

**NEW CAR ASSESSMENT PROGRAM  
FORWARD COLLISION WARNING CONFIRMATION TEST  
NCAP-DRI-FCW-20-10**

**2020 Jeep Grand Cherokee Limited X**

**DYNAMIC RESEARCH, INC.**

355 Van Ness Avenue, STE 200  
Torrance, California 90501



**28 January 2020**

**Final Report**

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

**U. S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
New Car Assessment Program  
1200 New Jersey Avenue, SE  
West Building, 4<sup>th</sup> Floor (NRM-110)  
Washington, DC 20590**

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-14-D-00333.

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturer's names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products of manufacturers.

Prepared By: J. Lenkeit and A. Ricci  
Program Manager Test Engineer  
Date: 28 January 2020

1. Report No. NCAP-DRI-FCW-20-10	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of Forward Collision Warning Confirmation Test of a 2020 Jeep Grand Cherokee Limited X.		5. Report Date 28 January 2020	
		6. Performing Organization Code DRI	
7. Author(s) J. Lenkeit, Program Manager A. Ricci, Test Engineer		8. Performing Organization Report No. DRI-TM-19-178	
9. Performing Organization Name and Address Dynamic Research, Inc. 355 Van Ness Ave, STE 200 Torrance, CA 90501		10. Work Unit No.	
		11. Contract or Grant No. DTNH22-14-D-00333	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration New Car Assessment Program 1200 New Jersey Avenue, SE, West Building, 4th Floor (NRM-110) Washington, D.C. 20590		13. Type of Report and Period Covered Final Test Report December 2019 - January 2020	
		14. Sponsoring Agency Code NRM-110	
15. Supplementary Notes			
16. Abstract These tests were conducted on the subject 2020 Jeep Grand Cherokee Limited X 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.			
17. Key Words Forward Collision Warning, FCW, New Car Assessment Program, NCAP		18. Distribution Statement Copies of this report are available from the following: NHTSA Technical Reference Division National Highway Traffic Safety Administration 1200 New Jersey Avenue, SE Washington, D.C. 20590	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 108	22. Price

## 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 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 Jeep Grand Cherokee Limited X**

---

VIN: 1C4RJEBG9LC1xxxx

Test Date: 12/12/2019

Forward Collision Warning setting: Far

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

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

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

Overall: **Pass**

Notes:

**FORWARD COLLISION WARNING**

**DATA SHEET 2: VEHICLE DATA**

(Page 1 of 1)

2020 Jeep Grand Cherokee Limited X

---

**TEST VEHICLE INFORMATION**

VIN: 1C4RJEBG9LC1xxxx

Body Style: SUV

Color: Bright White Clear-Coat

Date Received: 11/27/2019

Odometer Reading: 34 mi

**DATA FROM VEHICLE'S CERTIFICATON LABEL**

Vehicle manufactured by: FCA US LLC

Date of manufacture: 8-19

Vehicle Type: MPV

**DATA FROM TIRE PLACARD**

Tires size as stated on Tire Placard: Front: 265/50R20

Rear: 265/50R20

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

Rear: 250 kPa (36 psi)

**TIRES**

Tire manufacturer and model: Pirelli Scorpion Verde

Front tire size: 265/50R20

Rear tire size: 265/50R20

Front tire DOT prefix: UN KB R542

Rear tire DOT prefix: UN KB R542



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

(Page 1 of 2)

2020 Jeep Grand Cherokee Limited X

---

**GENERAL INFORMATION**

Test date: 12/12/2019

**AMBIENT CONDITIONS**

Air temperature: -7.2 C (19 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: 230 kPa (33 psi)

Rear: 250 kPa (36 psi)

**FORWARD COLLISION WARNING**  
**DATA SHEET 3: TEST CONDITIONS**  
(Page 2 of 2)  
2020 Jeep Grand Cherokee Limited X

---

**WEIGHT**

Weight of vehicle as tested including driver and instrumentation:

Left Front: 558.4 kg (1231 lb)

Right Front 573.8 kg (1265 lb)

Left Rear 570.6 kg (1258 lb)

Right Rear 536.1 kg (1182 lb)

Total: 2238.9 kg (4936 lb)

**FORWARD COLLISION WARNING**

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

(Page 1 of 3)

**2020 Jeep Grand Cherokee Limited X**

---

Name of the DBS option, option package, etc. Full Speed Forward Collision Warning Plus

Type of sensors the system uses: Radar

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

<input checked="" type="checkbox"/>	Warning light
<input checked="" type="checkbox"/>	Buzzer or audible alarm
<input type="checkbox"/>	Vibration
<input checked="" type="checkbox"/>	Other (brake jerk)

---

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 Forward Collision Warning (FCW) with Mitigation system provides the driver with audible warnings, visual warnings (within the instrument cluster display), and may apply a brake jerk to warn the driver when it detects a potential frontal collision.

The audible warning is a repeated beep of 695 Hz.

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

The FCW may also apply a brake jerk to warn the driver when it detects a potential frontal collision.

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 Forward Collision menu setting is located in the Uconnect settings.

See response to next question for method of selecting FCW off by means of Uconnect settings.

The system will retain the last setting selected by the driver after ignition shut down.



**FORWARD COLLISION WARNING**

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

(Page 3 of 3)

**2020 Jeep Grand Cherokee Limited X**

---

Are there other driving modes or conditions that render FCW inoperable or reduce its effectiveness?	<u>  <b>X</b>  </u>	Yes
	<u>      </u>	No

If yes, please provide a full description.

The minimum speed for FCW activation is 1 mph (2 km/h).

The FCW alerts may be triggered on objects other than vehicles such as guard rails or sign posts based on the course prediction. This is expected and is a part of normal FCW activation and functionality.

After four Active Braking events within an ignition cycle, the Active Braking portion of FCW will be deactivated until the next ignition cycle.

FCW may not react to irrelevant objects such as overhead objects, ground reflections, objects not in the path of the vehicle, stationary objects that are far away, oncoming traffic, or leading vehicles with the same or higher rate of speed.

For a more comprehensive list of driving modes or conditions that may render FCW inoperable or reduce its effectiveness, please see pages 223-225 of the Owner's Manual shown in pages B-7 through B-9.

Notes:

## Section III

### TEST PROCEDURES

#### A. Test Procedure Overview

Three test procedures were used, as follows:

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

Test 2. Subject Vehicle Encounters Decelerating Principal Other Vehicle

Test 3. Subject Vehicle Encounters Slower Principal Other Vehicle

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

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

An overview of each of the test procedures follows.

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

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

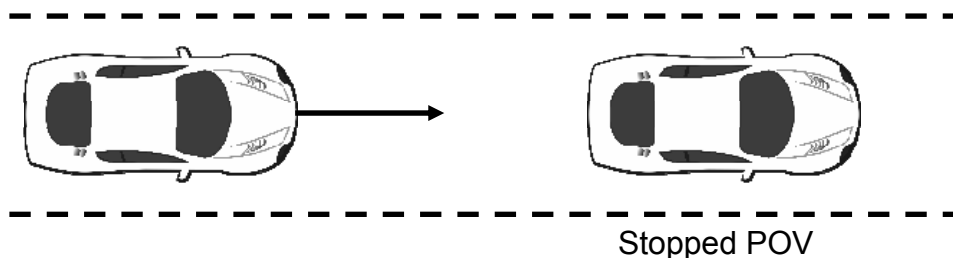


Figure 1. Depiction of Test 1

#### a. Alert Criteria

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

#### b. Procedure

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

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

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

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

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

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

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

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

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

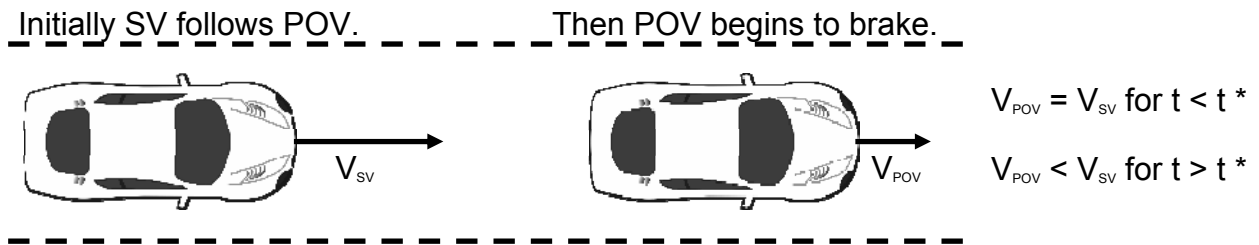


Figure 2. Depiction of Test 2

### a. Alert Criteria

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

### b. Procedure

Test 2 began with the SV and the POV traveling on a straight, flat road at a constant speed of 45.0 mph (72.4 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.

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

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



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

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

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

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

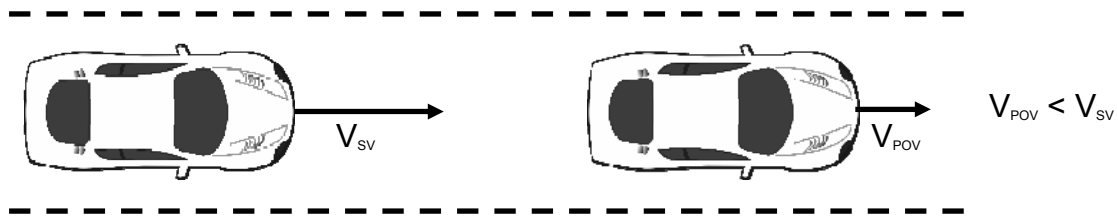


Figure 3. Depiction of Test 3

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  $\pm 1$  deg/sec during the test.
- SV driver could not apply any force to the brake pedal before (1) the required

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

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

### **B. Principal Other Vehicle**

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

### **C. Automatic Braking System**

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

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

### **D. Instrumentation**

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

**TABLE 1. TEST INSTRUMENTATION AND EQUIPMENT**

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and	Omega DPG8001	17042707002	By: DRI Date: 6/21/2018 Due: 6/21/2019
Platform Scales	Vehicle Total, Wheel, and Axle Load	1200 lb/platform 5338 N/	0.5% of applied load	Intercomp SWI	1110M206352	By: DRI Date: 1/3/2019 Due: 1/3/2020
Differential Global Positioning System	Position, Velocity	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots	Horizontal Position: ±1 cm Vertical Position: ±2 cm Velocity: 0.05 km/h	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	NA
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Accels ± 10g, Angular Rat	Accels .01g, Angular Rate	Oxford Inertial +		By: Oxford Technical Solutions
					2258	Date: 5/3/2019 Due: 5/3/2021
					2176	Date: 4/11/2018 Due: 4/11/2020
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec Longitudinal Range to POV: ±200 m Longitudinal Range Rate: ±50 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec Longitudinal Range: ±3 cm Longitudinal Range Rate: ±0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	NA

**TABLE 1. TEST INSTRUMENTATION AND EQUIPMENT (continued)**

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Microphone	Sound (to measure time at auditory alert)	Frequency Response: 80 Hz – 20 kHz	Signal-to-noise: 64 dB, 1 kHz at 1 Pa	Audio-Technica AT899	NA	NA
Light Sensor	Light intensity (to measure time at visual alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	NA	NA
Accelerometer	Acceleration (to measure time at haptic alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005	NA	NA
Coordinate Measurement Machine	Inertial Sensing System Coordinates	0-8 ft 0-2.4 m	±.0020 in. ±.051 mm (Single point articulation accuracy)	Faro Arm, Fusion	UO8-05-08-06636	By: DRI Date: 1/2/2019 Due: 1/2/2020
Type	Description			Mfr, Model	Serial Number	
Data Acquisition System	Data acquisition is achieved using a dSPACE MicroAutoBox II. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the MicroAutoBox. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (listed above).			dSPACE Micro-Autobox II 1401/1513		
				Base Board	549068	
				I/O Board	588523	

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

**Table 2. Audible and Tactile Warning Filter Parameters**

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

## APPENDIX A

### Photographs

## 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. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle.....	A-10
Figure A9. Sensor for Detecting Visual Alerts .....	A-11
Figure A10. Sensor for Detecting Auditory Alerts.....	A-12
Figure A11. Computer Installed in Subject Vehicle .....	A-13
Figure A12. Brake Actuation System Installed in Principal Other Vehicle .....	A-14
Figure A13. FCW Visual Alert .....	A-15
Figure A14. FCW System Setting Menus.....	A-16





Figure A1. Front View of Subject Vehicle



Figure A2. Rear View of Subject Vehicle





# GRAND CHEROKEE LIMITED X 4X2

For more information visit: [www.jeep.com](http://www.jeep.com)  
or call 1-877-IAM-JEEP

FCA US LLC

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

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

Base Price: **\$39,855**

**JEOP GRAND CHEROKEE LIMITED 4X2**  
Exterior Color: Bright White Clear-Coat Exterior Paint  
Interior Color: Black Interior Color  
Interior: Leather-Trimmed Seats  
Engine: 3.6L V6 24V VVT Engine Upp I w/ESS  
Transmission: 8-Speed Automatic 850RE Transmission

**STANDARD EQUIPMENT** (UNLESS REPLACED BY OPTIONAL EQUIPMENT)

### FUNCTIONAL SAFETY FEATURES

Advanced Multistage Front Air Bags  
Supplemental Side-Curtain Front and Rear Air Bags  
Supplemental Front Seat Side Air Bags  
Driver Inflatable Knee-Bolster Air Bag  
ParkView® Rear Back-Up Camera  
ParkSense® Rear Park-Assist with Stop  
Blind-Spot and Cross-Path Detection  
ECO Suspension I  
Sport Mode  
Keyless Enter-N-Go  
Remote-Start System  
Sentry Key® Theft Deterrent System  
Ready-Alert Braking  
Power Liftgate  
Electronic Stability Control  
Anti-Lock 4-Wheel Disc Brakes  
Hill Start Assist  
Trailer-Sway Damping

### INTERIOR FEATURES

Uconnect® 4C NAV with 8.4-Inch Display  
SiriusXM® with 1-Year Radio Subscription  
SiriusXM Guardian™ Connected Services w/1-Yr Trial  
5-Year SiriusXM® Traffic™ Service  
5-Year SiriusXM® Travel Link Service  
Apple CarPlay®  
Google Android Auto™  
Integrated Voice Command with Bluetooth®  
Media Hub (2 USB, Aux)  
4G LTE Wi-Fi Hot Spot  
Heated Front Seats  
8-Way Power Driver Memory and 8-Way Passenger Seats  
Illuminated Entry  
Leather-Wrapped Steering Wheel  
Heated Steering Wheel  
Air Conditioning with Dual-Zone Temperature Control  
Deep Tint Sunscreen Glass

**OPTIONAL EQUIPMENT** (May Replace Standard Equipment)

**Customer Preferred Package Z8G** **\$4,900**  
20-Inch x 8.0-Inch Granite Crystal Alum Wheels  
205/50R20 Performance All-Season Tires  
Gloss Black Exterior Accents  
Gloss Black Roof Rails  
Liquid Titanium Accents

Body-Color Fascias with Granite Accents  
Body-Color Sill Extension  
Dual Dark Chrome Exhaust Tip  
Granite Crystal Exterior Accents  
Granite Crystal / Black Grille  
Granite Crystal Exterior Badging  
Premium LED Fog Lamps  
Steering Wheel Mounted Shift Control  
Bi-Xenon HID Headlamps  
Dark Headlamp Bezel Finish  
Dark Lens Tail Lamps  
Dark Daylight Opening Moldings  
LED Daytime Running Headlamps  
Pirelli Brand Tires  
"Limited X" Badge  
Sport Hood  
ProTech II  
Adaptive Cruise Control with Stop  
Advanced Brake Assist  
Full Speed Forward Collision Warn Plus  
Lane Departure Warning Plus  
Parallel and Perp Park-Assist with Stop  
Rain-Sensitive Windshield Wipers  
Dual-Pane Panoramic Sunroof  
Full-Size Spare Tire

\$1,495

\$1,495

\$150

### DESTINATION CHARGE

\$1,495

### ProTech I Pkg. Std. (\$995 Value)

ParkView Rear Back Up Camera  
ParkSense Rear Park-Assist with Stop  
Blind-Spot and Cross-Path Detection

**TOTAL PRICE: \* \$49,390**

### WARRANTY COVERAGE

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

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

Assembly Point/Port of Entry: DETROIT, MICHIGAN, U.S.A.

VIN: 1C4RJEBG9LC-11

L4-V0N: 5863

0821



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

## EPA DOT Fuel Economy and Environment

Gasoline Vehicle

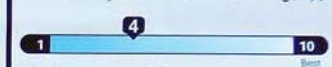
Fuel Economy  
**21** MPG  
combined city/hwy  
4.8 gallons per 100 miles  
19 city  
26 highway  
These estimates reflect new EPA methods beginning with 2017 models.  
Standard SUV 2WD range from: 13 to 93 MPGe.  
The best vehicle rates 136 MPGe.

You spend  
**\$2,250**

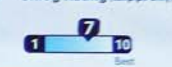
more in fuel costs  
over 5 years  
compared to the  
average new vehicle.

Annual fuel cost  
**\$1,950**

### Fuel Economy & Greenhouse Gas Rating (tailpipe only)



### Smog Rating (tailpipe only)



This vehicle emits 414 grams CO2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also creates emissions; learn more at [fuelconomy.gov](http://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 cost \$7,500 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.

## fuelconomy.gov

Calculate personalized estimates and compare vehicles



## 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](http://www.safercar.gov) or 1-888-327-4236

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

## PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:  
U.S./CANADIAN PARTS CONTENT: 58%

### MAJOR SOURCES OF FOREIGN PARTS CONTENT:

MEXICO: 25%  
NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:  
FINAL ASSEMBLY POINT:  
DETROIT, MICHIGAN, U.S.A.

COUNTRY OF ORIGIN:  
ENGINE: MEXICO  
TRANSMISSION: UNITED STATES



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

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

Figure A3. Window Sticker (Monroney Label)



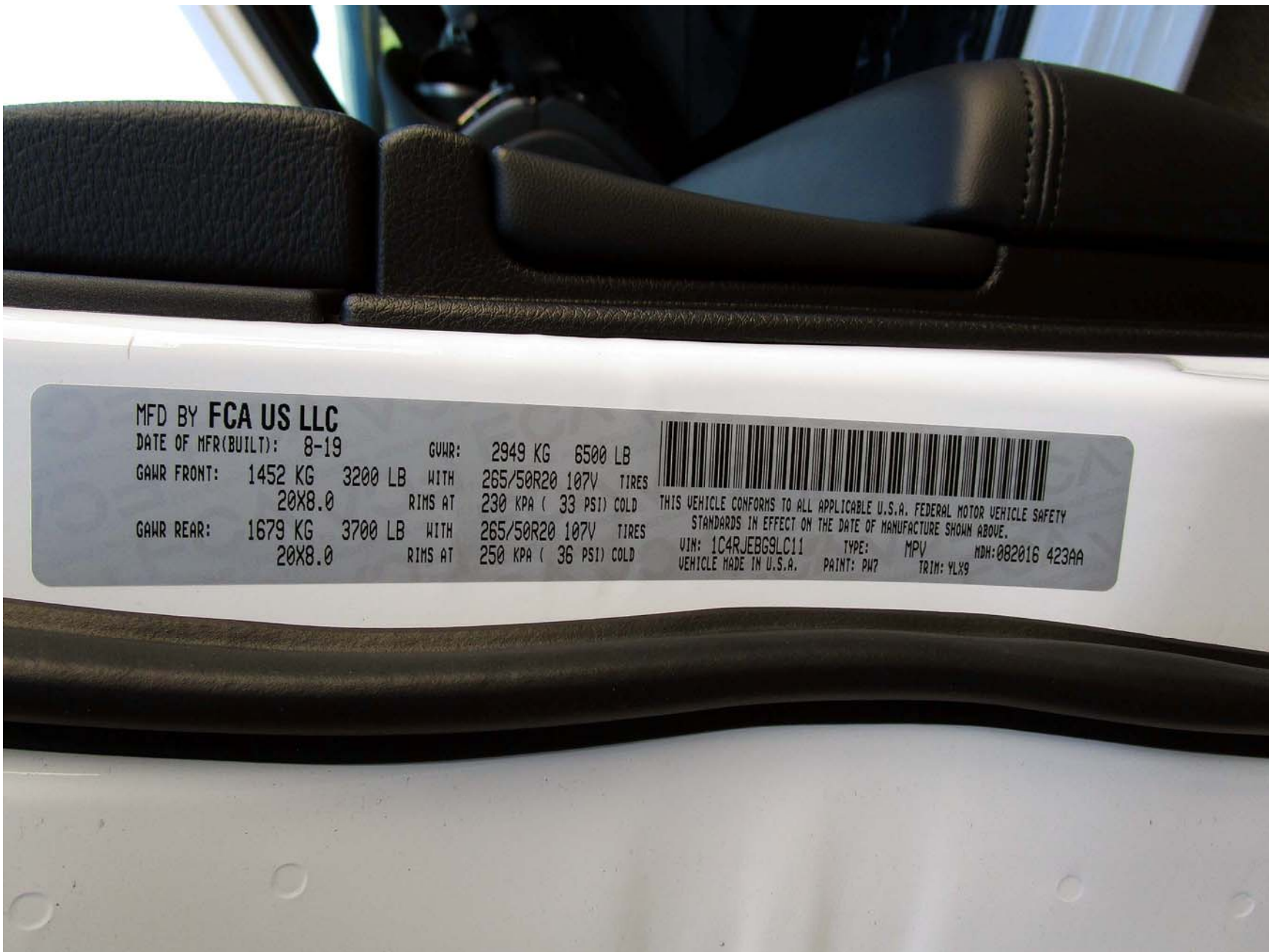



Figure A4. Vehicle Certification Label



**TIRE AND LOADING INFORMATION**

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

THE COMBINED WEIGHT OF OCCUPANTS AND CARGO SHOULD NEVER EXCEED  
476 KG OR 1050 LB

TIRE	FRONT	REAR	SPARE
ORIGINAL TIRE SIZE	265/50R20 107V	265/50R20 107V	P245/65R18 110H
COLD TIRE INFLATION PRESSURE	230 kPa / 33 PSI	250 kPa / 36 PSI	270 kPa / 39 PSI


SEE OWNERS MANUAL FOR ADDITIONAL INFORMATION  LC1

Figure A5. Tire Placard



Figure A6. Front View of Principal Other Vehicle





Figure A7. Rear View of Principal Other Vehicle



Figure A8. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle





Figure A9. Sensor for Detecting Visual Alerts





Figure A10. Sensor for Detecting Auditory Alerts





Figure A11. Computer Installed in Subject Vehicle



Figure A12. Brake Actuation System Installed in Principal Other Vehicle





Figure A13. FCW Visual Alert



Figure A14. FCW System Setting Menus

## APPENDIX B

Excerpts from Owner's Manual



Certain conditions, such as a loose or missing gas cap, poor quality fuel, etc., may illuminate the light after engine start. The vehicle should be serviced if the light stays on through several typical driving styles. In most situations, the vehicle will drive normally and will not require towing.

When the engine is running, the MIL may flash to alert serious conditions that could lead to immediate loss of power or severe catalytic converter damage. The vehicle should be serviced by an authorized dealer as soon as possible if this occurs.

**WARNING!**

A malfunctioning catalytic converter, as referenced above, can reach higher temperatures than in normal operating conditions. This can cause a fire if you drive slowly or park over flammable substances such as dry plants, wood, cardboard, etc. This could result in death or serious injury to the driver, occupants or others.

**CAUTION!**

Prolonged driving with the Malfunction Indicator Light (MIL) on could cause damage to the vehicle control system. It also could affect fuel economy and driveability. If the MIL is flashing, severe catalytic converter damage and power loss will soon occur. Immediate service is required.

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



This warning light will illuminate to signal a fault with the 4WD system. If the light stays on or comes on during driving, it means that the 4WD system is not functioning properly and that service is required. We recommend you drive to the nearest service center and have the vehicle serviced immediately.

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



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

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

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



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

**Tire Pressure Monitoring System (TPMS) Warning Light**



The warning light switches on and a message is displayed to indicate that the tire pressure is lower than the recommended value and/or that slow pressure loss is occurring. In these cases, optimal tire duration and fuel consumption may not be guaranteed.



**Yellow Indicator Lights**

**Air Suspension Active Indicator Light – If Equipped**



This light will illuminate when the air suspension system is actively adjusting the ride height.

Refer to “Quadra-Lift – If Equipped” in “Starting And Operating” for further information.

**Air Suspension Entry/Exit Indicator Light– If Equipped**



This light will illuminate when the vehicle is automatically lowered from ride height position downward for easy entry and exit of the vehicle.

**Air Suspension Aerodynamic Height Indicator Light– If Equipped**



This light will illuminate when the air suspension system is set to the Aerodynamic setting.

Refer to “Quadra-Lift – If Equipped” in “Starting And Operating” for further information.

**Air Suspension Off-Road 1 Indicator Light – If Equipped**



This light will illuminate when the air suspension system is set to the Off-Road 1 setting.

Refer to “Quadra-Lift – If Equipped” in “Starting And Operating” for further information.

**Air Suspension Off-Road 2 Indicator Light – If Equipped**



This light will illuminate when the air suspension system is set to the Off-Road 2 setting.

Refer to “Quadra-Lift – If Equipped” in “Starting And Operating” for further information.

**Forward Collision Warning Off Indicator Light – If Equipped**



This indicator light illuminates to indicate that Forward Collision

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

**4WD Low Indicator Light – If Equipped**



This light alerts the driver that the vehicle is in the four-wheel drive LOW mode. The front and rear driveshafts are mechanically locked together

forcing the front and rear wheels to rotate at the same speed. Low range provides a greater gear reduction ratio to provide increased torque at the wheels.

Refer to “Four-Wheel Drive Operation – If Equipped” in “Starting And Operating” for further information on four-wheel drive operation and proper use.

**NEUTRAL Indicator Light – If Equipped**



This light alerts the driver that the 4WD power transfer case is in the NEUTRAL mode and the front and rear driveshafts are disengaged from the

powertrain.

**General Information**

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

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

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

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

1. l'appareil ne doit pas produire de brouillage, et

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

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

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

**NOTE:**

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

**Forward Collision Warning (FCW) With Mitigation**

The Forward Collision Warning (FCW) with Mitigation system provides the driver with audible warnings, visual warnings (within the instrument cluster display), and may apply a brake jerk to warn the driver when it detects a

potential frontal collision. The warnings and limited braking are intended to provide the driver with enough time to react, avoid or mitigate the potential collision.

**NOTE:**

FCW monitors the information from the forward looking sensors as well as the Electronic Brake Controller (EBC), to calculate the probability of a forward collision. When the system determines that a forward collision is probable, the driver will be provided with audible and visual warnings and may provide a brake jerk warning. If the driver does not take action based upon these progressive warnings, then the system will provide a limited level of active braking to help slow the vehicle and mitigate the potential forward collision. If the driver reacts to the warnings by braking and the system determines that the driver intends to avoid the collision by braking but has not applied sufficient brake force, the system will compensate and provide additional brake force as required.

If a Forward Collision Warning with Mitigation event begins at a speed below 26 mph (42 km/h), the system may provide the maximum or partial braking to mitigate the potential forward collision. If the Forward Collision Warning with Mitigation event stops the vehicle completely, the system will hold the vehicle at a standstill for two seconds and then release the brakes.



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

**NOTE:**

- The minimum speed for FCW activation is 1 mph (2 km/h).

- The FCW alerts may be triggered on objects other than vehicles, such as guard rails or sign posts based on the course prediction. This is expected and is a part of normal FCW activation and functionality.
- It is unsafe to test the FCW system. To prevent such misuse of the system, after four Active Braking events within an ignition cycle, the Active Braking portion of FCW will be deactivated until the next ignition cycle.
- The FCW system is intended for on-road use only. If the vehicle is taken off-road, the FCW system should be deactivated to prevent unnecessary warnings to the surroundings. If the vehicle enters 4L Range or ESC "Full Off" Mode is active, the FCW system will be automatically deactivated.

**WARNING!**

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

**FCW Braking Status And Sensitivity**

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

The default sensitivity of FCW is the "Medium" setting and the system status is "Warning & Braking". This allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warnings and it applies autonomous braking.

Changing the FCW status to the "Far" setting allows the system to warn the driver of a possible collision with the vehicle in front using audible/visual warning when the latter is at a farther distance than "Medium" setting. This provides the most reaction time to avoid a possible collision.

Changing the FCW status to the "Near" setting, allows the system to warn the driver of a possible collision with the vehicle in front when the distance between the vehicle in the front is much closer. This setting provides less reaction time than the "Far" and "Medium" settings, which allows for a more dynamic driving experience.

**NOTE:**

- Changing the FCW status to “Only Warning” prevents the system from providing limited active braking, or additional brake support if the driver is not braking adequately in the event of a potential frontal collision, but maintains the audible and visual warnings.
- Changing the FCW status to “Off” prevents the system from providing autonomous braking, or additional brake support if the driver is not braking adequately in the event of a potential frontal collision.
- The system will retain the last setting selected by the driver after ignition shut down.
- FCW may not react to irrelevant objects such as overhead objects, ground reflections, objects not in the path of the vehicle, stationary objects that are far away, oncoming traffic, or leading vehicles with the same or higher rate of speed.
- FCW will be disabled like ACC, with the unavailable screens.

**FCW Limited Warning**

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

**Service FCW Warning**

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

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

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

**Tire Pressure Monitoring System (TPMS)****NOTE:**

For vehicles equipped with run flat tires, when the TPMS indicates a tire pressure of 14 psi (96 kPa) or lower, always check tire pressure and replace the tire at the first opportunity. At inflation pressure of or below 14 psi (96 kPa) the tire is in the run-flat mode of operation. In this condition, it is recommended a vehicle maximum speed of 50 mph (80 km/h) for a maximum distance of 50 miles (80 km). The manufacturer does not recommend using the run flat feature while driving a vehicle loaded at full capacity or towing a trailer.

The Tire Pressure Monitoring System (TPMS) will warn the driver of a low tire pressure based on the vehicle recommended cold tire pressure.

The tire pressure will vary with temperature by about 1 psi (7 kPa) for every 12° F (6.5° C). This means that when the outside temperature decreases, the tire pressure will decrease. Tire pressure should always be set based on cold inflation tire pressure. This is defined as the tire pressure after the vehicle has not been driven for at least three hours, or driven less than 1 mile (1.6 km) after a three-hour period.



### Display Warnings And Maintenance

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

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

This most often occurs at times of poor visibility, such as in snow or heavy rain. The ACC system may also become temporarily blinded due to obstructions, such as mud, dirt or ice. In these cases, the instrument cluster display will display “ACC/FCW Unavailable Wipe Front Radar Sensor” and the system will deactivate.

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

#### NOTE:

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

If weather conditions are not a factor, the driver should examine the sensor. It may require cleaning or removal of an obstruction. The sensor is located in the center of the vehicle behind the lower grille.

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

- Always keep the sensor clean. Carefully wipe the sensor lens with a soft cloth. Be cautious not to damage the sensor lens.
- Do not remove any screws from the sensor. Doing so could cause an ACC system malfunction or failure and require a sensor realignment.
- If the sensor or front end of the vehicle is damaged due to a collision, see an authorized dealer for service.

- Do not attach or install any accessories near the sensor, including transparent material or aftermarket grilles. Doing so could cause an ACC system failure or malfunction.

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

#### NOTE:

- If the “ACC/FCW Unavailable Wipe Front Radar Sensor” message occurs frequently (e.g. more than once on every trip) without any snow, rain, mud, or other obstruction, have the radar sensor realigned at your authorized dealer.
- Installing a snow plow, front-end protector, an aftermarket grille or modifying the grille is not recommended. Doing so may block the sensor and inhibit ACC/FCW operation.

**“Clean Front Windshield” Warning**

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

The “ACC/FCW Limited Functionality Clean Front Windshield” message can sometimes be displayed while driving in adverse weather conditions. The ACC/FCW system will recover after the vehicle has left these areas. Under rare conditions, when the camera is not tracking any vehicles or objects in its path this warning may temporarily occur.

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

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

**NOTE:**

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

**Service ACC/FCW Warning**

If the system turns off, and the instrument cluster displays “ACC/FCW Unavailable Service Required” or “Cruise/FCW Unavailable Service Required”, there may be an internal system fault or a temporary malfunction that limits ACC functionality. Although the vehicle is still drivable under normal conditions, ACC will be temporarily unavailable. If this occurs, try activating ACC again later, following an ignition cycle. If the problem persists, see an authorized dealer.

**Precautions While Driving With ACC**

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

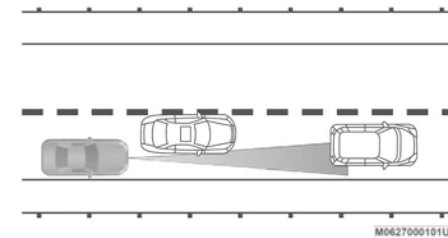
**Towing A Trailer**

Towing a trailer is not advised when using ACC.

**Offset Driving**

ACC may not detect a vehicle in the same lane that is offset from your direct line of travel, or a vehicle merging in from a side lane. There may not be sufficient distance to the vehicle ahead. The offset vehicle may move in and out of the line of travel, which can cause your vehicle to brake or accelerate unexpectedly.

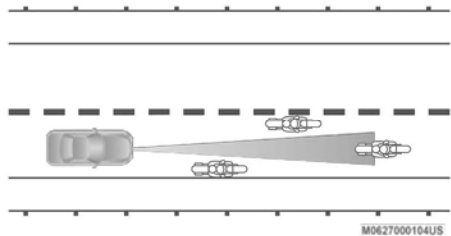
5



**Offset Driving Condition Example**

### Narrow Vehicles

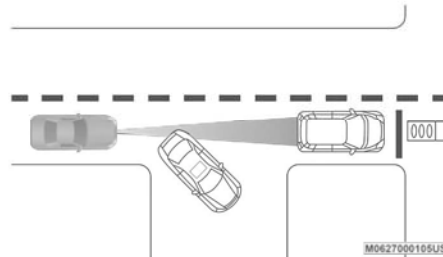
Some narrow vehicles traveling near the outer edges of the lane or edging into the lane are not detected until they have moved fully into the lane. There may not be sufficient distance to the vehicle ahead.



**Narrow Vehicle Example**

### Stationary Objects And Vehicles

ACC does not react to stationary objects and stationary vehicles. For example, ACC will not react in situations where the vehicle you are following exits your lane and the vehicle ahead is stopped in your lane. Always be attentive and ready to apply the brakes if necessary.



**Stationary Object And Stationary Vehicle Example**

### General Information

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

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

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

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

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

5

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

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

### NOTE:

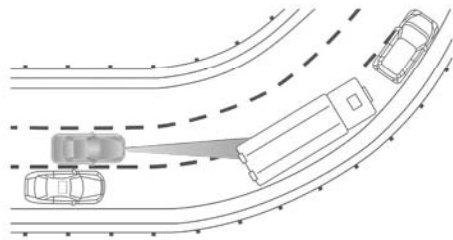
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**Turns And Bends**

When driving on a curve with ACC engaged, the system may decrease the vehicle speed and acceleration for stability reasons, with no target vehicle detected. Once the vehicle is out of the curve the system will resume your original set speed. This is a part of normal ACC system functionality.

**NOTE:**

On tight turns ACC performance may be limited.



**Turn Or Bend Example**

M0627000102US

**Using ACC On Hills**

When driving on hills, ACC may not detect a vehicle in your lane. Depending on the speed, vehicle load, traffic conditions, and the steepness of the hills, ACC performance may be limited.

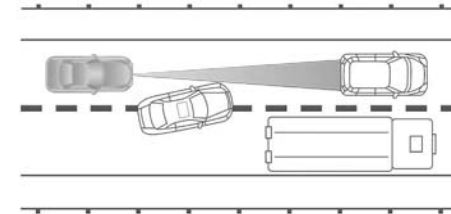


**ACC Hill Example**

M0627000100US

**Lane Changing**

ACC may not detect a vehicle until it is completely in the lane in which you are traveling. In the illustration shown, ACC has not yet detected the vehicle changing lanes and it may not detect the vehicle until it's too late for the ACC system to take action. ACC may not detect a vehicle until it is completely in the lane. There may not be sufficient distance to the lane-changing vehicle. Always be attentive and ready to apply the brakes if necessary.



**Lane Changing Example**

M0627000103US



Setting Name	Selectable Options		
Forward Collision Warning – If Equipped	Off	Warning Only	Warning & Braking
<p><b>NOTE:</b> Changing the FCW status to “Off” prevents the system from warning you of a possible collision with the vehicle in front of you.</p> <p>The FCW system state is kept in memory from one ignition cycle to the next. If the system is turned OFF, it will remain off when the vehicle is restarted.</p> <p>FCW includes Advanced Brake Assist (ABA). The ABA applies additional brake pressure when the driver requests insufficient brake pressure to avoid a potential frontal collision. When the “Warning Only” option is selected, a chime sounds alerting you of a possible collision with the vehicle in front of you and more brake pressure is needed. When the “Warning &amp; Braking” option is selected, it applies the brakes to slow your vehicle in case of potential forward collision and sounds an audible chime to alert you.</p>			
Forward Collision Warning Sensitivity – If Equipped	Far	Med	Near
<p><b>NOTE:</b> The “Forward Collision Warning Sensitivity” setting determines at what relative distance the vehicle directly in front of you needs to be at before the system warns you of a possible collision based on the option selected. “Far” gives you the most amount of reaction time, whereas “Near” will give you the least amount of reaction time, based on the distance between the two vehicles.</p>			
ParkSense – If Equipped	Sound	Sound & Display	
<p><b>NOTE:</b> The “ParkSense” system setting scans for objects behind the vehicle when the transmission gear selector is in REVERSE and the vehicle speed is less than 7 mph (11 km/h), when enabled. It provides an alert (audible and/or visual) to indicate the proximity to other objects. The system can be enabled with “Sound” or “Sound &amp; Display.”</p>			
Front ParkSense Volume – If Equipped	Low	Medium	High
Rear ParkSense Volume	Low	Medium	High

Setting Name	Selectable Options	
Active ParkView Backup Camera Guidelines	On	Off
<p><b>NOTE:</b> The "Active ParkView Backup Camera Guidelines" feature overlays the Rear Backup Camera image with active, or dynamic, grid lines to help illustrate the width of the vehicle and its projected backup path, based on the steering wheel position when the option is checked. A dashed center line overlay indicates the center of the vehicle to assist with parking or aligning to a hitch/receiver.</p>		

#### Safety & Driving Assistance

After pressing the Safety & Driving Assistance button on the touchscreen, the following settings will be available:

Setting Name	Selectable Options		
Forward Collision Warning – If Equipped	Off	Only Warning	Warning + Active Braking
<p><b>NOTE:</b> Changing the FCW status to "Off" prevents the system from warning you of a possible collision with the vehicle in front of you.</p> <p>The FCW system state is kept in memory from one ignition cycle to the next. If the system is turned OFF, it remains off when the vehicle is restarted.</p> <p>FCW includes Advanced Brake Assist (ABA). The ABA applies additional brake pressure when the driver requests insufficient brake pressure to avoid a potential frontal collision. When the "Only Warning" option is selected, a chime sound alerting you of a possible collision with the vehicle in front of you and more brake pressure is needed. When the "Warning + Active Braking" option is selected, it applies the brakes to slow your vehicle in case of potential forward collision and sounds an audible chime to alert you.</p>			

APPENDIX C

Run Log

Subject Vehicle: **2020 Jeep Grand Cherokee Limited X**

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

Principal Other Vehicle: **2006 Acura RL**

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	<b>Stopped POV</b>	Y	2.33	1.98	0.23	Pass	
2		Y	2.31	2.13	0.21	Pass	
3		Y	2.25	2.08	0.15	Pass	
4		Y	2.37	2.19	0.27	Pass	
5		Y	2.39	2.20	0.29	Pass	
6		Y	2.35	2.17	0.25	Pass	
7		Y	2.24	2.07	0.14	Pass	
15	<b>Decelerating POV, 45</b>	N					Headway
16		Y	2.78	2.61	0.38	Pass	
17		Y	2.86	2.69	0.46	Pass	
18		N					POV Braking
19		Y	2.76	2.57	0.36	Pass	
20		Y	2.63	2.45	0.23	Pass	
21		Y	2.80	2.68	0.40	Pass	
22		Y	2.76	2.62	0.36	Pass	
23		Y	2.62	2.42	0.22	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
8	Slower POV, 45 vs 20	Y	2.22	2.03	0.22	Pass	
9		Y	2.30	2.11	0.30	Pass	
10		Y	2.17	2.00	0.17	Pass	
11		Y	2.25	2.06	0.25	Pass	
12		Y	2.23	2.03	0.23	Pass	
13		Y	2.13	1.95	0.13	Pass	
14		Y	2.22	1.85	0.22	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 2, Failing.....	D-9
Figure D3. Example Time History for Test Type 2, Passing.....	D-10
Figure D4. Example Time History for Test Type 3, Failing.....	D-11
Figure D5. Example Time History for Test Type 3, Passing.....	D-12
Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate .....	D-13
Figure D7. Time History for Run 01, FCW Test 1, Audible Warning .....	D-14
Figure D8. Time History for Run 01, FCW Test 1, Visual Warning.....	D-15
Figure D9. Time History for Run 02, FCW Test 1, Audible Warning .....	D-16
Figure D10. Time History for Run 02, FCW Test 1, Visual Warning.....	D-17
Figure D11. Time History for Run 03, FCW Test 1, Audible Warning.....	D-18
Figure D12. Time History for Run 03, FCW Test 1, Visual Warning.....	D-19
Figure D13. Time History for Run 04, FCW Test 1, Audible Warning.....	D-20
Figure D14. Time History for Run 04, FCW Test 1, Visual Warning.....	D-21
Figure D15. Time History for Run 05, FCW Test 1, Audible Warning.....	D-22
Figure D16. Time History for Run 05, FCW Test 1, Visual Warning.....	D-23
Figure D17. Time History for Run 06, FCW Test 1, Audible Warning.....	D-24
Figure D18. Time History for Run 06, FCW Test 1, Visual Warning.....	D-25
Figure D19. Time History for Run 07, FCW Test 1, Audible Warning.....	D-26
Figure D20. Time History for Run 07, FCW Test 1, Visual Warning.....	D-27
Figure D21. Time History for Run 16, FCW Test 2, Audible Warning.....	D-28
Figure D22. Time History for Run 16, FCW Test 2, Visual Warning.....	D-29
Figure D23. Time History for Run 17, FCW Test 2, Audible Warning.....	D-30
Figure D24. Time History for Run 17, FCW Test 2, Visual Warning.....	D-31
Figure D25. Time History for Run 19, FCW Test 2, Audible Warning.....	D-32
Figure D26. Time History for Run 19, FCW Test 2, Visual Warning.....	D-33
Figure D27. Time History for Run 20, FCW Test 2, Audible Warning.....	D-34
Figure D28. Time History for Run 20, FCW Test 2, Visual Warning.....	D-35
Figure D29. Time History for Run 21, FCW Test 2, Audible Warning.....	D-36
Figure D30. Time History for Run 21, FCW Test 2, Visual Warning.....	D-37
Figure D31. Time History for Run 22, FCW Test 2, Audible Warning.....	D-38
Figure D32. Time History for Run 22, FCW Test 2, Visual Warning.....	D-39
Figure D33. Time History for Run 23, FCW Test 2, Audible Warning.....	D-40
Figure D34. Time History for Run 23, FCW Test 2, Visual Warning.....	D-41
Figure D35. Time History for Run 08, FCW Test 3, Audible Warning.....	D-42
Figure D36. Time History for Run 08, FCW Test 3, Visual Warning.....	D-43
Figure D37. Time History for Run 09, FCW Test 3, Audible Warning.....	D-44
Figure D38. Time History for Run 09, FCW Test 3, Visual Warning.....	D-45
Figure D39. Time History for Run 10, FCW Test 3, Audible Warning.....	D-46
Figure D40. Time History for Run 10, FCW Test 3, Visual Warning.....	D-47

Figure D41. Time History for Run 11, FCW Test 3, Audible Warning.....	D-48
Figure D42. Time History for Run 11, FCW Test 3, Visual Warning.....	D-49
Figure D43. Time History for Run 12, FCW Test 3, Audible Warning.....	D-50
Figure D44. Time History for Run 12, FCW Test 3, Visual Warning.....	D-51
Figure D45. Time History for Run 13, FCW Test 3, Audible Warning.....	D-52
Figure D46. Time History for Run 13, FCW Test 3, Visual Warning.....	D-53
Figure D47. Time History for Run 14, FCW Test 3, Audible Warning.....	D-54
Figure D48. Time History for Run 14, FCW Test 3, 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.

### 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.

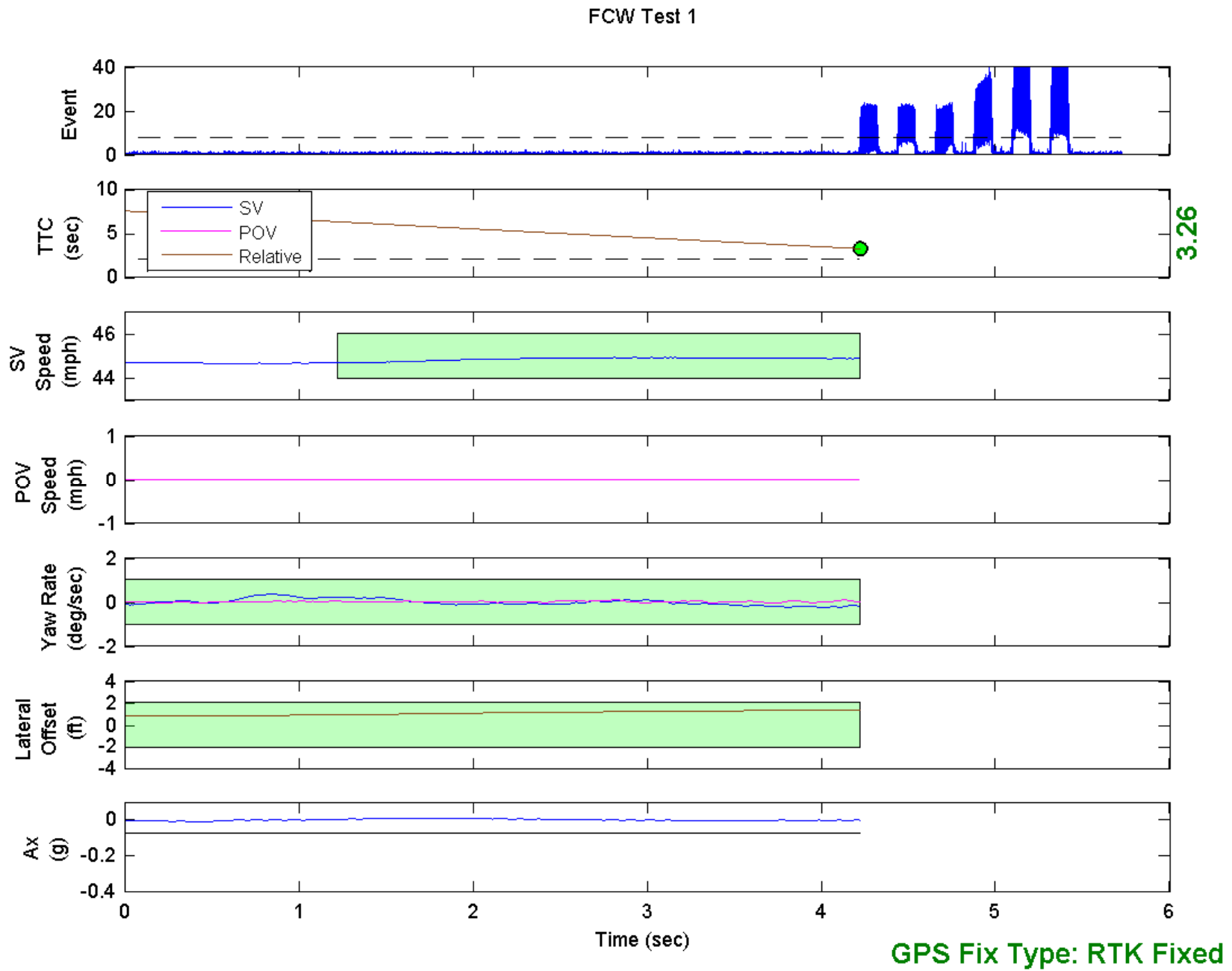
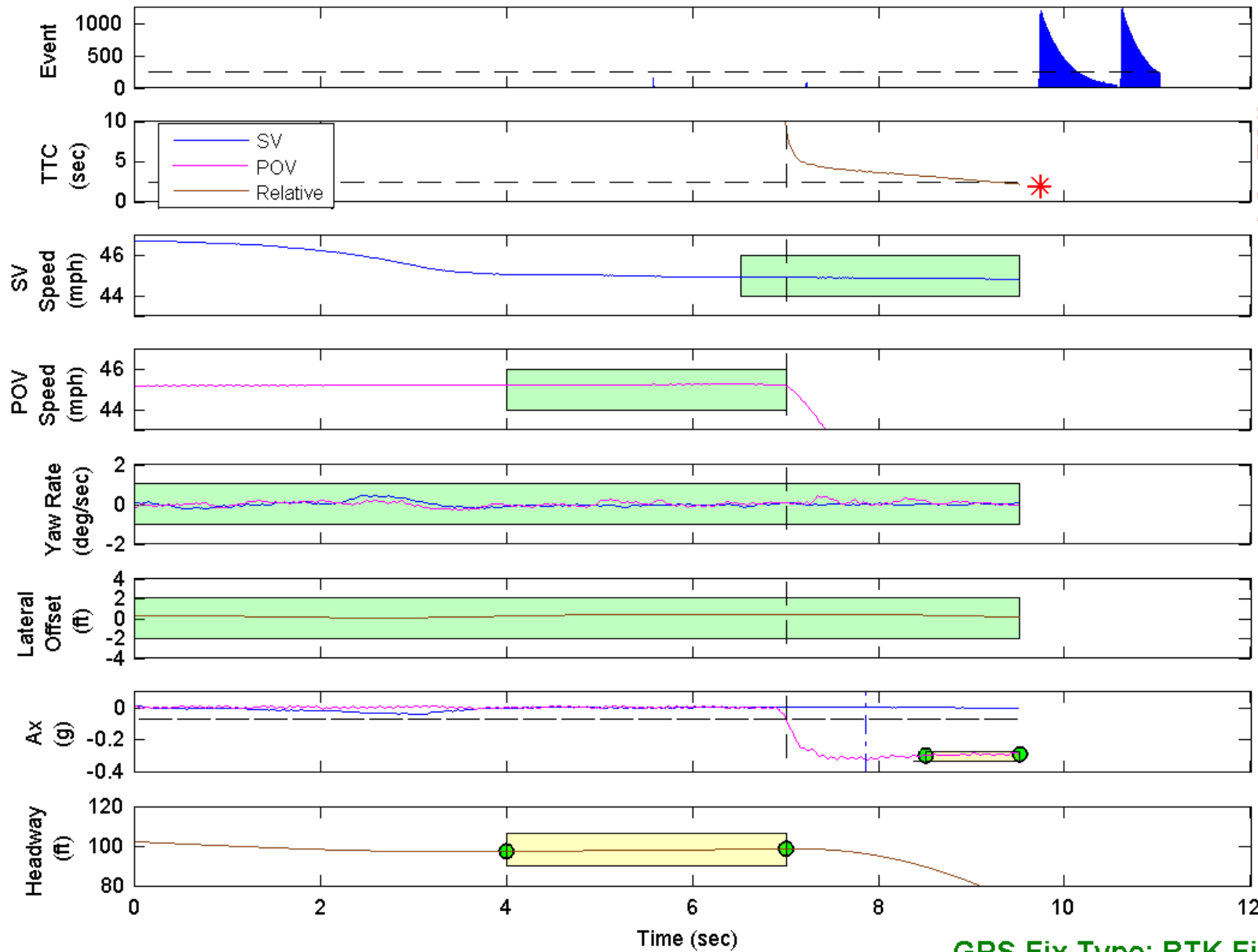


Figure D1. Example Time History for Test Type 1, Passing



### FCW Test 2



1.9 FAIL

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

FCW Test 2

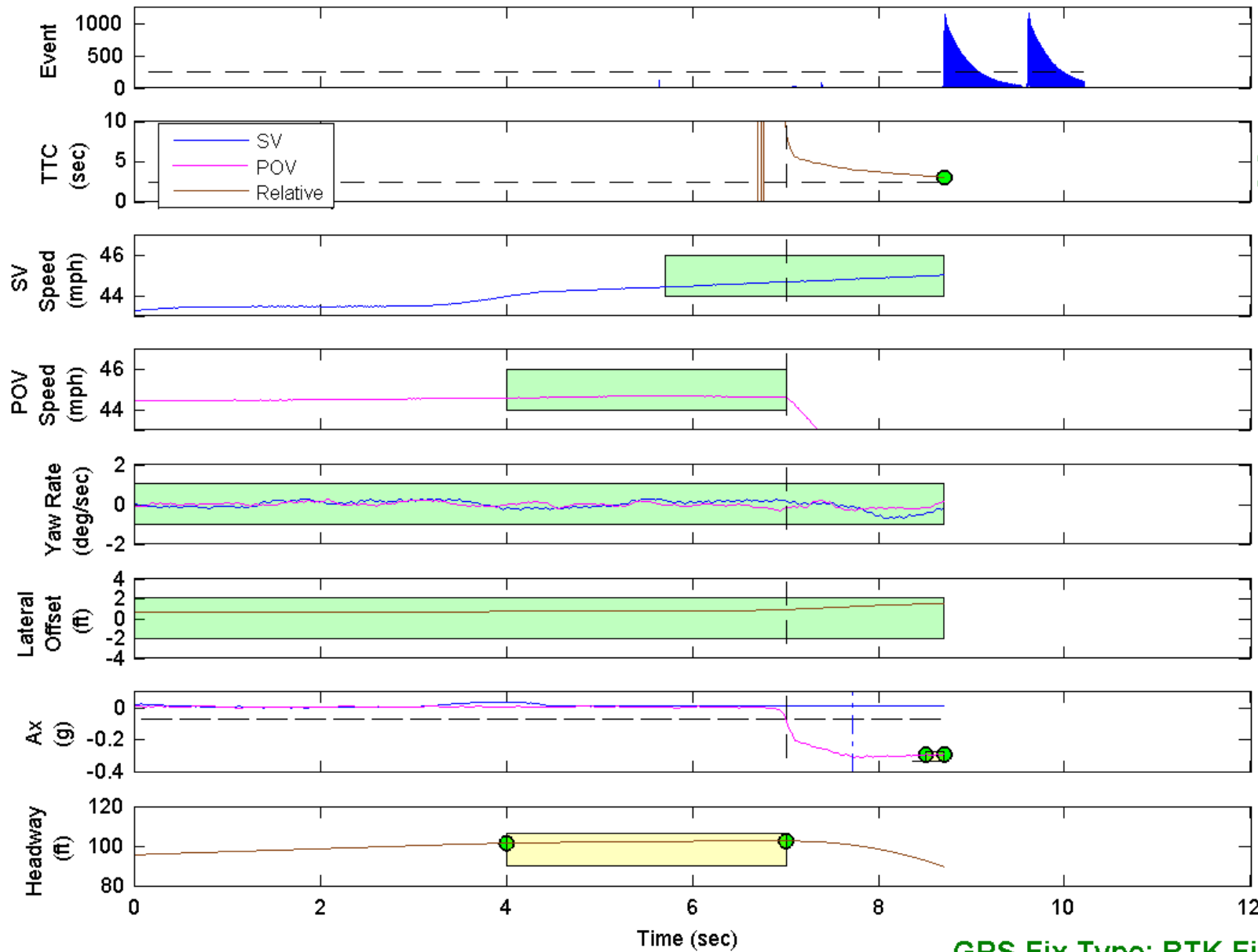


Figure D3. Example Time History for Test Type 2, Passing

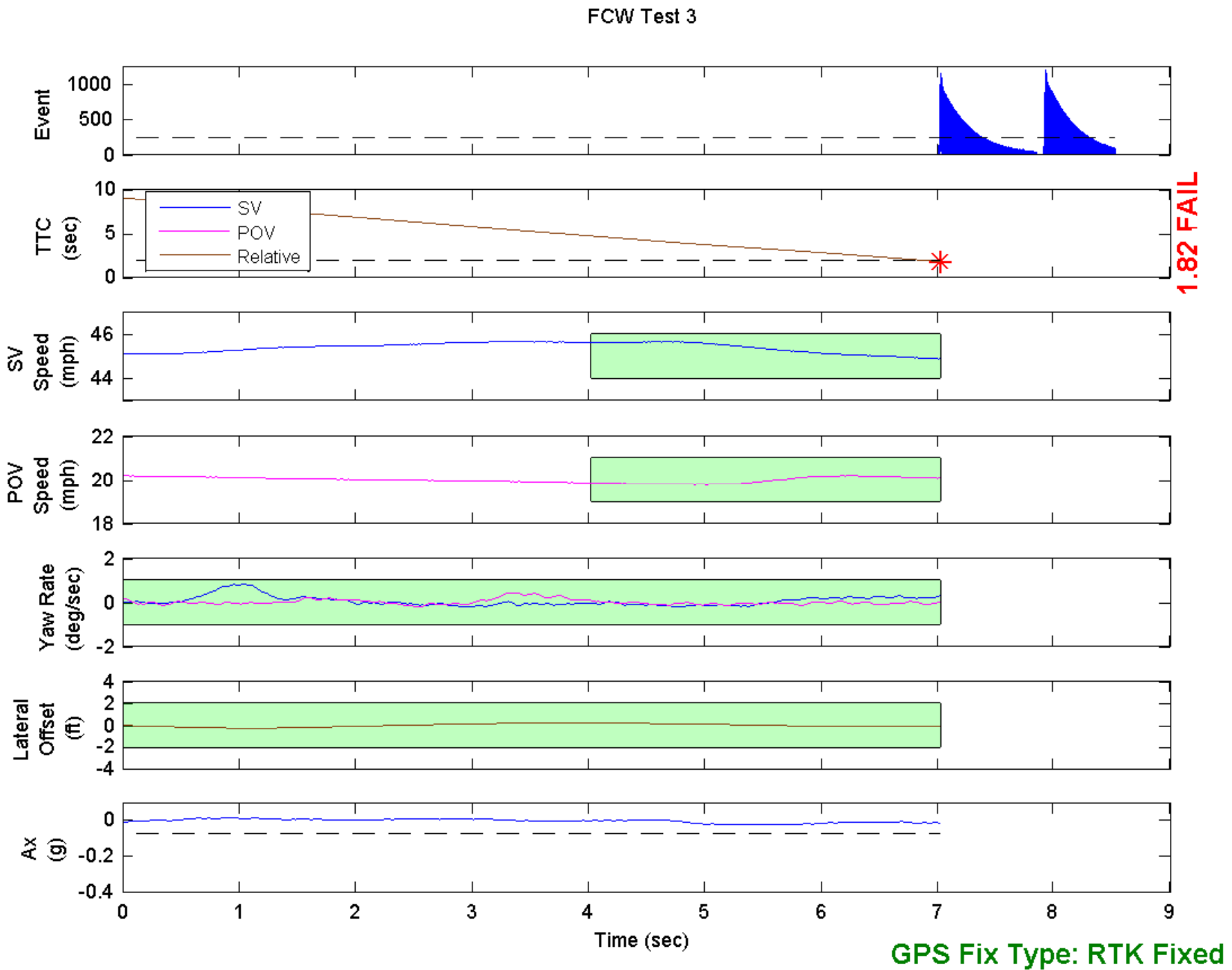


Figure D4. Example Time History for Test Type 3, Failing

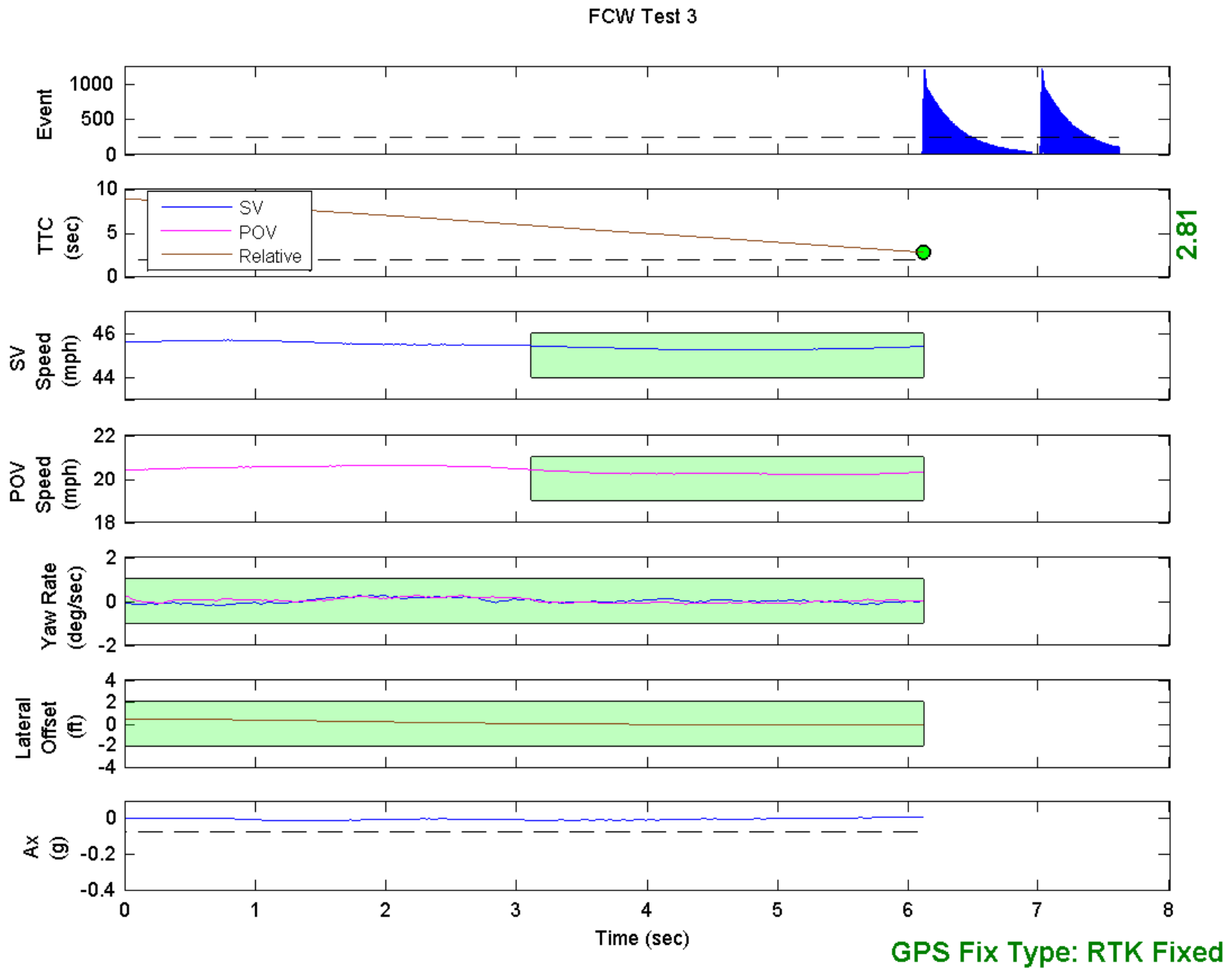


Figure D5. Example Time History for Test Type 3, Passing

### FCW Test 2

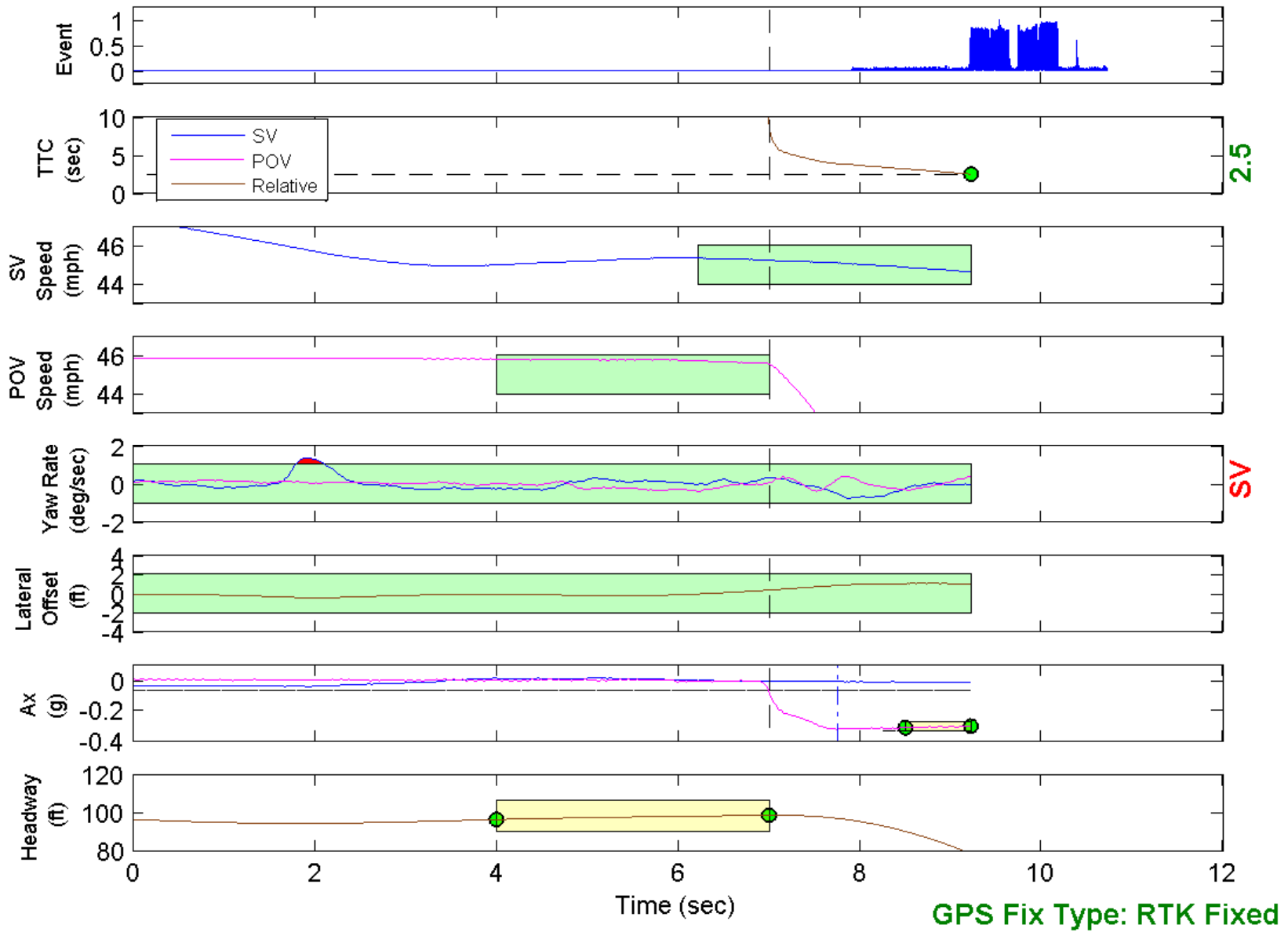


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

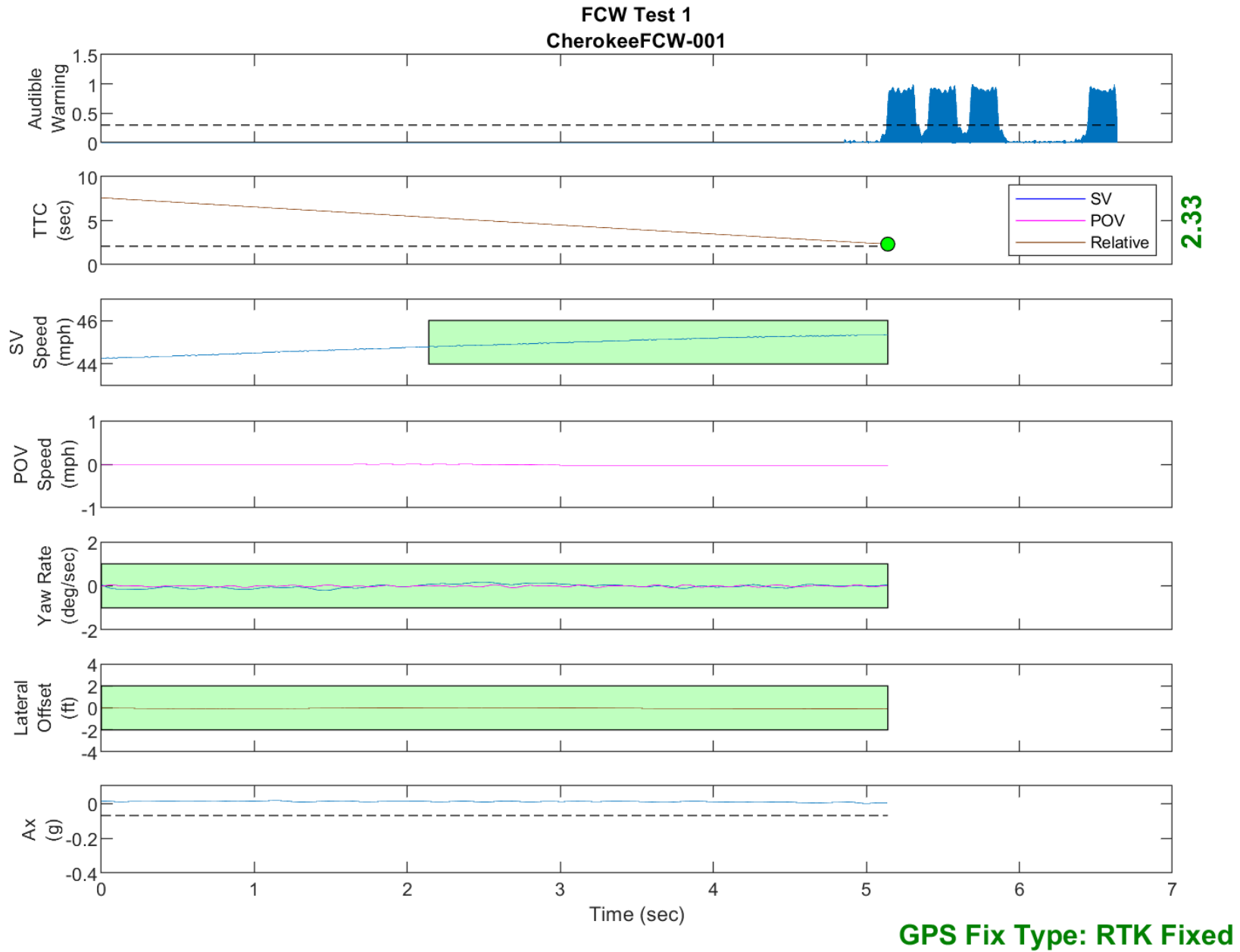


Figure D7. Time History for Run 01, FCW Test 1, Audible Warning



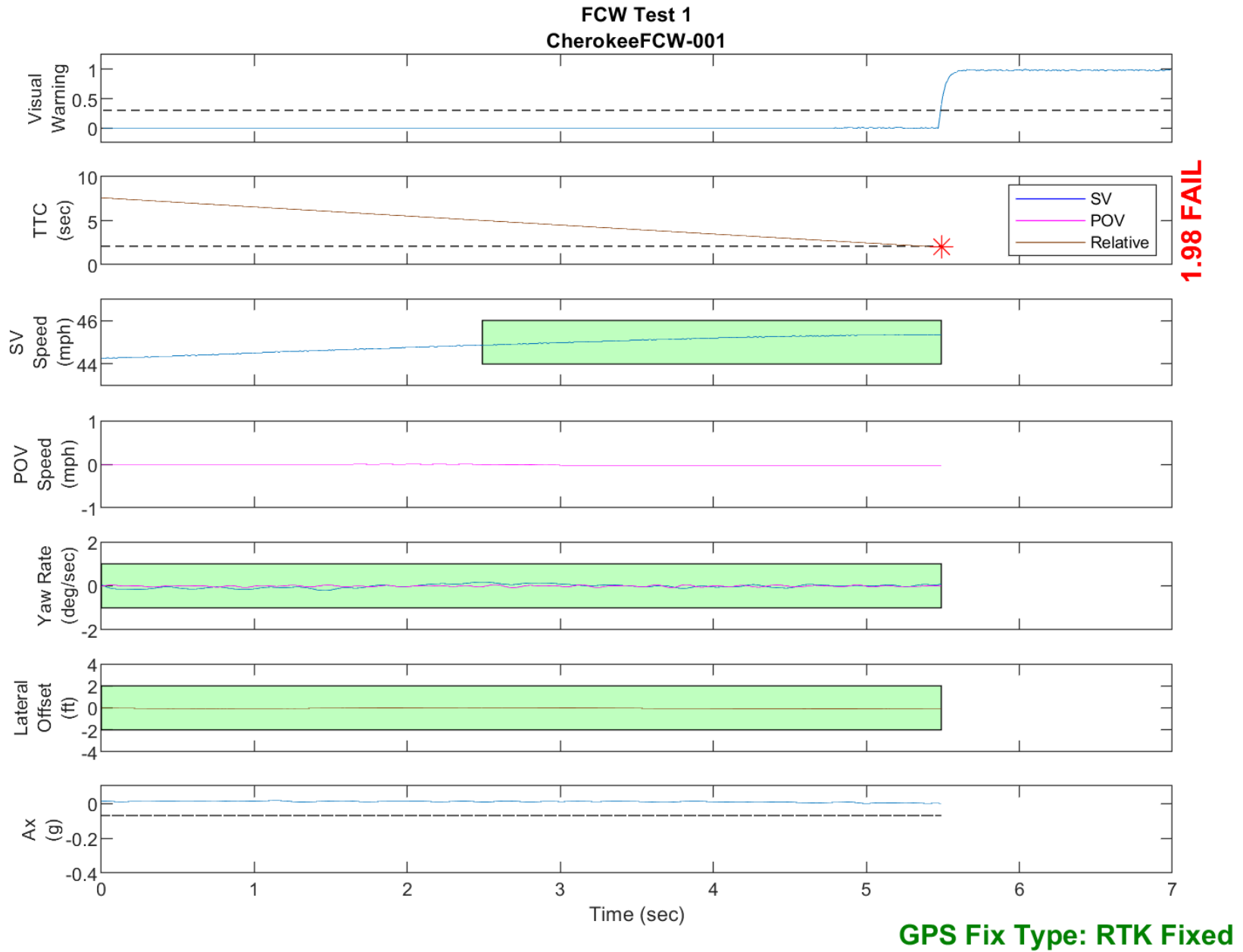


Figure D8. Time History for Run 01, FCW Test 1, Visual Warning

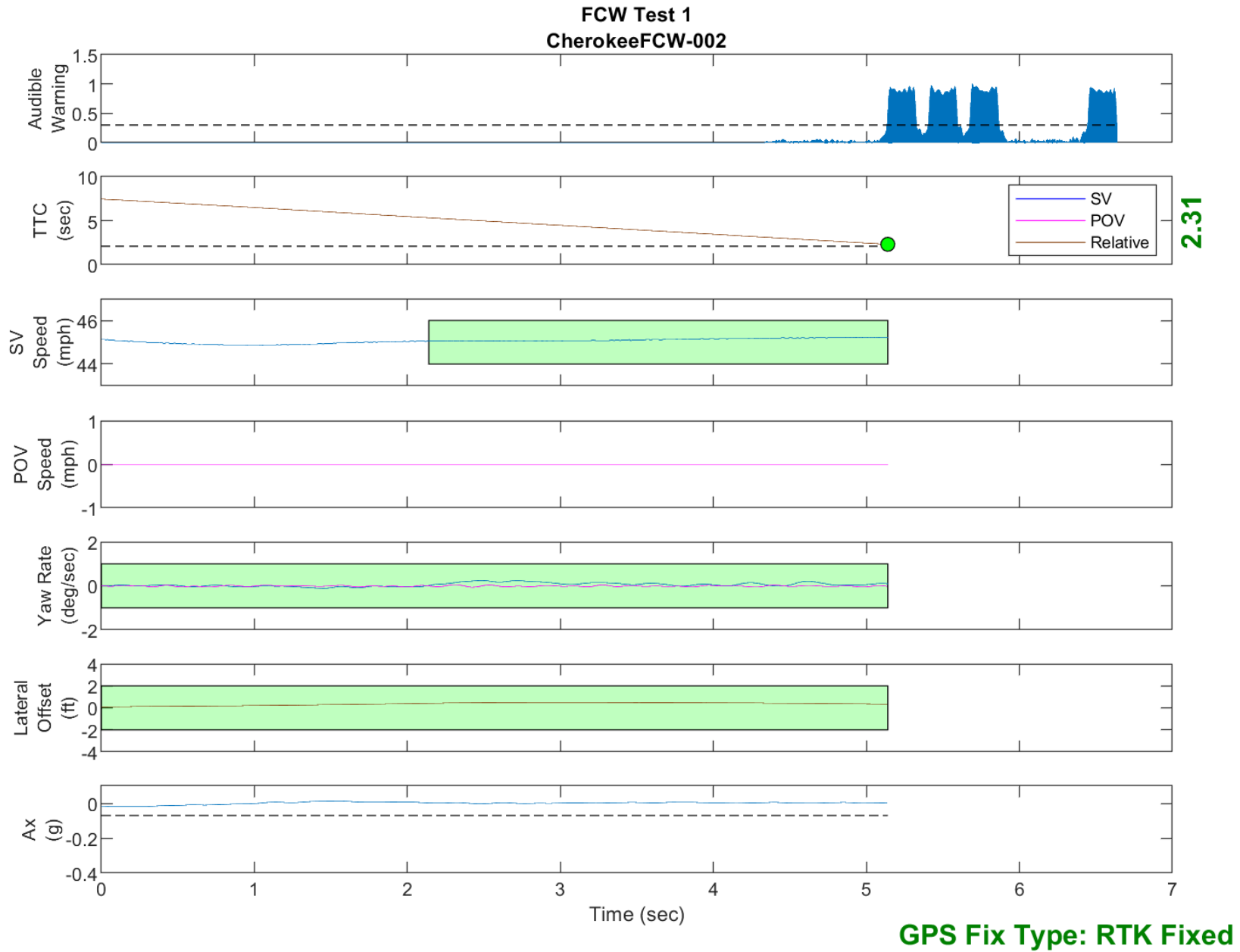


Figure D9. Time History for Run 02, FCW Test 1, Audible Warning

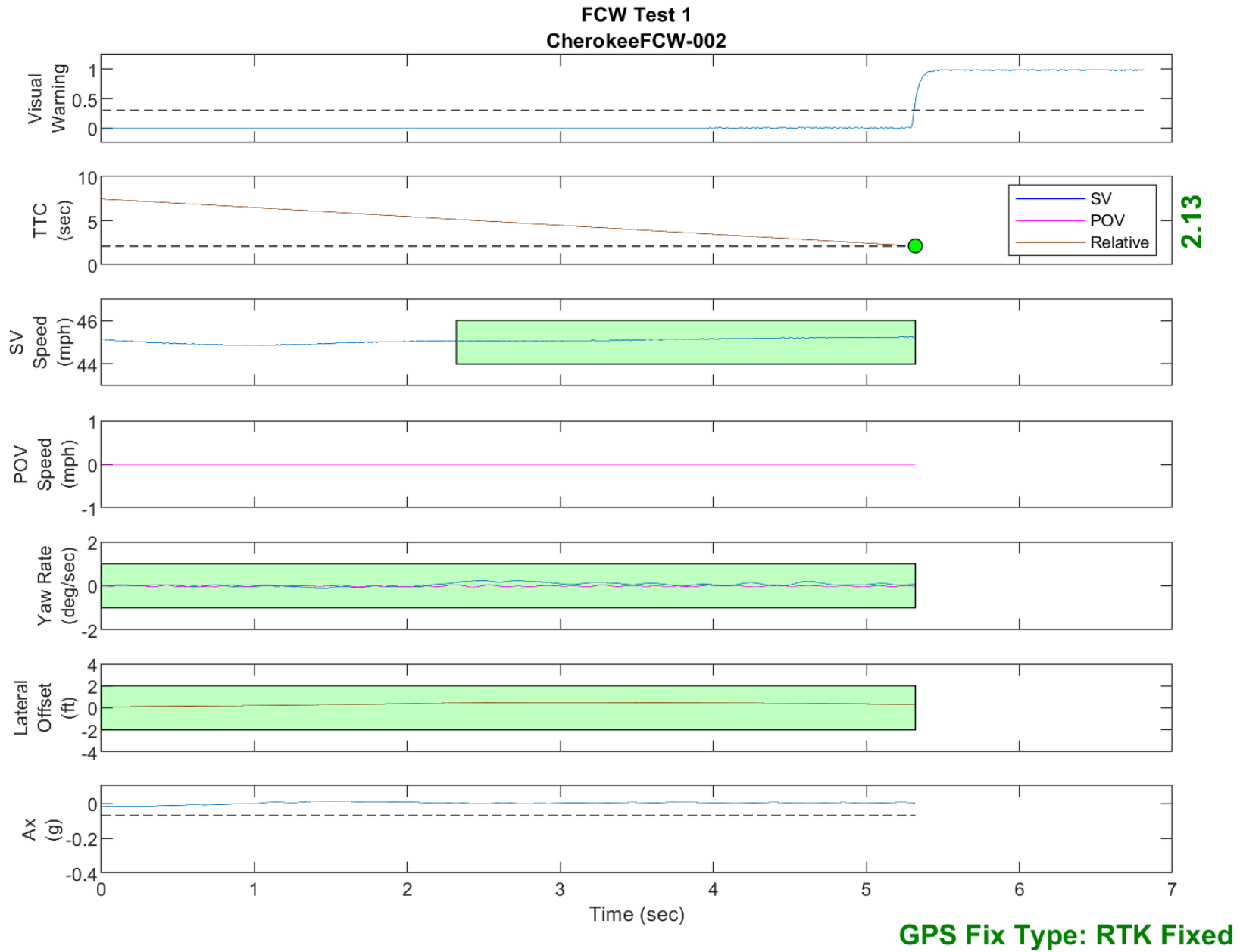


Figure D10. Time History for Run 02, FCW Test 1, Visual Warning

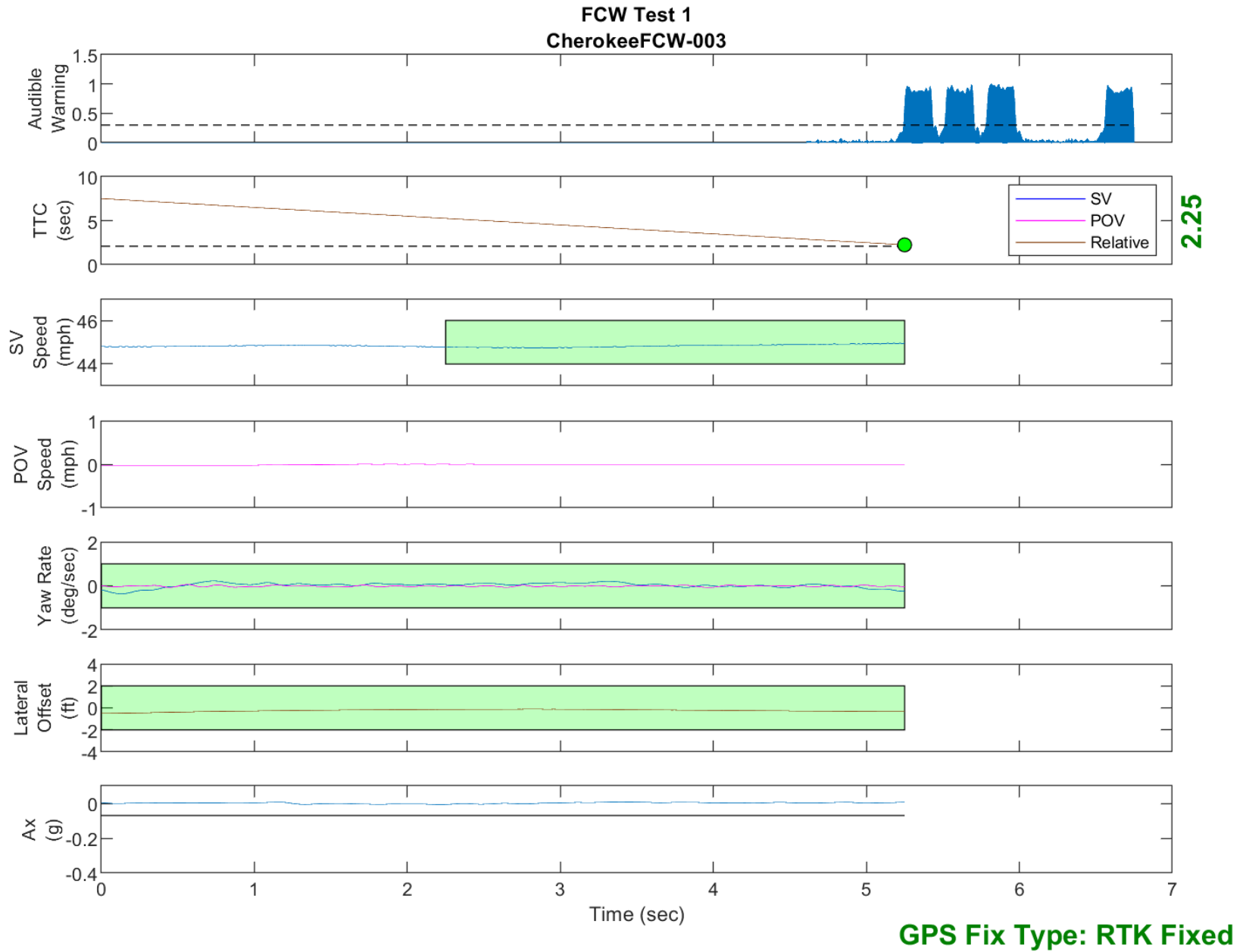


Figure D11. Time History for Run 03, FCW Test 1, Audible Warning

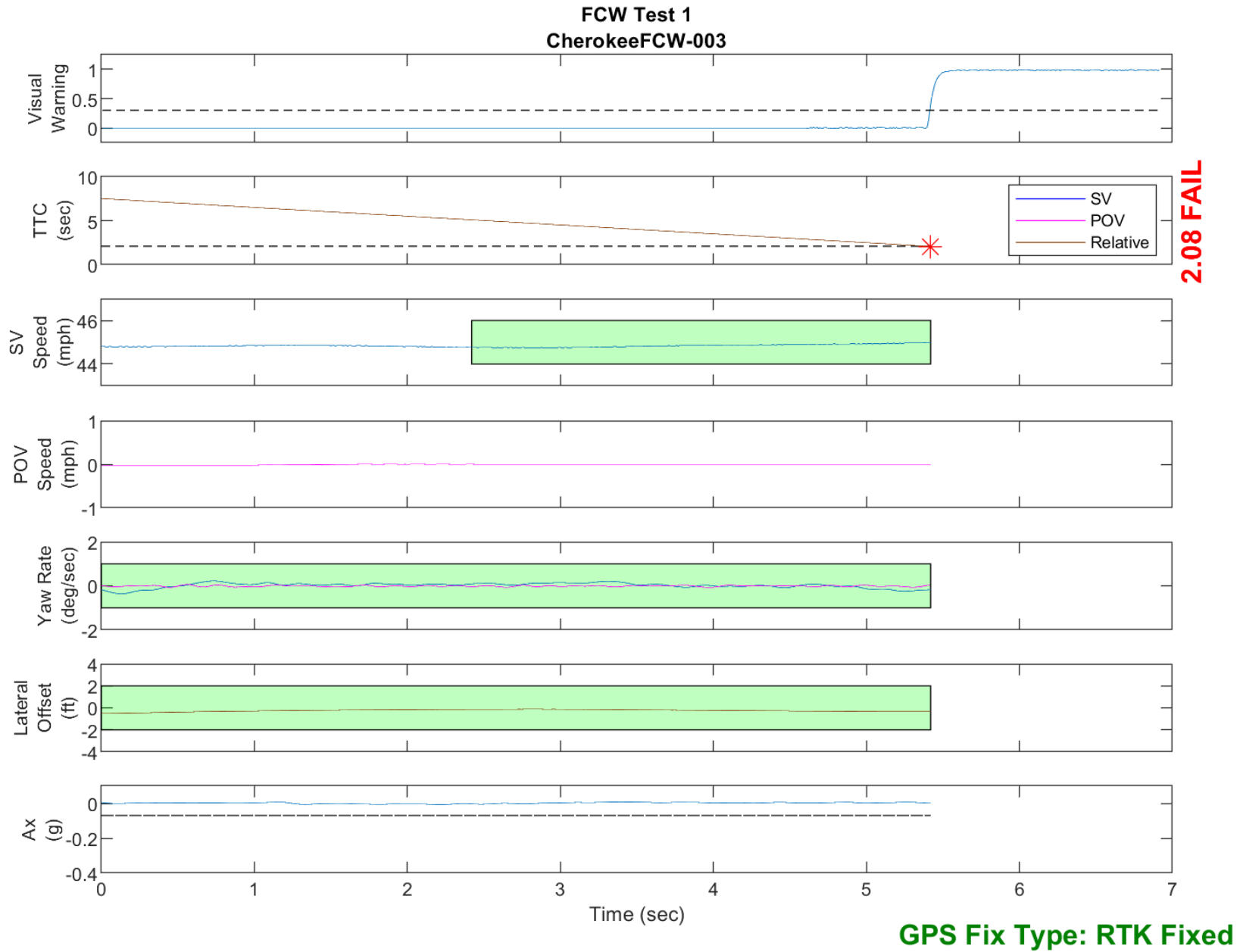


Figure D12. Time History for Run 03, FCW Test 1, Visual Warning

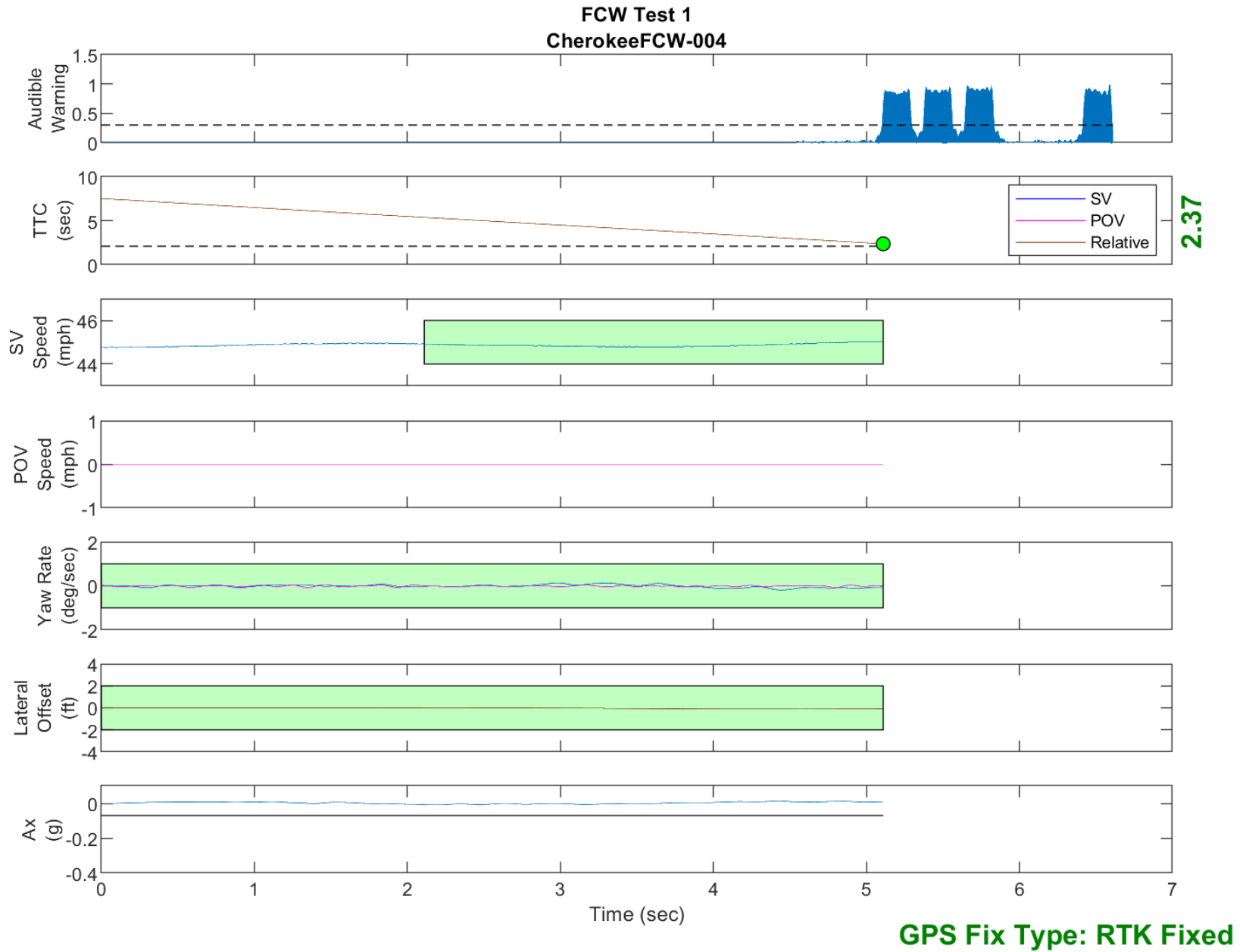


Figure D13. Time History for Run 04, FCW Test 1, Audible Warning



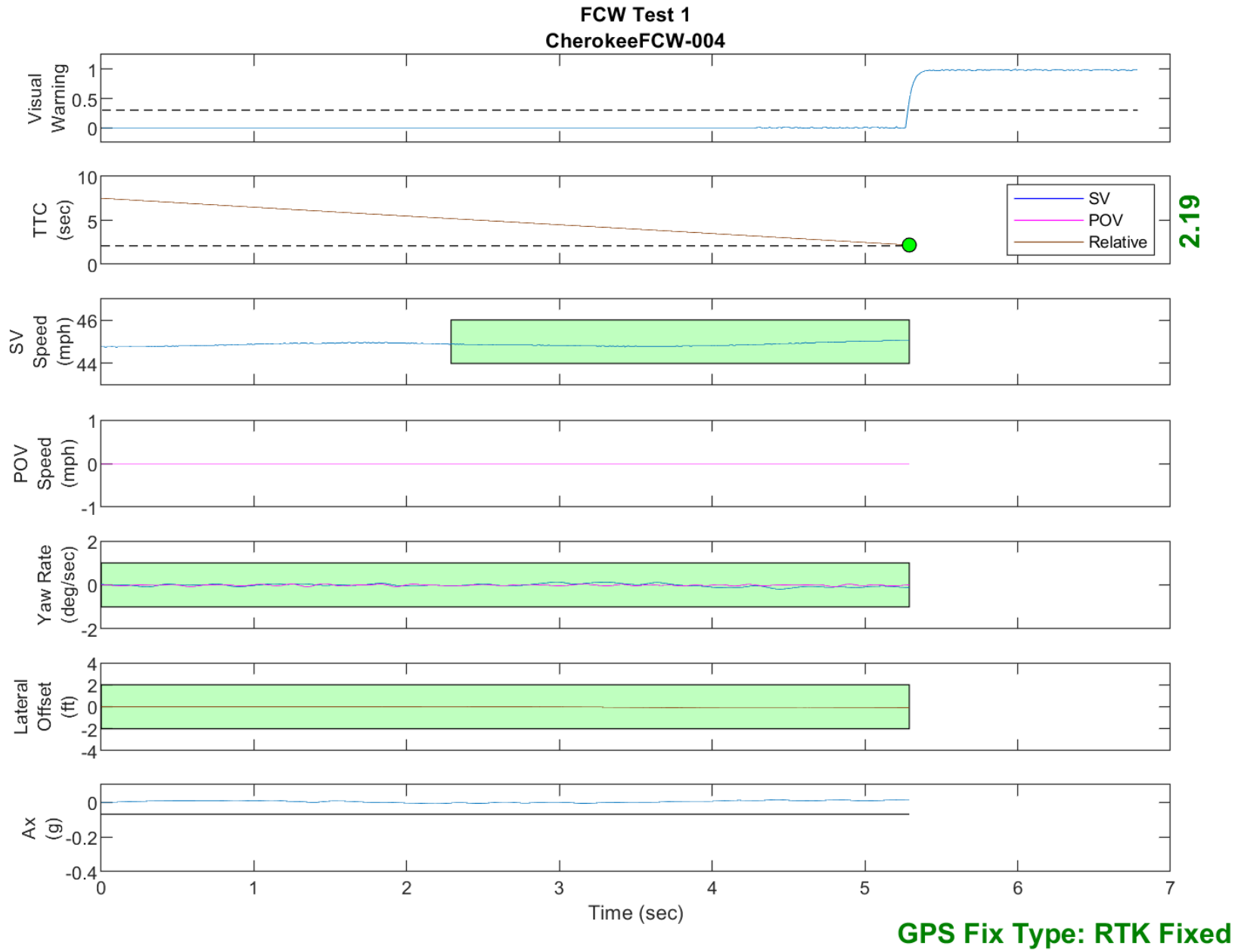


Figure D14. Time History for Run 04, FCW Test 1, Visual Warning

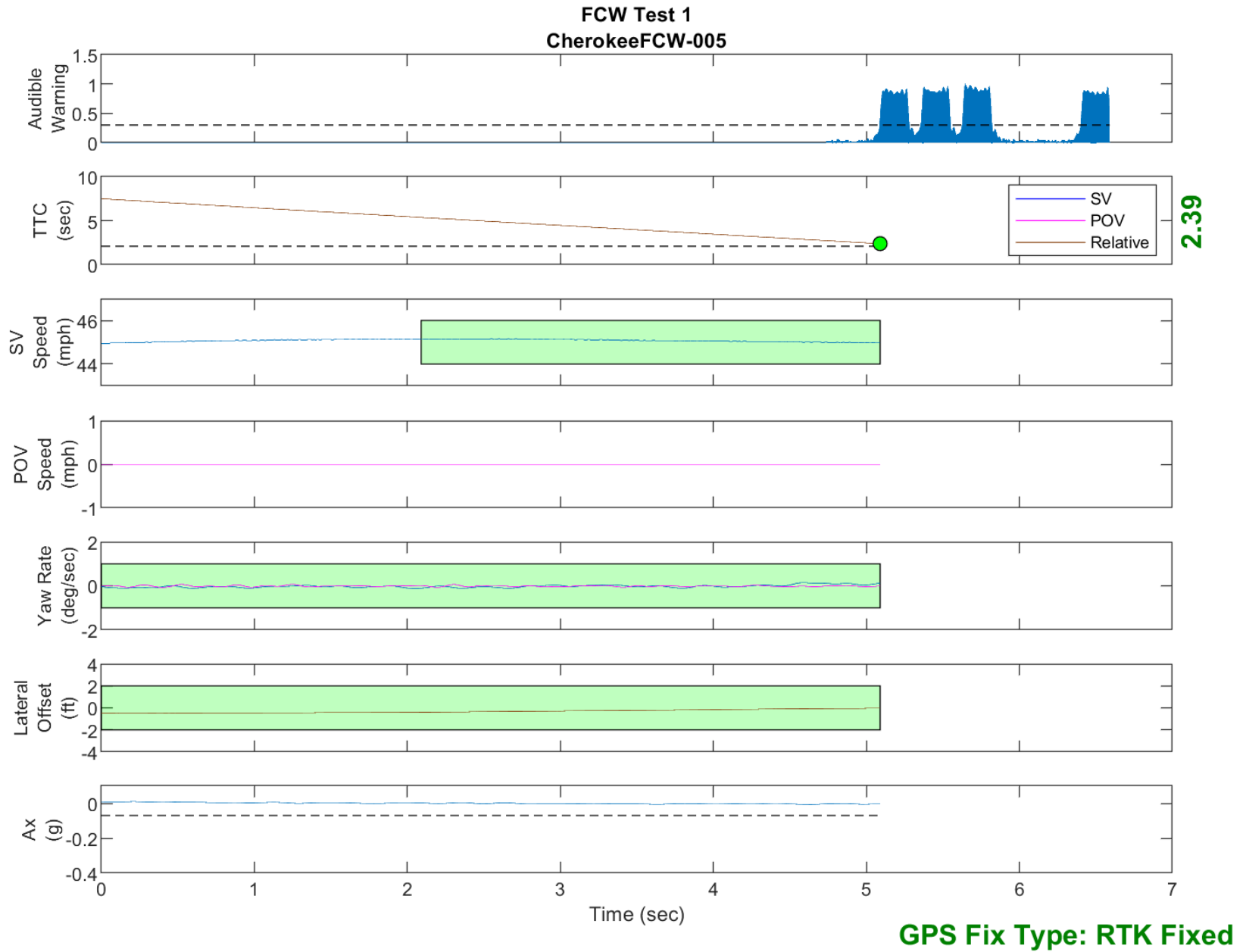


Figure D15. Time History for Run 05, FCW Test 1, Audible Warning

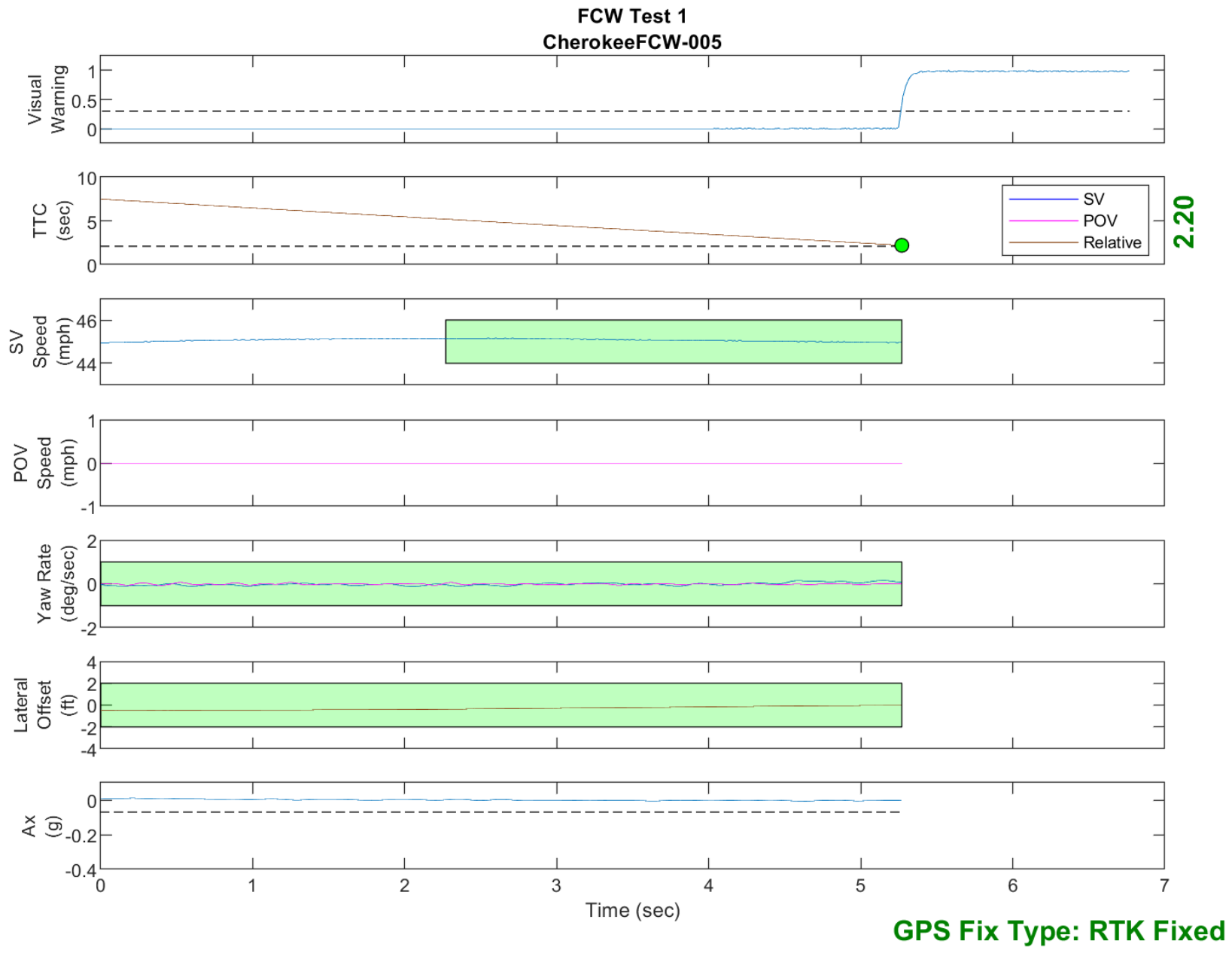


Figure D16. Time History for Run 05, FCW Test 1, Visual Warning

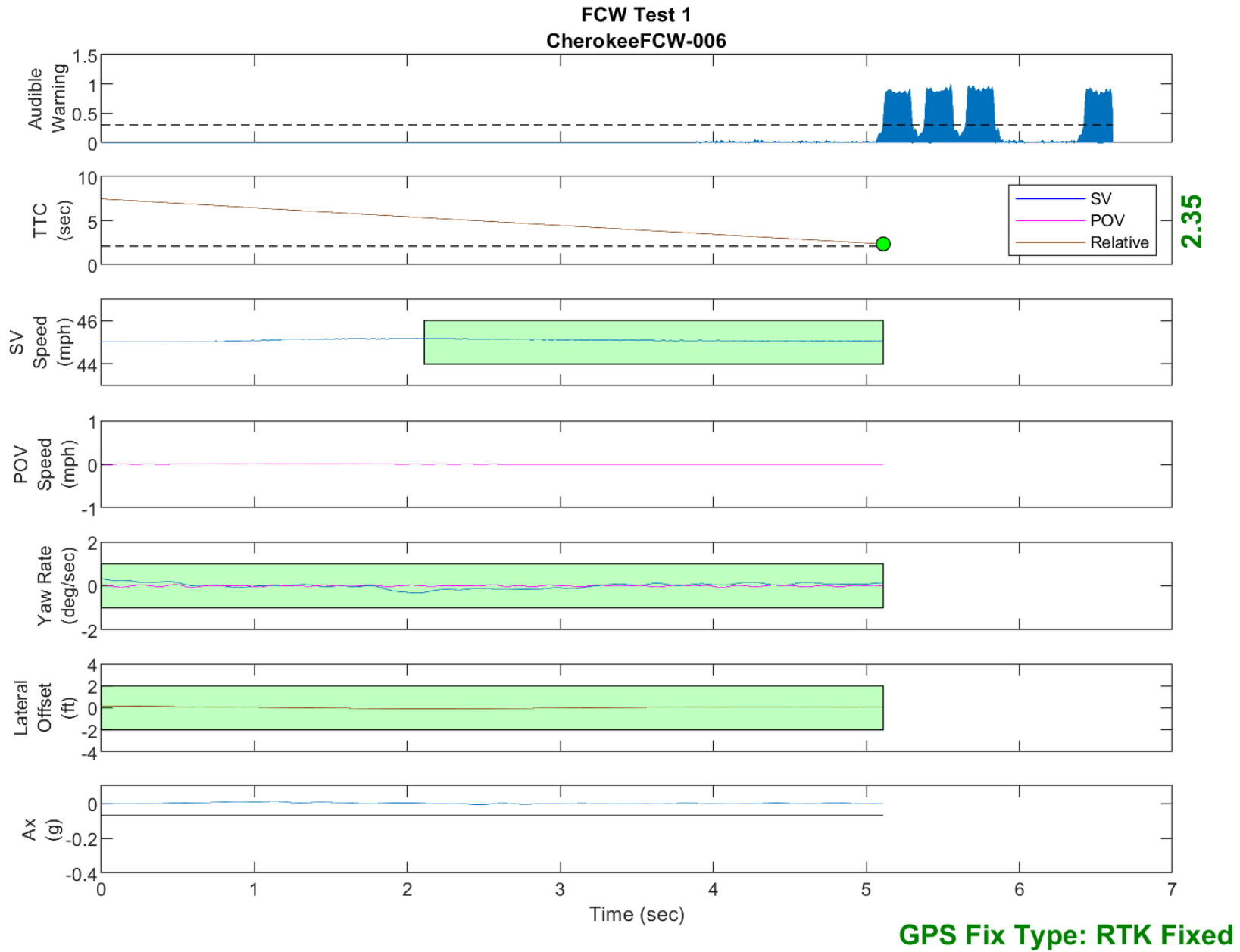


Figure D17. Time History for Run 06, FCW Test 1, Audible Warning

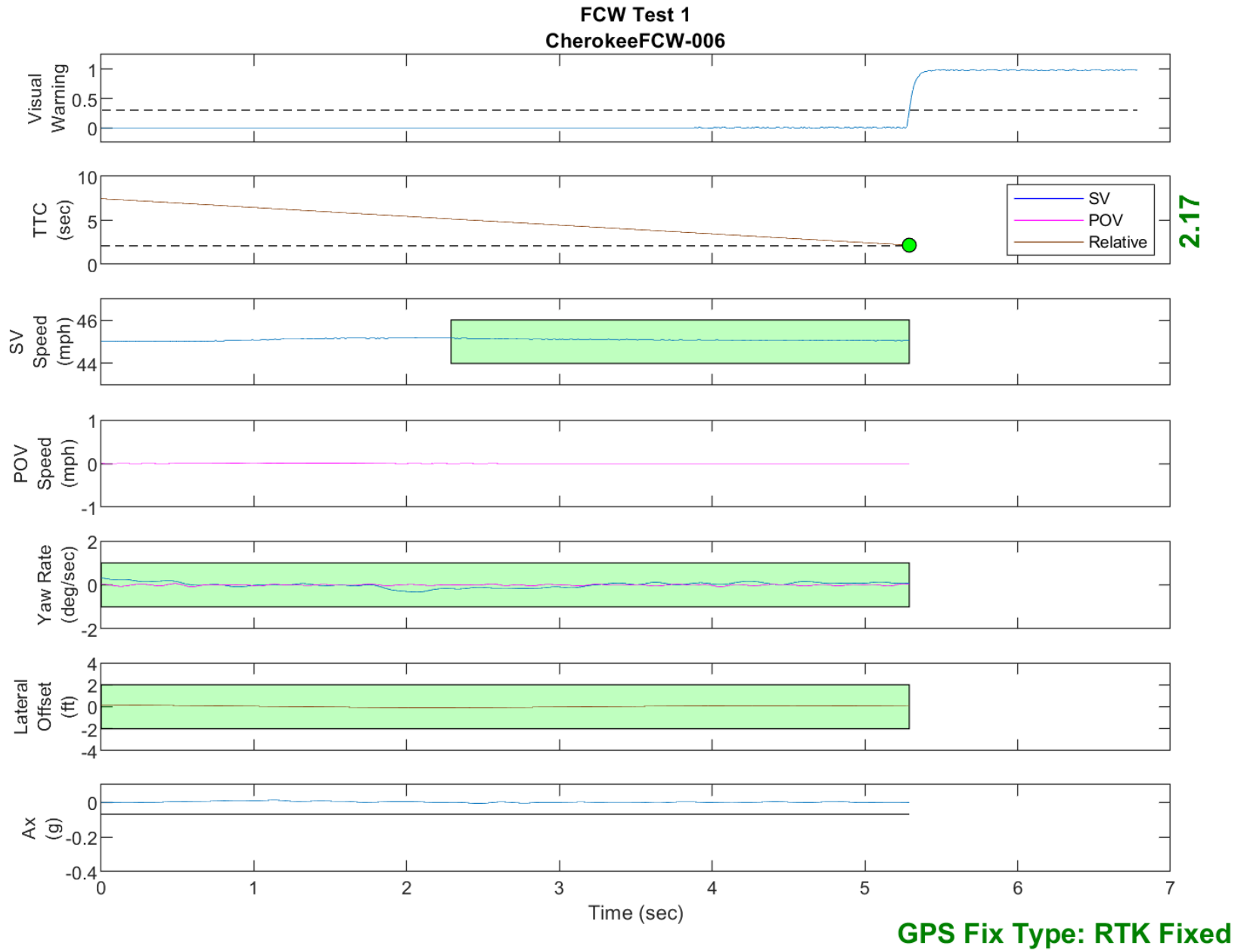


Figure D18. Time History for Run 06, FCW Test 1, Visual Warning

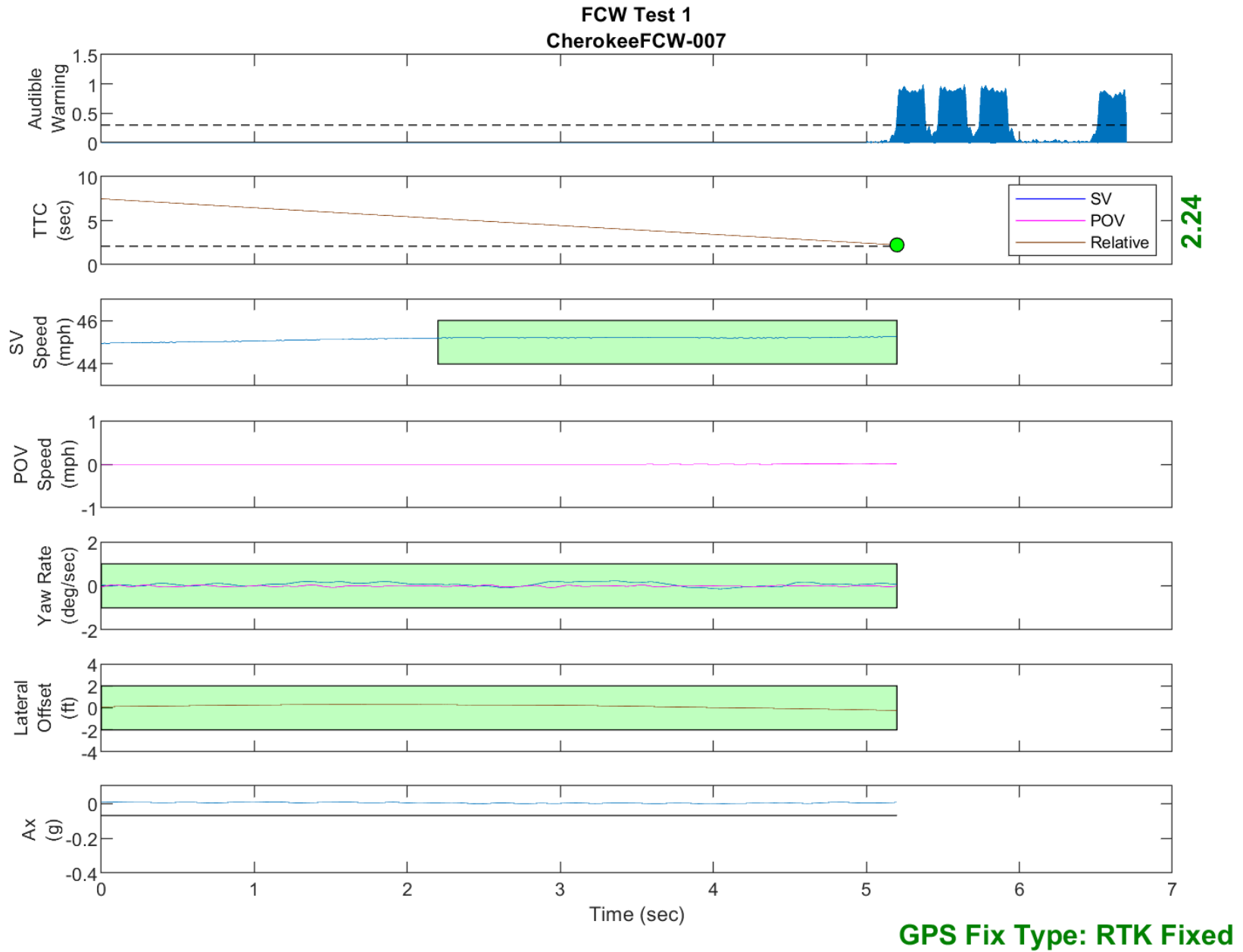


Figure D19. Time History for Run 07, FCW Test 1, Audible Warning



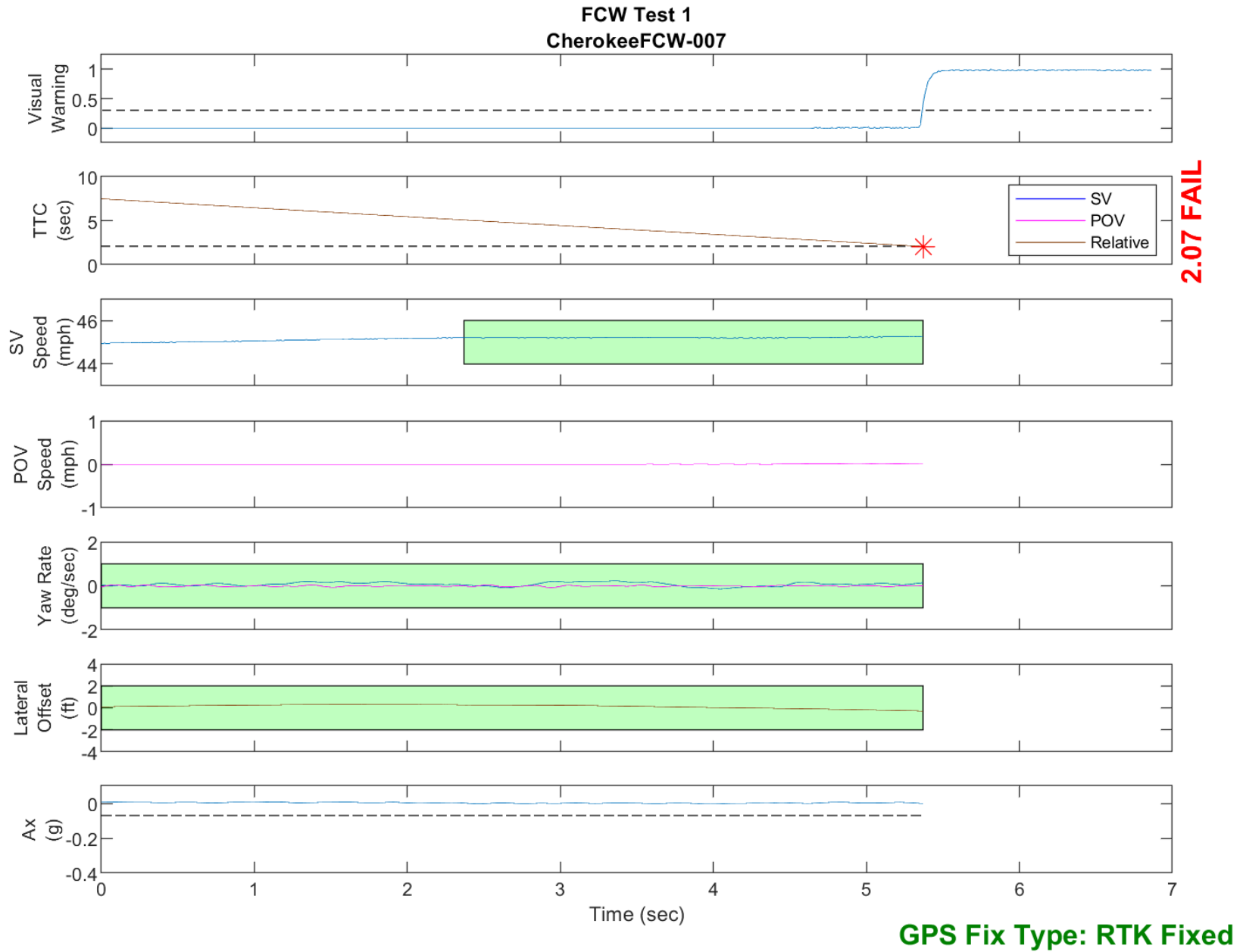


Figure D20. Time History for Run 07, FCW Test 1, Visual Warning

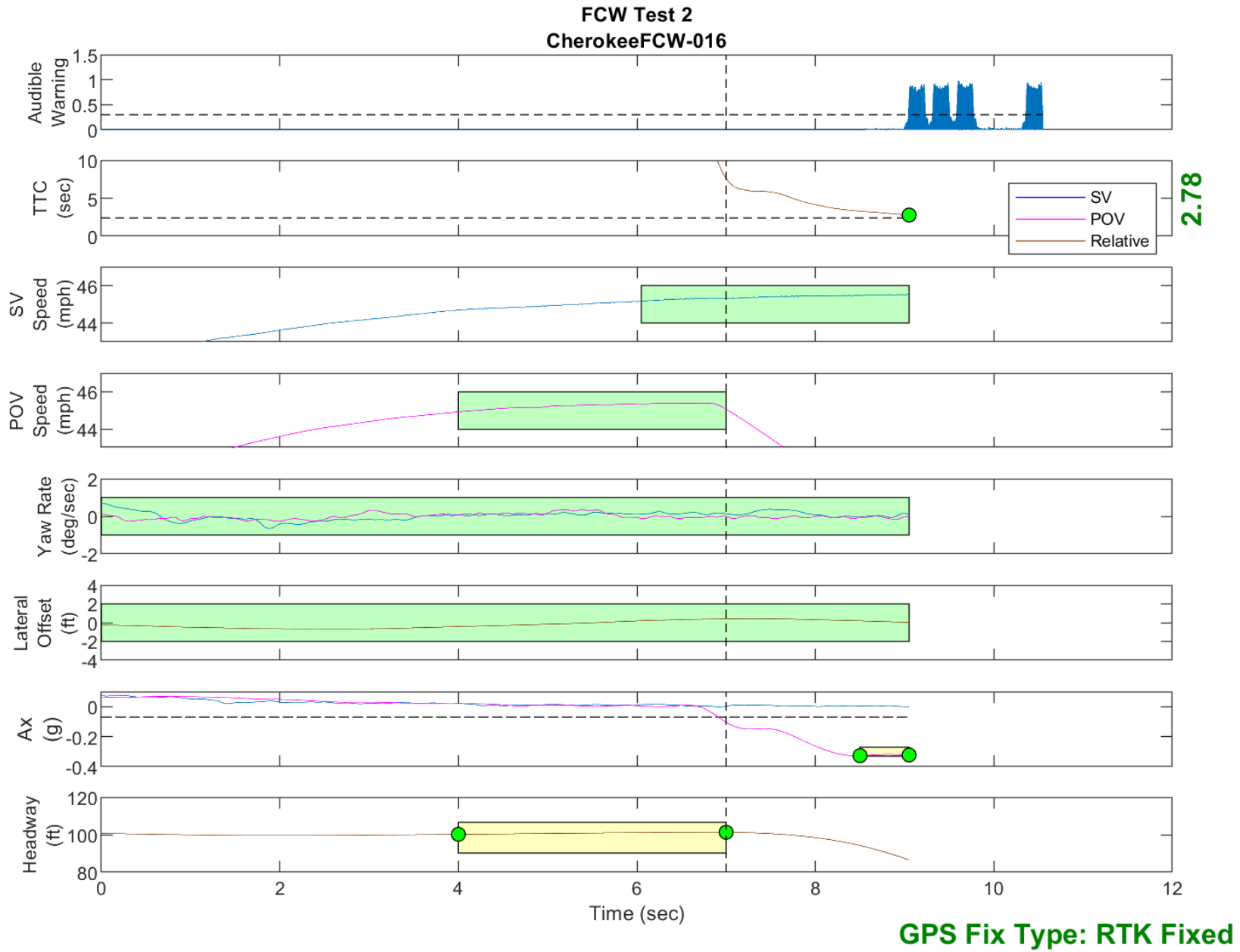


Figure D21. Time History for Run 16, FCW Test 2, Audible Warning

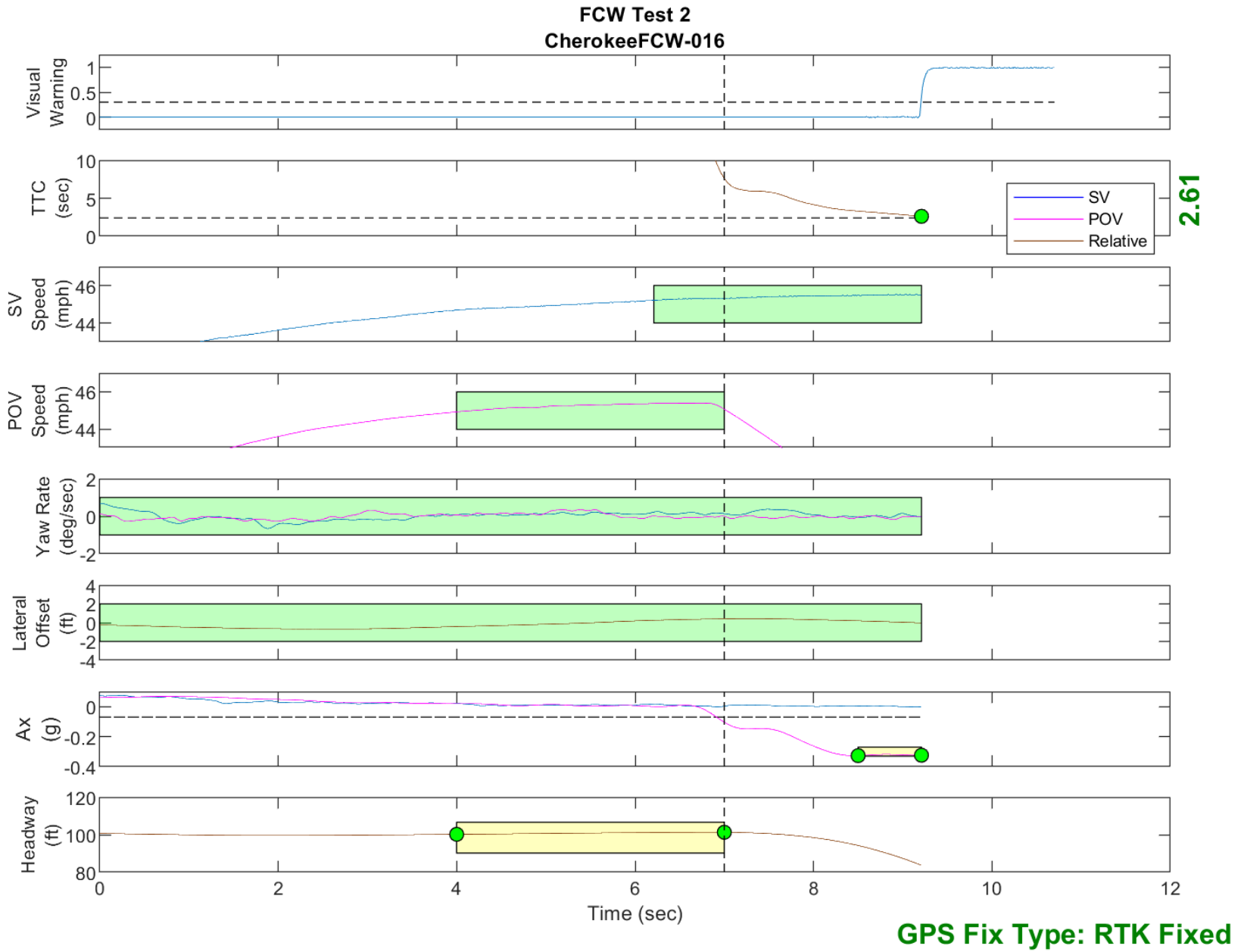


Figure D22. Time History for Run 16, FCW Test 2, Visual Warning

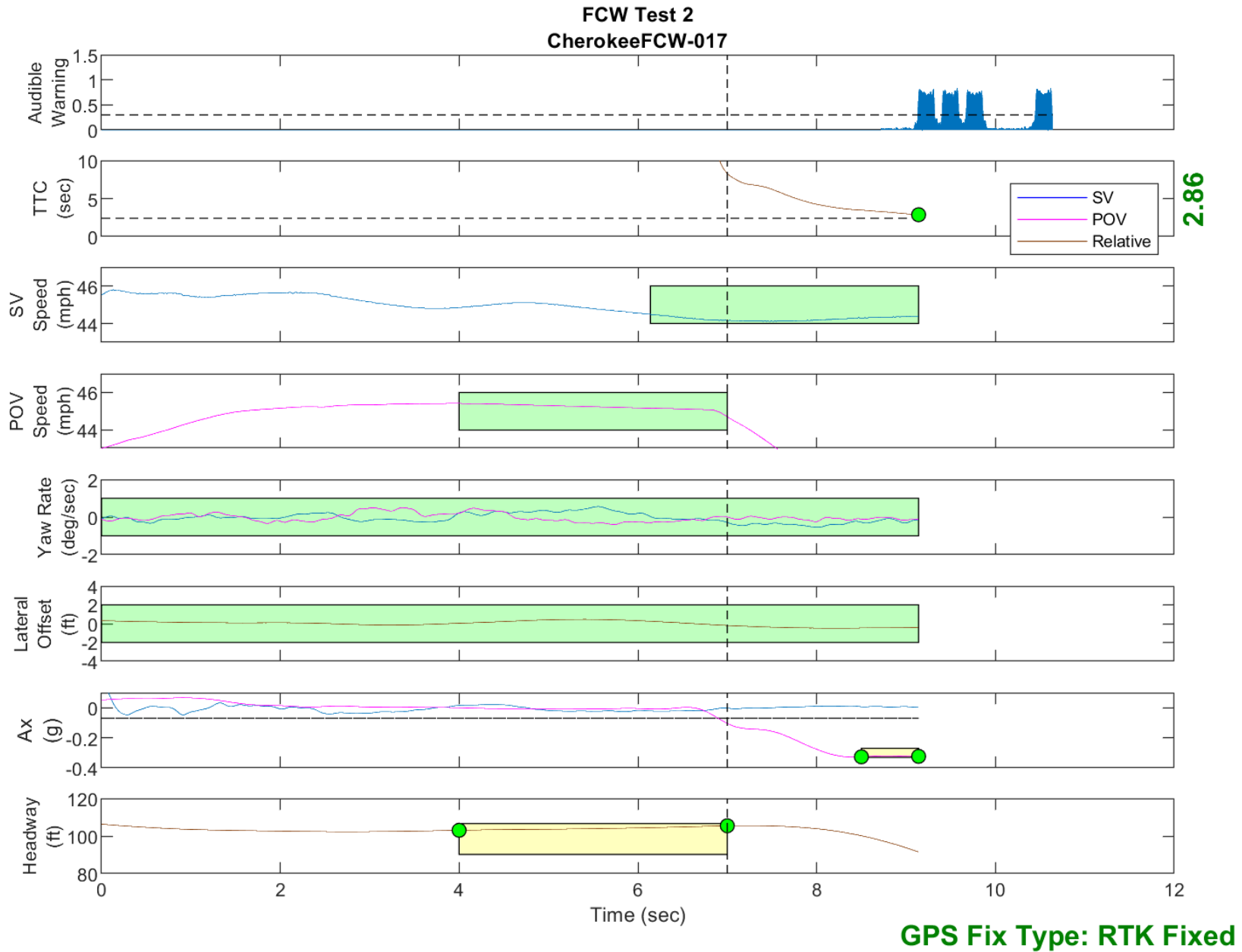


Figure D23. Time History for Run 17, FCW Test 2, Audible Warning

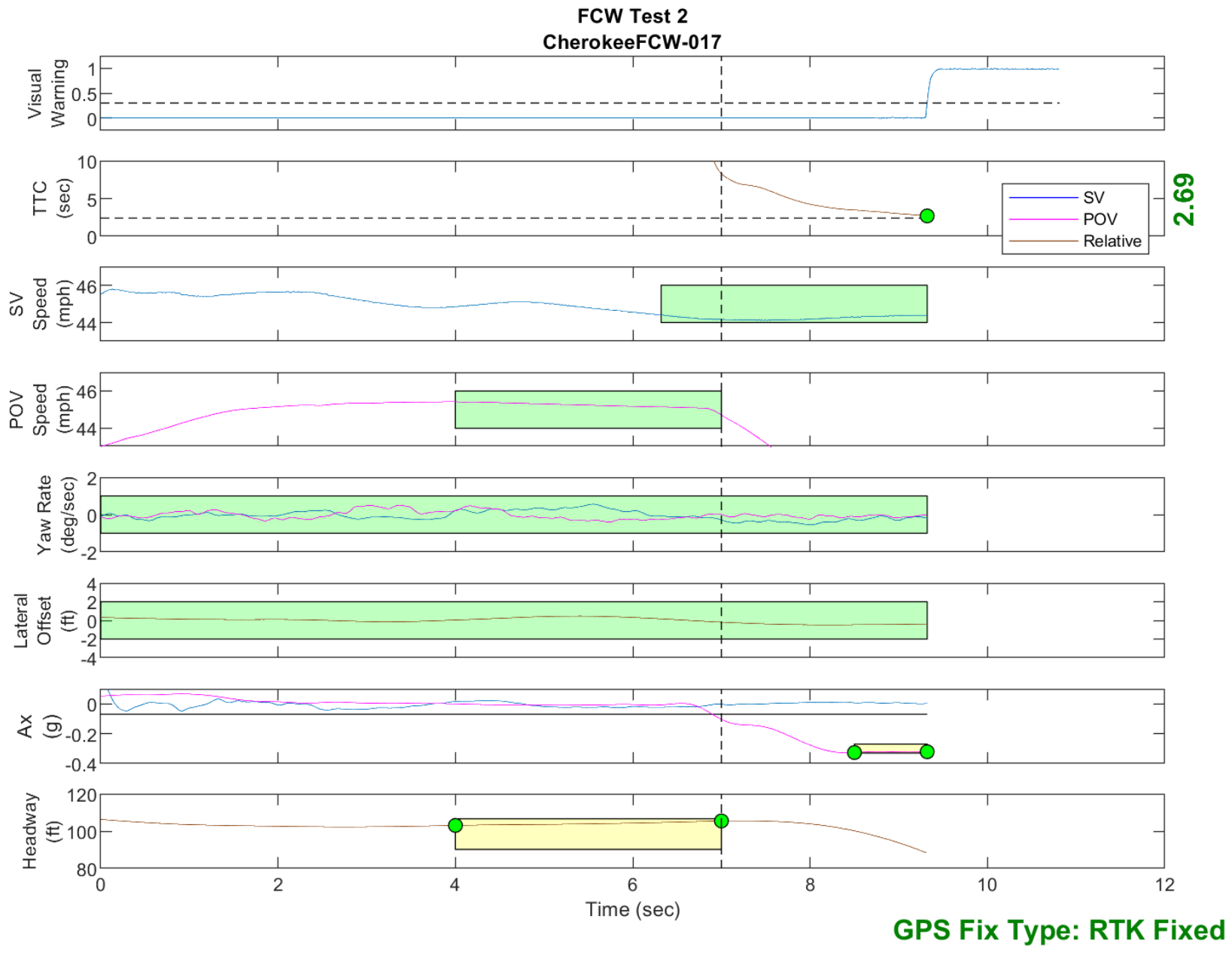


Figure D24. Time History for Run 17, FCW Test 2, Visual Warning

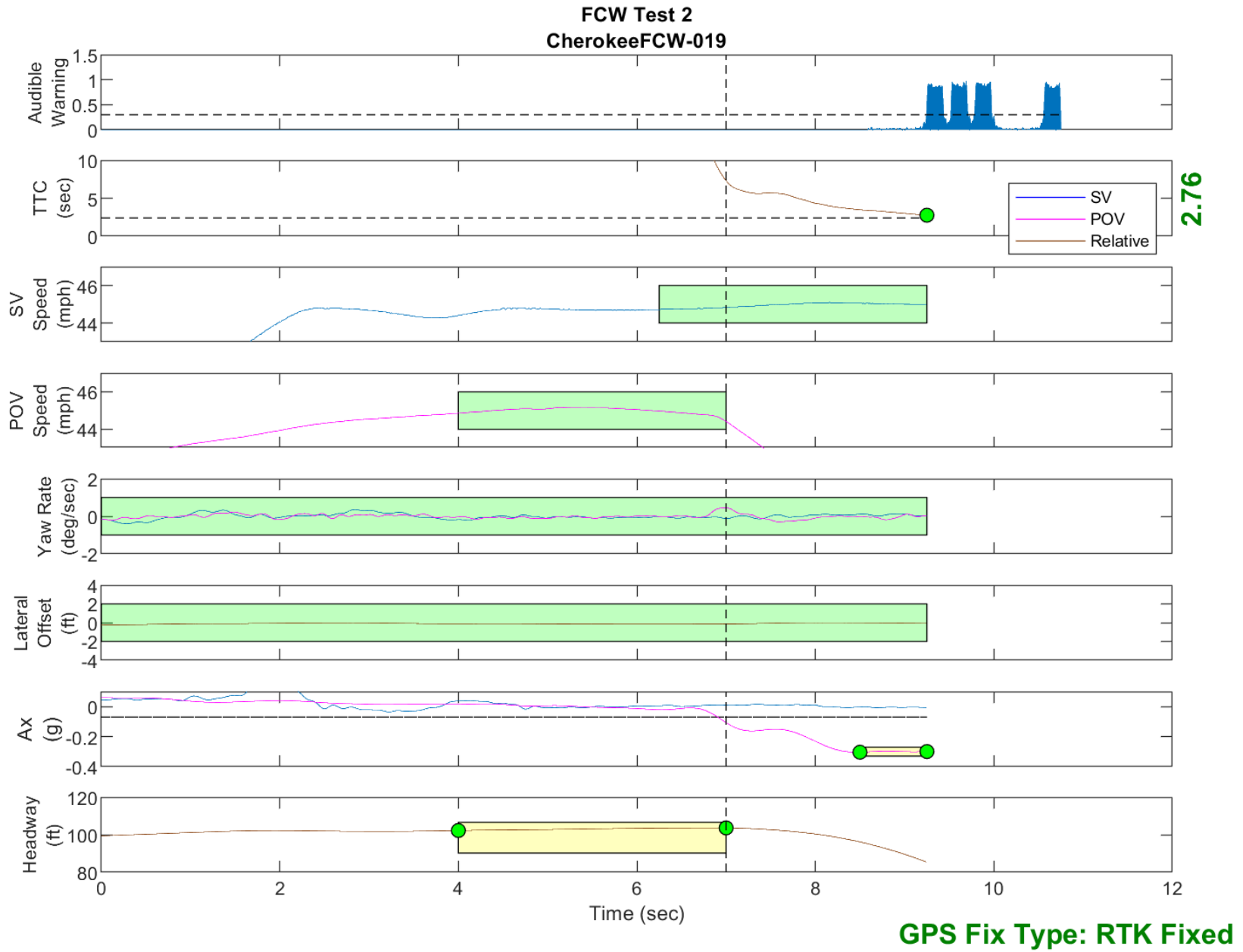


Figure D25. Time History for Run 19, FCW Test 2, Audible Warning



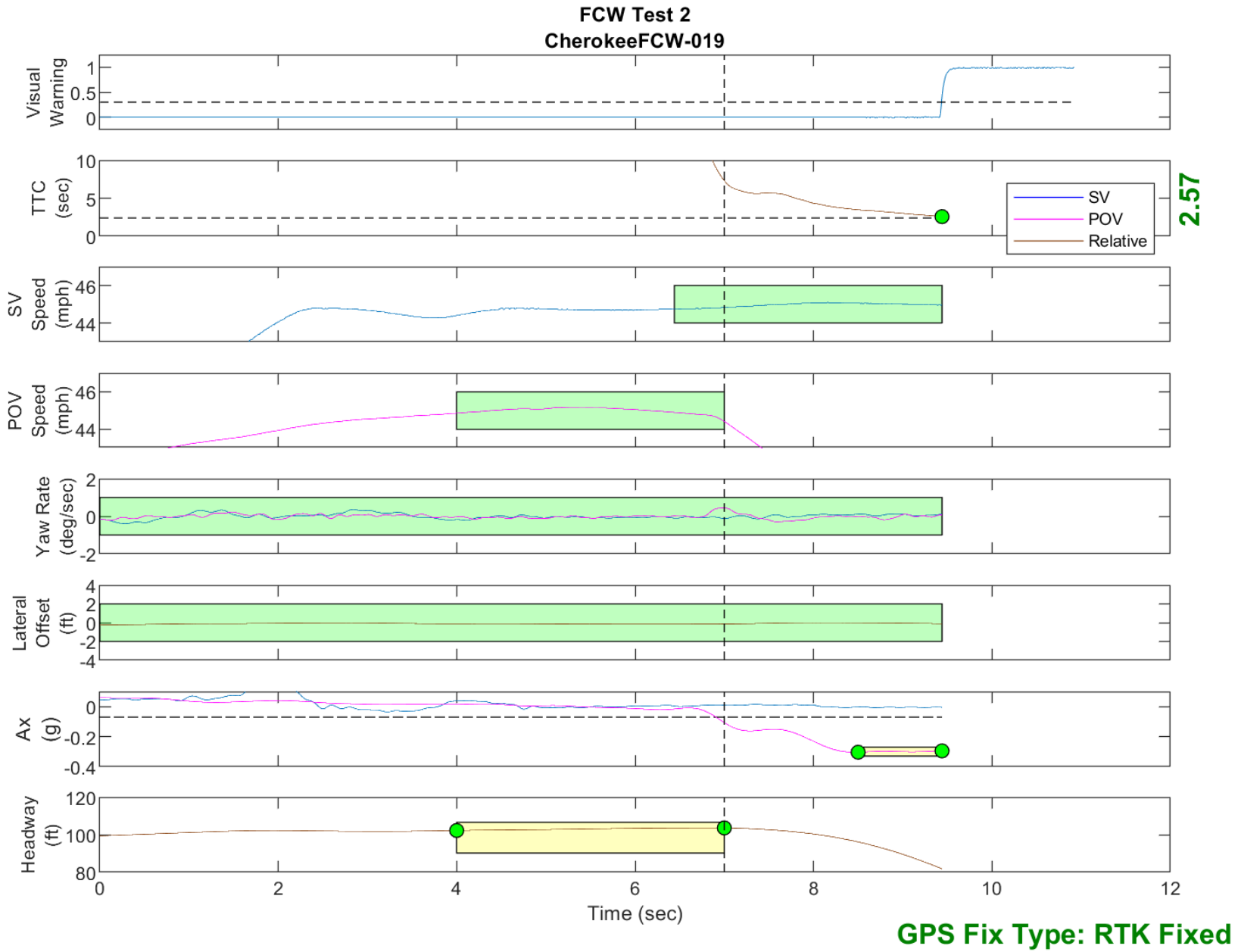


Figure D26. Time History for Run 19, FCW Test 2, Visual Warning

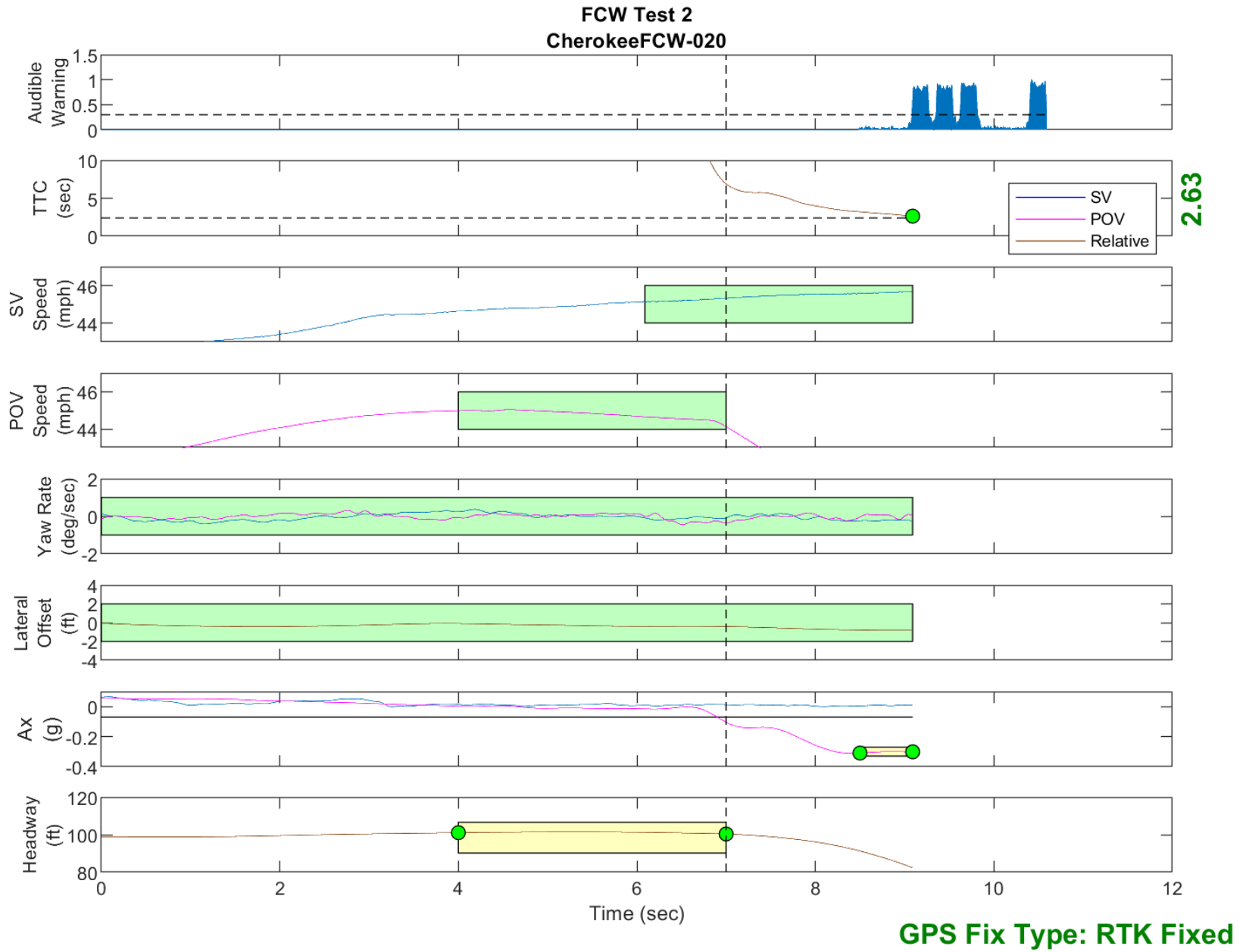


Figure D27. Time History for Run 20, FCW Test 2, Audible Warning

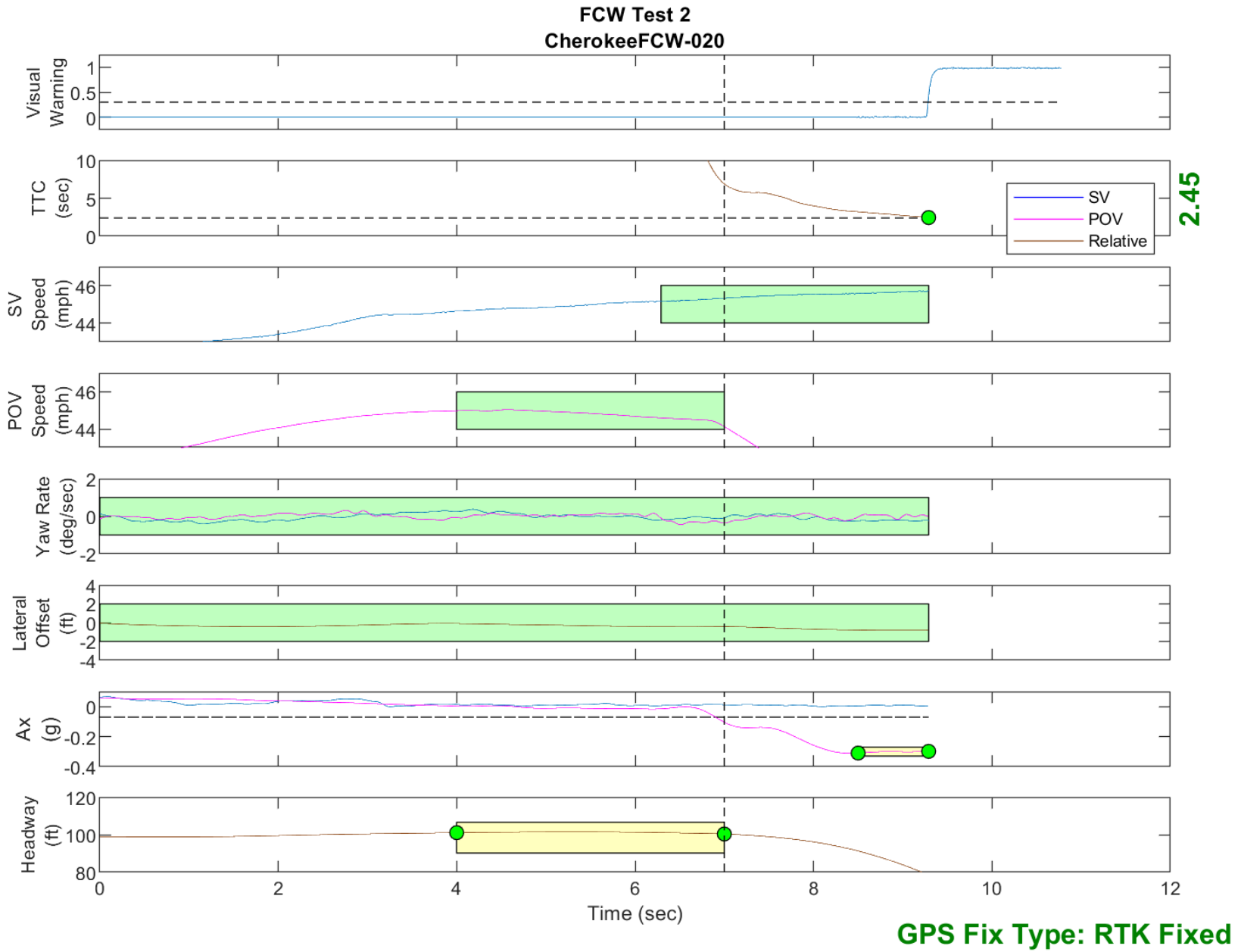


Figure D28. Time History for Run 20, FCW Test 2, Visual Warning

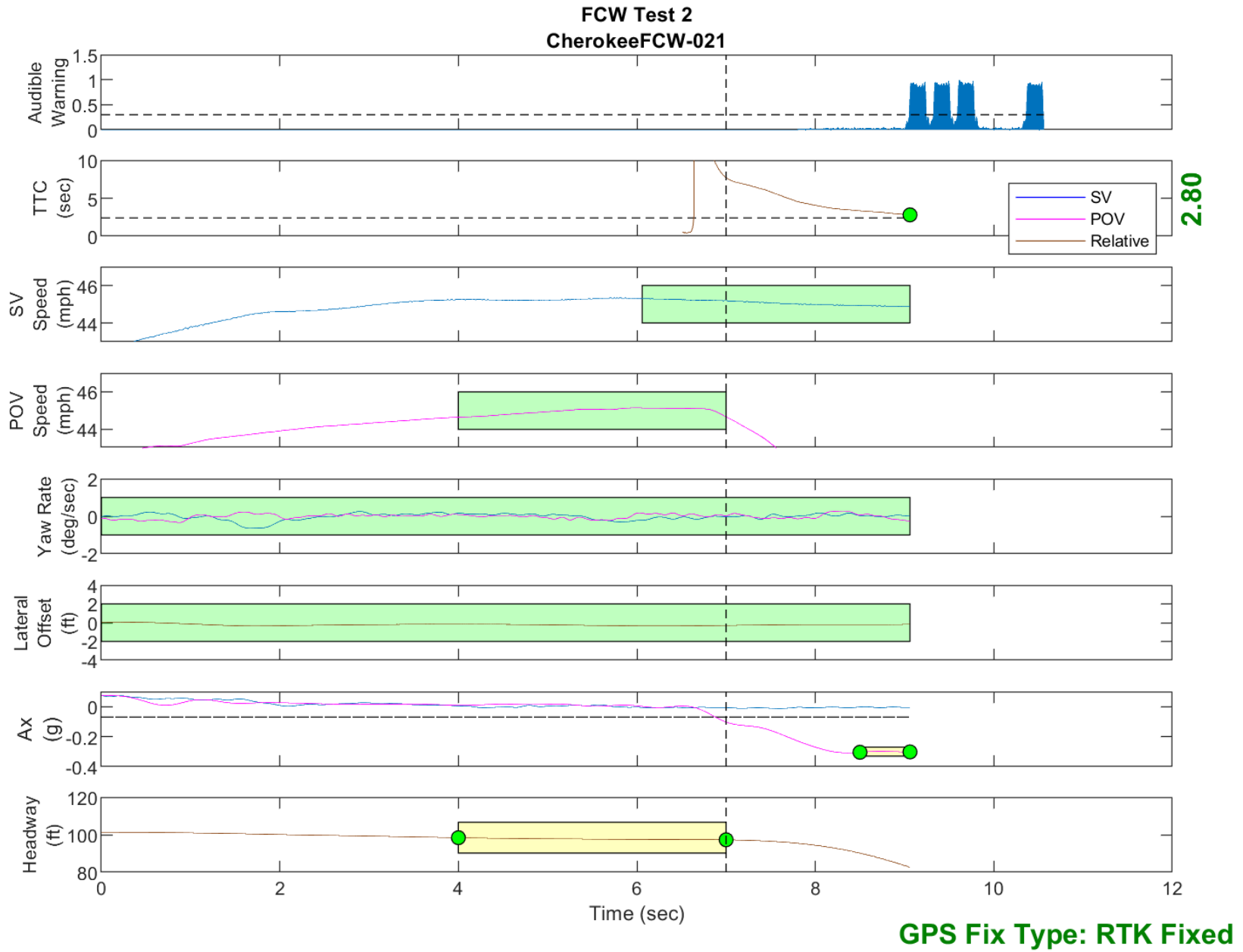


Figure D29. Time History for Run 21, FCW Test 2, Audible Warning

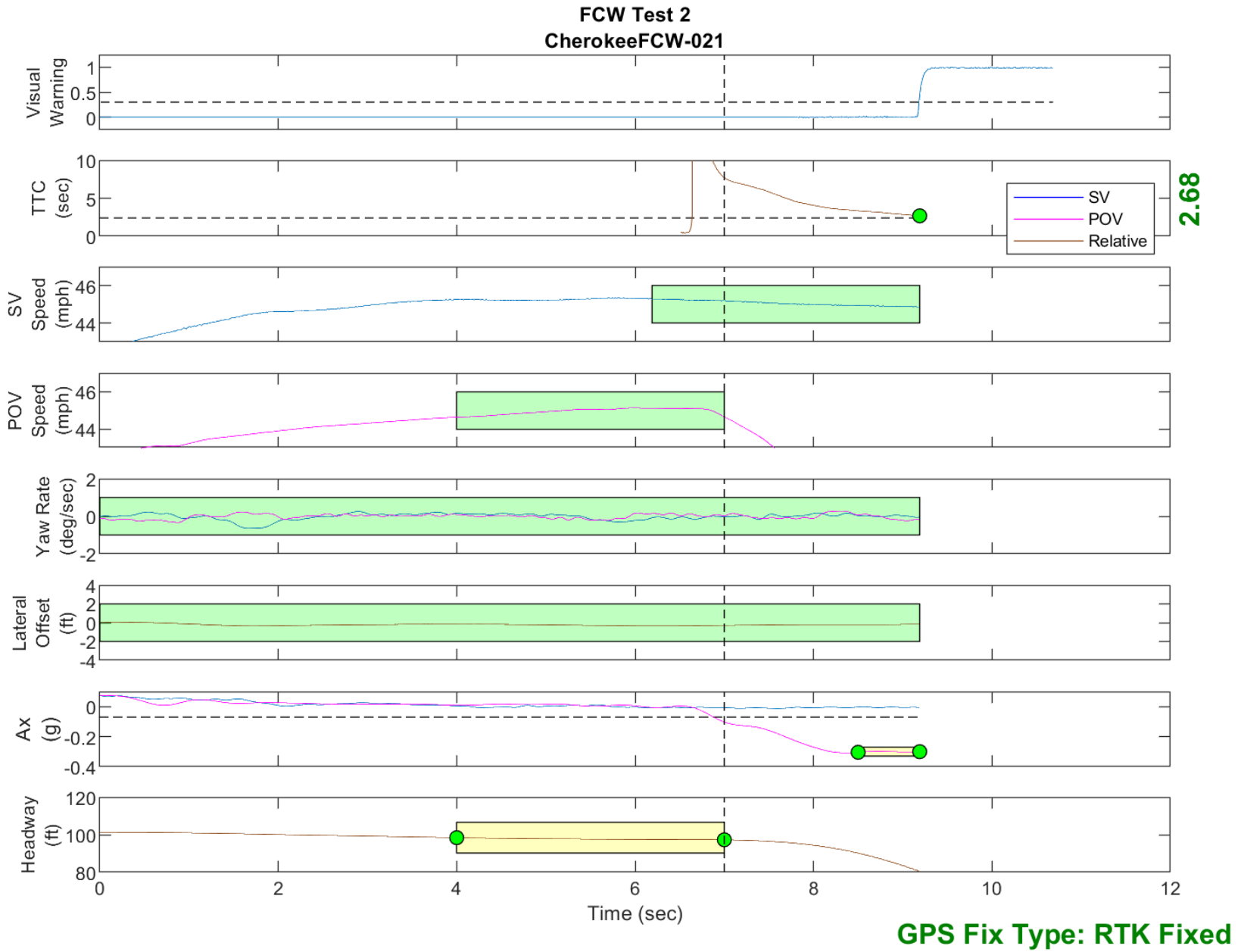


Figure D30. Time History for Run 21, FCW Test 2, Visual Warning

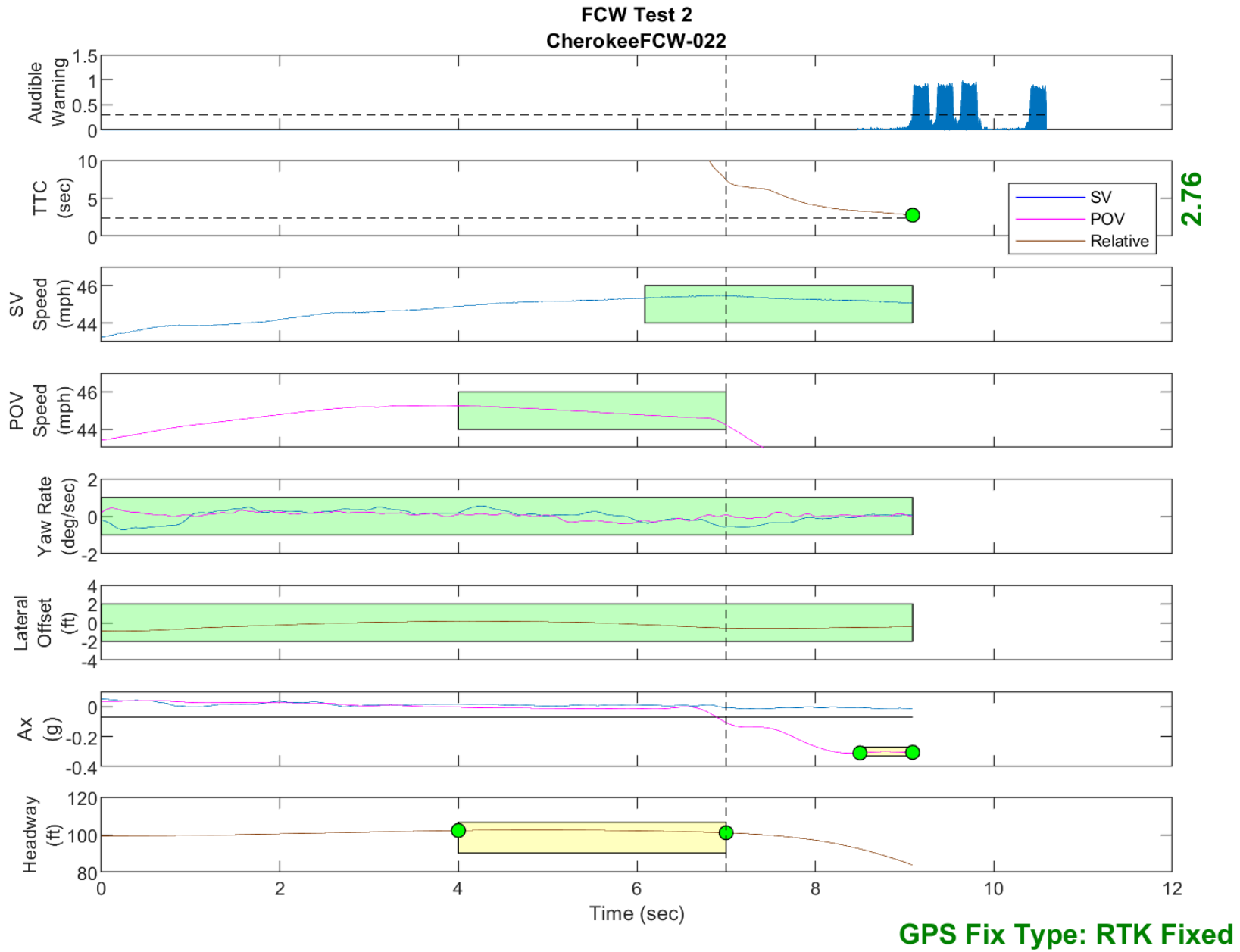


Figure D31. Time History for Run 22, FCW Test 2, Audible Warning

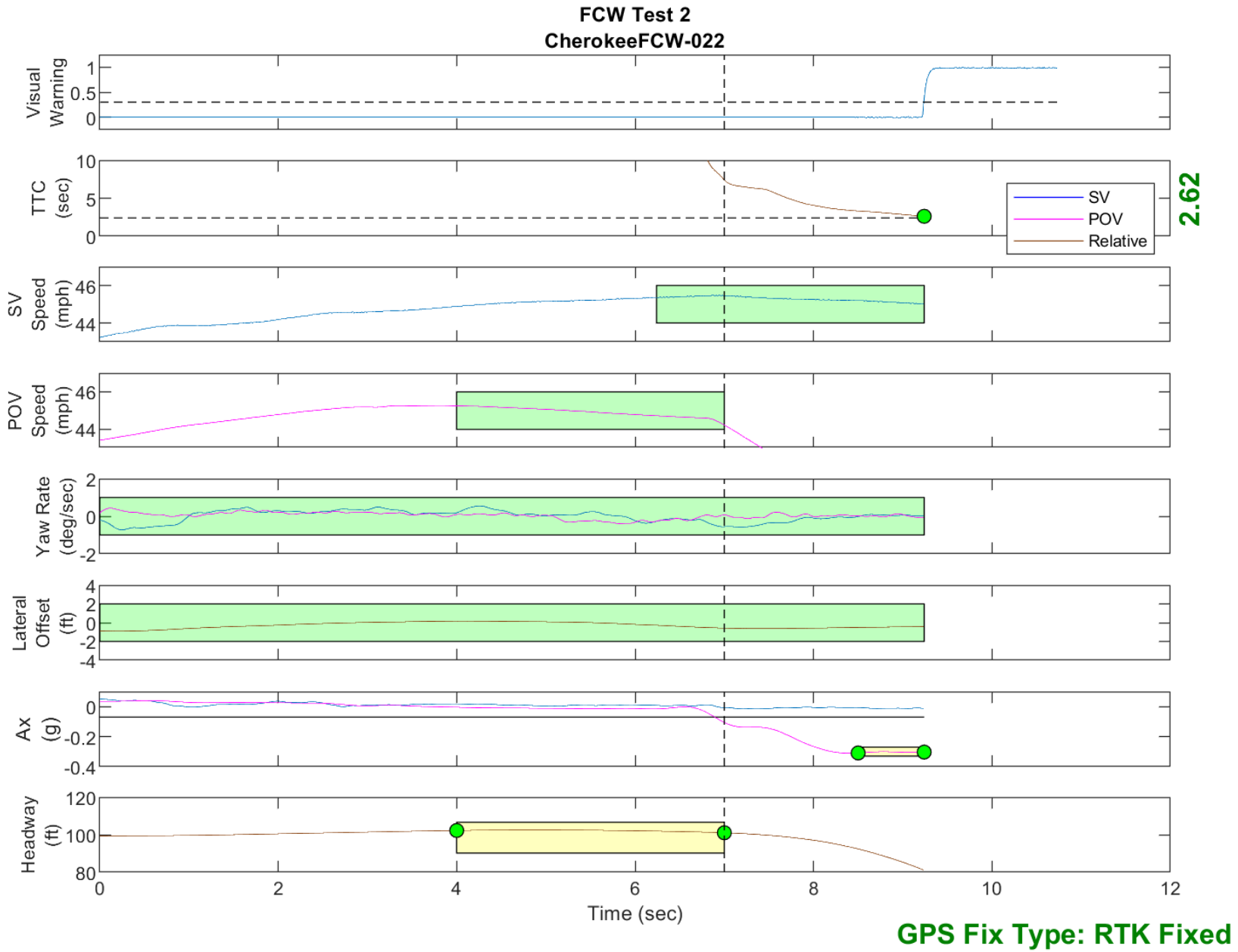


Figure D32. Time History for Run 22, FCW Test 2, Visual Warning



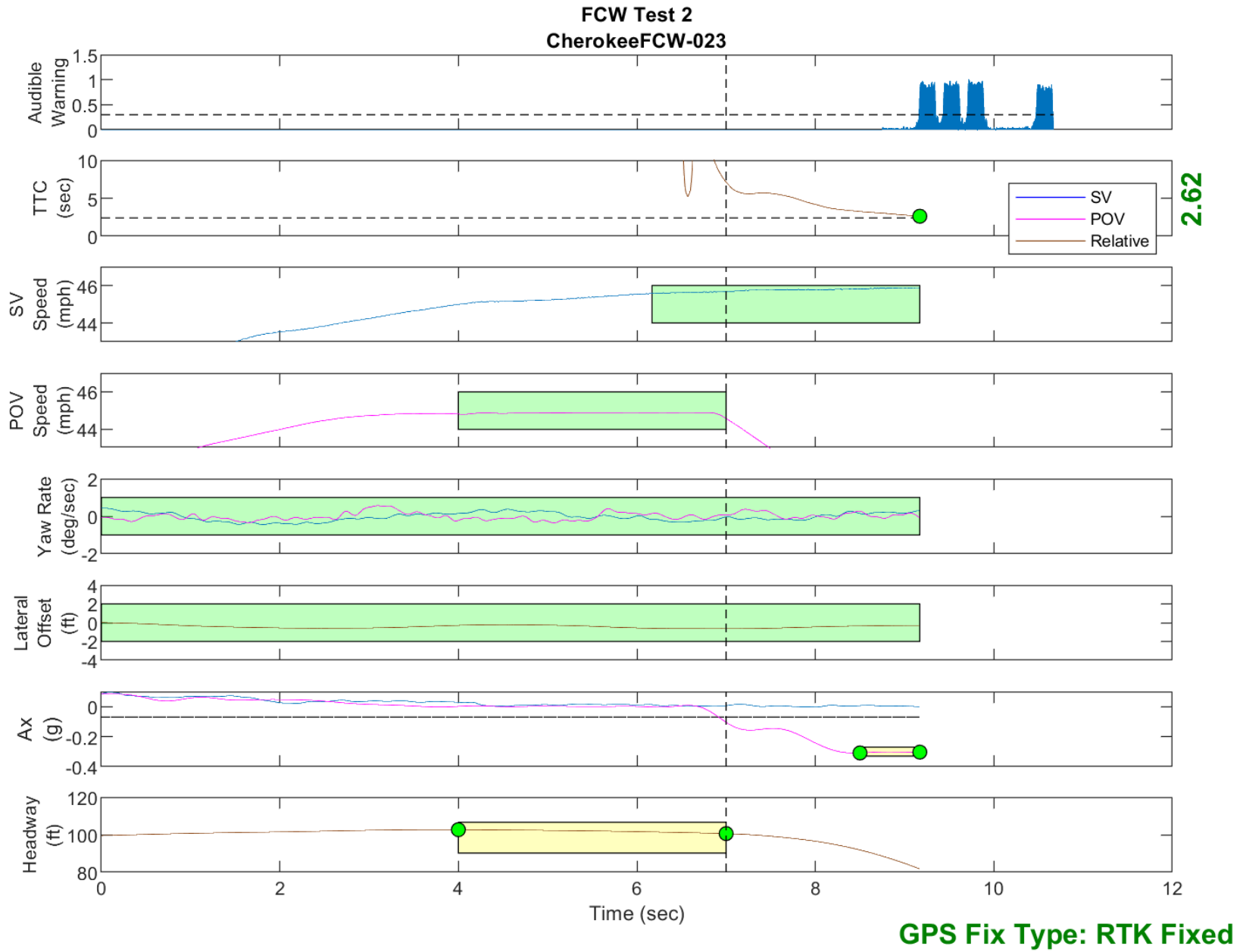


Figure D33. Time History for Run 23, FCW Test 2, Audible Warning

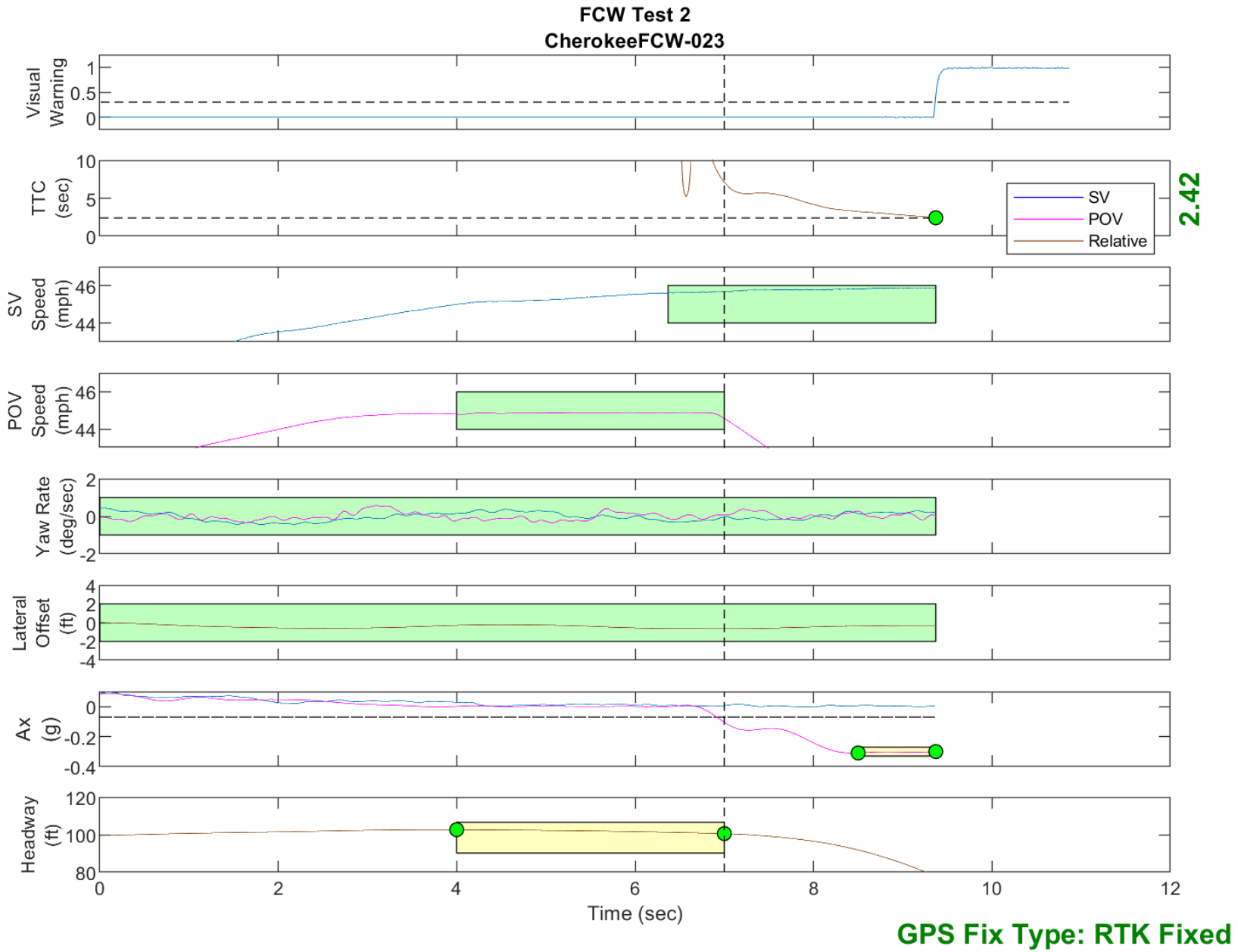


Figure D34. Time History for Run 23, FCW Test 2, Visual Warning

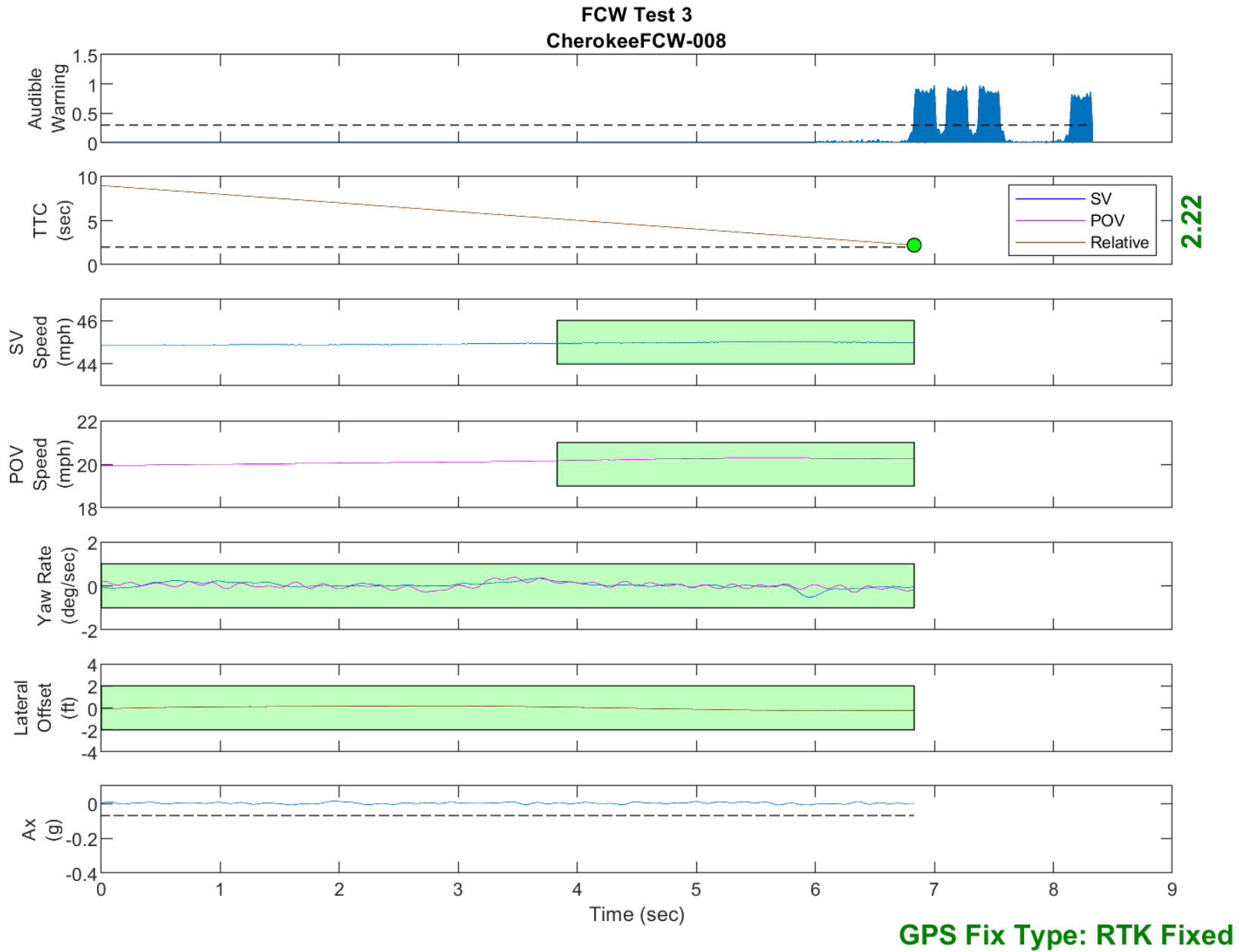


Figure D35. Time History for Run 08, FCW Test 3, Audible Warning

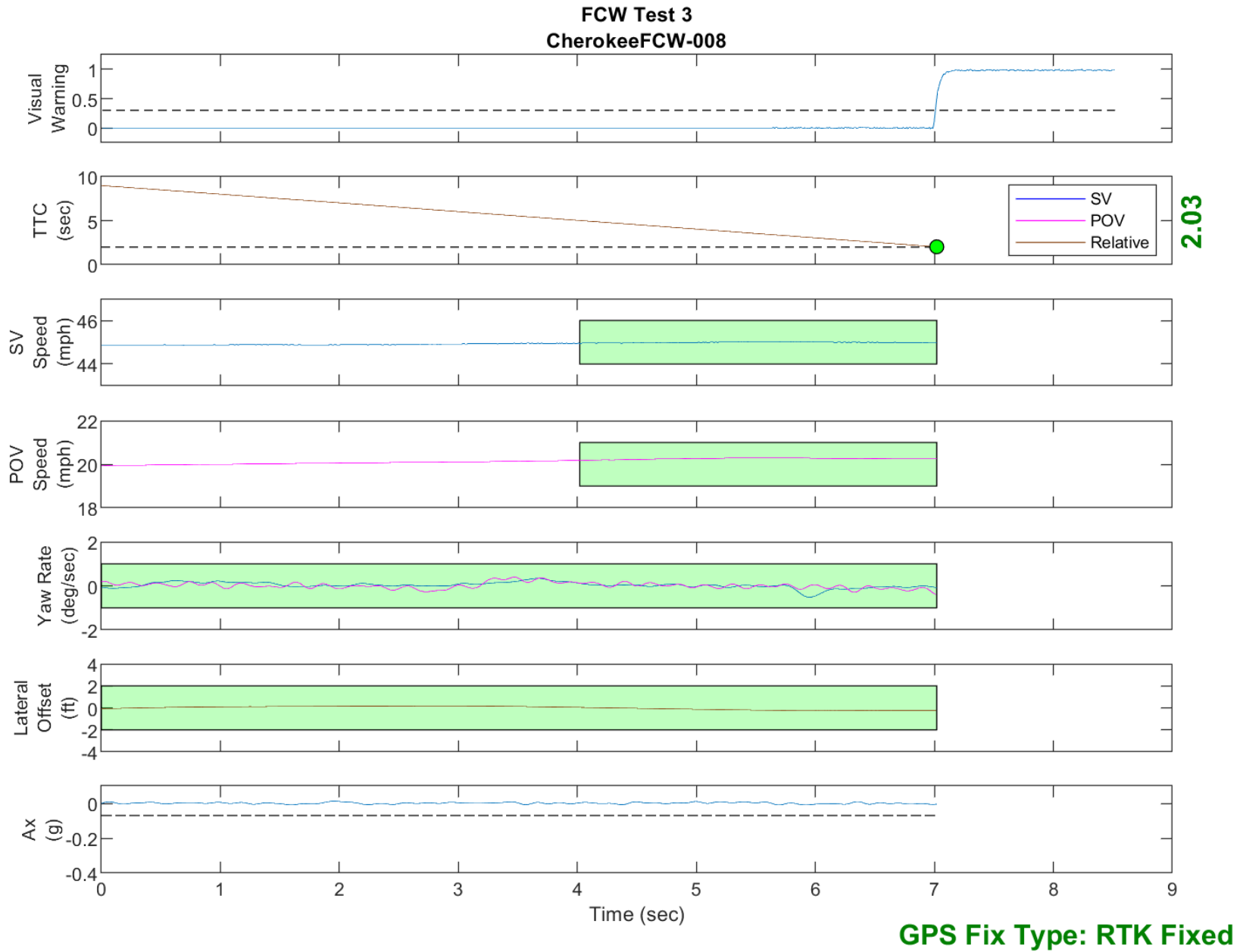


Figure D36. Time History for Run 08, FCW Test 3, Visual Warning

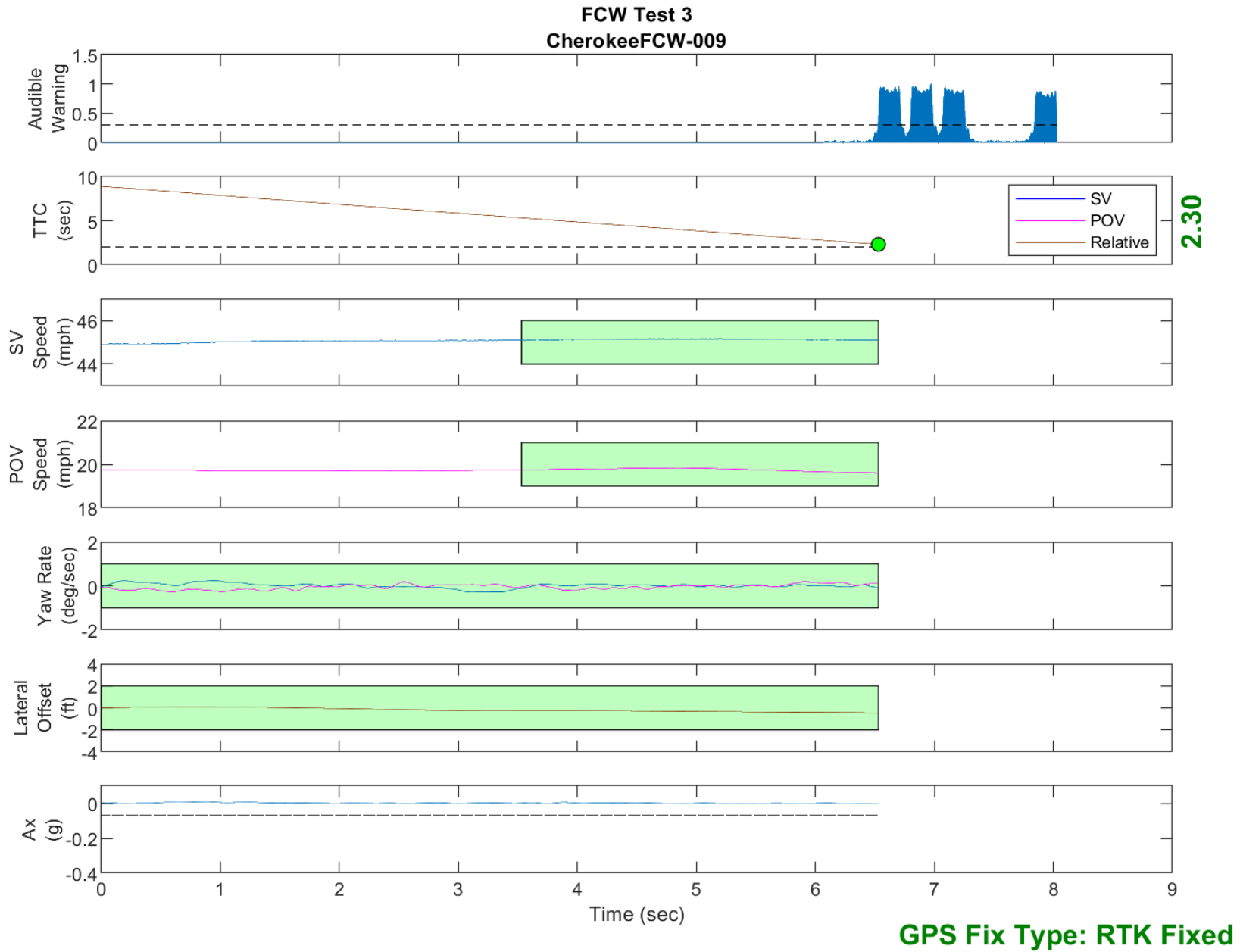


Figure D37. Time History for Run 09, FCW Test 3, Audible Warning

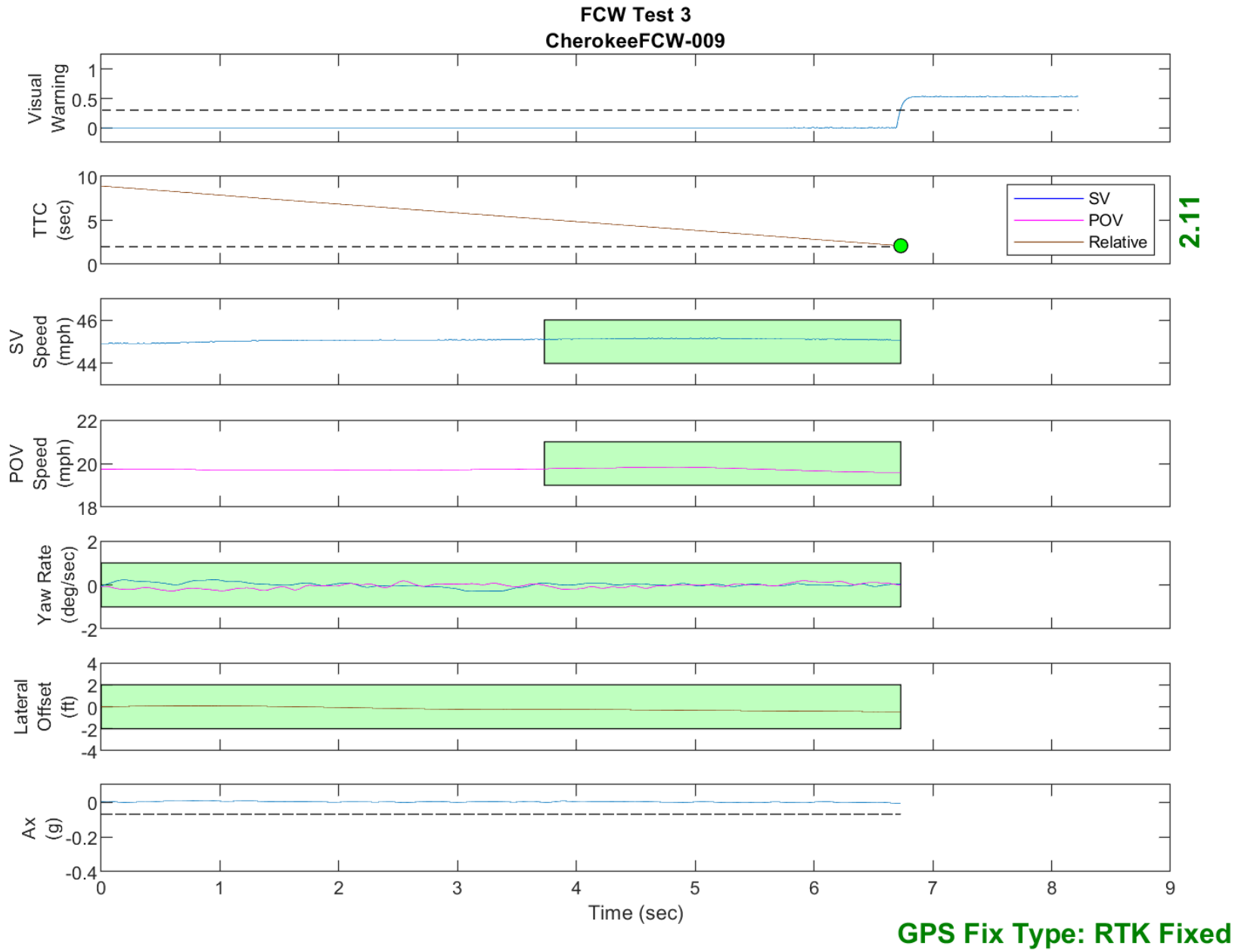


Figure D38. Time History for Run 09, FCW Test 3, Visual Warning

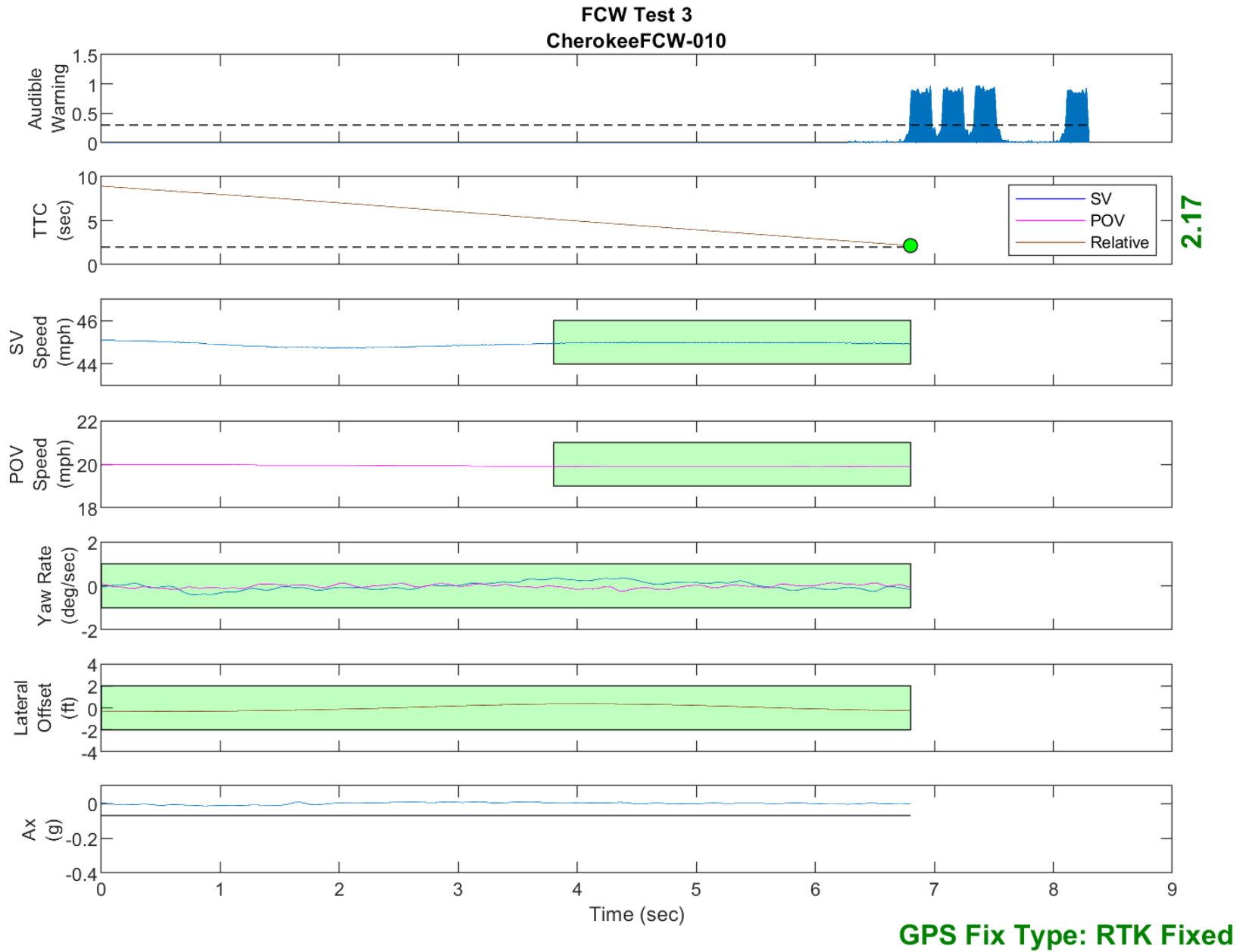


Figure D39. Time History for Run 10, FCW Test 3, Audible Warning



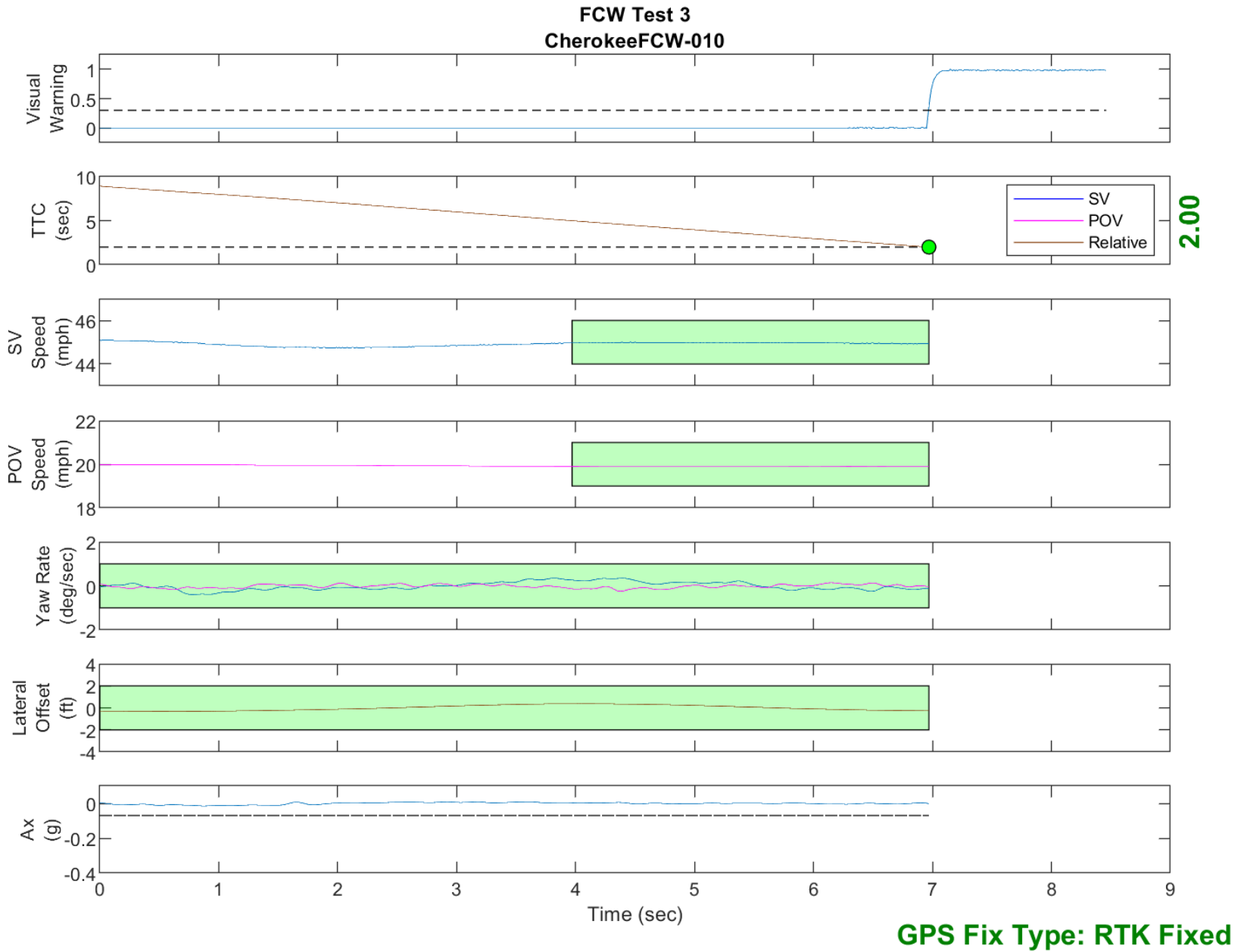


Figure D40. Time History for Run 10, FCW Test 3, Visual Warning

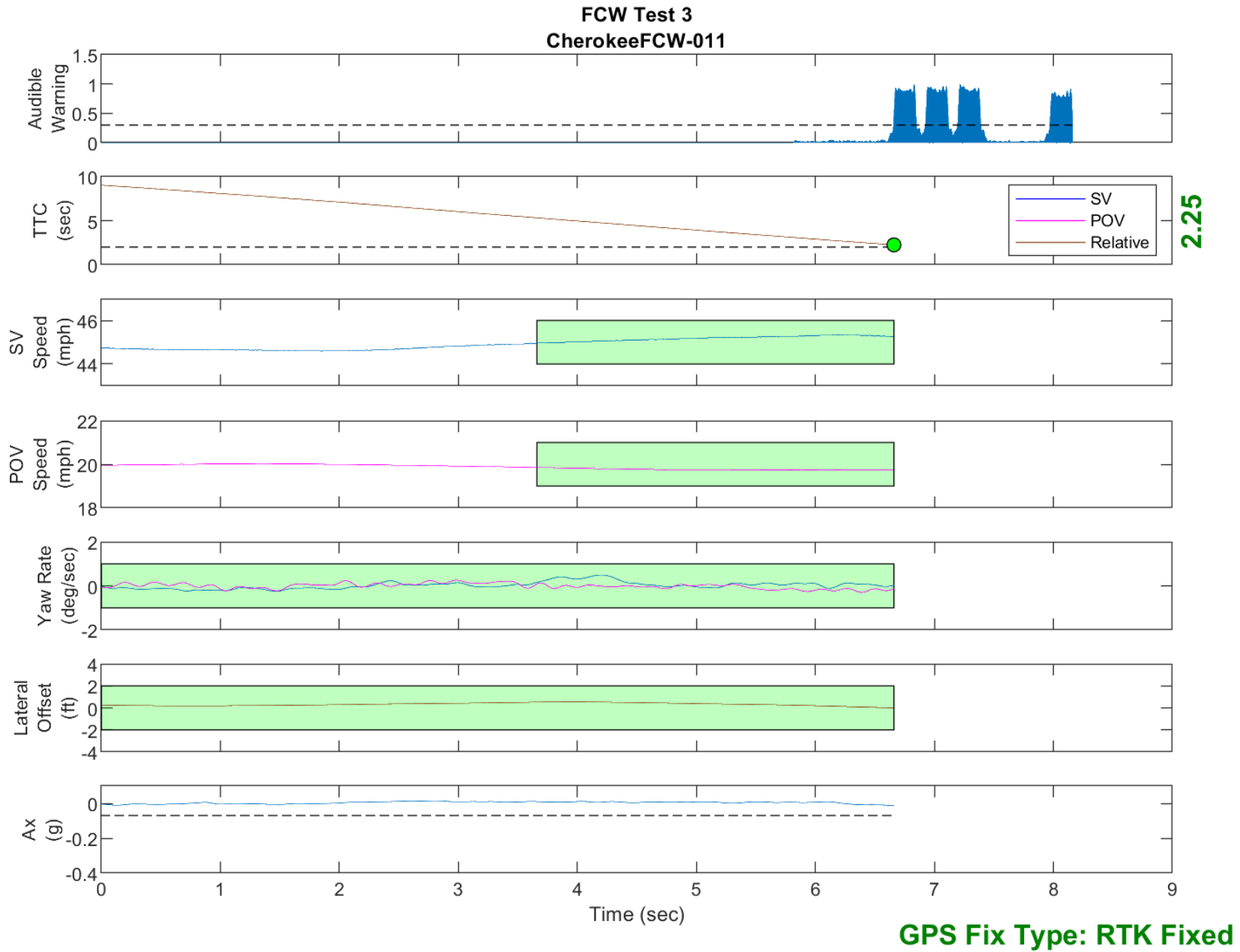


Figure D41. Time History for Run 11, FCW Test 3, Audible Warning

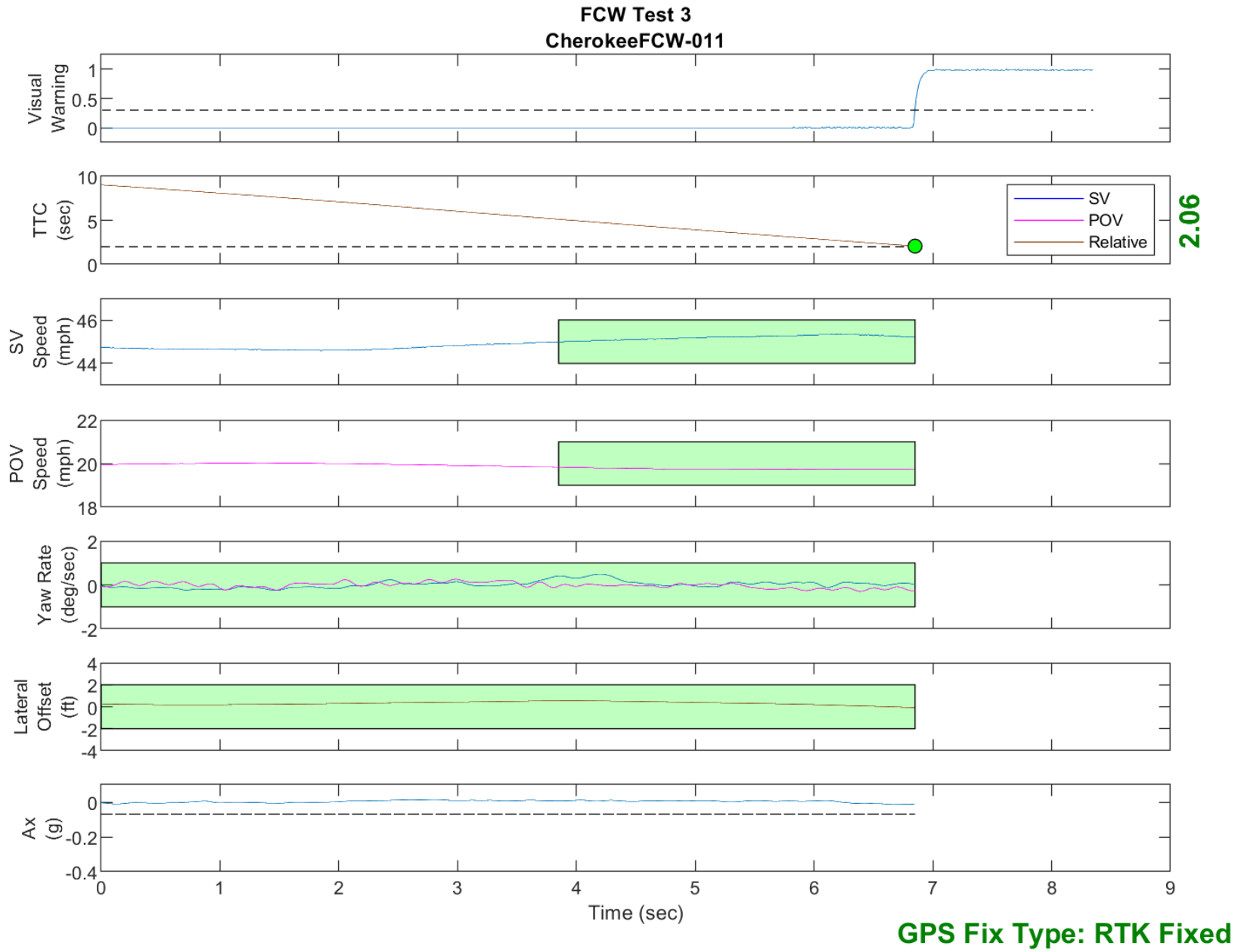


Figure D42. Time History for Run 11, FCW Test 3, Visual Warning

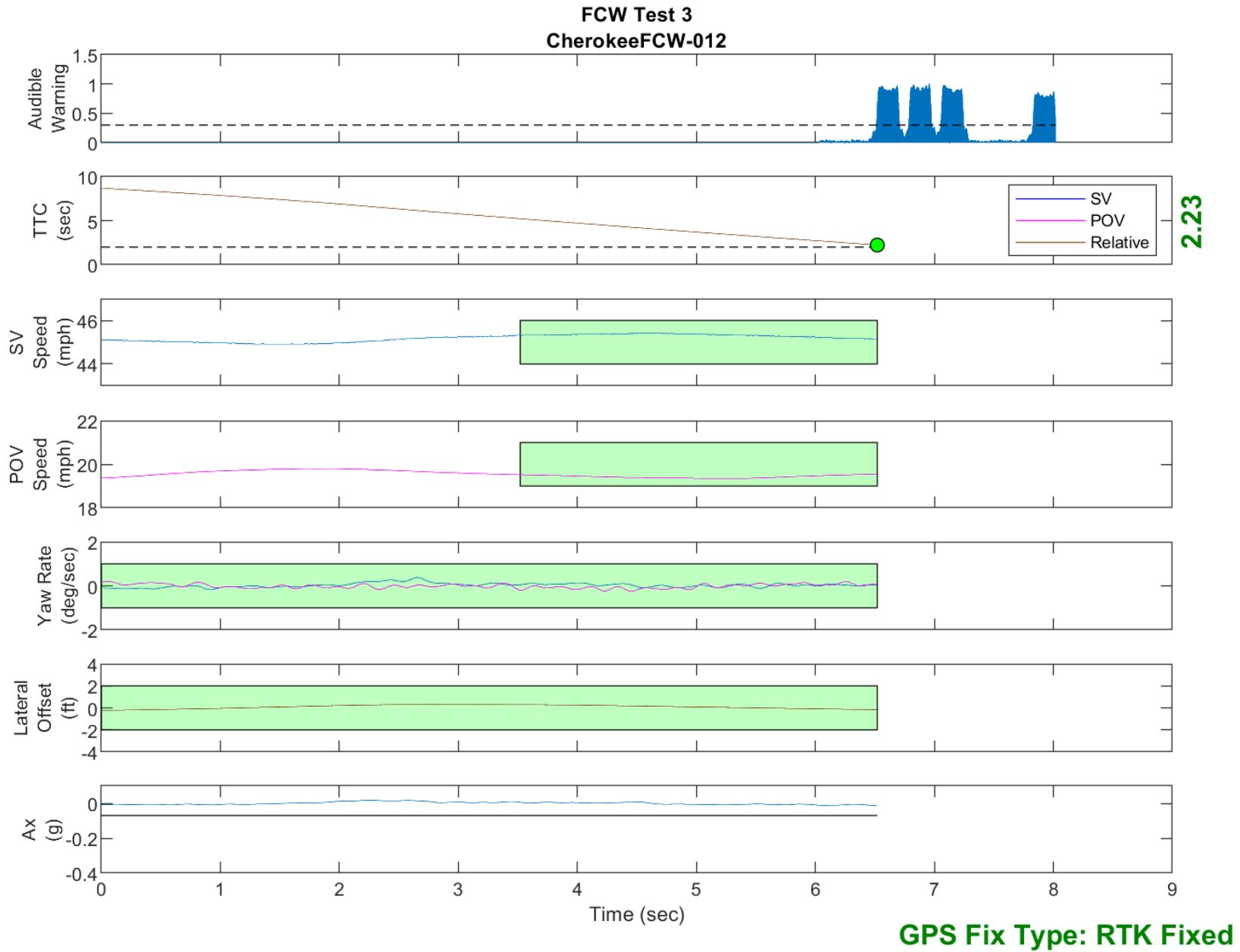


Figure D43. Time History for Run 12, FCW Test 3, Audible Warning

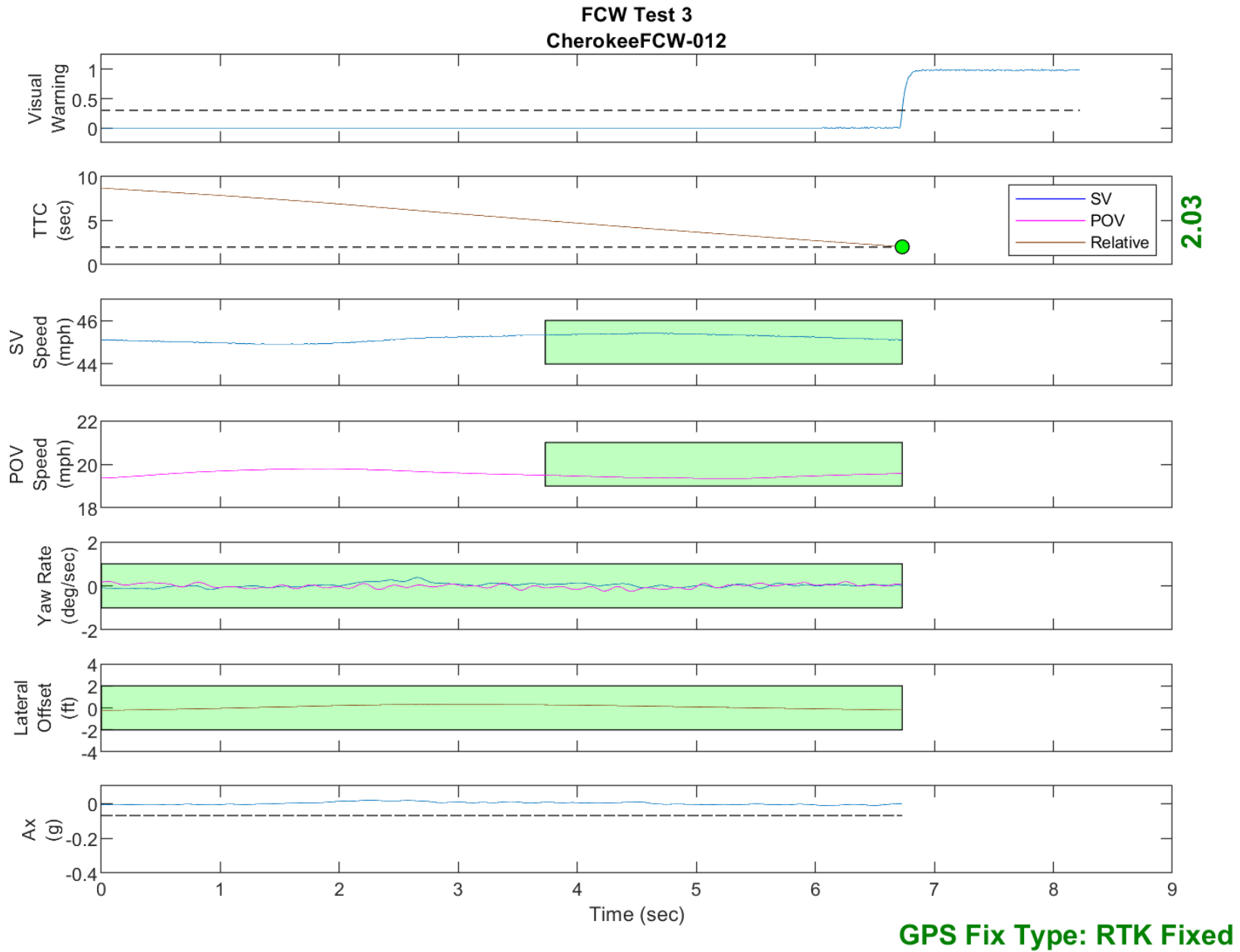


Figure D44. Time History for Run 12, FCW Test 3, Visual Warning

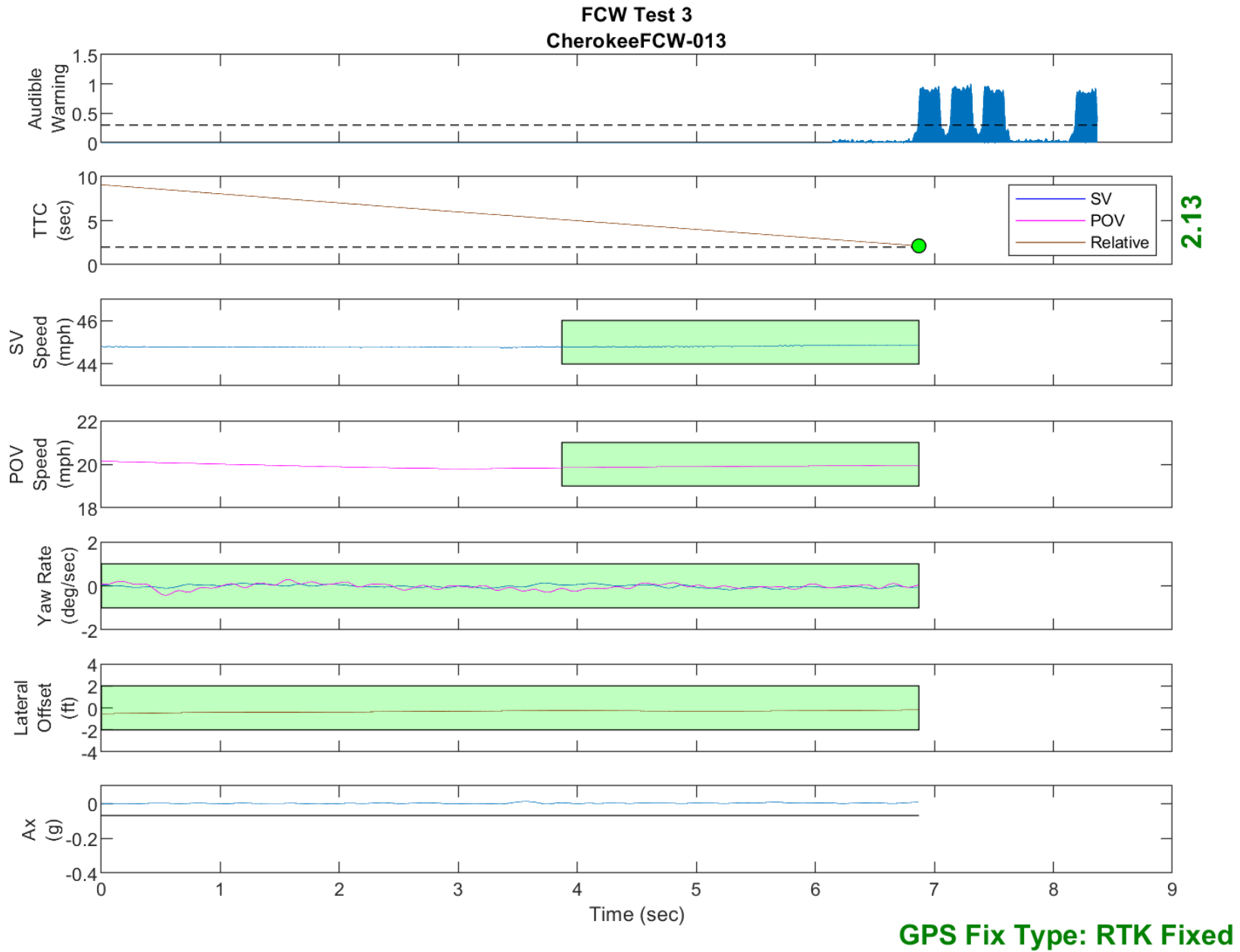


Figure D45. Time History for Run 13, FCW Test 3, Audible Warning

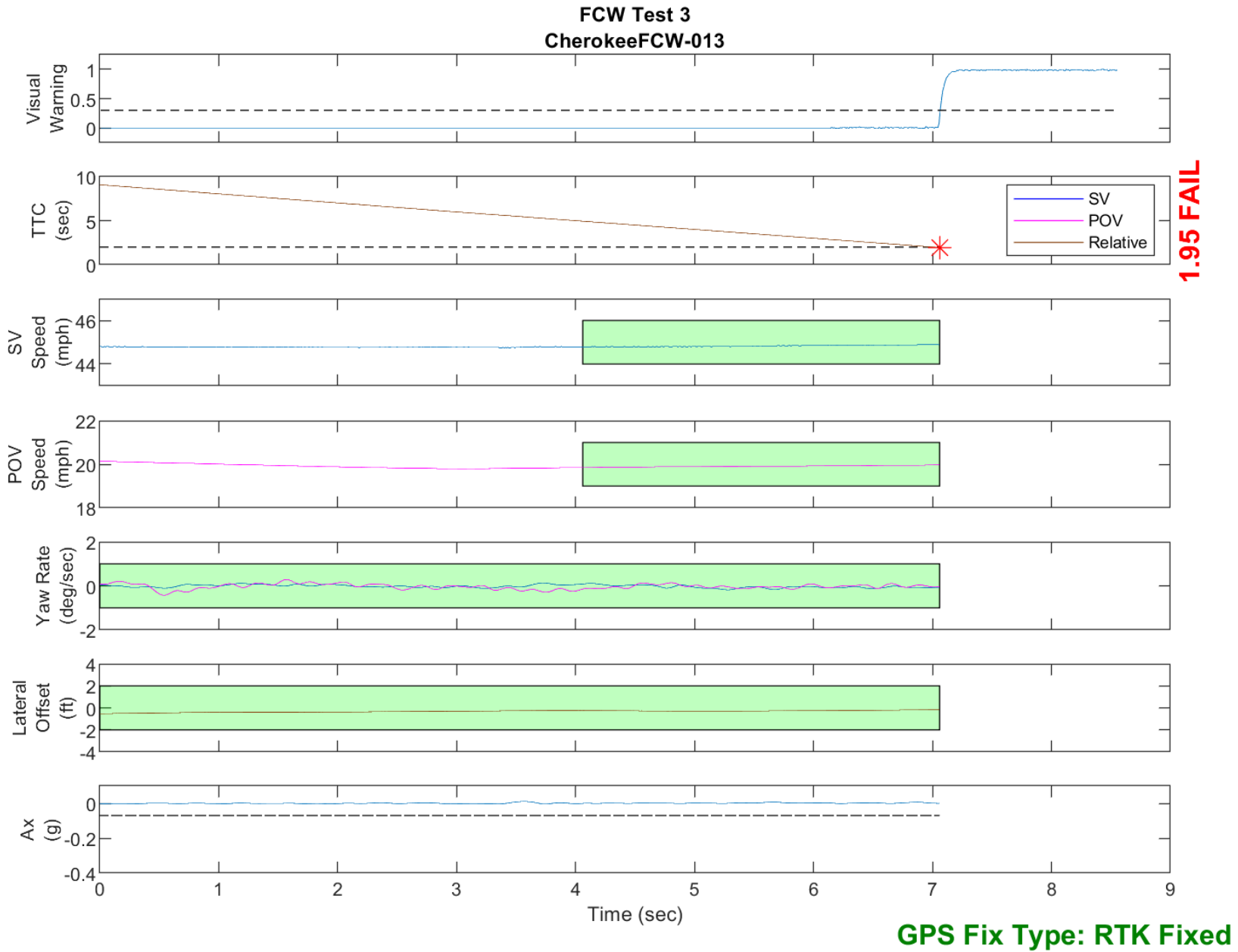


Figure D46. Time History for Run 13, FCW Test 3, Visual Warning



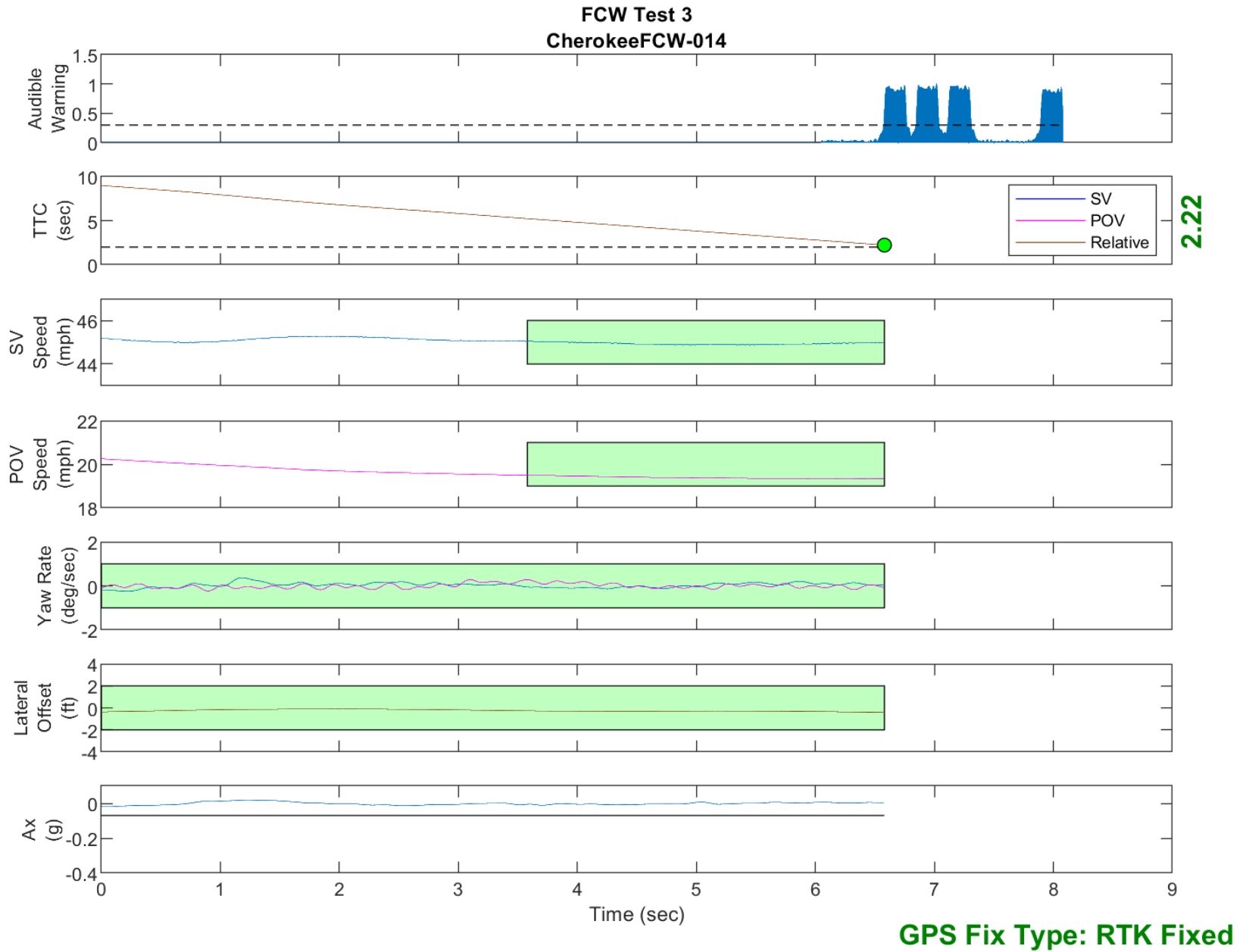


Figure D47. Time History for Run 14, FCW Test 3, Audible Warning

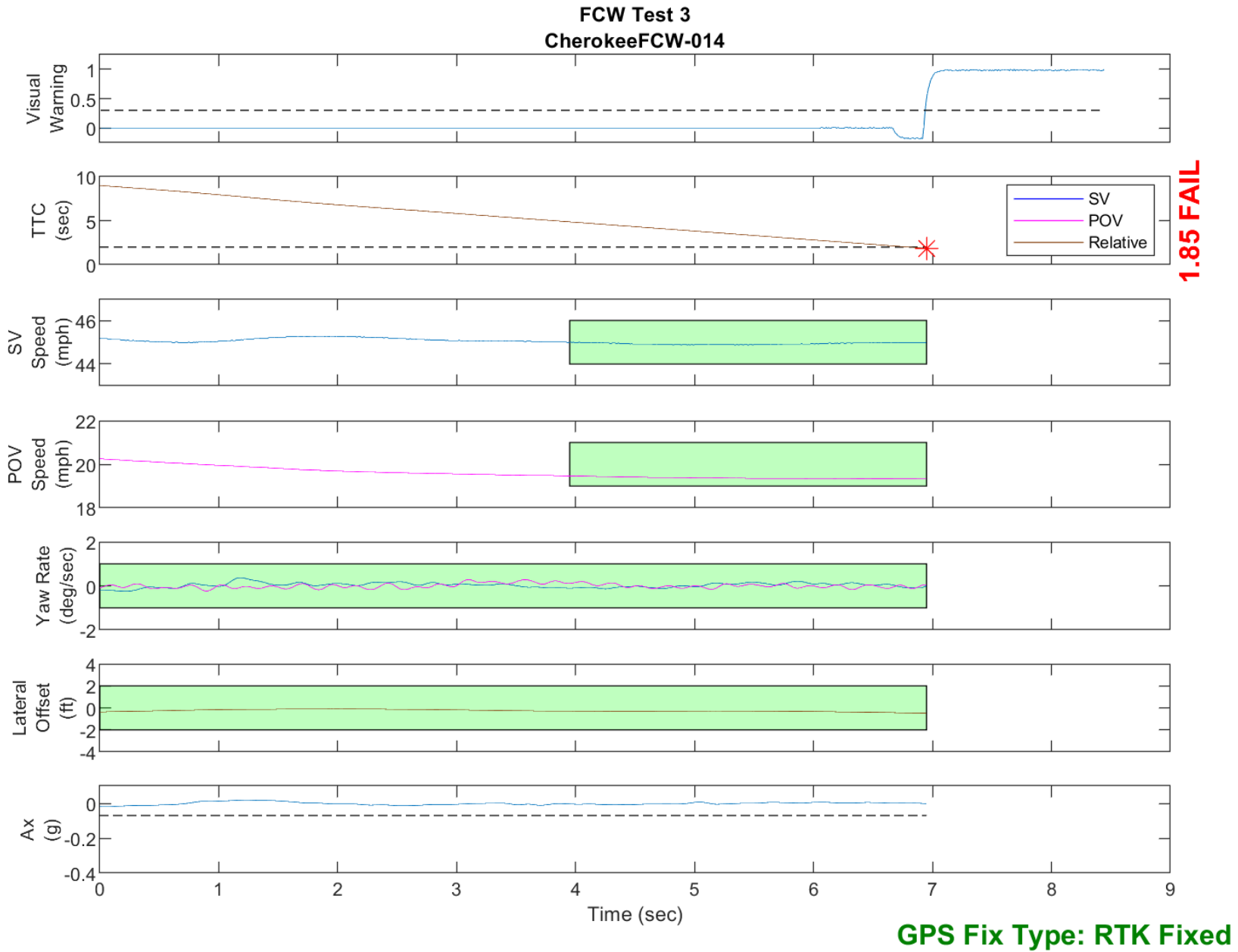


Figure D48. Time History for Run 14, FCW Test 3, Visual Warning