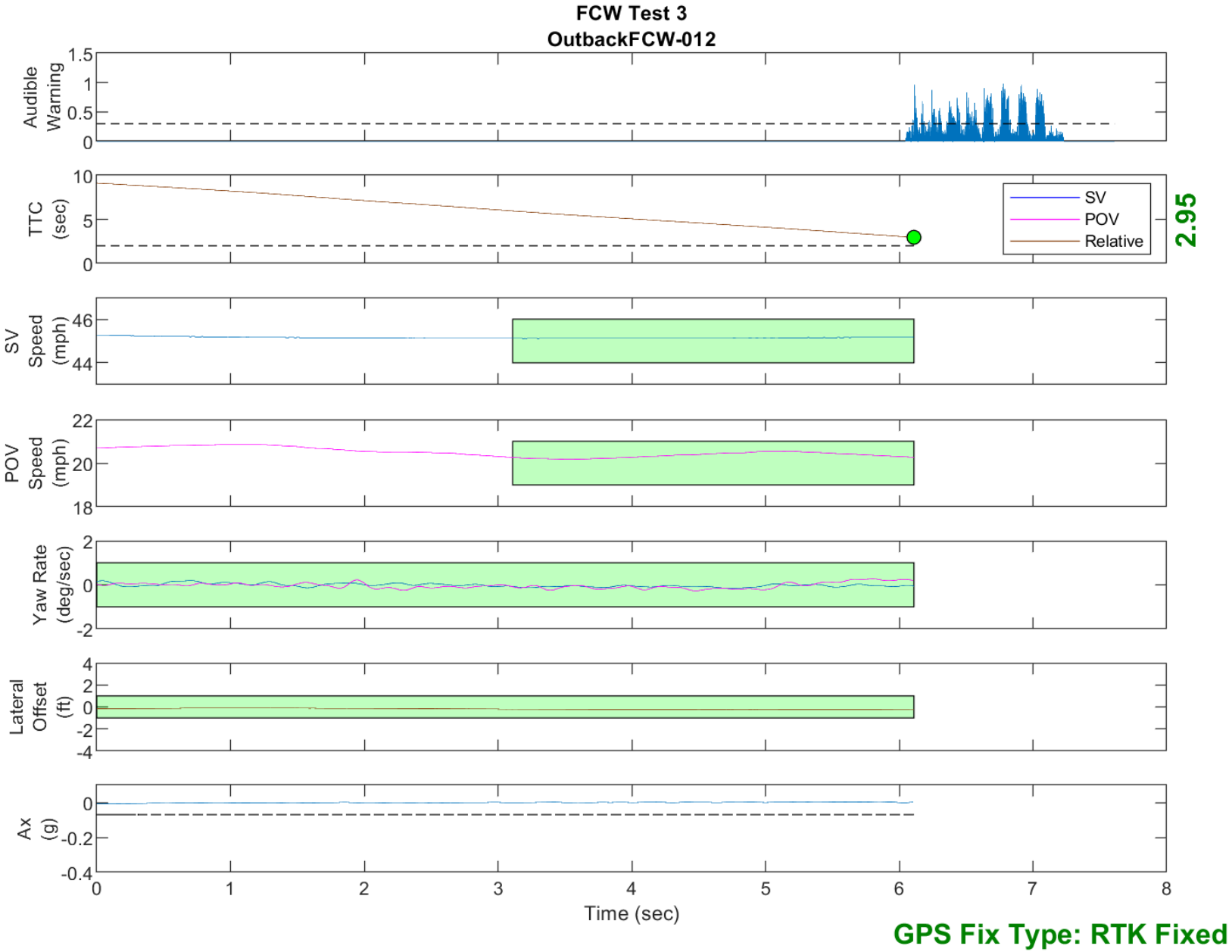


Figure D41. Time History for Run 12, FCW Test 3, Audible Warning

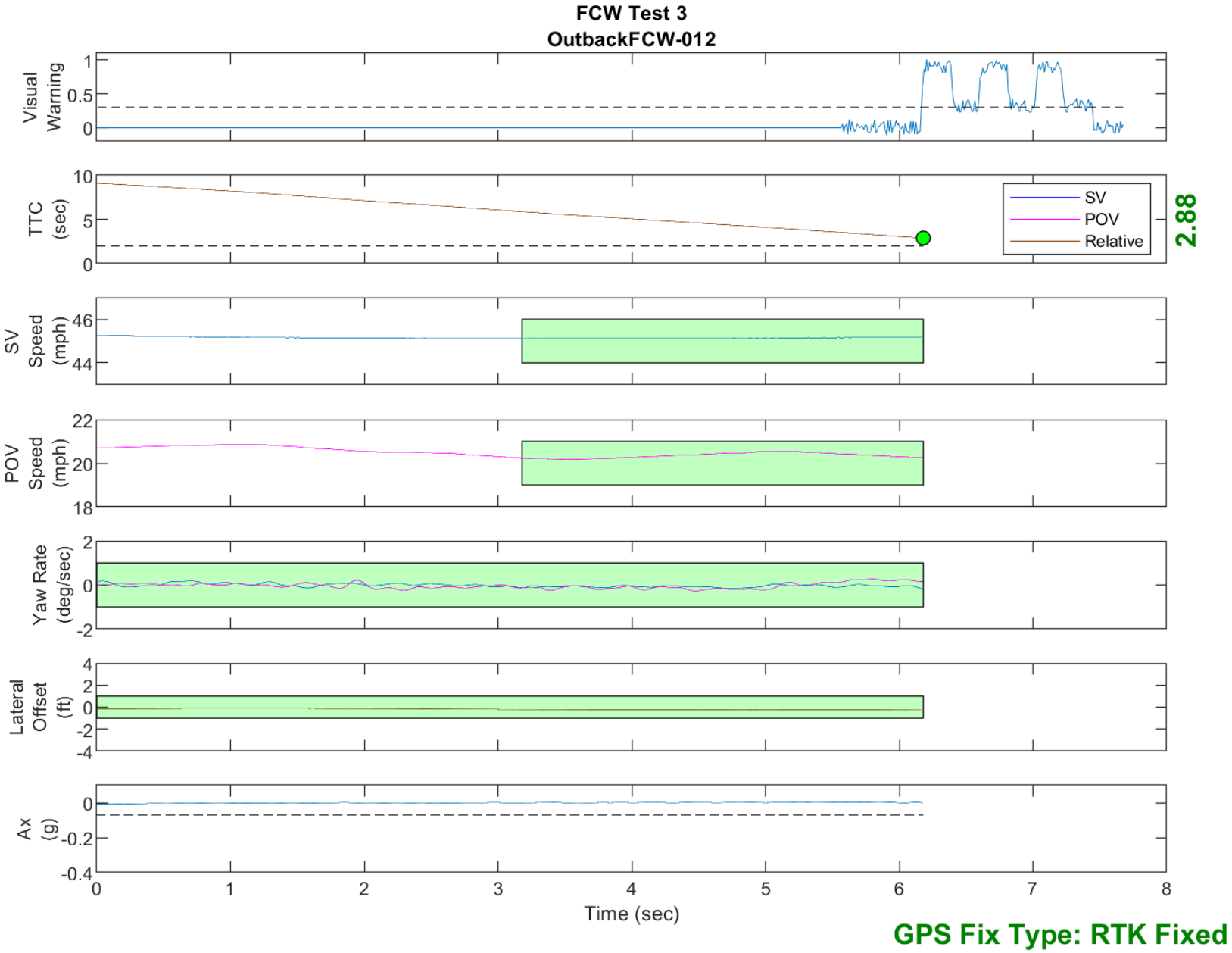


Figure D42. Time History for Run 12, FCW Test 3, Visual Warning

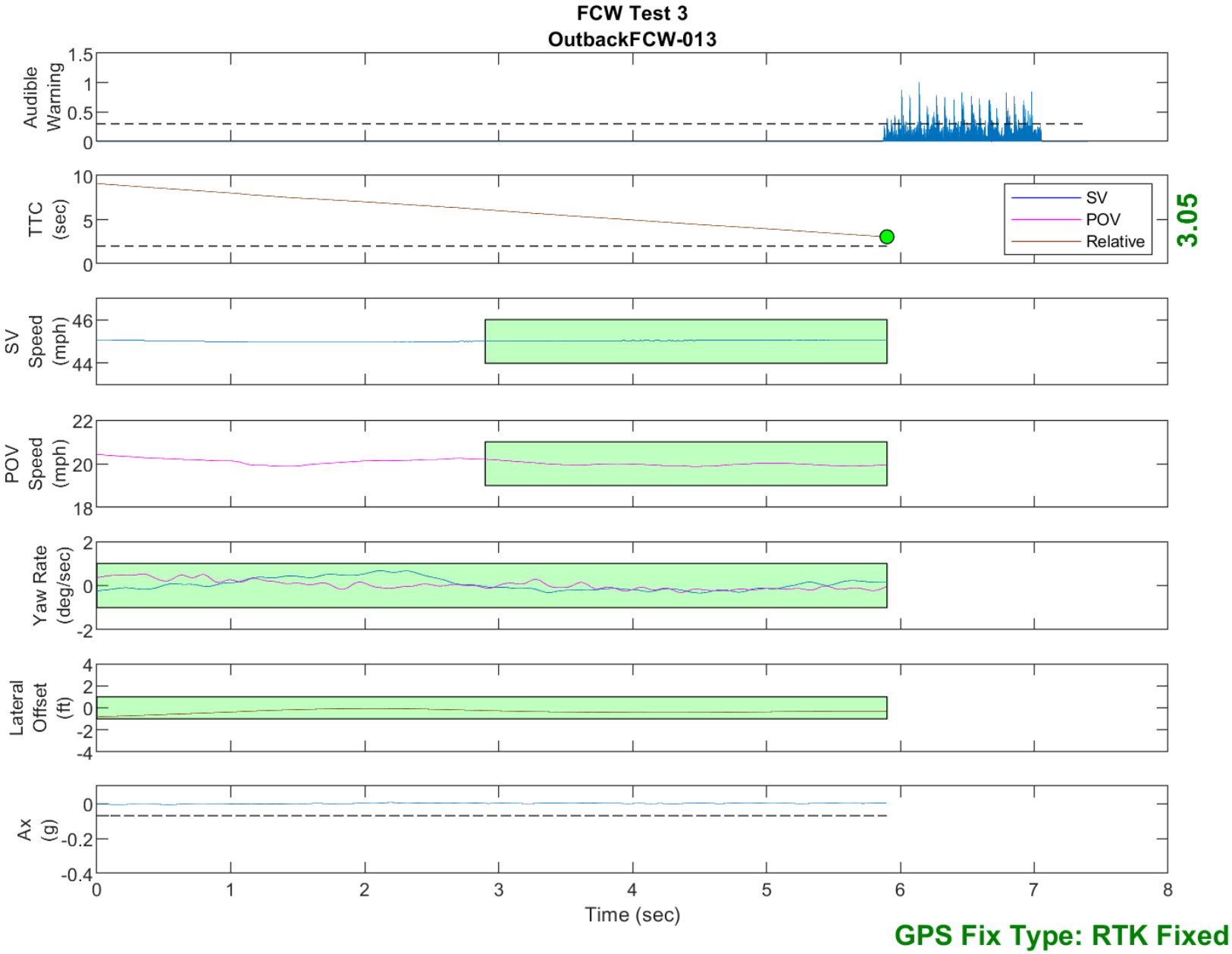


Figure D43. Time History for Run 13, FCW Test 3, Audible Warning

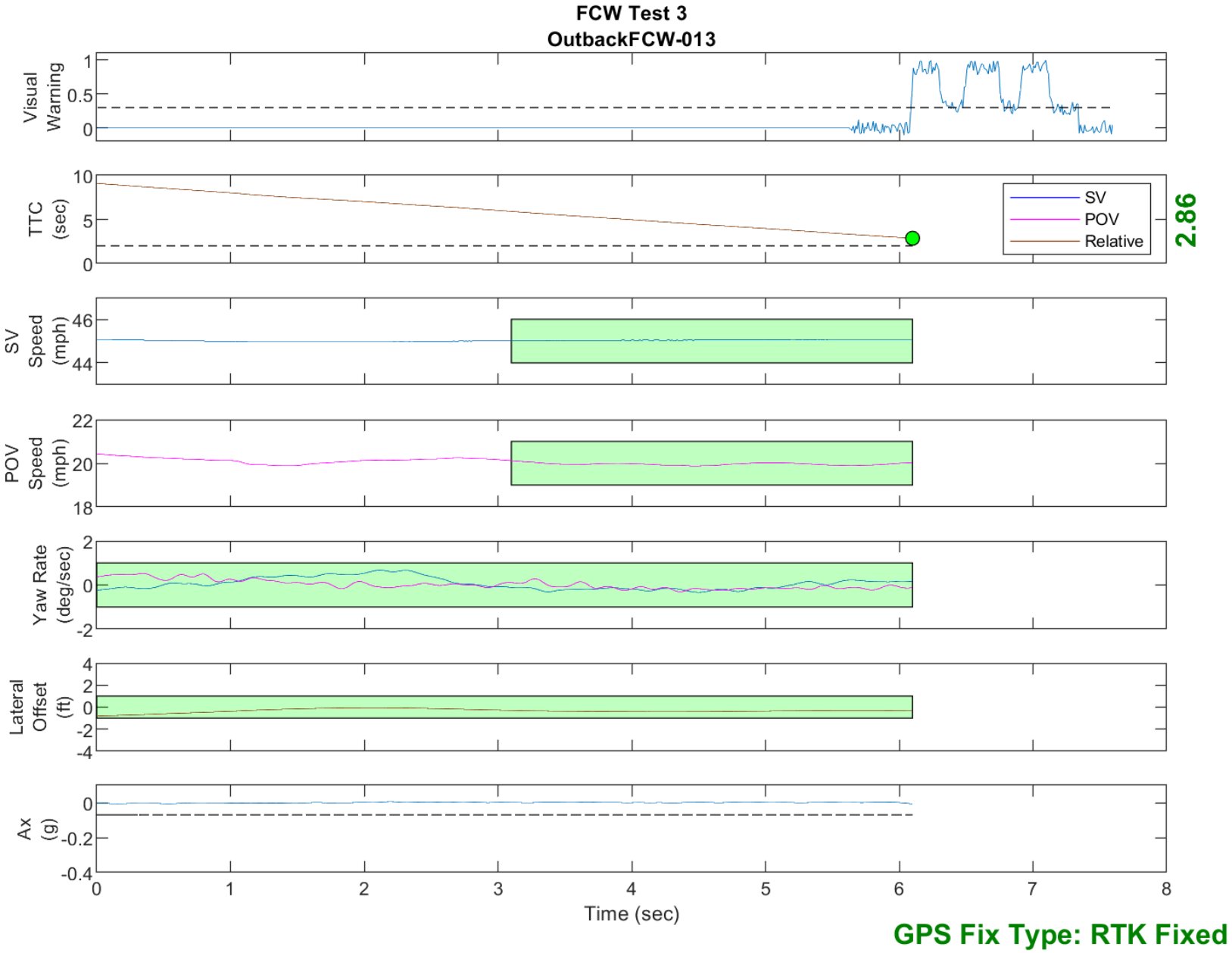


Figure D44. Time History for Run 13, FCW Test 3, Visual Warning

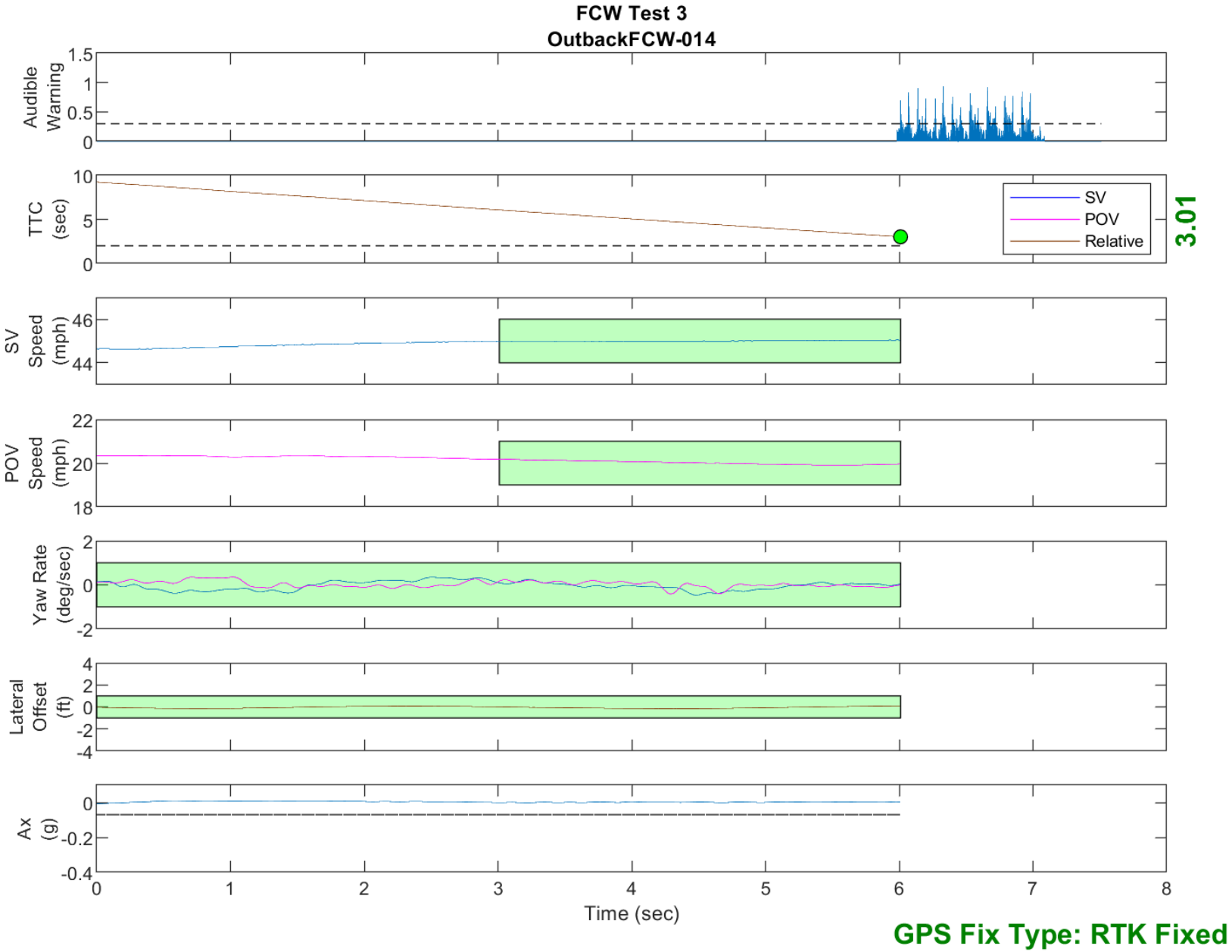


Figure D45. Time History for Run 14, FCW Test 3, Audible Warning

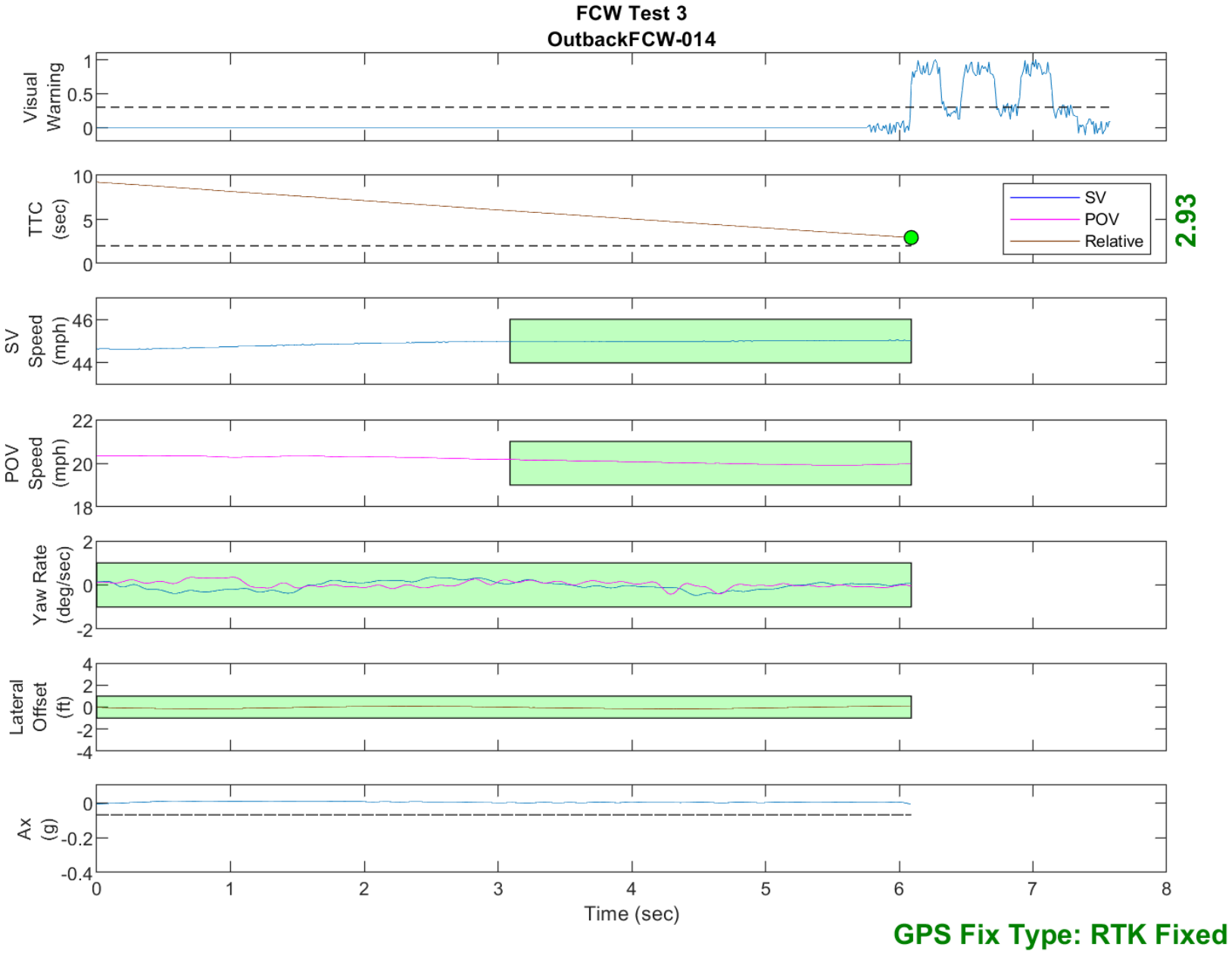


Figure D46. Time History for Run 14, FCW Test 3, Visual Warning

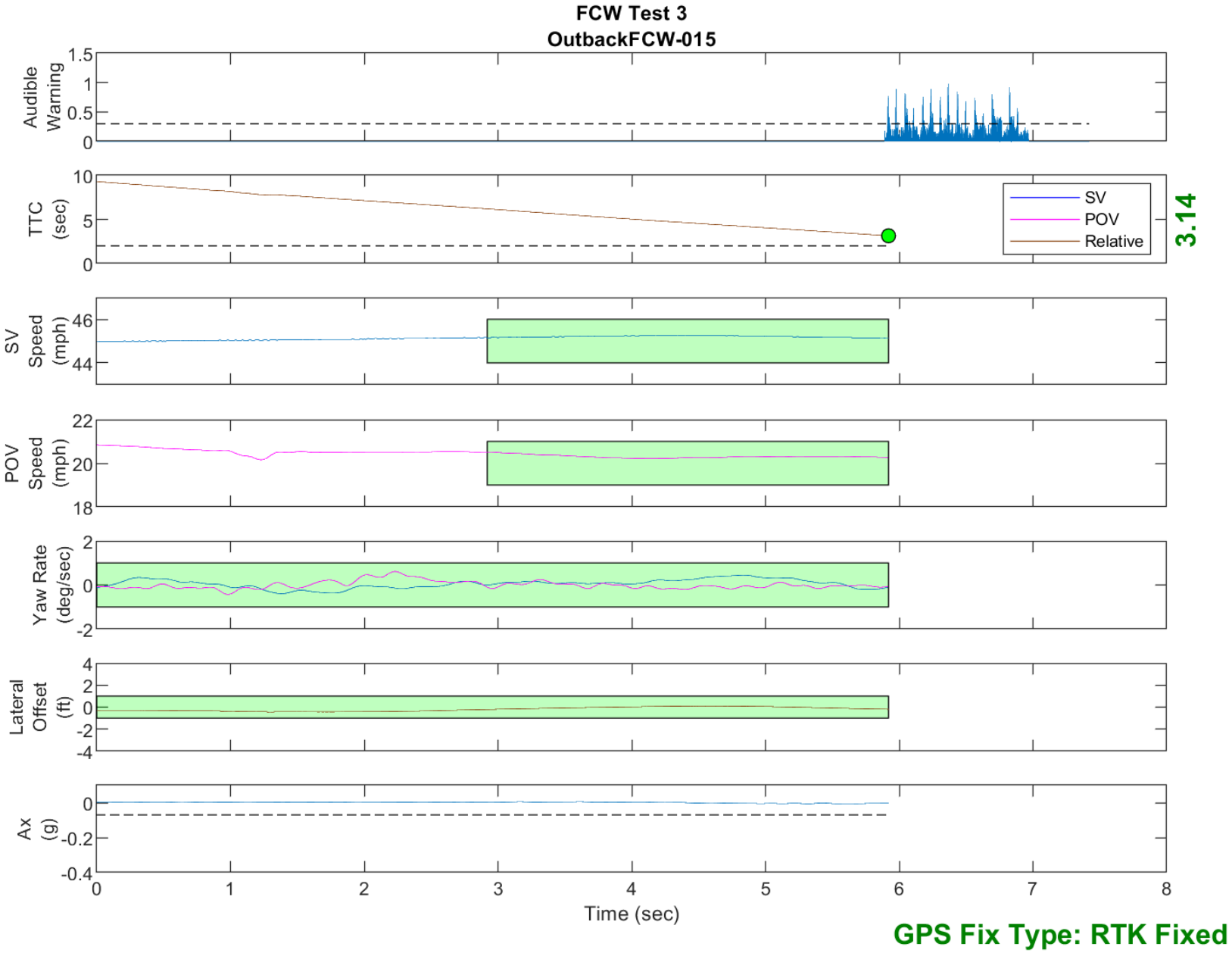


Figure D47. Time History for Run 15, FCW Test 3, Audible Warning

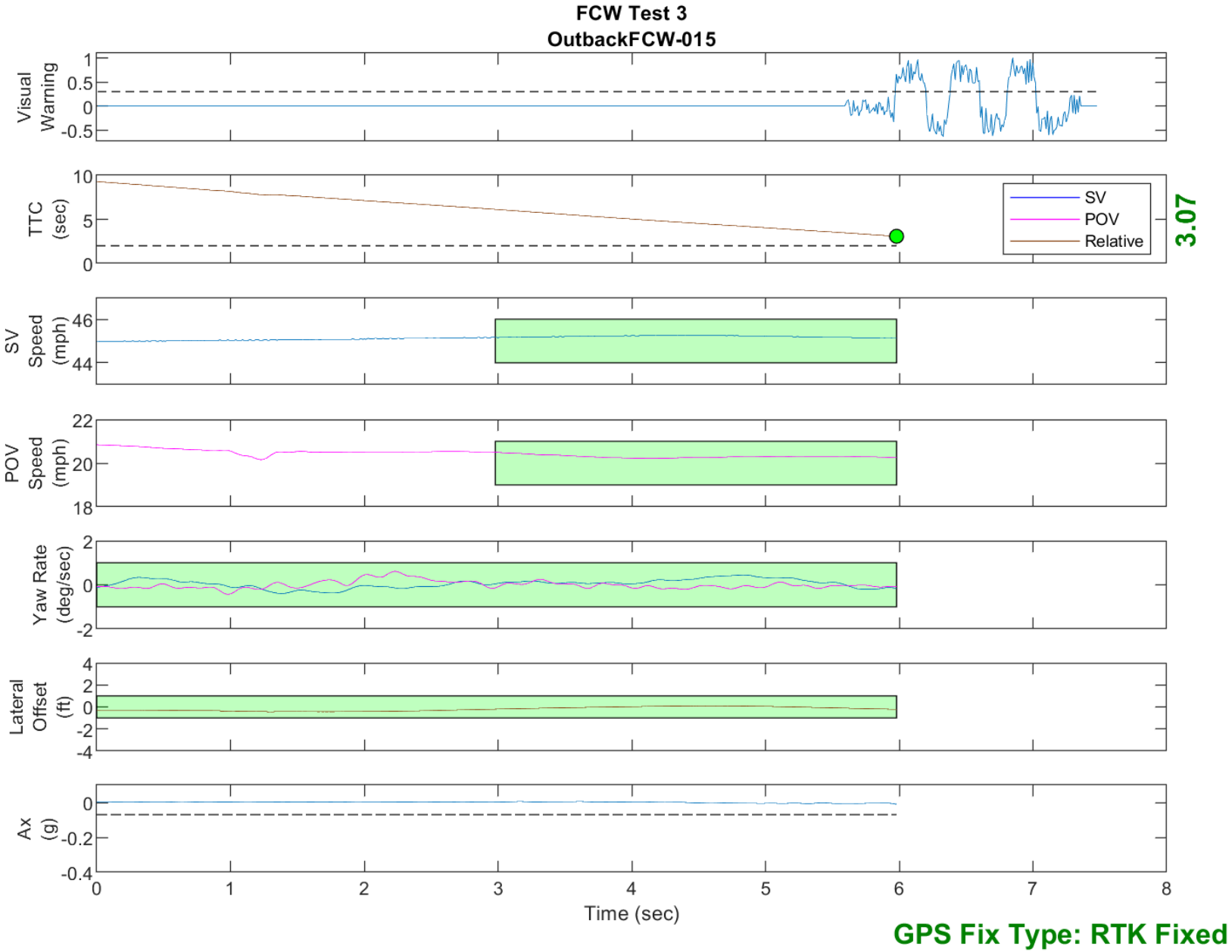


Figure D48. Time History for Run 15, FCW Test 3, Visual Warning