

**NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST
NCAP-DRI-FCW-22-12**

2022 Toyota RAV4 XLE

DYNAMIC RESEARCH, INC.

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1 February 2022

Draft Report

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National Highway Traffic Safety Administration
New Car Assessment Program
1200 New Jersey Avenue, SE
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16. Abstract These tests were conducted on the subject 2022 Toyota RAV4 XLE in accordance with the specifications of the New Car Assessment Program's (NCAP's) most current Test Procedure in docket NHTSA-2006-26555-0134 to confirm the performance of a Forward Collision Warning system. The vehicle passed the requirements of the test for all three FCW test scenarios.			
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TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
I. INTRODUCTION	1
II. DATA SHEETS.....	2
Data Sheet 1: Test Results Summary.....	3
Data Sheet 2: Vehicle Data	4
Data Sheet 3: Test Conditions.....	5
Data Sheet 4: Forward Collision Warning System Operation	7
III. TEST PROCEDURES	10
A. Test Procedure Overview	10
B. Principal Other Vehicle	15
C. Automatic Braking System.....	15
D. Instrumentation	15
APPENDIX A Photographs	A-1
APPENDIX B Excerpts from Owner's Manual.....	B-1
APPENDIX C Run Log.....	C-1
APPENDIX D Time Histories.....	D-1

Section I

INTRODUCTION

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

Section II
DATA SHEETS

FORWARD COLLISION WARNING
DATA SHEET 1: TEST RESULTS SUMMARY

(Page 1 of 1)

2022 Toyota RAV4 XLE

VIN: 2T3W1RFV3NC17xxxx

Test start date: 1/25/2022

Test end date: 1/25/2022

Forward Collision Warning setting: Early

Test 1 – Subject Vehicle Encounters
Stopped Principal Other Vehicle: **Pass**

Test 2 – Subject Vehicle Encounters
Decelerating Principal Other Vehicle: **Pass**

Test 3 – Subject Vehicle Encounters
Slower Principal Other Vehicle: **Pass**

Overall: **Pass**

Notes:

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2022 Toyota RAV4 XLE

TEST VEHICLE INFORMATION

VIN: 2T3W1RFV3NC17xxxx

Body Style: SUV

Color: White

Date Received: 1/11/2022

Odometer Reading: 226 mi

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: Toyota Motor Manufacturing Canada Inc.

Date of manufacture: 12/21

Vehicle Type: MPV

DATA FROM TIRE PLACARD

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

Rear: 225/65R17

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

Rear: 240 kPa (35 psi)

TIRES

Tire manufacturer and model: Dunlop Grandtrek PT20

Front tire specification: 225/65R17 102H

Rear tire specification: 225/65R17 102H

Front tire DOT prefix: R8F5 DM9R

Rear tire DOT prefix: R8F5 DM9R

FORWARD COLLISION WARNING
DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2022 Toyota RAV4 XLE

GENERAL INFORMATION

Test start date: 1/25/2022 Test end date: 1/25/2022

AMBIENT CONDITIONS

Air temperature: 13.3 C (56 F)

Wind speed: 1.8 m/s (4.0 mph)

- Wind speed \leq 10 m/s (22 mph).
- Tests were not performed during periods of inclement weather. This includes, but is not limited to, rain, snow, hail, fog, smoke, or ash.
- Tests were conducted during daylight hours with good atmospheric visibility (defined as an absence of fog and the ability to see clearly for more than 5000 meters). The tests were not conducted with the vehicle oriented into the sun during very low sun angle conditions, where the sun is oriented 15 degrees or less from horizontal, and camera "washout" or system inoperability results.

VEHICLE PREPARATION

Verify the following:

All non-consumable fluids at 100% capacity: X

Fuel tank is full: X

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

Front: 240 kPa (35 psi)

Rear: 240 kPa (35 psi)

FORWARD COLLISION WARNING
DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2022 Toyota RAV4 XLE

WEIGHT

Weight of vehicle as tested including driver and instrumentation:

Left Front: 504.8 kg (1113 lb)

Right Front: 526.2 kg (1160 lb)

Left Rear: 367.0 kg (809 lb)

Right Rear: 355.6 kg (784 lb)

Total: 1753.6 kg (3866 lb)

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 1 of 3)

2022 Toyota RAV4 XLE

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

Toyota Safety Sense 2.0: Pre-Collision System w/ Pedestrian Detection

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

Millimeter wave radar mounted behind the front bumper grill and a mono camera in the top center of the windshield.

Forward Collision Warning Setting used in test: Early

How is the Forward Collision Warning presented to the driver? Warning light
(Check all that apply) Buzzer or auditory alarm
 Vibration
 Other _____

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

The FCW system alerts the driver with a visual and auditory alert. The visual alert is displayed in the multi-information display located in the center of the instrument panel and consists of a red box and the word "BRAKE!". The auditory alert consists of repeated beeps with a primary frequency of approximately 2400 Hz.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 2 of 3)

2022 Toyota RAV4 XLE

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.

The FCW system (referred to as the Pre-Collision System (PCS) in the owner's manual pages 227-230 shown in Appendix B pages B-2 to B-5) can be turned on/off using the buttons on the left side of the steering wheel. The procedure is as follows:

1. Press the < > button until the gear icon is selected in the multi-information display.
2. Scroll down until "PCS" is outlined and hold the "OK" button to select.
3. Within the PCS menu, scroll down to "PCS" and press "OK" to turn the FCW system on/off.

When the FCW system is turned off, the PCS warning light illuminates, and a message is displayed in the multi-information display. The system is automatically enabled each time the engine switch is turned on and the operation timing will return to the default setting (middle).

Section III

TEST PROCEDURES

A. Test Procedure Overview

Three test procedures were used, as follows:

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

Test 2. Subject Vehicle Encounters Decelerating Principal Other Vehicle

Test 3. Subject Vehicle Encounters Slower Principal Other Vehicle

With the exception of trials associated with Test 1, all trials were performed with SV and POV automatic transmissions in “Drive” or with manual transmissions in the highest gear capable of sustaining the desired test speed. Manual transmission clutches remained engaged during all maneuvers. Except for Test 2, the brake lights of the POV were not illuminated.

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

An overview of each of the test procedures follows.

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

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

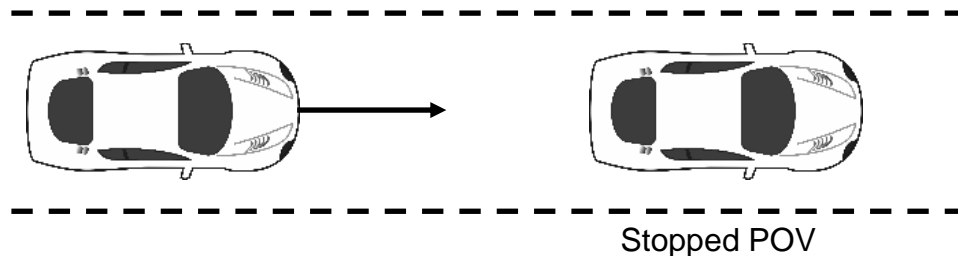


Figure 1. Depiction of Test 1

a. Alert Criteria

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

b. Procedure

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

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

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

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

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

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

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

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

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

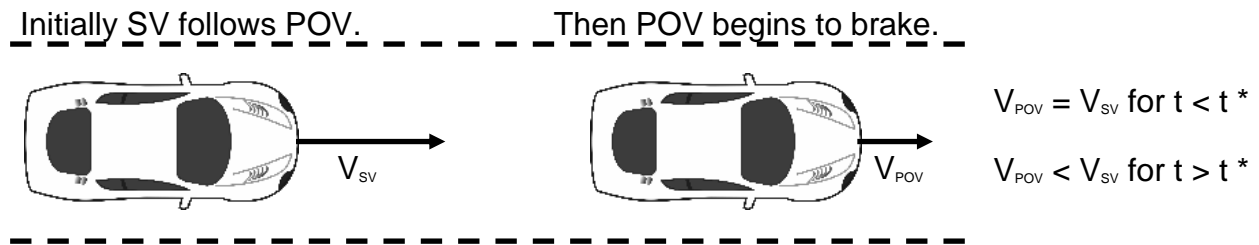


Figure 2. Depiction of Test 2

a. Alert Criteria

In order to pass the test, the FCW alert must be issued when TTC is at least 2.4 seconds. The TTC for this test, a prediction of the time it would take for the SV to collide with the POV, was calculated by considering three factors at the time of the FCW alert: (1) the speed of the SV, (2) the speed of the POV, and (3) the deceleration of the POV¹.

b. Procedure

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

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

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

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

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

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

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

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

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

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

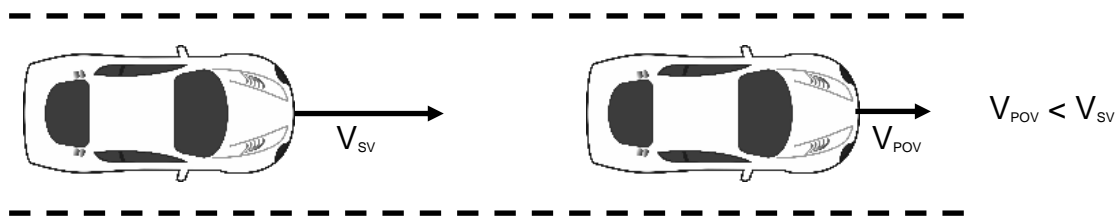


Figure 3. Depiction of Test 3

a. Alert Criteria

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

b. Procedure

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

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

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

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

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

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

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

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

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

B. Principal Other Vehicle

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

C. Automatic Braking System

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

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

D. Instrumentation

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

Table 1. Test Instrumentation and Equipment

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

Table 1. Test Instrumentation and Equipment (continued)

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Microphone	Sound (to measure time at auditory alert)	Frequency Response: 80 Hz – 20 kHz	Signal-to-noise: 64 dB, 1 kHz at 1 Pa	Audio-Technica AT899	N/A	N/A
Light Sensor	Light intensity (to measure time at visual alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	N/A	N/A
Accelerometer	Acceleration (to measure time at haptic alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	N/A	N/A
Coordinate Measurement Machine	Inertial Sensing System Coordinates	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm, Fusion	UO8-05-08-06636	By: DRI Date: 1/6/2022 Due: 1/6/2023
Type	Description			Mfr, Model	Serial Number	
Data Acquisition System	Data acquisition is achieved using a dSPACE MicroAutoBox II. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the MicroAutoBox. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (listed above).			dSPACE Micro-Autobox II 1401/1513		
				Base Board	549068	
				I/O Board	588523	

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

Table 2. Auditory and Tactile Warning Filter Parameters

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

APPENDIX A

Photographs

LIST OF FIGURES

		Page
Figure A1.	Front View of Subject Vehicle.....	A-3
Figure A2.	Rear View of Subject Vehicle	A-4
Figure A3.	Window Sticker (Monroney Label).....	A-5
Figure A4.	Vehicle Certification Label	A-6
Figure A5.	Tire Placard	A-7
Figure A6.	Front View of Principal Other Vehicle	A-8
Figure A7.	Rear View of Principal Other Vehicle.....	A-9
Figure A8.	MicroAutoBox Installed in Subject Vehicle	A-10
Figure A9.	Sensors for Detecting Auditory and Visual Alerts	A-11
Figure A10.	Computer Installed in Subject Vehicle	A-12
Figure A11.	Brake Actuation System Installed in Principal Other Vehicle.....	A-13
Figure A12.	Buttons for Accessing System Setup Menus.....	A-14
Figure A13.	System Setup Menu and Alert Sensitivity	A-15
Figure A14.	FCW Visual Alert	A-16



Figure A1. Front View of Subject Vehicle



Figure A2. Rear View of Subject Vehicle



DESC.: **RAV4** **XLE FWD SUV**
 VIN: **2T3W1RFV3NC17**
 YR/MDL: 2022/444DA
 CLR: WHITE/FA20 (0040/20)
 FINAL ASSEMBLY POINT: CAMBRIDGE, ONTARIO, CANADA

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 Crash	Driver Passenger	★★★★★
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.		
Side Crash	Front seat 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 or 1-888-327-4236

STANDARD EQUIPMENT
 UNLESS REPLACED BY OPTIONAL EQUIPMENT

MECHANICAL & PERFORMANCE
 - 2.5L 4-Cylinder Engine w/ Start-Stop
 - 203 hp @ 6600 rpm / 184 lb-ft @ 5000 rpm
 - 8-Speed Automatic Transmission
 - Front-Wheel Drive

SAFETY & CONVENIENCE
 - Toyota Safety Sense 2.0: Pre-Collision Sys w/ Pedestrian Detection, Full-Speed Range Dynamic Radar Cruise Control, Lane Departure Alert w/ Steering Assist, Lane Tracing Assist, Automatic High Beams, Road Sign Assist
 - 8 Airbags: Star Safety System
 - Backup Camera
 - LATCH-Lower Anchor & Tether for Children
 - Blind Spot Monitor w/ Rear Cross-Traffic Alert

EXTERIOR
 - LED Projector Headlights
 - LED Daytime Running Lights
 - 17-in Five-Spoke Silver Alloy Wheels

INTERIOR
 - Audio - 7-in Touchscreen, 6 Speakers, Hands-Free Bluetooth Phone/Music, USB-A, Media Port, 4 USB-C Charge Ports, SiriusXM w/ 3-Month Platinum Plan Trial, Android Auto & Apple CarPlay Compatible
 - Dual Zone Auto A/C w/ Rear Air Vents
 - Fabric-Trimmed Seats
 - Power Driver's Seat
 - Smart Key System w/ Push Button Start

MANUFACTURER'S SUGGESTED RETAIL PRICE \$27,995.00

OPTIONAL EQUIPMENT		
FE	50 State Emissions	
3J	Blackout Emblem Overlays	129.00
3T	Cross Bars	315.00
CF	Carpet Floor Mats/Cargo Mat	269.00
DS	Door Edge Guard	140.00
DK	Owner's Portfolio	
MF	Mudguard	129.00

EPA DOT Fuel Economy and Environment Gasoline Vehicle

Fuel Economy Small SUVs range from 18 to 125 MPG. The best vehicle rates 142 MPG.

30 MPG combined city/hwy
27 MPG city
35 MPG highway
3.3 gallons per 100 miles

You save \$500 in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$1,200

Fuel Economy & Greenhouse Gas Rating (tailpipe only) **6** **Smog Rating** (tailpipe only) **7**

This vehicle emits 292 grams CO₂ per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions. Learn more at fuelconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs \$5,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$2.28 per gallon. MPG is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuelconomy.gov
 Calculate personalized estimates and compare vehicles

Smartphone QR Code

DELIVERY, PROCESSING AND HANDLING FEE 1,215.00

TOTAL \$30,192.00

The New Vehicle Limited Warranty provides 3-year/36,000-mile basic coverage, 5-year/60,000-mile powertrain coverage, plus 5-year/unlimited-mile corrosion-perforation coverage. See Warranty and Maintenance Guide for details. An extended service contract may be available for the vehicle. Ask dealer for details.
 Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline, license and title fees, applicable federal, state and local taxes and dealer and distributor installed options and accessories are not included in the manufacturer's suggested retail price.
 ToyotaCare, which covers normal factory scheduled maintenance for two years or 25,000 miles, whichever occurs first, is included as part of the sales price of the vehicle for qualifying buyers. See participating dealer for eligibility and coverage details.

Delivered by Truck to: 04836
 THLEINISOFOWO

Figure A3. Window Sticker (Monroney Label)

MFD. BY: TOYOTA MOTOR MANUFACTURING CANADA INC. 12/21


GVWR: 2090KG (4610LB)

GAWR: FRT. 1150KG (2535LB) WITH 225/65R17 TIRES,
 17x7.0J RIMS.

RR. 1150KG (2535LB) WITH 225/65R17 TIRES,
 17x7.0J RIMS.

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
 VEHICLE SAFETY AND THEFT PREVENTION STANDARDS IN EFFECT ON
 THE DATE OF MANUFACTURE SHOWN ABOVE.

2T3W1RFV3NC17 MPV



C/TR: 040/FA20 AXAA52L-CNZMBA 010 A

A/TM: /UB80E MADE IN CANADA

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 410kg or 900lbs.

SEE OWNER'S
MANUAL FOR
ADDITIONAL
INFORMATION.

TIRE	SIZE	COLD TIRE PRESSURE
FRONT	225/65R17	240kPa, 35PSI
REAR	225/65R17	240kPa, 35PSI
SPARE	T165/80D17	420kPa, 60PSI

RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

NOMBRE DE PLACES: TOTAL 5
AVANT 2 : ARRIÈRE 3

Le poids total des occupants et du chargement ne doit jamais dépasser 410kg ou 900lb.

PNEU	DIMENSIONS	PRESSION DES PNEUS À FROID
AVANT	225/65R17	240kPa, 35PSI
ARRIÈRE	225/65R17	240kPa, 35PSI
DE SECOURS	T165/80D17	420kPa, 60PSI

VOIR LE MANUEL
DE L'USAGER
POUR PLUS DE
RENSEIGNEMENTS

PZ OR160

Figure A5. Tire Placard



Figure A6. Front View of Principal Other Vehicle



Figure A7. Rear View of Principal Other Vehicle



Figure A8. 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. Buttons for Accessing System Setup Menu

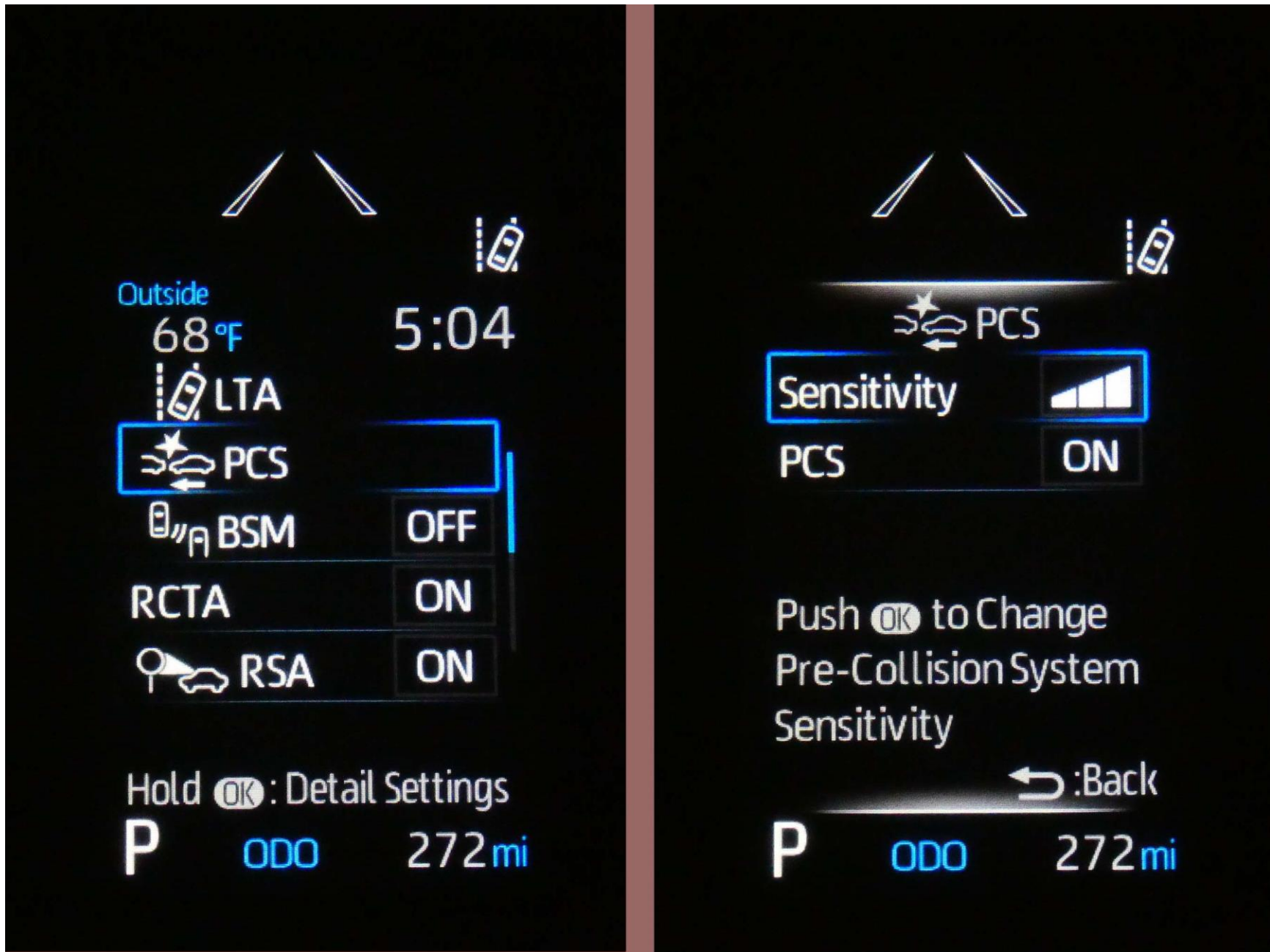


Figure A13. System Setup Menu and Alert Sensitivity



Figure A14. FCW Visual Alert

APPENDIX B

Excerpts from Owner's Manual

PCS (Pre-Collision System)

The pre-collision system uses a radar sensor and front camera to detect objects (→P.227) in front of the vehicle. When the system determines that the possibility of a frontal collision with an object is high, a warning operates to urge the driver to take evasive action and the potential brake pressure is increased to help the driver avoid the collision. If the system determines that the possibility of a frontal collision with an object is extremely high, the brakes are automatically applied to help avoid the collision or help reduce the impact of the collision.

The pre-collision system can be disabled/enabled and the warning timing can be changed. (→P.229)

Detectable objects

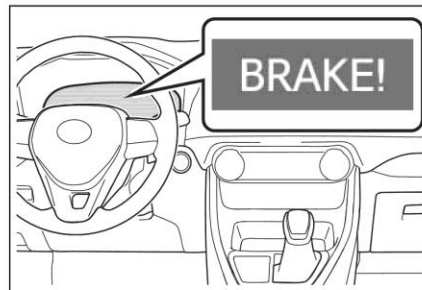
The system can detect the following:

- Vehicles
- Bicyclists
- Pedestrians

System functions

■ **Pre-collision warning**

When the system determines that the possibility of a frontal collision is high, a buzzer will sound and a warning message will be displayed on the multi-information display to urge the driver to take evasive action.



■ **Pre-collision brake assist**

When the system determines that the possibility of a frontal collision is high, the system applies greater braking force in relation to how strongly the brake pedal is depressed.

■ **Pre-collision braking**

If the system determines that the possibility of a frontal collision is extremely high, the brakes are automatically applied to help avoid the collision or reduce the impact of the collision.



WARNING

■ Limitations of the pre-collision system

- The driver is solely responsible for safe driving. Always drive safely, taking care to observe your surroundings.
Do not use the pre-collision system instead of normal braking operations under any circumstances. This system will not prevent collisions or lessen collision damage or injury in every situation. Do not overly rely on this system. Failure to do so may lead to an accident, resulting in death or serious injury.
- Although this system is designed to help avoid a collision or help reduce the impact of the collision, its effectiveness may change according to various conditions, therefore the system may not always be able to achieve the same level of performance.
Read the following conditions carefully. Do not overly rely on this system and always drive carefully.
- Conditions under which the system may operate even if there is no possibility of a collision:
→P.231
- Conditions under which the system may not operate properly:
→P.232
- Do not attempt to test the operation of the pre-collision system yourself.
Depending on the objects used for testing (dummies, cardboard objects imitating detectable objects, etc.), the system may not operate properly, possibly leading to an accident.

■ Pre-collision braking

- When the pre-collision braking function is operating, a large amount of braking force will be applied.
- If the vehicle is stopped by the operation of the pre-collision braking function, the pre-collision braking function operation will be canceled after approximately 2 seconds. Depress the brake pedal as necessary.
- The pre-collision braking function may not operate if certain operations are performed by the driver. If the accelerator pedal is being depressed strongly or the steering wheel is being turned, the system may determine that the driver is taking evasive action and possibly prevent the pre-collision braking function from operating.
- In some situations, while the pre-collision braking function is operating, operation of the function may be canceled if the accelerator pedal is depressed strongly or the steering wheel is turned and the system determines that the driver is taking evasive action.
- If the brake pedal is being depressed, the system may determine that the driver is taking evasive action and possibly delay the operation timing of the pre-collision braking function.

■ When to disable the pre-collision system


In the following situations, disable the system, as it may not operate properly, possibly leading to an accident resulting in death or serious injury:

- When the vehicle is being towed

- ⚠ WARNING**
- When your vehicle is towing another vehicle
 - When transporting the vehicle via truck, boat, train or similar means of transportation
 - When the vehicle is raised on a lift with the engine running and the tires are allowed to rotate freely
 - When inspecting the vehicle using a drum tester such as a chassis dynamometer or speedometer tester, or when using an on vehicle wheel balancer
 - When a strong impact is applied to the front bumper or front grille, due to an accident or other reasons
 - If the vehicle cannot be driven in a stable manner, such as when the vehicle has been in an accident or is malfunctioning
 - When the vehicle is driven in a sporty manner or off-road
 - When the tires are not properly inflated
 - When the tires are very worn
 - When tires of a size other than specified are installed
 - When tire chains are installed
 - When a compact spare tire or an emergency tire puncture repair kit is used
 - If equipment (snow plow, etc.) that may obstruct the radar sensor or front camera is temporarily installed to the vehicle

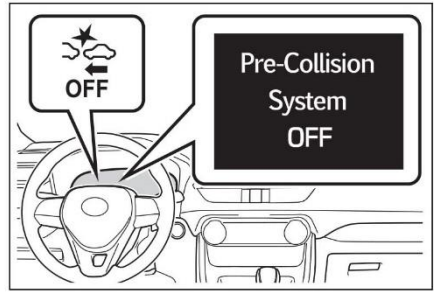
Changing settings of the pre-collision system

■ **Enabling/disabling the pre-collision system**


The pre-collision system can be enabled/disabled on the  screen (→P.94) of the multi-information display.

The system is automatically enabled each time the engine switch is turned to ON.

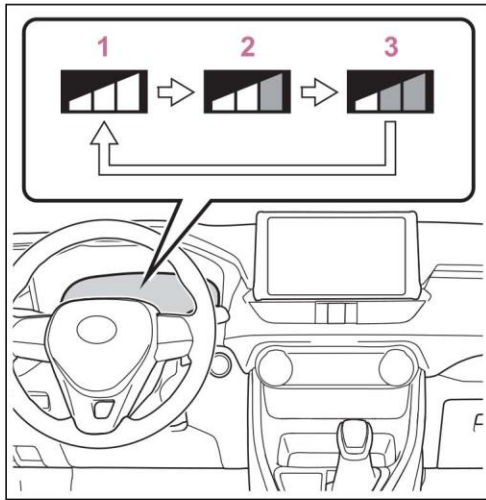
If the system is disabled, the PCS warning light will turn on and a message will be displayed on the multi-information display.



■ **Changing the pre-collision warning timing**

The pre-collision warning timing can be changed on the  screen (→P.94) of the multi-information display.

The warning timing setting is retained when the engine switch is turned to OFF. However, if the pre-collision system is disabled and re-enabled, the operation timing will return to the default setting (middle).



- 1** Early
- 2** Middle
This is the default setting.
- 3** Late

Operational conditions for each pre-collision function

The pre-collision system is enabled and the system determines that the possibility of a frontal collision with a detected object is high.

The system may not operate in the following situations:

- If a battery terminal has been disconnected and reconnected and then the vehicle has not been driven for a certain amount of time
- If the shift lever is in R
- When the VSC OFF indicator is illuminated (only the pre-collision warning function will be operational)

The operation speeds and operation cancellation for each function is listed below.

● Pre-collision warning

Detectable objects	Vehicle speed	Relative speed between your vehicle and object
Vehicles	Approx. 7 to 110 mph (10 to 180 km/h)	Approx. 7 to 110 mph (10 to 180 km/h)
Bicyclists and pedestrians	Approx. 7 to 50 mph (10 to 80 km/h)	Approx. 7 to 50 mph (10 to 80 km/h)

● Pre-collision brake assist

Detectable objects	Vehicle speed	Relative speed between your vehicle and object
Vehicles	Approx. 20 to 110 mph (30 to 180 km/h)	Approx. 20 to 110 mph (30 to 180 km/h)
Bicyclists and pedestrians	Approx. 20 to 50 mph (30 to 80 km/h)	Approx. 20 to 50 mph (30 to 80 km/h)

● Pre-collision braking

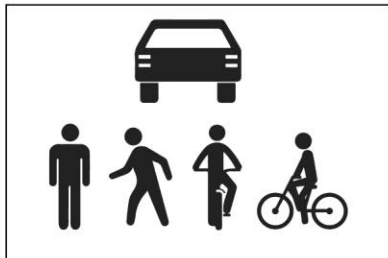
Detectable objects	Vehicle speed	Relative speed between your vehicle and object
Vehicles	Approx. 7 to 110 mph (10 to 180 km/h)	Approx. 7 to 110 mph (10 to 180 km/h)
Bicyclists and pedestrians	Approx. 7 to 50 mph (10 to 80 km/h)	Approx. 7 to 50 mph (10 to 80 km/h)

If either of the following occur while the pre-collision braking function is operating, it will be canceled:

- The accelerator pedal is depressed strongly.
- The steering wheel is turned sharply or abruptly.

■ Object detection function

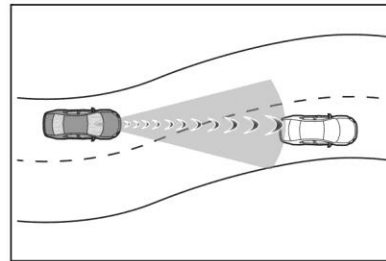
The system detects objects based on their size, profile, motion, etc. However, an object may not be detected depending on the surrounding brightness and the motion, posture, and angle of the detected object, preventing the system from operating properly. (→P.232)
The illustration shows an image of detectable objects.



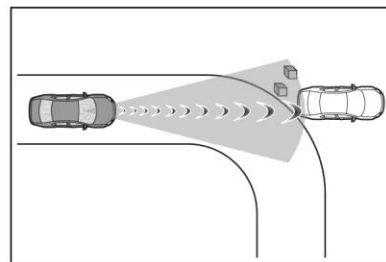
■ Conditions under which the system may operate even if there is no possibility of a collision

- In some situations such as the following, the system may determine that there is a possibility of a frontal collision and operate.
 - When passing a detectable object, etc.
 - When changing lanes while overtaking a detectable object, etc.
 - When approaching a detectable object in an adjacent lane or on the roadside, such as when changing the course of travel or

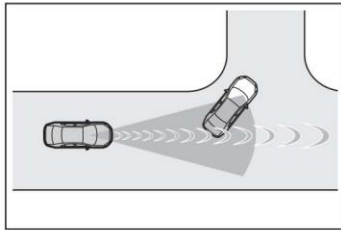
driving on a winding road



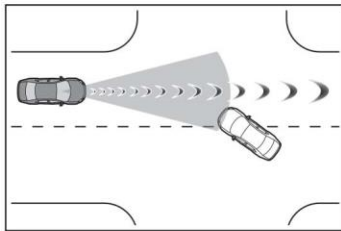
- When rapidly closing on a detectable object, etc.
- When approaching objects on the roadside, such as detectable objects, guardrails, utility poles, trees, or walls
- When there is a detectable object or other object by the roadside at the entrance of a curve



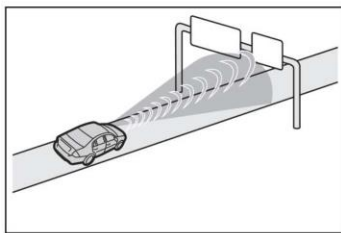
- When there are patterns or paint in front of your vehicle that may be mistaken for a detectable object
- When the front of your vehicle is hit by water, snow, dust, etc.
- When overtaking a detectable object that is changing lanes or making a right/left turn



- When passing a detectable object in an oncoming lane that is stopped to make a right/left turn

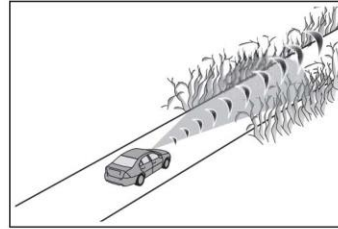


- When a detectable object approaches very close and then stops before entering the path of your vehicle
- If the front of your vehicle is raised or lowered, such as when on an uneven or undulating road surface
- When driving on a road surrounded by a structure, such as in a tunnel or on an iron bridge
- When there is a metal object (manhole cover, steel plate, etc.), steps, or a protrusion in front of your vehicle
- When passing under an object (road sign, billboard, etc.)



- When approaching an electric toll gate barrier, parking area barrier, or other barrier that opens and closes
- When using an automatic car wash
- When driving through or under

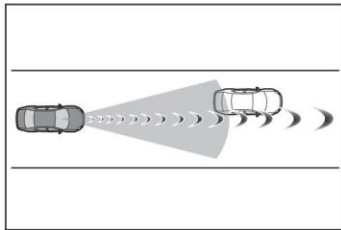
objects that may contact your vehicle, such as thick grass, tree branches, or a banner



- When driving through steam or smoke
- When driving near an object that reflects radio waves, such as a large truck or guardrail
- When driving near a TV tower, broadcasting station, electric power plant, radar equipped vehicles, etc., or other location where strong radio waves or electrical noise may be present
- When there are many things which can reflect the radio waves of the radar in the vicinity (tunnels, truss bridges, gravel roads, snow covered road that have tracks, etc.)

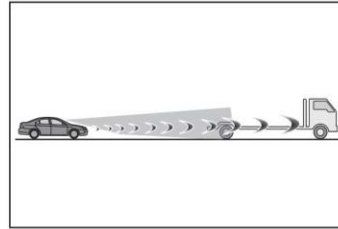
■ **Situations in which the system may not operate properly**

- In some situations such as the following, an object may not be detected by the radar sensor and front camera, preventing the system from operating properly:
 - When a detectable object is approaching your vehicle
 - When your vehicle or a detectable object is wobbling
 - If a detectable object makes an abrupt maneuver (such as sudden swerving, acceleration or deceleration)
 - When your vehicle approaches a detectable object rapidly
 - When a detectable object is not directly in front of your vehicle

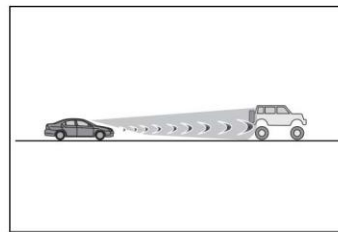


- When a detectable object is near a wall, fence, guardrail, manhole cover, vehicle, steel plate on the road, etc.
- When a detectable object is under a structure
- When part of a detectable object is hidden by an object, such as large baggage, an umbrella, or guardrail
- When there are many things which can reflect the radio waves of the radar in the vicinity (tunnels, truss bridges, gravel roads, snow covered road that have tracks, etc.)
- When there is an effect on the radio waves to the radar that is installed on another vehicle
- When multiple detectable objects are close together
- If the sun or other light is shining directly on a detectable object
- When a detectable object is a shade of white and looks extremely bright
- When a detectable object appears to be nearly the same color or brightness as its surroundings
- If a detectable object cuts or suddenly emerges in front of your vehicle
- When the front of your vehicle is hit by water, snow, dust, etc.
- When a very bright light ahead, such as the sun or the headlights of oncoming traffic, shines directly into the front camera
- When approaching the side or front of a vehicle ahead
- If a vehicle ahead is a motorcycle
- If a vehicle ahead is narrow, such as a personal mobility vehicle
- If a preceding vehicle has a small rear end, such as an unloaded

- truck
- If a preceding vehicle has a low rear end, such as a low bed trailer

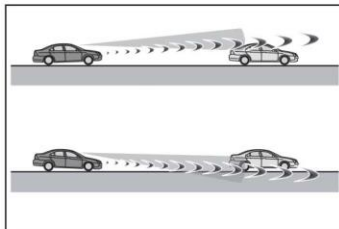


- If a vehicle ahead has extremely high ground clearance



- If a vehicle ahead is carrying a load which protrudes past its rear bumper
- If a vehicle ahead is irregularly shaped, such as a tractor or side car
- If a vehicle ahead is a child sized bicycle, a bicycle that is carrying a large load, a bicycle ridden by more than one person, or a uniquely shaped bicycle (bicycle with a child seat, tandem bicycle, etc.)
- If a pedestrian/or the riding height of a bicyclist ahead is shorter than approximately 3.2 ft. (1 m) or taller than approximately 6.5 ft. (2 m)
- If a pedestrian/bicyclist is wearing oversized clothing (a rain coat, long skirt, etc.), making their silhouette obscure
- If a pedestrian is bending forward or squatting or bicyclist is bending forward
- If a pedestrian/bicyclist is moving fast
- If a pedestrian is pushing a stroller, wheelchair, bicycle or other vehicle
- When driving in inclement weather

- such as heavy rain, fog, snow or a sandstorm
- When driving through steam or smoke
- When the surrounding area is dim, such as at dawn or dusk, or while at night or in a tunnel, making a detectable object appear to be nearly the same color as its surroundings
- When driving in a place where the surrounding brightness changes suddenly, such as at the entrance or exit of a tunnel
- After the engine has started the vehicle has not been driven for a certain amount of time
- While making a left/right turn and for a few seconds after making a left/right turn
- While driving on a curve and for a few seconds after driving on a curve
- If your vehicle is skidding
- If the front of the vehicle is raised or lowered



- If the wheels are misaligned
- If a wiper blade is blocking the front camera
- The vehicle is being driven at extremely high speeds
- When driving on a hill
- If the radar sensor or front camera is misaligned
- In some situations such as the following, sufficient braking force may not be obtained, preventing the system from performing properly:
 - If the braking functions cannot operate to their full extent, such as when the brake parts are extremely cold, extremely hot, or wet

- If the vehicle is not properly maintained (brakes or tires are excessively worn, improper tire inflation pressure, etc.)
- When the vehicle is being driven on a gravel road or other slippery surface
- When the road surface has deep wheel tracks
- When driving on a hill road
- When driving on a road that has inclines to the left or right

■ **If VSC is disabled**

- If VSC is disabled (→P.357), the pre-collision brake assist and pre-collision braking functions are also disabled.
- The PCS warning light will turn on and “VSC Turned Off Pre-Collision Brake System Unavailable” will be displayed on the multi-information display.

APPENDIX C

Run Log

Subject Vehicle: **2022 Toyota RAV4 XLE**

Test Date: **1/25/2022**

Principal Other Vehicle: **2006 Acura RL**

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	Stopped POV	Y	2.57	2.45	0.47	Pass	
2		Y	2.90	2.79	0.80	Pass	
3		Y	2.90	2.75	0.80	Pass	
4		Y	2.40	2.30	0.30	Pass	
5		Y	2.65	2.53	0.55	Pass	
6		Y	2.91	2.81	0.81	Pass	
7		Y	2.92	2.82	0.82	Pass	
15	Decelerating POV, 45	N					Lateral Offset, POV Brakes
16		Y	2.87	2.76	0.47	Pass	
17		N					Lateral Offset
18		N					Lateral Offset
19		N					Lateral Offset
20		Y	2.93	2.80	0.53	Pass	
21		Y	2.86	2.76	0.46	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
22		Y	2.85	2.72	0.45	Pass	
23		Y	2.82	2.70	0.42	Pass	
24		Y	2.82	2.75	0.42	Pass	
25		N					Lateral Offset
26		Y	2.76	2.68	0.36	Pass	
8	Slower POV, 45 vs 20	Y	2.71	2.62	0.71	Pass	
9		Y	2.69	2.57	0.69	Pass	
10		Y	2.71	2.59	0.71	Pass	
11		Y	2.65	2.56	0.65	Pass	
12		Y	2.64	2.52	0.64	Pass	
13		Y	2.67	2.53	0.67	Pass	
14		Y	2.68	2.61	0.68	Pass	

APPENDIX D

Time History Plots

LIST OF FIGURES

	Page
Figure D1. Example Time History for Test Type 1, Passing.....	D-8
Figure D2. Example Time History for Test Type 1, Failing.....	D-9
Figure D3. Example Time History for Test Type 2, Passing.....	D-10
Figure D4. Example Time History for Test Type 2, Failing.....	D-11
Figure D5. Example Time History for Test Type 3, Passing.....	D-12
Figure D6. Example Time History Showing Invalid Lateral Offset Criteria.....	D-13
Figure D7. Time History for Run 1, Test 1 - Stopped POV, Auditory Warning.....	D-14
Figure D8. Time History for Run 1, Test 1 - Stopped POV, Visual Warning.....	D-15
Figure D9. Time History for Run 2, Test 1 - Stopped POV, Auditory Warning.....	D-16
Figure D10. Time History for Run 2, Test 1 - Stopped POV, Visual Warning.....	D-17
Figure D11. Time History for Run 3, Test 1 - Stopped POV, Auditory Warning.....	D-18
Figure D12. Time History for Run 3, Test 1 - Stopped POV, Visual Warning.....	D-19
Figure D13. Time History for Run 4, Test 1 - Stopped POV, Auditory Warning.....	D-20
Figure D14. Time History for Run 4, Test 1 - Stopped POV, Visual Warning.....	D-21
Figure D15. Time History for Run 5, Test 1 - Stopped POV, Auditory Warning.....	D-22
Figure D16. Time History for Run 5, Test 1 - Stopped POV, Visual Warning.....	D-23
Figure D17. Time History for Run 6, Test 1 - Stopped POV, Auditory Warning.....	D-24
Figure D18. Time History for Run 6, Test 1 - Stopped POV, Visual Warning.....	D-25
Figure D19. Time History for Run 7, Test 1 - Stopped POV, Auditory Warning.....	D-26
Figure D20. Time History for Run 7, Test 1 - Stopped POV, Visual Warning.....	D-27
Figure D21. Time History for Run 16, Test 2 - Decelerating POV, Auditory Warning.....	D-28
Figure D22. Time History for Run 16, Test 2 - Decelerating POV, Visual Warning.....	D-29
Figure D23. Time History for Run 20, Test 2 - Decelerating POV, Auditory Warning.....	D-30
Figure D24. Time History for Run 20, Test 2 - Decelerating POV, Visual Warning.....	D-31
Figure D25. Time History for Run 21, Test 2 - Decelerating POV, Auditory Warning.....	D-32
Figure D26. Time History for Run 21, Test 2 - Decelerating POV, Visual Warning.....	D-33
Figure D27. Time History for Run 22, Test 2 - Decelerating POV, Auditory Warning.....	D-34
Figure D28. Time History for Run 22, Test 2 - Decelerating POV, Visual Warning.....	D-35
Figure D29. Time History for Run 23, Test 2 - Decelerating POV, Auditory Warning.....	D-36
Figure D30. Time History for Run 23, Test 2 - Decelerating POV, Visual Warning.....	D-37
Figure D31. Time History for Run 24, Test 2 - Decelerating POV, Auditory Warning.....	D-38
Figure D32. Time History for Run 24, Test 2 - Decelerating POV, Visual Warning.....	D-39
Figure D33. Time History for Run 26, Test 2 - Decelerating POV, Auditory Warning.....	D-40
Figure D34. Time History for Run 26, Test 2 - Decelerating POV, Visual Warning.....	D-41
Figure D35. Time History for Run 8, Test 3 - Slower Moving POV, Auditory Warning.....	D-42
Figure D36. Time History for Run 8, Test 3 - Slower Moving POV, Visual Warning.....	D-43
Figure D37. Time History for Run 9, Test 3 - Slower Moving POV, Auditory Warning.....	D-44
Figure D38. Time History for Run 9, Test 3 - Slower Moving POV, Visual Warning.....	D-45
Figure D39. Time History for Run 10, Test 3 - Slower Moving POV, Auditory Warning.....	D-46
Figure D40. Time History for Run 10, Test 3 - Slower Moving POV, Visual Warning.....	D-47
Figure D41. Time History for Run 11, Test 3 - Slower Moving POV, Auditory Warning.....	D-48

Figure D42. Time History for Run 11, Test 3 - Slower Moving POV, Visual Warning.....	D-49
Figure D43. Time History for Run 12, Test 3 - Slower Moving POV, Auditory Warning	D-50
Figure D44. Time History for Run 12, Test 3 - Slower Moving POV, Visual Warning.....	D-51
Figure D45. Time History for Run 13, Test 3 - Slower Moving POV, Auditory Warning	D-52
Figure D46. Time History for Run 13, Test 3 - Slower Moving POV, Visual Warning.....	D-53
Figure D47. Time History for Run 14, Test 3 - Slower Moving POV, Auditory Warning	D-54
Figure D48. Time History for Run 14, Test 3 - Slower Moving POV, Visual Warning.....	D-55

Description of Time History Plots

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

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

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

Time history figures include the following sub-plots:

- Warning – Displays the Forward Collision Warning Alert (which can be auditory, visual, or haptic). Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any of the following:
 - Filtered, rectified, and normalized sound signal. The vertical scale is 0 to 1.
 - Filtered, rectified, and normalized acceleration (e.g., haptic alert, such as steering wheel vibration). The vertical scale is 0 to 1.
 - Light sensor signal.
- TTC (sec) – Indicates the Time to Collision as calculated up to the point of FCW alert issuance. The value of TTCW (Time to Collision at Warning) is given numerically on the right side of the figure. A passing value is indicated in green, while a failing value is indicated in red.
- SV Speed (mph) – Speed of the Subject Vehicle
- POV Speed (mph) – Speed of the Principal Other Vehicle
- Yaw Rate (deg/sec) – Yaw rate of both the Subject Vehicle and Principal Other Vehicle

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

Envelopes and Thresholds

Each of the time history plot figures can contain either green or yellow envelopes and/or black threshold lines. These envelopes and thresholds are used to programmatically and visually determine the validity of a given test run. Envelope and threshold exceedances are indicated with either red shading or red asterisks, and red text is placed to the right side of the plot indicating the type of exceedance.

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

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

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

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

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

Color Codes

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

Color codes can be broken into four categories:

1. Time-varying data
2. Validation envelopes and thresholds
3. Instantaneous samplings
4. Text

1. Time-varying data color codes:

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

2. Validation envelope and threshold color codes:

- Green envelope = time varying data must be within the envelope at all times in order to be valid
- Yellow envelope = time varying data must be within limits at left and/or right ends
- Black threshold (Solid) = time varying data must not exceed this threshold in order to be valid
- Black threshold (Dashed) = for reference only – this can include warning level thresholds, TTC thresholds, and acceleration thresholds

3. Instantaneous sampling color codes:

- Green circle = passing or valid value at a given moment in time
- Red asterisk = failing or invalid value at a given moment in time

4. Text color codes:

- Green = passing or valid value
- Red = failing or invalid value

Other Notations

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

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

Examples of time history plots for each test type (including passing, failing and invalid runs) are shown in Figure D1 through Figure D6. Actual time history data plots for the vehicle under consideration are provided subsequently.

Notes

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

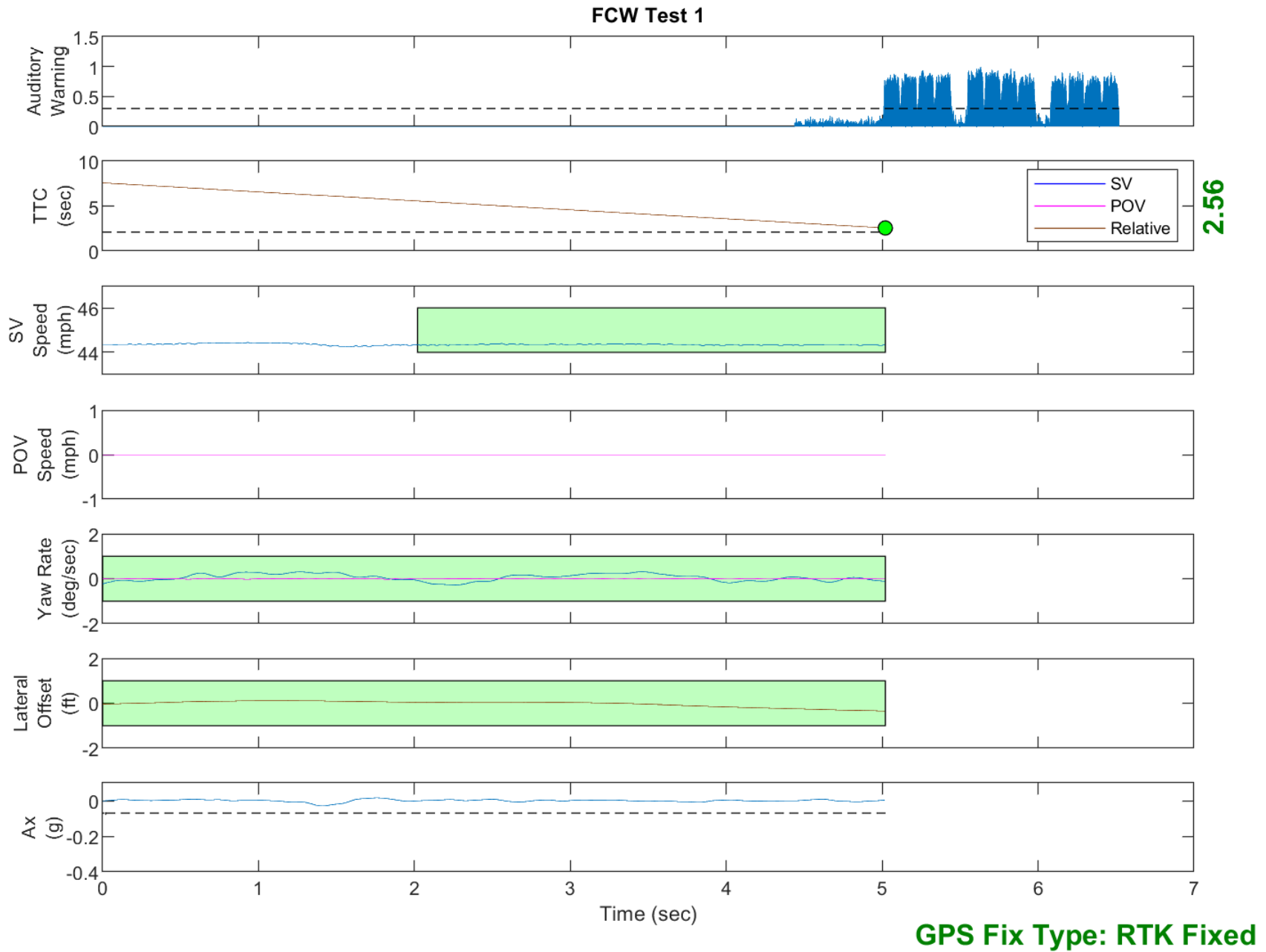
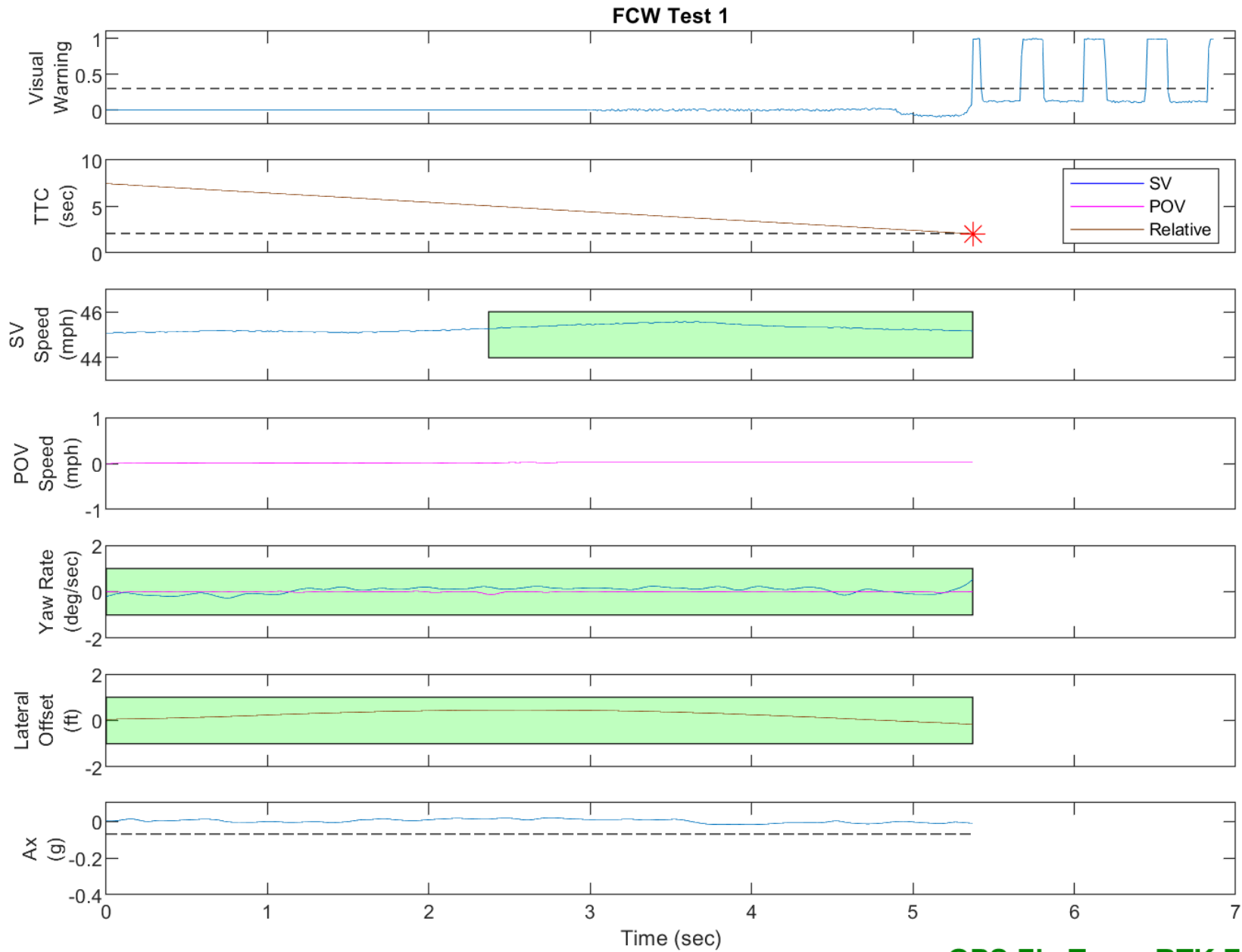


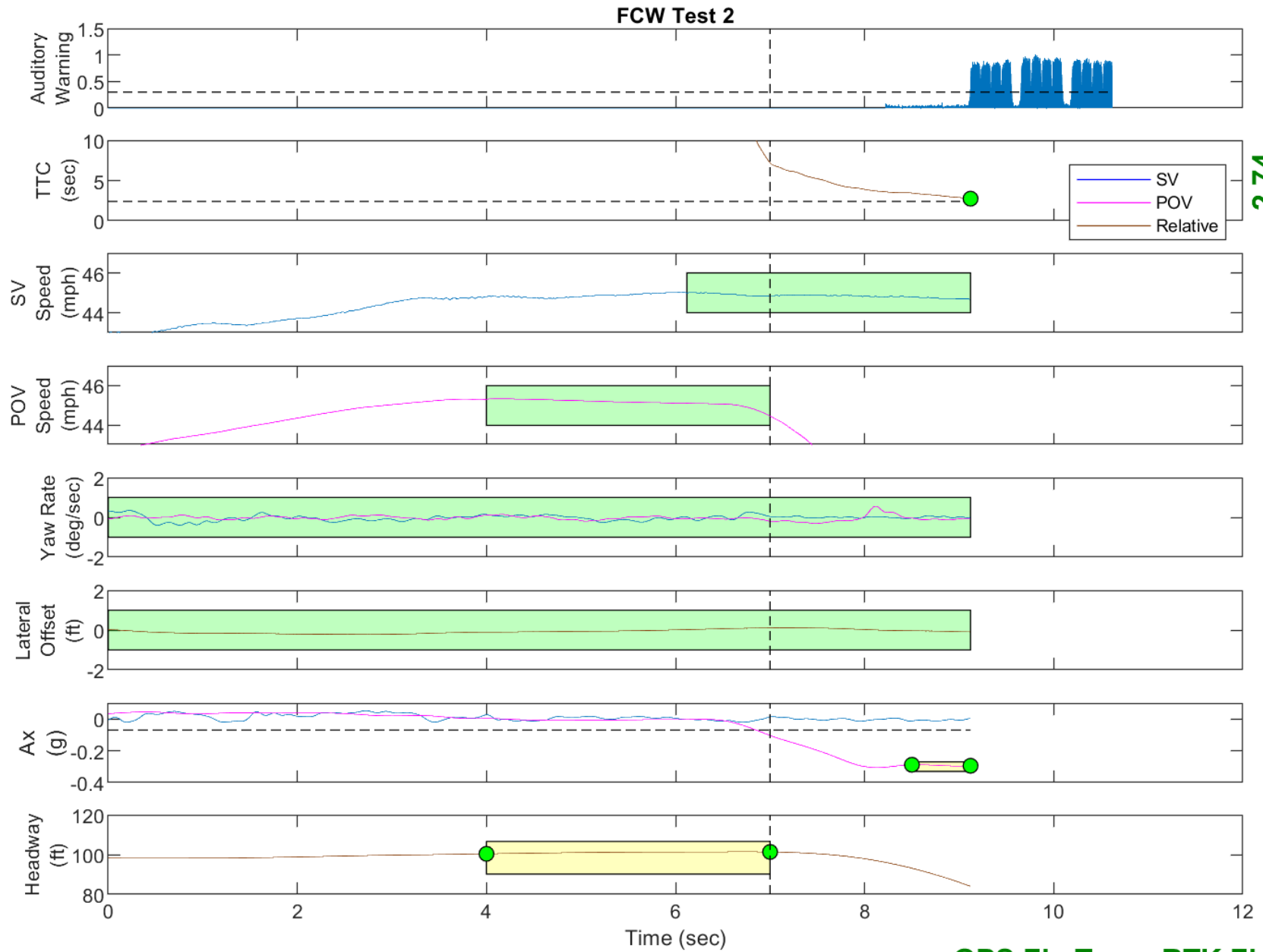
Figure D1. Example Time History for Test Type 1, Passing



2.06 FAIL

GPS Fix Type: RTK Fixed

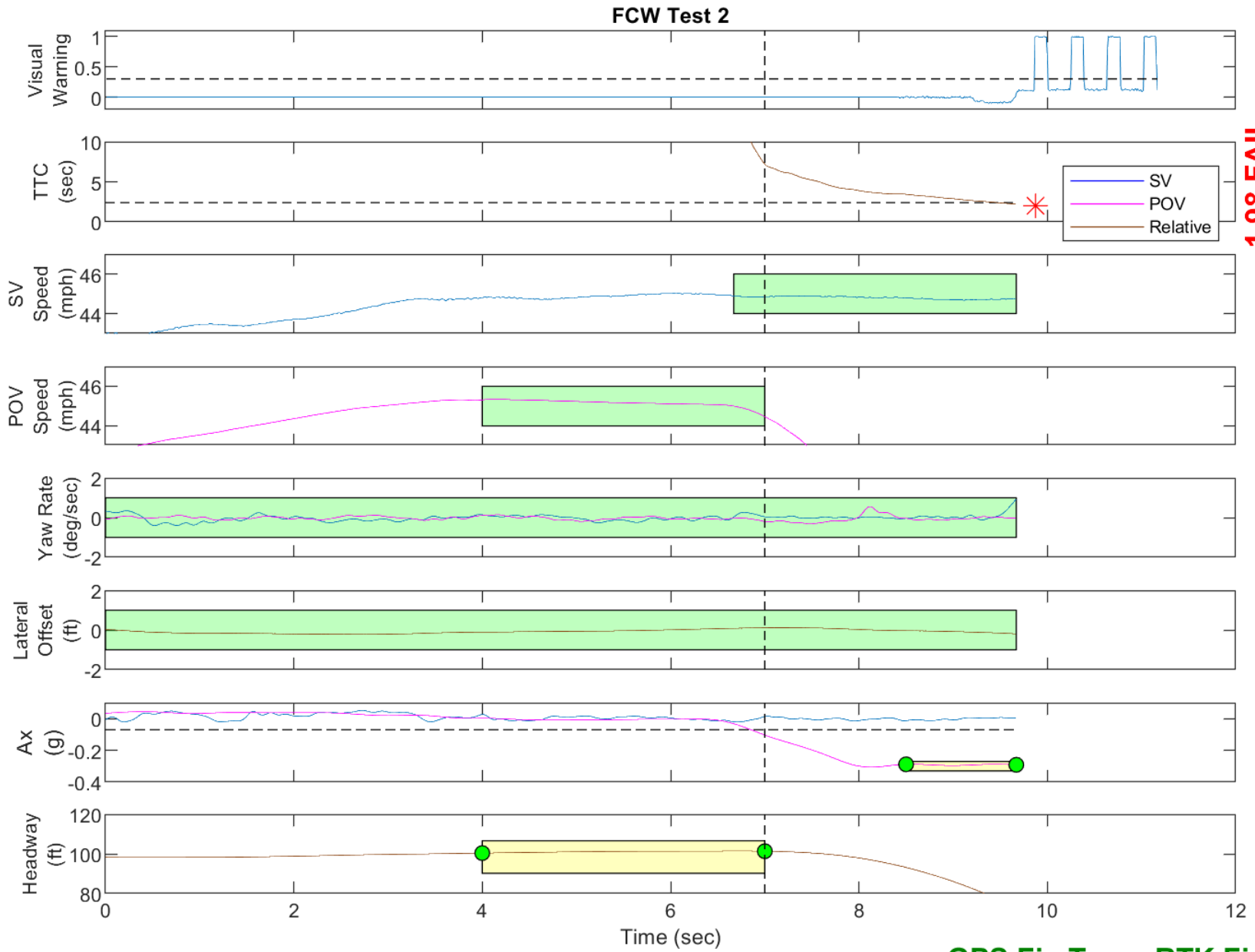
Figure D2. Example Time History for Test Type 1, Failing



2.74

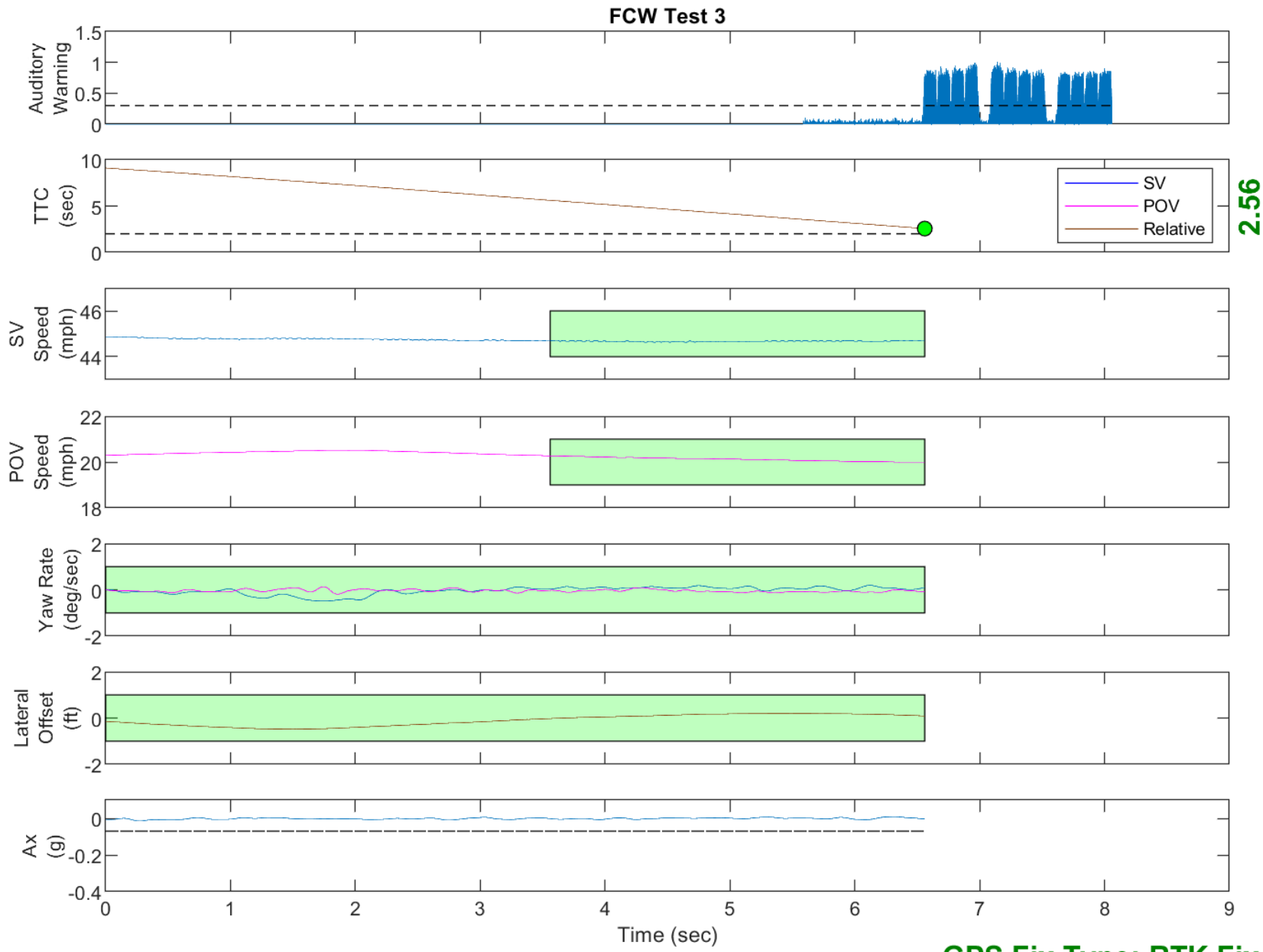
GPS Fix Type: RTK Fixed

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



GPS Fix Type: RTK Fixed

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



2.56

GPS Fix Type: RTK Fixed

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

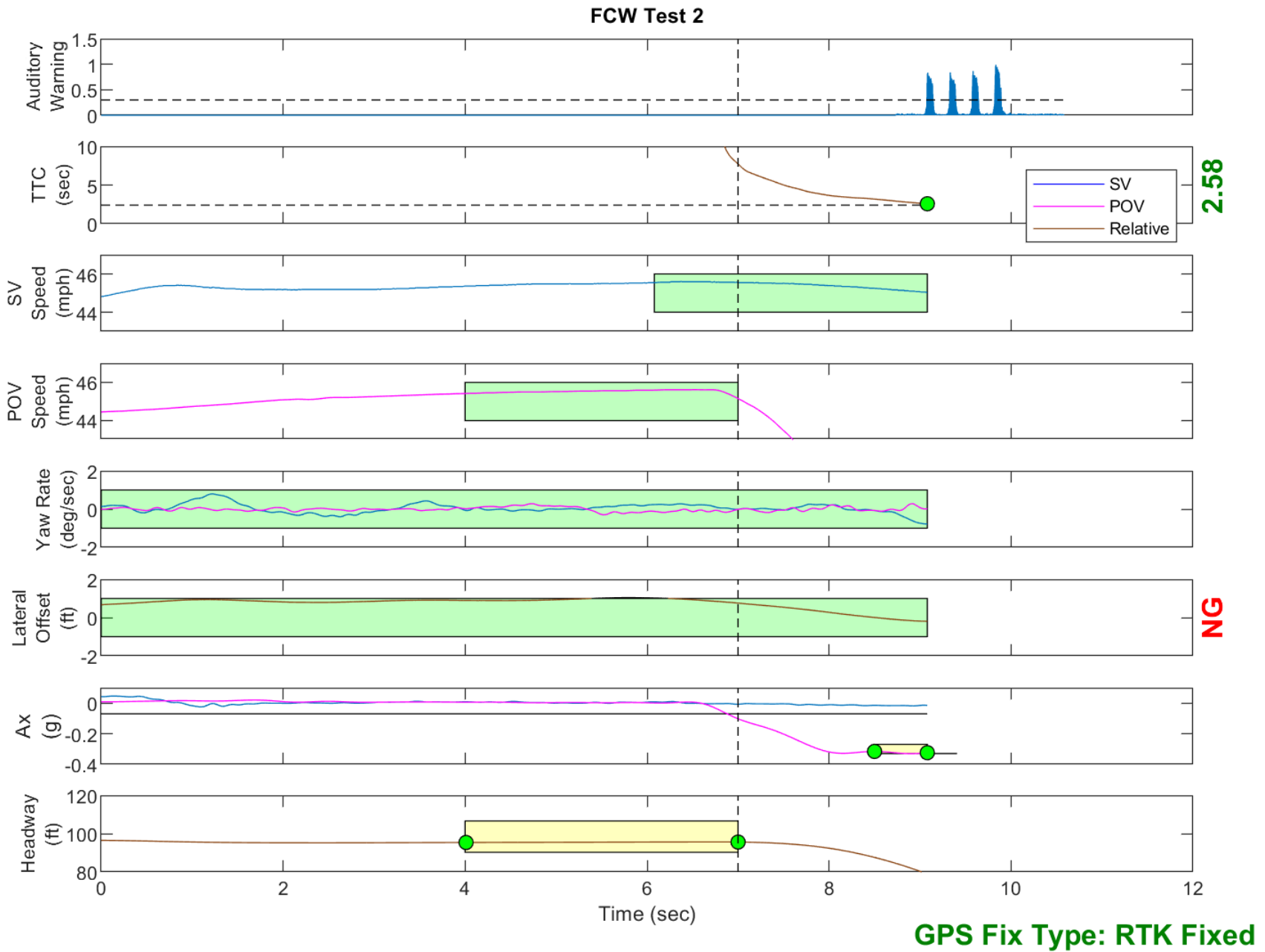


Figure D6. Example Time History Showing Invalid Lateral Offset Criteria

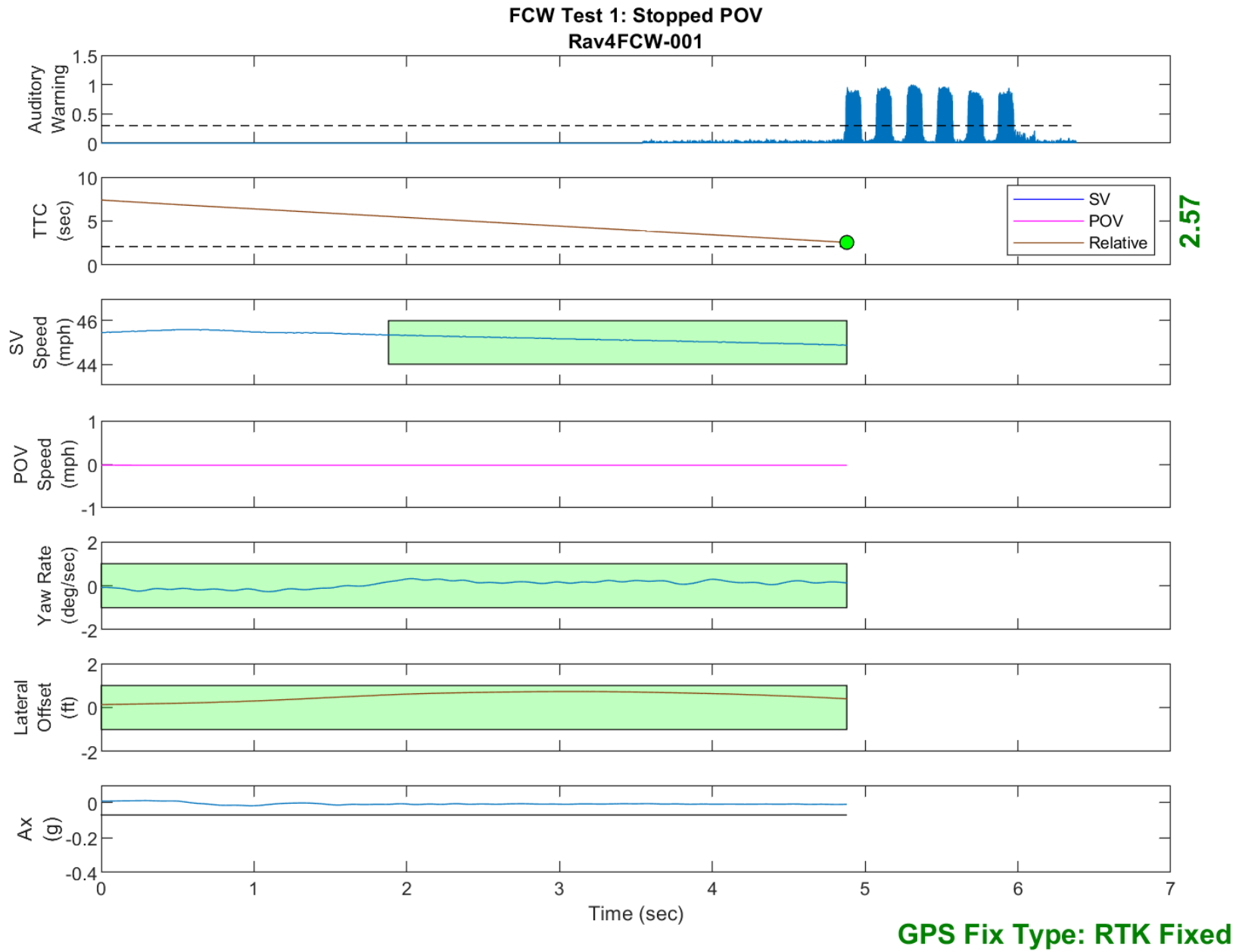


Figure D7. Time History for Run 1, Test 1 - Stopped POV, Auditory Warning

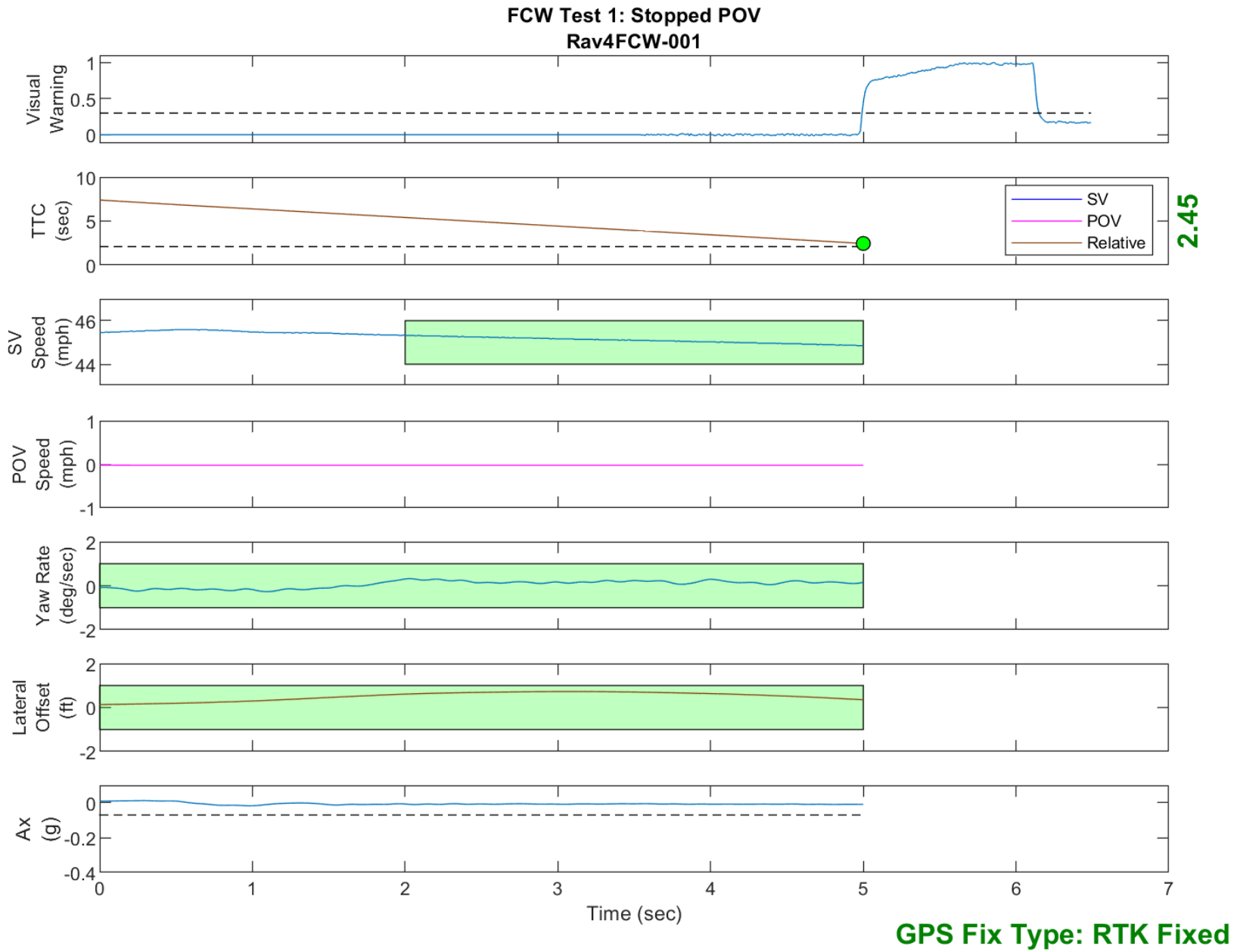


Figure D8. Time History for Run 1, Test 1 - Stopped POV, Visual Warning

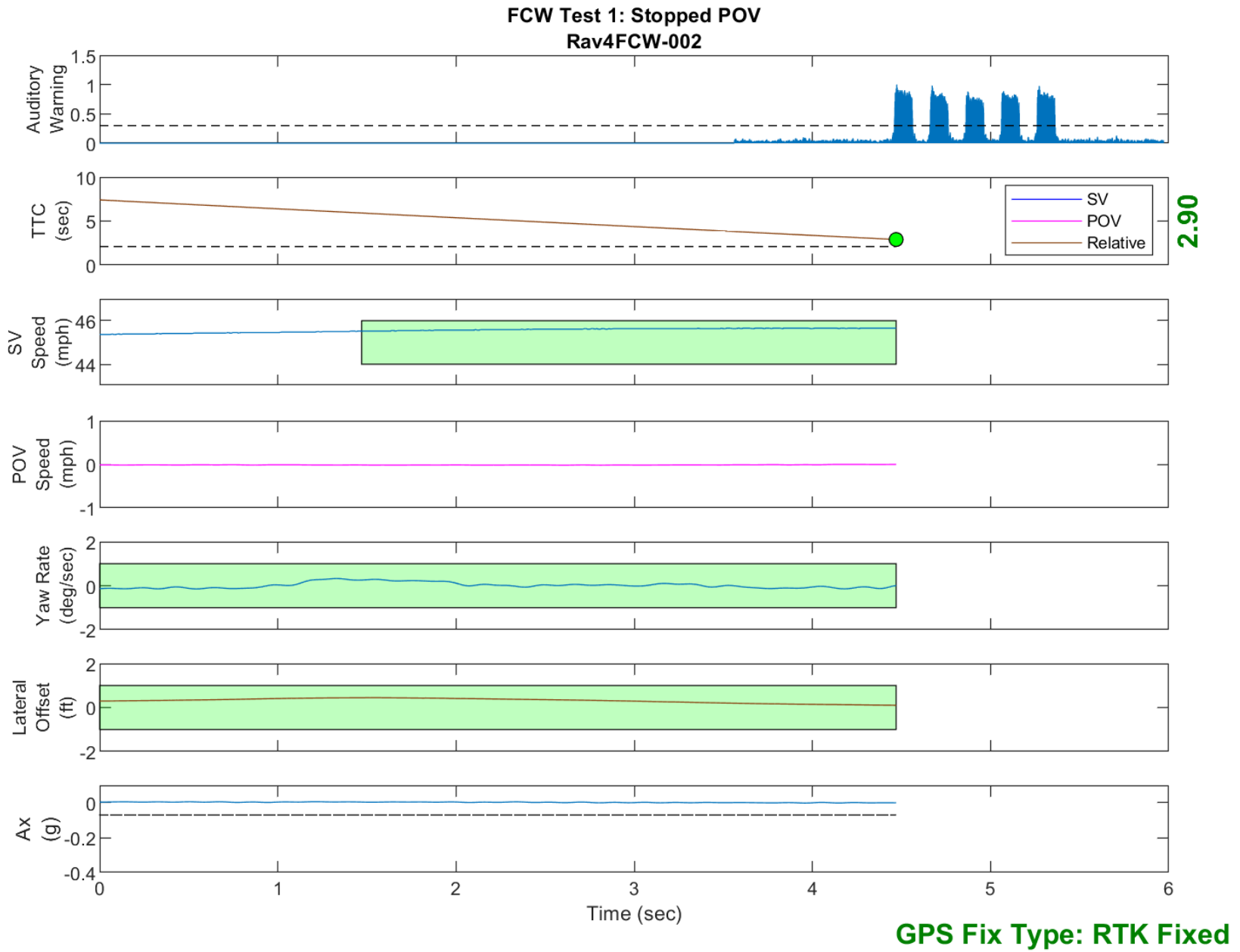


Figure D9. Time History for Run 2, Test 1 - Stopped POV, Auditory Warning

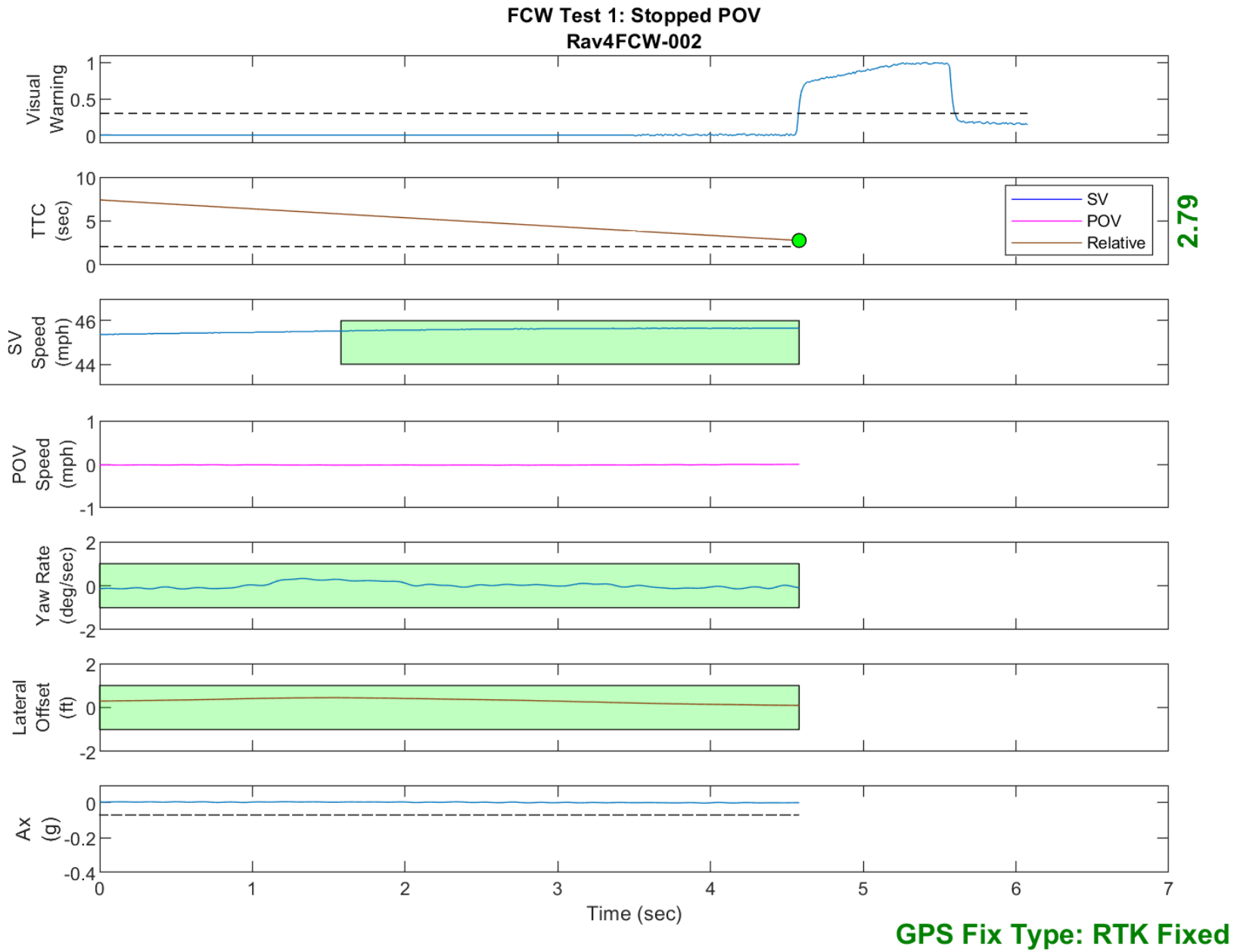


Figure D10. Time History for Run 2, Test 1 - Stopped POV, Visual Warning

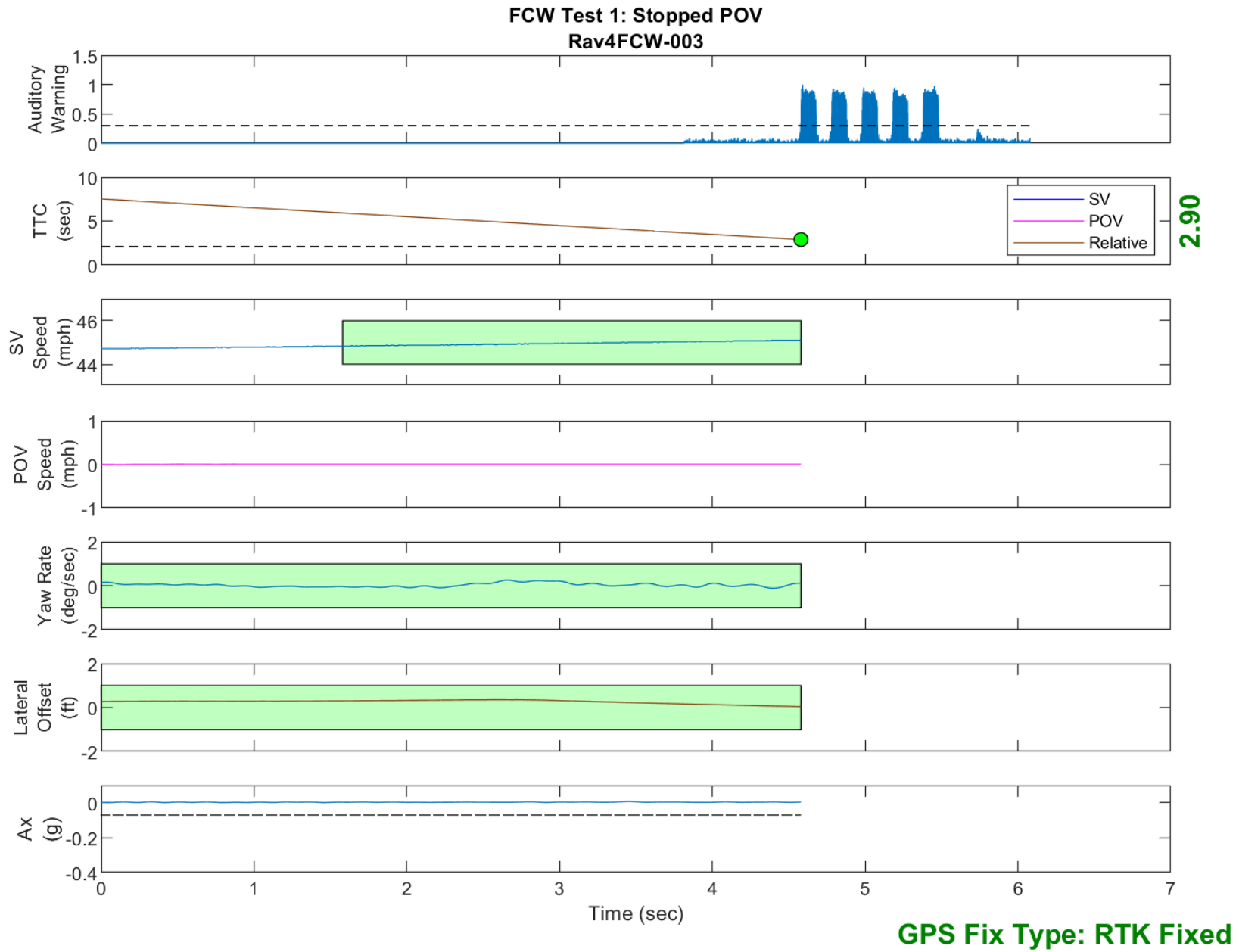


Figure D11. Time History for Run 3, Test 1 - Stopped POV, Auditory Warning

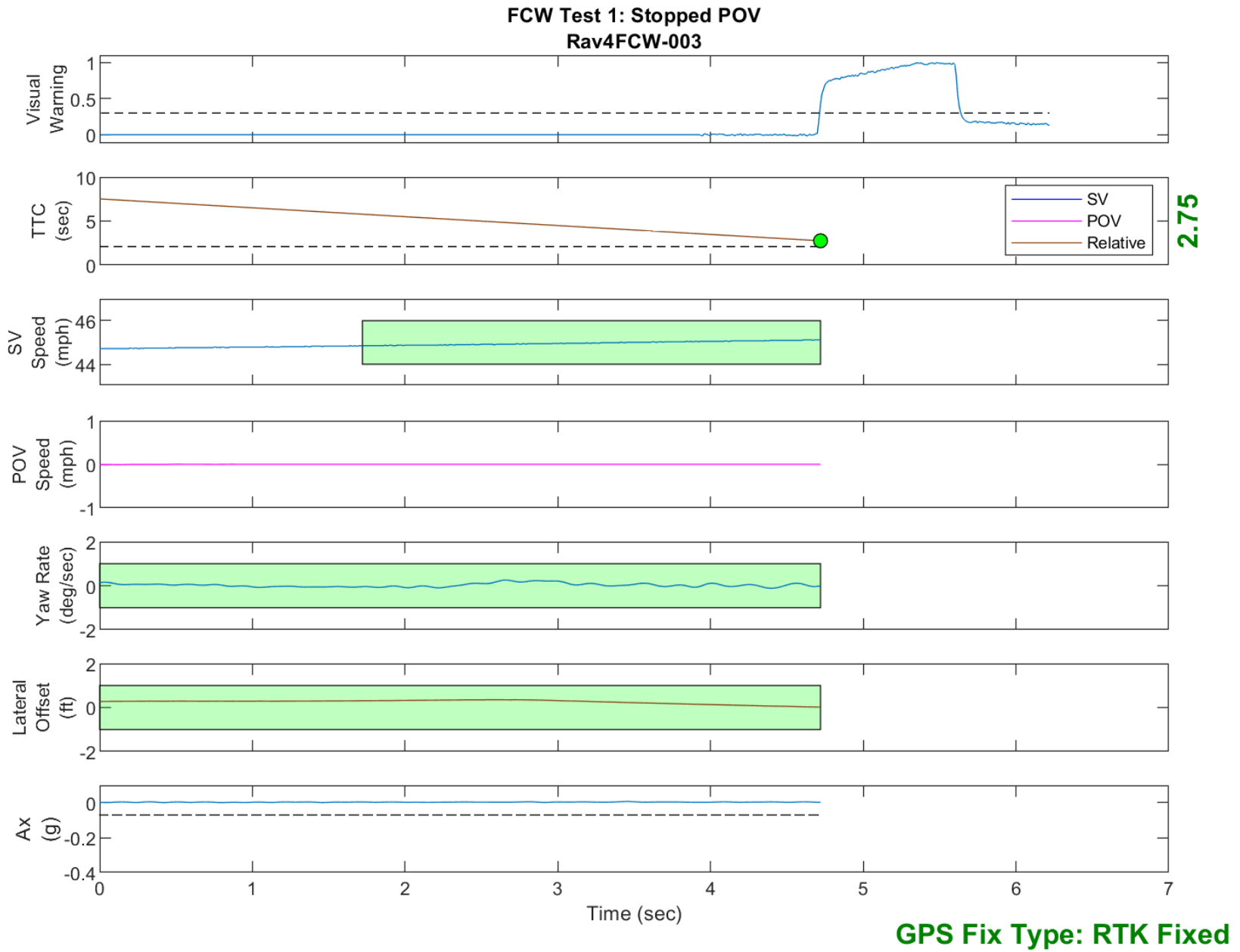


Figure D12. Time History for Run 3, Test 1 - Stopped POV, Visual Warning

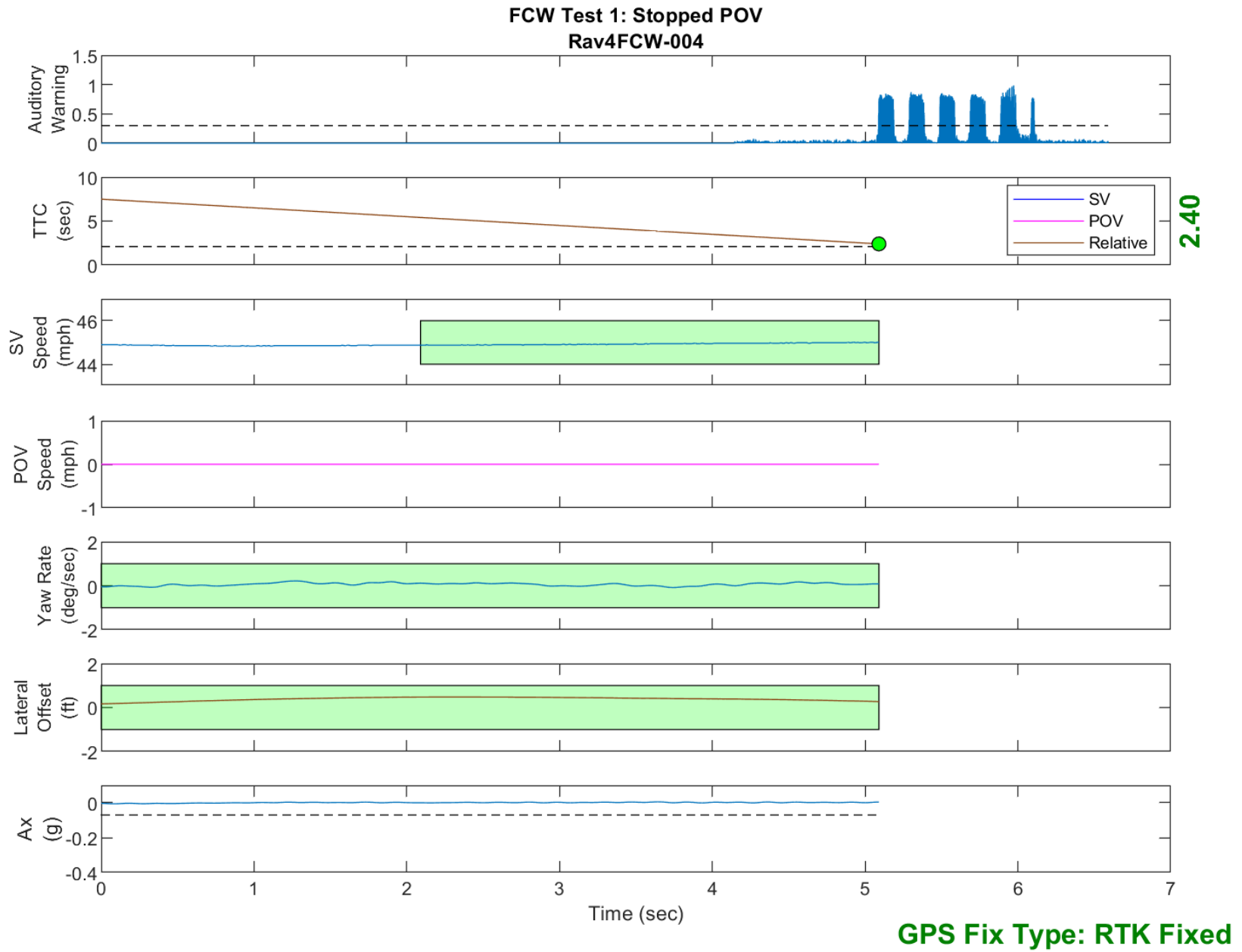


Figure D13. Time History for Run 4, Test 1 - Stopped POV, Auditory Warning

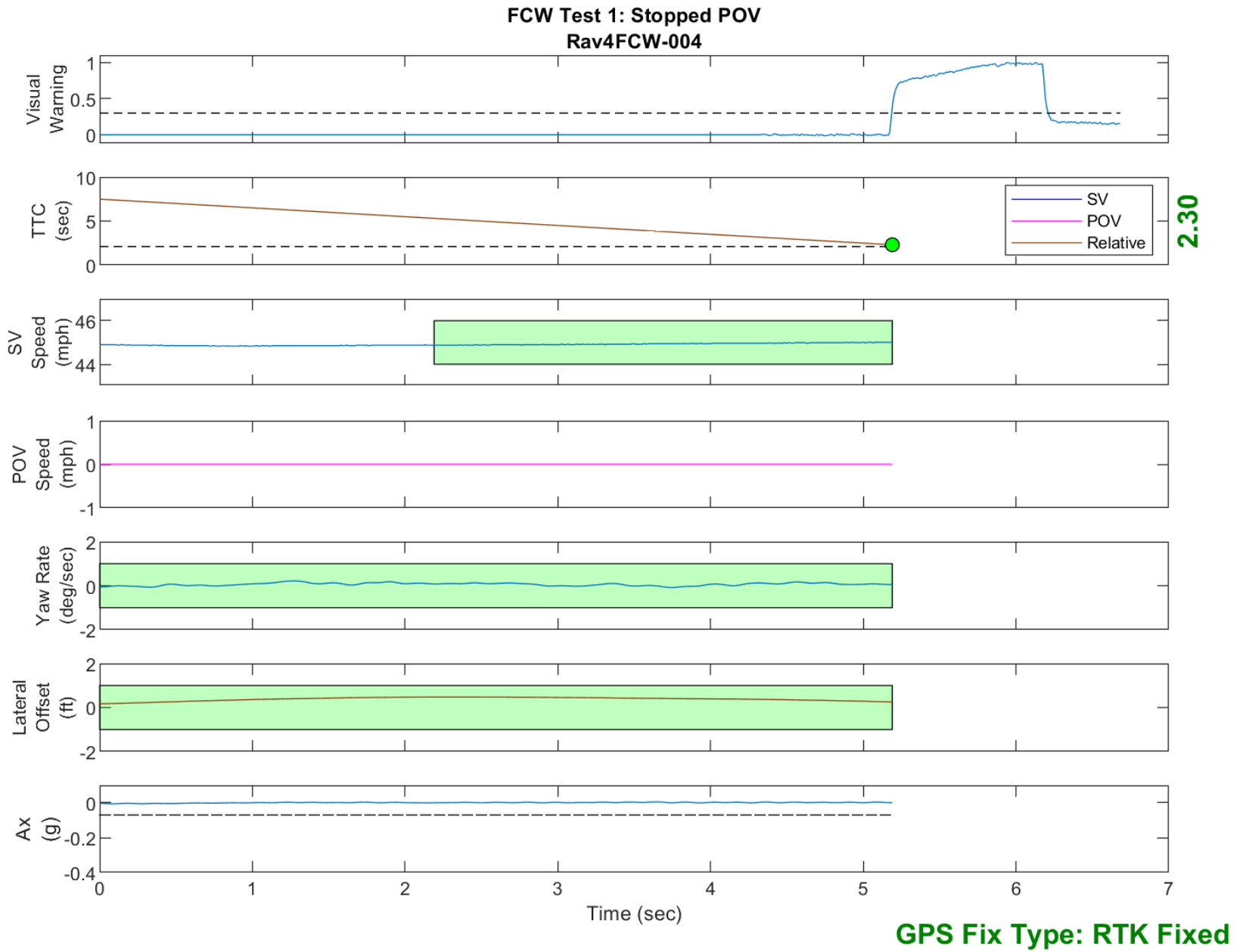


Figure D14. Time History for Run 4, Test 1 - Stopped POV, Visual Warning

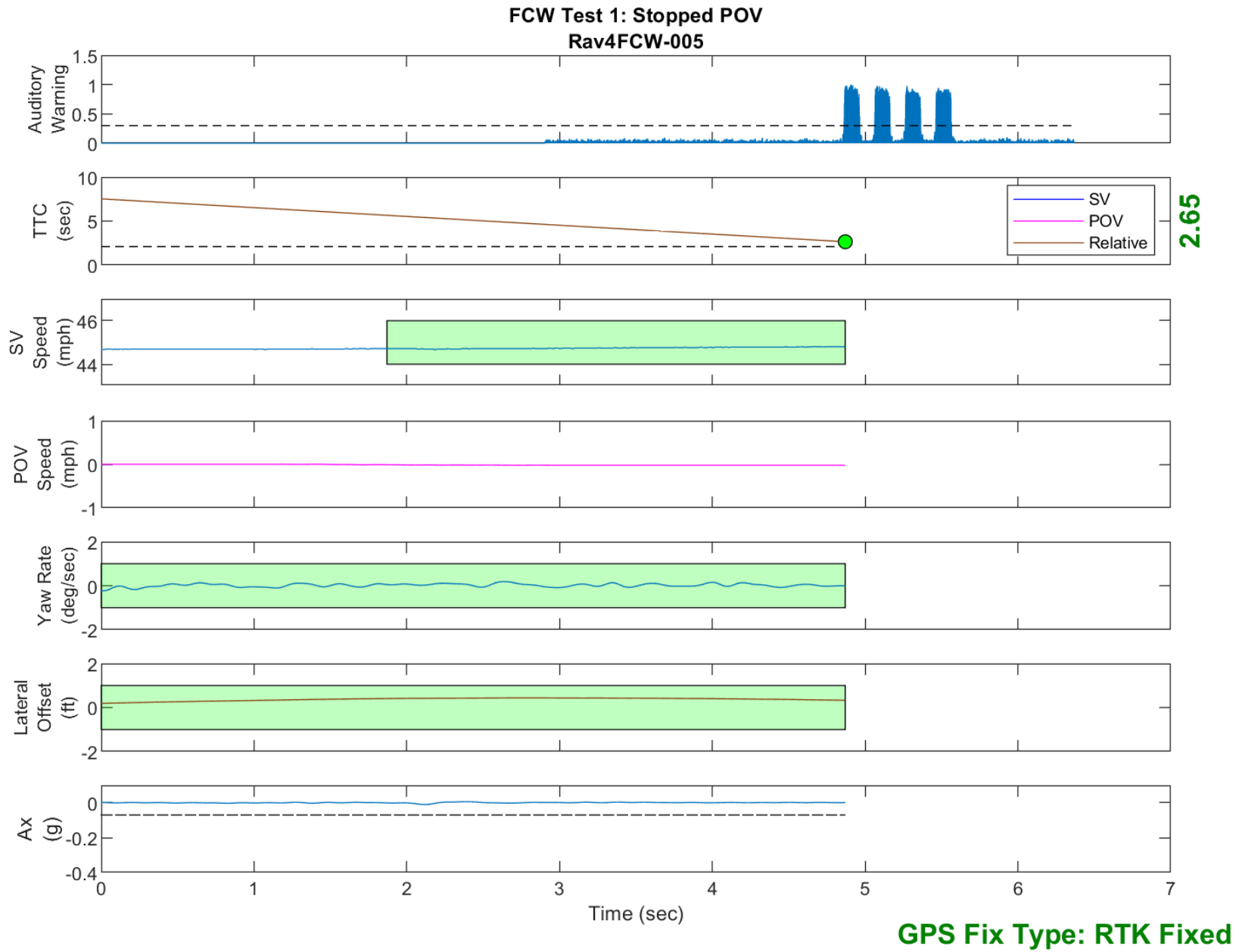


Figure D15. Time History for Run 5, Test 1 - Stopped POV, Auditory Warning

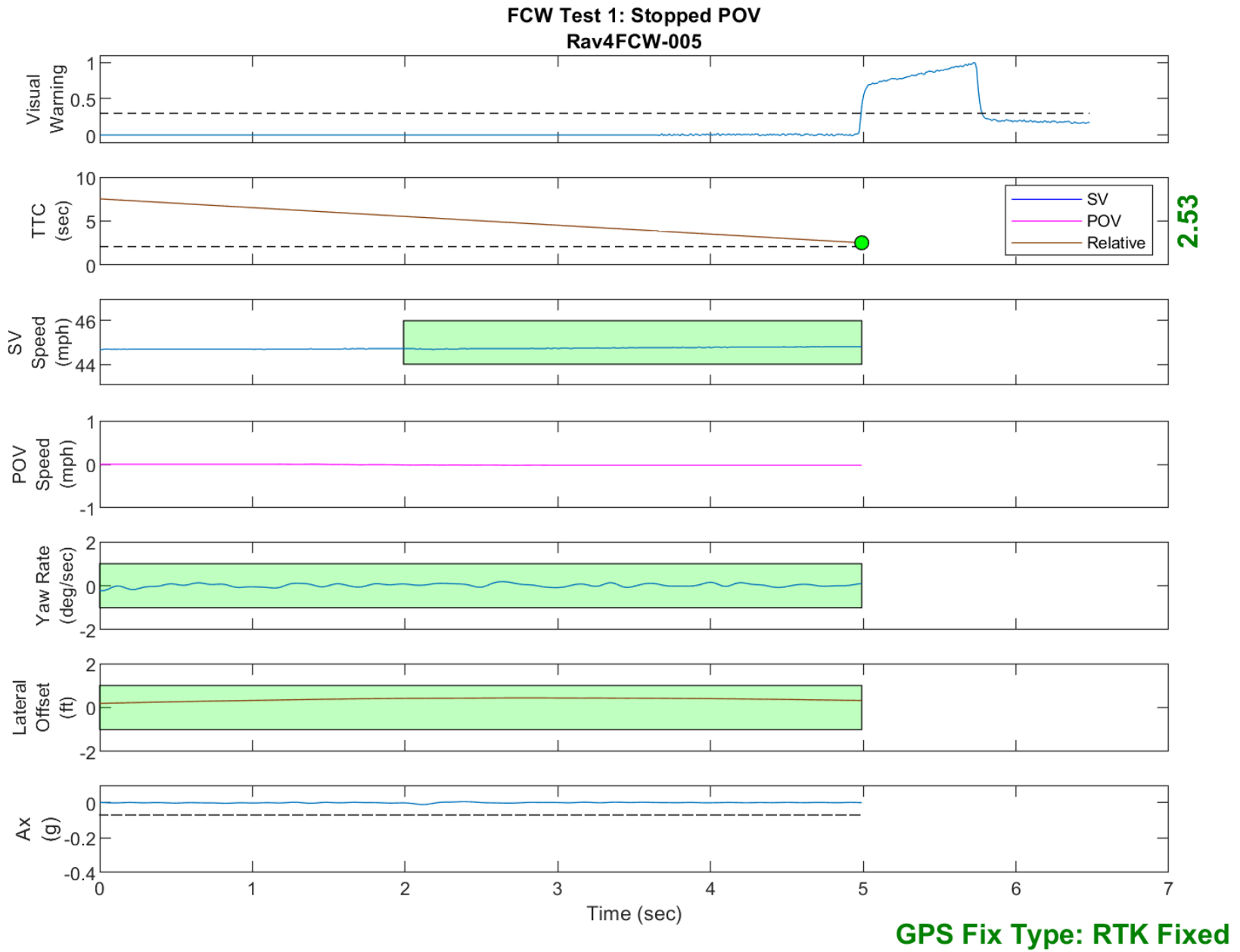


Figure D16. Time History for Run 5, Test 1 - Stopped POV, Visual Warning

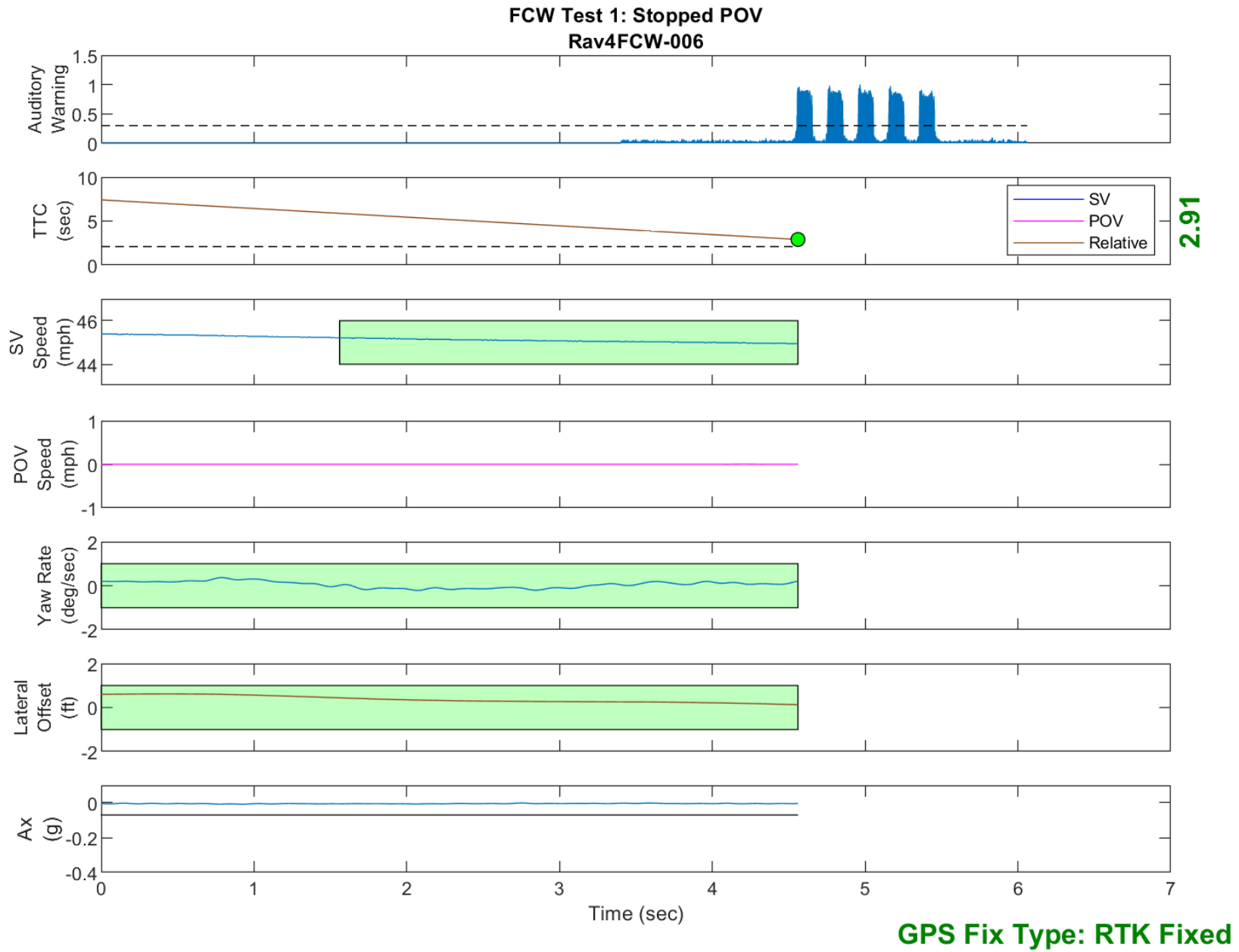


Figure D17. Time History for Run 6, Test 1 - Stopped POV, Auditory Warning

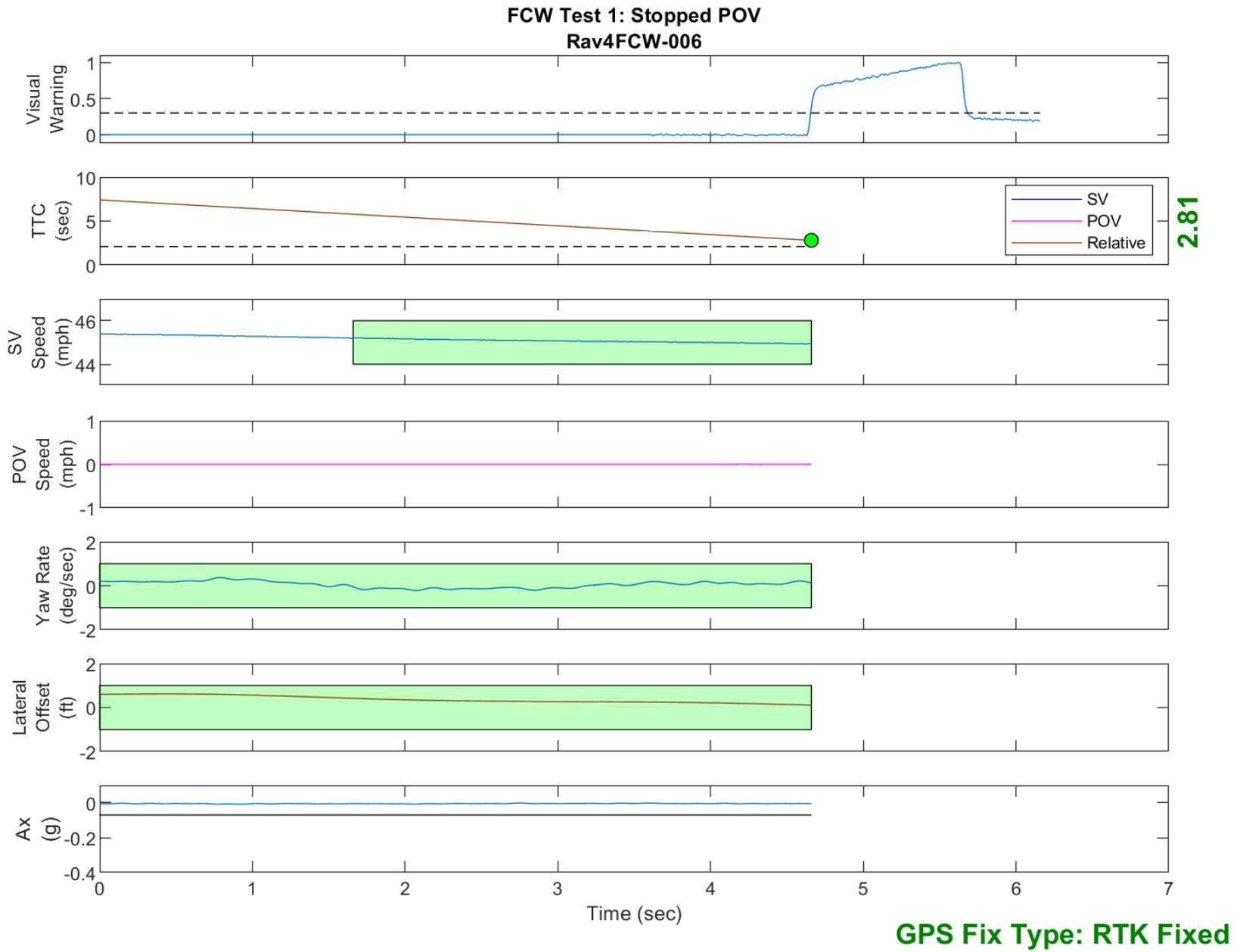


Figure D18. Time History for Run 6, Test 1 - Stopped POV, Visual Warning

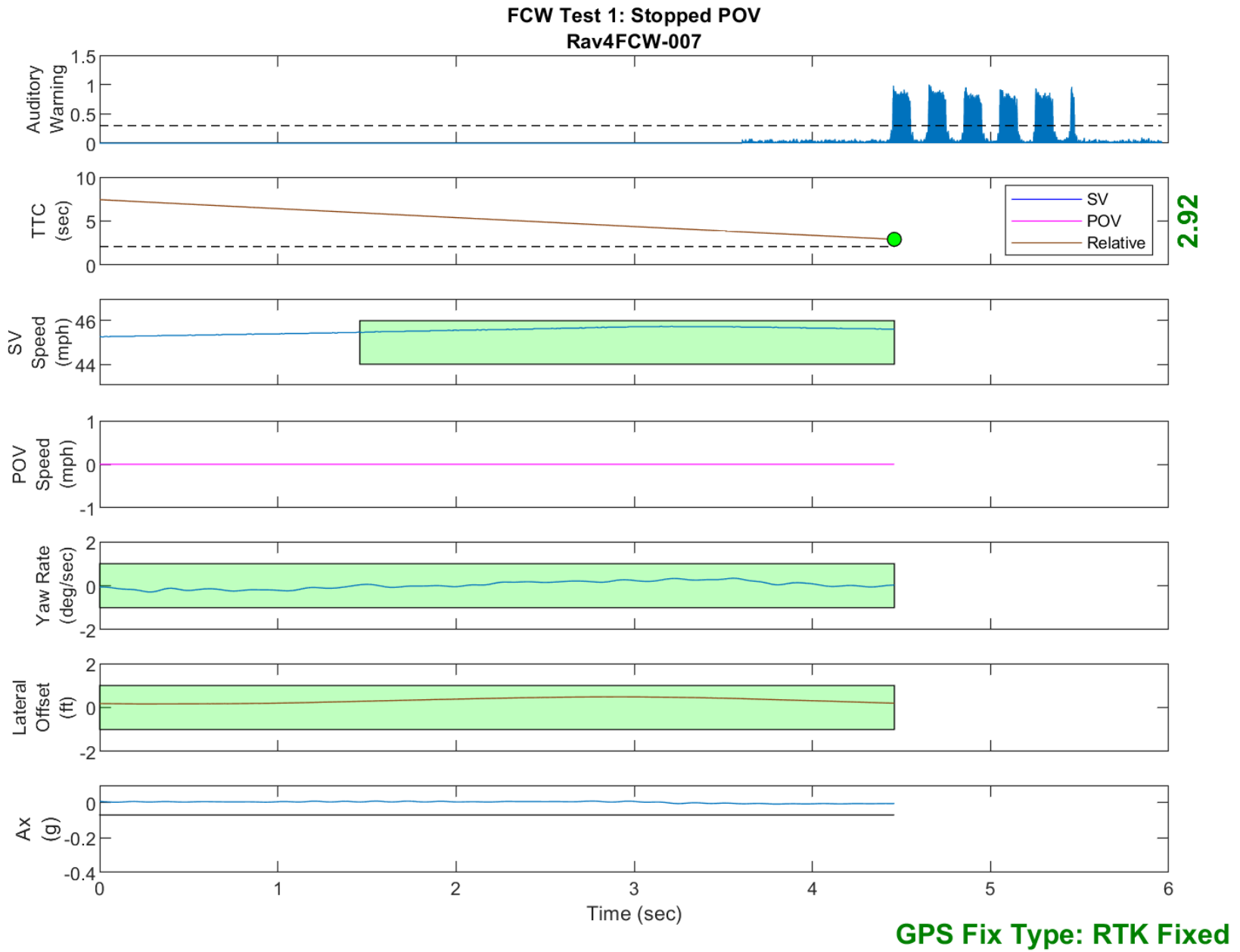


Figure D19. Time History for Run 7, Test 1 - Stopped POV, Auditory Warning

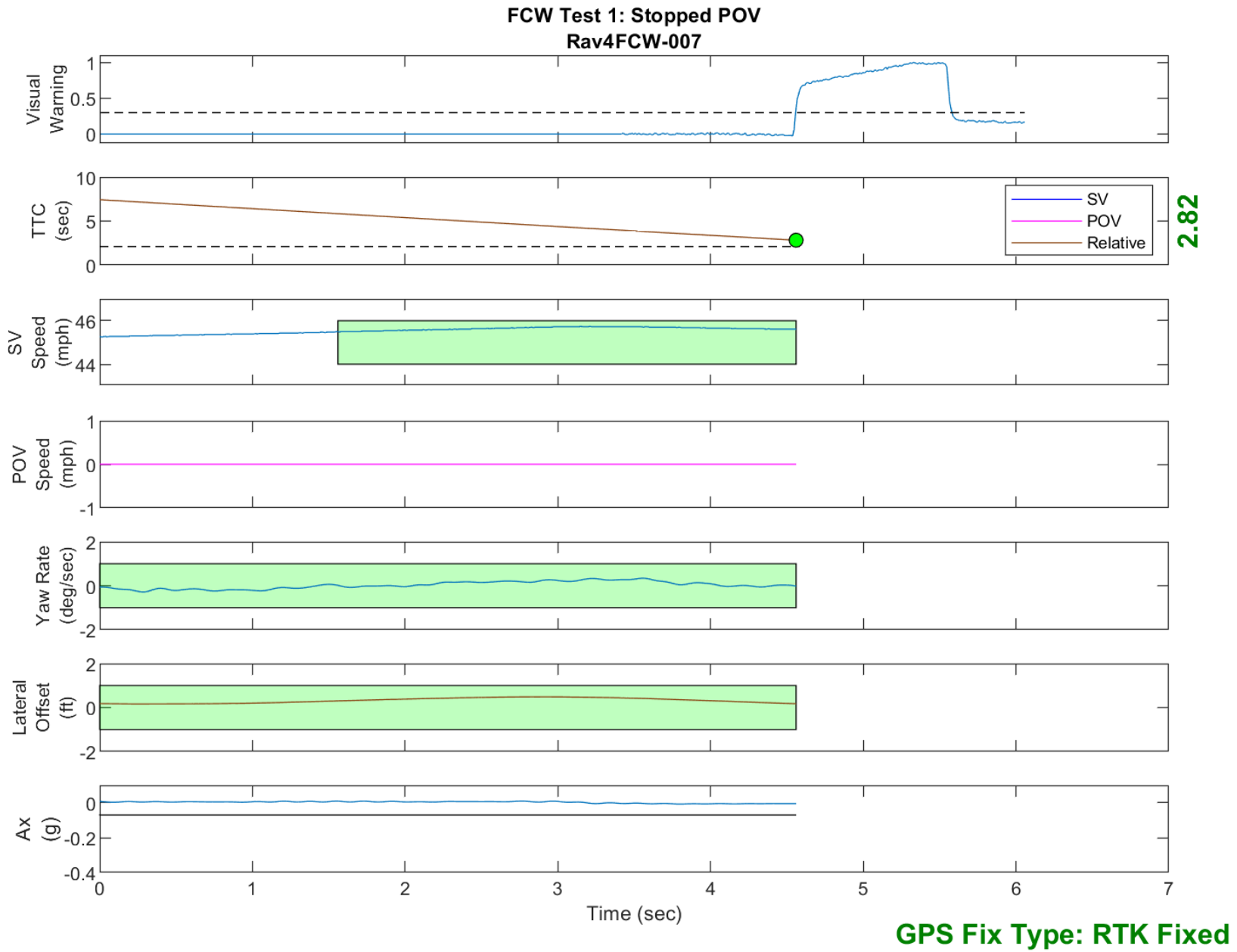


Figure D20. Time History for Run 7, Test 1 - Stopped POV, Visual Warning

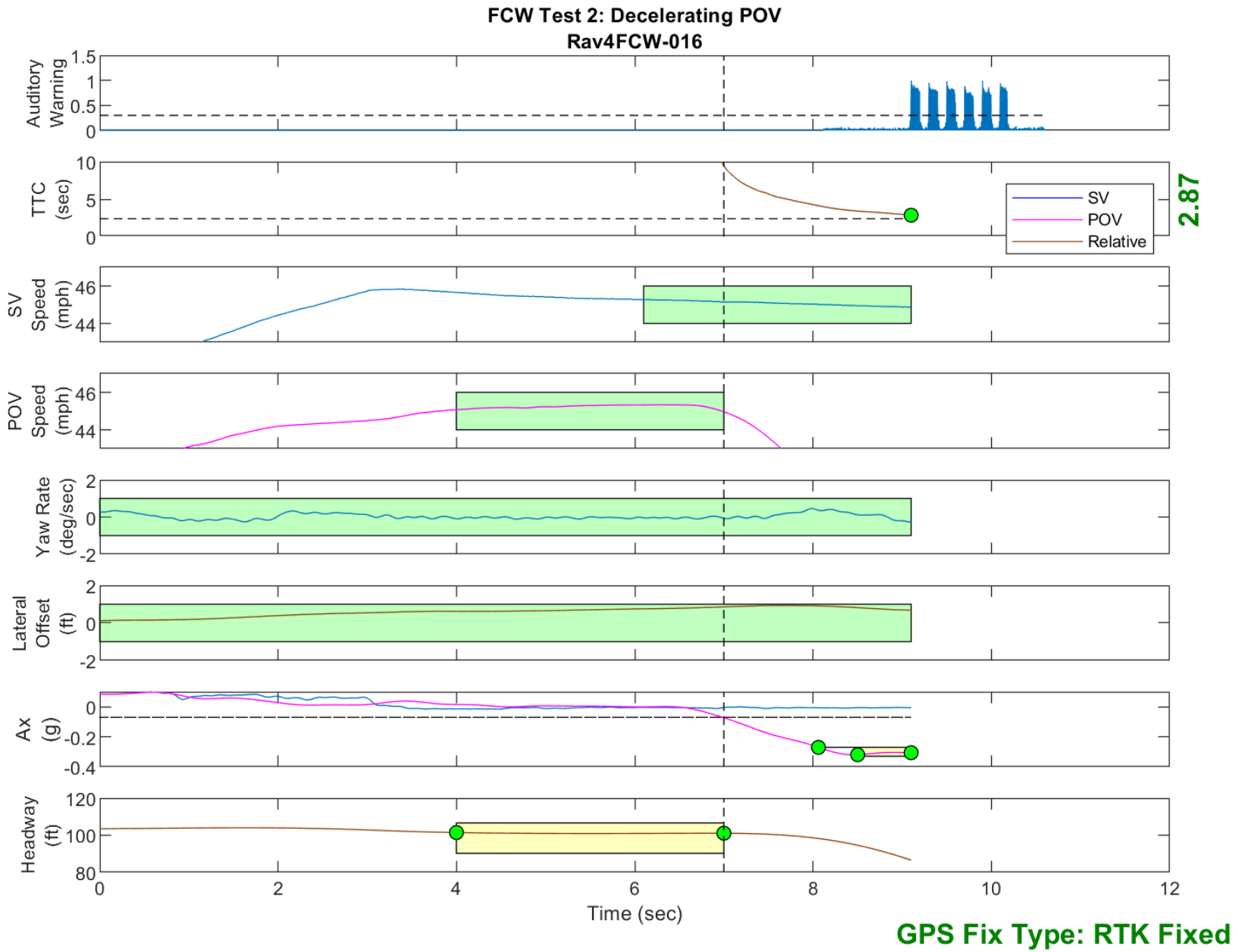


Figure D21. Time History for Run 16, Test 2 - Decelerating POV, Auditory Warning

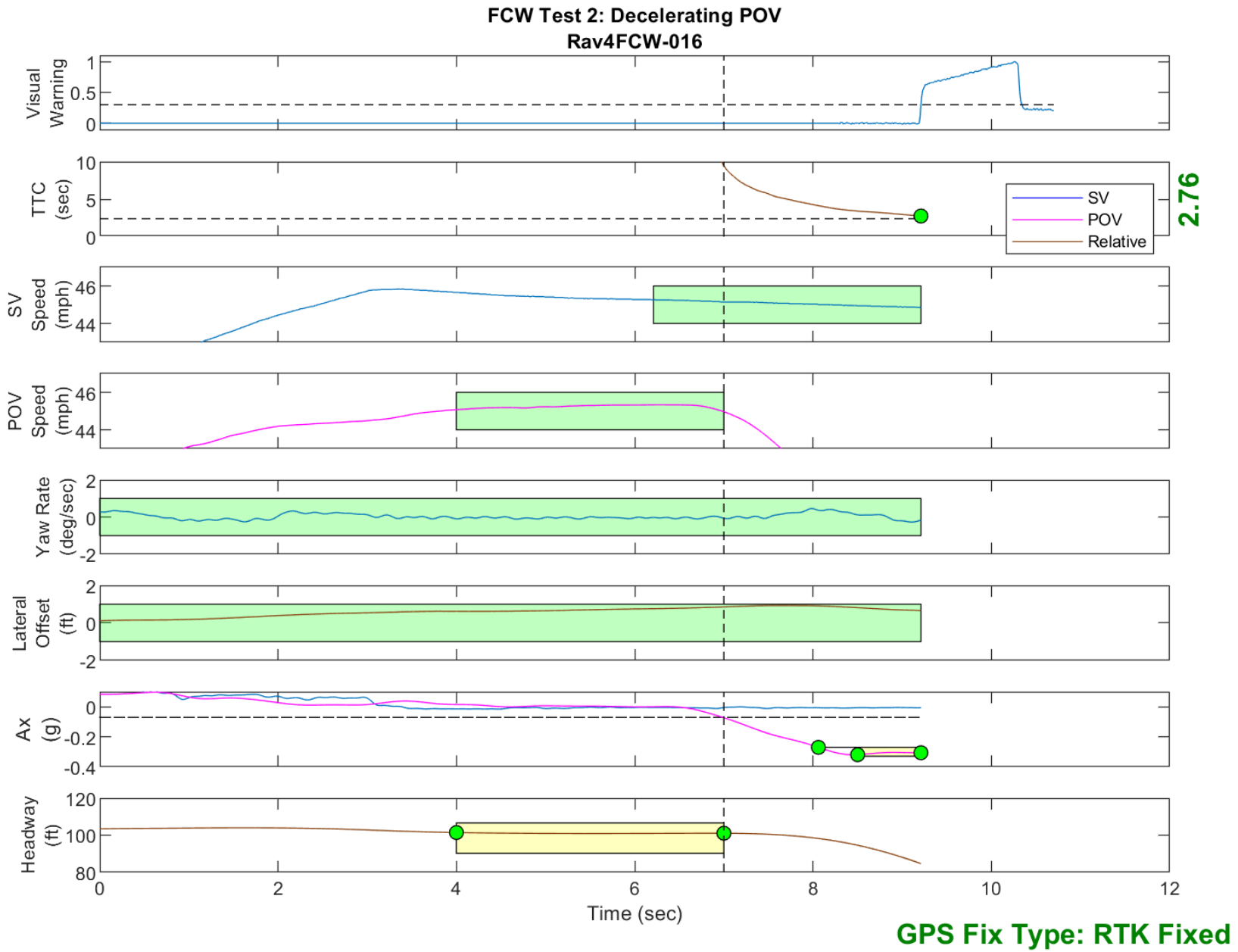


Figure D22. Time History for Run 16, Test 2 - Decelerating POV, Visual Warning

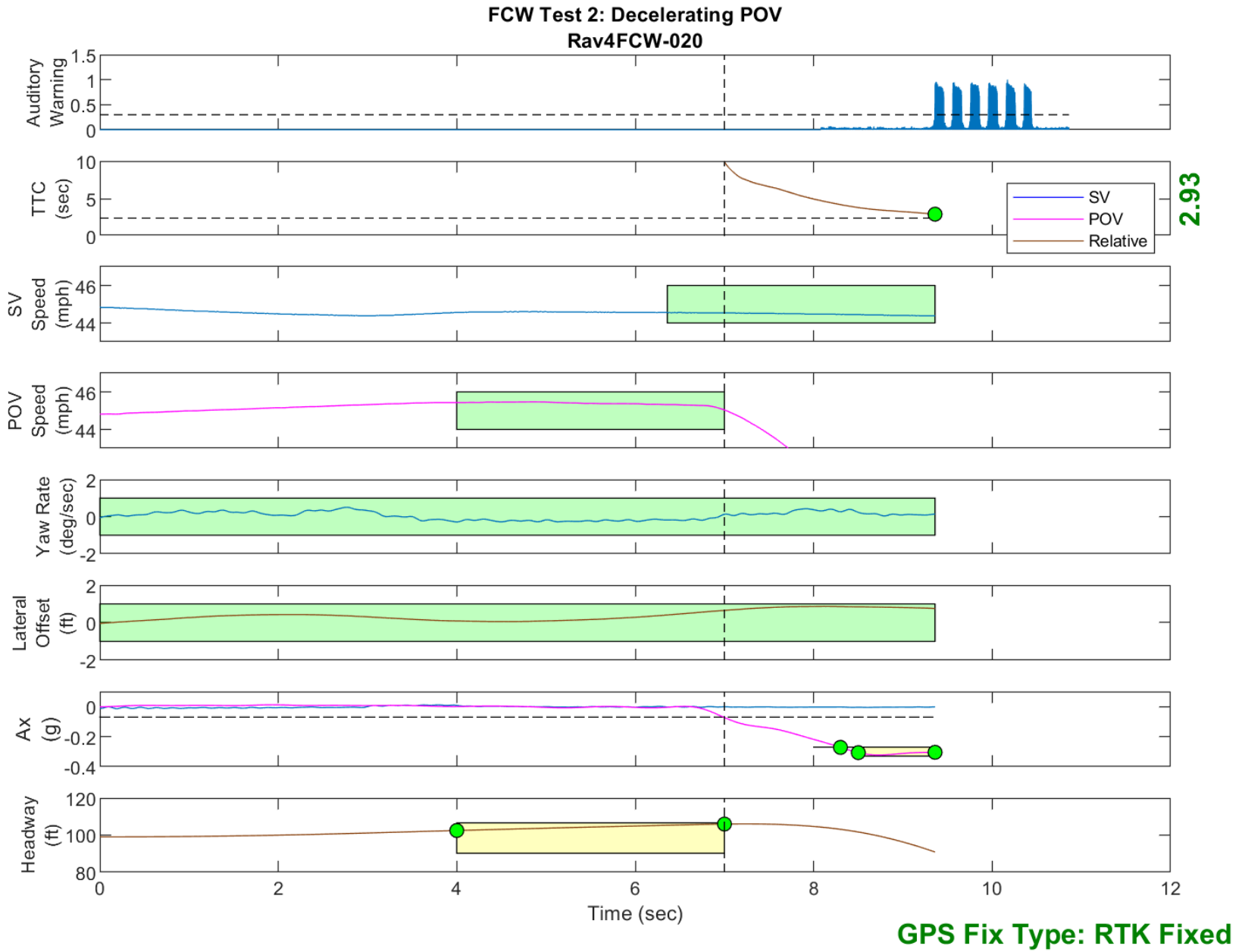


Figure D23. Time History for Run 20, Test 2 - Decelerating POV, Auditory Warning

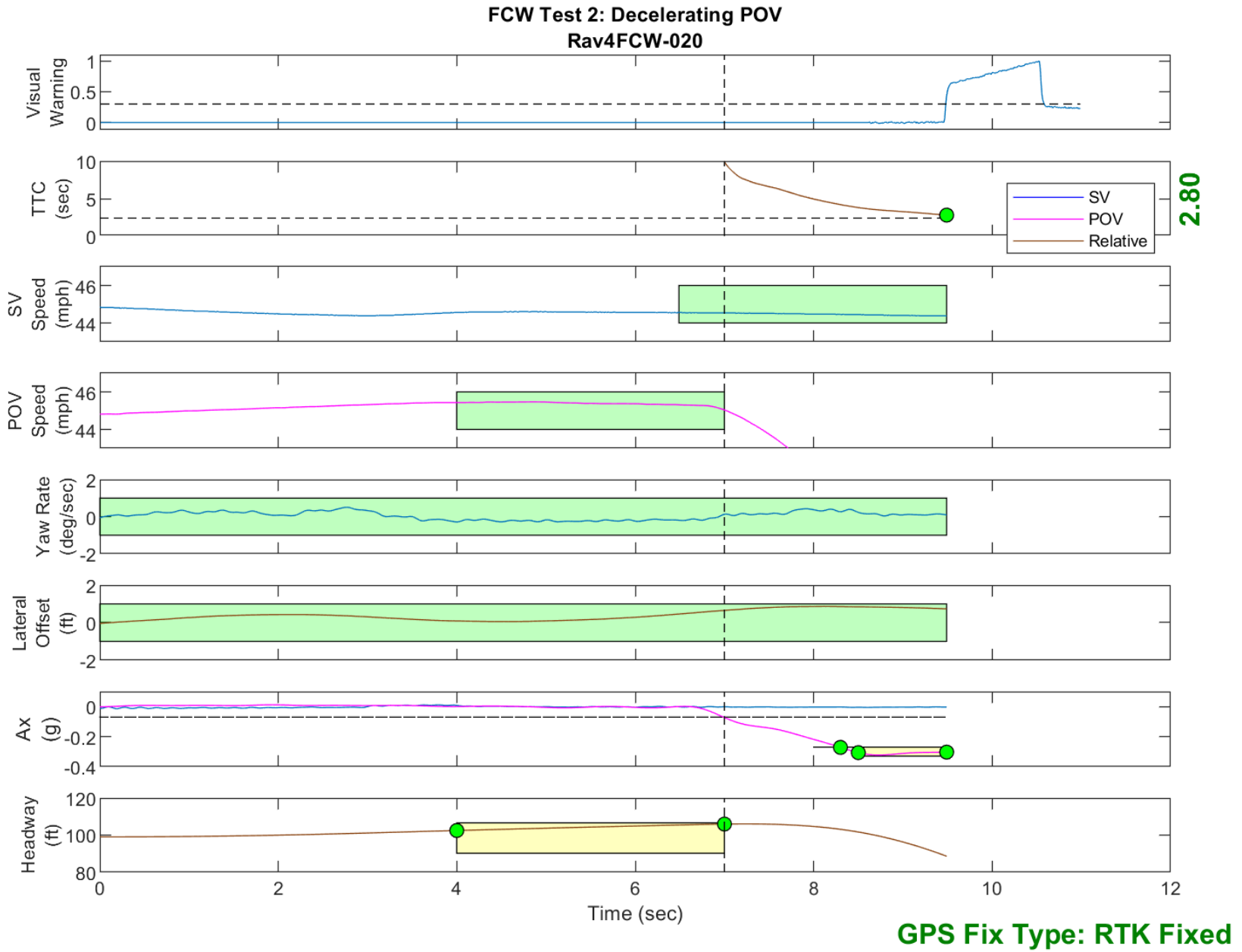


Figure D24. Time History for Run 20, Test 2 - Decelerating POV, Visual Warning

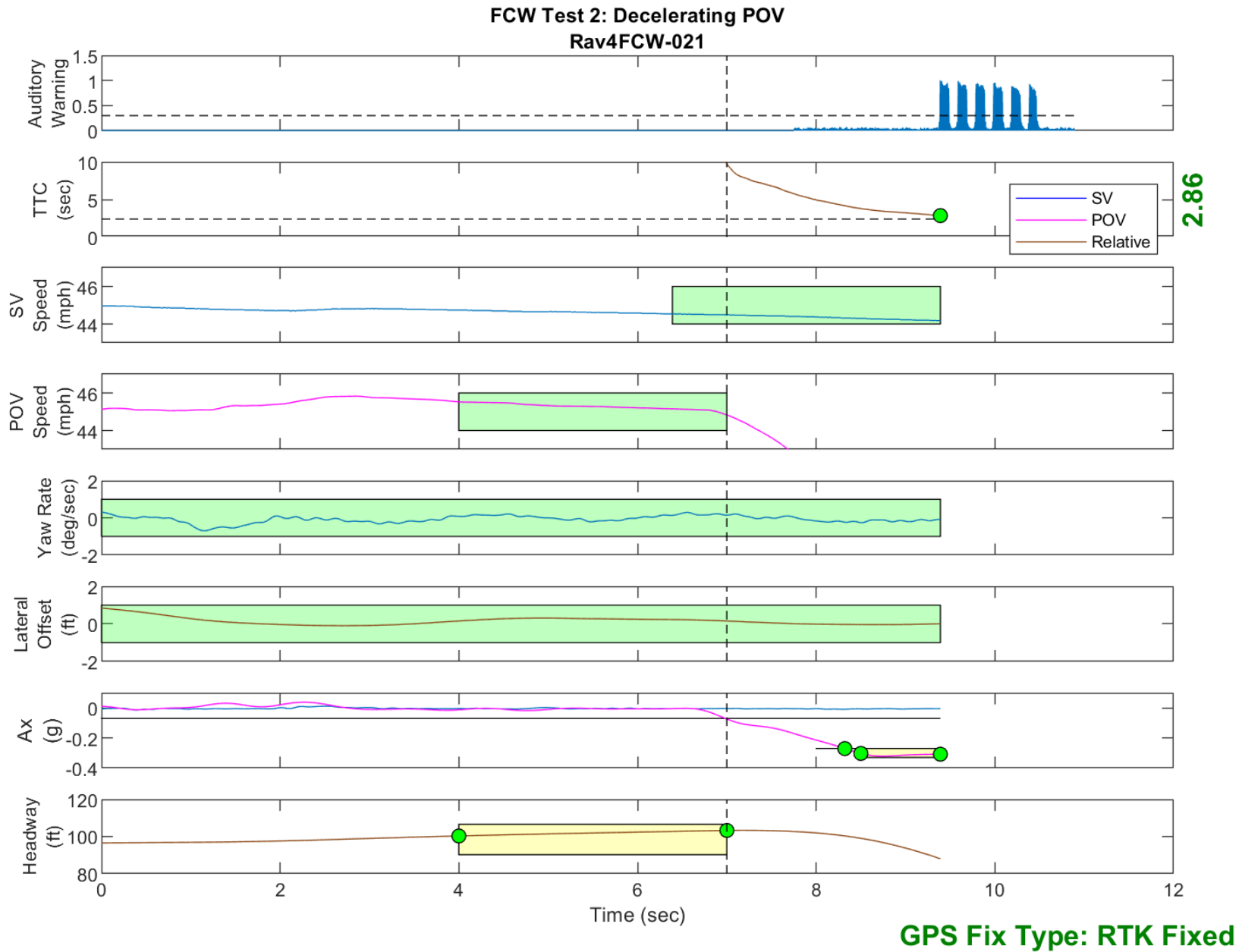


Figure D25. Time History for Run 21, Test 2 - Decelerating POV, Auditory Warning

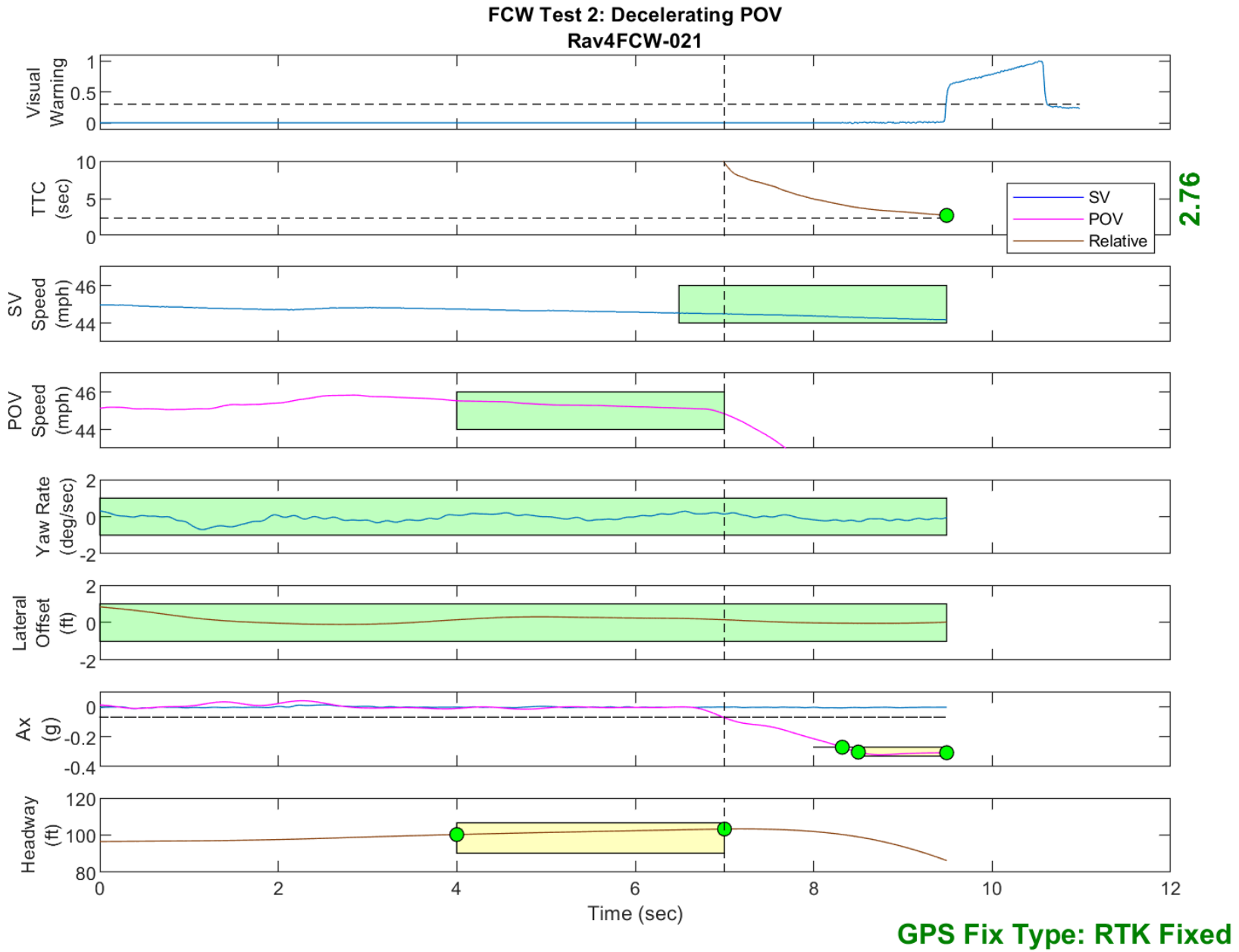


Figure D26. Time History for Run 21, Test 2 - Decelerating POV, Visual Warning

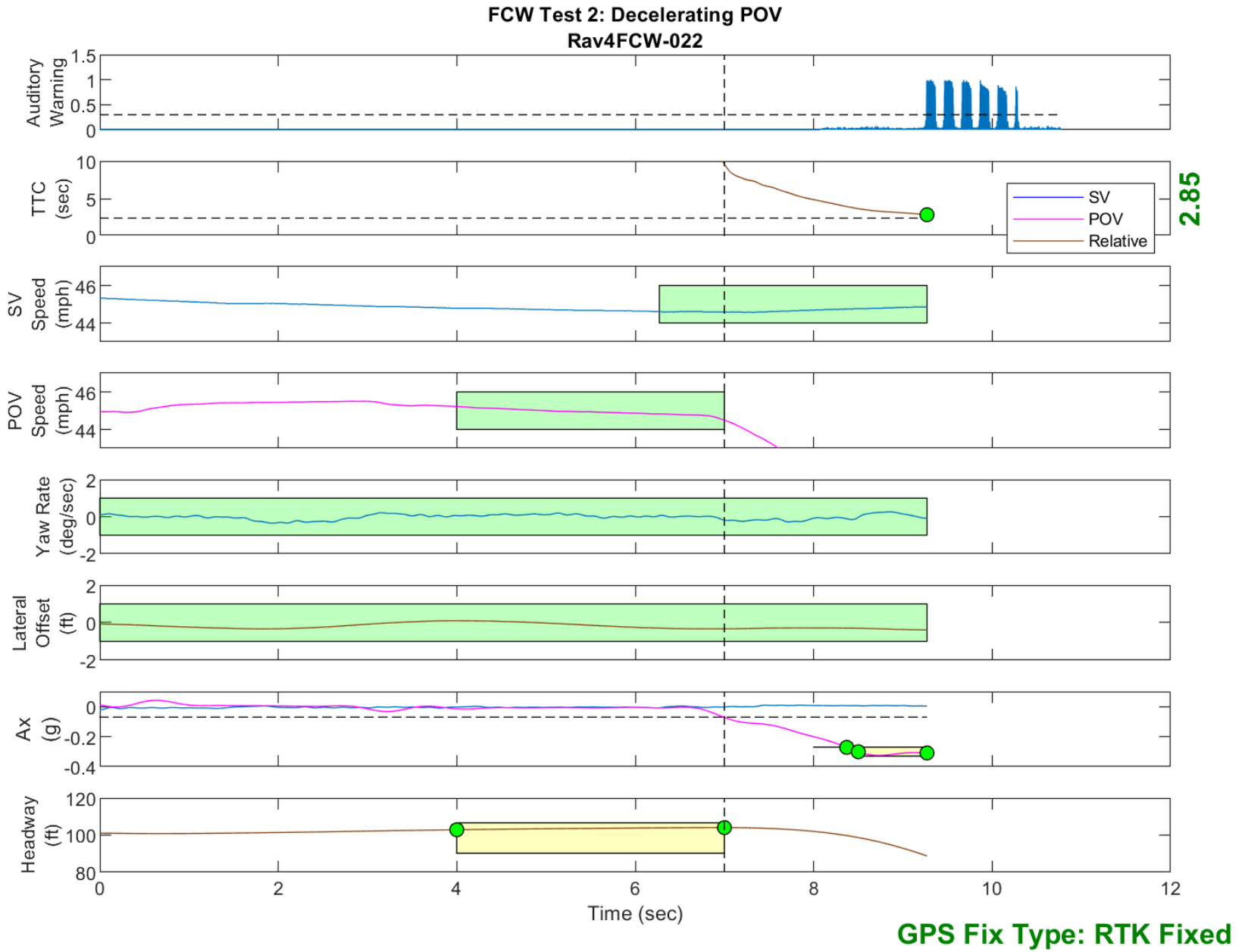


Figure D27. Time History for Run 22, Test 2 - Decelerating POV, Auditory Warning

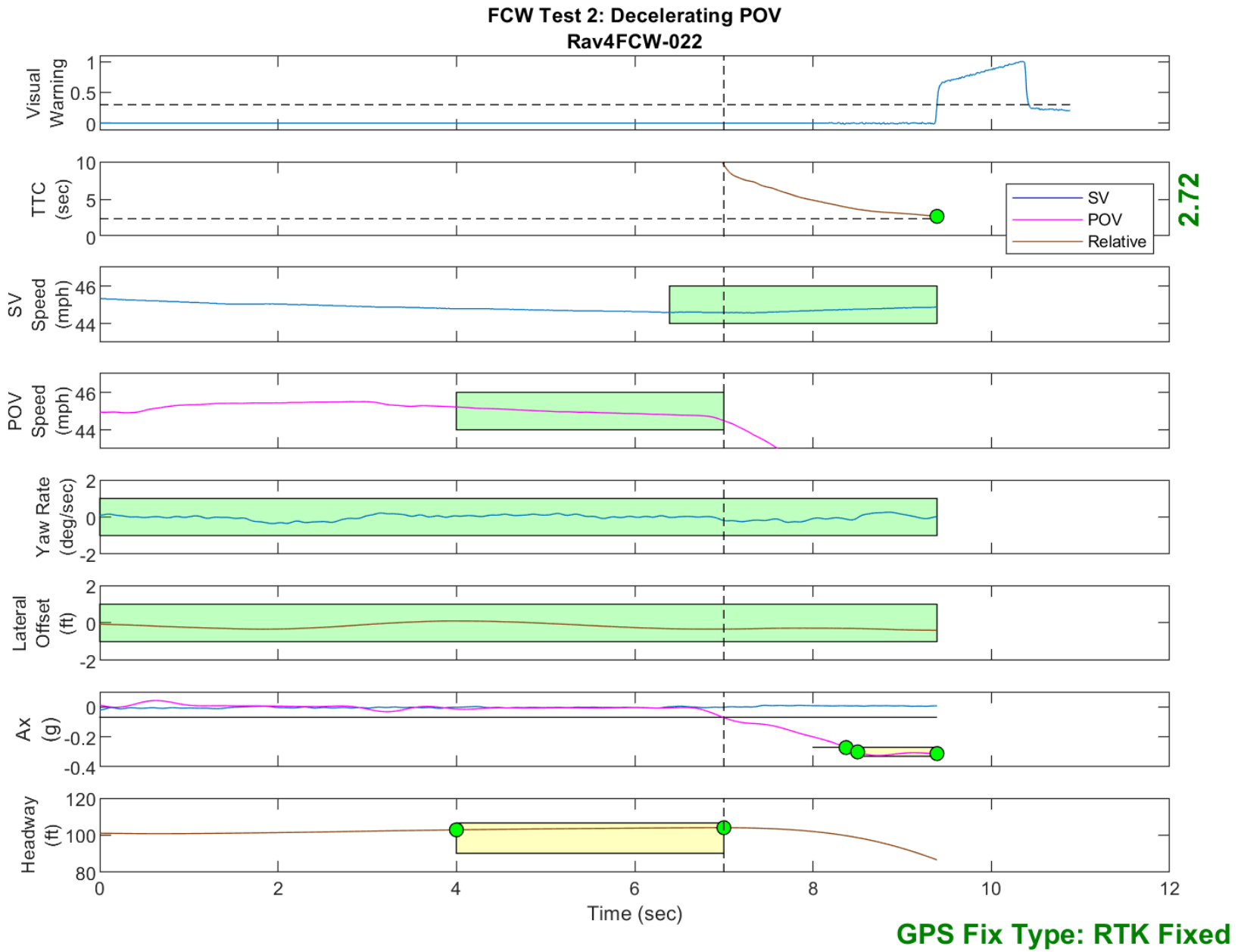


Figure D28. Time History for Run 22, Test 2 - Decelerating POV, Visual Warning

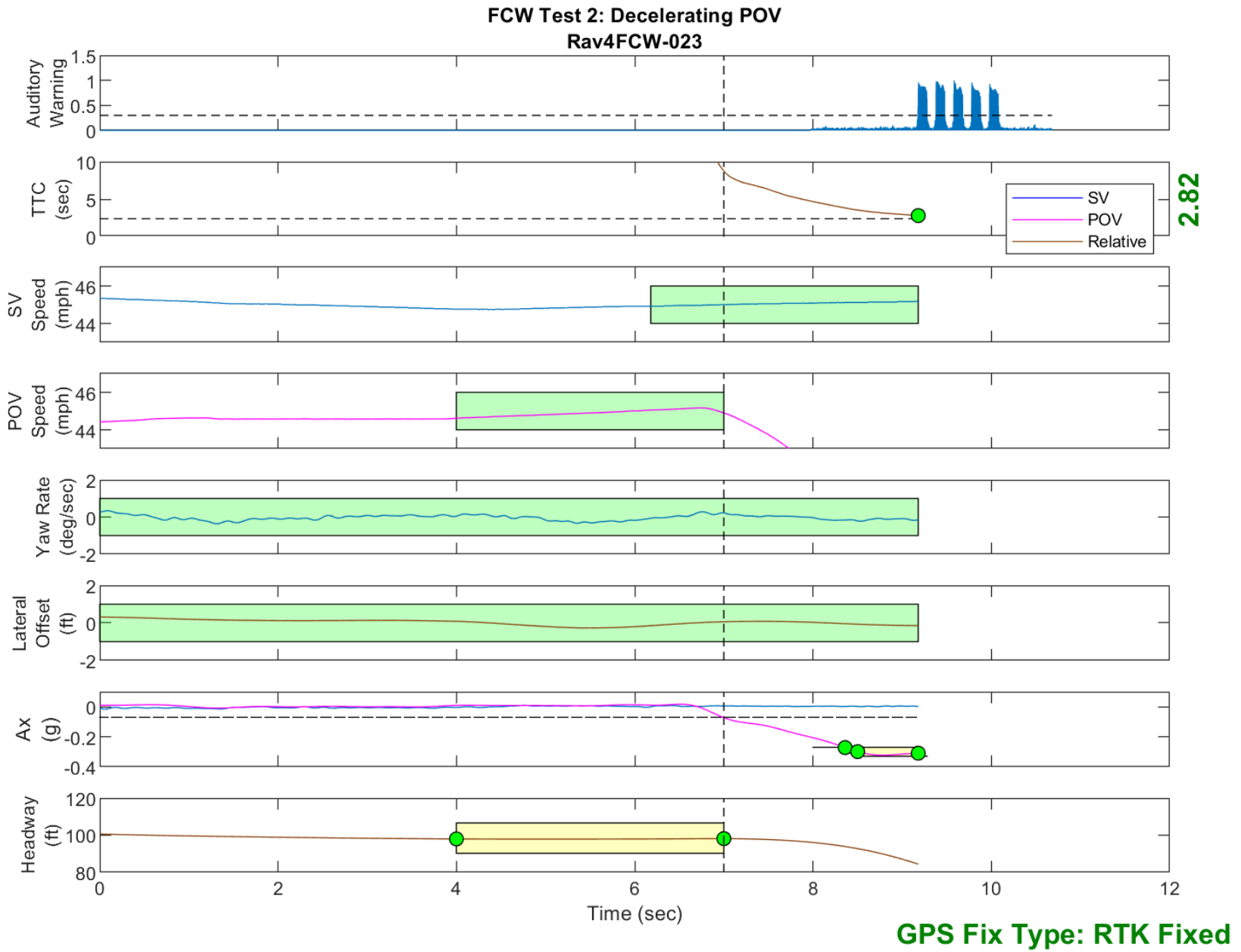


Figure D29. Time History for Run 23, Test 2 - Decelerating POV, Auditory Warning

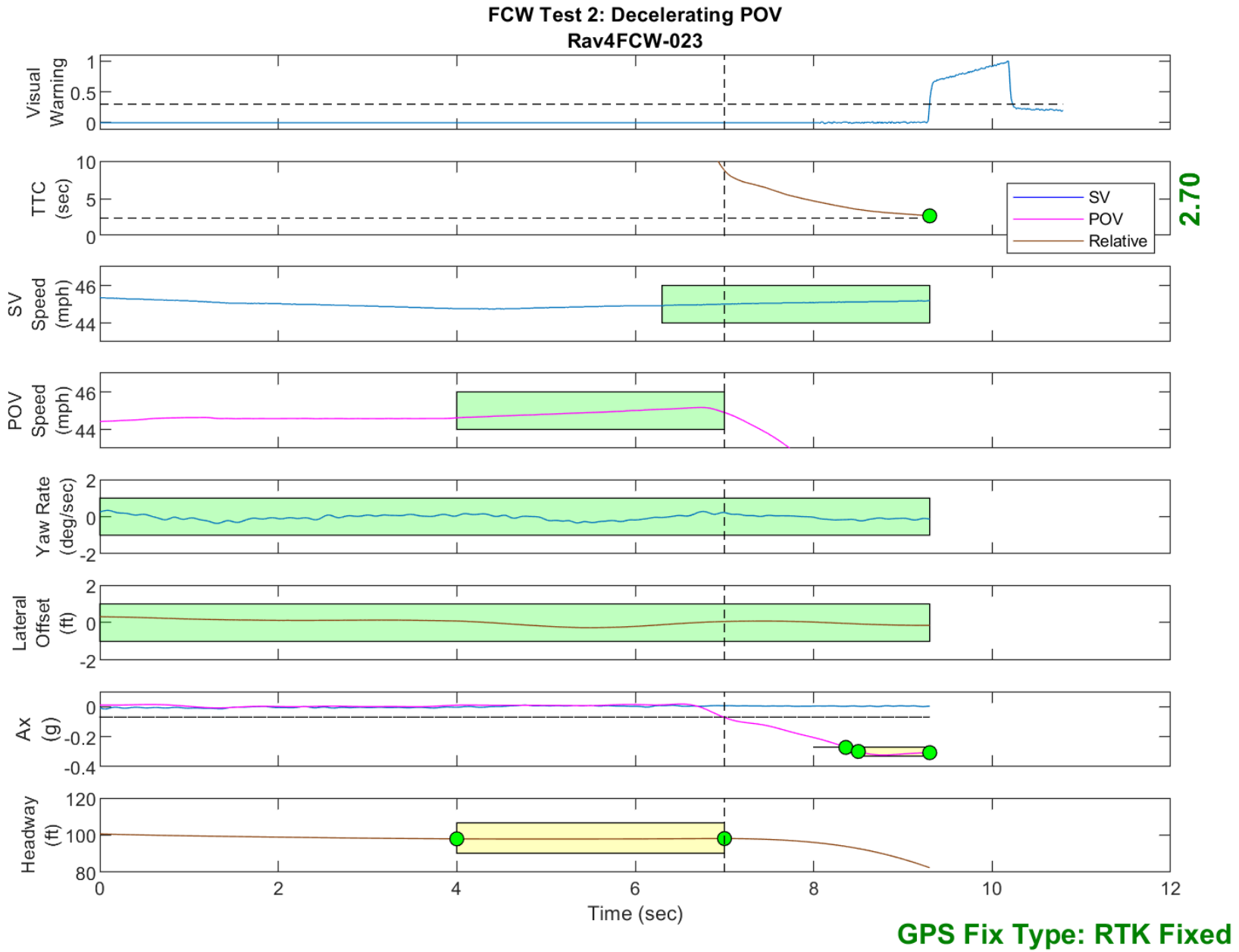


Figure D30. Time History for Run 23, Test 2 - Decelerating POV, Visual Warning

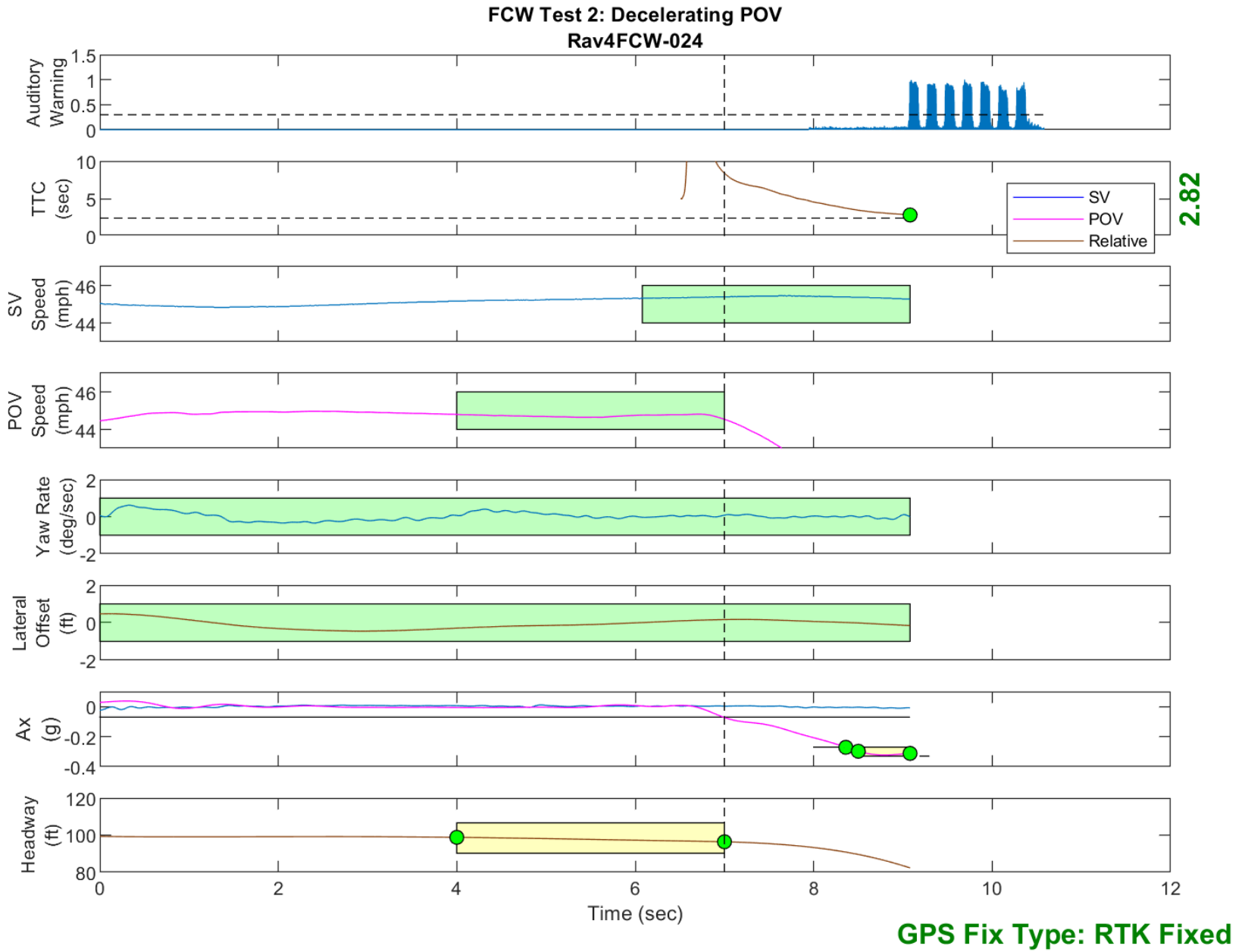


Figure D31. Time History for Run 24, Test 2 - Decelerating POV, Auditory Warning

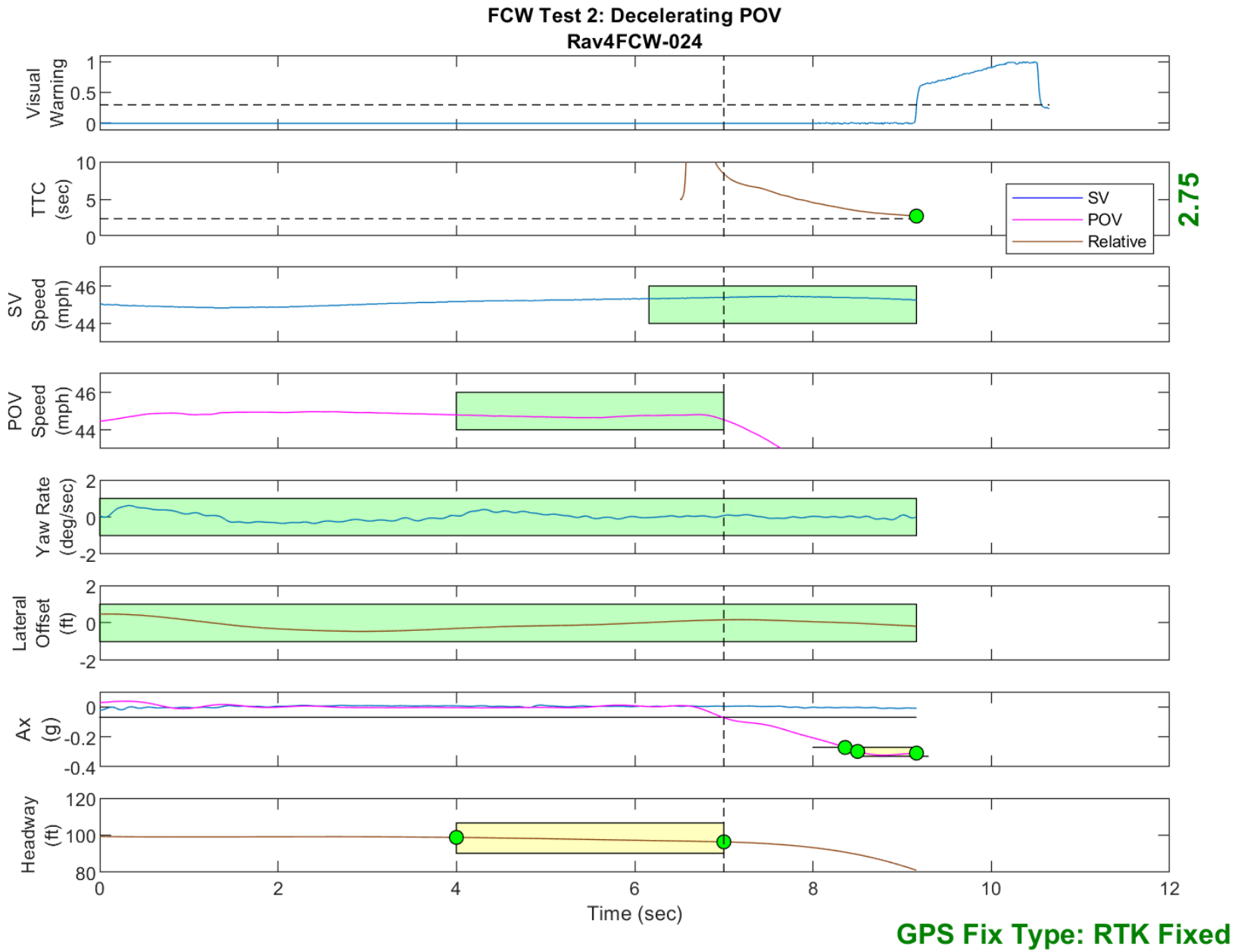


Figure D32. Time History for Run 24, Test 2 - Decelerating POV, Visual Warning

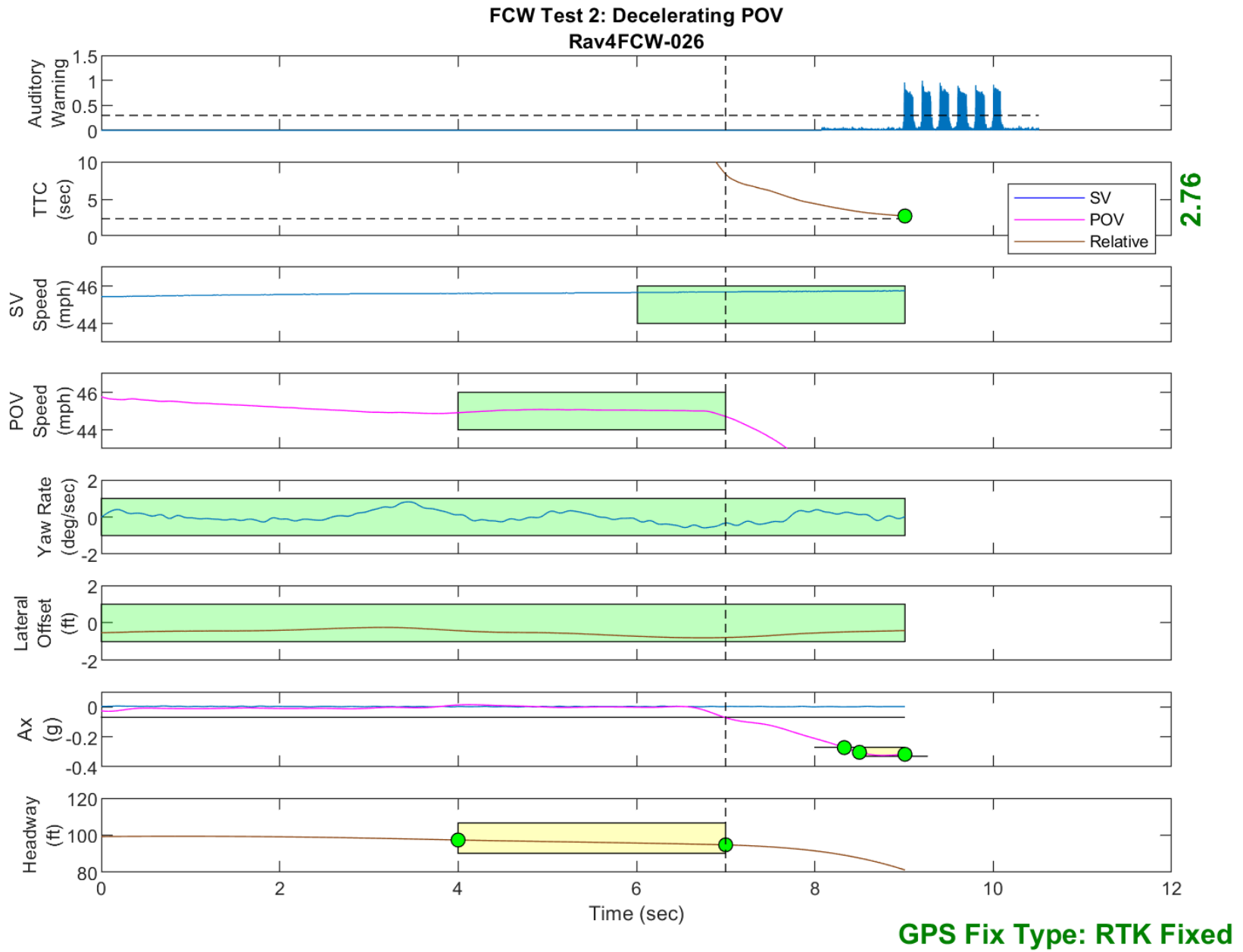


Figure D33. Time History for Run 26, Test 2 - Decelerating POV, Auditory Warning

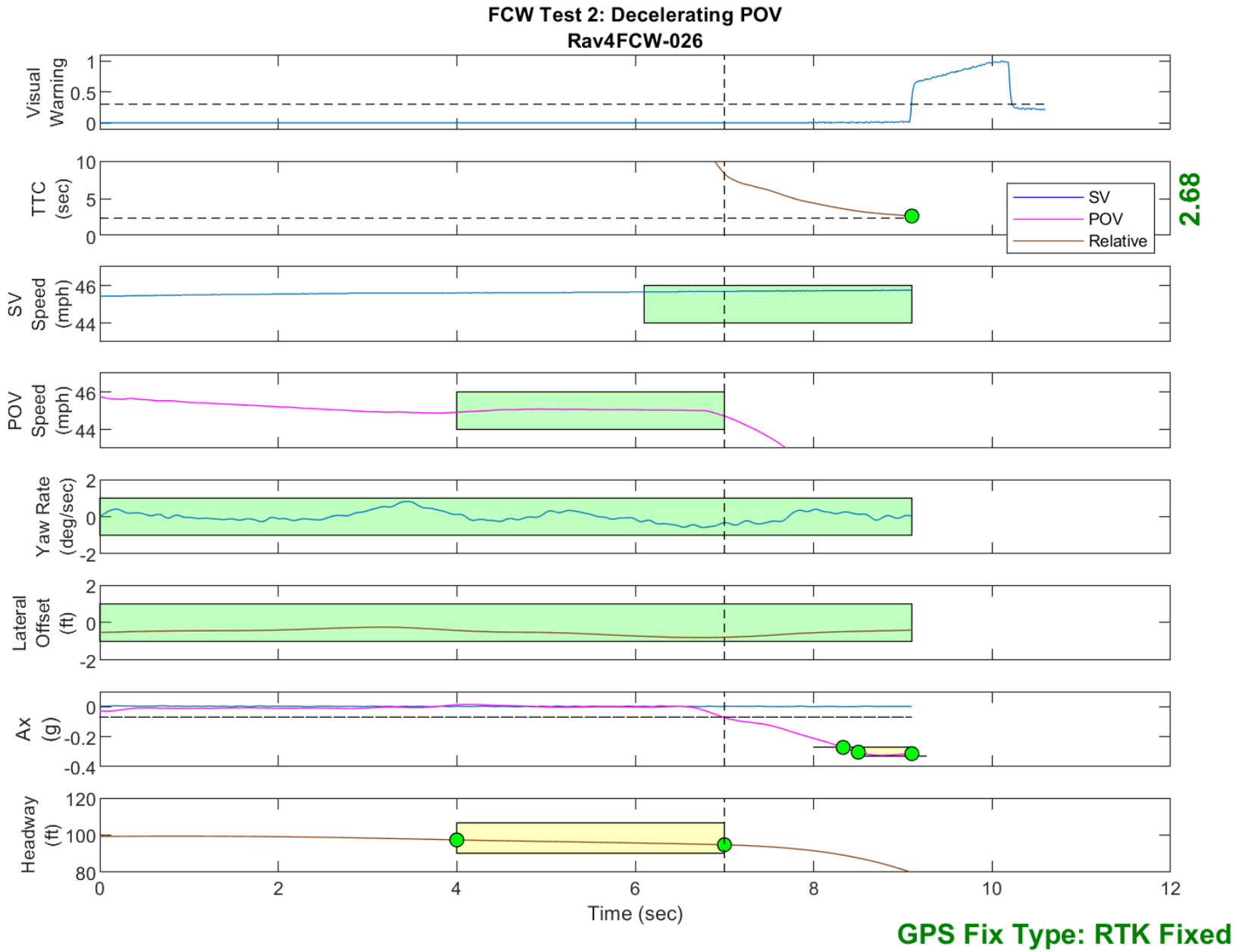


Figure D34. Time History for Run 26, Test 2 - Decelerating POV, Visual Warning

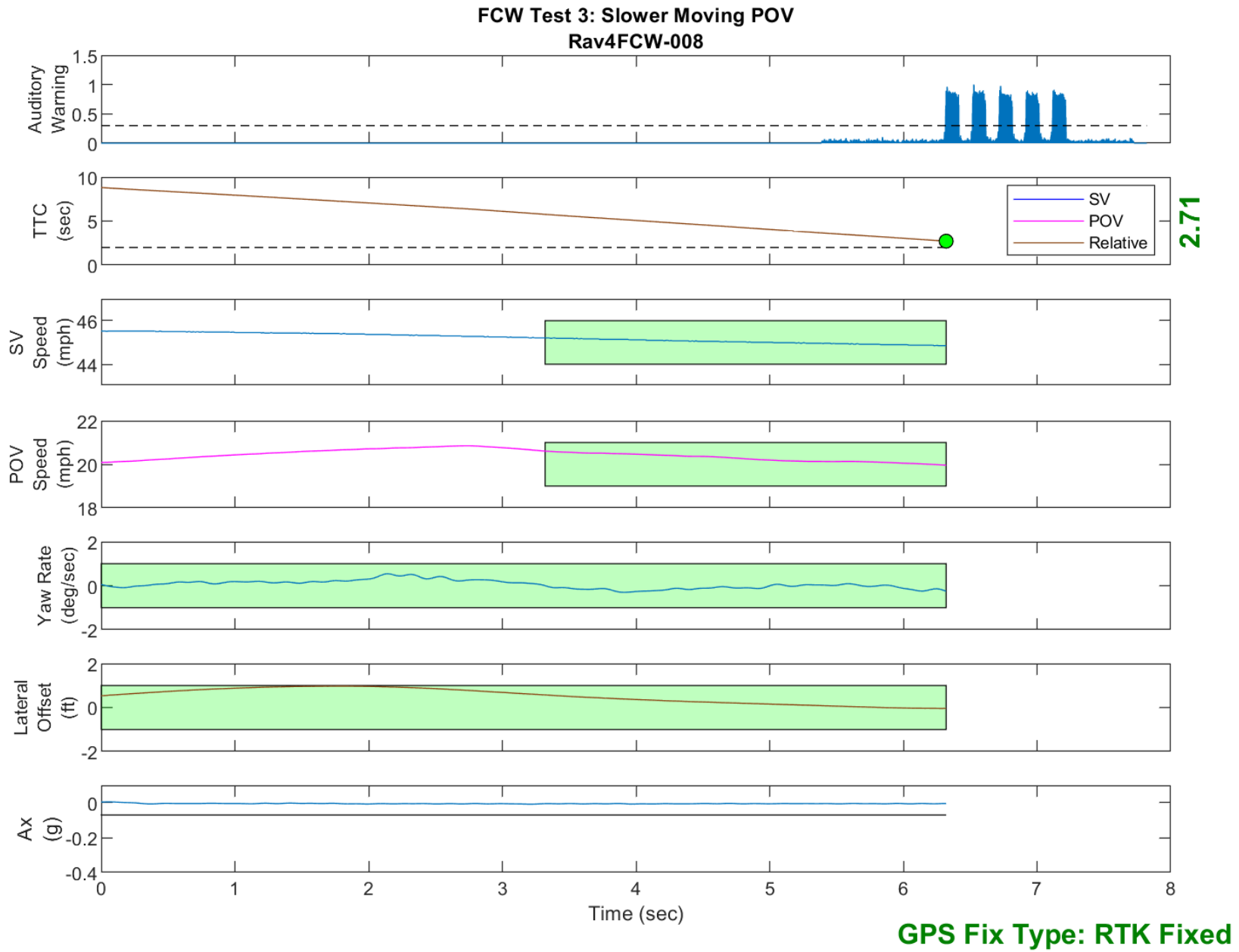


Figure D35. Time History for Run 8, Test 3 - Slower Moving POV, Auditory Warning

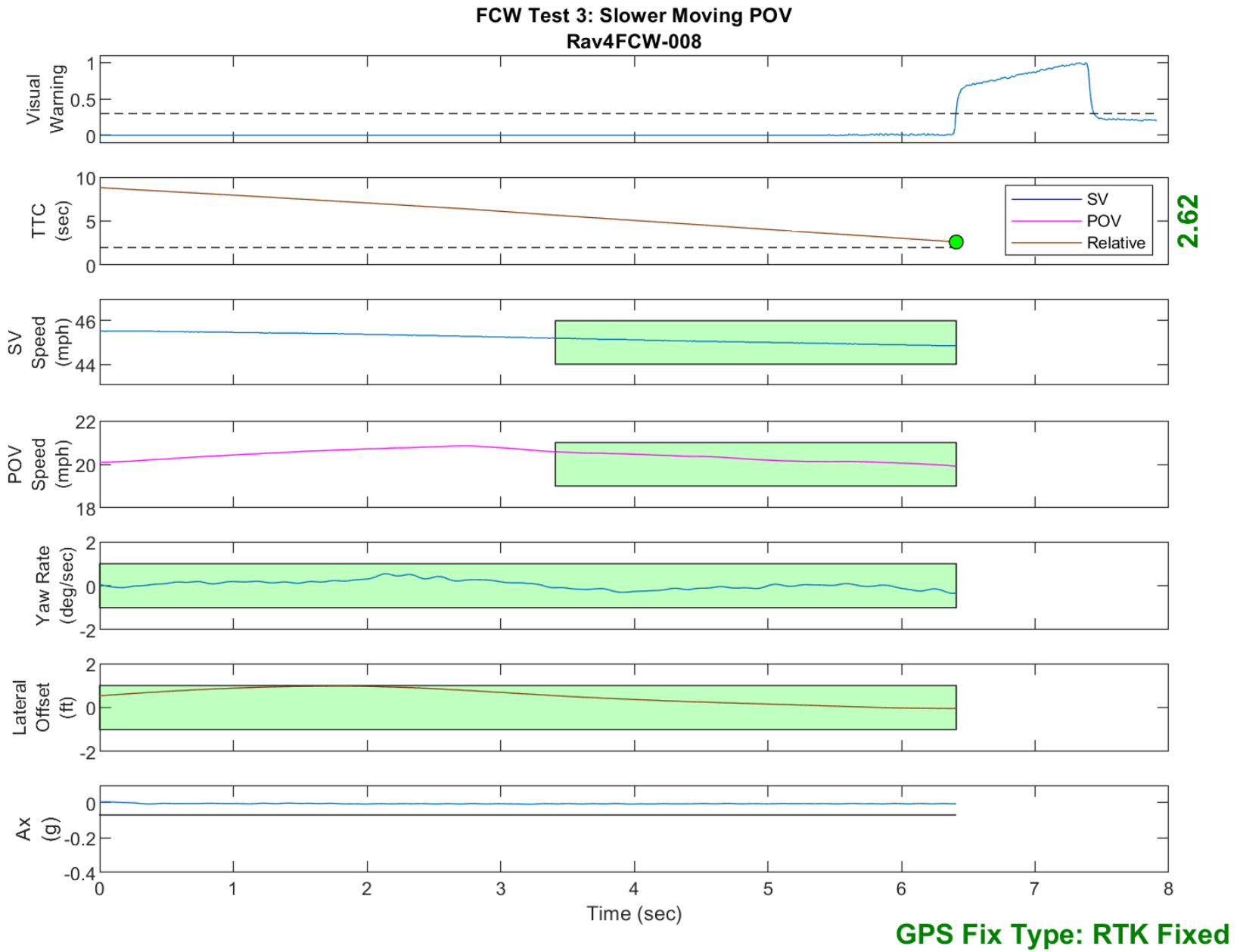


Figure D36. Time History for Run 8, Test 3 - Slower Moving POV, Visual Warning

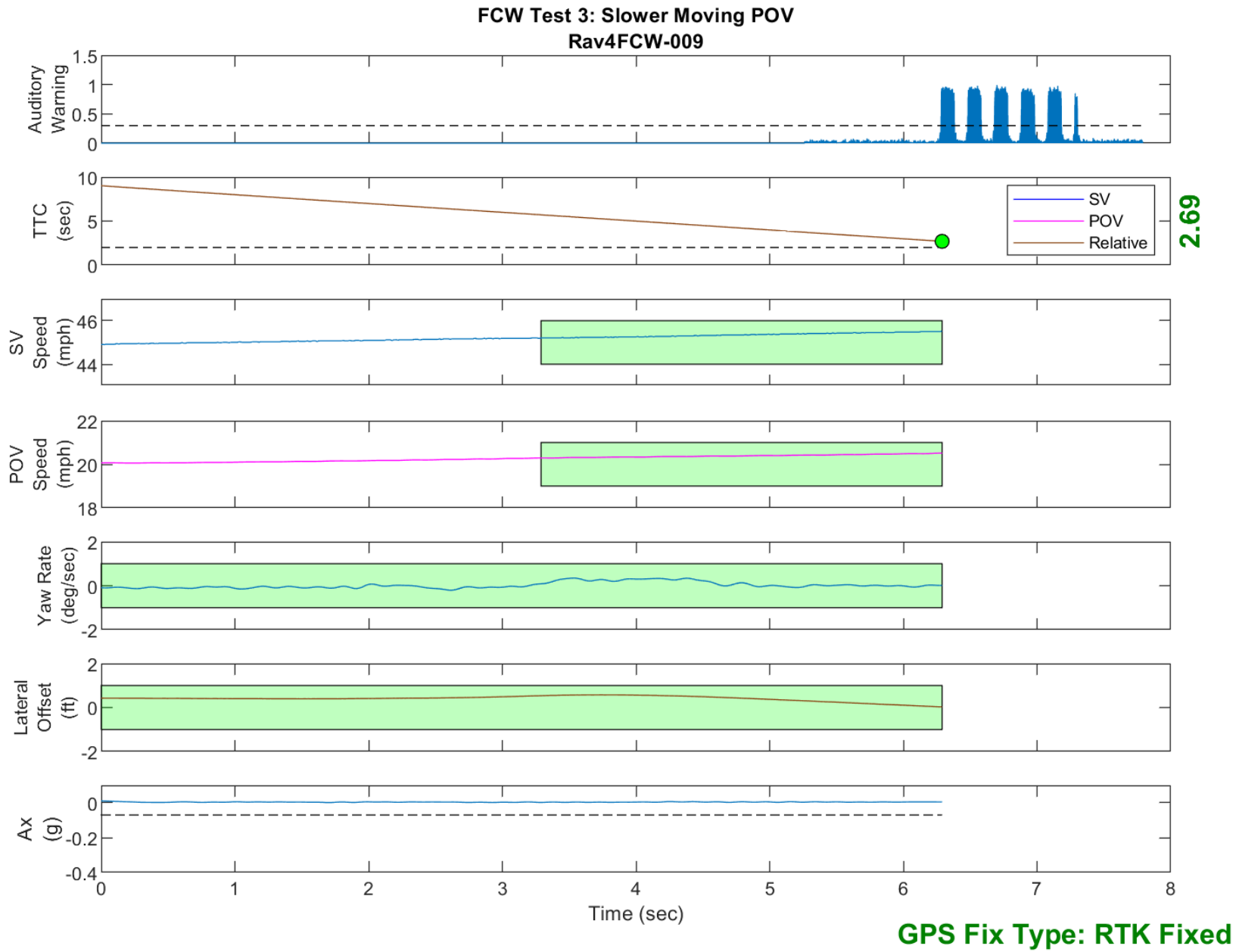


Figure D37. Time History for Run 9, Test 3 - Slower Moving POV, Auditory Warning

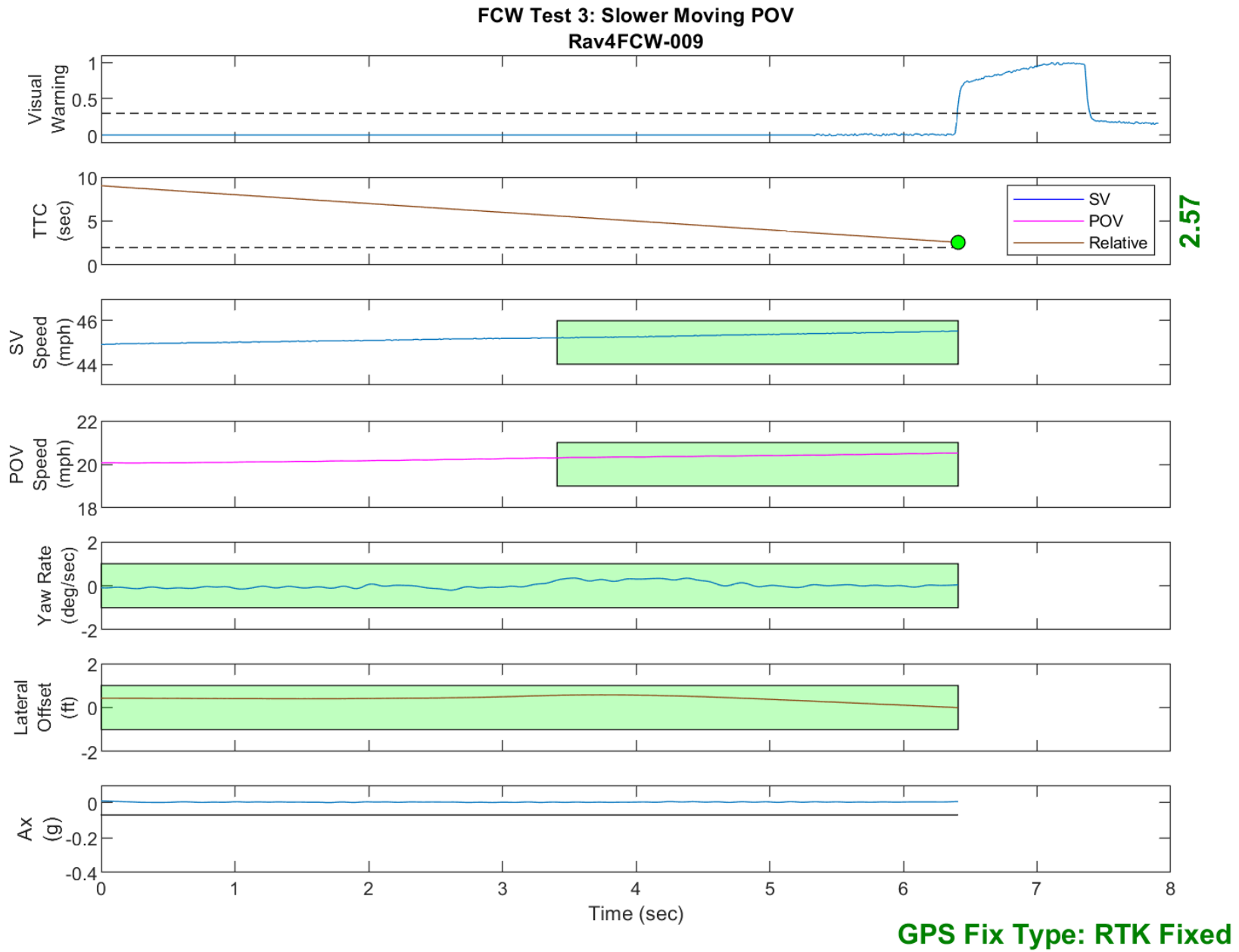


Figure D38. Time History for Run 9, Test 3 - Slower Moving POV, Visual Warning

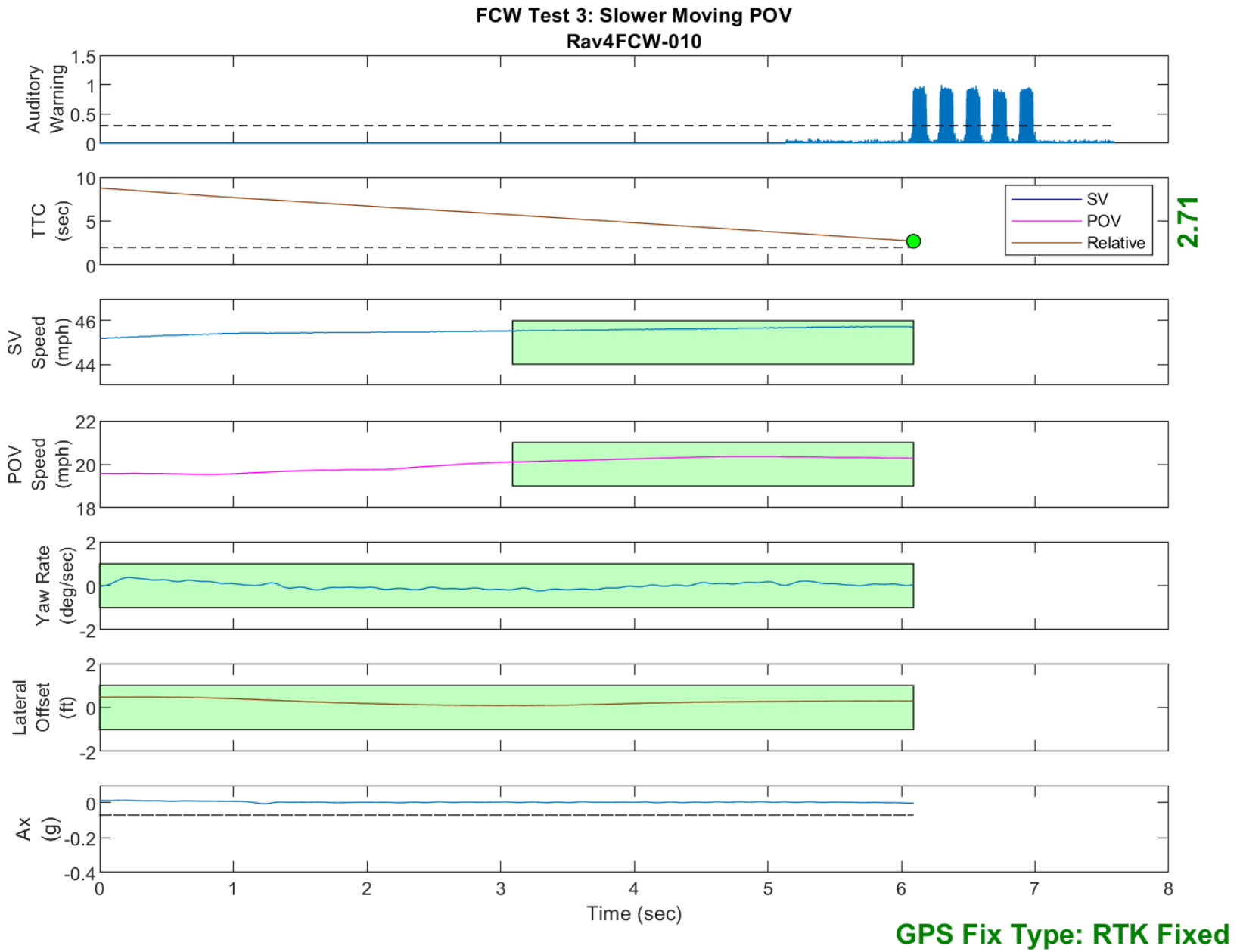


Figure D39. Time History for Run 10, Test 3 - Slower Moving POV, Auditory Warning

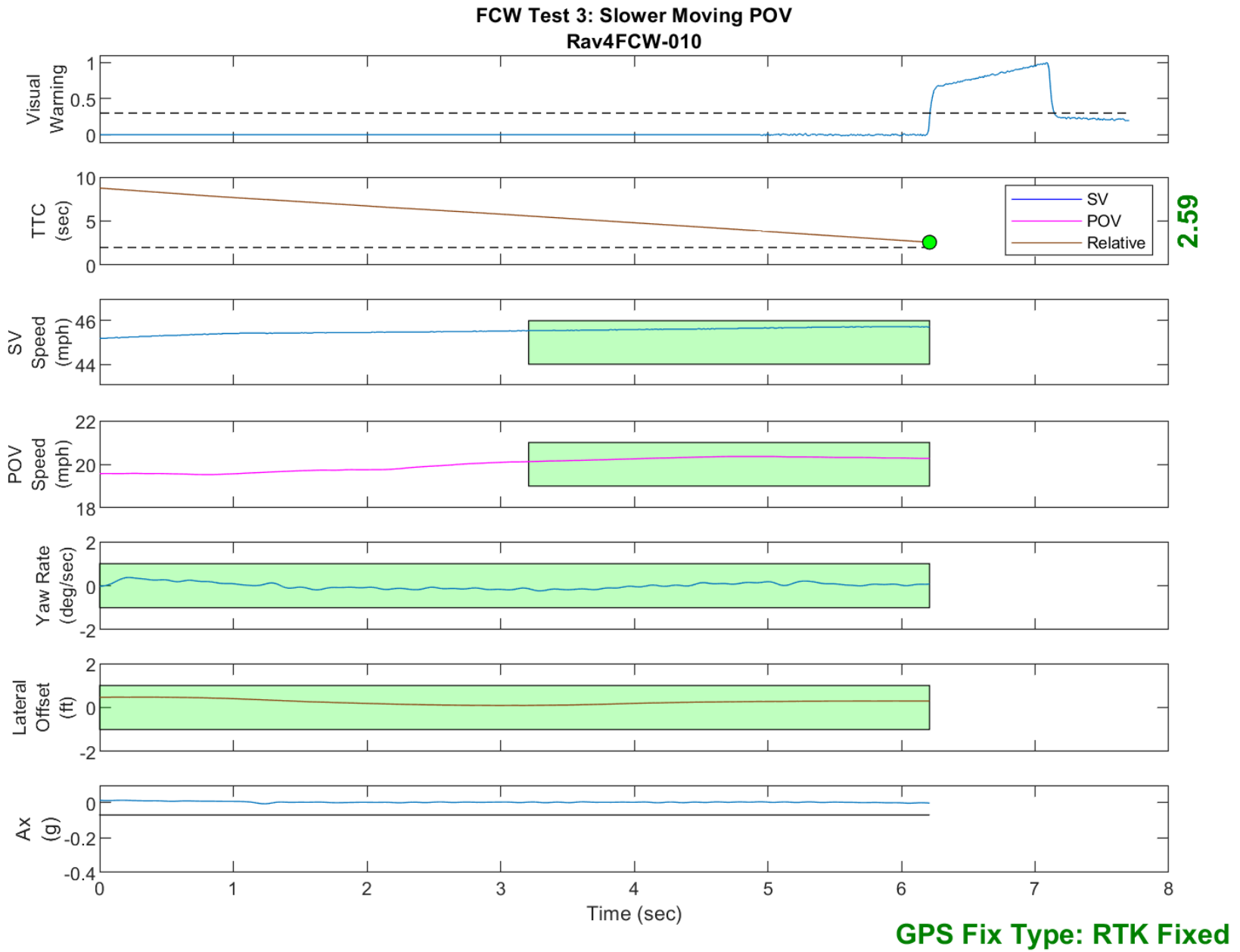


Figure D40. Time History for Run 10, Test 3 - Slower Moving POV, Visual Warning

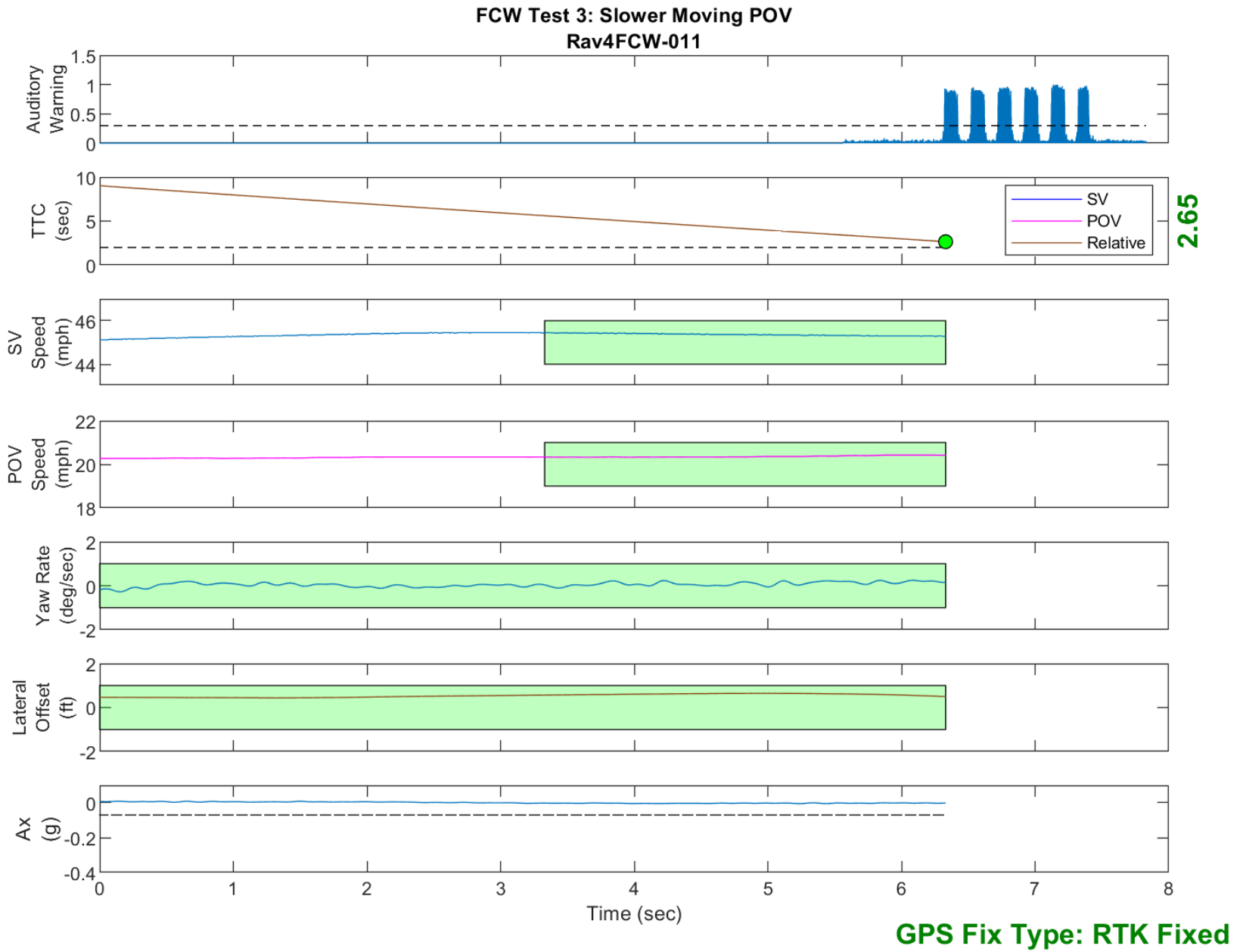


Figure D41. Time History for Run 11, Test 3 - Slower Moving POV, Auditory Warning

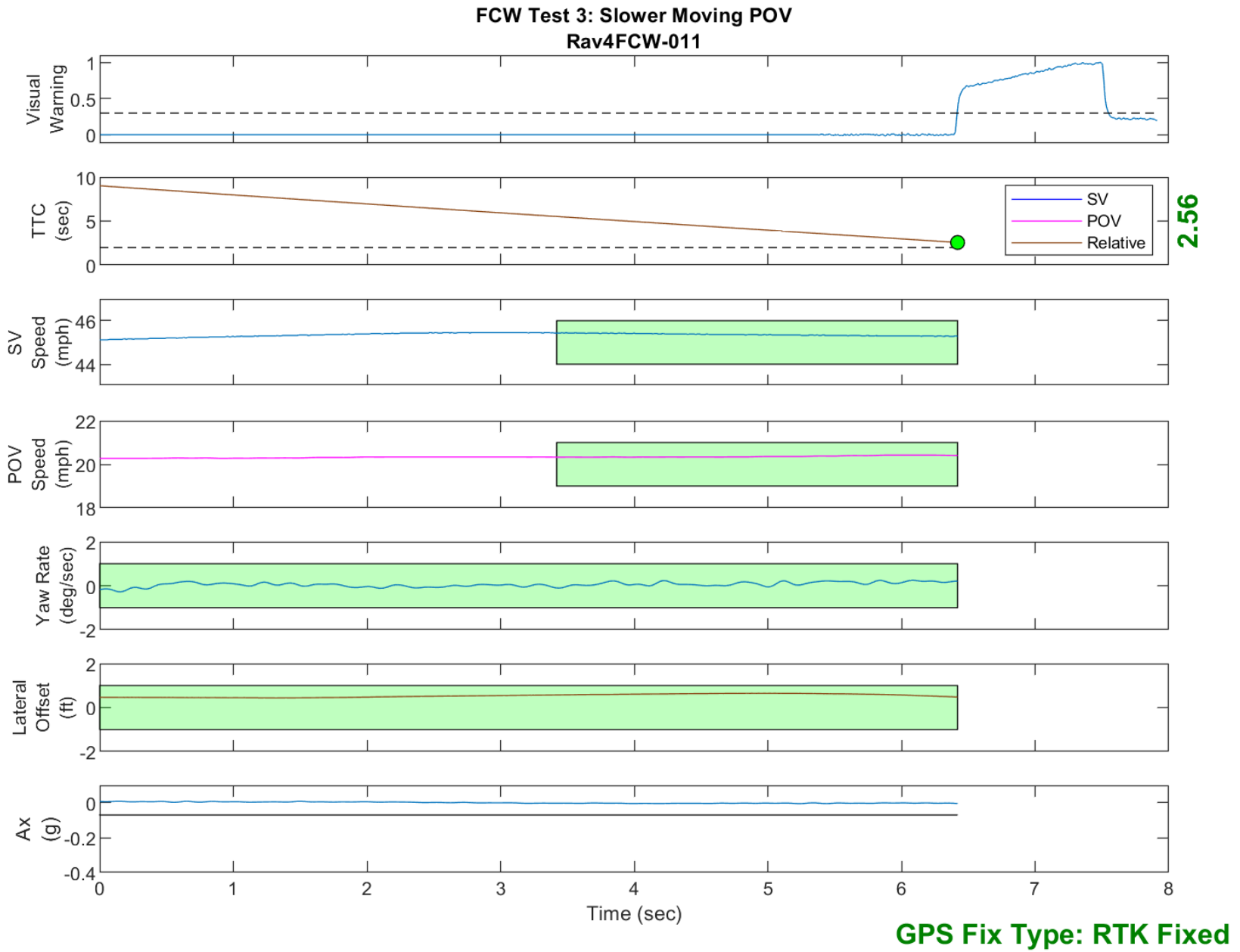


Figure D42. Time History for Run 11, Test 3 - Slower Moving POV, Visual Warning

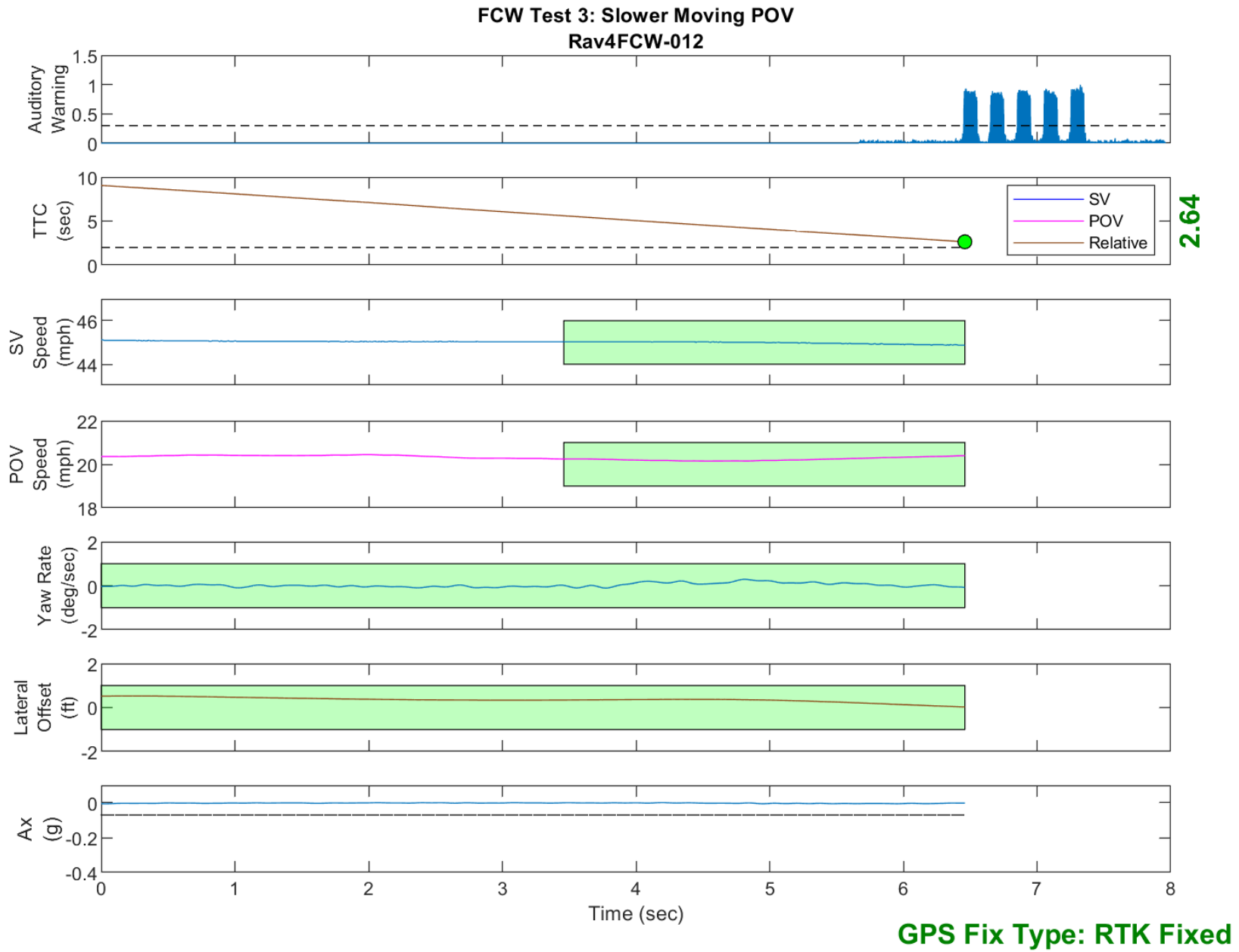


Figure D43. Time History for Run 12, Test 3 - Slower Moving POV, Auditory Warning

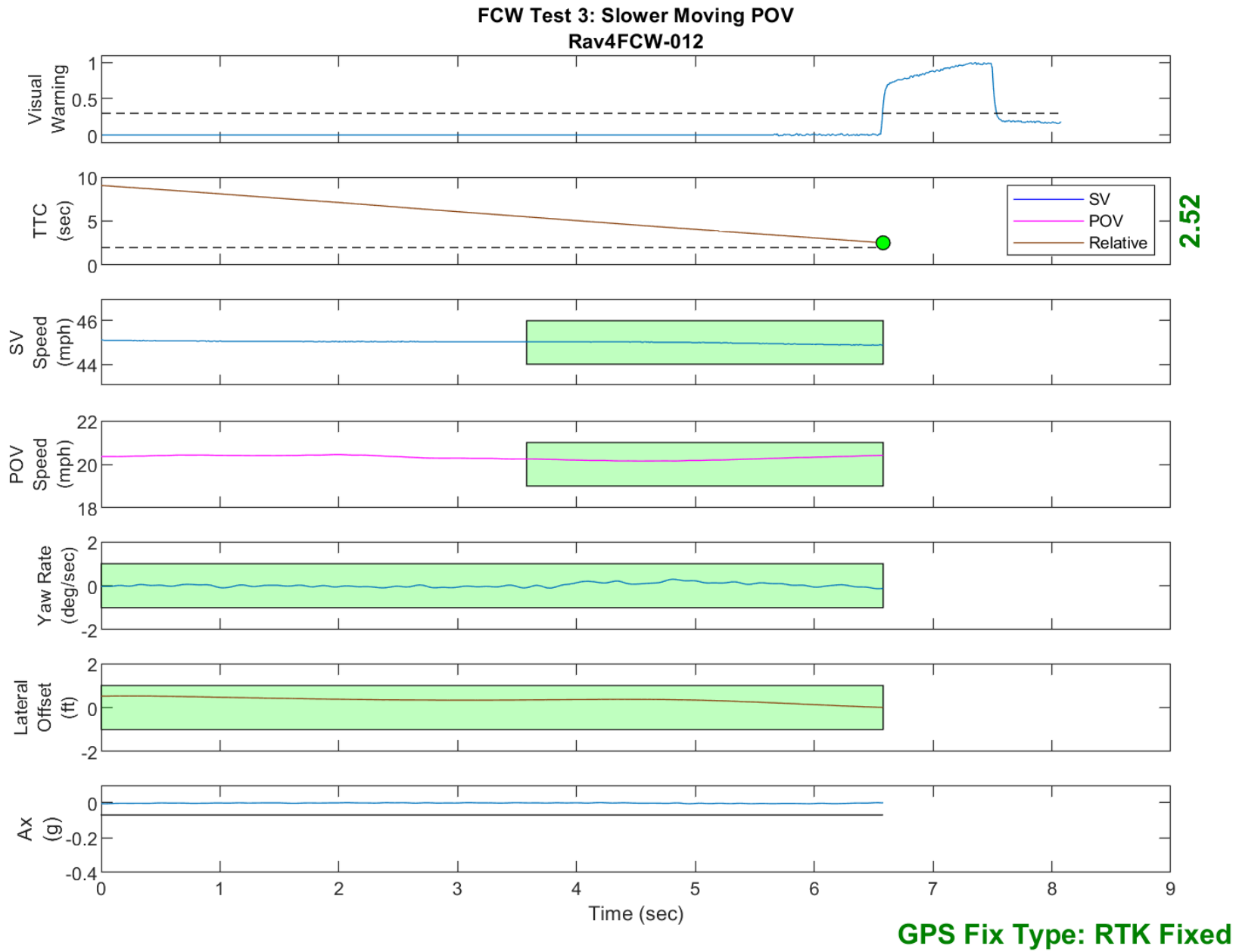


Figure D44. Time History for Run 12, Test 3 - Slower Moving POV, Visual Warning

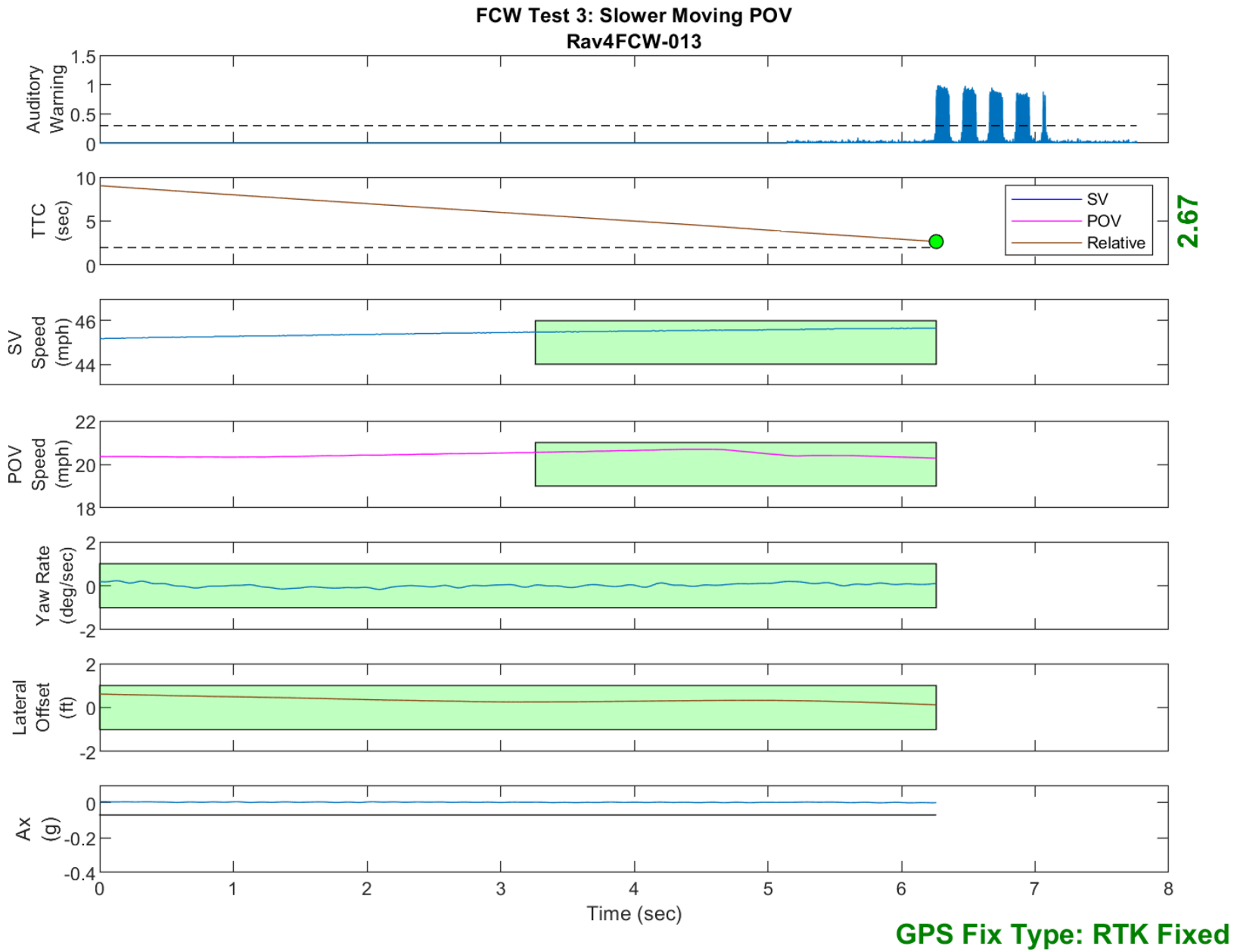


Figure D45. Time History for Run 13, Test 3 - Slower Moving POV, Auditory Warning

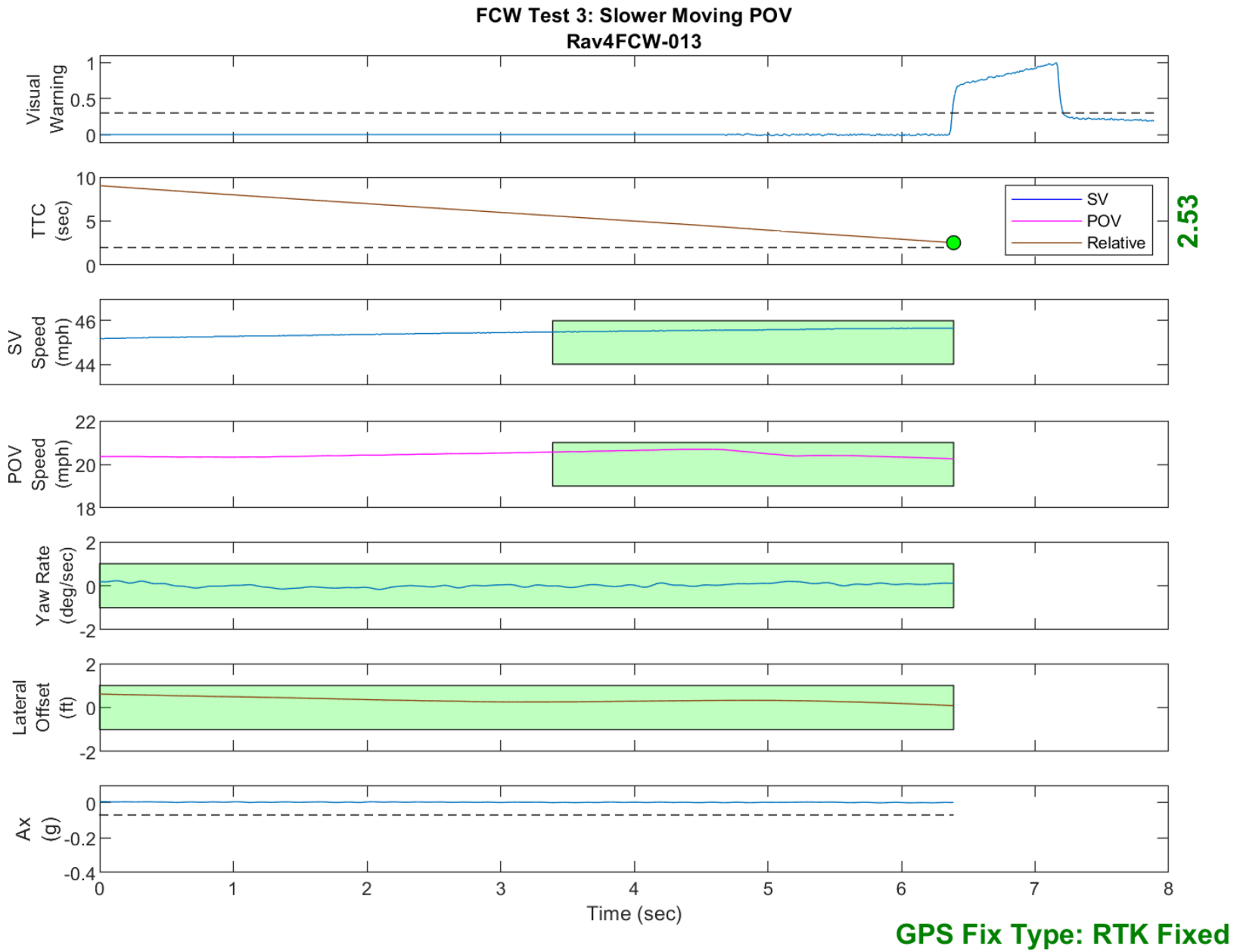


Figure D46. Time History for Run 13, Test 3 - Slower Moving POV, Visual Warning

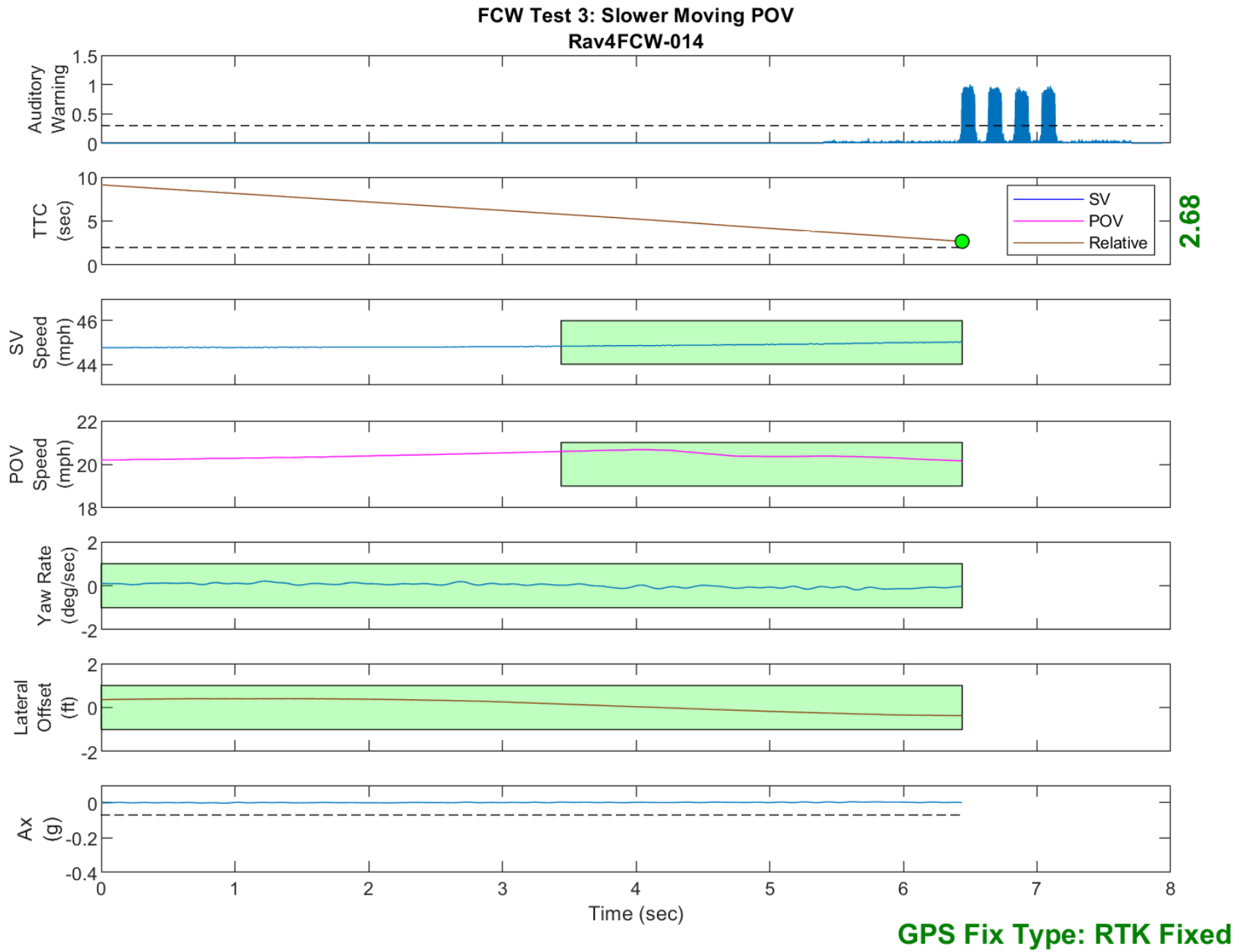


Figure D47. Time History for Run 14, Test 3 - Slower Moving POV, Auditory Warning

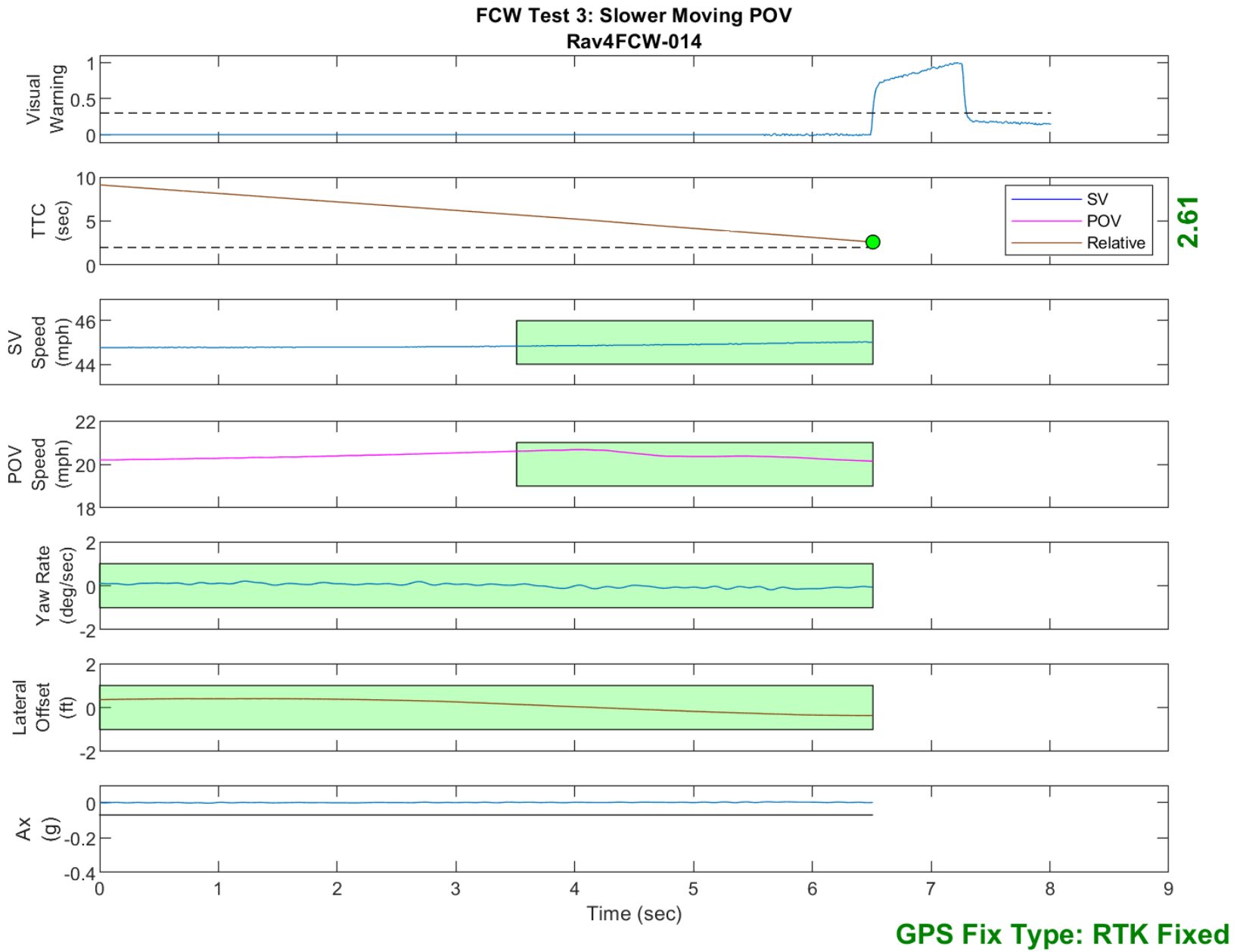


Figure D48. Time History for Run 14, Test 3 - Slower Moving POV, Visual Warning