

**NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST
NCAP-DRI-FCW-20-09**

2020 Hyundai Palisade SEL FWD

DYNAMIC RESEARCH, INC.

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Torrance, California 90501



5 February 2020

Final Report

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

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National Highway Traffic Safety Administration
New Car Assessment Program
1200 New Jersey Avenue, SE
West Building, 4th Floor (NRM-110)
Washington, DC 20590**

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

INTRODUCTION

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

Section II
DATA SHEETS

FORWARD COLLISION WARNING
DATA SHEET 1: TEST RESULTS SUMMARY

(Page 1 of 1)

2020 Hyundai Palisade SEL FWD

VIN: KM8R44HE0LU0xxxx

Test Date: 12/18/2019

Forward Collision Warning setting: Normal

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 Hyundai Palisade SEL FWD

TEST VEHICLE INFORMATION

VIN: KM8R44HE0LU0xxxx

Body Style: SUV

Color: Becketts Black

Date Received: 12/9/2019

Odometer Reading: 22 mi

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: Hyundai Motor Company

Date of manufacture: May/27/19

Vehicle Type: MPV

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: 245/50R20

Rear: 245/50R20

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

Rear: 240 kPa (35 psi)

TIRES

Tire manufacturer and model: Bridgestone Dueler H/P Sport AS

Front tire size: 245/50R20

Rear tire size: 245/50R20

Front tire DOT prefix: EJ KH

Rear tire DOT prefix: EJ KH

FORWARD COLLISION WARNING
DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Hyundai Palisade SEL FWD

GENERAL INFORMATION

Test date: 12/18/2019

AMBIENT CONDITIONS

Air temperature: 15.6 C (60 F)

Wind speed: 1.5 m/s (3.5 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: 240 kPa (35 psi)

Rear: 240 kPa (35 psi)

FORWARD COLLISION WARNING
DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2020 Hyundai Palisade SEL FWD

WEIGHT

Weight of vehicle as tested including driver and instrumentation:

Left Front: 597.4 kg (1317 lb)

Right Front 563.8 kg (1243 lb)

Left Rear 473.1 kg (1043 lb)

Right Rear 460.4 kg (1015 lb)

Total: 2094.7 kg (4618 lb)

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 1 of 2)

2020 Hyundai Palisade SEL FWD

Name of the FCW option, option package, etc. Forward Collision-Avoidance Assist (FCA)

Type of sensors the system uses: The system uses a fusion type which includes radar and mono camera.

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.

The driver is alerted by a visual display (Figure A16), a repeated beep with a dominant frequency of 1506 Hz, and steering wheel vibration.

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

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

The driver can deactivate the FCA via User Select Menu (USM) interface:

User Settings

Driver Assistance

Forward Safety

Off

The FCA is reactivated on each ignition cycle.

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

(Page 2 of 2)

2020 Hyundai Palisade SEL FWD

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 driver can change the FCA settings via the User Select Menu (USM) interface:

User Settings

Driver Assistance

Warning Timing

Normal

Later

Warning Volume

High

Medium

Low

Off

Forward Safety

Active Assist

Warning Only

Off

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

If yes, please provide a full description.

See pages 5-72 through 5-77 of the Owner's manual shown in Appendix B pages B-13 through B-18.

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.

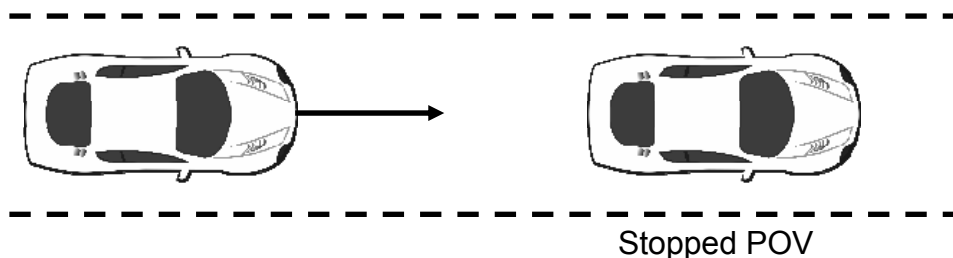


Figure 1. Depiction of Test 1

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 ± 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.

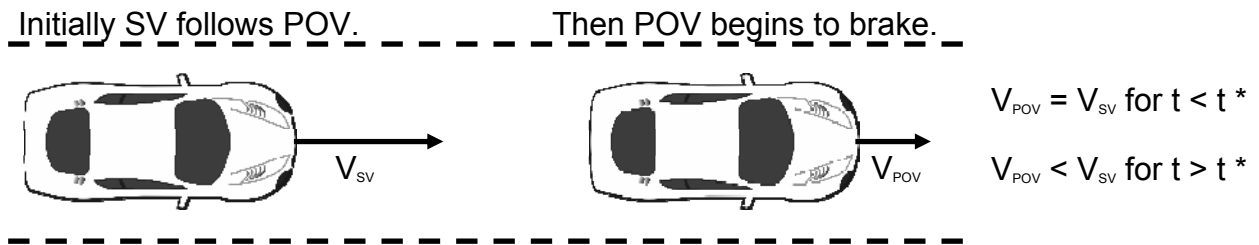


Figure 2. Depiction of Test 2

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 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:

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).

- The initial POV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of 3 seconds prior to the initiation of POV braking.
- The speed of the SV could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of 3 seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90% of the minimum allowable range for onset of the required FCW alert.
- The lateral distance between the centerline of the SV, relative to the centerline of the POV, in road coordinates, could not exceed 2.0 ft (0.6 m).
- The yaw rates of the SV and POV could not exceed ± 1 deg/sec during the test.
- The POV deceleration level was nominally required to be 0.3 g within 1.5 seconds after initiation of POV braking. The acceptable error magnitude of the POV deceleration was $\pm 0.03g$, 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 ± 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 kph).

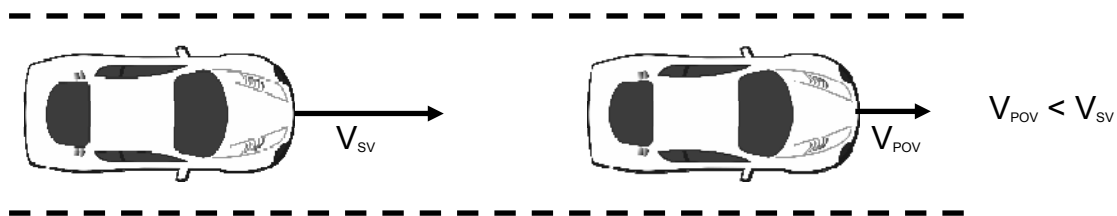


Figure 3. Depiction of Test 3

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 ± 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

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Pass-Band Frequency Range
Audible	5 th	3 dB	60 dB	Identified Center Frequency \pm 5%
Tactile	5 th	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 PALISADE SEL FWD

SOLD TO:

SHIPPED TO:

VIN: KMSR44HE0LU03
MODEL: J1442F65
ENGINE: G6DNKA209471
PORT OF ENTRY: HU
EXTERIOR COLOR: BECKETTS BLACK
INTERIOR/SEAT COLOR: GRAY W/ BLACK/GRAY W/ BLACK
TRANSPORT: TRUCK
ACCESSORY WEIGHT: 17 lbs./ 8 kgs.
EMISSIONS: This vehicle is certified to meet emission requirements in all 50 states

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash or rollover risk.

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

STANDARD FEATURES:

AMERICA'S BEST WARRANTY

5-year/60,000-mile New Vehicle Warranty*
 10-year/100,000-mile Powertrain Warranty*
 7-year/Unlimited-mile Anti-perforation Warranty*
 5-year/Unlimited-mile Roadside Assistance
 *Limited warranties, see dealer for details

ADVANCED SAFETY TECHNOLOGY

Vehicle Stability Management w/ ESC & TCS
 ABS w/ Electronic Brake-Force Distribution & Brake Assist
 Shift-By-Wire, Electric Parking Brake
 Front, Front Side Impact, Side-Curtain & Driver's Knee Airbag
 Tire Pressure Monitoring System & Rearview Camera
 Forward Collision-Avoidance Assist with Ped. Detection
 Lane Keeping Assist, Driver Attention Warning
 Rear Occupant Alert, Rear Parking Distance Warning
 Blind-Spot Collision-Avoidance Assist, Safe Exit Assist
 Rear Cross-Traffic Collision-Avoidance Assist

POWERTRAIN TECHNOLOGY

3.8L GDI V6 Engine w/ Idle Stop & Go, 291 HP / 262 lb-ft Torque
 8-Speed Automatic Transmission w/ SHIFTRONIC® paddle shifters
 Drive Mode Select knob

EXTERIOR

18" Alloy Wheels & 245/60 R18 Tires; Satin Chrm ext dr handles
 LED Daytime Running Lights; High Beam Assist with auto on/off
 Heated Dual Power Side Mirrors w/ turn signal indicators
 Solar Front Glass & Privacy Rear Glass; Roof Side Rails
 Trailering pkg (pre-wiring, transmission cooler, sway control)

COMFORT & CONVENIENCE

9-inch Display Audio w/ Android Auto(TM) & Apple CarPlay(TM)
 Captain's chairs; Prox key w/ push button start & immobilizer
 Pwr windows w/ front row auto down/up; Pwr driver seat
 Rear Seat Quiet Mode; Bluetooth® Hands-free Phone System
 Front Heated Cloth Seats; One-touch 2nd row; Remote Engine Starter
 Front USB ports; 2nd row USB charging ports on seats
 Leather wrapped steering wheel w/ audio, cruise & phone controls
 Auto-dimming interior rearview mirror with HomeLink
 Dual auto temp control; 2nd row auto HVAC; Haptic steering whl
 Smart Cruise Control w/ Stop & Go; Lane Following Assist
 Full tank of Fuel

INCLUDED
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Manufacturer's Suggested Retail Price: \$33,500.00

ADDED FEATURES:

***Convenience Package**
 20" alloy wheels, split 5-spoke
 Auto-leveling rear suspension
 LED taillights
 Front Parking Distance Warning
 Hands-free smart luggage w/ auto open
 7" high-resolution cluster display
 Ultrasonic Rear Occupant Alert
 Rear side window sunshades; Wireless Phone Charger
 3rd row USB outlets; 115-volt AC power outlet

***Premium Package**
 Leather seating surfaces; Premium dashboard/door armrests
 Bi-LED headlights
 8-way power passenger seat; Dr Integrated Memory System
 Heated 2nd row; Heated Steering Wheel
 3rd Row Seating; Power Folding/Unfolding/Reclining

***Bench Seat Option**
 8-passenger seating with bench 2nd row seat
 (replaces captain's chairs)

***Sunroof Option**
 Power Sunroof; LED interior/map lamps

***Drive Guidance Option**
 Navigation with 10.25" touchscreen
 Highway Drive Assist I
 SiriusXM®; HD Radio®
 Blue Link® Connected Services 3-years Standard
 (enrollment req)

Blue Link Remote Start (3-year Complimentary Service)
 Driver Talk In-Car Intercom
 Carpeted Floor Mats
 *Cargo Net
 *Cargo Tray, up seatback
 *Splash trim

\$1,045.00
\$41,775.00

Inland Freight & Handling
Total Price :



EPA DOT Fuel Economy and Environment

Fuel Economy

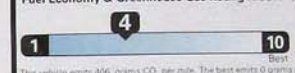
22 MPG
 19 26
 combined city/hwy city highway
 4.5 gallons per 100 miles

Standard SUVs range from 13 to 93 MPG. The best vehicle rates 136 MPG.

You spend \$1,750
 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$1,850

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 22 MPG and costs \$1,750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$ 2.70 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



#2208074

Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline license and title fees, state and local taxes and dealer installed options and accessories are not included in the manufacturer's suggested retail price. This label has been affixed to this vehicle by Hyundai Motor America, pursuant to the requirements of 15 U.S.C. 1231 et seq. which prohibits its removal or alteration prior to delivery to the ultimate purchaser.

PARTS CONTENT INFORMATION FOR VEHICLE IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 2 %
MAJOR SOURCES OF FOREIGN PARTS CONTENT: KOREA: 91 % JAPAN: 1 %

Note: Parts content does not include final assembly, distribution, or other non-parts costs.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: ULSAN, KOREA
COUNTRY OF ORIGIN:
ENGINE: KOREA
TRANSMISSION: KOREA



Figure A3. Window Sticker (Monroney Label)



MANUFACTURED IN KOREA BY
HYUNDAI MOTOR COMPANY

MAY/27/19

GVWR 5732 lbs PAINT RB5 TRIM YJY

GAWR

TIRES

RIMS

COLD TIRE INFL

FRONT 2954 lbs 245/50R20 7.5JX20 35psi SINGLE

REAR 3197 lbs 245/50R20 7.5JX20 35psi SINGLE

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

V.I.N. KM8R44HE0LU03 TYPE : MPV



C07

Figure A4. Vehicle Certification Label



TIRE AND LOADING INFORMATION RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

SEATING CAPACITY NOMBRE DE PLACES	TOTAL 8	FRONT AVANT 2	REAR ARRIÈRE 6
--------------------------------------	---------	------------------	-------------------

The combined weight of occupants and cargo should never exceed 600 kg or 1323 lbs.
Le poids total des occupants et du chargement ne doit jamais dépasser 600 kg ou 1323 lb.

TIRE PNEU	SIZE DIMENSIONS	COLD TIRE PRESSURE PRESSION DES PNEUS À FROID	SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION
FRONT AVANT	245/50R20	240kPa, 35psi	VOIR LE MANUEL DE L'USAGER POUR PLUS DE RENSEIGNEMENTS
REAR ARRIÈRE	245/50R20	240kPa, 35psi	
SPARE DE SECOURS	T155/90R18	420kPa, 60psi	

C07

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 System Setting Menus (page 1 of 2)



Figure A14. FCW System Setting Menus (page 2 of 2)



Figure A15. Steering Wheel Mounted Controls for Adjusting Settings



Figure A16. AEB Visual Alert

APPENDIX B

Excerpts from Owner's Manual

Forward Collision-Avoidance Assist (FCA) System Warning Light



This warning light illuminates:

- When you set the ignition switch or the Engine Start/Stop button to the ON position.
 - It illuminates for approximately 3 seconds and then goes off.
- When there is a malfunction with the FCA.

If this occurs, have the vehicle inspected by an authorized HYUNDAI dealer.

For more details, refer to "Forward Collision-Avoidance Assist (FCA) system" in chapter 5.

Lane Keeping Assist (LKA) System Indicator Light



This indicator light illuminates:

- [Green] When the system operating conditions are satisfied.
- [White] The system operating conditions are not satisfied.
- [Yellow] When there is a malfunction with the lane keeping assist system.

If this occurs, have your vehicle inspected by an authorized HYUNDAI dealer.

For more details, refer to "Lane Keeping Assist (LKA) system" in chapter 5.

LED Headlight Warning Light (if equipped)



This warning light illuminates:

- When you set the ignition switch or the Engine Start/Stop button to the ON position.
- When there is a malfunction with the LED headlight.
 - If this occurs, have the vehicle inspected by an authorized HYUNDAI dealer.

This warning light blinks:

When there is a malfunction with a LED headlight related part.

If this occurs, have the vehicle inspected by an authorized HYUNDAI dealer.

NOTICE

Continuous driving with the LED Headlight Warning Light on or blinking can reduce LED headlight life.

Check headlight (if equipped)

This warning message is displayed if the headlights are not operating properly. A headlight bulb may need to be replaced.

***i* Information**

Make sure to replace the burned out bulb with a new one of the same wattage rating.

Check turn signal (if equipped)

This warning message is displayed if the turn signal lamps are not operating properly. A lamp may need to be replaced.

***i* Information**

Make sure to replace the burned out bulb with a new one of the same wattage rating.

Check High Beam Assist (HBA) system (if equipped)

This warning message is displayed if there is a problem with the High Beam Assist (HBA) system. Have the vehicle inspected by an authorized HYUNDAI dealer.

For more details, refer to "High Beam Assist (HBA) system" in chapter 3.

Check headlight LED (if equipped)

This warning message is displayed if there is a problem with the LED headlight. Have the vehicle inspected by an authorized HYUNDAI dealer.

Check Forward Collision-Avoidance Assist system (if equipped)

This warning message is displayed if there is a problem with the Forward Collision-Avoidance Assist (FCA) system. Have the vehicle inspected by an authorized HYUNDAI dealer.

For more details, refer to "Forward Collision-Avoidance Assist (FCA) system" in chapter 5.

Check Blind-Spot Collision Warning (BCW) system (if equipped)

This warning message is displayed if there is a problem with the Blind-Spot Collision Warning system. Have the vehicle inspected by an authorized HYUNDAI dealer.

For more details, refer to "Blind-Spot Collision Warning (BCW)/ Blind-Spot Collision-Avoidance Assist (BCA)" or "Rear Cross-Traffic Collision Warning (RCCW)/ Rear Cross-Traffic Collision-Avoidance Assist (RCCA)" System in chapter 5.

FORWARD COLLISION-AVOIDANCE ASSIST (FCA) SYSTEM

The Forward Collision-Avoidance Assist (FCA) system is designed to help detect and monitor the vehicle ahead or help detect a pedestrian in the roadway through radar signals and camera recognition to warn the driver that a collision is imminent, and if necessary, apply emergency braking.

⚠ WARNING

Take the following precautions when using the Forward Collision-Avoidance Assist (FCA) system:

- This system is only a supplemental system and it is not intended to, nor does it replace the need for extreme care and attention of the driver. The sensing range and objects detectable by the sensors are limited. Pay attention to the road conditions at all times.
- Drive at posted speed limits and accordance to road conditions.
- Always drive cautiously to prevent unexpected and sudden situations from occurring. The Forward Collision-Avoidance system may not always stop the vehicle completely and is only intended to help mitigate a collision that is imminent.

System Setting and Operation

System setting



- Setting Forward Safety function
The driver can activate the FCA by placing the ignition switch to the ON position and by selecting:
'User Settings → Driver Assistance → Forward Safety'
- If you select "Active Assist", the FCA system activates. The FCA produces warning messages and warning alarms in accordance with the collision risk levels. Braking assist will be applied in accordance with the collision risk.

5

Driving your vehicle

5-63

- If you select 'Warning Only', the FCA system activates and produces only warning alarms in accordance with the collision risk levels. Braking assist will not be applied in this setting.
- If you select 'Off', the FCA system deactivates.



The warning light illuminates on the LCD display, when you cancel the FCA system.

The driver can monitor the FCA ON/OFF status on the LCD display. Also, the warning light illuminates when the ESC (Electronic Stability Control) is turned off. If the warning light remains ON when the FCA is activated, have the system checked by an authorized HYUNDAI dealer.



- Setting Warning Timing

The driver can select the initial warning activation time on the LCD display.

Go to the 'User Settings → Driver Assistance → Warning Timing → Normal/Later'.

The options for the initial Forward Collision Warning includes the following:

- Normal:

When this option is selected, the initial Forward Collision Warning is activated sensitively. If you feel the warning activates too early, set the Forward Collision Warning to 'Later'.

Even though, 'Normal' is selected if the front vehicle suddenly stops the initial warning activation time may not seem fast.

- Later:

When this option is selected, the initial Forward Collision Warning is activated later than normal. This setting reduces the amount of distance between the vehicle, pedestrian ahead before the initial warning occurs.

Select 'Later' when traffic is light and when driving speed is slow.

i Information

If you change the warning timing, the warning time of other systems may change. Always be aware before changing the warning timing.

Prerequisite for activation

The FCA system is on and ready when 'Active Assist' or 'Warning Only' under Forward Safety is selected in the LCD display and when the following prerequisites are satisfied:

- ESC (Electronic Stability Control) is on.
- Vehicle speed is over 5 mph (8 km/h) (The FCA is only activated within a certain speed range.)
- The system detects a pedestrian or a vehicle in front, which may collide with your vehicle. However, FCA may not be activated or may only sound a warning alarm depending on the driving or vehicle conditions.

⚠ WARNING

- To avoid driver distractions, do not attempt to set or cancel the FCA while driving the vehicle. Always completely stop the vehicle at a safe place before setting or canceling the system.
- FCA automatically activates upon placing the ignition switch to the ON position. The driver can deactivate FCA by canceling the system setting in the cluster LCD display.
- FCA automatically deactivates upon canceling ESC. When ESC is canceled, FCA cannot be activated in the cluster LCD display. In this situation, the FCA warning light will illuminate which is normal.

FCA Warning Message and Brake Control

FCA produces warning messages, warning alarms, and emergency braking based on the level of risk of a frontal collision, such as when a vehicle ahead suddenly brakes, or when the system detects that a collision with a pedestrian is imminent.

Collision Warning (First and second warning)



- The warning message appears on the cluster LCD display with a warning chime.
- Your vehicle speed may decelerate moderately.
- If FCA detects a vehicle in front, the system operates when your vehicle speed is between 5 mph (8 km/h) and 100 mph (160km/h). Maximum vehicle speed may decrease depending on the condition of the vehicle ahead and surroundings.

- If FCA detects a pedestrian in front, the system operates when your vehicle speed is between 5 mph (8 km/h) and 55 mph (90 km/h). Maximum vehicle speed may decrease depending on the condition of the vehicle ahead and surroundings.
- If you select 'Warning only' for the system setting, the FCA system activates and produces only warning alarms in accordance with the collision risk levels. You should control the brake directly because the FCA system will not control the brake.

Emergency Braking (Third warning)



- The warning message appears on the cluster LCD display with a warning chime.
- Additionally, some vehicle system intervention occurs by the engine management system to help decelerate the vehicle.
- The brake control is maximized just before a collision, reducing impact when it strikes a forward vehicle.

- If FCA detects a vehicle in front, the system operates when your vehicle speed is above 5 mph (8 km/h) and 50 mph (80 km/h) or under. Maximum vehicle speed may decrease depending on the condition of the vehicle ahead and surroundings.
- If FCA detects a pedestrian in front, the system operates when your vehicle speed is 5 mph (8 km/h) or above and under 45 mph (70 km/h). Maximum vehicle speed may decrease depending on the condition of the vehicle ahead and surroundings.
- If you select 'Warning only' for the system setting, the FCA system activates and produces only warning alarms in accordance with the collision risk levels. You should control the brake directly because the FCA system do not control the brake.

Brake operation

- In an urgent situation, the braking system enters into the ready status for prompt reaction against the driver's depressing the brake pedal.
- The FCA provides additional braking power for optimum braking performance, when the driver depresses the brake pedal.
- The braking control is automatically deactivated, when the driver sharply depresses the accelerator pedal, or when the driver abruptly operates the steering wheel.
- The FCA braking control is automatically canceled, when risk factors disappear.

CAUTION

- The driver should always use extreme caution while operating the vehicle, whether or not there is a warning message or alarm from the FCA system.
- After the brake control is activated, the driver must immediately depress the brake pedal and check the surroundings. The brake activation by the system lasts for about 2 seconds.
- If any other warning sound such as seat belt warning chime is already generated, the Forward Collision-Avoidance Assist (FCA) system warning may not sound.
- Playing the vehicle audio system at high volume may prevent occupants from hearing the system warning sounds.

WARNING

The FCA braking control cannot completely stop the vehicle nor avoid all collisions. The driver should hold the responsibility to safely drive and control the vehicle.

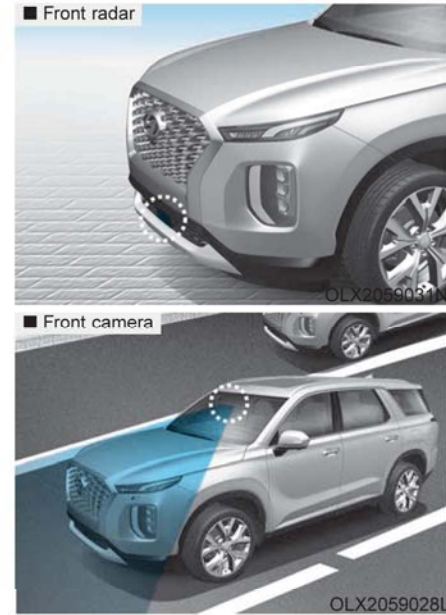
WARNING

The FCA system logic operates within certain parameters, such as the distance from the vehicle, pedestrian ahead, the speed of the vehicle ahead, and the driver's vehicle speed. Certain conditions such as inclement weather and road conditions may affect the operation of the FCA system.

WARNING

Never deliberately drive dangerously to activate the system.

FCA Sensor (Front Radar/Front Camera)



In order for the FCA system to operate properly, always make sure the sensor cover or sensor is clean and free of dirt, snow, and debris.

Dirt, snow, or foreign substances on the sensor cover or sensor may adversely affect the sensing performance of the sensor.

NOTICE

- Do not apply license plate frame or foreign objects such as a bumper sticker or a bumper guard near the sensor. Doing so may adversely affect the sensing performance of the radar.
- Always keep the sensor and cover clean and free of dirt and debris.
- Use only a soft cloth to wash the vehicle. Do not spray pressurized water directly on the sensor or sensor cover.
- Be careful not to apply unnecessary force on the sensor or sensor cover. If the sensor is forcibly moved out of proper alignment, the FCA system may not operate correctly. In this case, a warning message may not be displayed. Have the vehicle inspected by an authorized HYUNDAI dealer.

- If the front bumper becomes damaged in the area around the sensor, the FCA system may not operate properly. Have the vehicle inspected by an authorized HYUNDAI dealer.
- Use only genuine HYUNDAI parts to repair or replace a damaged sensor or sensor cover. Do not apply paint to the sensor cover.

NOTICE

- NEVER install any accessories or stickers on the front windshield, or tint the front windshield.
- NEVER place any reflective objects (i.e. white paper, mirror) over the crash pad. Any light reflection may prevent the system from functioning properly.
- Pay extreme caution to keep the camera dry.
- NEVER disassemble the camera assembly, or apply any impact on the camera assembly.

- If the sensor is forcibly moved out of proper alignment, the FCA system may not operate correctly. In this case, a warning message may not be displayed. Have the vehicle inspected by an authorized HYUNDAI dealer.

i Information

Have the system checked by an authorized HYUNDAI dealer when:

- The windshield glass is replaced.
- The radar sensor or cover gets damaged or replaced.

Warning message and warning light



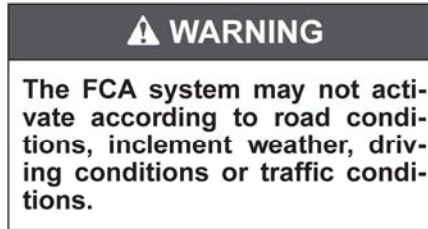
Forward Collision-Avoidance Assist (FCA) system disabled. Radar blocked

When the sensor cover is covered with dirt, snow, or debris, the FCA system operation may not be able to detect other vehicles. If this occurs, a warning message will appear on the LCD display.

The system will operate normally when such dirt, snow or debris is removed.

FCA may not properly operate in an area (e.g. open terrain) where any objects or vehicles are not detected after turning on the engine.

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System Malfunction



Check Forward Collision-Avoidance Assist system

- When FCA is not working properly, the FCA warning light (🚨) will illuminate and the warning message will appear for a few seconds. After the message disappears, the master warning light (⚠️) will illuminate. In this case, have the vehicle inspected by an authorized HYUNDAI dealer.
- The FCA warning message may appear along with the illumination of the ESC (Electronic Stability Control) warning light.

Both FCA warning light and warning message will disappear once the ESC warning light issue is resolved.

⚠ WARNING

- FCA is only a supplemental system for the driver's convenience. It is the driver's responsibility to control the vehicle operation. Do not solely depend on the FCA system. Rather, maintain a safe braking distance, and, if necessary, depress the brake pedal to reduce the driving speed or to stop the vehicle.
- In certain instances and under certain driving conditions, the FCA system may activate prematurely. This initial warning message appears on the LCD display with a warning chime.

Also due to sensing limitations, in certain situations, the front radar sensor or camera recognition system may not detect the vehicle, pedestrian ahead. The FCA system may not activate and the warning message may not be displayed.

- If there is a malfunction with the FCA system, the Forward Collision avoidance assist system is not applied even though the braking system is operating normally.
- If the vehicle in front stops suddenly, you may have less control of the brake system. Therefore, always keep a safe distance between your vehicle and the vehicle in front of you.
- The FCA system may activate during braking and the vehicle may stop suddenly shifting loose objects toward the passengers. Always keep loose objects secured.

- The FCA system may not activate if the driver applies the brake pedal to avoid collision.
- The brake control may be insufficient, possibly causing a collision, if a vehicle in front abruptly stops. Always pay extreme caution.
- The FCA system may not activate according to the road conditions, inclement weather, driving conditions or traffic conditions.
- Occupants may get injured, if the vehicle abruptly stops by the activated FCA system. Pay extreme caution.
- The FCA system operates only to detect vehicles, pedestrian in front of the vehicle.

⚠ WARNING

- The FCA system operates only to help detect vehicles or pedestrians in front of the vehicle.
- The FCA system does not operate when the vehicle is in reverse.
- The FCA system is not designed to detect other objects on the road such as animals.
- The FCA system does not detect vehicles in the opposite lane.
- The FCA system does not detect cross traffic vehicles that are approaching.
- The FCA system cannot detect the cross traffic cyclist that are approaching.
- The FCA system cannot detect vehicles that are stopped vertically to your vehicle at a intersection or dead end street.

In these cases, you must maintain a safe braking distance, and if necessary, depress the brake pedal to reduce the driving speed in order to maintain a safe distance or to stop the vehicle.

Limitations of the System

The Forward Collision Avoidance Assist (FCA) system is designed to monitor the vehicle ahead or a pedestrian on the roadway through radar signals and camera recognition to warn the driver that a collision is imminent, and if necessary, apply emergency braking.

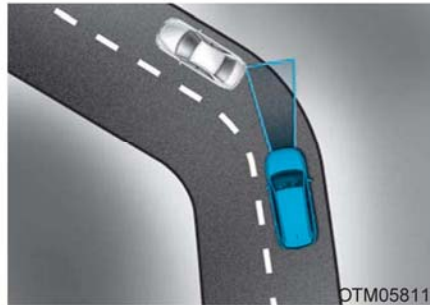
In certain situations, the radar sensor or the camera may not be able to detect the vehicle, pedestrian ahead. In these cases, the FCA system may not operate normally. The driver must pay careful attention in the following situations where the FCA operation may be limited.

Detecting vehicles

The sensor may be limited when:

- The system may not operate for 15 seconds after the engine is started or the camera is initialized
- The radar sensor or camera is covered with a foreign object or debris
- The camera lens is contaminated due to tinted, filmed or coated windshield, damaged glass, or stuck of foreign matter (sticker, bug, etc.) on the glass
- Inclement weather such as heavy rain or snow obscures the field of view of the radar sensor or camera
- There is interference by electromagnetic waves
- There is severe irregular reflection from the radar sensor
- The radar/camera sensor recognition is limited
- The vehicle in front is too small to be detected (for example a motorcycle or a bicycle, etc.)
- The vehicle in front is an oversize vehicle or trailer that is too big to be detected by the camera recognition system (for example a tractor trailer, etc.)
- The camera's field of view is not well illuminated (either too dark or too much reflection or too much backlight that obscures the field of view)
- The vehicle in front does not have their rear lights properly turned ON or their rear lights are located unusually
- The outside brightness changes suddenly, for example when entering or exiting a tunnel
- Light coming from a street light or an oncoming vehicle is reflected on a wet road surface such as a puddle in the road
- The field of view in front is obstructed by sun glare
- The windshield glass is fogged up; a clear view of the road is obstructed
- The vehicle in front is driving erratically
- The vehicle is on unpaved or uneven rough surfaces, or road with sudden gradient changes
- The vehicle is driven near areas containing metal substances as a construction zone, railroad, etc.
- The vehicle drives inside a building, such as a basement parking lot
- The camera does not recognize the entire vehicle in front
- The camera is damaged
- The brightness outside is too low such as when the headlamps are not on at night or the vehicle is going through a tunnel
- The shadow is on the road by a median strip, trees, etc.
- The vehicle drives through a toll-gate.
- The rear part of the vehicle in front is not normally visible (the vehicle turns in other direction or the vehicle is overturned.)
- The adverse road conditions cause excessive vehicle vibrations while driving

- The sensor recognition changes suddenly when passing over a speed bump
- The vehicle in front is moving vertically to the driving direction
- The vehicle in front is stopped vertically
- The vehicle in front is driving towards your vehicle or reversing
- You are on a roundabout and the vehicle in front circles



- Driving on a curve

The performance of the FCA system may be limited when driving on a curved road.

In certain instances on a curved road, the FCA system may activate prematurely.

Also, in certain instances the front radar sensor or camera recognition system may not detect the vehicle traveling on a curved road.

In these cases, the driver must maintain a safe braking distance, and if necessary, depress the brake pedal to reduce your driving speed in order to maintain a safe distance.

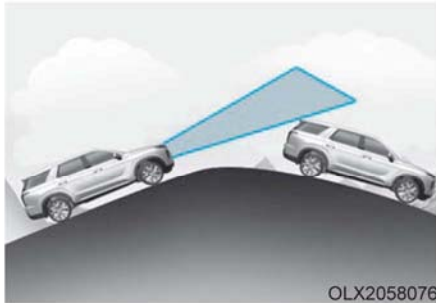


The FCA system may recognize a vehicle in the next lane when driving on a curved road.

In this case, the system may unnecessarily alarm the driver and apply the brake.

Always pay attention to road and driving conditions, while driving. If necessary, depress the brake pedal to reduce your driving speed in order to maintain a safe distance.

Also, when necessary depress the accelerator pedal to prevent the system from unnecessarily decelerating your vehicle.

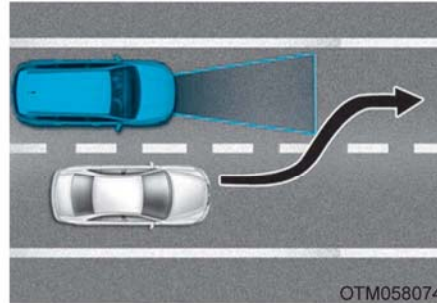


- Driving on a slope

The performance of the FCA decreases while driving upward or downward on a slope, not recognizing the vehicle in front in the same lane. It may unnecessarily produce the warning message and the warning alarm, or it may not produce the warning message and the warning alarm at all.

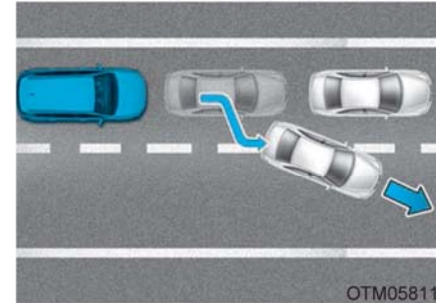
When the FCA suddenly recognizes the vehicle in front while passing over a slope, you may experience sharp deceleration.

Always keep your eyes forward while driving upward or downward on a slope, and, if necessary, depress the brake pedal to reduce your driving speed in order to maintain distance.

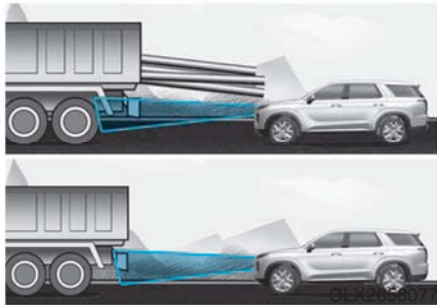


- Changing lanes

When a vehicle changes lanes in front of you, the FCA system may not immediately detect the vehicle, especially if the vehicle changes lanes abruptly. In this case, you must maintain a safe braking distance, and if necessary, depress the brake pedal to reduce your driving speed in order to maintain a safe distance.



When driving in stop-and-go traffic, and a vehicle in front of you merges out of the lane, the FCA system may not immediately detect the new vehicle that is now in front of you. In this case, you must maintain a safe braking distance, and if necessary, depress the brake pedal to reduce your driving speed in order to maintain a safe distance.



- Detecting the vehicle in front of you
If the vehicle in front of you has cargo that extends rearward from the cab, or when the vehicle in front of you has higher ground clearance, additional special attention is required. The FCA system may not be able to detect the cargo extending from the vehicle. In these instances, you must maintain a safe braking distance from the rearmost object, and if necessary, depress the brake pedal to reduce your driving speed in order to maintain distance.

Detecting pedestrians

The sensor may be limited when:

- The pedestrian is not fully detected by the camera recognition system, for example, if the pedestrian is leaning over or is not fully walking upright
- The pedestrian is moving very quickly or appears abruptly in the camera detection area
- The pedestrian is wearing clothing that easily blends into the background, making it difficult to be detected by the camera recognition system
- The outside lighting is too bright (e.g. when driving in bright sunlight or in sun glare) or too dark (e.g. when driving on a dark rural road at night)
- It is difficult to detect and distinguish the pedestrian from other objects in the surroundings, for example, when there is a group of pedestrians or a large crowd
- There is an item similar to a person's body structure
- The pedestrian is small
- The pedestrian has impaired mobility
- The sensor recognition is limited
- The radar sensor or camera is covered with a foreign object or debris
- The camera lens is contaminated due to tinted, filmed or coated windshield, damaged glass, or stuck of foreign matter (sticker, bug, etc.) on the glass
- The brightness outside is too low such as when the headlamps are not on at night or the vehicle is going through a tunnel
- Inclement weather such as heavy rain or snow obscures the field of view of the radar sensor or camera
- Light coming from a street light or an oncoming vehicle is reflected on a wet road surface such as a puddle in the road
- The field of view in front is obstructed by sun glare
- The windshield glass is fogged up; a clear view of the road is obstructed

- The adverse road conditions cause excessive vehicle vibrations while driving
- The sensor recognition changes suddenly when passing over a speed bump
- You are on a roundabout
- When the pedestrian suddenly interrupts in front of the vehicle
- When there is any other electromagnetic interference
- When the construction area, rail or other metal object is near the cyclist

WARNING

- Do not use the Forward Collision Avoidance Assist (FCA) system when towing a vehicle. Application of the FCA system while towing may adversely affect the safety of your vehicle or the towing vehicle.
- Use extreme caution when the vehicle in front of you has cargo that extends rearward from the cab, or when the vehicle in front of you has higher ground clearance.
- The FCA system is designed to help detect and monitor the vehicle ahead to help detect a pedestrian in the roadway through radar signals and camera recognition. It is not designed to detect bicycles, motorcycles, or smaller wheeled objects such as luggage bags, shopping carts, or strollers.

- Never try to test the operation of the FCA system. Doing so may cause severe injury or death.

Information

In some instances, the FCA system may be canceled when subjected to electromagnetic interference.

Information

This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

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

APPENDIX C

Run Log

Subject Vehicle: **2020 Hyundai Palisade SEL FWD**

Test Date: **12/18/2019**

Principal Other Vehicle: **2006 Acura RL**

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	Stopped POV	N					SV yaw
2		Y	2.71	2.65	0.61	Pass	
3		N					SV yaw
4		Y	2.68	2.62	0.58	Pass	
5		Y	2.68	2.62	0.58	Pass	
6		Y	2.70	2.64	0.60	Pass	
7		Y	2.69	2.63	0.59	Pass	
8		Y	2.69	2.63	0.59	Pass	
9		Y	2.73	2.65	0.63	Pass	
21	Decelerating POV, 45	Y	2.53	2.47	0.13	Pass	
22		Y	2.42	2.35	0.02	Pass	
23		N					Lateral Offset
24		Y	2.53	2.46	0.13	Pass	
25		Y	2.45	2.39	0.05	Pass	
26		Y	2.53	2.45	0.13	Pass	
27		Y	2.46	2.41	0.06	Pass	
28		Y	2.54	2.43	0.14	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
10	Slower POV, 45 vs 20	N					POV speed
11		Y	2.34	2.23	0.34	Pass	
12		Y	2.36	2.31	0.36	Pass	
13		N					SV yaw
14		N					SV yaw
15		Y	2.30	2.24	0.30	Pass	
16		Y	2.32	2.26	0.32	Pass	
17		N					Radio interference
18		Y	2.34	2.27	0.34	Pass	
19		Y	2.33	2.26	0.33	Pass	
20		Y	2.33	2.28	0.33	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.

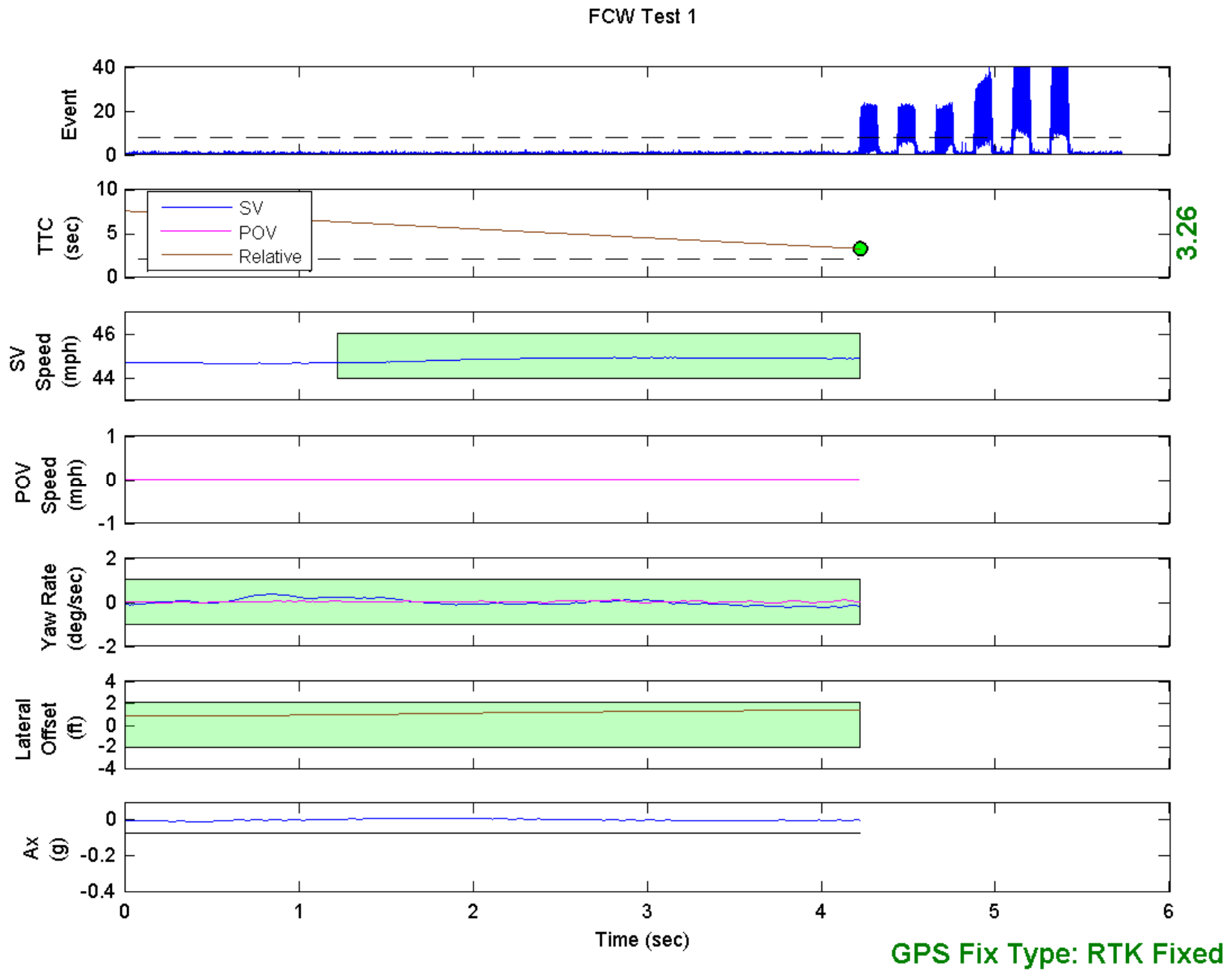


Figure D1. Example Time History for Test Type 1, Passing

FCW Test 2

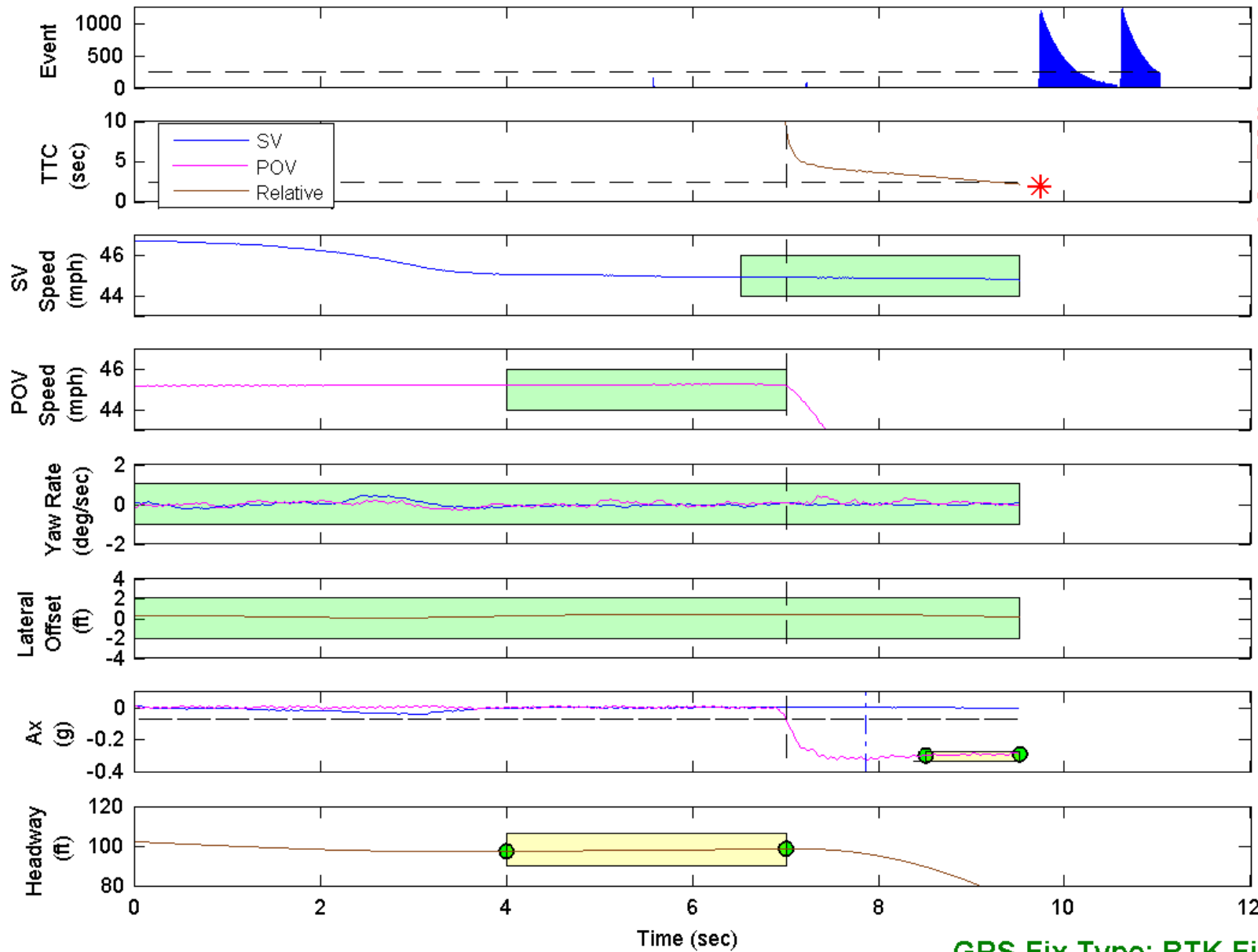
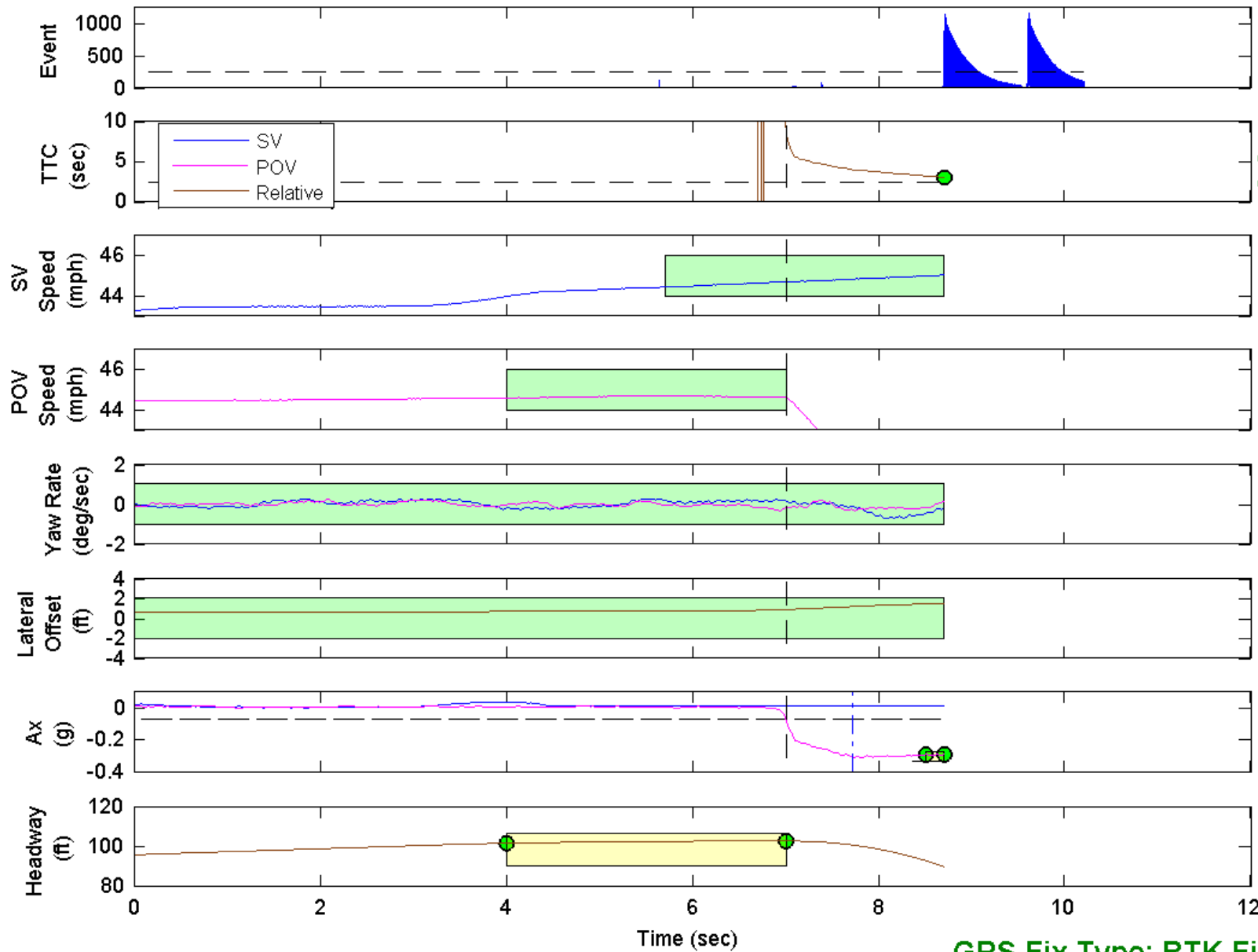


Figure D2. Example Time History for Test Type 2, Failing

FCW Test 2



GPS Fix Type: RTK Fixed

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

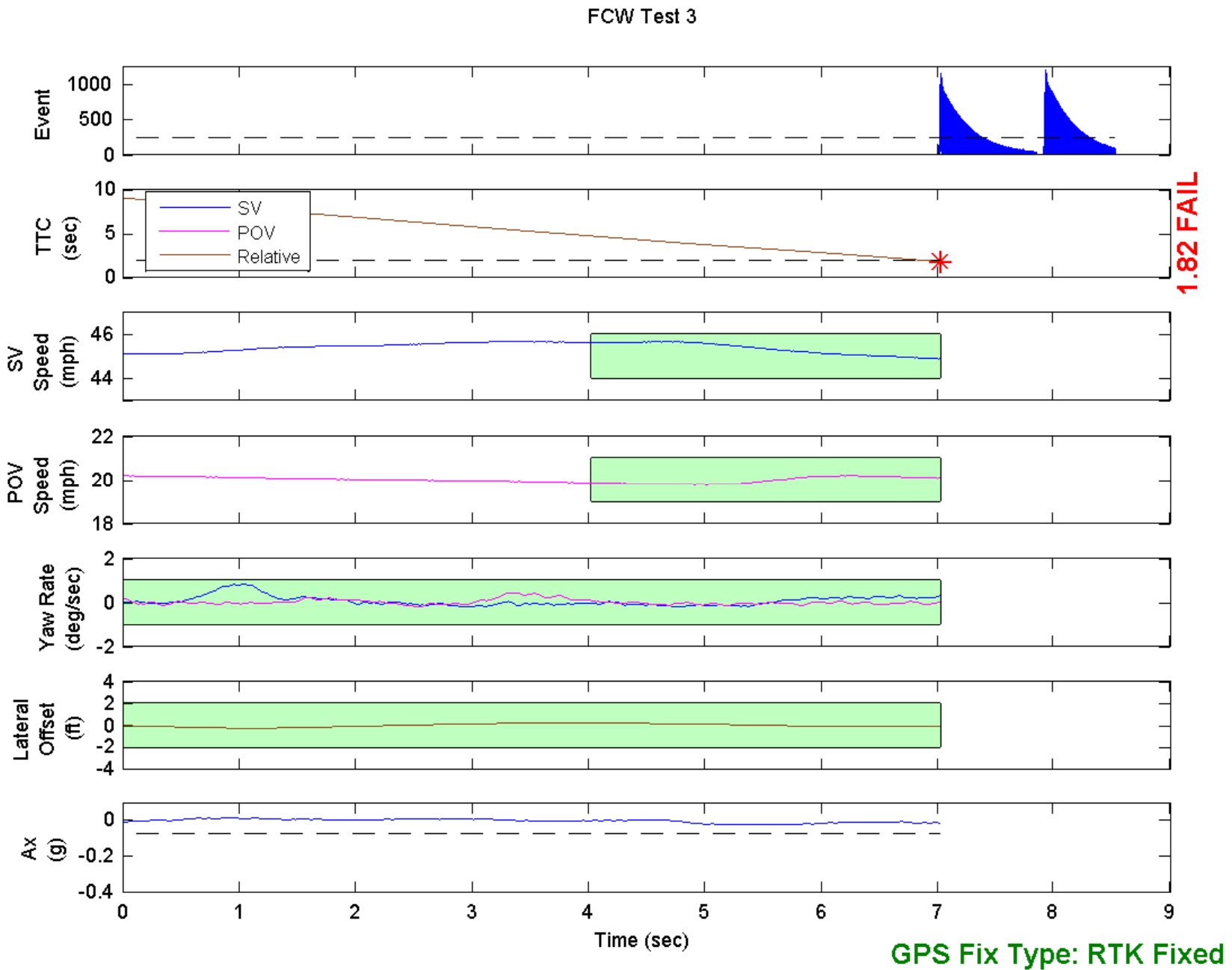


Figure D4. Example Time History for Test Type 3, Failing

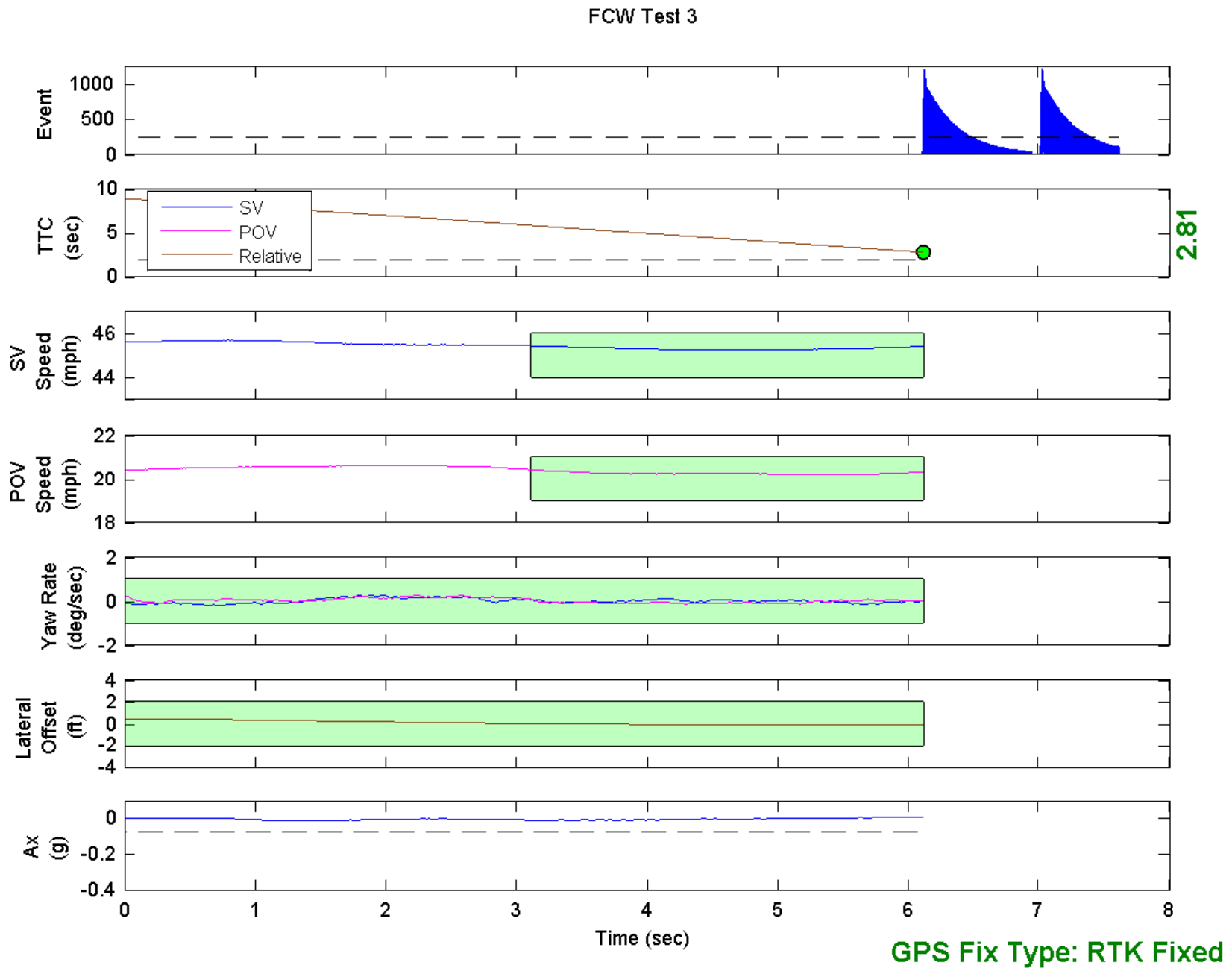


Figure D5. Example Time History for Test Type 3, Passing

FCW Test 2

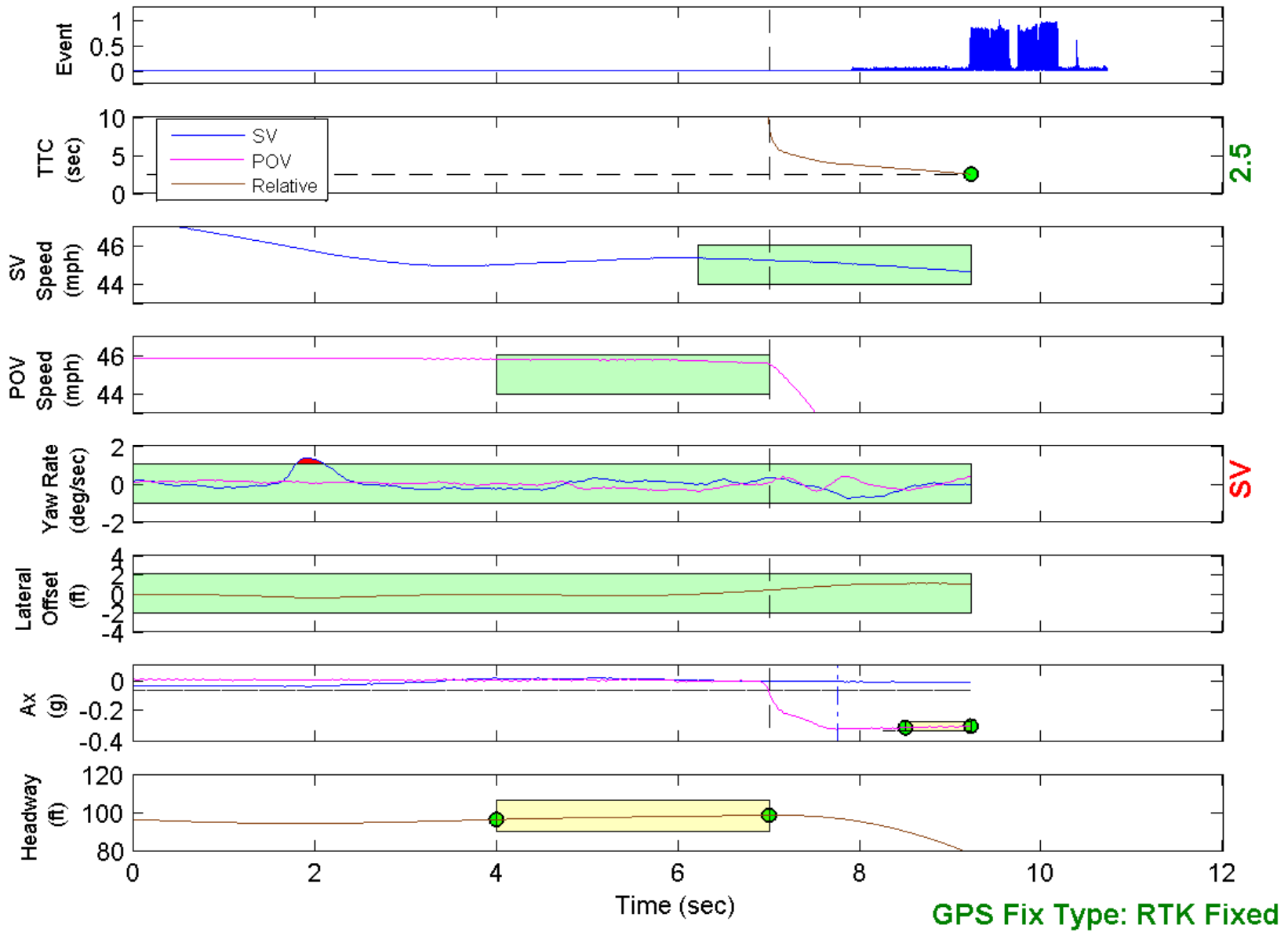


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

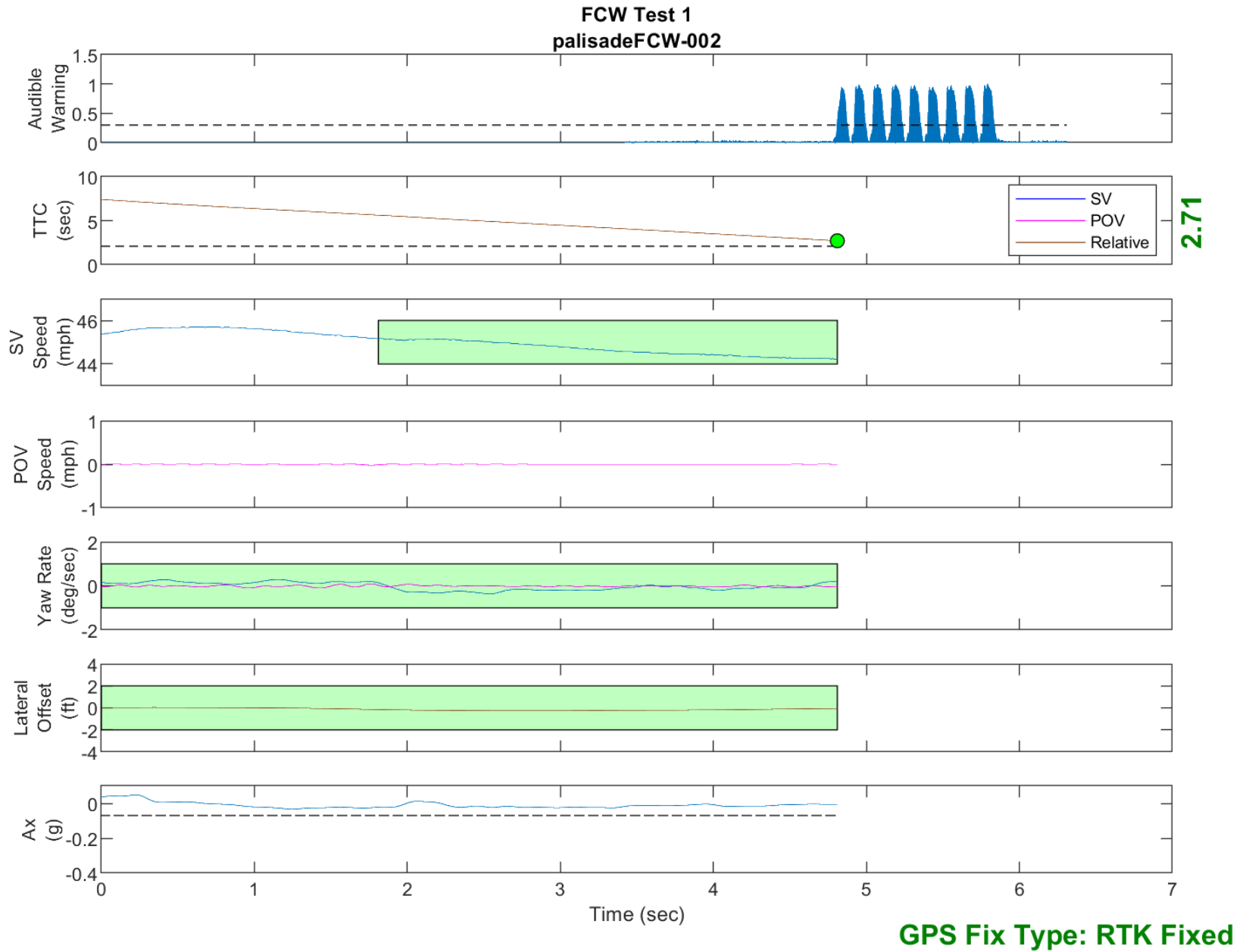


Figure D7. Time History for Run 02, FCW Test 1, Audible Warning

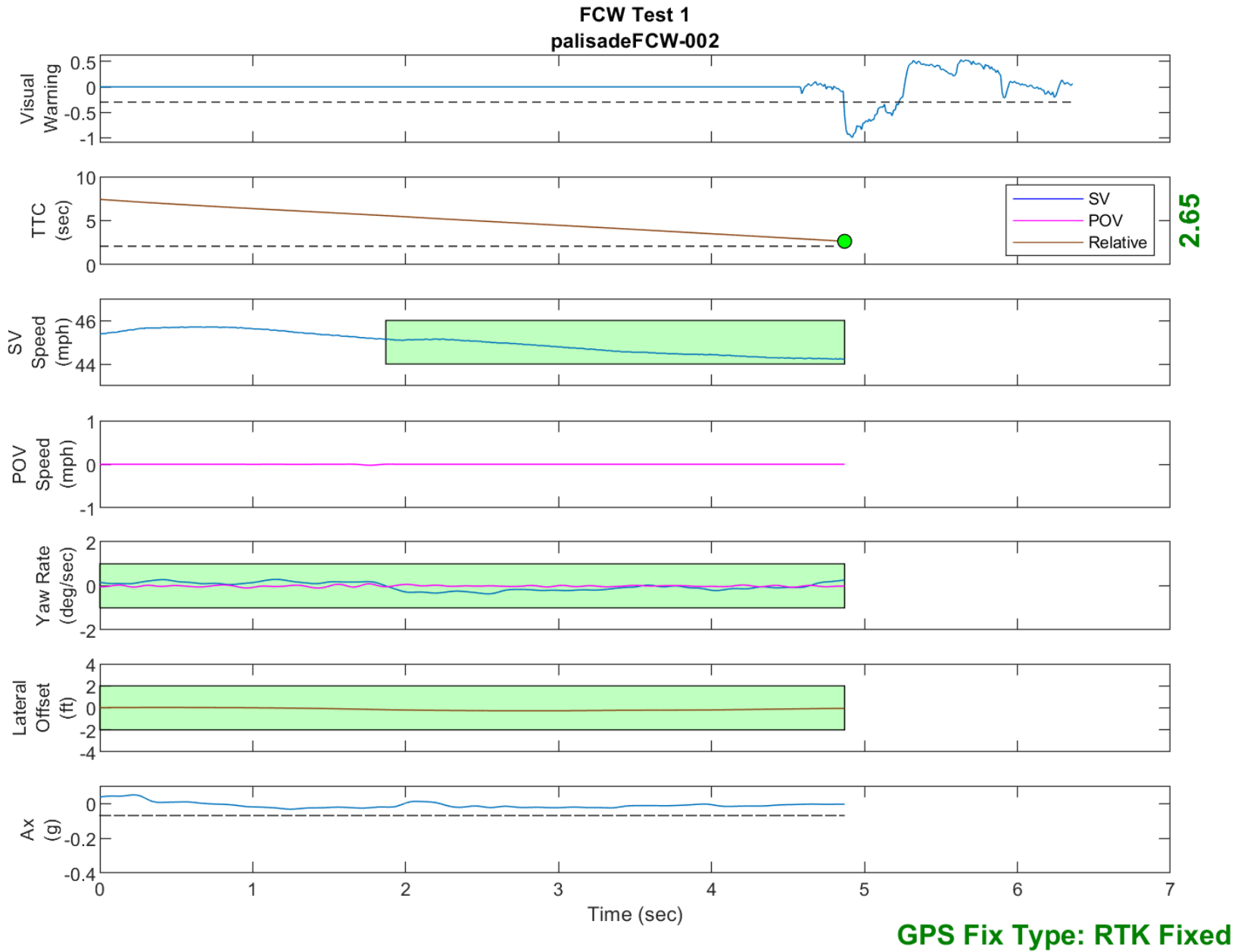


Figure D8. Time History for Run 02, FCW Test 1, Visual Warning

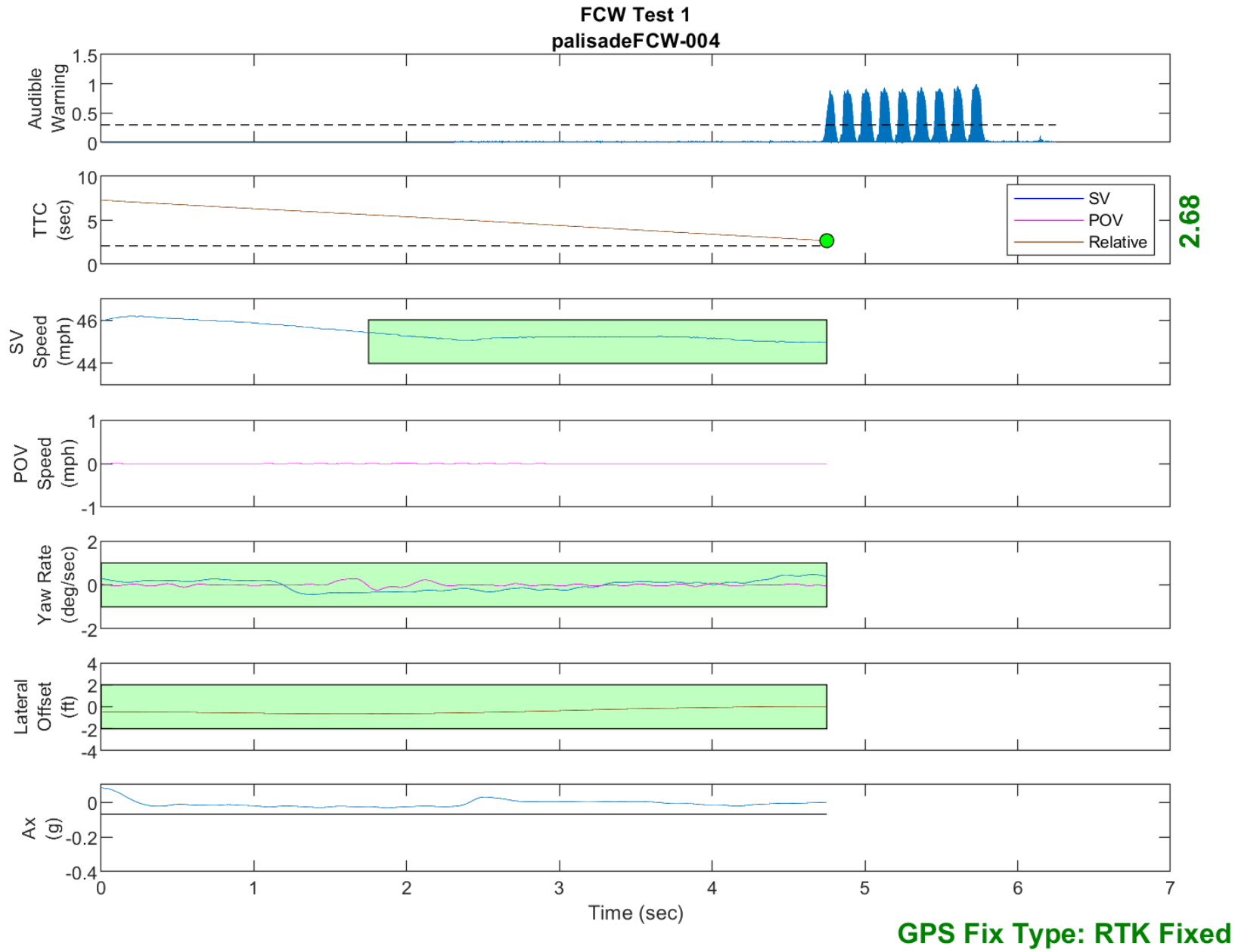


Figure D9. Time History for Run 04, FCW Test 1, Audible Warning

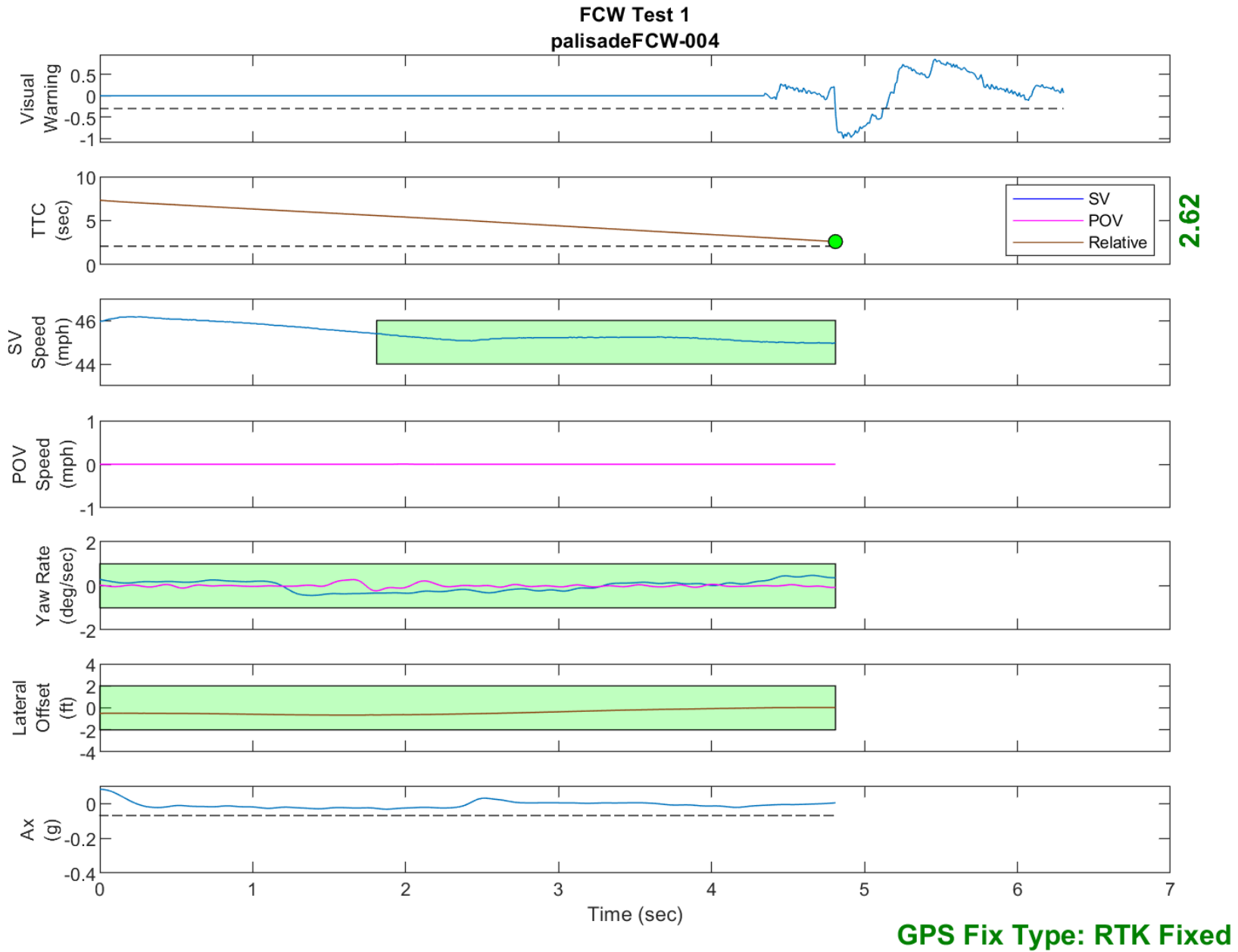


Figure D10. Time History for Run 04, FCW Test 1, Visual Warning

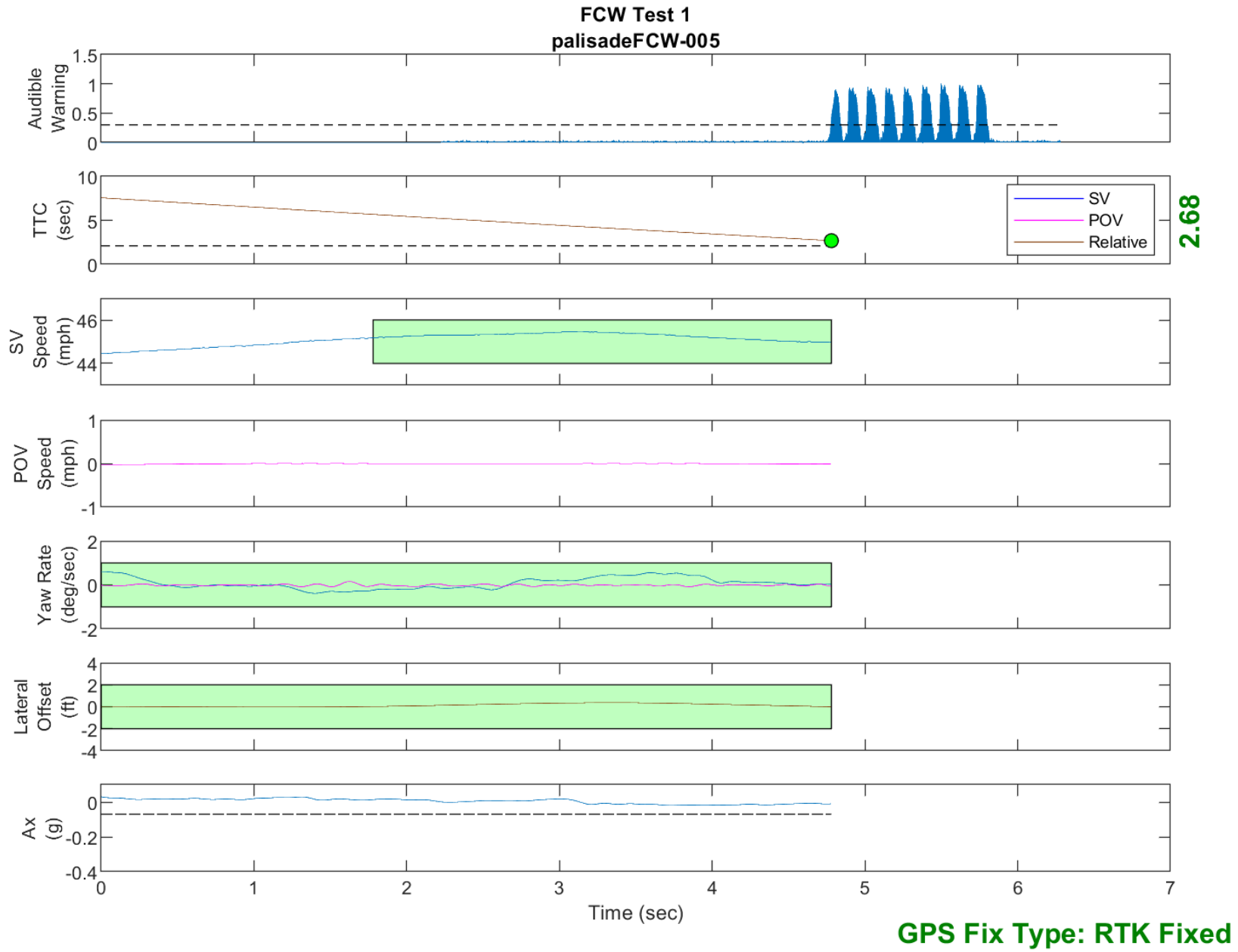


Figure D11. Time History for Run 05, FCW Test 1, Audible Warning

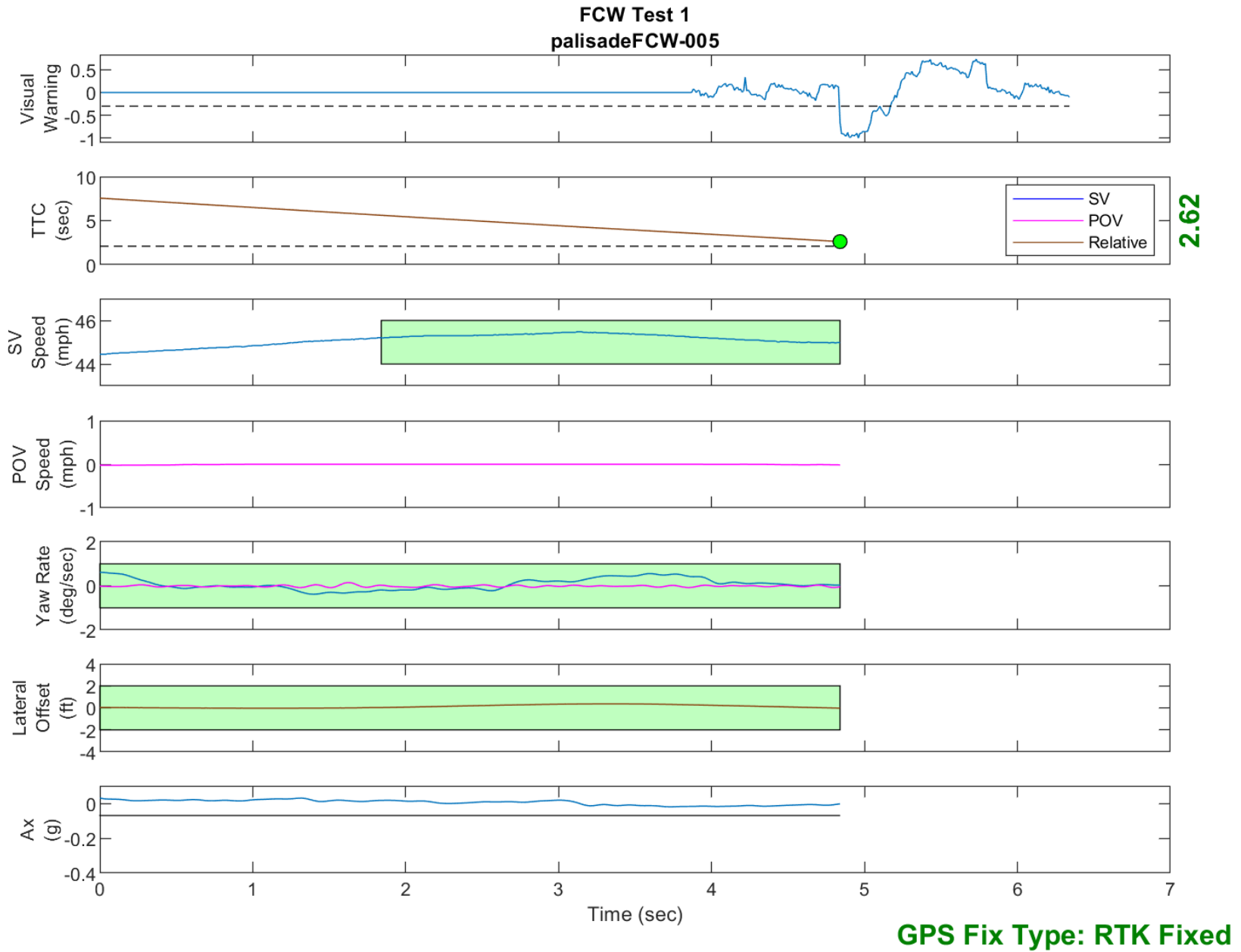


Figure D12. Time History for Run 05, FCW Test 1, Visual Warning

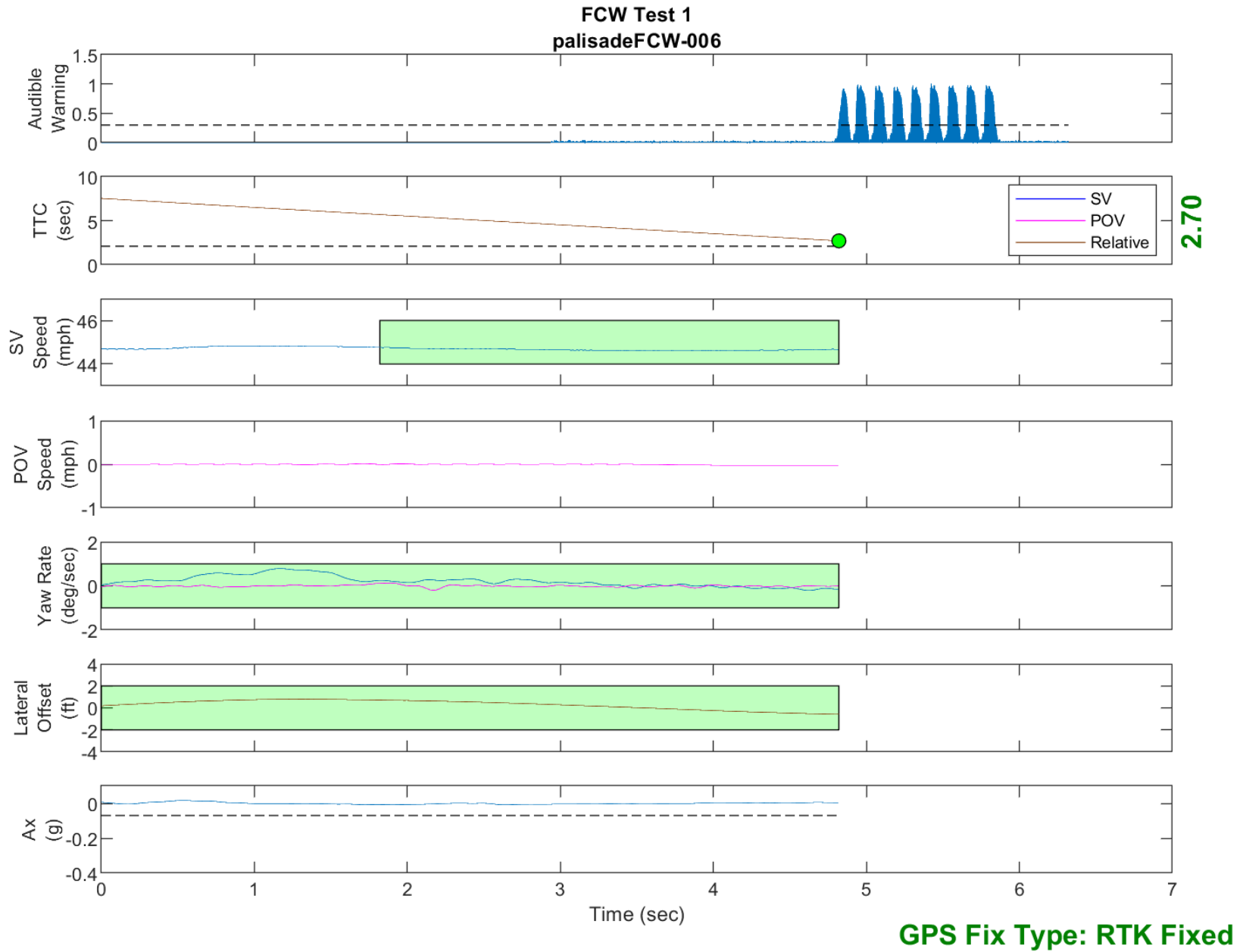


Figure D13. Time History for Run 06, FCW Test 1, Audible Warning

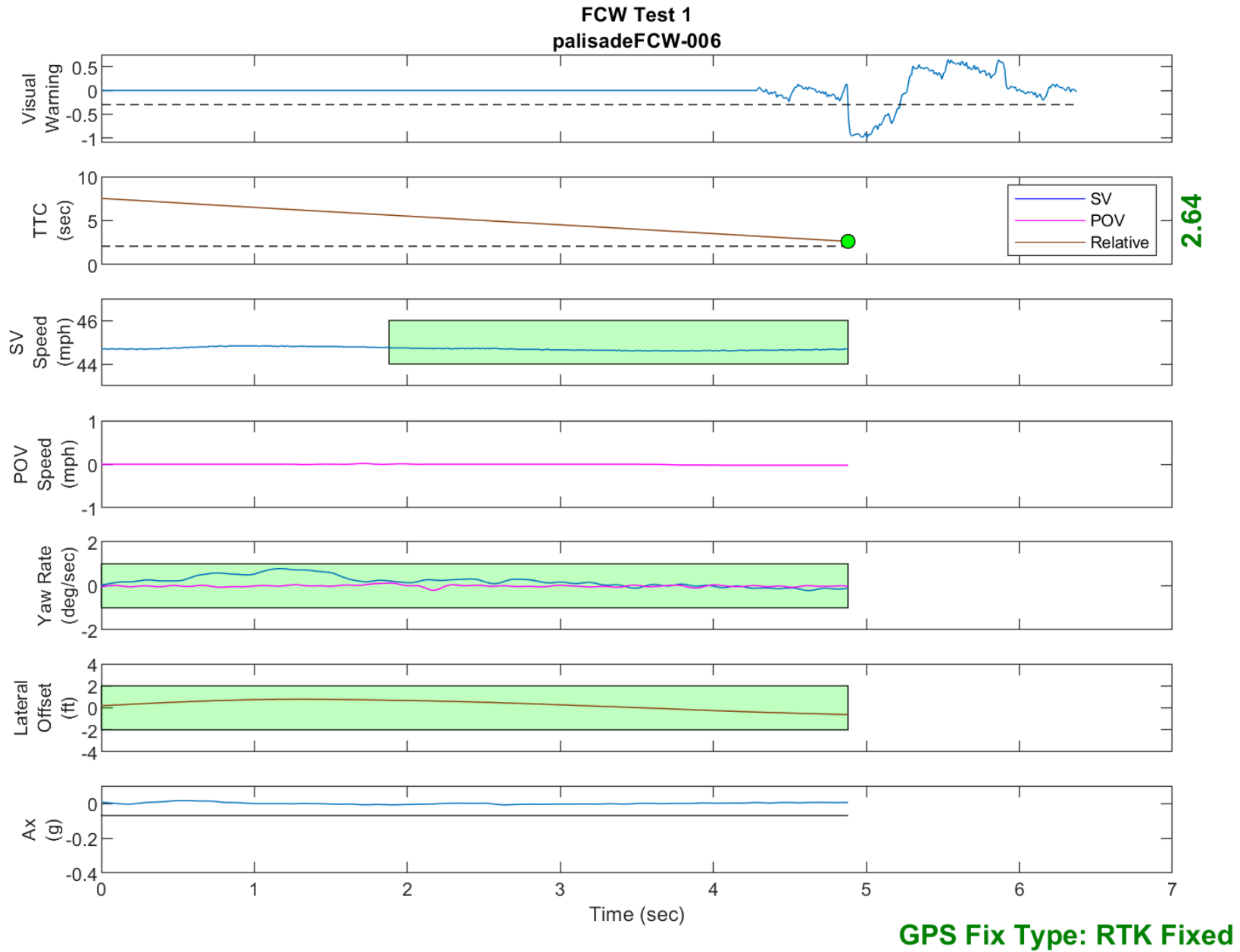


Figure D14. Time History for Run 06, FCW Test 1, Visual Warning

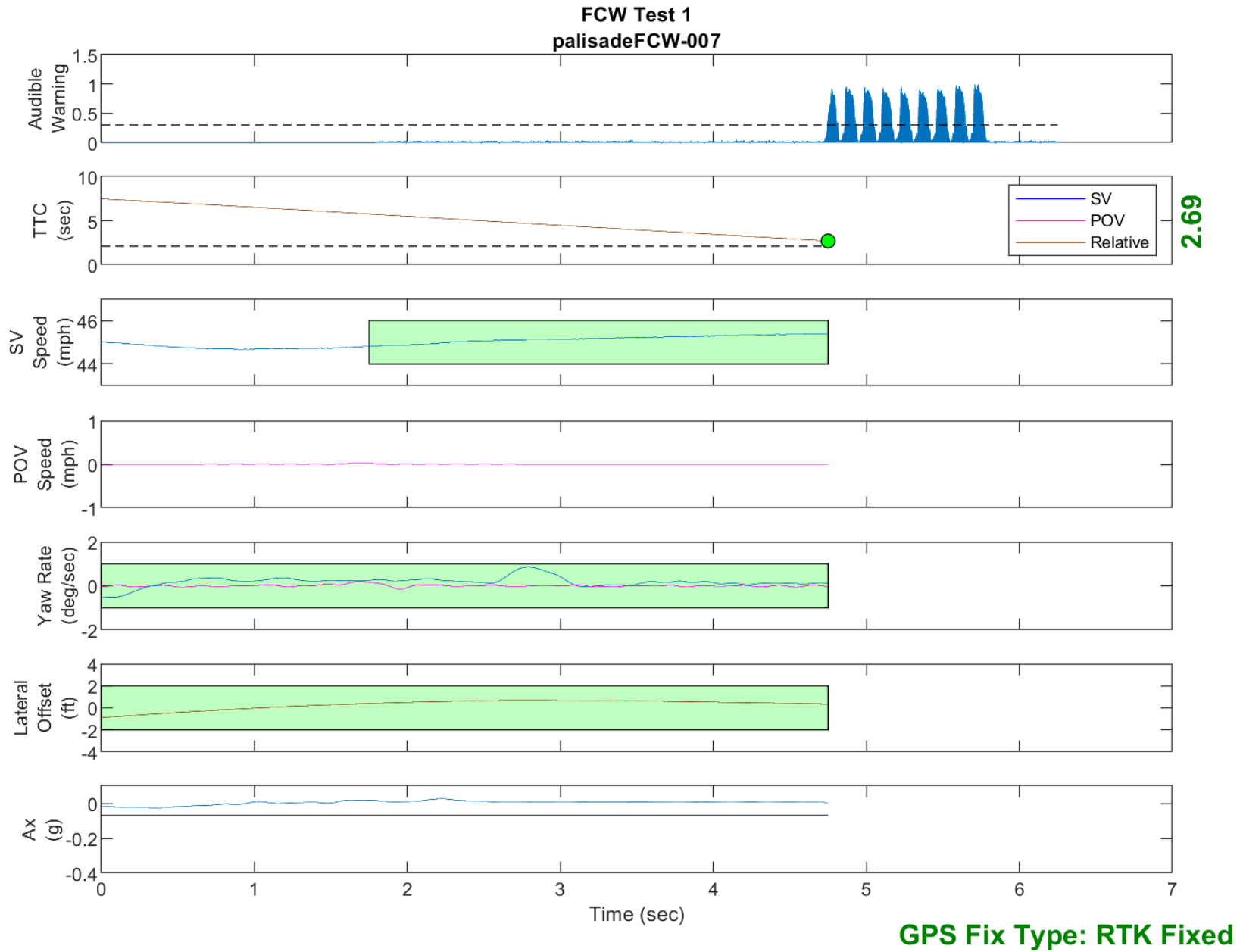


Figure D15. Time History for Run 07, FCW Test 1, Audible Warning

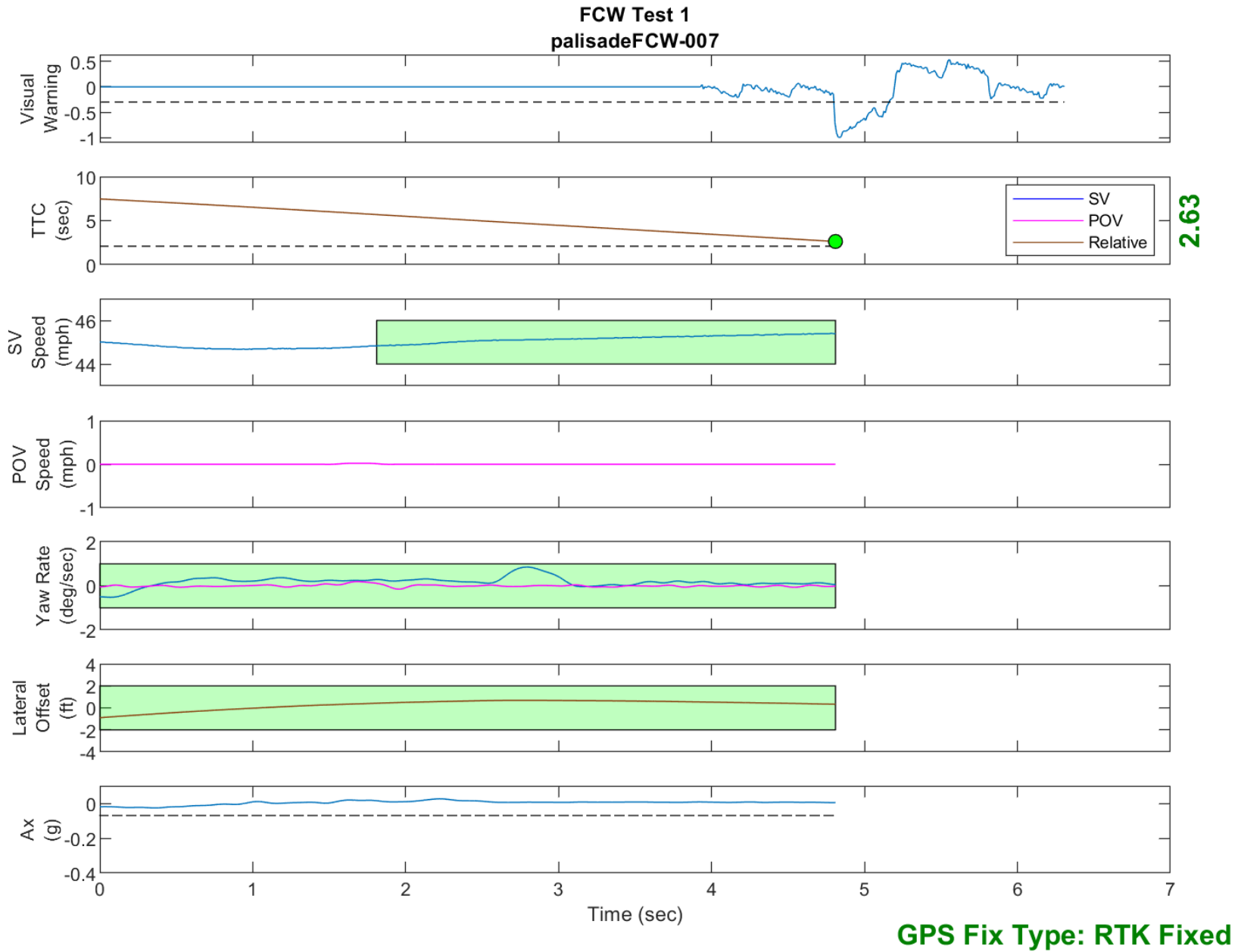


Figure D16. Time History for Run 07, FCW Test 1, Visual Warning

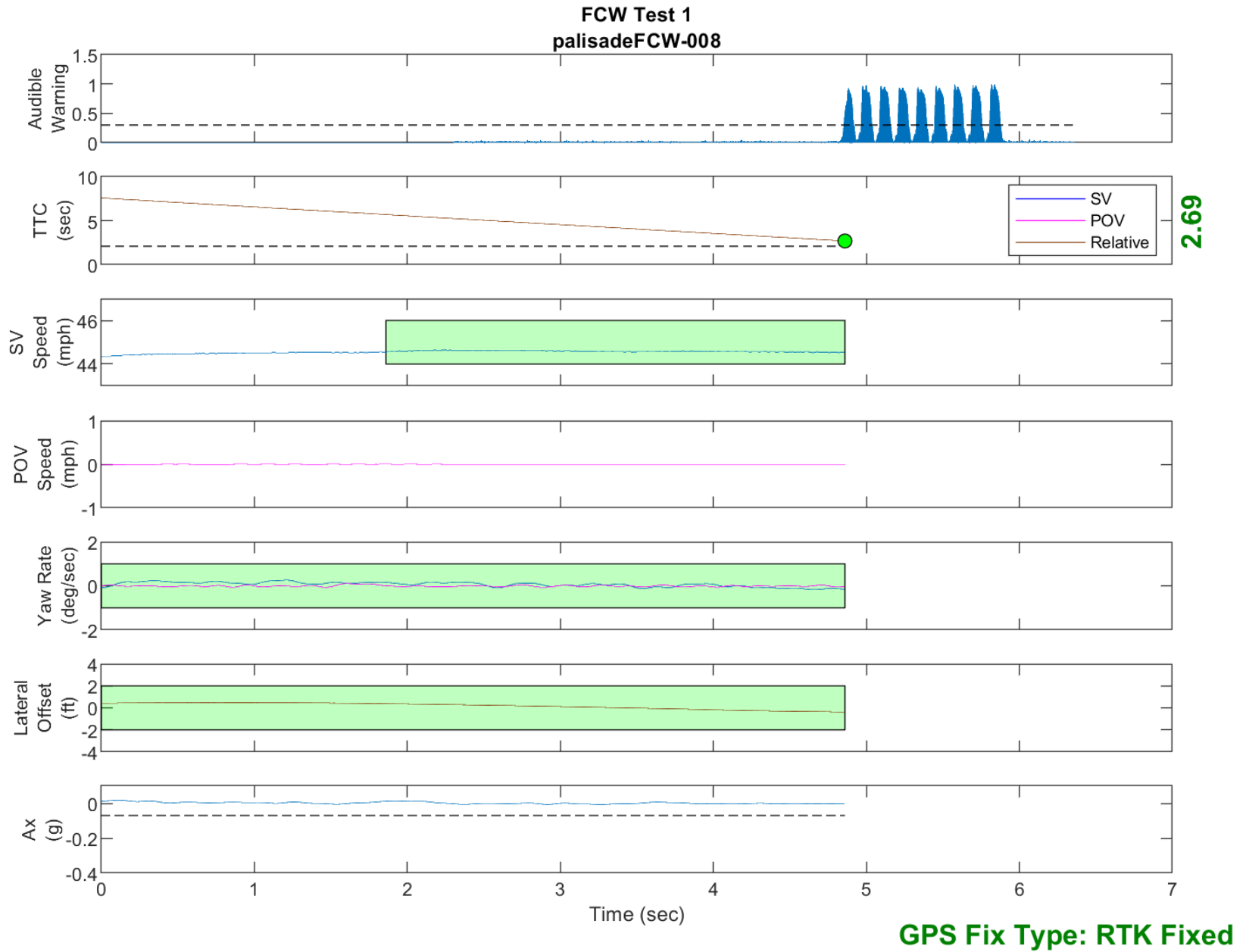


Figure D17. Time History for Run 08, FCW Test 1, Audible Warning

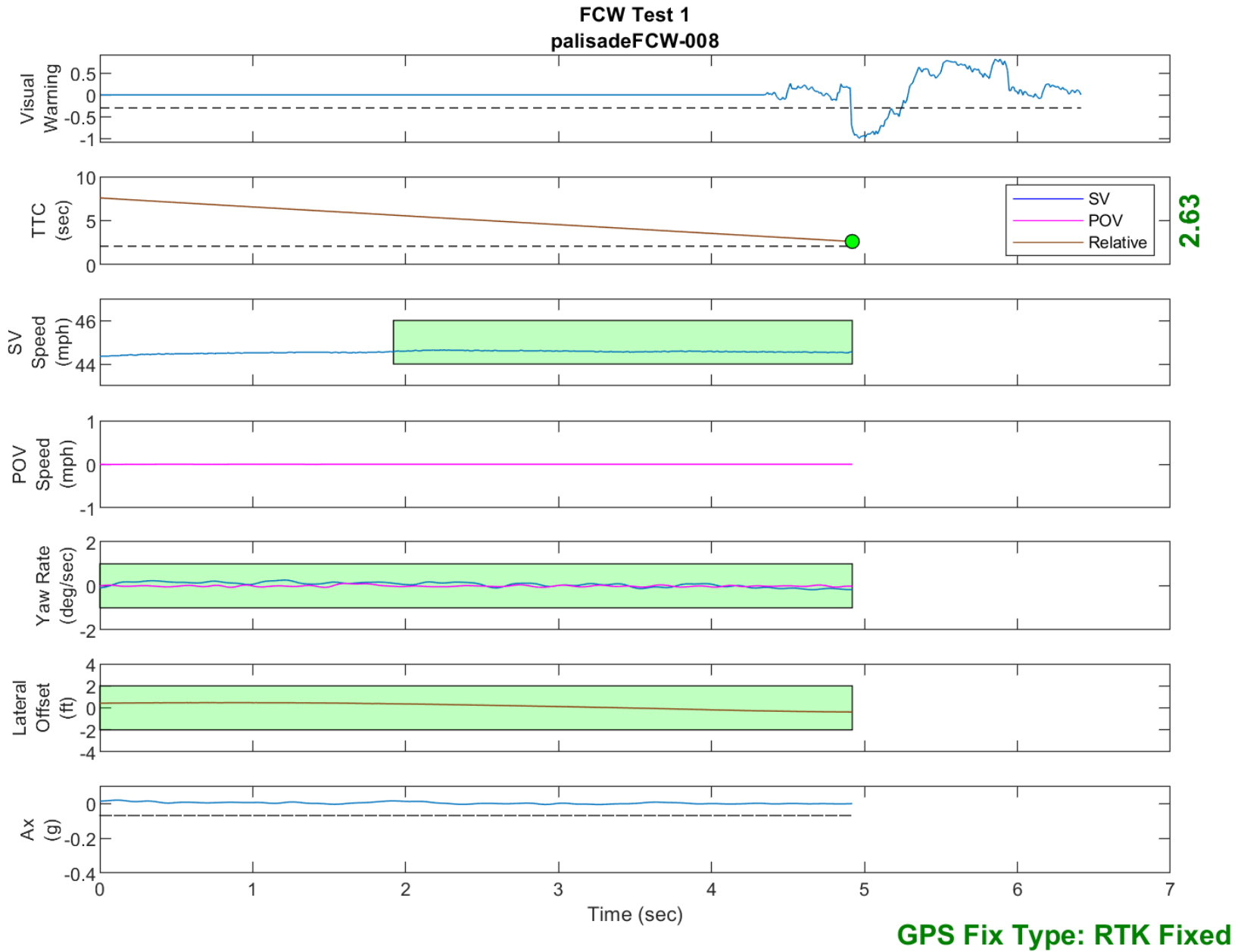


Figure D18. Time History for Run 08, FCW Test 1, Visual Warning

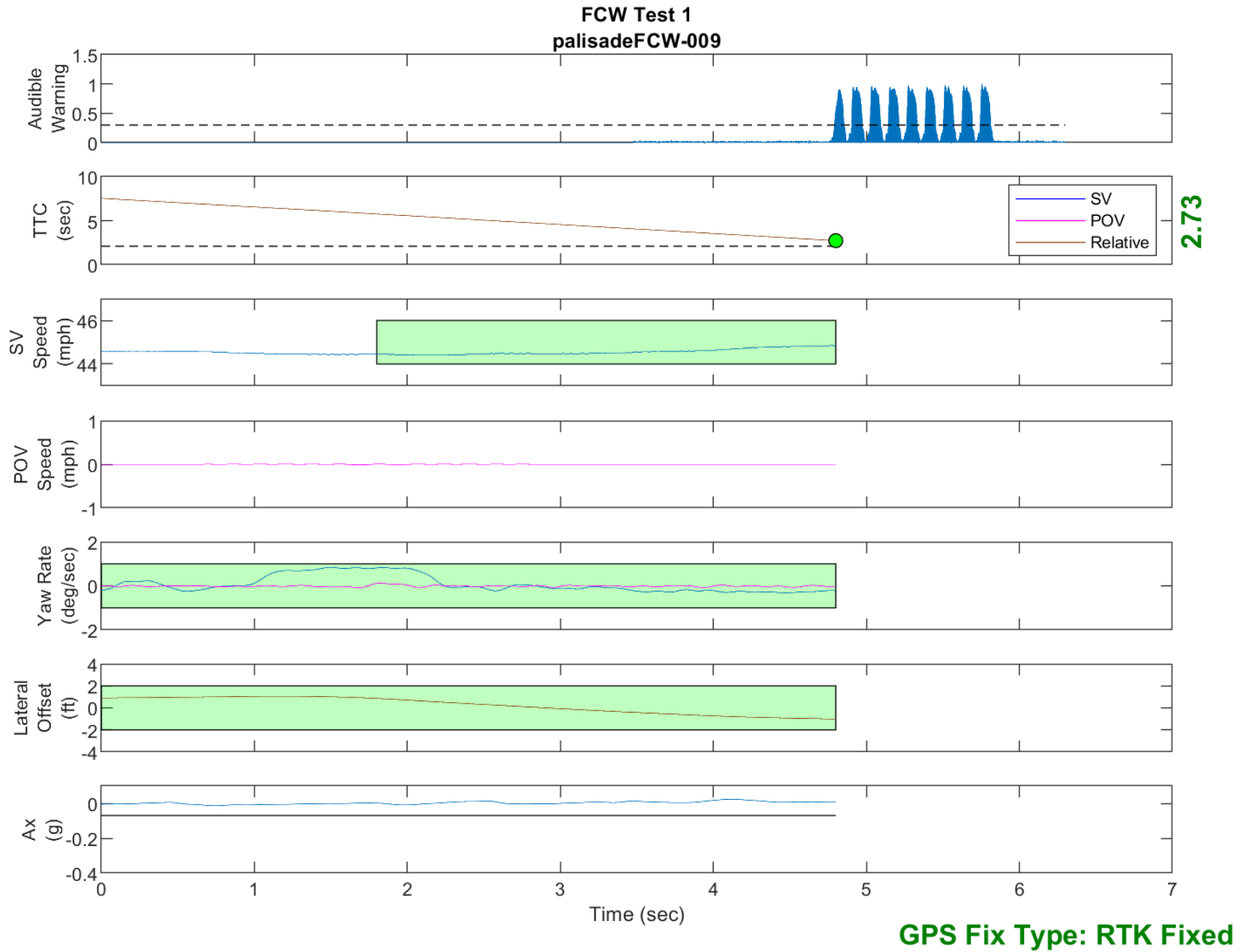


Figure D19. Time History for Run 09, FCW Test 1, Audible Warning

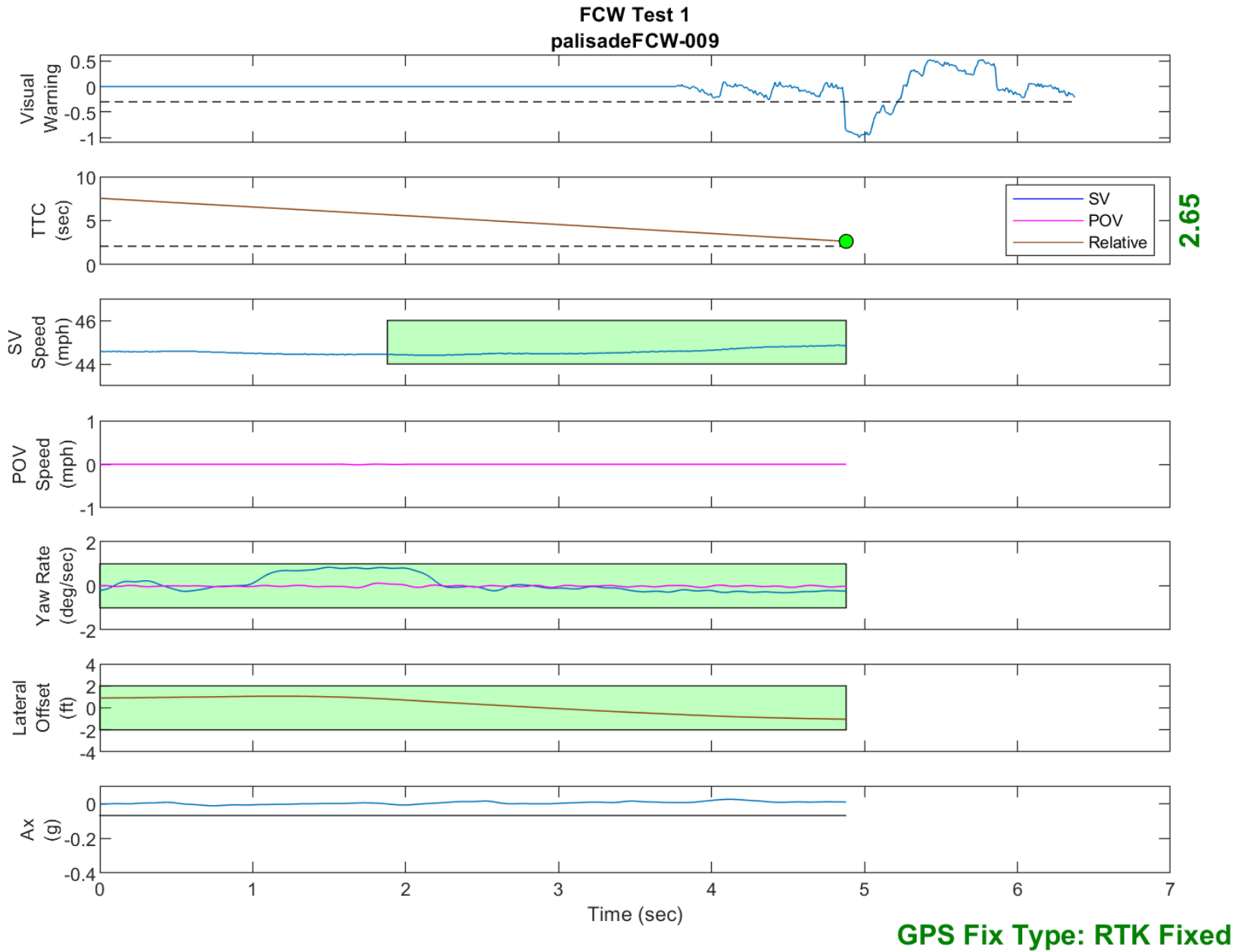


Figure D20. Time History for Run 09, FCW Test 1, Visual Warning

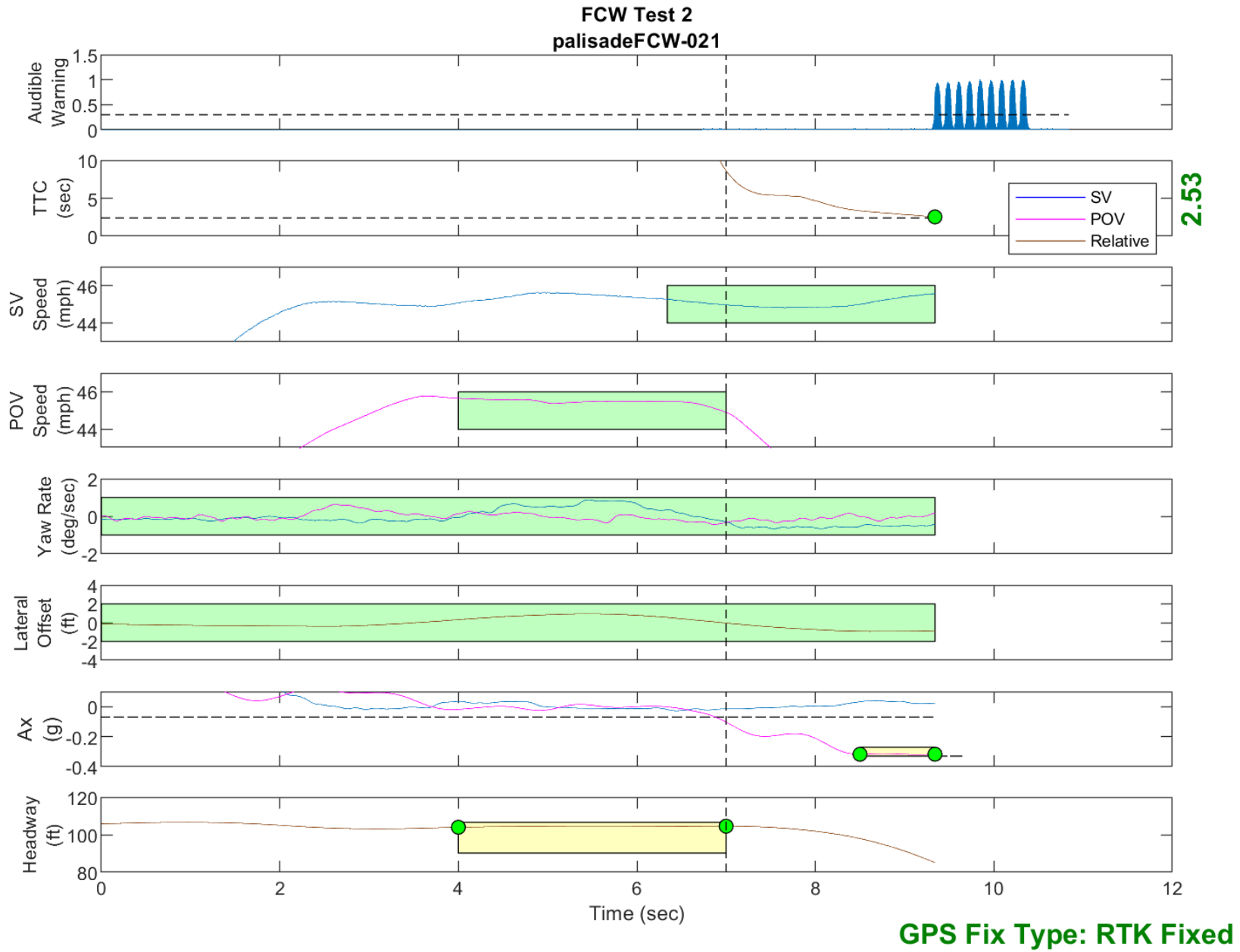


Figure D21. Time History for Run 21, FCW Test 2, Audible Warning

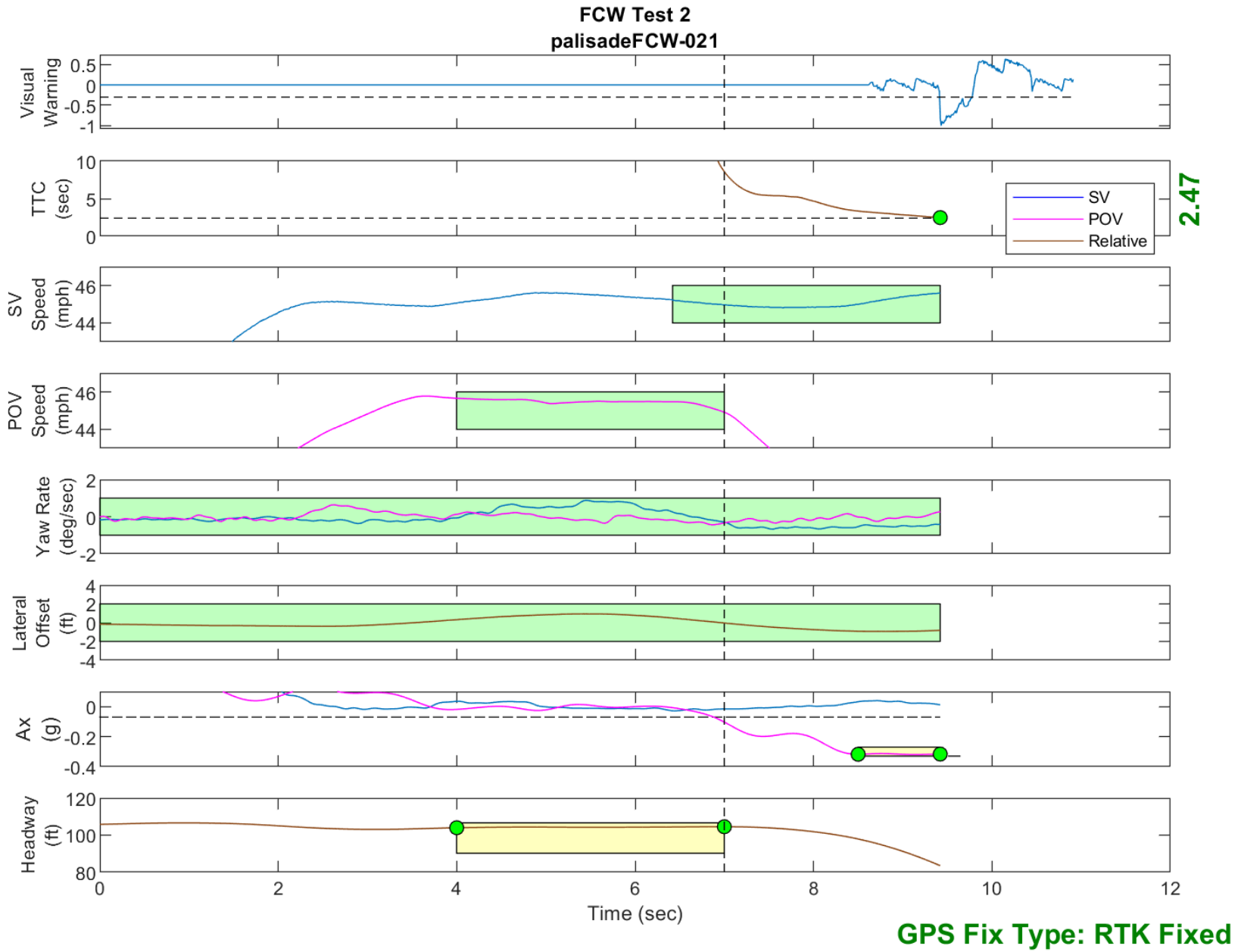


Figure D22. Time History for Run 21, FCW Test 2, Visual Warning

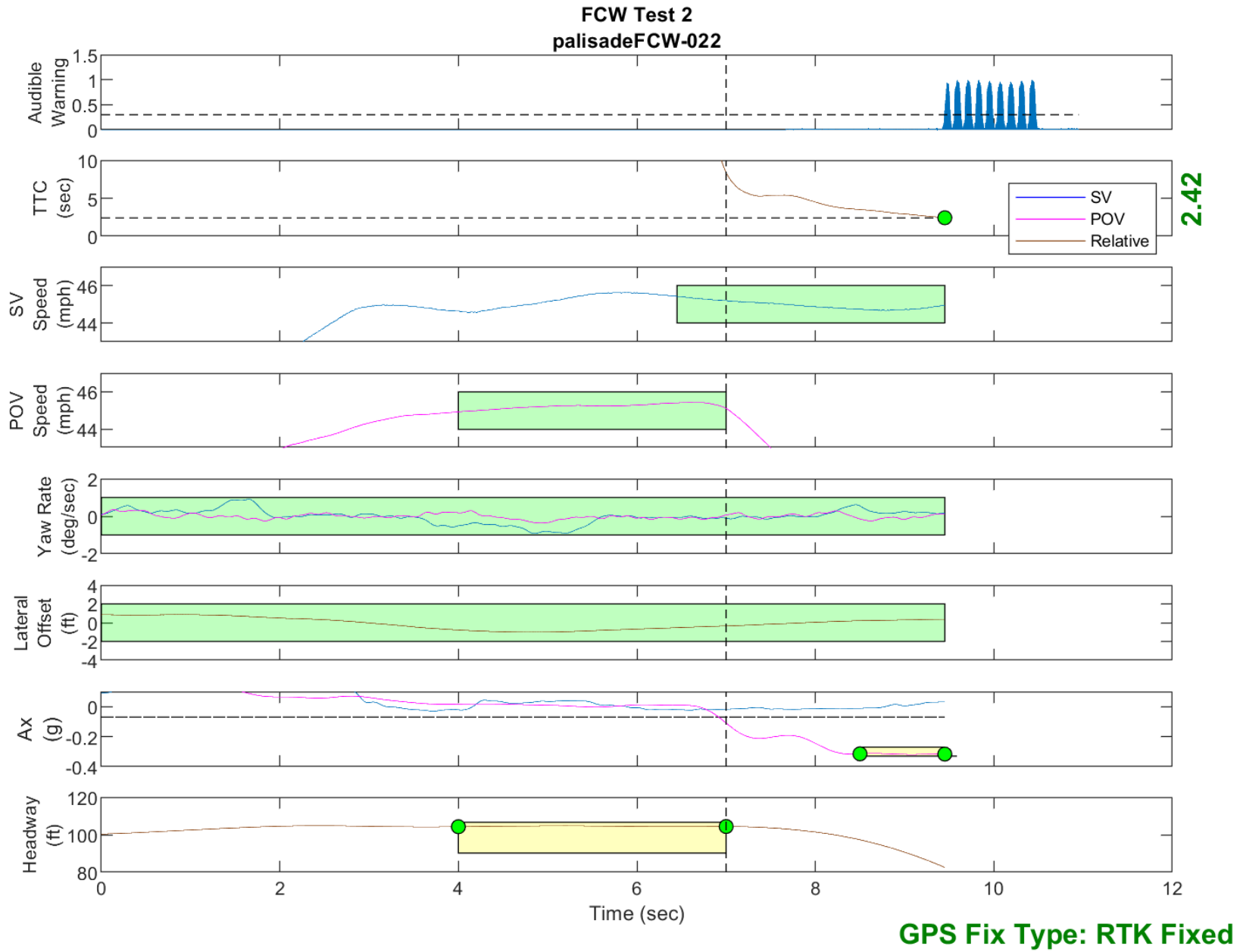


Figure D23. Time History for Run 22, FCW Test 2, Audible Warning

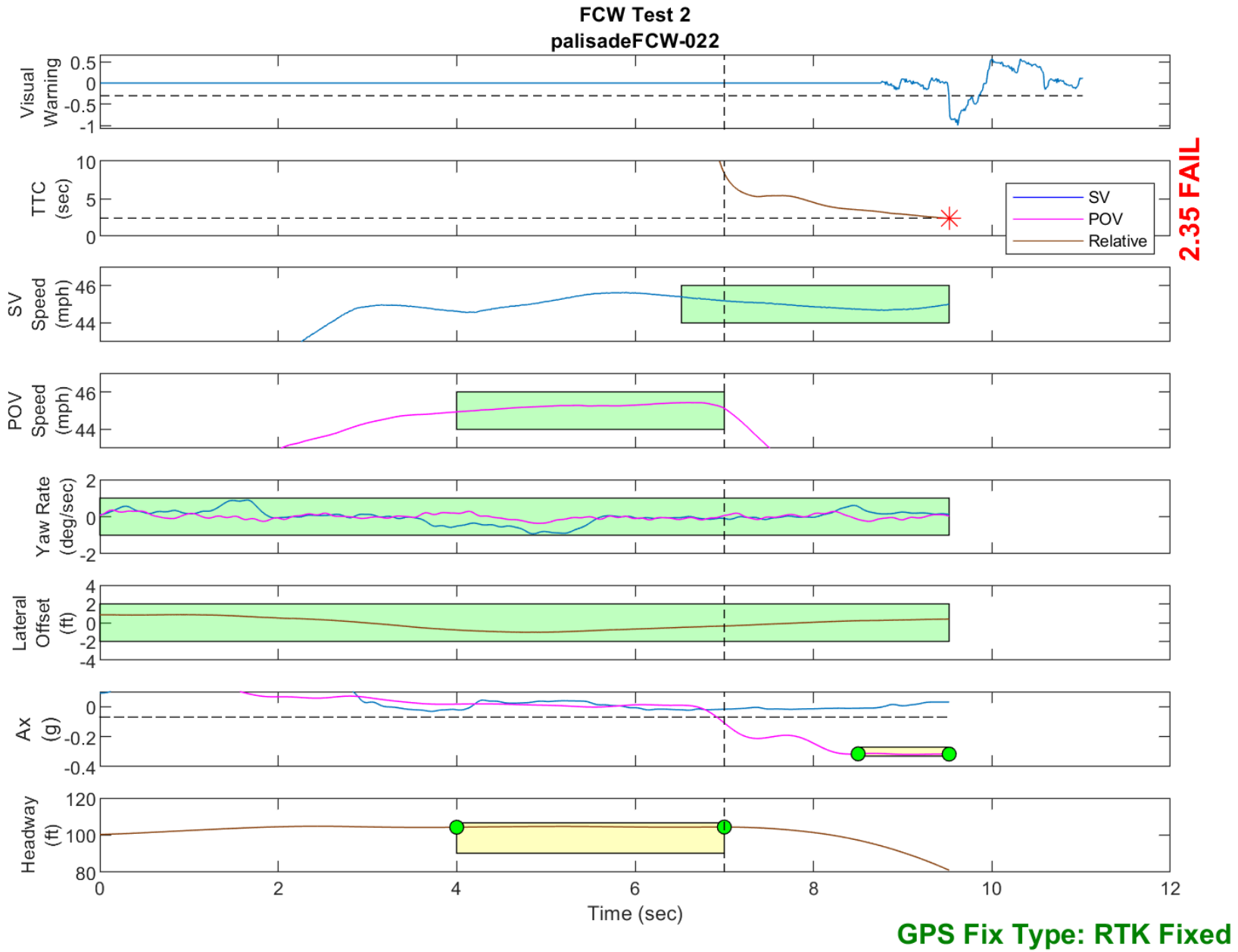


Figure D24. Time History for Run 22, FCW Test 2, Visual Warning

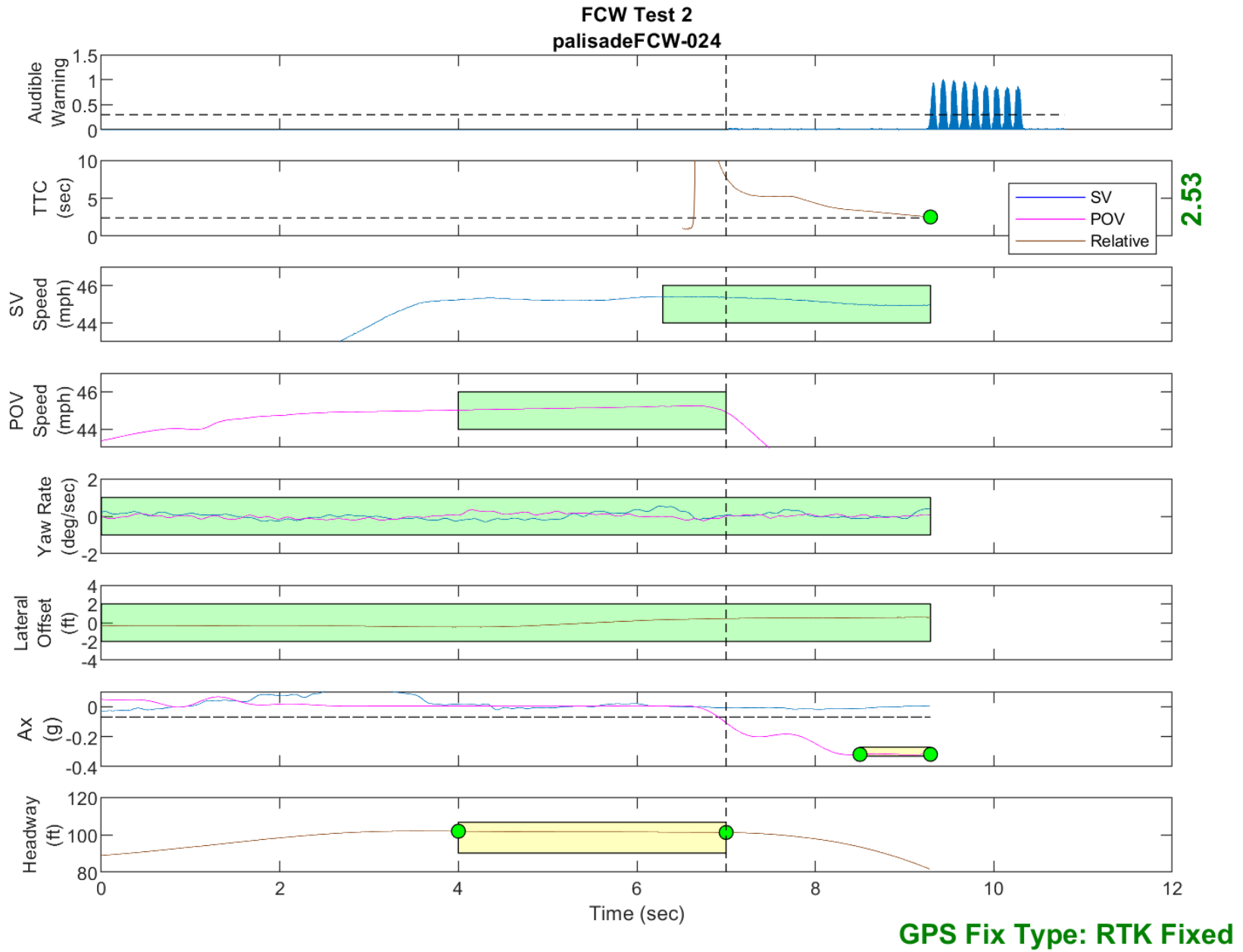


Figure D25. Time History for Run 24, FCW Test 2, Audible Warning

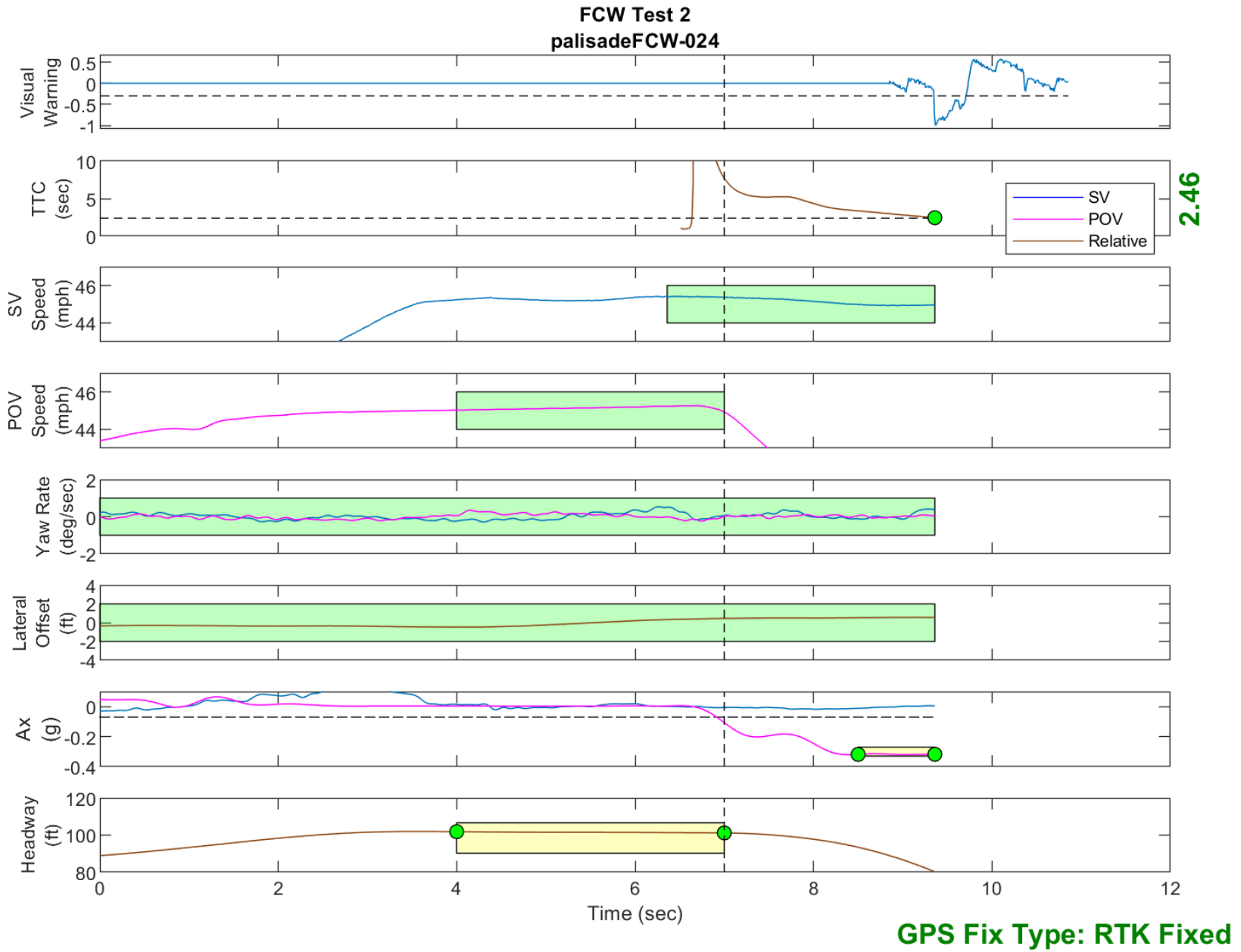


Figure D26. Time History for Run 24, FCW Test 2, Visual Warning

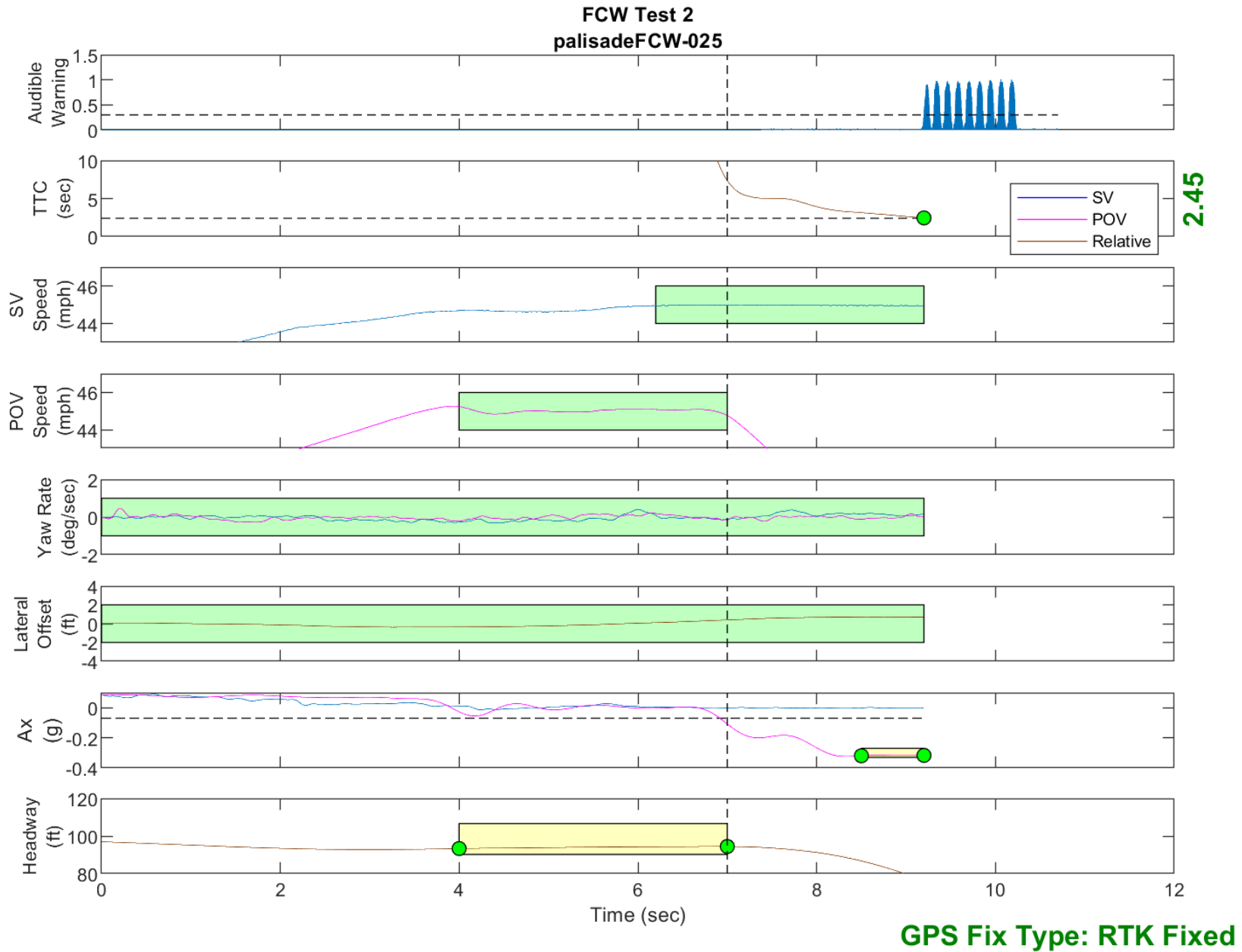


Figure D27. Time History for Run 25, FCW Test 2, Audible Warning

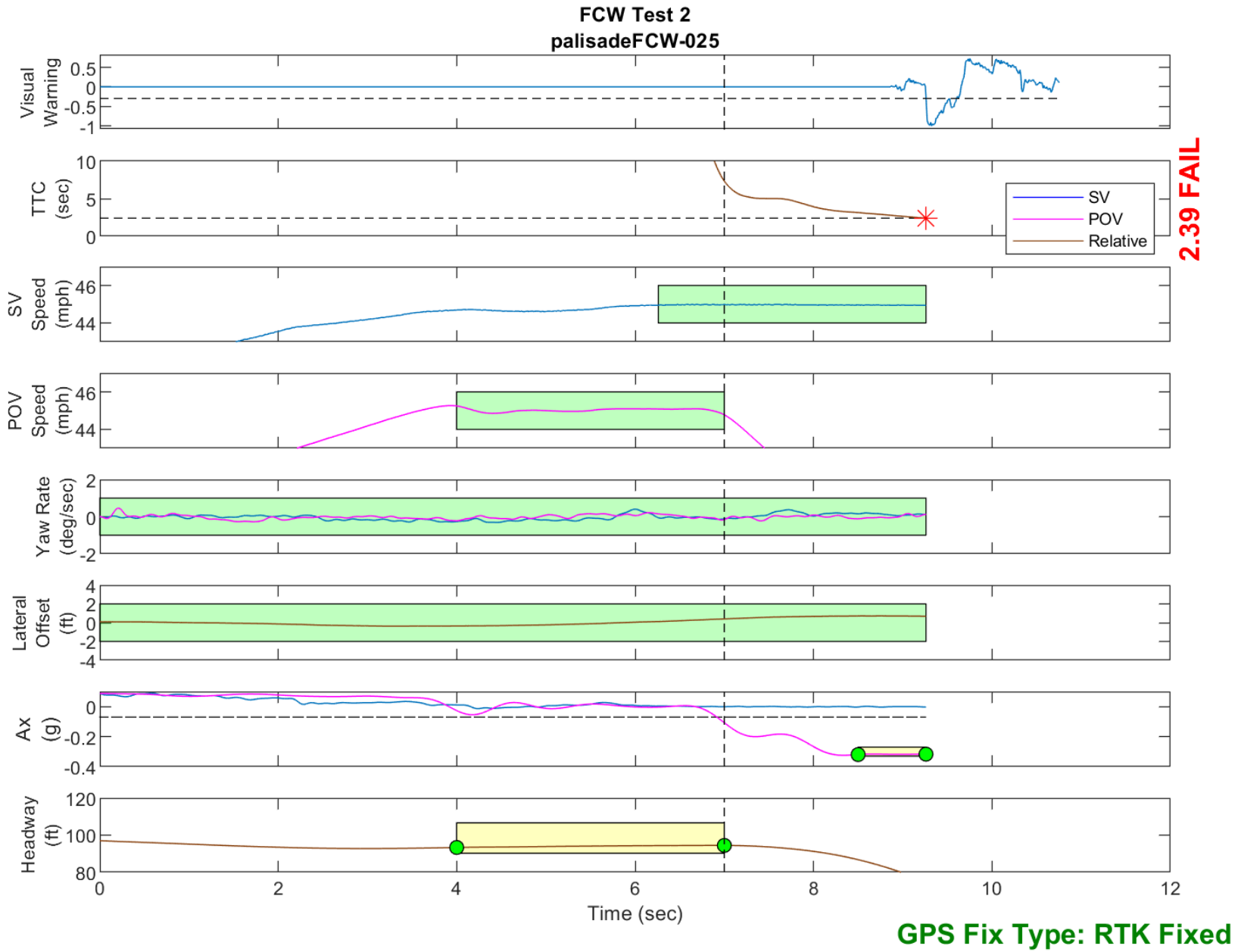


Figure D28. Time History for Run 25, FCW Test 2, Visual Warning

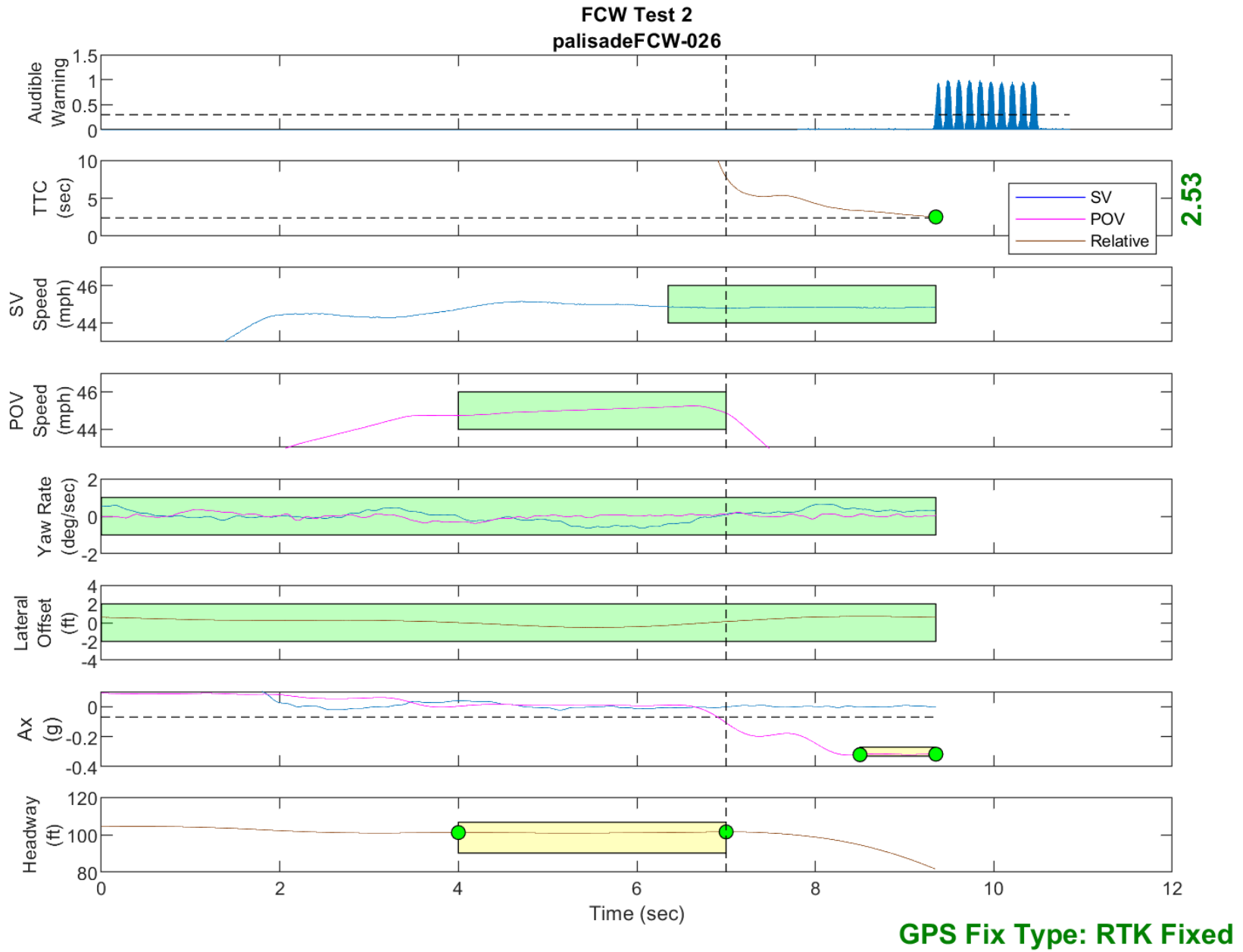


Figure D29. Time History for Run 26, FCW Test 2, Audible Warning

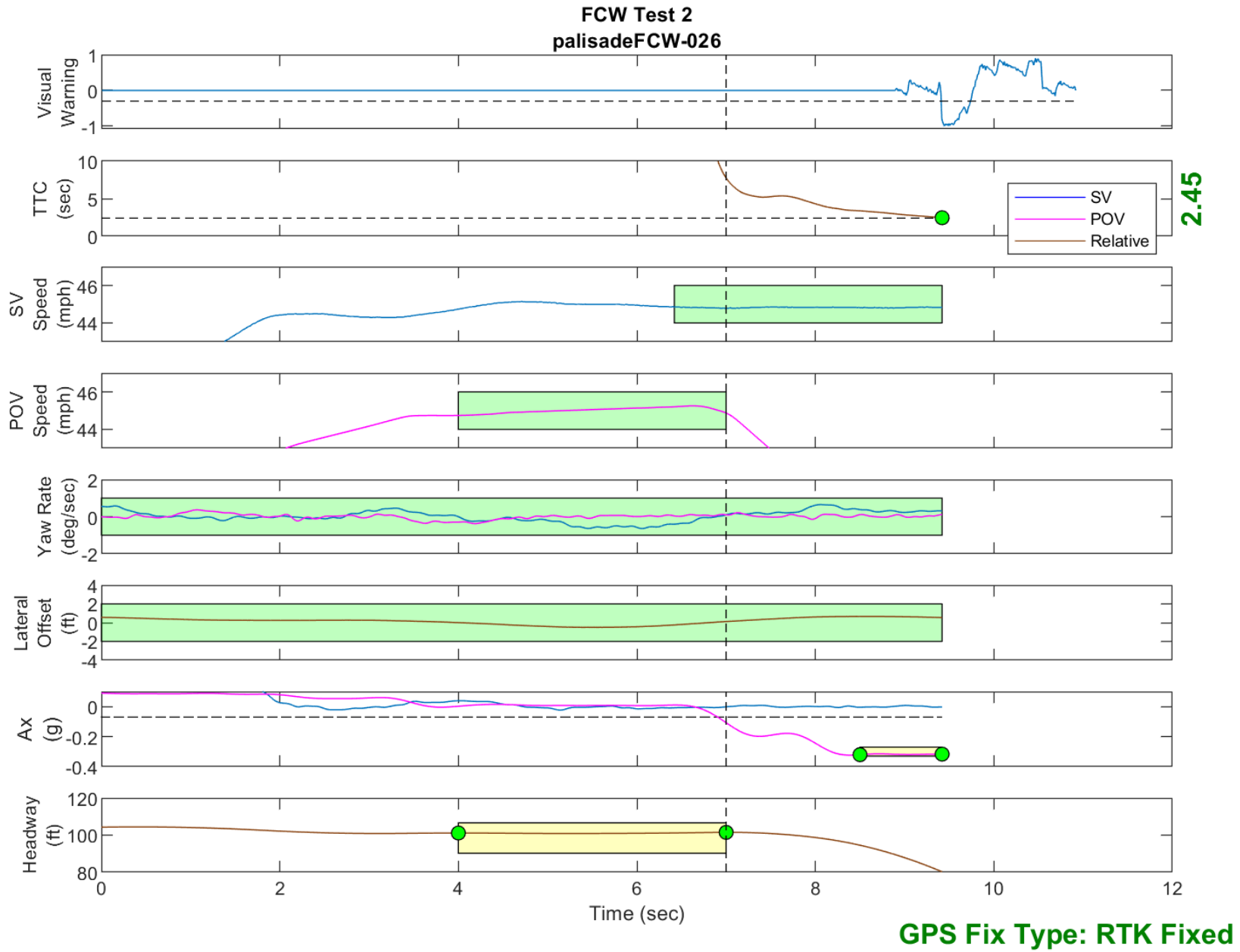


Figure D30. Time History for Run 26, FCW Test 2, Visual Warning

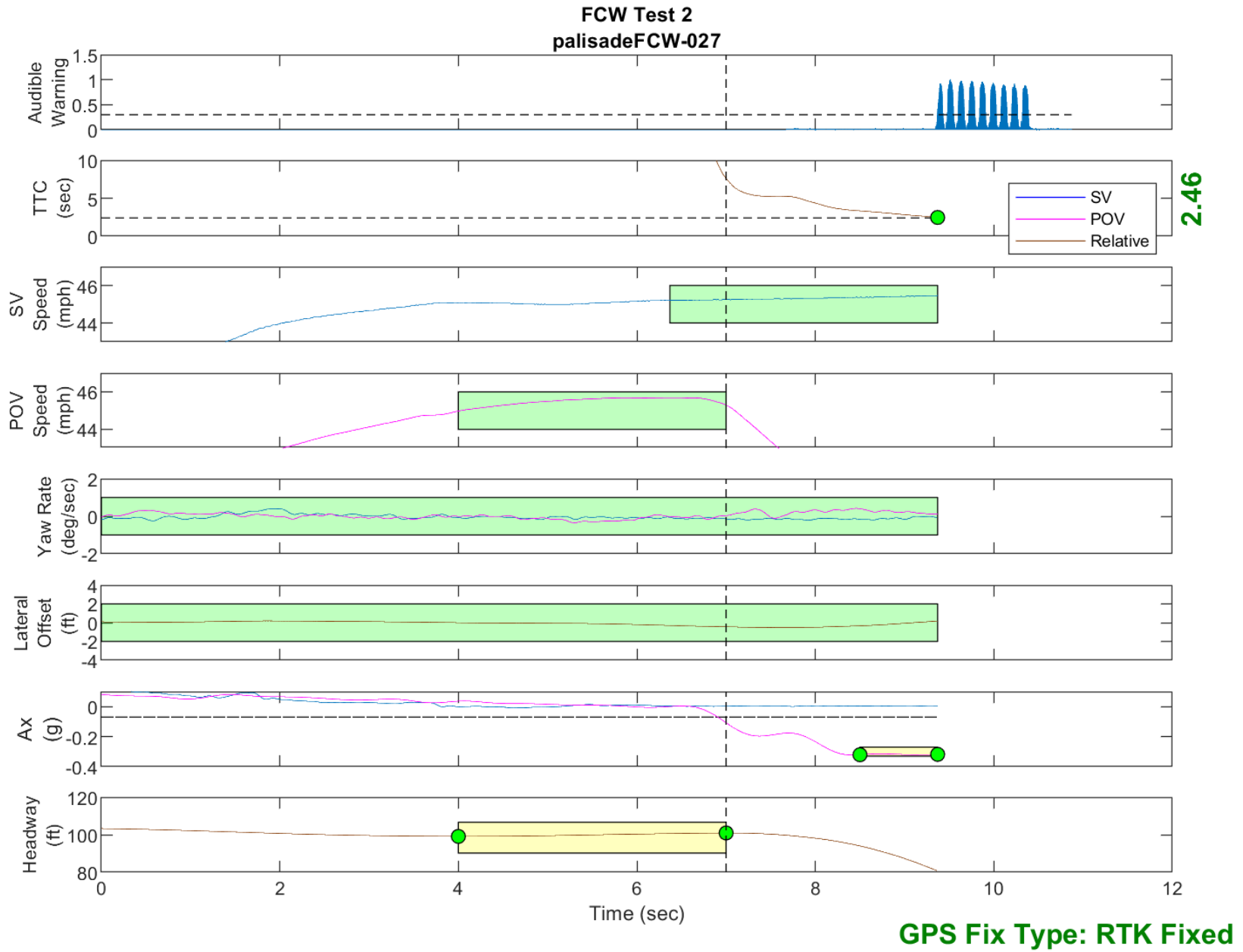


Figure D31. Time History for Run 27, FCW Test 2, Audible Warning

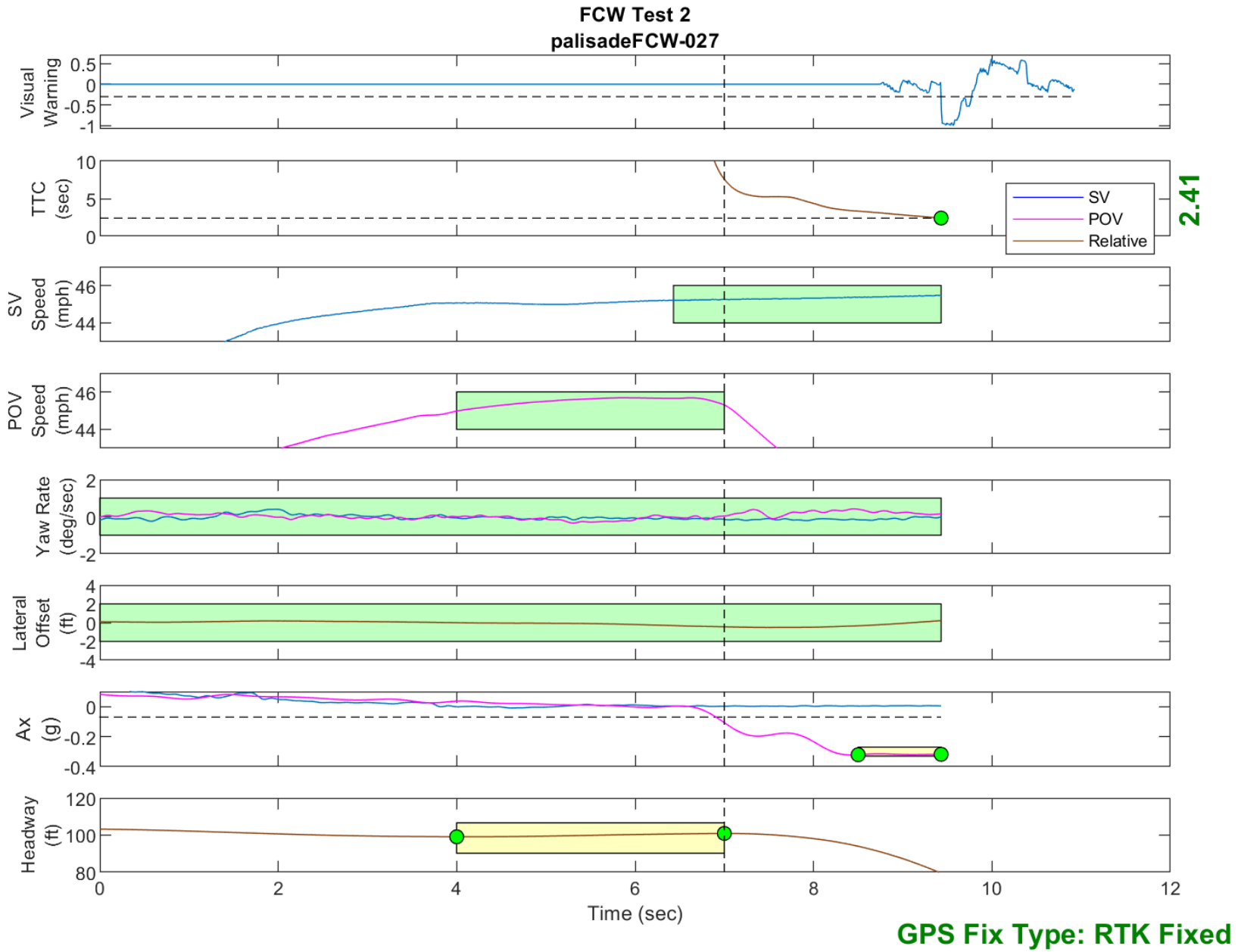


Figure D32. Time History for Run 27, FCW Test 2, Visual Warning

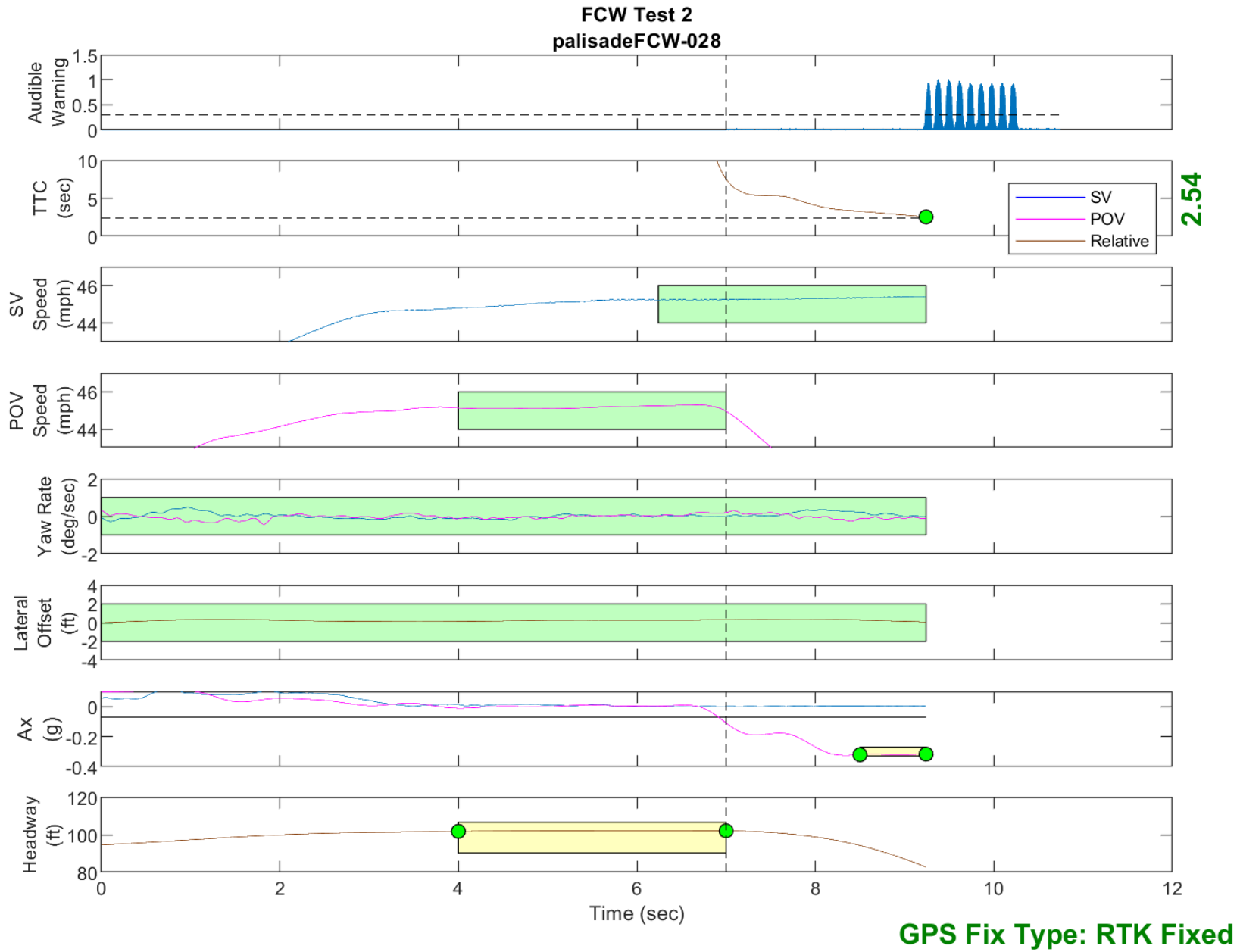


Figure D33. Time History for Run 28, FCW Test 2, Audible Warning

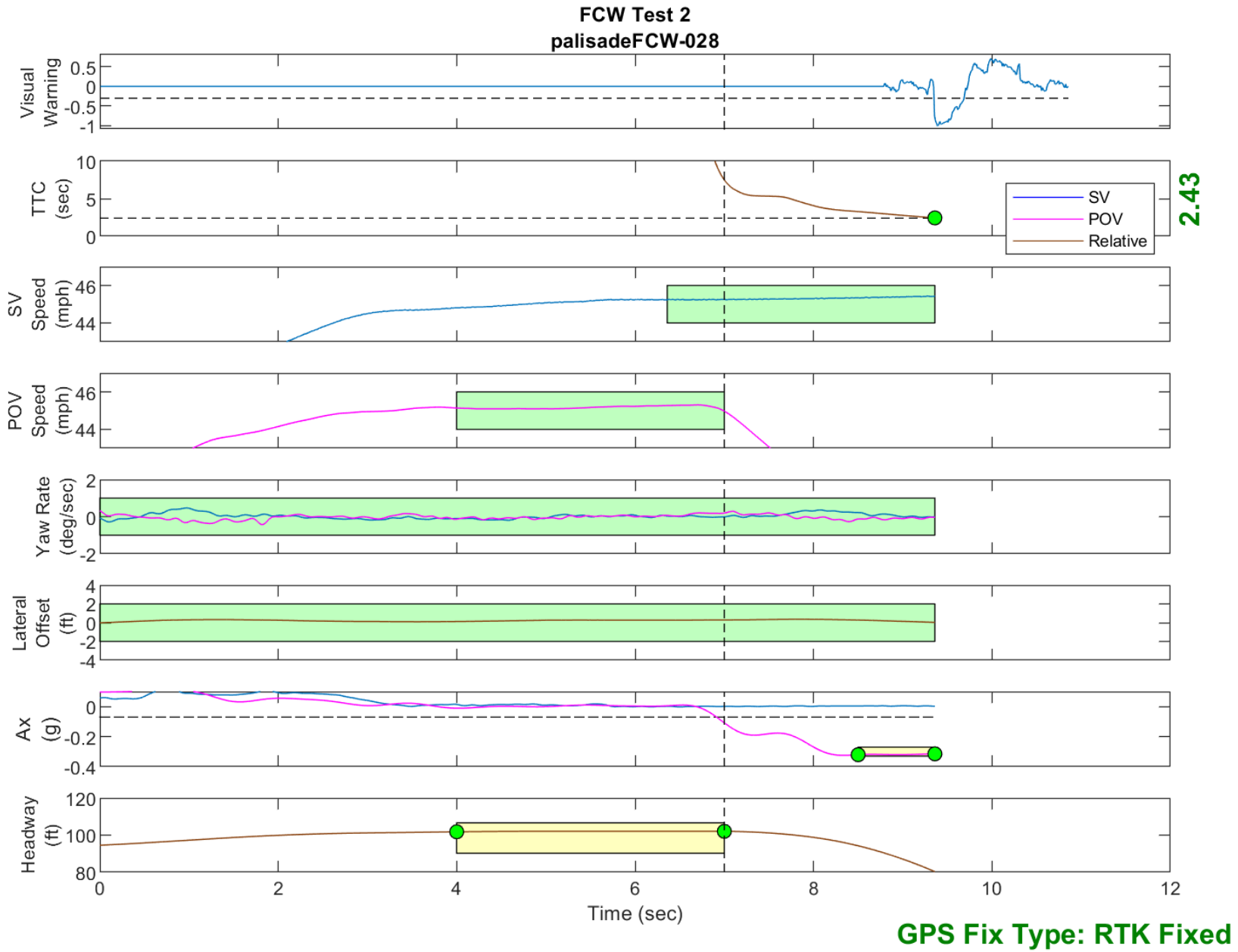


Figure D34. Time History for Run 28, FCW Test 2, Visual Warning

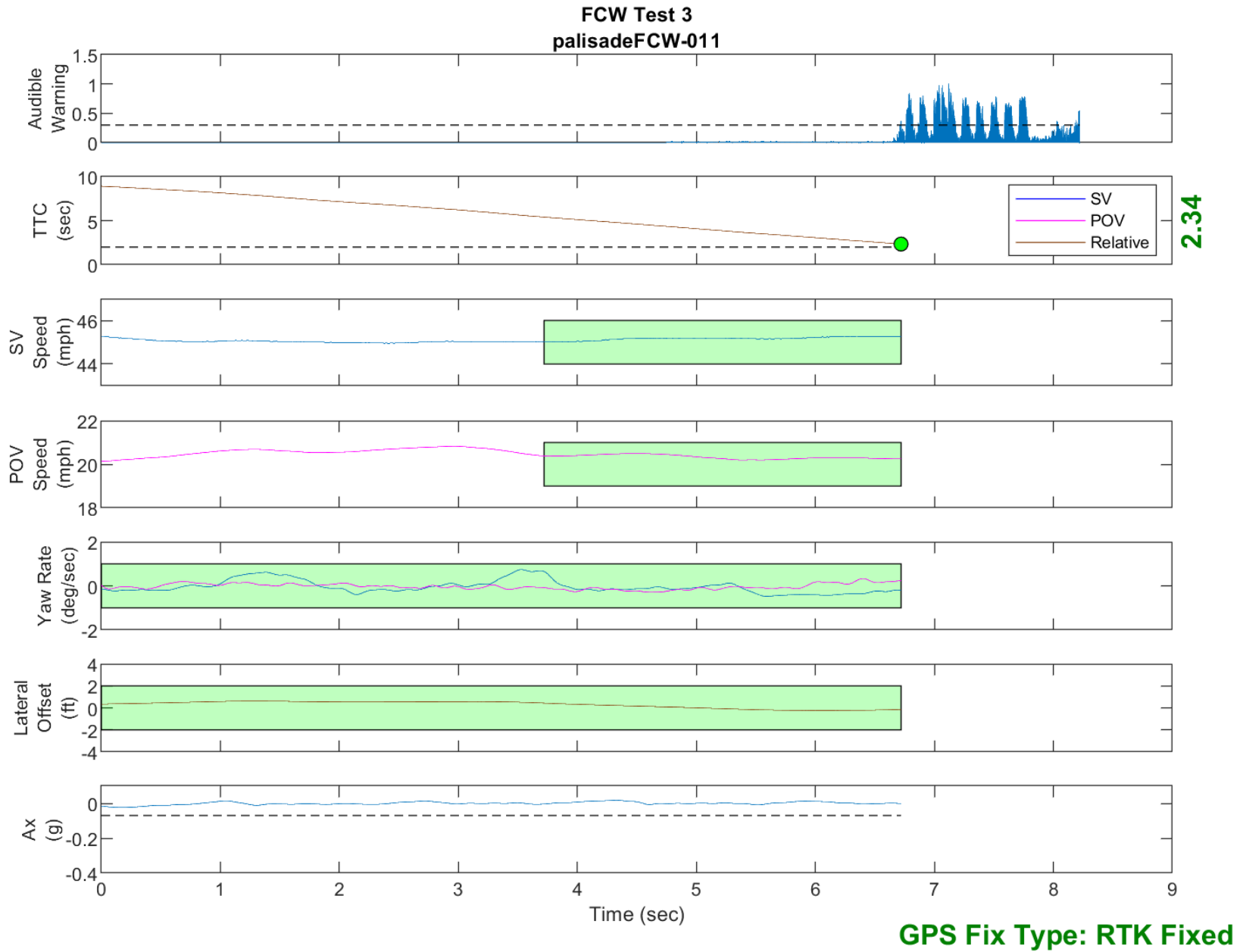


Figure D35. Time History for Run 11, FCW Test 3, Audible Warning

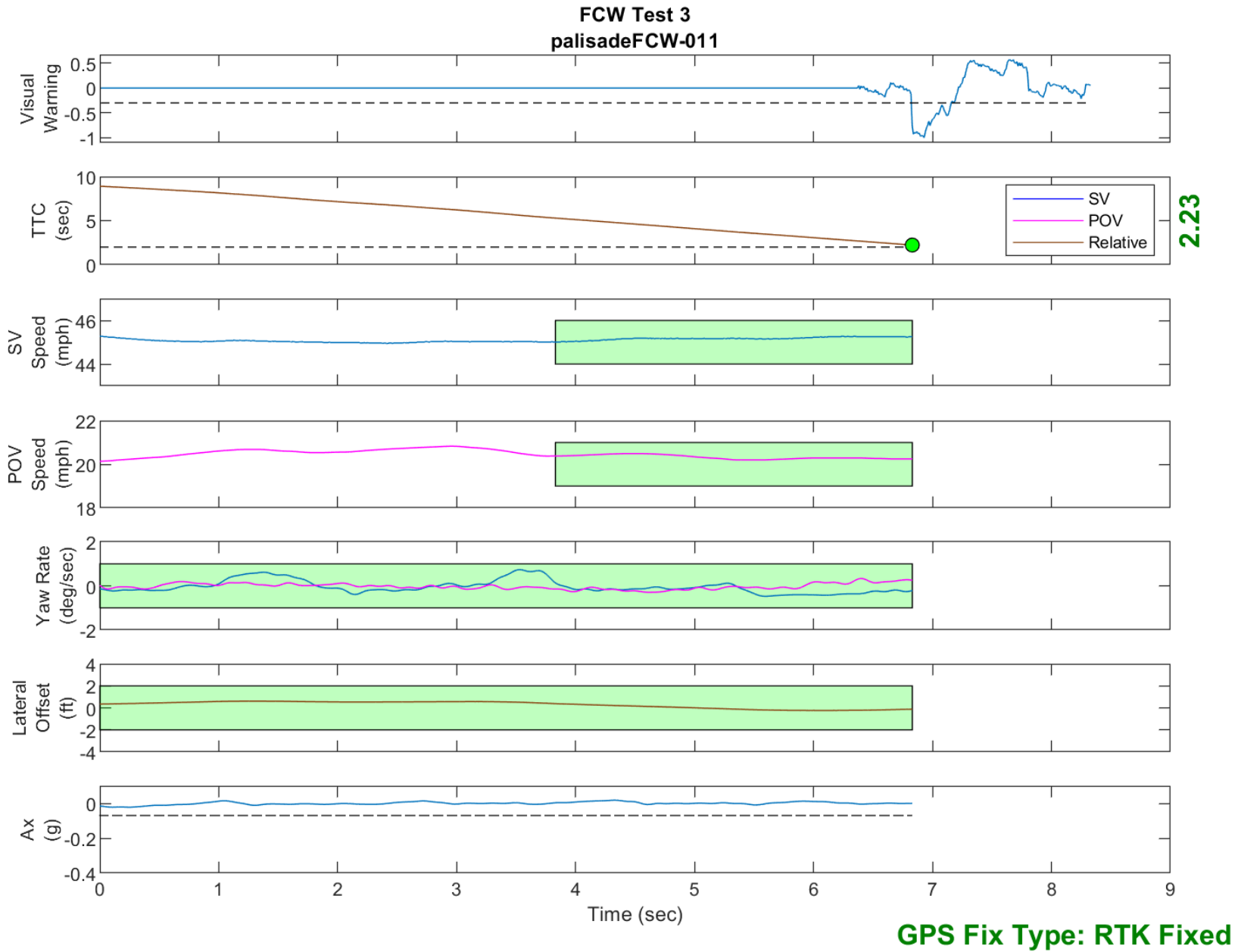


Figure D36. Time History for Run 11, FCW Test 3, Visual Warning

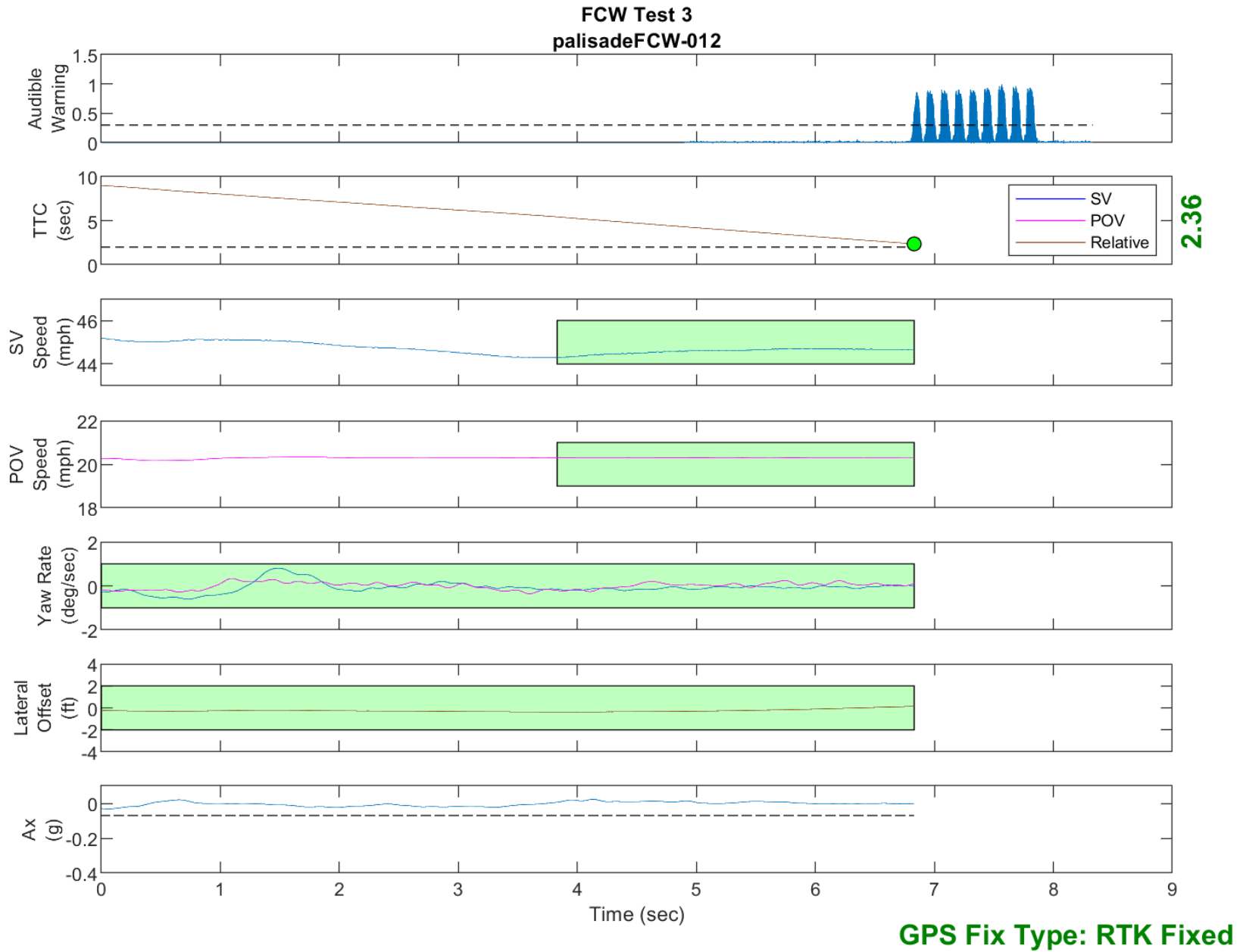


Figure D37. Time History for Run 12, FCW Test 3, Audible Warning

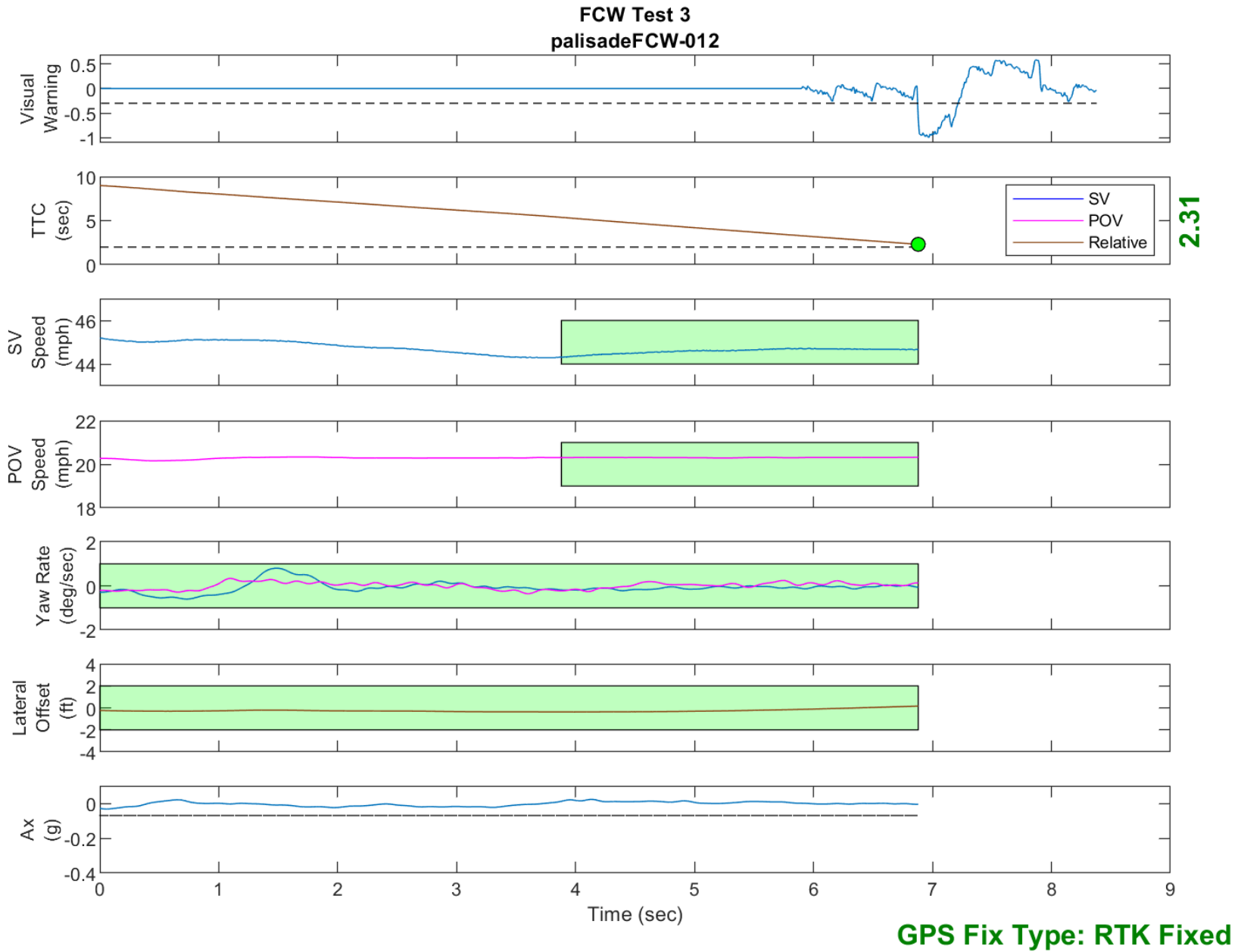


Figure D38. Time History for Run 12, FCW Test 3, Visual Warning

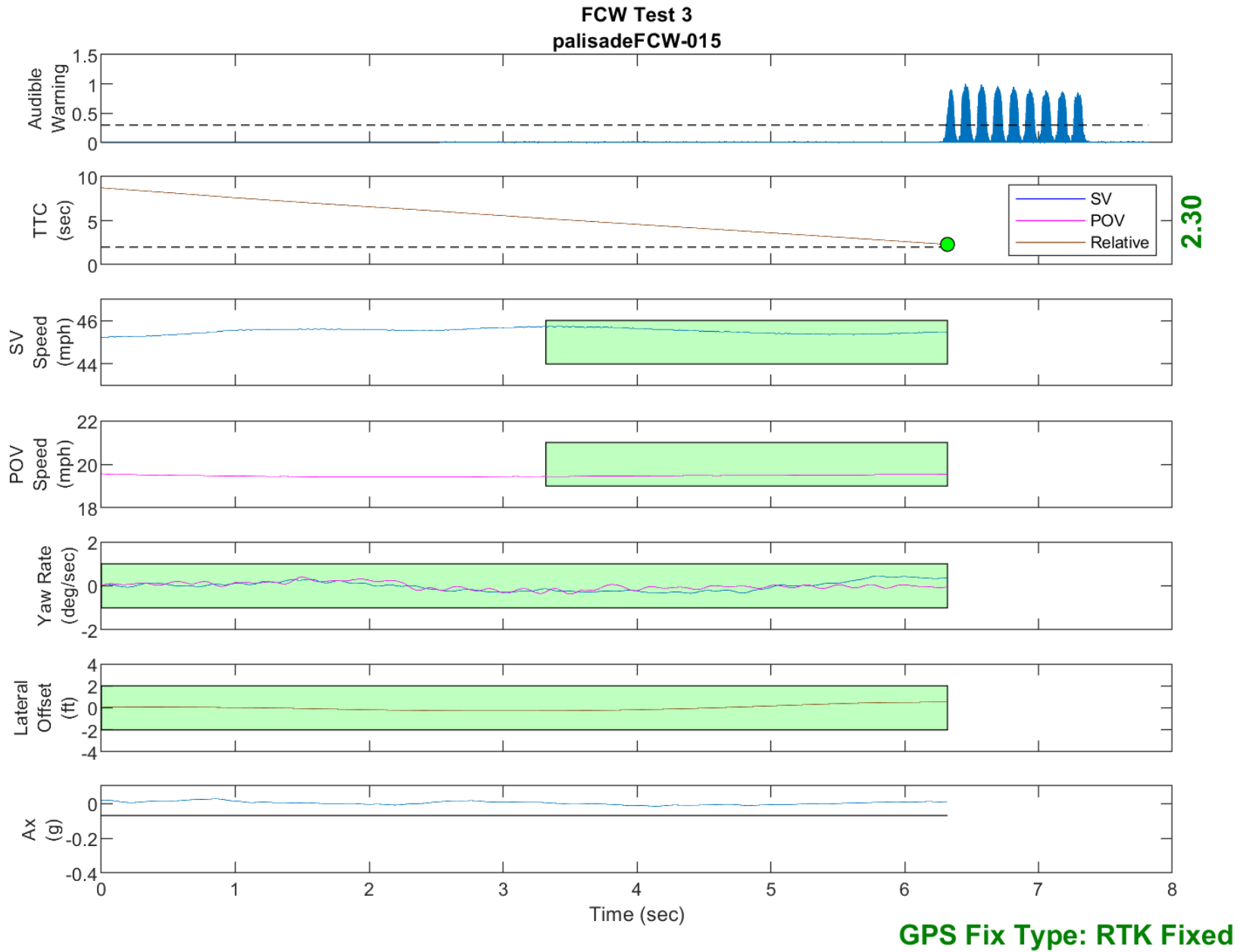


Figure D39. Time History for Run 15, FCW Test 3, Audible Warning

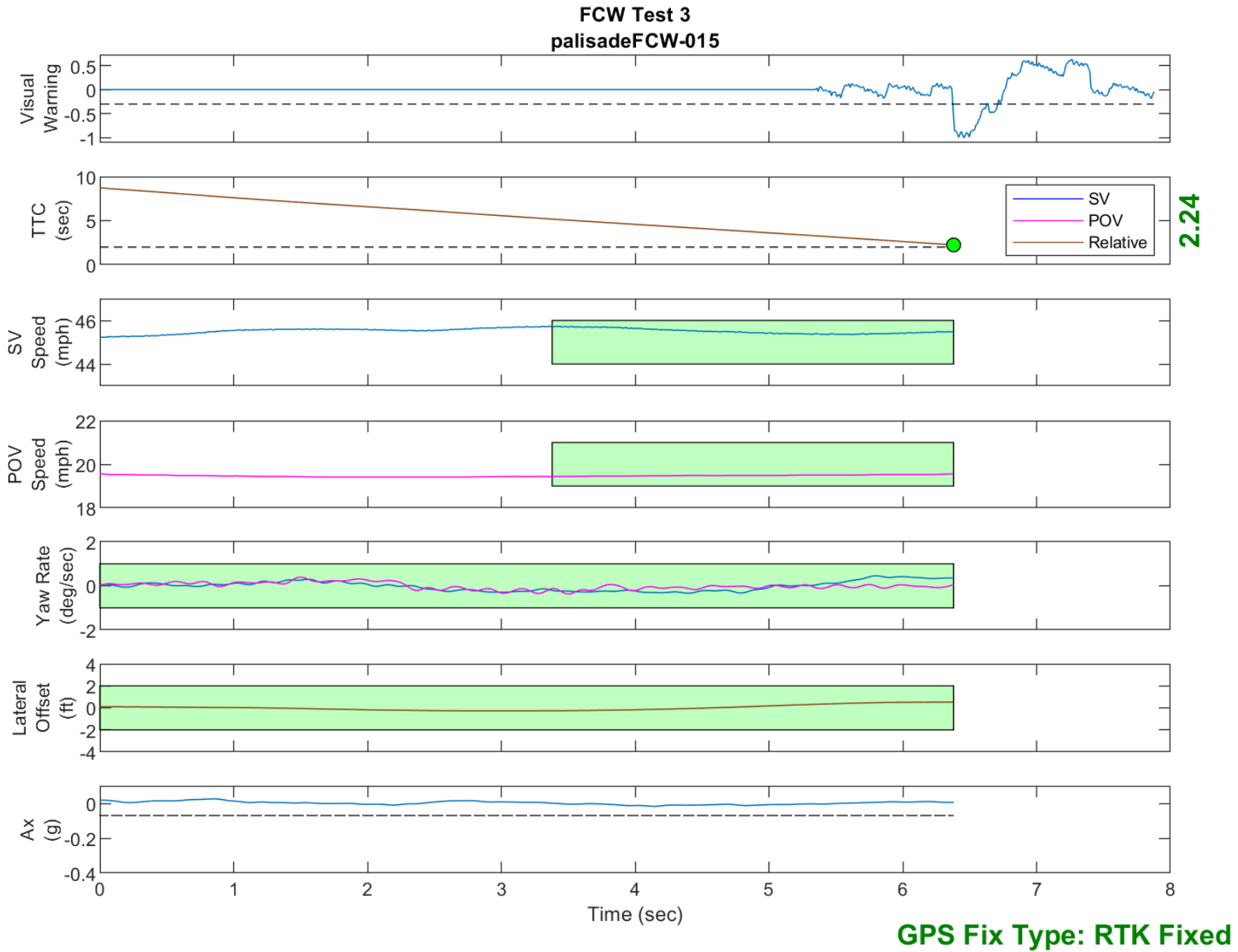


Figure D40. Time History for Run 15, FCW Test 3, Visual Warning

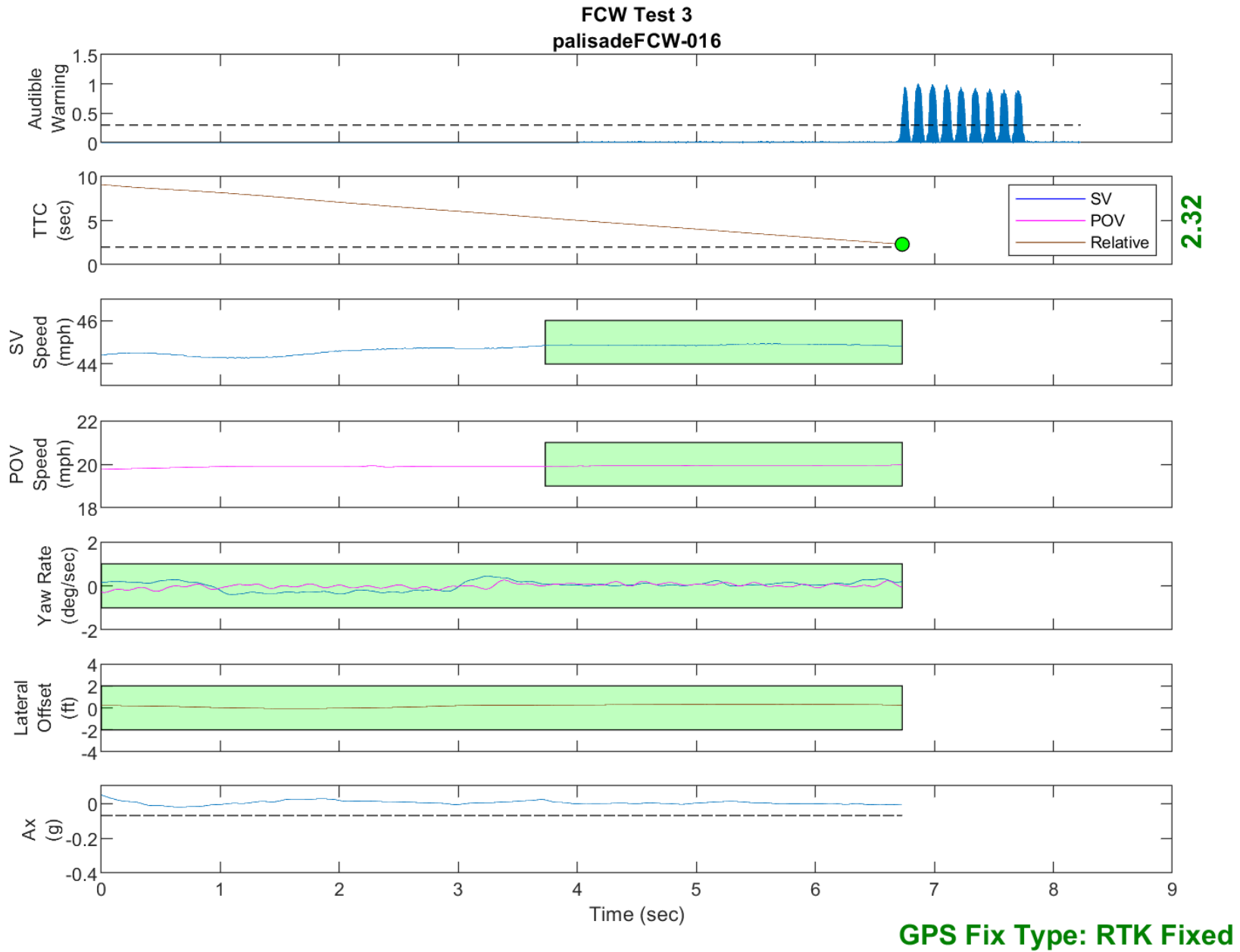


Figure D41. Time History for Run 16, FCW Test 3, Audible Warning

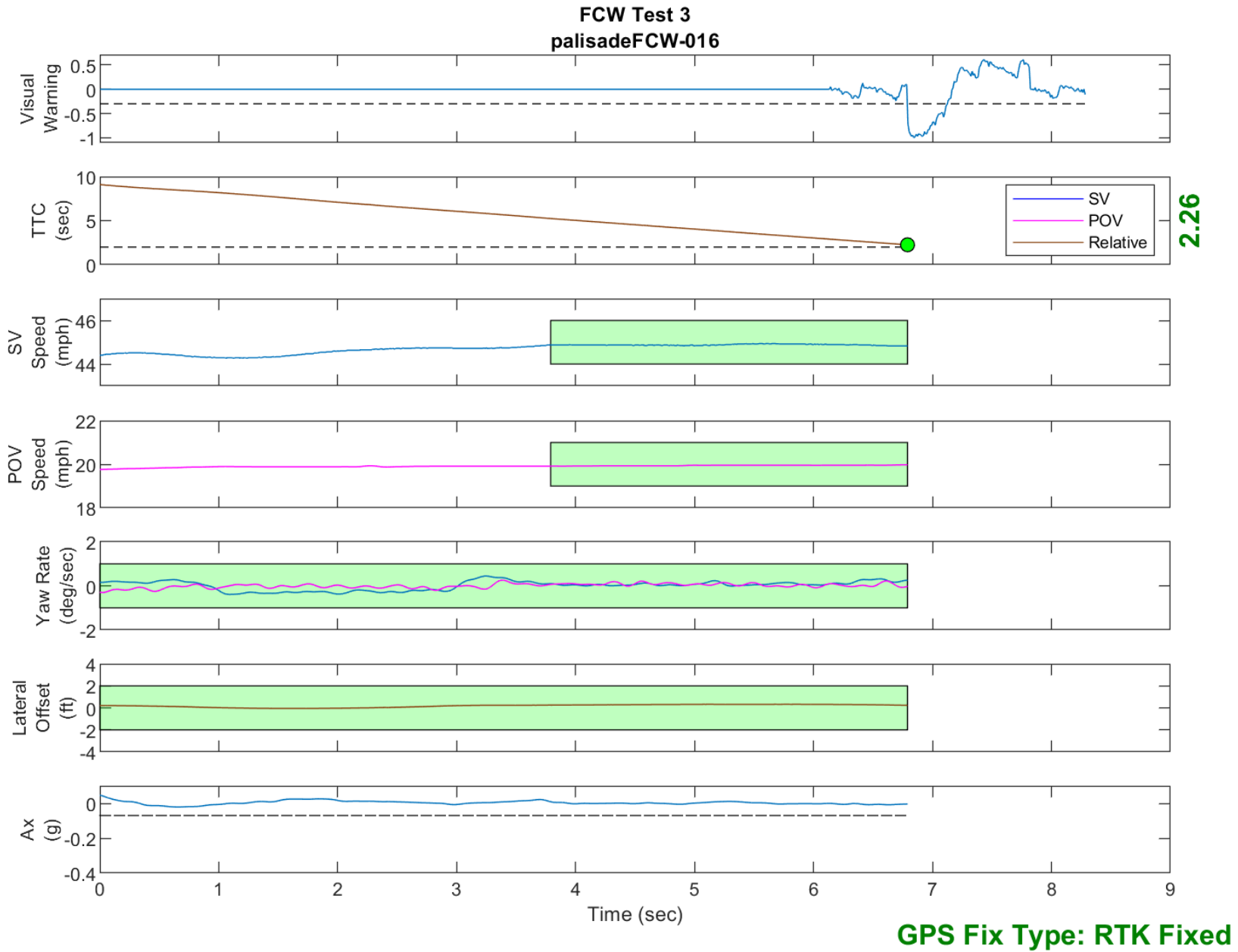


Figure D42. Time History for Run 16, FCW Test 3, Visual Warning

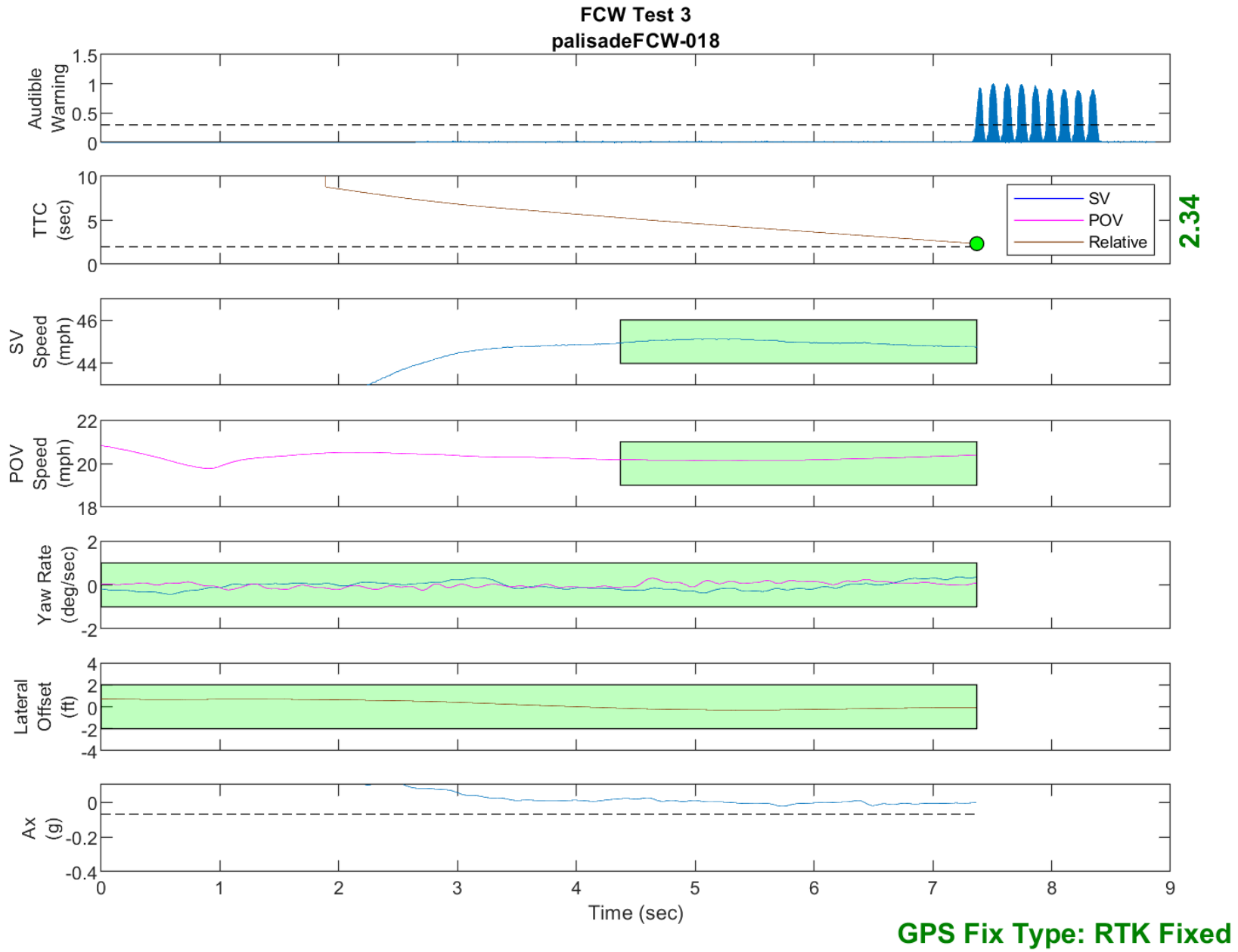


Figure D43. Time History for Run 18, FCW Test 3, Audible Warning

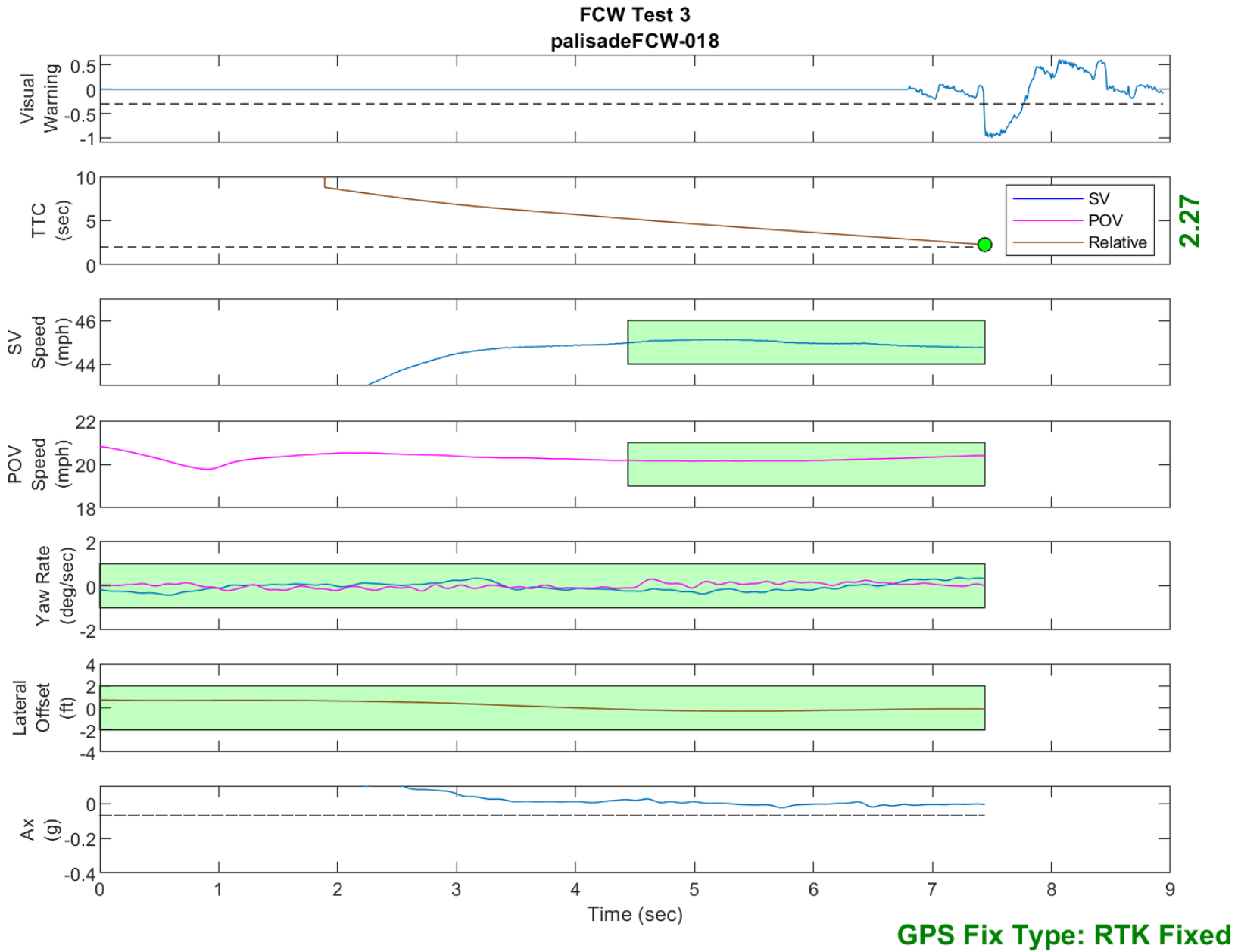


Figure D44. Time History for Run 18, FCW Test 3, Visual Warning

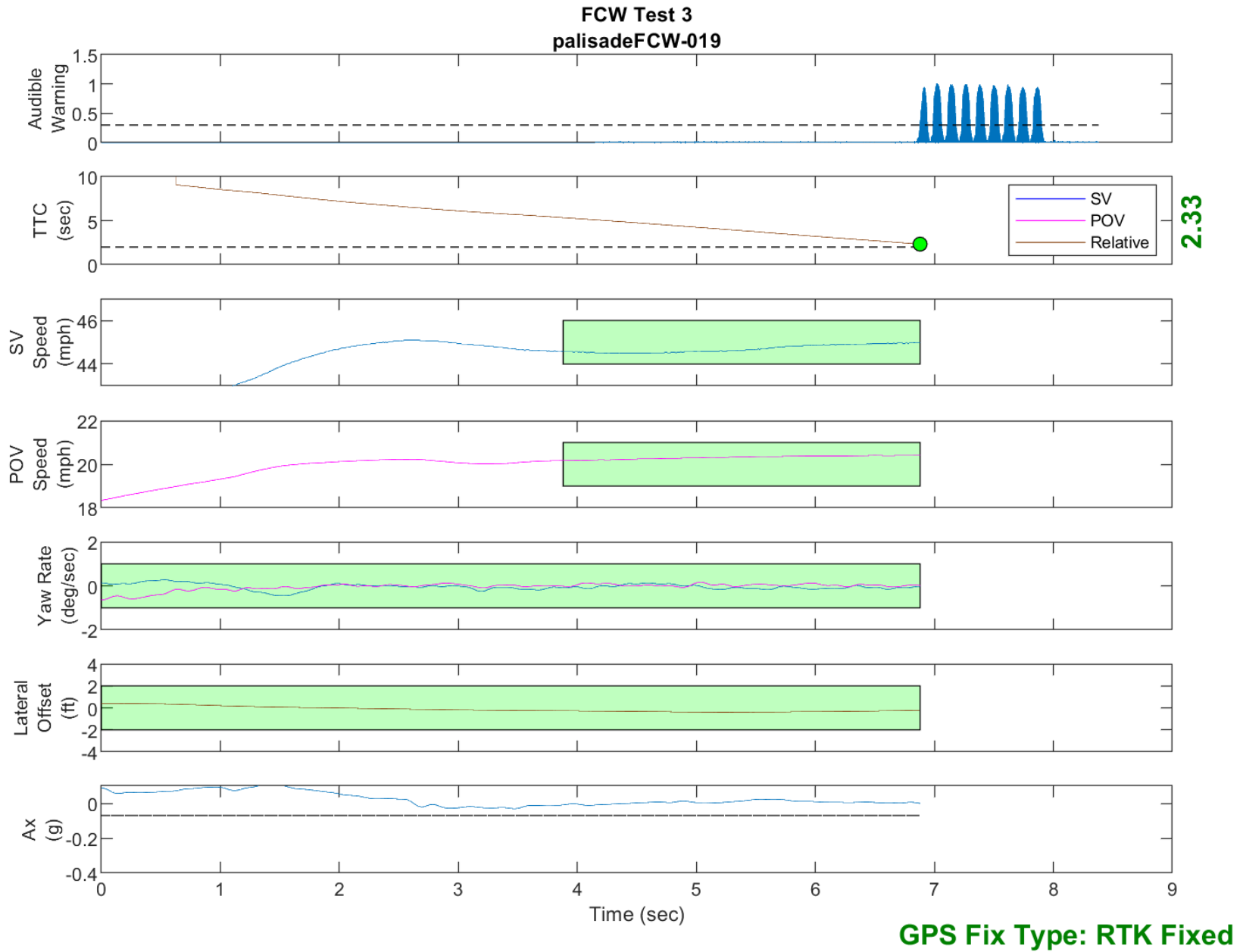


Figure D45. Time History for Run 19, FCW Test 3, Audible Warning

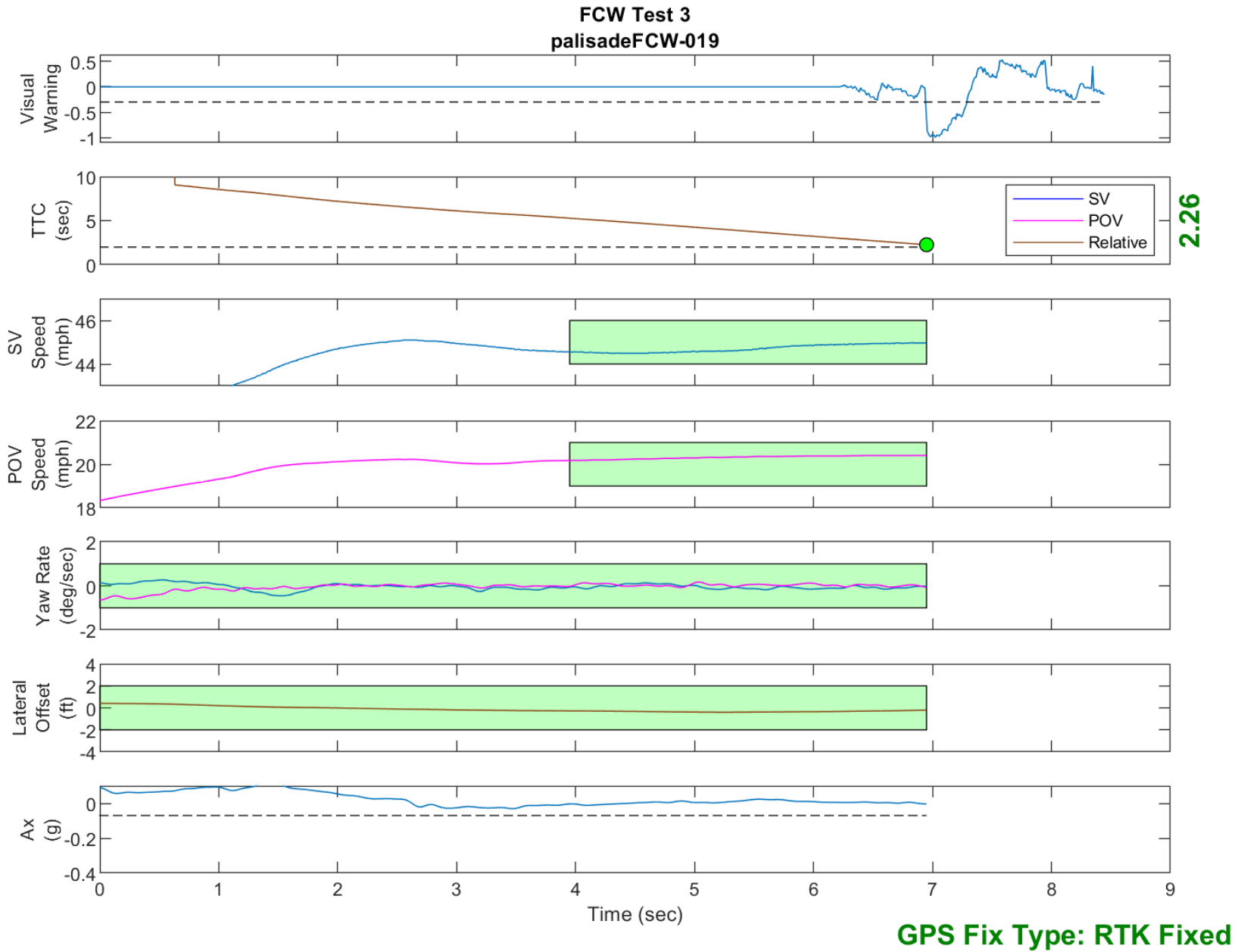


Figure D46. Time History for Run 19, FCW Test 3, Visual Warning

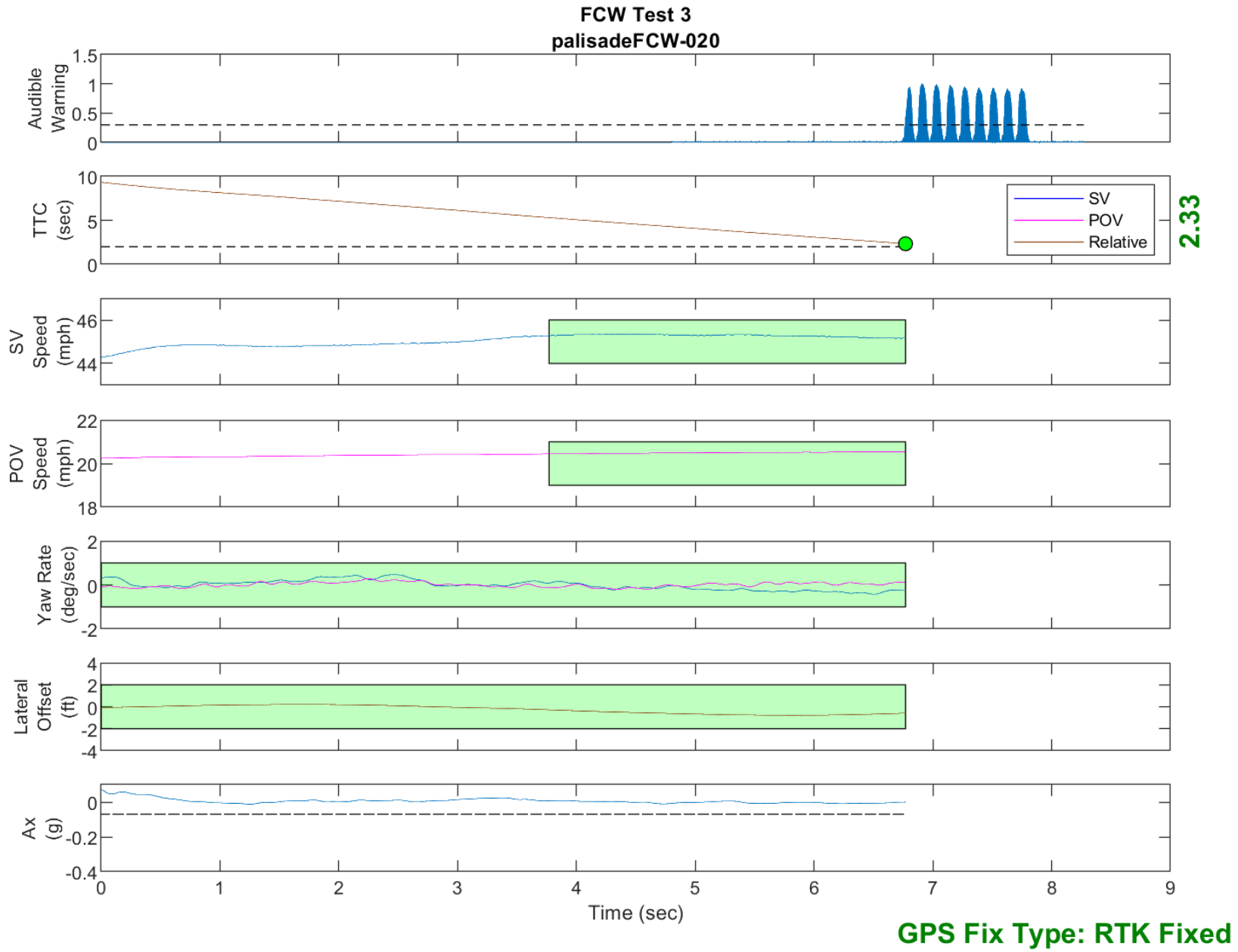


Figure D47. Time History for Run 20, FCW Test 3, Audible Warning

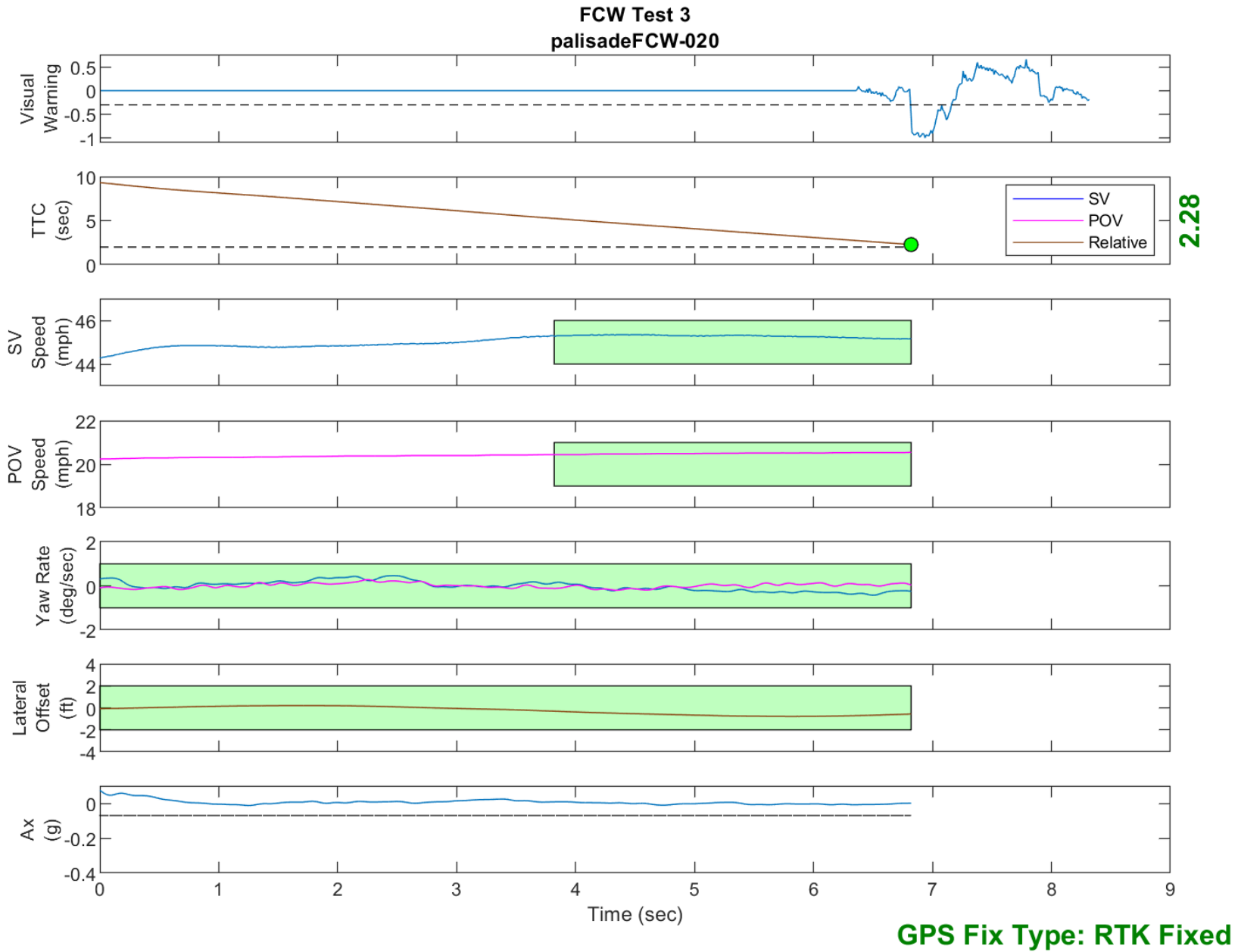


Figure D48. Time History for Run 20, FCW Test 3, Visual Warning