NEW CAR ASSESSMENT PROGRAM
FORWARD COLLISION WARNING CONFIRMATION TEST
NCAP-DRI-FCW-20-21

2020 Mercedes-Benz GLC 300 4Matic SUV

DYNAMIC RESEARCH, INC.
355 Van Ness Avenue, STE 200
Torrance, California 90501

11 August 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, 4th Floor (NRM-110)
Washington, DC 20590

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

Prepared By: J. Lenkeit and A. Ricci

Program Manager Test Engineer

Date: 11 August 2020

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16. Abstract These tests were conducted on the subject 2020 Mercedes-Benz GLC 300 4Matic SUV 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 Principal Other Vehicle (POV) in the same lane of travel. The second test begins with the SV initially following the POV at the same constant speed. After a short while, the POV stops suddenly. The third test consists of the SV, traveling at a constant speed, approaching a slower moving POV, which is also being driven at a constant speed.

Section II

DATA SHEETS

FORWARD COLLISION WARNING

DATA SHEET 1: TEST RESULTS SUMMARY

(Page 1 of 1)

2020 Mercedes-Benz GLC 300 4Matic SUV

VIN: *WDC0G8EB8LF72xxxx*

Test Date: *6/17/2020*

Forward Collision Warning setting: *Early*

Test 1 –	Subject Vehicle Encounters Stopped Principal Other Vehicle:	***Pass***
Test 2 –	Subject Vehicle Encounters Decelerating Principal Other Vehicle:	***Pass***
Test 3 –	Subject Vehicle Encounters Slower Principal Other Vehicle:	***Pass***

Overall: ***Pass***

Notes:

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2020 Mercedes-Benz GLC 300 4Matic SUV

TEST VEHICLE INFORMATION

VIN: *WDC0G8EB8LF72xxxx*

Body Style: *SUV* Color: *Brilliant Blue Metallic*

Date Received: *6/1/2020* Odometer Reading: *94 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Daimler AG Stuttgart*

Date of manufacture: *09/19*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *235/60R18*

Rear: *235/60R18*

Recommended cold tire pressure: Front: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

TIRES

Tire manufacturer and model: *Pirelli Scorpion Verde All Season*

Front tire specification: *235/60R18 103H*

Rear tire specification: *235/60R18 103H*

Front tire DOT prefix: *93 K3 T899*

Rear tire DOT prefix: *93 K3 T899*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Mercedes-Benz GLC 300 4Matic SUV

GENERAL INFORMATION

Test date: *6/17/2020*

AMBIENT CONDITIONS

Air temperature: *22.2 C (72 F)*

Wind speed: *1.5 m/s (3.5 mph)*

X Wind speed ≤ 10 m/s (22 mph).

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

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

VEHICLE PREPARATION

Verify the following:

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

Fuel tank is full: **X**

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

Front: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS

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2020 Mercedes-Benz GLC 300 4Matic SUV

WEIGHT

Weight of vehicle as tested including driver and instrumentation:

Left Front:	*514.8 kg (1135 lb)*	Right Front:	*509.4 kg (1123 lb)*
Left Rear:	*469.0 kg (1034 lb)*	Right Rear:	*469.9 kg (1036 lb)*
		Total:	*1963.1 kg (4328 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 1 of 3)

2020 Mercedes-Benz GLC 300 4Matic SUV

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

Active Brake Assist; a component of option package DA2, Driver Assistance Package

Forward Collision Warning Setting used in test: *Early*

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

Radar located behind the star emblem in the front grill.

Stereo camera located behind the windshield near the rearview mirror.

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

- [X] Warning light
- [X] Buzzer or audible alarm
- [ ] Vibration
- [ ] Other _____

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

If Active Brake Assist has detected a risk of collision, a warning tone sounds and the distance warning lamp lights up in the instrument cluster. The distance warning light is shown in the upper portion of the speedometer and depicts a front view of a vehicle inside a triangle. See the Owner's Manual, Pages 10 and 562, shown in Appendix B, Pages B-2 and B-14.

The auditory warning is a 2000 Hz tone having a pulse width of approximately 1/3 second.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2020 Mercedes-Benz GLC 300 4Matic SUV

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

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

Controls on the right side of the steering wheel or a touch pad located in the center console can be used to interact with the multimedia system menus. The hierarchy is:

Settings

Assistance

Active Brake Assist.

Select "Off" to disable

See Appendix A, Figures A12 and A13

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

If yes, please provide a full description.

The sensitivity of the system can be adjusted. Controls on the right side of the steering wheel or a touch pad located in the center console can be used to interact with the multimedia system menus. The hierarchy is:

Settings

Assistance

Active Brake Assist.

Select Early – Medium (default) – Late – Off

See Appendix A, Figures A12 and A13

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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

If yes, please provide a full description.

The system may be impaired or may not function in the following situations:

- *In snow, rain, fog, heavy spray, if there is glare, in direct sunlight or in greatly varying ambient light.*
- *If the sensors are dirty, fogged up, damaged or covered.*
- *If the sensors are impaired due to interference from other radar sources, e.g. strong radar reflections in parking garages.*
- *If a loss of tire pressure or a faulty tire has been detected and displayed.*
- *If Downhill Speed Regulation (DSR) is activated.*
- *In complex traffic situations where objects cannot always be clearly identified.*
- *If pedestrians or vehicles move quickly into the sensor detection range.*
- *If pedestrians are hidden by other objects.*
- *If the typical outline of a pedestrian cannot be distinguished from the background.*
- *If a pedestrian is not detected as such, e.g. due to special clothing or other objects.*
- *On bends with a tight radius.*

See Appendix B, Pages B-9 to B-10 (Owner's Manual, Pages 196-197).

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.

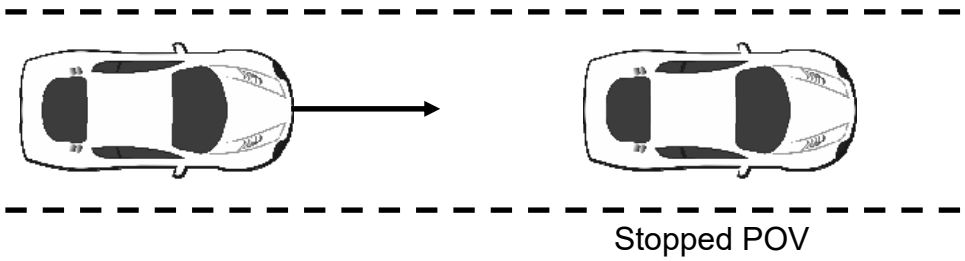


Figure 1. Depiction of Test 1

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 ±1 deg/sec during the test.

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

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

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

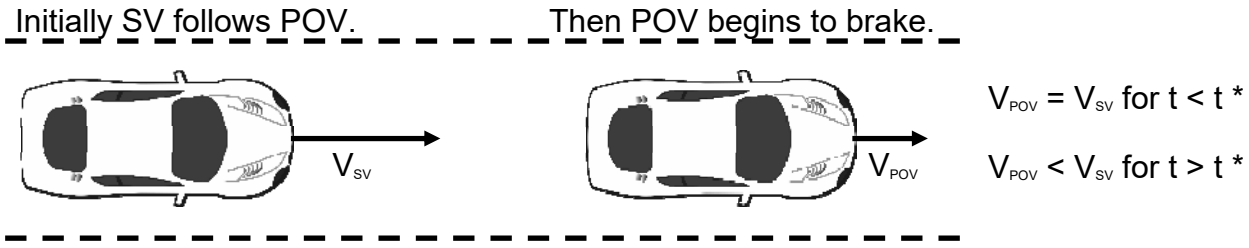


Figure 2. Depiction of Test 2

a. Alert Criteria

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

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.

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

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

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

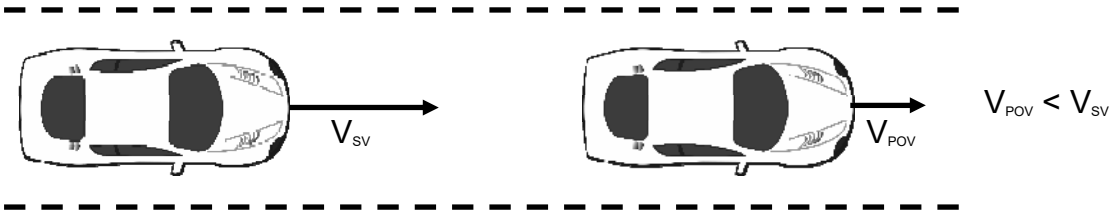


Figure 3. Depiction of Test 3

a. Alert Criteria

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

b. Procedure

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

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

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

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

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

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

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

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

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

B. Principal Other Vehicle

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

C. Automatic Braking System

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

- 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	2200 lb/platform	0.1% of reading	Intercomp SW wireless	0410MN20001	By: DRI Date: 4/20/2020 Due: 4/20/2021
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 Rate ±100 deg/s, Angle >45 deg, Velocity >200 km/h	Accels .01g, Angular Rate 0.05 deg/s, Angle 0.05 deg, Velocity 0.1 km/h			By: Oxford Technical Solutions
				SV: Oxford Inertial +	2258	Date: 5/3/2019 Due: 5/3/2021
				POV: Oxford Inertial +	2182	Date: 9/16/2019 Due: 9/16/2021
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: 1/6/2020 Due: 1/6/2021

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 band-pass filter used for these warning signal types is a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 2.

Table 2. Audible and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Passband Frequency Range
Audible	5^{th}	3 dB	60 dB	Identified Center Frequency ± 5%
Tactile	5^{th}	3 dB	60 dB	Identified Center Frequency ± 20%

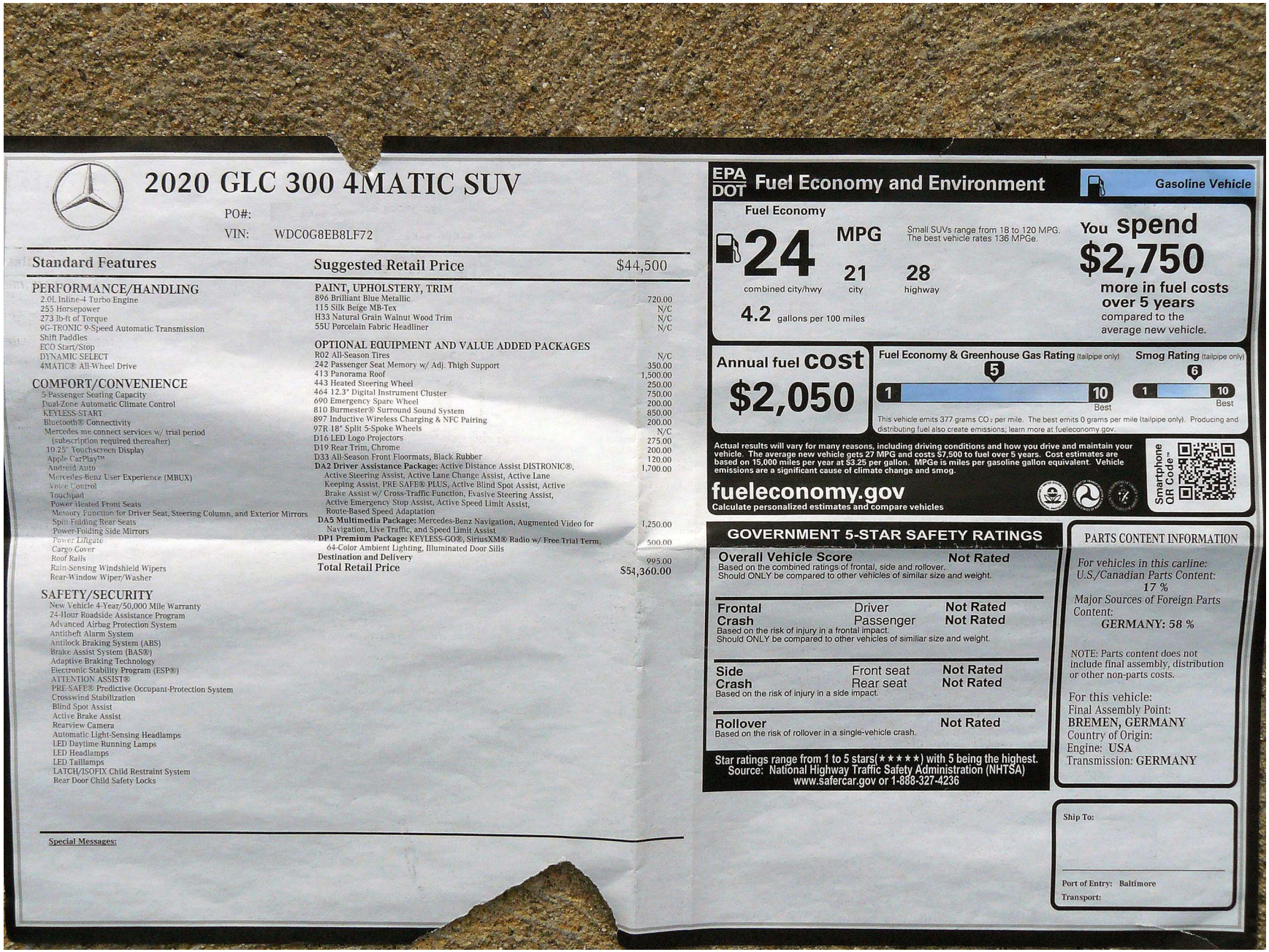
APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle



2020 GLC 300 4MATIC SUV

PO#:

VIN: WDC0G8EB8LF72

Standard Features

PERFORMANCE/HANDLING
- 2.0L Inline-4 Turbo Engine
- 255 Horsepower
- 273 lb-ft of Torque
- 9G-TRONIC 9-Speed Automatic Transmission
- Shift Paddles
- ECO Start/Stop
- DYNAMIC SELECT
- 4MATIC® All-Wheel Drive

COMFORT/CONVENIENCE
- 5-Passenger Seating Capacity
- Dual-Zone Automatic Climate Control
- KEYLESS-START
- Bluetooth® Connectivity
- Mercedes me connect services w/ trial period (subscription required thereafter)
- 10.25" Touchscreen Display
- Apple CarPlay™
- Android Auto
- Mercedes-Benz User Experience (MBUX)
- Voice Control
- Touchpad
- Power Heated Front Seats
- Memory Function for Driver Seat, Steering Column, and Exterior Mirrors
- Split Folding Rear Seats
- Power-Folding Side Mirrors
- Power Liftgate
- Cargo Cover
- Roof Rails
- Rain-Sensing Windshield Wipers
- Rear-Window Wiper/Washer

SAFETY/SECURITY
- New Vehicle 4-Year/50,000 Mile Warranty
- 24-Hour Roadside Assistance Program
- Advanced Airbag Protection System
- Antitheft Alarm System
- Antilock Braking System (ABS)
- Brake Assist System (BAS®)
- Adaptive Braking Technology
- Electronic Stability Program (ESP®)
- ATTENTION ASSIST®
- PRE-SAFE® Predictive Occupant-Protection System
- Crosswind Stabilization
- Blind Spot Assist
- Active Brake Assist
- Rearview Camera
- Automatic Light-Sensing Headlamps
- LED Daytime Running Lamps
- LED Headlamps
- LED Taillamps
- LATCH/ISOFIX Child Restraint System
- Rear Door Child Safety Locks

Suggested Retail Price $44,500

PAINT, UPHOLSTERY, TRIM

896 Brilliant Blue Metallic	720.00
115 Silk Beige MB-Tex	N/C
H33 Natural Grain Walnut Wood Trim	N/C
55U Porcelain Fabric Headliner	N/C

OPTIONAL EQUIPMENT AND VALUE ADDED PACKAGES

R02 All-Season Tires	N/C
242 Passenger Seat Memory w/ Adj. Thigh Support	350.00
413 Panorama Roof	1,500.00
443 Heated Steering Wheel	250.00
464 12.3" Digital Instrument Cluster	750.00
690 Emergency Spare Wheel	200.00
810 Burmester® Surround Sound System	850.00
897 Inductive Wireless Charging & NFC Pairing	200.00
97R 18" Split 5-Spoke Wheels	N/C
D16 LED Logo Projectors	275.00
D19 Rear Trim, Chrome	200.00
D33 All-Season Front Floormats, Black Rubber	120.00
DA2 Driver Assistance Package: Active Distance Assist DISTRONIC®, Active Steering Assist, Active Lane Change Assist, Active Lane Keeping Assist, PRE-SAFE® PLUS, Active Blind Spot Assist, Active Brake Assist w/ Cross-Traffic Function, Evasive Steering Assist, Active Emergency Stop Assist, Active Speed Limit Assist, Route-Based Speed Adaptation	1,700.00
DA5 Multimedia Package: Mercedes-Benz Navigation, Augmented Video for Navigation, Live Traffic, and Speed Limit Assist	1,250.00
DP1 Premium Package: KEYLESS-GO®, SiriusXM® Radio w/ Free Trial Term, 64-Color Ambient Lighting, Illuminated Door Sills	500.00
Destination and Delivery	995.00
Total Retail Price	$54,360.00

Special Messages:

EPA DOT Fuel Economy and Environment

Gasoline Vehicle

Fuel Economy

24 MPG combined city/hwy

21 city

28 highway

Small SUVs range from 18 to 120 MPG. The best vehicle rates 136 MPGe.

4.2 gallons per 100 miles

You **spend $2,750** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost $2,050

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 – 10, Best)

Smog Rating (tailpipe only): 6 (1 – 10, Best)

This vehicle emits 377 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions; learn more at fueleconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs $7,500 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $3.25 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score — Not Rated
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: Not Rated; Passenger: Not Rated
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: Not Rated; Rear seat: Not Rated
Based on the risk of injury in a side impact.

Rollover — Not Rated
Based on the risk of rollover in a single-vehicle crash.

Star ratings range from 1 to 5 stars(★★★★★) with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

PARTS CONTENT INFORMATION

For vehicles in this carline:
U.S./Canadian Parts Content:
17 %
Major Sources of Foreign Parts Content:
GERMANY: 58 %

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

For this vehicle:
Final Assembly Point:
BREMEN, GERMANY
Country of Origin:
Engine: **USA**
Transmission: **GERMANY**

Ship To:

Port of Entry: **Baltimore**
Transport:

Figure A3. Window Sticker (Monroney Label)

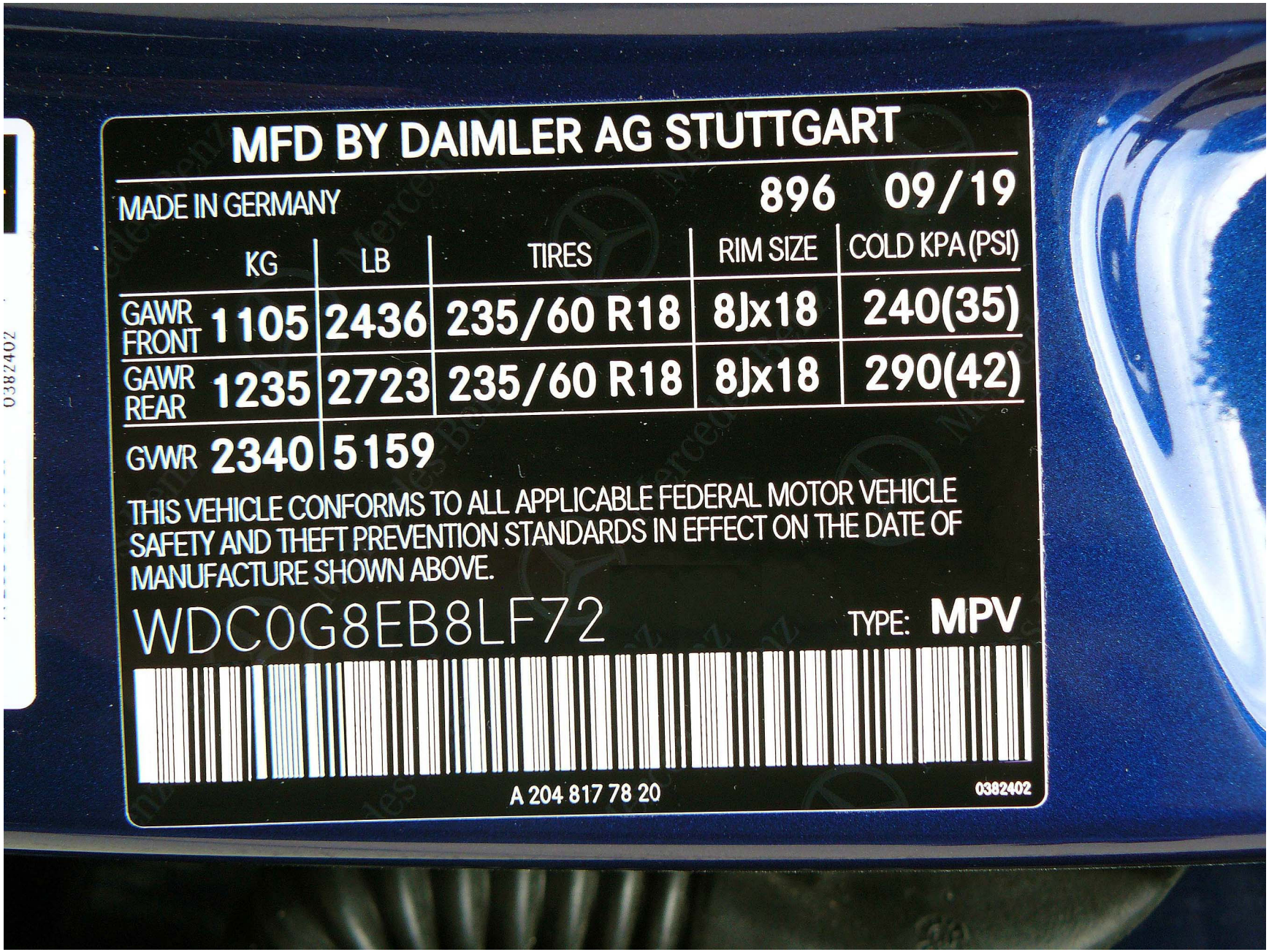


Figure A4. Vehicle Certification Label

Figure A5. Tire Placard

Figure A6. Front View of Principal Other Vehicle

Figure A7. Rear View of Principal Other Vehicle

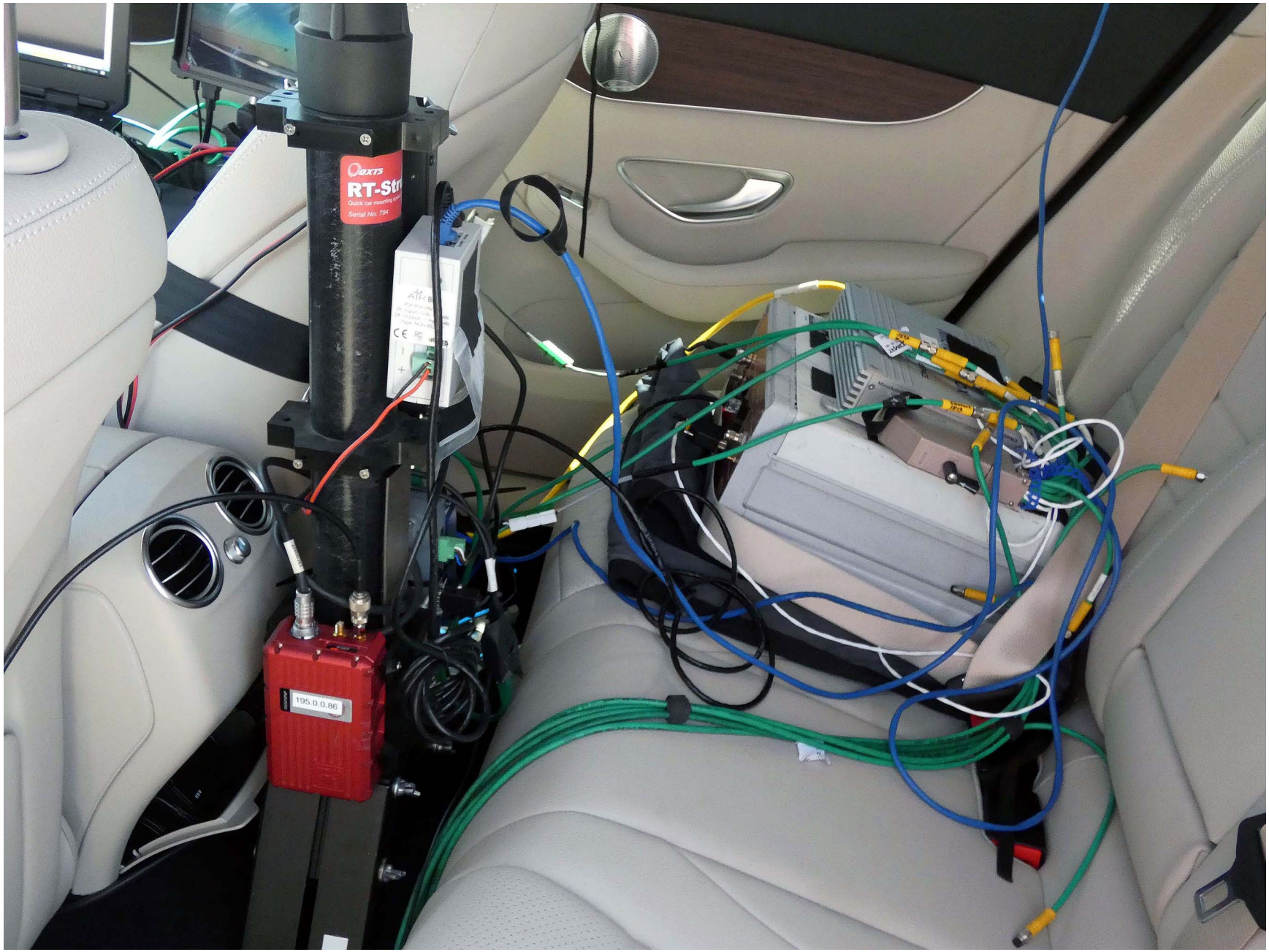


Figure A8. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A9. Sensors for Detecting Auditory and Visual Alerts

Figure A10. Computer Installed in Subject Vehicle

Figure A11. Brake Actuation System Installed in Principal Other Vehicle

Figure A12. System Setup Menus

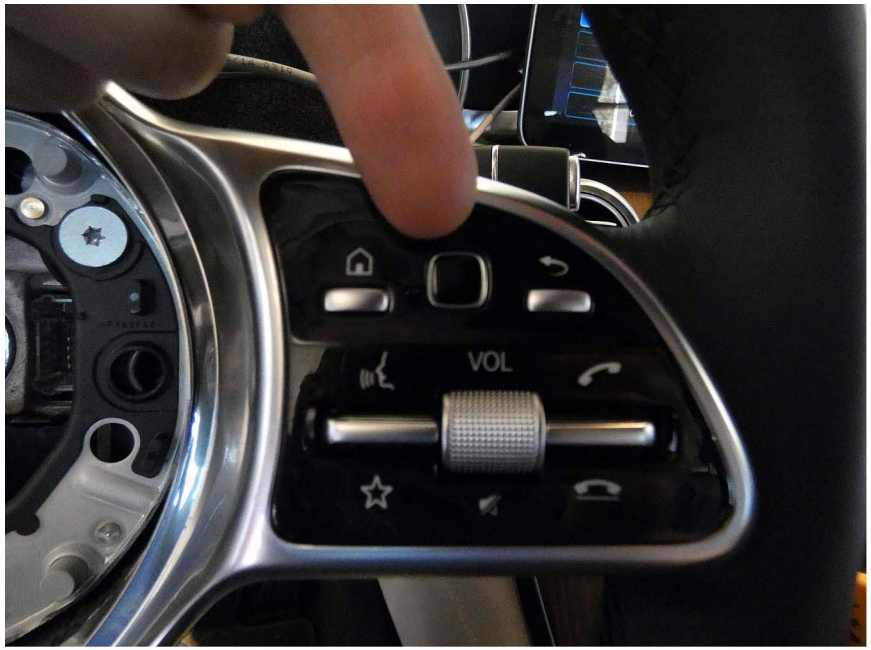
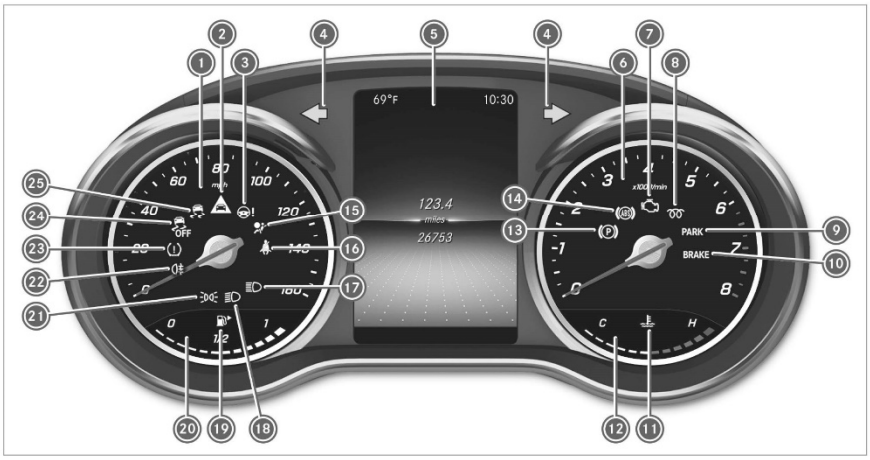


Figure A13. Controls for Changing System Parameters

APPENDIX B

Excerpts from Owner’s Manual



Instrument Display (standard)

- The engine is switched off.

Multimedia system:

→ ⌂ ▸▸ Settings ▸▸ Vehicle

▶ Switch Standby Mode on or off.
When you activate the function, a prompt appears.

▶ Select Yes.
Standby mode is activated.

Driving and driving safety systems

Driving systems and your responsibility

Your vehicle is equipped with driving systems which assist you in driving, parking and maneuvering the vehicle. The driving systems are aids and do not relieve you of your responsibility pertaining to road traffic law. Pay attention to the traffic conditions at all times and intervene when necessary. Be aware of the limitations regarding the safe use of these systems.

Information on radar and ultrasonic sensors

Some driving and driving safety systems use radar or ultrasonic sensors to monitor the area in front of, behind or next to the vehicle (depending on the vehicle's equipment).

Depending on the vehicle's equipment, the radar sensors are integrated behind the bumpers and/or behind the Mercedes star. The ultrasonic sensors are located in the front and rear bumpers. Keep these parts free of dirt, ice and slush (→ page 433). The sensors must not be covered, for example by bicycle racks, overhanging loads, stickers, foil or foils to protect against stone chipping. Additional license plate brackets can likewise impair the function of the ultrasonic sensors. In the event of damage to the bumpers or radiator grill, or following a collision impacting the bumpers or radiator grill, have the function of the sensors checked at a qualified specialist workshop. If the sensors are damaged, some driving systems and driving safety systems may no longer function properly.

Overview of driving systems and driving safety systems

In this section, you will find information about the following driving systems and driving safety systems:

- 360° Camera (→ page 228)
- ABS (**A**nti-lock **B**raking **S**ystem) (→ page 185)
- Active Distance Assist DISTRONIC (→ page 201)
- AIR BODY CONTROL (→ page 214)
- Active Brake Assist (→ page 191)
- Active Lane Keeping Assist (→ page 245)
- ATTENTION ASSIST (→ page 238)
- BAS (**B**rake **A**ssist **S**ystem) (→ page 186)
- Hill Start Assist (→ page 213)
- DSR (**D**ownhill **S**peed **R**egulation) (→ page 199)
- EBD (**E**lectronic **B**rakeforce **D**istribution) (→ page 191)

Function of ESP® trailer stabilization

WARNING Risk of accident in poor road and weather conditions

In poor road and weather conditions, the trailer stabilization cannot prevent lurching of the vehicle/trailer combination. Trailers with a high center of gravity may tip over before ESP® detects this.

▶ Always adapt your driving style to suit the current road and weather conditions.

When driving with a trailer, ESP® can stabilize your vehicle if the trailer begins to swerve from side to side:

- ESP® trailer stabilization is active above speeds of 40 mph (65 km/h).
- Slight swerving is reduced by means of a targeted, individual brake application on one side.
- In the event of severe swerving, the engine output is also reduced and all wheels are braked.

ESP® trailer stabilization may be impaired or may not function if:

- The trailer is not connected correctly or is not detected properly by the vehicle.

Function of EBD (electronic brake force distribution)

EBD is characterized by the following:

- Monitoring and regulating the brake pressure on the rear wheels.
- Improved driving stability when braking, especially on bends.

Function of STEER CONTROL

STEER CONTROL helps you by transmitting a noticeable steering force to the steering wheel in the direction required for vehicle stabilization.

This steering recommendation is given particularly in the following situations:

- Both right wheels or both left wheels are on a wet or slippery road surface when you brake
- The vehicle starts to skid

System limits

STEER CONTROL may be impaired or may not function in the following situations:

- ESP® is deactivated.
- ESP® is malfunctioning.
- The steering is malfunctioning.

If ESP® is malfunctioning, you will be assisted further by the electric power steering.

Function of Active Brake Assist

Active Brake Assist consists of the following functions:

- Distance warning function
- Autonomous braking function

- Situation-dependent braking assistance
- **Vehicles with Driving Assistance Package:** Evasive Steering Assist and cornering function

Active Brake Assist can help you to minimize the risk of a collision with vehicles, cyclists or pedestrians, or reduce the effects of such a collision.

If Active Brake Assist has detected a risk of collision, a warning tone sounds and the distance warning lamp lights up in the instrument cluster.

If you do not react to the warning, autonomous braking can be initiated in critical situations.

In especially critical situations, Active Brake Assist can initiate autonomous braking directly. In this case, the warning lamp and warning tone occur simultaneously with the braking application.

If you apply the brake yourself in a critical situation or apply the brake during autonomous braking, situation-dependent braking assistance occurs. The brake pressure increases up to maximum full-stop braking if necessary.

If autonomous braking or situation-dependent braking assistance has occurred, display ⓘ appears in the multifunction display and then automatically goes out after a short time.

If the autonomous braking function or the situation-dependent braking assistance is triggered, additional preventive measures for occupant protection (PRE-SAFE®) may also be initiated.

⚠ **WARNING** Risk of an accident caused by limited detection performance of Active Brake Assist

Active Brake Assist cannot always clearly identify objects and complex traffic situations.

In such cases, Active Brake Assist might:

- Give a warning or brake without reason
- Not give a warning or not brake

▶ Always pay careful attention to the traffic situation; do not rely on Active Brake Assist alone. Active Brake Assist is only an aid. The driver is responsible for maintaining a suitable distance to the vehicle in front, vehicle speed and for braking in good time.

▶ Be prepared to brake or swerve if necessary.

ⓘ If the system is unavailable, the OFF display appears in the multifunction display.

Also observe the system limits of Active Brake Assist.

The individual subfunctions are available in the following speed ranges:

The distance warning function issues a warning in the following situations:

- From approximately 4 mph (7 km/h), if your vehicle is critically close to a vehicle or pedestrian, you will hear an intermittent warning tone and the distance warning lamp lights up in the instrument cluster.

Brake immediately or take evasive action, provided it is safe to do so and the traffic situation allows this.

The distance warning function can aid you in the following situations with an intermittent warning tone and a warning lamp:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

The autonomous braking function may intervene at speeds starting from approximately 4 mph (7 km/h) in the following situations:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 124 mph (200 km/h)	Up to approx. 31 mph (50 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

Situation-dependent braking assistance may intervene at speeds starting from approximately 4 mph (7 km/h) in the following situations:

	Vehicles traveling in front	Stationary vehicles	Crossing vehicles	Moving pedestrians	Stationary pedestrians	Crossing cyclists	Cyclists traveling in front	Stationary cyclists
Vehicles without Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 50 mph (80 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	No reaction	Up to approx. 37 mph (60 km/h)	Up to approx. 50 mph (80 km/h)	No reaction
Vehicles with Driving Assistance Package	Up to approx. 155 mph (250 km/h)	Up to approx. 62 mph (100 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 43 mph (70 km/h)	Up to approx. 50 mph (80 km/h)	Up to approx. 43 mph (70 km/h)

Canceling a brake application of Active Brake Assist

You can cancel a brake application of Active Brake Assist at any time by:

- Fully depressing the accelerator pedal or with kickdown.
- Releasing the brake pedal.

Active Brake Assist may cancel the brake application when one of the following conditions is fulfilled:

- You maneuver to avoid the obstacle.
- There is no longer a risk of collision.
- An obstacle is no longer detected in front of your vehicle.

Evasive Steering Assist (only vehicles with Driving Assistance Package)

Evasive Steering Assist has the following characteristics:

- The ability to detect stationary or moving pedestrians.
- Assistance through power-assisted steering if it detects a swerving maneuver.

- Activation by an abrupt steering movement during a swerving maneuver.
- Assistance during swerving and straightening of the vehicle.
- Reaction from a speed of approximately 12 mph (20 km/h) up to a speed of approximately 43 mph (70 km/h).

You can prevent the assistance at any time by actively steering.

Cornering function (only vehicles with Driving Assistance Package)
If a danger of collision from an oncoming vehicle is detected when turning across an oncoming lane, autonomous braking can be initiated at speeds below 9 mph (15 km/h) before you have left the lane in which you are driving.

⚠ **WARNING** Risk of an accident despite Evasive Steering Assist

Evasive Steering Assist cannot always clearly identify objects and complex traffic situations.

In addition, the steering support of Evasive Steering Assist is generally not sufficient to avoid a collision.

In such cases Evasive Steering Assist can:

- give an unnecessary warning or provide assistance
- not give a warning or not provide assistance

▶ Always pay careful attention to the traffic situation; do not rely on Evasive Steering Assist alone.
▶ Be ready to brake and take evasive action if necessary.
▶ Prevent the assistance by actively steering in non-critical driving situations.
▶ Drive at an appropriate speed if pedestrians are close to the path of your vehicle.

System limits
Full system performance is not available for a few seconds after switching on the ignition or after driving off.

The system may be impaired or may not function in the following situations:

- In snow, rain, fog, heavy spray, if there is glare, in direct sunlight or in greatly varying ambient light.
- If the sensors are dirty, fogged up, damaged or covered.
- If the sensors are impaired due to interference from other radar sources, e.g. strong radar reflections in parking garages.
- If a loss of tire pressure or a faulty tire has been detected and displayed.
- If DSR is activated.
- In complex traffic situations where objects cannot always be clearly identified.
- If pedestrians or vehicles move quickly into the sensor detection range.
- If pedestrians are hidden by other objects.

- If the typical outline of a pedestrian cannot be distinguished from the background.
- If a pedestrian is not detected as such, e.g. due to special clothing or other objects.
- On bends with a tight radius.

ⓘ The Active Brake Assist sensors adjust automatically while a certain distance is being driven after the vehicle has been delivered. Active Brake Assist is unavailable or only partially available during this teach-in period.

Setting Active Brake Assist

Requirements:

- The ignition is switched on.

Multimedia system:

→ ⌂ ▸▸ Settings ▸▸ Assistance ▸▸ Active Brake Assist

The following settings are available:

- Early
- Medium
- Late

▶ Select a setting.
The setting is retained when the engine is next started.

Deactivating Active Brake Assist

ⓘ It is recommended that you always leave Active Brake Assist activated.

▶ Select Off.
The distance warning function, the autonomous braking function and the Evasive Steering Assist are deactivated.
When the vehicle is next started, the middle setting is automatically selected.

ⓘ If Active Brake Assist is deactivated, the symbol appears in the status bar of the multifunction display.

Speed control cruise control

Function of cruise control
Cruise control regulates the speed to the value selected by the driver.

If you accelerate to overtake, for example, the stored speed is not deleted. If you remove your foot from the accelerator pedal after overtaking, cruise control will resume speed regulation back to the stored speed.

Cruise control is operated using the corresponding steering wheel buttons. You can store any speed above 15 mph (20 km/h) up to the maximum speed.

If you fail to adapt your driving style, cruise control can neither reduce the risk of an accident nor override the laws of physics. It cannot take into account road, weather or traffic conditions. Cruise control is only an aid. The driver is responsible for the distance to the vehicle in front, for vehicle speed, for braking in good time and for staying in lane.

Mercedes-AMG vehicles: Cruise control is available up to a maximum speed of 155 mph (250 km/h).

Displays on the multifunction display
The status of cruise control and the stored speed are shown in the multifunction display.

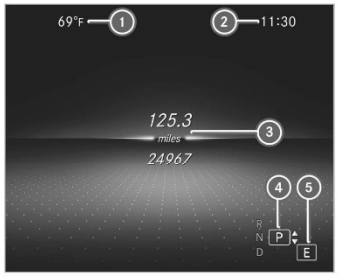
The following display content can be selected in the Classic and Sport designs:

- Tachometer
- Navigation
- ECO display
- Consumption
- G-meter

The following content can be selected in the Progressive design:

- date
- Navigation
- ECO display
- Consumption
- G-meter

Overview of displays on the multifunction display



1. Outside temperature
2. Time
3. Display section
4. Transmission position
5. Drive program

Further displays on the multifunction display:

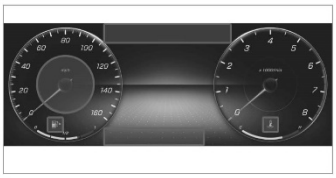
- Gearshift recommendation (→ page 171)
- Active Parking Assist activated (→ page 234)
- Parking Assist PARKTRONIC deactivated (→ page 224, 223, 224)
- Cruise control (→ page 197)
- DSR (→ page 199)
- Active Distance Assist DISTRONIC (→ page 201)
- Active Brake Assist(→ page 197)
- Active Steering Assist (→ page 207)
- Active Lane Keeping Assist (→ page 245)
- Active Lane Change Assist (→ page 209)
- ECO start/stop function (→ page 162)
- HOLD function (→ page 213)
- Adaptive Highbeam Assist (→ page 133)

Vehicles with Traffic Sign Assist: Detected instructions and traffic signs (→ page 240).

Display messages	Possible causes/consequences and ▶ Solutions
	▶ Drive on carefully. ▶ Consult a qualified specialist workshop immediately.
Active Brake Assist Functions Currently Limited See Operator's Manual	* **Vehicles with the Driving Assistance Package:** Active Brake Assist with cross-traffic function, Evasive Steering Assist or PRE-SAFE® PLUS are temporarily unavailable or only partially available. **Vehicles without the Driving Assistance Package:** Active Brake Assist is temporarily unavailable or only partially available. The ambient conditions are outside the system limits (→ page 191). ▶ Drive on. As soon as the ambient conditions are within the system limits, the system will become available again. ▶ If the display message does not disappear, stop the vehicle in accordance with the traffic conditions and restart the engine.
Active Brake Assist Functions Limited See Operator's Manual	* **Vehicles with Driving Assistance Package:** Active Brake Assist with cross-traffic function, Evasive Steering Assist or PRE-SAFE® PLUS is malfunctioning. **Vehicles without Driving Assistance Package:** Active Brake Assist is malfunctioning. ▶ Consult a qualified specialist workshop.
Radar Sensors Dirty See Operator's Manual	* The radar sensor system is malfunctioning. Possible causes: • Dirt on the sensors • Heavy rain or snow • Extended country driving without other traffic, e.g. in the desert

Instrument Display (standard)

Widescreen Cockpit Instrument Display



Depending on the display setting, the positions of the indicator lamps on the Instrument Display may differ from the example shown.

Indicator and warning lamps:

- Low beam (→ page 130)
- Parking lamps (→ page 130)
- High beam (→ page 131)
- Turn signal lights (→ page 131)
- Rear fog lamp (→ page 130)
- Restraint system (→ page 555)
- Seat belt not fastened (→ page 555)
- BRAKE USA: brakes (red) (→ page 560)
- Canada: brakes (red) (→ page 560)
- Electric parking brake (yellow) (→ page 560)
- PARK USA: electric parking brake applied (red) (→ page 560)
- Canada: electric parking brake applied (red) (→ page 560)
- ABS malfunction (→ page 563)
- ESP® (→ page 563)
- ESP® OFF (→ page 563)
- Distance warning (→ page 562)
- Electric power steering malfunction (→ page 556)
- AIR BODY CONTROL malfunction (→ page 562)
- Check Engine (→ page 557)
- Electrical malfunction (→ page 557)
- Fuel reserve with fuel filler cap location indicator (→ page 557)
- Coolant too hot/cold (→ page 557)
- Tire pressure monitor (→ page 566)

Warning/indicator lamp	Possible causes/consequences and ▶ Solutions
	▶ Observe the messages on the multifunction display. ▶ Consult a qualified specialist workshop.

Driving systems

Warning/indicator lamp	Possible causes/consequences and ▶ Solutions
 Warning lamp for distance warning function	The red distance warning lamp lights up while the vehicle is in motion. * The distance to the vehicle in front is too small for the speed selected. If there is an additional warning tone, you are approaching an obstacle at too high a speed. ▶ Be prepared to brake immediately. ▶ Increase the distance. Function of Active Brake Assist (→ page 191).
 Suspension warning lamp	The yellow AIR BODY CONTROL warning lamp is lit. * A malfunction has occurred in the AIR BODY CONTROL. ▶ Note the messages on the multifunction display.

APPENDIX C

Run Log

Subject Vehicle: **2020 Mercedes-Benz GLC 300 4Matic SUV** Test Date: **6/17/2020**

Principal Other Vehicle: **2006 Acura RL**

Note: Unable to accurately record visual alerts

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	**Stopped POV**	Y	2.19	0.09	Pass	
2		Y	2.19	0.09	Pass	
3		Y	2.15	0.05	Pass	
4		Y	2.21	0.11	Pass	
5		Y	2.17	0.07	Pass	
6		Y	2.16	0.06	Pass	
7		Y	2.05	-0.05	Fail	
15	**Decelerating POV**	Y	3.11	0.71	Pass	
16		Y	3.11	0.71	Pass	
17		N				POV Speed
18		Y	3.20	0.80	Pass	
19		N				SV Yaw
20		Y	3.10	0.70	Pass	
21		Y	3.11	0.71	Pass	
22		Y	3.22	0.82	Pass	
23		Y	3.00	0.60	Pass	

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Margin (sec)	Pass/Fail	Notes
8	**Slower POV**	Y	2.92	0.92	Pass	
9		Y	2.95	0.95	Pass	
10		Y	2.71	0.71	Pass	
11		Y	2.91	0.91	Pass	
12		Y	2.91	0.91	Pass	
13		Y	2.91	0.91	Pass	
14		Y	2.90	0.90	Pass	

APPENDIX D

Time History Plots

LIST OF FIGURES

Description of Time History Plots

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

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 g ± 0.03 g) allowed while braking. Exceedance of this threshold is indicated with red asterisks at the beginning and/or end of the threshold boundary.

Color Codes

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

Color codes can be broken into four categories:

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

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

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

3. Instantaneous sampling color codes:
   - Green circle = passing or valid value at a given moment in time
   - Red asterisk = failing or invalid value at a given moment in time

4. Text color codes:
   - Green = passing or valid value
   - Red = failing or invalid value

Other Notations

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

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

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

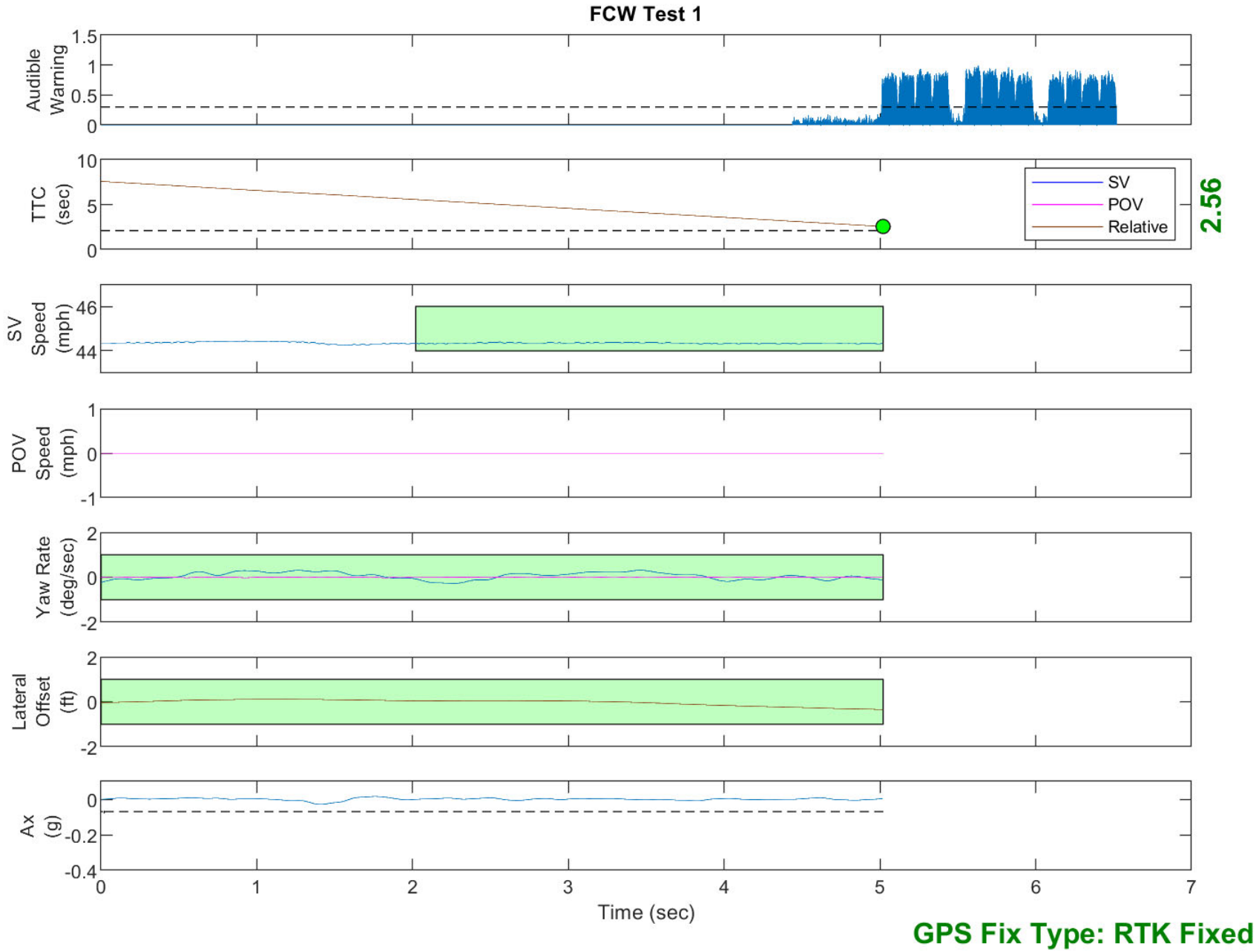


Figure D1. Example Time History for Test Type 1, Passing

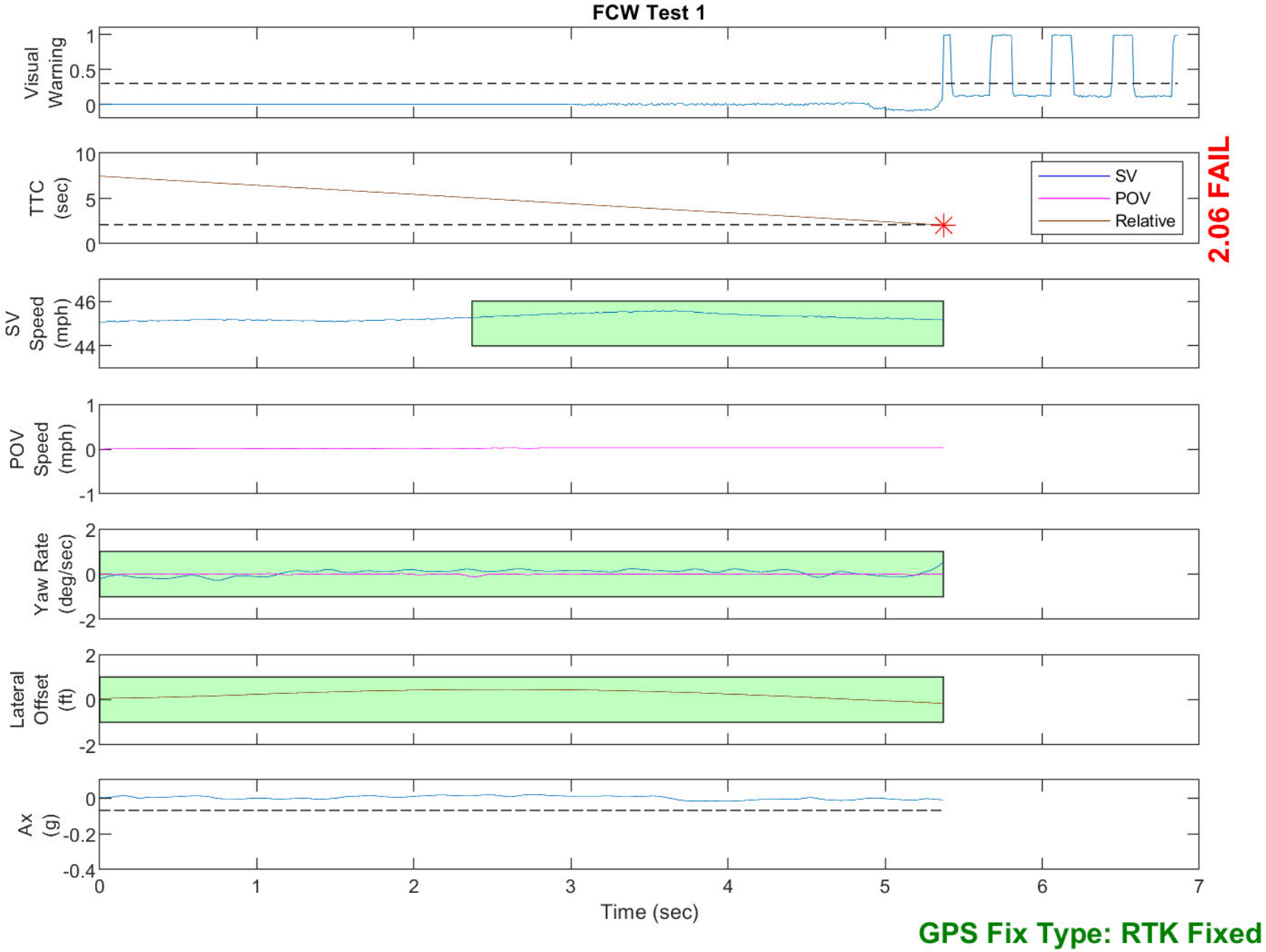


Figure D2. Example Time History for Test Type 1, Failing

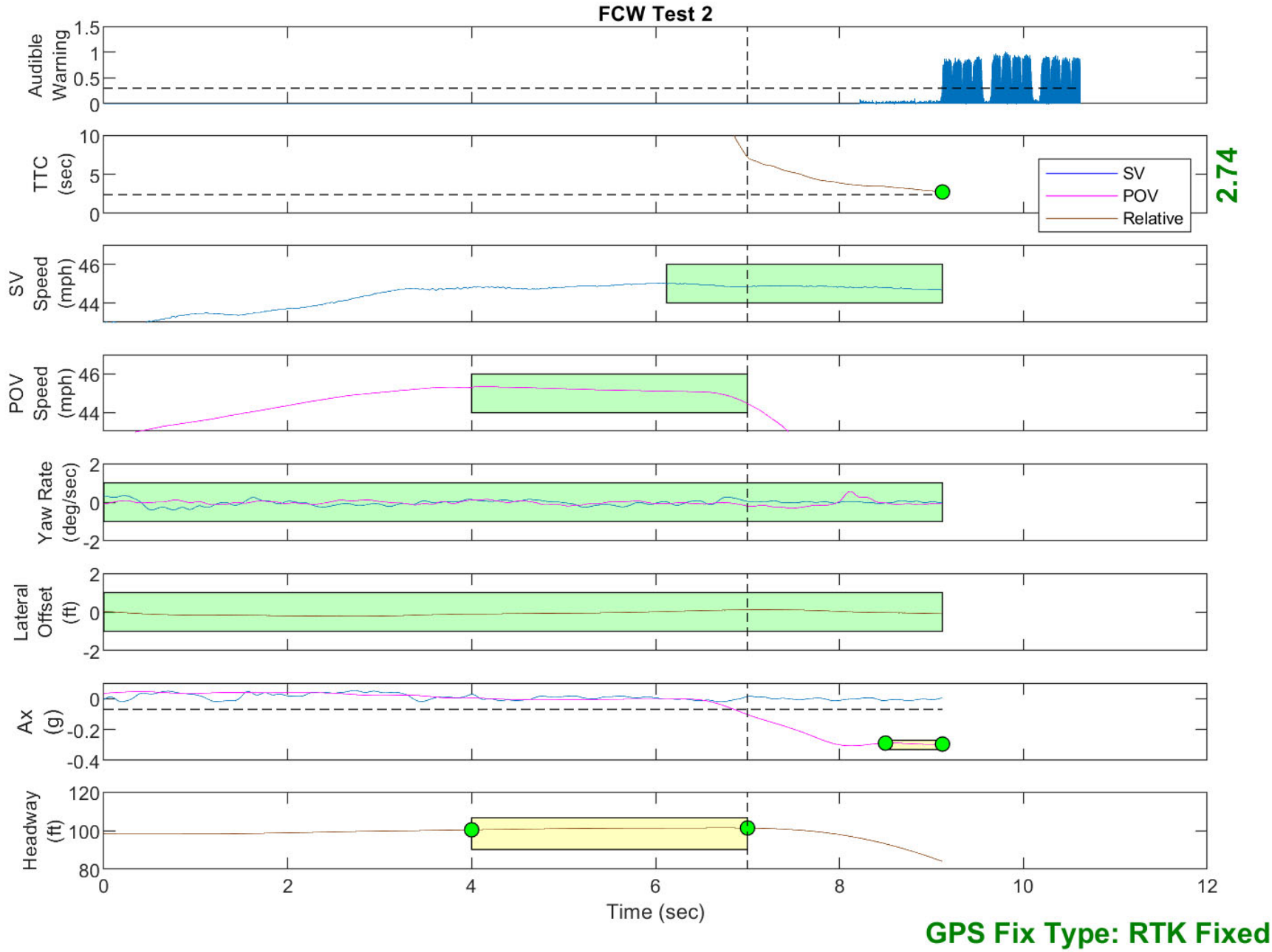


Figure D3. Example Time History for Test Type 2, Passing

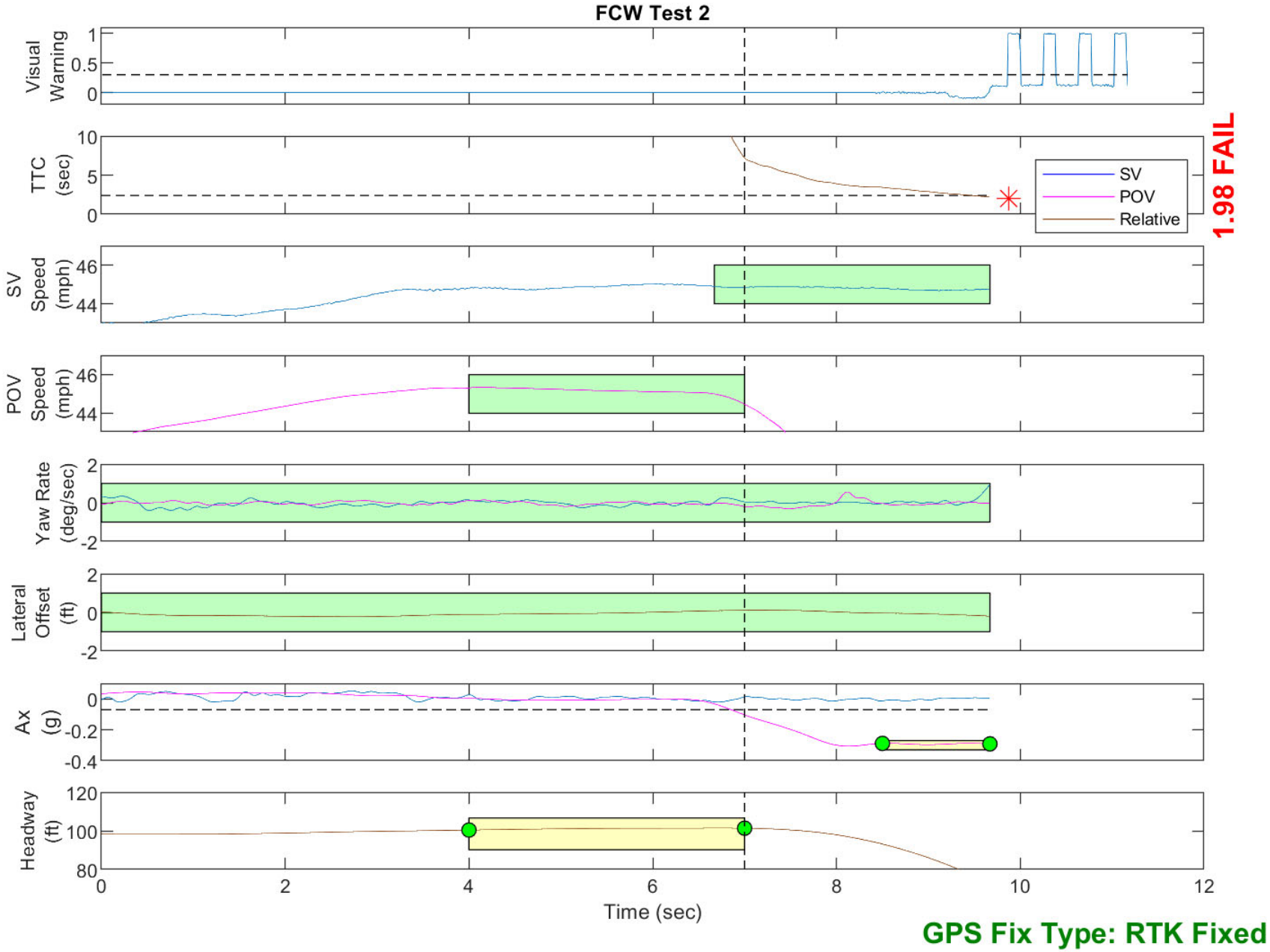


Figure D4. Example Time History for Test Type 2, Failing

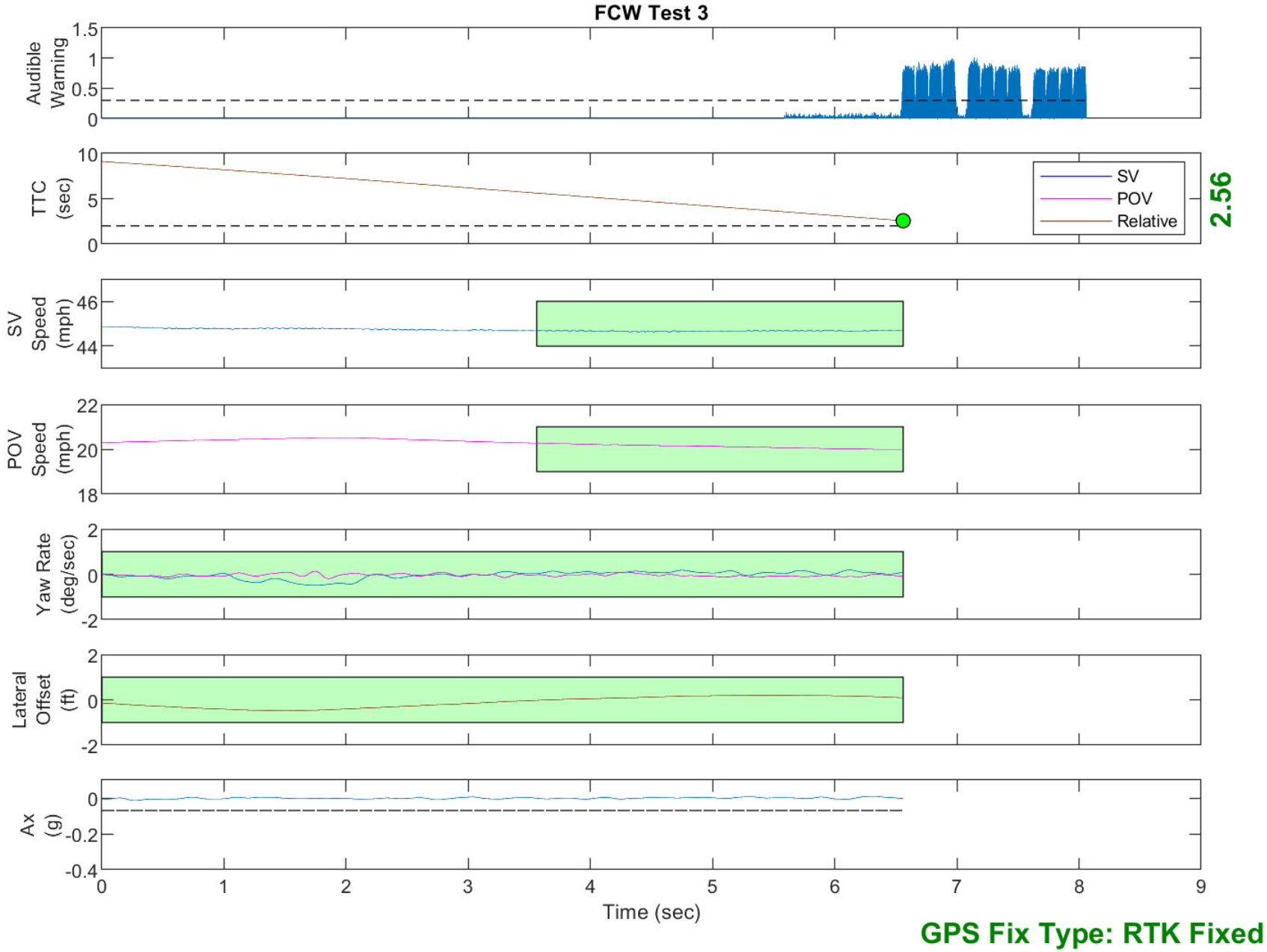


Figure D5. Example Time History for Test Type 3, Passing

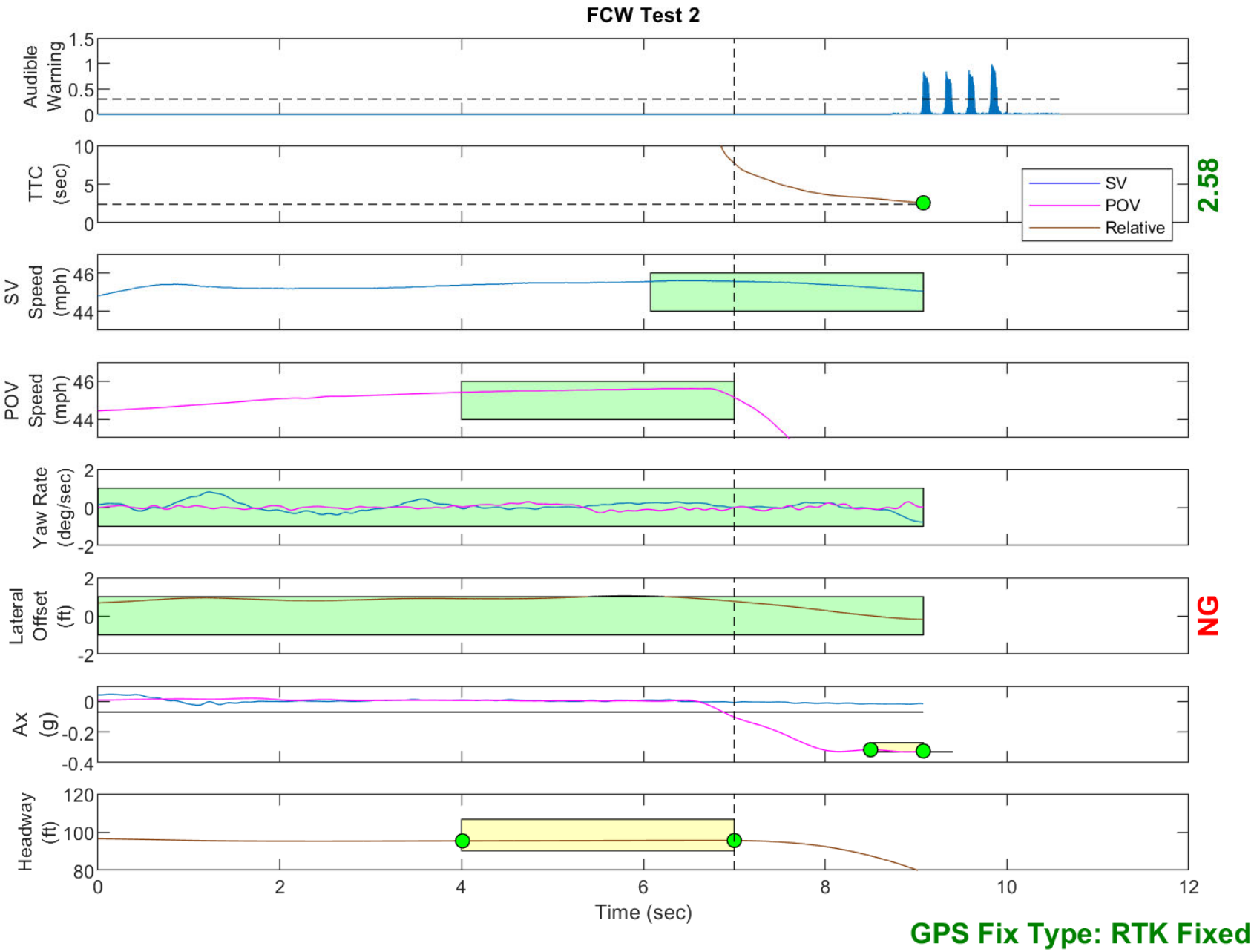


Figure D6. Example Time History Showing Invalid Lateral Offset Criteria

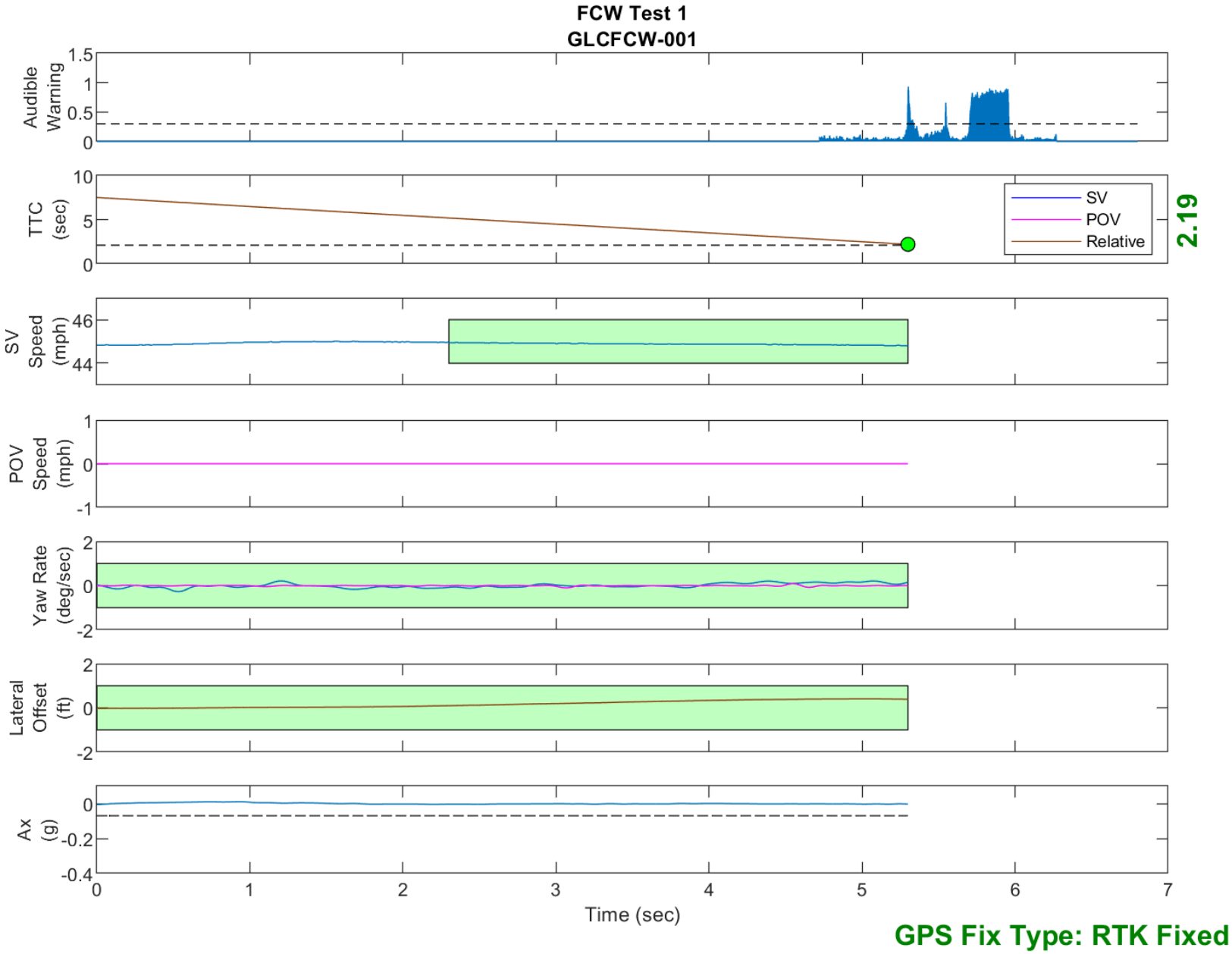


Figure D7. Time History for Run 1, FCW Test 1, Audible Warning

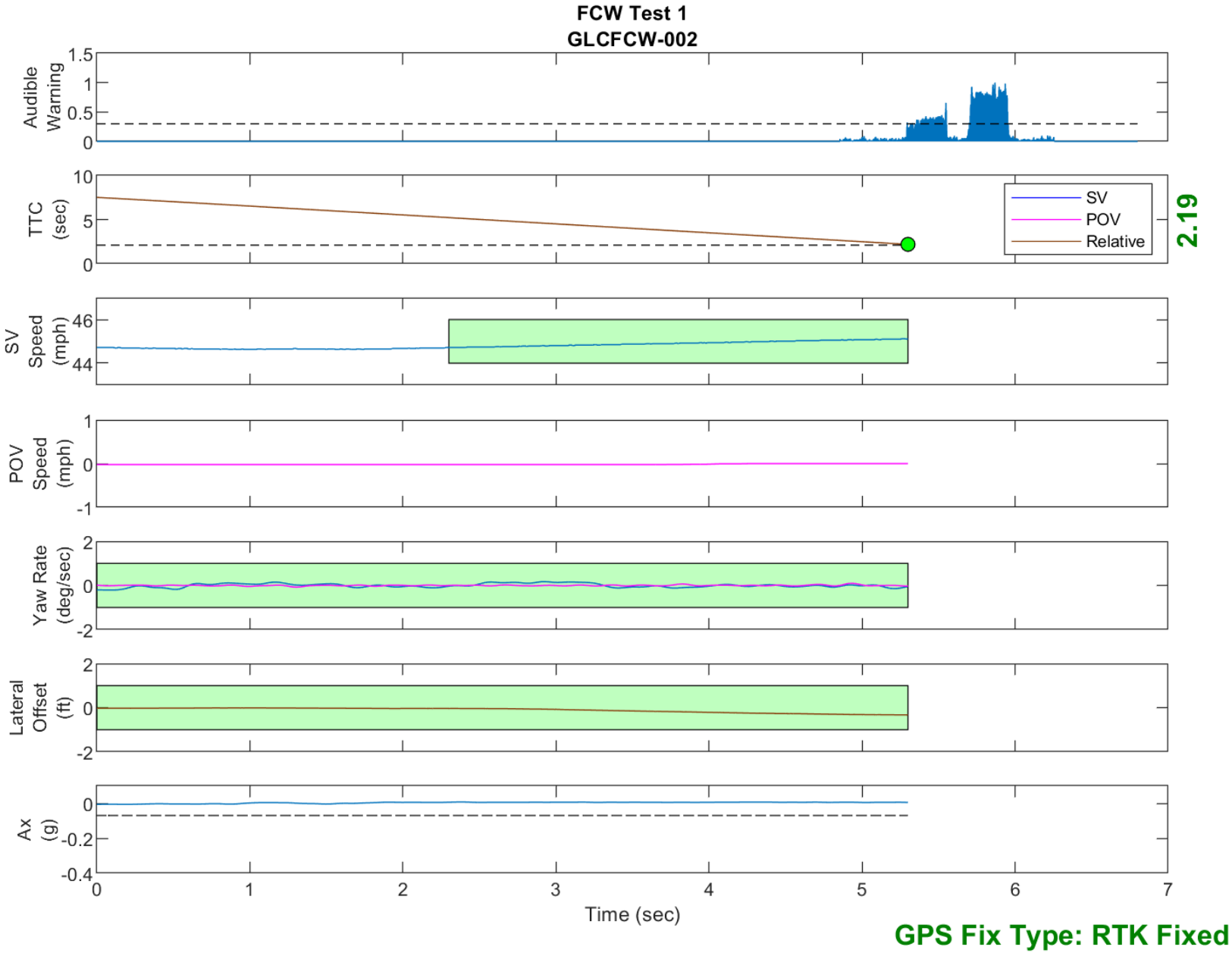


Figure D8. Time History for Run 2, FCW Test 1, Audible Warning

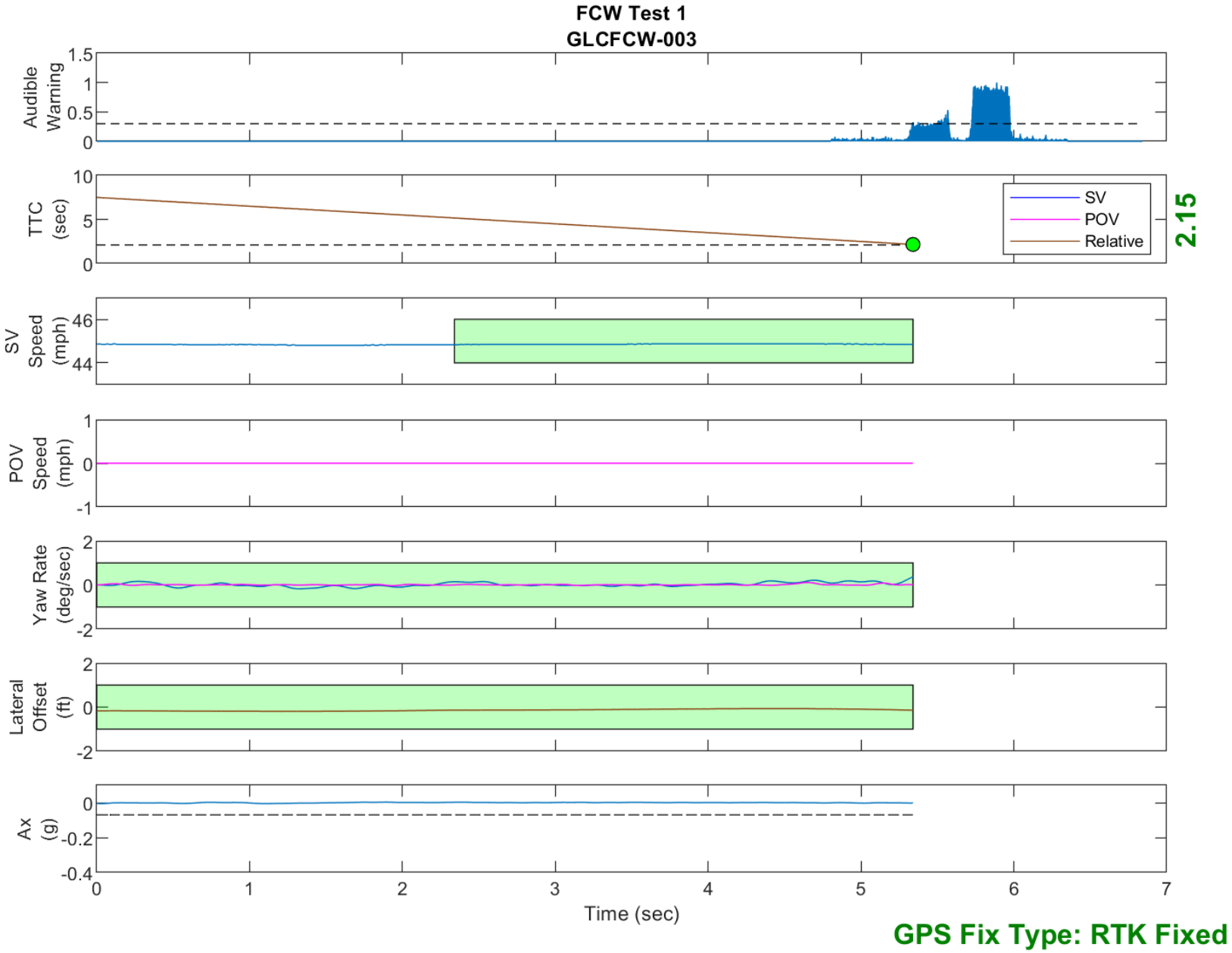


Figure D9. Time History for Run 3, FCW Test 1, Audible Warning

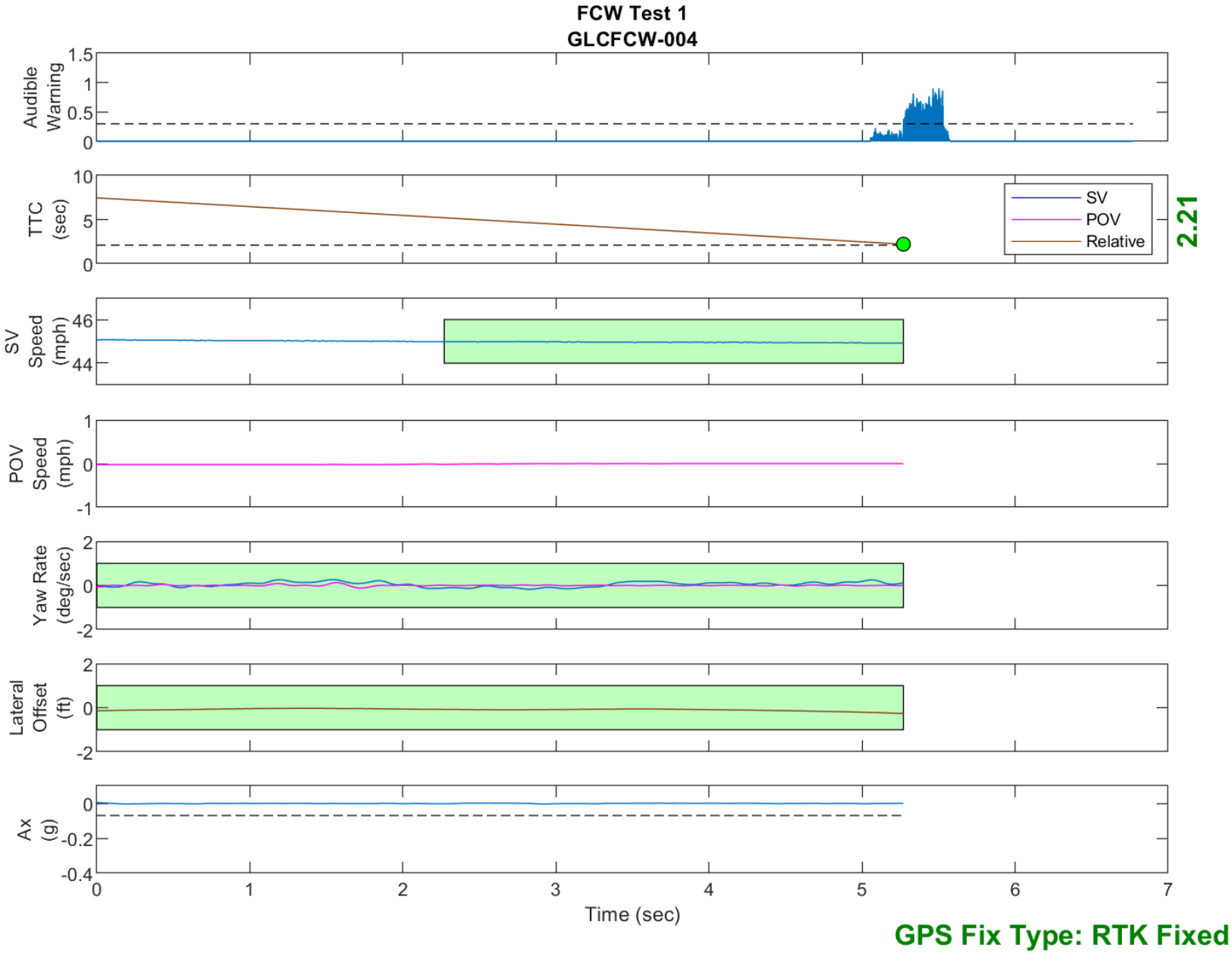


Figure D10. Time History for Run 4, FCW Test 1, Audible Warning

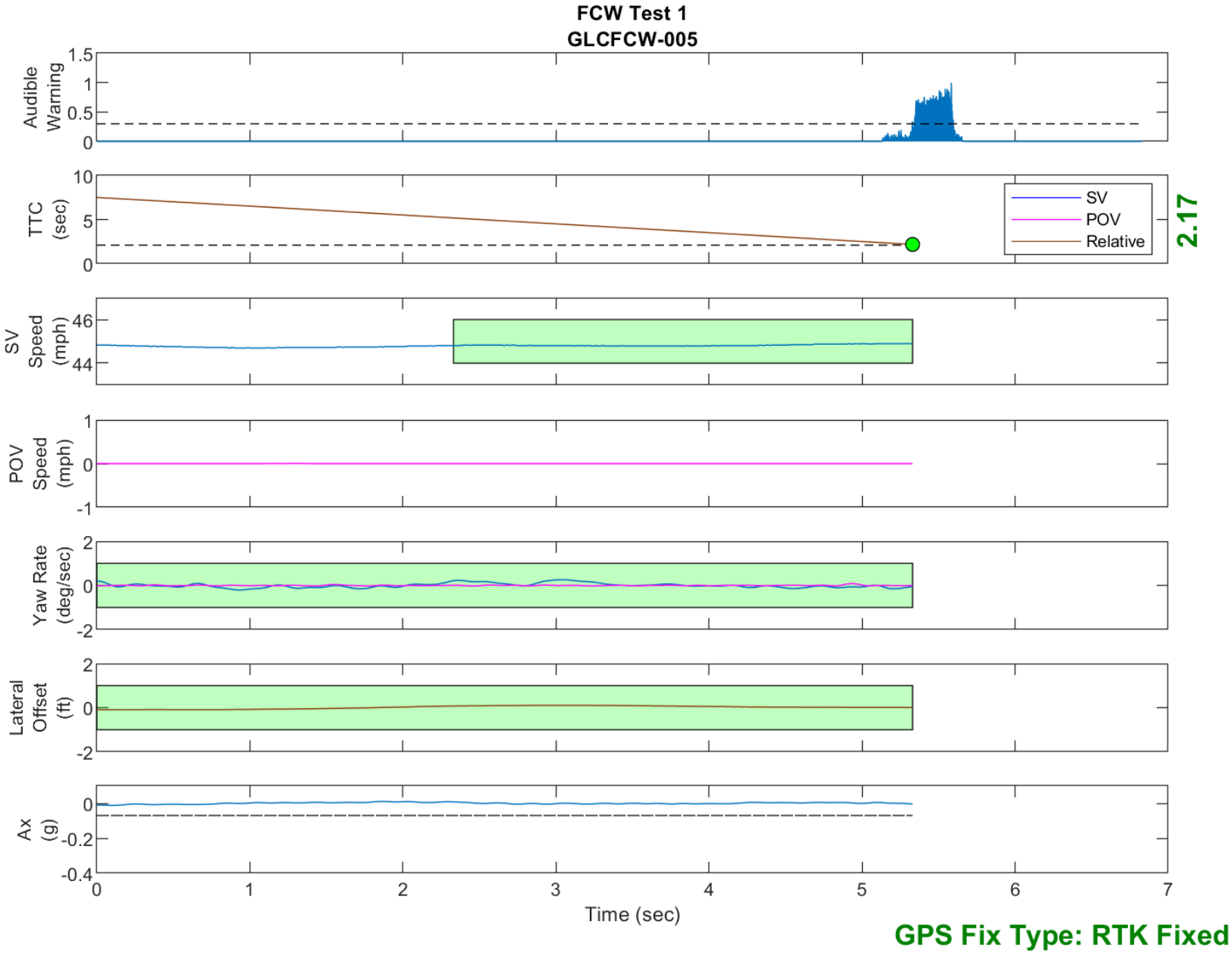


Figure D11. Time History for Run 5, FCW Test 1, Audible Warning

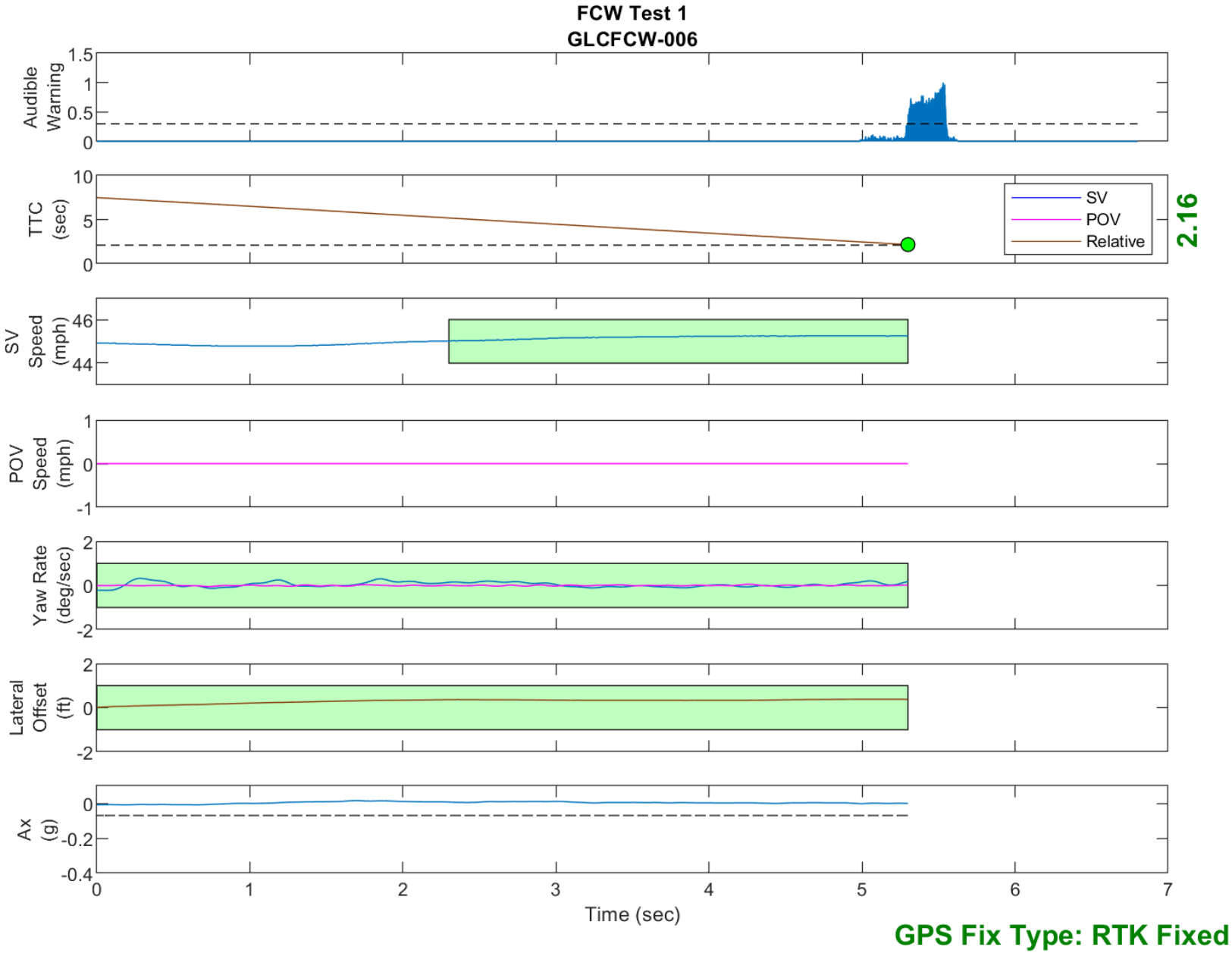


Figure D12. Time History for Run 6, FCW Test 1, Audible Warning

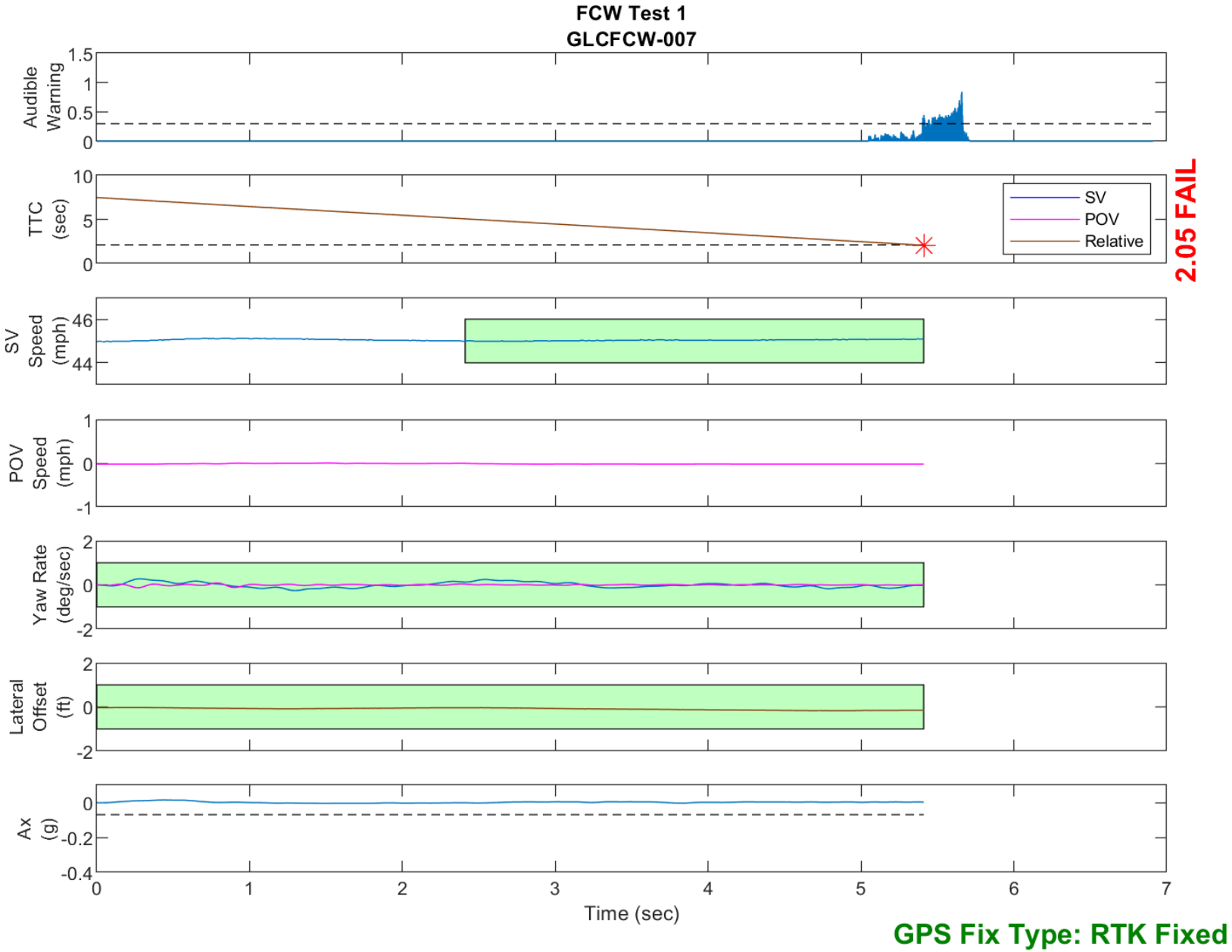


Figure D13. Time History for Run 7, FCW Test 1, Audible Warning

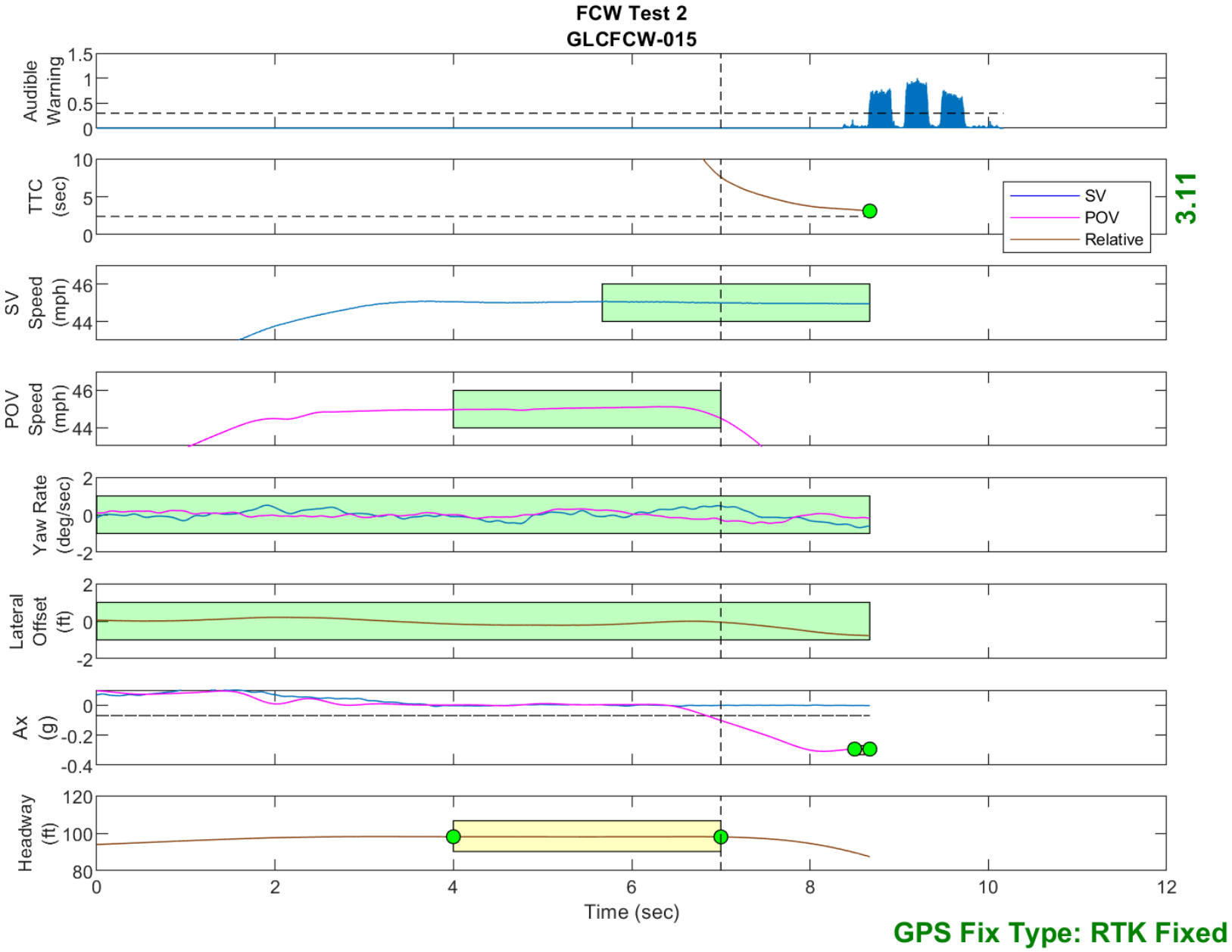


Figure D14. Time History for Run 15, FCW Test 2, Audible Warning

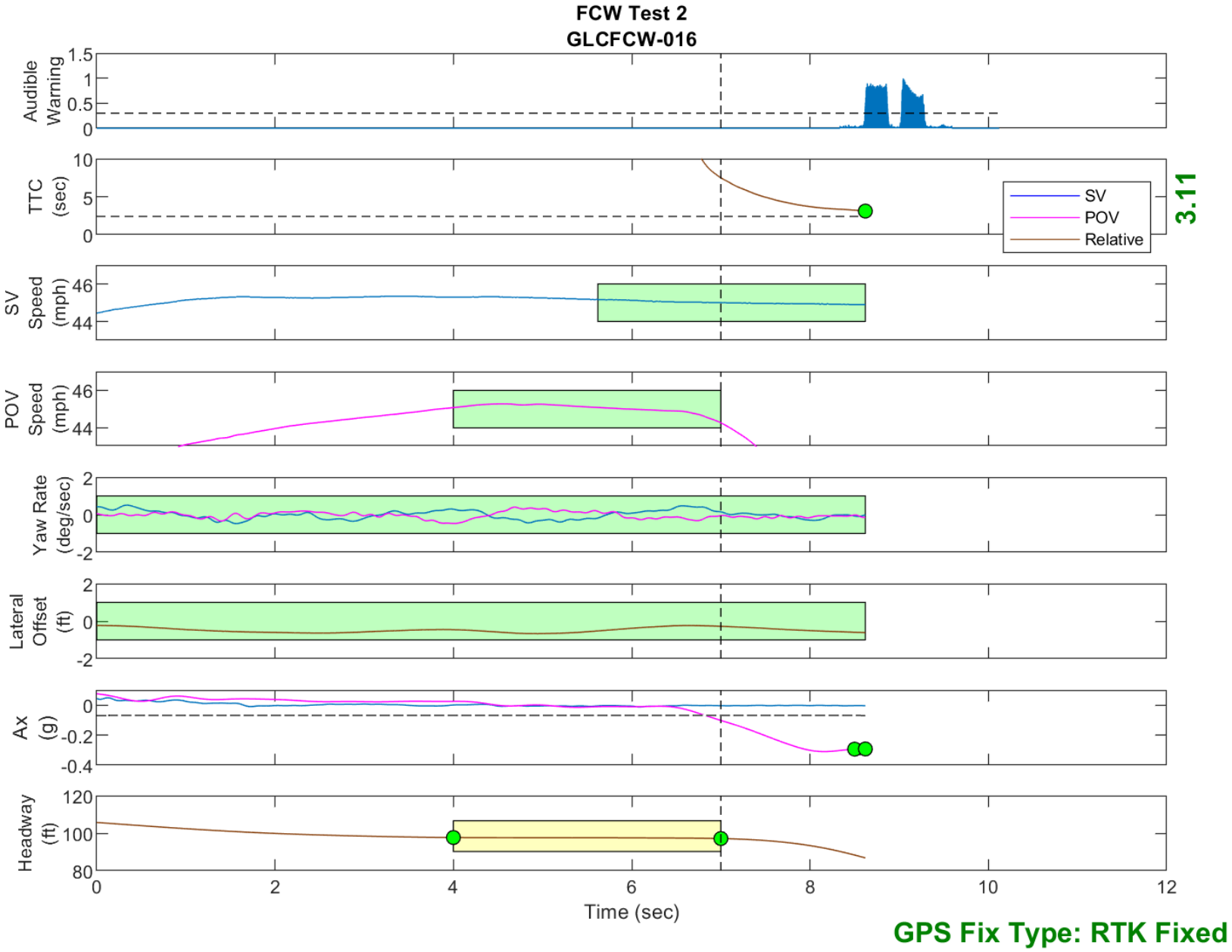


Figure D15. Time History for Run 16, FCW Test 2, Audible Warning

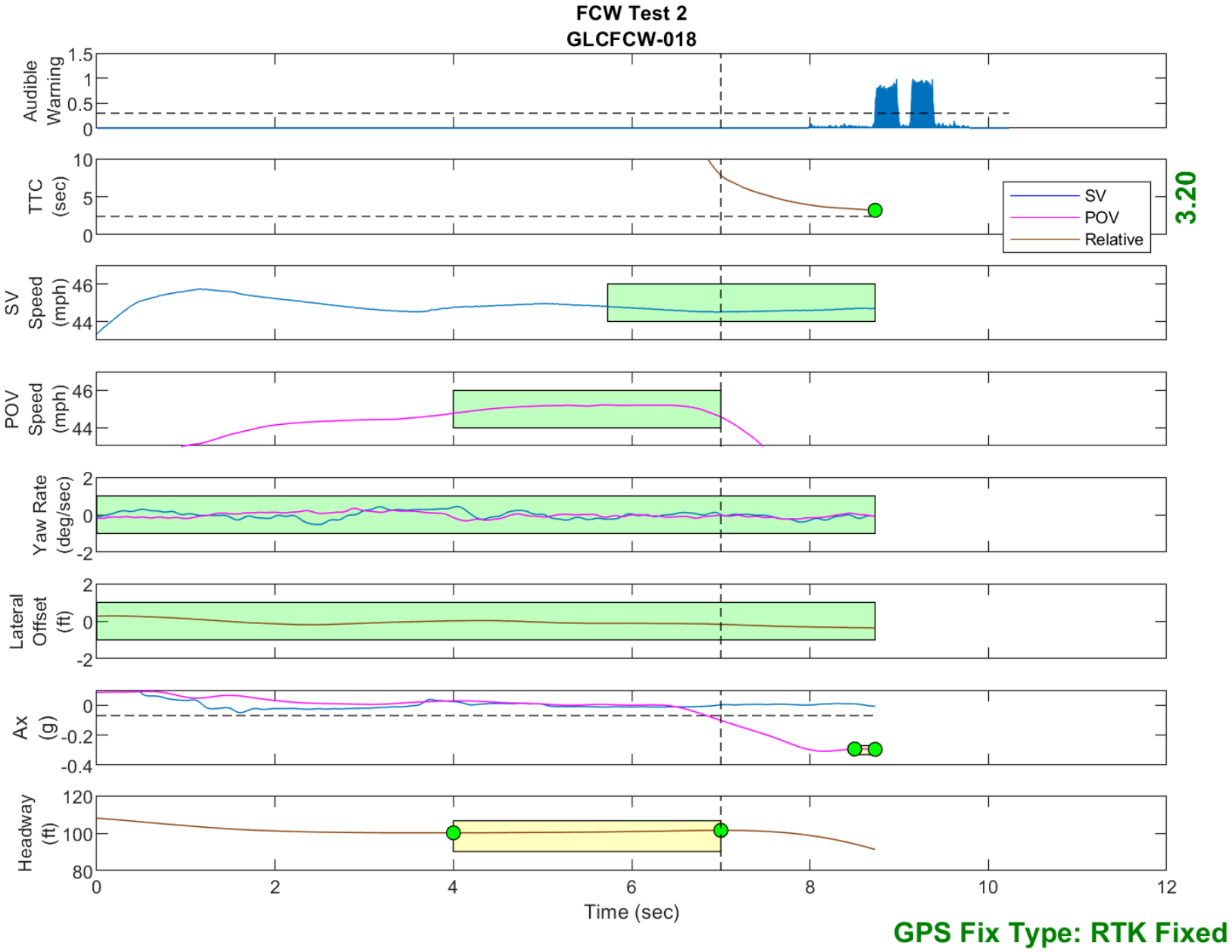


Figure D16. Time History for Run 18, FCW Test 2, Audible Warning

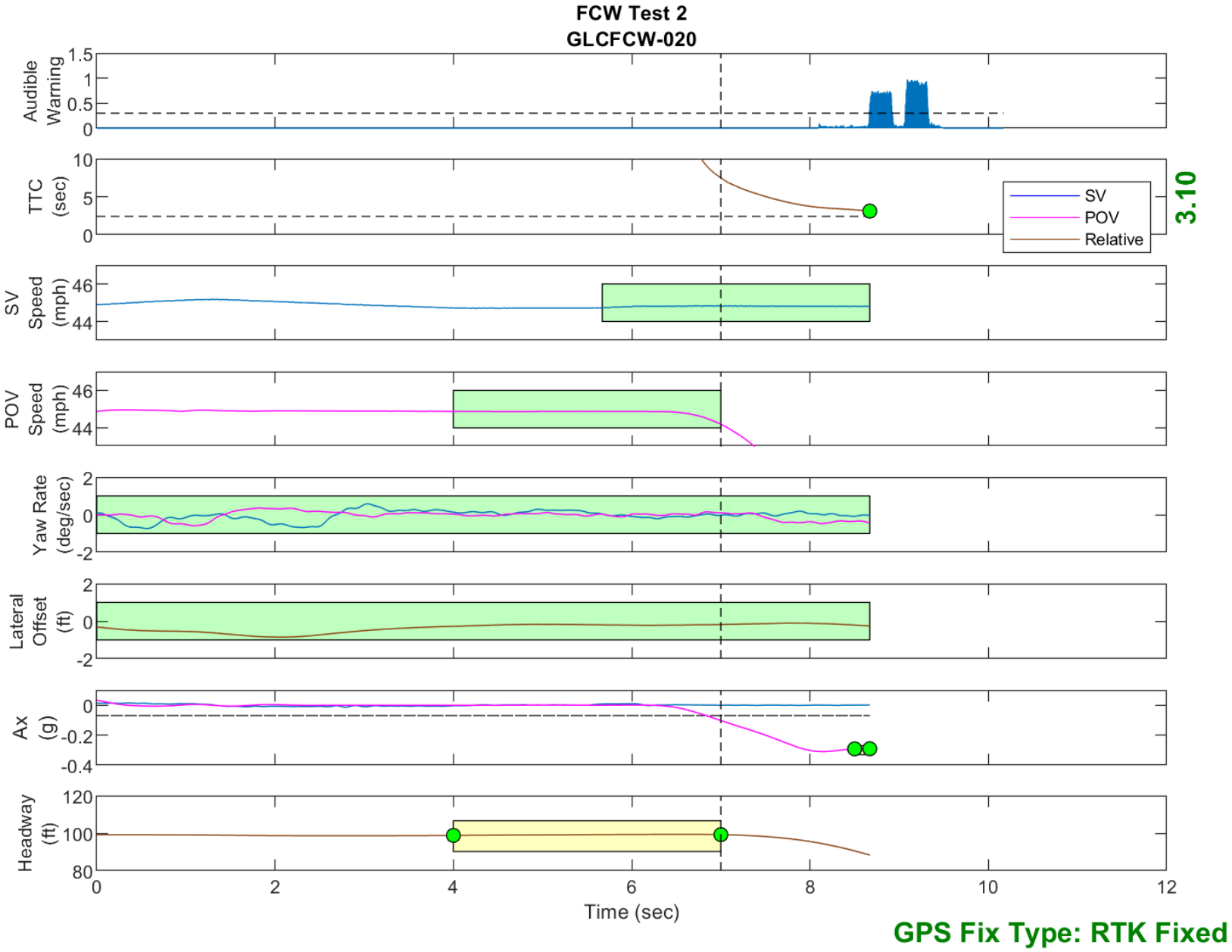


Figure D17. Time History for Run 20, FCW Test 2, Audible Warning

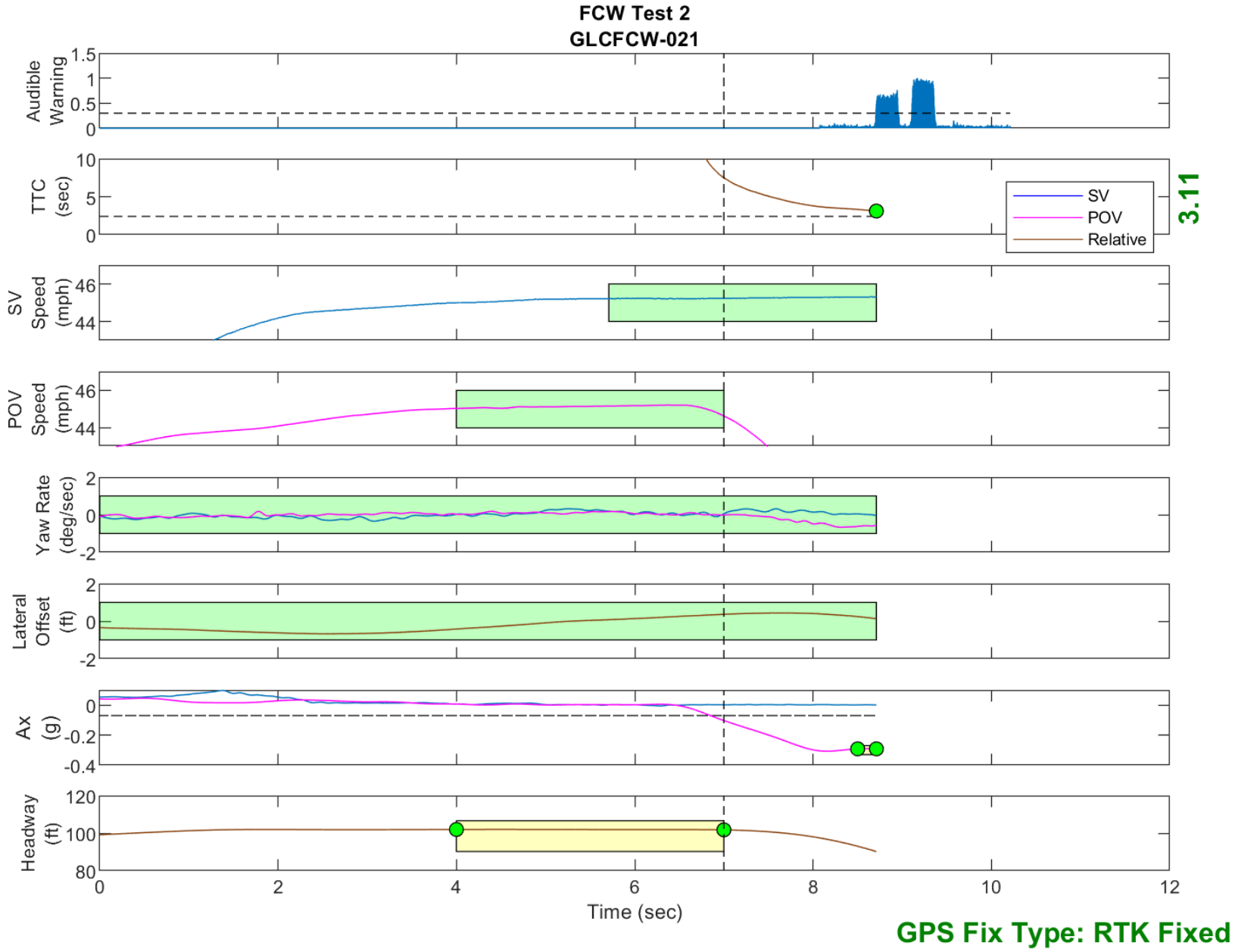


Figure D18. Time History for Run 21, FCW Test 2, Audible Warning

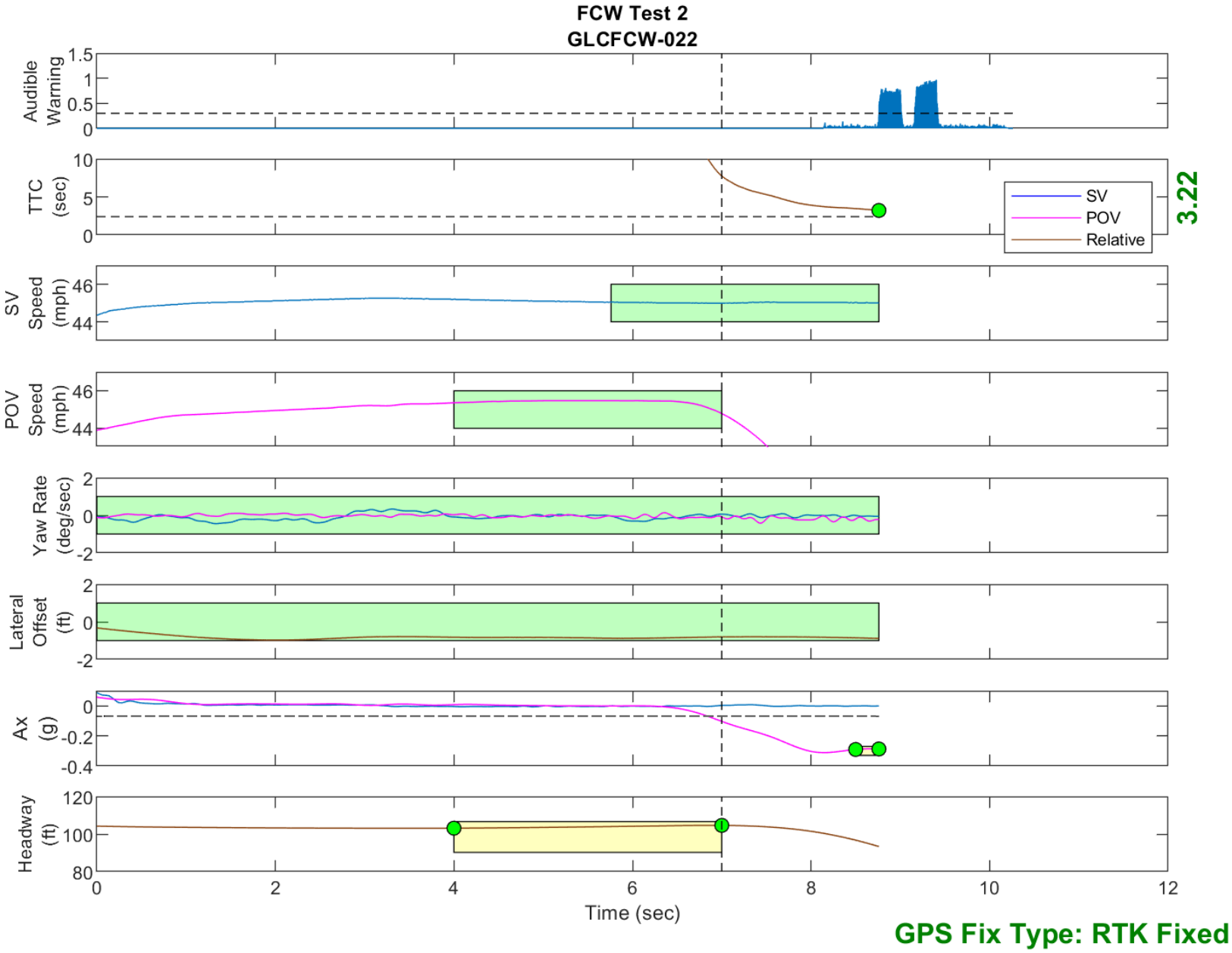


Figure D19. Time History for Run 22, FCW Test 2, Audible Warning

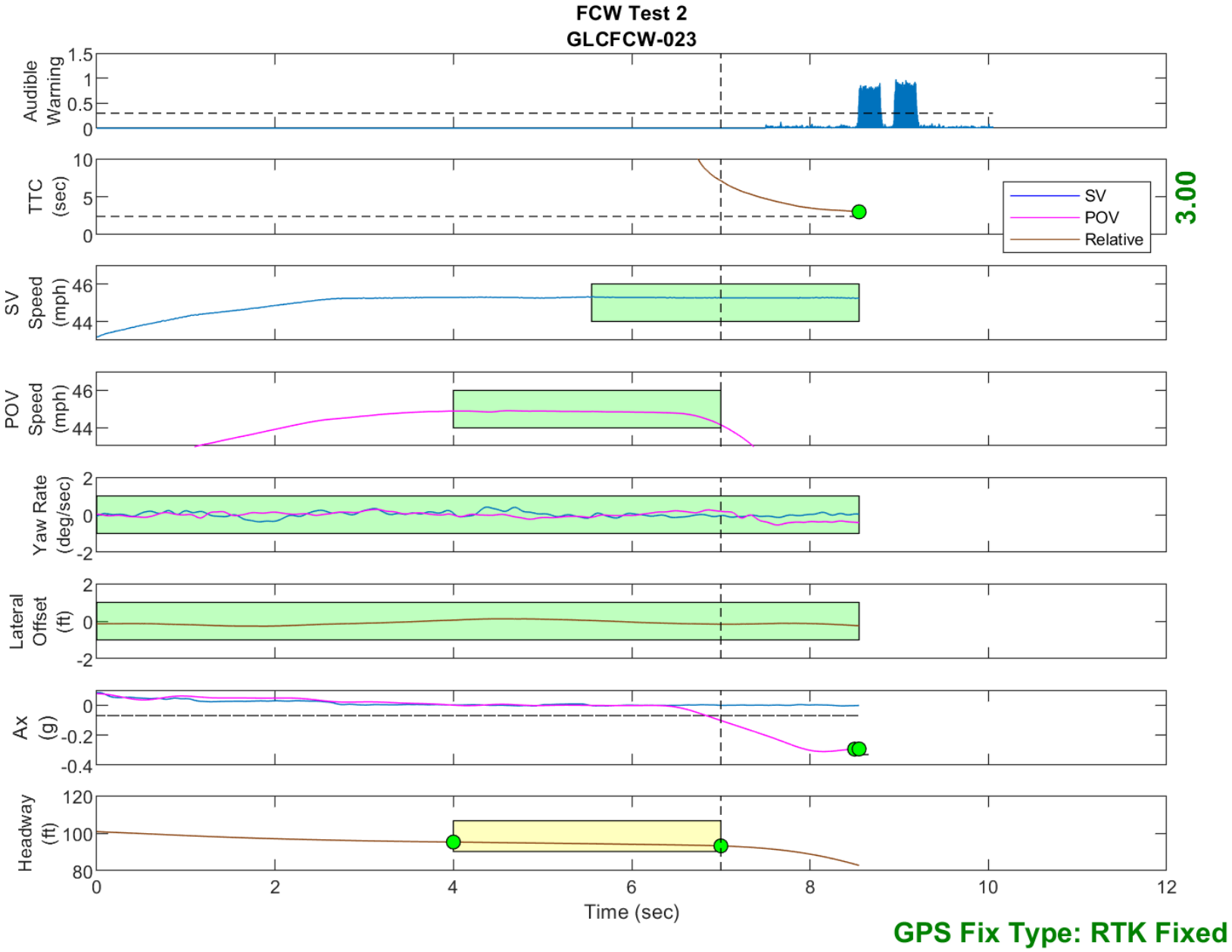


Figure D20. Time History for Run 23, FCW Test 2, Audible Warning

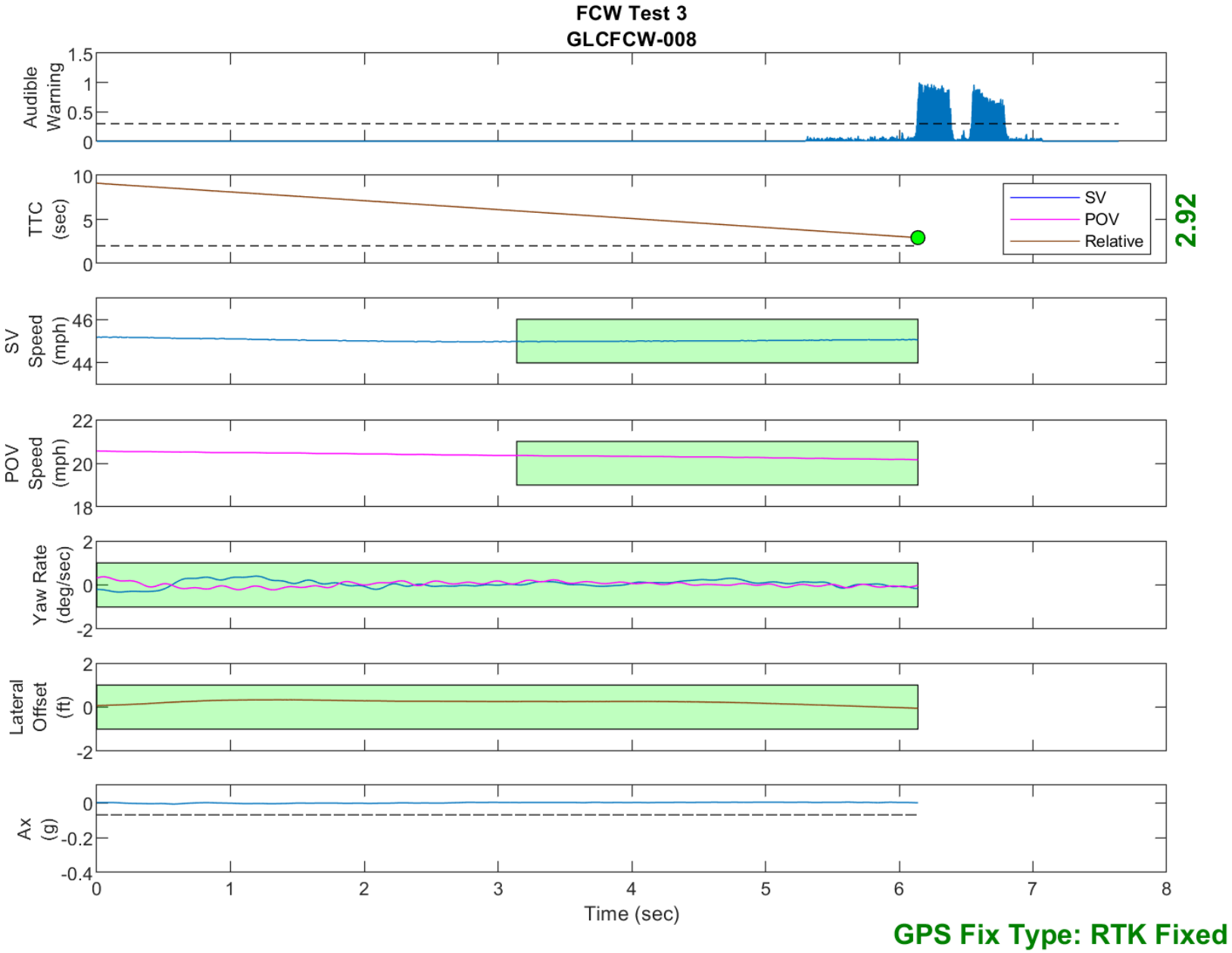


Figure D21. Time History for Run 8, FCW Test 3, Audible Warning

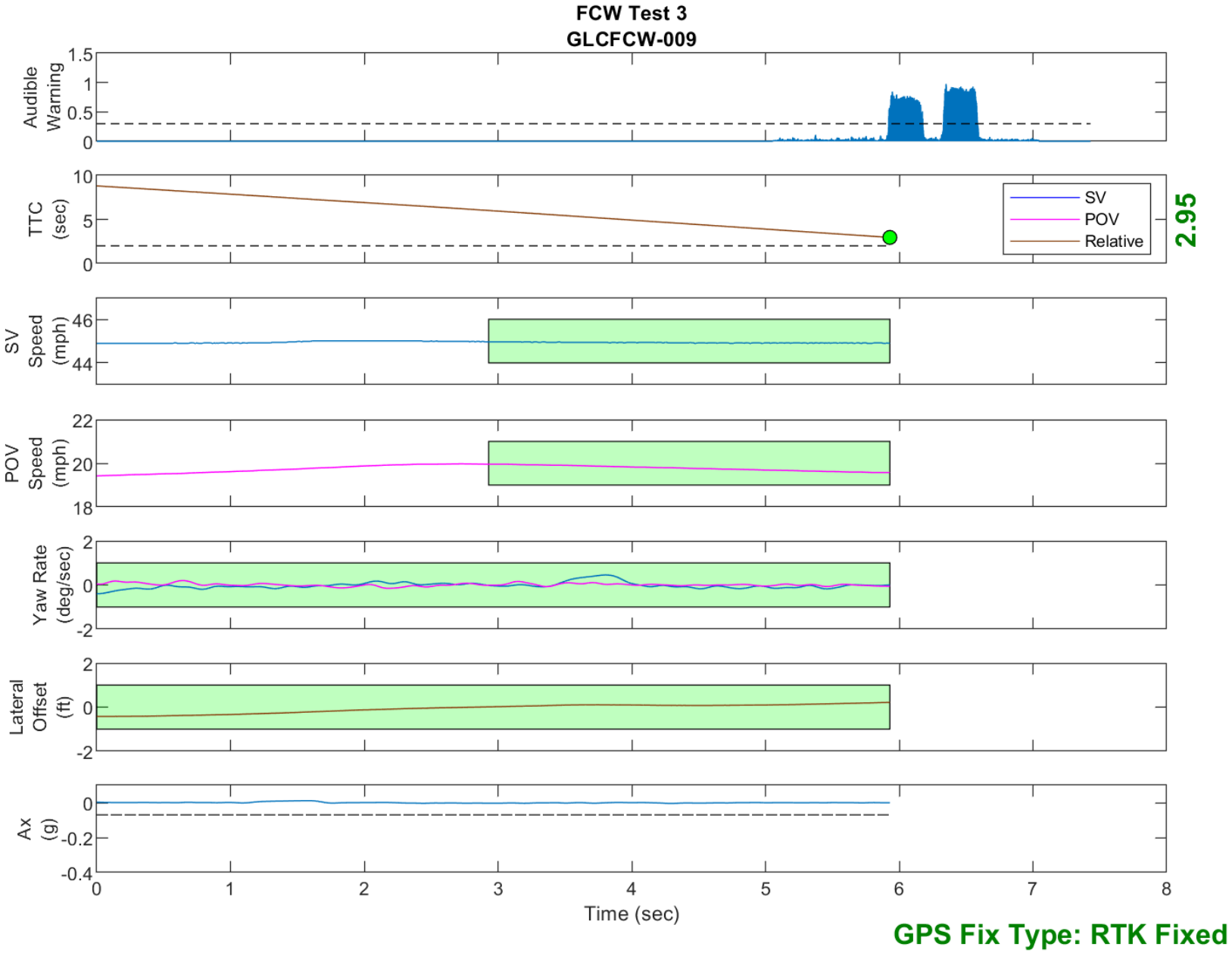


Figure D22. Time History for Run 9, FCW Test 3, Audible Warning

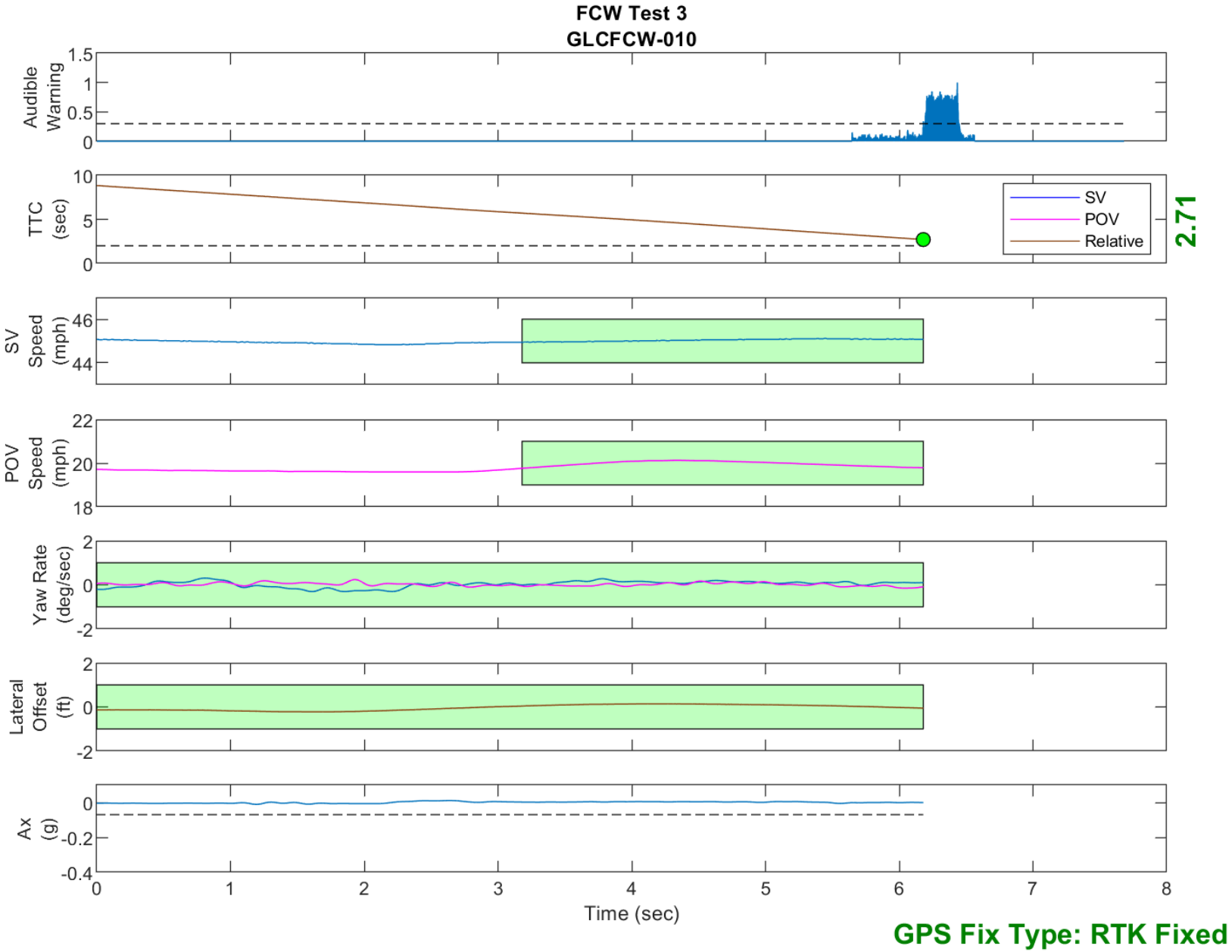


Figure D23. Time History for Run 10, FCW Test 3, Audible Warning

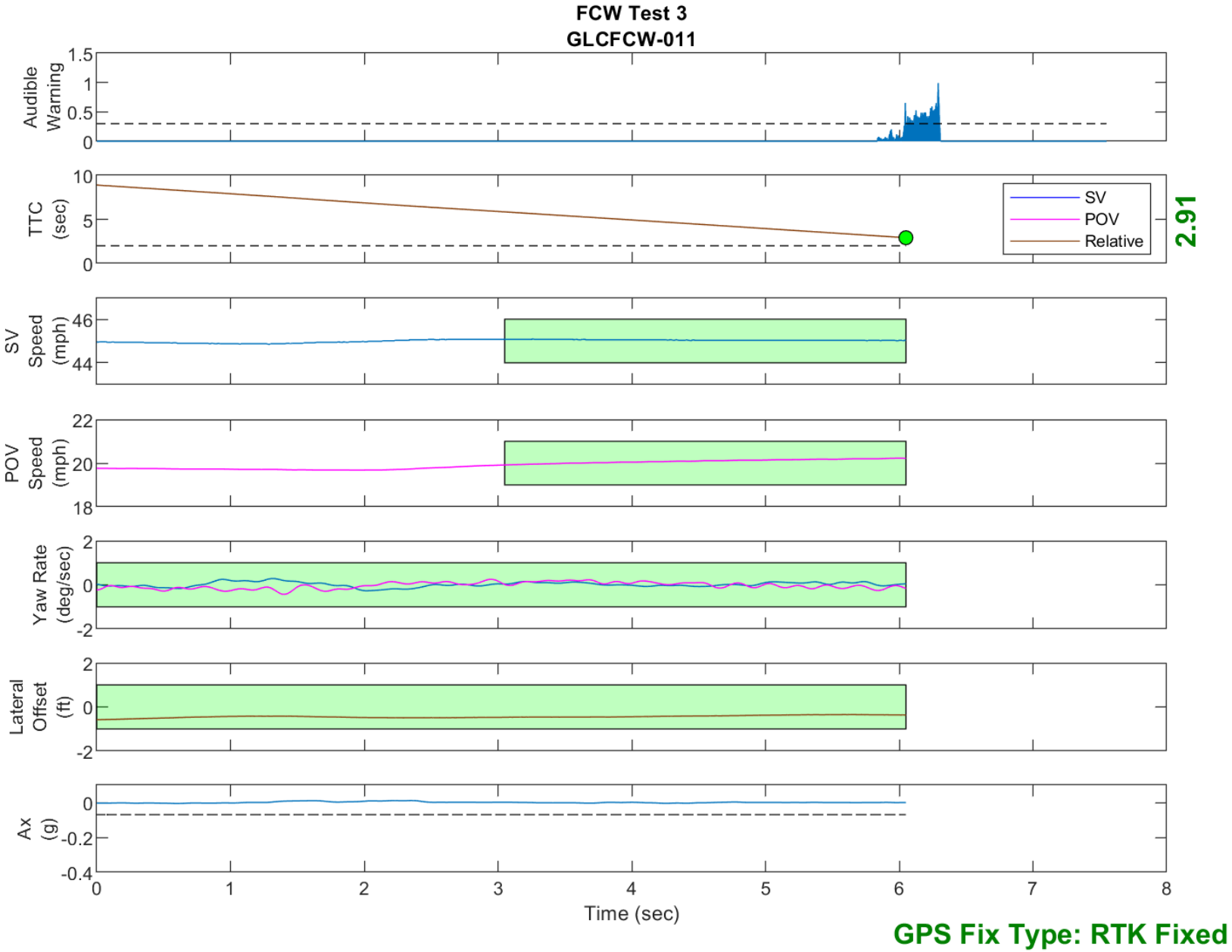


Figure D24. Time History for Run 11, FCW Test 3, Audible Warning

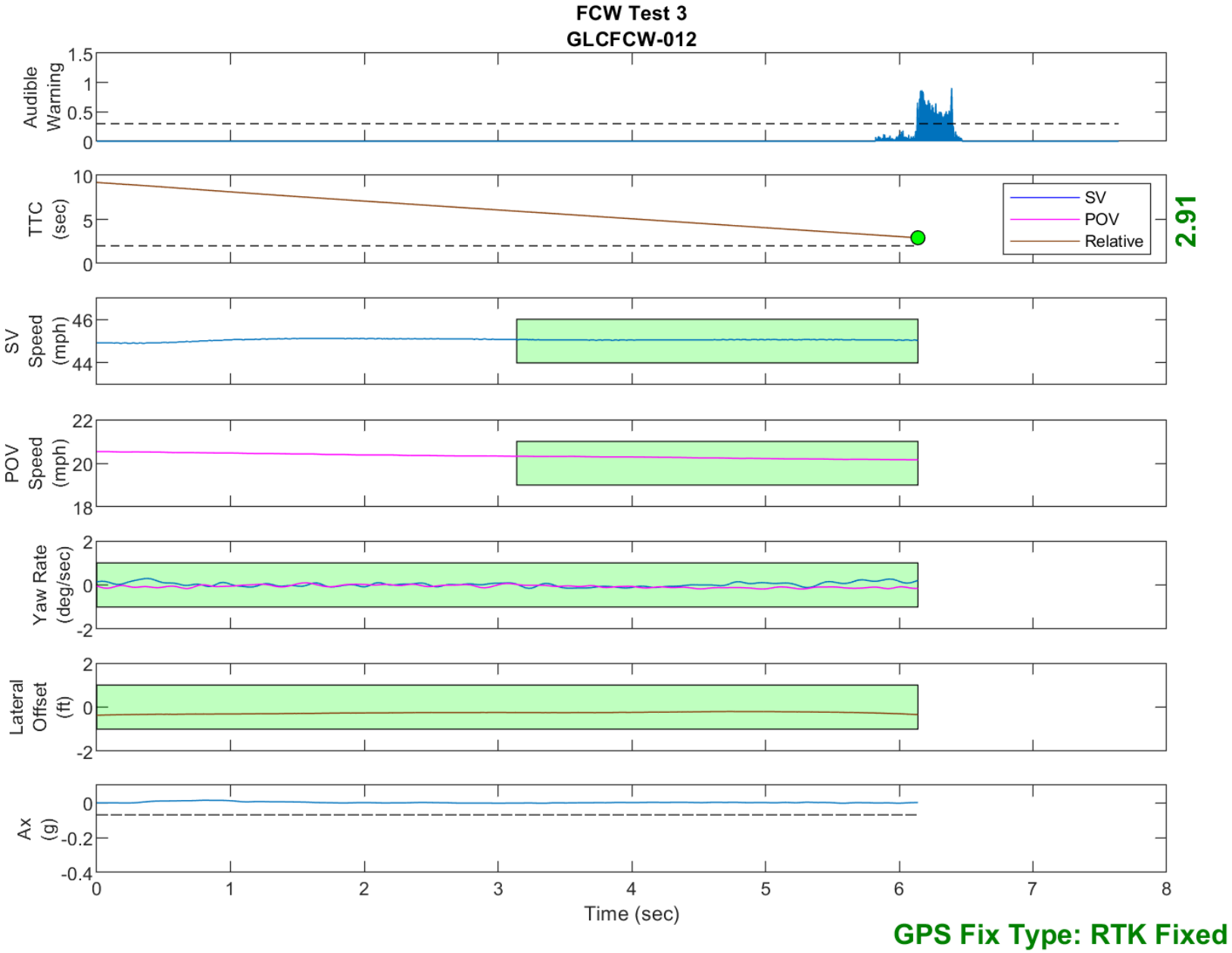


Figure D25. Time History for Run 12, FCW Test 3, Audible Warning

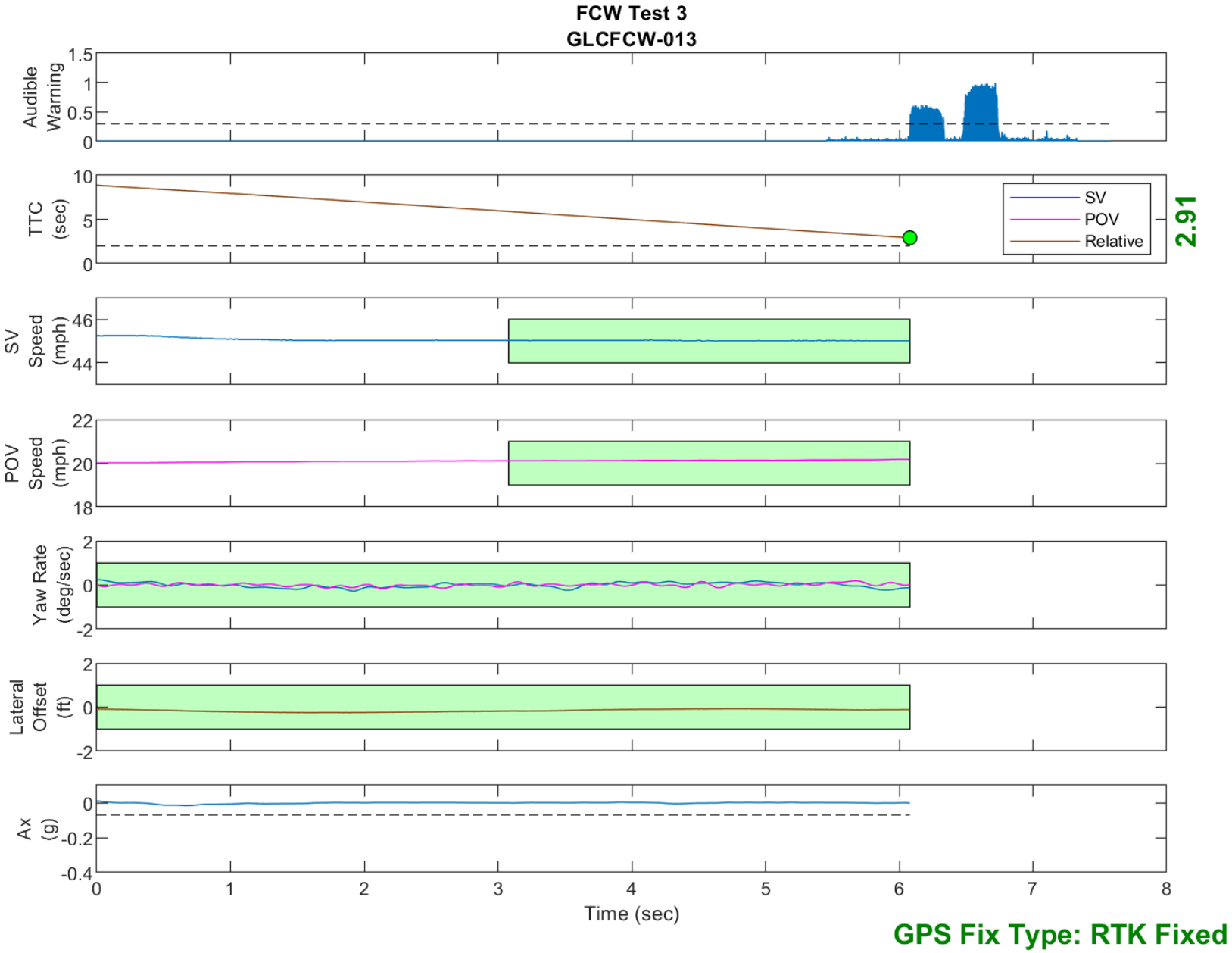


Figure D26. Time History for Run 13, FCW Test 3, Audible Warning

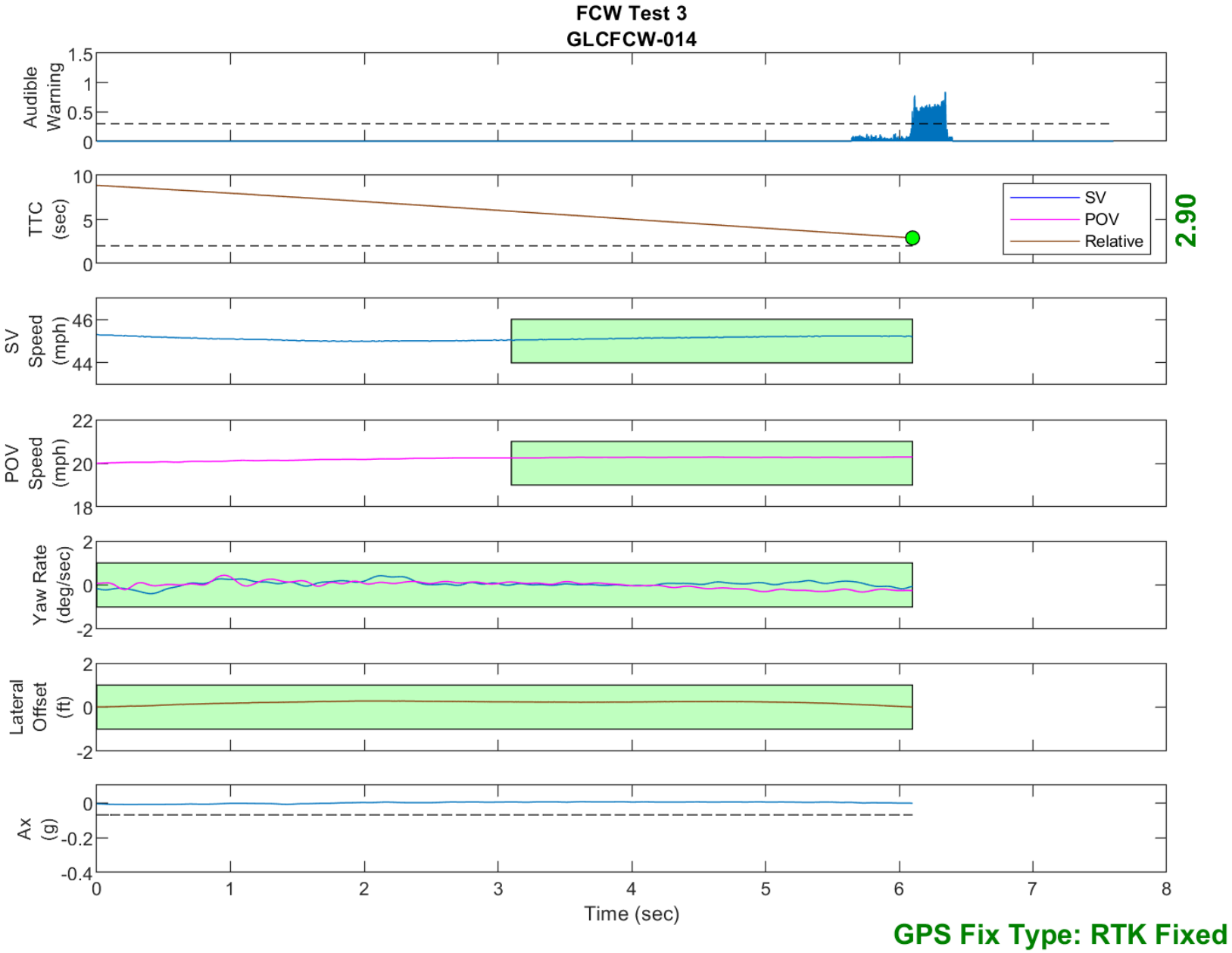


Figure D27. Time History for Run 14, FCW Test 3, Audible Warning