# OCAS-DRI-FCW-13-009

# NCAP FORWARD COLLISION WARNING CONFIRMATION TEST

## 2013 Ford Explorer


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



**30 October, 2012**

**Draft 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.



Prepared By: John Lenkeit

Approved By: Brian Kebschull

Approval Date: 30 October, 2012

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|---|---|---|---|
| 1. Report No.<br><br>OCAS-DRI-FCW-13-009 | 2. Government Accession No. | 3. Recipient's Catalog No. | |
| 4. Title and Subtitle<br><br>Final Report of Forward Collision Warning Testing of a 2013 Ford Explorer. | | 5. Report Date<br><br>30 October, 2012 | |
| | | 6. Performing Organization Code<br><br>DRI | |
| 7. Author(s)<br>John F. Lenkeit, Technical Director<br>Brian Kebschull, Principal Engineer | | 8. Performing Organization Report No.<br><br>DRI-TM-12-108 | |
| 9. Performing Organization Name and Address<br><br>Dynamic Research, Inc.<br>355 Van Ness Ave, STE 200<br>Torrance, CA 90501 | | 10. Work Unit No. | |
| | | 11. Contract or Grant No.<br><br>DTNH22-08-D-00095 | |
| 12. Sponsoring Agency Name and Address<br>U.S. Department of Transportation<br>National Highway Traffic Safety Administration<br>Office of Crash Avoidance Standards<br>1200 New Jersey Avenue, SE,<br>West Building, 4th Floor (NVS-120)<br>Washington, D.C. 20590 | | 13. Type of Report and Period Covered<br><br>Draft Test Report<br>October 2012 | |
| | | 14. Sponsoring Agency Code<br><br>NVS-120 | |
| 15. Supplementary Notes | | | |
| 16. Abstract<br><br>These tests were conducted on the subject 2013 Ford Explorer 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. | | | |
| 17. Key Words<br><br>Forward Collision Warning,<br>FCW,<br>New Car Assessment Program,<br>NCAP | | 18. Distribution Statement<br><br>Copies of this report are available from the following:<br><br>NHTSA Technical Reference Division<br>National Highway Traffic Safety Administration<br>1200 New Jersey Avenue, SE<br>Washington, D.C. 20590 | |
| 19. Security Classif. (of this report)<br><br>Unclassified | 20. Security Classif. (of this page)<br><br>Unclassified | 21. No. of Pages<br><br>127 | 22. Price |

## TABLE OF CONTENTS

## 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 Explorer

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VIN: *1FM5K7F85DGAxxxx*

Test Date: *10/4/2012*

Forward Collision Warning setting: *Sensitivity 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 Explorer**

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## TEST VEHICLE INFORMATION

VIN: *1FM5K7F85DGAxxxx*

Body Style: *SUV* Color: *Green*

Date Received: *9/24/2012* Odometer Reading: *46 mi*

Engine: *3.5 L V-6*

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 Co.*

Date of manufacture: *03/12*

## DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: *P255/50 R20*

Rear: *P255/50 R20*

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

Rear: *240 kPa (35 psi)*

**FORWARD COLLISION WARNING**

**DATA SHEET 2: VEHICLE DATA**

**(Page 2 of 2)**

**2013 Ford Explorer**

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## TIRES

Tire manufacturer and model: *Hankook Optimo H426*

Front tire size: *P255/50 R20*

Rear tire size: *P255/50 R20*

## 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 Explorer**

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## GENERAL INFORMATION

Test date: *10/4/2012*

## AMBIENT CONDITIONS

Air temperature: *29.4 C (85 F)*

Wind speed: *3.6 m/s (8.1 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: *240 kPa (35 psi)*

Rear: *240 kPa (35 psi)*

**FORWARD COLLISION WARNING**

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

**2013 Ford Explorer**

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**WEIGHT**

Weight of vehicle as tested including driver and instrumentation

| | | | |
|---|---|---|---|
| Left Front: | *620.1 kg (1367 lb)* | Right Front | *610.5 kg (1346 lb)* |
| Left Rear | *540.7 kg (1192 lb)* | Right Rear | *490.3 kg (1081 lb)* |
| | | Total: | *2261.6 kg (4986 lb)* |

**FORWARD COLLISION WARNING**

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

**(Page 1 of 3)**

**2013 Ford Explorer**

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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.

*Warning light is seen in the lower portion of the windshield directly in front of the driver. The audible warning is a repeated tone (3 sets of 4 beeps at 1800 Hz).*

**FORWARD COLLISION WARNING**

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

**(Page 2 of 3)**

**2013 Ford Explorer**

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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.

*Control on left spoke of the steering wheel operates the information display in the center of the instrument display. Menu path as follows:*
*-> Settings*
*->Driver Assist*
*-> Collision Warn*
*-> Warning-ON: select On/Off*

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

*- Stationary vehicles or vehicles moving below 6 mph*
*- Pedestrians or obstacles in the roadway*
*- Oncoming vehicles in the same lane*
*- Severe weather conditions*
*- Debris build-up on the grille near the headlamps*
*- Small distance to the vehicle ahead*
*- Steering wheel or pedal movements are large (very active driving style)*
*- High interior temperatures which may deactivate the operation of the warning lamp*

**FORWARD COLLISION WARNING**

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

**(Page 3 of 3)**

**2013 Ford Explorer**

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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.

*Control on left spoke of the steering wheel operates the information display in the center of the instrument display. Menu path as follows:*
*-> Settings*
*->Driver Assist*
*-> Collision Warn*
*--> Sensitivity: select High, Normal or Low*

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.

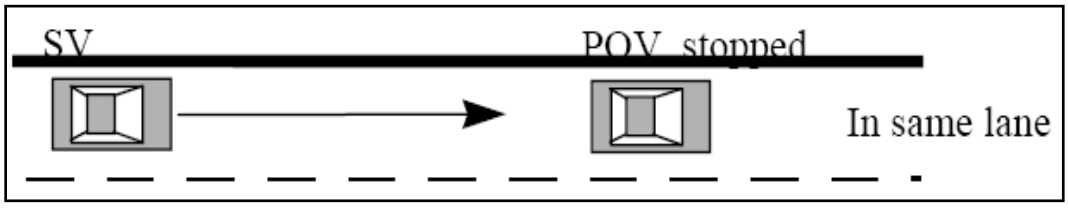



Figure 1. Depiction of Test 1

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.

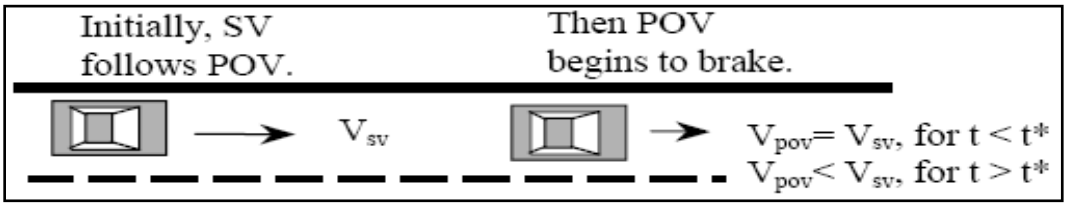



Figure 2. Depiction of Test 2

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 ±0.03g, 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 (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).

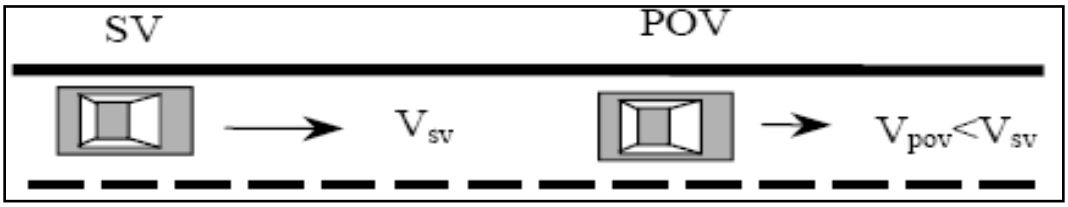



Figure 3. Depiction of Test 3

### 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<br>0-690 kPa | 0.5 psi<br>3.45 kPa | Ashcroft,<br>D1005PS |
| Platform Scales | Vehicle Total, Wheel, and Axle Load | 8000 lb<br>35.6 kN | ±1.0% of applied load | Intercomp,<br>SWII |
| Differential Global Positioning System | Position, Velocity | Latitude: ±90 deg<br>Longitude: ±180 deg<br>Altitude: 0-18 km<br>Velocity: 0-1000 knots | Horizontal Position: ±1 cm<br>Vertical Position: ±2 cm<br>Velocity: 0.05 km/h | Trimble GPS Receiver,<br>5700 (base station and in-vehicle) |
| Multi-Axis Inertial Sensing System | Position;<br>Longitudinal, Lateral, and Vertical Accels;<br>Lateral, Longitudinal and Vertical Velocities;<br>Roll, Pitch, Yaw Rates;<br>Roll, Pitch, Yaw Angles | Latitude: ±90 deg<br>Longitude: ±180 deg<br>Altitude: 0-18 km<br>Velocity: 0-1000 knots<br>Accel: ±100 $m/s^2$<br>Angular Rate: ±100 deg/s<br>Angular Disp: ±180 deg | Position: ±2 cm<br>Velocity: 0.05 km/h<br>Accel: ≤ 0.01% of full range<br>Angular Rate: ≤ 0.01% of full range<br>Roll/Pitch Angle: ±0.03 deg<br>Heading Angle: ±0.1 deg | Oxford Technical Solutions (OXTS),<br>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<br>Lateral Lane Velocity: ±20 m/sec<br>Longitudinal Range to POV: ±200 m<br>Longitudinal Range Rate: ±50 m/sec | Lateral Distance to Lane Marking: ±2 cm<br>Lateral Velocity to Lane Marking: ±0.02m/sec<br>Longitudinal Range: ±3 cm<br>Longitudinal Range Rate: ±0.02 m/sec | Oxford Technical Solutions (OXTS),<br>RT-Range |

## TABLE 1. TEST INSTRUMENTATION AND EQUIPMENT (CONTD)

| Type | Output | Range | Accuracy, Other Primary Specs | Mfr, Model |
|---|---|---|---|---|
| Data Acquisition System<br><br>[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<br>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<br>0-2.4 m | ±.0020 in.<br>±.051 mm<br>(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

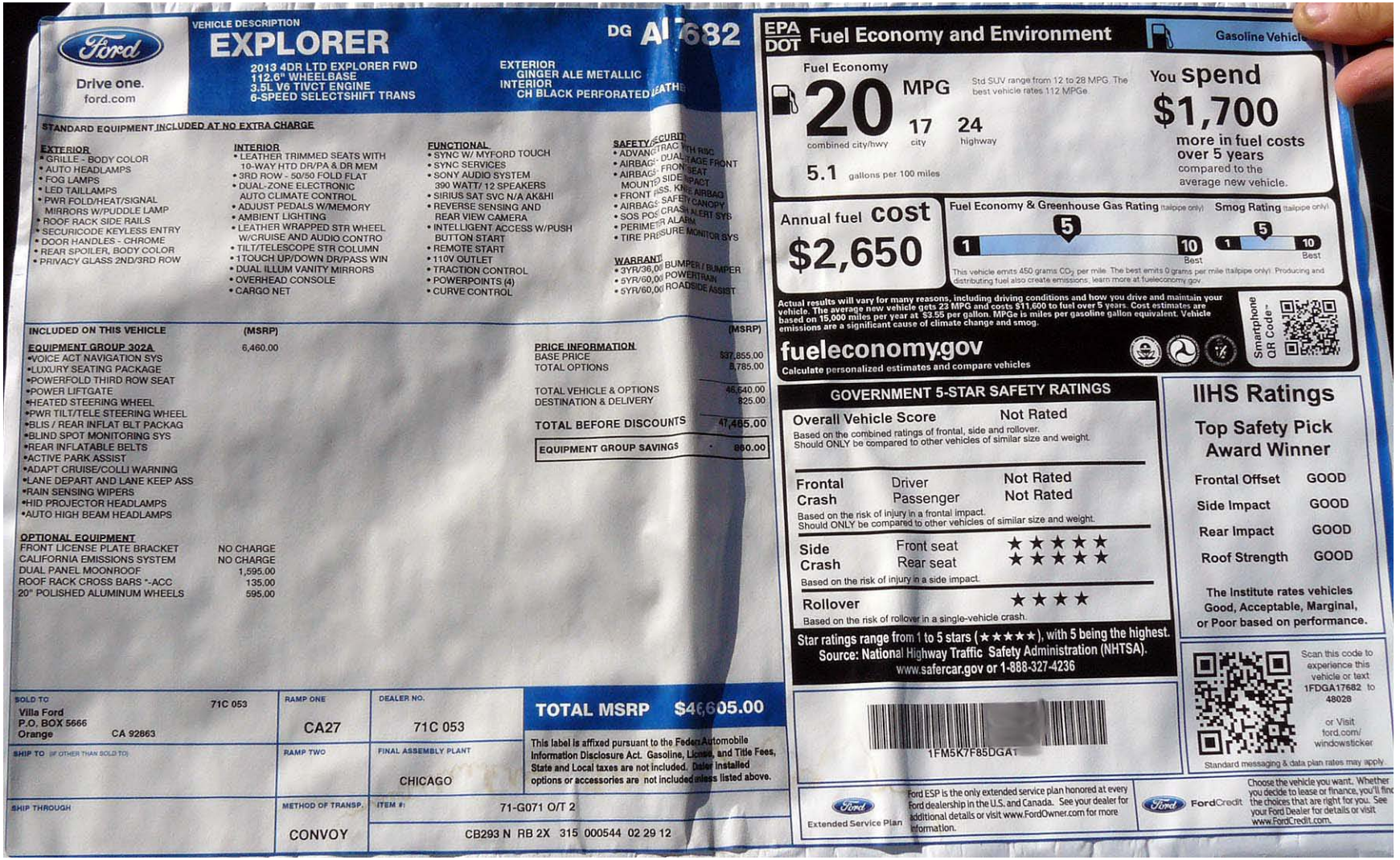



Figure A3. Window Sticker (Monroney Label)

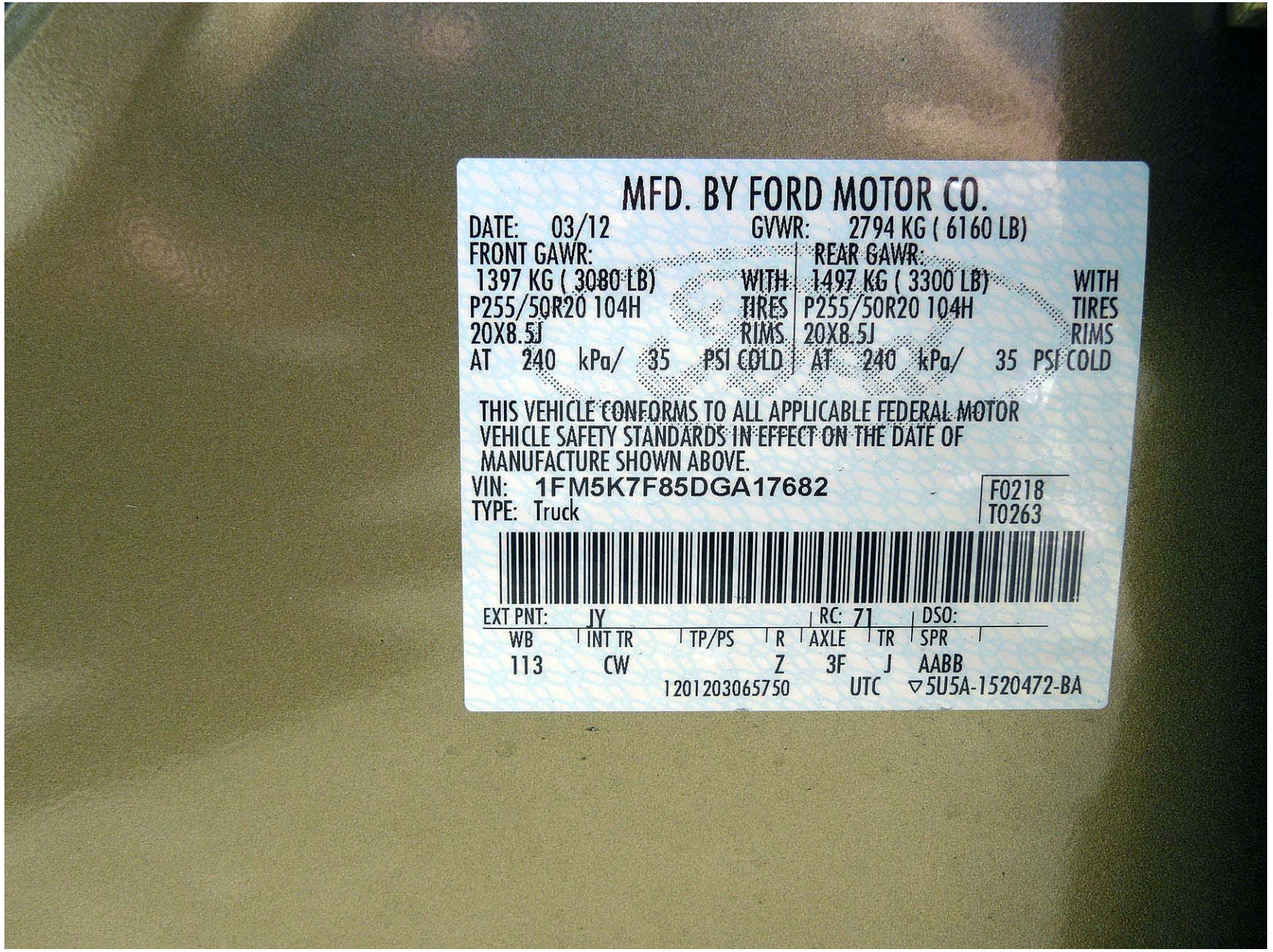



Figure A4. Vehicle Certification Label

Figure A5. Front View of Principal Other Vehicle


Figure A6. Rear View of Principal Other Vehicle

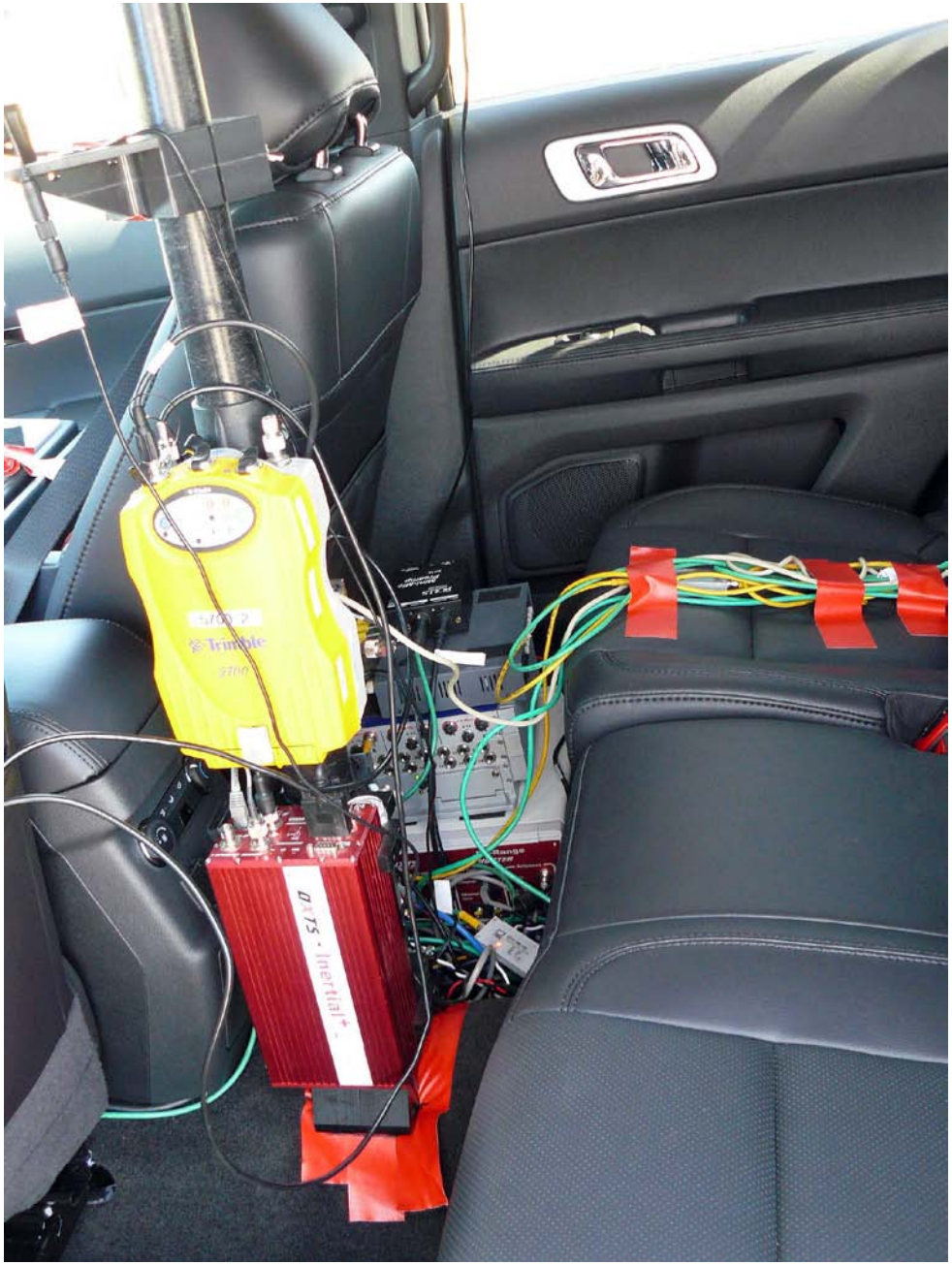


Figure A7. DGPS and Inertial Measurement Unit Installed in Subject Vehicle

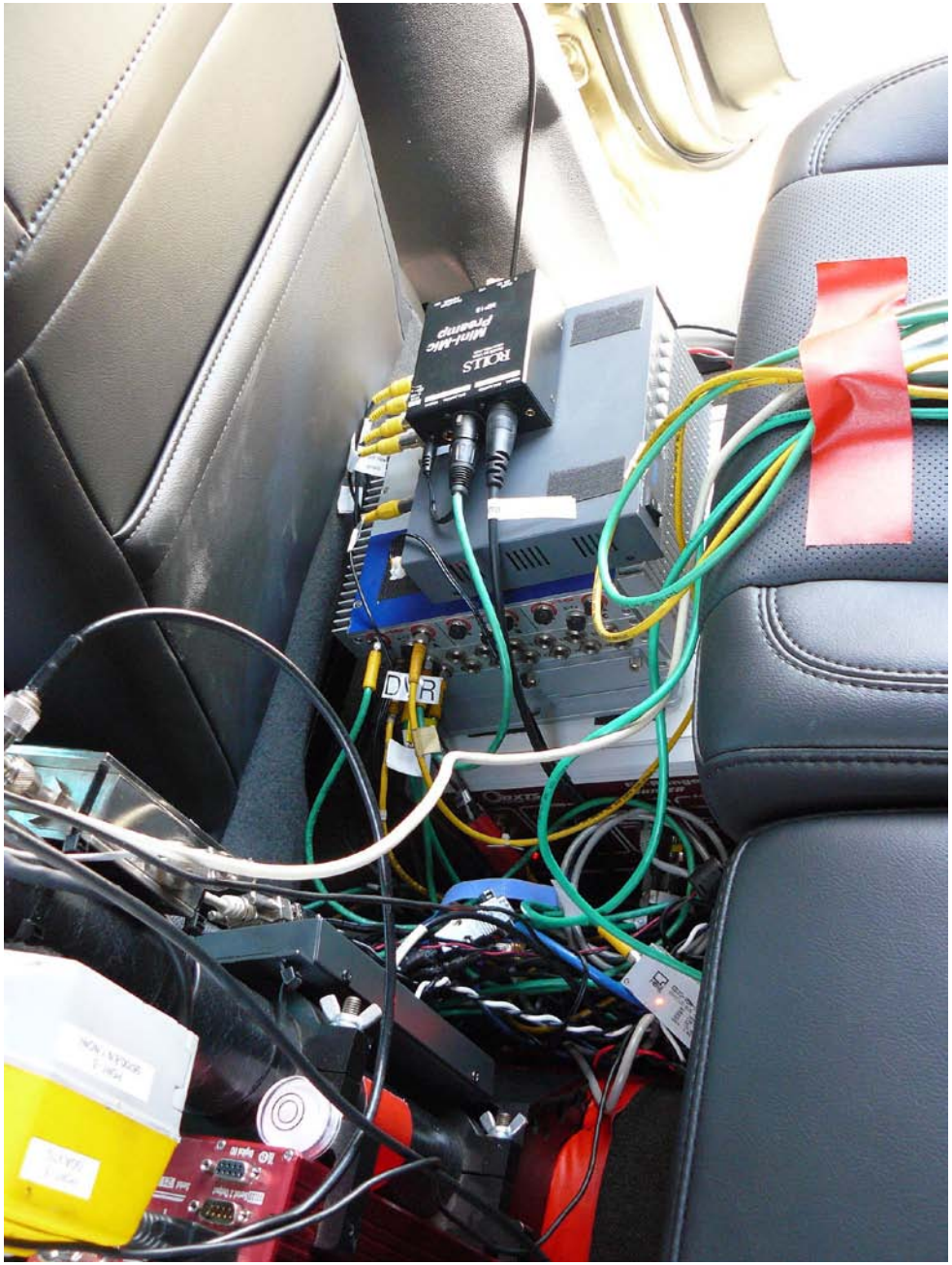


Figure A8. Data Acquisition System Installed in Subject Vehicle


Figure A9. Computer Installed in Subject Vehicle


Figure A10. Brake Actuation System Installed in Principal Other Vehicle

Figure A11. Forward Collision Visual Warning

Figure A12. Sensor for Detecting Visual Warning

Figure A13. Sensor for Detecting Acoustic Warning


Figure A14. Controls for Adjusting Vehicle Settings


Figure A15. FCW Settings Menu


Figure A16. FCW Settings Menu (cont.)

# APPENDIX B

Excerpts from Owner's Manual

| †Trip 1 / 2 |
|---|
| Total Odometer (located in lower right of display). **Note:** this will also display in other menus. |
| †See *Trip computer* later in this section for more information. |

| Information |
|---|
| Intelligent 4WD — Displays power distribution between the front and rear wheels. More power to either front or rear wheels will be displayed by more area filled in. Also indicates currently selected terrain management mode. |
| MyKey® Distance (if key is programmed) — Distance traveled when a programmed key is in use. |
| MyKey® Information — Number of MyKeys and admin keys programmed) |
| Coolant Temp. — The engine coolant indicator will change colors indicating: blue for cool, gray for normal and red for hot. If the engine coolant temperature exceeds the normal range, stop the vehicle as soon as safely possible, switch off the engine and let the engine cool. |

| Settings | | | |
|---|---|---|---|
| Driver Assist | Traction Ctrl | | |
| | Blind Spot | | |
| | Collision Warning | Sensitivity (if MyKey is programmed) | High, Normal or Low |
| | | Chimes (not selectable if using a MyKey) | |
| | | Warning (not selectable if using a MyKey) | |
| | Cross Traffic | | |
| | Rear Park Aid | | |
| | Trailer Sway | | |
| Display | Language | English, Español or Français | |
| | Units | Distance | Miles and Gal. or Km and Liters |
| | | Temperature | Fahrenheit (°F) or Celsius (°C) |

***Fuel Economy***

Use the left/right arrow buttons to choose the desired fuel economy display.

| Fuel Economy | Inst Fuel Economy | XX. Min Fuel History |
|---|---|---|
| Instantaneous fuel usage | X | |
| †Fuel usage over a 5, 10, or 30 minute time span | | X |
| Total odometer (lower left corner) | | |
| Press and hold OK to reset the currently displayed fuel usage information. | | |
| †To configure the fuel usage time span, press the right arrow button when in this screen. | | |

- Inst. Fuel Economy: This display shows a visual graph of your instantaneous fuel economy.
- XX. Min Fuel History: This display shows a bar chart of your fuel history.

***Settings/Vehicle Settings***

In this mode, you can configure different driver setting choices.

**Note:** Some items are optional and may not appear.

| **Driver Assist** | | |
|---|---|---|
| Traction Ctrl | On (default setting) / Off | |
| Blindspot | On (default on key cycle) / Off | |
| Collision Warning | Sensitivity | High / Normal / Low |
| | Chimes | On (default on key cycle) / Off |
| | Warn-ON | On (default on key cycle) / Off |
| Cross Traffic | On (default on key cycle) / Off | |
| Cruise Control | Adaptive (default on key cycle) or Normal | |
| Driver Alert | On (default on key cycle) / Off | |

| Collision Warning System Messages | Action / Description |
|---|---|
| Collision Warn 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. |
| Collision Warn Not Available Sensor Blocked | 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 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 Display Fault | Displayed when there is a system malfunction with the collision warning system display. Contact your authorized dealer as soon as possible. |

| Door Messages | Action / Description |
|---|---|
| X Door Ajar | Displayed when a door is not completely closed. |
| Liftgate Ajar | Displayed when the liftgate is not completely closed. |

| Driver Alert Messages | Action / Description |
|---|---|
| Driver Alert Warning Rest Now | Stop and rest as soon as it is safe to do so. |
| Driver Alert Warning Rest suggested | Take a rest break soon. |

### Switching the Systems Off and On

One or both systems can be switched off temporarily by using the information display control; refer to the *Information Display* chapter. When the BLIS® is switched off, the driver does not receive alerts and the information display shows BLIND SPOT SYS OFF and/or CTA SYSTEM OFF. The system switches back on whenever the ignition is switched on.

One or both systems can also be switched off permanently at your authorized dealer. Once switched off, switching it back on must also be done at the dealership.

## COLLISION WARNING SYSTEM (IF EQUIPPED)

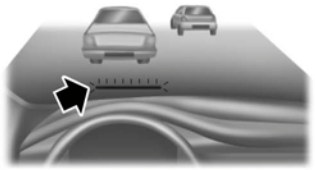
**WARNING:** This system is designed to be a supplementary driving aid. It is not intended to replace the driver's attention, and judgment, or the need to apply the brakes. This system does NOT activate the brakes automatically. Failure to press the brake pedal to activate the brakes may result in a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

**WARNING:** 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).

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.



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; the warning system sensitivity can be adjusted to one of three possible settings by using the information display control. Refer to the *Information Displays* chapter.

**Note:** If the system cannot be turned off in a vehicle equipped with MyKey®, refer to the *MyKey®* chapter.

**Note:** If collision warnings are perceived as being too frequent or disturbing then the warning sensitivity can be reduced, though the manufacturer recommends using the highest sensitivity setting where possible. Setting lower sensitivity would lead to fewer and later system warnings. Refer to the *Information Displays* chapter for instructions on reducing the sensitivity.

### Blocked Sensors

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).
- High interior temperatures, which may deactivate the illumination or the warning lamps until the interior temperature reduces (audible warning still sounds).

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.

# APPENDIX C

## Run Log

Subject Vehicle: **2013 Ford Explorer** Date: 10/4/2012

Principal Other Vehicle: 2000 Honda Accord

| Run | Test Type | Valid Run? | TTCW Sound (sec) | TTCW Light (sec) | TTCW CAN (sec) | TTCW Margin (sec) | Pass/Fail | Notes |
|---|---|---|---|---|---|---|---|---|
| 13 | FCW3 (Slower) | Y | 2.57 | 2.56 | 2.57 | 0.57 | | |
| 14 | | Y | 2.66 | 2.67 | 2.69 | 0.69 | | |
| 15 | | Y | 2.59 | 2.60 | 2.61 | 0.61 | | |
| 16 | | Y | 2.61 | 2.61 | 2.63 | 0.63 | | |
| 17 | | N | | | | | | SV speed high |
| 18 | | Y | 2.69 | 2.71 | 2.72 | 0.72 | | |
| 19 | | N | | | | | | Lateral offset high |
| 20 | | Y | 2.58 | 2.60 | 2.61 | 0.61 | | |
| 21 | | Y | 2.58 | 2.59 | 2.61 | 0.61 | | |
| | | | | | | | | |
| 22 | FCW2 (Braking) | Y | 2.98 | 3.04 | 3.06 | 0.66 | | |
| 23 | | Y | 2.92 | 2.94 | 2.95 | 0.55 | | |
| 24 | | N | | | | | | Aborted |
| 25 | | Y | 3.01 | 3.02 | 3.05 | 0.65 | | |
| 26 | | Y | 3.03 | 3.05 | 3.06 | 0.66 | | |
| 27 | | Y | 2.92 | 2.93 | 2.94 | 0.54 | | |
| 28 | | Y | 3.00 | 3.03 | 3.05 | 0.65 | | |

Subject Vehicle: **2013 Ford Explorer** Date: 10/4/2012

Principal Other Vehicle: 2000 Honda Accord

| Run | Test Type | Valid Run? | TTCW Sound (sec) | TTCW Light (sec) | TTCW CAN (sec) | TTCW Margin (sec) | Pass/Fail | Notes |
|---|---|---|---|---|---|---|---|---|
| 29 | FCW2 (Braking) | Y | 2.98 | 3.00 | 3.01 | 0.61 | | |
| | | | | | | | | |
| 31 | FCW1 (Stopped) | Y | 1.81 | 1.83 | 1.84 | -0.26 | Fail | |
| 32 | | Y | 2.14 | 2.15 | 2.17 | 0.06 | Pass | |
| 33 | | Y | 2.38 | 2.39 | 2.42 | 0.32 | Pass | |
| 34 | | N | | | | | | Lateral offset high |
| 35 | | N | | | | | | SV speed low |
| 36 | | Y | 2.43 | 2.44 | 2.45 | 0.35 | Pass | |
| 37 | | Y | 2.24 | 2.26 | 2.27 | 0.17 | Pass | |
| 38 | | Y | 2.04 | 2.05 | 2.07 | -0.03 | Fail | |
| 39 | | Y | 2.41 | 2.41 | 2.44 | 0.34 | 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.

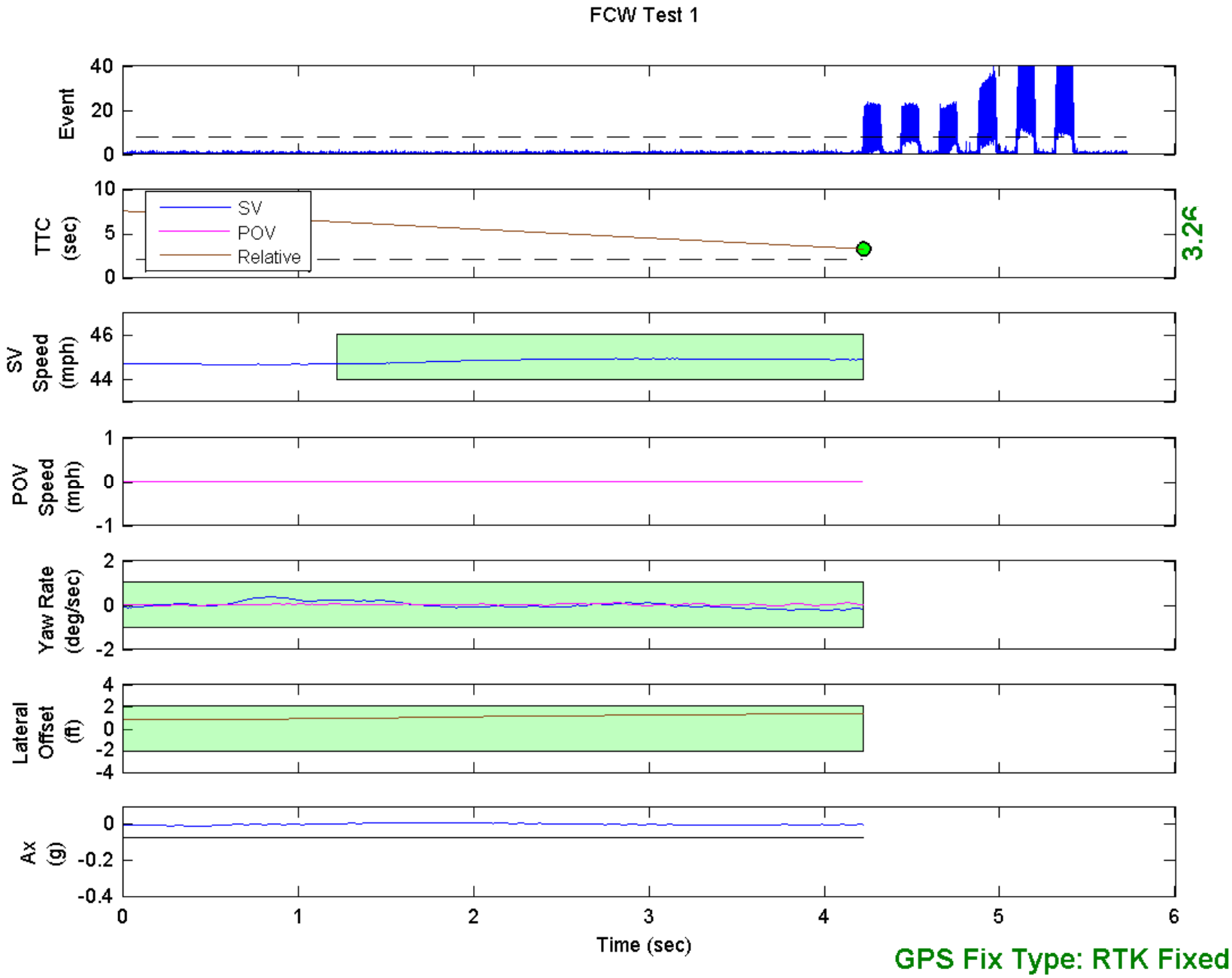



Figure D1. Example Time History for Test Type 1, Passing

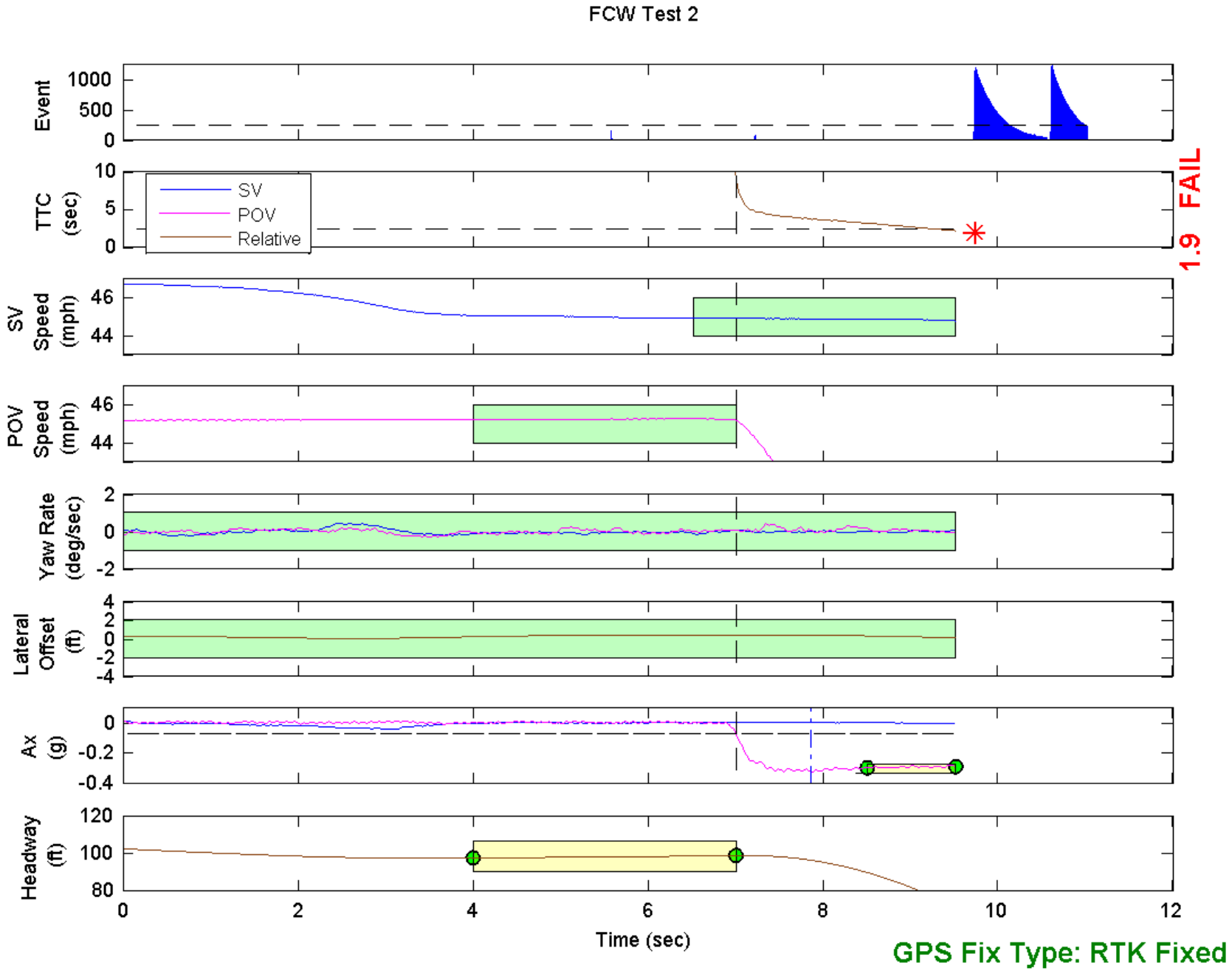



Figure D2. Example Time History for Test Type 2, Failing

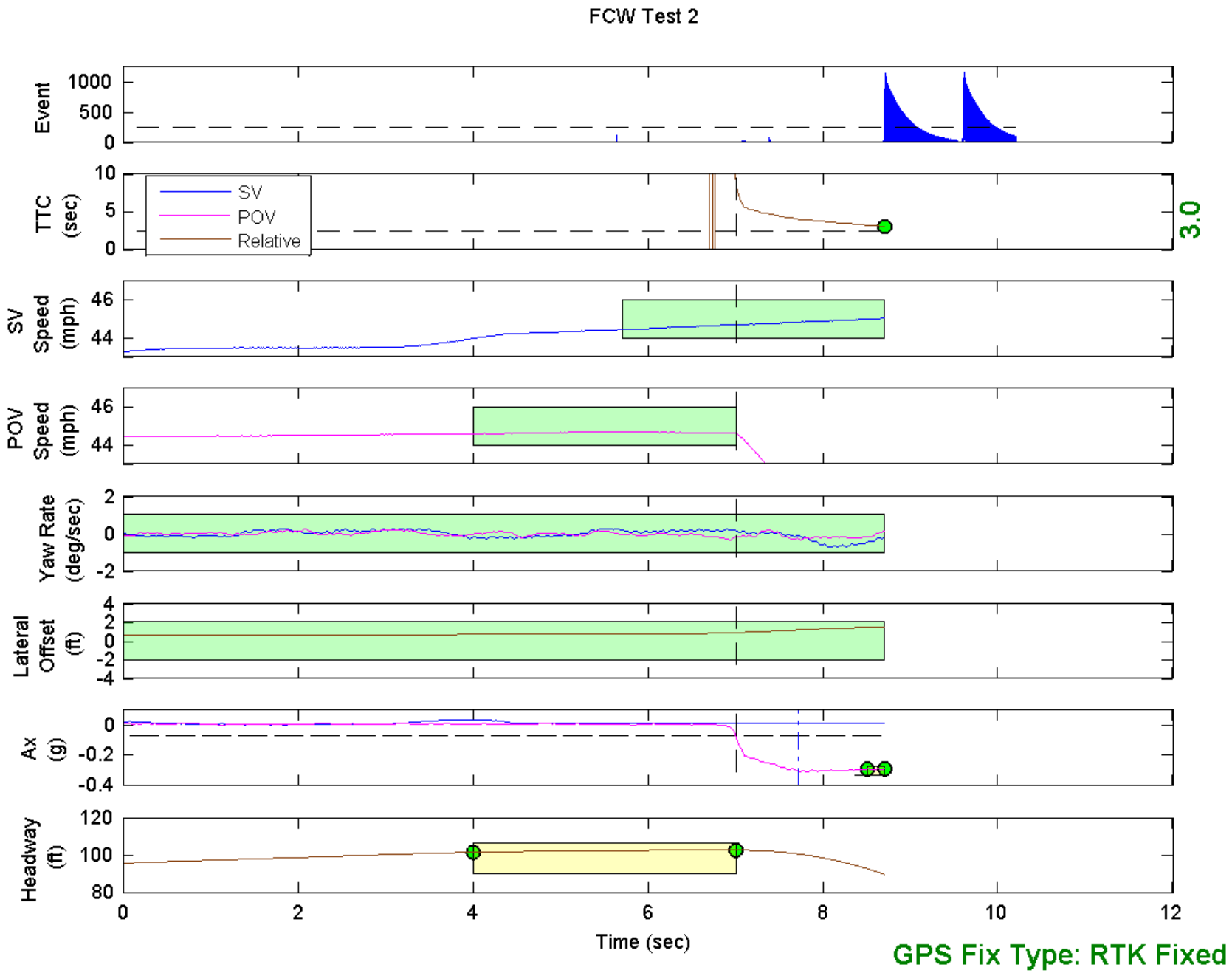



Figure D3. Example Time History for Test Type 2, Passing

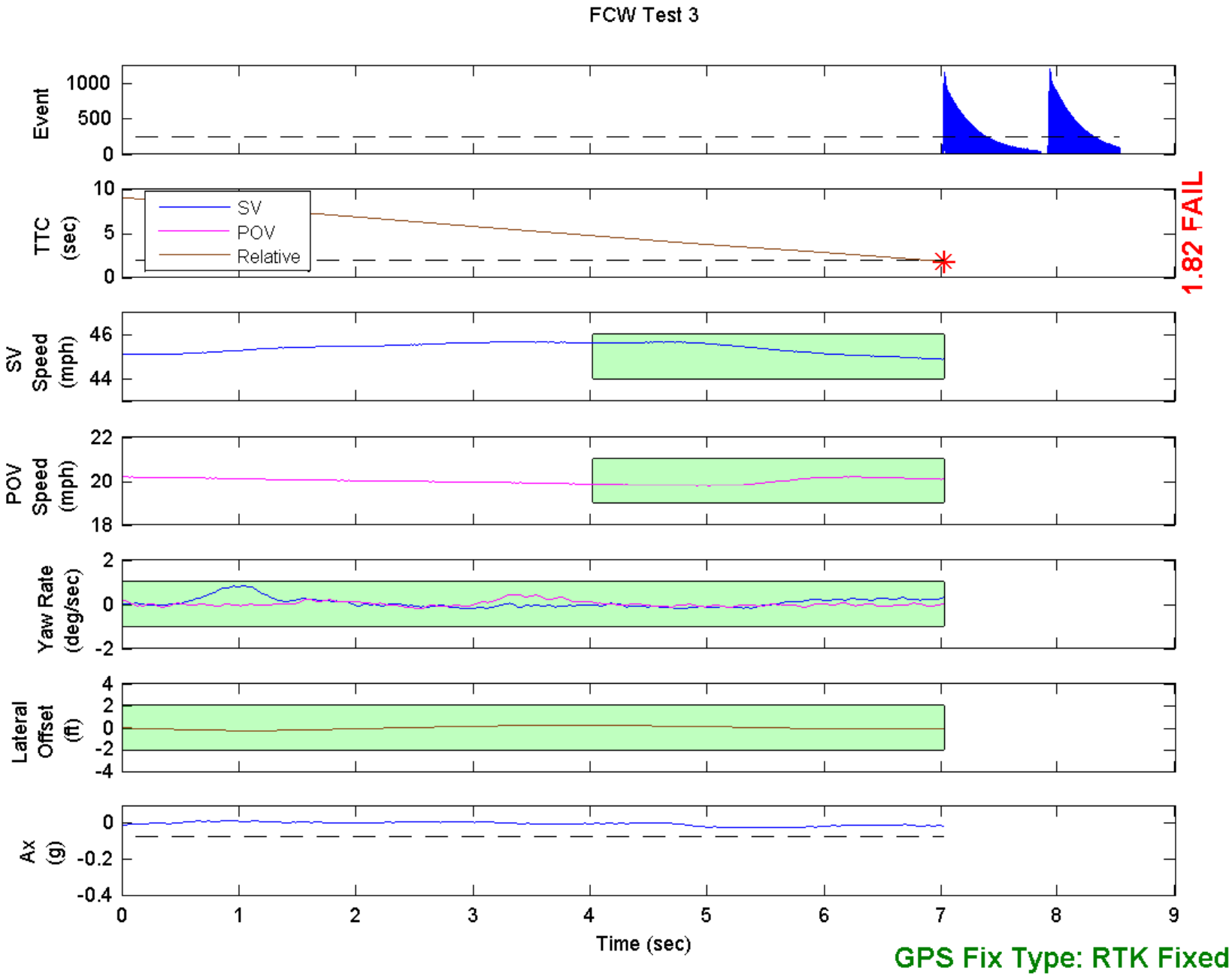



Figure D4. Example Time History for Test Type 3, Failing

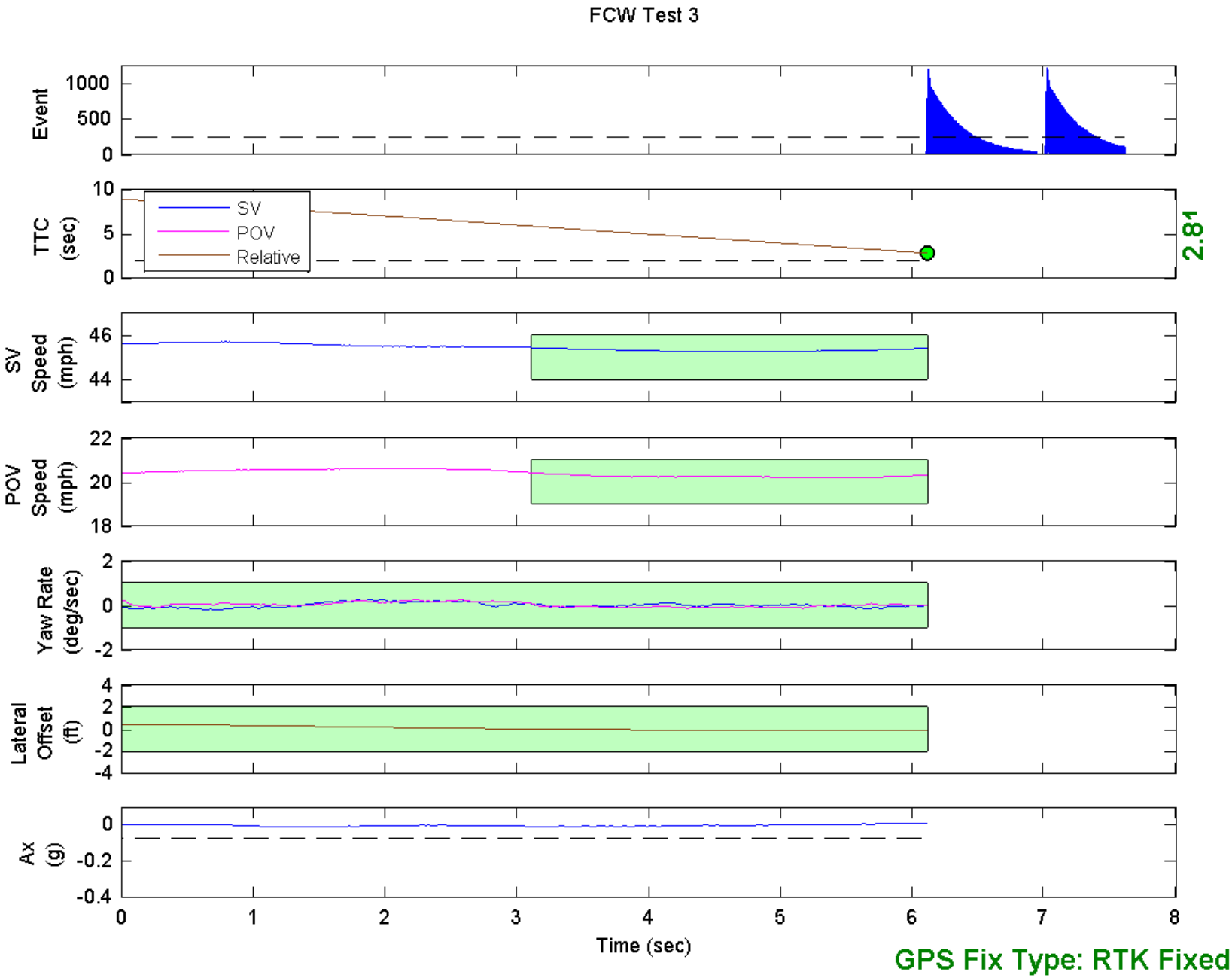



Figure D5. Example Time History for Test Type 3, Passing

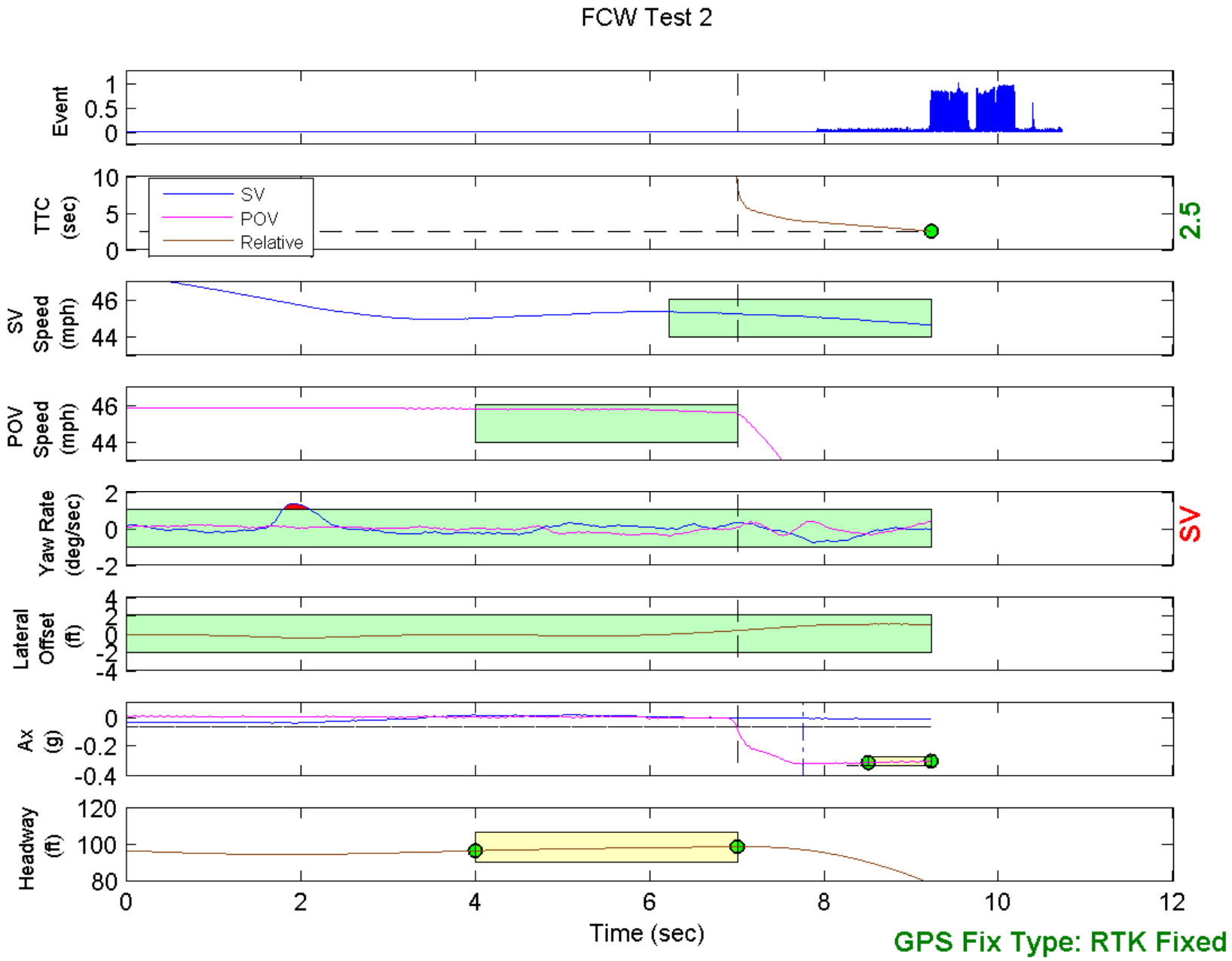



Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

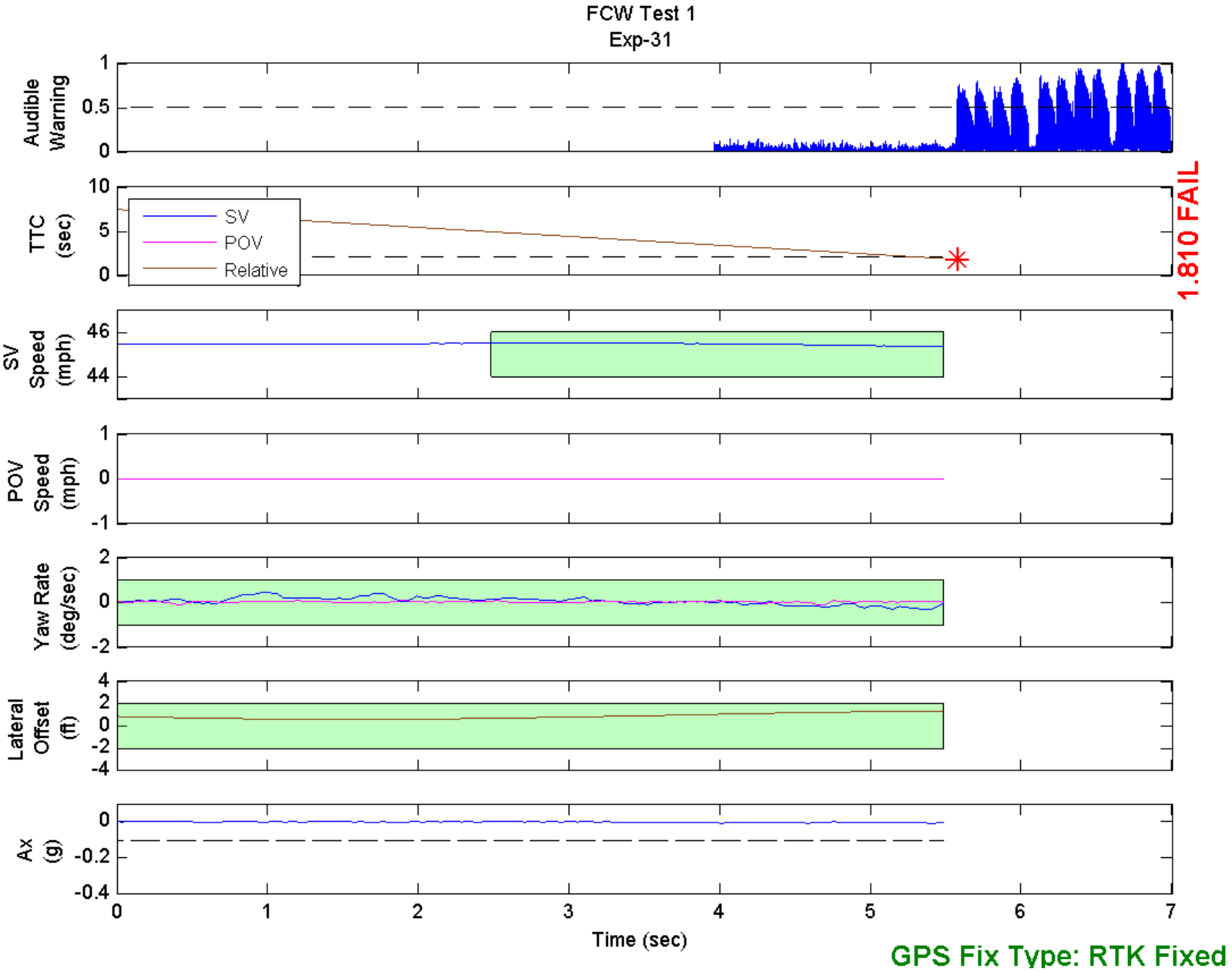



Figure D7. Time History for Run 31, FCW Test 1, Acoustic Warning

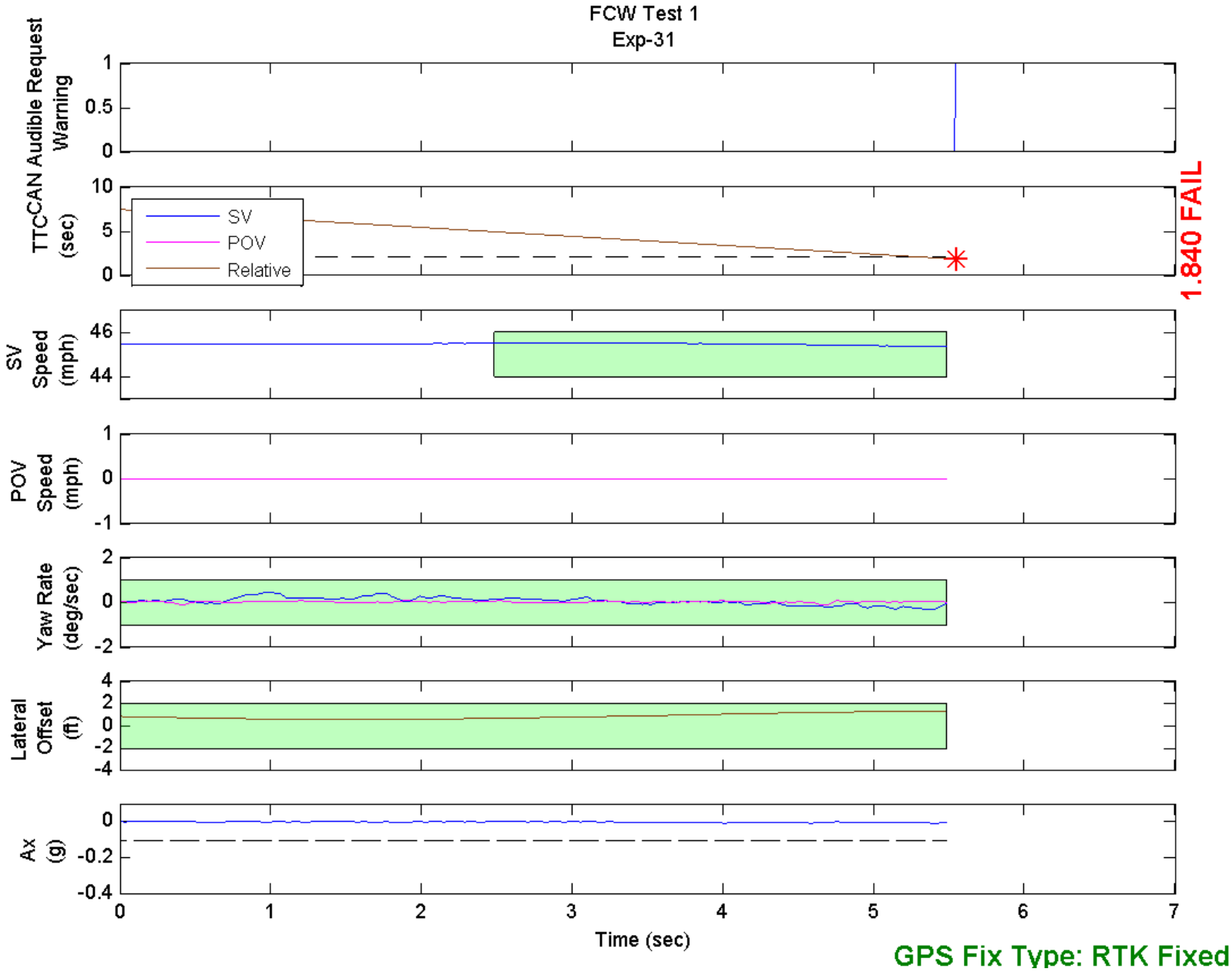



Figure D8. Time History for Run 31, FCW Test 1, CAN Acoustic Warning Request

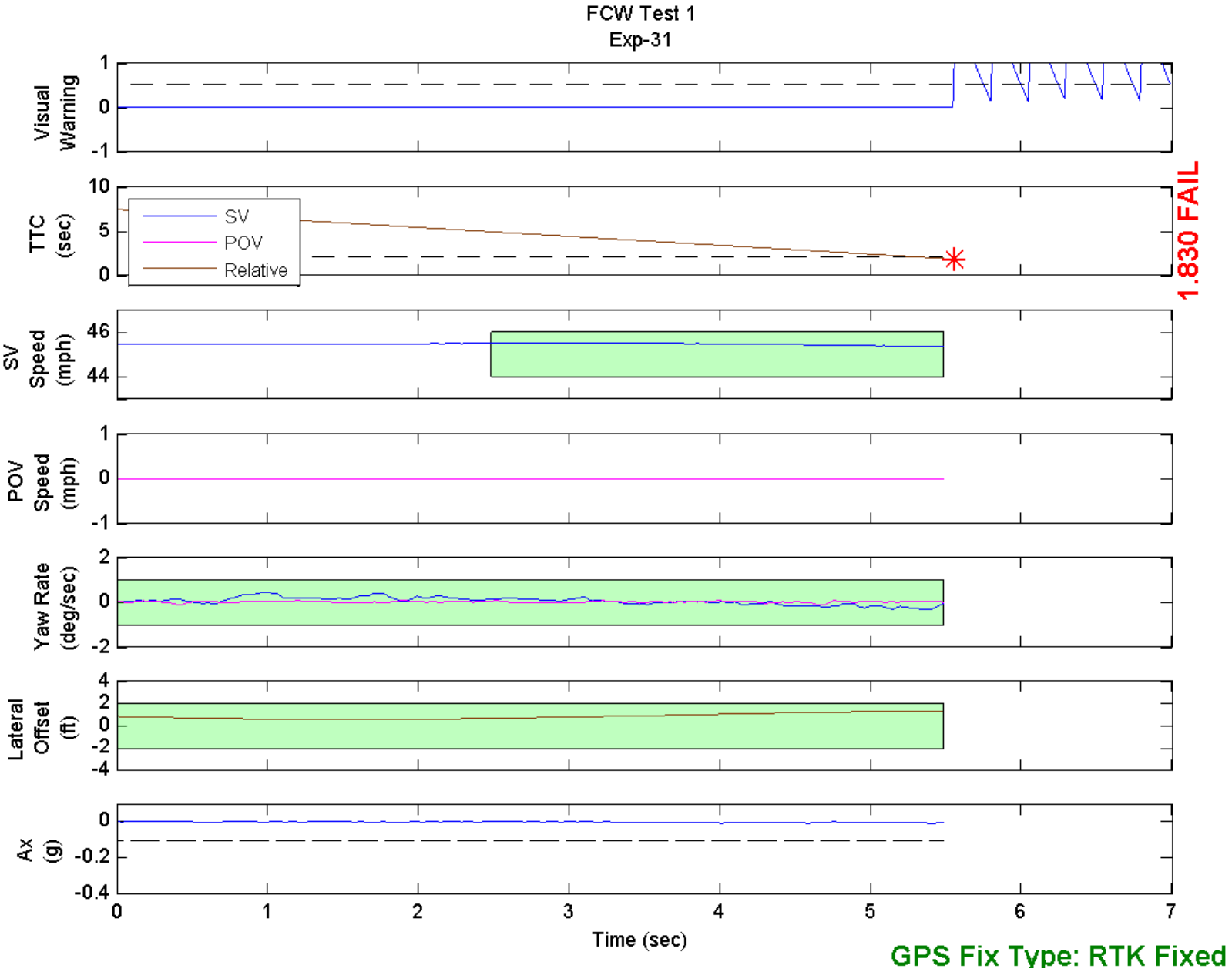



Figure D9. Time History for Run 31, FCW Test 1, Visual Warning

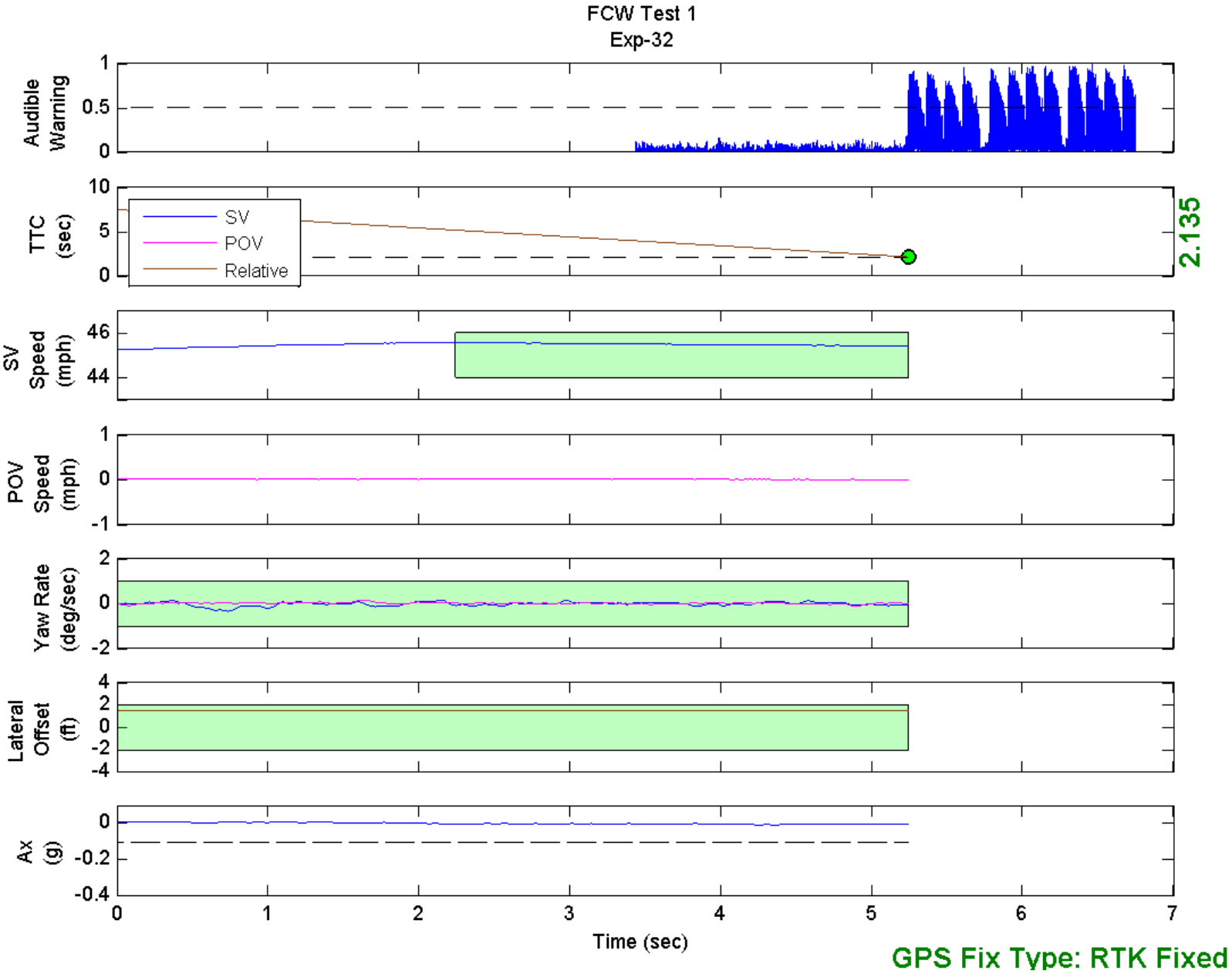



Figure D10. Time History for Run 32, FCW Test 1, Acoustic Warning

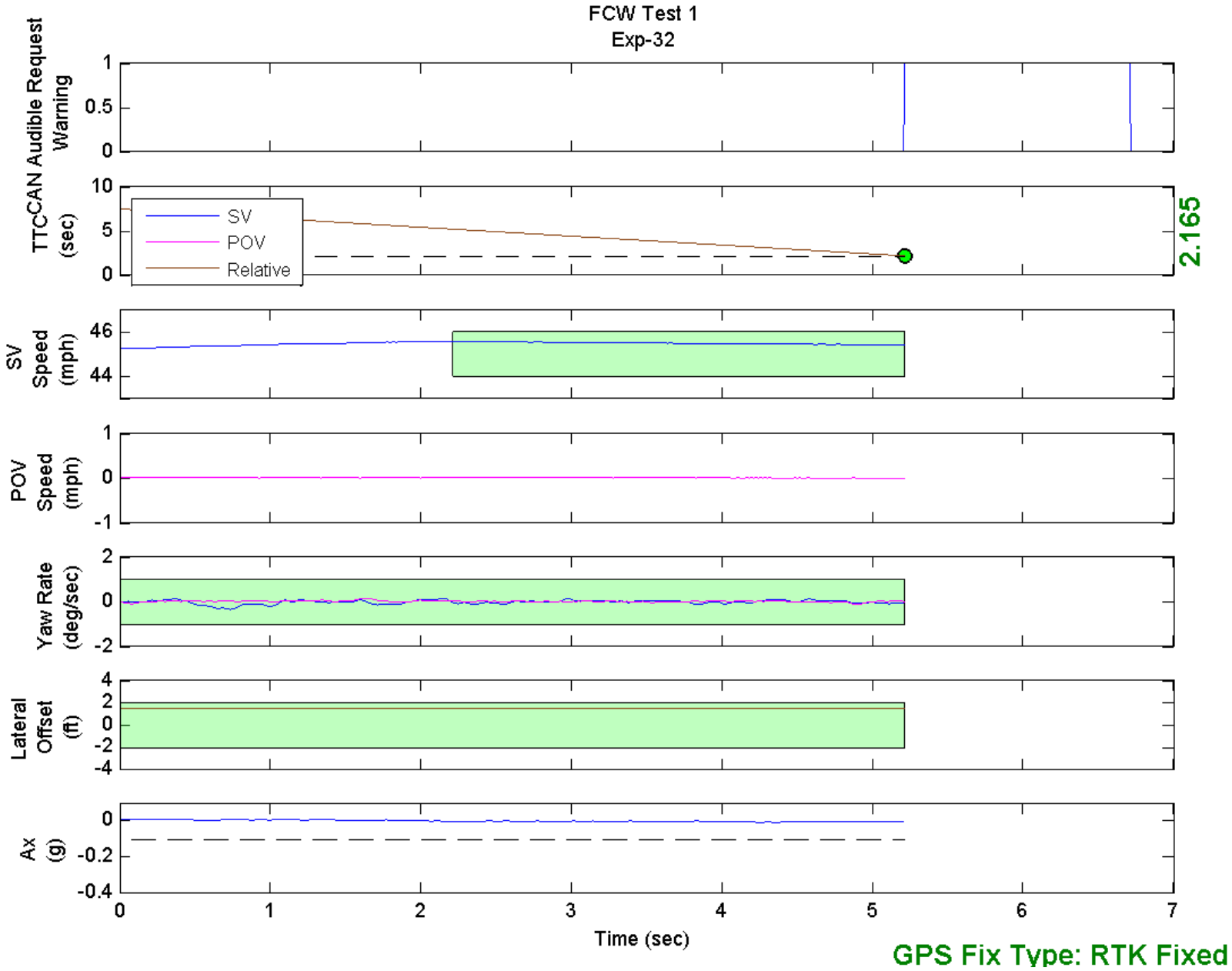



Figure D11. Time History for Run 32, FCW Test 1, CAN Acoustic Warning Request

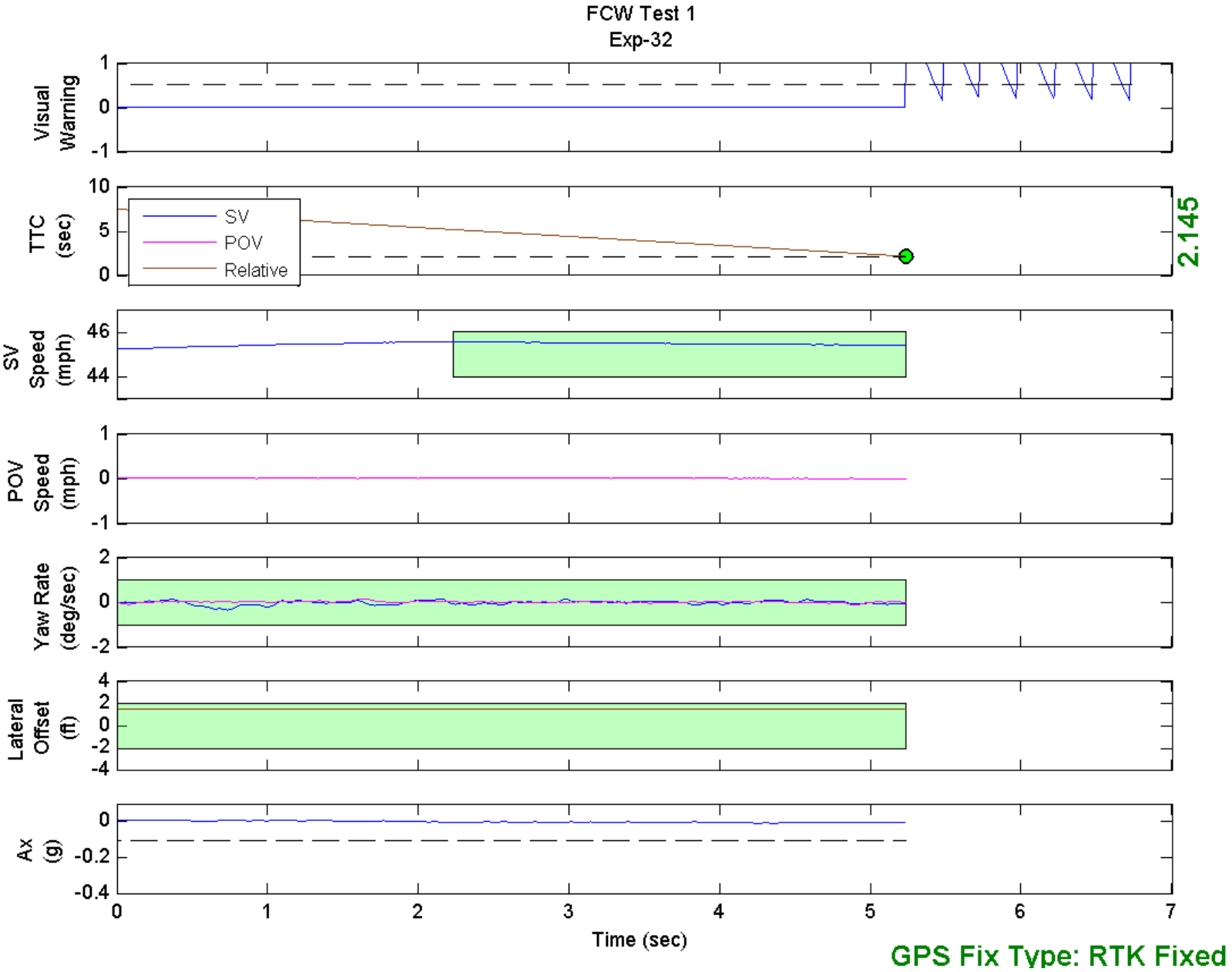



Figure D12. Time History for Run 32, FCW Test 1, Visual Warning

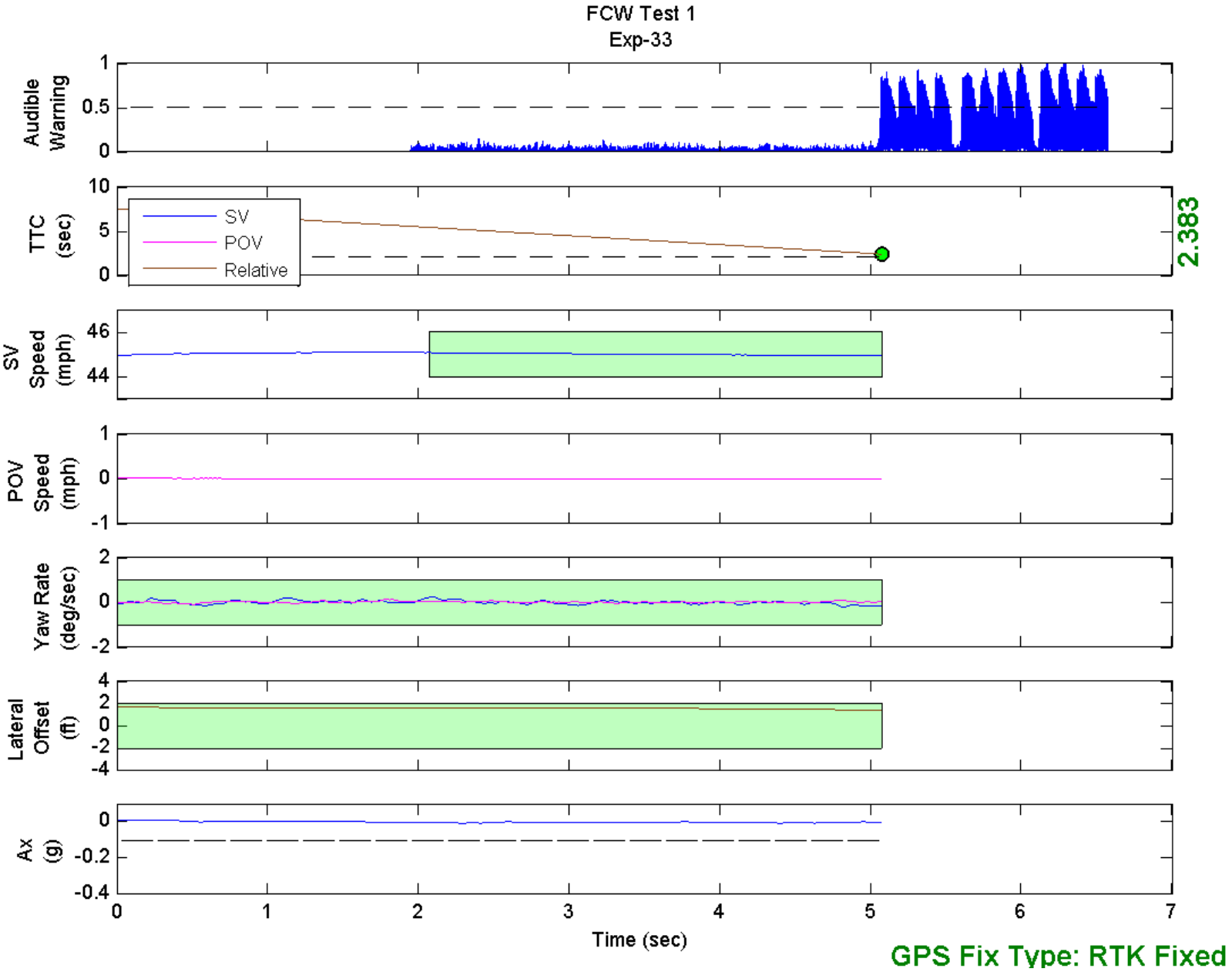



Figure D13. Time History for Run 33, FCW Test 1, Acoustic Warning

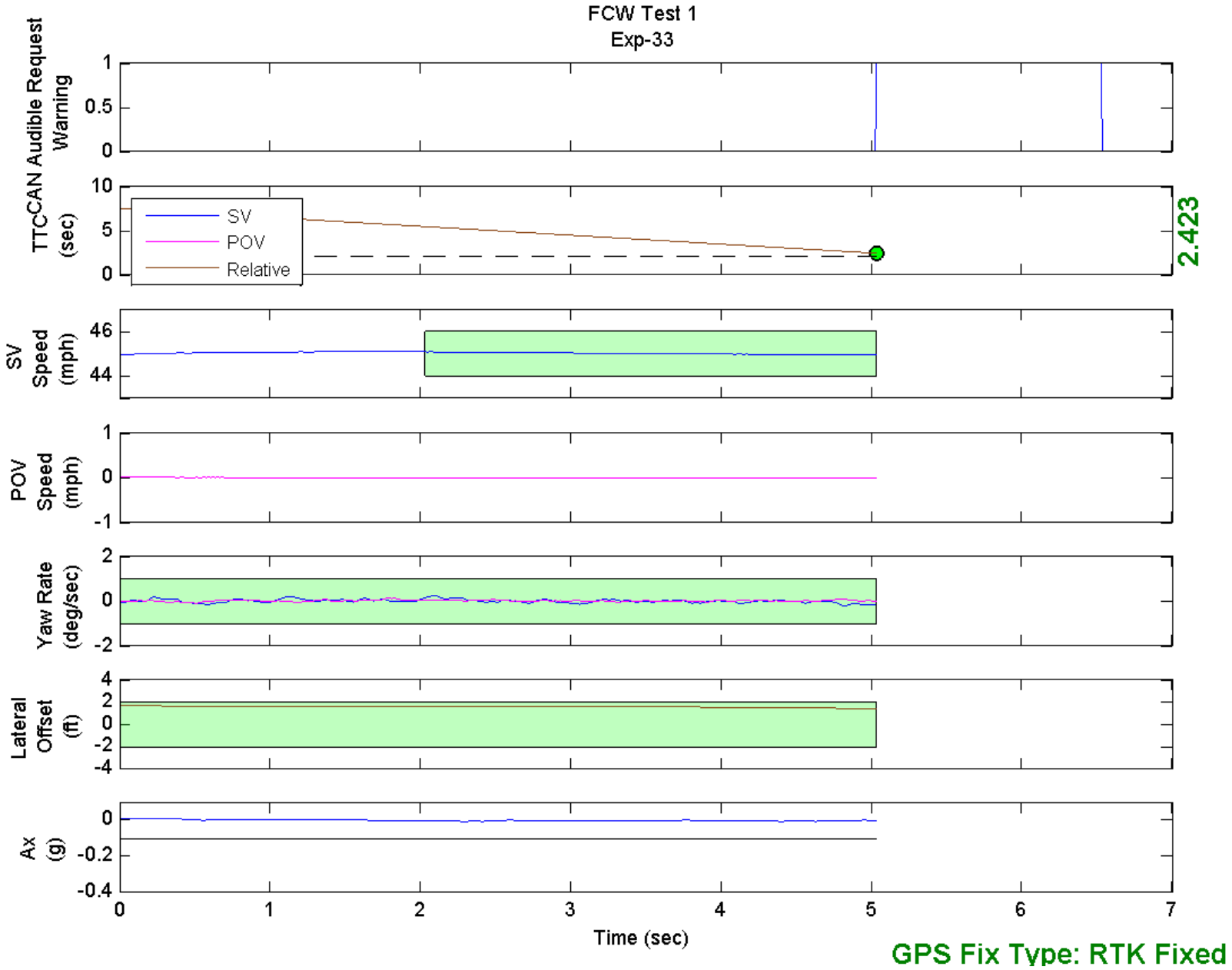



Figure D14. Time History for Run 33, FCW Test 1, CAN Acoustic Warning Request

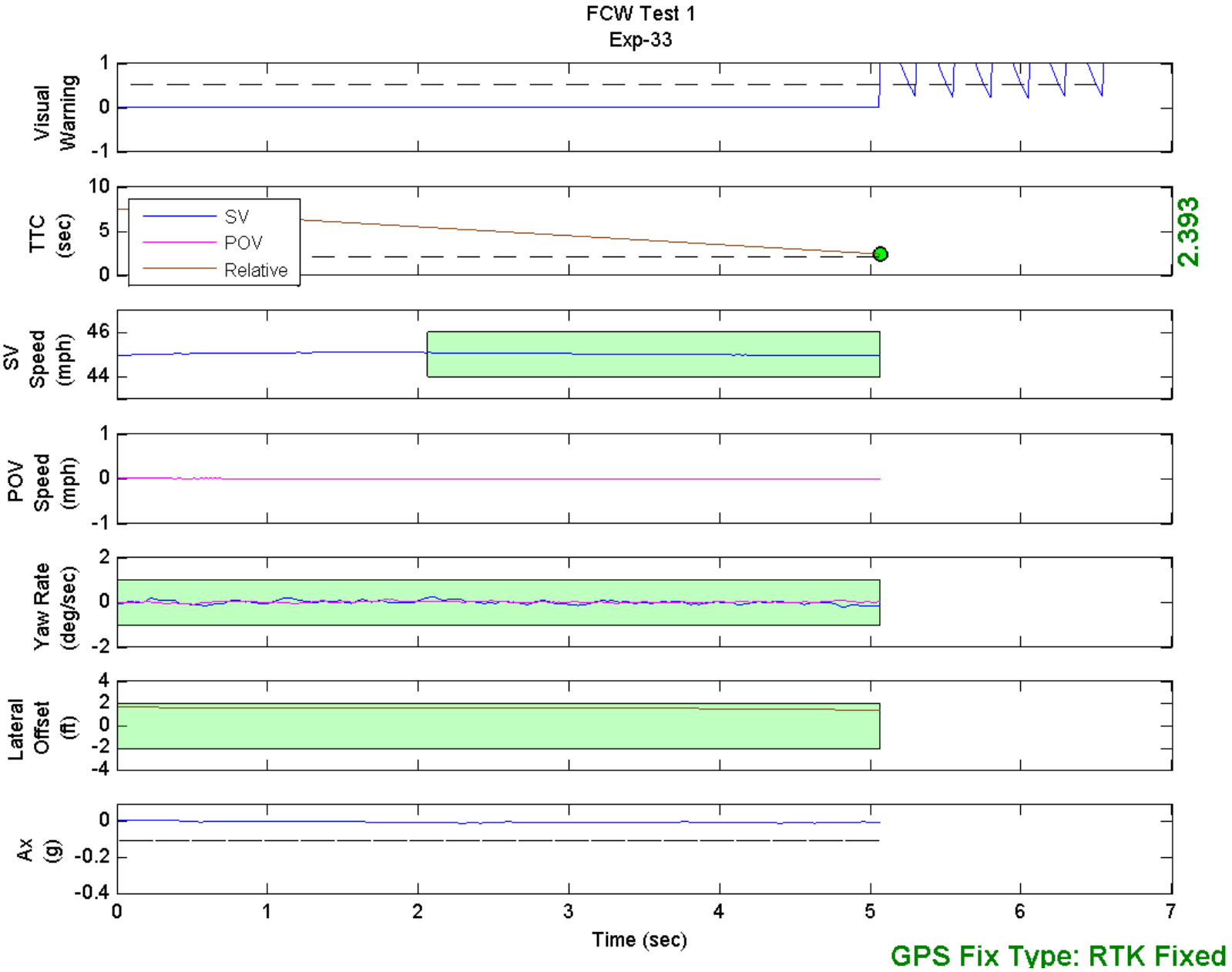



Figure D15. Time History for Run 33, FCW Test 1, Visual Warning

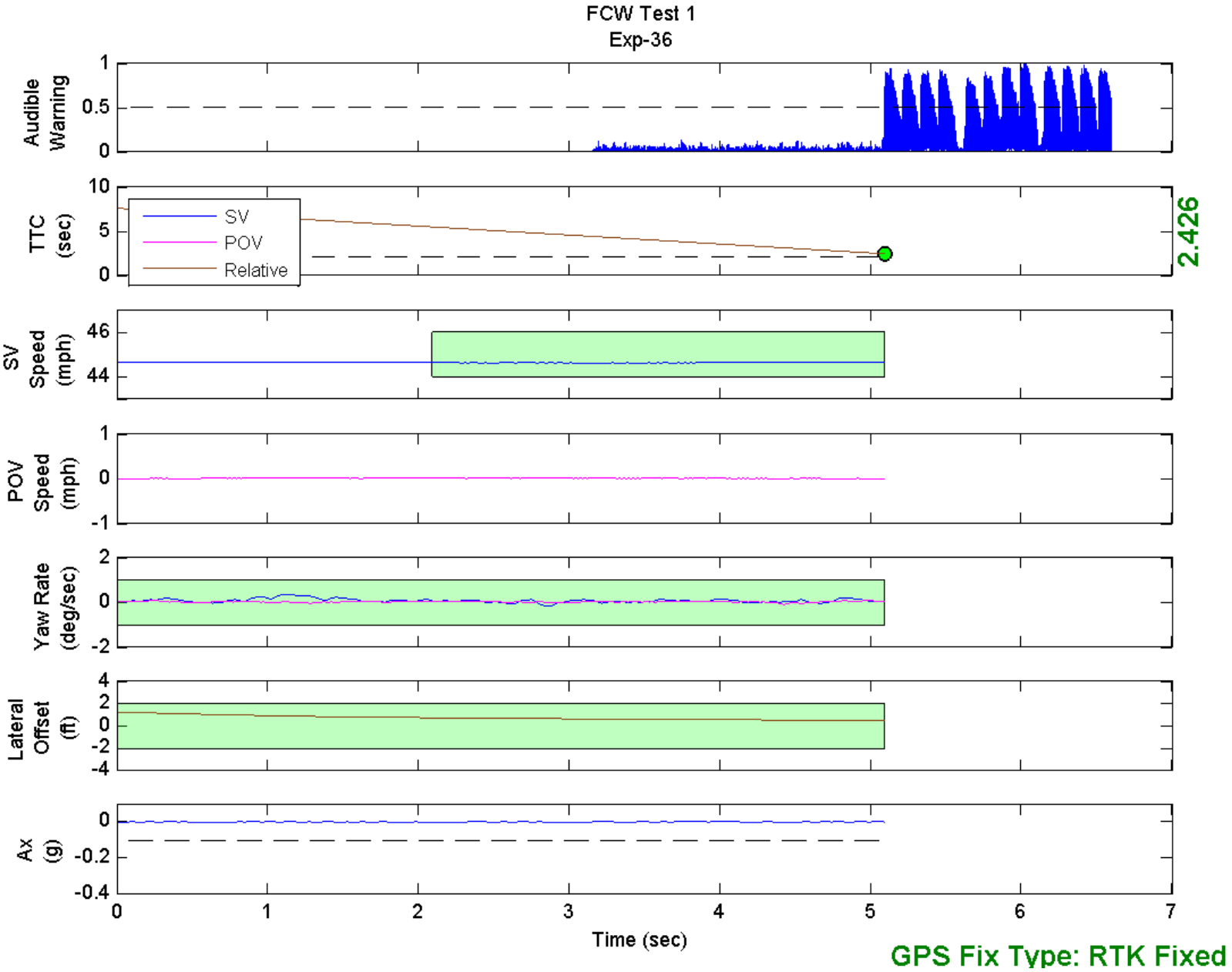



Figure D16. Time History for Run 36, FCW Test 1, Acoustic Warning

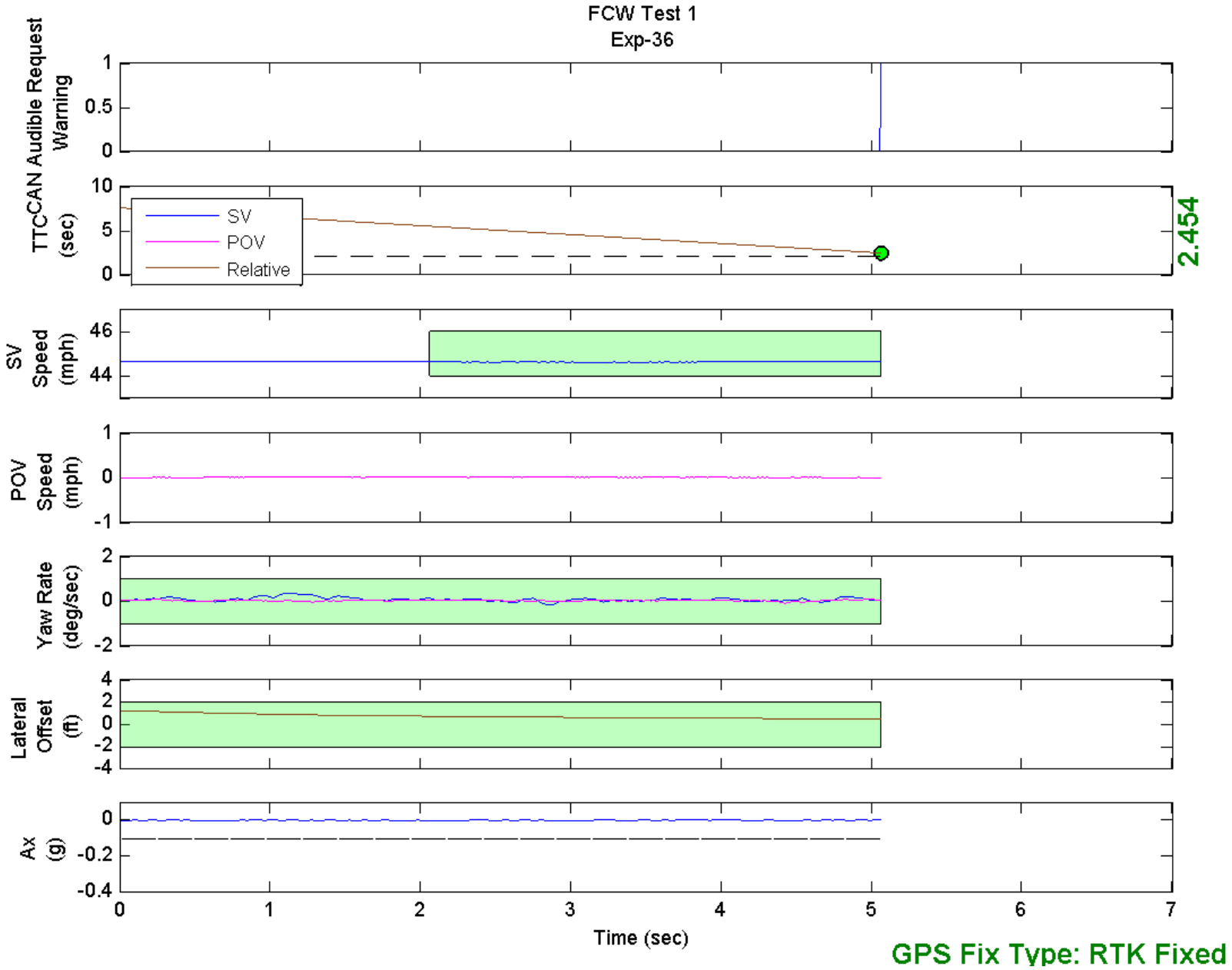



Figure D17. Time History for Run 36, FCW Test 1, CAN Acoustic Warning Request

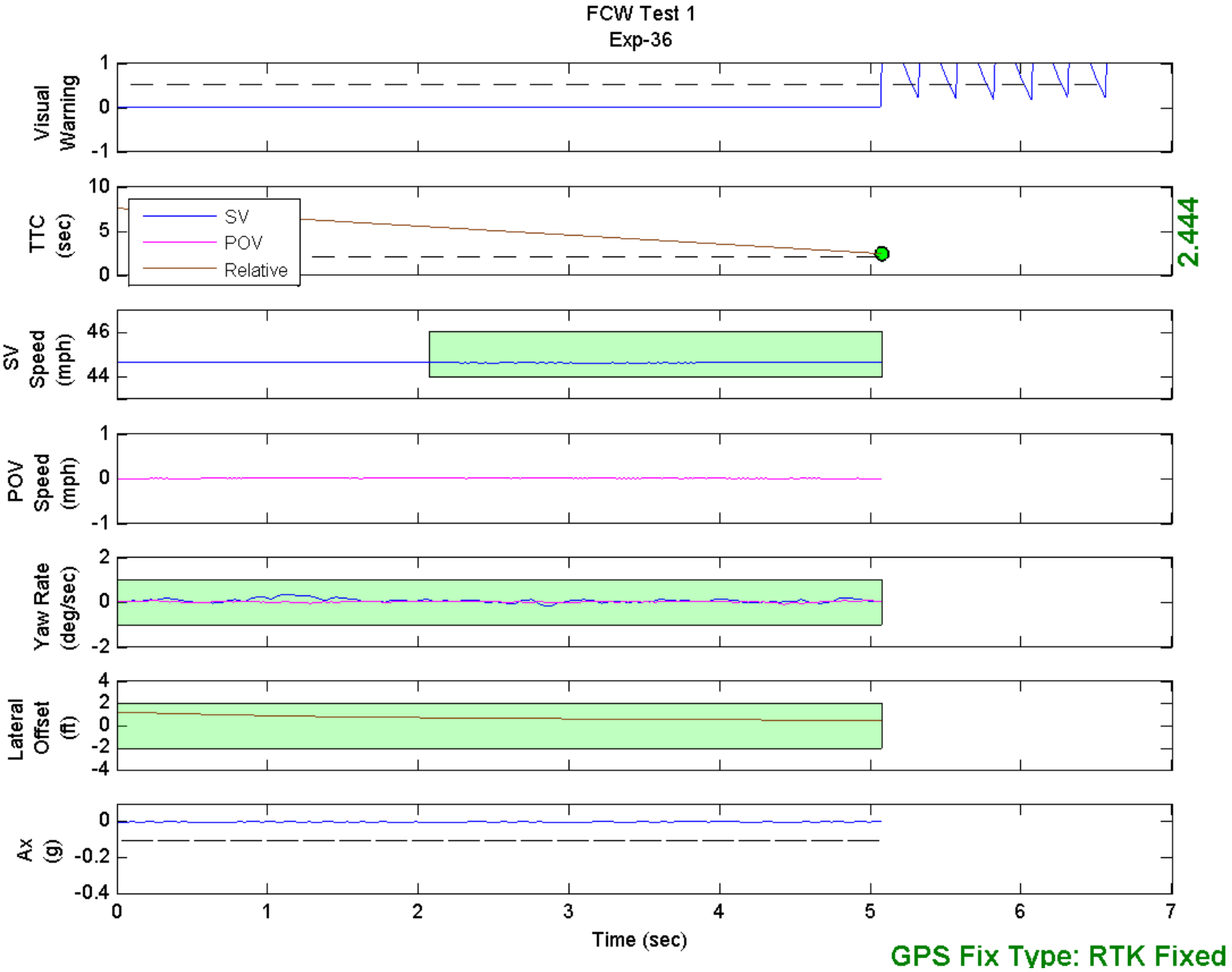



Figure D18. Time History for Run 36, FCW Test 1, Visual Warning

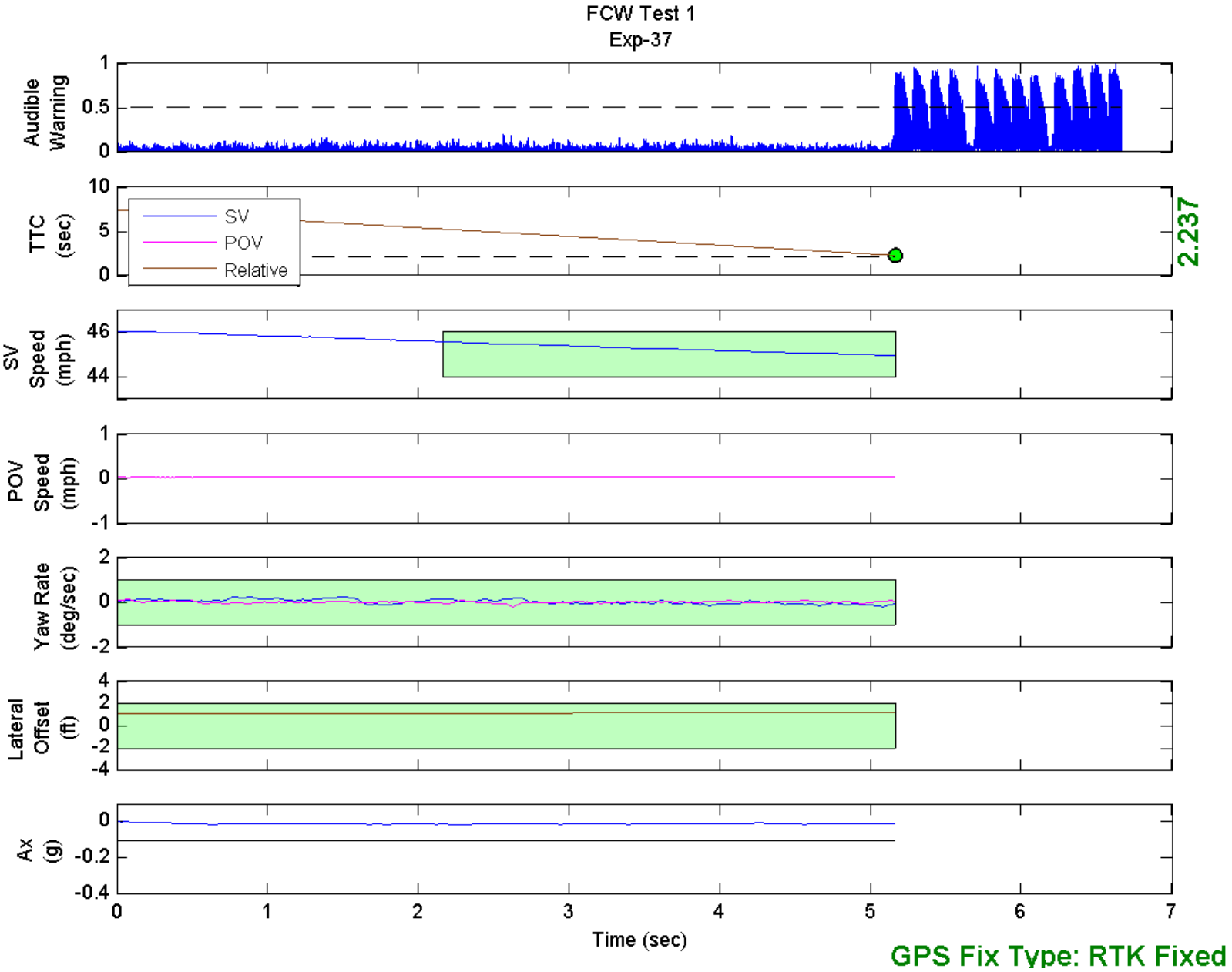



Figure D19. Time History for Run 37, FCW Test 1, Acoustic Warning

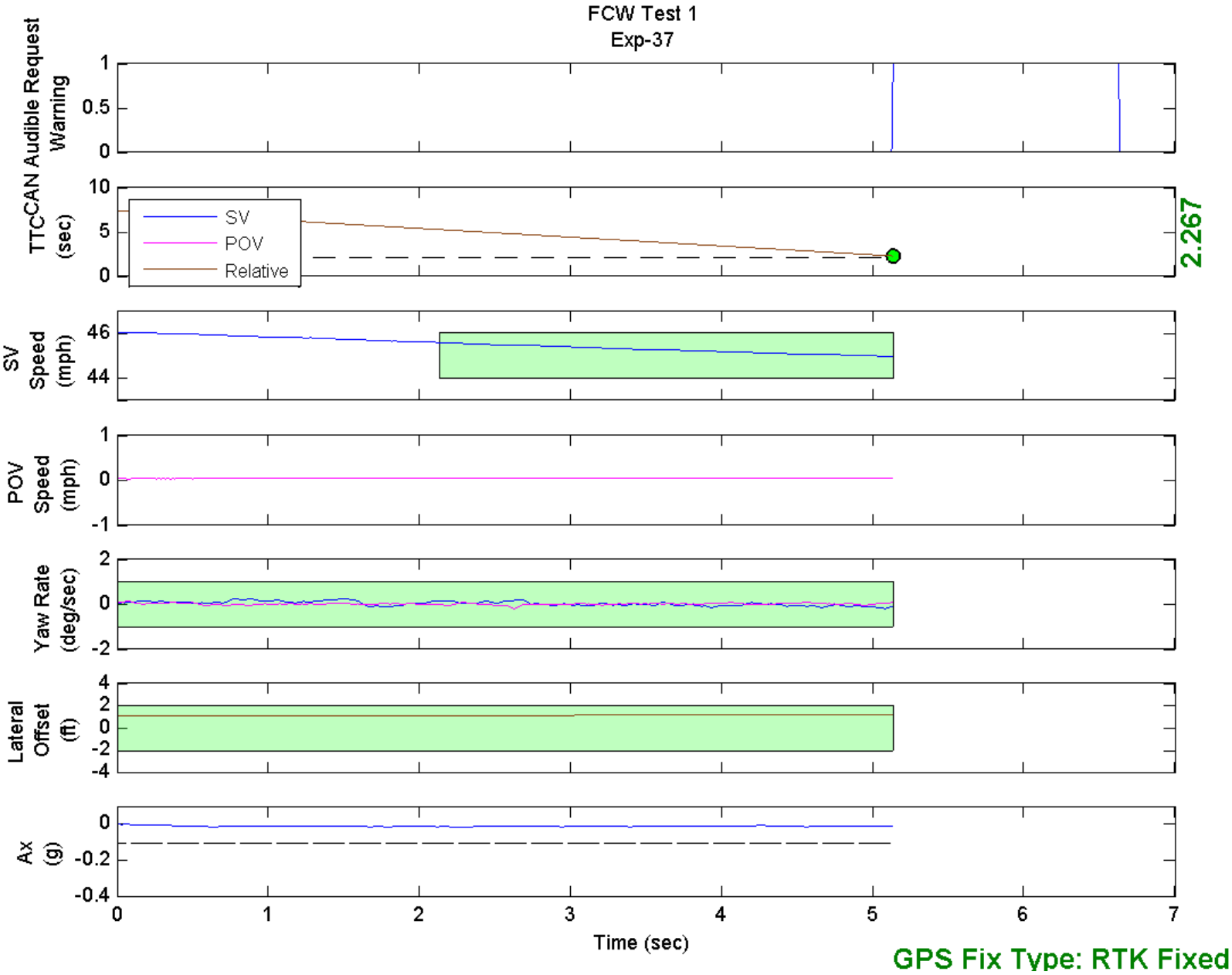



Figure D20. Time History for Run 37, FCW Test 1, CAN Acoustic Warning Request

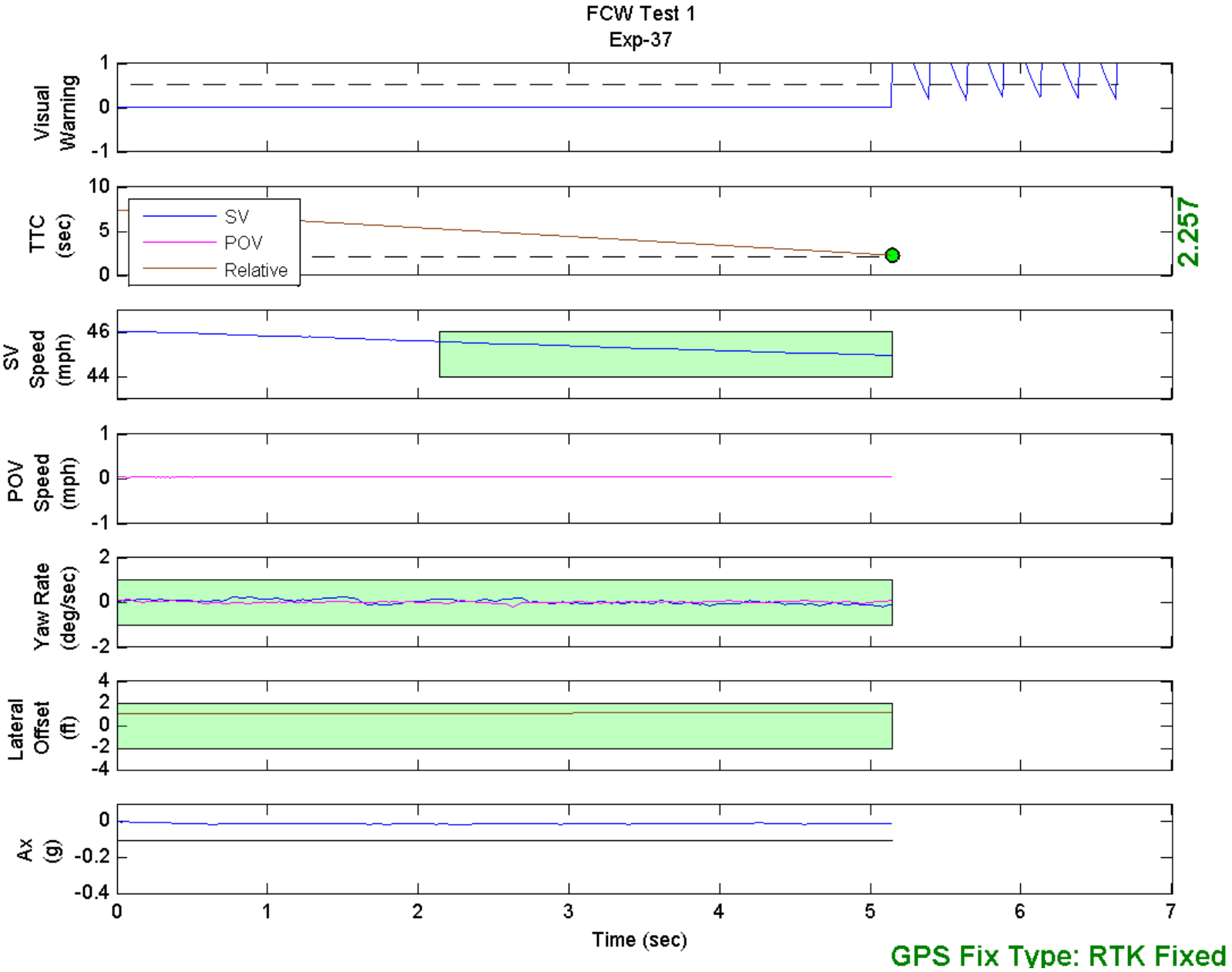



Figure D21. Time History for Run 37, FCW Test 1, Visual Warning

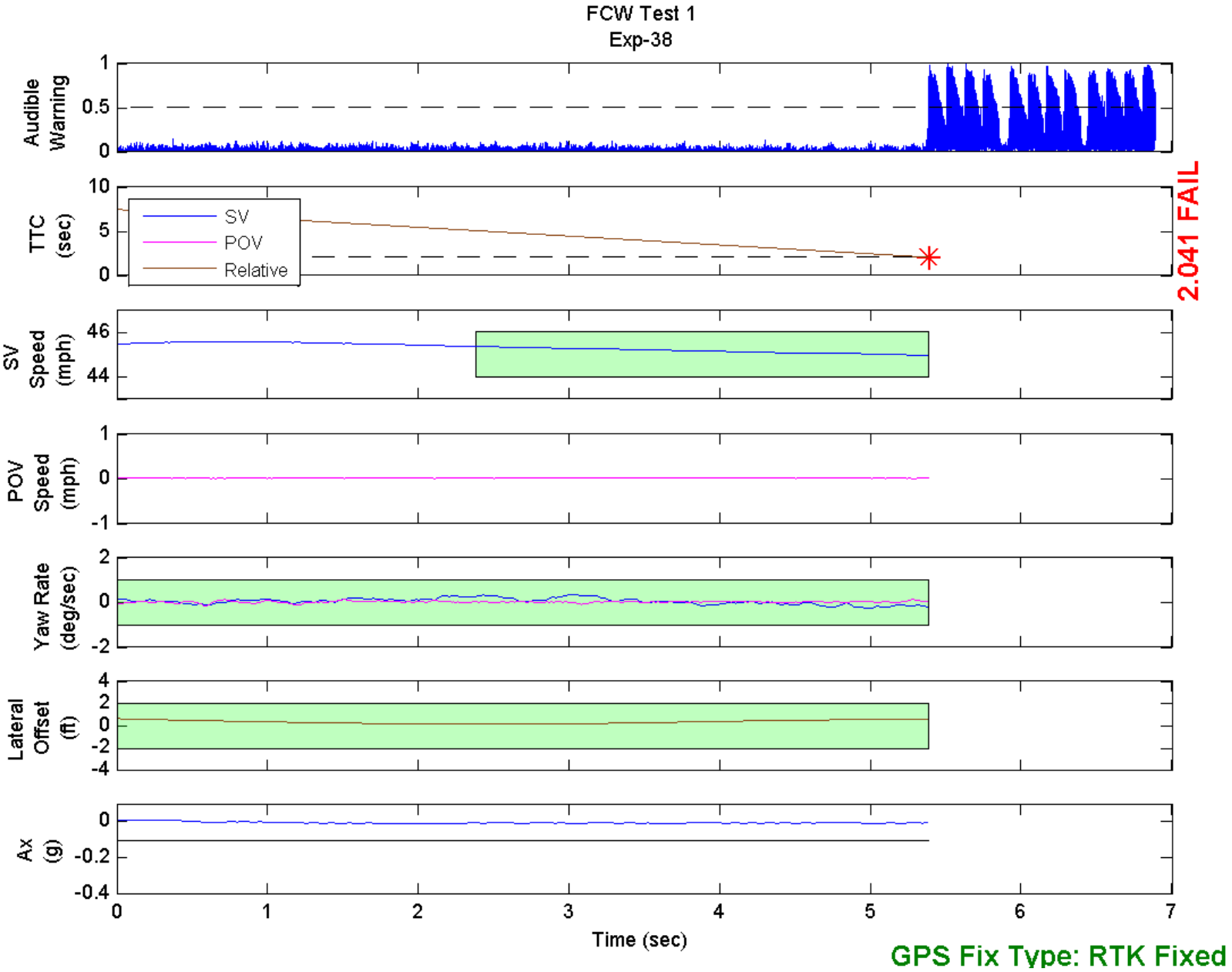



Figure D22. Time History for Run 38, FCW Test 1, Acoustic Warning

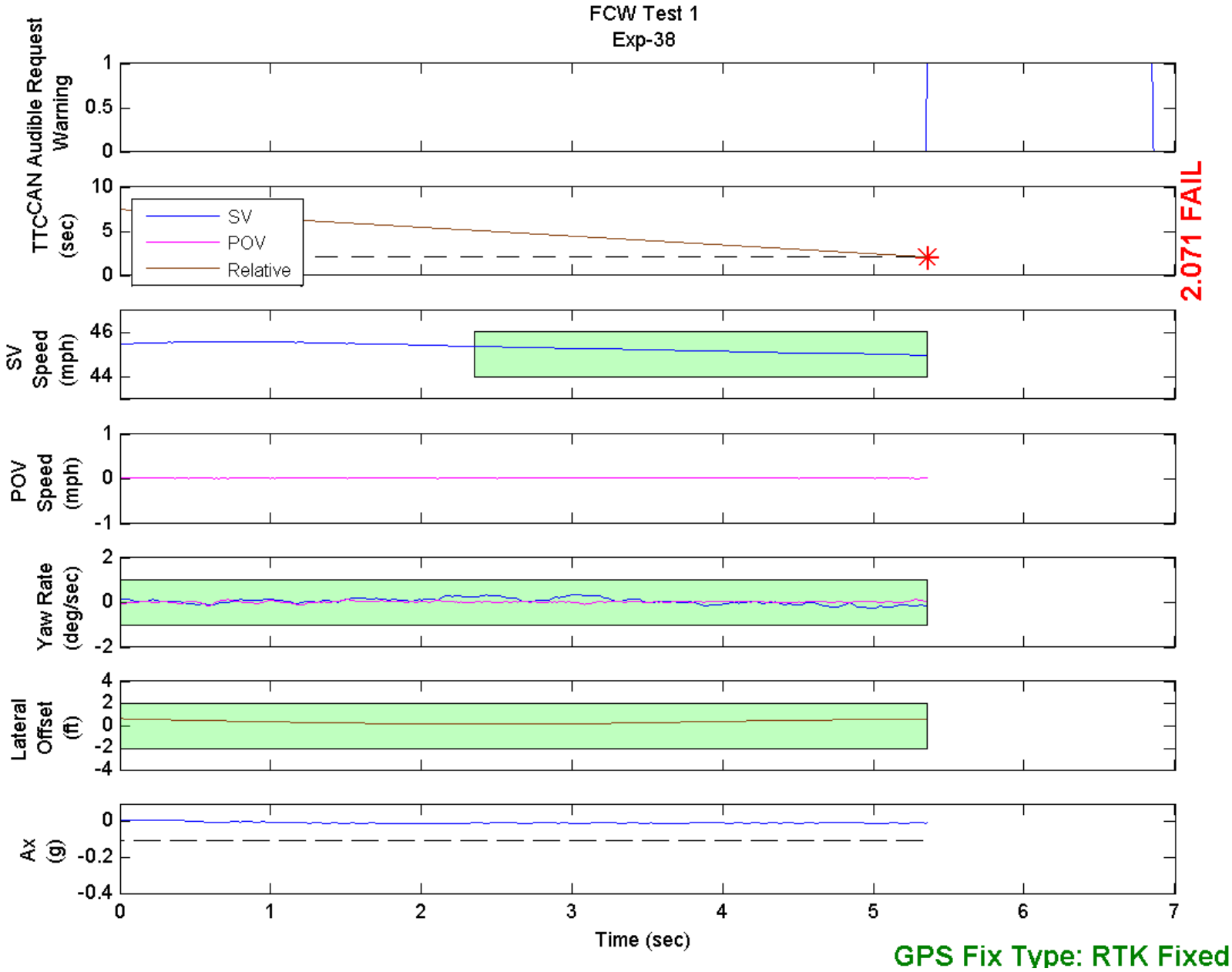



Figure D23. Time History for Run 38, FCW Test 1, CAN Acoustic Warning Request

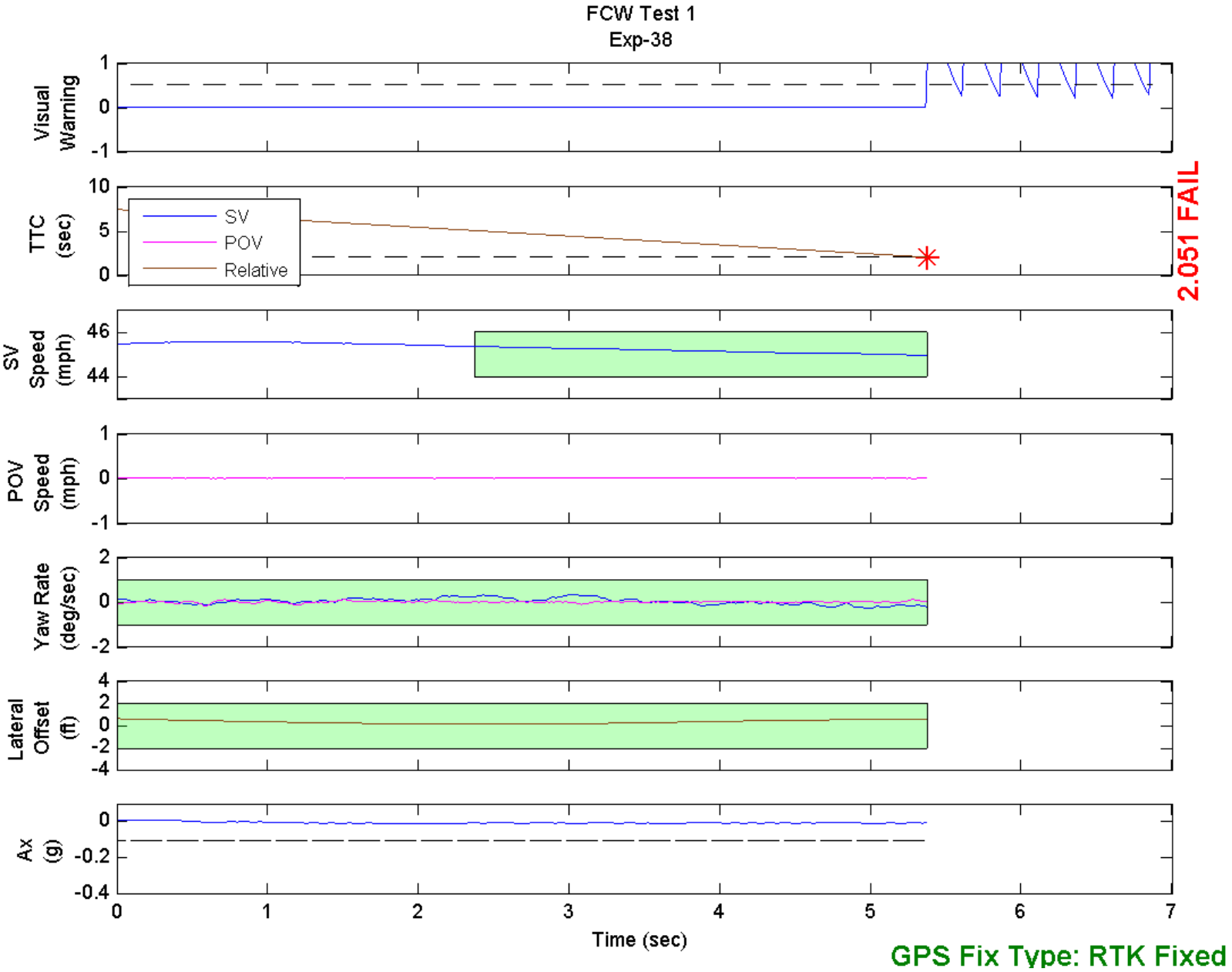



Figure D24. Time History for Run 38, FCW Test 1, Visual Warning

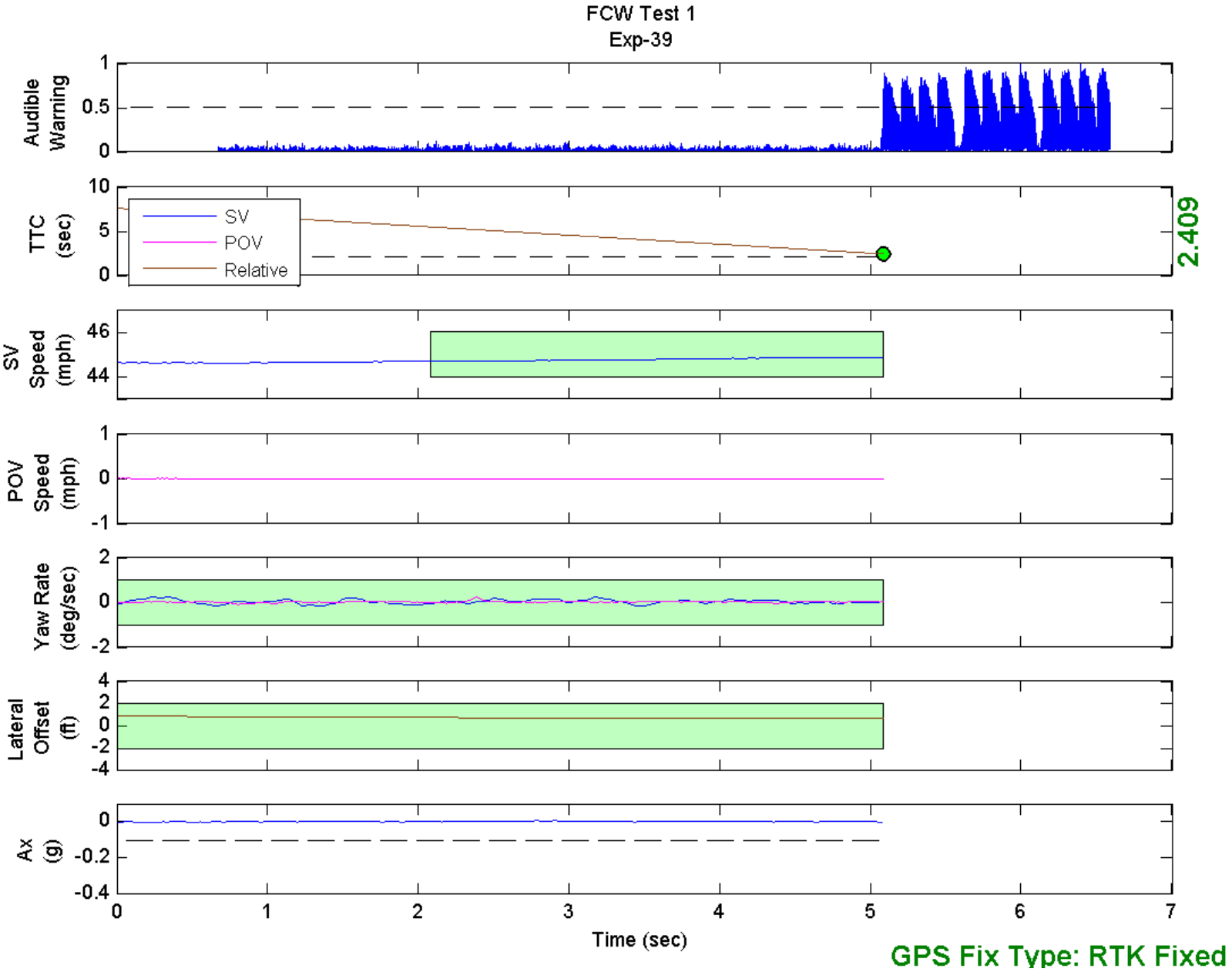



Figure D25. Time History for Run 39, FCW Test 1, Acoustic Warning

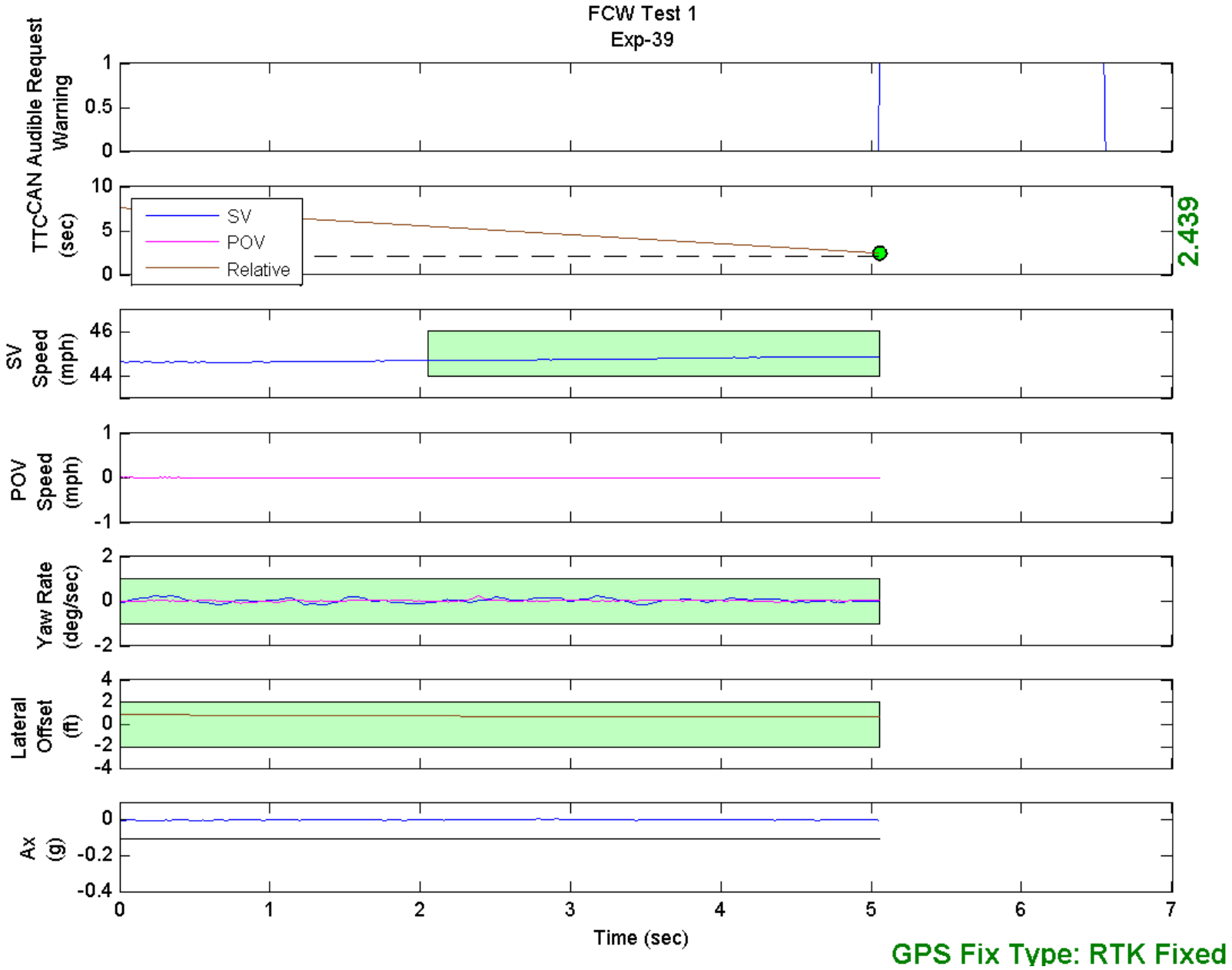



Figure D26. Time History for Run 39, FCW Test 1, CAN Acoustic Warning Request

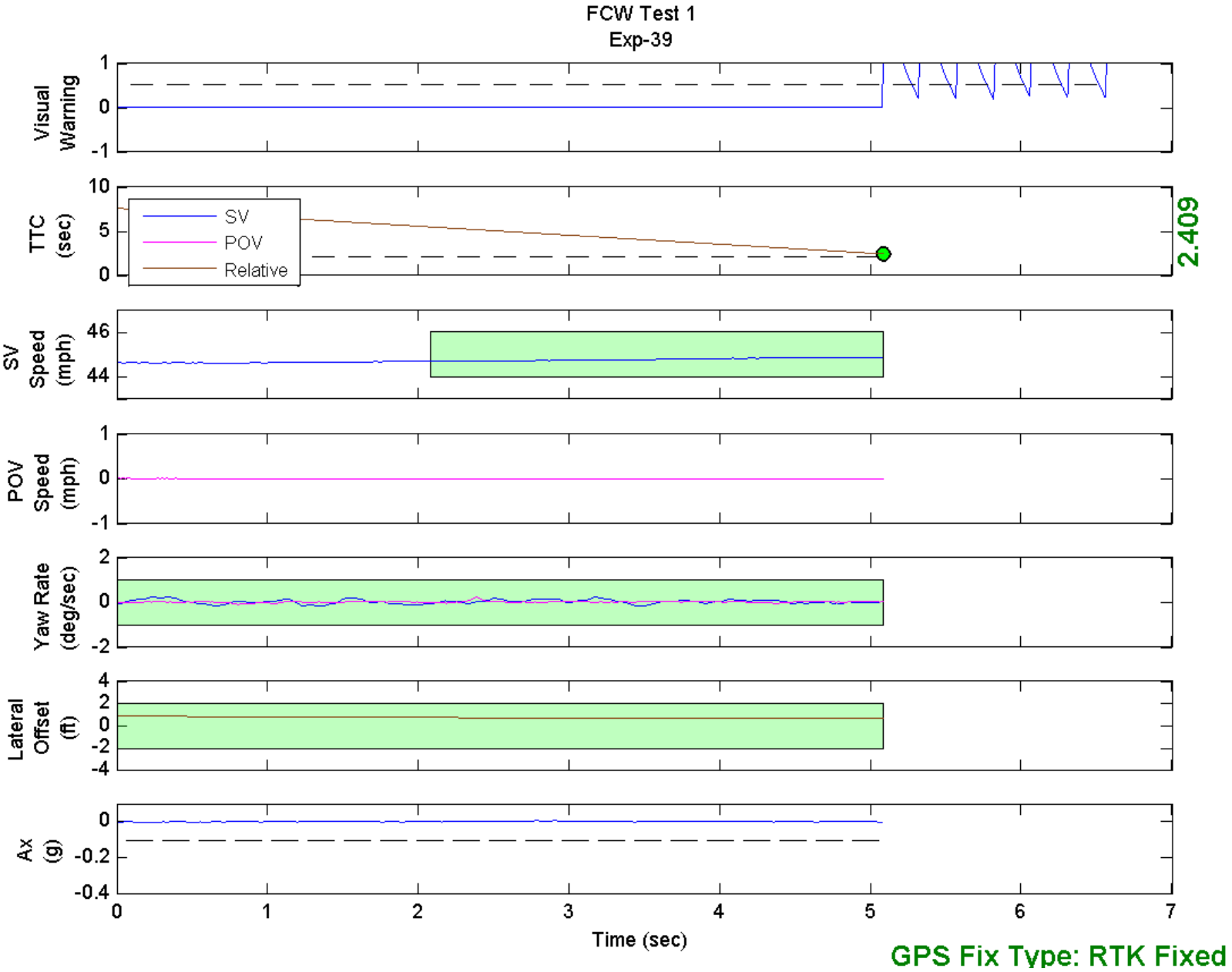



Figure D27. Time History for Run 39, FCW Test 1, Visual Warning

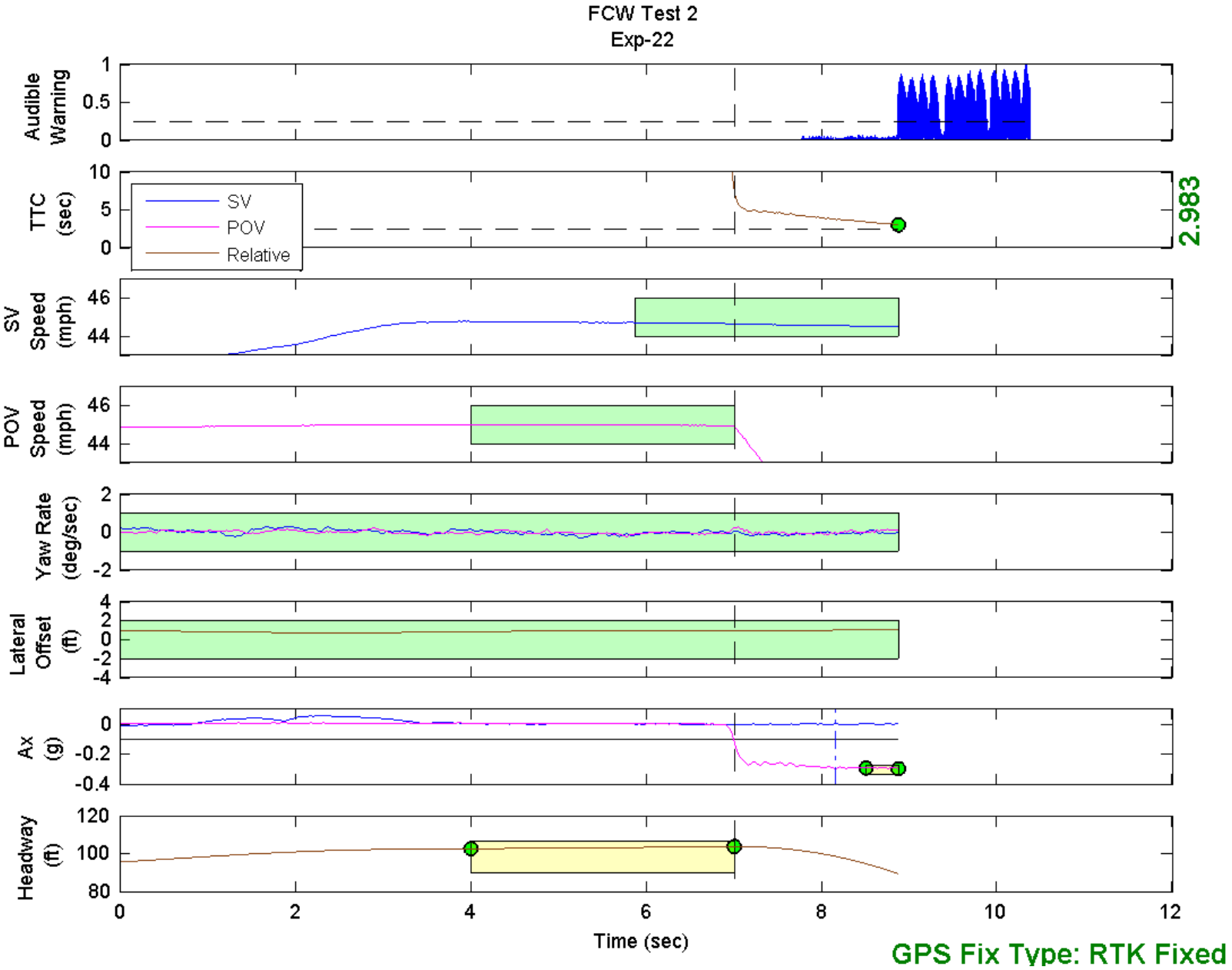



Figure D28. Time History for Run 22, FCW Test 2, Acoustic Warning

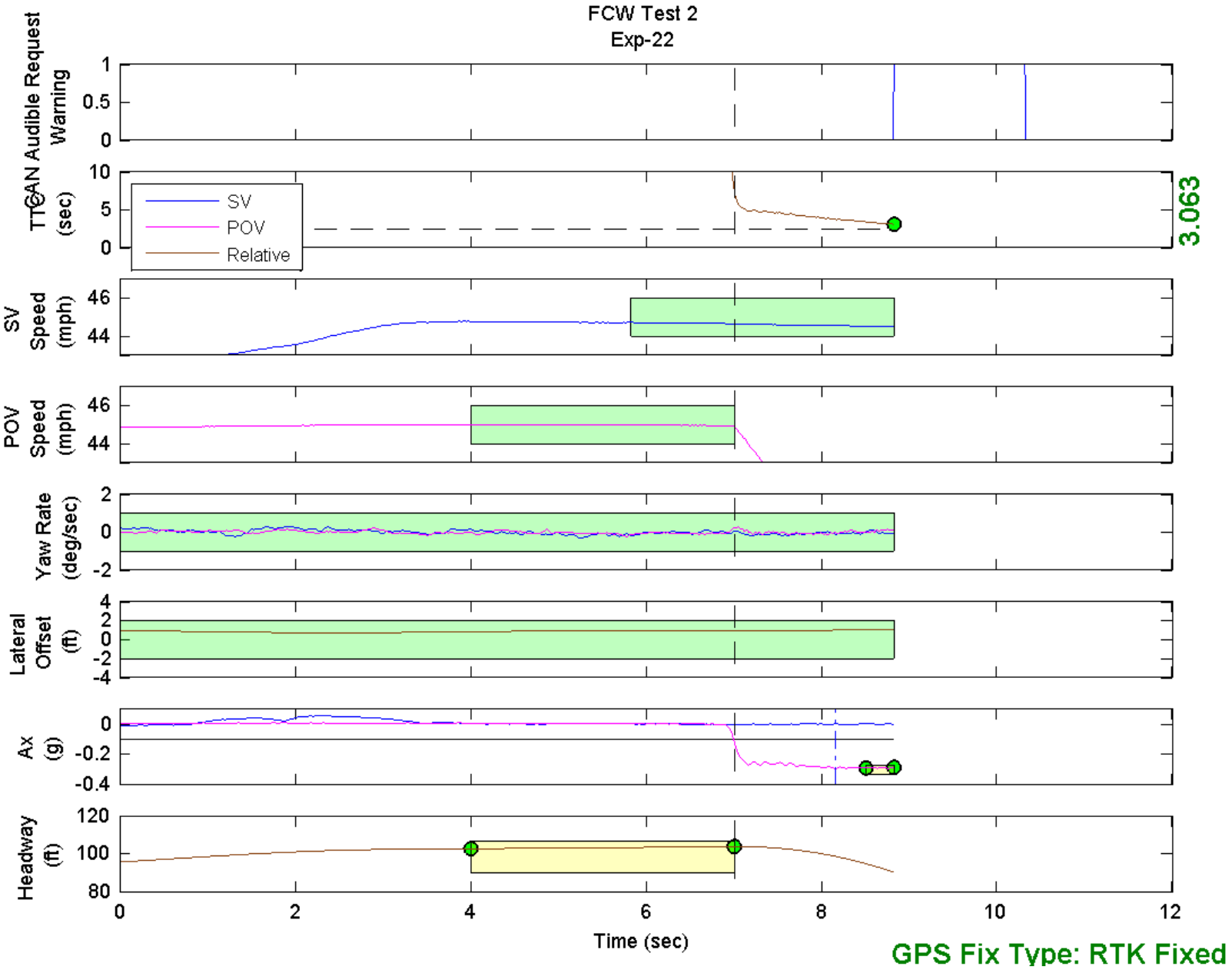



Figure D29. Time History for Run 22, FCW Test 2, CAN Acoustic Warning Request

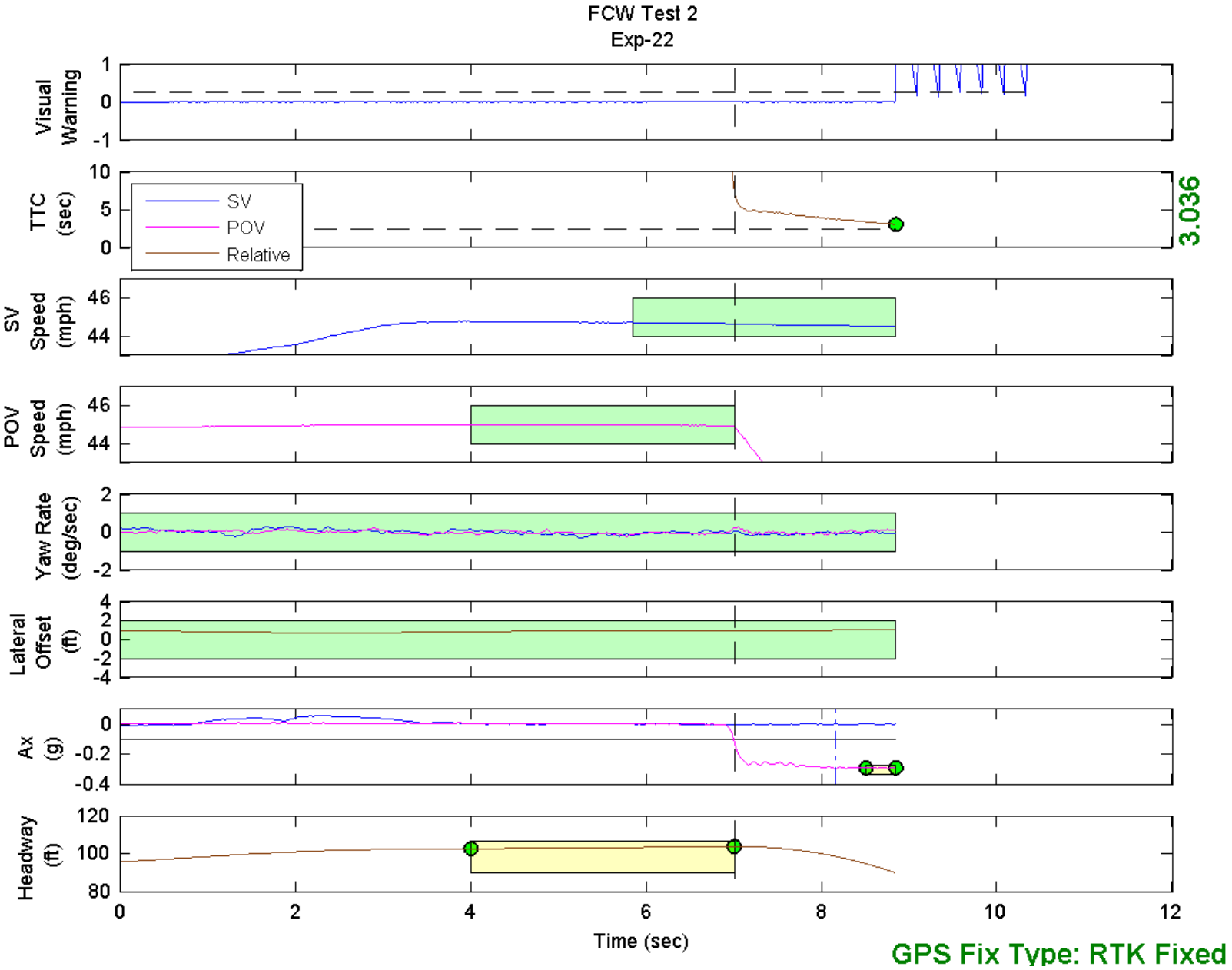



Figure D30. Time History for Run 22, FCW Test 2, Visual Warning

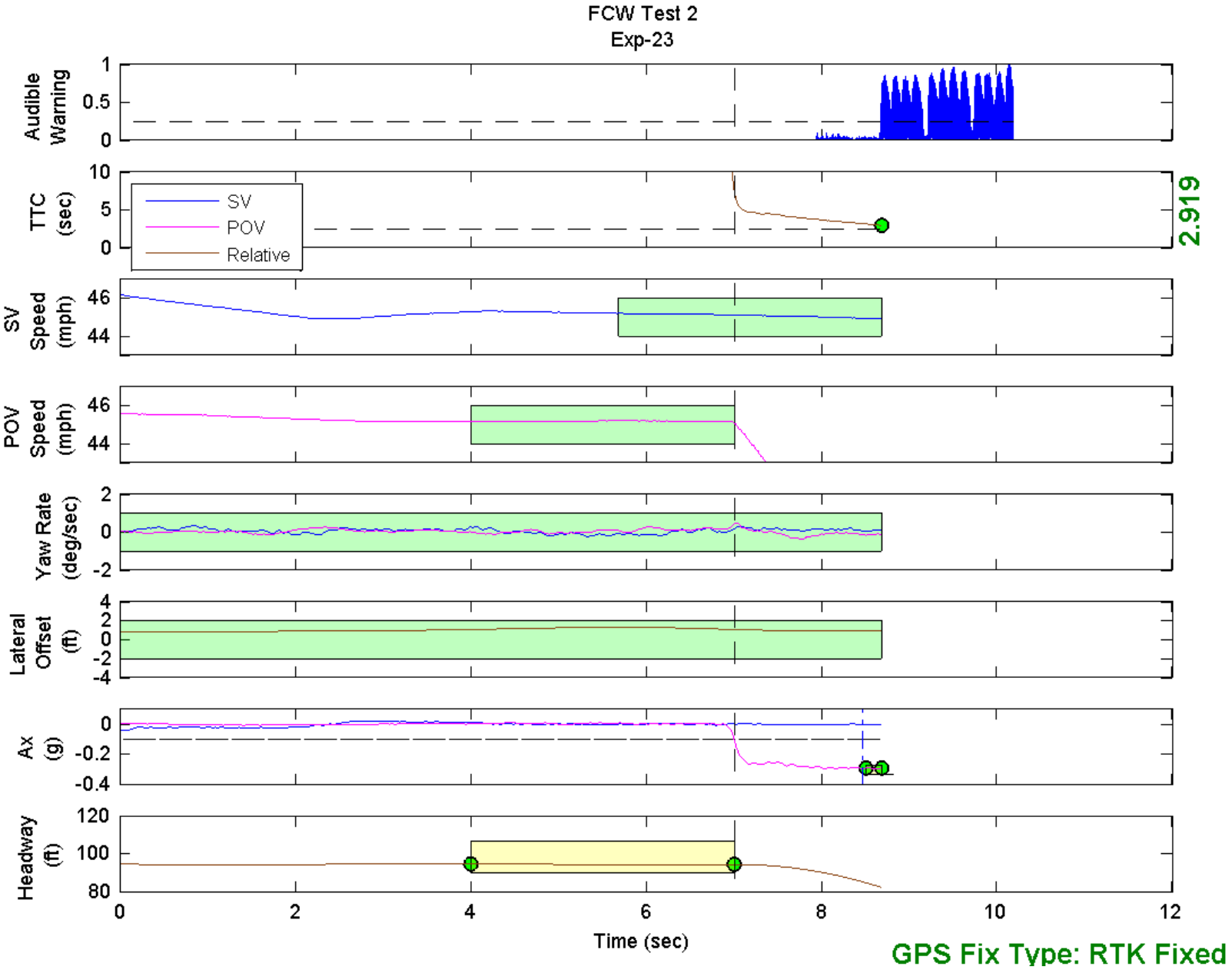



Figure D31. Time History for Run 23, FCW Test 2, Acoustic Warning

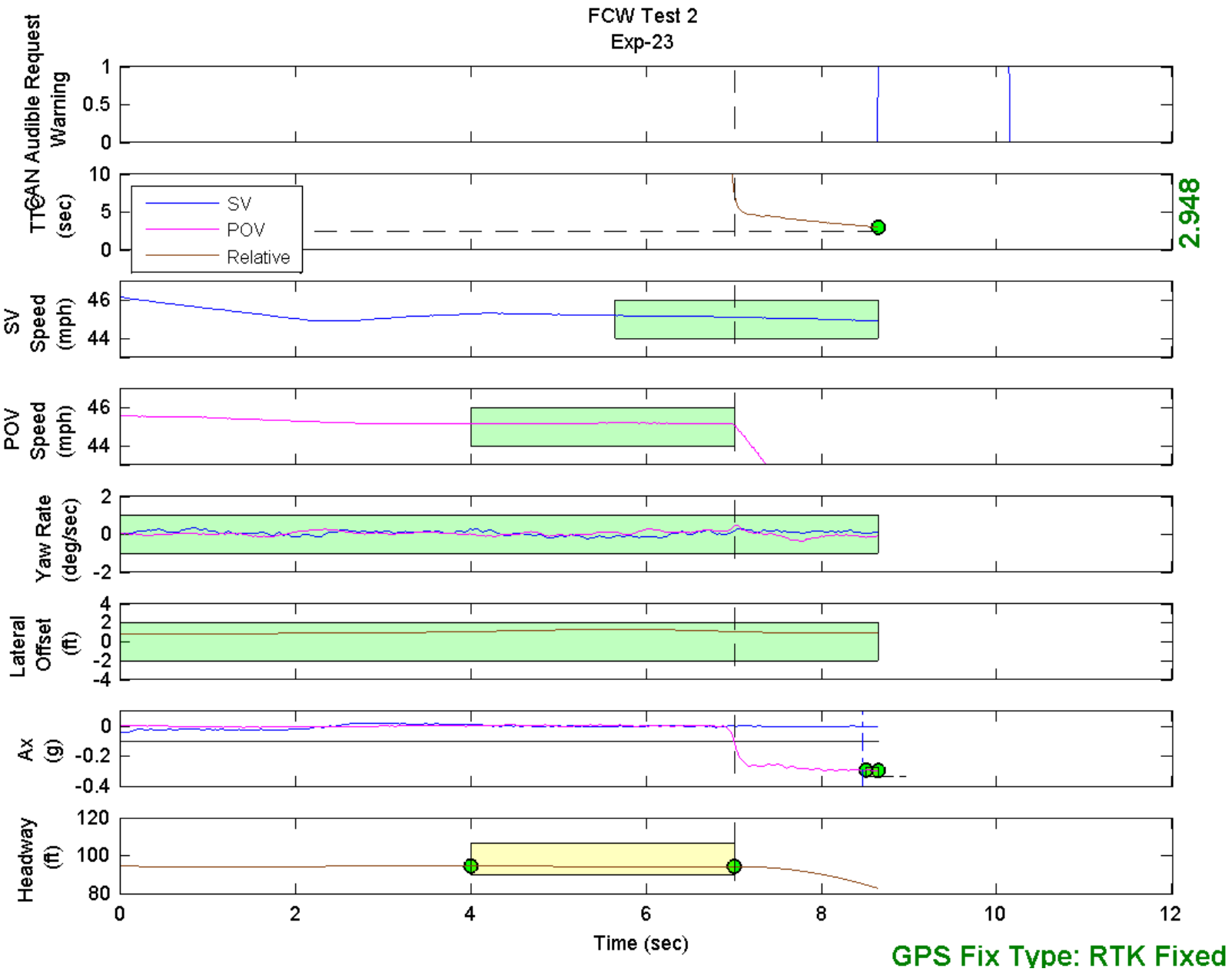



Figure D32. Time History for Run 23, FCW Test 2, CAN Acoustic Warning Request

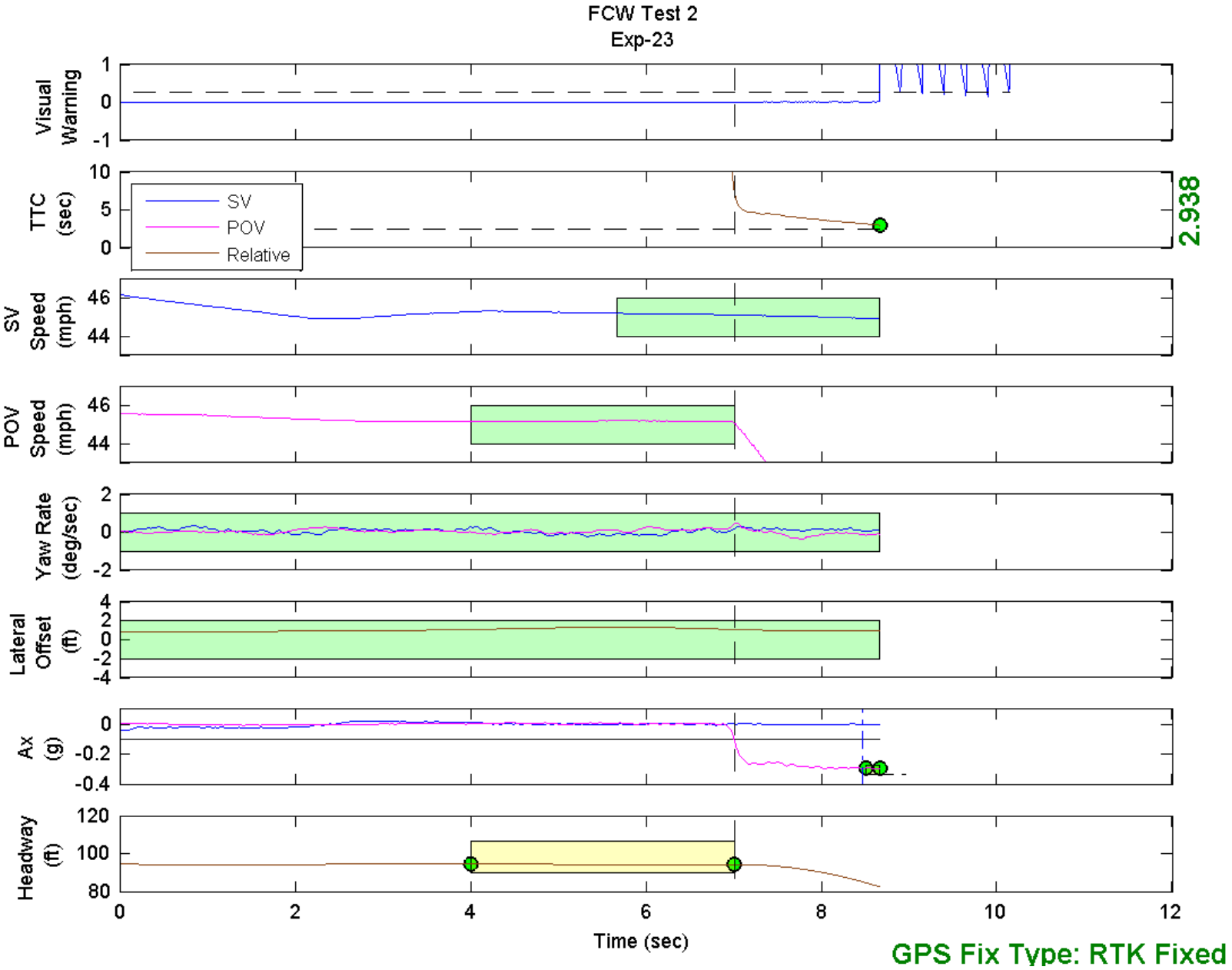



Figure D33. Time History for Run 23, FCW Test 2, Visual Warning

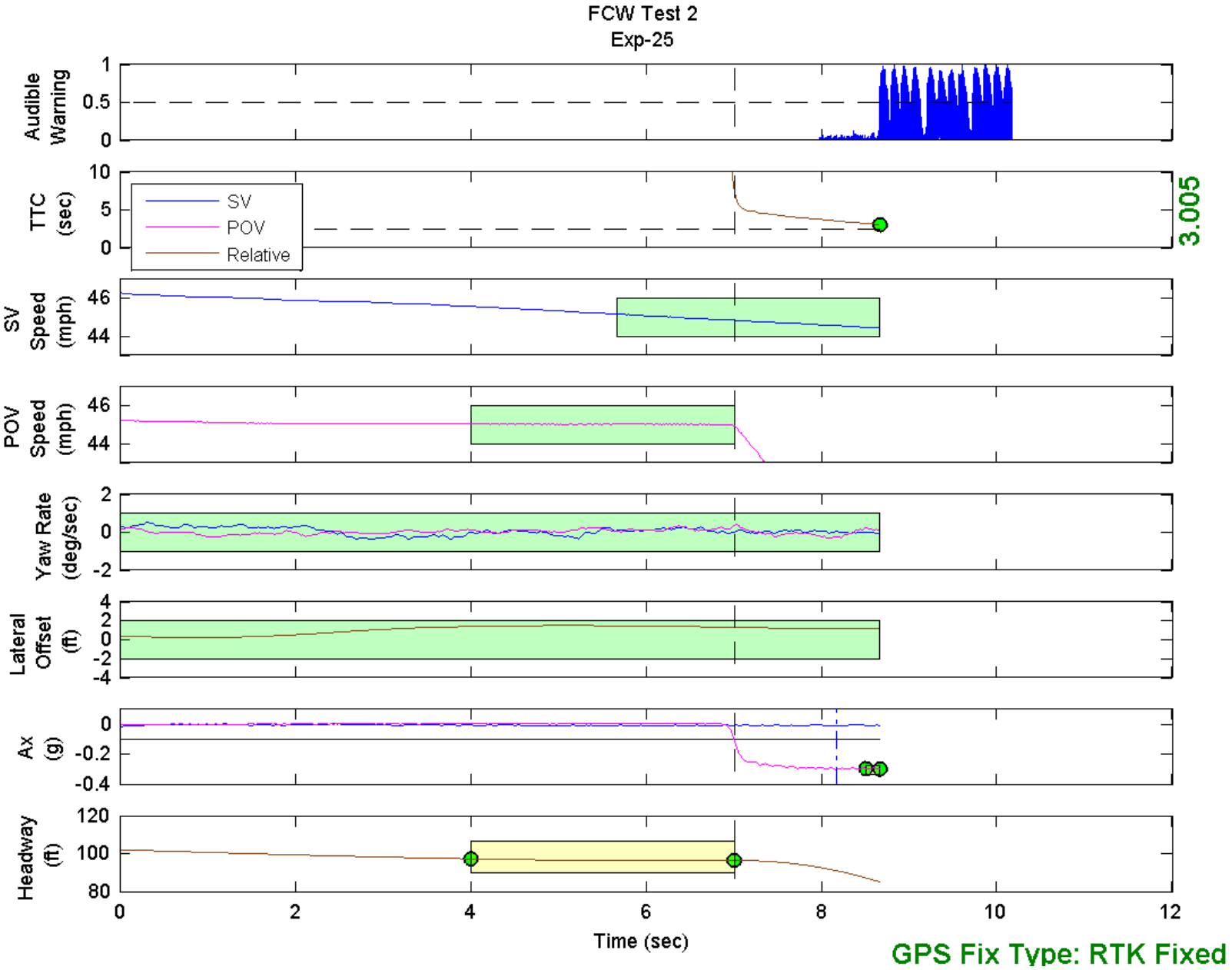



Figure D34. Time History for Run 25, FCW Test 2, Acoustic Warning

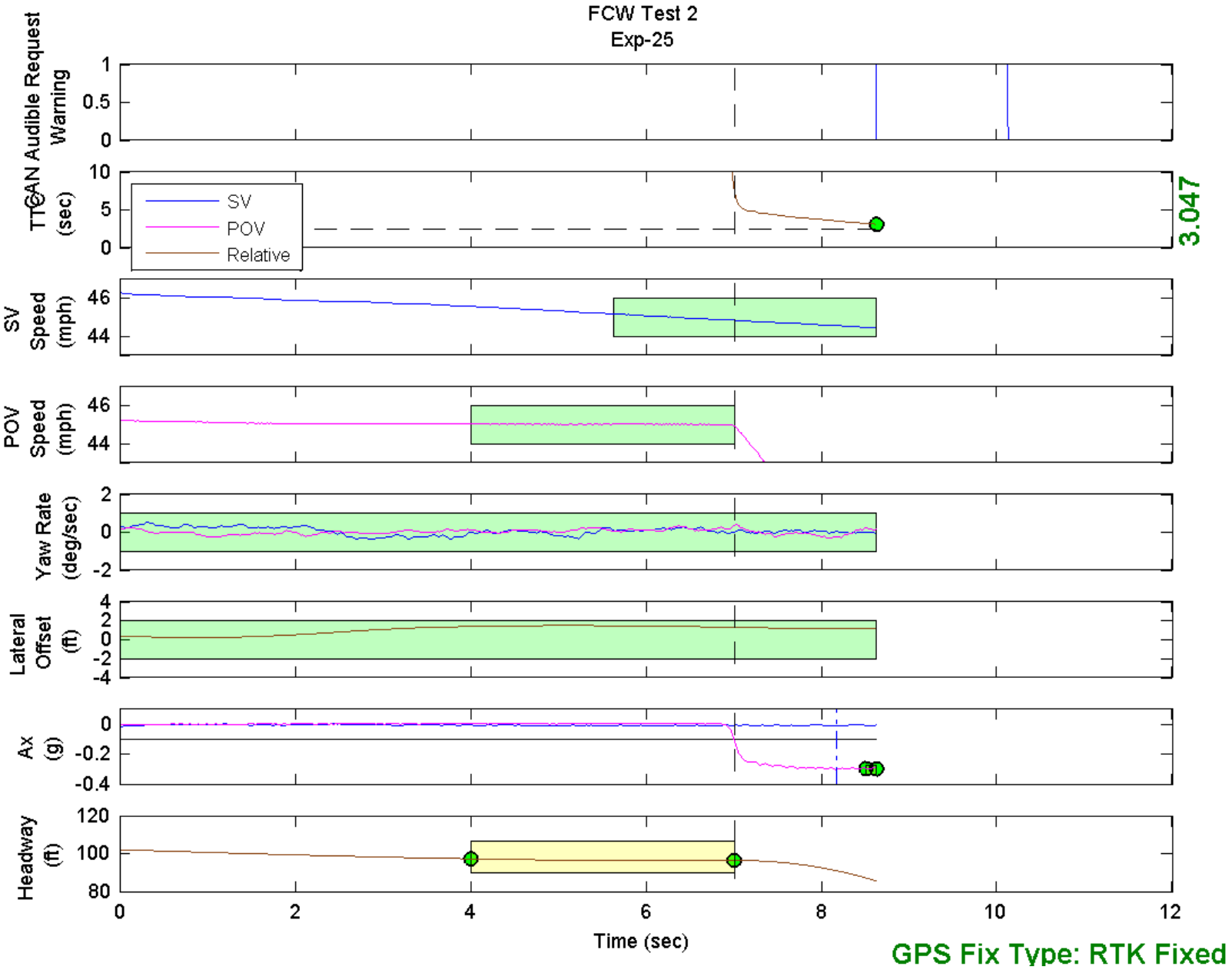



Figure D35. Time History for Run 25, FCW Test 2, CAN Acoustic Warning Request

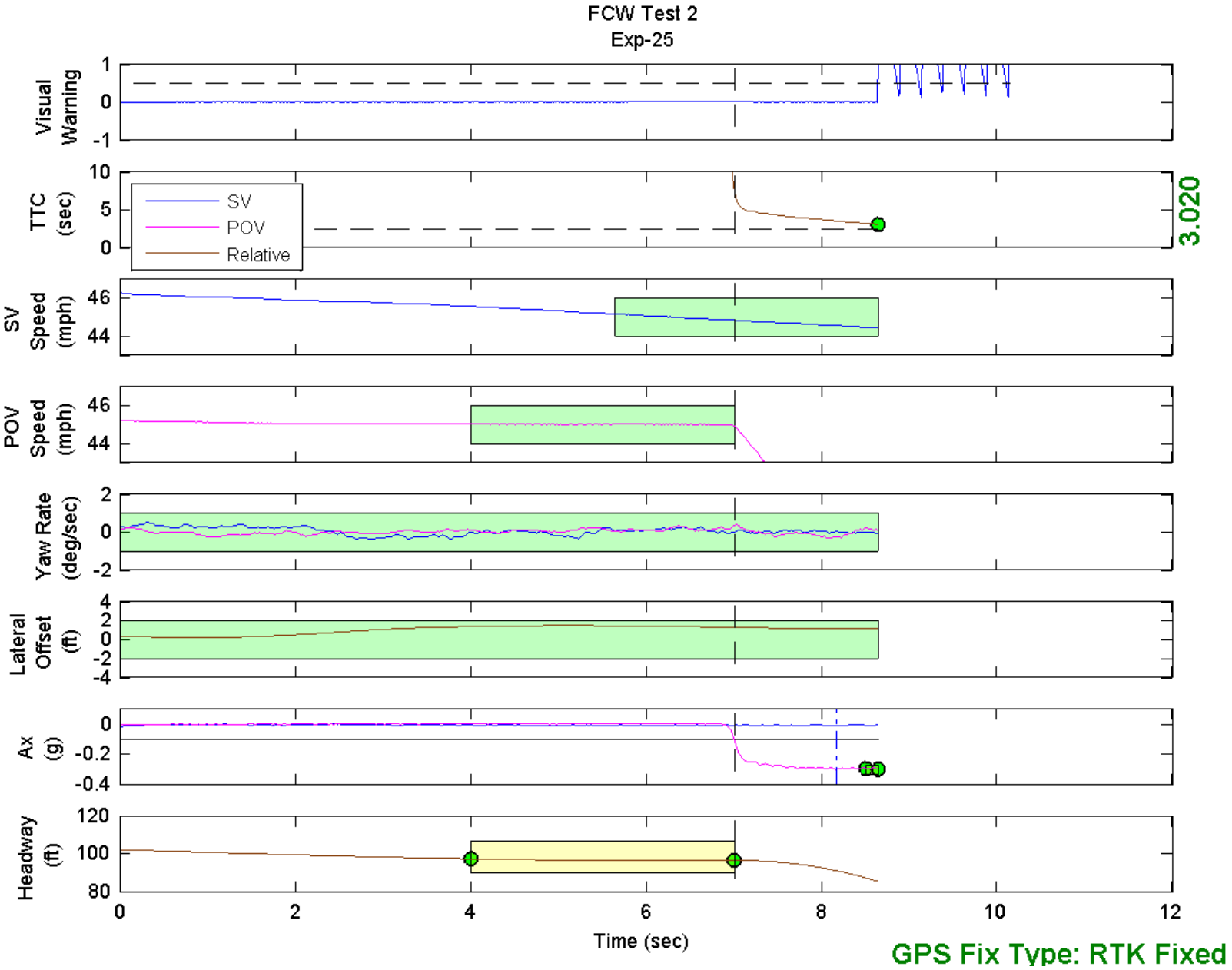



Figure D36. Time History for Run 25, FCW Test 2, Visual Warning

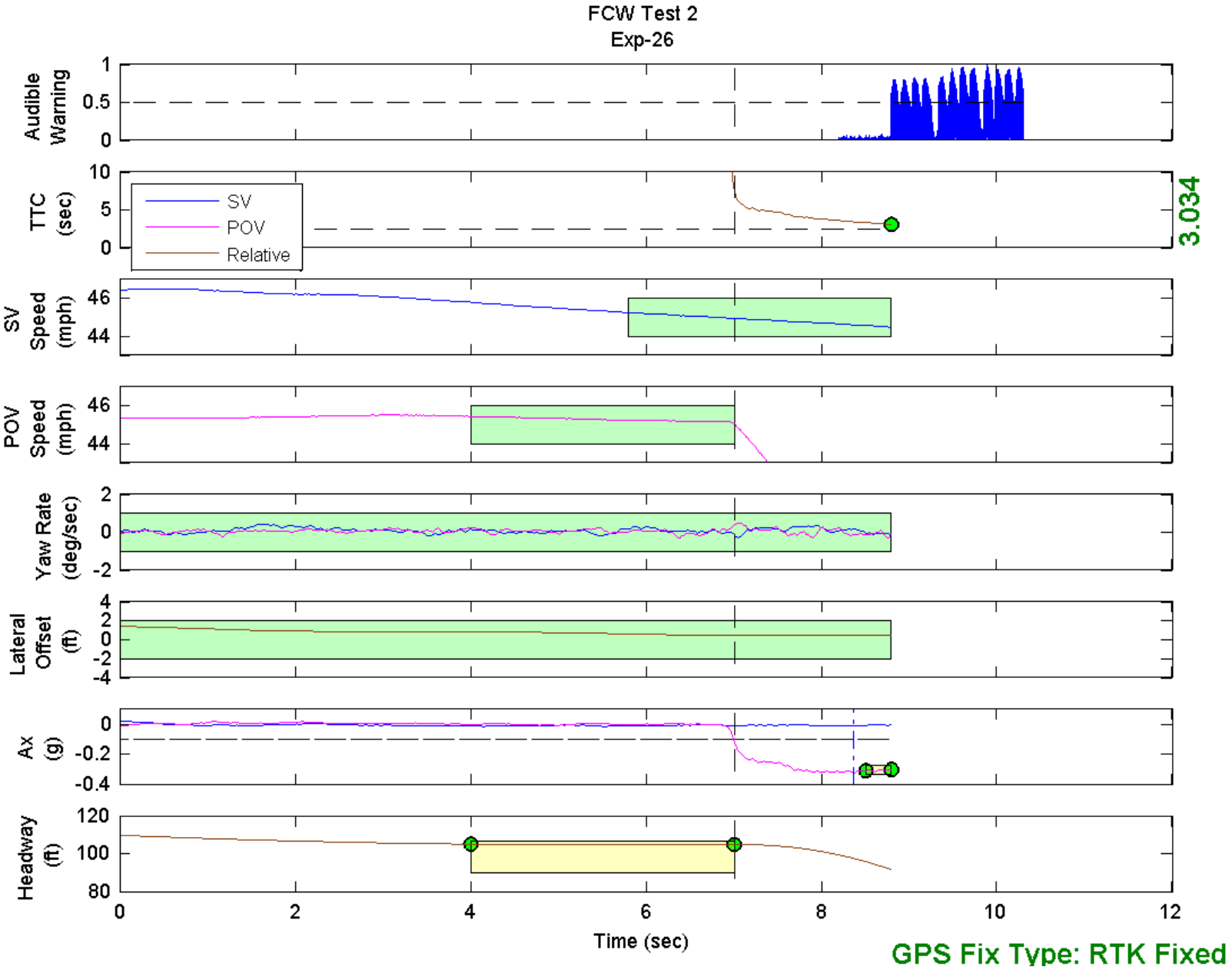



Figure D37. Time History for Run 26, FCW Test 2, Acoustic Warning

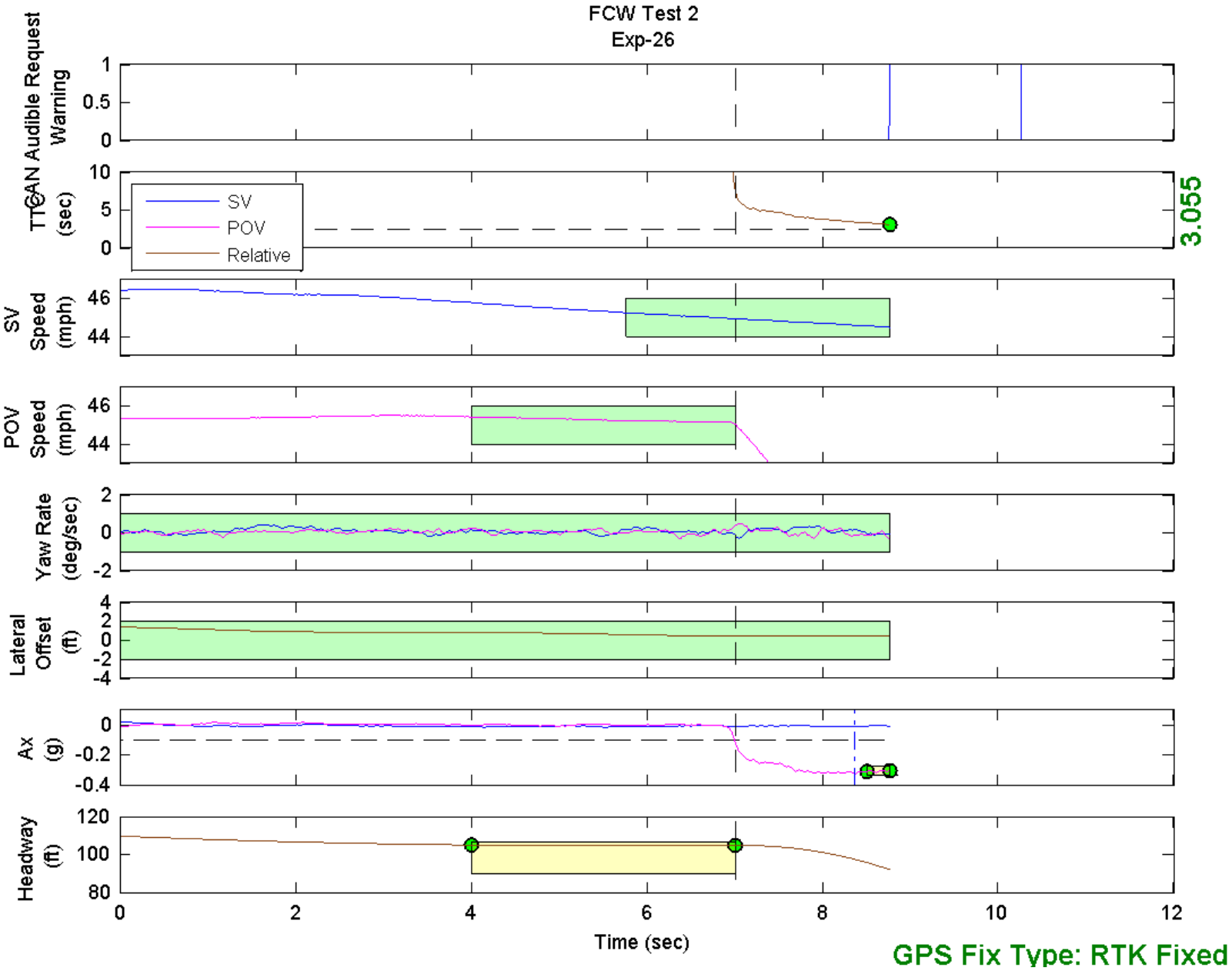



Figure D38. Time History for Run 26, FCW Test 2, CAN Acoustic Warning Request

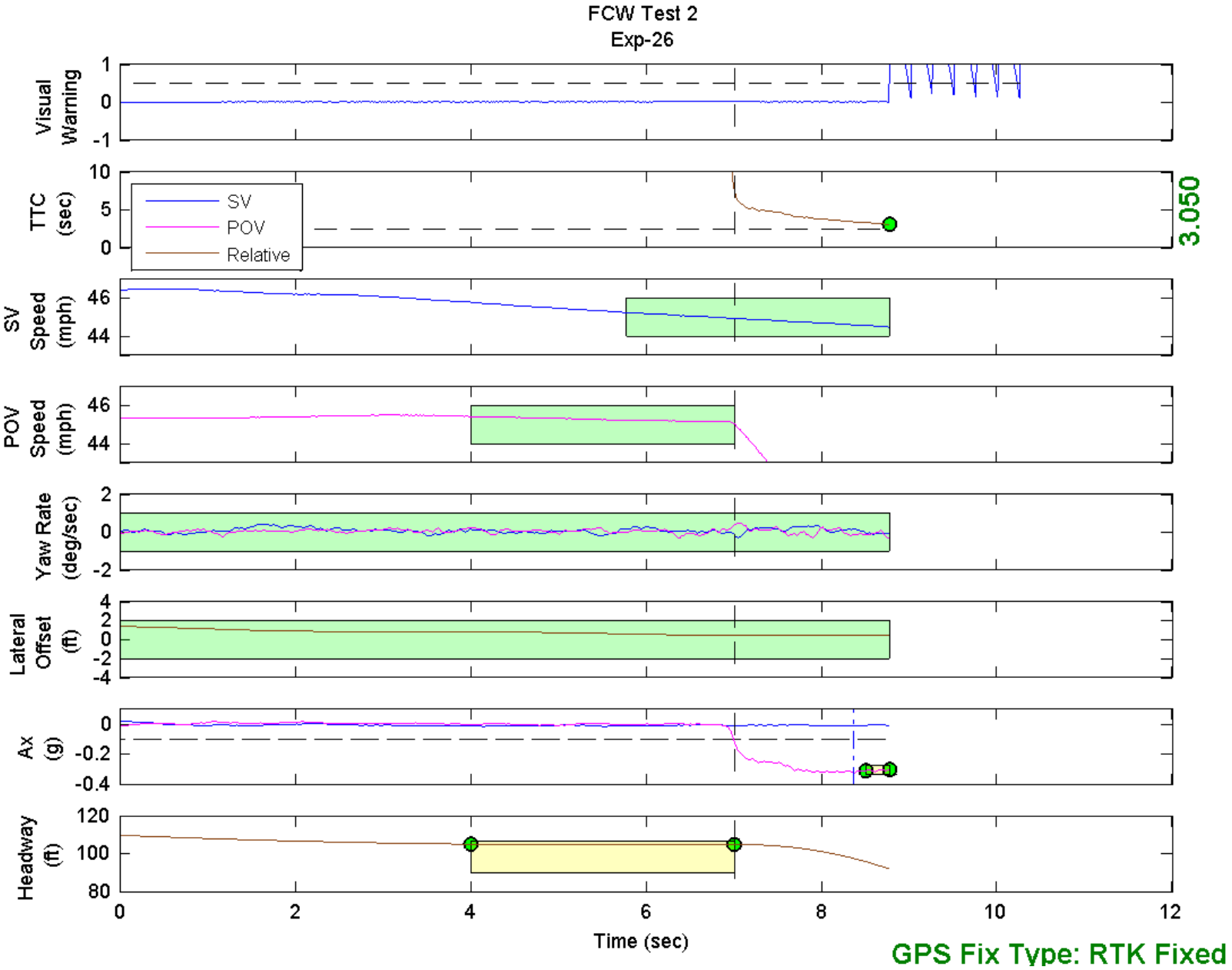



Figure D39. Time History for Run 26, FCW Test 2, Visual Warning

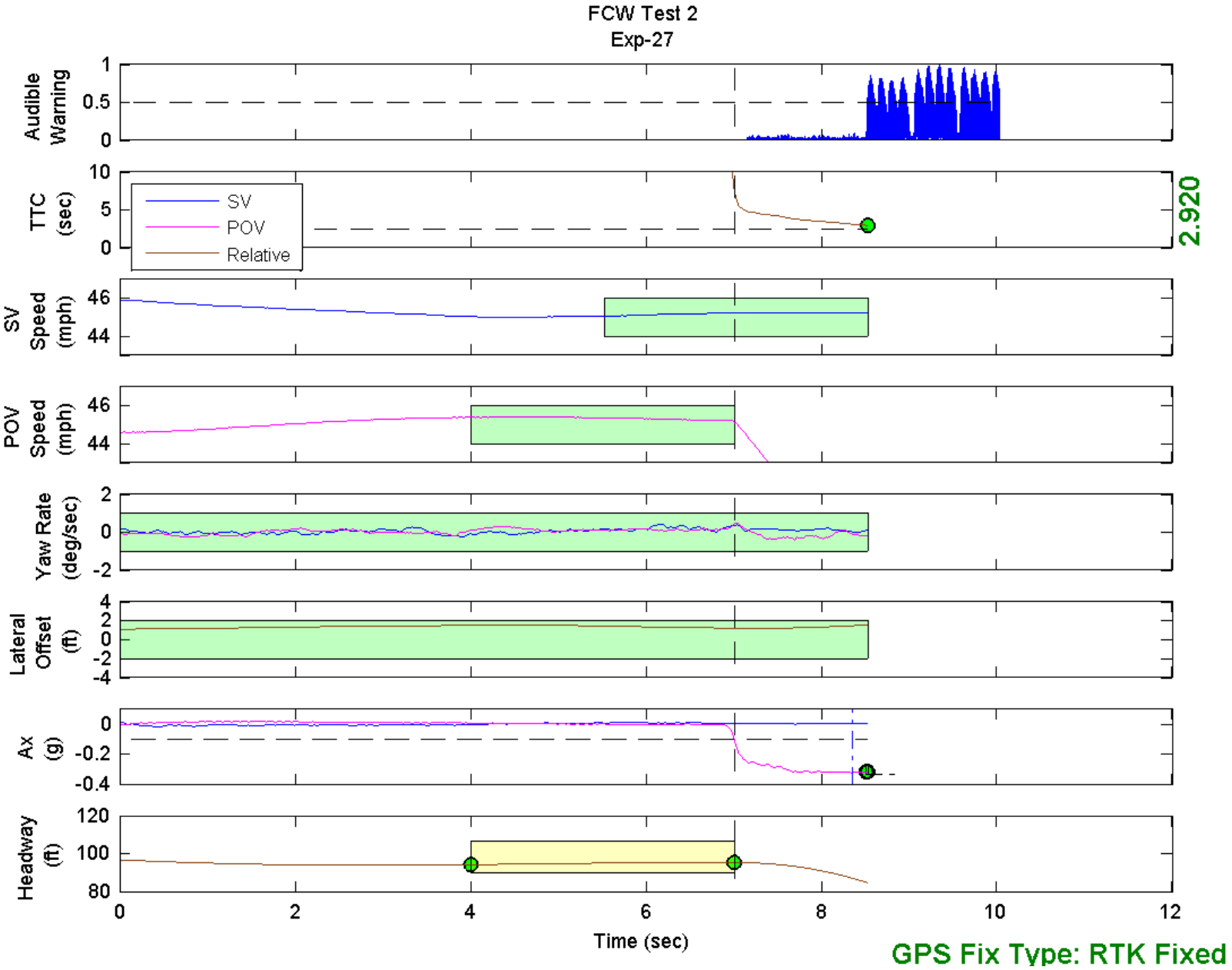



Figure D40. Time History for Run 27, FCW Test 2, Acoustic Warning

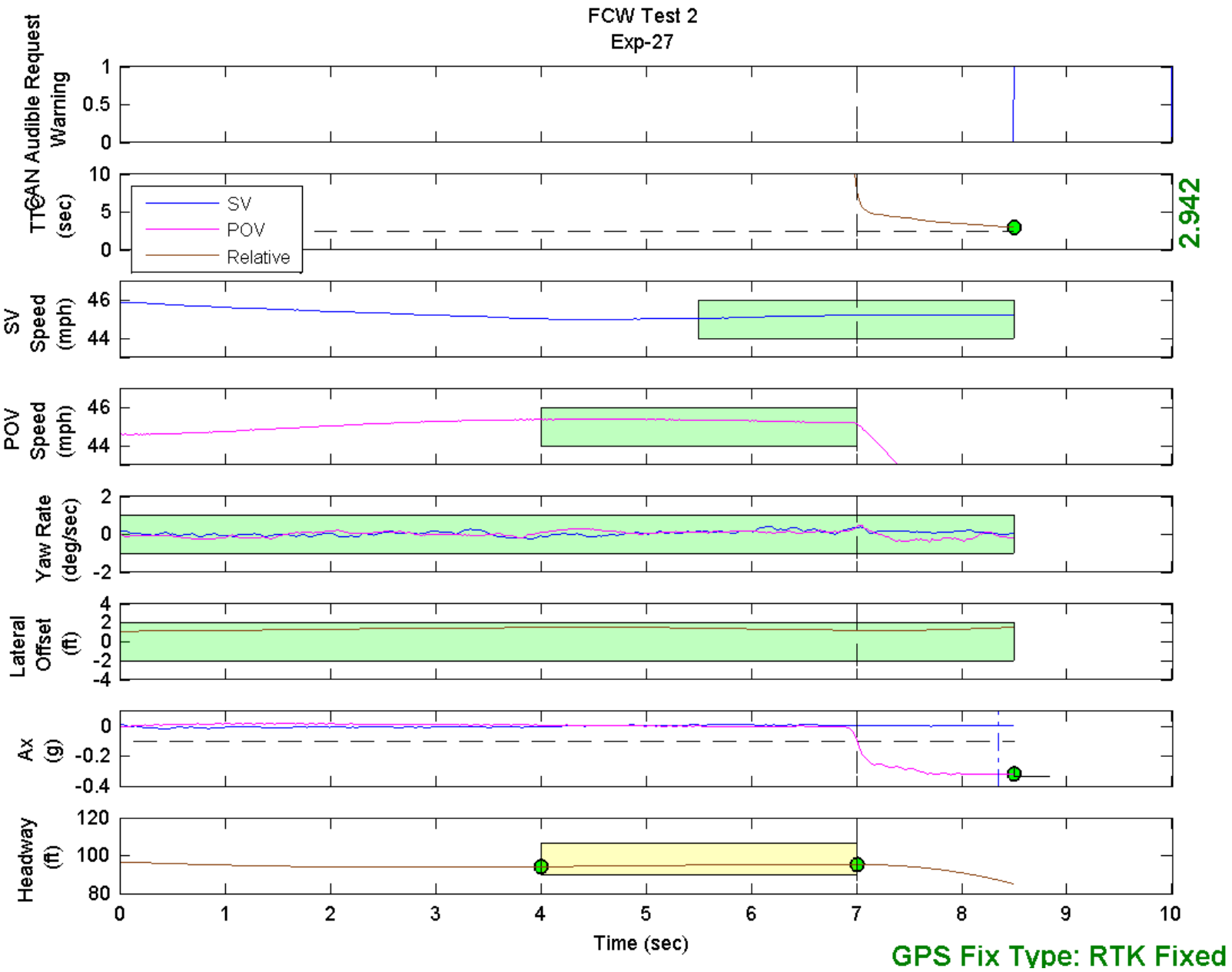



Figure D41. Time History for Run 27, FCW Test 2, CAN Acoustic Warning Request

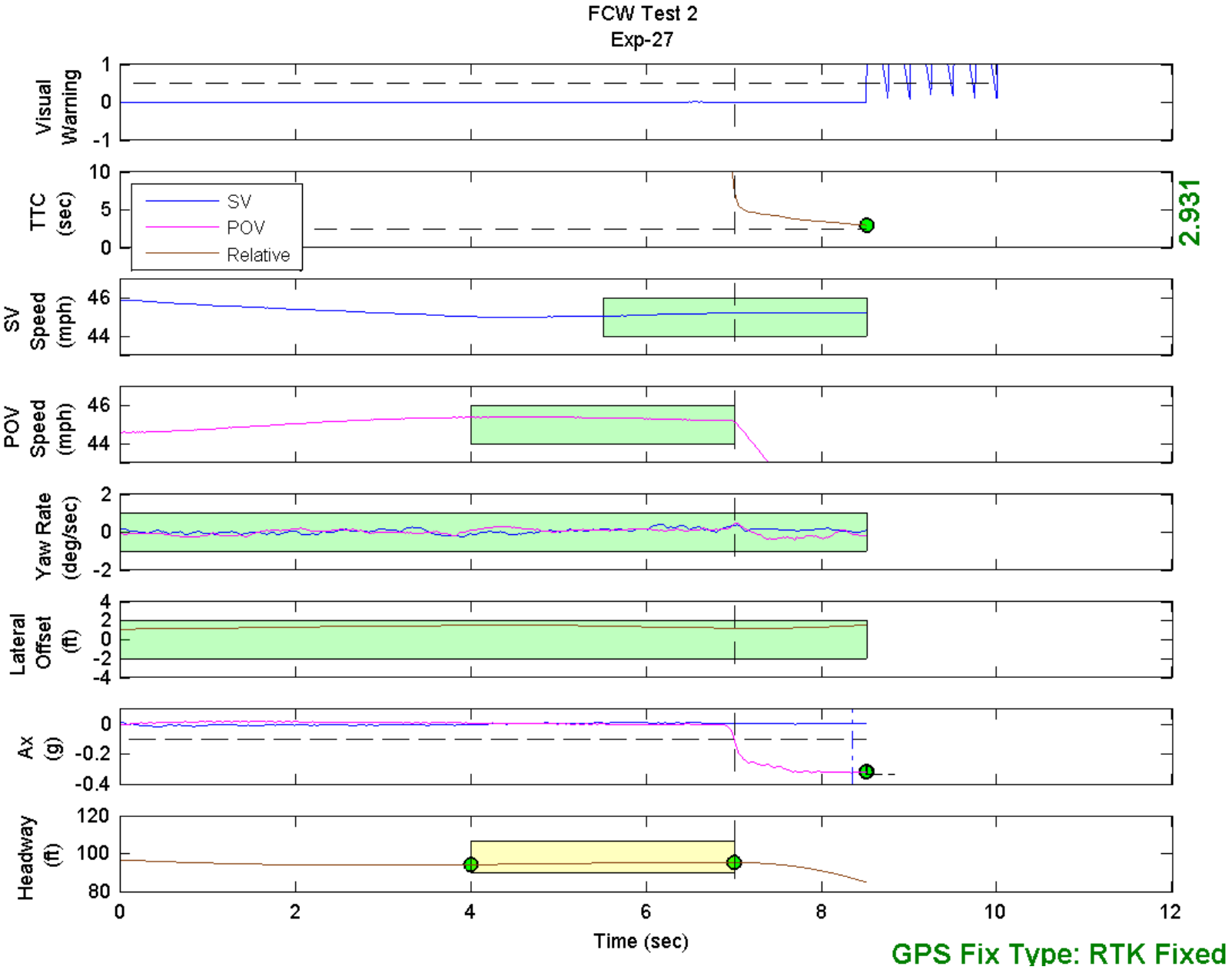



Figure D42. Time History for Run 27, FCW Test 2, Visual Warning

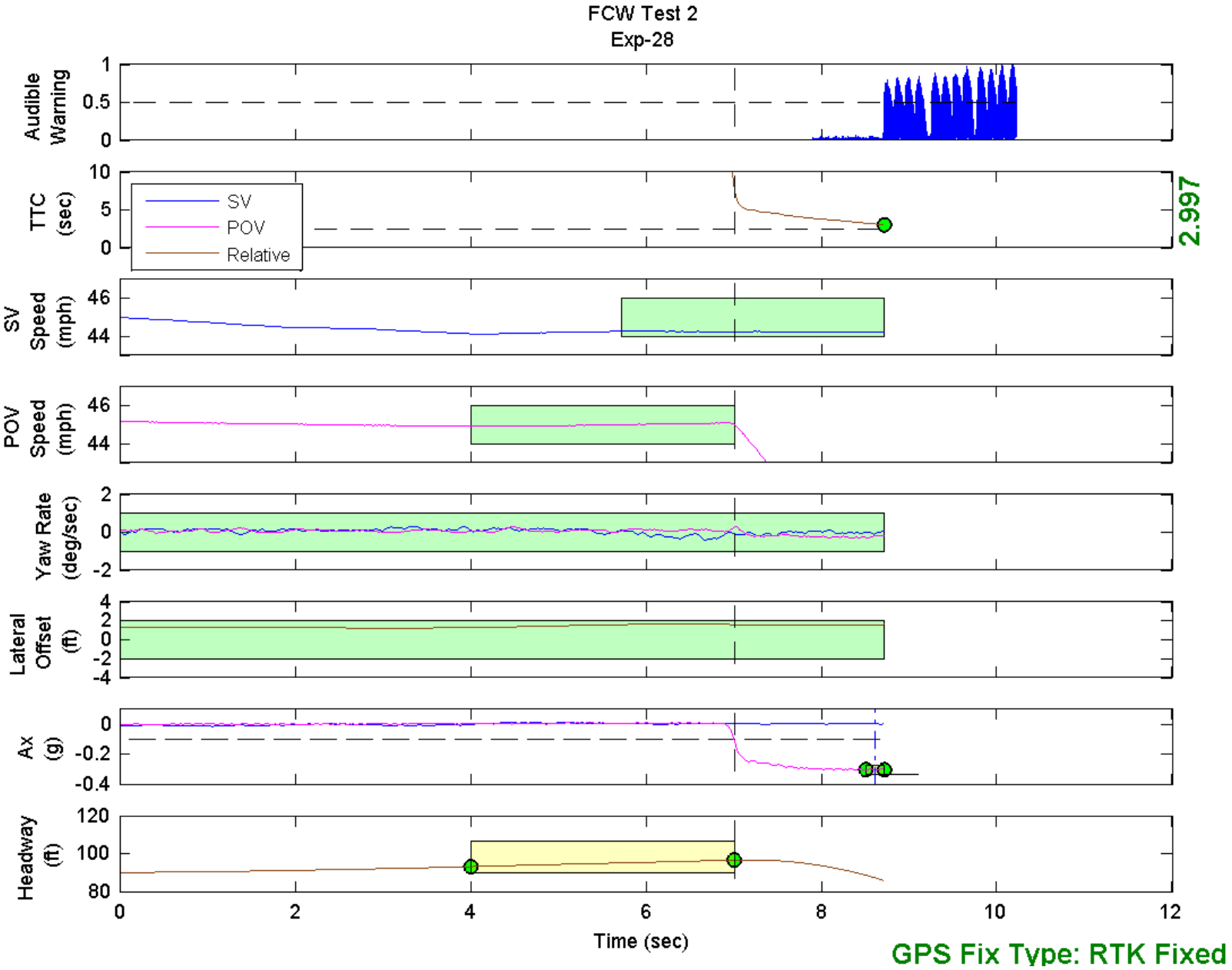



Figure D43. Time History for Run 28, FCW Test 2, Acoustic Warning

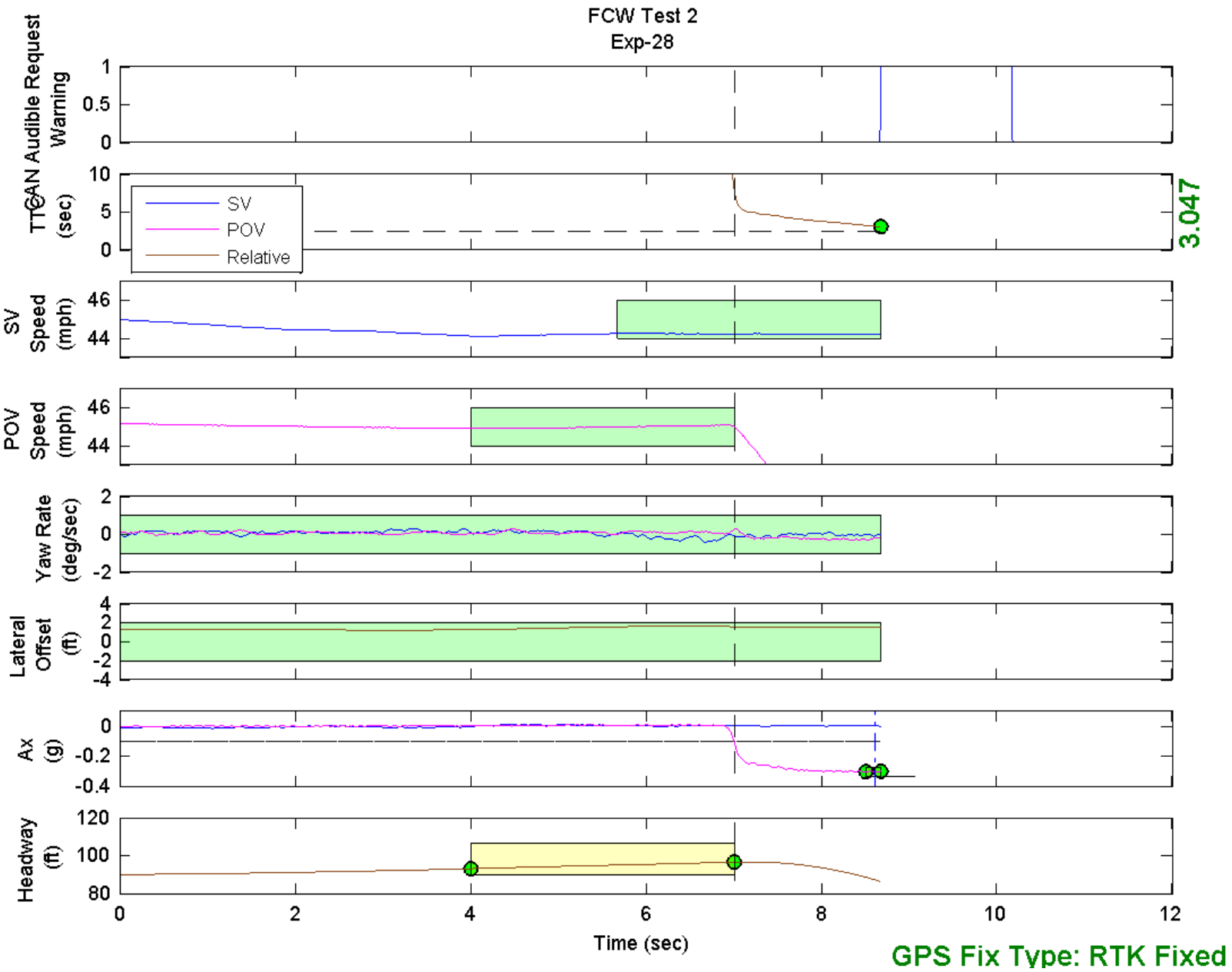



Figure D44. Time History for Run 28, FCW Test 2, CAN Acoustic Warning Request

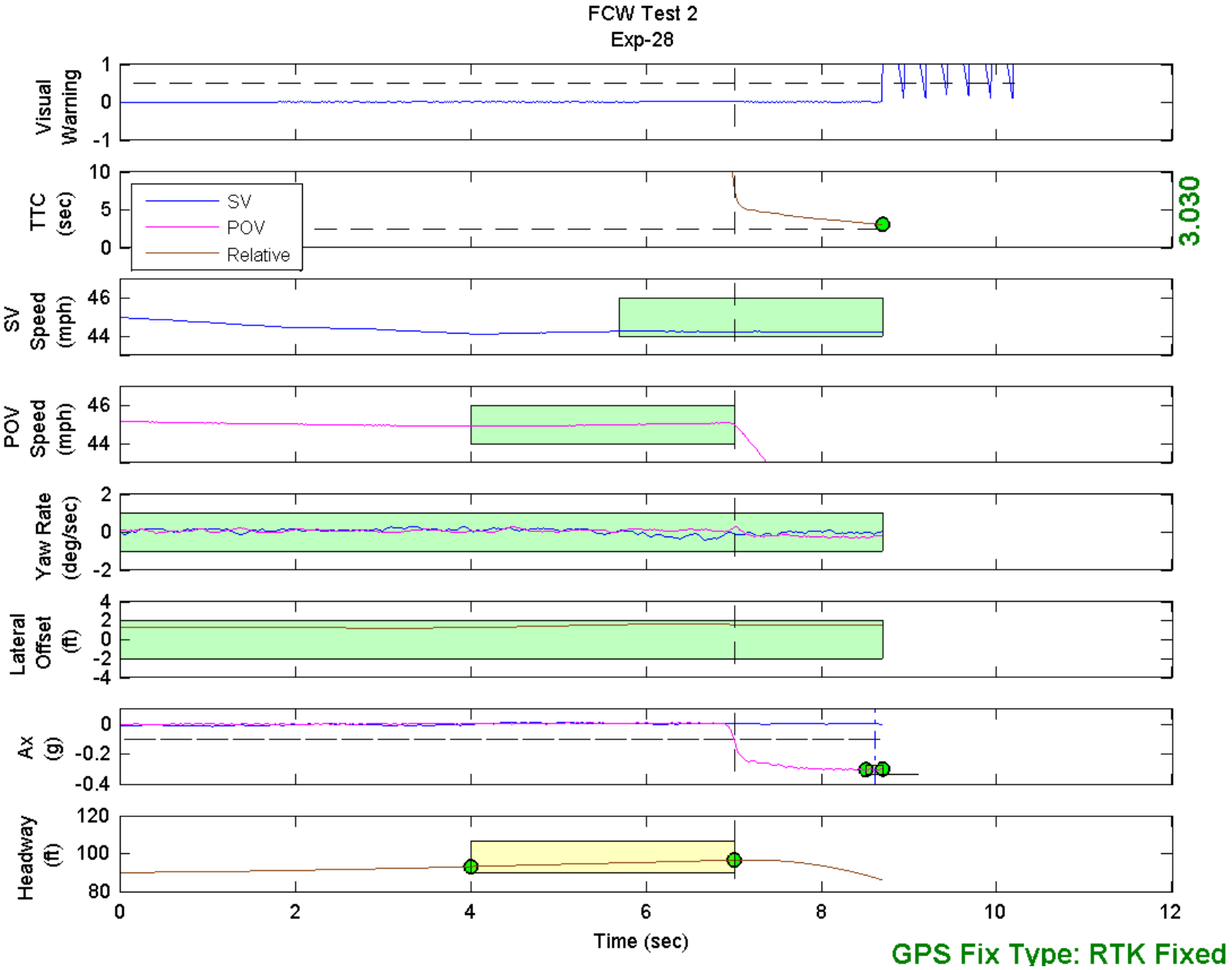



Figure D45. Time History for Run 28, FCW Test 2, Visual Warning

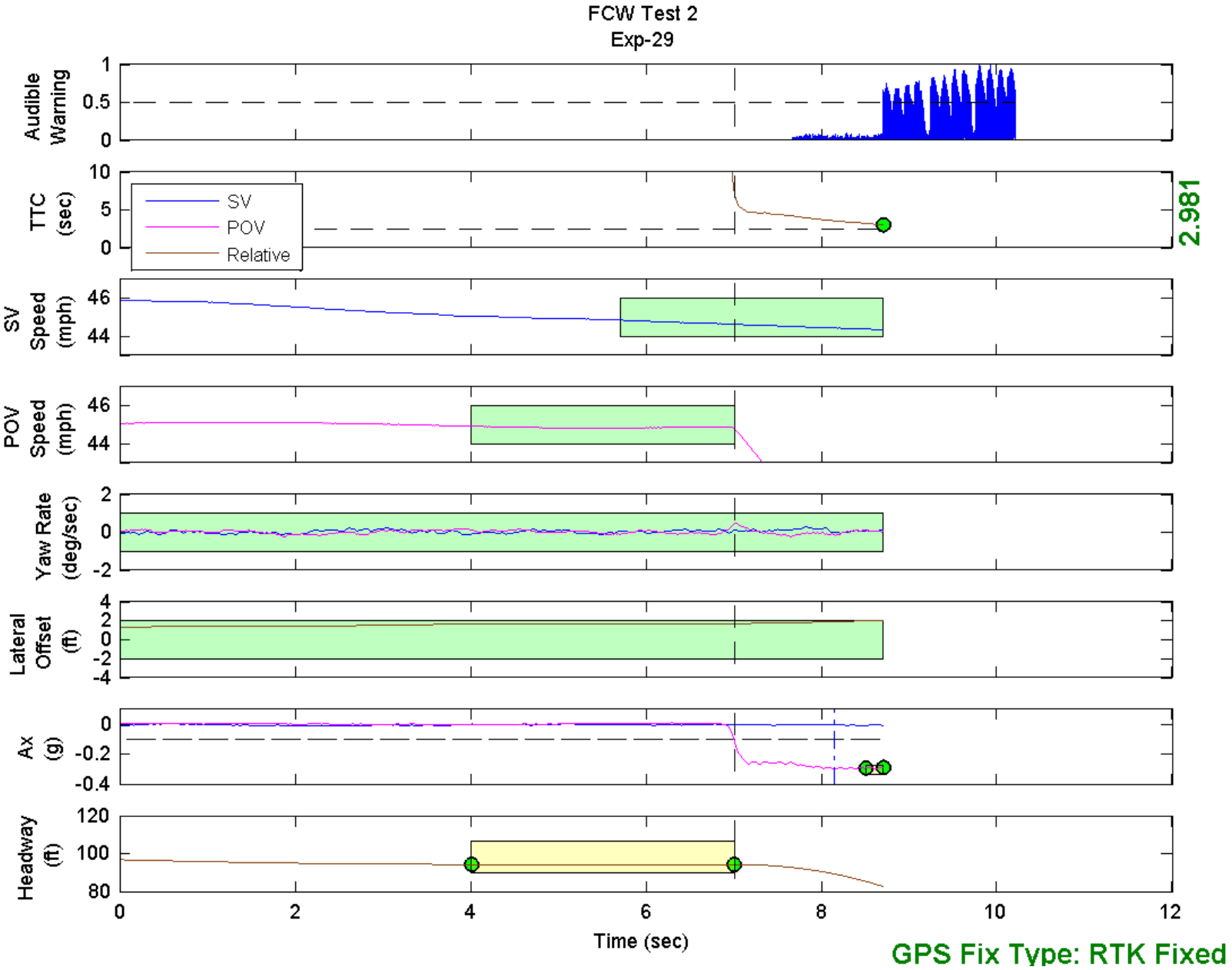



Figure D46. Time History for Run 29, FCW Test 2, Acoustic Warning

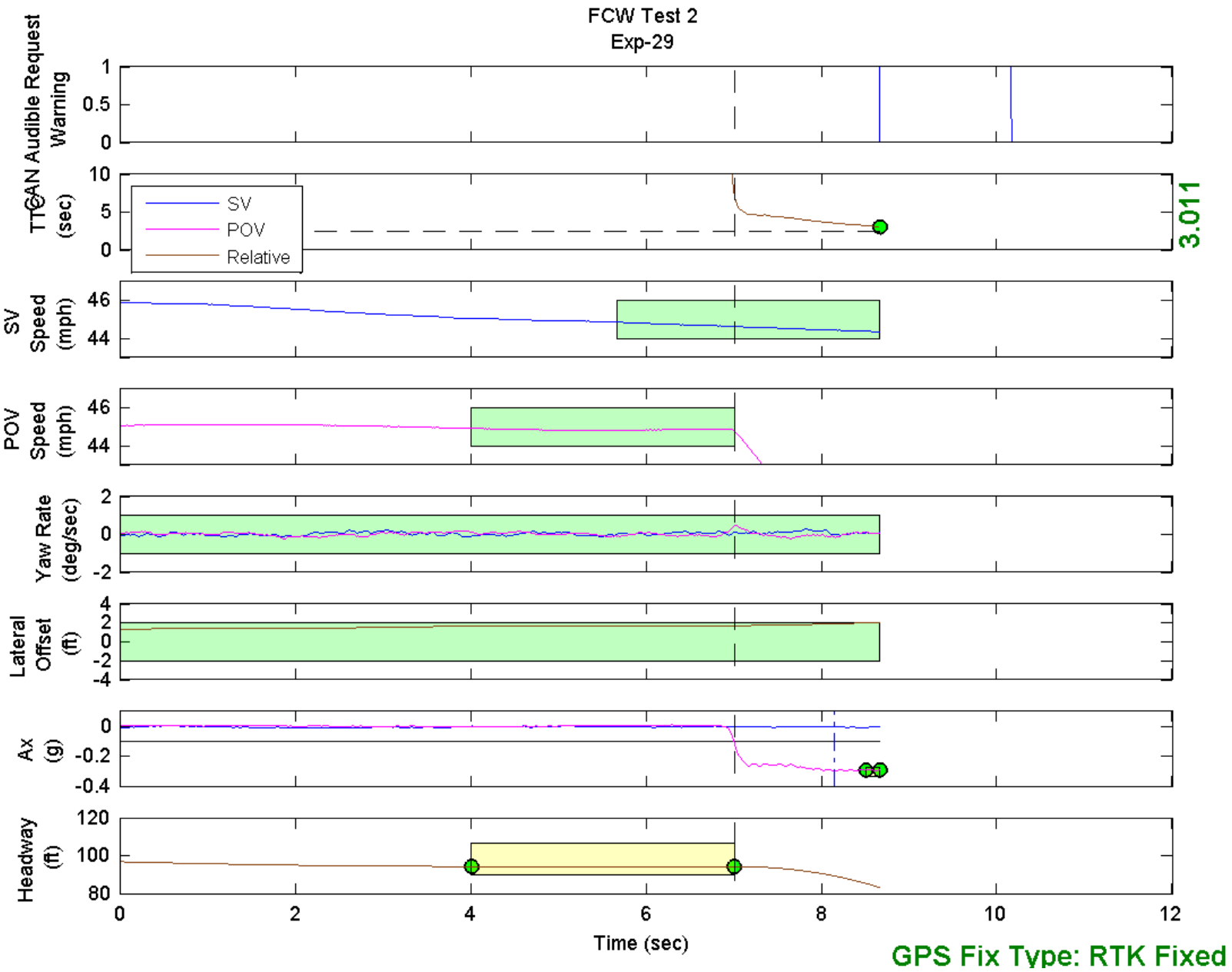



Figure D47. Time History for Run 29, FCW Test 2, CAN Acoustic Warning Request

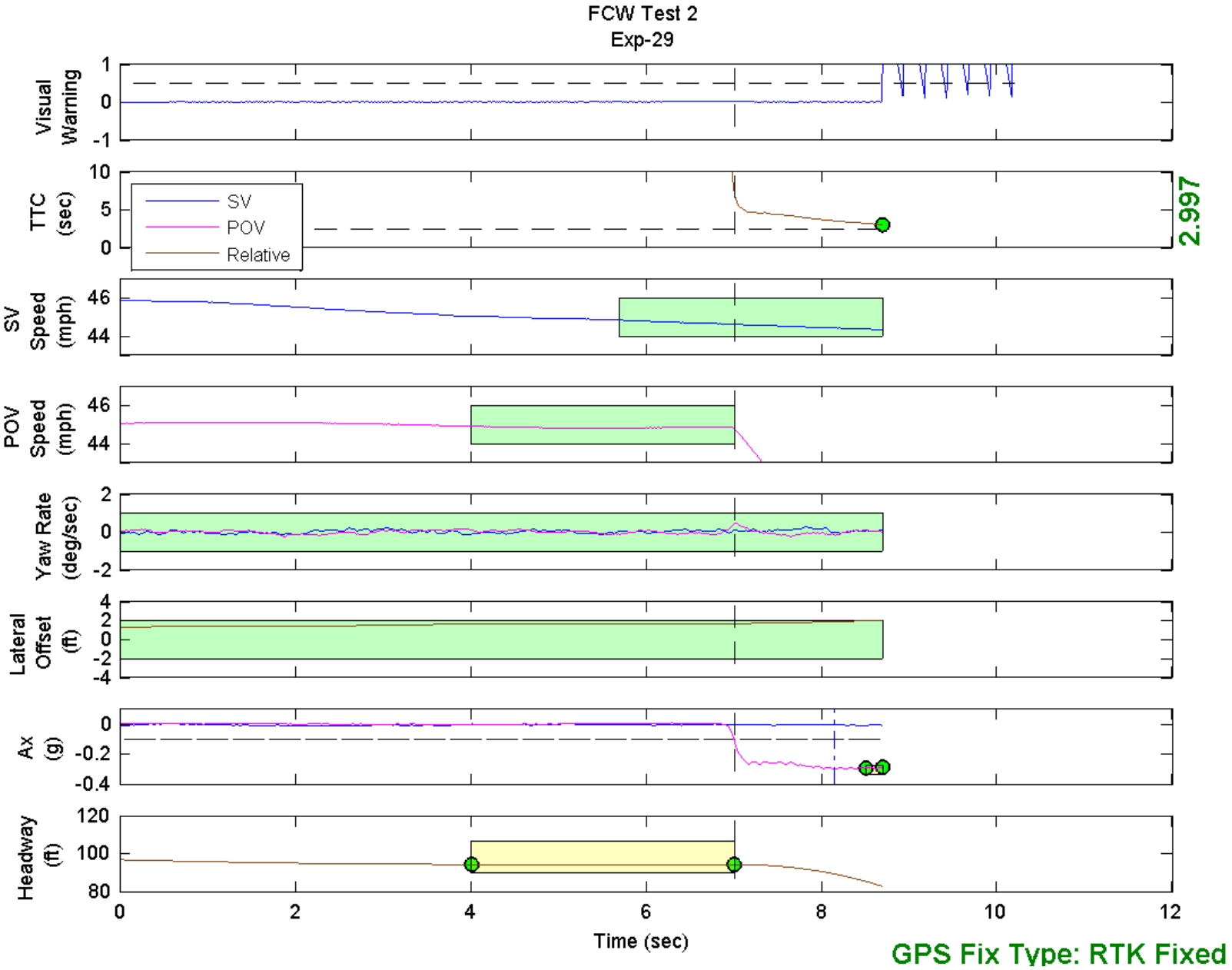



Figure D48. Time History for Run 29, FCW Test 2, Visual Warning

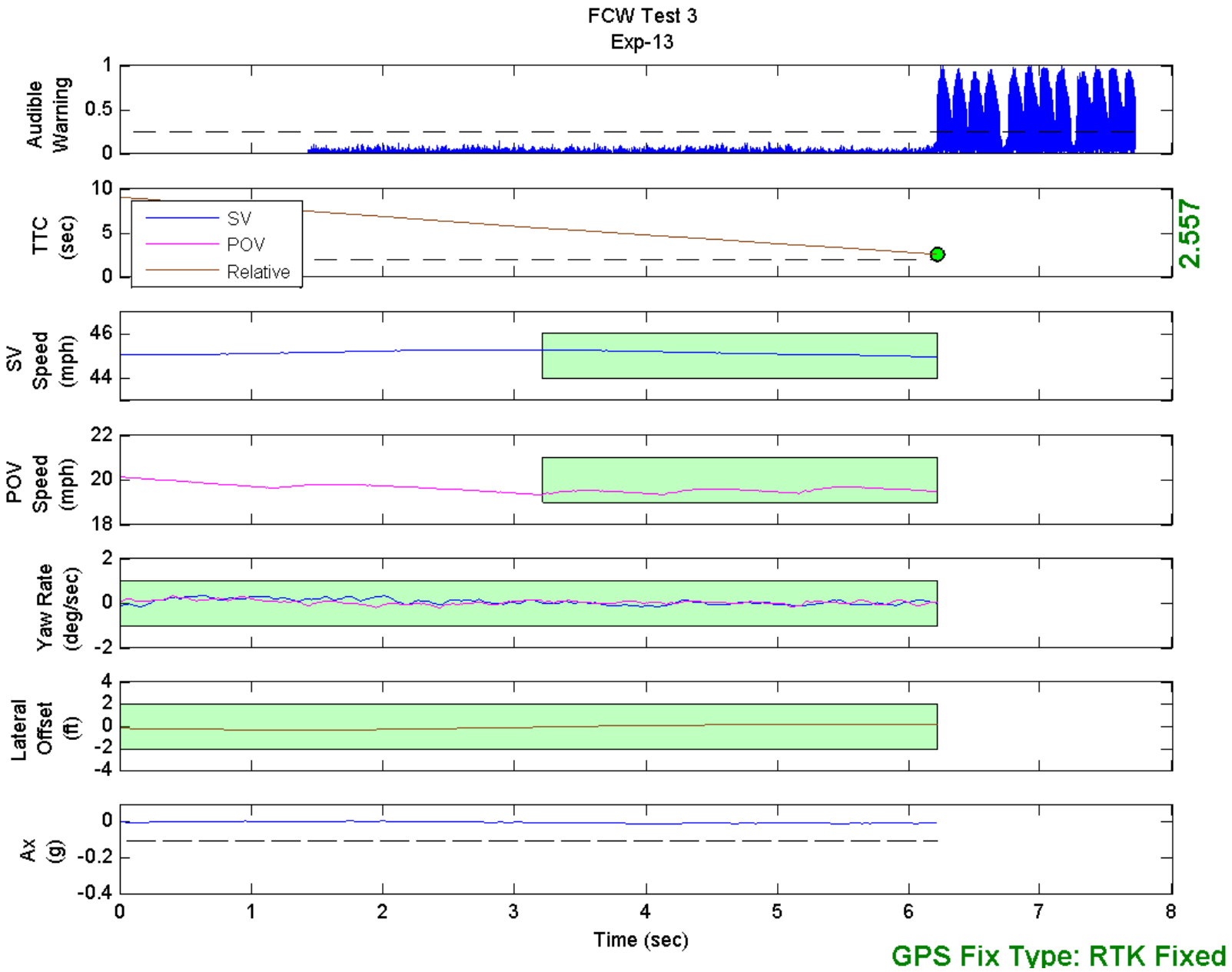



Figure D49. Time History for Run 13, FCW Test 3, Acoustic Warning

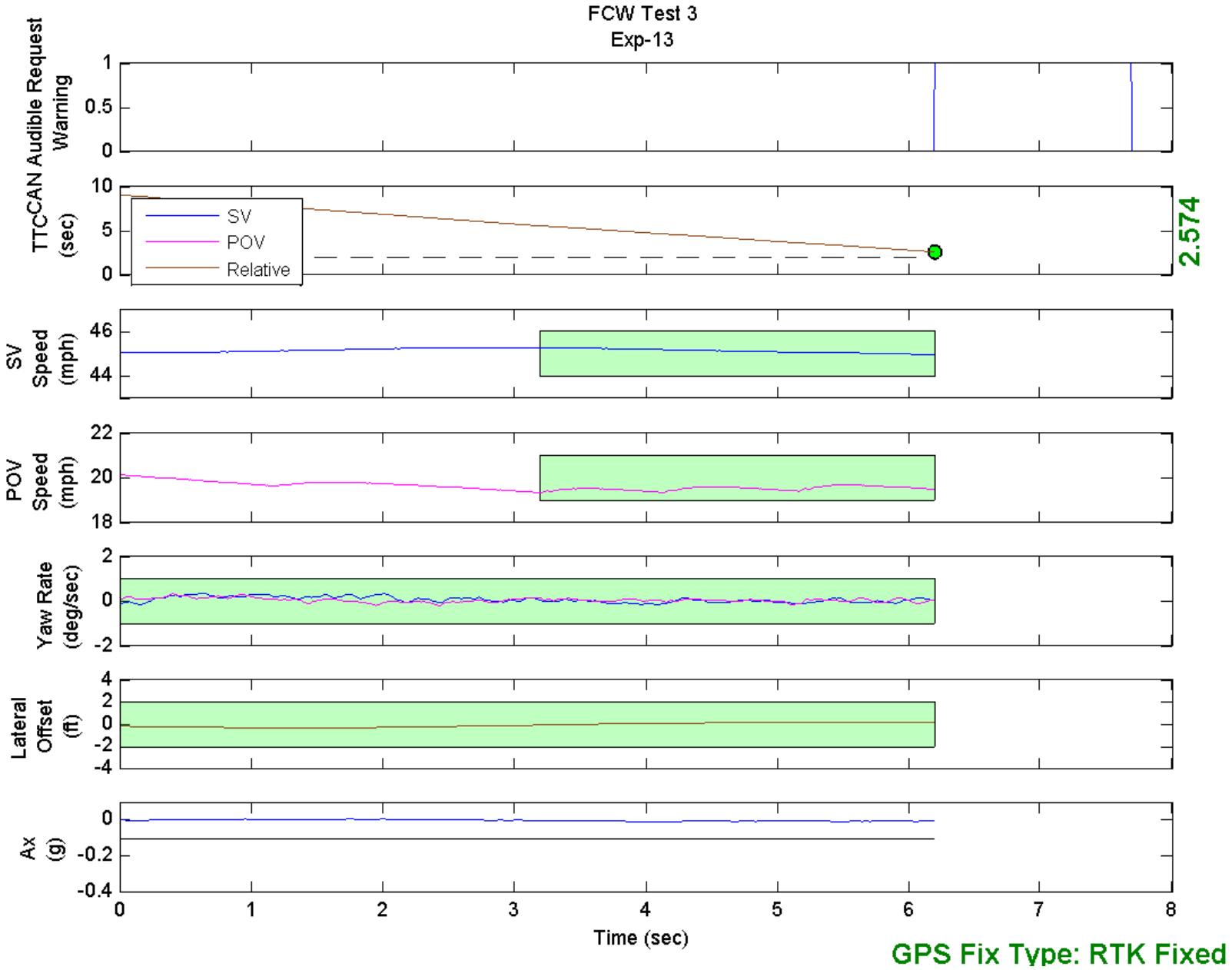



Figure D50. Time History for Run 13, FCW Test 3, CAN Acoustic Warning Request

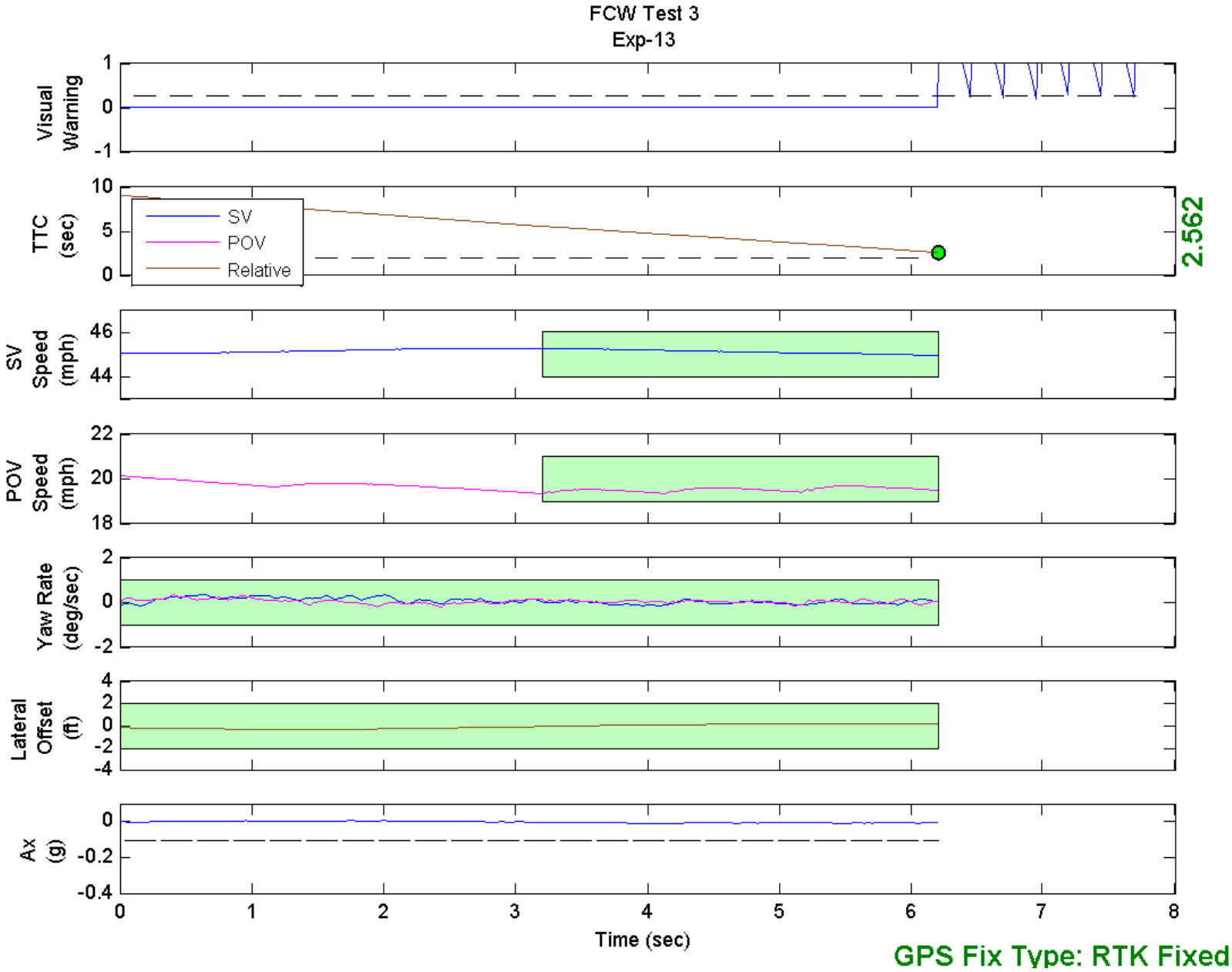



Figure D51. Time History for Run 13, FCW Test 3, Visual Warning

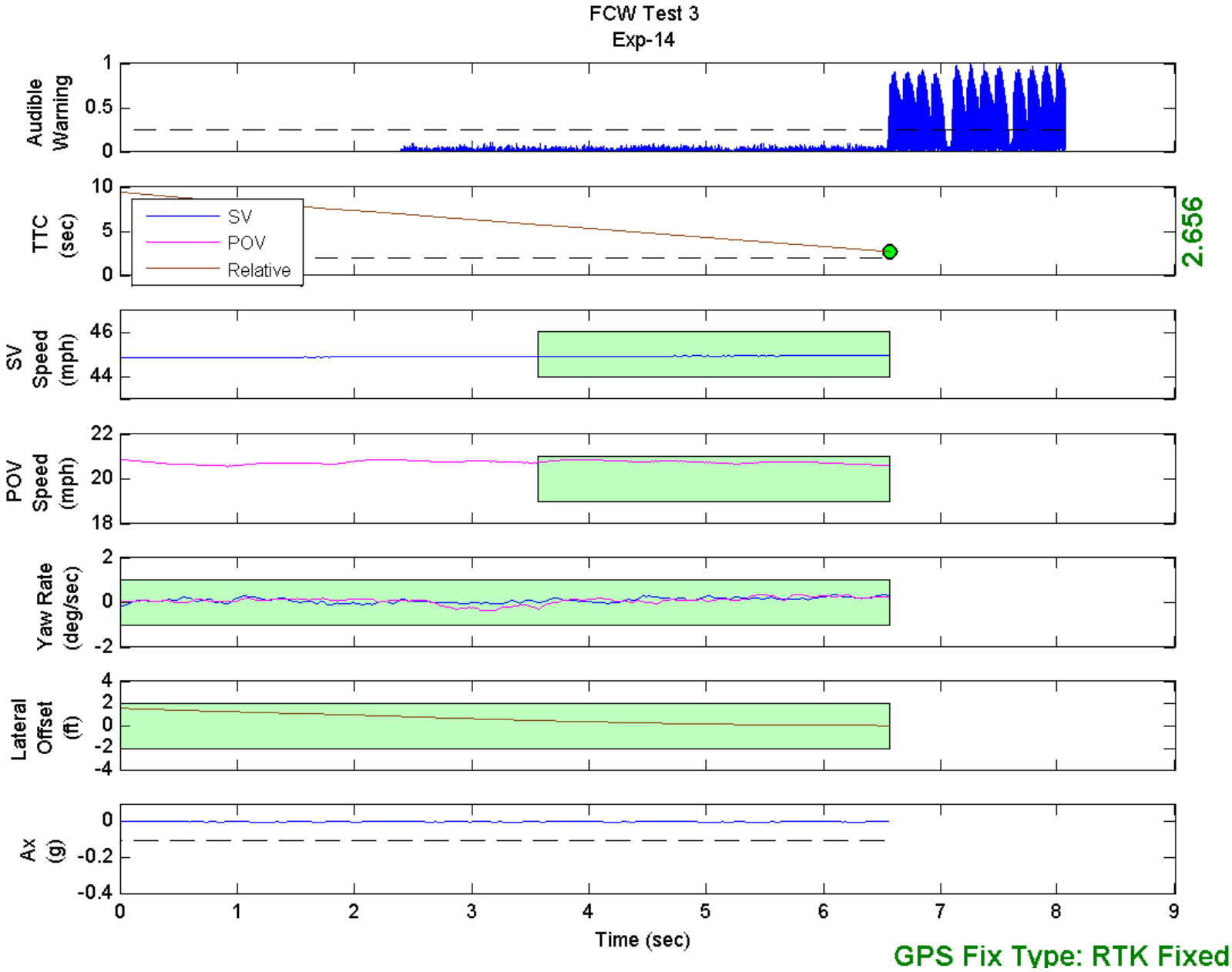



Figure D52. Time History for Run 14, FCW Test 3, Acoustic Warning

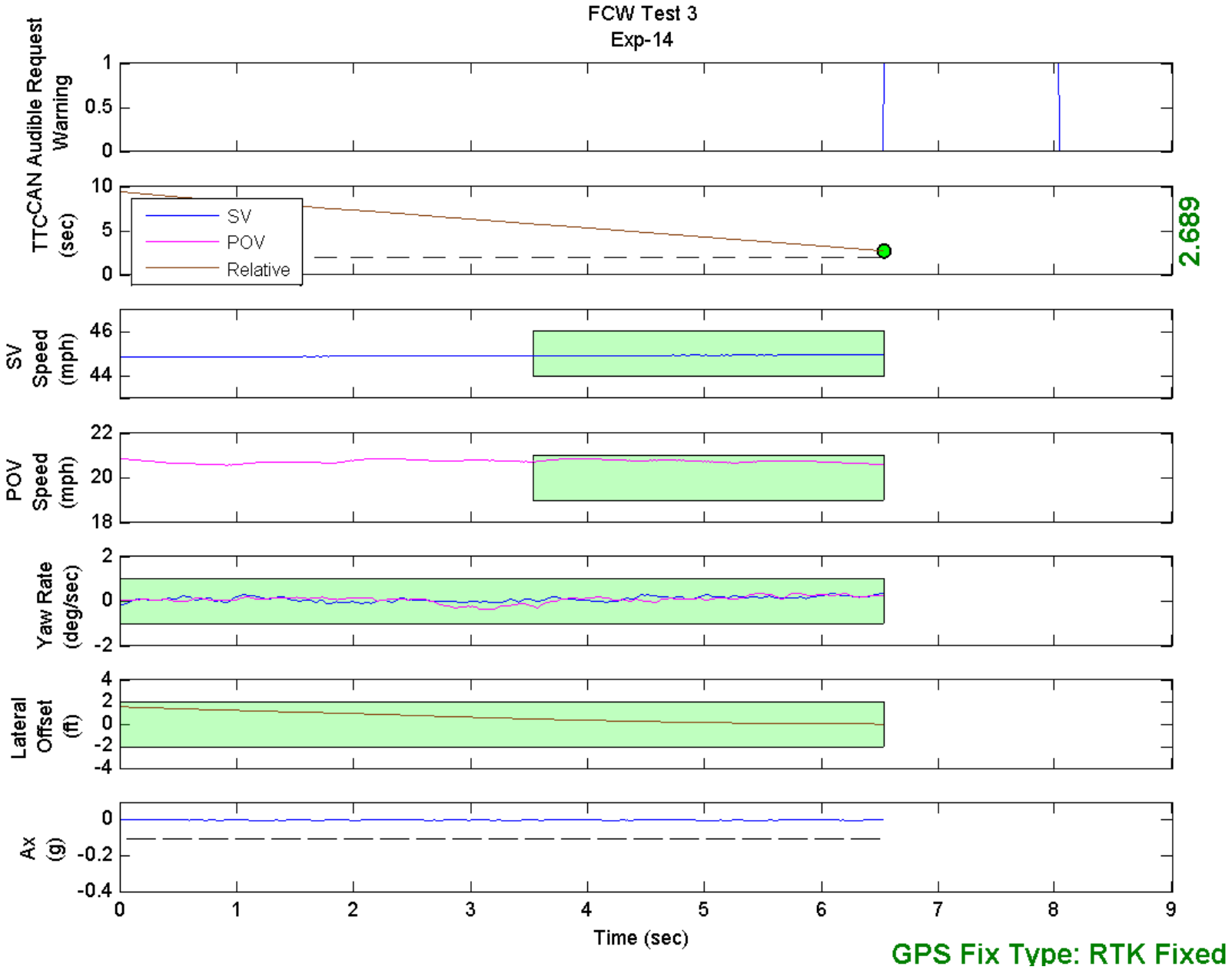



Figure D53. Time History for Run 14, FCW Test 3, CAN Acoustic Warning Request

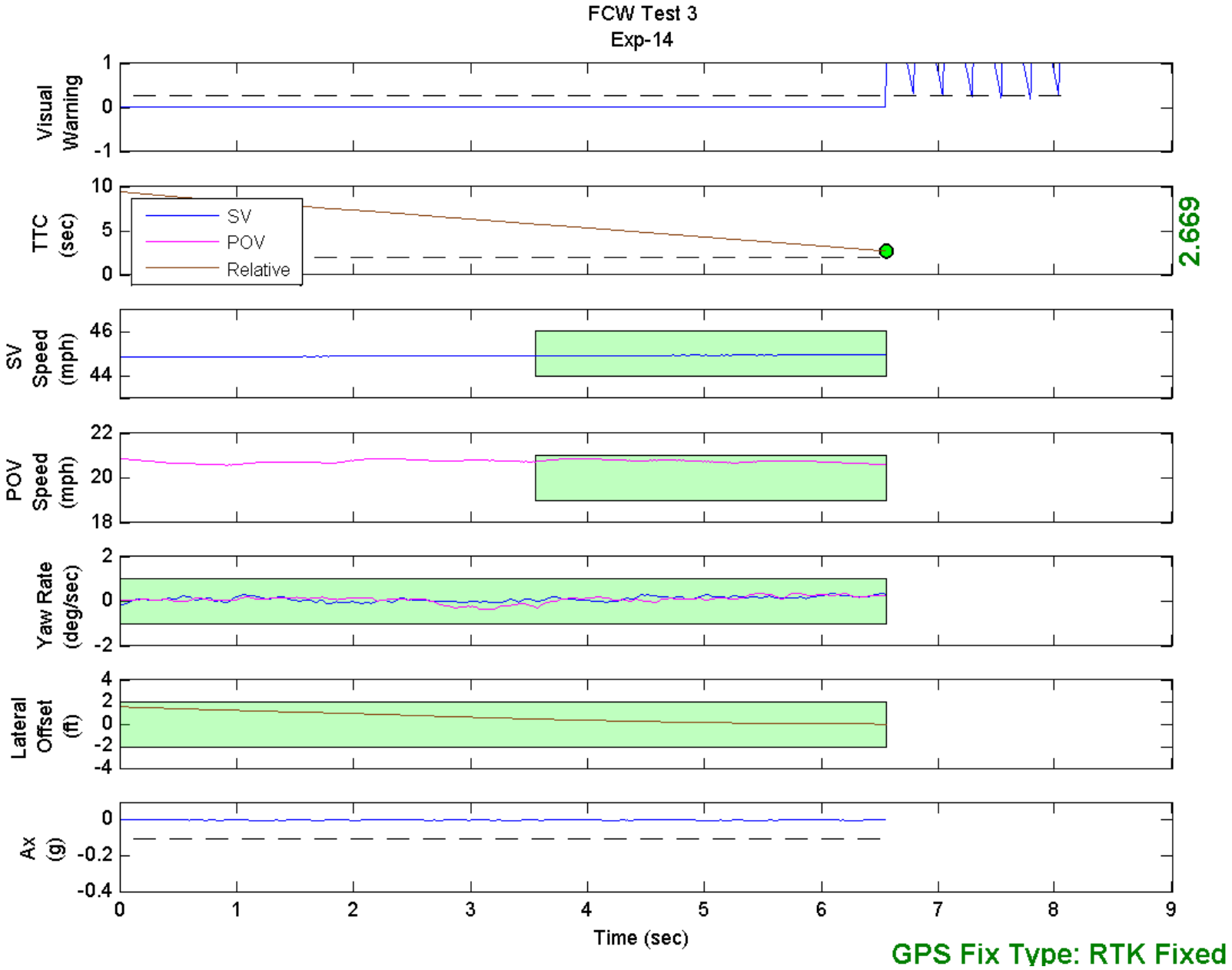



Figure D54. Time History for Run 14, FCW Test 3, Visual Warning

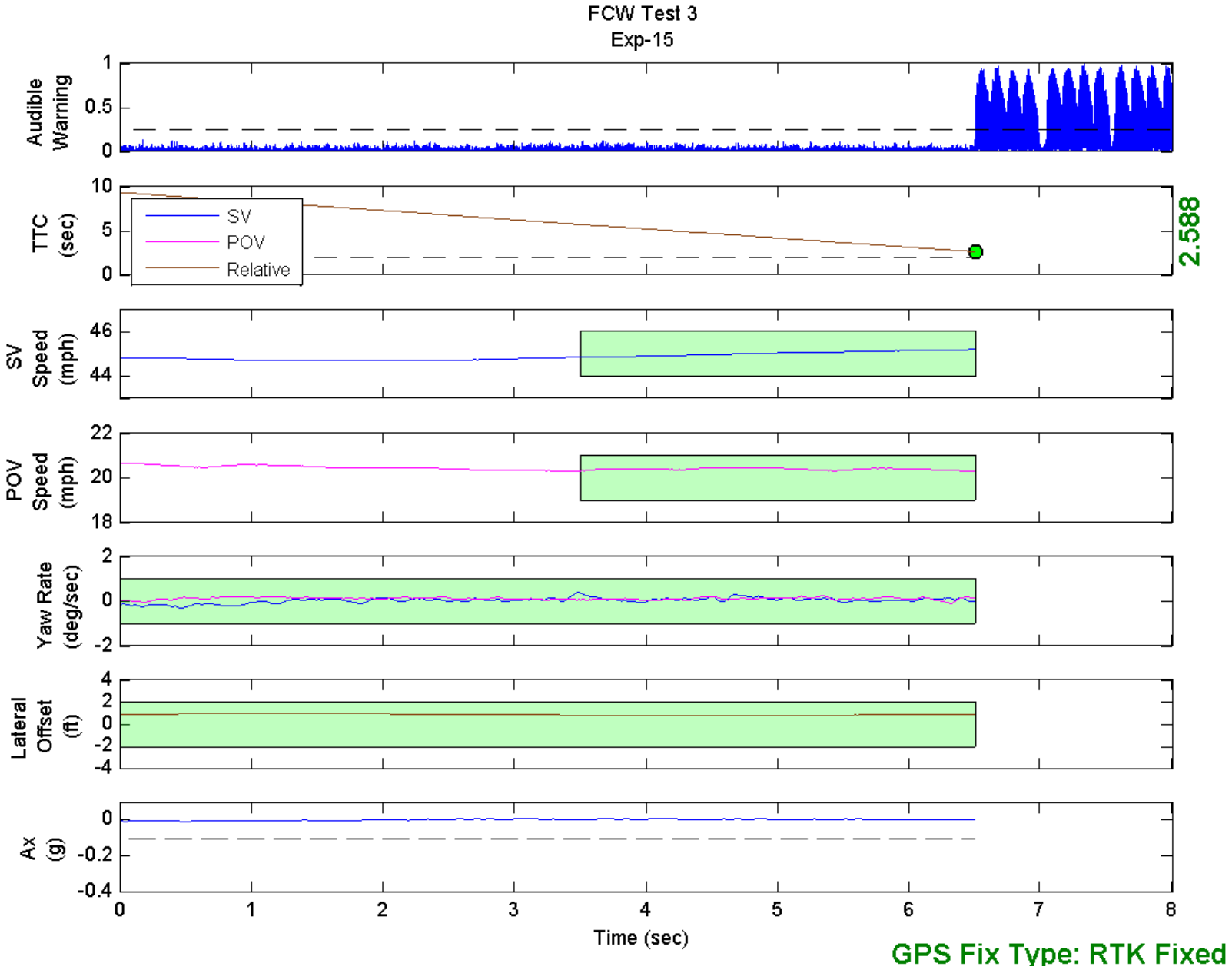



Figure D55. Time History for Run 15, FCW Test 3, Acoustic Warning

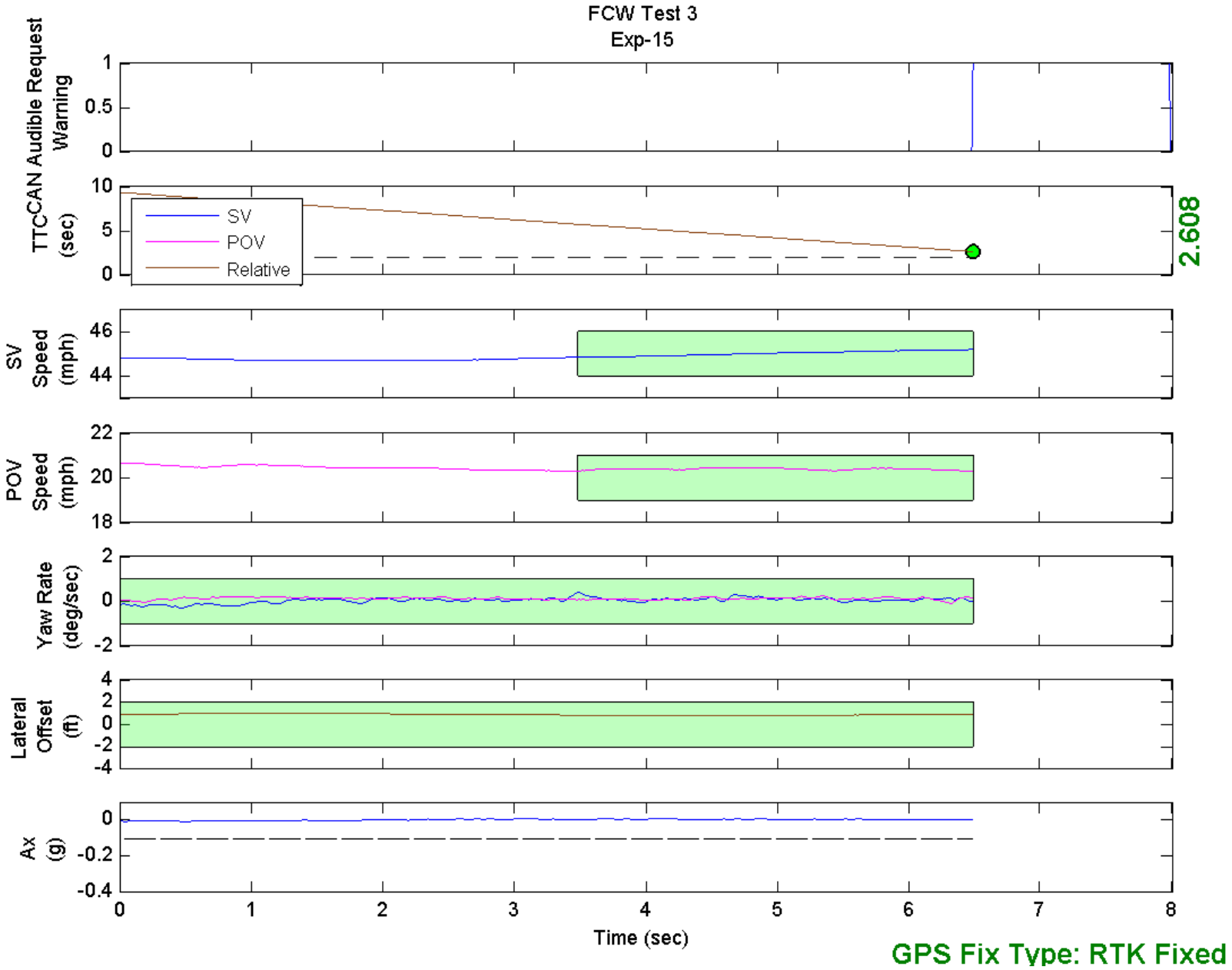



Figure D56. Time History for Run 15, FCW Test 3, CAN Acoustic Warning Request

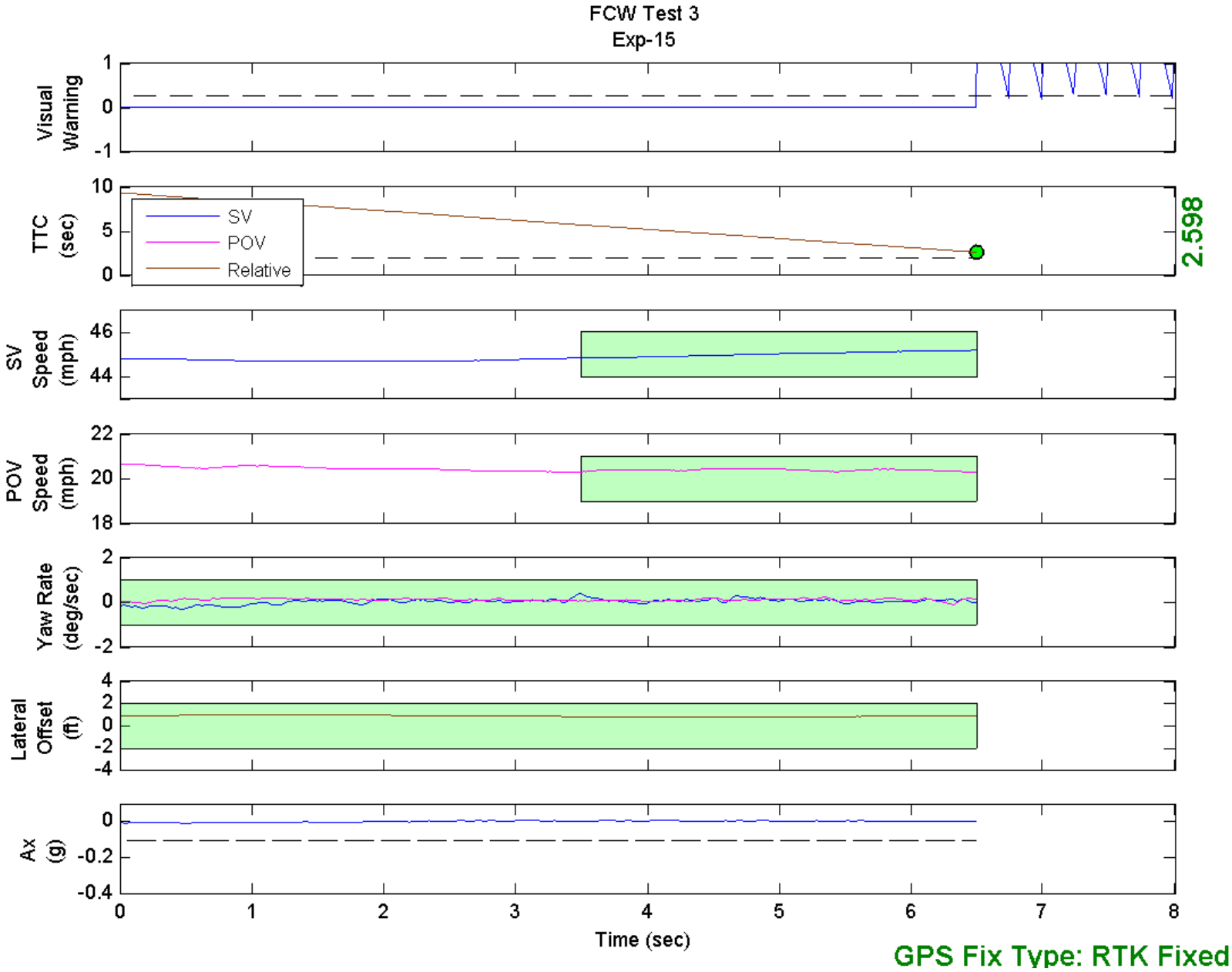



Figure D57. Time History for Run 15, FCW Test 3, Visual Warning

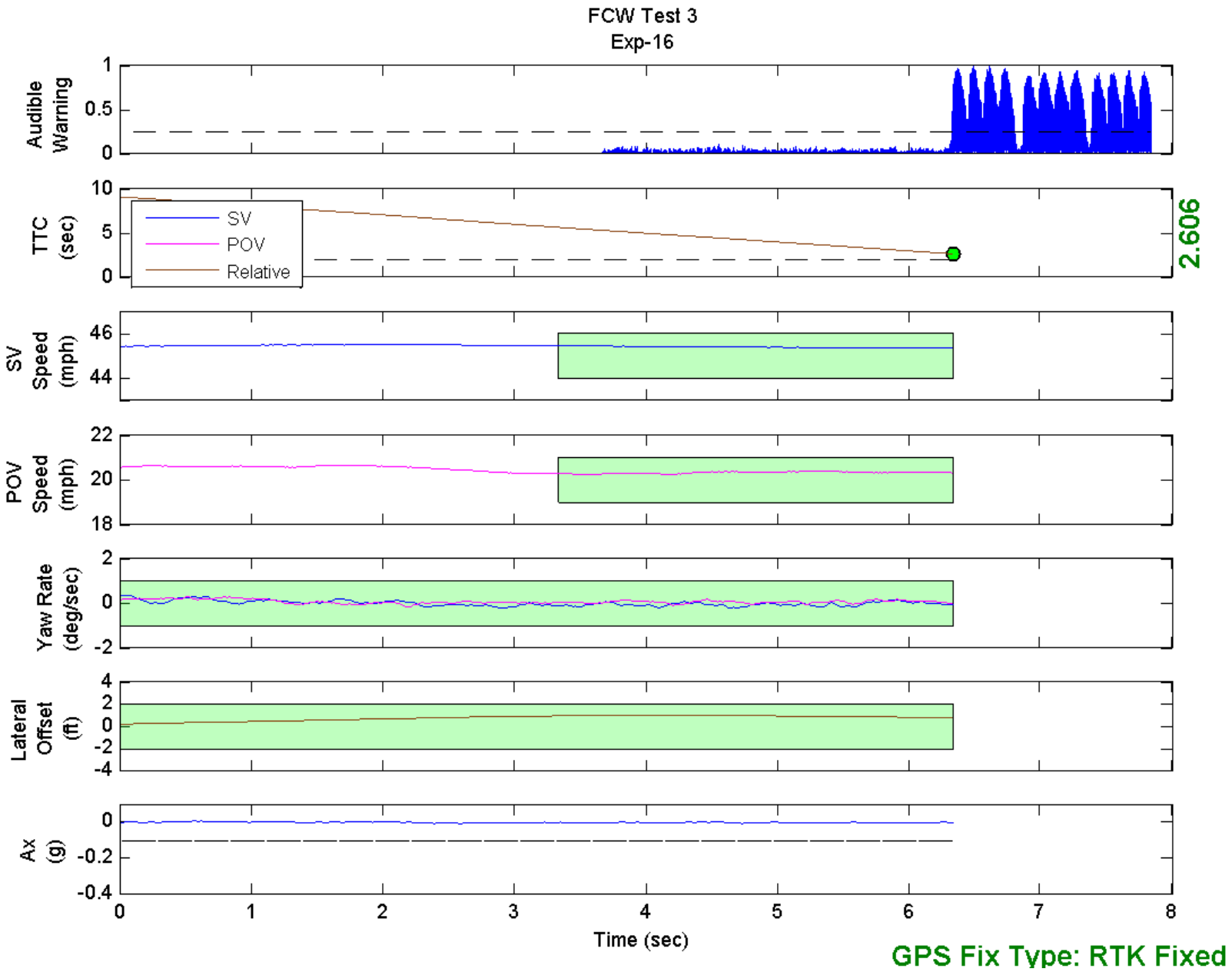



Figure D58. Time History for Run 16, FCW Test 3, Acoustic Warning

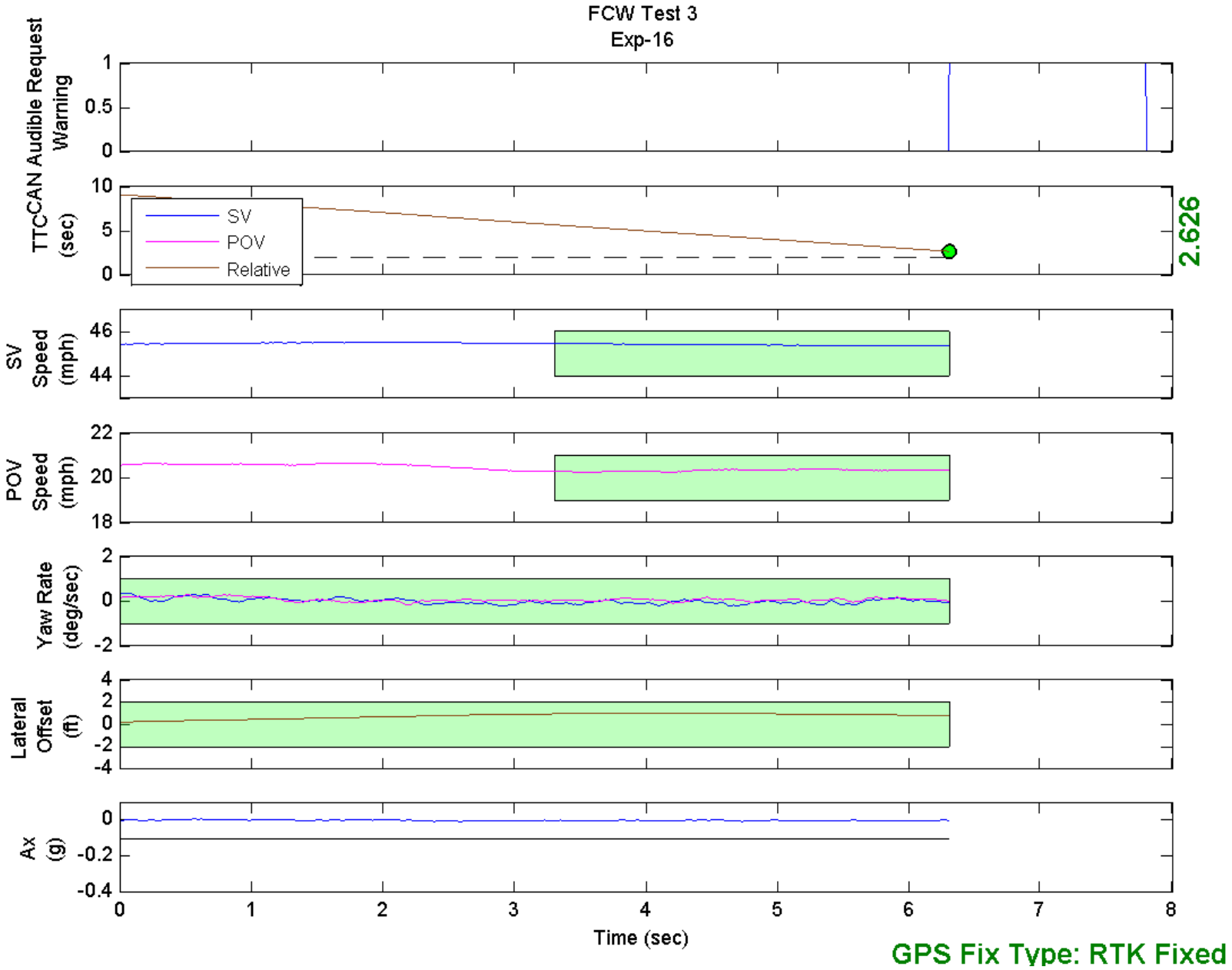



Figure D59. Time History for Run 16, FCW Test 3, CAN Acoustic Warning Request

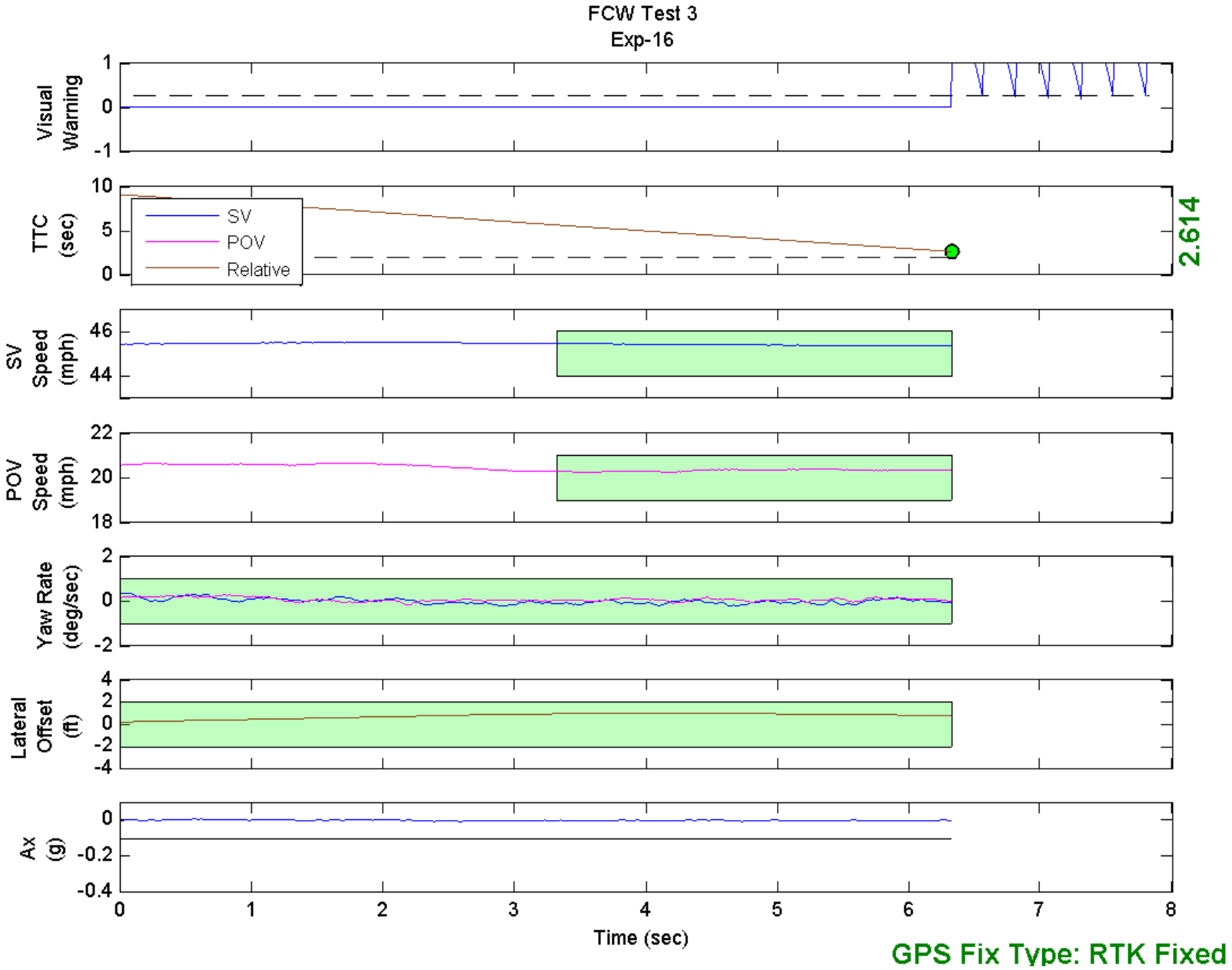



Figure D60. Time History for Run 16, FCW Test 3, Visual Warning

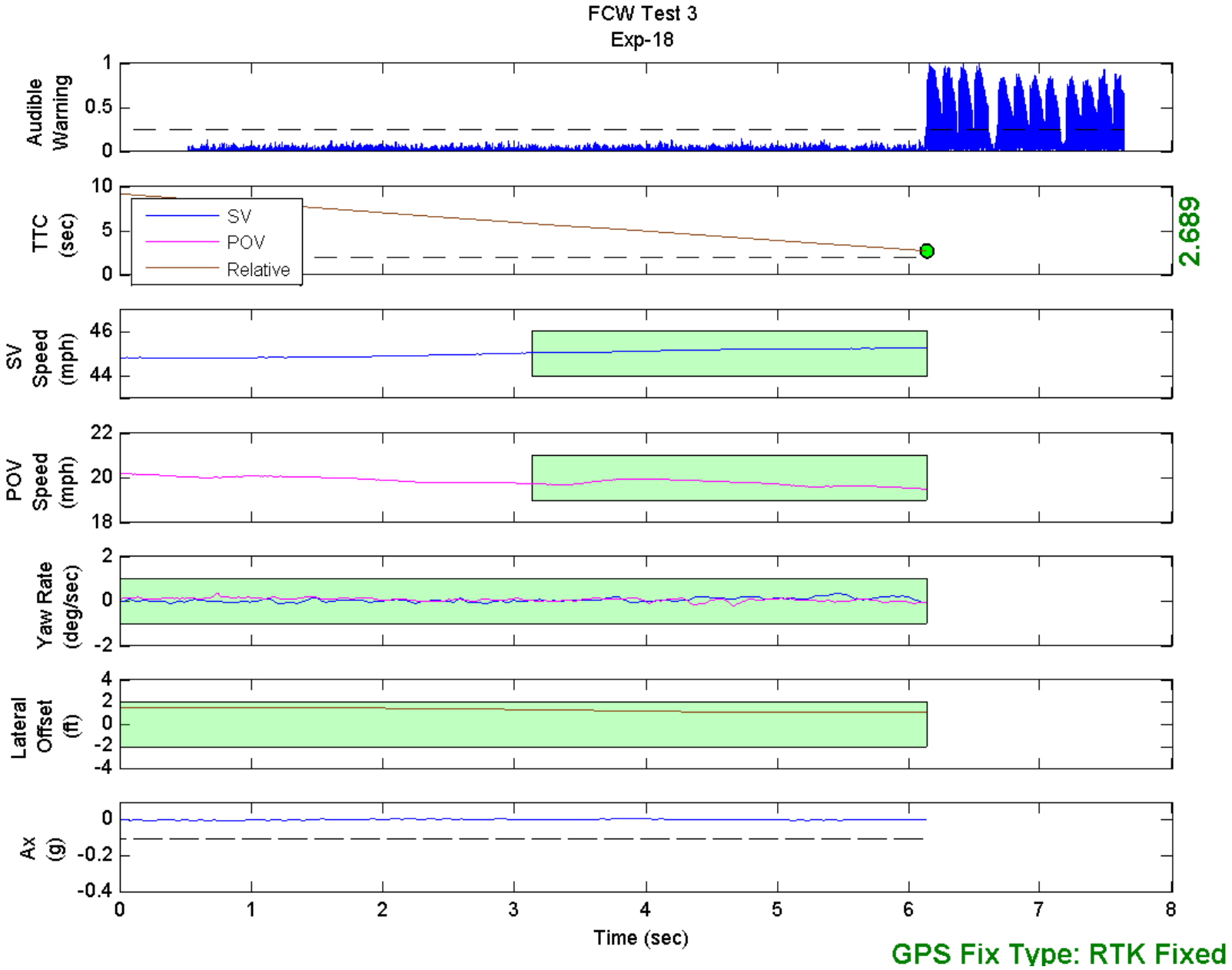



Figure D61. Time History for Run 18, FCW Test 3, Acoustic Warning

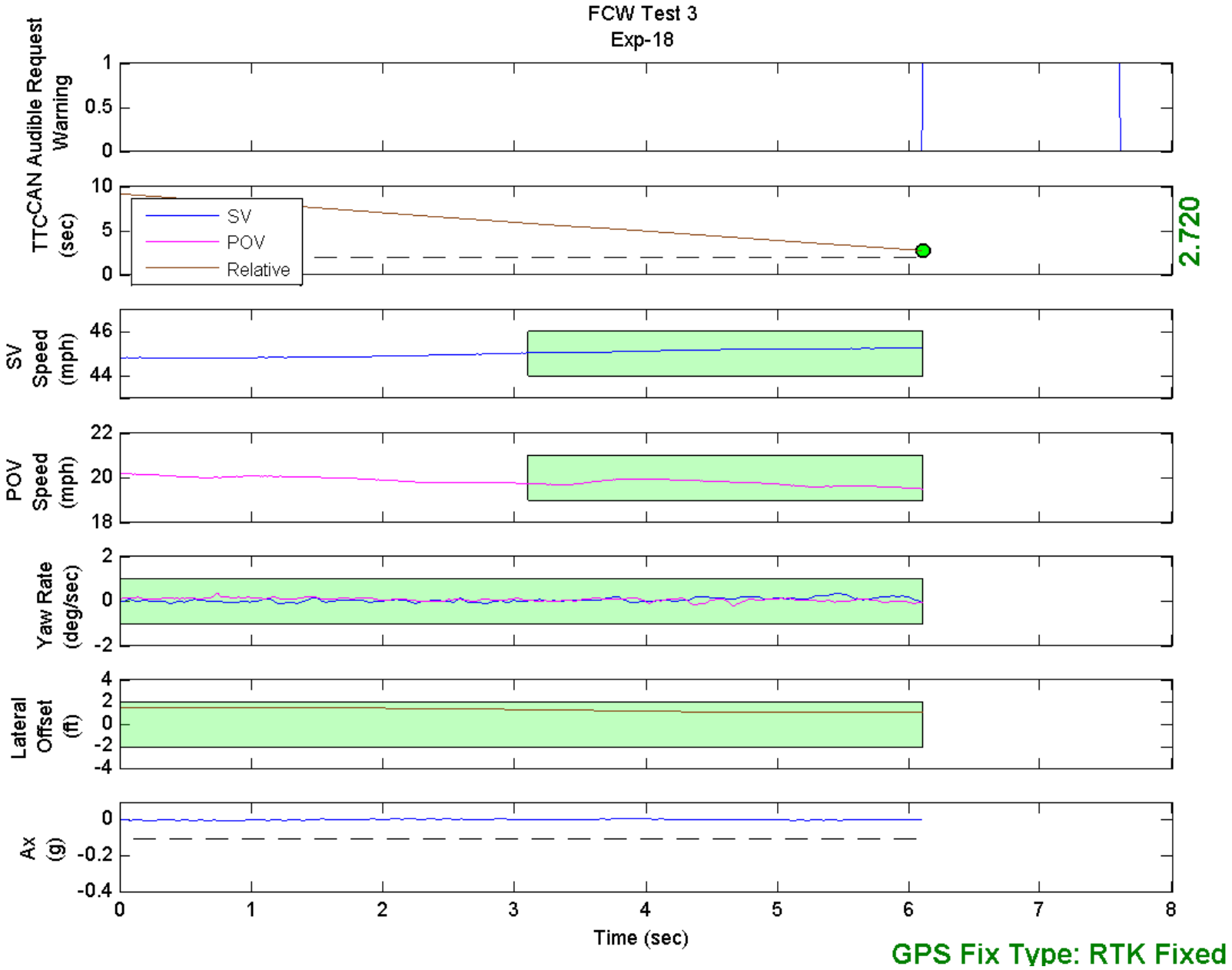



Figure D62. Time History for Run 18, FCW Test 3, CAN Acoustic Warning Request

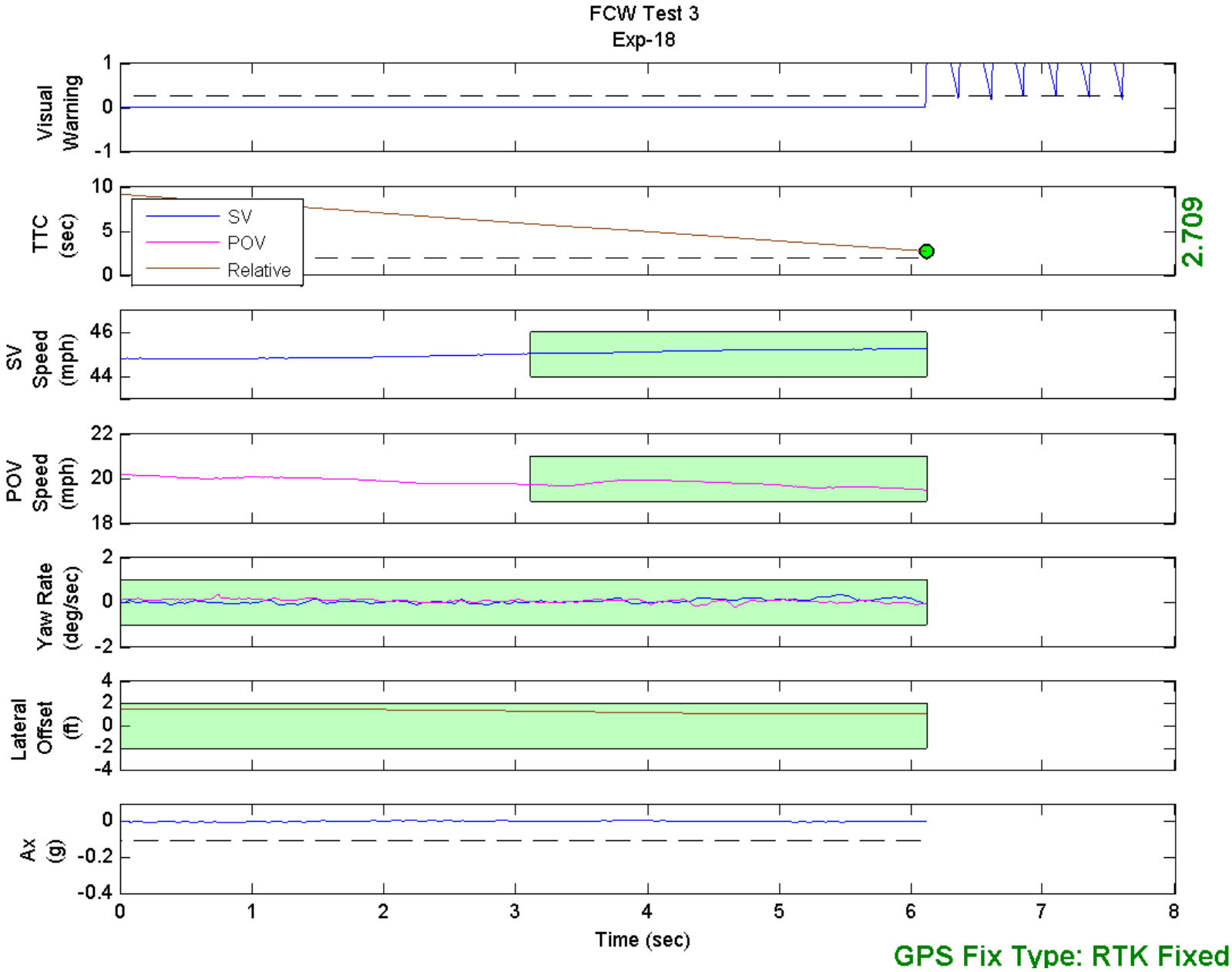



Figure D63. Time History for Run 18, FCW Test 3, Visual Warning

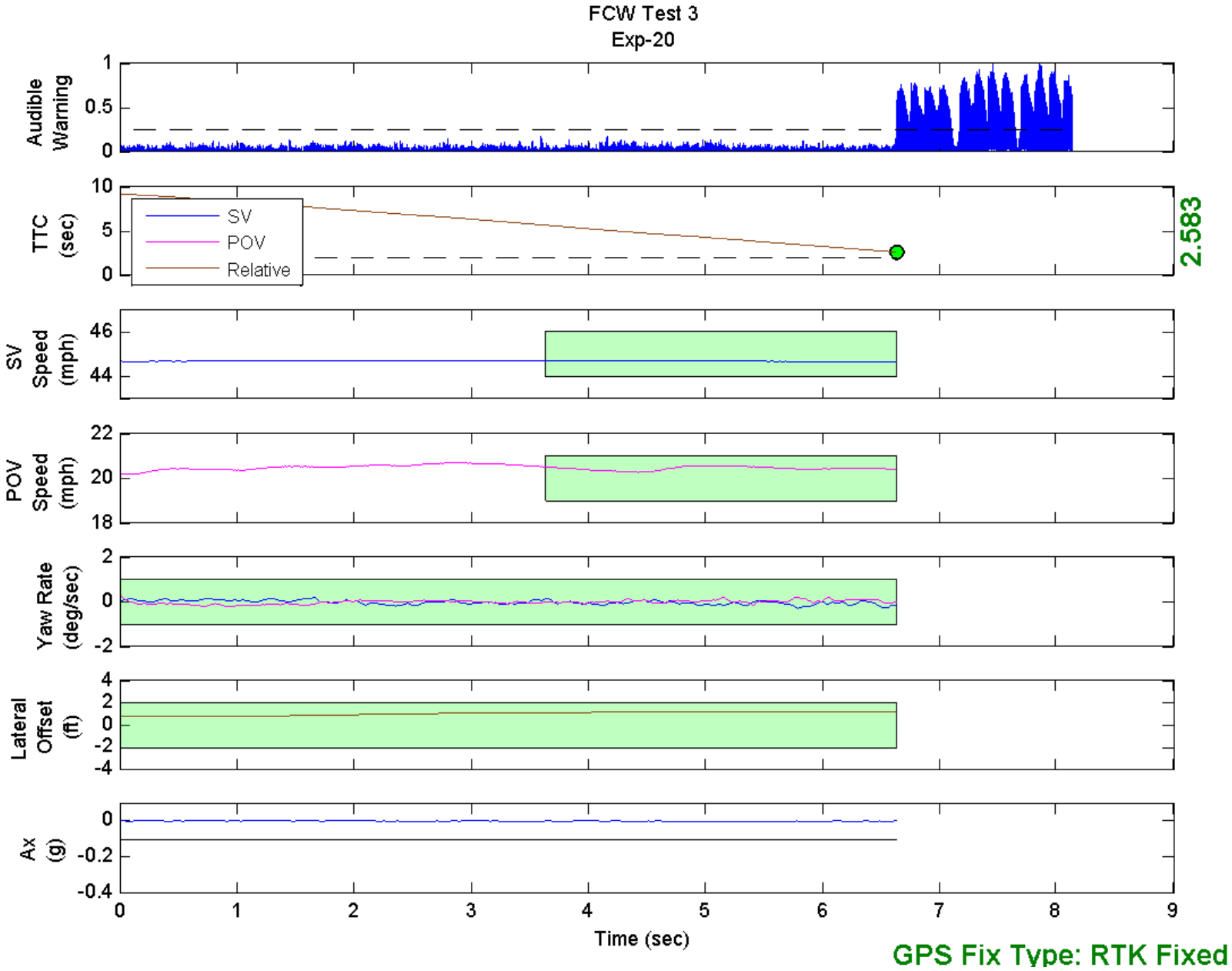



Figure D64. Time History for Run 20, FCW Test 3, Acoustic Warning

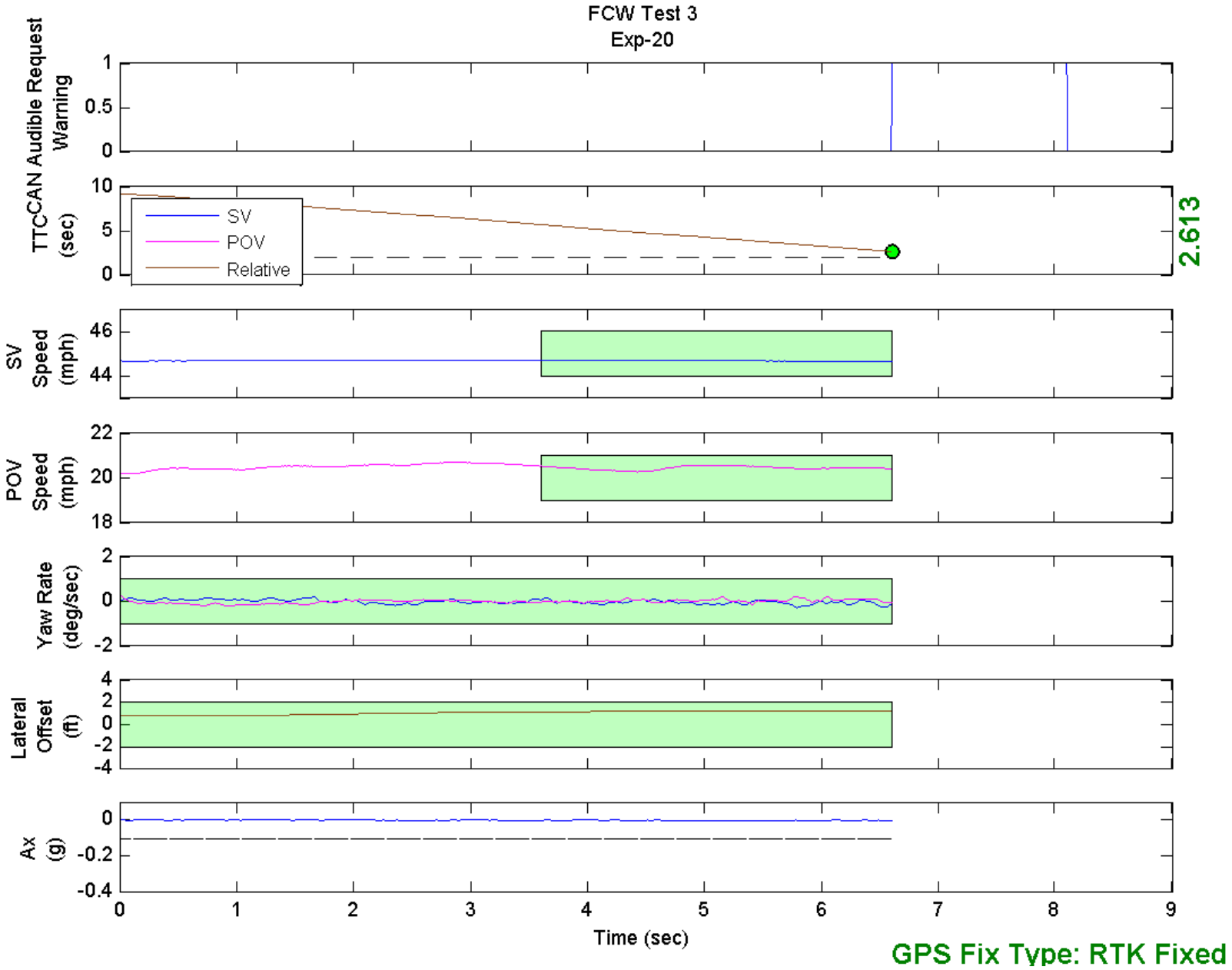



Figure D65. Time History for Run 20, FCW Test 3, CAN Acoustic Warning Request

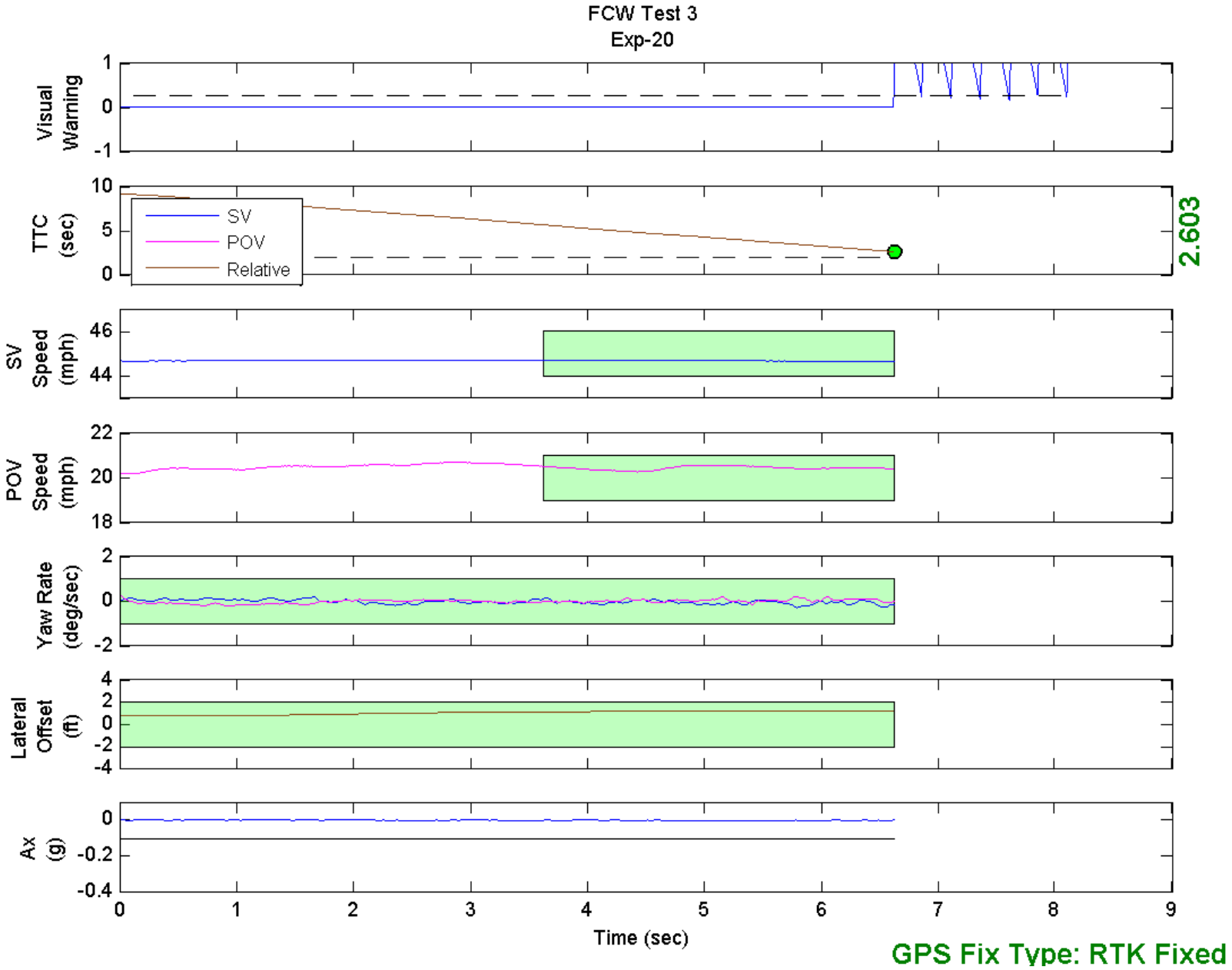



Figure D66. Time History for Run 20, FCW Test 3, Visual Warning

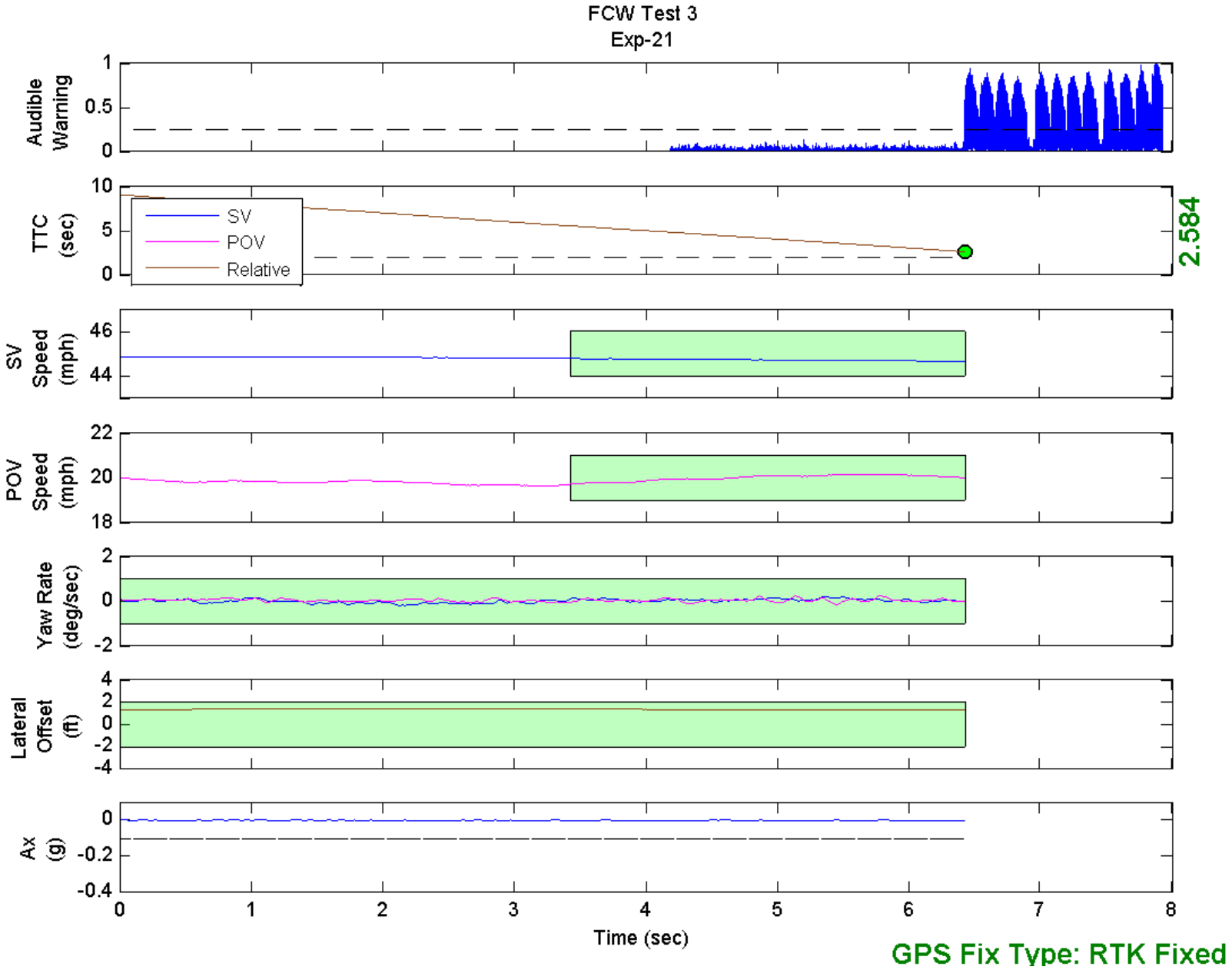



Figure D67. Time History for Run 21, FCW Test 3, Acoustic Warning

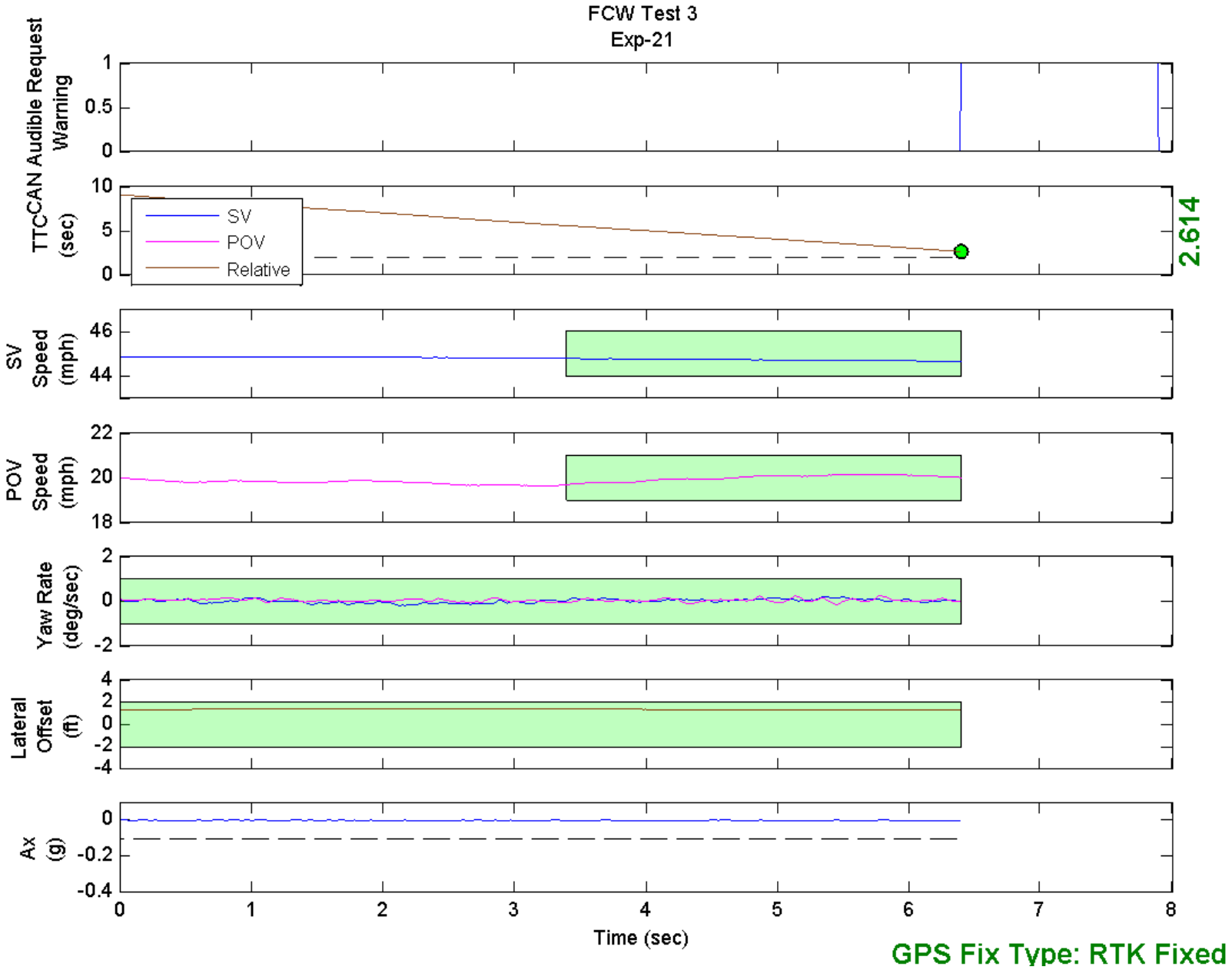



Figure D68. Time History for Run 21, FCW Test 3, CAN Acoustic Warning Request

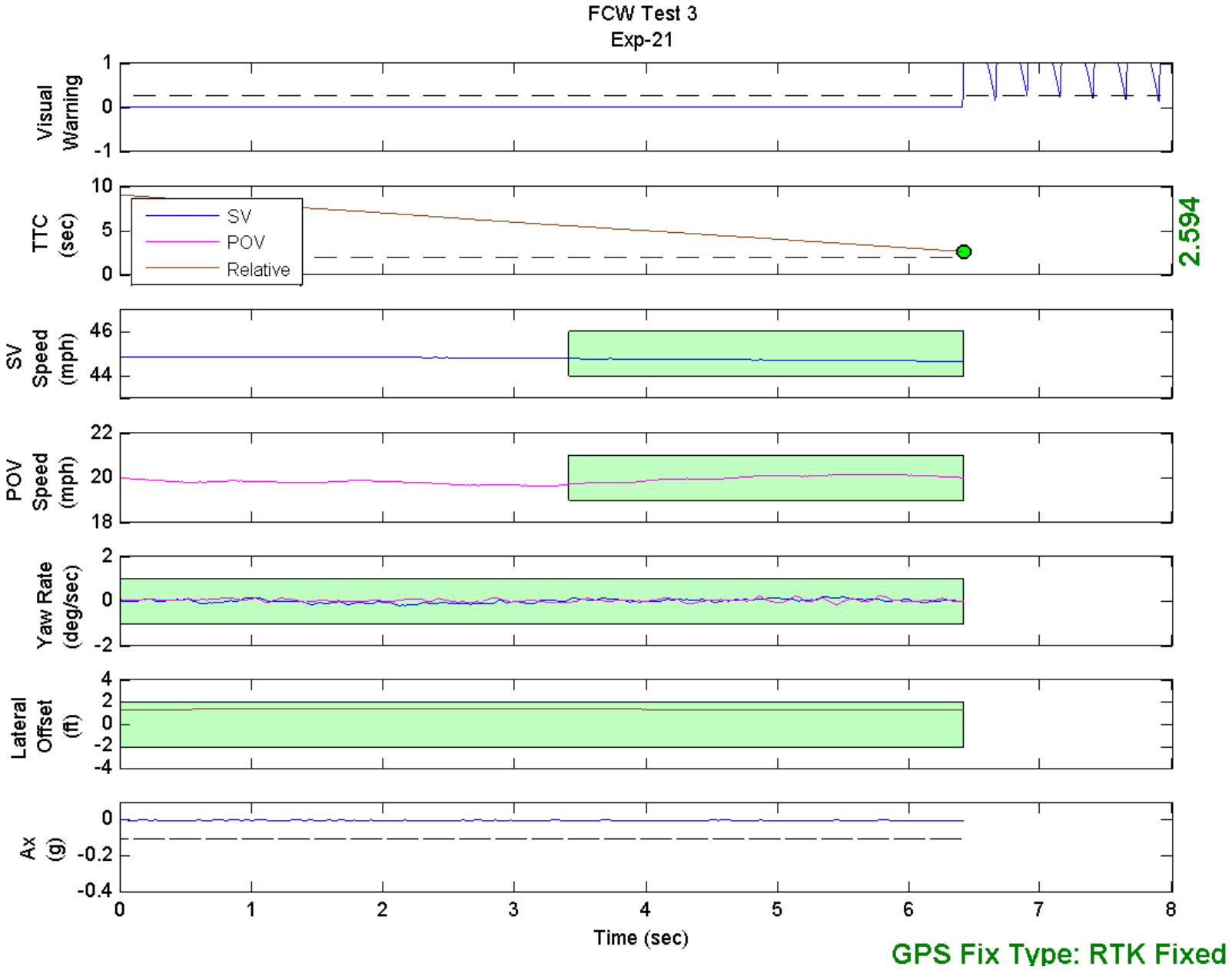



Figure D69. Time History for Run 21, FCW Test 3, Visual Warning