OCAS-DRI-FCW-13-016

NCAP FORWARD COLLISION WARNING CONFIRMATION TEST

2013 Infiniti FX37

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

23 May 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.

Prepared By: John Lenkeit

Approved By: Brian Kebschull

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16. Abstract These tests were conducted on the subject 2013 Infiniti FX37 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 Infiniti FX37

VIN: *JN8CS1MUXDM1xxxx*

Test Date: *5/1/2013*

Forward Collision Warning setting: *Nominal*

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 Infiniti FX37

TEST VEHICLE INFORMATION

VIN: *JN8CS1MUXDM1xxxx*

Body Style: *SUV* Color: *Grey*

Date Received: *4/24/2013* Odometer Reading: *59 mi*

Engine: *3.7 L V-6*

Transmission: *Automatic*

Final Drive: *RWD*

Is the vehicle equipped with:

ABS X Yes ____ No

Adaptive Cruise Control X Yes ____ No

Collision Mitigating Brake System X Yes ____ No

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Nissan Motor Co., Ltd.*

Date of manufacture: *02/13*

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: *P265/50R20*

Rear: *P265/50R20*

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

Rear: *230 kPa (33 psi)*

FORWARD COLLISION WARNING

DATA SHEET 2: VEHICLE DATA

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2013 Infiniti FX37

TIRES

Tire manufacturer and model: *Bridgestone Dueler H/P 92A*

Front tire size: *P265/50R20*

Rear tire size: *P265/50R20*

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 Infiniti FX37

GENERAL INFORMATION

Test date: *5/1/2013*

AMBIENT CONDITIONS

Air temperature: *28.9 C (84 F)*

Wind speed: *9.3 m/s (20.7 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: *230 kPa (33 psi)*

Rear: *230 kPa (33 psi)*

FORWARD COLLISION WARNING

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

2013 Infiniti FX37

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*542.5 kg (1196 lb)*	Right Front	*513.0 kg (1131 lb)*
Left Rear	*518.0 kg (1142 lb)*	Right Rear	*509.4 kg (1123 lb)*
		Total:	*2082.9 kg (4592 lb)*

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2013 Infiniti FX37

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 audible alert consists of a repeated beeping, whose primary frequency is approximately 3082 Hz. The beeping continues until the subject vehicle is clear of the POV.

The visual alert consists of the image of the rear of a vehicle, which is displayed in the common display area in the center portion of the IP (Figure A-12). The alert is white. It flashes until the subject vehicle is clear of the POV.

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2013 Infiniti FX37

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.

A "Warning System Switch" is located on the far left side of the dashboard (Figure A-13). When pressed, this switch disables the FCW and LDW systems (simultaneously). The warning systems are re-enabled each time the ignition is switched on. However, if the switch is pressed for at least 4 seconds, the default status will change to off, and the warning systems will continue to be disabled (i.e., not re-enable upon ignition). The image on the switch appears to be the top view of a vehicle with two ovals around it, and the image of a speaker. The switch also has a light which turns off if the button is pressed (i.e., the light is off when the warning systems are disabled).

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

If yes please provide a full description

FORWARD COLLISION WARNING

DATA SHEET 4: FORWARD COLLISION WARNING SYSTEM OPERATION

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2013 Infiniti FX37

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

X Yes

____ No

If yes please provide a full description.

The system will not detect the following objects:

- *Pedestrians, animals, or obstacles in the roadway*
- *Oncoming vehicles in the same lane.*

The system will not detect another vehicle under the following conditions:

- *When the sensor gets dirty and it is impossible to detect the distance from the vehicle ahead.*
- *When driving into a strong light, for example, sunlight*

The sensor generally detects the signals returned from the reflectors on a vehicle ahead. Therefore, the system may not function properly under the following conditions:

- *When the reflectors on the vehicle ahead are positioned high or close to each other (including a small vehicle such as motorcycles).*
- *When the sensor gets dirty or it is impossible to detect the distance from the vehicle ahead.*
- *When the reflectors on the vehicle ahead are missing, damaged, or covered.*
- *When the reflectors on the vehicle ahead are covered with dirt, snow, or road spray.*
- *When visibility is low (such as rain, fog, snow, etc)*
- *When dense exhaust or other smoke (black smoke) from vehicles reduces the visibility of the sensor.*
- *When excessively heavy baggage is loaded in the rear seat or the luggage room of the vehicle.*
- *When abruptly accelerating or decelerating.*
- *On a steep downhill slope or on roads with sharp curves.*
- *When there is a highly reflective object near the vehicle ahead (for example, being very close to another vehicle, signboard, etc).*
- *When towing a trailer.*

Depending on certain road conditions (curved or beginning of a curve), vehicle conditions (steering position or vehicle position), or the preceding vehicle's conditions (position in lane, etc), the system may not function properly. The system may detect highly reflective objects such as reflectors, signs, white markers, and other stationary objects on the road or near the travelling lane and provide unnecessary warning.

The system may not function in offset conditions.

The system may not function when the distance to the vehicle ahead is extremely close.

The system is designed to automatically check the sensor's functionality. If the sensor is covered with ice, a transparent or translucent bag, etc, the system may not detect them. In these instances, the system may not be able to warn the driver properly. Be sure to check and clean the sensor regularly.

Excessive noise will interfere with the warning chime sound, and the chime may not be heard.

A sudden appearance of a vehicle in front (for example, it abruptly cuts in) may not be detected, and the system may not warn the driver soon enough. The system will be cancelled automatically with a beep sound and the IBA Off indicator light will illuminate under the following conditions:

- *When the sensor window is dirty*
- *When the system malfunctions.*

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.

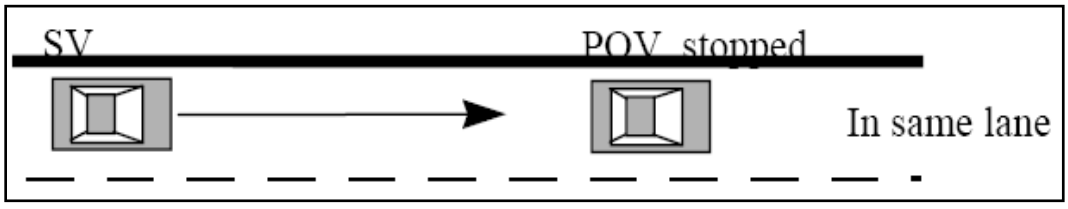


Figure 1. Depiction of Test 1

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.

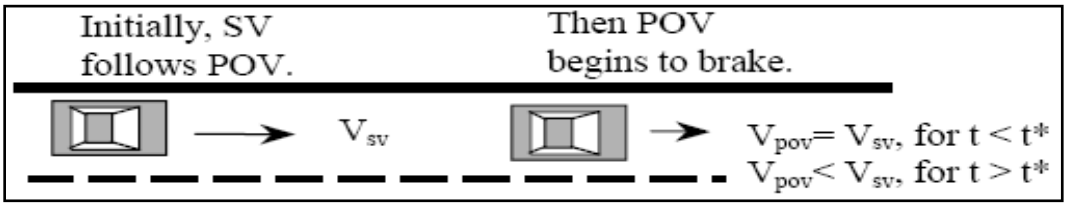


Figure 2. Depiction of Test 2

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 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

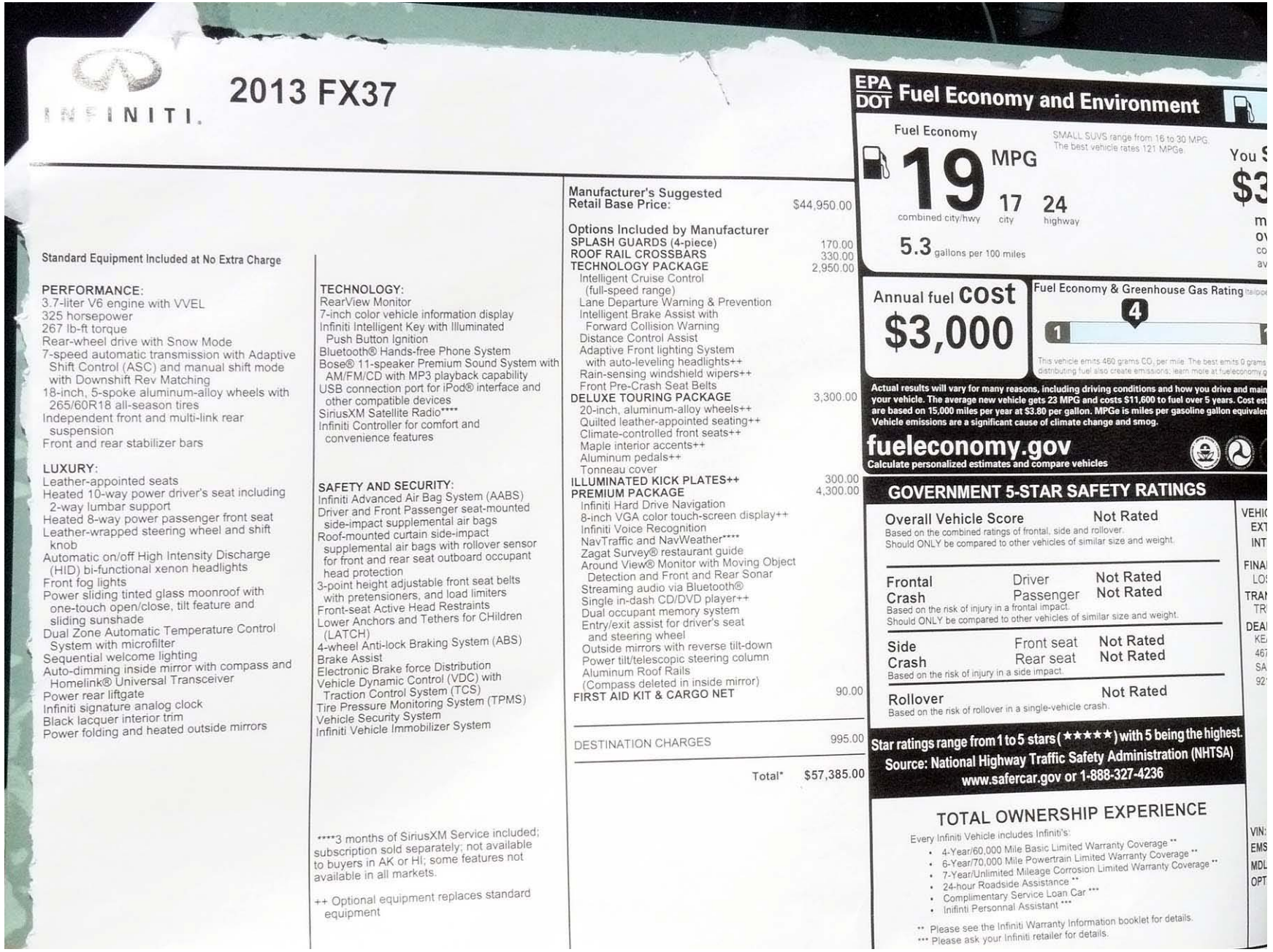


Figure A3. Window Sticker (Monroney Label)

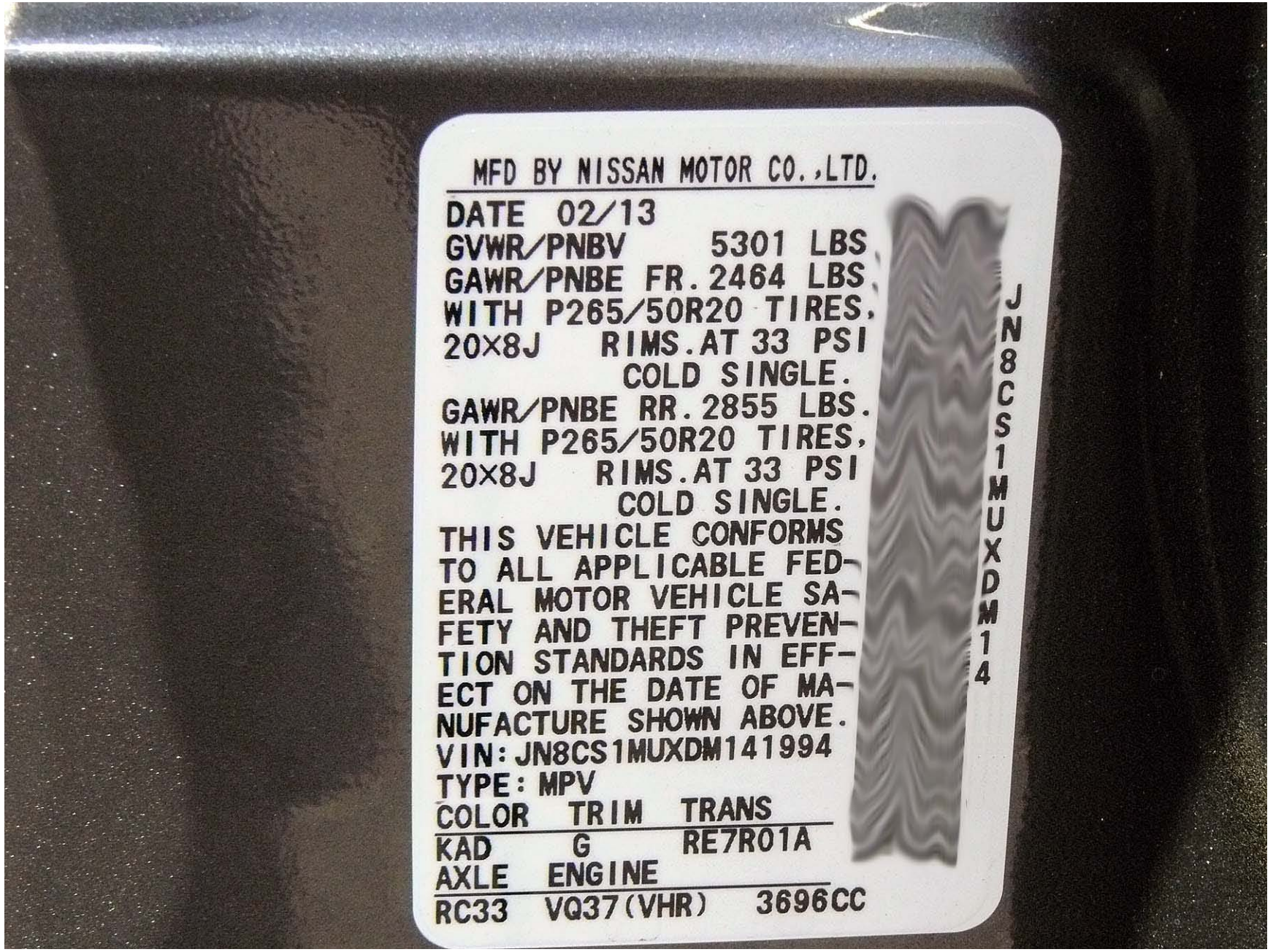


Figure A4. Vehicle Certification Label

Figure A5. Front View of Principal Other Vehicle

Figure A6. Rear View of Principal Other Vehicle

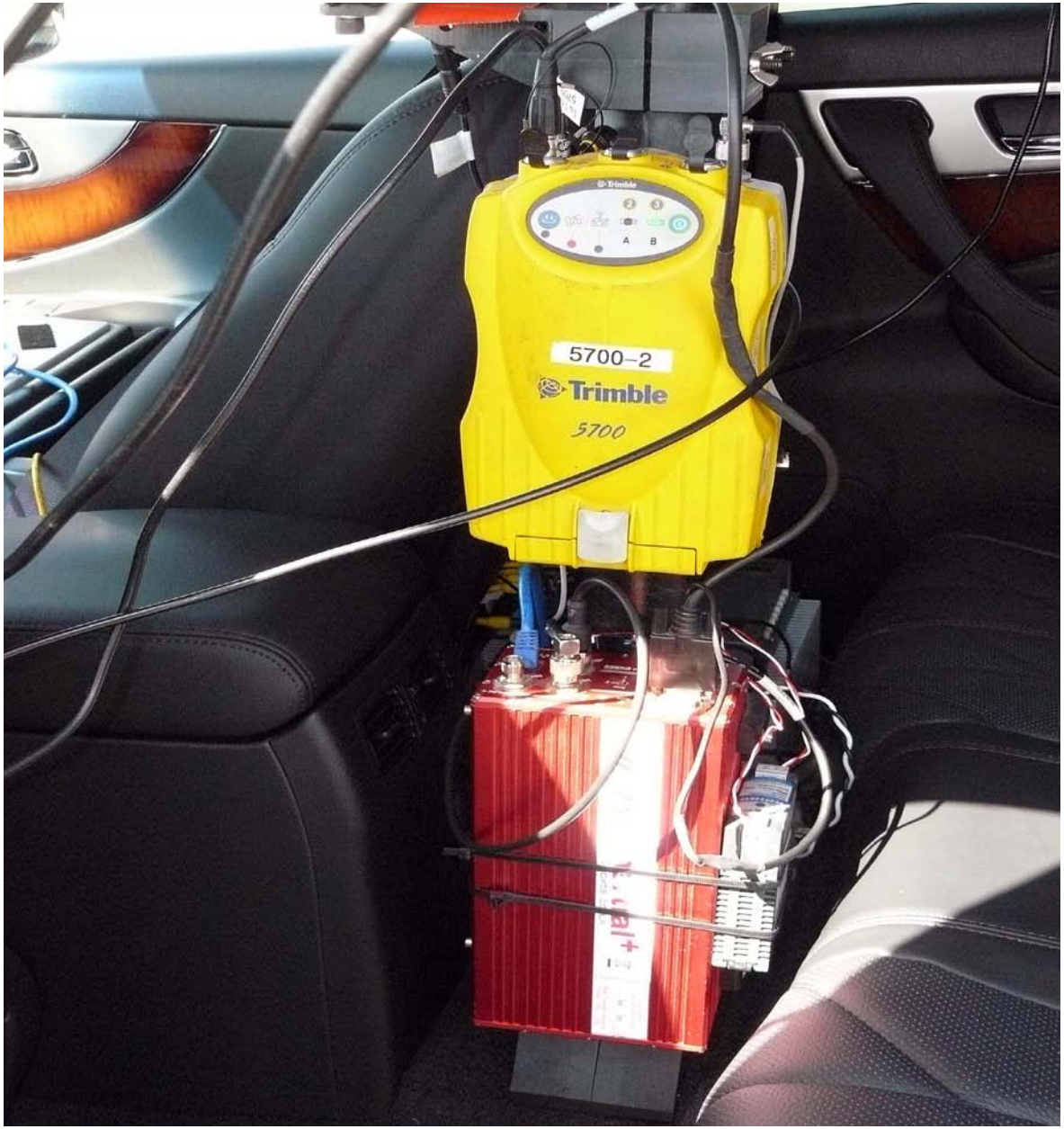


Figure A7. DGPS and Inertial Measurement Unit Installed in Subject Vehicle

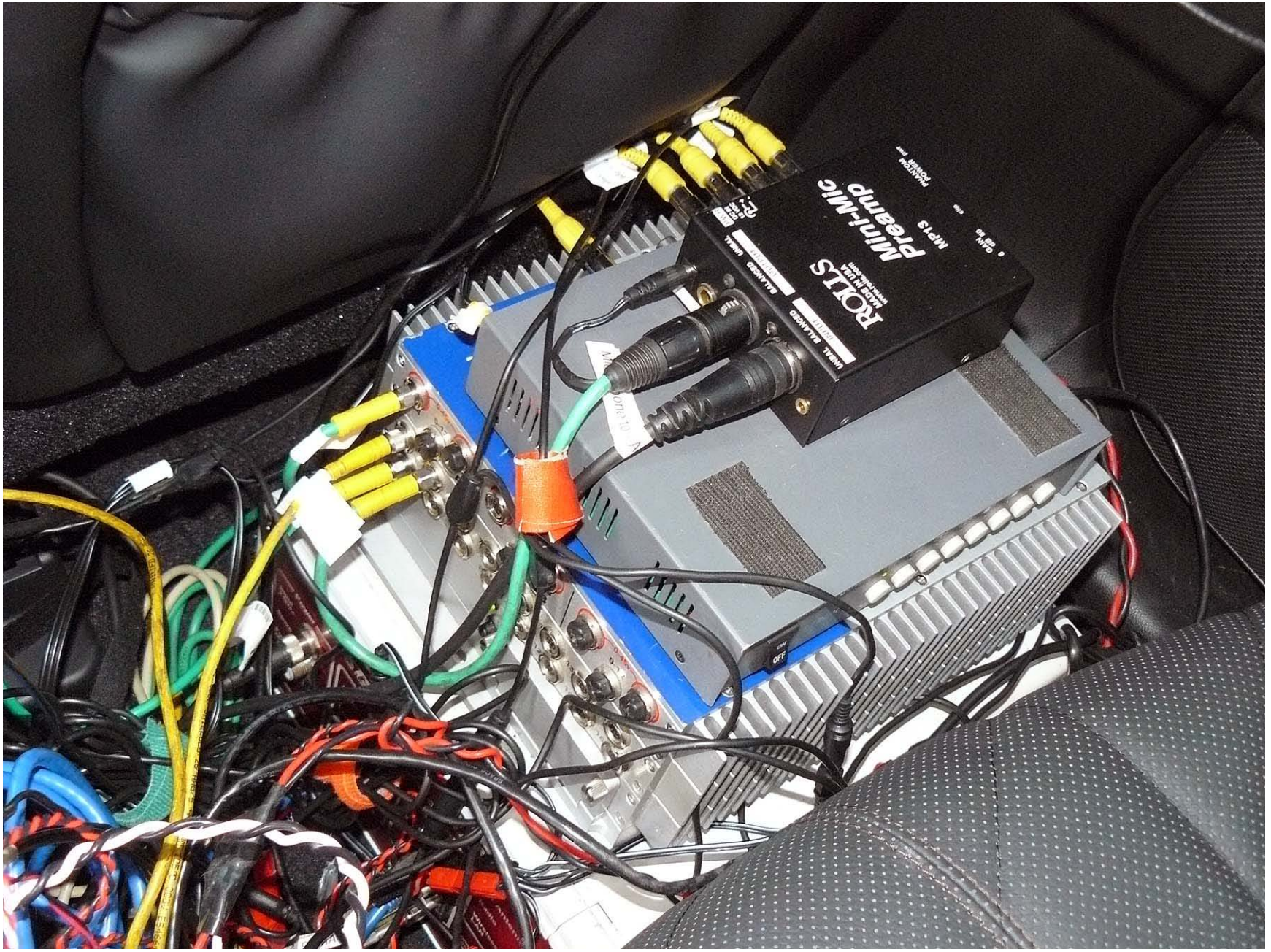


Figure A8. Data Acquisition System Installed in Subject Vehicle

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

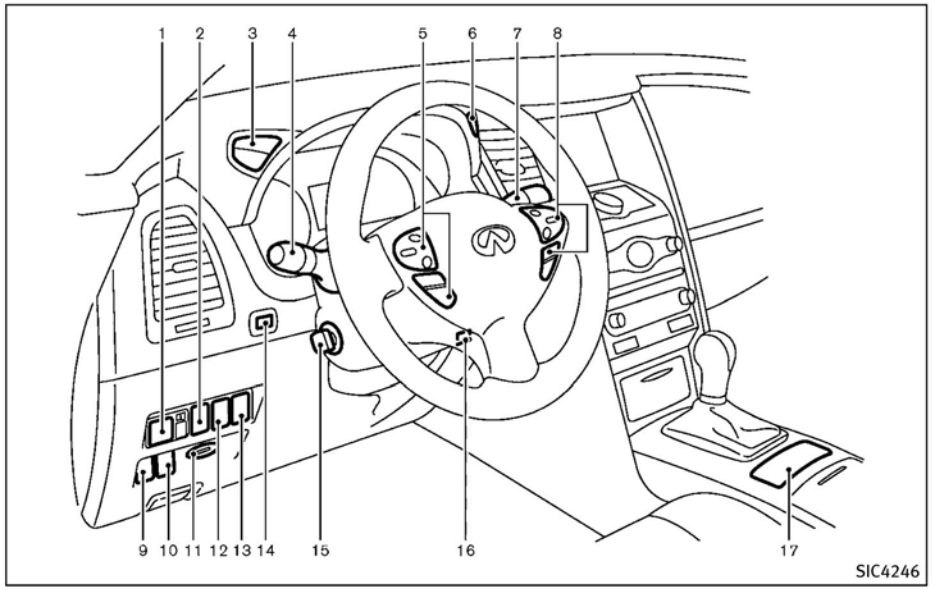
Figure A12. Visual Warning Display

Figure A13. Warning Systems (LDW) On-Off Switch

APPENDIX B

Excerpts from Owner's Manual

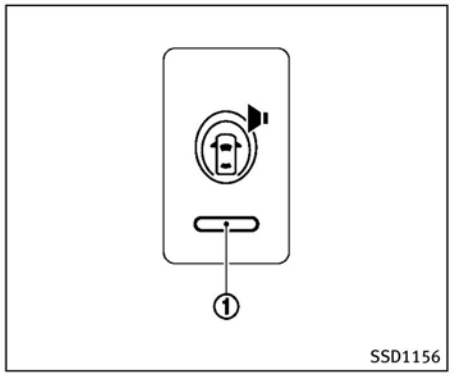
COCKPIT



1. Outside mirror remote control switch (P.3-30)
2. Intelligent Brake Assist (IBA) off switch (if so equipped) (P.2-48)
3. Instrument brightness control switch (P.2-42)
4. Headlight, fog light and turn signal switch (P.2-37)
5. Steering-wheel-mounted controls (left side)
   — For audio system (P.4-54)
   — For Bluetooth® Hands-Free Phone System (with navigation system) (P.4-94)
   — For Bluetooth® Hands-Free Phone System (without navigation system) (P.4-104)
   — For INFINITI Voice Recognition System (with navigation system) (P.4-119)
6. Trip computer switch (P.2-28)
7. Windshield wiper and washer switch (P.2-33)
8. Steering-wheel-mounted controls (right side)
   — Cruise control switches (if so equipped) (P.5-30)
   — Intelligent Cruise Control (ICC) switches (if so equipped) (P.5-32)
   — Dynamic Driver Assistance switch (if so equipped) (P.5-21, P.5-54)
9. Warning systems switch (if so equipped)
   — Forward Collision Warning (FCW) (P.2-46, P.5-67)
   — Lane Departure Warning (LDW) (P.2-46, P.5-21)
9. Headlight aiming control (if so equipped) (P.2-40)

turn the switch off and have the system checked by an INFINITI retailer.

WARNING SYSTEMS SWITCH (if so equipped)



The warning systems switch will turn on and off the Lane Departure Warning (LDW) system and the Forward Collision Warning (FCW) system at the same time.

The LDW system will sound a warning chime and blink the lane departure warning light (orange) to alert the driver if the vehicle is traveling close to either the left or the right of a traveling lane with detectable lane markers. (See “Lane Departure Warning (LDW) system/Lane Departure Prevention (LDP) system” (P.5-21).)

The FCW system will sound a warning chime and the vehicle ahead detection indicator light blinks to alert the driver if the vehicle is traveling close to the vehicle ahead. (See “Forward Collision Warning (FCW) system” (P.5-67).)

The warning systems switch is automatically turned on when the engine is started, and the warning systems ON indicator ① on the switch illuminates.

To cancel the warning systems, push the warning systems switch to turn off the system. The warning systems ON indicator will turn off.

NOTE:

If you continue to push the warning systems switch from off to on for over 4 seconds, a chime will sound. This will change the default status of the LDW and FCW systems to OFF so that these systems will not automatically turn on when the engine is started. If this procedure is repeated, the default status will return to ON.

The LDW and LDP systems monitor the lane markers on the traveling lane using the camera unit ① located above the inside mirror. When the camera unit detects that the vehicle is traveling close to either the left or the right of the traveling lane, the lane departure warning light ② on the instrument panel blinks in orange and a warning chime sounds. When the LDP system is on, it will automatically apply the brakes for a short period of time, using the function of the Vehicle Dynamic Control (VDC) system.

To turn on the LDW system, push the warning systems switch ③. The warning systems ON indicator light ④ on the switch will illuminate.

When the warning systems switch is pushed, the FCW system will also turn on or off simultaneously.

See “Forward Collision Warning (FCW) system” (P.5-67).

To turn on the LDP system, push the Dynamic driver assistance switch ⑤. The LDP ON indicator light ② will illuminate in green.

See “Lane Departure Prevention (LDP) system” (P.5-24).

LANE DEPARTURE WARNING (LDW) SYSTEM

Precautions on LDW system

⚠ WARNING

- **This system is only a warning device to inform the driver of a potential unintended lane departure. It will not steer the vehicle or prevent loss of control. It is the driver's responsibility to stay alert, drive safely, keep the vehicle in the traveling lane, and be in control of the vehicle at all times.**
- **The system will not operate at speeds below approximately 45 MPH or if it cannot detect lane markers.**
- **If the LDW system malfunctions, it will cancel automatically, and the lane departure warning light (orange) will illuminate.**
- **If the lane departure warning light (orange) illuminates, pull off the road to a safe location and stop the vehicle. Turn the engine off and restart the engine. If the lane departure warning light (orange) continues to illuminate, have the system checked by an INFINITI retailer.**
- **Excessive noise will interfere with the warning chime sound, and the chime may not be heard.**

The system may not function properly under the following conditions:

- On roads where there are multiple parallel lane markers; lane markers that are faded or not painted clearly; yellow painted lane markers; non-standard lane markers; or lane markers covered with water, dirt, snow, etc.
- On roads where the discontinued lane markers are still detectable.
- On roads where there are sharp curves.
- On roads where there are sharply contrasting objects, such as shadows, snow, water, wheel ruts, seams or lines remaining after road repairs. (The LDW system could detect these items as lane markers.)
- On roads where the traveling lane merges or separates.
- When the vehicle’s traveling direction does not align with the lane marker.

conditions, have the vehicle checked at an INFINITI retailer.

Sensor maintenance

How to handle the sensor:

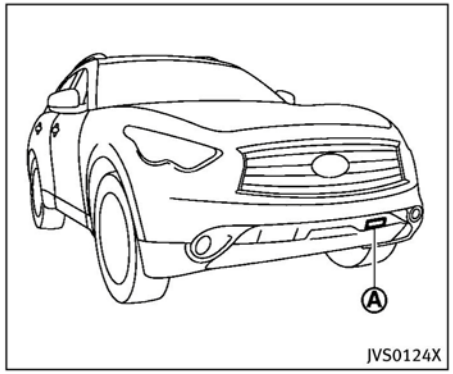
The sensor for the DCA system is common with Intelligent Cruise Control and is located below the front bumper.

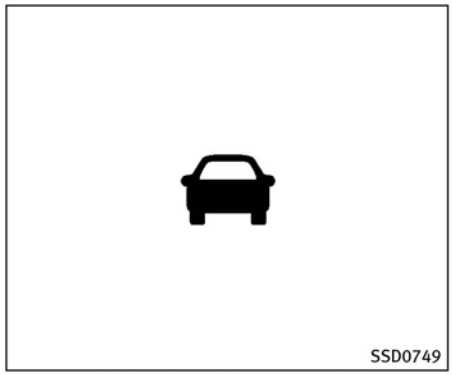
To handle the sensor, see “Intelligent Cruise Control (ICC) system (FULL SPEED RANGE)” (P.5-32).

FORWARD COLLISION WARNING (FCW) SYSTEM (if so equipped)

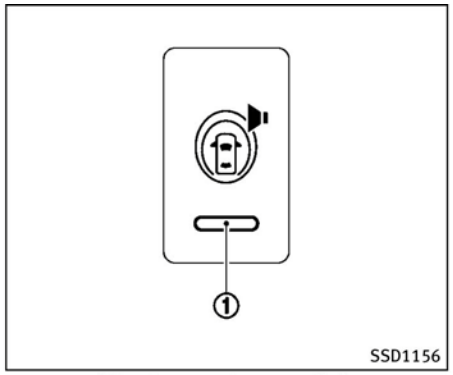
The Forward Collision Warning (FCW) system will warn the driver by a warning light and chime when your vehicle is getting close to the vehicle ahead in the traveling lane.

The FCW system will function when your vehicle is driven at speeds of approximately 10 MPH (15 km/h) and above.





Vehicle ahead detection light



Warning systems switch

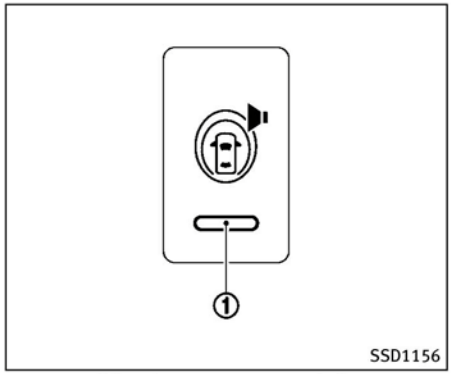
The FCW system uses the distance sensor Ⓐ located below the front bumper to measure the distance to the vehicle ahead. When the system judges that your vehicle is getting close to the vehicle ahead in the travel lane, the vehicle ahead detection indicator light on the instrument panel blinks and a warning chime sounds.

The FCW system will be turned on/off by pushing the warning systems switch. The warning systems ON indicator light ① on the switch will illuminate when the system turns on.

PRECAUTIONS ON FCW SYSTEM

WARNING

- **The FCW system is intended to warn you before a collision but will not avoid a collision. It is the driver's responsibility to stay alert, drive safely and be in control of the vehicle at all times.**
- **As there is a performance limit, the system may not provide a warning in certain conditions.**
- **The system will not detect the following objects:**
  - **— Pedestrians, animals or obstacles in the roadway**
  - **— Oncoming vehicles in the same lane**
- **The system will not detect another vehicle under the following conditions:**
  - **— When the sensor gets dirty and it is impossible to detect the distance from the vehicle ahead.**
  - **— When driving into a strong light (for example, sunlight)**
- **The sensor generally detects the signals returned from the reflectors on a vehicle ahead. Therefore, the system may not function properly under the following conditions:**
  - **— When the reflectors of the vehicle ahead are positioned high or close to each other (including a small vehicle such as motorcycles).**
  - **— When the sensor gets dirty or it is impossible to detect the distance from the vehicle ahead.**
  - **— When the reflectors on the vehicle ahead are missing, damaged or covered.**
  - **— When the reflectors of the vehicle ahead are covered with dirt, snow or road spray.**
  - **— When visibility is low (such as rain, fog, snow, etc.).**
  - **— When snow or road spray from traveling vehicles is splashed.**
  - **— When dense exhaust or other smoke (black smoke) from vehicles reduces the visibility of the sensor.**
  - **— When excessively heavy baggage is loaded in the rear seat or the luggage room of your vehicle.**



Warning systems switch

FCW system operation

The FCW system will function at speeds of approximately 10 MPH (15 km/h) and above, when the system turns on.

The FCW system has an automatic setting mode and a manual setting mode to turn the system on. The setting mode can be changed. In the automatic setting mode, the FCW system is automatically turned on when the ignition switch is pushed to the ON position. When the FCW system is on, the warning systems ON indicator light ① on the warning systems switch illuminates. To cancel the FCW system, push the warning systems switch. The warning systems ON indicator light will turn off. To turn on the system, push the warning systems switch again.

When the warning systems switch is pushed, the LDW system will also turn on or off simultaneously. See “Lane Departure Warning (LDW) system/Lane Departure Prevention (LDP) system” (P.5-21).

In the manual setting mode, you need to push the warning systems switch to turn on the system after the ignition switch is pushed to the ON position.

The setting mode can be changed using the warning systems switch. To change the setting mode, push and hold the warning systems switch for more than 4 seconds when the warning systems ON indicator is off. When the mode is changed, a chime sounds and the lane departure warning light (orange) flashes.

For the sensor maintenance, see “Intelligent Cruise Control (ICC) system (FULL SPEED RANGE)” (P.5-32).

INTELLIGENT BRAKE ASSIST (IBA) SYSTEM (if so equipped)

The Intelligent Brake Assist (IBA) system warns the driver by a warning light and chime when there is a risk of a collision with the vehicle ahead in the traveling lane and the driver must take avoidance action immediately. The system helps reduce the rear-end collision speed by applying the brakes when the system judges that the collision cannot be prevented.

The IBA system will function when your vehicle is driven at speeds of approximately 10 MPH (15 km/h) and above, and when your vehicle is driven at speeds approximately 10 MPH (15 km/h) faster than the vehicle ahead.

APPENDIX C

Run Log

Subject Vehicle: **2013 Infiniti FX37** Date: May 1-2, 2013

Principal Other Vehicle: 2000 Honda Accord

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
1	FCW1 (Stopped)	N					
2		Y	2.68	2.48	0.58	Pass	
3		Y	2.65	2.41	0.55	Pass	
4		Y	2.68	2.46	0.58	Pass	
5		Y	2.81	2.59	0.71	Pass	
6		Y	2.72	2.54	0.62	Pass	
7		Y	2.74	2.57	0.64	Pass	
8		Y	2.74	2.54	0.64	Pass	
9	FCW3 (Slower)	Y	3.58	3.44	1.58	Pass	
10		Y	3.68	3.53	1.68	Pass	
11		Y	3.75	3.61	1.75	Pass	
12		Y	3.68	3.54	1.68	Pass	
13		Y	3.78	3.61	1.78	Pass	
14		Y	3.78	3.63	1.78	Pass	
15		Y	3.77	3.66	1.77	Pass	

Subject Vehicle: **2013 Infiniti FX37** Date: May 1-2, 2013

Principal Other Vehicle: 2000 Honda Accord

Run	Test Type	Valid Run?	TTCW Sound (sec)	TTCW Light (sec)	TTCW Margin (sec)	Pass/Fail	Notes
16	FCW2 (Braking)	N					
17		N					
18		N					
19		Y	2.57	2.32	0.17	Pass	
20		Y	2.69	2.51	0.29	Pass	
21		Y	2.67	2.50	0.27	Pass	
22		Y	2.60	2.45	0.20	Pass	
23		N					
24		N					
25		N					
26		N					
27		Y	2.50	2.34	0.10	Pass	
28		Y	2.42	2.30	0.02	Pass	
29		Y	2.57	2.45	0.17	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.

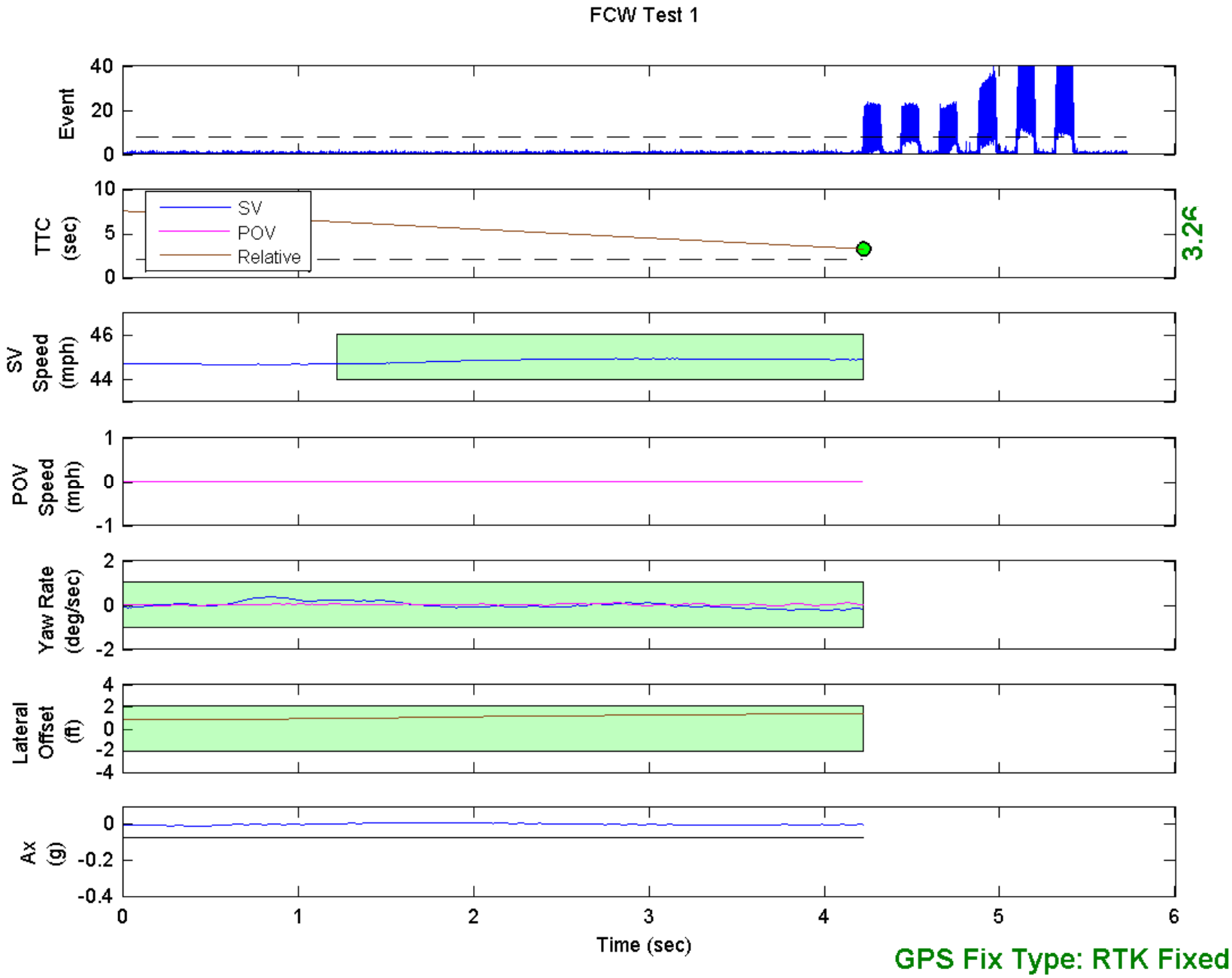


Figure D1. Example Time History for Test Type 1, Passing

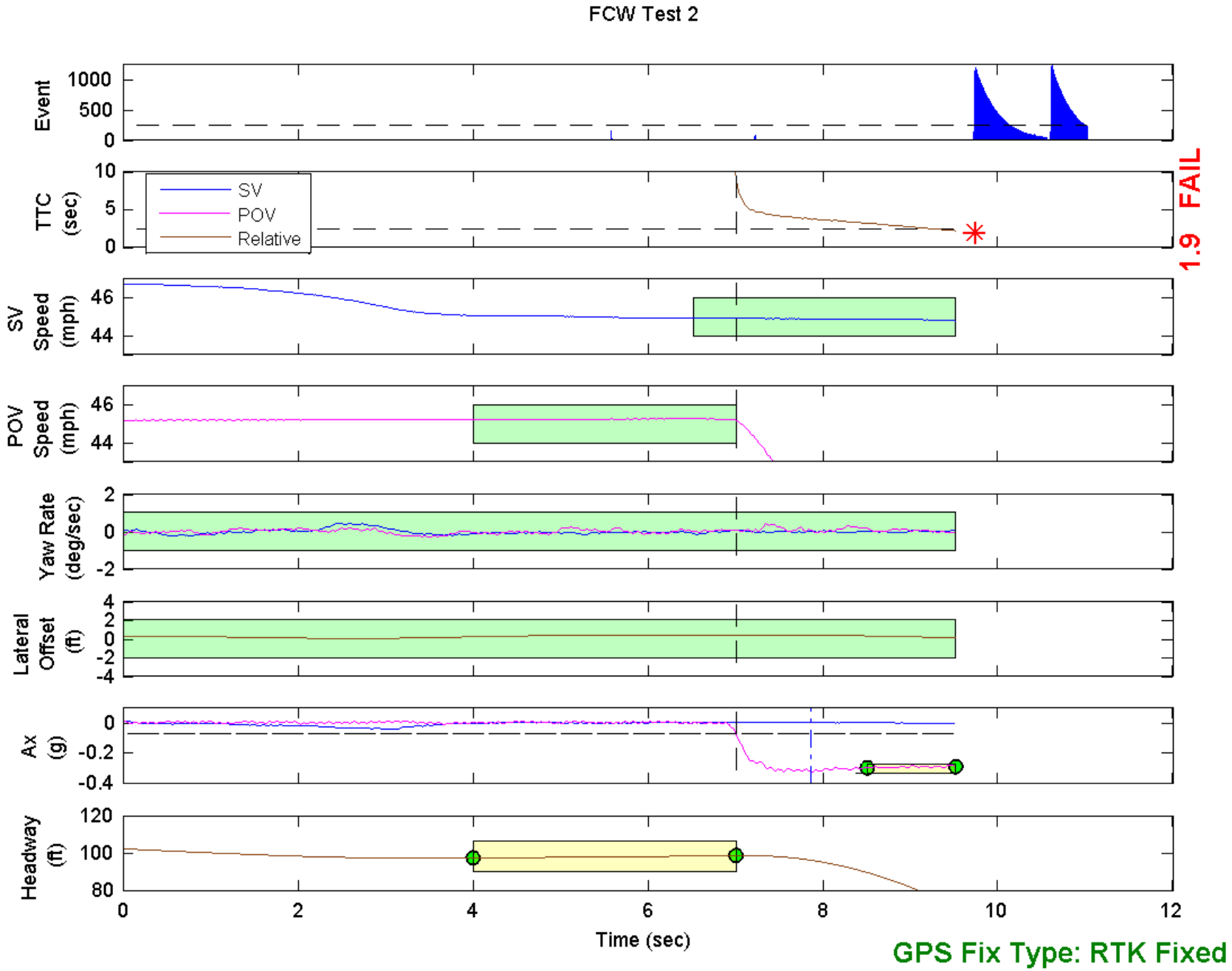


Figure D2. Example Time History for Test Type 2, Failing

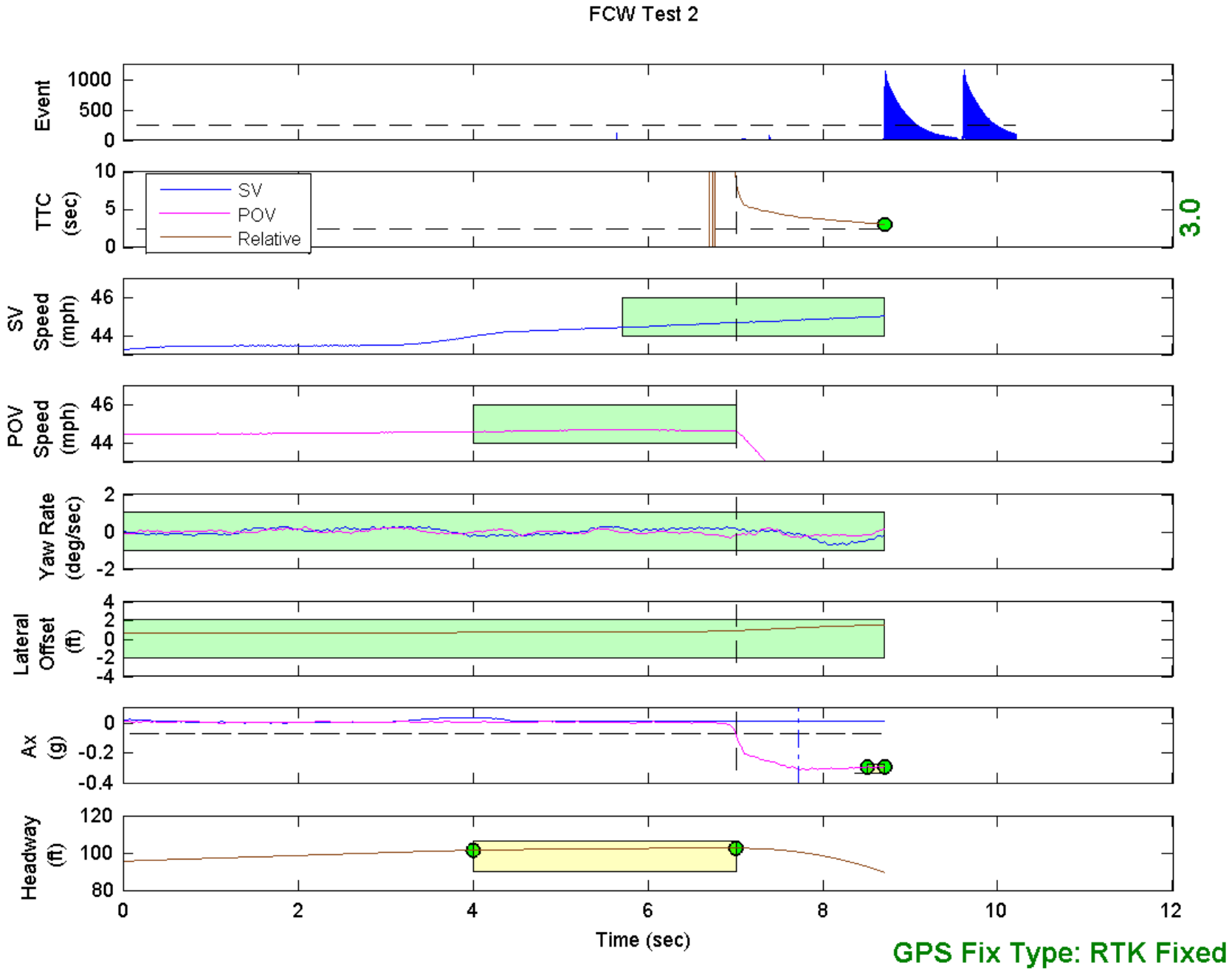


Figure D3. Example Time History for Test Type 2, Passing

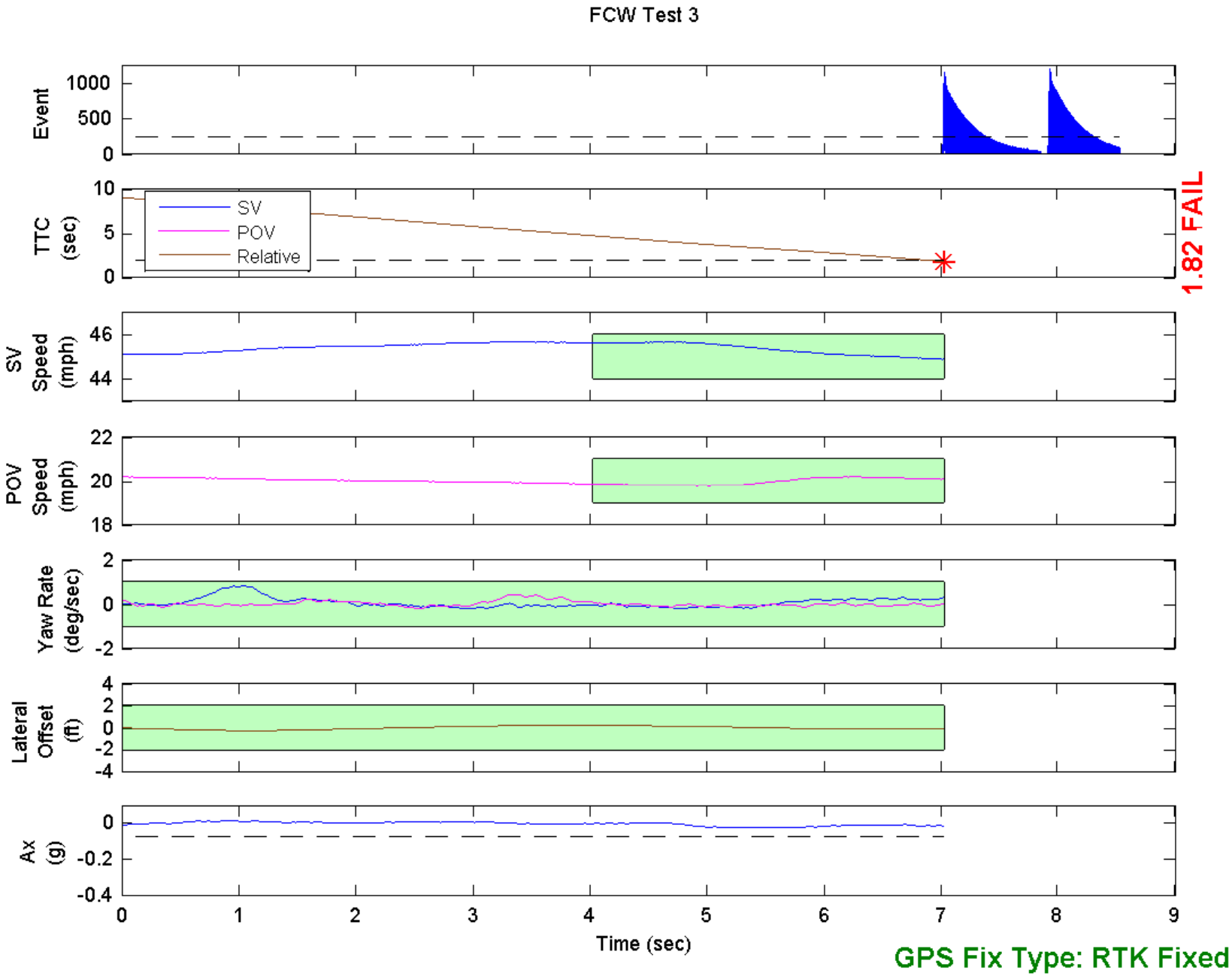


Figure D4. Example Time History for Test Type 3, Failing

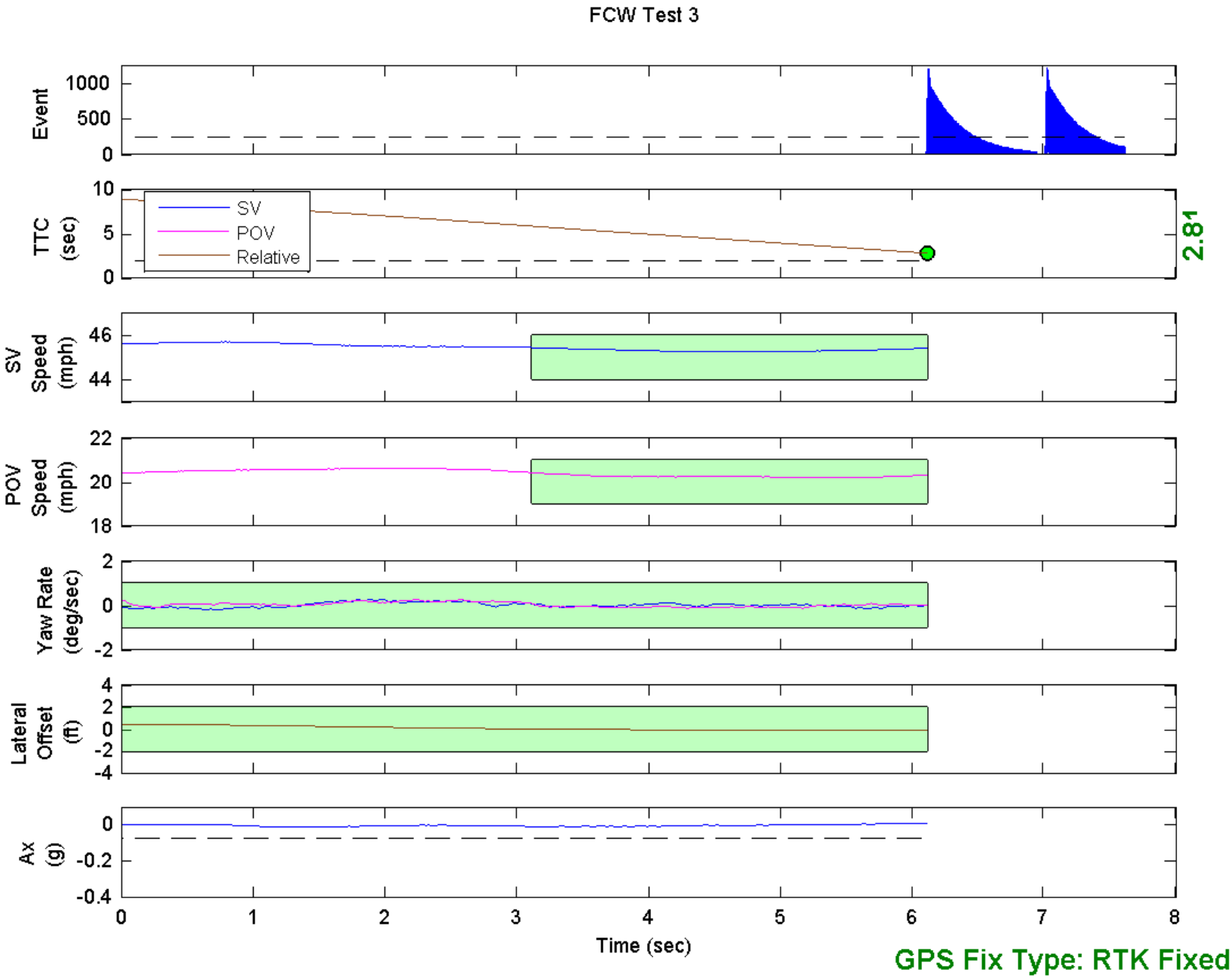


Figure D5. Example Time History for Test Type 3, Passing

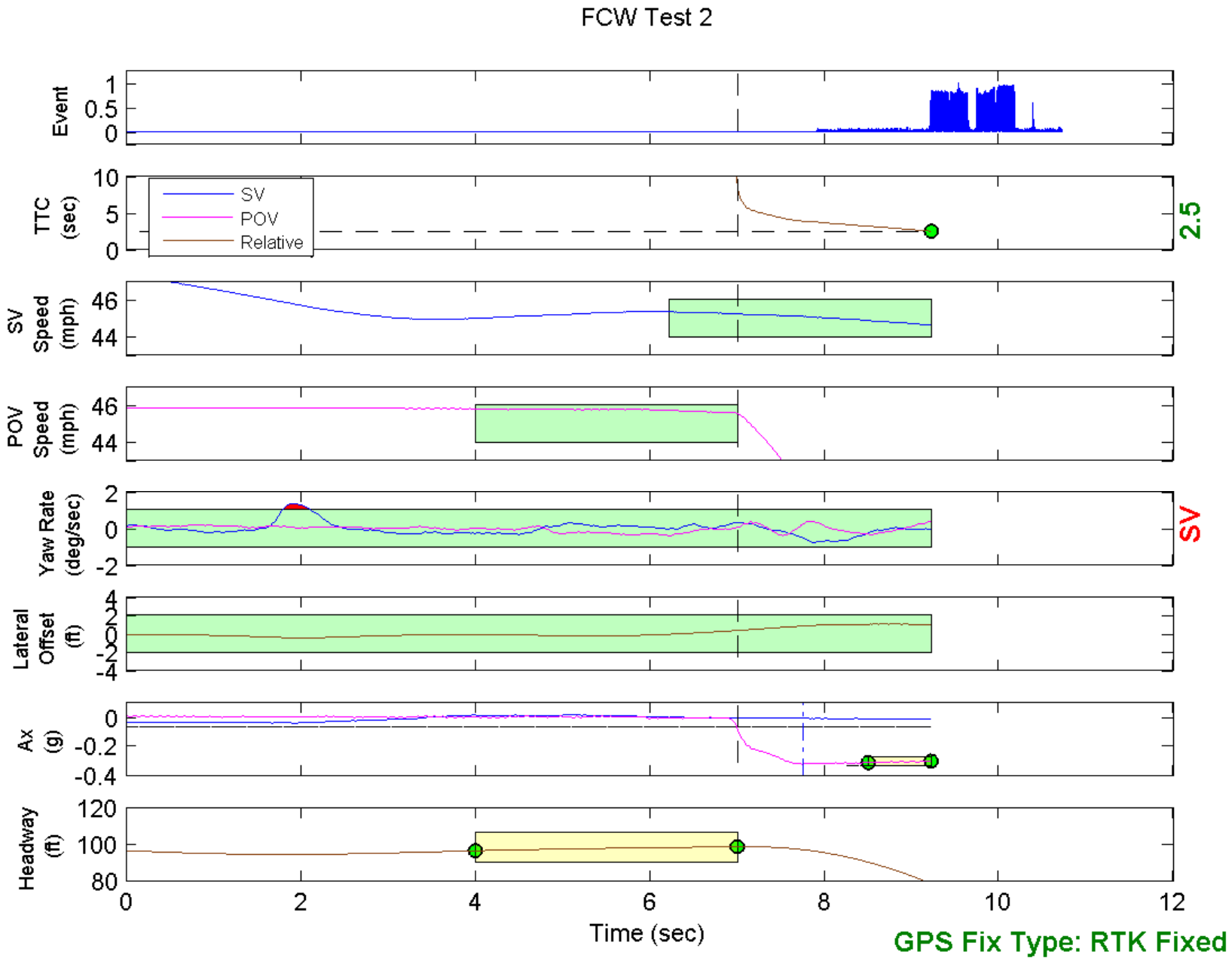


Figure D6. Example Time History for Test Type 2, Invalid Run Due to Subject Vehicle Yaw Rate

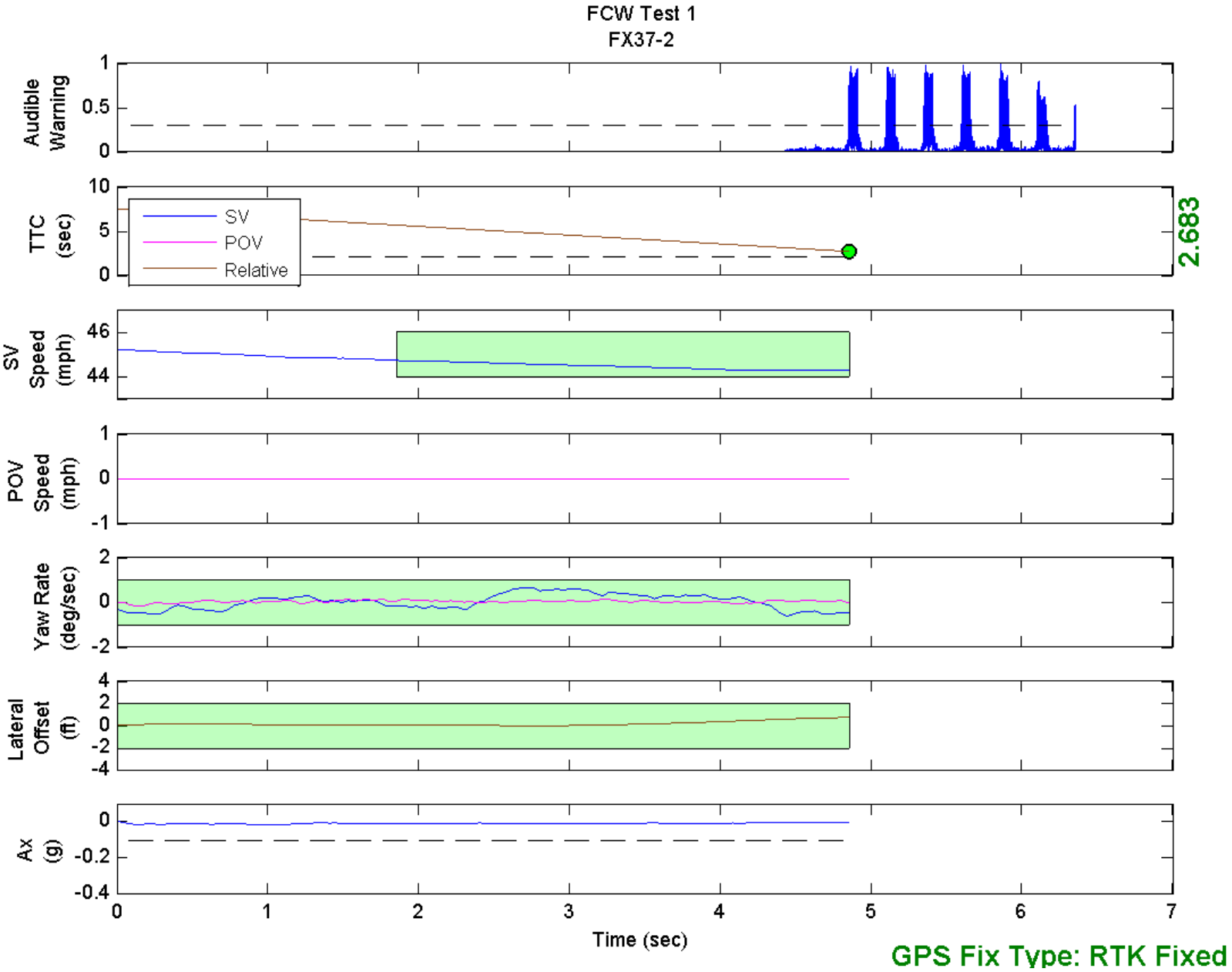


Figure D7. Time History for Run 2, FCW Test 1, Audible Warning

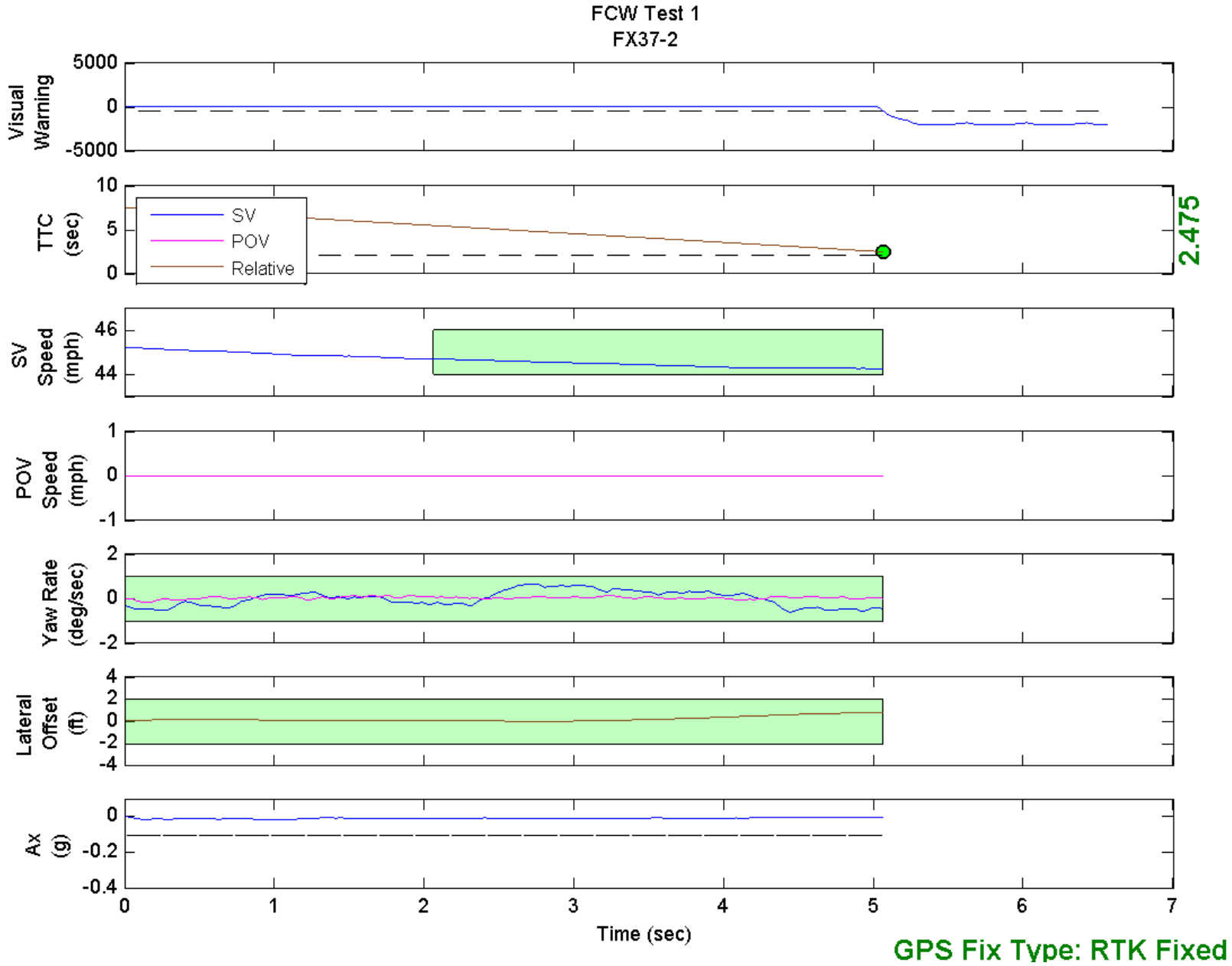


Figure D8. Time History for Run 2, FCW Test 1, Visual Warning

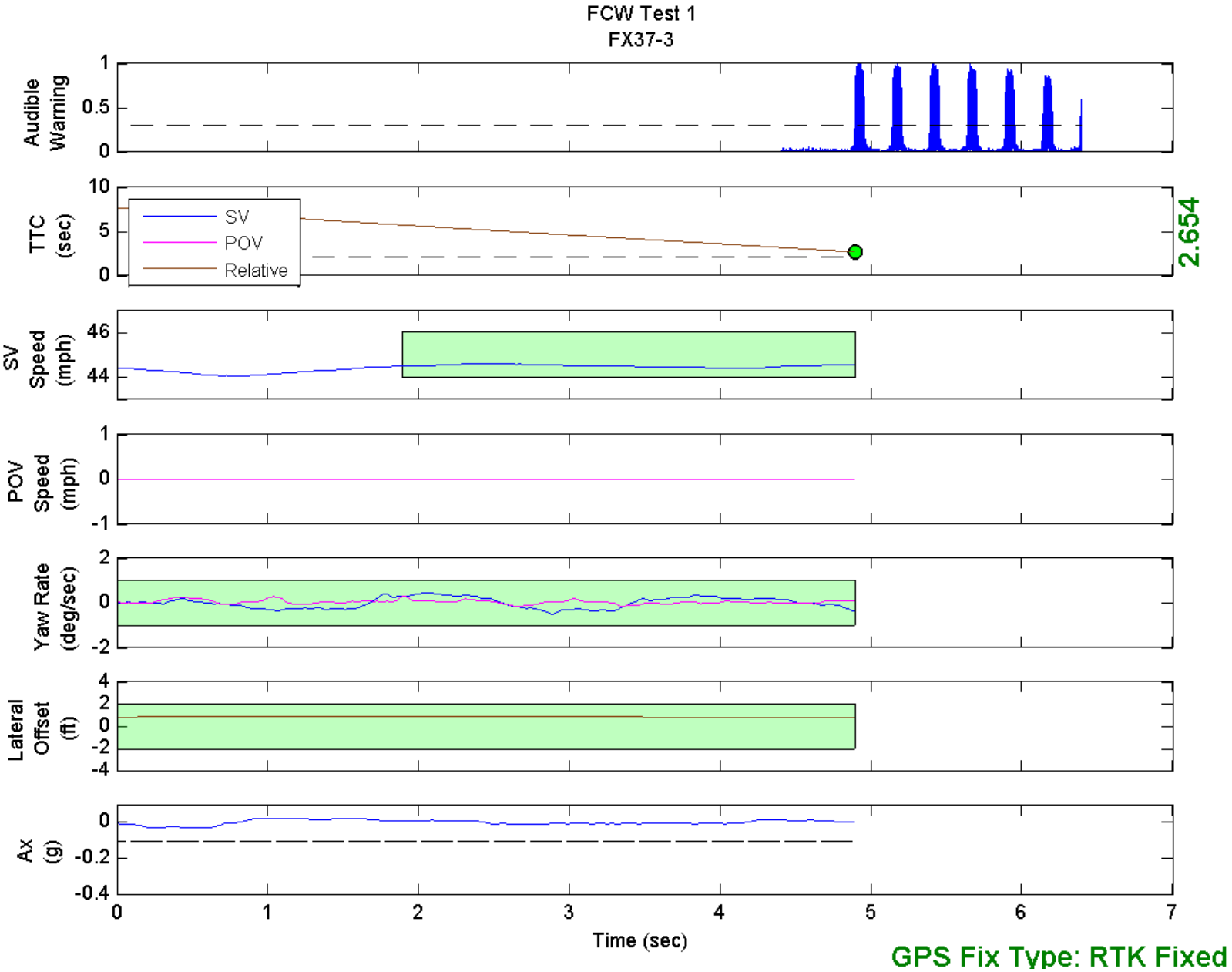


Figure D9. Time History for Run 3, FCW Test 1, Audible Warning

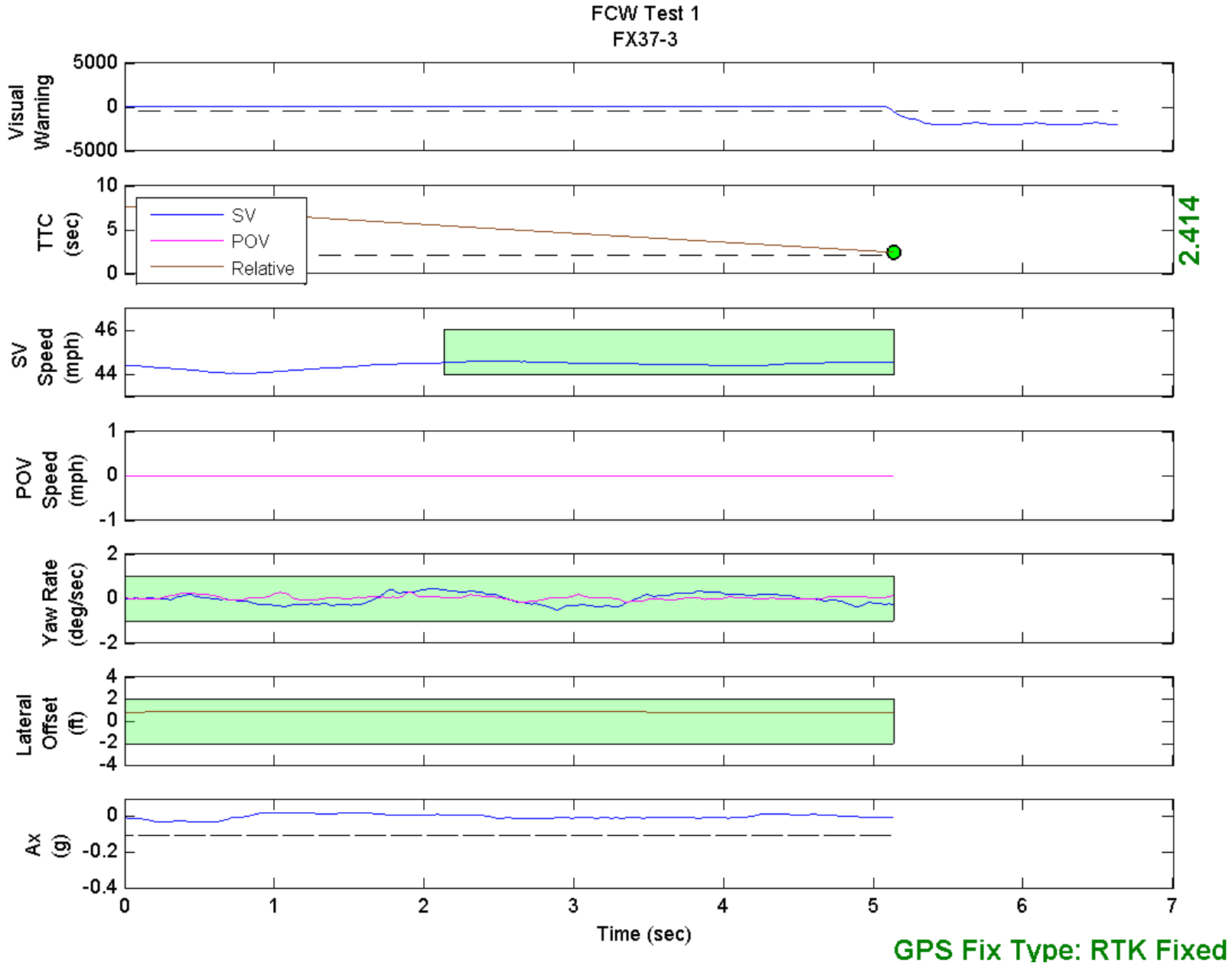


Figure D10. Time History for Run 3, FCW Test 1, Visual Warning

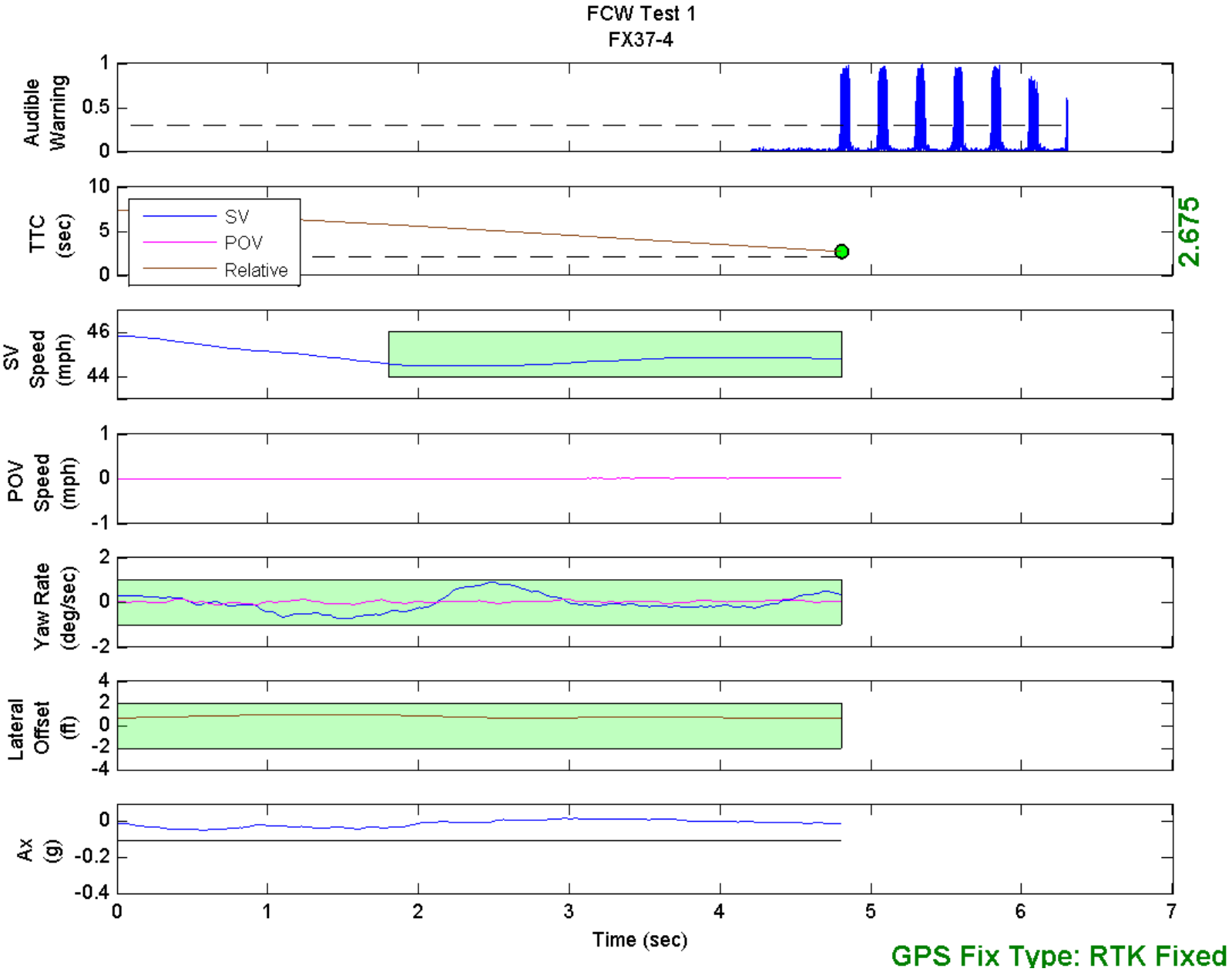


Figure D11. Time History for Run 4, FCW Test 1, Audible Warning

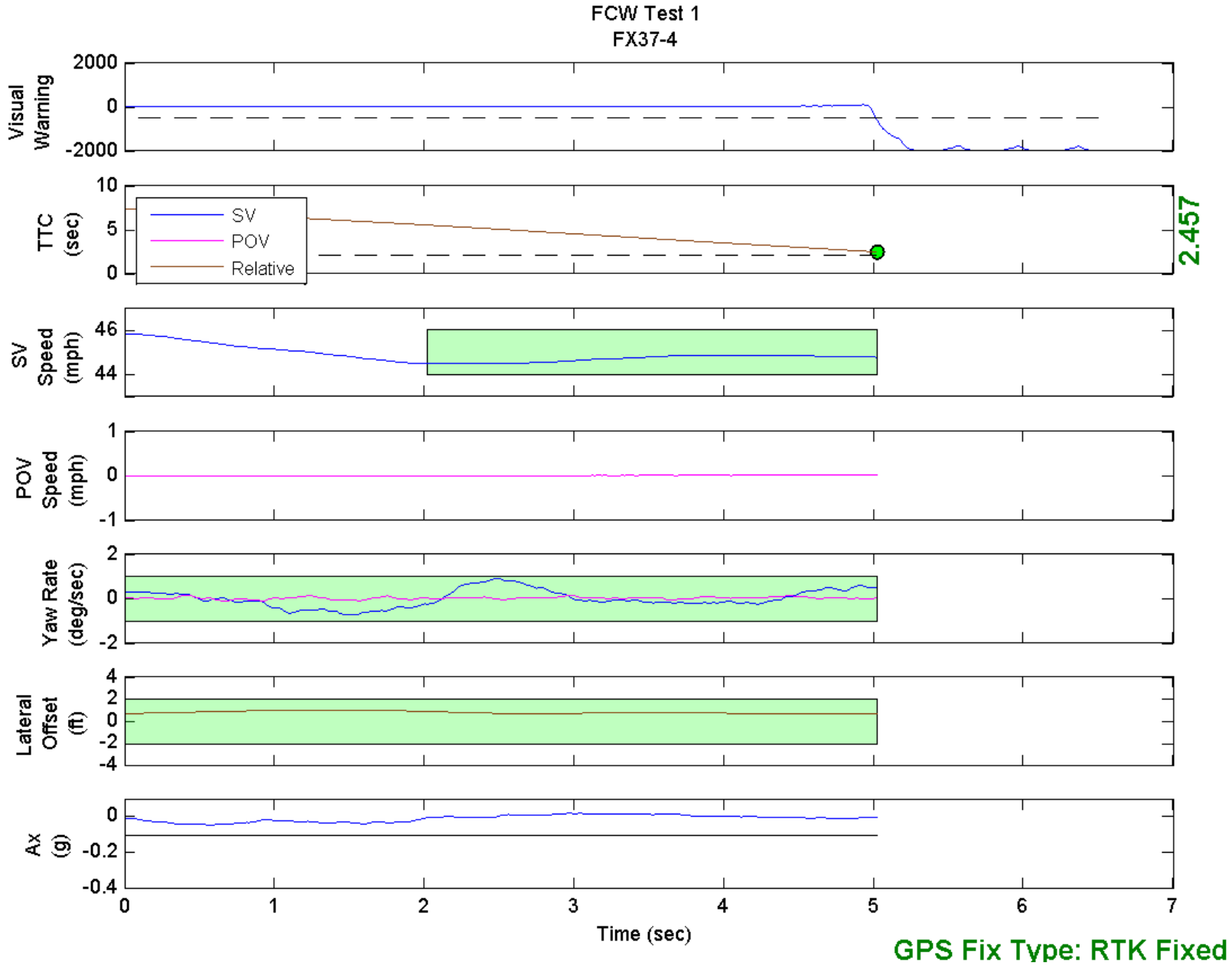


Figure D12. Time History for Run 4, FCW Test 1, Visual Warning

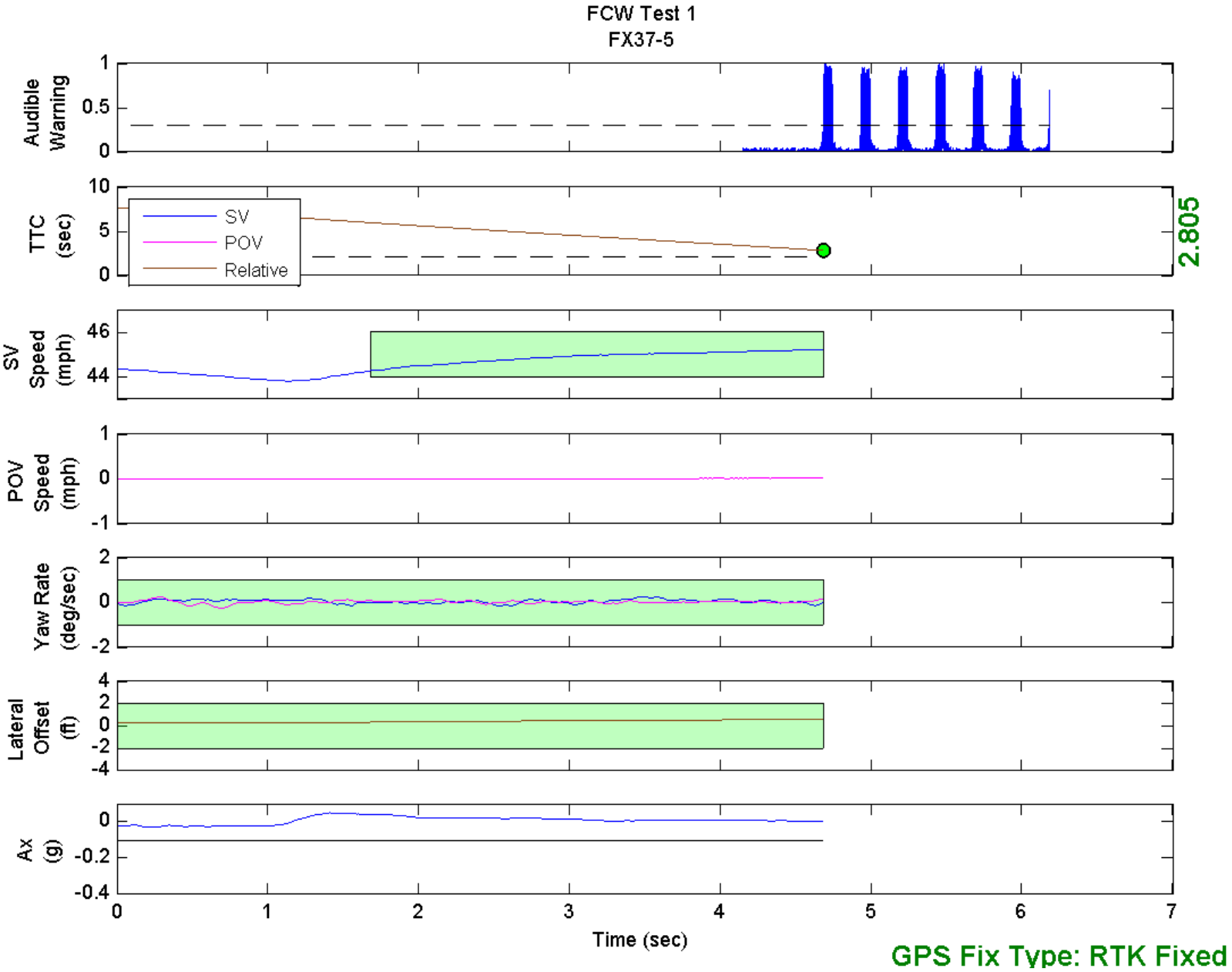


Figure D13. Time History for Run 5, FCW Test 1, Audible Warning

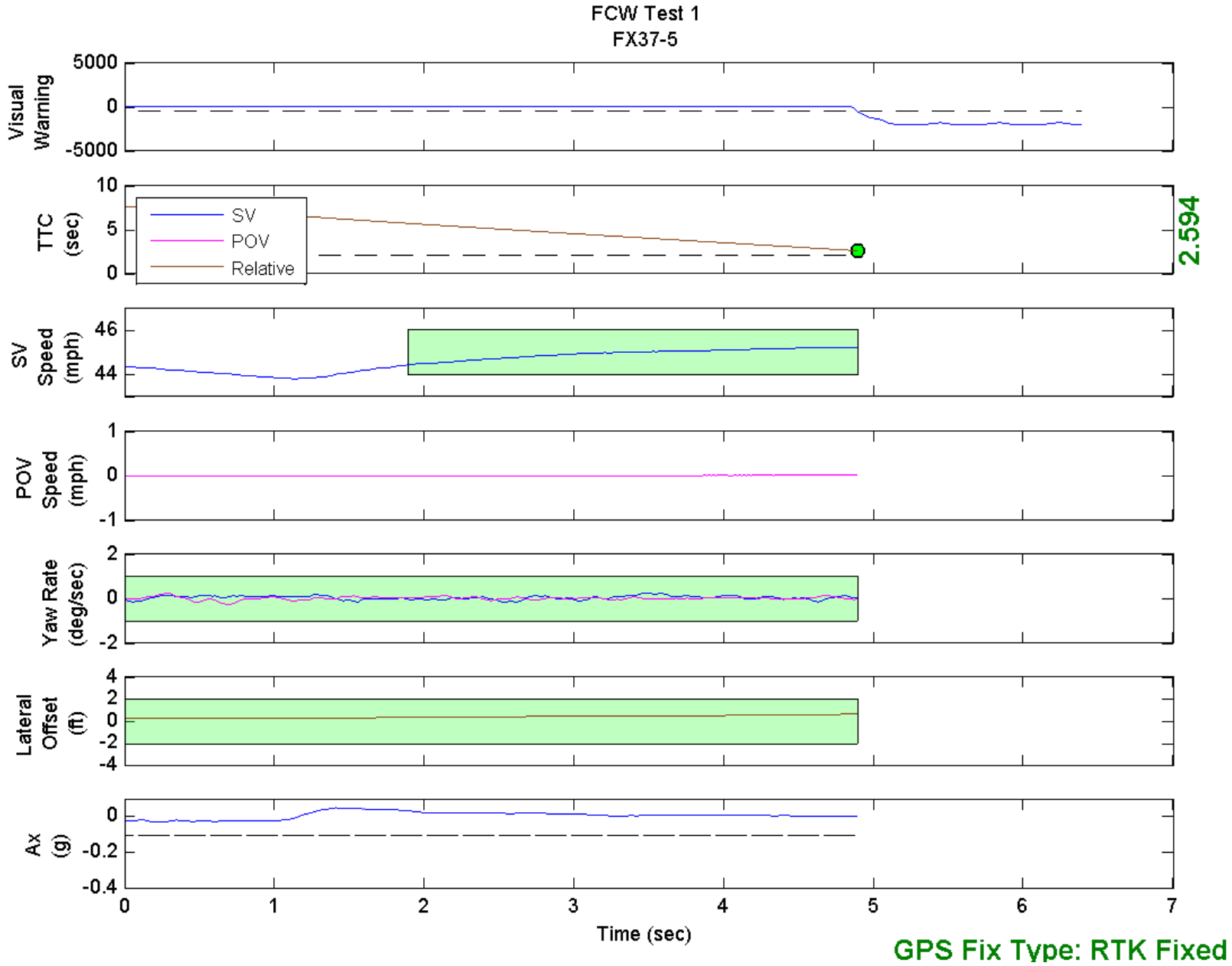


Figure D14. Time History for Run 5, FCW Test 1, Visual Warning

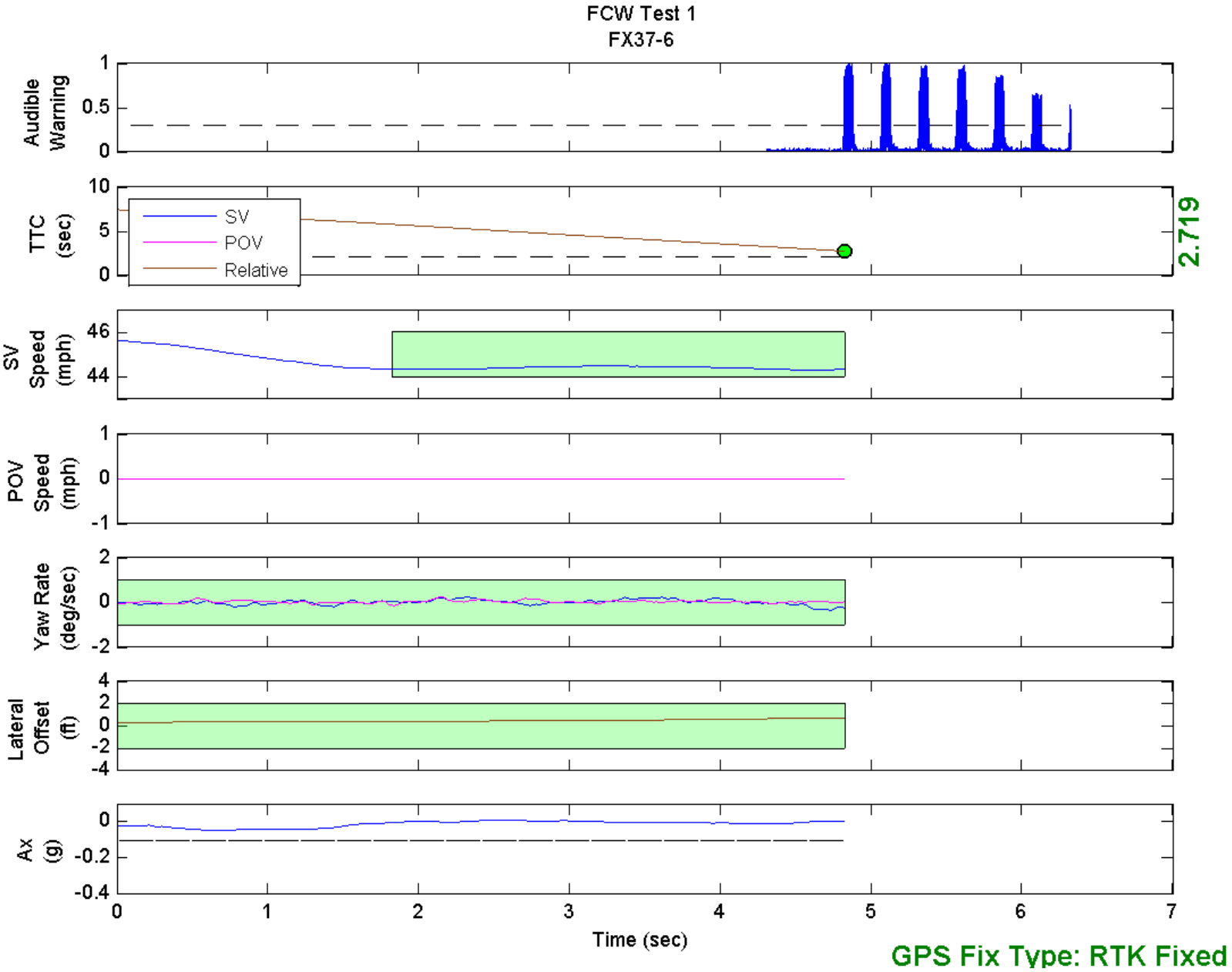


Figure D15. Time History for Run 6, FCW Test 1, Audible Warning

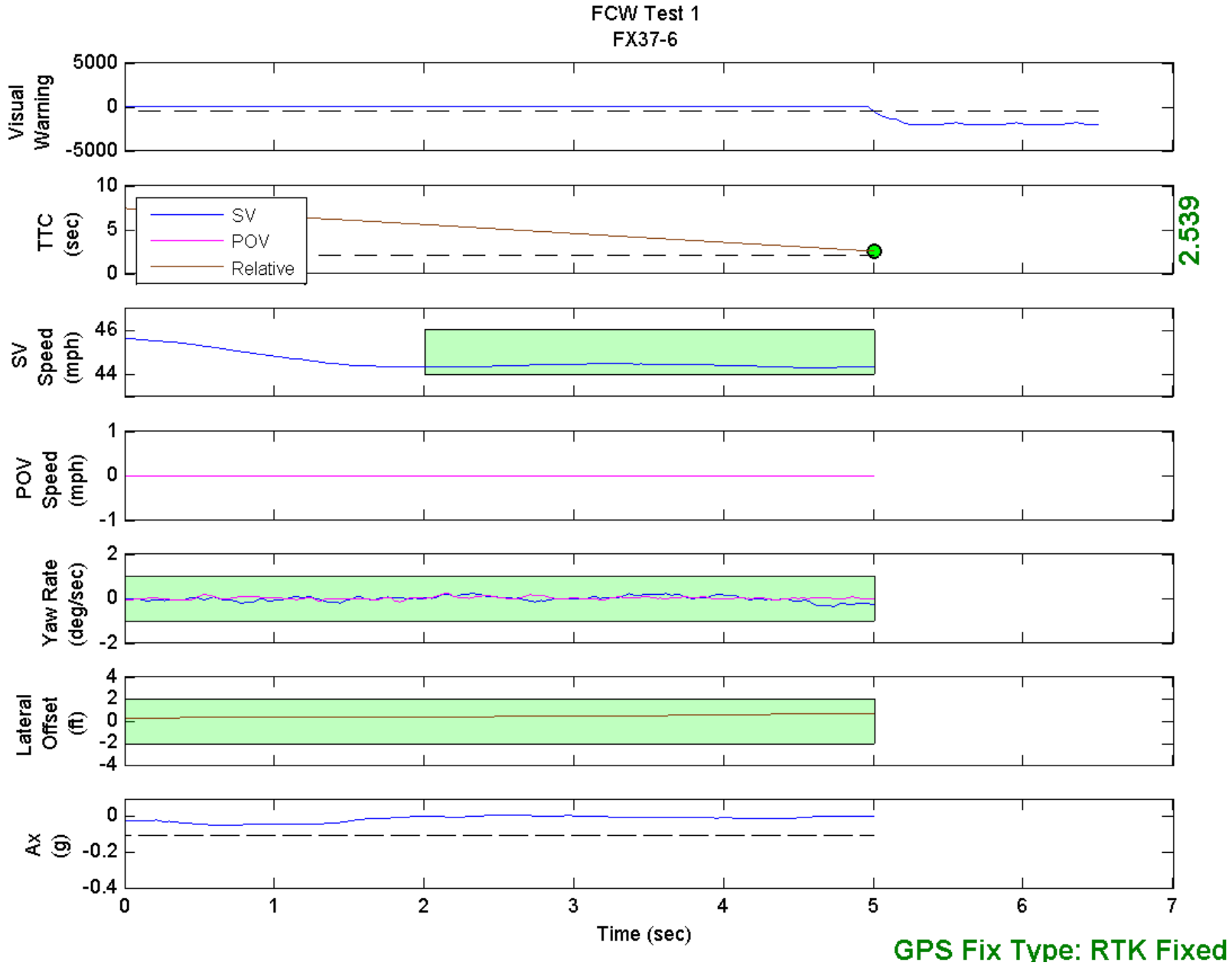


Figure D16. Time History for Run 6, FCW Test 1, Visual Warning

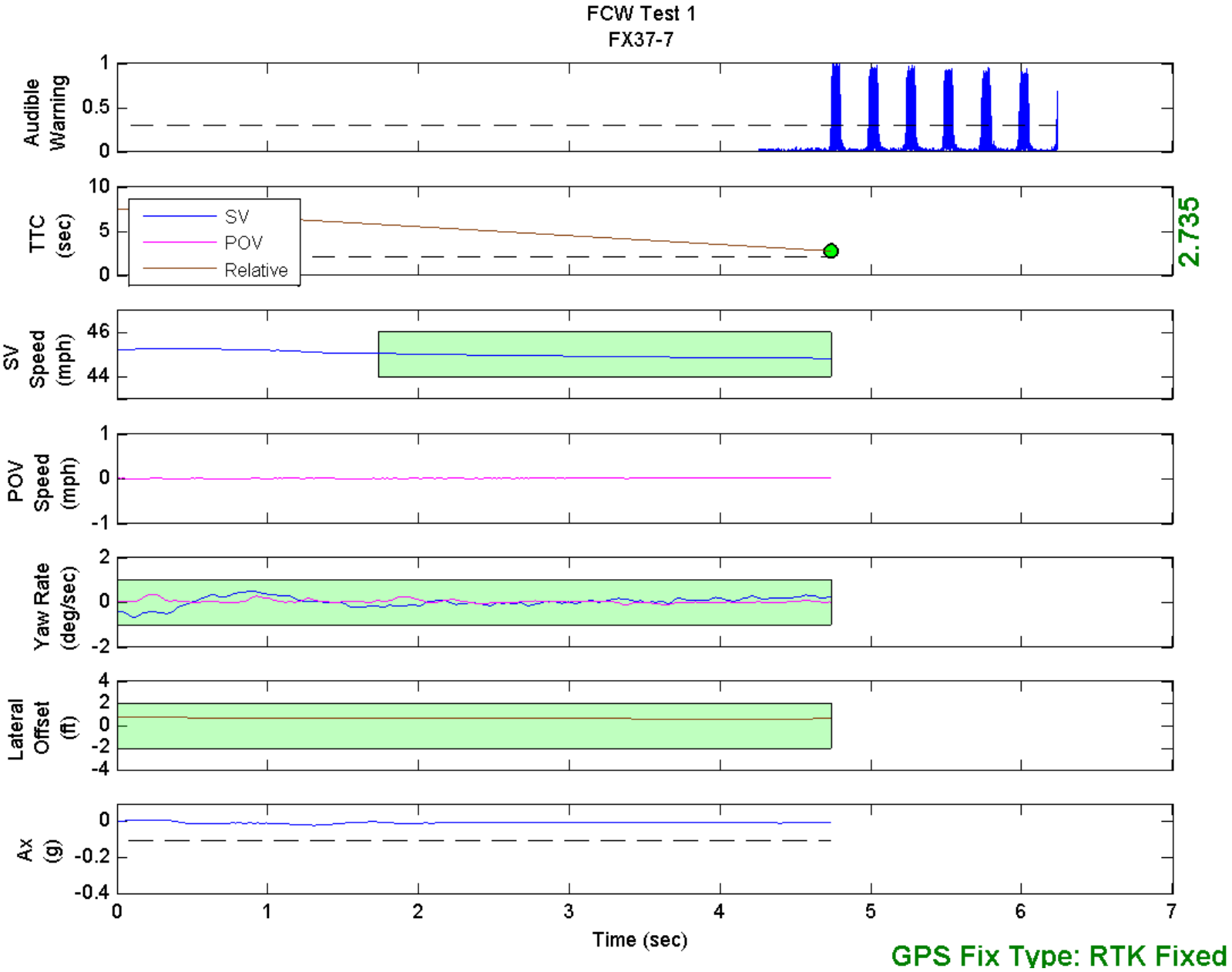


Figure D17. Time History for Run 7, FCW Test 1, Audible Warning

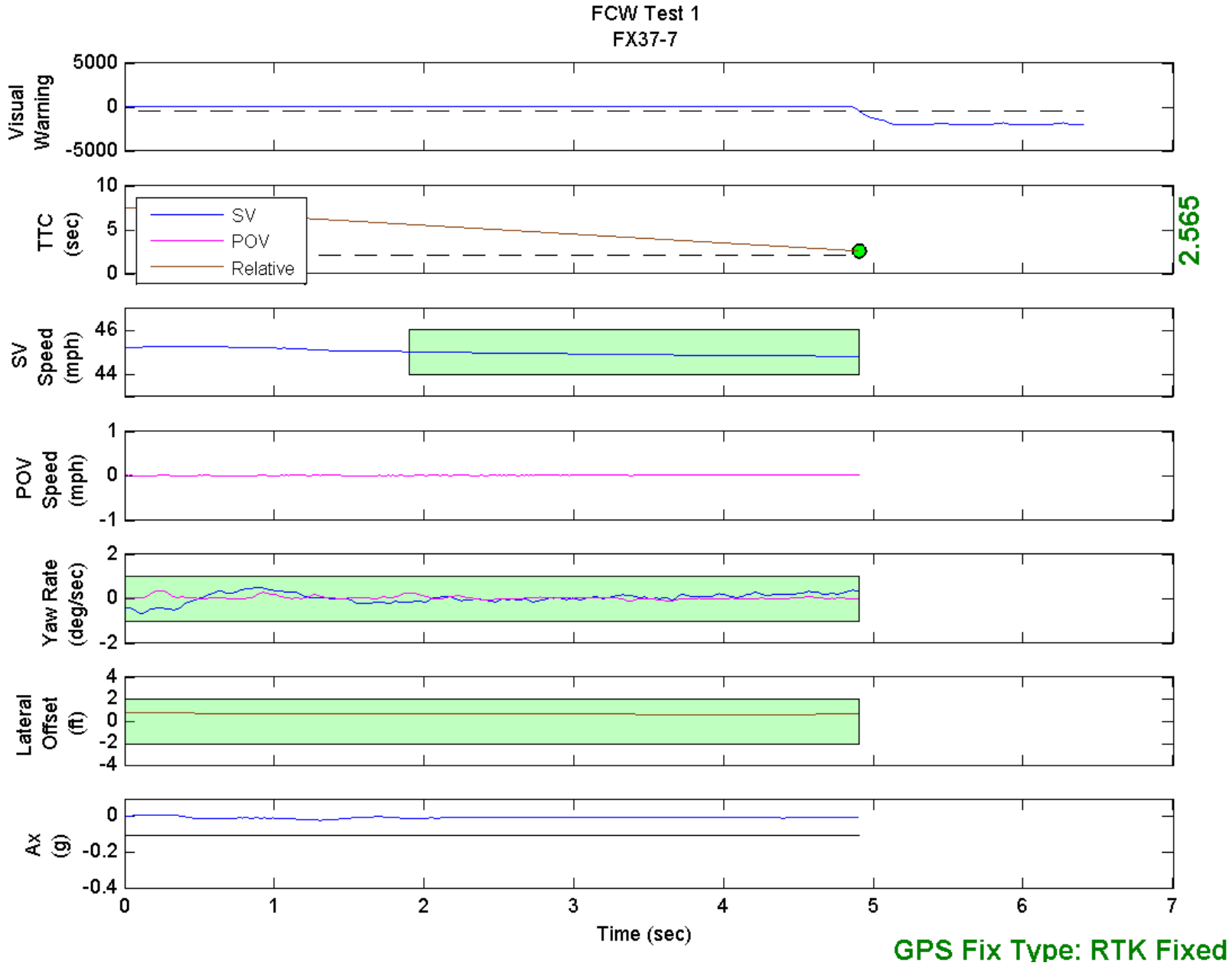


Figure D18. Time History for Run 7, FCW Test 1, Visual Warning

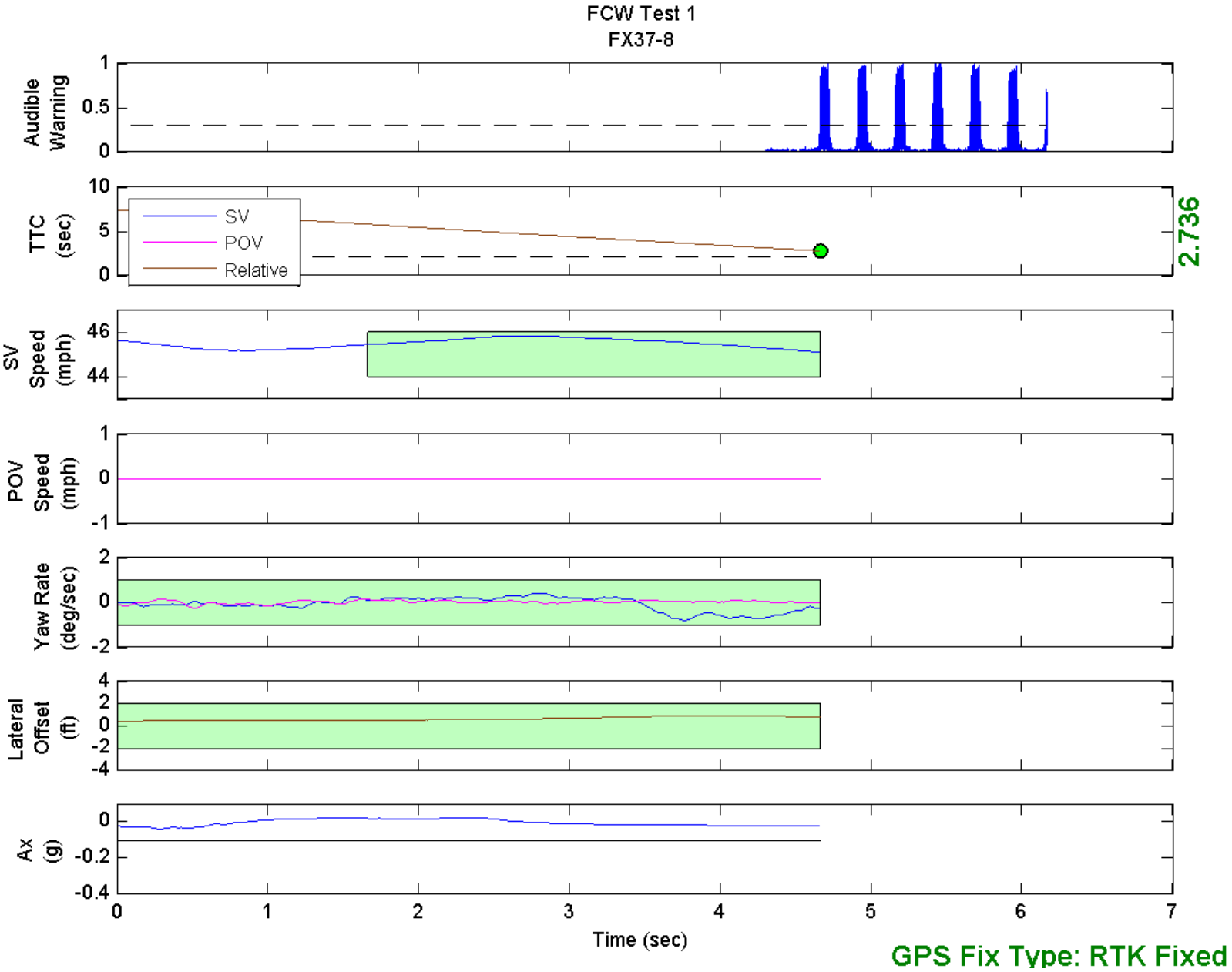


Figure D19. Time History for Run 8, FCW Test 1, Audible Warning

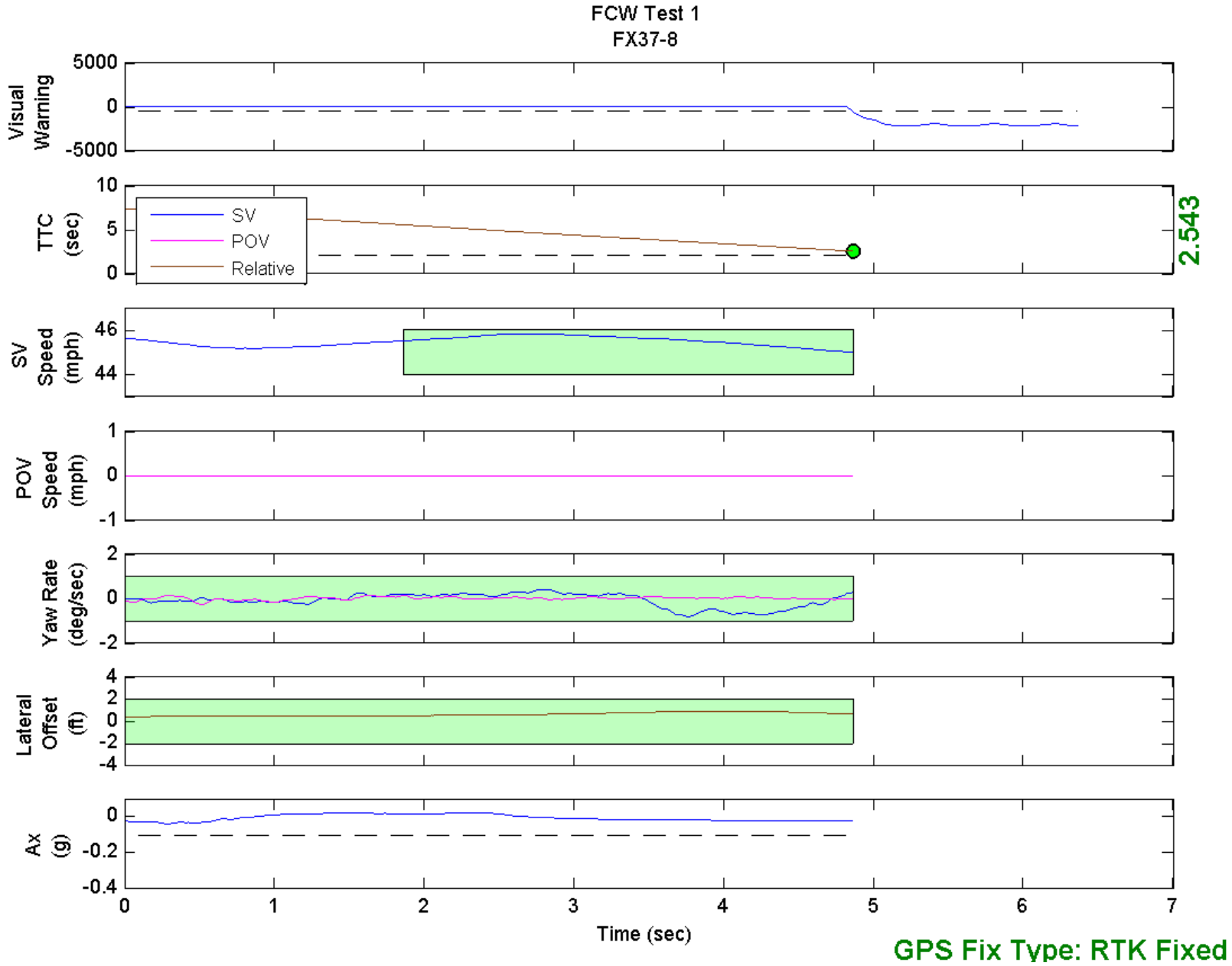


Figure D20. Time History for Run 8, FCW Test 1, Visual Warning

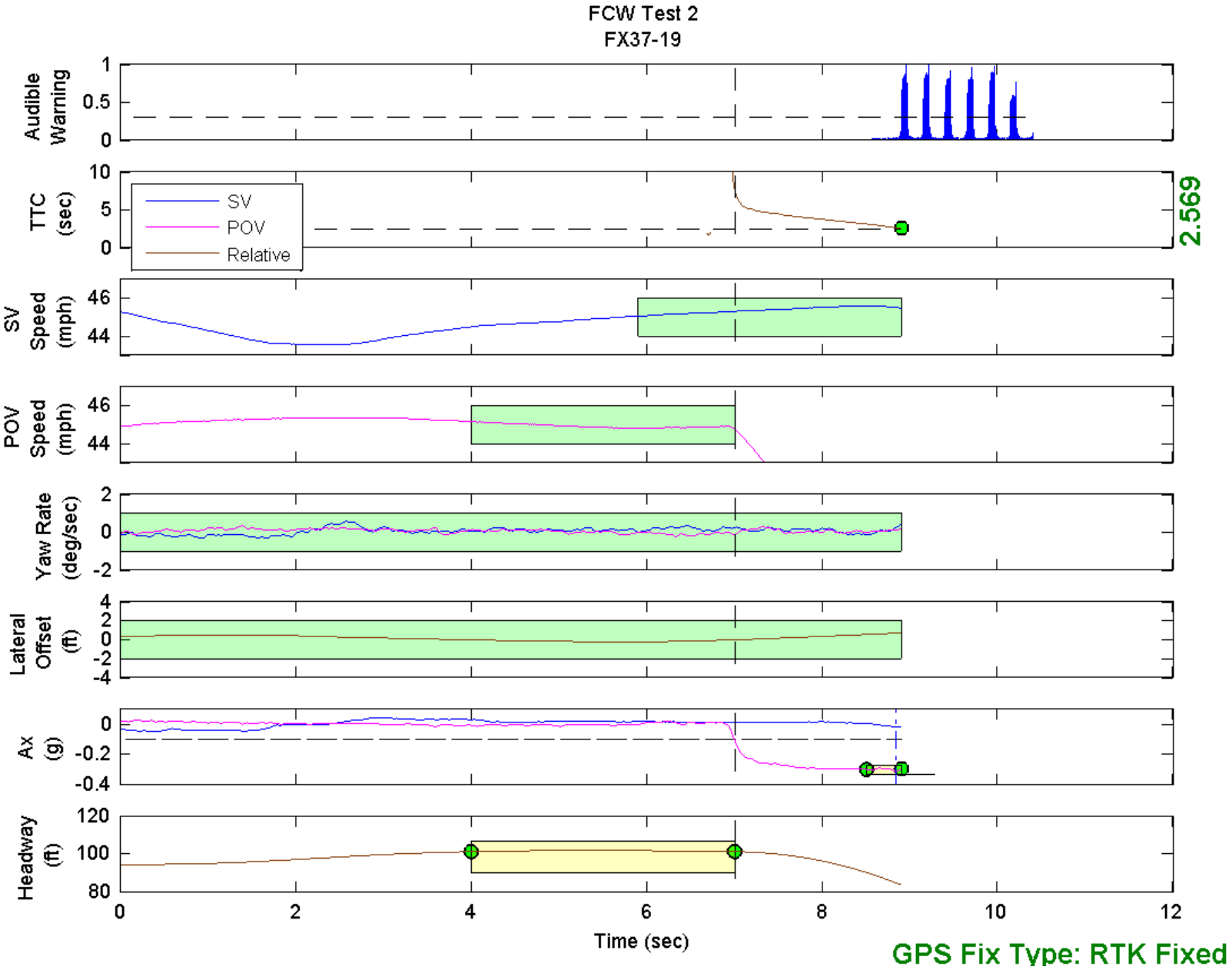


Figure D21. Time History for Run 19, FCW Test 2, Audible Warning

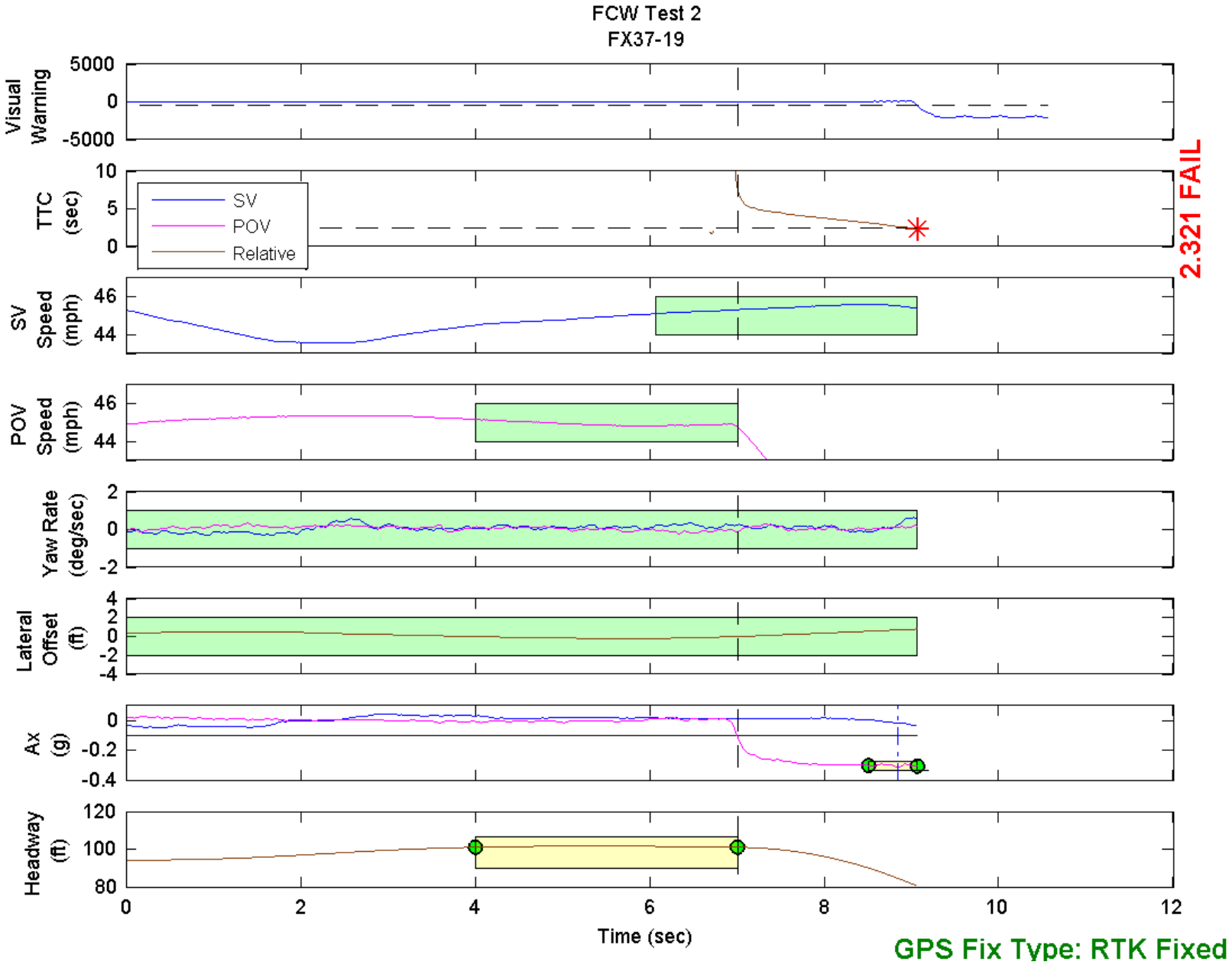


Figure D22. Time History for Run 19, FCW Test 2, Visual Warning

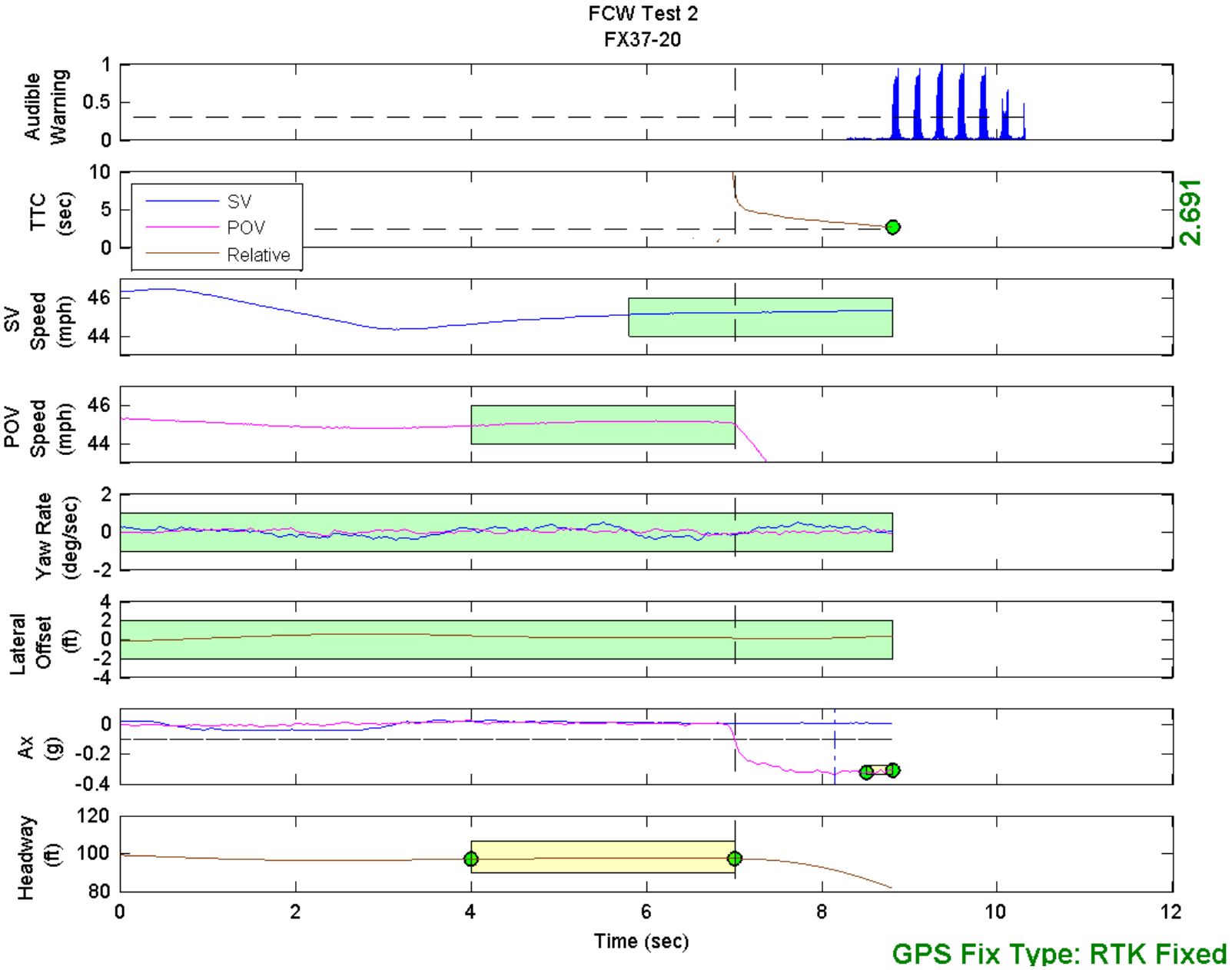


Figure D23. Time History for Run 20, FCW Test 2, Audible Warning

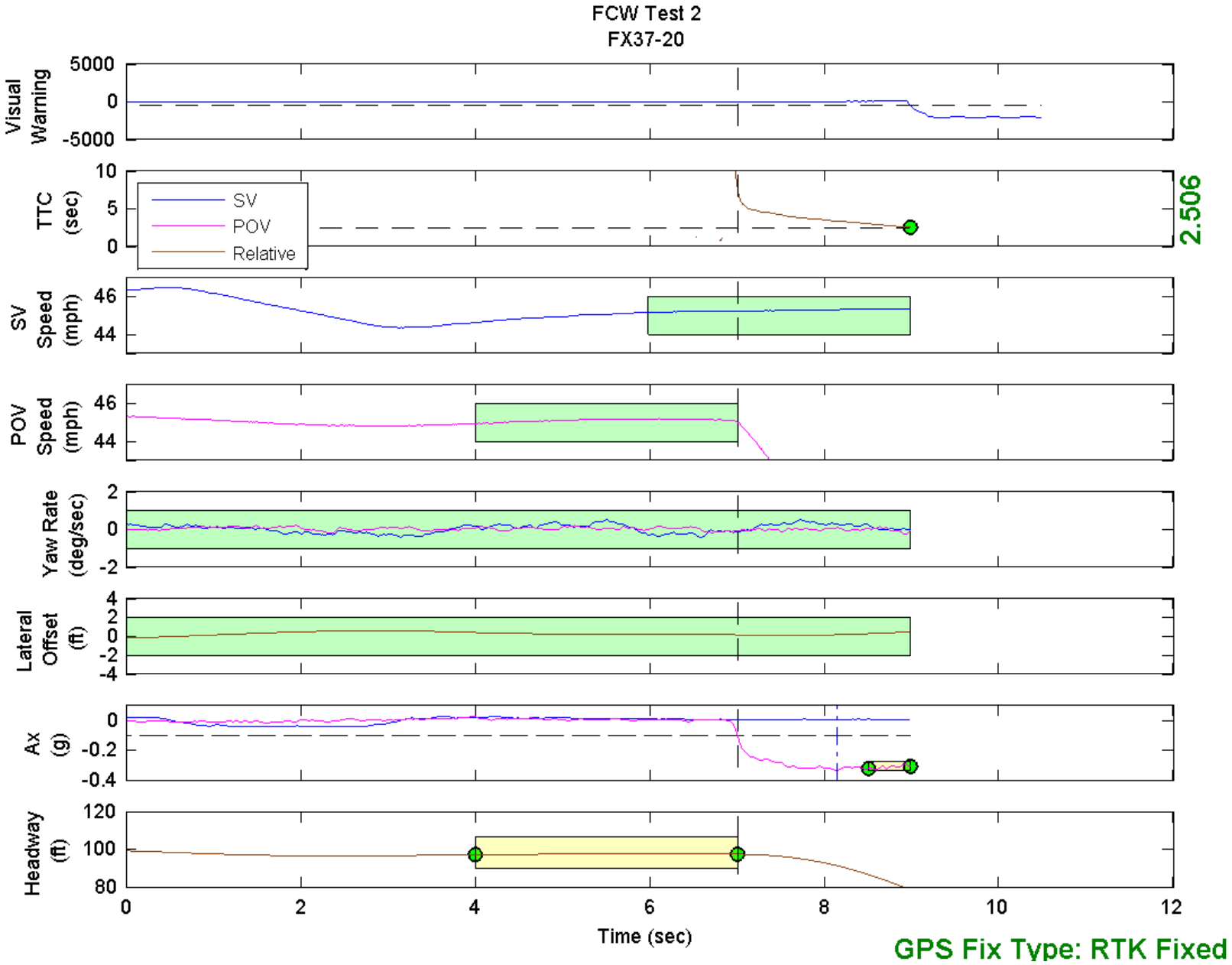


Figure D24. Time History for Run 20, FCW Test 2, Visual Warning

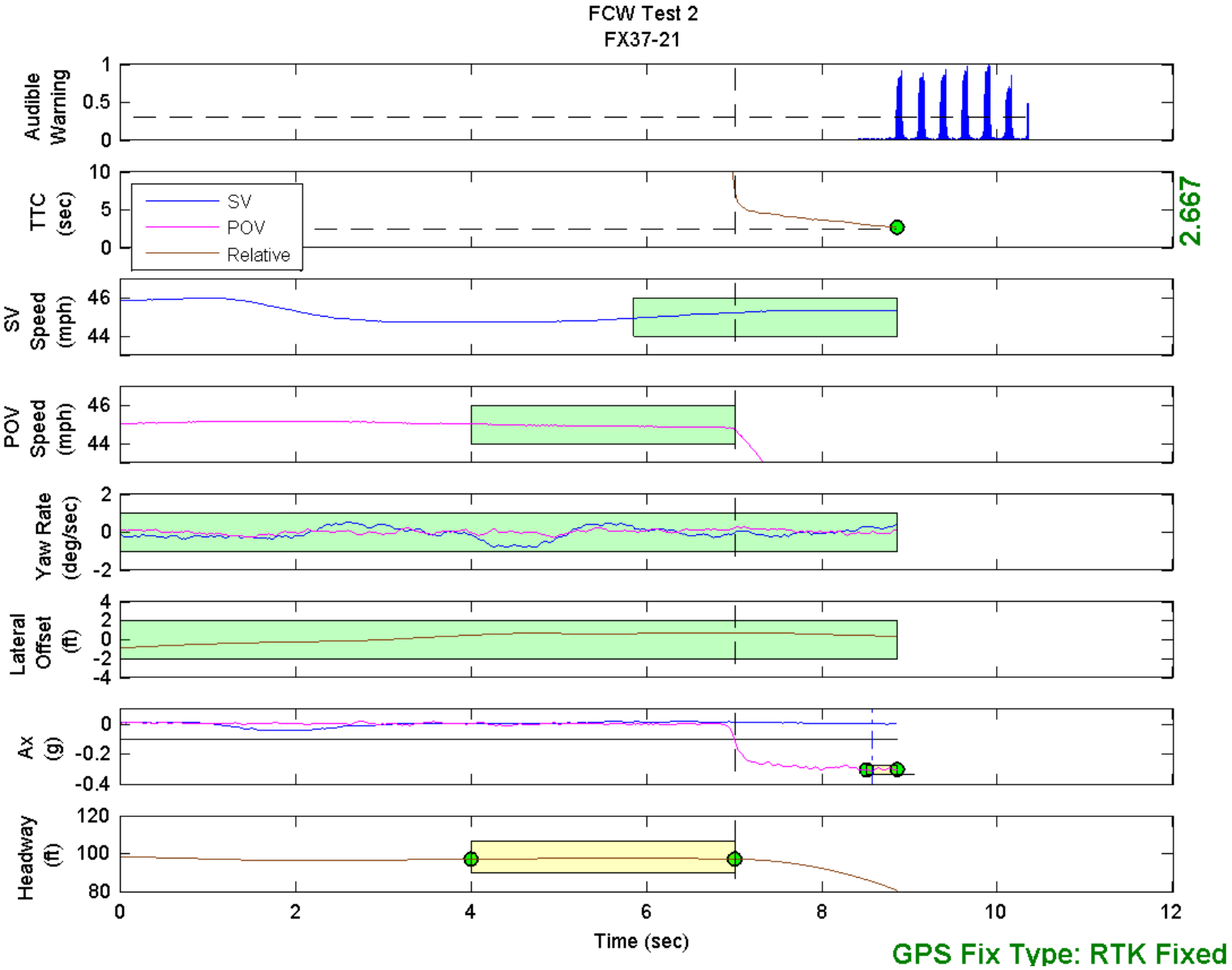


Figure D25. Time History for Run 21, FCW Test 2, Audible Warning

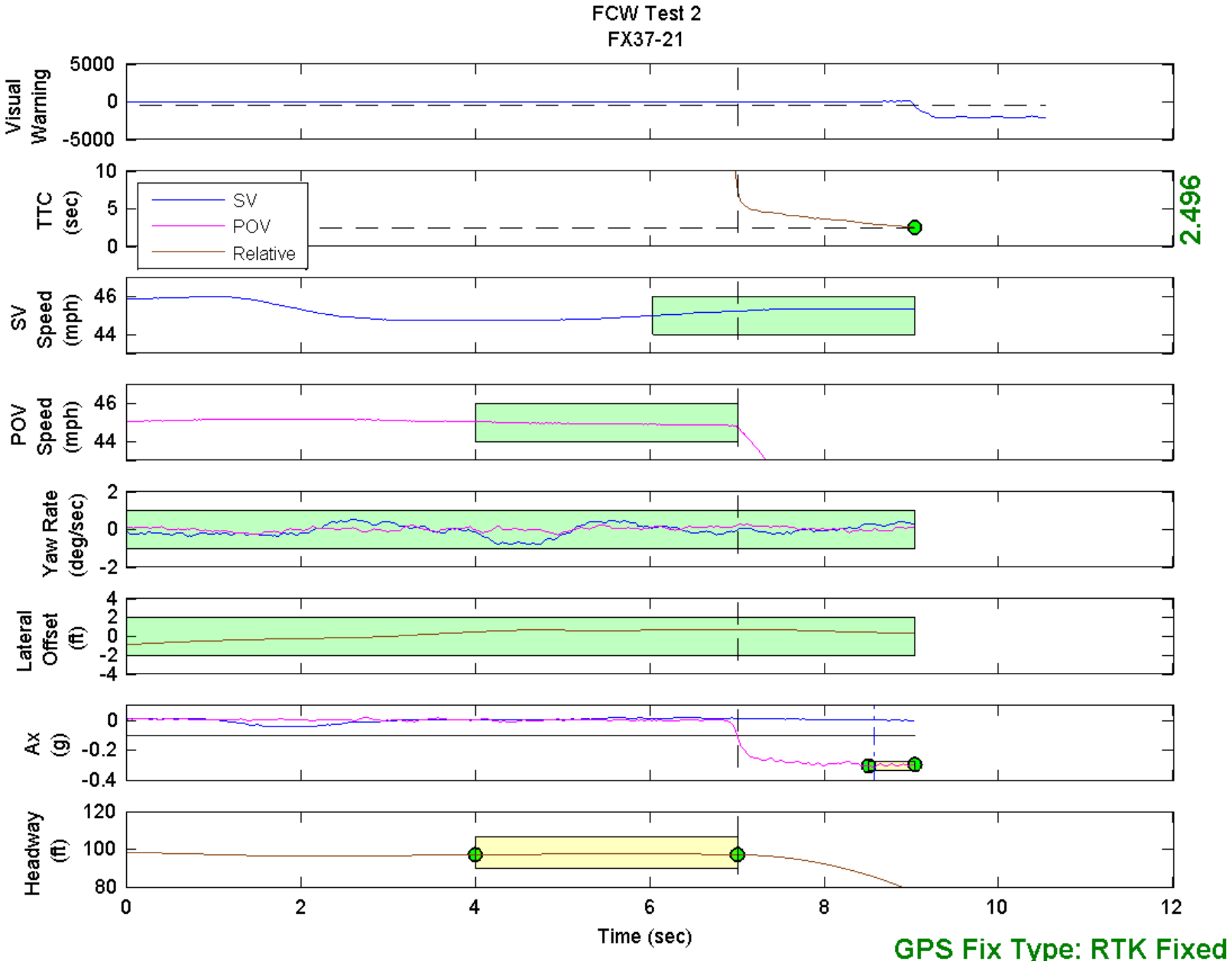


Figure D26. Time History for Run 21, FCW Test 2, Visual Warning

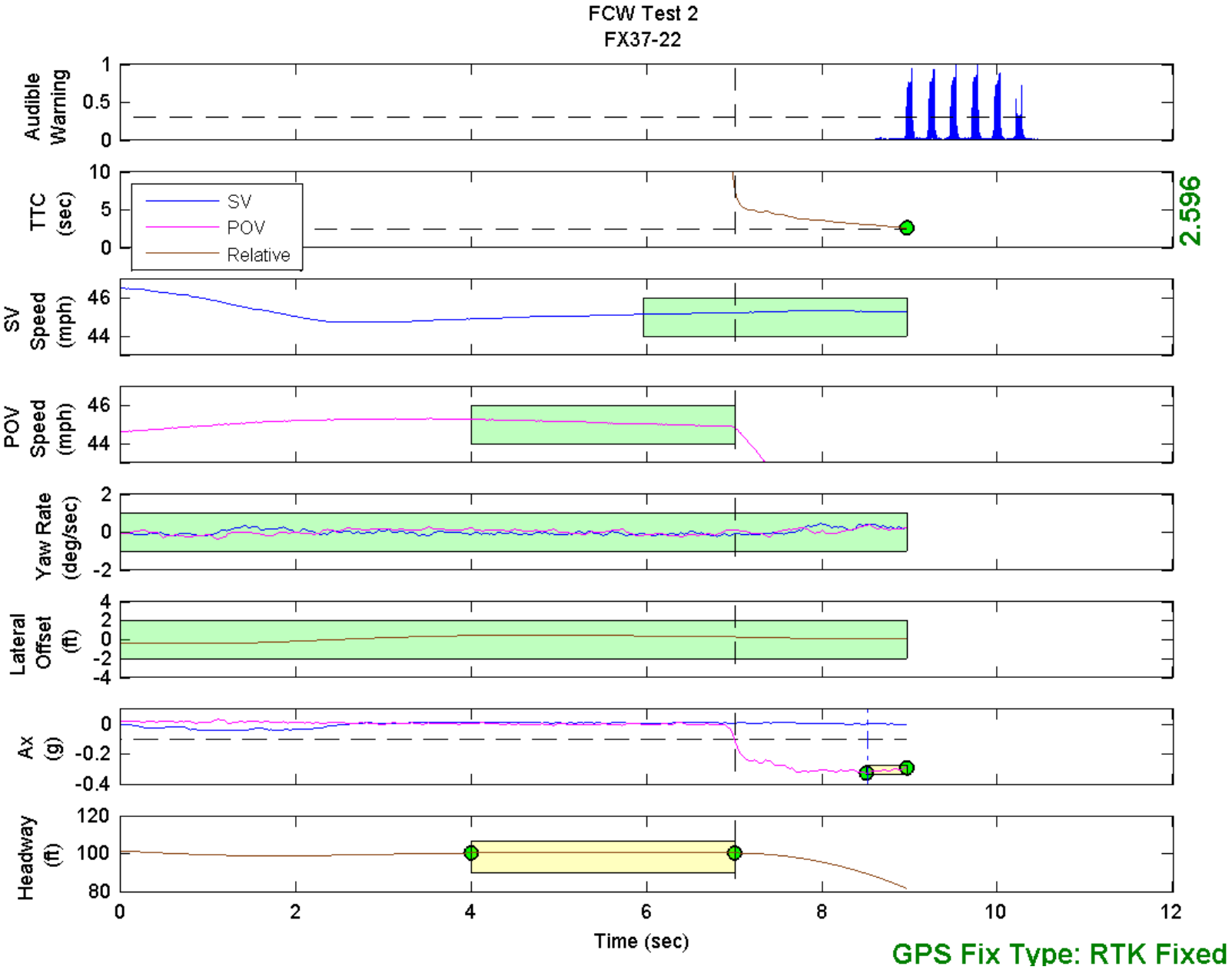


Figure D27. Time History for Run 22, FCW Test 2, Audible Warning

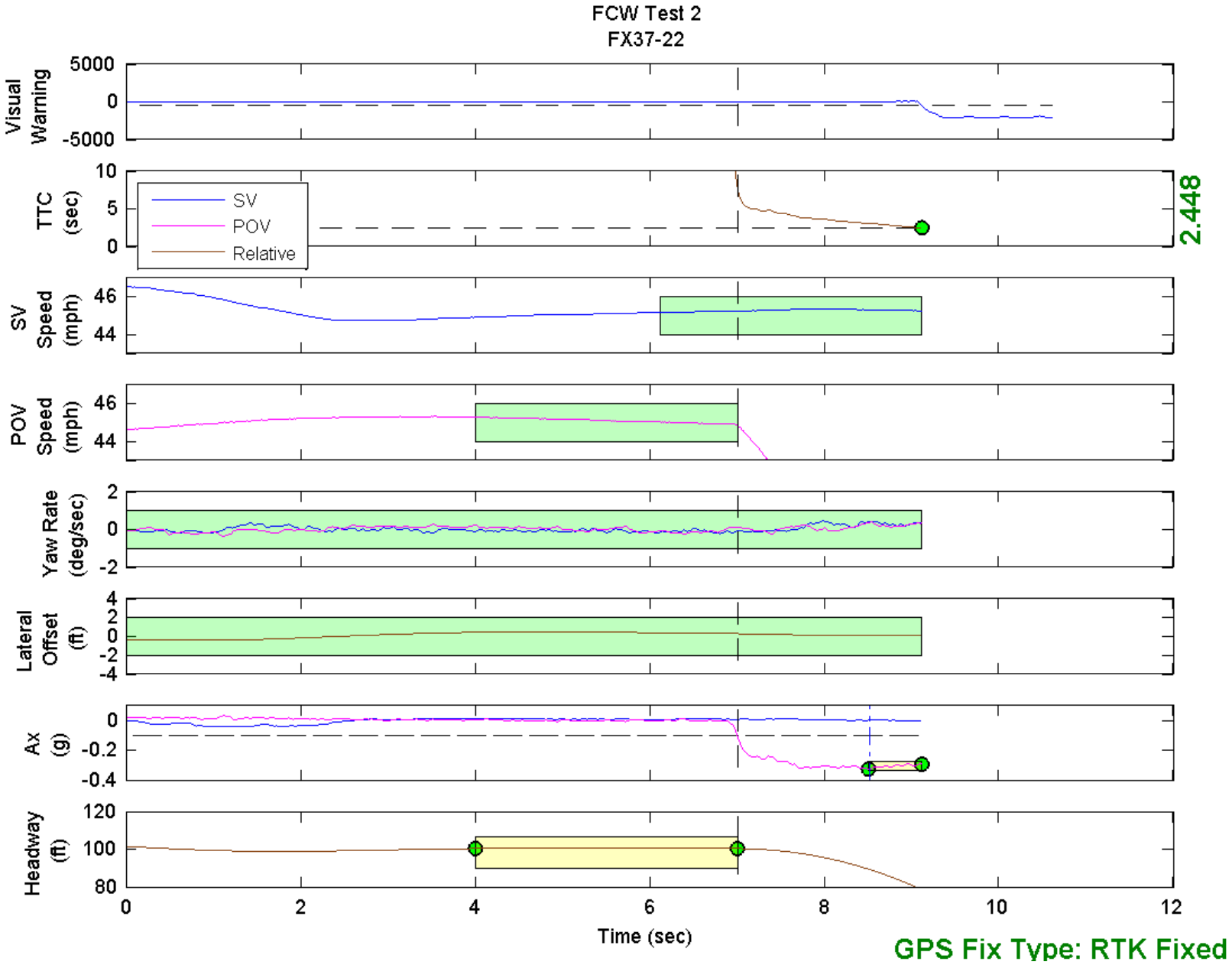


Figure D28. Time History for Run 22, FCW Test 2, Visual Warning

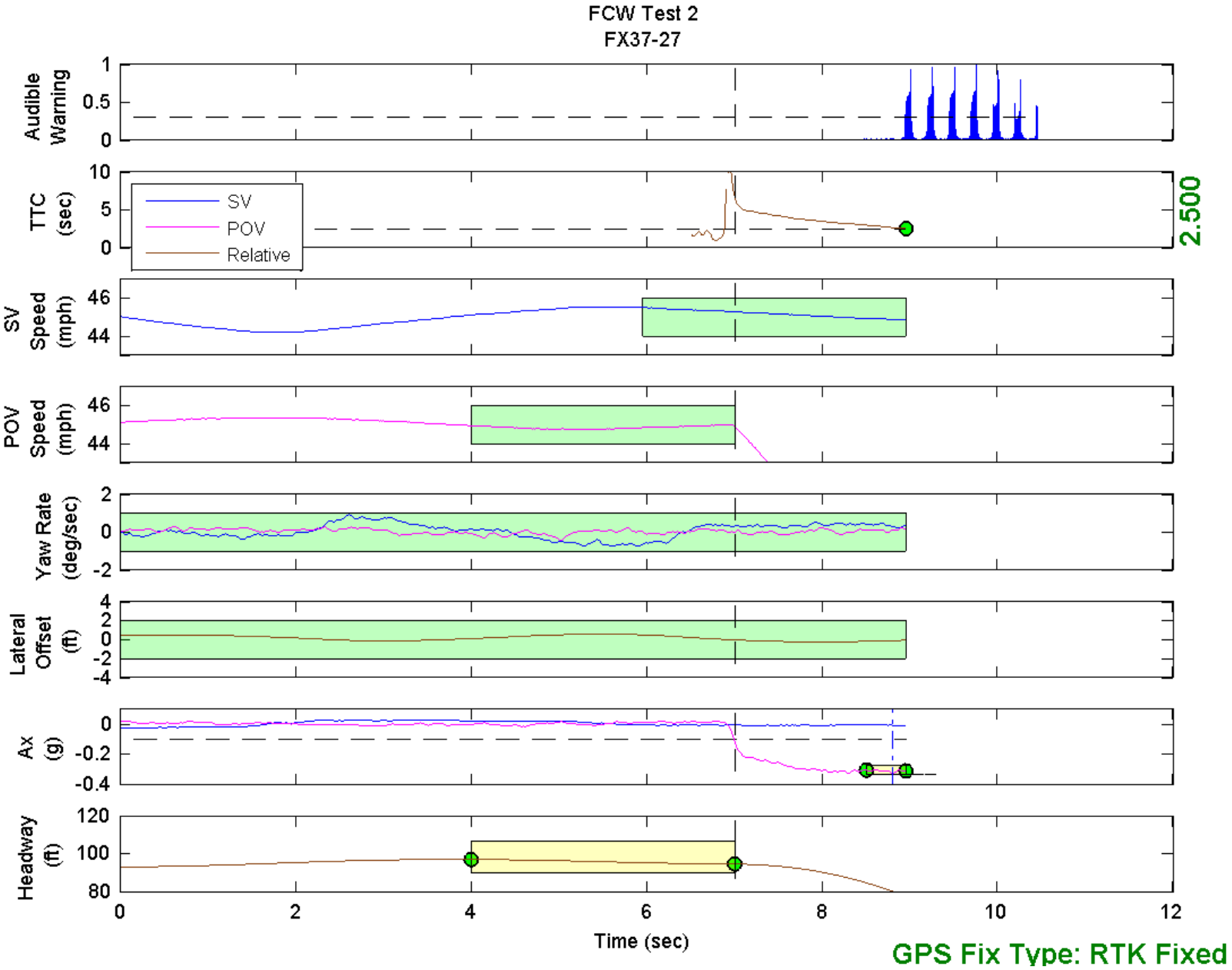


Figure D29. Time History for Run 27, FCW Test 2, Audible Warning

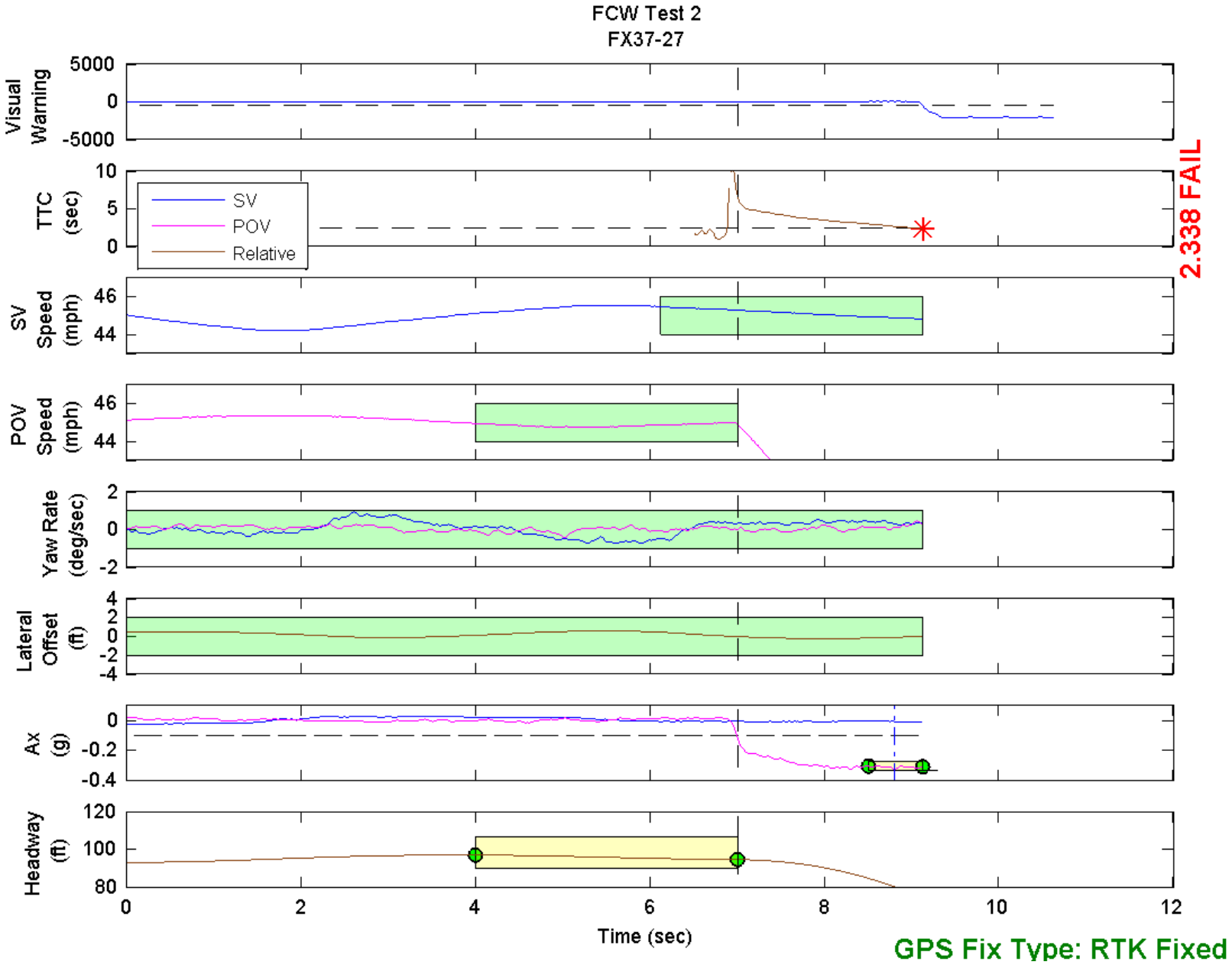


Figure D30. Time History for Run 27, FCW Test 2, Visual Warning

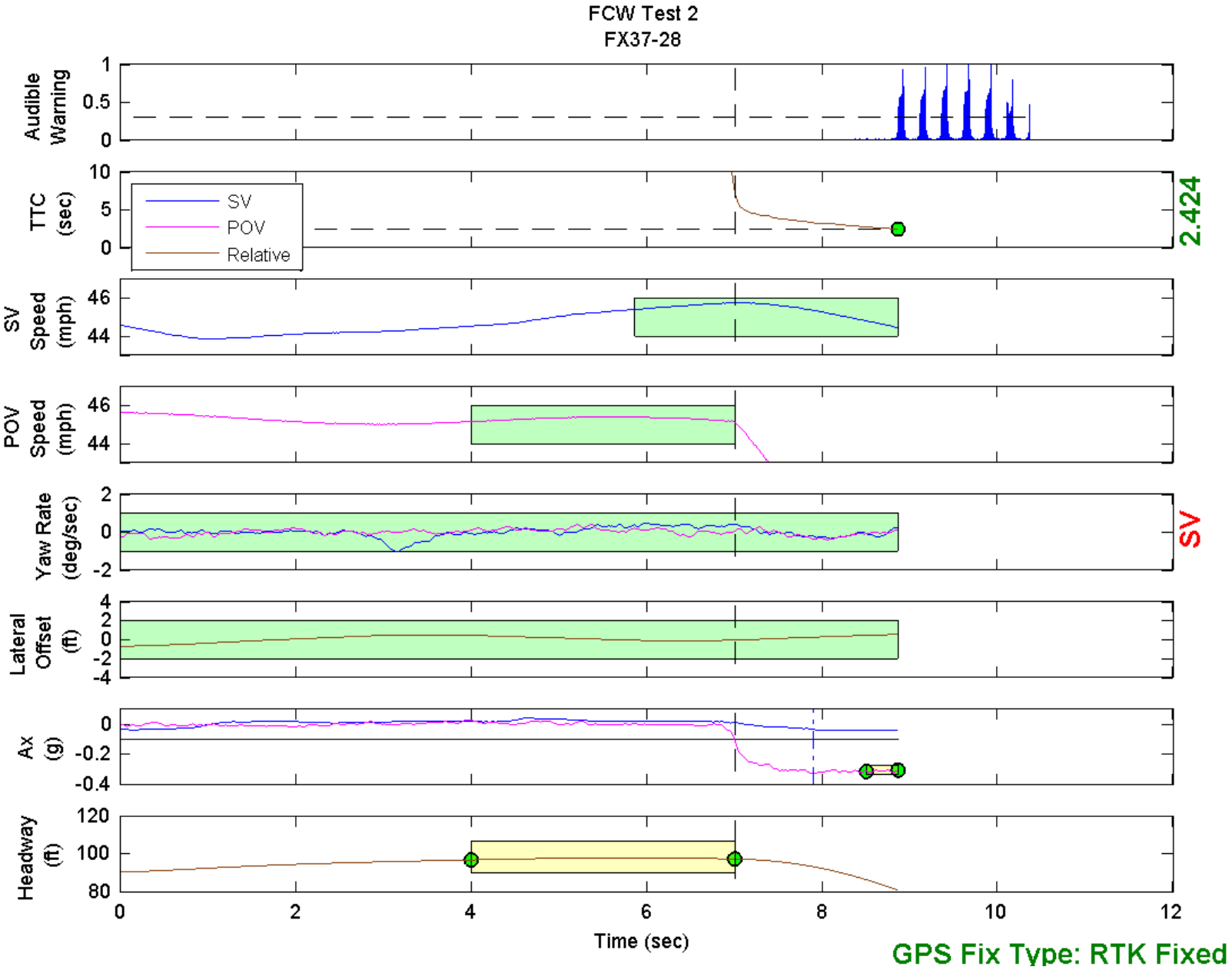


Figure D31. Time History for Run 28, FCW Test 2, Audible Warning

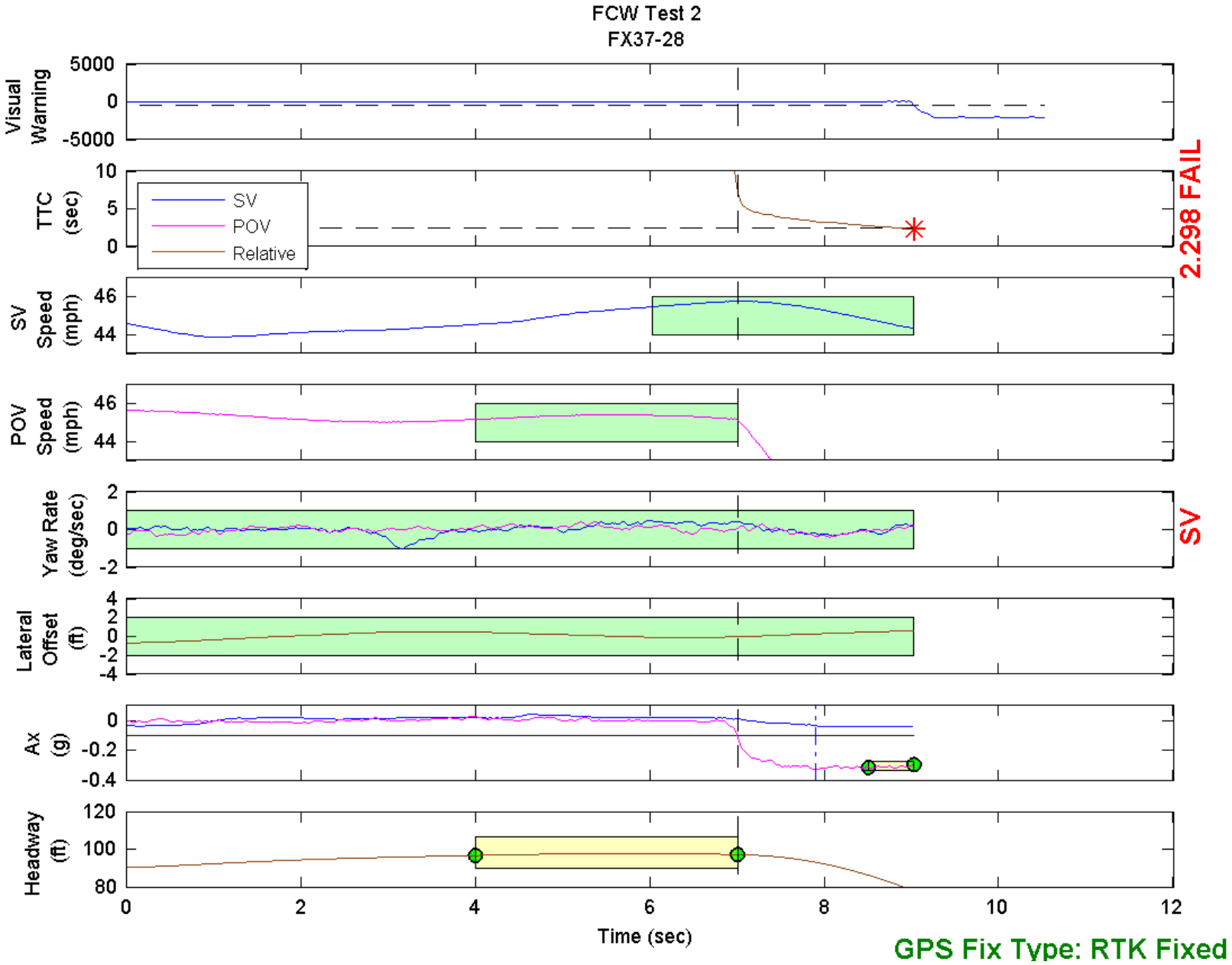


Figure D32. Time History for Run 28, FCW Test 2, Visual Warning

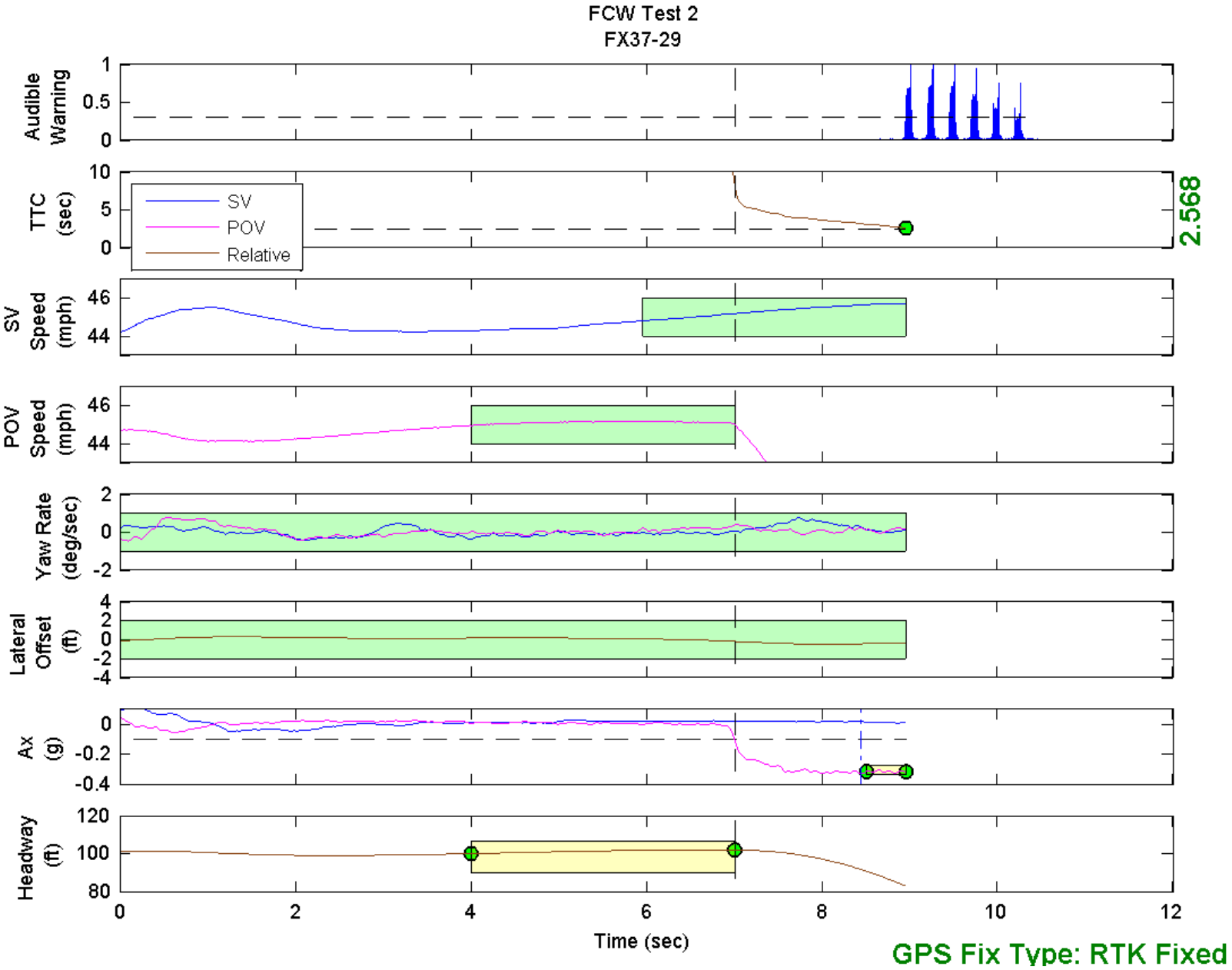


Figure D33. Time History for Run 29, FCW Test 2, Audible Warning

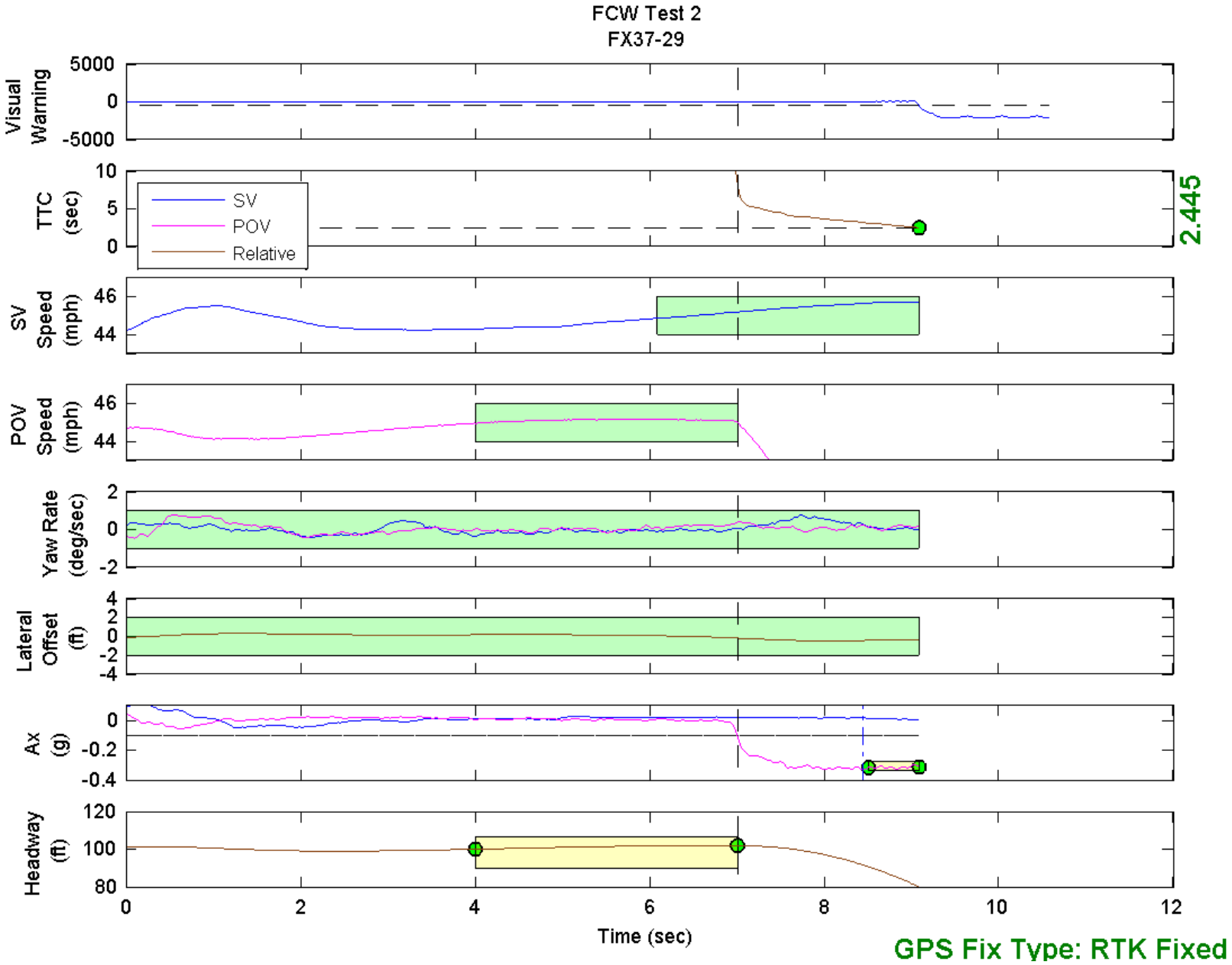


Figure D34. Time History for Run 29, FCW Test 2, Visual Warning

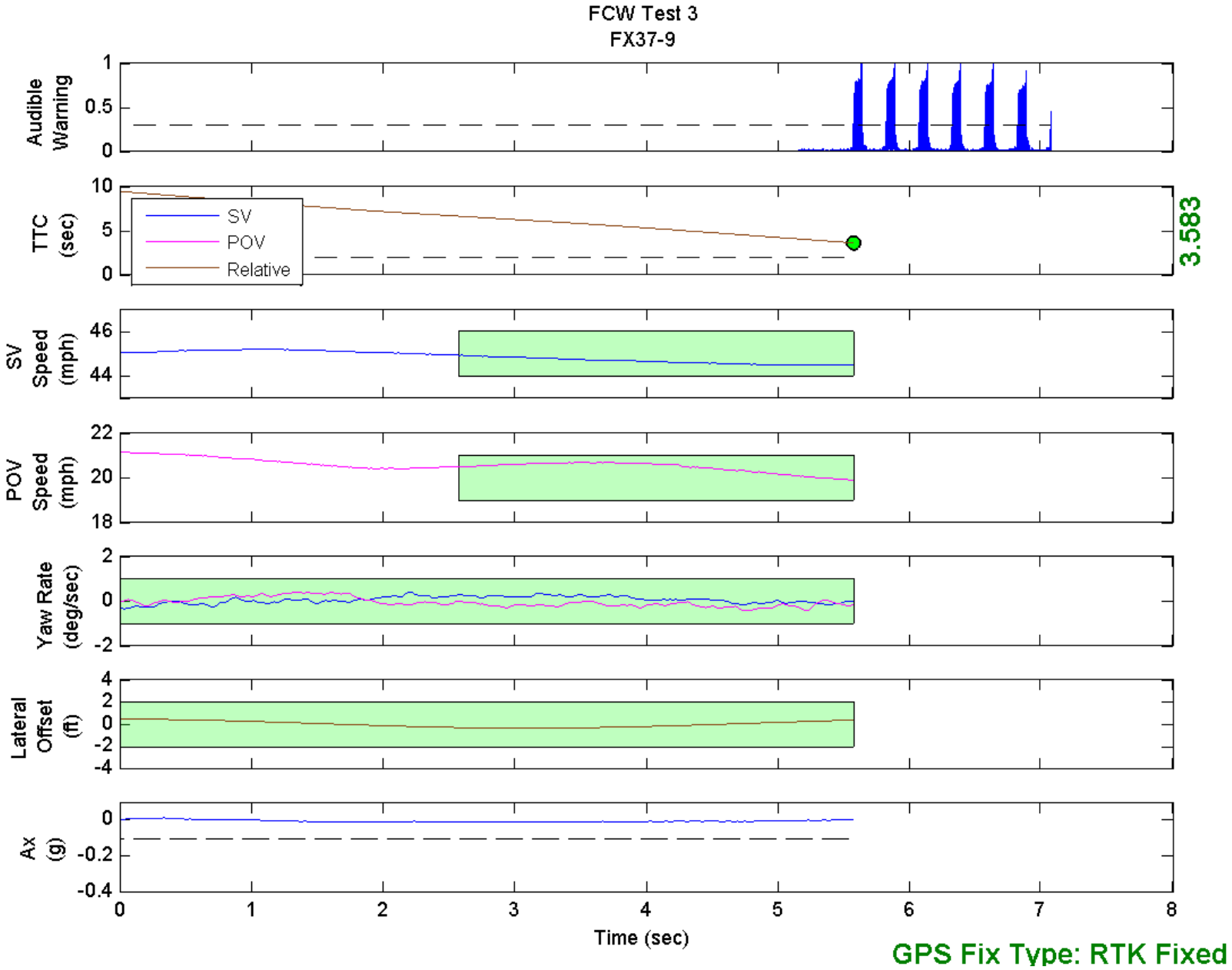


Figure D35. Time History for Run 9, FCW Test 3, Audible Warning

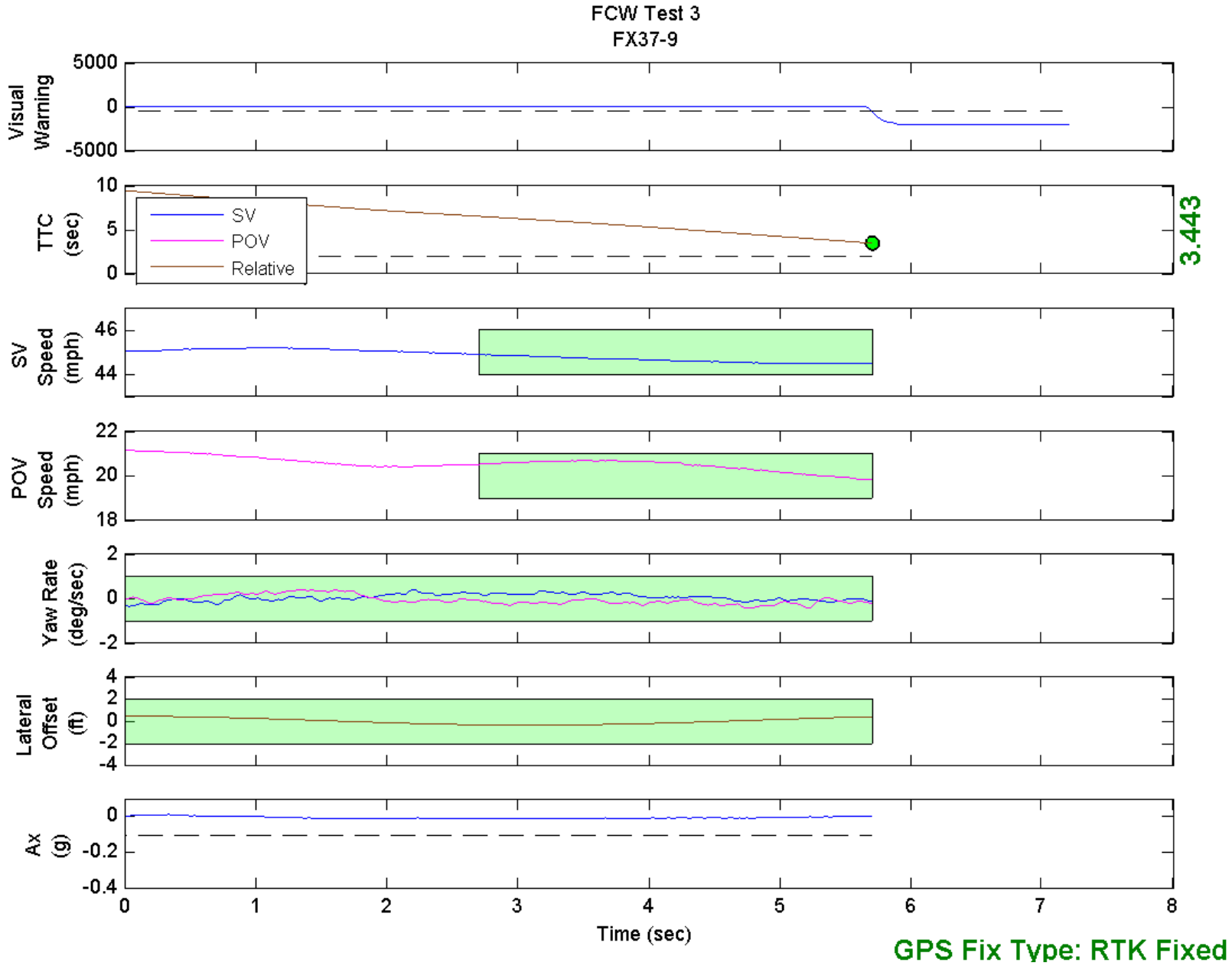


Figure D36. Time History for Run 9, FCW Test 3, Visual Warning

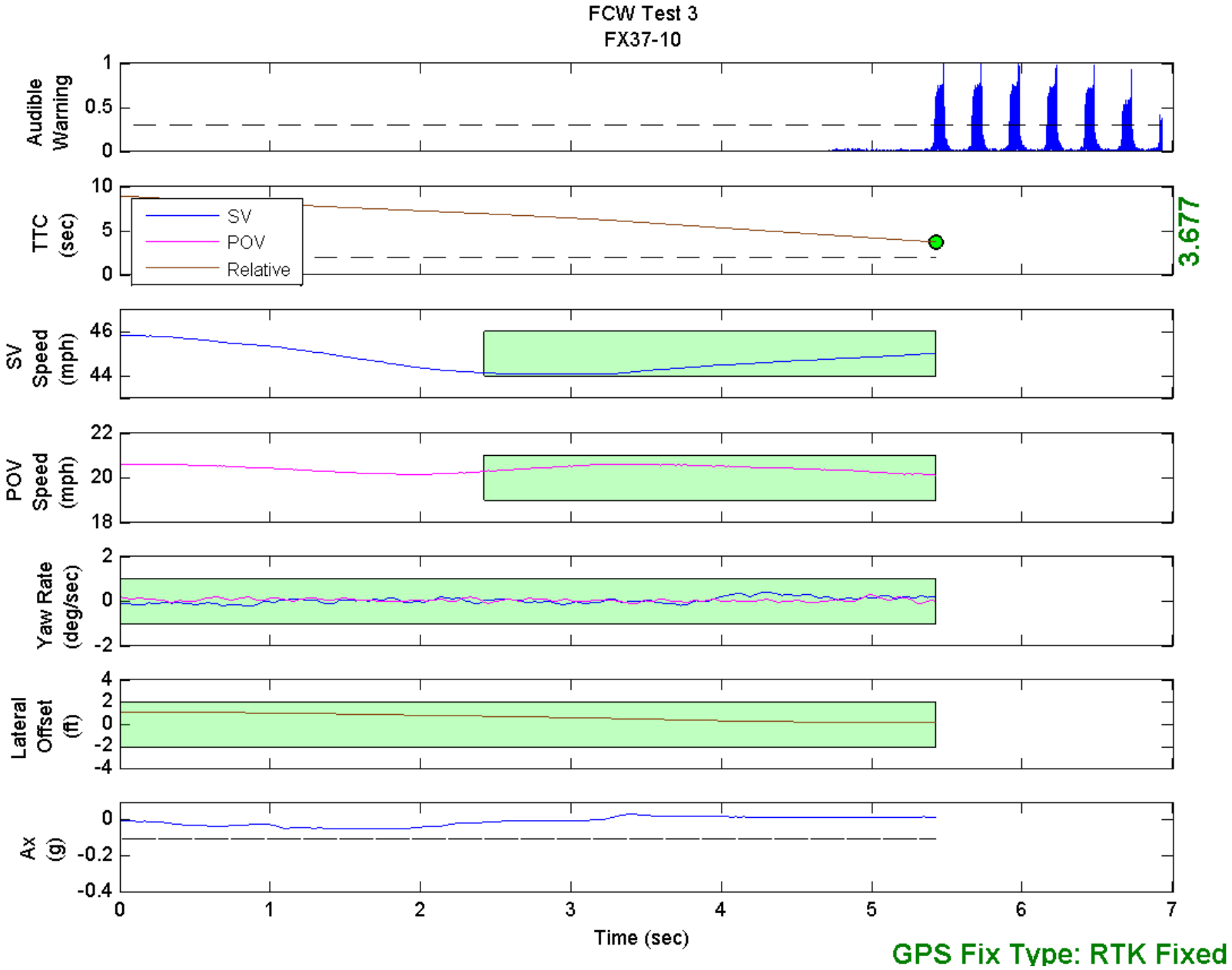


Figure D37. Time History for Run 10, FCW Test 3, Audible Warning

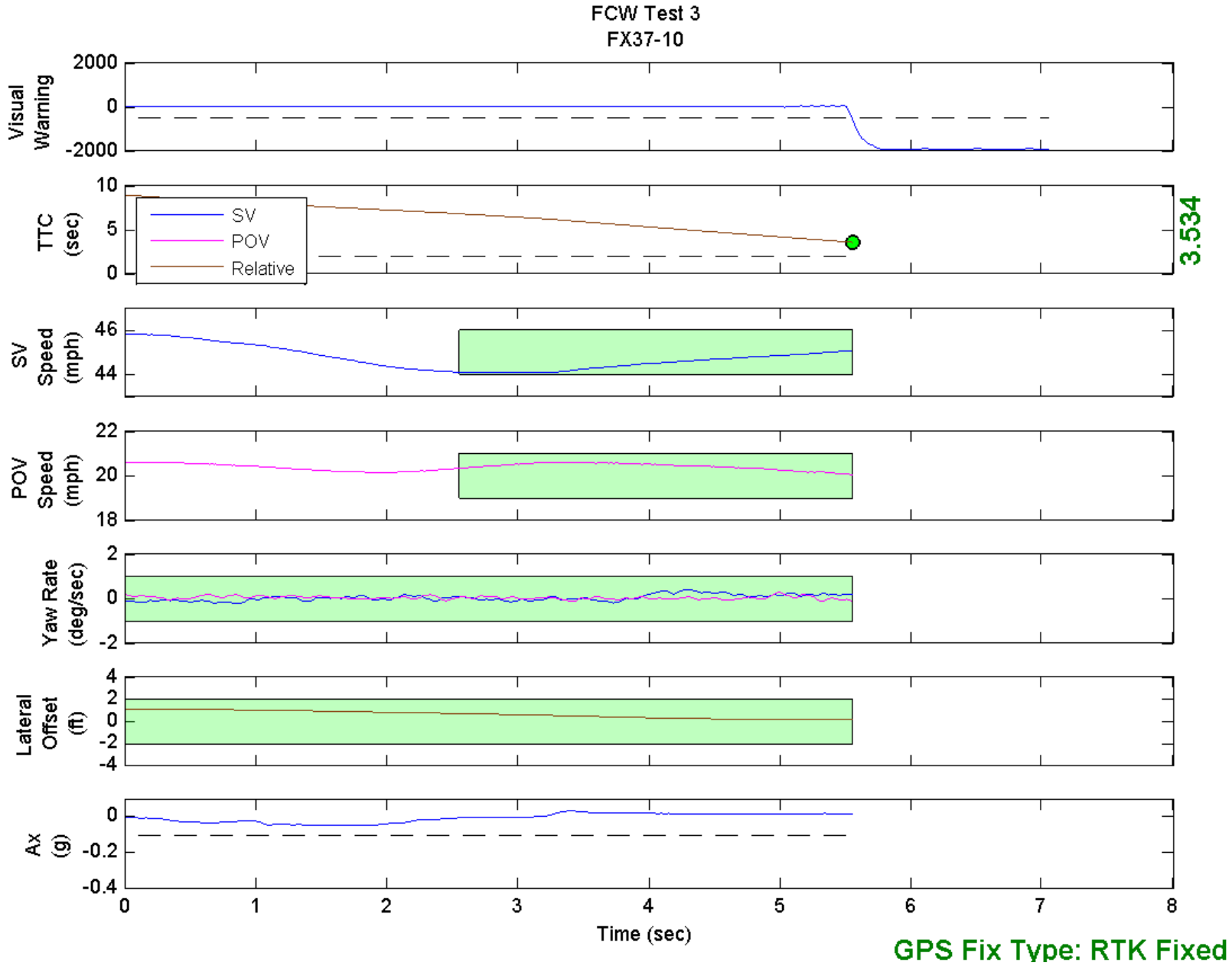


Figure D38. Time History for Run 10, FCW Test 3, Visual Warning

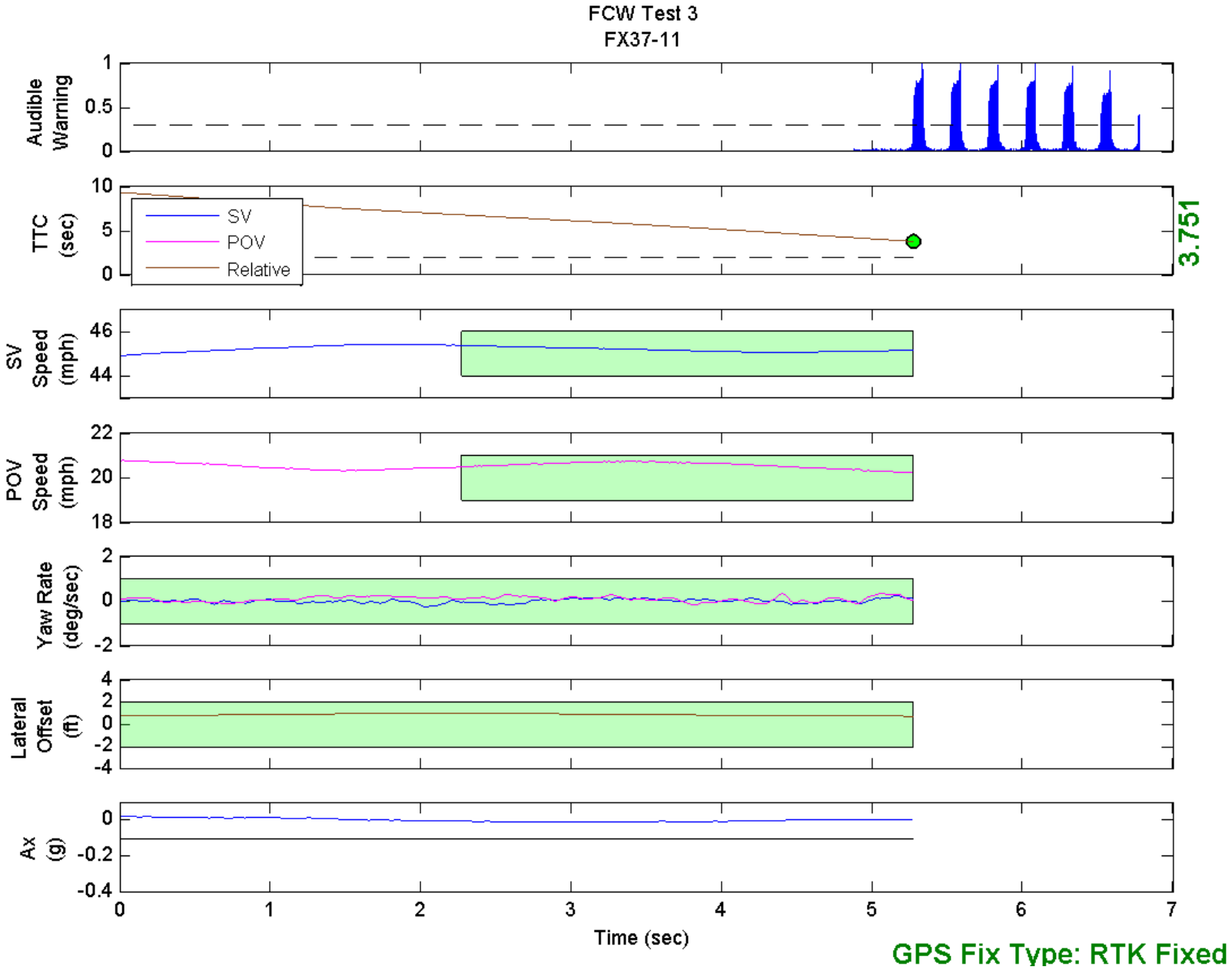


Figure D39. Time History for Run 11, FCW Test 3, Audible Warning

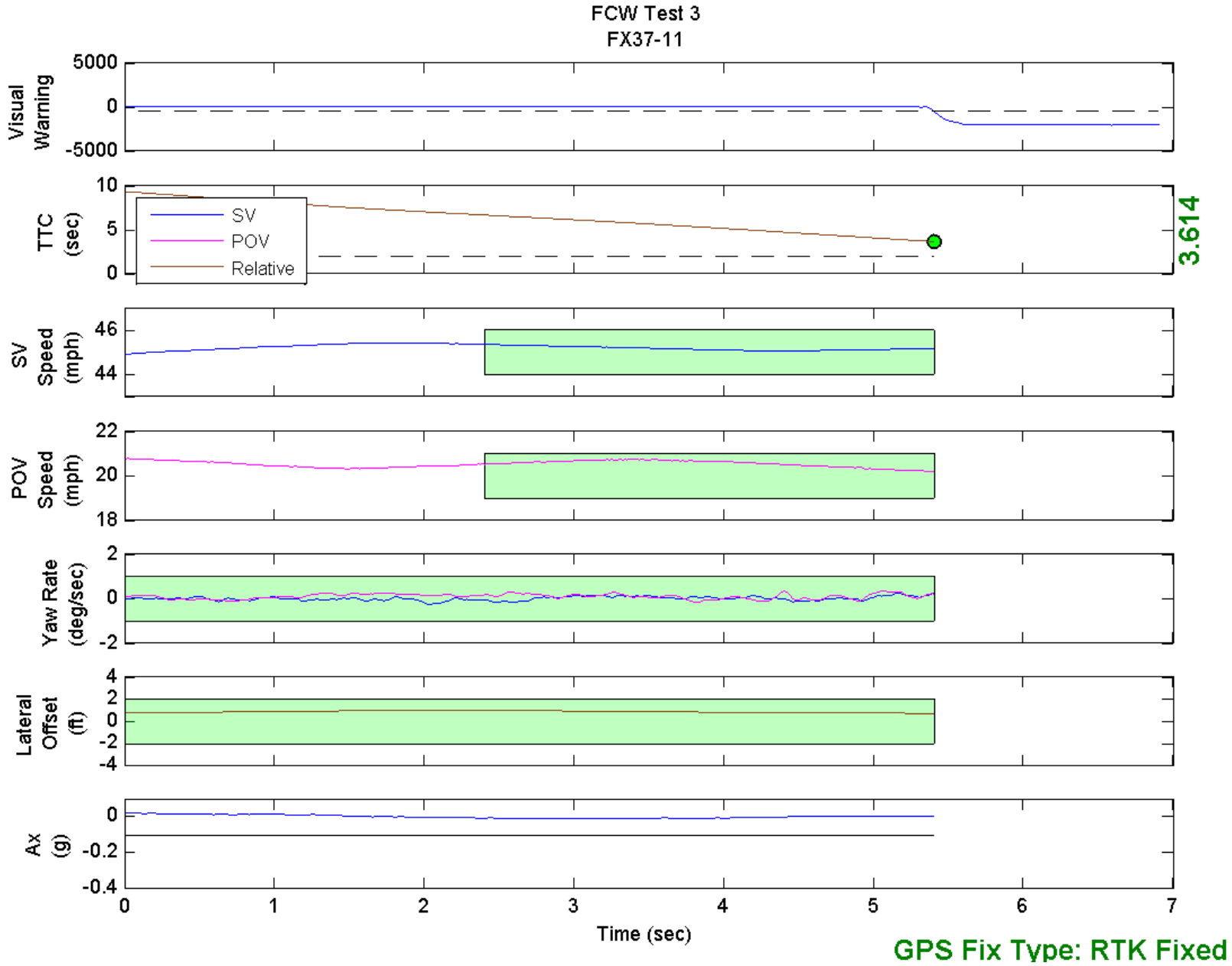


Figure D40. Time History for Run 11, FCW Test 3, Visual Warning

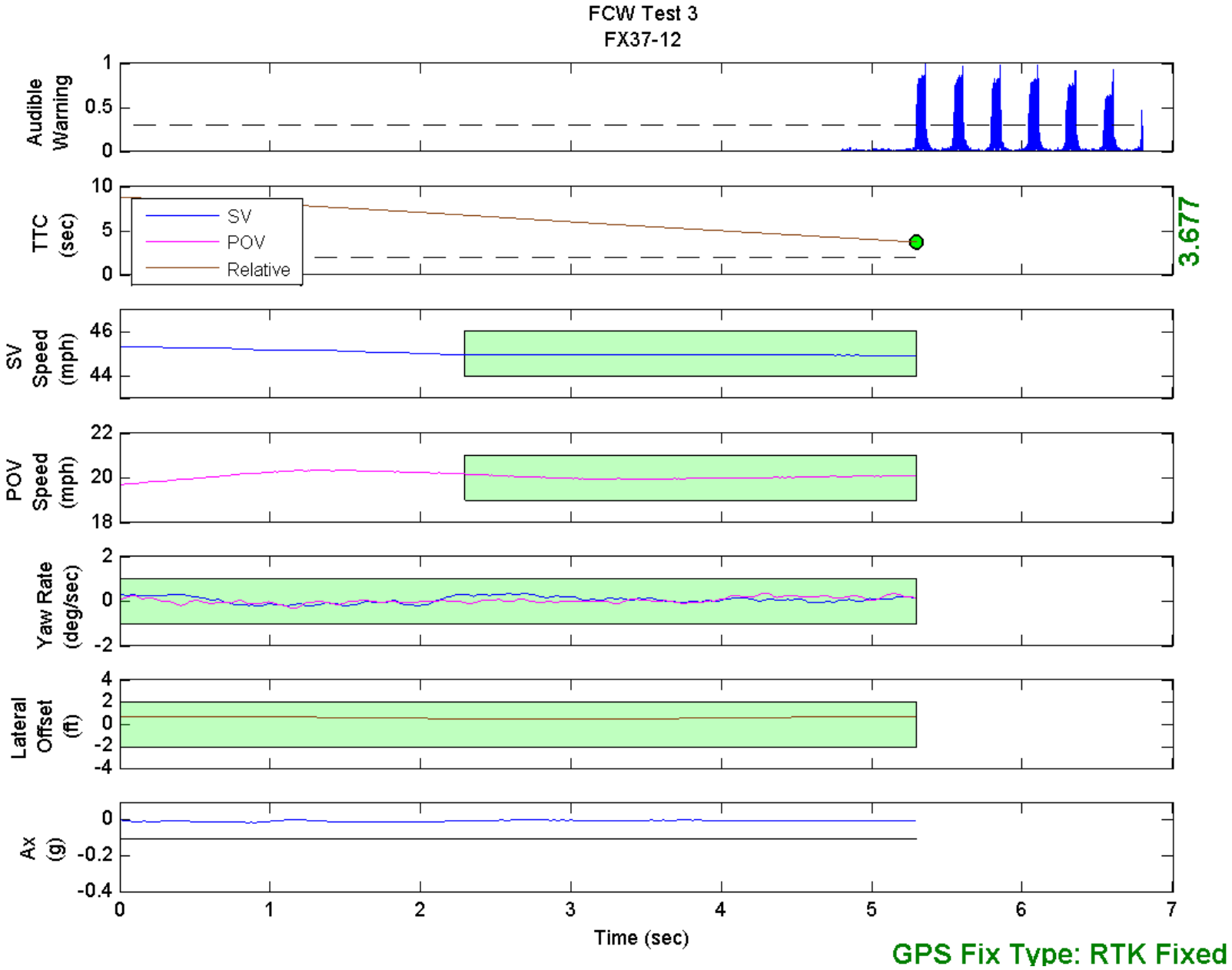


Figure D41. Time History for Run 12, FCW Test 3, Audible Warning

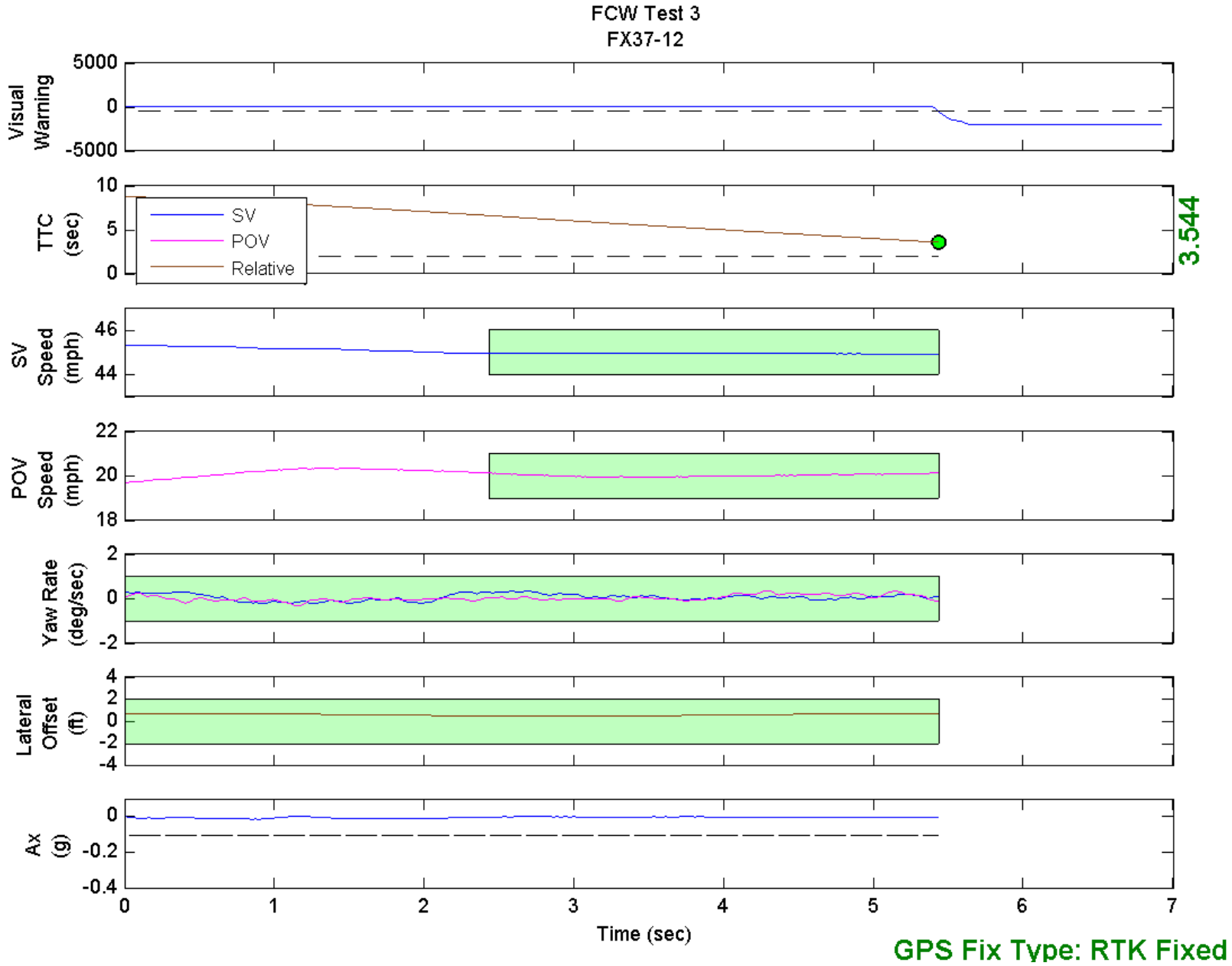


Figure D42. Time History for Run 12, FCW Test 3, Visual Warning

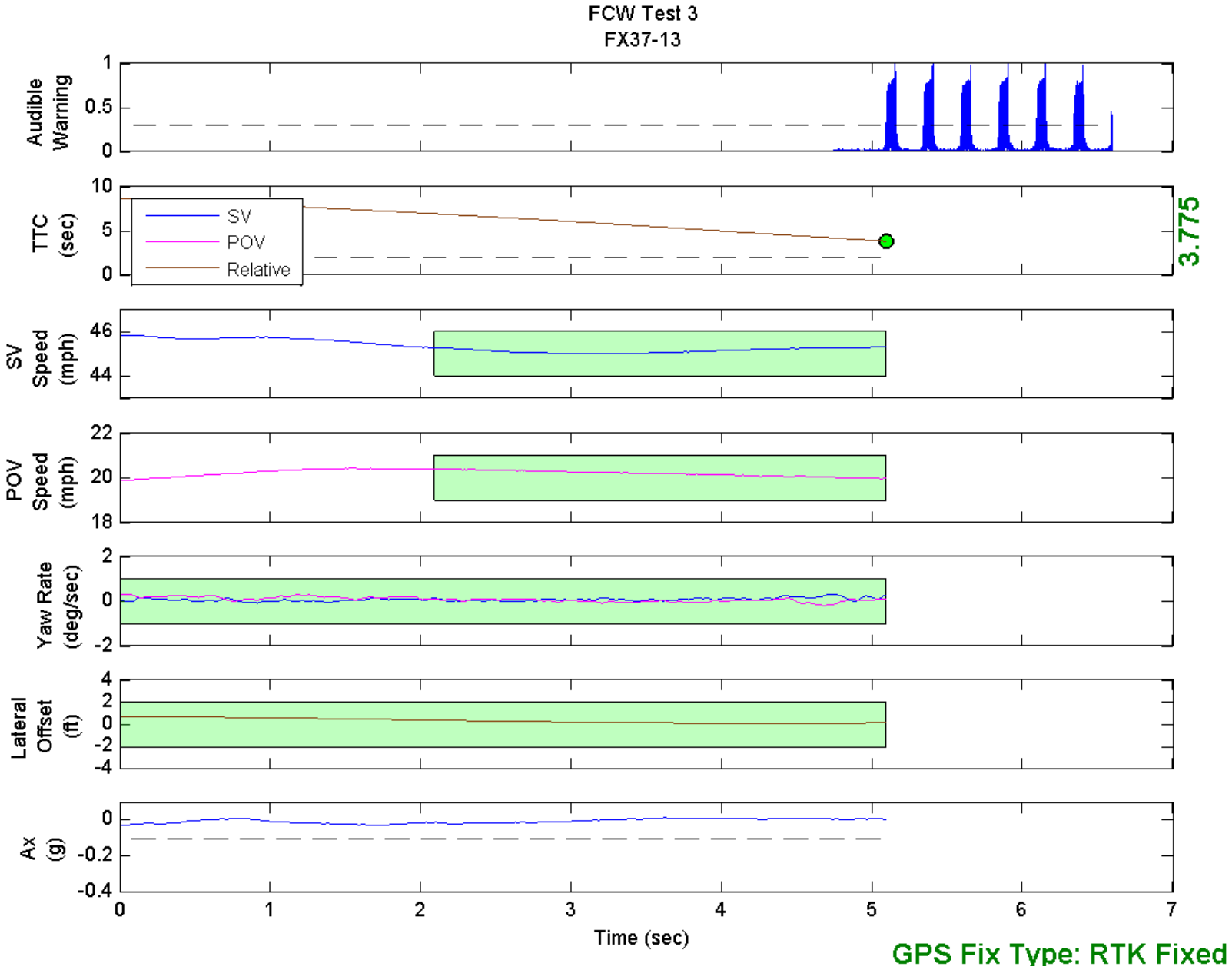


Figure D43. Time History for Run 13, FCW Test 3, Audible Warning

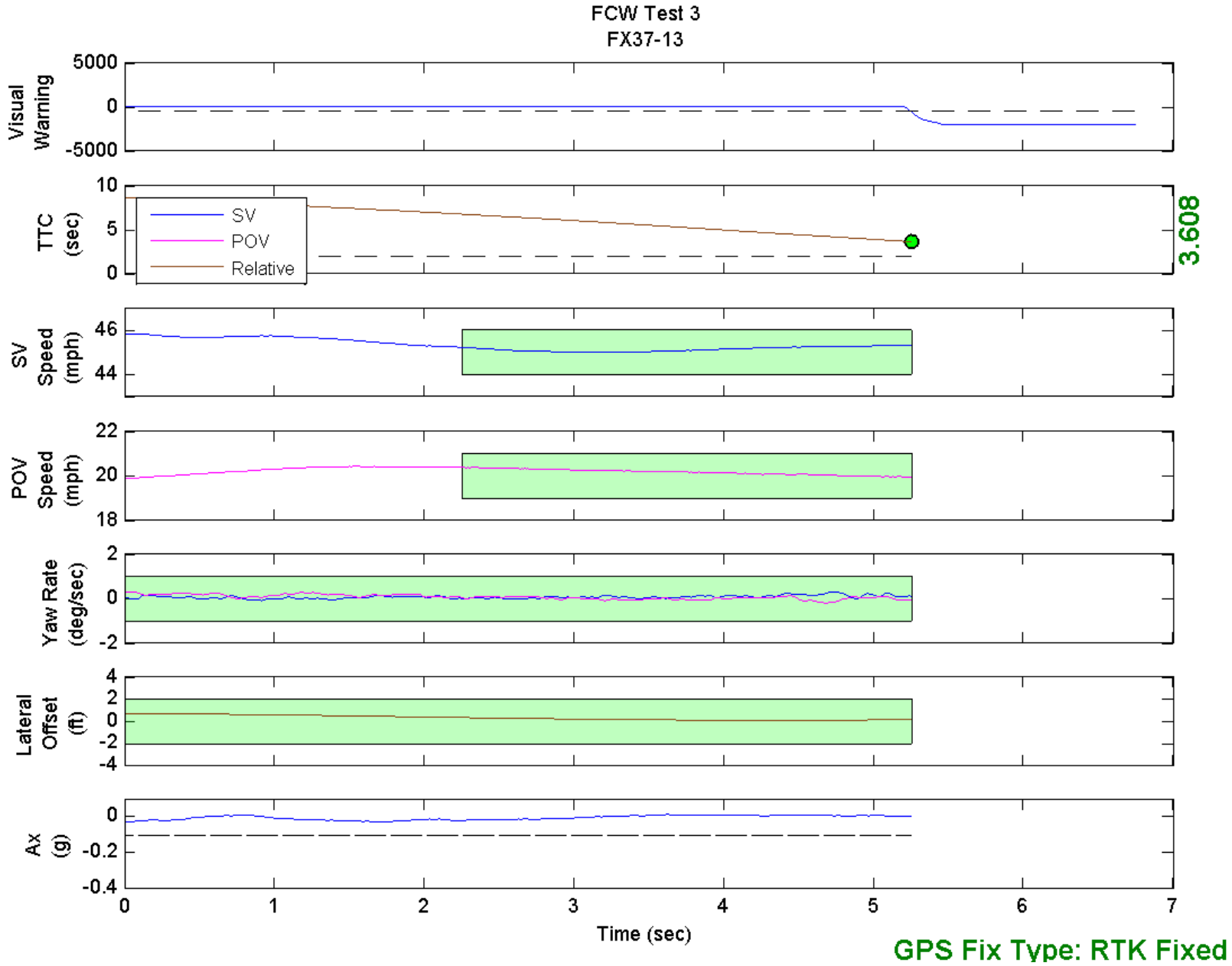


Figure D44. Time History for Run 13, FCW Test 3, Visual Warning

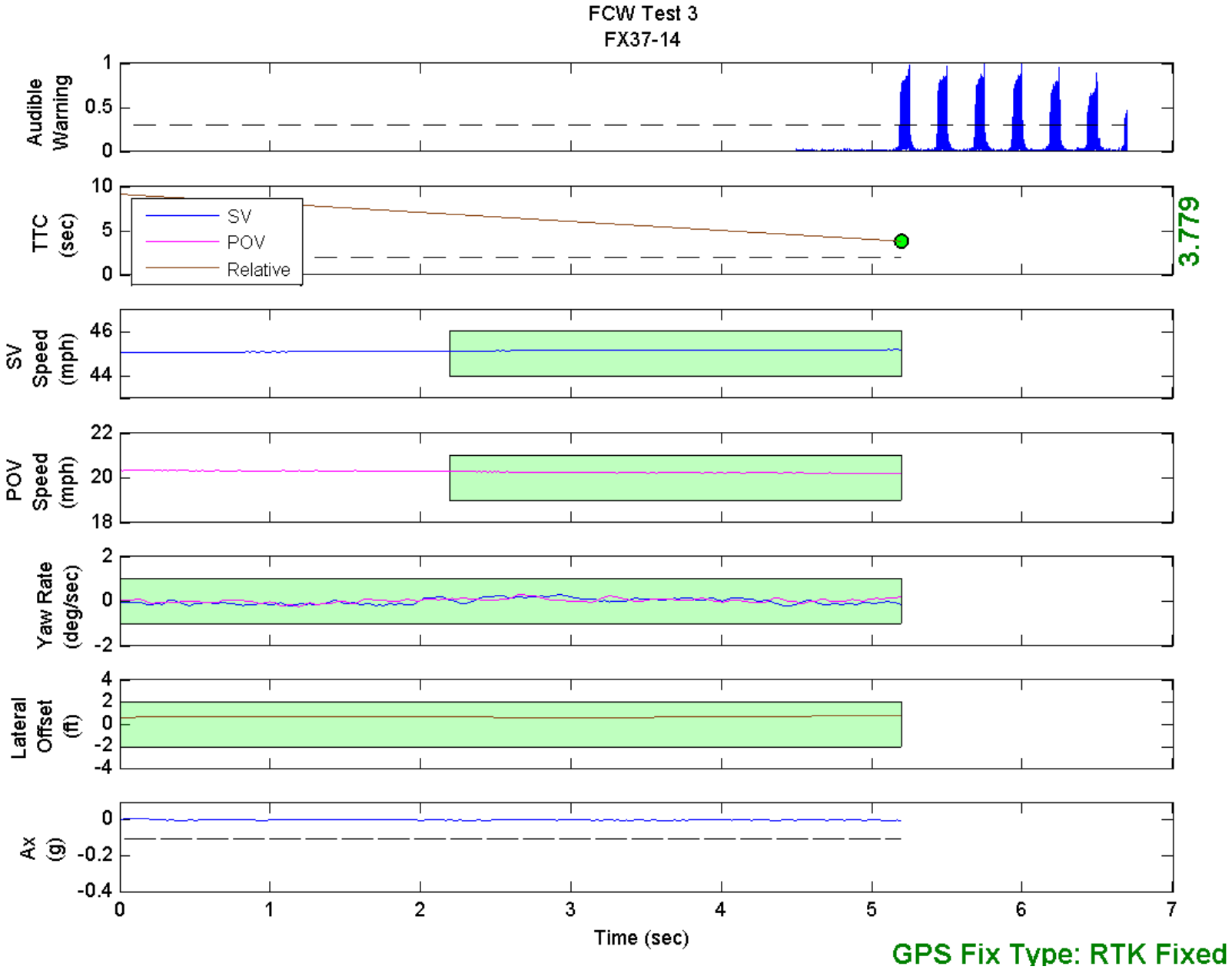


Figure D45. Time History for Run 14, FCW Test 3, Audible Warning

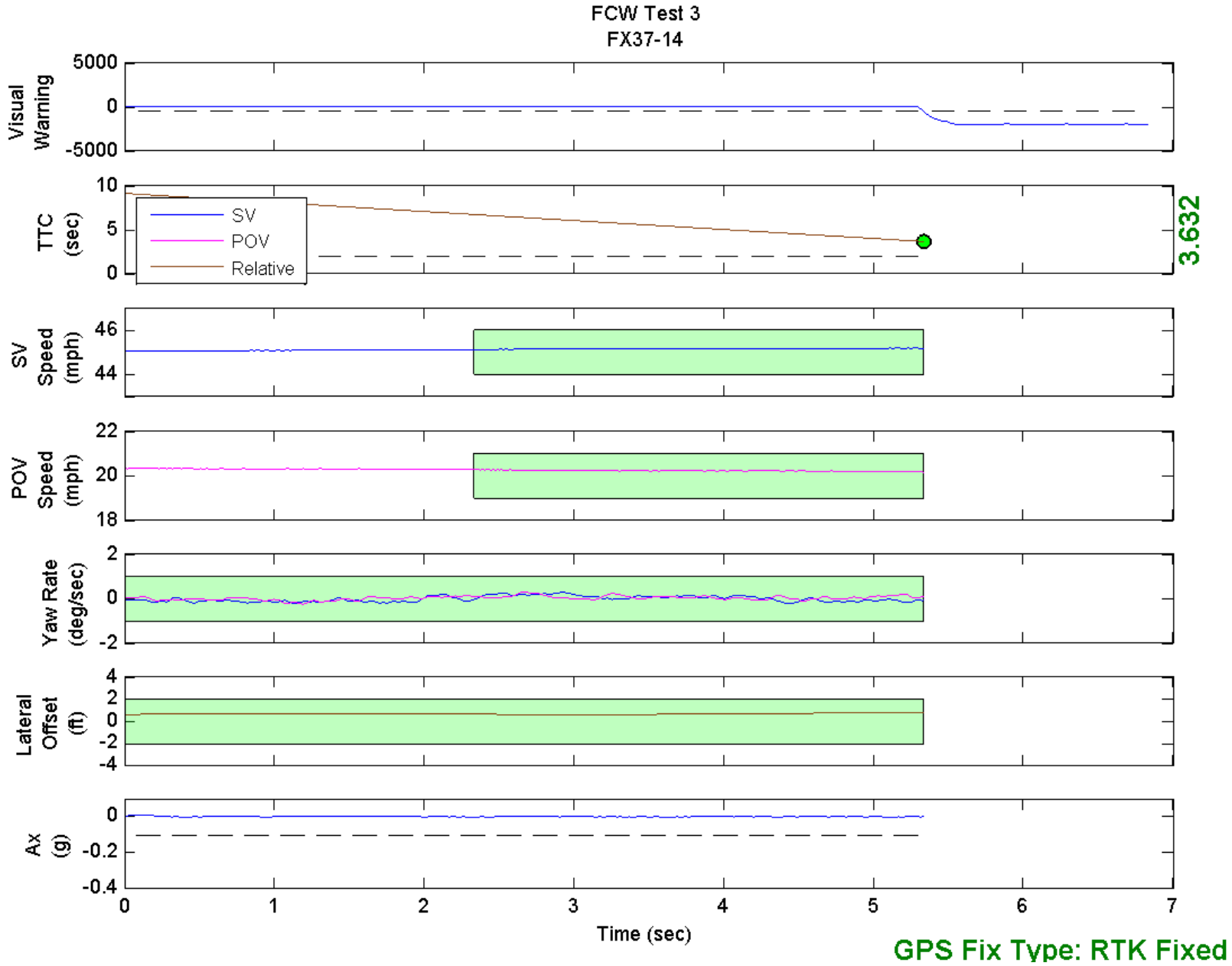


Figure D46. Time History for Run 14, FCW Test 3, Visual Warning

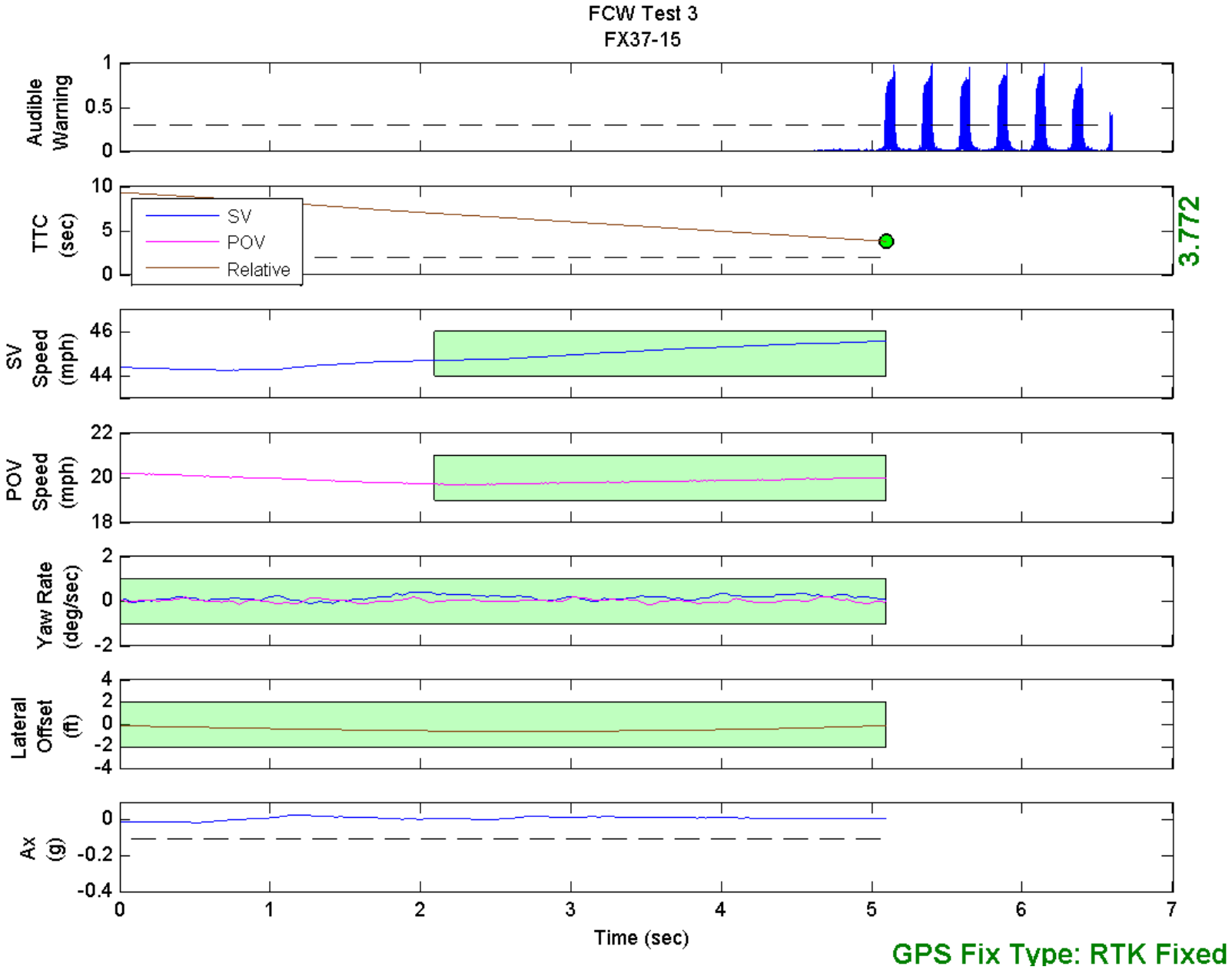


Figure D47. Time History for Run 15, FCW Test 3, Audible Warning

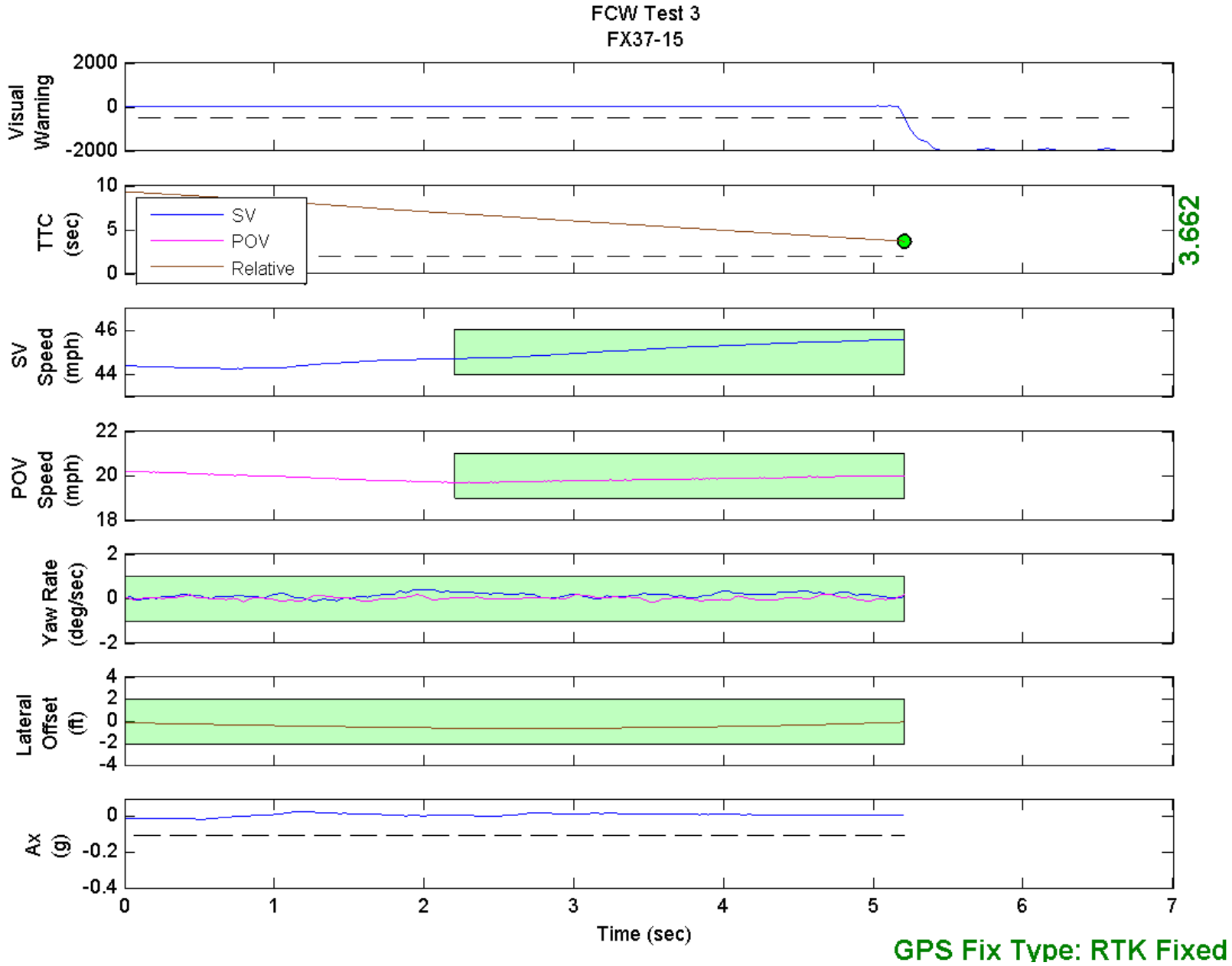


Figure D48. Time History for Run 15, FCW Test 3, Visual Warning