OCAS-DRI-FCW-13-010

NCAP FORWARD COLLISION WARNING CONFIRMATION TEST

2013 Ford Fusion

DYNAMIC RESEARCH, INC.
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Torrance, California 90501

26 March 2013

Final Report

Prepared Under Contract No.: DTNH22-08-D-00095

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
1200 New Jersey Avenue, SE
West Building, 4th Floor (NVS-120)
Washington, DC 20590

Prepared for the Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00095.

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15. Supplementary Notes

16. Abstract

These tests were conducted on the subject 2013 Ford Fusion in accordance with the specifications of the Office of Crash Avoidance Standards most current Test Procedure in docket NHTSA-2006-26555 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 "Forward Collision Warning Confirmation", March 2010. 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 SUMMARY

2013 Ford Fusion

VIN: *3FA6P0H99DR2xxxx*

Test Date: *3/6/2013*

Forward Collision Warning setting: *High*

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 2)

2013 Ford Fusion

TEST VEHICLE INFORMATION

VIN: *3FA6P0H99DR2xxxx*

Body Style: *Passenger Car* Color: *White*

Date Received: *2/26/2013* Odometer Reading: *312 mi*

Engine: *2 L Inline 4*

Transmission: *Automatic*

Final Drive: *FWD*

Is the vehicle equipped with:

ABS	X Yes	____ No
Adaptive Cruise Control	X Yes	____ No
Collision Mitigating Brake System	____ Yes	X No

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Ford Motor Company*

Date of manufacture: *12/12*

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: *235/45R18 94V*

Rear: *235/45R18 94V*

Recommended cold tire pressure: Front: *235 kPa (34 psi)*

Rear: *235 kPa (34 psi)*

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

(Page 2 of 2)

2013 Ford Fusion

TIRES

Tire manufacturer and model: *Goodyear Eagle LS2*

Front tire size: *235/45R18*

Rear tire size: *235/45R18*

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle

_X_ All options listed on the "window sticker" are present on the test vehicle

_X_ Tires and wheel rims are the same as listed.

_X_ There are no dents or other interior or exterior flaws.

_X_ The vehicle has been properly prepared and is in running condition.

_X_ Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS (Page 1 of 2)

2013 Ford Fusion

GENERAL INFORMATION

Test date: *3/6/2013*

AMBIENT CONDITIONS

Air temperature: *15.6 C (60 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: *235 kPa (34 psi)*

Rear: *235 kPa (34 psi)*

FORWARD COLLISION WARNING

DATA SHEET 3: TEST CONDITIONS (Page 2 of 2)

2013 Ford Fusion

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*534.3 kg (1178 lb)*	Right Front	*519.8 kg (1146 lb)*
Left Rear	*376.5 kg (830 lb)*	Right Rear	*348.4 kg (768 lb)*
		Total:	*1779.0 kg (3922 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

(Page 1 of 3)

2013 Ford Fusion

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 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 consists of both visual and aural alerts. The visual alert consists of a row of flashing red lights which are displayed on the HUD. The visual alert flashes 6 times.

The aural alert consists of repeated beeps whose primary frequency is approximately 1800 Hz.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2013 Ford Fusion

Is the vehicle equipped with a switch whose purpose is to render FCW inoperable?

____ Yes

__**X**__ No

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

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 FCW system can be adjusted through the menu settings operated by using a directional pad on the left side of the steering wheel. The settings can be adjusted between "High", "Normal", and "Low" sensitivity settings. This can be found through: Settings --> Driver Assist--> Collision Warn--> Sensitivity--> High/Normal/Low.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2013 Ford Fusion

Are there other driving modes or conditions that render FCW inoperable or reduce its effectiveness

____ Yes

__**X**__ No

If yes please provide a full description.

There may be certain instances where the vehicle does not provide a collision warning. These include:

- *Stationary vehicles or vehicles moving below 6 mph.*
- *Pedestrians or objects in the roadway.*
- *Oncoming vehicles in the same lane.*
- *Severe weather conditions (spray, snow, heavy rain, or fog).*
- *Debris build-up on the front grille near the headlamps.*
- *Small distance to the vehicle ahead.*
- *Steering wheel and pedal movements are large (very active driving style).*
- *High interior temperatures, which may deactivate the illumination of the warning lamps until the interior temperature reduces (audible warning still sounds).*

If the front end of the vehicle is hit or damaged, the radar sensing zone may be altered causing missed or false collision warnings.

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) on a Straight Road
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.

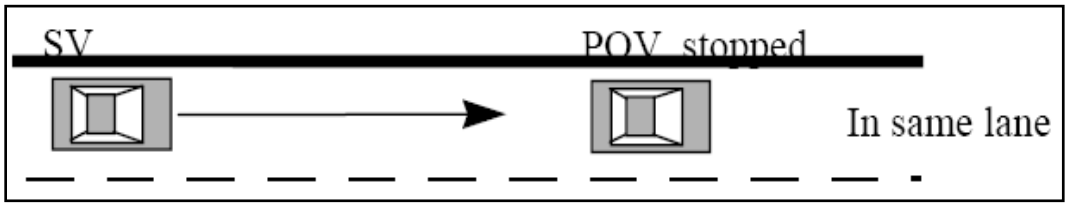


Figure 1. Depiction of Test 1

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. (Note: TTC values were computed in accordance with Ref 1). The TTC for this test was calculated by considering the speeds of the subject vehicle (SV) and the lead vehicle (POV) at the time of the FCW alert (i.e., when the SV and POV speeds are nominally equal to 45 and 0 mph (72.4 and 0 kph), respectively).

b. Procedure

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

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

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

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

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

- The SV vehicle speed could not deviate from the nominal speed by more than 1.0 mph (1.6 kph) for a period of three seconds prior to (1) the required FCW alert or (2) before the range fell to less than 90 percent 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 the required FCW alert occurred, or before the range fell to less than 90 percent 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.

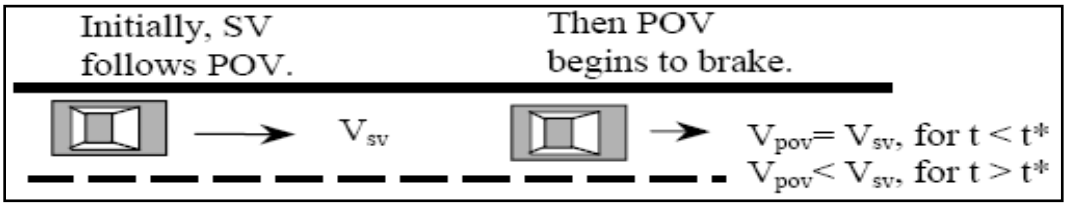


Figure 2. Depiction of Test 2

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

[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).

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

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

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

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

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

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

overshoot beyond the deceleration target was acceptable, however the first local deceleration peak observed during an individual trial could not exceed 0.375 g for more than 50 ms. Additionally, the deceleration could not exceed 0.33 g over a period defined from (1) 500 ms after the first local deceleration peak occurs, to (2) 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 the required FCW alert occurred, or before the range fell to less than 90 percent 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 issue a timely alert. As depicted in Figure 3, the scenario was conducted with a closing speed equal to 25.0 mph (40.2 kph).

Figure 3. Depiction of Test 3

a. Alert Criteria

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

b. Procedure

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

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

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

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

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

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

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

- SV driver could not apply any force to the brake pedal before the required FCW alert occurred, or before the range fell to less than 90 percent 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 2000 Honda Accord. This satisfied the test requirement of Ref 1 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.

As part of the pre-test instrumentation verification process, the tonal frequency of the audible warning was determined through use of the PSD (Power Spectral Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible warning data such that the beginning of the audible warning could be programmatically determined. The band-pass filter used for the audible warning signal was a phase-less, forward-reverse pass, 5^{th} order elliptical (Cauer) digital filter, with 3 dB peak-to-peak ripple, minimum stop-band attenuation of 60 dB, and a pass-band of center frequency +/- 5% of the identified center frequency.

TABLE 1. TEST INSTRUMENTATION AND EQUIPMENT

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	0.5 psi 3.45 kPa	Ashcroft, D1005PS
Platform Scales	Vehicle Total, Wheel, and Axle Load	8000 lb 35.6 kN	±1.0% of applied load	Intercomp, SWII
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)
Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots Accel: ±100 m/s^2 Angular Rate: ±100 deg/s Angular Disp: ±180 deg	Position: ±2 cm Velocity: 0.05 km/h Accel: ≤ 0.01% of full range Angular Rate: ≤ 0.01% of full range Roll/Pitch Angle: ±0.03 deg Heading Angle: ±0.1 deg	Oxford Technical Solutions (OXTS), Inertial+
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

TABLE 1. TEST INSTRUMENTATION AND EQUIPMENT (CONTD)

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model
Data Acquisition System [Includes amplification, anti-aliasing, and analog to digital conversion.]	Record Time; Position; Velocity; Distance to lane markings; Headway distance; Closing Velocity; Lateral, Longitudinal, and Vertical Accels; Roll, Yaw, and Pitch Rates; Roll, Yaw and Pitch Angles.	Sufficient to meet or exceed individual sensors	Sound digitized at 10 kHz, all other channels digitized at 100 Hz. Accuracy is sufficient to meet or exceed individual sensors	SoMat, eDaq ECPU processor
				SoMat, High level Board EHLS
Microphone	Sound (to measure time at alert)	Max SPL: 139 dB/SPL Frequency Response: 40 Hz – 20 kHz	≤ 3 dB over Freq. Resp. Range	Sennheiser, e614
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor
Accelerometer	Acceleration (to measure time at alert)	±5g	≤ 3% of full range	Silicon Designs, 2210-005
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

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle

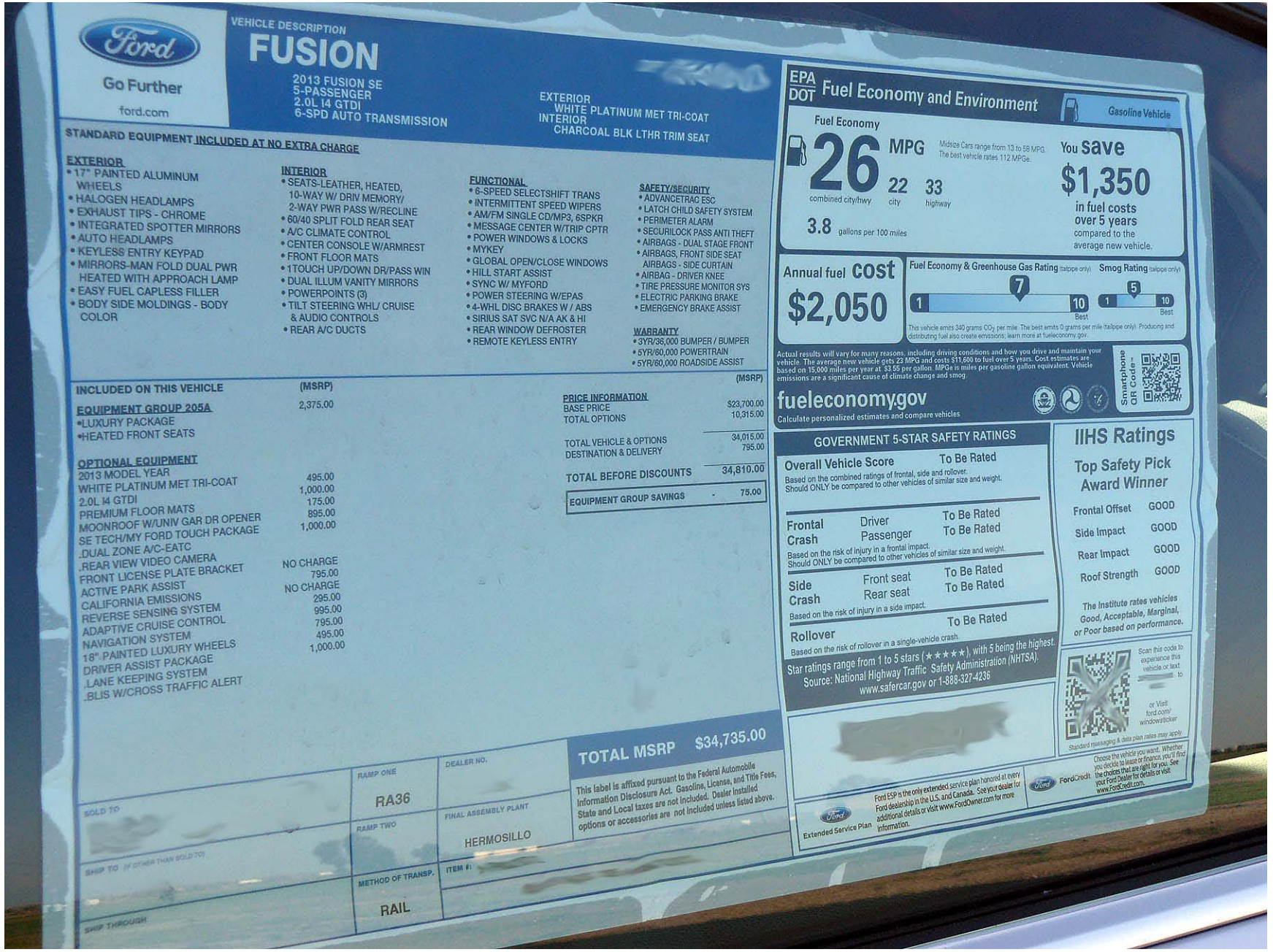


Figure A3. Window Sticker (Monroney Label)

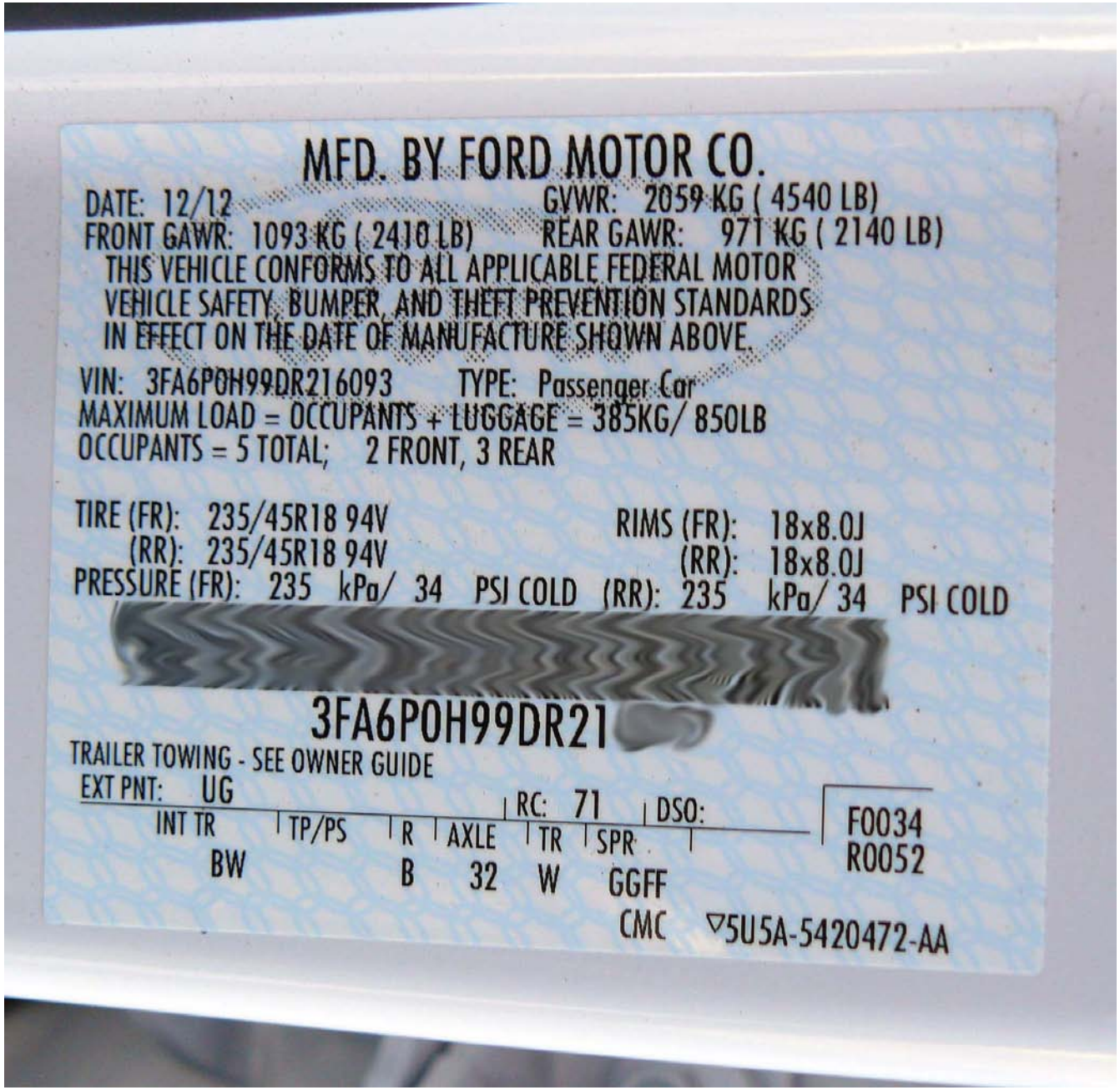


Figure A4. Vehicle Certification Label

Figure A5. Front View of Principal Other Vehicle

Figure A6. Rear View of Principal Other Vehicle

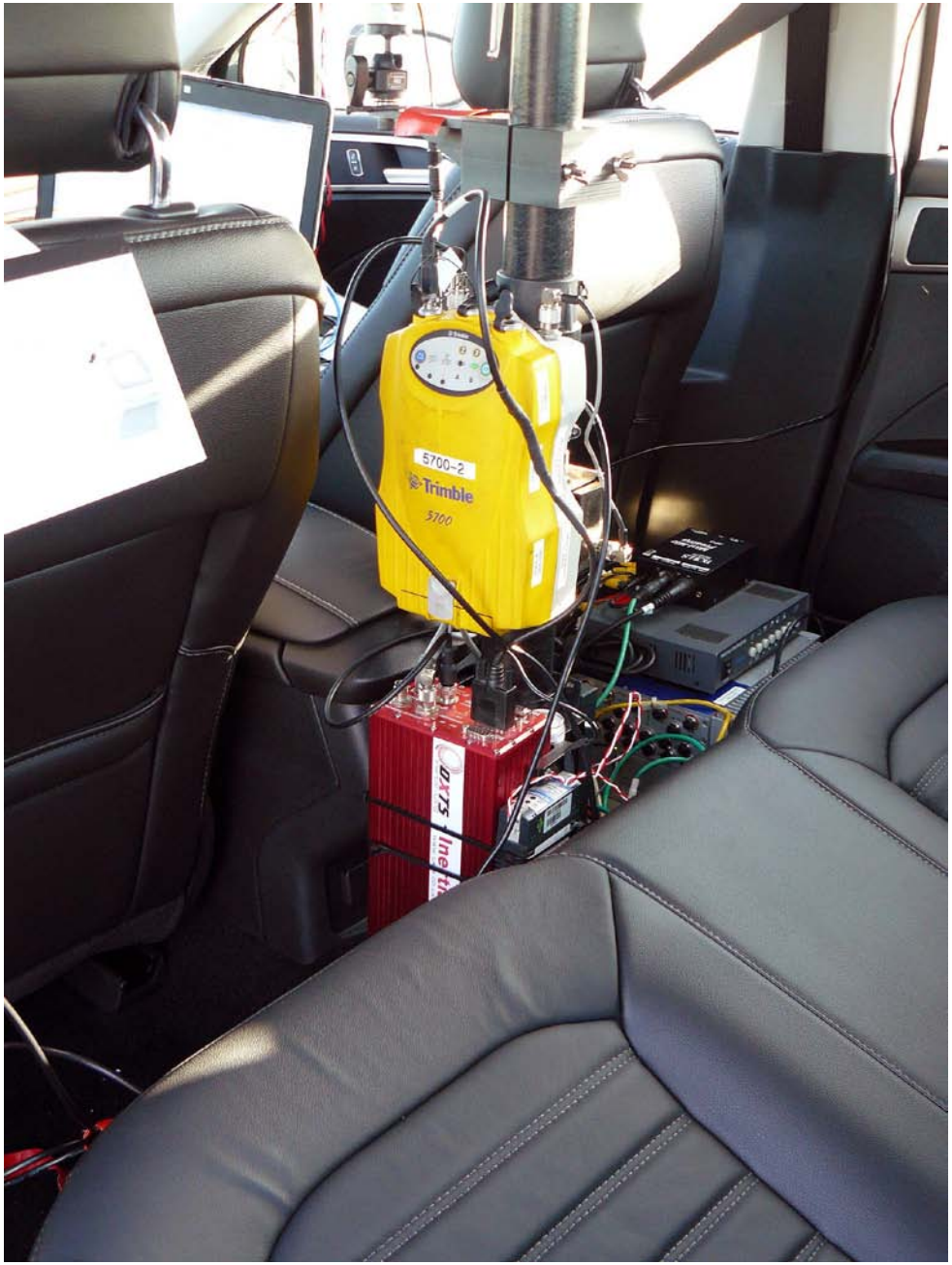


Figure A7. DGPS and Inertial Measurement Unit Installed in Subject Vehicle

Figure A8. Data Acquisition System Installed in Subject Vehicle

Figure A9. Computer Installed in Subject Vehicle

Figure A10. Brake Actuation System Installed in Principal Other Vehicle

Figure A11. Sensors for Detecting Acoustic and Visual Alerts

Figure A12. Visual Warning Display

Figure A13. Adjustment of FCW Settings

Figure A14. Adjustment of FCW Settings (cont)

APPENDIX B

Excerpts from Owner's Manual

Heads Up Display (If Equipped)

A red beam of lights will illuminate on the windshield in certain instances when using adaptive cruise control and/or the collision warning system. It will also illuminate momentarily when you start your vehicle to make sure the display works.

High Beam

It will illuminate when you switch the high beam headlamps on. It will flash when you use the headlamp flasher.

Hood Ajar

Displays when the ignition is on and the hood is not completely closed.

Lane Keeping Aid (If Equipped)

Illuminates when the lane keeping system is activated.

Low Fuel Level

It will illuminate when the fuel level is low or the fuel tank is nearly empty. Refuel as soon as possible.

Low Tire Pressure Warning

It will illuminate when your tire pressure is low. If the lamp remains on with the engine running or when driving, check your tire pressure as soon as possible.

It will also illuminate momentarily when you switch the ignition on to confirm the lamp is functional. If it does not illuminate when you switch the ignition on, or begins to flash at any time, have the system checked by your authorized dealer.

Parking Lamps

It will illuminate when you switch the parking lamps on.

Powertrain Fault

Illuminates when a powertrain or an AWD fault has been detected. Contact your authorized dealer as soon as possible.

Service Engine Soon

If the service engine soon indicator light stays illuminated after the engine is started, it indicates that the On Board Diagnostics system (OBD) has detected a malfunction of the vehicle emissions control system. Refer to On board diagnostics (OBD) in the Fuel and Refueling chapter for more information about having your vehicle serviced. See **Emission Control System** (page 155).

If the light is blinking, engine misfire is occurring which could damage your catalytic converter. Drive in a moderate fashion (avoid heavy acceleration and deceleration) and have your vehicle serviced immediately.

Note: *Under engine misfire conditions, excessive exhaust temperatures could damage the catalytic converter or other vehicle components.*

Blind Spot Information and Cross Traffic Alert System

Message	Action
Blindspot System Fault	Displayed when a fault with the system has occurred. Contact your authorized dealer as soon as possible.
Blindspot Not Available Sensor Blocked See Manual	Displayed when the system sensors are blocked. Contact your authorized dealer as soon as possible. See **Blind Spot Monitor** (page 198).
Cross Traffic Vehicle Coming From X	Displayed when the system detects a vehicle. See **Blind Spot Monitor** (page 198).
Cross Traffic Not Available Sensor Blocked See Manual	Displayed when the blind spot information system and cross traffic alert system sensors are blocked. See **Blind Spot Monitor** (page 198).
Cross Traffic System Fault	Displays when a fault with the system has occurred. Contact your authorized dealer as soon as possible.

Collision Warning System

Message	Action
Collision Warning Malfunction	Displayed when there is a system malfunction with the collision warning system. The system will be disabled. Contact your authorized dealer as soon as possible.
Collision Warning Not Available Sensor Blocked See Manual	Displayed when the collision warning system radar is blocked because of poor radar visibility due to bad weather or ice/mud/water in front of the radar. Driver can typically clean the sensor to resolve. Contact your authorized dealer as soon as possible.
Collision Warning Not Available	Displayed when there is a system malfunction with the collision warning system. The system will be disabled. Contact your authorized dealer as soon as possible.

The status bar will travel from left to right as the calculated alertness level decreases. As the rest icon is approached the color turns from green to yellow and then finally red when a rest break should be taken.

- Green - No rest required.
- Yellow - First (temporary) warning.
- Red - Second warning.

Note: *If you have recently received a warning; you should consider resting, even if the current assessment is with the typical range.*

Note: *The alertness level will be shown in grey if the camera sensor cannot track the road lane markings or if the vehicle speed drops below approximately 40 mph (65 km/h).*

Resetting the System

You can reset the system by either:

- Switching the ignition off and on.
- Stopping the vehicle and then opening and closing the driver's door.

COLLISION WARNING SYSTEM (If Equipped)

WARNINGS

This system is designed to be a supplementary driving aid. It is not intended to replace the driver's attention, and judgment, or the need to apply the brakes. This system does NOT activate the brakes automatically. Failure to press the brake pedal to activate the brakes may result in a collision.

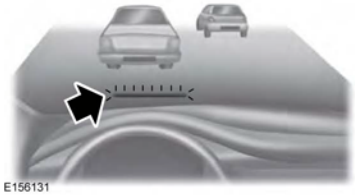
The collision warning system with brake support cannot help prevent all collisions. Do not rely on this system to replace driver judgment and the need to maintain distance and speed.

Note: *The system does not detect, warn or respond to potential collisions with vehicles to the rear or sides of the vehicle.*

Note: *The collision warning system is active at speeds above approximately 5 mph (8 km/h).*

E156130

This system is designed to alert the driver of certain collision risks. A radar detects if your vehicle is rapidly approaching another vehicle traveling in the same direction as yours.



E156131

If it is, a red warning light illuminates and an audible warning chime sounds.

The brake support system assists the driver in reducing the collision speed by charging the brakes. If the risk of collision further increases after the warning light illuminates, the brake support prepares the brake system for rapid braking. This may be apparent to the driver. The system does not automatically activate the brakes but, if the brake pedal is pressed, full force braking is applied even if the brake pedal is lightly pressed.

Using the Collision Warning System

WARNING

The collision warning system's brake support can only help reduce the speed at which a collision occurs if the driver applies the vehicle's brakes. The brake pedal must be pressed just like any typical braking situation.

The warning system and chime can be turned on and off separately by using the information display control. See **General Information** (page 82).

Note: *If the system cannot be turned off in a vehicle equipped with MyKey®, See **Principle of Operation** (page 48).*

Blocked Sensors

E145632

If a message regarding a blocked sensor appears in the information display, the radar signals from the sensor have been obstructed. The sensors are located behind a fascia cover near the driver side of the lower grille. When the sensors are obstructed, a vehicle ahead cannot be detected and the collision warning system does not function. The following table lists possible causes and actions for this message being displayed.

Cause	Action
The surface of the radar in the grille is dirty or obstructed in some way	Clean the grille surface in front of the radar or remove the object causing the obstruction
The surface of the radar in the grille is clean but the message remains in the display	Wait a short time. It may take several minutes for the radar to detect that it is no longer obstructed
Heavy rain, spray, snow, or fog is interfering with the radar signals	The collision warning system is temporarily disabled. Collision warning should automatically reactivate a short time after the weather conditions improve
Swirling water, or snow or ice on the surface of the road may interfere with the radar signals	The collision warning system is temporarily disabled. Collision warning should automatically reactivate a short time after the weather conditions improve

System Limitations

WARNING

The collision warning system's brake support can only help reduce the speed at which a collision occurs if the driver applies the vehicle's brakes. The brake pedal must be pressed just like any typical braking situation.

Due to the nature of radar technology, there may be certain instances where vehicles do not provide a collision warning. These include:

- Stationary vehicles or vehicles moving below 6 mph (10 km/h).
- Pedestrians or objects in the roadway.
- Oncoming vehicles in the same lane.
- Severe weather conditions (see blocked sensor section).
- Debris build-up on the grille near the headlamps (see blocked sensor section).
- Small distance to vehicle ahead.
- Steering wheel and pedal movements are large (very active driving style).
-

Certain conditions may reduce the visibility of the warning lamp; therefore, it is recommended to keep the audible warning on.

If the front end of the vehicle is hit or damaged, the radar sensing zone may be altered causing missed or false collision warnings. See your authorized dealer to have your collision warning radar checked for proper coverage and operation.

LANE KEEPING SYSTEM (IF EQUIPPED)

WARNING

The system is designed to aid the driver. It is not intended to replace the driver's attention and judgment. The driver is still responsible to drive with due care and attention.

Note: *The system needs to be activated by the driver at each key cycle.*

Note: *The system works above 40 mph (64 km/h).*

Note: *The system works as long as one lane marking can be detected by the camera.*

Note: *If the camera is blocked or if the windshield is damaged, the system may not function.*

Note: *When Aid mode is on and the system detects no driver steering activity for a short continuous period of time, the system alerts the driver to put their hands on the steering wheel. The system may detect a light grip/touch on the steering wheel as hands off driving.*

The system detects unintentional drifting toward the outside of the lane and alerts and/or aids the driver to stay in the lane through the steering system and instrument cluster display. The system automatically detects and tracks the road lane markings using a camera that is mounted behind the interior rear view mirror.

Switching the System On and Off

Note: *The system defaults to off each time the vehicle is started, unless a MyKey® is detected. If a MyKey® is detected, the system is defaulted to on and the Alert mode is automatically selected.*

APPENDIX C

Run Log

Subject Vehicle: **2013 Ford Fusion** Date: 5 March 2013

Principal Other Vehicle: 2000 Honda Accord

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW CAN Sound (sec)	TTCW CAN Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	FCW1 (Stopped)	Y	2.28	2.36	2.36	2.38	0.26	Pass	
2		Y	2.33	2.44	2.39	2.45	0.35	Pass	
3		Y	2.33	2.39	2.39	2.41	0.31	Pass	
4		Y	2.38	2.42	2.44	2.44	0.34	Pass	
5		Y	2.40	2.45	2.46	2.46	0.36	Pass	
6		Y	2.26	2.37	2.33	2.39	0.29	Pass	
7		Y	2.31	2.37	2.39	2.39	0.29	Pass	
8	FCW3 (Slower)	Y	2.82	2.92	2.89	2.95	0.95	Pass	
9		Y	2.64	2.74	2.70	2.76	0.76	Pass	
10		Y	2.60	2.64	2.66	2.66	0.66	Pass	
11		Y	2.59	2.67	2.65	2.69	0.69	Pass	
12		Y	2.53	2.59	2.61	2.61	0.61	Pass	
13		Y	2.58	2.71	2.66	2.72	0.72	Pass	
14		Y	2.72	2.79	2.79	2.81	0.81	Pass	
15	FCW2 (Braking)	Y	2.968	3.08	3.06	3.09	0.69	Pass	
16		Y	2.94	3.01	3.01	3.02	0.62	Pass	
17		Y	3.07	3.11	3.13	3.13	0.73	Pass	

Subject Vehicle: **2013 Ford Fusion** Date: 5 March 2013

Principal Other Vehicle: 2000 Honda Accord

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW CAN Sound (sec)	TTCW CAN Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
18	FCW2 (Braking)	N							GPS fix
19		Y	3.04	3.07	3.09	3.09	0.69	Pass	
20		Y	3.04	3.18	3.09	3.20	0.80	Pass	
21		N							GPS fix
22		Y	3.06	3.10	3.10	3.11	0.71	Pass	
23		N							Ran out of track
24		Y	2.97	3.06	3.05	3.09	0.69	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 and the Principal Other Vehicle, 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. The data shown in time history plots for test type 2 differs slightly from the data shown in test types 1 and 3, owing to the headway distance criterion which is used exclusively for test type 2.

Time history figures include the following sub-plots:

- Event – indicates timing of warning issued by FCW system. Depending on the type of FCW alert or instrumentation used to measure the alert, this can be any of the following,:
    - Filtered and rectified sound signal
    - Filtered and rectified acceleration (e.g., steering wheel vibration)
    - Light sensor signal
    - Discrete on/off value
- TTC (sec) – indicates the Time to Collision as calculated up to the point of FCW alert issuance. The value of TTCW (Time to Collision at Warning) is given numerically on the right side of the figure. A passing value is indicated in green, while a failing value is indicated in red.
- SV Speed (mph) – speed of the Subject Vehicle
- POV Speed (mph) – speed of the Principal Other Vehicle
- Yaw Rate (deg/sec) – yaw rate of both the Subject Vehicle and Principal Other Vehicle
- Lateral Offset (ft) – lateral offset within the lane from the Subject Vehicle to the Principal Other Vehicle
- Ax (g) – Longitudinal acceleration of both the Subject Vehicle and Principal Other Vehicle
- Headway (ft) – Longitudinal separation between front of Subject Vehicle to rear of Principal Other Vehicle (Exclusive to test type 2)

Envelopes and Thresholds

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

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

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

For test type 2, the plot indicating the longitudinal acceleration of the Principal Other Vehicle includes a solid black threshold line indicating the maximum deceleration (-0.33 g) allowed while braking. Exceedance of this threshold is indicated with red shading in the area between the measured time-varying data and 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.

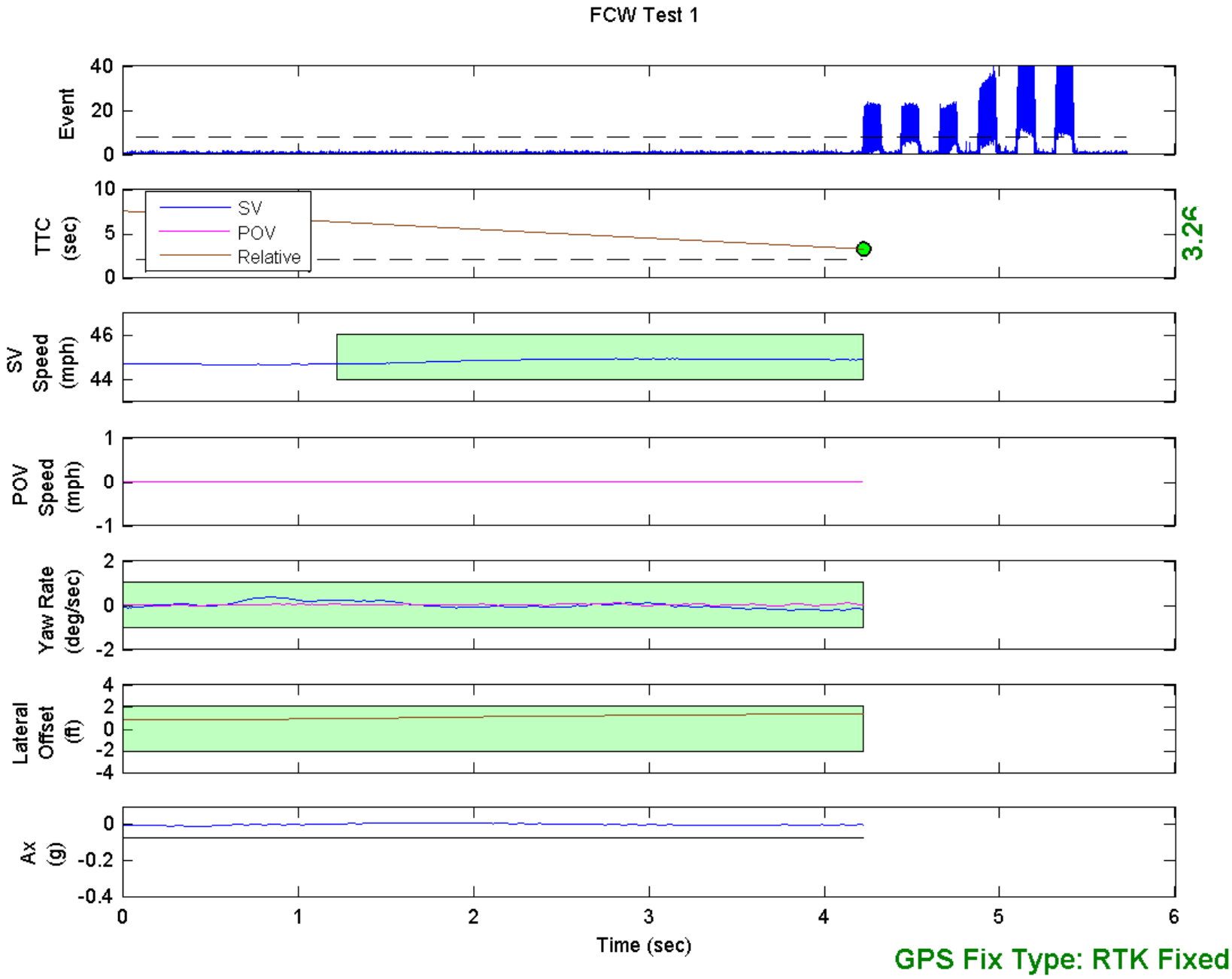


Figure D1. Example Time History for Test Type 1, Passing

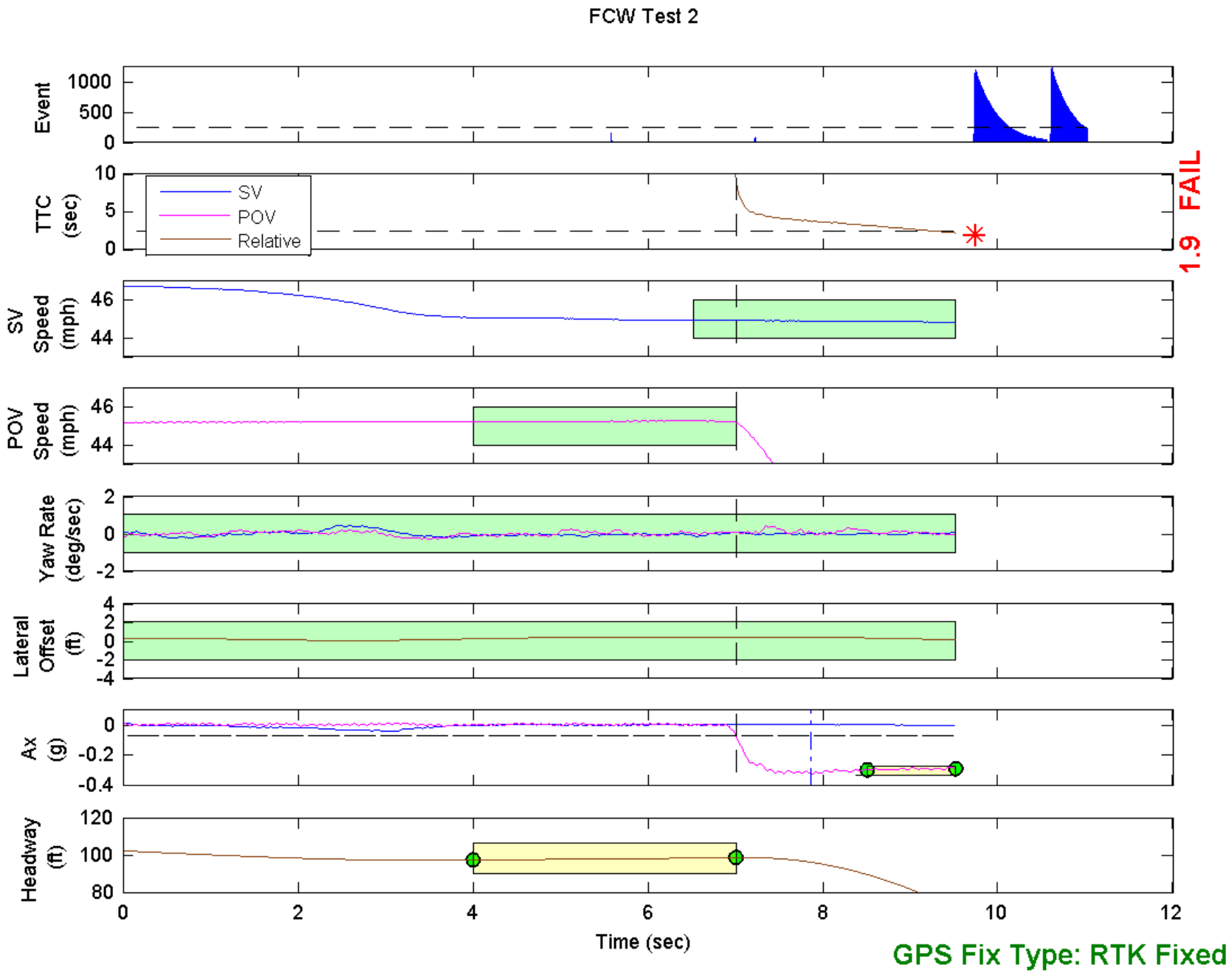


Figure D2. Example Time History for Test Type 2, Failing

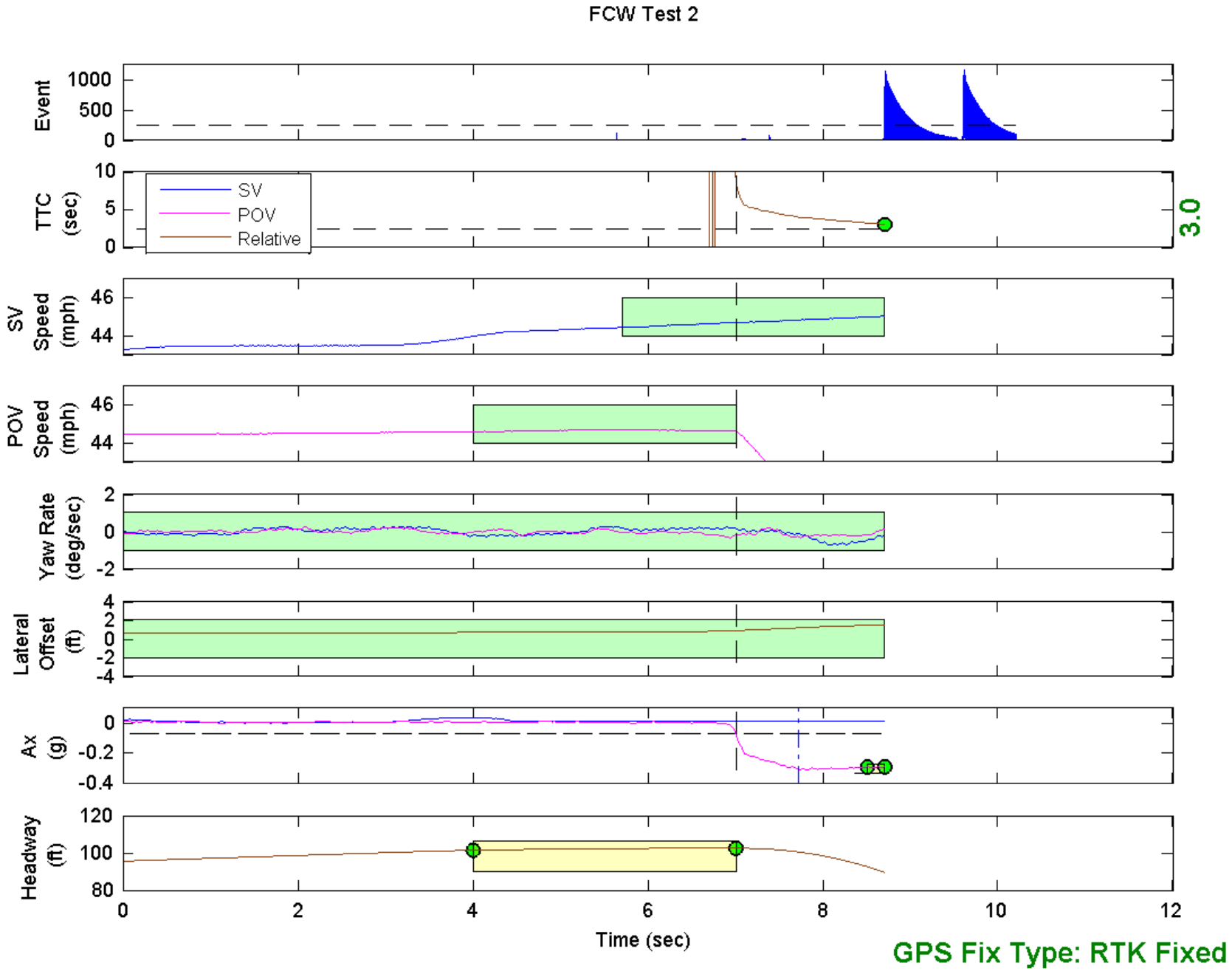


Figure D3. Example Time History for Test Type 2, Passing

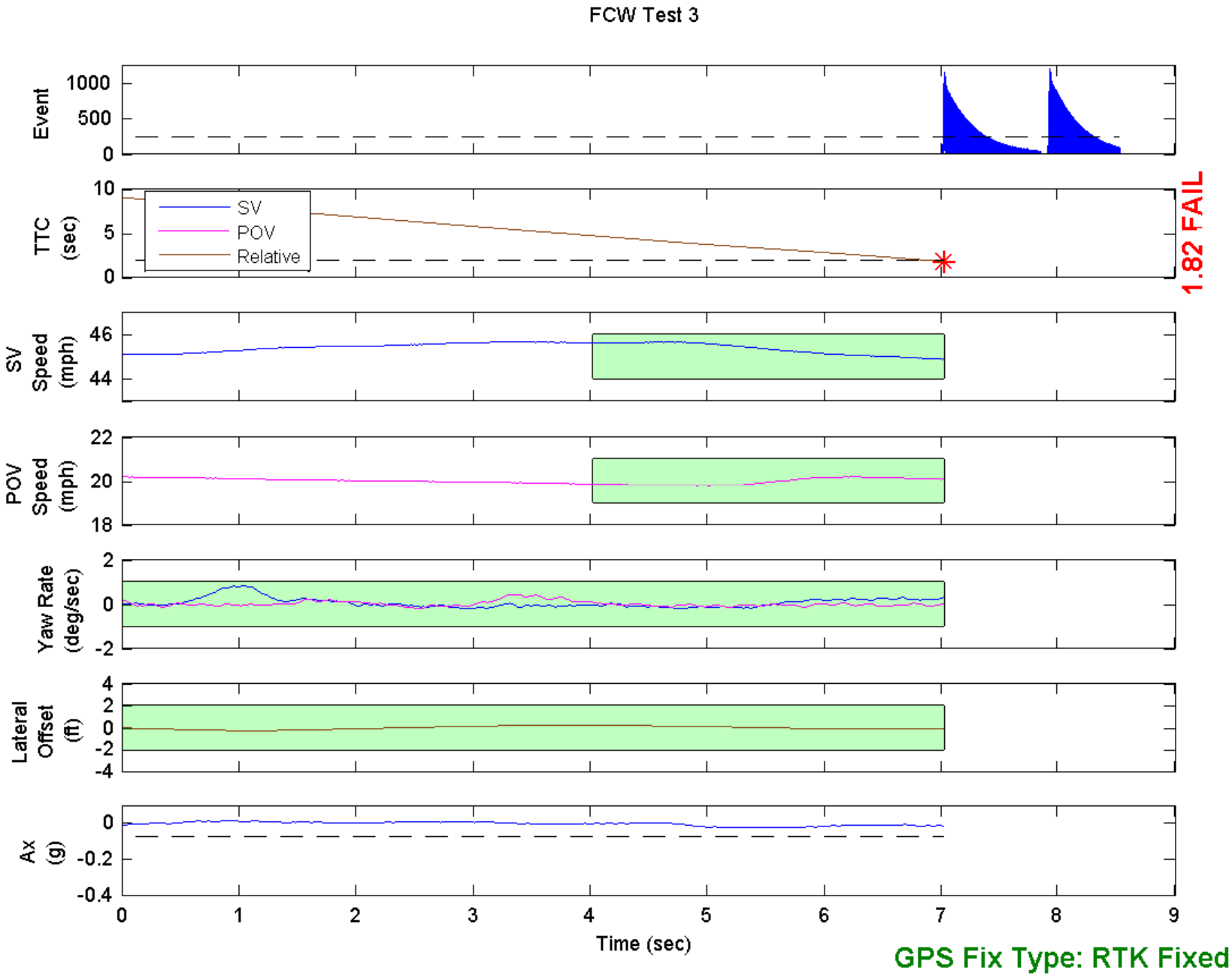


Figure D4. Example Time History for Test Type 3, Failing

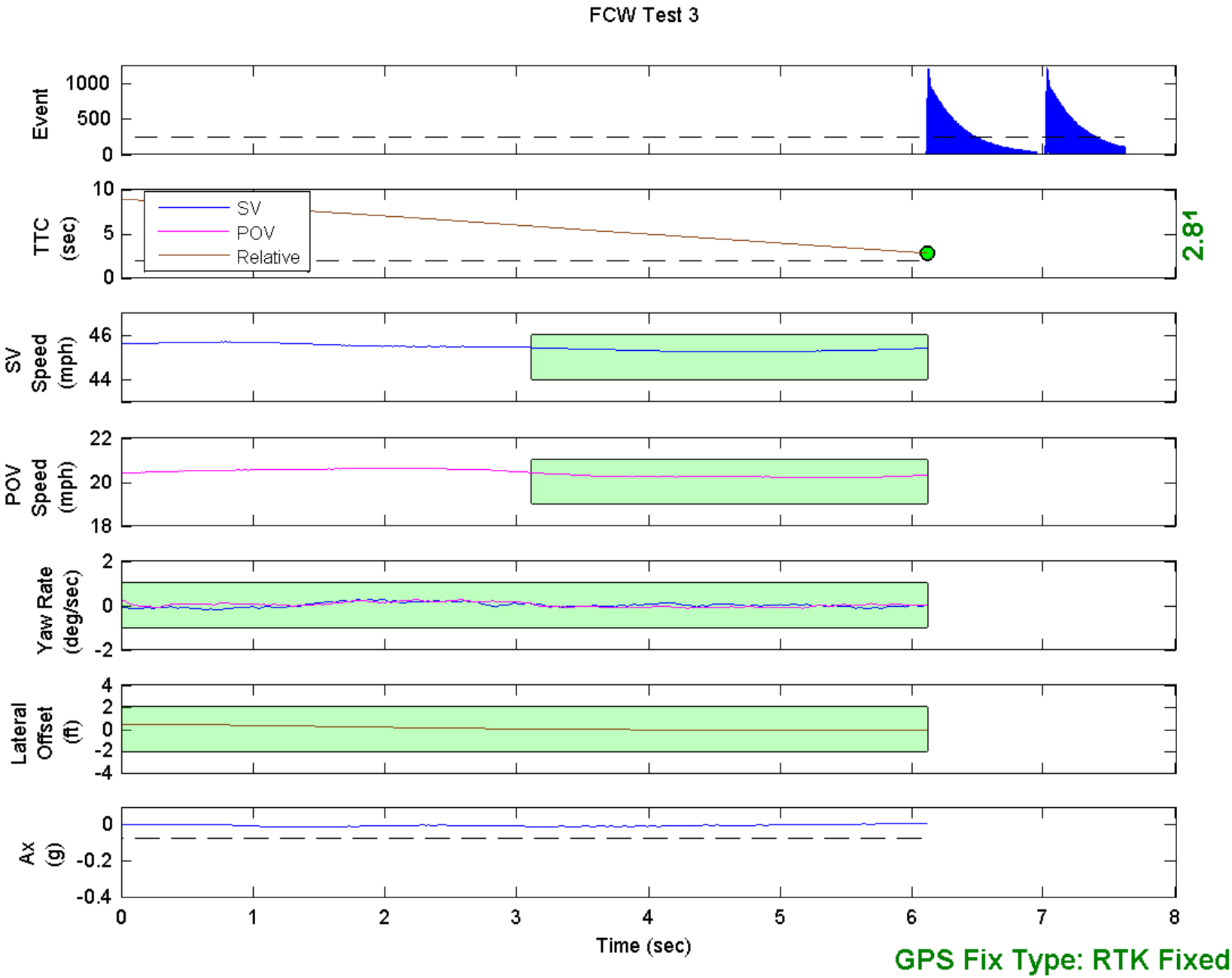


Figure D5. Example Time History for Test Type 3, Passing

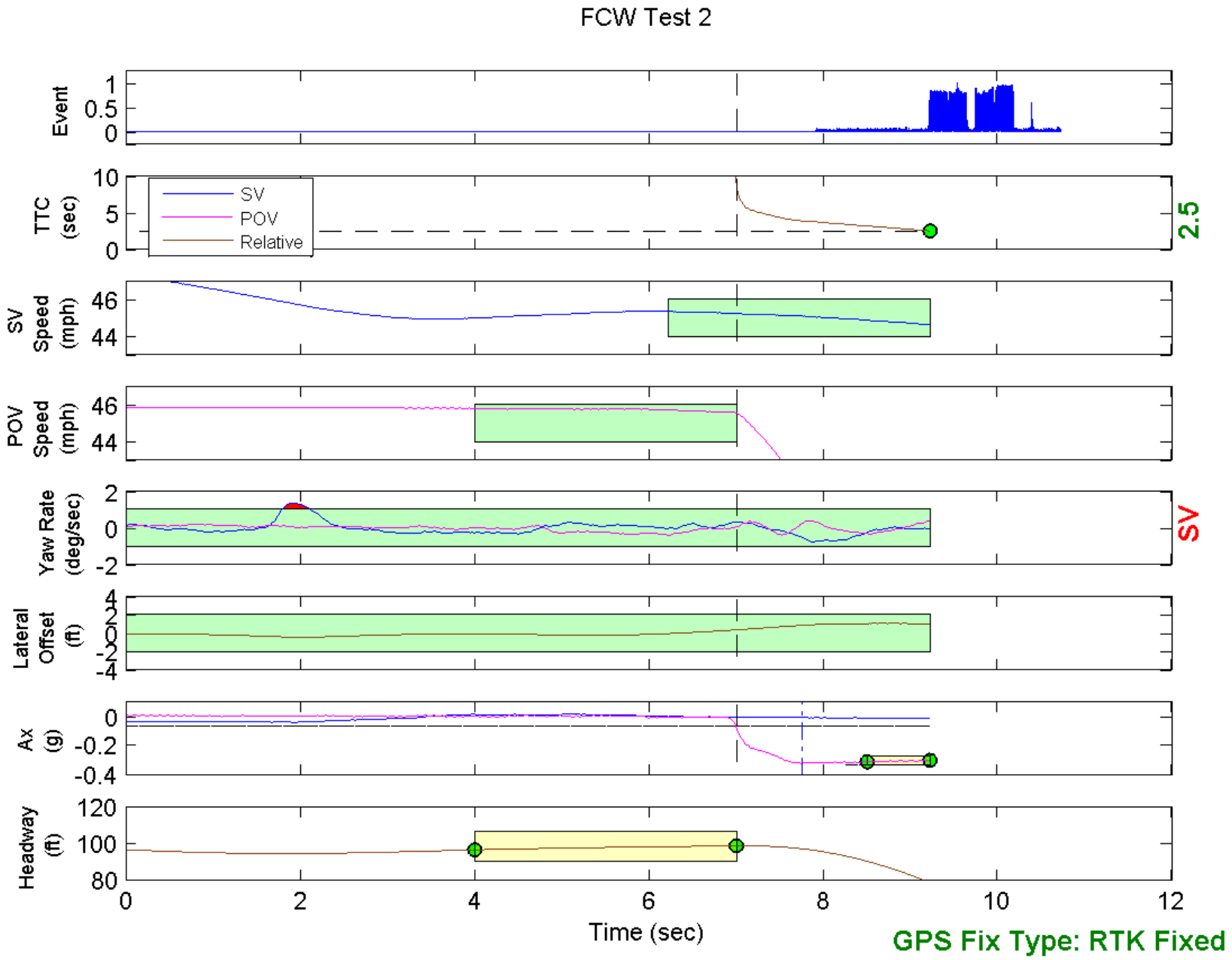


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

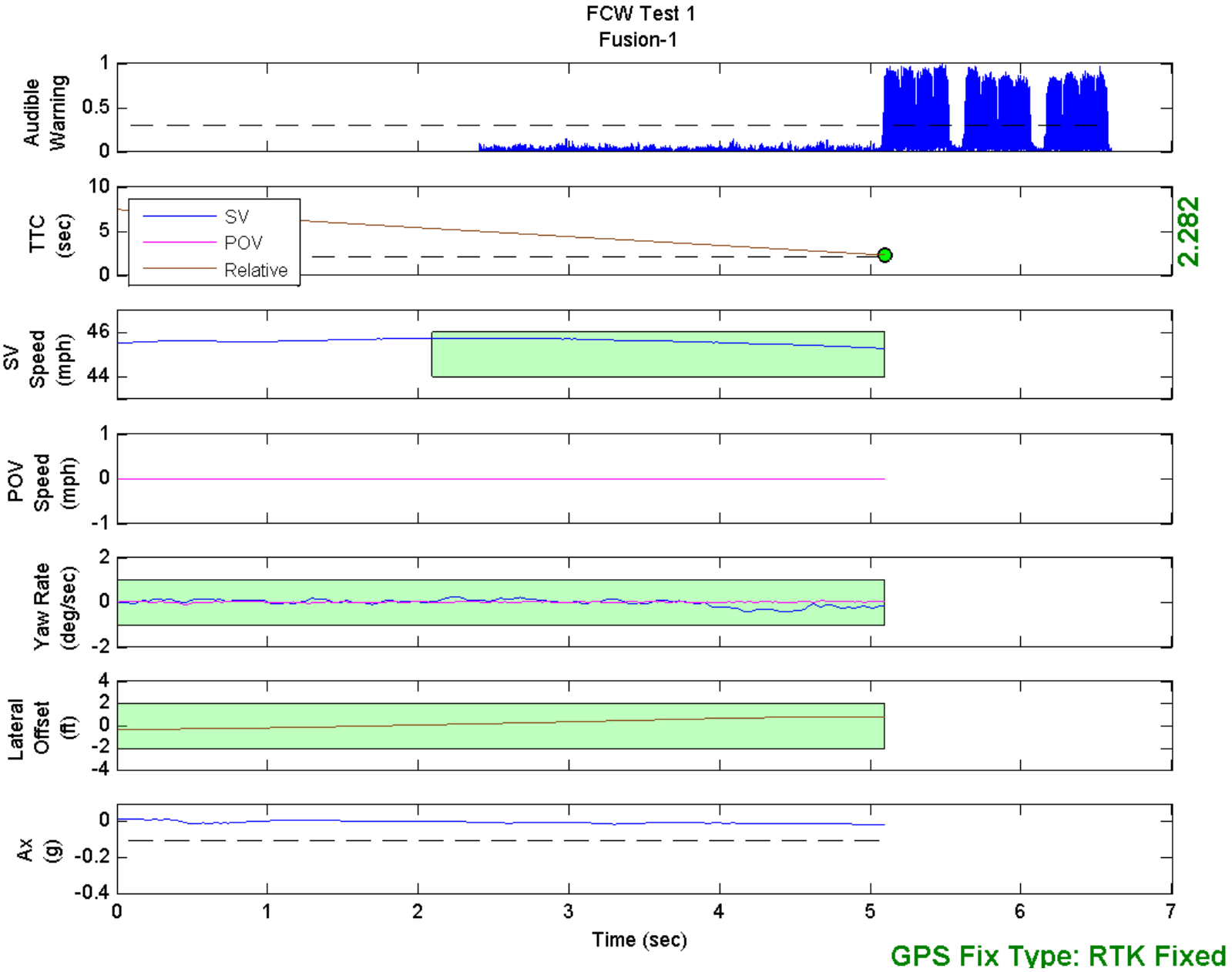


Figure D7. Time History for Run 1, FCW Test 1, Audible Warning

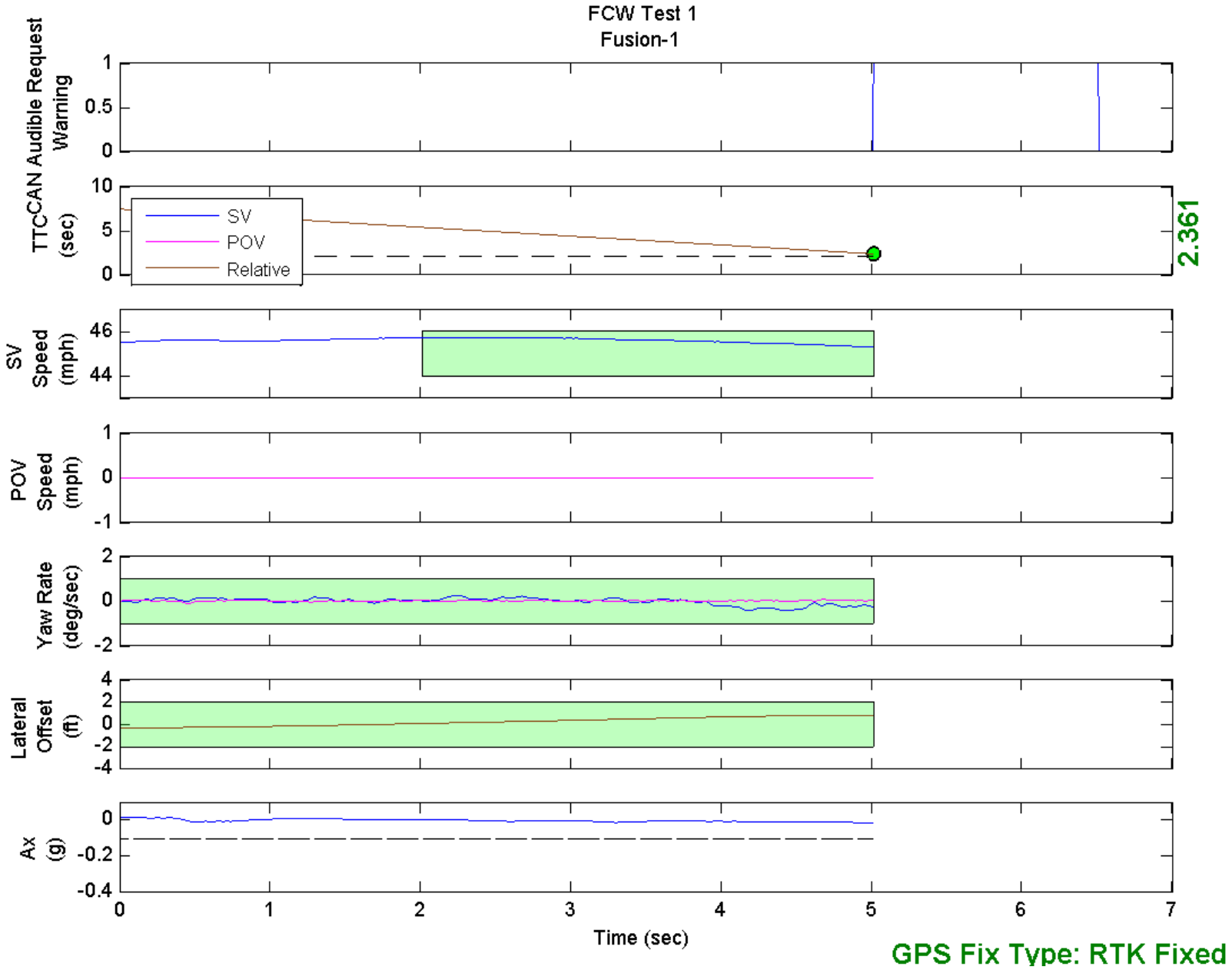


Figure D8. Time History for Run 1, FCW Test 1, CAN Audible Warning Request

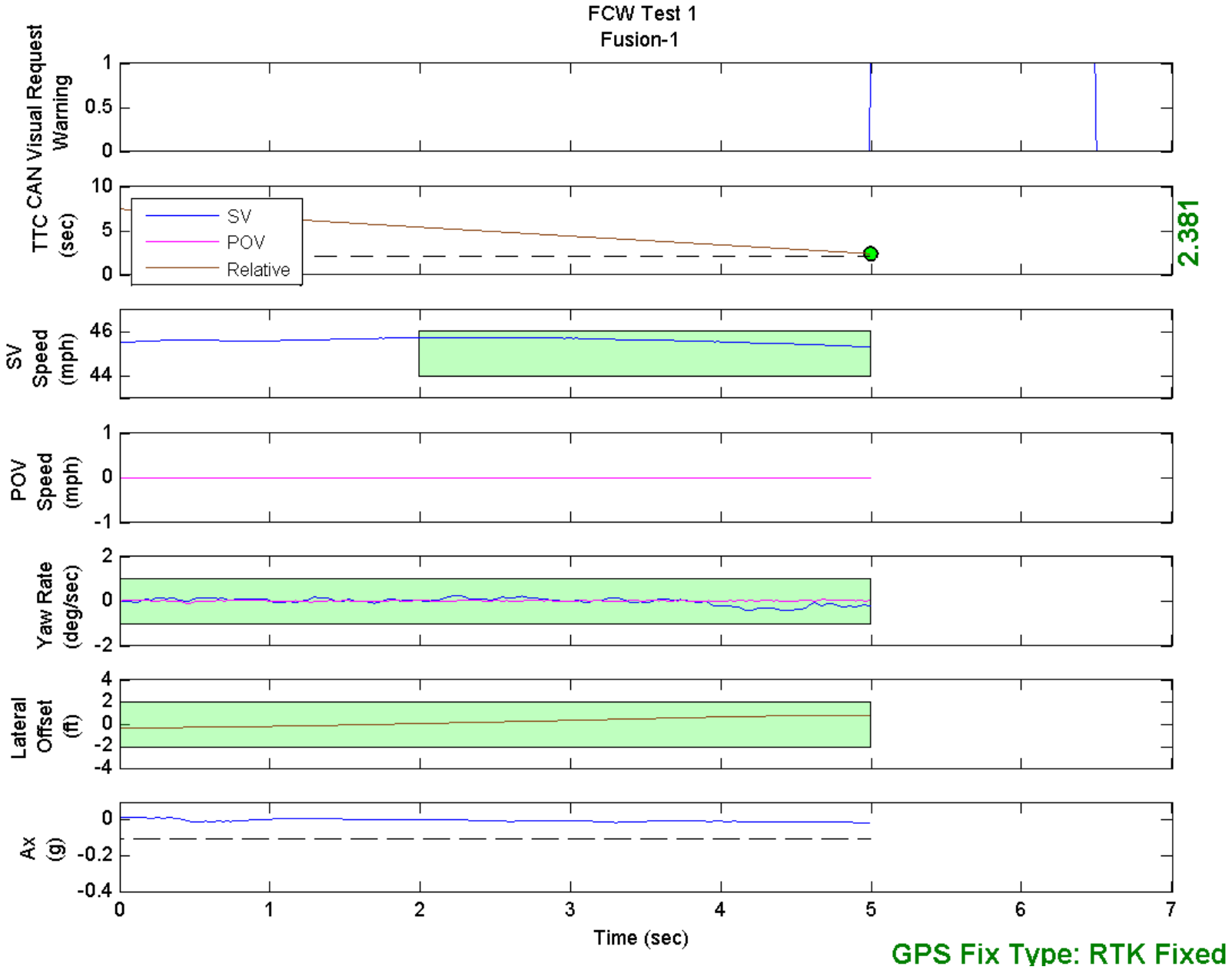


Figure D9. Time History for Run 1, FCW Test 1, CAN Visual Warning Request

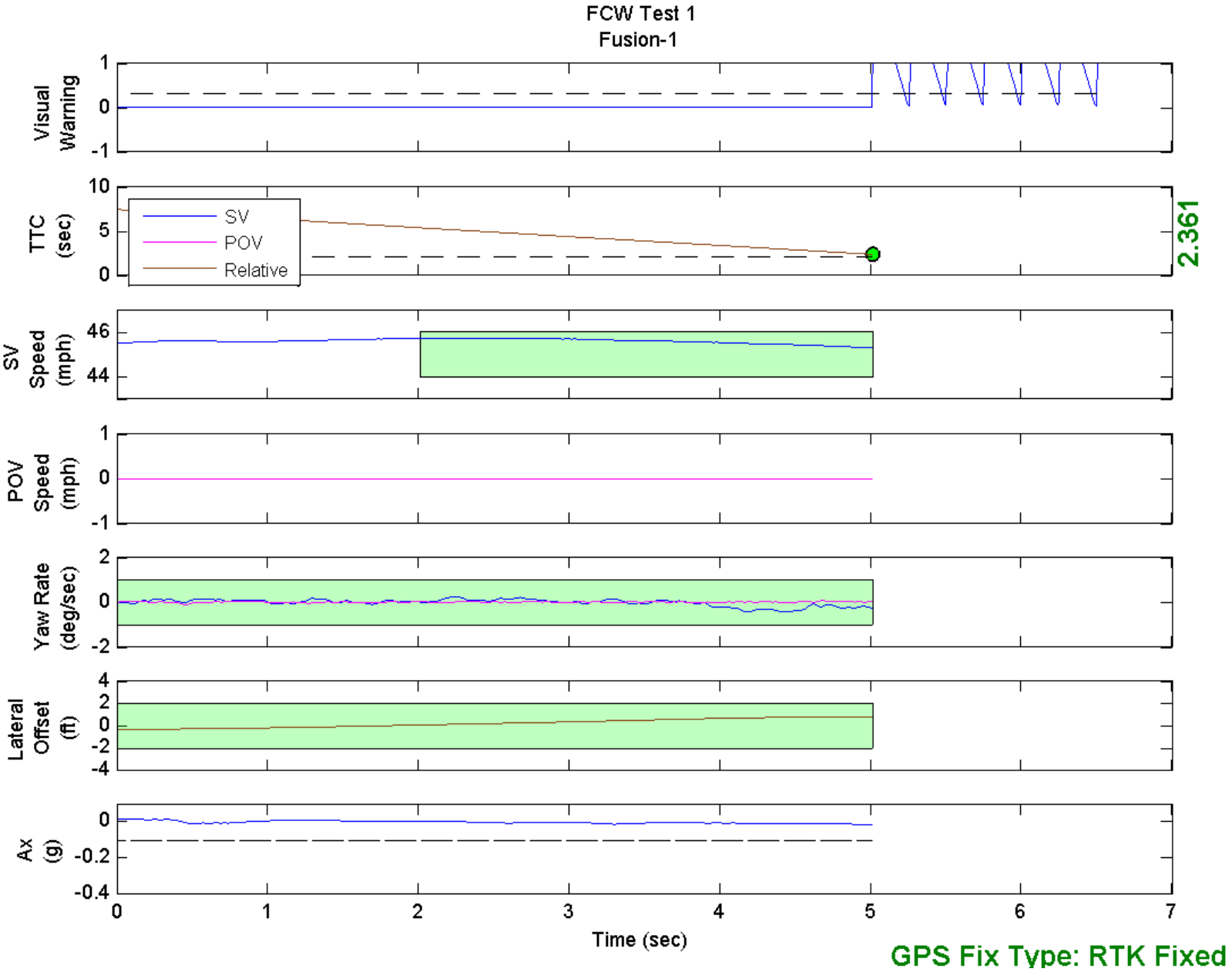


Figure D10. Time History for Run 1, FCW Test 1, Visual Warning

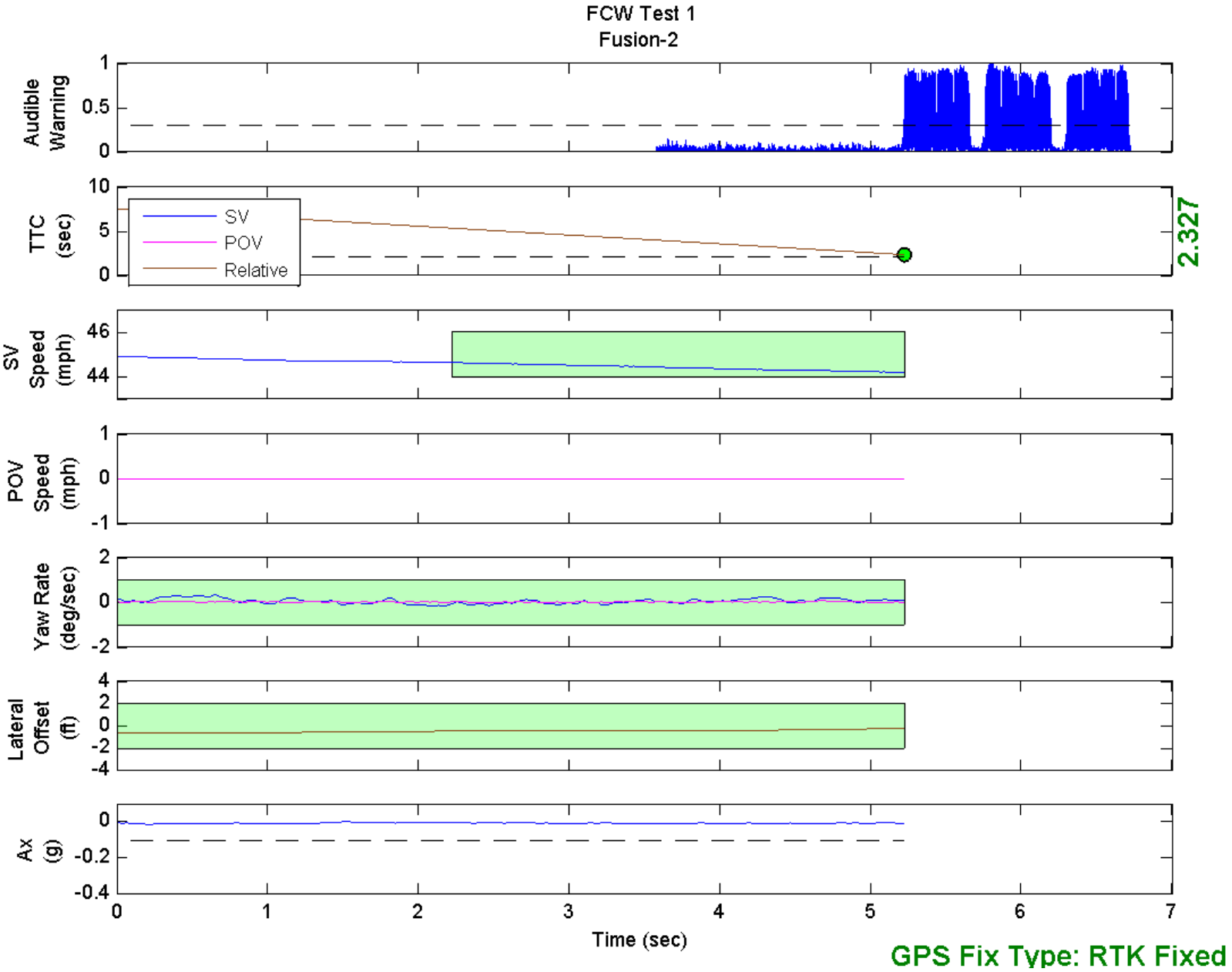


Figure D11. Time History for Run 2, FCW Test 1, Audible Warning

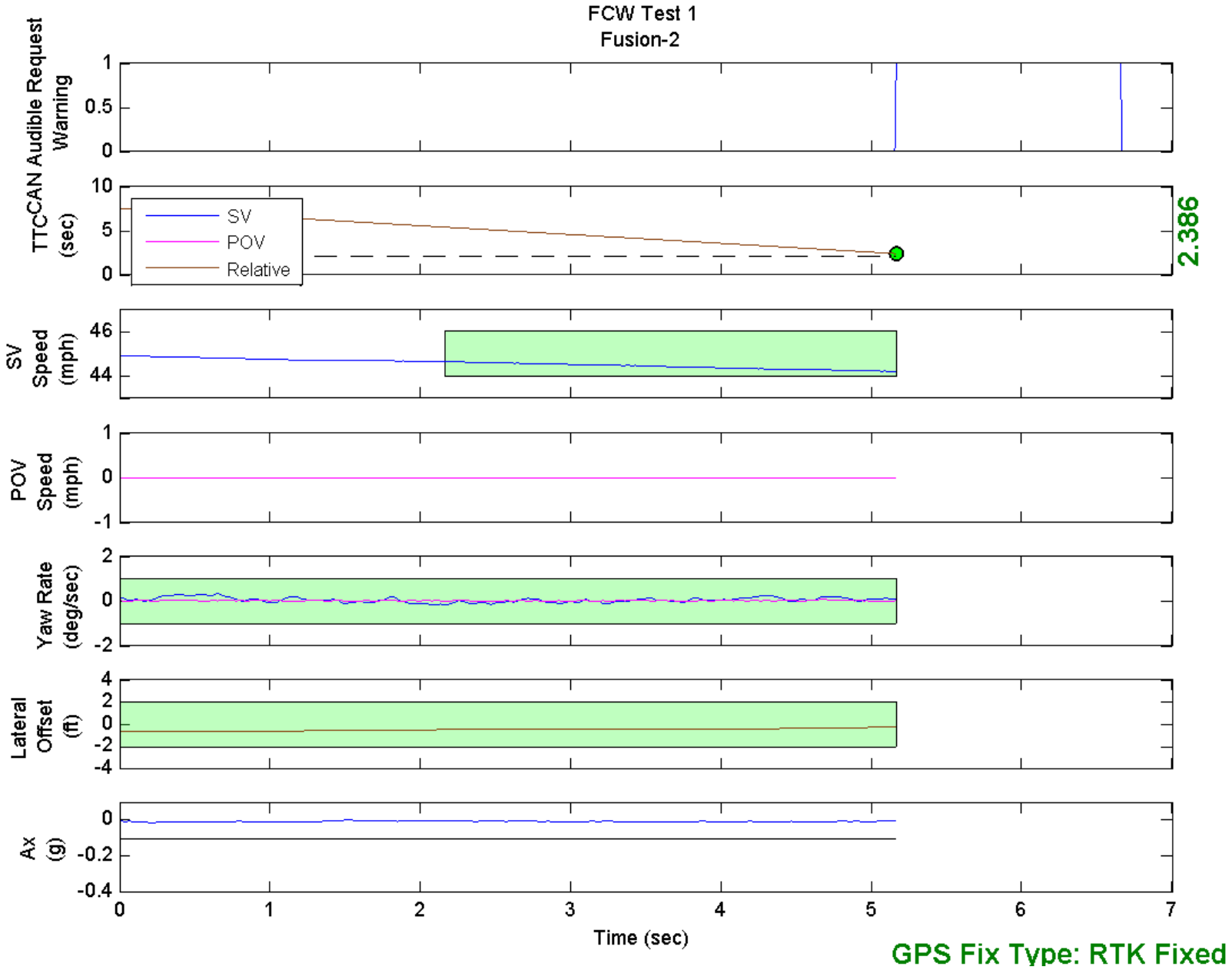


Figure D12. Time History for Run 2, FCW Test 1, CAN Audible Warning Request

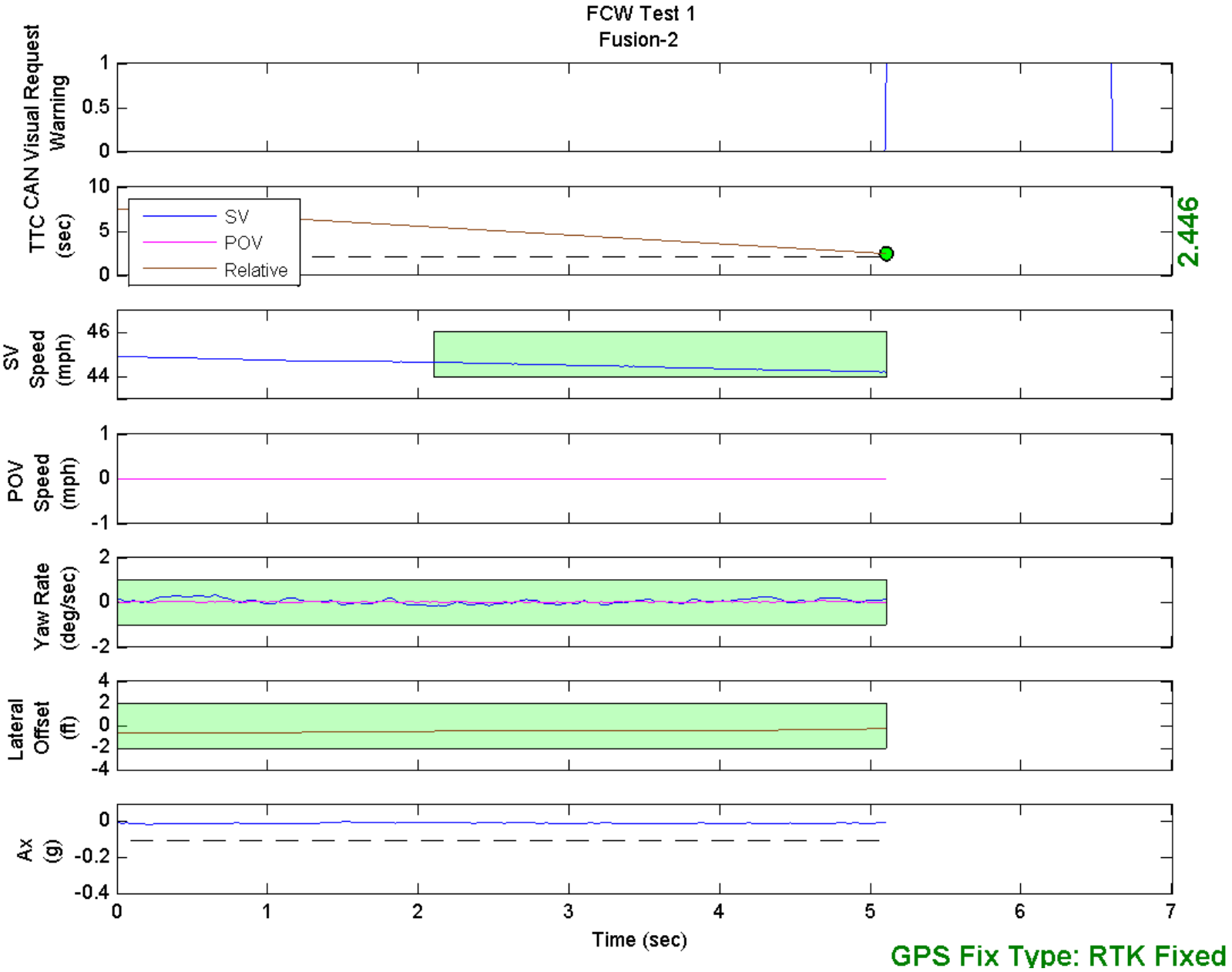


Figure D13. Time History for Run 2, FCW Test 1, CAN Visual Warning Request

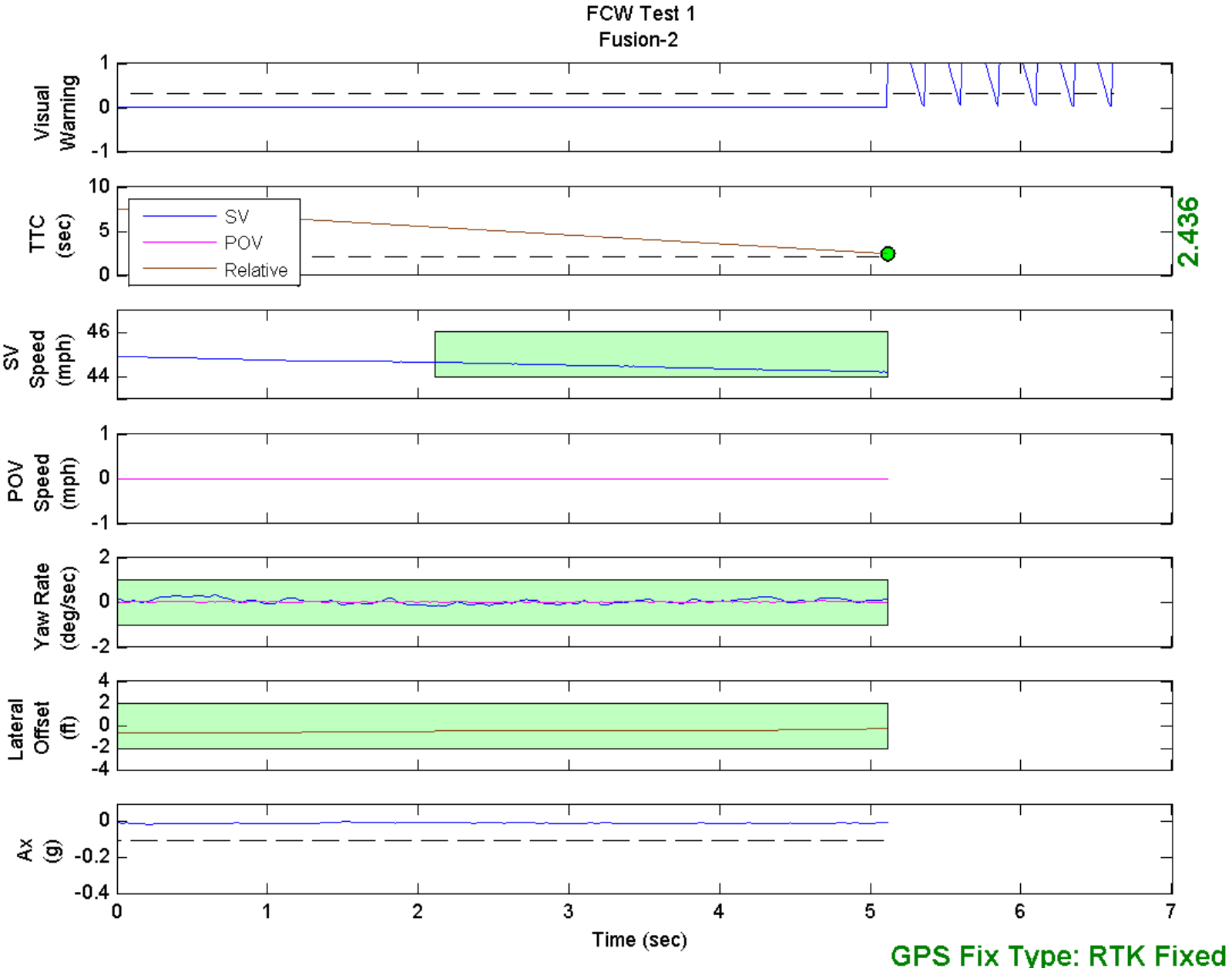


Figure D14. Time History for Run 2, FCW Test 1, Visual Warning

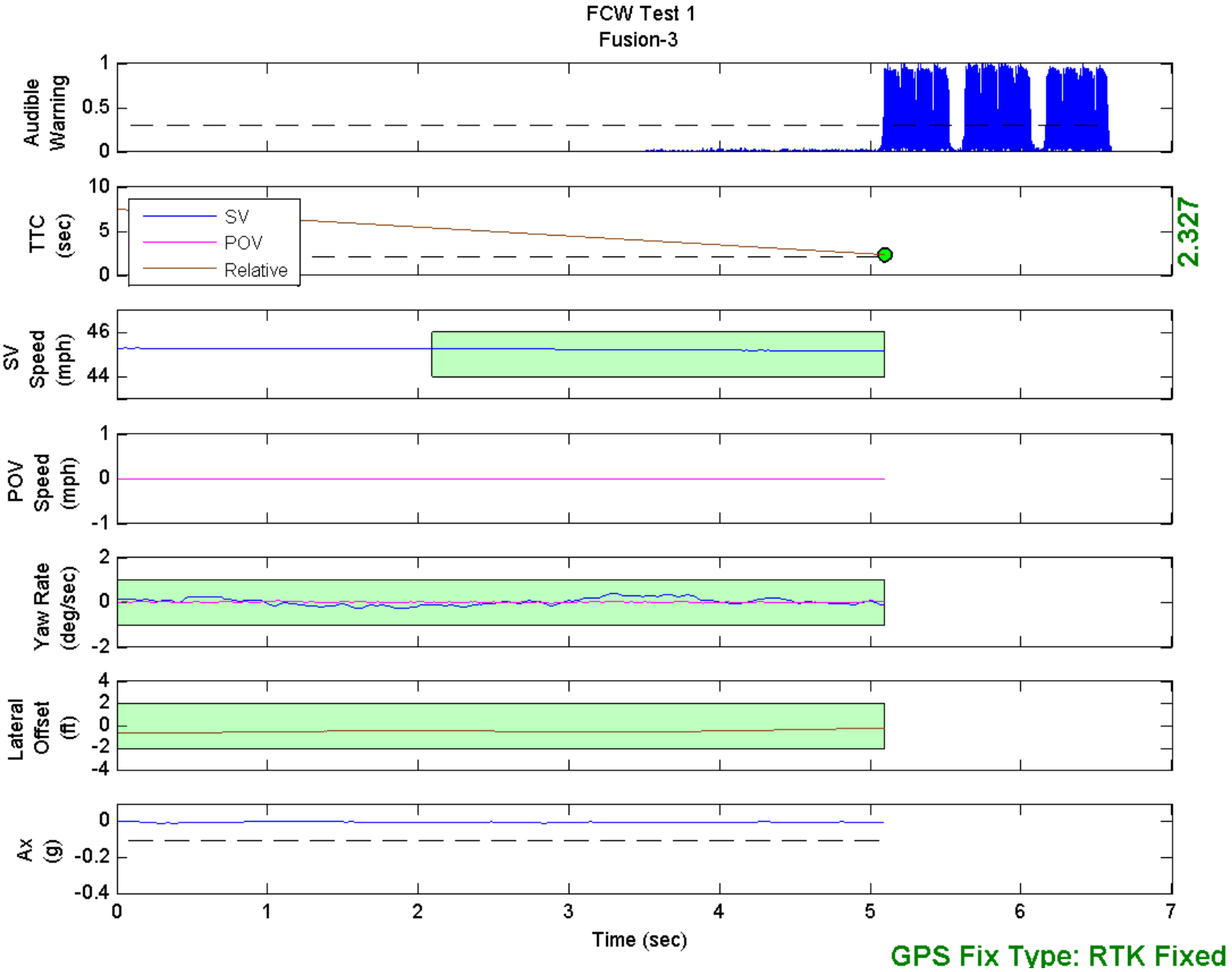


Figure D15. Time History for Run 3, FCW Test 1, Audible Warning

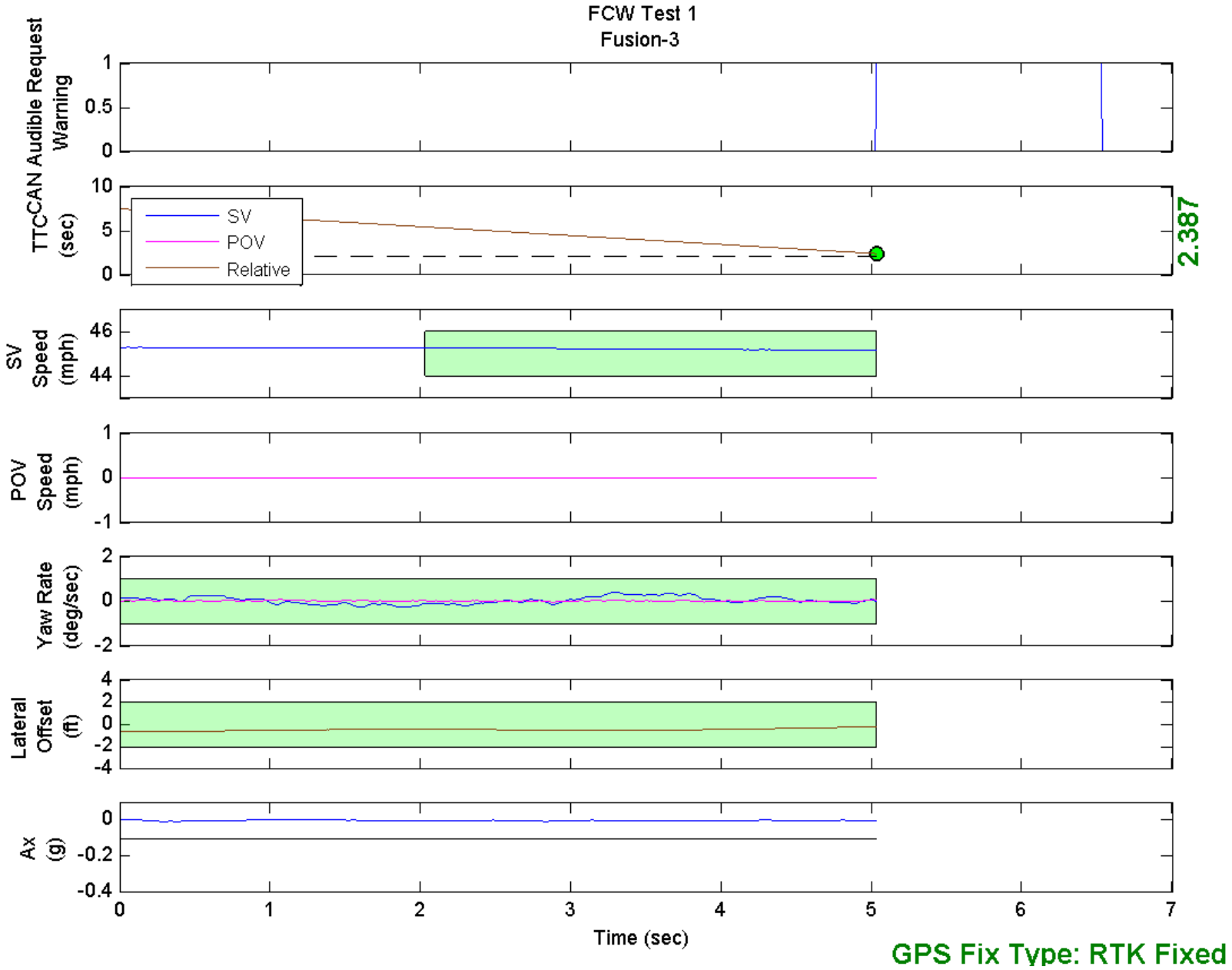


Figure D16. Time History for Run 3, FCW Test 1, CAN Audible Warning Request

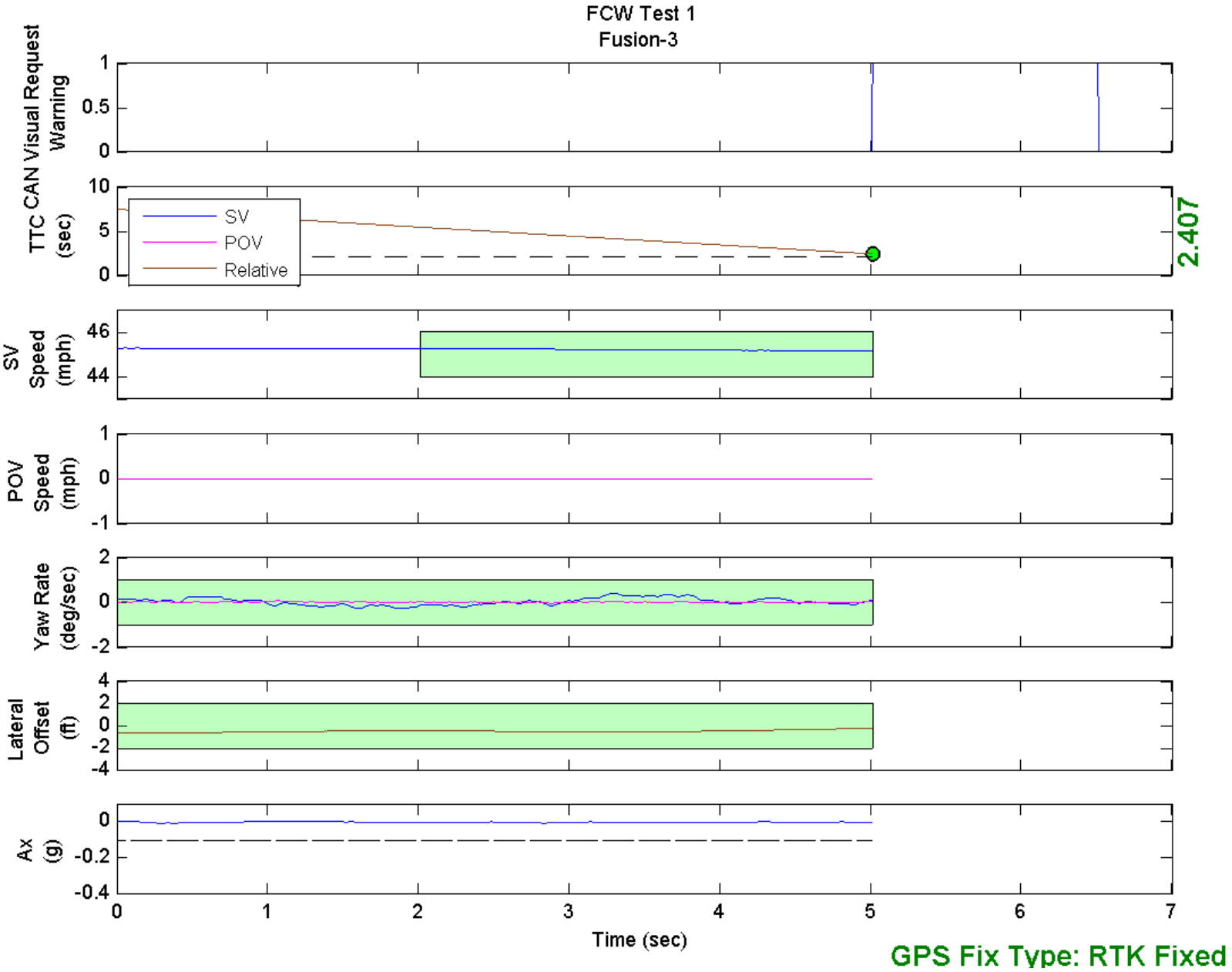


Figure D17. Time History for Run 3, FCW Test 1, CAN Visual Warning Request

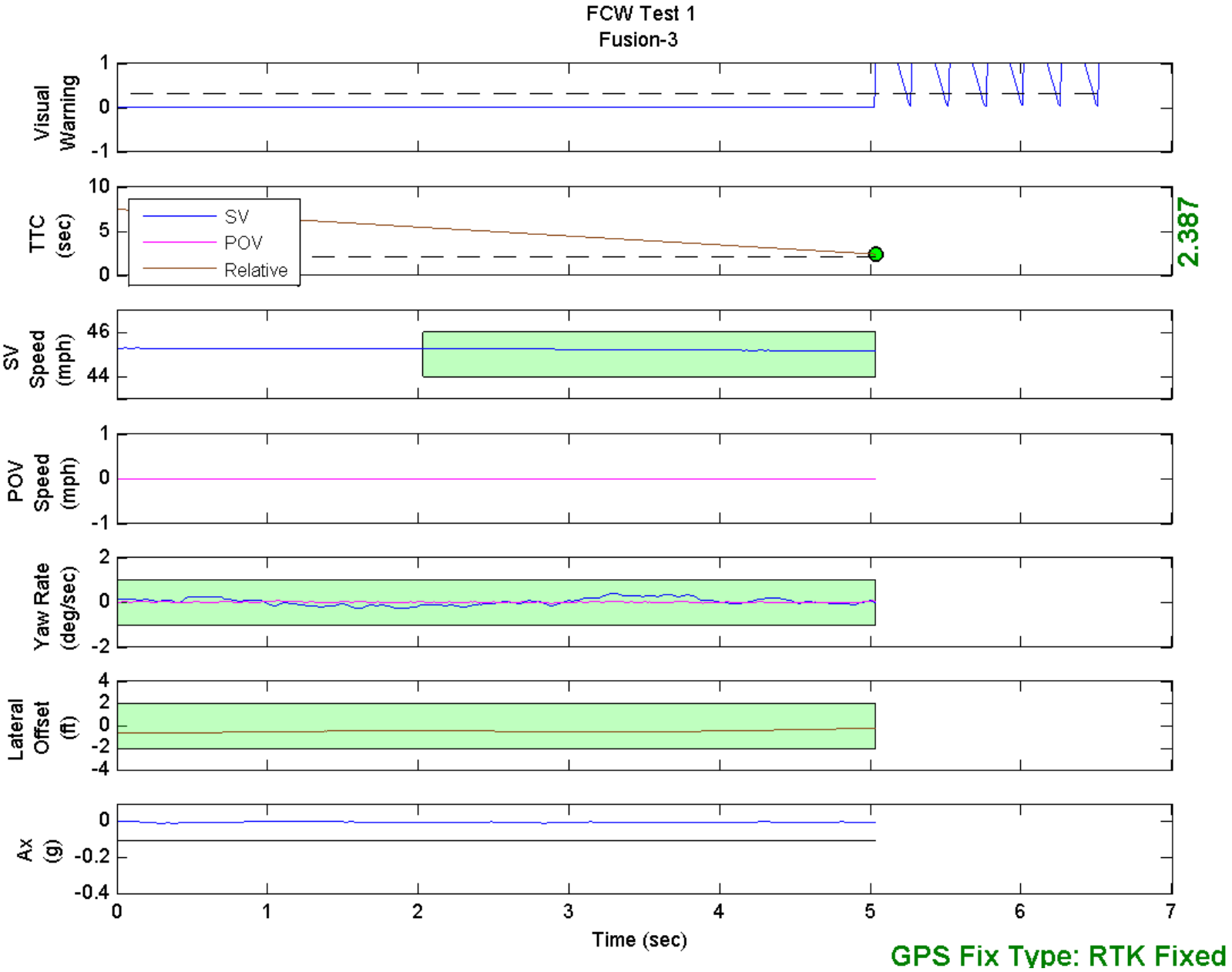


Figure D18. Time History for Run 3, FCW Test 1, Visual Warning

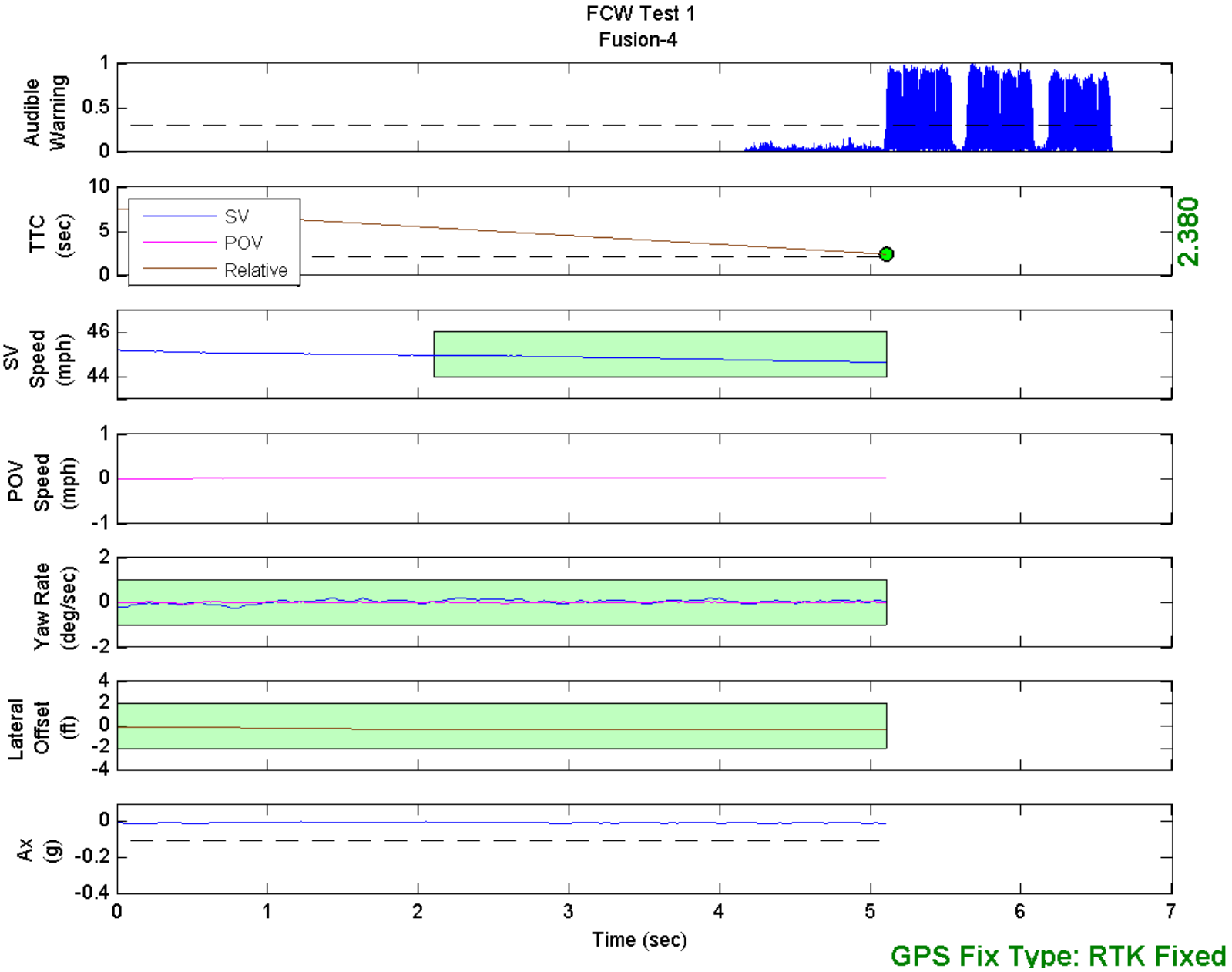


Figure D19. Time History for Run 4, FCW Test 1, Audible Warning

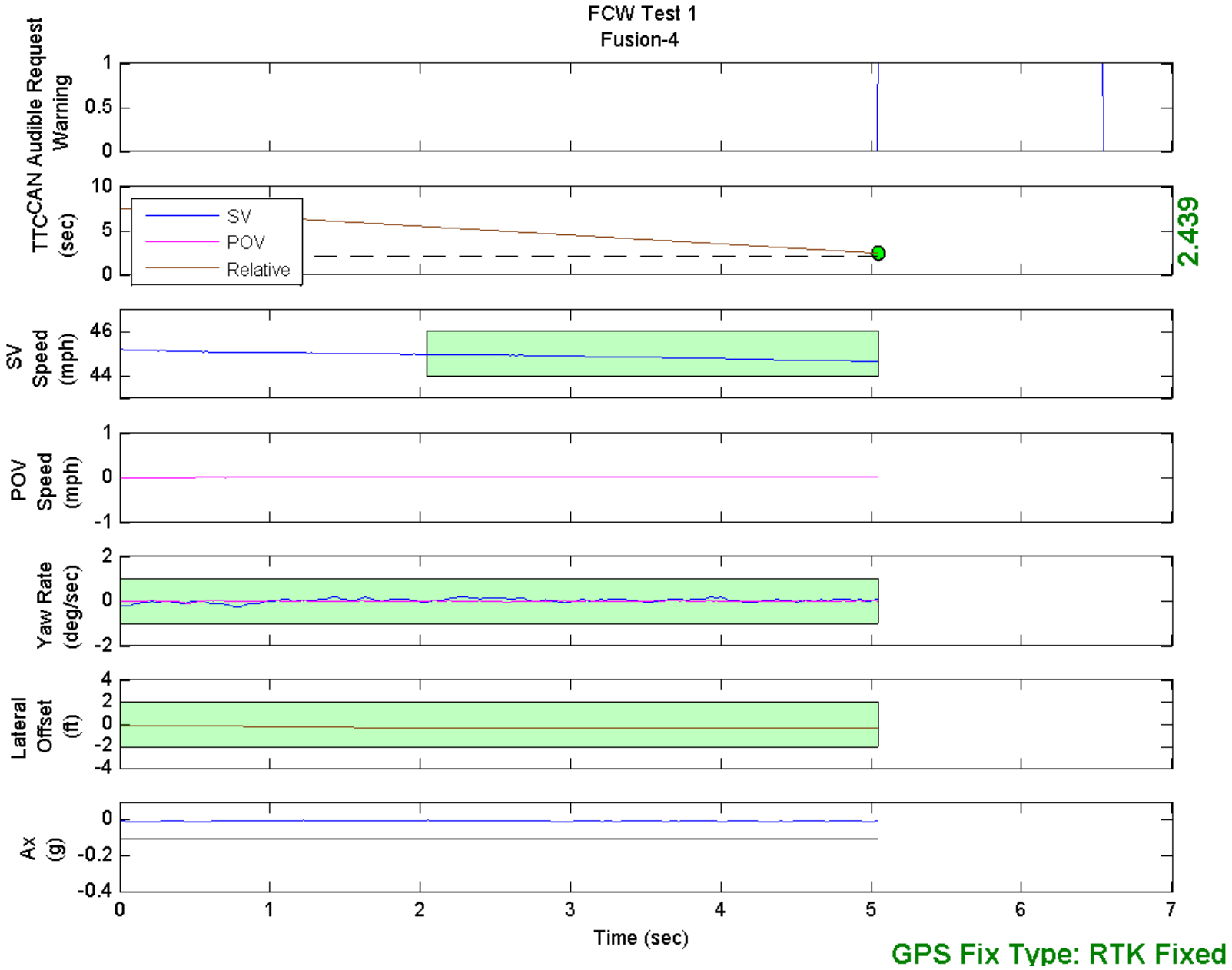


Figure D20. Time History for Run 4, FCW Test 1, CAN Audible Warning Request

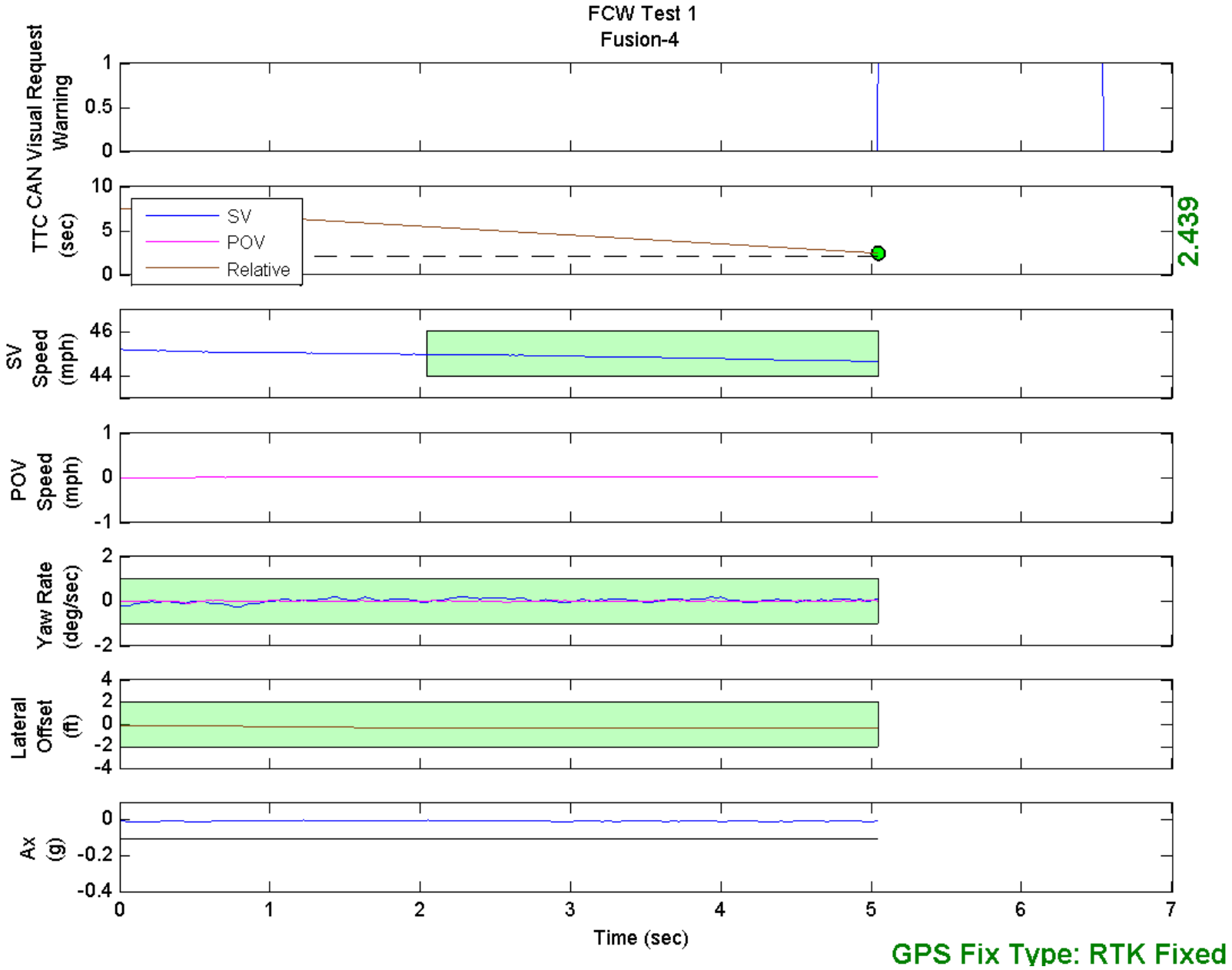


Figure D21. Time History for Run 4, FCW Test 1, CAN Visual Warning Request

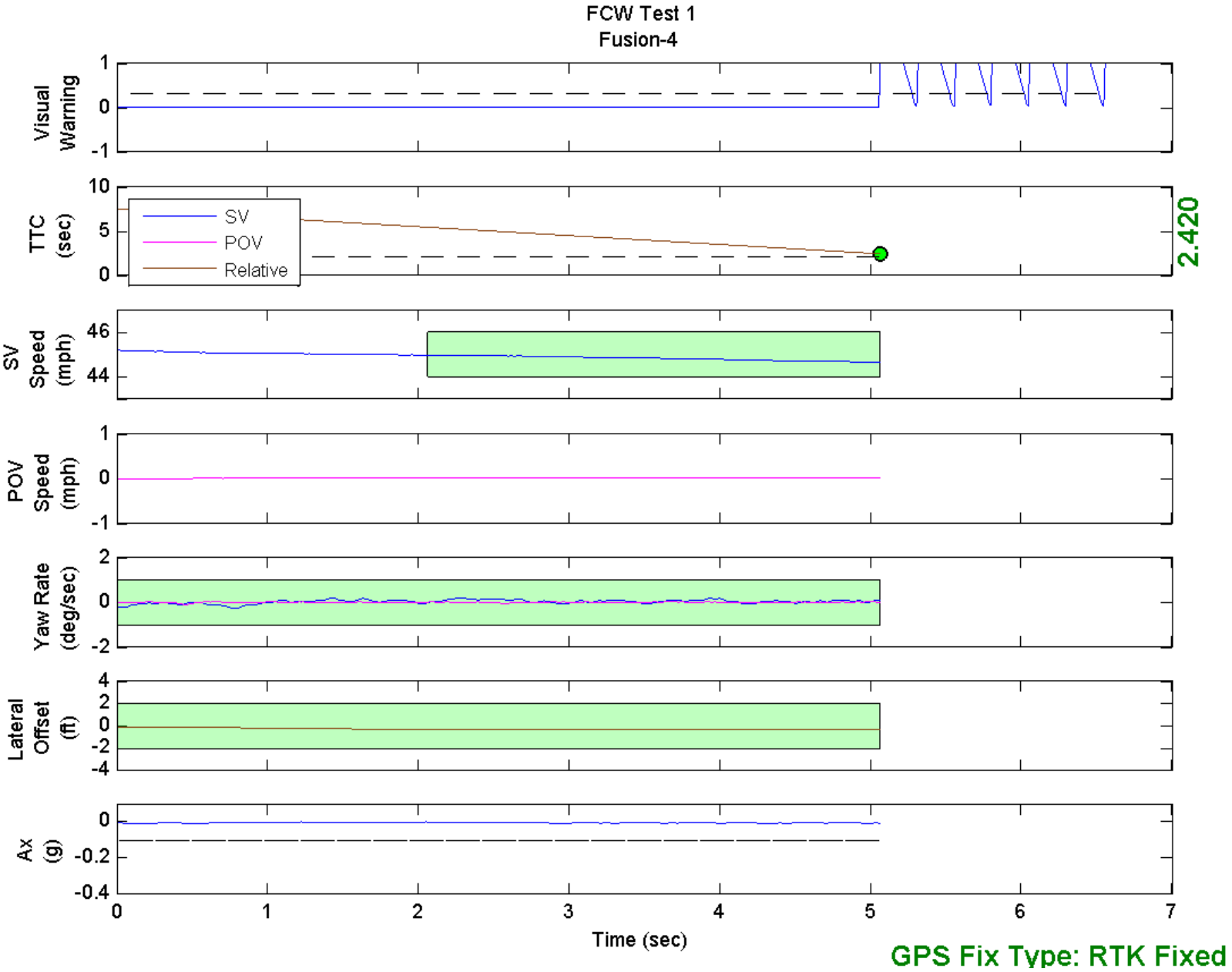


Figure D22. Time History for Run 4, FCW Test 1, Visual Warning

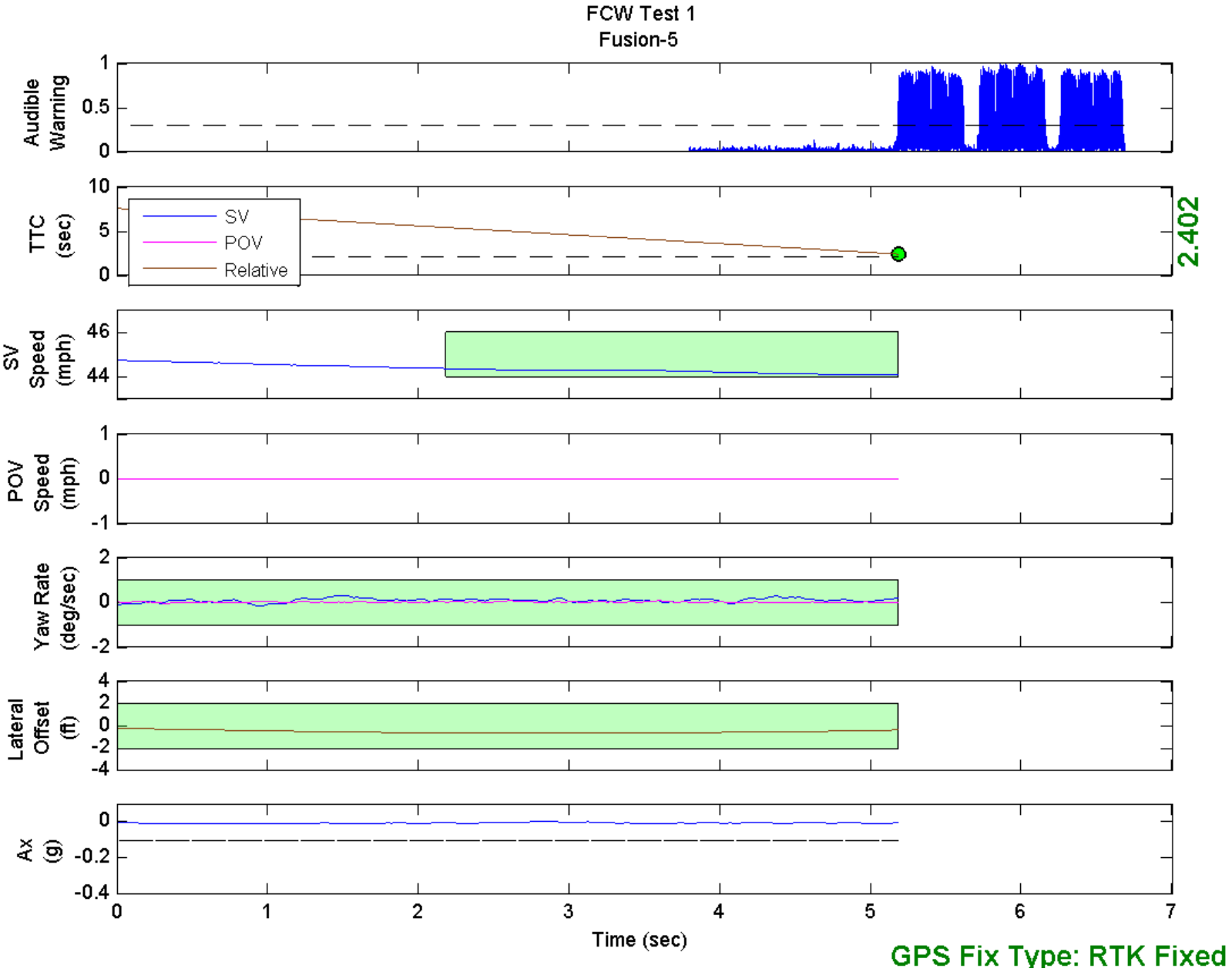


Figure D23. Time History for Run 5, FCW Test 1, Audible Warning

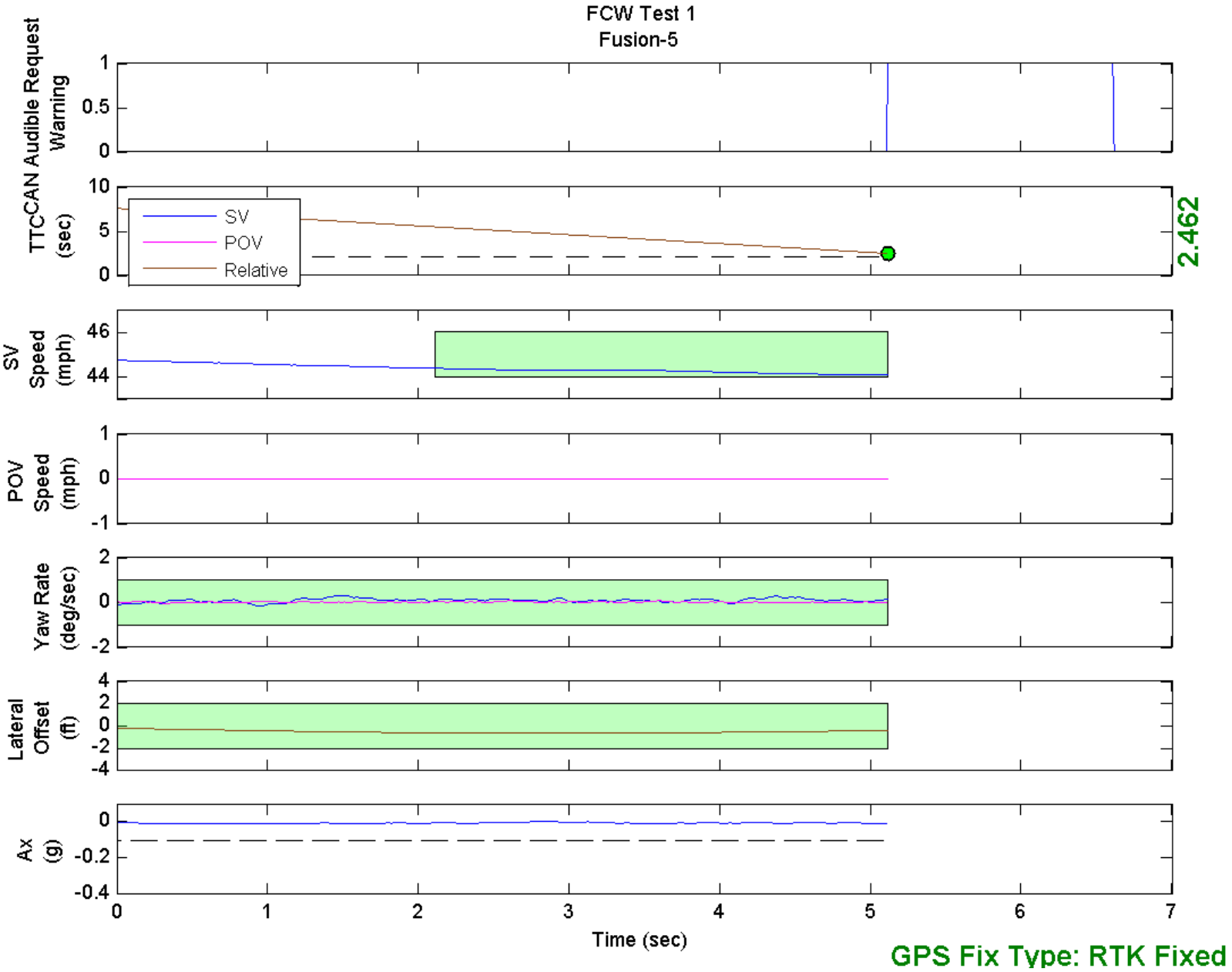


Figure D24. Time History for Run 5, FCW Test 1, CAN Audible Warning Request

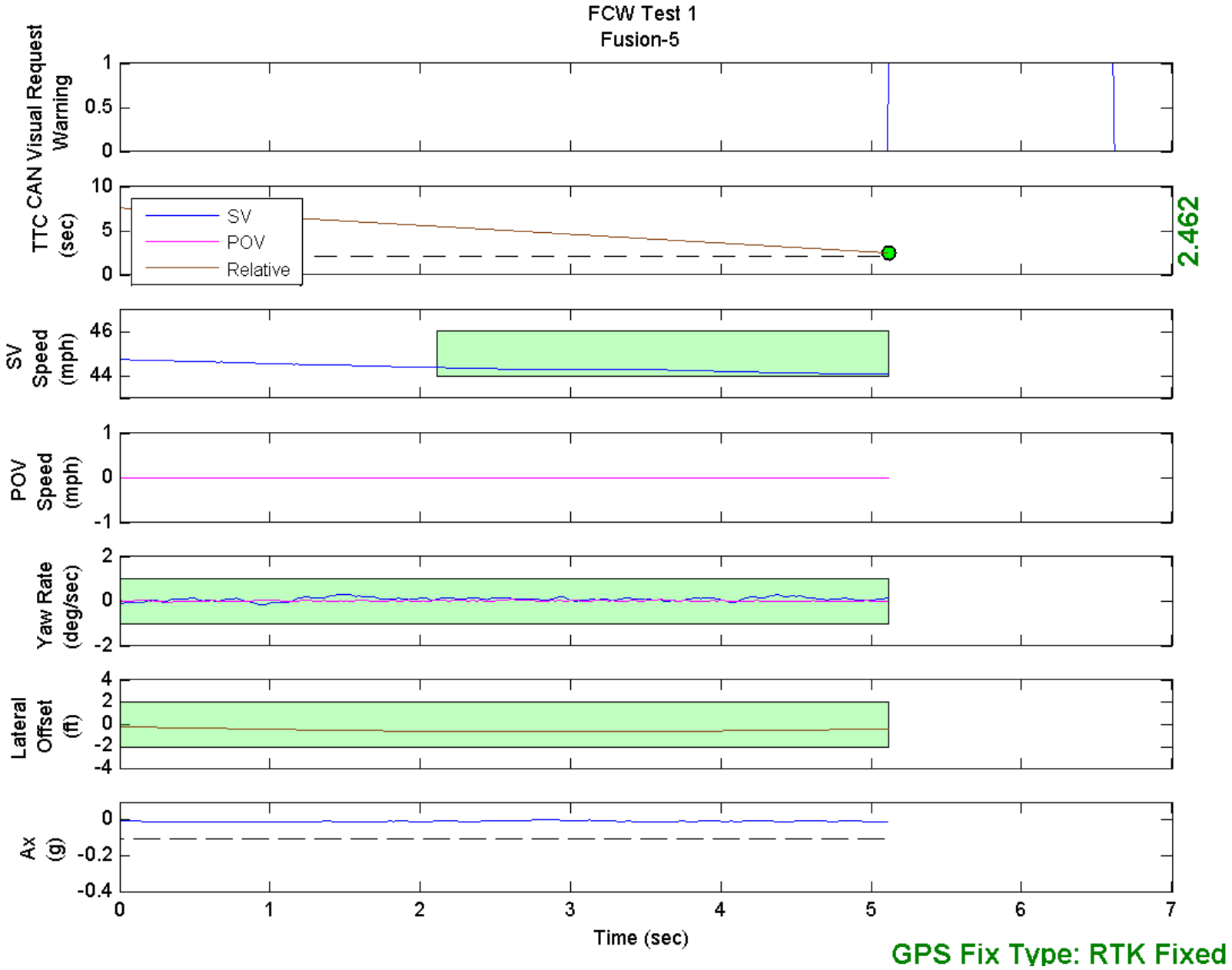


Figure D25. Time History for Run 5, FCW Test 1, CAN Visual Warning Request

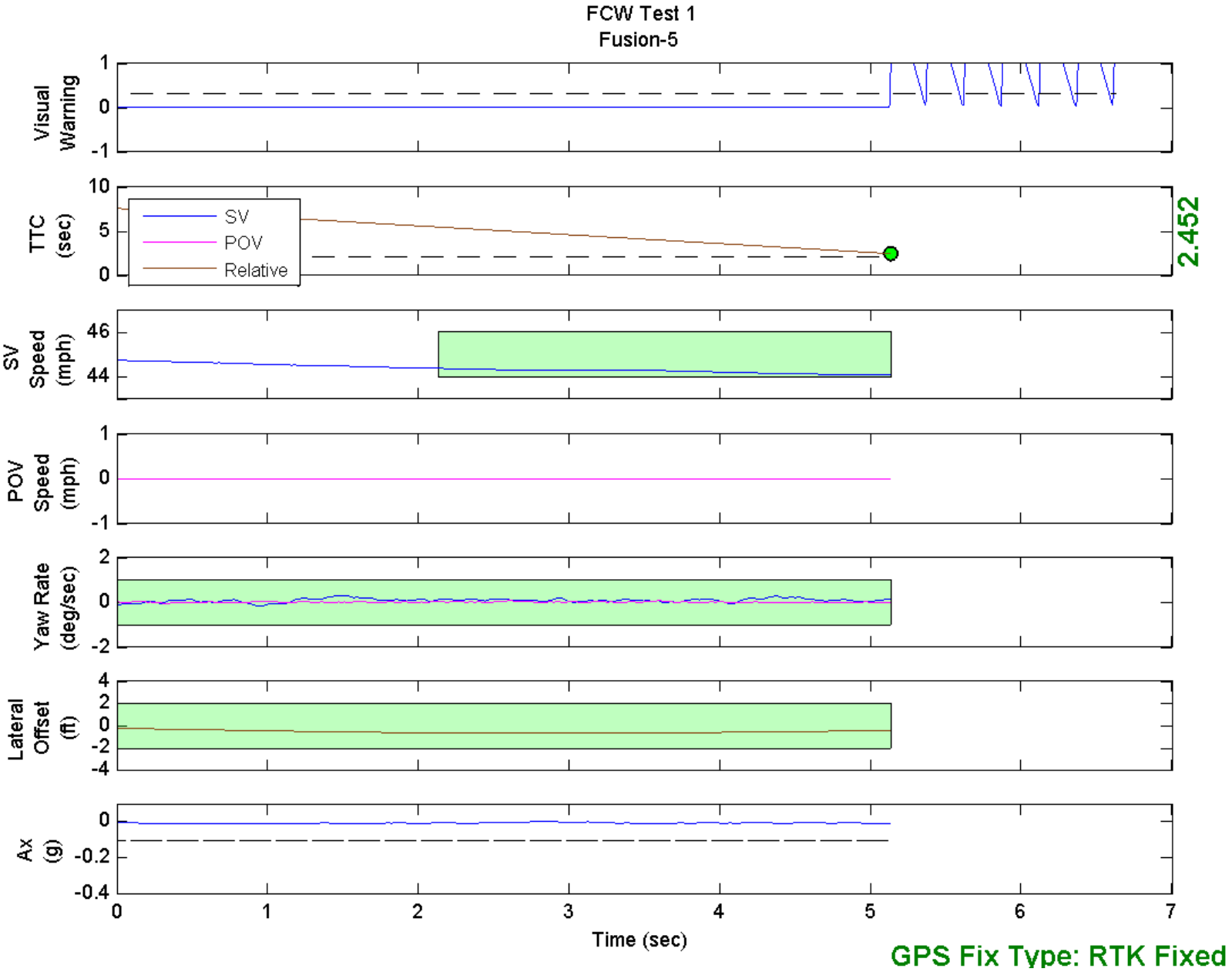


Figure D26. Time History for Run 5, FCW Test 1, Visual Warning

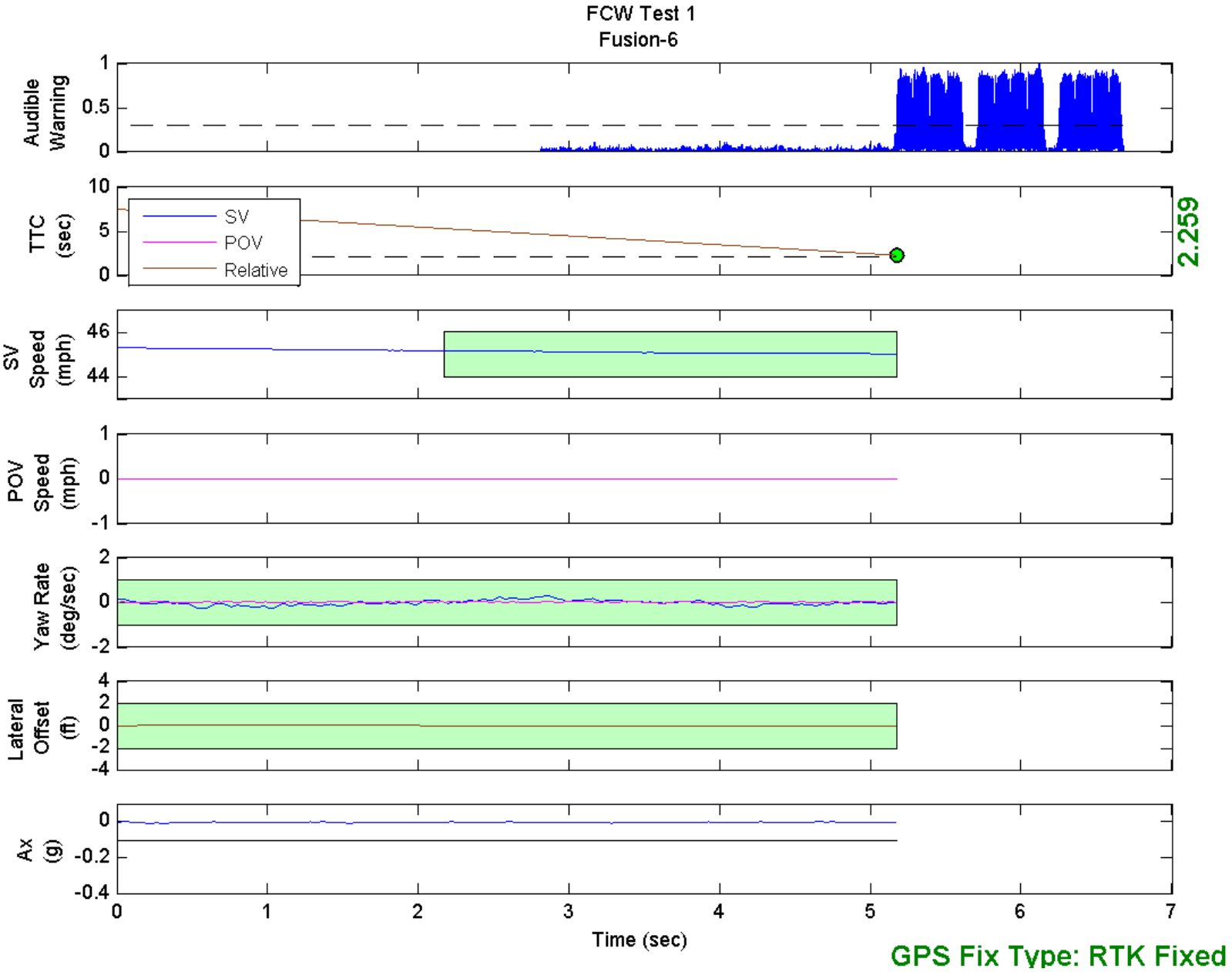


Figure D27. Time History for Run 6, FCW Test 1, Audible Warning

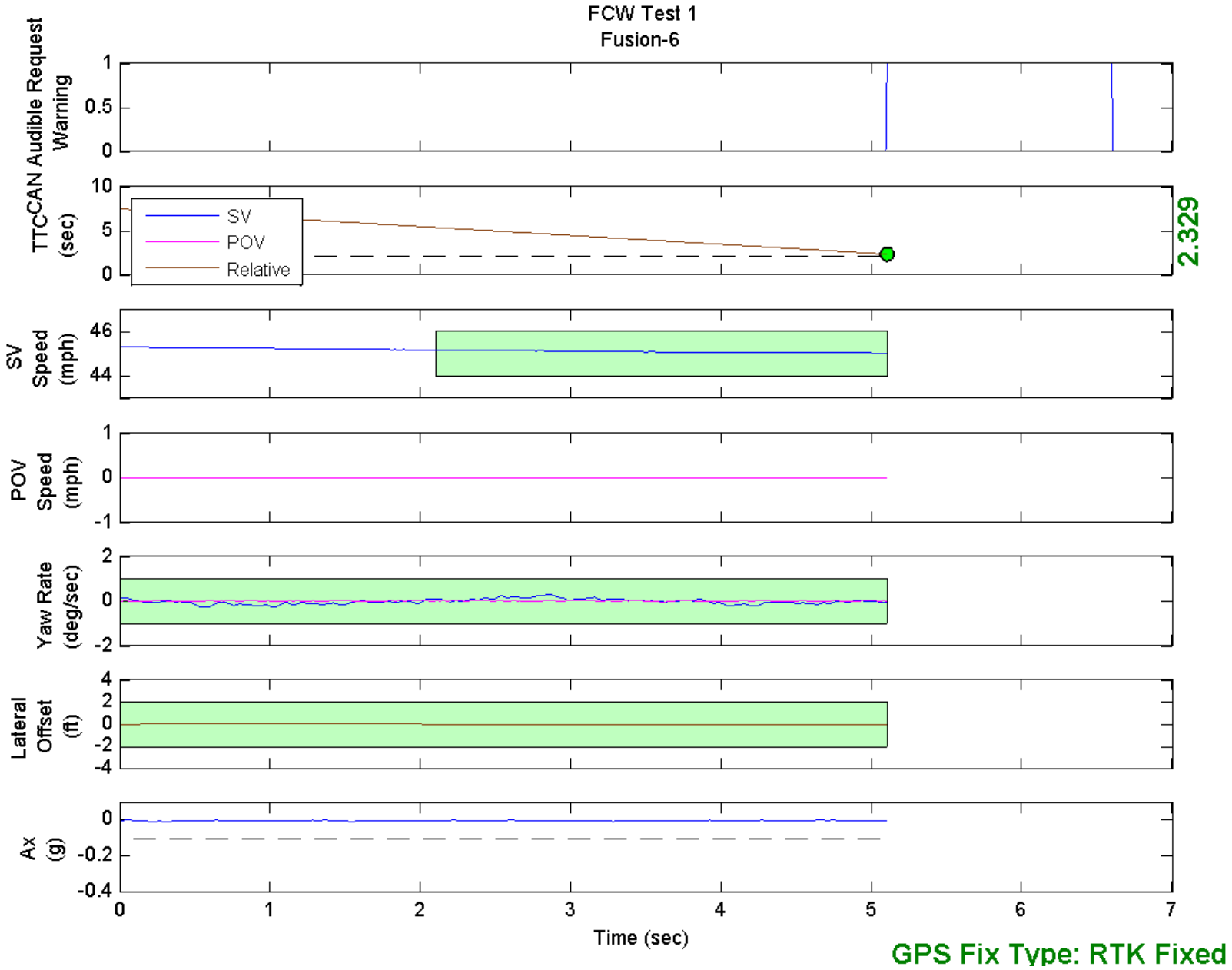


Figure D28. Time History for Run 6, FCW Test 1, CAN Audible Warning Request

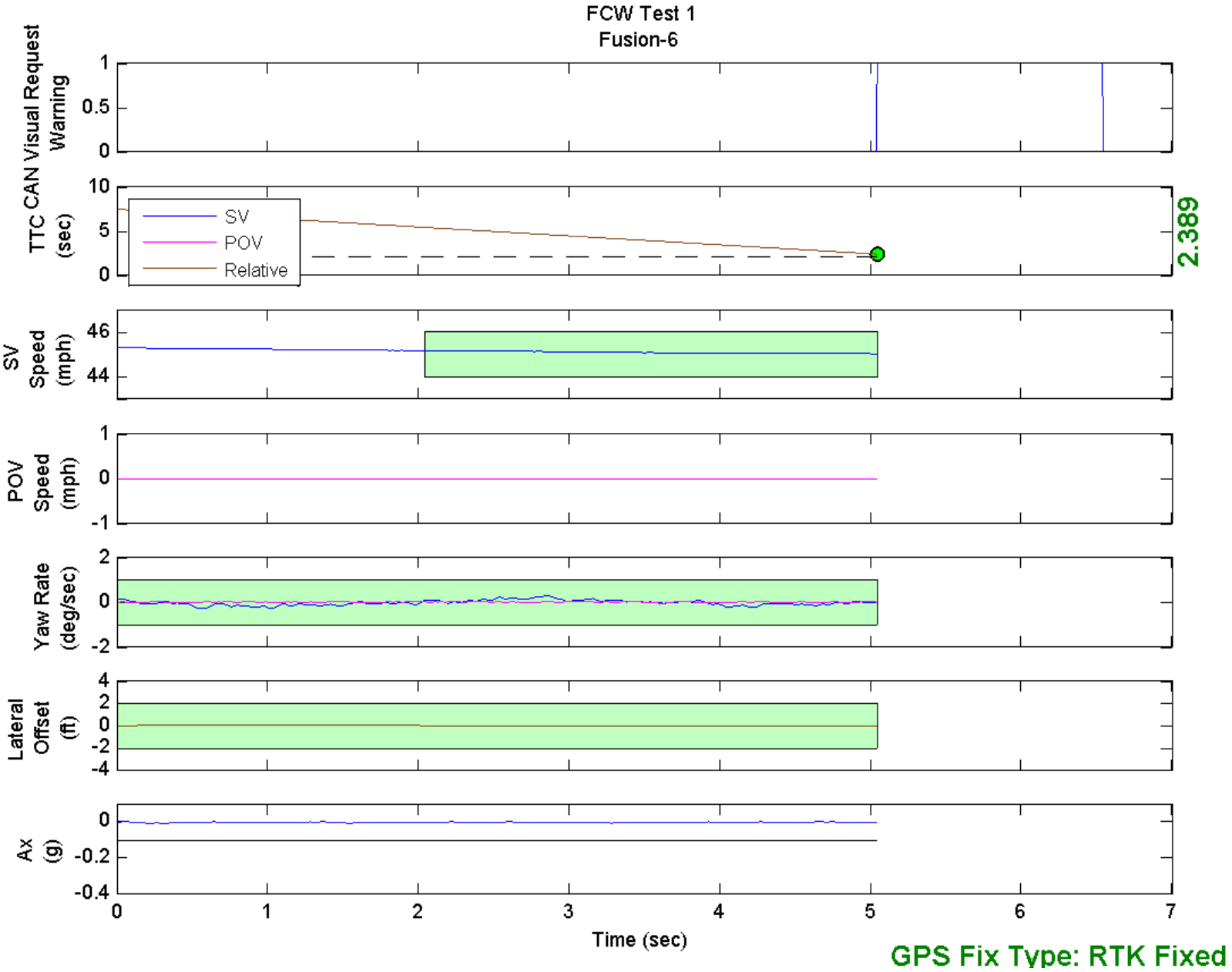


Figure D29. Time History for Run 6, FCW Test 1, CAN Visual Warning Request

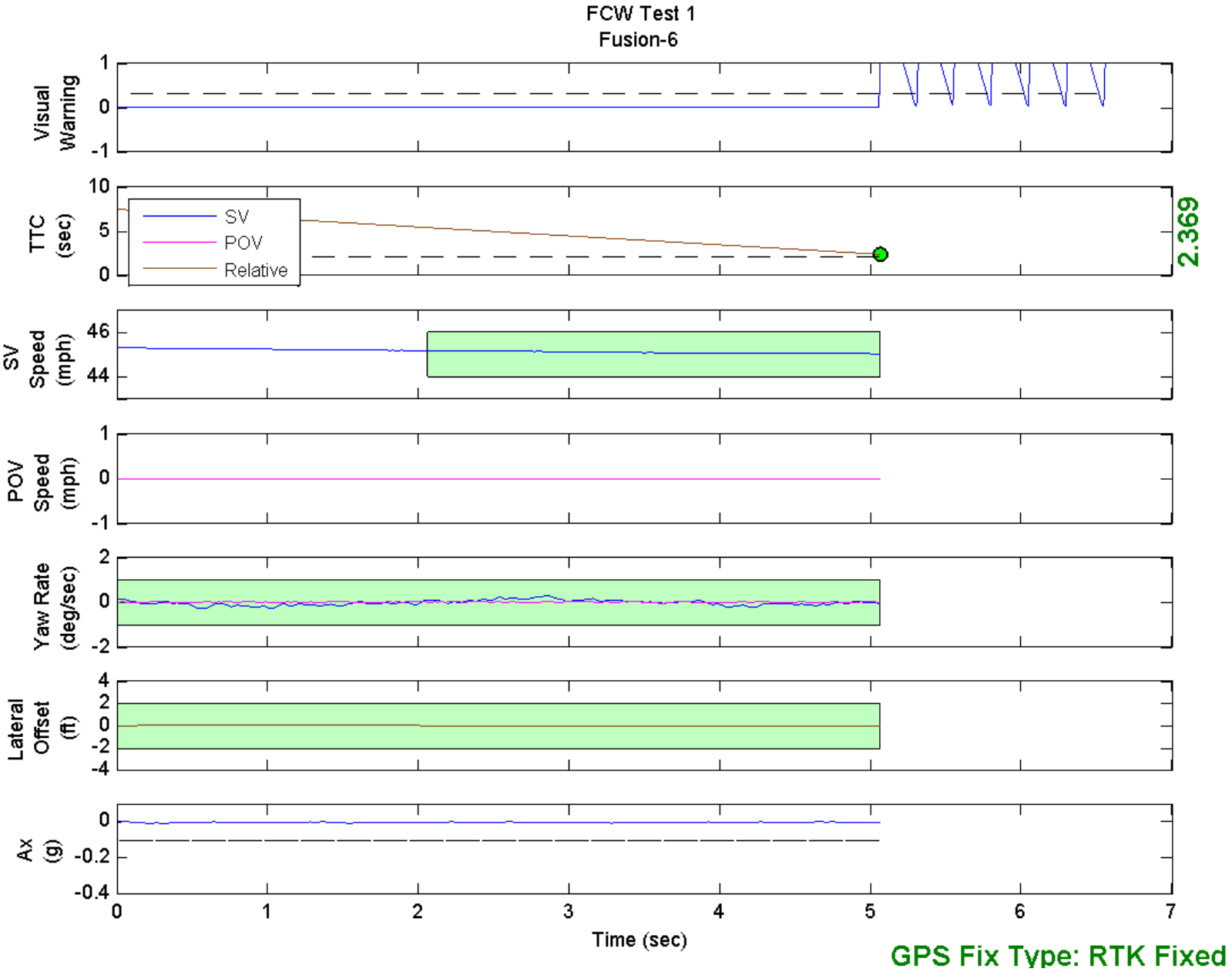


Figure D30. Time History for Run 6, FCW Test 1, Visual Warning

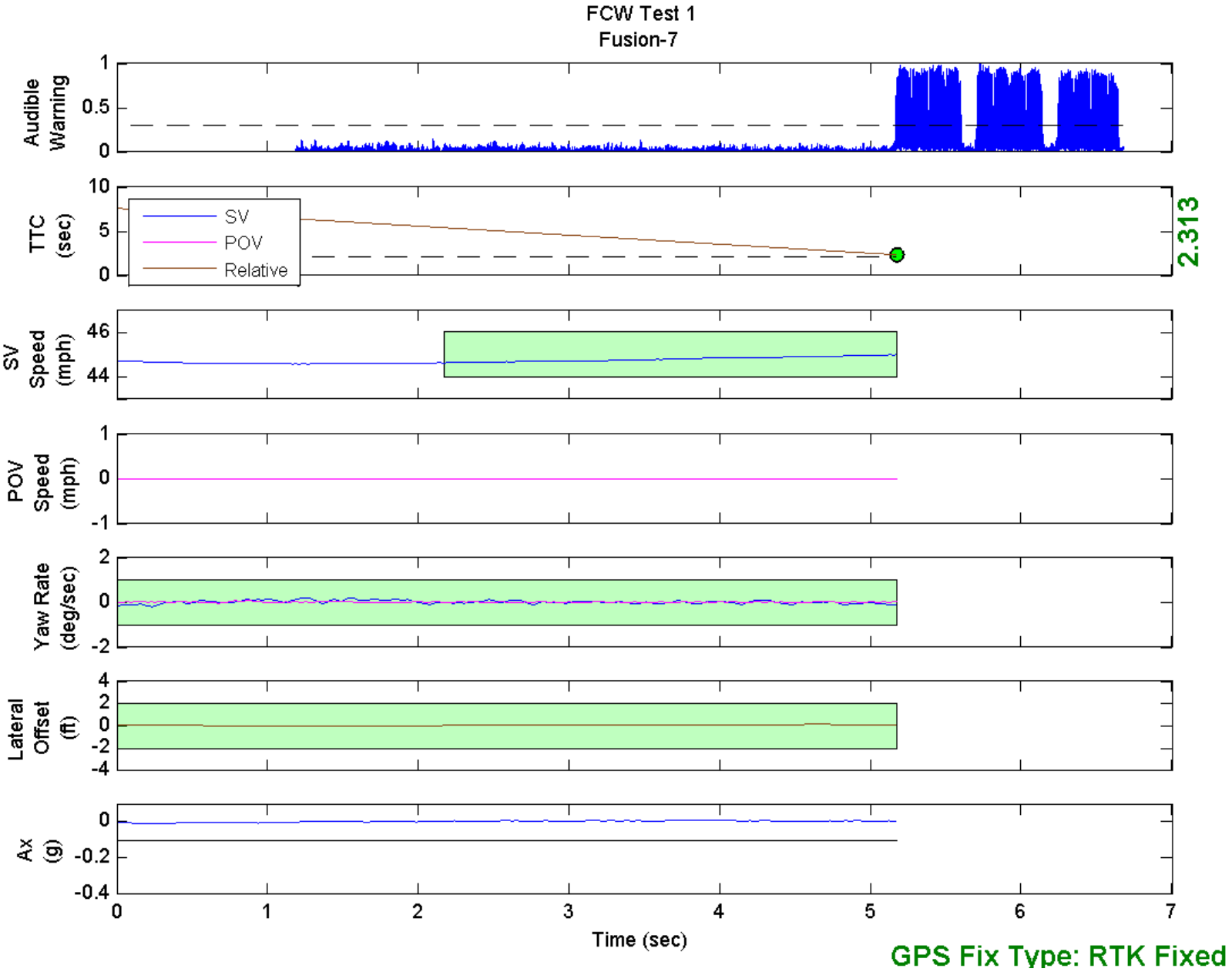


Figure D31. Time History for Run 7, FCW Test 1, Audible Warning

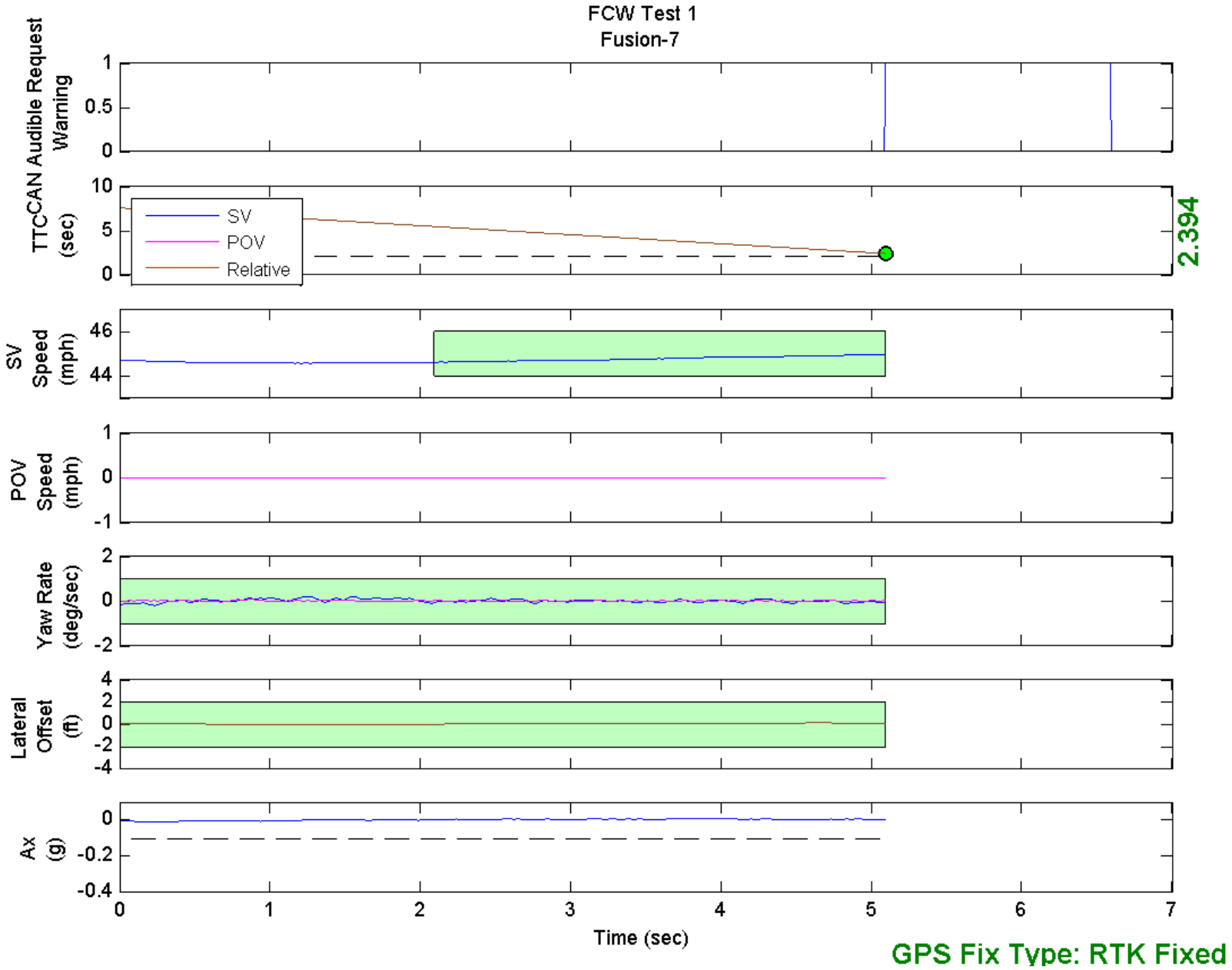


Figure D32. Time History for Run 7, FCW Test 1, CAN Audible Warning Request

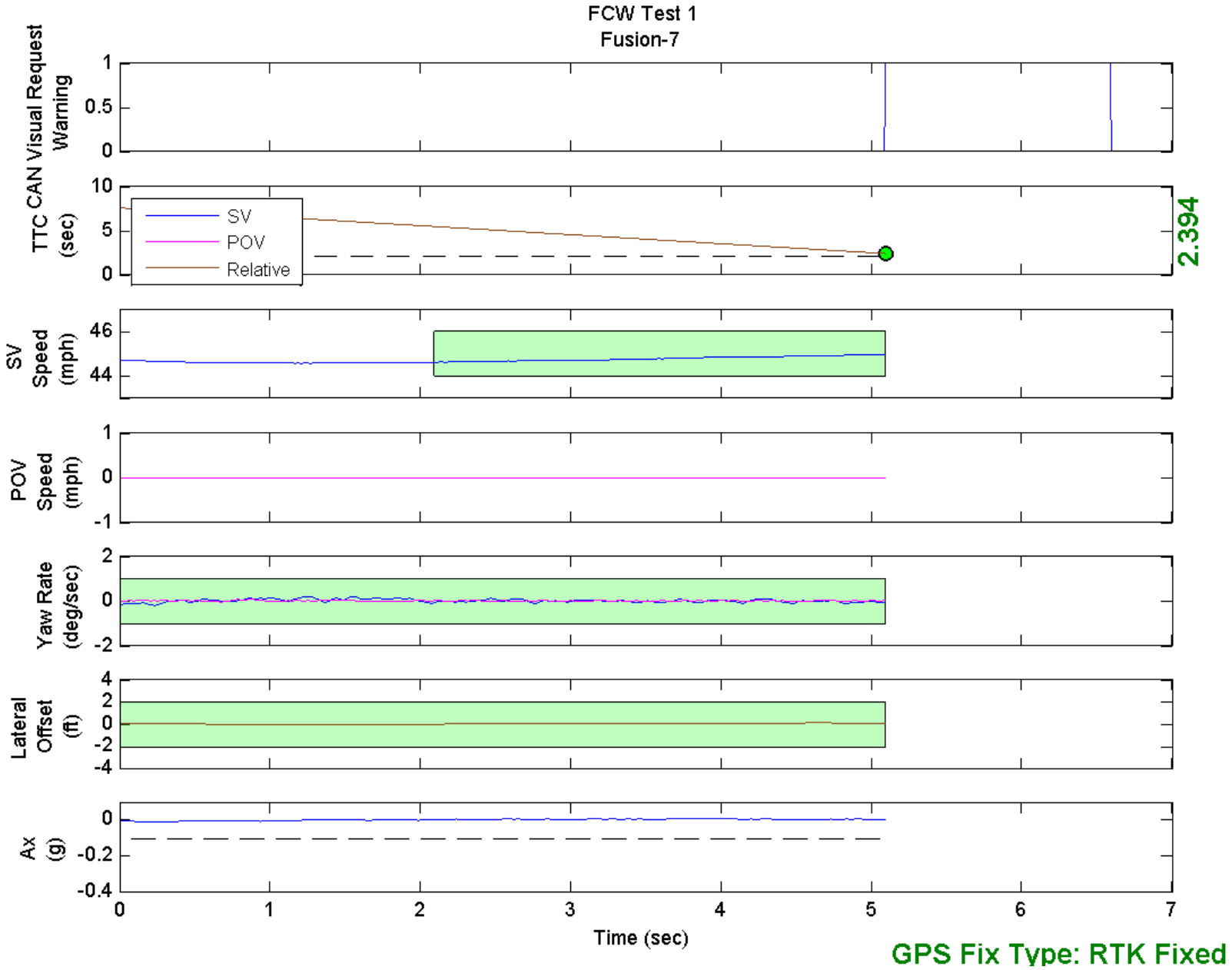


Figure D33. Time History for Run 7, FCW Test 1, CAN Visual Warning Request

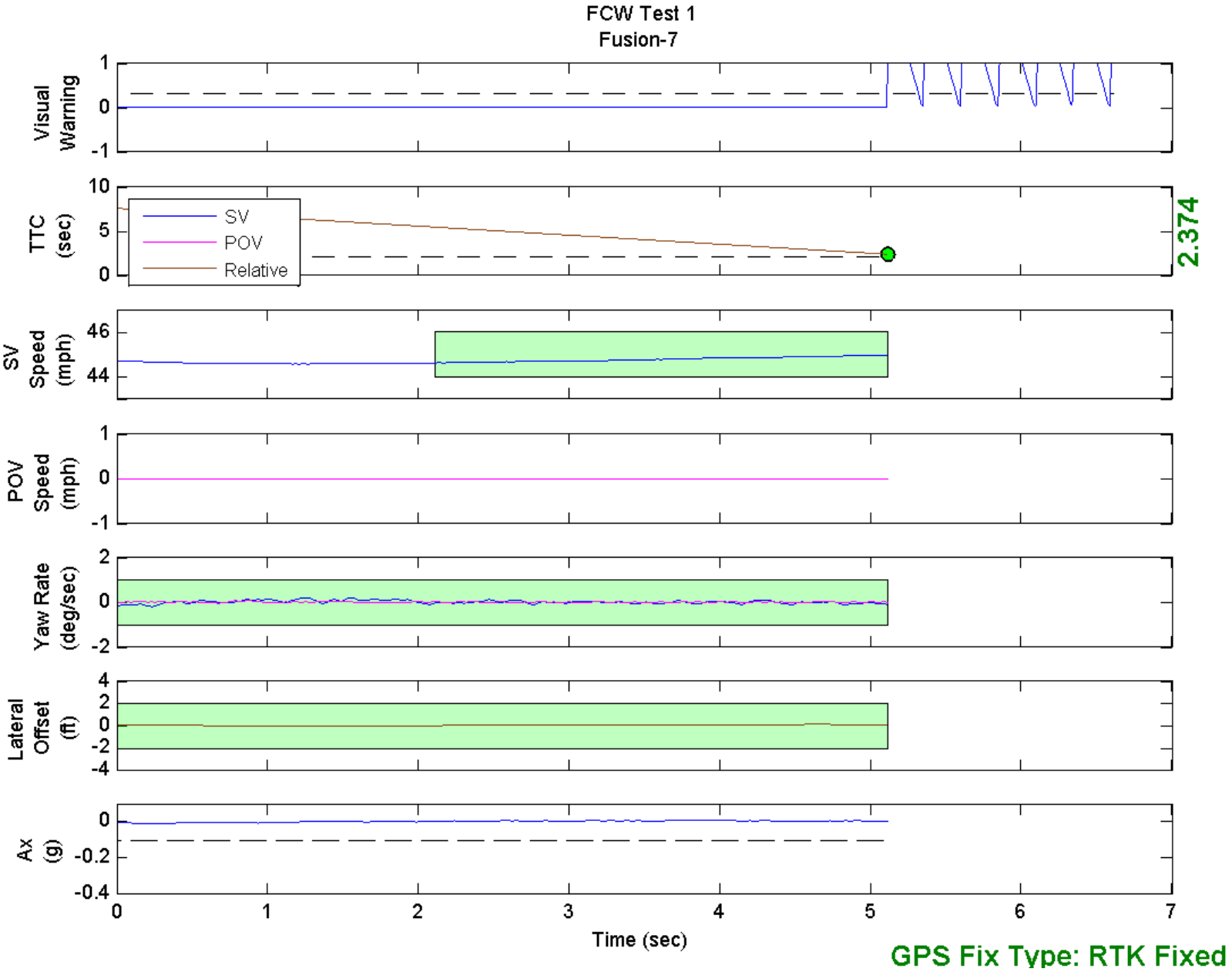


Figure D34. Time History for Run 7, FCW Test 1, Visual Warning

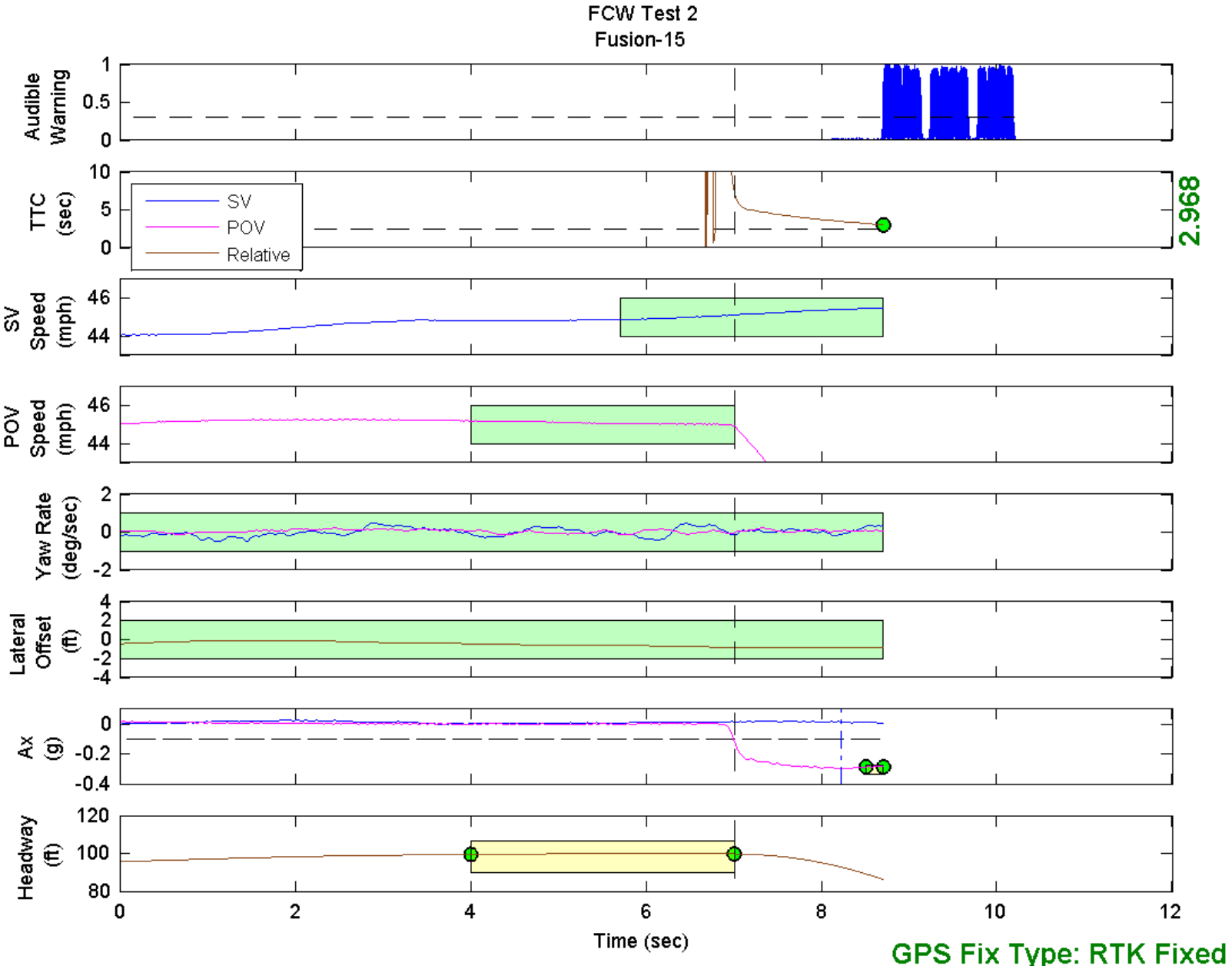


Figure D35. Time History for Run 15, FCW Test 2, Audible Warning

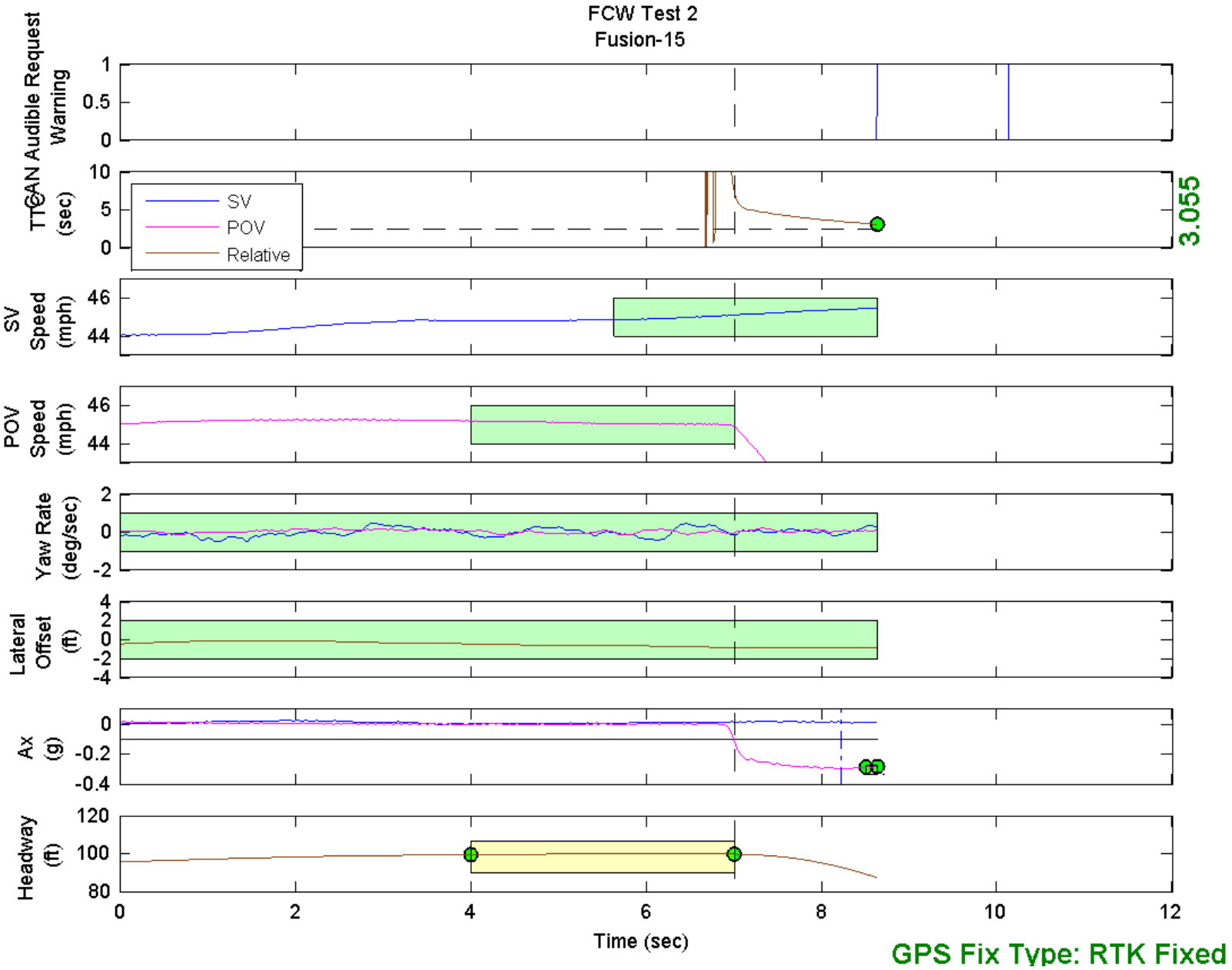


Figure D36. Time History for Run 15, FCW Test 2, CAN Audible Warning Request

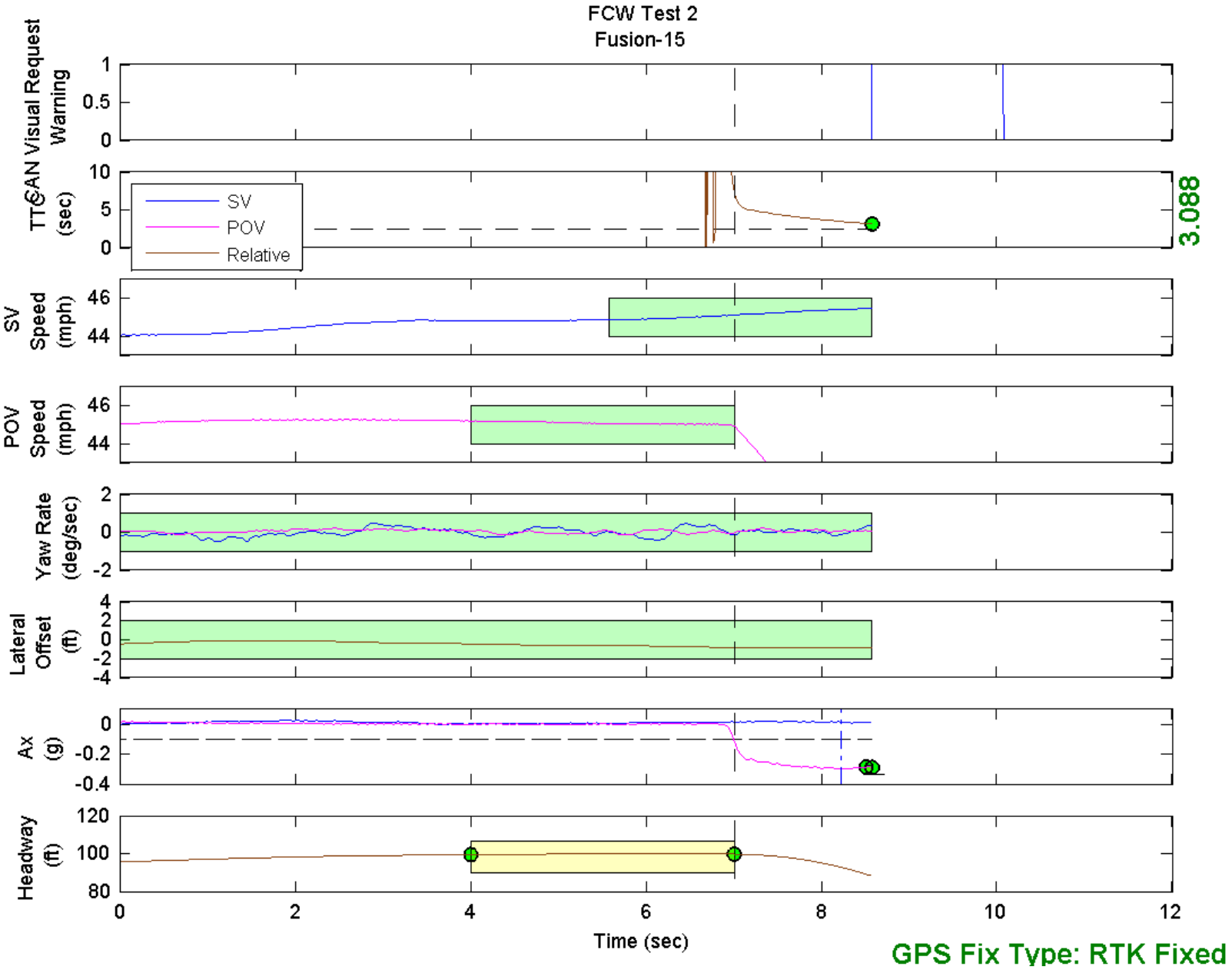


Figure D37. Time History for Run 15, FCW Test 2, CAN Visual Warning Request

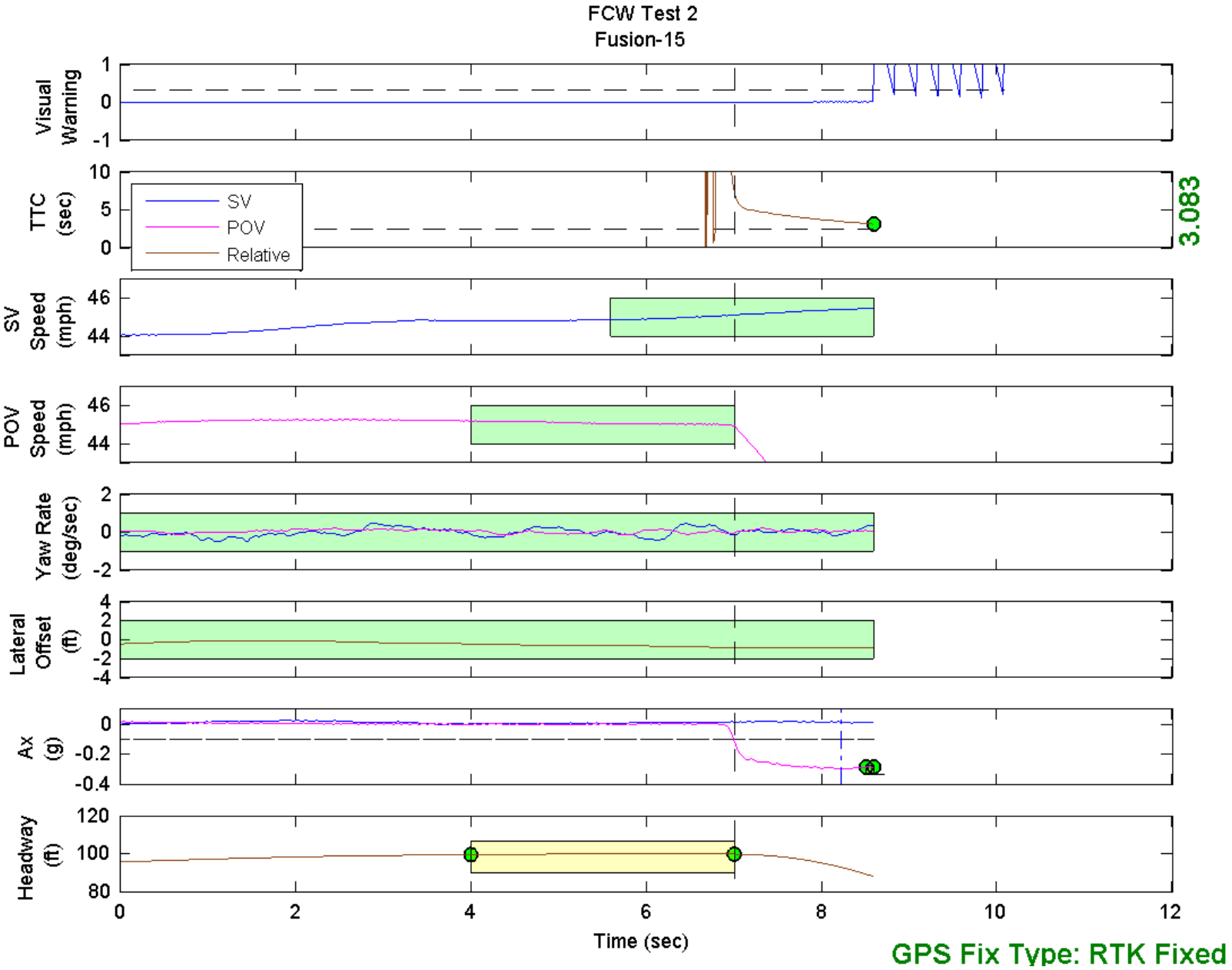


Figure D38. Time History for Run 15, FCW Test 2, Visual Warning

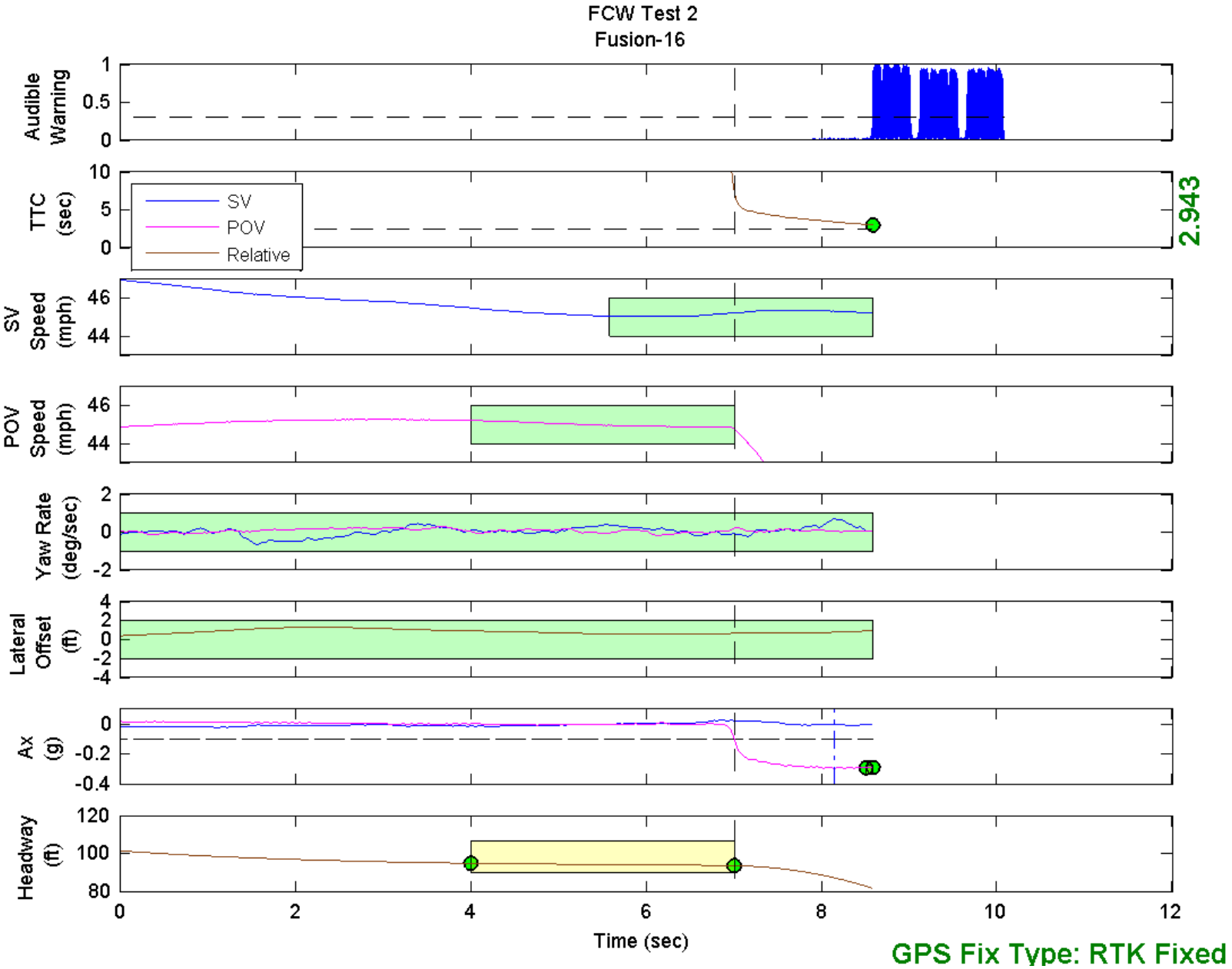


Figure D39. Time History for Run 16, FCW Test 2, Audible Warning

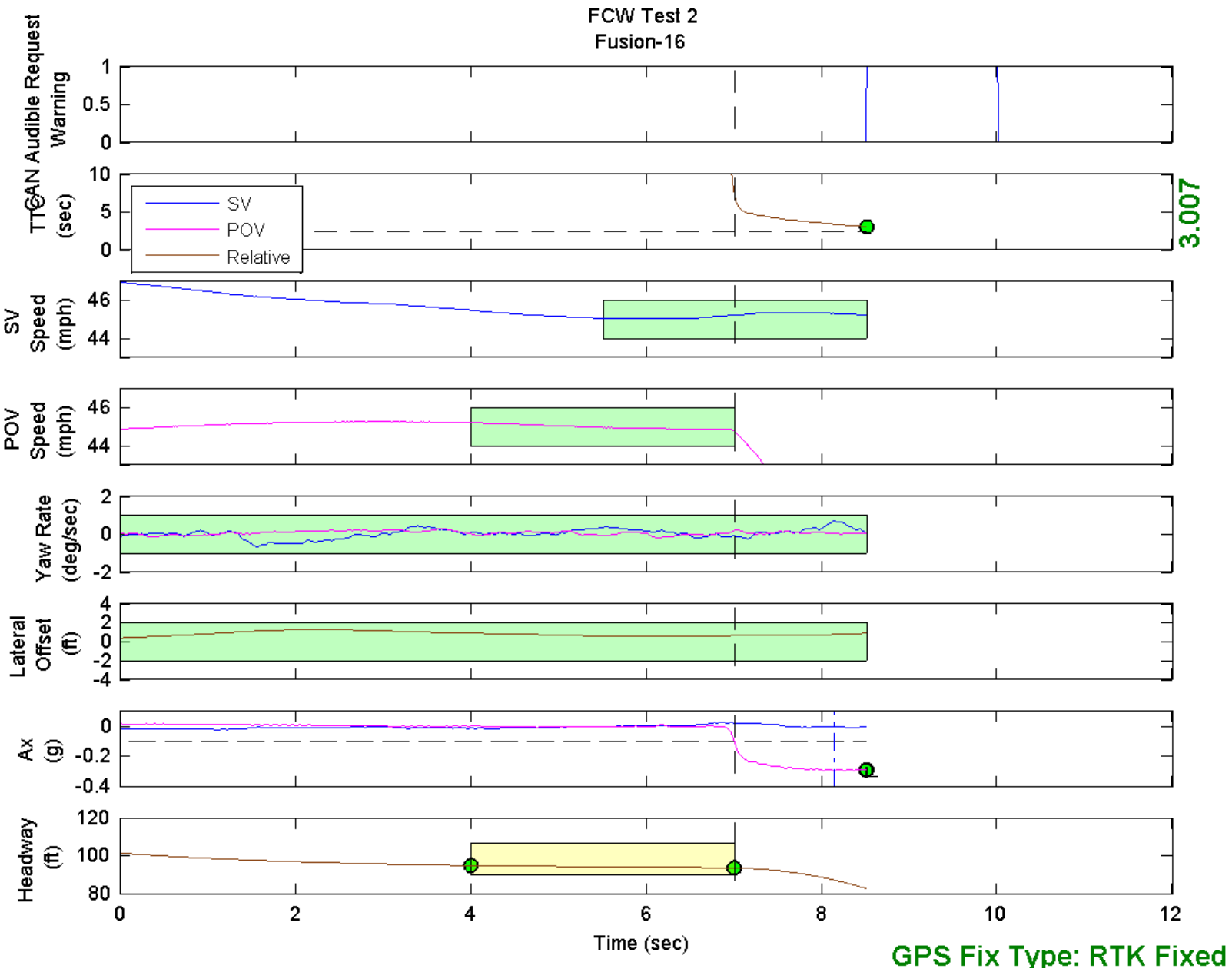


Figure D40. Time History for Run 16, FCW Test 2, CAN Audible Warning Request

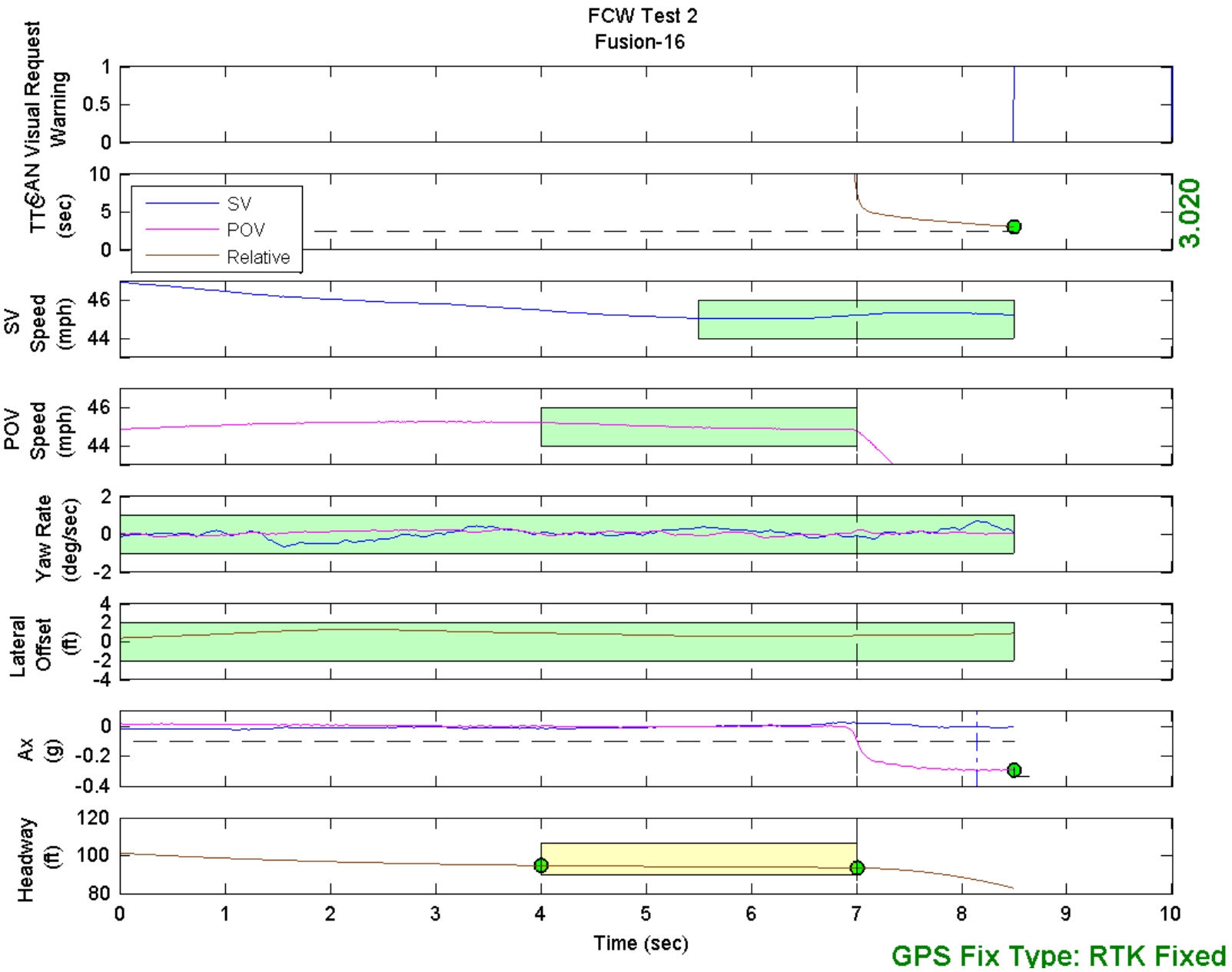


Figure D41. Time History for Run 16, FCW Test 2, CAN Visual Warning Request

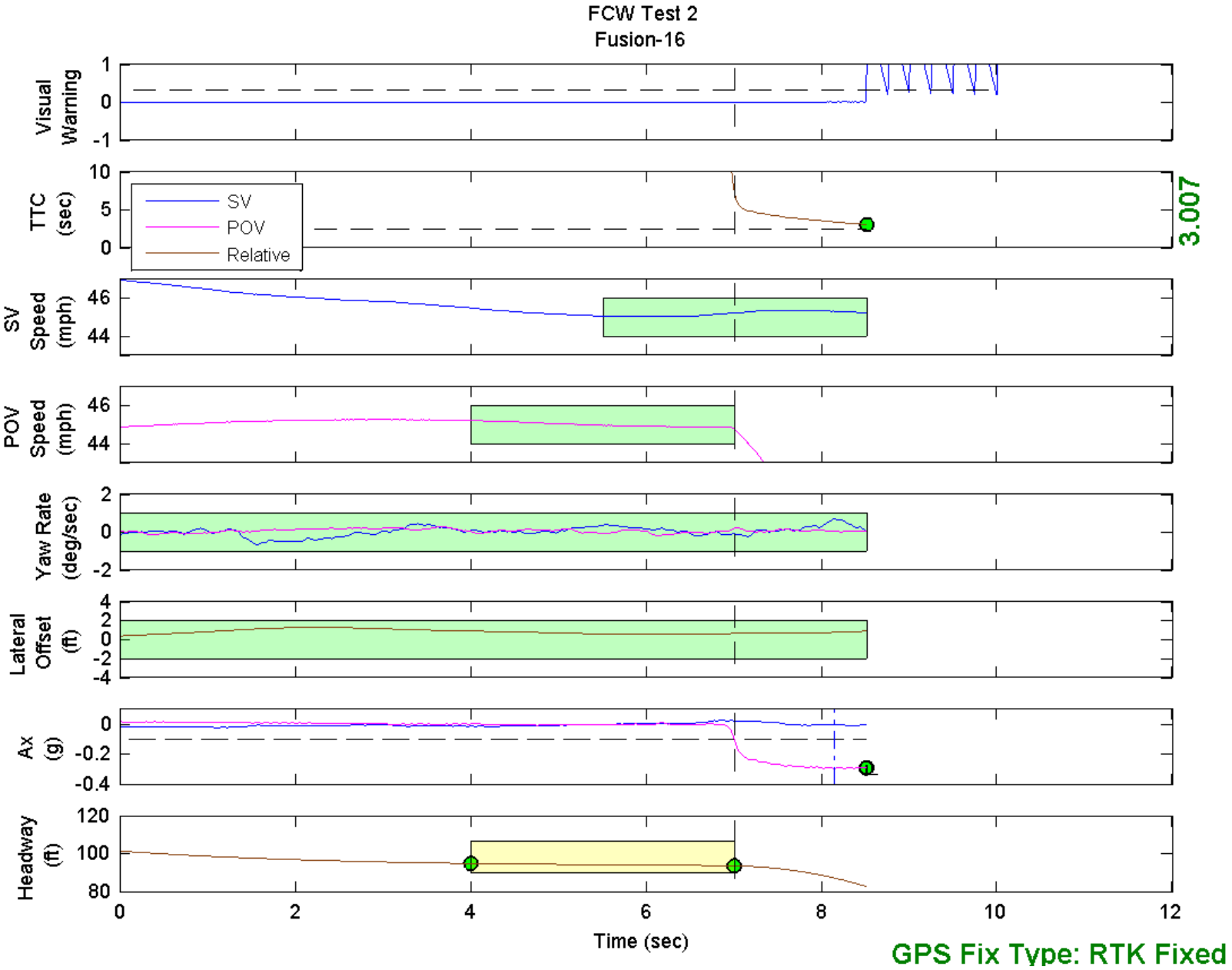


Figure D42. Time History for Run 16, FCW Test 2, Visual Warning

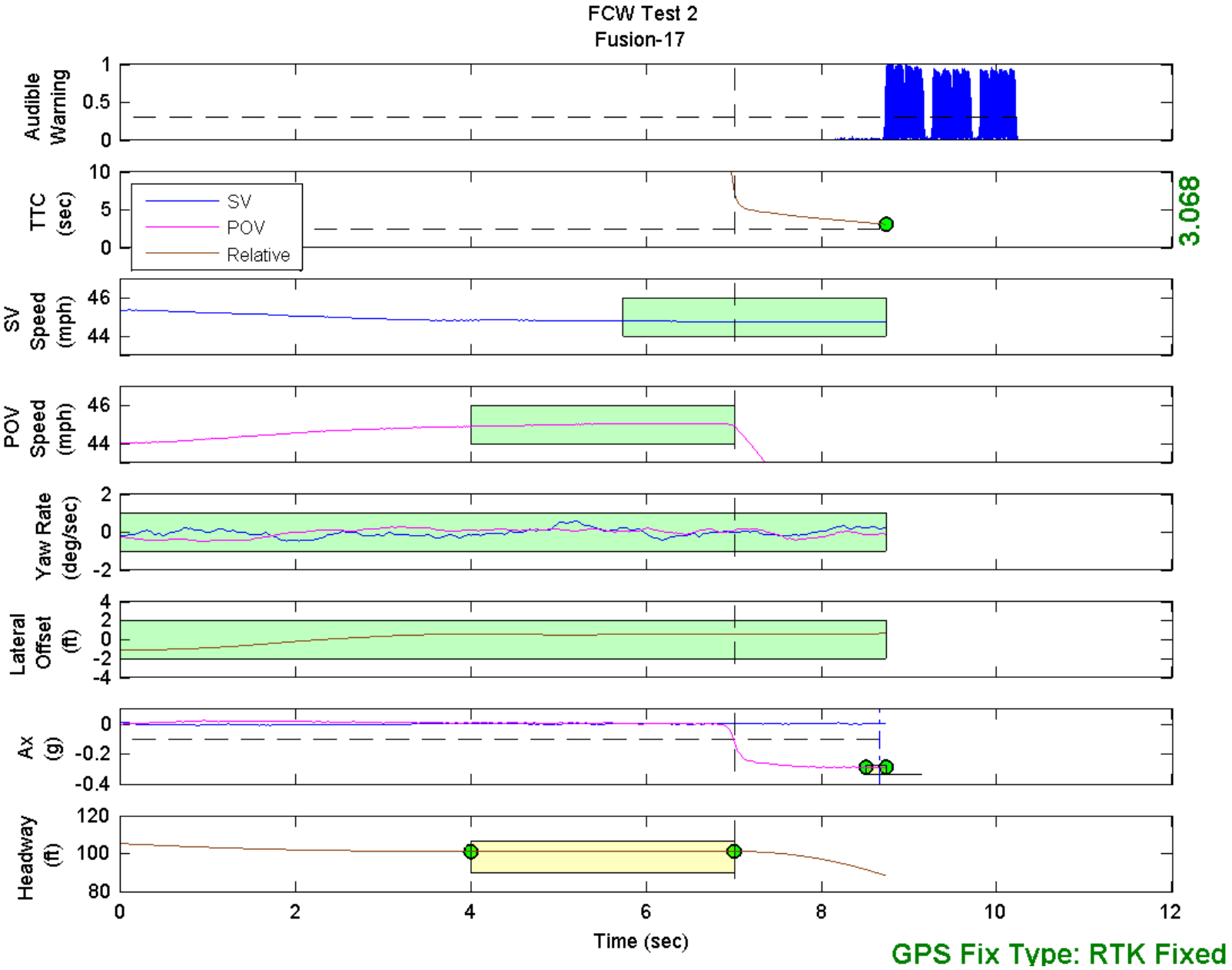


Figure D43. Time History for Run 17, FCW Test 2, Audible Warning

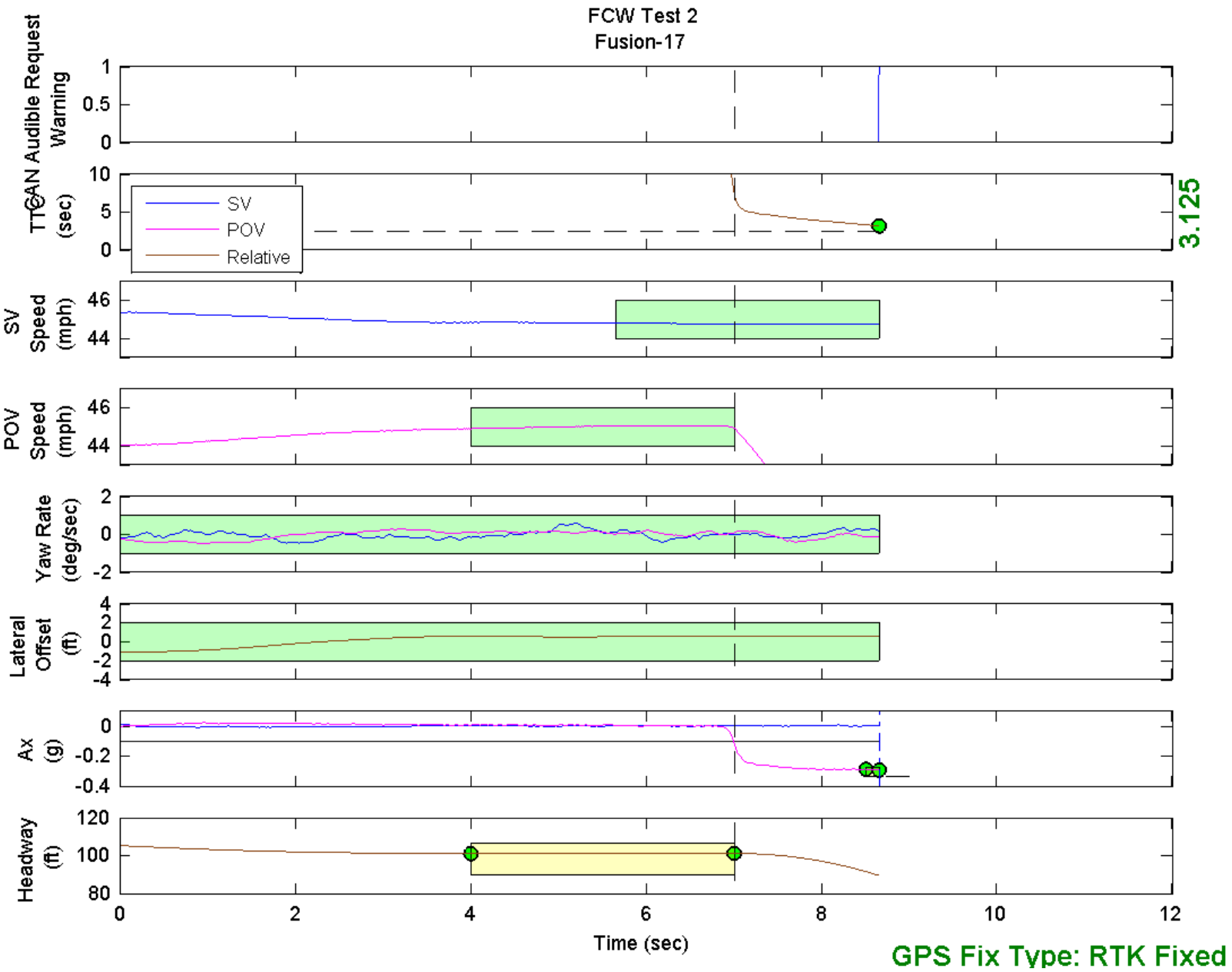


Figure D44. Time History for Run 17, FCW Test 2, CAN Audible Warning Request

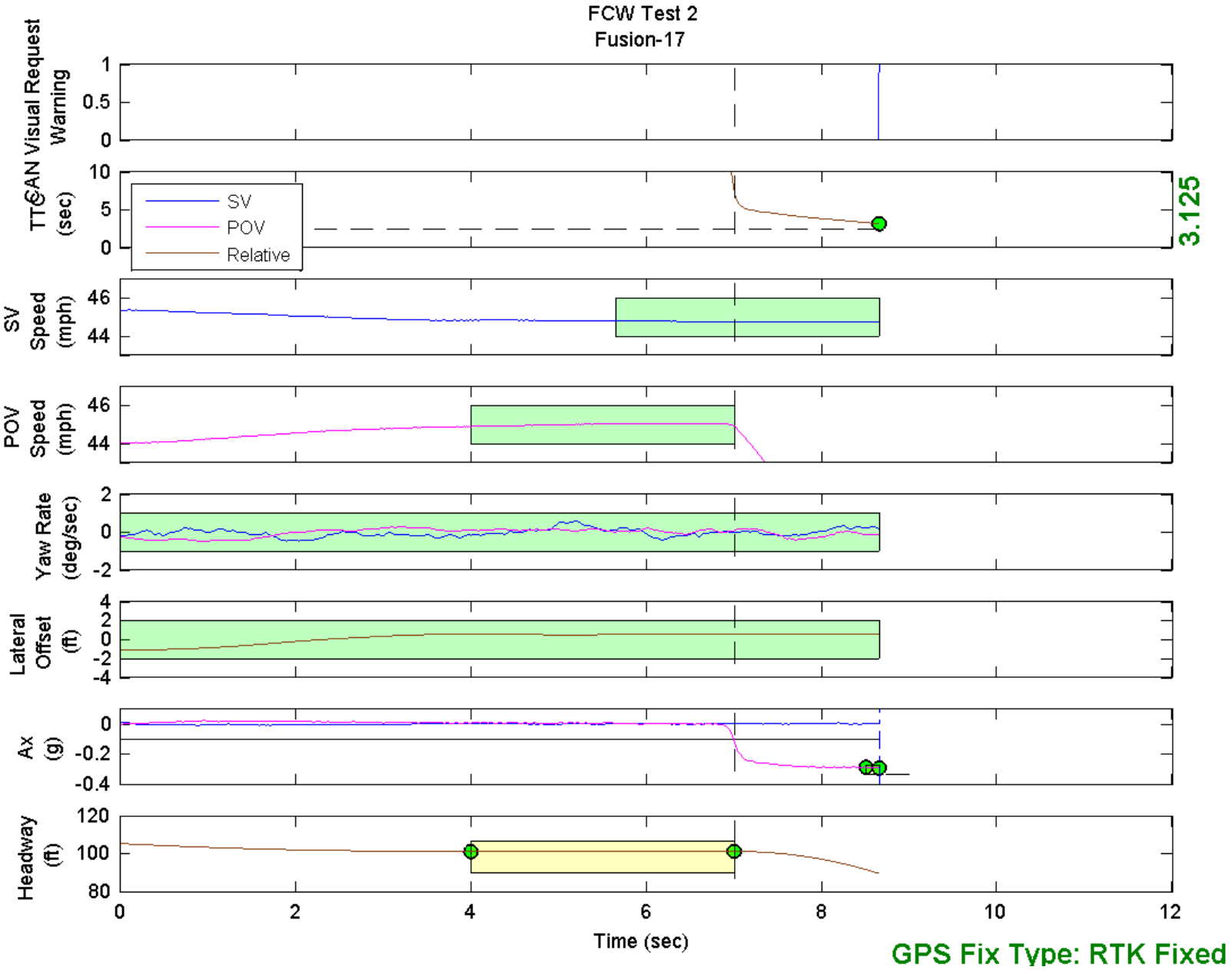


Figure D45. Time History for Run 17, FCW Test 2, CAN Visual Warning Request

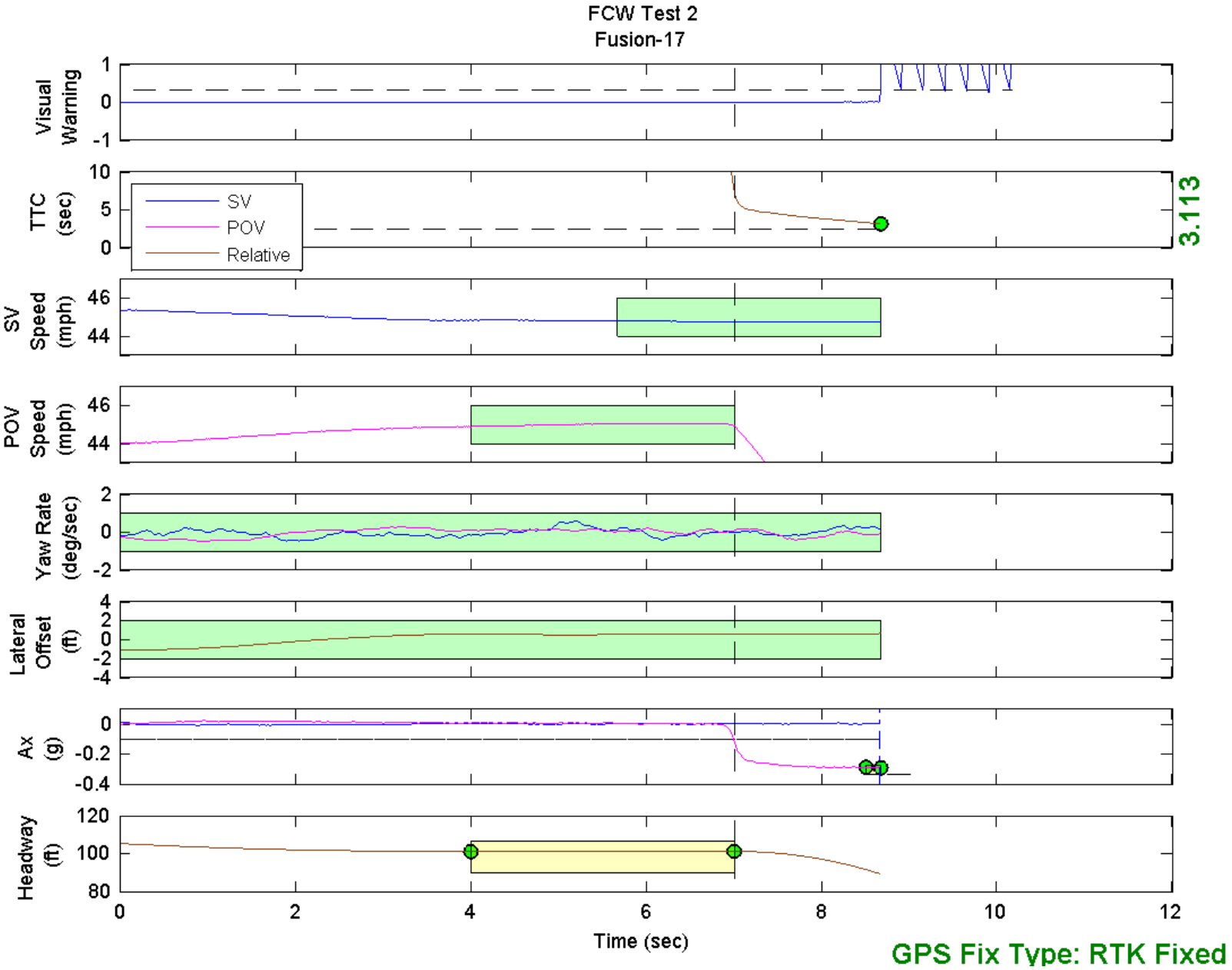


Figure D46. Time History for Run 17, FCW Test 2, Visual Warning

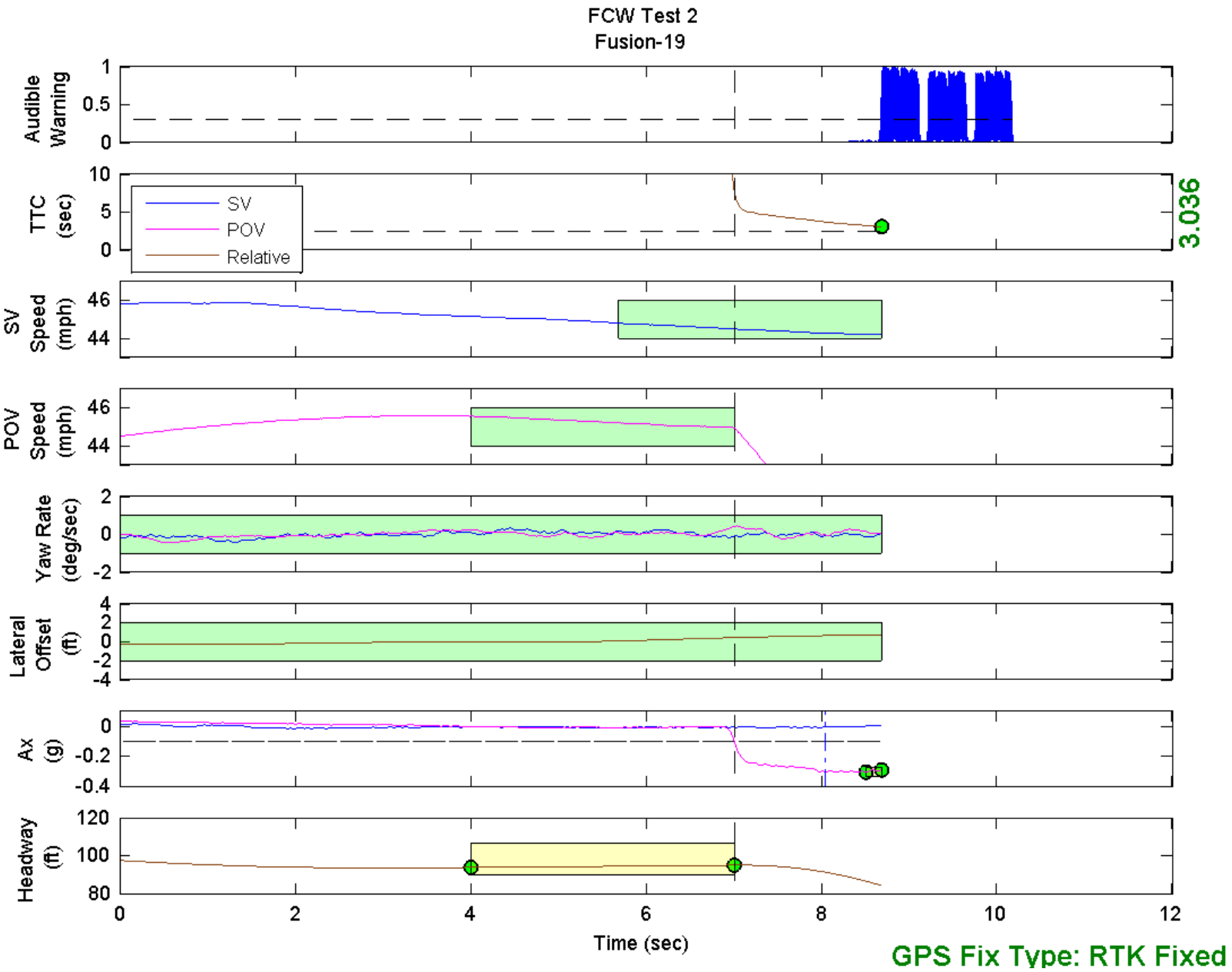


Figure D47. Time History for Run 19, FCW Test 2, Audible Warning

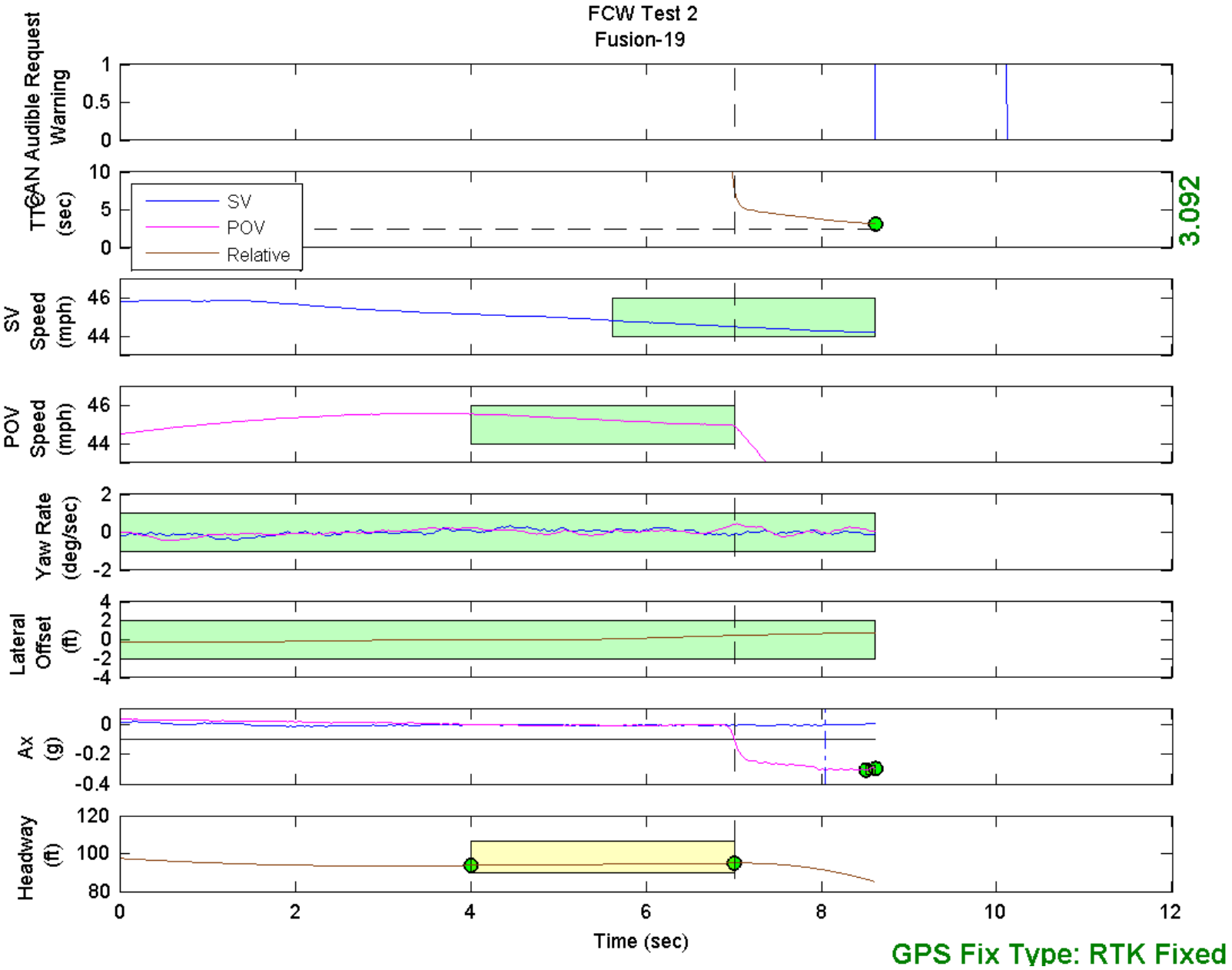


Figure D48. Time History for Run 19, FCW Test 2, CAN Audible Warning Request

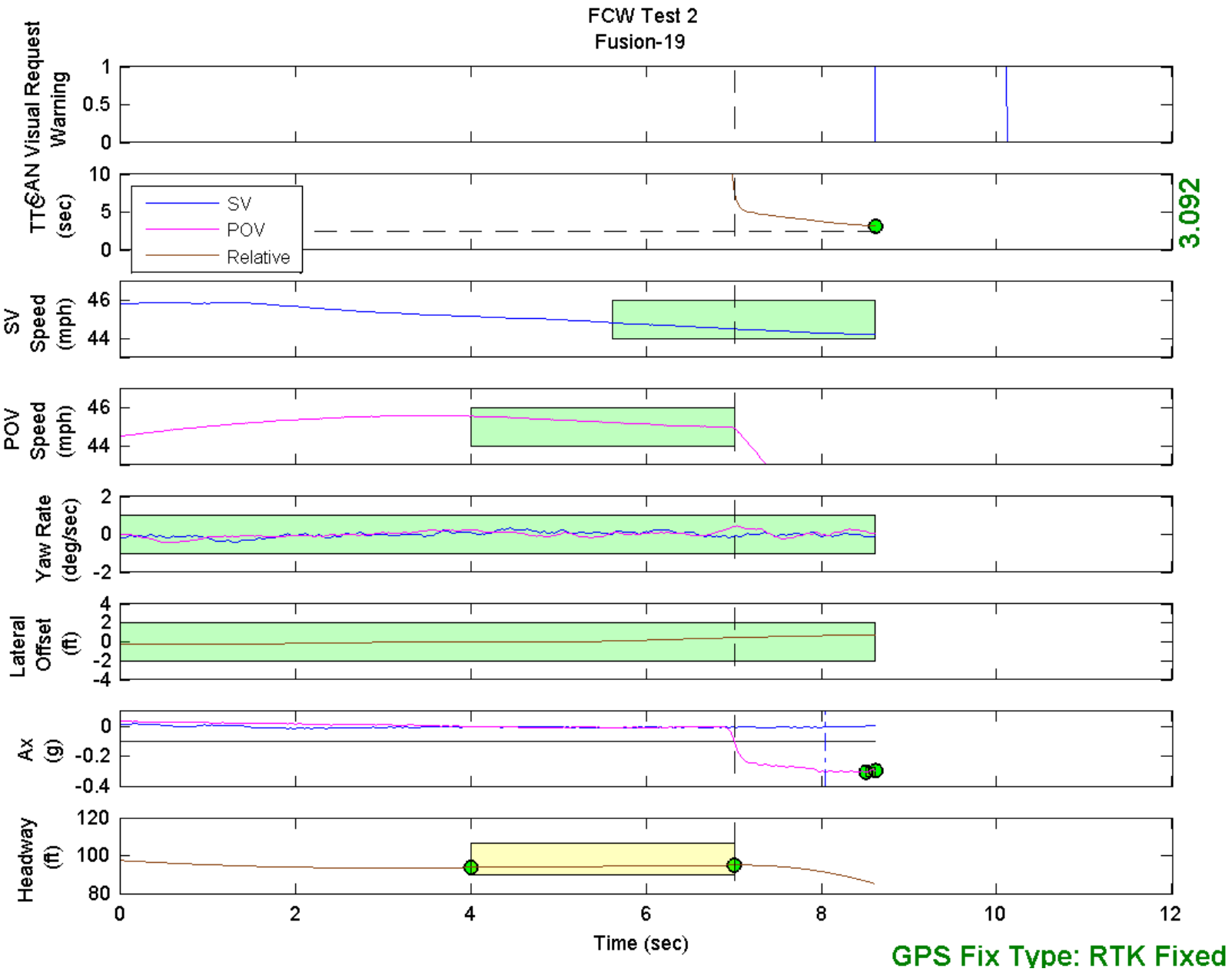


Figure D49. Time History for Run 19, FCW Test 2, CAN Visual Warning Request

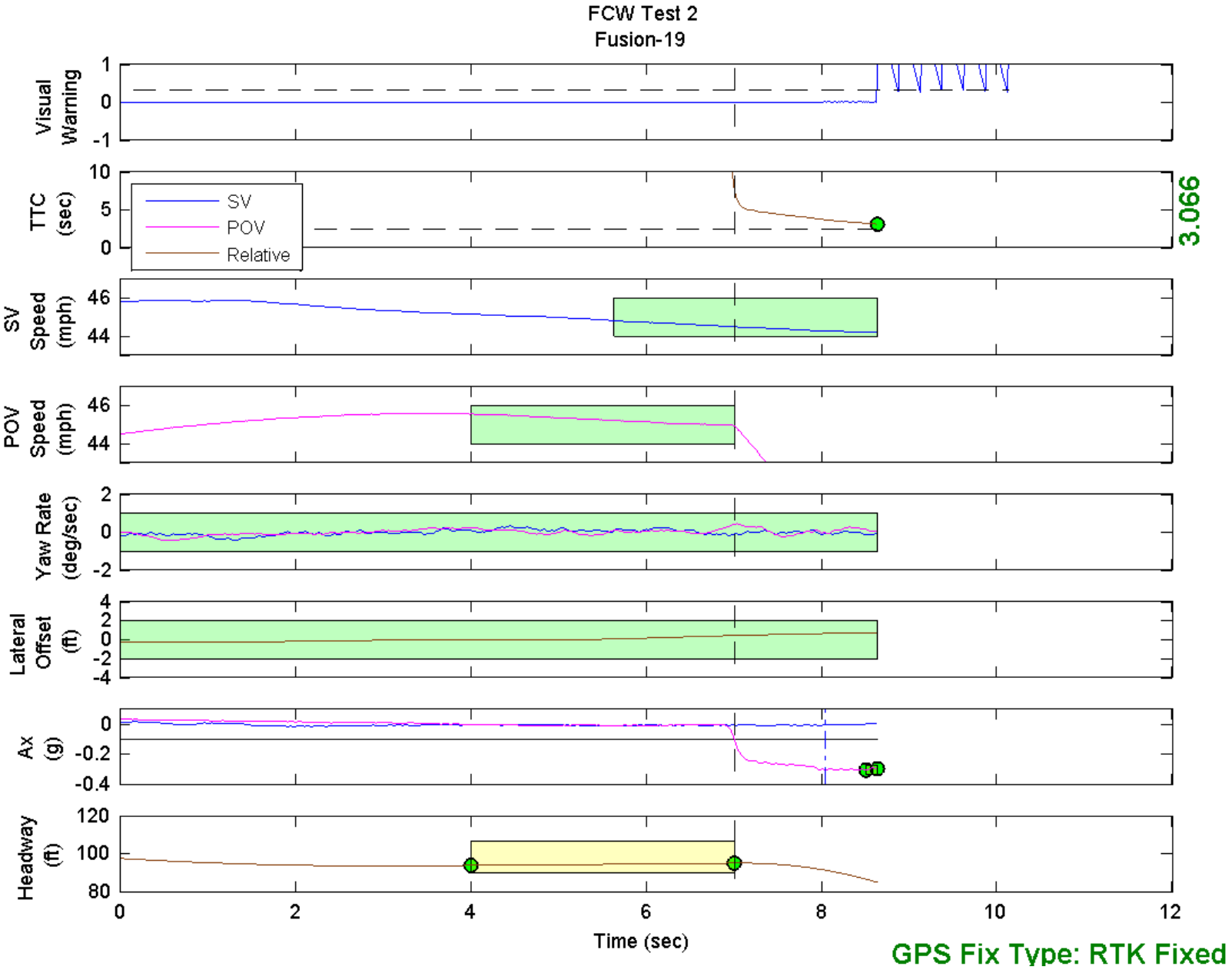


Figure D50. Time History for Run 19, FCW Test 2, Visual Warning

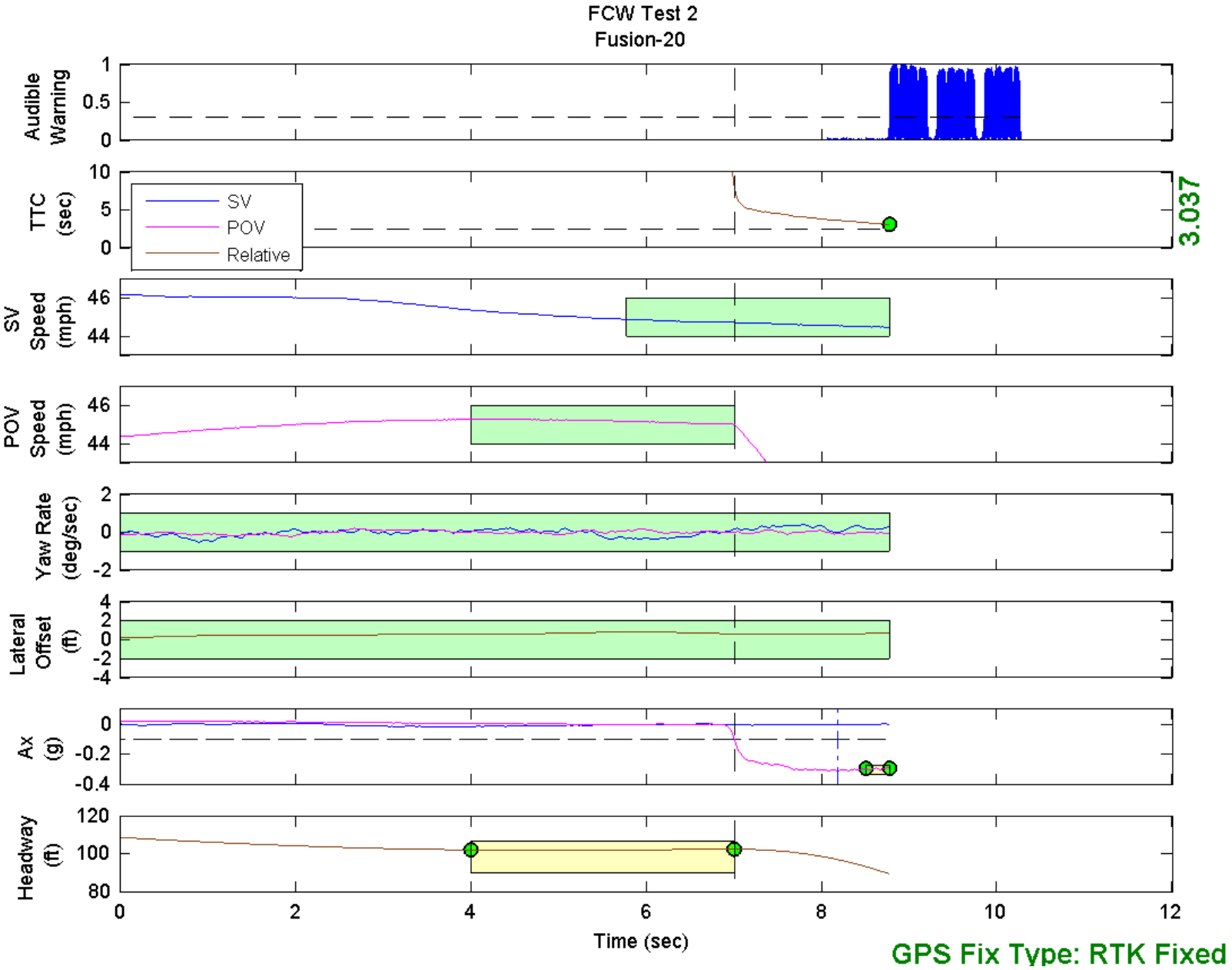


Figure D51. Time History for Run 20, FCW Test 2, Audible Warning

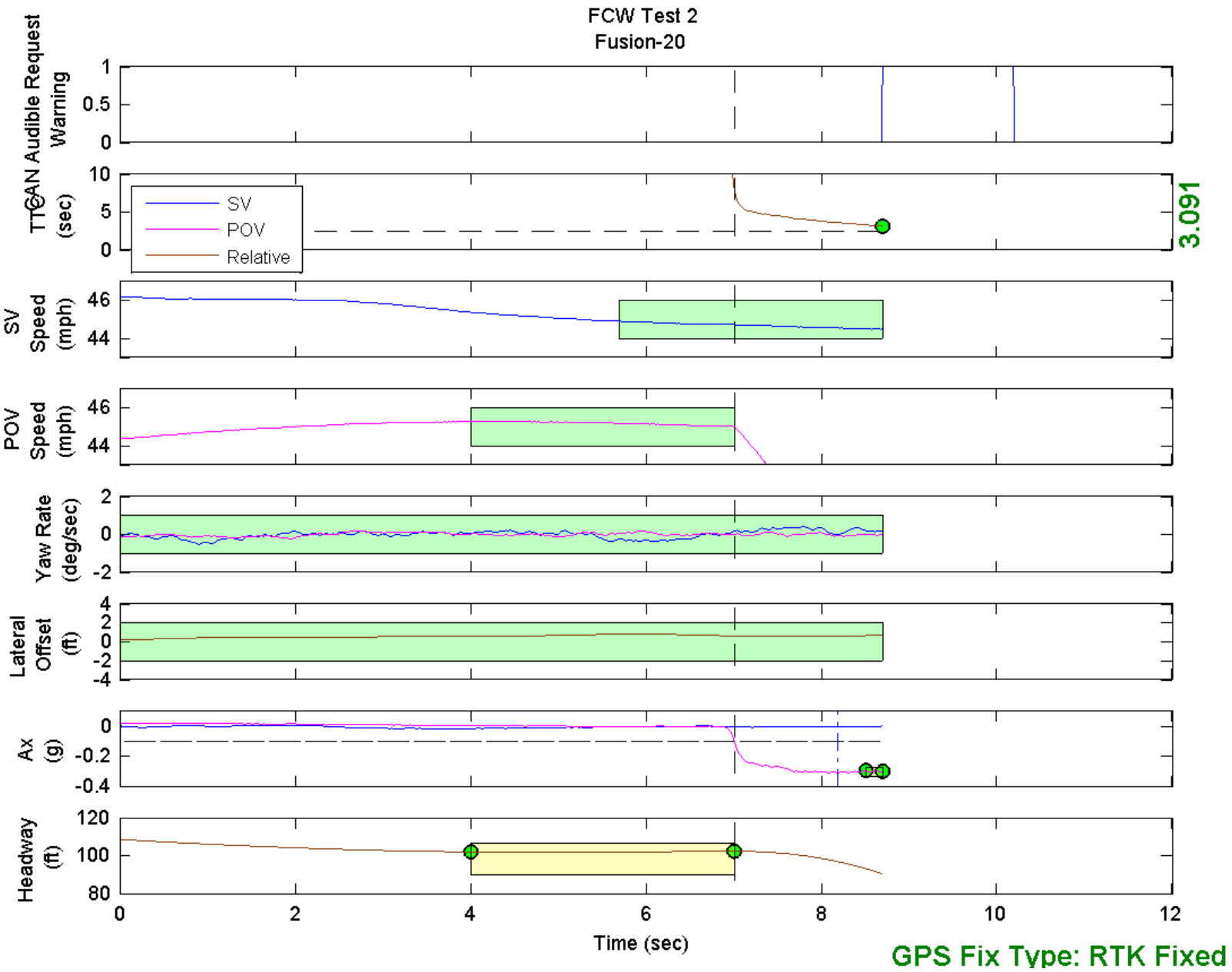


Figure D52. Time History for Run 20, FCW Test 2, CAN Audible Warning Request

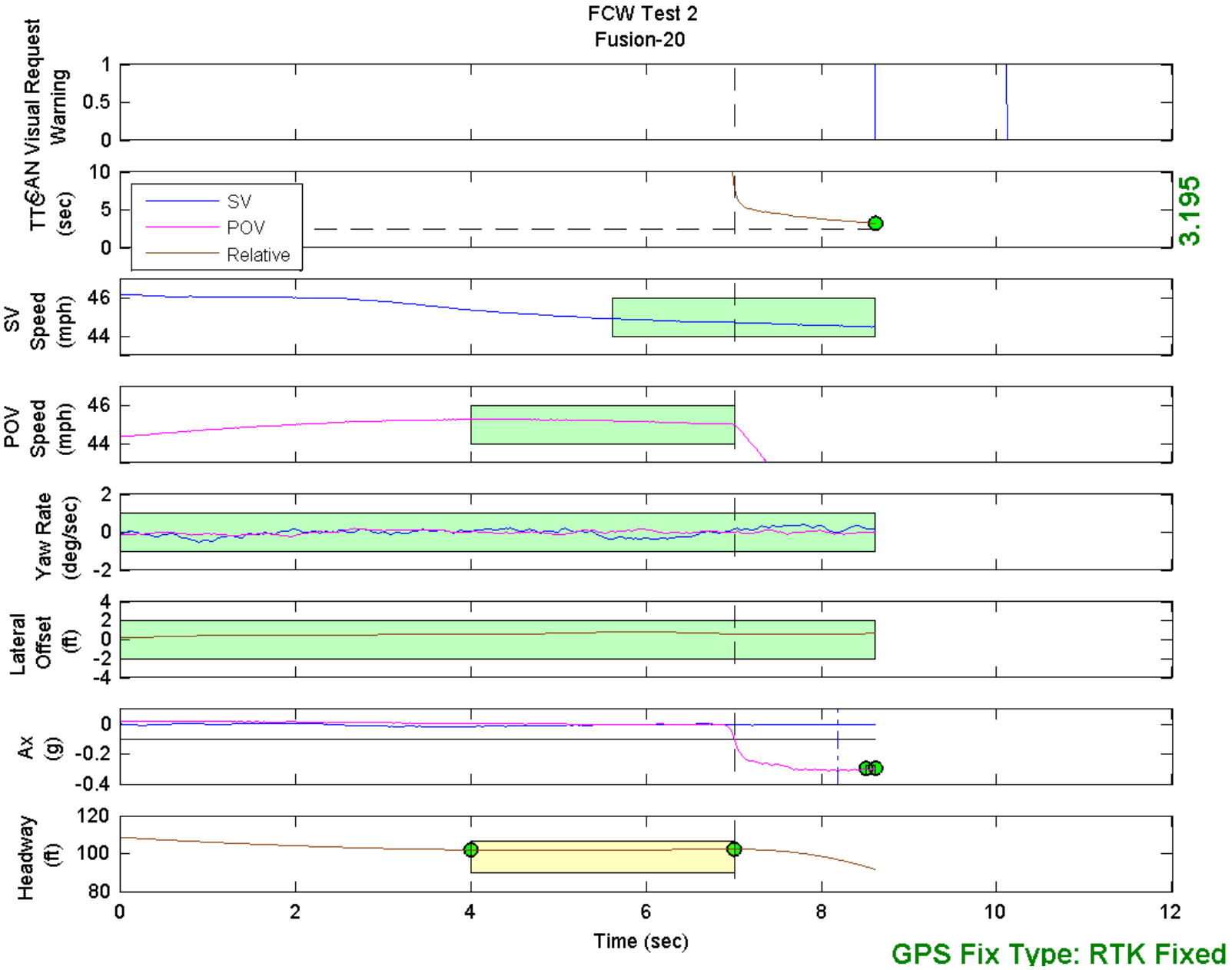


Figure D53. Time History for Run 20, FCW Test 2, CAN Visual Warning Request

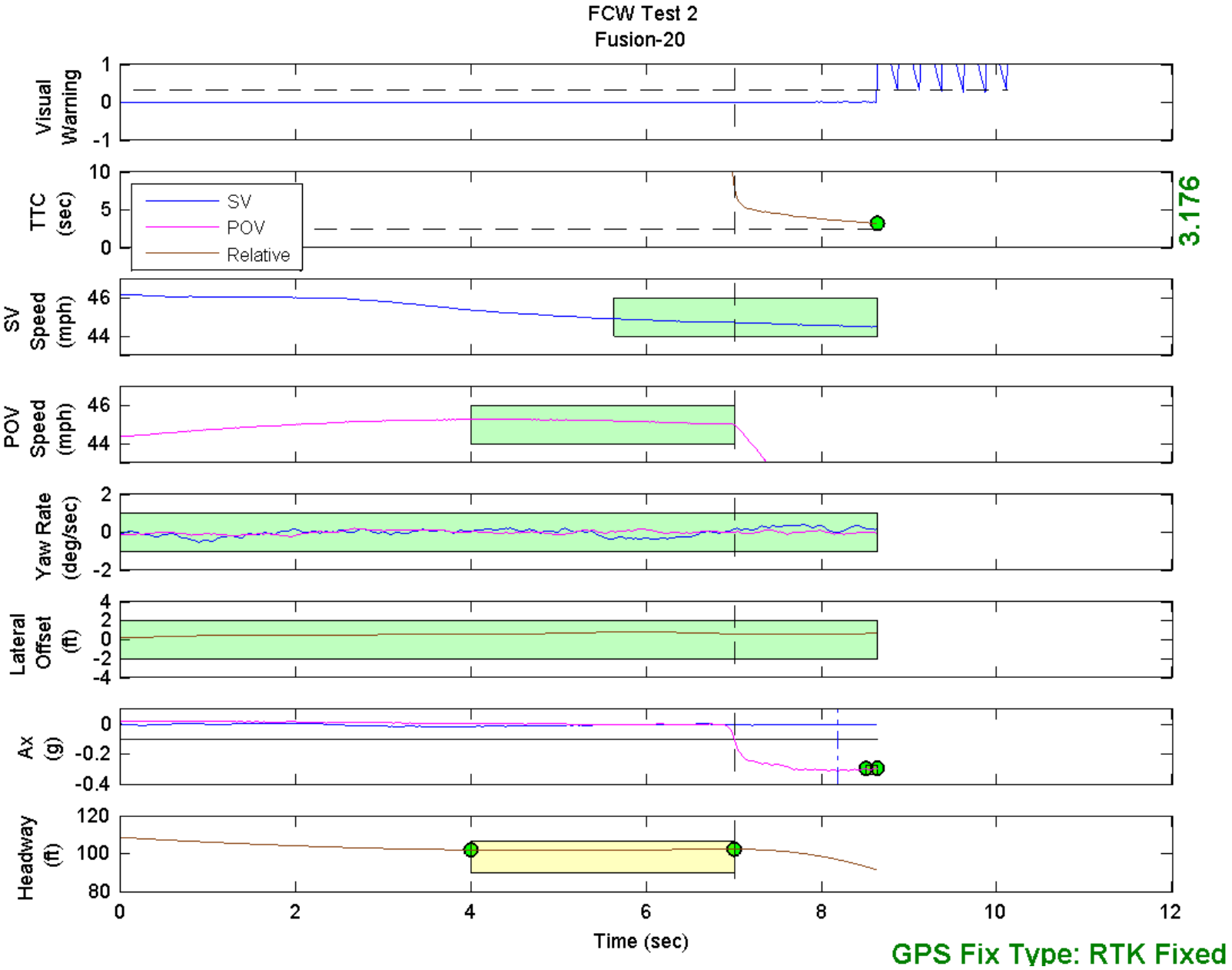


Figure D54. Time History for Run 20, FCW Test 2, Visual Warning

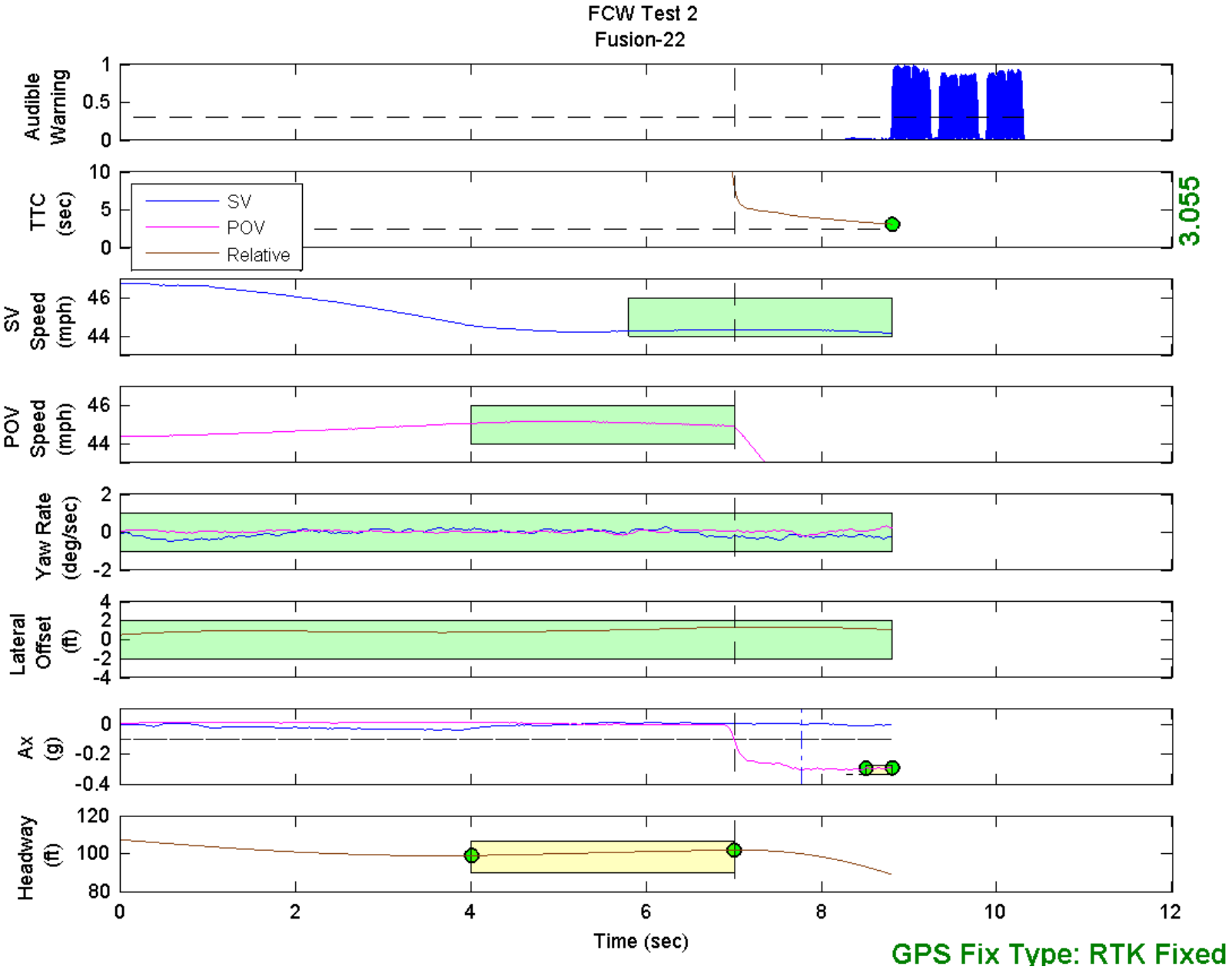


Figure D55. Time History for Run 22, FCW Test 2, Audible Warning

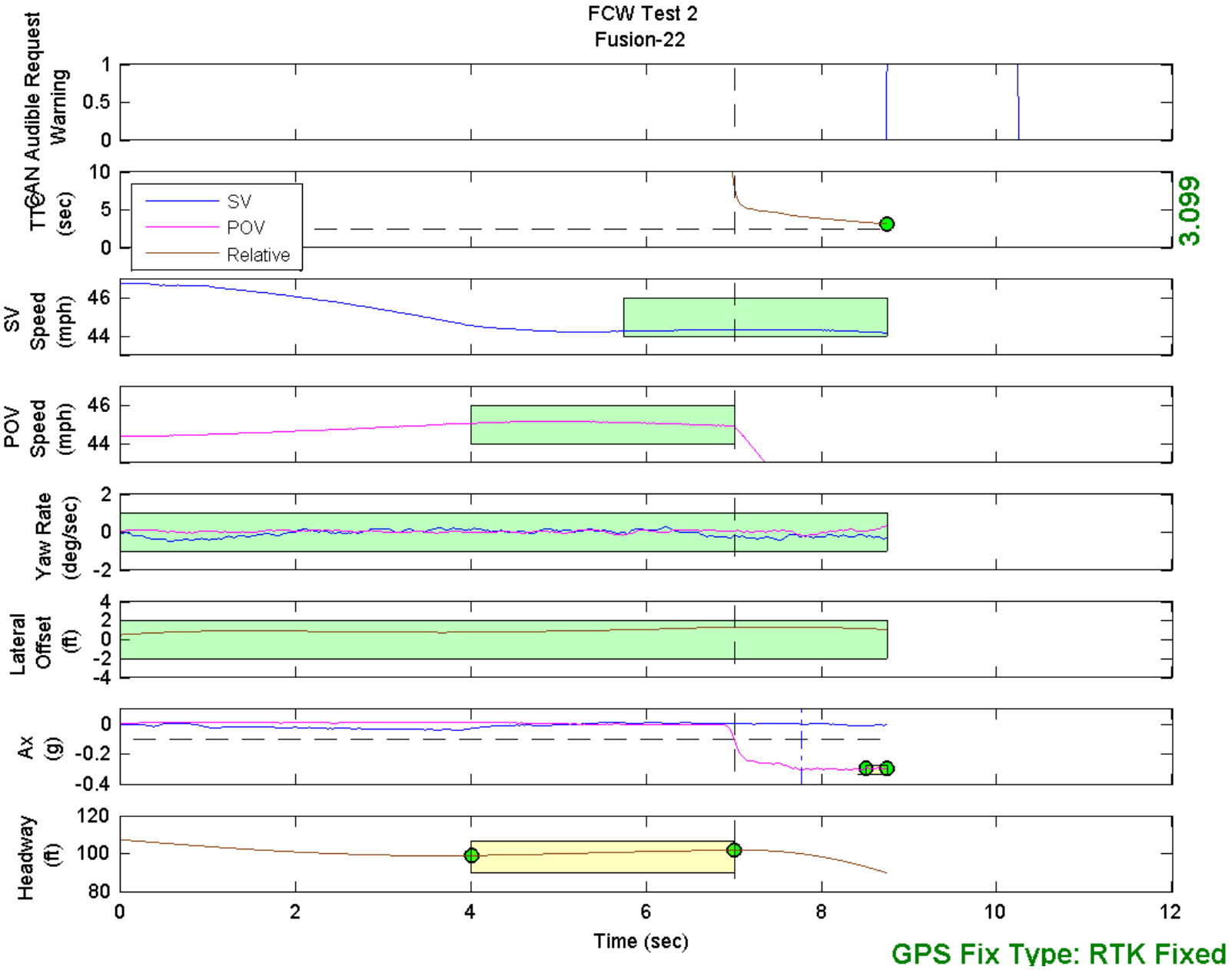


Figure D56. Time History for Run 22, FCW Test 2, CAN Audible Warning Request

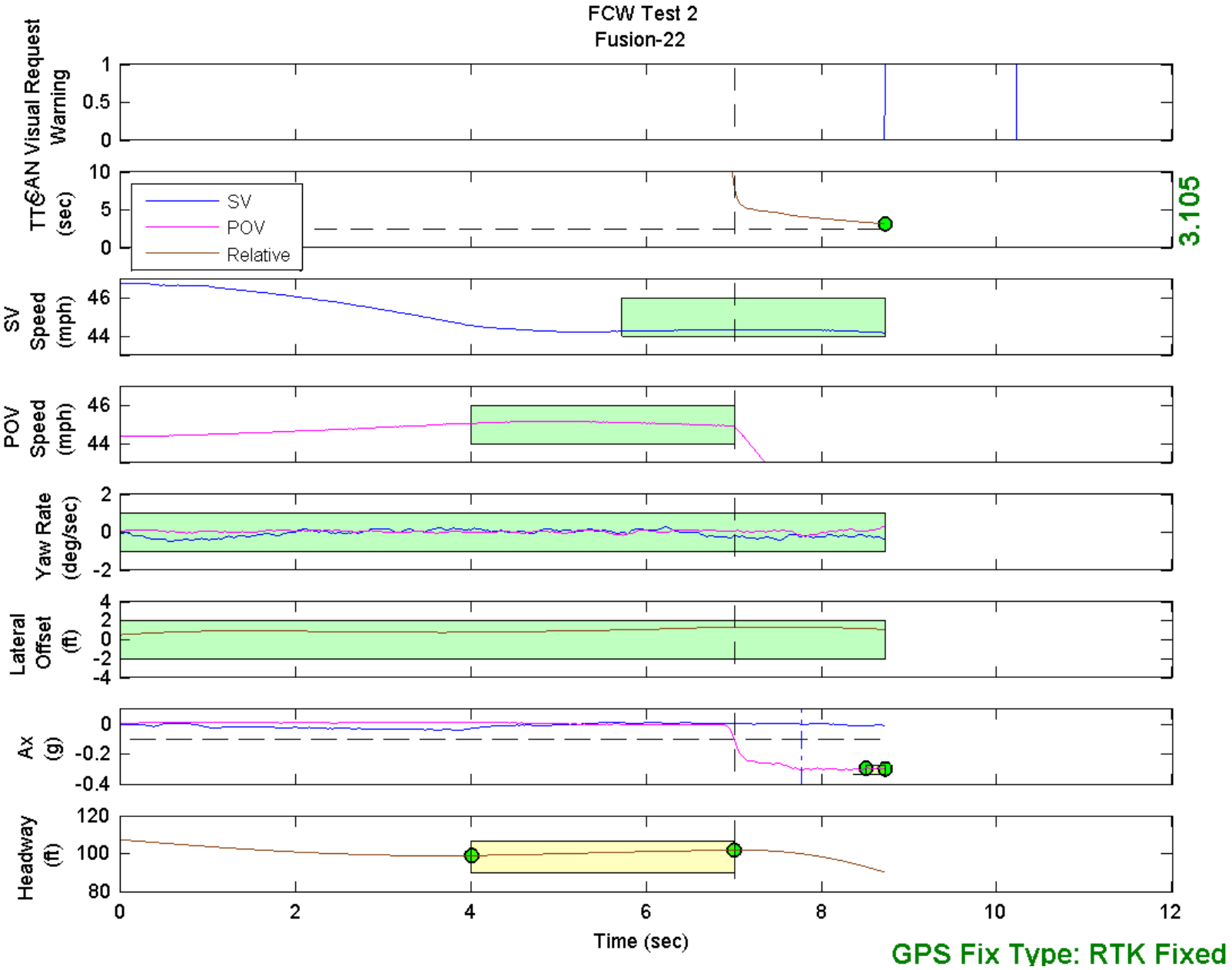


Figure D57. Time History for Run 22, FCW Test 2, CAN Visual Warning Request

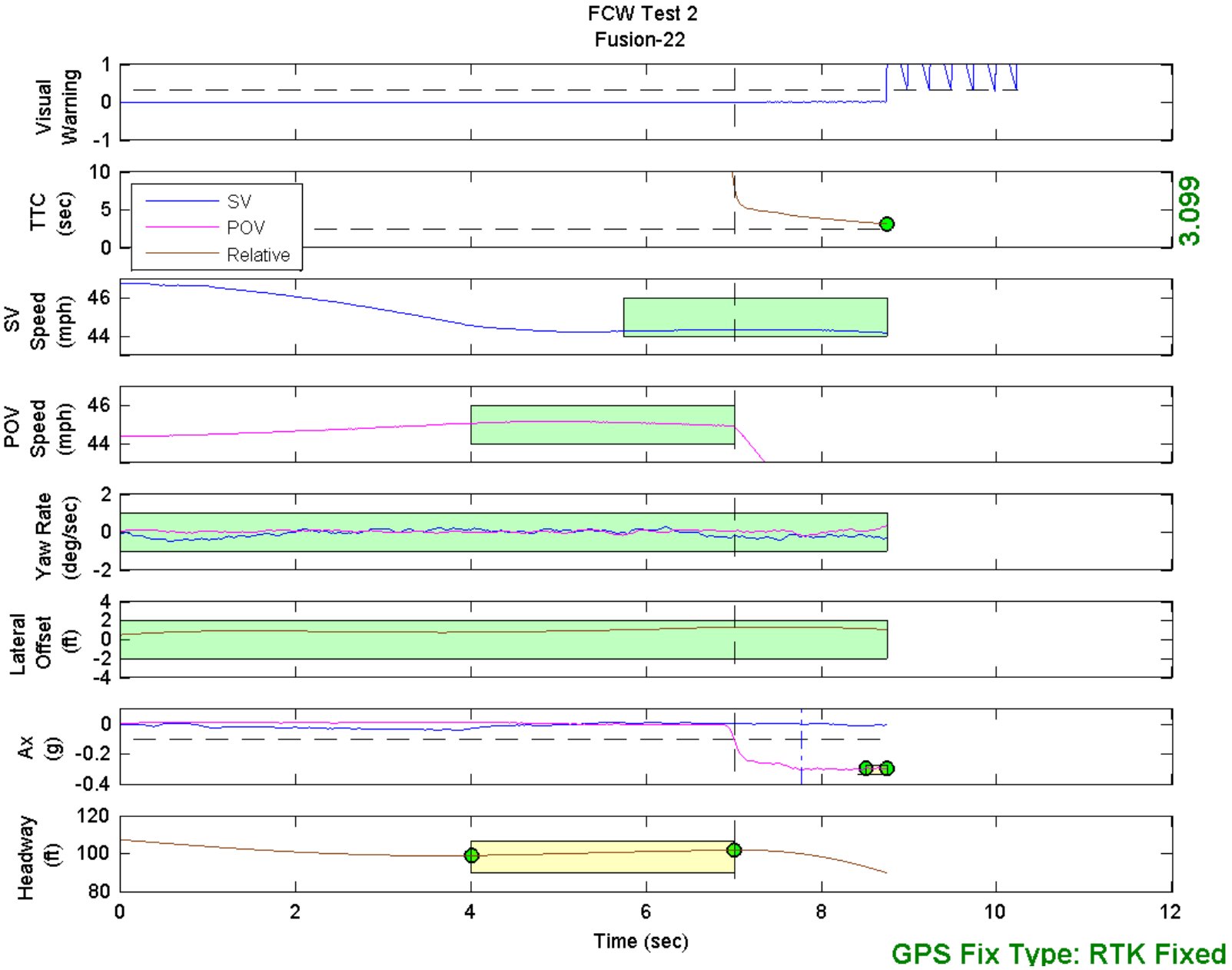


Figure D58. Time History for Run 22, FCW Test 2, Visual Warning

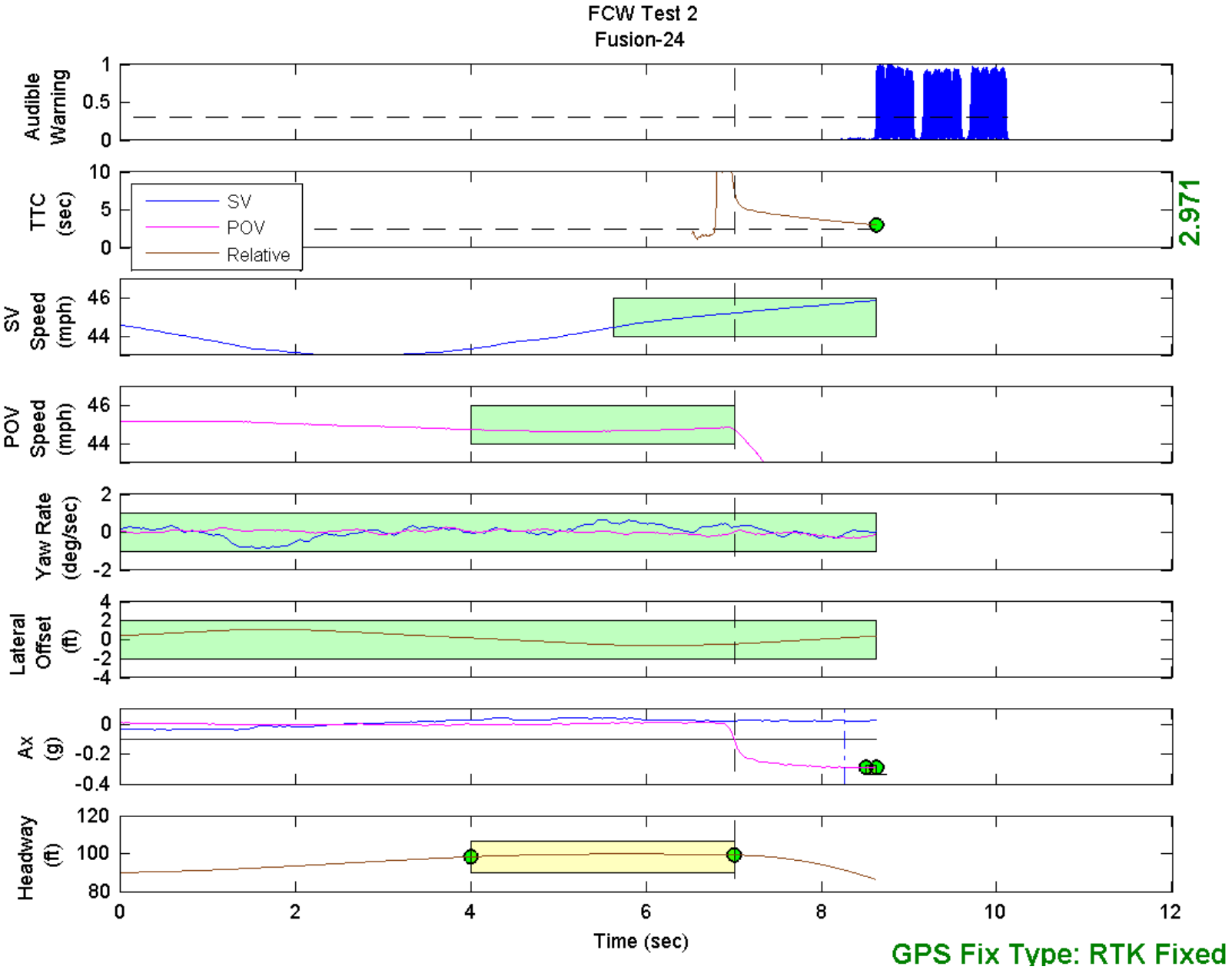


Figure D59. Time History for Run 24, FCW Test 2, Audible Warning

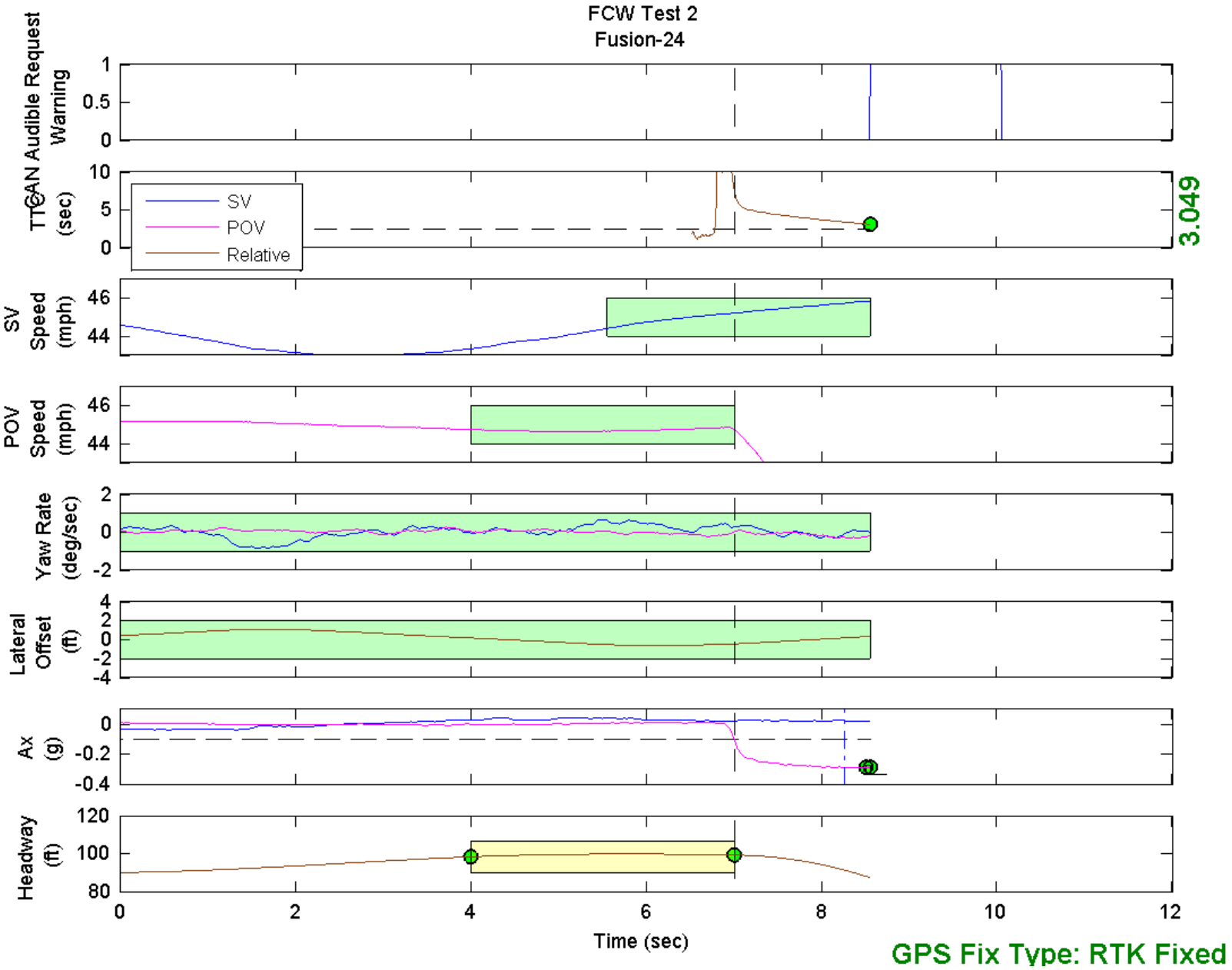


Figure D60. Time History for Run 24, FCW Test 2, CAN Audible Warning Request

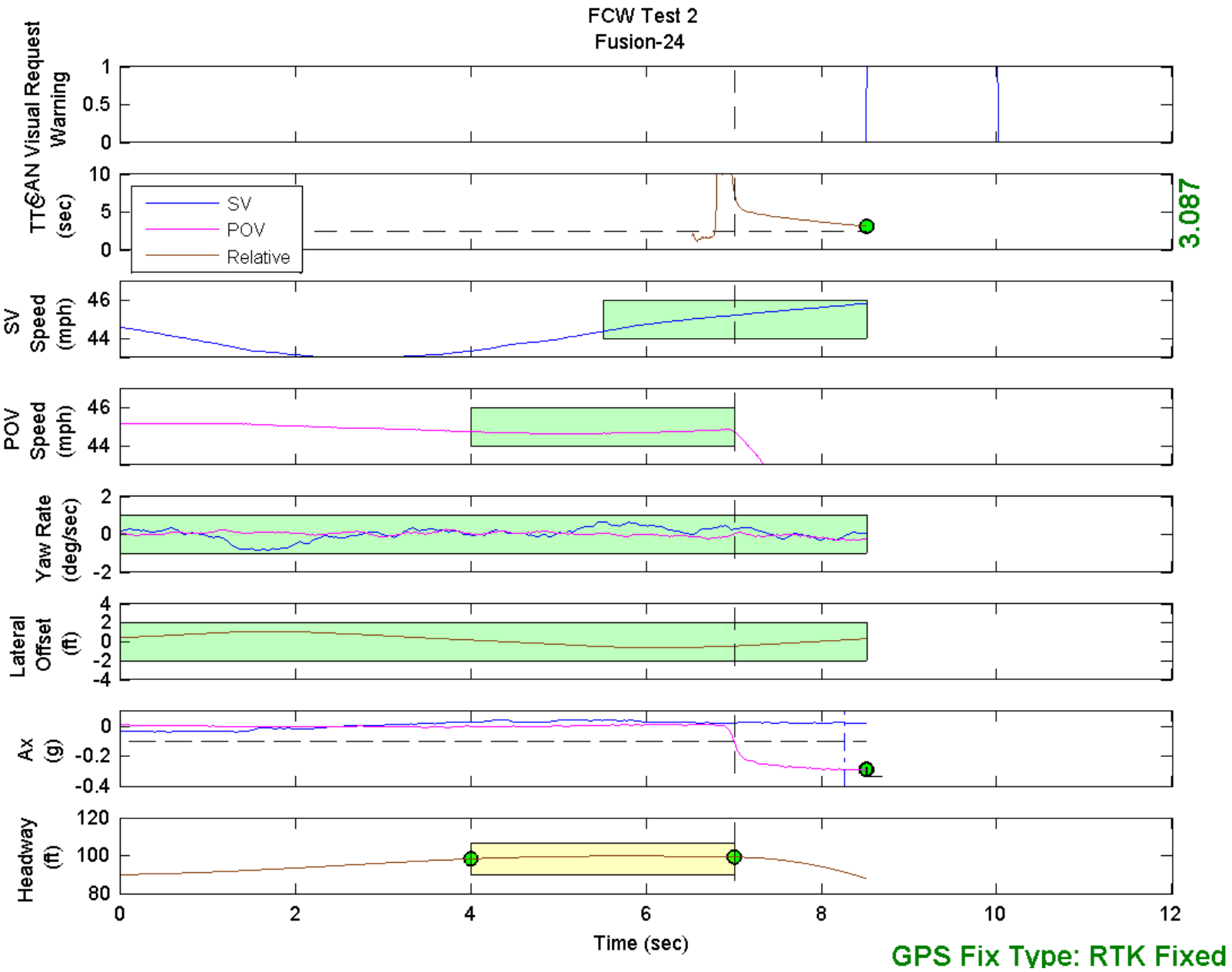


Figure D61. Time History for Run 24, FCW Test 2, CAN Visual Warning Request

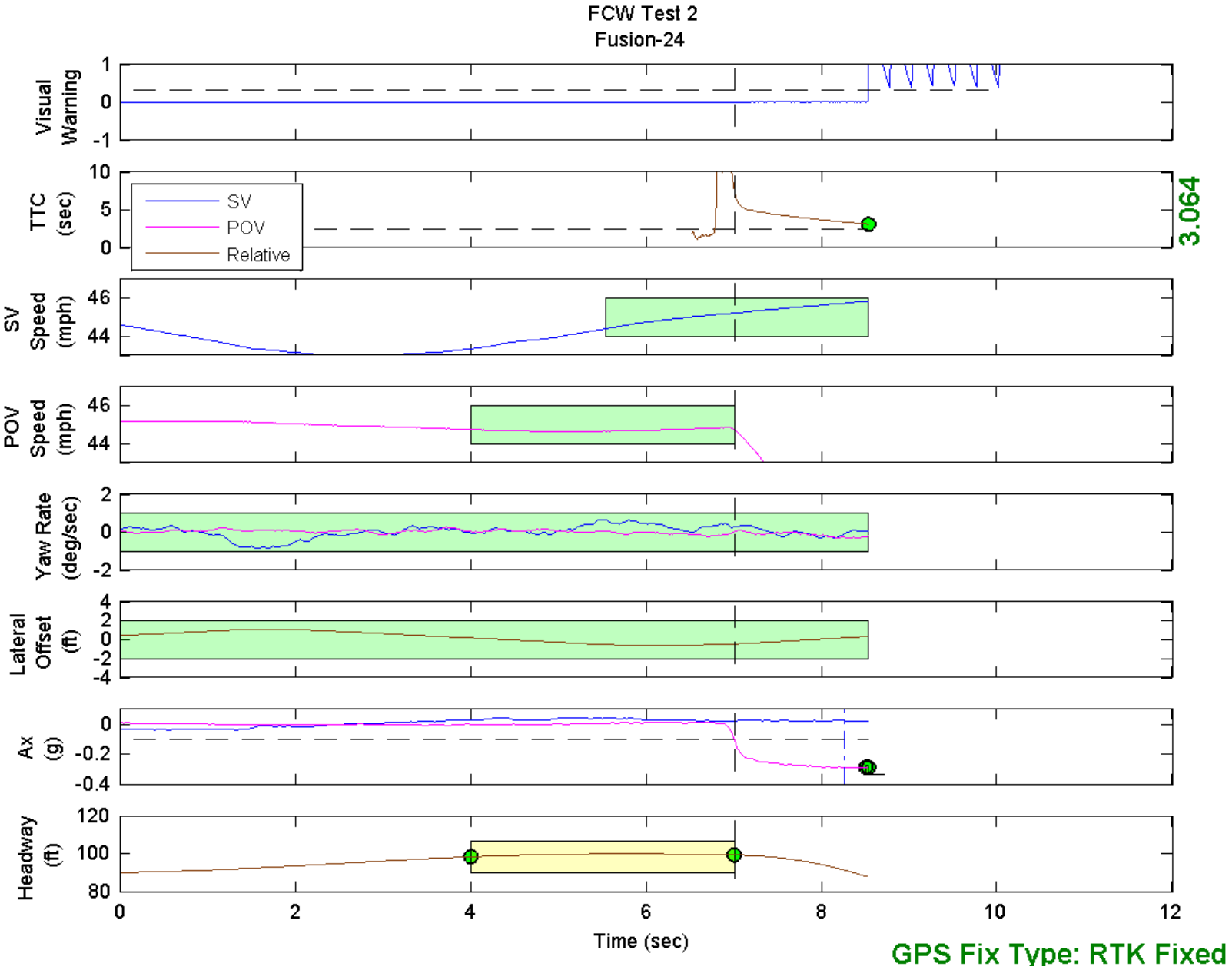


Figure D62. Time History for Run 24, FCW Test 2, Visual Warning

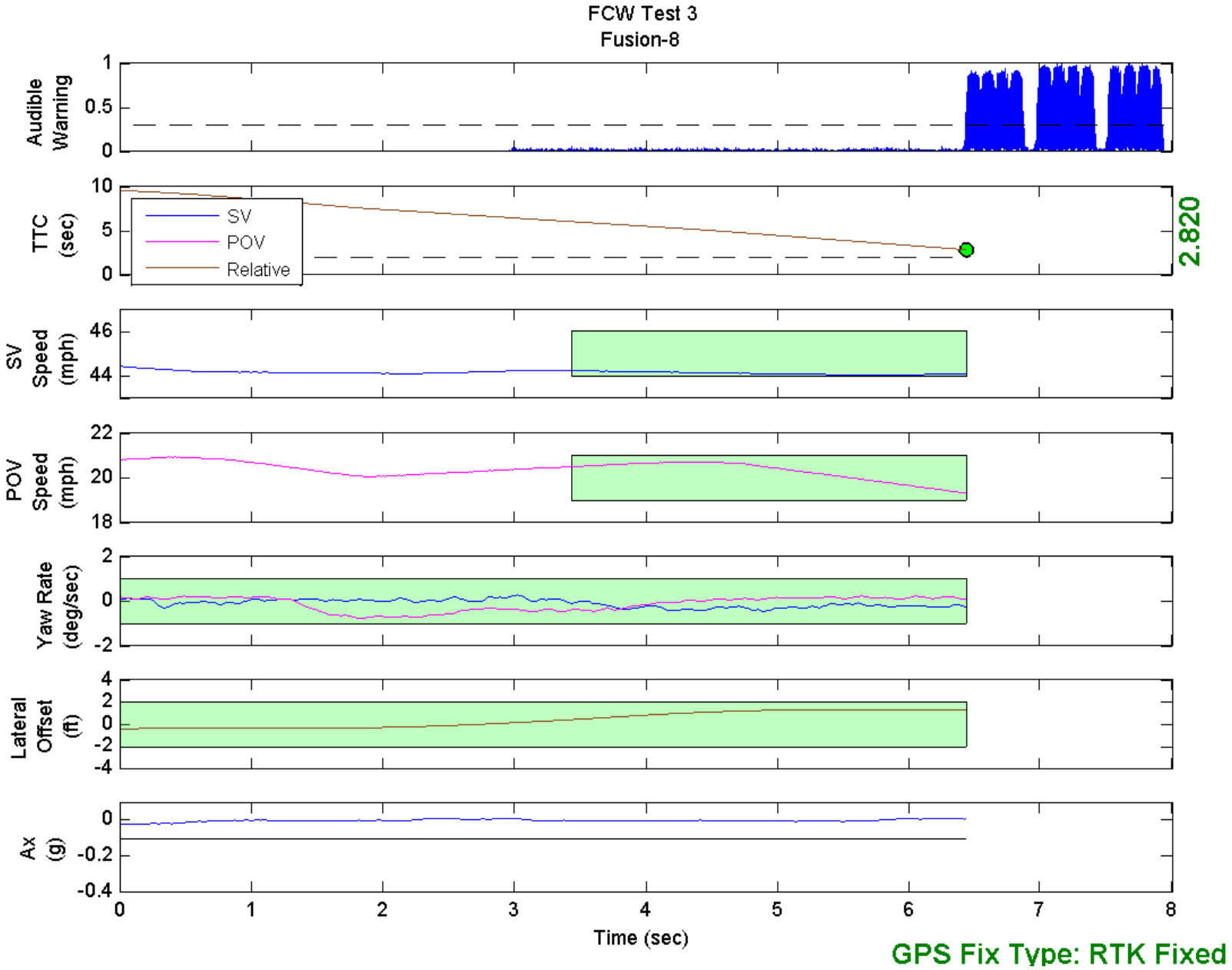


Figure D63. Time History for Run 8, FCW Test 3, Audible Warning

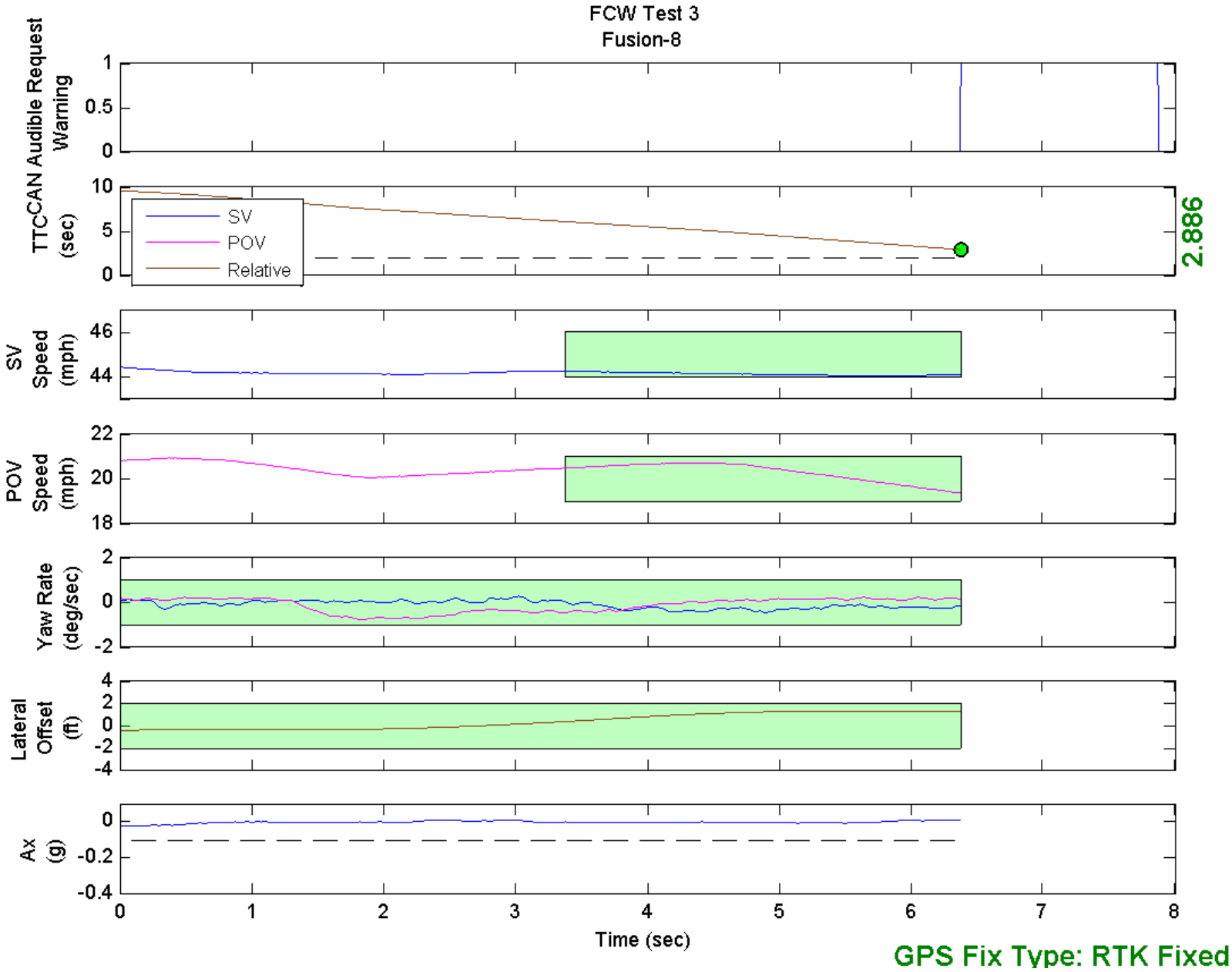


Figure D64. Time History for Run 8, FCW Test 3, CAN Audible Warning Request

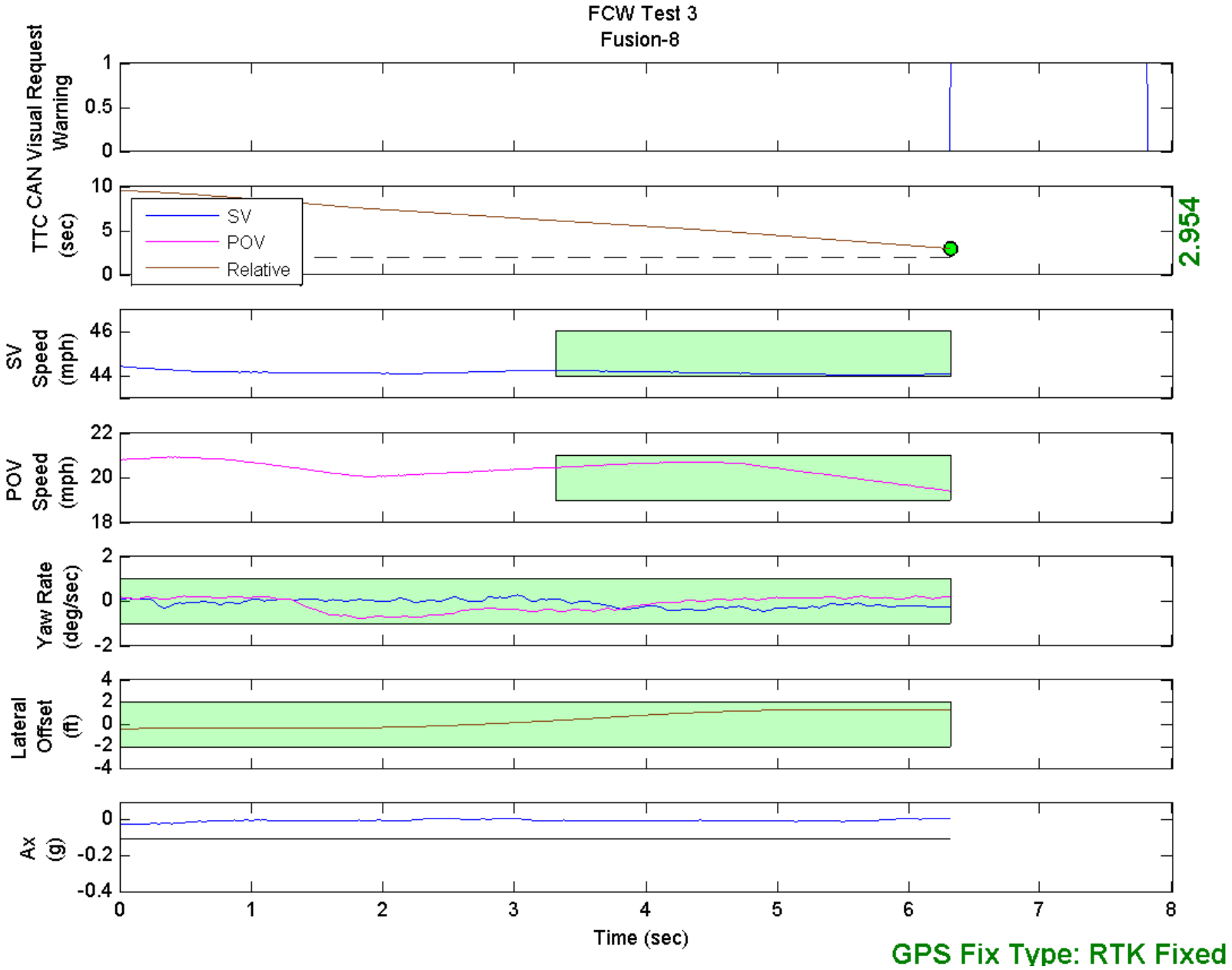


Figure D65. Time History for Run 8, FCW Test 3, CAN Visual Warning Request

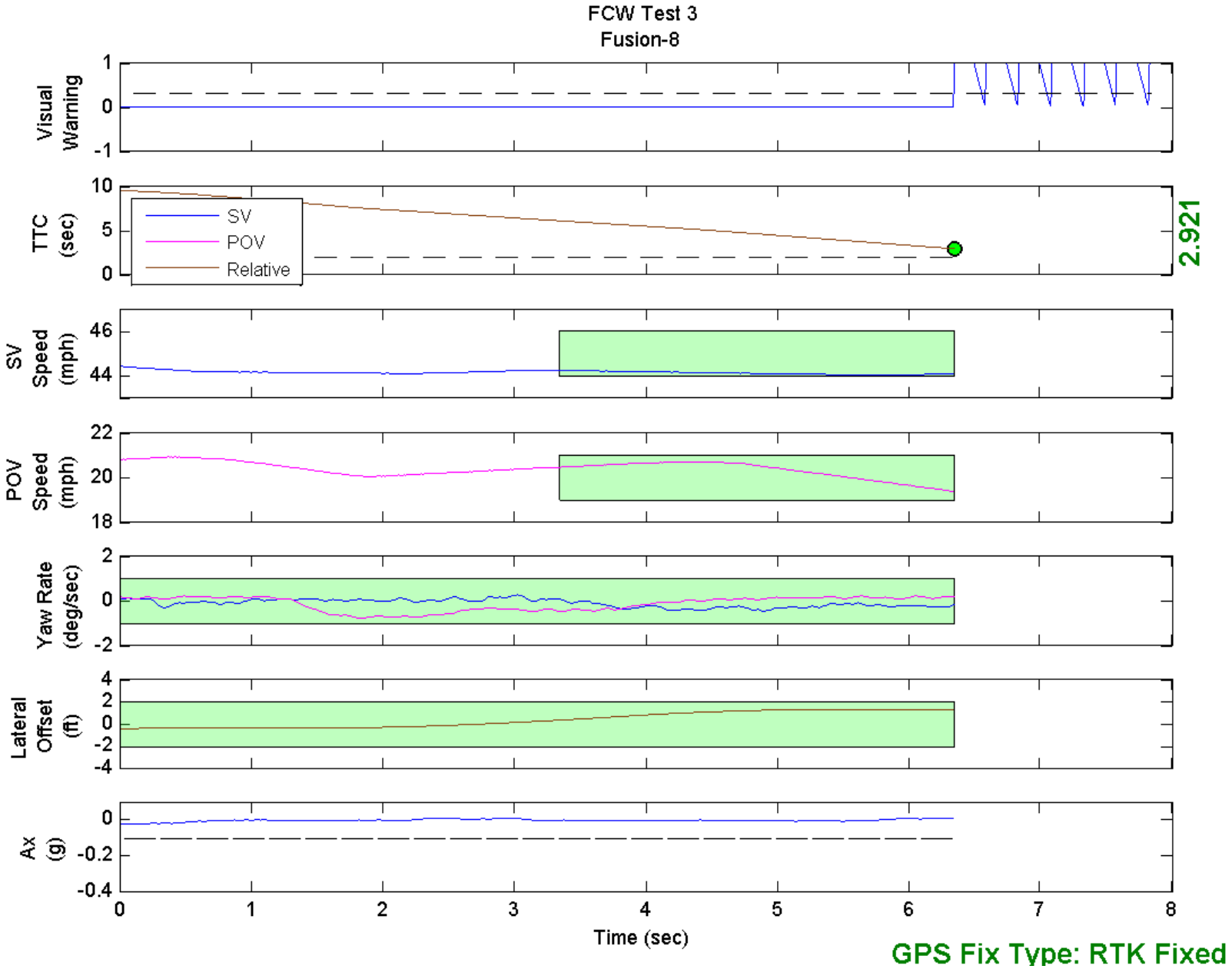


Figure D66. Time History for Run 8, FCW Test 3, Visual Warning

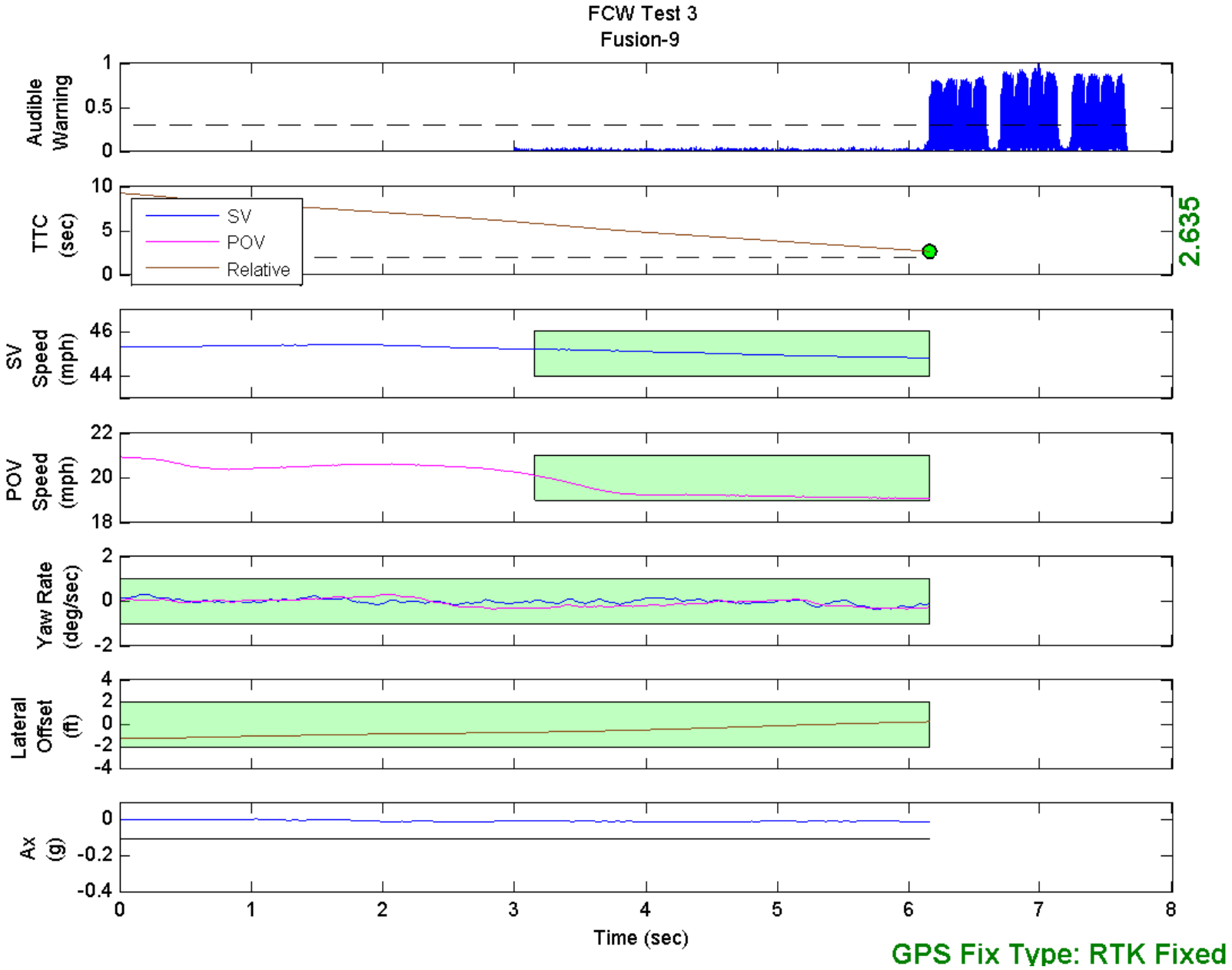


Figure D67. Time History for Run 9, FCW Test 3, Audible Warning

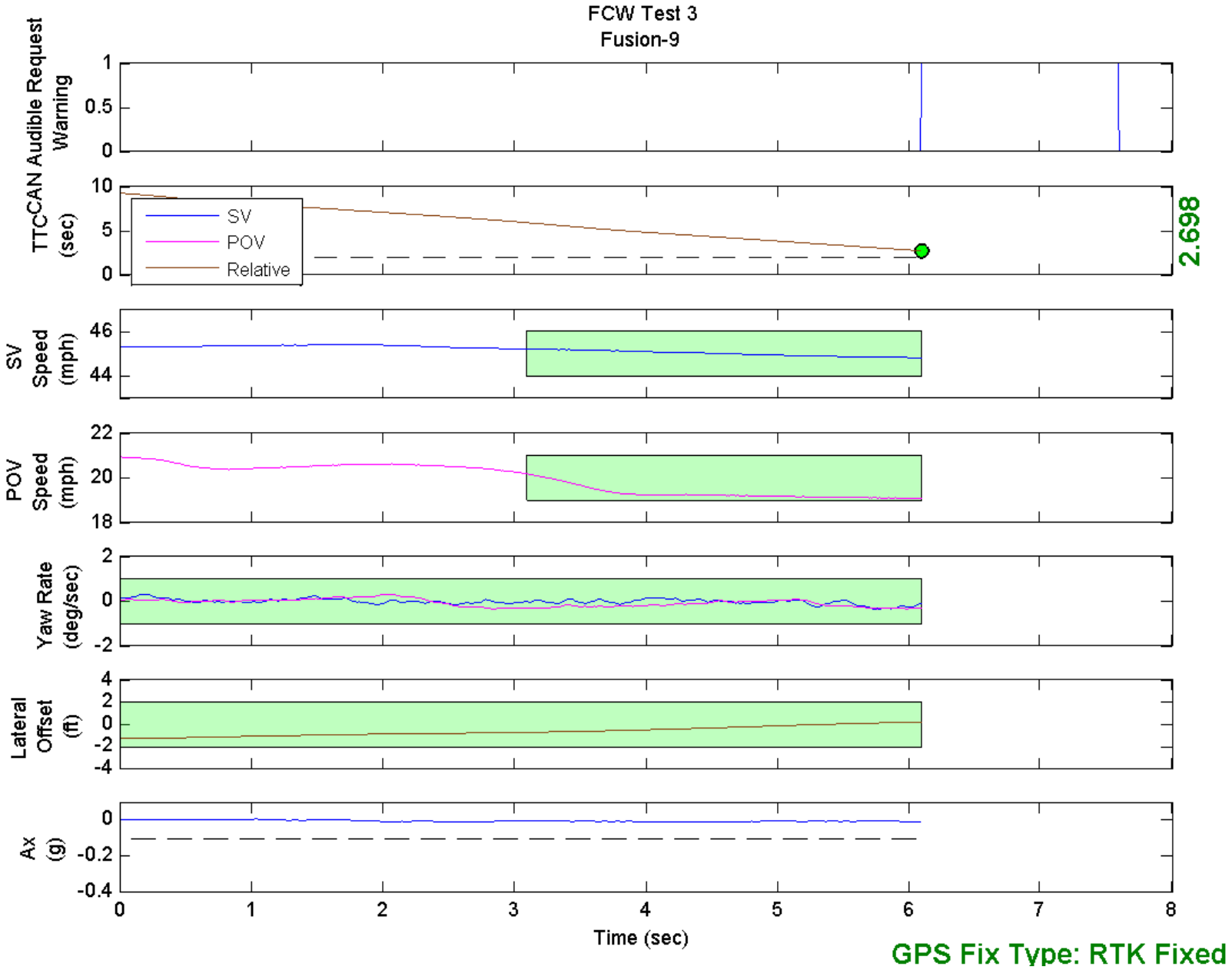


Figure D68. Time History for Run 9, FCW Test 3, CAN Audible Warning Request

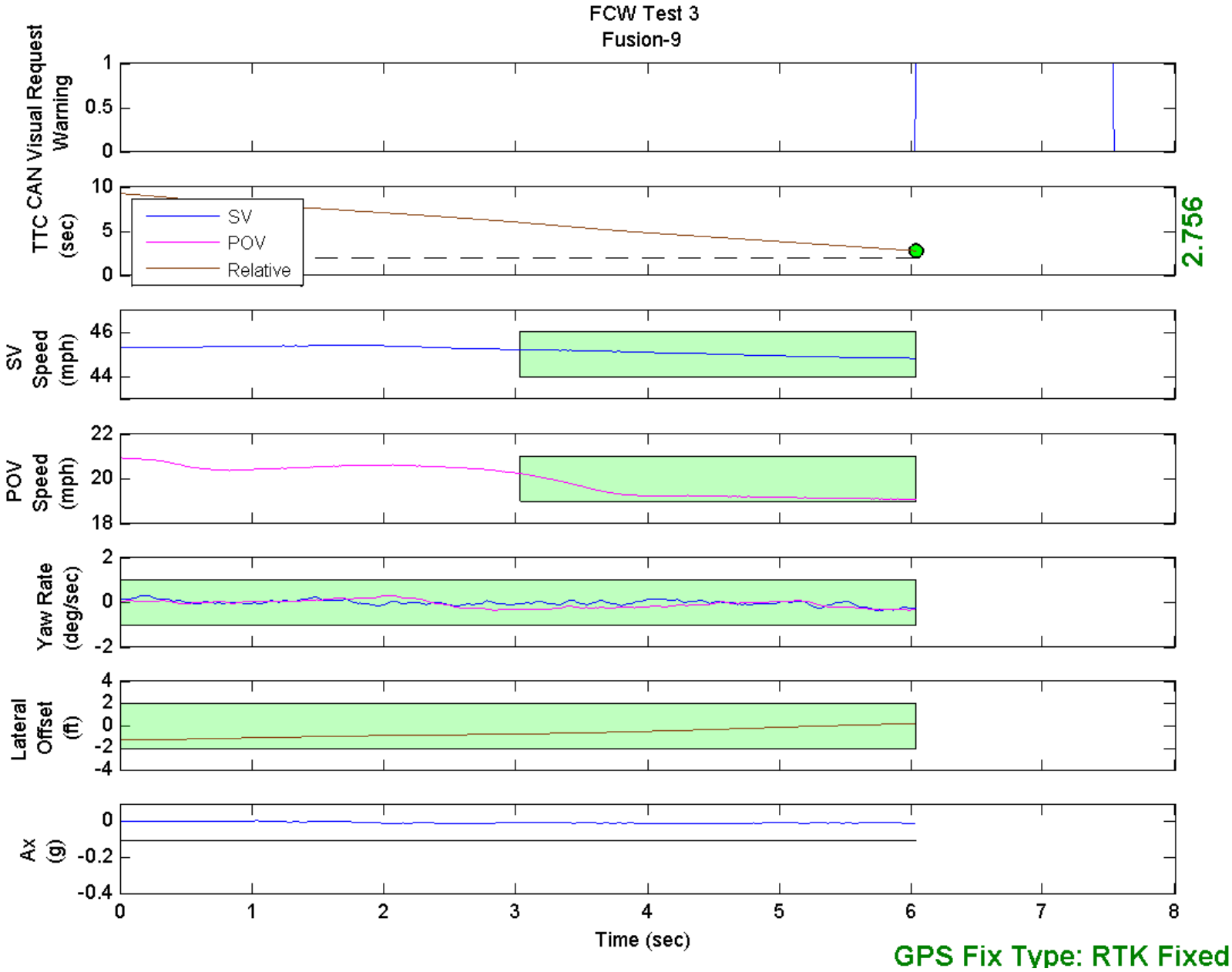


Figure D69. Time History for Run 9, FCW Test 3, CAN Visual Warning Request

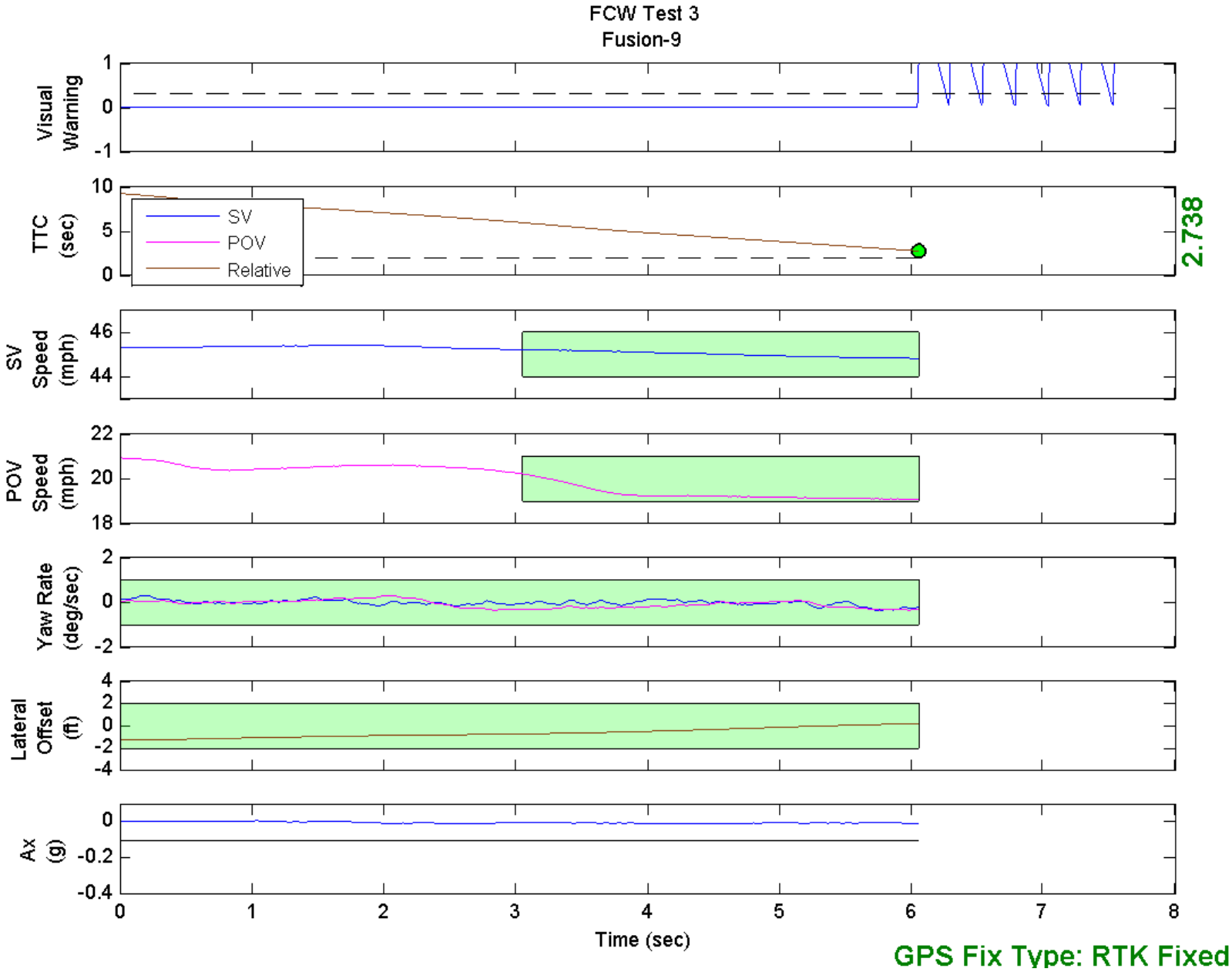


Figure D70. Time History for Run 9, FCW Test 3, Visual Warning

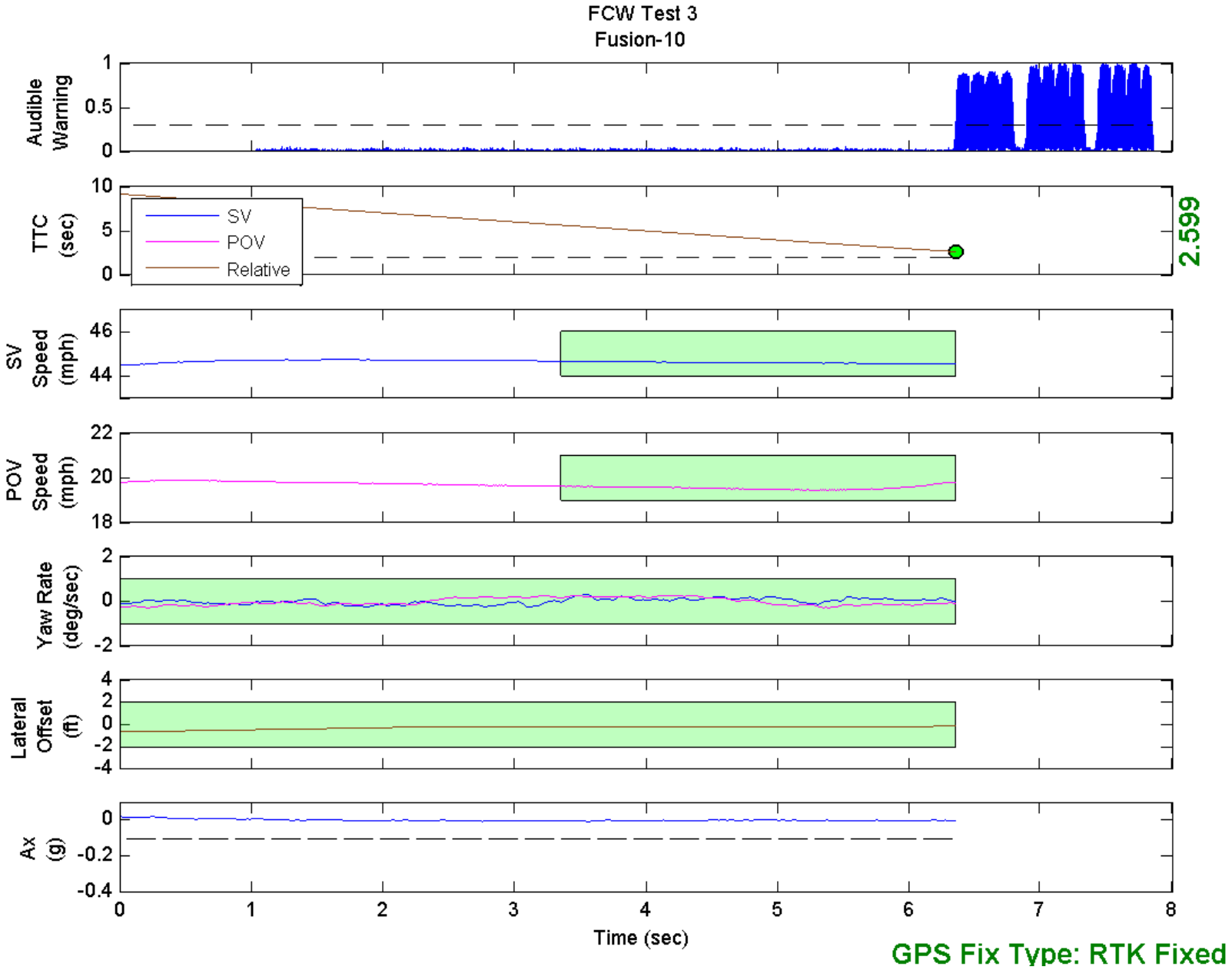


Figure D71. Time History for Run 10, FCW Test 3, Audible Warning

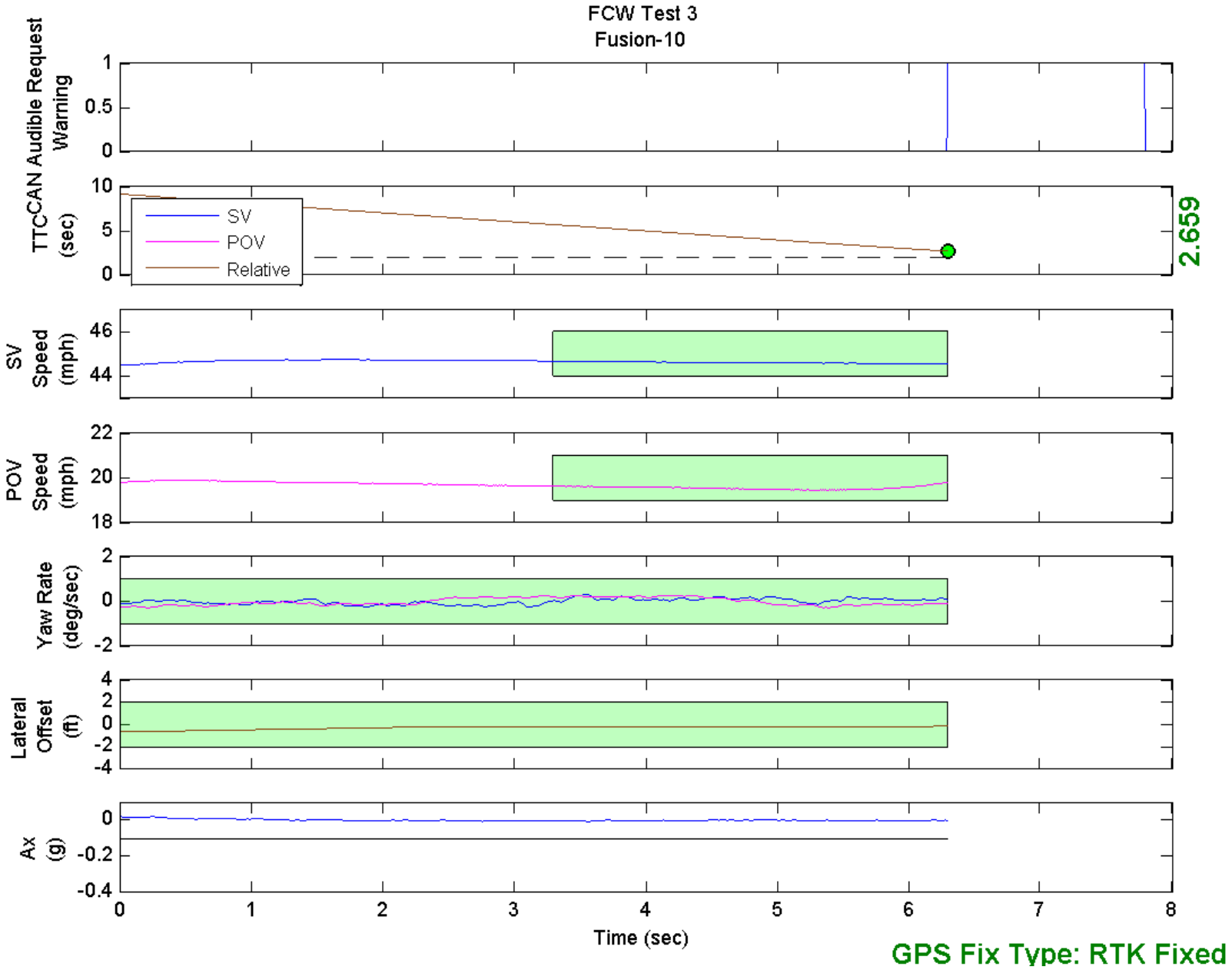


Figure D72. Time History for Run 10, FCW Test 3, CAN Audible Warning Request

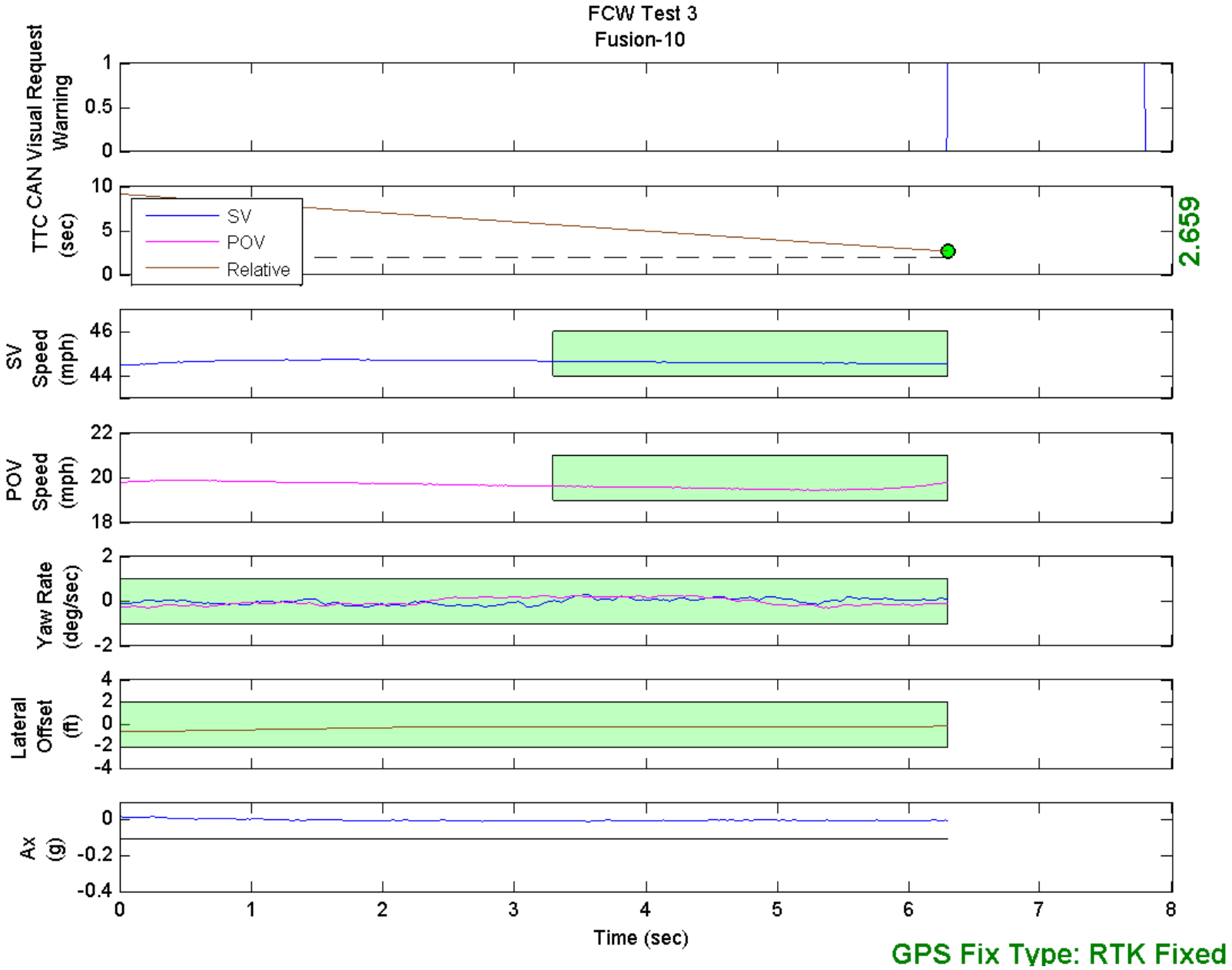


Figure D73. Time History for Run 10, FCW Test 3, CAN Visual Warning Request

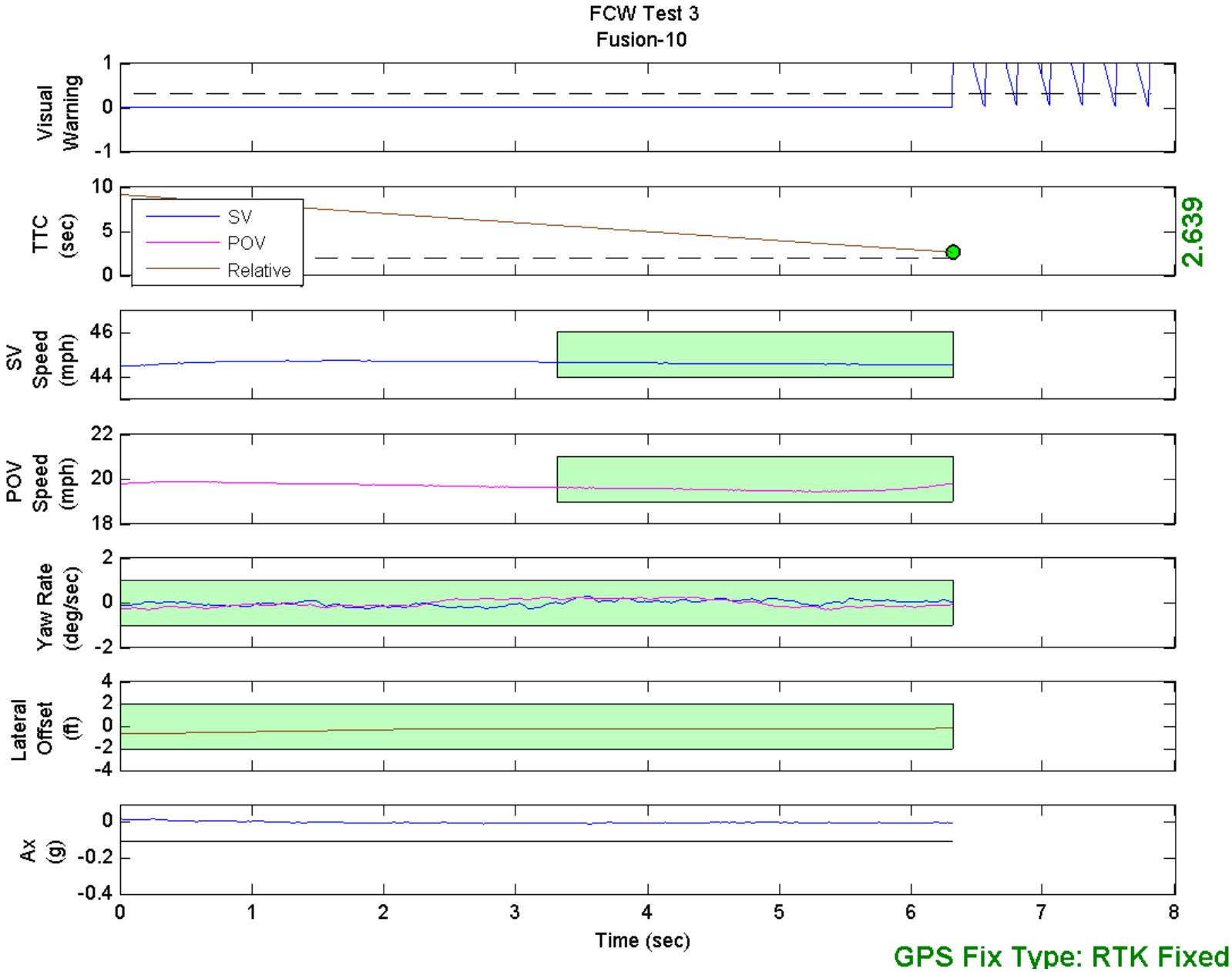


Figure D74. Time History for Run 10, FCW Test 3, Visual Warning

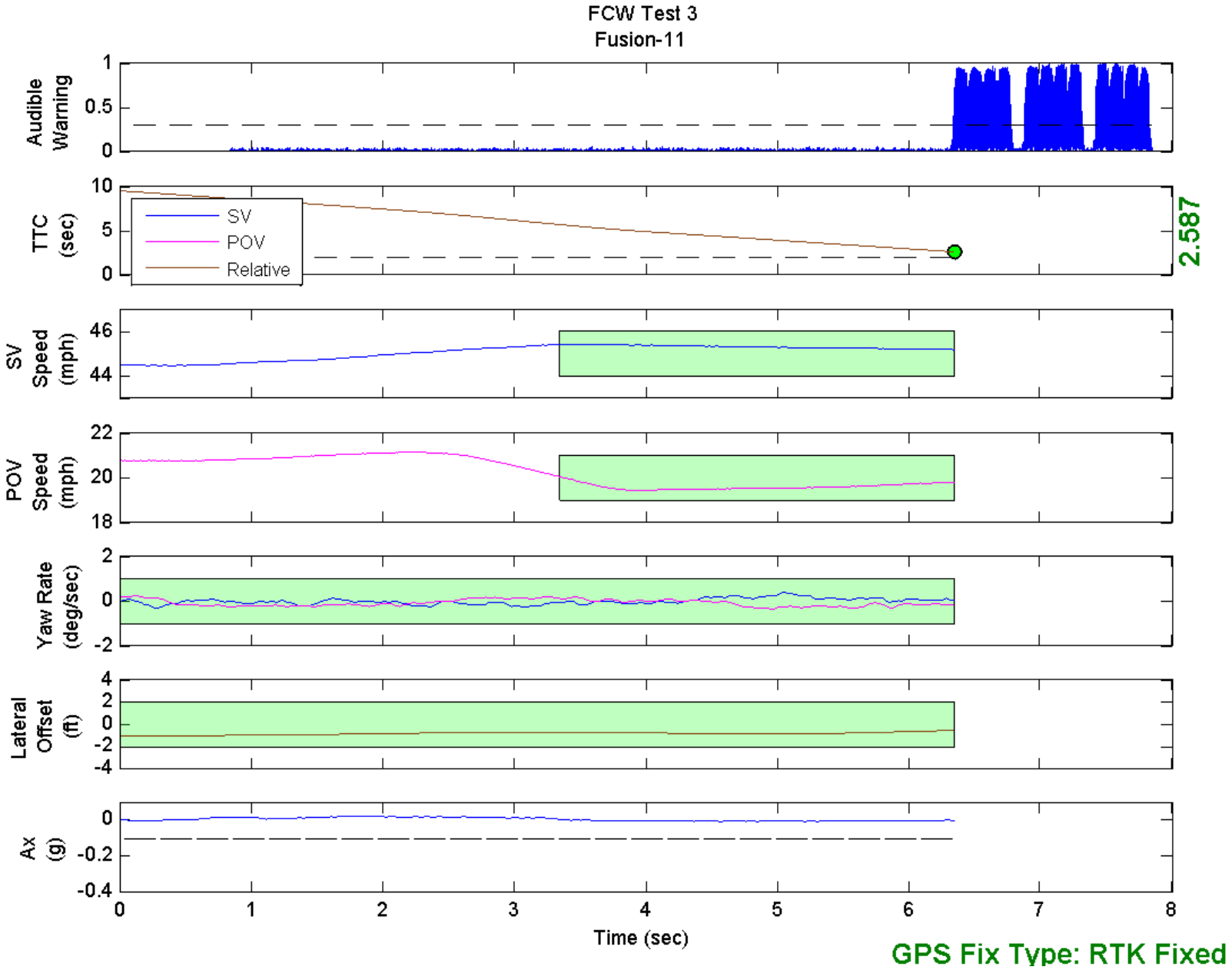


Figure D75. Time History for Run 11, FCW Test 3, Audible Warning

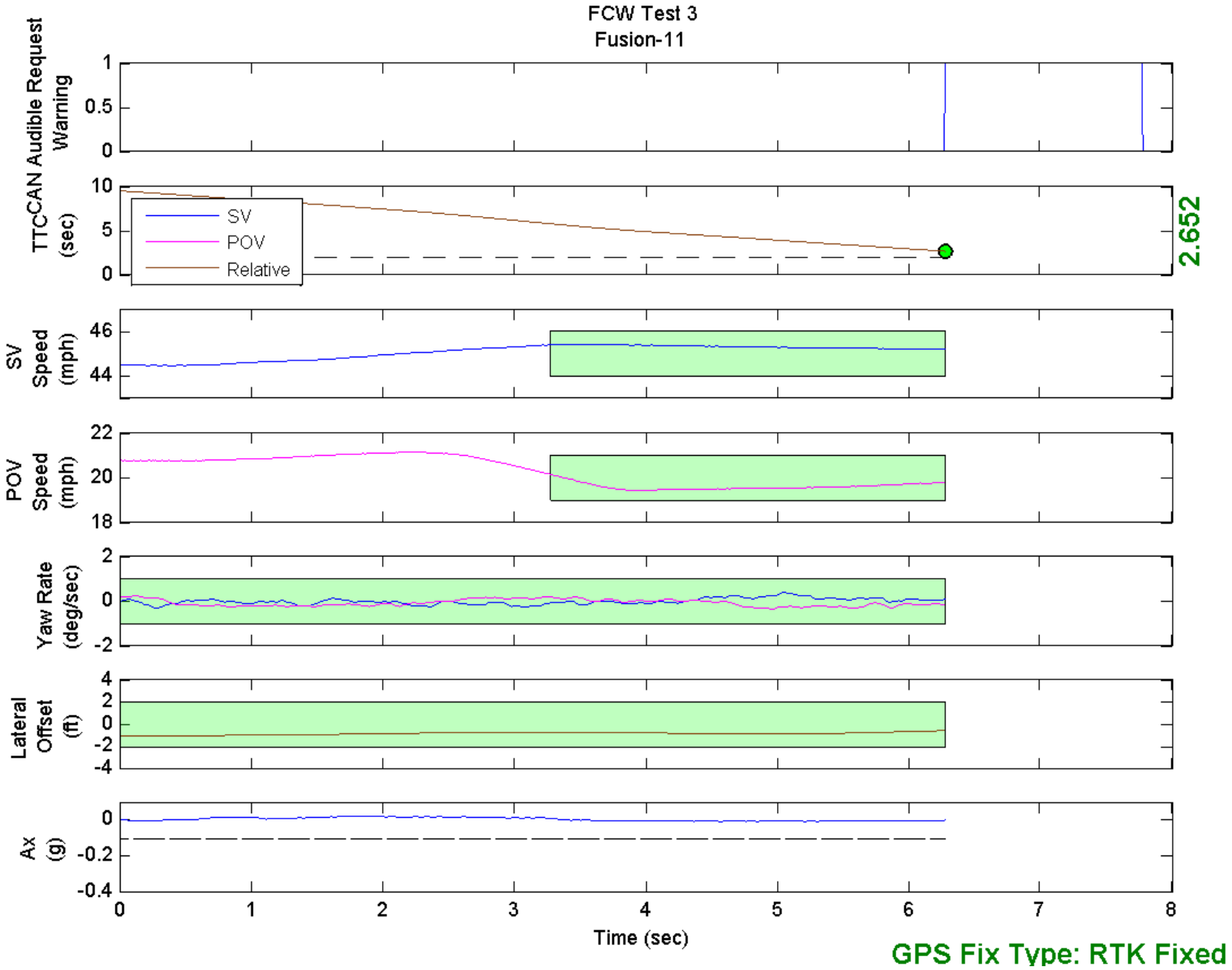


Figure D76. Time History for Run 11, FCW Test 3, CAN Audible Warning Request

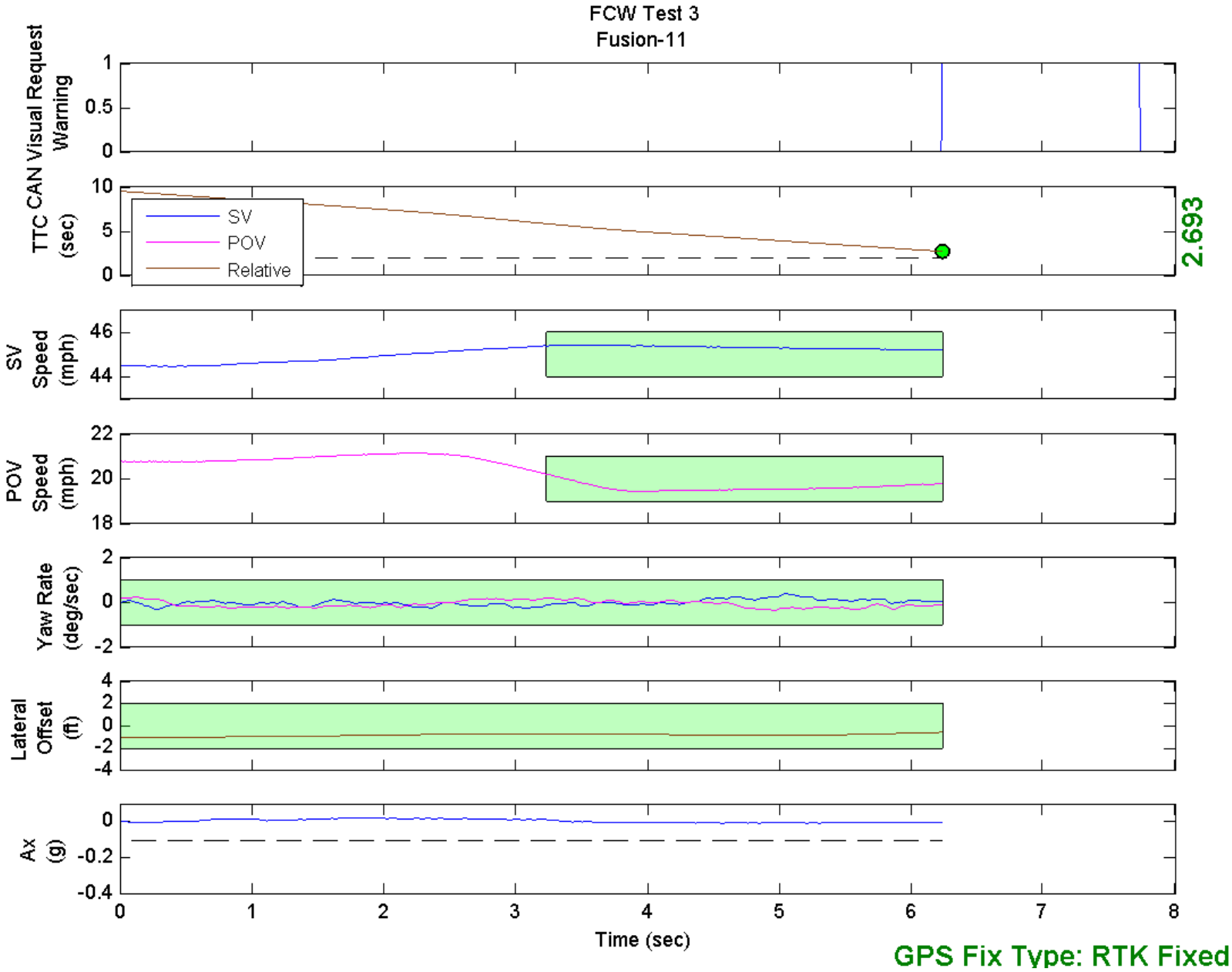


Figure D77. Time History for Run 11, FCW Test 3, CAN Visual Warning Request

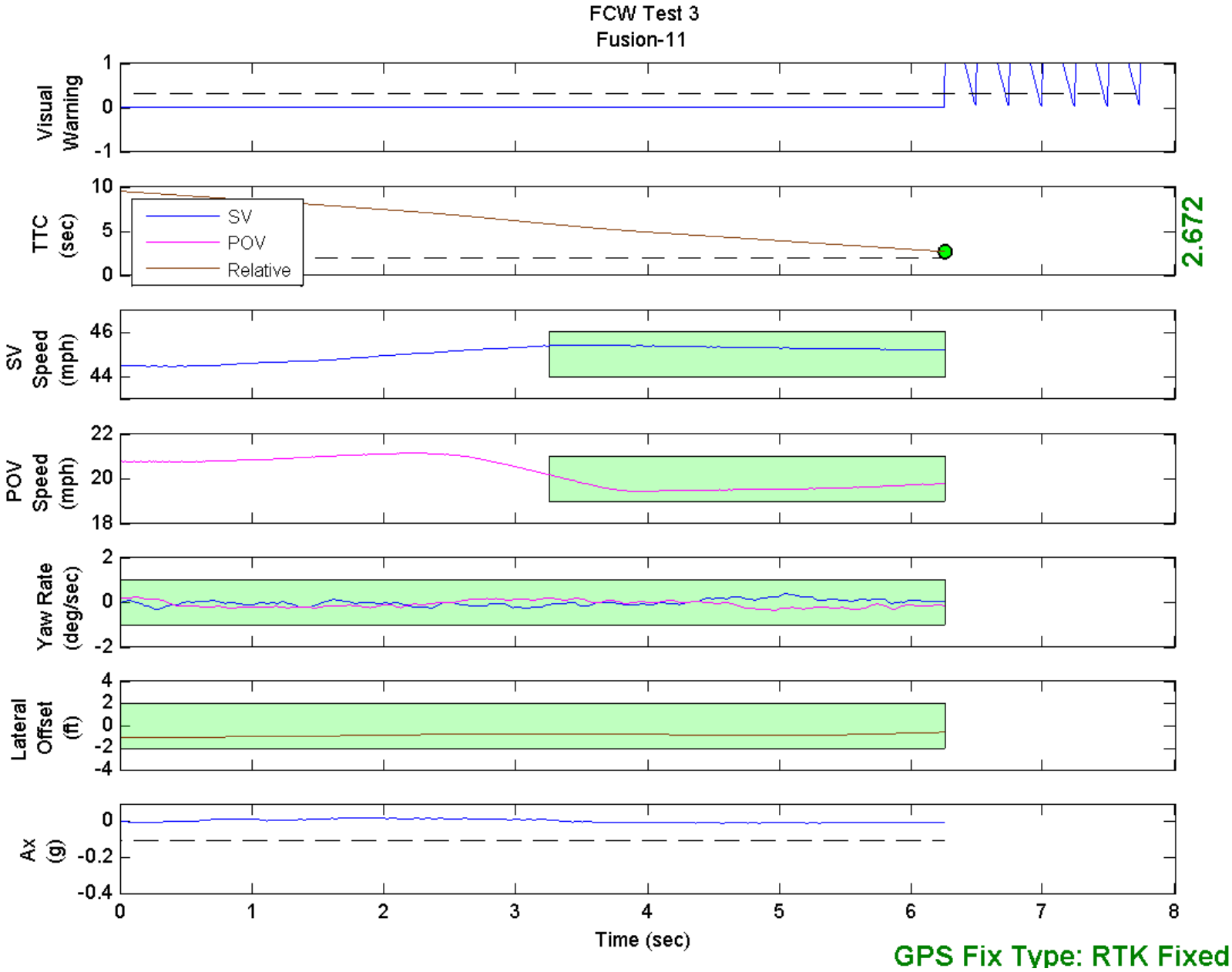


Figure D78. Time History for Run 11, FCW Test 3, Visual Warning

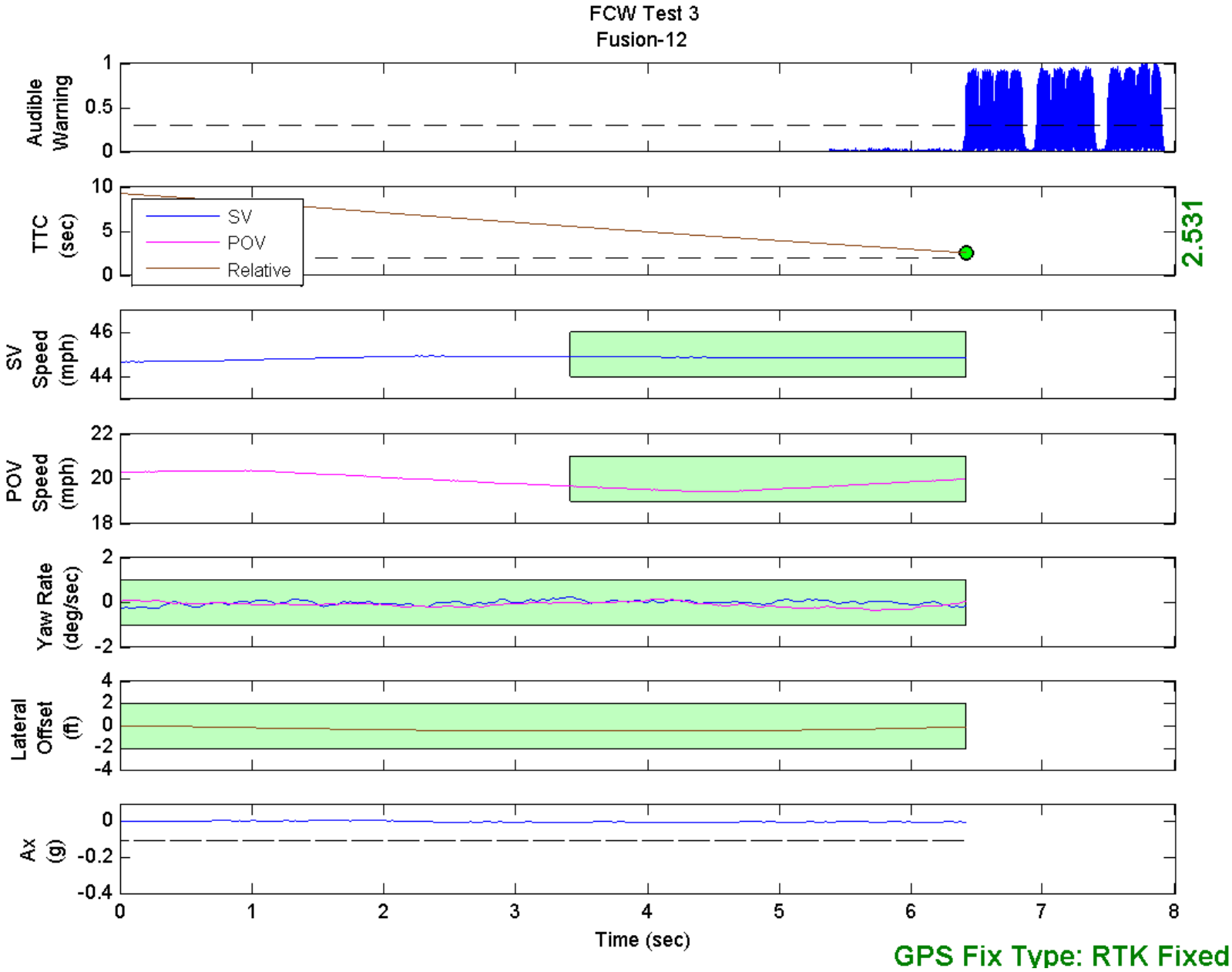


Figure D79. Time History for Run 12, FCW Test 3, Audible Warning

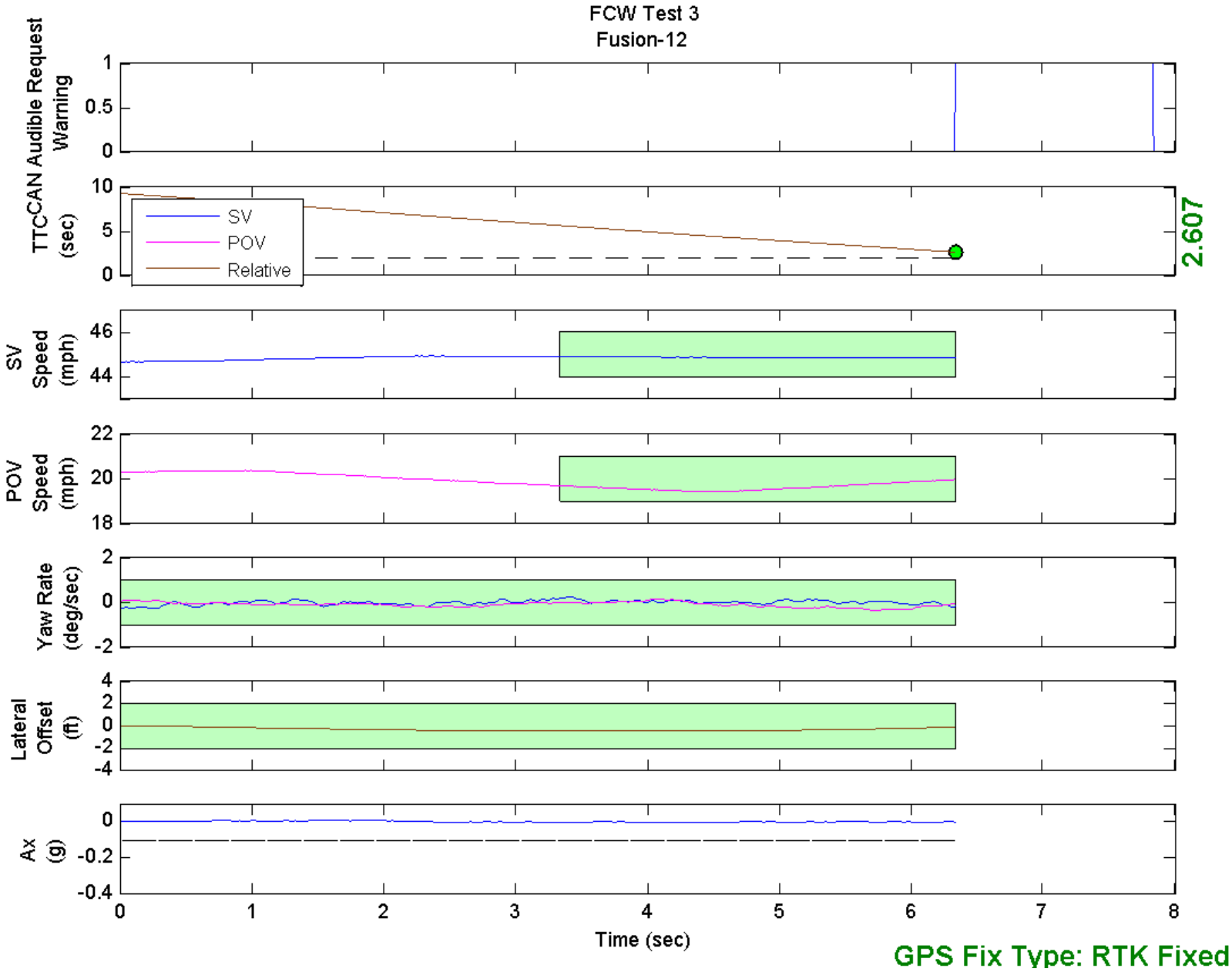


Figure D80. Time History for Run 12, FCW Test 3, CAN Audible Warning Request

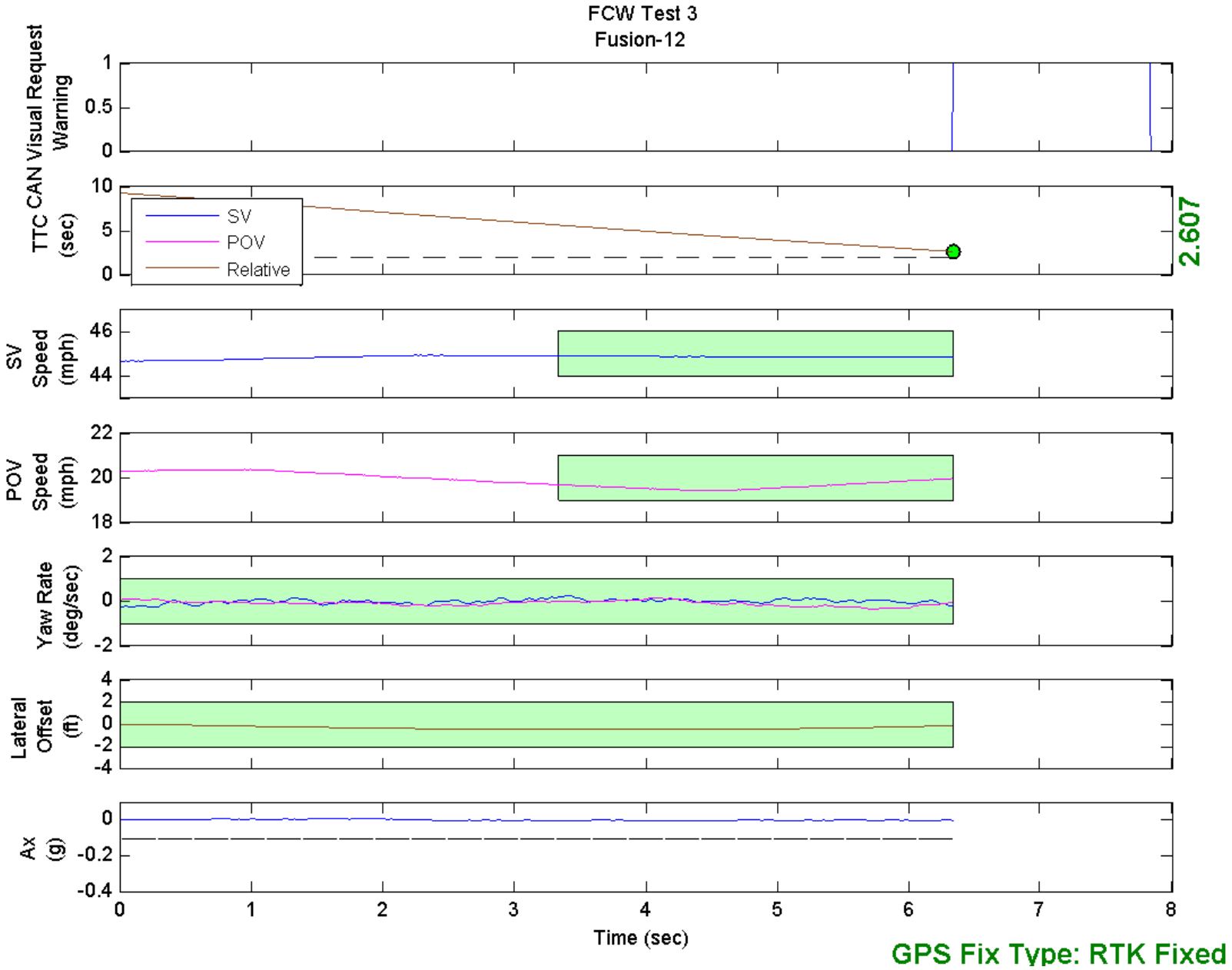


Figure D81. Time History for Run 12, FCW Test 3, CAN Visual Warning Request

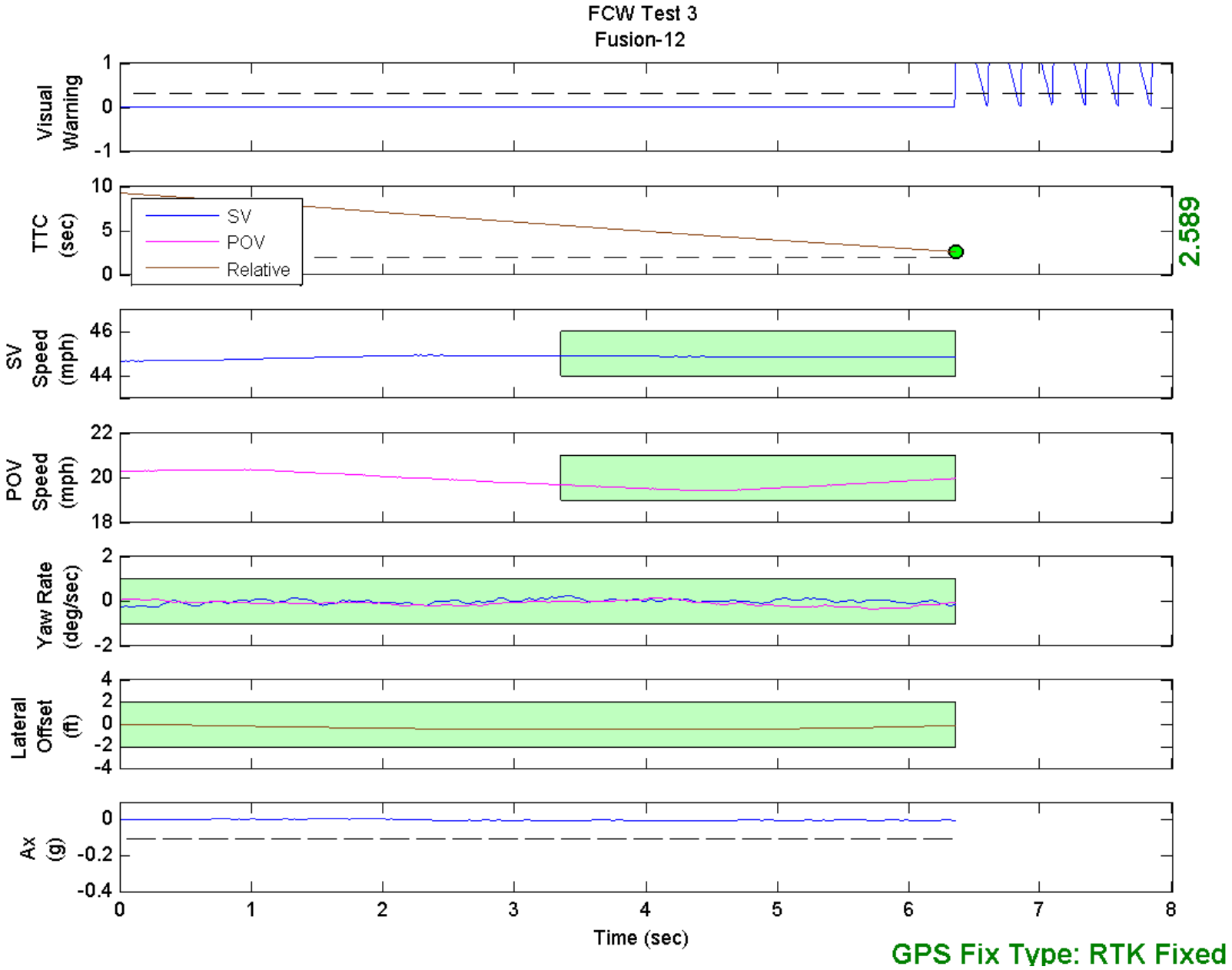


Figure D82. Time History for Run 12, FCW Test 3, Visual Warning

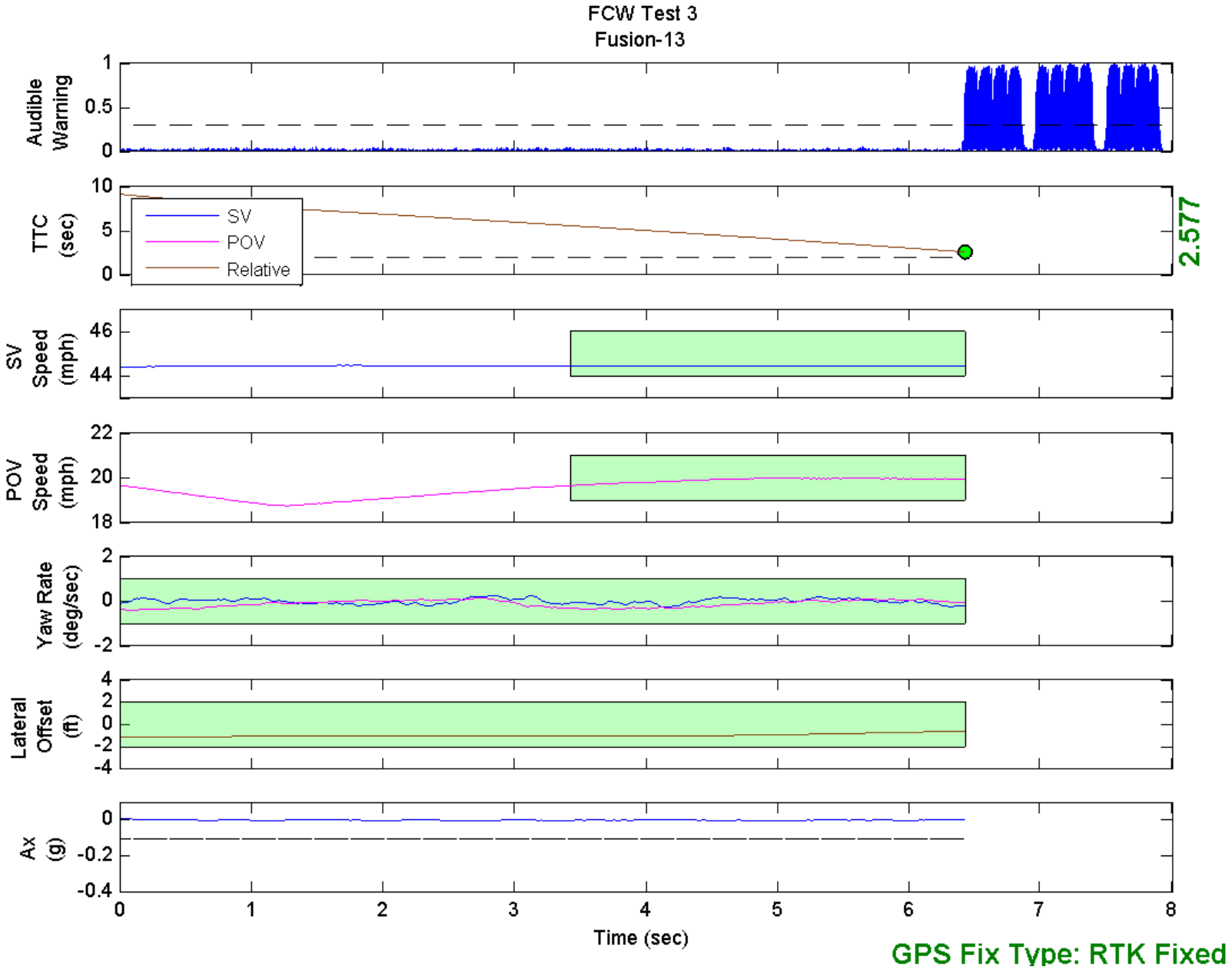


Figure D83. Time History for Run 13, FCW Test 3, Audible Warning

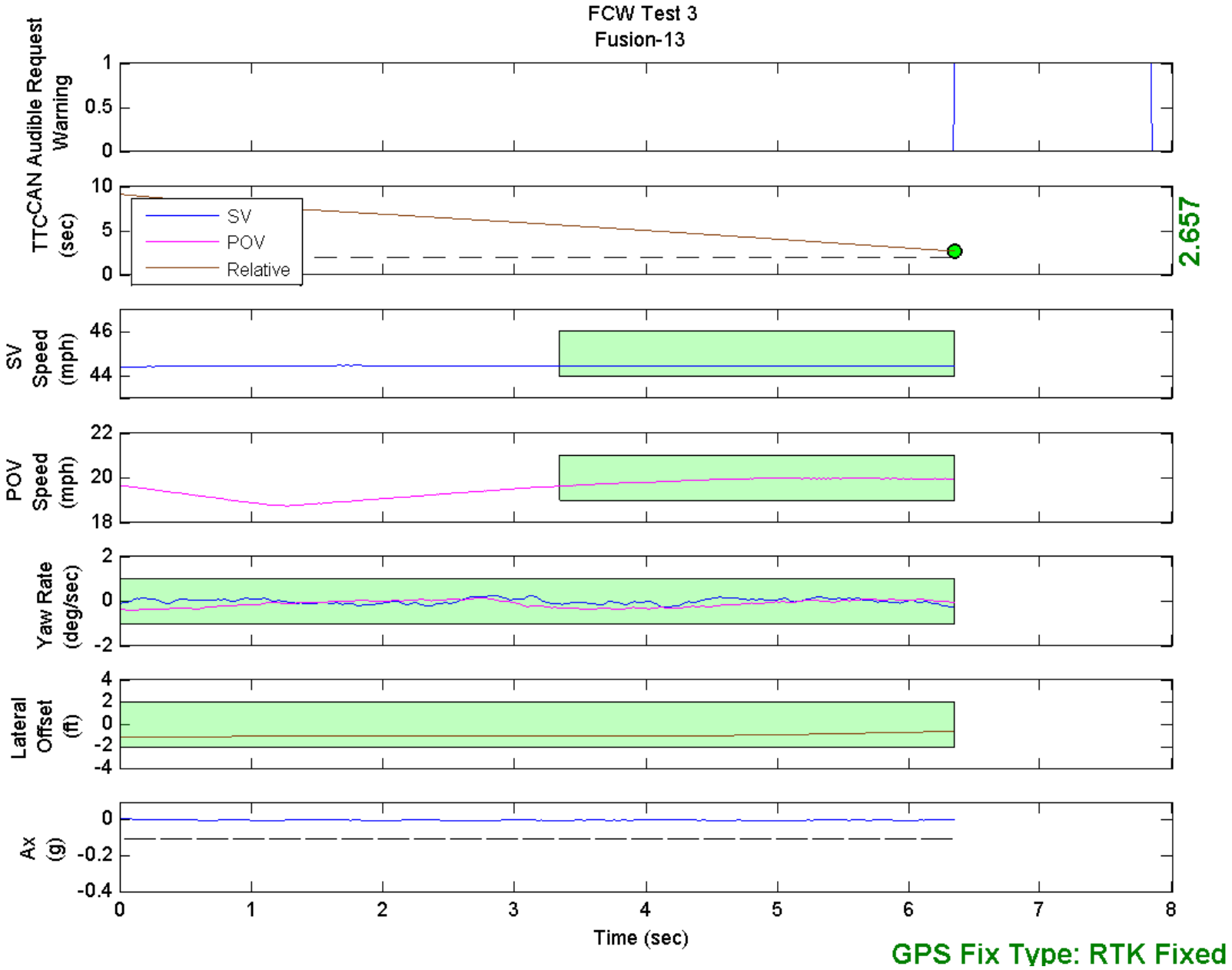


Figure D84. Time History for Run 13, FCW Test 3, CAN Audible Warning Request

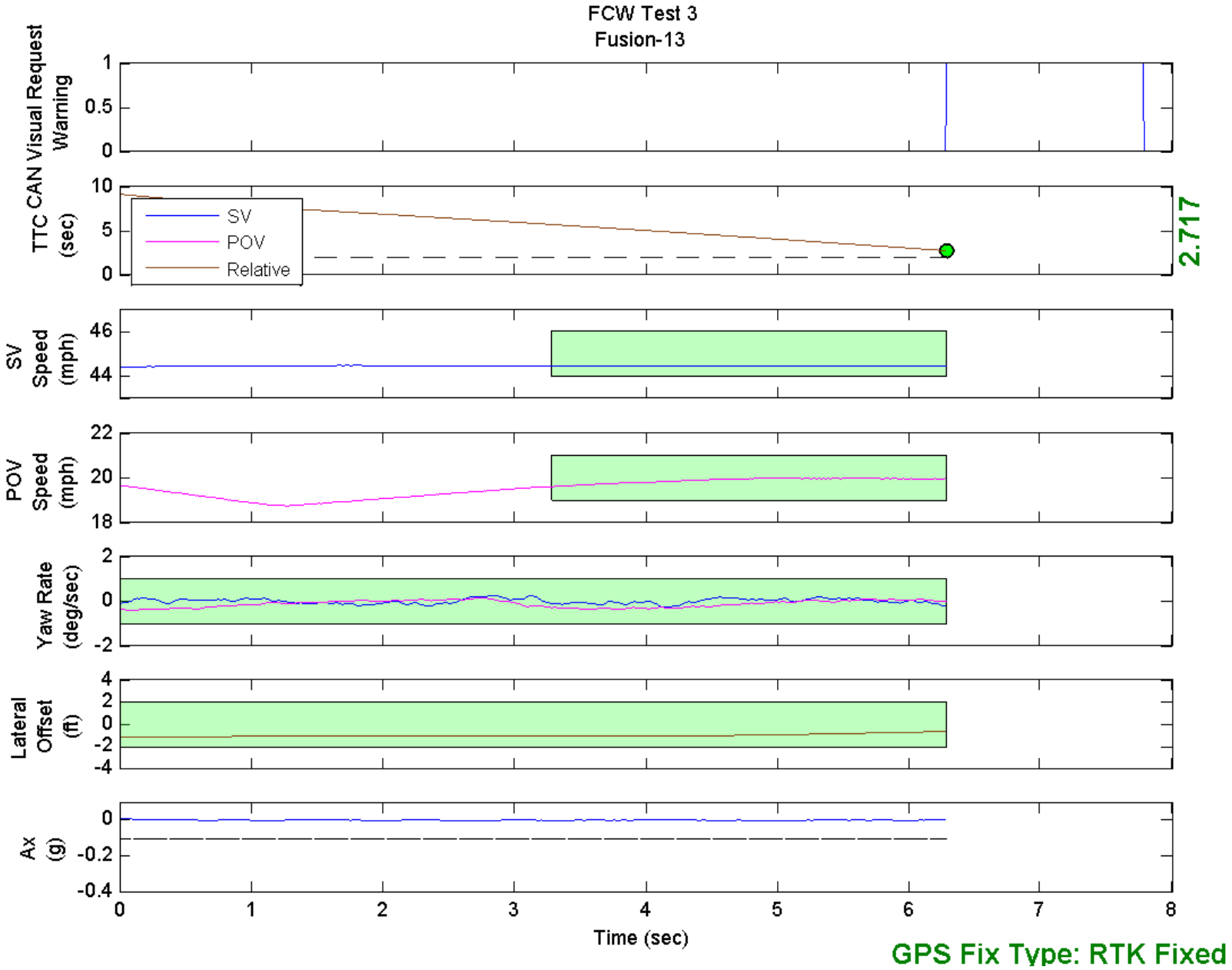


Figure D85. Time History for Run 13, FCW Test 3, CAN Visual Warning Request

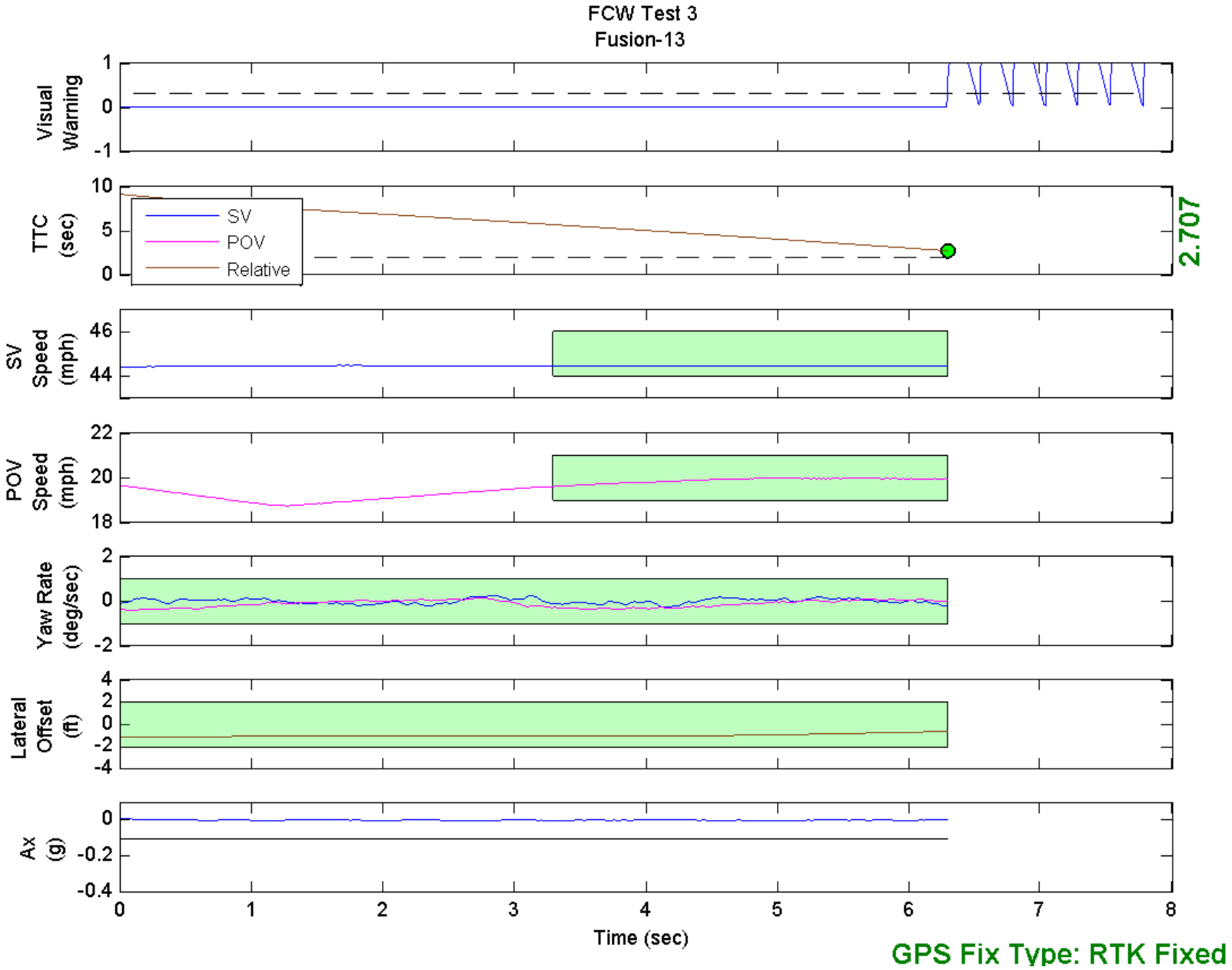


Figure D86. Time History for Run 13, FCW Test 3, Visual Warning

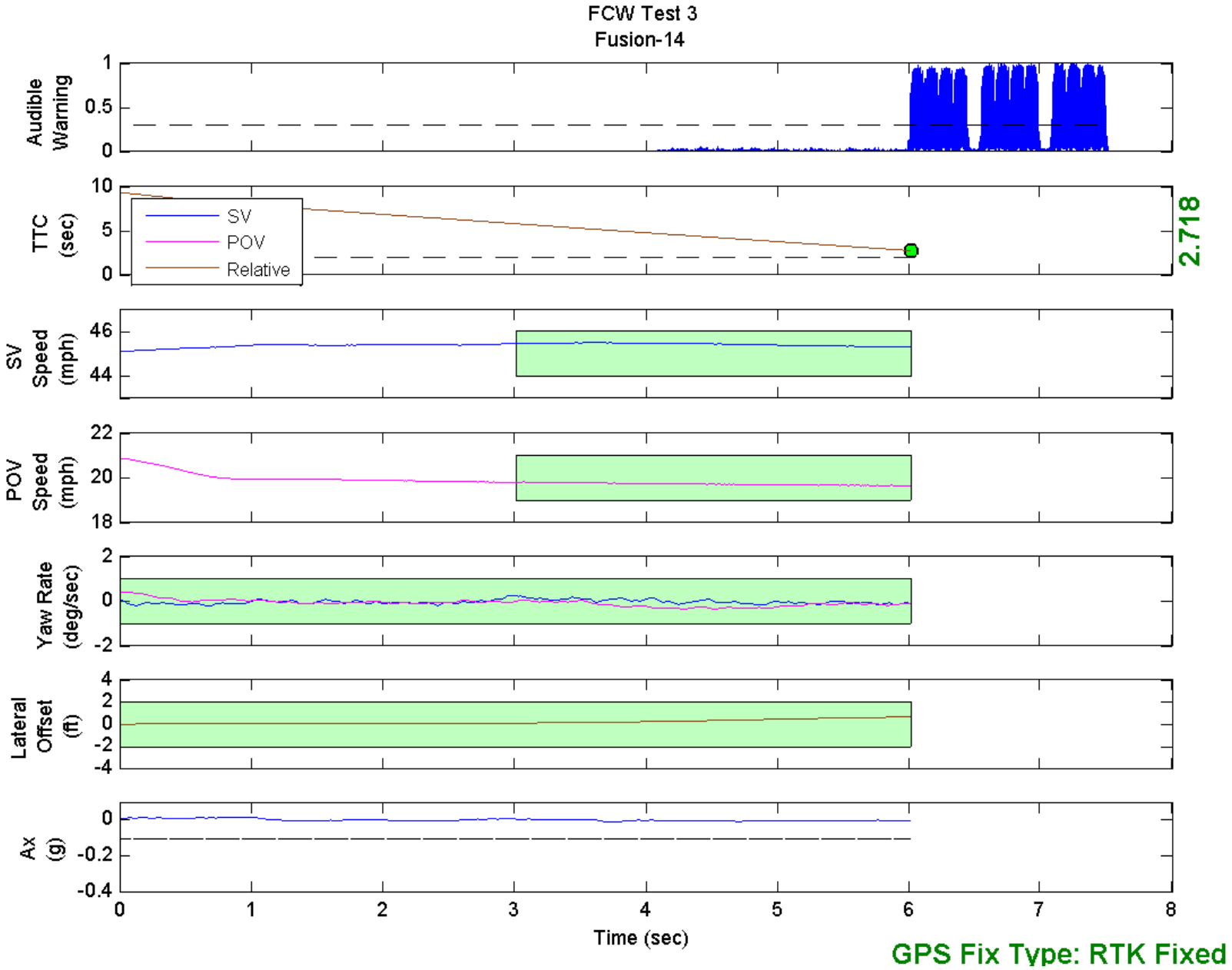


Figure D87. Time History for Run 14, FCW Test 3, Audible Warning

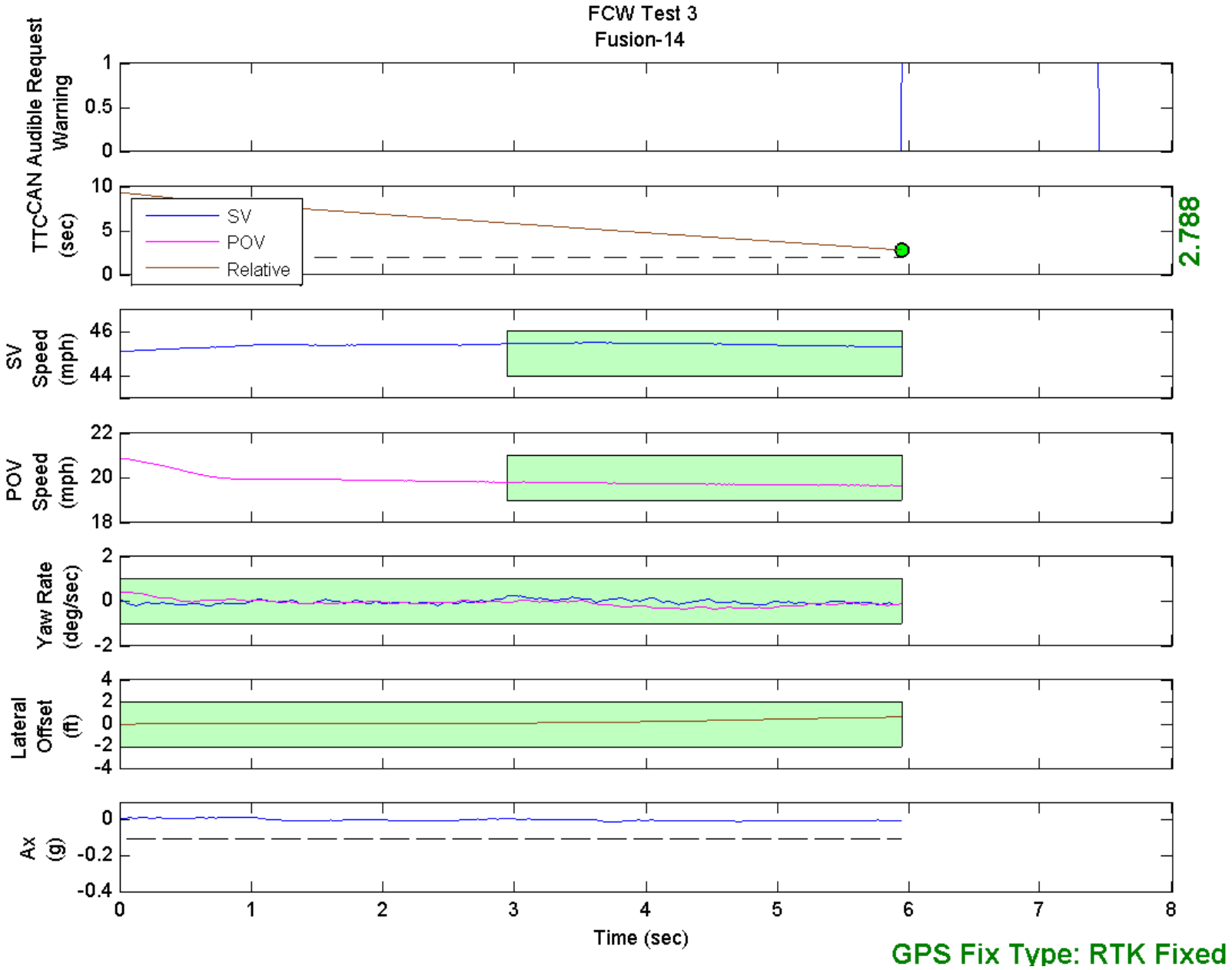


Figure D88. Time History for Run 14, FCW Test 3, CAN Audible Warning Request

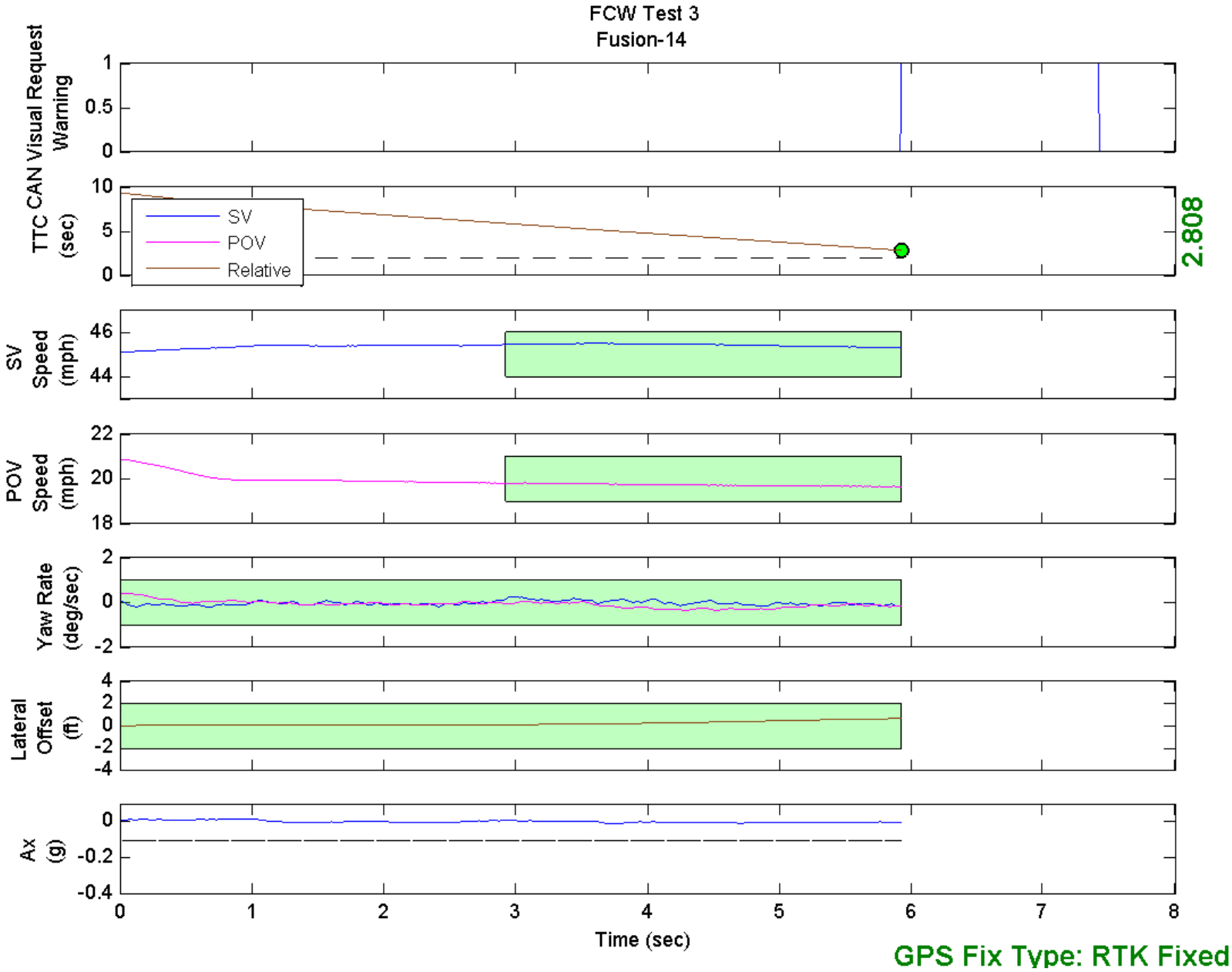


Figure D89. Time History for Run 14, FCW Test 3, CAN Visual Warning Request

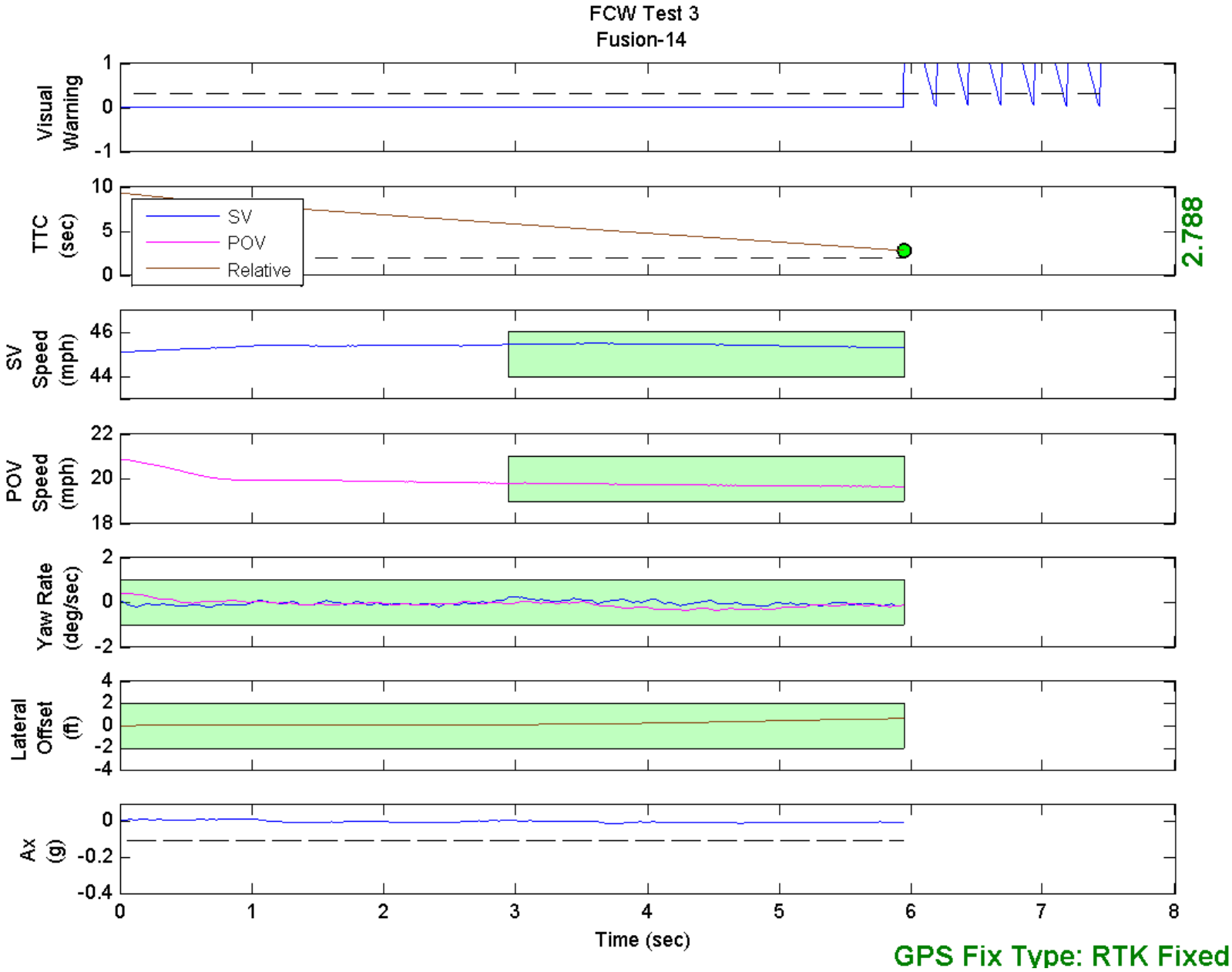


Figure D90. Time History for Run 14, FCW Test 3, Visual Warning