OCAS-DRI-FCW-19-01
NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST

2019 Alfa Romeo Stelvio

DYNAMIC RESEARCH, INC.
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29 April 2019

Final Report

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

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
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Washington, DC 20590

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Date: 29 April 2019

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16. Abstract These tests were conducted on the subject 2019 Alfa Romeo Stelvio in accordance with the specifications of the Office of Crash Avoidance Standards 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 the slower moving POV, the deccelerating POV case, but failed the requirements for the Stopped POV case. Therefore, it failed the overall test.			
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TABLE OF CONTENTS

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 SUMMARY

(Page 1 of 1)

2019 Alfa Romeo Stelvio

VIN: *ZASPAKBN5K7Cxxxx*

Test Date: *4/3/2019*

Forward Collision Warning setting: *FAR*

Test 1 -	Subject Vehicle Encounters Stopped Principal Other Vehicle:	***FAIL***
Test 2 -	Subject Vehicle Encounters Decelerating Principal Other Vehicle:	***PASS***
Test 3 -	Subject Vehicle Encounters Slower Principal Other Vehicle:	***PASS***

Overall: ***FAIL***

Notes:

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 2)

2019 Alfa Romeo Stelvio

TEST VEHICLE INFORMATION

VIN: *ZASPAKBN5K7Cxxxx*

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

Date Received: *3/18/2019* Odometer Reading: *34 mi*

Engine: *2 L Inline 4*

Transmission: *Automatic*

Final Drive: *AWD*

Is the vehicle equipped with:

ABS	**X**	Yes		No
Adaptive Cruise Control	**X**	Yes		No
Collision Mitigating Brake System	**X**	Yes		No

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *ALFA ROMEO S.P.A.*

Date of manufacture: *11/18*

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: *255/45R20*

Rear: *255/45R20*

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

Rear: *250 kPa (36 psi)*

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 2 of 2)

2019 Alfa Romeo Stelvio

TIRES

Tire manufacturer and model: *Continental Crosscontact LX Sport*

Front tire size: *255/45R20*

Rear tire size: *255/45R20*

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle:

X All options listed on the "window sticker" are present on the test vehicle

X Tires and wheel rims are the same as listed.

X There are no dents or other interior or exterior flaws.

X The vehicle has been properly prepared and is in running condition.

X Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

2019 Alfa Romeo Stelvio

GENERAL INFORMATION

Test date: *4/3/2019*

AMBIENT CONDITIONS

Air temperature: *19 C (66.2 F)*

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

X Wind speed ≤ 10 m/s (22 mph)

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

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

VEHICLE PREPARATION

Verify the following:

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

Fuel tank is full: **X**

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

Front: *230 kPa (33 psi)*

Rear: *250 kPa (36 psi)*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2019 Alfa Romeo Stelvio

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*523.9 kg (1155 lb)*	Right Front	*488.1 kg (1076 lb)*
Left Rear	*510.7 kg (1126 lb)*	Right Rear	*487.6 kg (1075 lb)*
		Total:	*2010.3 kg (4432 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 1 of 4)

2019 Alfa Romeo Stelvio

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 driver is alerted by an audible warning with a frequency of approximately 939 Hz. The driver is also alerted by a visual warning in the center of the instrument panel. The visual warning is a graphic of a vehicle approaching another one with a star and the word "Brake".

The system may lightly brake to warn the driver if a possible frontal accident is detected. (owner's manual p 107)

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.

Yes, by using the Information and Entertainment System display in the center of the dashboard and controls located on center console, select:
Menu
Settings
Safety
Forward Collision Warning
Mode
Disable
Each time the engine is started, the system is activated regardless of what setting was selected when the engine was turned OFF.

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

If yes, please provide a full description.

Yes, by using the Information and Entertainment System display in the center of the dashboard and controls located on center console, select:
Menu
Settings
Safety
Forward Collision Warning
Sensitivity - Far, Medium, Near
The system sensitivity setting is kept in the memory when the engine is turned OFF.

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.

- *The function of this system can also be temporarily reduced due to obstructions such as mud, dirt or ice on the bumper. In such cases, a dedicated message will be shown on the display and the system will be deactivated. This message can sometimes appear in conditions of high reflectivity (e.g. tunnels with reflective tiles or ice or snow).*

Driving In Special Conditions

- *In certain driving conditions, system intervention might be unexpected or delayed.*
  - *Driving close to a bend.*
  - *The vehicle ahead is leaving a roundabout.*
  - *Vehicles with small dimensions and/or not aligned in the driving lane.*
  - *Lane change by other vehicles.*
  - *Vehicles traveling at right angles to the vehicle.*

Driving Close To A Bend

- *When entering or leaving a wide bend, the system may detect a vehicle in front you, but not driving in the same driving lane. In cases such as these, the system may intervene.*

The Vehicle Ahead Is Leaving A Roundabout

- *On a roundabout, the system could intervene when it detects a vehicle ahead that is leaving the roundabout.*

(continued next page)

Vehicles With Small Dimensions And/Or Not Aligned In The Driving Lane

- *The system cannot detect vehicles in front of the vehicle if they are outside the range of the radar sensor or may not react to small vehicles, such as bicycles or motorcycles.*

Lane Change By Other Vehicles

- *Vehicles suddenly changing lanes to enter the same lane as your vehicle within the operating range of the radar sensor, may cause the system to intervene.*
-

Vehicles Traveling At Right Angles To The Vehicle

- *The system could temporarily react to a vehicle that is passing at right angles through the radar sensor's operating range.*

The system may activate, assessing the trajectory of the vehicle, for the presence of reflecting metal objects different from other vehicles, such as safety barriers, road signs, barriers before parking lots, tollgates, level crossings, gates, railways, objects near road constructions sites or higher than the vehicle (e.g. a fly-over). In the same way, the system may intervene inside multi-story parking lots or tunnels, or due to a glare on the road surface. These possible activations are a consequence of the real driving scenario coverage by the system and must not be regarded as faults.

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) on a Straight Road
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.

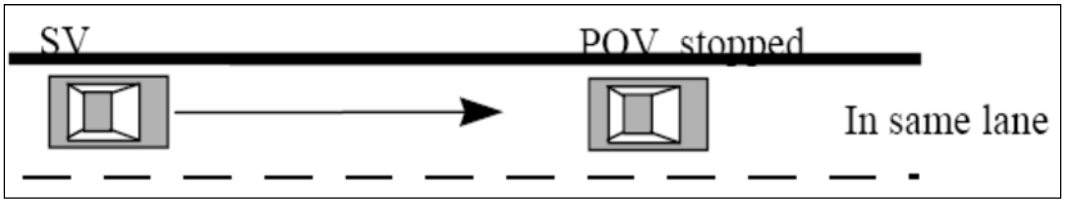

Figure 1. Depiction of Test 1

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 kph), 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 the SV approaches the rear of the POV.

The SV was driven at a nominal speed of 45 mph (72.4 kph) 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 kph) 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 the required FCW alert occurred, or 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 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.

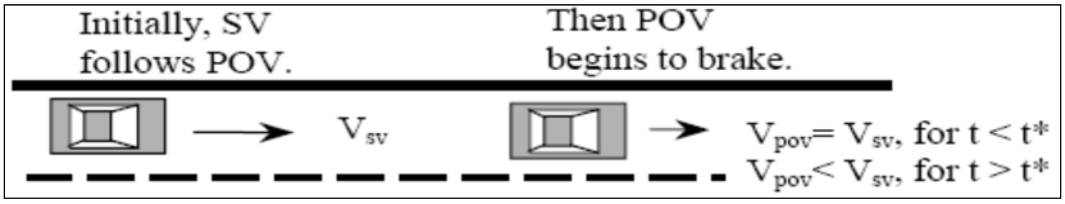

Figure 2. Depiction of Test 2

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].

[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).

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 kph), 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.

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 kph) 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 kph) 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 (1) 500 ms after the first local deceleration peak occurs, to (2) 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 the required FCW alert occurred, or before 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 issue a timely alert. As depicted in Figure 3, the scenario was conducted with a closing speed equal to 25.0 mph (40.2 kph).

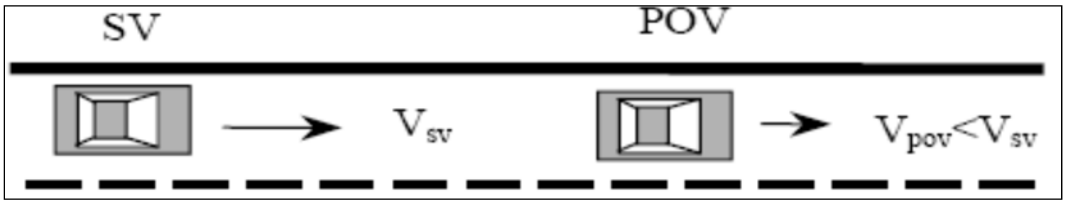

Figure 3. Depiction of Test 3

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 kph) in the center of the lane of travel.

The SV was driven at 45.0 mph (72.4 kph), 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., TTC = 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 kph) 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 kph) 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 the required FCW alert occurred, or 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: 6/21/2018 Due: 6/21/2019
Platform Scales	Vehicle Total, Wheel, and Axle Load	1200 lb/platform 5338 N/	0.5% of applied load	Intercomp SWI	1110M206352	By: DRI Date: 1/3/2019 Due: 1/3/2020
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 Rat	Accels .01g, Angular Rate	Oxford Inertial +		By: Oxford Technical Solutions
					2182	Date: 10/16/2017 Due: 10/16/2019
					2176	Date: 4/11/2018 Due: 4/11/2020
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: 1/2/2019 Due: 1/2/2020

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).	D-Space 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 bandpass 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	Pass-Band 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

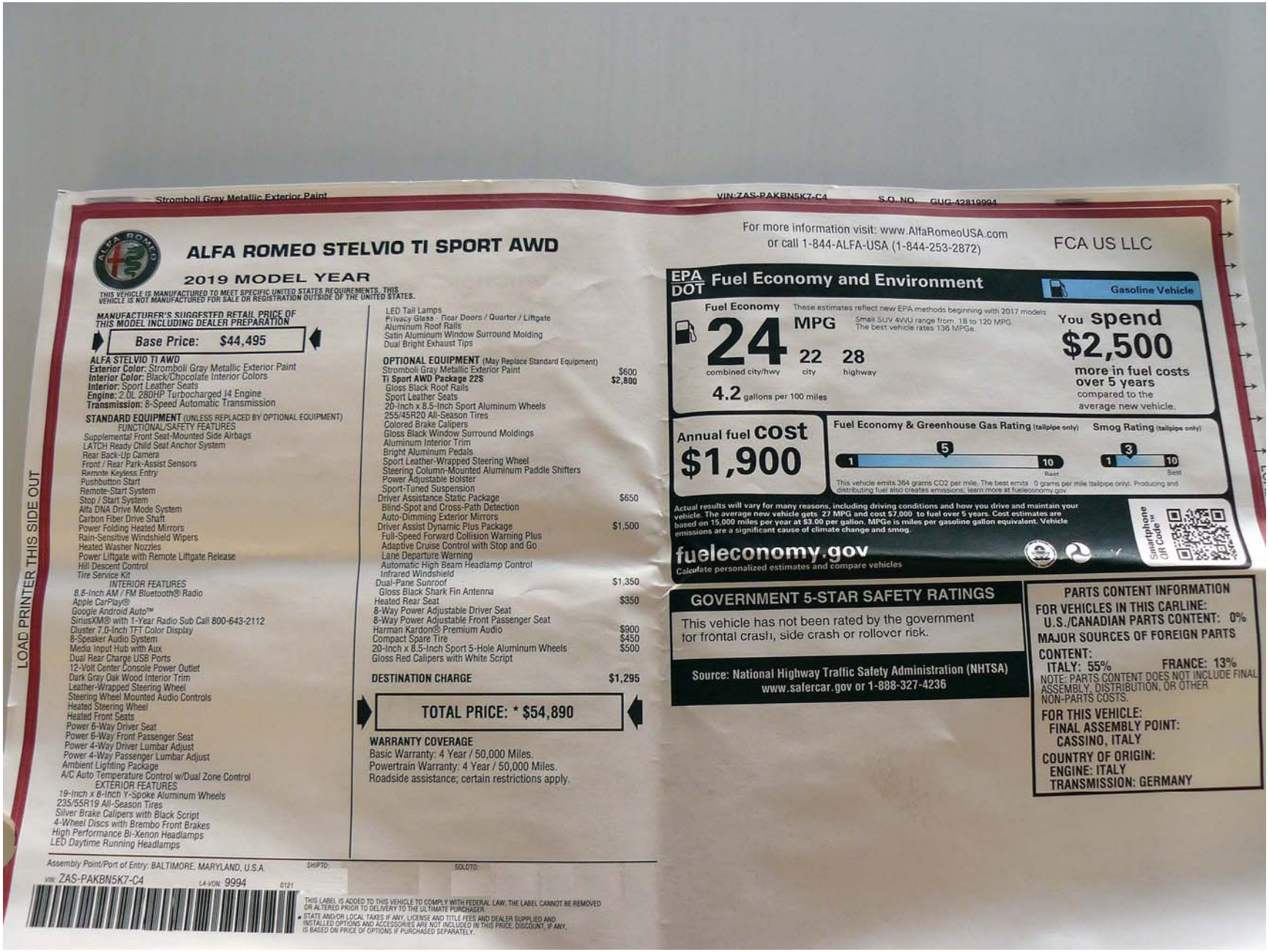

Figure A3. Window Sticker (Monroney Label)

Figure A4. Vehicle Certification Label

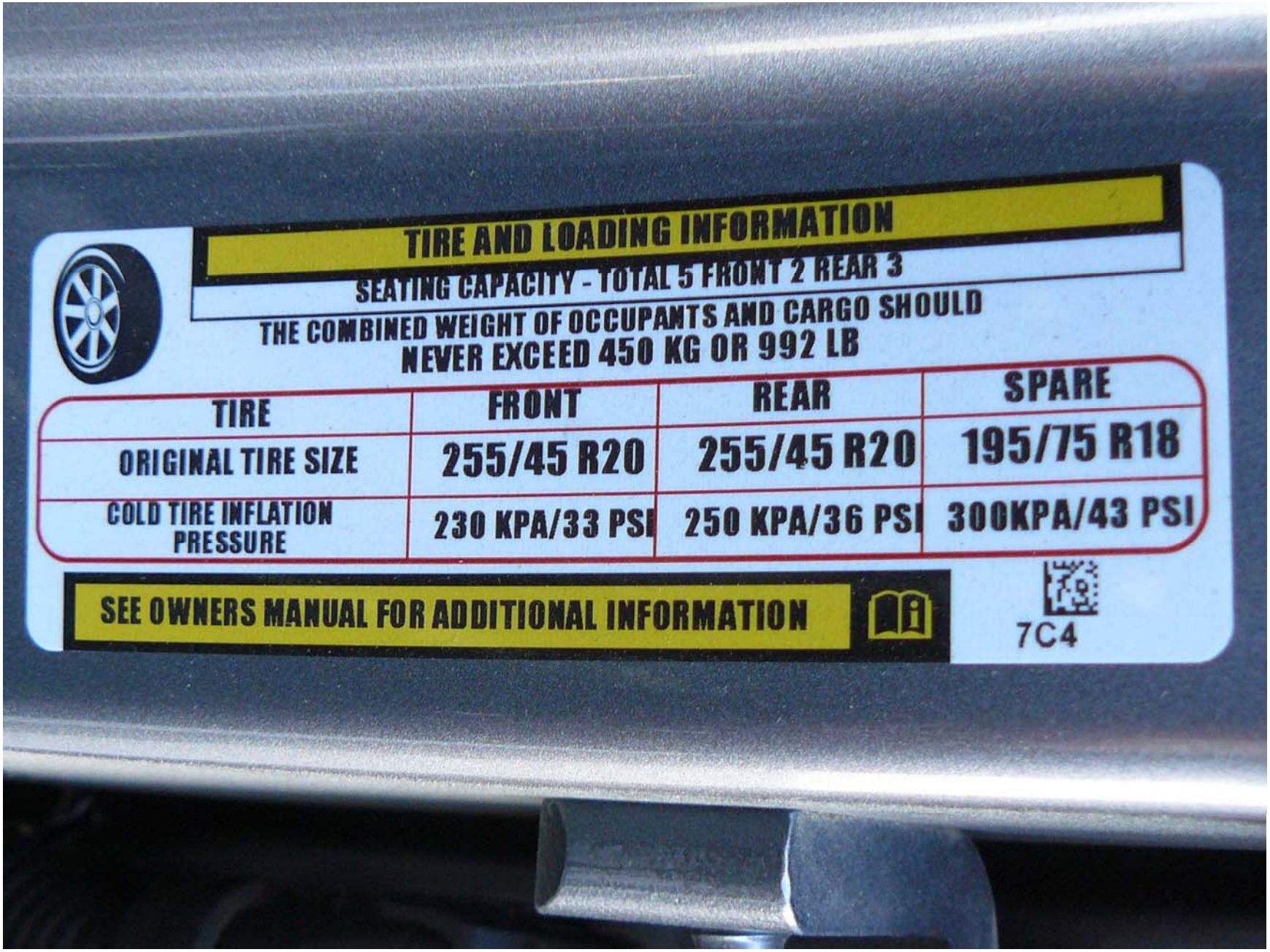

Figure A5. Tire Placard

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. Sensors for Detecting Auditory and Visual Alerts

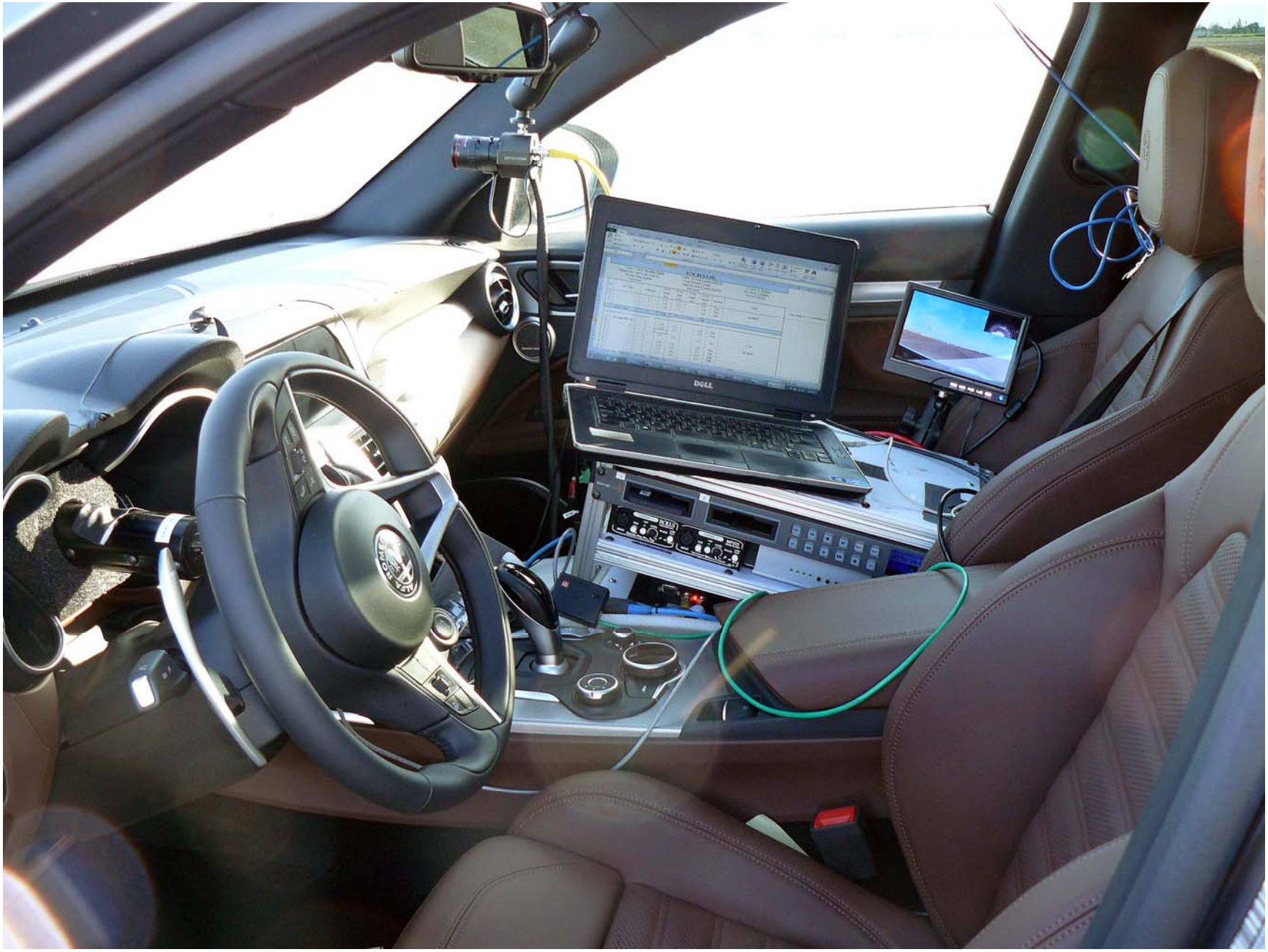

Figure A10. Computer Installed in Subject Vehicle

Figure A11. Brake Actuation System Installed in Principal Other Vehicle

Figure A12. FCW Visual Alert

Figure A13. FCW Setup Menus

Figure A14. Control for Changing Parameters

APPENDIX B

Excerpts from Owner's Manual

Reconfigurable Display Items

1. **Headlight Warning Lights**

Displays the headlight warning light for either of the following active modes:

- ❒ Headlights
- ❒ Automatic Headlights

2. **Gear Selector Information**

Displays the following information controlled by the gear selector function:

- ❒ **P** = PARK
- ❒ **R** = REVERSE
- ❒ **N** = NEUTRAL
- ❒ **D** = DRIVE, (automatic forward speed)
- ❒ **AutoStick**: + shifting to higher gear in manual (sequential) driving mode – shifting to lower gear in sequential driving mode

3. **Forward Collision, Lane Departure, Cruise Control**

Displays operations for the following modes:

- ❒ Forward Collision Warning (FCW)
- ❒ Lane Departure Warning (LDW)
- ❒ Cruise Control (CC) or Active Cruise Control (ACC) (if equipped)

4. **Speed Limit Warning Light**

Shows information regarding the Speed Limiter function.

5. **Compass**

6. **Reconfigurable Main Area**

Can display the following screens:

- ❒ Home
- ❒ Trip A
- ❒ Trip B (can be activated/deactivated through the Information and Entertainment System)
- ❒ Performance

The screens can be selected, on rotation, by pushing the MENU selection button on the windshield wiper stalk.

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MENU Selection Button

Depending on the driving mode chosen using the Alfa DNA (Dynamic, Natural, and Advanced Efficiency, the screens can be graphically different. Navigation instructions and call information can be set and displayed in the Information and Entertainment System.

Home

The parameters shown on the display, for the modes: Dynamic, Natural and Advanced Efficiency are:

- ❒ Time
- ❒ Outside Temperature
- ❒ Current Speed (shown if the repeat modes of the Phone and Navigation functions are not active)
- ❒ Range

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Instrument Cluster Display

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Instrument Cluster Display

Warning Light	What It Means	What To Do
	ENGINE CHECK/MALFUNCTION INDICATOR LIGHT (MIL) In normal conditions, when the ignition is cycled to ON, the indicator light illuminates, but it should turn off as soon as the engine is started. The operation of the indicator light may be checked by the traffic police using specific devices. Comply with the laws and regulations of the country where you are driving.	Under these conditions, the vehicle can continue travelling at moderate speed but without demanding excessive effort from the engine or high speed. Prolonged use of the vehicle with the indicator light on constantly may cause damage. Contact an authorized dealer as soon as possible.

Caution!

If, turning the ignition device to ON, the warning light does not turn on or if it turns on steadily or flashing when travelling (on some versions together with the message on the display), contact an authorized dealer as soon as possible.

Warning Light	What It Means	What To Do
	FORWARD COLLISION WARNING SYSTEM (FCW) — IF EQUIPPED This indicator light informs the driver that the frontal collision alarm function is not enabled.	Drive carefully and contact an authorized dealer as soon as possible.
	FUEL RESERVE / LIMITED RANGE The indicator light (or the symbol in the display) illuminates when about 2.4 gallons (9 liters) of fuel is left in the tank.	Refuel the vehicle.

Warning!

If the warning light (or the icon on the display) flashes while driving, contact an authorized dealer.

Warning Light	What It Means	What To Do
	FORWARD COLLISION WARNING (FCW) SYSTEM FAILURE The telltale will illuminate in the case of failure of the Forward Collision Warning system.	Contact an authorized dealer as soon as possible.
	STOP/START SYSTEM FAILURE This telltale will illuminate to report a Stop/Start system failure.	Contact an authorized dealer as soon as possible to have the failure eliminated.
	RAIN SENSOR FAILURE The telltale will illuminate in the case of failure of the automatic windshield wiper.	Contact an authorized dealer as soon as possible.
	DUSK SENSOR FAILURE The telltale will illuminate in the case of failure of the automatic low beam alignment.	Contact an authorized dealer as soon as possible.
	BLIND SPOT MONITORING SYSTEM FAILURE The telltale will illuminate in the event of a Blind Spot Monitoring system failure.	Contact an authorized dealer as soon as possible.
	FUEL LEVEL SENSOR FAILURE The telltale will illuminate in the event of fuel level sensor failure.	Contact an authorized dealer as soon as possible.
	EXTERIOR LIGHTS FAILURE The telltale will illuminate to indicate a failure on the following lights: daytime running lights (DRLs) / parking lights / trailer turn signal indicators (if present) / trailer lights (if present) / side lights / turn signal indicators / rear fog light / reversing light / brake lights / license plate lights.	The failure may be caused by a blown bulb, a blown protection fuse, or an interruption of the electrical connection. Replace the bulb or the relevant fuse. Contact an authorized dealer.

Changes or modifications to any of these systems by other than an authorized service facility could void authorization to use this equipment.

Forward Collision Warning Plus (FCW+) System — If Equipped

This is a driving assistance system composed of a radar located behind the front bumper and a camera located in the center of the windshield.

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Front Bumper Radar Location

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Windshield Camera Location

In the event of an imminent collision, the system intervenes by automatically applying the vehicle's brakes to prevent a collision or reduce its effects.

The system provides the driver with audible and visual signals through specific messages on the instrument cluster display.

The system may lightly brake to warn the driver if a possible frontal accident is detected (limited braking). Signals and limited braking are intended to allow the driver to react promptly, in order to prevent or reduce the effects of a potential accident.

In situations with the risk of collision, if the system detects no intervention by the driver, it provides automatic braking to help slow the vehicle and mitigate the potential frontal collision (automatic braking). If intervention by the driver on the brake pedal is detected, but not deemed sufficient, the system may intervene in order to improve the reaction of the braking system, therefore reducing vehicle speed further (additional assistance in braking stage).

The system will intervene automatically in case of imminent collision or impact against a pedestrian crossing the road (speed under 31 mph (50 km/h).

Note: For safety reasons, when the vehicle has stopped, the brake calipers may remain blocked for about two seconds. Make sure you press the brake pedal if the vehicle moves slightly forward.

Warning!

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

Engagement/Disengagement

The following functions can be selected in sequence using the Information and Entertainment System:

1. "Settings."
2. "Safety."
3. "Forward Collision Warning."
4. "Mode."

Select from among three operating modes:

❒ **Warning and brake**: the system (if active), in addition to the visual and audible warnings, provides limited braking, automatic braking and additional assistance in braking stage, where the driver does not brake sufficiently in the event of a potential frontal impact.

❒ **Only warning**: the system (if active), does not provide limited braking, but guarantees automatic braking or additional assistance in braking stage, where the driver does not brake at all or not sufficiently in the event of a potential frontal impact.

❒ **Disable**: the system does not provide visual and audible warnings, limited braking, automatic braking or additional assistance in braking stage. The system will therefore provide no indication of a possible collision.

Activation/Deactivation

The Forward Collision Warning system is activated whenever the engine is started regardless of what is shown in the Information and Entertainment System.

Following a deactivation, the system will not warn the driver about the possible collision with a preceding vehicle, regardless of the setting selected in the Information and Entertainment System.

Note: Each time the engine is started, the system is activated regardless of what setting was selected when the engine was turned OFF.

This function is not active at a speed lower than 4 mph (7 km/h) or higher than 124 mph (200 km/h).

The system is active:

❒ Each time the engine is started.

❒ When feature is selected within the Information and Entertainment System.

❒ When the ignition is in the ON position.

❒ When the vehicle speed is between 4 mph (7 km/h) and 124 mph (200 km/h).

❒ When the front seat belts are fastened.

Changing The System Sensitivity

The sensitivity of the system can be changed through the Information and Entertainment System menu, choosing from one of the following three options: "Near", "Med" or "Far". Refer to the description in the Information and Entertainment System Supplement for how to change the settings.

The default setting is "Med". With this setting, the system warns the driver of a possible collision with the vehicle in front when that vehicle is at a standard distance, between that of the other two settings.

With the system sensitivity set to "Far", the system will warn the driver of a possible collision with the vehicle in front when that vehicle is at a greater distance, thus providing the possibility of acting on the brakes more lightly and gradually. This setting provides the drivers with the maximum possible reaction time to prevent a potential accident.

With the option set to "Near", the system will alert the driver of a possible collision with the vehicle in front when that vehicle is close. This setting offers the driver a lower reaction time compared to the "Med" and "Far" settings, in the event of a potential collision, but permits more dynamic driving of the vehicle.

The system sensitivity setting is kept in the memory when the engine is turned OFF.

System Limited Operation Warning

If a dedicated message is displayed, a condition limiting the system operation may have occurred. The possible reasons of this limitation are something is blocking the camera view or a fault.

If an obstruction is signaled, clean the area of the radar on the front bumper, and the camera area on the windshield.

If a fault in the system is occurring, it will still be possible to drive the vehicle normally, but automatic braking will not be available in the event of an impending collision.

When the conditions limiting the system functions end, this will go back to normal and complete operation. Should the fault persist, contact your authorized dealer.

System Failure Signaling

If the system turns off and a dedicated message is shown on the display, it means that there is a fault with the system.

In this case, it is still possible to drive the vehicle, but you are advised to contact your authorized dealer as soon as possible.

Radar Indication Not Available

If conditions are such that the radar cannot detect obstacles correctly, the system is deactivated and a dedicated message appears on the display. This generally occurs in the event of poor visibility, such as when it is snowing or raining heavily.

The function of this system can also be temporarily reduced due to obstructions such as mud, dirt or ice on the bumper. In such cases, a dedicated message will be shown on the display and the system will be deactivated. This message can sometimes appear in conditions of high reflectivity (e.g. tunnels with reflective tiles or ice or snow). When the conditions limiting the system functions end, it will go back to normal and complete operation.

In certain cases, this dedicated message could be displayed when the radar is not detecting any vehicles or objects within its view range.

If atmospheric conditions are not the reason behind this message, check if the sensor is dirty. It could be necessary to clean or remove any obstructions in the area.

If the message appears frequently, even in the absence of atmospheric conditions such as snow, rain, mud or other obstructions, contact your authorized dealer for a sensor alignment check.

In the absence of visible obstructions, manually removing the decorative cover trim and cleaning the radar surface could be required. Have this operation performed at your authorized dealer.

Note: It is recommended that you do not install devices, accessories or aerodynamic attachments in front of the sensor or darken it in any way, as this can compromise the correct functioning of the system.

Frontal Collision Alarm With Active Braking — If Equipped

If this function is selected, the brakes are operated to reduce the speed of the vehicle in the event of potential frontal impact.

This function applies an additional braking pressure if the braking pressure applied by the driver does not suffice to prevent potential frontal impact.

The function is active with speed above 4 mph (7 km/h).

Driving In Special Conditions

In certain driving conditions, system intervention might be unexpected or delayed. The driver must therefore be very careful, keeping control of the vehicle to drive in complete safety.

❒ Driving close to a bend.

❒ The vehicle ahead is leaving a roundabout.

❒ Vehicles with small dimensions and/or not aligned in the driving lane.

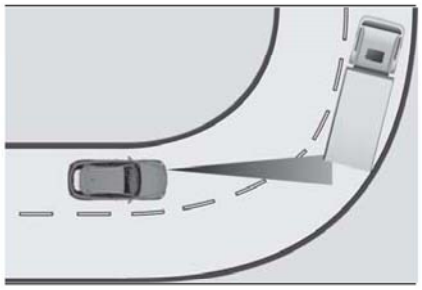
❒ Lane change by other vehicles.

❒ Vehicles traveling at right angles to the vehicle.

Note: In particularly complex traffic conditions, the driver can deactivate the system manually through the Information and Entertainment System.

Driving Close To A Bend

When entering or leaving a wide bend, the system may detect a vehicle in front you, but not driving in the same driving lane. In cases such as these, the system may intervene.



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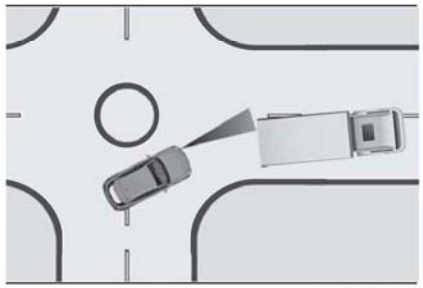
Driving Around Wide Curves

The Vehicle Ahead Is Leaving A Roundabout

On a roundabout, the system could intervene when it detects a vehicle ahead that is leaving the roundabout.

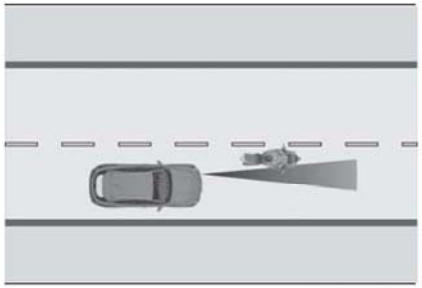


06016V0010EM

Driving In Roundabouts

Vehicles With Small Dimensions And/Or Not Aligned In The Driving Lane

The system cannot detect vehicles in front of the vehicle if they are outside the range of the radar sensor or may not react to small vehicles, such as bicycles or motorcycles.

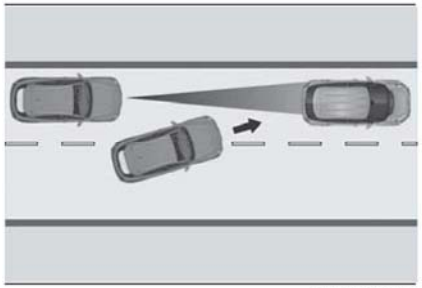


06016V0006EM

Driving Near Small Vehicles

Lane Change By Other Vehicles

Vehicles suddenly changing lanes to enter the same lane as your vehicle within the operating range of the radar sensor, may cause the system to intervene.

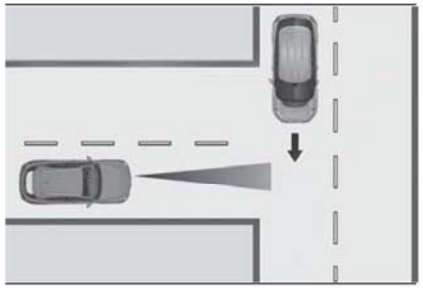


06016V0007EM

Other Vehicles Changing Lanes

Vehicles Traveling At Right Angles To The Vehicle

The system could temporarily react to a vehicle that is passing at right angles through the radar sensor's operating range.



06016V0008EM

Other Vehicle Passing Through Radar Range

Warning!

❒ *The system has not been designed to prevent impacts and cannot detect possible conditions leading to an accident in advance. Failure to take into account this warning may lead to serious or fatal injuries.*

❒ *The system may activate, assessing the trajectory of the vehicle, for the presence of reflecting metal objects different from other vehicles, such as safety barriers, road signs, barriers before parking lots, tollgates, level crossings, gates, railways, objects near road constructions sites or higher than the vehicle (e.g. a fly-over). In the same way, the system may intervene inside multi-story parking lots or tunnels, or due to a glare on the road surface. These possible activations are a consequence of the real driving scenario coverage by the system and must not be regarded as faults.*

❒ *The system has been designed for road use only. If the vehicle is driven on a track, the system must be deactivated to avoid unnecessary warnings. Automatic deactivation is signaled by the dedicated warning light/symbol switching on in the instrument panel (refer to the instructions in the "Warning Lights And Messages On The Instrument Panel" in "Getting To Know Your Instrument Panel" for further information).*

General Information

This vehicle has systems that operate on radio frequency that comply with Part 15 of the Federal Communications Commission (FCC) rules and with Industry Canada Standards RSS-GEN/210/220/310.

Operation is subject to the following two conditions:

1. The device may not cause harmful interference.

2. The device must accept any interference received, including interference that may cause undesired operation of the device.

Changes or modifications to any of these systems by other than an authorized service facility could void authorization to use this equipment.

Tire Pressure Monitoring System (TPMS)

The vehicle is equipped with a Tire Pressure Monitoring System (TPMS) that sends the inflation pressure information of each tire to the control unit, and will signal the driver in the event of insufficient tire pressure.

Tire pressure will vary with temperature by approximately 1 psi (7 kPa) for every 12°F (6.5°C). This means that when the outside temperature decreases, the tire pressure will also decrease. Tire pressure should always be set based on cold inflation tire pressure. This is defined as the tire pressure after the vehicle has not been driven for at least three hours, or driven less than 1 mile (1.6 km) after a three hour period. The cold tire inflation pressure must not exceed the maximum inflation pressure molded into the tire sidewall. Refer to "Tires" in "Servicing And Maintenance" for information on how to properly inflate the vehicle's tires. The tire pressure will also increase as the vehicle is driven. This is normal, and there should be no adjustment for this increased pressure.

The TPMS will signal the driver if pressure falls below the warning limit for any reason, including the effects of low temperature and normal loss of pressure from the tire.

The TPMS will stop indicating insufficient tire pressure when pressure is equal to or greater than the prescribed cold inflation level. Therefore, if insufficient tire pressure is indicated by the ( ) warning light displaying in the instrument cluster, increase the inflation pressure up to the prescribed cold inflation value.

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

Operating Example

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

APPENDIX C

Run Log

Subject Vehicle: **2019 Alfa Romeo Stelvio** Test Date: **4/3/2019**

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**	N					post processor issues
2		N					post processor issues
3		Y	1.73	1.69	-0.37	Fail	
4		Y	1.86	1.81	-0.24	Fail	
5		Y	1.99	1.99	-0.11	Fail	
6		Y	1.91	1.89	-0.19	Fail	
7		Y	1.81	1.72	-0.29	Fail	
8	**Slower POV, 45 vs 20**	Y	2.75	2.66	0.75	Pass	
9		N					POV speed
10		Y	2.84	2.74	0.84	Pass	
11		Y	2.84	2.73	0.84	Pass	
12		N					POV speed
13		Y	2.81	2.71	0.81	Pass	
14		Y	2.76	2.71	0.76	Pass	

Subject Vehicle: **2019 Alfa Romeo Stelvio** Test Date: **4/3/2019**

Principal Other Vehicle: 2006 Acura RL

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
15		Y	2.90	2.79	0.90	Pass	
16		Y	2.80	2.72	0.80	Pass	
17	**Braking POV, 45**	Y	2.44	2.35	0.04	Pass	
18		Y	2.59	2.52	0.19	Pass	
19		N					SV yaw
20		Y	2.61	2.54	0.21	Pass	
21		N					POV speed
22		Y	2.69	2.59	0.29	Pass	
23		Y	2.39	2.29	-0.01	Fail	
24		Y	2.72	2.62	0.32	Pass	
25		Y	2.51	2.44	0.11	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.

Time History Plot Description

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 – Braking 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

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.

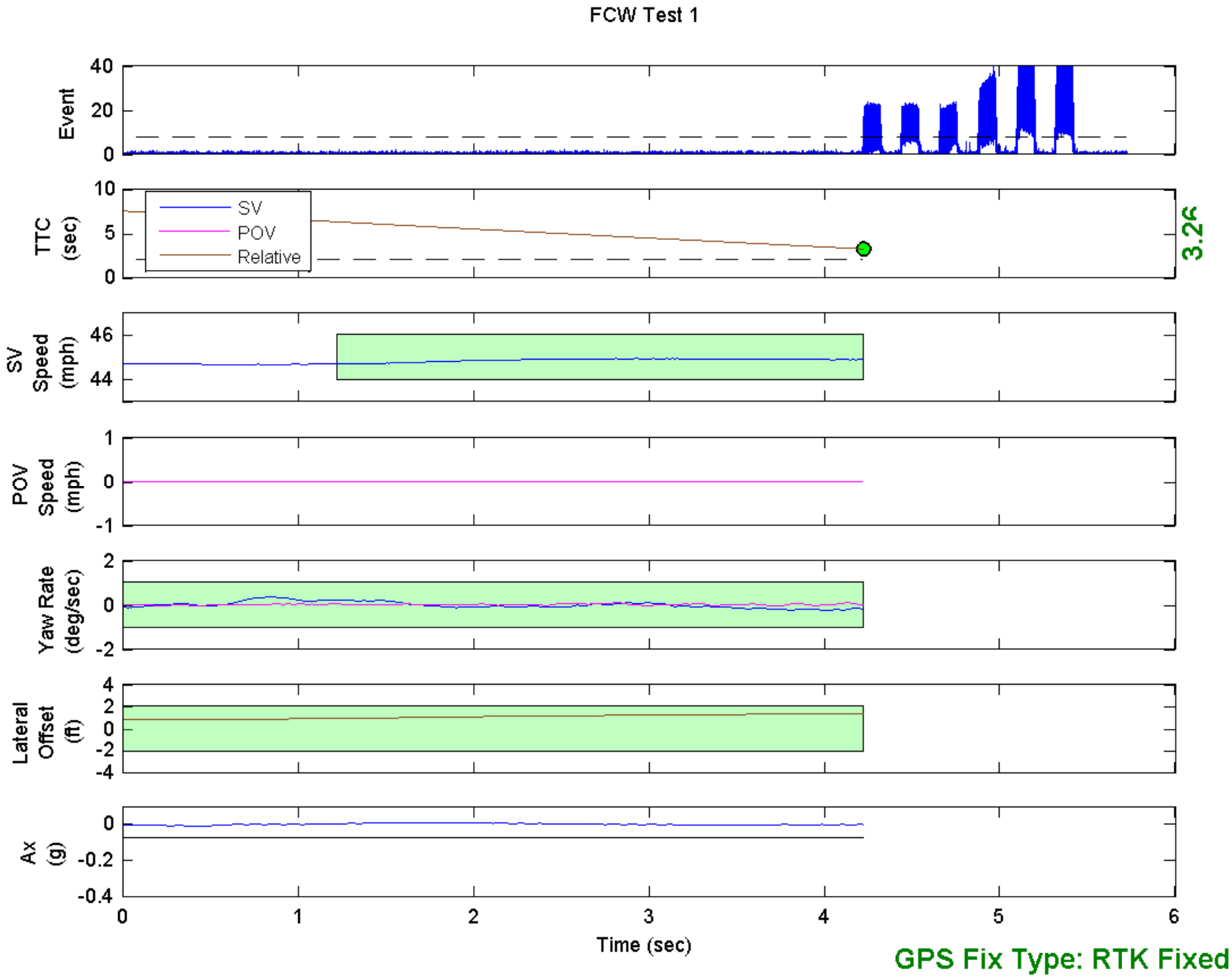


Figure D1. Example Time History for Test Type 1, Passing

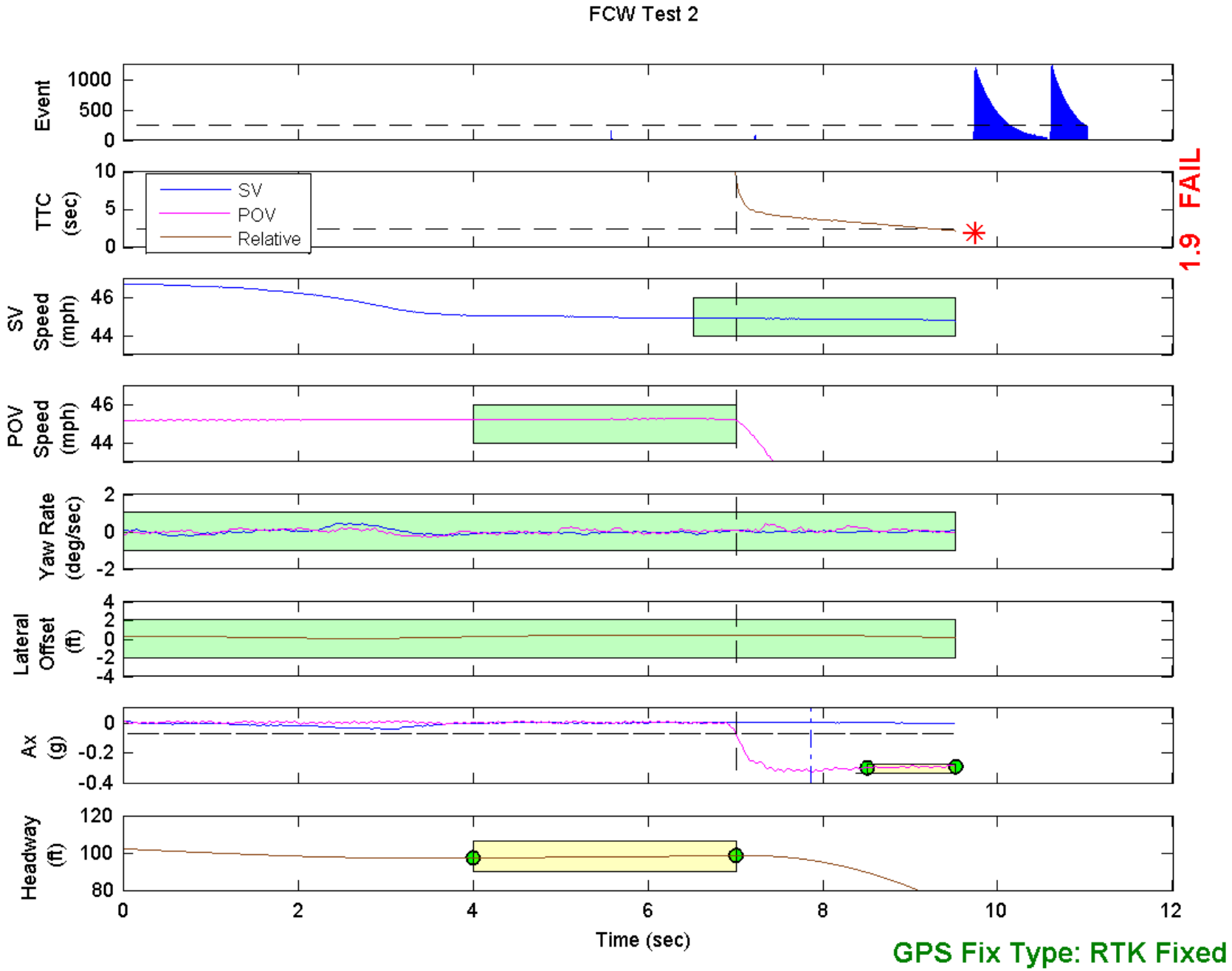


Figure D2. Example Time History for Test Type 2, Failing

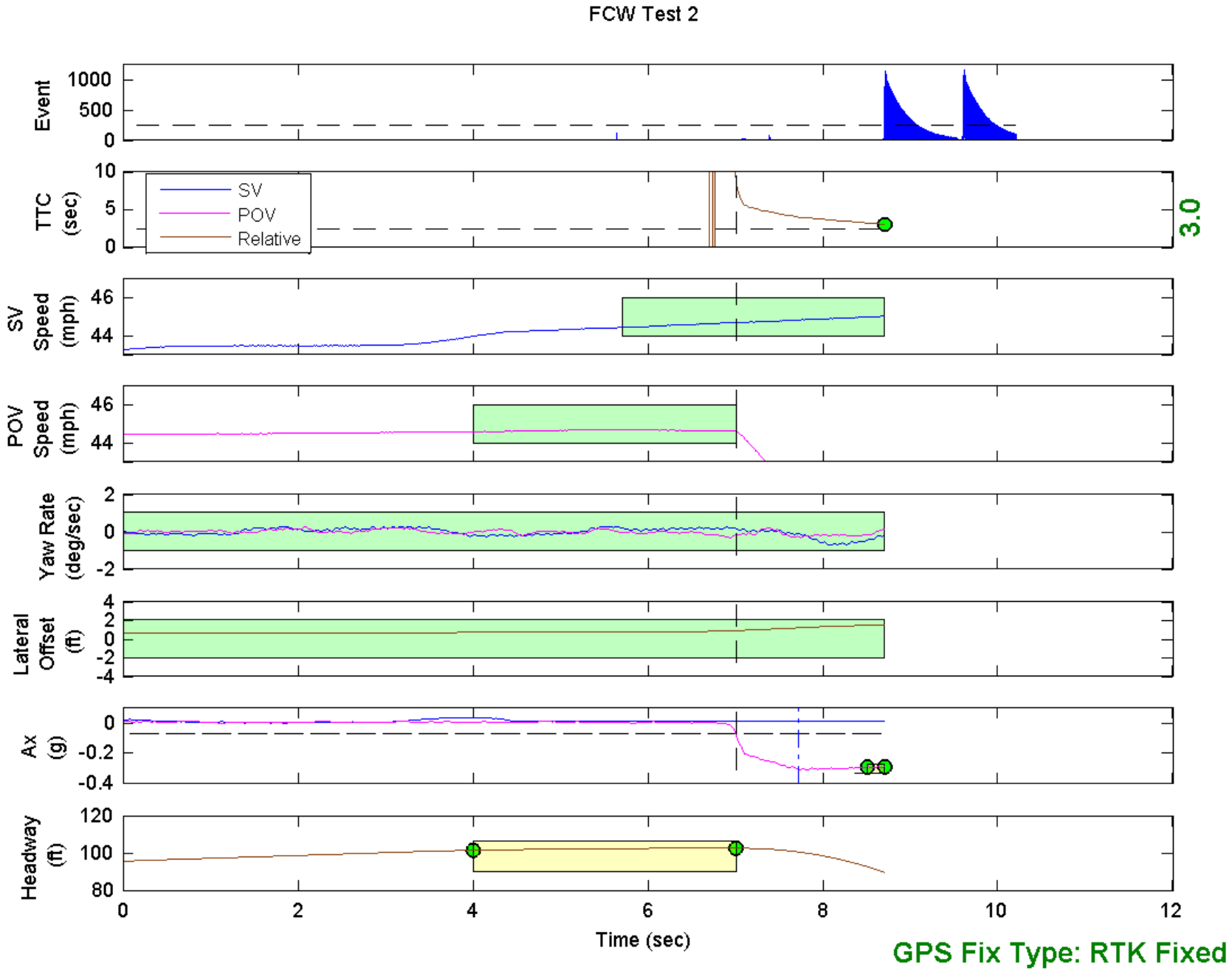


Figure D3. Example Time History for Test Type 2, Passing

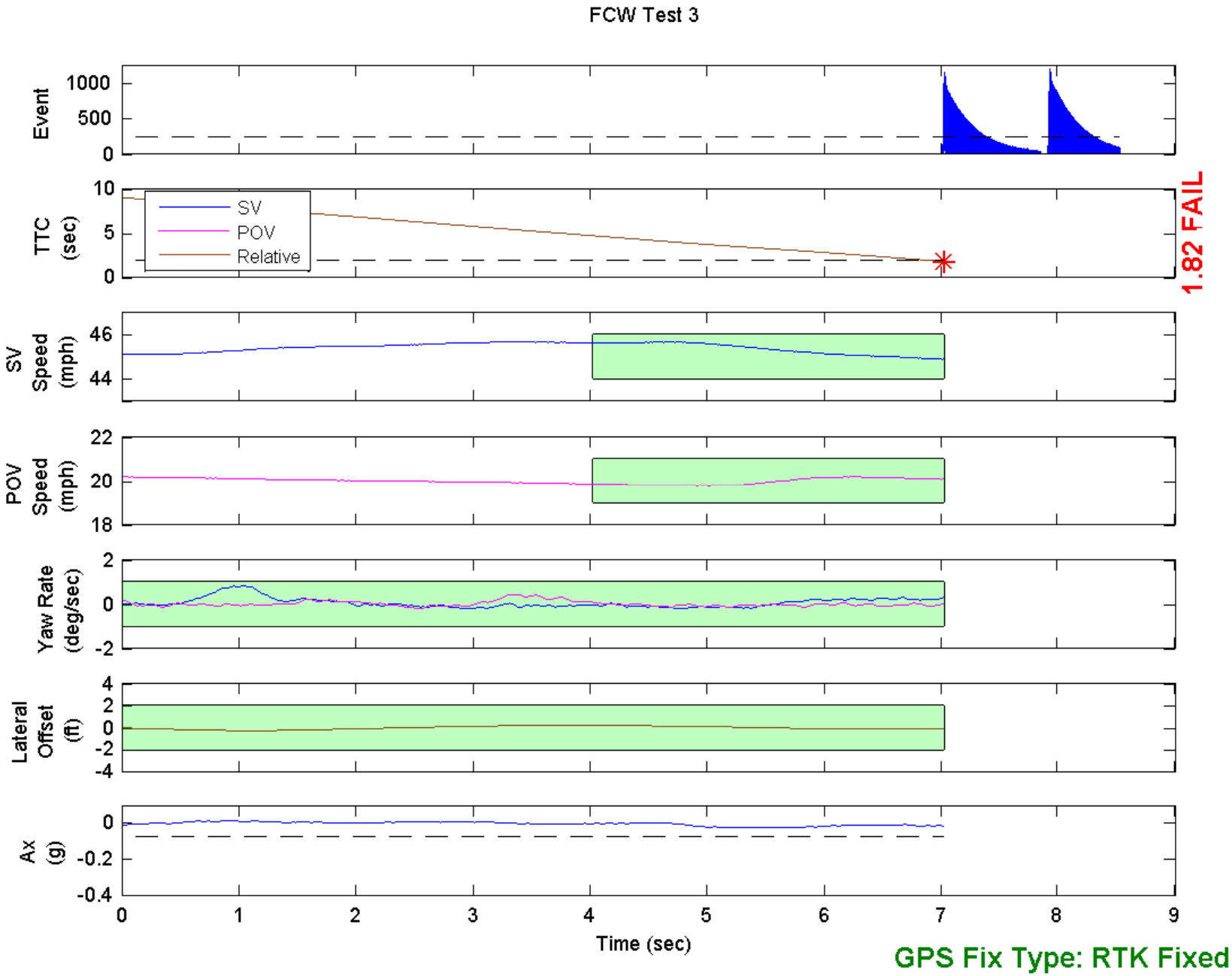


Figure D4. Example Time History for Test Type 3, Failing

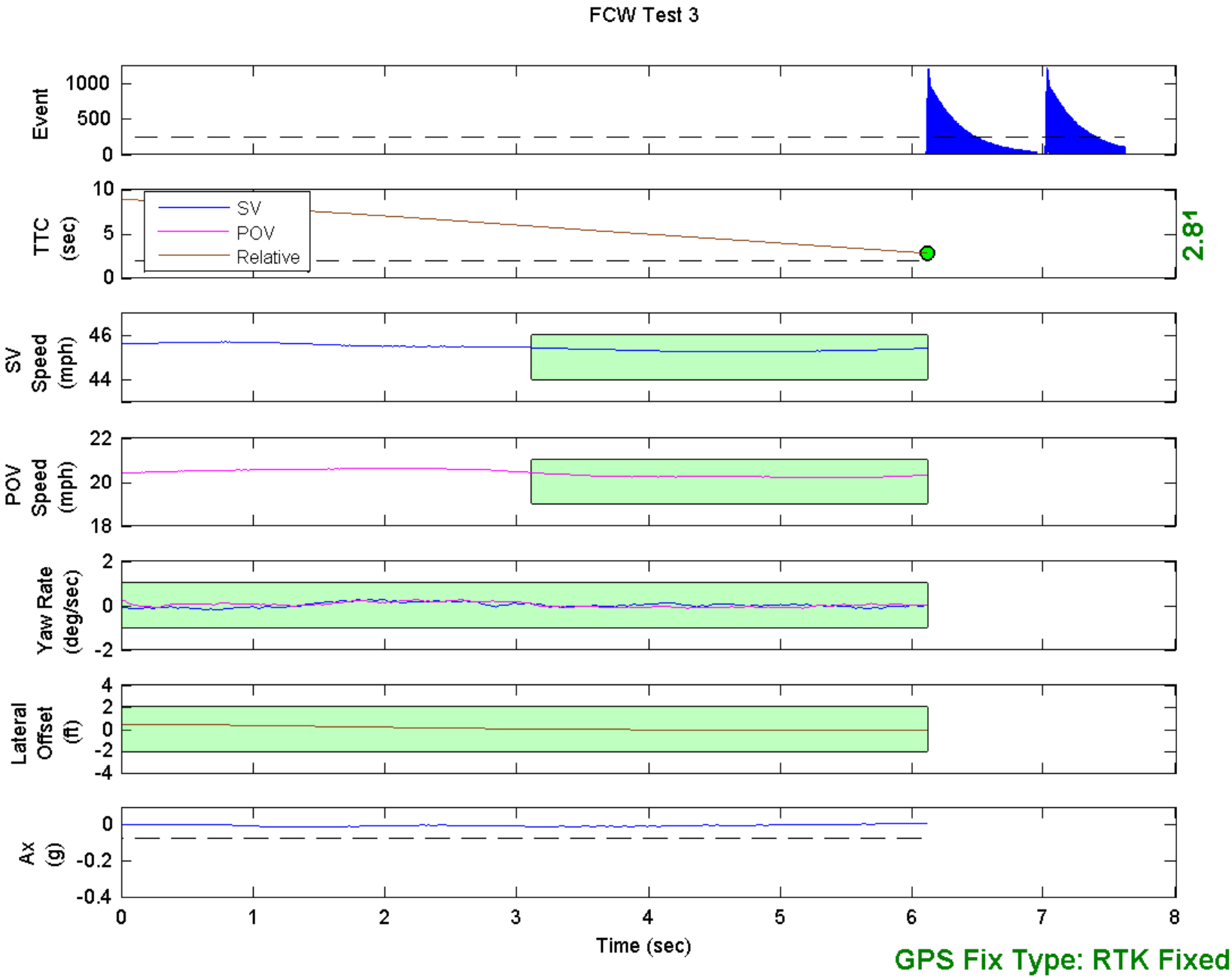


Figure D5. Example Time History for Test Type 3, Passing

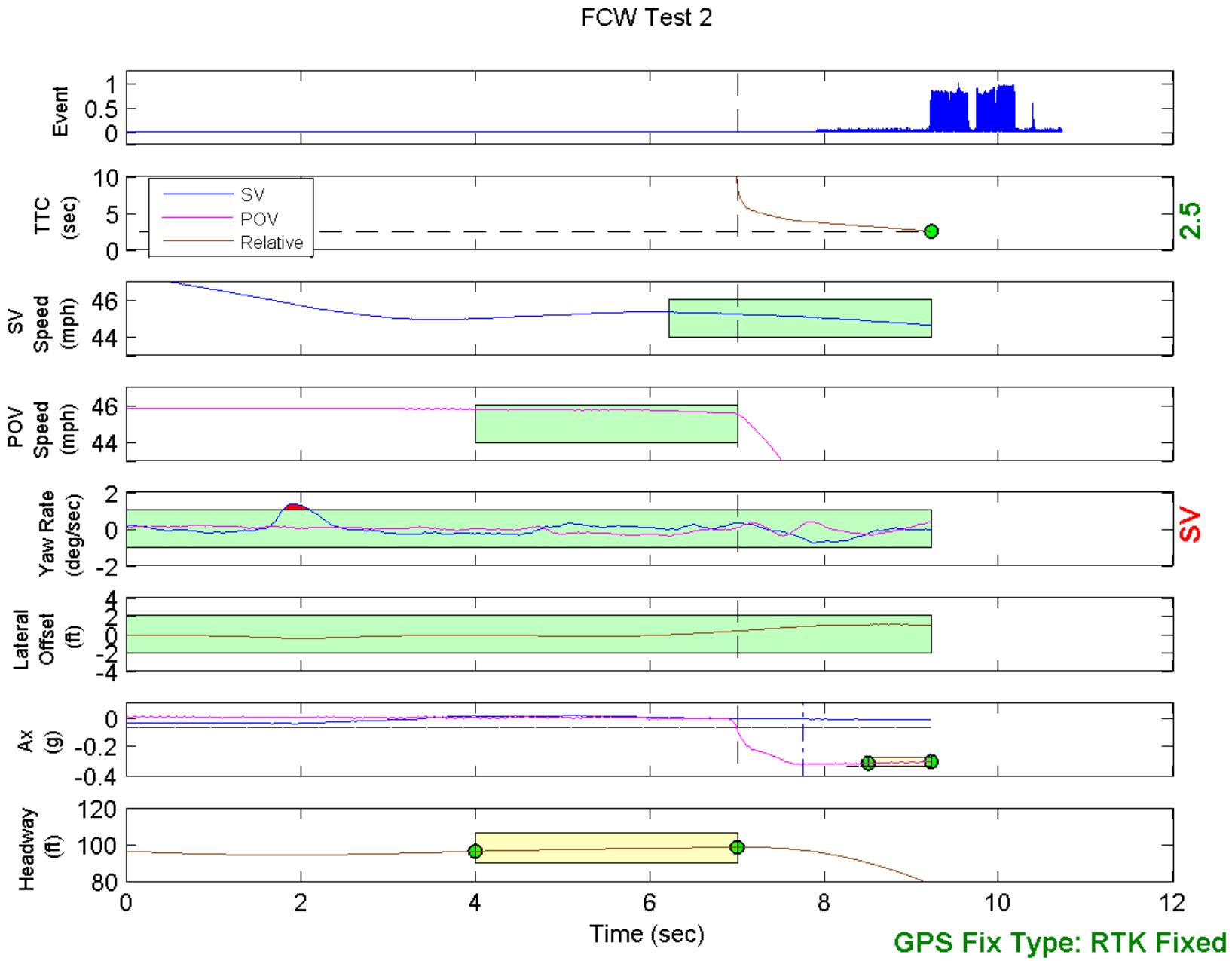


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

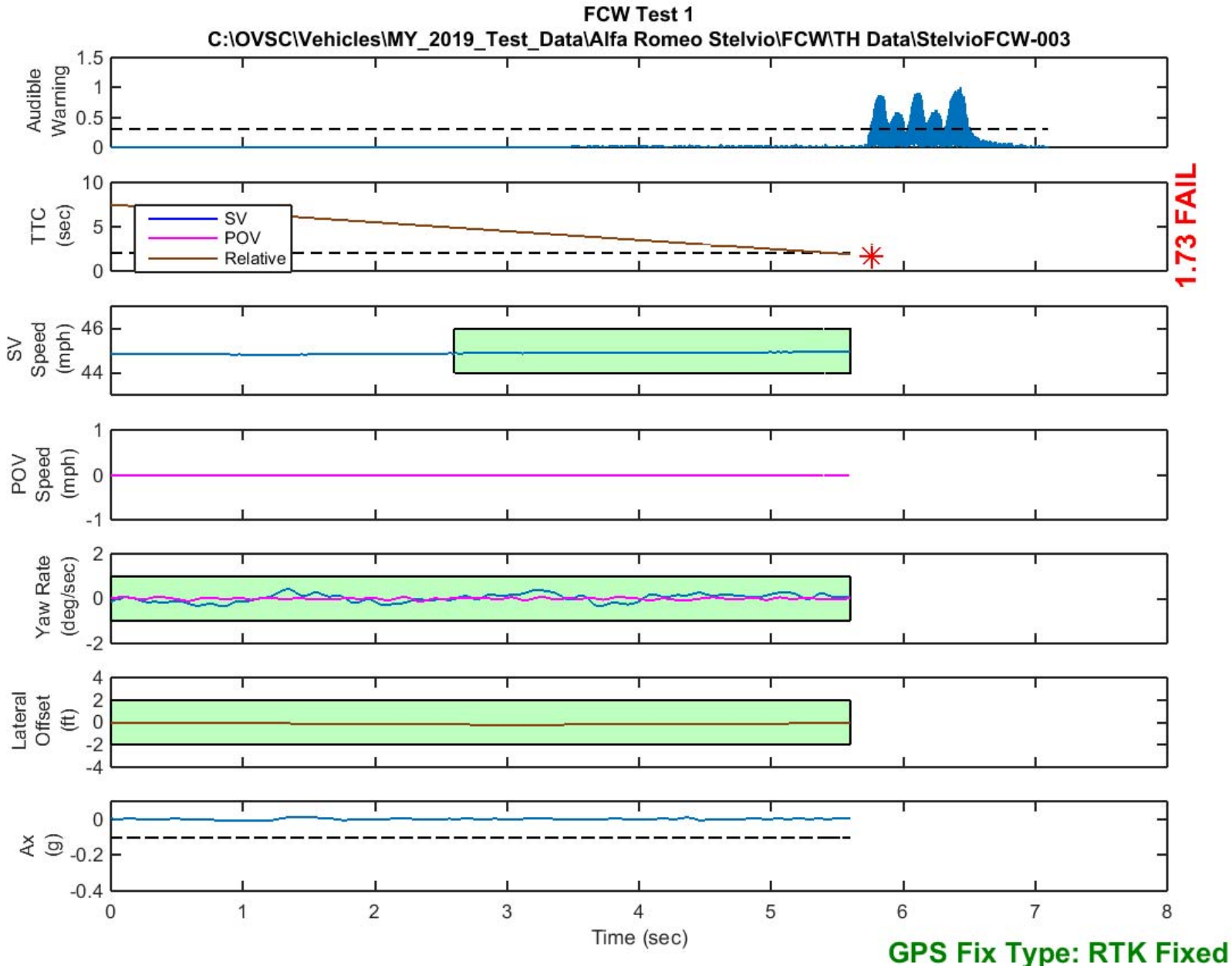


Figure D7. Time History for Run 03, FCW Test 1, Audible Warning

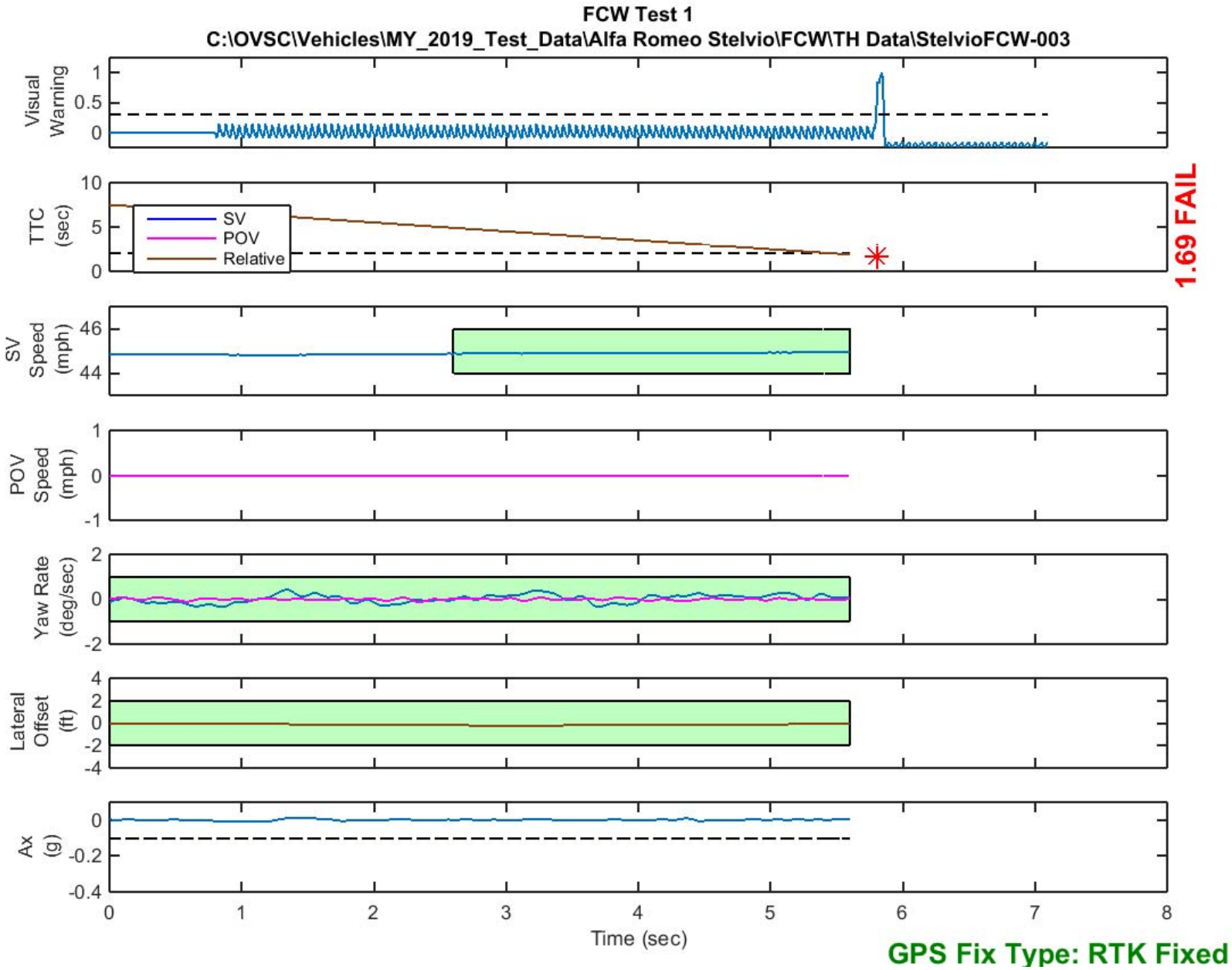


Figure D8. Time History for Run 03, FCW Test 1, Visual Warning

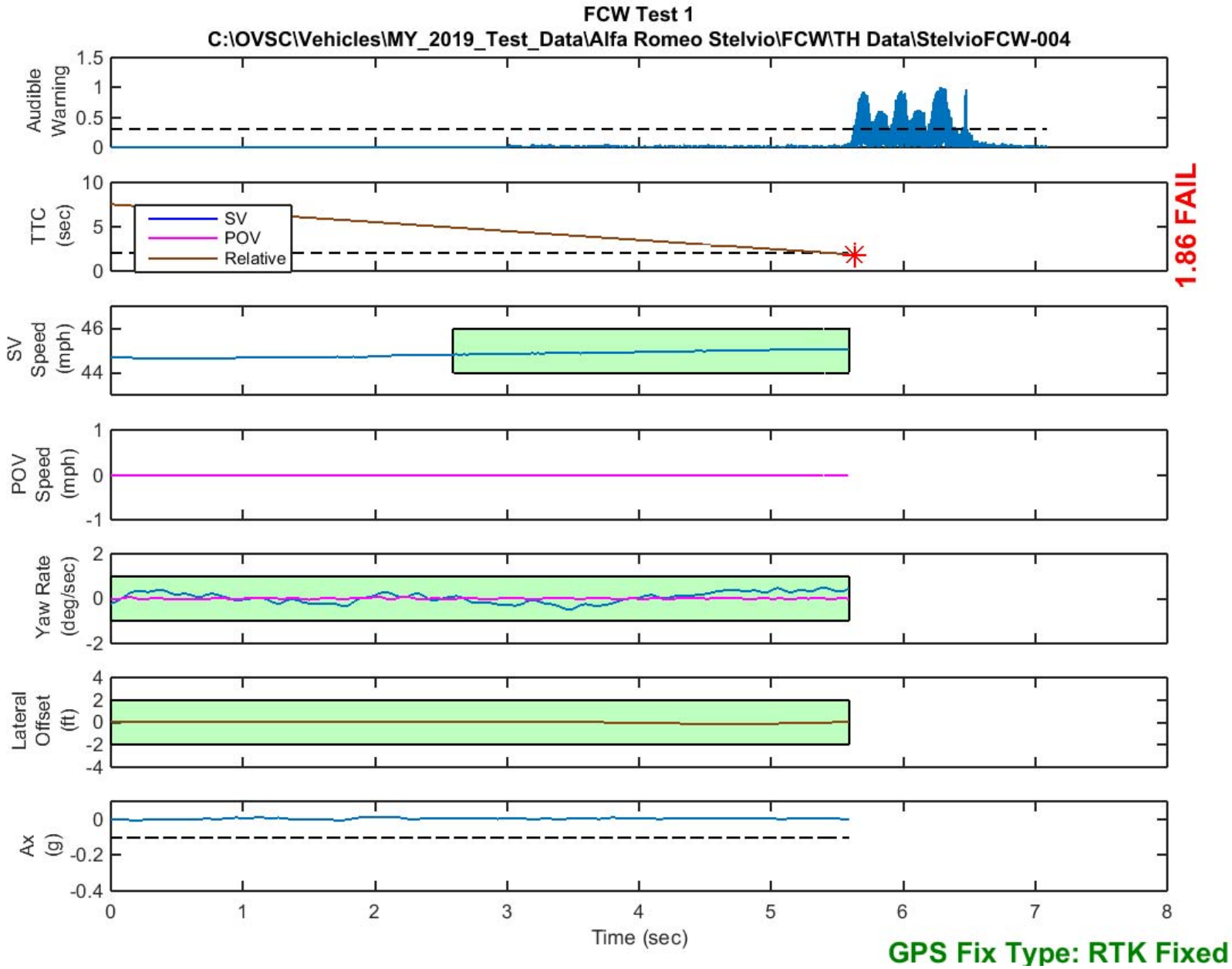


Figure D9. Time History for Run 04, FCW Test 1, Audible Warning

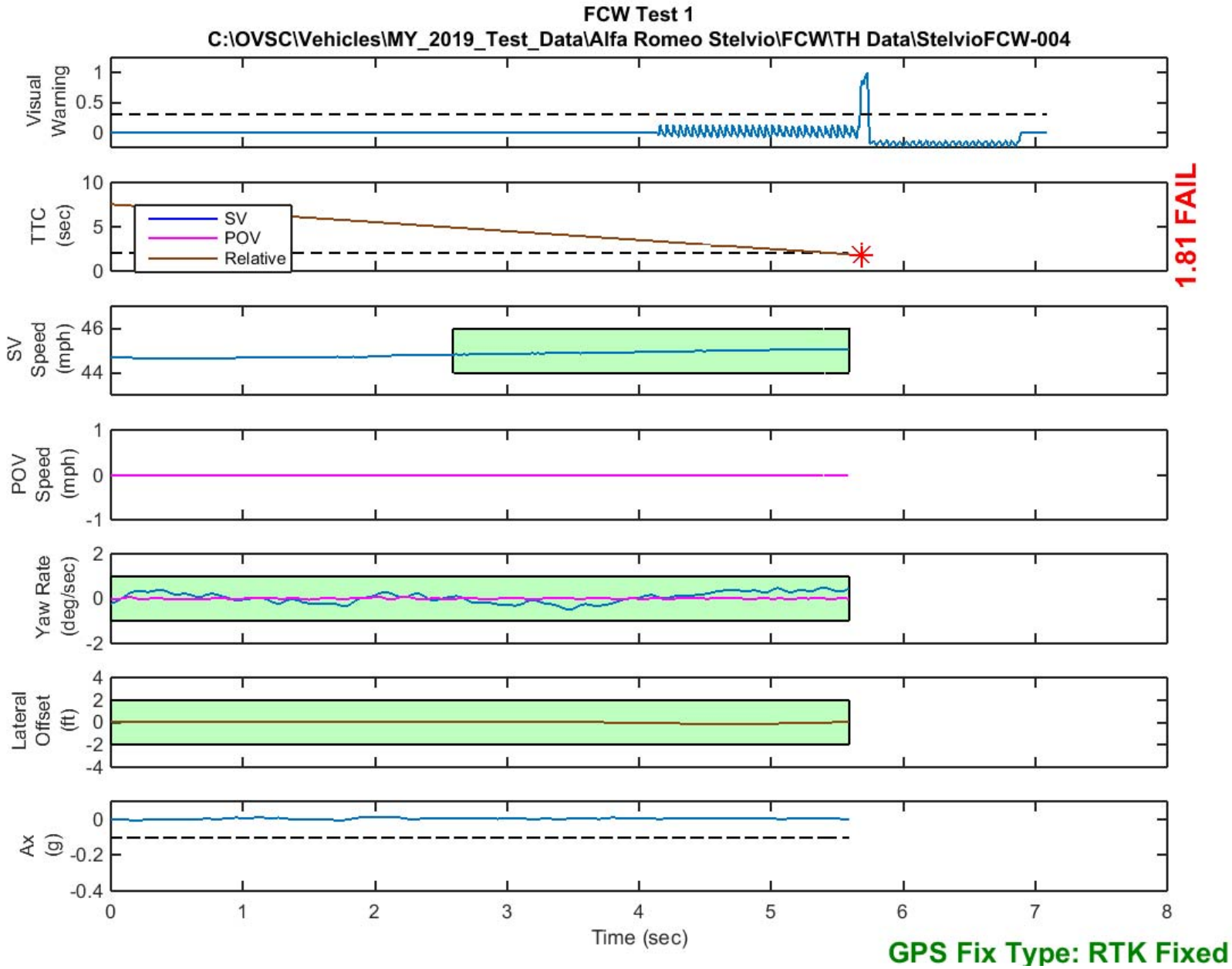


Figure D10. Time History for Run 04, FCW Test 1, Visual Warning

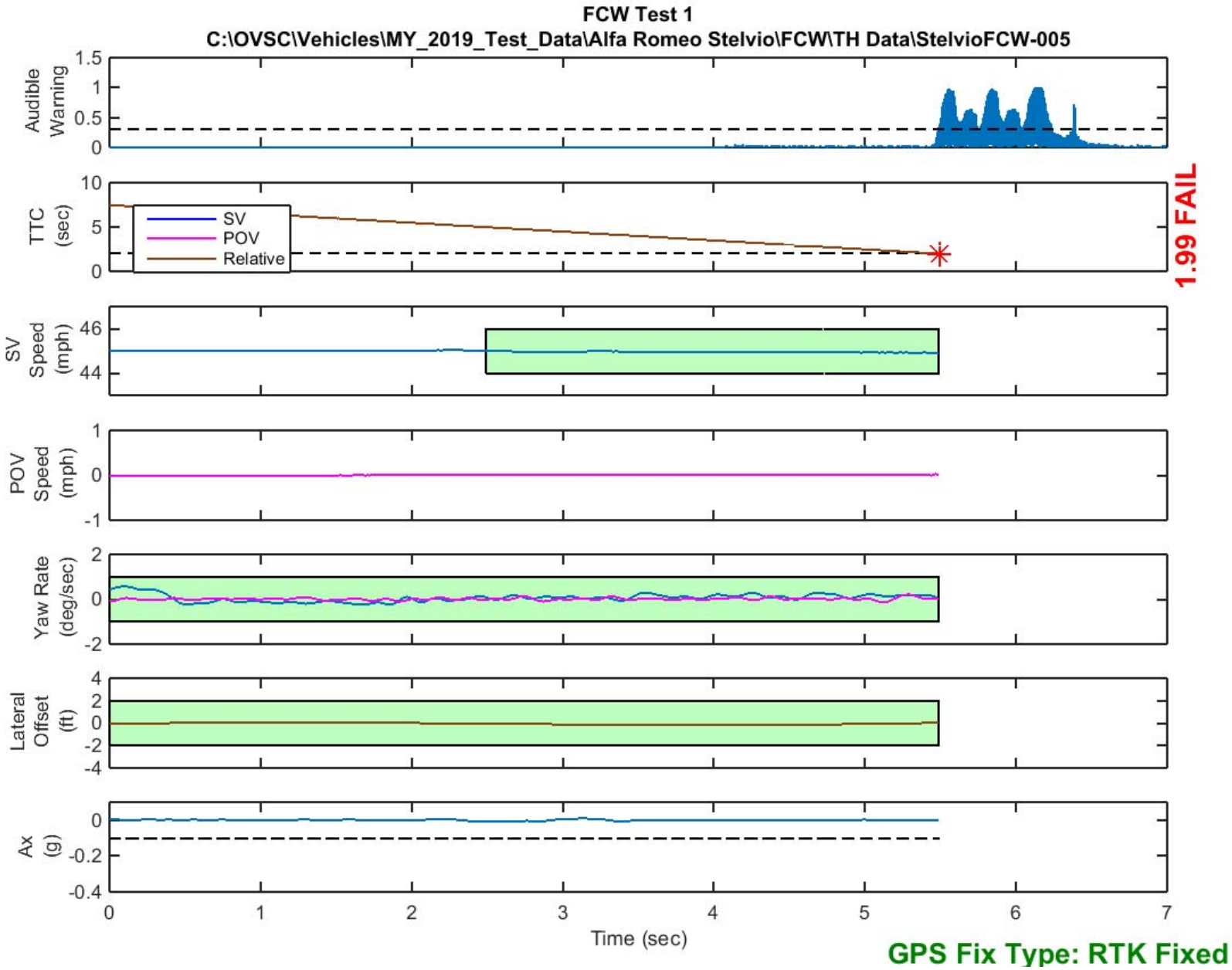


Figure D11. Time History for Run 05, FCW Test 1, Audible Warning

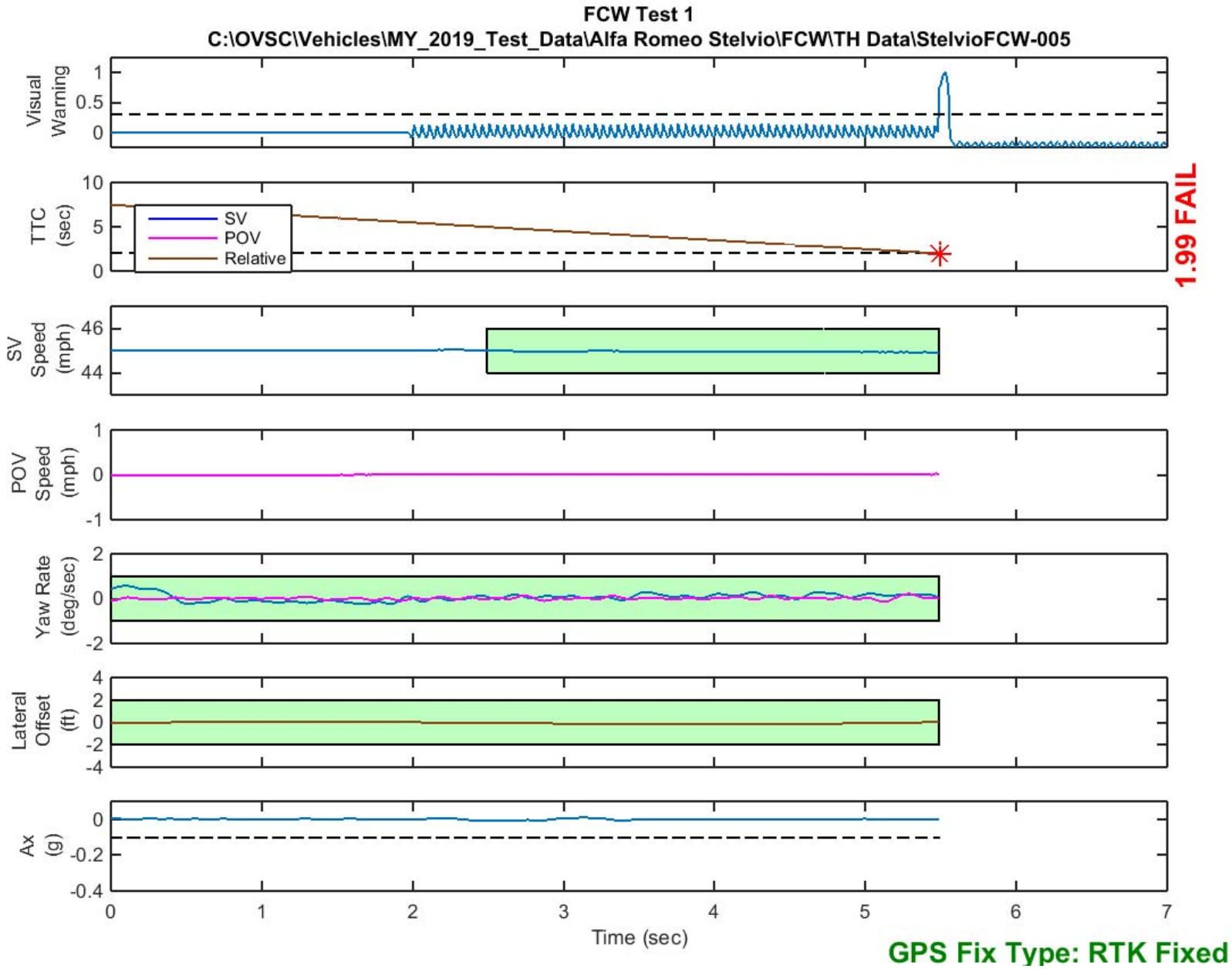


Figure D12. Time History for Run 05, FCW Test 1, Visual Warning

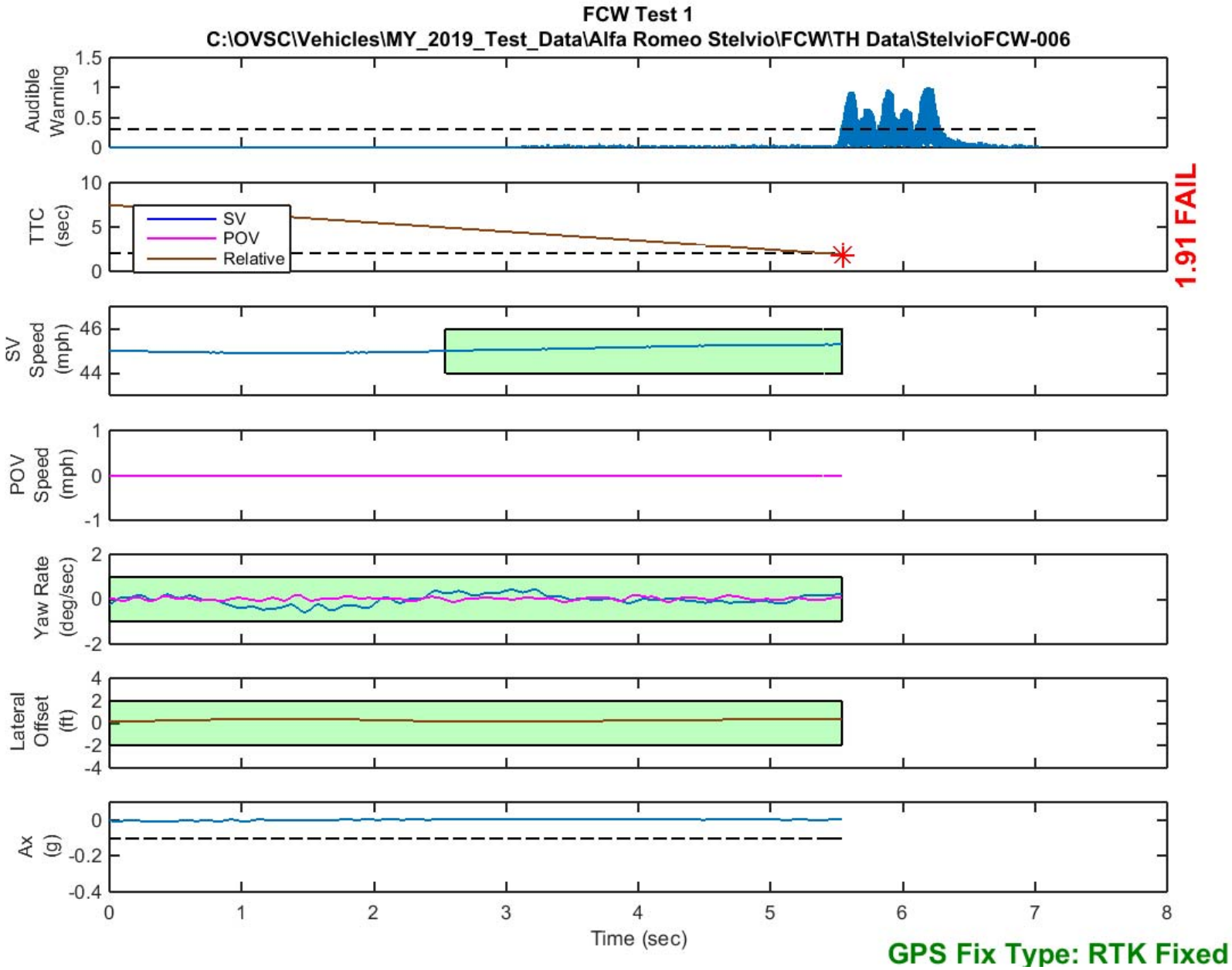


Figure D13. Time History for Run 06, FCW Test 1, Audible Warning

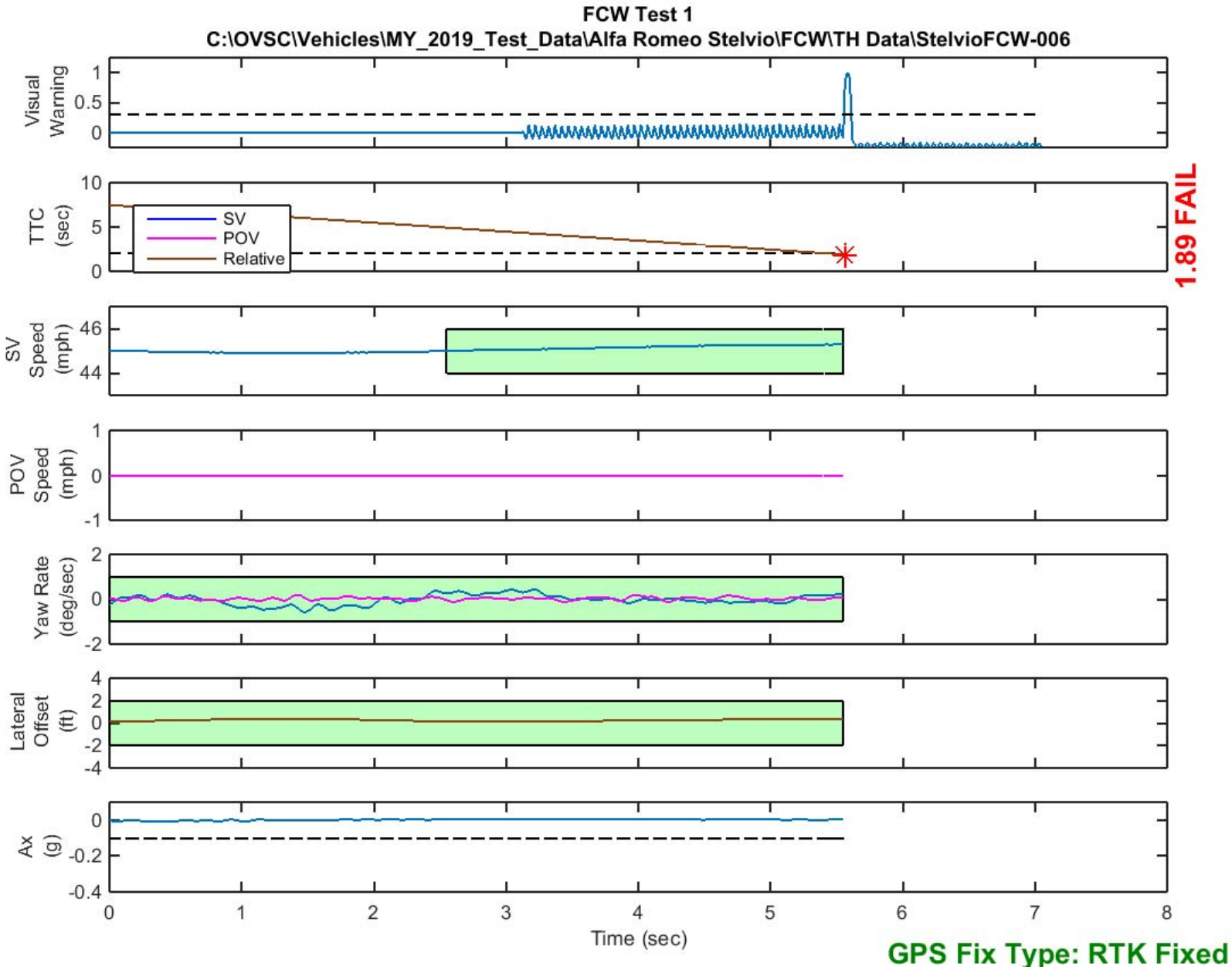


Figure D14. Time History for Run 06, FCW Test 1, Visual Warning

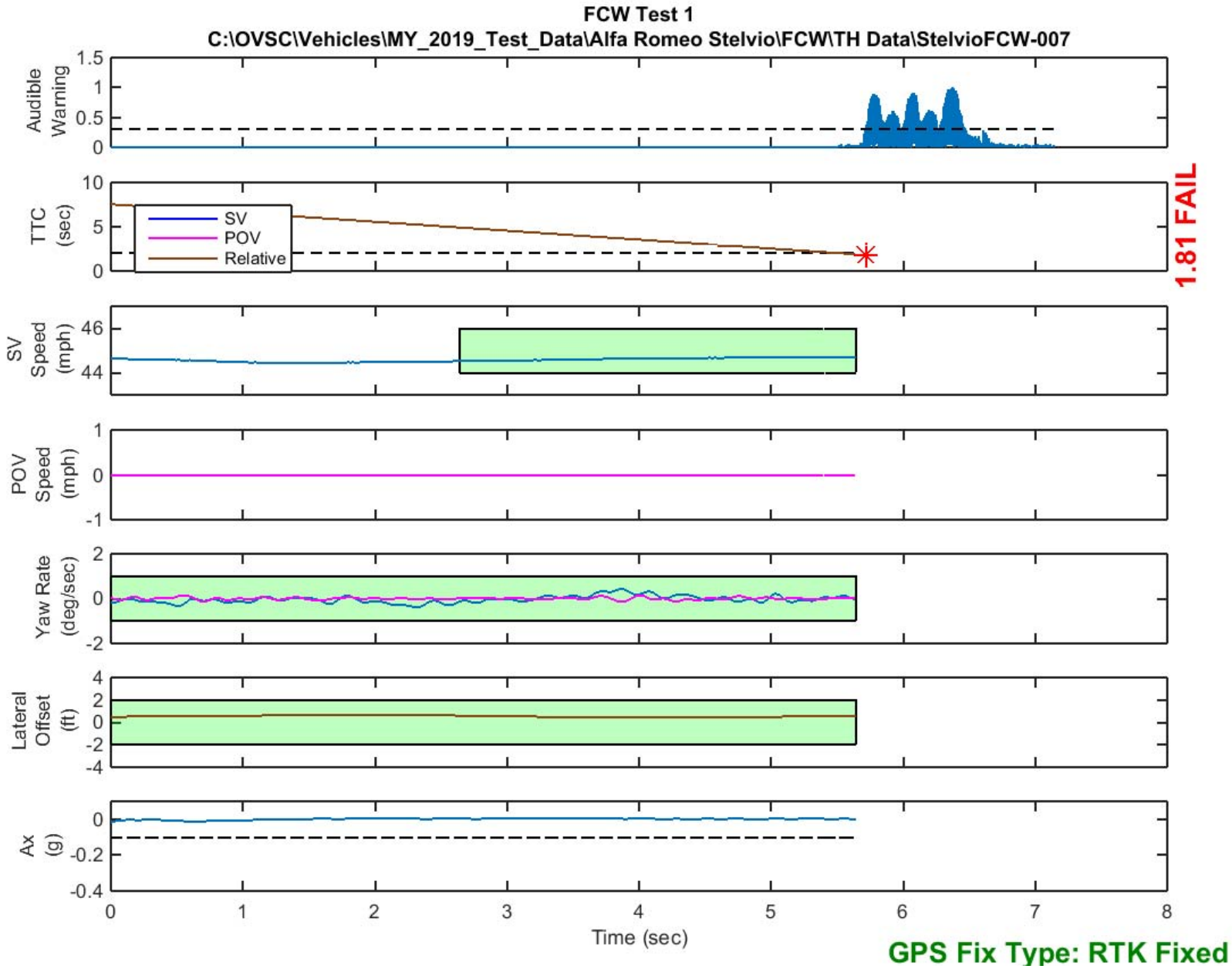


Figure D15. Time History for Run 07, FCW Test 1, Audible Warning

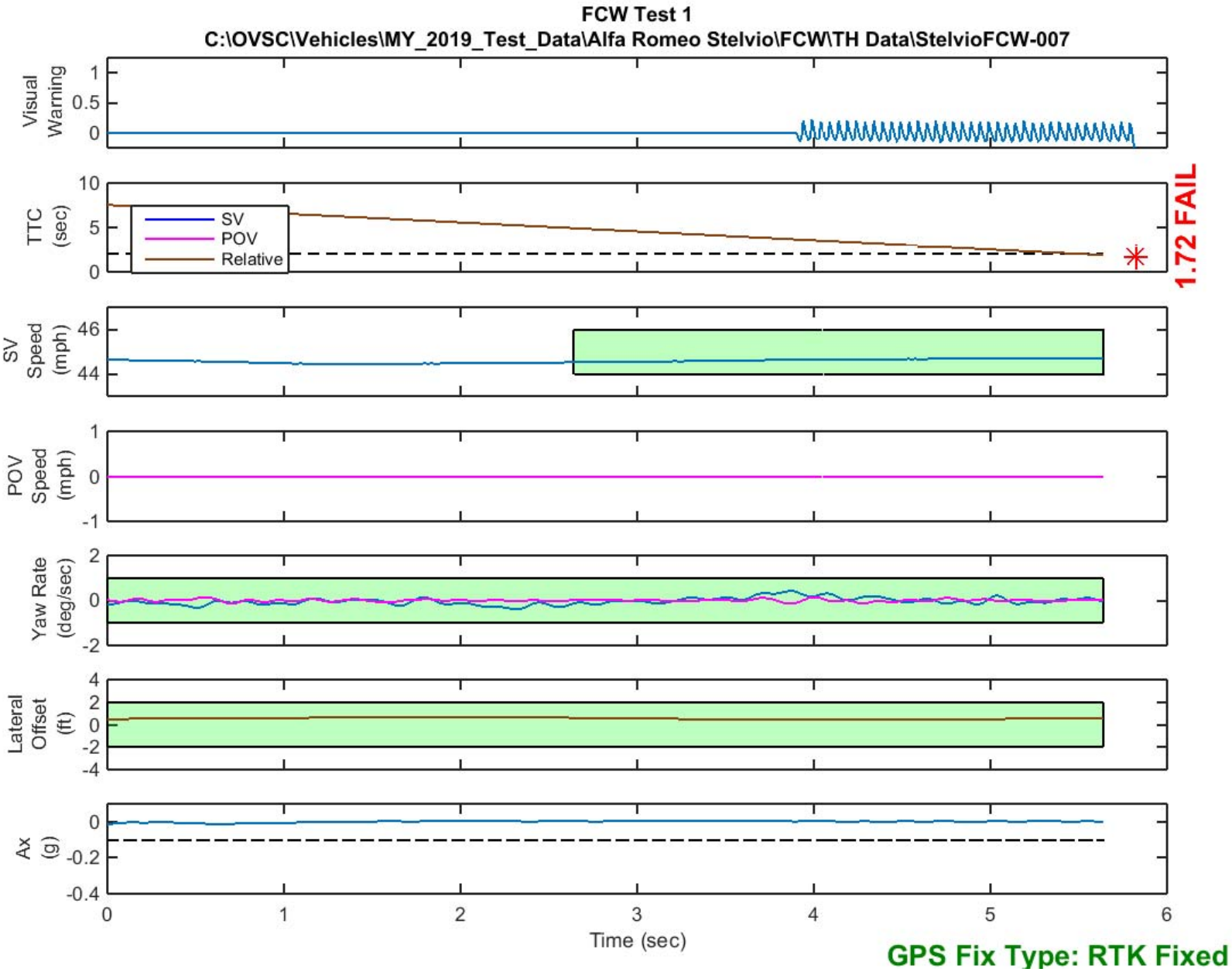


Figure D16. Time History for Run 07, FCW Test 1, Visual Warning

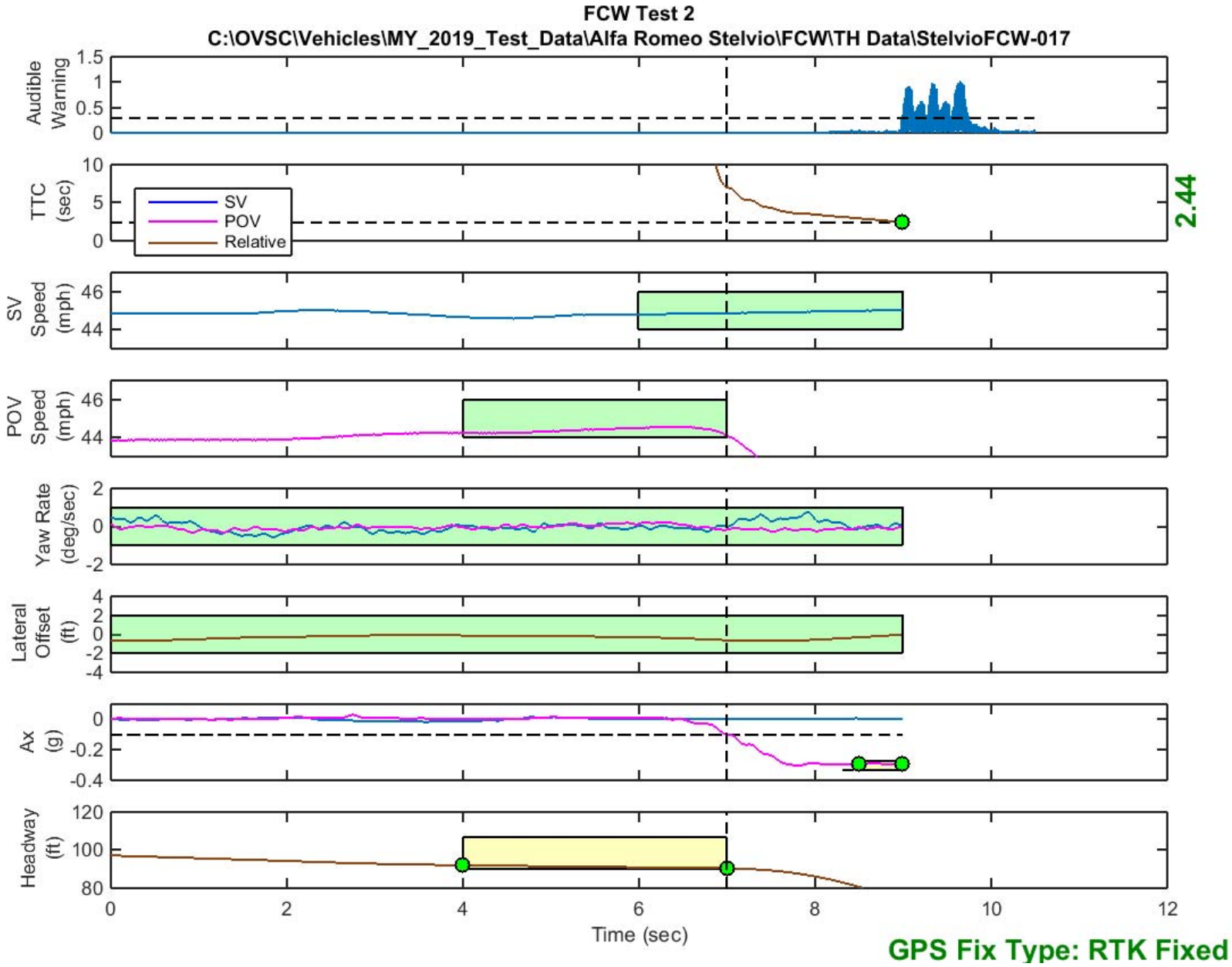


Figure D17. Time History for Run 17, FCW Test 2, Audible Warning

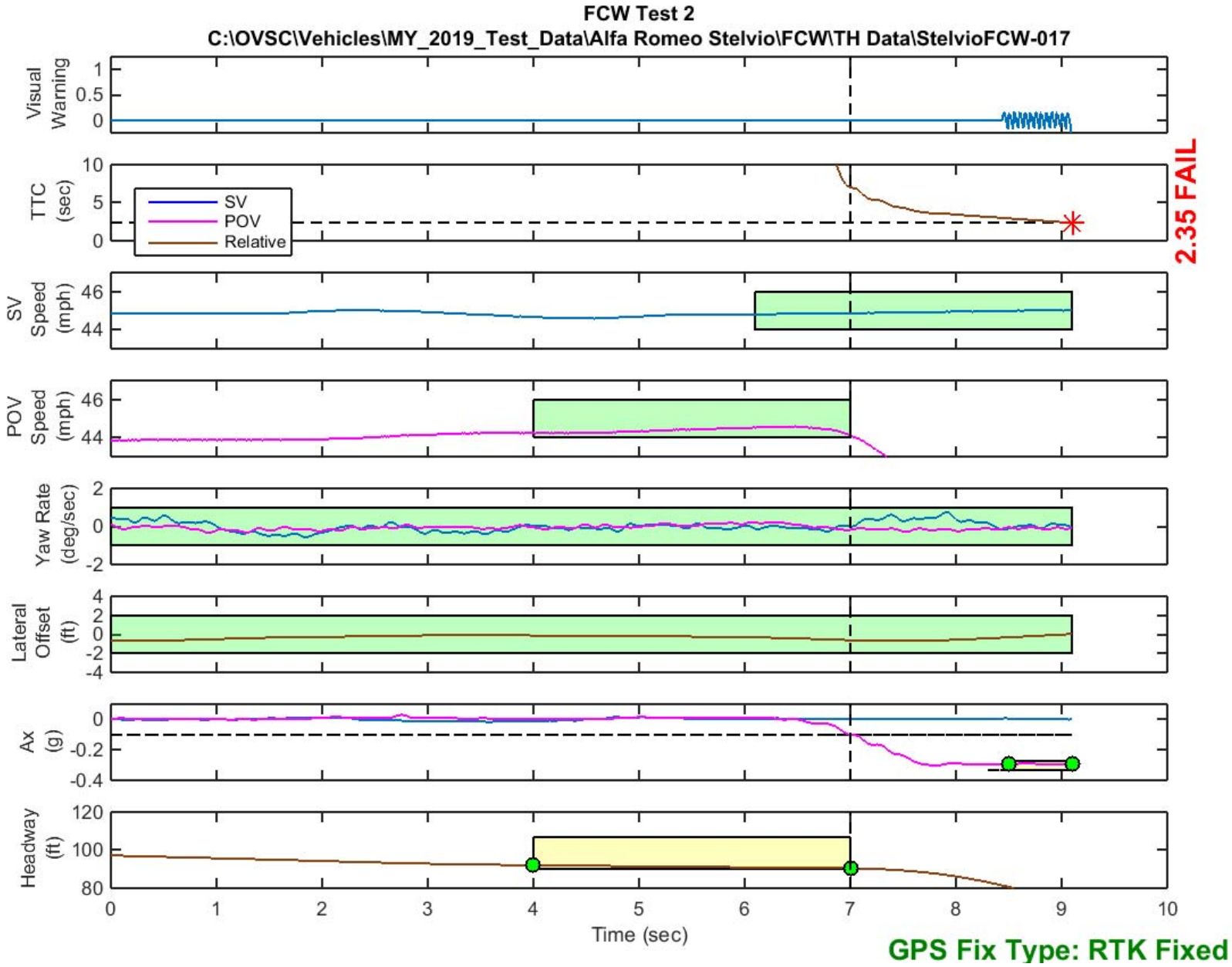


Figure D18. Time History for Run 17, FCW Test 2, Visual Warning

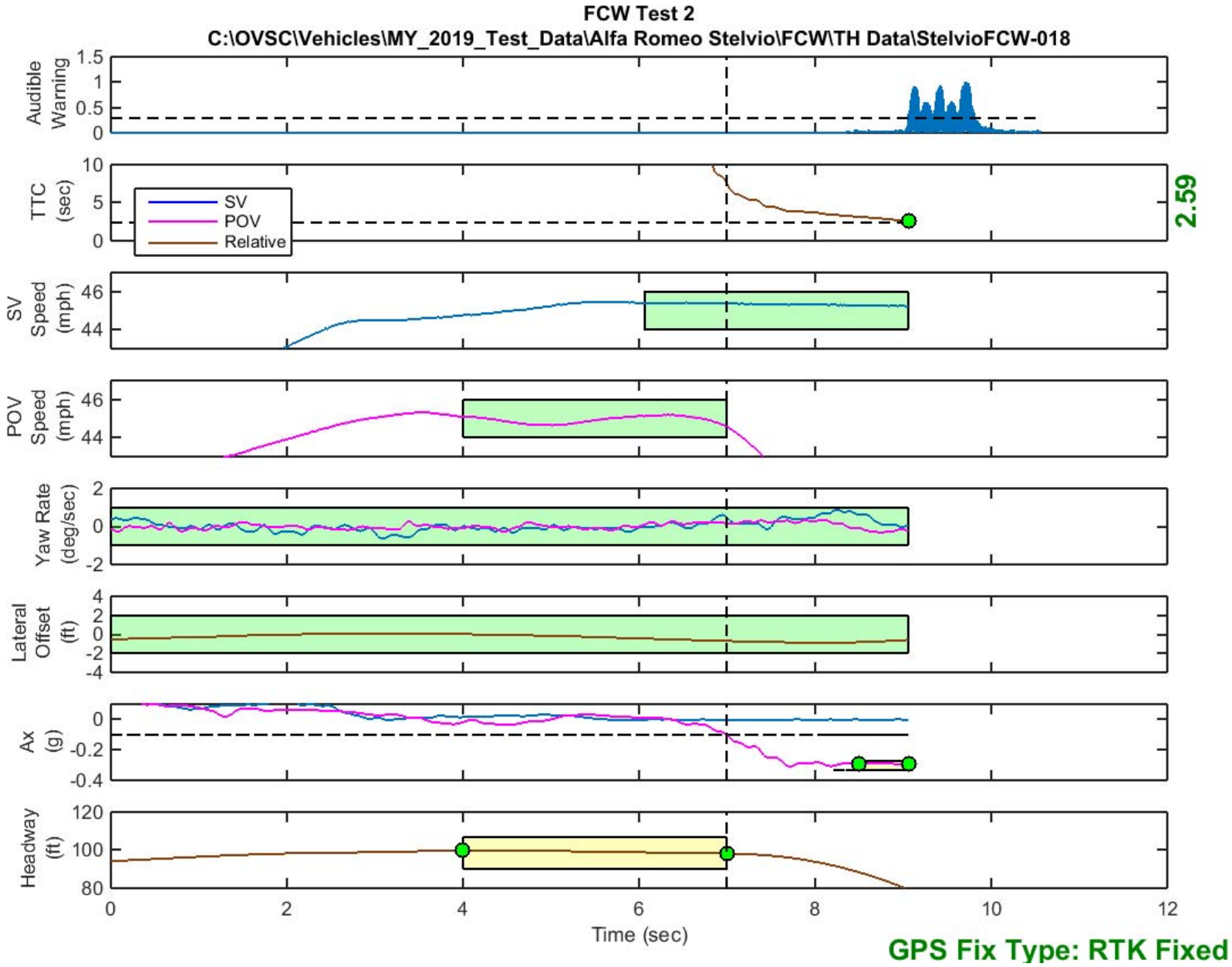


Figure D19. Time History for Run 18, FCW Test 2, Audible Warning

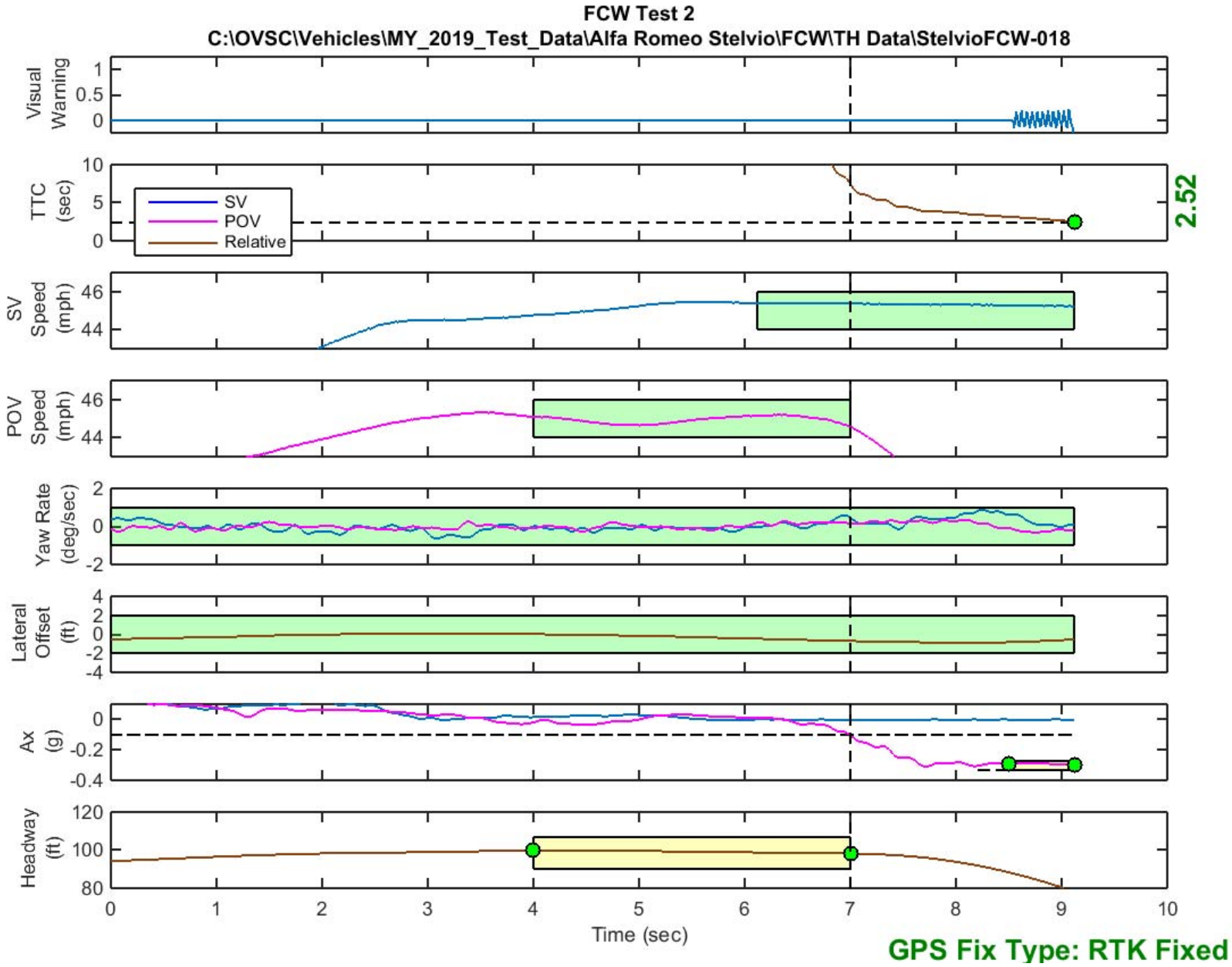


Figure D20. Time History for Run 18, FCW Test 2, Visual Warning

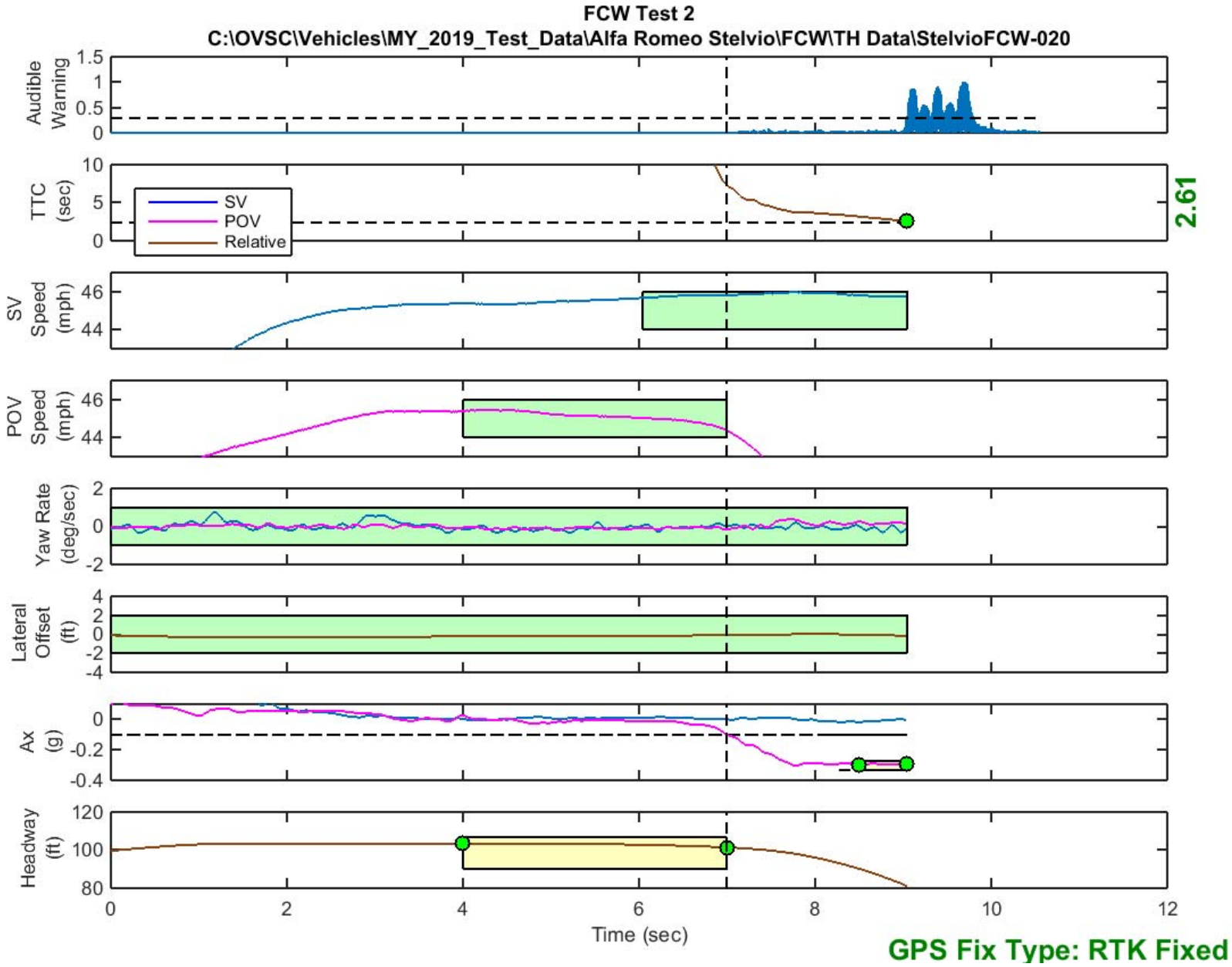


Figure D21. Time History for Run 20, FCW Test 2, Audible Warning

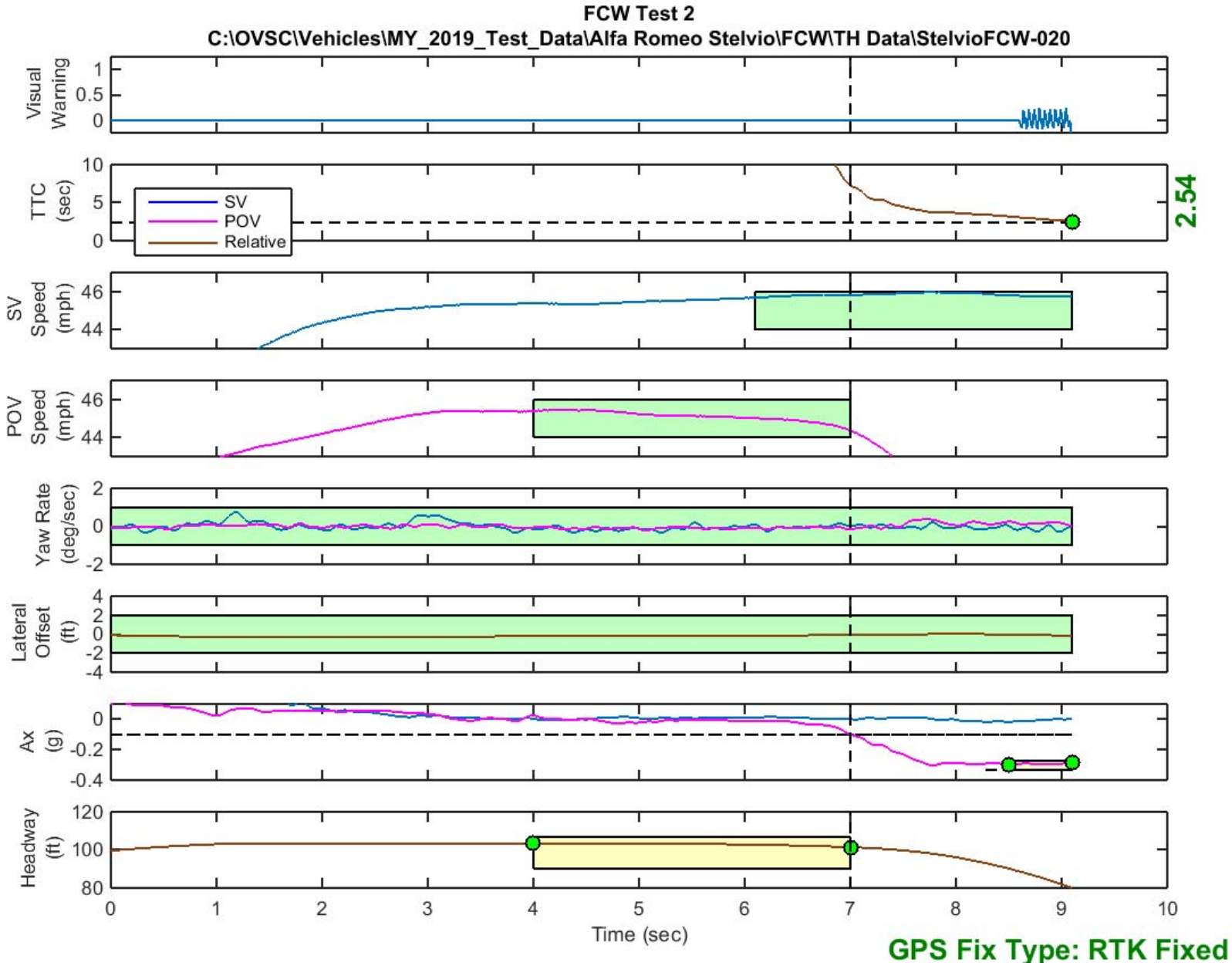


Figure D22. Time History for Run 20, FCW Test 2, Visual Warning

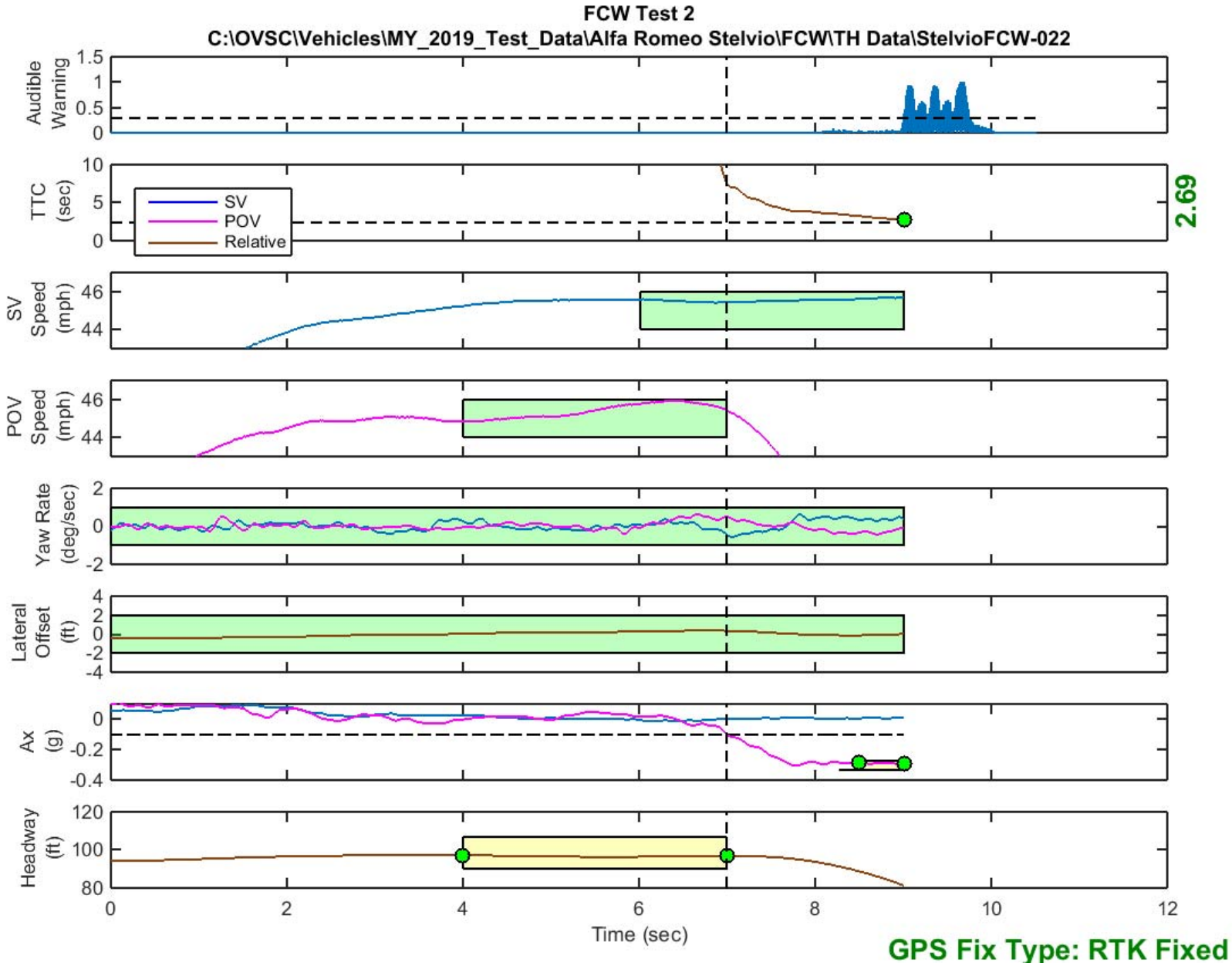


Figure D23. Time History for Run 22, FCW Test 2, Audible Warning

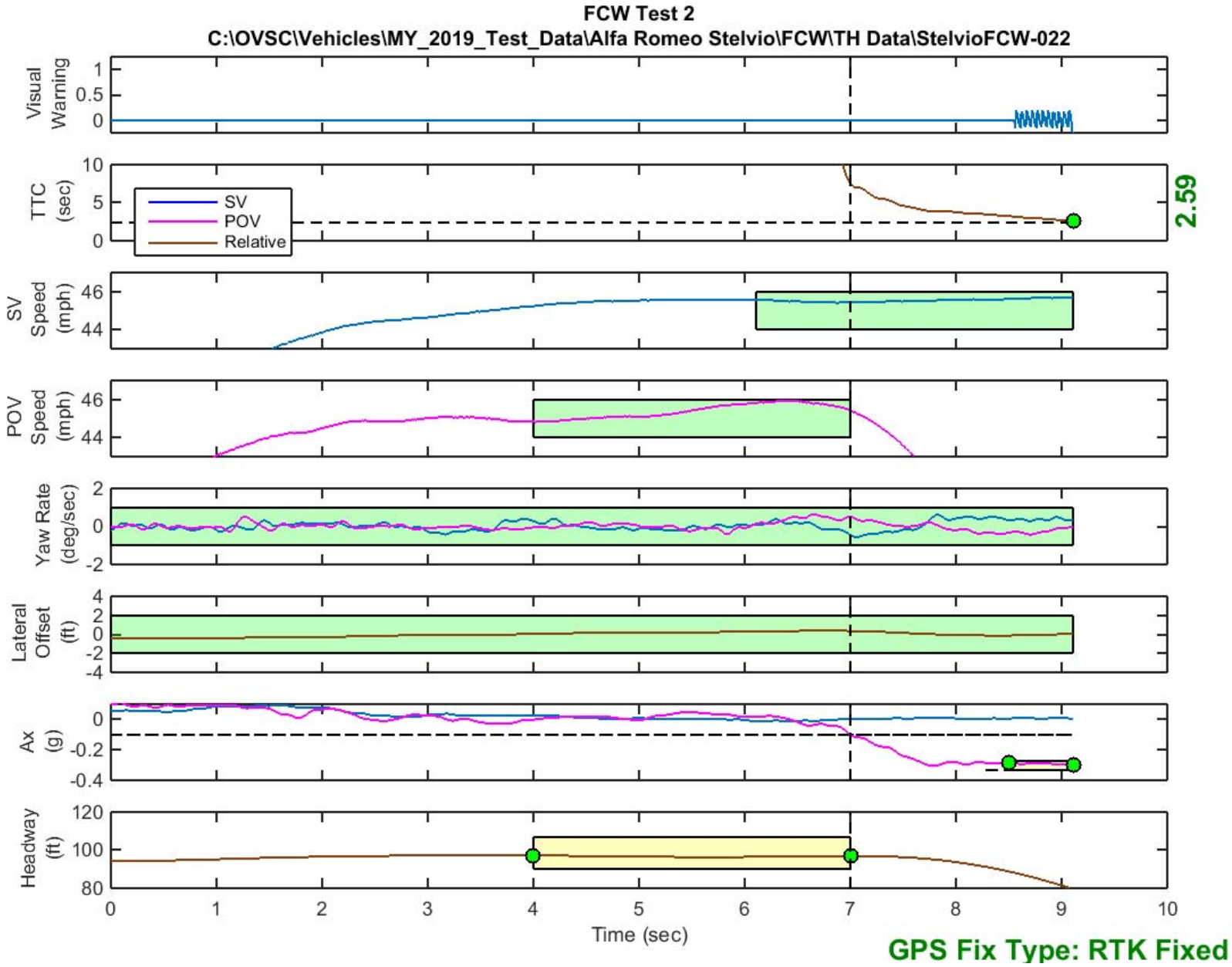


Figure D24. Time History for Run 22, FCW Test 2, Visual Warning

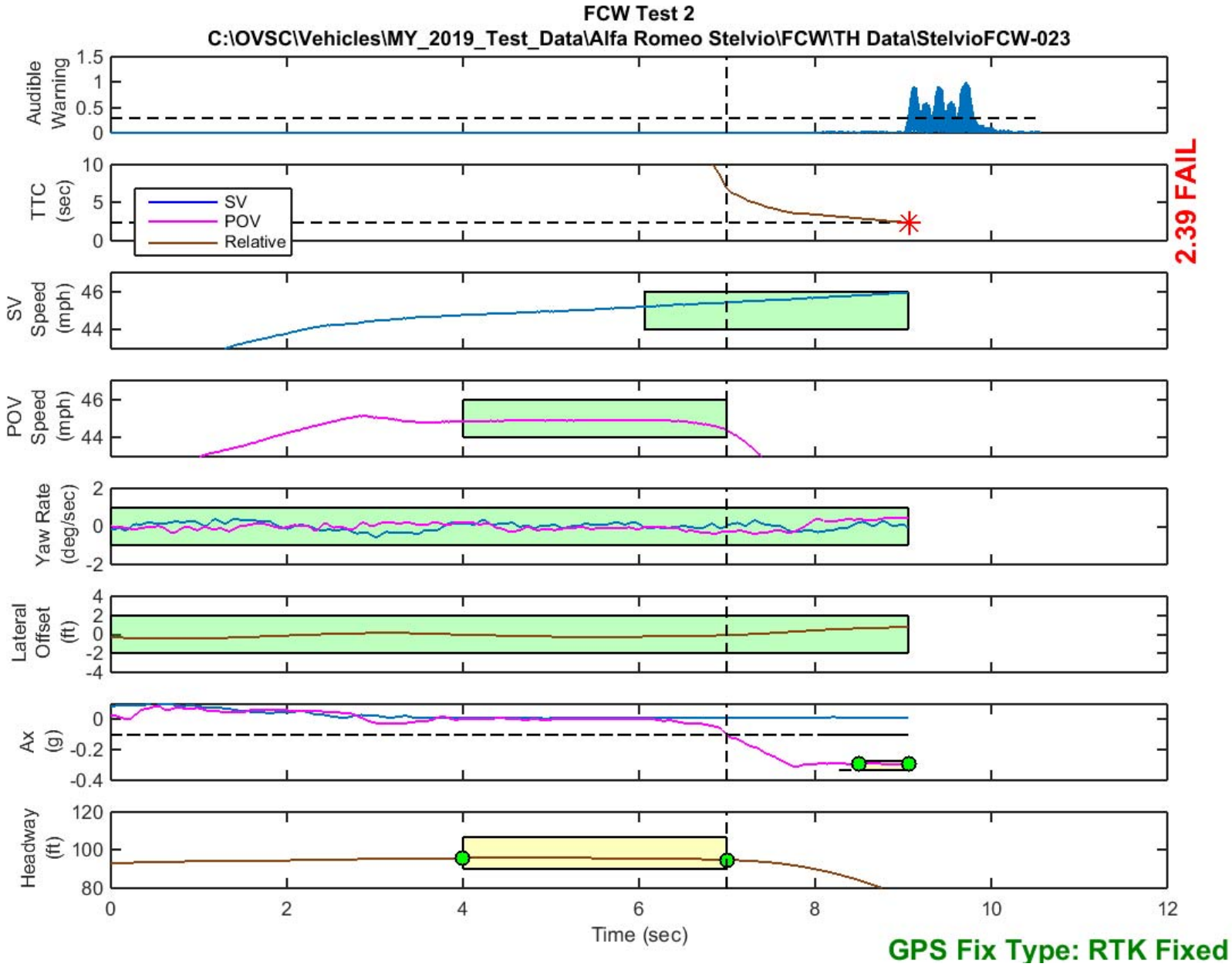


Figure D25. Time History for Run 23, FCW Test 2, Audible Warning

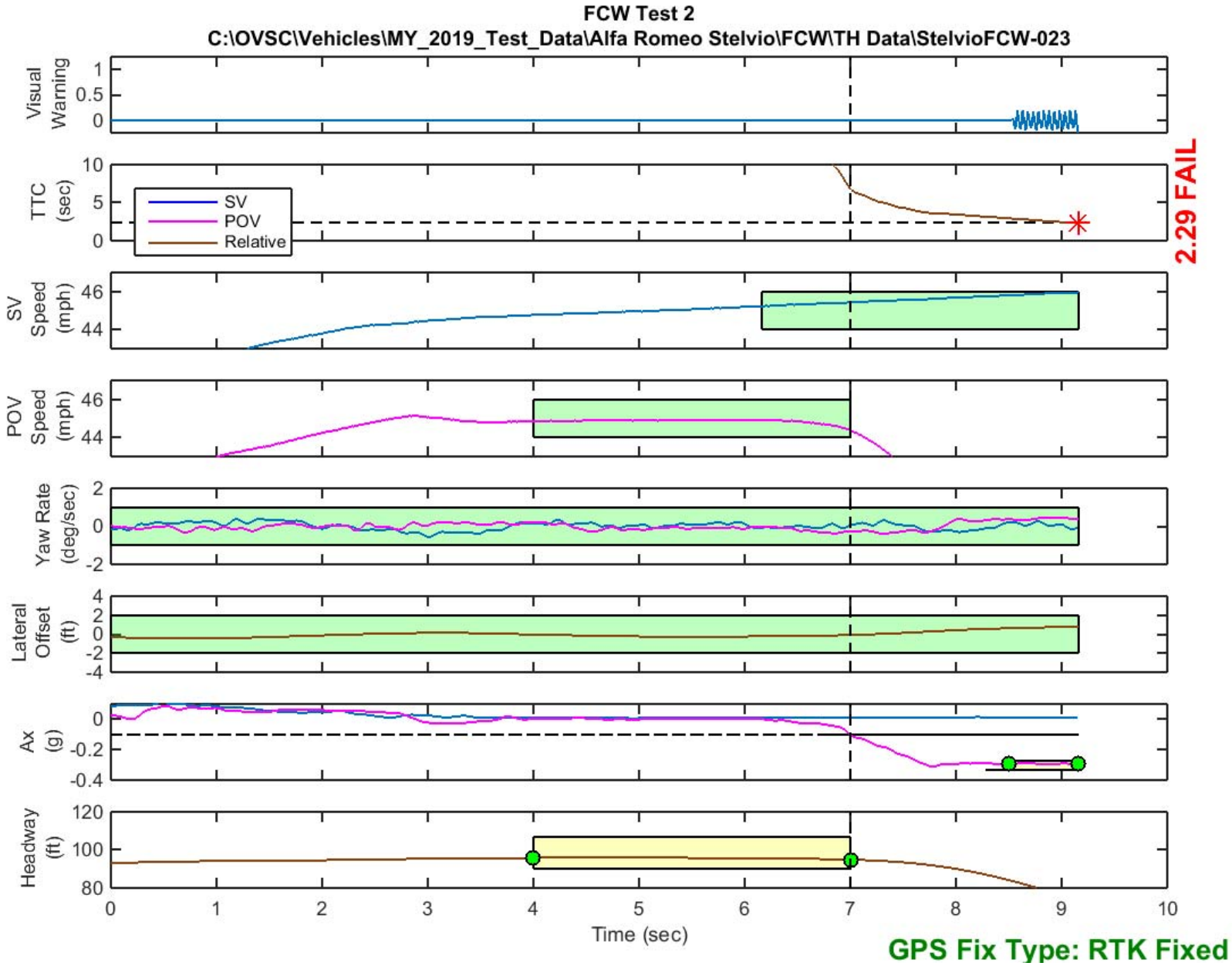


Figure D26. Time History for Run 23, FCW Test 2, Visual Warning

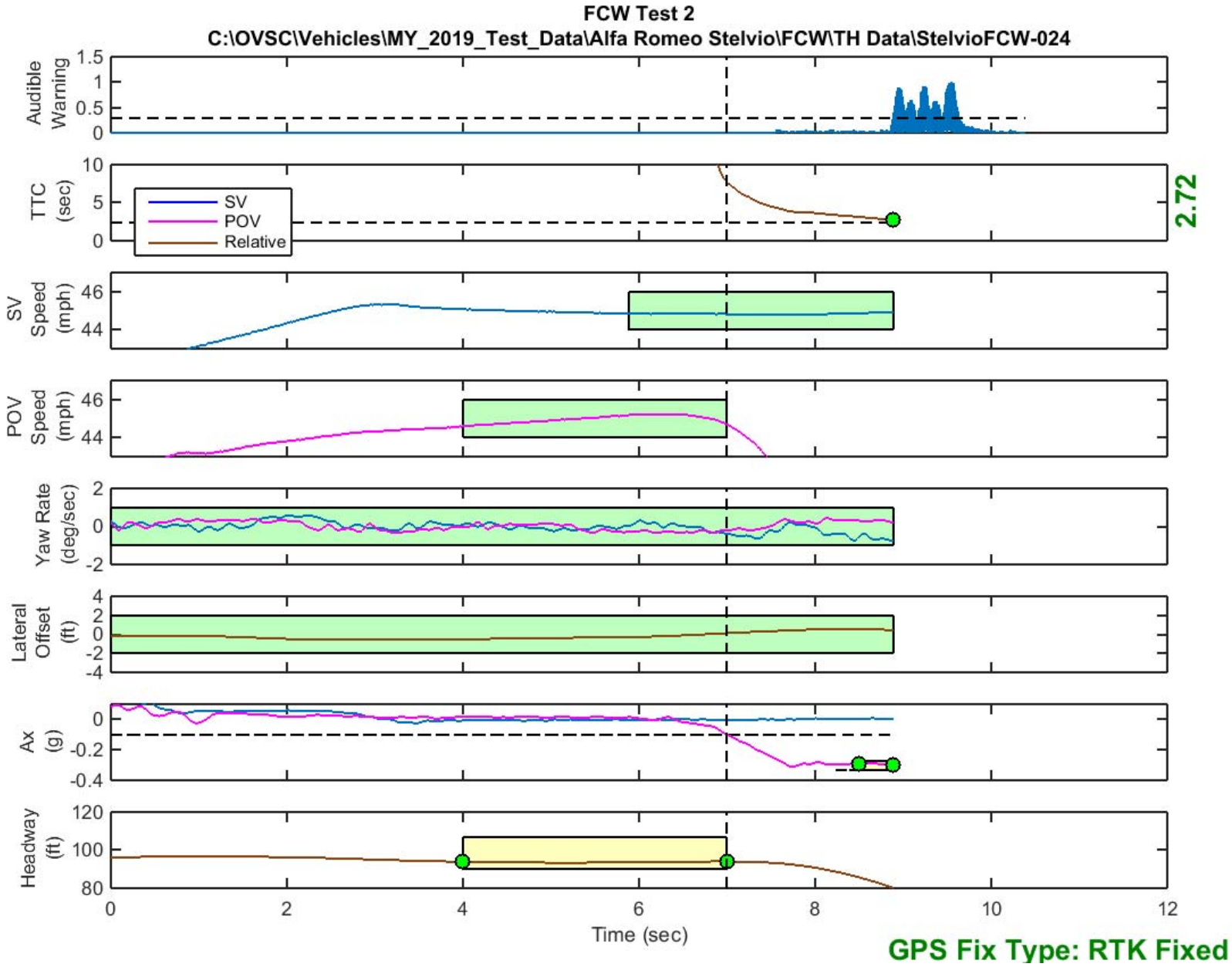


Figure D27. Time History for Run 24, FCW Test 2, Audible Warning

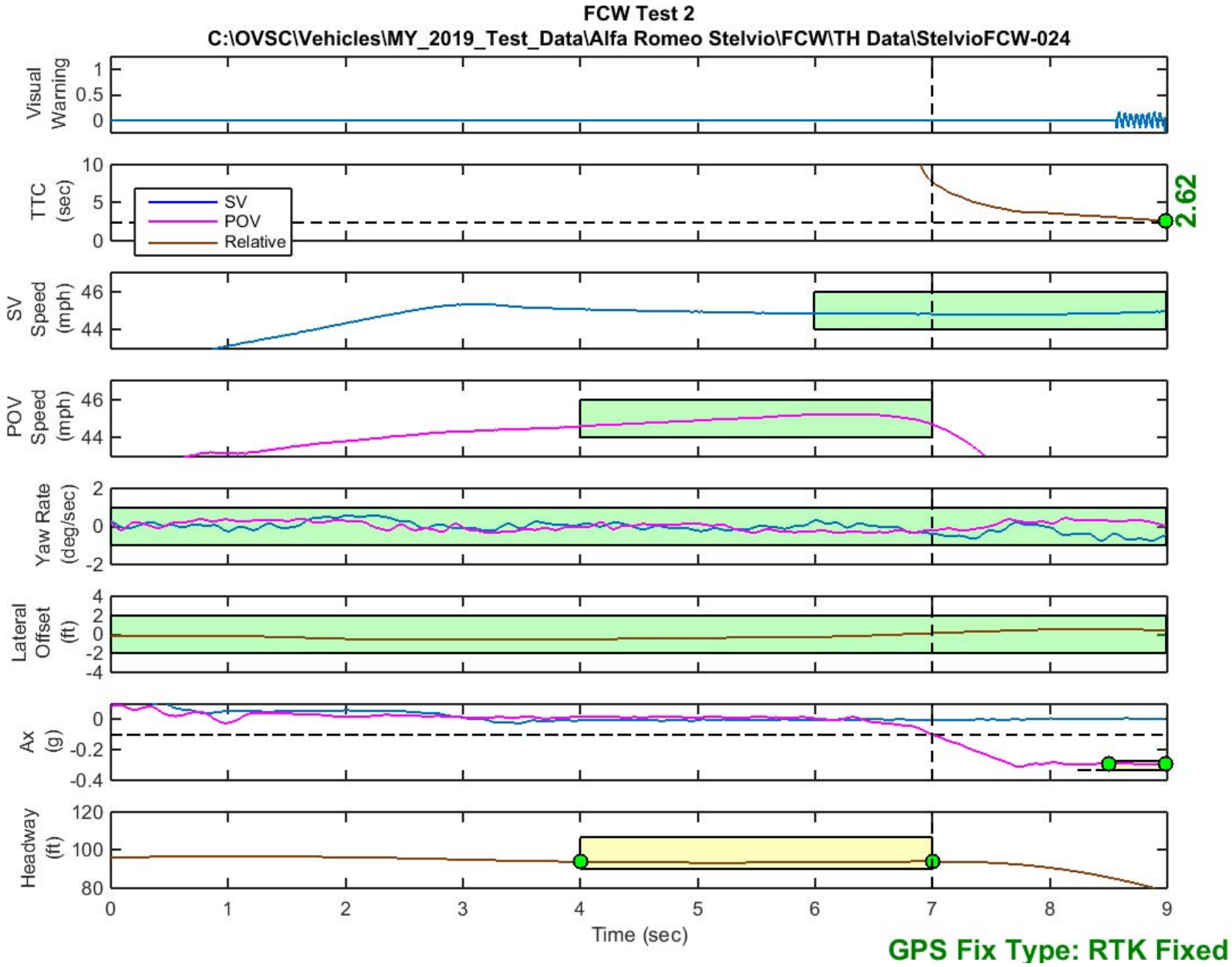


Figure D28. Time History for Run 24, FCW Test 2, Visual Warning

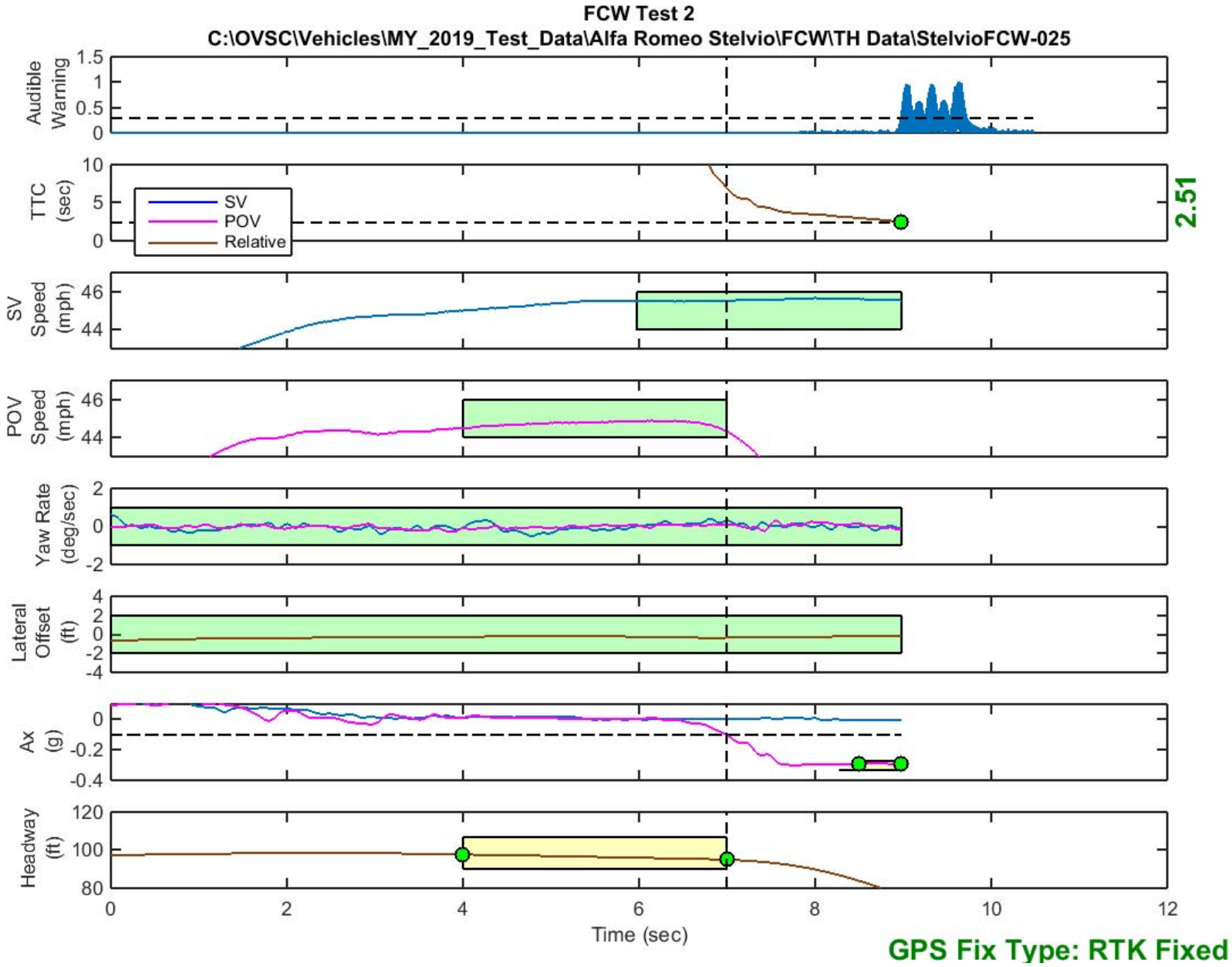


Figure D29. Time History for Run 25, FCW Test 2, Audible Warning

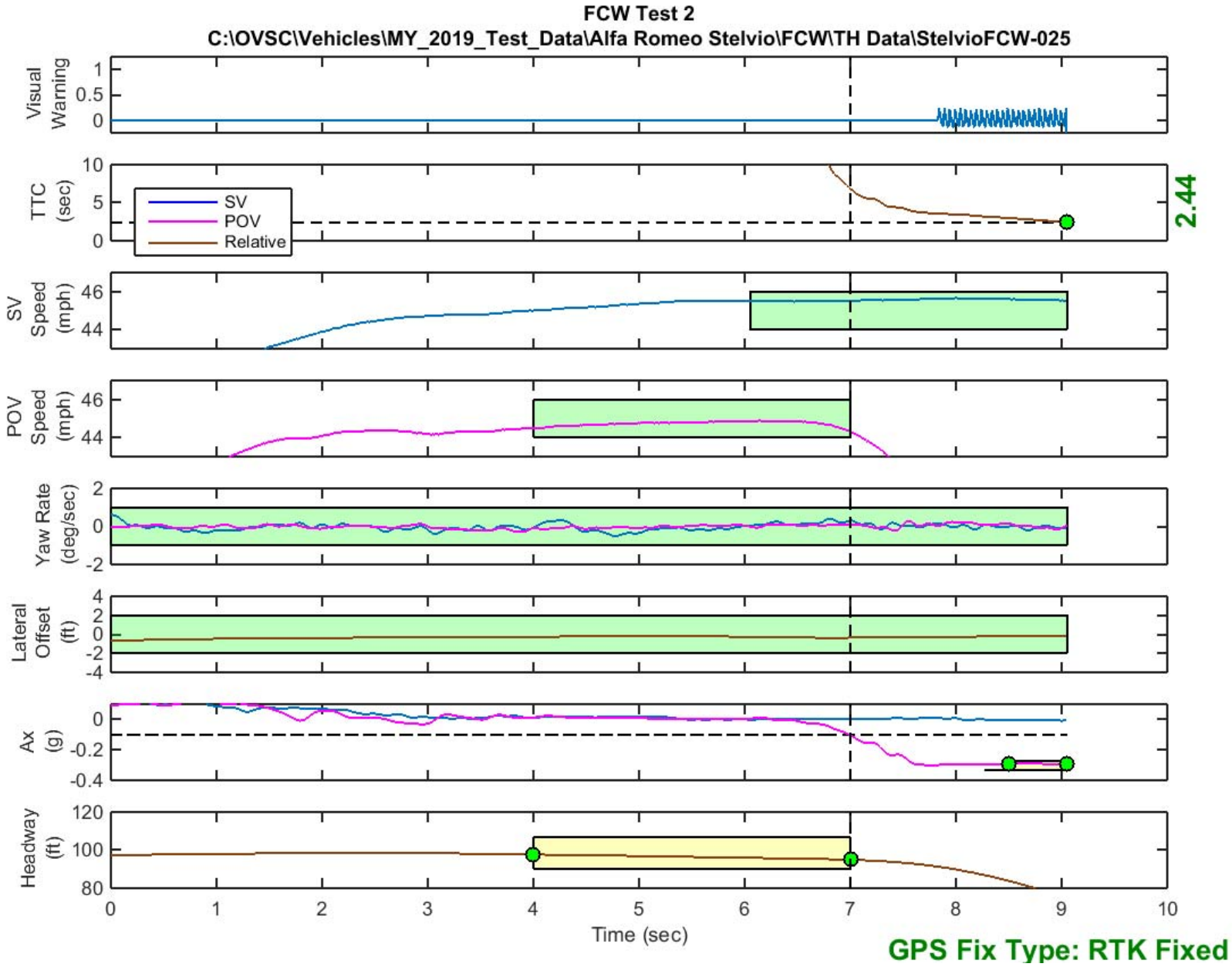


Figure D30. Time History for Run 25, FCW Test 2, Visual Warning

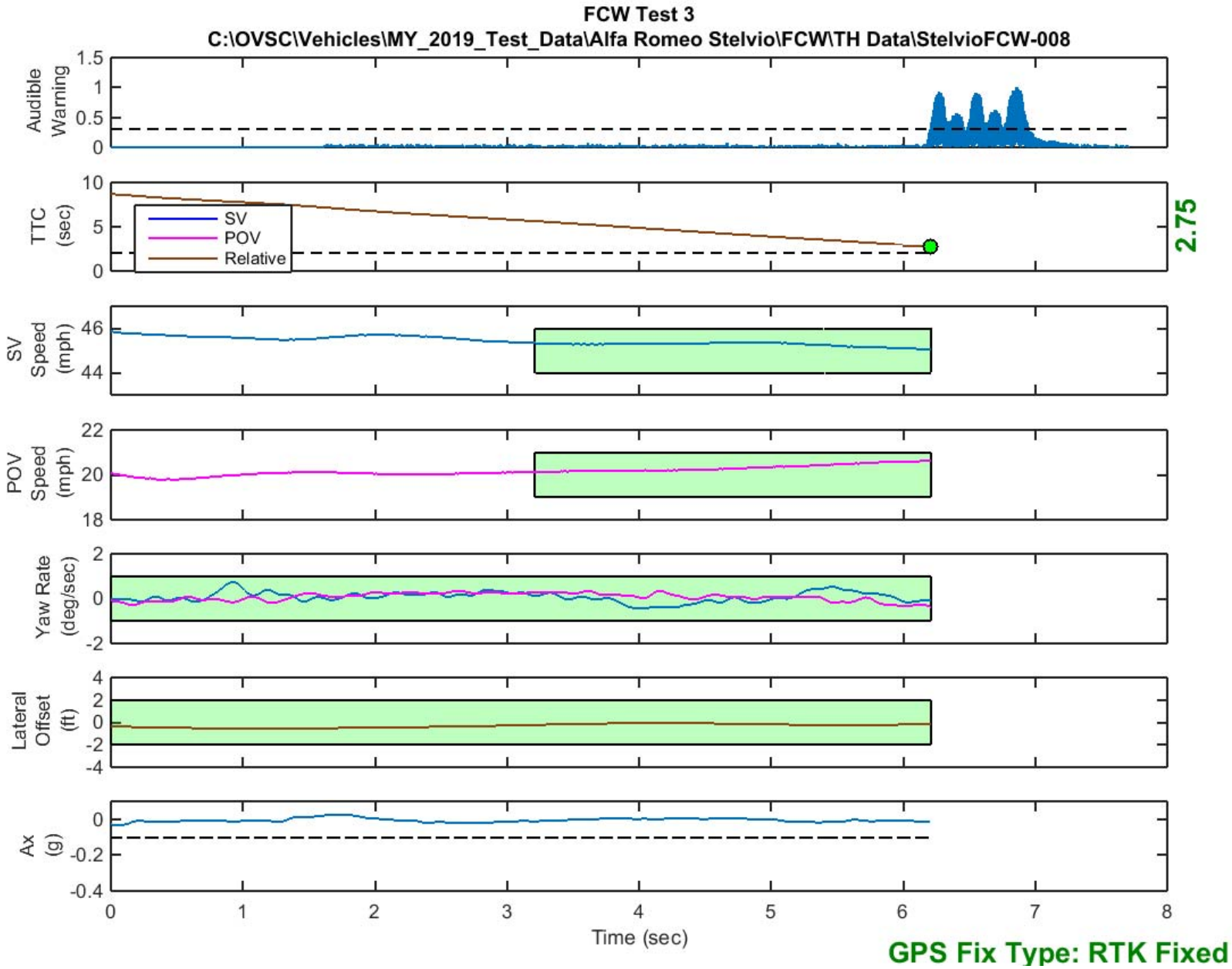


Figure D31. Time History for Run 08, FCW Test 3, Audible Warning

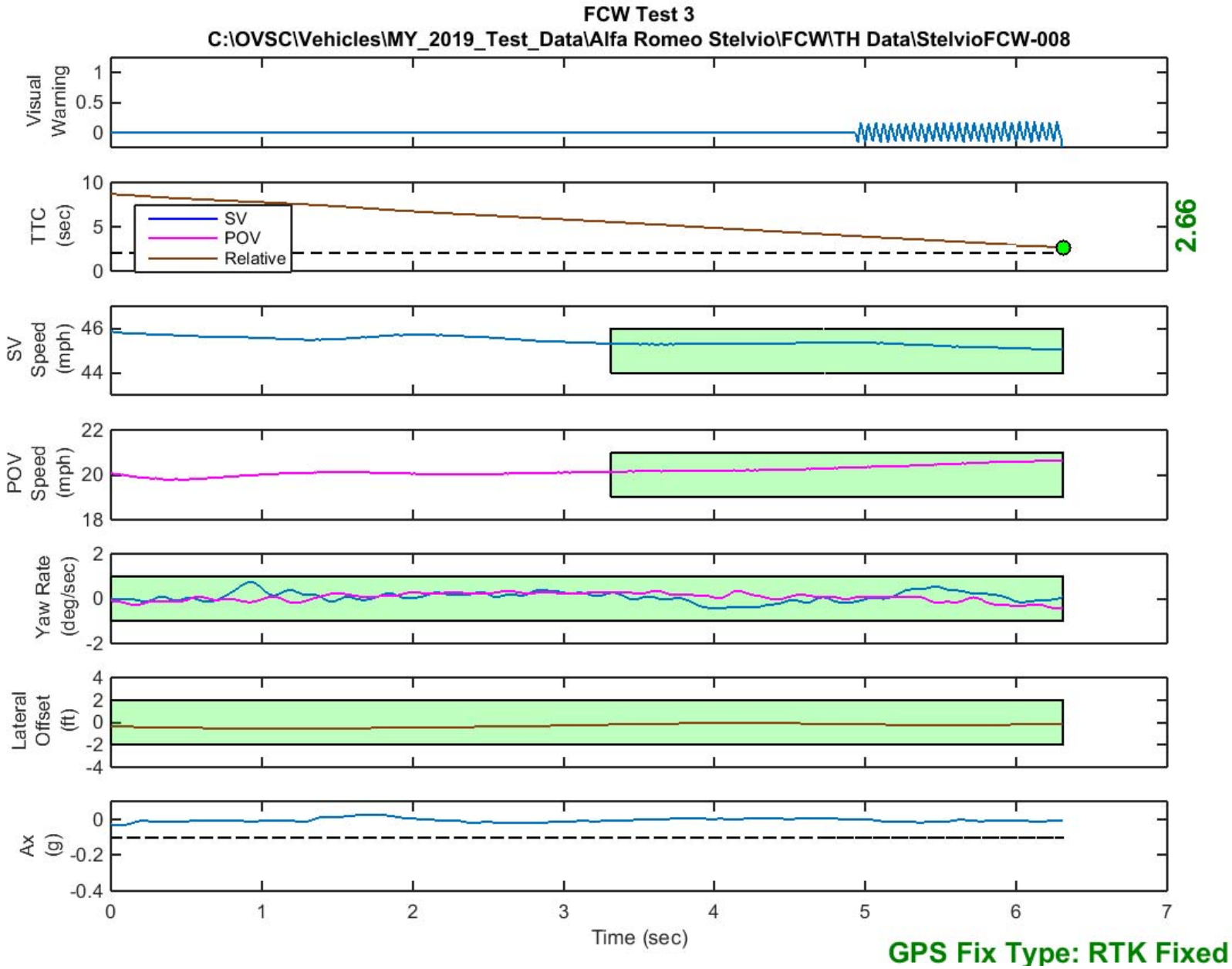


Figure D32. Time History for Run 08, FCW Test 3, Visual Warning

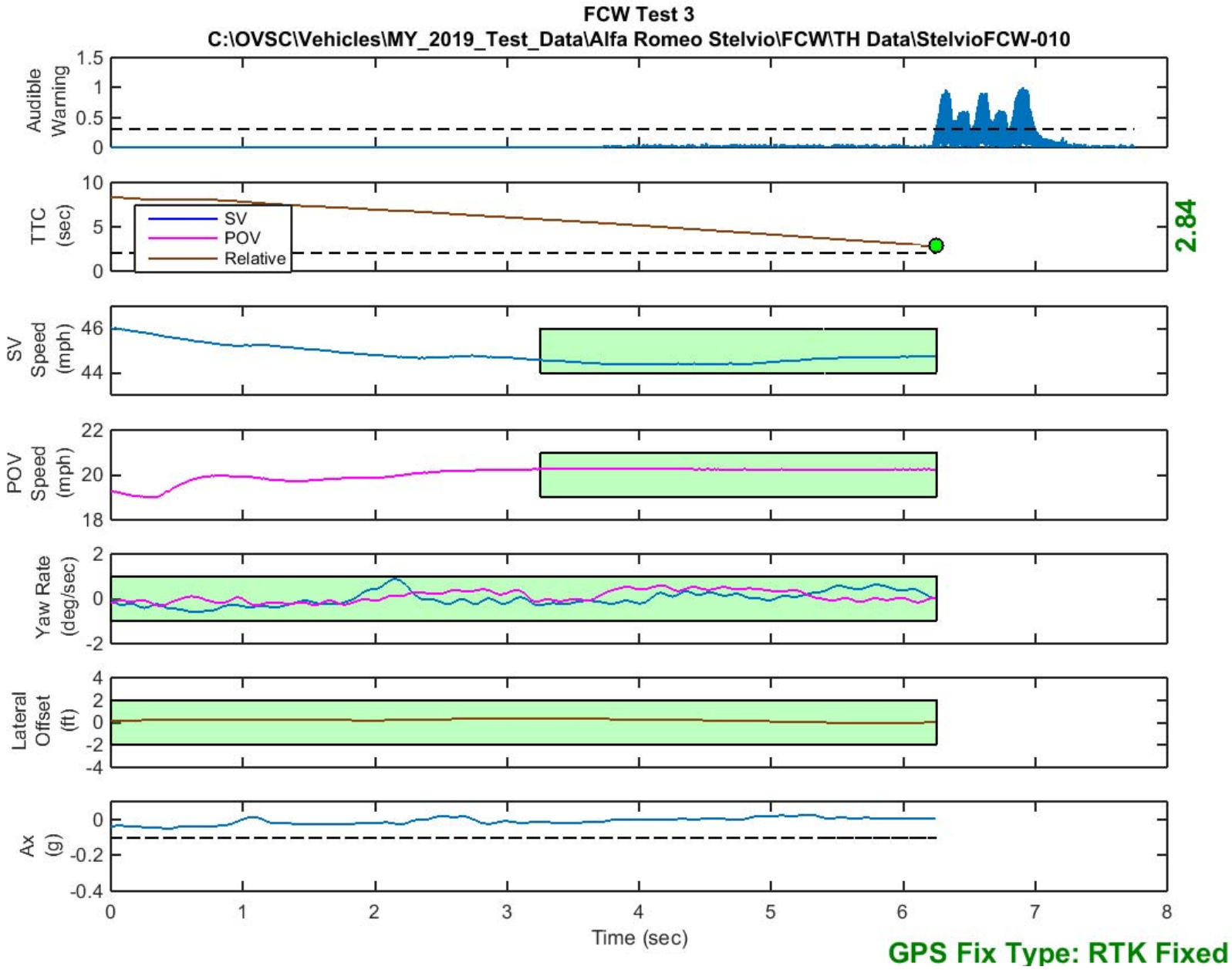


Figure D33. Time History for Run 10, FCW Test 3, Audible Warning

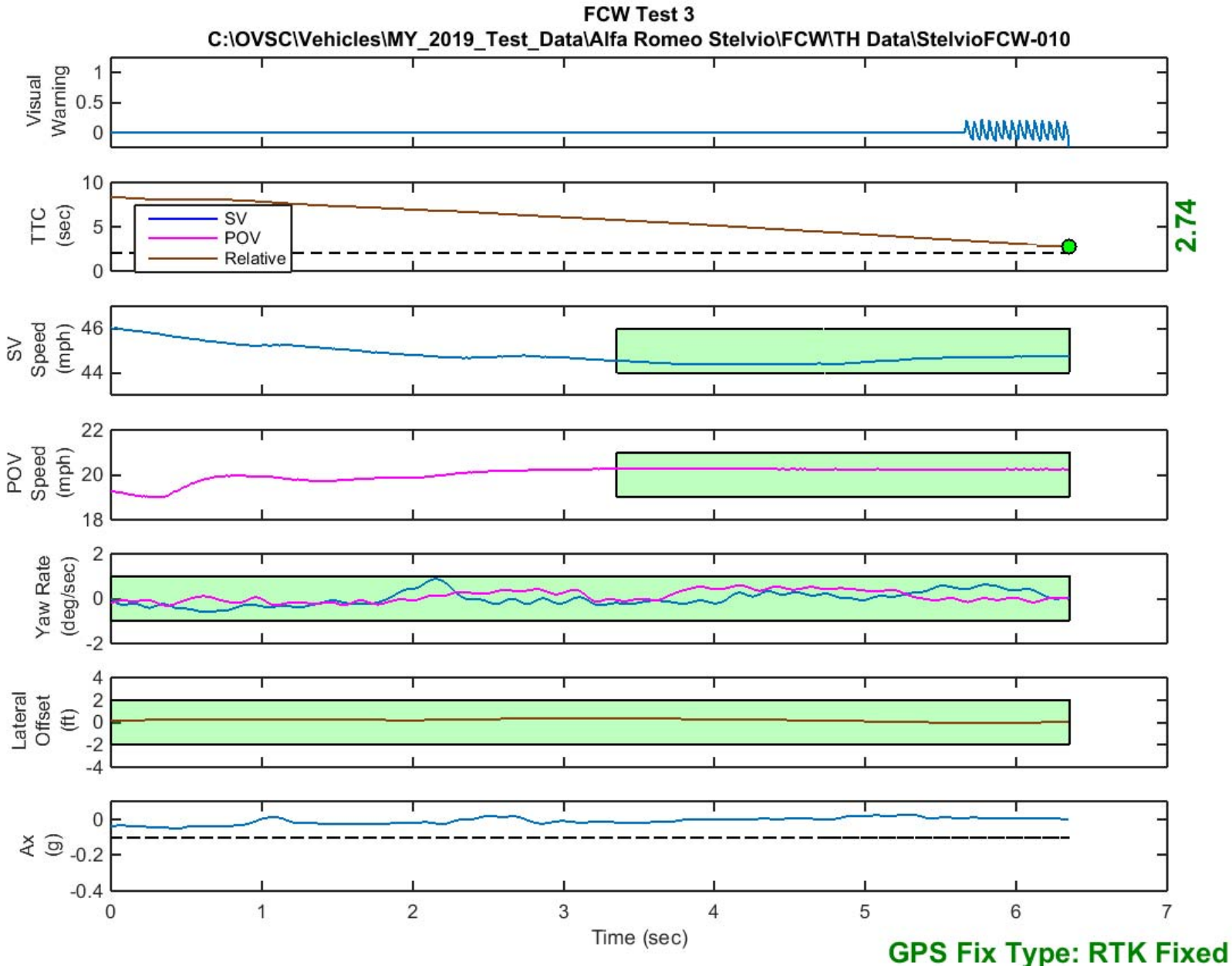


Figure D34. Time History for Run 10, FCW Test 3, Visual Warning

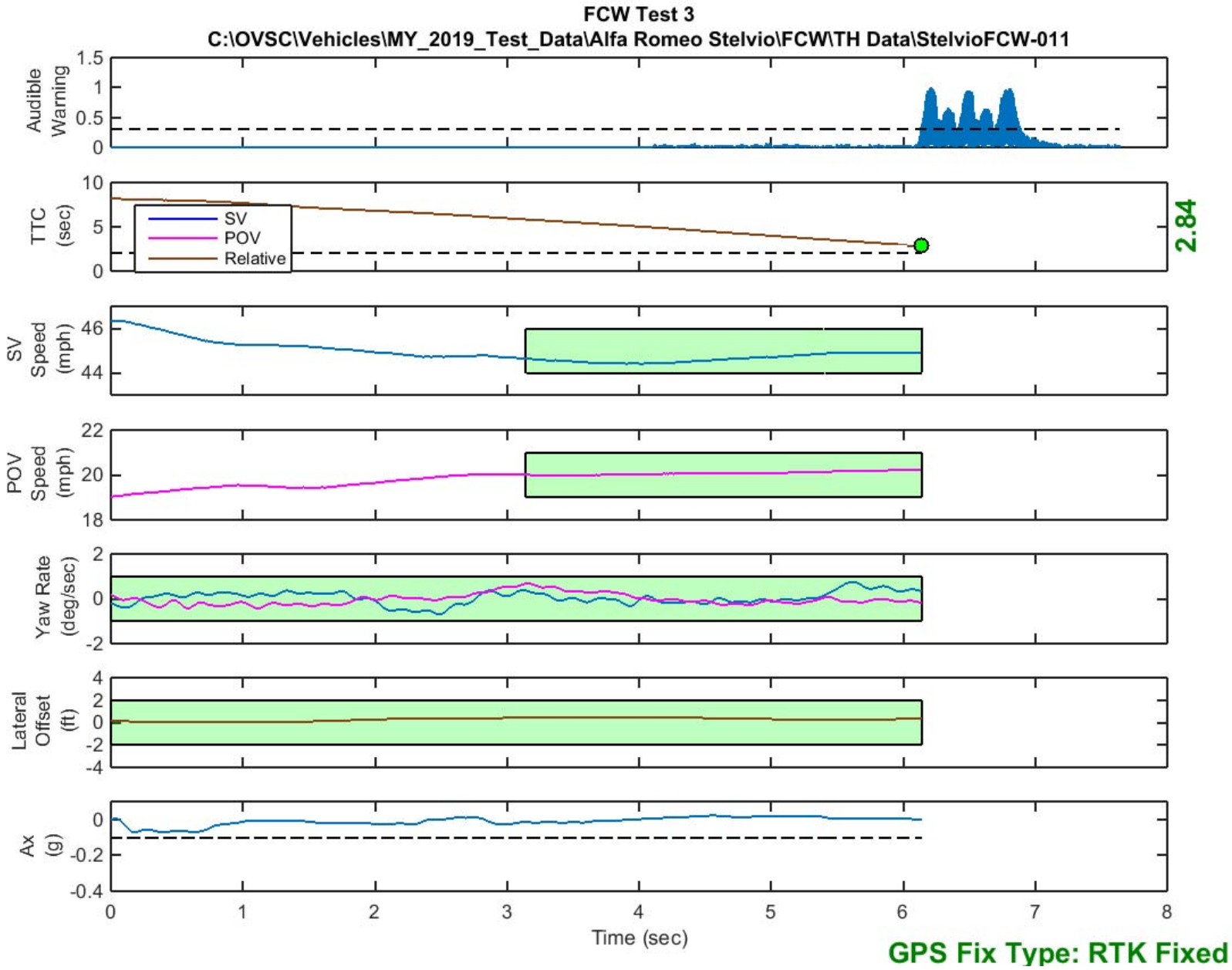


Figure D35. Time History for Run 11, FCW Test 3, Audible Warning

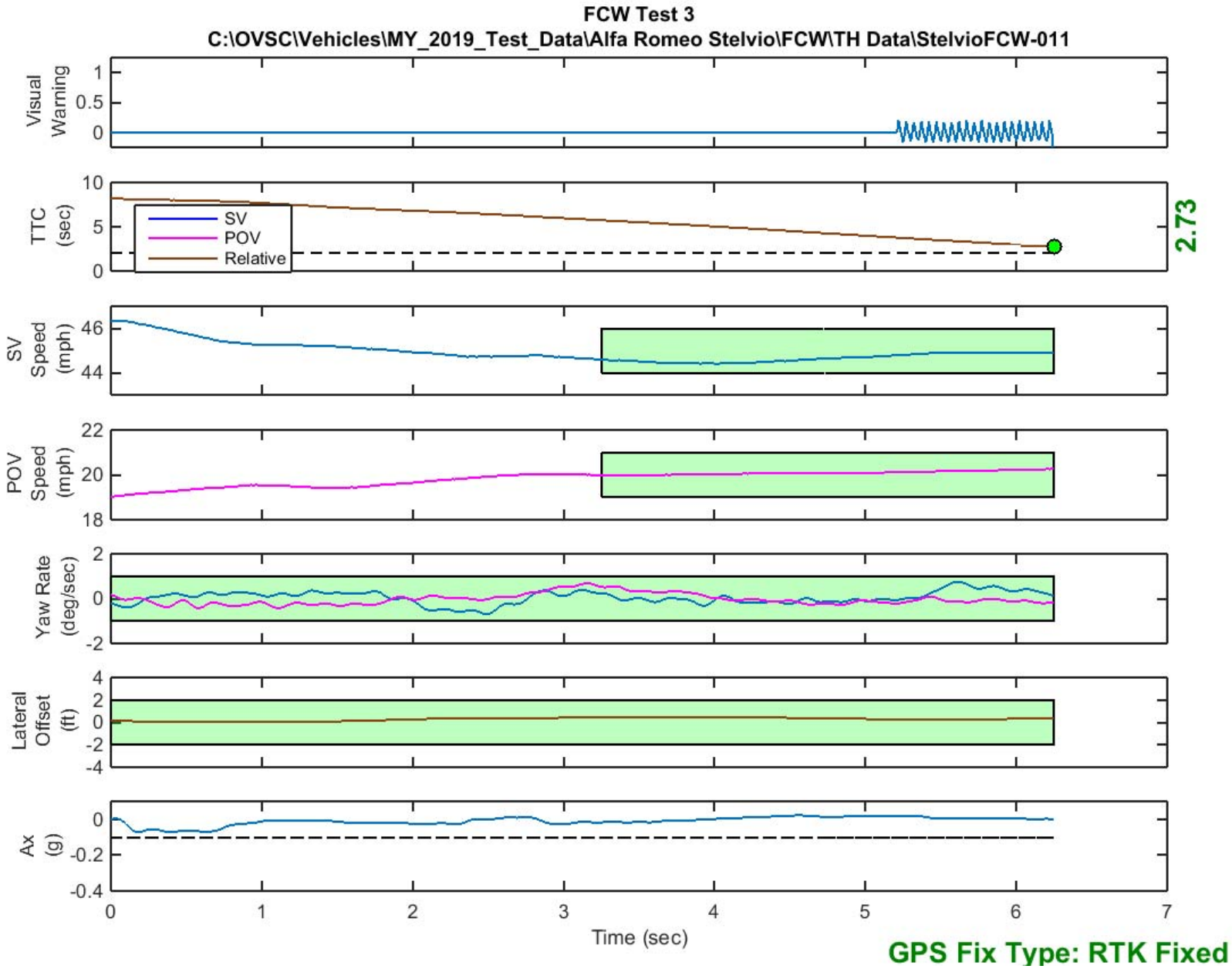


Figure D36. Time History for Run 11, FCW Test 3, Visual Warning

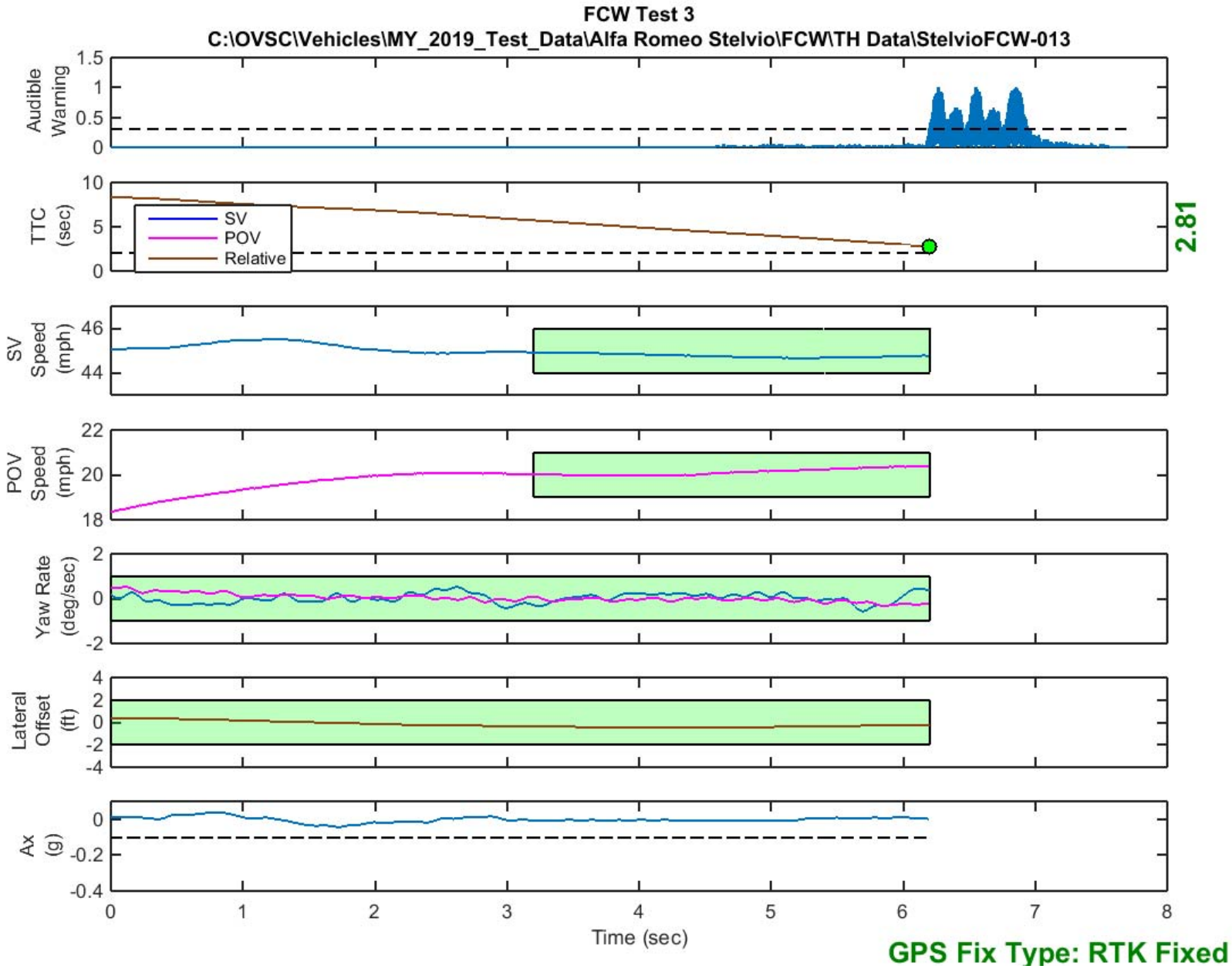


Figure D37. Time History for Run 13, FCW Test 3, Audible Warning

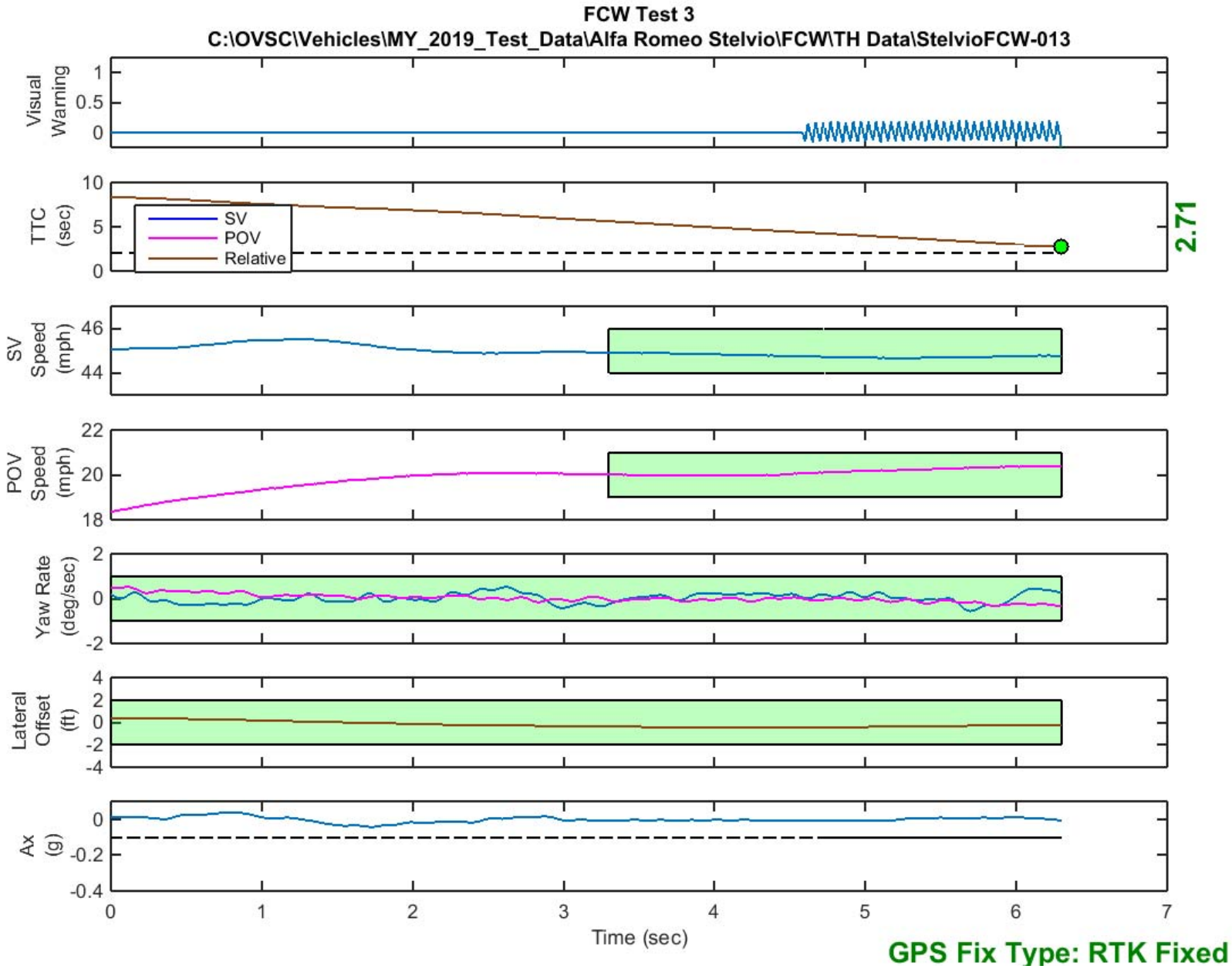


Figure D38. Time History for Run 13, FCW Test 3, Visual Warning

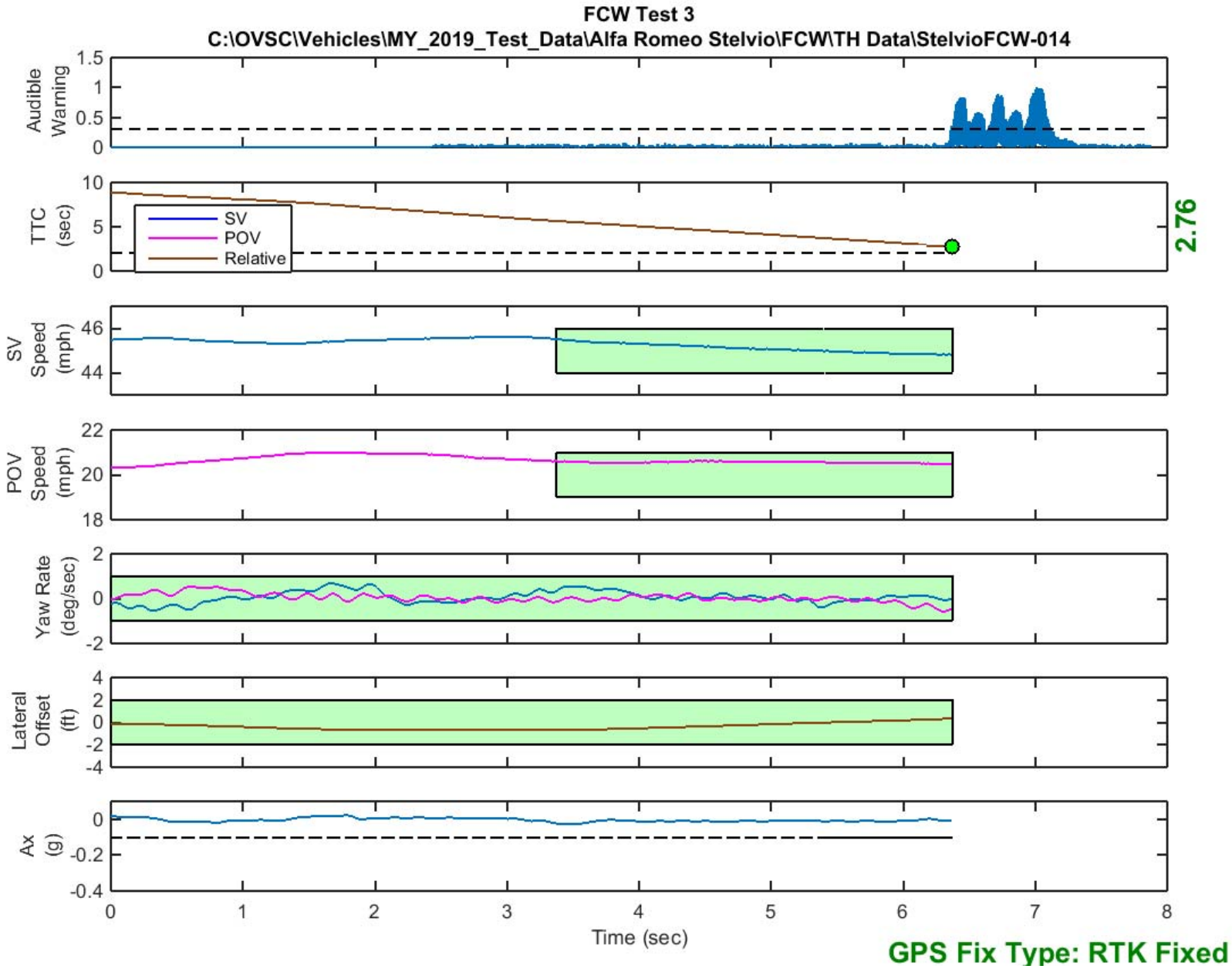


Figure D39. Time History for Run 14, FCW Test 3, Audible Warning

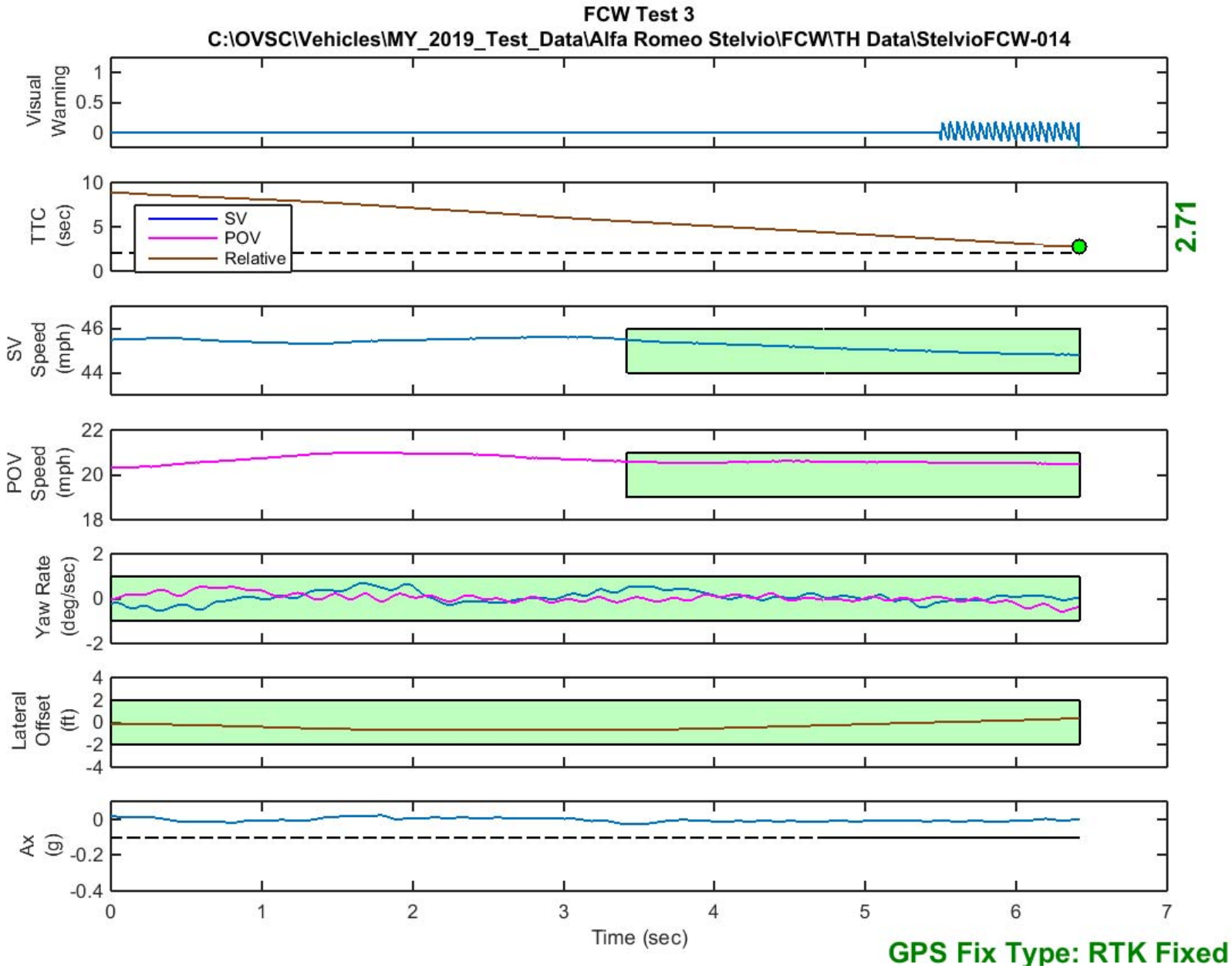


Figure D40. Time History for Run 14, FCW Test 3, Visual Warning

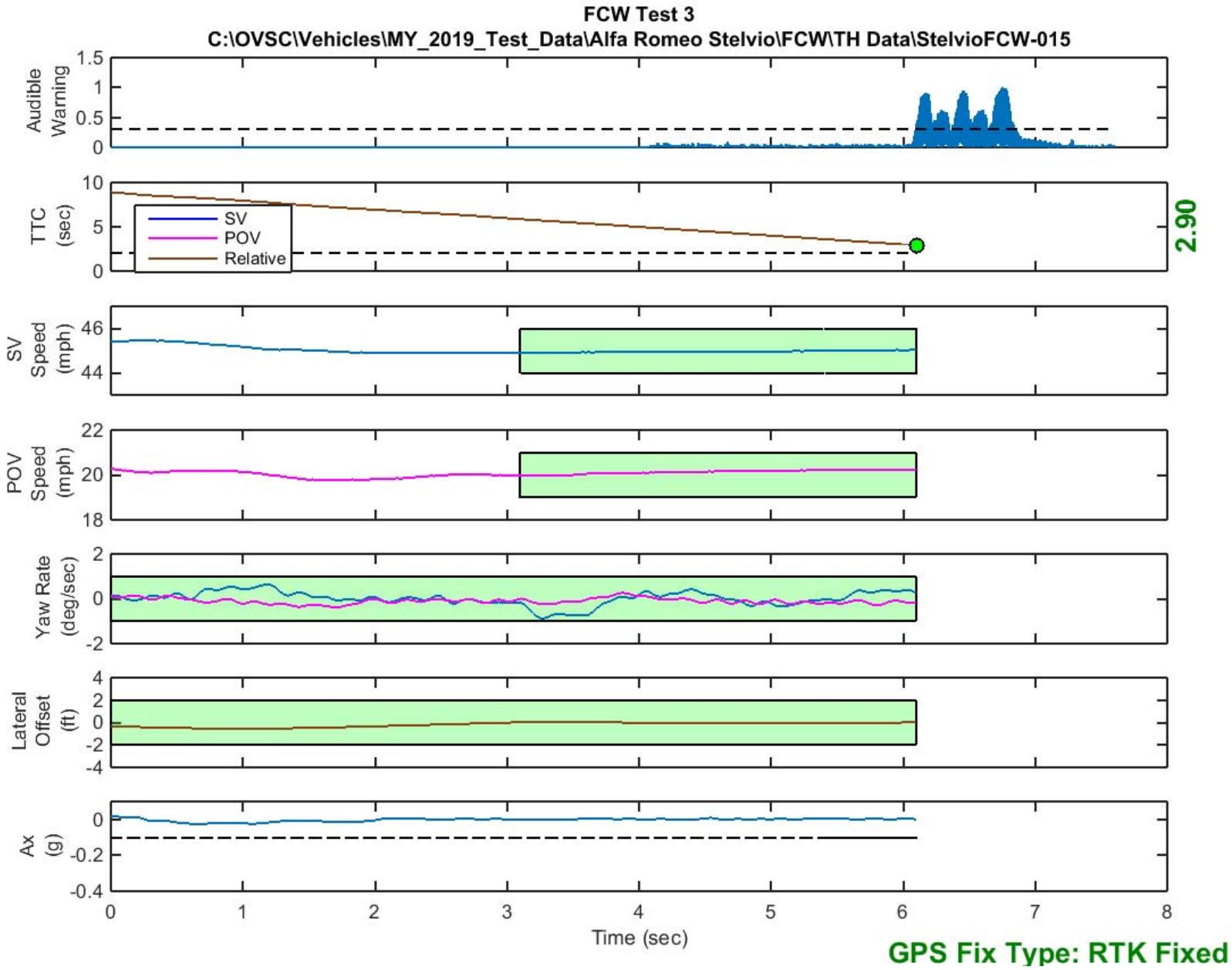


Figure D41. Time History for Run 15, FCW Test 3, Audible Warning

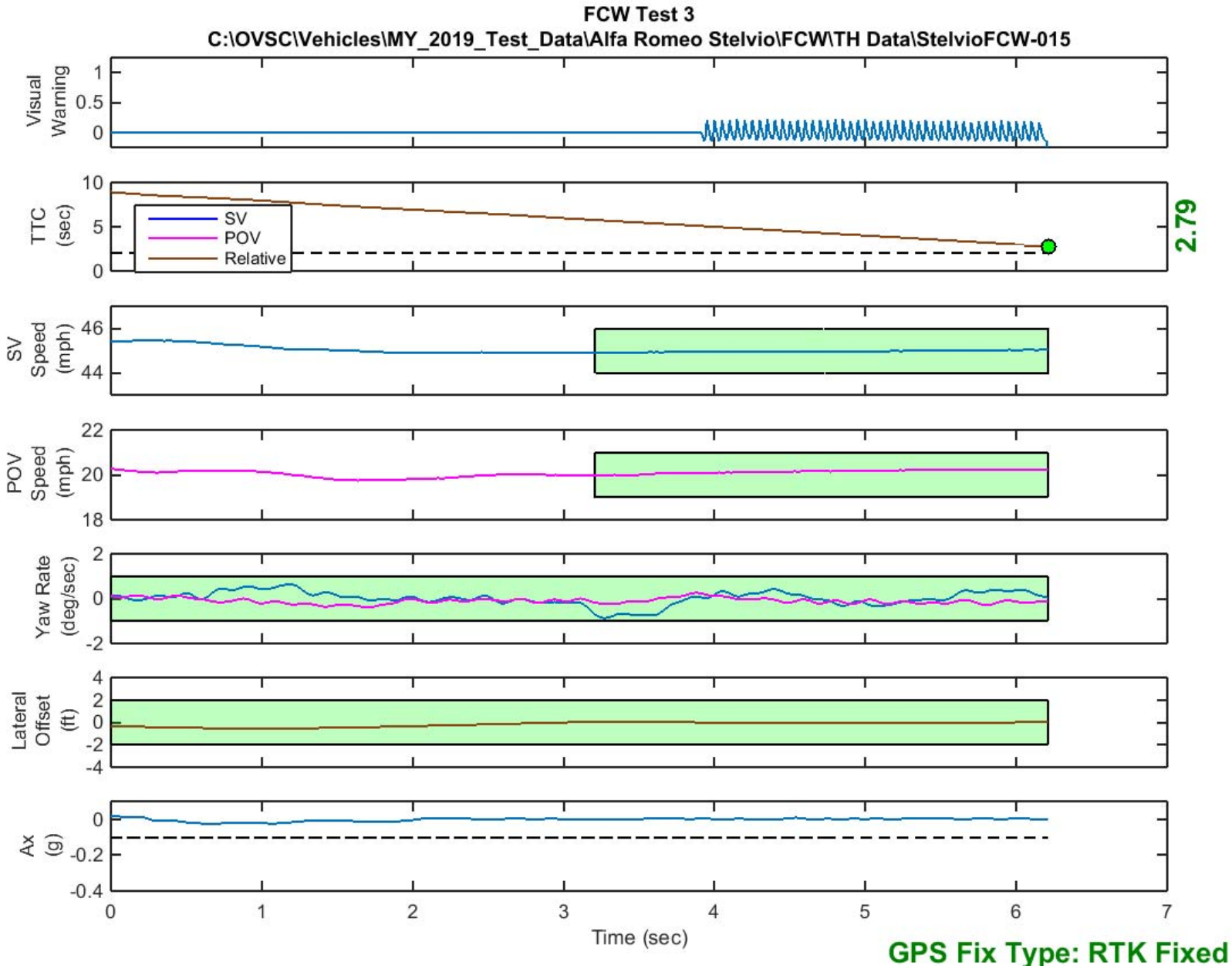


Figure D42. Time History for Run 15, FCW Test 3, Visual Warning

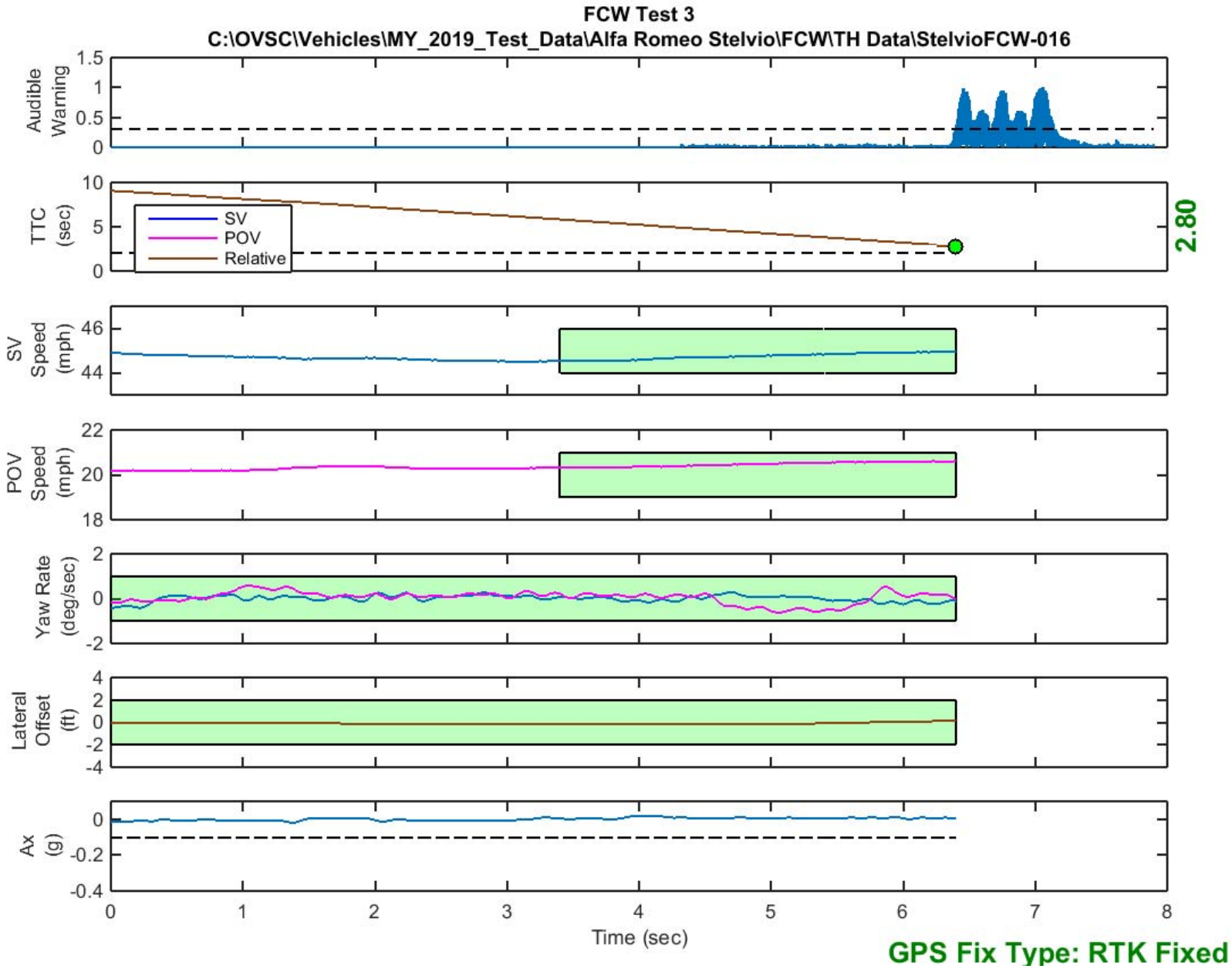


Figure D43. Time History for Run 16, FCW Test 3, Audible Warning

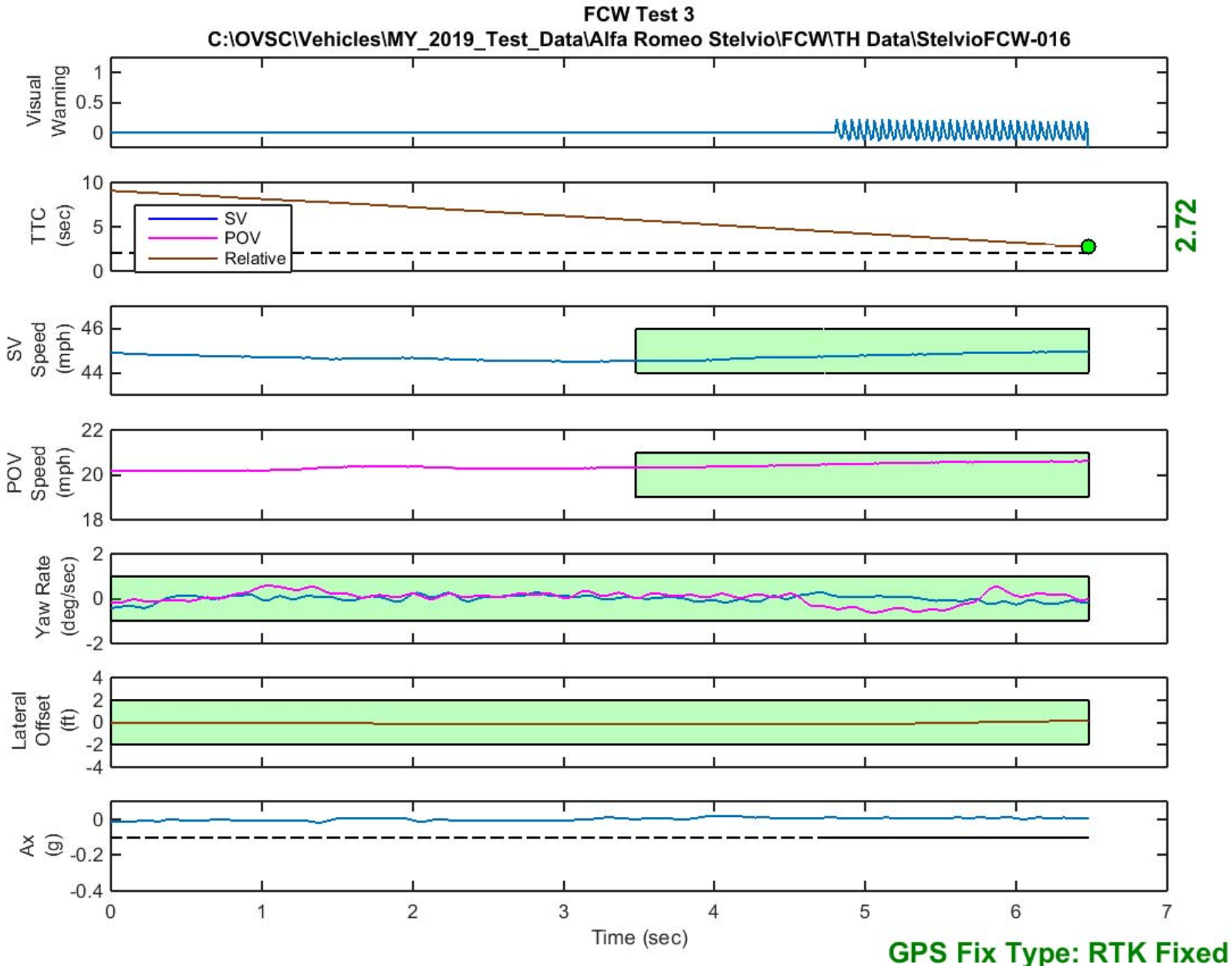


Figure D44. Time History for Run 16, FCW Test 3, Visual Warning