

**NEW CAR ASSESSMENT PROGRAM  
FORWARD COLLISION WARNING CONFIRMATION TEST  
OCAS-DRI-FCW-20-17**

**2020 Ram 1500 Crew Cab**

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**8 January 2020**

**Final Report**

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

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Date: 23 December 2019

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16. Abstract These tests were conducted on the subject 2020 Ram 1500 Crew Cab in accordance with the specifications of the New Car Assessment Program's most current Test Procedure in docket NHTSA-2006-26555-0134 to confirm the performance of a forward collision warning system. The vehicle passed the requirements of the test for all three FCW test scenarios.			
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## Section I INTRODUCTION

This test evaluates the ability of a Forward Collision Warning (FCW) system to detect and alert drivers to potential hazards in the path of the vehicle as specified in the New Car Assessment Program's "Forward Collision Warning Confirmation" test procedure, dated February 2013. Three driving scenarios are utilized to assess this technology. In the first test, a subject vehicle (SV) approaches a stopped 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 Ram 1500 Crew Cab**

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VIN: 1C6SRFLT3LN1xxxx

Test Date: 12/11/2019

Forward Collision Warning setting: Far

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 Ram 1500 Crew Cab

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**TEST VEHICLE INFORMATION**

VIN: 1C6SRFLT3LN1xxxx

Body Style: Crew Cab

Color: Diamond Black Crystal Pearl

Date Received: 11/27/2019

Odometer Reading: 51 mi

**DATA FROM VEHICLE'S CERTIFICATON LABEL**

Vehicle manufactured by: FCA US LLC

Date of manufacture: 8/19

Vehicle Type: Truck

**DATA FROM TIRE PLACARD**

Tires size as stated on Tire Placard: Front: LT275/70R18E

Rear: LT275/70R18E

Recommended cold tire pressure: Front: 380 kPa (55 psi)

Rear: 310 kPa (45 psi)

**TIRES**

Tire manufacturer and model: Goodyear Wrangler Duratrac

Front tire size: LT275/70R18

Rear tire size: LT275/70R18

Front tire DOT prefix: PJ15 C21V

Rear tire DOT prefix: PJ15 C21V



**FORWARD COLLISION WARNING**  
**DATA SHEET 3: TEST CONDITIONS**

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2020 Ram 1500 Crew Cab

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**GENERAL INFORMATION**

Test date: 12/11/2019

**AMBIENT CONDITIONS**

Air temperature: -10.0 C (14 F)

Wind speed: 0.0 m/s (0.0 mph)

- X Wind speed  $\leq$  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: 380 kPa (55 psi)

Rear: 310 kPa (45 psi)

**FORWARD COLLISION WARNING**  
**DATA SHEET 3: TEST CONDITIONS**

(Page 2 of 2)

**2020 Ram 1500 Crew Cab**

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**WEIGHT**

Weight of vehicle as tested including driver and instrumentation:

Left Front: 823.3 kg (1815 lb)

Right Front: 752.5 kg (1659 lb)

Left Rear: 612.3 kg (1350 lb)

Right Rear: 582.9 kg (1285 lb)

Total: 2771.0 kg (6109 lb)

**FORWARD COLLISION WARNING**

**DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION**

(Page 1 of 3)

**2020 Ram 1500 Crew Cab**

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Name of the FCW option, option package, etc. Full Speed Range Forward Collision Warning Plus (FCW+)

Type of sensors the system uses: Radar

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

<input checked="" type="checkbox"/>	Warning light
<input checked="" type="checkbox"/>	Buzzer or audible alarm
<input checked="" type="checkbox"/>	Vibration
<input type="checkbox"/>	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.

When the system determines that a forward collision is probable, the driver will be provided with audible and visual warnings as well as a possible brake jerk warning.

The audible warning is a repeated beep.

The visual warning is an orange !BRAKE! In the center display of the instrument panel (see Figure A13).

Is the vehicle equipped with a switch whose purpose is to render FCW inoperable?  Yes  
 No

**FORWARD COLLISION WARNING**  
**DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION**

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**2020 Ram 1500 Crew Cab**

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

The Forward Collision menu setting is located in the Uconnect settings. See response to next question for method of selecting FCW off by means of Uconnect settings.

The FCW system state is defaulted to “Full On” from one ignition cycle to the next. If the system is turned off, it will reset to “Full On” when the vehicle is restarted.

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

If yes, please provide a full description.

The FCW menu settings are accessed through the Uconnect System, a set of menus displayed on a touch screen in the center of the front fascia (see Figure A14). The sequence to access the FCW settings is:

Apps

Settings

Safety and Driving assistance

Automatic Emergency Braking

Forward Collision Warning (choices are:)

Off, Only Warning, Warning + Active Braking

Forward Collision Sensitivity (same level) (choices are:)

Near, Med, Far

Far - When the sensitivity of FCW is set to the “Far” setting and the system status is “Only Warning” this allows the system to warn the driver of a possible more distant collisions with the vehicle in front using audible/visual warnings.

More cautious drivers that do not mind frequent warnings may prefer this setting.

(Continued next page)

**FORWARD COLLISION WARNING**

**DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION**

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**2020 Ram 1500 Crew Cab**

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

Near - When the sensitivity of FCW is set to the “Near” setting and the system status is “Only Warning”, this allows the system to warn the driver of a possible closer collisions with the vehicle in front using audible/visual warnings. This setting provides less reaction time than the “Far” and “Medium” settings, which allows for a more dynamic driving experience.

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

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

If yes, please provide a full description.

- The minimum speed for FCW activation is 3 mph (5 km/h).
- The FCW alerts may be triggered on objects other than vehicles such as guard rails or sign posts based on the course prediction. This is expected and is a part of normal FCW activation and functionality.
- FCW may not react to irrelevant objects such as overhead objects, ground reflections, objects not in the path of the vehicle, stationary objects that are far away, oncoming traffic, or leading vehicles with the same or higher rate of speed.

For a more comprehensive list of driving modes or conditions that may render FCW inoperable or reduce its effectiveness, please see pages 258-259 of the Owner’s Manual on pages B-6 and B-7 of Appendix B.

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.

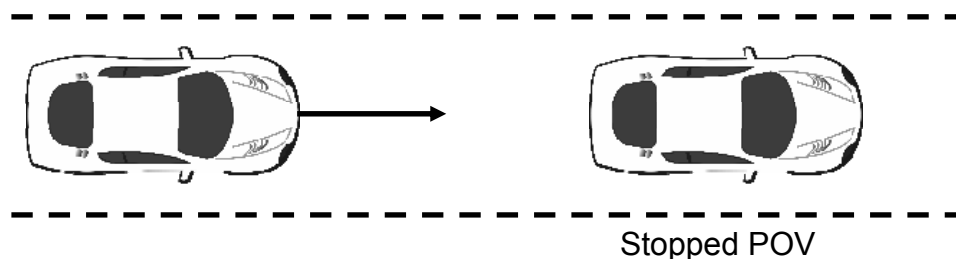


Figure 1. Depiction of Test 1

#### 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 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 that 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 (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  $\pm 1$  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.

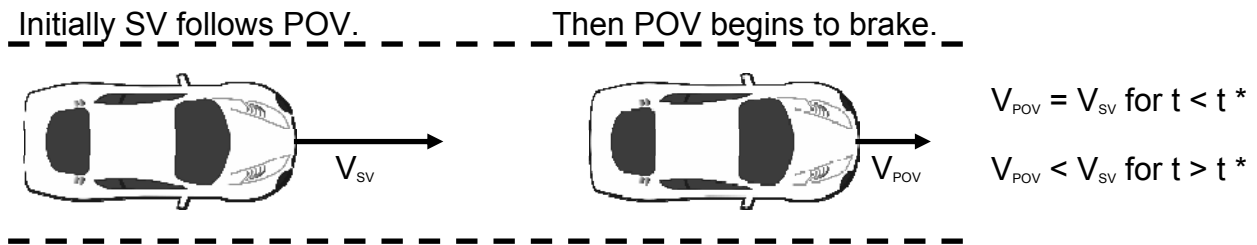


Figure 2. Depiction of Test 2

### 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<sup>1</sup>.

### 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:

<sup>1</sup>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).



- 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  $\pm 1$  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  $\pm 0.03g$ , 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  $\pm 8.2$  ft ( $\pm 2.5$  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 kph).

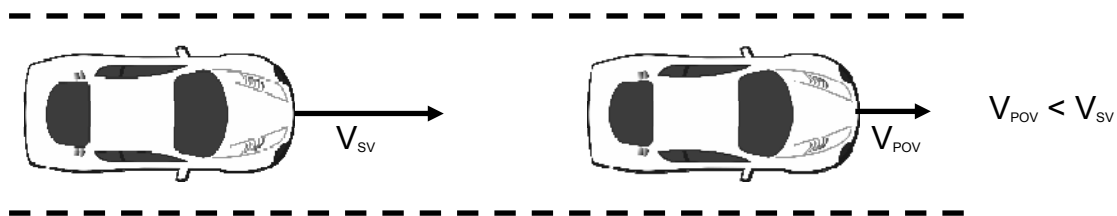


Figure 3. Depiction of Test 3

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.,  $TT = 1.8$  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 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  $\pm 1$  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	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
					2258	Date: 5/3/2019 Due: 5/3/2021
					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).			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 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**

<b>Warning Type</b>	<b>Filter Order</b>	<b>Peak-to-Peak Ripple</b>	<b>Minimum Stop Band Attenuation</b>	<b>Pass-Band Frequency Range</b>
Audible	5 <sup>th</sup>	3 dB	60 dB	Identified Center Frequency $\pm$ 5%
Tactile	5 <sup>th</sup>	3 dB	60 dB	Identified Center Frequency $\pm$ 20%

## APPENDIX A

### Photographs

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Figure A1. Front View of Subject Vehicle



Figure A2. Rear View of Subject Vehicle



2020 MODEL YEAR  
**RAM 1500 REBEL CREW CAB 4X4**

For more information visit: [www.ramtrucks.com](http://www.ramtrucks.com)  
or call 1-866-RAMINFO

FCA US LLC

THIS VEHICLE IS MANUFACTURED TO MEET SPECIFIC UNITED STATES REQUIREMENTS. THIS VEHICLE IS NOT MANUFACTURED FOR SALE OR REGISTRATION OUTSIDE OF THE UNITED STATES.

MANUFACTURER'S SUGGESTED RETAIL PRICE OF THIS MODEL INCLUDING DEALER PREPARATION

Base Price: **\$47,740**

**RAM 1500 REBEL CREW CAB 4X4**  
Exterior Color: Diamond Black Crystal Pearl-Coat Exterior Paint  
Interior Color: Black Interior Color  
Interior: Luxury Leather-Trimmed Bucket Seats  
Engine: 5.7L V8 HEMI® MDS VVT eTorque Engine  
Transmission: 8-Speed Automatic 8HP75 Transmission

STANDARD EQUIPMENT (UNLESS REPLACED BY OPTIONAL EQUIPMENT)  
FUNCTIONAL/SAFETY FEATURES

Advanced Multistage Front Air Bags  
Supplemental Front Seat Side Air Bags  
Supplemental Side-Curtain Front and Rear Air Bags  
Electronic Locking Rear Axle  
3.92 Rear Axle Ratio  
ParkView® Rear Back-Up Camera  
Class TV Receiver-Hitch  
7-Pin Wiring Harness  
Front Suspension Skid Plate  
Transfer Case Skid Plate  
Fuel Tank Skid Plate  
Front Performance-Tuned Shock Absorbers  
Rear Performance-Tuned Shock Absorbers  
Sport Performance Hood  
Push-Button Start  
Ready-Alert Braking  
Rain-Brake Support  
Dampened Tailgate

OPTIONAL EQUIPMENT (May Replace Standard Equipment)

Diamond Black Crystal Pearl-Coat Exterior Paint \$100  
Luxury Leather-Trimmed Bucket Seats \$1,545  
4-Way Power Lumbar Adjustable Passenger Seat  
8-Way Power Driver and Passenger Seats  
**Customer Preferred Package 27W**  
Safety and Convenience Group \$895  
Adaptive Cruise Control with Stop & Go  
Advanced Brake-Assist  
Automatic High Beam Headlamp Control  
Full-Speed Forward Collision Warn Plus  
Lane Keep Assist  
Trailer-Tow Group \$400  
Power Trailer Tow Mirrors with Manual Fold-Away  
Trailer Brake Control  
Black Appearance Package \$525  
Black Front Bumper with Black Plate  
Black "RAM" Grille Badge  
18-inch x 8.0-inch Gloss Black Wheels  
Monotone Paint  
Rebel Level 2 Equipment Group \$3,000  
115-Volt Auxiliary Rear Power Outlet  
8.4-Inch Touchscreen Display  
A/C Auto Temperature Control w/Dual-Zone Control  
Apple CarPlay®

Media Hub-2 USB, Full Funct/Chg Only  
Google Android Auto™  
Heated Front Seats  
Heated Steering Wheel  
ParkSense® Front and Rear Park-Assist with Stop  
Power Adjustable Pedals  
Power Folding Mirrors  
Rain-Sensitive Windshield Wipers  
Rear Underseat Compartment Storage  
Rear Window Defroster  
Remote Proximity Keyless Entry  
Remote-Start System  
Universal Garage Door Opener  
5.7L V8 HEMI® MDS VVT eTorque Engine \$1,695  
18-Inch Aluminum Spare Wheel \$695  
Black Tubular Side-Steps \$995  
Multi-Function Tailgate  
Ram's Head Badge \$445  
33-Gallon Fuel Tank \$595  
9-Amplified Speakers with Subwoofer \$2,095  
Uconnect® 12.0-Inch with Navigation  
4G LTE Wi-Fi Hot Spot  
SiriusXM® with 360L  
5-Year SiriusXM® Traffic™ Service  
HD™ Radio  
SiriusXM Guardian™ Connected Services w/1-Yr Trial  
SiriusXM® Traffic Plus  
SiriusXM® Travel Link  
Blind-Spot and Cross-Path Detection  
Spray-in Bedliner \$595

DESTINATION CHARGE \$1,695

**TOTAL PRICE: \* \$63,610**

WARRANTY COVERAGE

5-year or 60,000-mile Powertrain Limited Warranty  
3-year or 36,000-mile Basic Limited Warranty  
Ask Dealer for a copy of the limited warranties or see your owner's manual for details.

**5 YEAR / 60,000 MILE  
POWERTRAIN WARRANTY**

EPA DOT **Fuel Economy and Environment**

Gasoline Vehicle

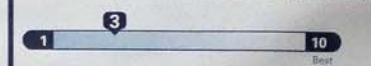
**Fuel Economy** These estimates reflect new EPA methods beginning with 2017 models.  
**19** MPG  
combined city/hwy  
17 city  
22 highway  
5.3 gallons per 100 miles  
Standard pickups range from 12 to 25 MPG.  
The best vehicle rates 136 MPG.

You spend  
**\$4,250**

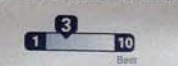
more in fuel costs  
over 5 years  
compared to the  
average new vehicle.

Annual fuel cost  
**\$2,350**

Fuel Economy & Greenhouse Gas Rating (tailpipe only)



Smog Rating (tailpipe only)



Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and cost \$7,200 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$3.00 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

**fuel economy.gov**

Calculate personalized estimates and compare vehicles



Smartphone  
QR Code



**GOVERNMENT 5-STAR SAFETY RATINGS**

Overall Vehicle Score ★★★★★

Based on the combined ratings of frontal, side, and rollover.  
Should ONLY be compared to other vehicles of similar size and weight.

Frontal Driver ★★★★★  
Crash Passenger ★★★★★

Based on the risk of injury in a frontal impact.  
Should ONLY be compared to other vehicles of similar size and weight.

Side Front seat ★★★★★  
Crash Rear seat ★★★★★

Based on the risk of injury in a side impact.

Rollover ★★★★★

Based on the risk of rollover in a single-vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest.

Source: National Highway Traffic Safety Administration (NHTSA)  
[www.safercar.gov](http://www.safercar.gov) or 1-888-327-4236

The safety ratings above are based on Federal Government tests of particular vehicles equipped with certain features and options. The performance of this vehicle may differ.

**PARTS CONTENT INFORMATION**

FOR VEHICLES IN THIS CARLINE:  
U.S./CANADIAN PARTS CONTENT: 53%  
MAJOR SOURCES OF FOREIGN PARTS

CONTENT:  
MEXICO: 26%  
NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:  
FINAL ASSEMBLY POINT:  
STERLING HTS, MICH., U.S.A.

COUNTRY OF ORIGIN:  
ENGINE: MEXICO  
TRANSMISSION: UNITED STATES

Assembly Point/Port of Entry: STERLING HTS, MICH., U.S.A.

MN 1C6-SRFLT3LN-12

LA#0N 2918

THIS LABEL IS ADDED TO THIS VEHICLE TO COMPLY WITH FEDERAL LAW. THE LABEL CANNOT BE REMOVED OR ALTERED PRIOR TO DELIVERY TO THE ULTIMATE PURCHASER.  
\* STATE AND/OR LOCAL TAXES IF ANY, LICENSE AND TITLE FEES AND DEALER SUPPLIES AND INSTALLED OPTIONS AND ACCESSORIES ARE NOT INCLUDED IN THIS PRICE. DISCOUNT, IF ANY, IS BASED ON PRICE OF OPTIONS IF PURCHASED SEPARATELY.




**VEHICLE PROTECTION**  
A PRODUCT OF FCA US LLC

Ask for Mopar Vehicle Protection for your vehicle. We Built It. We Back It.

Figure A3. Window Sticker (Monroney Label)



Figure A4. Vehicle Certification Label




**TIRE AND LOADING INFORMATION**

SEATING CAPACITY – TOTAL **5** FRONT **2** REAR **3**

THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED  
557 KG OR 1230 LB

TIRE	FRONT	REAR	SPARE
ORIGINAL TIRE SIZE	LT275/70R18E 125R	LT275/70R18E 125R	LT275/65R18C 113S
COLD TIRE INFLATION PRESSURE	380 kPa / 55 PSI	310 kPa / 45 PSI	260 kPa / 38 PSI

SEE OWNERS MANUAL FOR ADDITIONAL INFORMATION 

LN12

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 Visual Alerts



Figure A10. Sensor for Detecting Auditory Alerts



Figure A11. Computer Installed in Subject Vehicle



Figure A12. Brake Actuation System Installed in Principal Other Vehicle



Figure A13. FCW Visual Alert

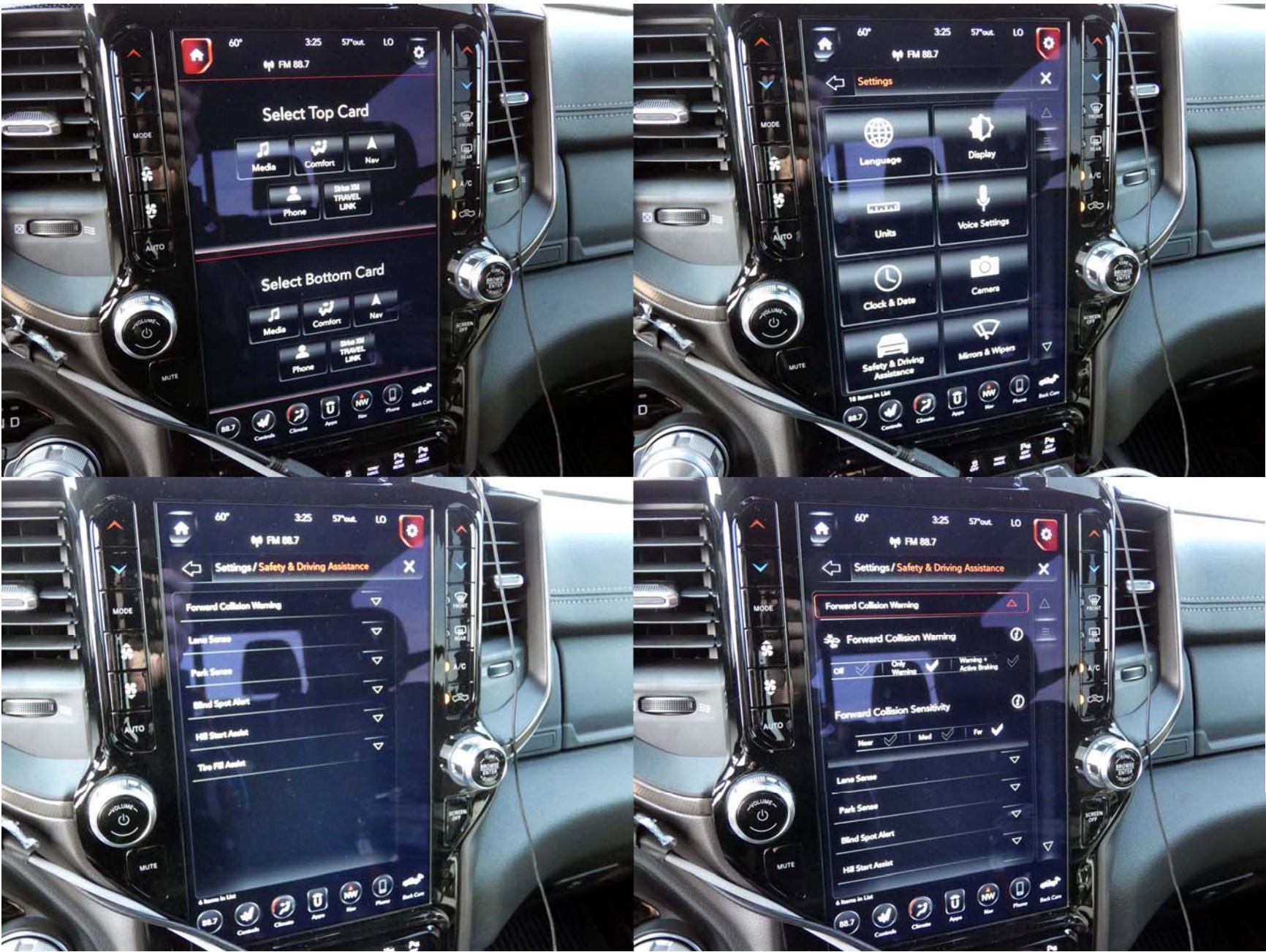


Figure A14. FCW System Setting Menus

## APPENDIX B

Excerpts from Owner's Manual

TPMS malfunction telltale after replacing one or more tires or wheels on your vehicle to ensure that the replacement or alternate tires and wheels allow the TPMS to continue to function properly.

**CAUTION!**

The TPMS has been optimized for the original equipment tires and wheels. TPMS pressures and warning have been established for the tire size equipped on your vehicle. Undesirable system operation or sensor damage may result when using replacement equipment that is not of the same size, type, and/or style. Aftermarket wheels can cause sensor damage. Using aftermarket tire sealants may cause the Tire Pressure Monitoring System (TPMS) sensor to become inoperable. After using an aftermarket tire sealant it is recommended that you take your vehicle to an authorized dealer to have your sensor function checked.

**Anti-Lock Brake System (ABS) Warning Light**



This warning light monitors the Anti-Lock Brake System (ABS). The light will turn on when the ignition is placed in the ON/RUN or ACC/ON/

RUN position and may stay on for as long as four seconds.

If the ABS light remains on or turns on while driving, then the Anti-Lock portion of the brake system is not functioning and service is required as soon as possible. However, the conventional brake system will continue to operate normally, assuming the Brake Warning Light is not also on.

If the ABS light does not turn on when the ignition is placed in the ON/RUN or ACC/ON/ RUN position, have the brake system inspected by an authorized dealer.

**Rear Axle Locker Fault Indicator Light – If Equipped**



This warning light will illuminate to indicate when a rear axle locker fault has been detected.

**Service Forward Collision Warning (FCW) Light – If Equipped**



This warning light will illuminate to indicate a fault in the Forward Collision Warning System. Contact an authorized dealer for service.

Refer to “Forward Collision Warning (FCW) With Mitigation” in “Safety” for further information.

**Service Stop/Start System Warning Light – If Equipped**



This warning light will illuminate when the Stop/Start system is not functioning properly and service is required. Contact an authorized dealer for service.

**Service 4WD Warning Light – If Equipped**



This warning light will illuminate to signal a fault with the 4WD system. If the light stays on or comes on during driving, it means that the 4WD system

is not functioning properly and that service is required. We recommend you drive to the nearest service center and have the vehicle serviced immediately.



**General Information**

The following regulatory statement applies to all Radio Frequency (RF) devices equipped in this vehicle:

This device complies with Part 15 of the FCC Rules and with Innovation, Science and Economic Development Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Innovation, Science and Economic Development applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

La operación de este equipo está sujeta a las siguientes dos condiciones:

1. es posible que este equipo o dispositivo no cause interferencia perjudicial y
2. este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

**NOTE:**

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**Forward Collision Warning (FCW) With Mitigation — If Equipped**

The Forward Collision Warning (FCW) with Mitigation system provides the driver with audible warnings, visual warnings (within the instrument cluster display), and may apply a brake jerk to warn the driver when it detects a potential frontal collision. The warnings and limited braking are intended to provide the driver with enough time to react, avoid or mitigate the potential collision.

**NOTE:**

FCW monitors the information from the forward looking sensors as well as the Electronic Brake Controller (EBC), to calculate the probability of a forward collision. When the system determines that a forward collision is probable, the driver will be provided with audible and visual warnings as well as a possible brake jerk warning.

If the driver does not take action based upon these progressive warnings, then the system will provide a limited level of active braking to help slow the vehicle and mitigate the potential forward collision. If the driver reacts to the warnings by braking and the system determines that the driver intends to avoid the collision by braking but has not applied sufficient brake force, the system will compensate and provide additional brake force as required.

If a FCW with Mitigation event begins at a speed below 32 mph (52 km/h), the system may provide the maximum braking possible to mitigate the potential forward collision. If the Forward Collision Warning with Mitigation event stops the vehicle completely, the system will hold the vehicle at standstill for two seconds and then release the brakes.

# !BRAKE!

0616123823US

## FCW Message

When the system determines a collision with the vehicle in front of you is no longer probable, the warning message will be deactivated.

### NOTE:

- The minimum speed for FCW activation is 3 mph (5 km/h).
- The FCW alerts may be triggered on objects other than vehicles such as guard rails or sign posts based on the course prediction. This is expected and is a part of normal FCW activation and functionality.
- It is unsafe to test the FCW system. To prevent such misuse of the system, after four Active Braking events within a key cycle, the Active Braking portion of FCW will be deactivated until the next key cycle.

- The FCW system is intended for on-road use only. If the vehicle is taken off-road, the FCW system should be deactivated to prevent unnecessary warnings to the surroundings.
- FCW may not react to irrelevant objects such as overhead objects, ground reflections, objects not in the path of the vehicle, stationary objects that are far away, oncoming traffic, or leading vehicles with the same or higher rate of speed.
- FCW will be disabled like ACC, with the unavailable screens.

### WARNING!

Forward Collision Warning (FCW) is not intended to avoid a collision on its own, nor can FCW detect every type of potential collision. 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.

## Turning FCW On or Off

The FCW button is located in the Uconnect display in the control settings. Refer to "Uconnect Settings" in "Multimedia" for further information.

- To turn the FCW system on, press the forward collision button once.
- To turn the FCW system off, press the forward collision button once.

### NOTE:

- When the FCW is "on", this allows the system to warn the driver of a possible collision with the vehicle in front.
- When the FCW is "off", this prevents the system from warning the driver of a possible collision with the vehicle in front. If the FCW is set to "off", "FCW OFF" will be displayed in the instrument cluster display.
- When FCW status is set to "Only Warning", this prevents the system from providing limited active braking, or additional brake support if the driver is not braking adequately in the event of a potential frontal collision.

4

- When FCW status is set to “Warning and Braking”, this allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warnings and it applies autonomous braking.
- The FCW system state is defaulted to “Full On” from one ignition cycle to the next. If the system is turned off, it will reset to “Full On” when the vehicle is restarted.

#### FCW Braking Status And Sensitivity

The FCW Sensitivity and Active Braking status are programmable through the Uconnect System. Refer to “Uconnect Settings” in “Multimedia” for further information.

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

- Medium
  - When the sensitivity of FCW is set to the “Medium” setting and the system status is “Only Warning”, this allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warnings.
- Near
  - When the sensitivity of FCW is set to the “Near” setting and the system status is “Only Warning”, this allows the system to warn the driver of a possible closer collisions with the vehicle in front using audible/visual warnings.
  - This setting provides less reaction time than the “Far” and “Medium” settings, which allows for a more dynamic driving experience.
  - More dynamic or aggressive drivers that want to avoid frequent warnings may prefer this setting.

#### FCW Limited Warning

If the instrument cluster displays “ACC/FCW Limited Functionality” or “ACC/FCW Limited Functionality Clean Front Windshield” momentarily, there may be a condition that limits FCW functionality. Although the vehicle is still driveable under normal conditions, the active braking may not be fully available. Once the condition that limited the system performance is no longer present, the system will return to its full performance state. If the problem persists, see an authorized dealer.

#### Service FCW Warning

If the system turns off, and the instrument cluster displays:

- ACC/FCW Unavailable Service Required
- Cruise/FCW Unavailable Service Required

This indicates there is an internal system fault. Although the vehicle is still drivable under normal conditions, have the system checked by an authorized dealer.

The ACC screen may display once again if any ACC activity occurs, which may include any of the following:

- System Cancel
- Driver Override
- System Off
- ACC Proximity Warning
- ACC Unavailable Warning

The instrument cluster display will return to the last display selected after five seconds of no ACC display activity

#### **Display Warnings And Maintenance**

##### **“Wipe Front Radar Sensor In Front Of Vehicle” Warning**

The “ACC/FCW Unavailable Wipe Front Radar Sensor” warning will display and also a chime will indicate when conditions temporarily limit system performance.

This most often occurs at times of poor visibility, such as in snow or heavy rain. The ACC system may also become temporarily blinded due to obstructions, such as mud, dirt or ice. In these

cases, the instrument cluster display will display “ACC/FCW Unavailable Wipe Front Radar Sensor” and the system will deactivate.

The “ACC/FCW Unavailable Wipe Front Radar Sensor” message can sometimes be displayed while driving in highly reflective areas (i.e. tunnels with reflective tiles, or ice and snow). The ACC system will recover after the vehicle has left these areas. Under rare conditions, when the radar is not tracking any vehicles or objects in its path this warning may temporarily occur.

#### **NOTE:**

If the “ACC/FCW Unavailable Wipe Front Radar Sensor” warning is active Normal (Fixed Speed) Cruise Control is still available. For additional information refer to “Normal (Fixed Speed) Cruise Control Mode” in this section.

If weather conditions are not a factor, the driver should examine the sensor. It may require cleaning or removal of an obstruction. The sensor is located in the camera in the center of the windshield, on the forward side of the rearview mirror.

To keep the ACC System operating properly, it is important to note the following maintenance items:

- Always keep the sensor clean. Carefully clear the windshield.
- Do not remove any screws from the sensor. Doing so could cause an ACC system malfunction or failure and require a sensor realignment.
- Do not attach or install any accessories near the sensor, including transparent material. Doing so could cause an ACC system failure or malfunction.

When the condition that deactivated the system is no longer present, the system will return to the “Adaptive Cruise Control Off” state and will resume function by simply reactivating it.

#### **NOTE:**

- If the “ACC/FCW Unavailable Wipe Front Radar Sensor” message occurs frequently (e.g. more than once on every trip) without any snow, rain, mud, or other obstruction, have the radar sensor realigned at an authorized dealer.

- Installing a snow plow, front-end protector, an aftermarket grille or modifying the grille is not recommended. These items may keep the sensors from properly detecting the road and can inhibit ACC/FCW operation, resulting in the warning message.

#### “Clean Front Windshield” Warning

The “ACC/FCW Limited Functionality Clean Front Windshield” warning will display and also a chime will indicate when conditions temporarily limit system performance. This most often occurs at times of poor visibility, such as in snow or heavy rain and fog. The ACC system may also become temporarily blinded due to obstructions, such as mud, dirt, or ice on windshield, driving directly into the sun and fog on the inside of glass. In these cases, the instrument cluster display will show “ACC/FCW Limited Functionality Clean Front Windshield” and the system will have degraded performance.

The “ACC/FCW Limited Functionality Clean Front Windshield” message can sometimes be displayed while driving in adverse weather conditions. The ACC/FCW system will recover after the vehicle has left these areas. Under

rare conditions, when the camera is not tracking any vehicles or objects in its path this warning may temporarily occur.

If weather conditions are not a factor, the driver should examine the windshield and the camera located on the back side of the inside rear view mirror. They may require cleaning or removal of an obstruction.

When the condition that created limited functionality is no longer present, the system will return to full functionality.

#### NOTE:

If the “ACC/FCW Limited Functionality Clean Front Windshield” message occurs frequently (e.g. more than once on every trip) without any snow, rain, mud, or other obstruction, have the windshield and forward facing camera inspected at your authorized dealer.

#### Service ACC/FCW Warning

If the system turns off, and the instrument cluster displays “ACC/FCW Unavailable Service Required” or “Cruise/FCW Unavailable Service Required”, there may be an internal system fault or a temporary malfunction that limits ACC functionality. Although the vehicle is still drivable under normal conditions, ACC will be

temporarily unavailable. If this occurs, try activating ACC again later, following an ignition cycle. If the problem persists, see your authorized dealer.

#### Precautions While Driving With ACC

In certain driving situations, ACC may have detection issues. In these cases, ACC may brake late or unexpectedly. The driver needs to stay alert and may need to intervene.

#### NOTE:

- Aftermarket add-ons such as snow plows, lift kits, and brush/grille bars can hinder module performance. Ensure the radar/camera has no obstructions in the field of view.
- Height modifications can limit module performance and functionality.
- Do not put stickers or easy passes over the camera/radar field of view.
- Any modifications to the vehicle that may obstruct the field of view of the radar/camera are not recommended.

#### Cleaning Instructions

Dust and dirt can accumulate on the cover and block the camera lens. Clean the camera lens

## APPENDIX C

### Run Log

Subject Vehicle: 2020 Ram 1500 Crew Cab

Test Date: 12/11/2019

Principal Other Vehicle: 2006 Acura RL

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	<b>Stopped POV</b>	Y	2.27	2.18	0.17	Pass	Reprocess for light signal drop
2		Y	2.36	2.34	0.26	Pass	
3		Y	2.33	2.28	0.23	Pass	
4		Y	2.36	2.31	0.26	Pass	
5		Y	2.42	2.38	0.32	Pass	Changed IP screen, light alert changed
6		Y	2.26	2.19	0.16	Pass	
7		Y	2.44	2.42	0.34	Pass	
15	<b>Decelerating POV, 45</b>	Y	2.55	2.50	0.15	Pass	
16		N					Yaw
17		Y	2.42	2.36	0.02	Pass	
18		Y	2.47	2.40	0.07	Pass	
19		Y	2.47	2.44	0.07	Pass	
20		Y	2.38	2.33	-0.02	Fail	
21		Y	2.39	2.32	-0.01	Fail	
22		Y	2.55	2.54	0.15	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
8	<b>Slower POV, 45 vs 20</b>	Y	2.49	2.49	0.49	Pass	
9		Y	2.45	2.39	0.45	Pass	
10		Y	2.50	2.44	0.50	Pass	
11		Y	2.38	2.36	0.38	Pass	
12		Y	2.44	2.41	0.44	Pass	
13		Y	2.38	2.31	0.38	Pass	
14		Y	2.46	2.39	0.46	Pass	



## APPENDIX D

### Time History Plots

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## 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 – 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 ( $0.3 \text{ g} \pm 0.03 \text{ g}$ ) 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.

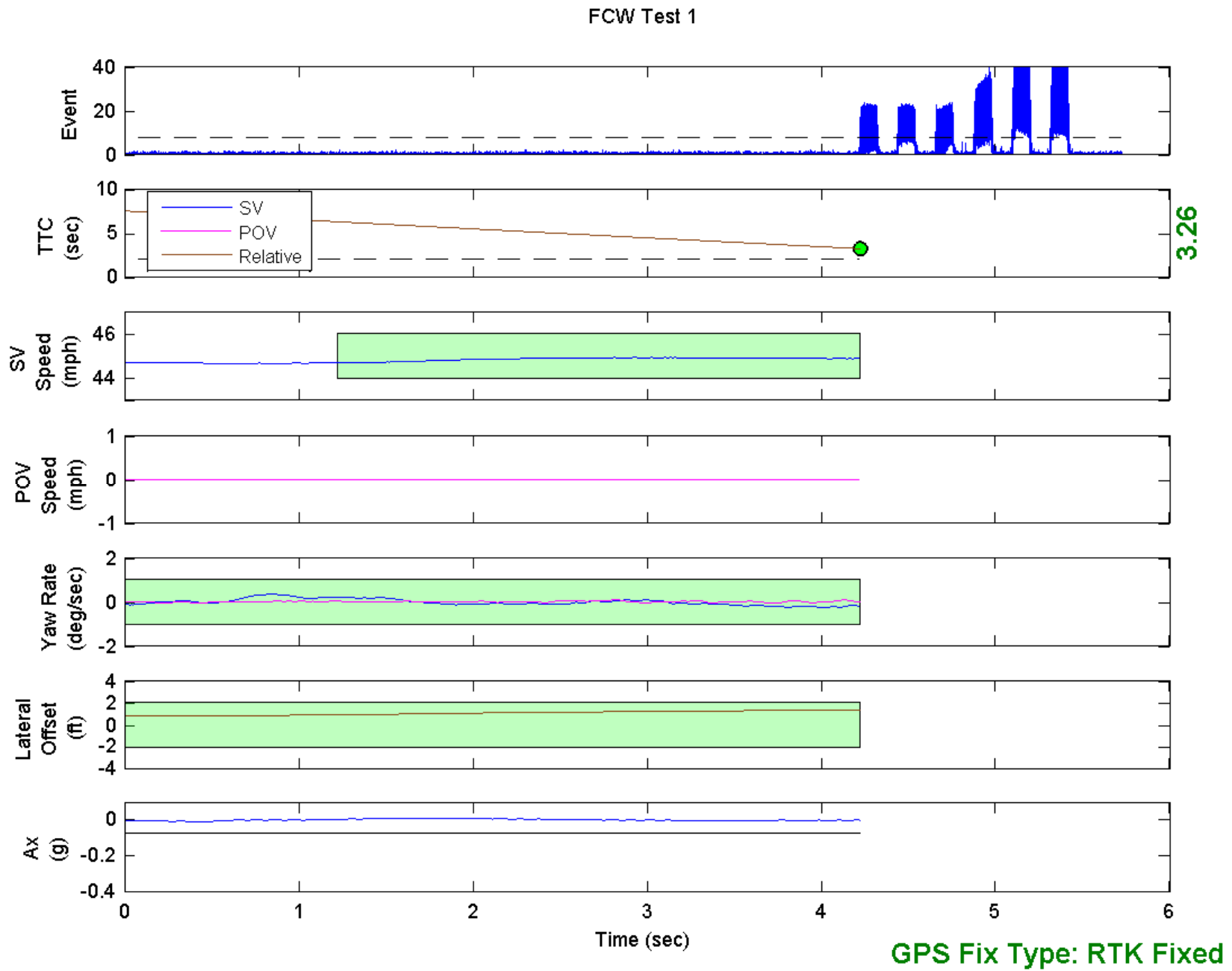
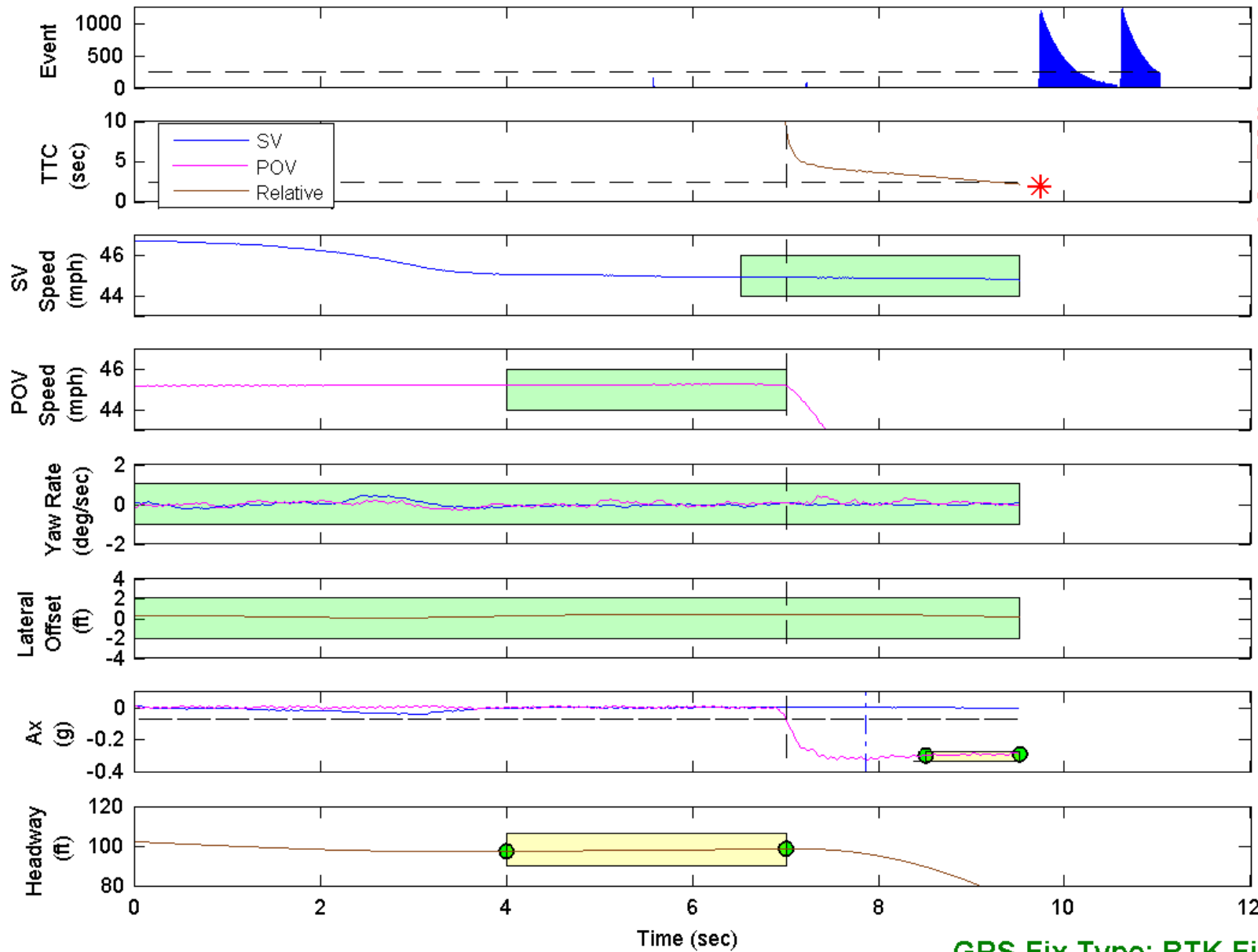


Figure D1. Example Time History for Test Type 1, Passing



### FCW Test 2



GPS Fix Type: RTK Fixed

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

FCW Test 2

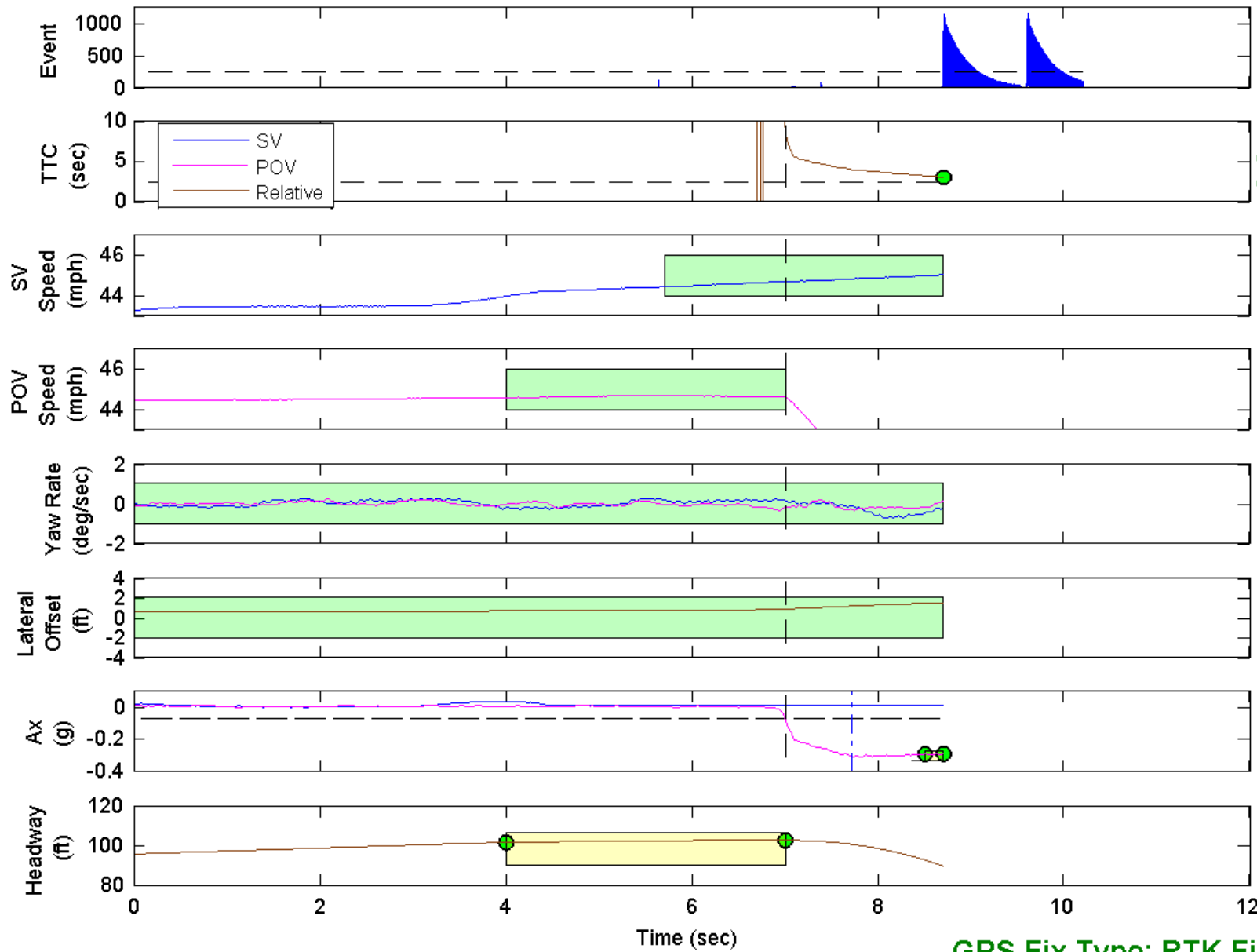


Figure D3. Example Time History for Test Type 2, Passing

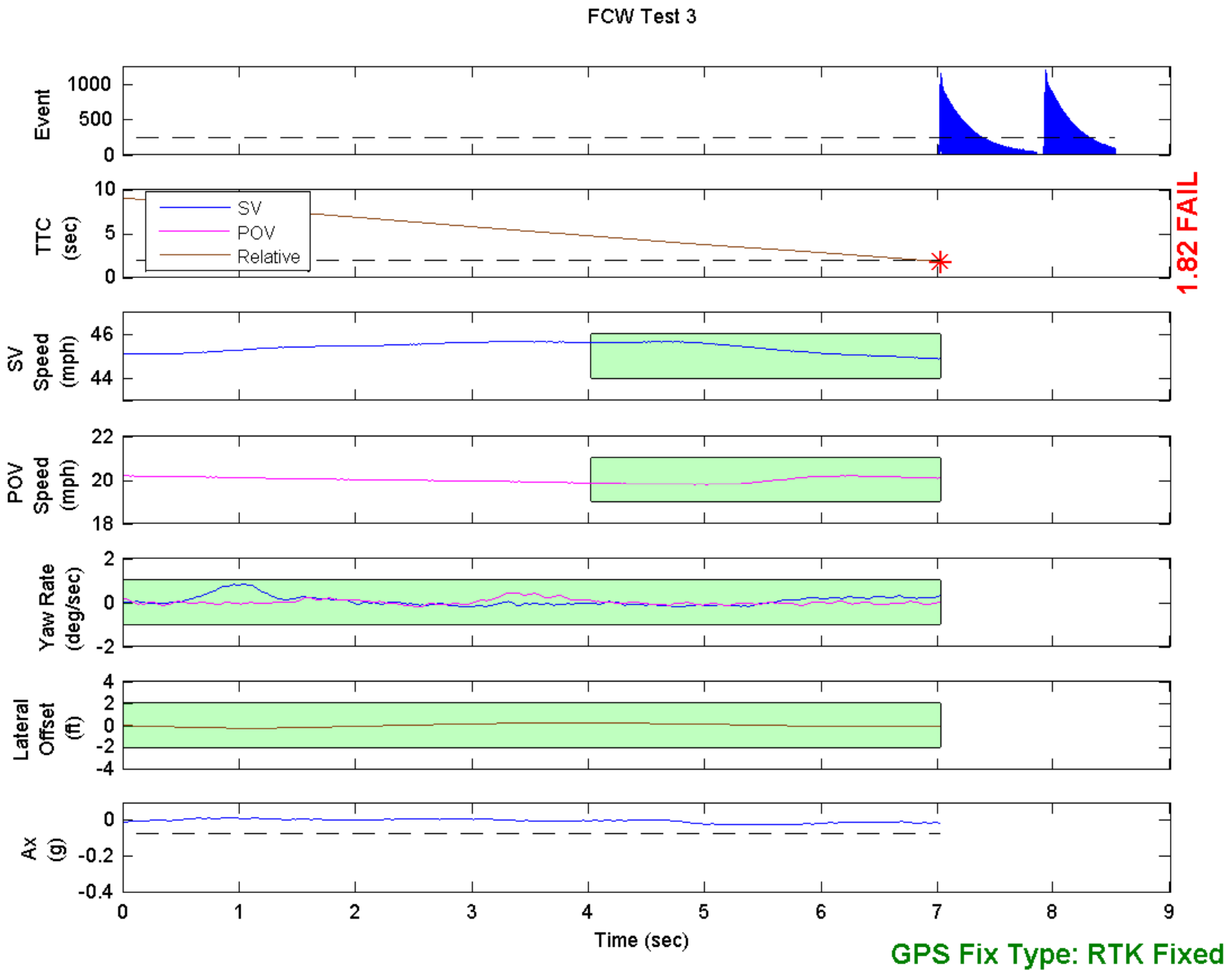


Figure D4. Example Time History for Test Type 3, Failing

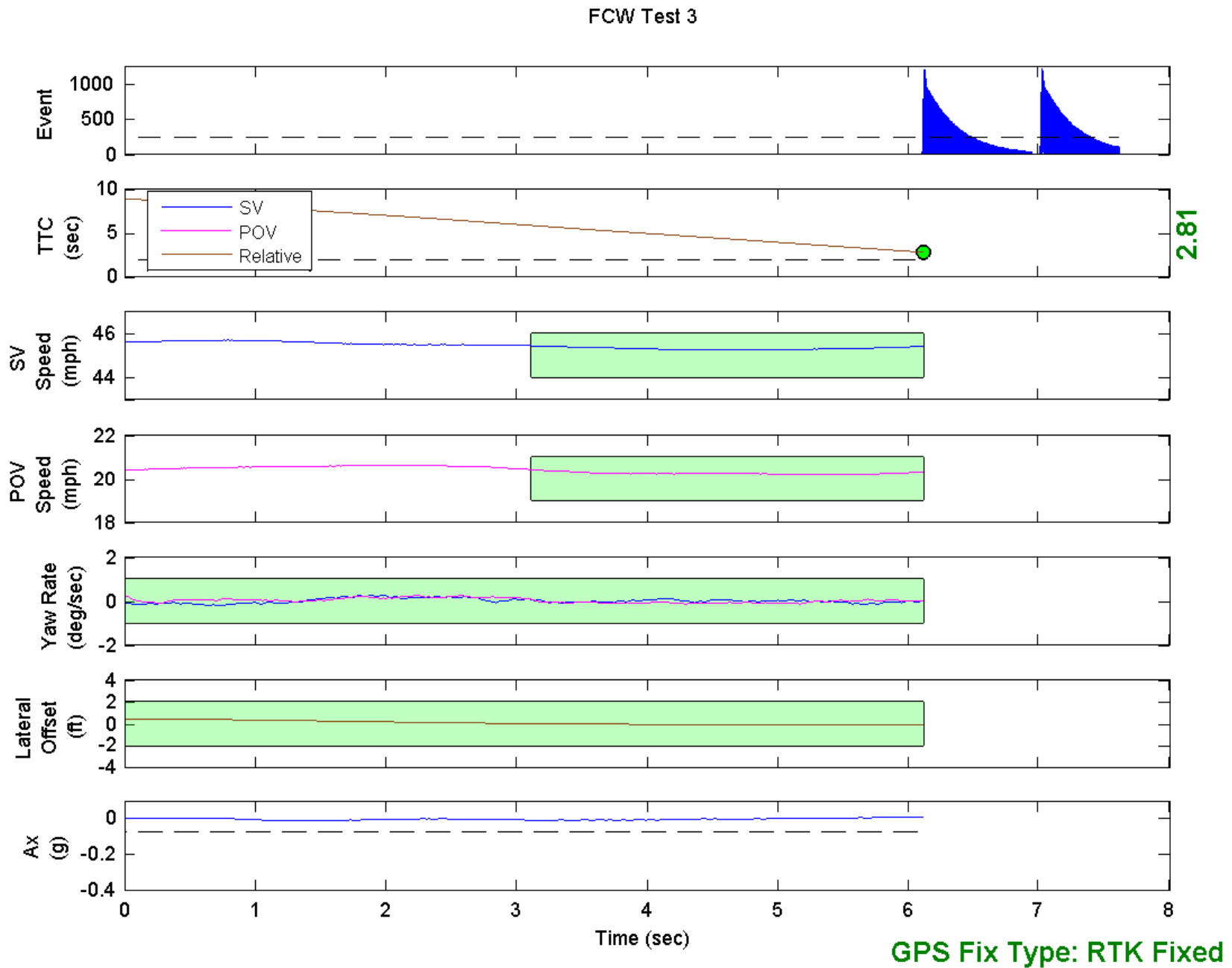


Figure D5. Example Time History for Test Type 3, Passing

FCW Test 2

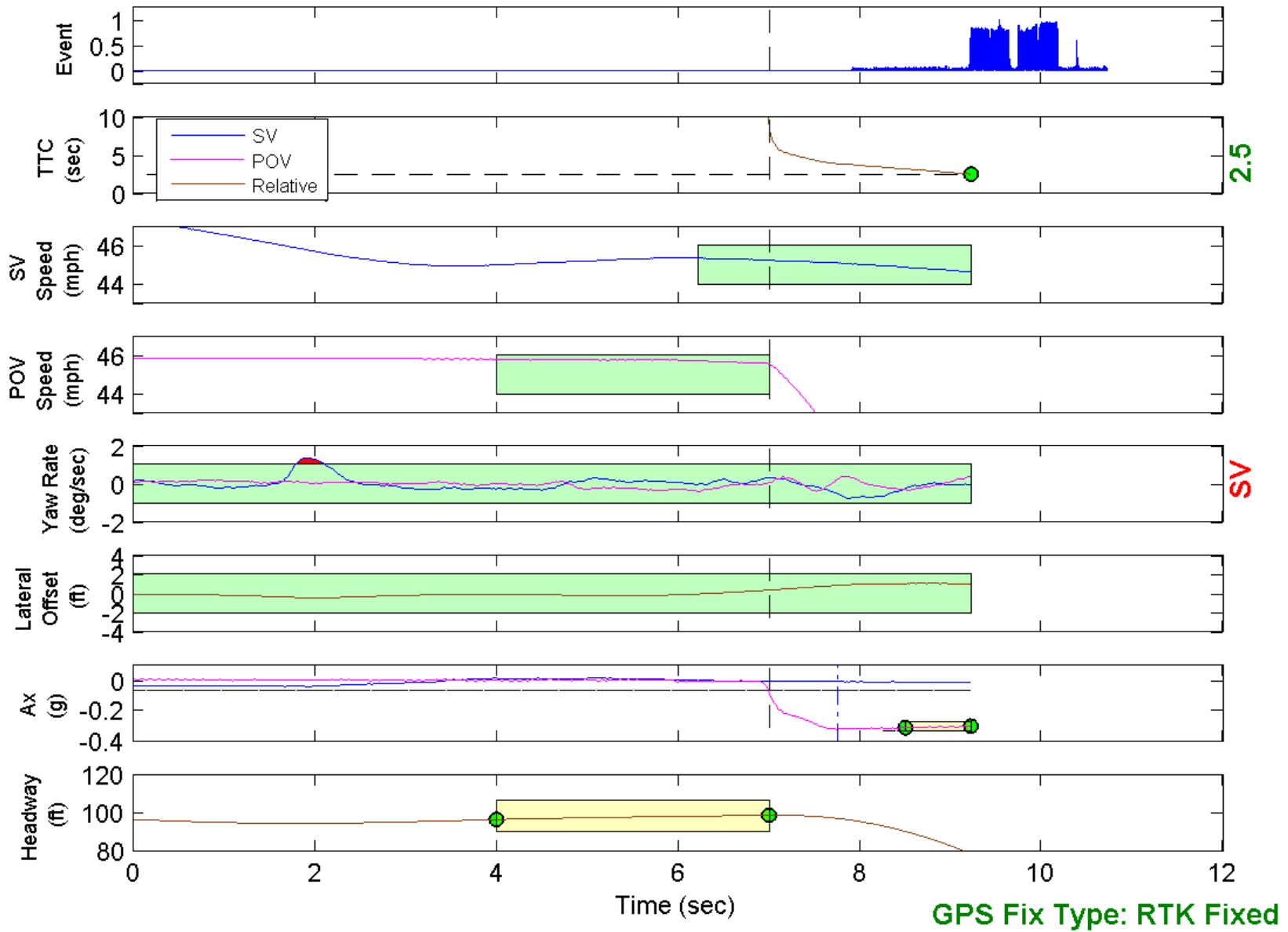


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

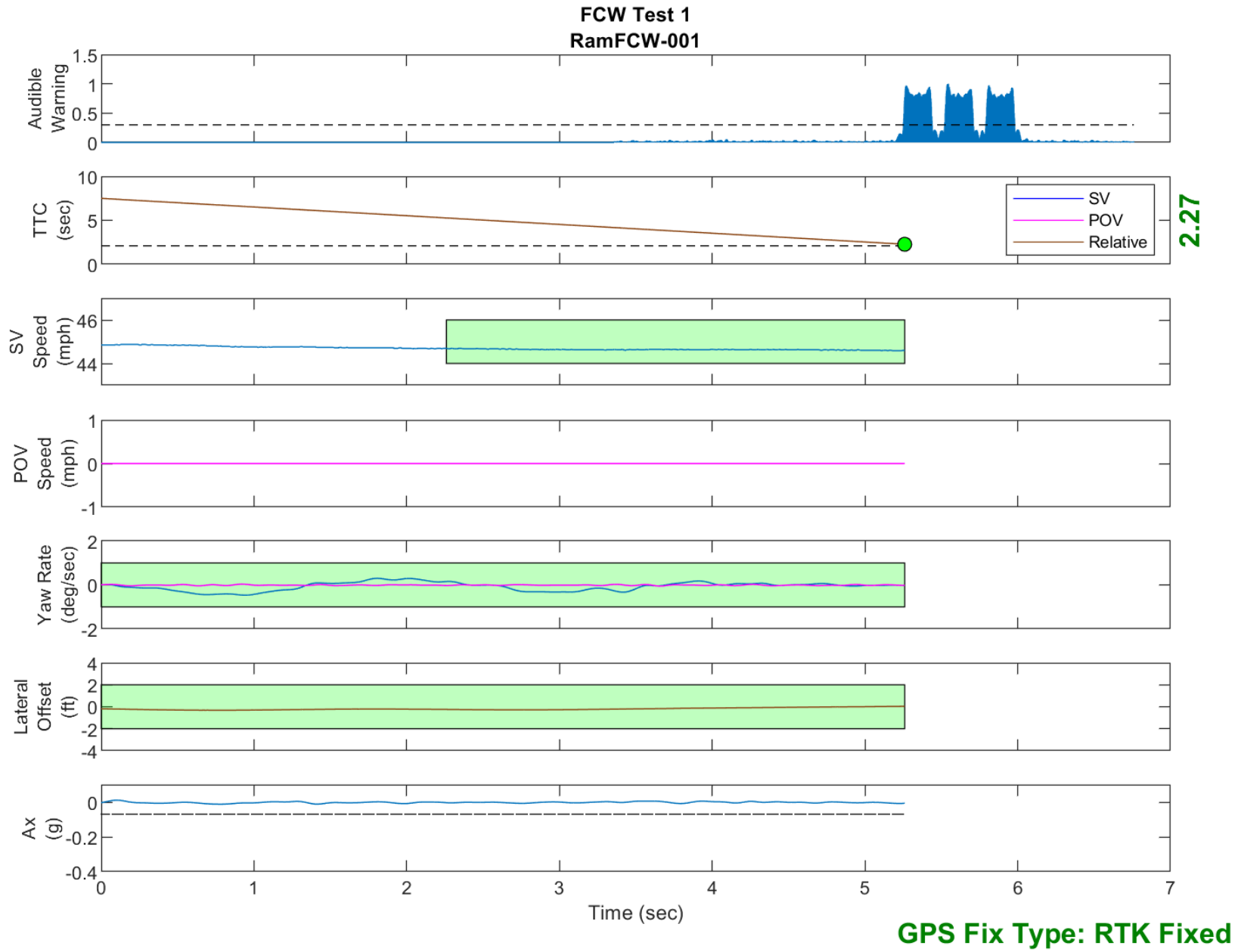


Figure D7. Time History for Run 01, FCW Test 1, Audible Warning

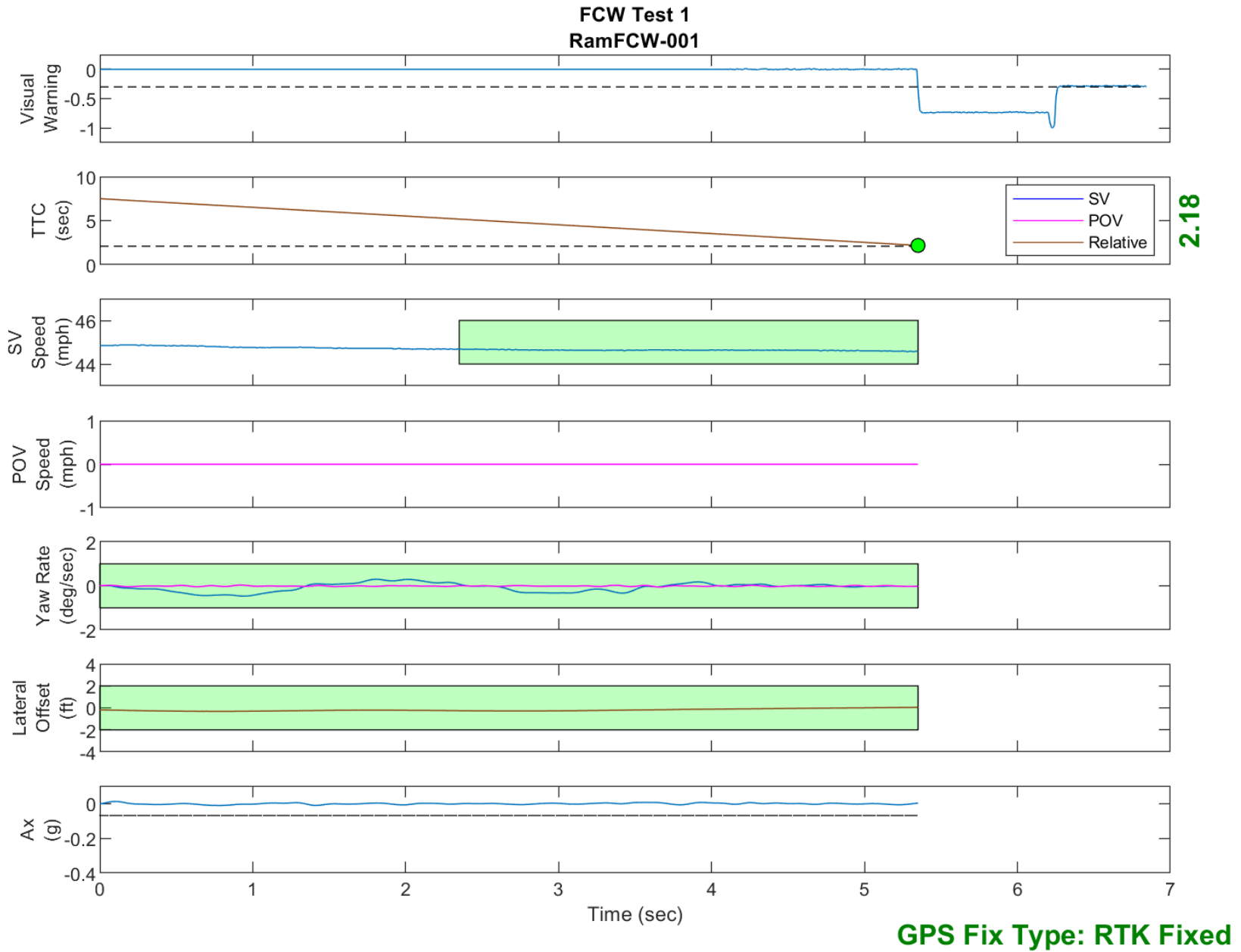


Figure D8. Time History for Run 01, FCW Test 1, Visual Warning

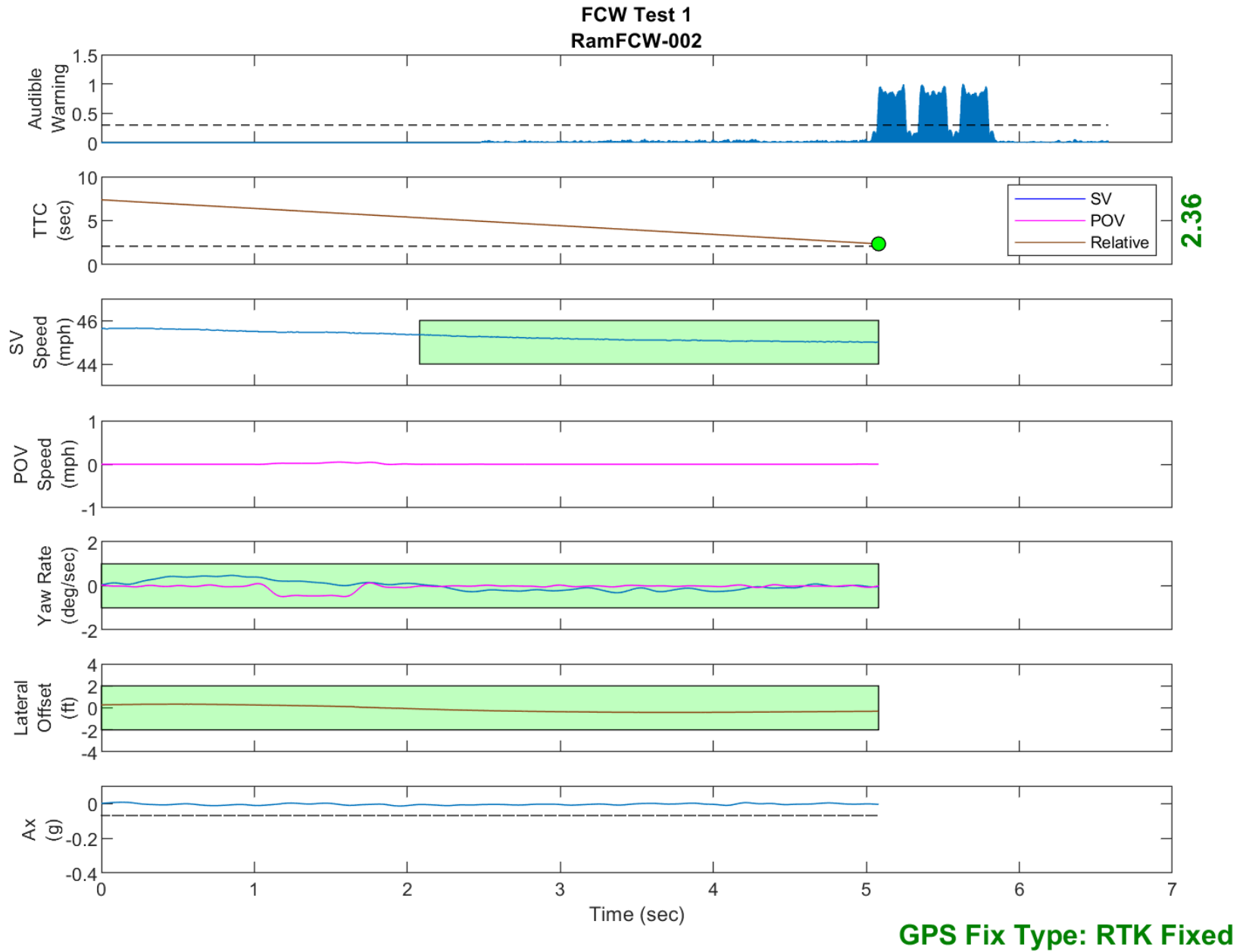


Figure D9. Time History for Run 02, FCW Test 1, Audible Warning



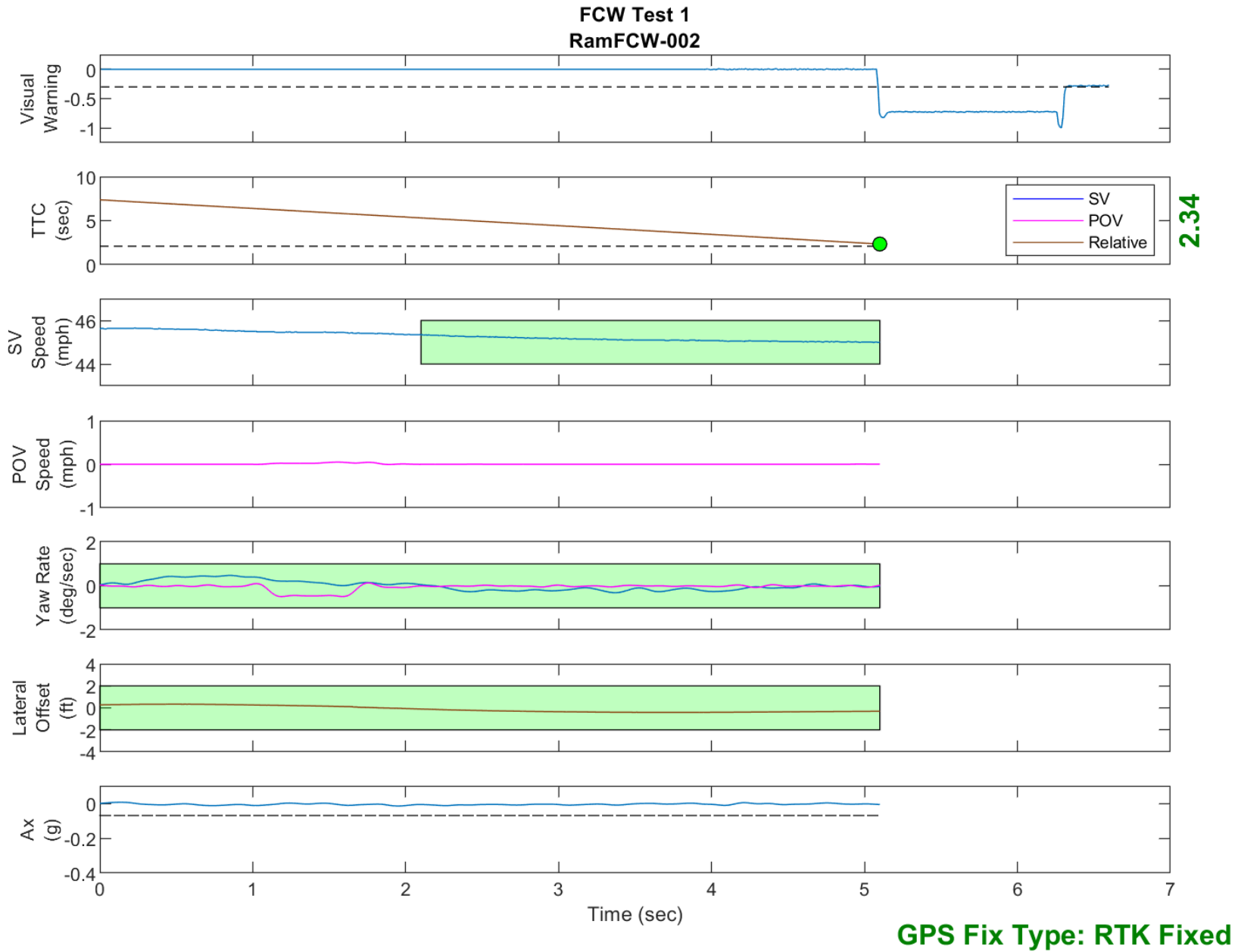


Figure D10. Time History for Run 02, FCW Test 1, Visual Warning

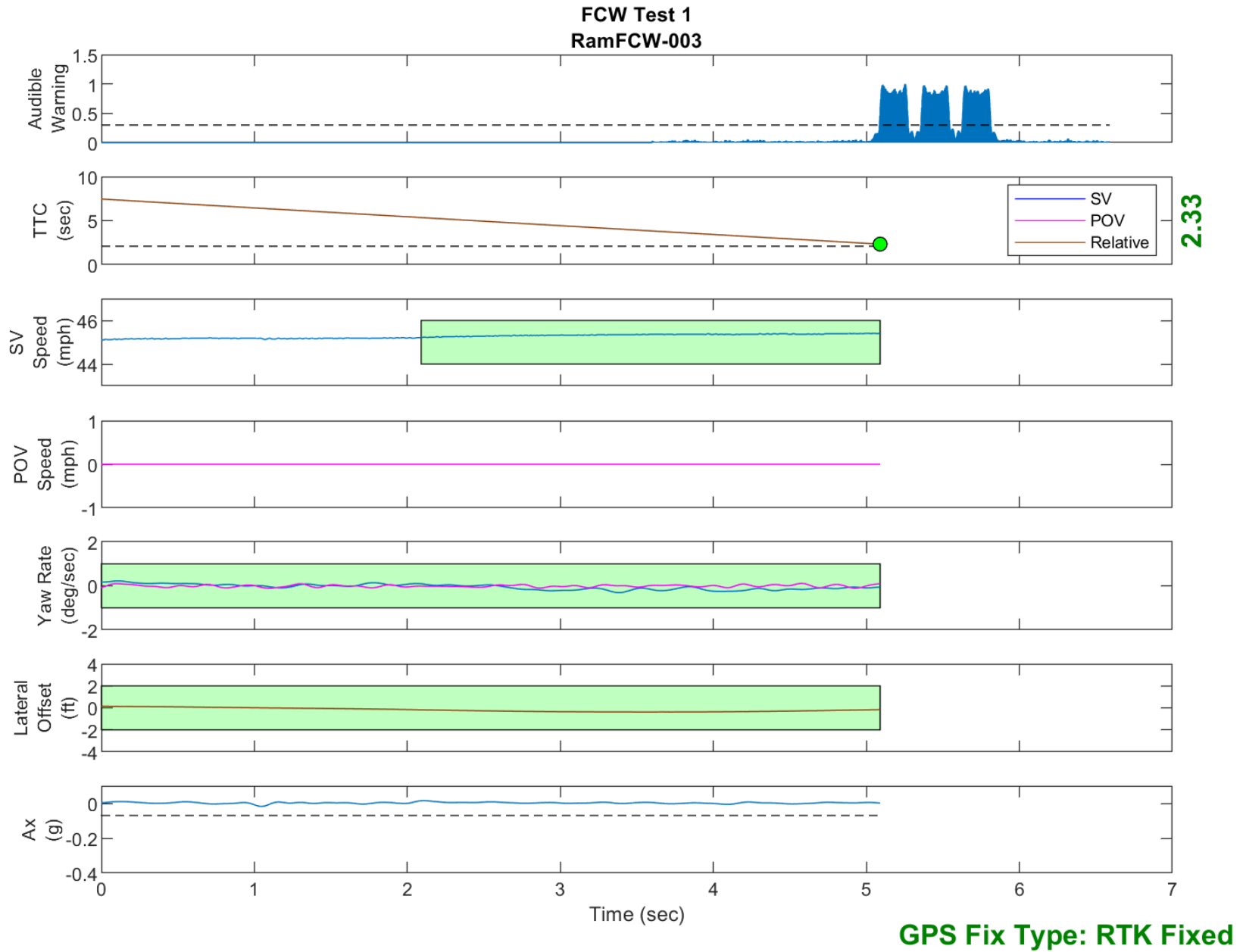


Figure D11. Time History for Run 03, FCW Test 1, Audible Warning

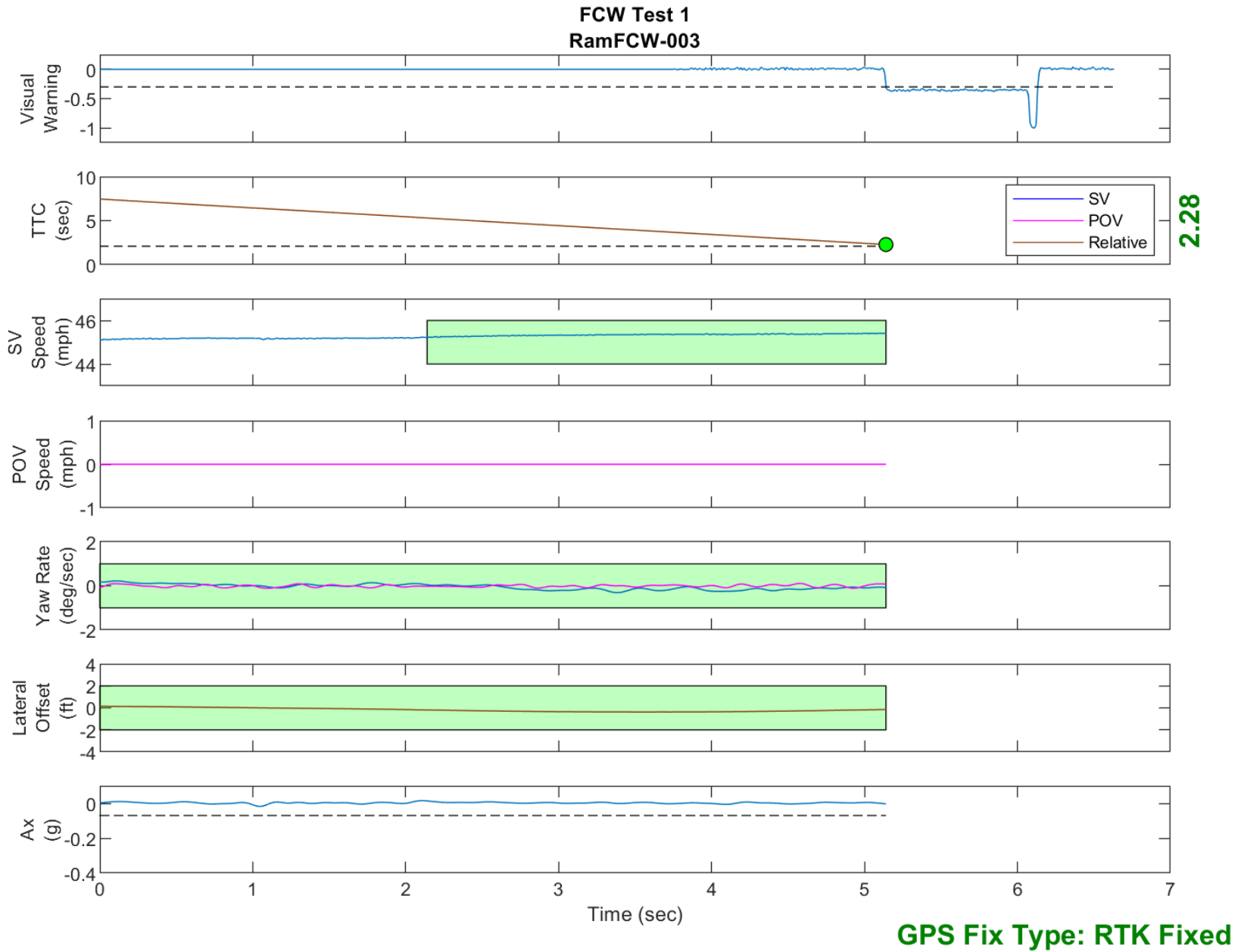


Figure D12. Time History for Run 03, FCW Test 1, Visual Warning

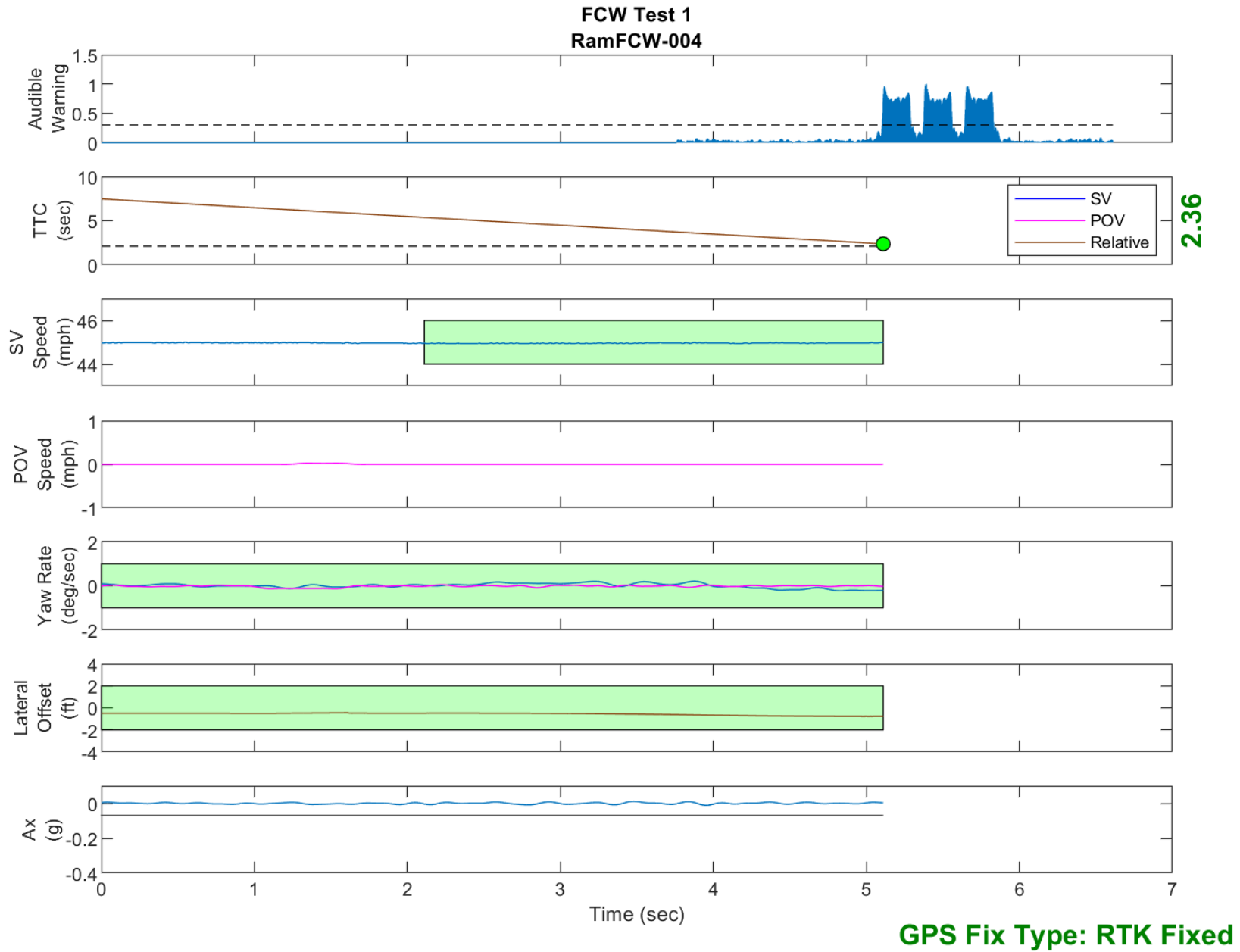


Figure D13. Time History for Run 04, FCW Test 1, Audible Warning

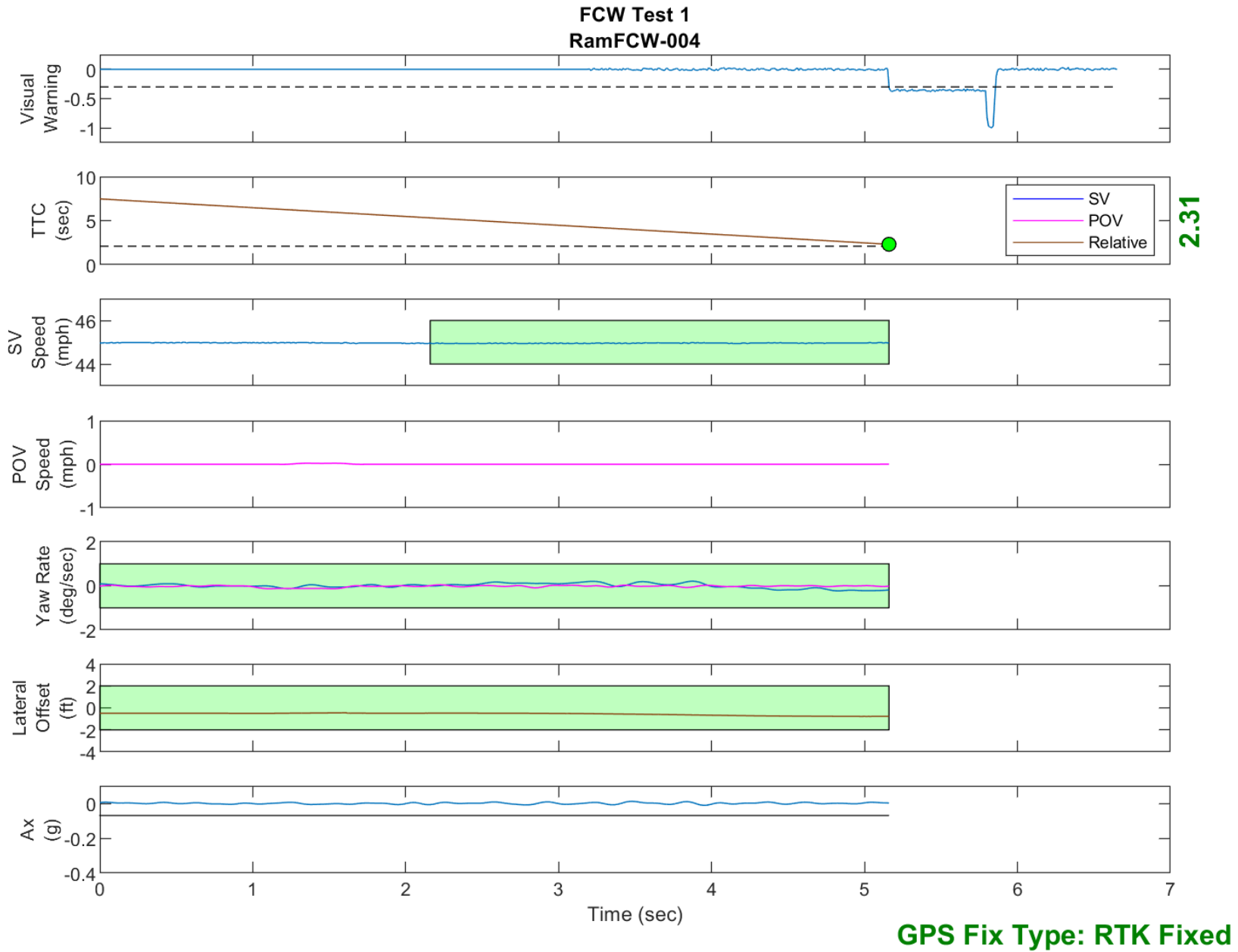


Figure D14. Time History for Run 04, FCW Test 1, Visual Warning

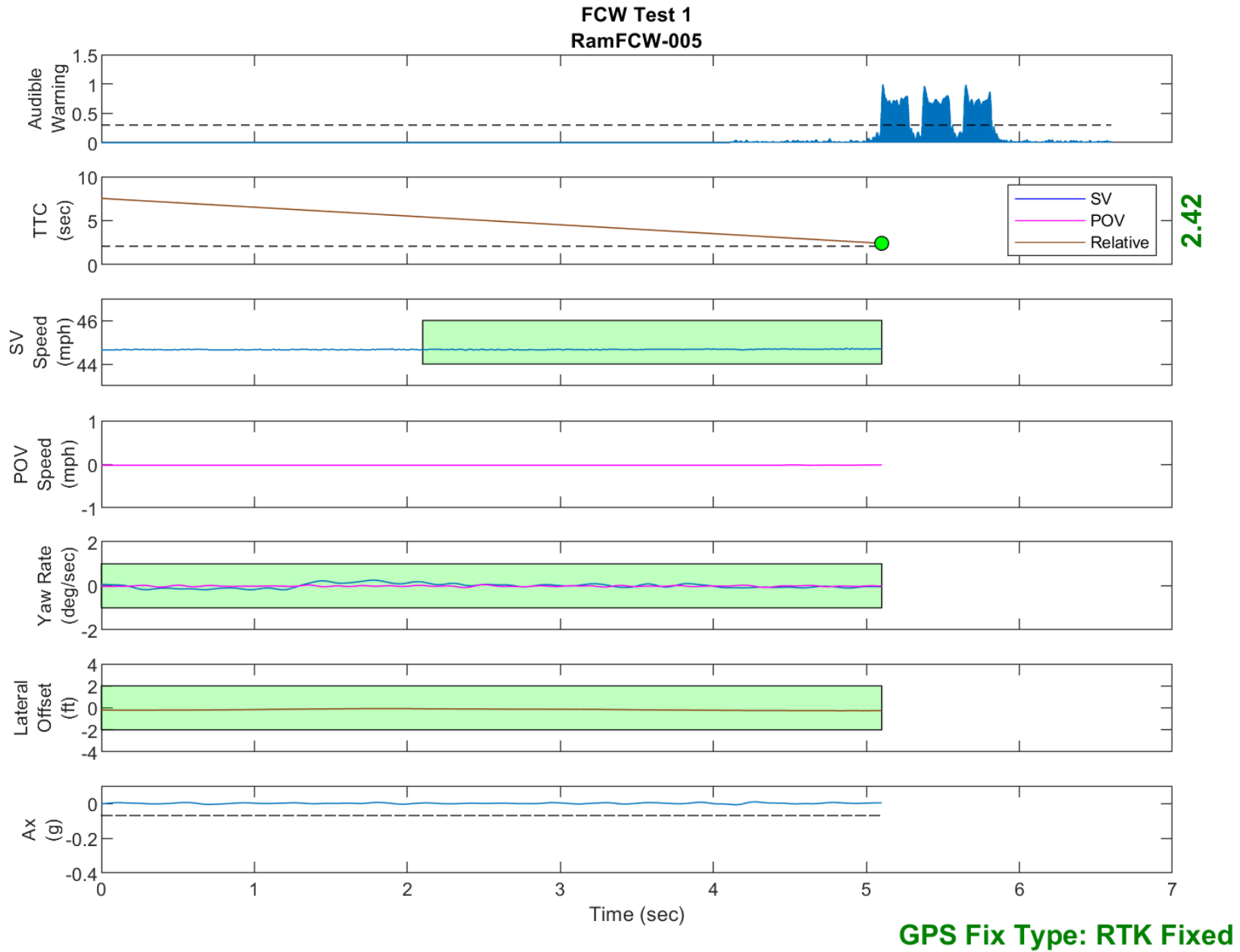


Figure D15. Time History for Run 05, FCW Test 1, Audible Warning

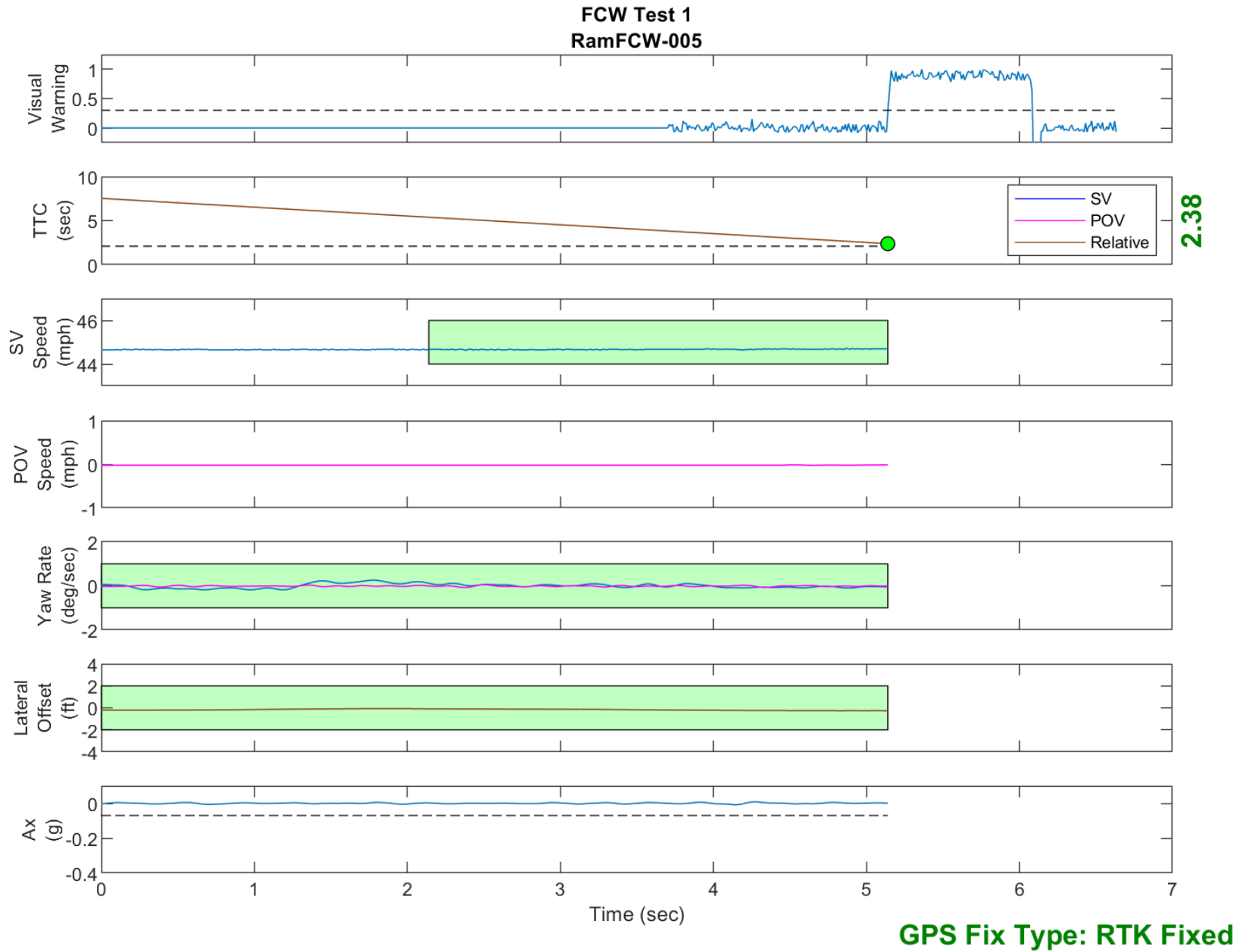


Figure D16. Time History for Run 05, FCW Test 1, Visual Warning

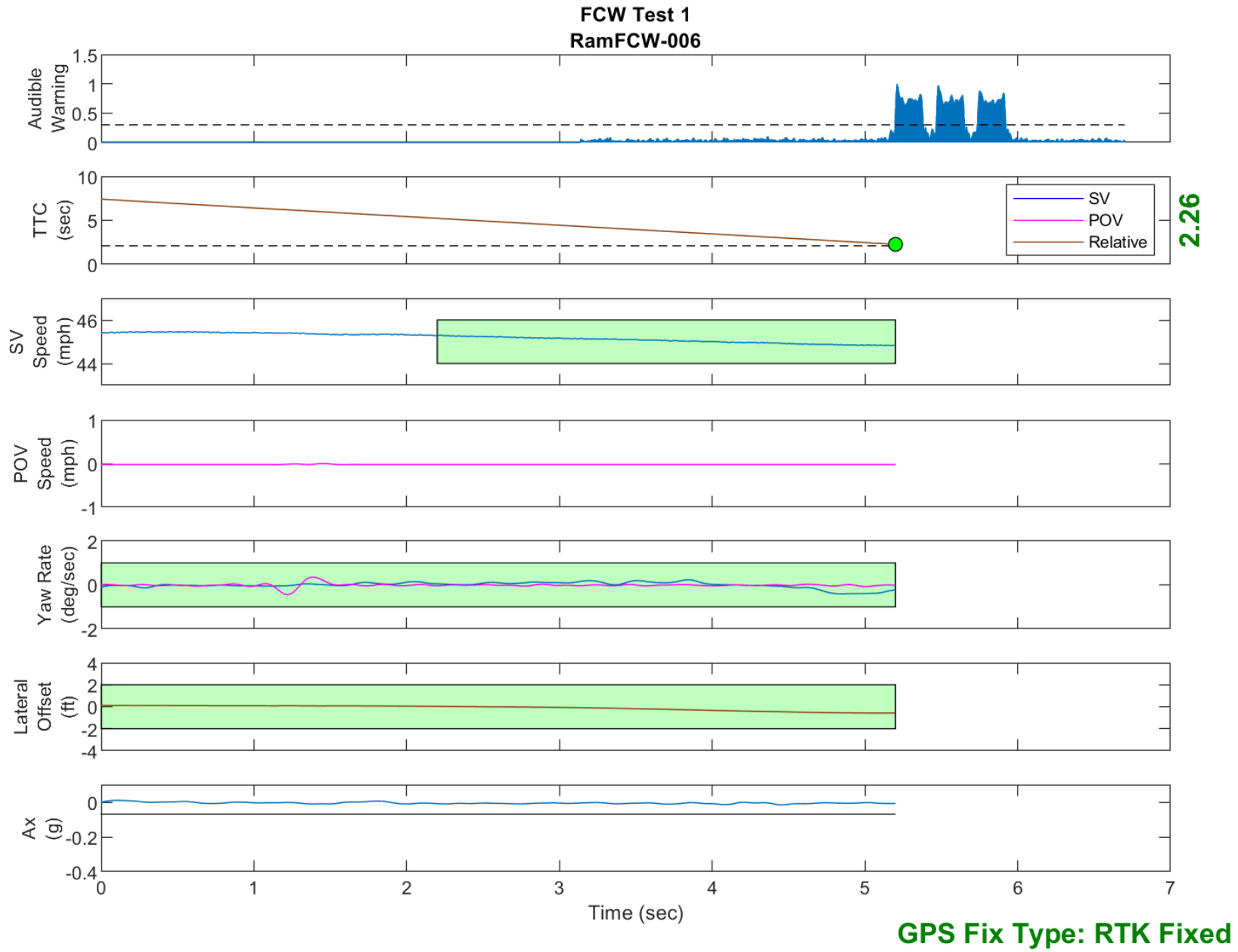


Figure D17. Time History for Run 06, FCW Test 1, Audible Warning



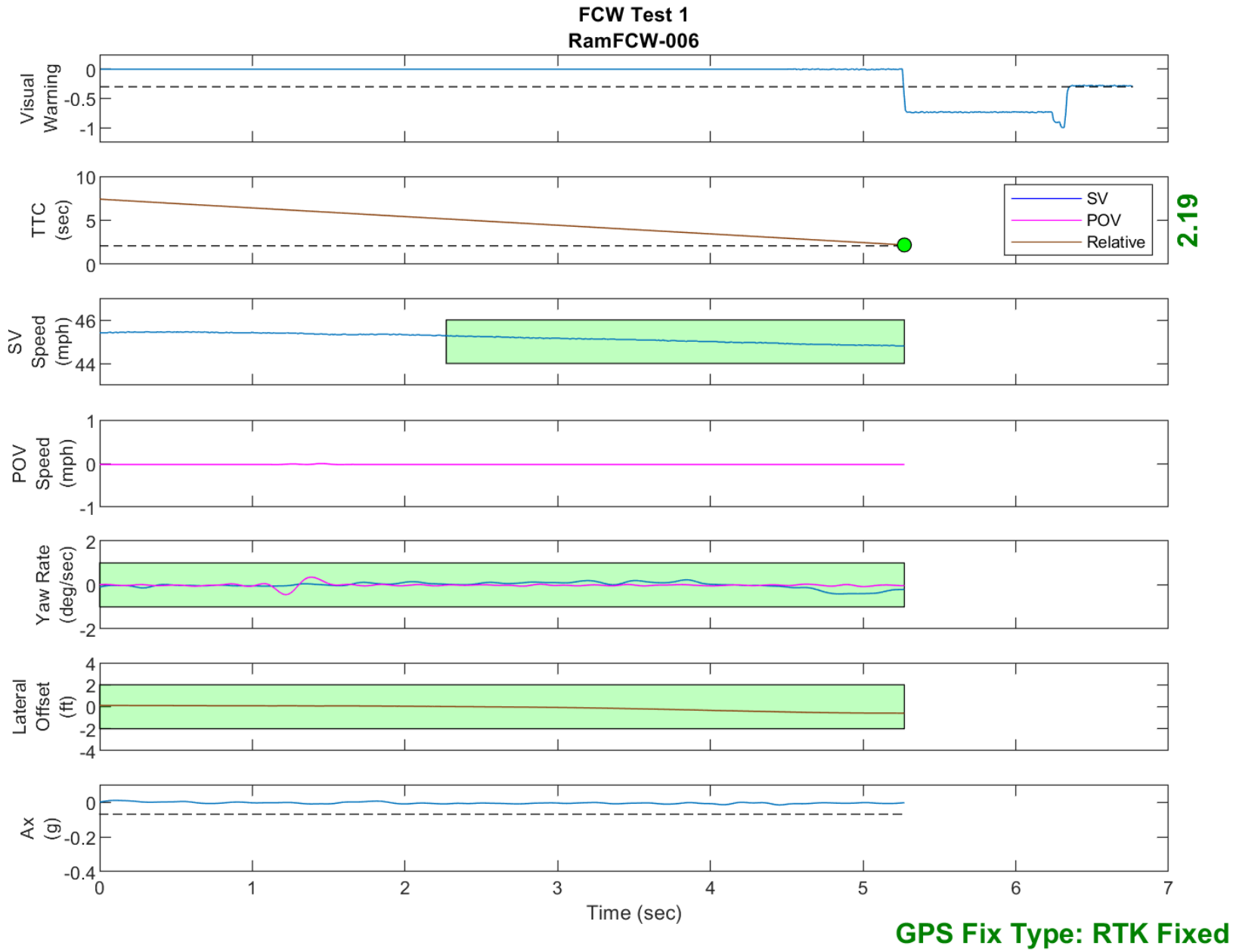


Figure D18. Time History for Run 06, FCW Test 1, Visual Warning

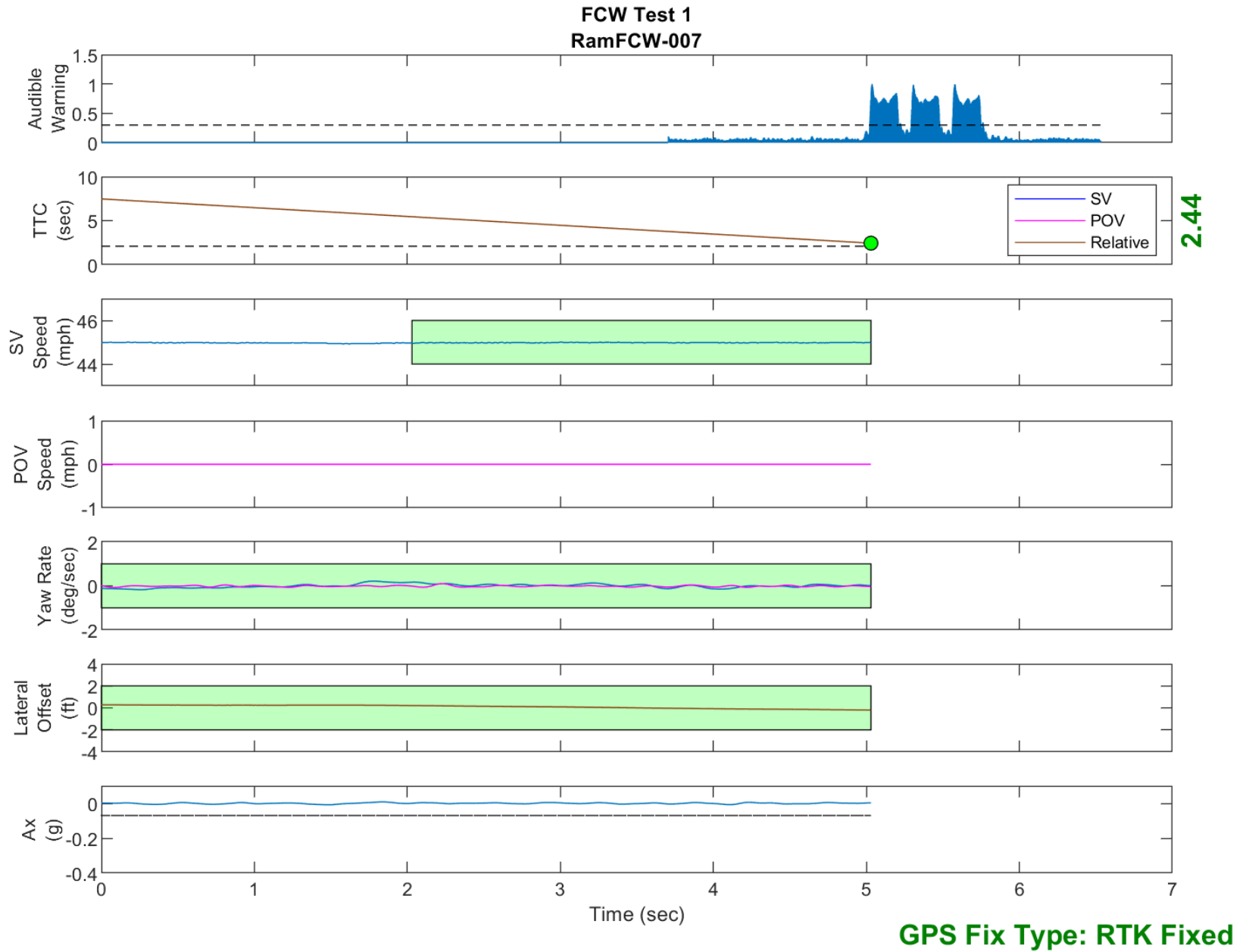


Figure D19. Time History for Run 07, FCW Test 1, Audible Warning

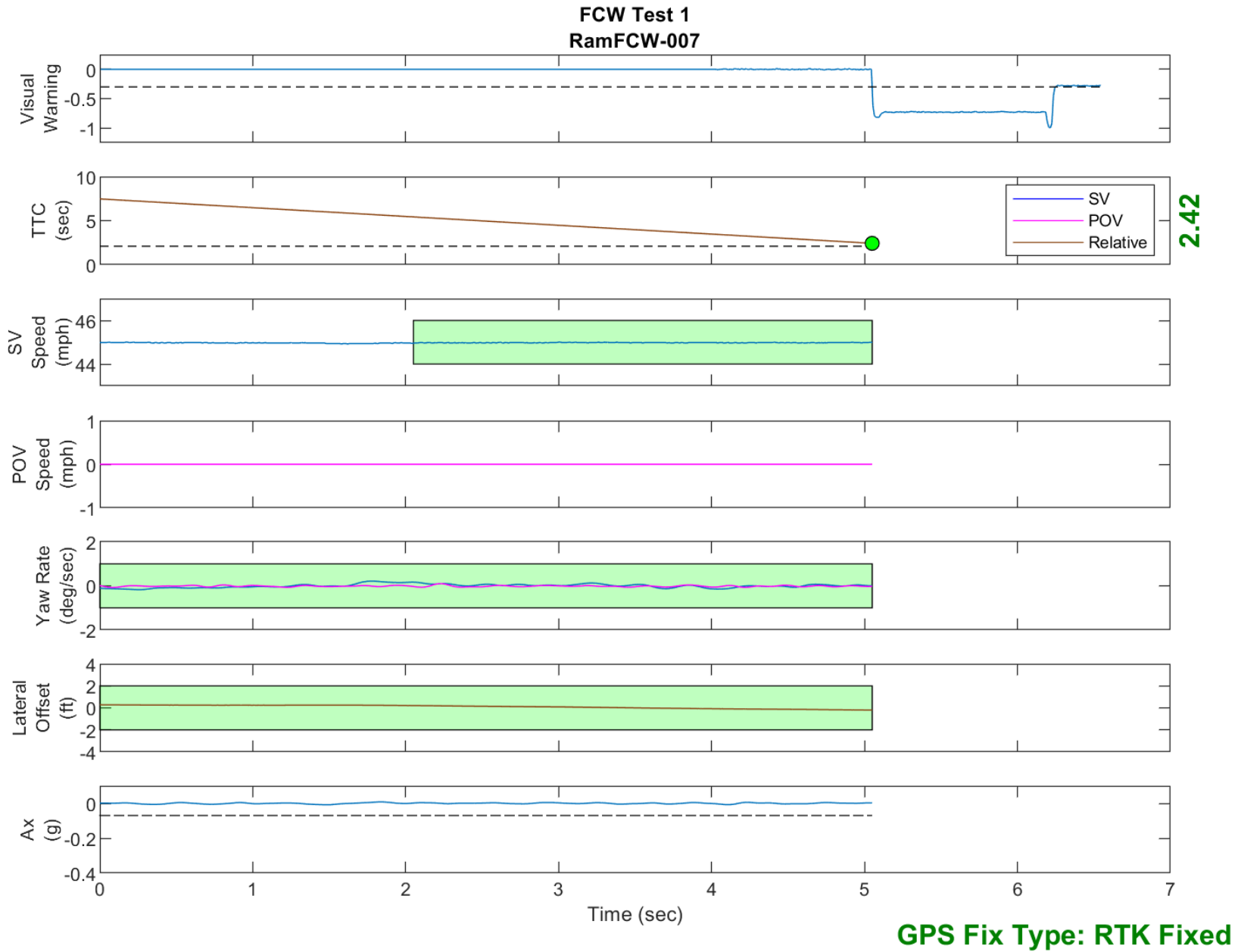


Figure D20. Time History for Run 07, FCW Test 1, Visual Warning

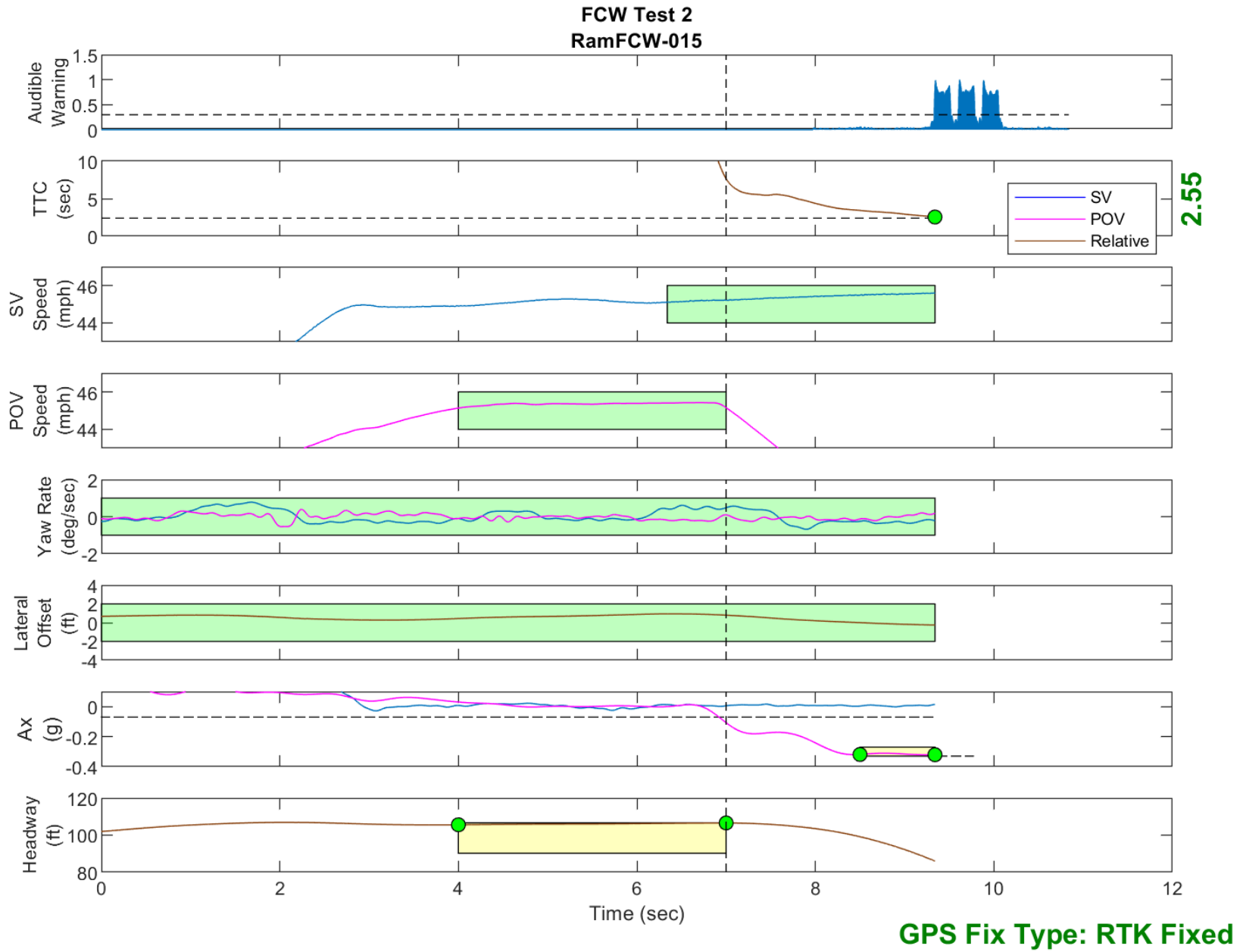


Figure D21. Time History for Run 15, FCW Test 2, Audible Warning

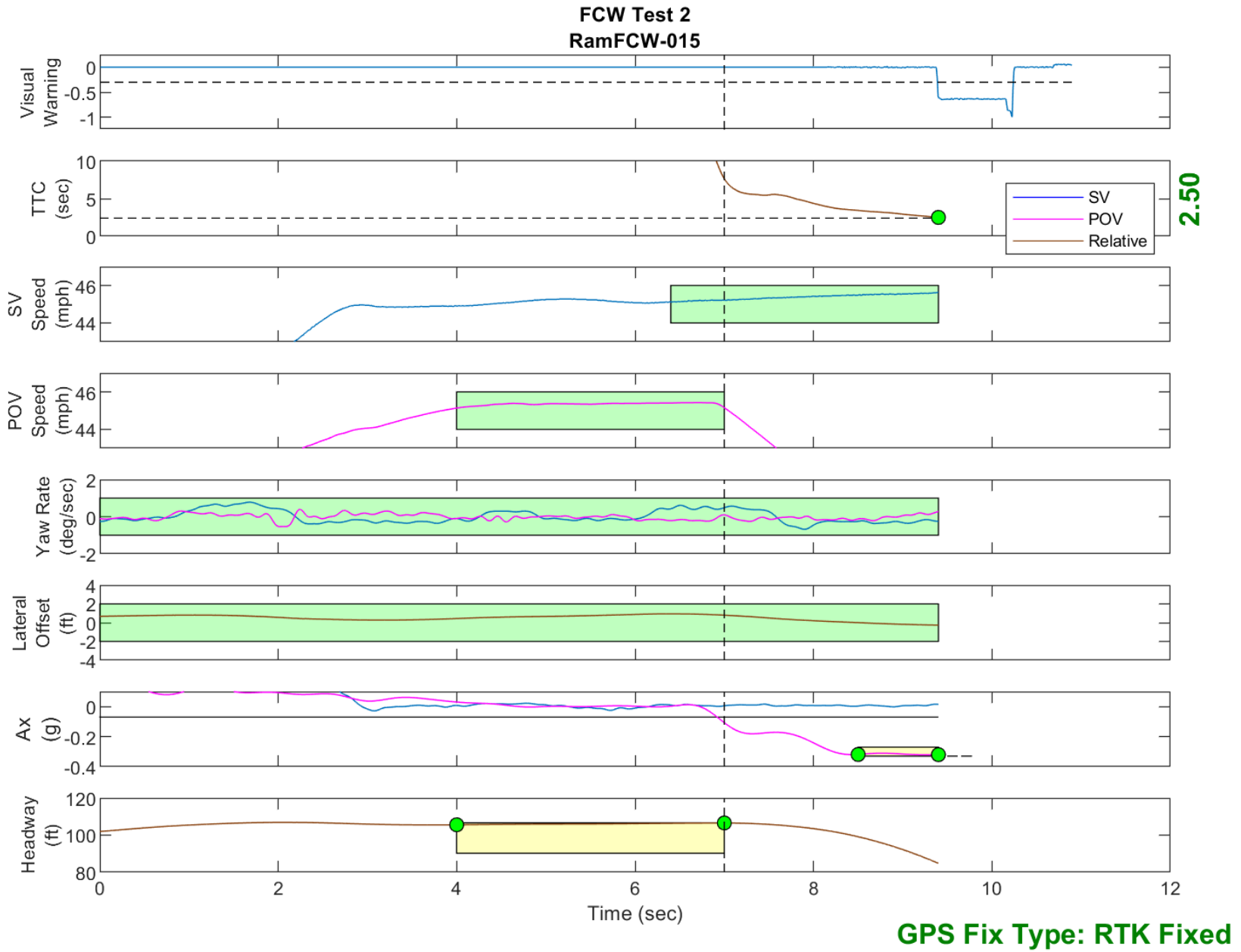


Figure D22. Time History for Run 15, FCW Test 2, Visual Warning

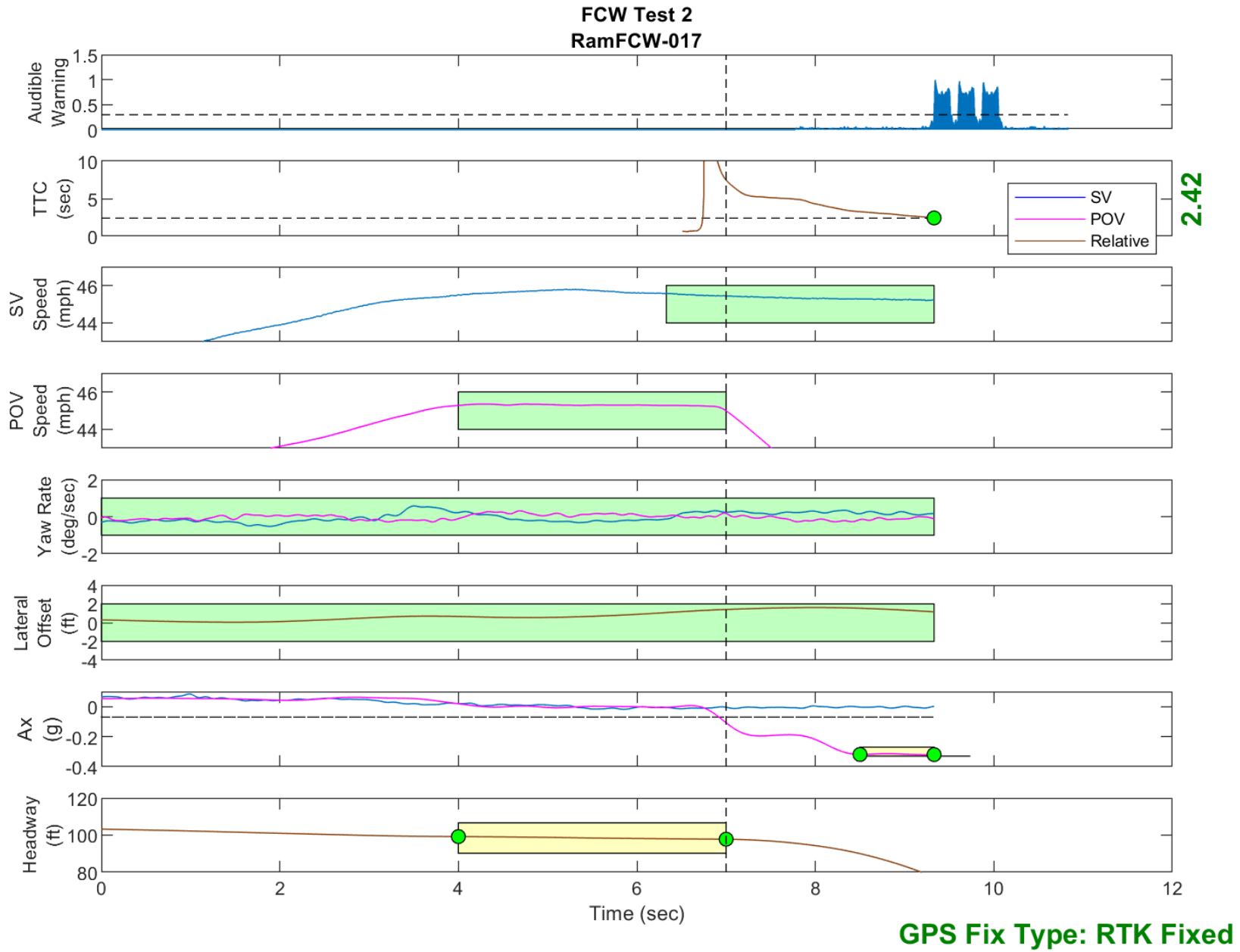


Figure D23. Time History for Run 17, FCW Test 2, Audible Warning

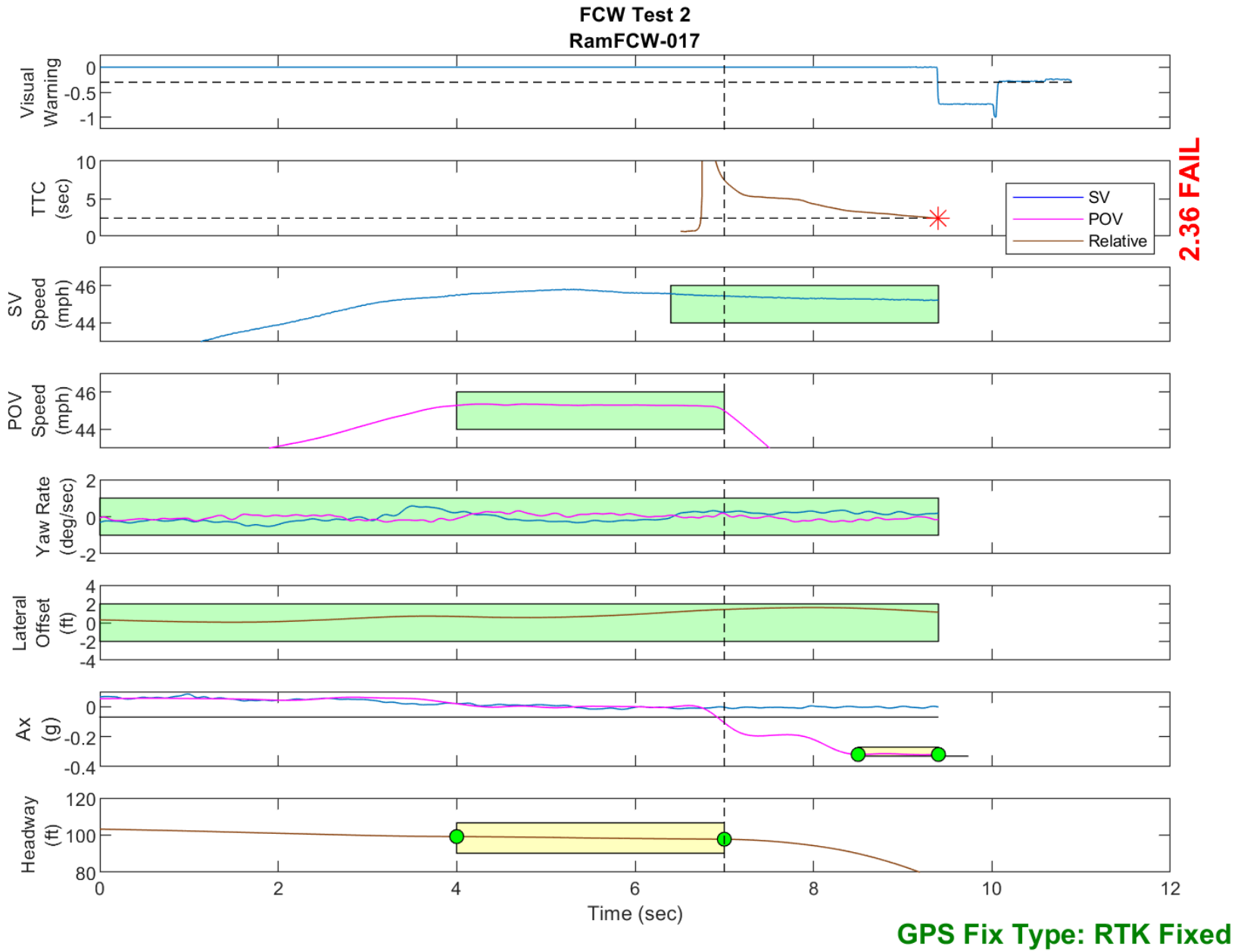


Figure D24. Time History for Run 17, FCW Test 2, Visual Warning

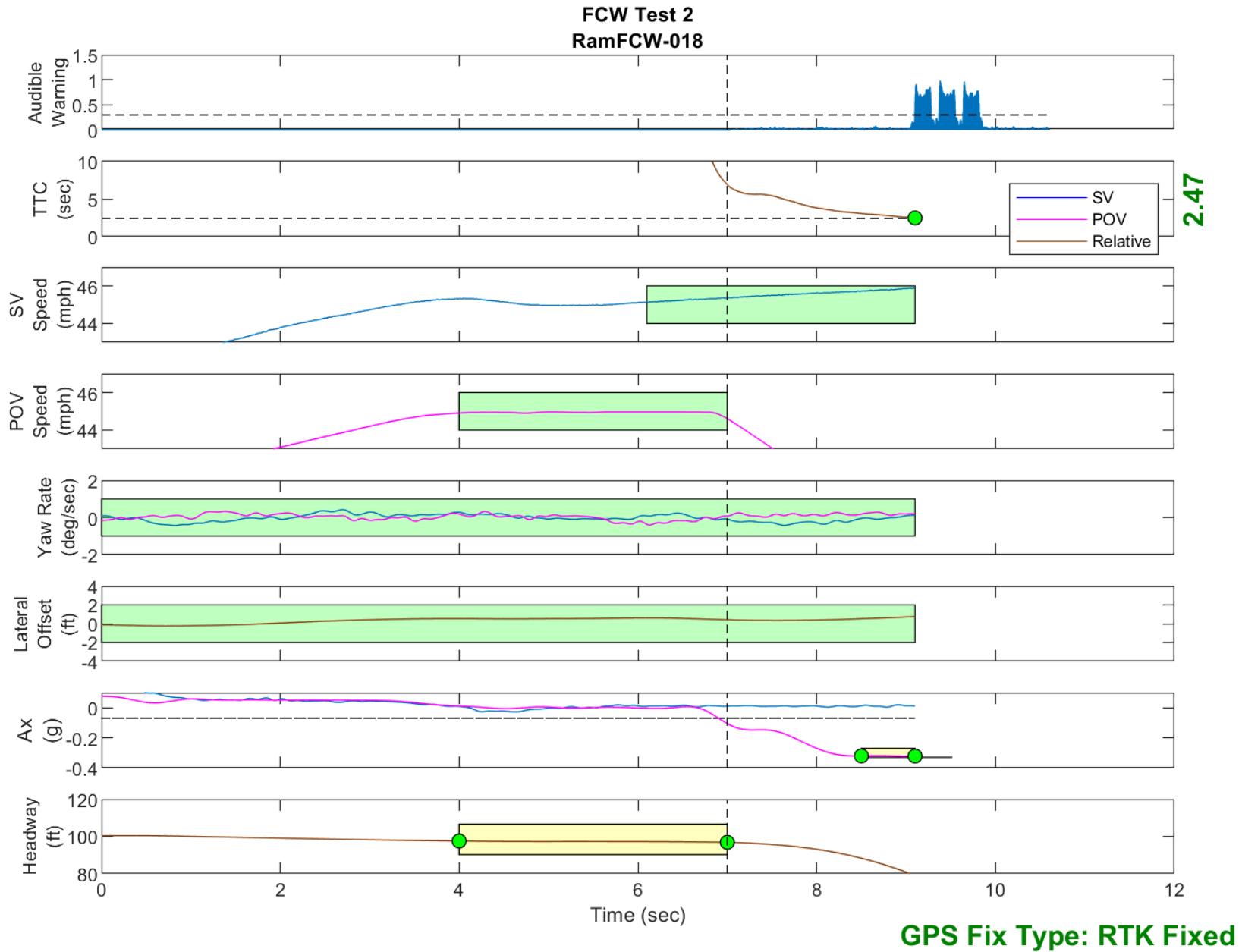


Figure D25. Time History for Run 18, FCW Test 2, Audible Warning



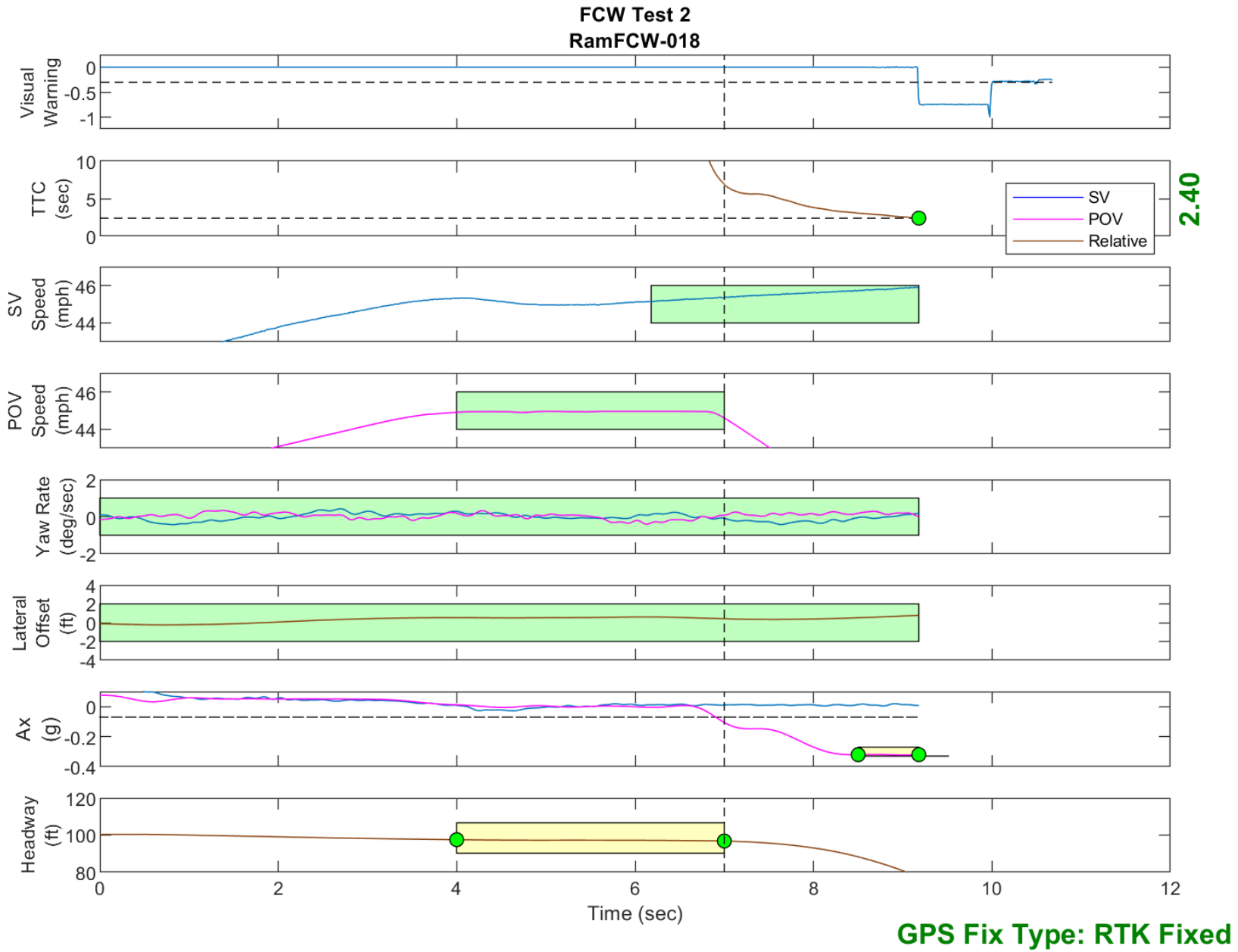


Figure D26. Time History for Run 18, FCW Test 2, Visual Warning

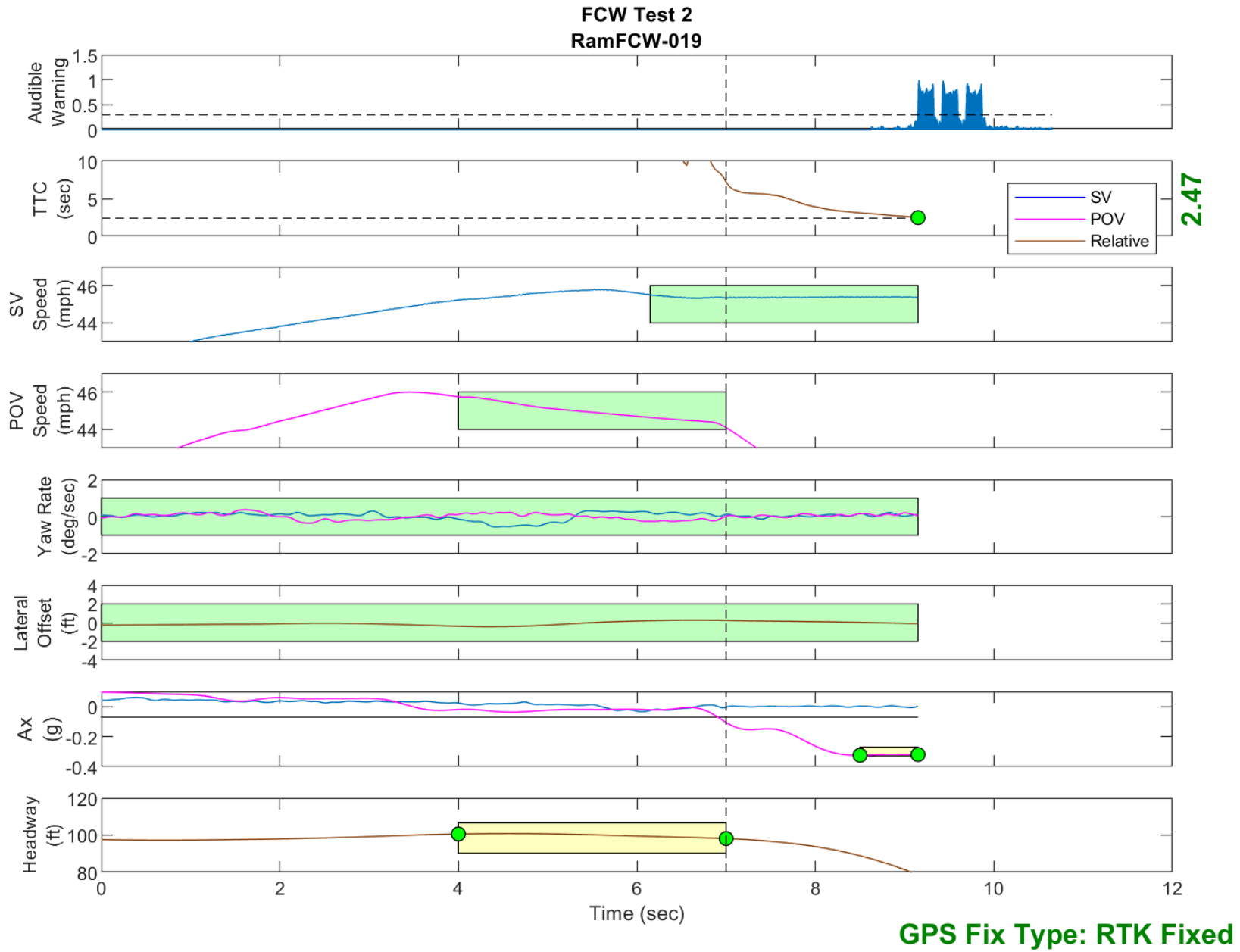


Figure D27. Time History for Run 19, FCW Test 2, Audible Warning

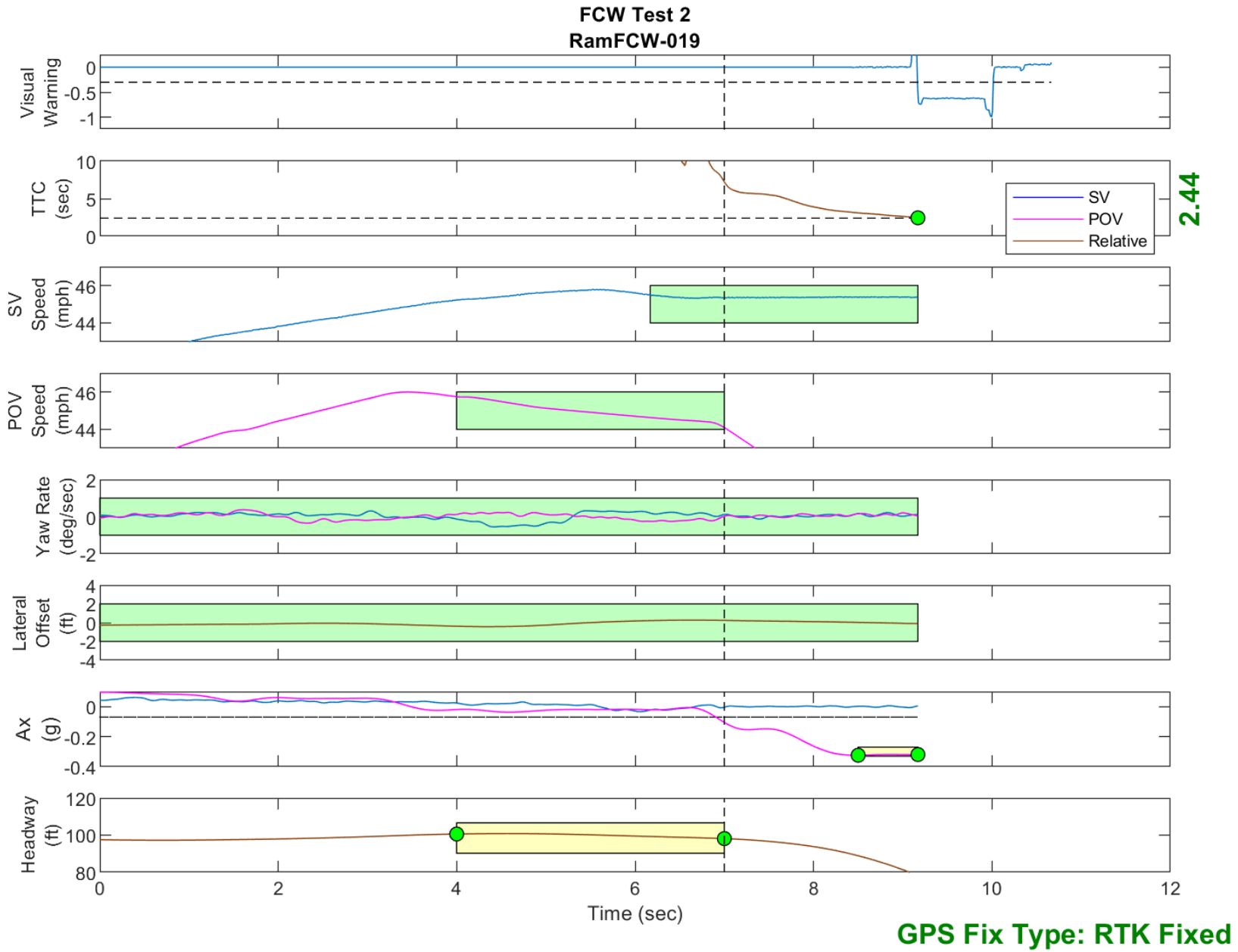


Figure D28. Time History for Run 19, FCW Test 2, Visual Warning

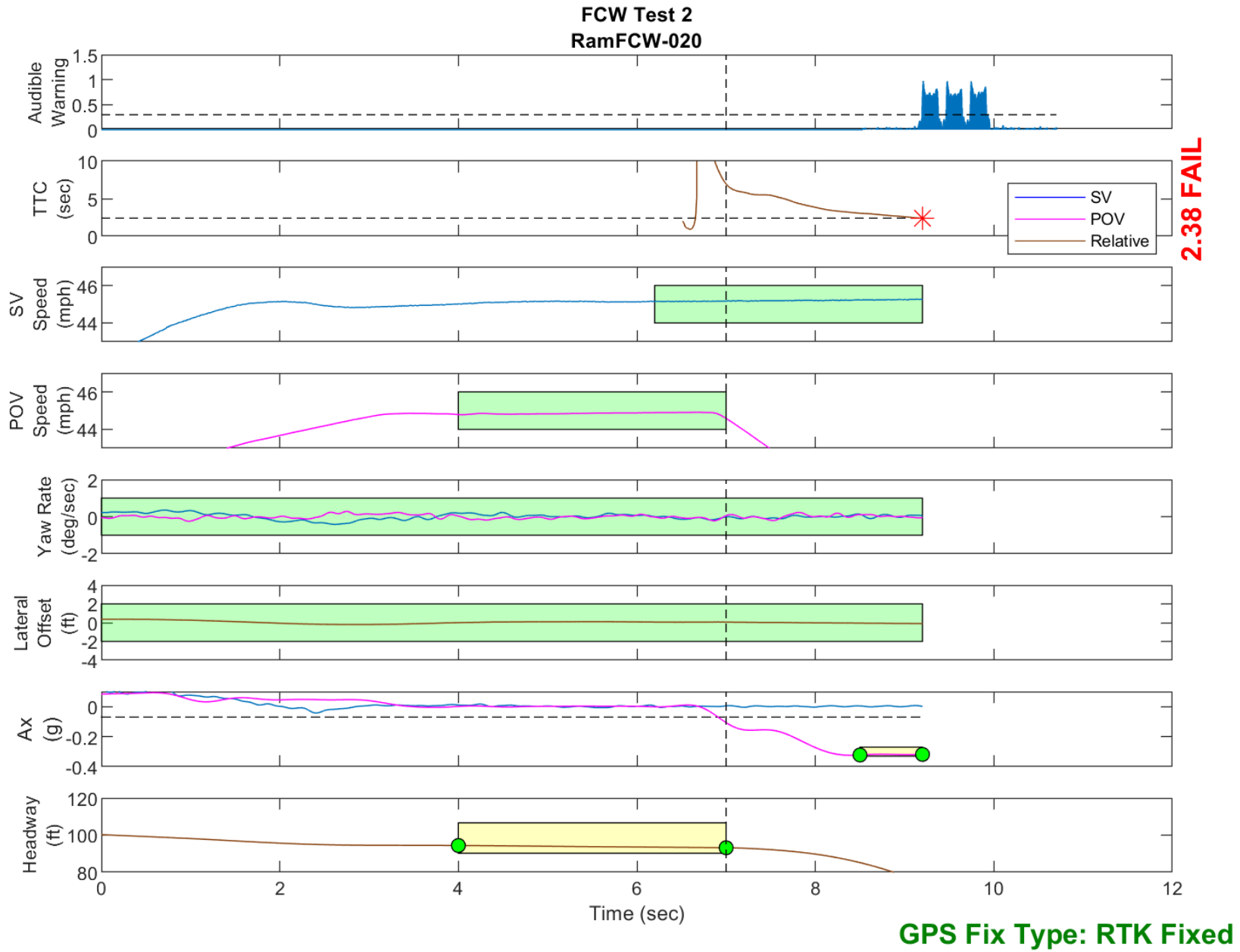


Figure D29. Time History for Run 20, FCW Test 2, Audible Warning

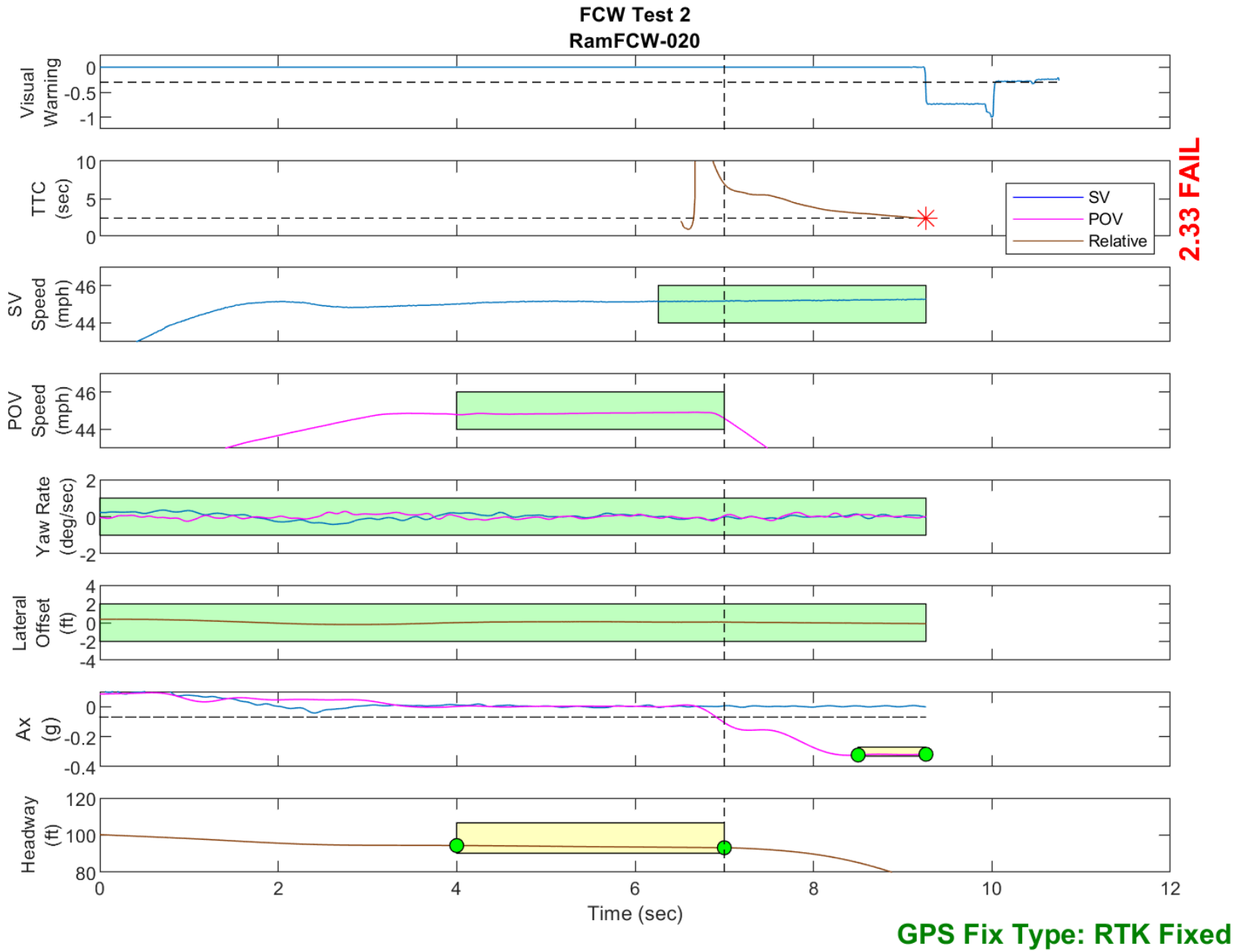


Figure D30. Time History for Run 20, FCW Test 2, Visual Warning

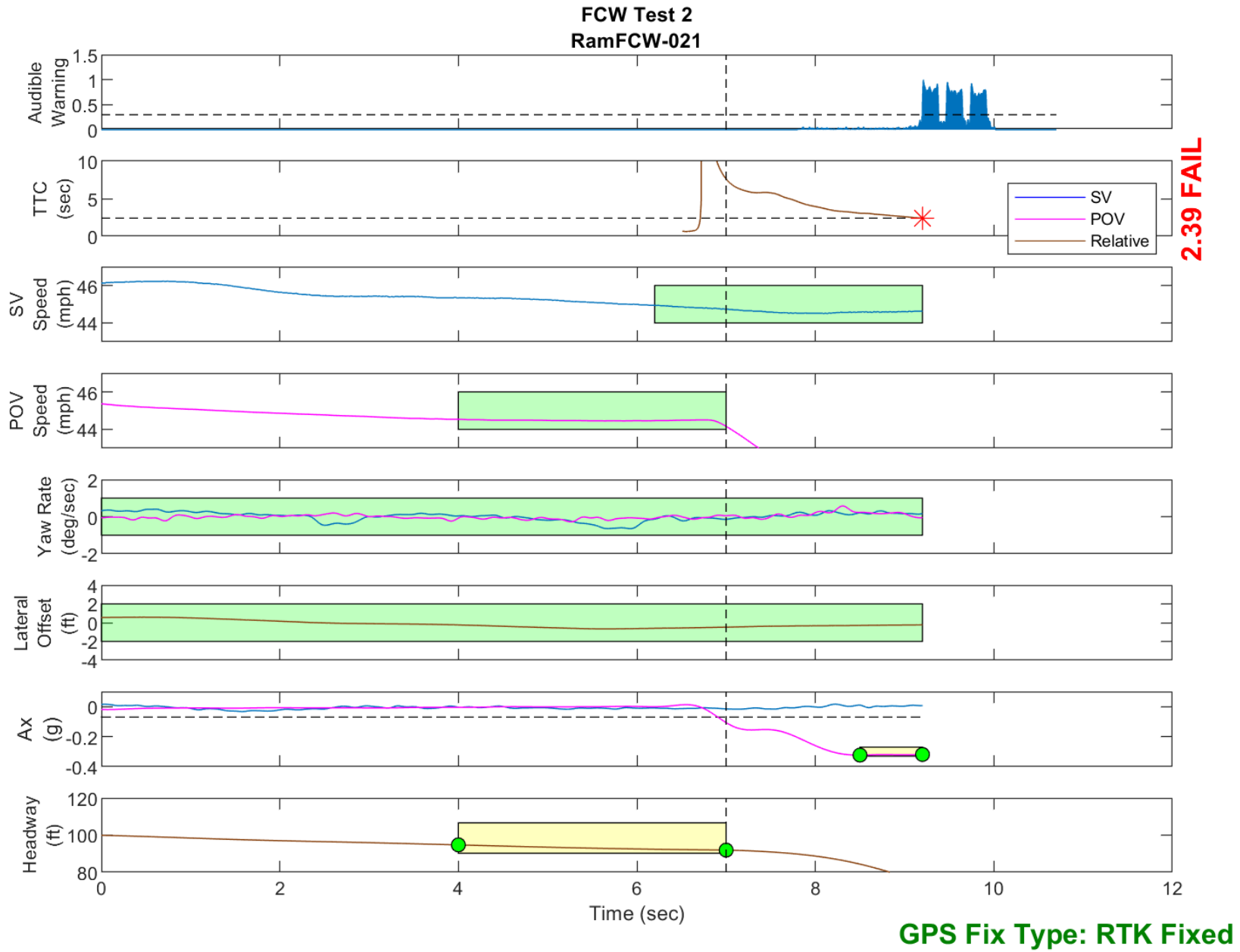


Figure D31. Time History for Run 21, FCW Test 2, Audible Warning

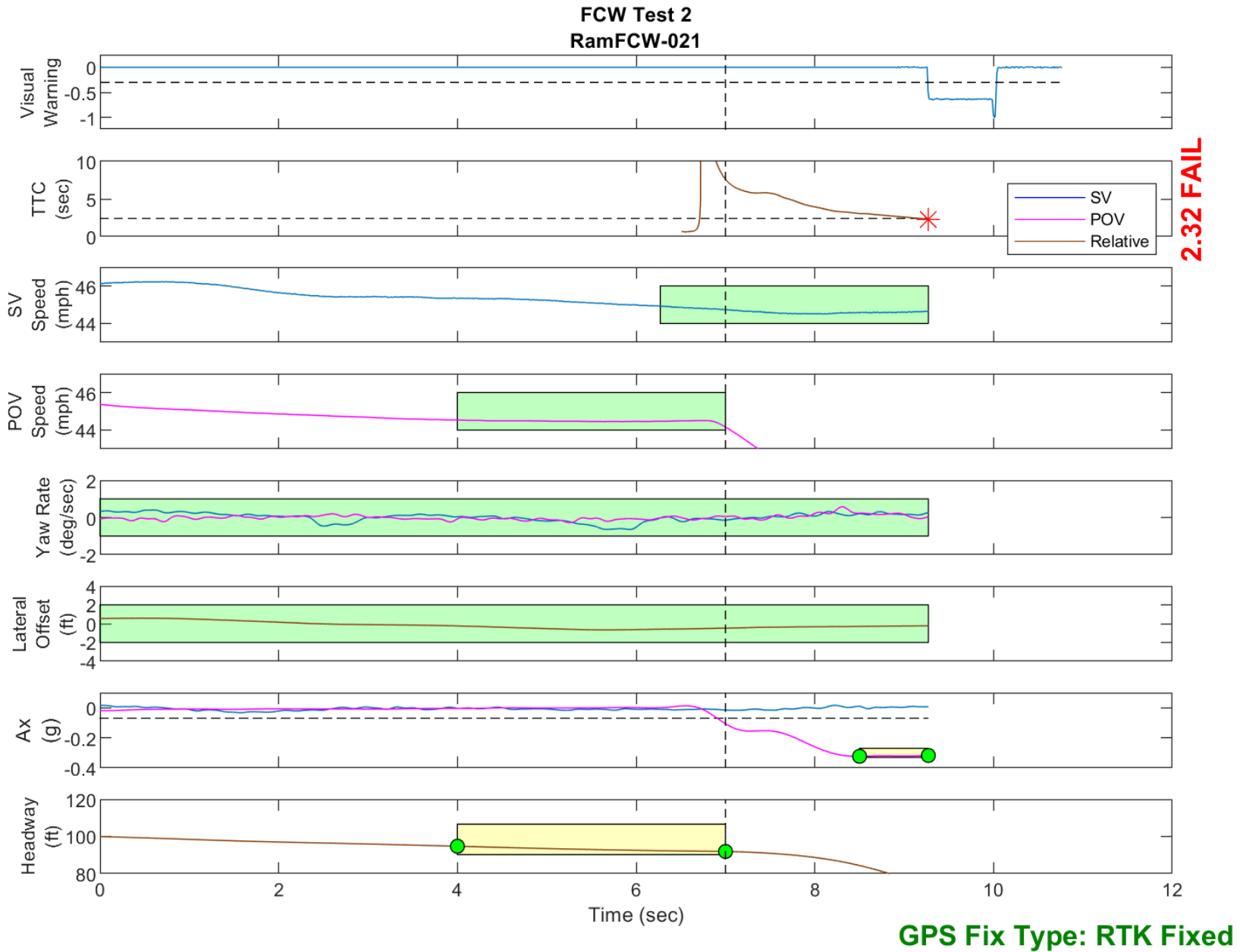


Figure D32. Time History for Run 21, FCW Test 2, Visual Warning

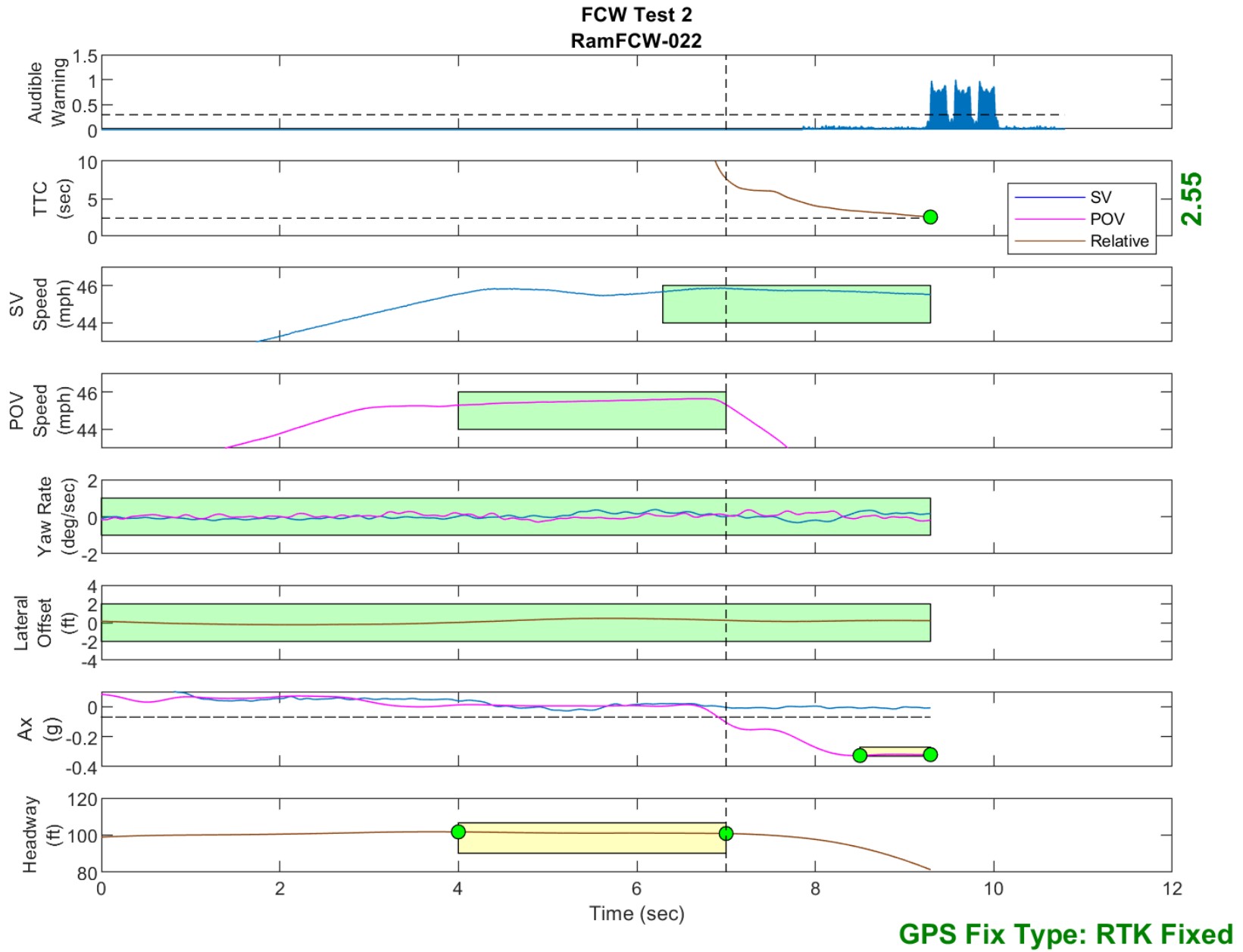


Figure D33. Time History for Run 22, FCW Test 2, Audible Warning



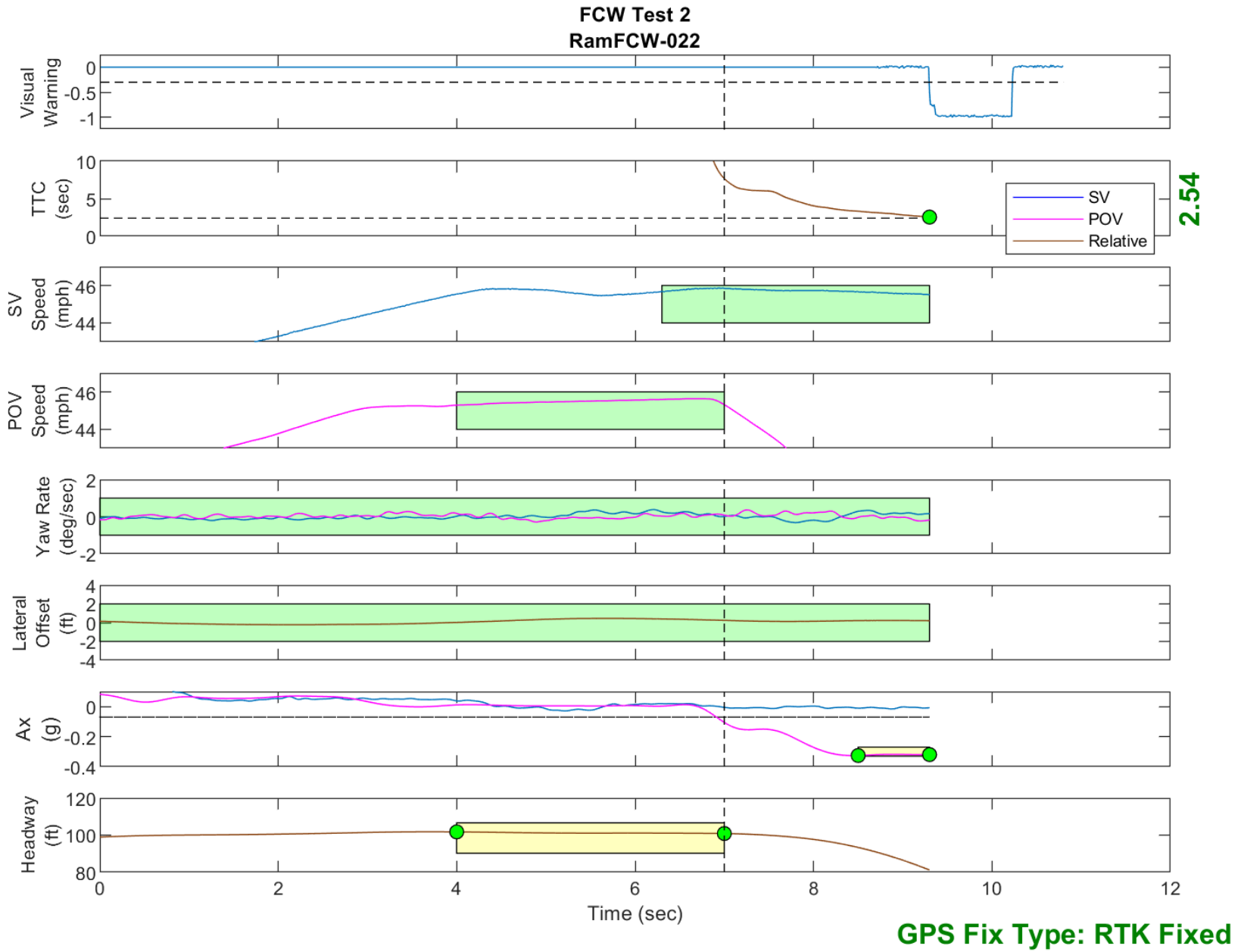


Figure D34. Time History for Run 22, FCW Test 2, Visual Warning

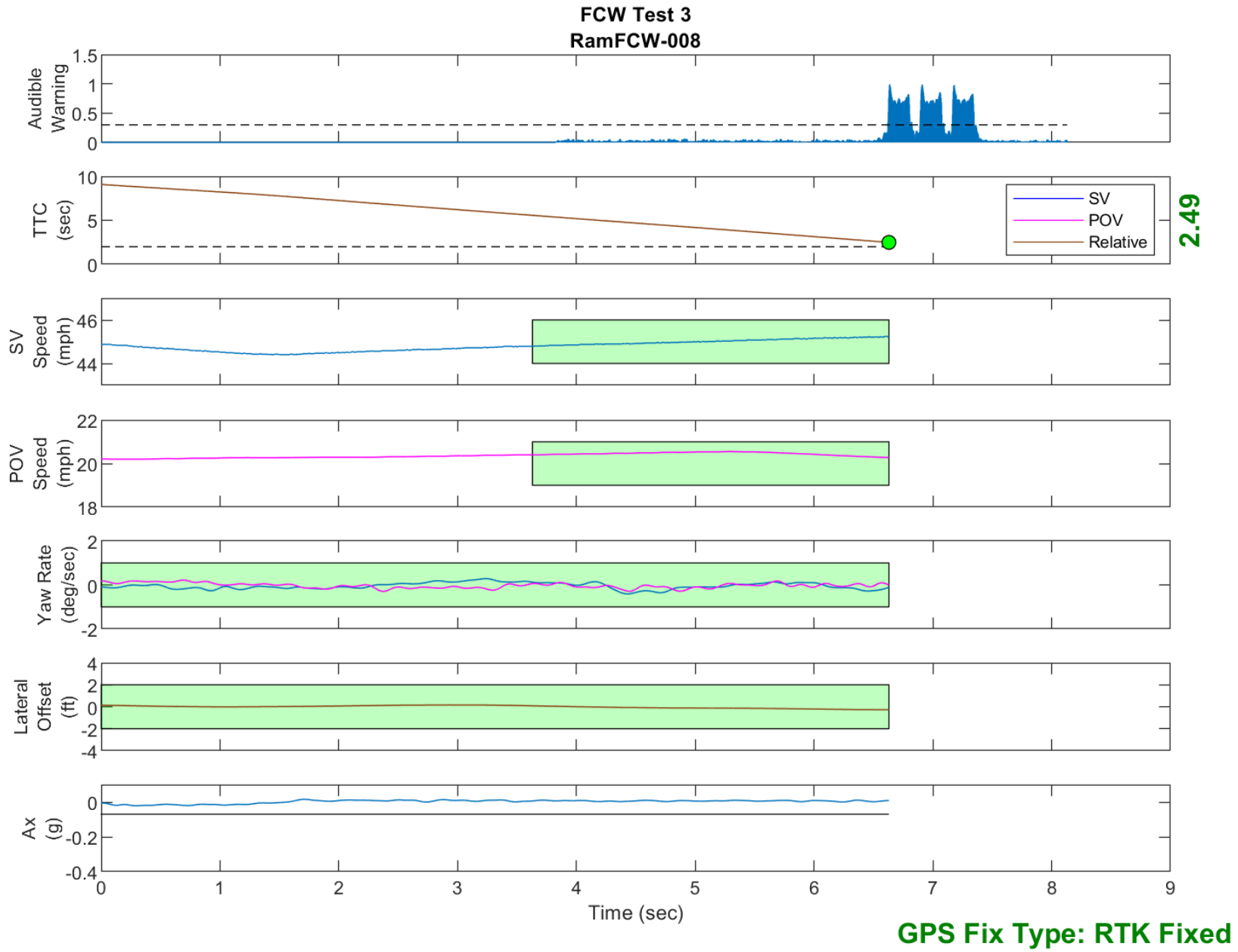


Figure D35. Time History for Run 08, FCW Test 3, Audible Warning

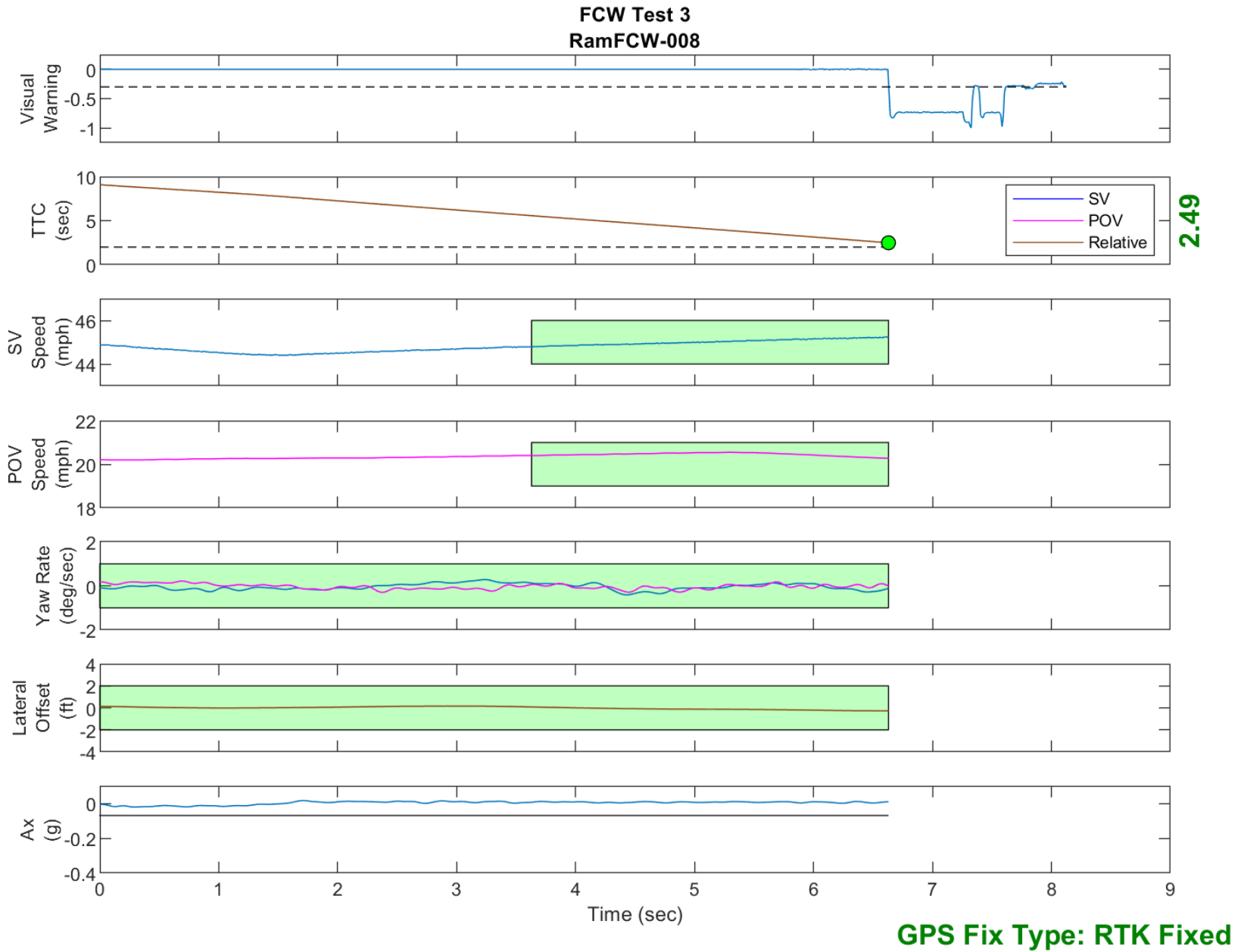


Figure D36. Time History for Run 08, FCW Test 3, Visual Warning

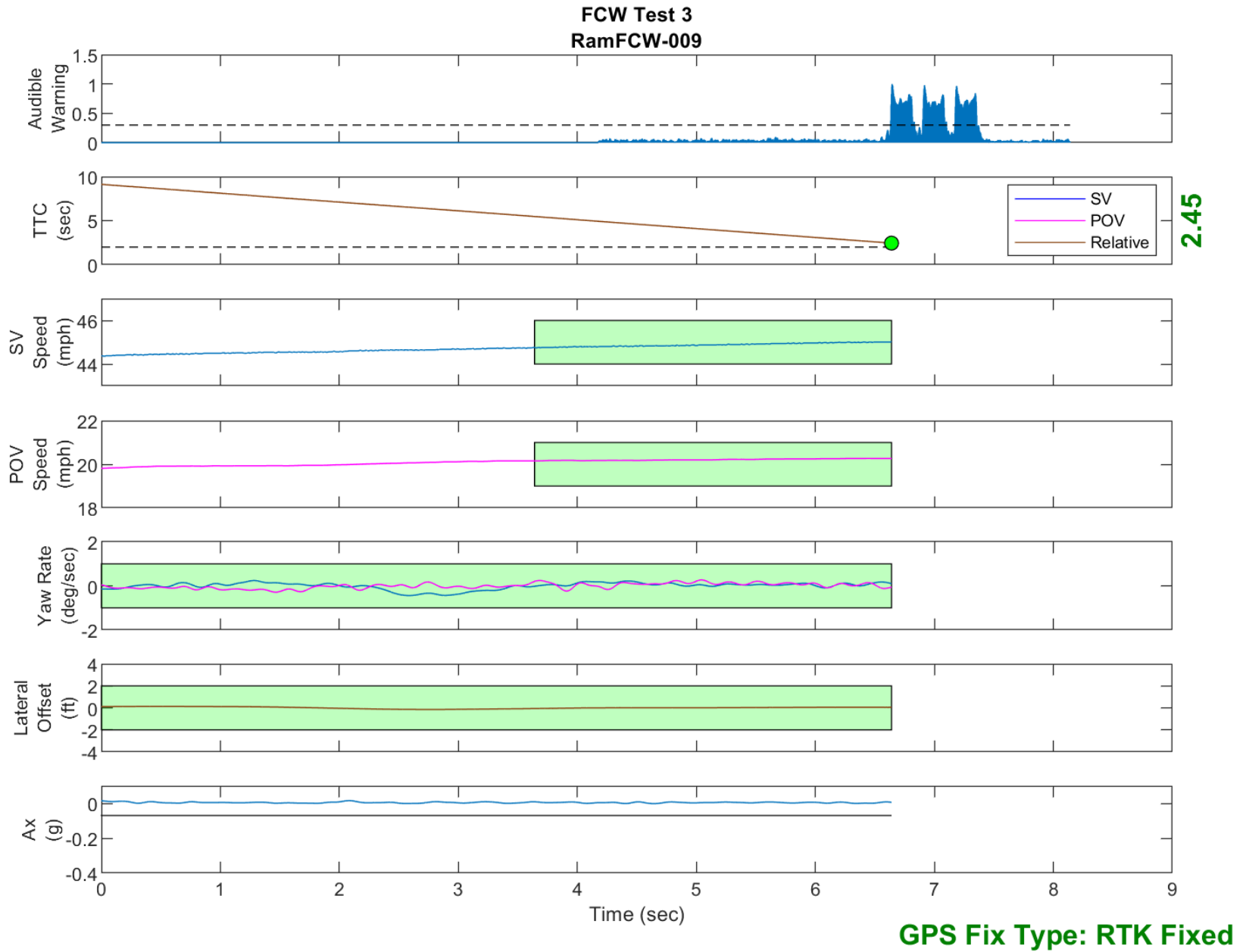


Figure D37. Time History for Run 09, FCW Test 3, Audible Warning

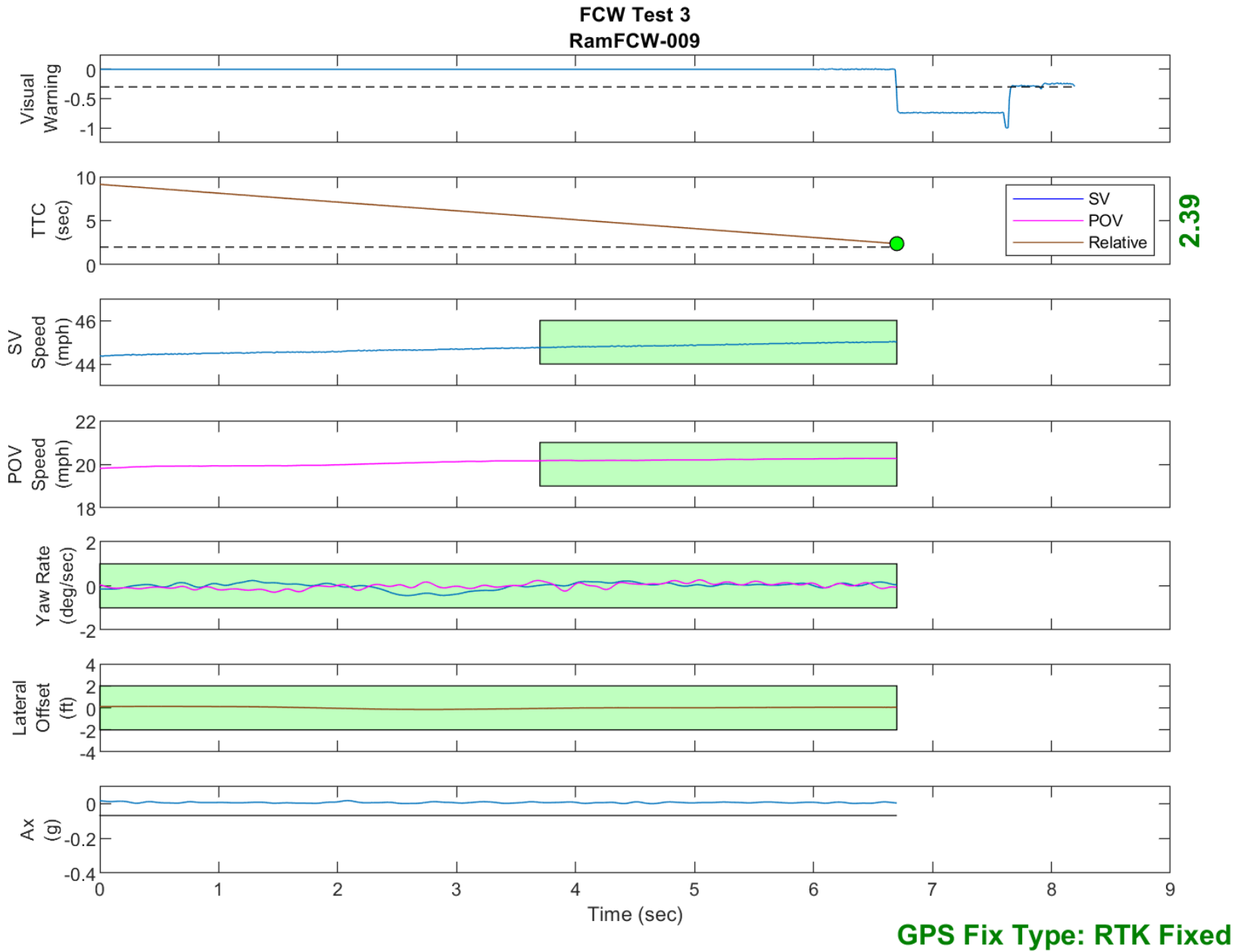


Figure D38. Time History for Run 09, FCW Test 3, Visual Warning

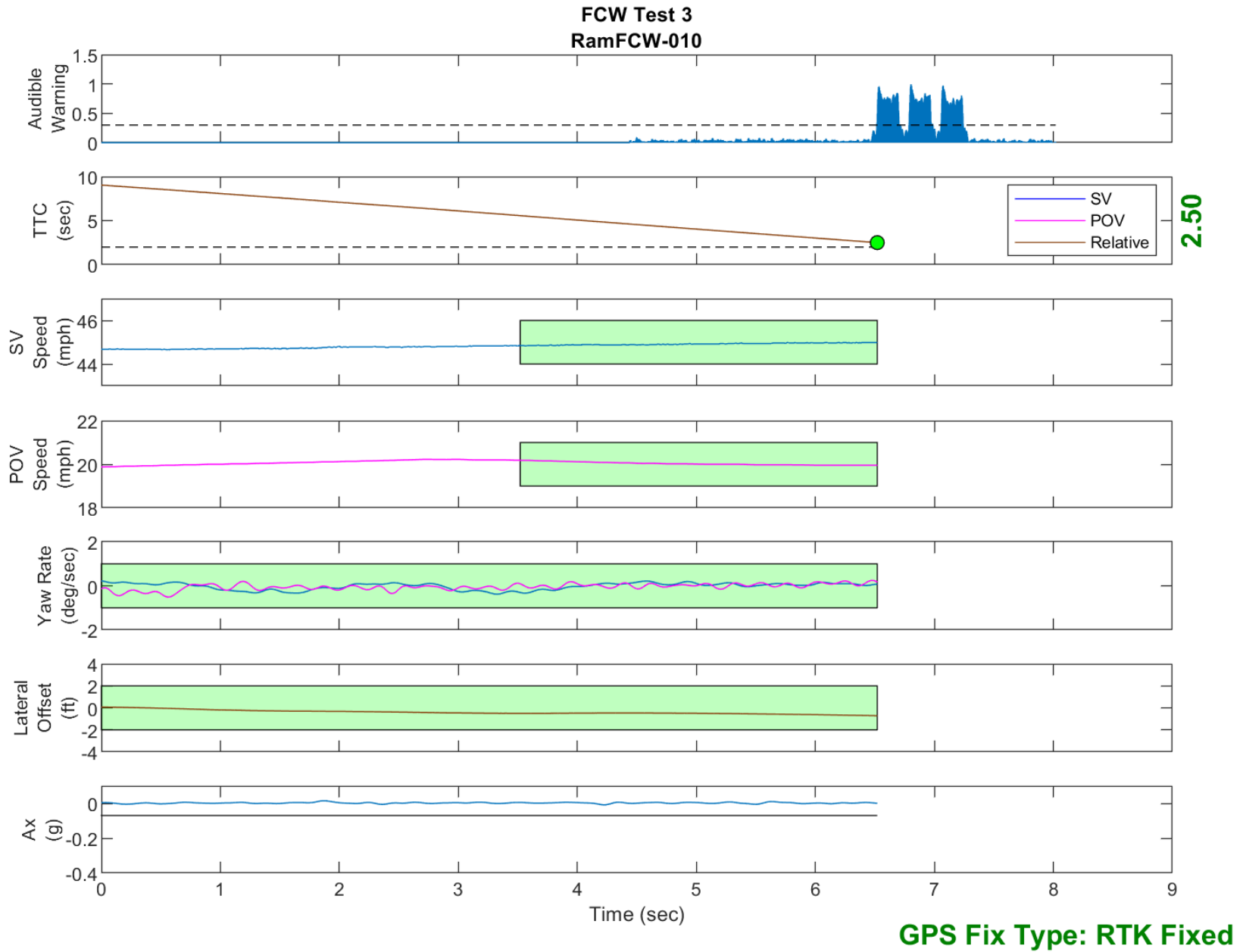


Figure D39. Time History for Run 10, FCW Test 3, Audible Warning

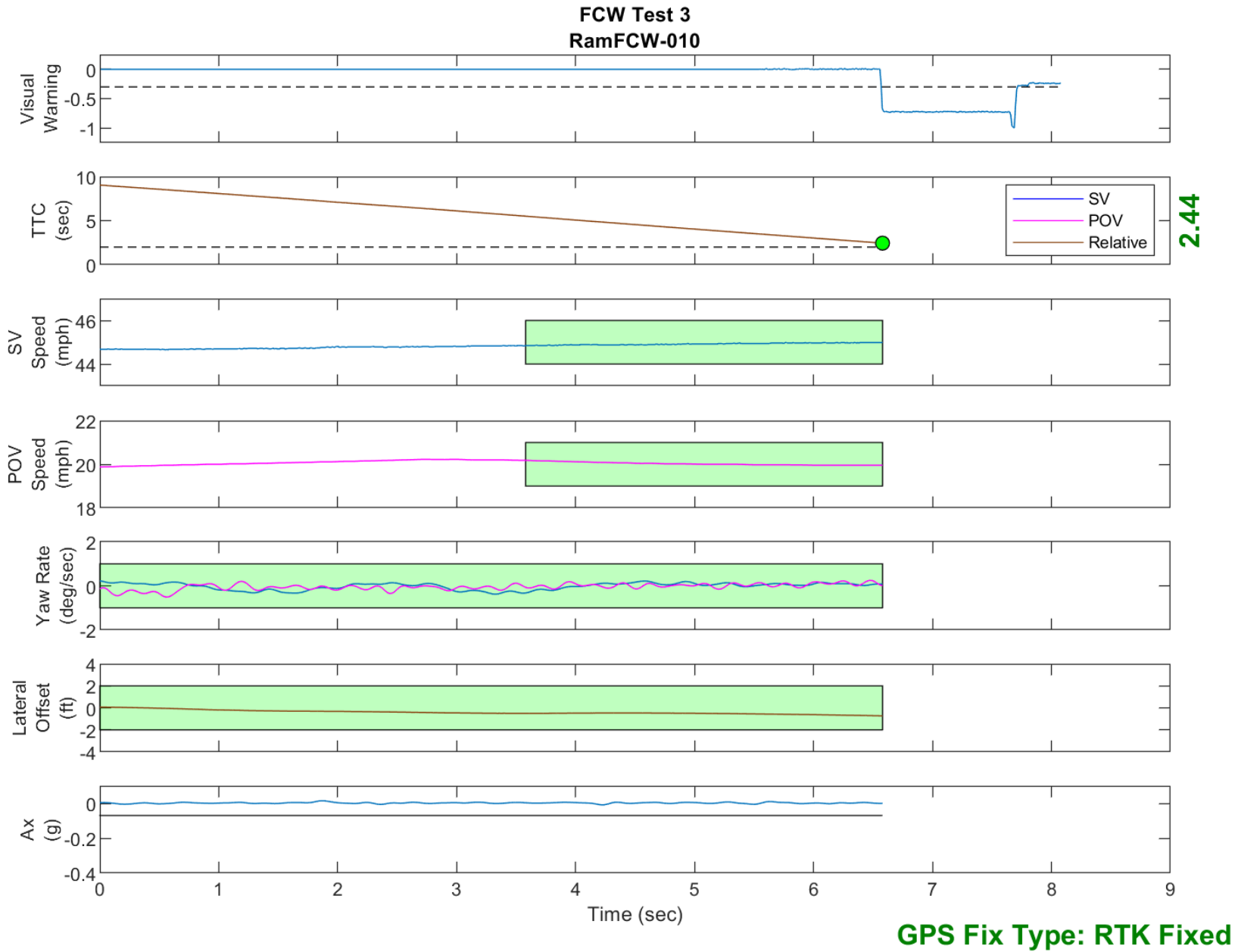


Figure D40. Time History for Run 10, FCW Test 3, Visual Warning

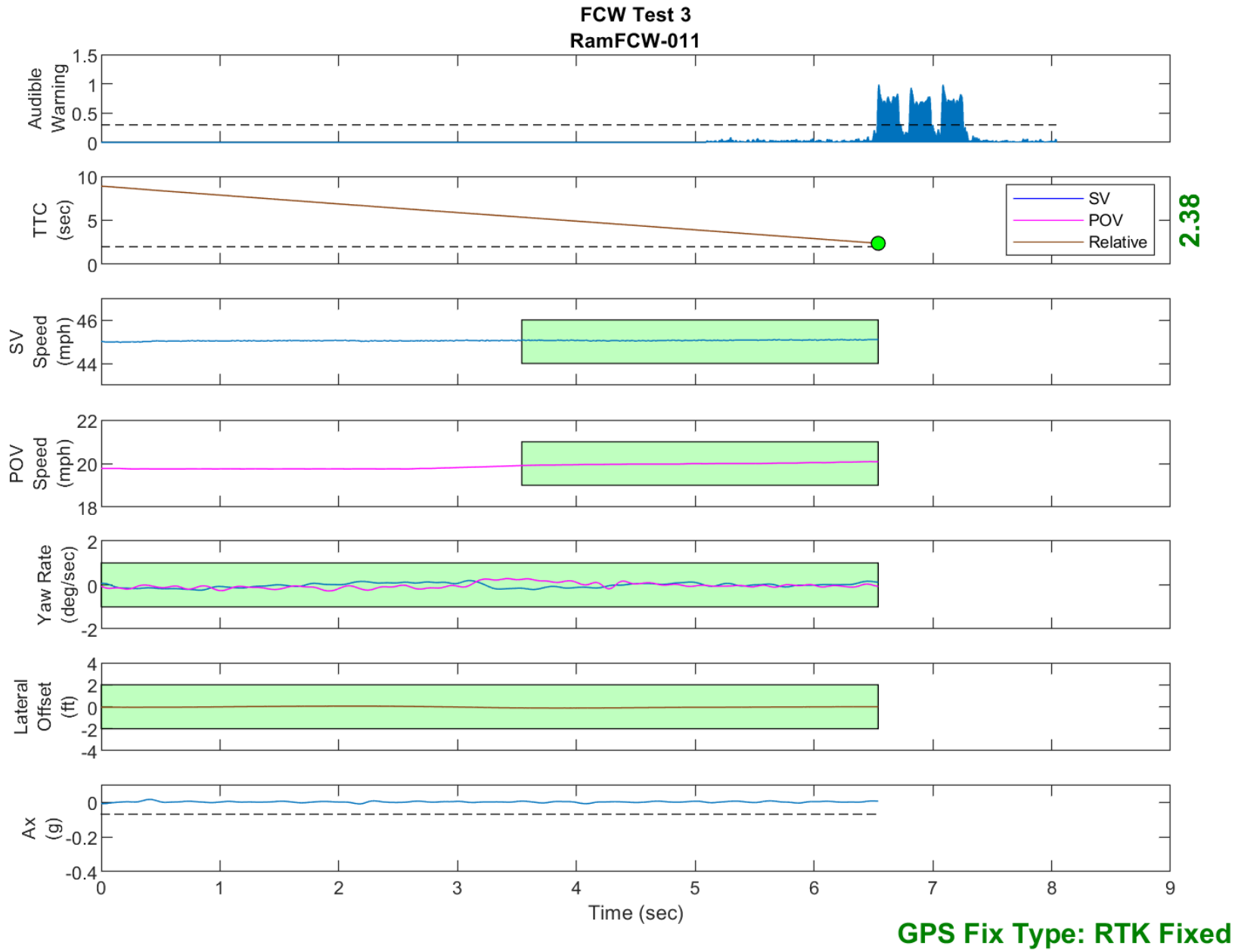


Figure D41. Time History for Run 11, FCW Test 3, Audible Warning



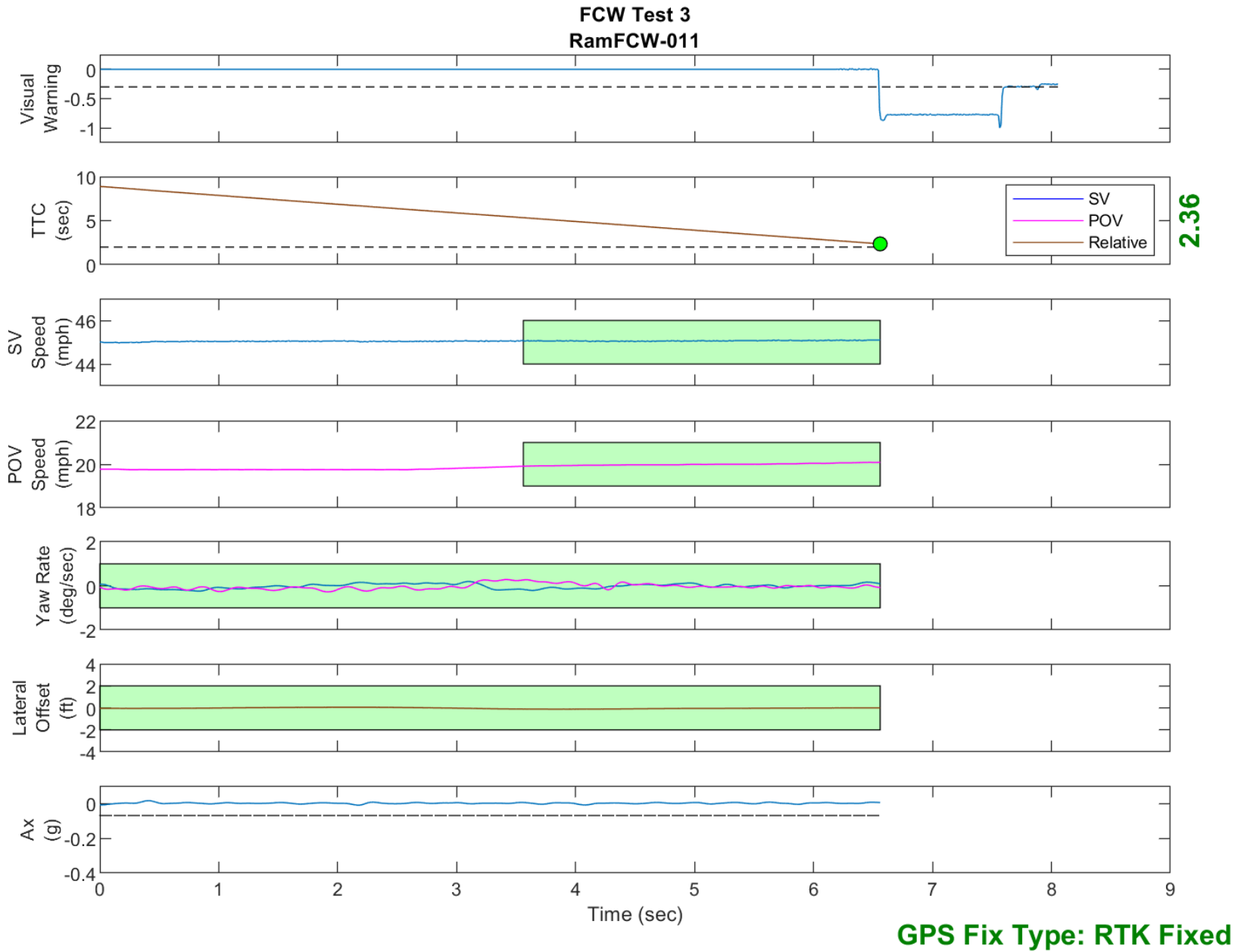


Figure D42. Time History for Run 11, FCW Test 3, Visual Warning

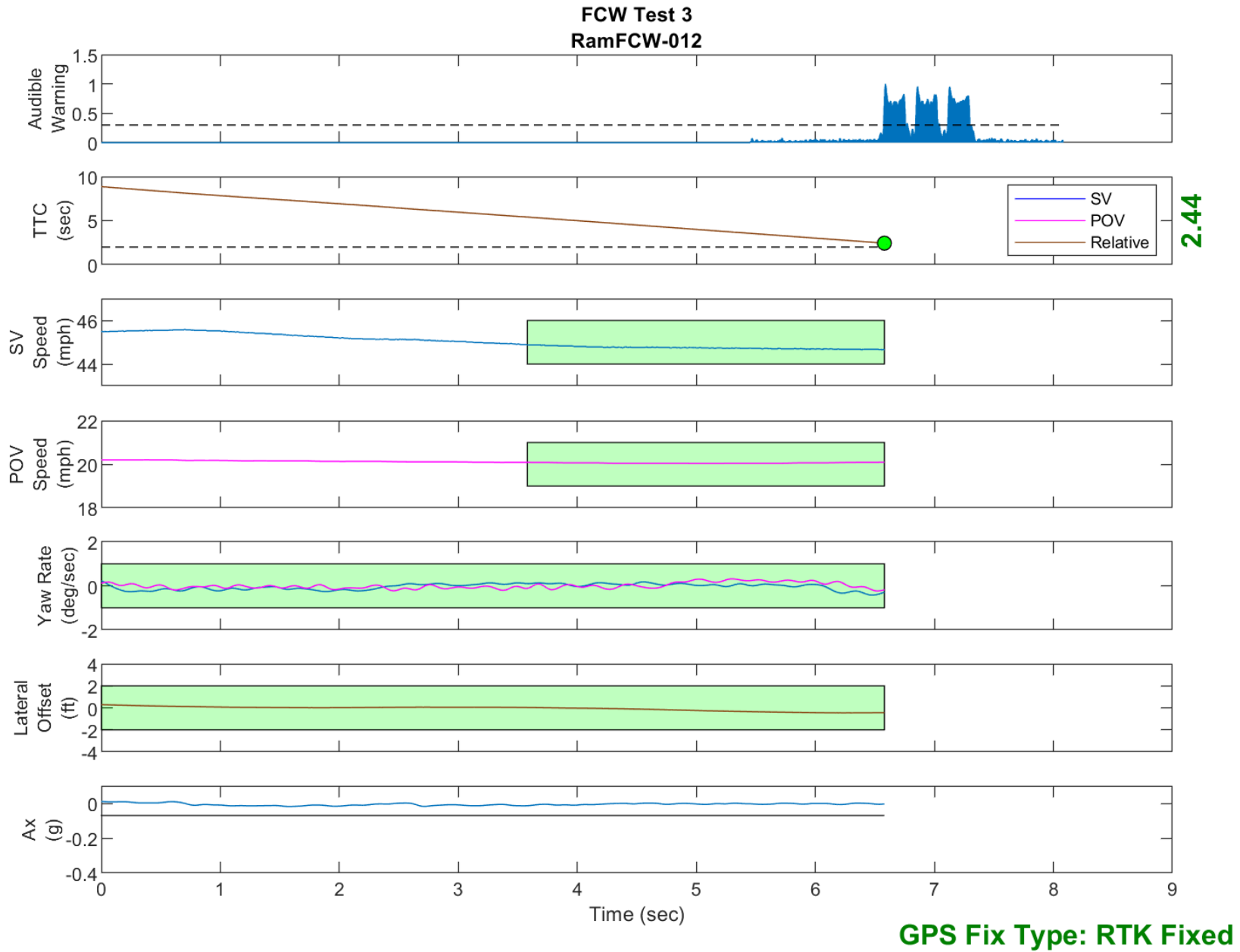


Figure D43. Time History for Run 12, FCW Test 3, Audible Warning

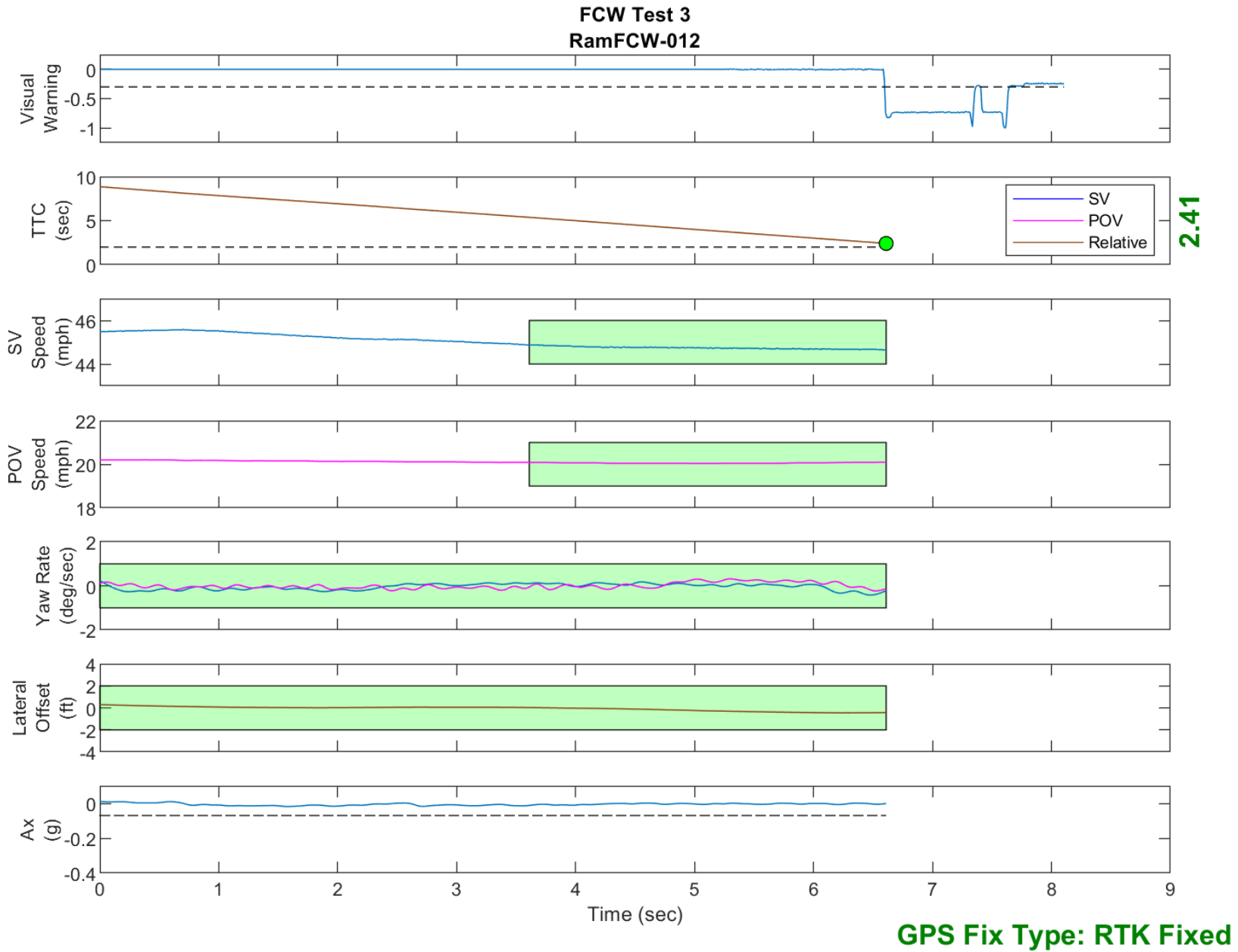


Figure D44. Time History for Run 12, FCW Test 3, Visual Warning

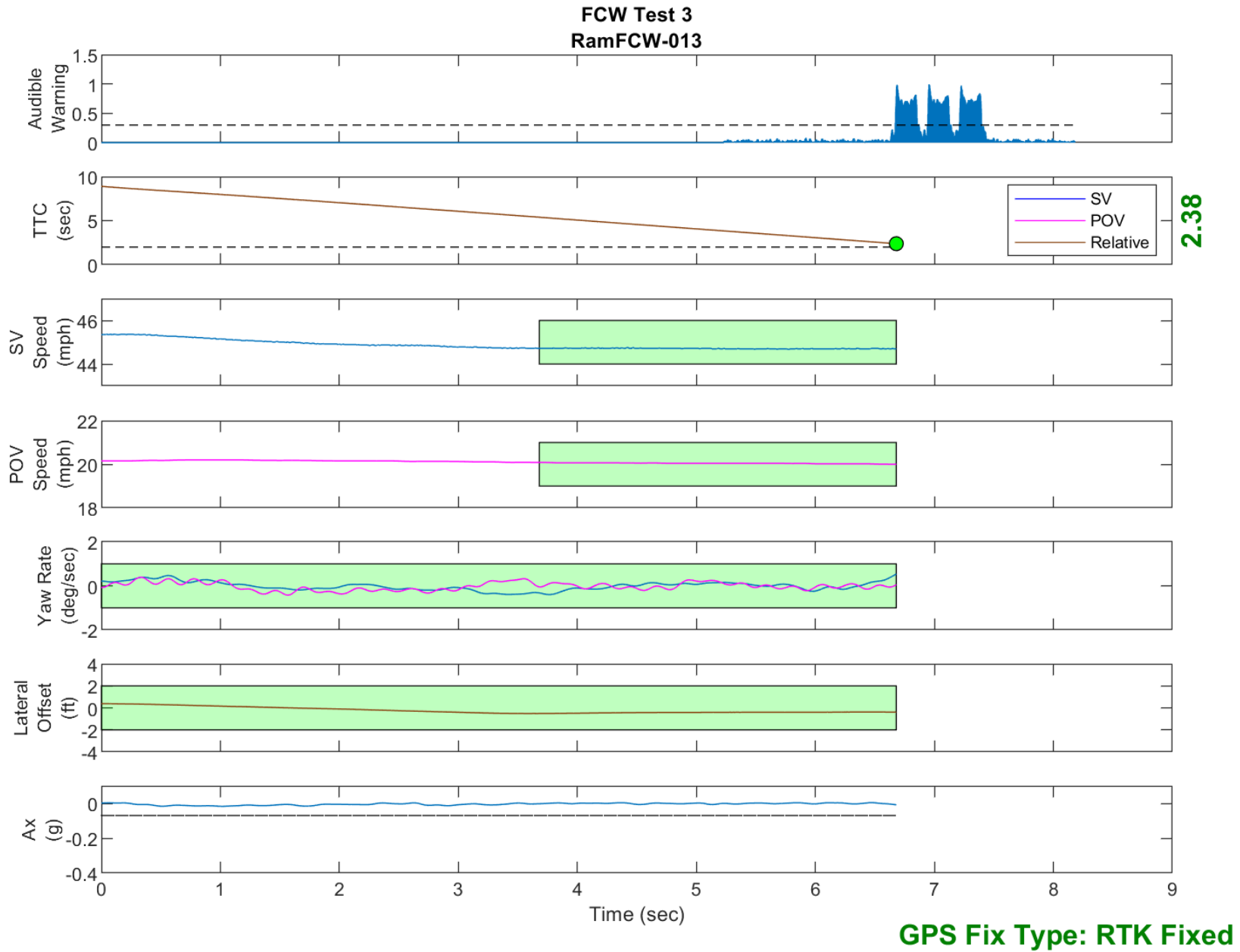


Figure D45. Time History for Run 13, FCW Test 3, Audible Warning

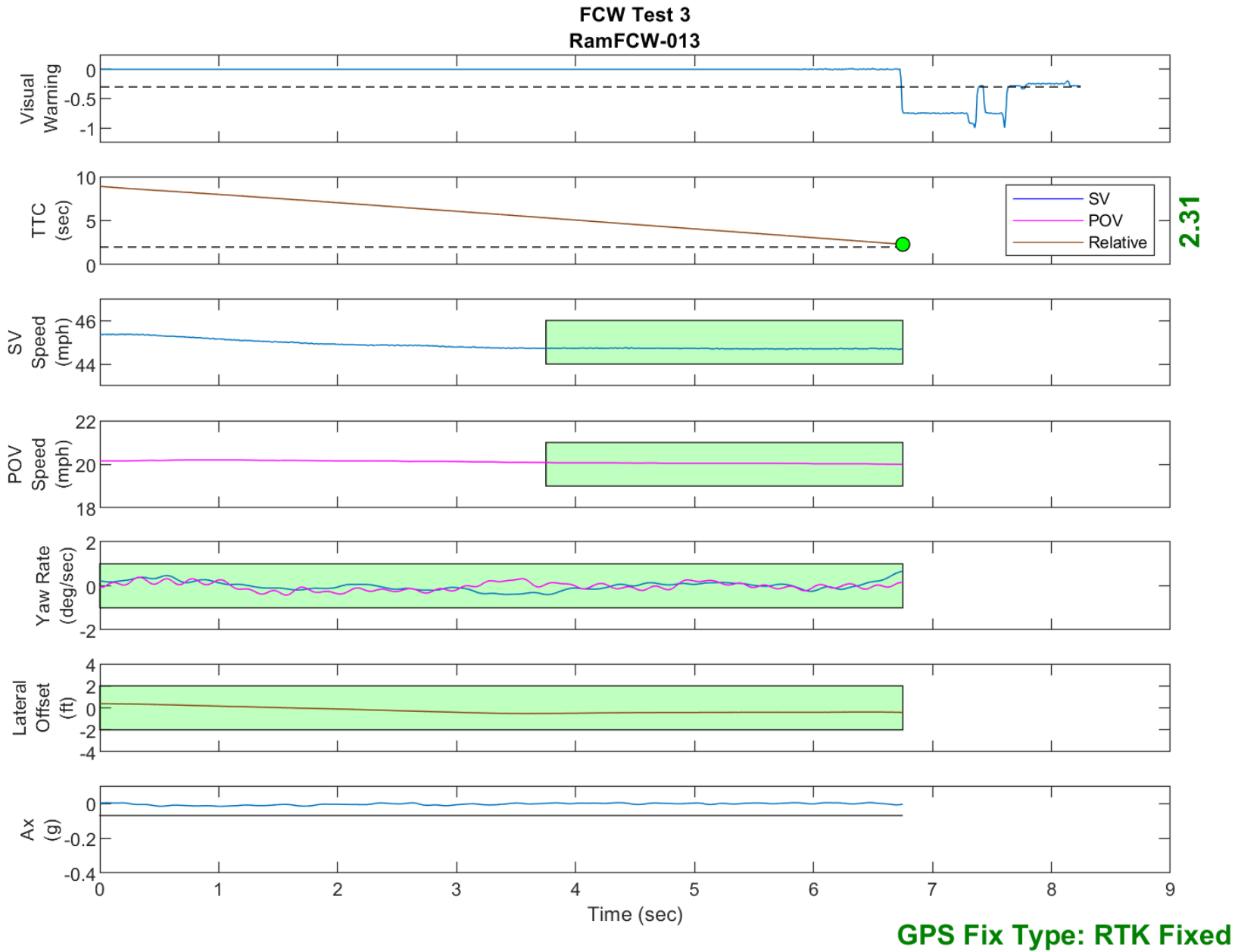


Figure D46. Time History for Run 13, FCW Test 3, Visual Warning

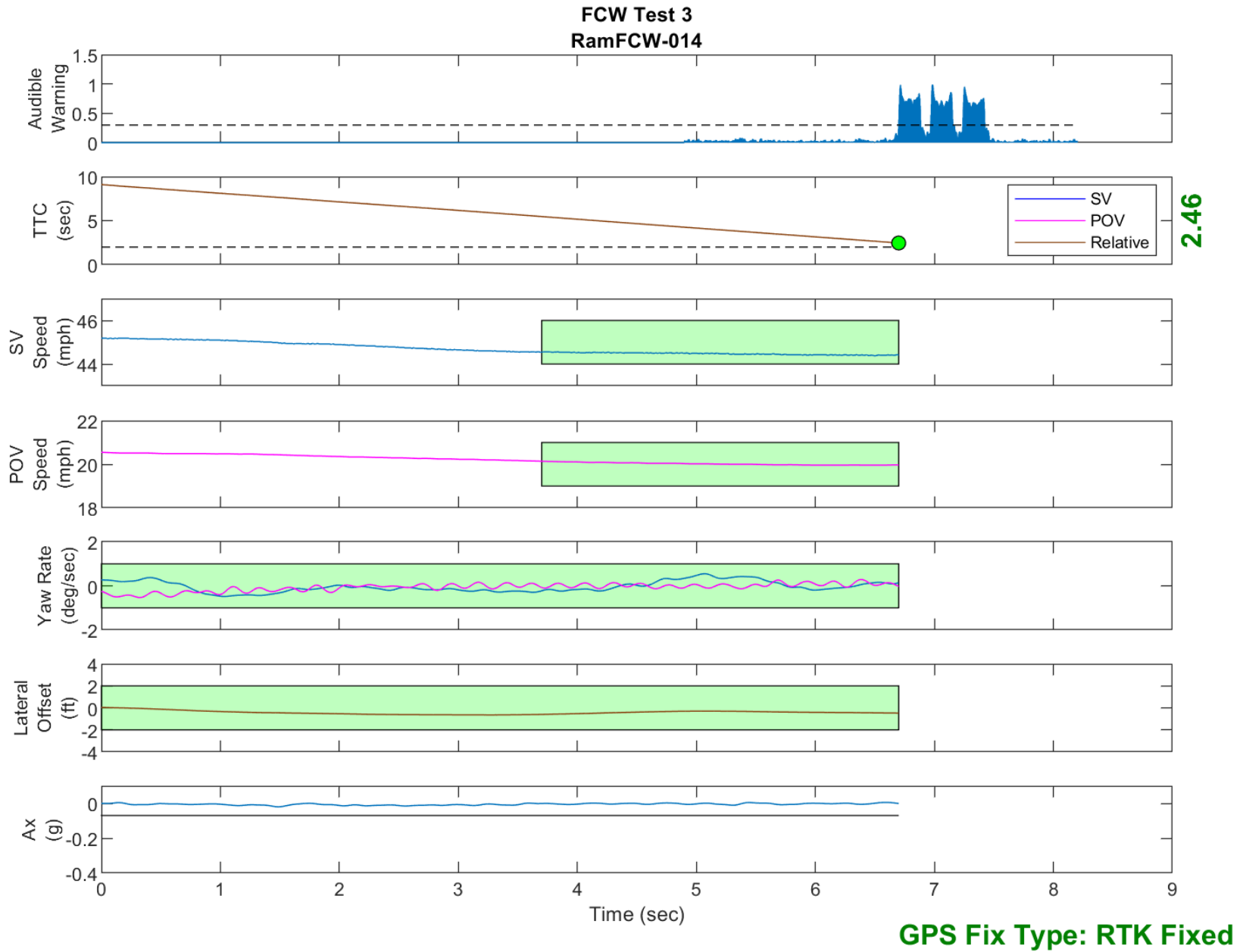


Figure D47. Time History for Run 14, FCW Test 3, Audible Warning

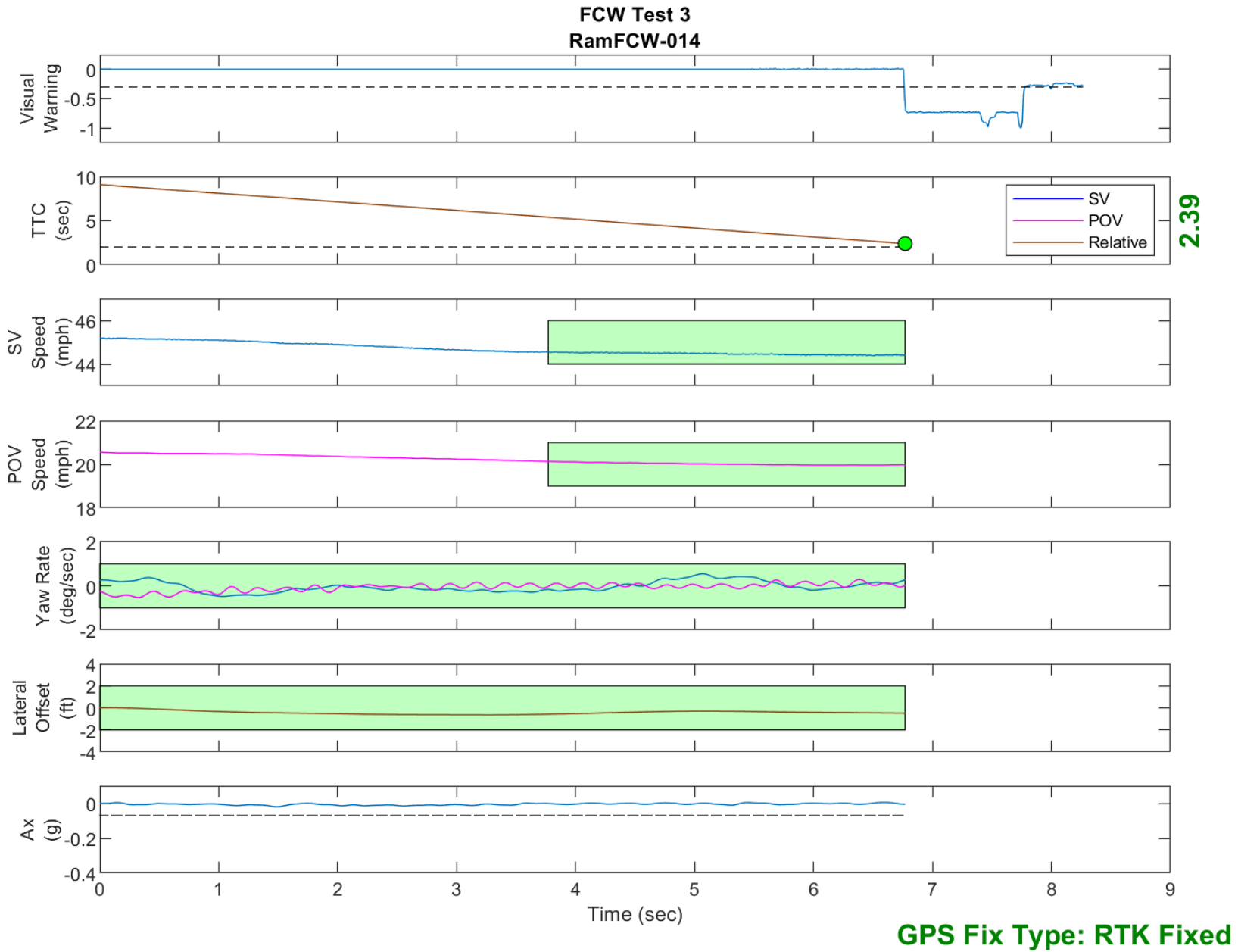


Figure D48. Time History for Run 14, FCW Test 3, Visual Warning