PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM RESEARCH TEST
NCAP-DRI-PAEB-20-13

2019 Audi A6 55 TFSI (3.0T) quattro

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

22 December 2020

Final Report

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

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE
West Building, 4th Floor (NRM-110)
Washington, DC 20590

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

Prepared By: J. Lenkeit, Program Manager

N. Wong, Test engineer

A. Ricci, Test Engineer

Date: 22 December 2020

1. Report No. NCAP-DRI-PAEB-20-13	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Final Report of Pedestrian Automatic Emergency Braking System Research Testing of a 2019 Audi A6 55 TFSI (3.0T) quattro		5. Report Date 22 December 2020
		6. Performing Organization Code DRI
7. Author(s) J. Lenkeit, Program Manager N. Wong, Test engineer A. Ricci, Test Engineer		8. Performing Organization Report No. DRI-TM-20-80
9. Performing Organization Name and Address Dynamic Research, Inc. 355 Van Ness Avenue Torrance, CA 90501		10. Work Unit No.
		11. Contract or Grant No. DTNH22-14-D-00333
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration 1200 New Jersey Avenue, SE, West Building, 4th Floor (NRM-110) Washington, DC 20590		13. Type of Report and Period Covered Final Test Report August - December 2020
		14. Sponsoring Agency Code NRM-110
15. Supplementary Notes		
16. Abstract These research tests were conducted on the subject 2019 Audi A6 55 TFSI (3.0T) quattro in accordance with the specifications of the National Highway Traffic Safety Administration's draft test procedure in docket NHTSA-2019-0102-0005 to confirm the performance of a Pedestrian Automatic Emergency Braking system, with modifications to include use of an articulated pedestrian test mannequin and additional tests speeds and lighting conditions.		
17. Key Words Pedestrian Automatic Emergency Braking, PAEB, New Car Assessment Program, NCAP		18. Distribution Statement Copies of this report are available from the following: NHTSA Technical Reference Division National Highway Traffic Safety Administration 1200 New Jersey Avenue, SE Washington, DC 20590

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	462	

TABLE OF CONTENTS

SECTION **PAGE**

Section I

INTRODUCTION

Pedestrian Automatic Emergency Braking (PAEB) systems are a subset of Automatic Emergency Braking (AEB) systems. PAEB systems are designed to avoid or mitigate vehicle crashes with pedestrians by automatically applying the Subject Vehicle's (SV's) brakes when the system determines that, without intervention, collision with a pedestrian will occur. PAEB systems typically work as an extension of Forward Collision Warning (FCW) systems, which alert the driver to the possibility of a collision unless driver action is taken. PAEB systems employ sensors capable of detecting pedestrians in the forward path. Current PAEB technology typically involves RADAR, LIDAR, or vision-based (camera) sensors, and measurement of vehicle operating conditions such as speed, driver steering, and brake application, etc. Algorithms in the system's Central Processing Unit (CPU) use this information to continuously monitor the likelihood of a collision with a pedestrian and command a brake actuator to apply the brakes when necessary.

The test procedure contained herein provides methods and specifications for collecting performance data on PAEB systems for light vehicles with gross vehicle weight ratings of up to 4,536 kg (10,000 lbs).

The test method used to evaluate PAEB performance on the test track was prescribed by NHTSA in a test procedure titled, "Pedestrian Automatic Emergency Brake System Confirmation Test (Working Draft)", dated September 2019 (Docket NHTSA-2019-0102-0005). For the testing reported herein, an articulating Pedestrian Test Mannequin (PTM) was used for testing, as opposed to the poseable one prescribed. Furthermore, additional test conditions were used, involving additional SV test speeds and nighttime tests using the SV's high beam headlights and low beam headlights.

The PAEB tests include ten pedestrian pre-crash test scenarios. There are seven (S1) crossing test scenarios in which a pedestrian is traveling across the SV's lane of travel. In the first three S1 test scenarios, an SV approaches an adult PTM starting on the right-hand side of the lane of travel (i.e., nearside) and moving towards the left-hand side (i.e., offside) with a point of impact at (a) 25% overlap from the passenger side of the SV, (b) 50% overlap, and (c) 75% overlap. In the S1d scenario, the SV approaches a crossing child PTM running from behind parked vehicles from the right-hand side of the lane towards the left-hand side with the point of impact at 50% overlap. In the S1e scenario, the SV approaches an adult PTM running from the left side of the lane towards the right with a 50% overlap point of impact. The S1f and S1g scenarios are false positive tests. In the S1f scenario, the SV approaches an adult PTM, which begins moving from the right-hand side of the lane but safely stops short of entering the SV's lane of travel. In the S1g scenario, the adult PTM also crosses from the right-hand side of the lane towards the left-hand side, but safely crosses the lane of travel completely.

There are also three (S4) in-path scenarios in which an adult pedestrian is either standing or walking away from the vehicle within the SV's lane of travel. In the first two test scenarios, the SV approaches a stationary adult PTM in its lane of travel at a 25% overlap point of impact. In the S4a scenario, the PTM is facing away from the approaching SV. In the S4b scenario, the PTM is facing towards the SV. In the third test scenario (S4c), the SV approaches an adult PTM while the PTM is traveling within and in the same direction as the SV's lane of travel at a 25% overlap point of impact.

For all of these tests, the adult and child PTM's are strikeable mannequins with visual and radar reflectivity characteristics representing a pedestrian. In test scenario S1d, the child PTM has the characteristics of the 7-year-old child. All of the other test scenarios use an adult PTM with the characteristics of a 50th percentile adult male.

The false positive scenarios (S1f and S1g) are used to evaluate the propensity of a PAEB system to inappropriately activate in a non-critical driving scenario that does not present a safety risk to the SV occupant(s) or pedestrian.

The purpose of the testing reported herein was to objectively quantify the performance of a PAEB system installed on a 2019 Audi A6 55 TFSI (3.0T) quattro. This test is part of the Crash Avoidance program to assess Pedestrian Automatic Braking Systems sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-14-D-00333.

The test reported herein is one of a series of research and development tests accomplished for the purpose of refining test procedures, protocols, and specifications, as well as data analysis parameters and presentation methods that are preliminarily described in NHTSA 's test procedure titled, "Pedestrian Automatic Emergency Brake System Confirmation Test (Working Draft)", dated September 2019 (Docket NHTSA-2019-0102-0005). Some of these procedural details changed over the course of the test series in order to address unanticipated concerns or ambiguities, and also in recognition of the different characteristics of AEB implementation by the various manufacturers. In particular, the threshold for determining the onset of PAEB braking was originally set at -0.15 g, and subsequently changed to -0.03 g later in the series. As a result, some of the results indicate the earlier threshold and some the later. The results presented herein are for the -0.03 g threshold.

Section II

DATA SHEETS

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2019 Audi A6 55 TFSI (3.0T) quattro

VIN: *WAUL2AF2XKN04xxxx*

Day Test Date: *9/1/2020*

Night Test Date: *8/31/2020*

System Setting: *Early*

Upper Capabilities

	Maximum Test Speed Without Consistent SV-to-PTM Contact[1]		
Scenario	**Daytime (km/h)**	**Night-High Beam (km/h)**	**Night-Low Beam (km/h)**
S1a	40		
S1b	60	20	30
S1c	40		
S1d	40	11	11
S1e	40	*	*
S1f			
S1g			
S4a	45	16	16
S4b	40		
S4c	65	60	55

* All test series resulted in consistent SV-to-PTM contact

[1] Consistent SV-to-PTM Contact is defined as the SV contacting the PTM in more than 3 trials at a given test speed.

S1a: SV Encounters an Adult PTM Crossing at 5 km/h from the Nearside at 25% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	5	5	15.9						
40	6	6	39.5						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2019 Audi A6 55 TFSI (3.0T) quattro

S1b: SV Encounters an Adult PTM Crossing at 5 km/h from the Nearside at 50% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	6	6	16.3	7	7	16.2	6	6	16.3
20	5	5	20.1	5	4	18.8	5	5	20.0
25				5	2	23.1			
30	5	5	28.4	4	0	18.5	5	3	23.5
35							3	0	24.7
40	5	5	39.4	4	1	32.1	4	1	29.1
50	6	5	43.8						
55	1	1	49.3						
60	5	4	55.6						

S1c: SV Encounters an Adult PTM Crossing at 5 km/h from the Nearside at 75% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	5	5	15.7						
40	6	6	31.9						

S1d: SV Encounters a Crossing Child PTM Running at 5 km/h

From Behind Parked Cars from the Nearside at 50% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
11				5	4	9.9	6	5	9.4
16	7	7	16.1	3	0	3.1	4	1	4.5
20	5	5	19.8						
30	5	5	29.9						
40	5	4	39.2	3	0	0.0	3	0	0.0
45	5	0	24.8						

S1e: SV Encounters an Adult PTM Running at 8 km/h from the Offside at 50% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
35				5	1	14.6	4	1	23.1
40	6	3	29.3	3	0	22.5	4	0	18.8
45	4	1	31.7						

2019 Audi A6 55 TFSI (3.0T) quattro

S1f, S1g: Peak Deceleration Summary

(Day tests only)

S1f: SV Encounters an Adult PTM Crossing at 5 km/h from the Nearside that Stops Short of the Entering the SV Path of Travel

S1g: SV Encounters an Adult PTM Crossing at 5 km/h from the Nearside that Clears the SV Path of Travel

Trial Number	S1f SV: 40 km/h PTM: 5 km/h	S1g SV: 40 km/h PTM: 5 km/h
	Peak Deceleration (g)	
1	0.98	0.02
2	0.27	0.00
3	0.30	0.00
4	0.29	0.02
5	0.30	0.00

S4a: SV Encounters a Stationary Adult PTM Facing Away from the SV in the SV Lane of Travel at 25% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	6	6	16.3	5	5	16.1	5	5	16.3
20	5	5	20.0						
30	5	5	30.4						
35				3	0	20.5	3	0	29.0
40	5	3	35.2	3	0	23.5	5	2	30.9
45	5	3	43.8						
50	3	0	25.2						

S4b: SV Encounters a Stationary Adult PTM Facing Toward the SV in the SV Lane of Travel at 25% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	5	5	16.1						
40	5	3	35.9						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2019 Audi A6 55 TFSI (3.0T) quattro

S4c: SV Encounters an Adult PTM Traveling at 5 km/h in the SV Lane of Travel at 25% Overlap

Speed (km/h)	Daytime			Night-High Beam			Night-Low Beam		
	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)	# of Valid Trials		Avg Speed Reduction (km/h)
	Total	Without Contact		Total	Without Contact		Total	Without Contact	
16	6	5	14.1	6	3	10.0	5	3	11.5
40	5	5	40.0	5	4	33.1	5	4	32.7
50	5	5	49.8	5	5	50.1	5	3	31.6
55							5	3	39.4
60	6	4	44.8	5	3	37.9	4	1	34.3
65	5	5	64.9	3	0	24.6			
70	5	2	40.9						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2019 Audi A6 55 TFSI (3.0T) quattro

TEST VEHICLE INFORMATION

VIN: *WAUL2AF2XKN04xxxx*

Body Style: *Sedan* Color: *Vesuvius Gray Metallic*

Date Received: *8/24/2020* Odometer Reading: *2143 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Audi AG*

Date of manufacture: *11 18*

Vehicle Type: *Passenger Car*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *255/40 R20 101 H*

Rear: *255/40 R20 101 H*

Recommended cold tire pressure: Front: *250 kPa (36 psi)*

Rear: *260 kPa (38 psi)*

TIRES

Tire manufacturer and model: *Michelin Primacy MXM4*

Front tire size: *255/40 R20 101H*

Rear tire size: *255/40 R20 101H*

Front tire DOT prefix: *F3L2 00LX*

Rear tire DOT prefix: *F3L2 00LX*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 5)

2019 Audi A6 55 TFSI (3.0T) quattro

DAYTIME TEST GENERAL INFORMATION

Test date: *9/1/2020*

AMBIENT CONDITIONS

Air temperature: *35.0 C (95 F)*

Wind speed: *3.1 m/s (6.9 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.

The tests were conducted in an area void of overhead signs, bridges, or other significant structures over or near the testing site. Each trial was conducted with no vehicles, obstructions, or stationary objects within one lane width of either side of the SV path, unless otherwise specified. Shadows cast by objects other than the SV, test equipment, or the obstructing vehicles were not present in the SV lane of travel, or within one lane width of either side of the SV path

OBSTRUCTION VEHICLES

Forward obstructing vehicle: *1999 Honda Accord*

Rear obstructing vehicle: *2012 Toyota Highlander*

VEHICLE PREPARATION (DAY)

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: *250 kPa (36 psi)*

Rear: *260 kPa (38 psi)*

NIGHTTIME TEST GENERAL INFORMATION

Test date: *8/31/2020*

AMBIENT CONDITIONS

Air temperature: *22.8 C (73 F)*

Wind speed: *2.1 m/s (4.6 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 The tests were conducted between 1 hour after sunset and 1 hour before sunrise with good atmospheric visibility. There was no streetlighting.

The tests were conducted in an area void of overhead signs, bridges, or other significant structures over or near the testing site. Each trial was conducted with no vehicles, obstructions, or stationary objects within one lane width of either side of the SV path, unless otherwise specified. Shadows cast by objects other than the SV, test equipment, or the obstructing vehicles were not present in the SV lane of travel, or within one lane width of either side of the SV path.

OBSTRUCTION VEHICLES

Forward obstructing vehicle: *1999 Honda Accord*

Rear obstructing vehicle: *2012 Toyota Highlander*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 3: TEST CONDITIONS

2019 Audi A6 55 TFSI (3.0T) quattro

VEHICLE PREPARATION (NIGHT)

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: *250 kPa (36 psi)*

Rear: *260 kPa (38 psi)*

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*569.3 kg (1255 lb)*	Right Front:	*580.6 kg (1280 lb)*
Left Rear:	*451.8 kg (996 lb)*	Right Rear:	*476.3 kg (1050 lb)*
		Total:	*2078.0 kg (4581 lb)*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 4: PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM OPERATION

(Page 1 of 4)

2019 Audi A6 55 TFSI (3.0T) quattro

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

Pre Sense Front

Type and location of sensors the system uses:

Camera mounted near the inside rearview mirror

Are there any available settings for the PAEB system (i.e. Range adjustment, etc.)?

X Yes

____ No

If yes, please provide a full description.

The Pre Sense Front sensitivity can be adjusted by using the vehicle settings menus. These can be accessed by two different methods.

1. Using the touch screen select

Vehicle

Driver Assistance (See Figure A13)

2. Press the Driver assistance setting button (See Figure A15)

From the Driver Assistance page select the gear icon in the upper right of the screen, then

Audi pre sense

Prewarning

Select Early, Medium, or Late radio buttons

(See Figure A14)

System setting used for test (if applicable): *Early*

How is the PAEB alert presented to the driver?
(Check all that apply)

X Warning light

X Buzzer or audible alarm

___ Vibration

X Other

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

The visual alert is presented in the center of the instrument cluster between the speedometer and tachometer. It is shown in Figure A16 in Appendix A.

The auditory alert is presented as a single pulse tone centered at 1809 Hz.

In addition, there is a brake jerk as part of the warning cascade

Does the vehicle system require an initialization sequence/procedure?

___ Yes

X No

If yes, please provide a full description.

What are the minimum and maximum vehicle speeds over which the PAEB system is active?

Minimum: *6 mph (9.7 km/h) (Per manufacturer supplied information)*

Maximum: *52 mph (83.7 km/h) (Per manufacturer supplied information)*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 4: PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM OPERATION

2019 Audi A6 55 TFSI (3.0T) quattro

Will the system deactivate due to repeated PAEB activations, impacts or near-misses?

____ Yes

X No

If yes, please provide a full description.

Is there a way to deactivate the system?

X Yes

____ No

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

Pre Sense Front (FCW) can be disabled by using the vehicle settings menus. These can be accessed by two different methods.

1. Using the touch screen select

Vehicle

Driver Assistance (See Appendix A, Figures A13)

2. Press the Driver assistance setting button (Figure A15)

From the Driver Assistance page select the gear icon in the upper right of the screen, then

Audi pre sense

Prewarning

Toggle the top radio button for on/off

See Figure A14.

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

If yes, please provide a full description.

The system has a self-test algorithm, which will reduce the system performance or deactivate completely if the following conditions are observed:

- *Mud/dirt/snow accumulation on the sensor*
- *ESC Turned off or in sport mode*

If the systems detect sensor blockage, FCW, DBS, CIB will not be available and the system will show a notification in the vehicle cluster. See Owner's Manual, page 118, shown on Appendix B, page B-5.

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Ten test scenarios were used, as follows:

- S1a. Subject Vehicle (SV) Encounters a Crossing Adult Pedestrian Test Mannequin (PTM) from the Nearside at 25% Overlap
- S1b. SV Encounters a Crossing Adult PTM from the Nearside at 50% Overlap
- S1c. SV Encounters a Crossing Adult PTM from the Nearside at 75% Overlap
- S1d. SV Encounters a Crossing Child PTM Running from Behind Parked Cars from the Nearside at 50% Overlap
- S1e. SV Encounters a Crossing Adult PTM Running from the Offside at 50% Overlap
- S1f. SV Encounters a Crossing Adult PTM From the Nearside and Stops Short of Entering the SV Path of Travel
- S1g. SV Encounters a Crossing Adult PTM From the Nearside and Clears the SV Path of Travel
- S4a. SV Encounters a Stationary Adult PTM on the Nearside of the Road Facing Away from the SV at 25% Overlap
- S4b. SV Encounters a Stationary Adult PTM on the Nearside of the Road Facing Toward the SV at 25% Overlap
- S4c. SV Encounters an Adult PTM on the Nearside of the Road Walking in the Same Direction as the SV at 25% Overlap

The 89 different combinations of scenario, nominal SV speeds, and lighting conditions are listed in Table 1. This includes 35 daytime, 27 low beam nighttime, and 27 high beam nighttime combinations. Testing generally started at the lowest test speed in Table 1 and progressed through higher test speeds.

For all scenarios except S4c, the 16 and 40 km/h speeds were considered to be the "non-conditional" speeds. Testing at these speeds was conducted without regard to whether the results showed that "consistent contact" occurred between the SV and PTM. Consistent contact was defined as the SV contacting the PTM in three or more test trials at a given speed. If this occurred, then testing at any higher speeds was not conducted. Rather, the speed would be stepped down by 5 km/h and testing of that scenario and lighting treatment would be conducted at that lower speed. This was done to more precisely identify the highest speed at which the vehicle's PAEB system was able to avoid colliding with the PTM.

So, for example, for Scenario S1d, if the vehicle did not contact the PTM at 16, 20, or 30 km/h, but did contact the PTM in three trials at 40 km/h, then testing would be done at 35 km/h. However, testing would not be done at 50 or 60 km/h. Note that there were 20 possible scenario and ambient lighting condition combinations that could involve testing at the "step down" speed, for a total of 109 possible test combinations.

Table 1. Test Scenario, Speed, and Lighting Condition Matrix

	Nominal SV Speeds (km/h)								Lighting Condition		
										Night	
Scenario	16	20	30	40	50	60	70	80	Day	Low Beams	High Beams
S1a	X	-	-	X	-	-	-	-	X	-	-
S1b	X	X*	X*	X	X*	X*	-	-	X	X*	X*
S1c	X	-	-	X	-	-	-	-	X	-	-
S1d	X	X*	X*	X	X*	X*	-	-	X	X*	X*
S1e	-	-	-	X	X*	X*	-	-	X	X*	X*
S1f	-	-	-	X	-	-	-	-	X	-	-
S1g	-	-	-	X	-	-	-	-	X	-	-
S4a	X	-	-	X	X*	X*	X*	X*	X	X*	X*
S4b	X	-	-	X	-	-	-	-	X	-	-
S4c	-	-	-	X	-	-	-	-	X	X*	X*

* Additional test condition (i.e., not part of the test procedure titled, "Pedestrian Automatic Emergency Brake System Confirmation Test (Working Draft)", dated September 2019.

All of the test trials were performed with SV 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.

An overview of each of the test procedures follows.

B. SV Approach to a Crossing Pedestrian (S1)

1. S1 TEST SCENARIOS

The following S1 test scenarios were used to evaluate PAEB system performance.

a. S1a-b-c Scenarios – SV Encounters a Crossing Adult PTM from the Nearside at 25/50/75% Overlap

These tests evaluate the ability of the SV PAEB system to detect and respond to a crossing adult pedestrian walking into the SV path from the nearside.

Figure 1 below illustrates the S1a, S1b, and S1c test scenarios. See Table 3 for details on the test setup.

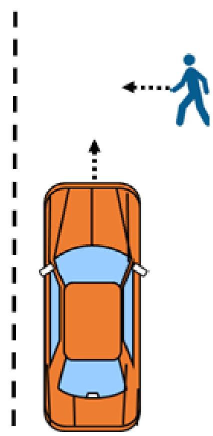


Figure 1. Scenarios S1a, b, c; Nearside Crossing Adult Pedestrian Walking 25/50/75% Overlap

- S1a test conditions:
  - SV Speeds (km/h): 16, 40
  - PTM Speed (km/h): 5
  - PTM Type: Adult
  - Overlap: 25%
  - Direction of PTM Approach: Nearside

- S1b test conditions:
    - SV Speeds (km/h): 16, 20, 30, 40, 50, 60
    - PTM Speed (km/h): 5
    - PTM Type: Adult
    - Overlap: 50%
    - Direction of PTM Approach: Nearside

- S1c test conditions:
    - SV Speeds (km/h): 16, 40
    - PTM Speed (km/h): 5
    - PTM Type: Adult
    - Overlap: 75%
    - Direction of PTM Approach: Nearside

b. S1d Scenario – SV Encounters a Crossing Child PTM Running from Behind Parked Cars from the Nearside at 50% Overlap

This test evaluates the ability of the SV PAEB system to detect and respond to a crossing child pedestrian running into the SV path from behind parked vehicles from the nearside.

Figure 2 below illustrates the S1d test scenario. See Table 3 for details on the test setup.

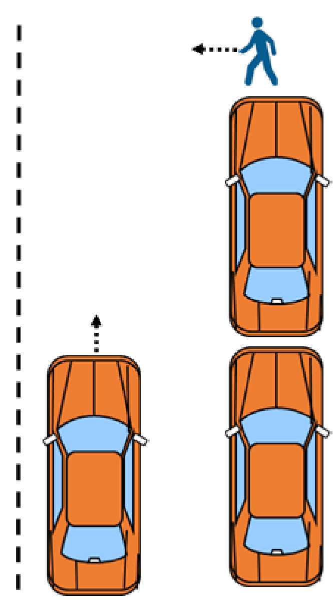


Figure 2. Scenario S1d; Nearside Obstructed Crossing Child Running, 50% Overlap

- S1d test conditions:
  - SV Speeds (km/h): 16, 20, 30, 40, 50, 60
  - PTM Speed (km/h): 5
  - PTM Type: Child
  - Overlap: 50%
  - Direction of PTM Approach: Nearside

c. S1e Scenario – SV Encounters a Crossing Adult PTM from the Offside at 50% Overlap

This test evaluates the ability of the SV PAEB system to detect and respond to a crossing adult pedestrian running into the SV path from the offside.

Figure 3 below illustrates the S1e test condition. See Table 4 for details on the test setup.

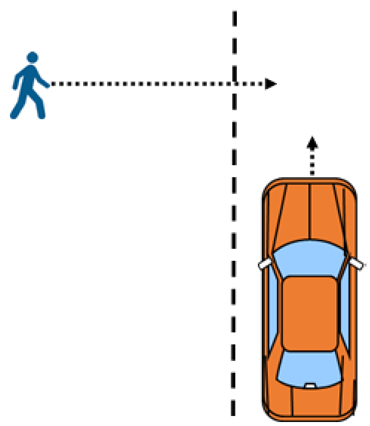


Figure 3. Scenario S1e; Offside Crossing Adult Running 50% Overlap

- S1e test conditions:
  - SV Speeds (km/h): 40, 50, 60
  - PTM Speed (km/h): 8
  - PTM Type: Adult
  - Overlap: 50%
  - Direction of PTM Approach: Offside

d. S1f Scenario – SV Encounters a Crossing Adult PTM from the Nearside that Stops Short of Entering the SV Travel Path

This test evaluates how the SV PAEB system will respond to a crossing adult pedestrian walking from the nearside that stops short of entering the vehicles path.

Figure 4 below illustrates the S1f test condition. See Table 3 for details on the test setup.

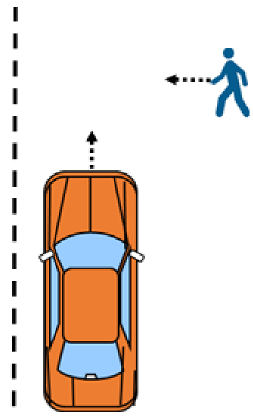


Figure 4. Scenario S1f; Nearside Crossing Adult Walking Stops Short

- S1f test conditions:
  - SV Speeds (km/h): 40
  - PTM Speed (km/h): 5
  - PTM Type: Adult
  - Overlap: 0% (stops short of vehicle path)
  - Direction of PTM Approach: Nearside

e. S1g Scenario – SV Encounters a Crossing Adult PTM from the Nearside that Clears the SV Travel Path

This test evaluates how the SV PAEB system will respond to a crossing adult pedestrian walking from the nearside that clears the vehicle’s path.

Figure 5 below illustrates the setup for the S1g test condition. See Table 3 for details on the test setup.

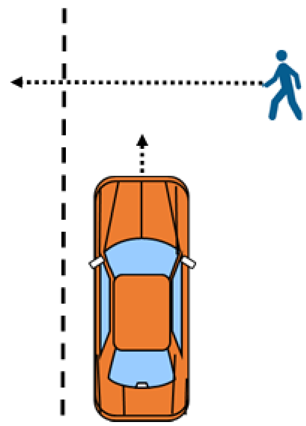


Figure 5. Scenario S1g; Nearside Crossing Adult Walking Clears Path

- S1g test conditions:
  - SV Speeds (km/h): 40
  - PTM Speed (km/h): 5
  - PTM Type: Adult
  - Overlap: 100% (crosses beyond vehicle path)
  - Direction of PTM Approach: Nearside

2. PEDESTRIAN TEST MANNEQUIN PLACEMENT AND MOVEMENT

For tests S1a-b-c-d-f-g, the PTM was positioned 3.5 m (11.5 ft) from the SV centerline on the nearside with its orientation perpendicular to the SV centerline. For test S1e, the PTM was positioned 5.5 m (18.0 ft) from the SV centerline on the offside with its orientation also perpendicular to the SV centerline.

Trigger timing for the S1 tests assumed that the SV will approach the crossing PTM at a constant speed with no PAEB system intervention. Trigger timing for the

- S1a test was set up so that the PTM would contact the front of the SV at 25% of the SV width (i.e., on the passenger side of the vehicle).
- S1b-d-e tests were set up so that the PTM would contact the front of the SV at 50% of the SV width (i.e., the center of the SV).
- S1c test was set up so that the PTM would contact on the front of the SV at 75% of the SV width (i.e., on the driver side of the vehicle).
- S1f test was set up so that the PTM would contact the front of the SV at 50% of the SV width, but the PTM forward motion was stopped at -25% of the SV width. This means that the PMT did not enter the direct path of the SV.
- S1g test was set up so that the PTM would clear the direct path of the SV. For

calculating trigger timing for PTM motion 125% of the SV width was used.

a. PTM Position as a Function of SV Position

i. PTM Position Validity Criterion

In the course of testing PAEB systems, it is necessary to confirm that the required conflict scenario was presented to each vehicle in a repeatable and verifiable fashion, trial after trial. This is particularly important in the pedestrian crossing scenarios (S1a-g). For the purposes of these tests, the ideal PTM lateral lane position (Y_{PTM}) is expressed as a function of SV position longitudinally within the lane (X_{SV} - i.e., headway between the front of the SV to the contact-side of the PTM.). That is:

$$Y_{PTM} = f(X_{SV})$$

Note that the terms "longitudinal" and "lateral" herein are defined relative to the SV lane of travel. Therefore, PTM lateral lane position refers to the PTM position across the lane.

On this basis, the validity of a given trial is determined by computing the sample-by-sample difference of the measured Y_{PTM} position and the ideal position, and then applying a tolerance. The tolerance chosen as the validity criterion for the S1 scenarios was 10% of the width of a typical 1.8-meter-wide vehicle, or 0.18 m (18 cm).

ii. Methodology

In order to compute a positional error of the PTM (laterally within the lane), it is necessary to pre-compute the ideal positional relationship between the SV longitudinal lane position and the lateral position of the PTM based on the parameters specified per scenario, assuming the SV had not begun its avoidance maneuver. These parameters include:

- SV speed (v_{SV})
- PTM speed (v_{PTM})
- Percent Overlap at Impact (%OL)
- PTM start distance (Y_{PTM0})
- PTM acceleration distance (D_{acc})
- PTM Move distance (D_{move})
- SV width (W_{SV})

From these parameters, the spatial relationship of the PTM relative to the SV position along the travel lane is determined.

Figure 6 illustrates the coordinate system used for the validation of Scenario 1 (S1a, b, c, d, e, f, g).

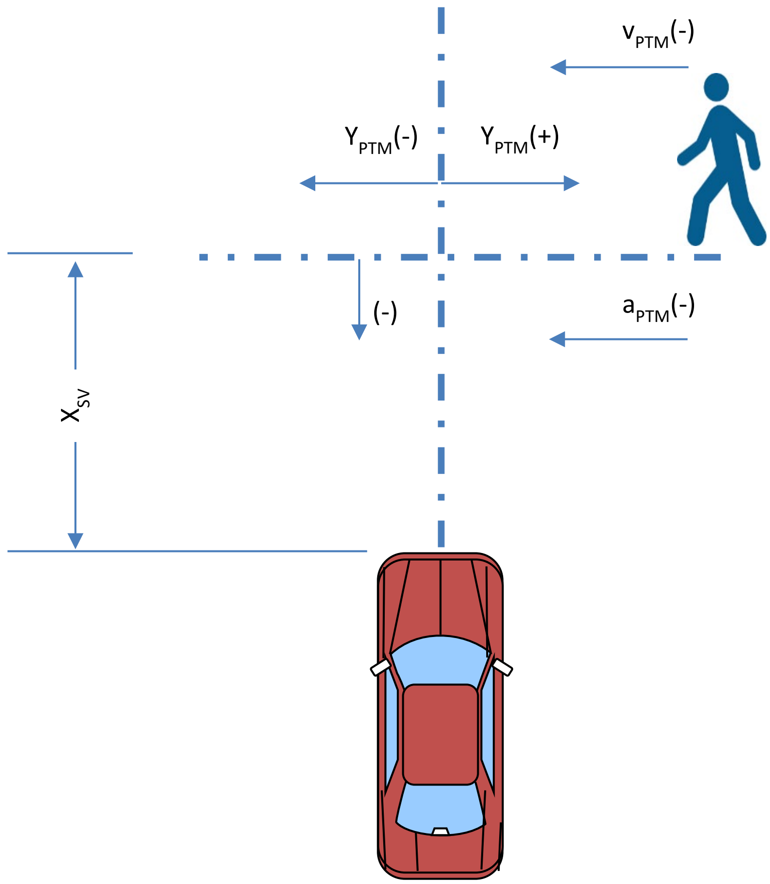


Figure 6. Coordinate System for Validation of Scenario 1

Note that Y_{PTM} is measured relative to the center of the lane (in this case, shown coincident with the center of the SV) with positive values to the right (as viewed from the SV). Note also that X_{SV} is measured parallel to the travel lane between the near edge of the PTM and the front-most point of the SV, such that X_{SV} is negative during the approach phase.

Figure 7 illustrates the ideal lateral lane position of the PTM as a function of SV longitudinal lane position, taking each scenario parameter into consideration.

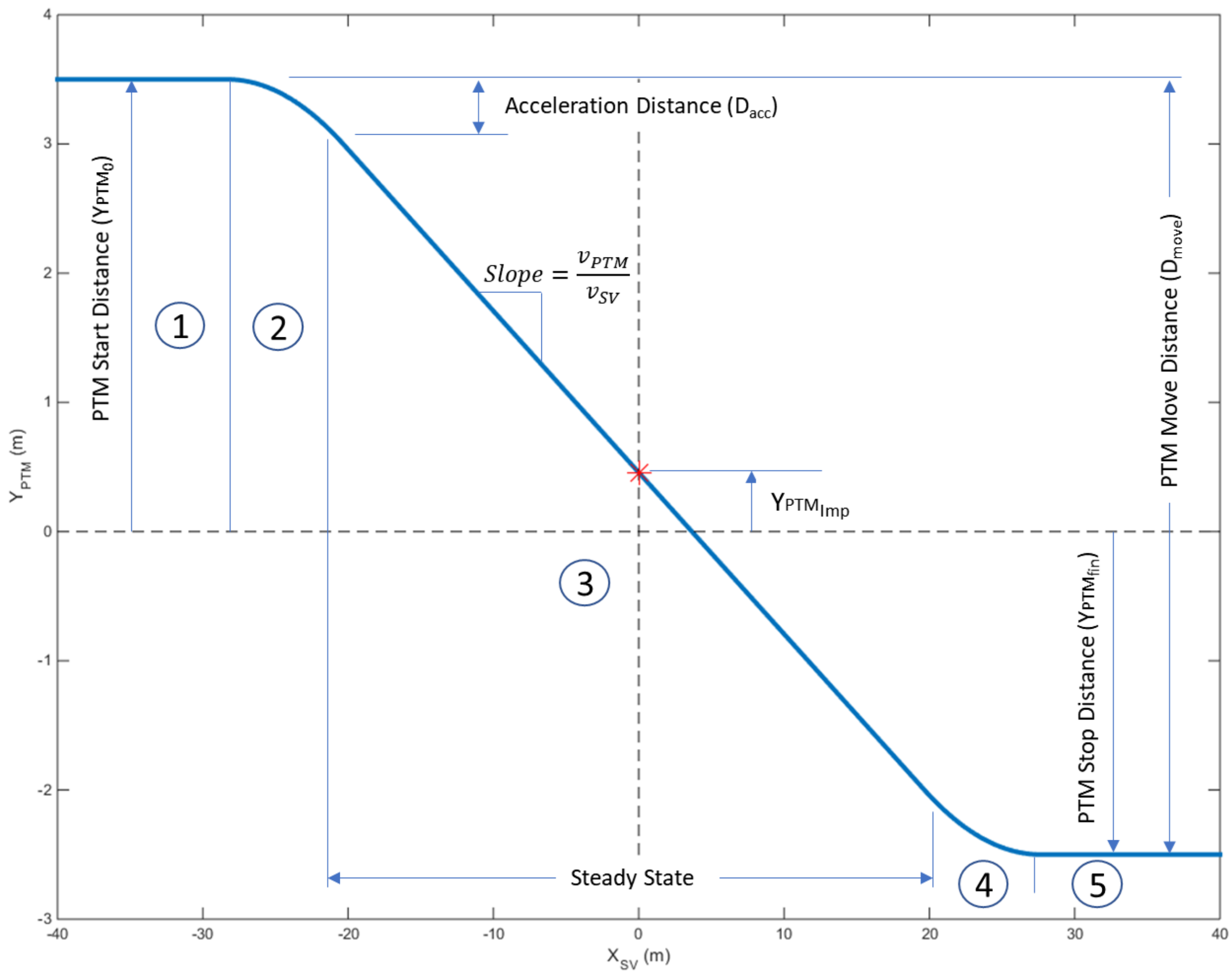


Figure 7. PTM Lateral Lane Position as a Function of SV Longitudinal Lane Position

The ideal trajectory of the PTM lateral lane position as a function of headway is computed in 5 separate domains. These domains are:

- Stationary domain, initial: The PTM is stationary at the side of the roadway as the SV approaches
- Acceleration domain: The PTM accelerates to its prescribed speed over a prescribed distance
- Steady State domain: The PTM speed, v_{PTM}, and SV speed, v_{SV}, are both steady-state. Note that $Y_{PTM_{imp}}$ is defined as the offset distance at impact (if there is no intervention by the PAEB system or driver braking)
- Deceleration domain: The PTM decelerates from its prescribed speed to rest over a prescribed distance (relevant only for scenario S1f)
- Stationary domain, final: The PTM is stationary at its final position as the SV proceeds in the lane (relevant only for scenario S1f)

The boundaries of these domains are:

- X_{SV} at PTM motion start ($X_{SV_{PTM\ Start}}$)
- X_{SV} at PTM steady state start ($X_{SV_{SS\ Start}}$)
- X_{SV} at PTM steady state end ($X_{SV_{SS\ end}}$)
- X_{SV} at PTM motion stop ($X_{SV_{PTM\ Stop}}$)

Table 2 provides the domain boundaries for each PAEB scenario for the standard scenario SV speeds. Note that the details of the calculations follow.

Table 2. Domain Boundaries Per Scenario

Scenario		Domain (X_{SV}, Y_{PTM})			
Type	SV Speed (km/h)	PTM Start (m)	Steady State Start (m)	Steady State End (m)	PTM Stop (m)
S1a	16	(-11.34, 3.50)	(-8.14, 3.00)	(7.86, -2.00)	(11.06, -2.50)
	40	(-28.34, 3.50)	(-20.34, 3.00)	(19.66, -2.00)	(27.66, -2.50)
S1b	16	(-12.80, 3.50)	(-9.60, 3.00)	(6.40, -2.00)	(9.60, -2.50)
	40	(-32.00, 3.50)	(-24.00, 3.00)	(16.00, -2.00)	(24.00, -2.50)
S1c	16	(-14.26, 3.50)	(-11.06, 3.00)	(4.94, -2.00)	(8.14, -2.50)
	40	(-35.66, 3.50)	(-27.66, 3.00)	(12.34, -2.00)	(20.34, -2.50)
S1d	16	(-12.80, 3.50)	(-9.60, 3.00)	(6.40, -2.00)	(9.60, -2.50)
	40	(-32.00, 3.50)	(-24.00, 3.00)	(16.00, -2.00)	(24.00, -2.50)
S1e	40	(-32.50, -5.50)	(-22.50, -4.50)	(12.50, 2.50)	(22.50, 3.50)
S1f	40	(-32.00, 3.50)	(-24.00, 3.00)	W_{SV} Dependent	W_{SV} Dependent
S1g	40	(-42.97, 3.50)	(-34.97, 3.00)	(5.03, -2.00)	(13.03, -2.50)

In order to compute the values for these domain boundaries, it is necessary to compute several intermediate values:

Y_{PTM} at the point of impact, as defined by the Percent Overlap specified by the scenario:

$$Y_{PTM_{imp}} = (50\% - \%OL)W_{SV}$$

where,

W_{SV} = SV width (assumed here to be 1.8 meters)

In scenario S1f, in which the PTM comes to rest without entering the SV lane of travel such that no collision can occur, it is also necessary to compute the deceleration and stop distances:

$$Y_{PTM_{fin}} = Y_{PTM_0} - D_{move}$$

where,

$Y_{PTM_{fin}}$ = final position of PTM with respect to the lane

Y_{PTM_0} = initial position of PTM with respect to the lane

D_{move} = distance moved by the PTM, defined by scenario

In the acceleration domain, it is assumed that the PTM undergoes constant acceleration from rest to the specified PTM speed, such that the acceleration can be computed as:

$$a = \frac{{v_{PTM}}^2}{2D_{acc}}$$

where,

v_{PTM} = velocity of PTM, defined by scenario

D_{acc} = acceleration distance of PTM, defined by scenario

The longitudinal distance covered by the SV during the acceleration phase of the PTM is computed as:

$$\Delta X_{SV_{acc}} = \frac{2D_{acc}v_{SV}}{v_{PTM}}$$

where,

$\Delta X_{SV_{acc}}$ = Change in SV longitudinal lane position during the acceleration of the PTM

v_{SV} = SV velocity, defined by scenario

Computing the domain boundaries:

$$X_{SV_{SS\ start}} = \left[Y_{PTM_0} - D_{acc} - Y_{PTM_{Imp}}\right]\frac{v_{SV}}{v_{PTM}}$$

$$X_{SV_{SS\ end}} = \left[Y_{PTM_{fin}} + D_{acc} - Y_{PTM_{Imp}}\right]\frac{v_{SV}}{v_{PTM}}$$

$$X_{SV_{PTM\ start}} = \Delta X_{SV_{acc}} + X_{SV_{SS\ Start}}$$

$$X_{SV_{PTM\ stop}} = X_{SV_{SS\ end}} - \Delta X_{SV_{acc}}$$

where,

$X_{SV_{SS\ start}}$ = SV longitudinal lane position at the beginning of steady state domain

$X_{SV_{SS\ end}}$ = SV longitudinal lane position at the end of steady state domain

$X_{SV_{PTM\ start}}$ = SV longitudinal lane position at the start of PTM motion

$X_{SV_{PTM\ stop}}$ = SV longitudinal lane position at the end of PTM motion

Finally, lateral lane position values are computed for each domain.

Domain 1 (Stationary):

$$Y_{PTM} = Y_{PTM_0} \qquad \text{for} \quad X_{SV} \leq X_{SV_{PTM\ start}}$$

Domain 2 (Acceleration):

$$Y_{PTM} = Y_{PTM_0} - \frac{1}{2}a_{PTM}\left[\frac{X_{SV} - X_{SV_{PTM\ Start}}}{v_{SV}}\right]^2 \qquad \text{for} \quad X_{SV_{PTM\ start}} < X_{SV} \leq X_{SV_{SS\ start}}$$

where,

a_{PTM}	= PTM acceleration, defined by scenario
X_{SV}	= measured SV longitudinal lane position

Domain 3 (Steady State):

$$Y_{PTM} = \frac{v_{PTM}}{v_{SV}} X_{SV} + Y_{PTM_{imp}} \qquad \text{for} \quad X_{SV_{SS\,start}} < X_{SV} \leq X_{SV_{SS\,end}}$$

Domain 4 (Deceleration):

$$Y_{PTM} = Y_{PTM_{fin}} + D_{acc} + v_{PTM} \frac{\left(X_{SV} - X_{SV_{SS\,end}}\right)}{v_{SV}} + \frac{1}{2} a_{PTM} \left[\frac{X_{SV} - X_{SV_{SS\,end}}}{v_{SV}}\right]^2$$

$$\text{for} \quad X_{SV_{SS\,end}} < X_{SV} \leq X_{SV_{PTM\,stop}}$$

Domain 5 (Stationary):

$$Y_{PTM} = Y_{PTM_{fin}} \qquad \text{for} \quad X_{SV} > X_{SV_{PTM\,stop}}$$

After each trial is completed, the measured X_{SV} values are used to compute ideal Y_{PTM} values, sample-by-sample. Measured Y_{PTM} values are then compared to the ideal Y_{PTM} values in order to compute a lateral lane position error for the PTM:

$$Y_{PTM_{err}} = Y_{PTM_{ideal}} - Y_{PTM_{meas}}$$

Y_{PTM} error is then plotted in the time domain for the entire validity window and checked to determine exceedances beyond the acceptable threshold of ±18 cm (or 10% of a typical 1.8 m wide vehicle). The validity window started at 4.0 sec Time-To-Collision (TTC) and ends at the earliest of any of the following:

- SV braking is initiated
- SV-to-PTM contact occurs
- The front of the SV crosses the X_{SV} zero point

3. OBSTRUCTION VEHICLES

Two parked vehicles positioned along the nearside of the test lane were used as obstructions. The obstructions blocked the view of the pedestrian from the vehicle sensors limiting the reveal time (the time that the vehicle's sensors have to process that a pedestrian is approaching the SV lane of travel). Parked Obstruction Vehicle 1 (PV1) was a mid-sized sedan (1999 Honda Accord) positioned closest to the pedestrian path.

Parked Obstruction Vehicle 2 (PV2) was a mid-sized Sport Utility Vehicle (2012 Toyota Highlander) positioned behind PV1.

4. SV ZERO POSITION

- The SV and PTM were centered on the SV centerline with the PTM facing the direction specified for each test scenario.

- The front-most location of the SV was positioned such that it just contacted the PTM. This was the "zero position." The zero position did not change based on different overlap test conditions. Note that the determination of whether there was a collision between the SV and PTM is based on whether the zero position has been crossed. This means that for this purpose, the front of the SV is considered to have a rectangular shape (even if it actually has some curvature). Note also that the arms of the PTM were not considered contact points.

- The zero position was documented both prior to and immediately after conduct of a test series.

5. LAST MOMENT BRAKING

In order to reduce the likelihood of damage to both the PTM and test vehicle, it was determined that Last Moment Braking (LMB) would be implemented for scenarios in which the nominal speed was 40 km/h or higher. LMB is defined as braking applied by the driver to reduce the speed and energy of the collision with the PTM in the event that a collision becomes impossible to avoid.

LMB was implemented as follows: the computer onboard the SV continuously computed and monitored TTC. If TTC dropped below a preset value (i.e. 1.0 sec) and no alert or braking had been provided by the PAEB system at that time, then the computer would provide an audible beep, and the driver would apply the brakes forcefully and as quickly as possible. When LMB was used, the preset TTC value was selected such that a collision would be inevitable (i.e., even immediate maximum braking would not reduce SV speed enough to avoid colliding with the PTM). Thus, the overall outcome of the trial (collision/no collision) would not be affected by the use of LMB.

6. TEST TRIAL CONDUCT AND VALIDITY (S1)

An overview of each test trial is as follows: For each trial for the S1 scenarios, the SV and PTM were first positioned at their respective start positions. The SV was accelerated to its nominal test speed, and the driver maintained its position in the center of the lane. When the SV was at a designated longitudinal distance from the PTM, the PTM accelerated to its nominal test speed. If a PAEB alert was issued by the vehicle, the driver then fully released the throttle (within 500 ms of the alert). After the vehicle either came to a stop or passed through the plane defined by the PTM's movement, which was perpendicular to the SV's line of travel, the trial was concluded.

a. PTM Validity

For each test trial to be valid, the following criteria were required to be met.

- The PTM was secured to the apparatus used for motion such that its position relative to the apparatus remained constant.
- The PTM was at the start position distance on the PTM path from the SV path and did not move until the triggering criteria for motion were met.
- PTM start position nearside: 3.5 m±2.54 cm (11.4 ft±1 in)
- PTM start position offside: 5.5 m±2.54 cm (18.04 ft±1 in)
- When triggered, the PTM was accelerated to the test speed over the required distance and held at that test speed until the PTM was clear of the SV path, stopped short of entering the SV path, or was contacted by the SV.
- PTM speed:
  - 5 km/h (3.1 mph) within an acceleration distance of 0.5 m (1.64 ft)
  - 8 km/h (4.9 mph) within acceleration distance 1.0 m (3.28 ft)
- PTM position: ±0.18m from ideal lateral position within the lane, as a function of SV longitudinal position within the lane[2].
- While the PTM was in motion, the PTM path remained perpendicular to the SV centerline. Lateral deviations induced by wind, equipment, or surface conditions were monitored.

b. SV Validity

For an individual test trial to be valid, the following criteria were required to be met:

- The SV driver seatbelt was latched.
- The SV driver cycled the ignition prior to each run.

[2] The ideal lateral position of the PTM within the lane was calculated as a function of SV longitudinal lane position as described in Section III B 2 a ii and shown in Figure 7.

- The front initial brake temperature (IBT) was between 149°F (65°C) and 212°F (100°C) at the onset of each test.
    - If the IBT was less than 149°F (65°C), the brakes were heated to the IBT by making one or more brake applications from a speed of 31.1 mph (50 km/h), at a deceleration rate not greater than 0.31g (3 m/s²).
    - If the IBT was greater than 212°F (100°C), the SV was driven at speeds up to 62.1 mph (100 km/h) until the IBT specified in this section was reached.
- The SV was driven at the nominal speed specified for each test. The speed tolerance was ±1.0 km/h.
- The following requirements were held true throughout each trial.
    - The driver used the least amount of steering input necessary to maintain the SV position in the center of the test lane. The lateral distance between the centerline of the SV and the center of the travel lane did not deviate more than ± 20 cm (8 in). A measurement and display of SV lateral lane position was presented to the driver in order to regulate the lateral lane position during the execution of a trial. These data were also recorded and used as validation of lane position in post-process.
    - The yaw rate of the SV did not exceed ±1.0 deg/s.
    - The SV driver modulated the throttle, using smooth inputs, to maintain a constant SV speed ±1.0 km/h.
    - With the exception of LMB (described above), the SV driver did not apply any force to the brake pedal until the end of the test unless the PTM was contacted or the front of the SV had crossed the path of the PTM.
- The SV throttle was fully released within 500 ms after the SV PAEB warning event was presented (visual, haptic, or audible). If no SV warning event was presented by the SV PAEB system, the SV driver modulated the throttle to maintain a constant speed until either the onset of PAEB or, if the SV's PAEB system did not activate, the end of the test occurred (i.e., contact with the PTM occurred).

c. Validity Period

- The valid test interval began when the longitudinal TTC of the SV = 4.0 seconds.
- For scenarios S1a-b-c-d-e, the test ended when any of the following occurred:
    - The SV contacted the PTM; or
    - The SV stopped (via PAEB) before contacting the PTM; or
    - The PTM cleared the direct path of the SV.
- For scenarios S1f-g, the test ended when either of the following occurred:
    - The front of the SV crossed the path of the PTM (i.e., the front most location of the SV front bumper crosses the zero position.

- The SV stopped (via PAEB).

d. End-of-Test Instructions

After the test was complete, the SV driver manually applied force to the brake pedal, bringing the vehicle to a stop (if necessary), and placed the transmission in park (automatic transmission) or neutral (manual transmission).

The test trial was then complete.

e. Number of Test Trial Repeats

Combinations of test speeds, and lighting conditions were tested as shown in Table 1. Five repeat trials were conducted for each test condition. As noted above, for all scenarios, the 16 and 40 km/h speeds were considered to be the “non-conditional” speeds. Testing at these speeds was conducted without regard to whether the results showed that “consistent contact” occurred between the SV and PTM. Consistent contact was defined as the SV contacting the PTM in three or more test trials at a given speed. If this occurred, then testing at any higher speeds was not conducted. Rather, the speed would be reduced by 5 km/h and testing of that scenario and lighting treatment would be conducted at that lower speed. This was done to more precisely identify the highest speed at which the vehicle’s PAEB system was able to avoid colliding with the PTM.

f. Speed Reduction (S1a-b-c-d-e)

The magnitude of the SV speed reduction attributable to PAEB intervention (as shown in Datasheet 1) was calculated in one of two ways, depending on whether or not a test trial concluded with the SV colliding with the PTM.

- If the SV contacted the PTM during a test trial, the PAEB speed reduction was calculated by subtracting the SV speed at the time of contact (i.e., when longitudinal range becomes zero) from the average SV speed calculated at TTC = 4.0 seconds.
- If the SV did not contact the PTM during a test trial (i.e., PAEB intervention prevented the crash), the SV speed at the time of SV and PTM contact was taken to be zero. The speed reduction was therefore equal to the SV speed at TTC = 4.0 seconds.

g. Deceleration (S1f-g)

The peak SV deceleration within the validity period was documented for each test trial performed for the S1f-g scenarios.

h. Pass/Fail Criteria

There were no pass/fail criteria for these research tests.

C. SV Approach to a Pedestrian Walking Along/Against Traffic (S4)

1. S4 TEST SCENARIOS

a. S4a Scenario – SV Encounters a Stationary Adult PTM on the Nearside of the Road Facing Away from the SV at 25% Overlap

This test evaluates the ability of the SV PAEB system to detect and respond to an adult pedestrian standing in front of the vehicle on the nearside of the road facing away from the approaching SV.

Figure 8 below illustrates the test setup for the S4a test. See Table 5 for details on the test setup.

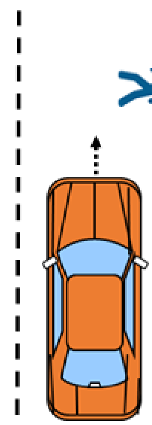


Figure 8. Scenario S4a; Nearside Standing Adult Facing Away From SV, 25% Overlap

- S4a test conditions:
    - SV Speeds (km/h): 16, 40
    - PTM Speed (km/h): 0
    - PTM Type: Adult
    - Overlap: 25%
    - Direction of PTM Approach: Facing away from the SV

b. S4b Scenario – SV Encounters a Stationary Adult PTM on the Nearside of the Road Facing Towards the SV at 25% Overlap

This test evaluates the ability of the SV PAEB system to detect and respond to an adult pedestrian standing in front of the vehicle on the nearside of the road facing towards the approaching SV.

Figure 9 below illustrates the test setup for the S4b test scenario. See Table 5 for details on the test setup.

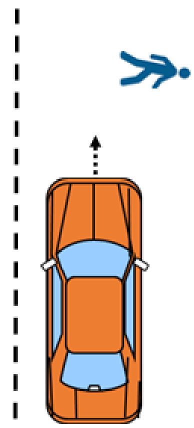


Figure 9. Scenario S4b; Nearside Standing Adult Facing Towards SV, 25% Overlap

- S4b test conditions:
  - SV Speeds (km/h): 16, 40
  - PTM Speed (km/h): 0
  - PTM Type: Adult
  - Overlap: 25%
  - Direction of PTM Approach: Facing towards the SV

c. S4c Scenario – SV Encounters an Adult PTM on the Nearside of the Road Walking Away from the SV, but in the Same Direction as the SV, at 25% Overlap

This test evaluates the ability of the SV PAEB system to detect and respond to an adult pedestrian walking in front of the vehicle on the nearside of the road facing away from the approaching SV.

Figure 10 below illustrates the test setup for the S4c test scenario. See Table 5 for details on the test setup.

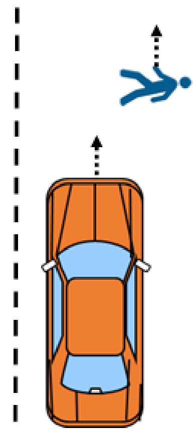


Figure 10. Scenario S4c; Nearside Walking Adult Away From SV, 25% Overlap

- S4c test conditions:
  - SV Speeds (km/h): 40
  - PTM Speed (km/h): 5
  - PTM Type: Adult
  - Overlap: 25%
  - Direction of PTM Approach: Facing and moving away from SV

2. PEDESTRIAN TEST MANNEQUIN PLACEMENT AND MOVEMENT

For the S4a-b-c scenarios, the PTM was positioned in the direct path of the SV at a 25% overlap on the nearside. The orientation of the PTM was either facing towards or away from the SV and was either stationary or moving for the duration of the tests.

The PTM was stationary in scenarios S4a and S4b, and therefore, no trigger timing was required.

Trigger timing for the S4c scenario was set up so that the PTM was moving and had reached steady state speed before TTC has been reduced to 7 seconds (i.e., 7 seconds before SV-to-PTM contact would occur if there was no PAEB system intervention).

3. SV ZERO POSITION

- The SV was centered on the SV path at the start of the test lane. The PTM was located on the PTM path which was parallel to the SV path inside the test lane located on the nearside. The SV overlap was 25% of the SV width, which was the distance between the SV centerline path and the PTM centerline path. The PTM faced the direction specified for each test scenario.

- The SV was positioned such that it just contacted the PTM. This was the “zero position.” Note that the determination of whether there was a collision between the SV and PTM was based on whether the zero position had been crossed. Note also that the arms of the PTM were not considered contact points.
- The zero position was documented prior to, and immediately after, conduct of a test series.

4. LAST MOMENT BRAKING

In order to reduce the likelihood of damage to both the PTM and test vehicle, it was determined that Last Moment Braking (LMB) would be implemented for scenarios in which the nominal speed was 40 km/h or higher. LMB is defined as braking applied by the driver to reduce the speed and energy of the collision with the PTM in the event that a collision becomes impossible to avoid.

LMB was implemented as follows: the computer onboard the SV continuously computed and monitored TTC. If TTC dropped below a preset value (i.e., 1.0 sec) and no alert or braking had been provided by the PAEB system at that time, then the computer would provide an audible beep, and the driver would apply the brakes forcefully and as quickly as possible. When LMB was used, the preset TTC value was selected such that a collision would be inevitable (i.e., even immediate maximum braking would not reduce SV speed enough to avoid colliding with the PTM). Thus, the overall outcome of the trial (collision/no collision) would not be affected by the use of LMB.

5. TEST TRIAL CONDUCT AND VALIDITY

An overview of each test trial is as follows: For each trial for the S4 scenarios, the SV and PTM were first positioned at their respective start positions. The SV was accelerated to its nominal test speed, and the driver maintained its position in the center of the lane. When the SV was at a designated longitudinal distance from the PTM, the PTM accelerated to its nominal test speed (S4c only). If a PAEB alert was issued by the vehicle, the driver then fully released the throttle (within 500 ms of the alert). After the vehicle either came to a stop or passed through the plane defined by the PTM’s movement (S4c only), which is parallel to the SV’s line of travel, the trial was concluded.

a. PTM Validity

For all S4 scenarios, a required condition for validity of every trial was that the PTM was secured to the motion apparatus such that its position relative to the apparatus remained constant throughout the test.

For the S4c scenario, the following additional criteria were required for test validity:

- The PTM was at the start position distance on the PTM path and did not move until the triggering criteria for motion were met.
- When triggered, the PTM was accelerated to the test speed over the required

distance and held at that test speed until a contact event or the SV speed was reduced to zero and no contact had occurred.

  - PTM speed: 5 km/h (3.1 mph) within an acceleration distance of 1.0 m (3.28 ft)
  - PTM position: ±0.18 m from the ideal lateral position within the lane, as a function of SV longitudinal position within the lane[3].

- While the PTM was in motion, the PTM path remained parallel to the SV path. Lateral deviations induced by wind, equipment, or surface conditions were monitored.

b. SV Validity

For an individual test trial to be valid, the following criteria were required to be met:

- The SV driver seatbelt was latched.
- The SV driver cycled the ignition prior to each run.
- The front IBT was between 149°F (65°C) and 212°F (100°C) at the onset of each test.
  - If the IBT was less than 149°F (65°C), the brakes were heated to the IBT by making one or more brake applications from a speed of 31.1 mph (50 km/h), at a deceleration rate not greater than 0.31g (3 m/s²).
  - If the IBT was greater than 212°F (100°C), the SV was driven at speeds up to 62.1 mph (100 km/h) until the IBT specified in this section is reached.
- The SV was driven at the nominal speed specified for each test. The speed tolerance was ±1.0 km/h
- For scenario S4c only, PTM motion began when the longitudinal TTC of the SV = 7.0 seconds.
- The following requirements were held true throughout each trial:
  - The driver used the least amount of steering input necessary to maintain the SV position in the center of the test lane. The lateral distance between the centerline of the SV and the center of the travel lane did not deviate more than ± 20 cm (8 in). A measurement and display of SV lateral lane position was presented to the driver in order to regulate the lateral lane position during the execution of a trial. These data were also recorded and used as validation of lane position in post-process.
  - The yaw rate of the SV did not exceed ± 1.0 deg/s.
  - The SV driver modulated the throttle using smooth inputs to maintain a constant SV speed ±1.0 km/h.
  - With the exception of LMB (described above), the SV driver did not apply

[3] The ideal lateral position of the PTM within the lane was calculated as a function of SV longitudinal lane position as described in Section III B 2 a ii and shown in Figure 7.

any force to the brake pedal until the end of the test unless the PTM was contacted by the SV.

- The SV throttle was fully released within 500 msec after the SV PAEB warning event was presented (visual, haptic, or audible). If no SV warning event was presented by the SV PAEB system, the SV driver modulated the throttle to maintain constant speed until either the onset of PAEB or, if the SV's PAEB system did not activate, the end of the test occurred (i.e., contact with the PTM occurred).

c. Validity Period

- The valid test interval began when the longitudinal TTC of the SV was 4.0 seconds.
- For scenarios S4a-b, the test ended when either of the following occurred:
  - The SV came into contact with the PTM; or
  - The SV came to a stop before making contact with the PTM.
- For scenario S4c, the test ended when either of the following occurred:
  - The SV came into contact with the PTM; or
  - 1 second after the velocity of the SV became less than or equal to that of the PTM.

d. End-of-Test Instructions

After the test was complete, the SV driver manually applied force to the brake pedal, bringing the vehicle to a stop (if necessary), and placed the transmission in park (automatic transmission) or neutral (manual transmission).

The test trial was then complete.

e. Number of Test Trial Repeats

Combinations of test speeds, and lighting conditions were tested as shown in Table 1. Five repeat trials were conducted for each test condition. As noted above, for all scenarios, the 16 and 40 km/h speeds were considered to be the "non-conditional" speeds. Testing at these speeds was conducted without regard to whether the results showed that "consistent contact" occurred between the SV and PTM. Consistent contact was defined as the SV contacting the PTM in three or more test trials at a given speed. If this occurred, then testing at any higher speeds was not conducted. Rather, the speed would be reduced by 5 km/h and testing of that scenario and lighting treatment would be conducted at that lower speed. This was done to more precisely identify the highest speed at which the vehicle's PAEB system was able to avoid colliding with the PTM.

f. Speed Reduction

The magnitude of the SV speed reduction attributable to PAEB intervention (as shown in Datasheet 1) was calculated in one of two ways, depending on whether a test trial concluded with the SV colliding with the PTM.

- If the SV contacted the PTM during a test trial, the PAEB speed reduction was calculated by subtracting the SV speed at the time of contact (i.e., when the longitudinal range becomes zero) from the average SV speed calculated at TTC = 4.0 seconds.

- If the SV did not contact the PTM during a test trial (i.e., PAEB intervention prevented the crash):
  - Scenario S4a-b: The SV speed at the time of SV and PTM contact was taken to be zero. The speed reduction was therefore equal to the SV speed at TTC = 4.0 seconds.
  - Scenario S4c: The PAEB speed reduction was calculated by subtracting the SV speed at the minimum longitudinal SV-to-PTM range during the validity period from the SV speed at TTC = 4.0 seconds.

g. Pass/Fail Criteria

There were no pass/fail criteria for these research tests.

D. Summary of Scenarios

Figure 11 illustrates the offset conditions used for the different scenarios and Tables 3 through 6 provide summaries of the scenario setups.

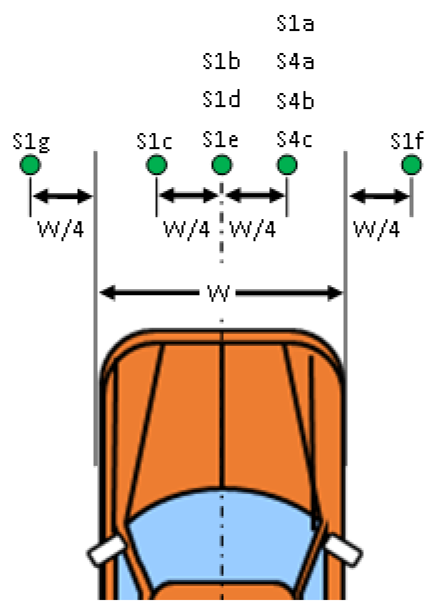


Figure 11. Offset Conditions

Table 3. Summary of S1a-b-c-d-f-g Scenarios Setup

PTM Type	Adult (S1a-b-c-f-g) Child (S1d)	
PTM Location	Nearside	
PTM Action	Crossing SV Path (S1a-b-c-d-g)	
	Not crossing SV Path (S1f)	
PTM Move Distance	6 m (19 ft)	
PTM Start Distance	3.5 m (11.48 ft)	
PTM Acceleration Distance	0.5 m (1.64 ft)	
Overlap *(Determined from the SV width. Measurement transferred to the location on the PTM path. Minus 25% and 125% do not result in SV-to-PTM contact.)*	S1a	25%
	S1 b-d	50%
	S1c	75%
	S1f	-25%
	S1g	125%
SV Start Distance	182 m (600 ft)	
Lane Width *(Not standard lane width. Adapted to SV width. Lane width should be centered on SV path.)*	SV Width + 40 cm (16 in)	
Lane Length *(Based on 4.0 sec TTC and SV speed = 40 km/h (25 mph).)*	44 m (145 ft)	
Obstruction *(S1d only)*	PV1D1	1 m (3.2 ft)
	PV2D1	
	PVD1	

Drawing illustrates setup but is not to scale

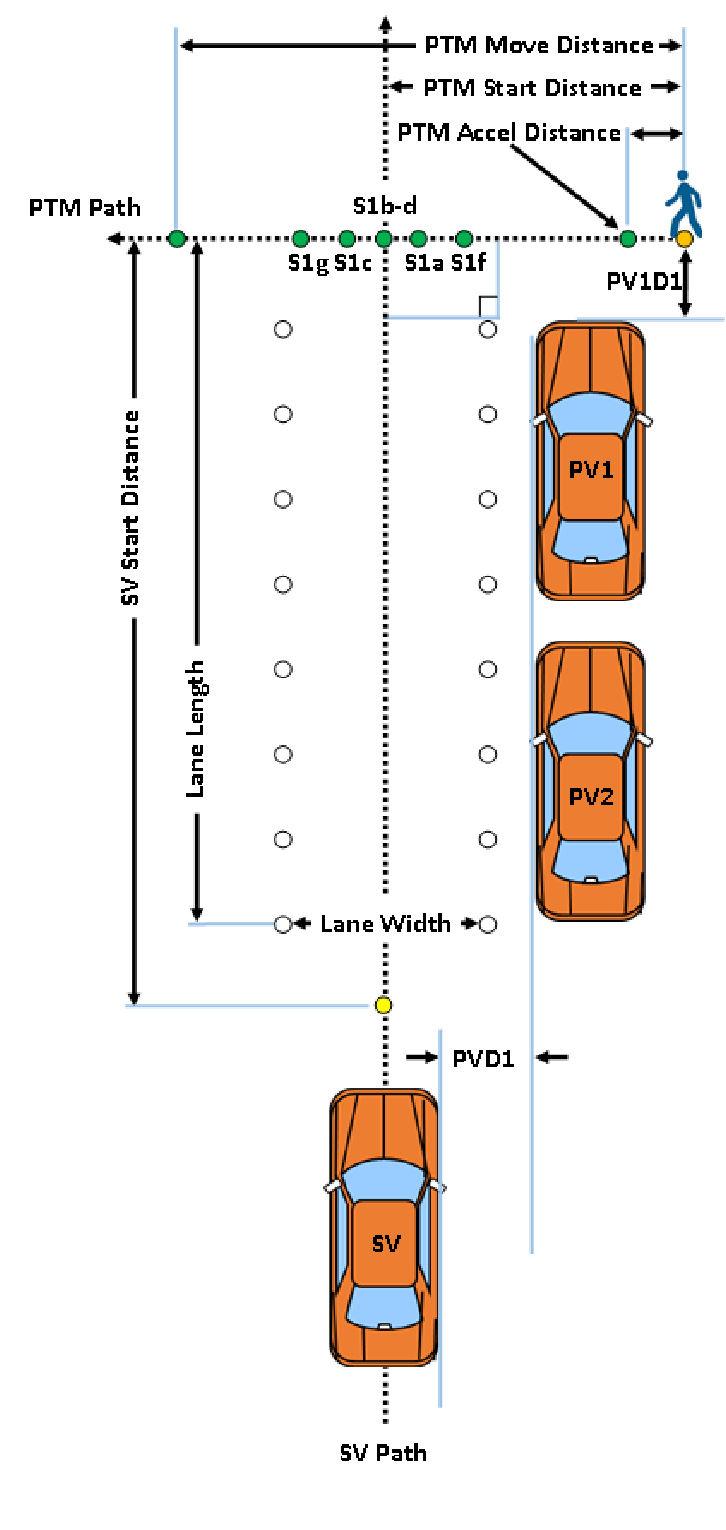


Table 4. Summary of S1e Scenario Setup

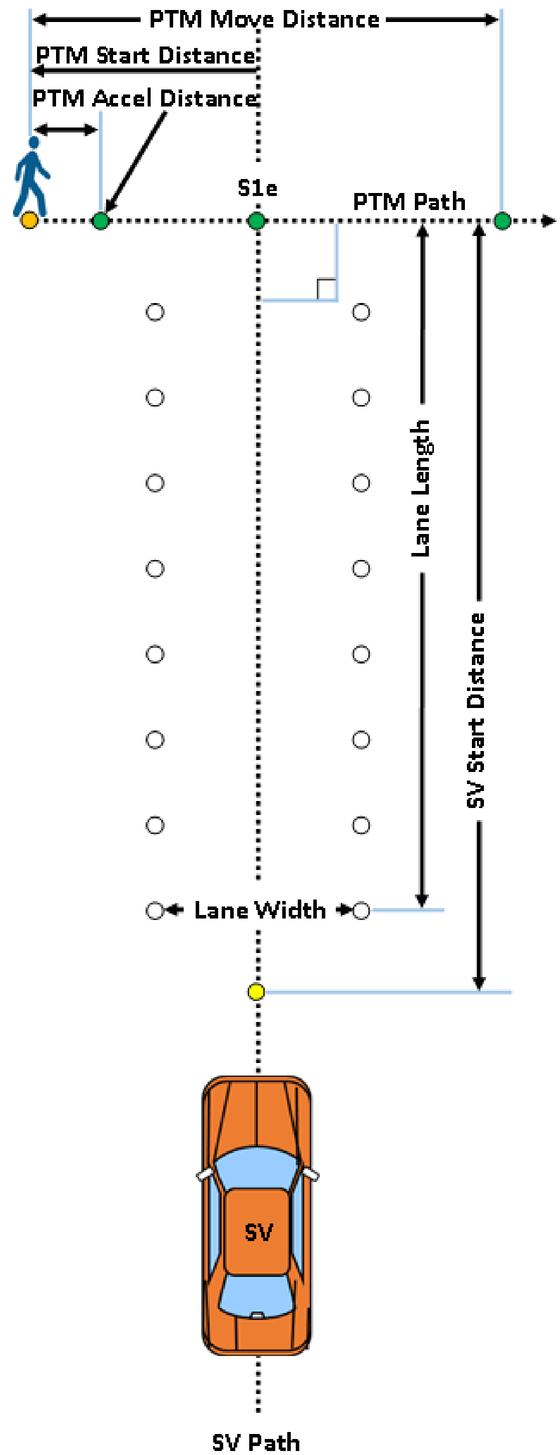
PTM Type	Adult	**Drawing illustrates setup but is not to scale**
PTM Location	Offside	
PTM Action	Crossing SV Path	
PTM Move Distance	9 m (29.5 ft)	
PTM Start Distance	5.5 m (18 ft)	
PTM Acceleration Distance	1.0 m (3.2 ft)	
Overlap *(Determined from the SV width. Measurement transferred to the location on the PTM path.*	50%	
SV Start Distance	182 m (600 ft)	
Lane Width *(Not standard lane width. Adapted to SV width. Lane width should be centered on SV path.)*	SV Width + 40 cm (16 in)	
Lane Length *(Based on 4.0 sec TTC and SV speed = 40 km/h (25 mph).)*	44 m (145 ft)	

Table 5. Summary of S4a-b Scenarios Setup

S4a-b Scenario		
PTM Type	Adult	
PTM Location	Nearside In-Path	
PTM Action	S4a	Stationary Facing Away
	S4b	Stationary Facing Towards
PTM Move Distance	NA	
PTM Start Distance	NA	
PTM Acceleration Distance	NA	
Overlap *(Determined from the SV width. Measurement transferred to the location on the PTM path.*	25%	
SV Start Distance	182 m (600 ft)	
Lane Width *(Not standard lane width. Adapted to SV width. Lane width should be centered on SV path.)*	SV Width + 40 cm (16 in)	
Lane Length *(Based on 4.0 sec TTC and SV speed = 40 km/h (25 mph).)*	44 m (145 ft)	

Drawing illustrates setup but is not to scale

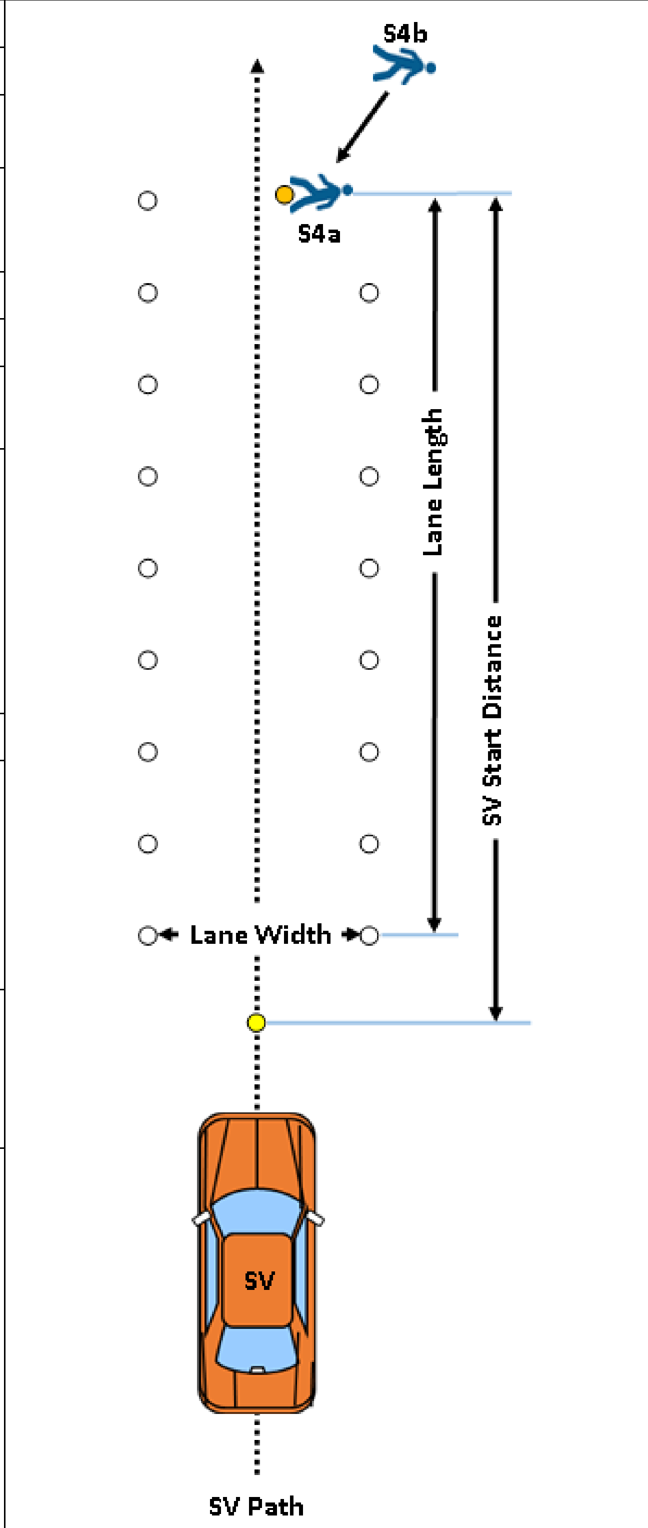
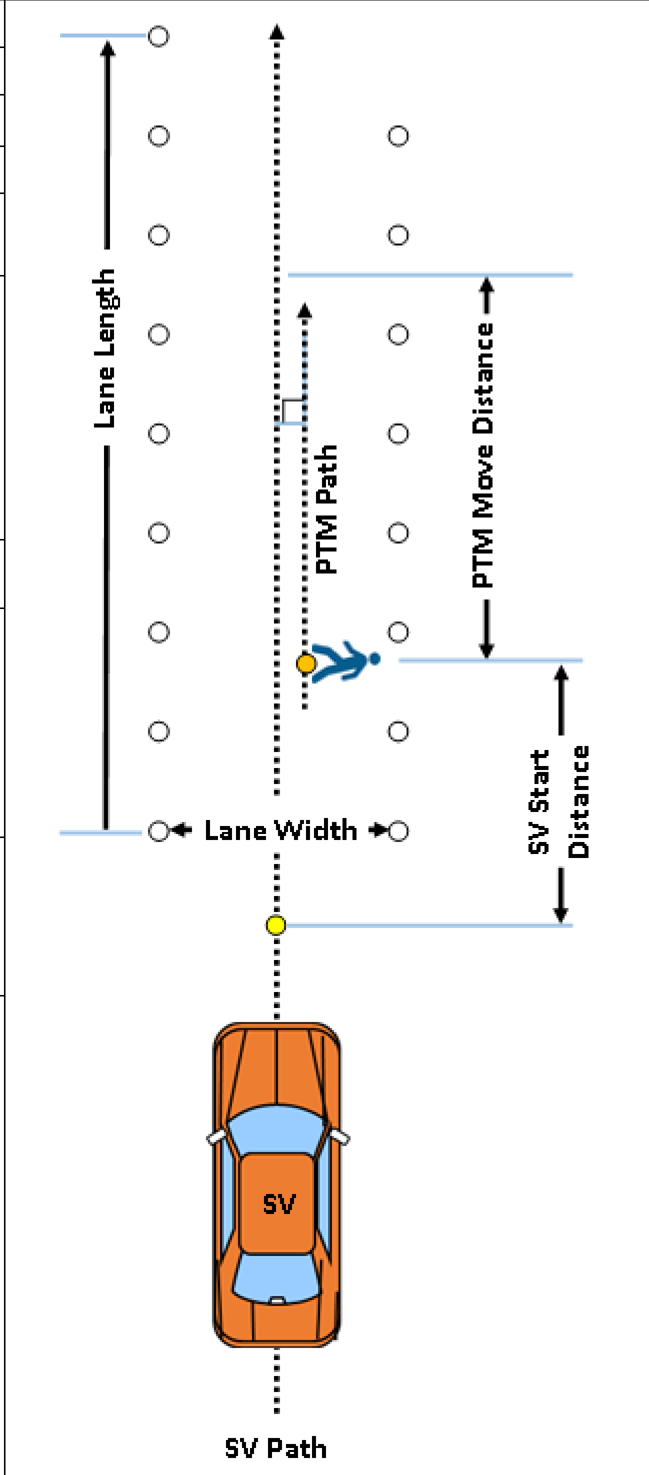


Table 6. Summary of S4c Scenario Setup

PTM Type	Adult	**Drawing illustrates setup but is not to scale**
PTM Location	Nearside In-Path	
PTM Action	Moving Away	
PTM Move Distance	17 m (55 ft)	
PTM Start Distance	NA	
PTM Acceleration Distance	1 m (3.28 ft)	
Overlap *(Determined from the SV width. Measurement transferred to the location on the PTM path.*	25%	
SV Start Distance	182 m (600 ft)	
Lane Width *(Not standard lane width. Adapted to SV width. Lane width should be centered on SV path.)*	SV Width + 40 cm (16 in)	
Lane Length *(Based on 4.0 sec TTC and SV speed = 40 km/h (25 mph).)*	44 m (145 ft)	



E. Pre-Test Brake Burnishing

To achieve full brake system capability, and to ensure consistent performance, the procedure defined in section 14.1.2 and section 14.1.3 of NHTSA Laboratory Test Procedure for FMVSS No. 135 Light Vehicle Brake Systems (TP-135-01) was used to burnish new SV brake components.

- The SV was loaded to its GVWR.
- From a speed of 49.7 mph (80 km/h), 200 stops were performed with an average deceleration of 0.31g (3.0 m/s²) during each stop.
  - Each stop was performed with the transmission in gear.
  - The Initial Brake Temperature (IBT), defined as the average brake pad or lining friction material temperature on the highest-temperature axle of the SV at the onset of a test trial, was ≤ 100°C (212°F) at the onset of each stop.
  - The interval from the onset of one stop to the onset of the next was either the time necessary to reduce the IBT to ≤ 100°C (212°F), or the distance of 2 km (1.24 miles), whichever occurred first.
  - The vehicle was accelerated to 49.7 mph (80 km/h) after each stop and that speed was maintained until initiating the next.

1. SV BRAKE WARM-UP AND TEMPERATURE MAINTENANCE DURING TESTING

The IBT was between 149°F (65°C) and 212°F (100°C) at the onset of each test.

- If the IBT was less than 149°F (65°C), the brakes were heated to the IBT by making one or more brake applications from a speed of 31.1 mph (50 km/h), at a deceleration rate not greater than 0.31g (3 m/s²).
- If the IBT was greater than 212°F (100°C), the SV was driven at speeds up to 62.1 mph (100 km/h) until the IBT specified was reached

F. Pedestrian Test Mannequin and Motion System

Adult and child Pedestrian Test Mannequins (PTMs) from 4activeSystems were used for these tests. These are articulated mannequins with movable legs and poseable arms. Note that these mannequins are used in Euro NCAP PAEB testing.

The mannequins are strikeable objects with certain characteristics representative of humans. The adult mannequin represents a 50^{th} percentile adult male, and the child mannequin represents a 7-year-old child. They were designed to be recognized by mono and stereo cameras, as well as by radar and infrared systems.

The motion system used for these tests was the Micro Low Profile Robotic Vehicle (µLPRV) developed by Dynamic Research, Inc. The µLPRV is a small robotic platform that is self-contained, self-propelled, self-guided, and programmable, such that it can follow 2-dimensional trajectories in coordination with the SV. The µLPRV comprises an over-runnable chassis, drive system, steering system, DGPS/IMU sensor, wireless communication system, and control software in order to measure and control the movements of the µLPRV during a test sequence. The pedestrian mannequins are affixed by means of a central clear plastic post. At the base of the clear plastic post, a plastic-covered steel flange is captured by a horseshoe-shaped clamp that attaches to a ferrous plate secured to the upper surface of the µLPRV by magnetic attraction between the ferrous plate on the surface of the µLPRV and the high-power magnets in the horseshoe shaped clamp.

In operation, position and velocity information from the SV are transmitted continuously over a WiFi network to a control computer. The control computer coordinates the motions of the µLPRV and the SV, so that the scenarios can be controlled in a precise and repeatable way.

G. Instrumentation

Table 7 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

Table 7. Test Instrumentation and Equipment

<table>
<tr><th>Type</th><th>Output</th><th>Range</th><th>Accuracy, Other Primary Specs</th><th>Mfr, Model</th><th>Serial Number</th><th>Calibration Dates
Last
Due</th></tr>
<tr><td>Tire Pressure Gauge</td><td>Vehicle Tire Pressure</td><td>0-100 psi</td><td>< 1% error between 20 and</td><td>Omega DPG8001</td><td>18111410000</td><td>By: DRI
Date: 5/4/2020
Due: 5/4/2021</td></tr>
<tr><td>Platform Scales</td><td>Vehicle Total, Wheel, and Axle Load</td><td>2200 lb/platform</td><td>0.1% of reading</td><td>Intercomp SW wireless</td><td>0410MN20001</td><td>By: DRI
Date: 4/20/2020
Due: 4/20/2021</td></tr>
<tr><td>Linear (string) encoder</td><td>Throttle pedal travel</td><td>10 in
254 mm</td><td>0.1 in
2.54 mm</td><td>UniMeasure LX-EP</td><td>45040532</td><td>By: DRI
Date: 7/2/2020
Due: 7/2/2021</td></tr>
<tr><td>SV Multi-Axis Inertial Sensing System</td><td rowspan="2">Position;
Longitudinal, Lateral, and Vertical Accels;
Lateral, Longitudinal and Vertical Velocities;
Roll, Pitch, Yaw Rates;
Roll, Pitch, Yaw Angles</td><td rowspan="2">Latitude: ±90º
Longitude: ±180º
Altitude: 0-18 km
Velocity: 0-1000 knots Accel: ±5g
Angular Rate: ±300 º/s
Angular Disp: ±180º</td><td rowspan="2">Position: ±2 cm
Velocity: 0.1 km/h
Accel: ≤ 0.05%
Angular Rate: ≤ 0.05%
Roll/Pitch Angle: ±0.05º
Heading Angle: ±0.1º</td><td rowspan="2">Oxford xNAV 550</td><td>015360</td><td>By: Oxford Technical Solutions
Date: 1/31/2020
Due: 1/31/2022</td></tr>
<tr><td>PTT Multi-Axis Inertial Sensing System</td><td>015102</td><td>By: Oxford Technical Solutions
Date: 3/6/2020
Due: 3/6/2022</td></tr>
</table>

Table 7. Test Instrumentation and Equipment (continued)

<table>
<tr><th>Type</th><th>Output</th><th>Range</th><th>Accuracy, Other Primary Specs</th><th>Mfr, Model</th><th>Serial Number</th><th>Calibration Dates Last Due</th></tr>
<tr><td>Coordinate Measurement Machine</td><td>Inertial Sensing System Coordinates</td><td>0-8 ft
0-2.4 m</td><td>±.0020 in.
±.051 mm
(Single point articulation accuracy)</td><td>Faro Arm,
Fusion</td><td>UO8-05-08-06636</td><td>By: DRI
Date: 1/6/2020
Due: 1/6/2021</td></tr>
<tr><td>Microphone</td><td>Sound
(to measure time at alert)</td><td>Frequency Response:
80 Hz – 20 kHz</td><td>Signal-to-noise: 64 dB, 1 kHz at 1 Pa</td><td>Audio-Technica
AT899</td><td>NA</td><td>NA</td></tr>
<tr><td>Light Sensor</td><td>Light intensity
(to measure time at alert)</td><td>Spectral Bandwidth:
440-800 nm</td><td>Rise time < 10 msec</td><td>DRI designed and developed Light Sensor</td><td>NA</td><td>NA</td></tr>
<tr><td>Accelerometer</td><td>Acceleration
(to measure time at alert)</td><td>±5g</td><td>≤ 3% of full range</td><td>Silicon Designs, 2210-005</td><td>NA</td><td>NA</td></tr>
<tr><th>Type</th><th colspan="3">Description</th><th colspan="2">Mfr, Model</th><th>Serial Number</th></tr>
<tr><td rowspan="3">Data Acquisition System</td><td colspan="3" rowspan="3">Data acquisition is achieved using a dSPACE MicroAutoBox II. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the MicroAutoBox. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (listed above).</td><td colspan="2">dSPACE Micro-Autobox II 1401/1513</td><td></td></tr>
<tr><td colspan="2">Base Board</td><td>549068</td></tr>
<tr><td colspan="2">I/O Board</td><td>588523</td></tr>
</table>

H. Pre-Test Brake Burnishing

To achieve full brake system capability, and to ensure consistent performance, the procedure defined in section 14.1.2 and section 14.1.3 of NHTSA Laboratory Test Procedure for FMVSS No. 135 Light Vehicle Brake Systems (TP-135-01) was used to burnish new SV brake components.

- The SV was loaded to its GVWR.
- From a speed of 49.7 mph (80 km/h), 200 stops were performed with an average deceleration of 0.31g (3.0 m/s²) during each stop.
  - Each stop was performed with the transmission in gear.
  - The Initial Brake Temperature (IBT), defined as the average brake pad or lining friction material temperature on the highest-temperature axle of the SV at the onset of a test trial, was ≤ 100°C (212°F) at the onset of each stop.
  - The interval from the onset of one stop to the onset of the next was either the time necessary to reduce the IBT to ≤ 100°C (212°F), or the distance of 2 km (1.24 miles), whichever occurred first.
  - The vehicle was accelerated to 49.7 mph (80 km/h) after each stop and that speed was maintained until initiating the next.

2. SV BRAKE WARM-UP AND TEMPERATURE MAINTENANCE DURING TESTING

The IBT was between 149°F (65°C) and 212°F (100°C) at the onset of each test.

- If the IBT was less than 149°F (65°C), the brakes were heated to the IBT by making one or more brake applications from a speed of 31.1 mph (50 km/h), at a deceleration rate not greater than 0.31g (3 m/s²).
- If the IBT was greater than 212°F (100°C), the SV was driven at speeds up to 62.1 mph (100 km/h) until the IBT specified was reached.

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle As-Delivered

Figure A2. Rear View of Subject Vehicle As-Delivered

Figure A3. Front View of Subject Vehicle As-Tested

Figure A4. Rear View of Subject Vehicle As-Tested

LOC: PR * Dealer Stock Status: SOLD
Exterior: Vesuvius Gray Metallic

VIN: WAUL2AF2XKN04
Interior: Black Interior

MODEL: 4A2B2Y-2019 Audi A6 55 TFSI (3.0T) quattro
2018345-ORIGINAL

2019 Audi A6 55 TFSI (3.0T) quattro

STANDARD EQUIPMENT (unless replaced by options)

TECHNICAL
- 3.0 TFSI® V6 engine
- quattro® all-wheel drive system
- 7-speed S tronic® transmission
- 19" 5-double-spoke bi color wheels, 245/45 all-season tires
- Energy recuperation with start-stop system
- Space-saving spare tire

COMFORT/TECHNOLOGY
- Audi connect® CARE (limited time subscription)
- Audi connect® PRIME & PLUS (6 month trial)
- Audi MMI Navigation w/ MMI touch response and traffic information online
- Audi smartphone interface
- Audi sound system
- Dark Brown Walnut wood inlays
- Garage door opener (HomeLink®)
- Heated, auto-dimming, exterior mirrors, w/ memory
- Heated, 8-way power front seats w/ driver memory and 4-way lumbar adjustment
- Leather seating surfaces
- LED headlights
- Parking system plus
- Preparation for mobile phone (Bluetooth®)
- Power adjustable steering column with memory
- Power sunroof
- S line exterior
- Split-folding rear seat back with pass-through (40/20/40)
- Three-zone automatic climate control
- 3-spoke multi-function steering wheel w/ shift paddles

SAFETY/CONVENIENCE
- Advanced Airbag Protection System with 8 airbags
- Anti-lock Braking System (ABS) w/ Brake Assist
- Audi pre sense basic (preventative occupant protection)
- Audi pre sense front (low speed collision assist)
- Child safety locks in rear doors, power
- Electronic Stabilization Control (ESC) w/ Sport mode
- Electronic vehicle immobilization w/ anti-theft alarm
- LED Daytime Running Lights (DRLs)
- LED taillights w/ dynamic turn signals
- Lower Anchors and Tethers for CHildren (LATCH)
- Rearview camera
- Tire Pressure Monitoring System (TPMS)

WARRANTY/MAINTENANCE
- 4 Year/50,000 mile (whichever occurs first) New Vehicle Limited Warranty*
- 12 Year Limited Warranty Against Corrosion Perforation
- 1 Year/10,000 mile (whichever occurs first) First Scheduled Maintenance Service FREE OF CHARGE
- 4 Years Roadside Assistance coverage provided by a third party supplier

*Please refer to the 2019 Audi Warranty and Maintenance Booklet for complete coverage information.

MANUFACTURER'S SUGGESTED RETAIL PRICE

2019 Audi A6 55 TFSI (3.0T) quattro	**$58,900.00**
PACKAGES / OPTIONS	
Vesuvius Gray metallic	$595.00
Black interior	Included
Premium Plus package	$3,800.00
Audi MMI Navigation w/touch response, 10.1" screen	
Audi virtual cockpit	
Bang & Olufsen® Premium 3D sound system	
Audi phone box w/wireless charging and antenna booster	
Audi advanced key	
Audi side assist, rear cross traffic,Audi pre sense rear	
Power-folding exterior mirrors	
Matrix design LED headlights	
Highbeam assist, Headlight washer system	
Top view camera system	
Driver Assistance package	$2,750.00
20" Sport package	$1,050.00
20" 5-V-spoke bi-color wheels, 255/40 all-season tires	
Sport suspension	
Cold Weather package	$600.00
Heated steering wheel	
Heated rear seats	
Audi Beam - Rings	$450.00
Interior Protection Package	$210.00
Gray/Brown Fine Grain Ash natural wood inlays	Included
Destination Charge	$995.00
Total Price:	**$69,350.00**

Fuel, license, title fees, taxes and dealer-installed accessories are not included.

MODEL: 4A2B2Y
VIN: WAUL2AF2XKN04
DEALER:
SHIP TO:

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score		**Not Rated**
Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.		
Frontal Crash	Driver	**Not Rated**
	Passenger	**Not Rated**
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.		
Side Crash	Front Seat	**Not Rated**
	Rear Seat	**Not Rated**
Based on the risk of injury in a side impact.		
Rollover		**Not Rated**
Based on the risk of rollover in a single-vehicle crash.		

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

EPA DOT Fuel Economy and Environment — Gasoline Vehicle

Fuel Economy
25 MPG combined city/hwy
22 city
29 highway
4 gallons per 100 miles

Mid-Size Cars range from 14 to 136 MPG.
The best vehicle rates 136 MPGe.

You **spend $2,000** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel **cost $1,800**

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

Smog Rating (tailpipe only): 5 (1 – 10 Best)

This vehicle emits 360 grams of CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions; learn more at fueleconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs $7,000 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $3.00 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:	FOR THIS VEHICLE:
U.S./CANADIAN PARTS CONTENT: 1%	FINAL ASSEMBLY POINT: NECKARSULM, GERMANY
MAJOR SOURCES OF FOREIGN PARTS CONTENT: GERMANY: 53%	COUNTRY OF ORIGIN: ENGINE: HUNGARY
HUNGARY: 21%	TRANSMISSION: GERMANY

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

Disclaimer: The Monroney describes the vehicle features when the vehicle was first sold/leased to the customer and that as of the present day the actual features on the vehicle might differ from the ones listed on the Monroney label. The Monroney label is for view only purposes and must not be used to paste on the vehicle as a Monroney sticker for resale.

Figure A5. Window Sticker (Monroney Label)

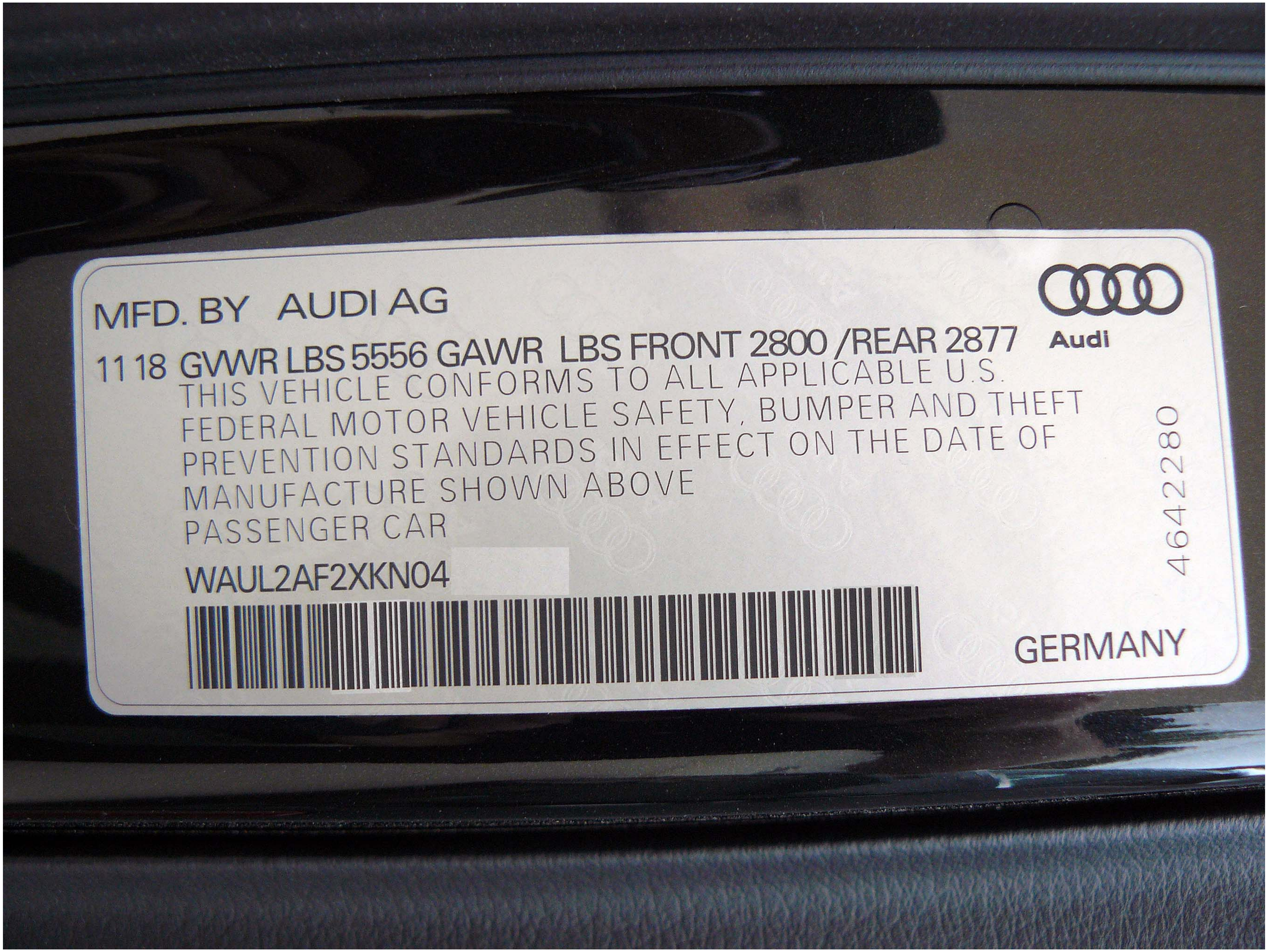


Figure A6. Vehicle Certification Label

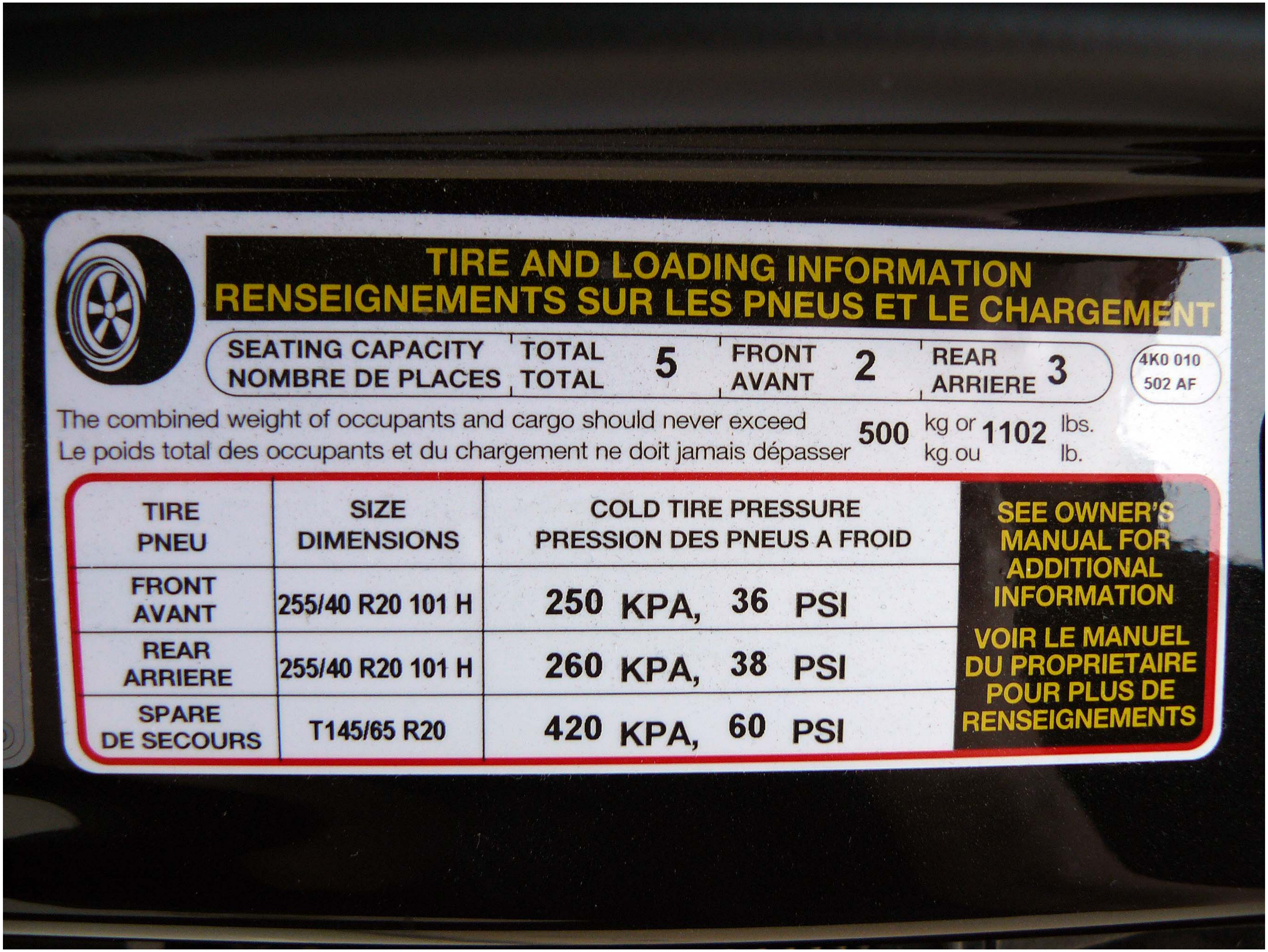


Figure A7. Tire Placard

Figure A8. Adult and Child Pedestrian Surrogates and Motion Platform

Figure A9. Obstruction Vehicles

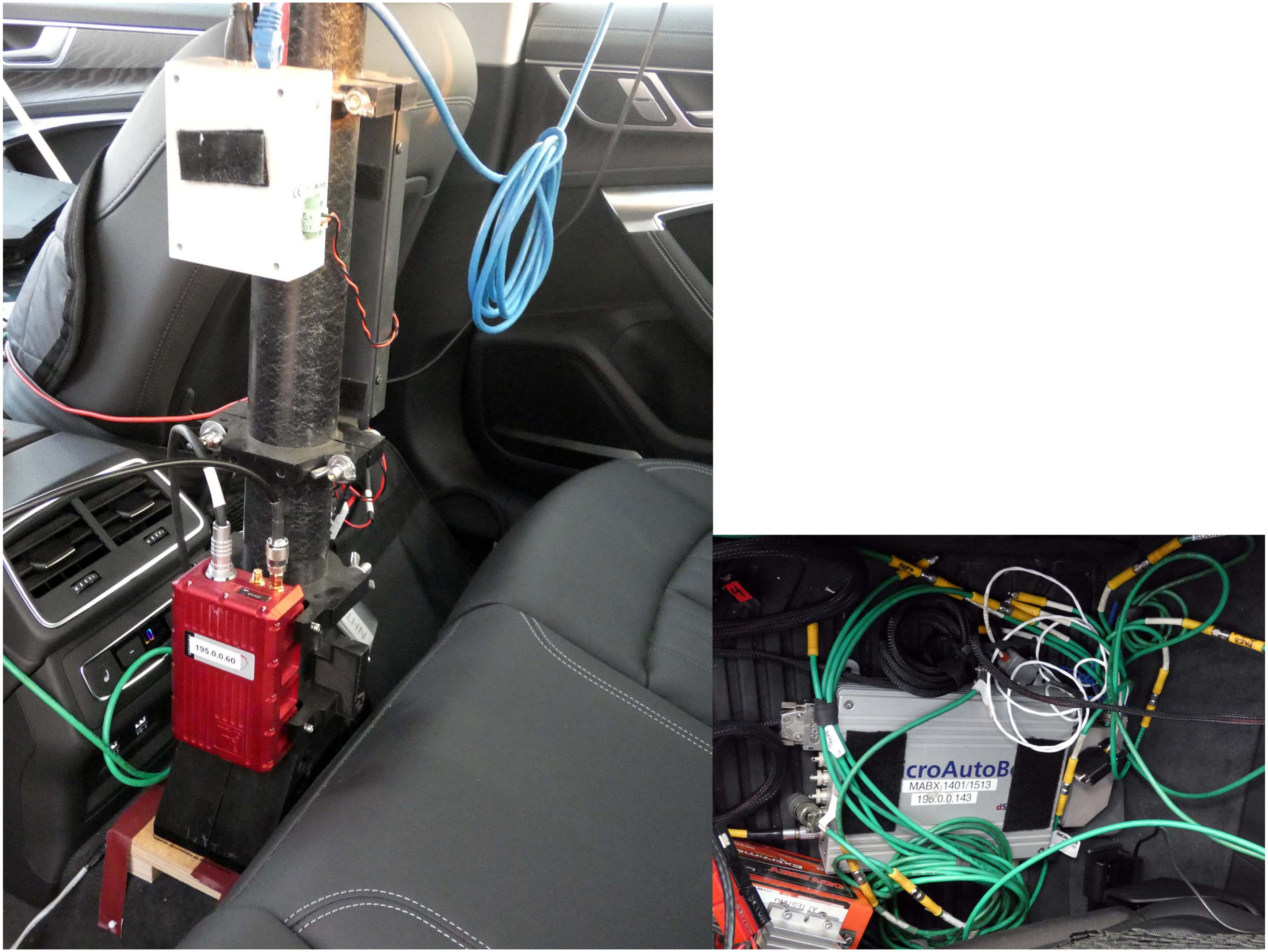


Figure A10. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A11. Sensors for Detecting Auditory and Visual Alerts

Figure A12. Computer Installed in Subject Vehicle

Figure A13. PAEB Setup Menus (page 1 of 2)

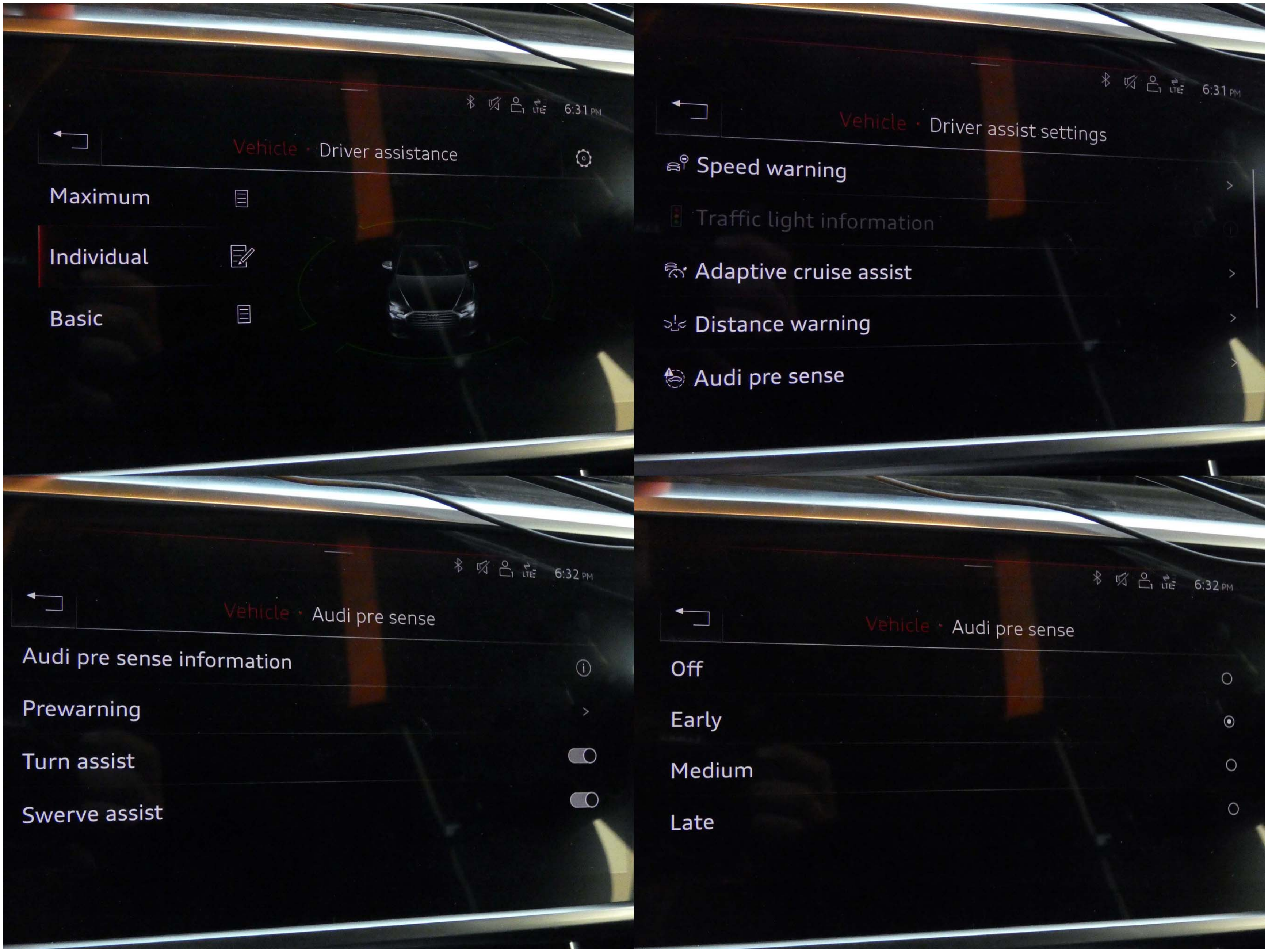


Figure A14. PAEB Setup Menus (page 2 of 2)

Figure A15. Button for Directly Accessing Driver Assistance Settings Menus

Figure A16. Visual Alert

APPENDIX B

Excerpts from Owner's Manual

	Steering lock ⇨ *page 110*
	Air suspension ⇨ *page 110*
	Electrical system ⇨ *page 240*
	Engine oil level (MIN) ⇨ *page 235*
	Engine oil pressure ⇨ *page 235*
	Cooling system ⇨ *page 238*
	Hood ⇨ *page 233*
	Loose wheel warning ⇨ *page 260*
	Night vision assist ⇨ *page 128*
	Night vision assist ⇨ *page 128*
	Distance warning ⇨ *page 143*
	Steering intervention request ⇨ *page 139*
	Safe start monitor ⇨ *page 141*, Driver intervention request ⇨ *page 141*
	Lane departure warning ⇨ *page 144*
	Lane departure warning ⇨ *page 144*
	Audi pre sense ⇨ *page 147*, Intersection assist ⇨ *page 153*

Yellow indicator lights

	Central indicator light ⇨ *page 7*
	Safety systems ⇨ *page 70*
	Transmission ⇨ *page 99*
	Drive system ⇨ *page 101* Cooling system ⇨ *page 238*
	Engine start system ⇨ *page 94*
	Keys ⇨ *page 94*
	Electromechanical parking brake ⇨ *page 105*
	Brake system ⇨ *page 103*
	Electronic Stabilization Control (ESC) ⇨ *page 112*
OFF	Electronic Stabilization Control (ESC) ⇨ *page 112*
ESC OFF	Electronic Stabilization Control (ESC) ⇨ *page 113*
ABS	Anti-lock braking system (ABS) ⇨ *page 114*
(ABS)	Anti-lock braking system (ABS) ⇨ *page 114*
	Steering ⇨ *page 110*
	Steering lock ⇨ *page 110*
	All wheel drive ⇨ *page 112*
	Suspension control ⇨ *page 110*
	Air suspension ⇨ *page 110*
	Engine speed limitation ⇨ *page 15*
	Tank system ⇨ *page 229*
	Electrical system ⇨ *page 240*

	Engine oil level (MIN) ⇨ *page 235*
	Engine oil level (MAX) ⇨ *page 235*
	Engine oil sensor ⇨ *page 235*
	Malfunction Indicator Lamp (MIL) ⇨ *page 231*
	Engine warm-up request ⇨ *page 235*
	Washer fluid level ⇨ *page 243*
	Windshield wipers ⇨ *page 58*
	Parking system plus ⇨ *page 157*
TPMS	Tire pressure ⇨ *page 263*
	Tire pressure ⇨ *page 263*
	Loose wheel warning ⇨ *page 260*
	Bulb failure indicator ⇨ *page 52*
	Adaptive light ⇨ *page 52*
	Light/rain sensor ⇨ *page 52*, ⇨ *page 58*
	Door lock ⇨ *page 34*
	Battery in vehicle key ⇨ *page 38*
	Night vision assist ⇨ *page 129*
	Intersection assistant ⇨ *page 153*
	Side assist ⇨ *page 151*; Exit warning ⇨ *page 152*
	Rear cross-traffic assist ⇨ *page 162*

	Adaptive cruise assist ⇨ *page 142*
	Steering intervention request ⇨ *page 139*, ⇨ *page 145*
	Lane departure warning ⇨ *page 145*
	Distance warning ⇨ *page 143*
	Audi pre sense ⇨ *page 149*
SOS	Emergency assist ⇨ *page 154*
SOS	Emergency call function ⇨ *page 184*

Other indicator lights

	Rear safety belt ⇨ *page 67*
	Start/Stop system ⇨ *page 101*
	Hill descent assist ⇨ *page 107*
	Low beam headlight ⇨ *page 49*
	Parking light ⇨ *page 49*
	Turn signals ⇨ *page 50*, ⇨ *page 51*
CRUISE	Cruise control system ⇨ *page 130*
	Cruise control system ⇨ *page 130*
	Efficiency assist ⇨ *page 131*
	Efficiency assist ⇨ *page 131*
50	Efficiency assist ⇨ *page 131*
km/h	Efficiency assist ⇨ *page 131*
MPH	Efficiency assist ⇨ *page 131*

4K0012721BD

	Lane departure warning ⇨ *page 145*
	Audi pre sense ⇨ *page 149*
SOS	Emergency assist ⇨ *page 154*

4K0012721BD

Assist systems

General information

Safety precautions

WARNING

- As the driver, you are always completely responsible for all driving tasks. The assist systems cannot replace the driver's attention. Give your full attention to driving the vehicle, and be ready to intervene in the traffic situation at all times.
- Activate the assist systems only if the surrounding conditions permit it. Always adapt your driving style to the current visual, weather, road, and traffic conditions.
- Loose objects can be thrown around the vehicle interior during sudden driving or braking maneuvers, which increases the risk of an accident. Store objects securely while driving.
- For the assist systems to be able to react correctly, the function of the sensors and cameras must not be restricted. Note the information on sensors and cameras ⇨ *page 119*.

Tips

- Pay attention to applicable local regulations relating to driving tasks, leaving space for emergency vehicles, vehicle distance, speed, parking location, wheel placement, etc. The driver is always responsible for following the laws that are applicable in the location where the vehicle is being operated.
- You can cancel a steering or braking intervention by the system, by braking or accelerating noticeably, steering, or deactivating the respective assist system.
- Always check the assist systems settings before driving. The settings could have been changed, for example, by other drivers or if another personal profile was used.

System limitations

WARNING

- The use of an assist system cannot overcome the natural laws of physics. A collision cannot be prevented in certain circumstances.
- Warnings, messages, or indicator lights may not be displayed or initiated on time or correctly, for example, if vehicles are approaching very fast.
- Corrective interventions by the assist systems, such as steering or braking interventions, may not be sufficient or they may not occur. Always be ready to intervene.

Tips

- Due to the system limitations when detecting the surrounding area, the systems may warn or intervene unexpectedly or too late in certain situations. The assist systems may also interpret a driving maneuver incorrectly and then warn the driver unexpectedly.
- The systems may not function as expected in unusual driving situations, such as driving offroad, on unpaved roads, on loose ground, on inclines, or on grooves in the road.
- The systems may not function correctly in unclear traffic situations, such as turning lanes, exit ramps, construction zones, rises or dips that obstruct visibility, intersections, toll stations, or city traffic.
- The detection of the surrounding area can be limited, for example by vehicles driving ahead or by rain, snow, heavy spray, or light shining into the camera.
- If accessories have been mounted on the steering wheel, the ability for the steering systems to react may be limited.

weather conditions may be too poor or the camera may be covered. Clean the area in front of the camera ⇨ *page 120* and try to turn on the systems again later.

If the malfunction remains, drive to an authorized Audi dealer or authorized Audi Service Facility immediately to have the malfunction corrected.

Audi pre sense

Introduction

Applies to: vehicles with Audi pre sense

Within the limits of the system, the Audi pre sense functions can initiate measures in certain driving situations to protect the vehicle occupants and other road users. Depending on the vehicle equipment, various Audi pre sense systems may be installed:

- **Audi pre sense basic** can react during emergency and dangerous braking maneuvers and unstable driving situations (such as oversteering or understeering).
- **Audi pre sense front**[1] can detect an impending frontal impact and react with warnings, braking interventions, and preemptive safety measures for the vehicle occupants.
- **Audi pre sense rear** monitors the rear traffic behind your vehicle and can react to an impending rear impact.
- **Audi pre sense side** can detect an impending side impact from cross-traffic and vehicles coming from the side, and can initiate preemptive safety measures.
- The **swerve assist** can assist during an evasive maneuver recognized as critical with steering movement and by braking individual wheels individually.
- The **turn assist** can detect vehicles in the opposite lane and react with braking maneuvers.

Audi pre sense preemptive safety measures

Applies to: vehicles with Audi pre sense

Depending on the vehicle speed and the vehicle equipment, the following functions may be initiated in certain situations:

- Visual and audio warnings
- Activation of the emergency flashers[1]
- Reversible tensioning of safety belts
- Closing the windows and panoramic glass roof
- Adjusting the seats
- Other preemptive safety measures by individual systems

⚠ WARNING

Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.

ⓘ Tips

- Depending on the risk situation that is detected and the selected Audi drive select* mode, not all preemptive safety measures may be initiated under certain circumstances. Certain functions can be adjusted or skipped if necessary.
- Audi pre sense may be restricted or unavailable under certain circumstances, for example if:
  - There are passengers with unfastened safety belts
  - It has only been several seconds since the ignition was switched on The indicator light turns on.
  - When driving in reverse
  - There is an airbag control module malfunction
  - System functions may not be available if the ESC is limited or switched off, or if there is a malfunction.

[1] This is not available in some countries.

Audi pre sense basic

Applies to: vehicles with Audi pre sense basic

Audi pre sense basic is automatically active at speeds of approximately 20 mph (30 km/h) and higher. Audi pre sense basic can trigger the Audi pre sense preemptive safety measures during emergency braking and dangerous braking maneuvers as well as in unstable driving situations, such as oversteering or understeering.

WARNING

Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.

Audi pre sense front

Applies to: vehicles with Audi pre sense front

The **Audi pre sense front** uses the data from the camera and calculates the probability of a rear-end collision. Within the limits of the system, an impending frontal impact with vehicles, pedestrians[1], or cyclists[1] may be detected in both urban and rural speed ranges.

Audi pre sense front is active at speeds of approximately 6 mph (10 km/h) and higher. It can react to pedestrians[1] or cyclists[1] at speeds up to approximately 50 mph (85 km/h), and can react to vehicles at speeds up to approximately 155 mph (250 km/h).

Early warning/acute warning

The system can recognize various dangerous situations. The **early warning** occurs if:

- A vehicle driving ahead brakes suddenly
- Your own vehicle approaches a vehicle in front of you that is traveling at a significantly slower speed or that is stationary
- A pedestrian or cyclist[1] is standing in the lane or is moving into the lane

The message **Audi pre sense** and a warning tone will warn you about the danger.

The brakes may also be applied as an **acute warning** when there is an impending collision. You will also be warned by an indicator in the instrument cluster display. When this warning occurs, it may only be possible to avoid a collision by swerving or braking strongly.

Automatic deceleration

If you do not react to the acute warning, Audi pre sense front can brake the vehicle to a full stop within the limits of the system [1]. This reduces the vehicle speed in the event of a collision.

Automatic braking force increase

If Audi pre sense determines that you are not braking strongly enough when a collision is imminent, it can increase the braking force based on the situation.

Take-over

If the message **Please take over!** appears, the vehicle has been braked to a stop by Audi pre sense and you must resume control of the vehicle.

WARNING

- Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.
- Audi pre sense front cannot overcome natural physical laws. It is a system designed to assist and it cannot prevent a collision in every circumstance. The driver must always intervene. The driver is always responsible for braking at the correct time. Do not let the increased safety provided tempt you into taking risks. This could increase your risk of a collision.
- Audi pre sense front does not react to certain objects, such as animals, crossing or oncoming vehicles, bars, railings, or railcars.
- Audi pre sense front may be limited or unavailable when driving in curves.
- Loose objects can be thrown around the vehicle interior during sudden driving or braking maneuvers, which increases the risk of an accident. Store objects securely while driving.

[1] This is not available in some countries.

4K0012721BD

Audi pre sense rear

Applies to: vehicles with Audi pre sense rear

Within the limits of the system, **Audi pre sense rear** uses data from radar sensors in the rear area of the vehicle and calculates the probability of a rear-end collision with the vehicle behind you.

Audi pre sense preemptive safety measures can be initiated if the risk of a collision with the vehicle behind you is detected.

WARNING

– Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.
– Audi pre sense rear does not react to pedestrians, animals, crossing objects, and objects not detected as vehicles.

Tips

Audi pre sense rear functions may also switch off if there is a malfunction in the side assist system.

Audi pre sense side

Applies to: vehicles with Audi pre sense side

Audi pre sense side uses data from the extra radar sensors installed in the front and rear areas of the vehicle, and other sensors can react to side impacts from cross-traffic and vehicles coming from the side.

Audi pre sense side is active at speeds up to approximately 35 mph (60 km/h). The Audi pre sense preemptive safety measures can be triggered when a collision risk is detected.

WARNING

– Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.
– Audi pre sense side does not react to pedestrians, animals, and objects not detected as vehicles.

Tips

The Audi pre sense side functions may also switch off if there is a malfunction in the intersection assistant*.

Swerve assist

Applies to: vehicles with swerve assist

The swerve assist can help you to steer the vehicle around an obstacle detected in a critical area. If you avoid an obstacle after the acute warning, then swerve assist assists you by specifically braking individual wheels and applying slight steering adjustment to correct the steering wheel angle as long as you are actively steering. The swerve assist is available at speeds between approximately 20 mph and 90 mph (30 km/h - 150 km/h) [1].

WARNING

– Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.
– Swerve assist does not react to pedestrians, animals, crossing objects, and objects not detected as vehicles.

Tips

– System functions may not be available if the ESC is limited or switched off, or if there is a malfunction.
– An indicator in the instrument cluster will inform you when there is an intervention.

Turn assist

Applies to: vehicles with turn assist

When your vehicle is turning

The turn assist can assist you with a braking intervention when starting to drive or when driving ▶

[1] In preparation at the time of printing. The speed range may be within approximately 30 mph - 90 mph (50 km/h - 150 km/h) depending on the vehicle production date.

slowly, to reduce the risk of your vehicle colliding with an oncoming vehicle when you are making a left turn. The braking intervention causes your vehicle to stay in its lane. The function is only available when the turn signal is turned on and at speeds up to maximum of 6 mph (10 km/h).

WARNING

– Follow the safety precautions and note the limits of the assist systems, sensors, and cameras ⇨ *page 118*.
– The turn assist does not react to pedestrians, animals, crossing objects, and objects not detected as vehicles.

Tips

– System functions may not be available if the ESC is limited or switched off, or if there is a malfunction.
– An indicator in the instrument cluster will inform you when there is an intervention.

Adjusting Audi pre sense

Applies to: vehicles with Audi pre sense

The system can be switched on and off in the MMI ⇨ *page 121*.

You can adjust the Audi pre sense functions to your preferences. The settings depend on the vehicle equipment.

▸ Applies to MMI: Select on the home screen: **VEHICLE** > **Driver assistance** > (⚙) > **Audi pre sense**.

Possible settings:

– **Turn assist**
– **Swerve assist**

Prewarning[1] - The prewarning can be switched off or the Audi pre sense warning time can be set (**Early**/**Medium**/**Late**).

Set the warning time for the early warning to **Early** at first. If you feel that the prewarnings appear too early, then set the warning time to **Medium**. The **Late** warning time should only be set in special circumstances.

Tips

– Switch Audi pre sense off when you are not using public streets, when loading the vehicle onto a vehicle carrier, train, ship, or other type of transportation, or when towing the vehicle. This can help to prevent an undesired intervention from the Audi pre sense system.
– If the system is switched off, it switches on again automatically once the ignition is switched on again[1].
– Certain settings are stored automatically in the active personal profile.

Messages

Applies to: vehicles with Audi pre sense

If or is displayed when there is a malfunction, the Audi pre sense functions may be unavailable or may be limited.

A message that indicates the cause and possible solution may appear with some displays. The weather conditions may be too poor or a sensor may be covered. Clean the area in front of the sensors ⇨ *page 120* and try to turn on the systems again later.

If the malfunction remains, drive to an authorized Audi dealer or authorized Audi Service Facility immediately to have the malfunction corrected.

[1] In certain countries

4K0012721BD

APPENDIX C

Run Log

Run Log for Daytime Tests

Subject Vehicle: *2019 Audi A6 55 TFSI (3.0T) quattro* Test Date: *9/1/2020*

Adult Pedestrian Test Mannequin: *Articulated 4A Adult* Test Driver: *N. Wong*

Child Pedestrian Test Mannequin: *Articulated 4A Child*

Forward Obstructing Vehicle: *1999 Honda Accord*

Rear Obstructing Vehicle: *2012 Toyota Highlander*

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
41	Static Run – 1 meter										
42	**S1a**	**16**	**Day**	Y	0.96	0.84	15.6	1.06	1.18	NC	
43				Y	1.00	1.00	15.7	1.09	1.12	NC	
44				Y	0.91	0.77	16.3	1.08	1.04	NC	
45				Y	0.98	1.01	16.2	1.07	1.15	NC	
46				Y	0.79	0.60	15.5	1.10	0.99	NC	
47	**S1a**	**40**	**Day**	Y	0.91	2.01	39.5	1.09	1.22	NC	
48				Y	0.86	1.51	39.7	1.07	1.10	NC	
49				Y	1.00	1.95	40.7	1.04	1.21	NC	
50				Y	1.03	2.33	40.7	1.04	1.23	NC	
51				Y	1.01	1.52	37.6	1.04	1.24	NC	
52				Y	1.02	1.25	38.7	1.04	1.30	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
1	Static Run – 1 meter										
2	S1b	16	Day	Y	0.74	0.64	16.1	1.09	0.96	NC	
3				Y	1.14	0.74	16.5	1.12	1.07	NC	Sound not synced in video?
4				Y	0.73	0.32	16.4	1.12	0.94	NC	Small short beep before longer beep alert
5				N							Sound alert data weird
6				Y	0.95	0.58	16.8	1.12	1.04	NC	
7				Y	0.87	0.51	16.2	1.11	1.00	NC	
8				Y	0.92	0.73	15.9	1.11	1.10	NC	
9	S1b	20	Day	Y	0.91	0.81	20.3	1.05	1.08	NC	
10				Y	0.99	0.67	20.3	1.05	1.02	NC	
11				Y	0.83	0.93	20.4	1.04	1.05	NC	
12				Y	0.97	0.87	19.6	1.05	1.14	NC	
13				Y	0.97	0.48	19.9	1.07	1.04	NC	
14	S1b	30	Day	Y	1.12	1.62	29.5	1.06	1.34	NC	
15				Y	1.10	0.59	27.6	1.03	1.24	NC	
16				Y	1.36	1.26	27.3	1.02	1.35	NC	
17				Y	1.15	1.29	29.9	1.03	1.29	NC	
18				N							PTM fell over
19				Y	1.08	1.06	27.9	1.01	1.24	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
20	**S1b**	**40**	**Day**	Y	1.22	1.04	38.0	1.04	1.31	NC	
21				Y	1.15	0.89	39.0	1.06	1.34	NC	
22				Y	1.11	0.31	40.6	1.05	1.32	NC	
23				Y	1.05	0.99	39.5	1.05	1.29	NC	
24				Y	1.27	0.81	39.7	1.04	1.43	NC	Light sensor moved during run
25	**S1b**	**50**	**Day**	Y	1.33	1.12	44.8	1.11	1.51	NC	
26				Y	1.21	0.24	46.6	1.08	1.46	NC	
27				Y	1.31	0.89	43.7	1.07	1.52	NC	
28				Y	1.32	0.88	46.2	1.07	1.52	NC	
29				N							PTM Lateral error
30				Y	1.30	0.00	33.3	1.06	1.52	Contact	
31				Y	1.34	0.59	48.4	1.05	1.55	NC	
32	**S1b**	**55**	**Day**	Y	1.28	1.10	49.3	1.06	1.56	NC	
33	**S1b**	**60**	**Day**	Y	1.35	0.00	53.4	1.08	1.57	Contact	Zero headway but no impact
34				N							SV lateral error
35				Y	1.25	0.27	53.2	1.04	1.52	NC	
36				N							PTM Lateral Error
37				N							SV Speed
38				Y	1.46	0.98	56.0	1.04	1.66	NC	
39				Y	1.24	0.46	58.2	1.07	1.48	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
40	**S1b**	**60**	**Day**	Y	1.33	1.02	57.1	1.03	1.56	NC	
53	Static Run										
54	**S1c**	**16**	**Day**	N							PTM leg fell off
55				Y	0.71	0.57	15.4	1.08	0.96	NC	
56				Y	0.98	1.04	16.3	1.06	1.09	NC	
57				Y	0.91	0.69	15.8	1.08	1.03	NC	
58				N							PTM Lateral Error
59				Y	0.81	0.31	14.4	0.97	0.95	NC	
60				N							PTM Lateral Error
61				Y	0.84	0.56	16.4	1.10	0.99	NC	
62	**S1c**	**40**	**Day**	Y	1.24	1.19	33.5	1.05	1.36	NC	
63				Y	1.20	1.70	34.3	1.04	1.40	NC	
64				N							Driver applied brakes too early
65				Y	1.08	0.35	31.1	1.07	1.31	NC	
66				Y	1.13	0.15	27.8	1.06	1.28	NC	
67				Y	1.07	-0.25	27.8	1.04	1.24	NC	Avoided dummy
68				Y	0.99	0.10	37.0	1.04	1.21	NC	
96	Static Run										
97	**S1d**	**16**	**Day**	Y	0.81	0.76	16.4	1.10	0.95	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
98	**S1d**	**16**	**Day**	N							PTM Lateral Error
99				Y	0.86	0.83	15.8	1.09	0.98	NC	
100				Y	0.65	0.64	16.2	1.11	0.94	NC	
101				Y	0.75	0.67	16.2	1.12	0.95	NC	
102				Y	0.64	0.51	16.5	1.11	0.89	NC	
103				Y	0.90	0.58	15.6	1.07	1.03	NC	
104				Y	0.74	0.65	15.9	1.12	0.93	NC	
105	**S1d**	**20**	**Day**	N							PTM Lateral Error
106				Y	0.97	0.66	19.8	1.10	1.04	NC	
107				Y	0.88	0.82	19.6	1.09	1.03	NC	
108				Y	1.03	0.49	20.3	1.06	1.20	NC	
109				Y	0.92	0.87	19.7	1.08	1.06	NC	
110				Y	0.86	1.23	19.7	1.12	1.03	NC	
111	**S1d**	**30**	**Day**	Y	0.85	0.58	30.3	1.08	1.12	NC	
112				Y	0.69	0.72	29.1	1.07	0.92	NC	
113				Y	0.90	0.52	29.9	1.05	1.14	NC	
114				Y	0.87	0.46	30.3	1.06	1.11	NC	
115				Y	0.77	0.18	29.7	1.05	1.01	NC	
116	**S1d**	**40**	**Day**	Y	0.72	0.28	39.8	1.10	1.00	NC	
117				Y	0.74	0.04	40.4	1.07	1.01	NC	
118				Y	0.61	0.03	40.1	1.07	0.91	NC	
119				Y	0.72	0.00	36.0	1.08	0.98	Contact	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
120	**S1d**	**40**	**Day**	Y	0.62	0.26	39.8	1.04	0.91	NC	
121	**S1d**	**45**	**Day**	Y	0.70	0.00	30.6	1.08	0.94	Contact	
122				Y	0.59	0.00	28.2	1.07	0.87	Contact	
123				Y	0.57	0.00	27.3	1.09	0.85	Contact	
124				Y	0.79	0.00	34.0	1.06	1.08	Contact	
125				Y	0.70	0.00	3.7	0.31	0.97	Contact	
126	Static Run – 1 meter										
84	Static Run – 1 meter										
85	**S1e**	**40**	**Day**	Y	0.65	0.26	37.1	1.07	0.96	NC	
86				Y	0.64	-0.02	37.1	1.12	0.91	NC	
87				Y	0.68	0.00	4.1	0.32	0.97	Contact	
88				Y	0.61	0.00	33.8	1.07	1.18	Contact	
89				Y	0.65	0.00	26.2	1.10	0.89	Contact	
90				Y	0.71	0.28	37.2	1.09	1.02	NC	
91	**S1e**	**45**	**Day**	Y	0.51	0.00	24.0	1.06	0.81	Contact	
92				Y	0.66	0.00	32.8	1.07	0.92	Contact	
93				Y	0.78	-0.16	37.4	1.07	1.06	NC	
94				Y	0.71	0.00	32.5	1.06	0.97	Contact	
95	Static Run										
69	Static Run										

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
70	**S1f**	**40**	**Day**	N							Driver steered away
71				Y	1.19	0.00	15.6	0.98	1.35	NC	AEB intervention. Vehicle hits edge of micro but not pedestrian
72				Y	1.16	0.00	4.1	0.27	1.33	NC	AEB intervention.
73				Y	1.19	0.00	37.1	0.30	1.35	NC	AEB intervention.
74				Y	1.20	0.00	3.9	0.29	1.35	NC	AEB intervention.
75				Y	1.13	0.00	5.1	0.30	1.32	NC	AEB intervention.
76	Static Run										
77	**S1g**	**40**	**Day**	N							PTM lateral error
78				Y		0.00	0.0	0.02		NC	No warning, no AEB
79				Y		0.00	0.2	0.00		NC	No warning, no AEB
80				Y		0.00	0.0	0.00		NC	No warning, no AEB
81				Y		0.00	0.5	0.02		NC	No warning, no AEB
82				Y		0.00	0.0	0.00		NC	No warning, no AEB
83	Static Run										
160	Static Run										

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
161	**S4a**	**16**	**Day**	Y	1.02	1.09	16.0	1.09	1.12	NC	
162				Y	1.09	1.03	16.4	1.09	1.20	NC	
163				Y	1.15	1.45	16.1	1.15	1.27	NC	
164				Y	1.11	1.38	16.3	1.12	1.24	NC	
165				Y	0.99	1.09	16.6	1.13	1.10	NC	
166				Y	1.06	1.14	16.4	1.13	1.17	NC	
167	**S4a**	**20**	**Day**	Y	1.14	1.24	19.7	1.13	1.21	NC	
168				Y	1.15	1.18	20.8	1.06	1.27	NC	
169				Y	1.14	1.09	20.3	1.02	1.21	NC	
170				Y	1.11	1.60	19.4	1.07	1.20	NC	
171				Y	1.18	1.44	20.0	1.08	1.24	NC	
172	**S4a**	**30**	**Day**	Y	1.33	1.27	29.7	1.07	1.24	NC	
173				Y	1.40	1.39	30.6	1.09	1.32	NC	
174				Y	1.37	1.37	30.1	1.02	1.58	NC	
175				Y	1.16	0.52	30.8	1.05	1.14	NC	
176				Y	1.33	0.43	30.6	1.05	1.21	NC	
177	**S4a**	**40**	**Day**	Y	1.27	0.21	39.9	1.07	1.29	NC	
178				Y	1.17	0.00	28.4	1.05	1.11	Contact	
179				Y	1.27	0.05	39.5	1.02	1.24	NC	
180				Y	1.40	1.12	39.5	1.08	1.08	NC	
181				Y	1.22	0.00	28.5	1.03	1.16	Contact	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
182	**S4a**	**45**	**Day**	Y	1.60	1.31	45.3	1.06	1.46	NC	
183				Y	1.19	0.00	39.6	1.05	1.32	Contact	
184				N							SV Speed
185				Y	1.36	0.69	45.3	1.08	1.25	NC	
186				Y	1.44	0.00	43.9	1.04	1.30	Contact	
187				Y	1.32	0.20	44.8	1.01	1.29	NC	
188	**S4a**	**50**	**Day**	Y	1.38	0.00	32.0	1.06	1.24	Contact	
189				Y	0.93	0.00	3.6	0.32	1.17	Contact	
190				Y	1.46	0.00	39.9	1.07	1.33	Contact	
191	Static Run										
192	**S4b**	**16**	**Day**	Y	1.05	1.53	15.9	1.11	1.20	NC	
193				N							Throttle
194				Y	1.05	1.44	15.9	1.11	1.17	NC	
195				Y	1.03	1.34	16.3	1.11	1.16	NC	
196				Y	1.04	1.34	16.1	1.12	1.14	NC	
197				Y	1.11	1.41	16.1	1.12	1.22	NC	
198	**S4b**	**40**	**Day**	Y	1.27	0.30	39.9	1.04	1.22	NC	
199				Y	1.23	0.00	27.7	1.05	1.15	Contact	
200				Y	1.24	0.00	32.1	1.08	1.12	Contact	
201				Y	1.41	1.17	40.3	1.02	1.32	NC	
202				Y	1.27	0.24	39.5	1.06	1.22	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
203	Static Run										
127	Static Run										
128	**S4c**	**16**	**Day**	Y	1.23	0.73	16.0	1.01	1.36	NC	
129				Y	1.18	0.81	16.4	1.08	1.28	NC	
130				Y	1.29	0.00	3.3	0.22	1.42	Contact	
131				Y	0.96	0.66	16.3	1.10	1.02	NC	
132				Y	0.95	1.51	16.5	1.05	1.11	NC	
133				Y	1.02	1.37	15.9	1.08	1.14	NC	
134	**S4c**	**40**	**Day**	Y	1.45	1.66	39.8	1.05	1.37	NC	
135				Y	1.78	2.85	40.3	1.03	1.44	NC	
136				Y	1.67	2.10	40.0	1.04	1.41	NC	
137				Y	1.69	3.46	39.7	1.04	1.64	NC	
138				Y	1.71	2.80	40.1	1.04	1.57	NC	
139	**S4c**	**50**	**Day**	Y	1.75	4.35	49.8	1.09	1.61	NC	
140				Y	1.63	4.47	49.7	1.08	1.71	NC	
141				Y	1.62	3.98	49.2	1.09	1.55	NC	
142				Y	1.48	4.69	50.3	1.05	1.62	NC	
143				Y	1.91	5.03	50.1	1.07	1.72	NC	
144	**S4c**	**60**	**Day**	Y	1.37	3.10	60.6	1.07	1.54	NC	
145				Y	1.22	0.00	3.9	0.29	1.48	Contact	
146				Y	1.53	2.59	60.1	1.06	1.65	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
147	**S4c**	**60**	**Day**	Y	1.62	4.24	60.1	1.07	1.71	NC	
148				Y	1.47	1.84	60.2	1.07	1.41	NC	
149				Y	1.08	0.00	24.1	1.03	1.37	Contact	
151	**S4c**	**65**	**Day**	Y	1.69	0.78	65.1	1.08	1.53	NC	
152				Y	1.51	3.06	64.9	1.07	1.64	NC	
153				Y	1.45	2.57	64.7	1.09	1.60	NC	
154				Y	1.40	2.84	64.7	1.08	1.59	NC	
155				Y	1.24	0.88	65.2	1.04	1.51	NC	
150	**S4c**	**70**	**Day**	Y	0.84	0.00	45.4	1.07	1.10	Contact	
156				Y	0.57	0.00	14.6	1.07	0.94	Contact	
157				Y	1.56	3.47	69.7	1.07	1.74	NC	
158				Y	1.54	2.85	69.6	1.08	1.68	NC	
159				Y	1.14	0.00	5.0	0.33	1.43	Contact	

Run Log for Nighttime Tests

Subject Vehicle: *2019 Audi A6 55 TFSI (3.0T) quattro* Test Date: *8/31/2020*

Adult Pedestrian Test Mannequin: *Articulated 4A Adult* Test Driver: *A. Ricci*

Child Pedestrian Test Mannequin: *Articulated 4A Child*

Forward Obstructing Vehicle: *1999 Honda Accord*

Rear Obstructing Vehicle: *2012 Toyota Highlander*

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
9	S1b	16	NHB	Y	0.87	0.60	15.9	1.13	0.98	NC	
10				Y	0.86	0.52	16.0	1.11	0.98	NC	
11				Y	0.88	0.55	16.6	1.13	1.01	NC	
12				Y	0.59	0.66	16.0	1.11	0.84	NC	
13				Y	0.84	0.04	16.2	1.04	0.97	NC	
14				Y	0.88	0.53	16.3	1.14	0.98	NC	
15				Y	0.90	0.57	16.4	1.14	1.03	NC	
29	S1b	20	NHB	Y	0.78	0.59	20.3	1.08	0.99	NC	
30				Y	0.64	0.00	13.4	1.13	0.71	Contact	
31				Y	0.87	0.48	20.4	1.07	0.96	NC	
32				Y	0.81	0.53	20.1	1.08	0.98	NC	
33				Y	0.72	0.62	20.0	1.06	0.95	NC	Passed moving onto 30 km/h

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
43	S1b	25	NHB	Y	1.06	0.40	24.9	1.08	1.16	NC	
44				Y	0.93	0.04	25.1	1.08	1.05	NC	
45				Y	0.81	0.00	24.3	1.09	1.00	Contact	
46				Y	0.88	0.00	20.6	1.07	0.98	Contact	
47				Y	0.83	0.00	20.6	1.08	0.97	Contact	
39	S1b	30	NHB	Y	1.08	0.00	16.9	1.10	0.96	Contact	
40				Y	1.06	0.00	20.2	1.03	0.85	Contact	
41				Y	1.00	0.00	17.9	1.06	0.97	Contact	
42				Y	0.98	0.00	19.1	1.08	0.98	Contact	3 fails proceeding down to 25 km/h
20	S1b	40	NHB	Y	1.22	0.25	40.4	1.11	1.26	NC	
21				Y	1.19	0.00	29.9	1.06	1.23	Contact	
22				Y	1.23	0.00	31.1	1.09	1.27	Contact	
23				Y	1.23	0.00	26.8	1.08	1.06	Contact	Contacted will test at lower speeds
166	S1d	11	NHB	Y	0.54	0.67	11.4	1.02	0.71	NC	
167				Y	0.09	0.00	4.7	0.82	0.36	Contact	
168				Y	0.62	0.36	11.3	1.03	0.85	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
169	S1d	11	NHB	N							PTM lateral position
170				Y	0.57	0.72	11.0	1.06	0.76	NC	
171				Y	0.53	0.65	11.3	1.02	0.74	NC	
150	S1d	16	NHB	Y		0.00	0.0	0.01		Contact	No warning, No AEB
151				Y	0.17	0.00	8.4	1.08	0.46	Contact	
152				Y	-0.21	0.00	0.8	0.29	0.14	Contact	Warning after impact
156	S1d	40	NHB	Y		0.00	0.0	0.01		Contact	No warning, No AEB
157				Y	-0.30	0.00	0.0	0.06		Contact	Warning after impact
158				Y	-0.17	0.00	0.0	0.16	0.06	Contact	Warning after impact
63	S1e	35	NHB	Y	0.62	0.17	34.8	1.10	0.88	NC	
64				Y	0.64	0.00	3.8	0.33	0.92	Contact	
65				Y	0.66	0.08	27.5	1.09	0.94	Contact	
66				Y	0.65	0.00	3.9	0.33	0.94	Contact	
67				Y	0.37	0.00	3.0	0.39	0.55	Contact	
56	S1e	40	NHB	Y	0.56	0.00	17.3	1.06	0.85	Contact	
57				Y	0.66	0.00	28.7	1.06	0.92	Contact	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
58	**S1e**	**40**	**NHB**	Y	0.47	0.00	21.6	1.09	0.76	Contact	Contacted moving to 35 km/h
126	**S4a**	**16**	**NHB**	Y	1.01	0.95	16.0	1.13	1.11	NC	
127				Y	0.99	1.08	16.3	1.13	1.12	NC	
128				Y	0.98	0.90	16.2	1.14	1.10	NC	
129				Y	1.06	0.96	16.0	1.11	1.18	NC	
130				Y	1.08	0.99	16.1	1.12	1.19	NC	
142	**S4a**	**35**	**NHB**	Y	0.93	0.00	20.0	1.07	1.01	Contact	
143				Y	0.96	0.00	20.9	1.08	0.99	Contact	
144				Y	1.07	0.00	20.6	1.09	1.02	Contact	
136	**S4a**	**40**	**NHB**	Y	1.05	0.00	21.9	1.10	1.03	Contact	
137				Y	1.02	0.00	23.6	1.09	1.04	Contact	
138				Y	1.15	0.00	24.9	1.10	1.07	Contact	Contacted, moving down to 35
76	**S4c**	**16**	**NHB**	Y	1.12	1.84	16.0	1.10	1.23	NC	
77				Y	1.02	1.96	16.1	1.11	1.04	NC	
78				Y	0.88	0.00	2.8	0.26	1.03	Contact	
79				Y	0.70	0.00	3.0	0.27	0.89	Contact	
80				Y	1.02	2.04	16.3	1.10	1.03	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
81	**S4c**	**16**	**NHB**	Y	0.80	0.00	5.6	0.67	1.02	Contact	
88	**S4c**	**40**	**NHB**	Y	1.89	0.00	5.4	0.27	1.88	Contact	
89				Y	1.54	2.47	39.9	1.07	1.40	NC	
90				Y	1.63	4.32	40.2	1.11	1.75	NC	
91				Y	1.63	4.36	40.3	1.08	1.80	NC	
92				Y	1.51	2.12	39.9	1.12	1.46	NC	Passed, moving up to 50 km/h
99	**S4c**	**50**	**NHB**	Y	1.71	2.16	50.1	1.08	1.57	NC	
100				Y	1.59	3.58	50.2	1.10	1.57	NC	
101				Y	1.77	3.79	49.5	1.13	1.62	NC	
102				Y	1.96	3.32	50.3	1.08	1.68	NC	
103				Y	1.64	3.29	50.4	1.09	1.51	NC	Passed, moving up to 60 km/h
108	**S4c**	**60**	**NHB**	Y	1.74	0.00	4.0	0.23	1.74	Contact	
109				Y	1.60	0.00	4.2	0.29	1.76	Contact	
110				Y	1.68	3.58	60.6	1.14	1.68	NC	
111				Y	1.67	2.02	60.6	1.13	1.61	NC	
112				Y	1.59	2.45	60.1	1.11	1.64	NC	Passed, moving up to 65 km/h to preserve dummy

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
118	**S4c**	**65**	**NHB**	Y	0.67	0.00	15.1	1.11	1.00	Contact	
119				Y	0.88	0.00	18.9	1.05	1.20	Contact	
120				Y	1.06	0.00	39.9	1.10	1.37	Contact	
1	Static Run										
2	**S1b**	**16**	**NLB**	Y	0.79	0.55	16.5	1.08	0.95	NC	
3				Y	0.63	0.67	16.3	1.12	0.88	NC	
4				Y	0.85	0.38	15.2	1.05	0.99	NC	
5				Y	0.97	0.65	16.6	1.14	1.01	NC	
6				N							SV speed
7				Y	0.99	0.66	16.3	1.09	1.07	NC	
8				Y	0.86	0.38	16.6	1.13	0.99	NC	
24	**S1b**	**20**	**NLB**	Y	0.96	0.58	20.3	1.08	0.96	NC	
25				Y	0.93	0.54	20.4	1.09	1.06	NC	
26				Y	0.93	0.18	20.3	1.13	0.93	NC	
27				Y	0.92	0.51	18.7	1.13	1.04	NC	
28				Y	0.77	0.76	20.2	1.10	0.91	NC	Passed moving onto 30 km/h
34	**S1b**	**30**	**NLB**	Y	0.81	0.14	30.1	1.06	1.03	NC	
35				Y	0.65	0.00	2.6	0.30	0.93	Contact	
36				Y	1.13	0.07	28.4	1.12	1.05	NC	
37				Y	1.13	0.07	30.3	1.09	1.01	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
38	**S1b**	**30**	**NLB**	Y	1.09	0.00	25.9	1.09	1.06	Contact	Passed, moving on to 35 km/h
48	**S1b**	**35**	**NLB**	Y	1.11	0.00	20.9	1.06	0.98	Contact	
49				Y	0.96	0.00	26.8	1.13	1.11	Contact	
50				Y	1.18	0.00	26.4	1.11	1.18	Contact	
16	**S1b**	**40**	**NLB**	Y	0.90	0.00	38.3	1.09	1.00	NC	No visual contact, collision checker also shows no contact
17				Y	1.11	0.00	22.0	1.08	1.06	Contact	
18				Y	1.16	0.00	29.1	1.08	1.09	Contact	
19				Y	1.09	0.00	26.8	1.07	1.10	Contact	Contacted will test at lower speeds
159	**S1d**	**11**	**NLB**	Y	0.62	0.85	10.9	1.05	0.83	NC	
160				Y	-0.07	0.00	1.1	0.24	0.23	Contact	Warning after impact
161				N							PTM lateral error
162				Y	0.48	0.71	10.9	1.06	0.65	NC	
163				Y	0.64	0.87	11.2	1.01	0.86	NC	
164				Y	0.59	0.88	11.1	1.06	0.79	NC	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
165	**S1d**	**11**	**NLB**	Y	0.66	0.97	11.1	0.95	0.84	NC	
145	Static Run, 1 meter										
146	**S1d**	**16**	**NLB**	Y	0.27	0.01	16.2	1.15	0.52	NC	
147				Y		0.00	0.0	0.00		Contact	No warning, no AEB
148				Y		0.00	0.3	0.03		Contact	No warning, no AEB
149				Y	-0.02	0.00	1.4	0.24	0.30	Contact	
153	**S1d**	**40**	**NLB**	Y		0.00	0.0	0.05		Contact	No warning, no AEB
154				Y		0.00	0.1	0.04		Contact	No warning, no AEB
155				Y		0.00	0.0	0.01		Contact	No warning, no AEB
59	**S1e**	**35**	**NLB**	Y	0.56	0.00	12.3	1.10	0.86	Contact	
60				Y	0.69	0.23	34.1	1.11	0.94	NC	
61				Y	0.56	0.00	23.8	1.06	0.85	Contact	
62				Y	0.62	0.00	22.4	1.09	0.95	Contact	
51	Static Run										
52	**S1e**	**40**	**NLB**	Y	0.49	0.00	3.4	0.31	0.81	Contact	
53				Y	0.82	0.00	26.4	1.06	1.10	Contact	
54				Y	0.62	0.00	23.7	1.06	0.88	Contact	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
55	**S1e**	**40**	**NLB**	Y	0.57	0.00	21.8	1.06	0.86	Contact	Contacted moving to 35 km/h
121	**S4a**	**16**	**NLB**	Y	1.06	0.73	16.2	1.21	1.14	NC	
122				Y	1.03	1.00	16.6	1.13	1.13	NC	
123				Y	1.00	1.37	16.4	1.15	1.08	NC	
124	**S4a**	**16**	**NLB**	Y	0.97	0.65	16.2	1.15	1.08	NC	
125				Y	1.03	1.05	16.0	1.14	1.14	NC	
139	**S4a**	**35**	**NLB**	Y	1.22	0.00	30.8	1.07	1.09	Contact	
140				Y	1.17	0.00	25.3	1.10	1.13	Contact	
141				Y	1.10	0.00	30.9	1.15	1.15	Contact	
131	**S4a**	**40**	**NLB**	Y	1.08	0.00	30.4	1.12	1.18	Contact	
132				Y	0.94	0.16	40.4	1.11	1.13	NC	
133				Y	1.23	0.12	39.8	1.09	1.18	NC	
134				Y	0.99	0.00	18.1	1.08	1.02	Contact	
135				Y	1.09	0.00	25.9	1.11	1.12	Contact	Contacted, moving down to 35
68	Static Run										
69	**S4c**	**16**	**NLB**	Y	1.24	2.35	16.4	1.13	1.33	NC	
70				Y	1.33	0.00	3.7	0.23	1.46	Contact	

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
71	S4c	16	NLB	Y	1.13	2.28	16.2	1.15	1.10	NC	
72				N							PTM fell over
73				Y	1.51	0.00	5.0	0.25	1.58	Contact	
74				Static Run							
75				Y	1.03	1.99	16.1	1.09	1.11	NC	
82	S4c	40	NLB	Y	1.56	0.00	3.6	0.30	1.25	Contact	
83				N							SV lateral, small window crack on left bottom
84				Y	0.96	2.77	40.0	1.11	1.17	NC	
85				Y	1.51	3.02	39.9	1.09	1.13	NC	
86				Y	1.36	3.34	39.9	1.06	1.49	NC	
87				Y	1.44	3.03	40.1	1.06	1.48	NC	Passed, moving up to 50 km/h
93	S4c	50	NLB	Y	1.62	1.84	50.3	1.09	1.03	NC	
94				N							Throttle
95				Y	1.26	1.04	50.3	1.09	1.40	NC	
96				Y	1.50	0.00	3.9	0.25	1.48	Contact	
97				Y	1.18	0.00	3.0	0.27	1.35	Contact	
98				Y	1.21	2.24	50.4	1.11	1.42	NC	Passed, moving up to 60 km/h

Run	Test Type	SV Speed (km/h)	Lighting Condition	Valid Run?	FCW TTC (s)	Minimum Distance (m)	Speed Reduction (km/h)	Peak Decel (g)	PAEB TTC (sec)	Contact/No Contact (NC)	Notes
113	S4c	55	NLB	Y	1.21	0.35	54.7	1.17	1.41	NC	
114				Y	1.20	0.83	54.9	1.13	1.45	NC	
115				Y	0.84	1.40	55.1	1.11	1.12	NC	
116				Y	0.74	0.00	21.1	1.10	0.98	Contact	
117				Y	0.41	0.00	11.0	1.06	0.67	Contact	
104	S4c	60	NLB	Y	0.75	0.00	33.6	1.09	1.00	Contact	
105				Y	1.08	0.00	39.3	1.08	1.34	Contact	
106				Y	1.25	0.41	60.6	1.09	1.43	NC	
107				Y	1.17	0.00	3.5	0.29	1.45	Contact	Contacted, moving down to 55 km/h

APPENDIX D

Time History Plots

LIST OF FIGURES

Time History Plot Description

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from both the Subject Vehicle (SV) and the Pedestrian Test Mannequin (PTM), 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 codes indicating to which vehicle the data pertain.

Time history figures include the following sub-plots:

- FCW Warning – Displays the audible Forward Collision Warning alert. The alert data are filtered, rectified, and normalized. The vertical scale is 0 to 1. When no warning is detected the plot will display “No Wng” in red except that for scenarios S1f and S1g, for which no contact is the appropriate result, “No Warning” will be displayed in black.

  A vertical black bar on the plot indicates the TTC (sec) at the first moment of the warning issued by the FCW system. The FCW TTC is displayed to the right of the subplot in green.

- Headway (m) – Longitudinal separation (gap) between the front-most point of the SV and the PTM as defined by a rectangle. The minimum headway during the run is displayed to the right of the subplot. Note that there are cases where minimum headway can be zero without collision. Because the plan view of the from profile of a vehicle is generally not rectangular, and headway is calculated from the front-most point of the vehicle. It is possible to have zero headway without. Also, for scenarios S1f and S1g, zero headway is appropriate since these are false positive tests.

  If no impact occurs, a green circle is displayed at the moment of minimum headway distance. If impact occurs, a red asterisk is displayed at the moment of impact and the word “Contact” is displayed in red. Additionally, along the time history data for the headway, the line is marked in bold if the PTM is within the forward path of the SV, and it is thin if the PTM is outside of the forward path of the SV.

- SV/PTM Speed (km/h) – Speed of the SV and PTM (if any). The speed reduction experienced by the SV is displayed to the right of the subplot. The speed tolerance applies until the until the FCW alert is given. If the PAEB intervenes before the FCW alert, the speed tolerance applies until the onset of PAEB braking. Note that there is no tolerance for PTM speed because PTM motion validity is a function of SV longitudinal position. Speed reduction (SR) values are shown in red when contact occurred.

- Yaw Rate (deg/sec) – Yaw rate of the SV. Its tolerance is ±1.0 deg/sec (required until there is PAEB system braking).

- Lateral Error (m) – For both the SV and PTM, Lateral Error is measured in the reference frame of the lane of travel. Note that for crossing (S1) test scenarios, Lateral Error for the PTM is the same as Longitudinal Error in its reference frame.

  For the SV, lateral error is defined to be the lateral distance between the centerline of the SV and the center of the lane of travel. Its tolerance is ±0.20 m.

  For the PTM in longitudinal (S4) test scenarios, the lateral error is defined to be the distance between the centerline of the PTM and its associated defined lateral position in the lane of travel. Its tolerance is ±0.18 m

  For the PTM in crossing (S1) test scenarios, the lateral error is defined to be the distance between the centerline of the PTM and its prescribed lateral position across the lane of travel as calculated by the defined SV longitudinal position and impact profiles provided by the test procedure. Its tolerance is ±0.18 m

- Ax (g) – Longitudinal acceleration of the SV. A dashed line is displayed at -0.03 g, which is used as the threshold to indicate PAEB braking. The onset of PAEB system braking is found by finding the moment when the SV's Ax crosses the threshold of -0.15 g. Once this point is found, the first moment when the SV Ax is below the indicated -0.03 g threshold but before the Ax crosses the -0.15 g point, is determined and said to be the moment of first PAEB braking. The TTC (sec) at first PAEB system braking is calculated and displayed to the right of the subplot, in green. Also, the peak value of Ax for the SV is shown on the subplot.

- Pedal Positions – Normalized positions of the accelerator pedal and brake pedal. As the brake pedal is only a contact switch; the position reading will either be 0 (off) or a 1 (on). A red "Brk" (indicating test invalidity) will appear to the right of the plot if the brake pedal was applied at any time during the run. The accelerator pedal is normalized, such that throttle off equals zero and wide-open throttle equals one. The throttle is required to be off starting 0.5 sec after either an audible FCW alert is provided or the onset of PAEB braking, whichever occurs first.

Envelopes and Thresholds

Some of the time history plot figures contain either green 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. Such exceedances indicate either that the test was invalid or that there was contact between the SV and PTM.

For plots with green envelopes, in order for the test to be valid, the time-varying data must not exceed the envelope boundaries at any time. Exceedances of a green envelope are indicated by red shading in the area between the measured time-varying data and the envelope boundaries.

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 color codes:

    - Blue = SV data
    - Magenta = PTM data
    - Brown = Relative data between SV and PTM (i.e., 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
    - Black threshold (Dashed) = for reference only – this can include warning level thresholds, TTC thresholds, and acceleration thresholds

3. Individual data point color codes:

    - Green circle = passing or valid value at a given moment in time
    - Red asterisk = failing or invalid value at a given moment in time

4. Text color codes:

   - Green = passing or valid value
   - Red = failing or invalid value

Other Notations

- Contact – Indicates that contact was made between the SV and PTM.
- ENV – Indicates that the value for that variable was outside of its specified validity envelope.
- NG – Indicates that the value for that variable was outside of bounds and therefore “No Good”.
- No Wng – No warning was detected.
- PTM – Indicates that the value for the Pedestrian Test Mannequin was out of bounds.
- SV – Indicates that the value for the Subject Vehicle was out of bounds.
- SR – Shows the speed reduction value.
- Thr – Indicates that the requirements for the throttle were not met.

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

Examples of time history plots for each test type (including passing, failing and invalid runs) are shown in Figures D1 through Figure D5. Figures D1 and D2 show typical passing and failing runs. Figures D3 through D5 show examples of invalid runs. Time history data plots for the tests of the vehicle under consideration herein are provided beginning with Figure D6.

The test reported herein is one of a series of research and development tests accomplished for the purpose of refining test procedures, protocols, and specifications, as well as data analysis parameters and presentation methods that are preliminarily described in NHTSA ‘s test procedure titled, “Pedestrian Automatic Emergency Brake System Confirmation Test (Working Draft)”, dated September 2019 (Docket NHTSA-2019-0102-0005). Some of these procedural details changed over the course of the test series in order to address unanticipated concerns or ambiguities, and also in recognition of the different characteristics of AEB implementation by the various manufacturers. In particular, the threshold for determining the onset of PAEB braking was originally set at -0.15 g, and subsequently changed to -0.03 g later in the series. As a result, some of the results indicate the earlier threshold and some the later. The results presented herein are for the -0.03 g threshold.

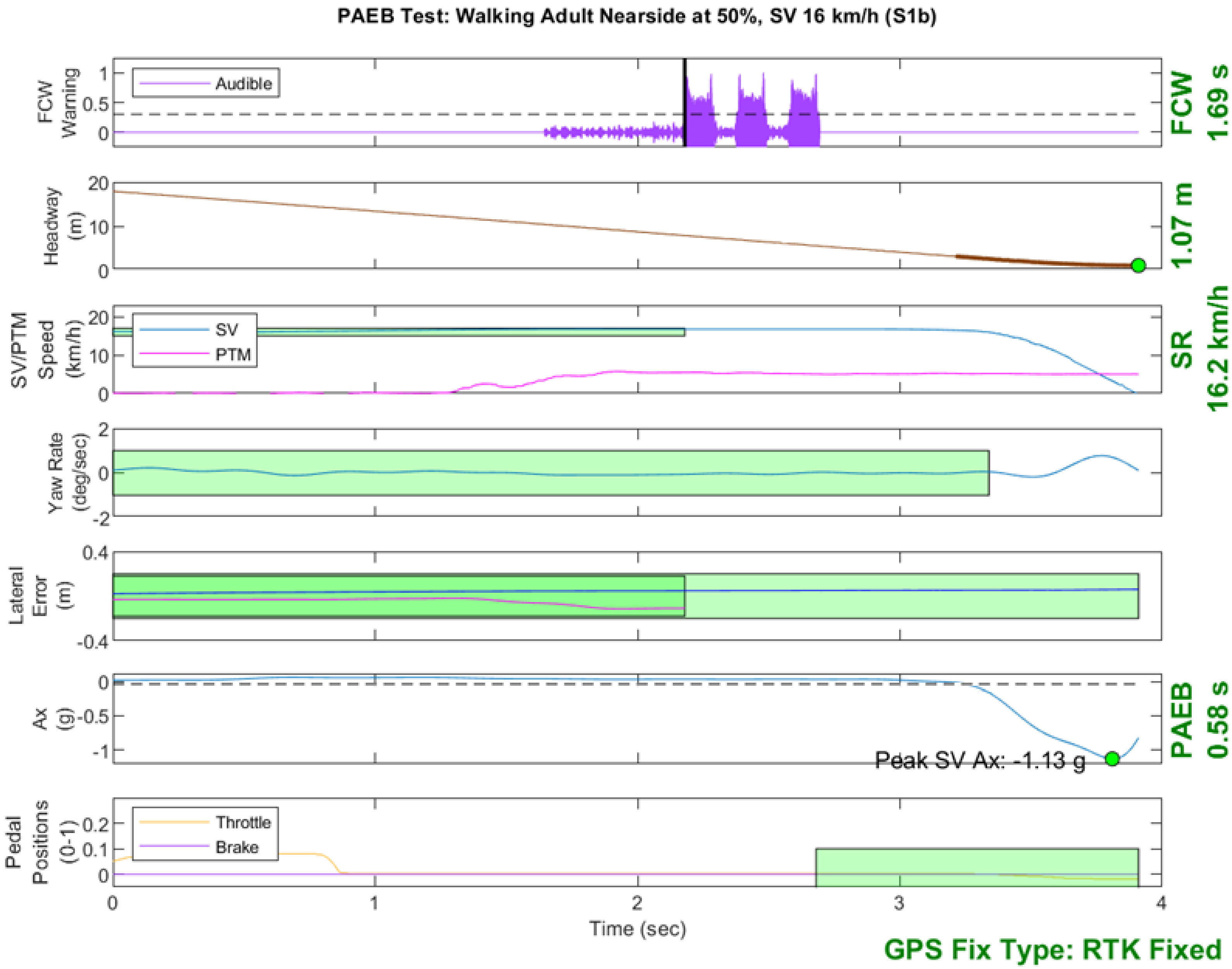


Figure D1. Example Time History for a Passing Run

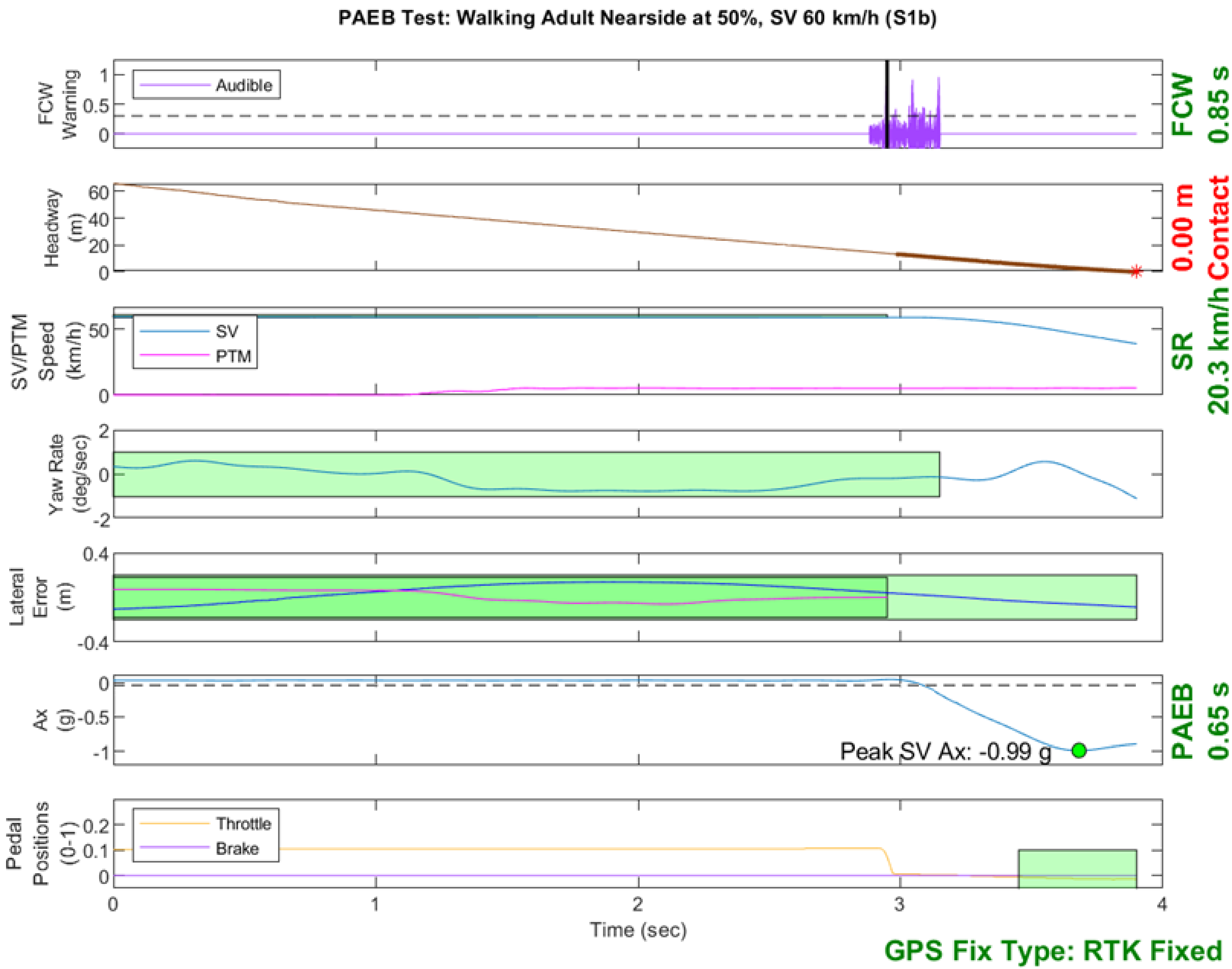


Figure D2. Example Time History for a Failed Run

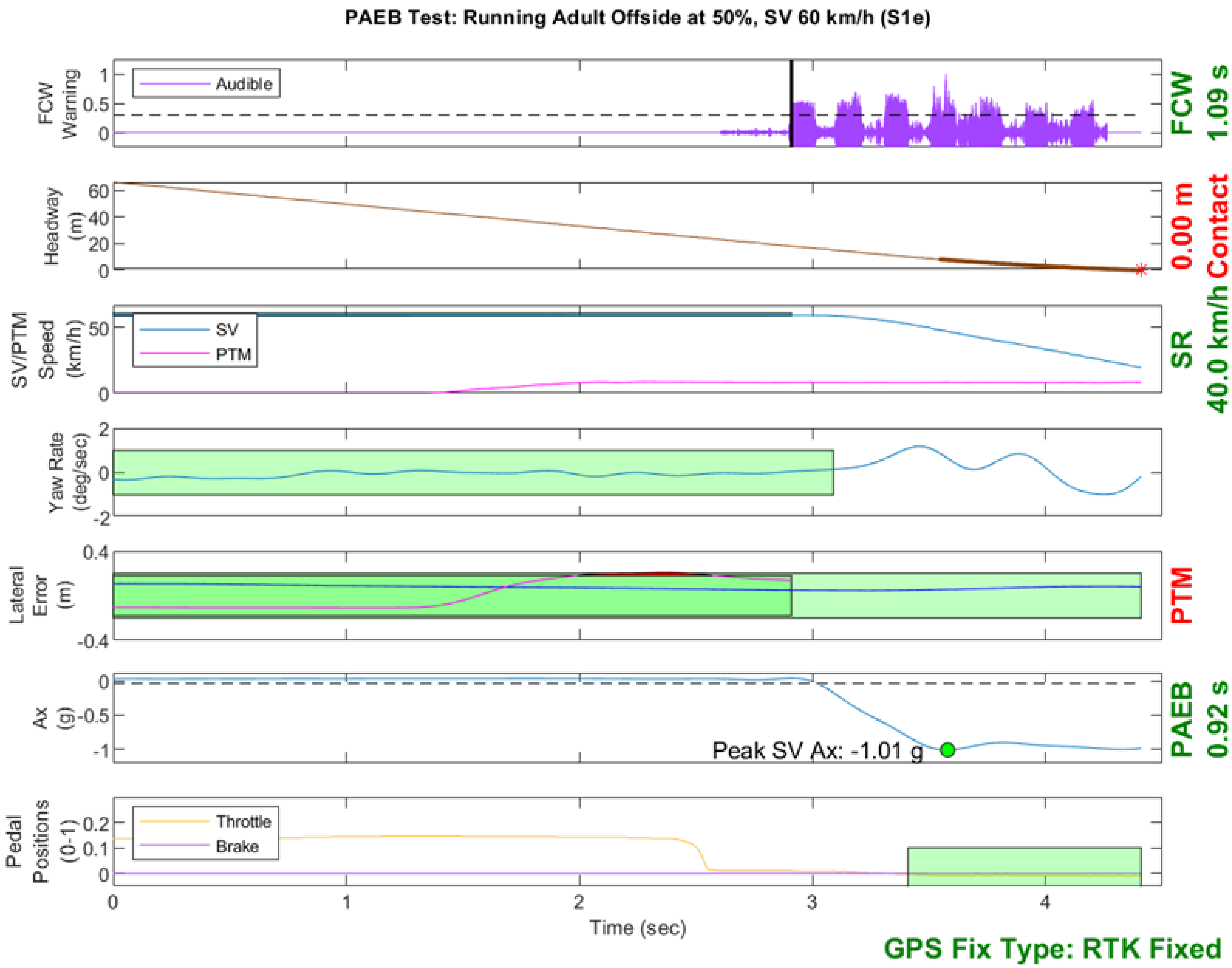


Figure D3. Example Time History for an Invalid Run Due to PTM Lateral Error

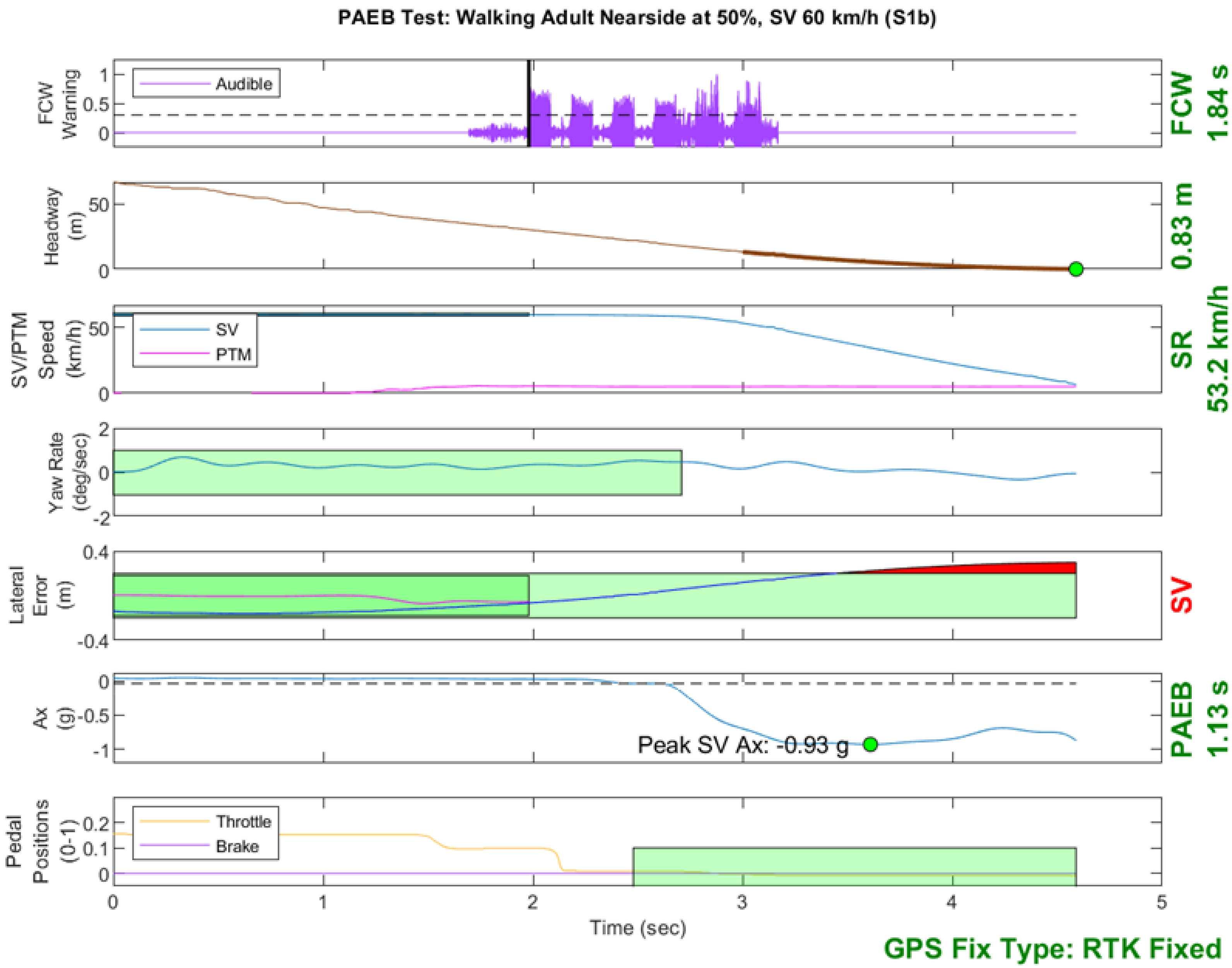


Figure D4. Example Time History for an Invalid Run Due to SV Lateral Error

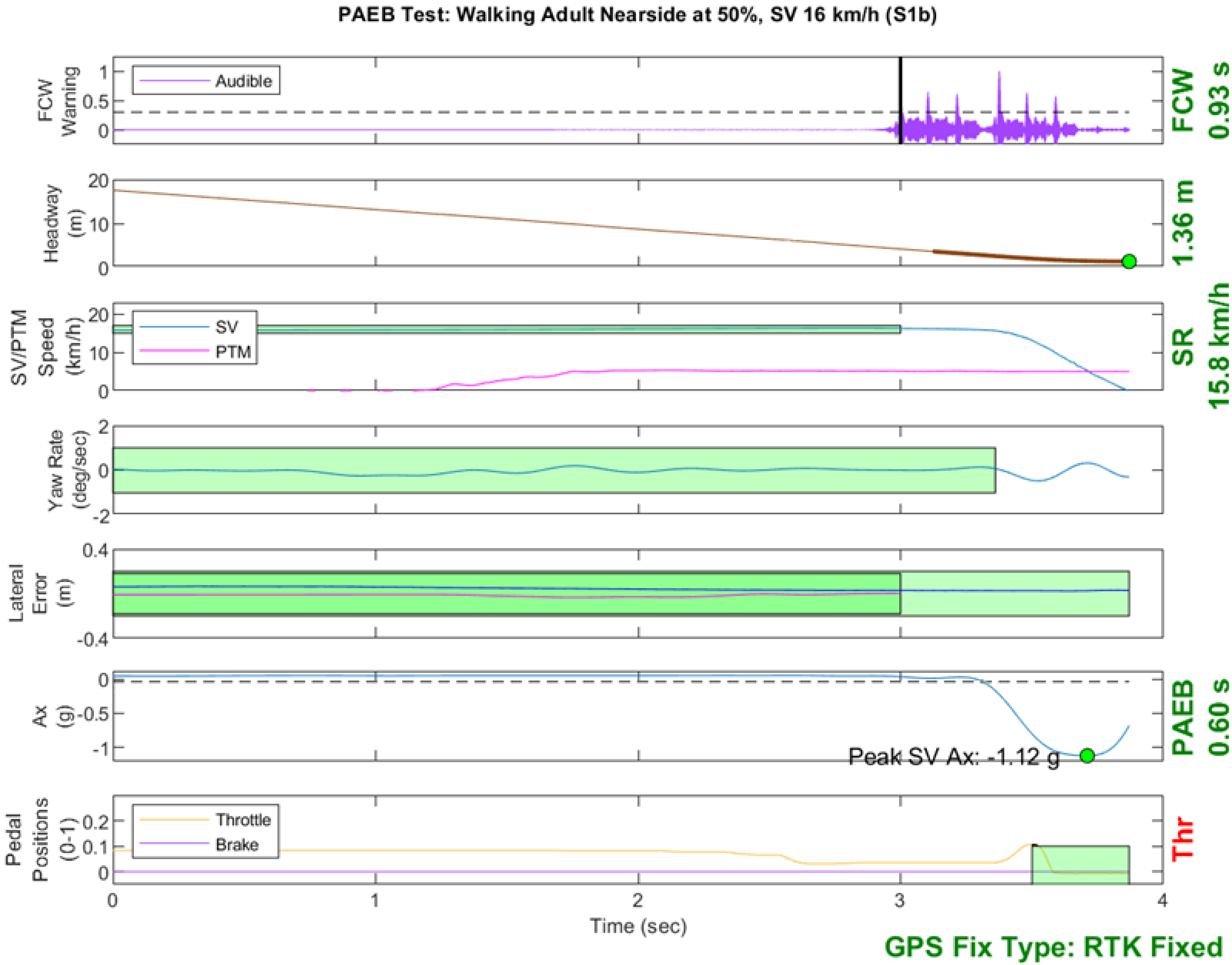


Figure D5. Example Time History for an Invalid Run Due to Throttle Error

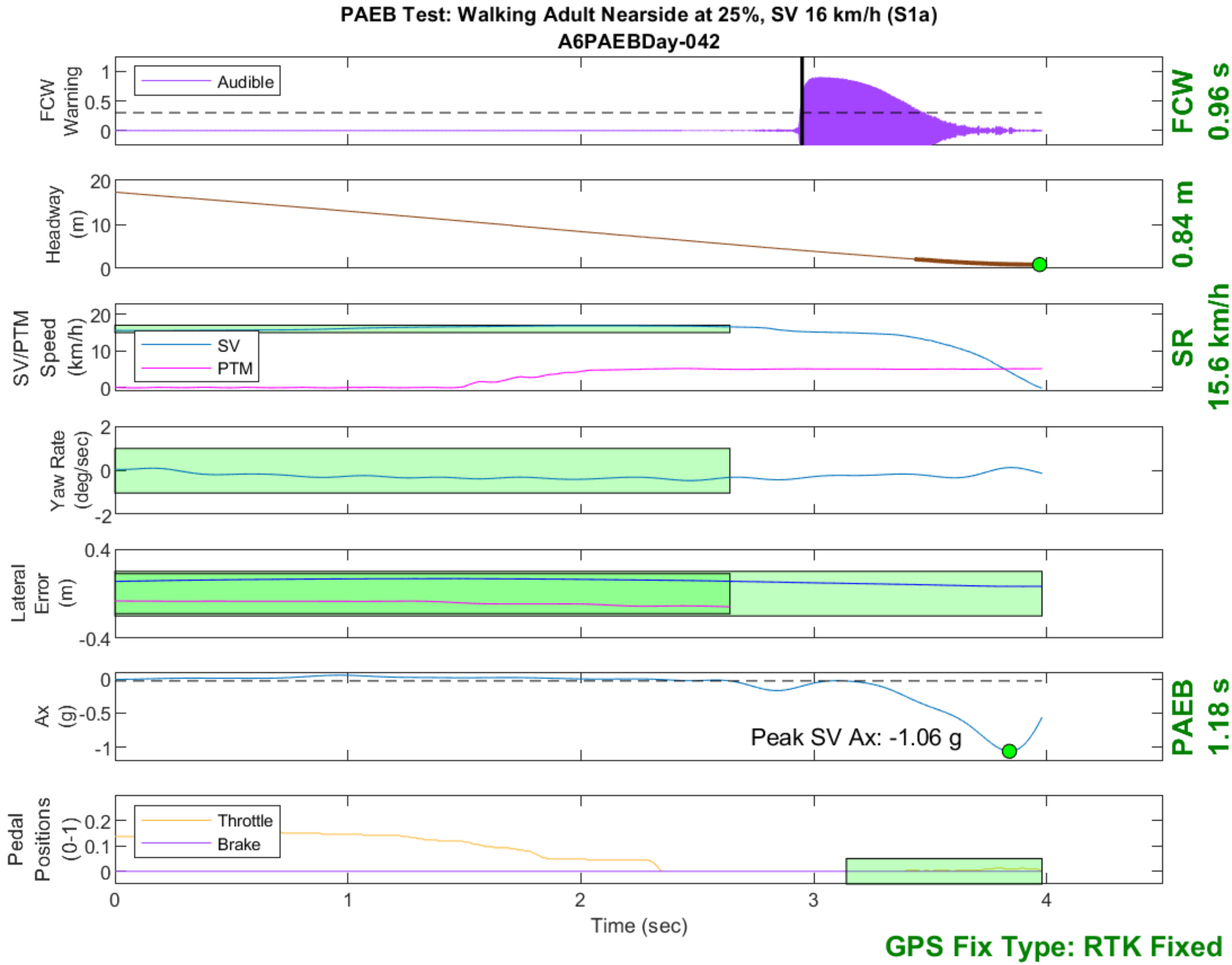


Figure D6. Time History for PAEB Run 42, S1a, Daytime, 16 km/h

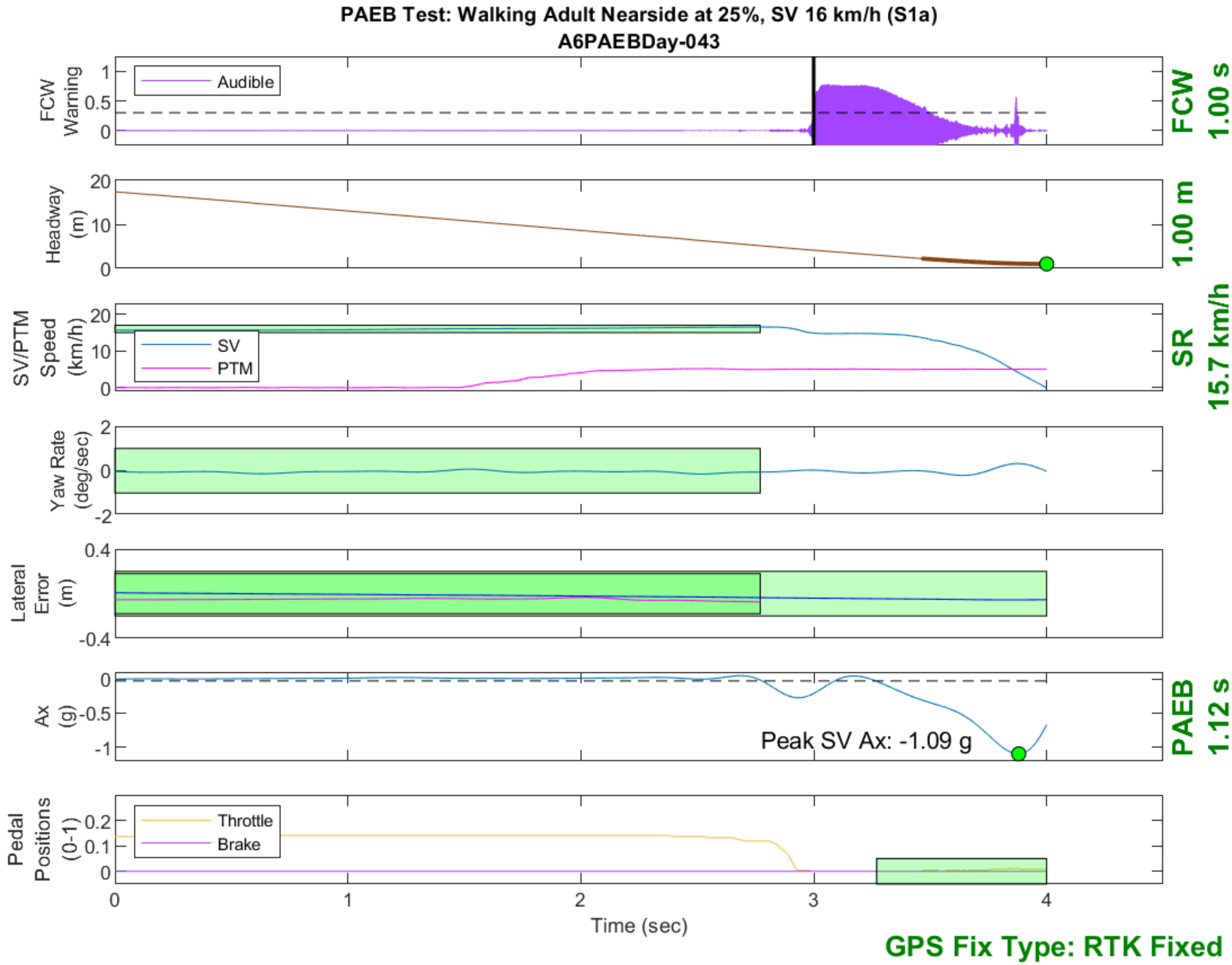


Figure D7. Time History for PAEB Run 43, S1a, Daytime, 16 km/h

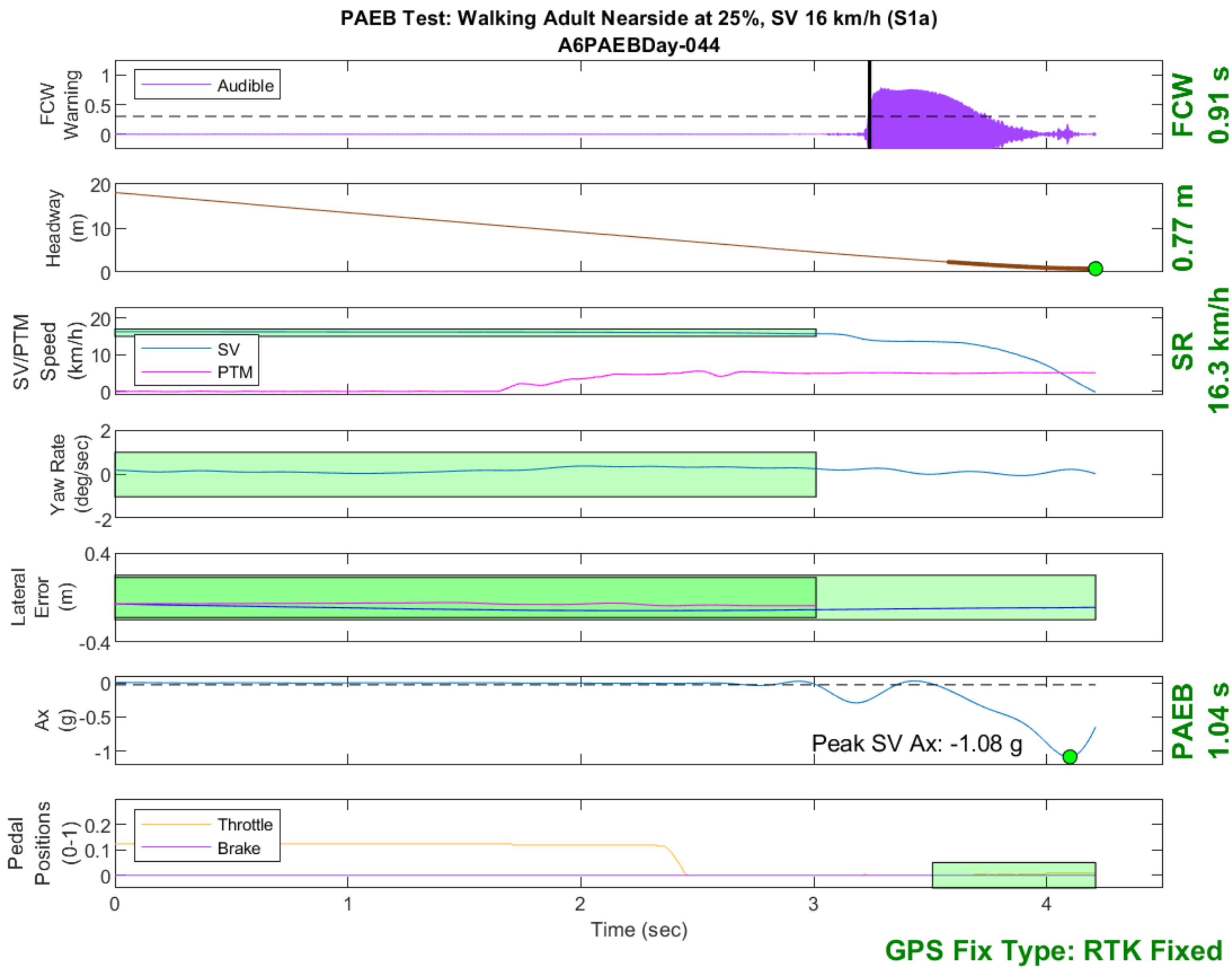


Figure D8. Time History for PAEB Run 44, S1a, Daytime, 16 km/h

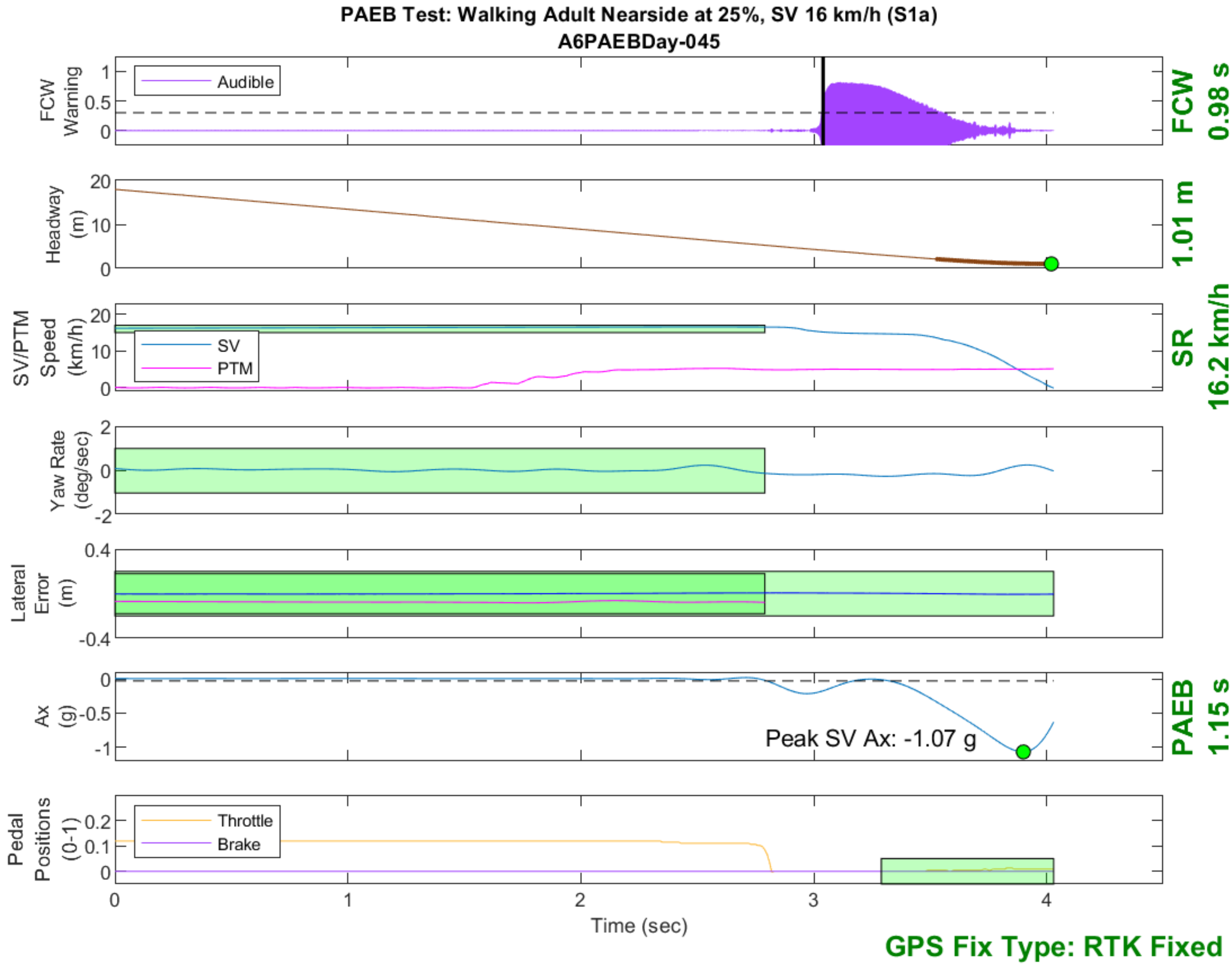


Figure D9. Time History for PAEB Run 45, S1a, Daytime, 16 km/h

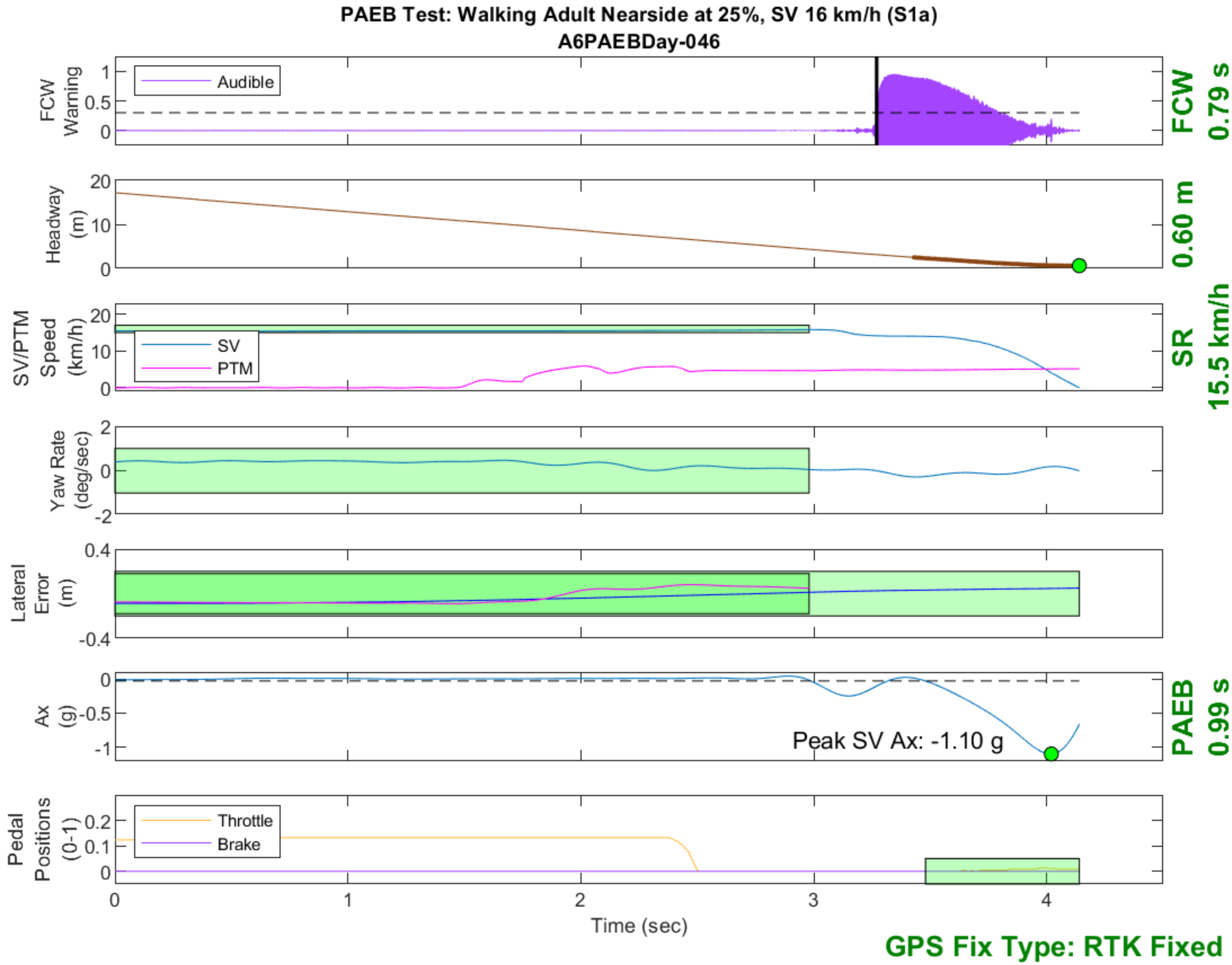


Figure D10. Time History for PAEB Run 46, S1a, Daytime, 16 km/h

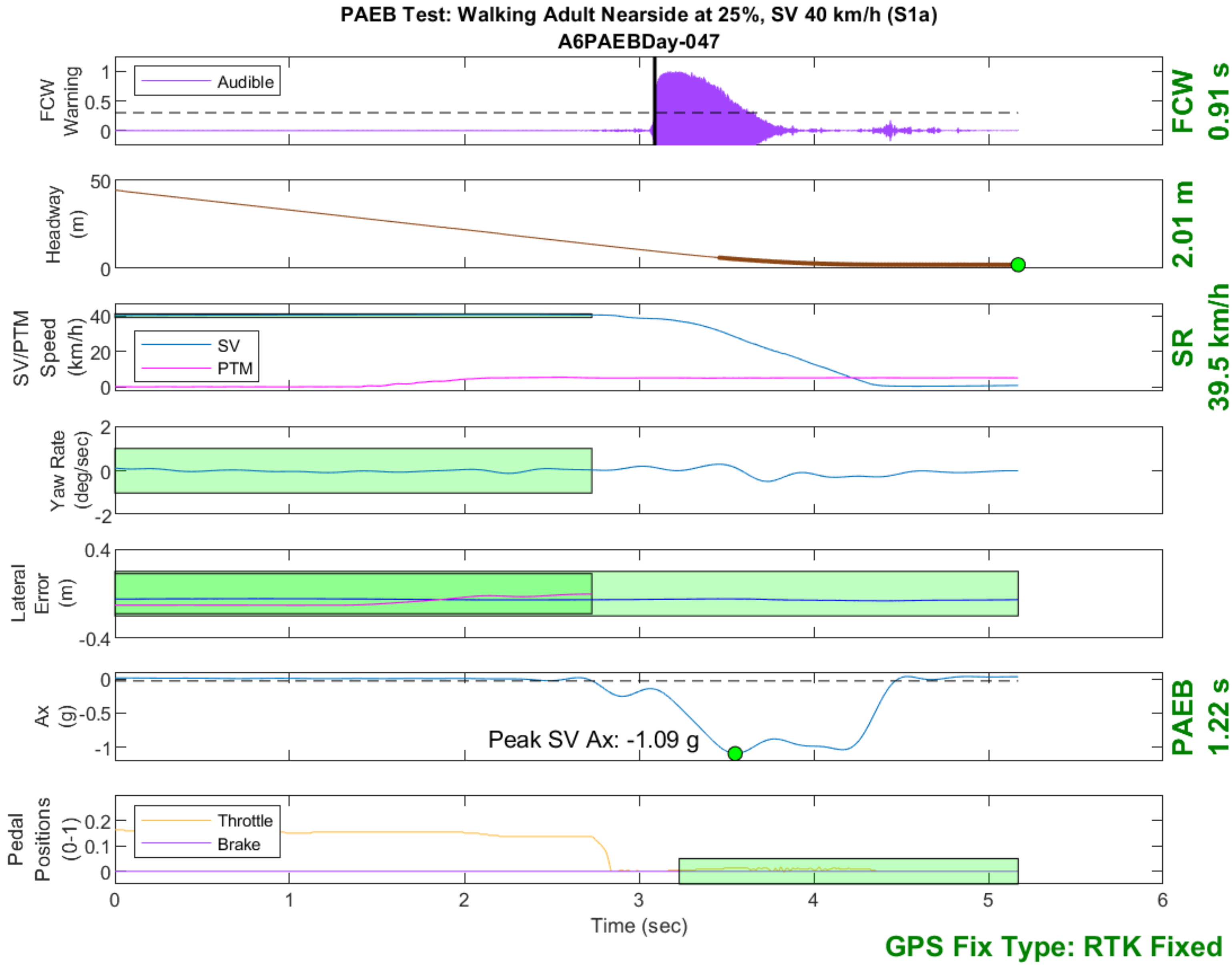


Figure D11. Time History for PAEB Run 47, S1a, Daytime, 40 km/h

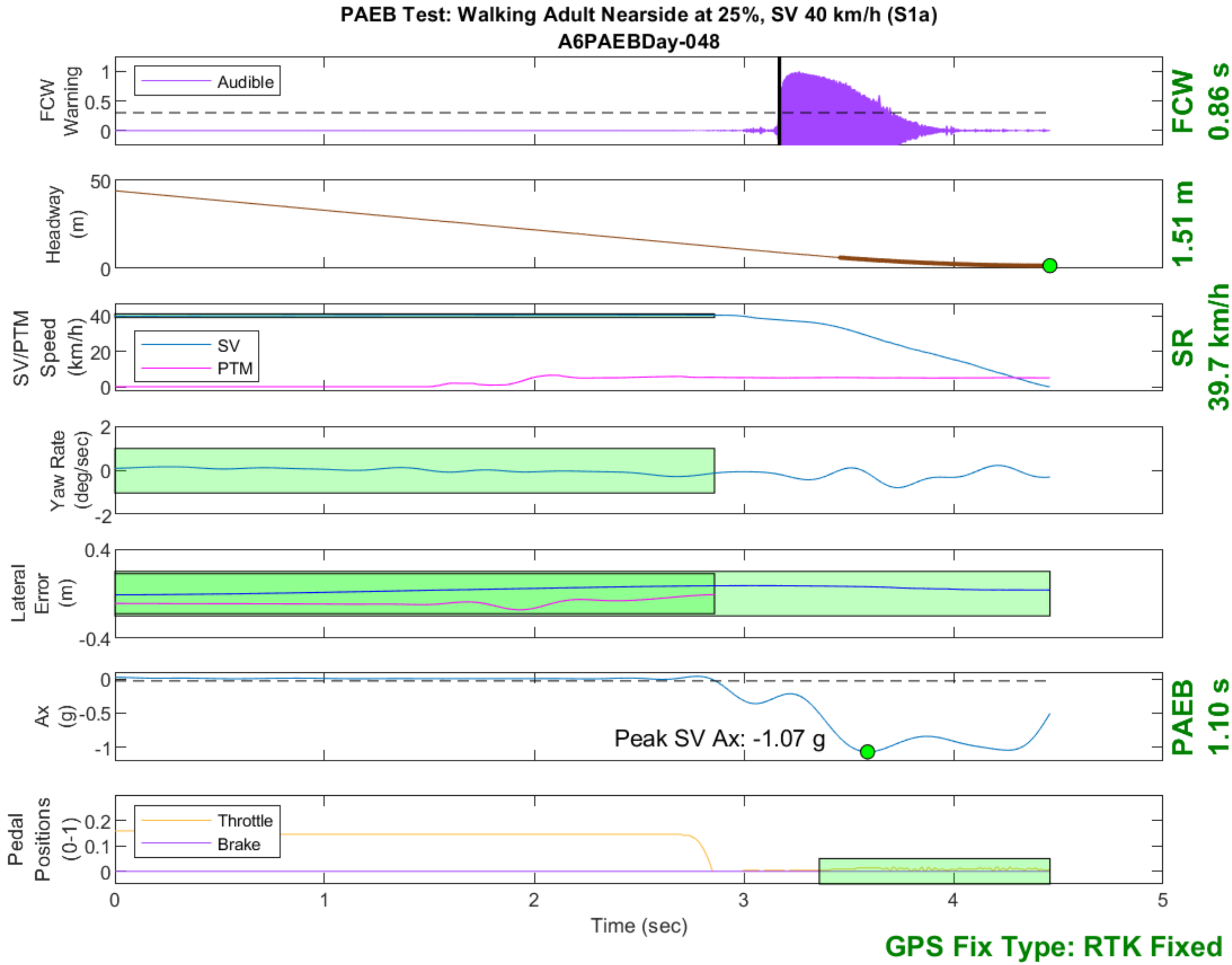


Figure D12. Time History for PAEB Run 48, S1a, Daytime, 40 km/h

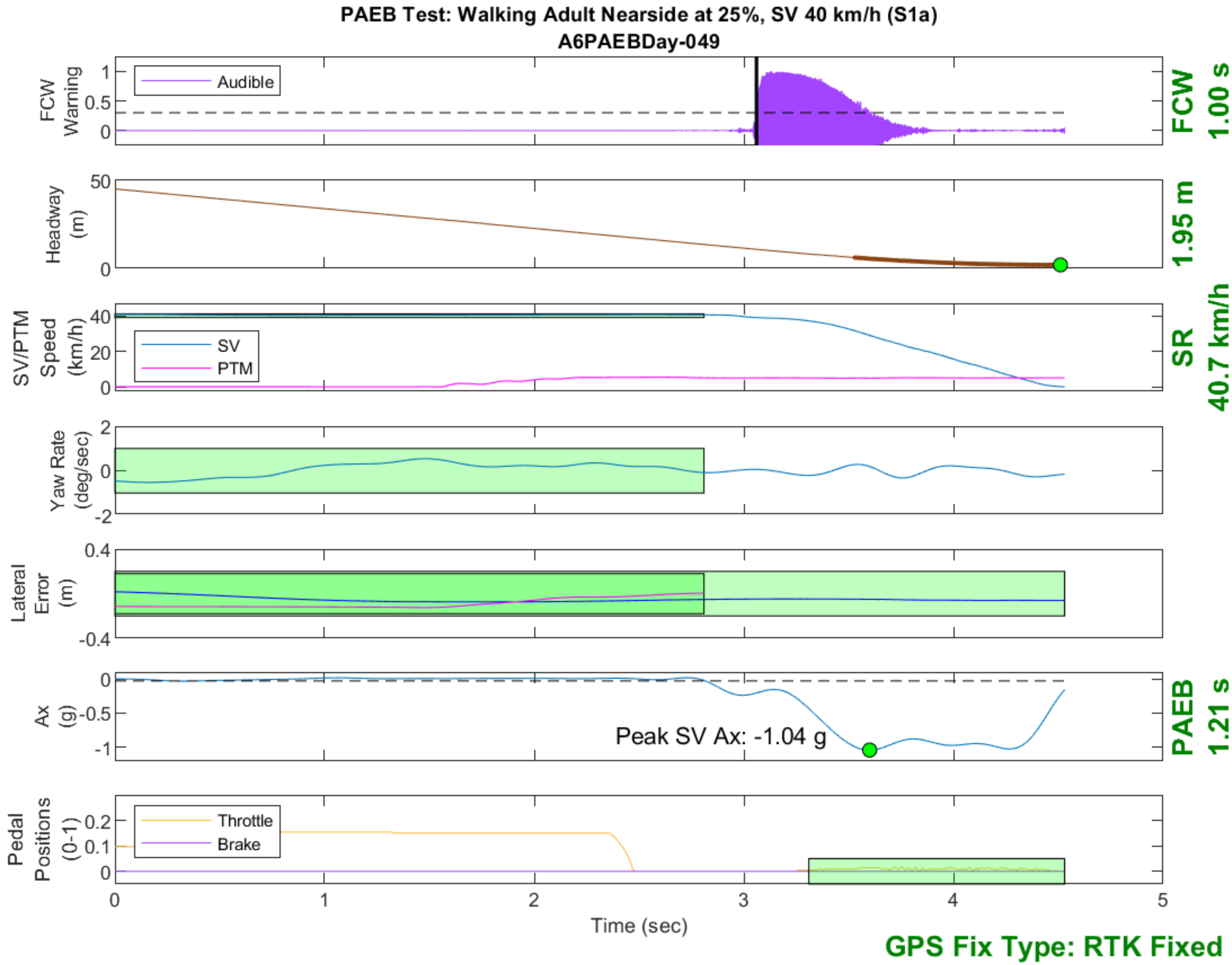


Figure D13. Time History for PAEB Run 49, S1a, Daytime, 40 km/h

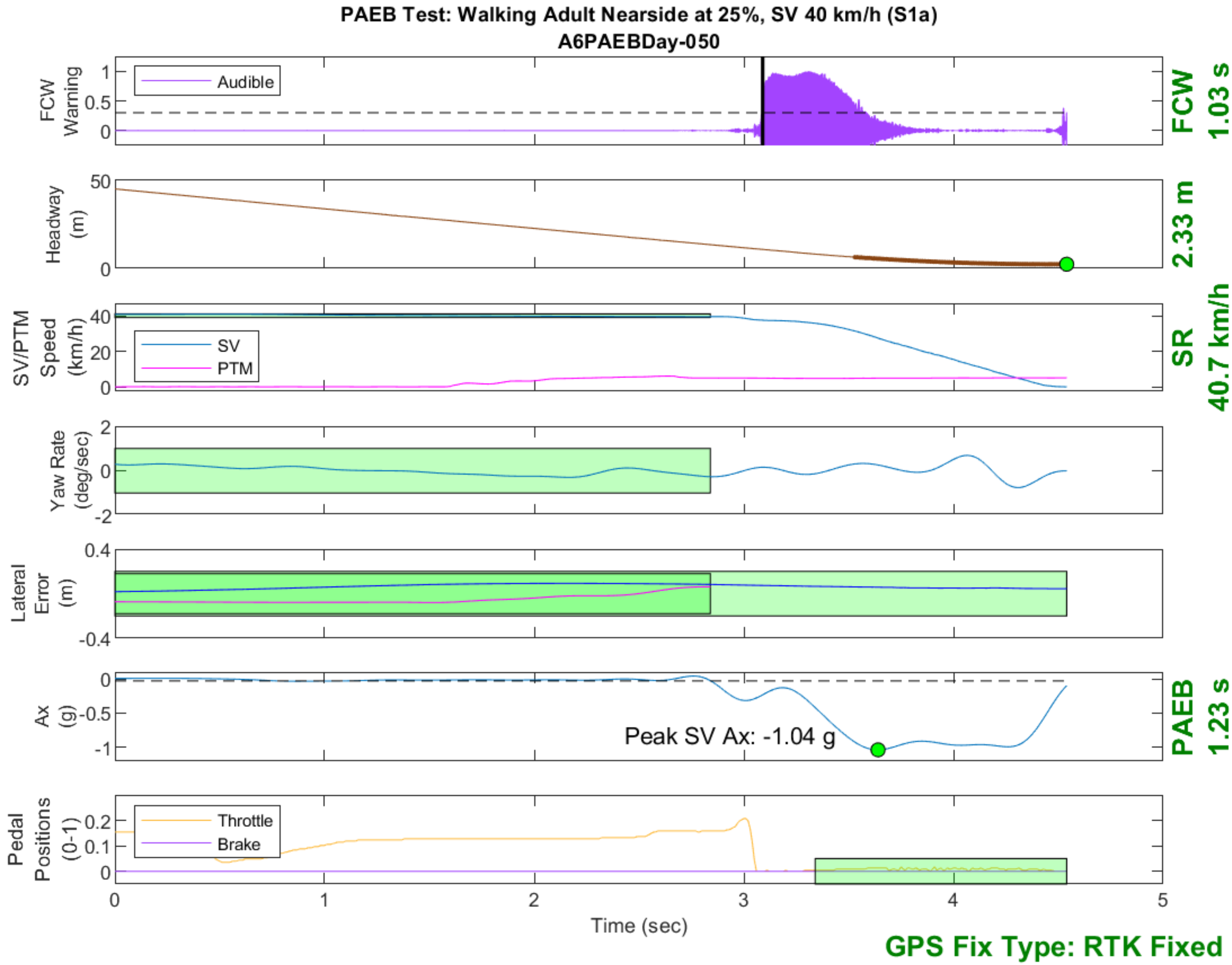


Figure D14. Time History for PAEB Run 50, S1a, Daytime, 40 km/h

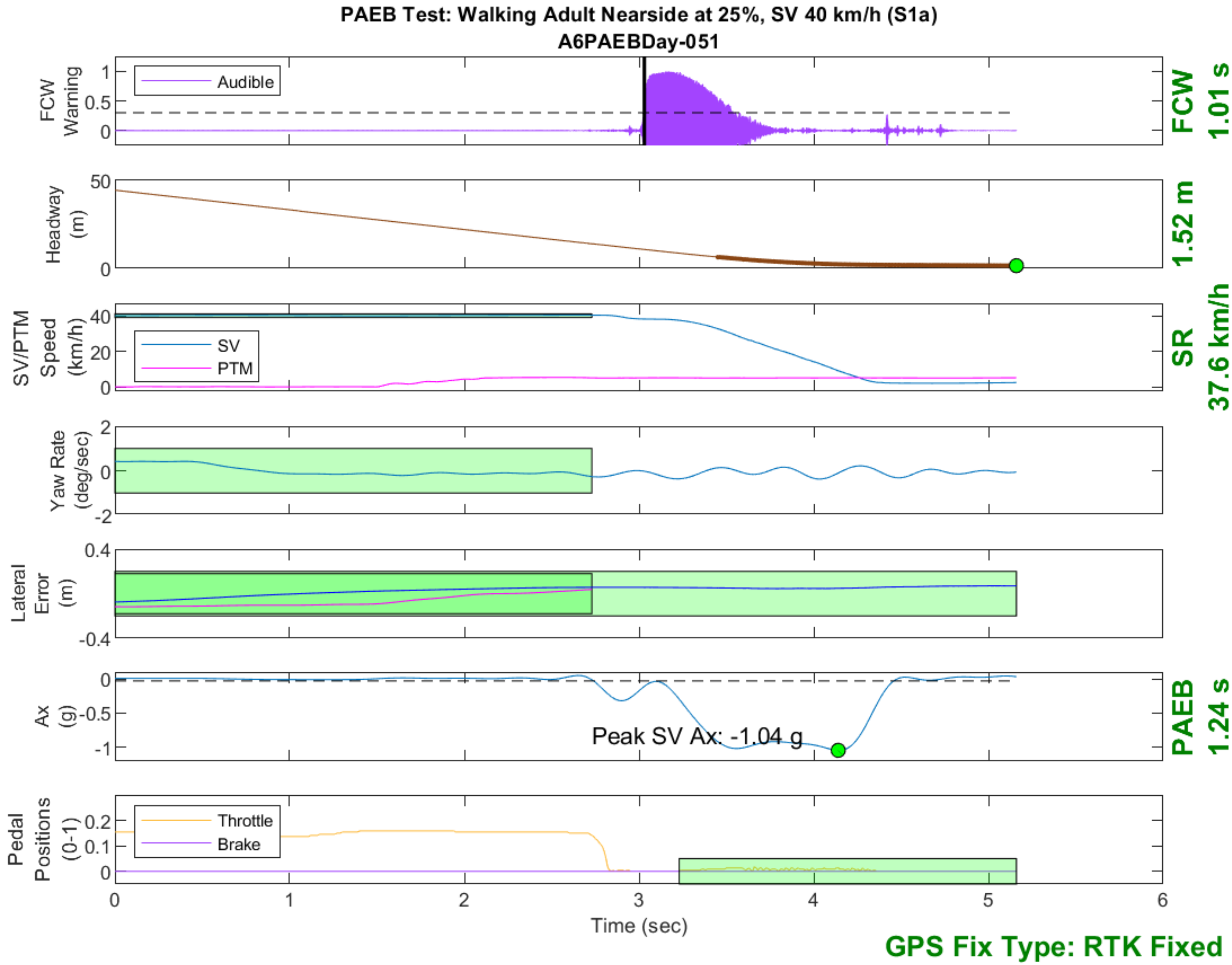


Figure D15. Time History for PAEB Run 51, S1a, Daytime, 40 km/h

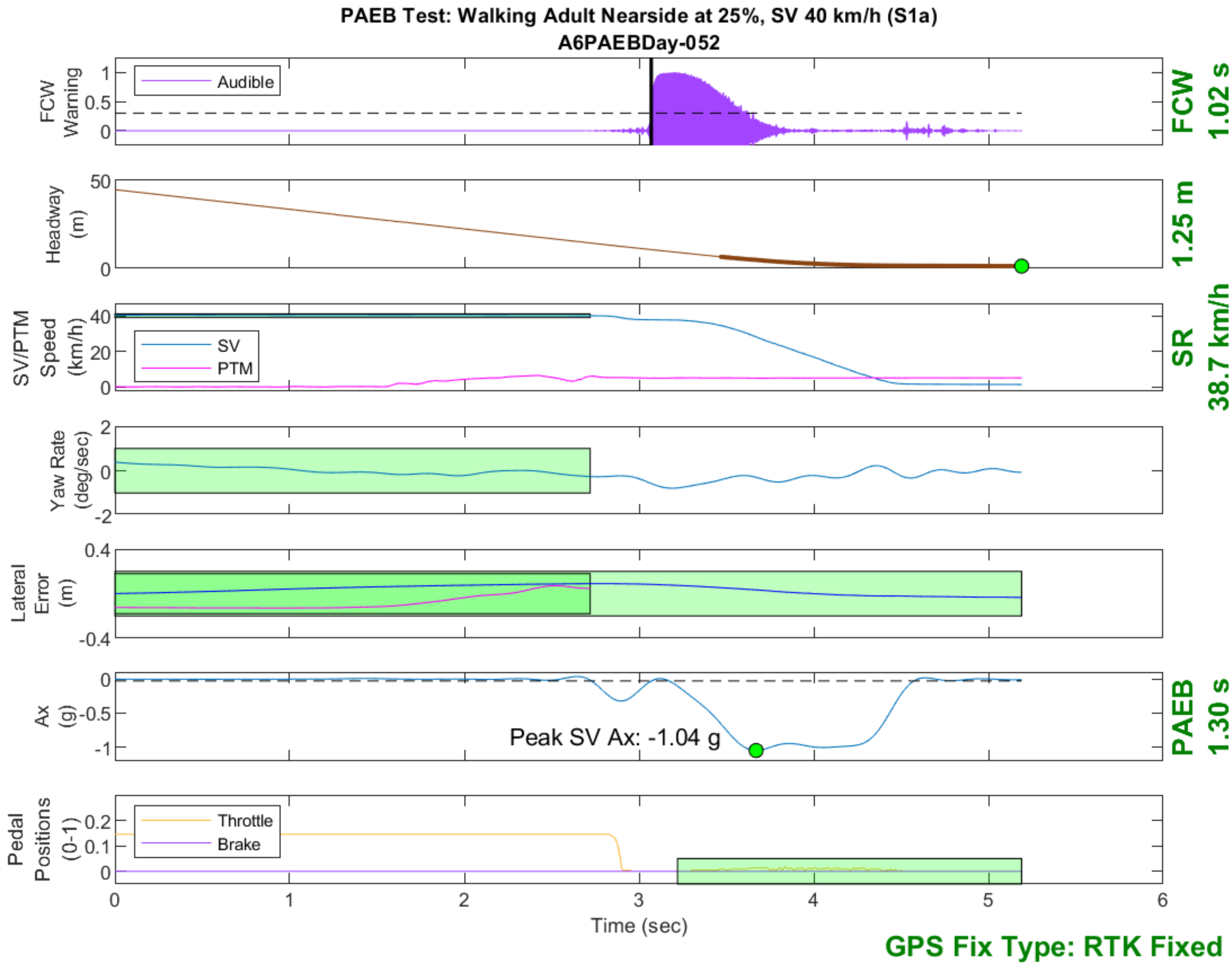


Figure D16. Time History for PAEB Run 52, S1a, Daytime, 40 km/h

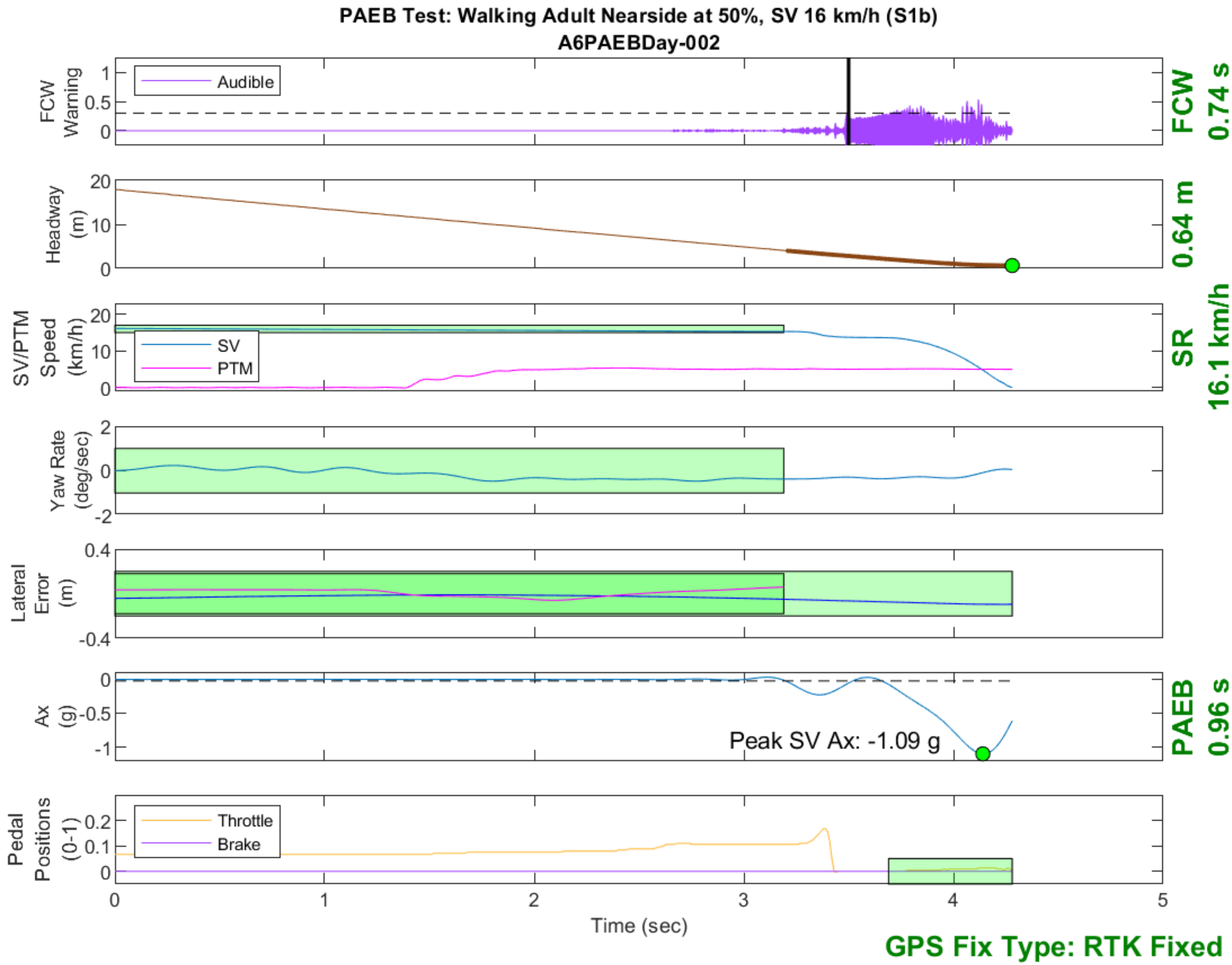


Figure D17. Time History for PAEB Run 2, S1b, Daytime, 16 km/h

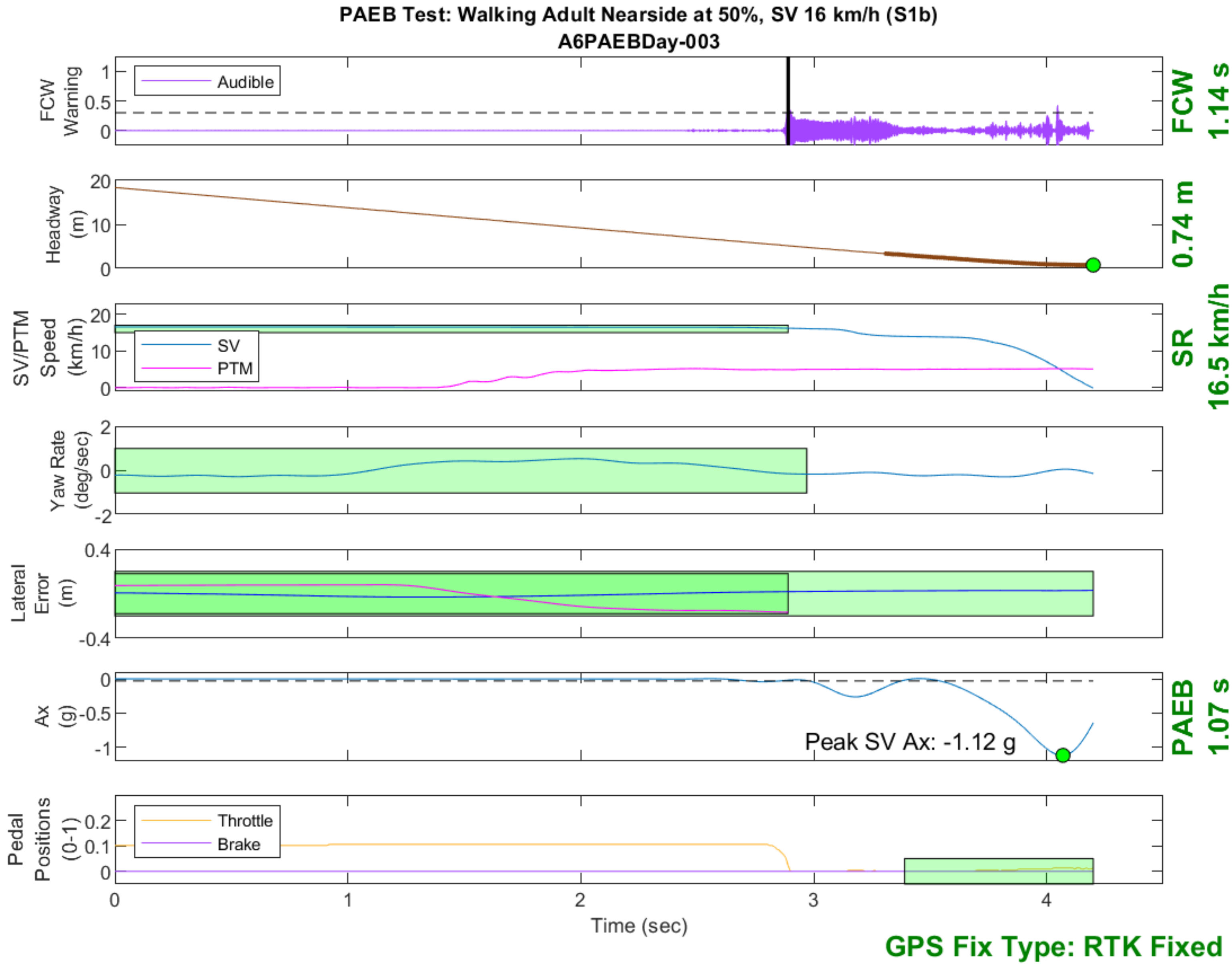


Figure D18. Time History for PAEB Run 3, S1b, Daytime, 16 km/h

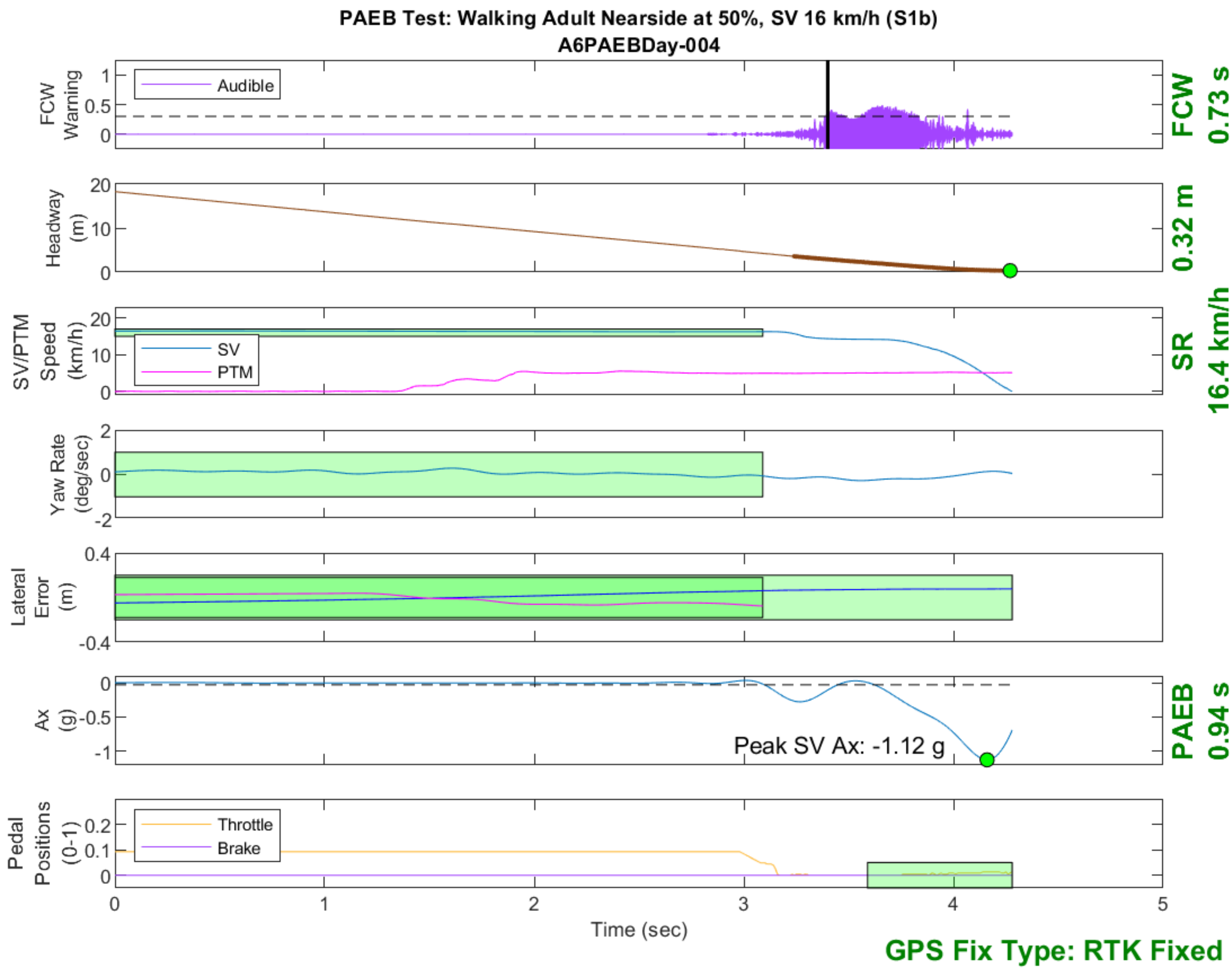


Figure D19. Time History for PAEB Run 4, S1b, Daytime, 16 km/h

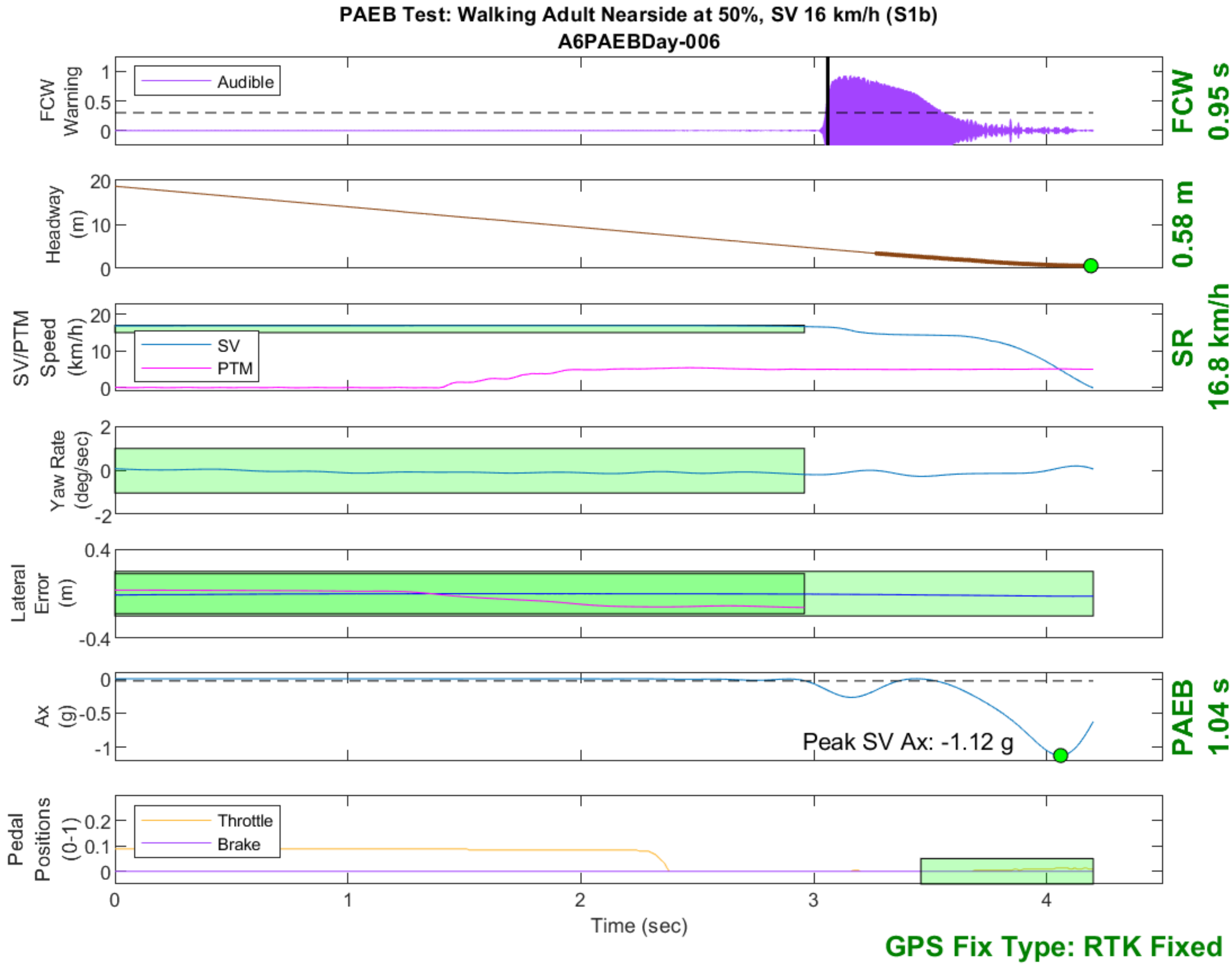


Figure D20. Time History for PAEB Run 6, S1b, Daytime, 16 km/h

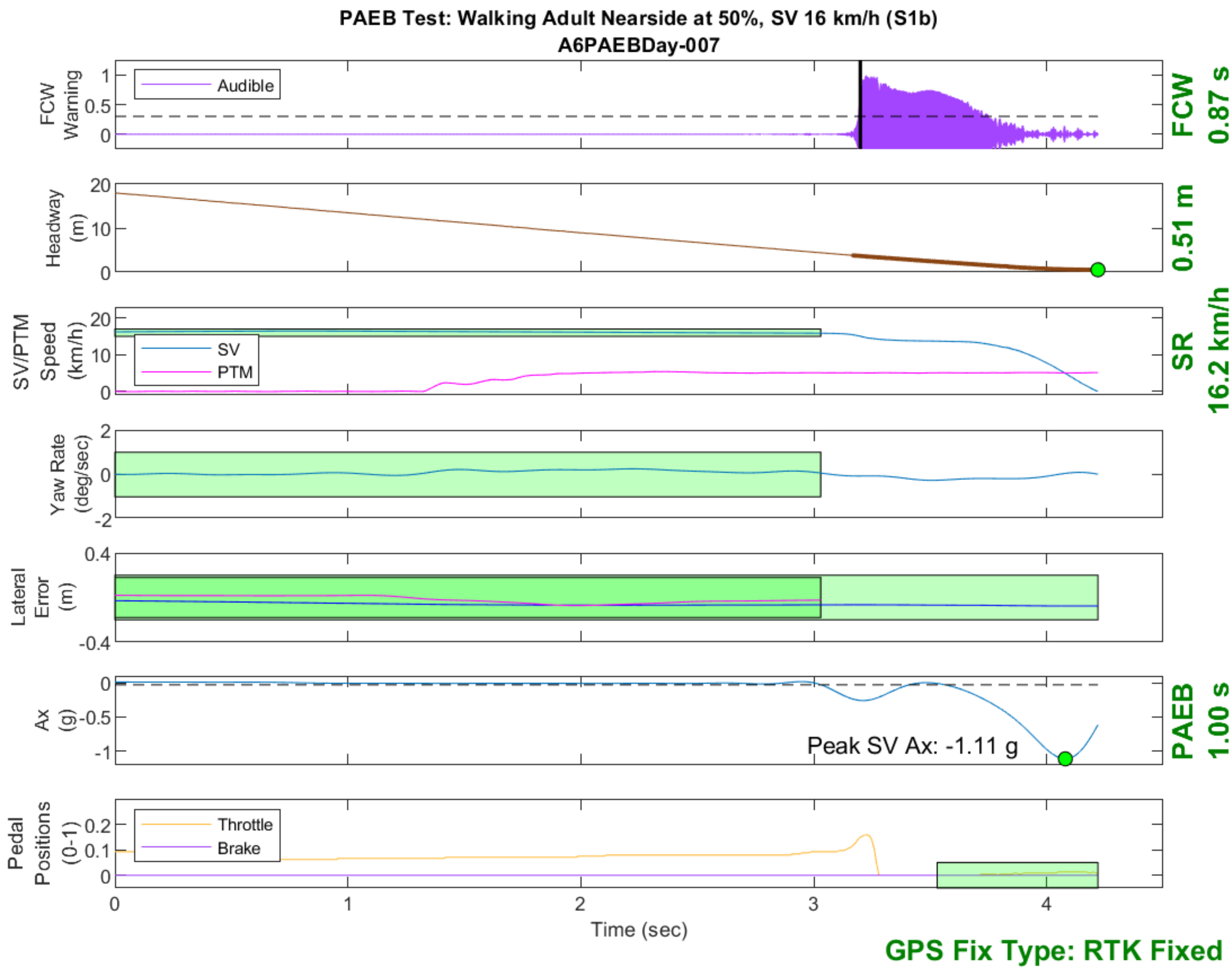


Figure D21. Time History for PAEB Run 7, S1b, Daytime, 16 km/h

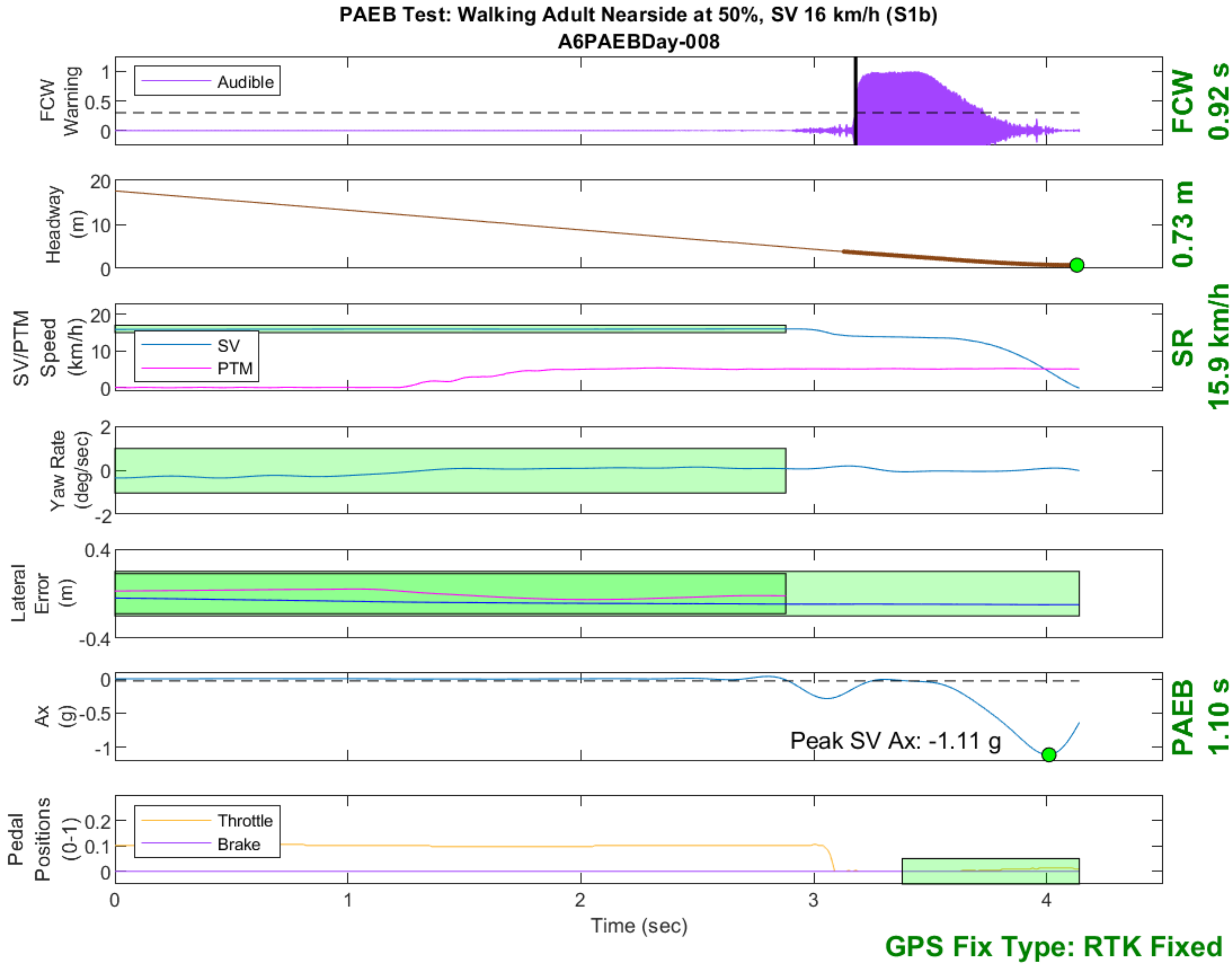


Figure D22. Time History for PAEB Run 8, S1b, Daytime, 16 km/h

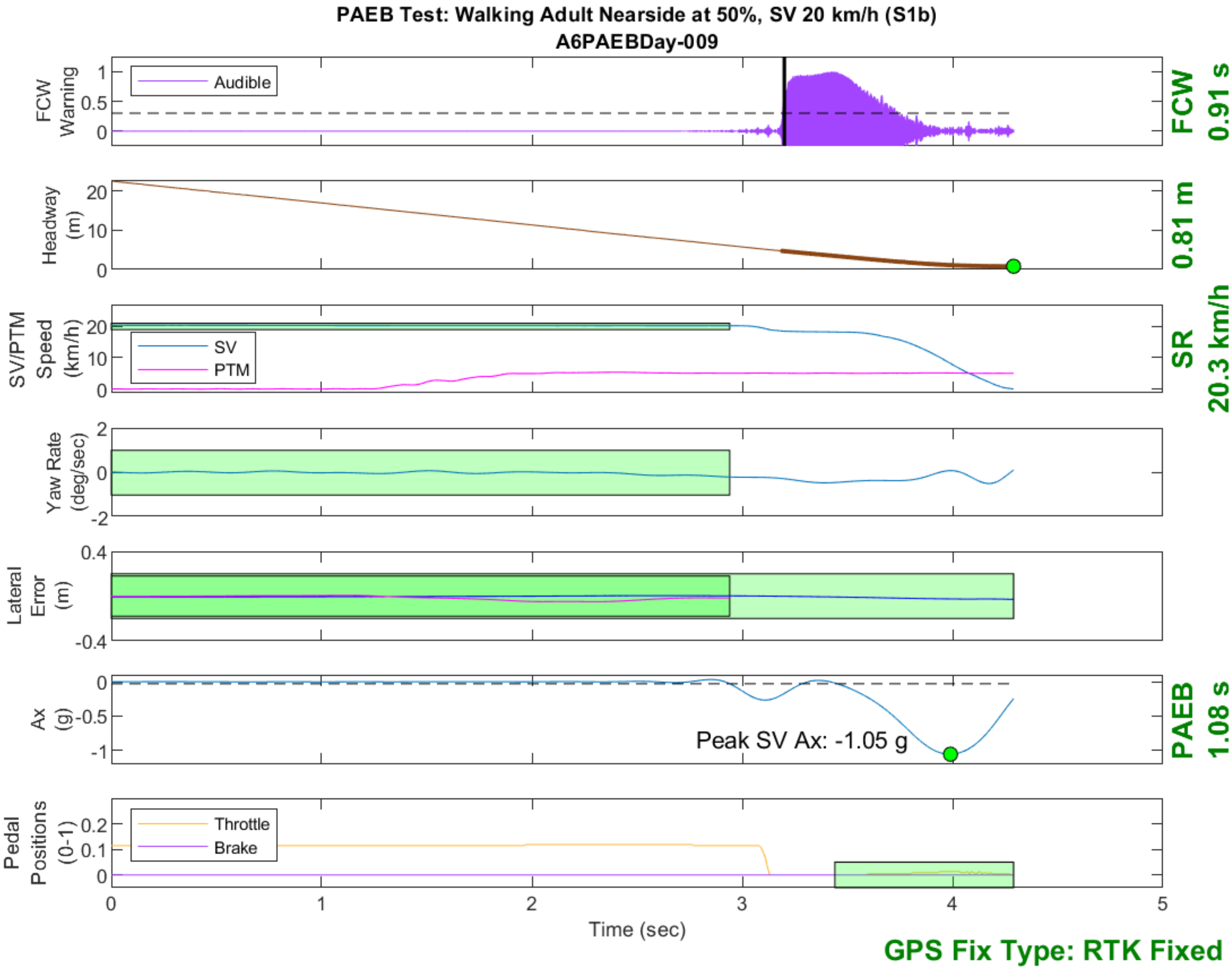


Figure D23. Time History for PAEB Run 9, S1b, Daytime, 20 km/h

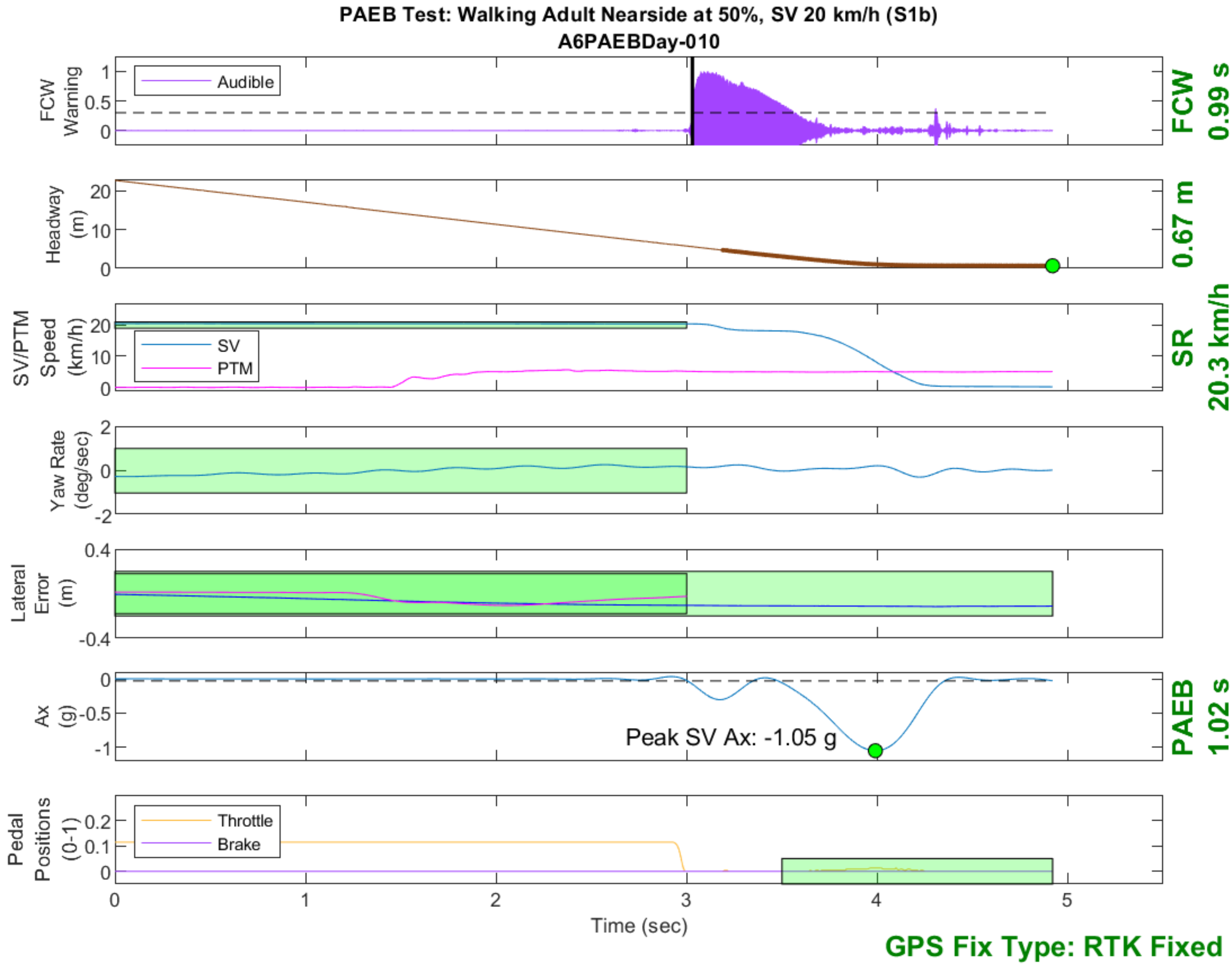


Figure D24. Time History for PAEB Run 10, S1b, Daytime, 20 km/h

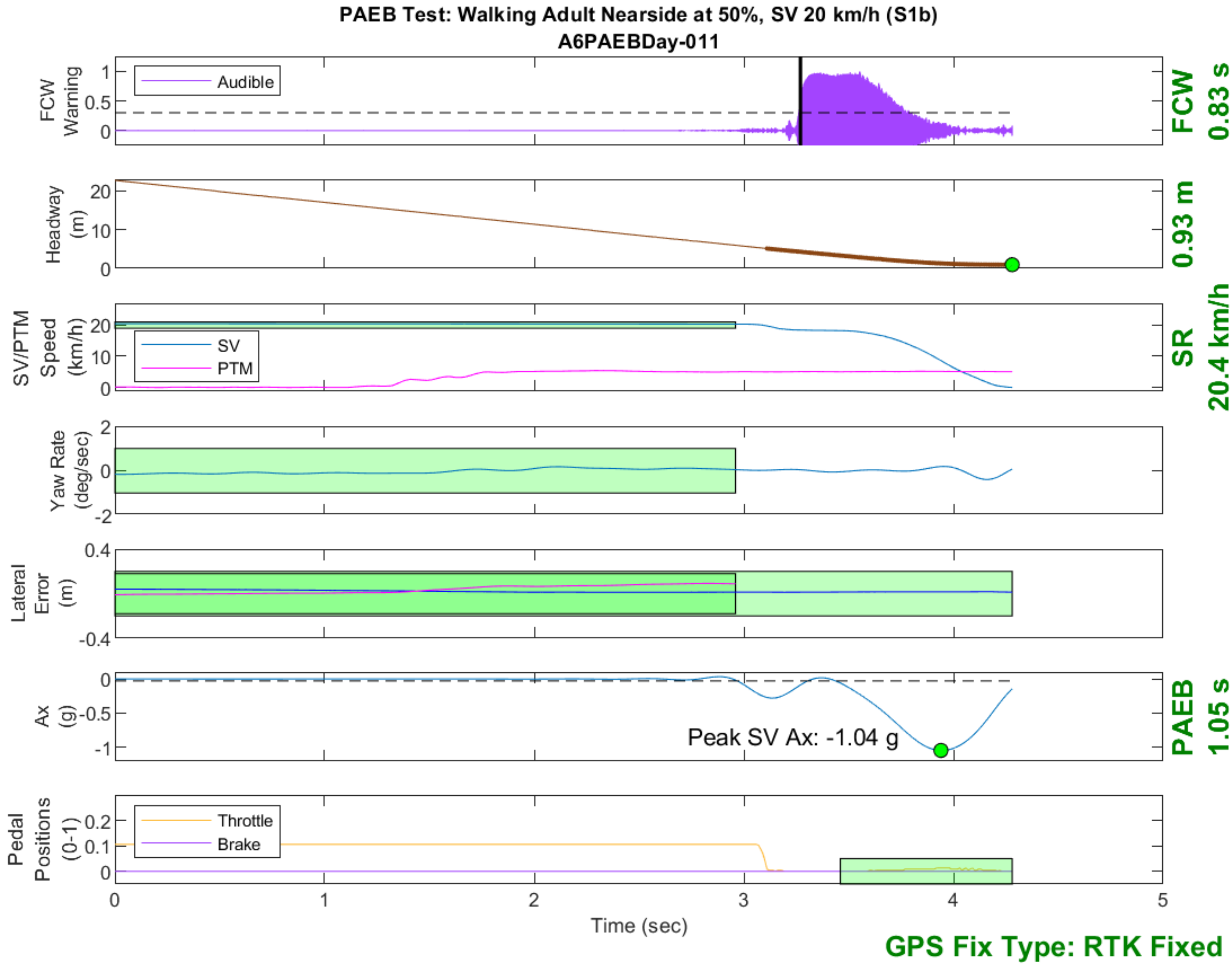


Figure D25. Time History for PAEB Run 11, S1b, Daytime, 20 km/h

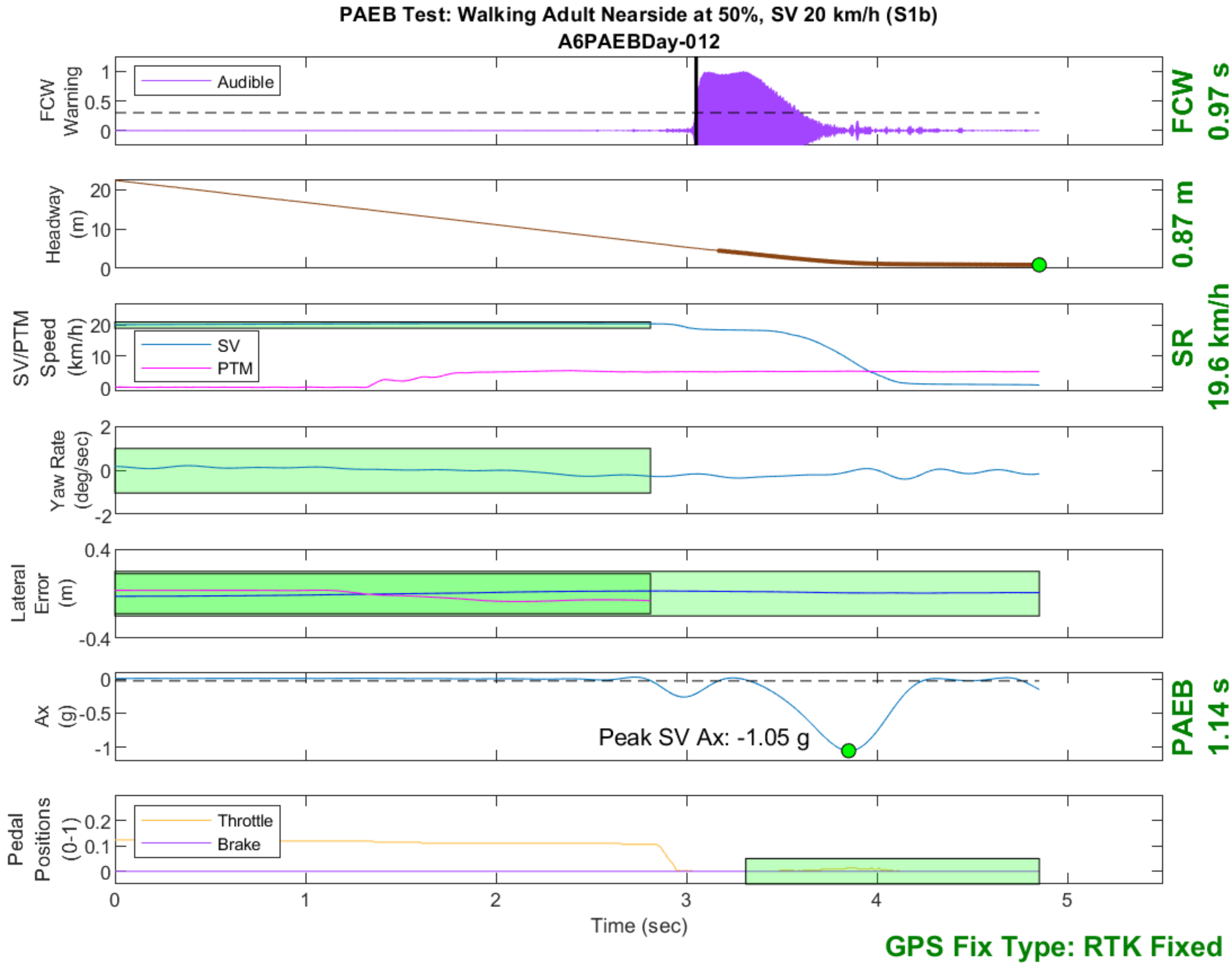


Figure D26. Time History for PAEB Run 12, S1b, Daytime, 20 km/h

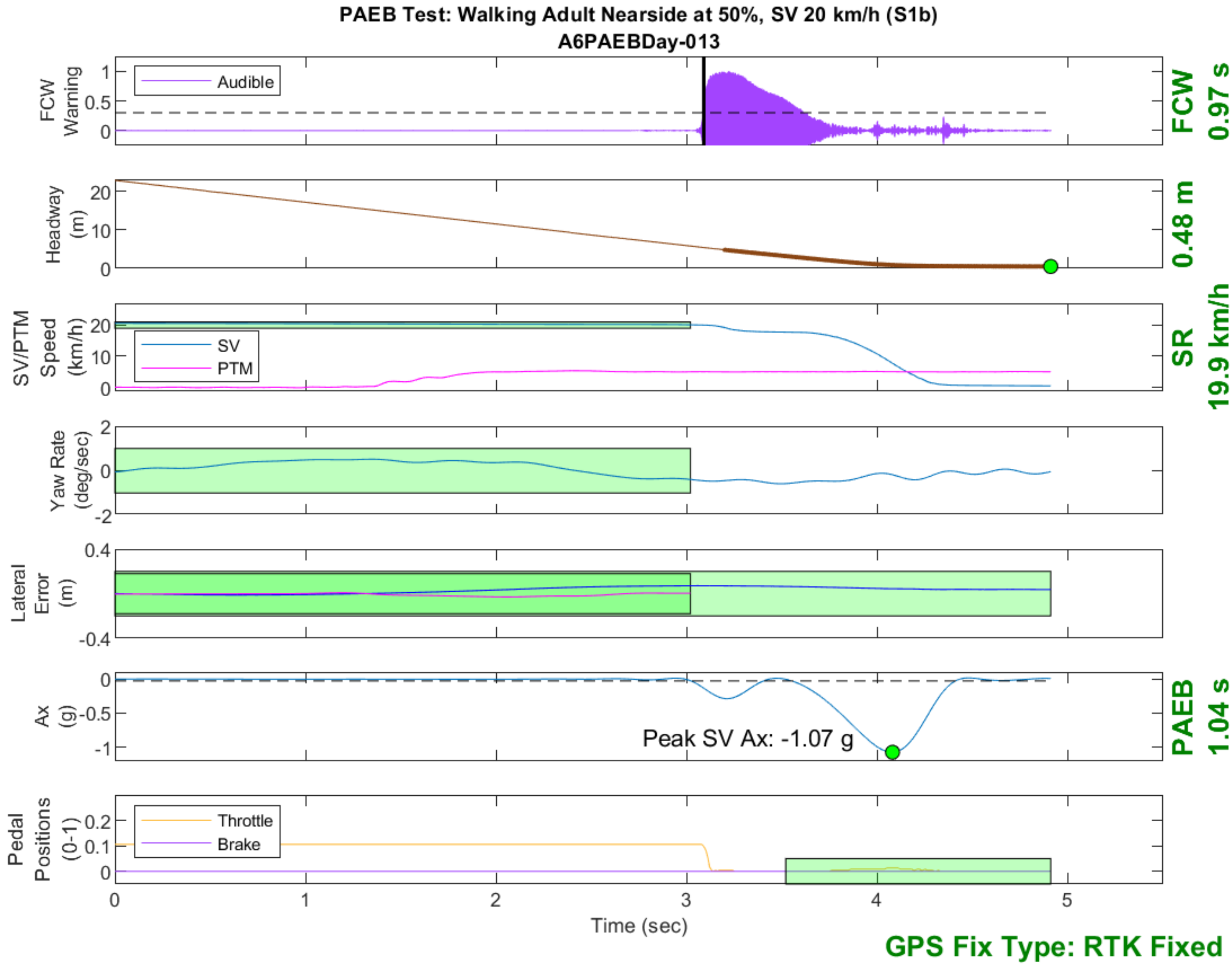


Figure D27. Time History for PAEB Run 13, S1b, Daytime, 20 km/h

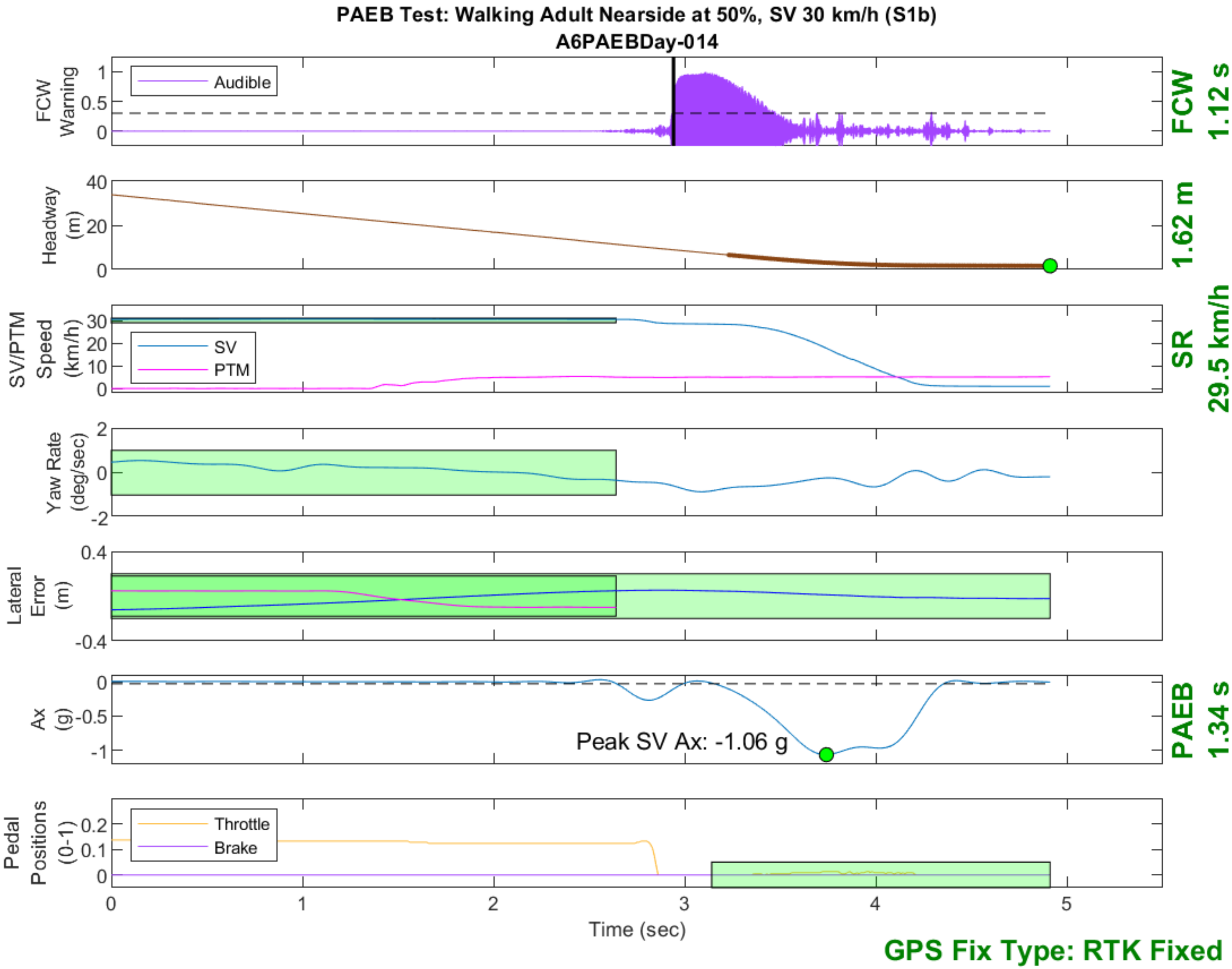


Figure D28. Time History for PAEB Run 14, S1b, Daytime, 30 km/h

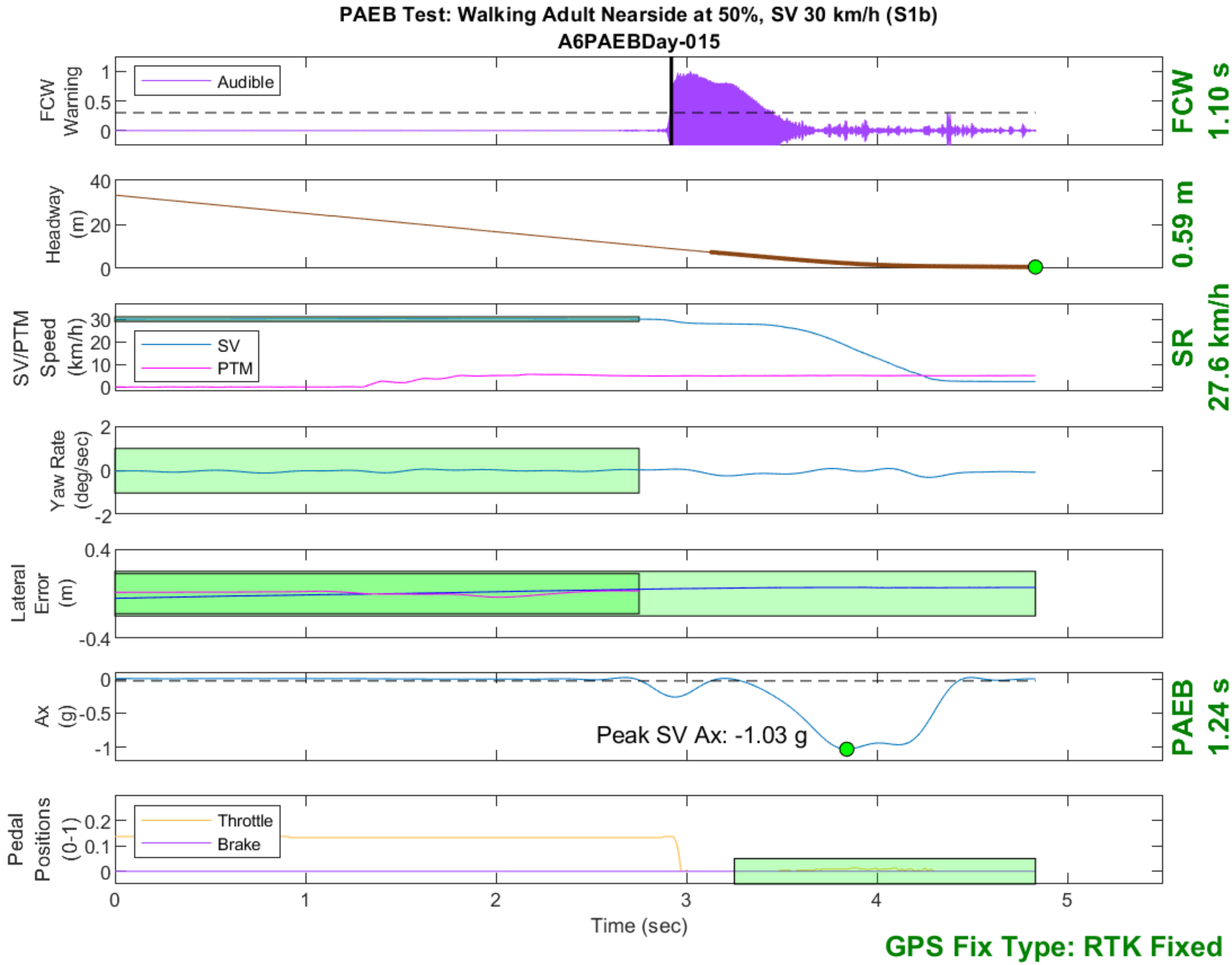


Figure D29. Time History for PAEB Run 15, S1b, Daytime, 30 km/h

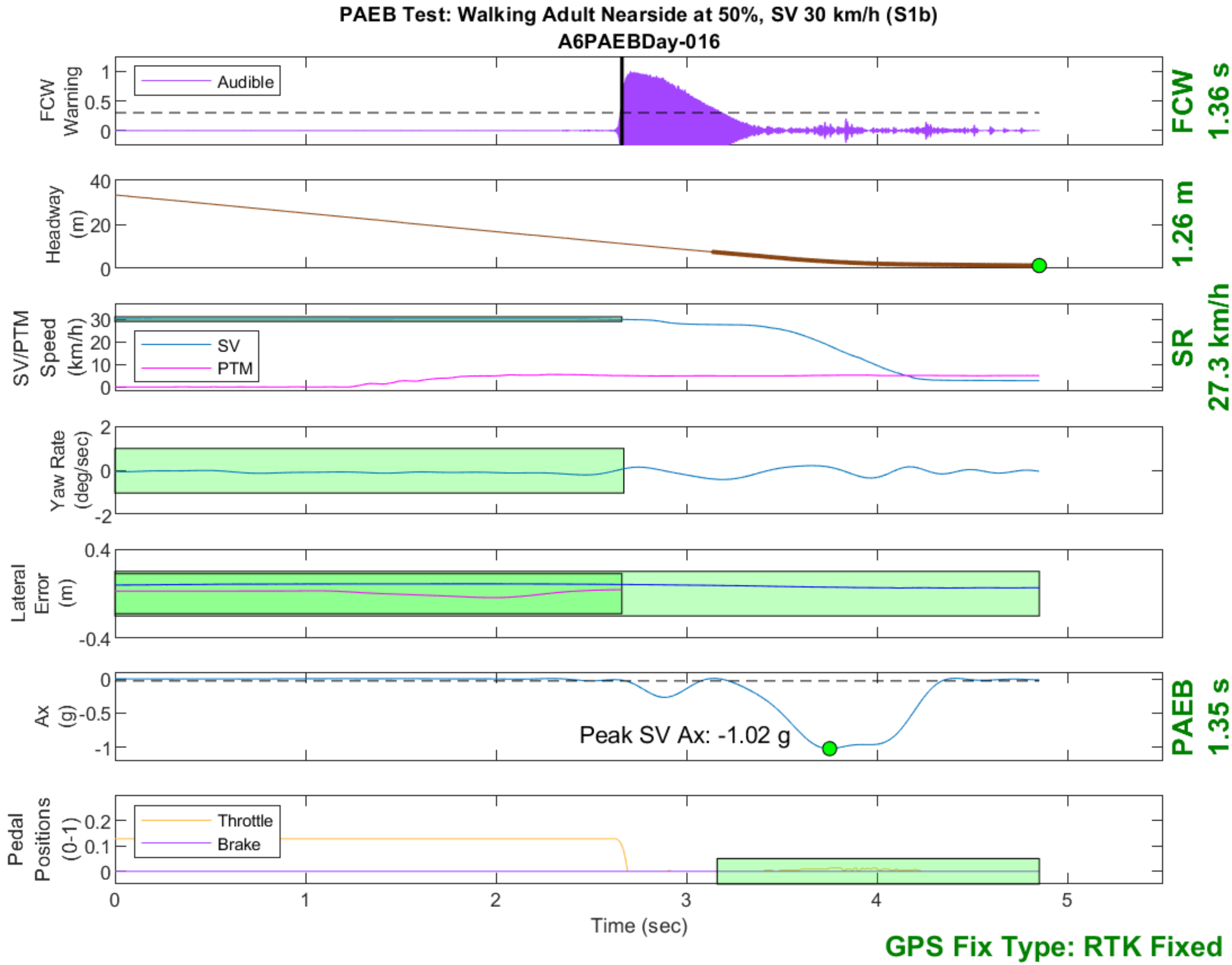


Figure D30. Time History for PAEB Run 16, S1b, Daytime, 30 km/h

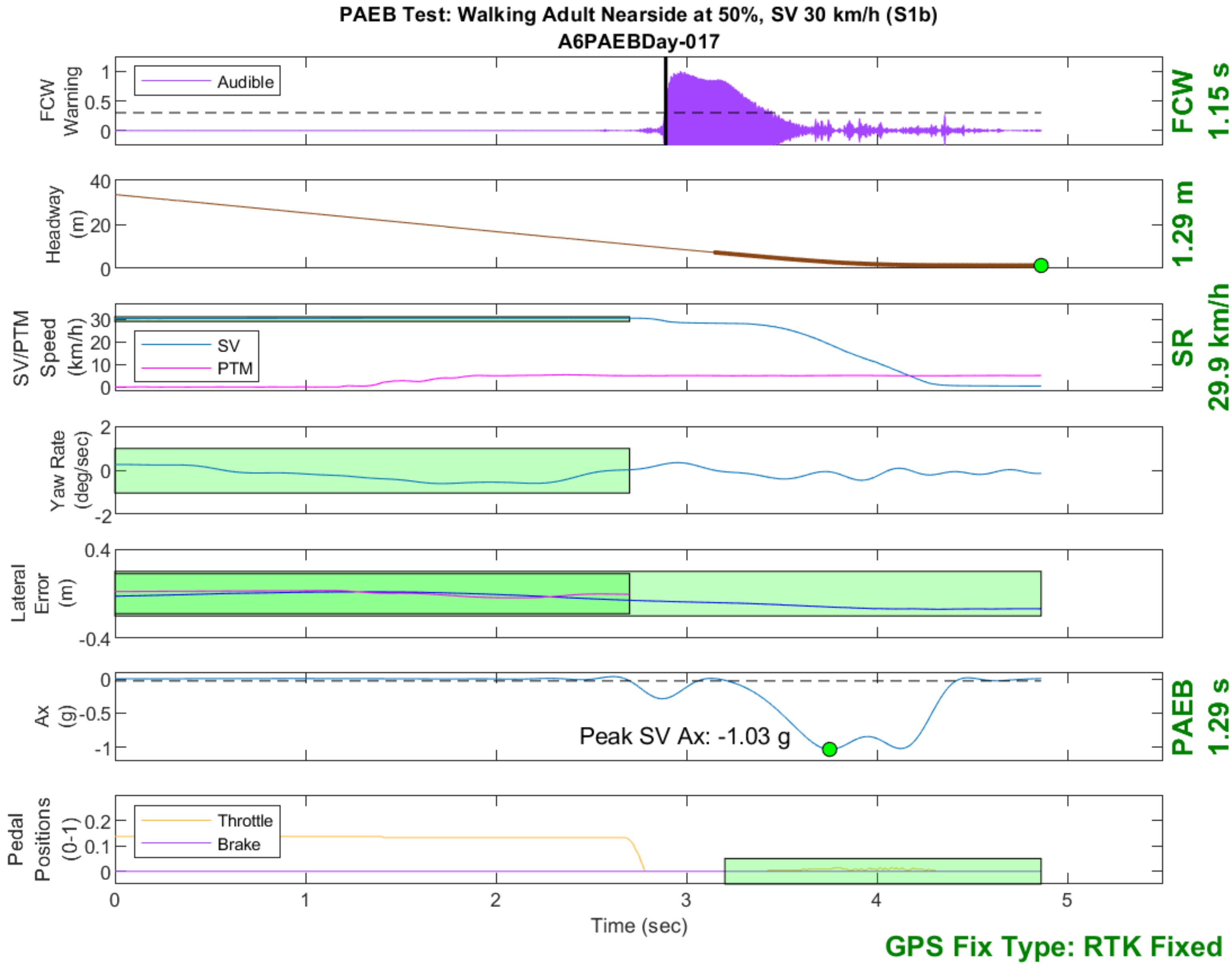


Figure D31. Time History for PAEB Run 17, S1b, Daytime, 30 km/h

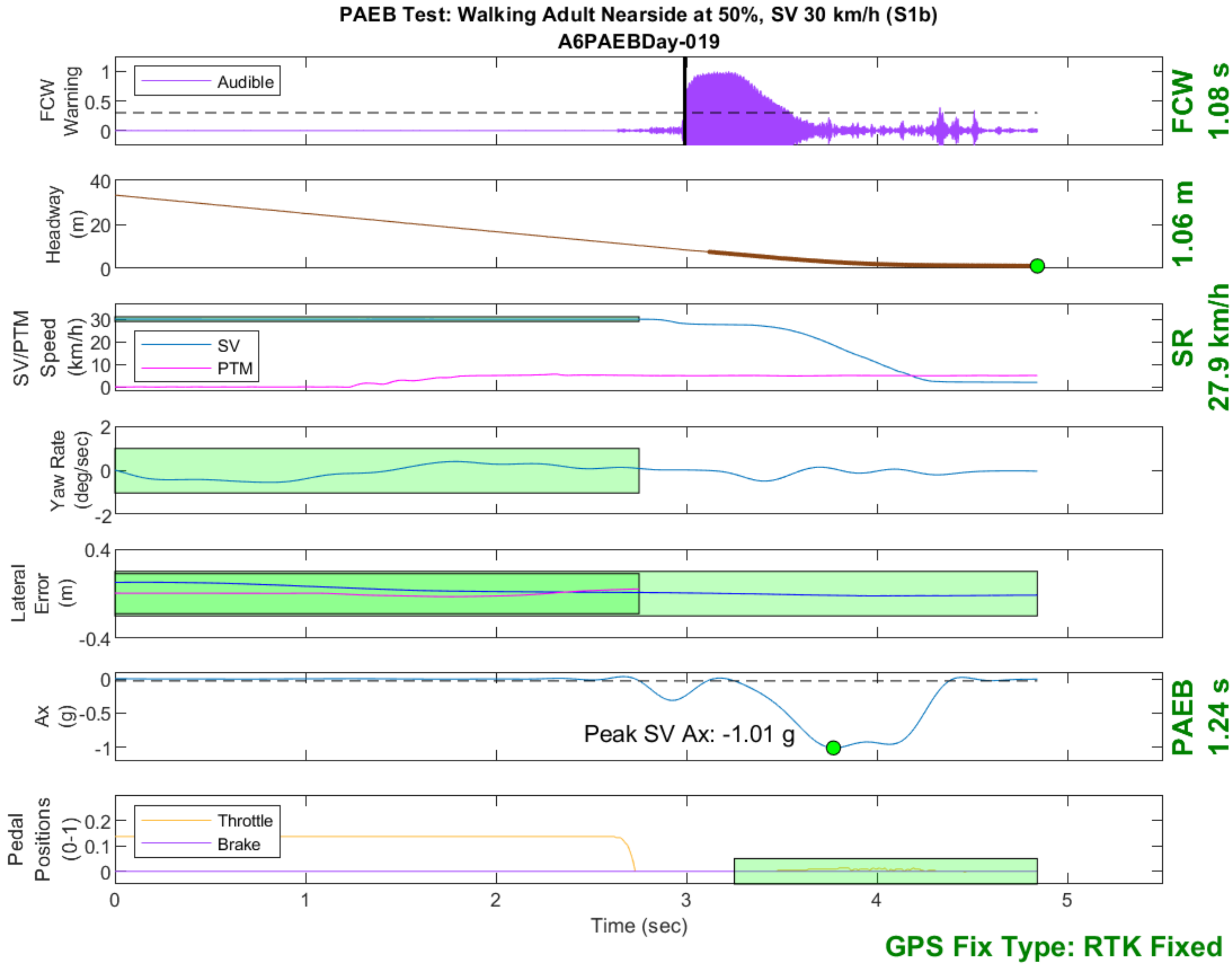


Figure D32. Time History for PAEB Run 19, S1b, Daytime, 30 km/h

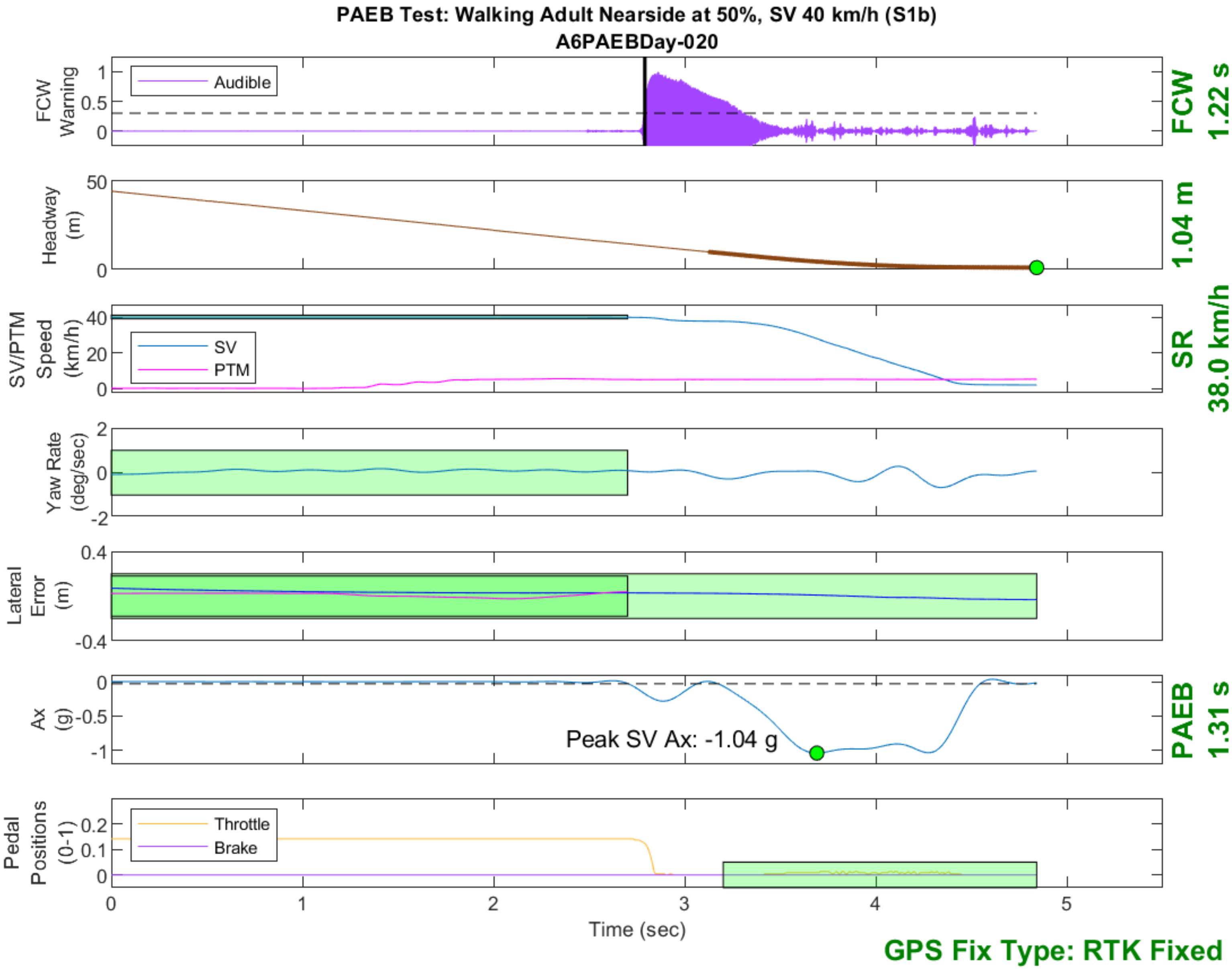


Figure D33. Time History for PAEB Run 20, S1b, Daytime, 40 km/h

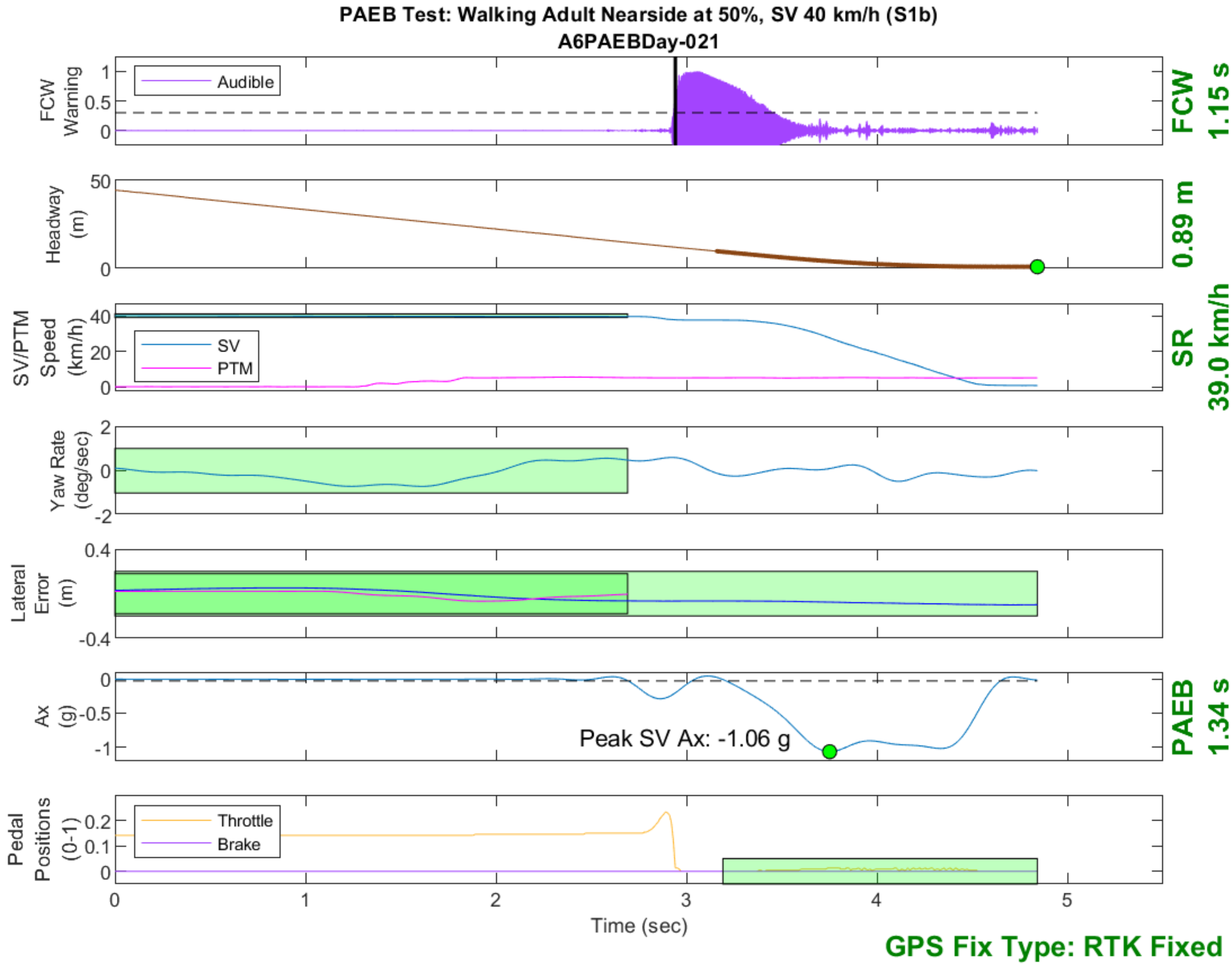


Figure D34. Time History for PAEB Run 21, S1b, Daytime, 40 km/h

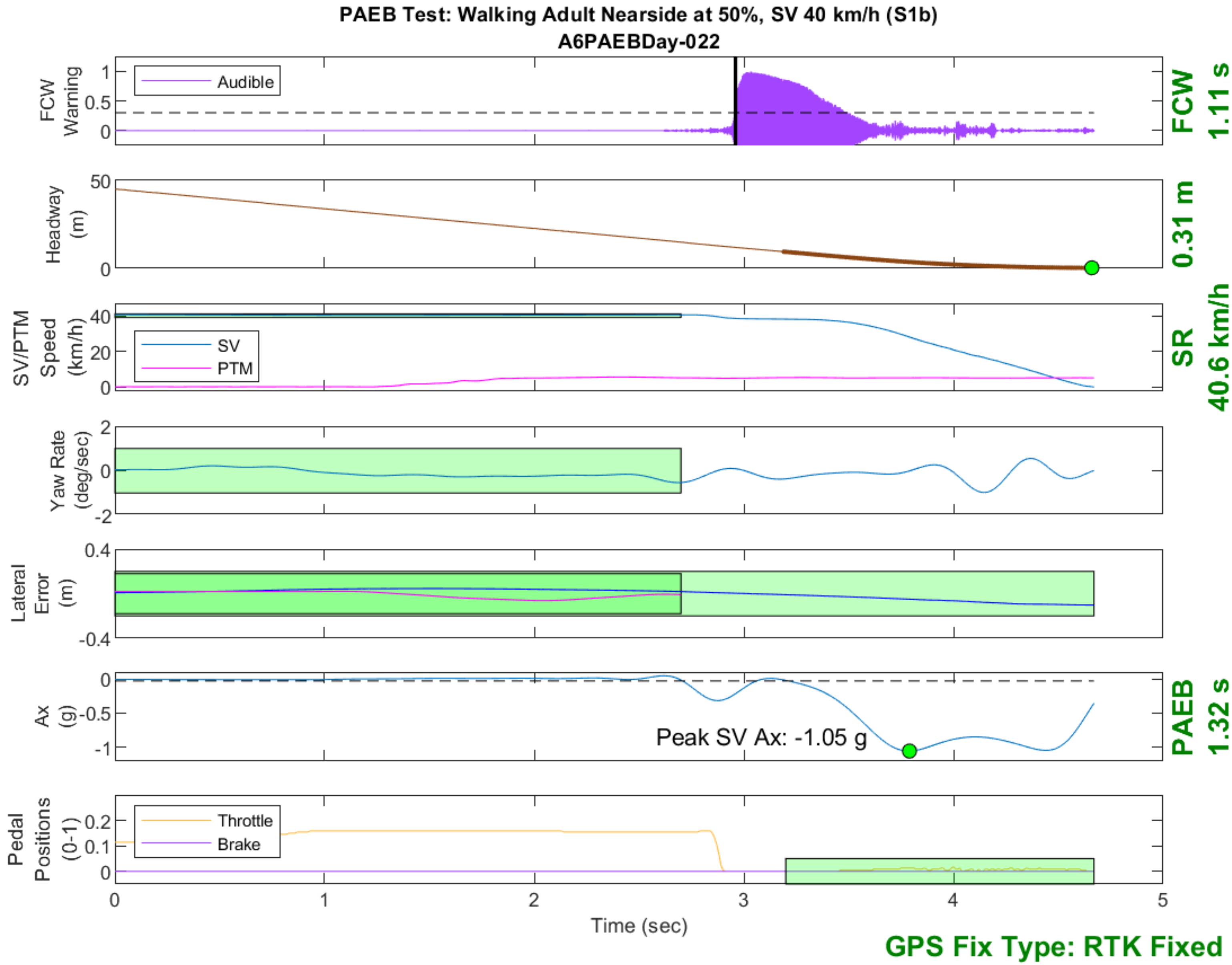


Figure D35. Time History for PAEB Run 22, S1b, Daytime, 40 km/h

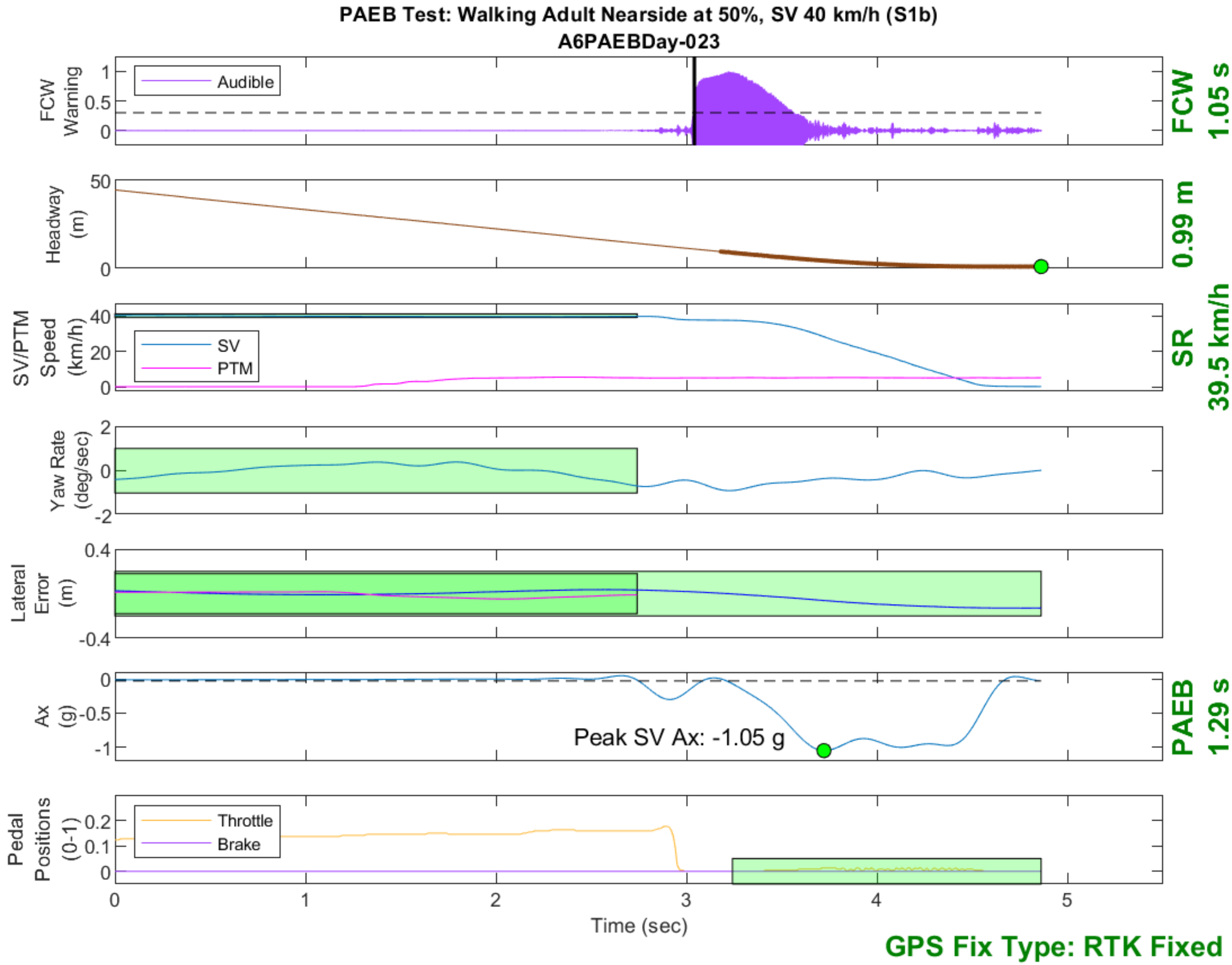


Figure D36. Time History for PAEB Run 23, S1b, Daytime, 40 km/h

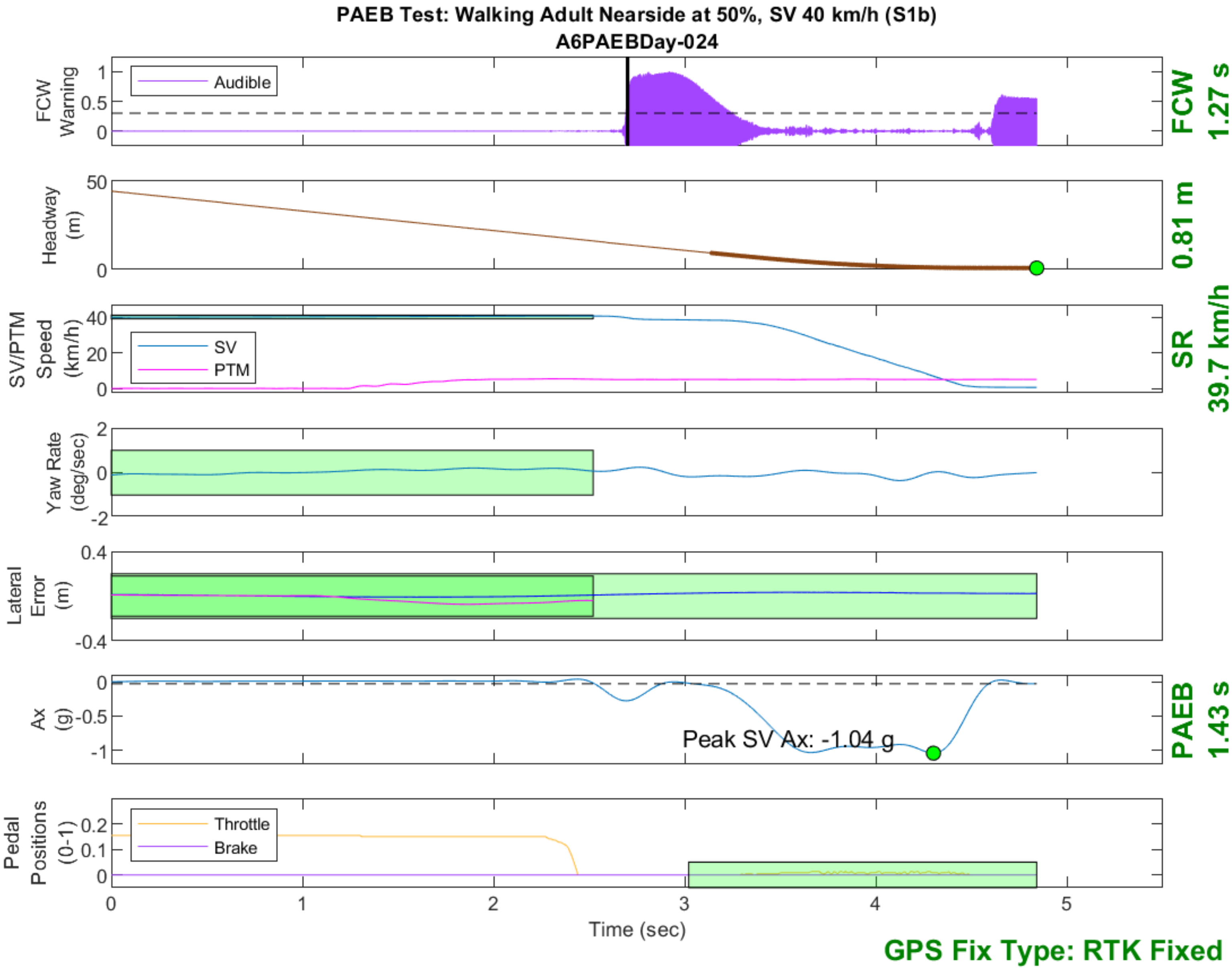


Figure D37. Time History for PAEB Run 24, S1b, Daytime, 40 km/h

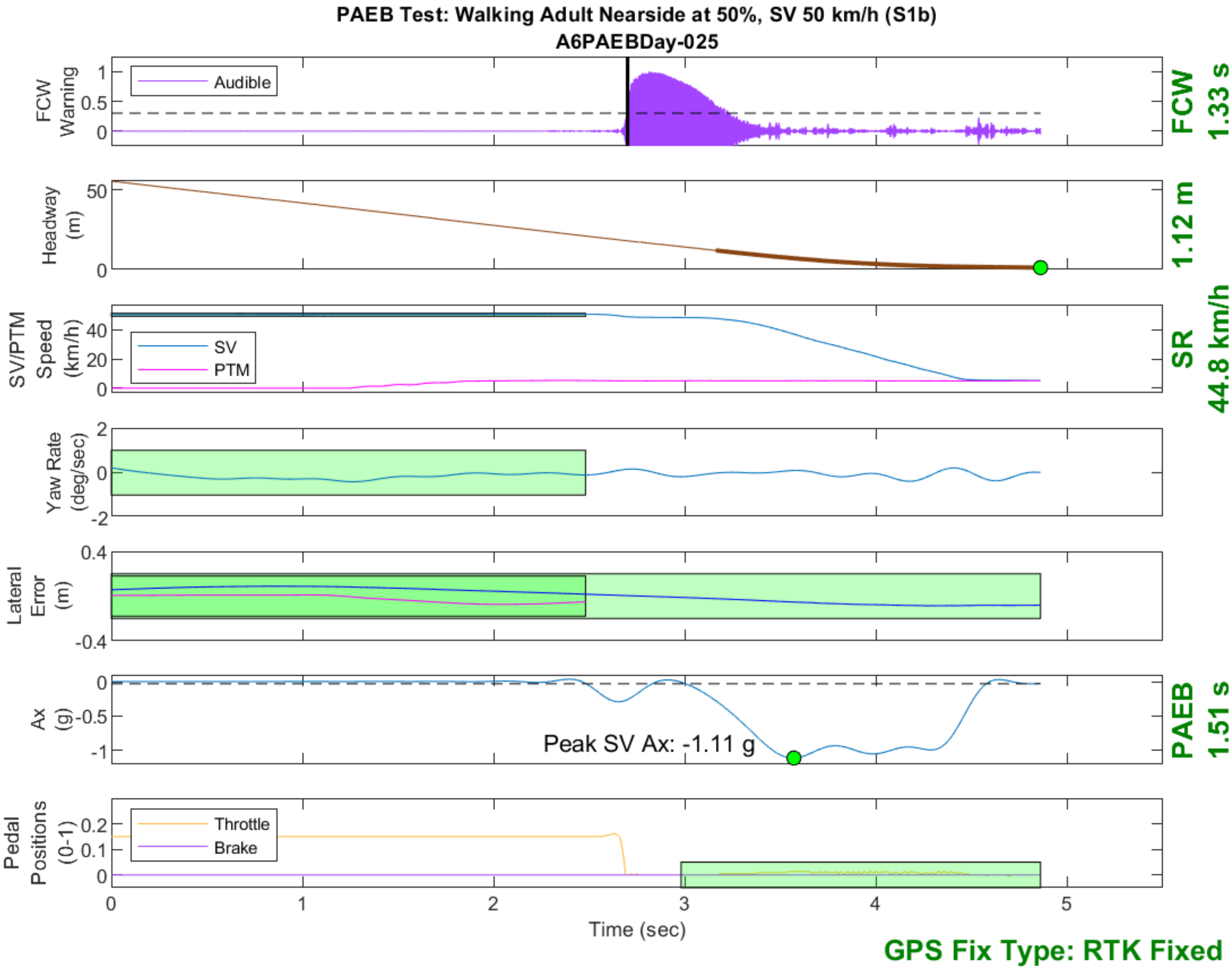


Figure D38. Time History for PAEB Run 25, S1b, Daytime, 50 km/h

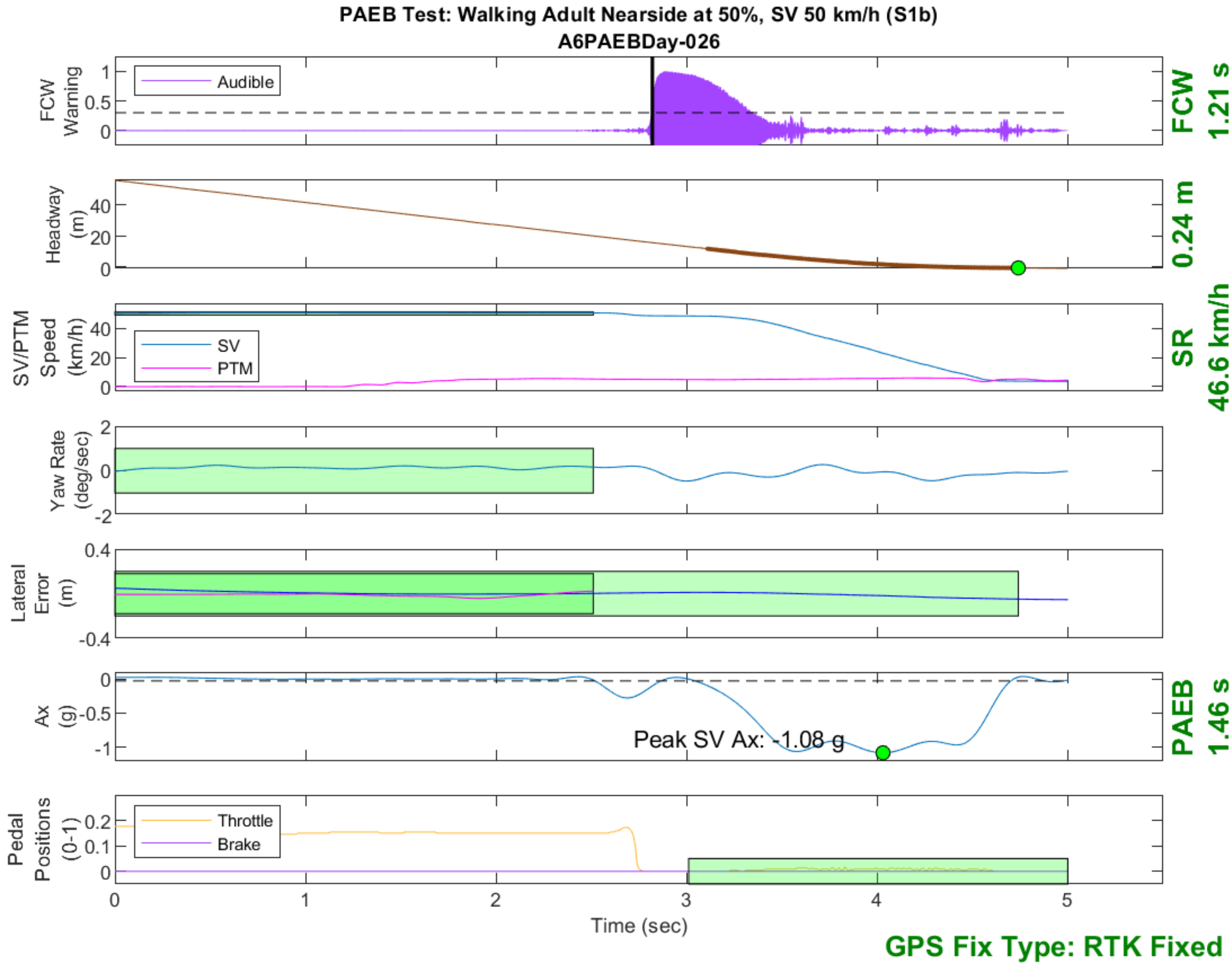


Figure D39. Time History for PAEB Run 26, S1b, Daytime, 50 km/h

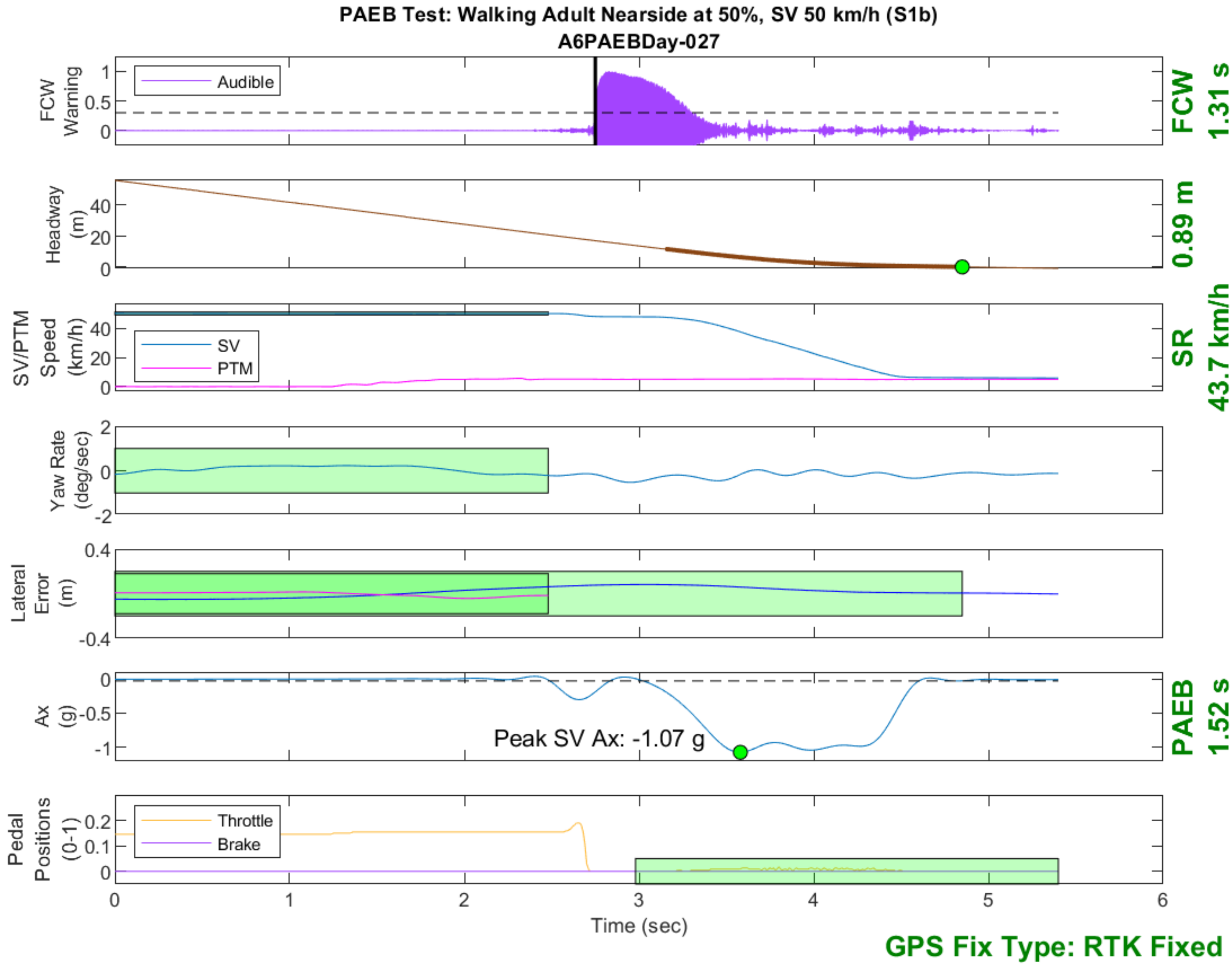


Figure D40. Time History for PAEB Run 27, S1b, Daytime, 50 km/h

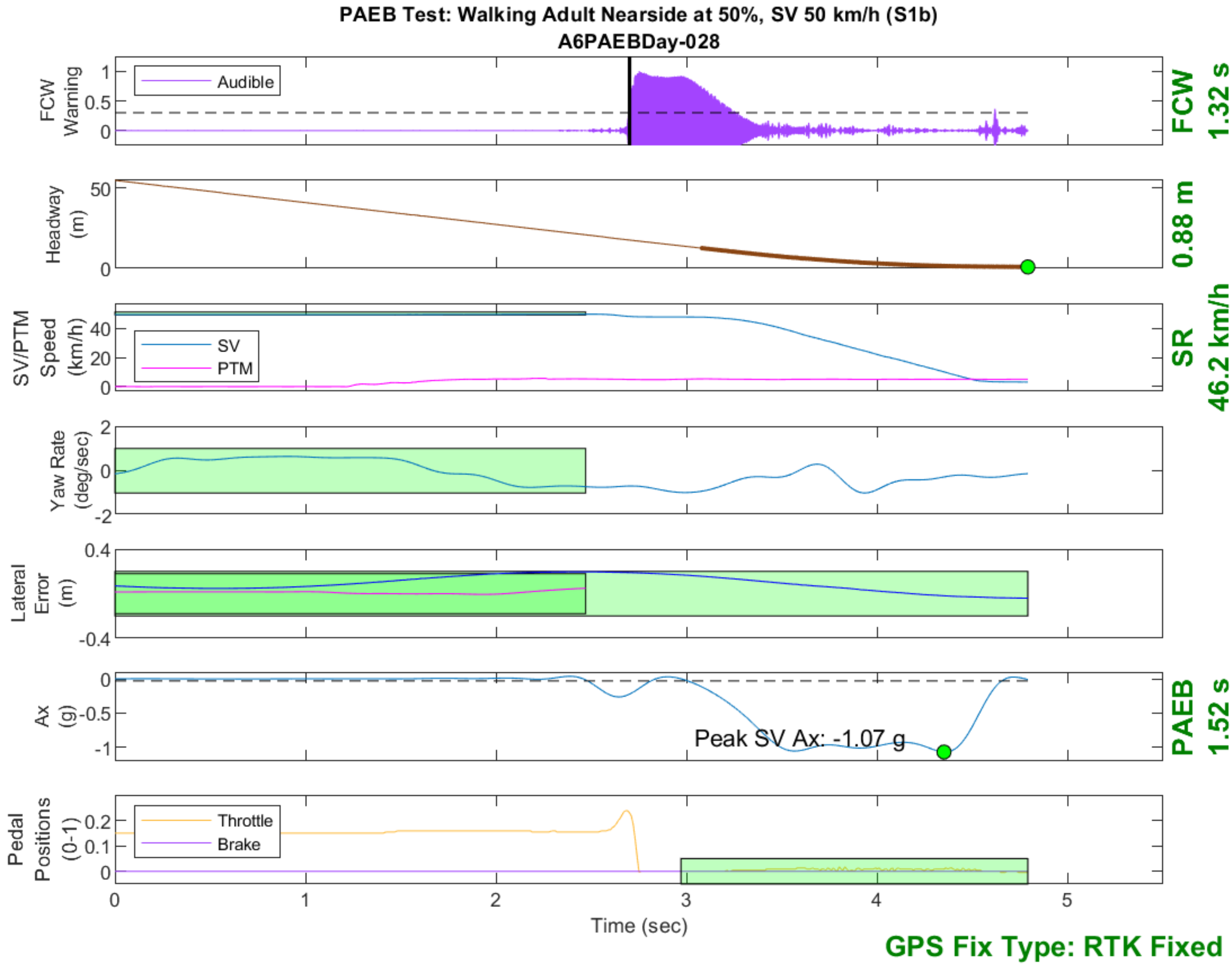


Figure D41. Time History for PAEB Run 28, S1b, Daytime, 50 km/h

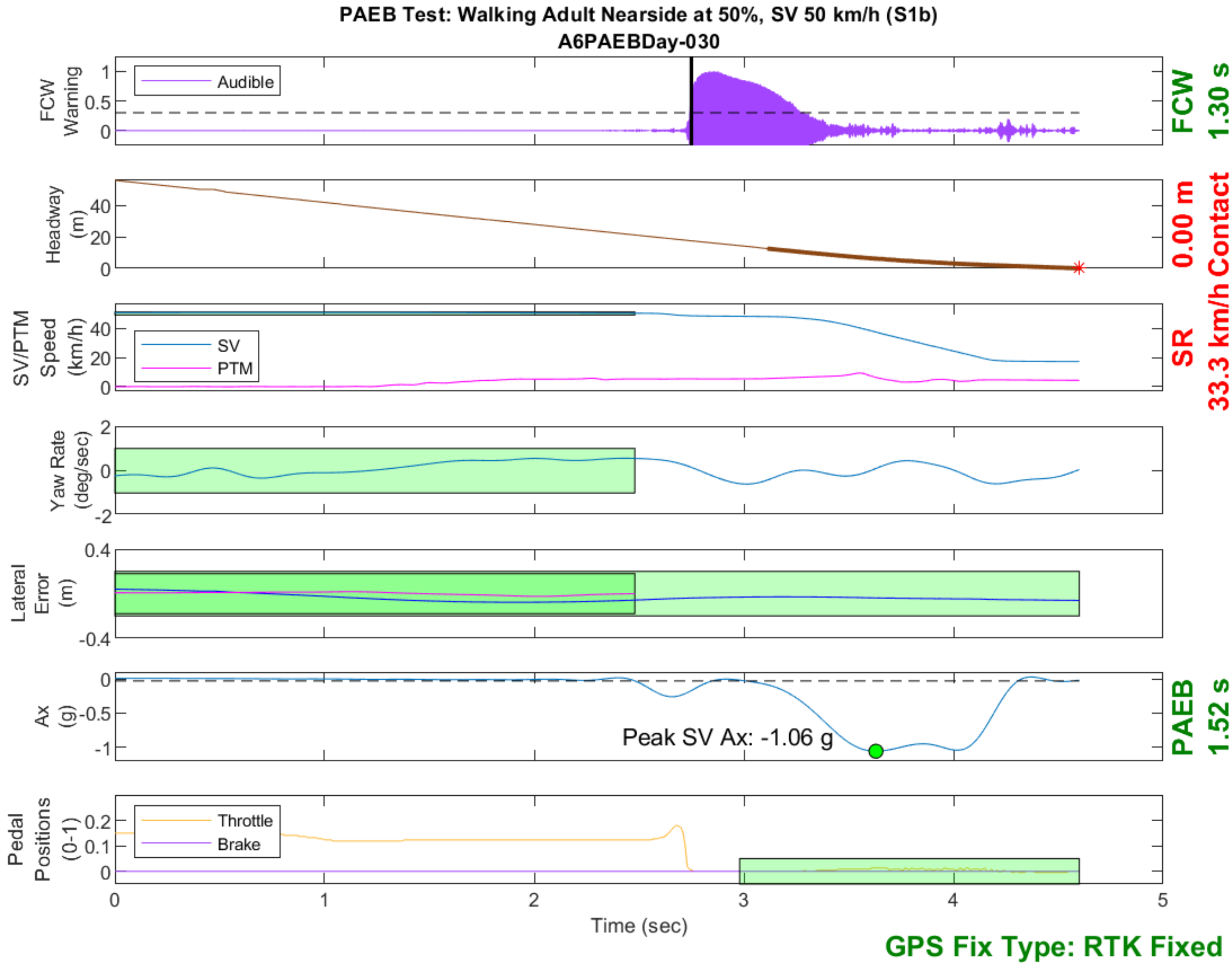


Figure D42. Time History for PAEB Run 30, S1b, Daytime, 50 km/h

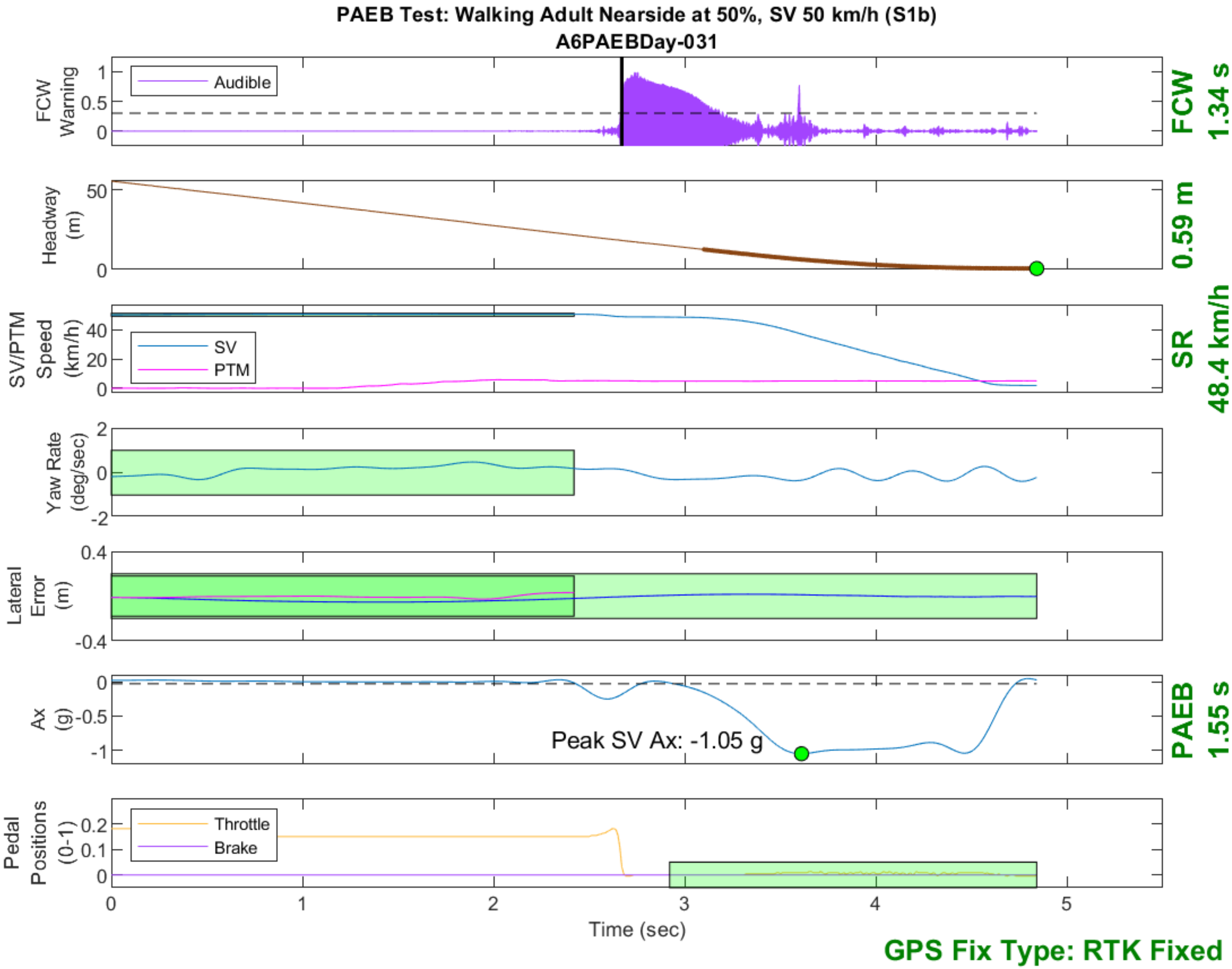


Figure D43. Time History for PAEB Run 31, S1b, Daytime, 50 km/h

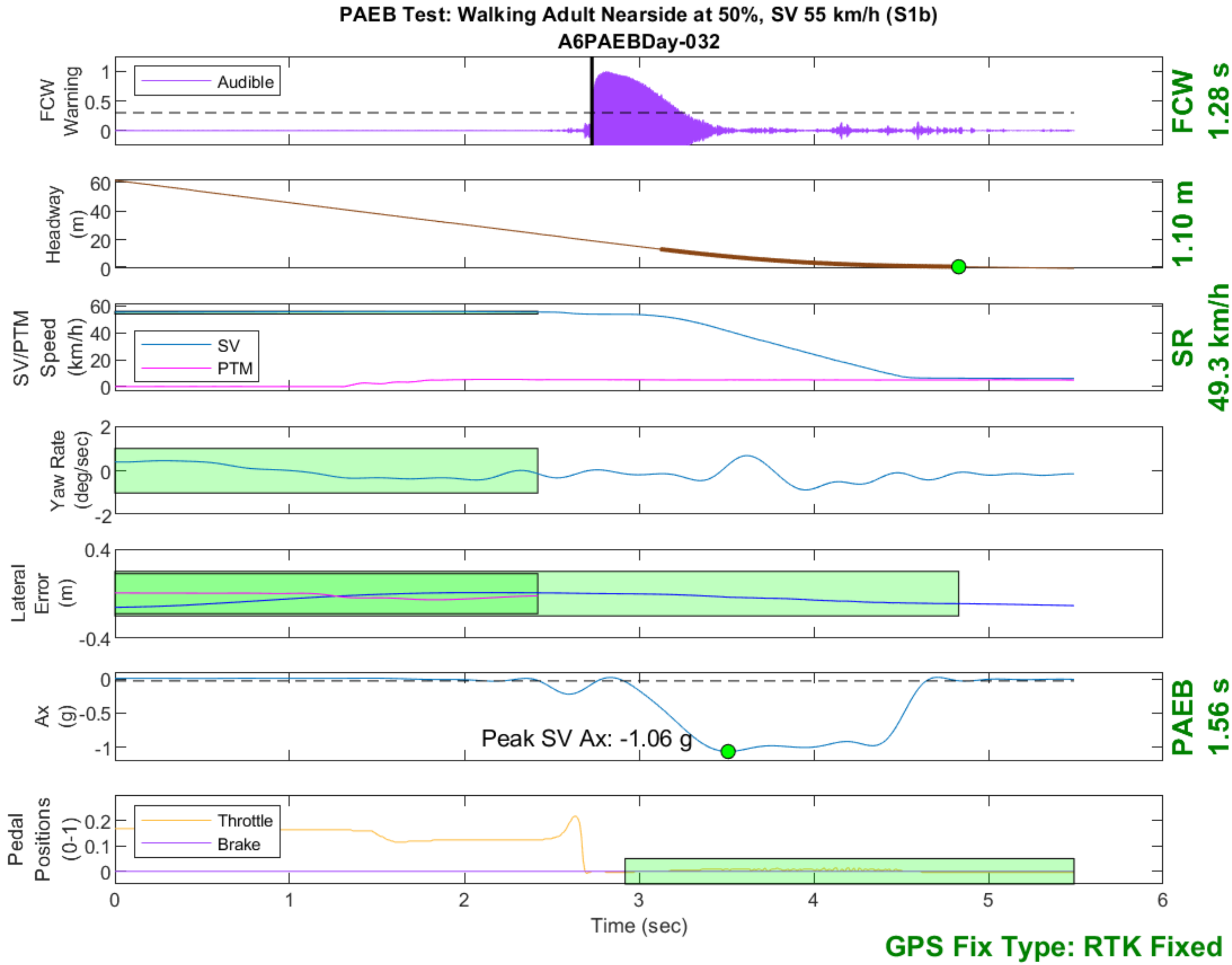


Figure D44. Time History for PAEB Run 32, S1b, Daytime, 55 km/h

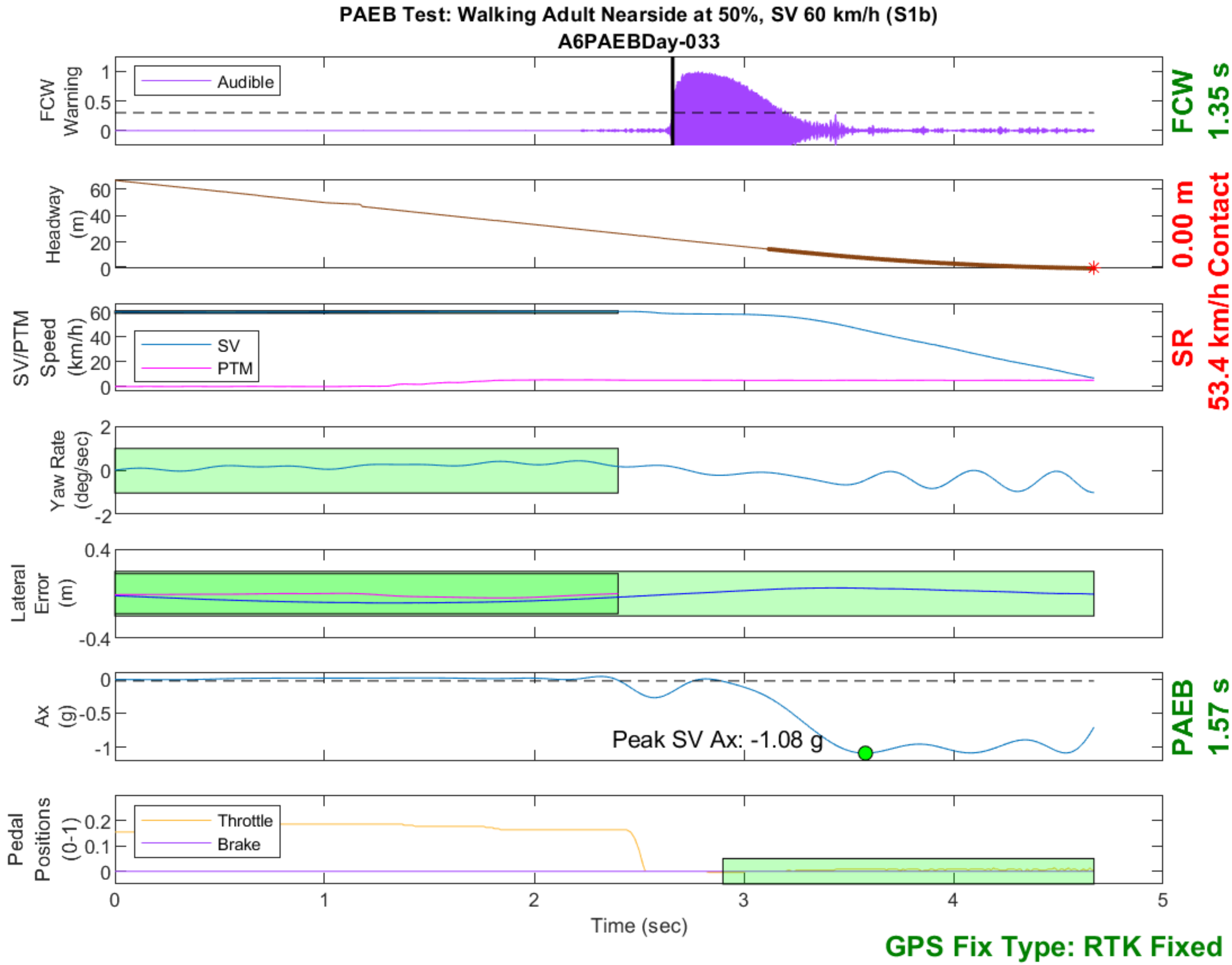


Figure D45. Time History for PAEB Run 33, S1b, Daytime, 60 km/h

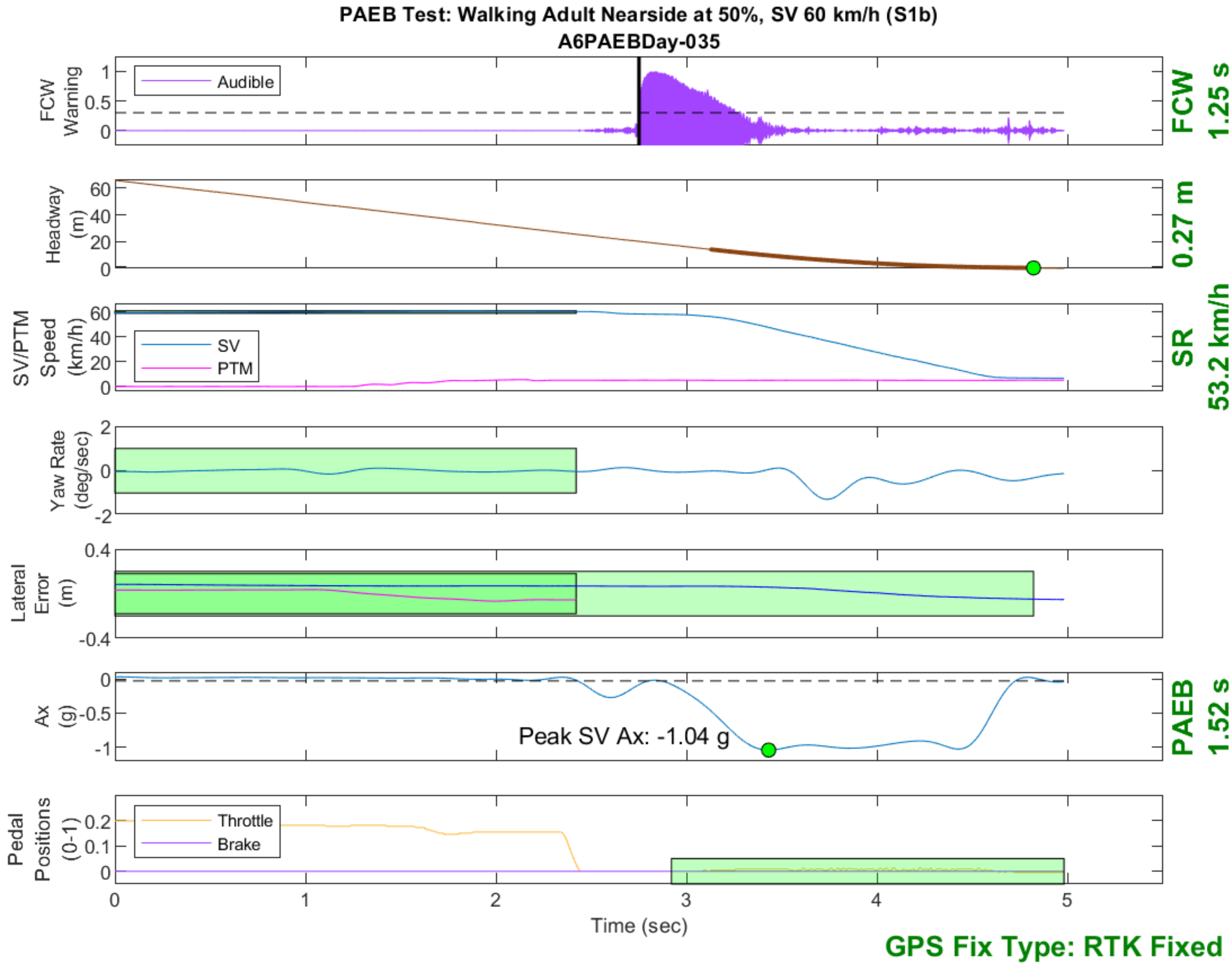


Figure D46. Time History for PAEB Run 35, S1b, Daytime, 60 km/h

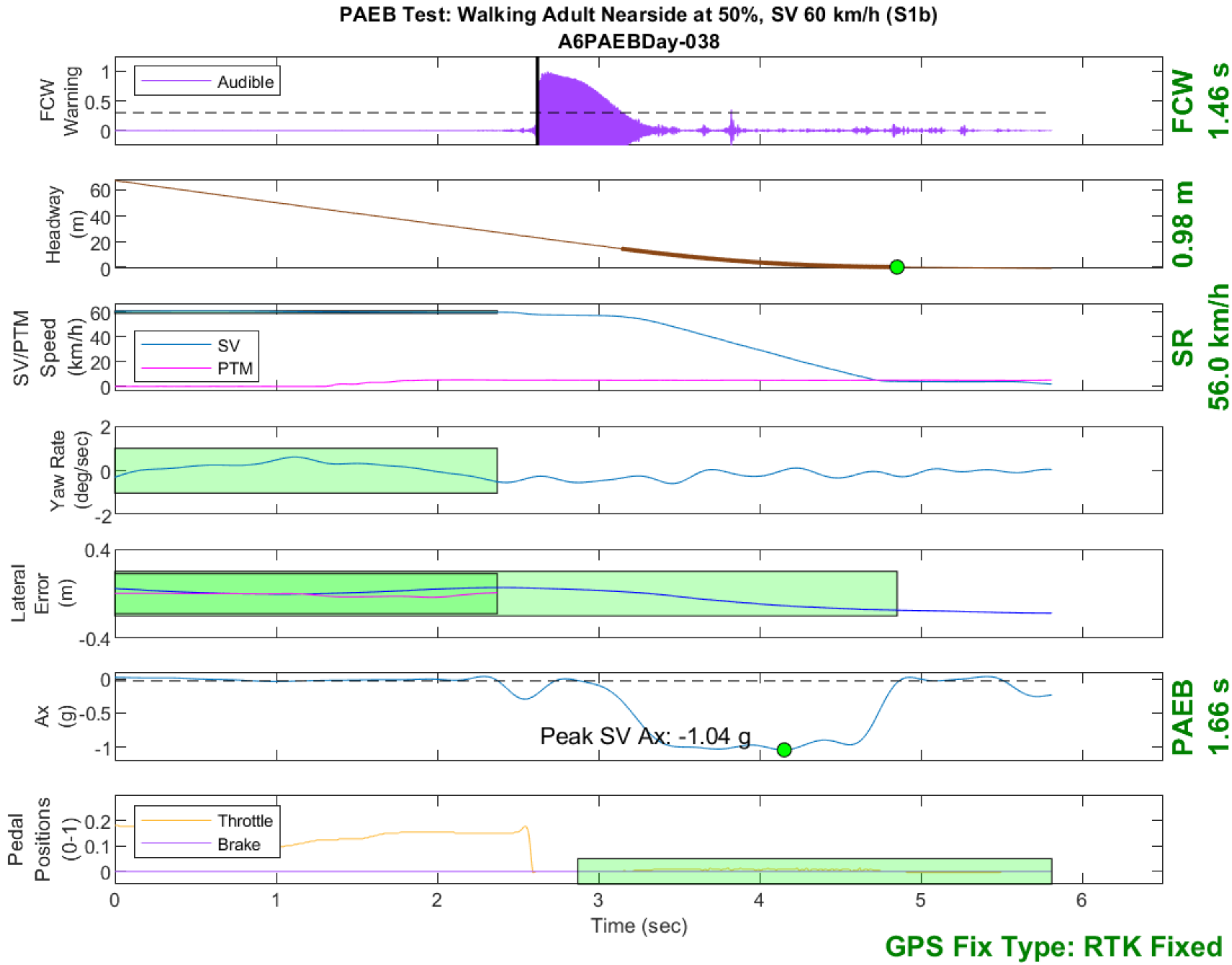


Figure D47. Time History for PAEB Run 38, S1b, Daytime, 60 km/h

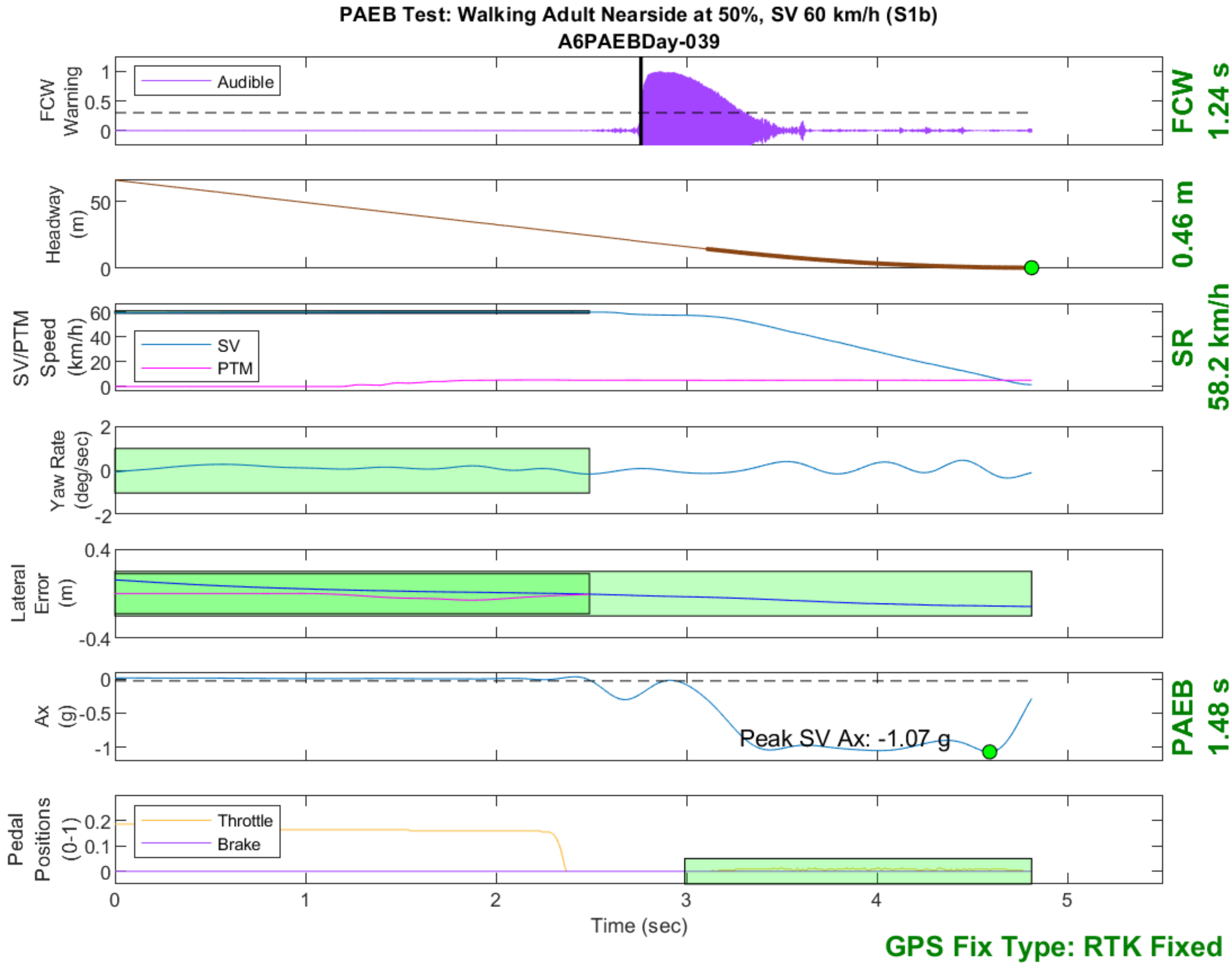


Figure D48. Time History for PAEB Run 39, S1b, Daytime, 60 km/h

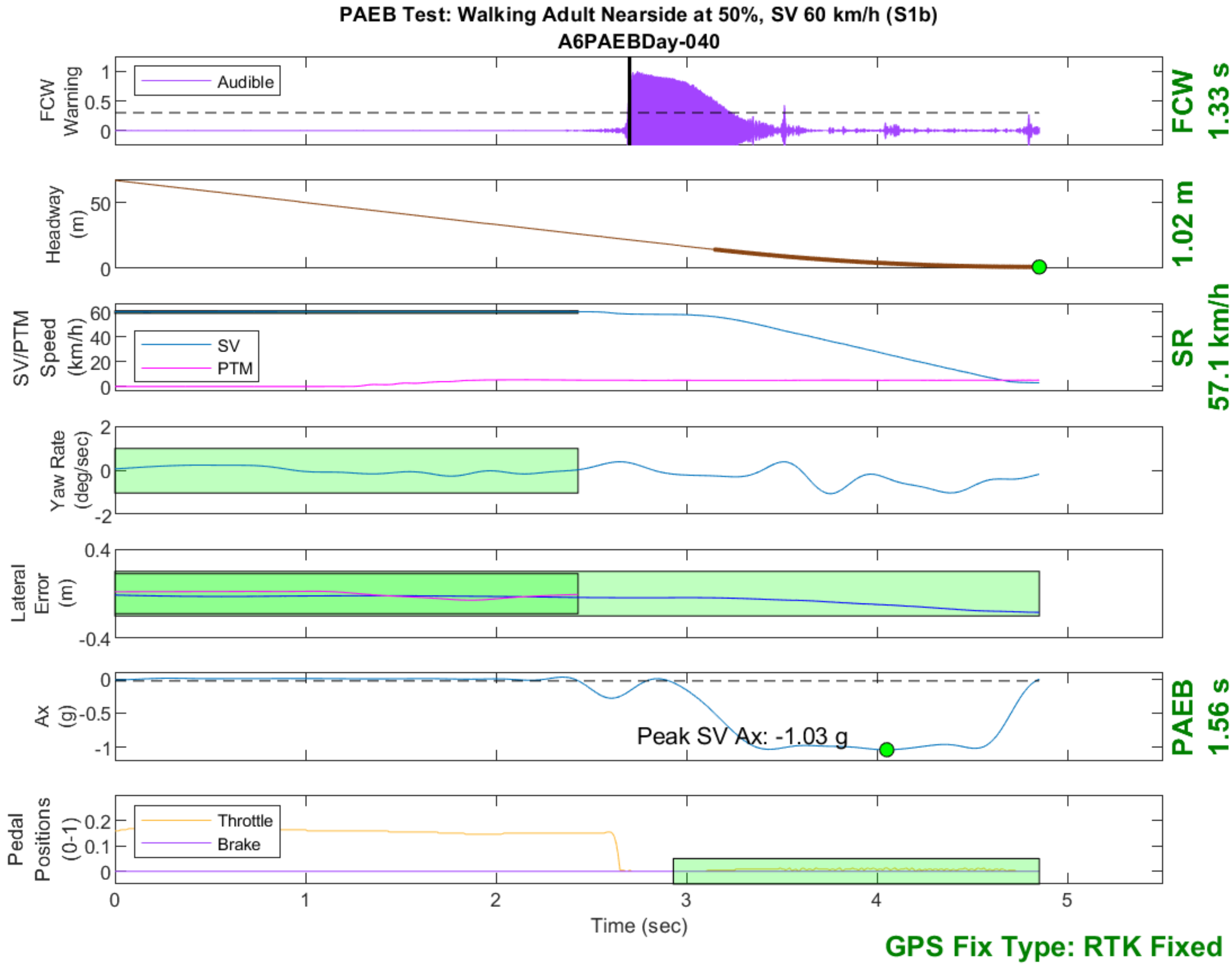


Figure D49. Time History for PAEB Run 40, S1b, Daytime, 60 km/h

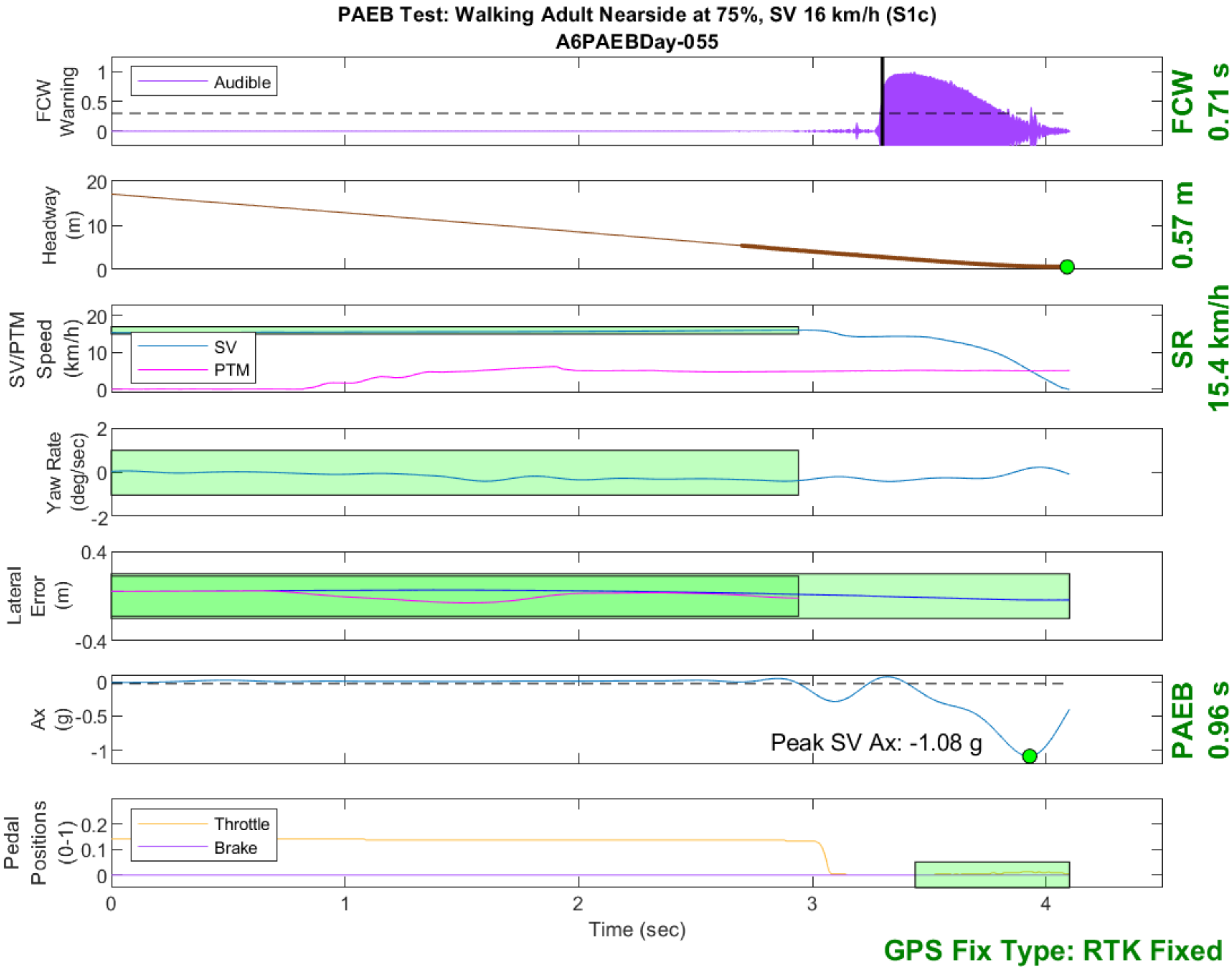


Figure D50. Time History for PAEB Run 55, S1c, Daytime, 16 km/h

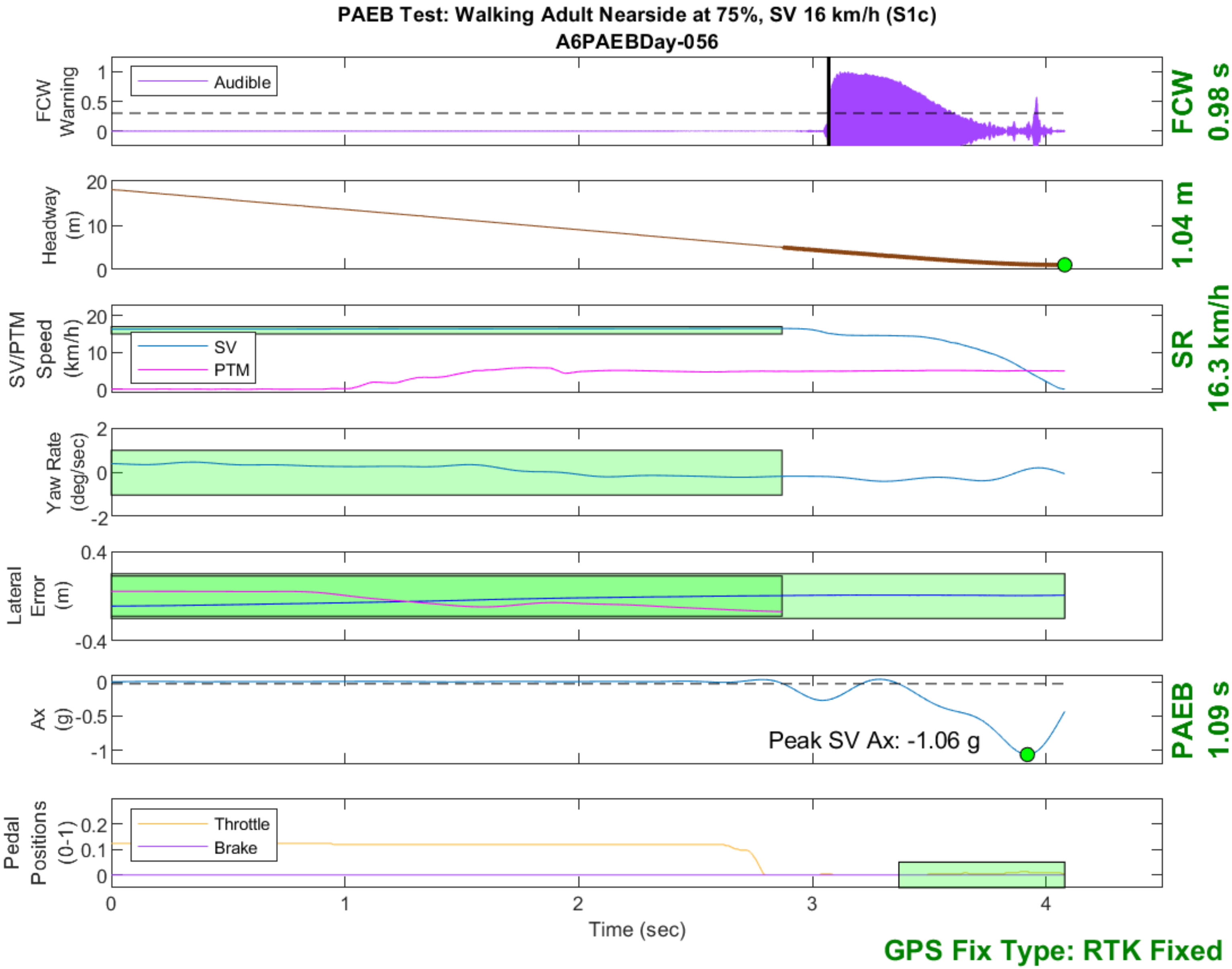


Figure D51. Time History for PAEB Run 56, S1c, Daytime, 16 km/h

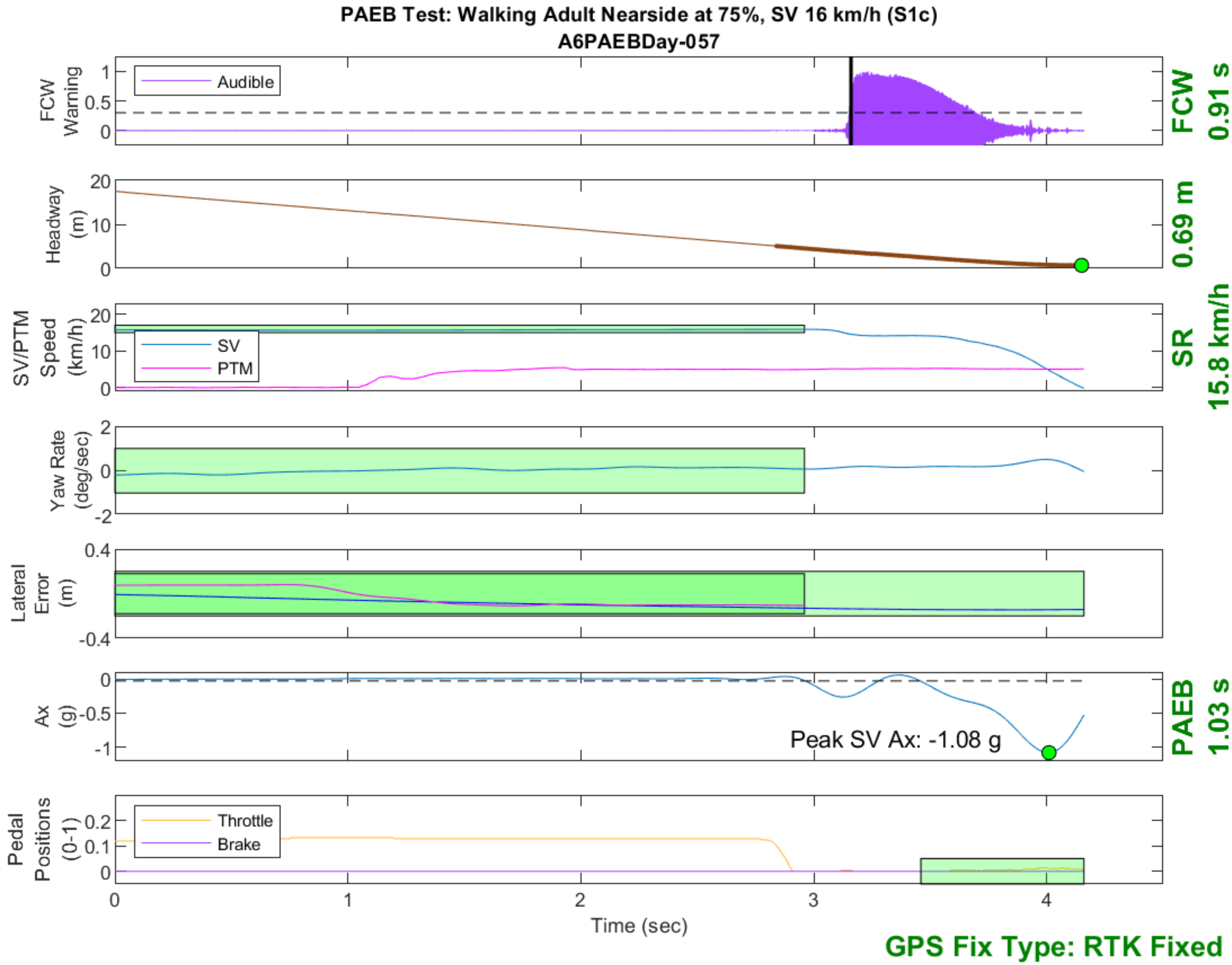


Figure D52. Time History for PAEB Run 57, S1c, Daytime, 16 km/h

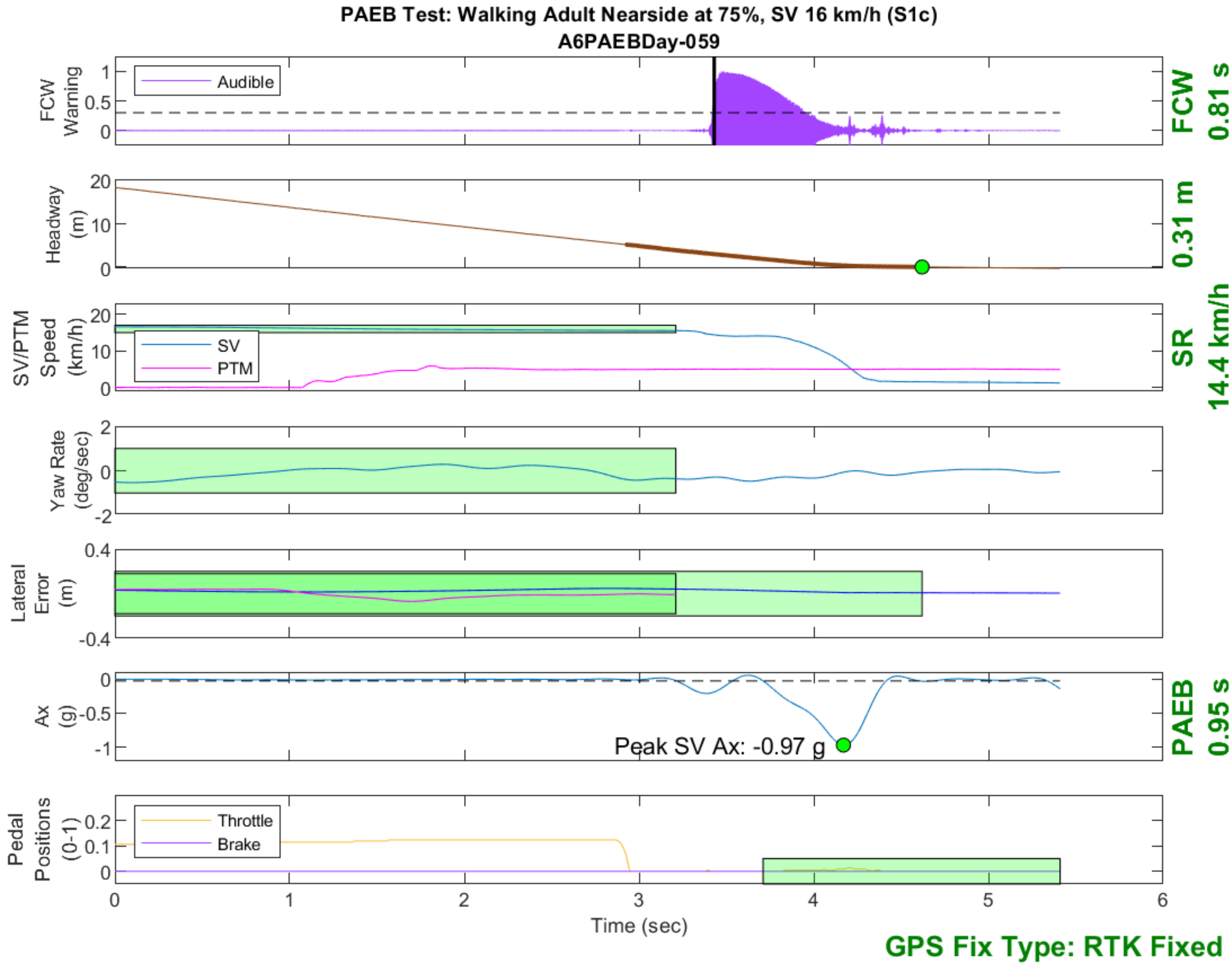


Figure D53. Time History for PAEB Run 59, S1c, Daytime, 16 km/h

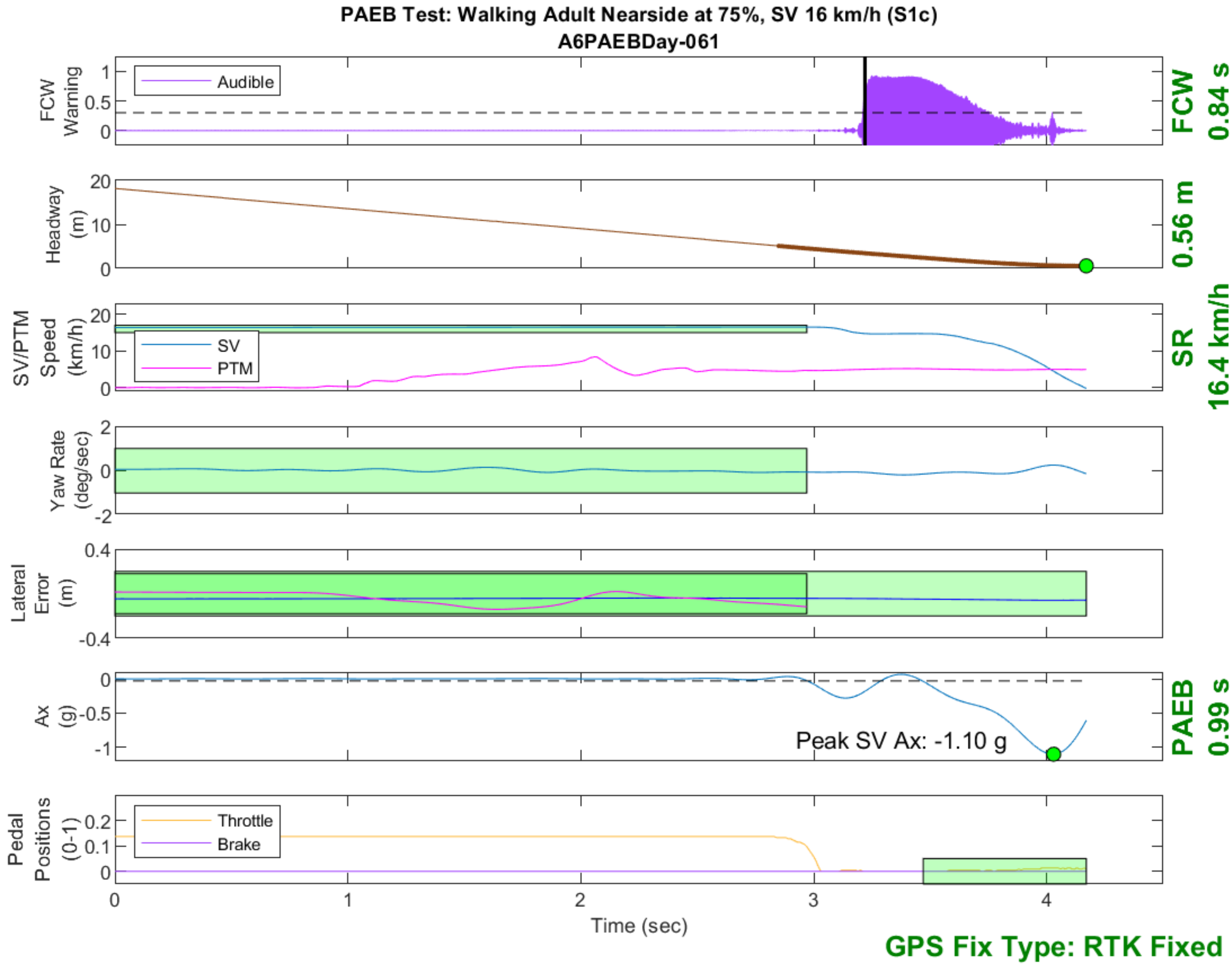


Figure D54. Time History for PAEB Run 61, S1c, Daytime, 16 km/h

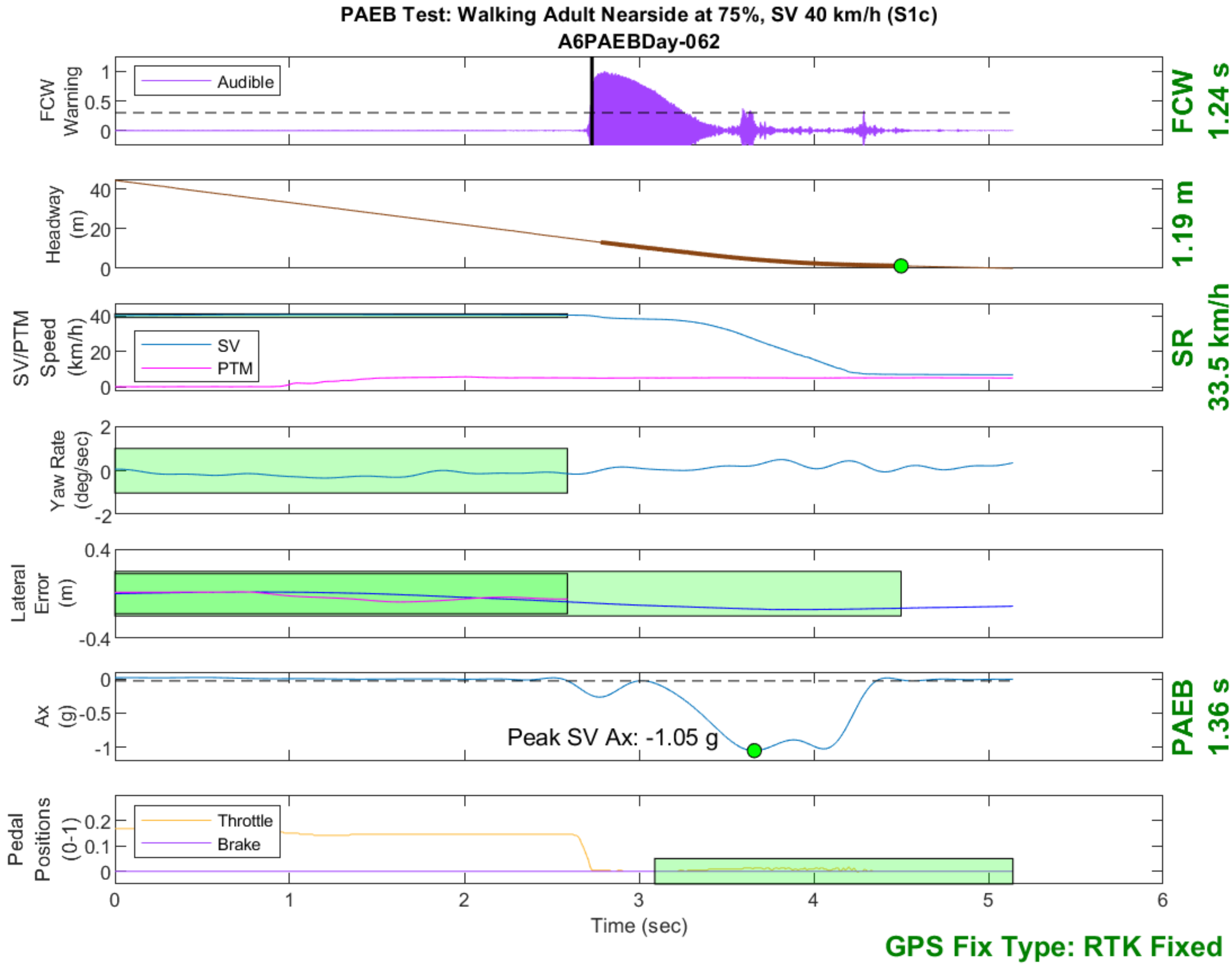


Figure D55. Time History for PAEB Run 62, S1c, Daytime, 40 km/h

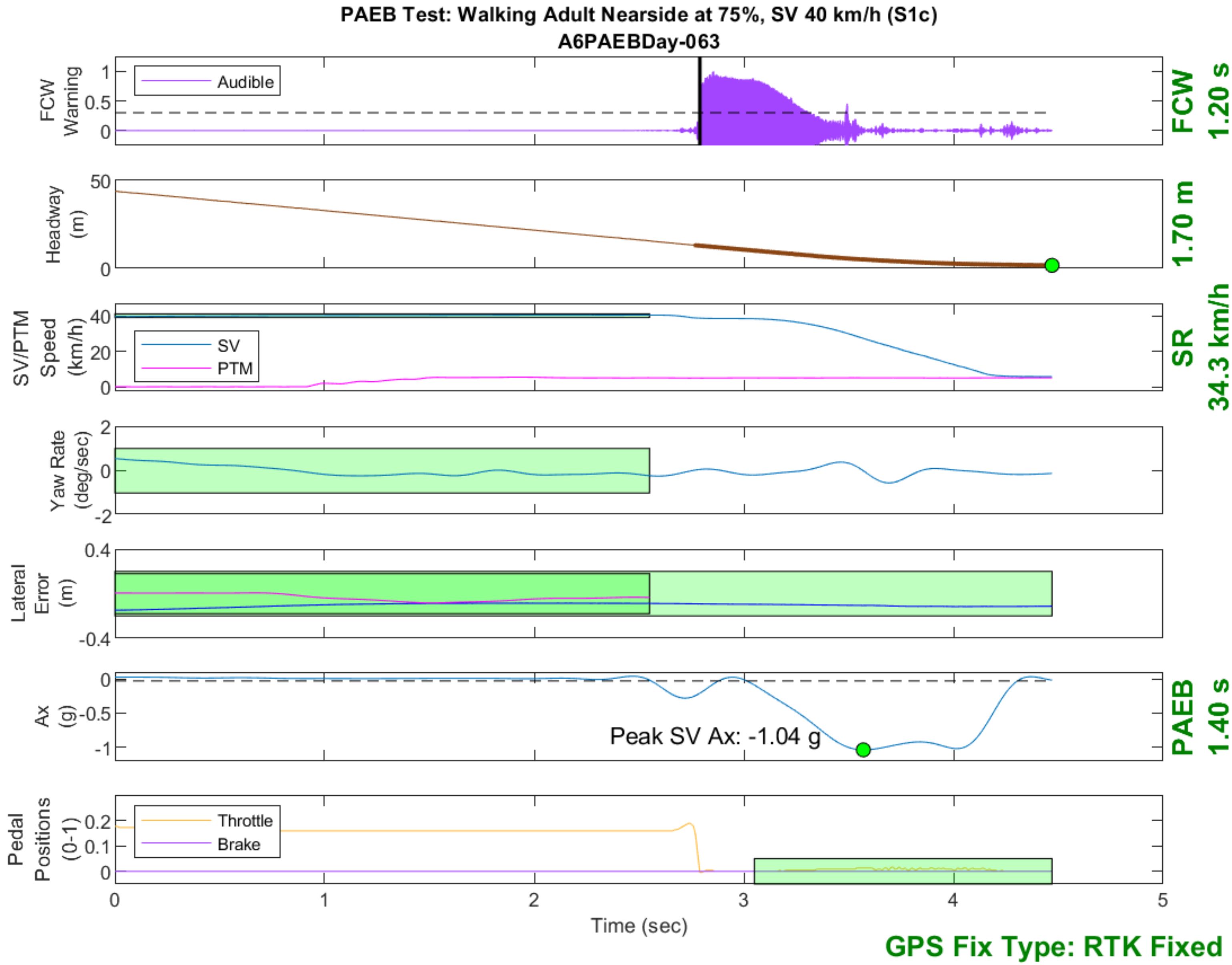


Figure D56. Time History for PAEB Run 63, S1c, Daytime, 40 km/h

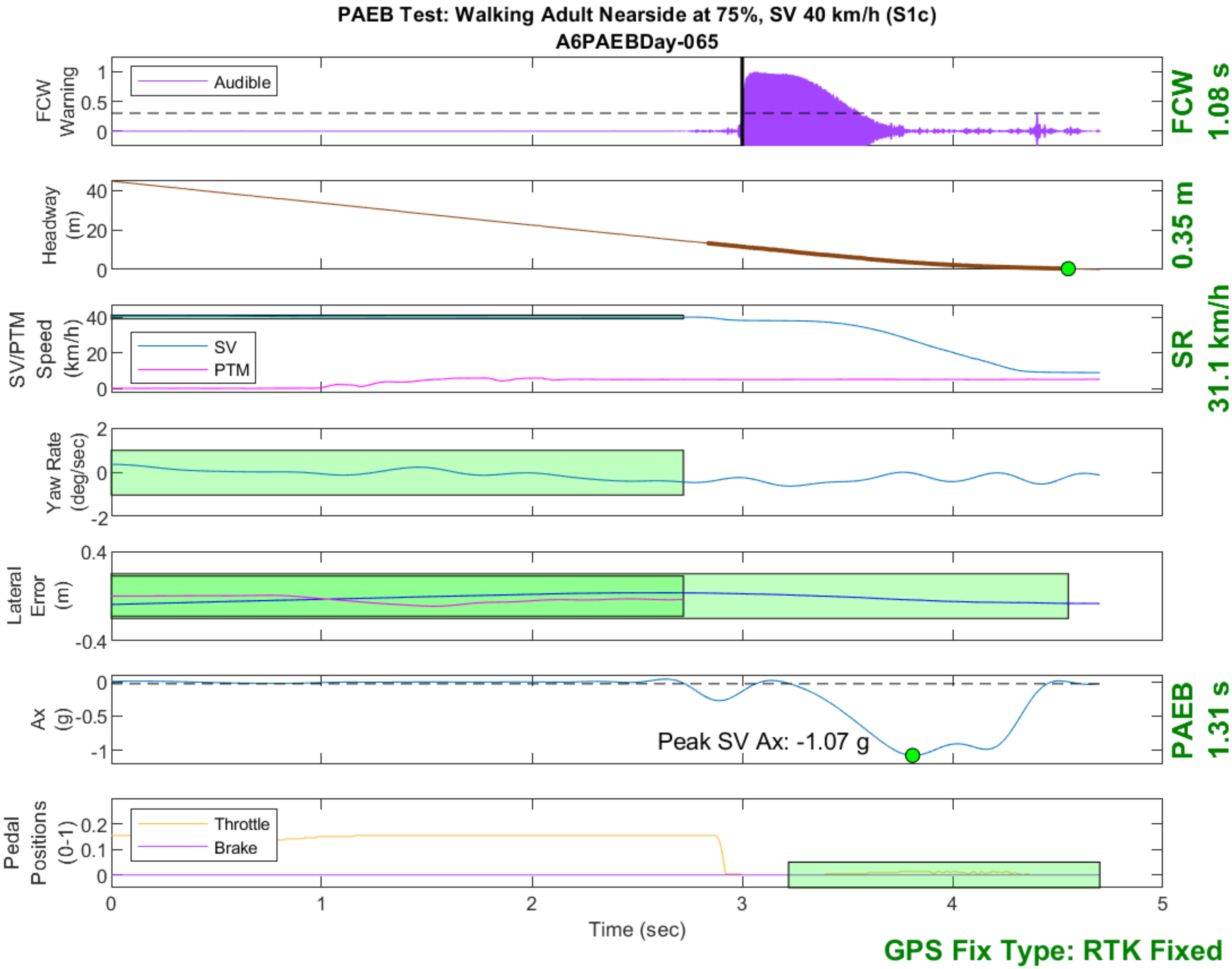


Figure D57. Time History for PAEB Run 65, S1c, Daytime, 40 km/h

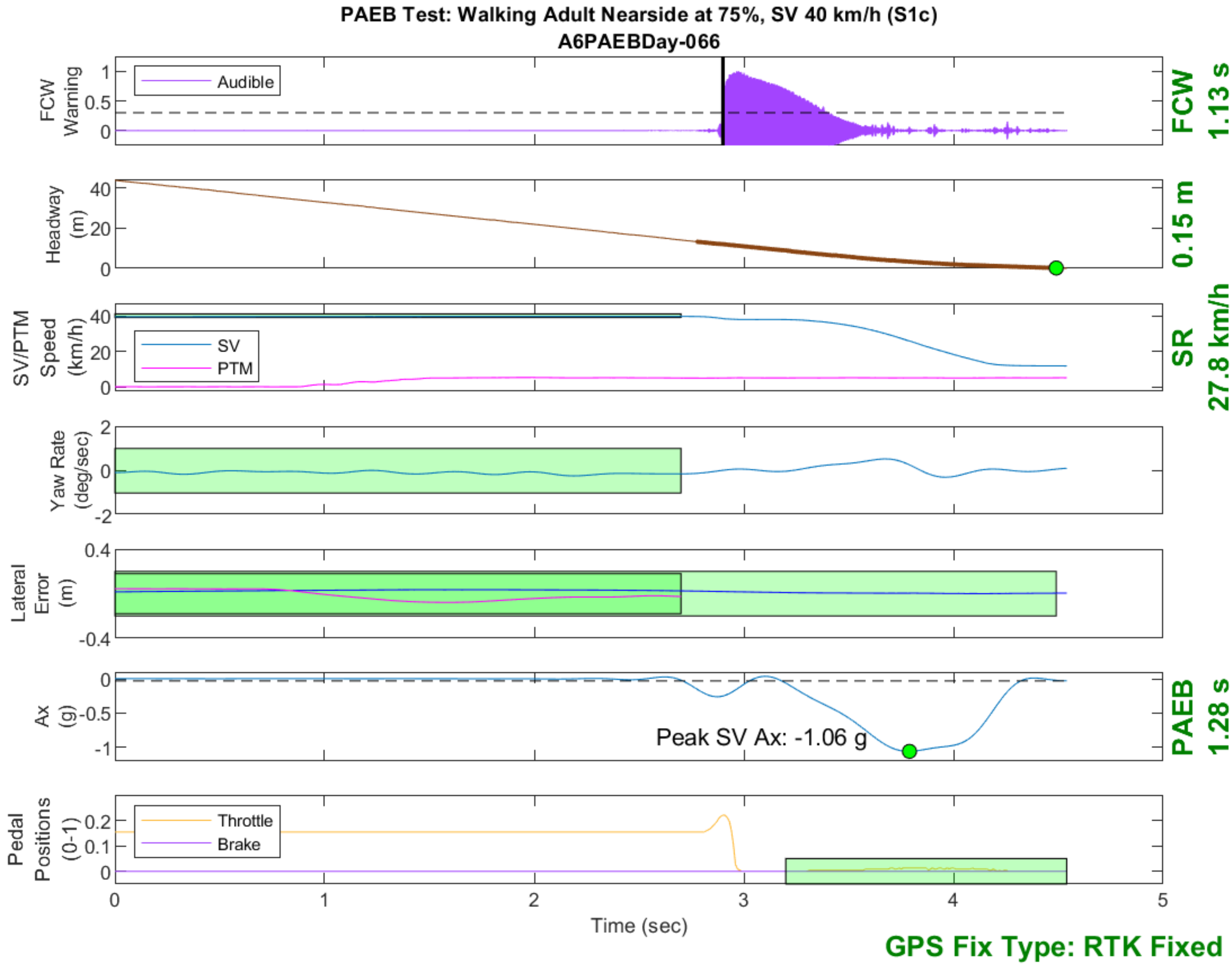


Figure D58. Time History for PAEB Run 66, S1c, Daytime, 40 km/h

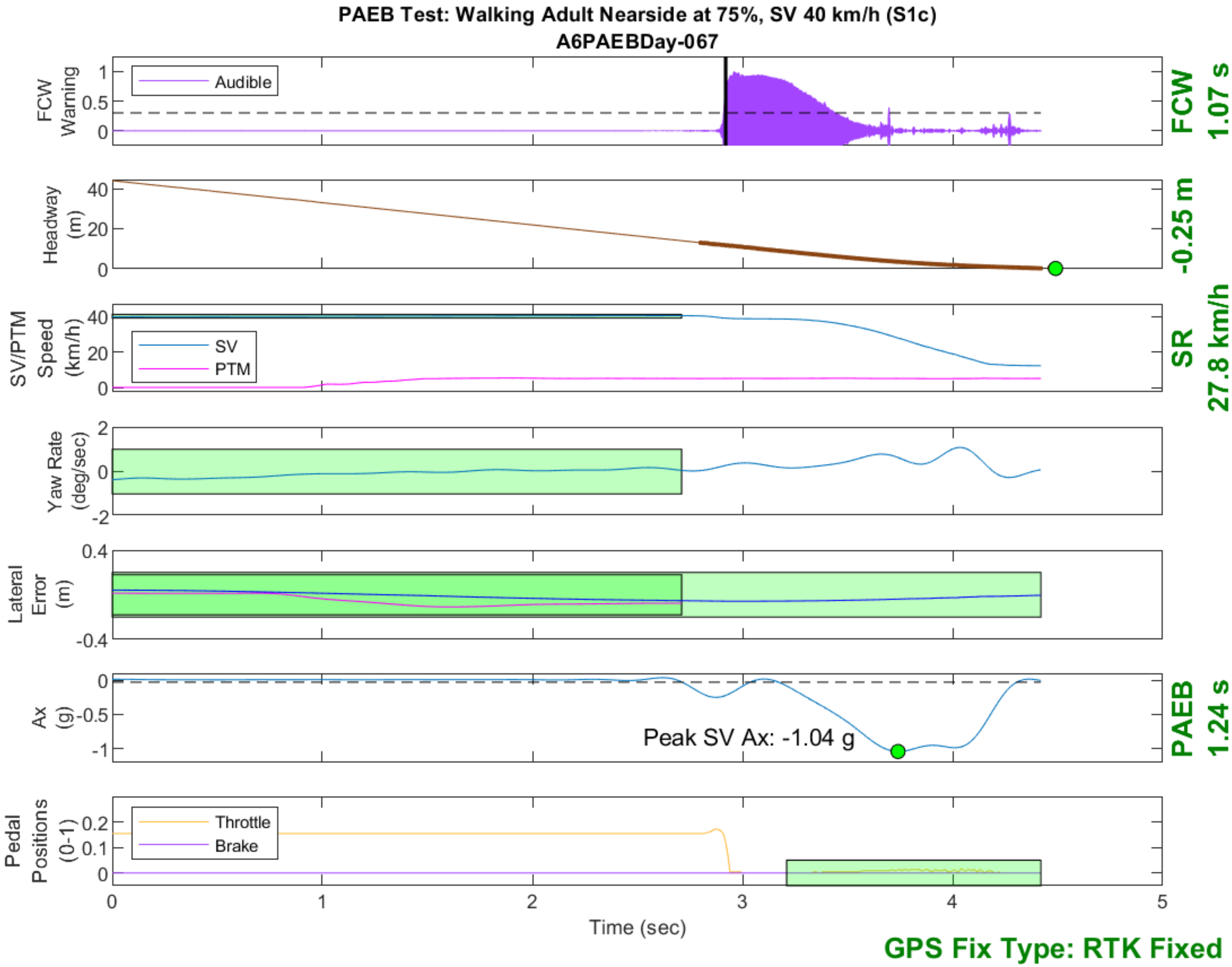


Figure D59. Time History for PAEB Run 67, S1c, Daytime, 40 km/h

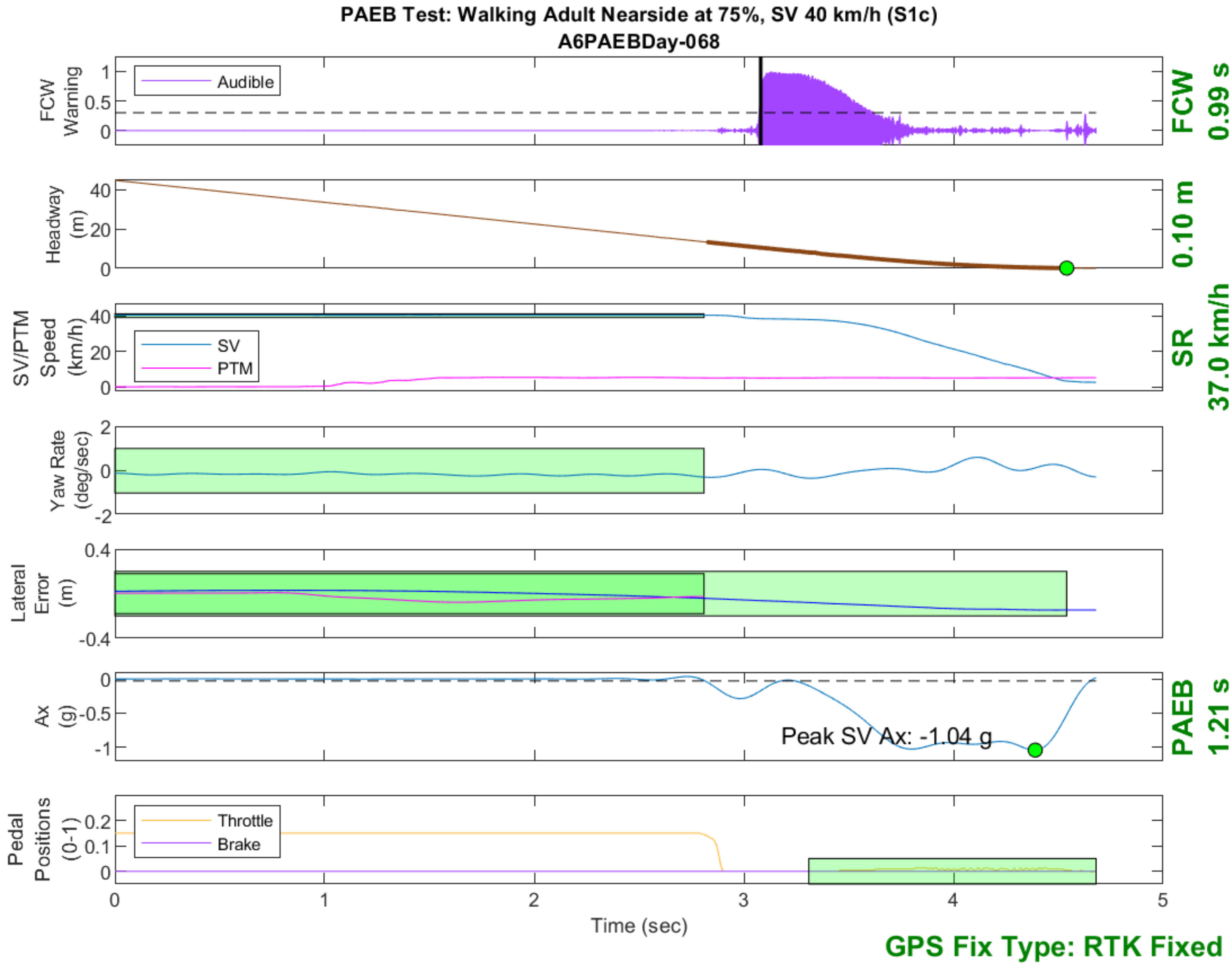


Figure D60. Time History for PAEB Run 68, S1c, Daytime, 40 km/h

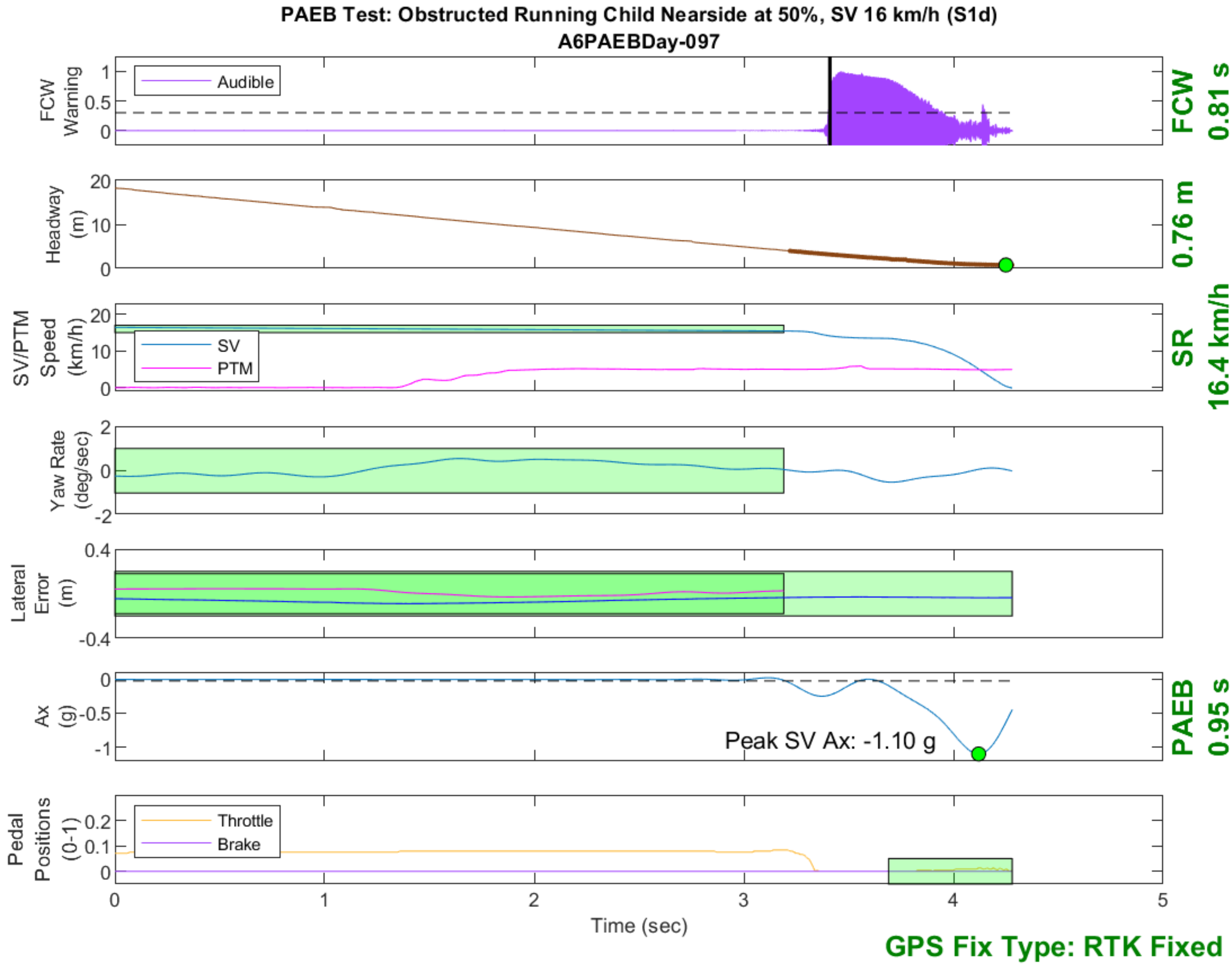


Figure D61. Time History for PAEB Run 97, S1d, Daytime, 16 km/h

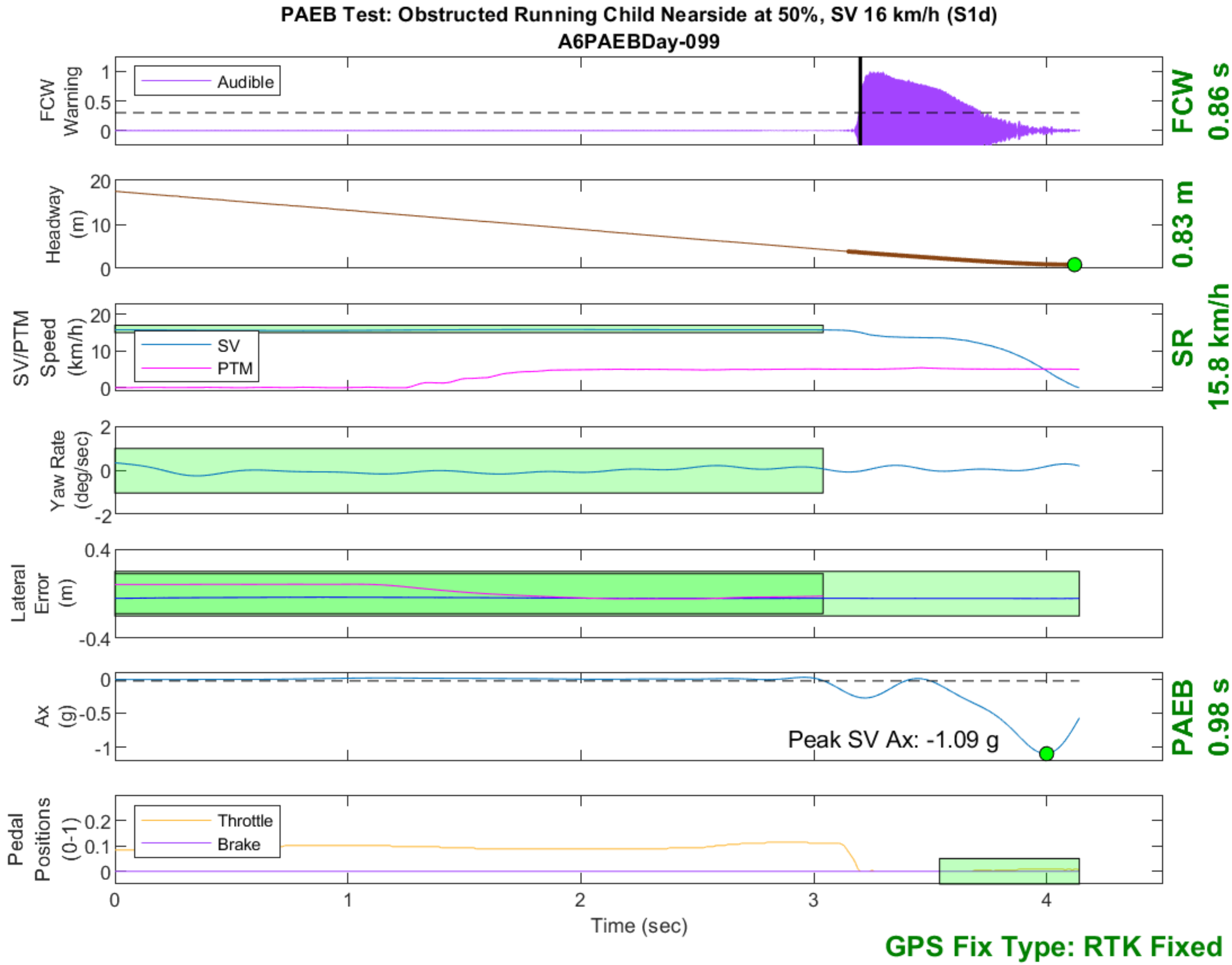


Figure D62. Time History for PAEB Run 99, S1d, Daytime, 16 km/h

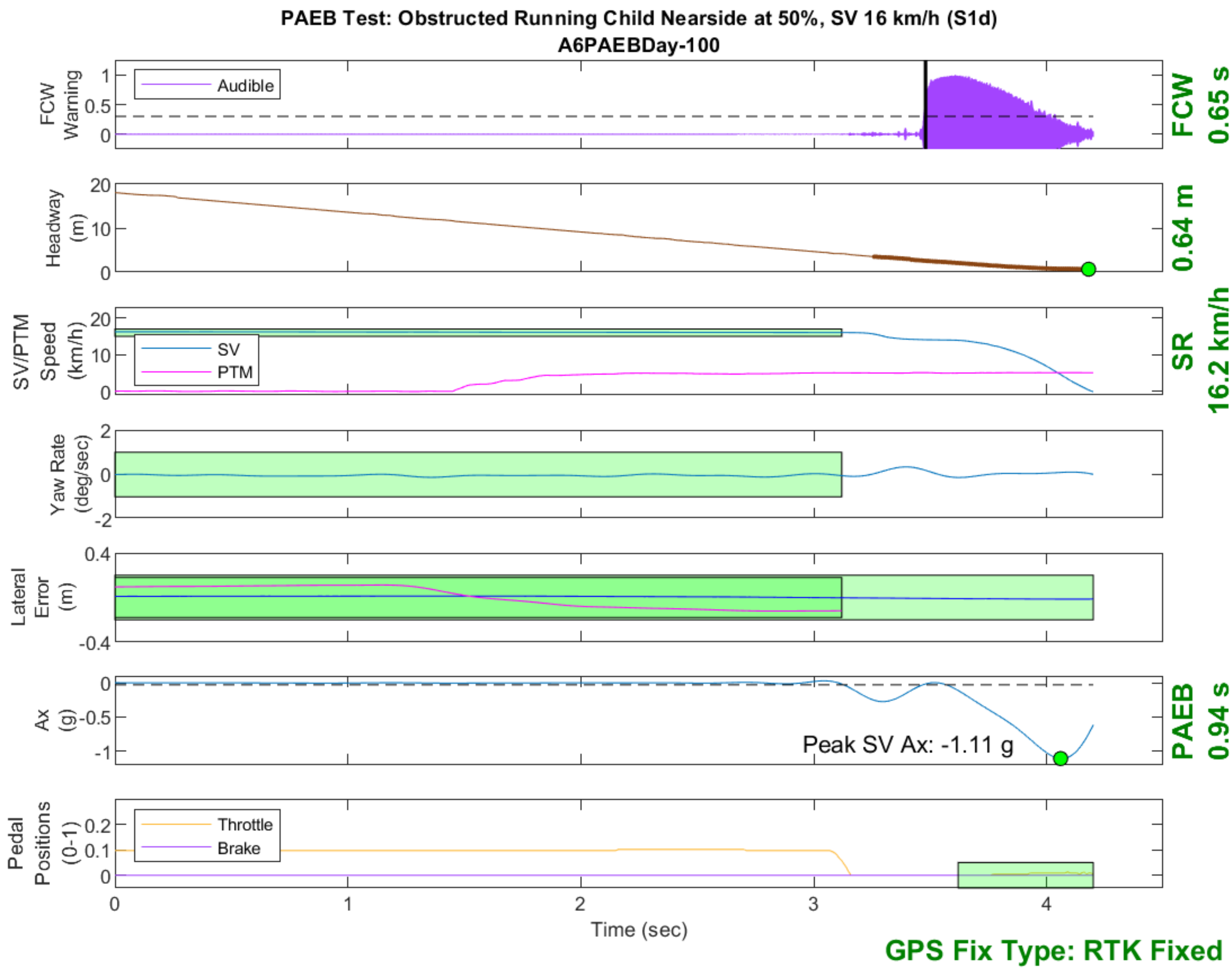


Figure D63. Time History for PAEB Run 100, S1d, Daytime, 16 km/h

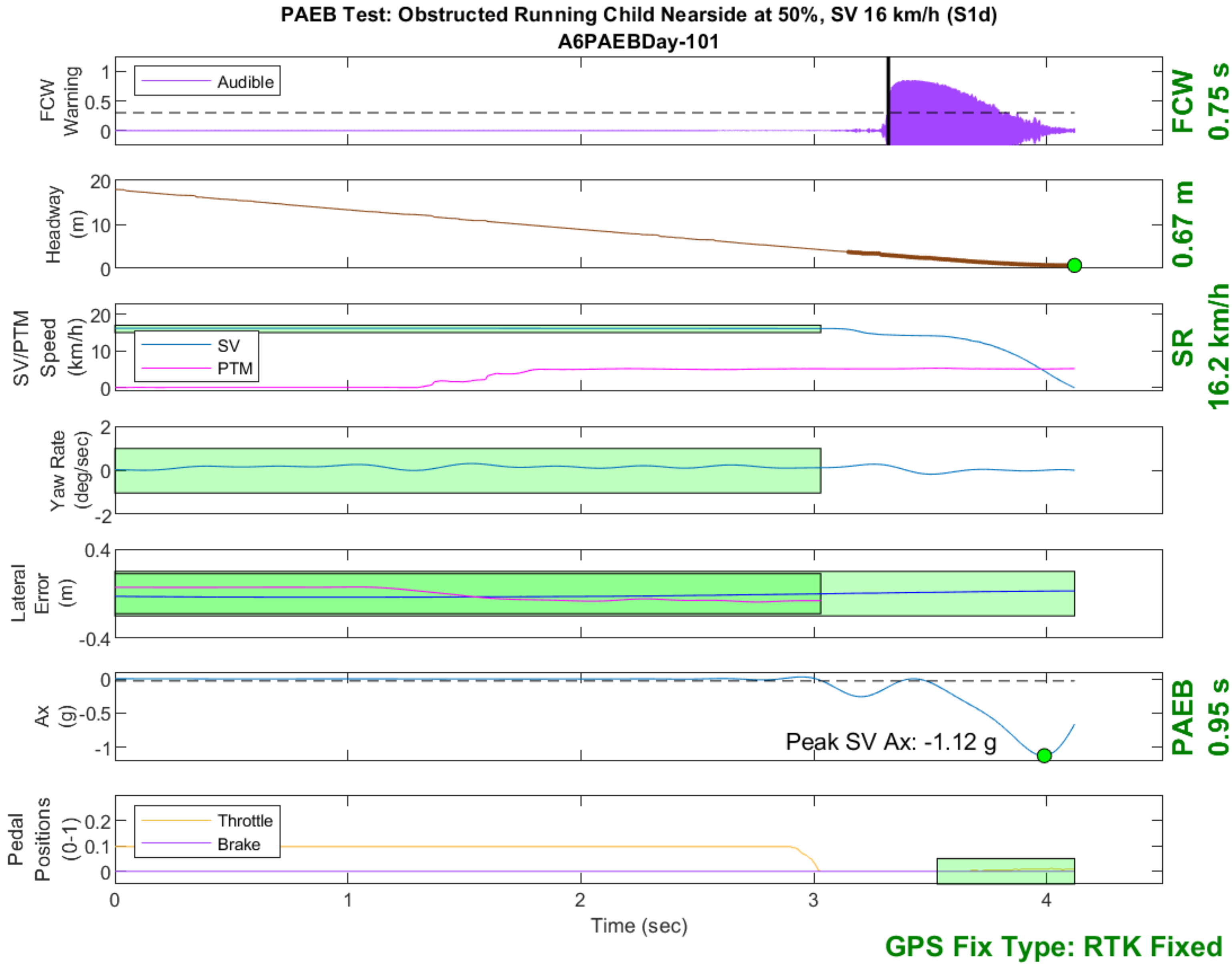


Figure D64. Time History for PAEB Run 101, S1d, Daytime, 16 km/h

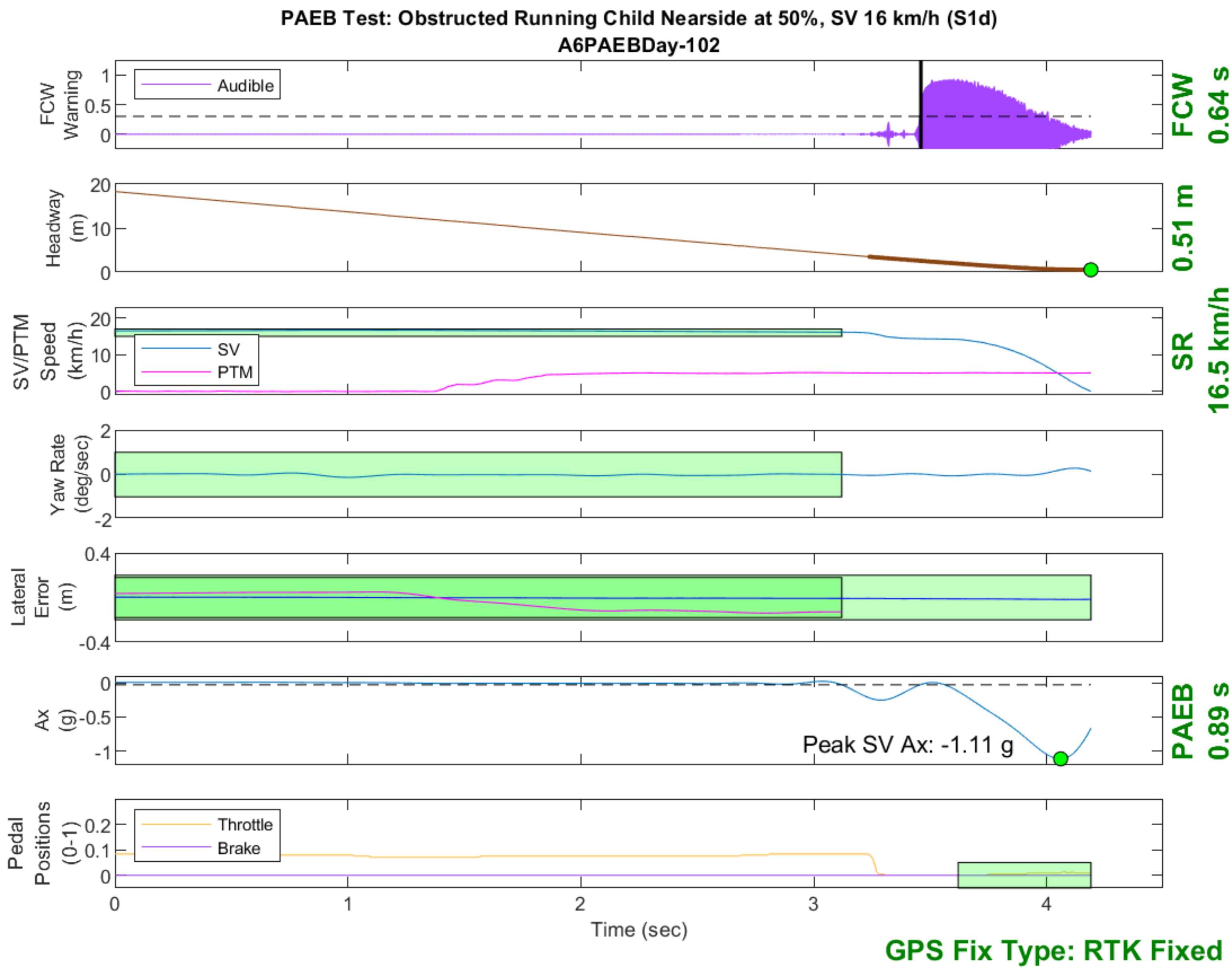


Figure D65. Time History for PAEB Run 102, S1d, Daytime, 16 km/h

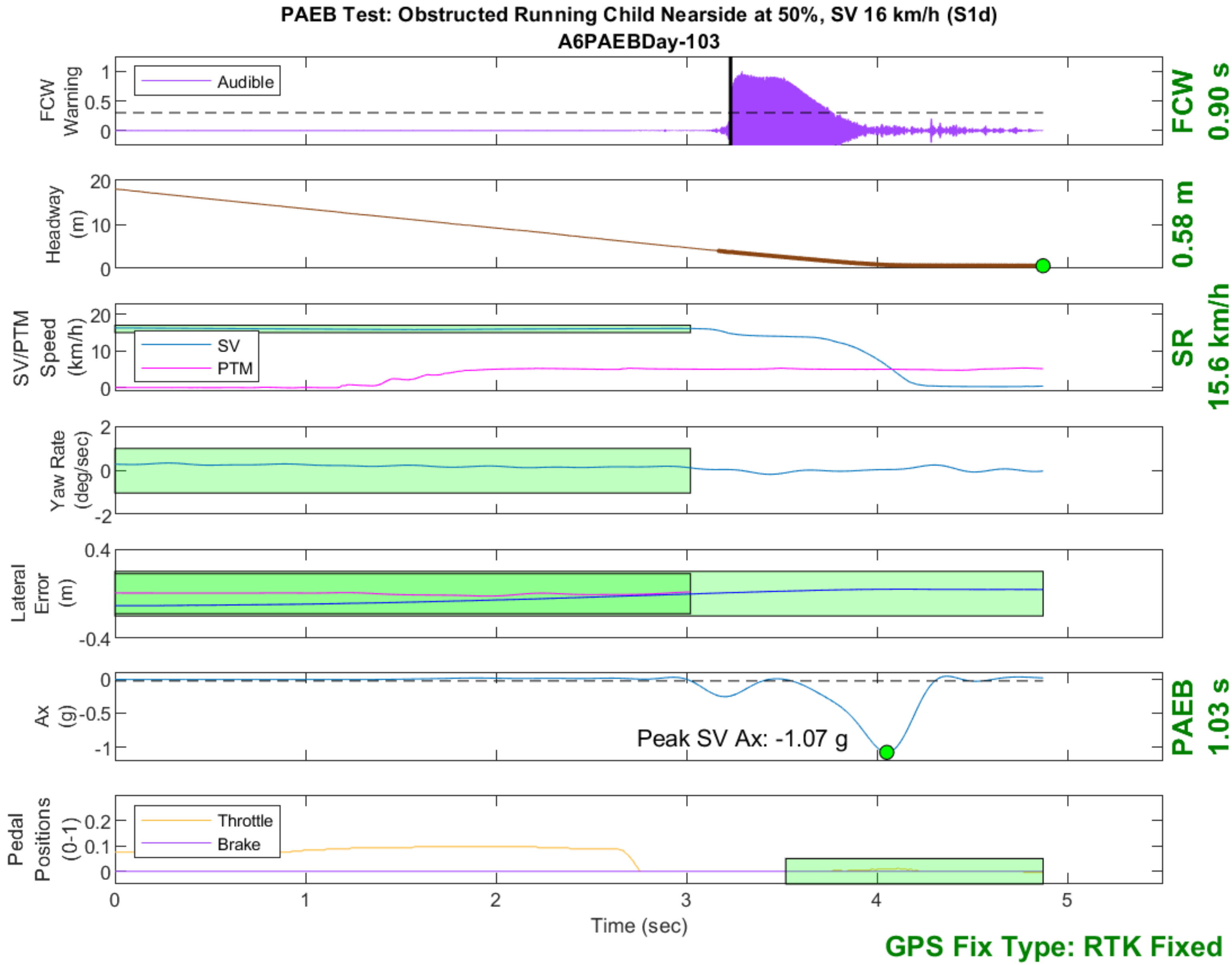


Figure D66. Time History for PAEB Run 103, S1d, Daytime, 16 km/h

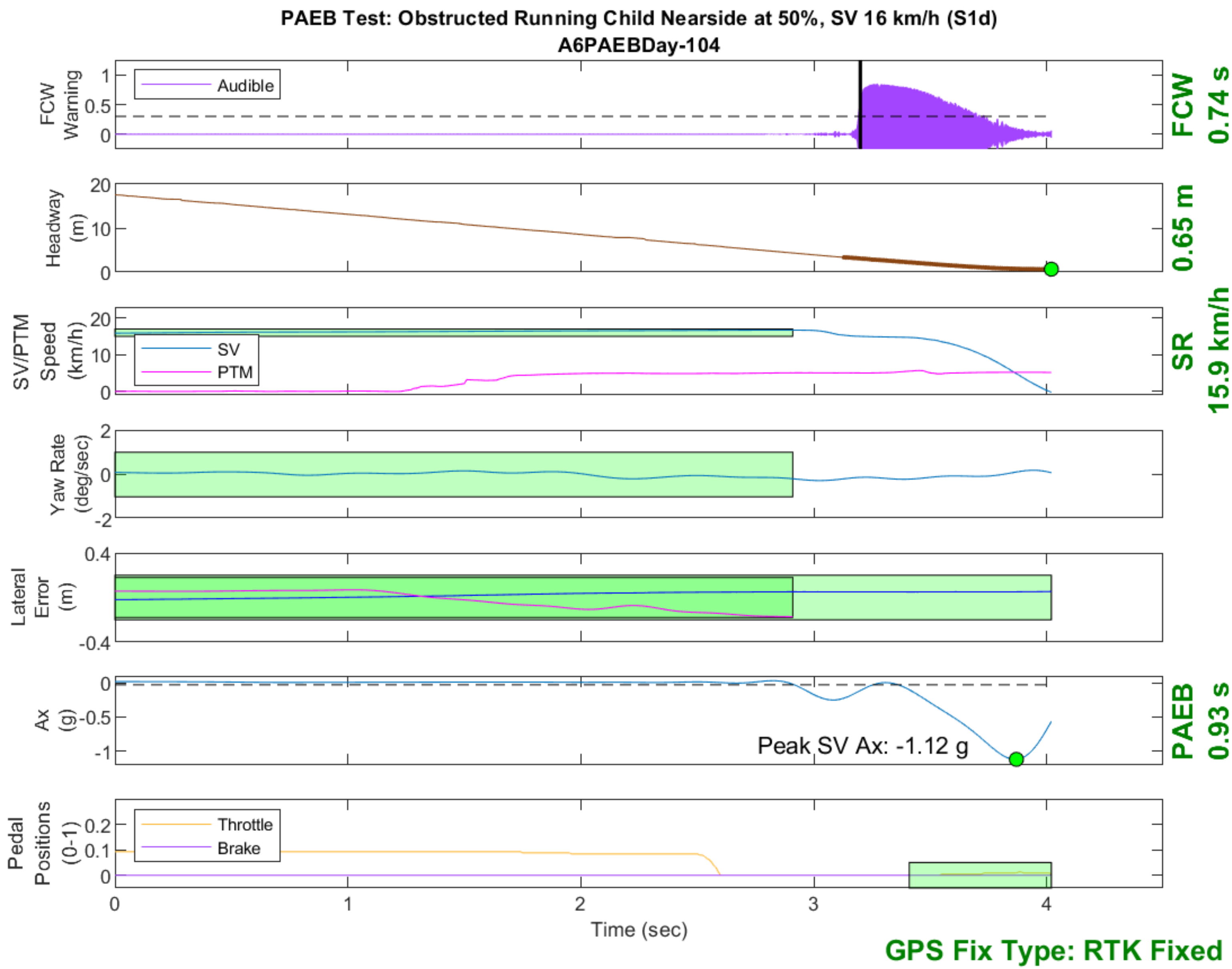


Figure D67. Time History for PAEB Run 104, S1d, Daytime, 16 km/h

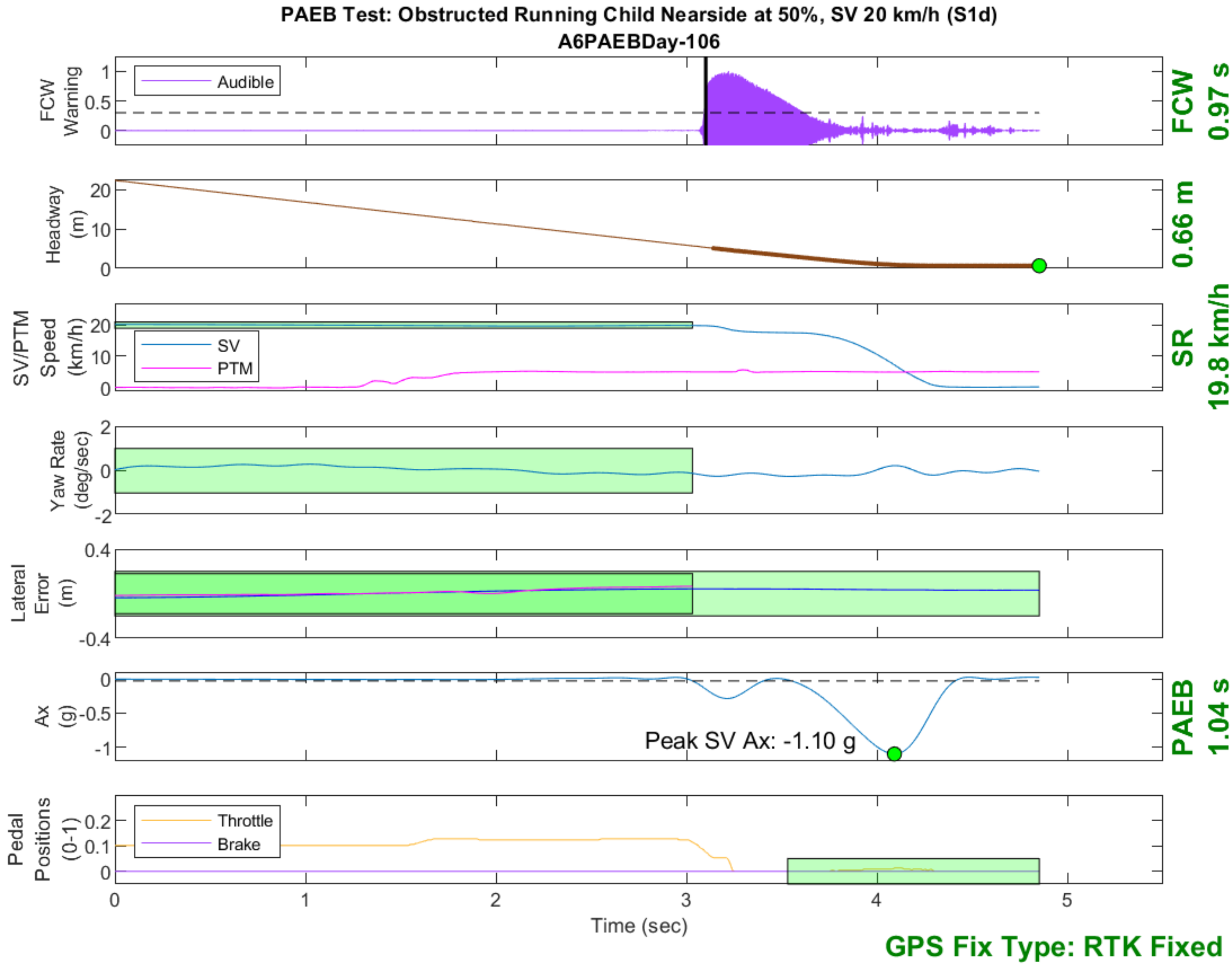


Figure D68. Time History for PAEB Run 106, S1d, Daytime, 20 km/h

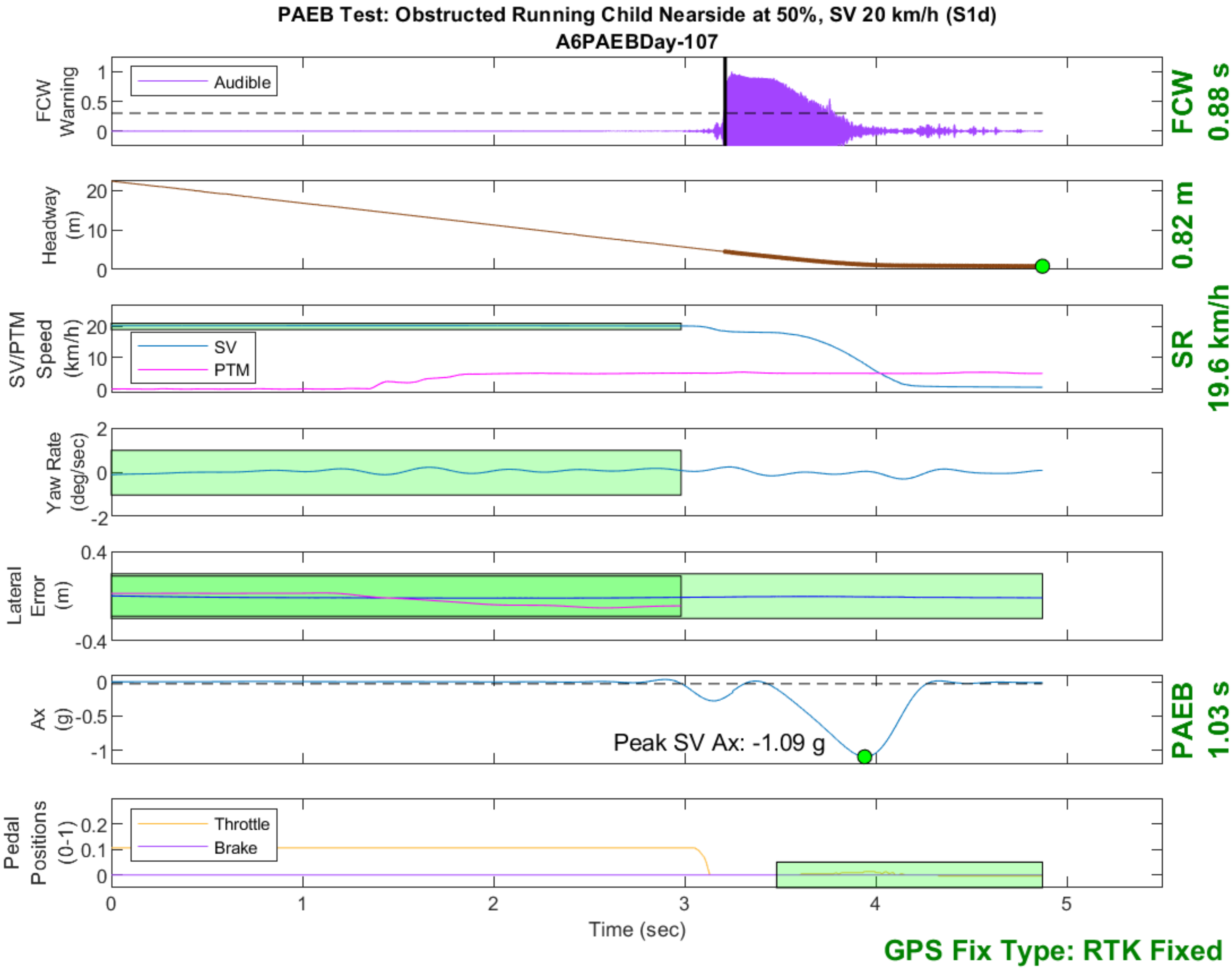


Figure D69. Time History for PAEB Run 107, S1d, Daytime, 20 km/h

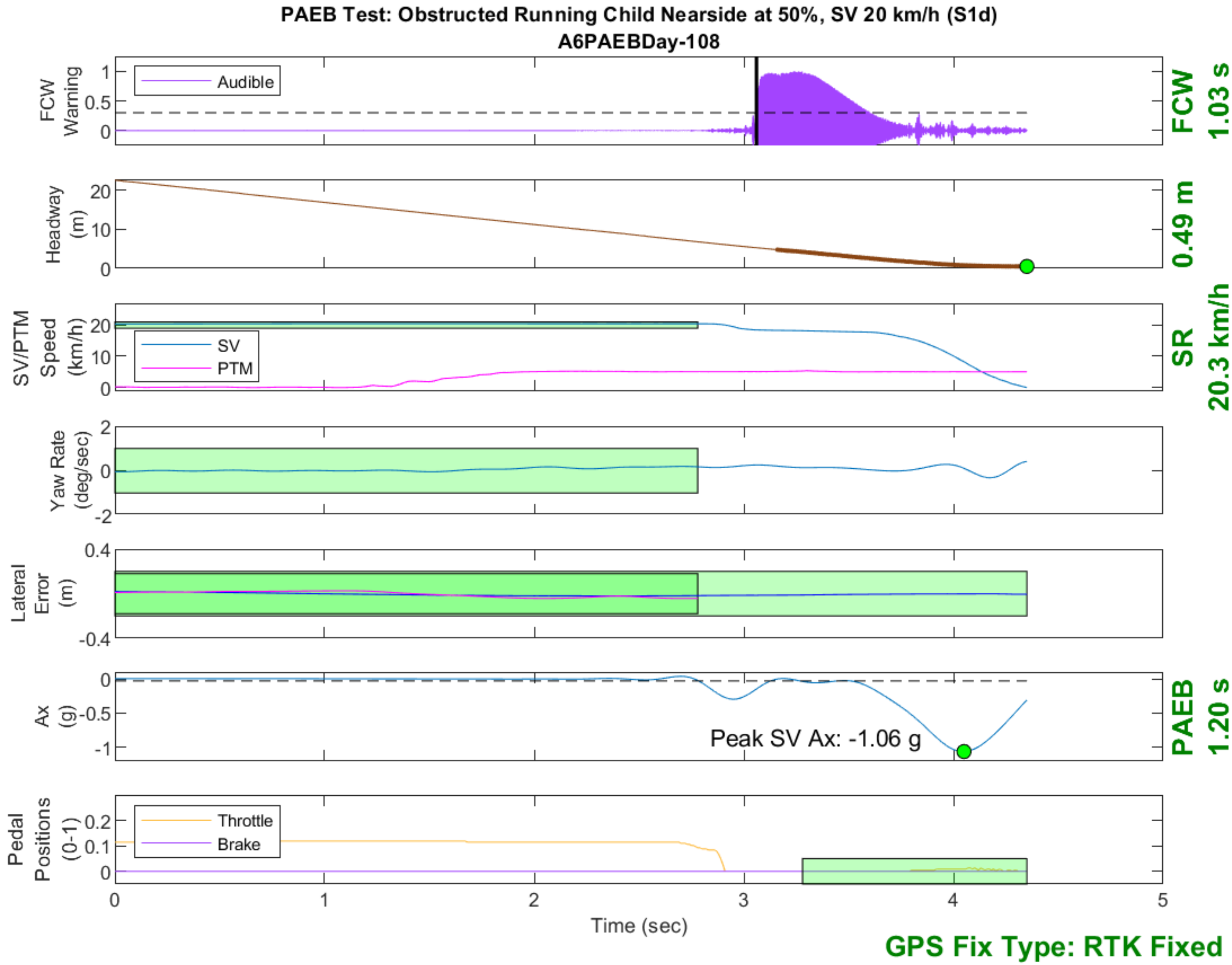


Figure D70. Time History for PAEB Run 108, S1d, Daytime, 20 km/h

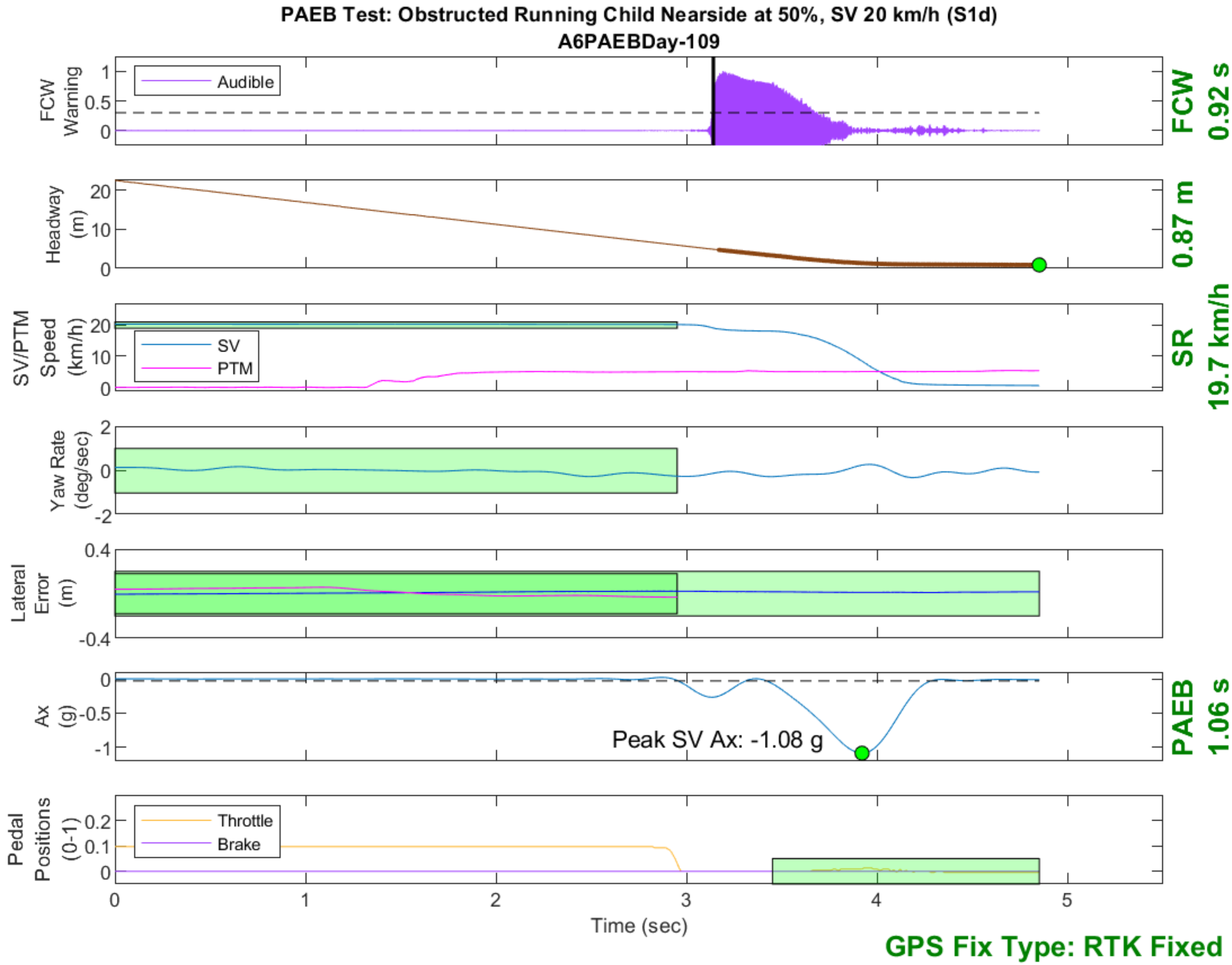


Figure D71. Time History for PAEB Run 109, S1d, Daytime, 20 km/h

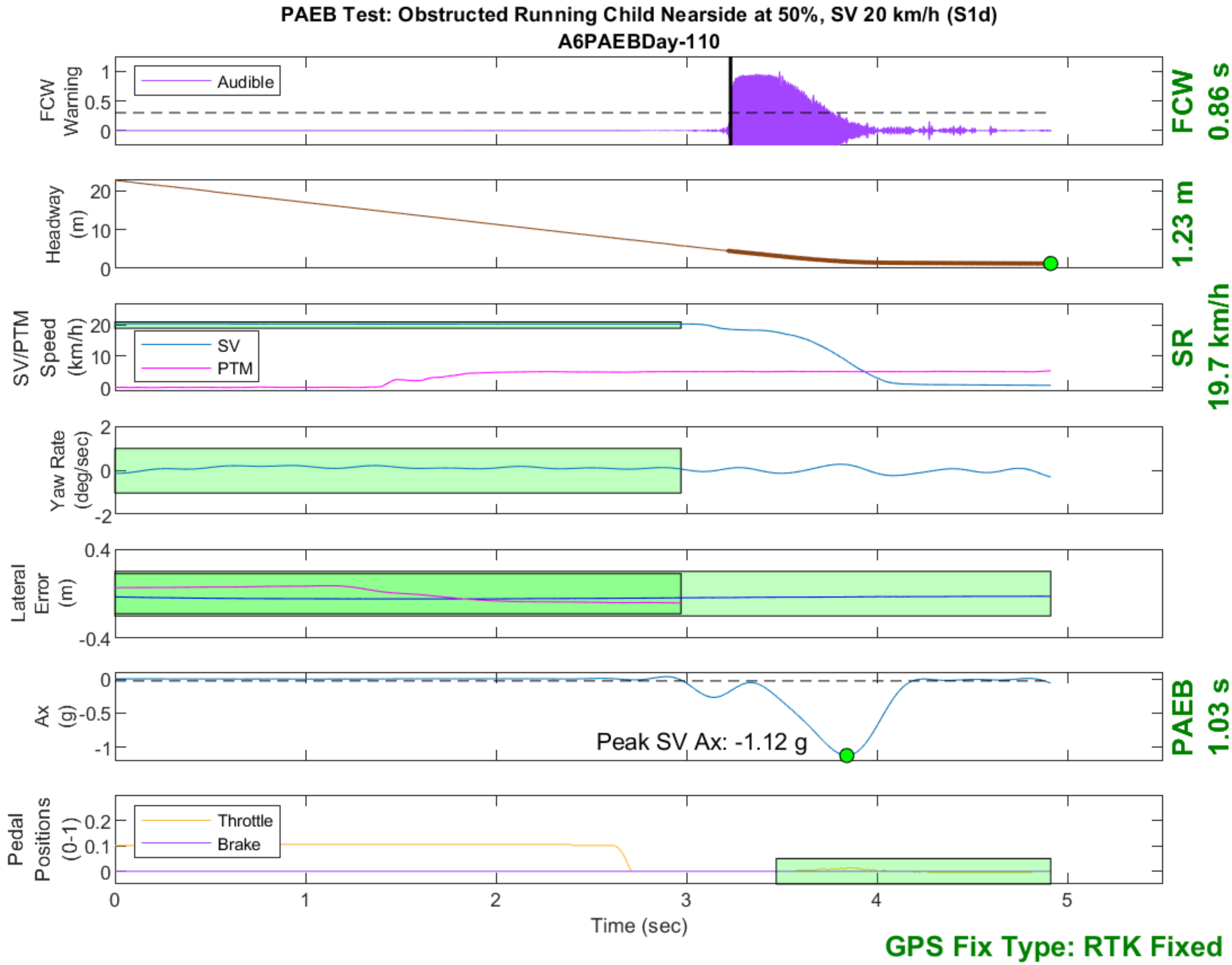


Figure D72. Time History for PAEB Run 110, S1d, Daytime, 20 km/h

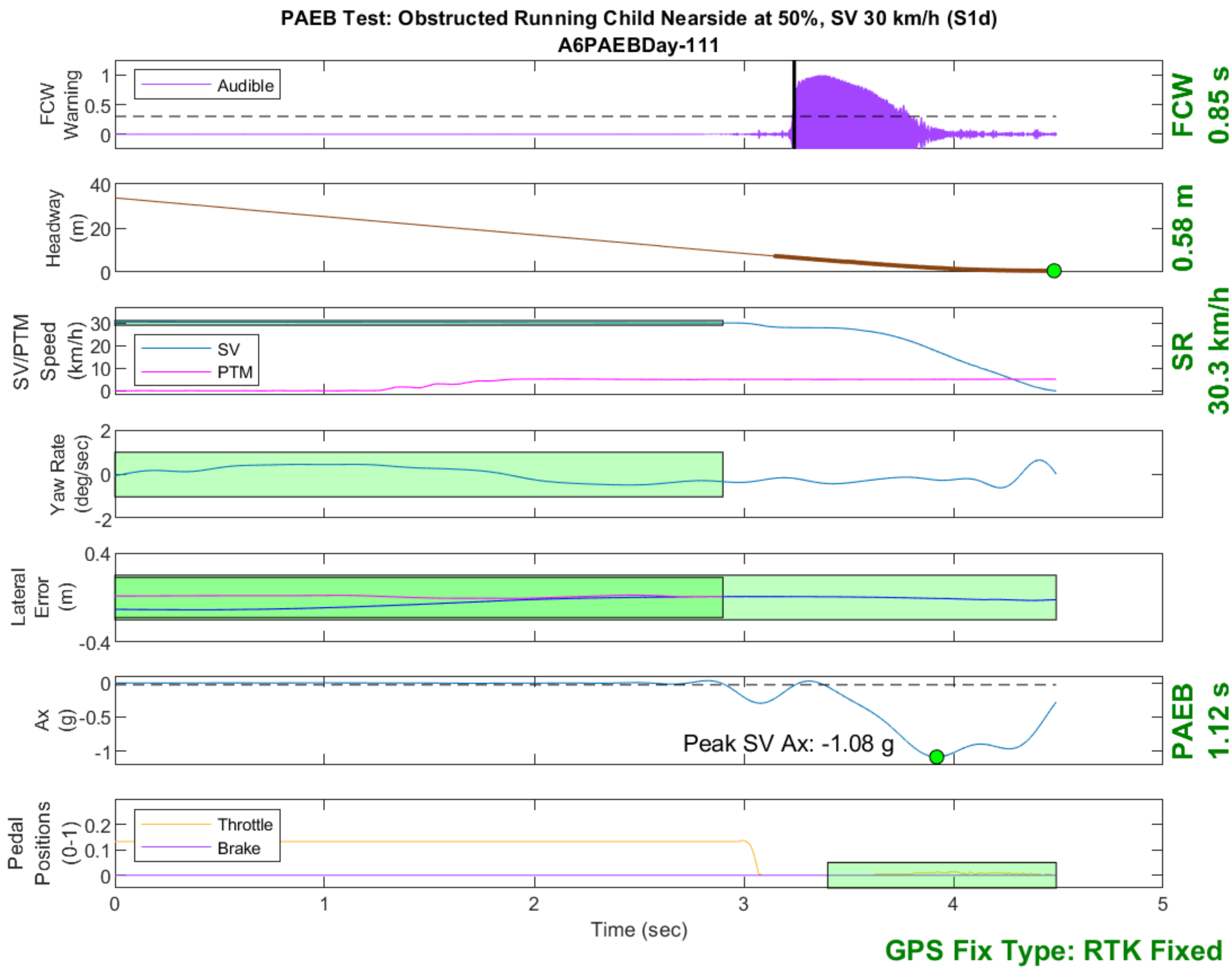


Figure D73. Time History for PAEB Run 111, S1d, Daytime, 30 km/h

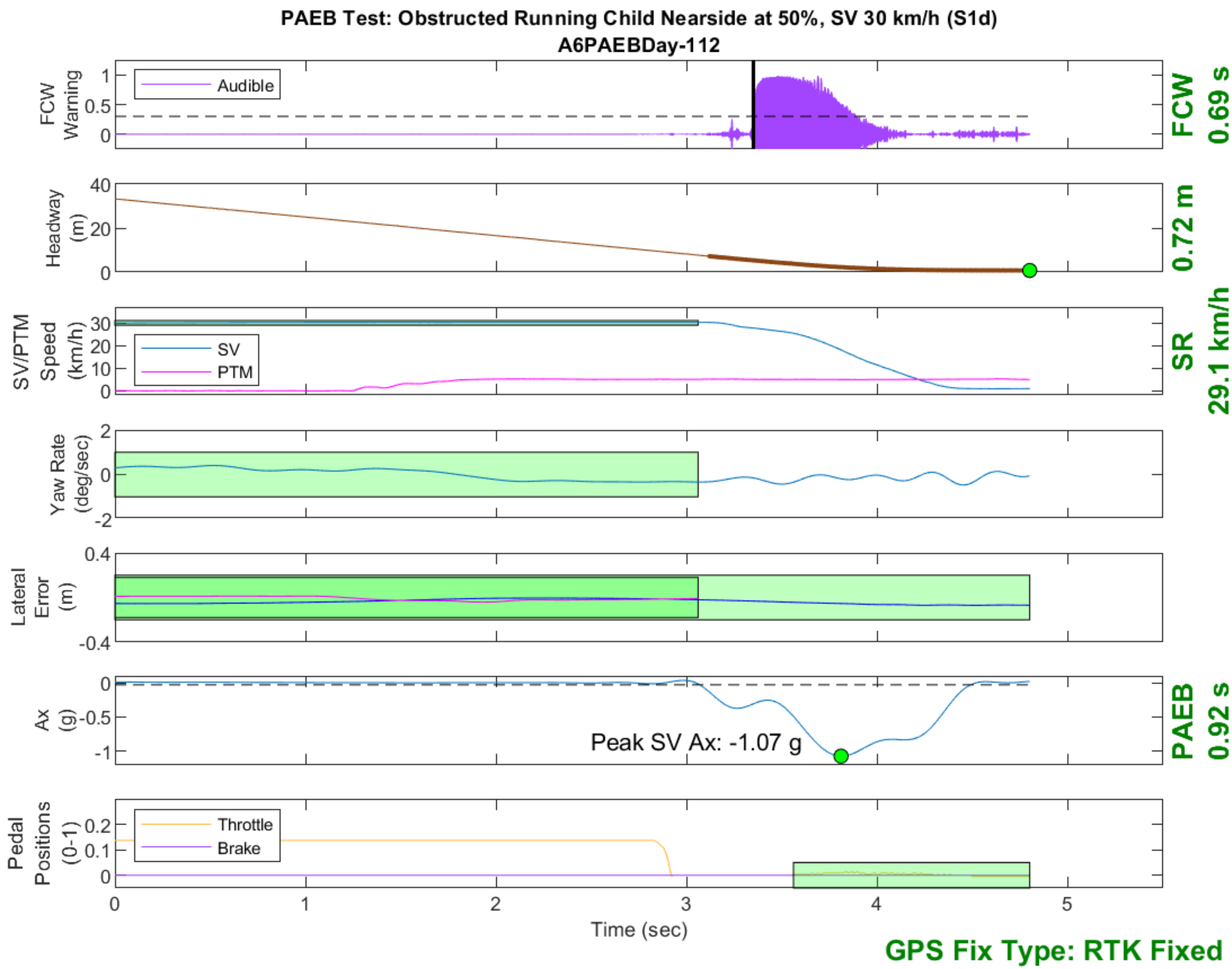


Figure D74. Time History for PAEB Run 112, S1d, Daytime, 30 km/h

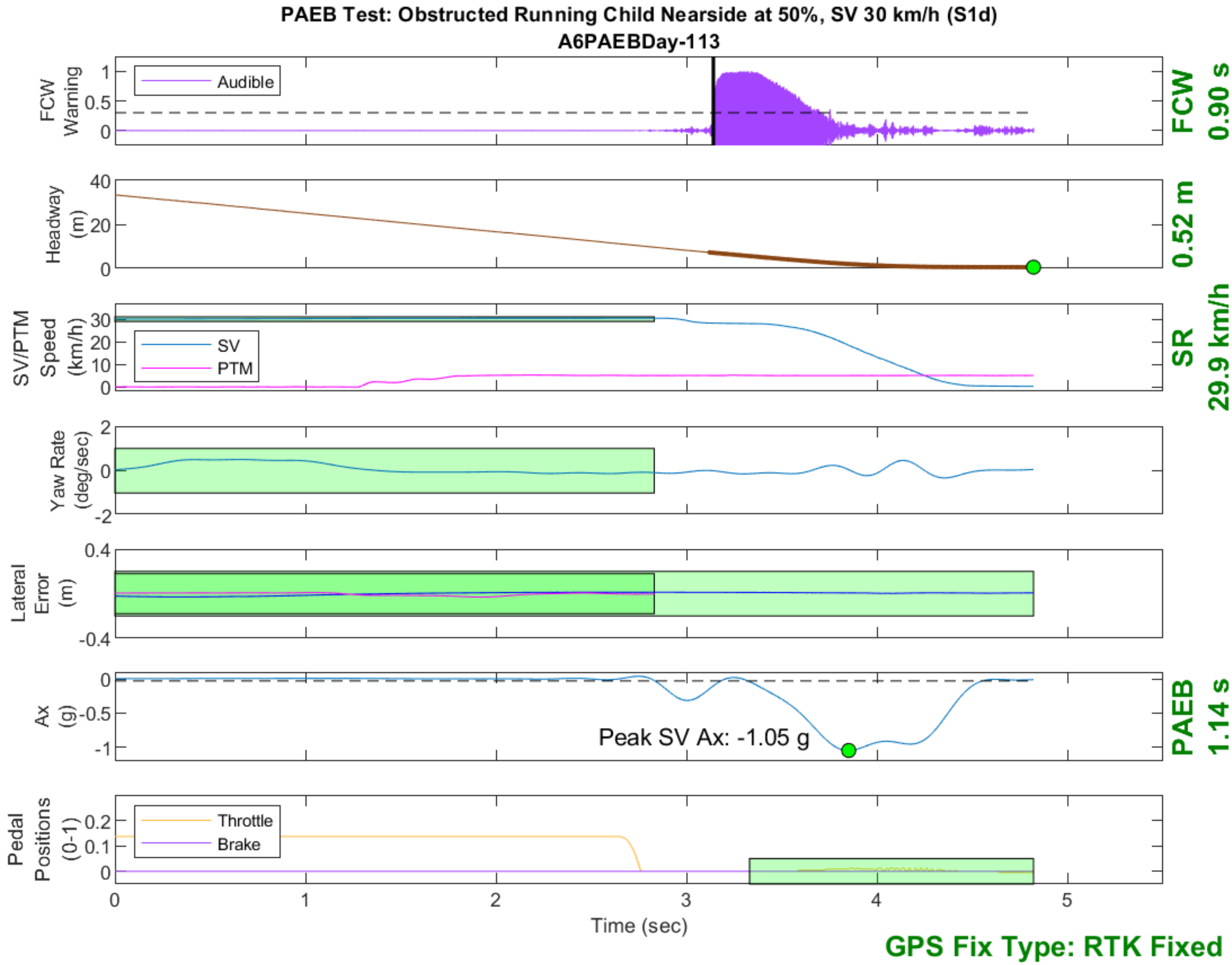


Figure D75. Time History for PAEB Run 113, S1d, Daytime, 30 km/h

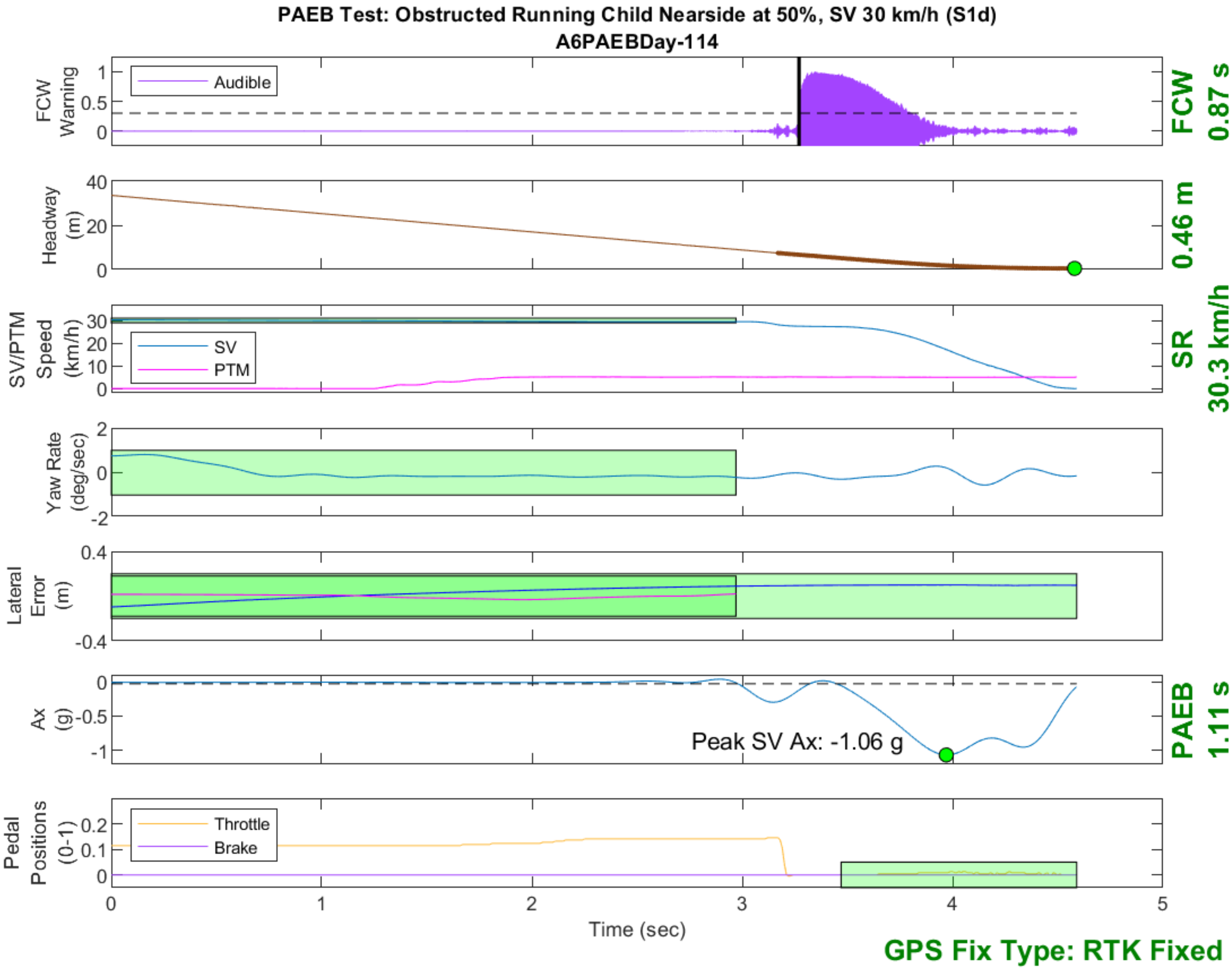


Figure D76. Time History for PAEB Run 114, S1d, Daytime, 30 km/h

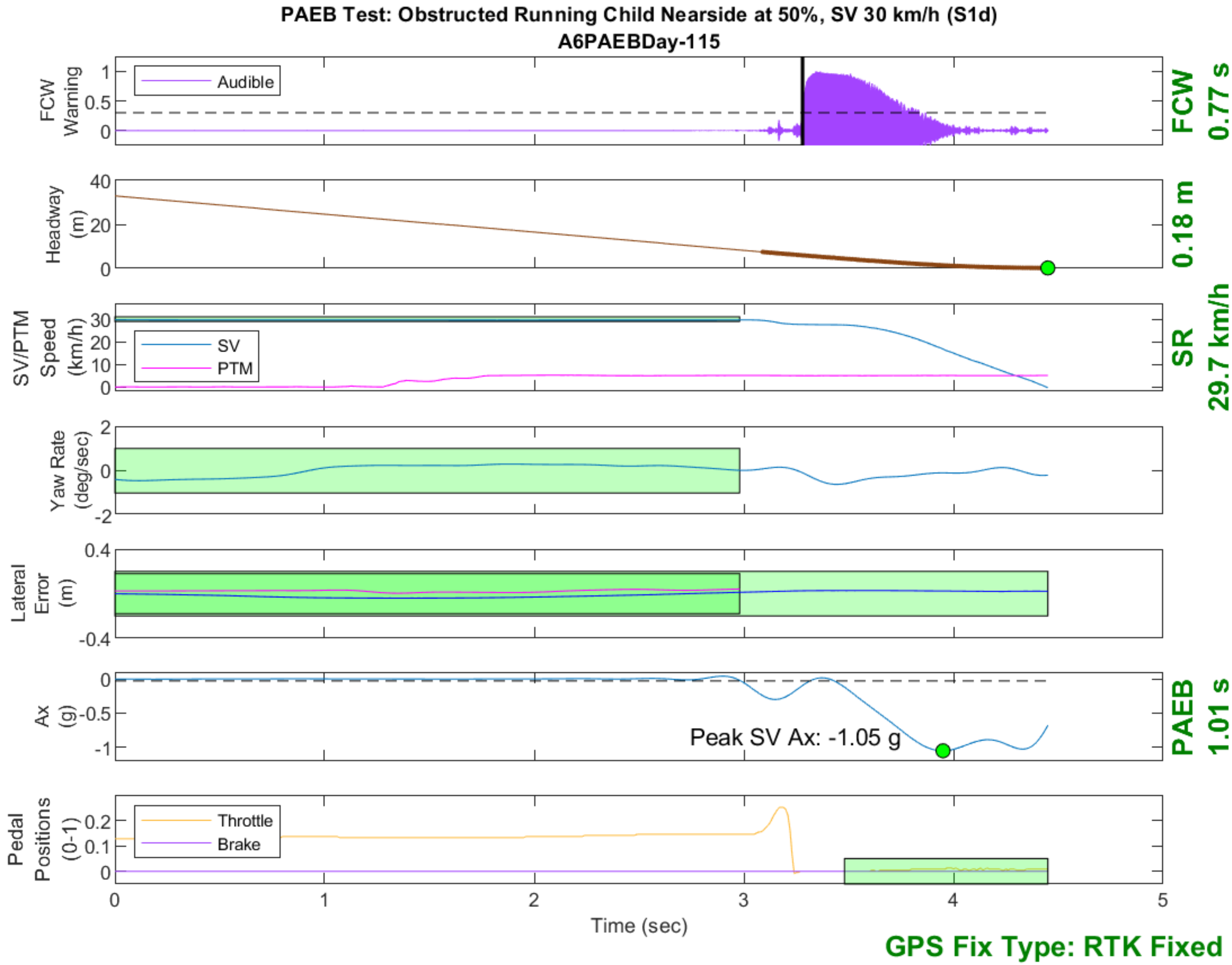


Figure D77. Time History for PAEB Run 115, S1d, Daytime, 30 km/h

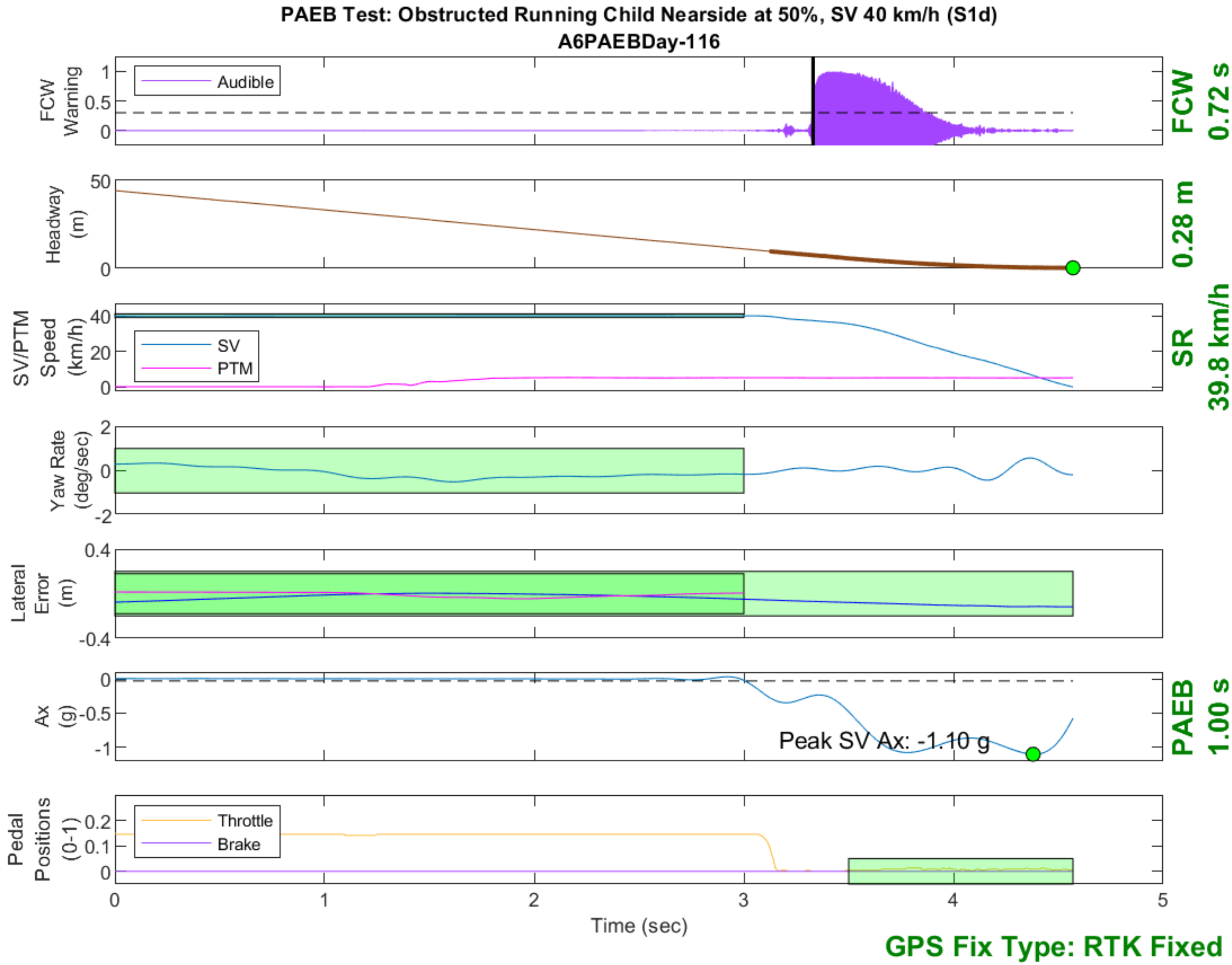


Figure D78. Time History for PAEB Run 116, S1d, Daytime, 40 km/h

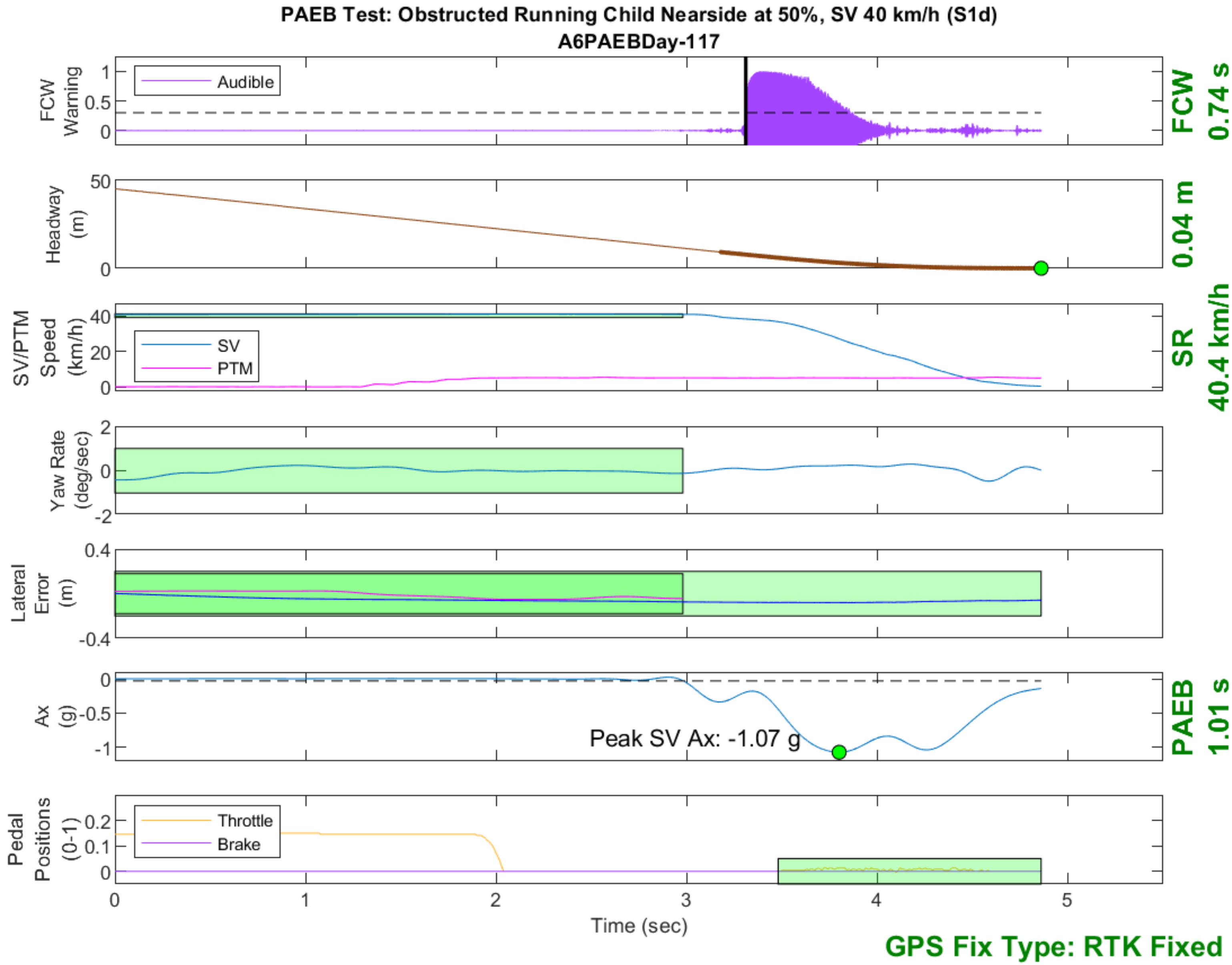


Figure D79. Time History for PAEB Run 117, S1d, Daytime, 40 km/h

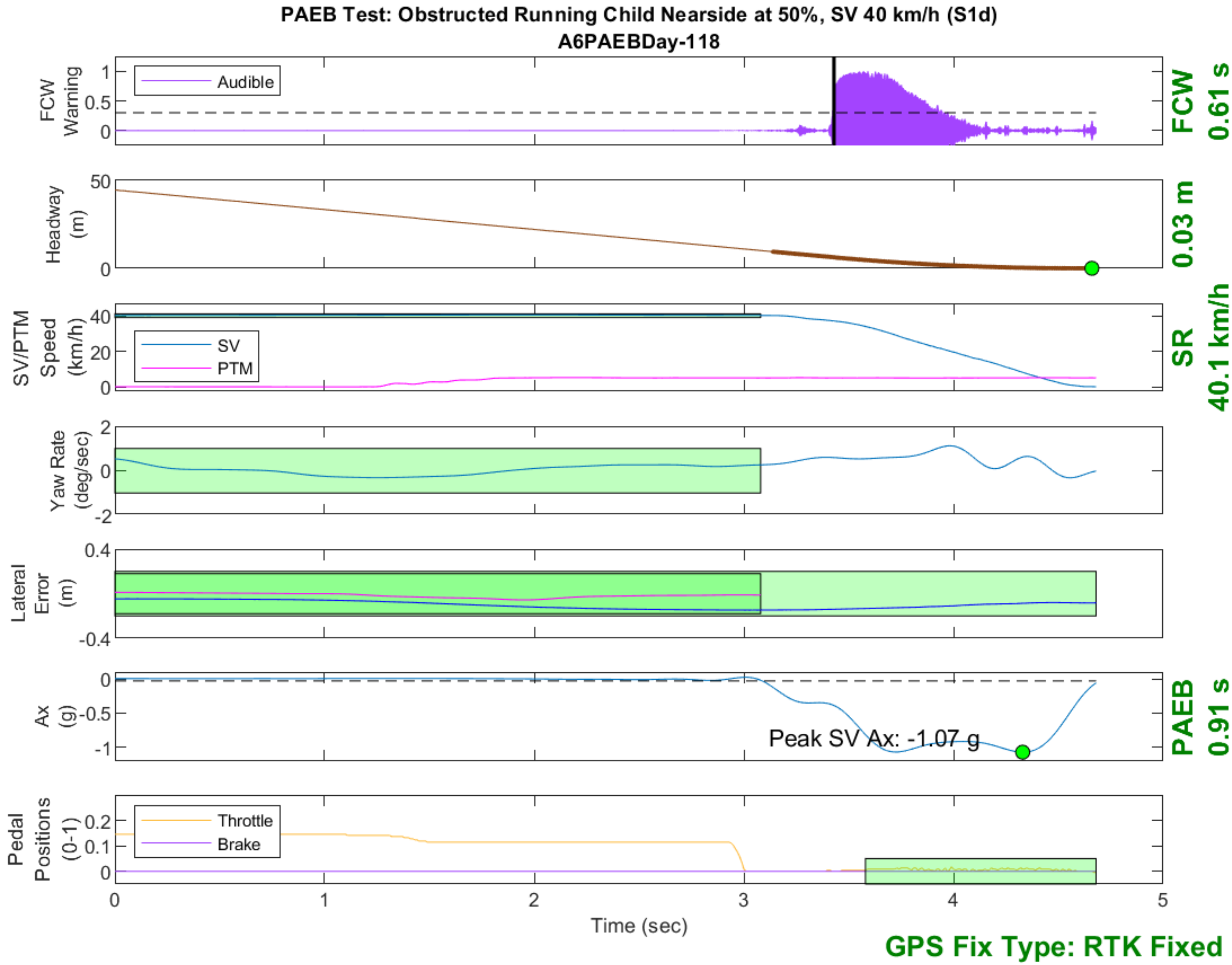


Figure D80. Time History for PAEB Run 118, S1d, Daytime, 40 km/h

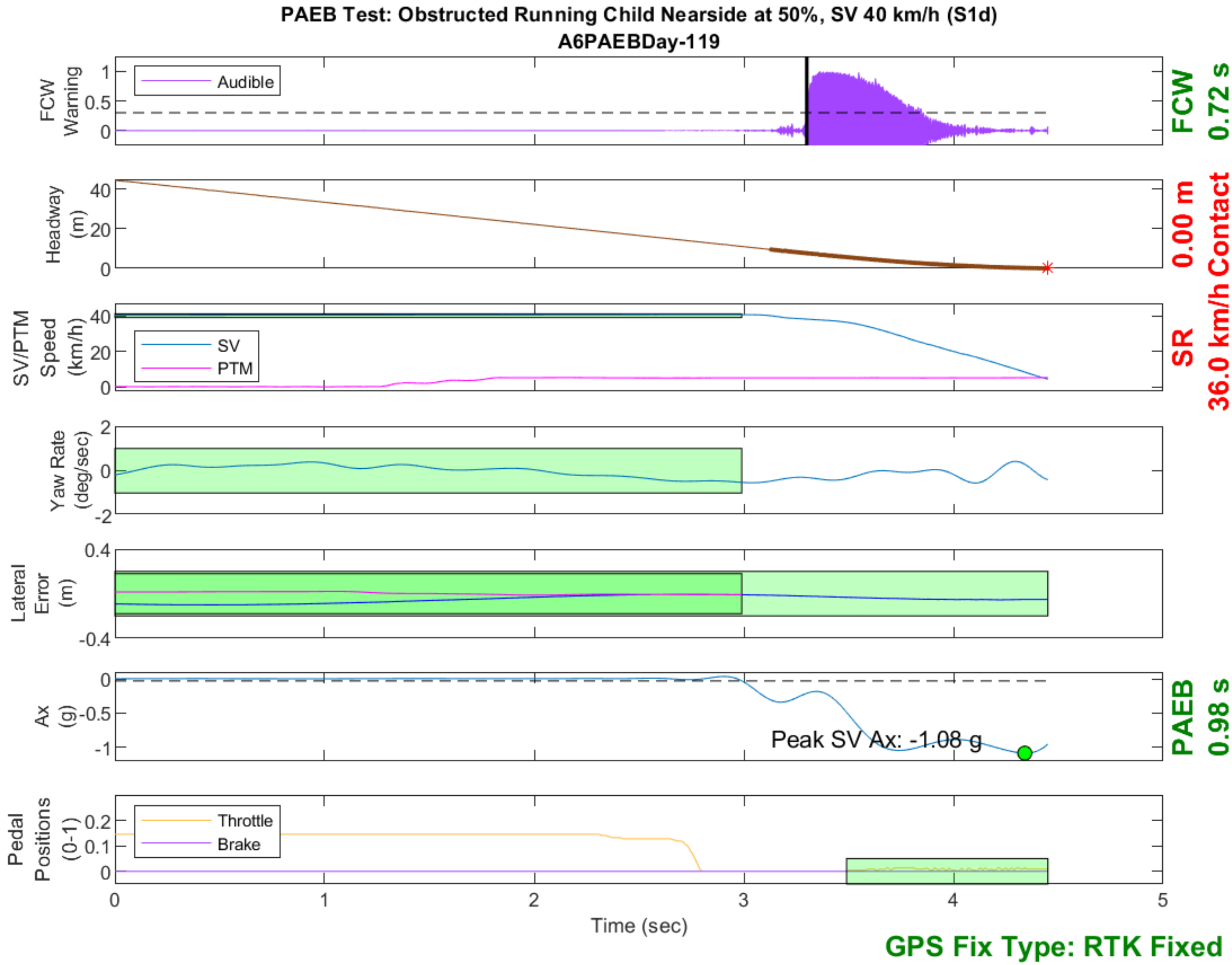


Figure D81. Time History for PAEB Run 119, S1d, Daytime, 40 km/h

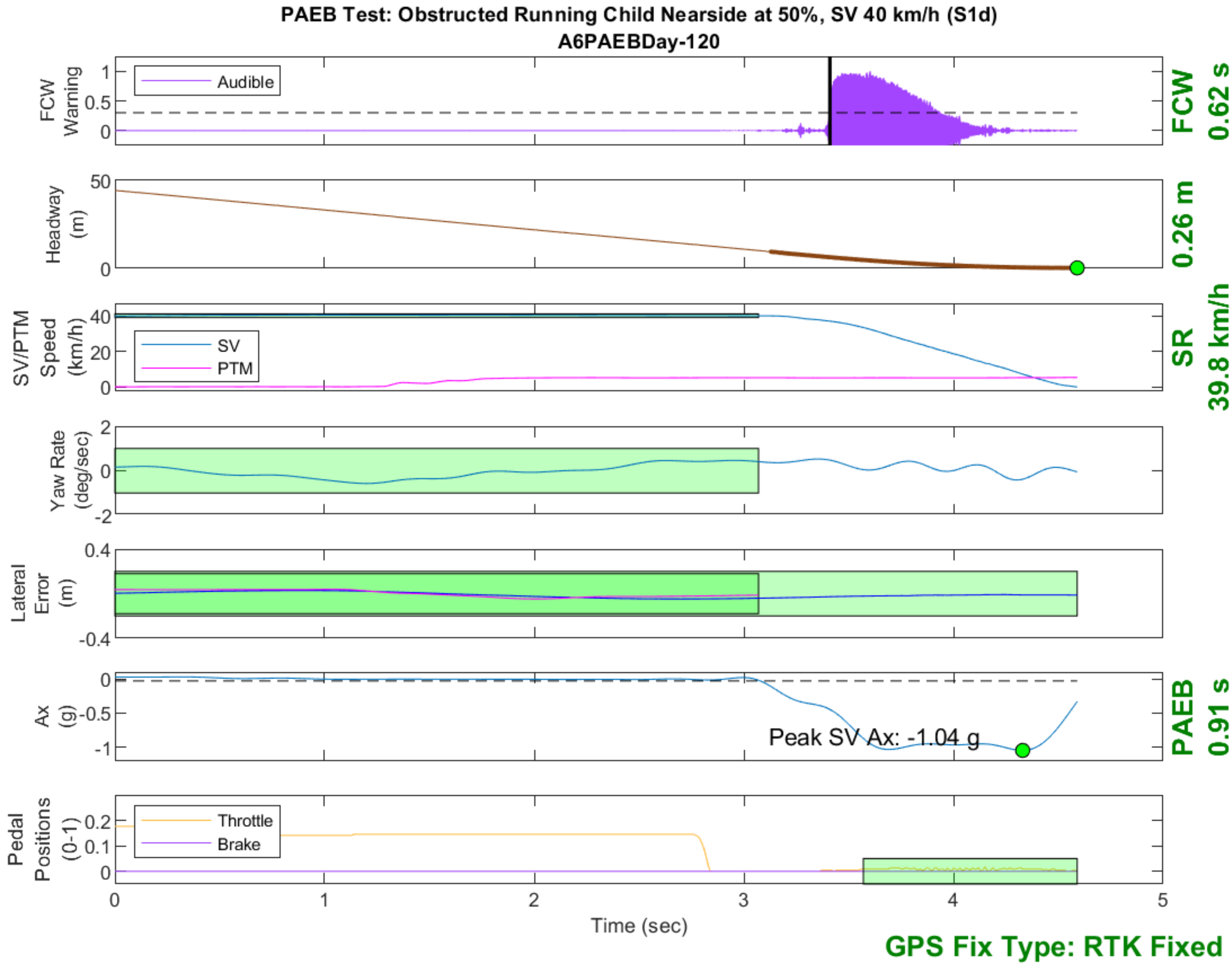


Figure D82. Time History for PAEB Run 120, S1d, Daytime, 40 km/h

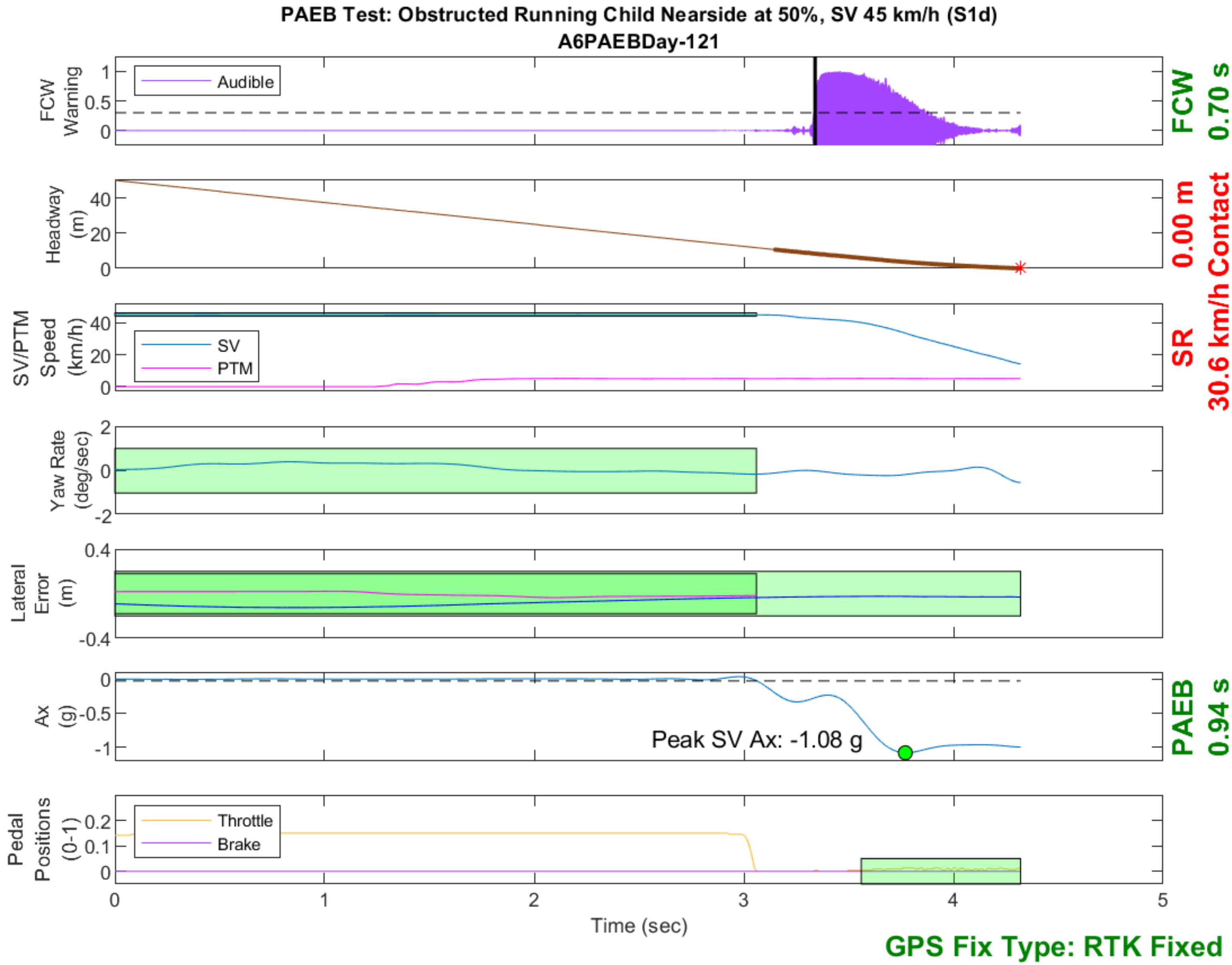


Figure D83. Time History for PAEB Run 121, S1d, Daytime, 45 km/h

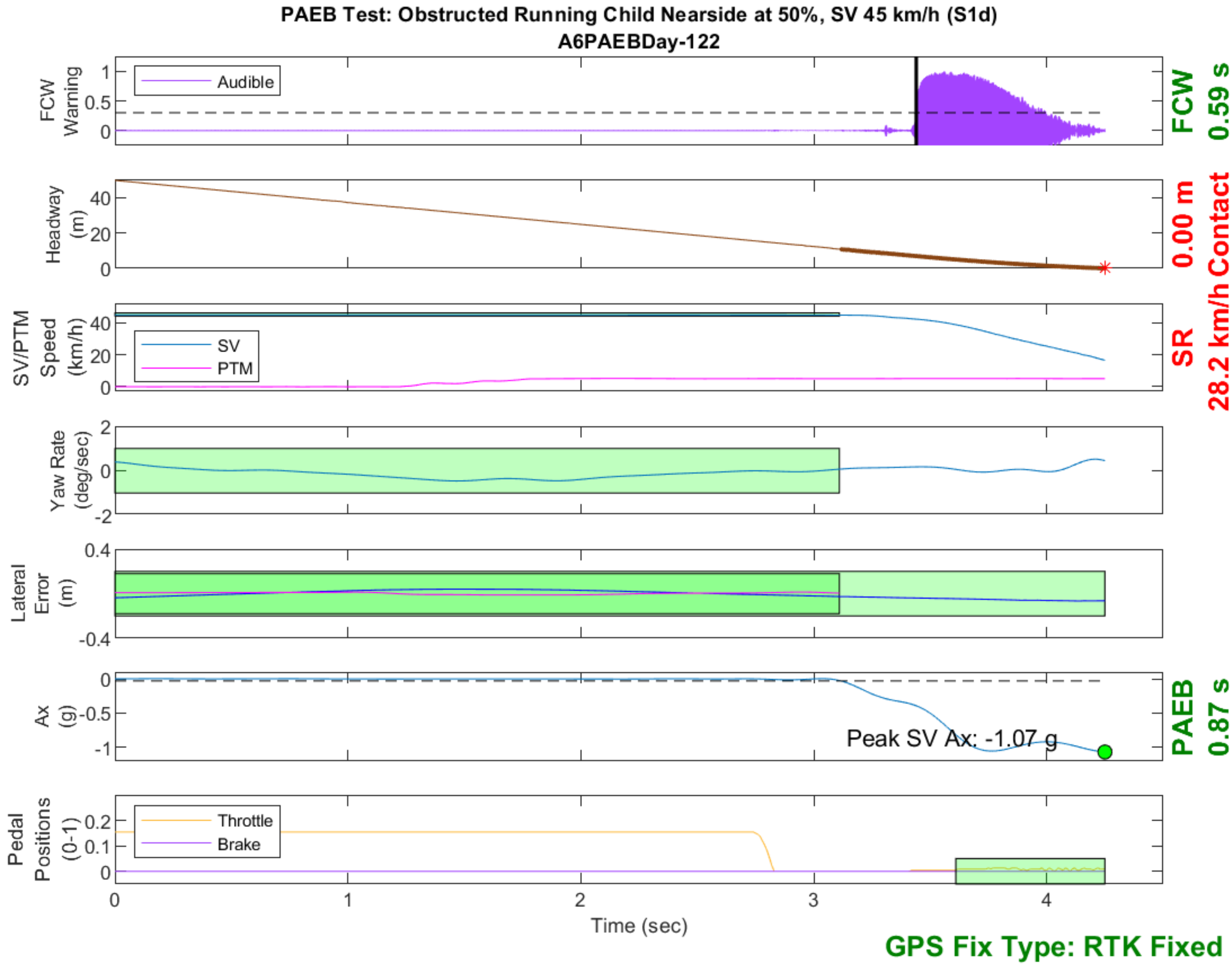


Figure D84. Time History for PAEB Run 122, S1d, Daytime, 45 km/h

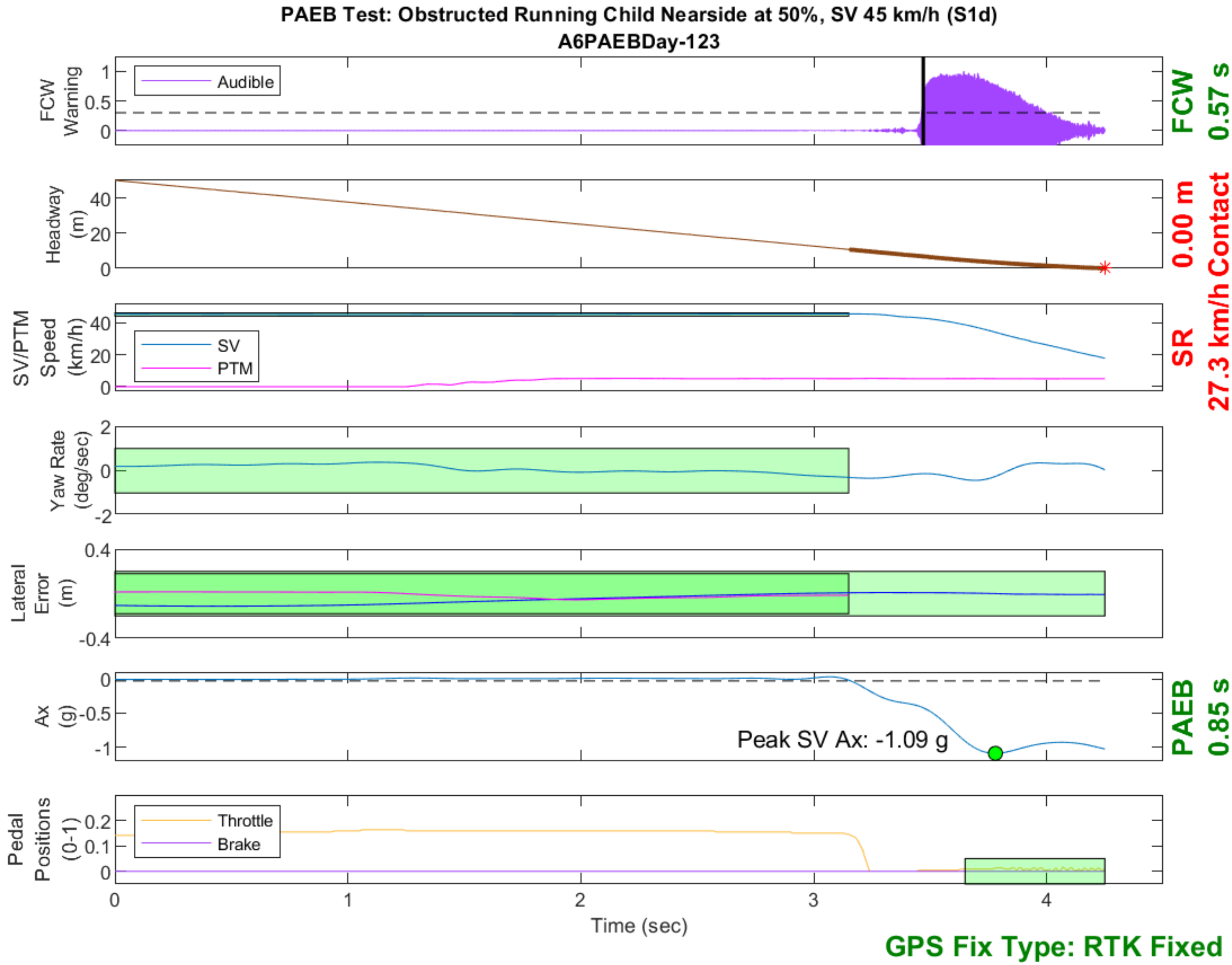


Figure D85. Time History for PAEB Run 123, S1d, Daytime, 45 km/h

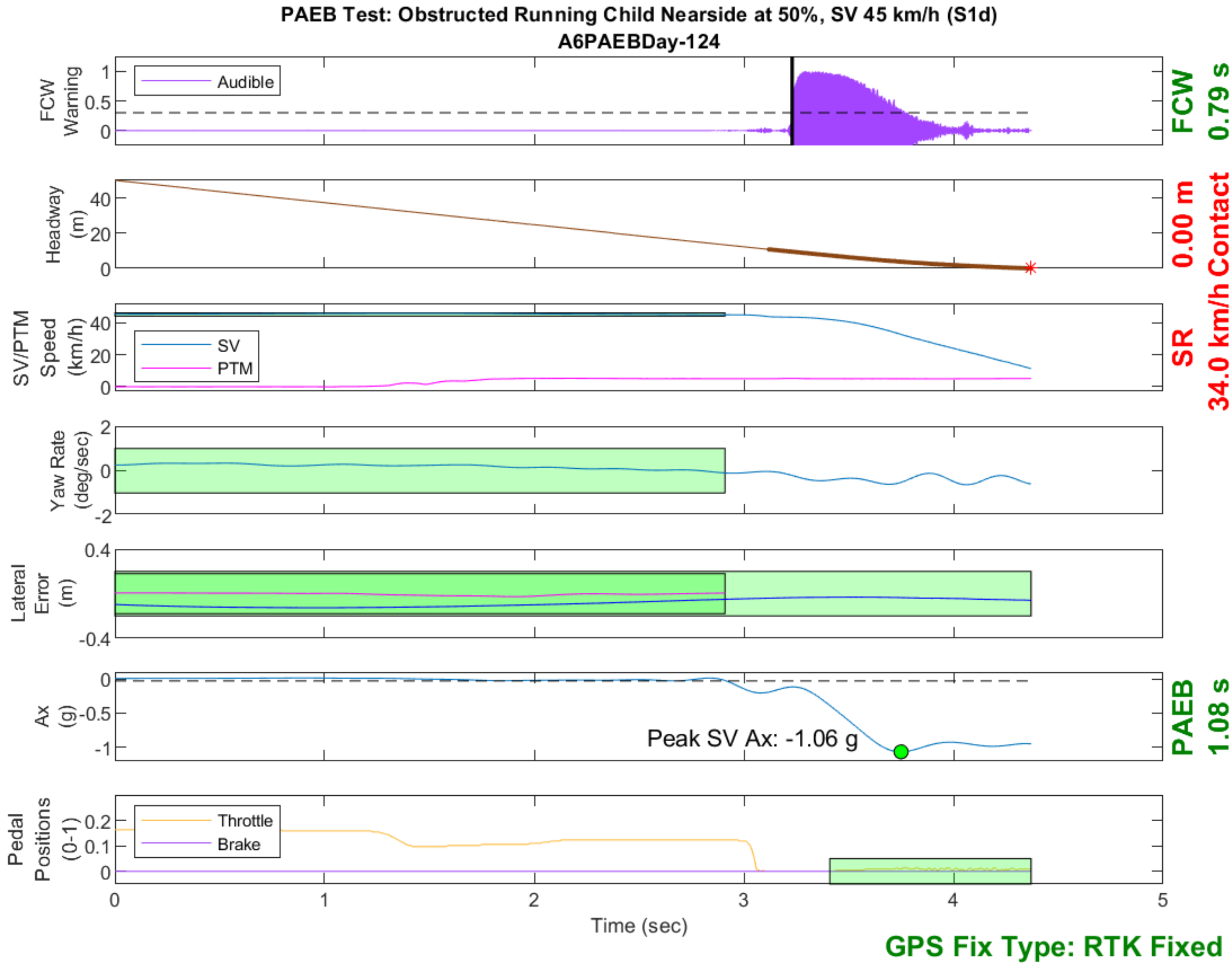


Figure D86. Time History for PAEB Run 124, S1d, Daytime, 45 km/h

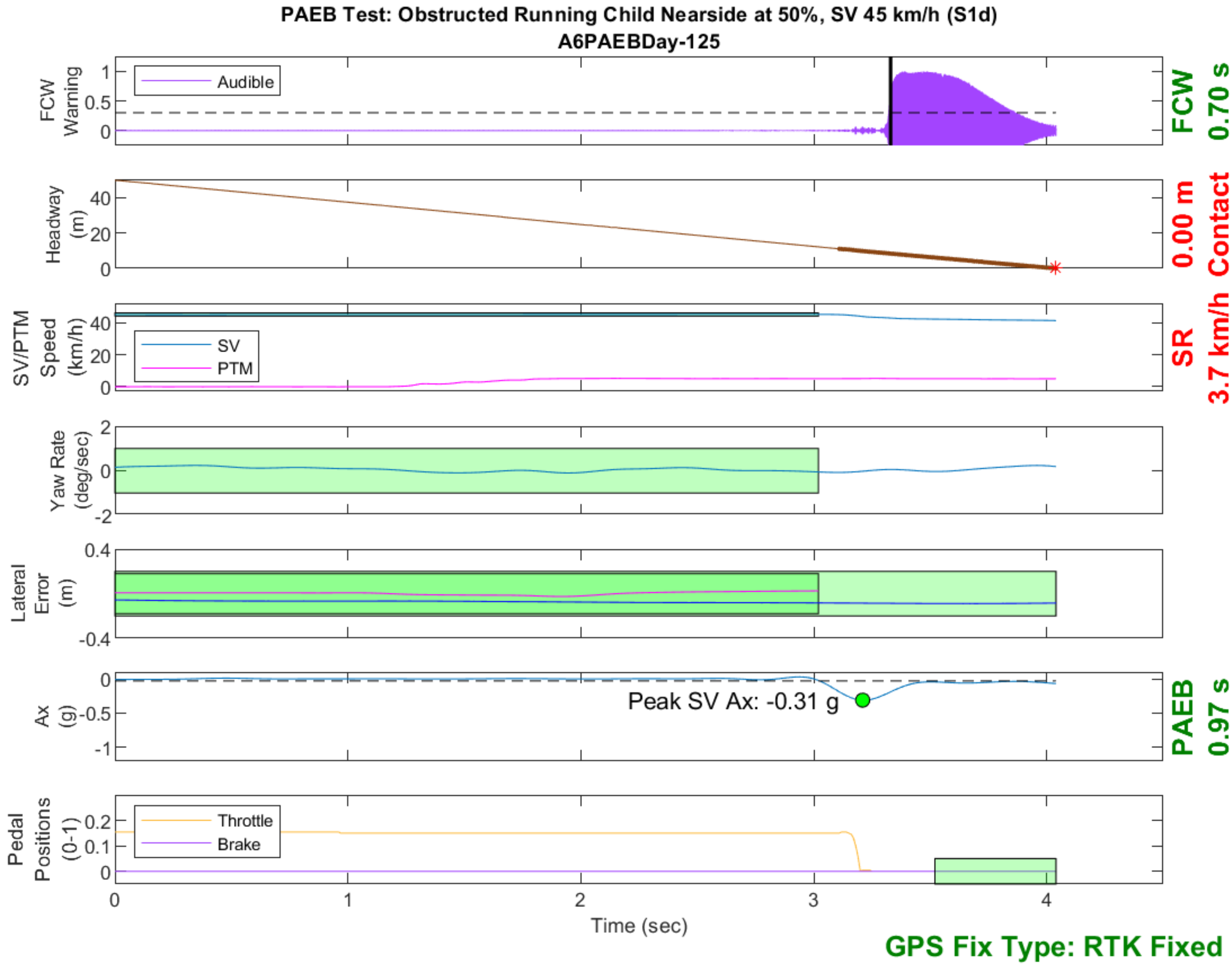


Figure D87. Time History for PAEB Run 125, S1d, Daytime, 45 km/h

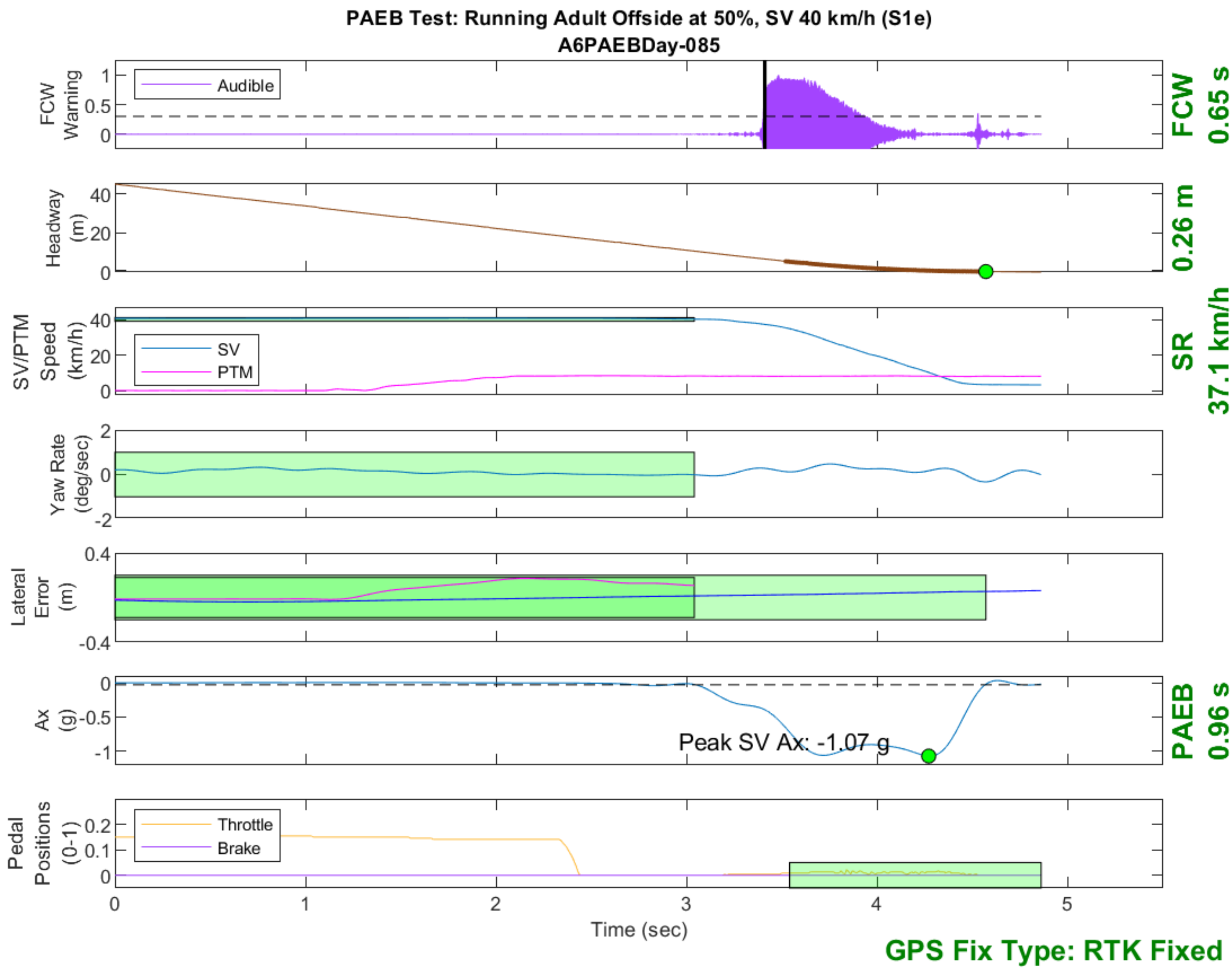


Figure D88. Time History for PAEB Run 85, S1e, Daytime, 40 km/h

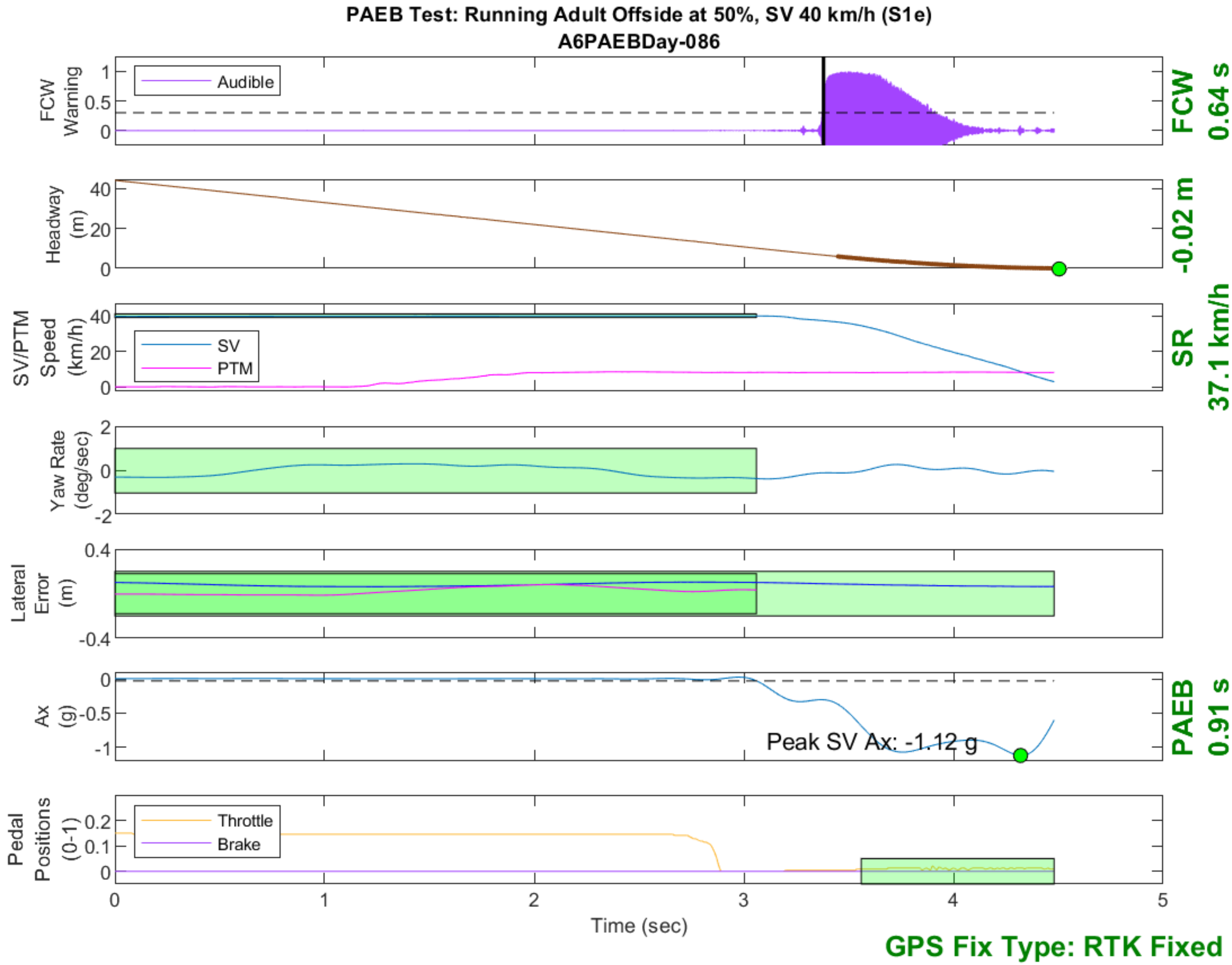


Figure D89. Time History for PAEB Run 86, S1e, Daytime, 40 km/h

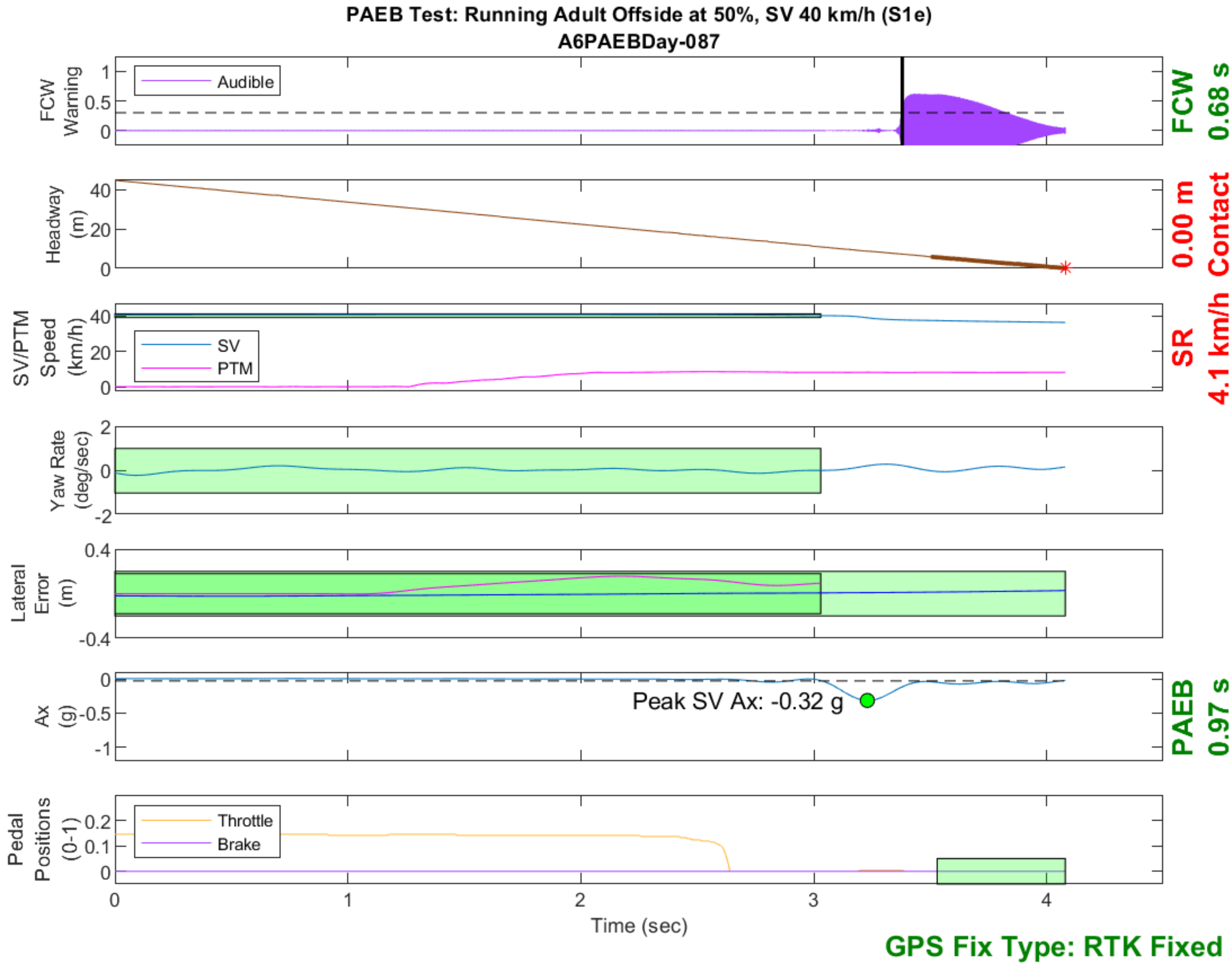


Figure D90. Time History for PAEB Run 87, S1e, Daytime, 40 km/h

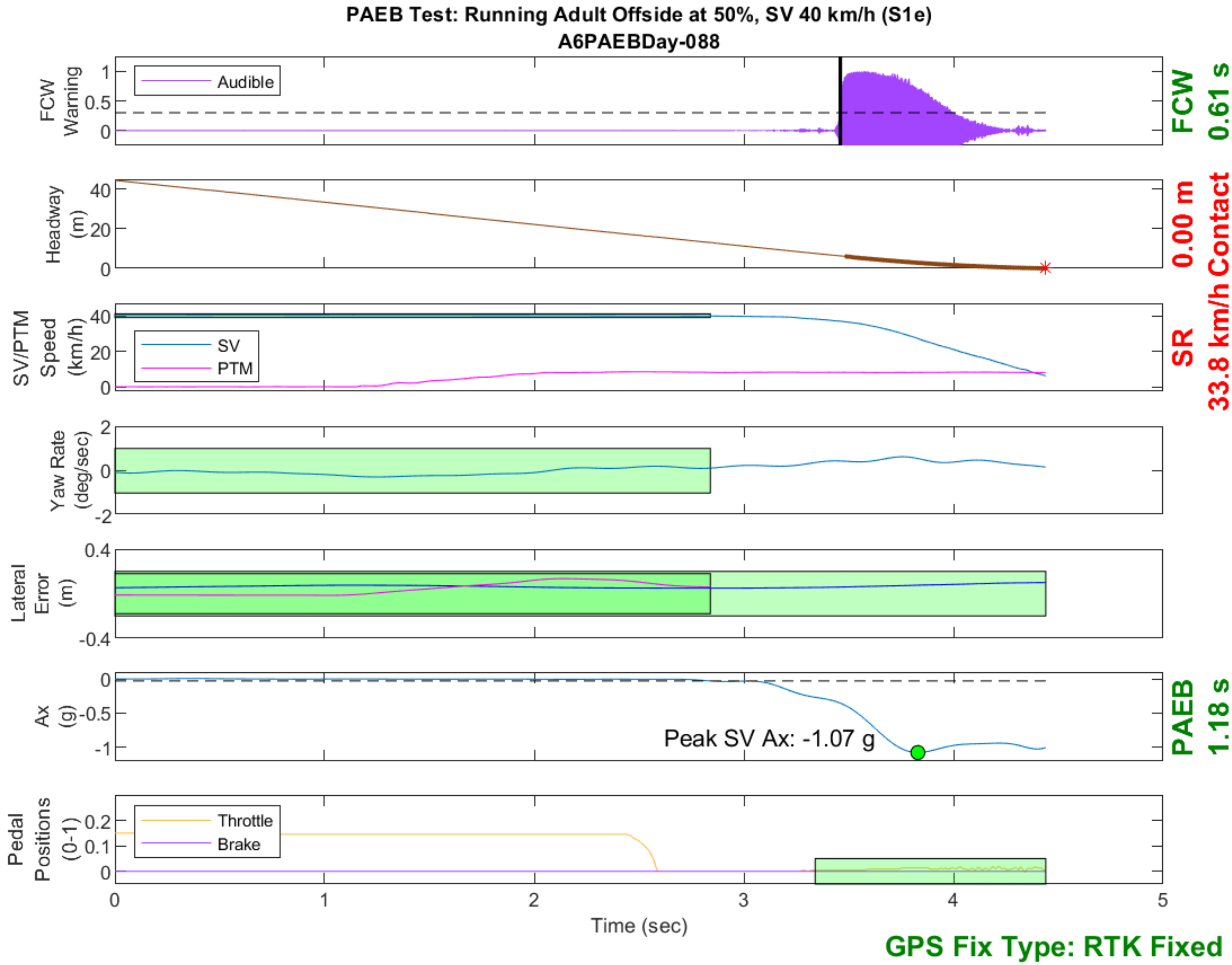


Figure D91. Time History for PAEB Run 88, S1e, Daytime, 40 km/h

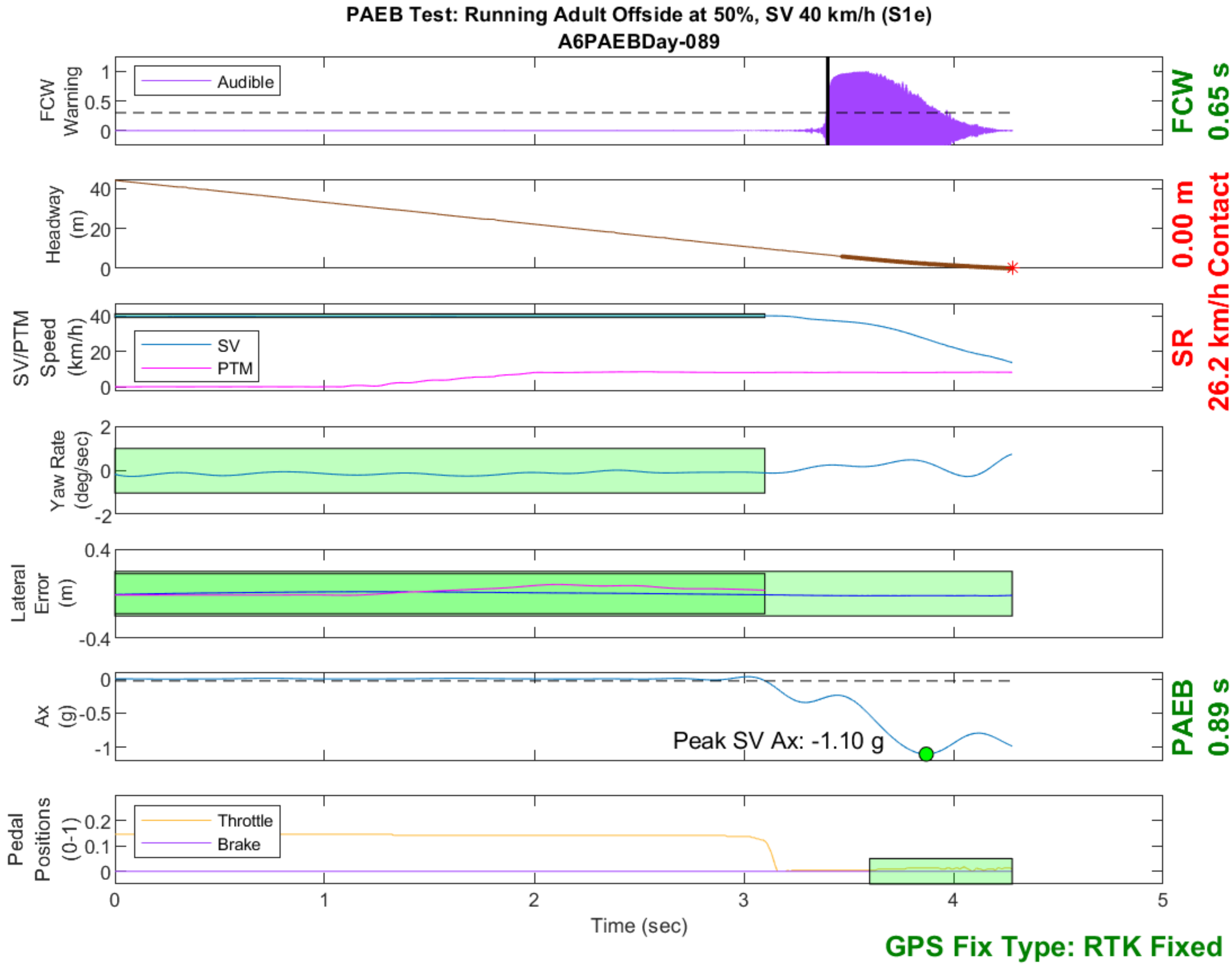


Figure D92. Time History for PAEB Run 89, S1e, Daytime, 40 km/h

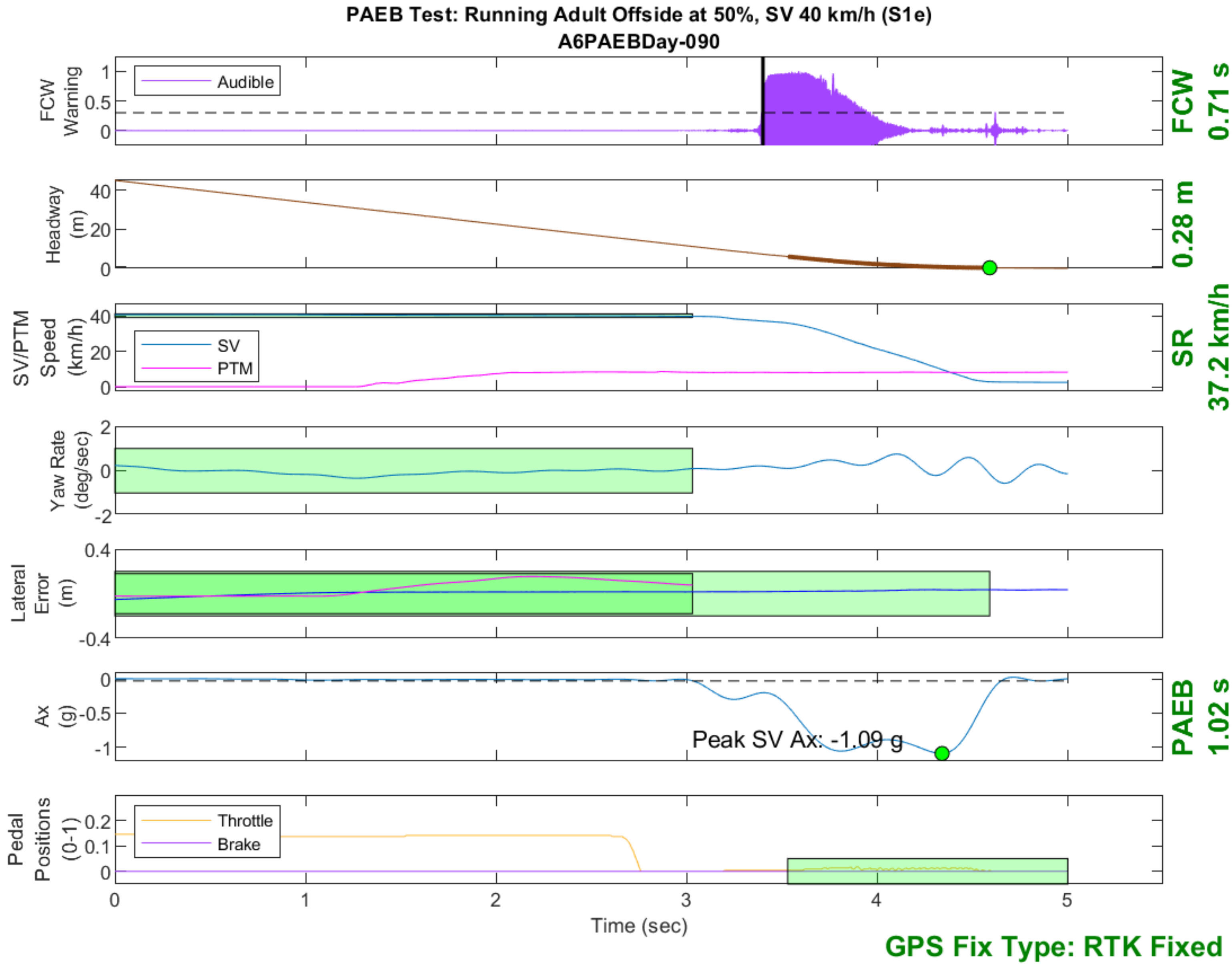


Figure D93. Time History for PAEB Run 90, S1e, Daytime, 40 km/h

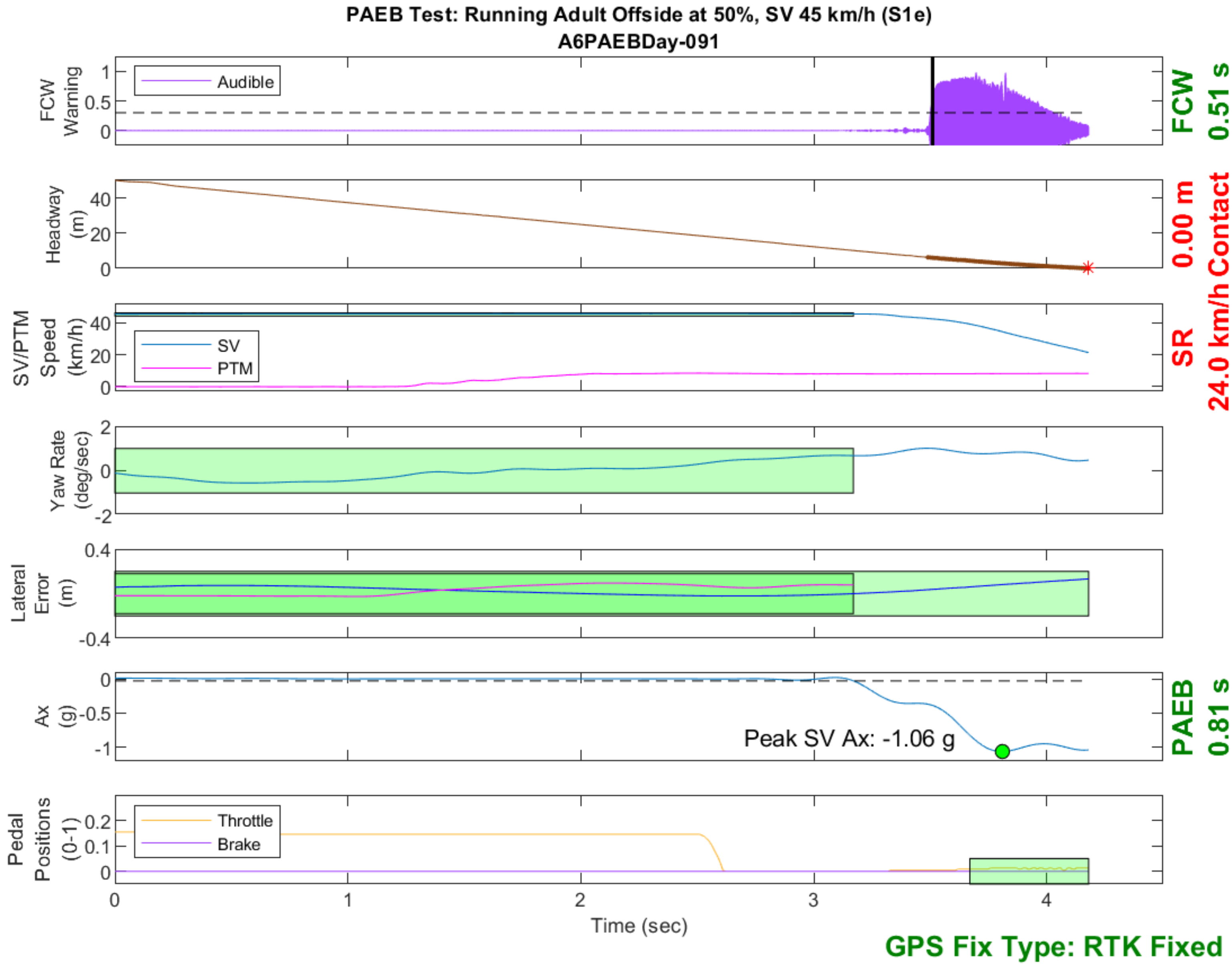


Figure D94. Time History for PAEB Run 91, S1e, Daytime, 45 km/h

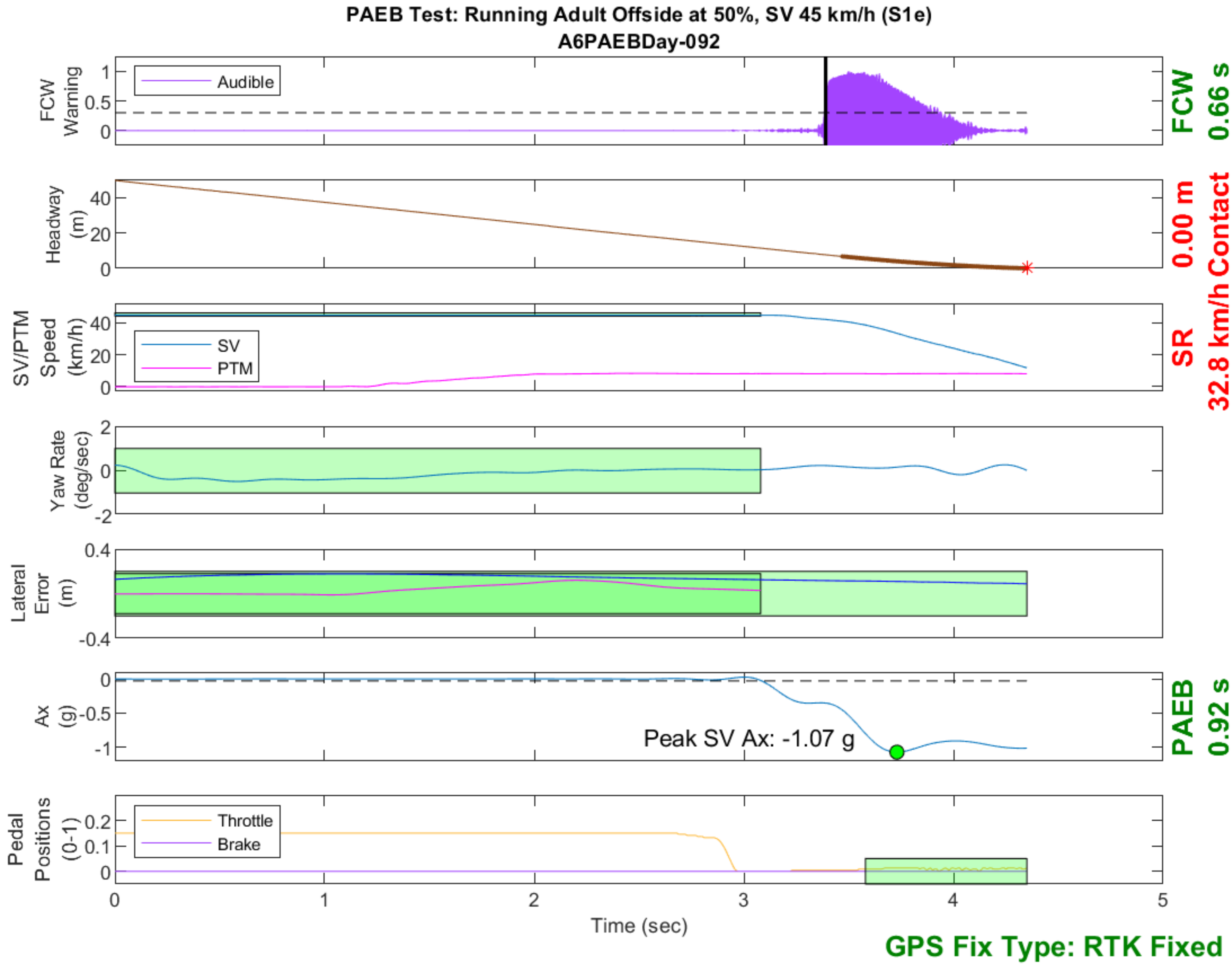


Figure D95. Time History for PAEB Run 92, S1e, Daytime, 45 km/h

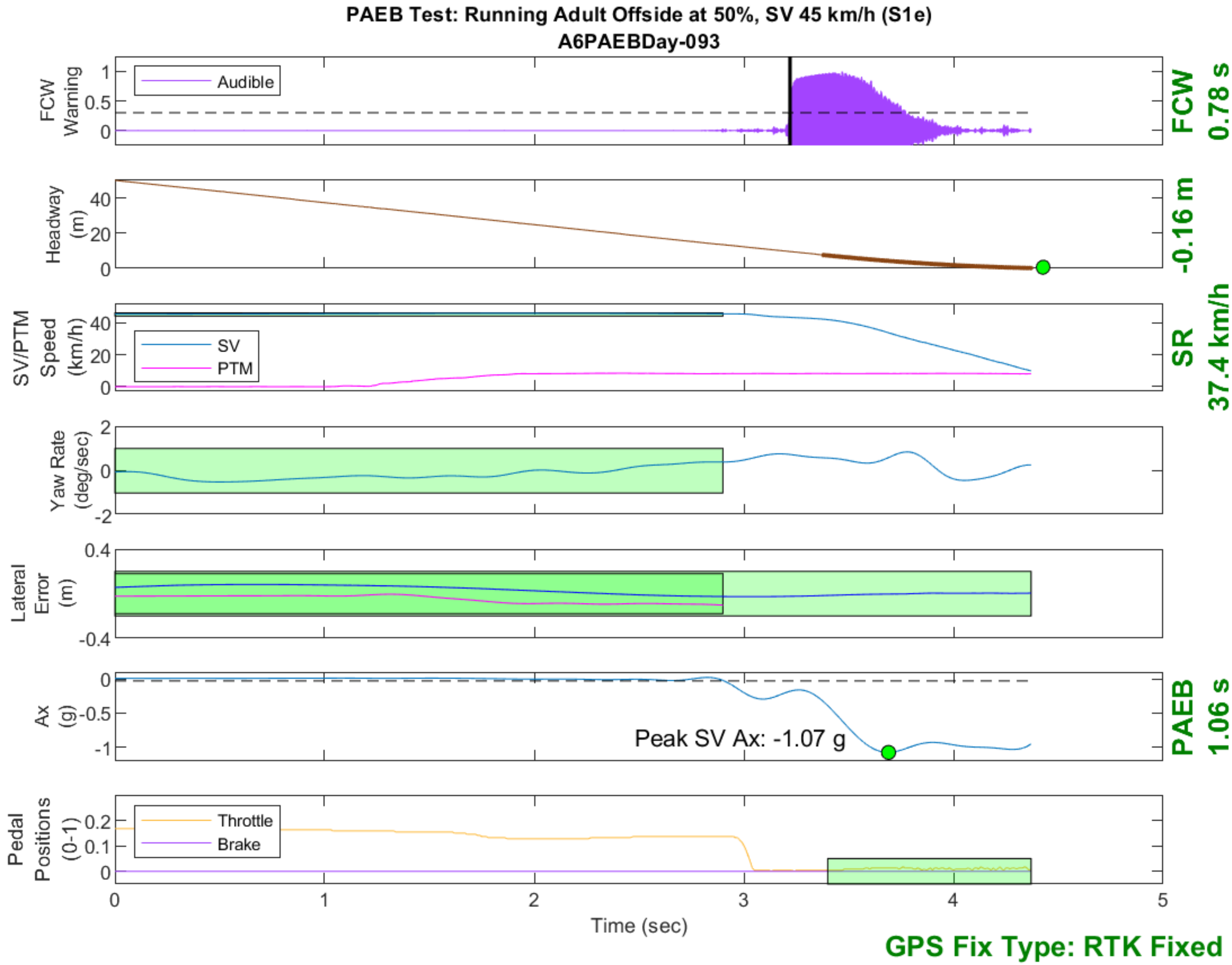


Figure D96. Time History for PAEB Run 93, S1e, Daytime, 45 km/h

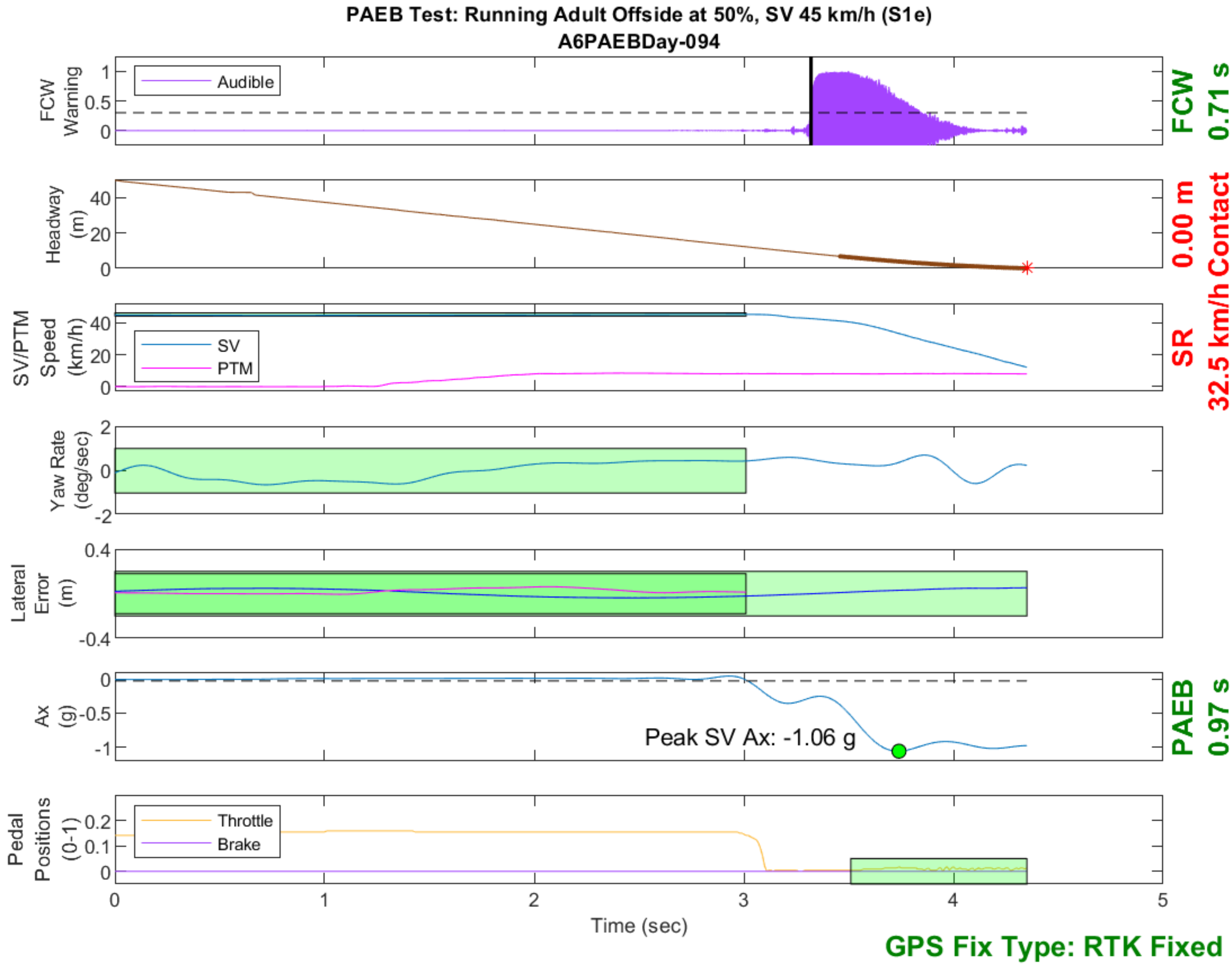


Figure D97. Time History for PAEB Run 94, S1e, Daytime, 45 km/h

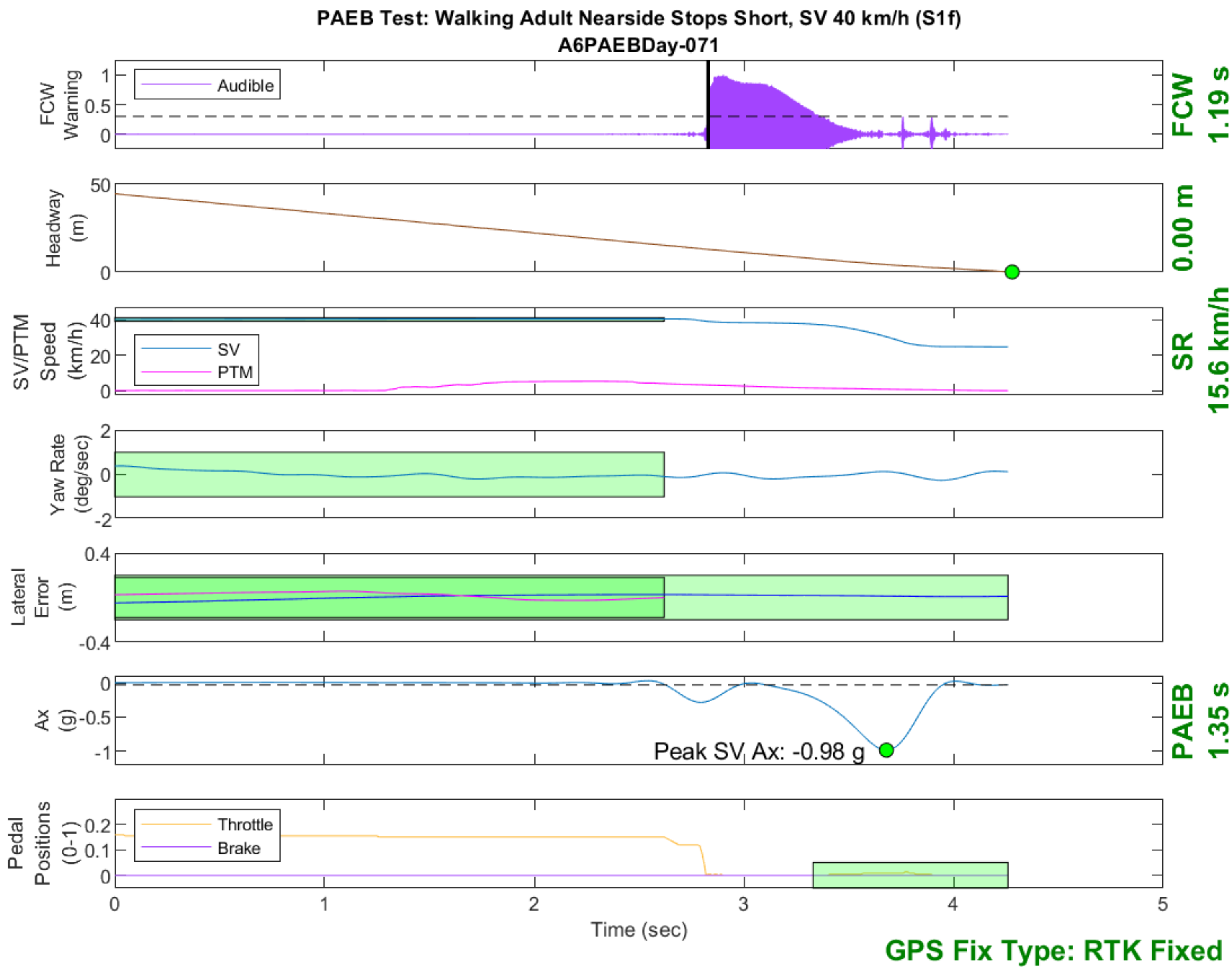


Figure D98. Time History for PAEB Run 71, S1f, Daytime, 40 km/h

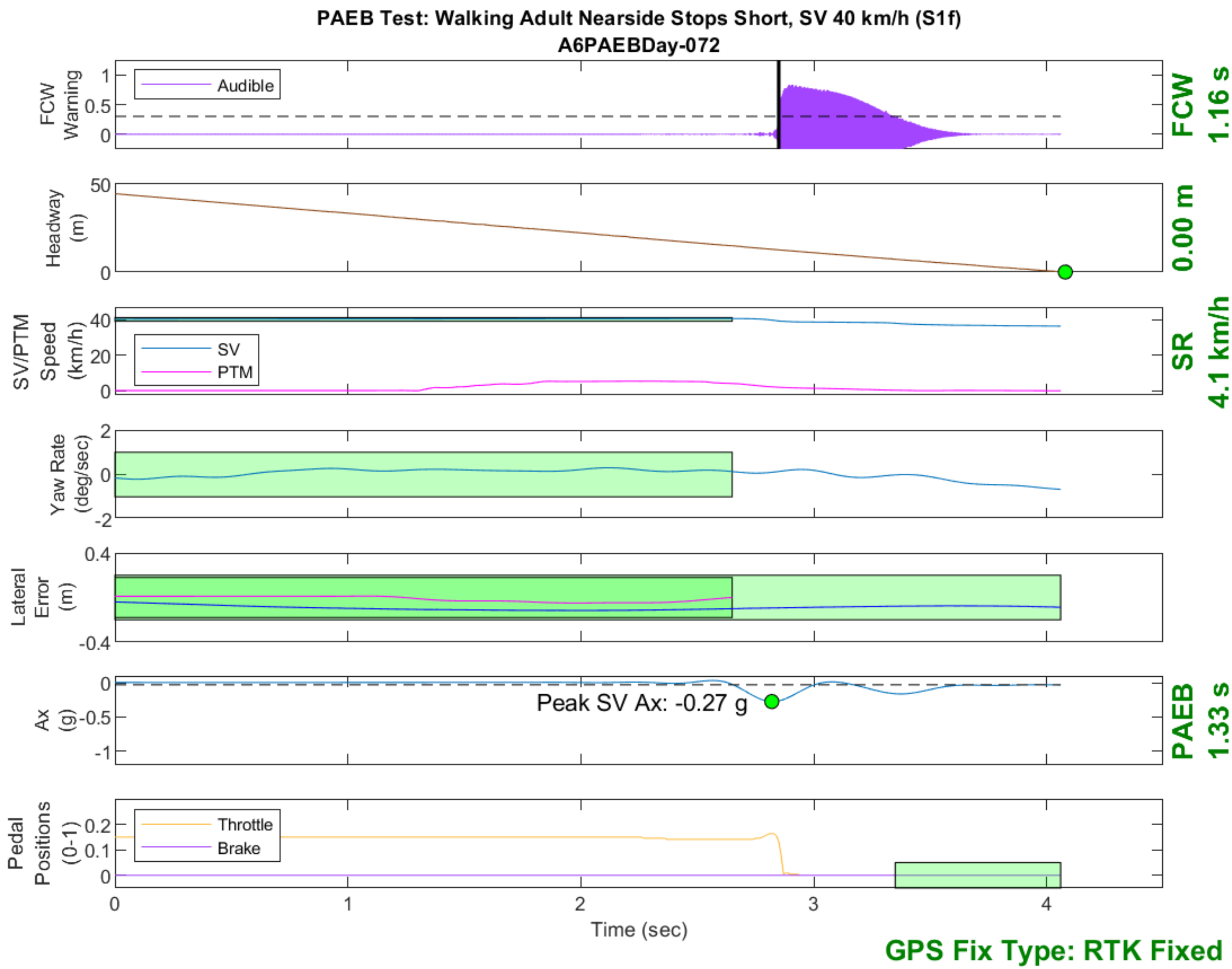


Figure D99. Time History for PAEB Run 72, S1f, Daytime, 40 km/h

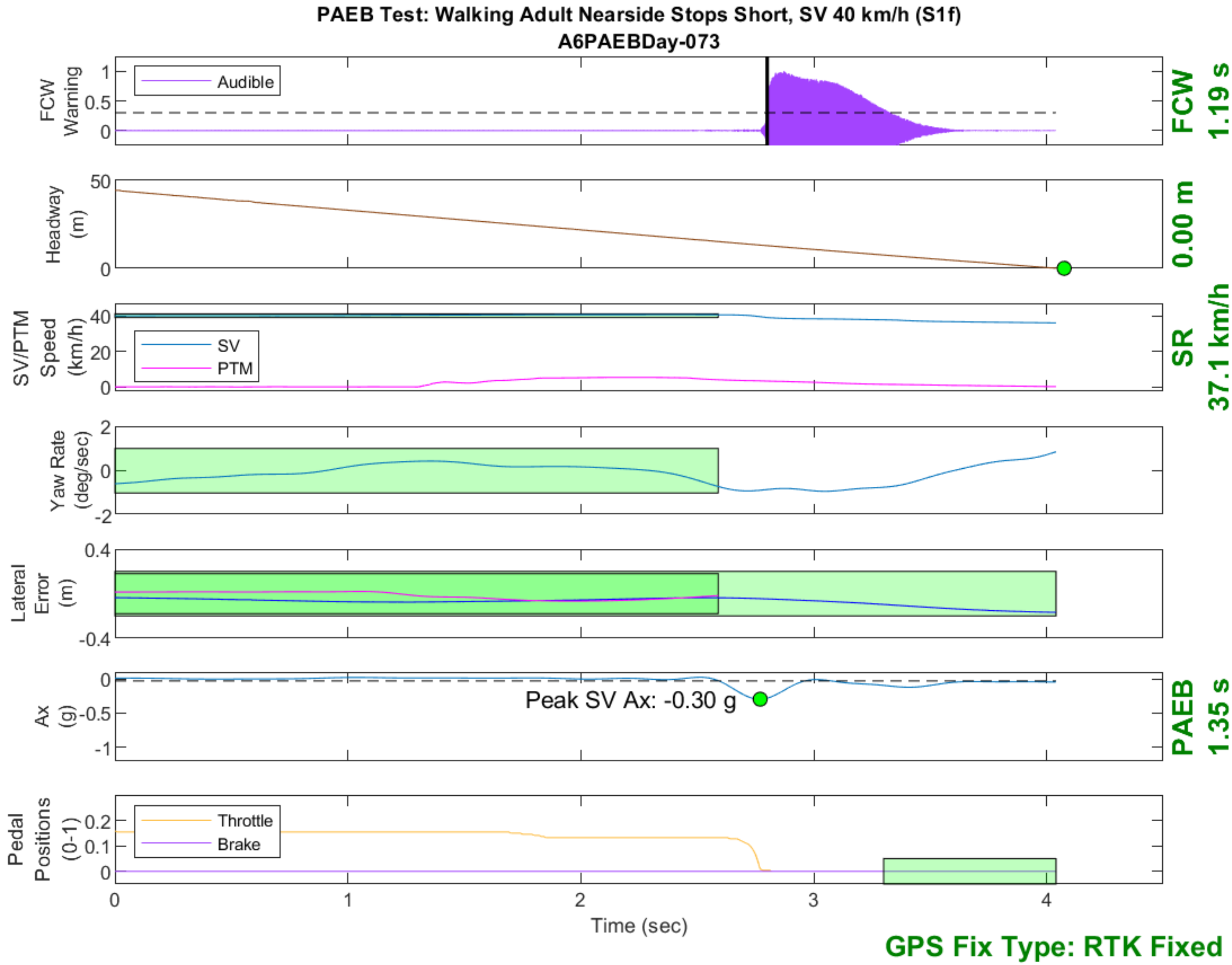


Figure D100. Time History for PAEB Run 73, S1f, Daytime, 40 km/h

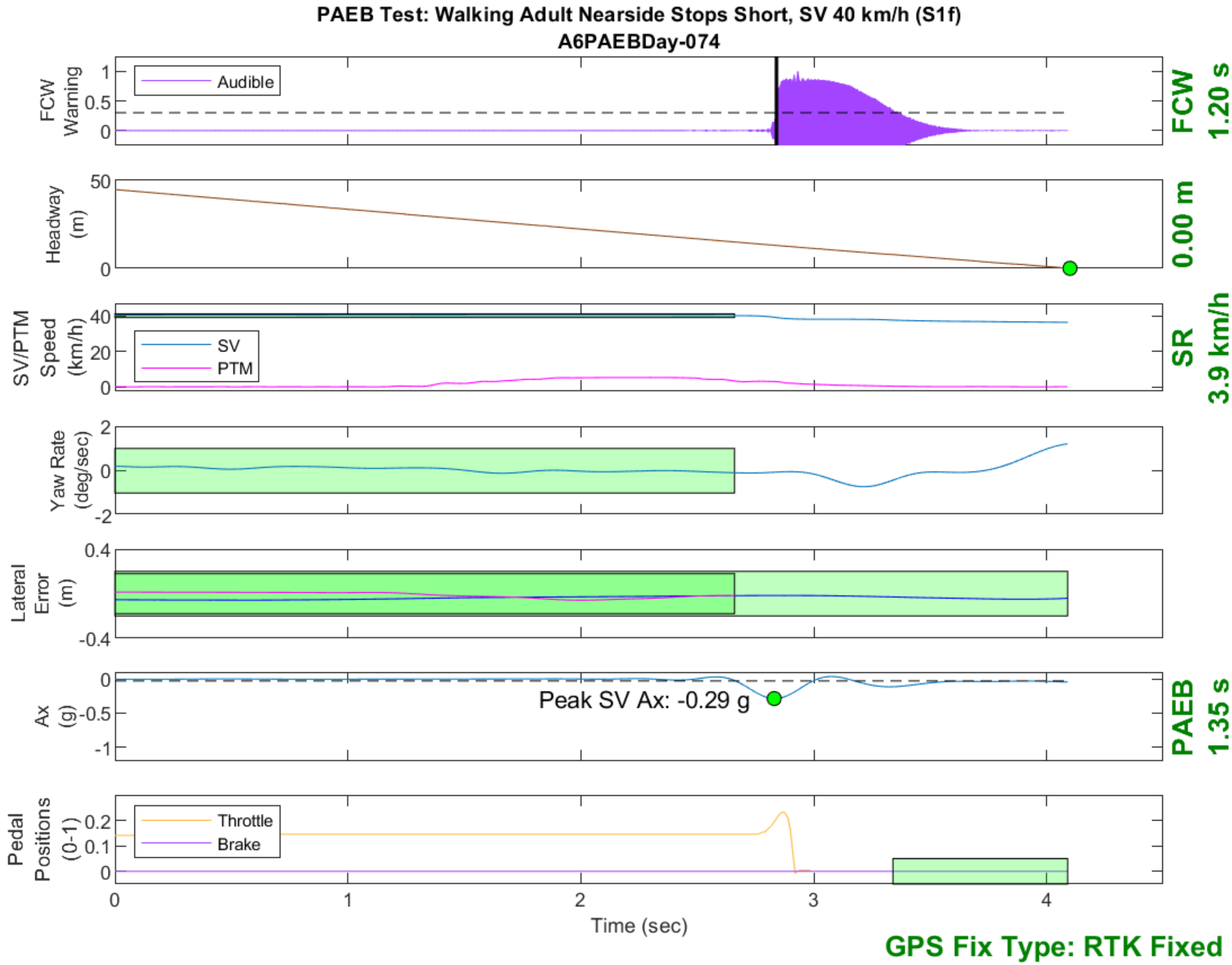


Figure D101. Time History for PAEB Run 74, S1f, Daytime, 40 km/h

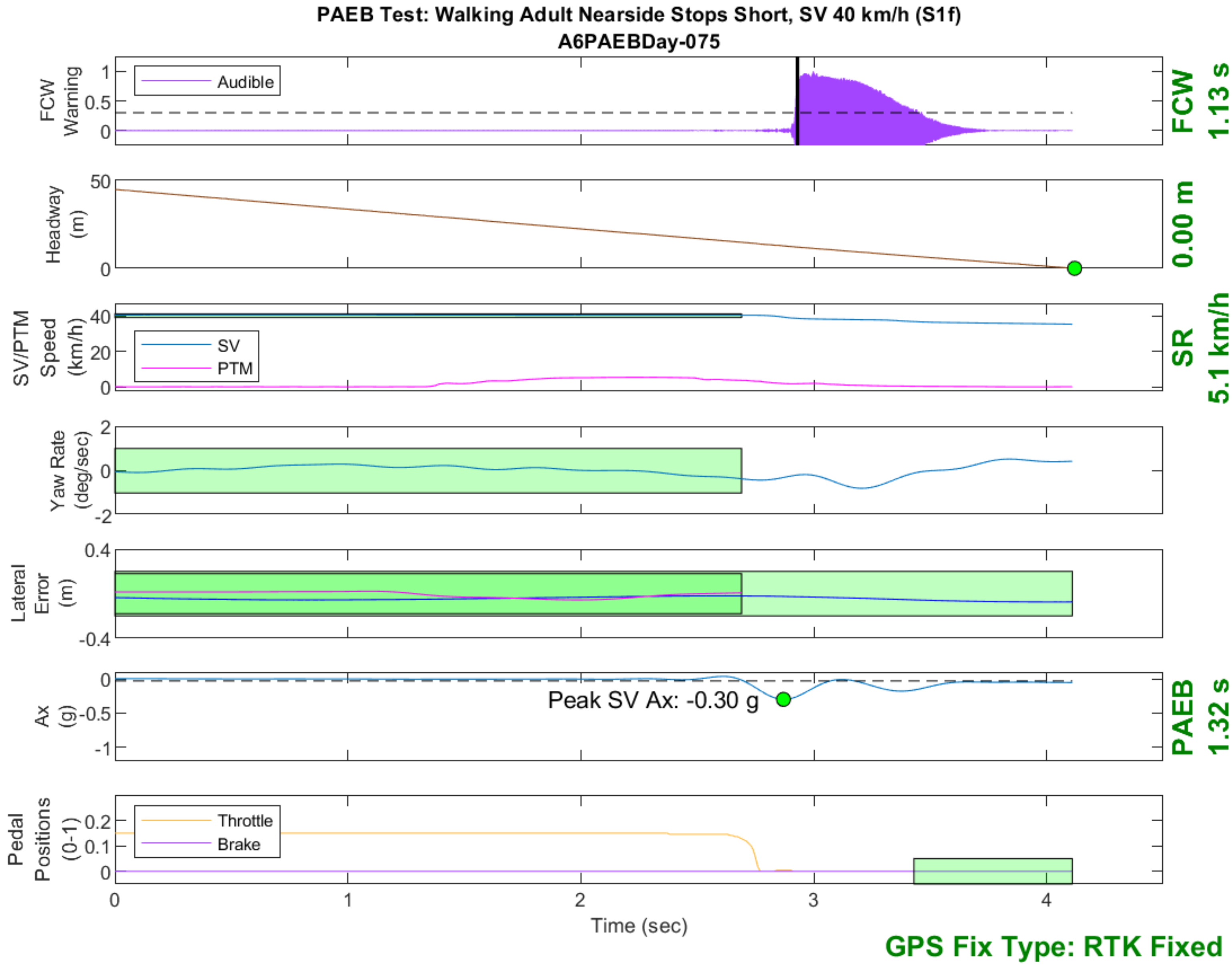


Figure D102. Time History for PAEB Run 75, S1f, Daytime, 40 km/h

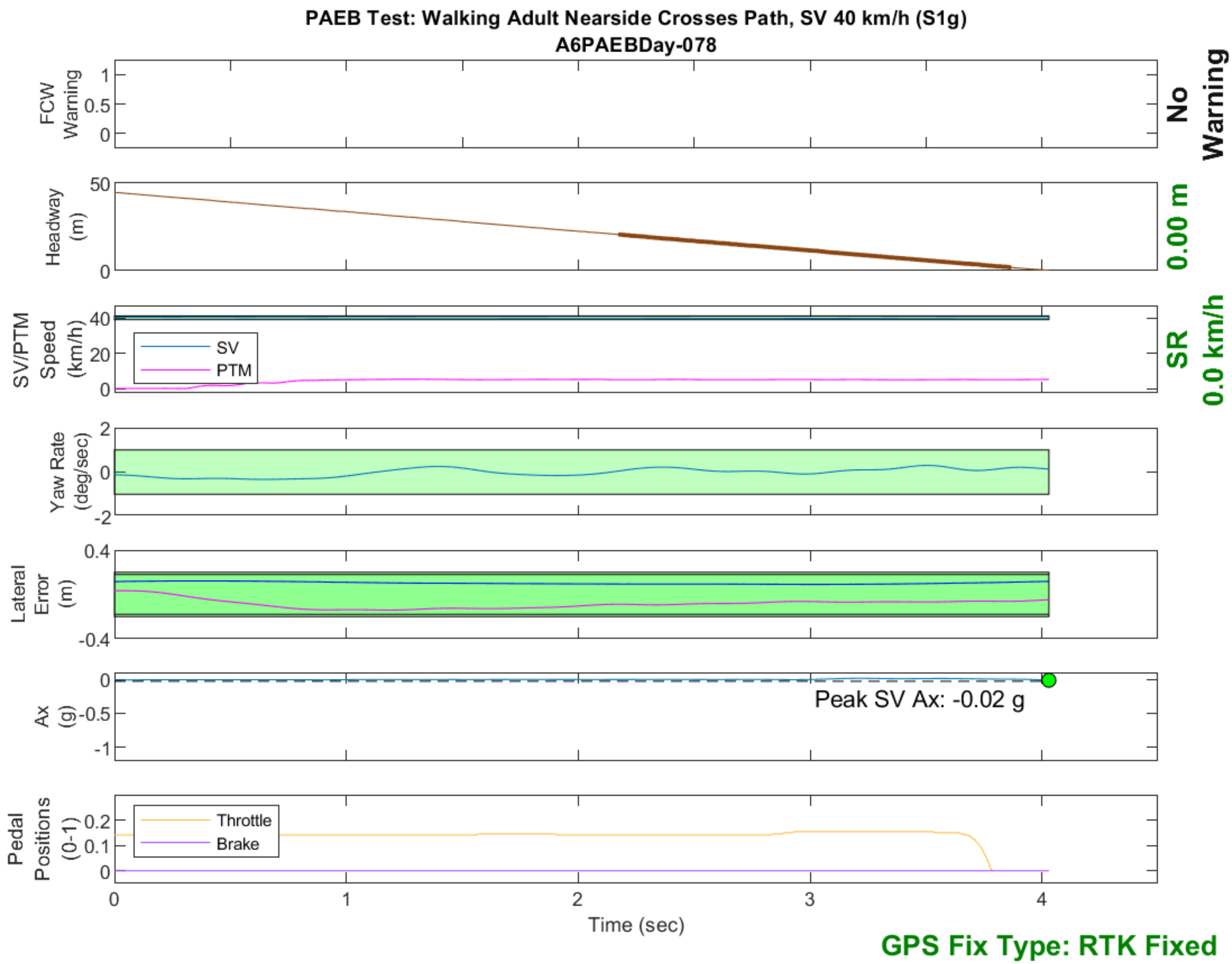


Figure D103. Time History for PAEB Run 78, S1g, Daytime, 40 km/h

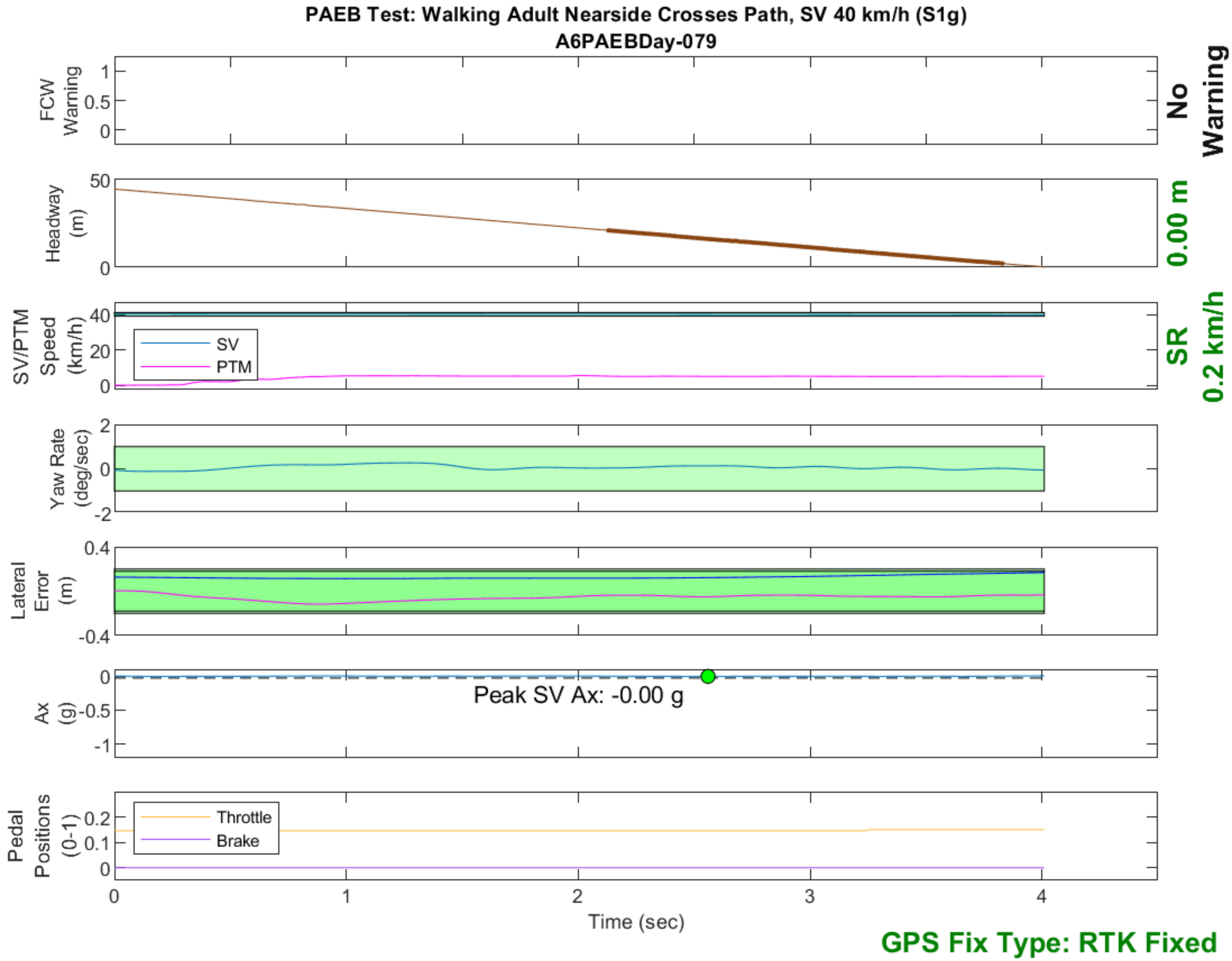


Figure D104. Time History for PAEB Run 79, S1g, Daytime, 40 km/h

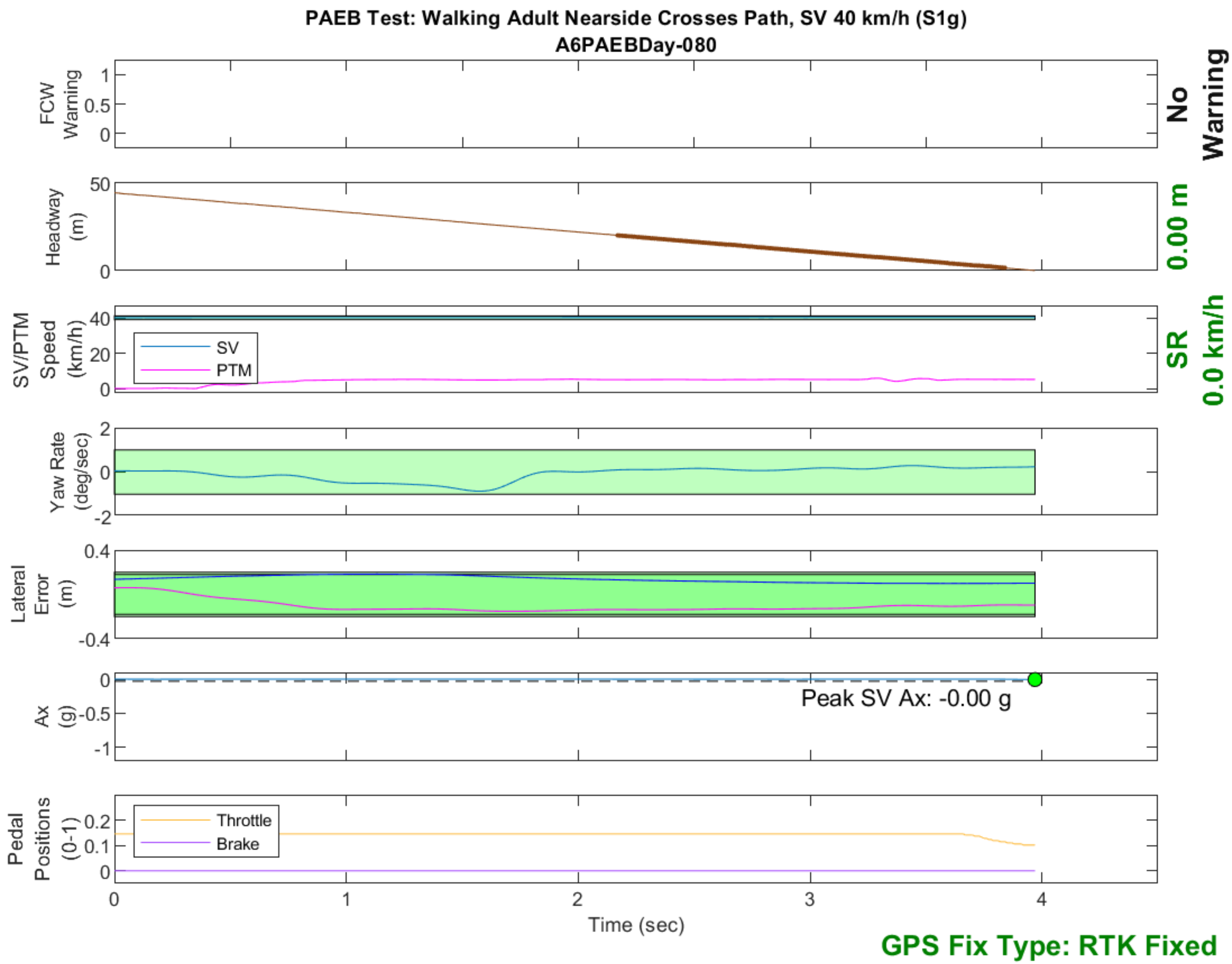


Figure D105. Time History for PAEB Run 80, S1g, Daytime, 40 km/h

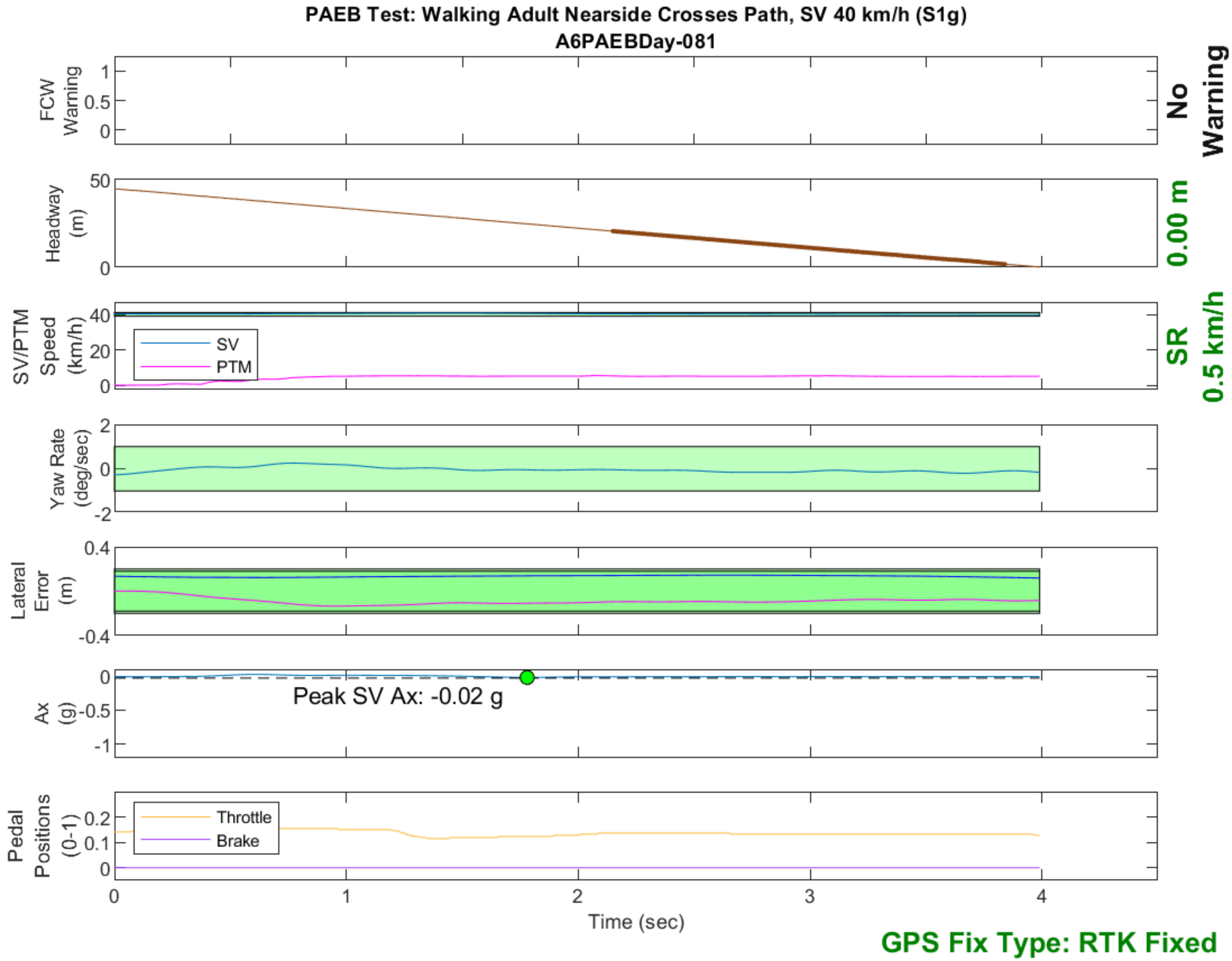


Figure D106. Time History for PAEB Run 81, S1g, Daytime, 40 km/h

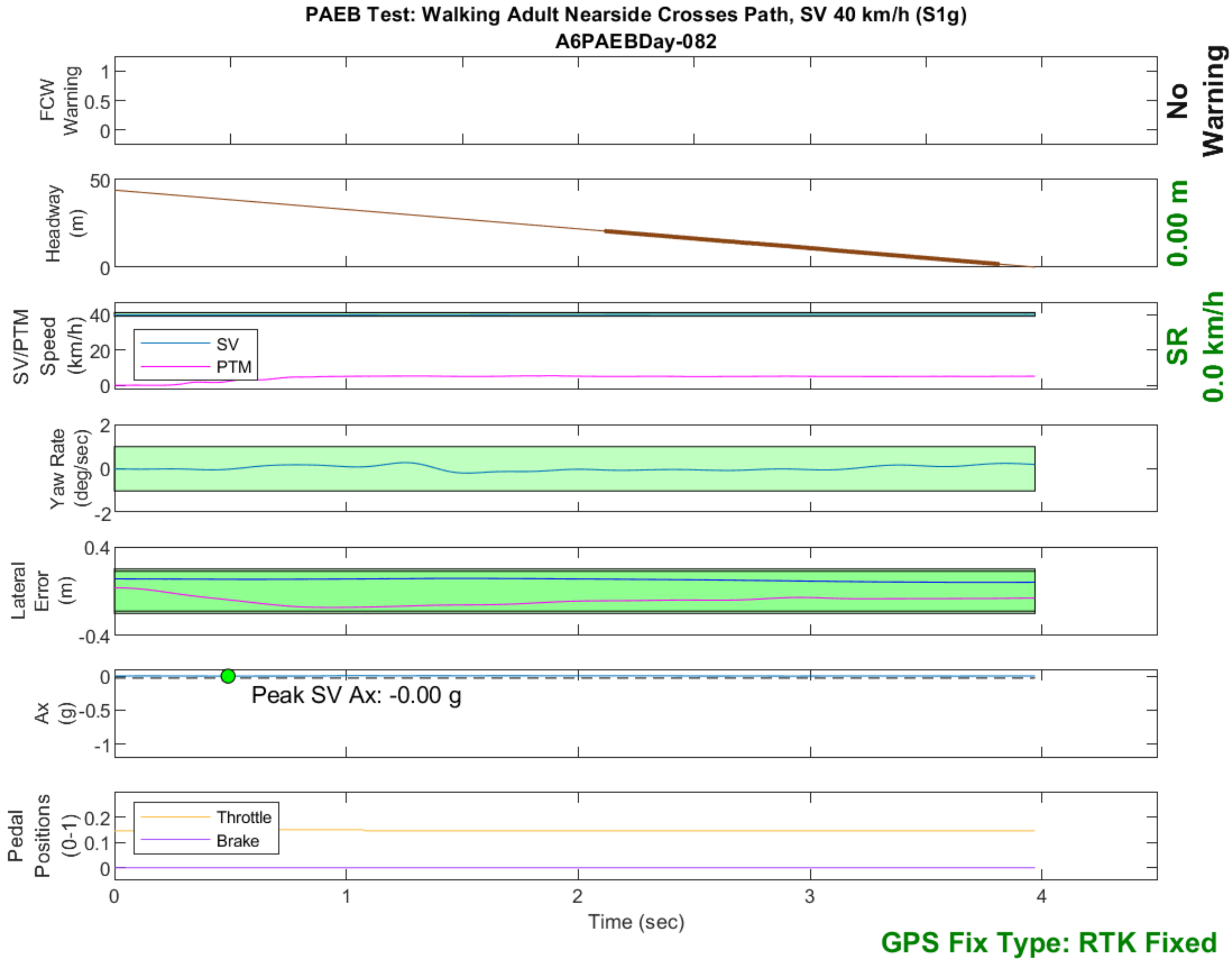


Figure D107. Time History for PAEB Run 82, S1g, Daytime, 40 km/h

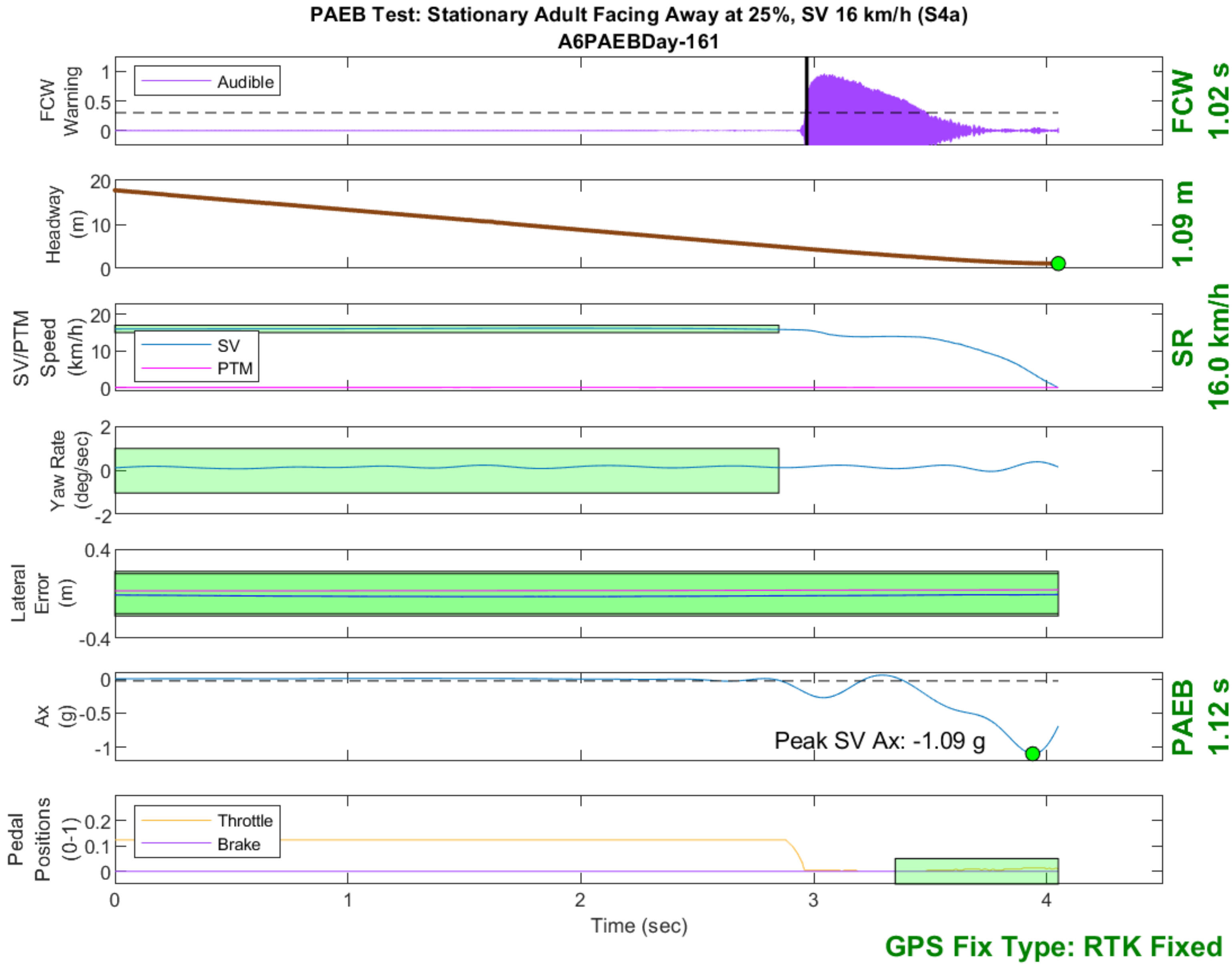


Figure D108. Time History for PAEB Run 161, S4a, Daytime, 16 km/h

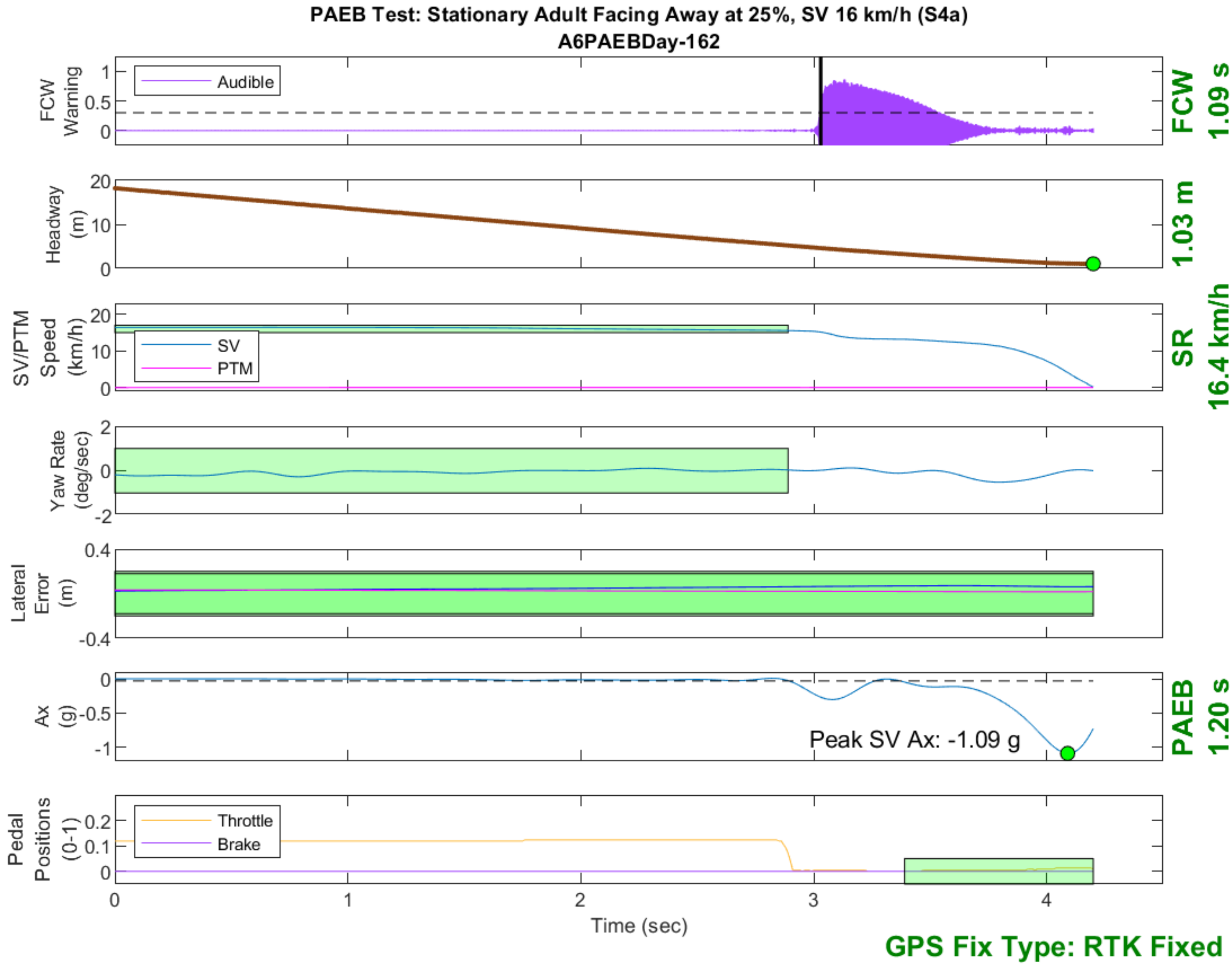


Figure D109. Time History for PAEB Run 162, S4a, Daytime, 16 km/h

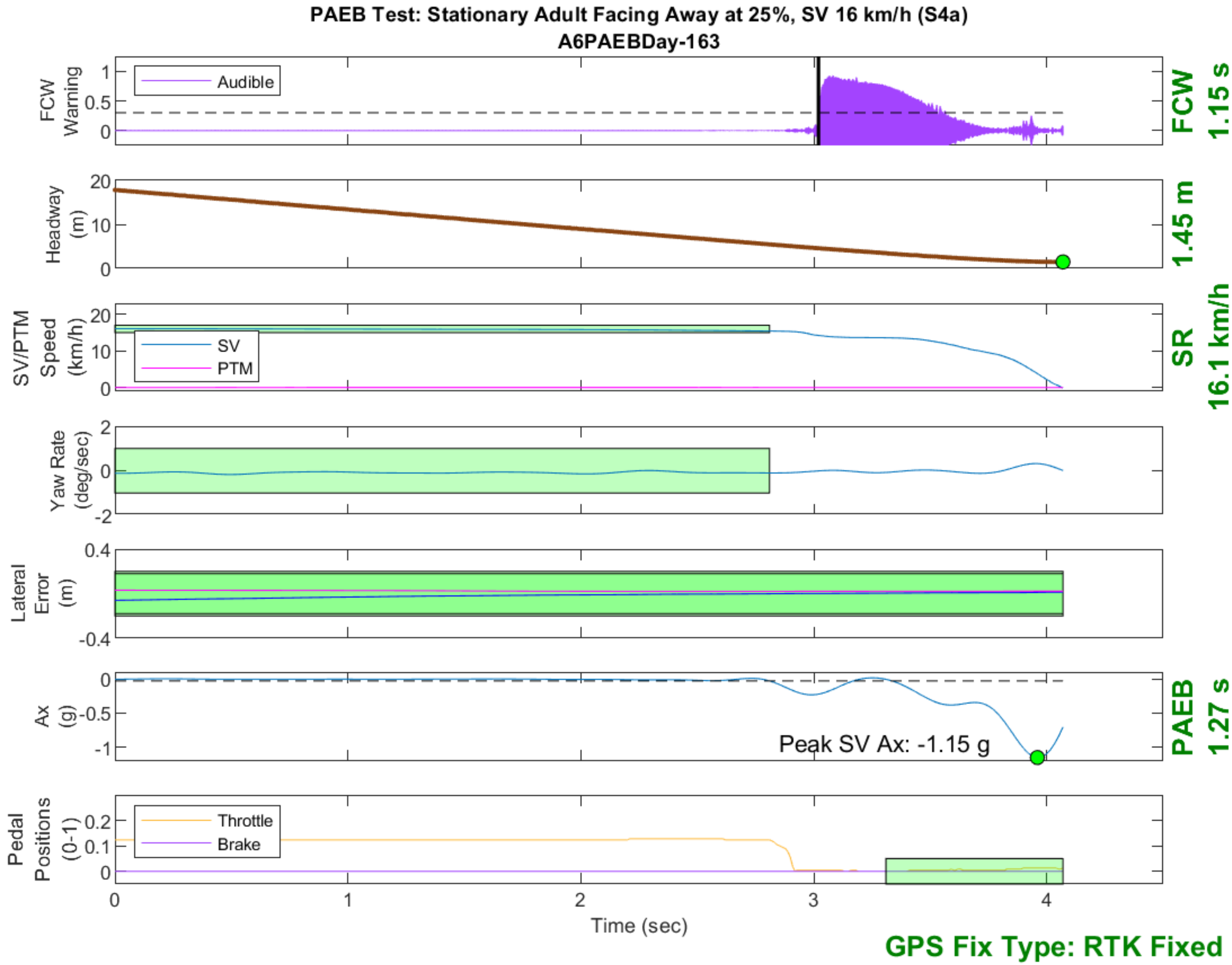


Figure D110. Time History for PAEB Run 163, S4a, Daytime, 16 km/h

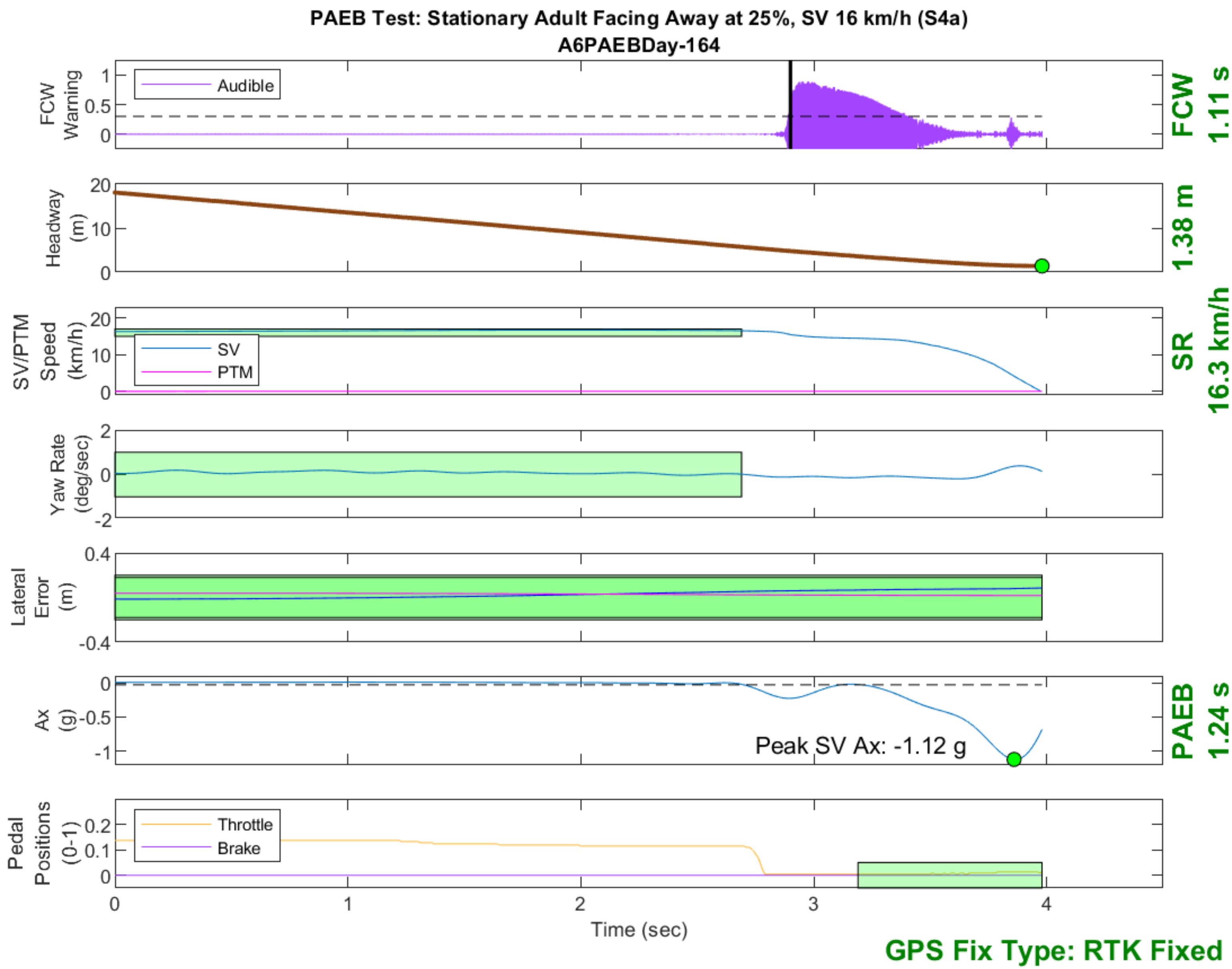


Figure D111. Time History for PAEB Run 164, S4a, Daytime, 16 km/h

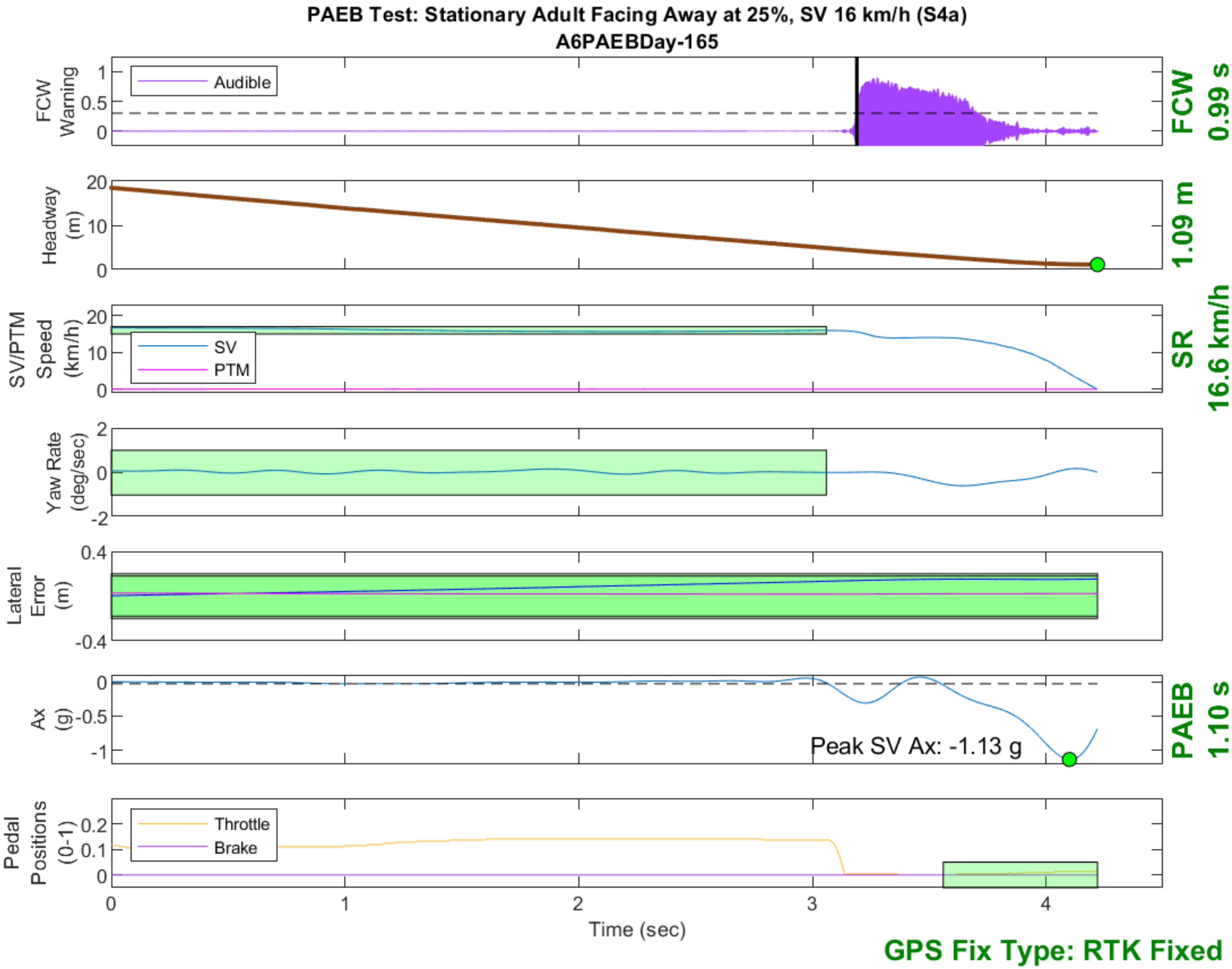


Figure D112. Time History for PAEB Run 165, S4a, Daytime, 16 km/h

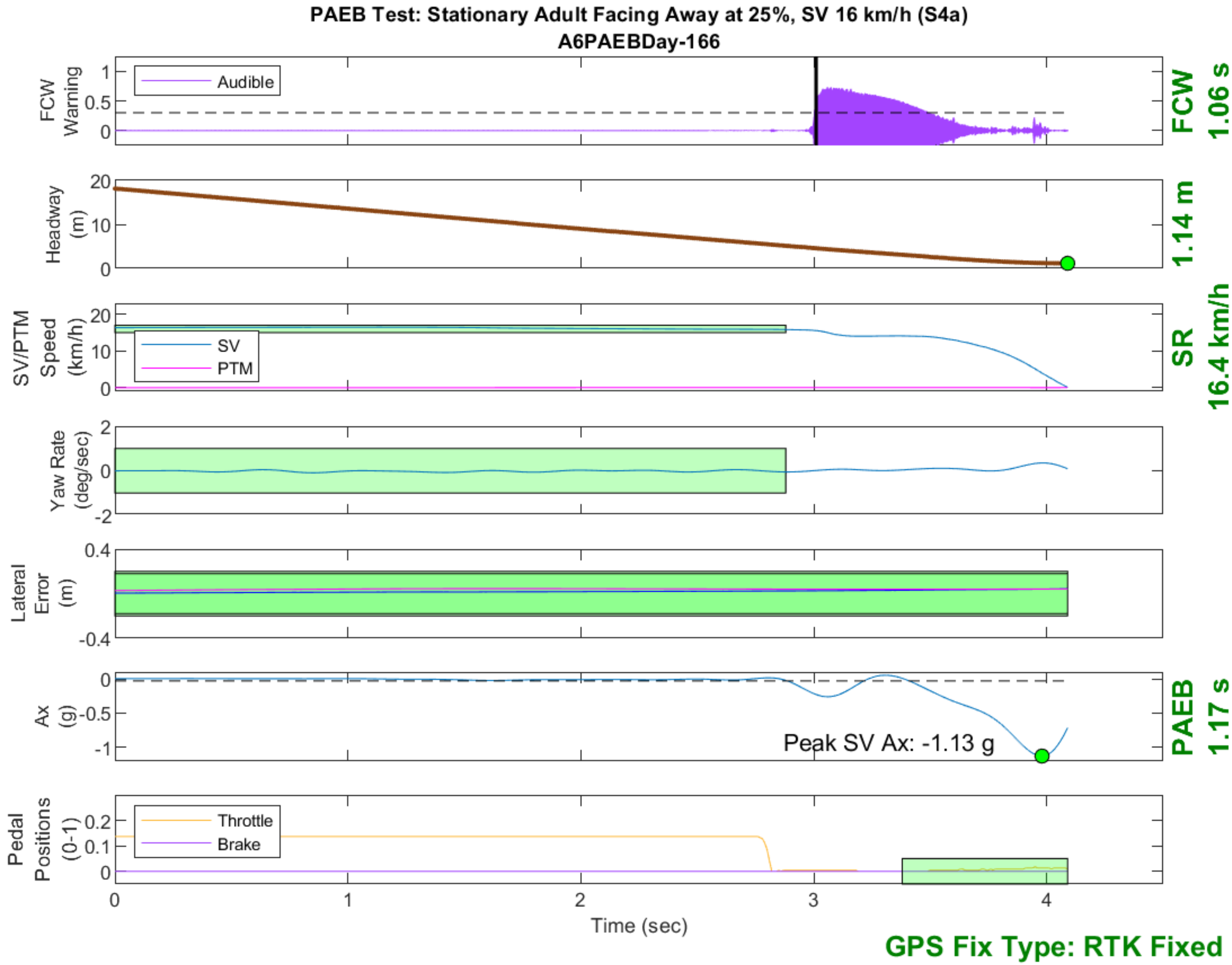


Figure D113. Time History for PAEB Run 166, S4a, Daytime, 16 km/h

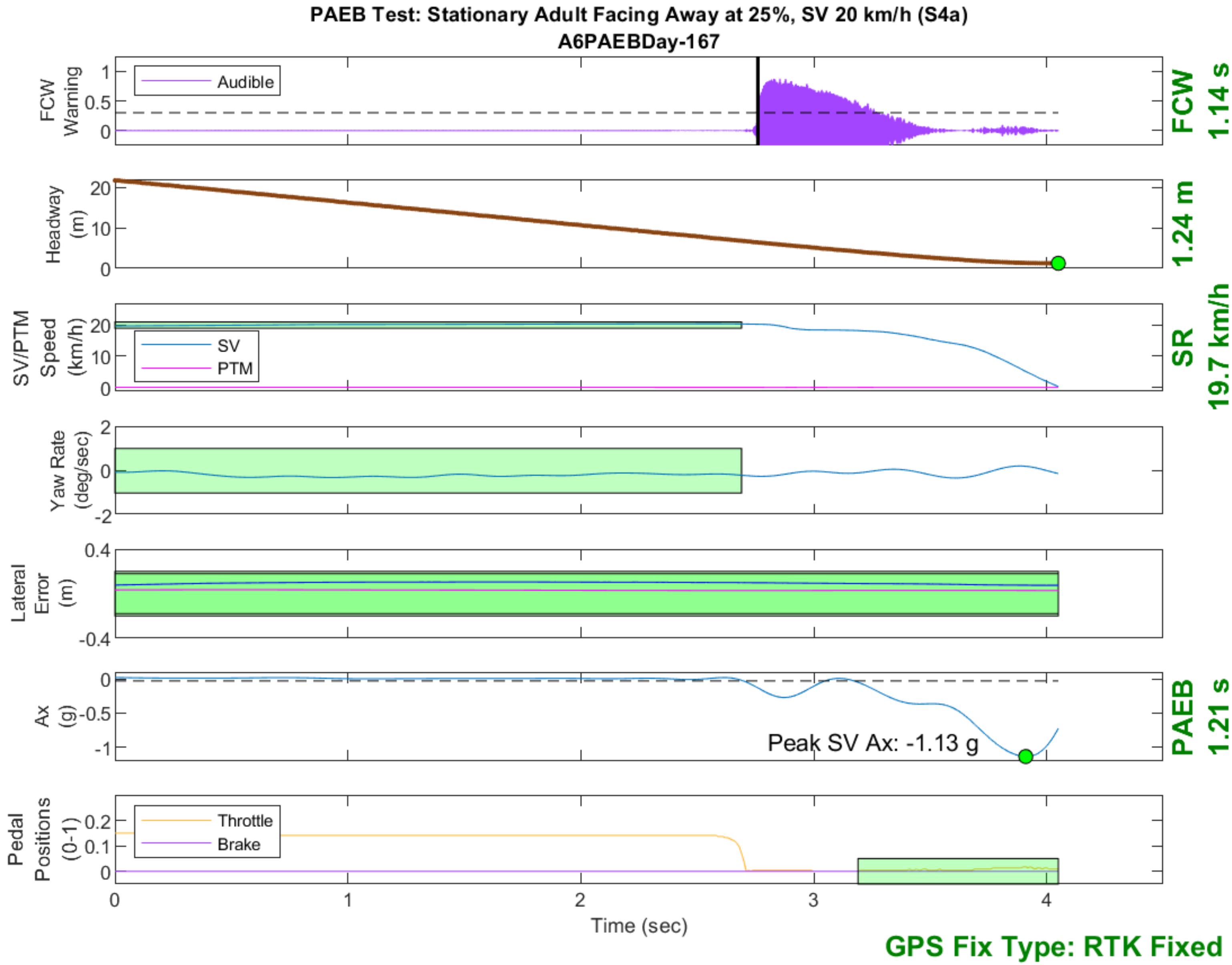


Figure D114. Time History for PAEB Run 167, S4a, Daytime, 20 km/h

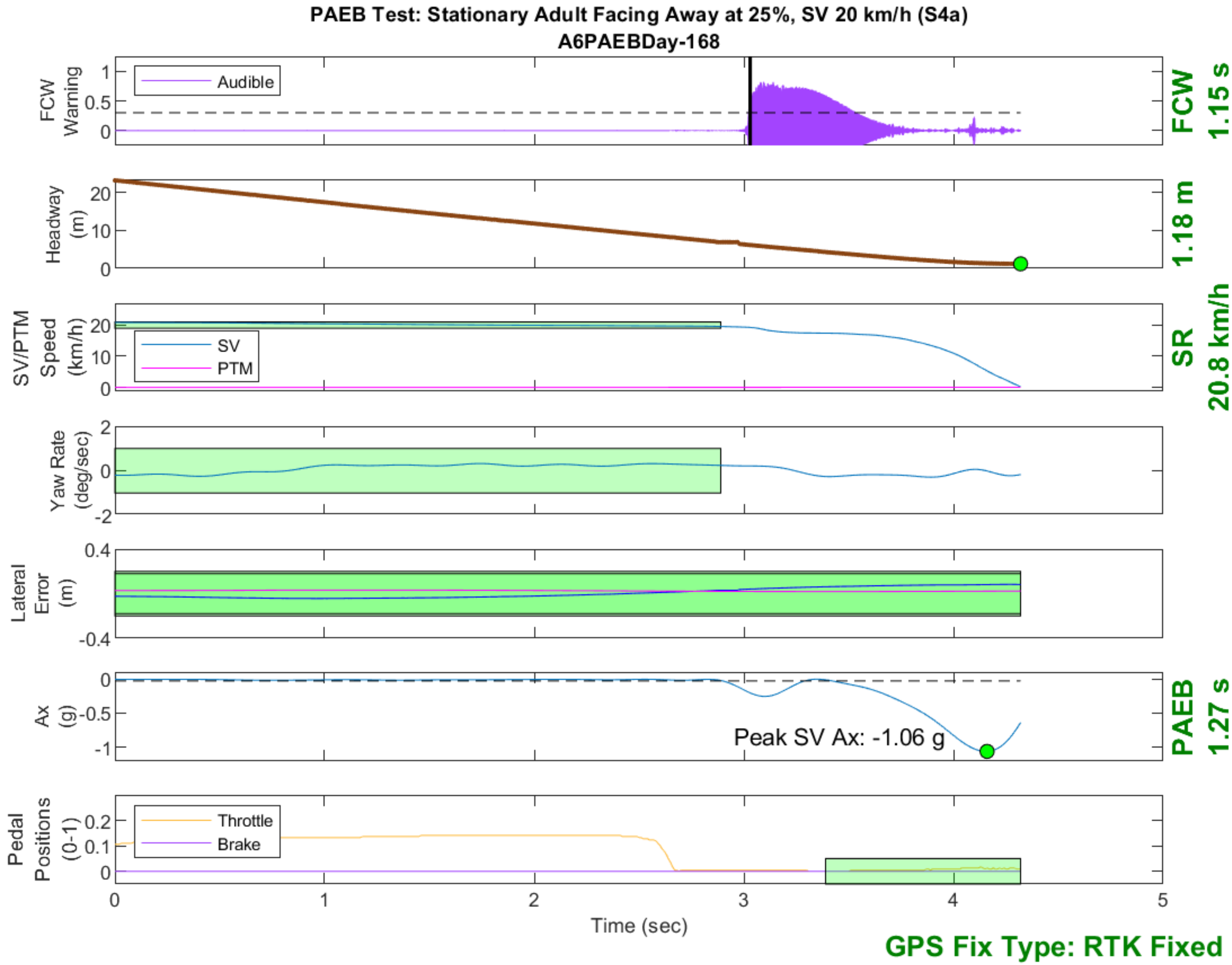


Figure D115. Time History for PAEB Run 168, S4a, Daytime, 20 km/h

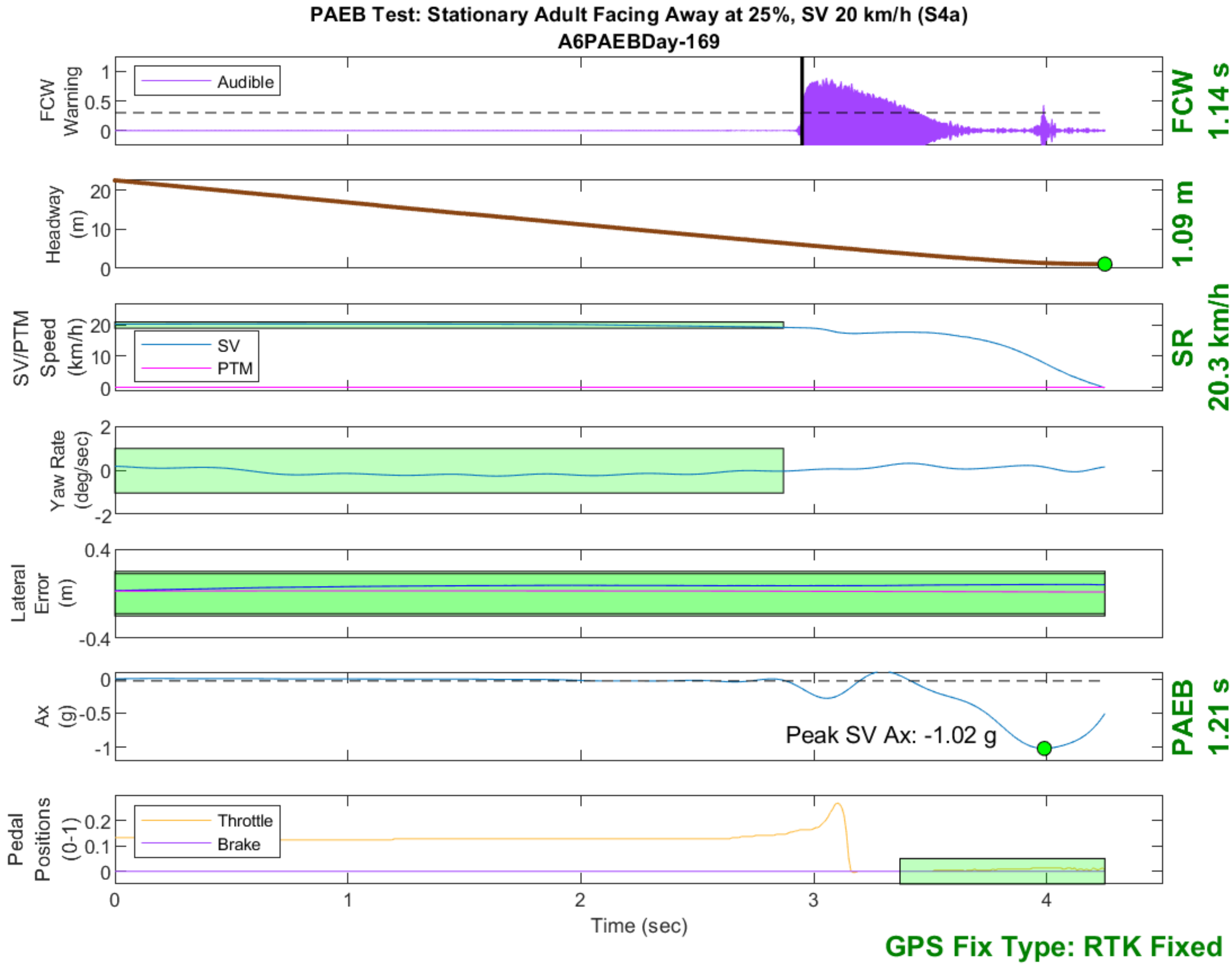


Figure D116. Time History for PAEB Run 169, S4a, Daytime, 20 km/h

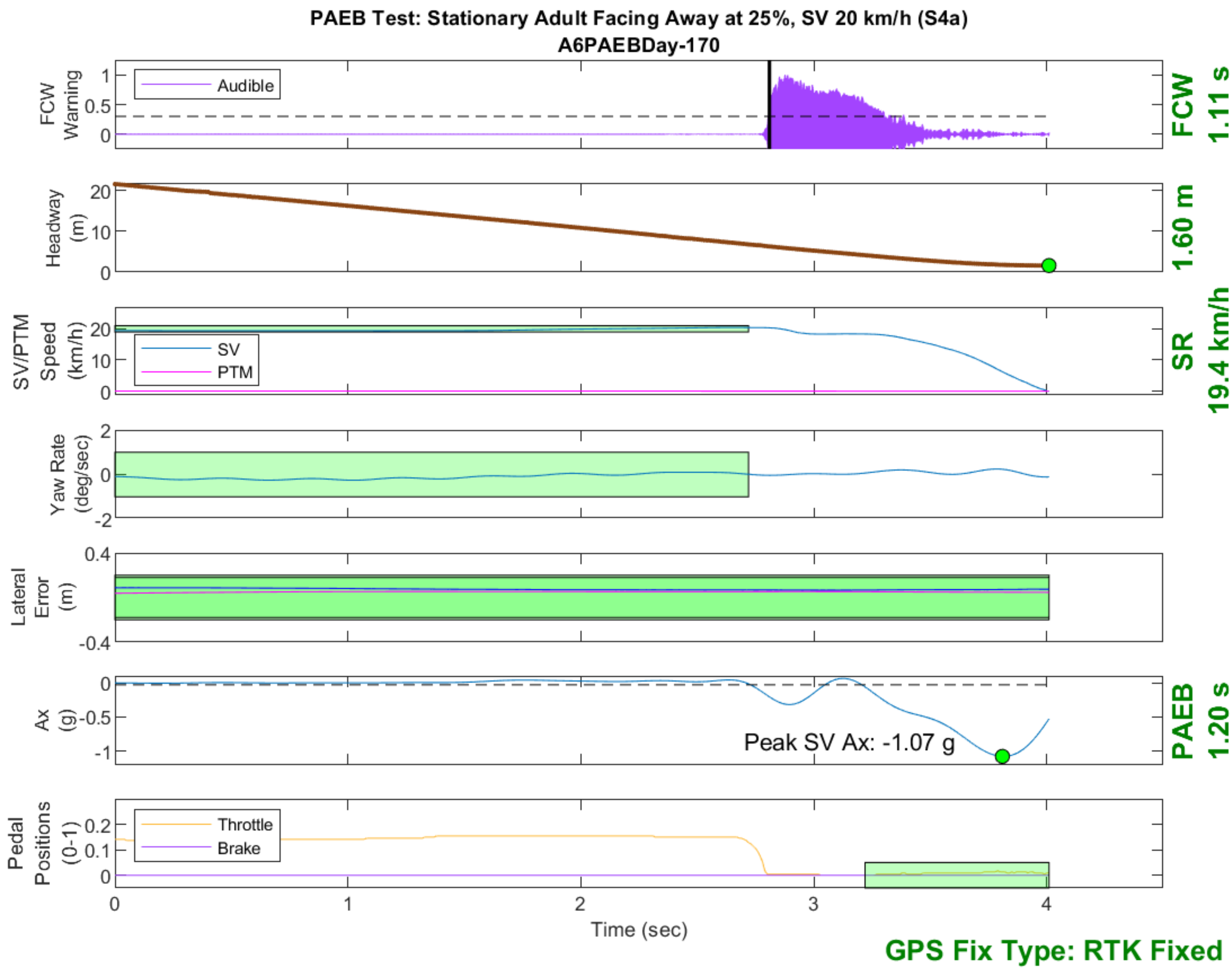


Figure D117. Time History for PAEB Run 170, S4a, Daytime, 20 km/h

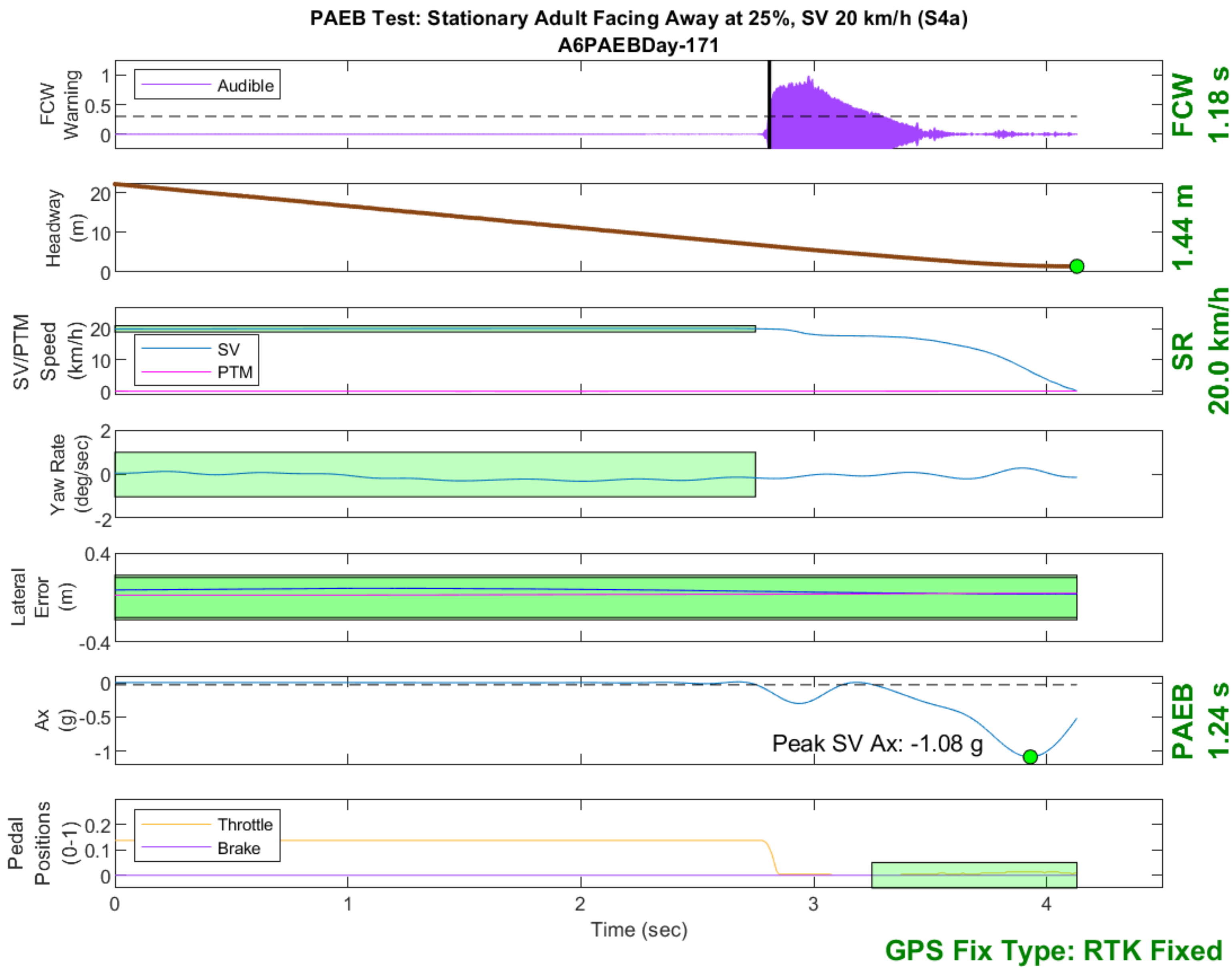


Figure D118. Time History for PAEB Run 171, S4a, Daytime, 20 km/h

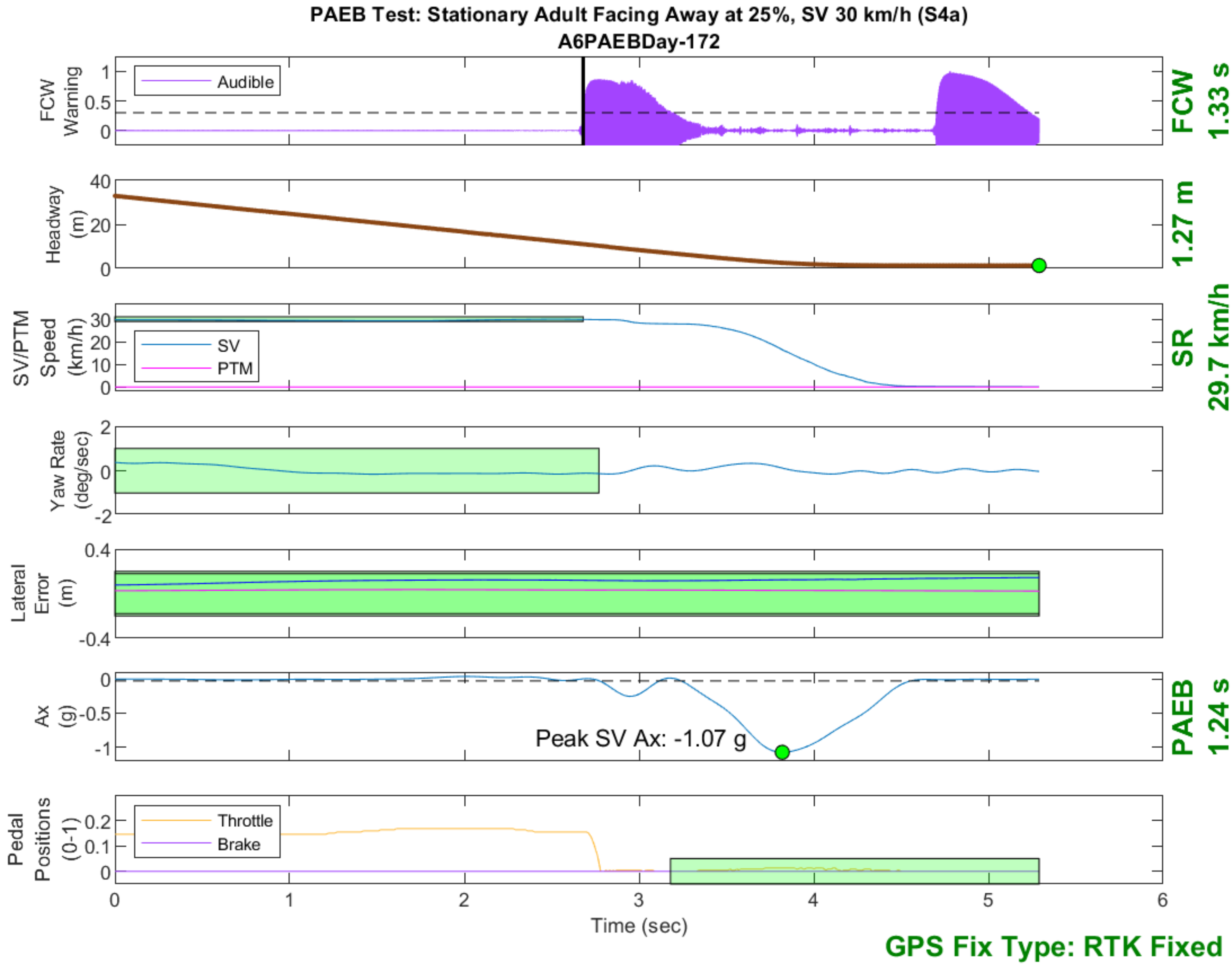


Figure D119. Time History for PAEB Run 172, S4a, Daytime, 30 km/h

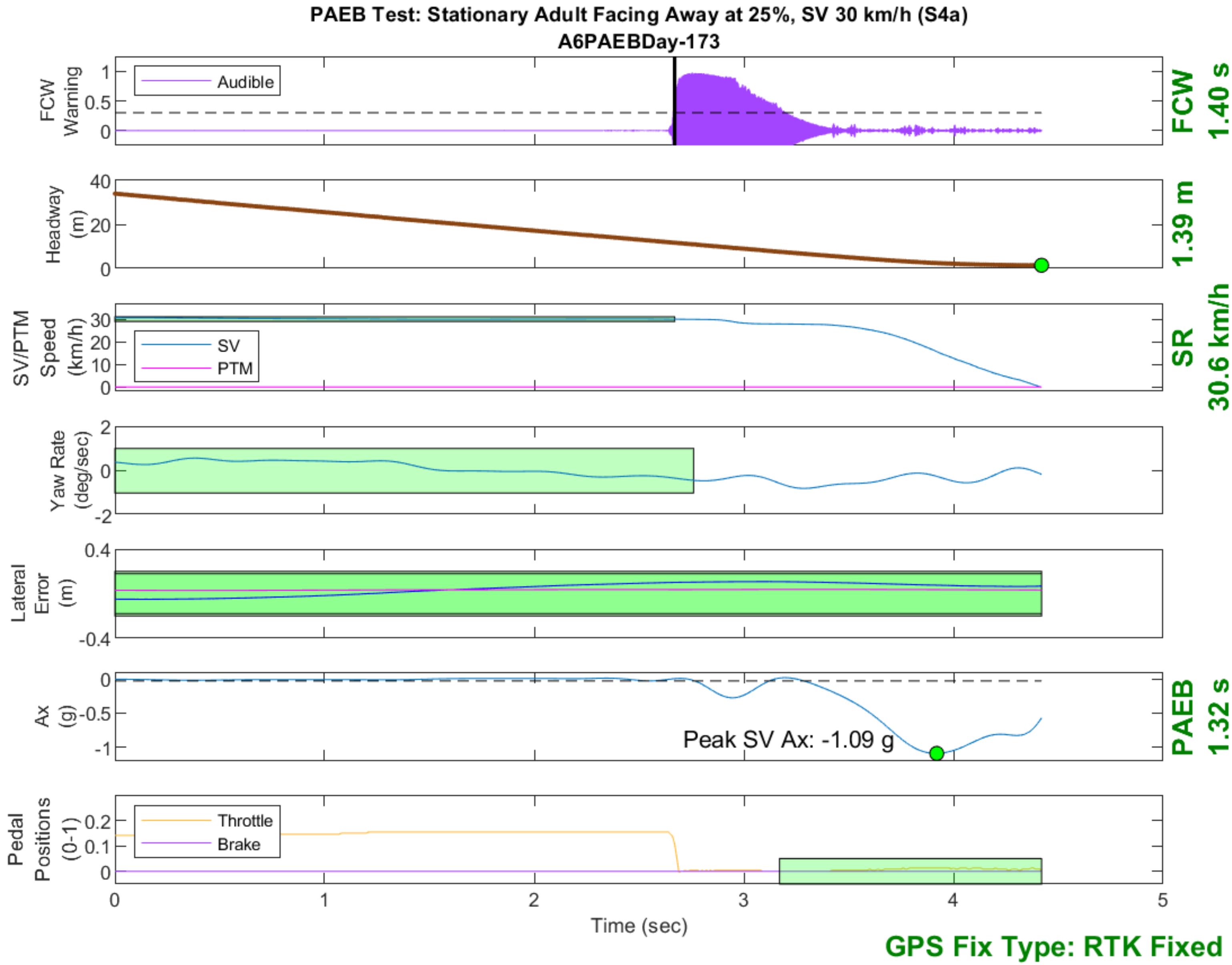


Figure D120. Time History for PAEB Run 173, S4a, Daytime, 30 km/h

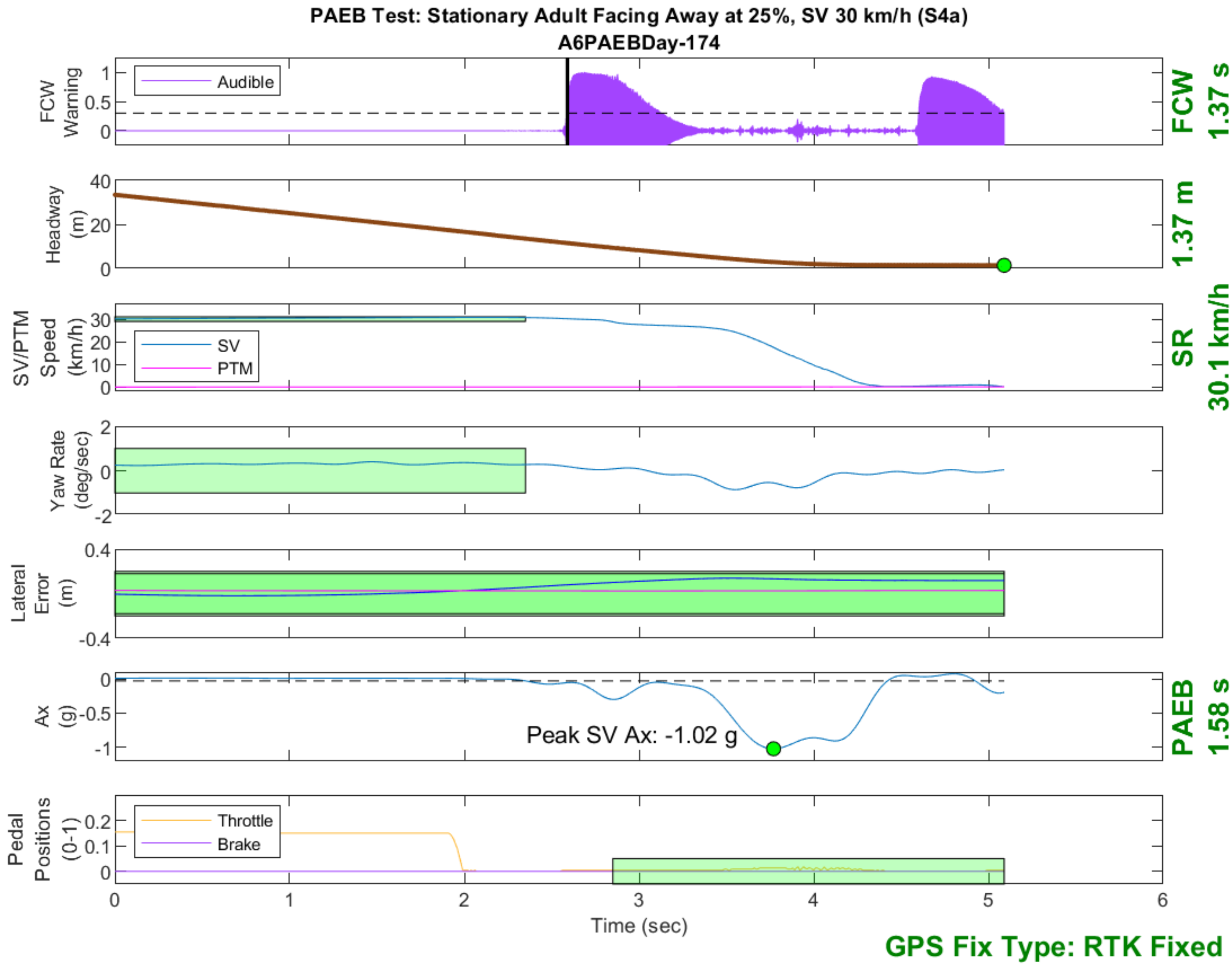


Figure D121. Time History for PAEB Run 174, S4a, Daytime, 30 km/h

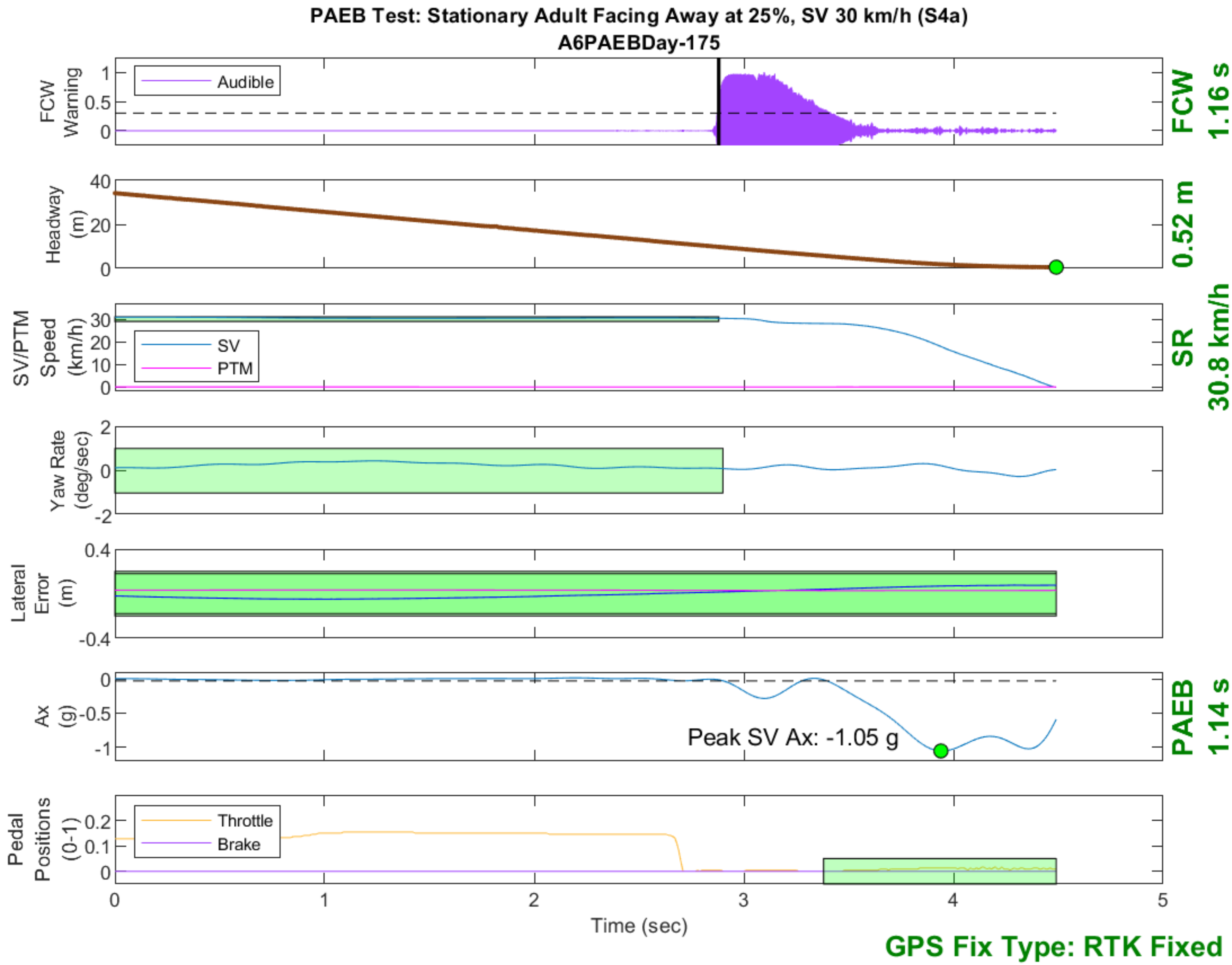


Figure D122. Time History for PAEB Run 175, S4a, Daytime, 30 km/h

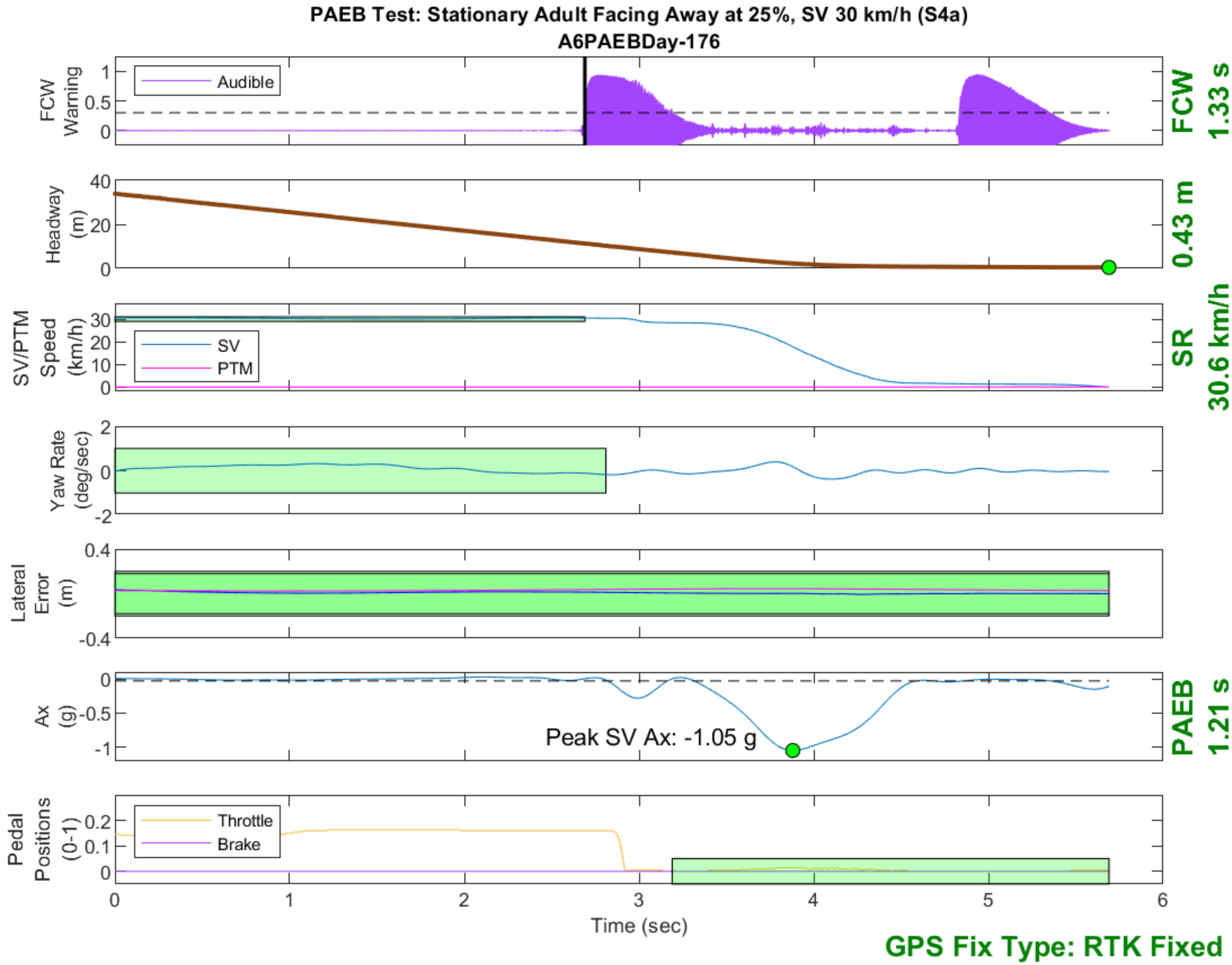


Figure D123. Time History for PAEB Run 176, S4a, Daytime, 30 km/h

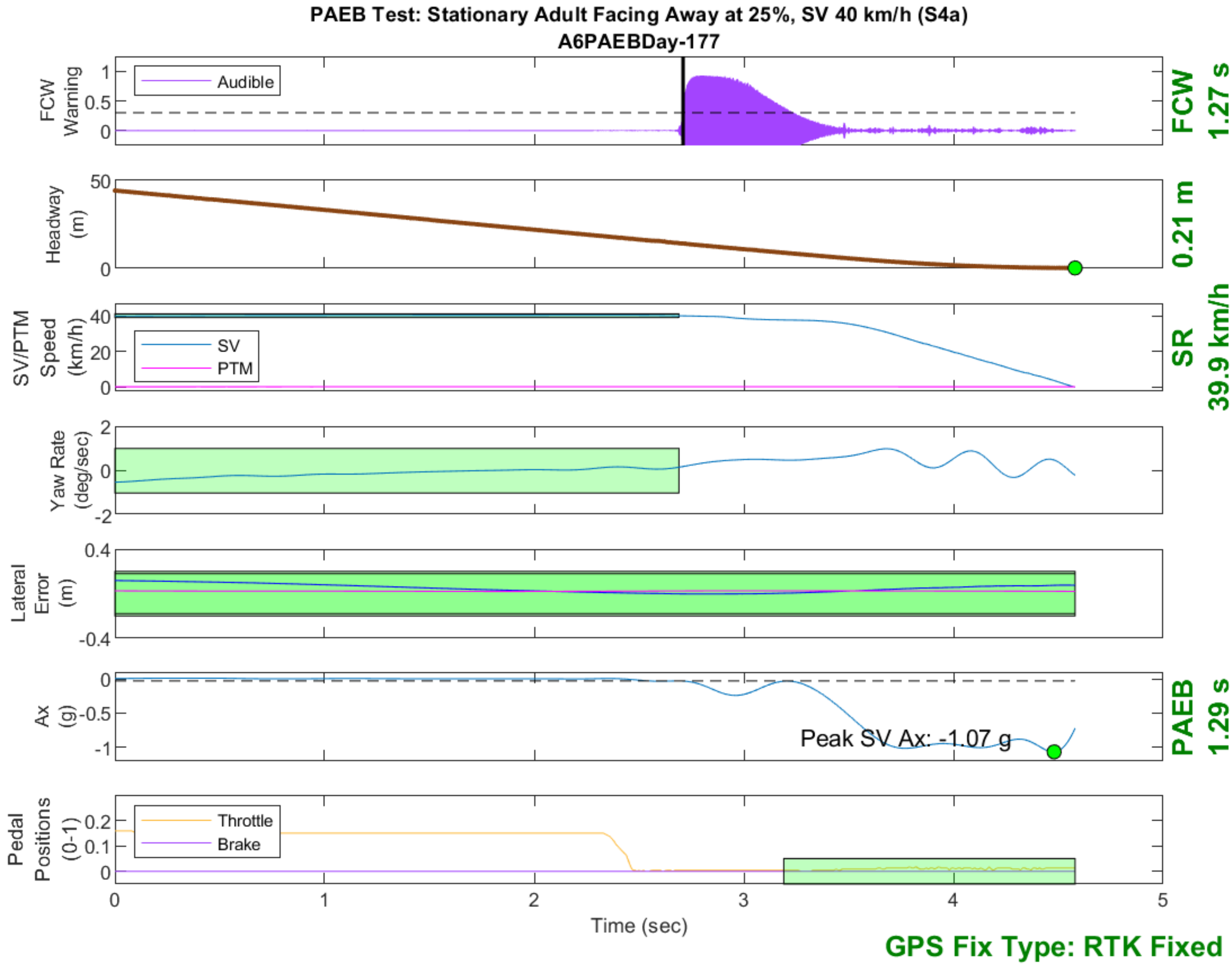


Figure D124. Time History for PAEB Run 177, S4a, Daytime, 40 km/h

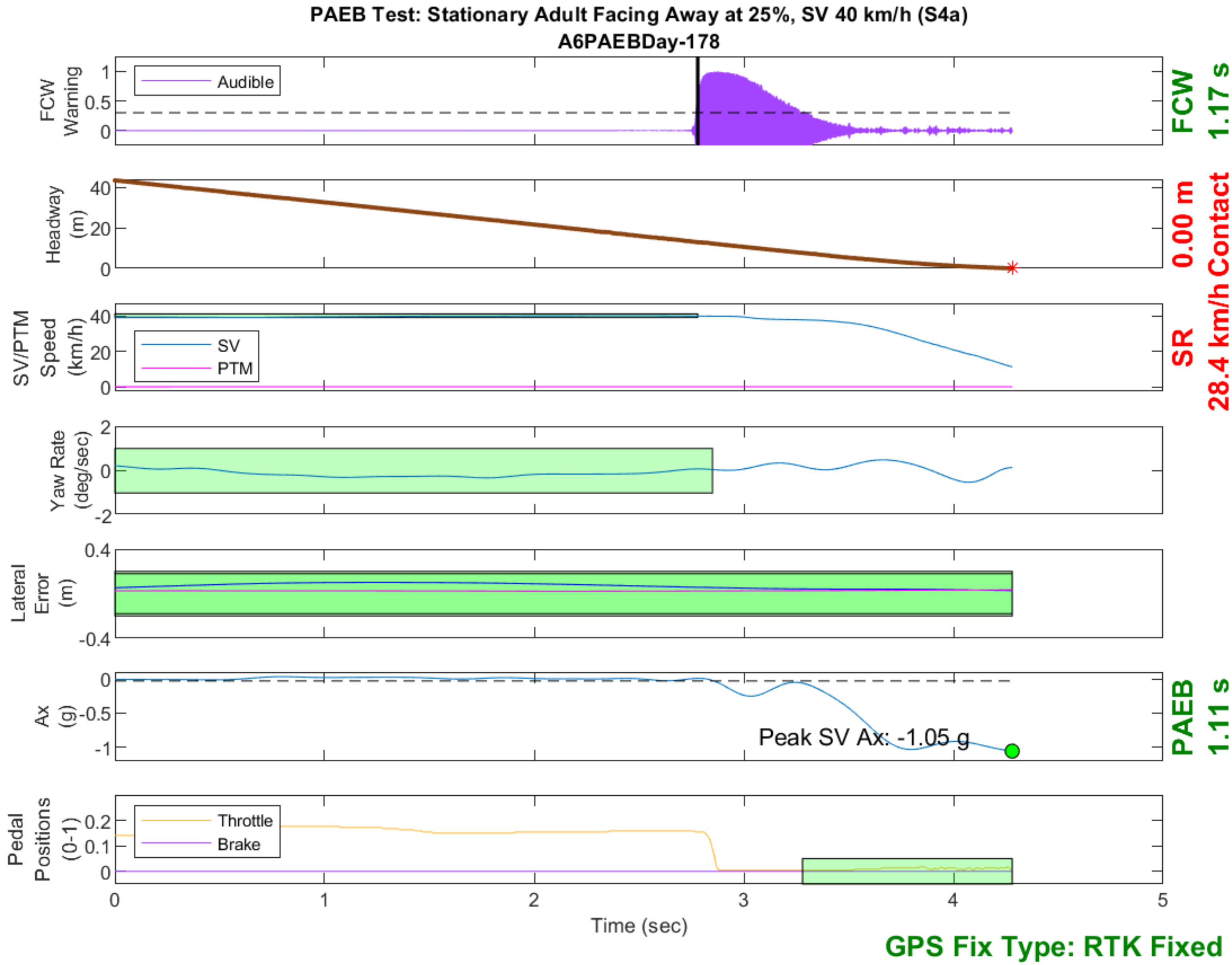


Figure D125. Time History for PAEB Run 178, S4a, Daytime, 40 km/h

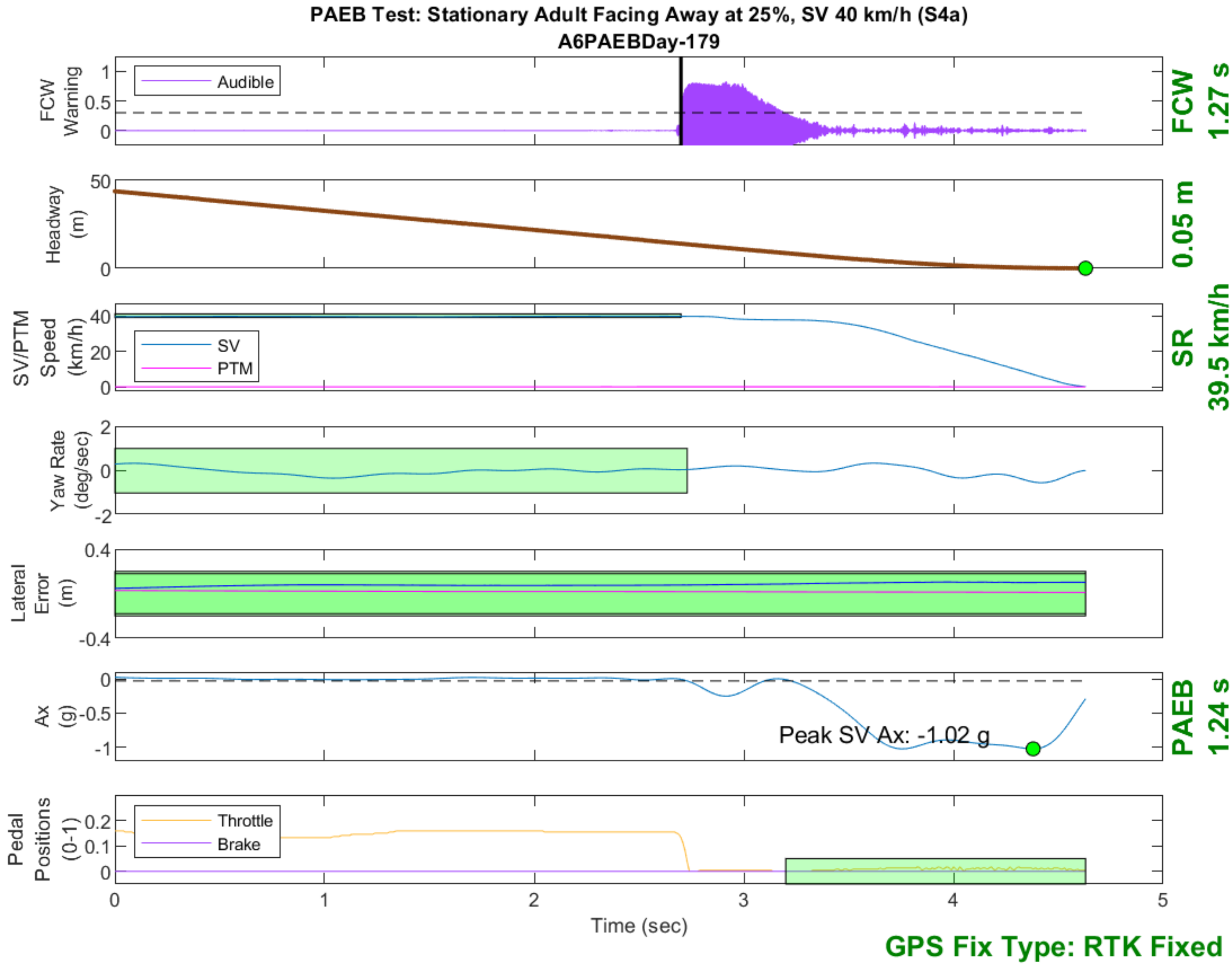


Figure D126. Time History for PAEB Run 179, S4a, Daytime, 40 km/h

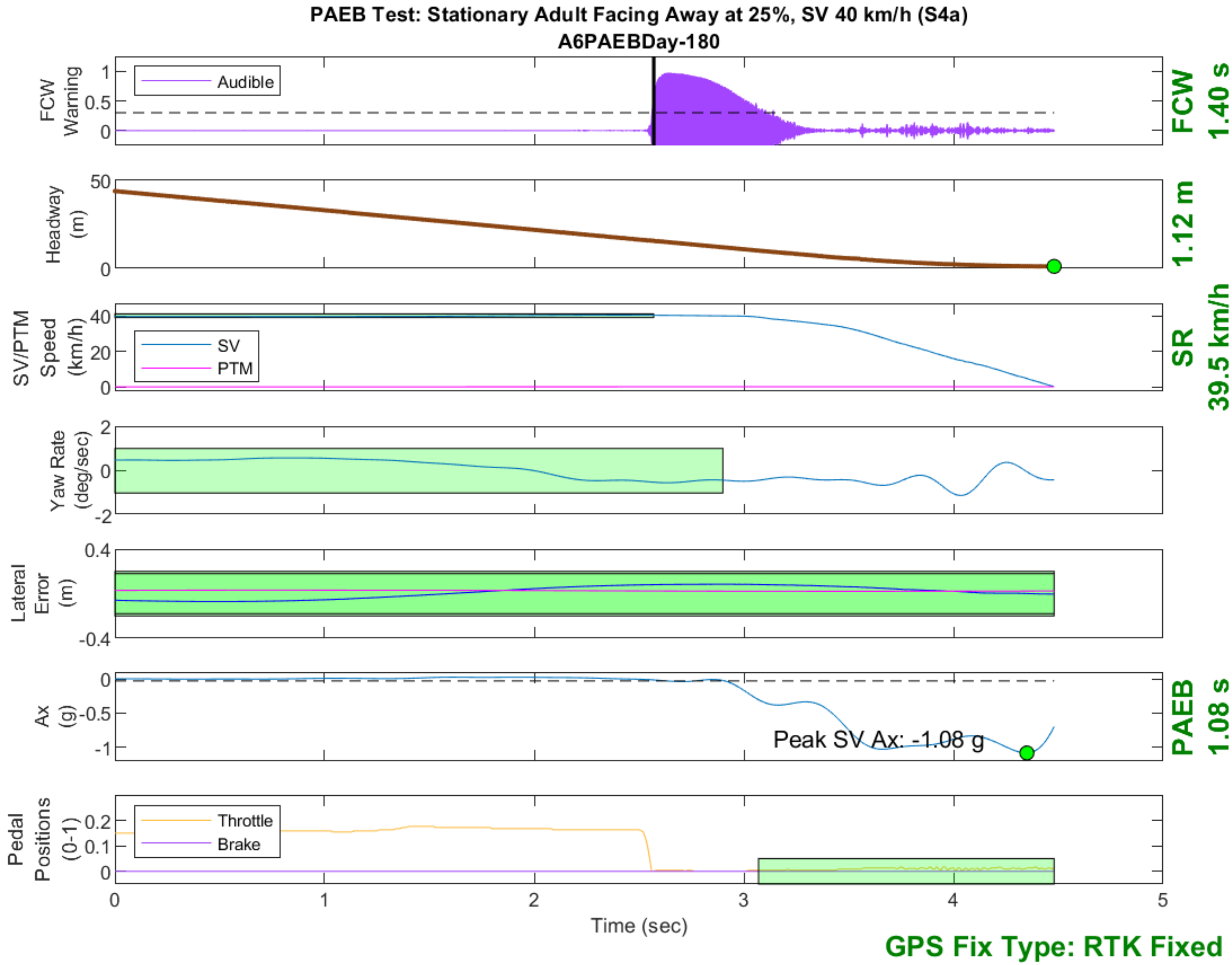


Figure D127. Time History for PAEB Run 180, S4a, Daytime, 40 km/h

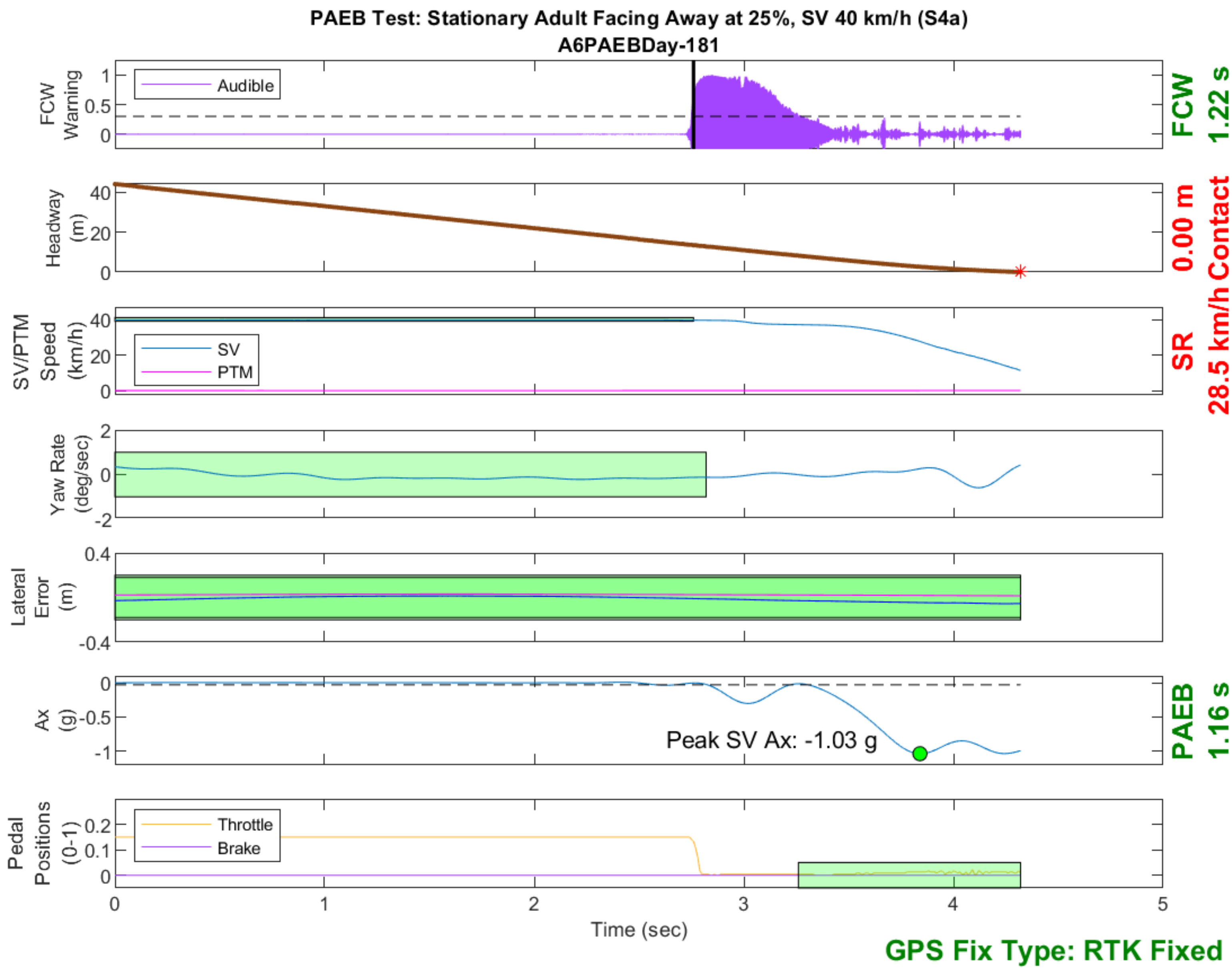


Figure D128. Time History for PAEB Run 181, S4a, Daytime, 40 km/h

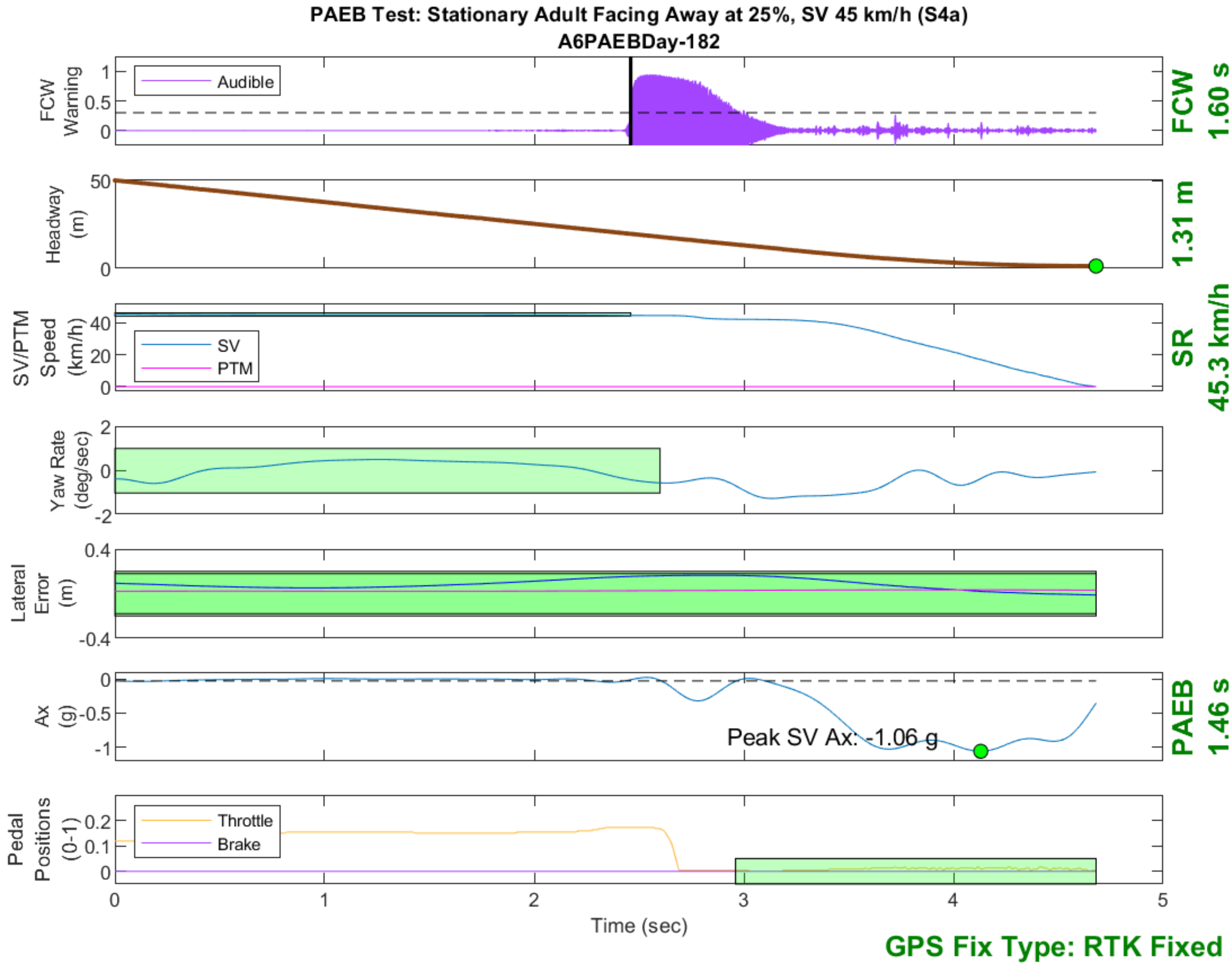


Figure D129. Time History for PAEB Run 182, S4a, Daytime, 45 km/h

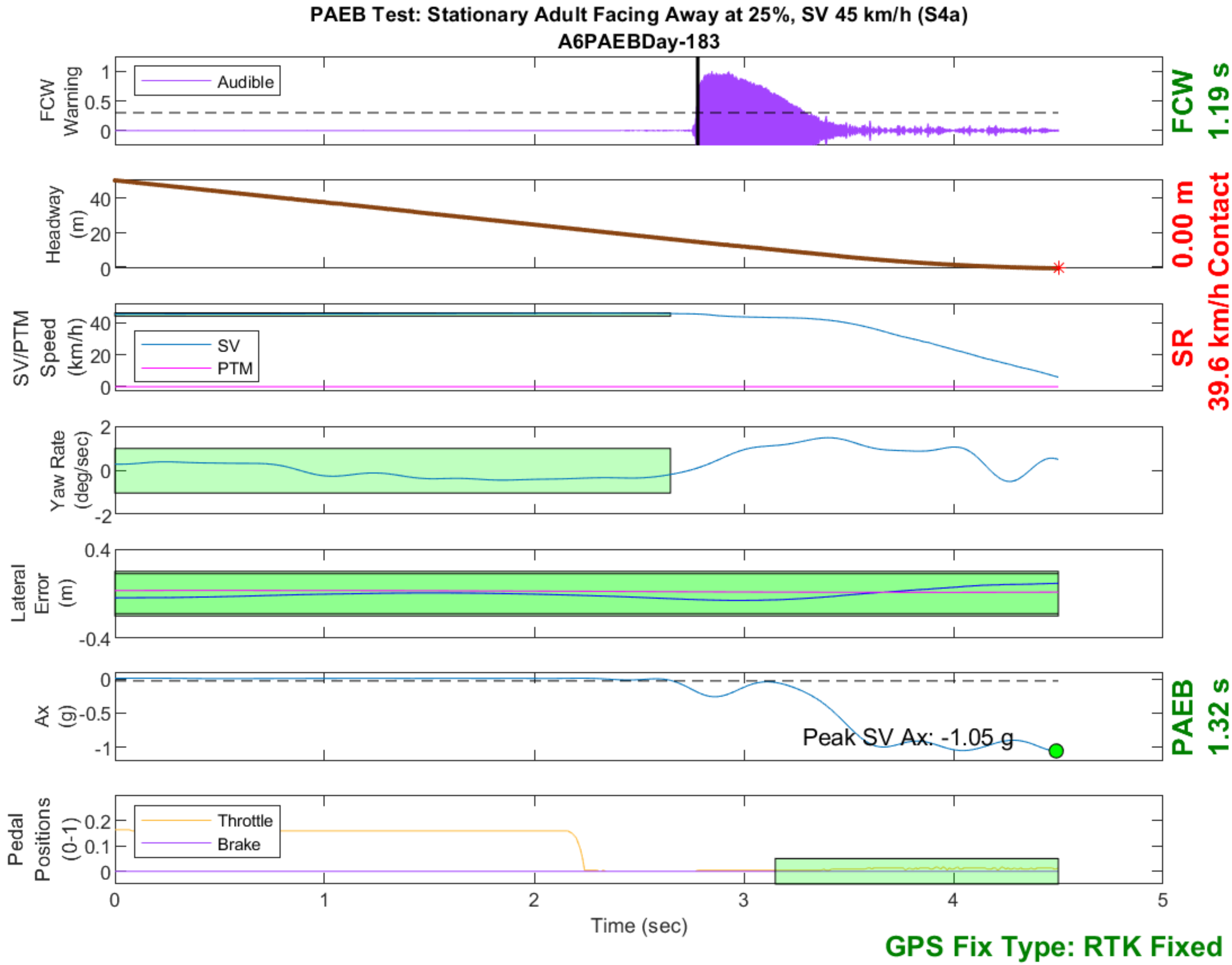


Figure D130. Time History for PAEB Run 183, S4a, Daytime, 45 km/h

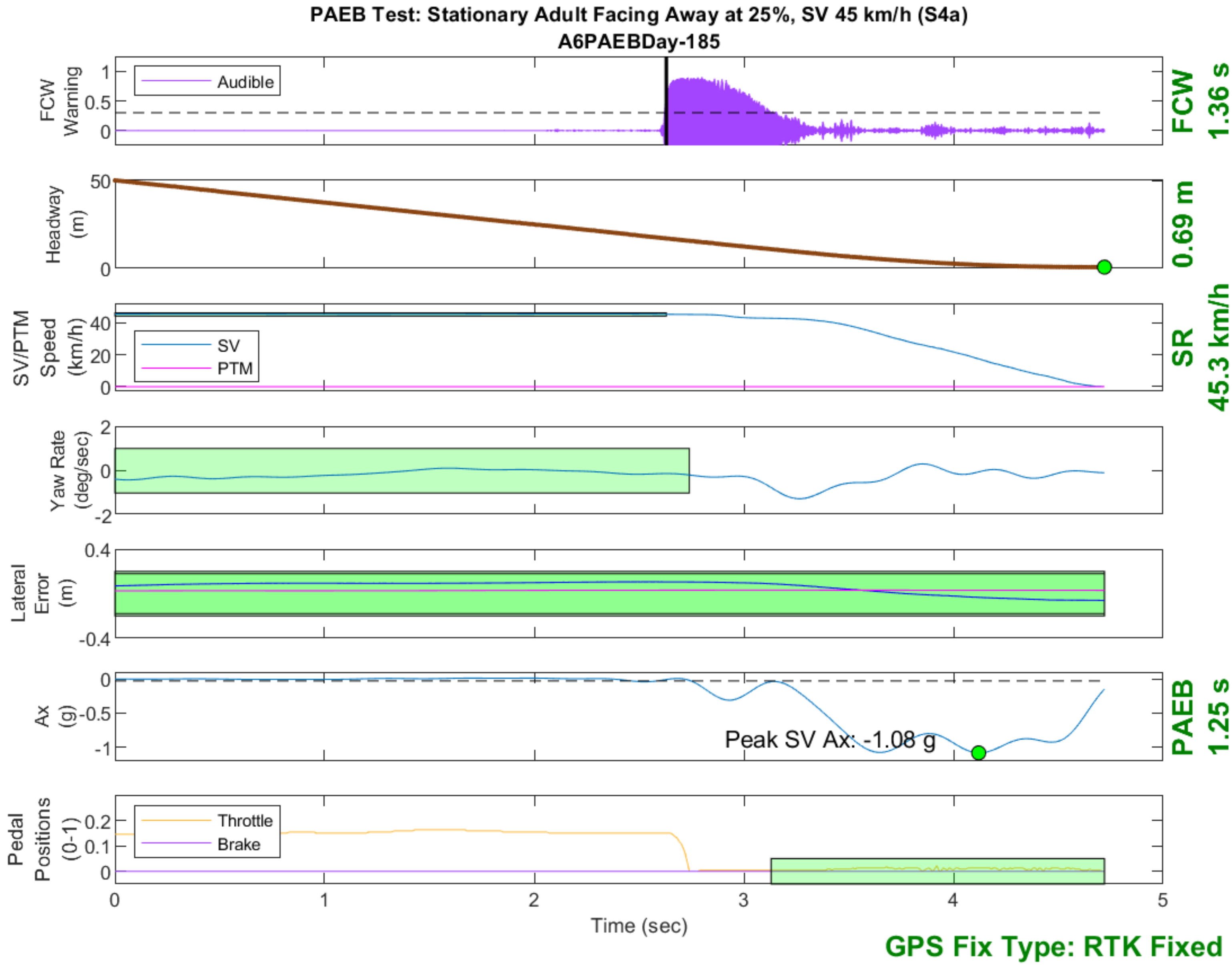


Figure D131. Time History for PAEB Run 185, S4a, Daytime, 45 km/h

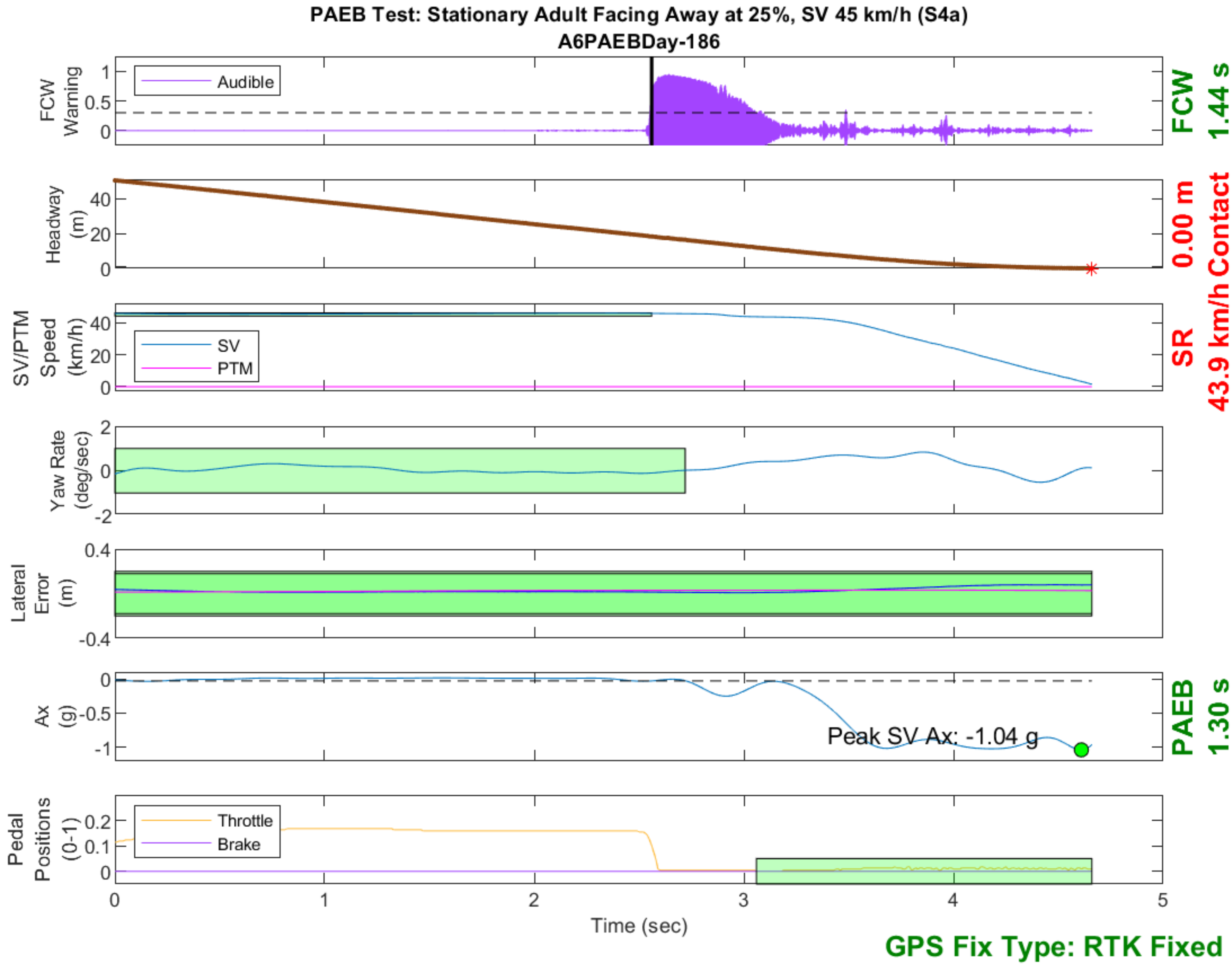


Figure D132. Time History for PAEB Run 186, S4a, Daytime, 45 km/h

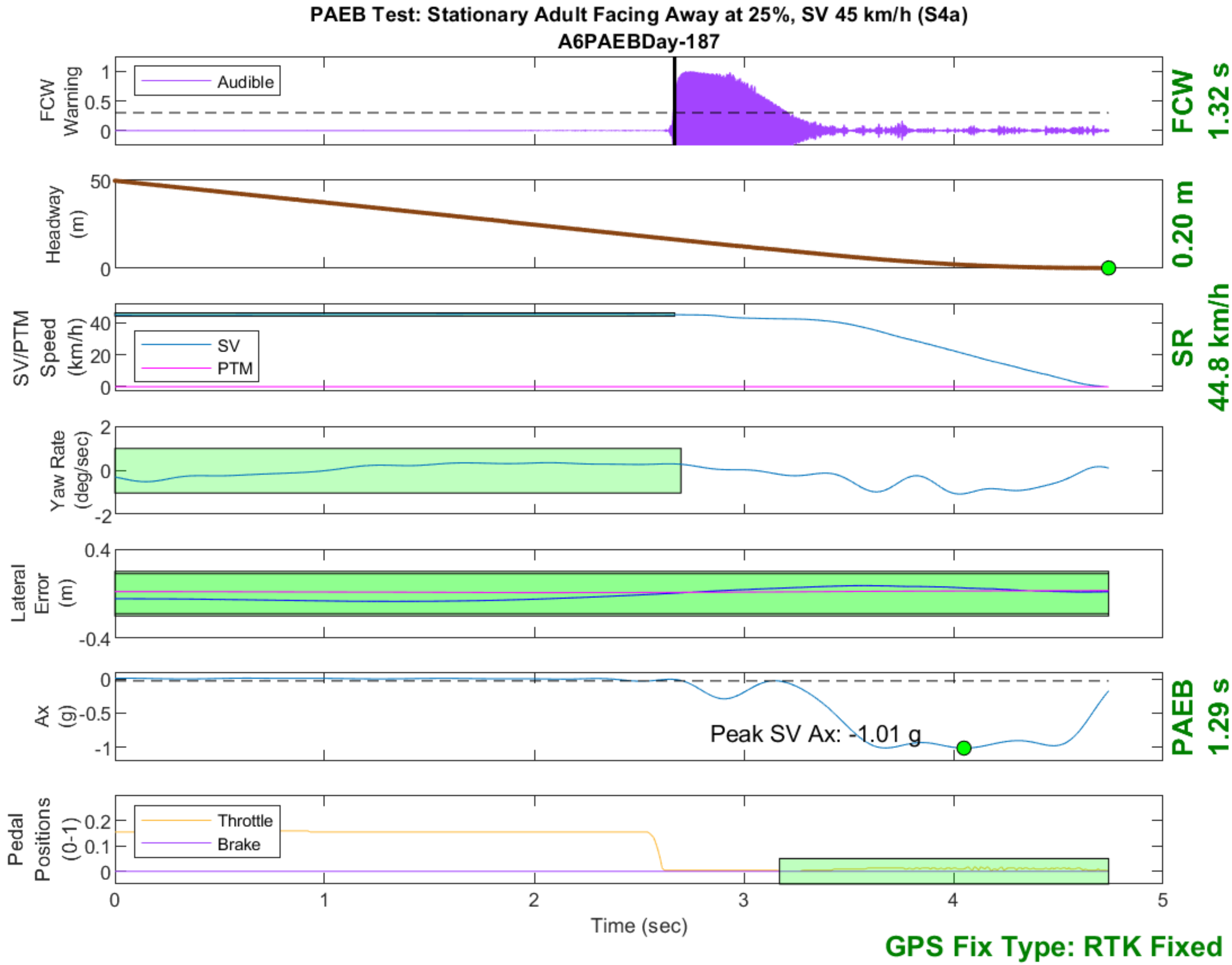


Figure D133. Time History for PAEB Run 187, S4a, Daytime, 45 km/h

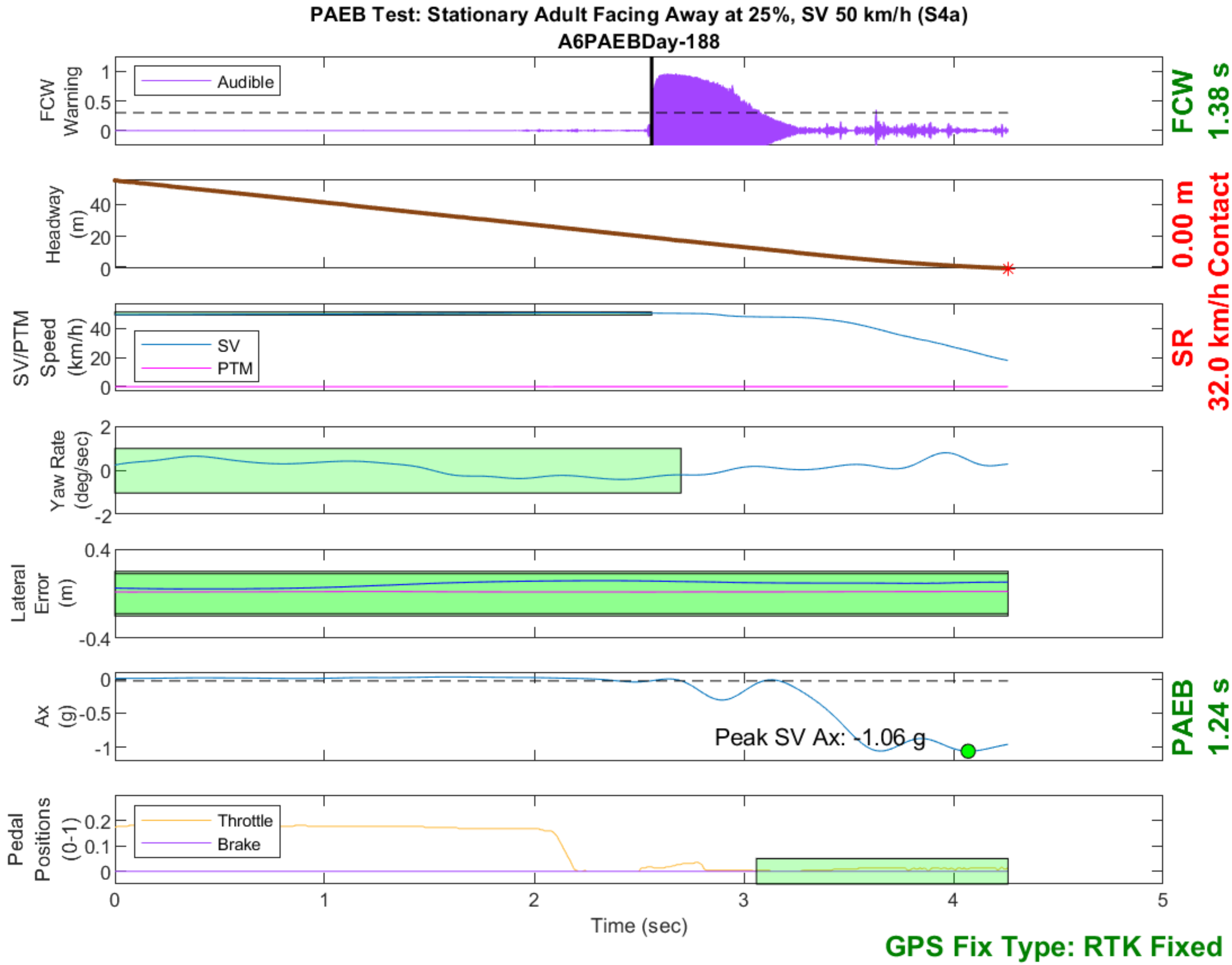


Figure D134. Time History for PAEB Run 188, S4a, Daytime, 50 km/h

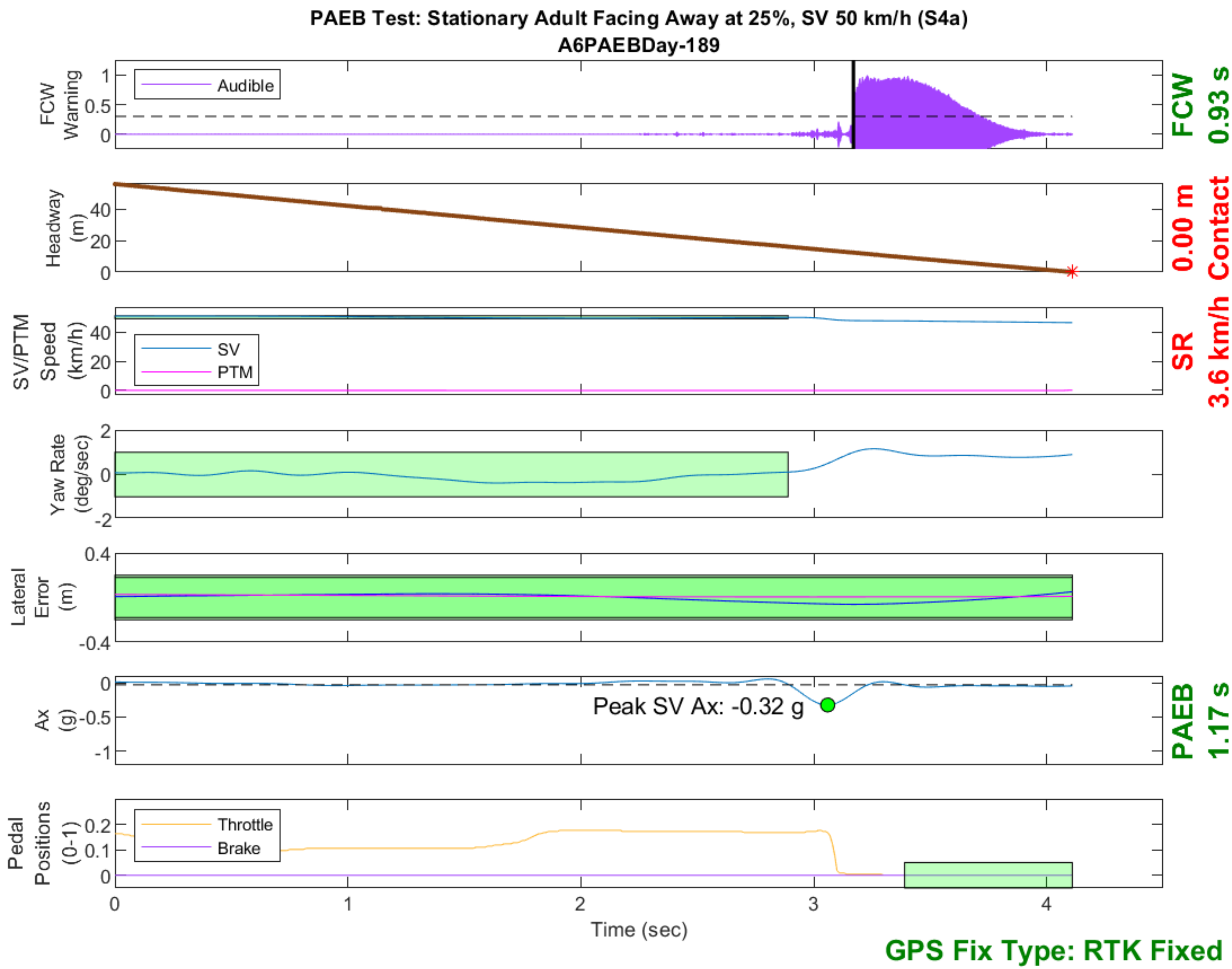


Figure D135. Time History for PAEB Run 189, S4a, Daytime, 50 km/h

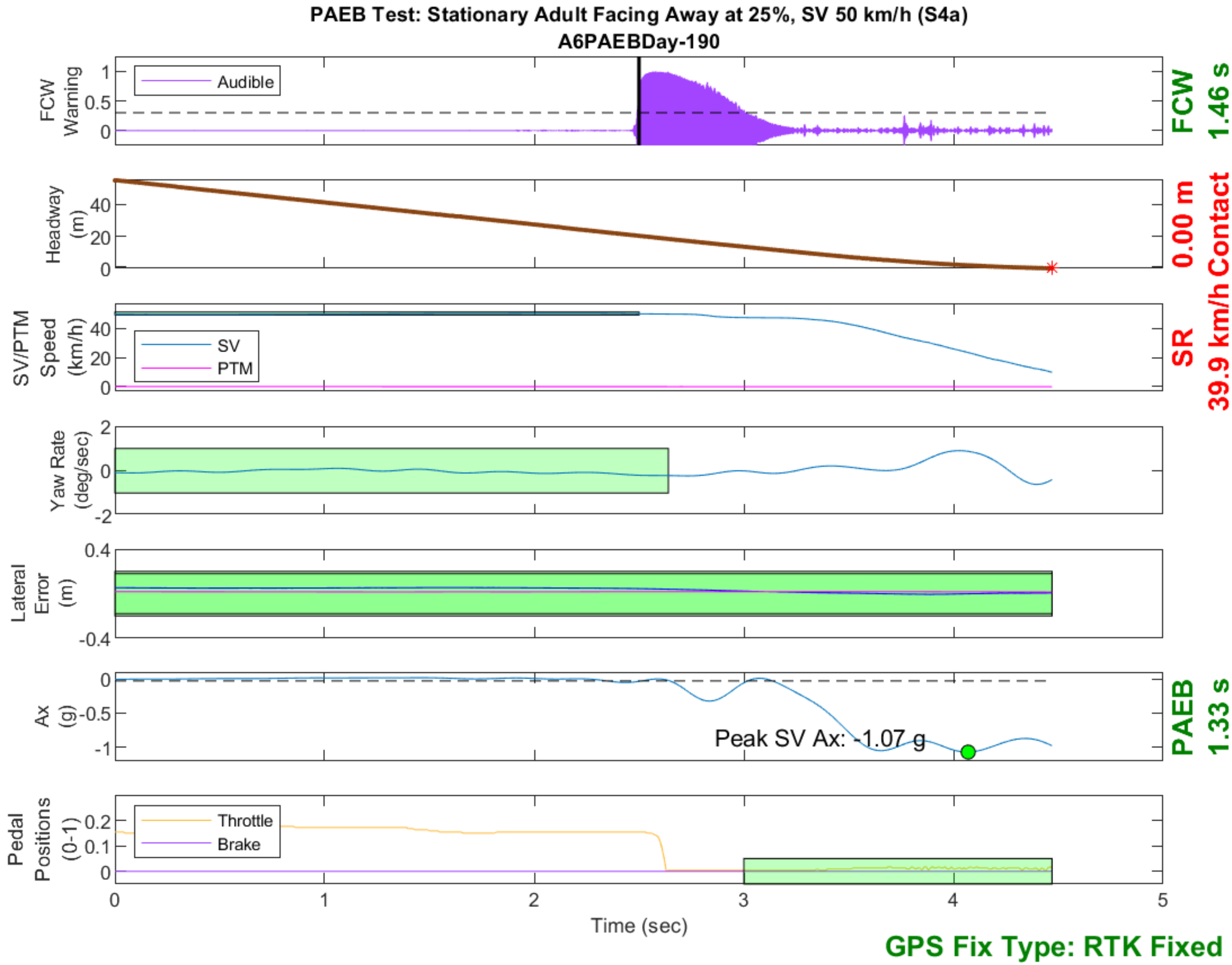


Figure D136. Time History for PAEB Run 190, S4a, Daytime, 50 km/h

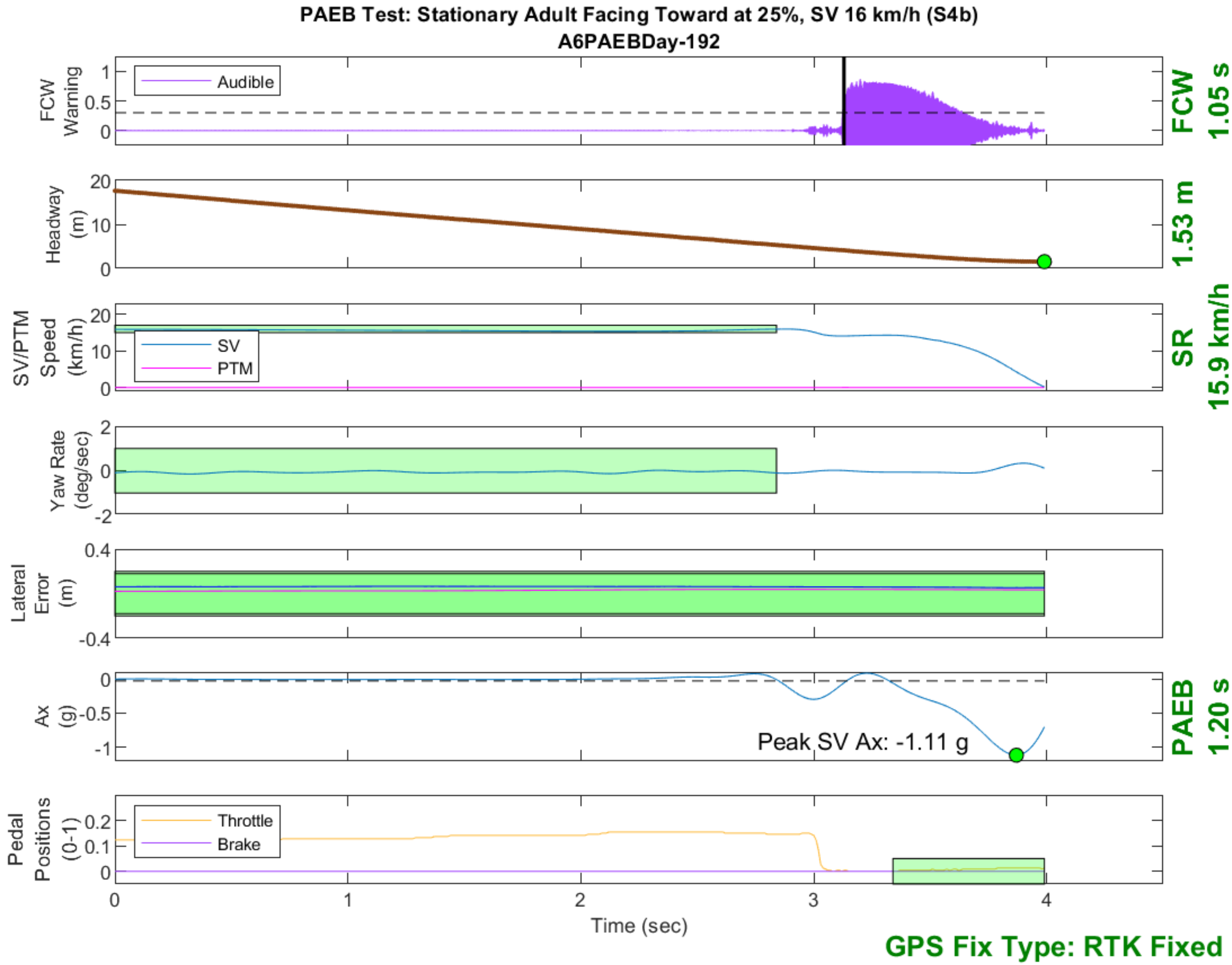


Figure D137. Time History for PAEB Run 192, S4b, Daytime, 16 km/h

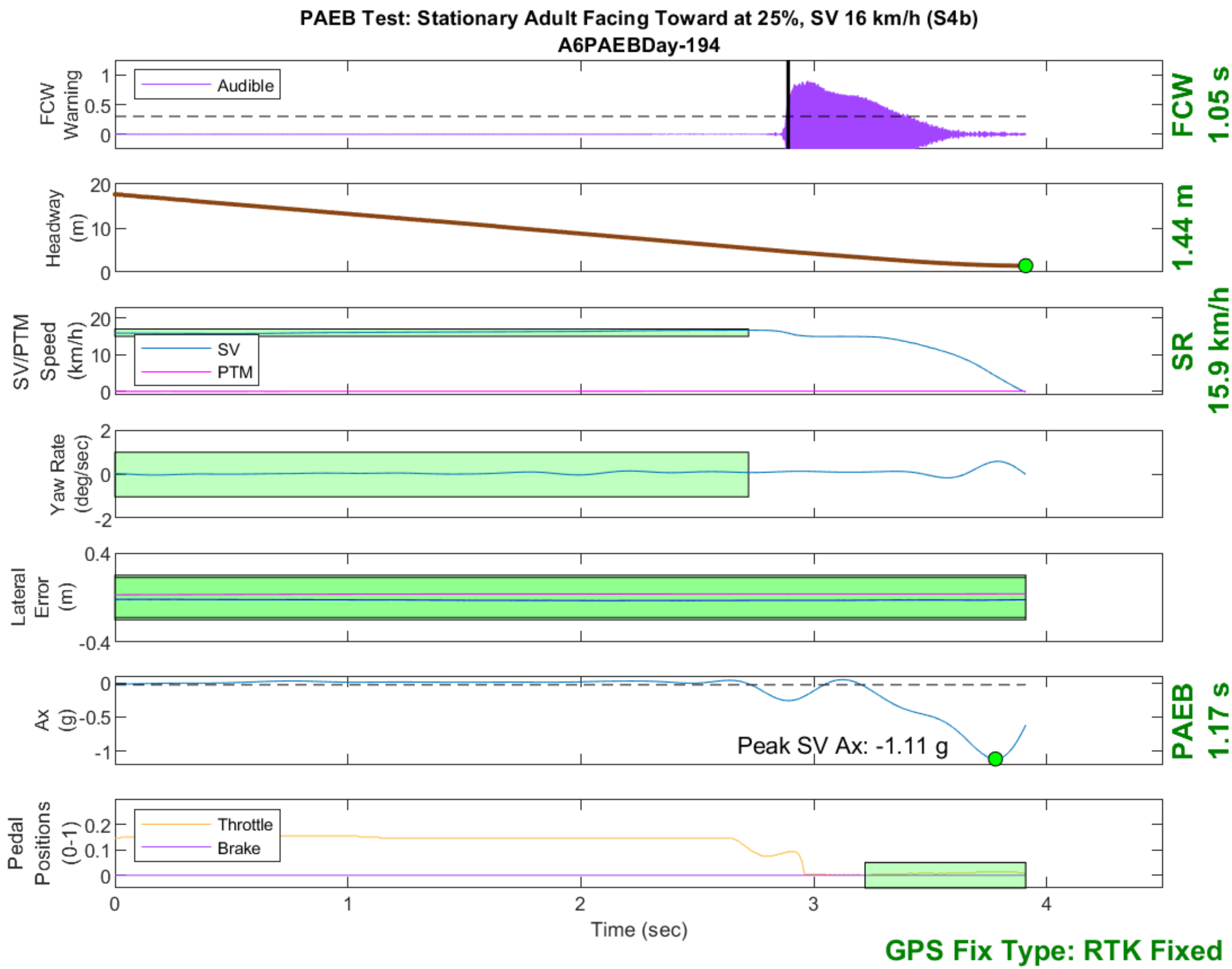


Figure D138. Time History for PAEB Run 194, S4b, Daytime, 16 km/h

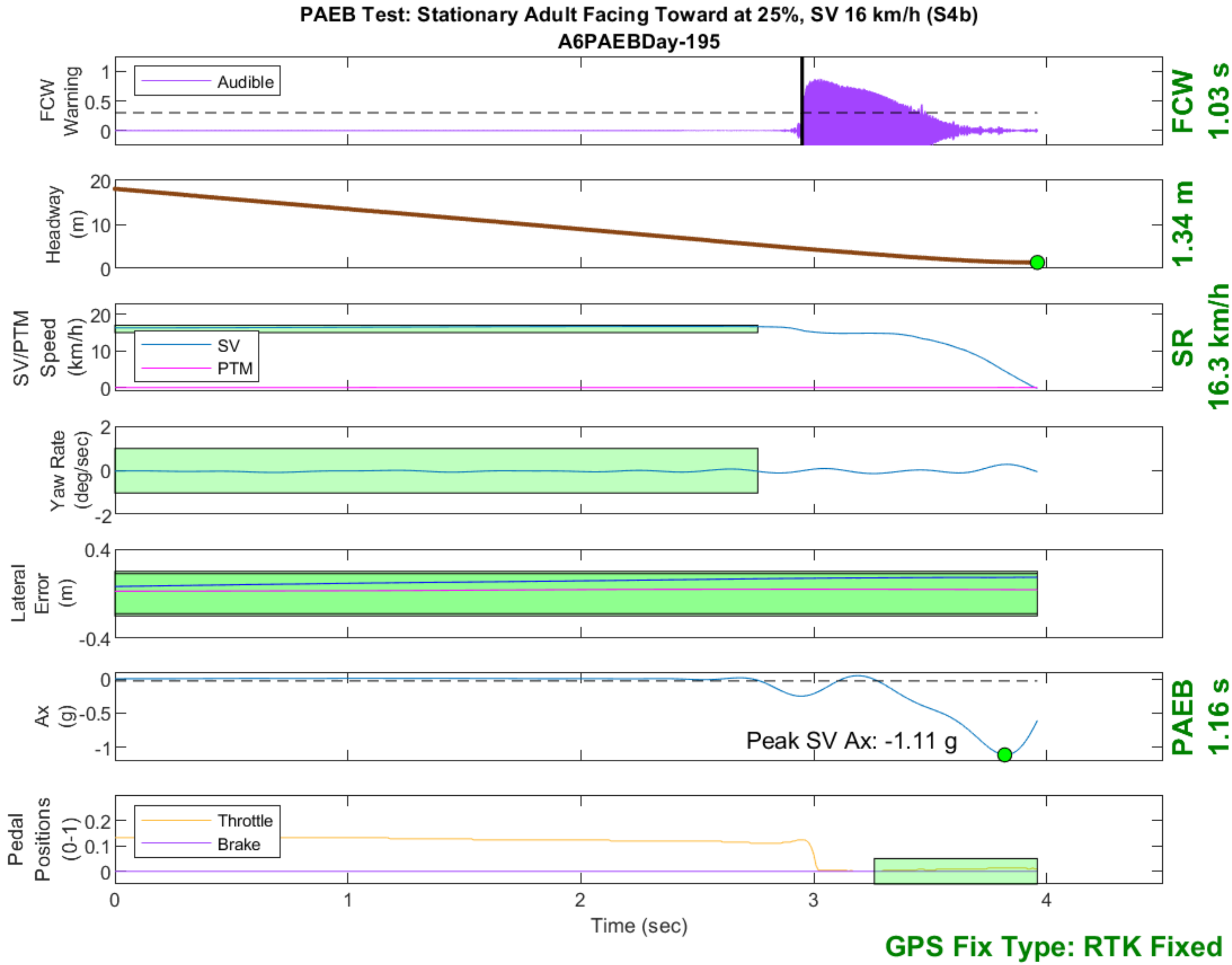


Figure D139. Time History for PAEB Run 195, S4b, Daytime, 16 km/h

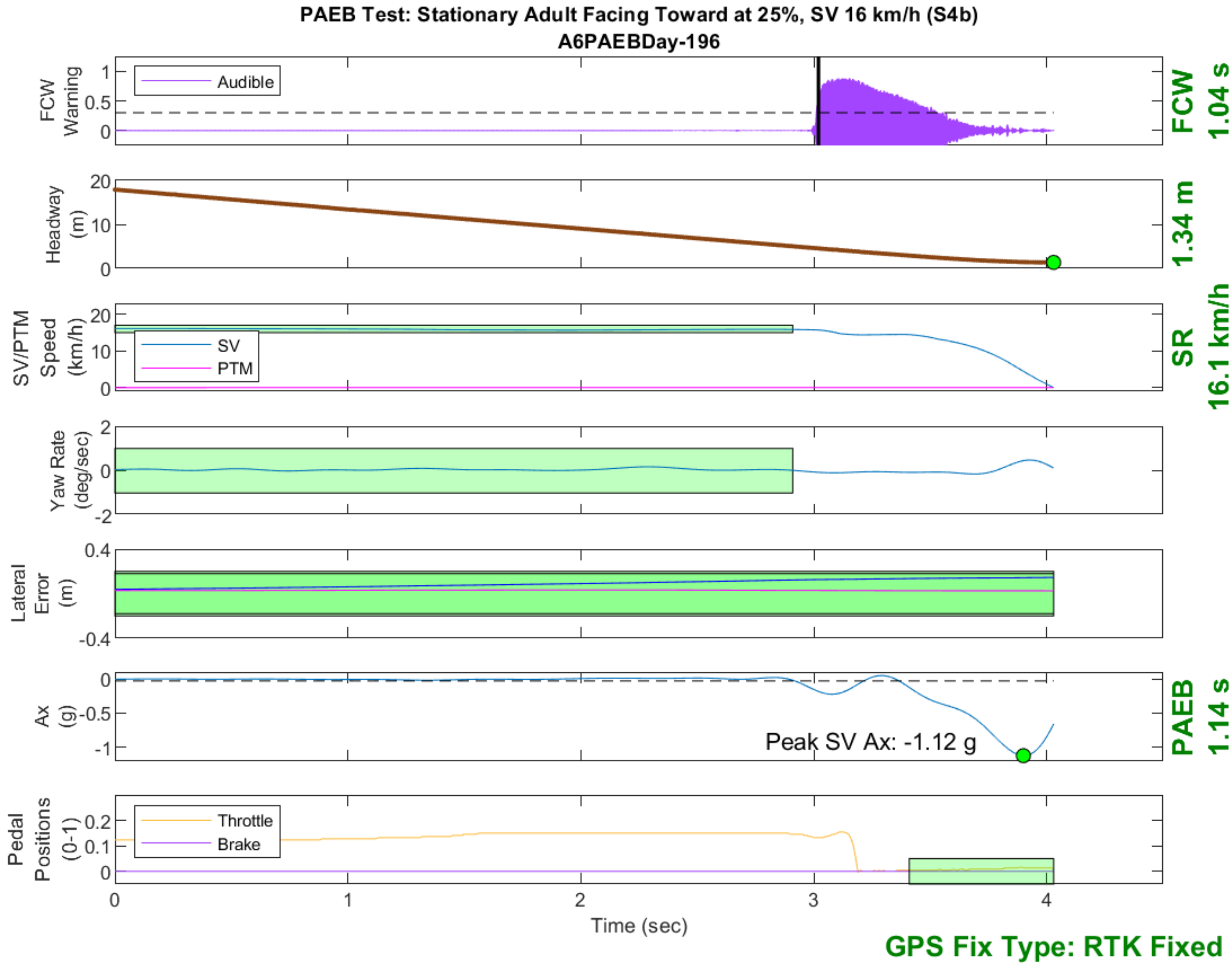


Figure D140. Time History for PAEB Run 196, S4b, Daytime, 16 km/h

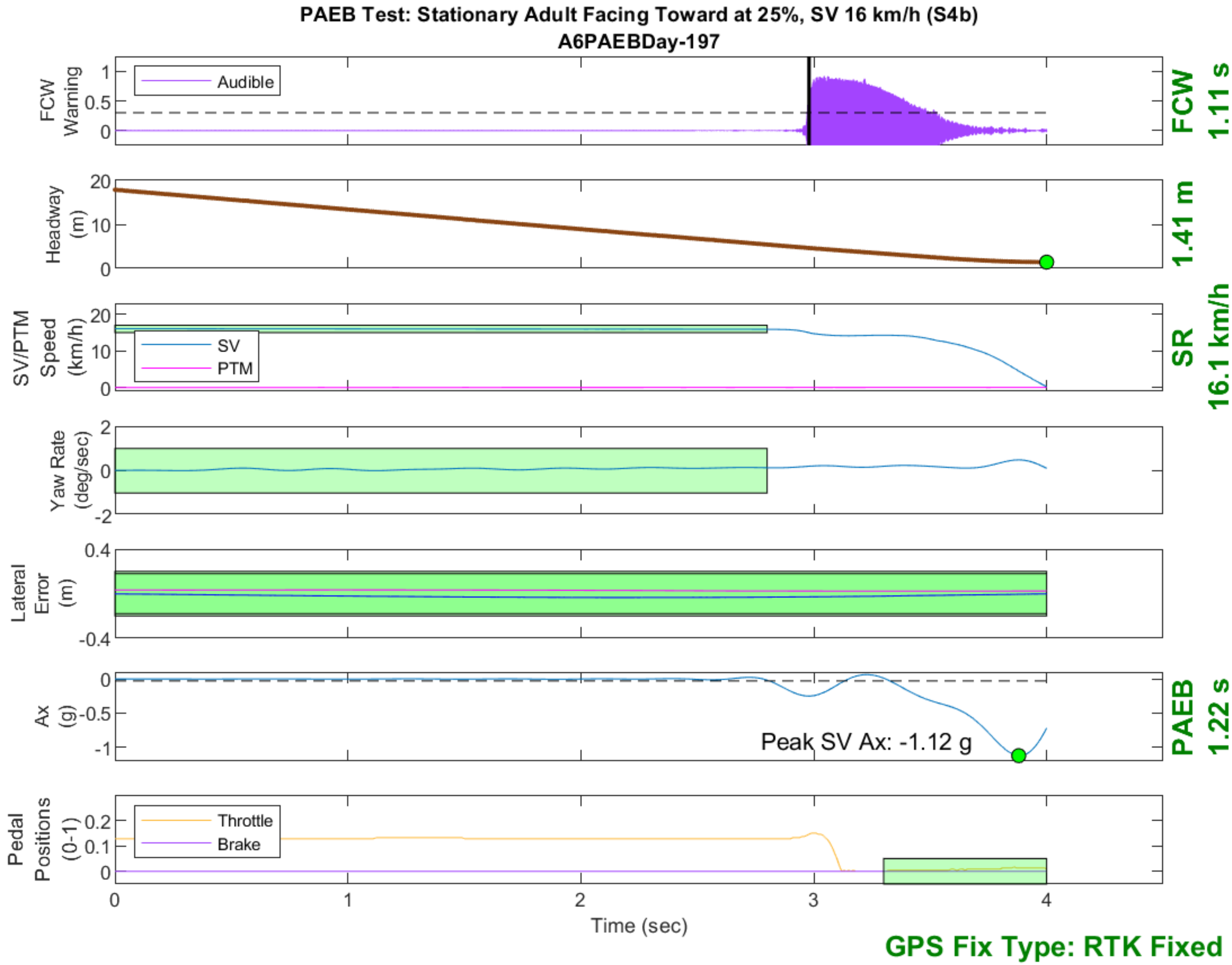


Figure D141. Time History for PAEB Run 197, S4b, Daytime, 16 km/h

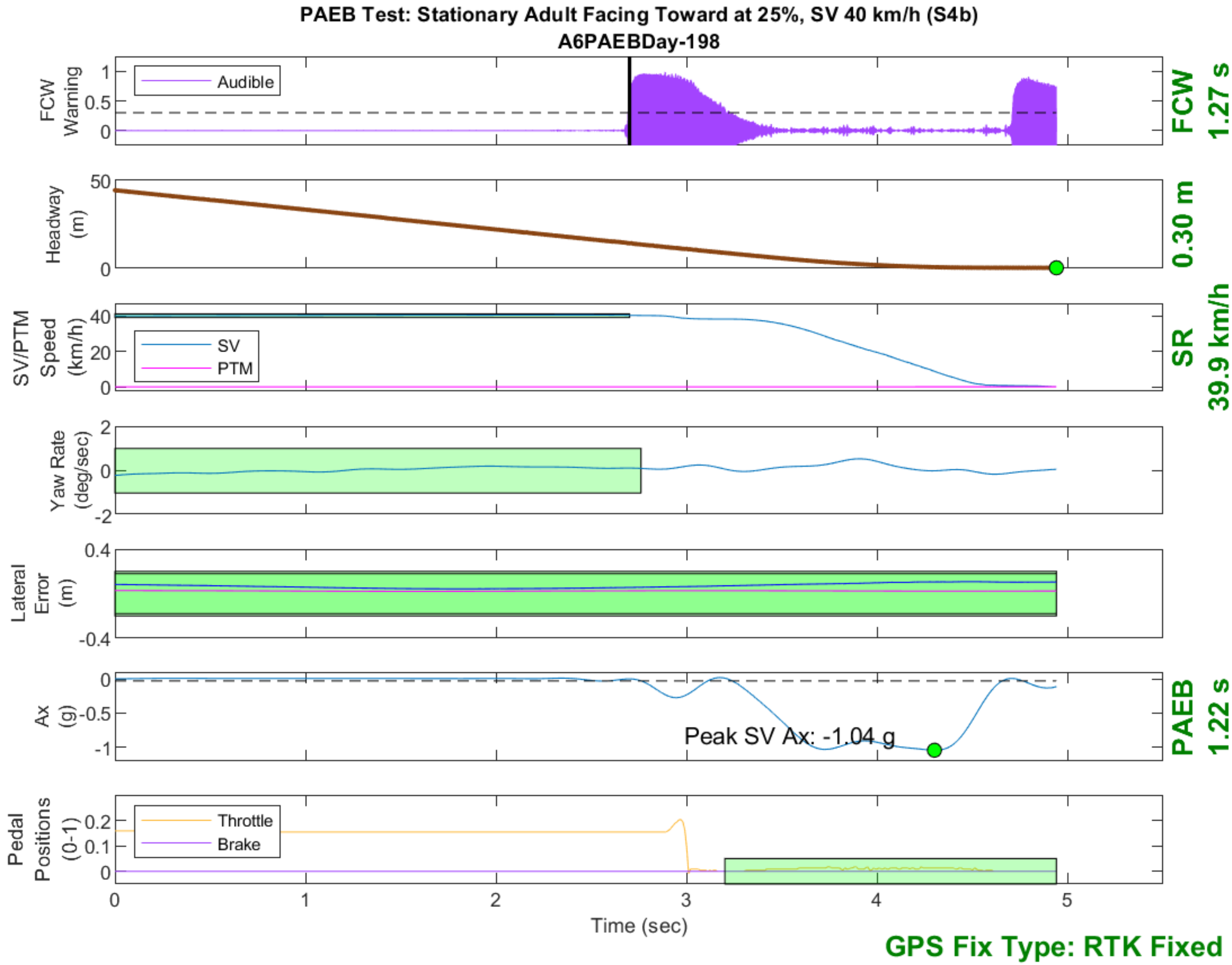


Figure D142. Time History for PAEB Run 198, S4b, Daytime, 40 km/h

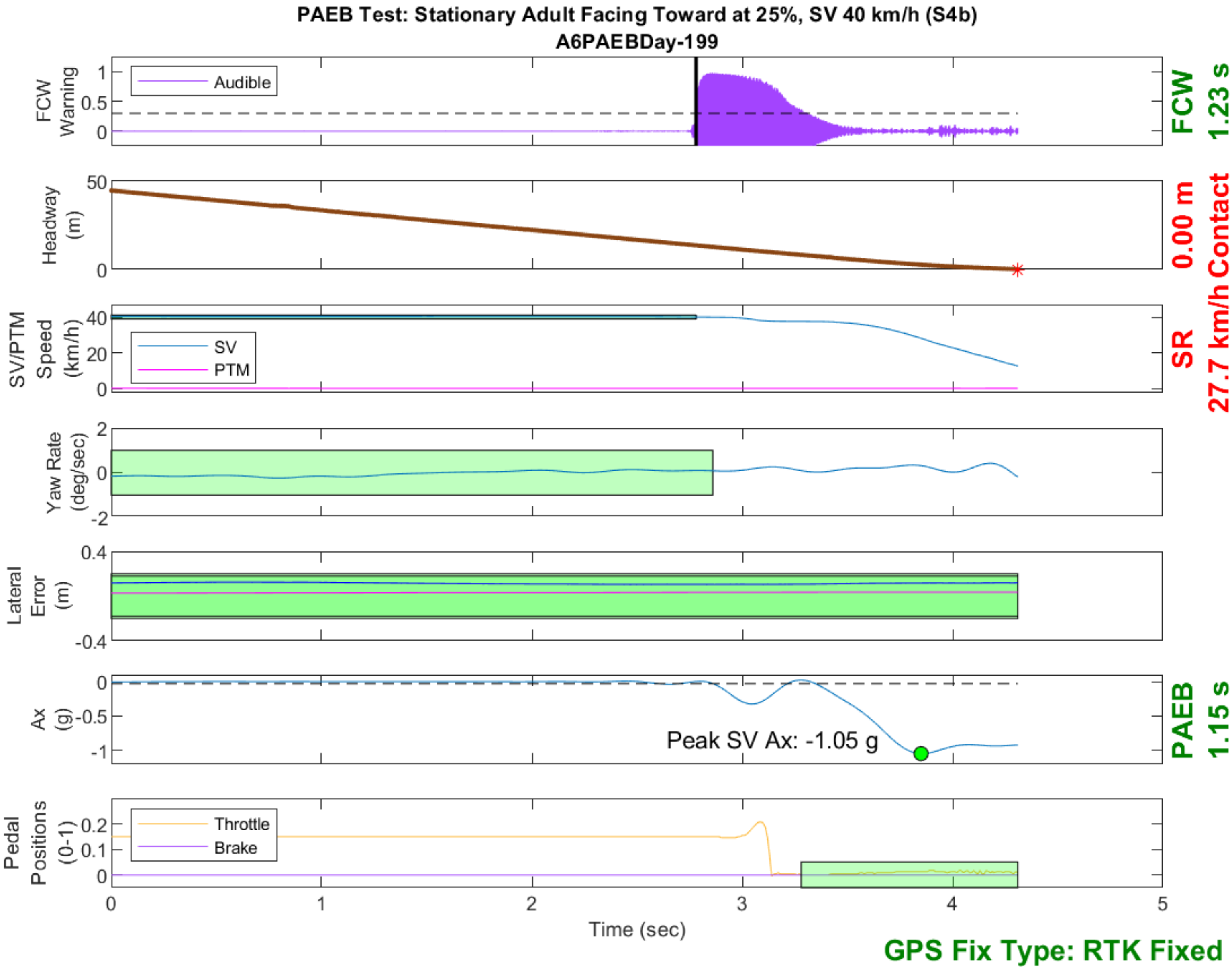


Figure D143. Time History for PAEB Run 199, S4b, Daytime, 40 km/h

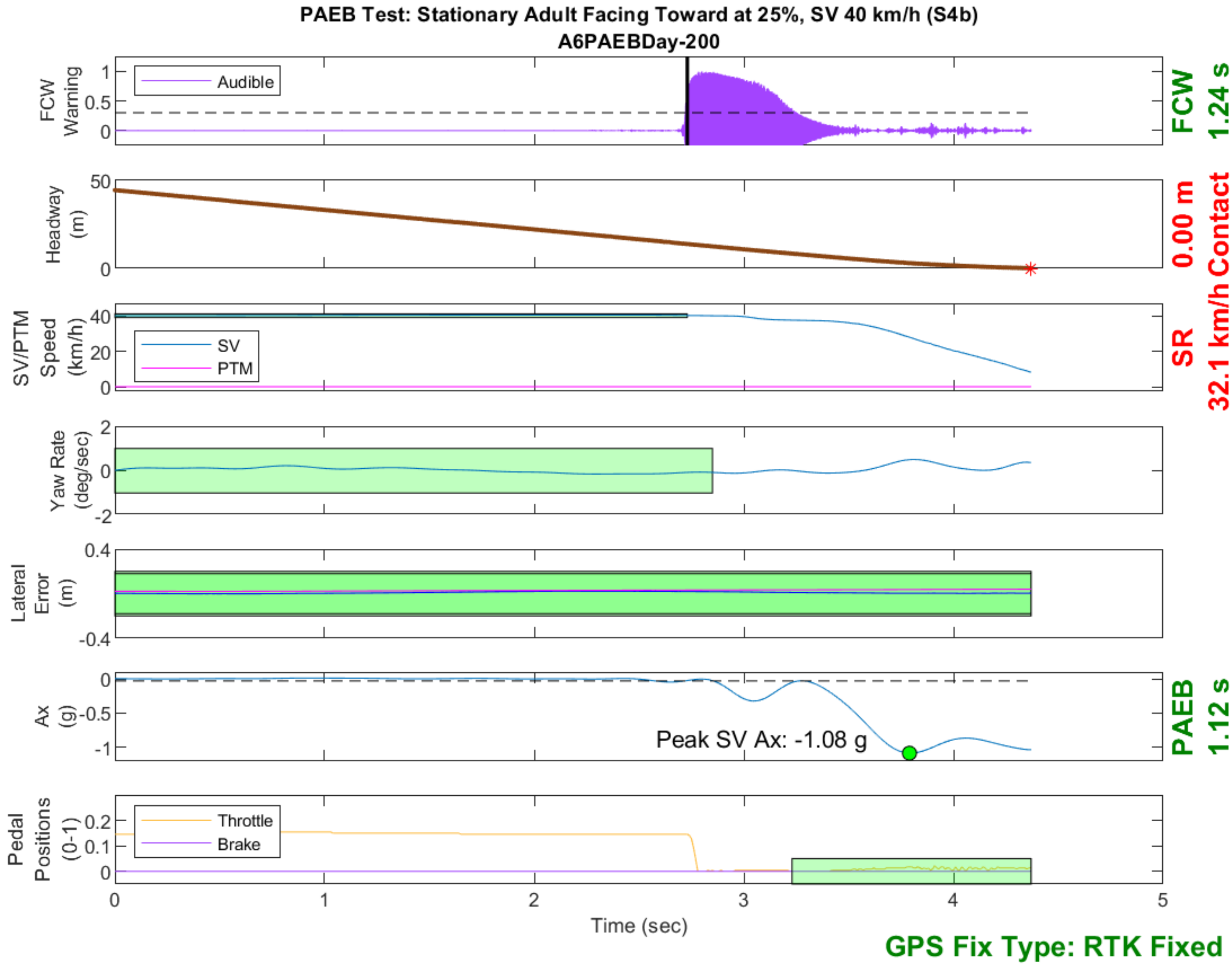


Figure D144. Time History for PAEB Run 200, S4b, Daytime, 40 km/h

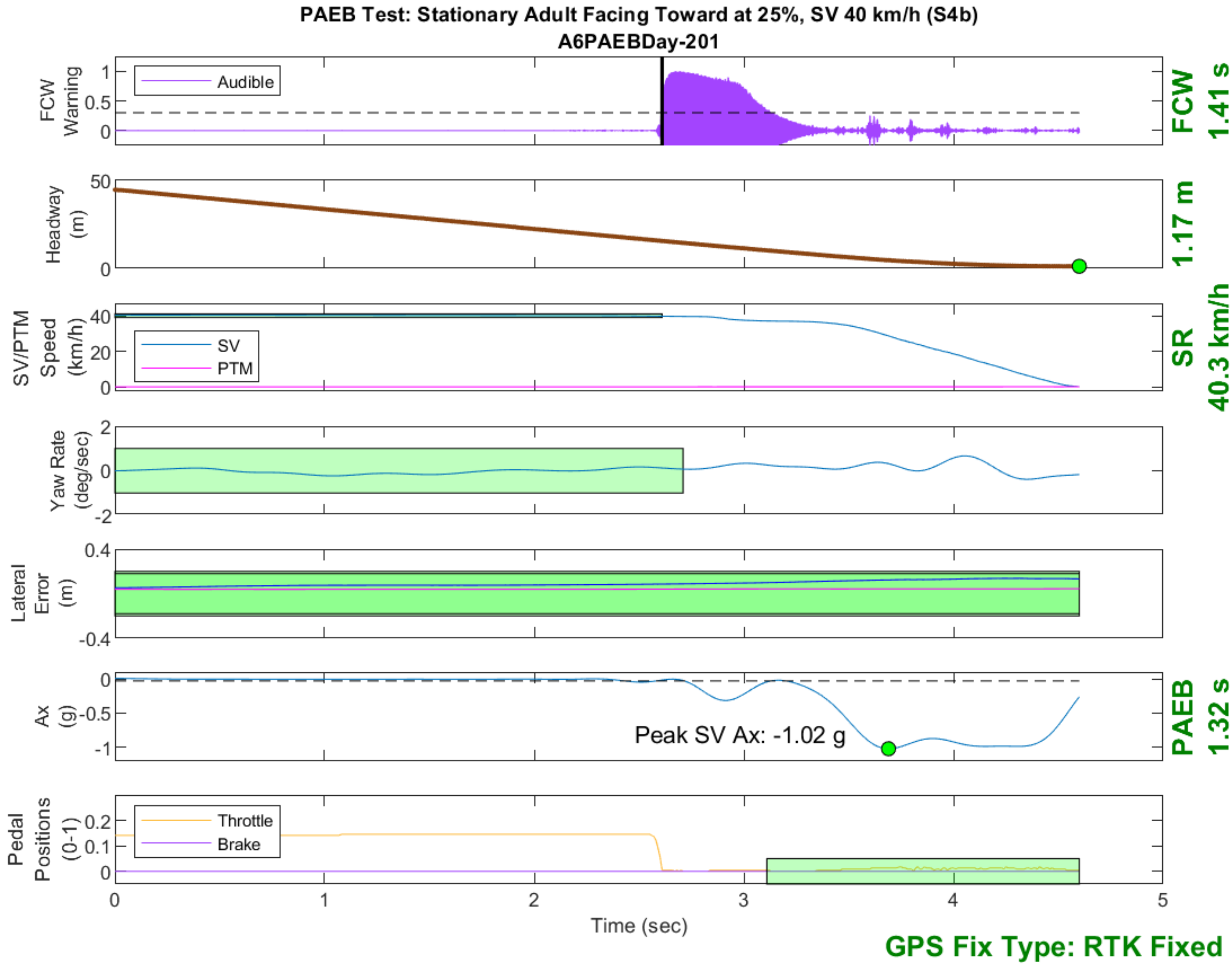


Figure D145. Time History for PAEB Run 201, S4b, Daytime, 40 km/h

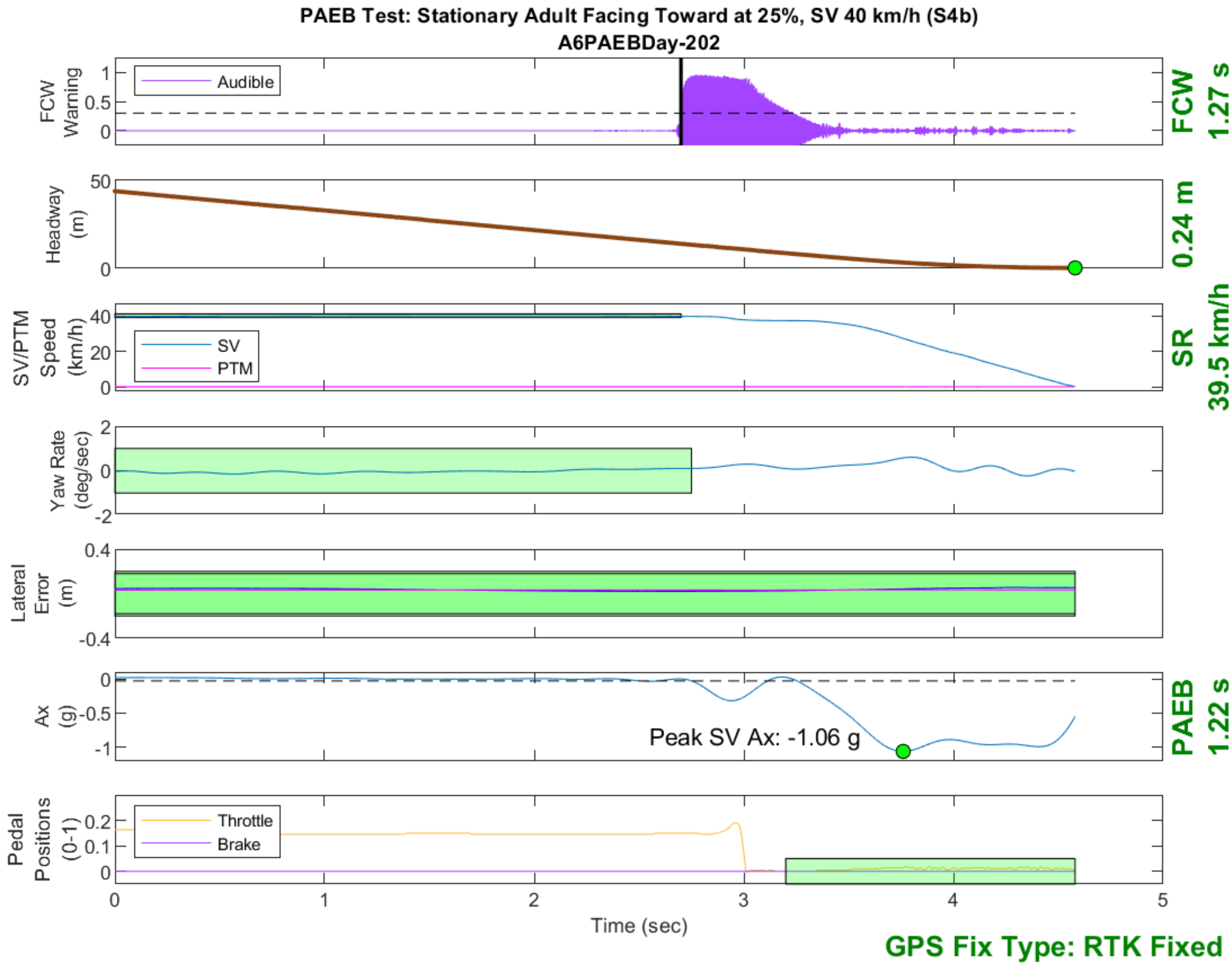


Figure D146. Time History for PAEB Run 202, S4b, Daytime, 40 km/h

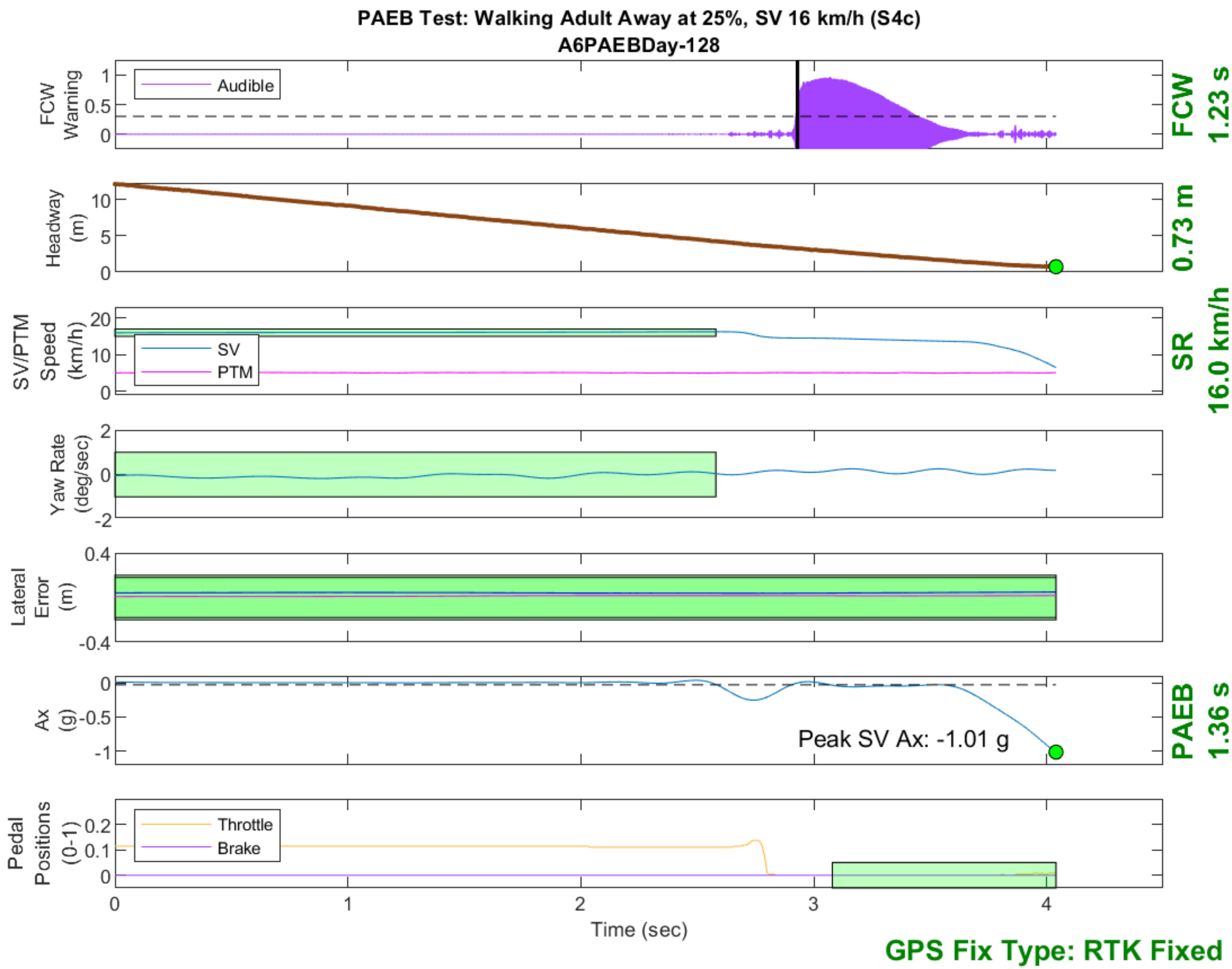


Figure D147. Time History for PAEB Run 128, S4c, Daytime, 16 km/h

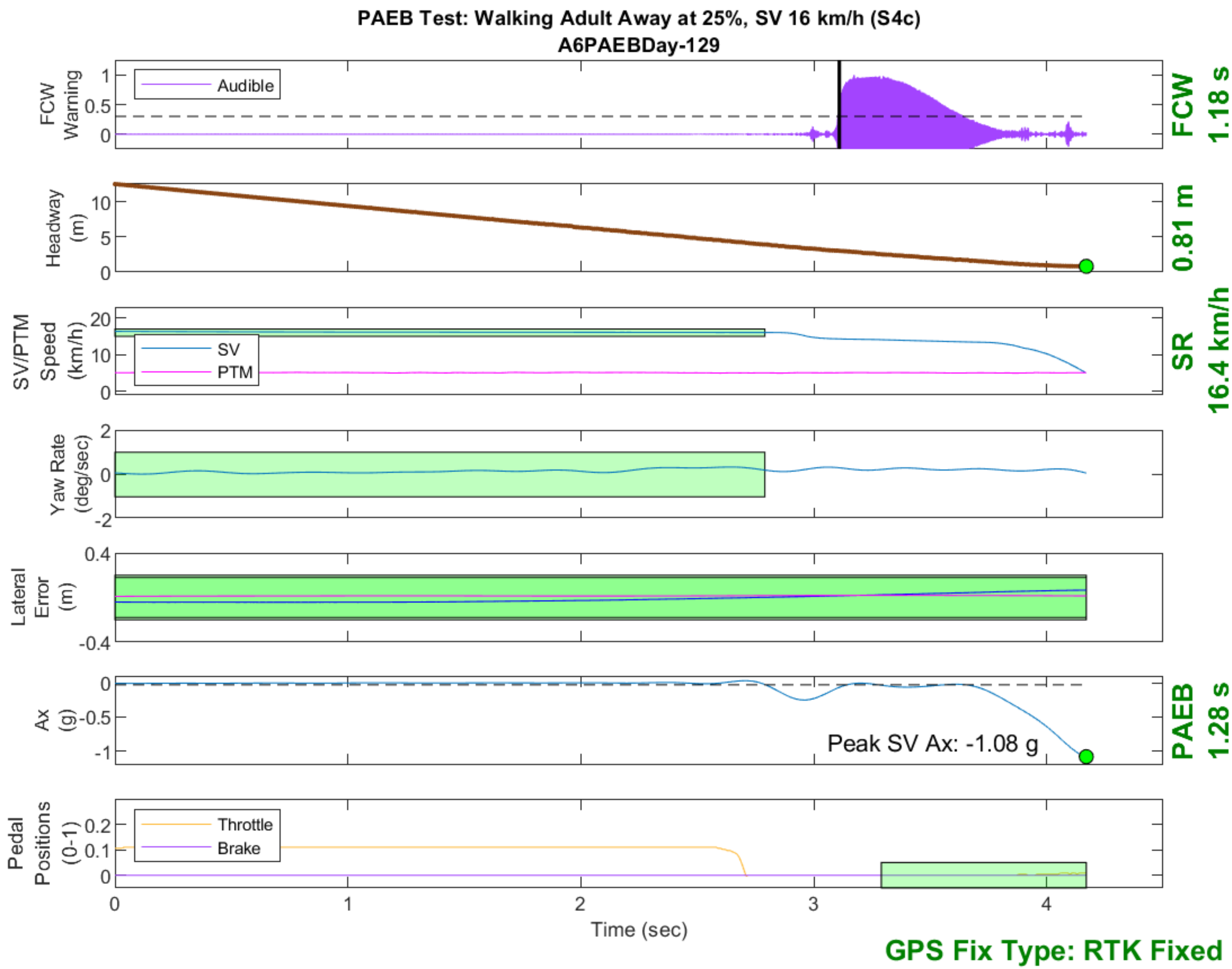


Figure D148. Time History for PAEB Run 129, S4c, Daytime, 16 km/h

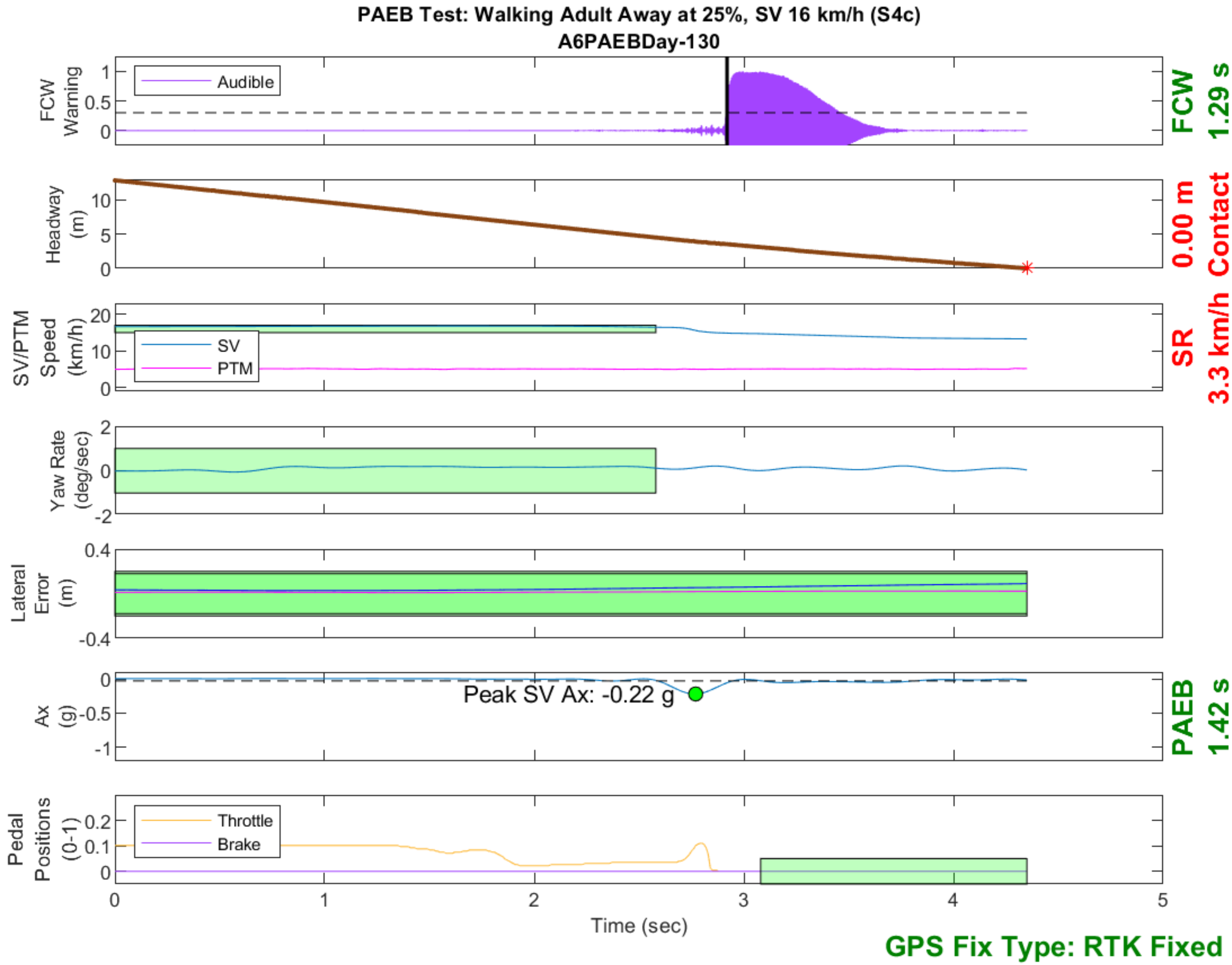


Figure D149. Time History for PAEB Run 130, S4c, Daytime, 16 km/h

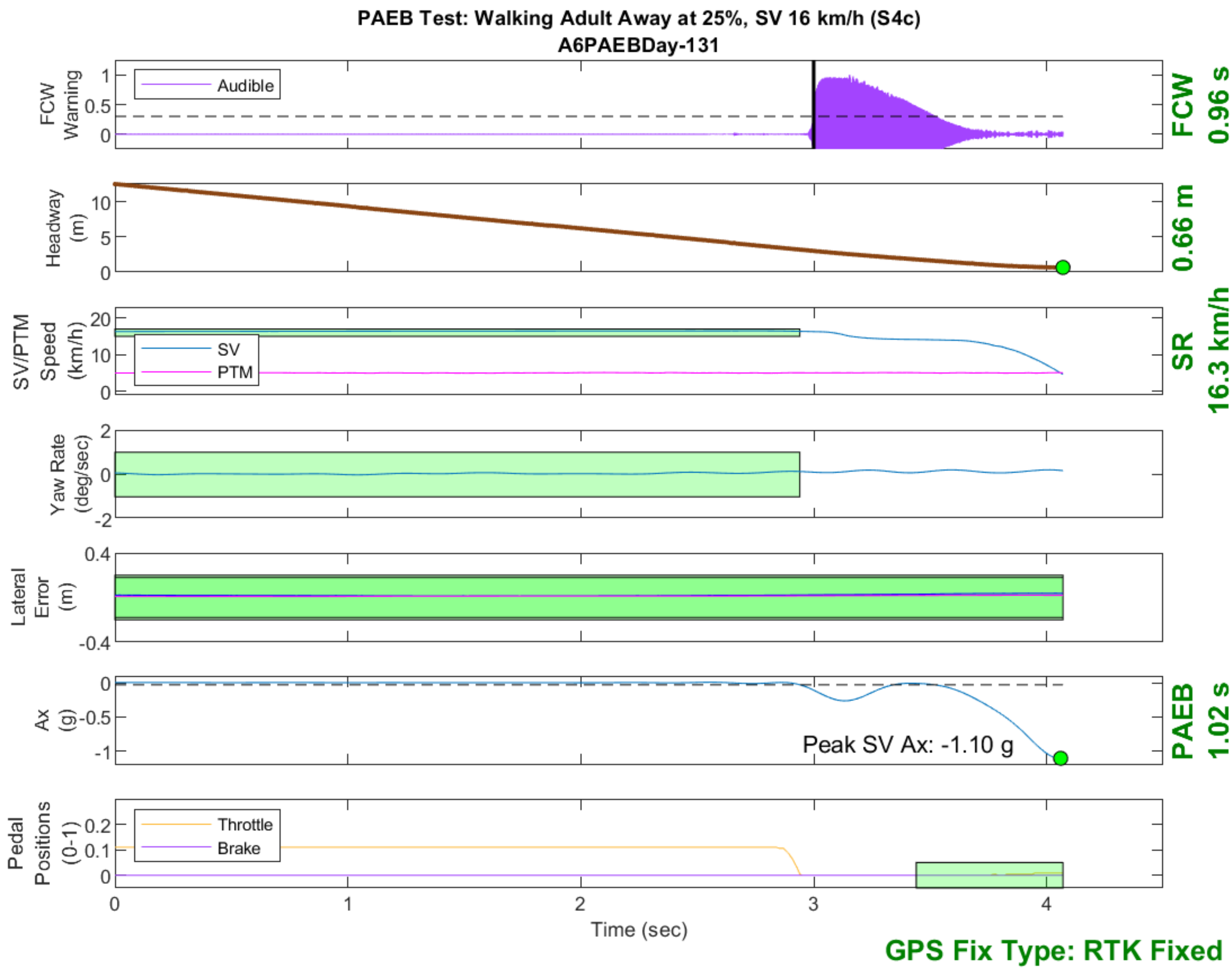


Figure D150. Time History for PAEB Run 131, S4c, Daytime, 16 km/h

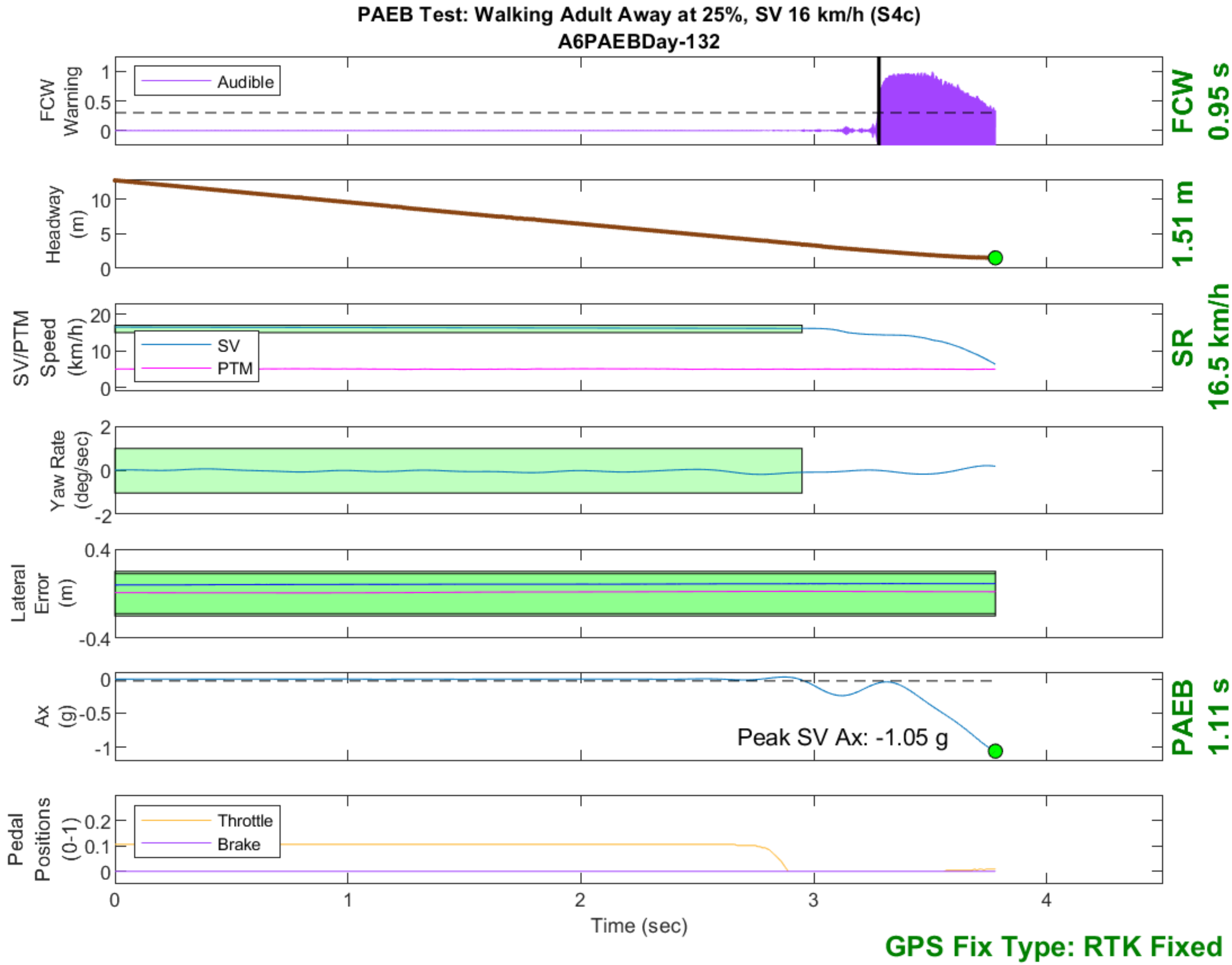


Figure D151. Time History for PAEB Run 132, S4c, Daytime, 16 km/h

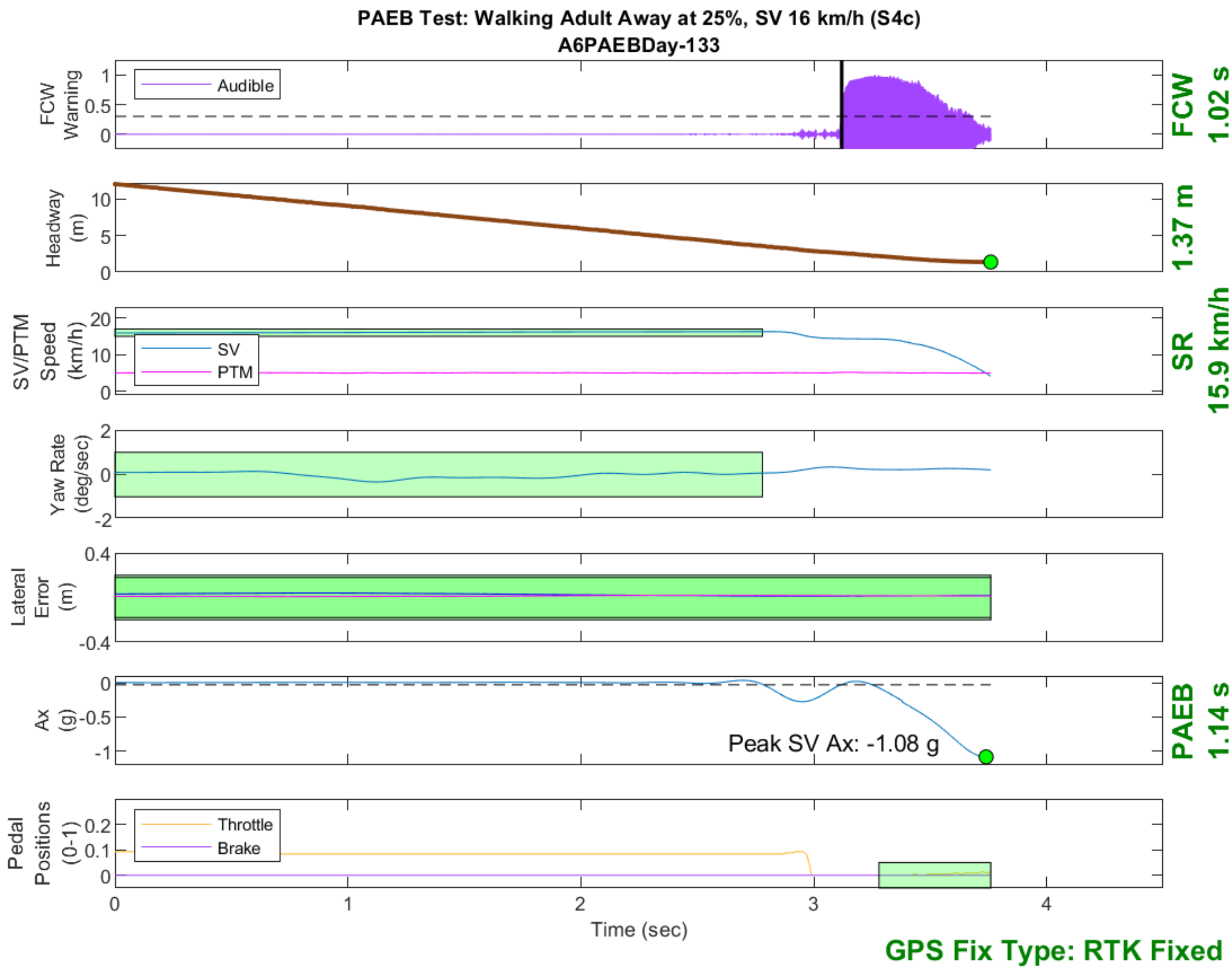


Figure D152. Time History for PAEB Run 133, S4c, Daytime, 16 km/h

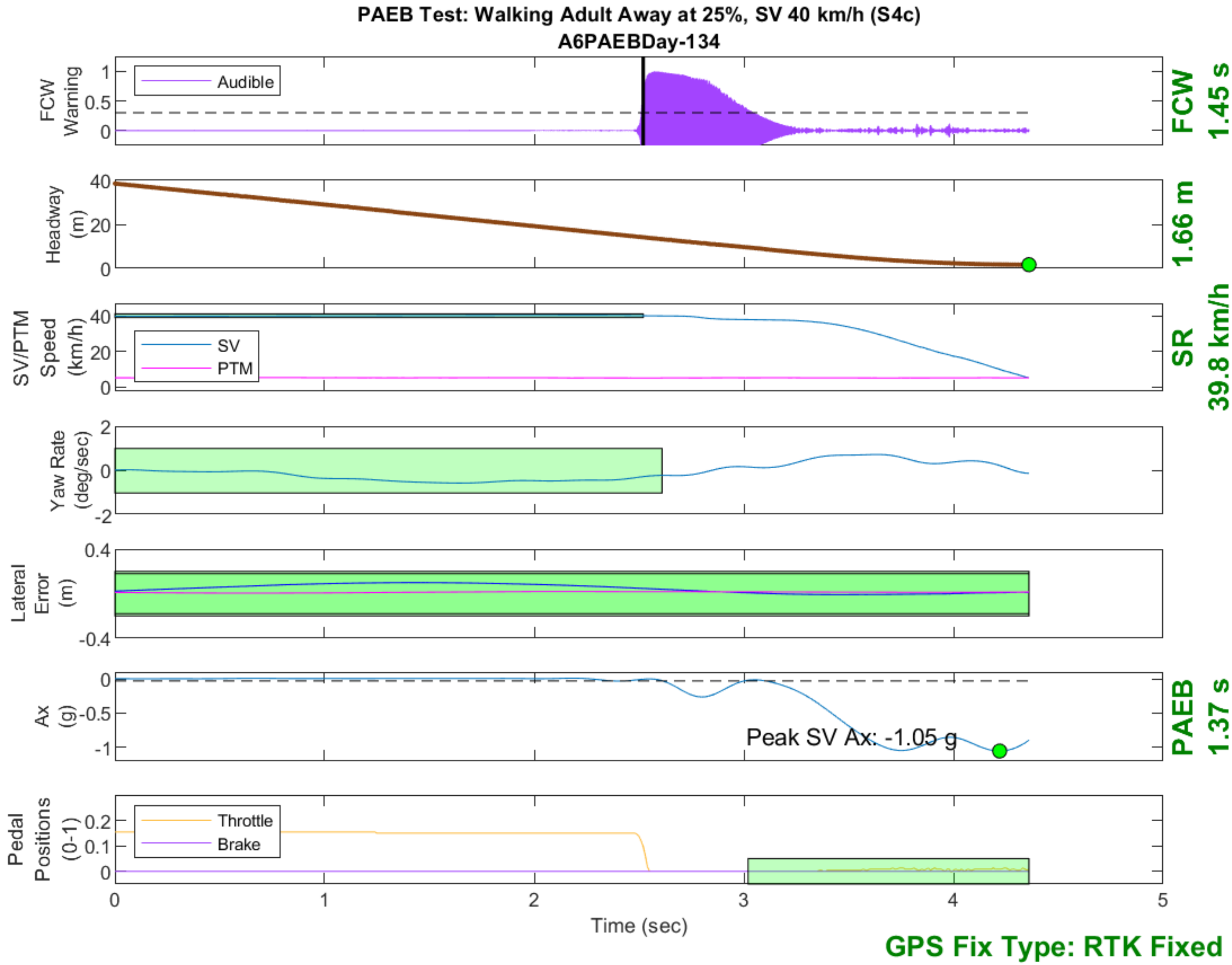


Figure D153. Time History for PAEB Run 134, S4c, Daytime, 40 km/h

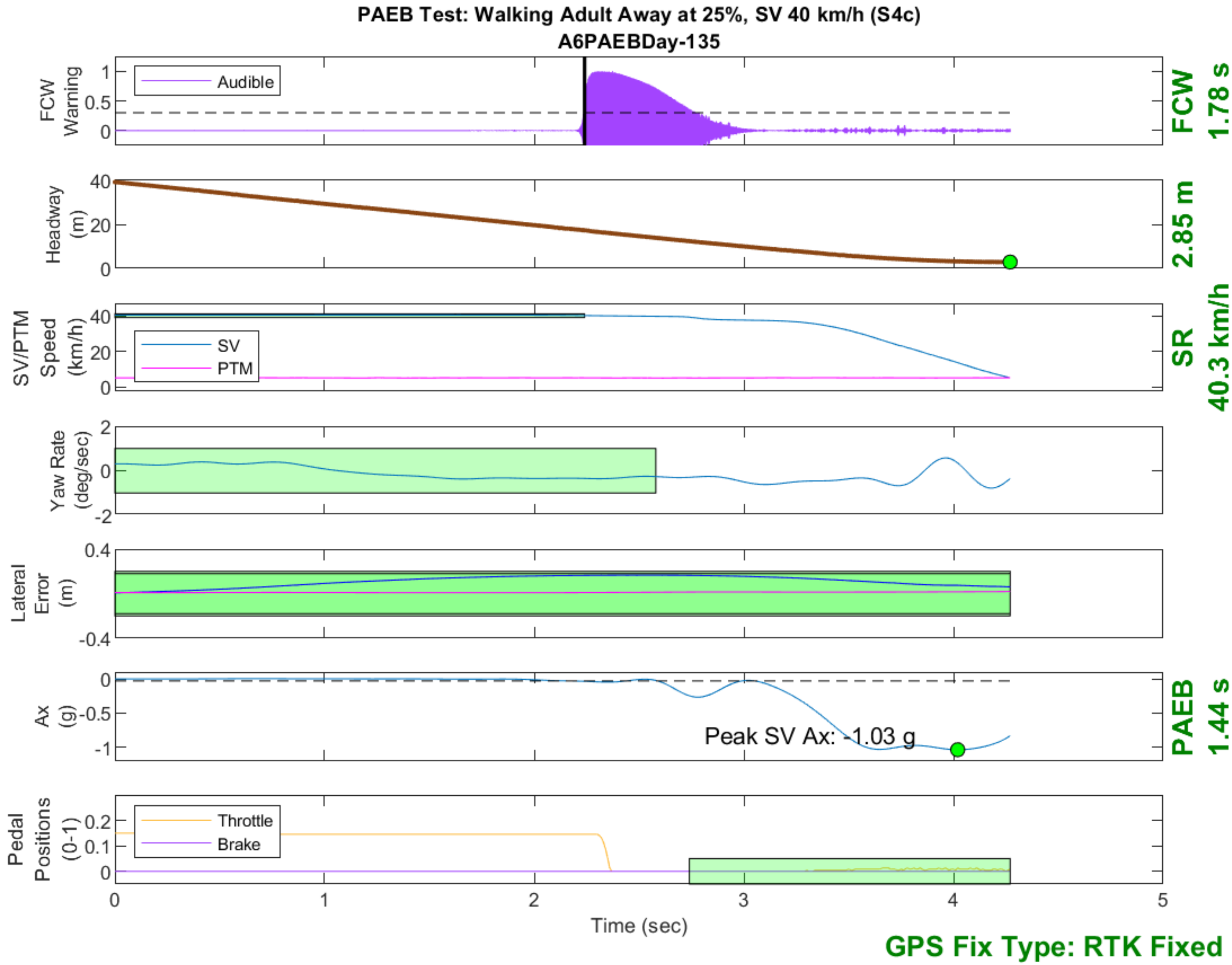


Figure D154. Time History for PAEB Run 135, S4c, Daytime, 40 km/h

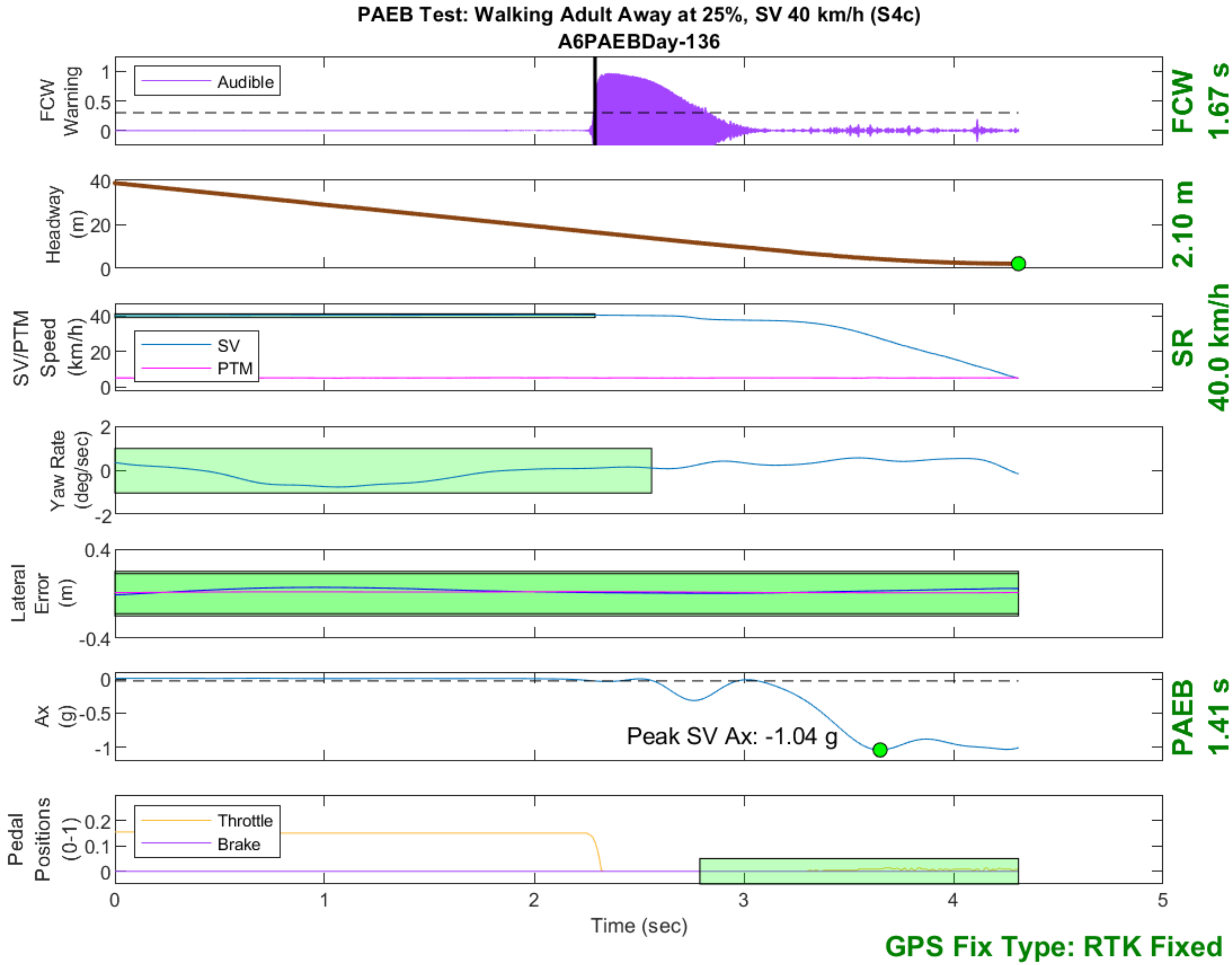


Figure D155. Time History for PAEB Run 136, S4c, Daytime, 40 km/h

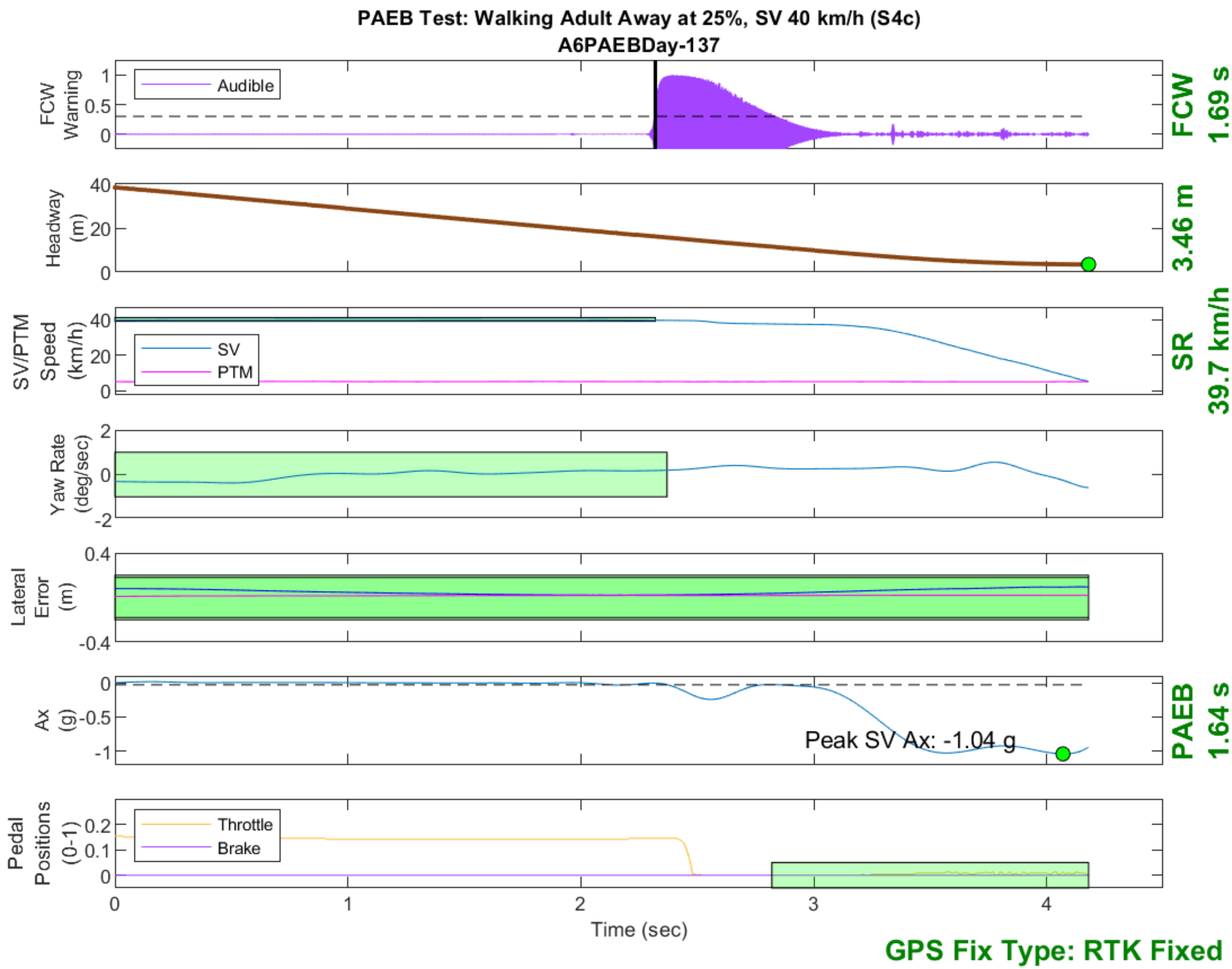


Figure D156. Time History for PAEB Run 137, S4c, Daytime, 40 km/h

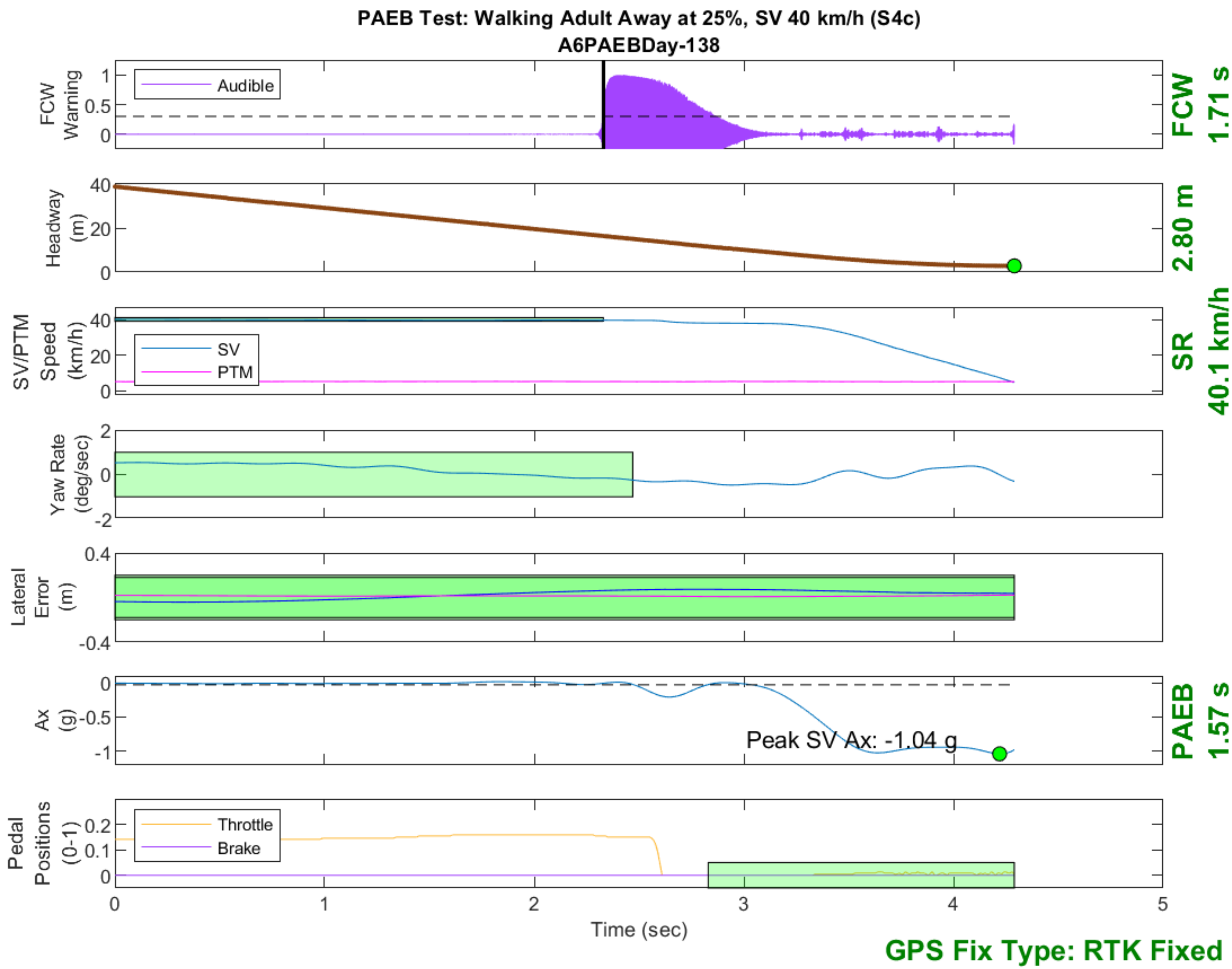


Figure D157. Time History for PAEB Run 138, S4c, Daytime, 40 km/h

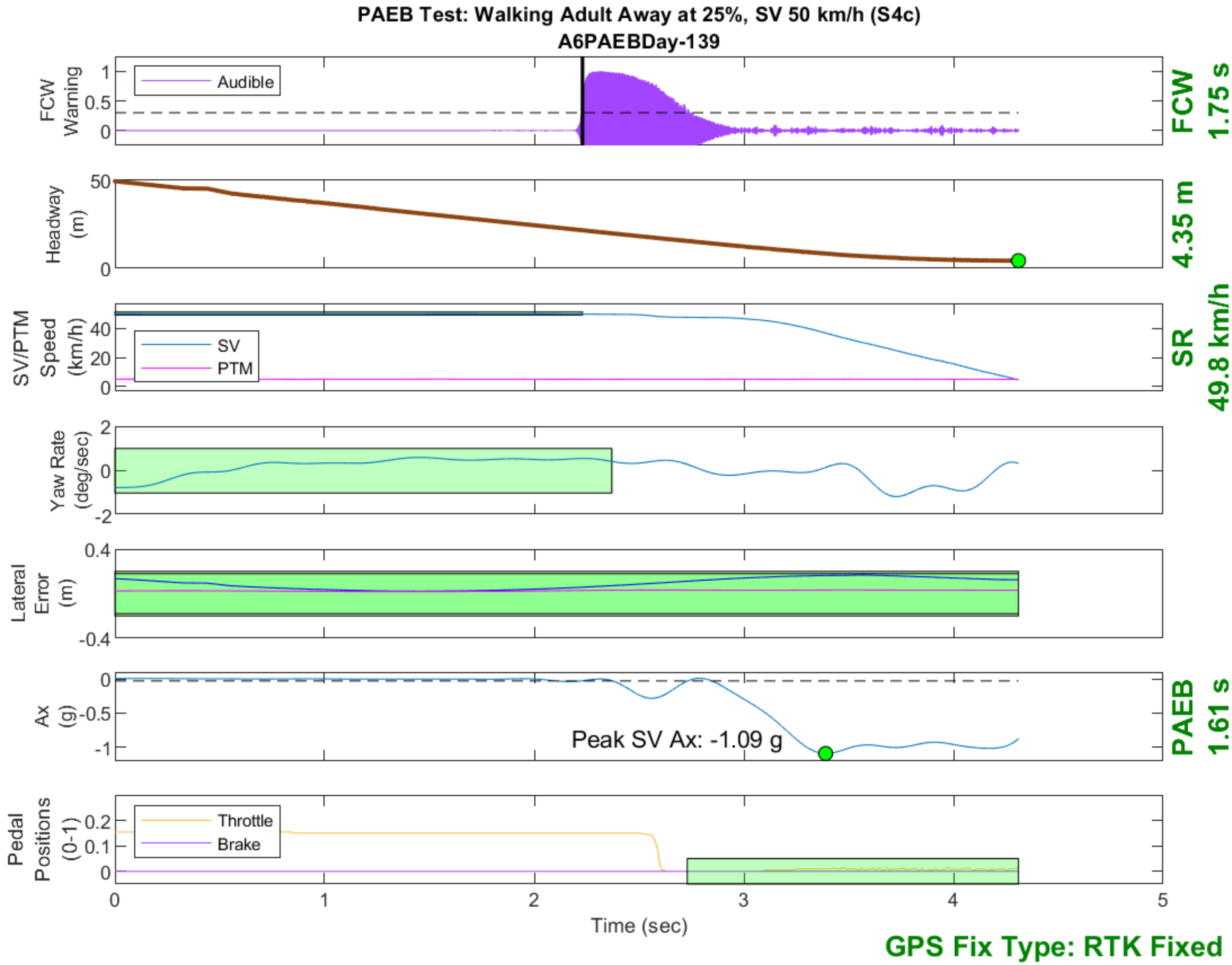


Figure D158. Time History for PAEB Run 139, S4c, Daytime, 50 km/h

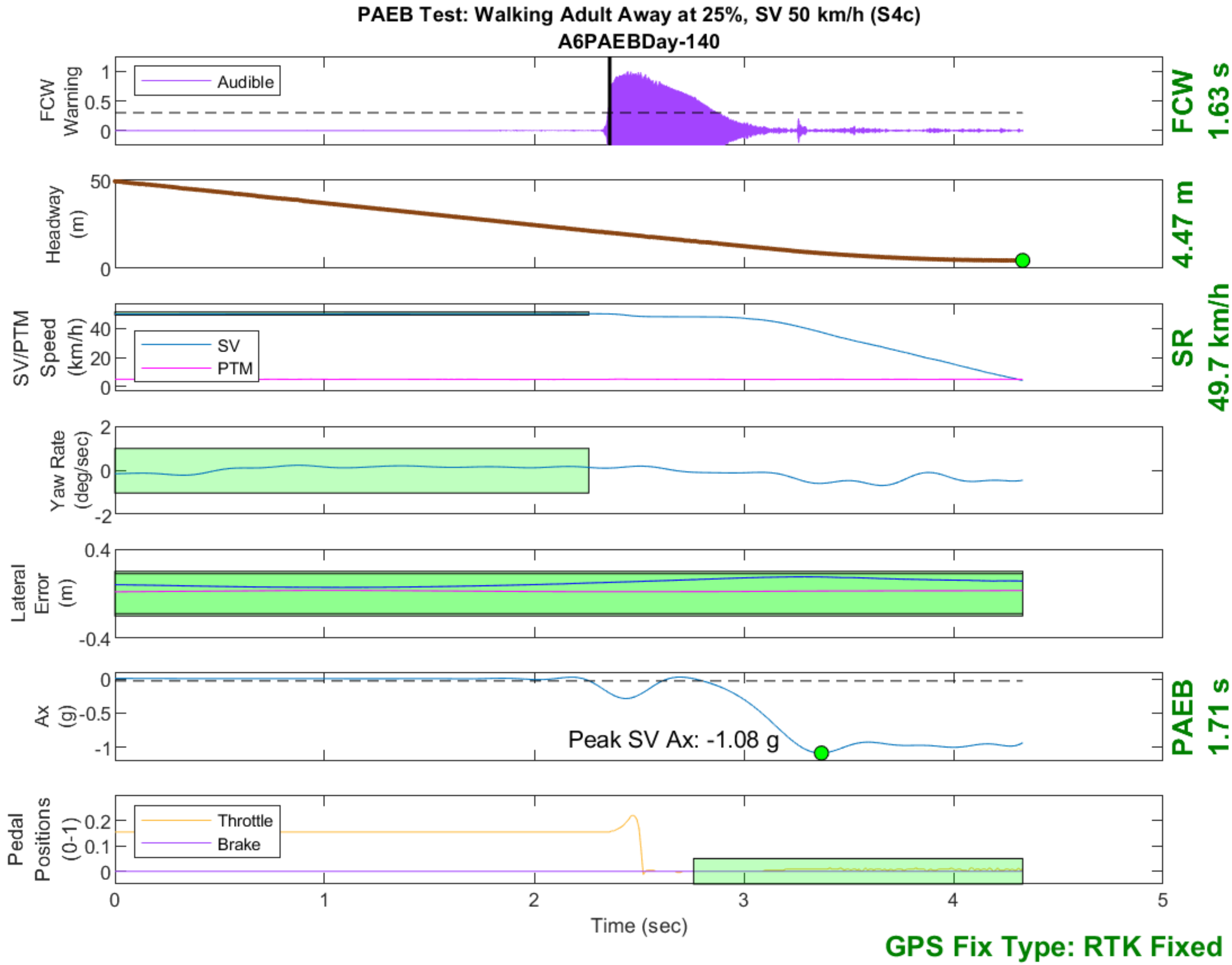


Figure D159. Time History for PAEB Run 140, S4c, Daytime, 50 km/h

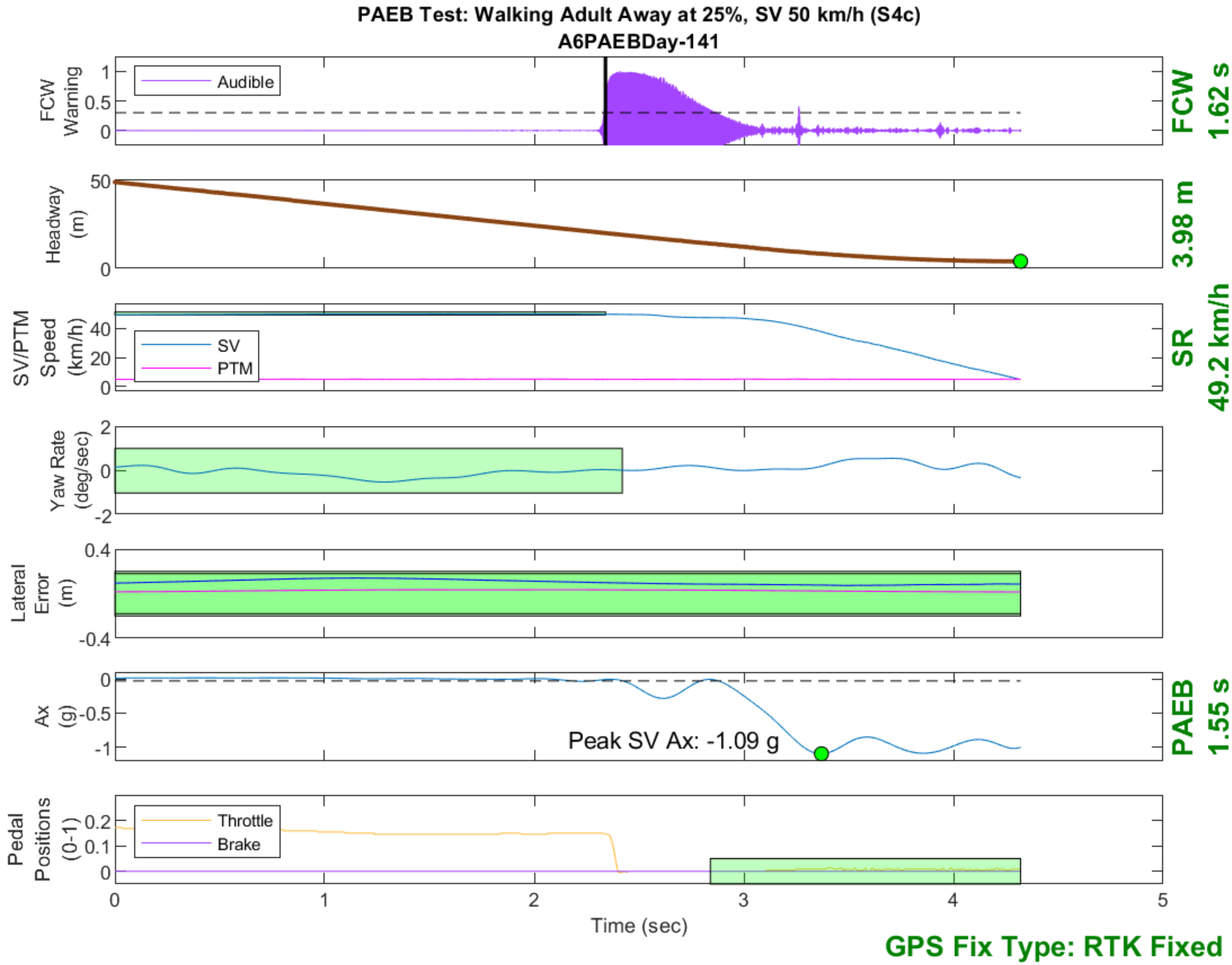


Figure D160. Time History for PAEB Run 141, S4c, Daytime, 50 km/h

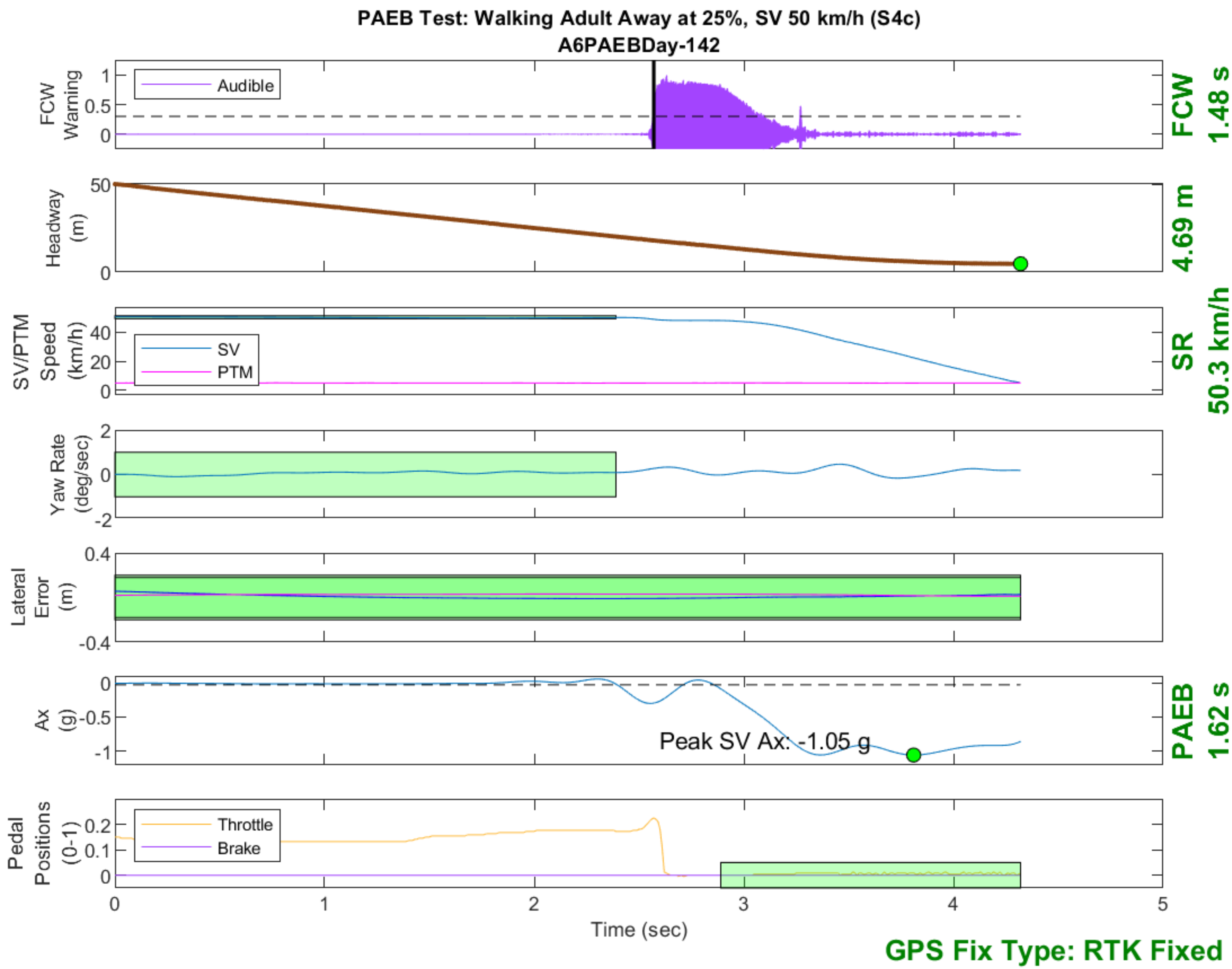


Figure D161. Time History for PAEB Run 142, S4c, Daytime, 50 km/h

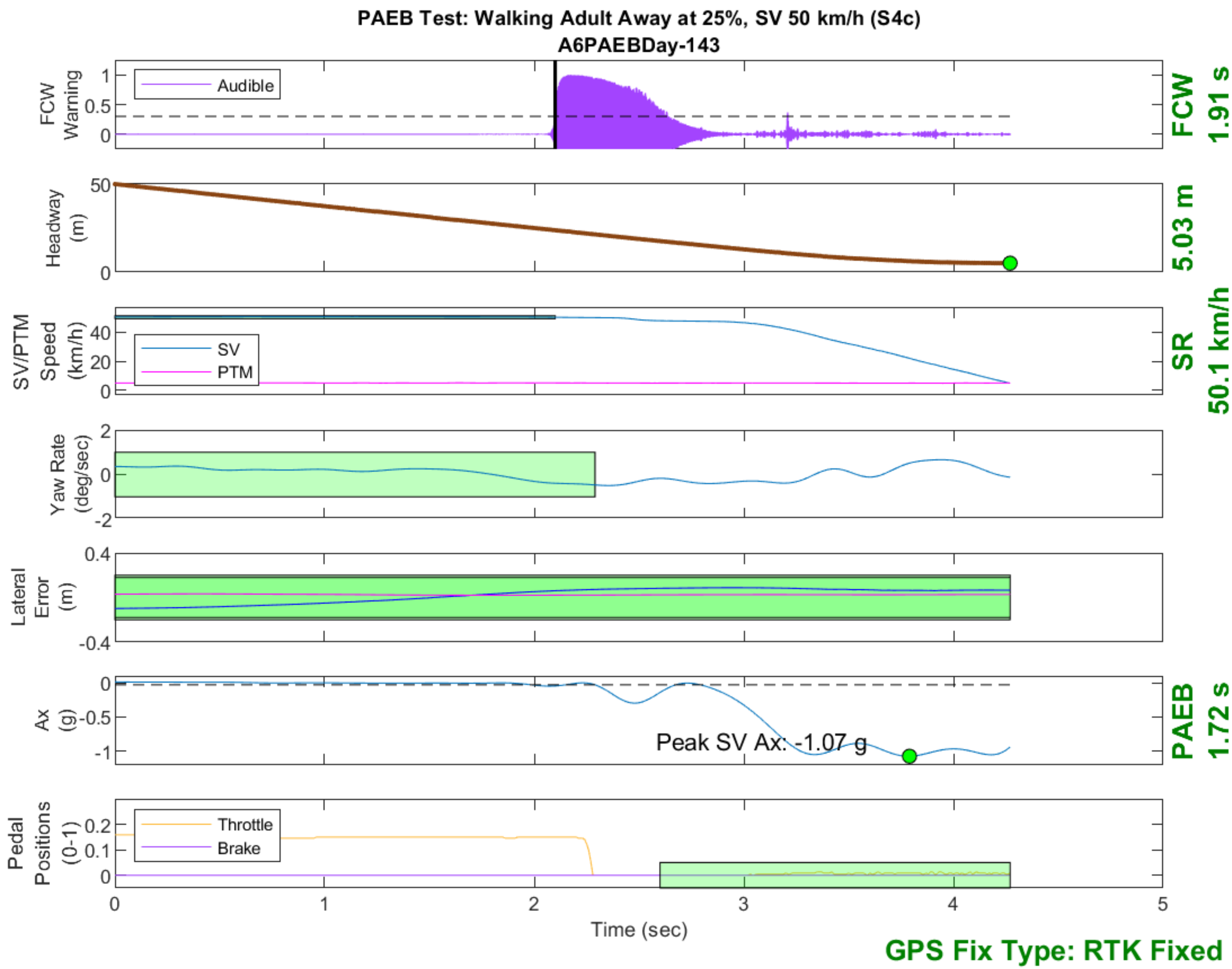


Figure D162. Time History for PAEB Run 143, S4c, Daytime, 50 km/h

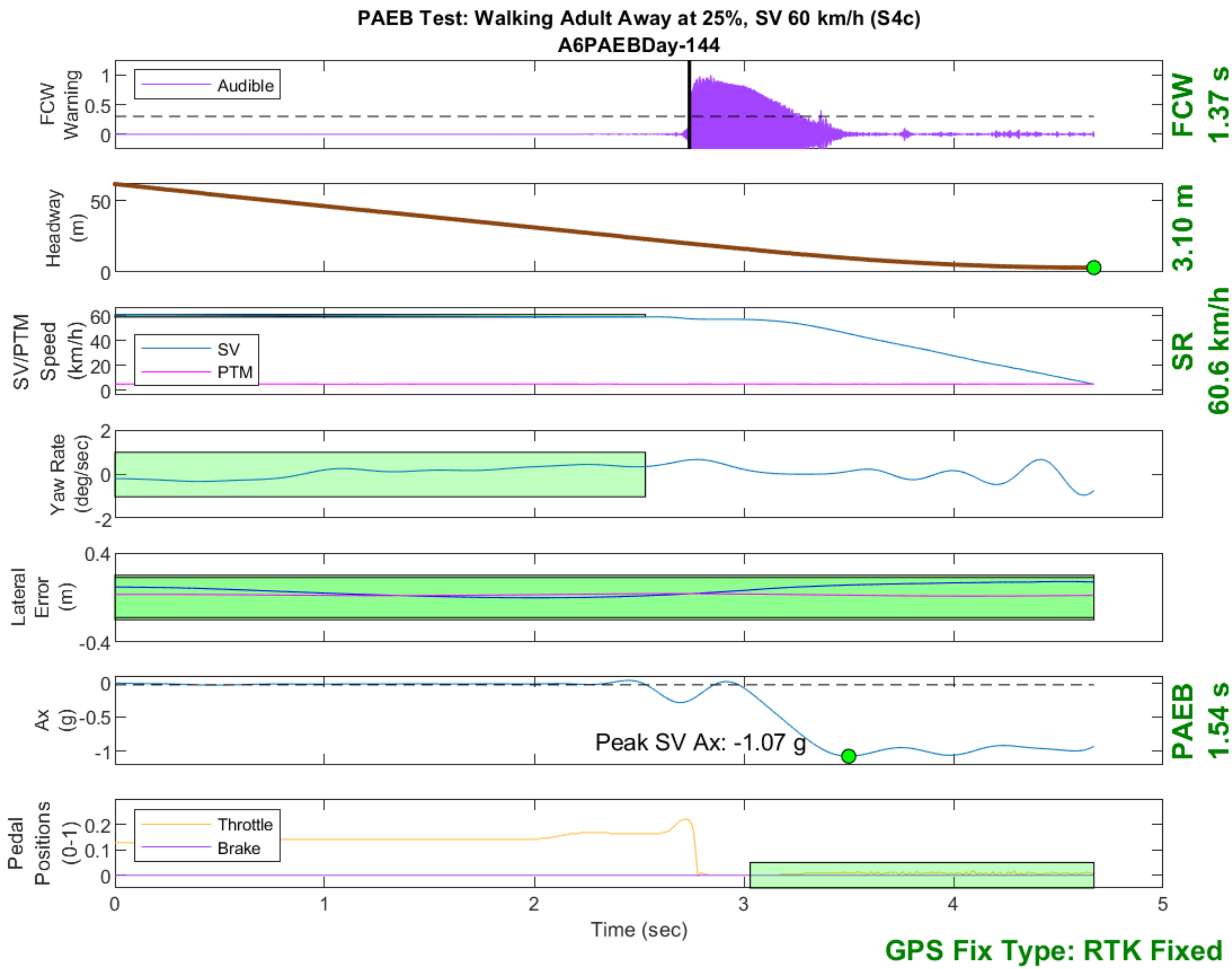


Figure D163. Time History for PAEB Run 144, S4c, Daytime, 60 km/h

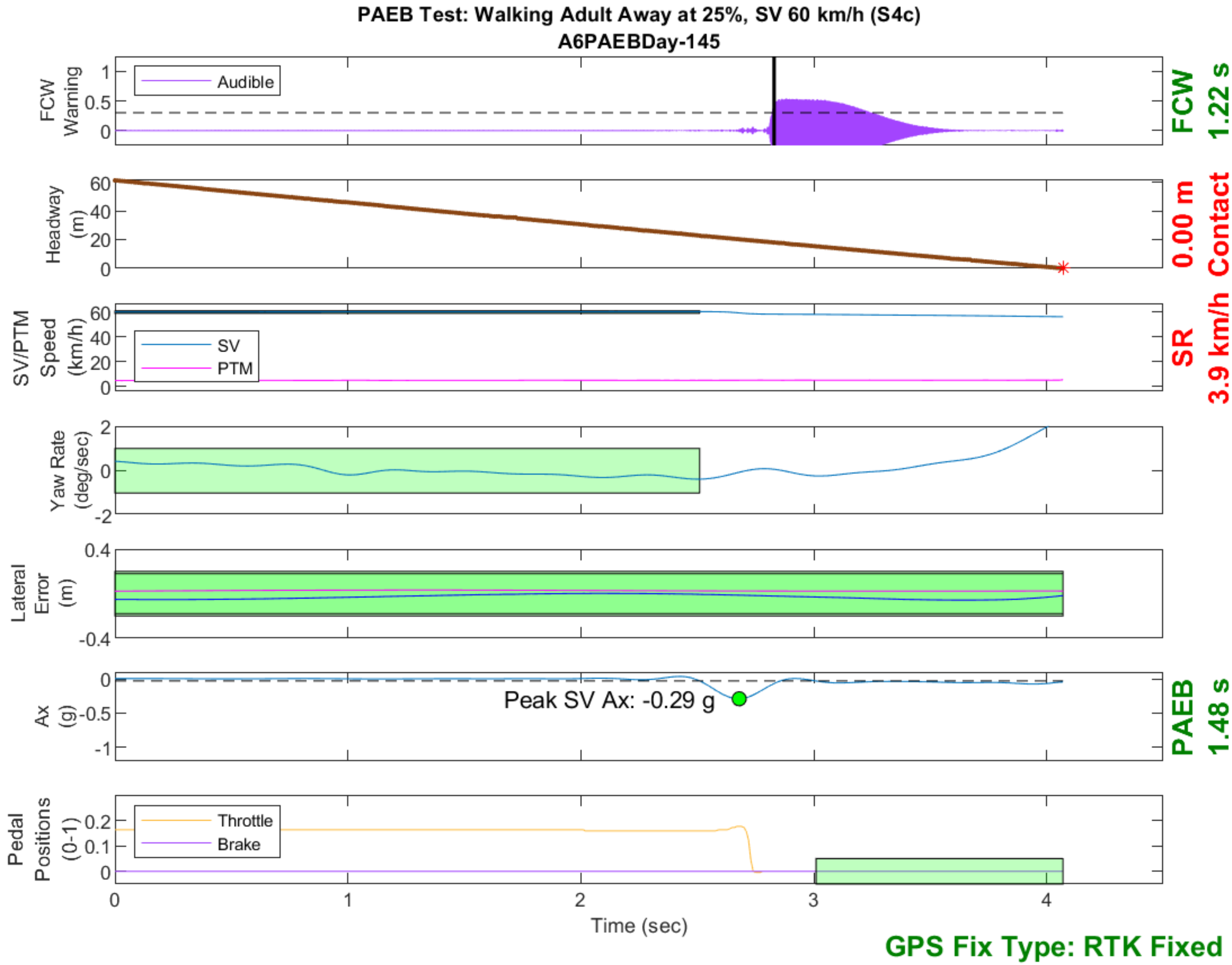


Figure D164. Time History for PAEB Run 145, S4c, Daytime, 60 km/h

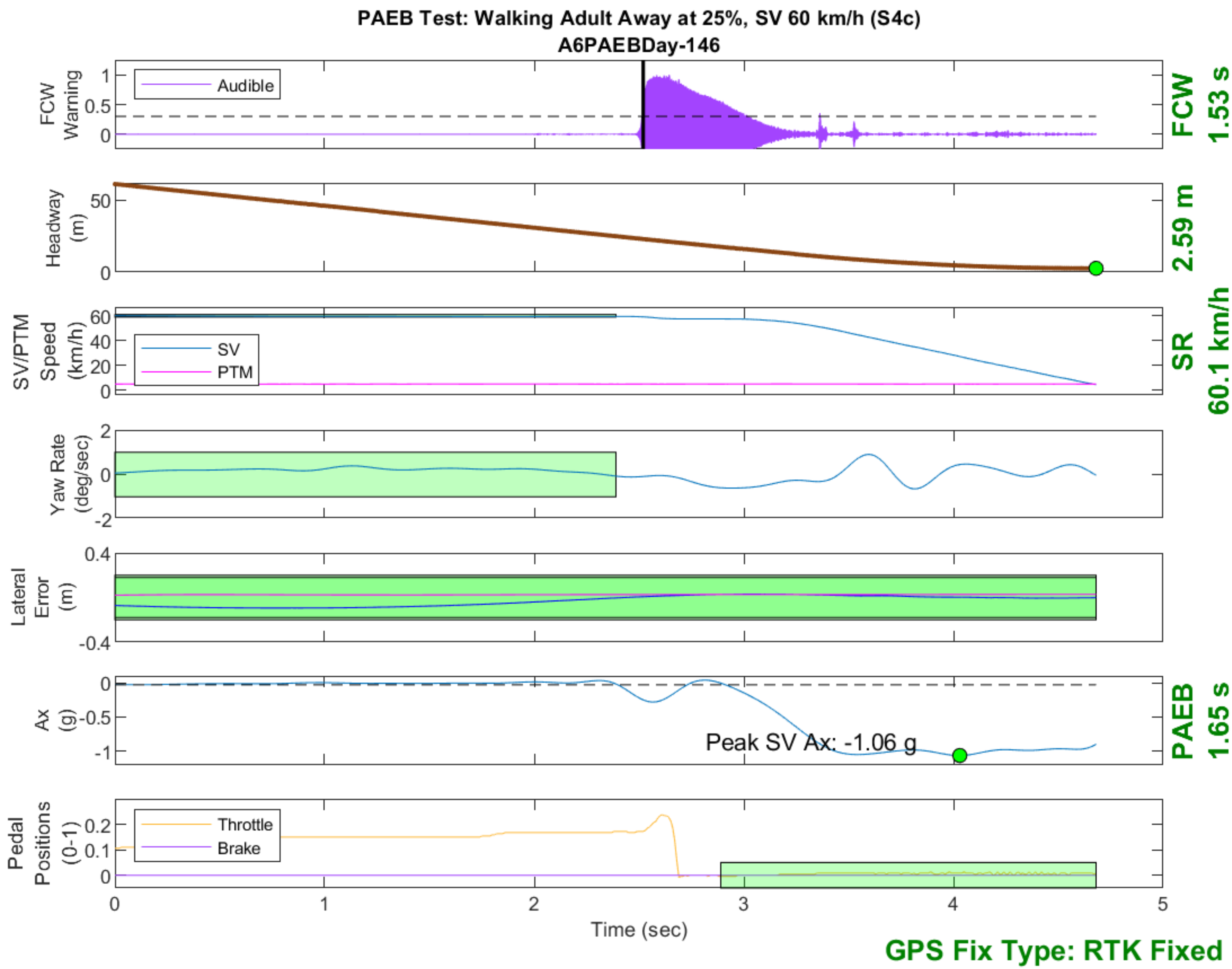


Figure D165. Time History for PAEB Run 146, S4c, Daytime, 60 km/h

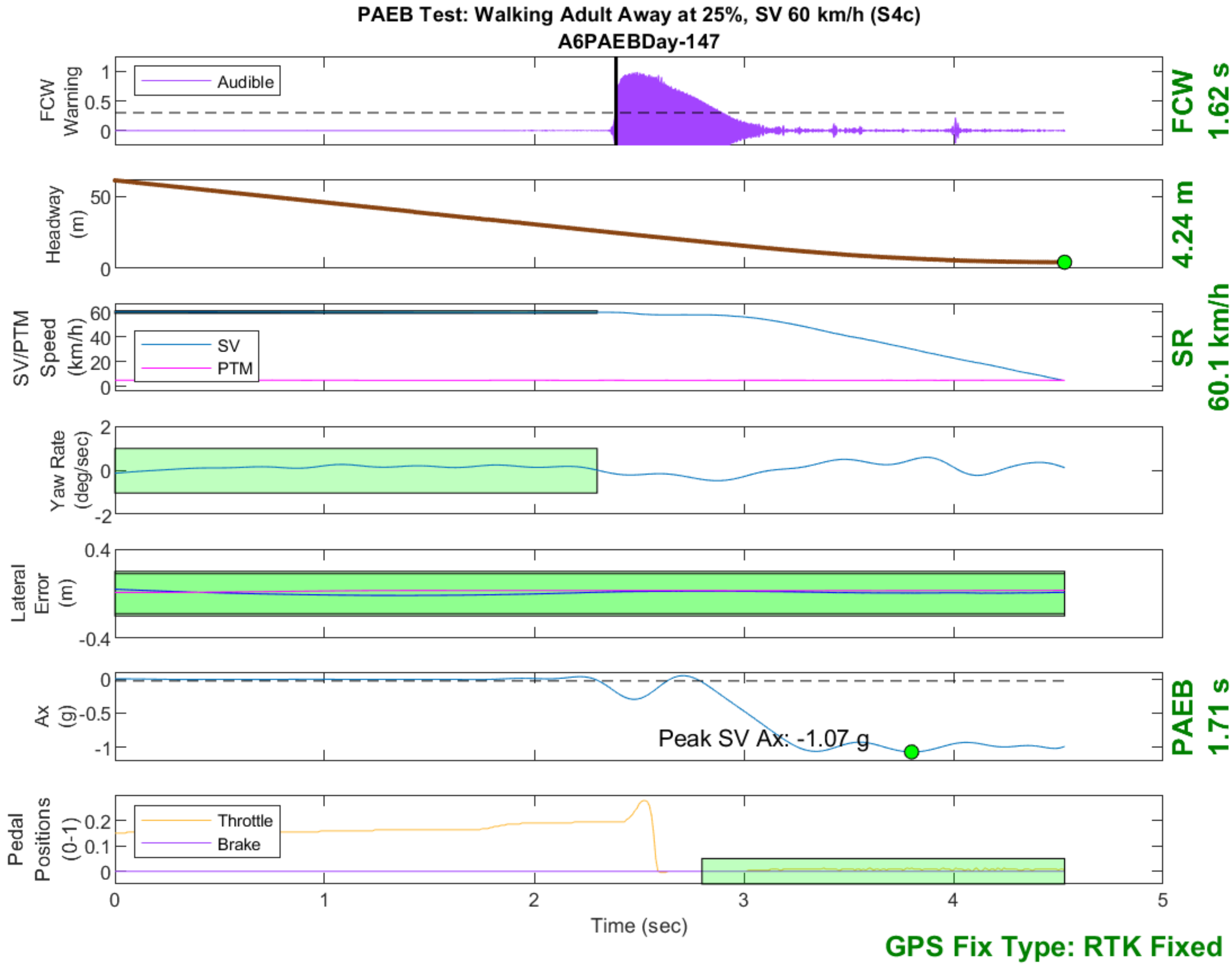


Figure D166. Time History for PAEB Run 147, S4c, Daytime, 60 km/h

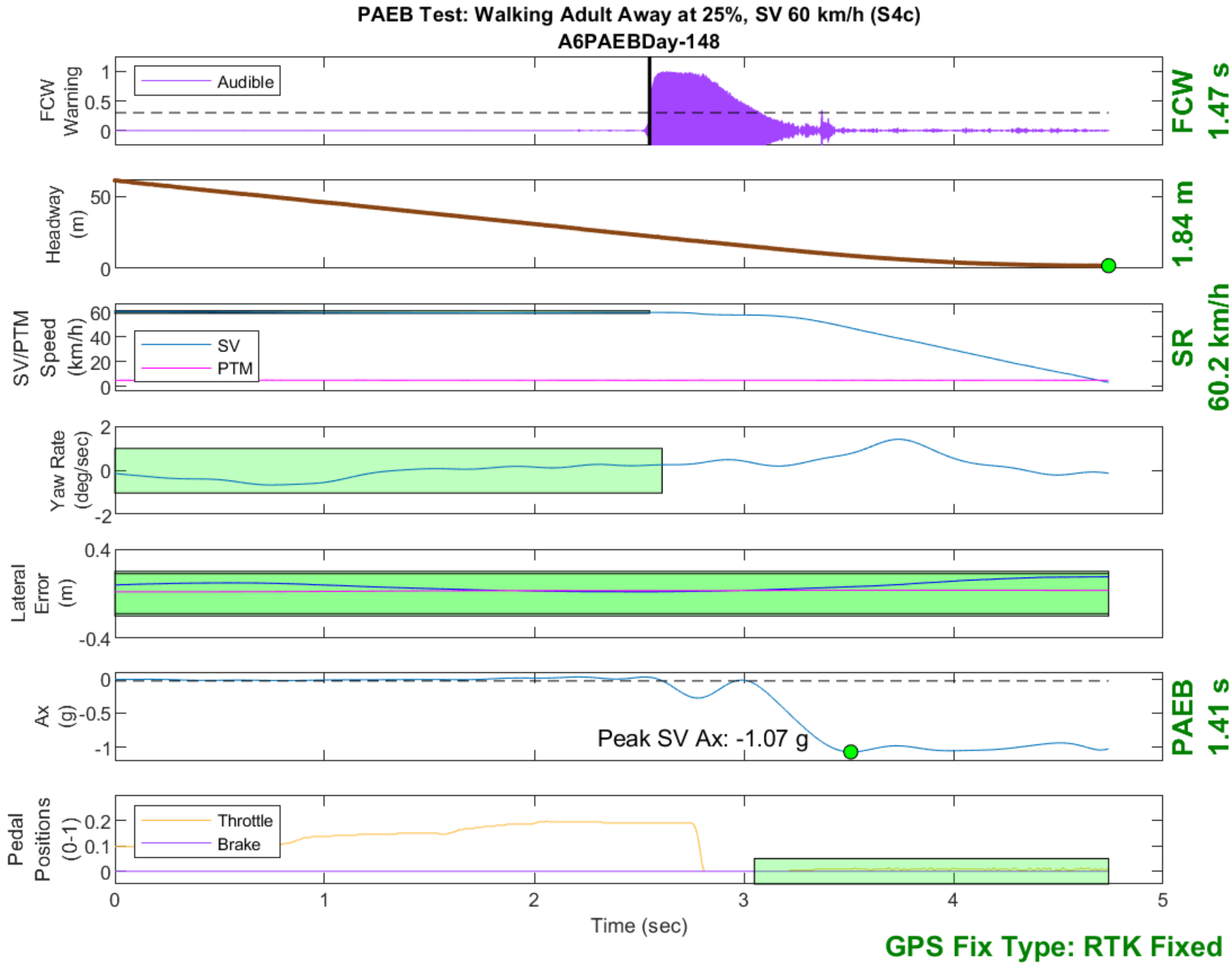


Figure D167. Time History for PAEB Run 148, S4c, Daytime, 60 km/h

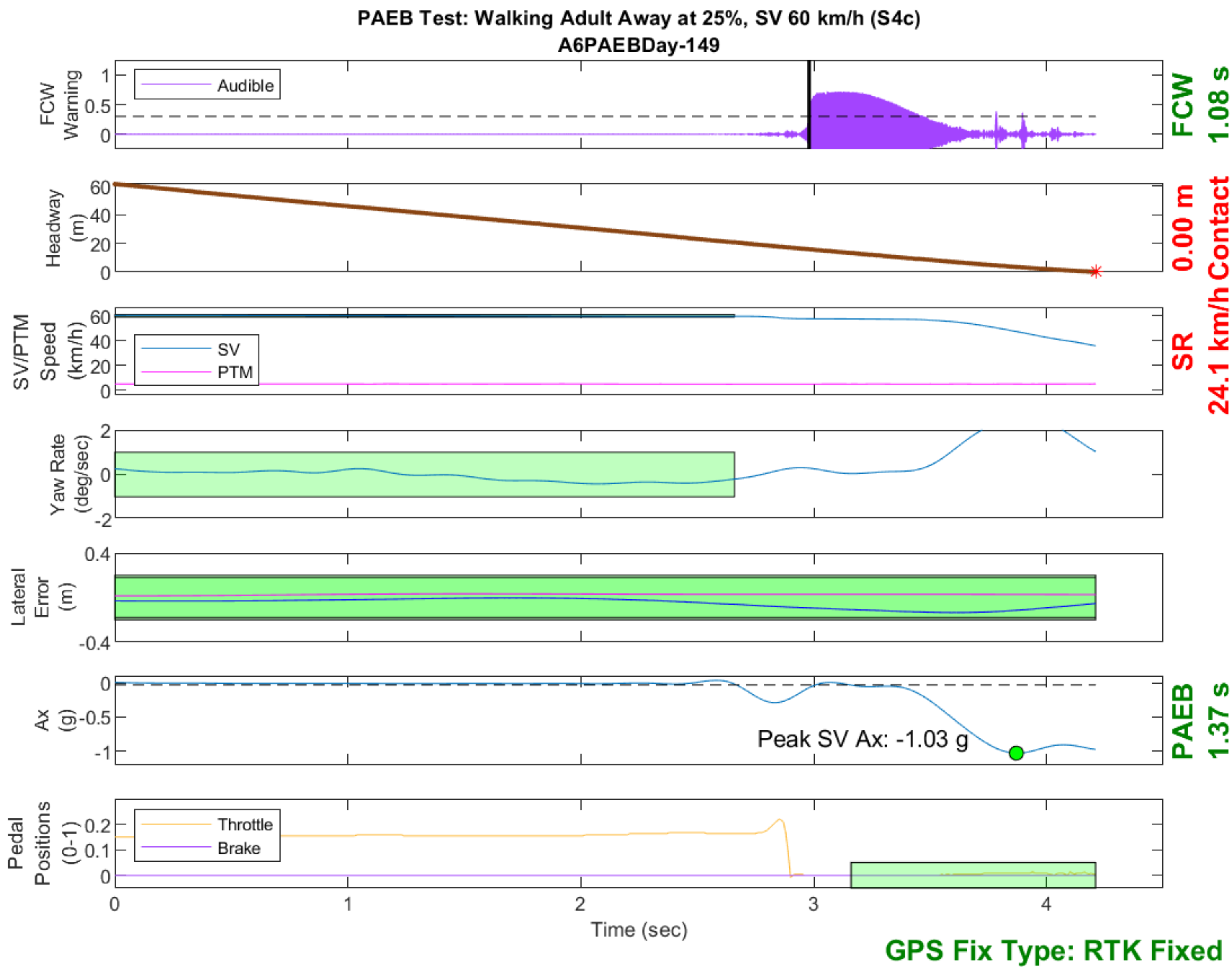


Figure D168. Time History for PAEB Run 149, S4c, Daytime, 60 km/h

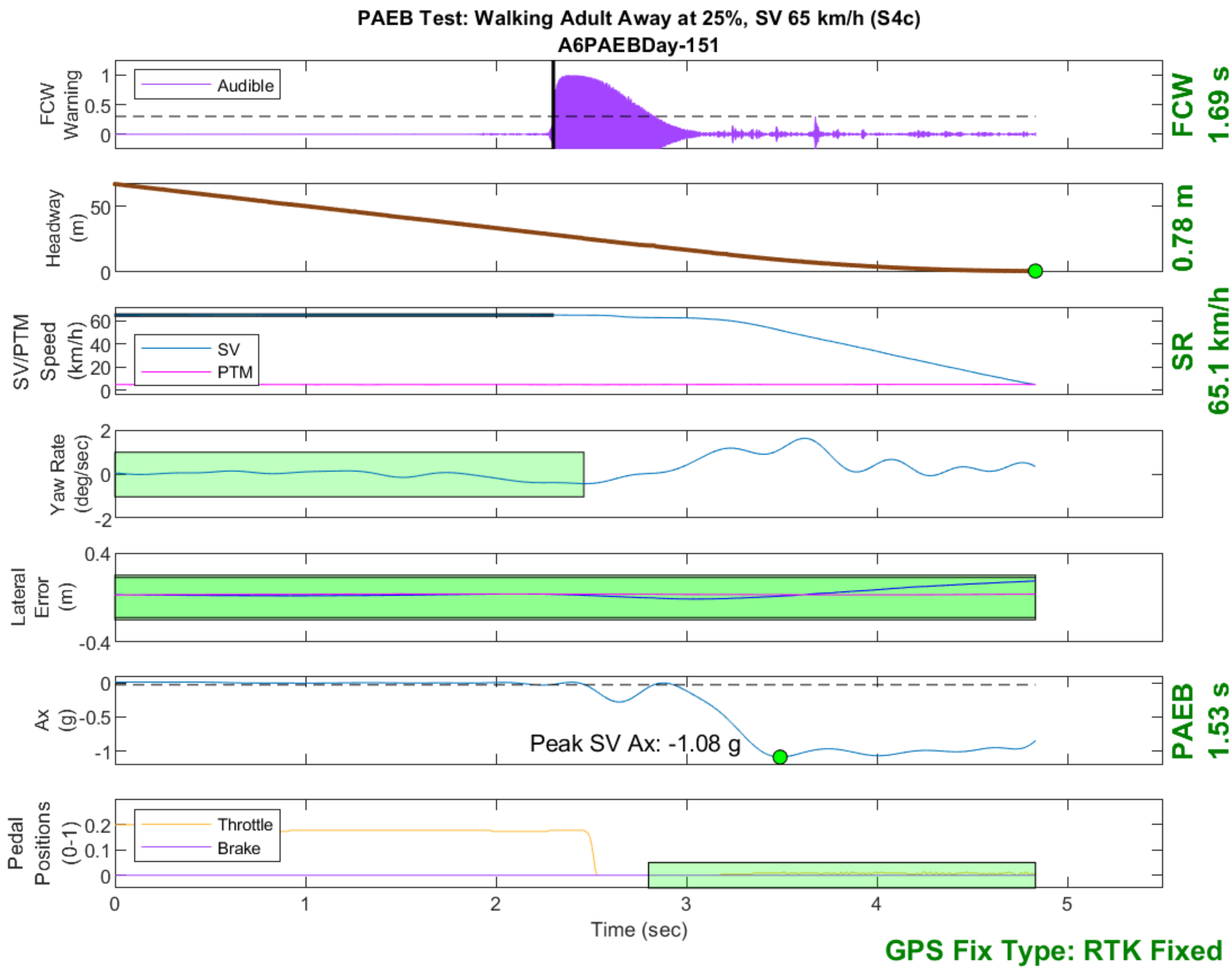


Figure D169. Time History for PAEB Run 151, S4c, Daytime, 65 km/h

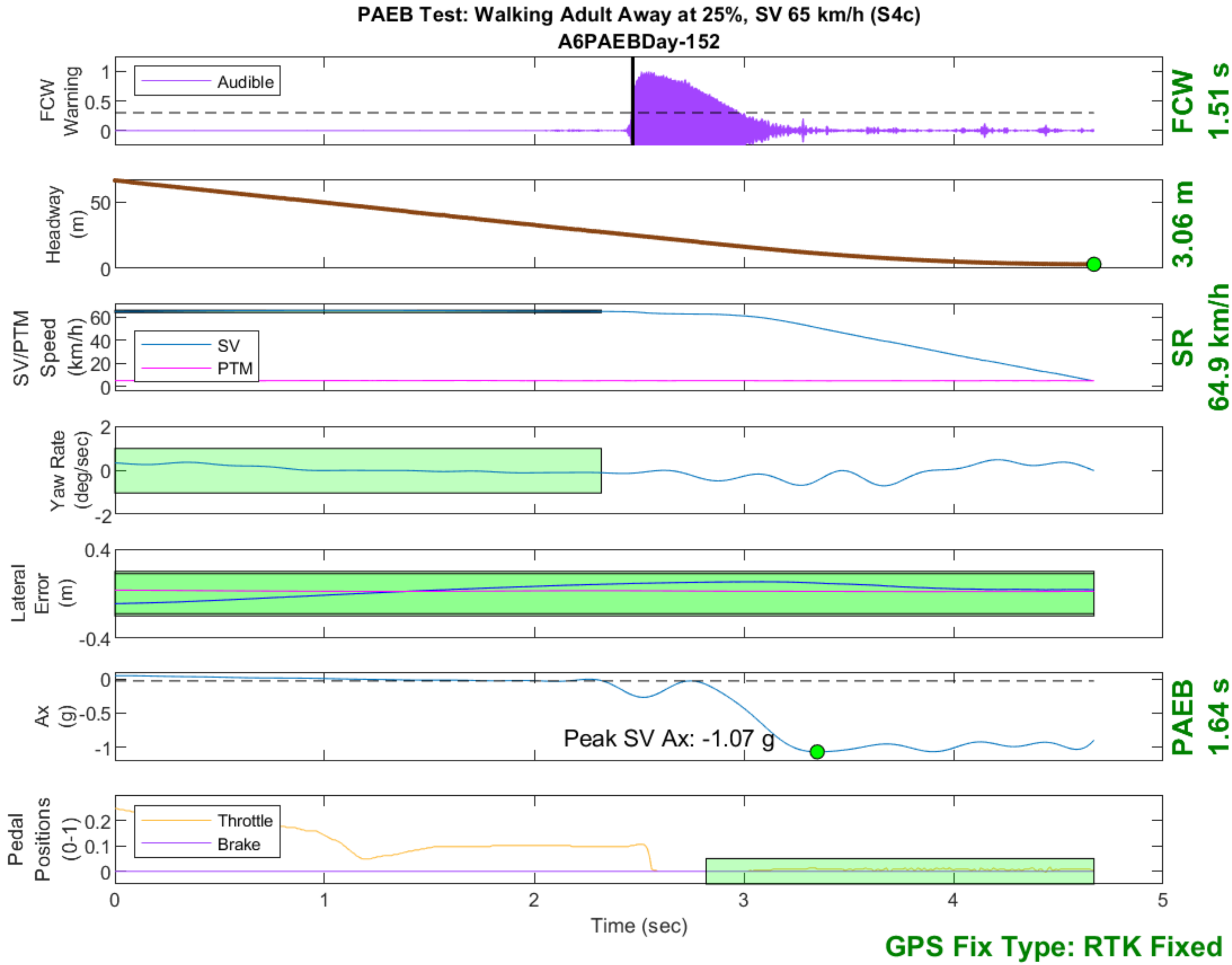


Figure D170. Time History for PAEB Run 152, S4c, Daytime, 65 km/h

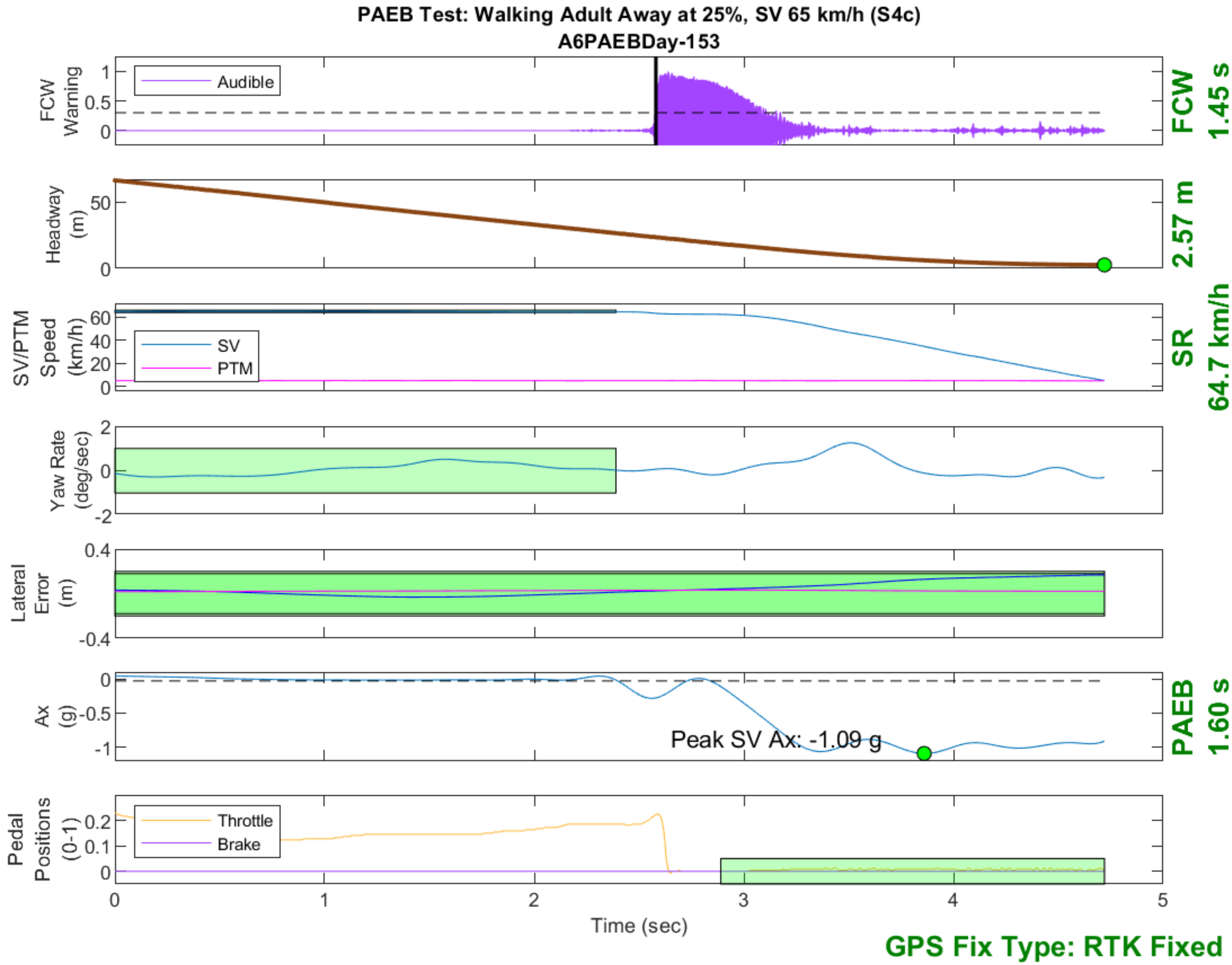


Figure D171. Time History for PAEB Run 153, S4c, Daytime, 65 km/h

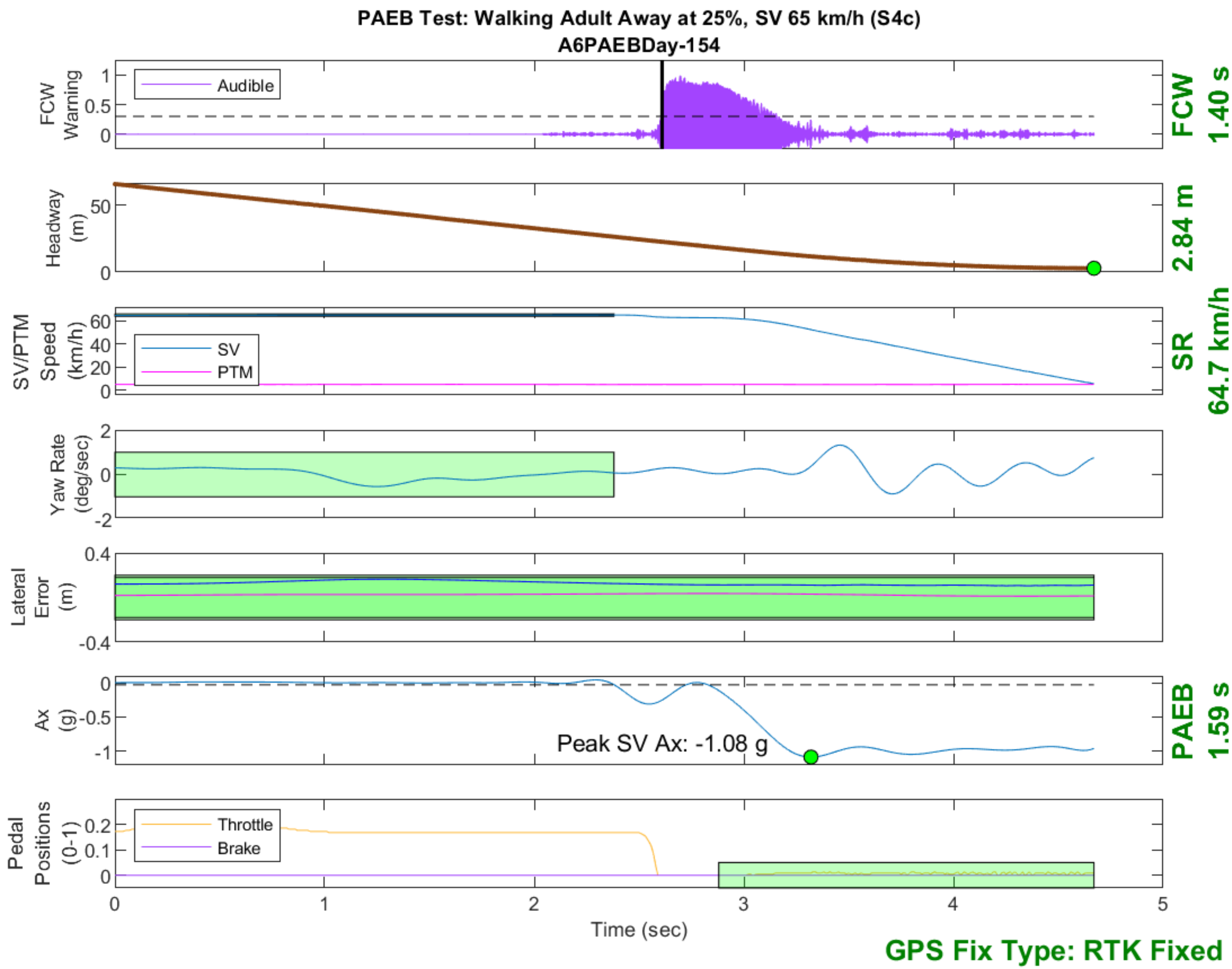


Figure D172. Time History for PAEB Run 154, S4c, Daytime, 65 km/h

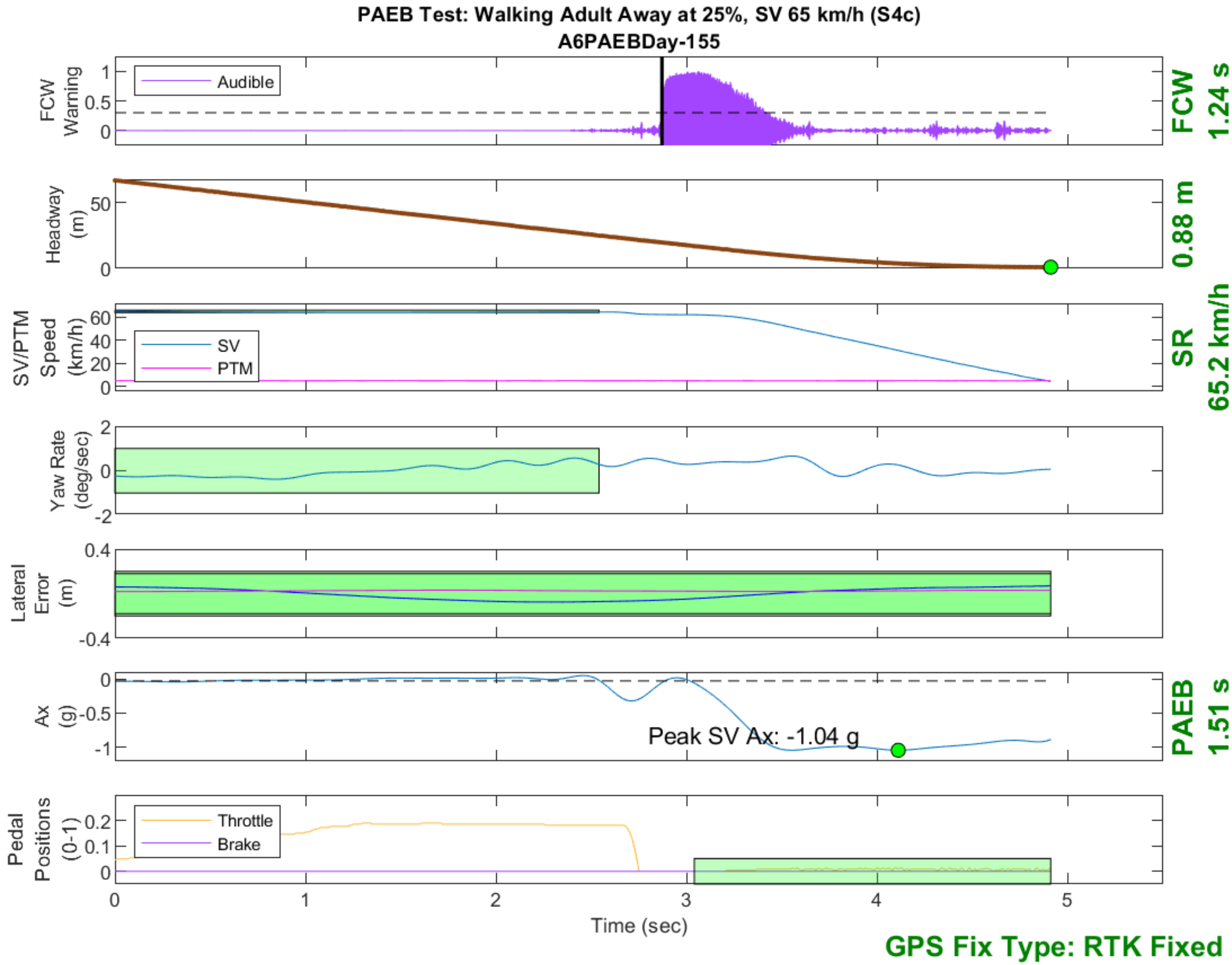


Figure D173. Time History for PAEB Run 155, S4c, Daytime, 65 km/h

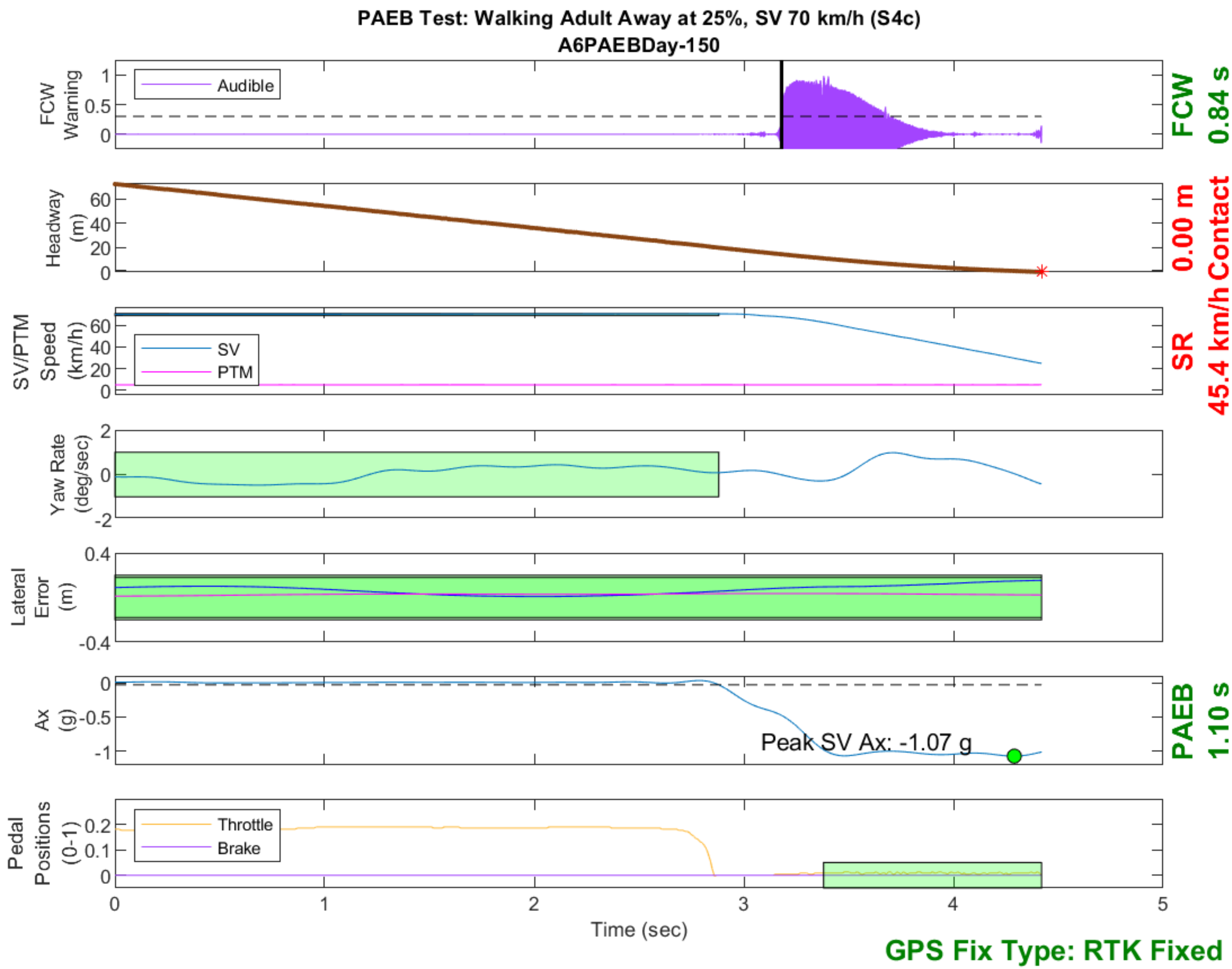


Figure D174. Time History for PAEB Run 150, S4c, Daytime, 70 km/h

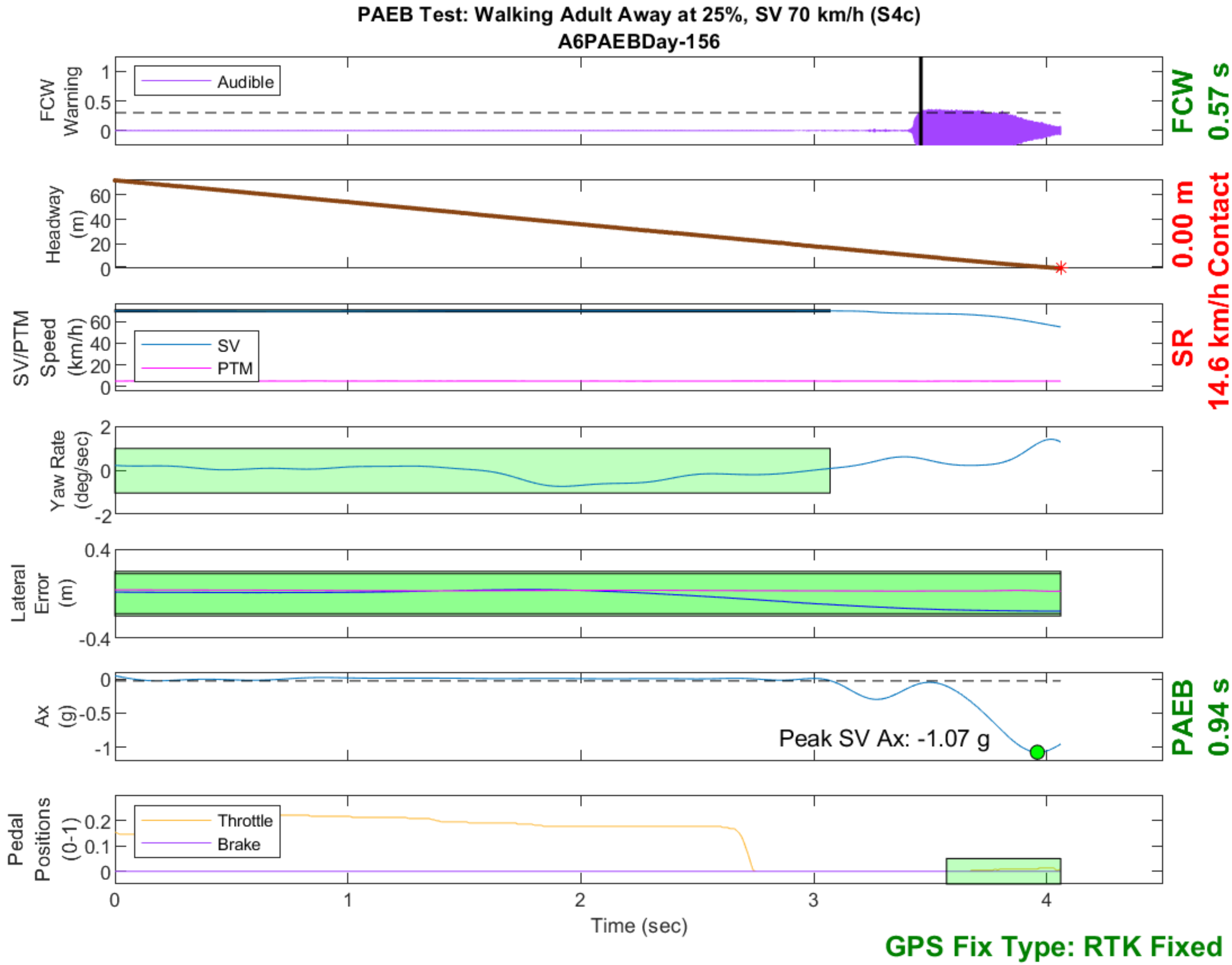


Figure D175. Time History for PAEB Run 156, S4c, Daytime, 70 km/h

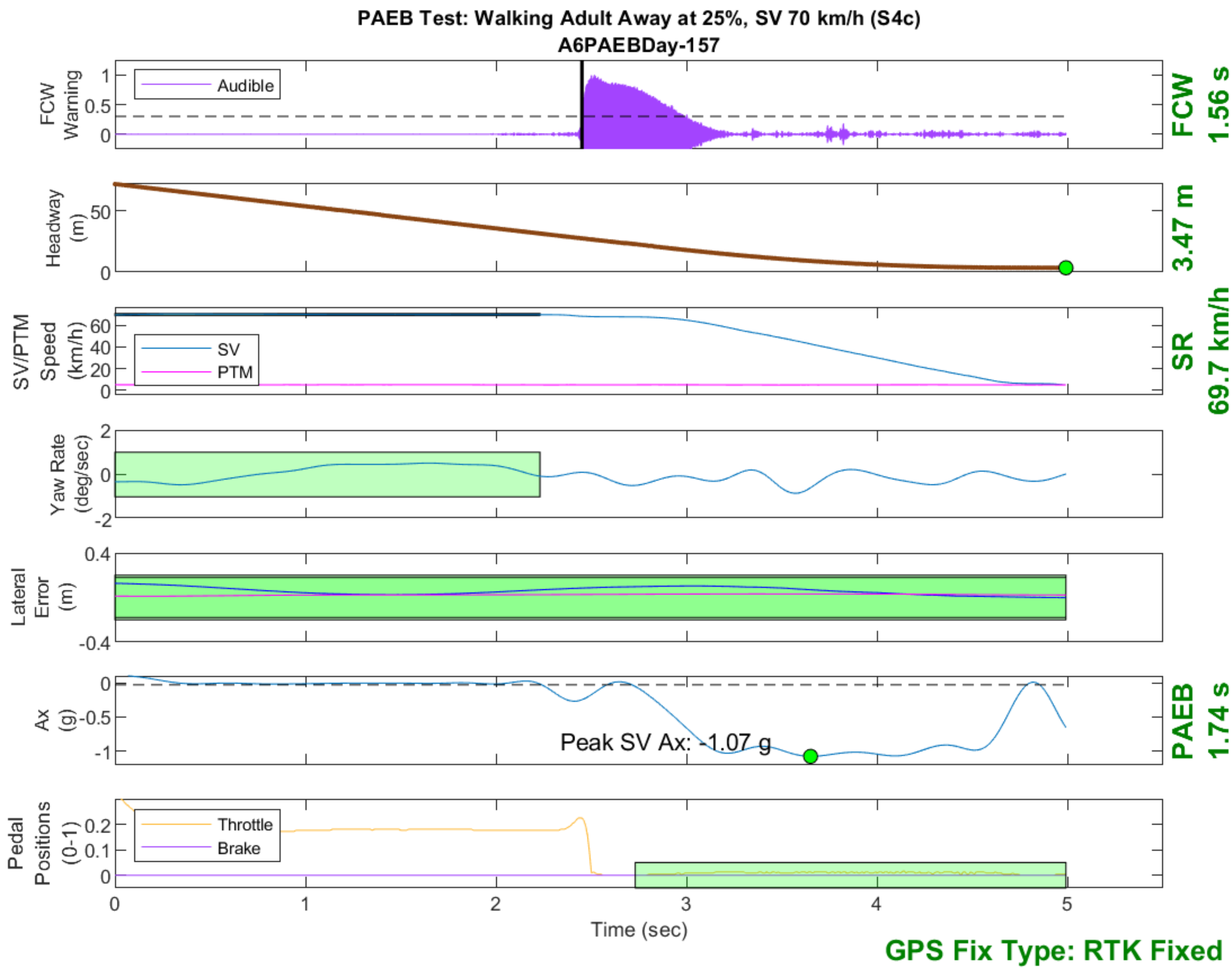


Figure D176. Time History for PAEB Run 157, S4c, Daytime, 70 km/h

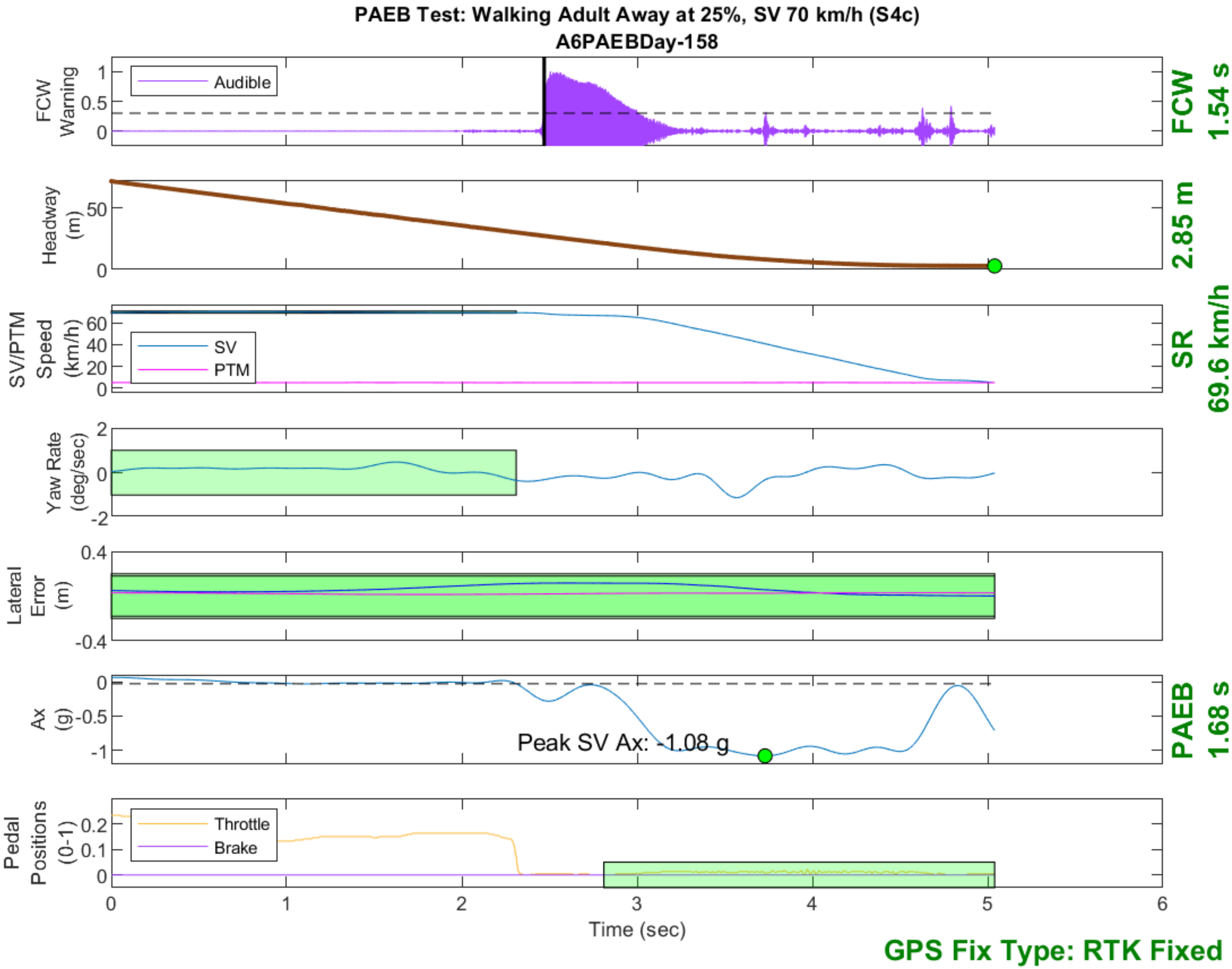


Figure D177. Time History for PAEB Run 158, S4c, Daytime, 70 km/h

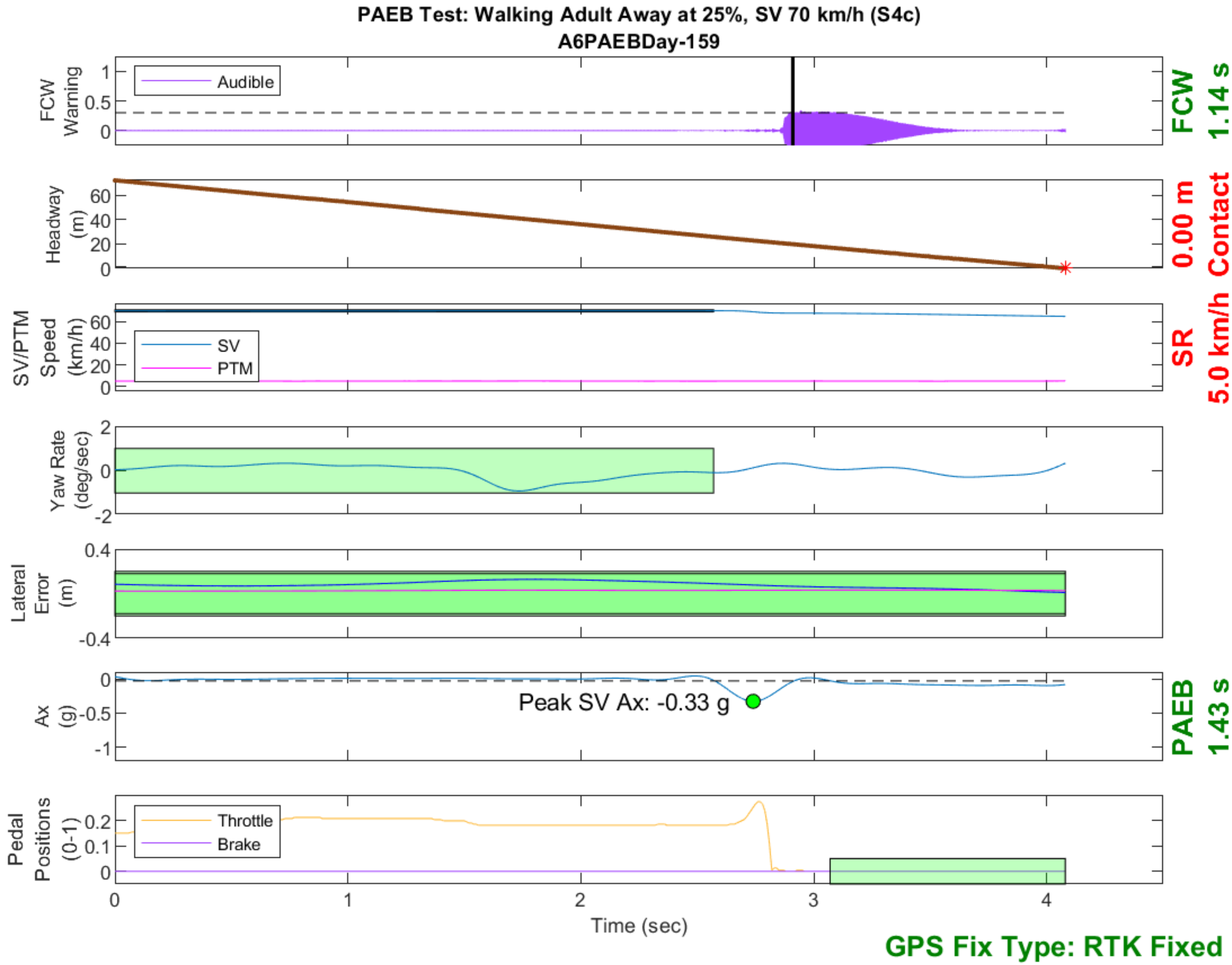


Figure D178. Time History for PAEB Run 159, S4c, Daytime, 70 km/h

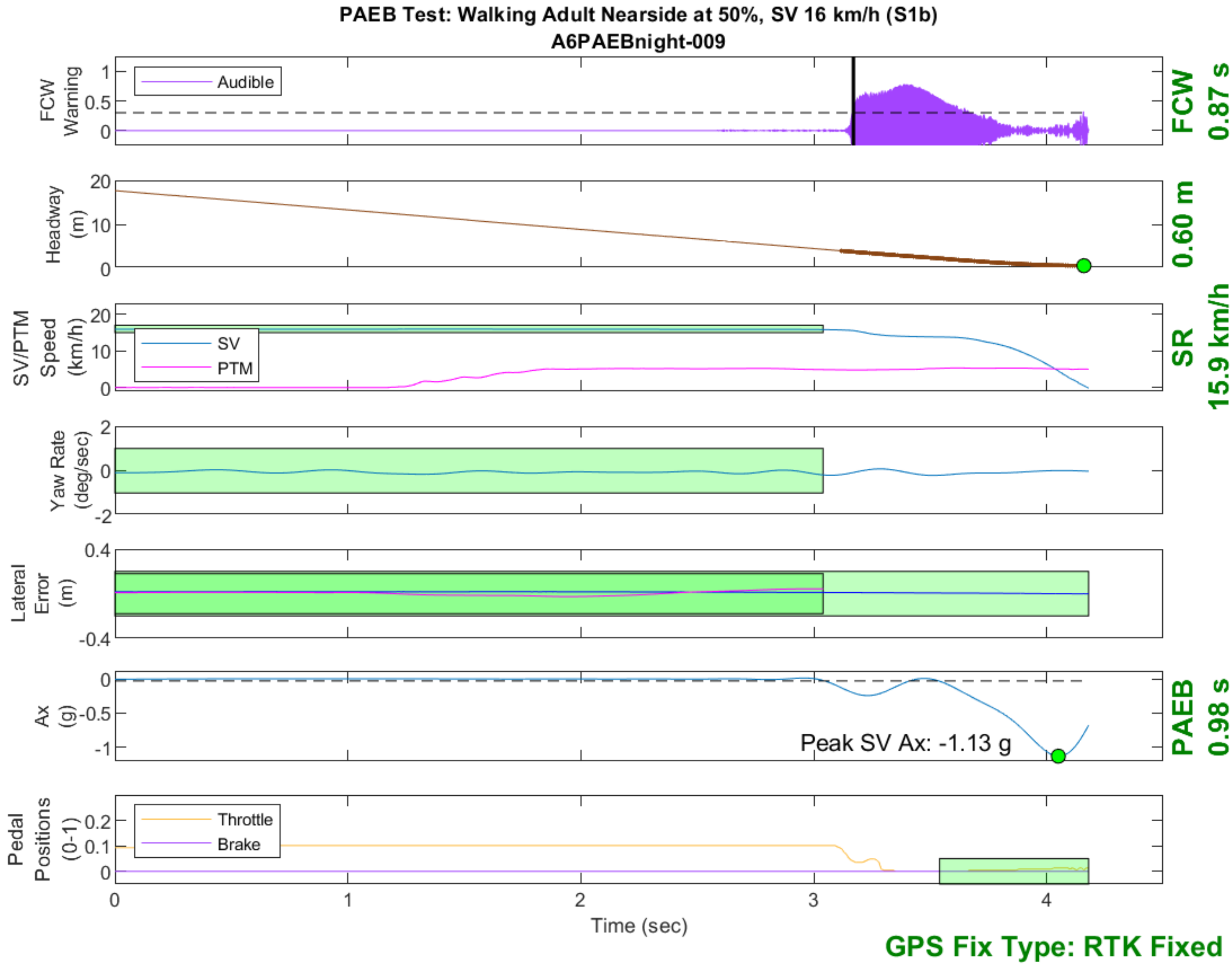


Figure D179. Time History for PAEB Run 9, S1b, Night, High Beam, 16 km/h

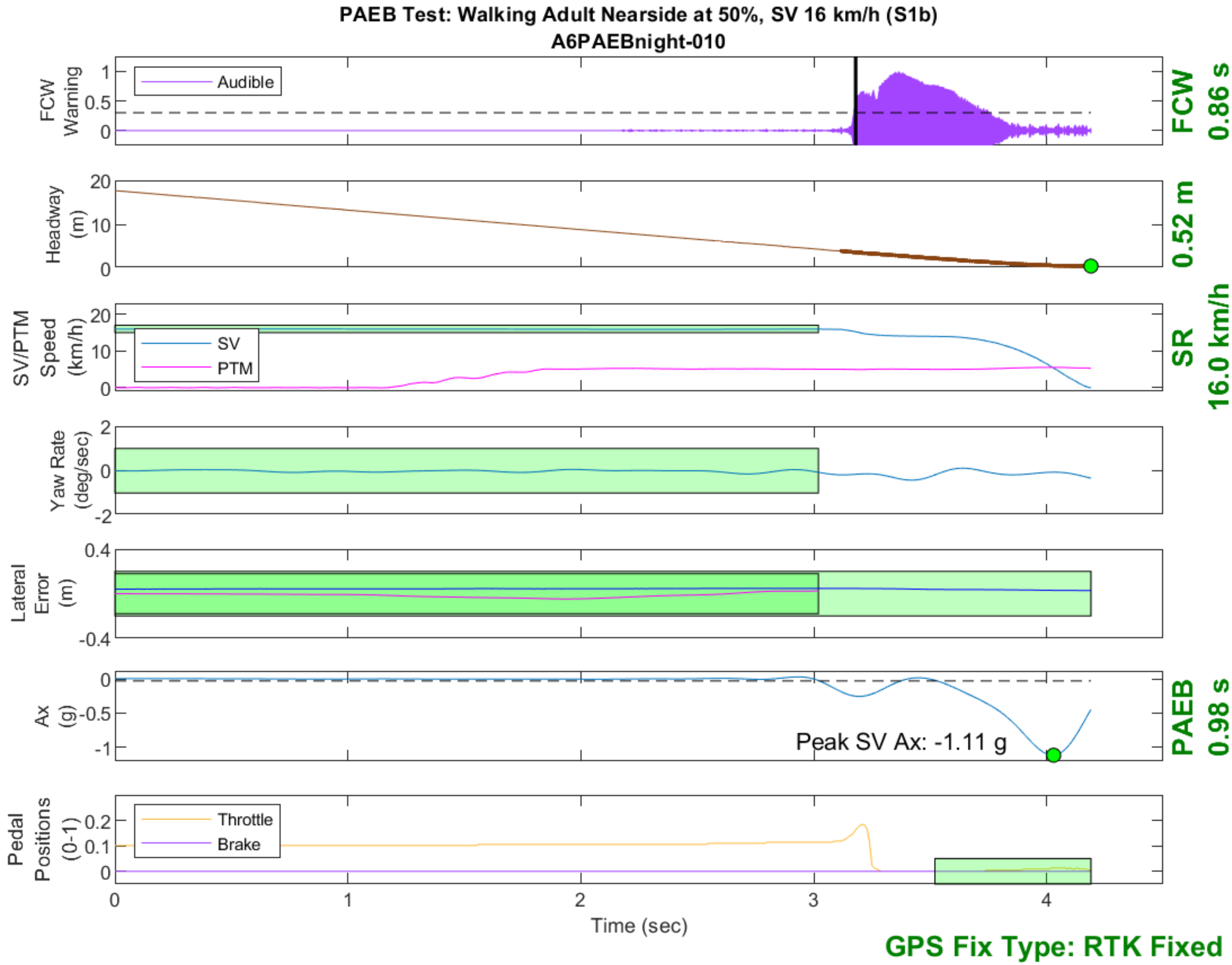


Figure D180. Time History for PAEB Run 10, S1b, Night, High Beam, 16 km/h

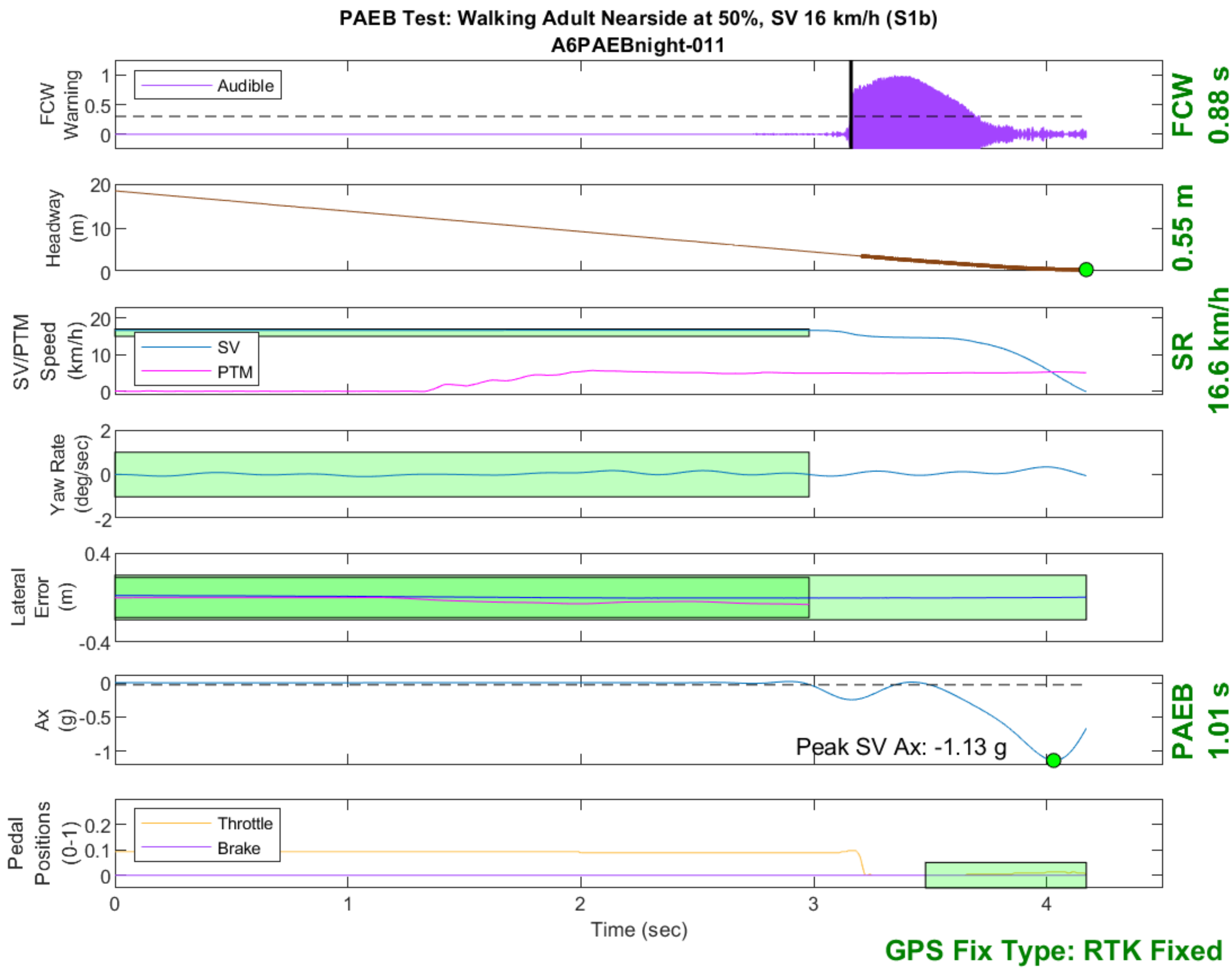


Figure D181. Time History for PAEB Run 11, S1b, Night, High Beam, 16 km/h

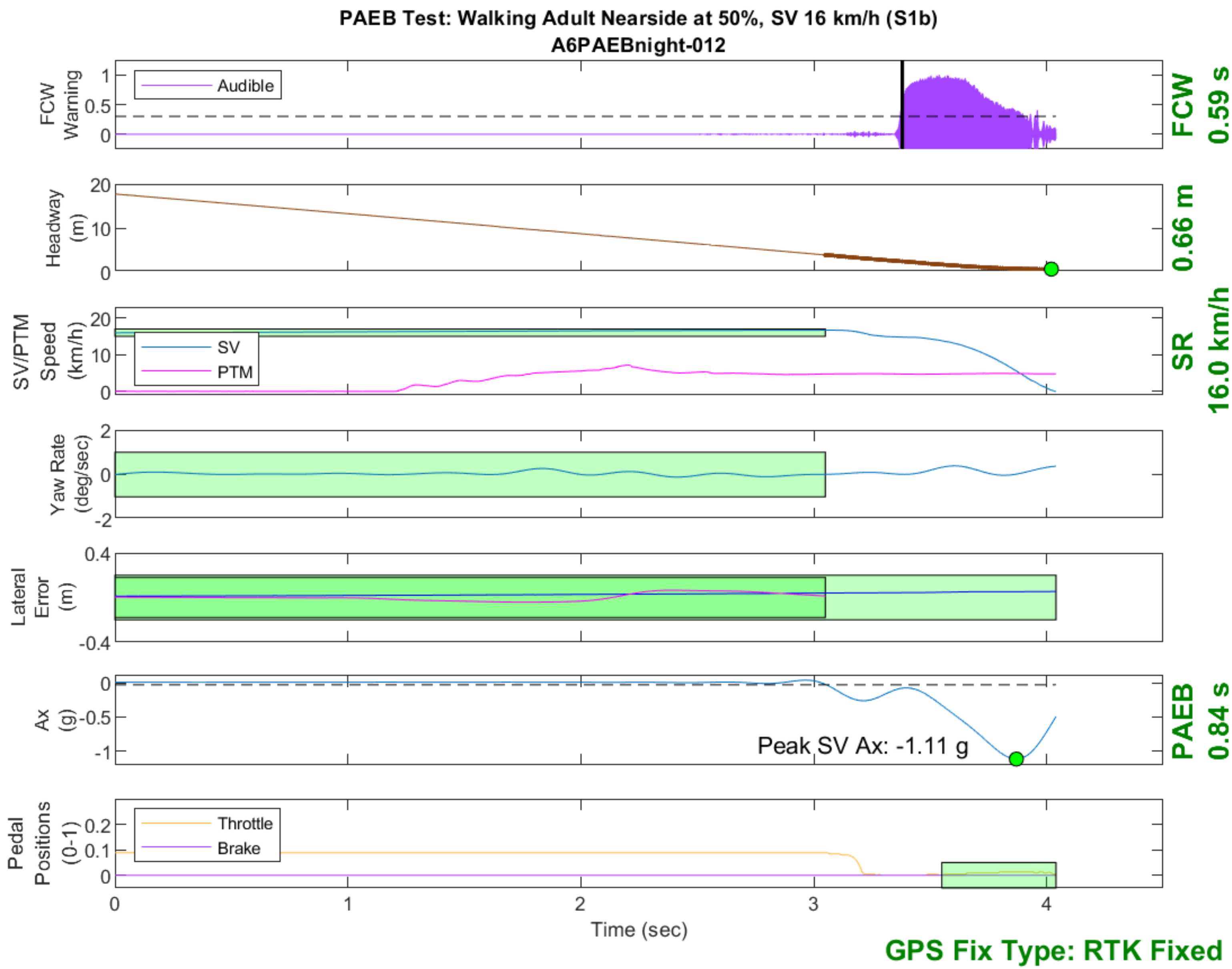


Figure D182. Time History for PAEB Run 12, S1b, Night, High Beam, 16 km/h

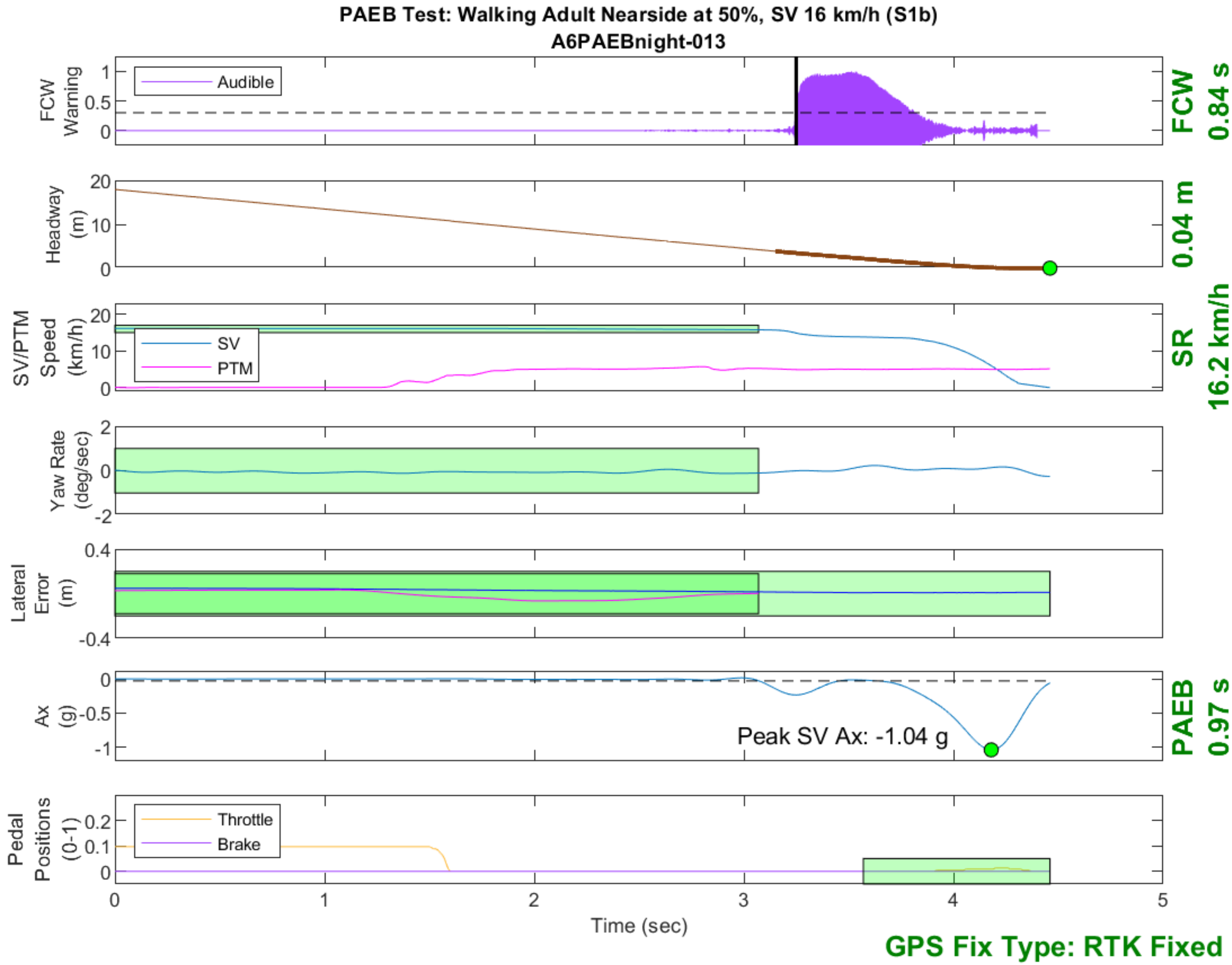


Figure D183. Time History for PAEB Run 13, S1b, Night, High Beam, 16 km/h

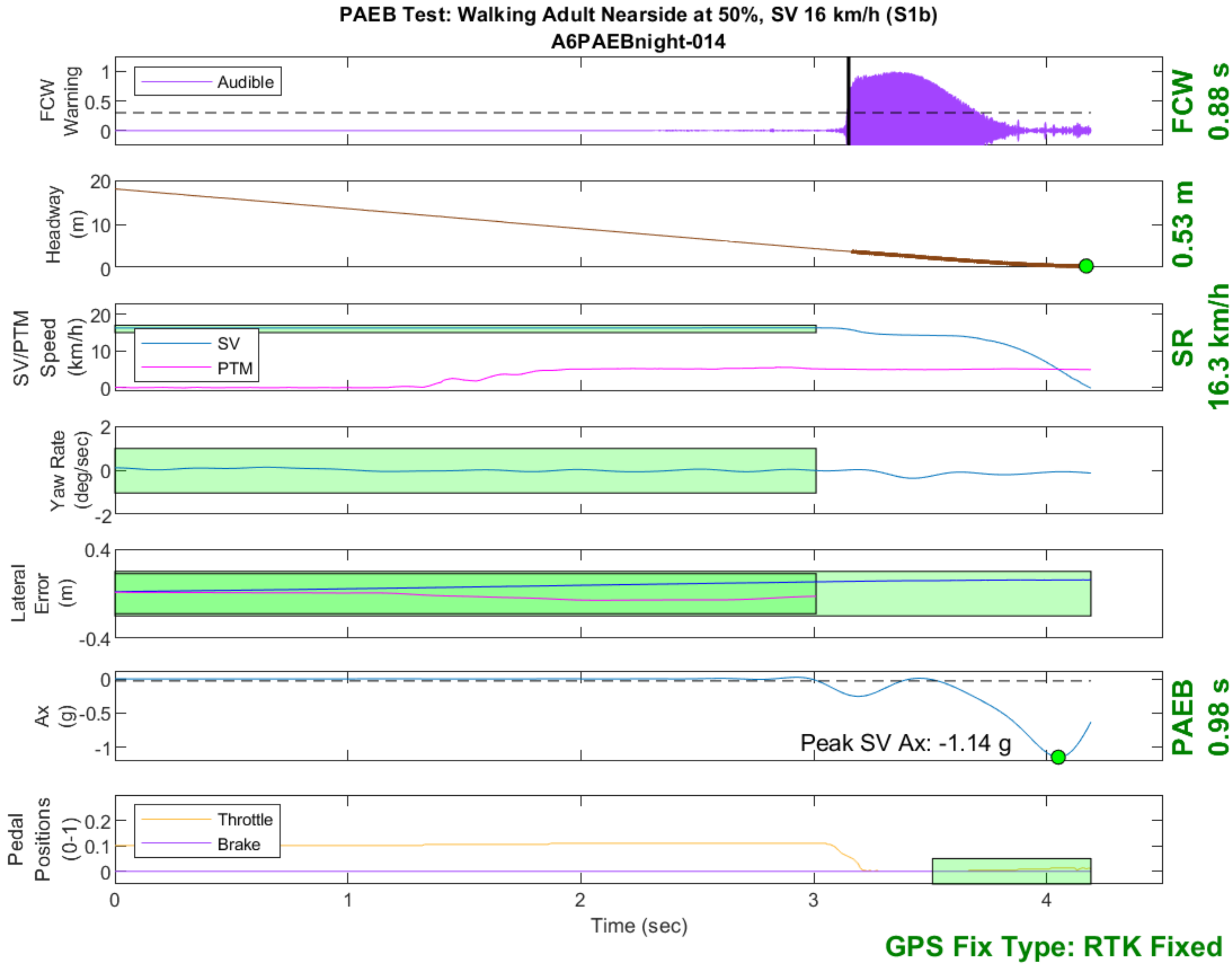


Figure D184. Time History for PAEB Run 14, S1b, Night, High Beam, 16 km/h

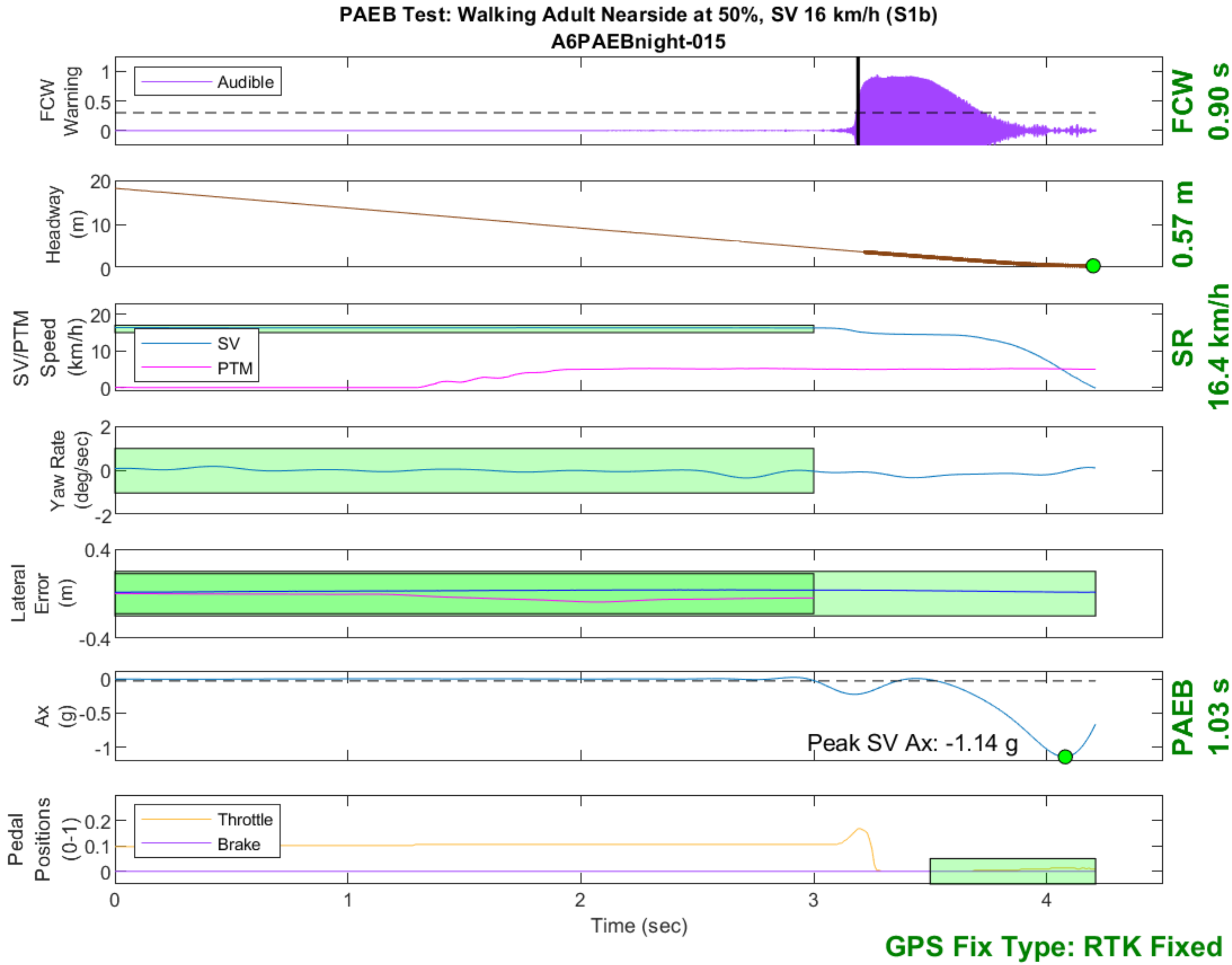


Figure D185. Time History for PAEB Run 15, S1b, Night, High Beam, 16 km/h

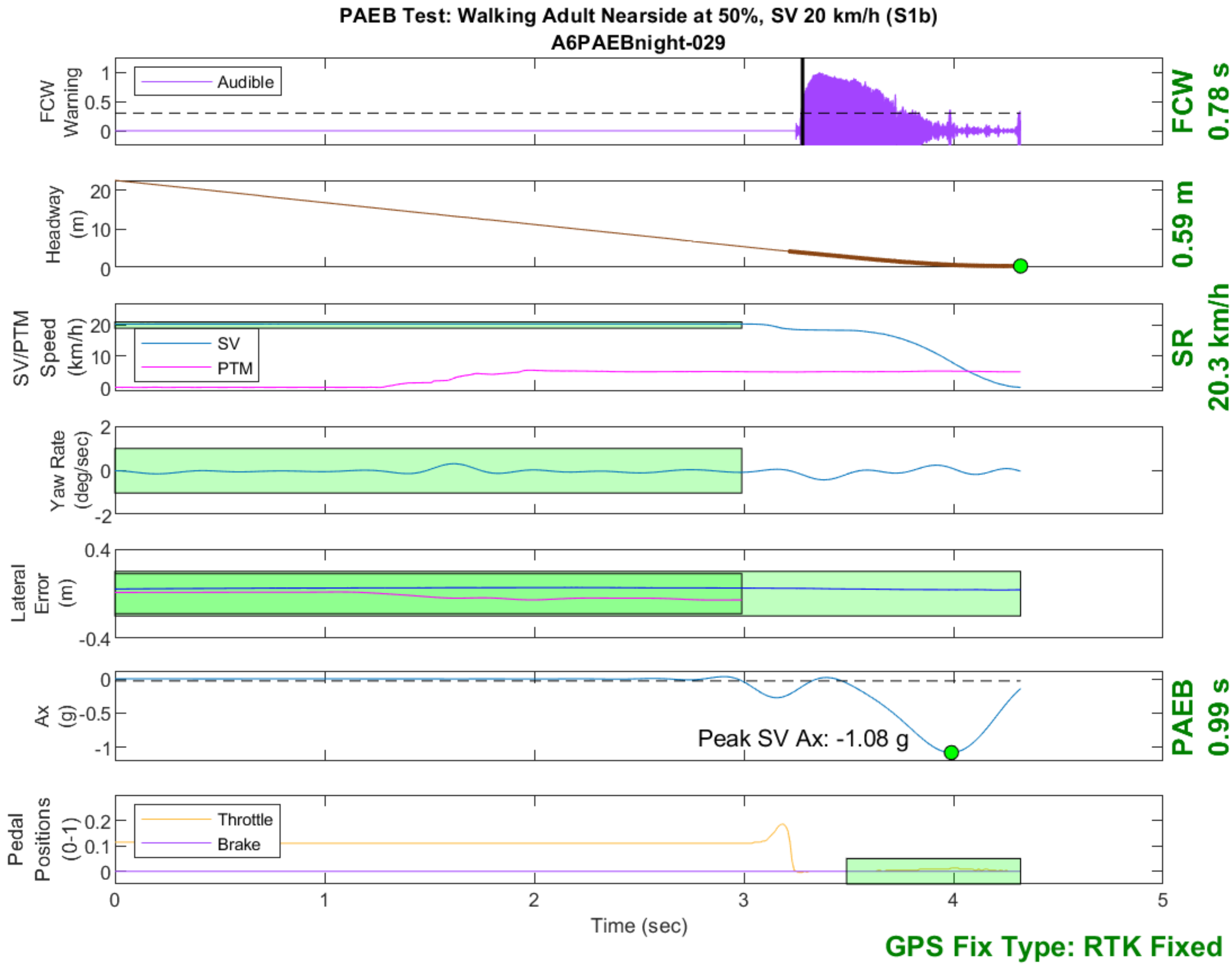


Figure D186. Time History for PAEB Run 29, S1b, Night, High Beam, 20 km/h

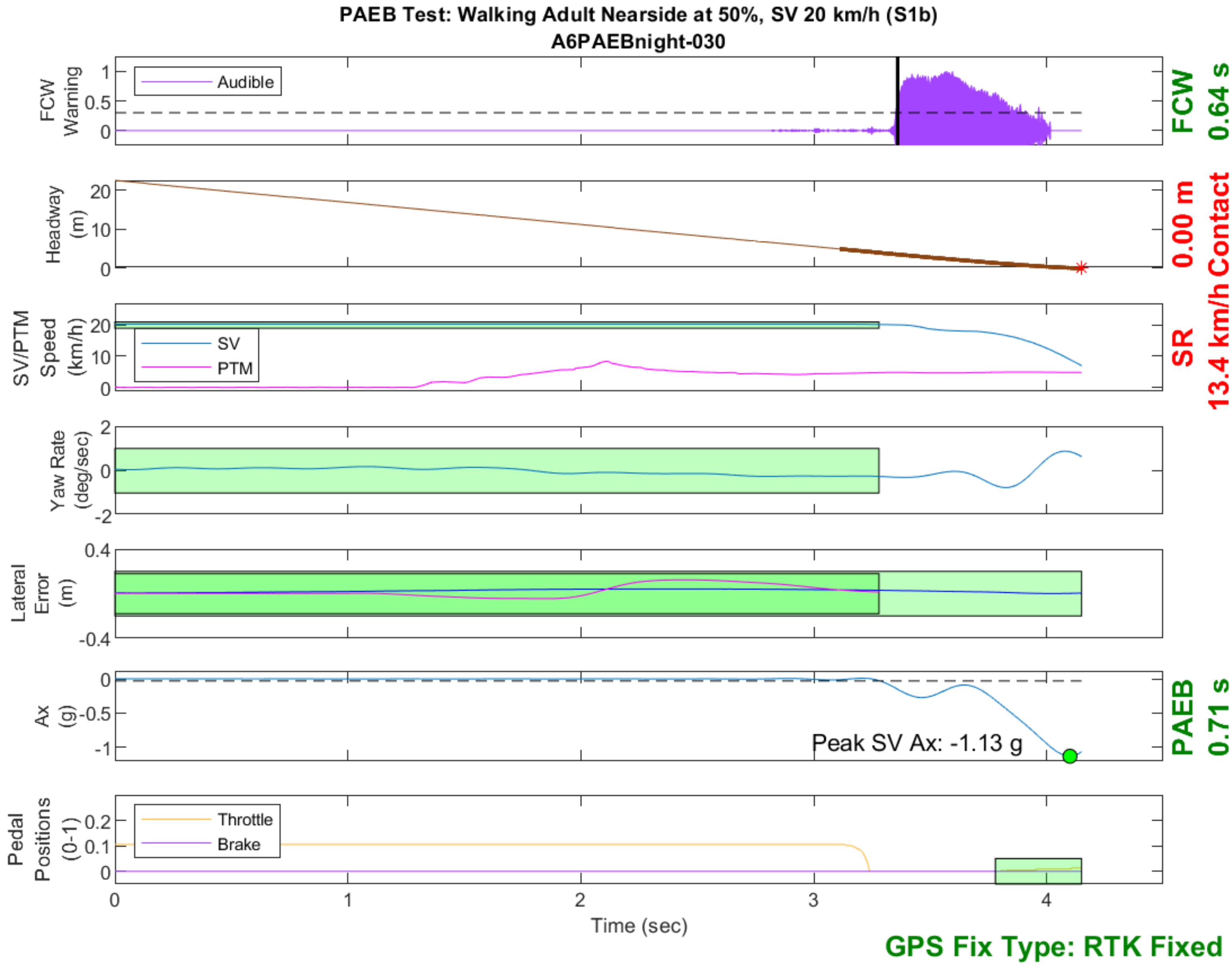


Figure D187. Time History for PAEB Run 30, S1b, Night, High Beam, 20 km/h

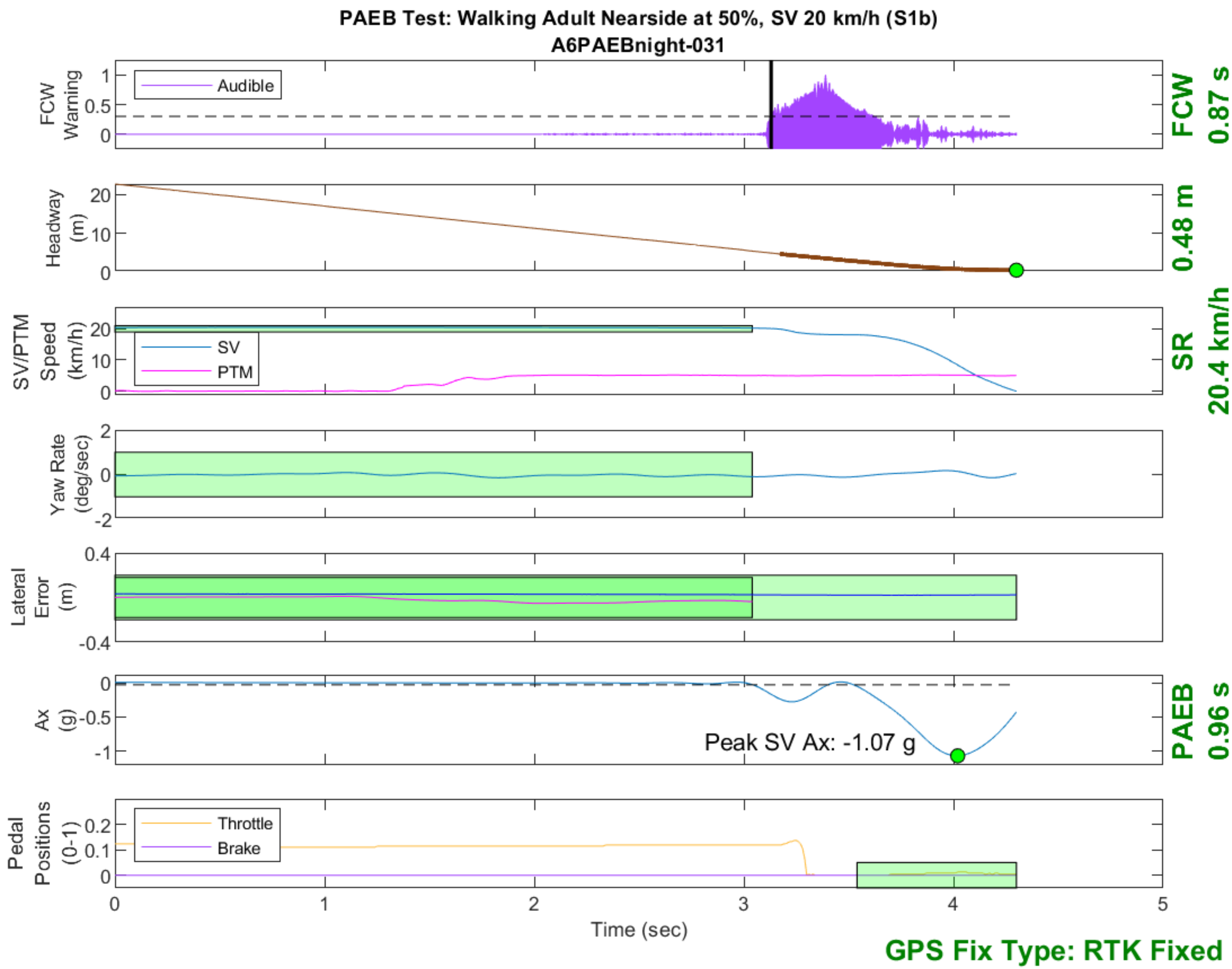


Figure D188. Time History for PAEB Run 31, S1b, Night, High Beam, 20 km/h

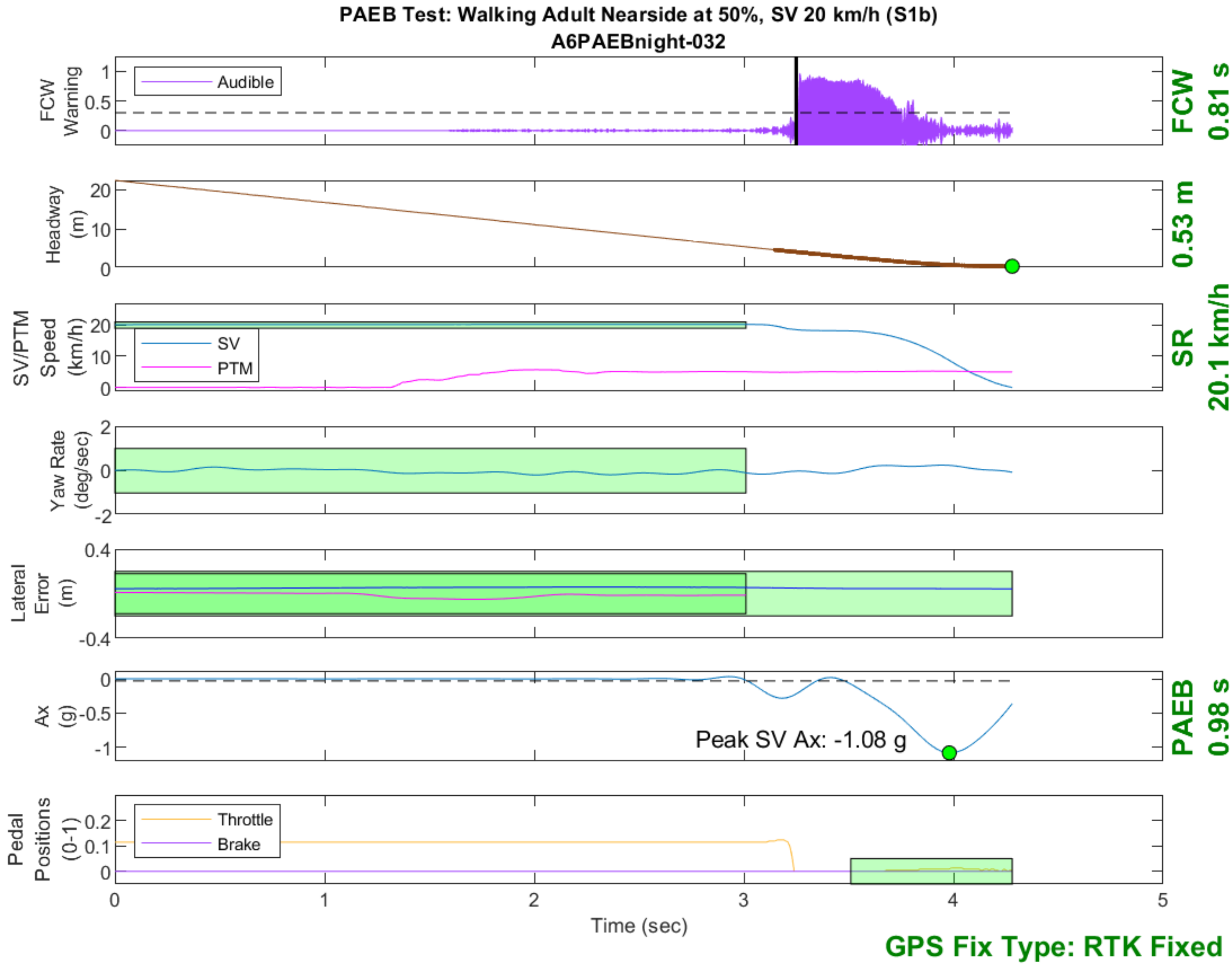


Figure D189. Time History for PAEB Run 32, S1b, Night, High Beam, 20 km/h

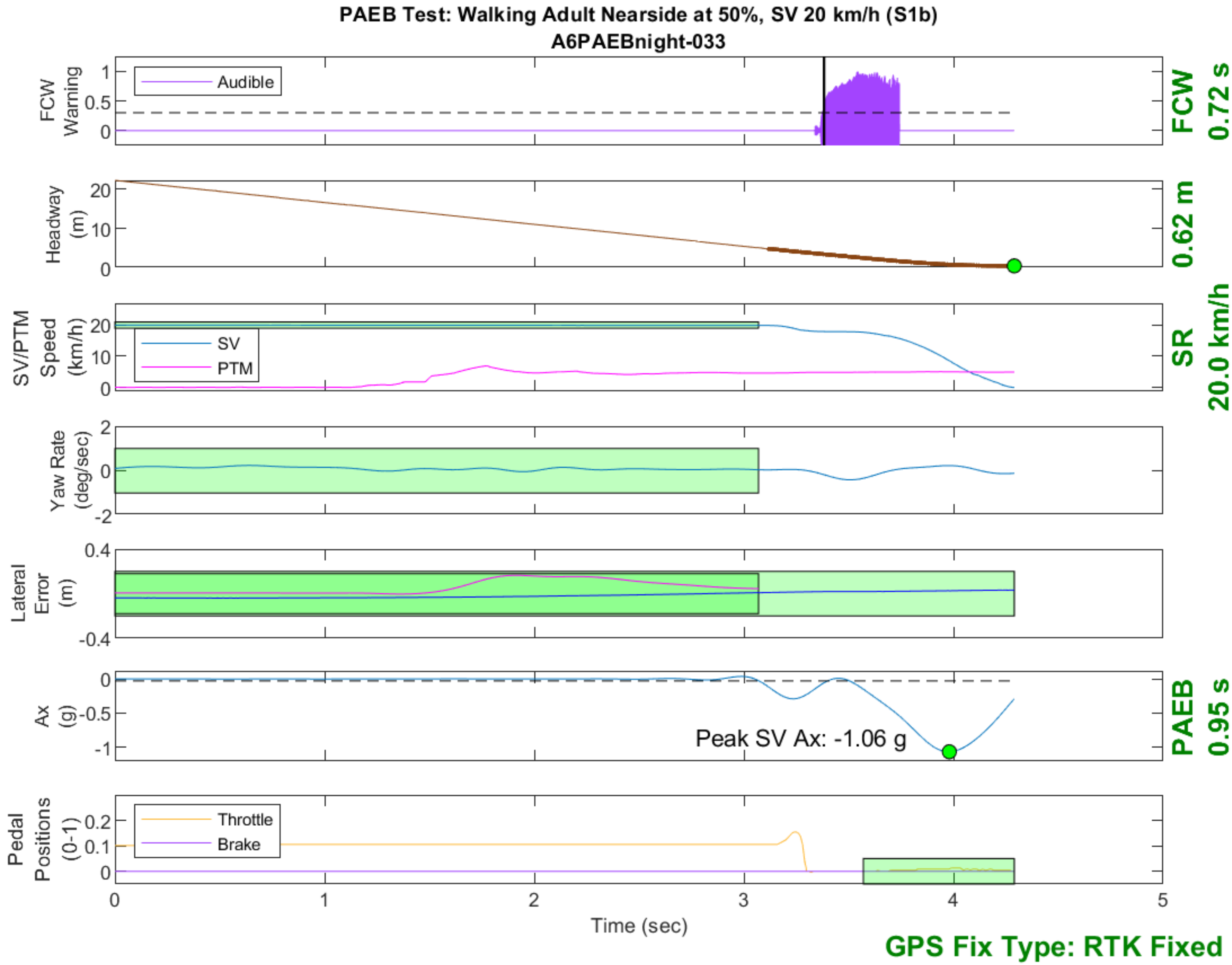


Figure D190. Time History for PAEB Run 33, S1b, Night, High Beam, 20 km/h

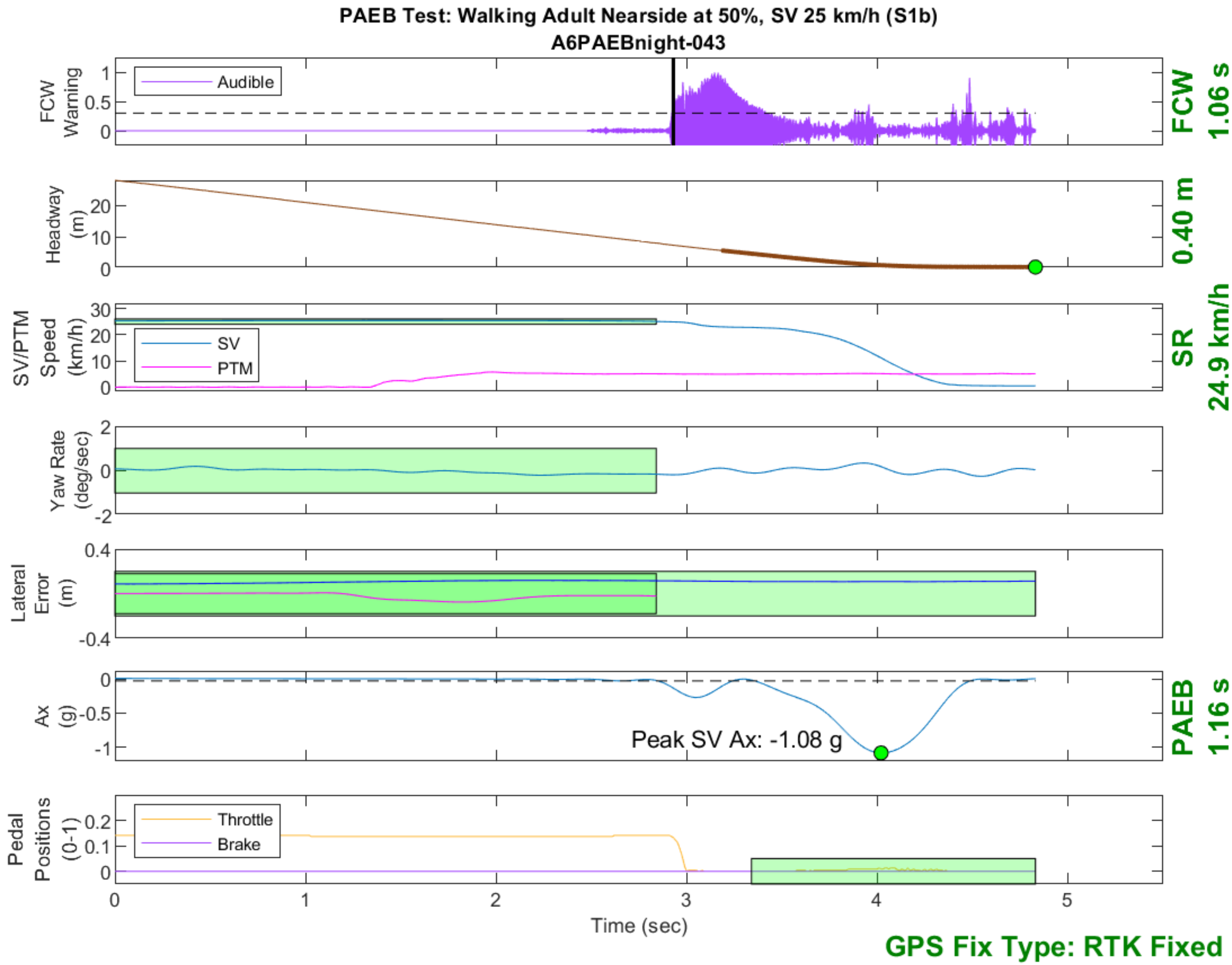


Figure D191. Time History for PAEB Run 43, S1b, Night, High Beam, 25 km/h

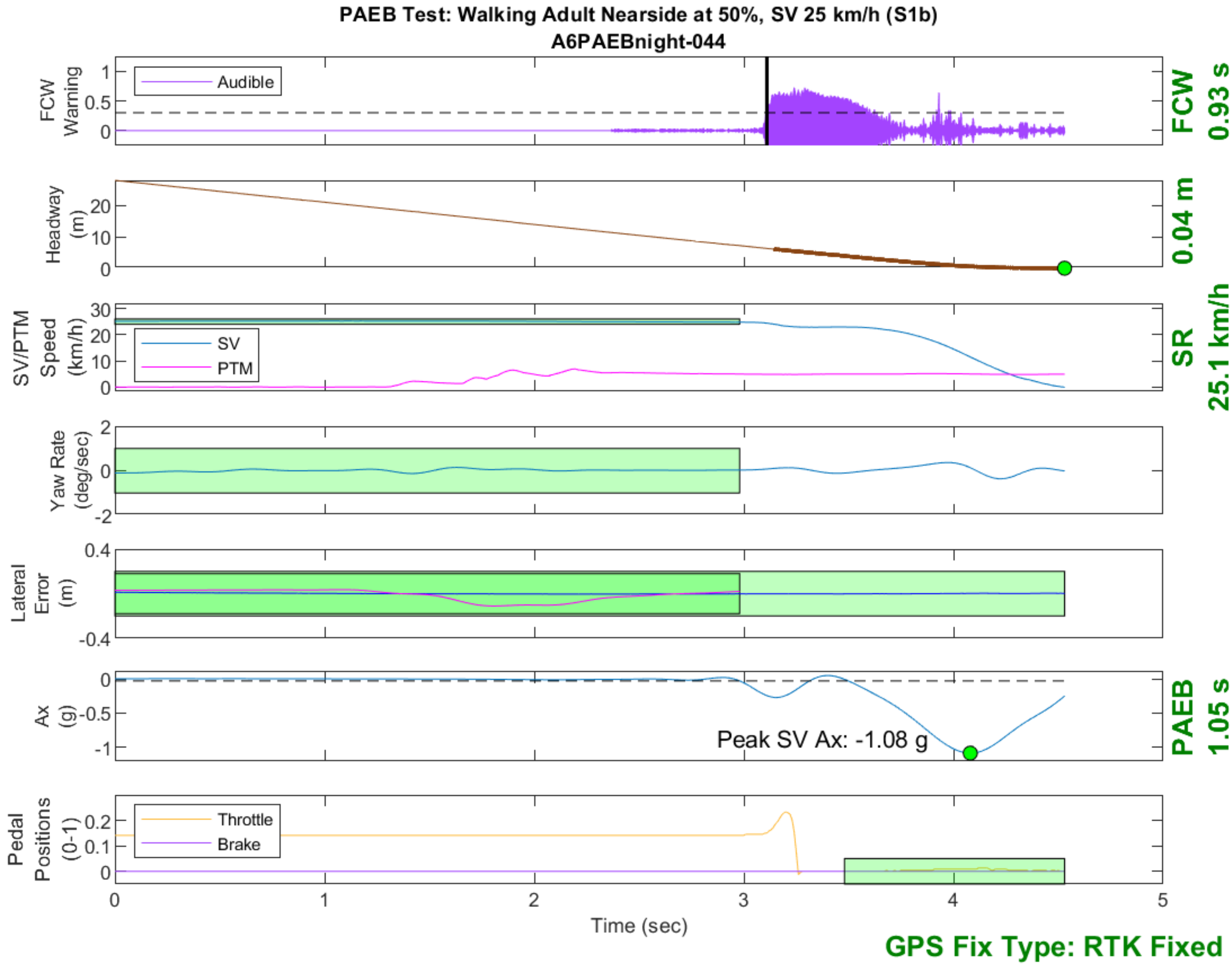


Figure D192. Time History for PAEB Run 44, S1b, Night, High Beam, 25 km/h

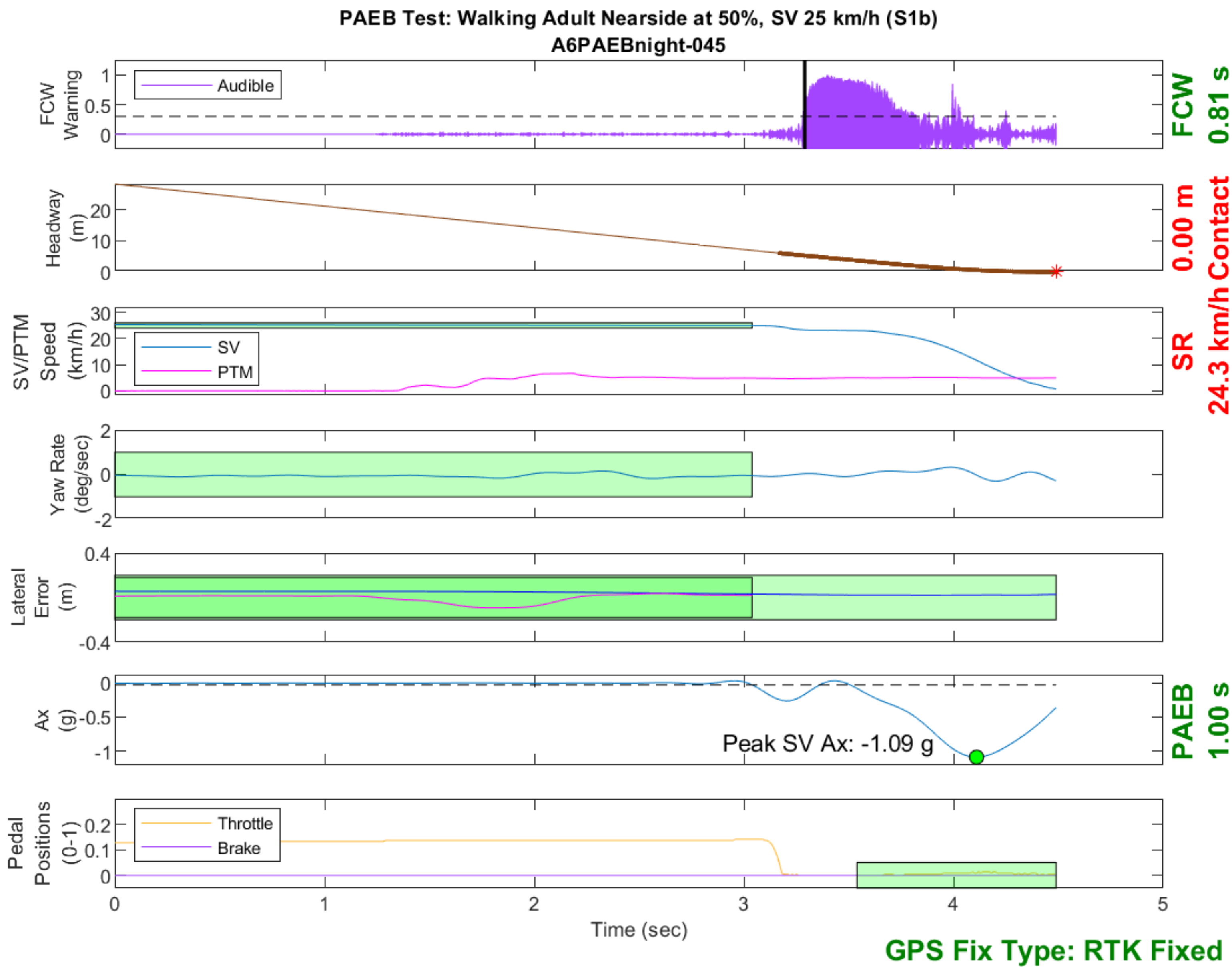


Figure D193. Time History for PAEB Run 45, S1b, Night, High Beam, 25 km/h

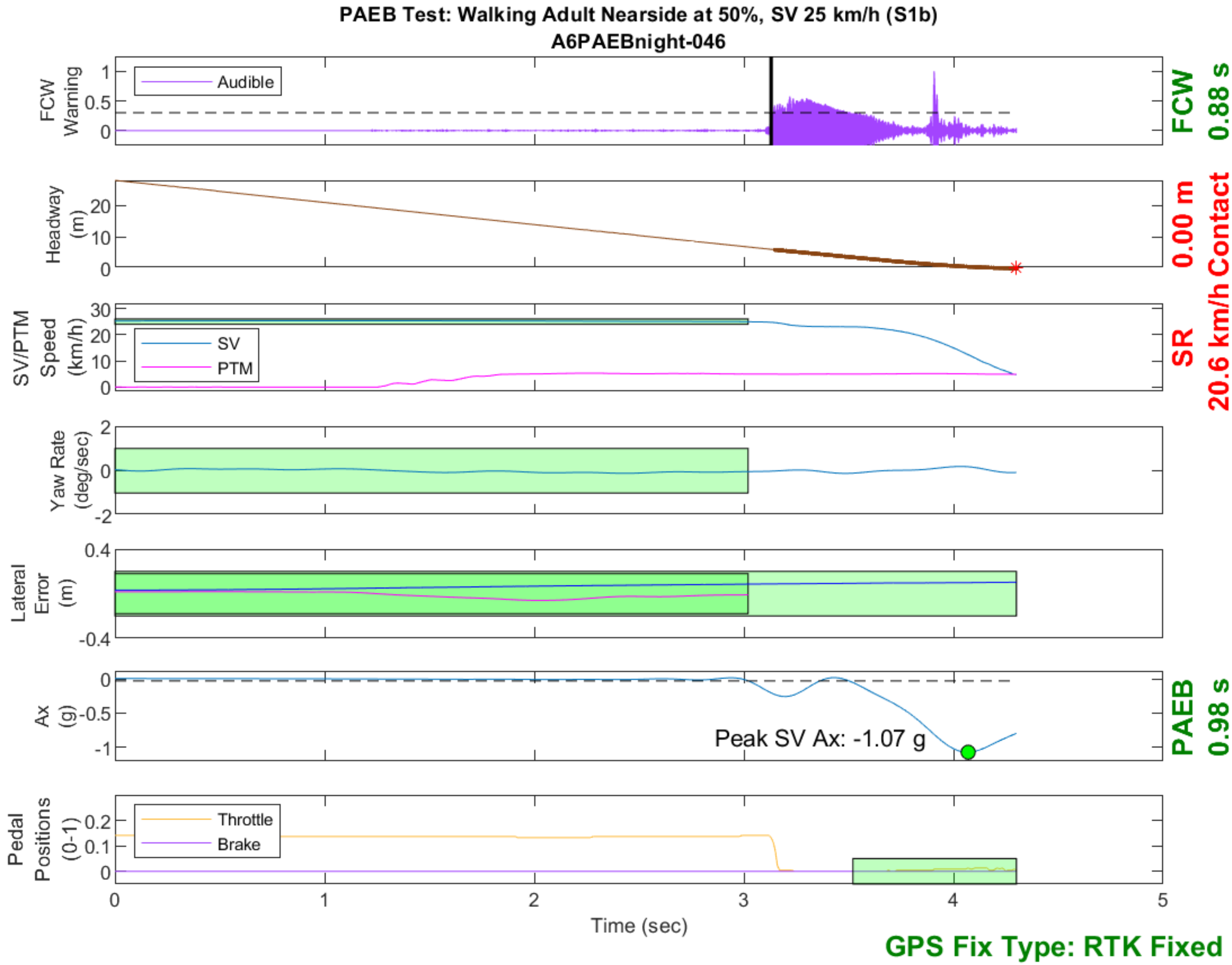


Figure D194. Time History for PAEB Run 46, S1b, Night, High Beam, 25 km/h

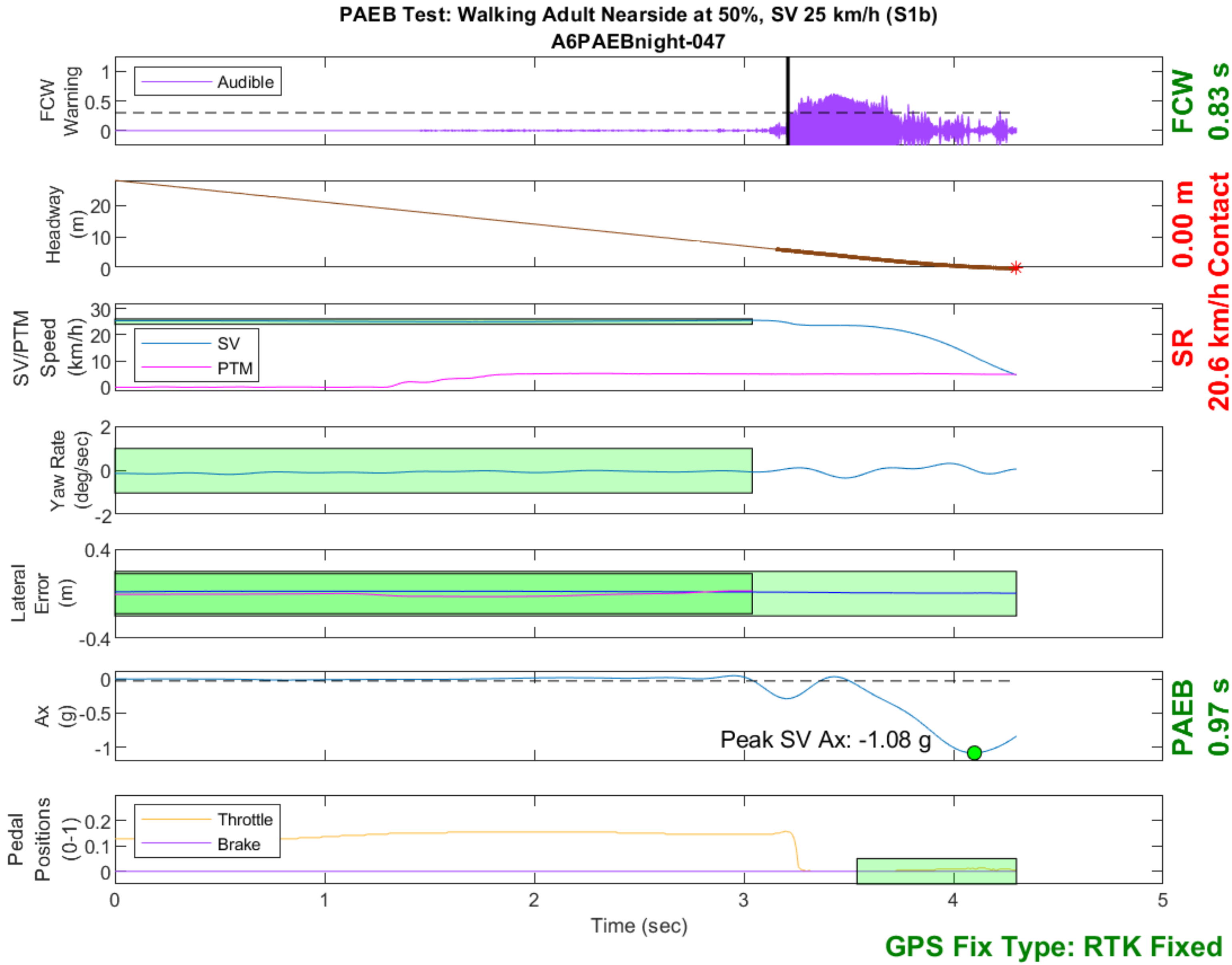


Figure D195. Time History for PAEB Run 47, S1b, Night, High Beam, 25 km/h

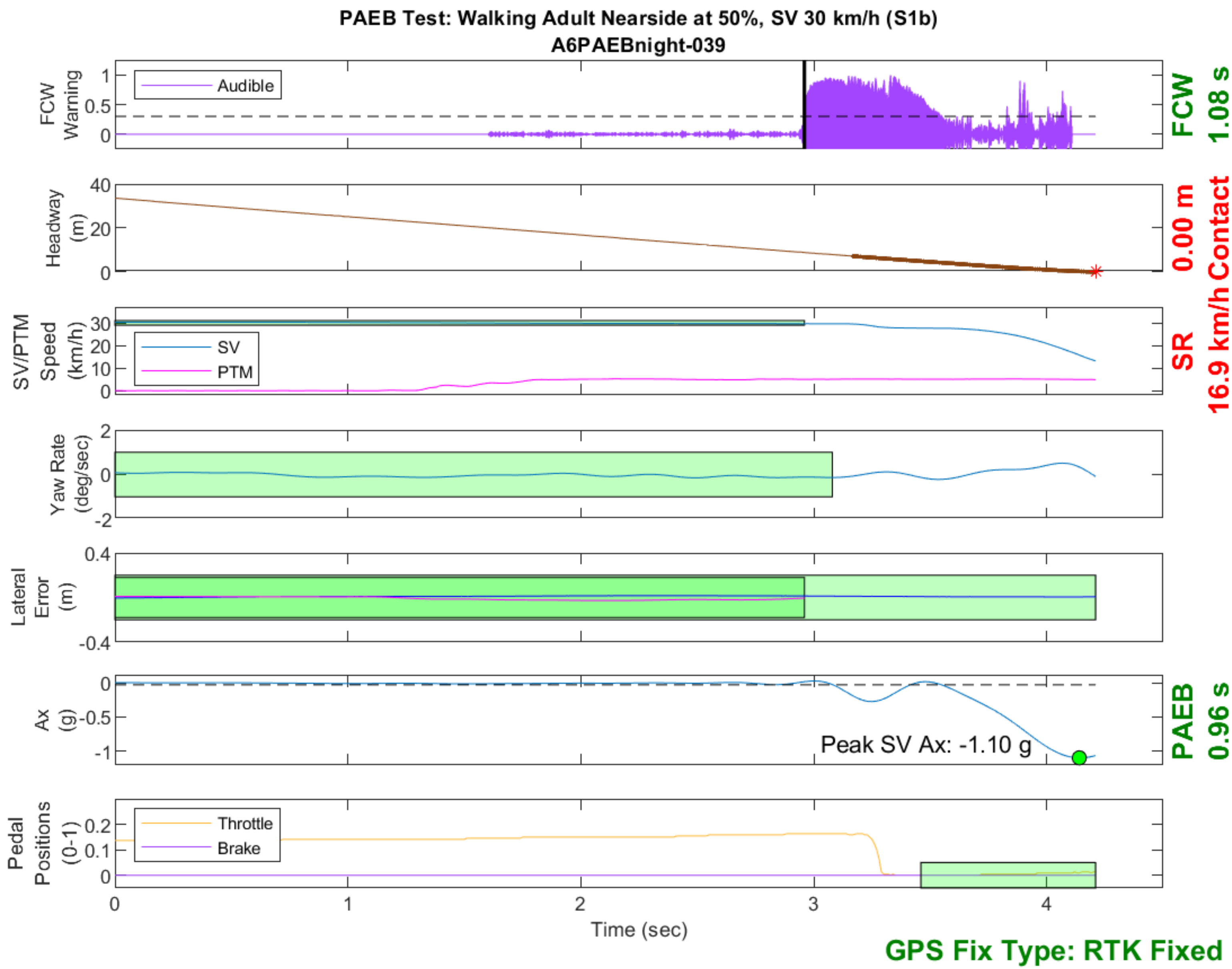


Figure D196. Time History for PAEB Run 39, S1b, Night, High Beam, 30 km/h

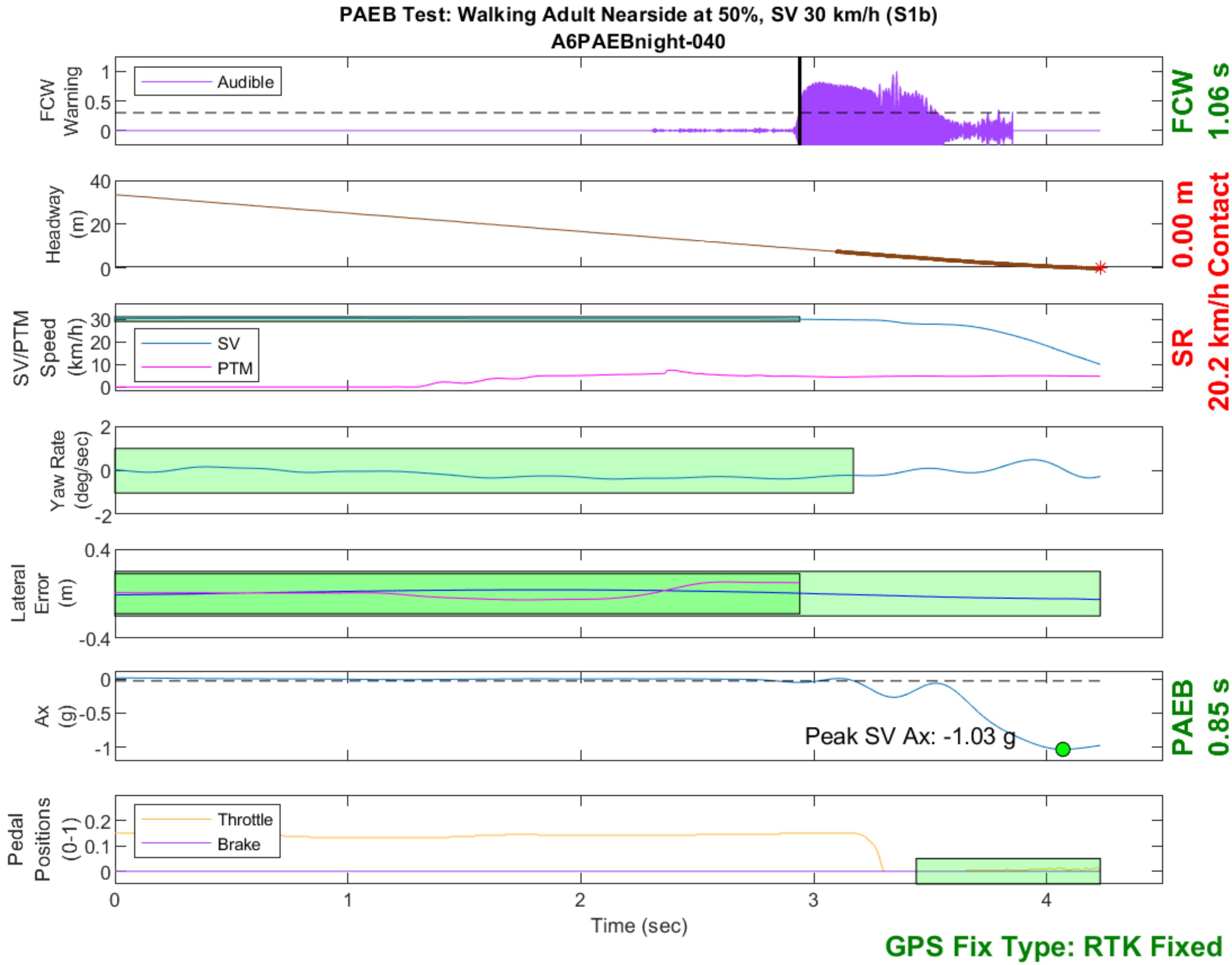


Figure D197. Time History for PAEB Run 40, S1b, Night, High Beam, 30 km/h

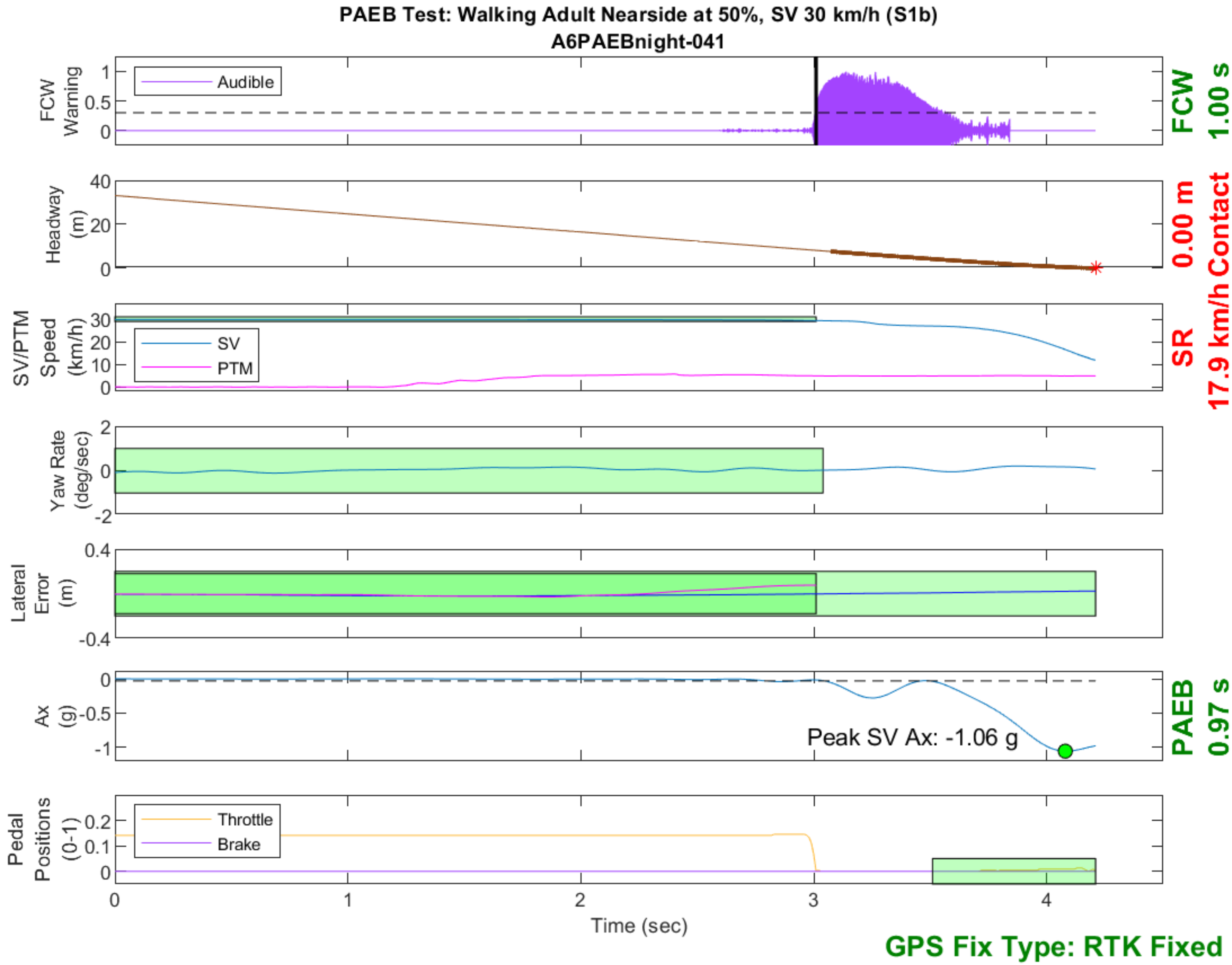


Figure D198. Time History for PAEB Run 41, S1b, Night, High Beam, 30 km/h

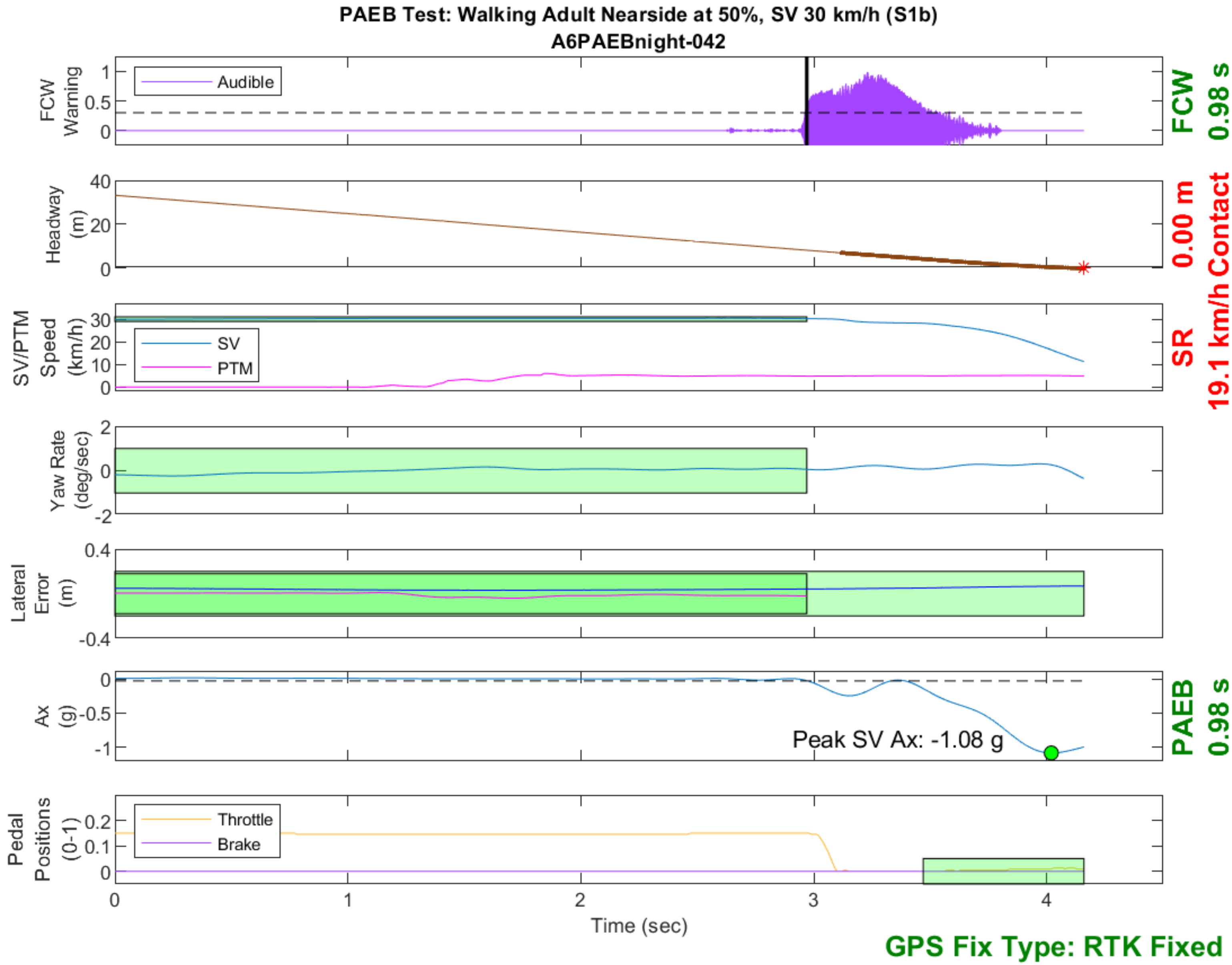


Figure D199. Time History for PAEB Run 42, S1b, Night, High Beam, 30 km/h

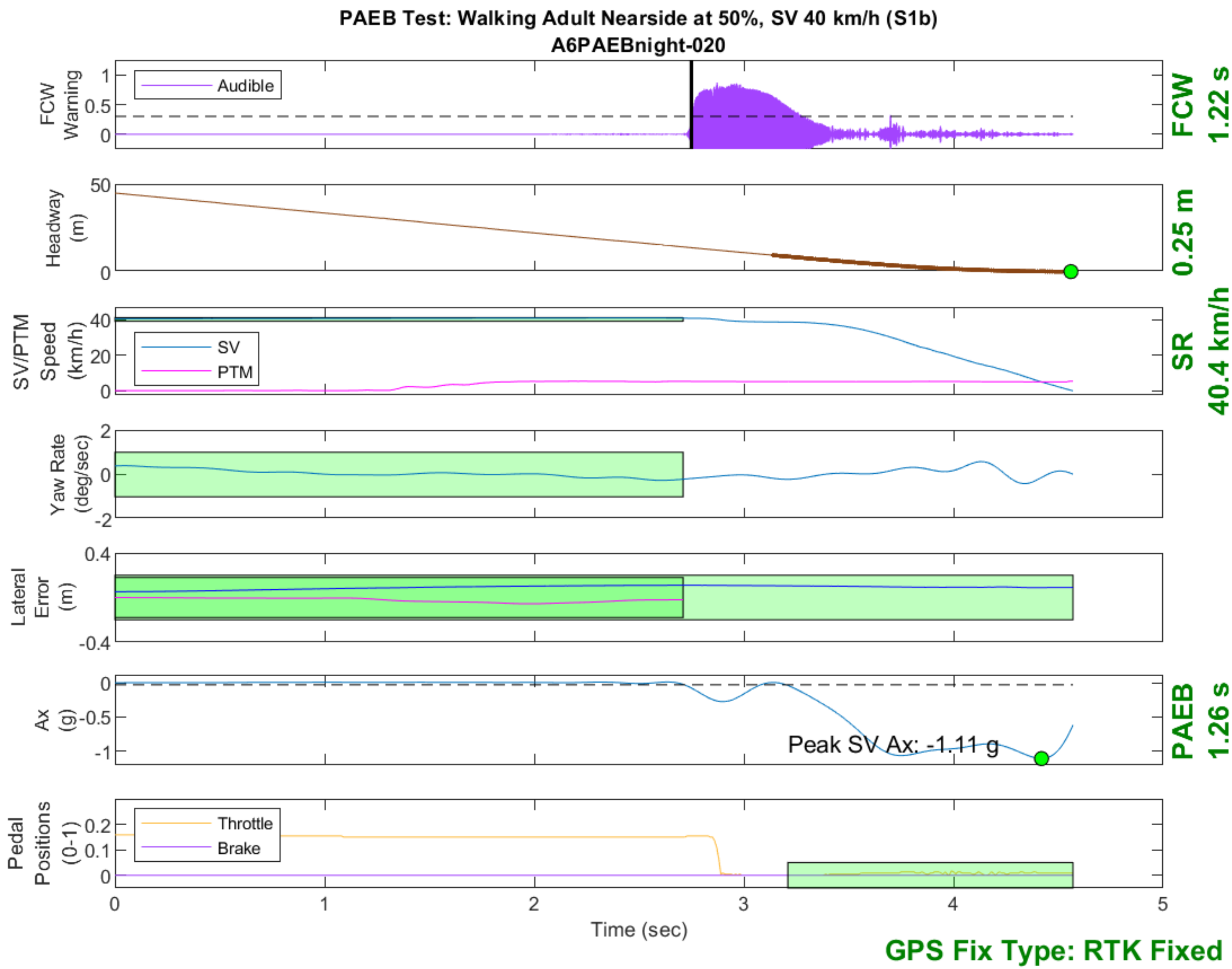


Figure D200. Time History for PAEB Run 20, S1b, Night, High Beam, 40 km/h

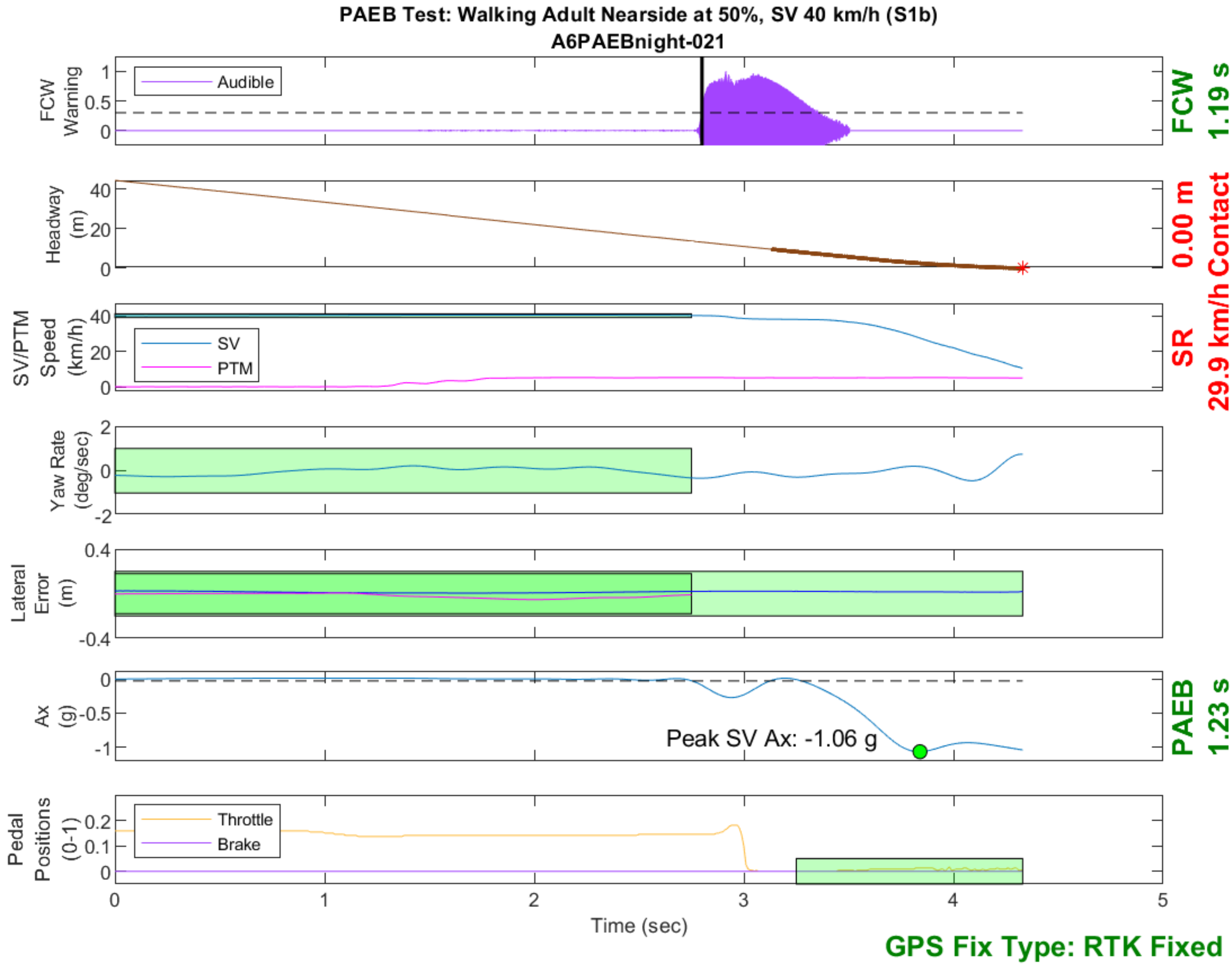


Figure D201. Time History for PAEB Run 21, S1b, Night, High Beam, 40 km/h

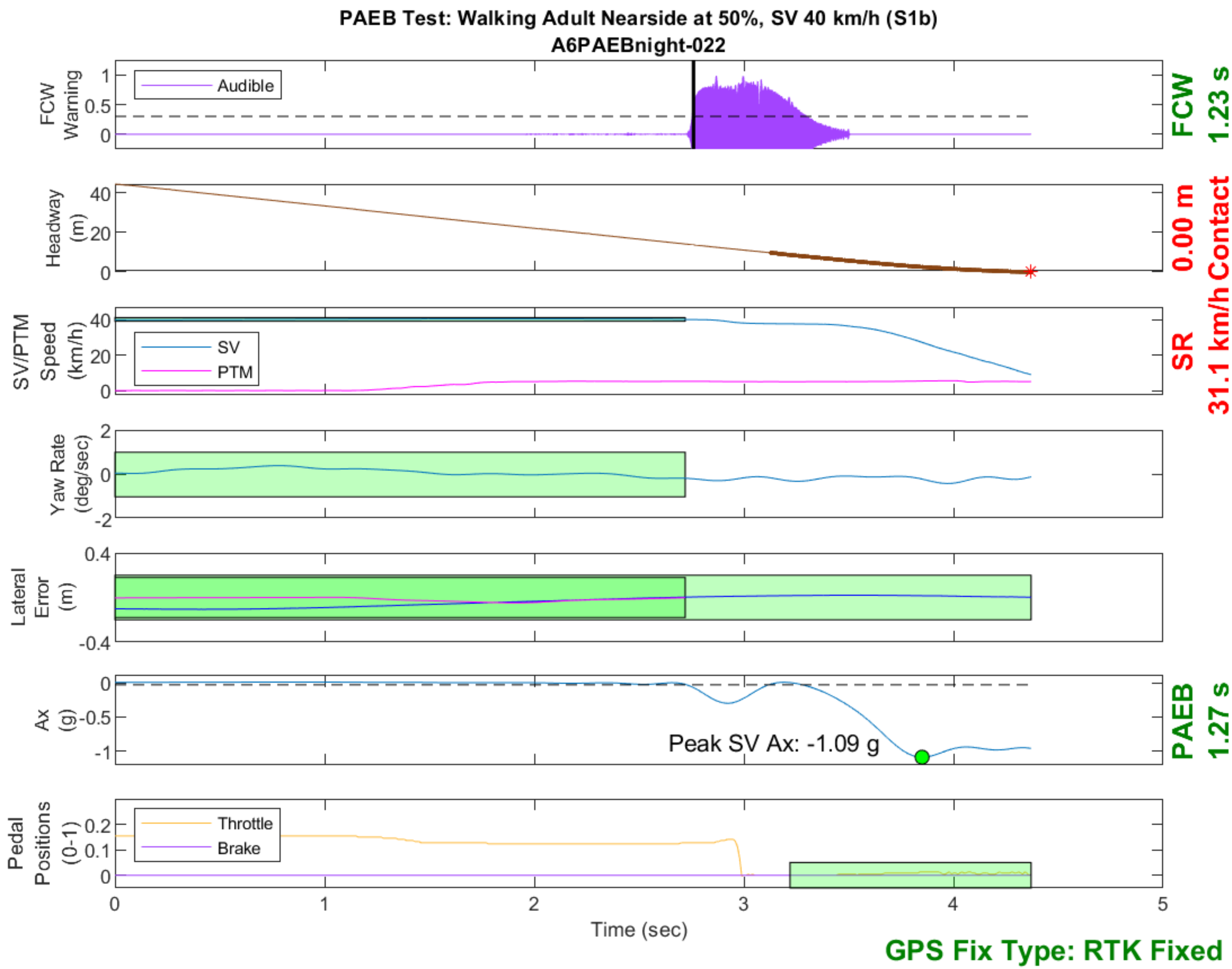


Figure D202. Time History for PAEB Run 22, S1b, Night, High Beam, 40 km/h

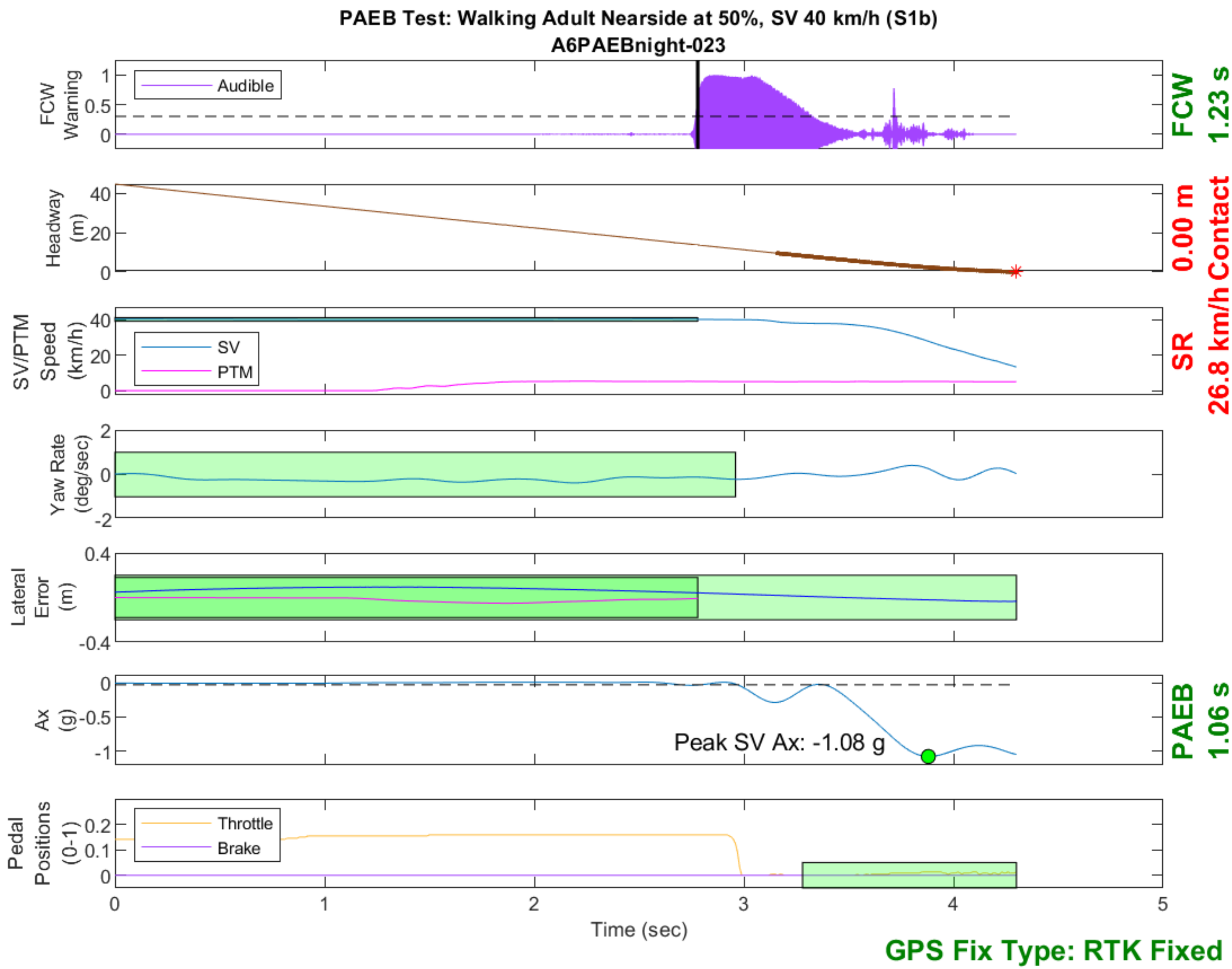


Figure D203. Time History for PAEB Run 23, S1b, Night, High Beam, 40 km/h

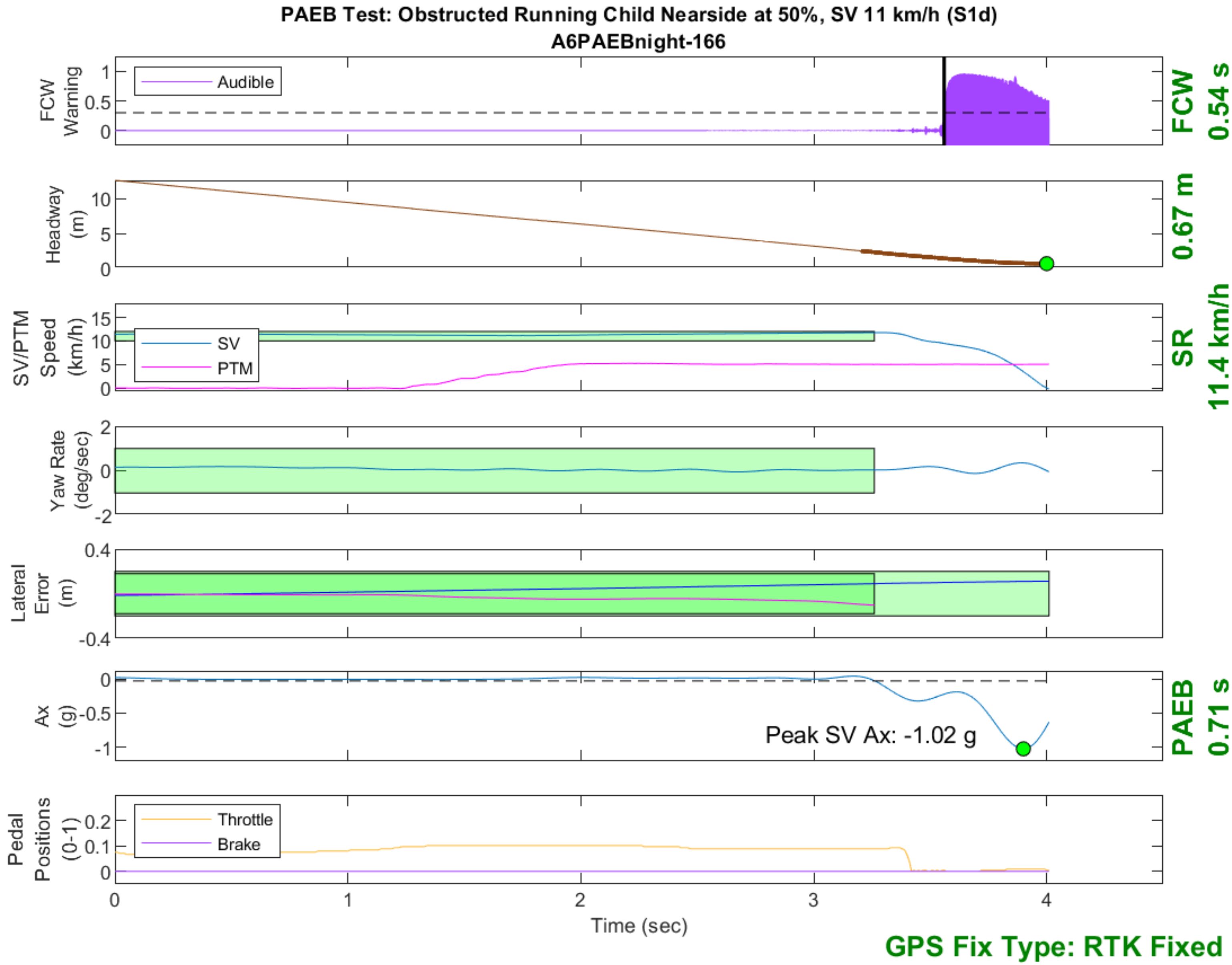


Figure D204. Time History for PAEB Run 166, S1d, Night, High Beam, 11 km/h

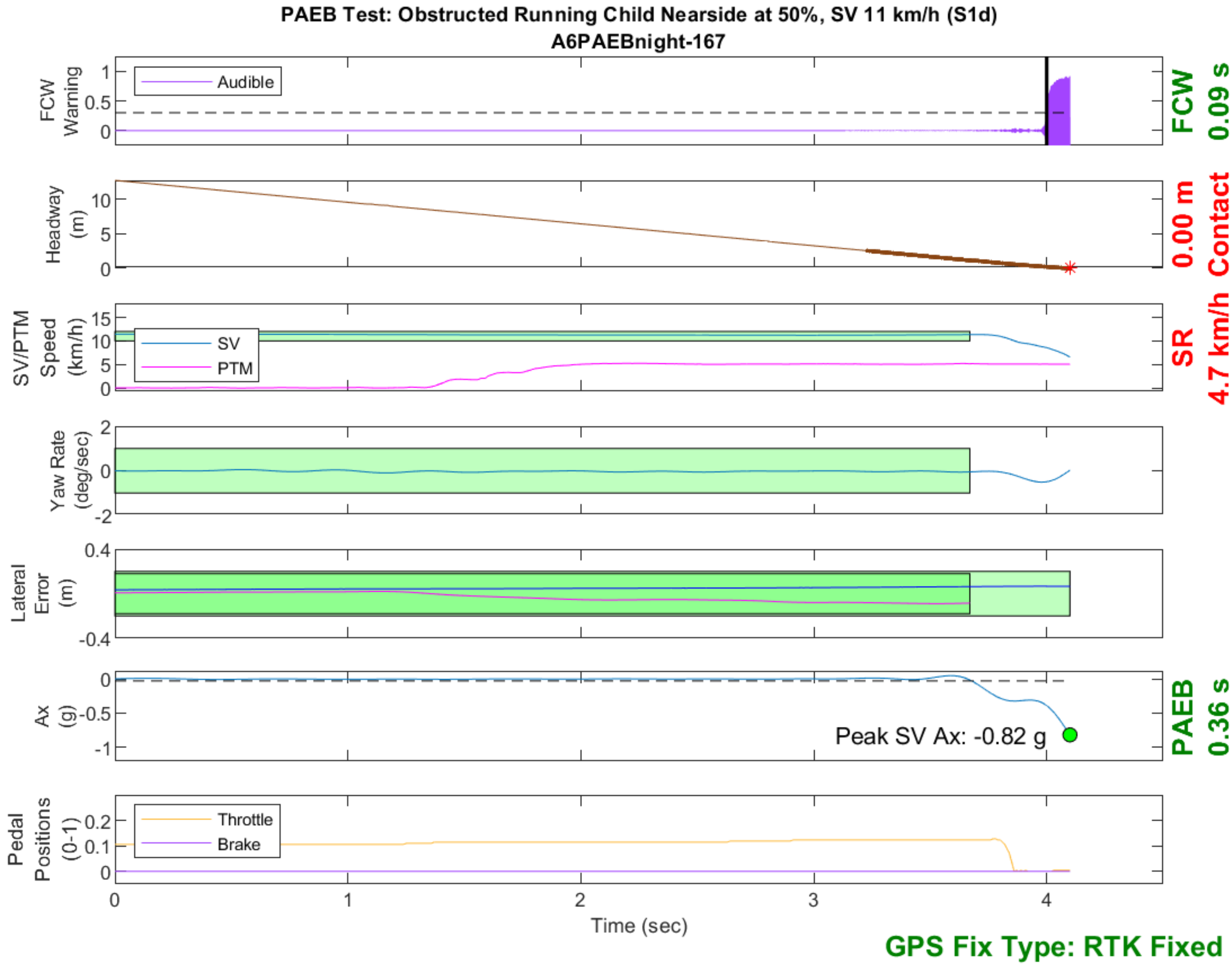


Figure D205. Time History for PAEB Run 167, S1d, Night, High Beam, 11 km/h

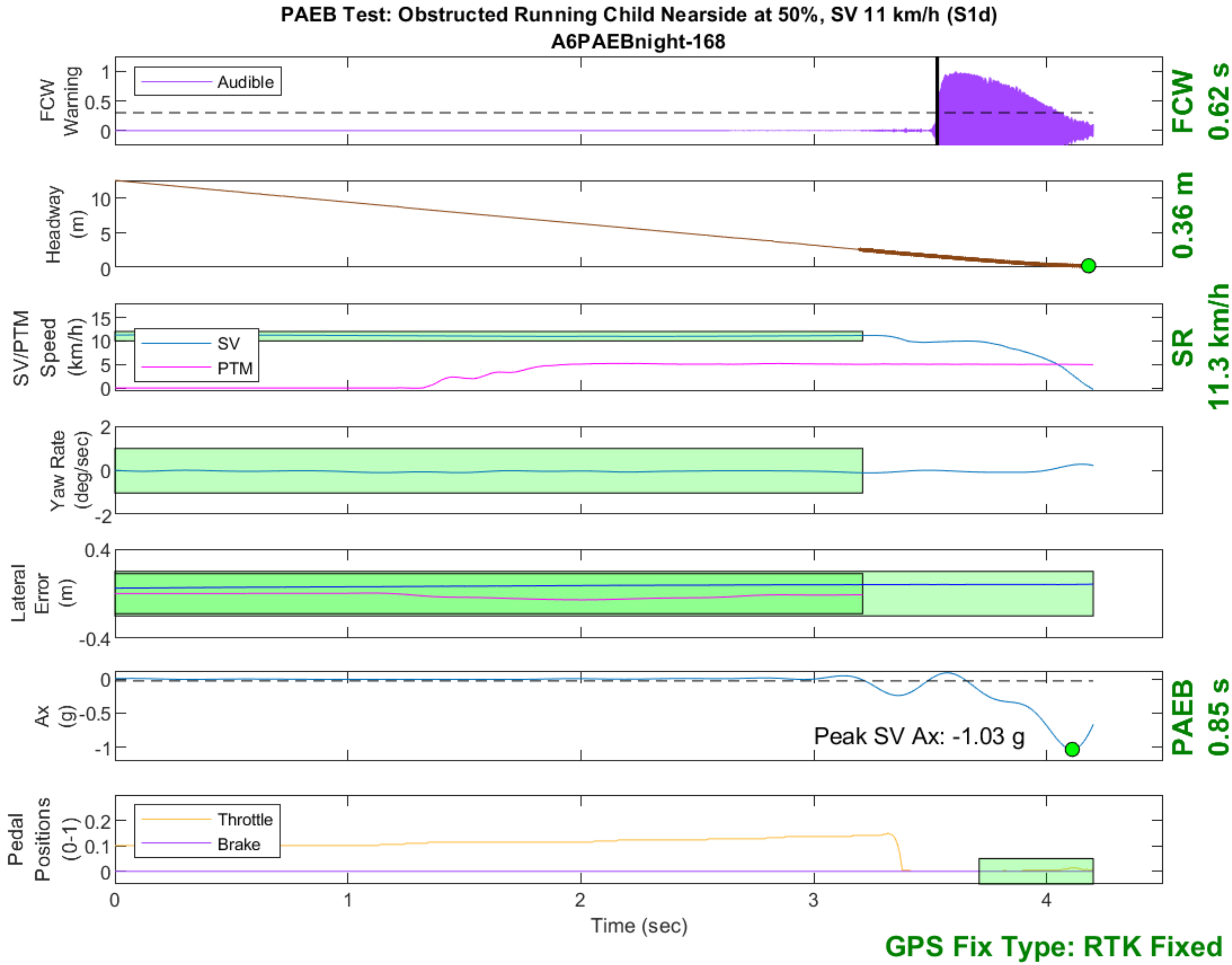


Figure D206. Time History for PAEB Run 168, S1d, Night, High Beam, 11 km/h

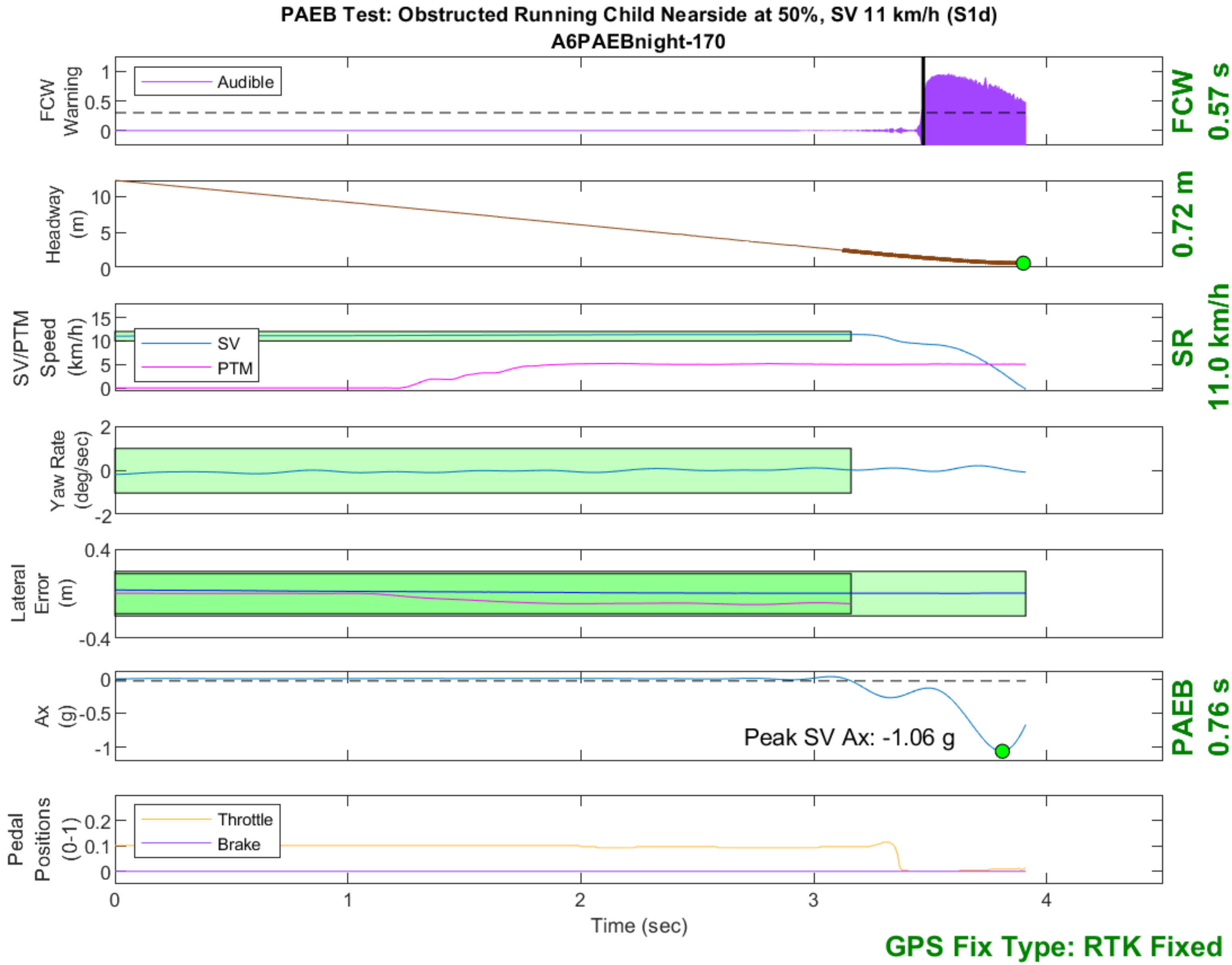


Figure D207. Time History for PAEB Run 170, S1d, Night, High Beam, 11 km/h

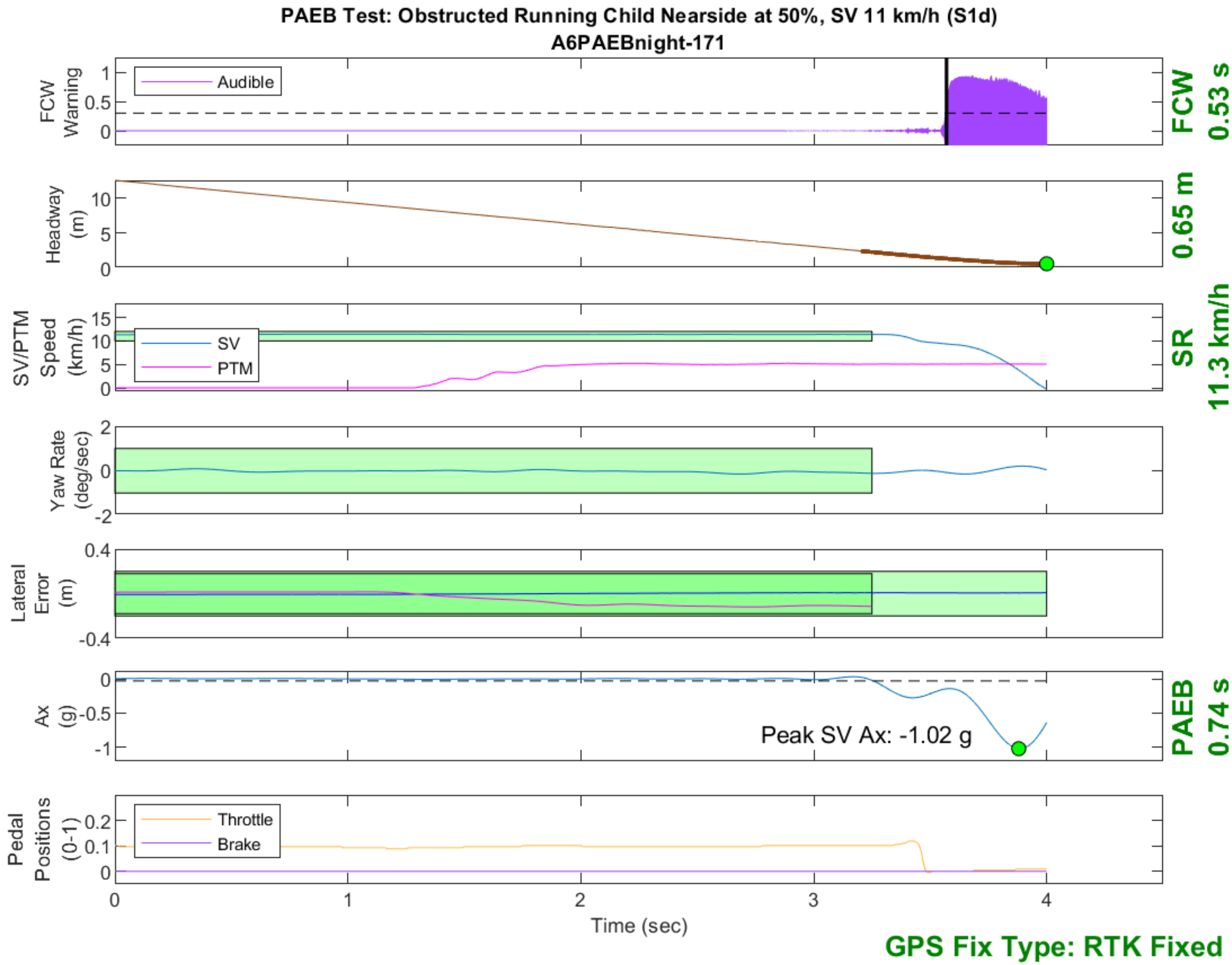


Figure D208. Time History for PAEB Run 171, S1d, Night, High Beam, 11 km/h

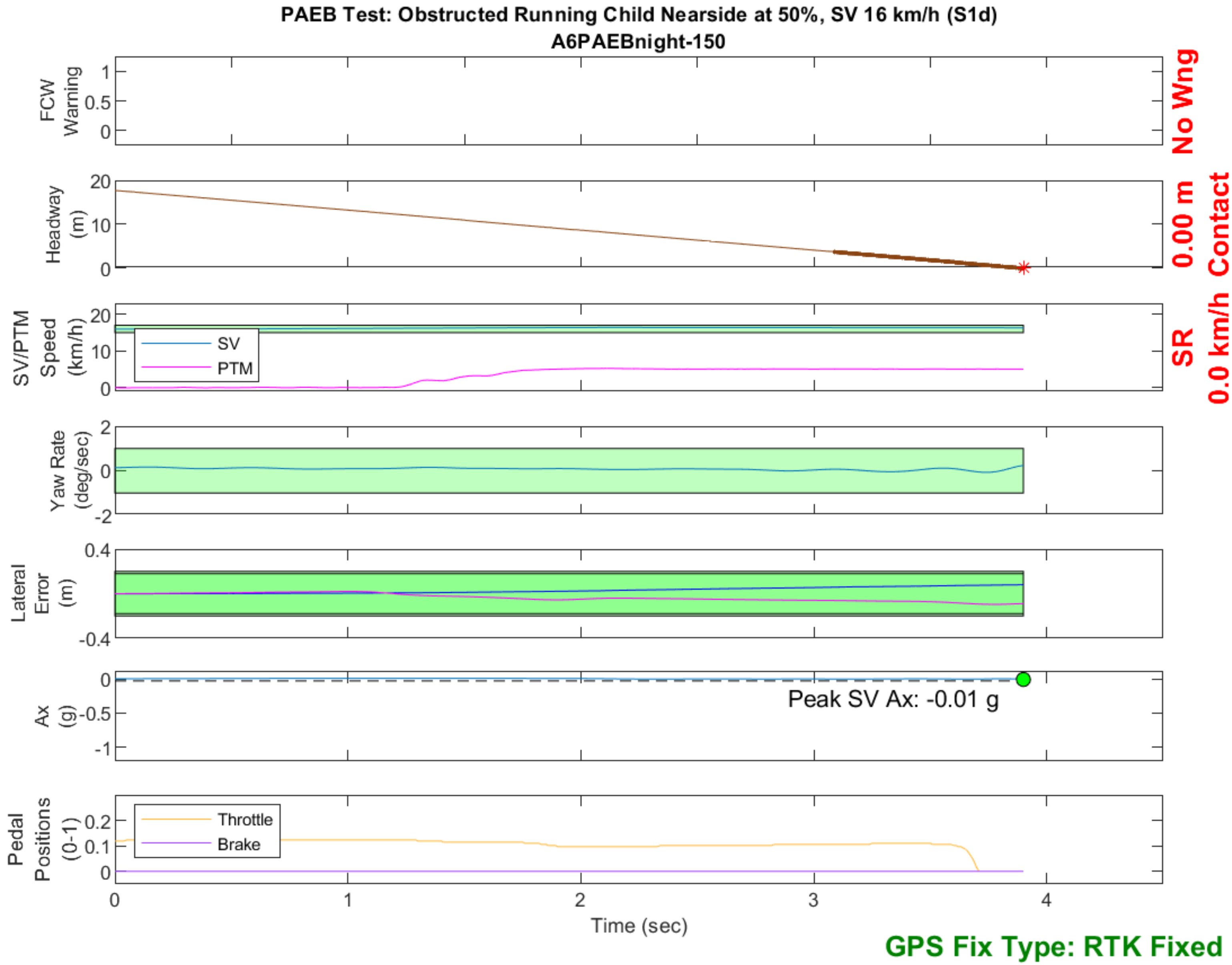


Figure D209. Time History for PAEB Run 150, S1d, Night, High Beam, 16 km/h

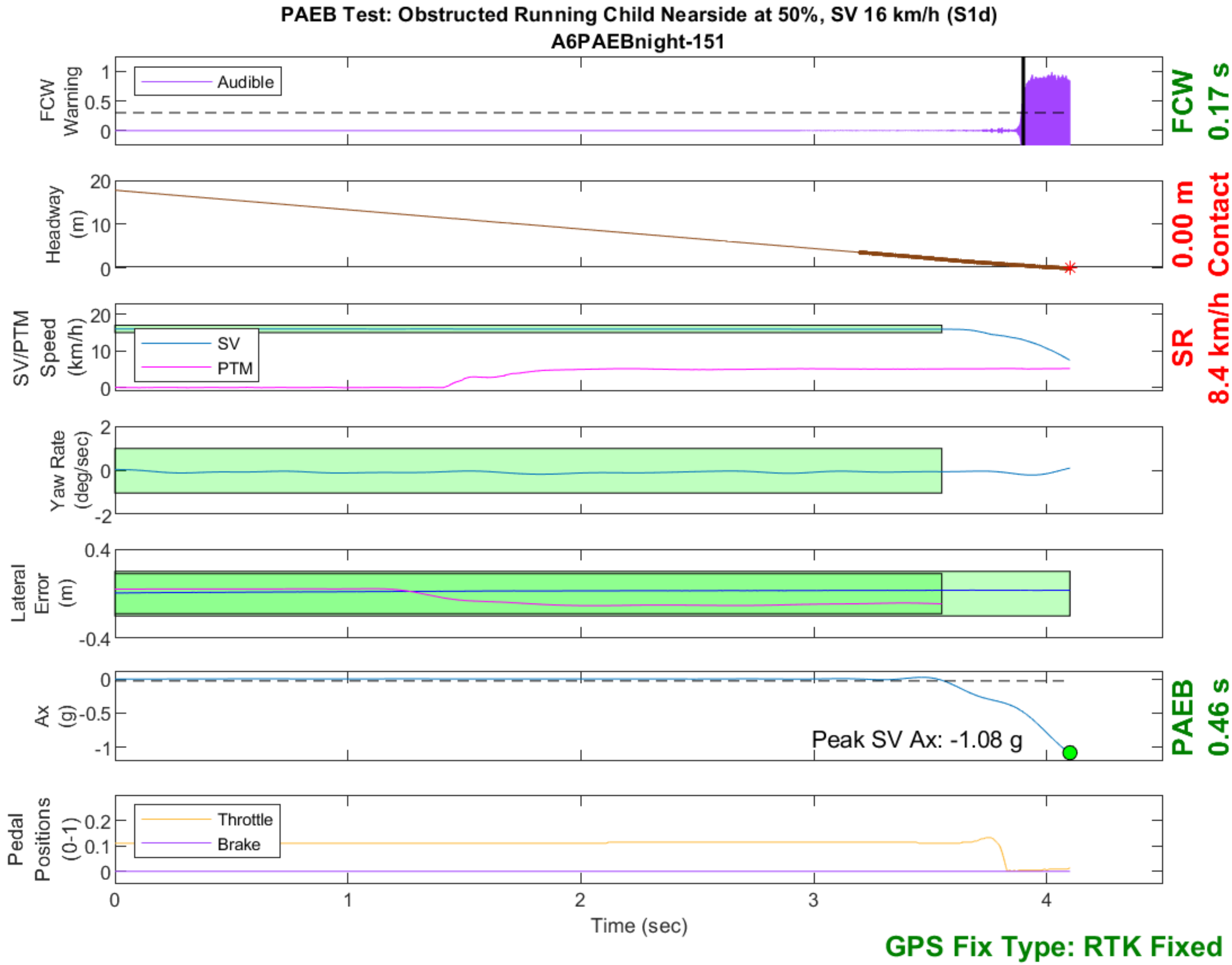


Figure D210. Time History for PAEB Run 151, S1d, Night, High Beam, 16 km/h

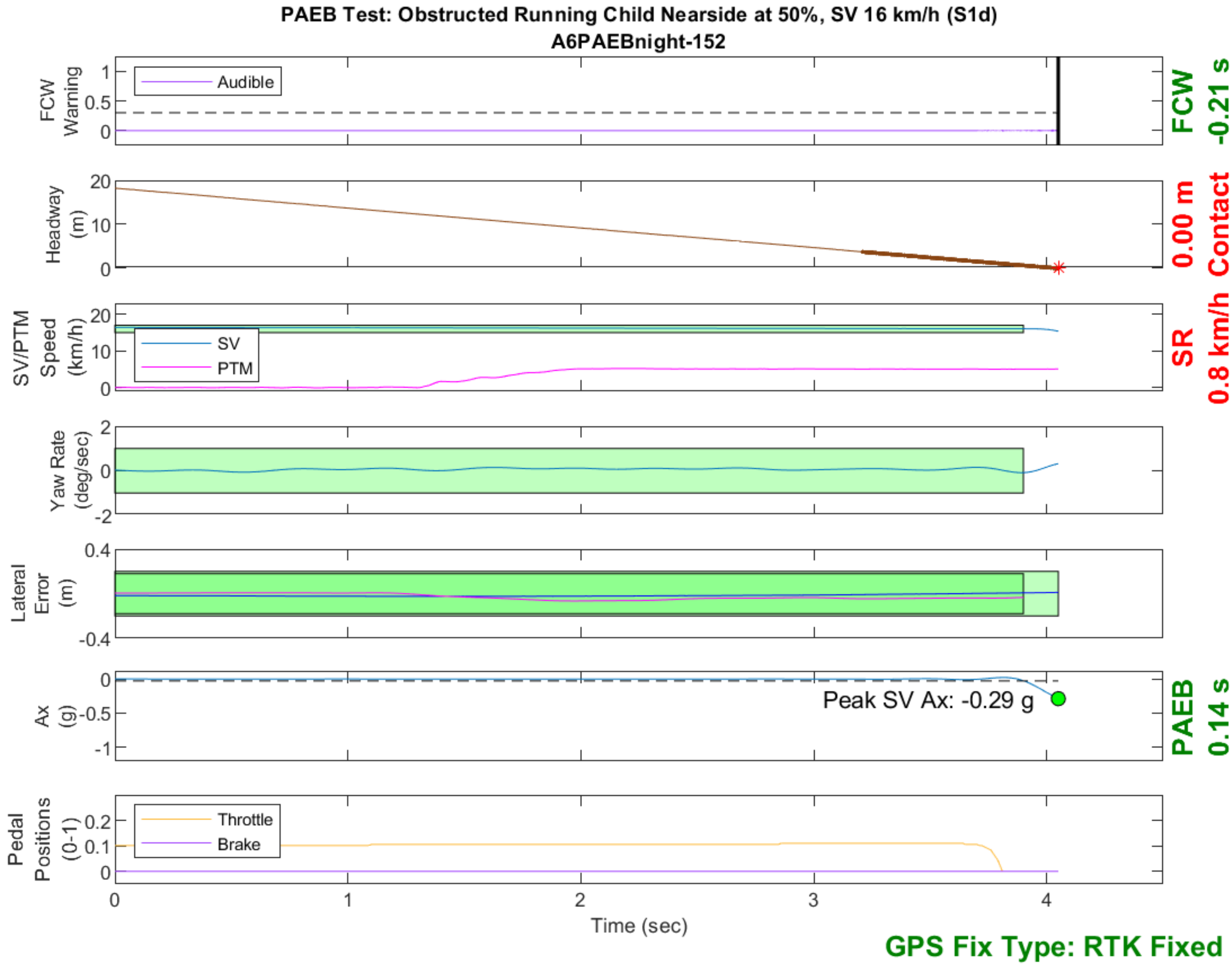


Figure D211. Time History for PAEB Run 152, S1d, Night, High Beam, 16 km/h

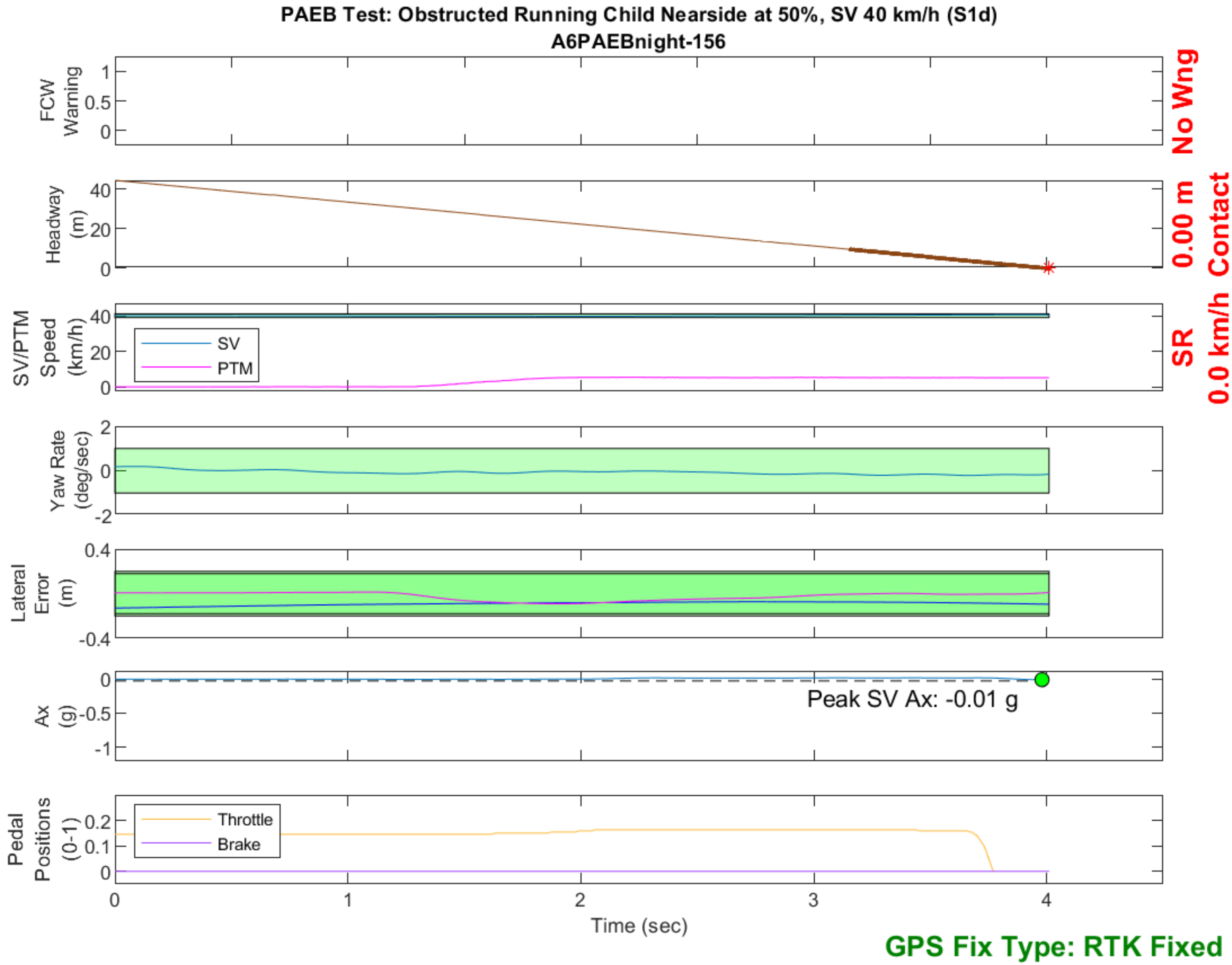


Figure D212. Time History for PAEB Run 156, S1d, Night, High Beam, 40 km/h

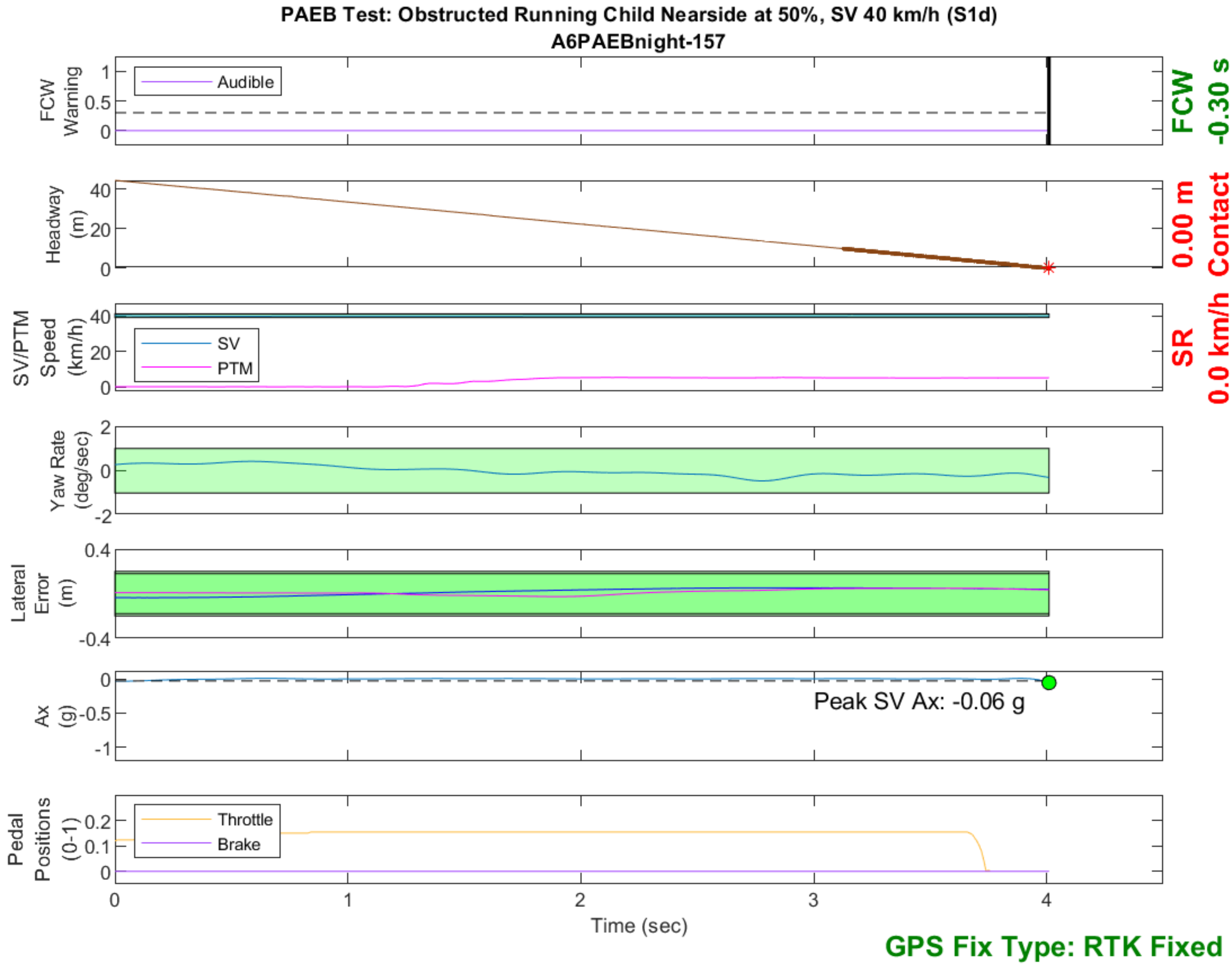


Figure D213. Time History for PAEB Run 157, S1d, Night, High Beam, 40 km/h

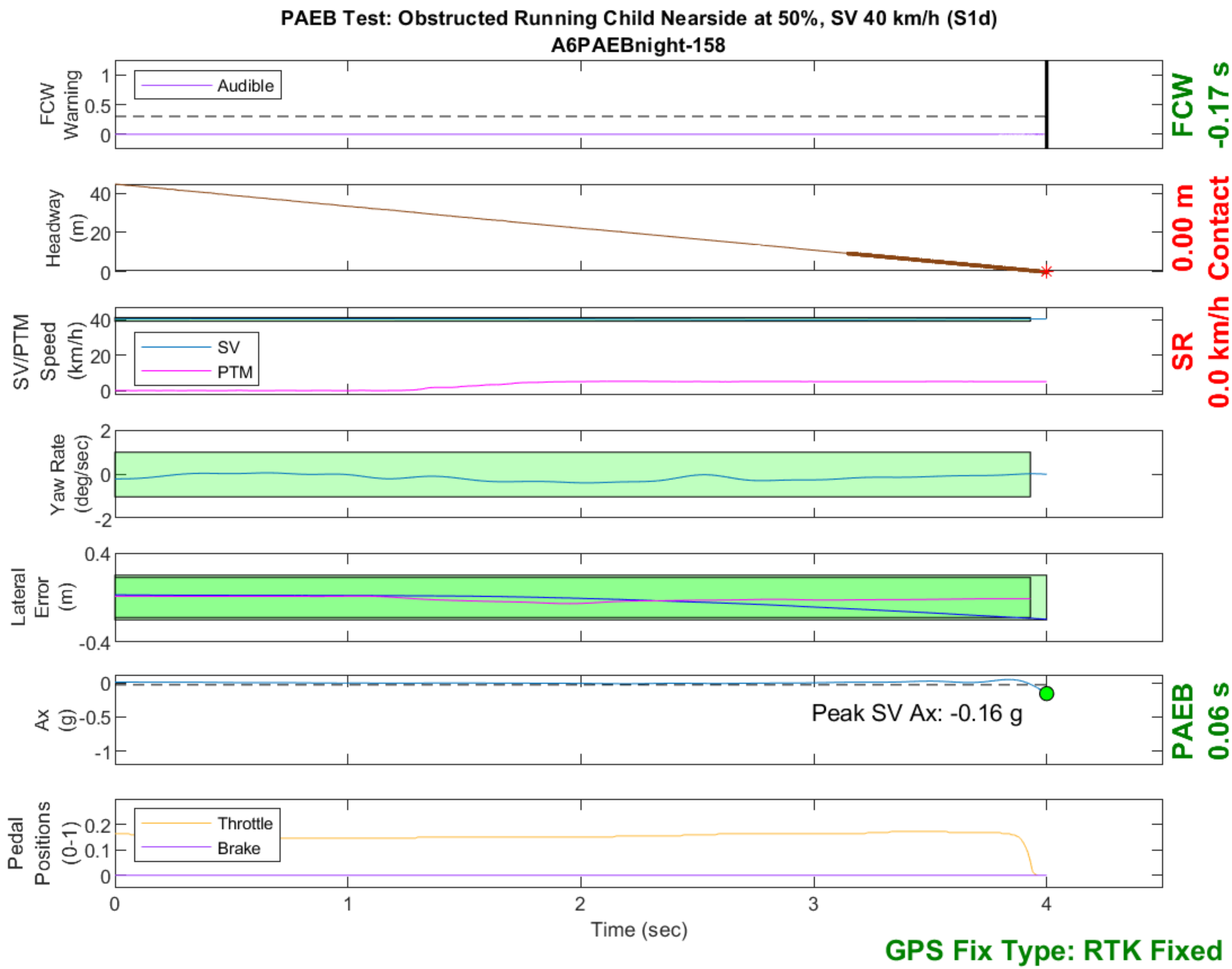


Figure D214. Time History for PAEB Run 158, S1d, Night, High Beam, 40 km/h

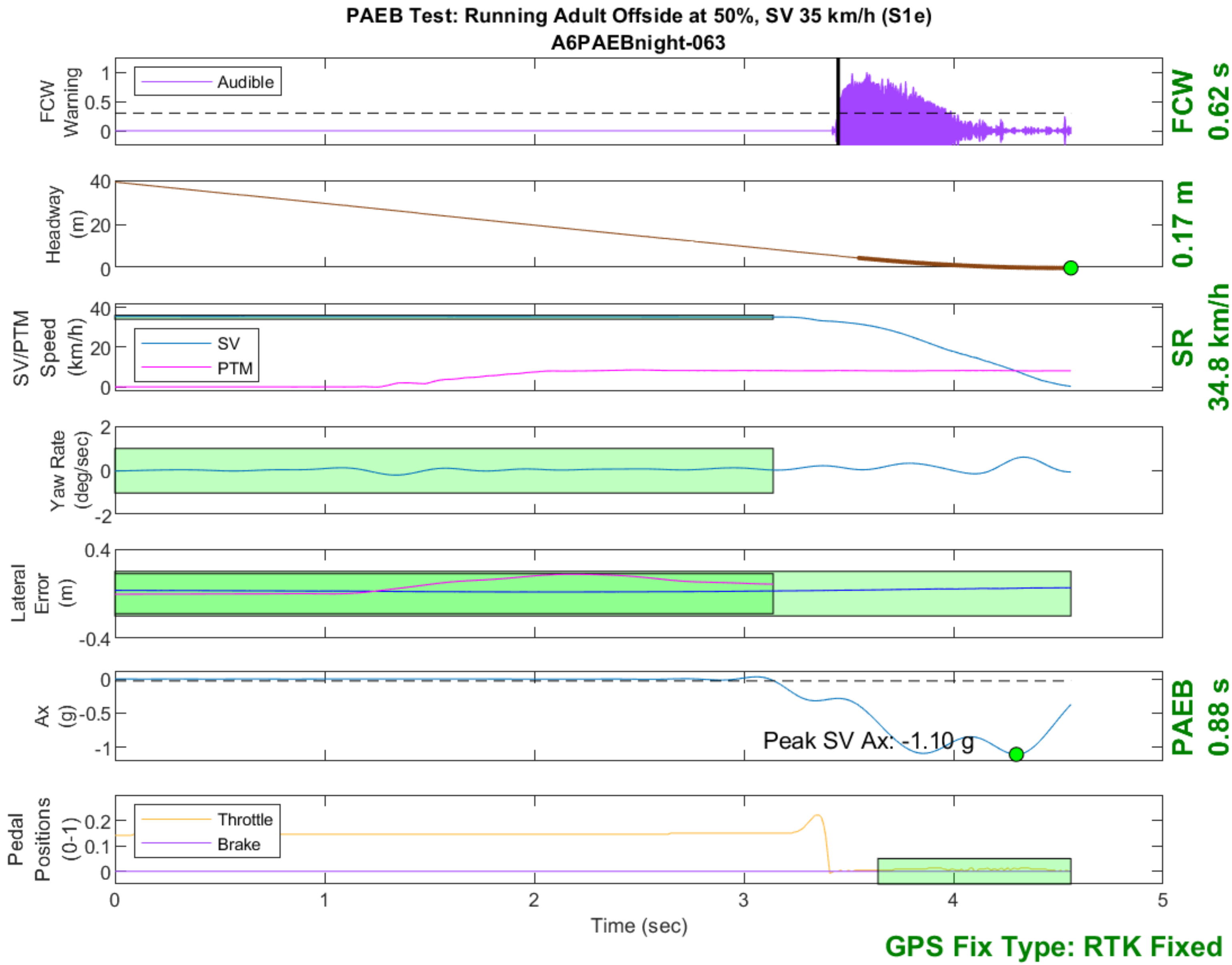


Figure D215. Time History for PAEB Run 63, S1e, Night, High Beam, 35 km/h

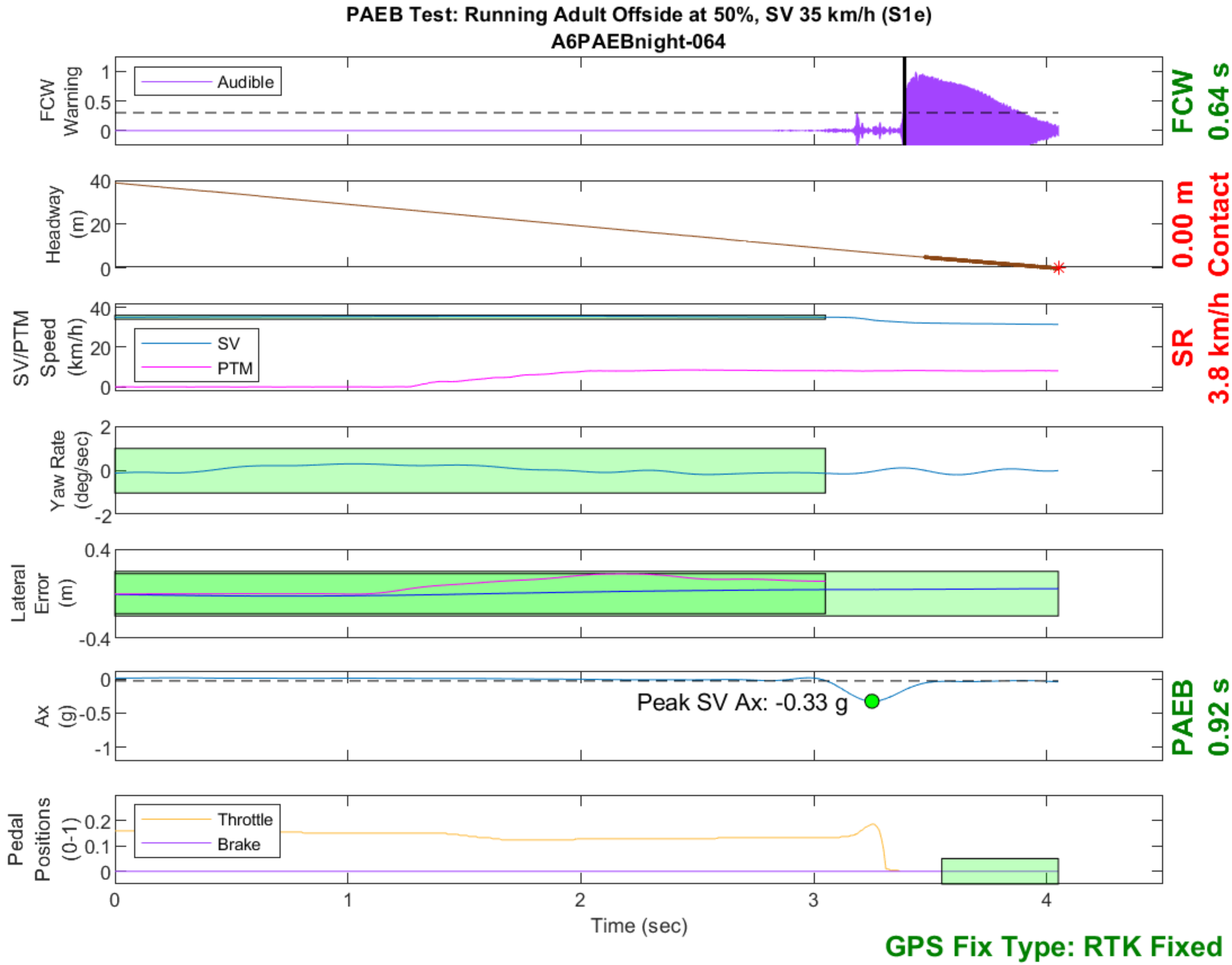


Figure D216. Time History for PAEB Run 64, S1e, Night, High Beam, 35 km/h

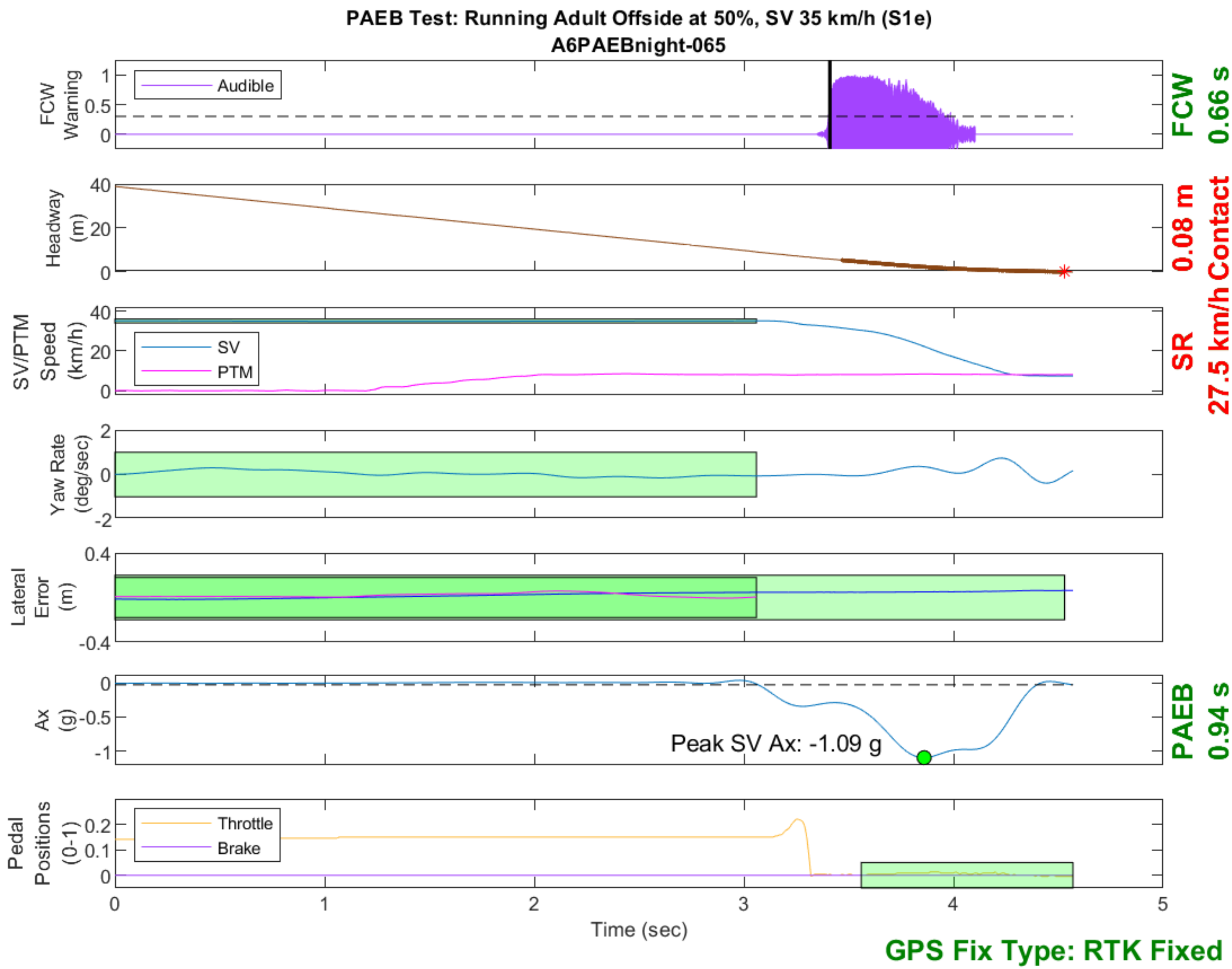


Figure D217. Time History for PAEB Run 65, S1e, Night, High Beam, 35 km/h

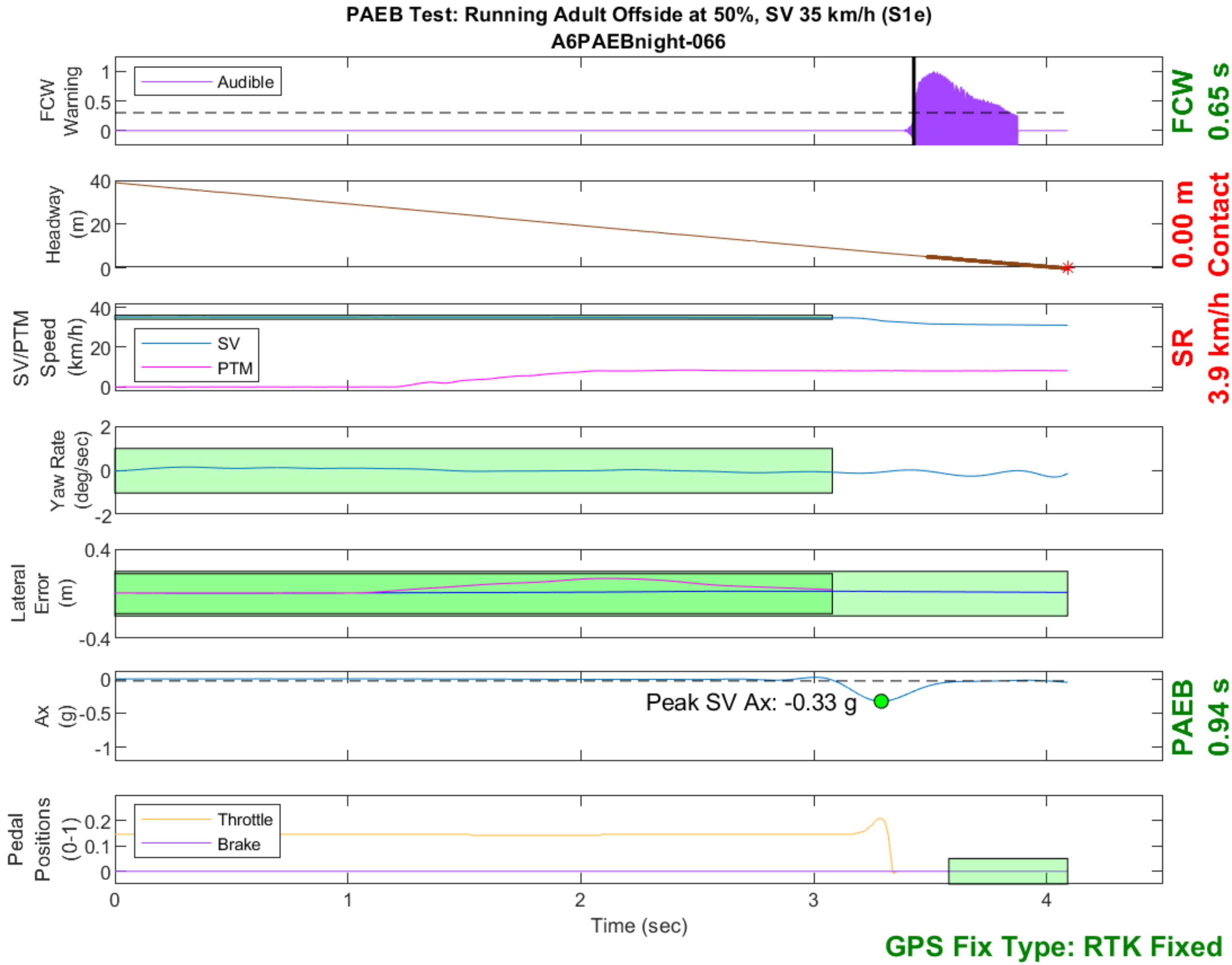


Figure D218. Time History for PAEB Run 66, S1e, Night, High Beam, 35 km/h

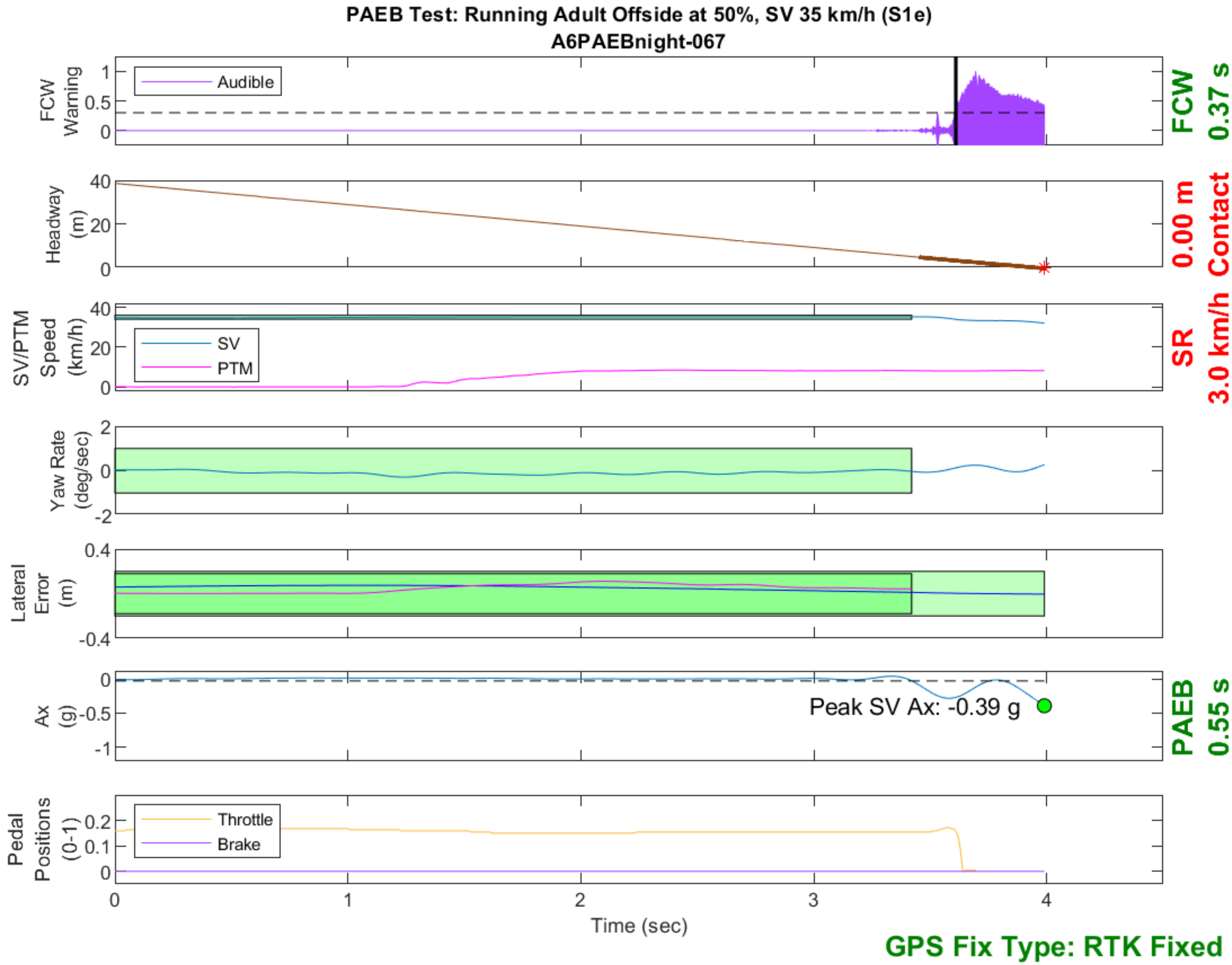


Figure D219. Time History for PAEB Run 67, S1e, Night, High Beam, 35 km/h

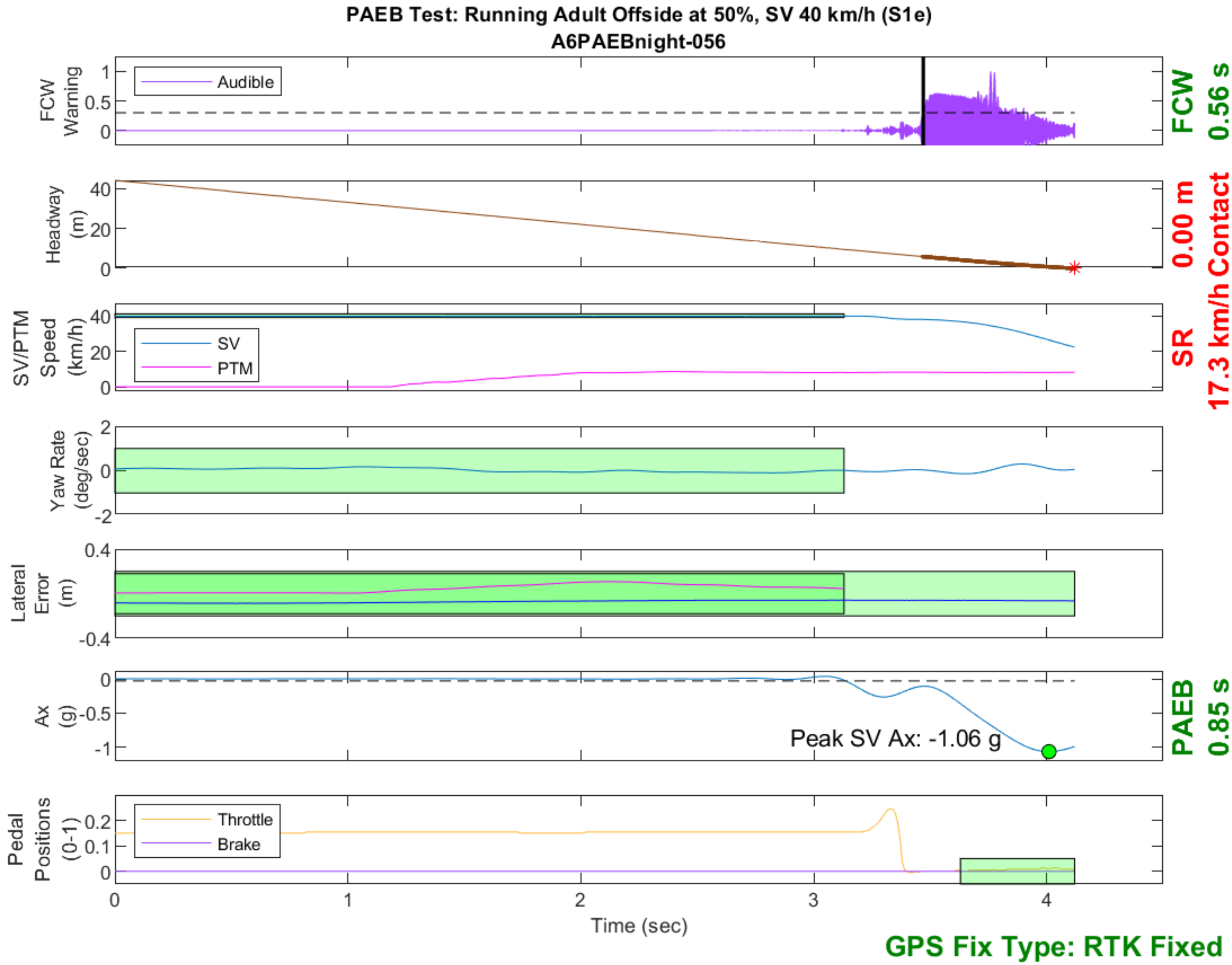


Figure D220. Time History for PAEB Run 56, S1e, Night, High Beam, 40 km/h

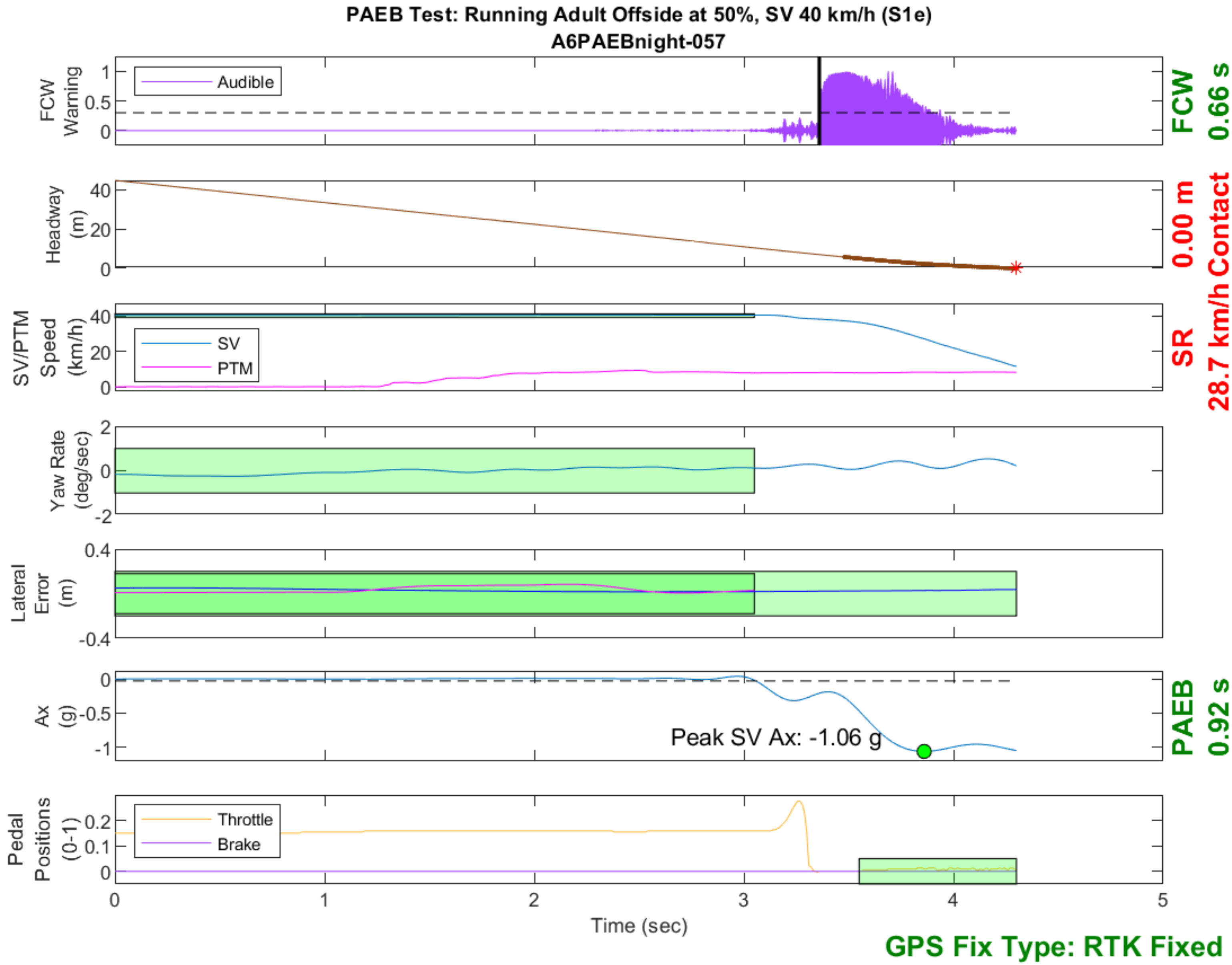


Figure D221. Time History for PAEB Run 57, S1e, Night, High Beam, 40 km/h

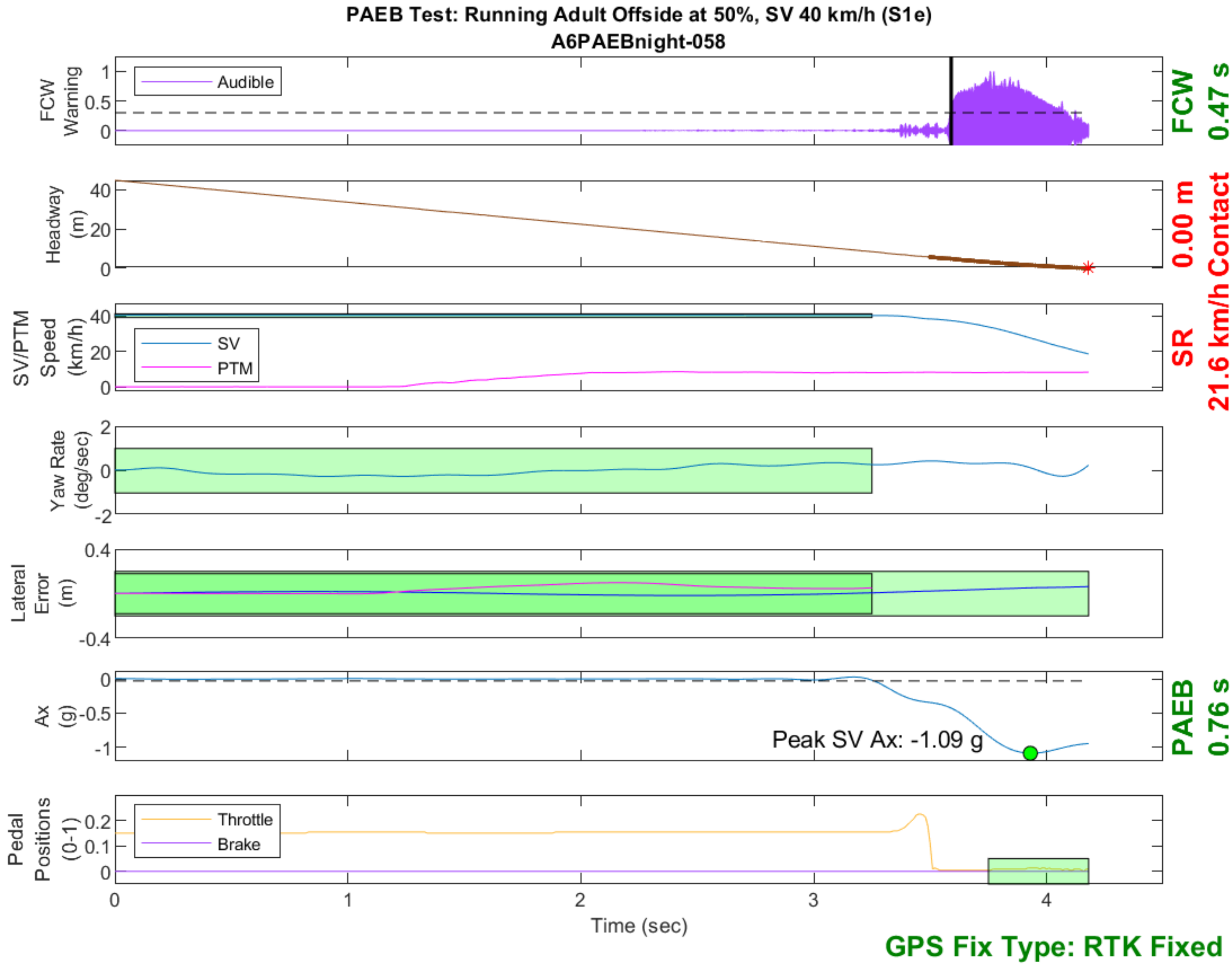


Figure D222. Time History for PAEB Run 58, S1e, Night, High Beam, 40 km/h

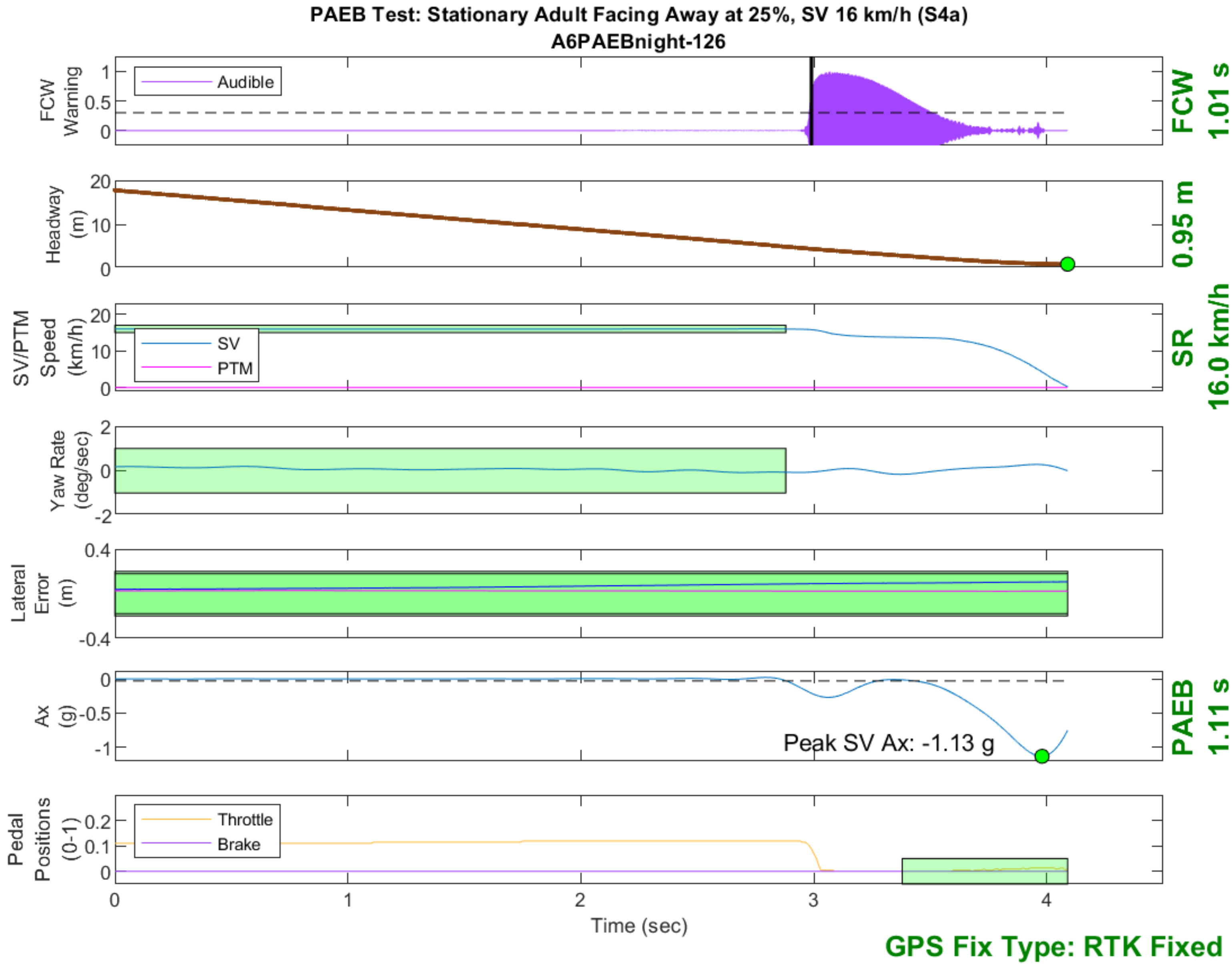


Figure D223. Time History for PAEB Run 126, S4a, Night, High Beam, 16 km/h

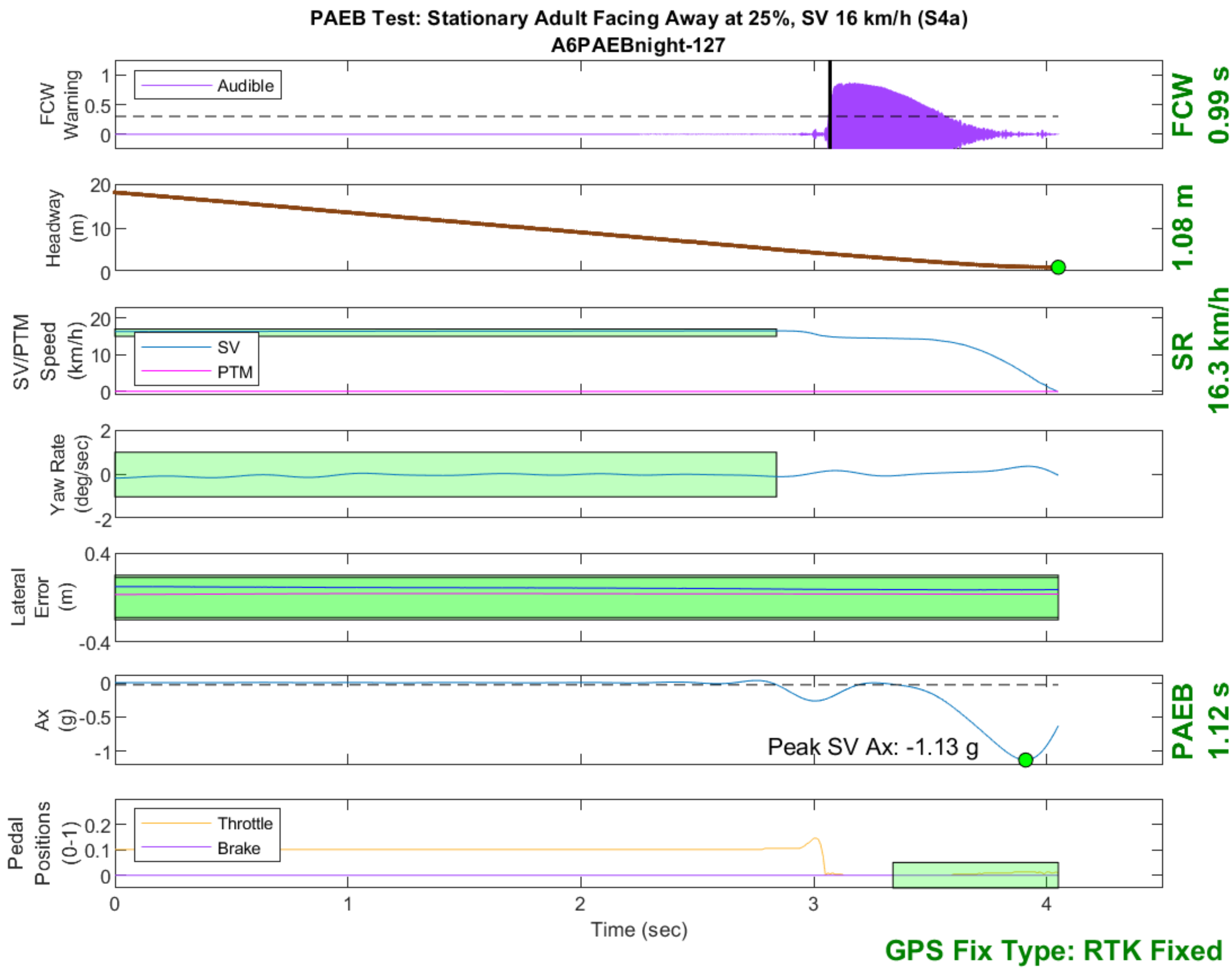


Figure D224. Time History for PAEB Run 127, S4a, Night, High Beam, 16 km/h

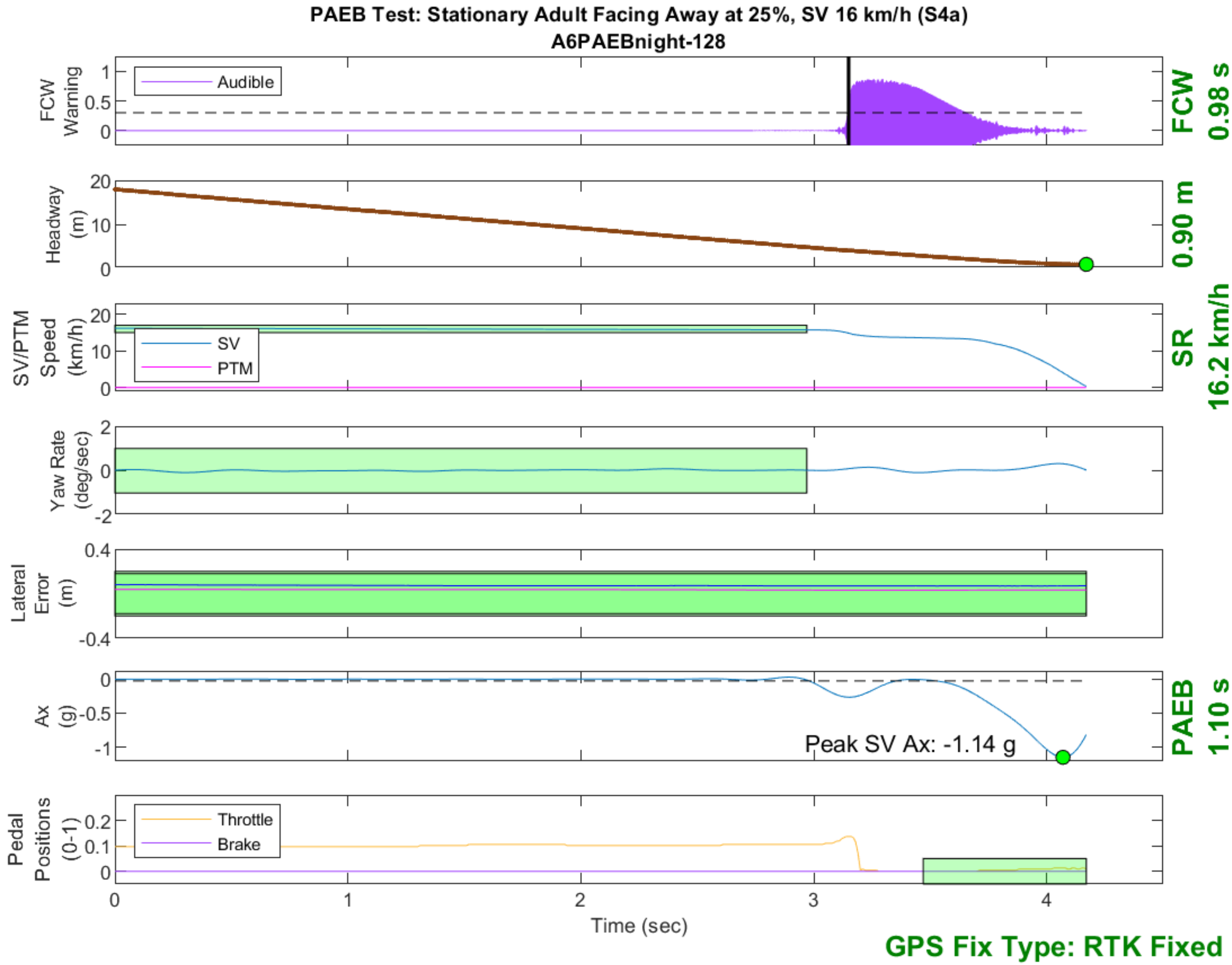


Figure D225. Time History for PAEB Run 128, S4a, Night, High Beam, 16 km/h

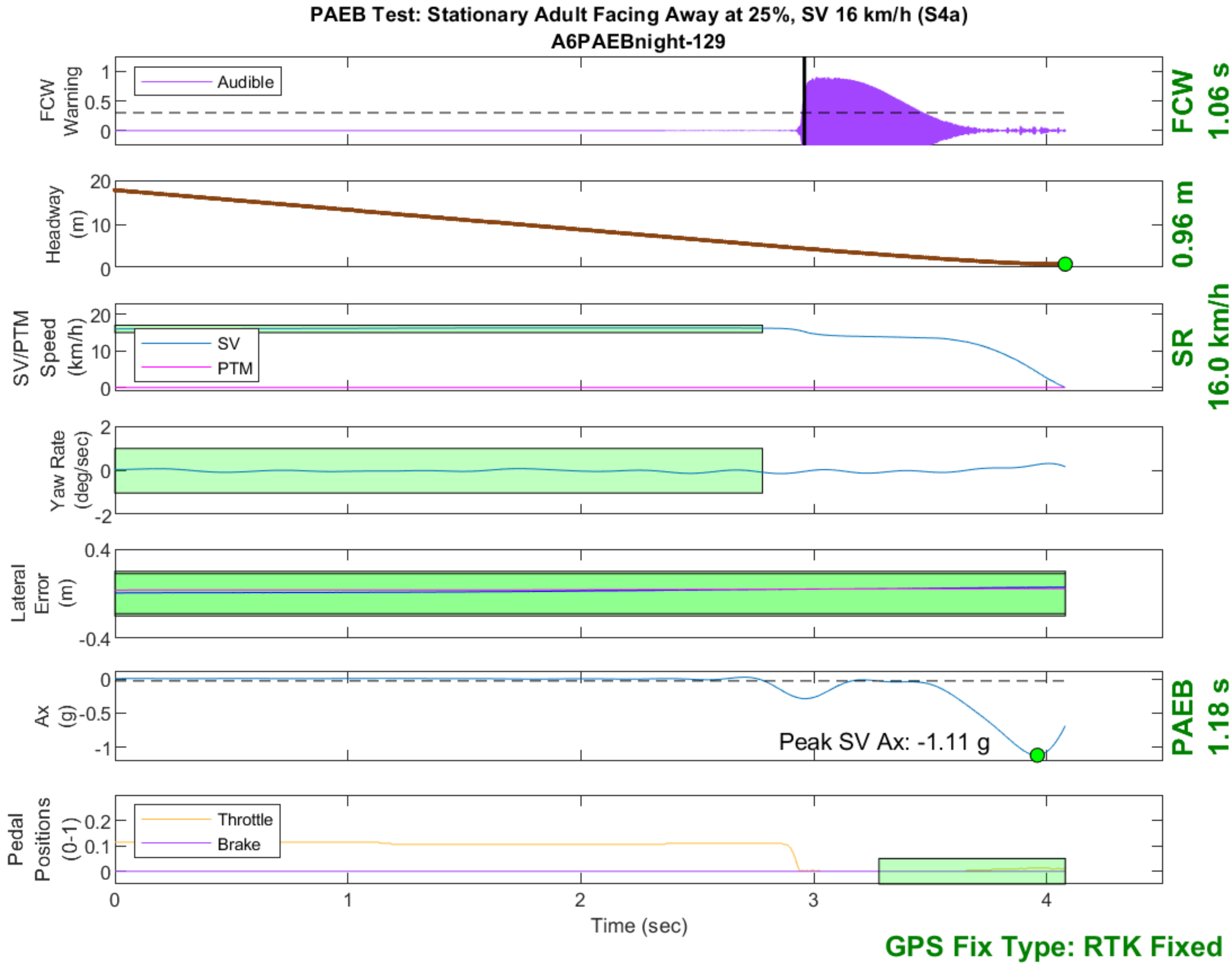


Figure D226. Time History for PAEB Run 129, S4a, Night, High Beam, 16 km/h

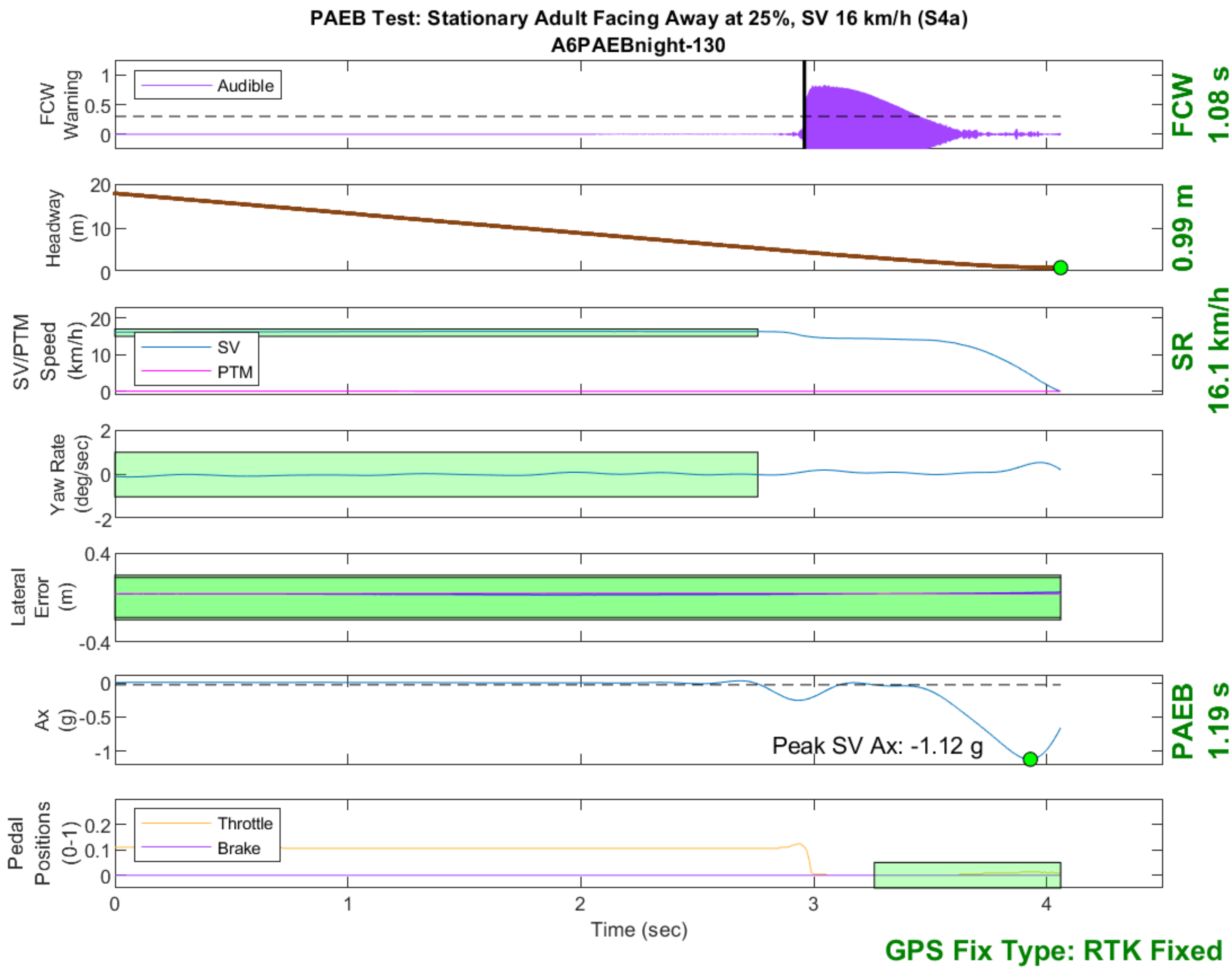


Figure D227. Time History for PAEB Run 130, S4a, Night, High Beam, 16 km/h

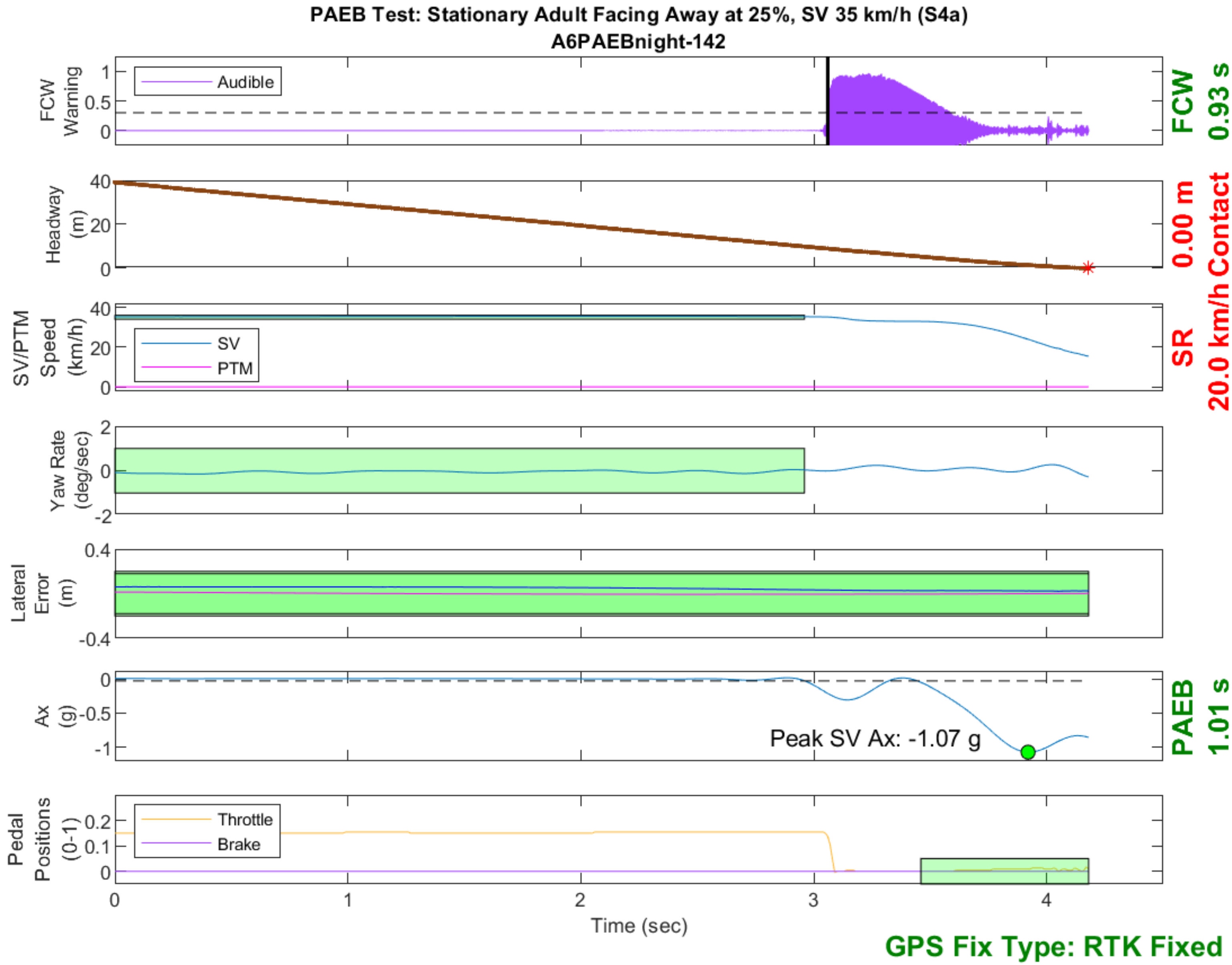


Figure D228. Time History for PAEB Run 142, S4a, Night, High Beam, 35 km/h

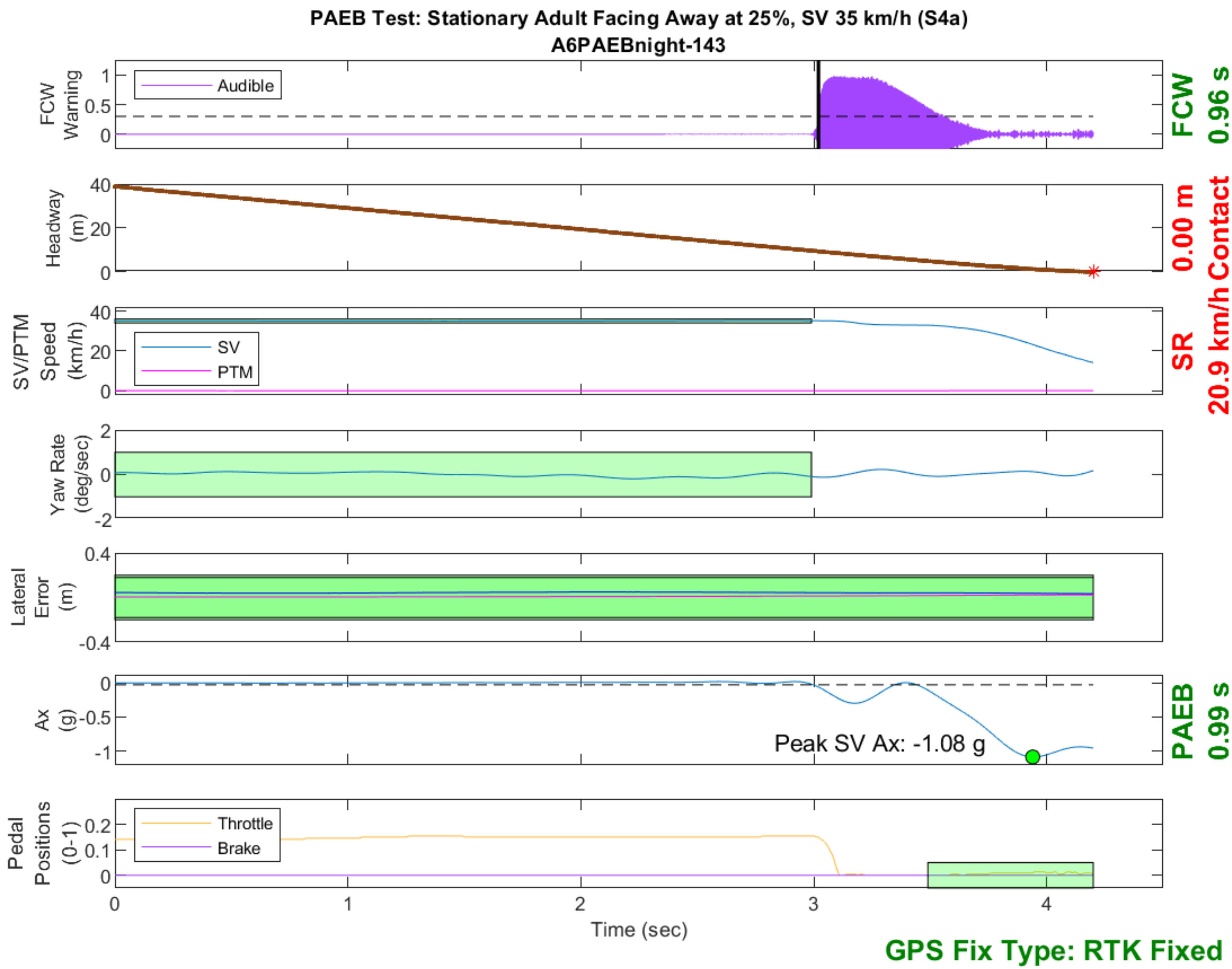


Figure D229. Time History for PAEB Run 143, S4a, Night, High Beam, 35 km/h

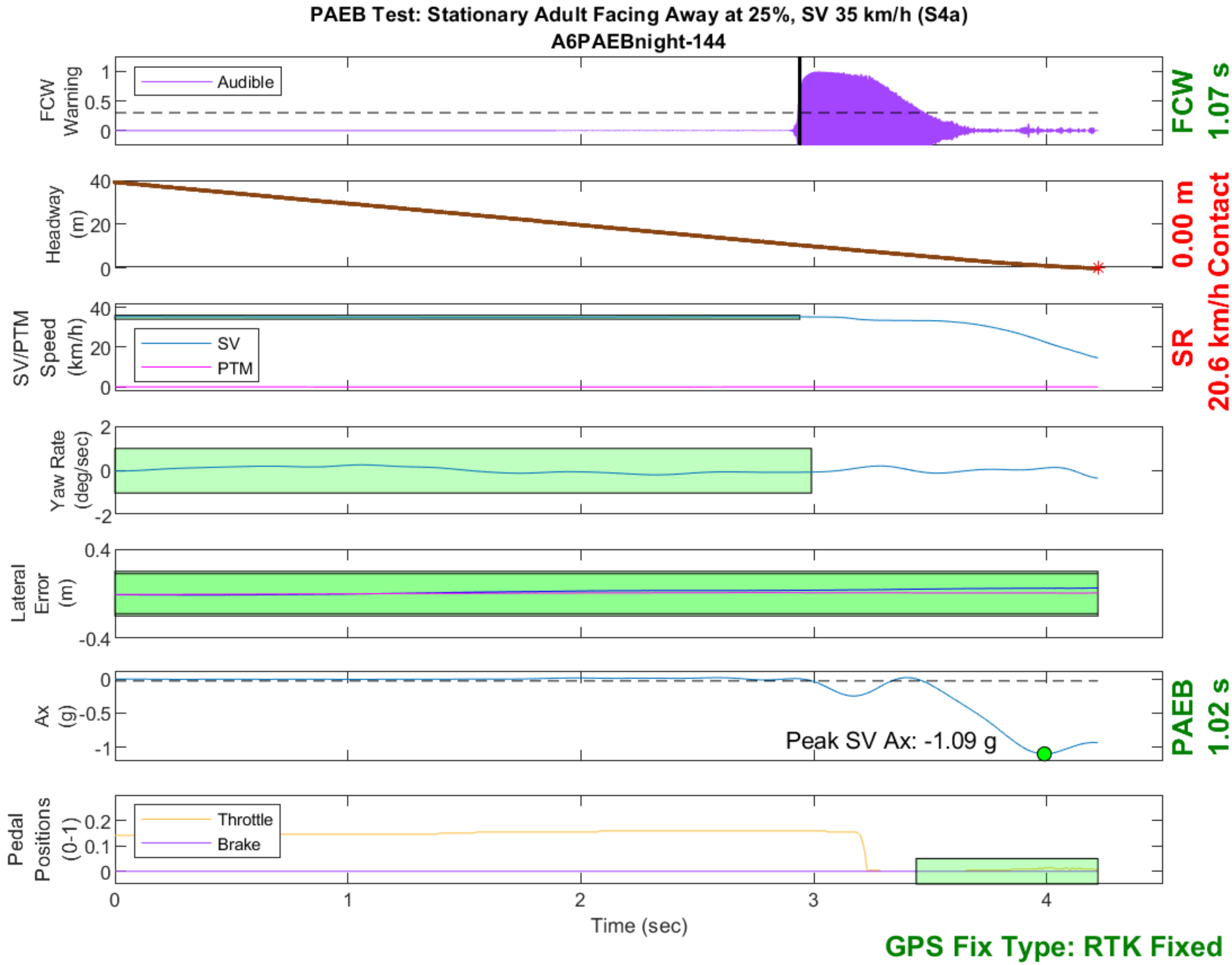


Figure D230. Time History for PAEB Run 144, S4a, Night, High Beam, 35 km/h

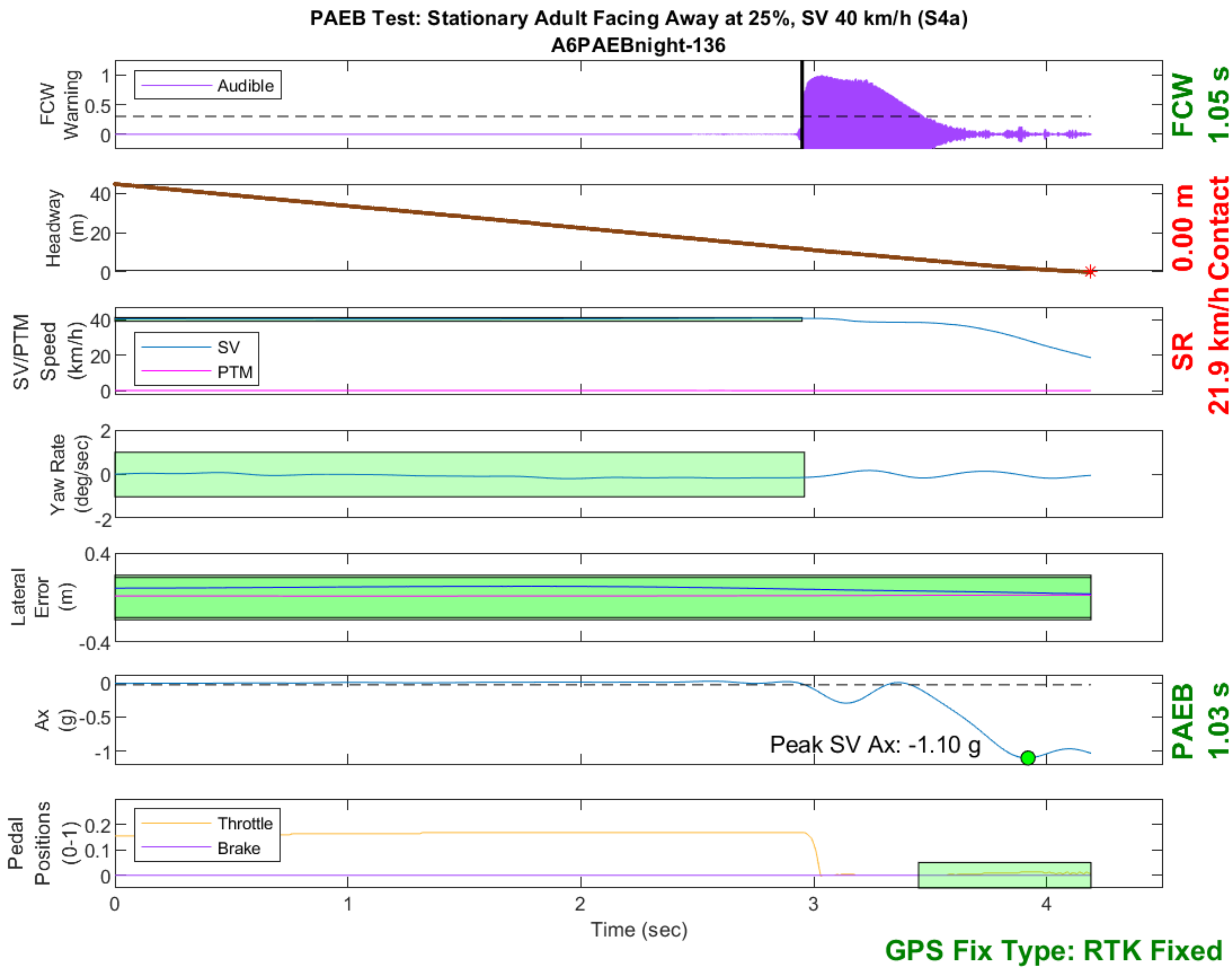


Figure D231. Time History for PAEB Run 136, S4a, Night, High Beam, 40 km/h

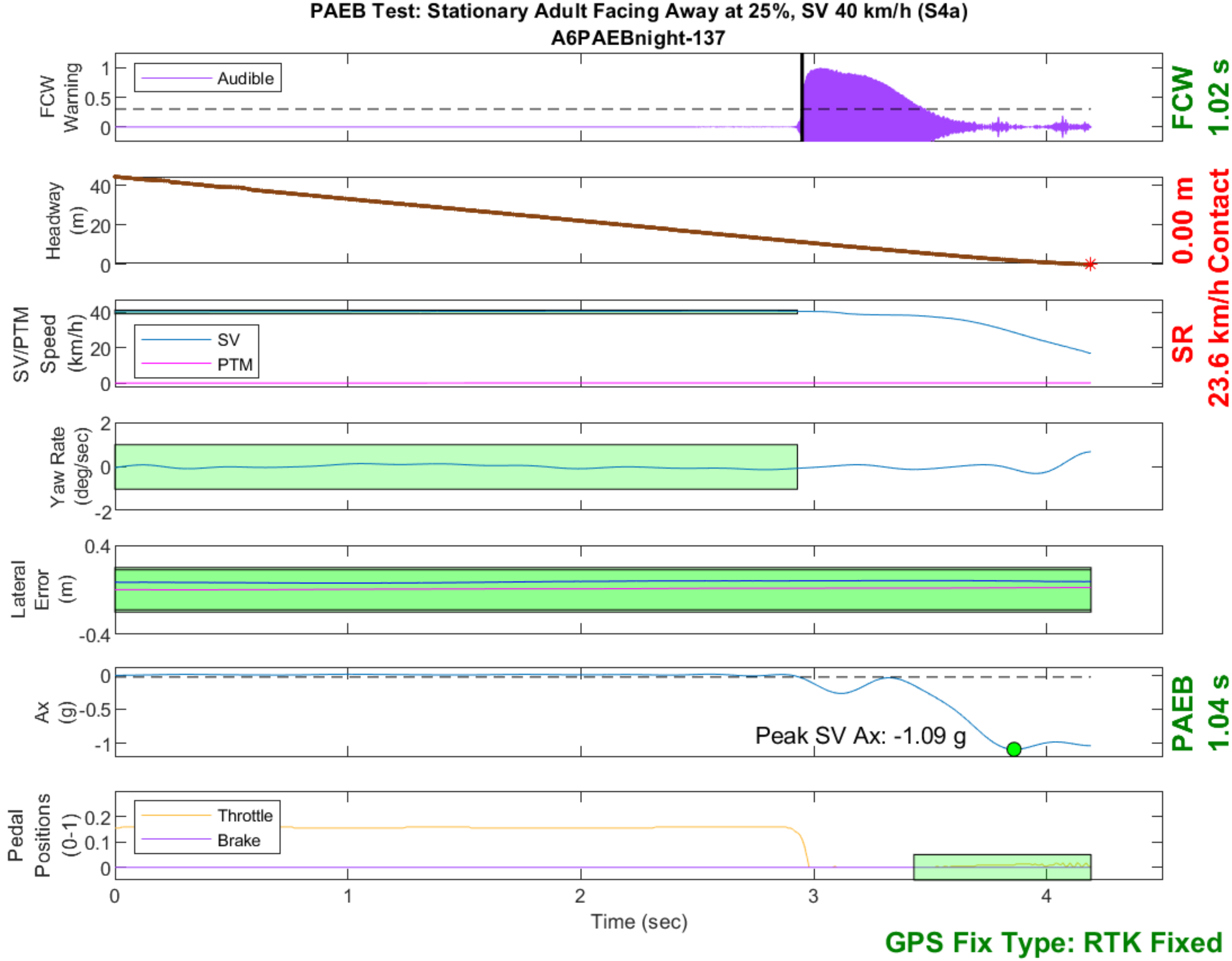


Figure D232. Time History for PAEB Run 137, S4a, Night, High Beam, 40 km/h

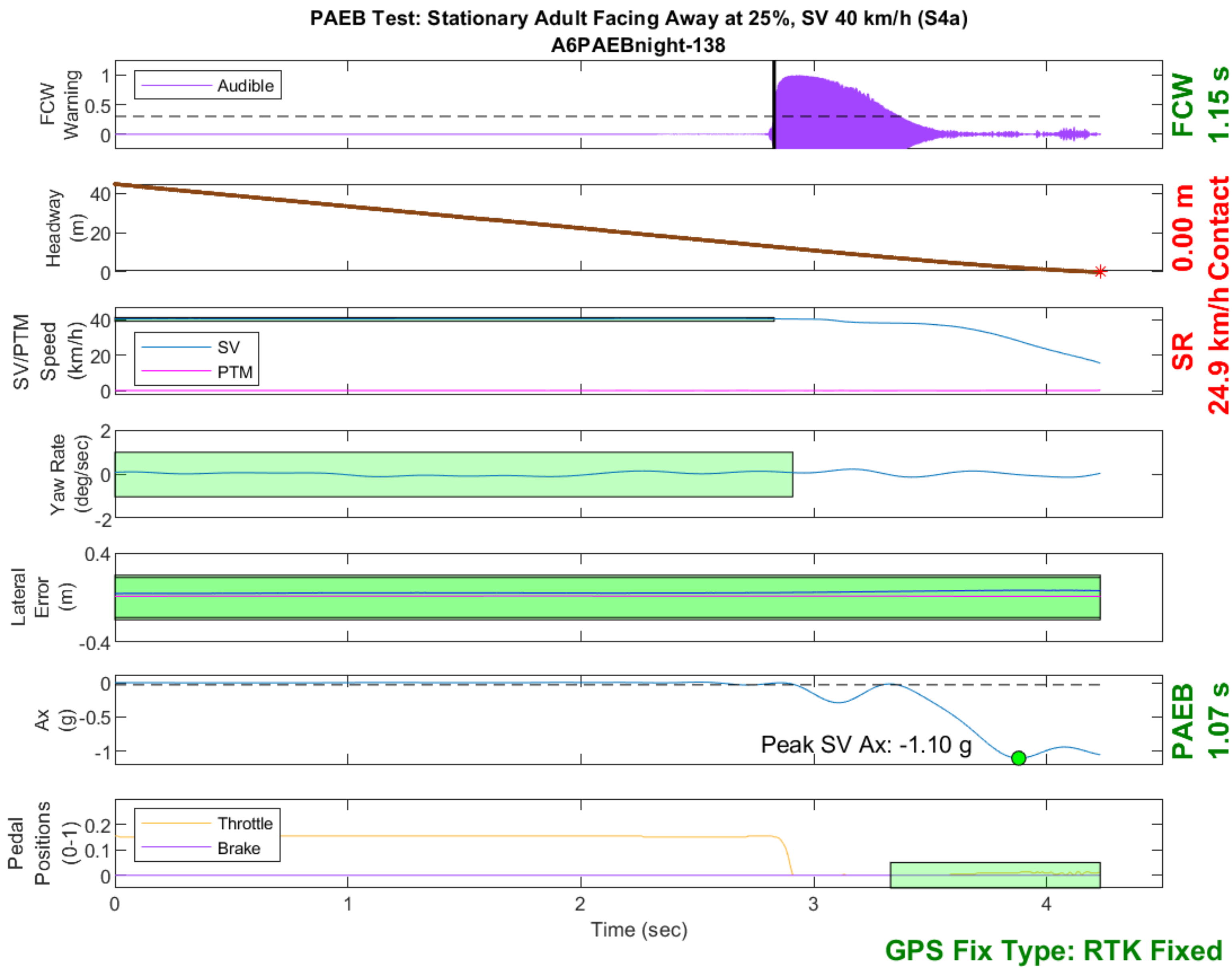


Figure D233. Time History for PAEB Run 138, S4a, Night, High Beam, 40 km/h

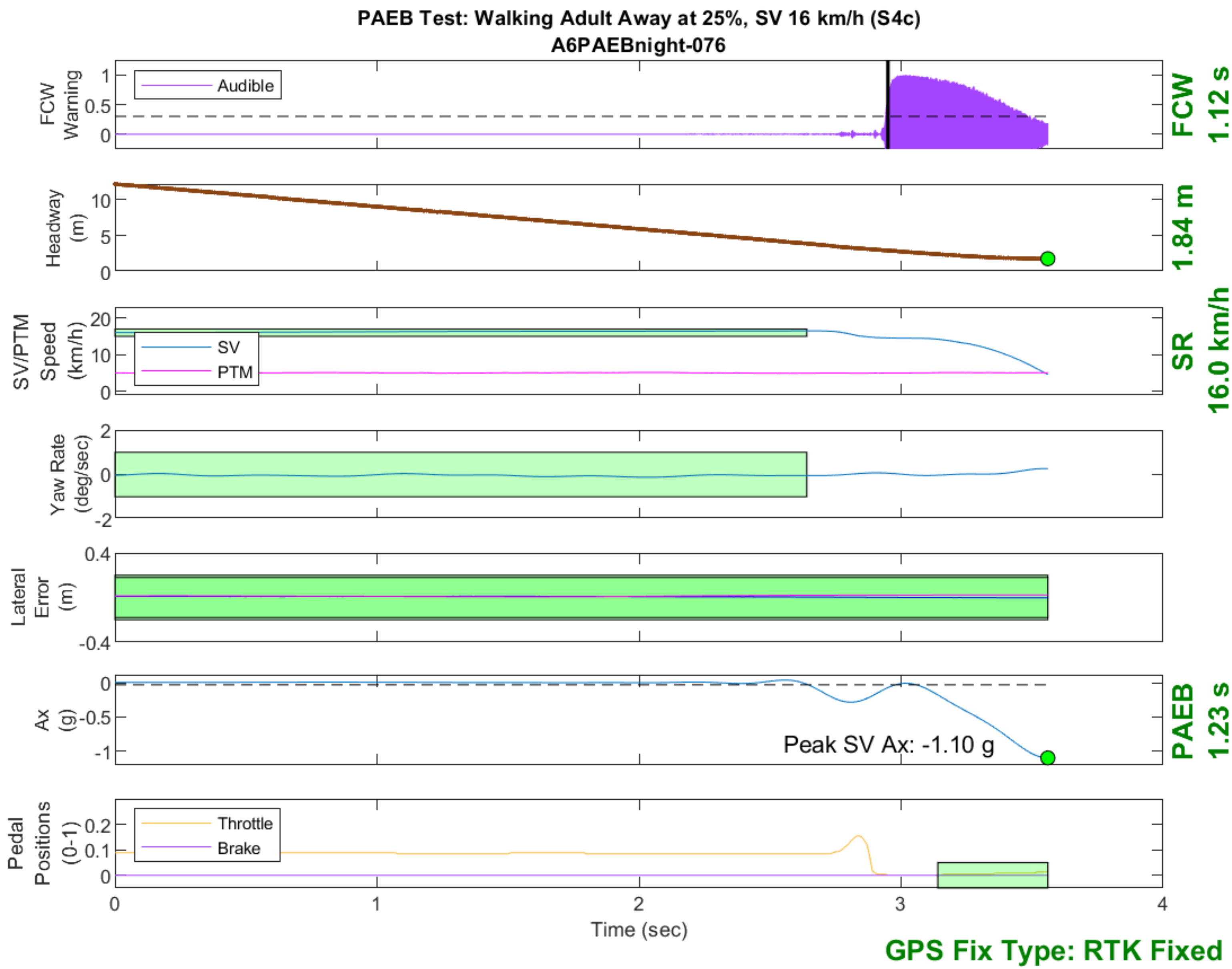


Figure D234. Time History for PAEB Run 76, S4c, Night, High Beam, 16 km/h

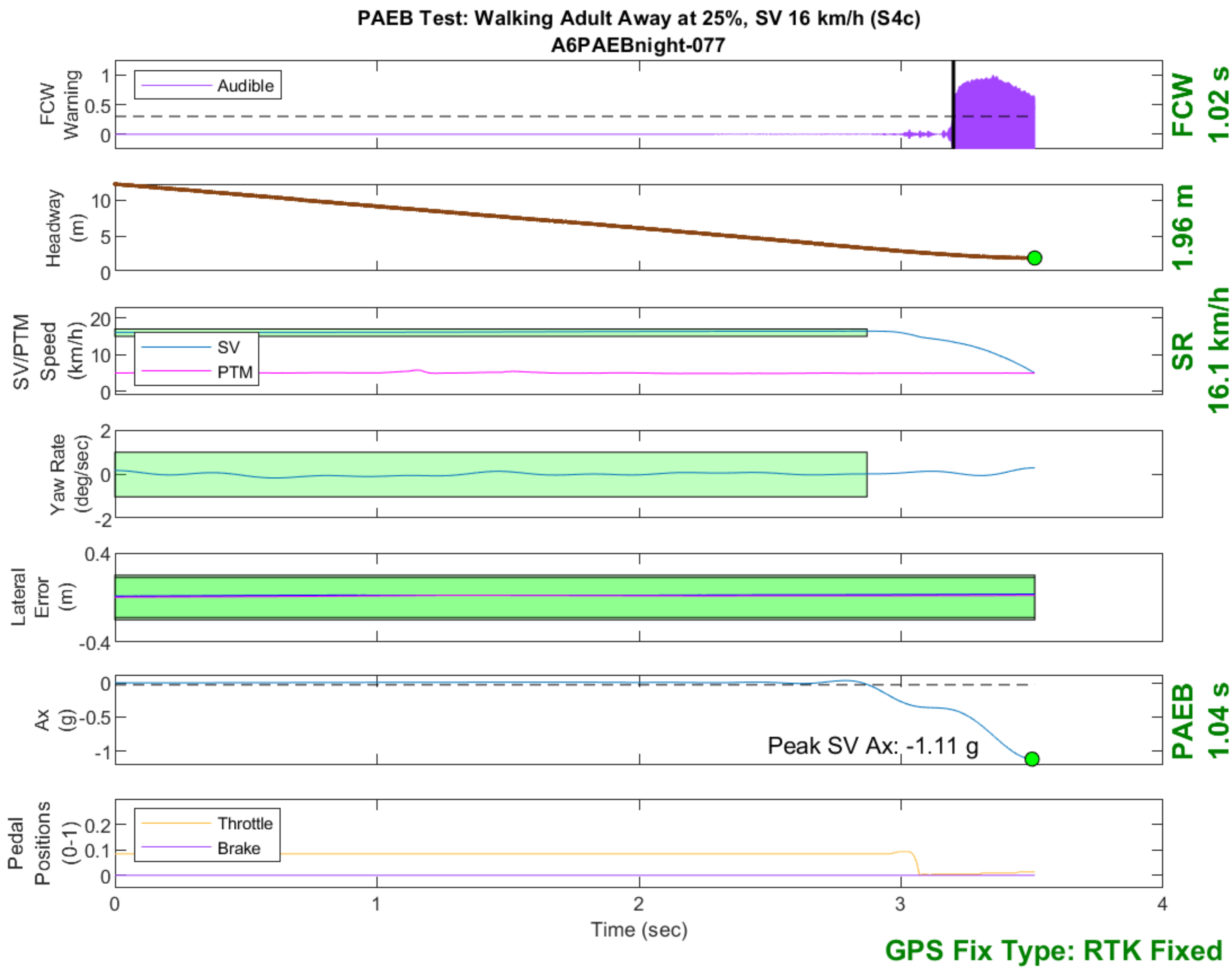


Figure D235. Time History for PAEB Run 77, S4c, Night, High Beam, 16 km/h

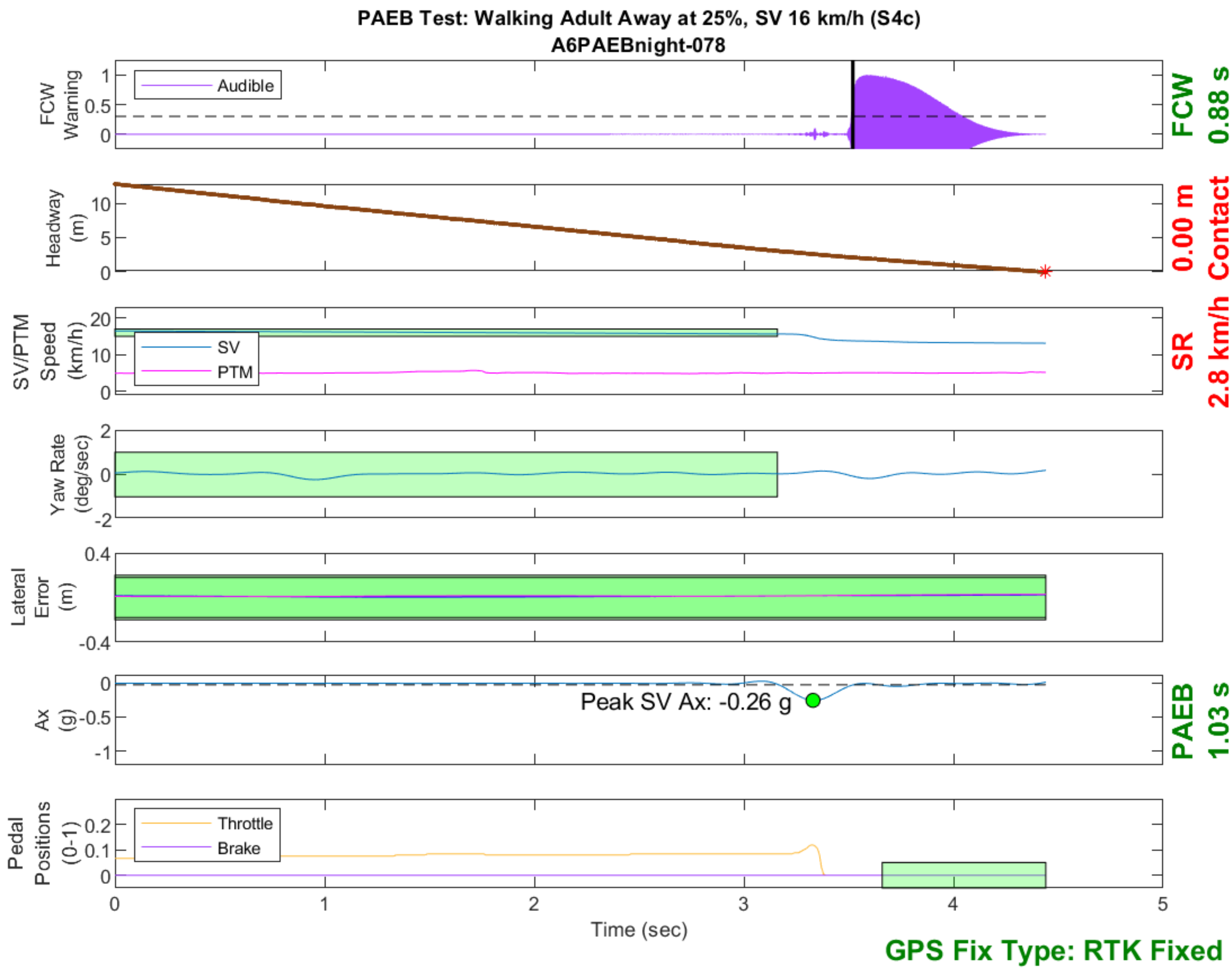


Figure D236. Time History for PAEB Run 78, S4c, Night, High Beam, 16 km/h

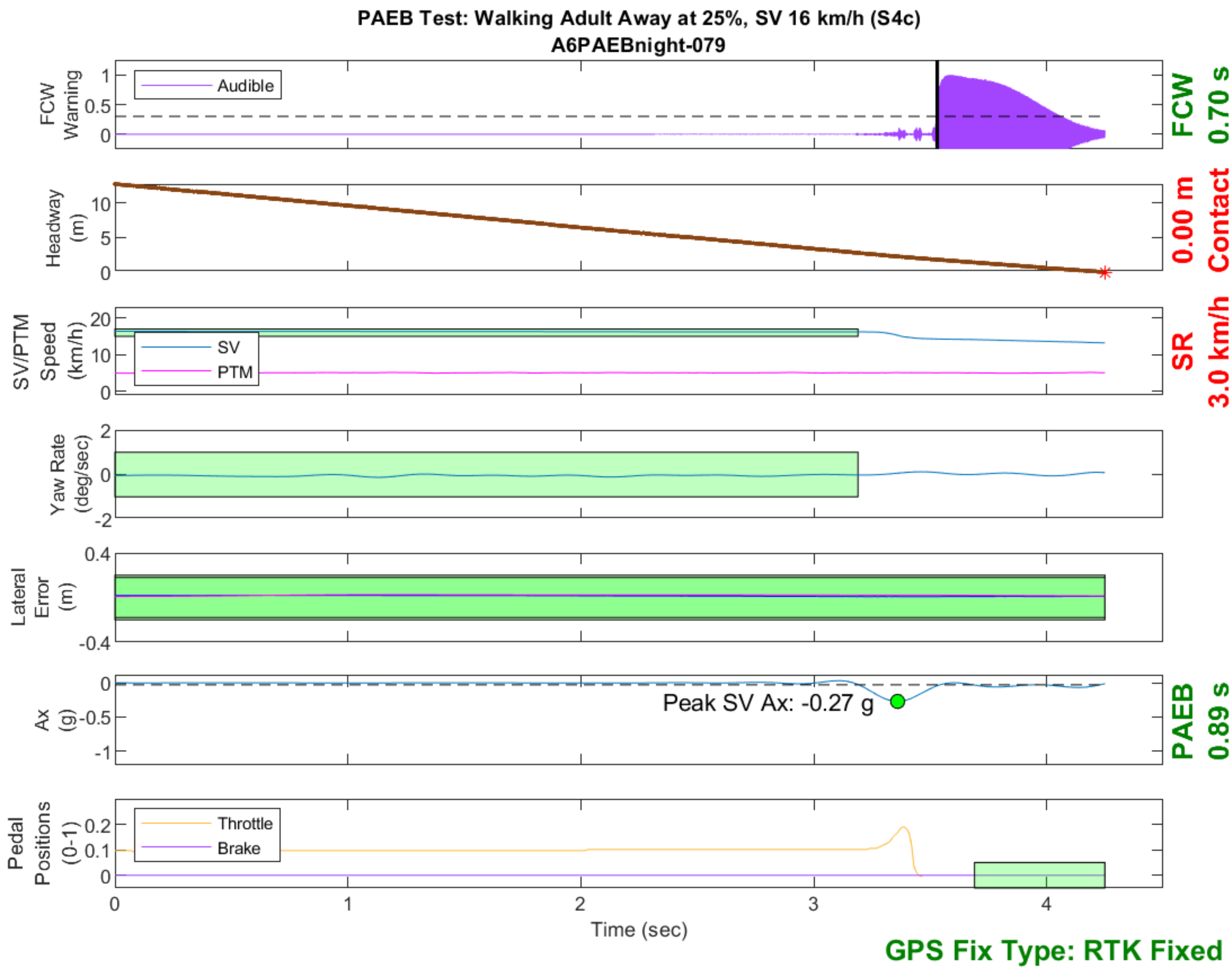


Figure D237. Time History for PAEB Run 79, S4c, Night, High Beam, 16 km/h

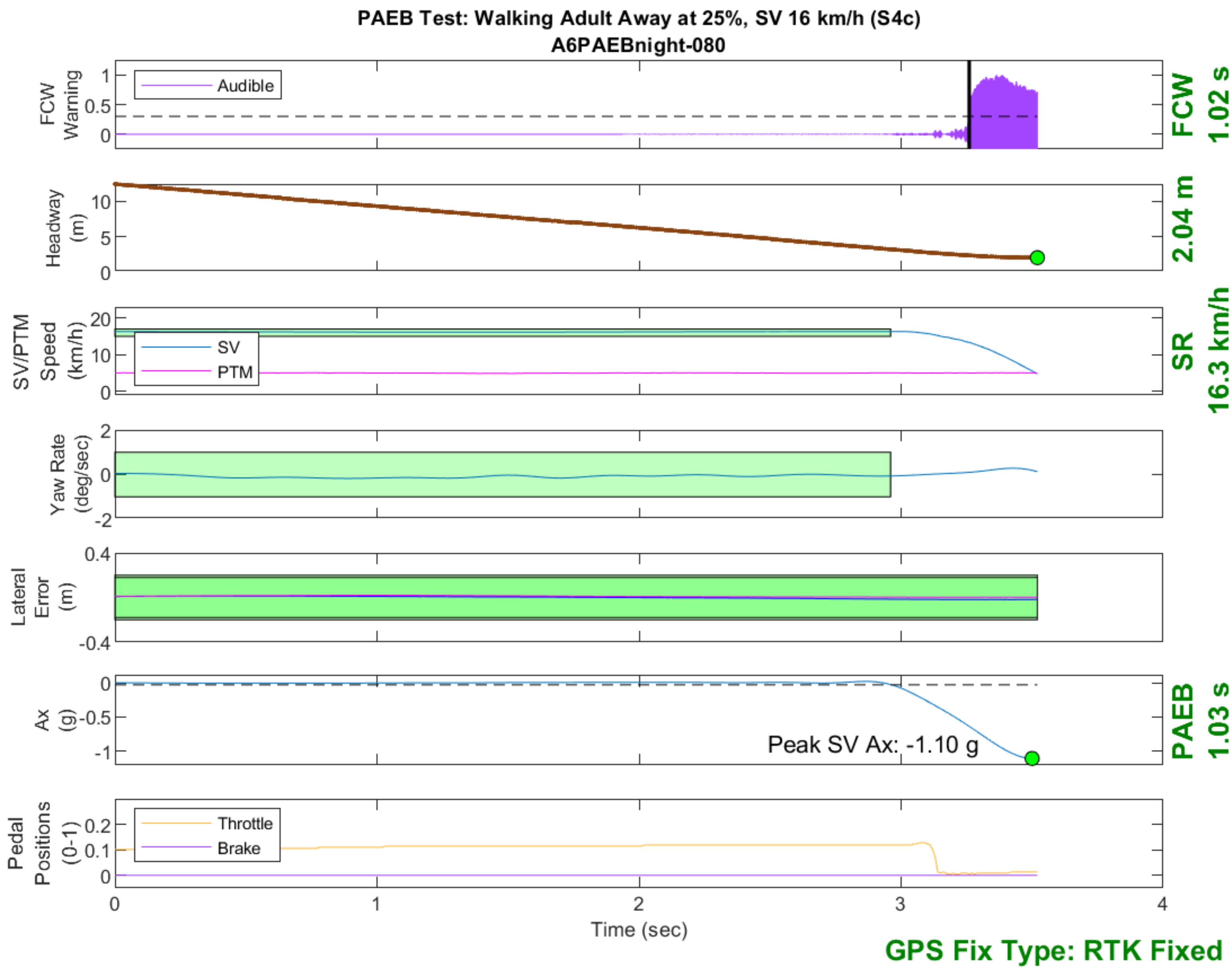


Figure D238. Time History for PAEB Run 80, S4c, Night, High Beam, 16 km/h

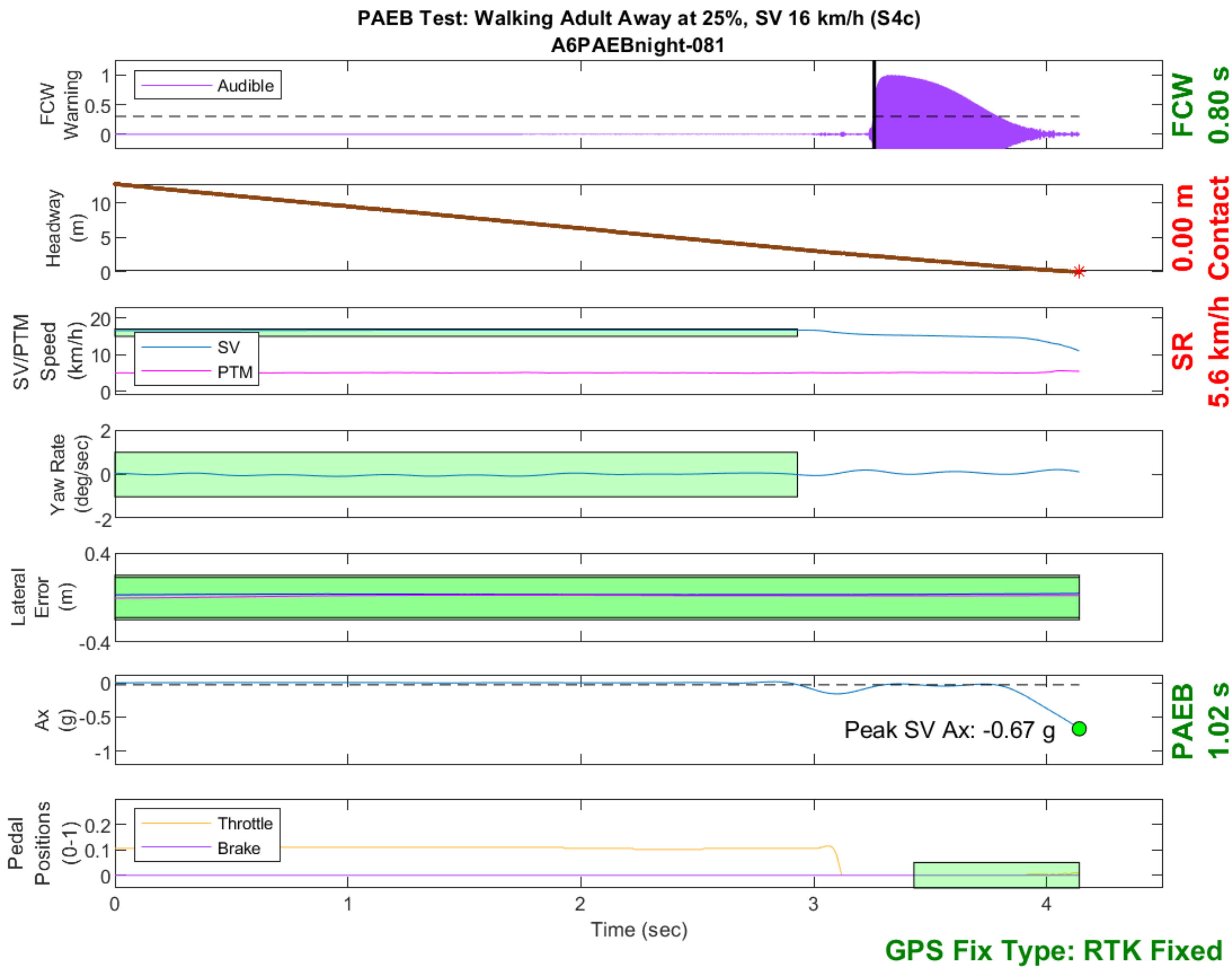


Figure D239. Time History for PAEB Run 81, S4c, Night, High Beam, 16 km/h

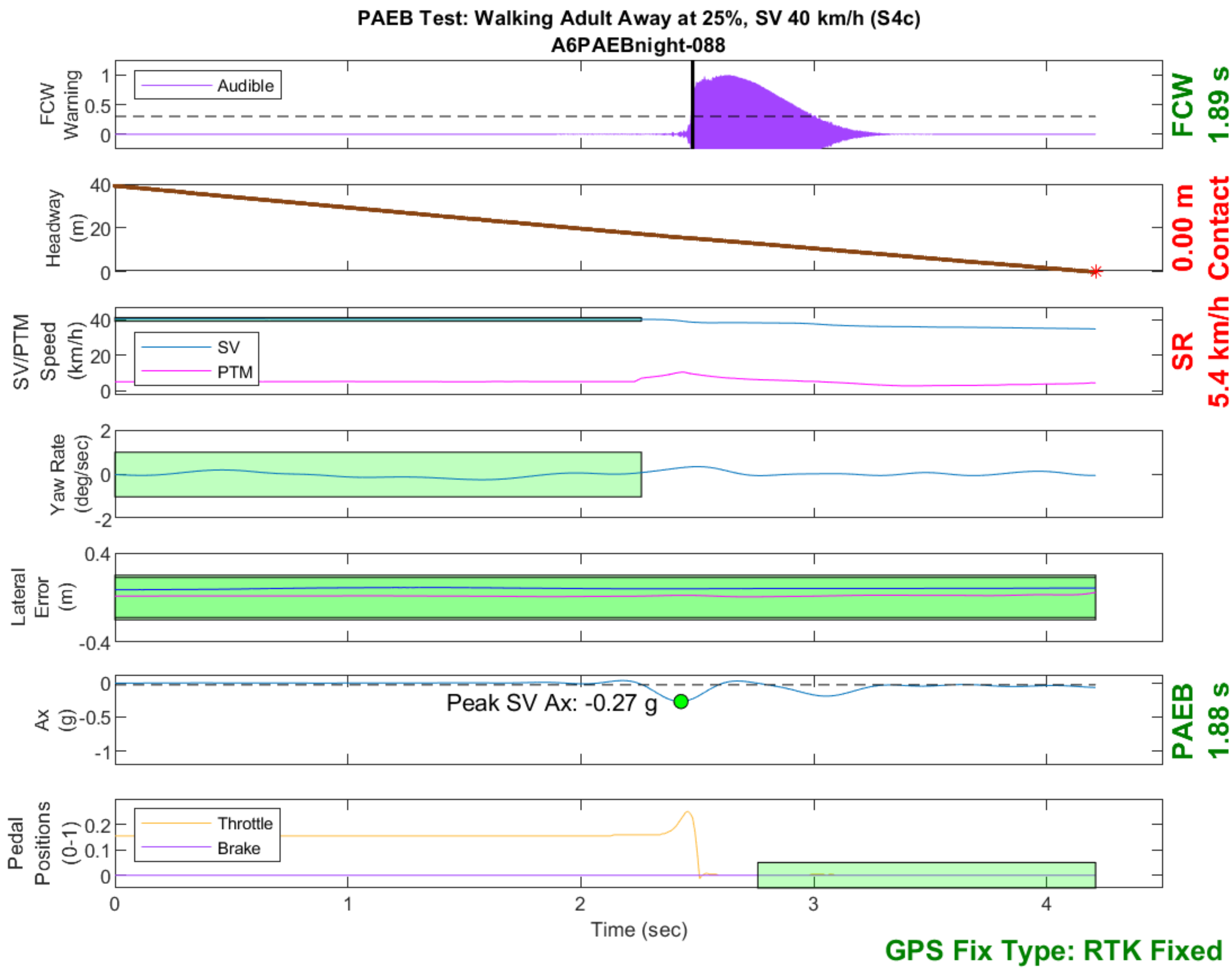


Figure D240. Time History for PAEB Run 88, S4c, Night, High Beam, 40 km/h

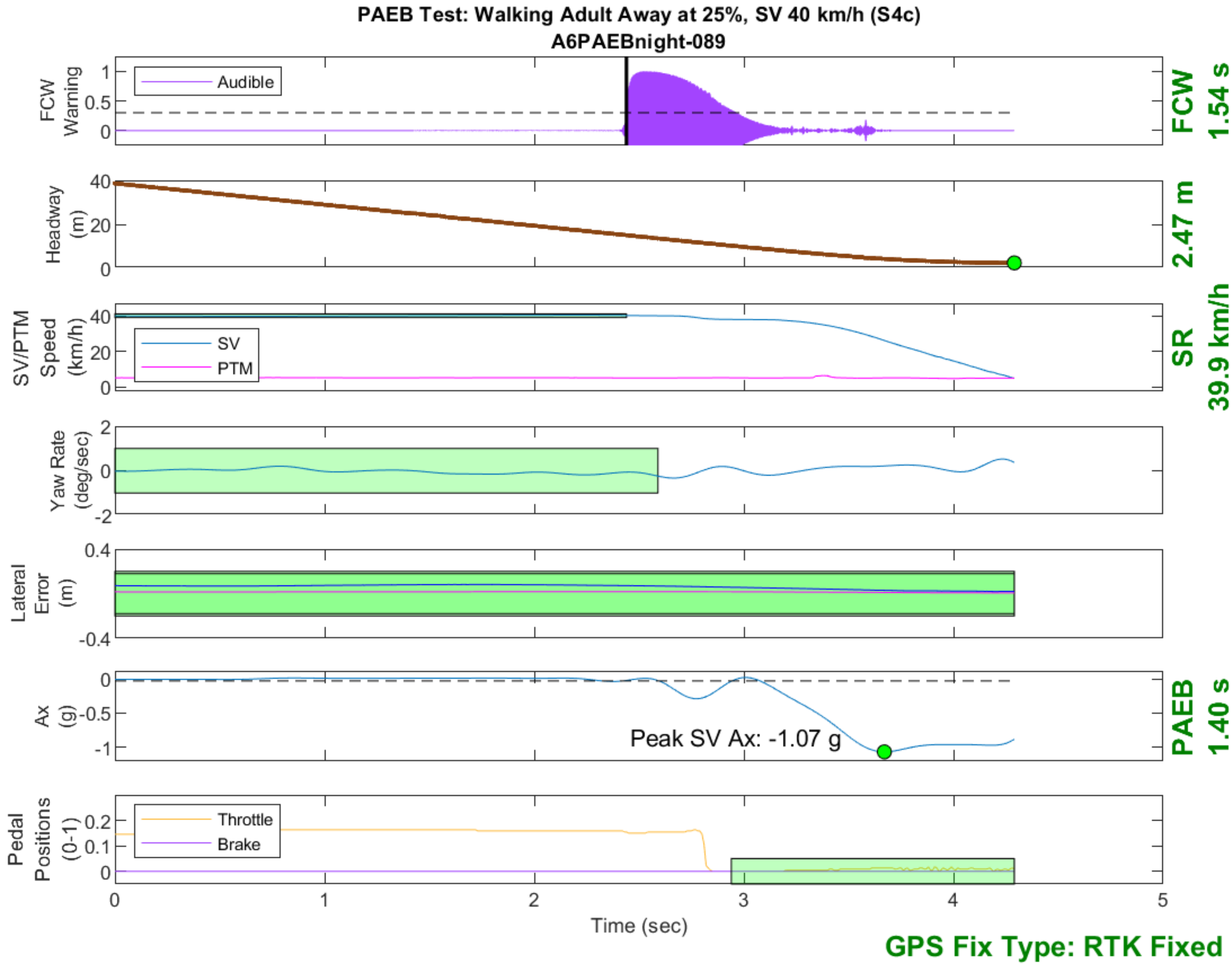


Figure D241. Time History for PAEB Run 89, S4c, Night, High Beam, 40 km/h

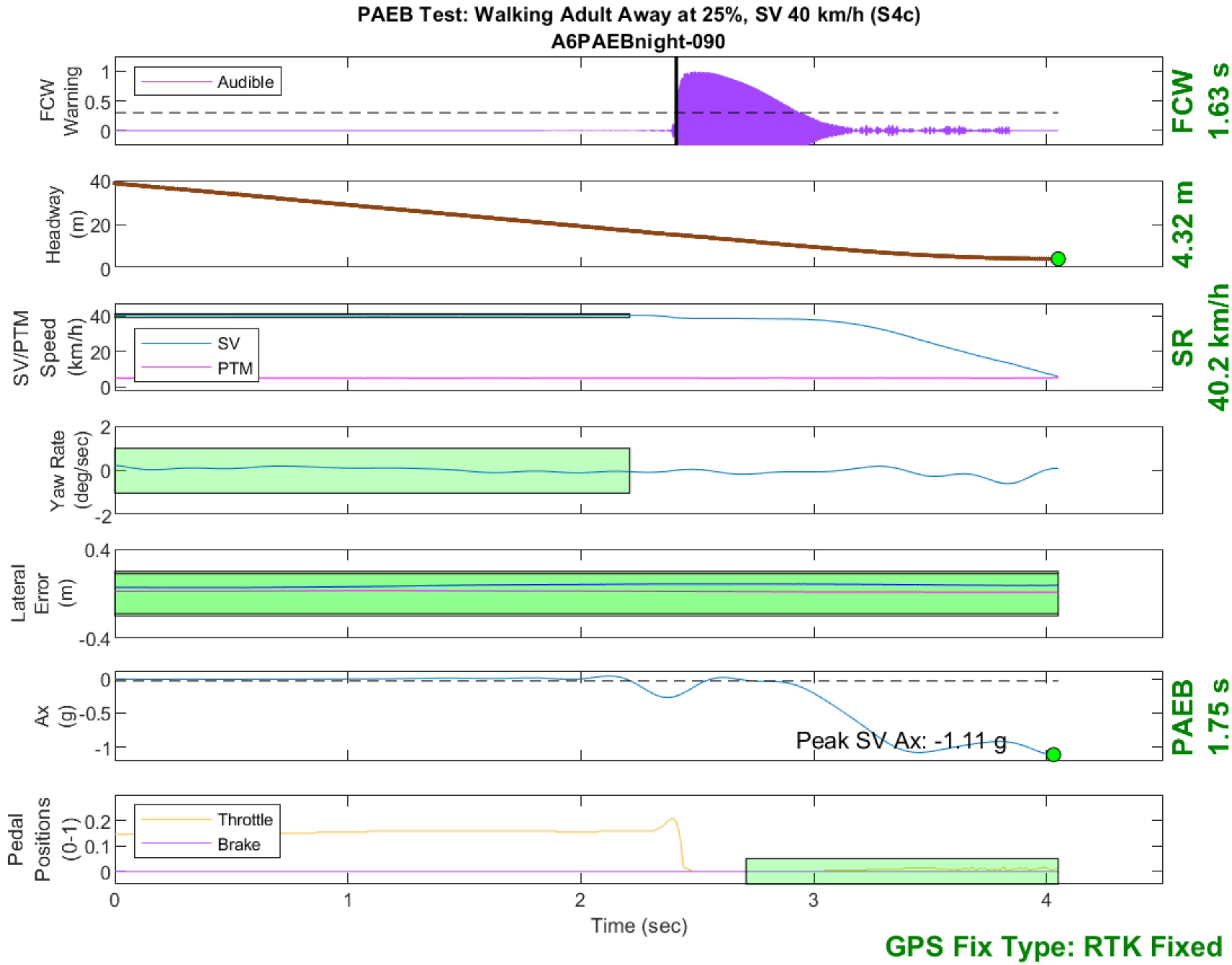


Figure D242. Time History for PAEB Run 90, S4c, Night, High Beam, 40 km/h

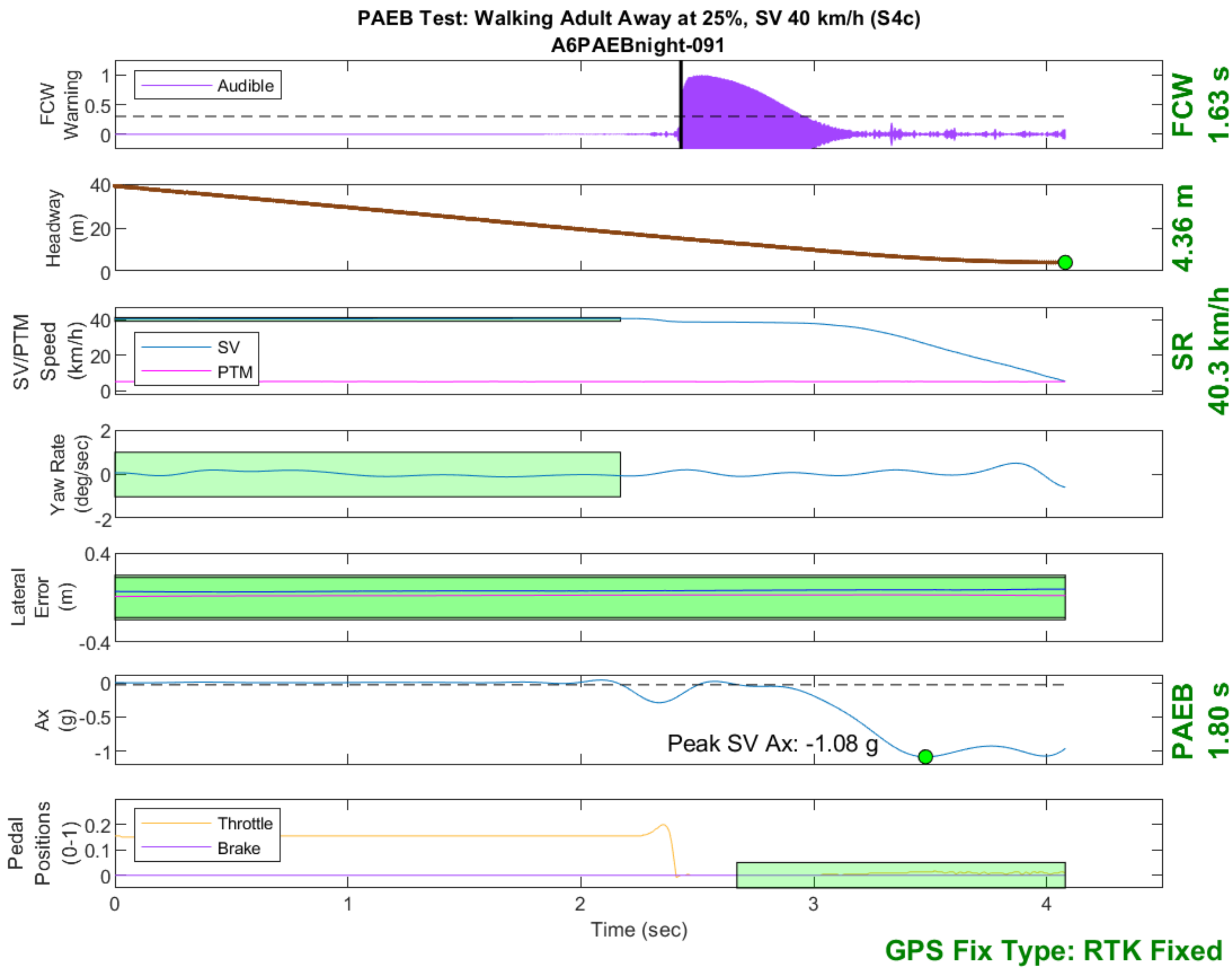


Figure D243. Time History for PAEB Run 91, S4c, Night, High Beam, 40 km/h

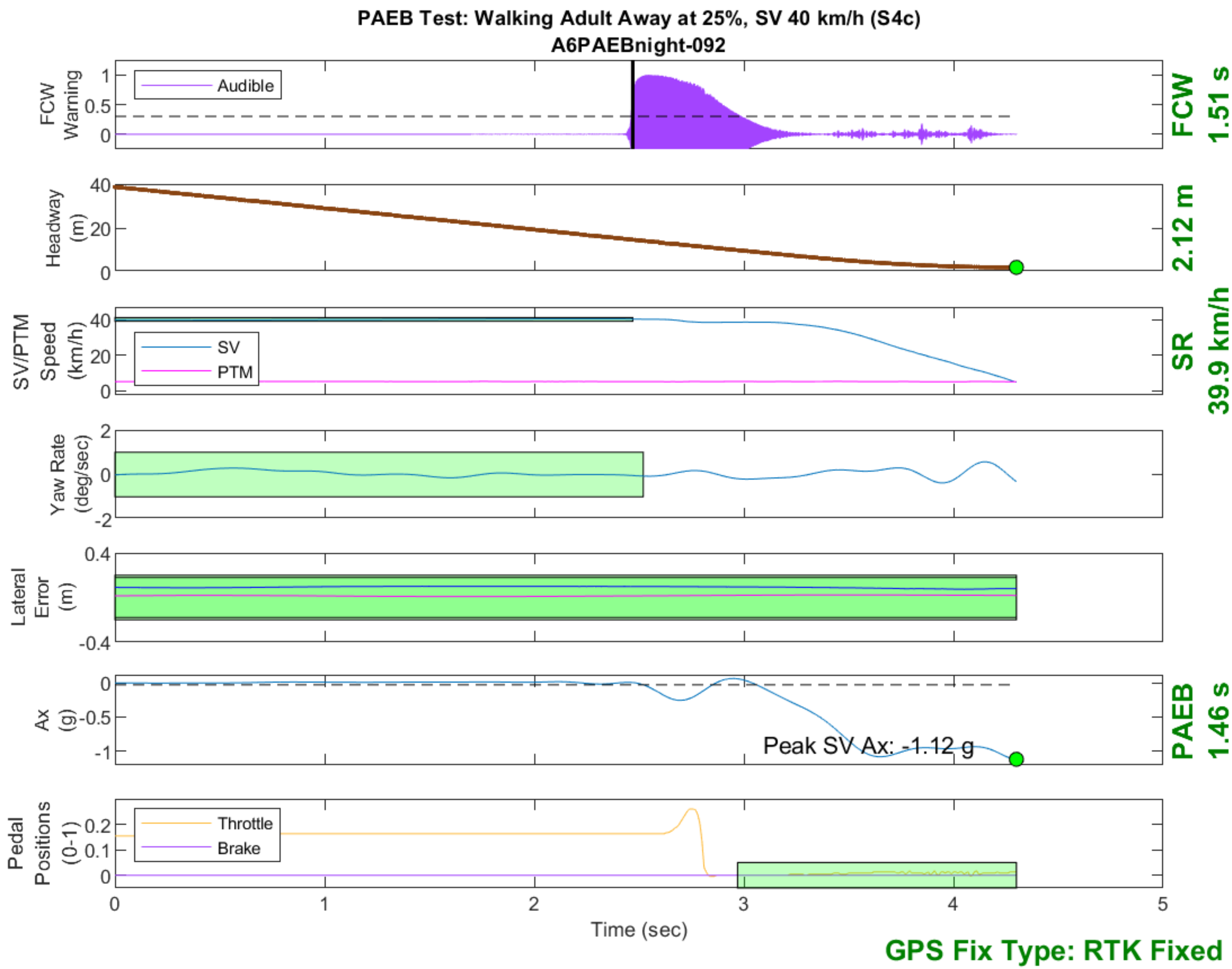


Figure D244. Time History for PAEB Run 92, S4c, Night, High Beam, 40 km/h

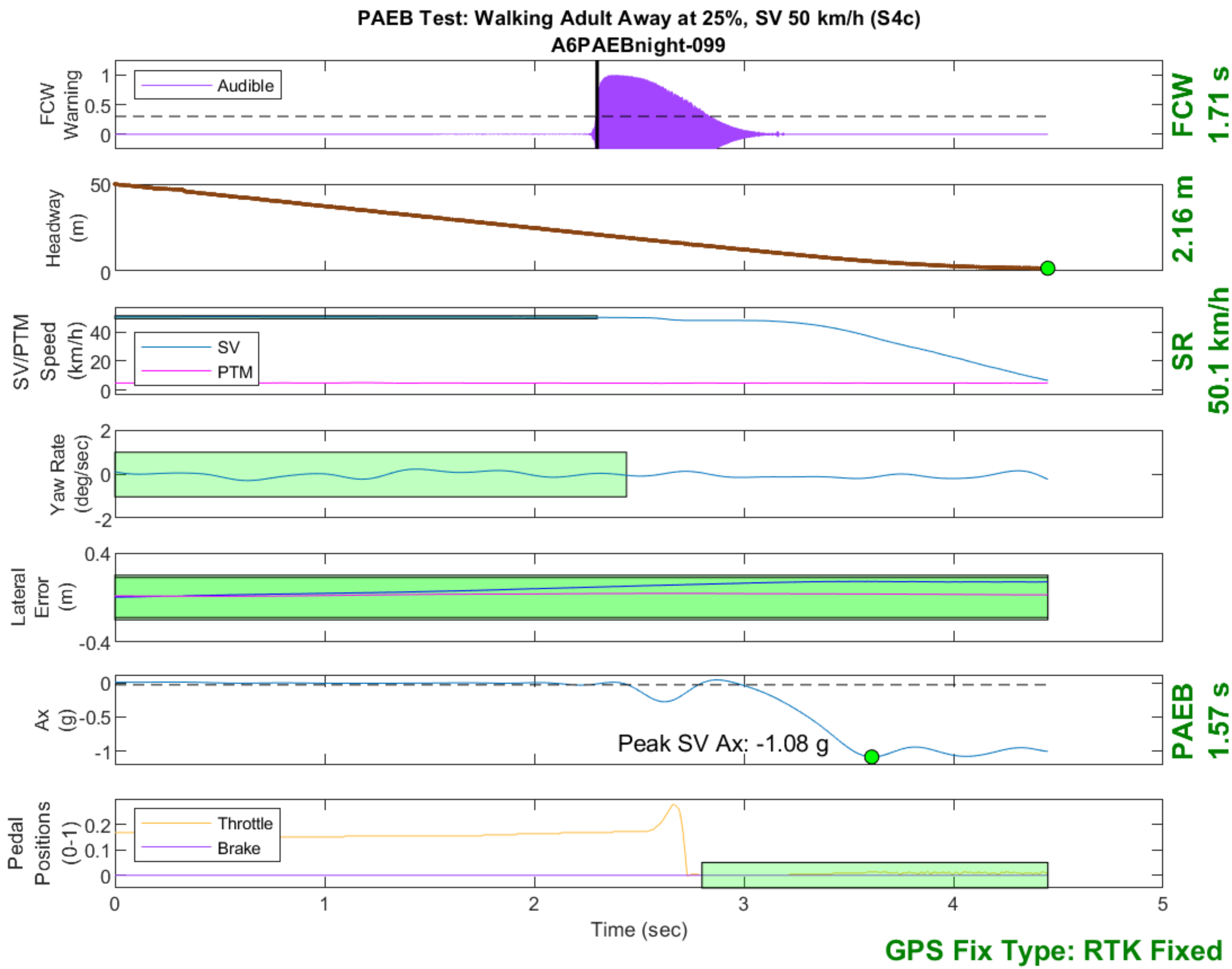


Figure D245. Time History for PAEB Run 99, S4c, Night, High Beam, 50 km/h

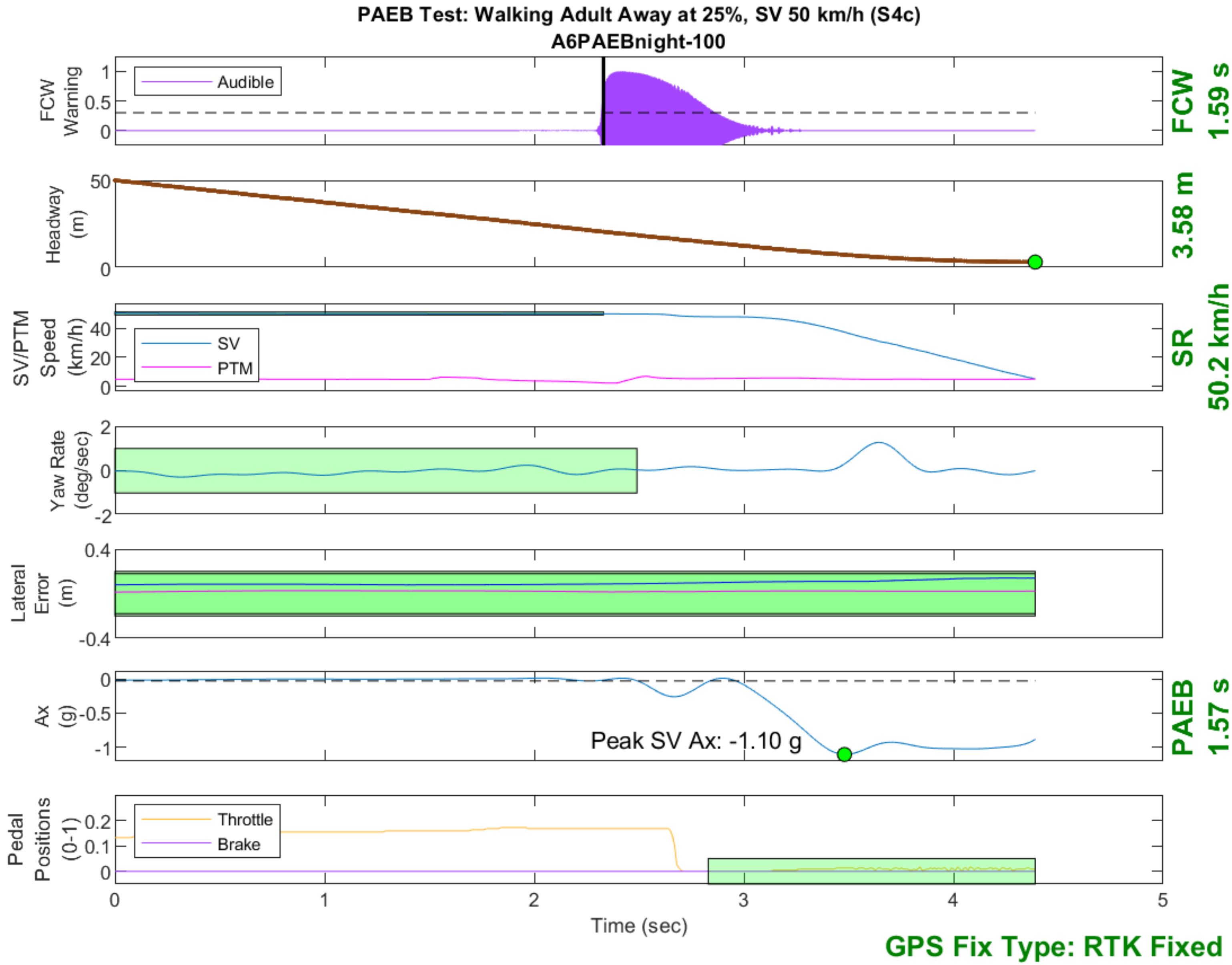


Figure D246. Time History for PAEB Run 100, S4c, Night, High Beam, 50 km/h

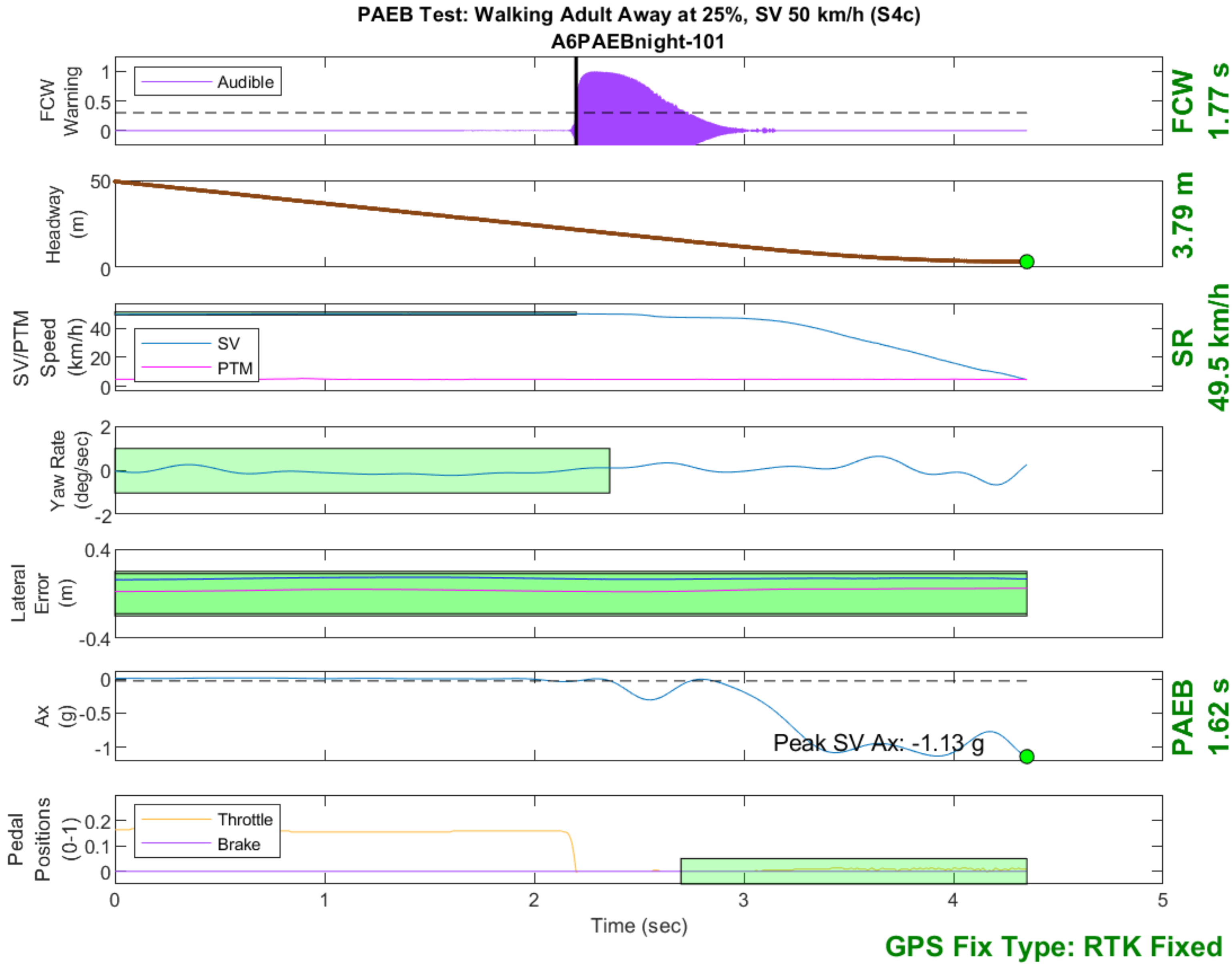


Figure D247. Time History for PAEB Run 101, S4c, Night, High Beam, 50 km/h

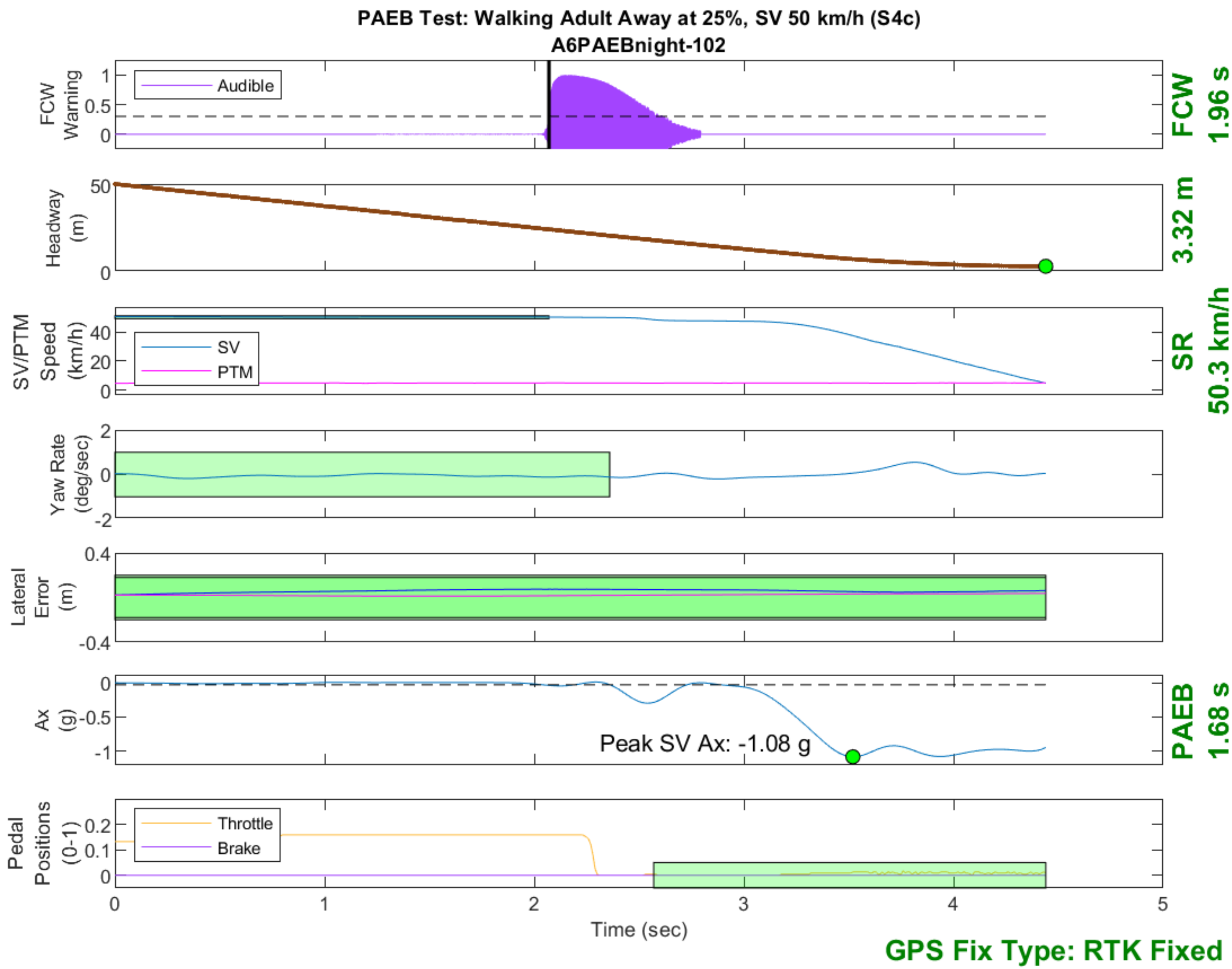


Figure D248. Time History for PAEB Run 102, S4c, Night, High Beam, 50 km/h

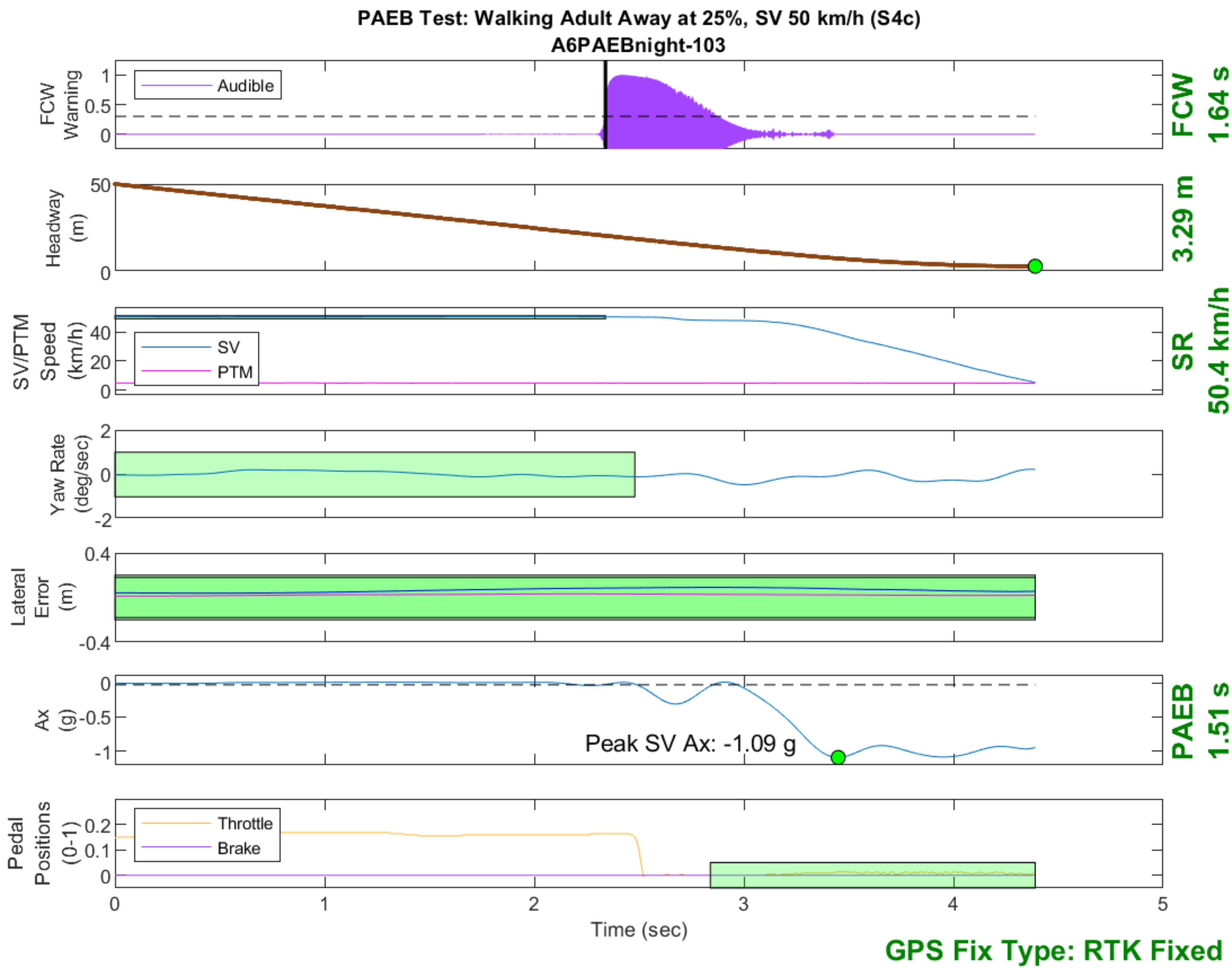


Figure D249. Time History for PAEB Run 103, S4c, Night, High Beam, 50 km/h

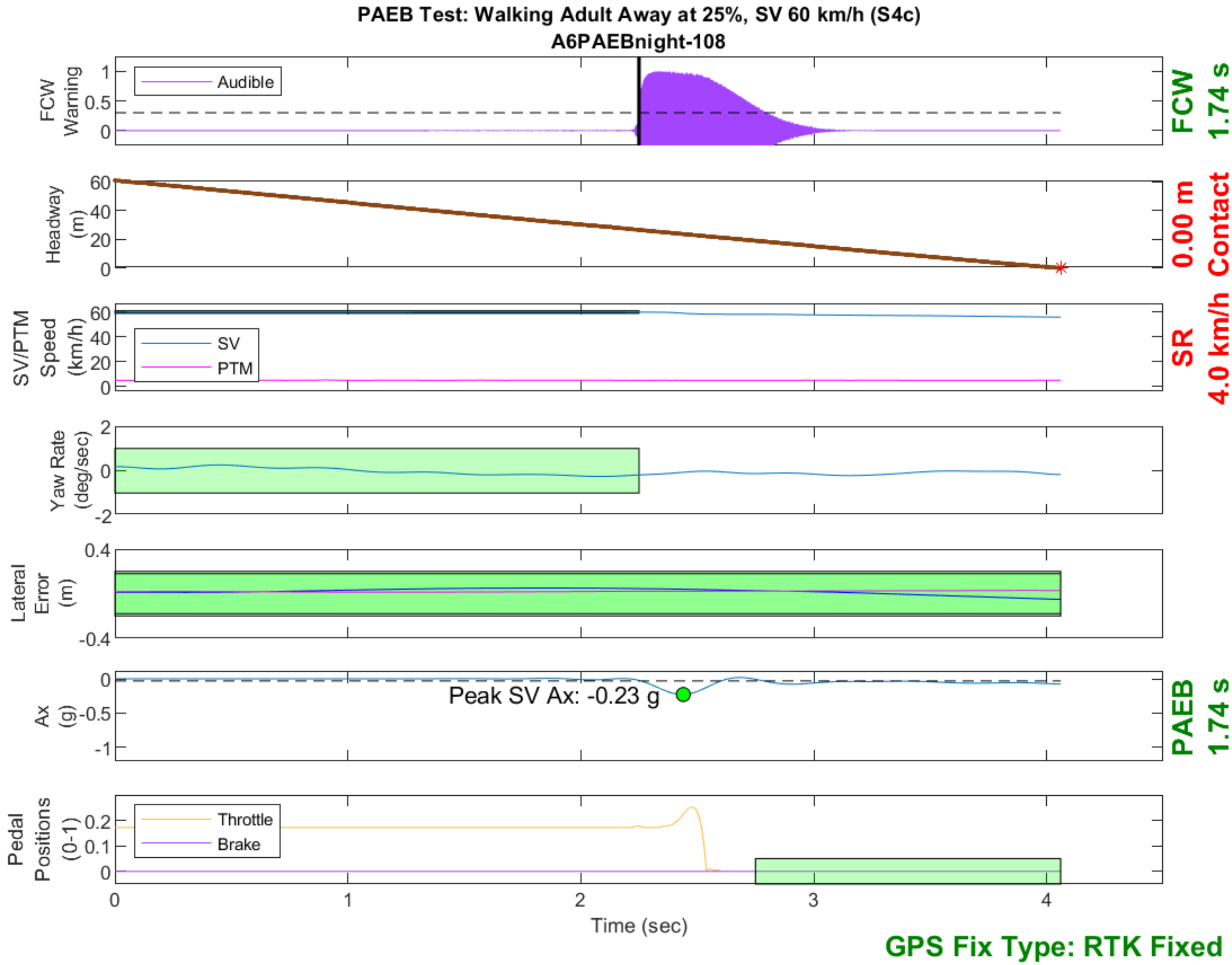


Figure D250. Time History for PAEB Run 108, S4c, Night, High Beam, 60 km/h

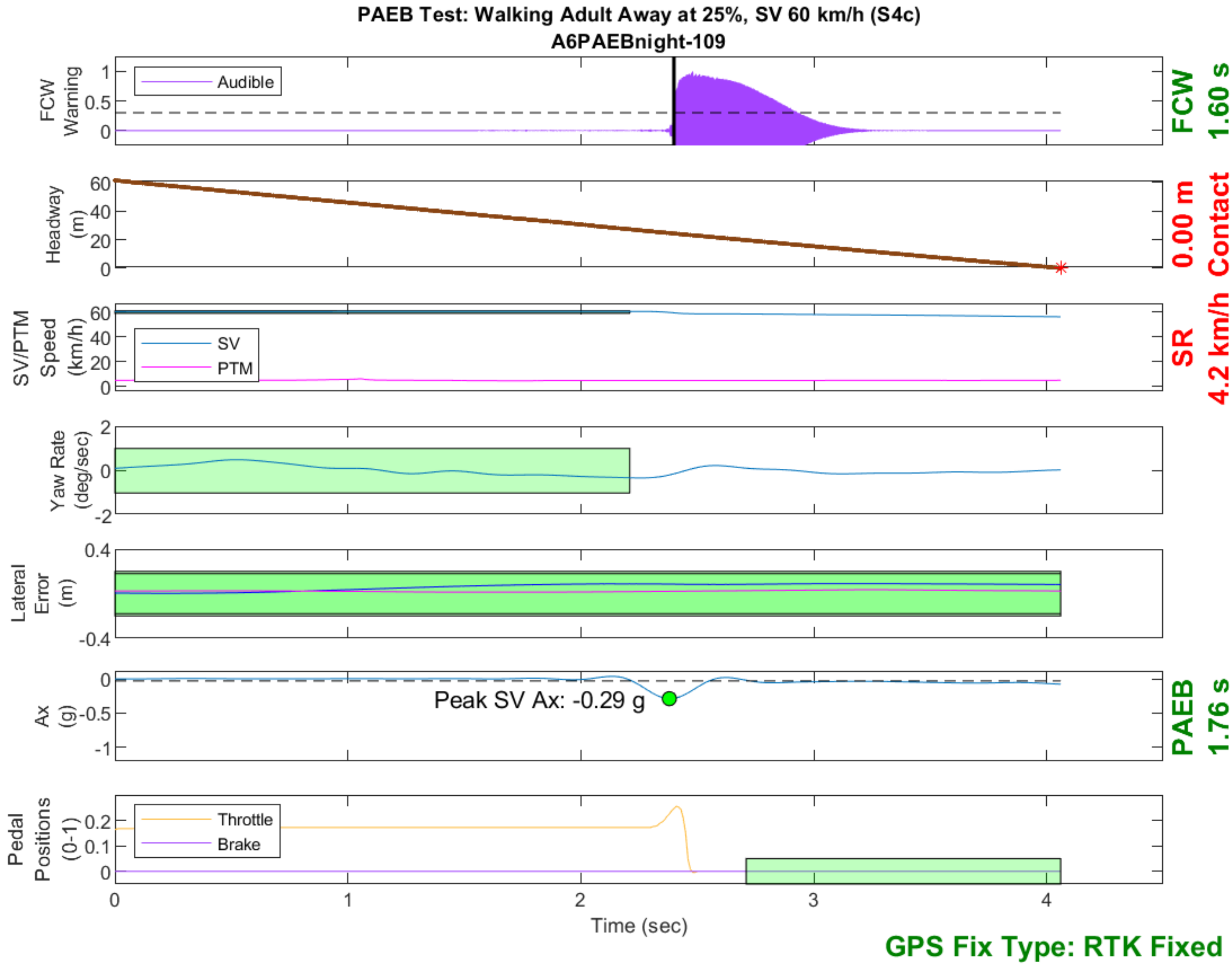


Figure D251. Time History for PAEB Run 109, S4c, Night, High Beam, 60 km/h

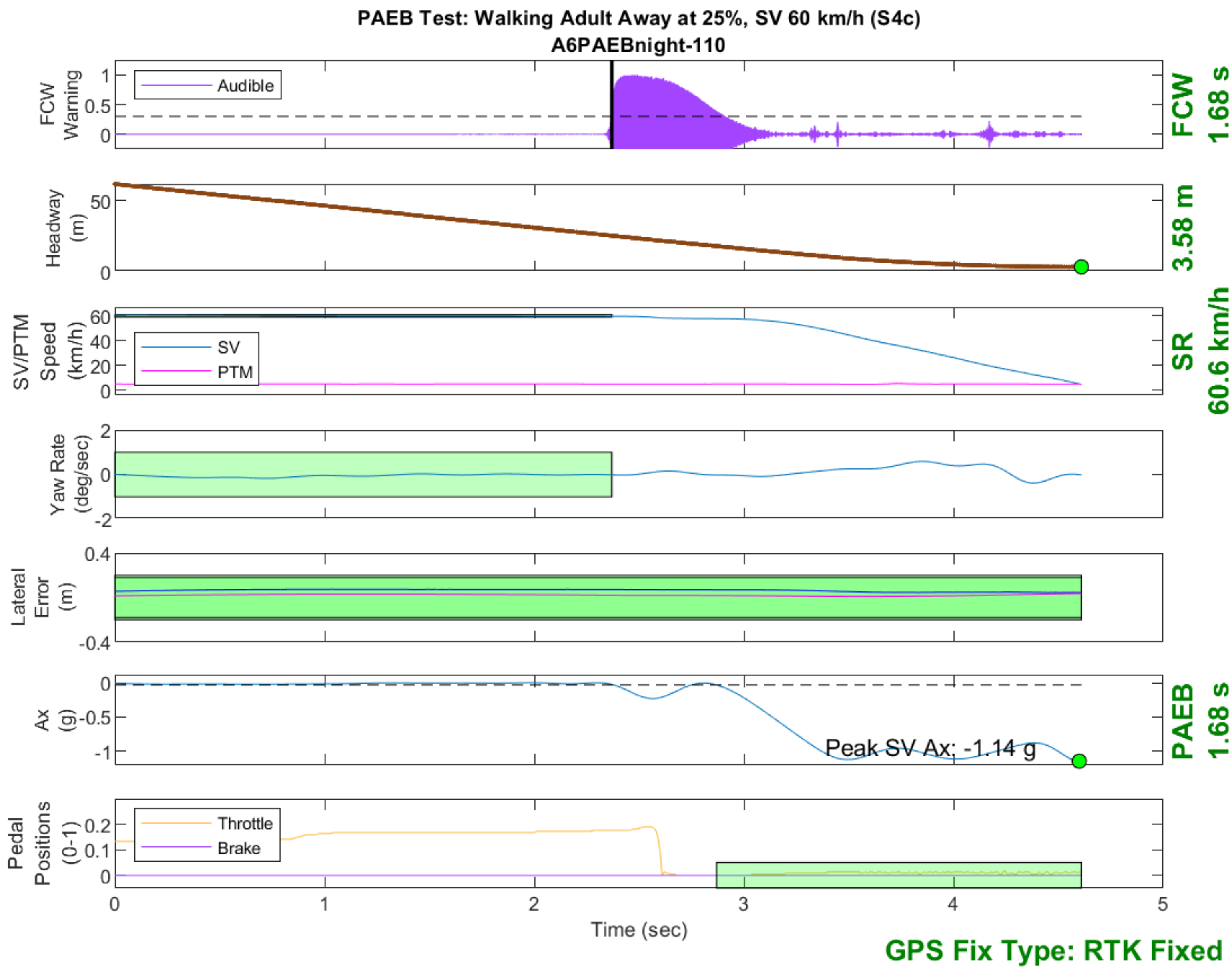


Figure D252. Time History for PAEB Run 110, S4c, Night, High Beam, 60 km/h

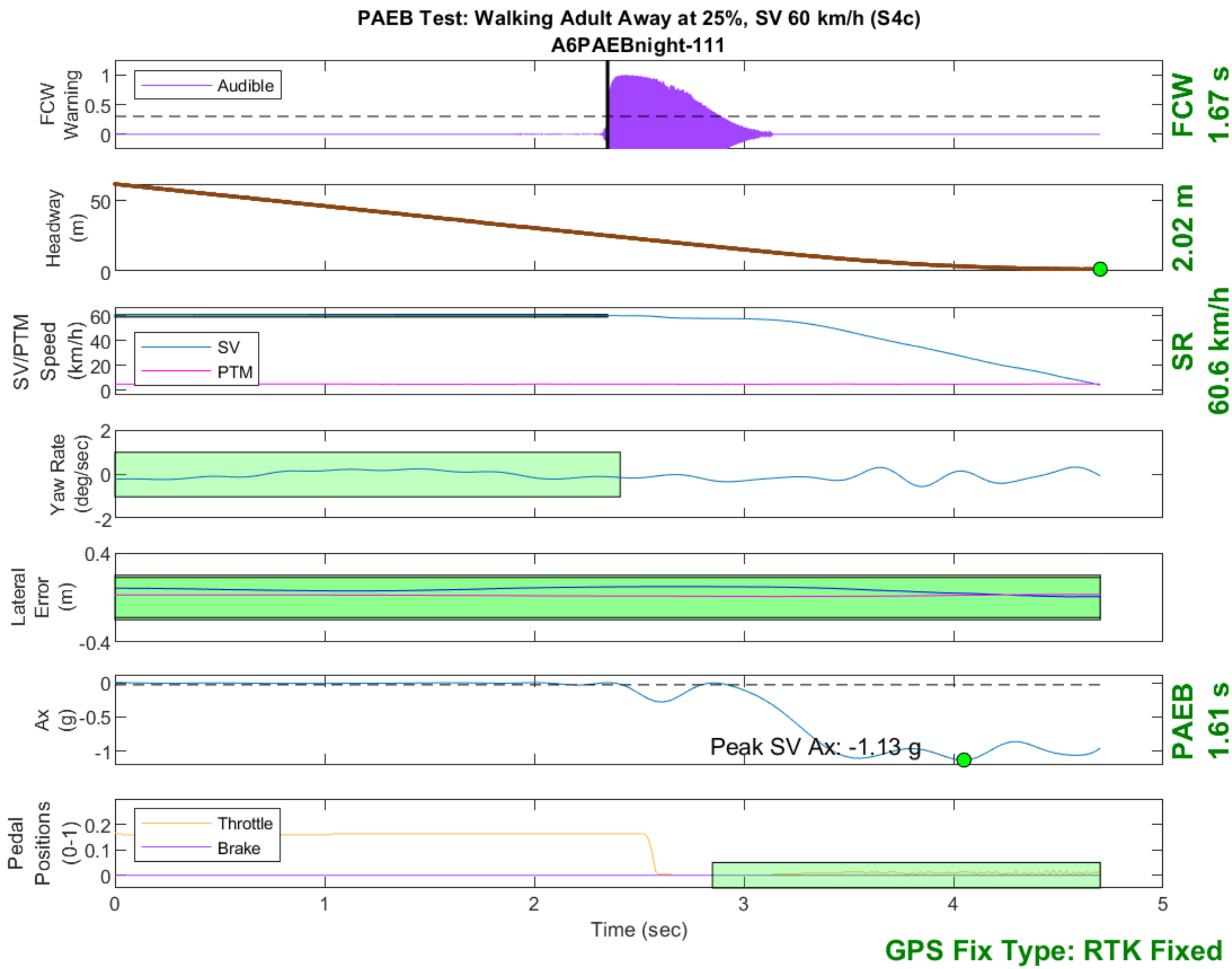


Figure D253. Time History for PAEB Run 111, S4c, Night, High Beam, 60 km/h

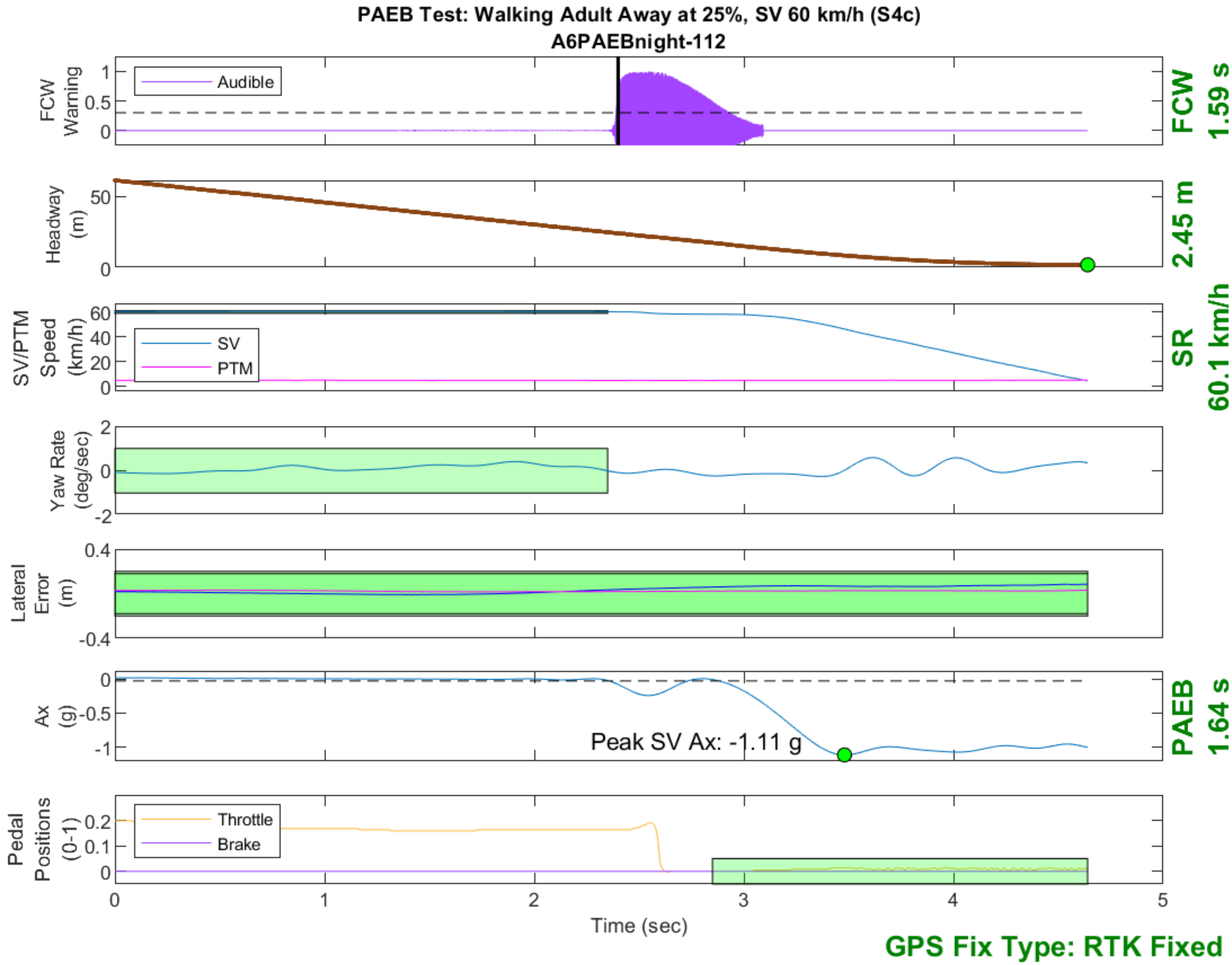


Figure D254. Time History for PAEB Run 112, S4c, Night, High Beam, 60 km/h

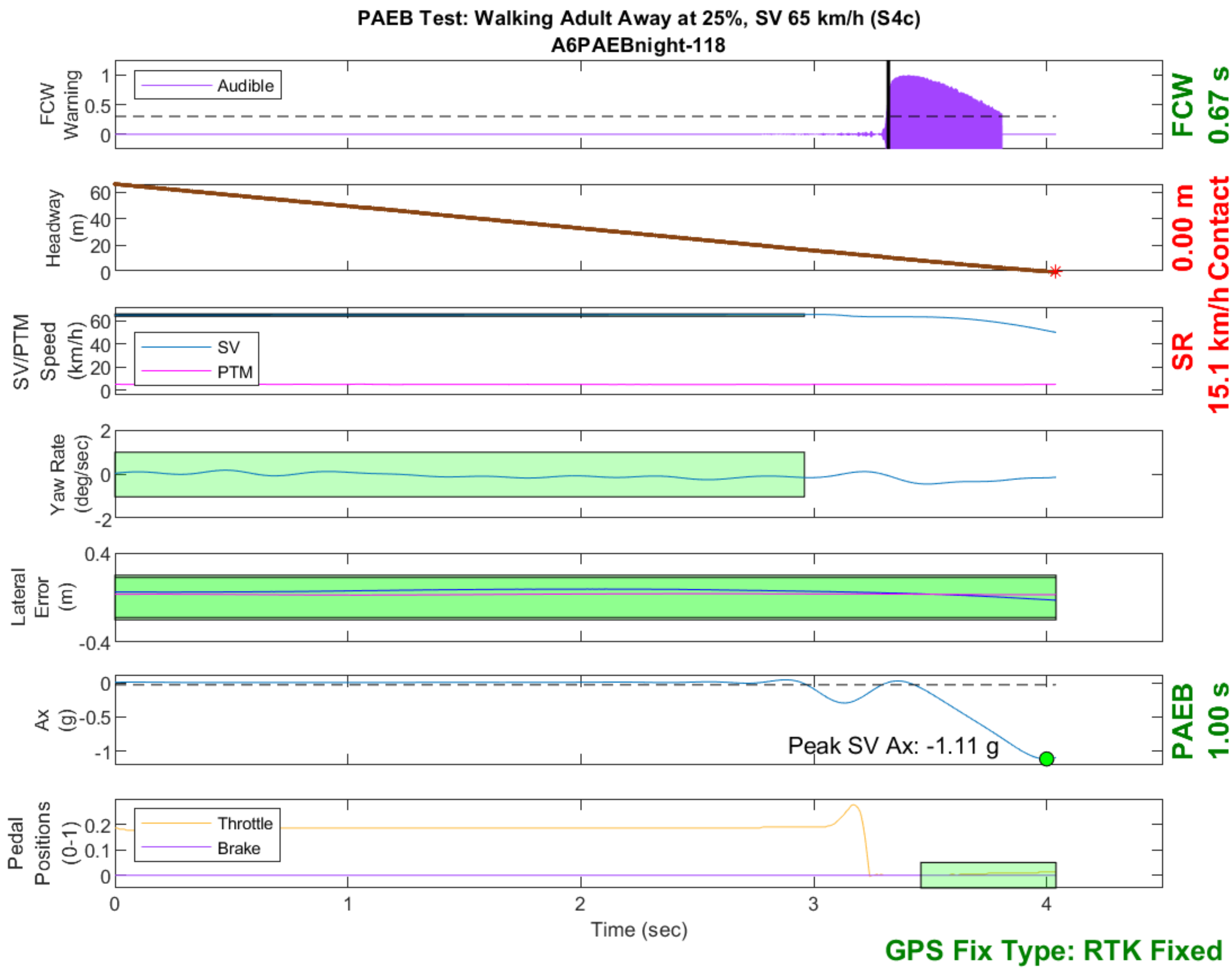


Figure D255. Time History for PAEB Run 118, S4c, Night, High Beam, 65 km/h

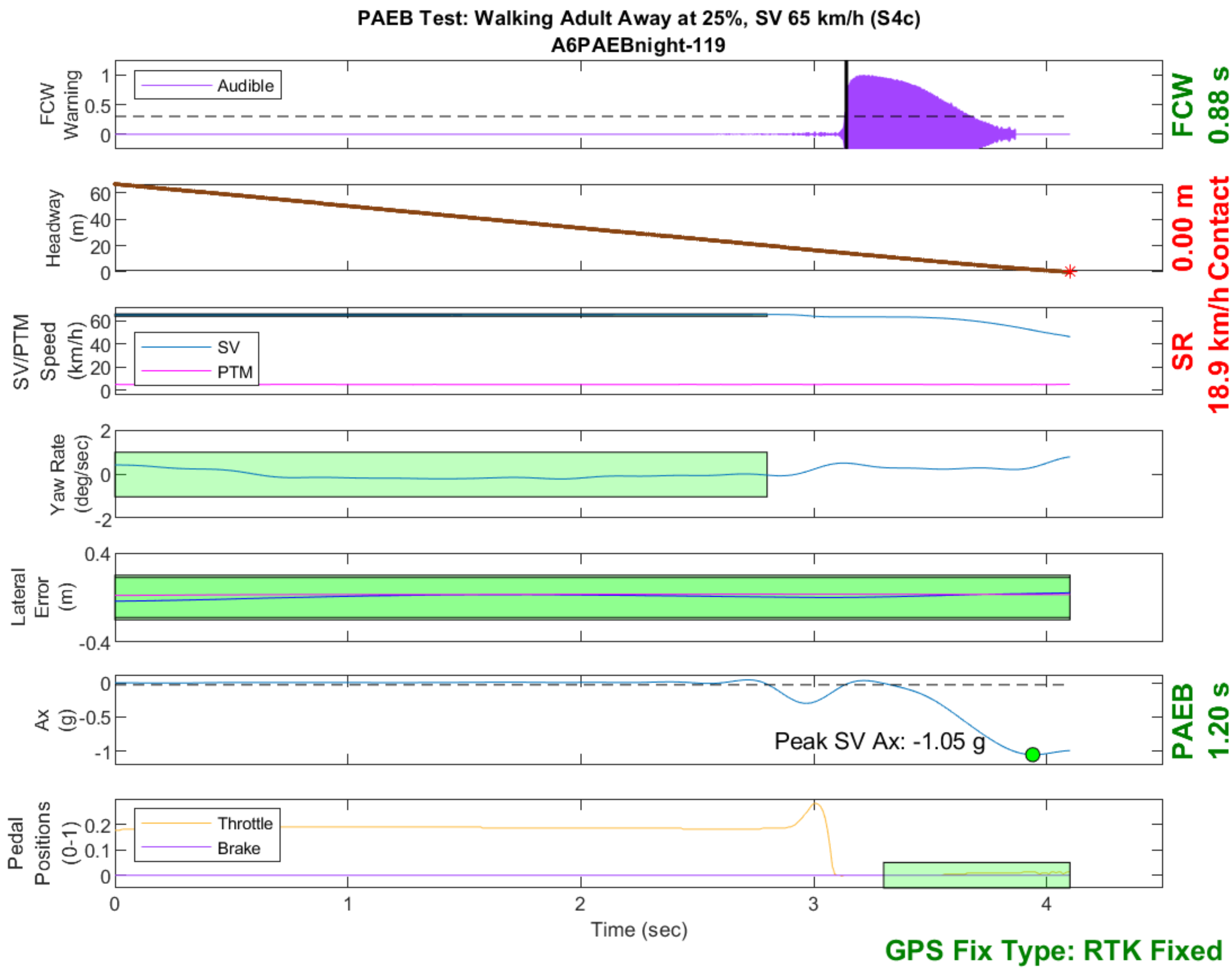


Figure D256. Time History for PAEB Run 119, S4c, Night, High Beam, 65 km/h

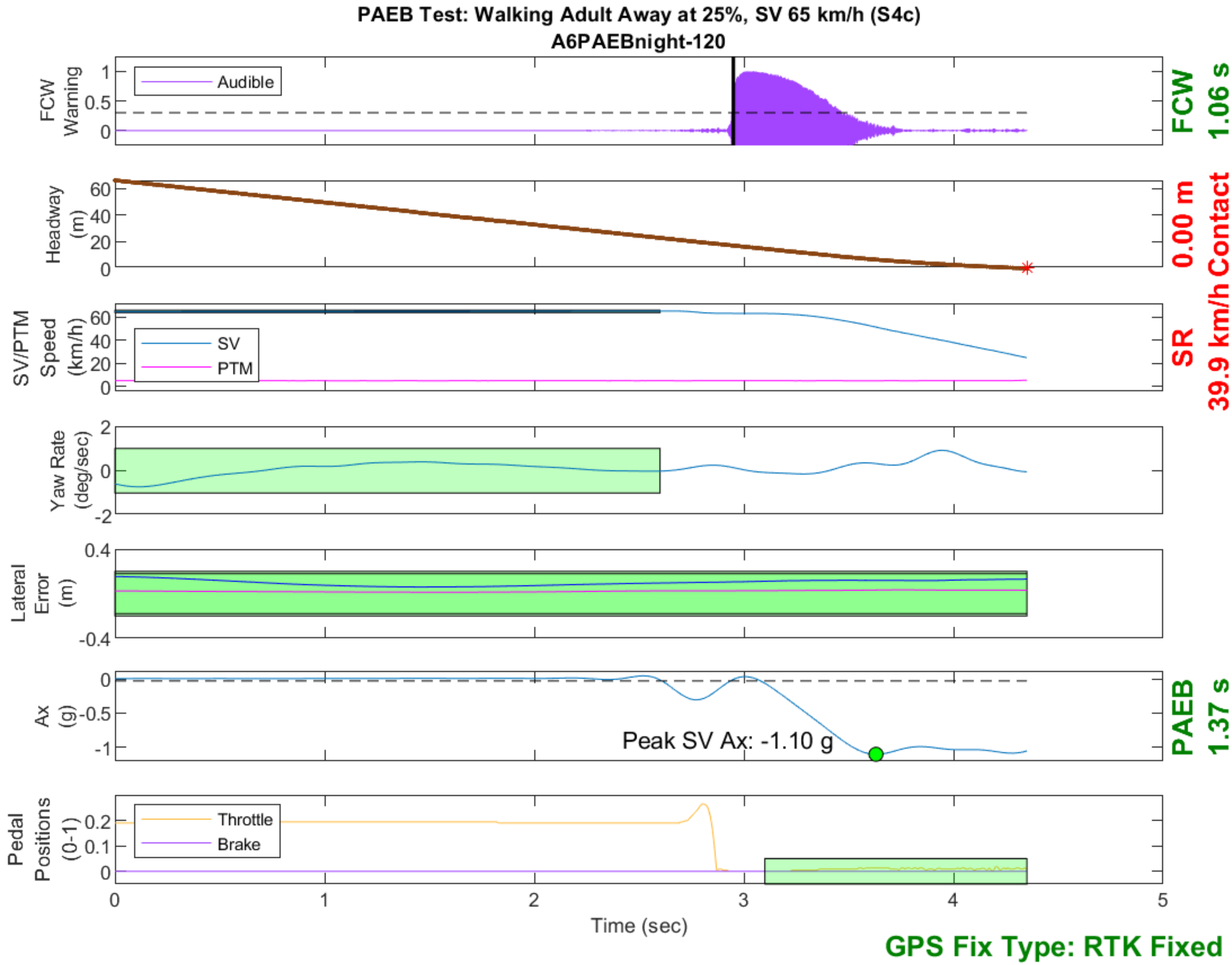


Figure D257. Time History for PAEB Run 120, S4c, Night, High Beam, 65 km/h

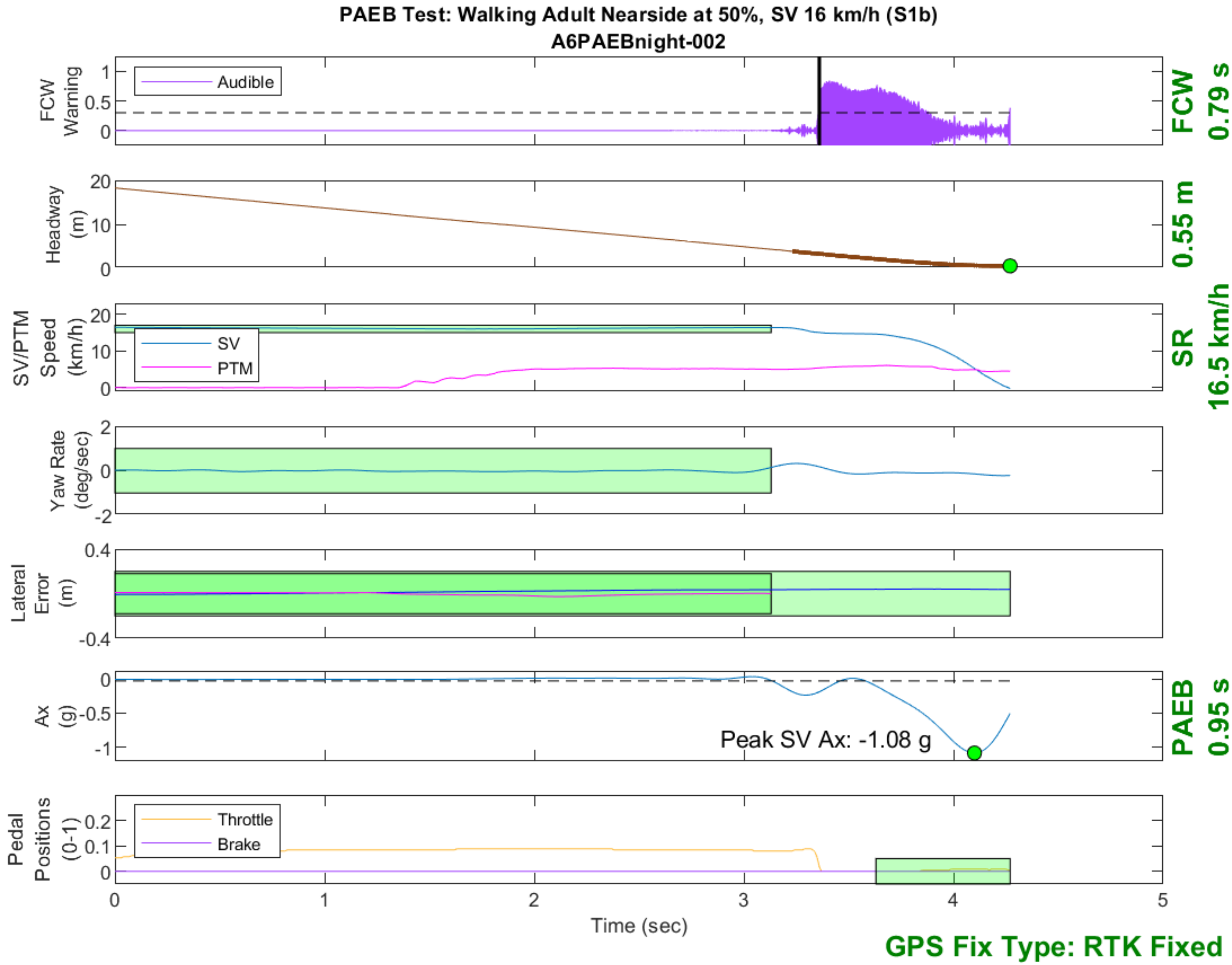


Figure D258. Time History for PAEB Run 2, S1b, Night, Low Beam, 16 km/h

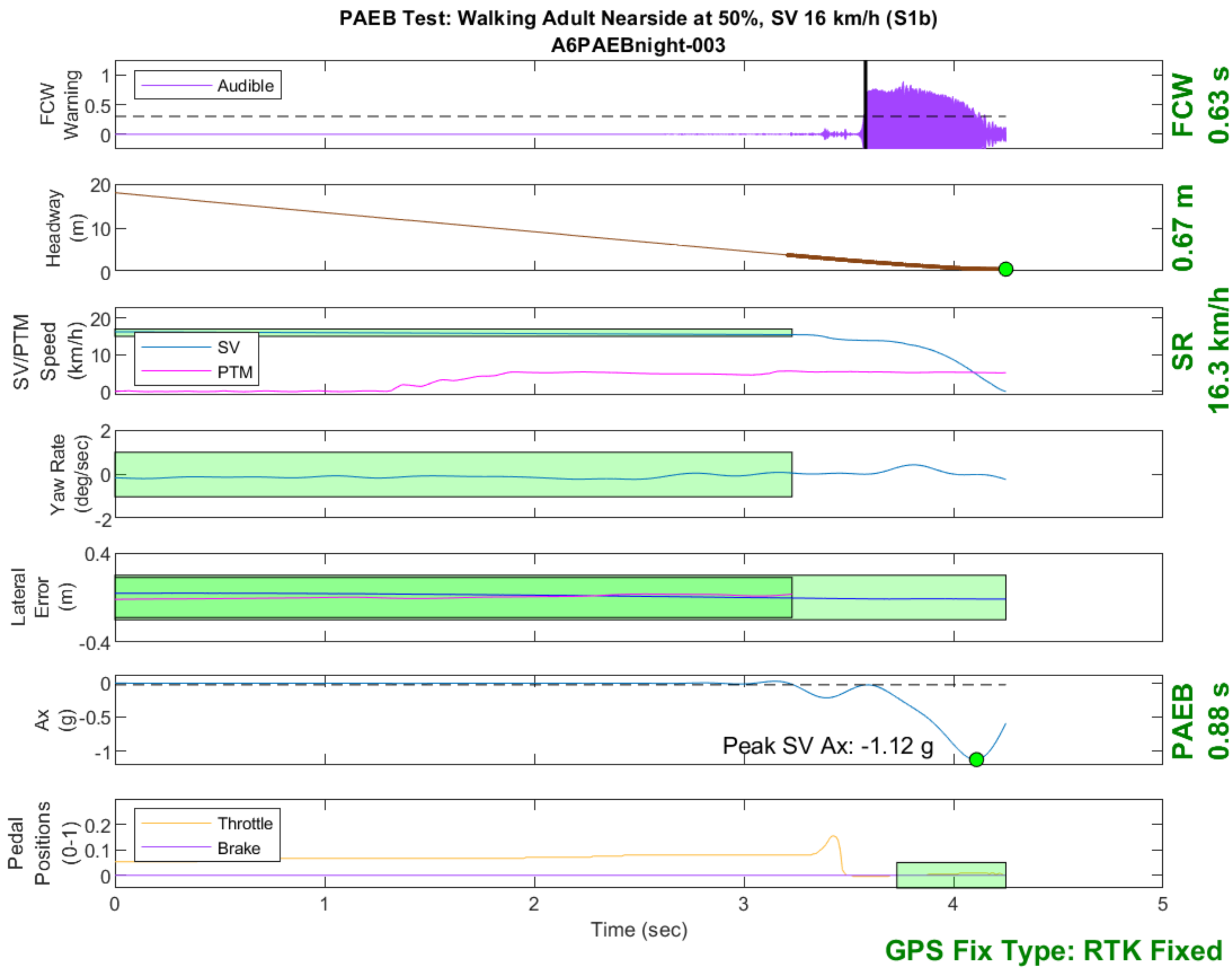


Figure D259. Time History for PAEB Run 3, S1b, Night, Low Beam, 16 km/h

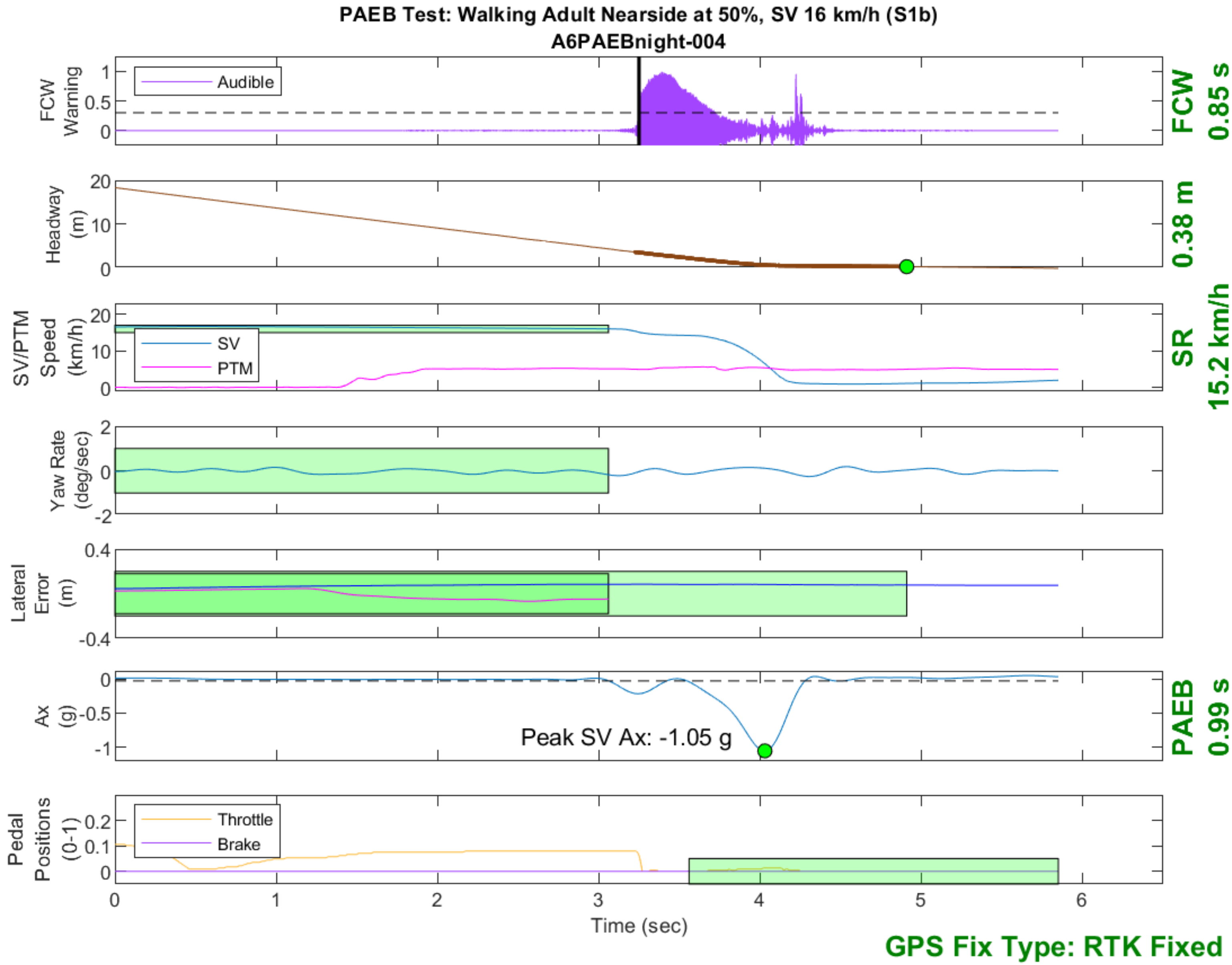


Figure D260. Time History for PAEB Run 4, S1b, Night, Low Beam, 16 km/h

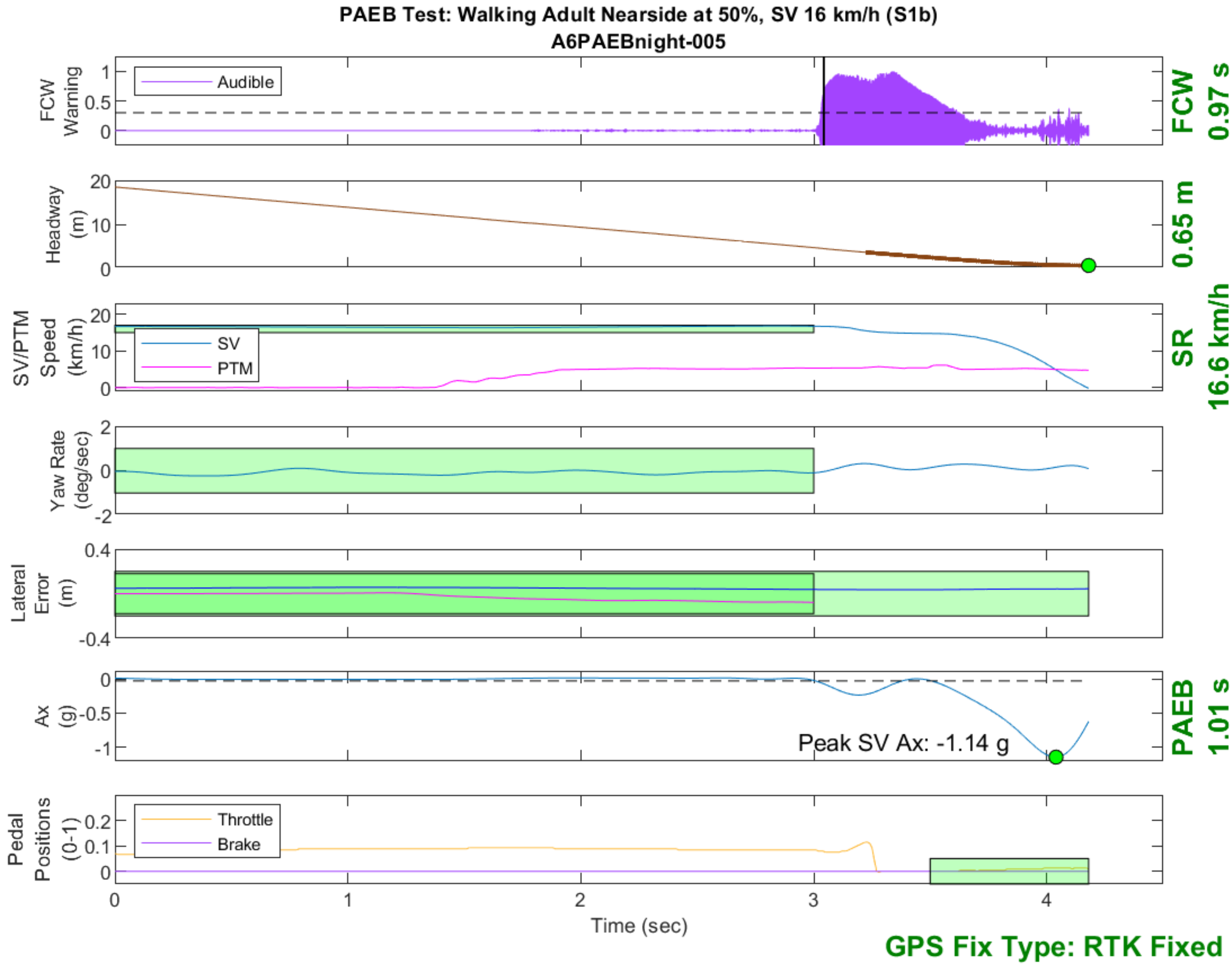


Figure D261. Time History for PAEB Run 5, S1b, Night, Low Beam, 16 km/h

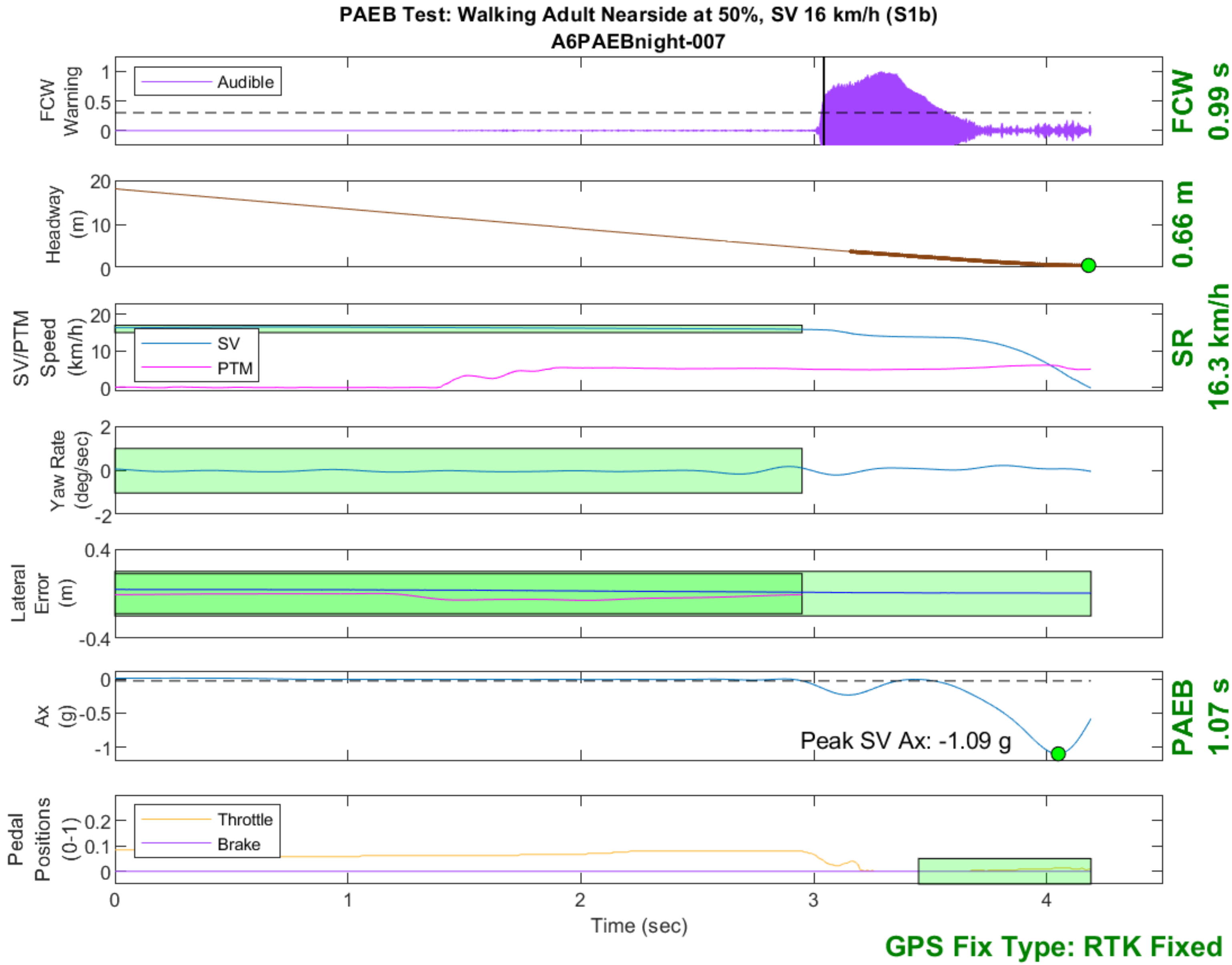


Figure D262. Time History for PAEB Run 7, S1b, Night, Low Beam, 16 km/h

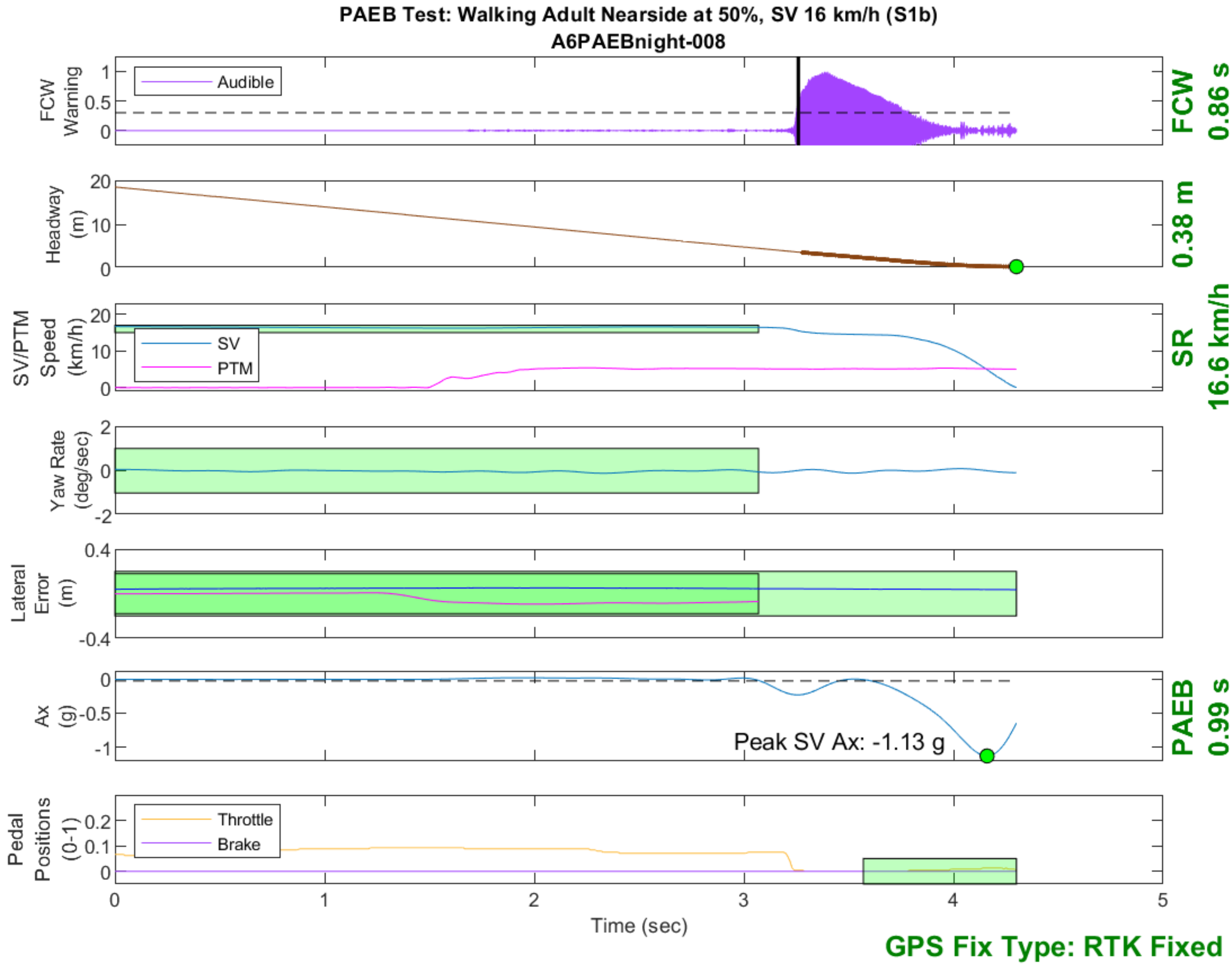


Figure D263. Time History for PAEB Run 8, S1b, Night, Low Beam, 16 km/h

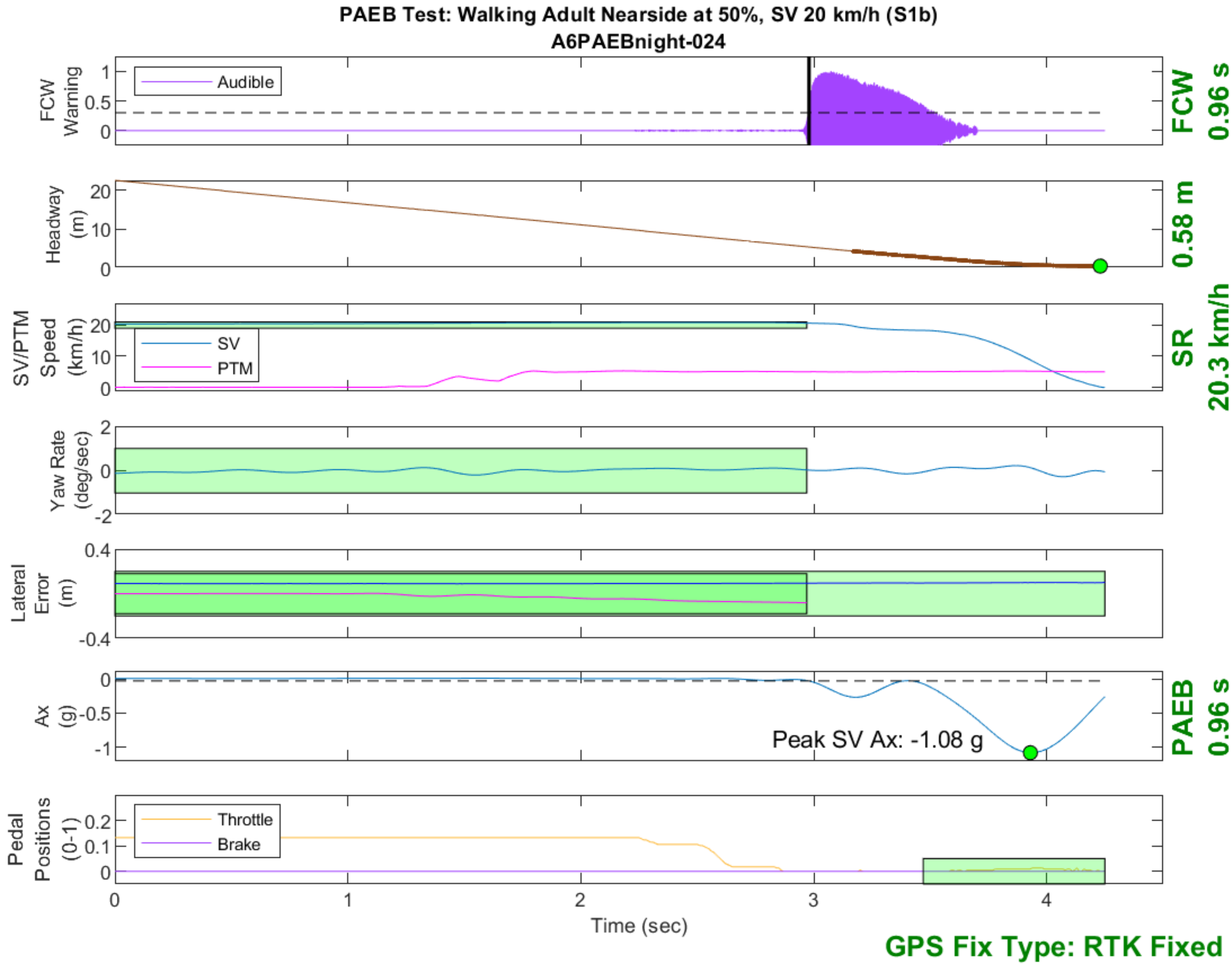


Figure D264. Time History for PAEB Run 24, S1b, Night, Low Beam, 20 km/h

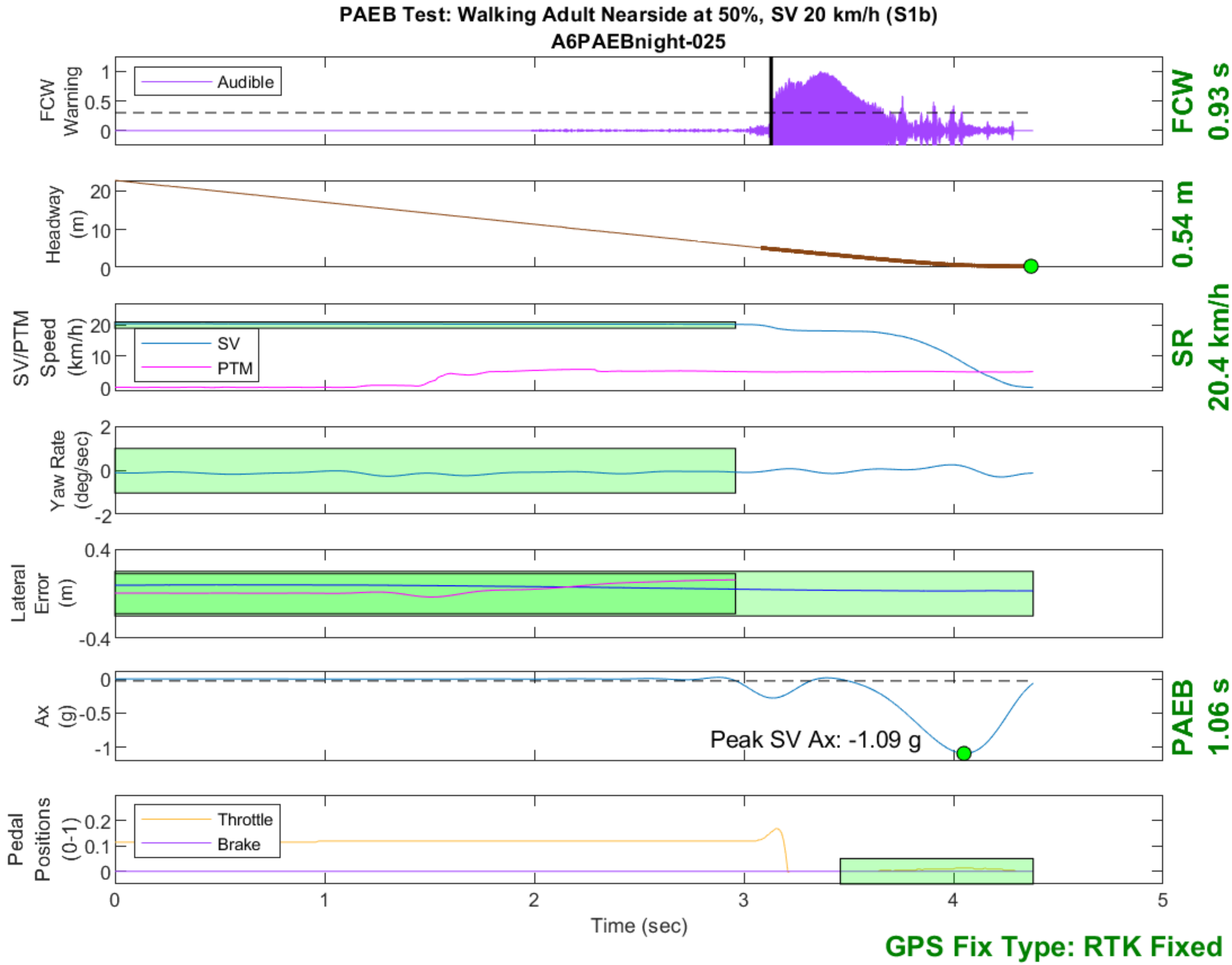


Figure D265. Time History for PAEB Run 25, S1b, Night, Low Beam, 20 km/h

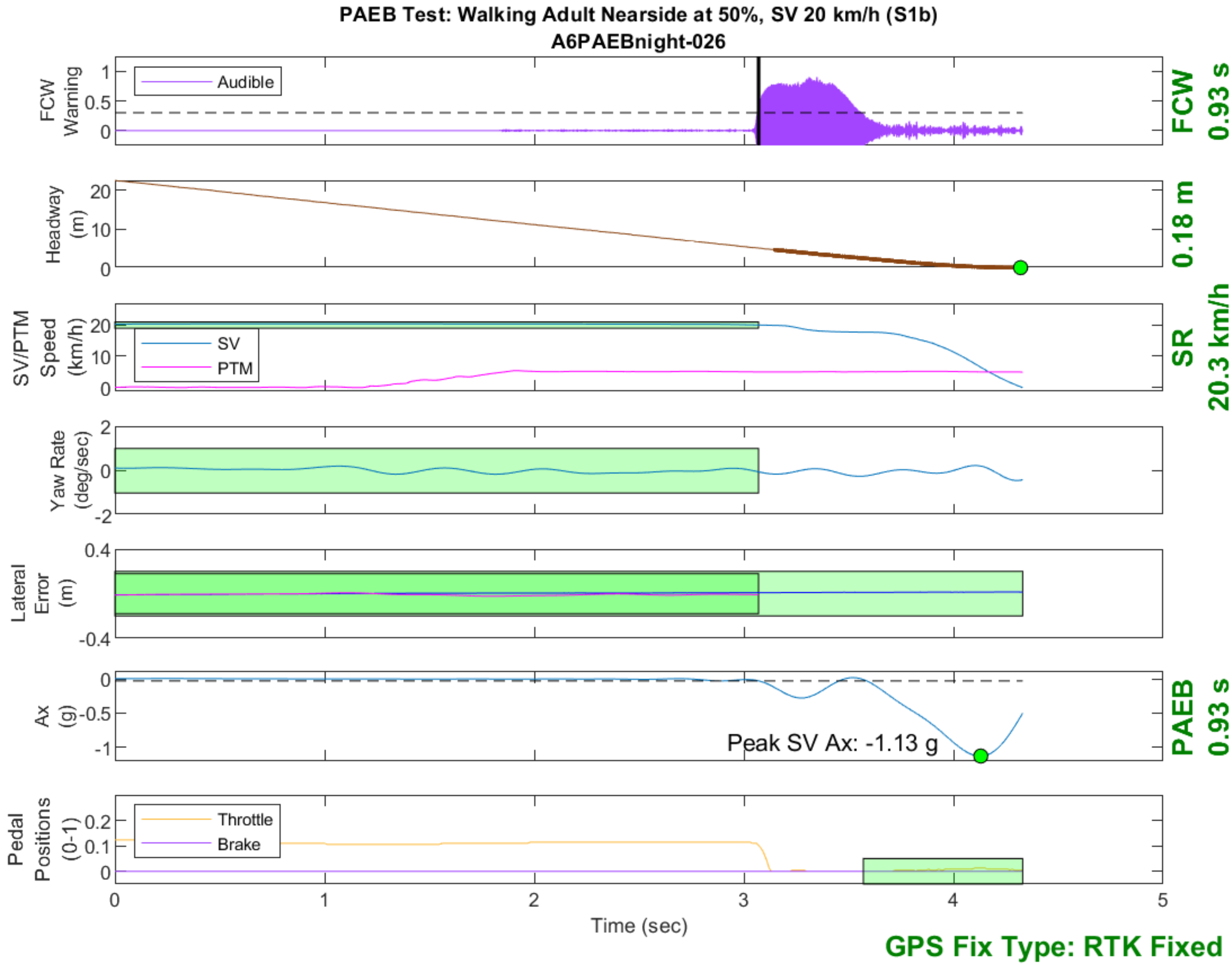


Figure D266. Time History for PAEB Run 26, S1b, Night, Low Beam, 20 km/h

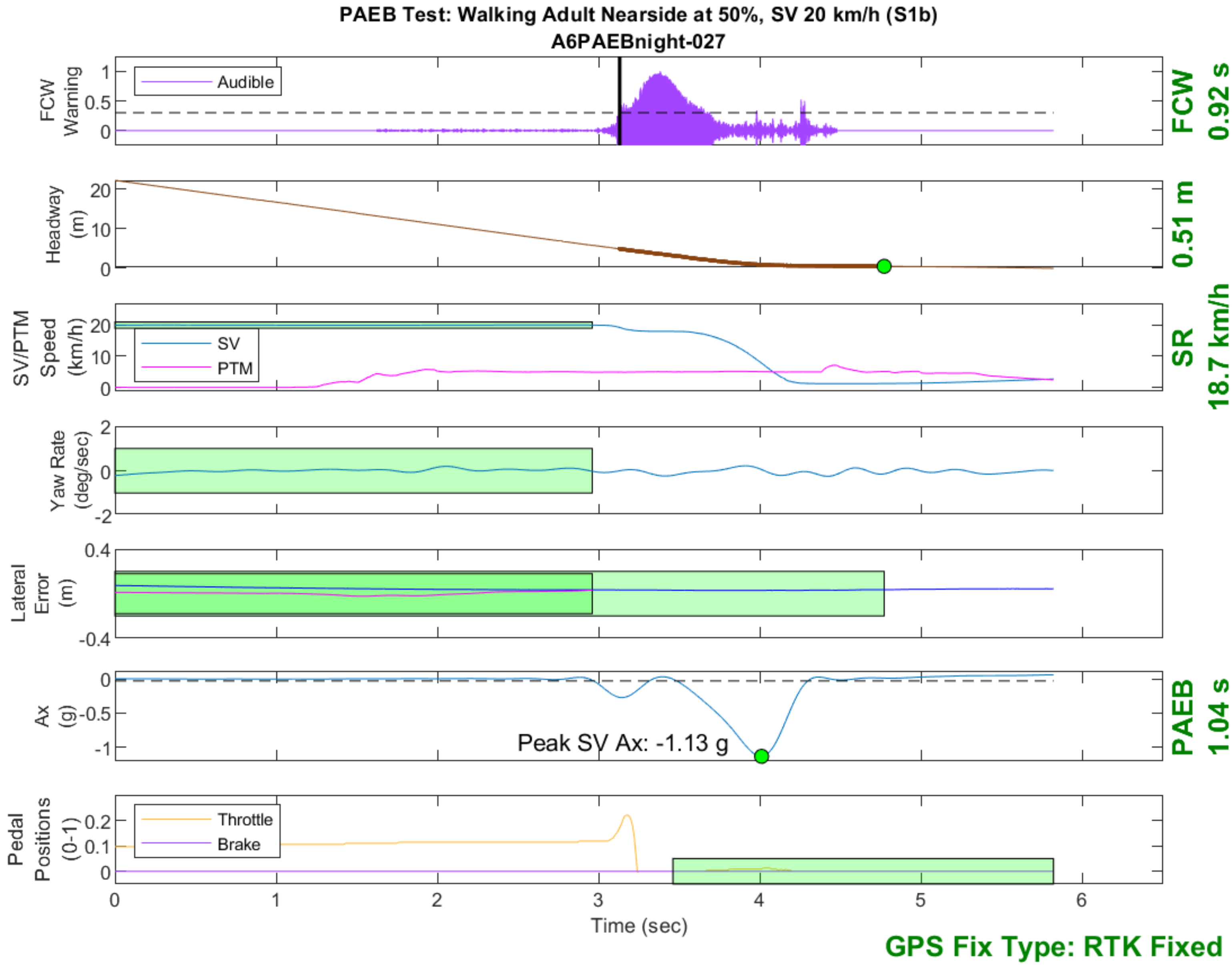


Figure D267. Time History for PAEB Run 27, S1b, Night, Low Beam, 20 km/h

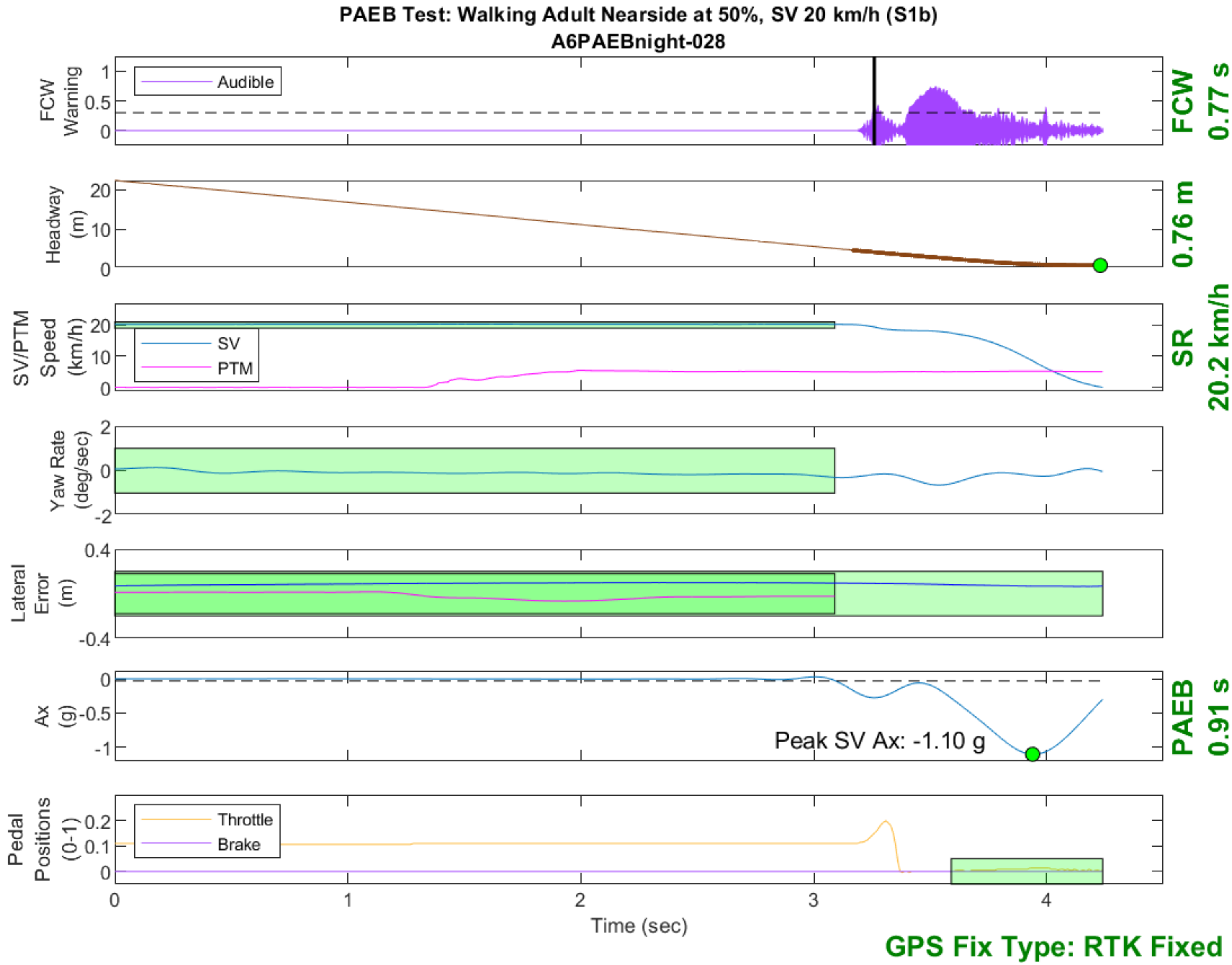


Figure D268. Time History for PAEB Run 28, S1b, Night, Low Beam, 20 km/h

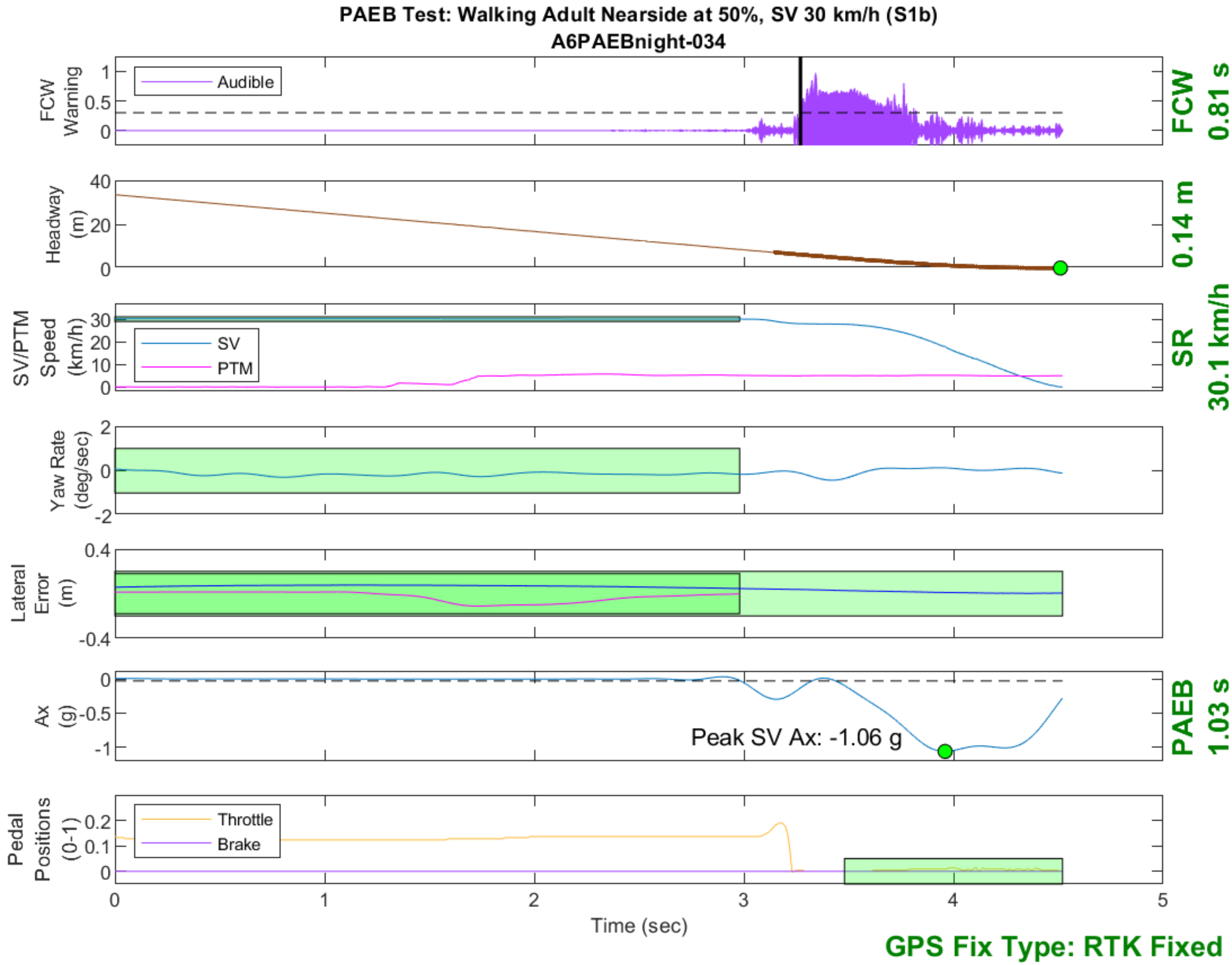


Figure D269. Time History for PAEB Run 34, S1b, Night, Low Beam, 30 km/h

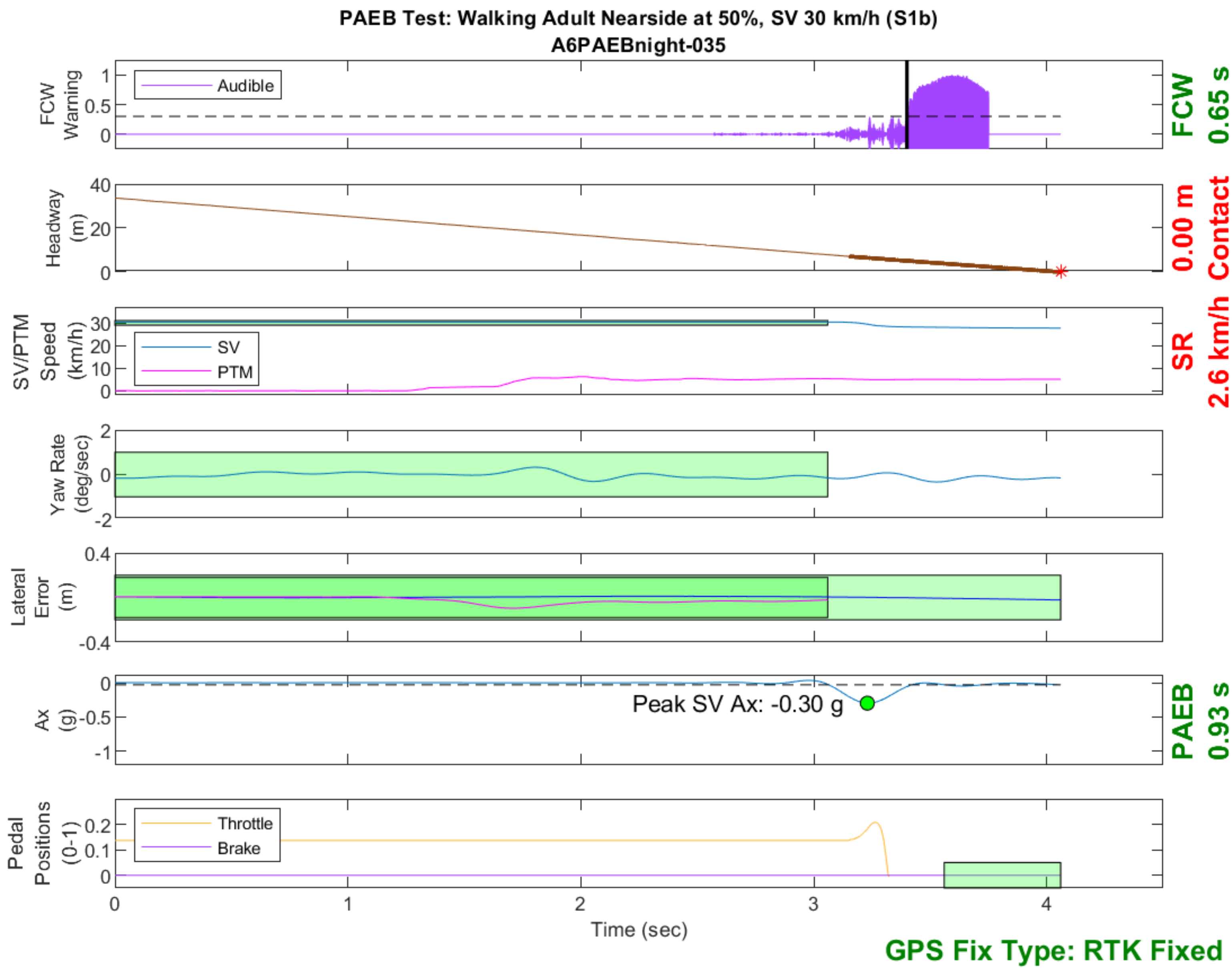


Figure D270. Time History for PAEB Run 35, S1b, Night, Low Beam, 30 km/h

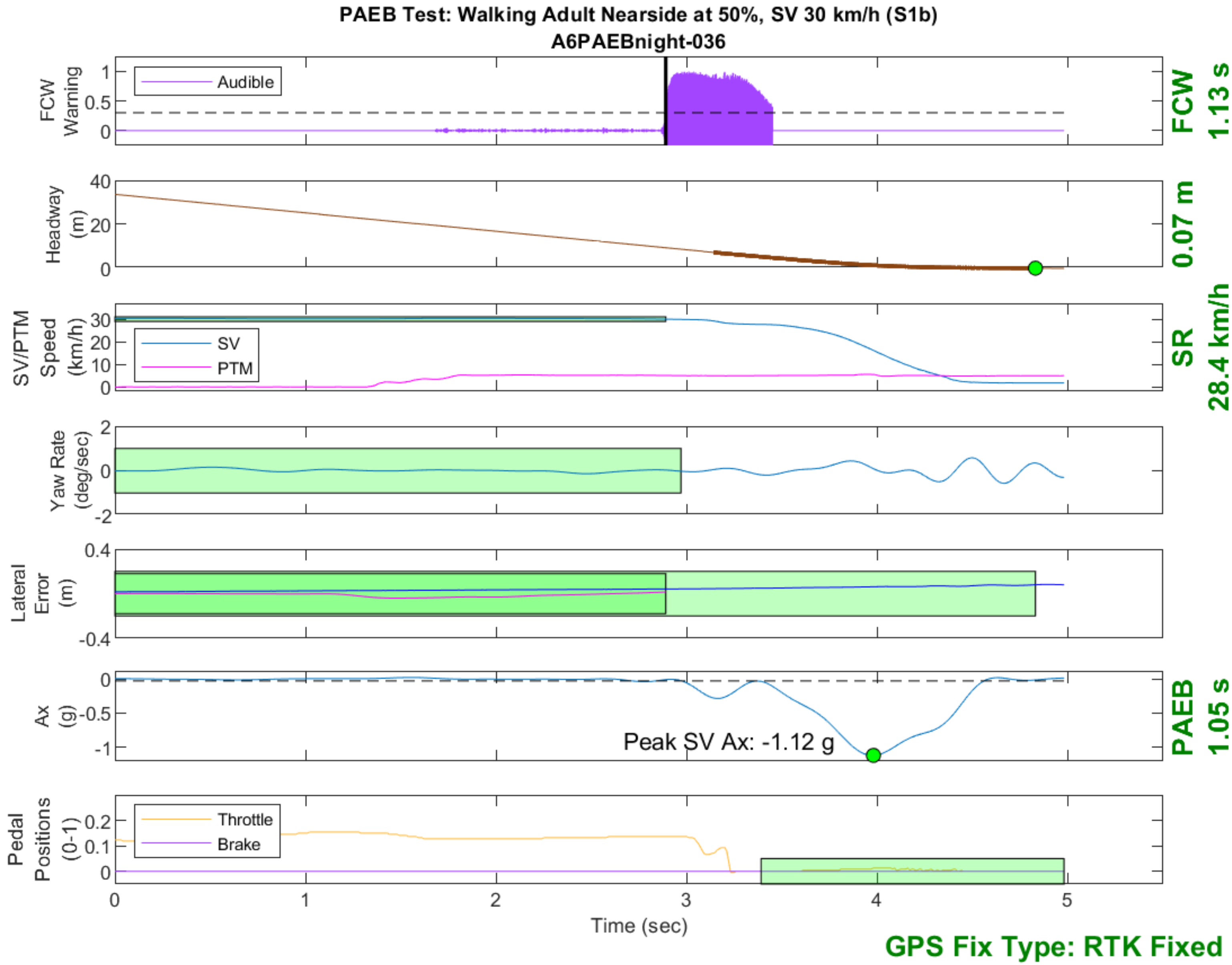


Figure D271. Time History for PAEB Run 36, S1b, Night, Low Beam, 30 km/h

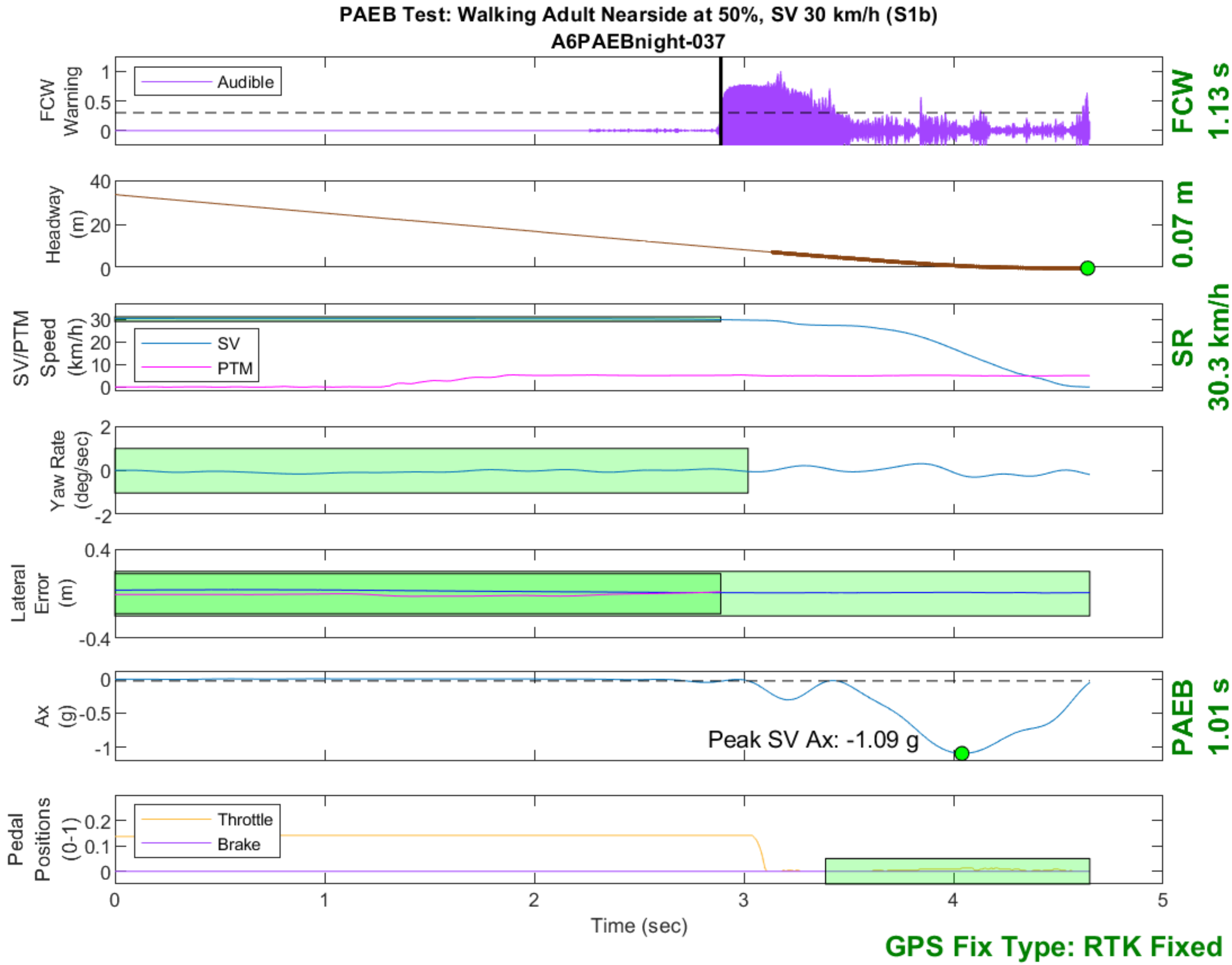


Figure D272. Time History for PAEB Run 37, S1b, Night, Low Beam, 30 km/h

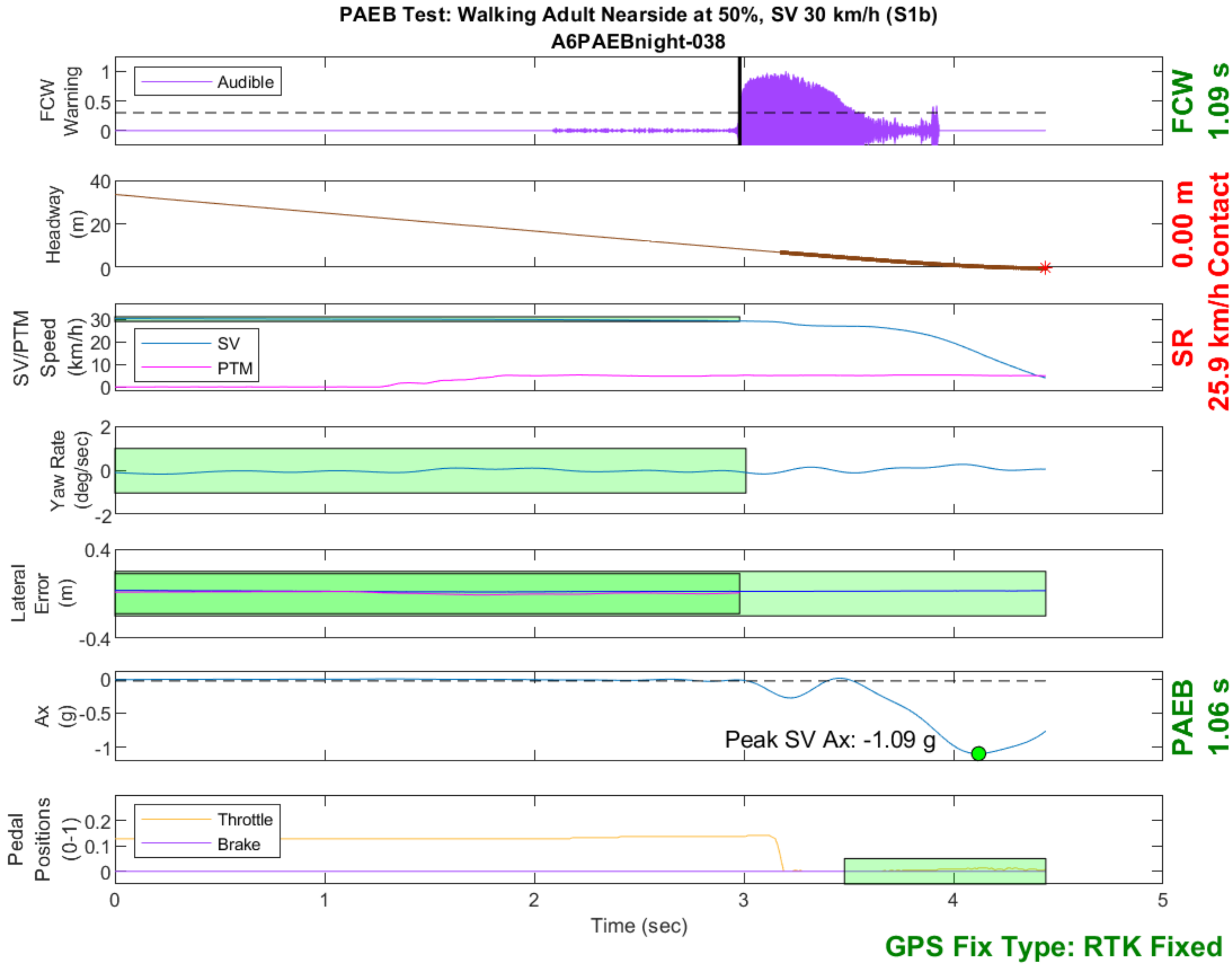


Figure D273. Time History for PAEB Run 38, S1b, Night, Low Beam, 30 km/h

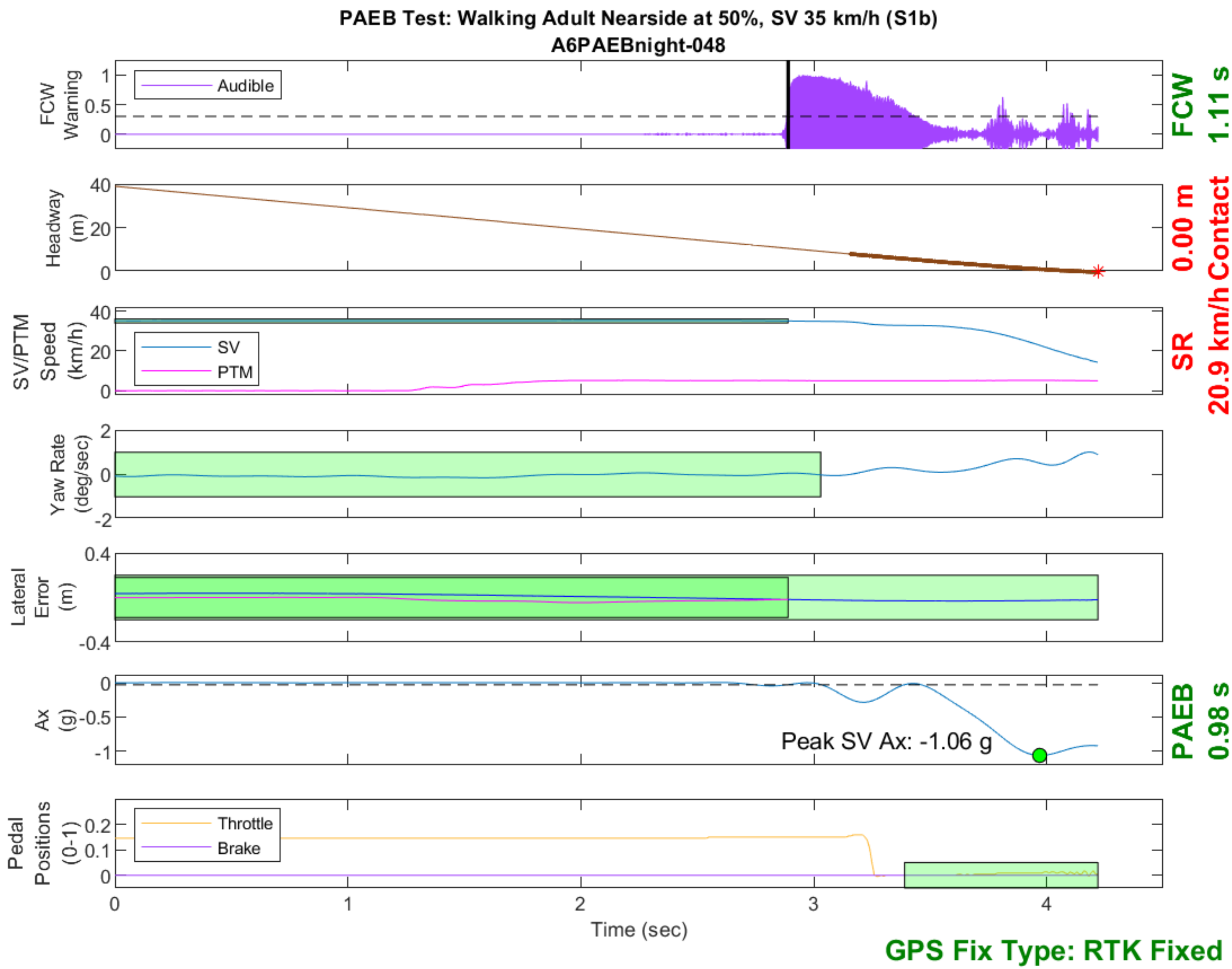


Figure D274. Time History for PAEB Run 48, S1b, Night, Low Beam, 35 km/h

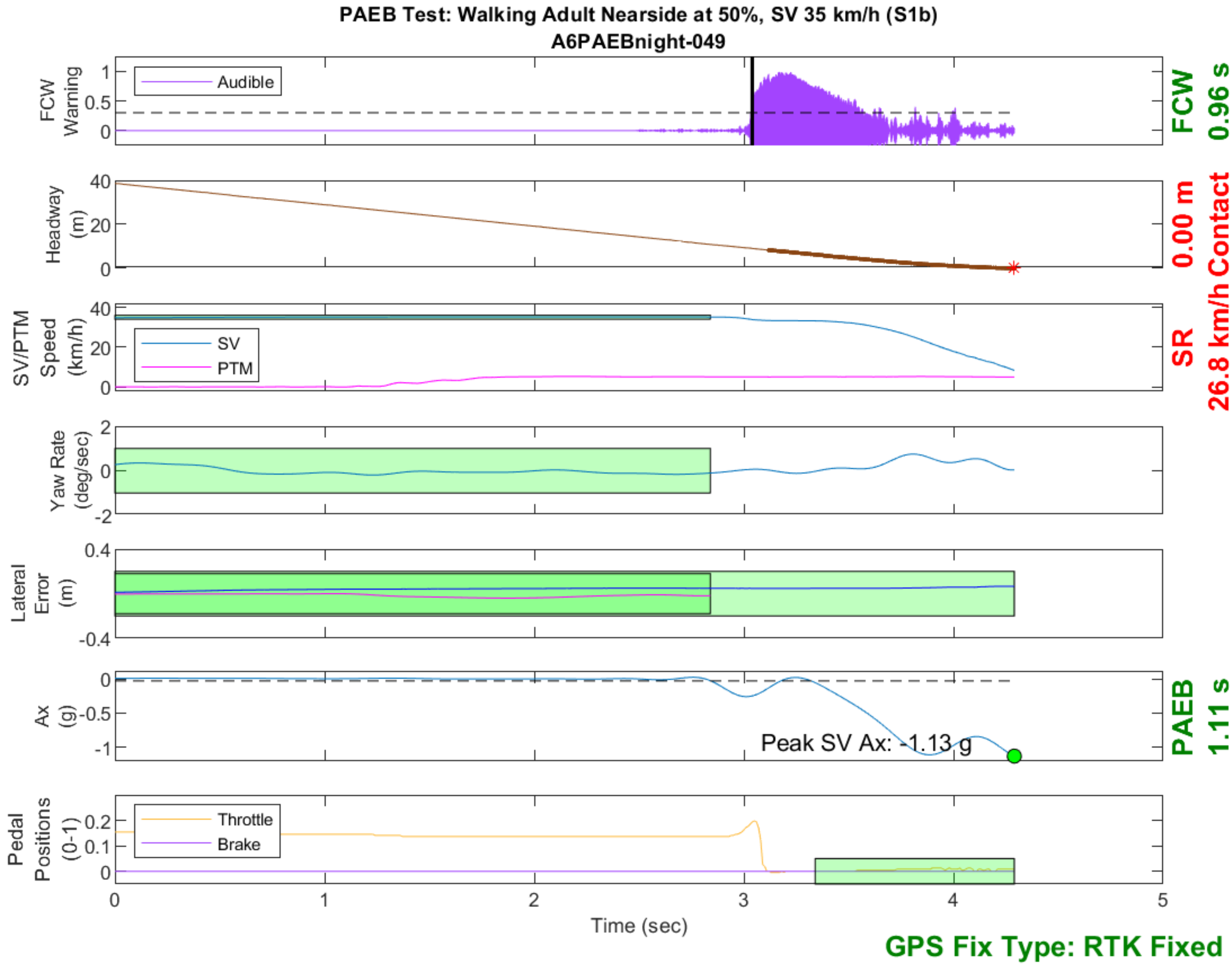


Figure D275. Time History for PAEB Run 49, S1b, Night, Low Beam, 35 km/h

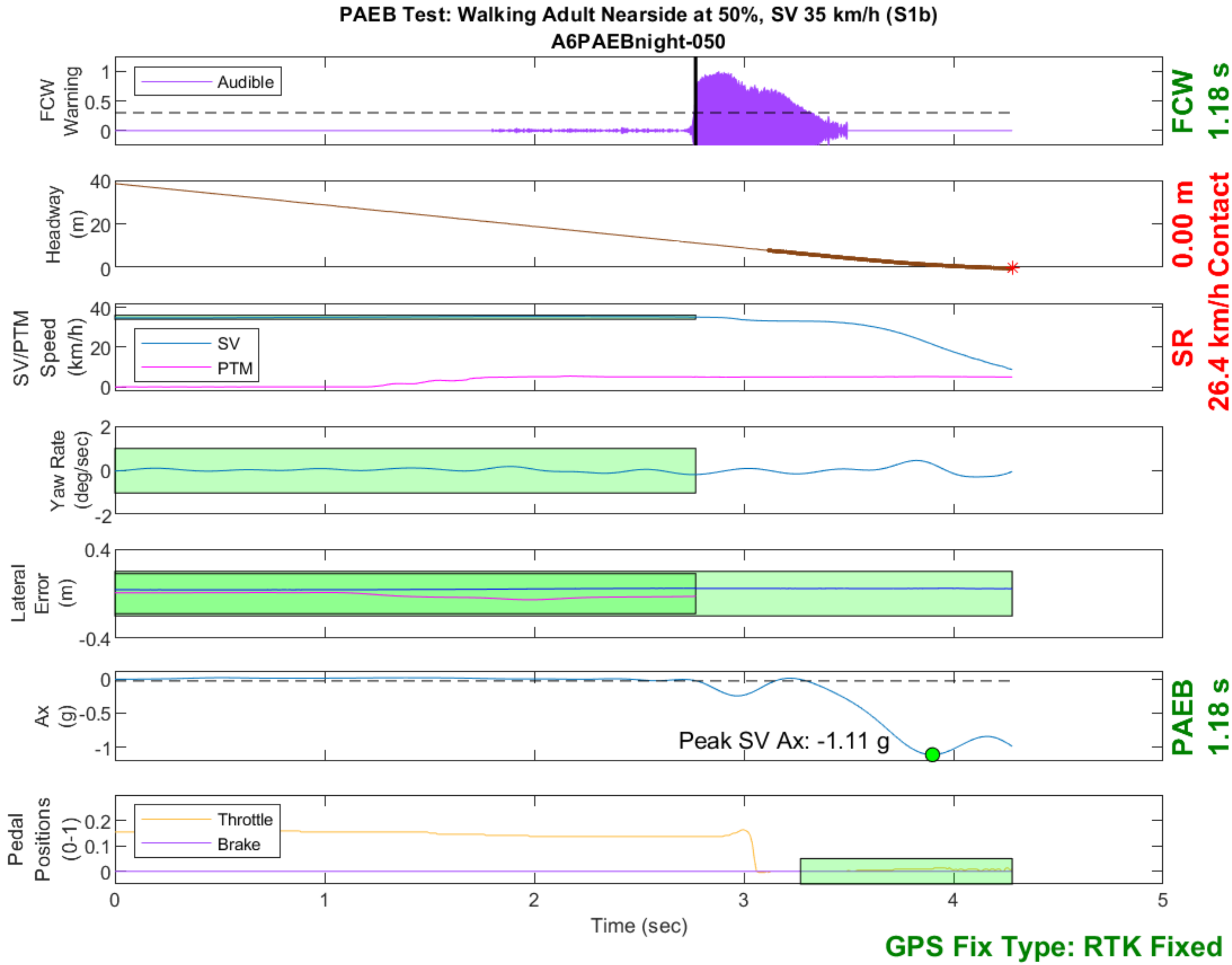


Figure D276. Time History for PAEB Run 50, S1b, Night, Low Beam, 35 km/h

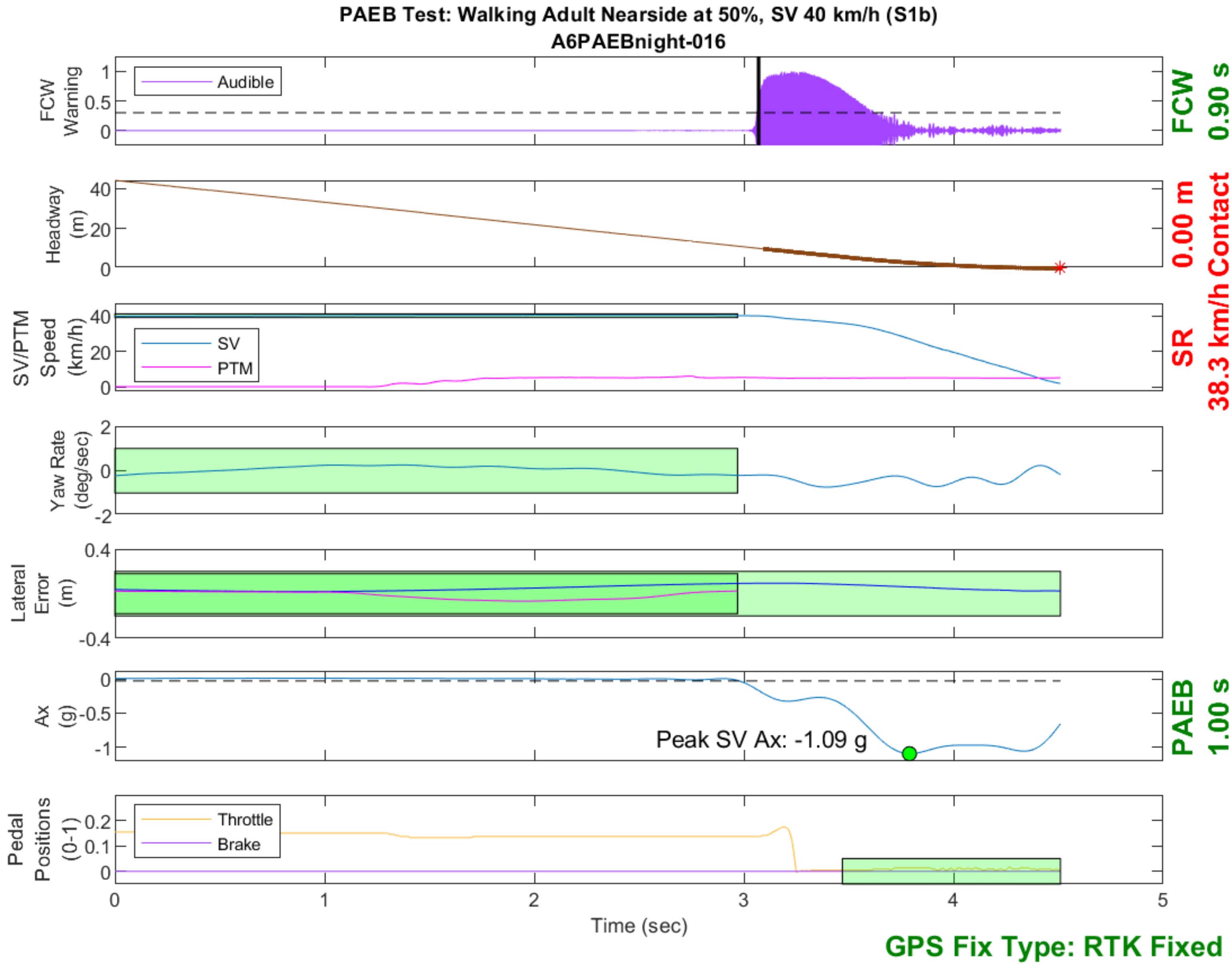


Figure D277. Time History for PAEB Run 16, S1b, Night, Low Beam, 40 km/h

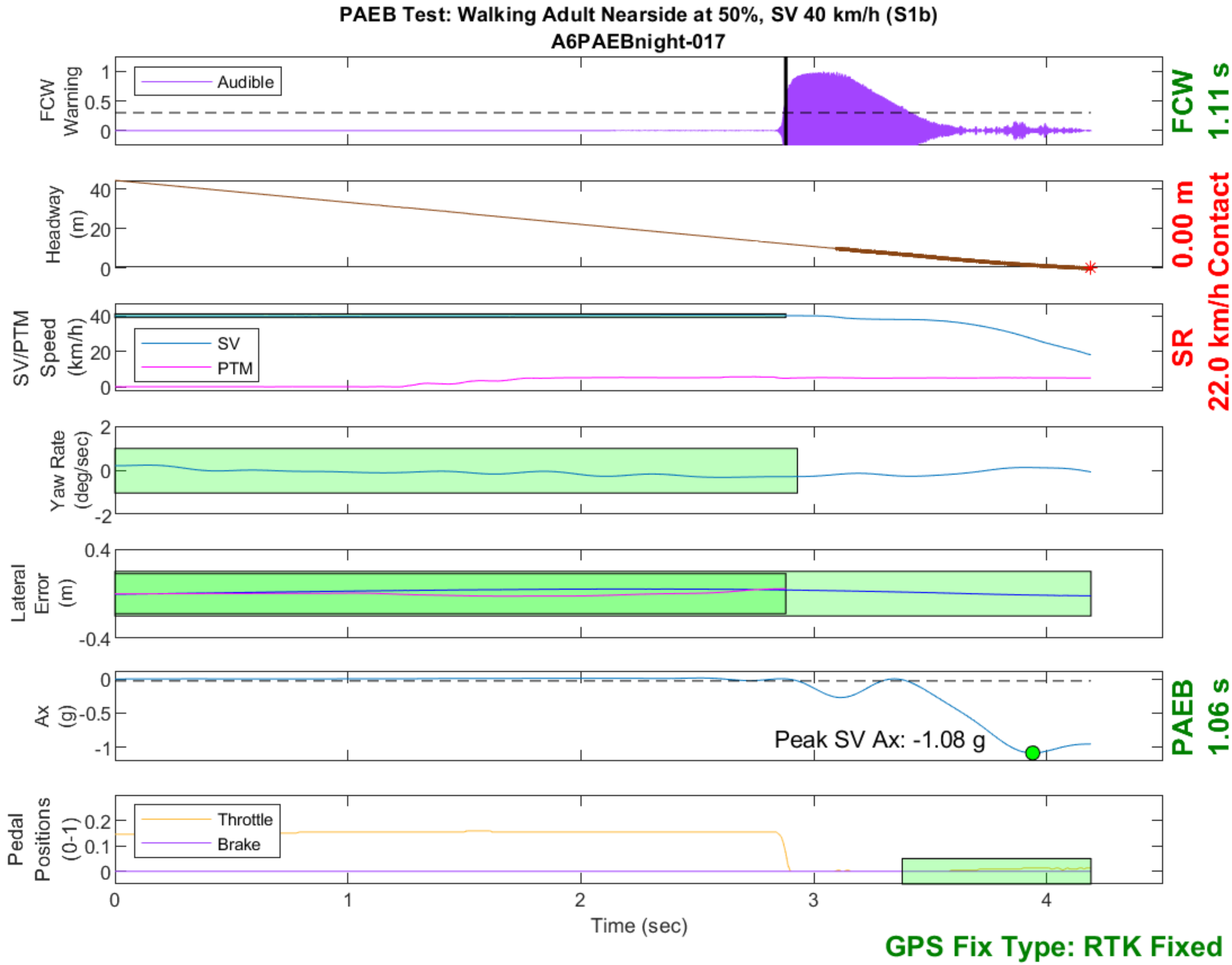


Figure D278. Time History for PAEB Run 17, S1b, Night, Low Beam, 40 km/h

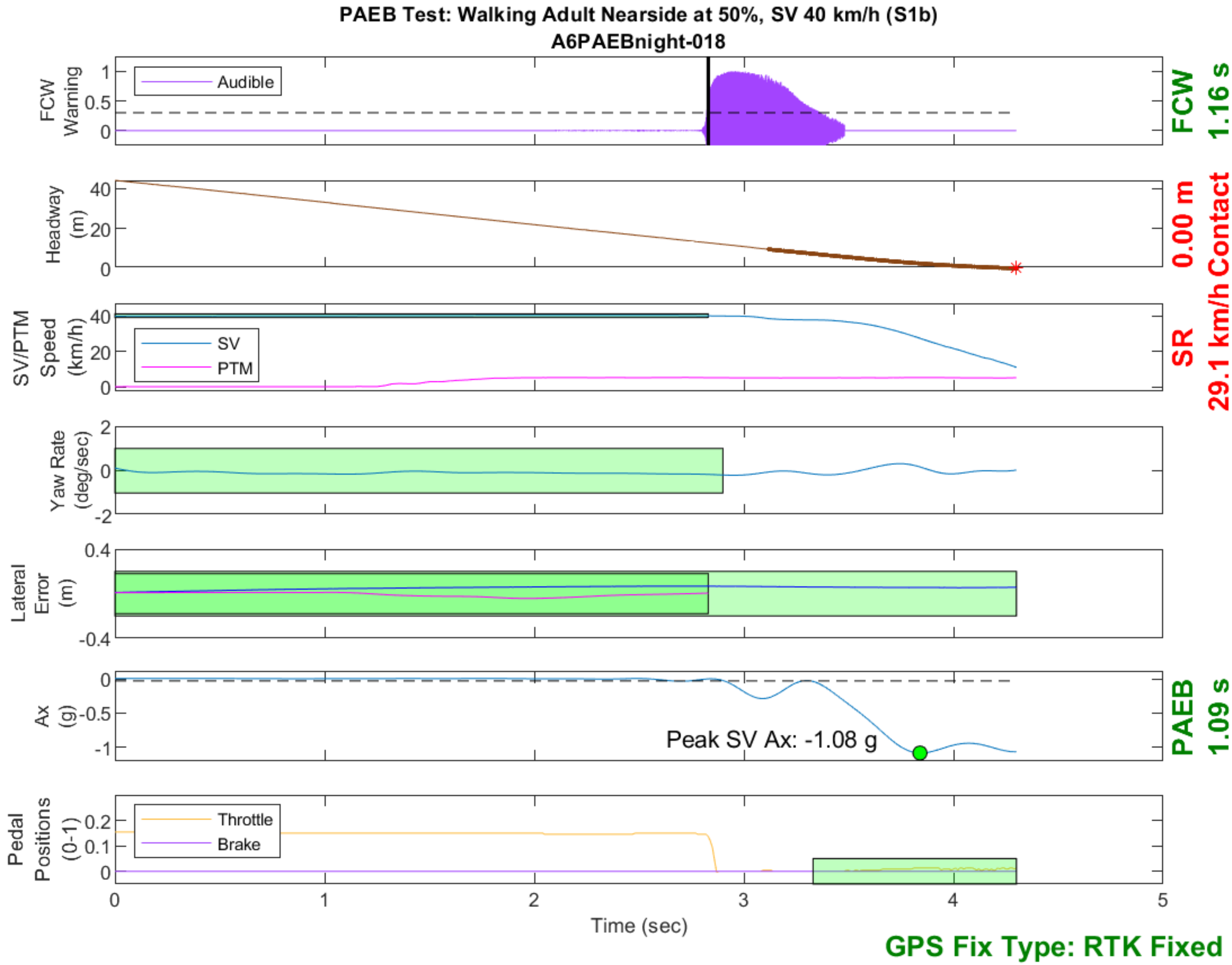


Figure D279. Time History for PAEB Run 18, S1b, Night, Low Beam, 40 km/h

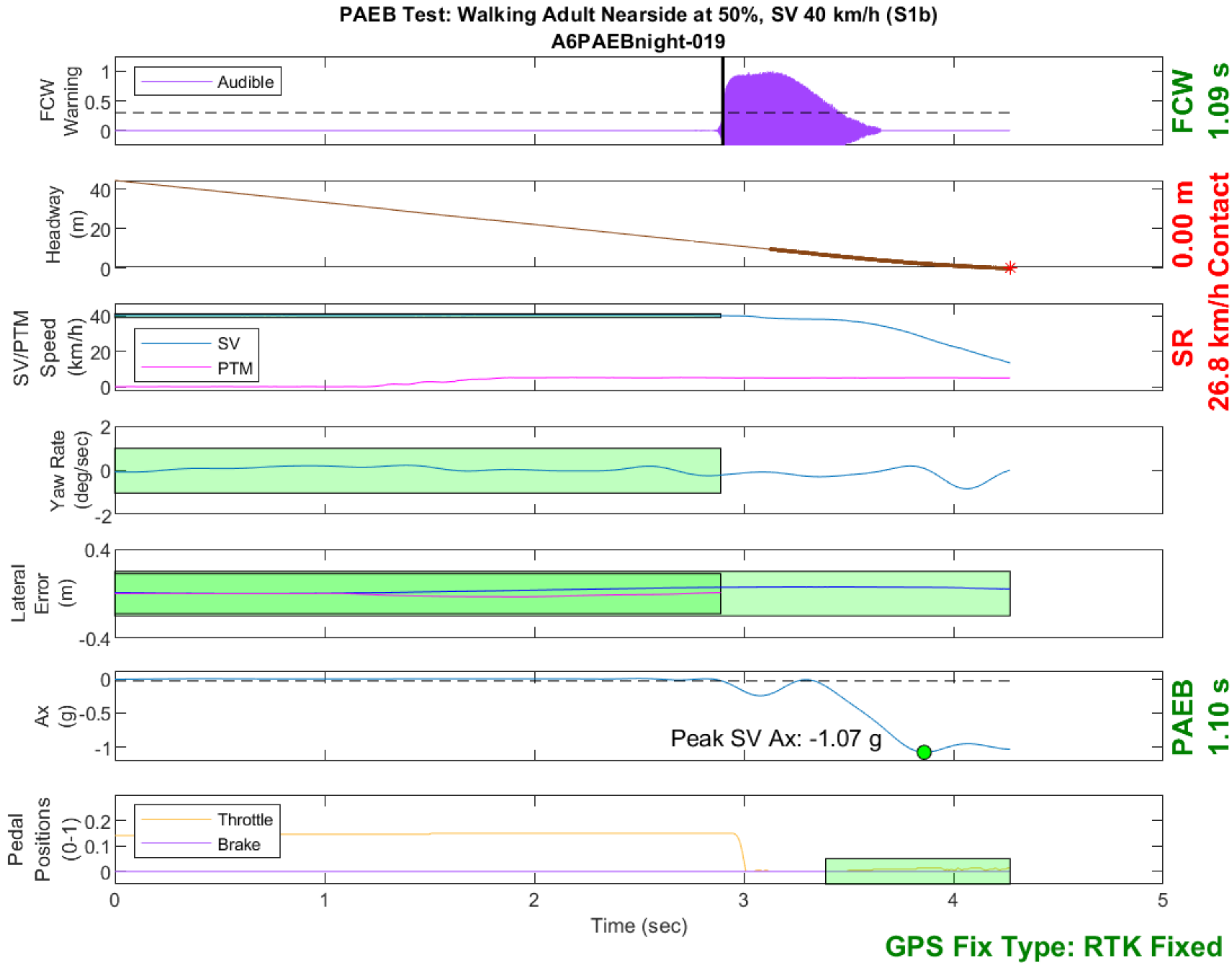


Figure D280. Time History for PAEB Run 19, S1b, Night, Low Beam, 40 km/h

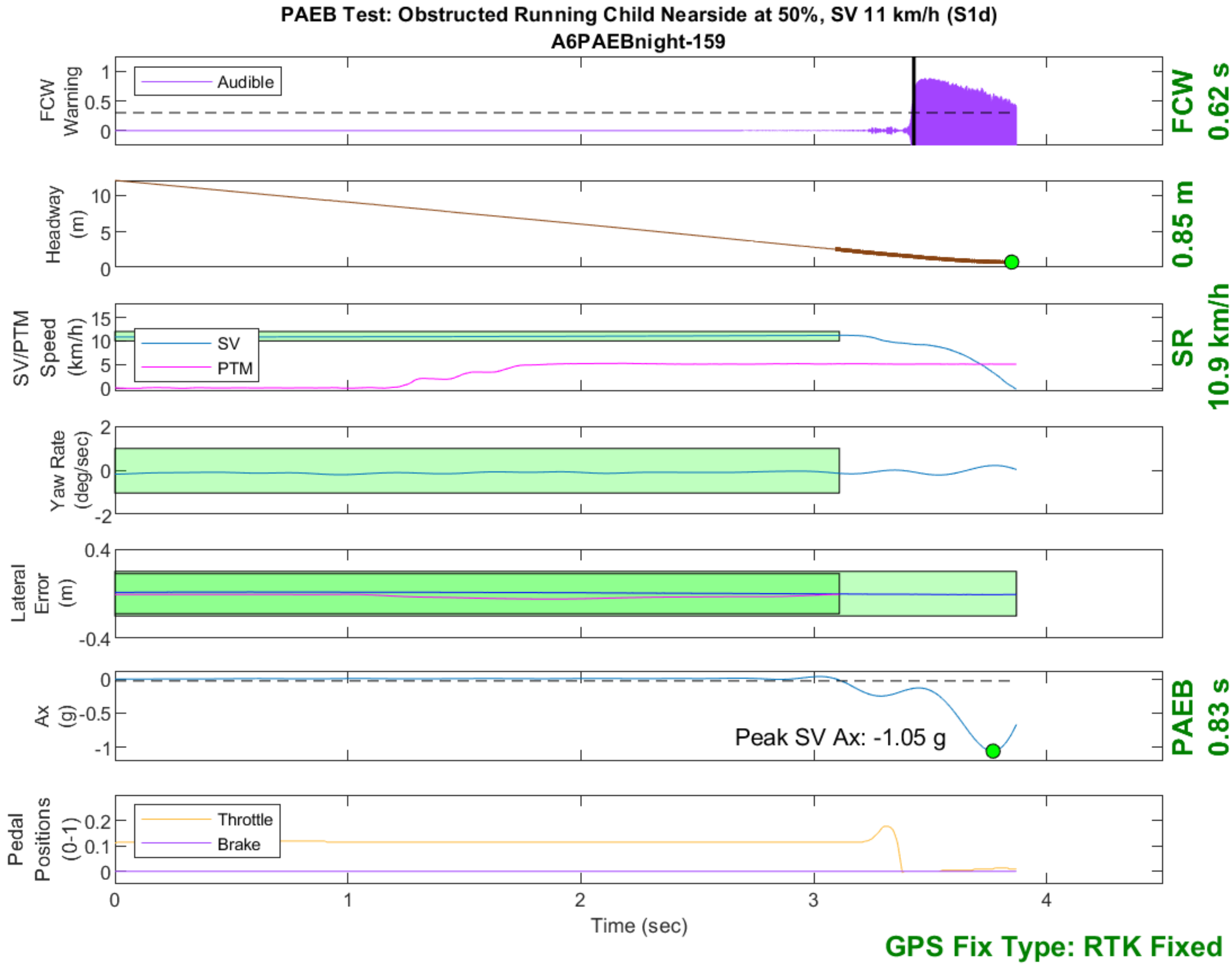


Figure D281. Time History for PAEB Run 159, S1d, Night, Low Beam, 11 km/h

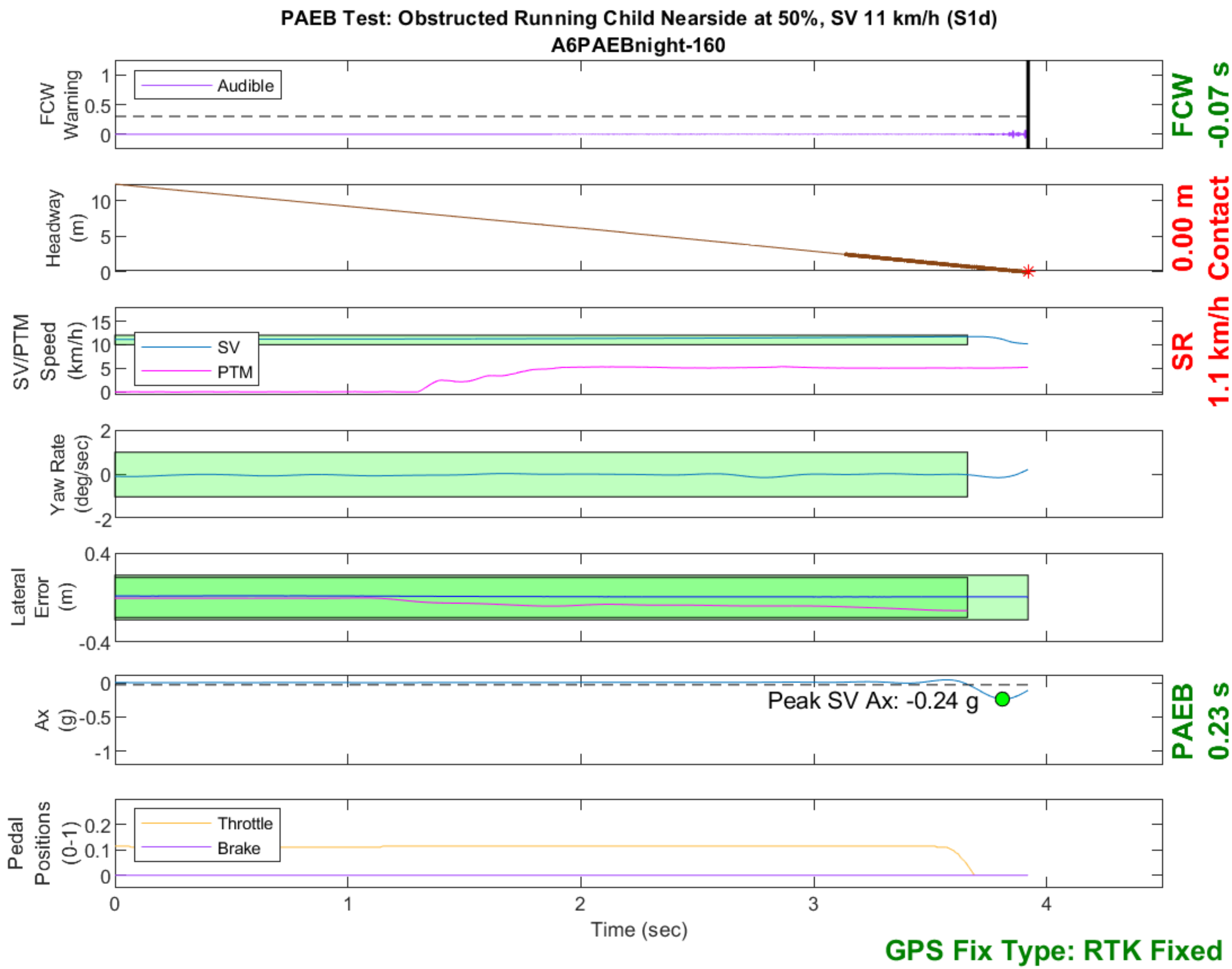


Figure D282. Time History for PAEB Run 160, S1d, Night, Low Beam, 11 km/h

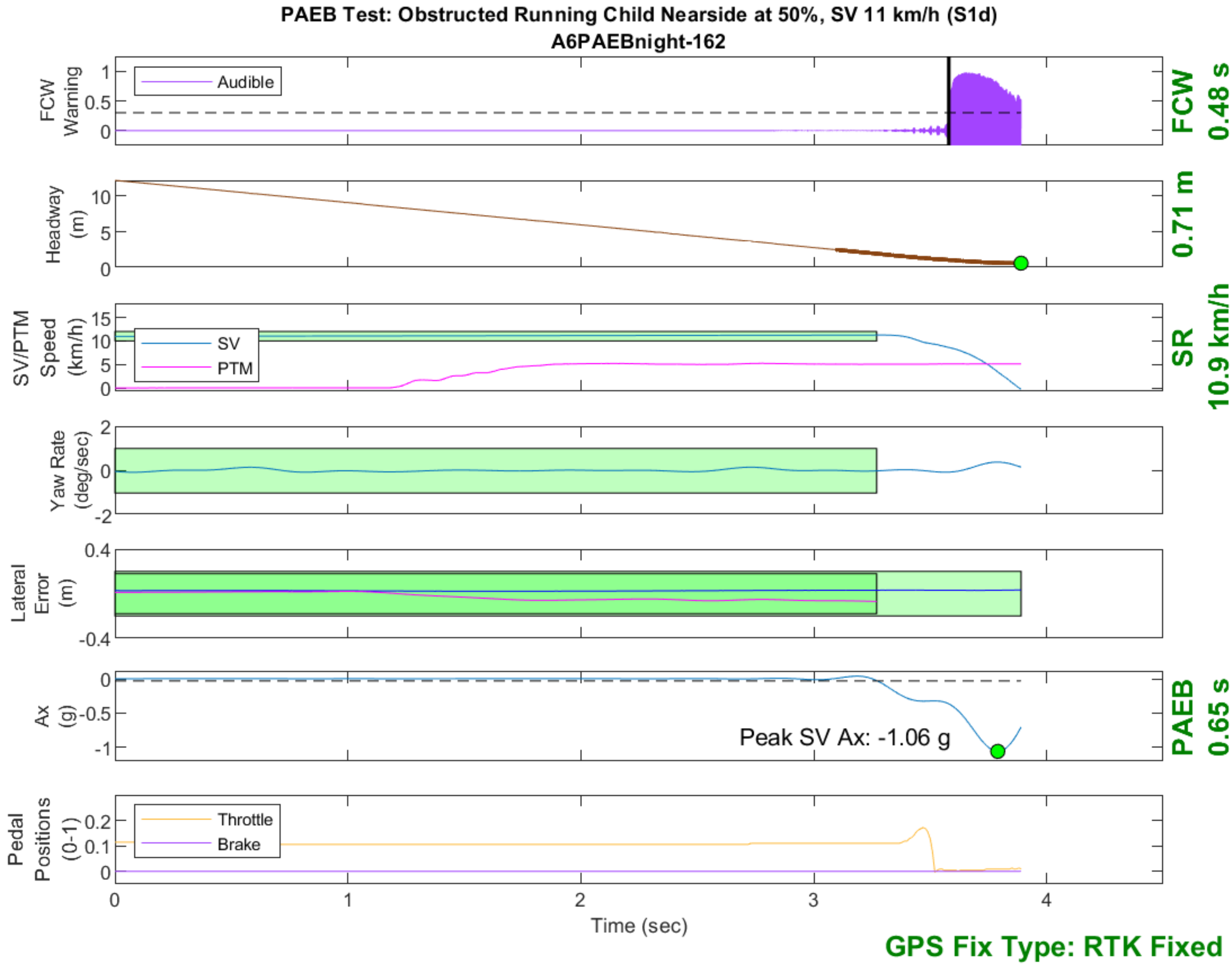


Figure D283. Time History for PAEB Run 162, S1d, Night, Low Beam, 11 km/h

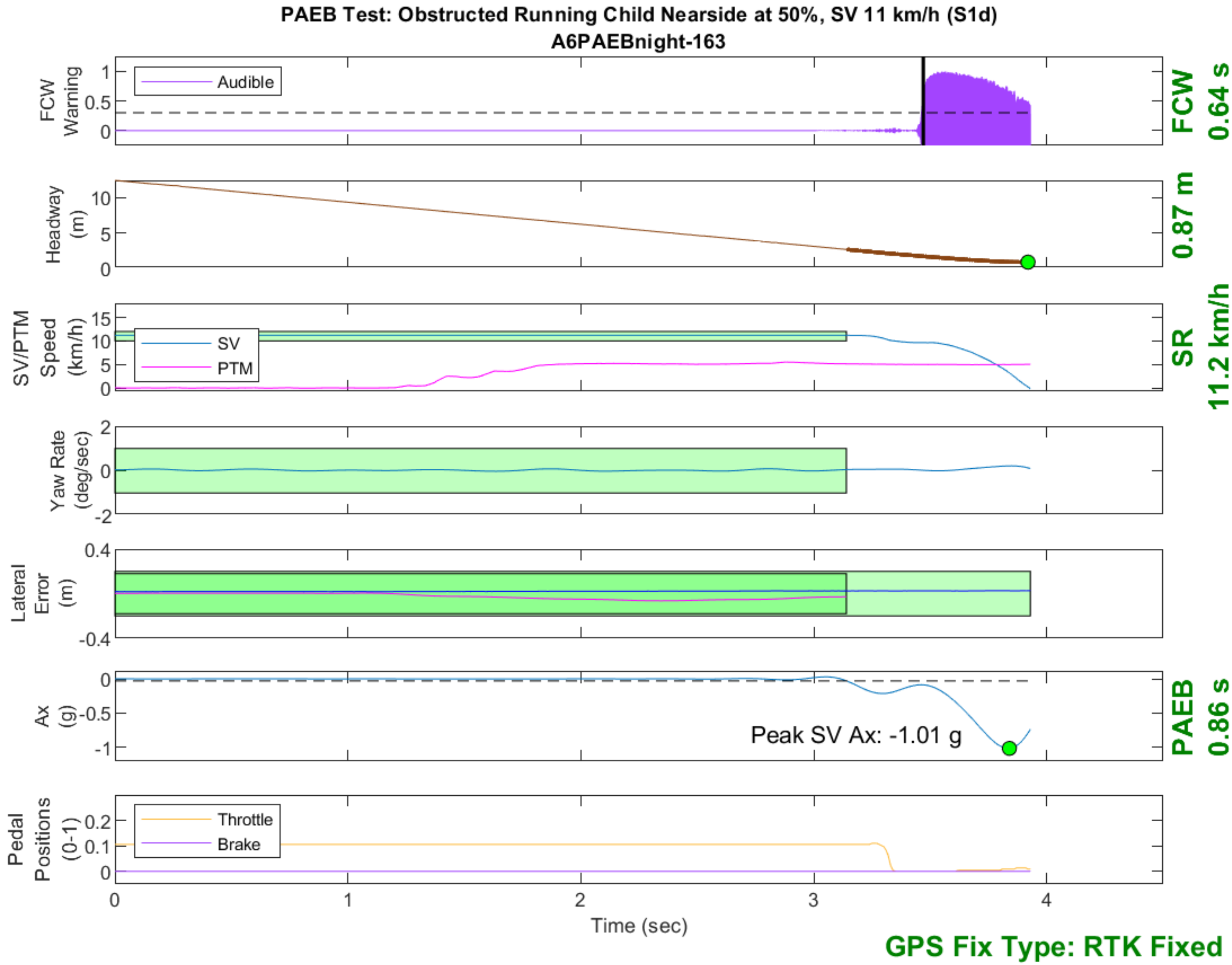


Figure D284. Time History for PAEB Run 163, S1d, Night, Low Beam, 11 km/h

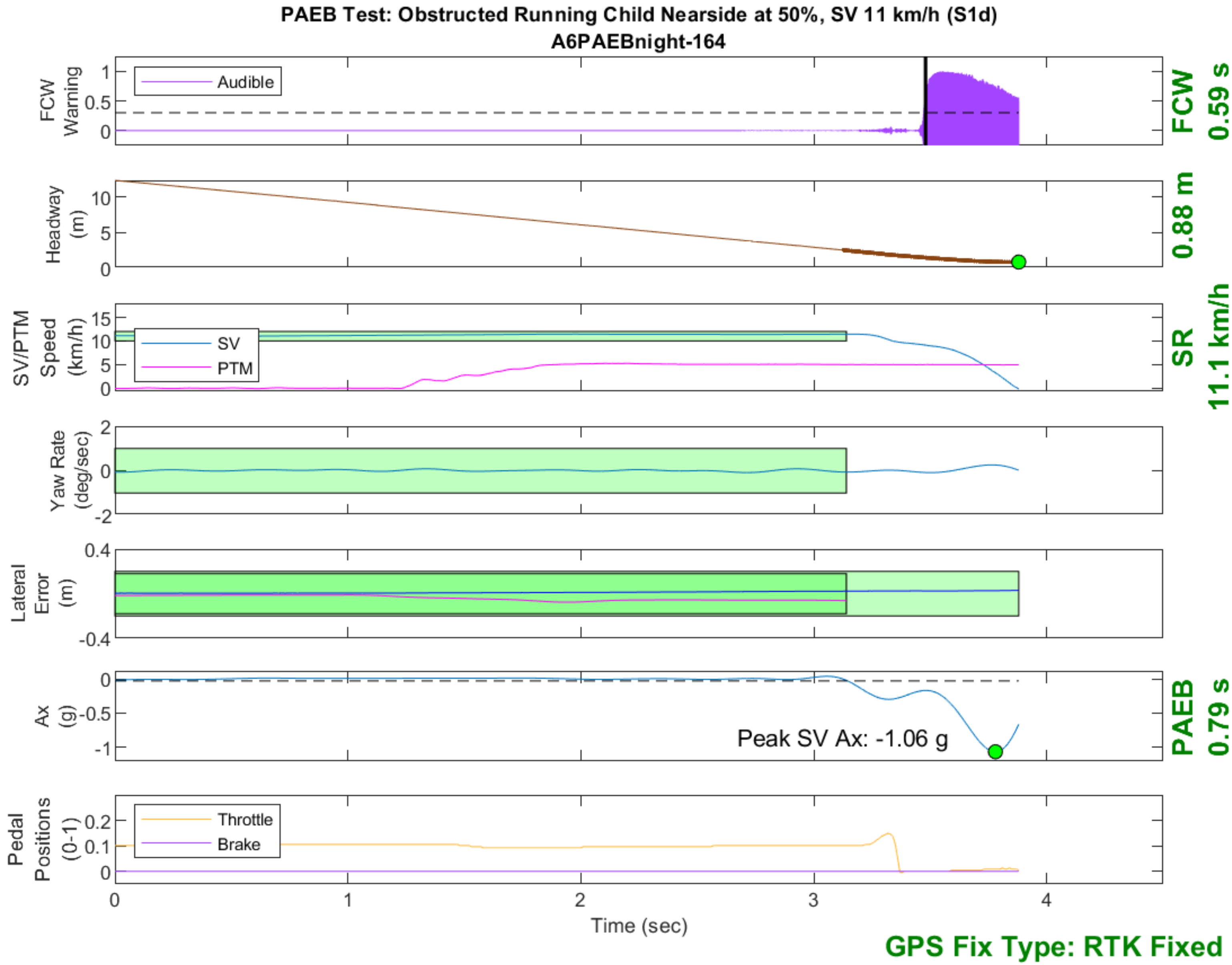


Figure D285. Time History for PAEB Run 164, S1d, Night, Low Beam, 11 km/h

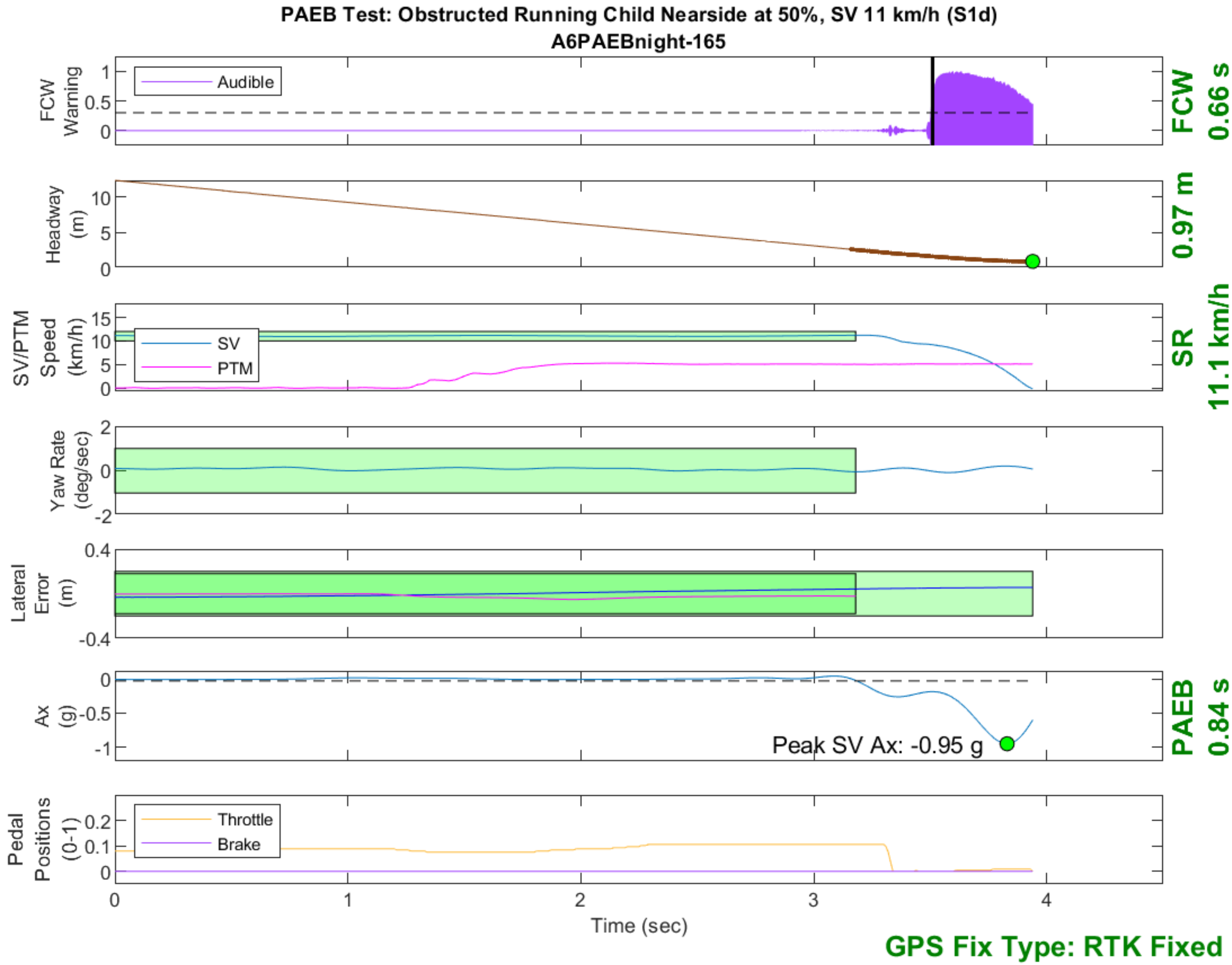


Figure D286. Time History for PAEB Run 165, S1d, Night, Low Beam, 11 km/h

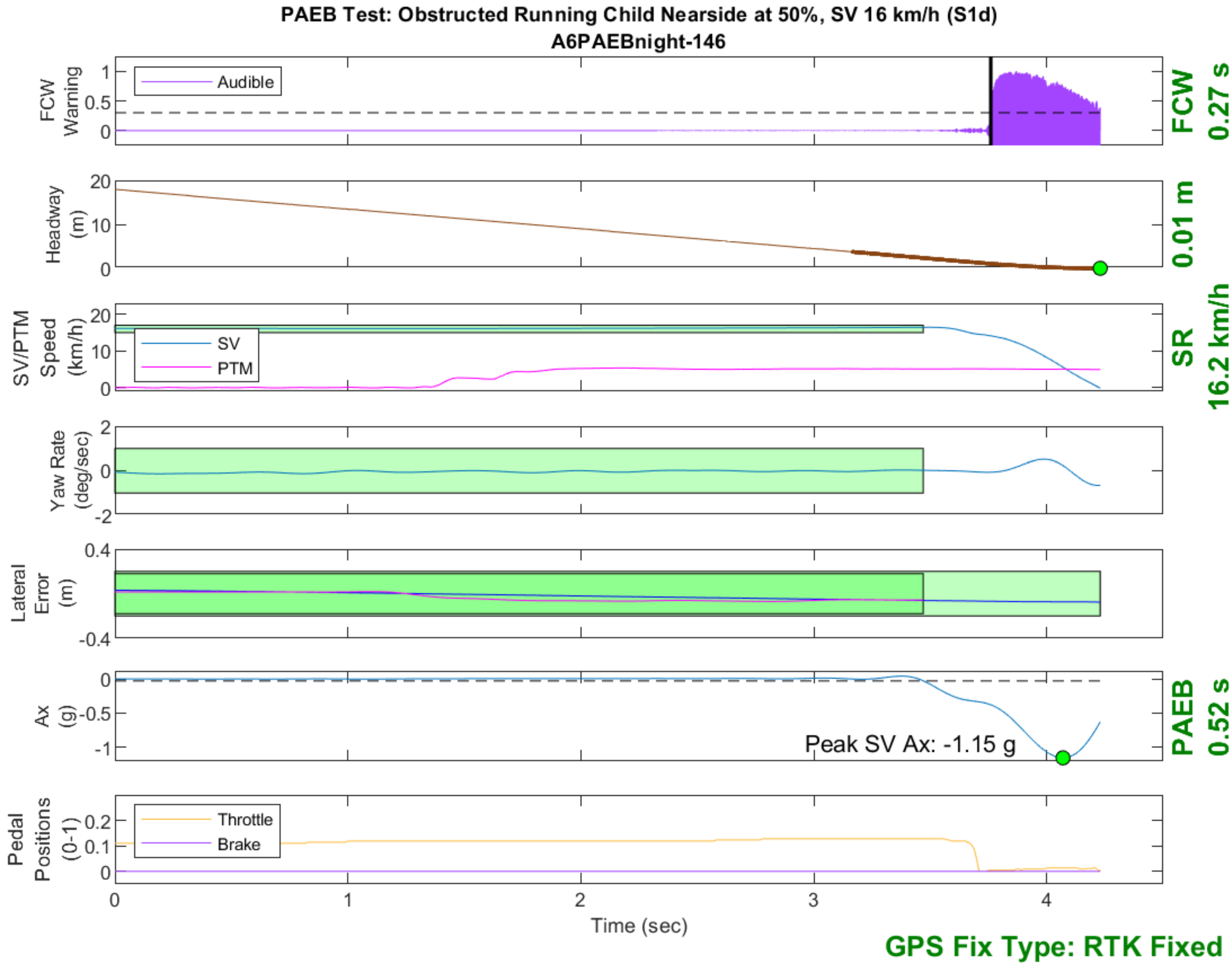


Figure D287. Time History for PAEB Run 146, S1d, Night, Low Beam, 16 km/h

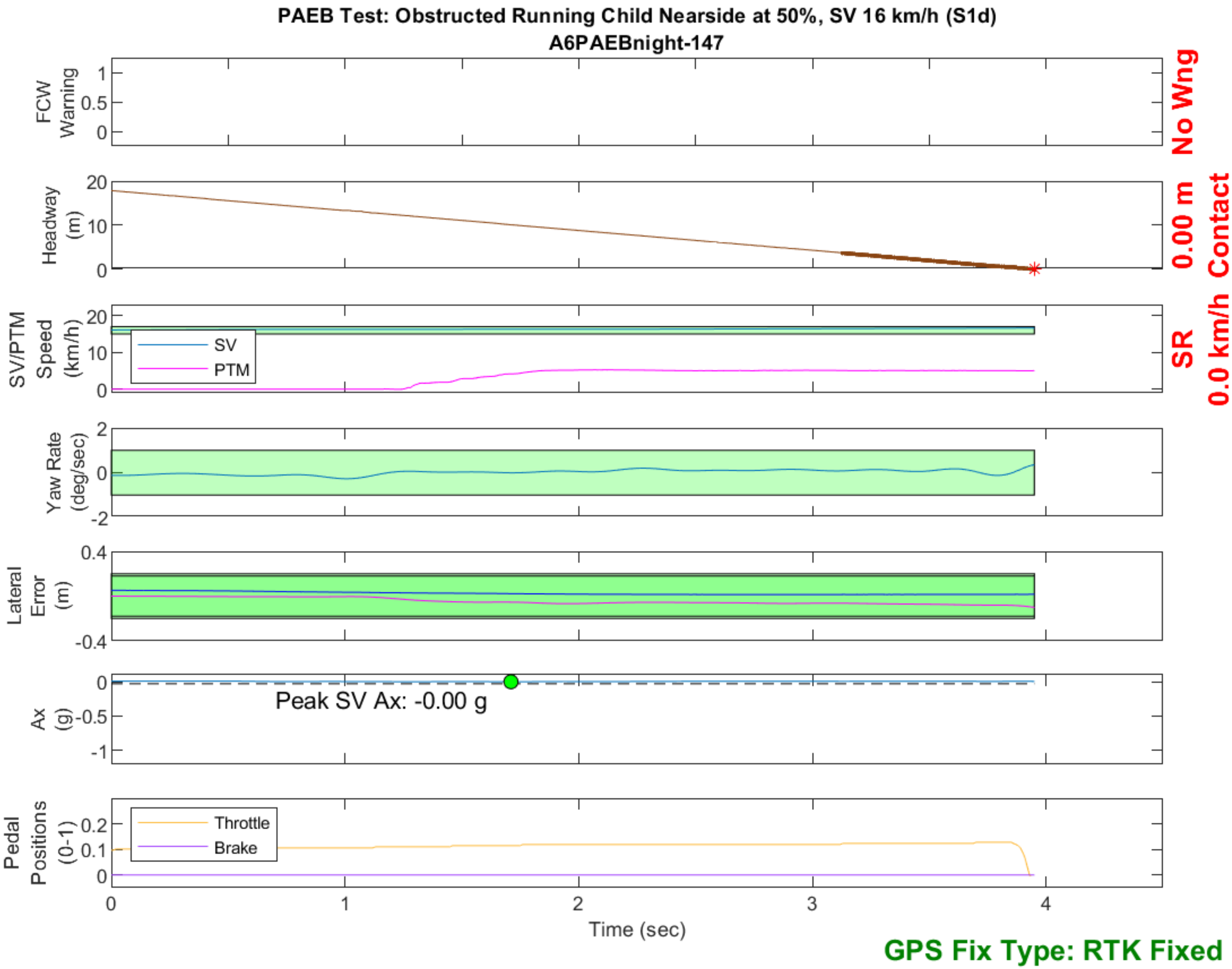


Figure D288. Time History for PAEB Run 147, S1d, Night, Low Beam, 16 km/h

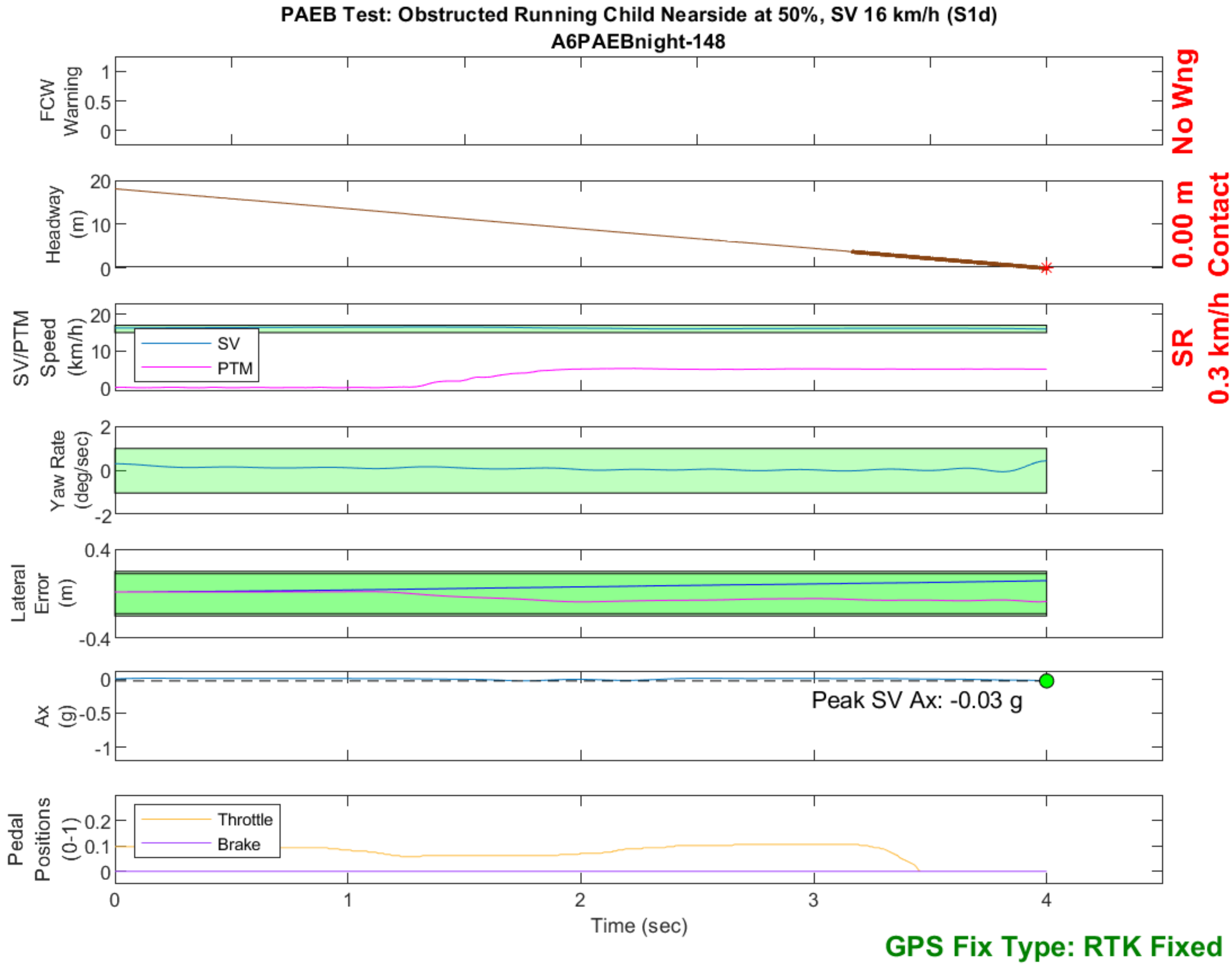


Figure D289. Time History for PAEB Run 148, S1d, Night, Low Beam, 16 km/h

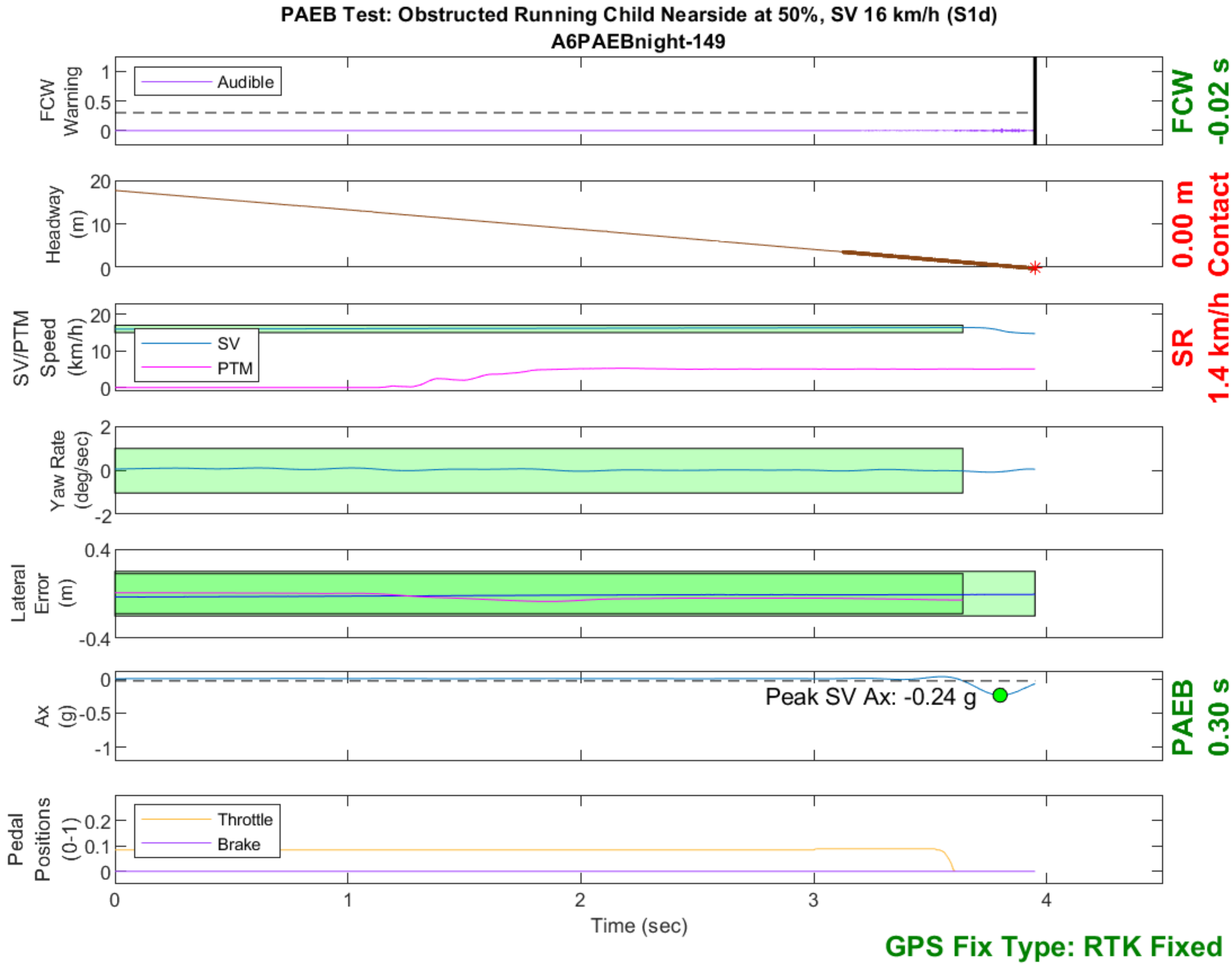


Figure D290. Time History for PAEB Run 149, S1d, Night, Low Beam, 16 km/h

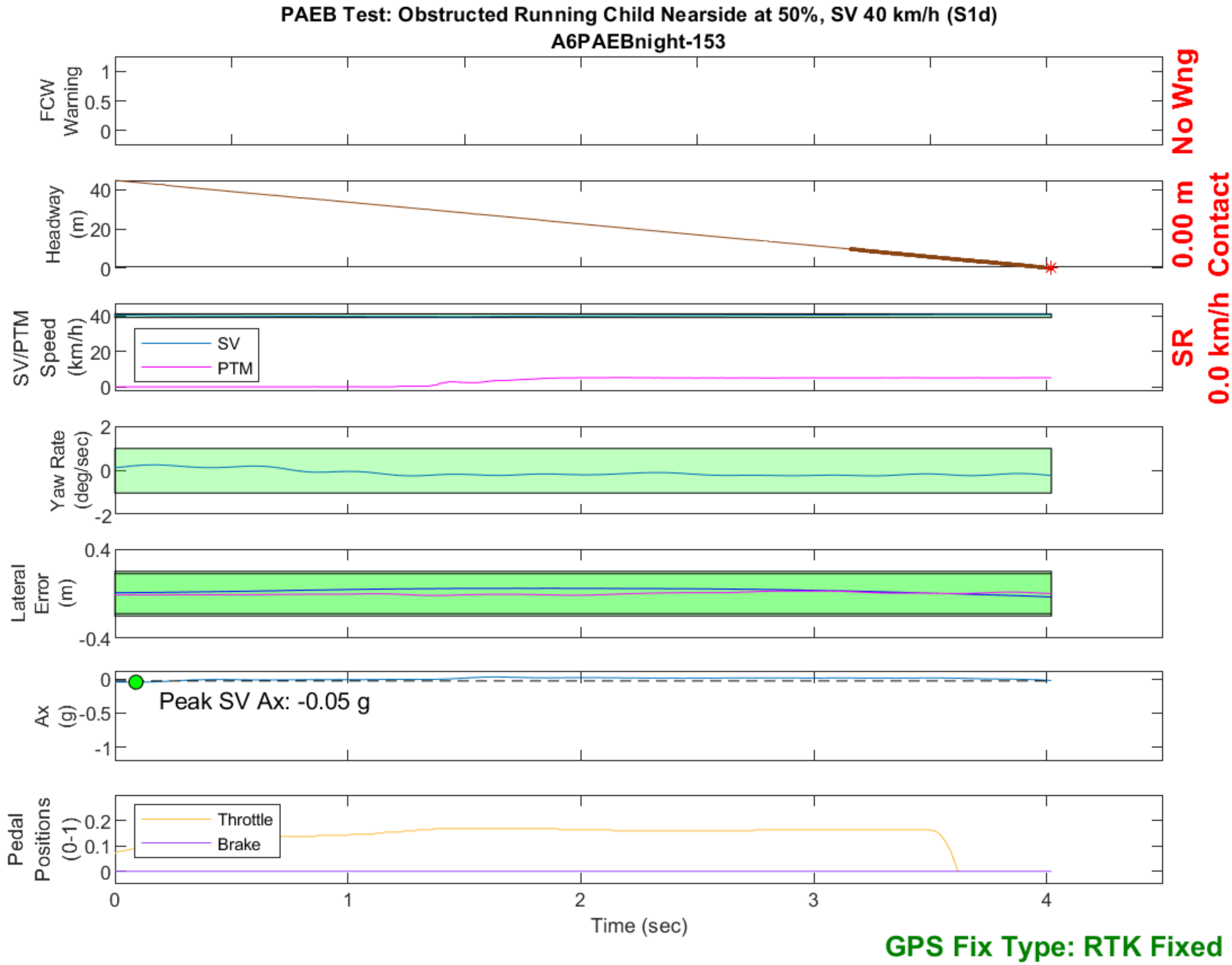


Figure D291. Time History for PAEB Run 153, S1d, Night, Low Beam, 40 km/h

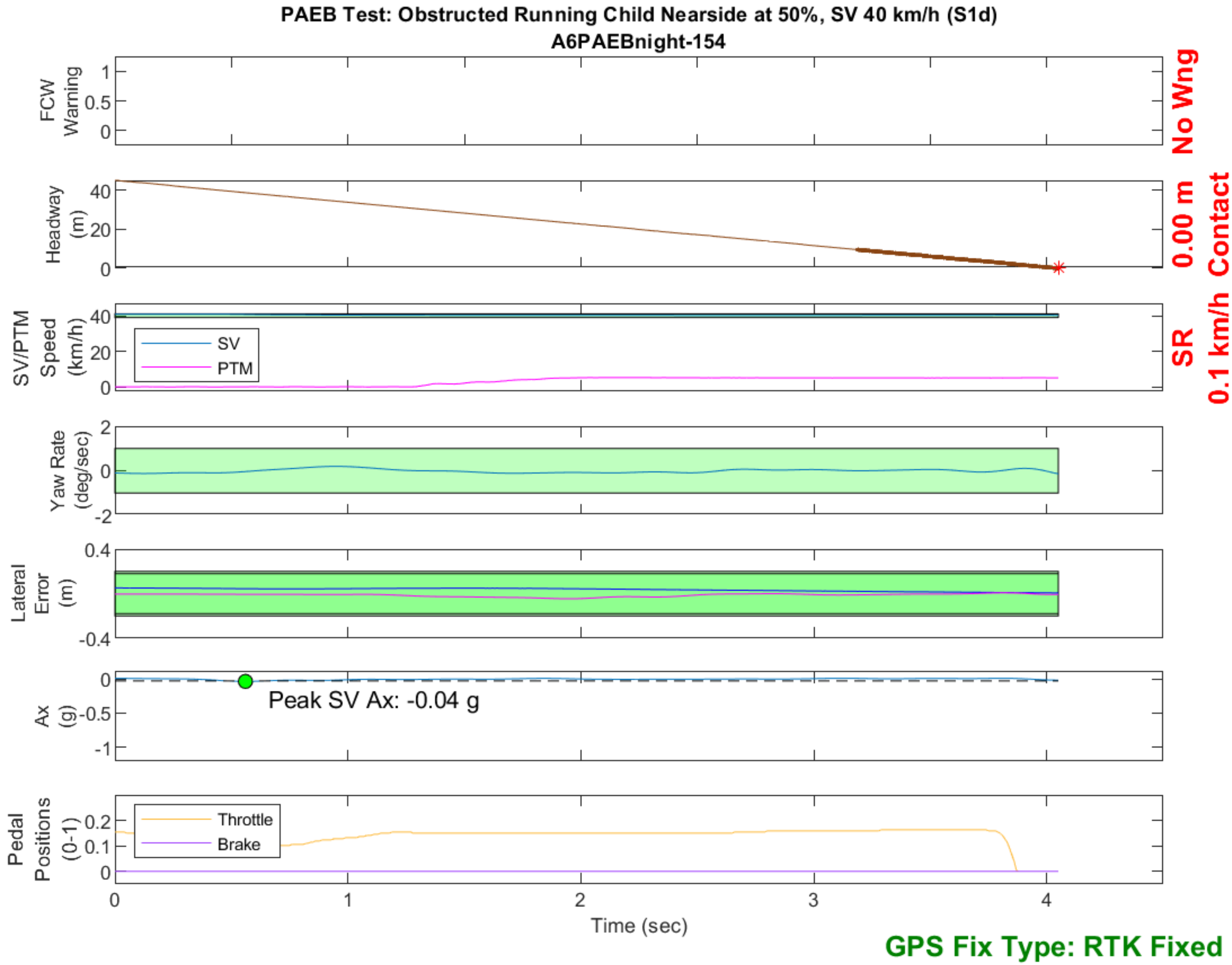


Figure D292. Time History for PAEB Run 154, S1d, Night, Low Beam, 40 km/h

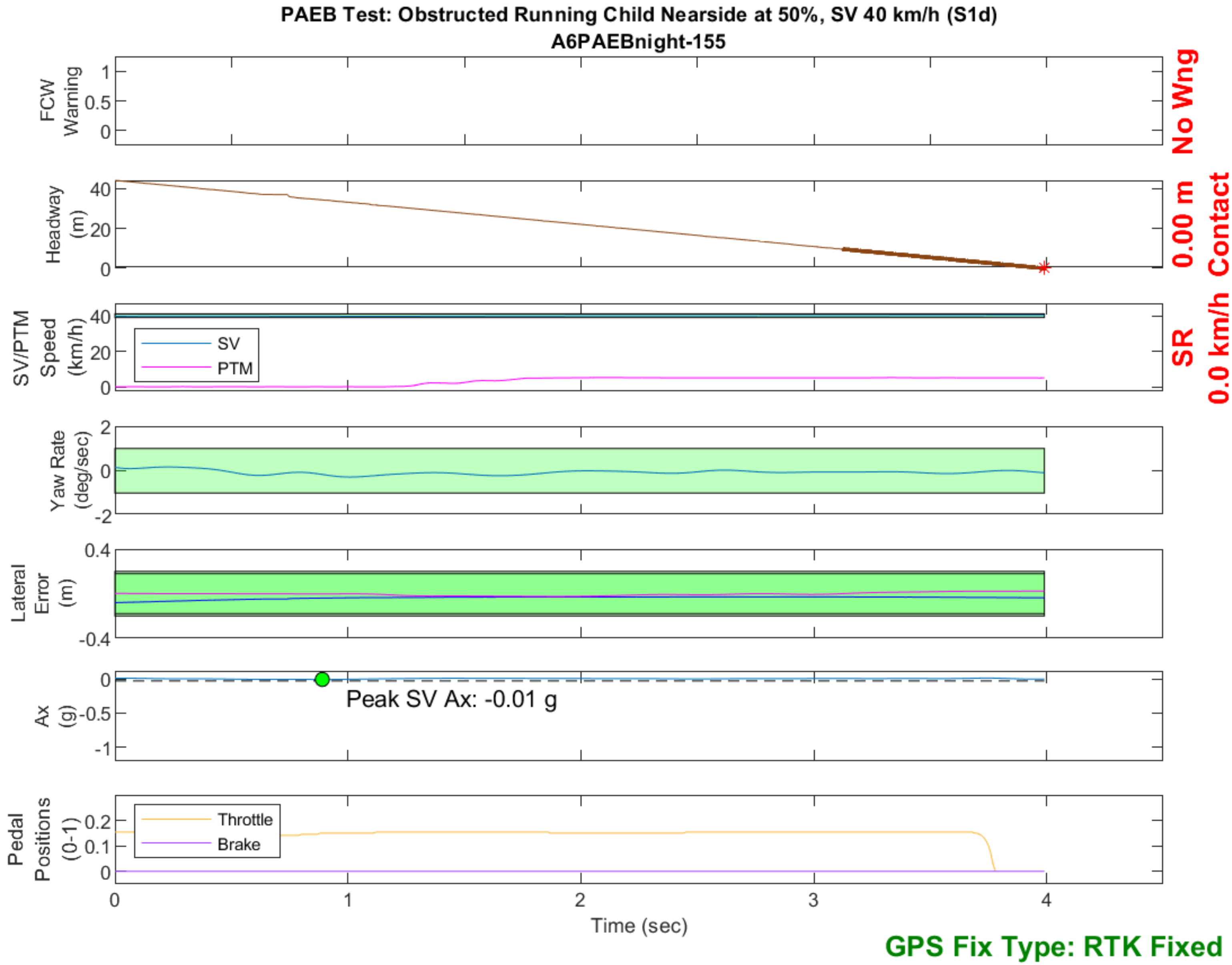


Figure D293. Time History for PAEB Run 155, S1d, Night, Low Beam, 40 km/h

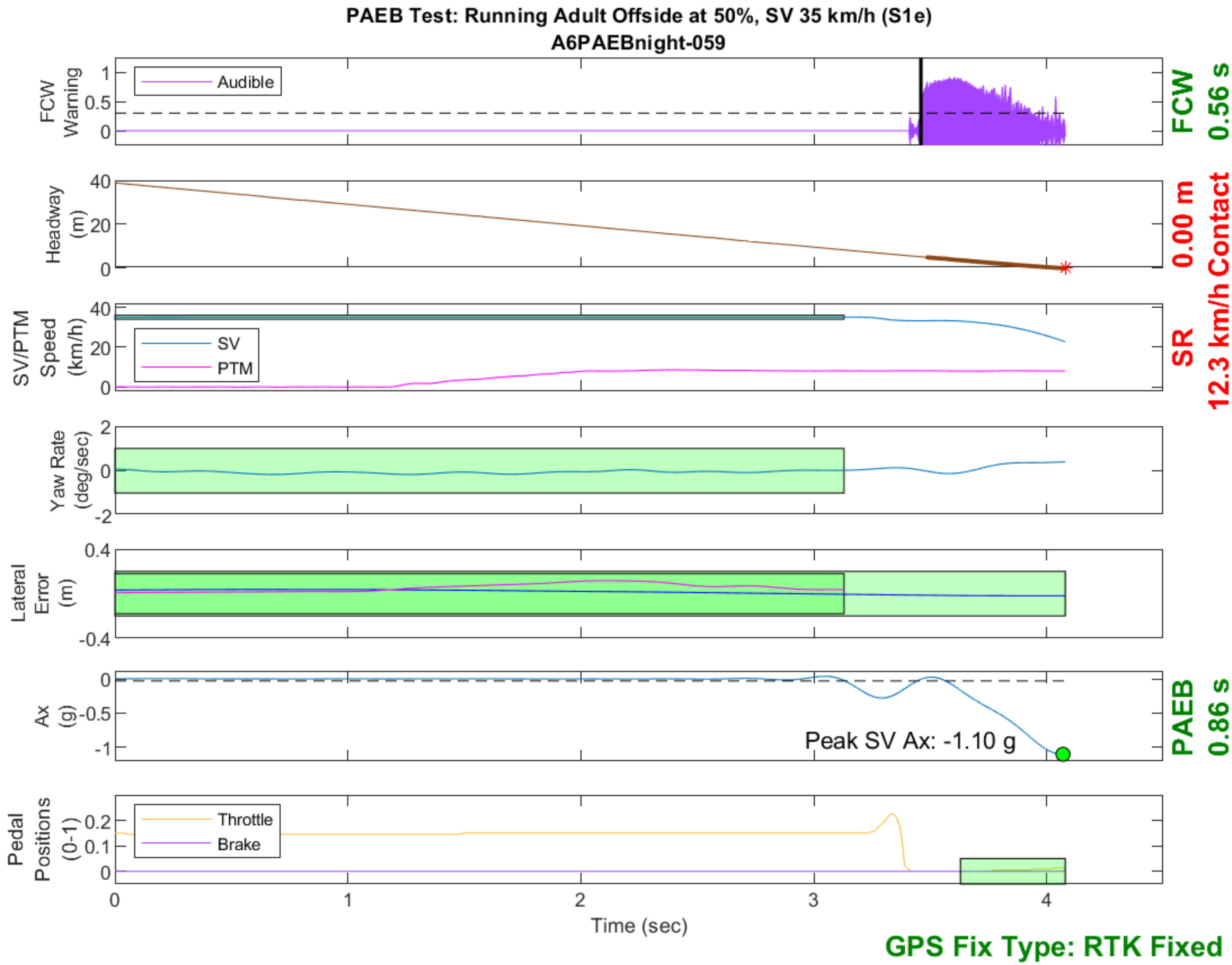


Figure D294. Time History for PAEB Run 59, S1e, Night, Low Beam, 35 km/h

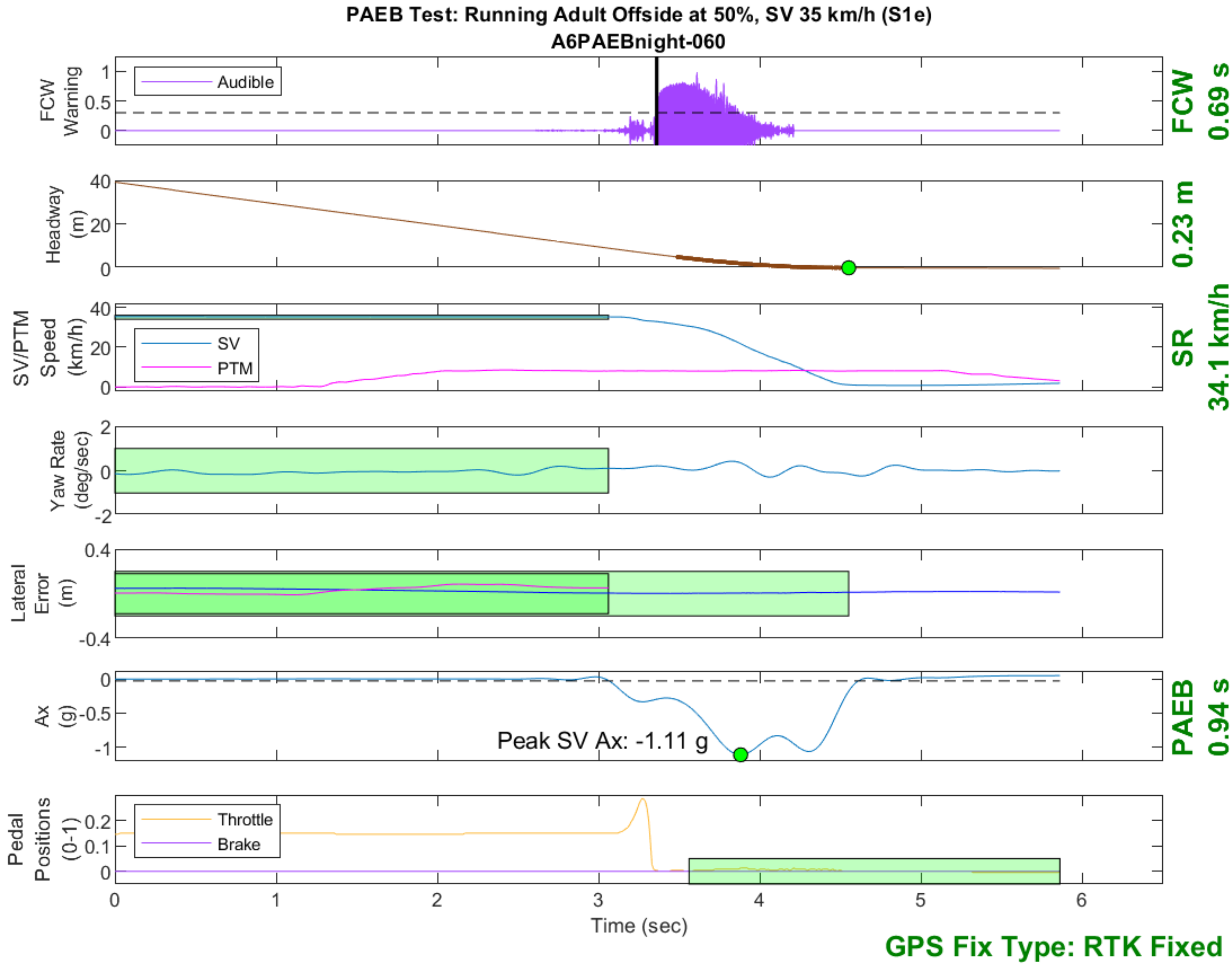


Figure D295. Time History for PAEB Run 60, S1e, Night, Low Beam, 35 km/h

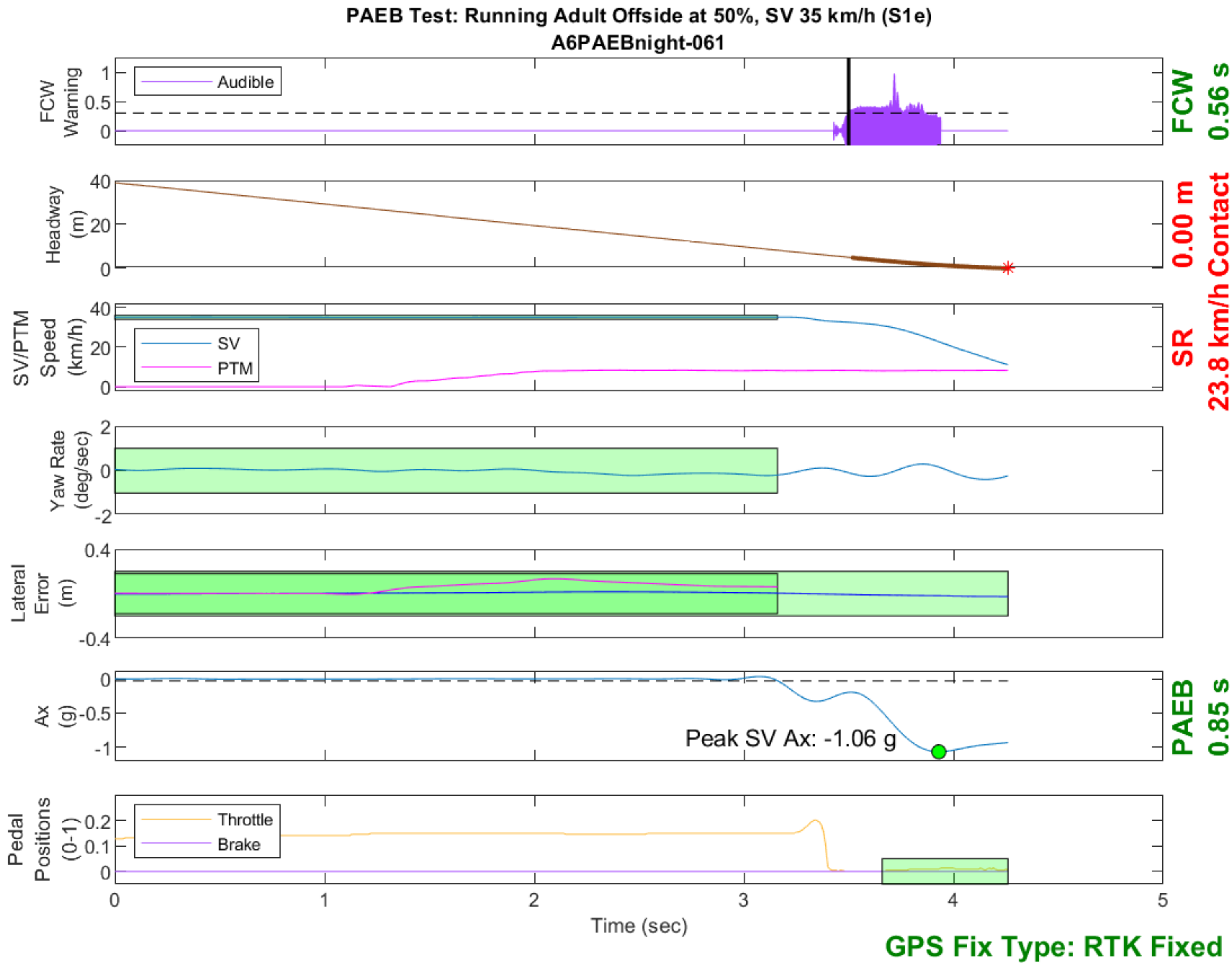


Figure D296. Time History for PAEB Run 61, S1e, Night, Low Beam, 35 km/h

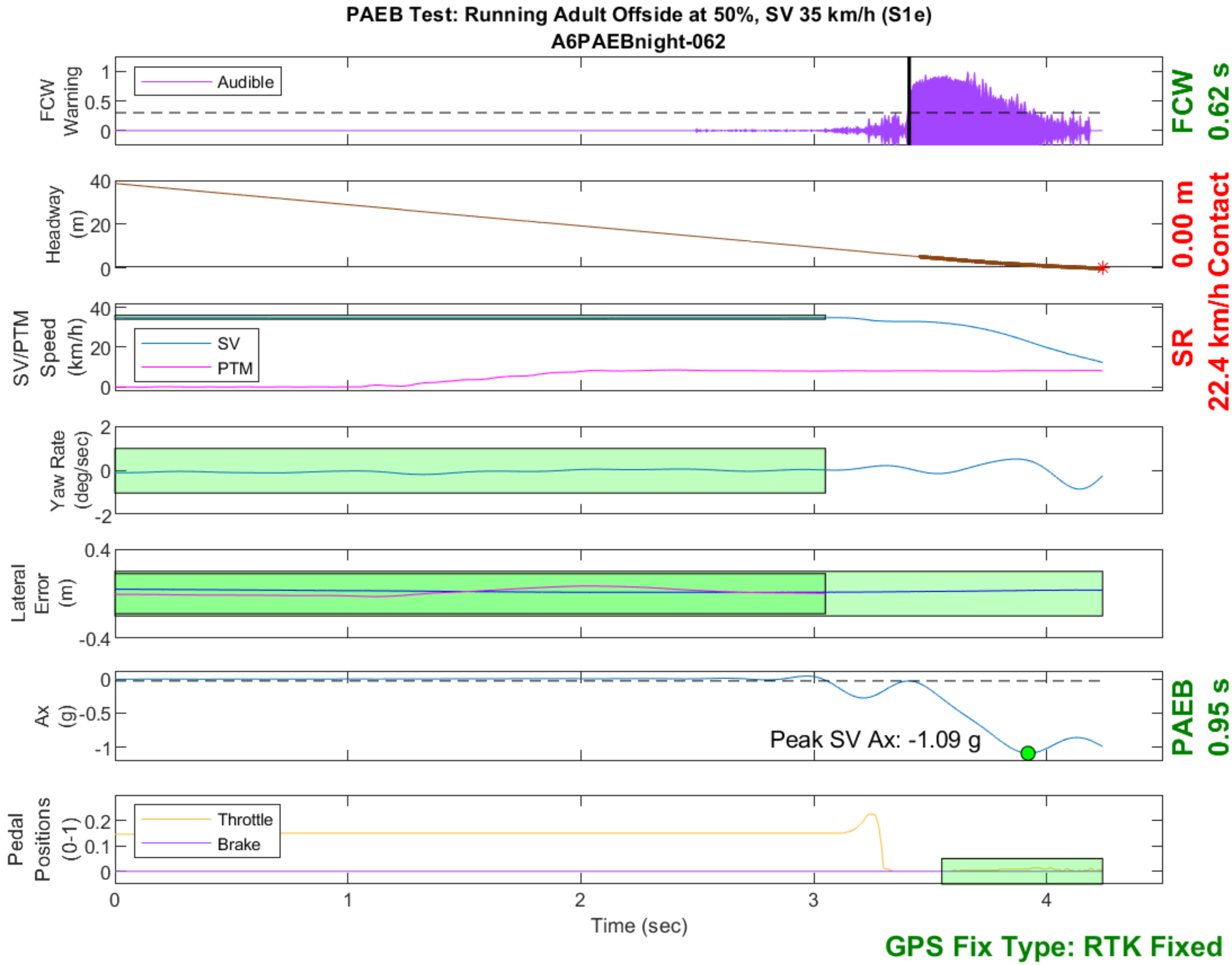


Figure D297. Time History for PAEB Run 62, S1e, Night, Low Beam, 35 km/h

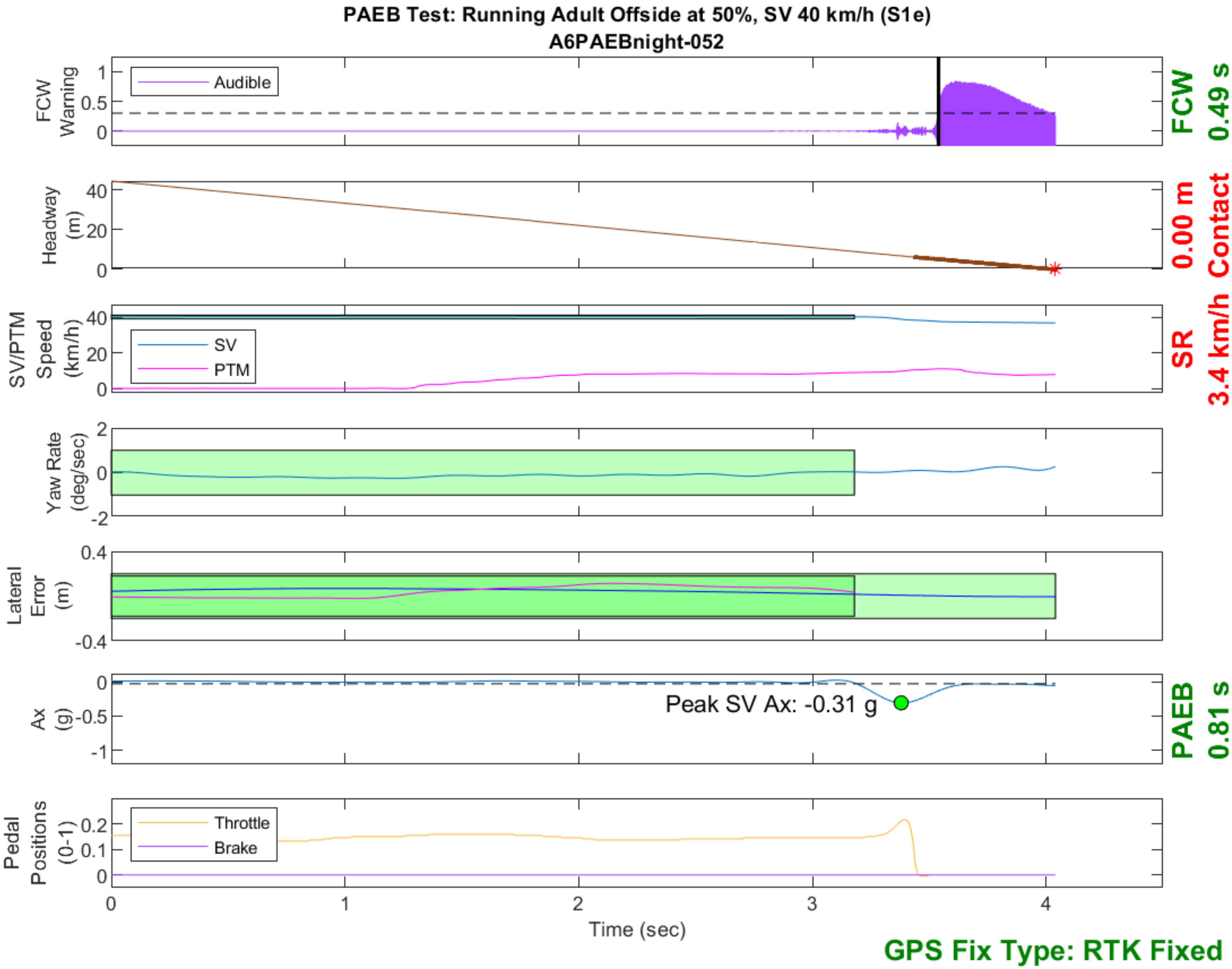


Figure D298. Time History for PAEB Run 52, S1e, Night, Low Beam, 40 km/h

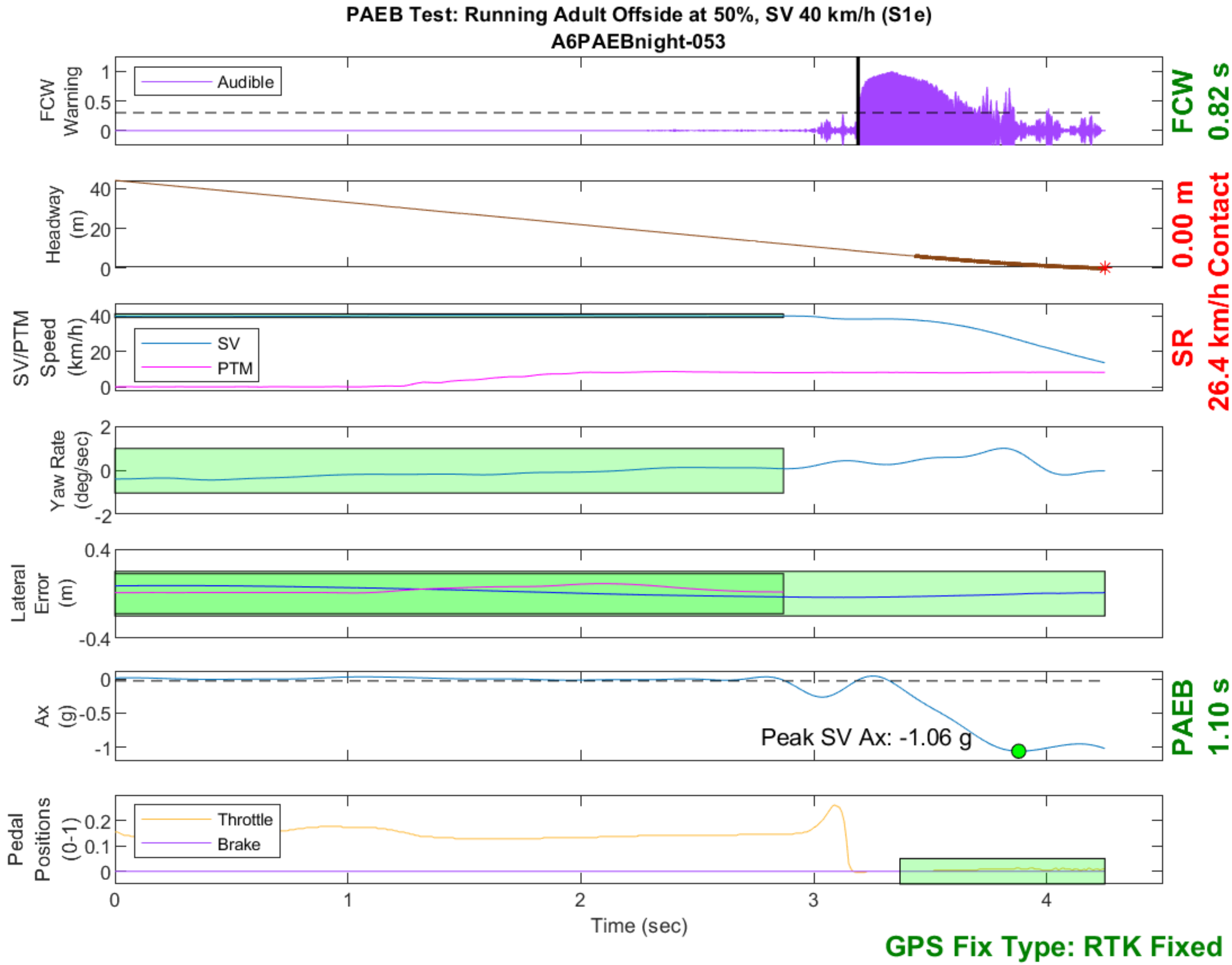


Figure D299. Time History for PAEB Run 53, S1e, Night, Low Beam, 40 km/h

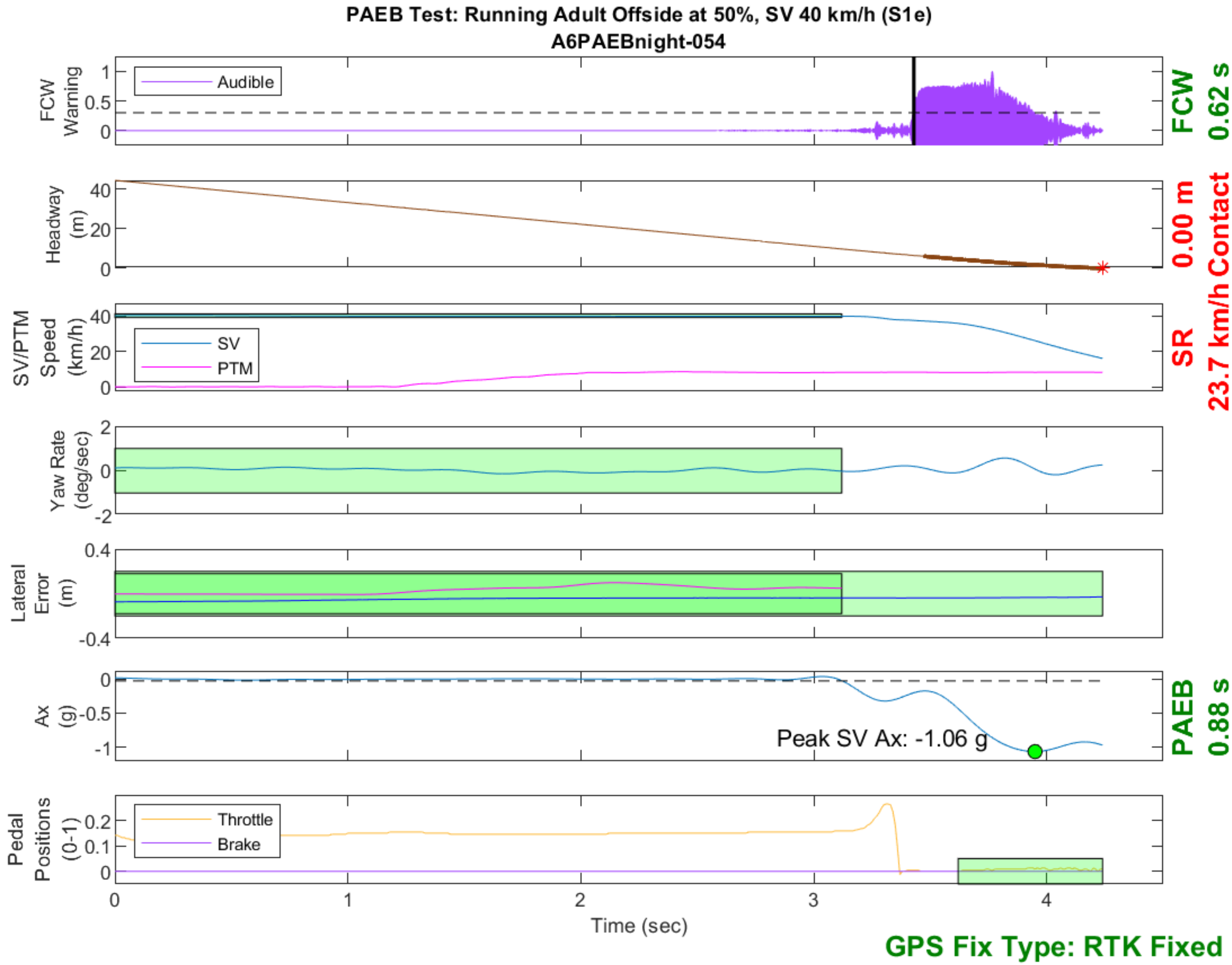


Figure D300. Time History for PAEB Run 54, S1e, Night, Low Beam, 40 km/h

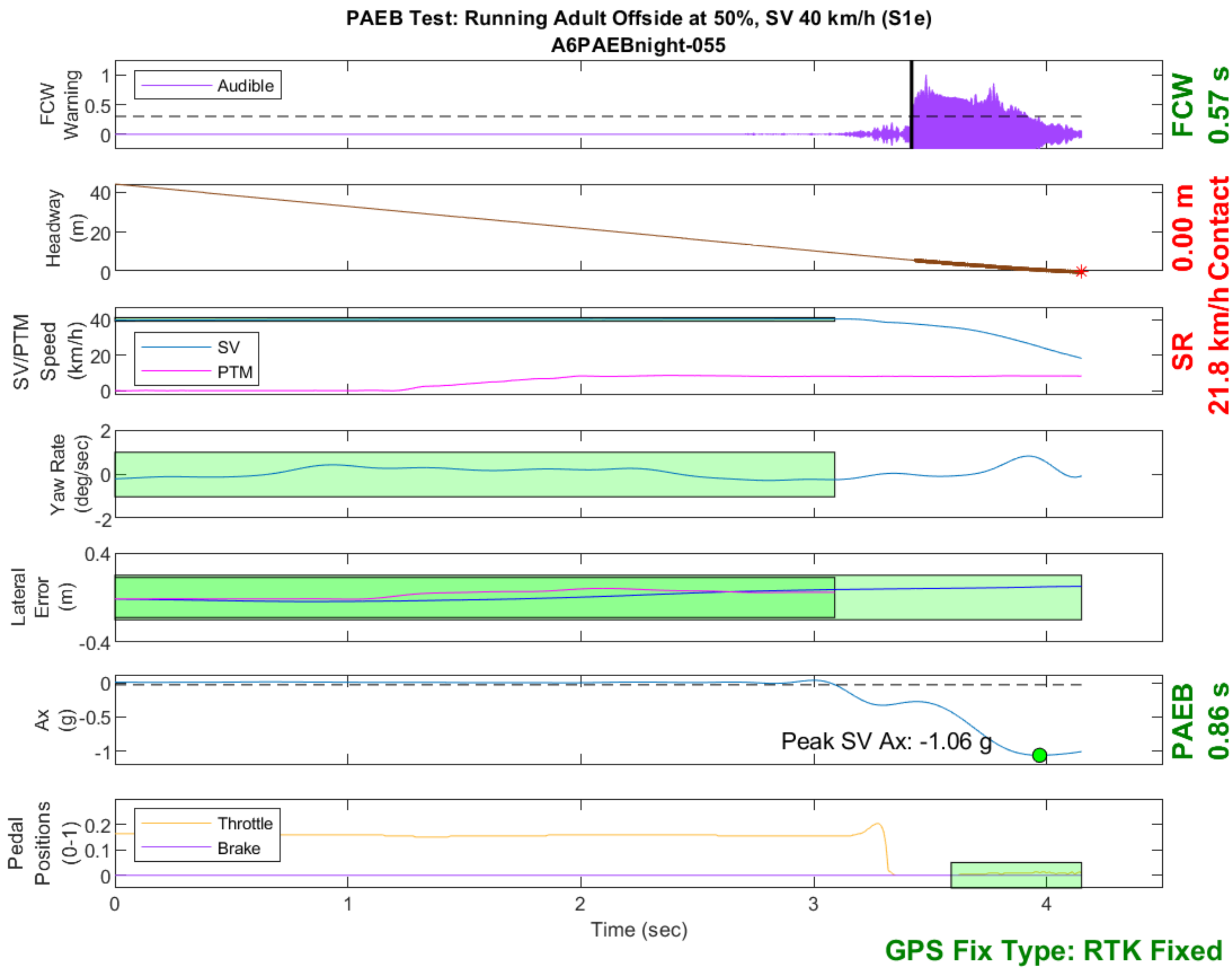


Figure D301. Time History for PAEB Run 55, S1e, Night, Low Beam, 40 km/h

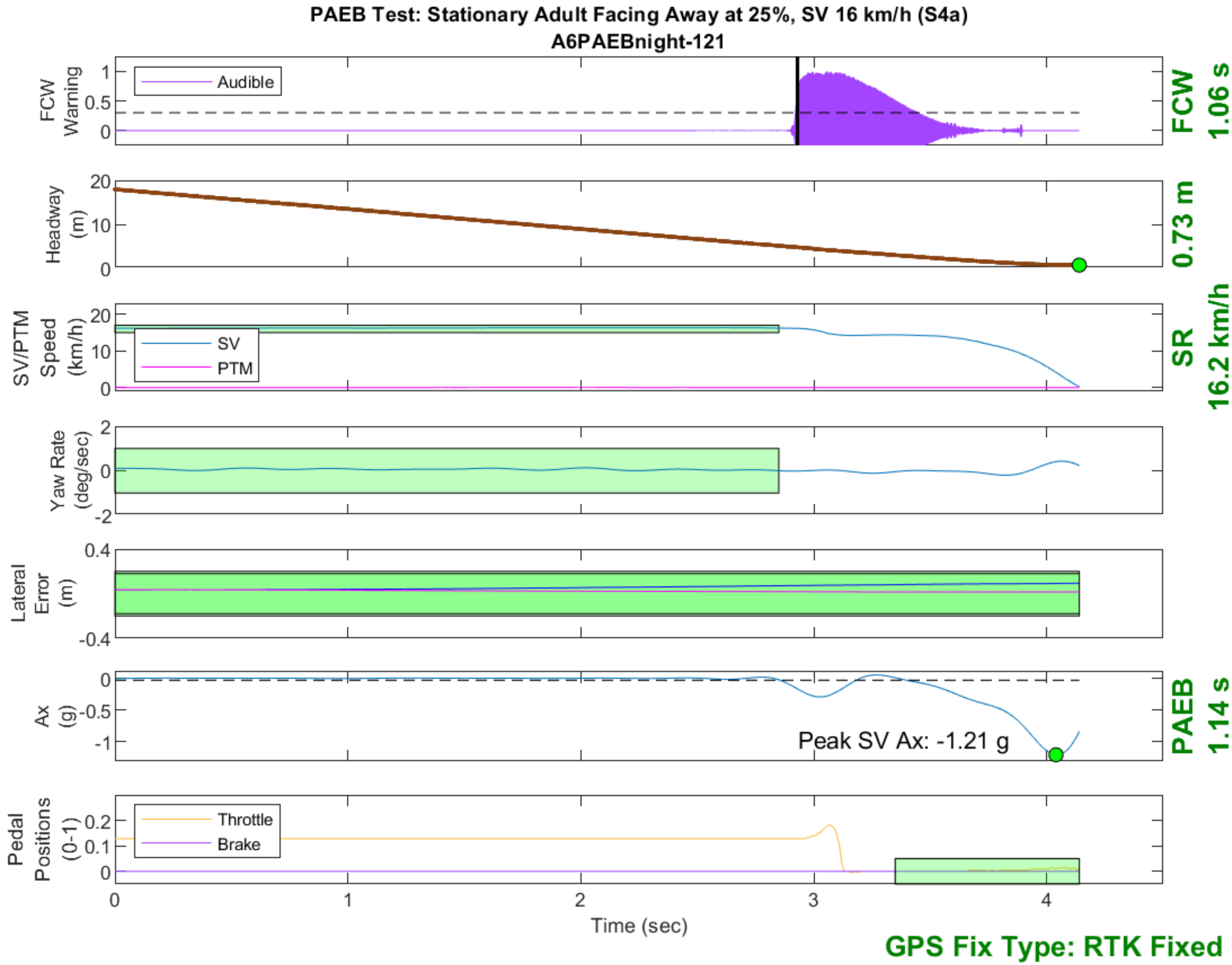


Figure D302. Time History for PAEB Run 121, S4a, Night, Low Beam, 16 km/h

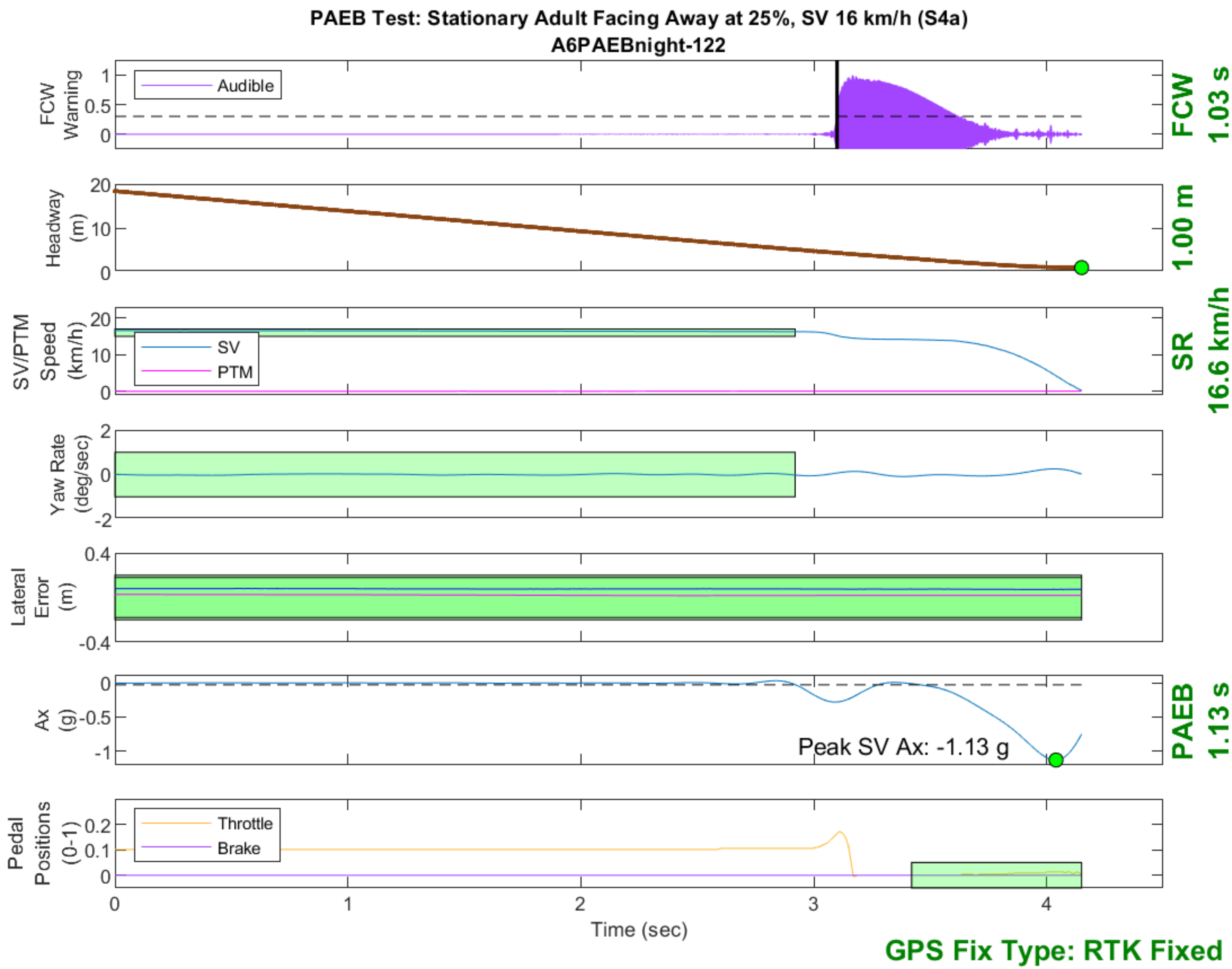


Figure D303. Time History for PAEB Run 122, S4a, Night, Low Beam, 16 km/h

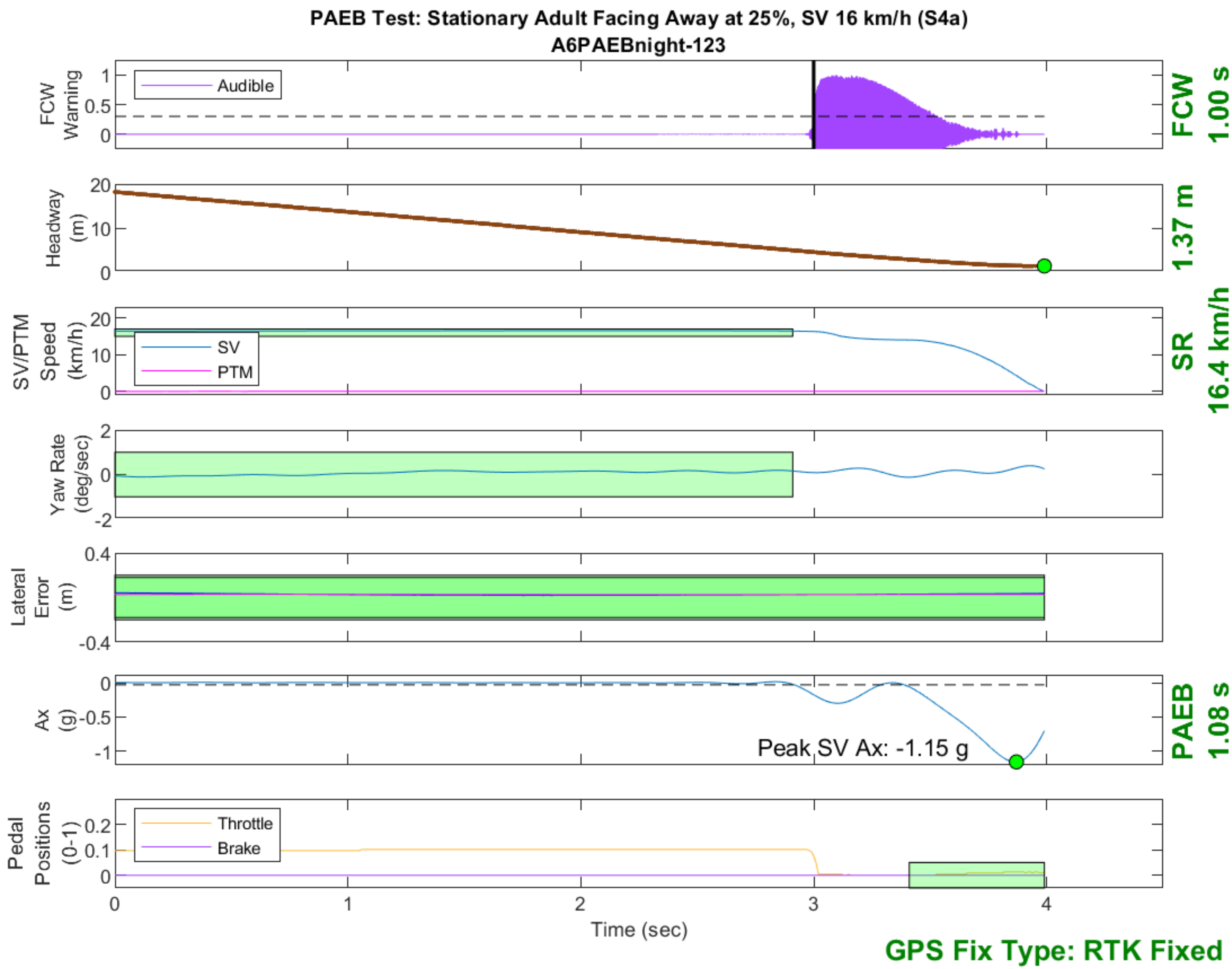


Figure D304. Time History for PAEB Run 123, S4a, Night, Low Beam, 16 km/h

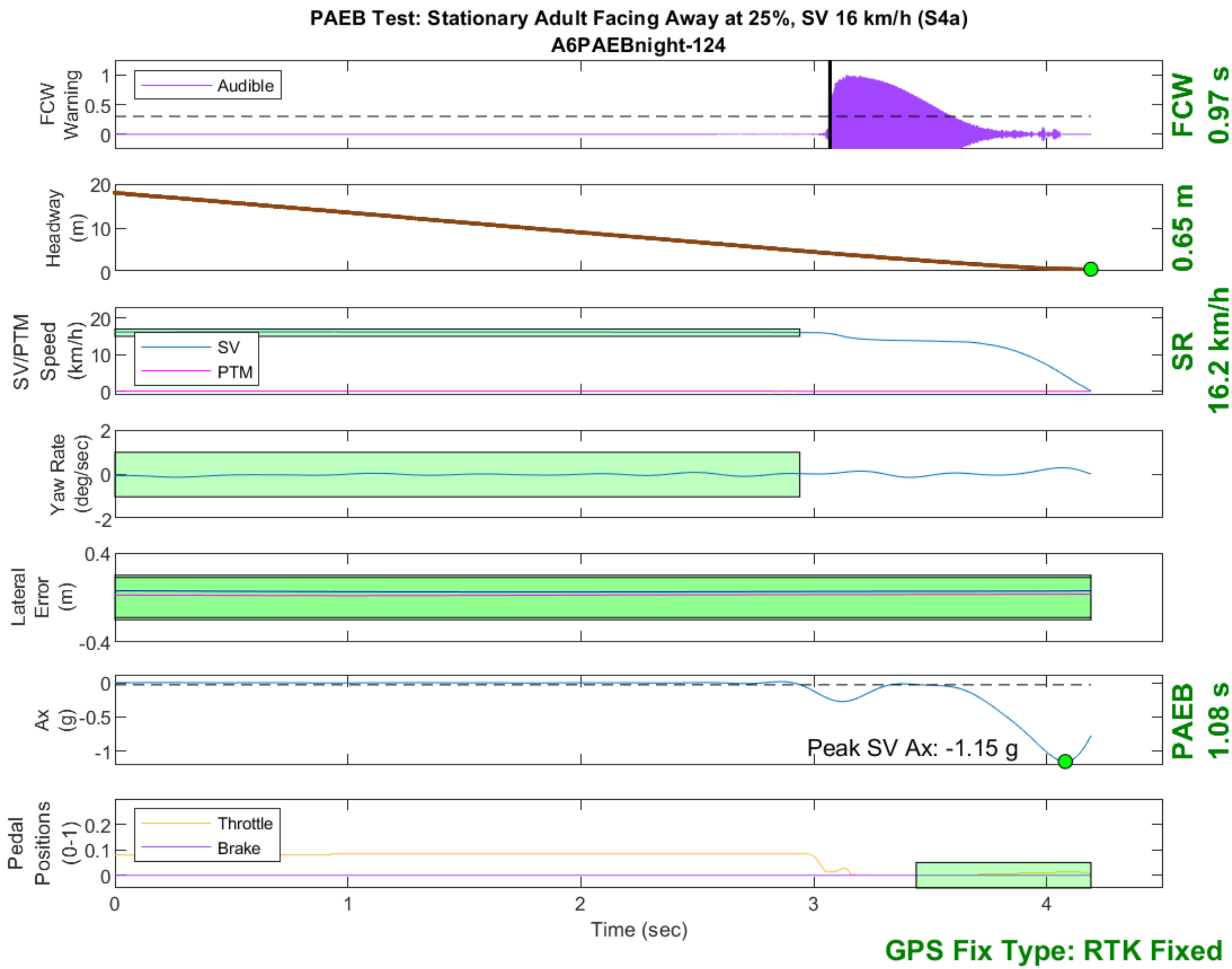


Figure D305. Time History for PAEB Run 124, S4a, Night, Low Beam, 16 km/h

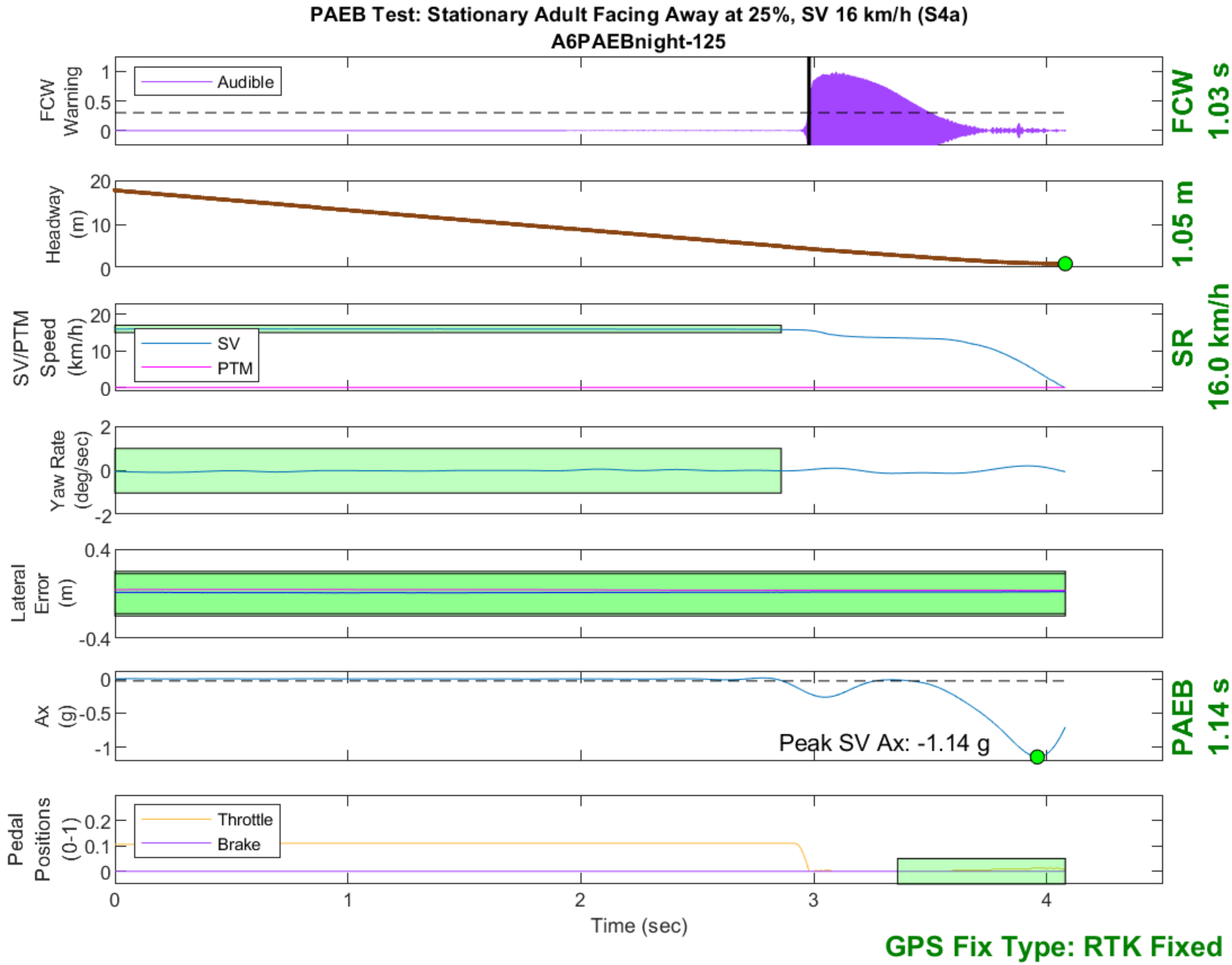


Figure D306. Time History for PAEB Run 125, S4a, Night, Low Beam, 16 km/h

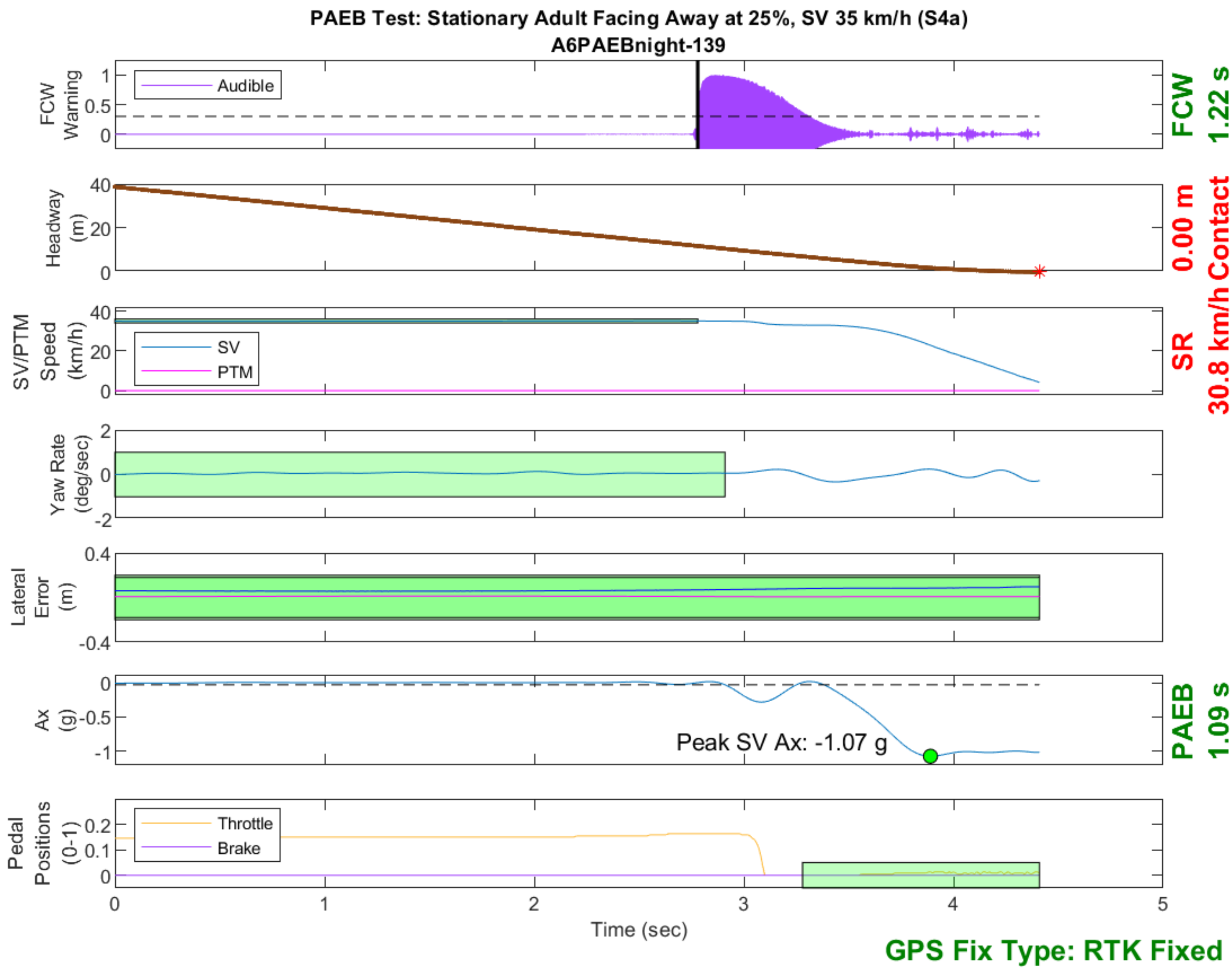


Figure D307. Time History for PAEB Run 139, S4a, Night, Low Beam, 35 km/h

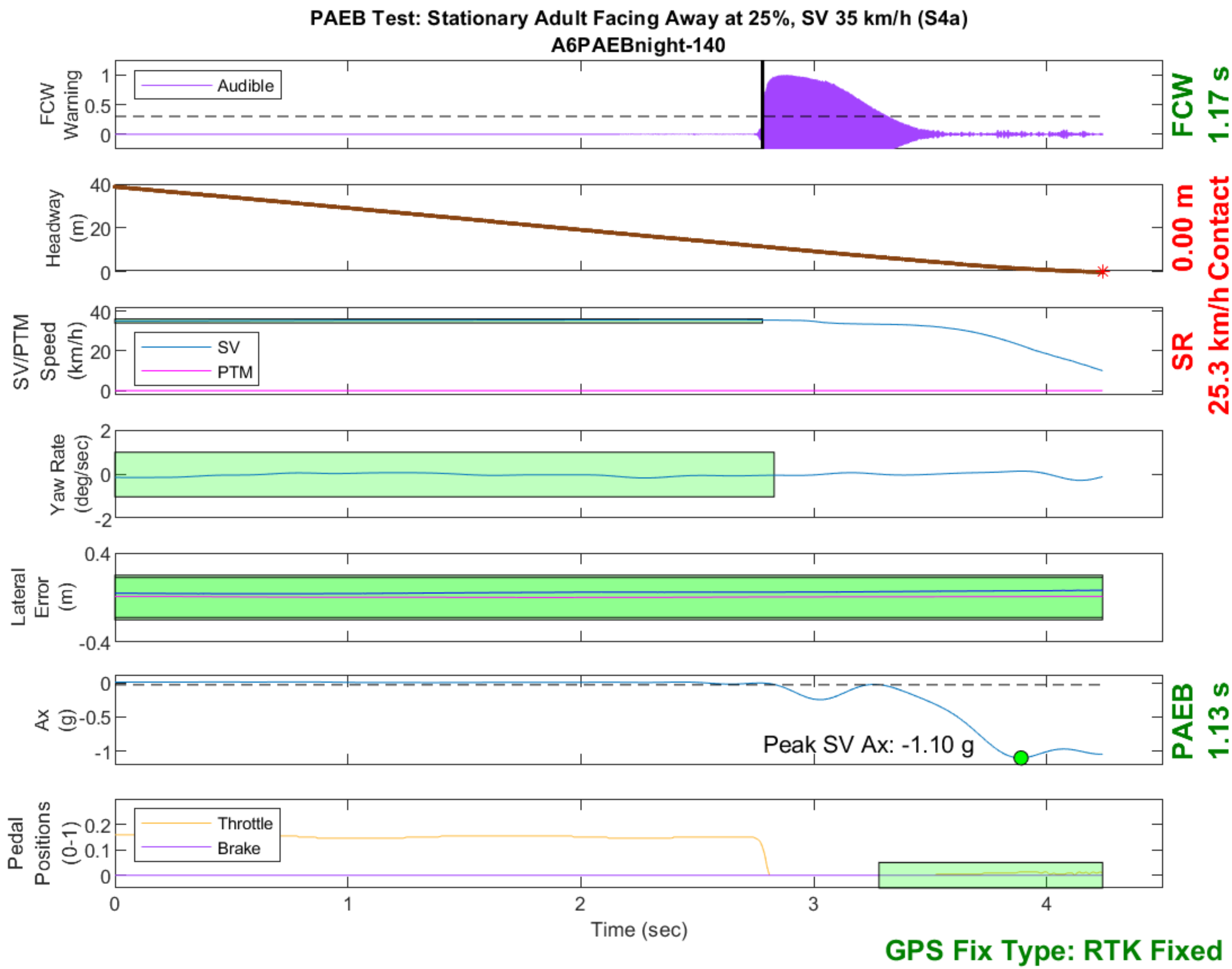


Figure D308. Time History for PAEB Run 140, S4a, Night, Low Beam, 35 km/h

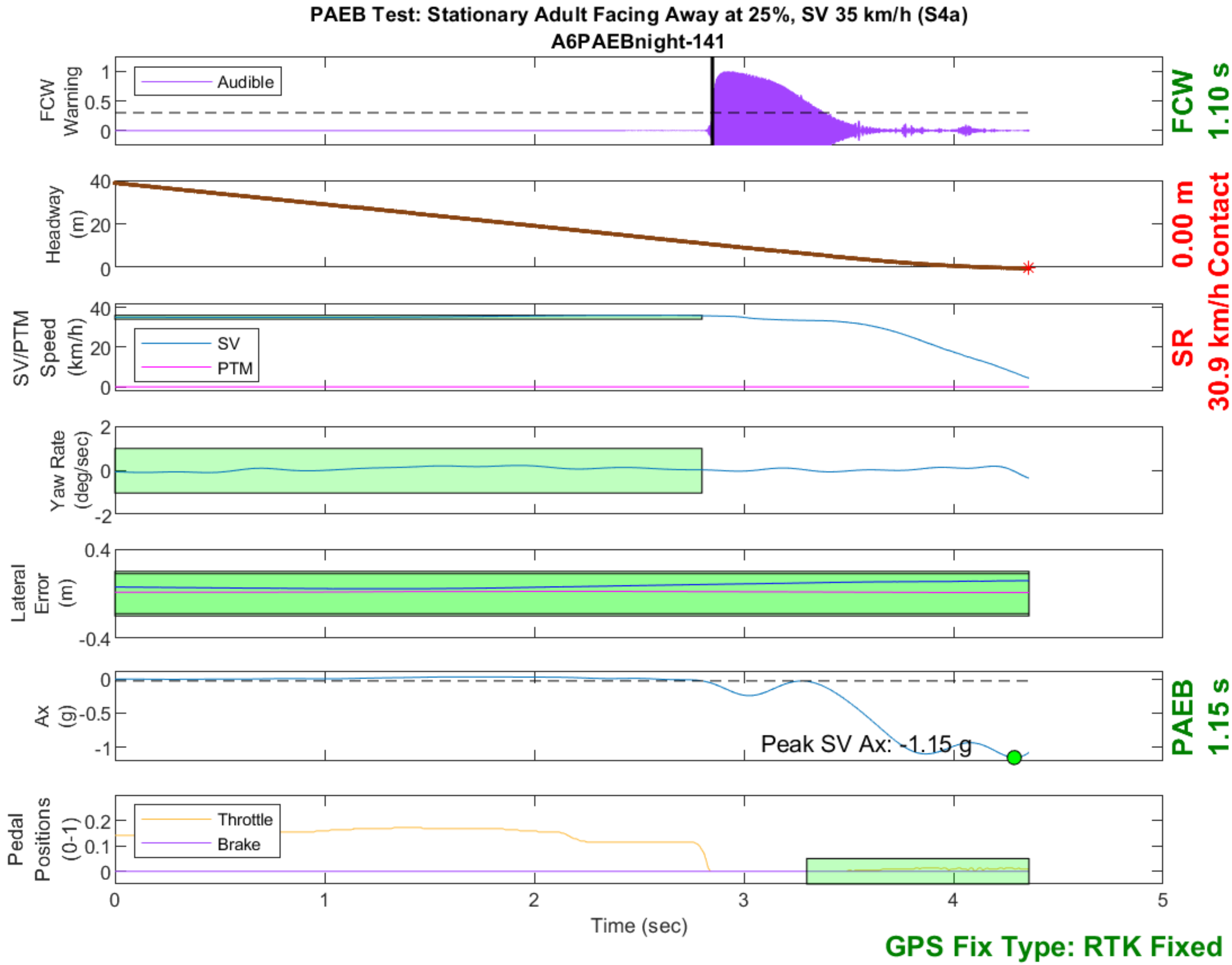


Figure D309. Time History for PAEB Run 141, S4a, Night, Low Beam, 35 km/h

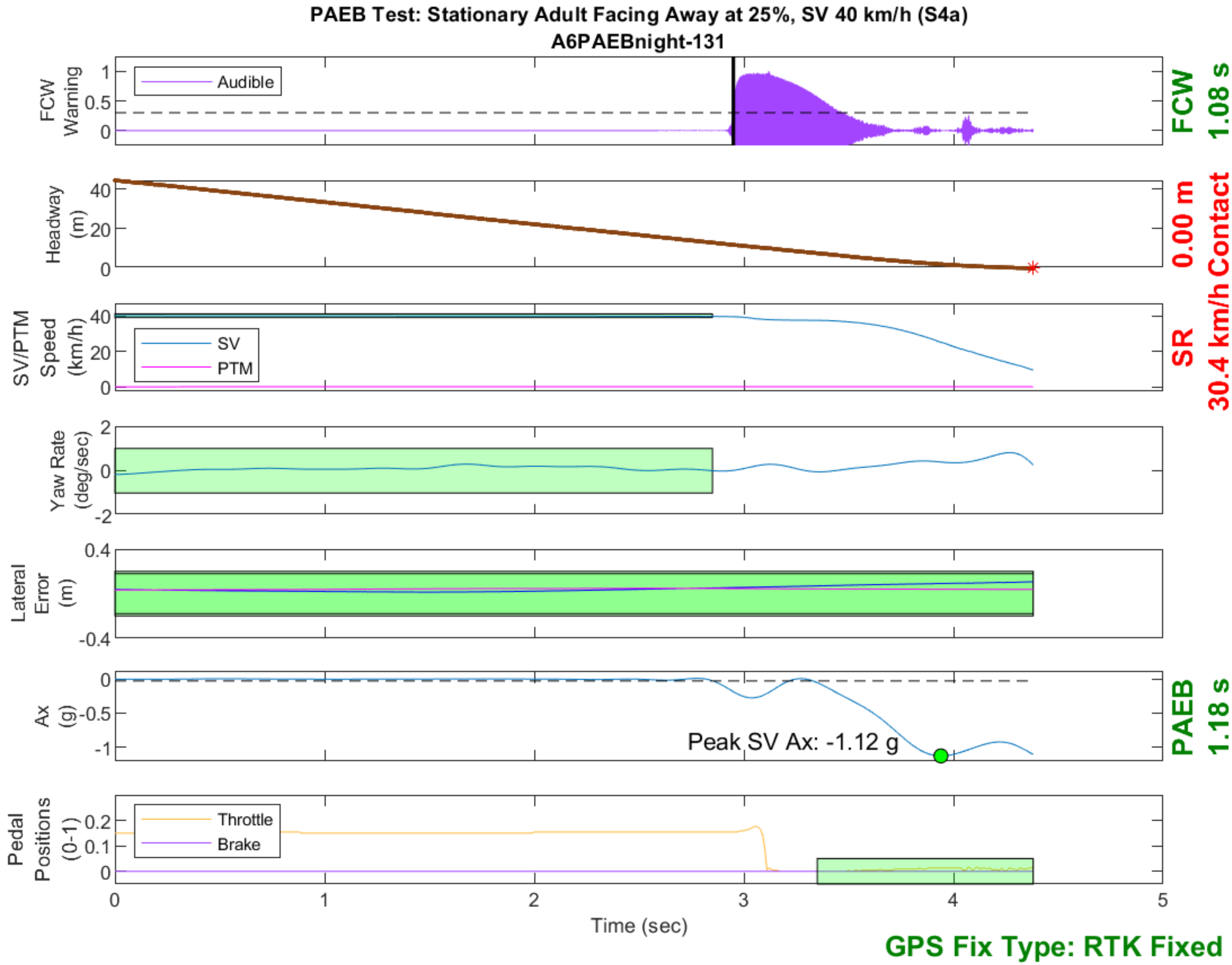


Figure D310. Time History for PAEB Run 131, S4a, Night, Low Beam, 40 km/h

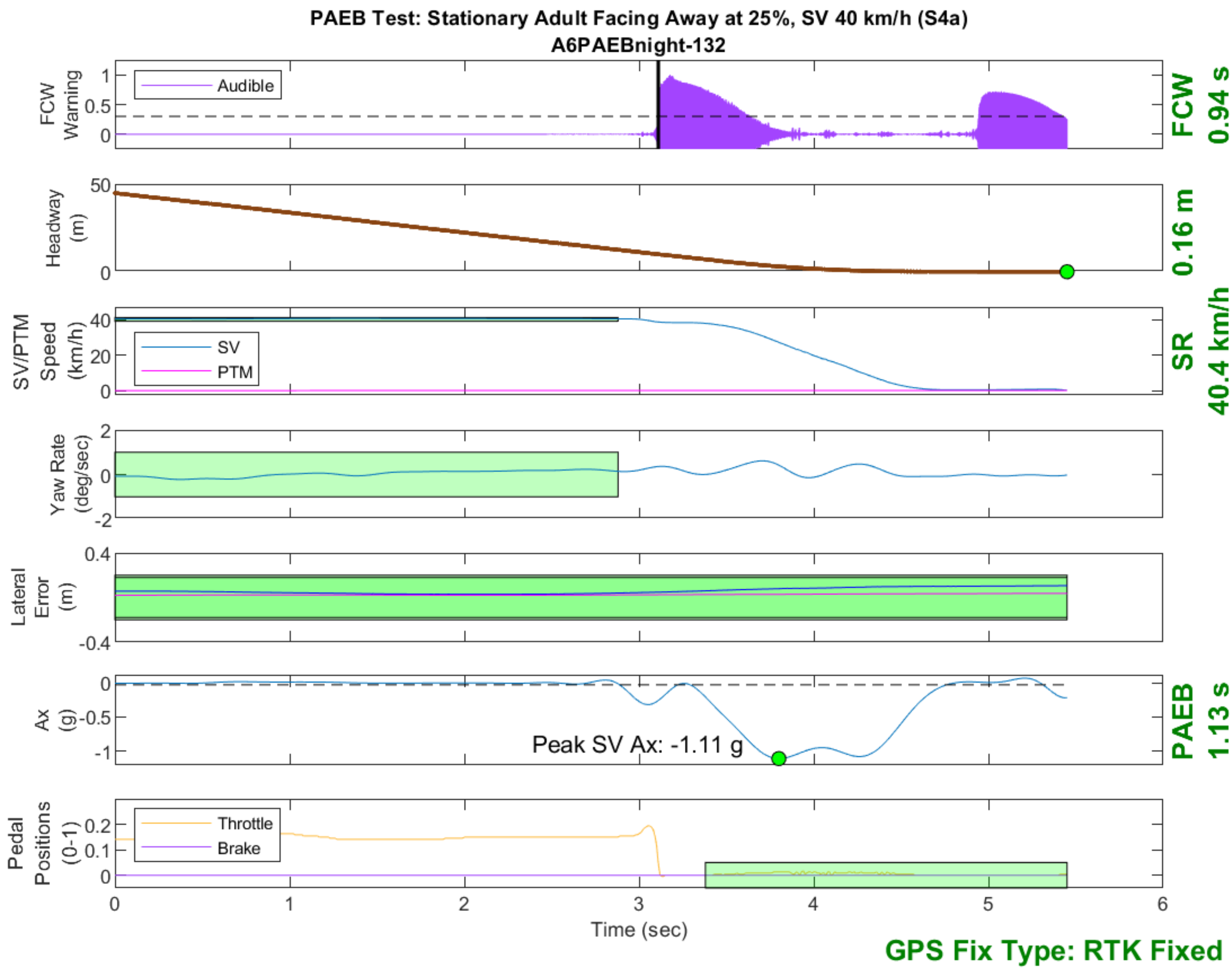


Figure D311. Time History for PAEB Run 132, S4a, Night, Low Beam, 40 km/h

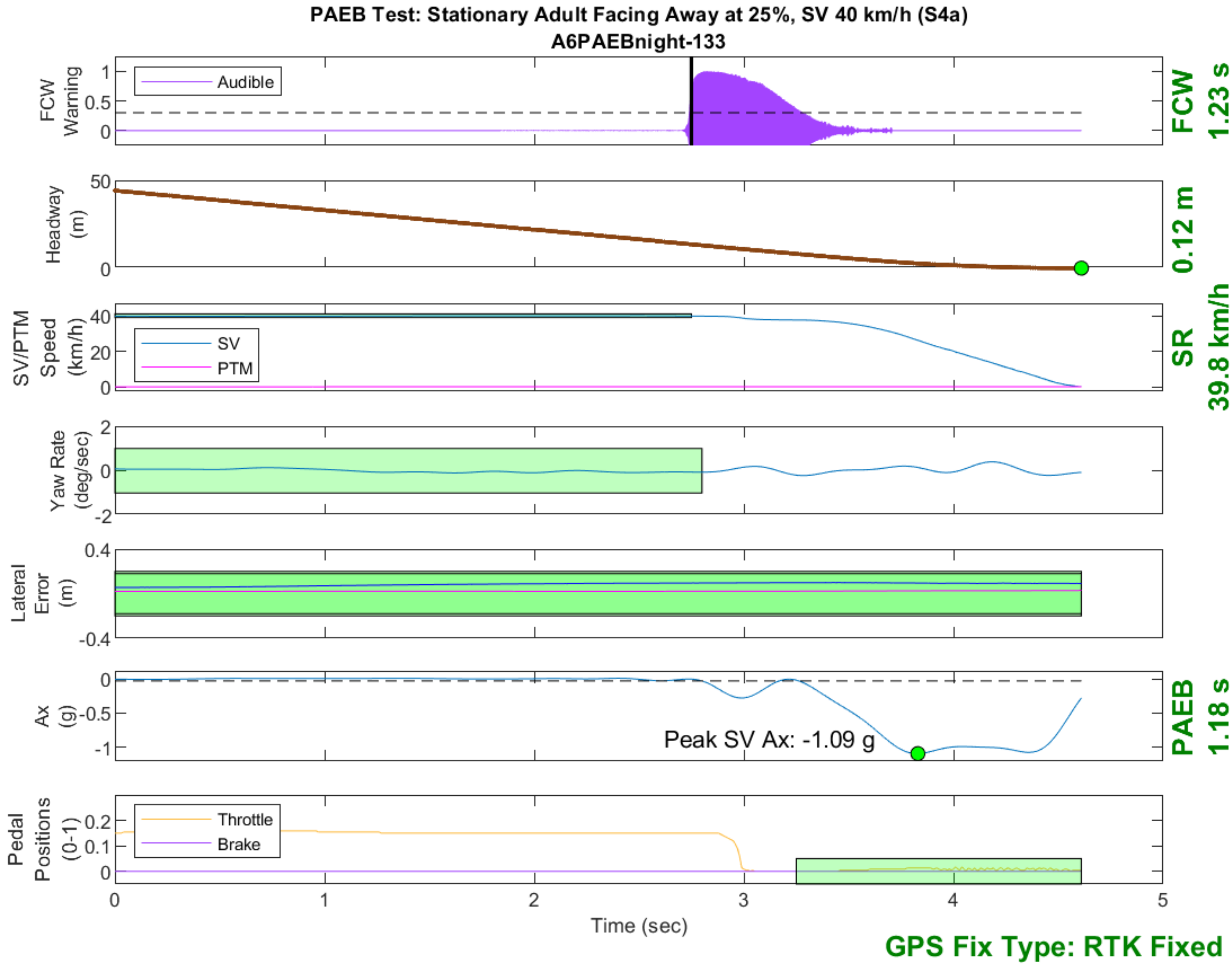


Figure D312. Time History for PAEB Run 133, S4a, Night, Low Beam, 40 km/h

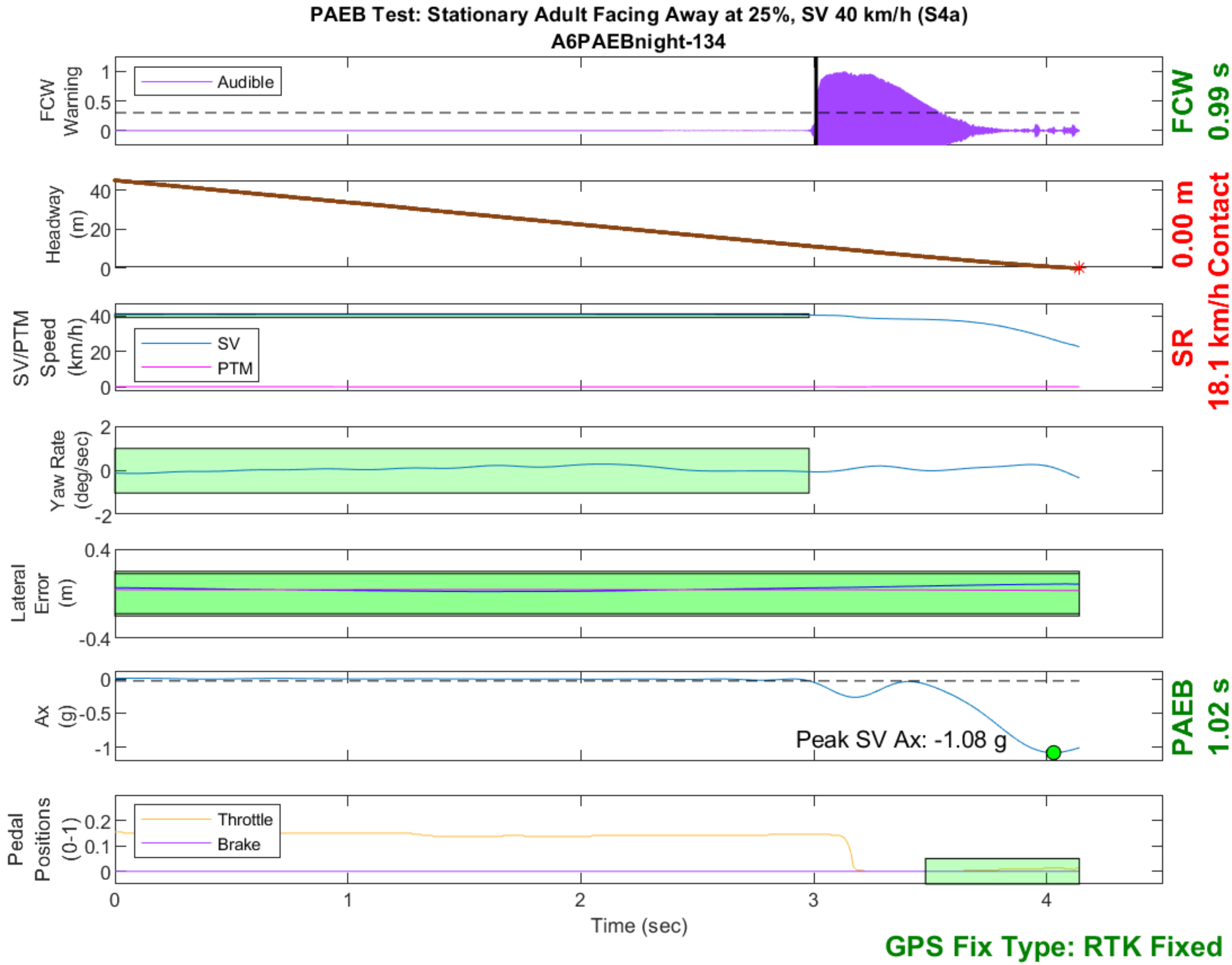


Figure D313. Time History for PAEB Run 134, S4a, Night, Low Beam, 40 km/h

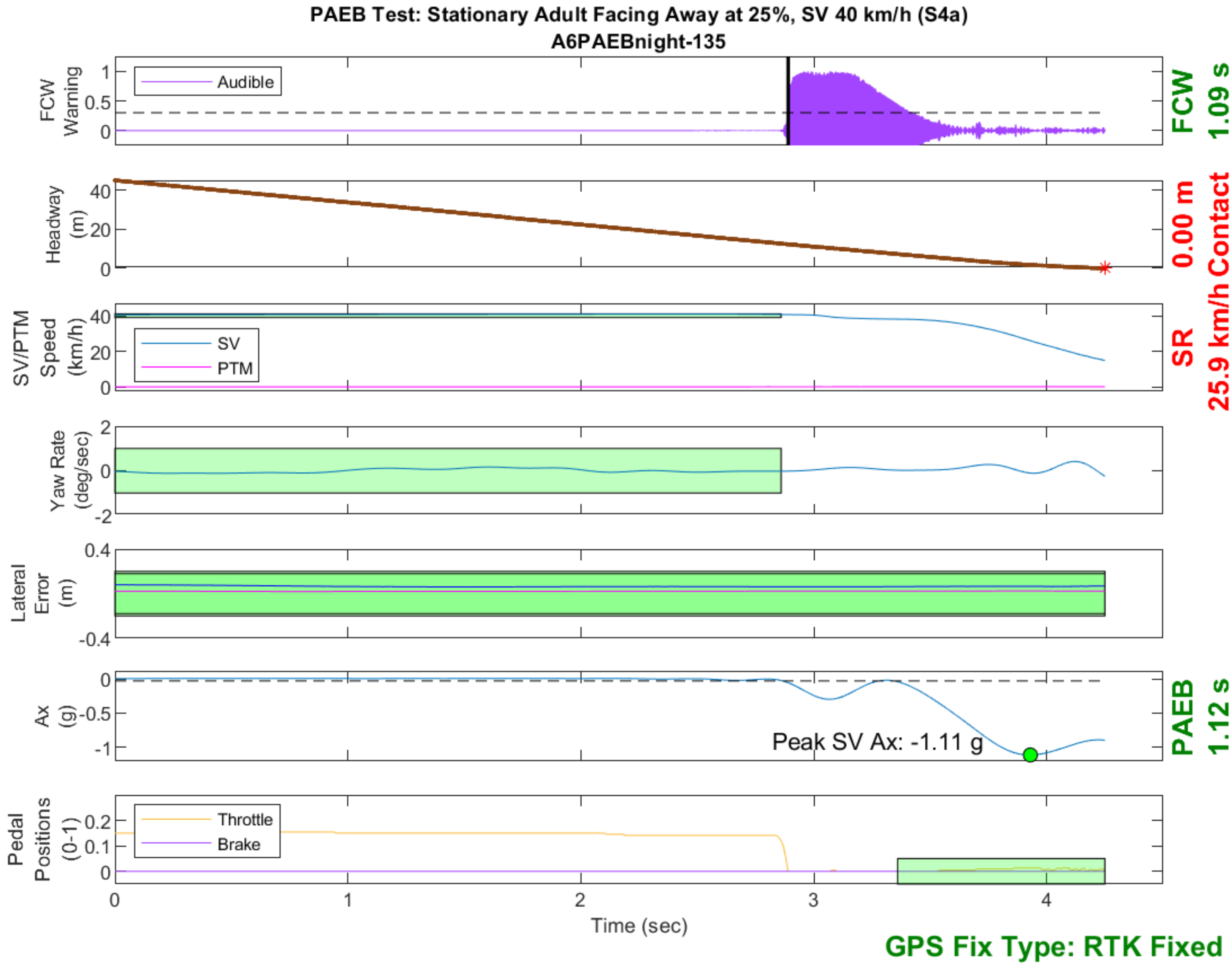


Figure D314. Time History for PAEB Run 135, S4a, Night, Low Beam, 40 km/h

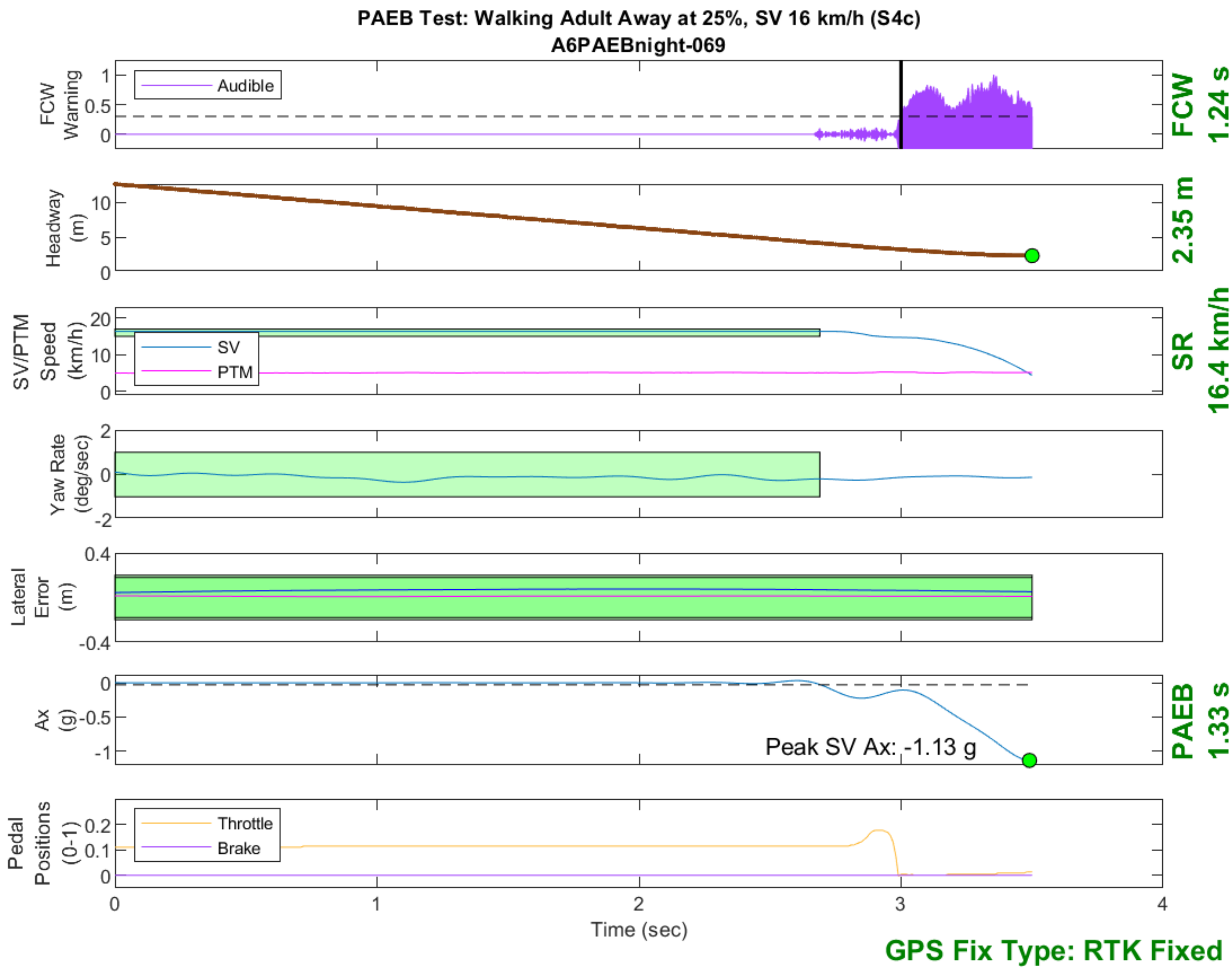


Figure D315. Time History for PAEB Run 69, S4c, Night, Low Beam, 16 km/h

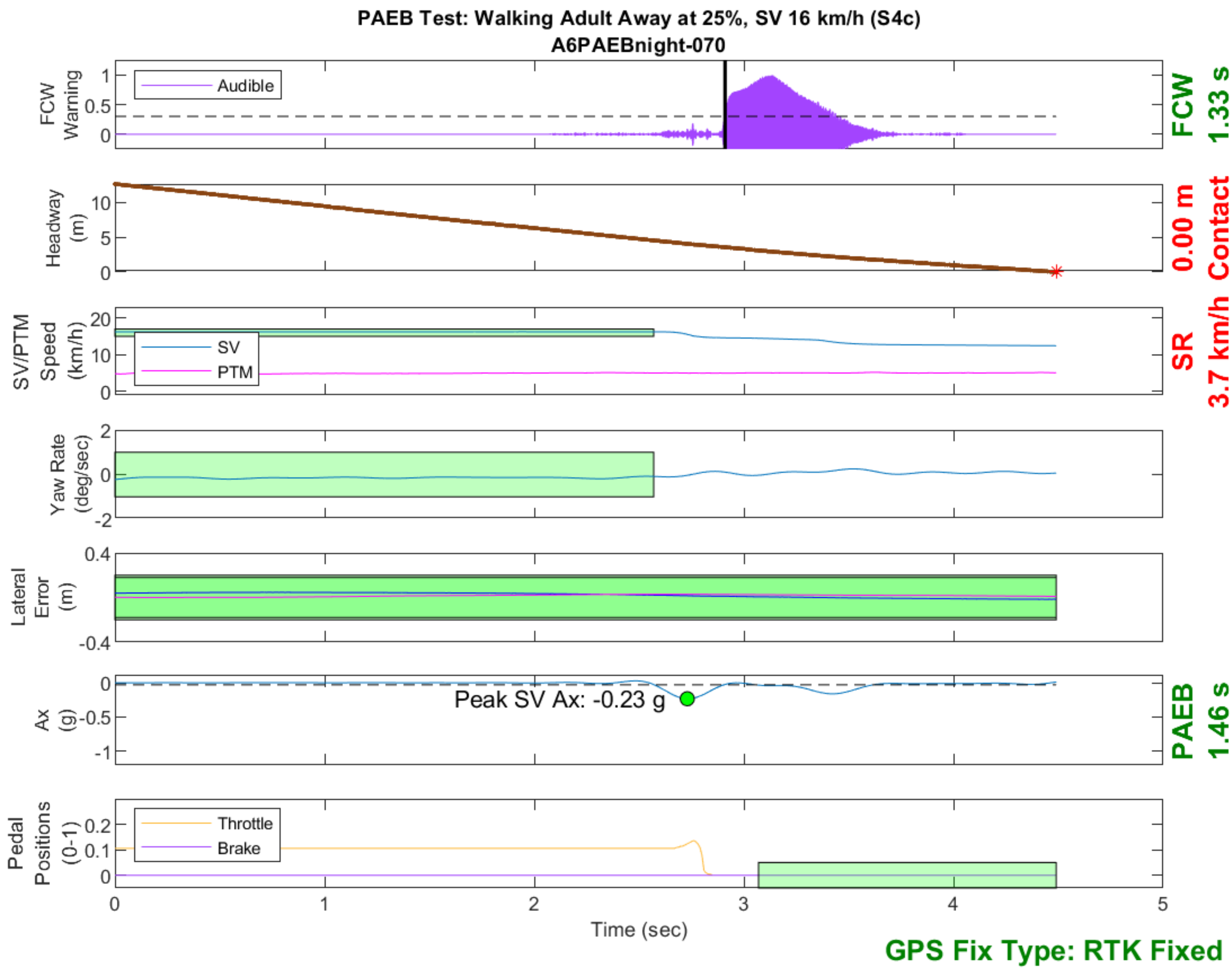


Figure D316. Time History for PAEB Run 70, S4c, Night, Low Beam, 16 km/h

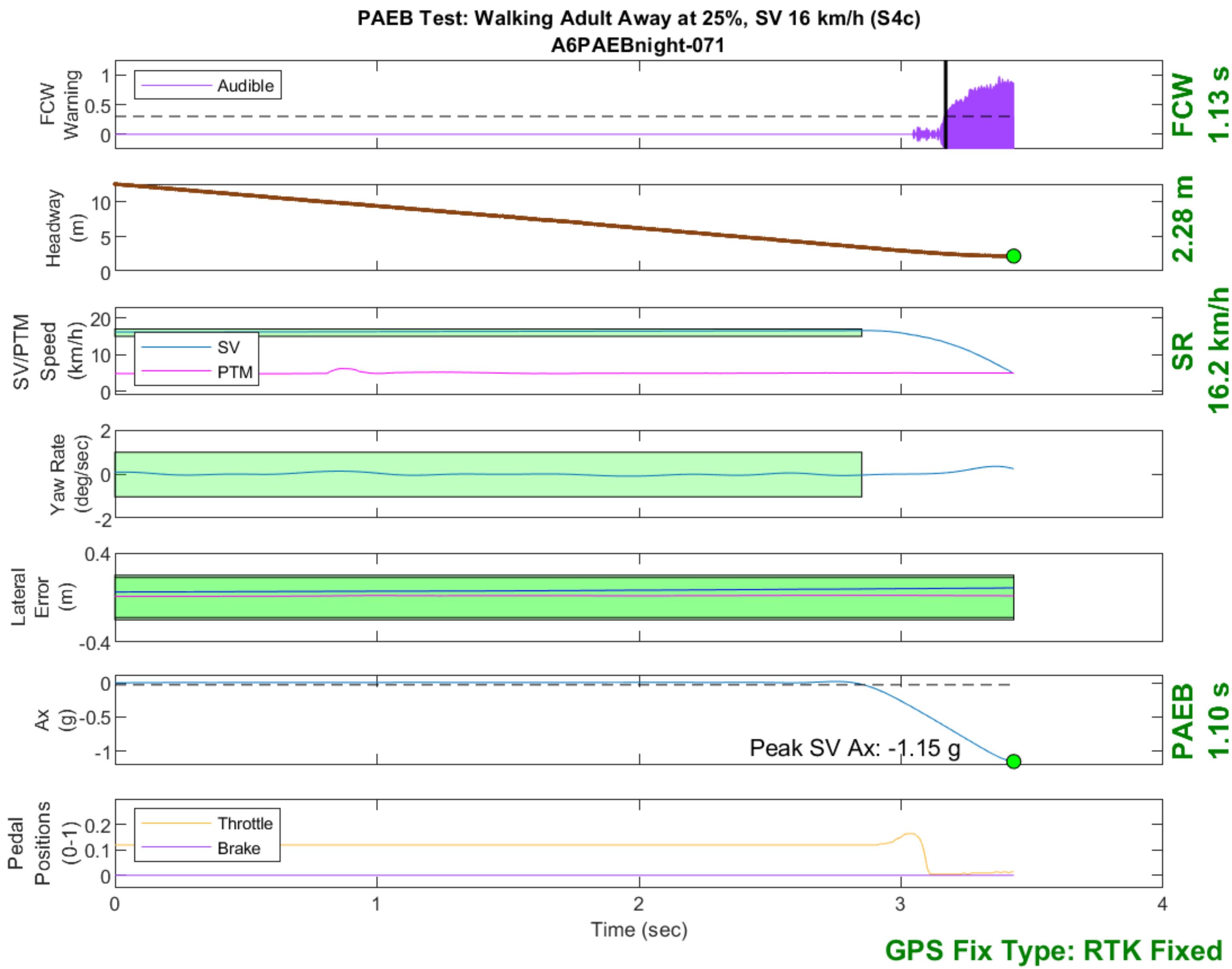


Figure D317. Time History for PAEB Run 71, S4c, Night, Low Beam, 16 km/h

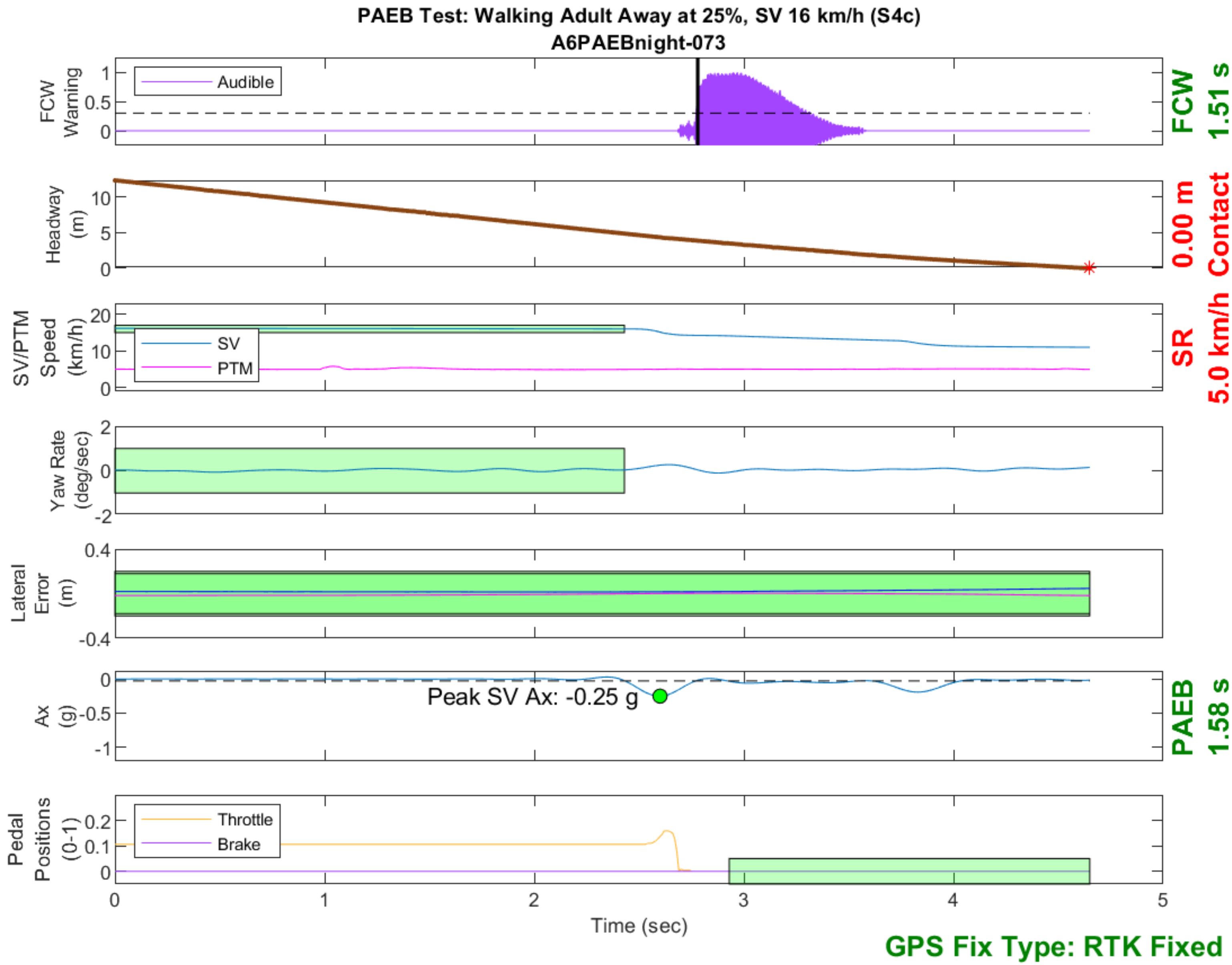


Figure D318. Time History for PAEB Run 73, S4c, Night, Low Beam, 16 km/h

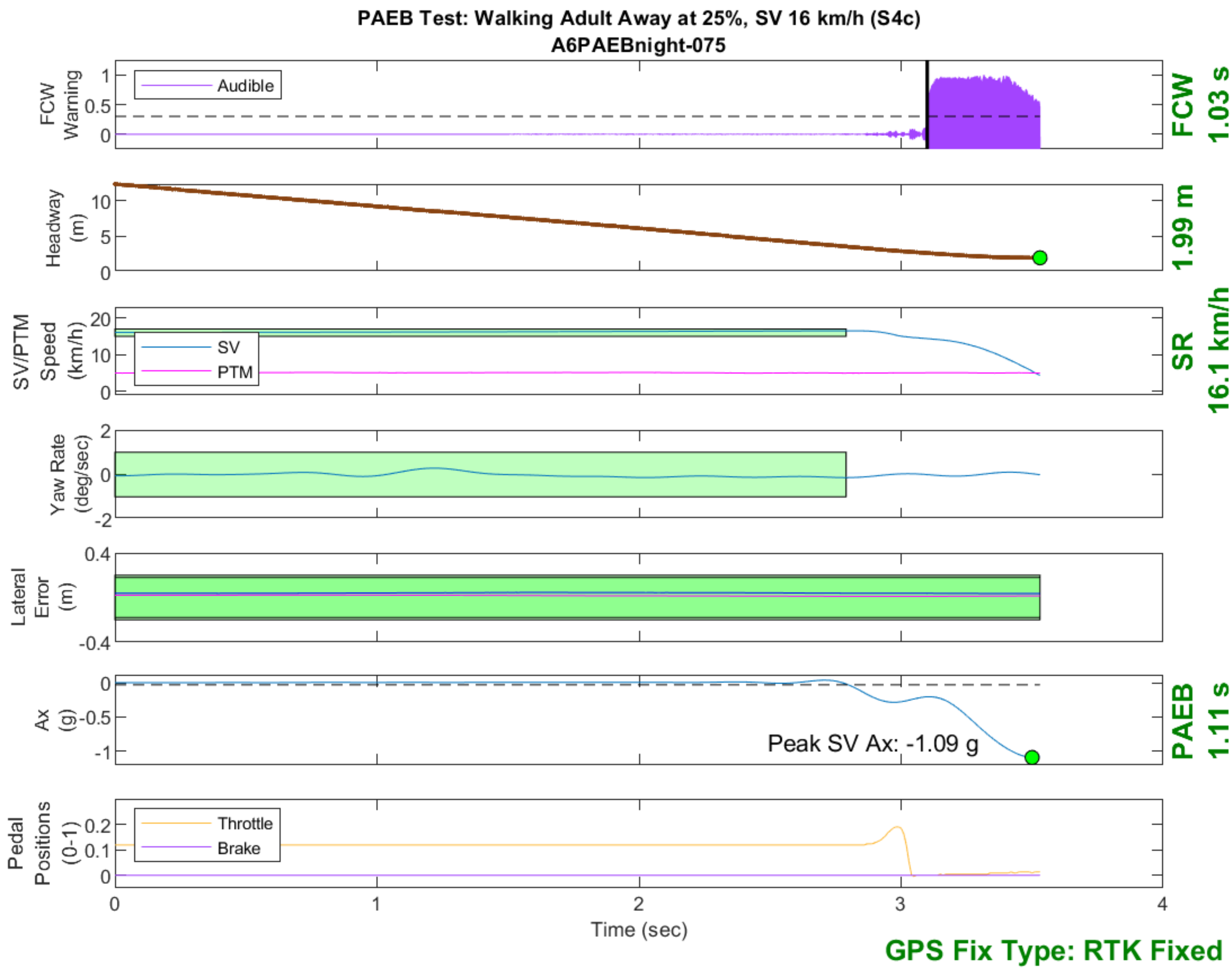


Figure D319. Time History for PAEB Run 75, S4c, Night, Low Beam, 16 km/h

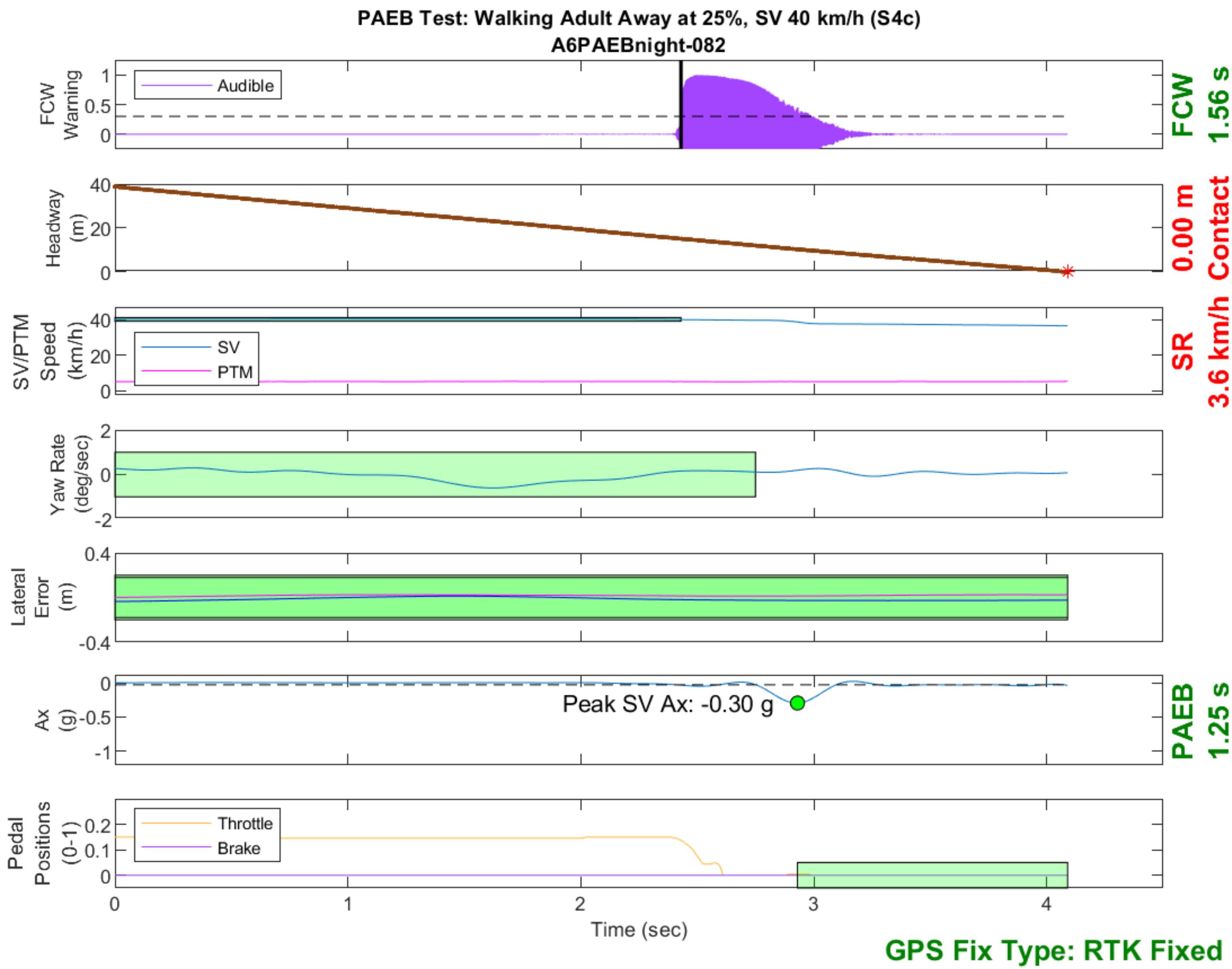


Figure D320. Time History for PAEB Run 82, S4c, Night, Low Beam, 40 km/h

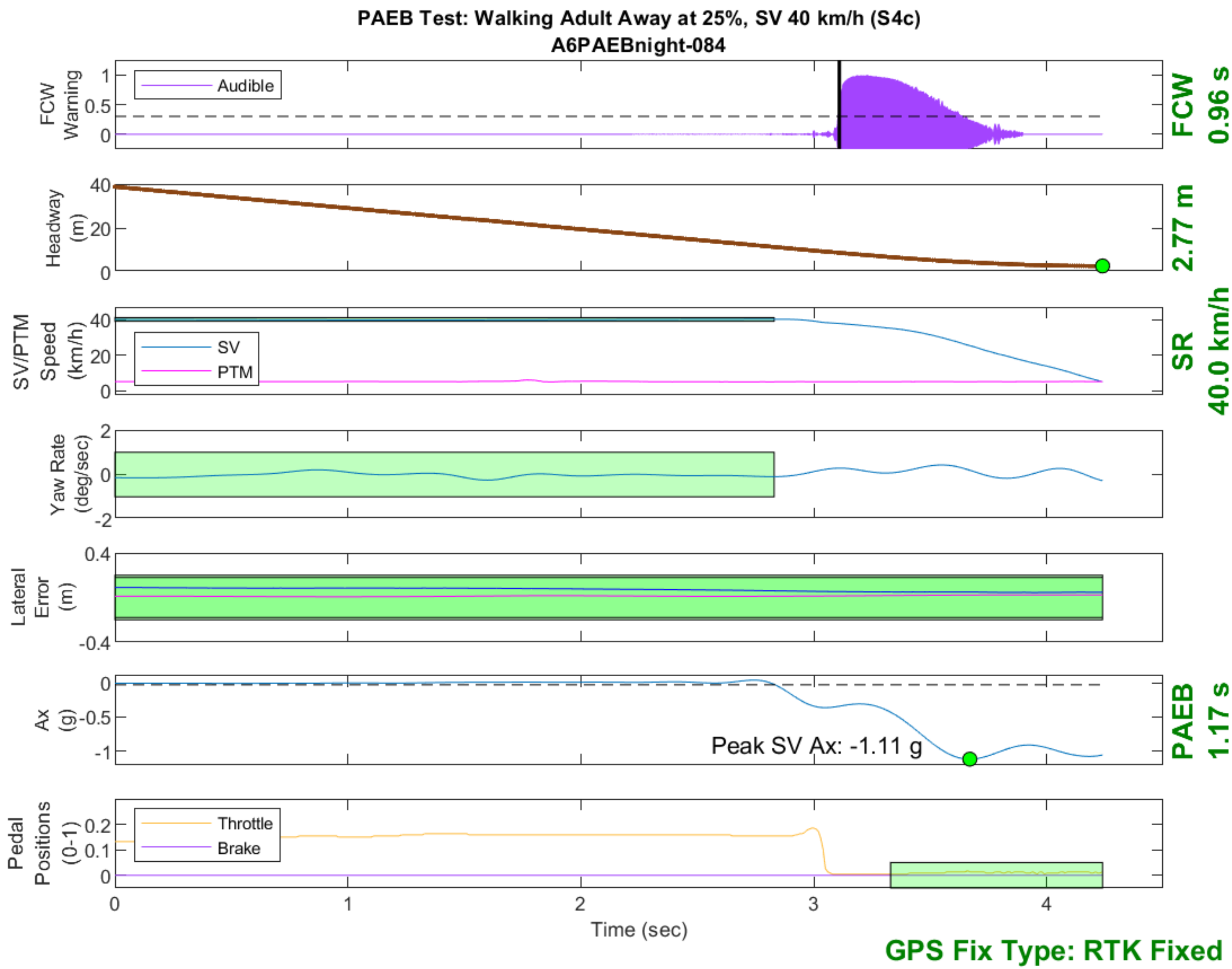


Figure D321. Time History for PAEB Run 84, S4c, Night, Low Beam, 40 km/h

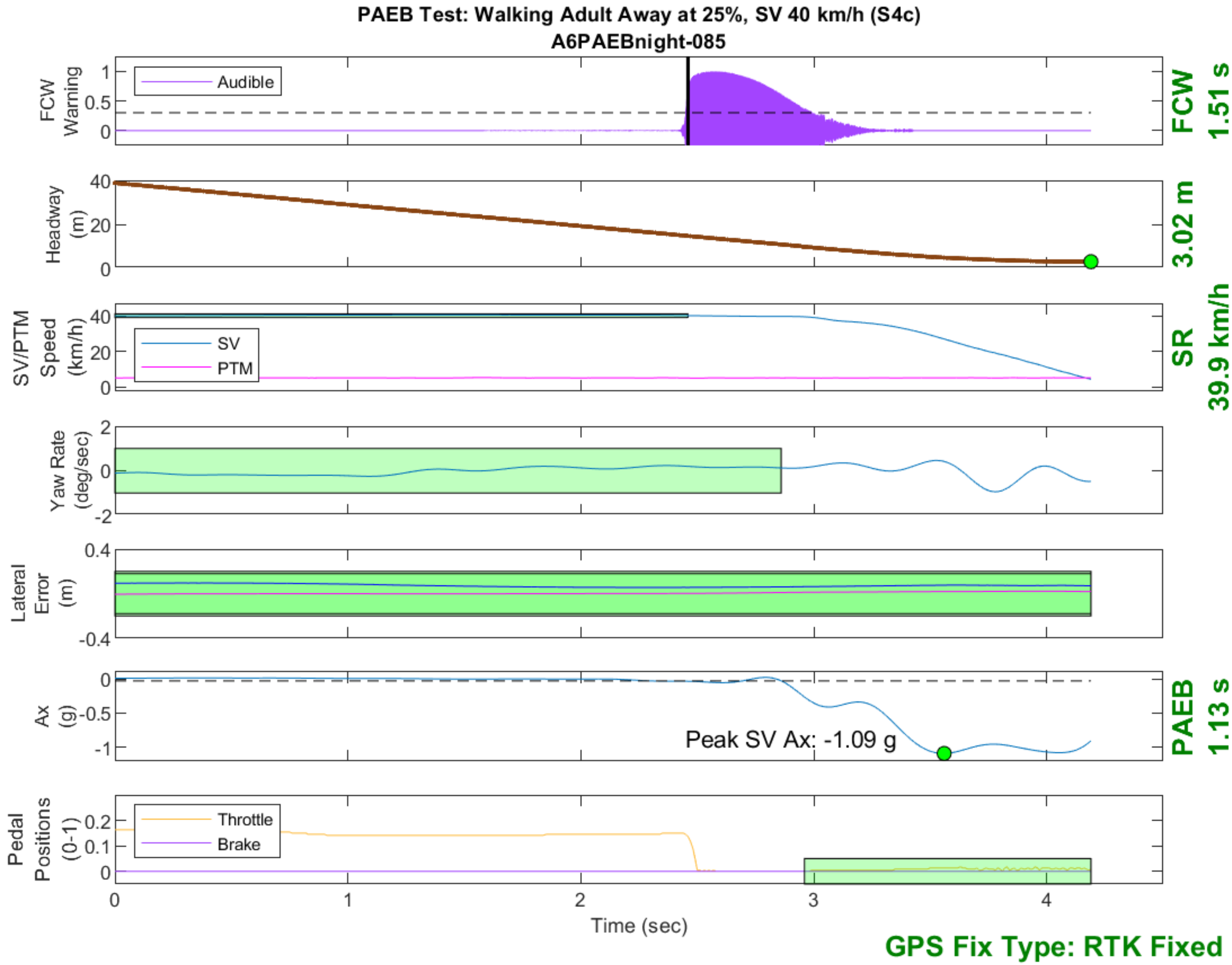


Figure D322. Time History for PAEB Run 85, S4c, Night, Low Beam, 40 km/h

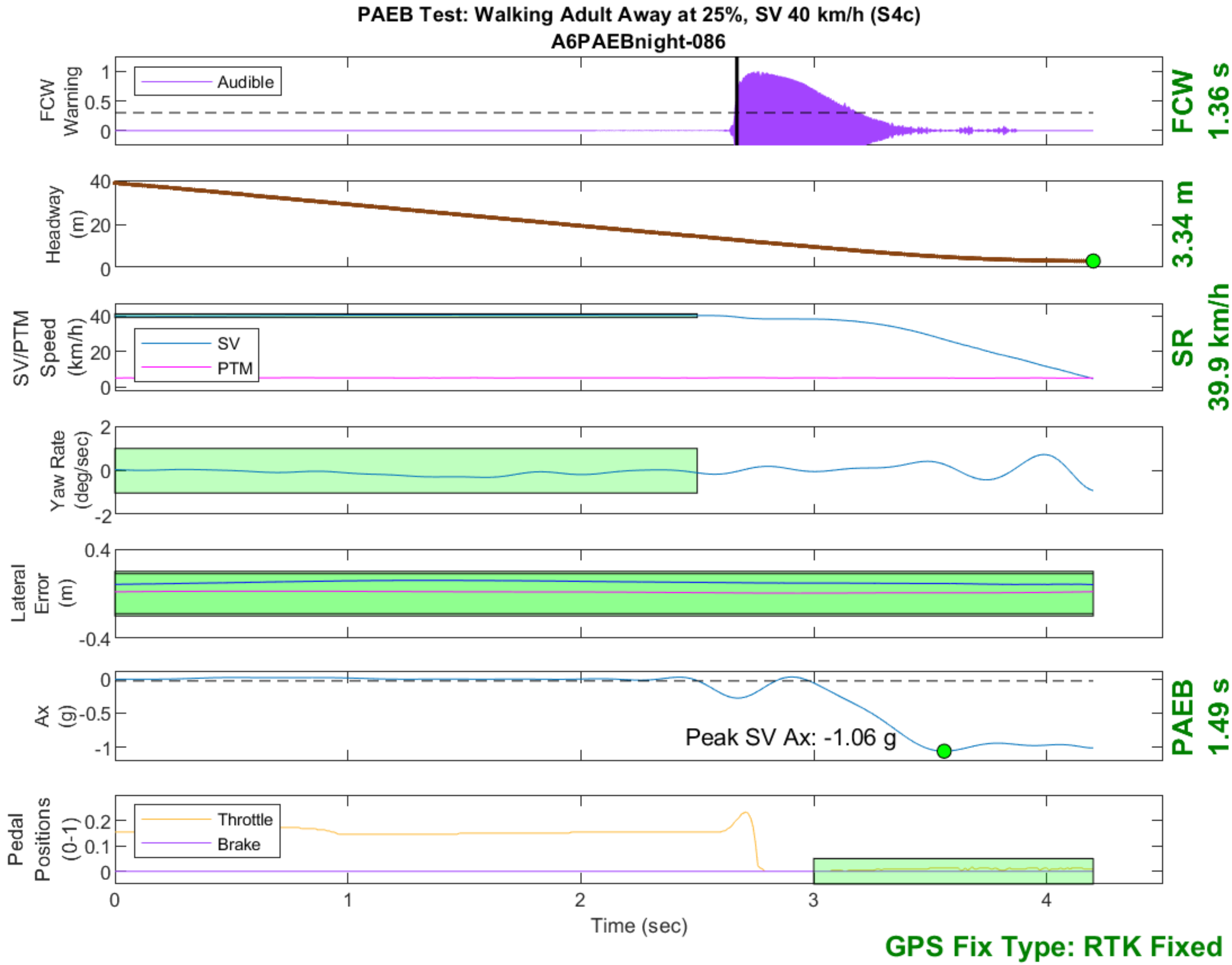


Figure D323. Time History for PAEB Run 86, S4c, Night, Low Beam, 40 km/h

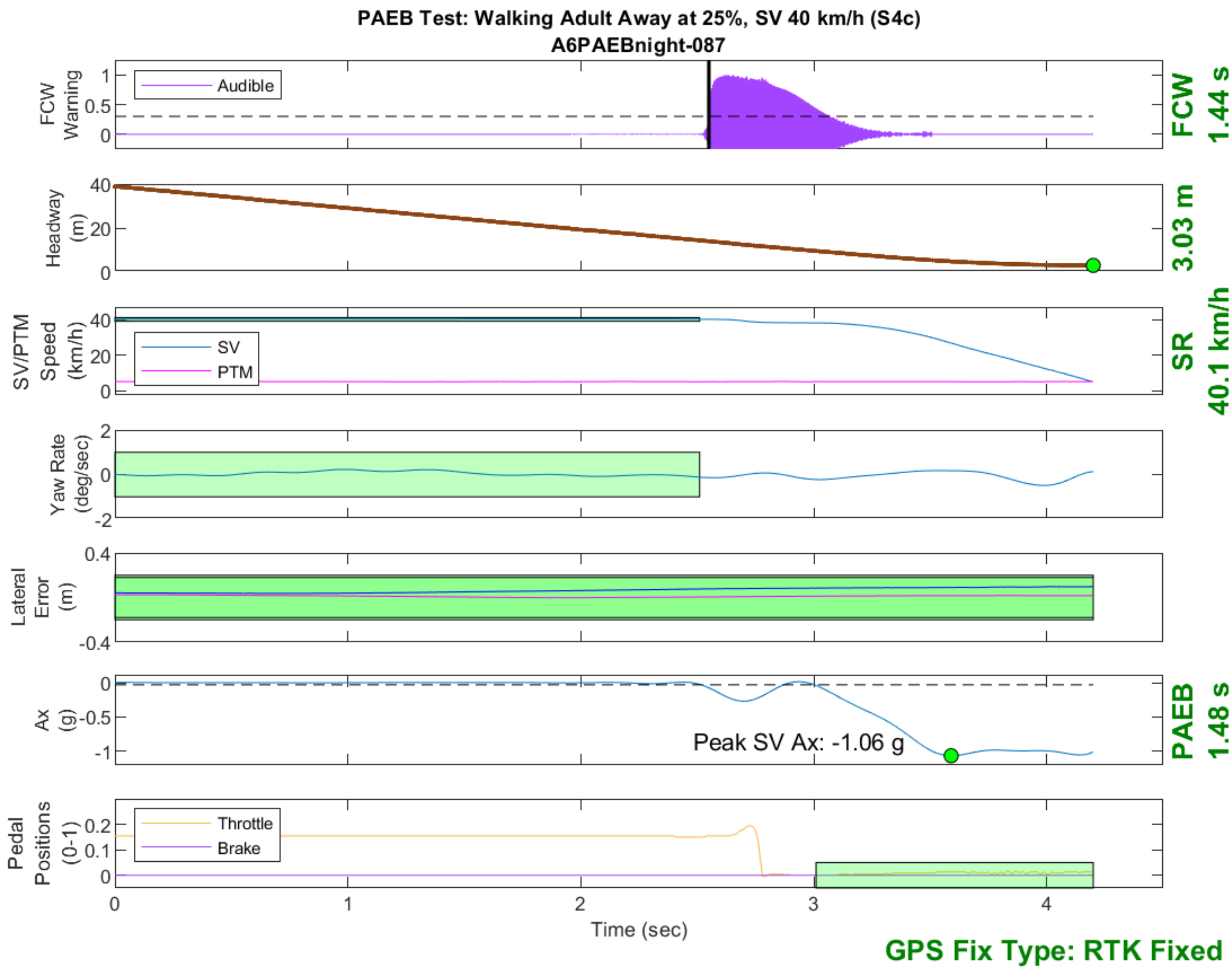


Figure D324. Time History for PAEB Run 87, S4c, Night, Low Beam, 40 km/h

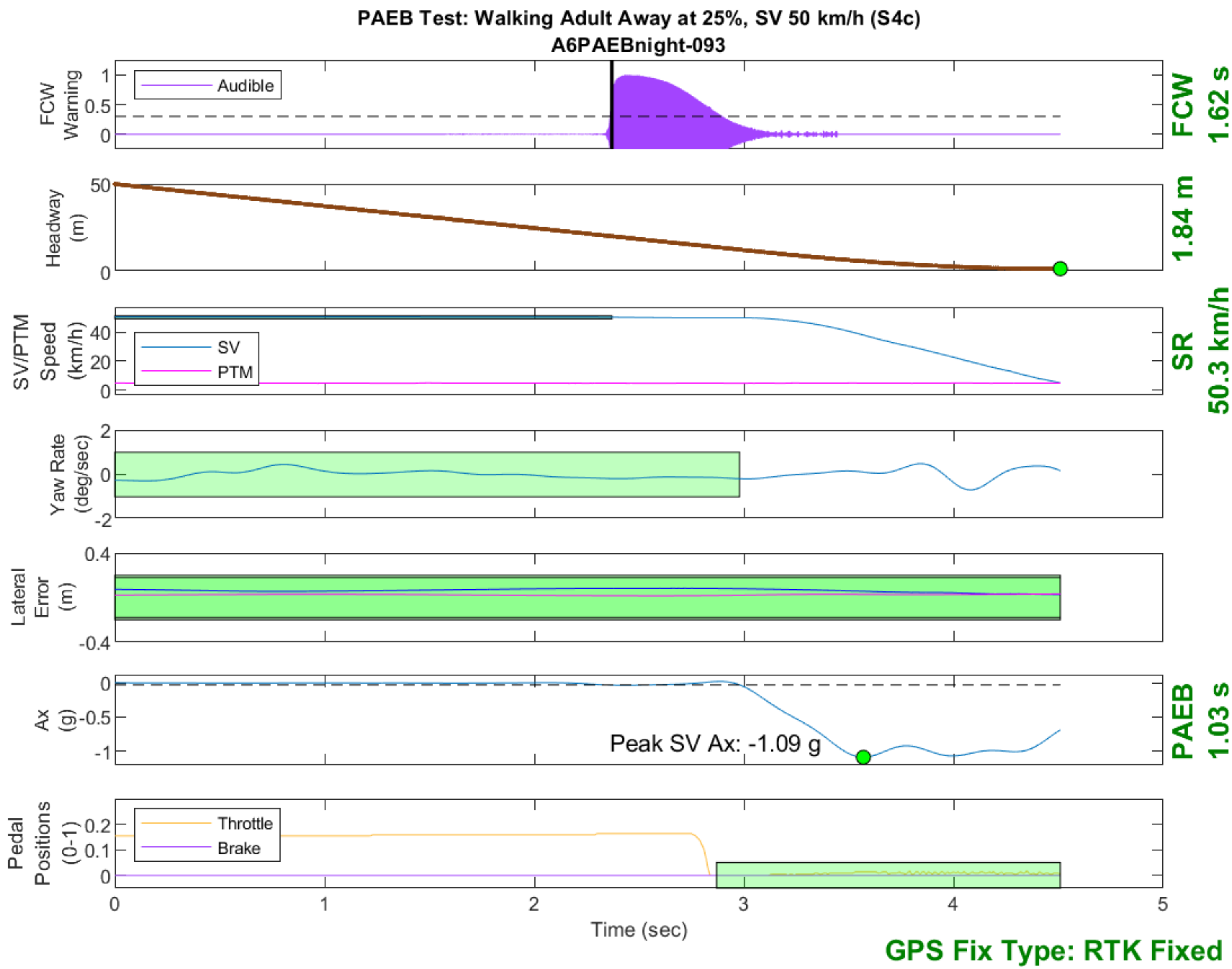


Figure D325. Time History for PAEB Run 93, S4c, Night, Low Beam, 50 km/h

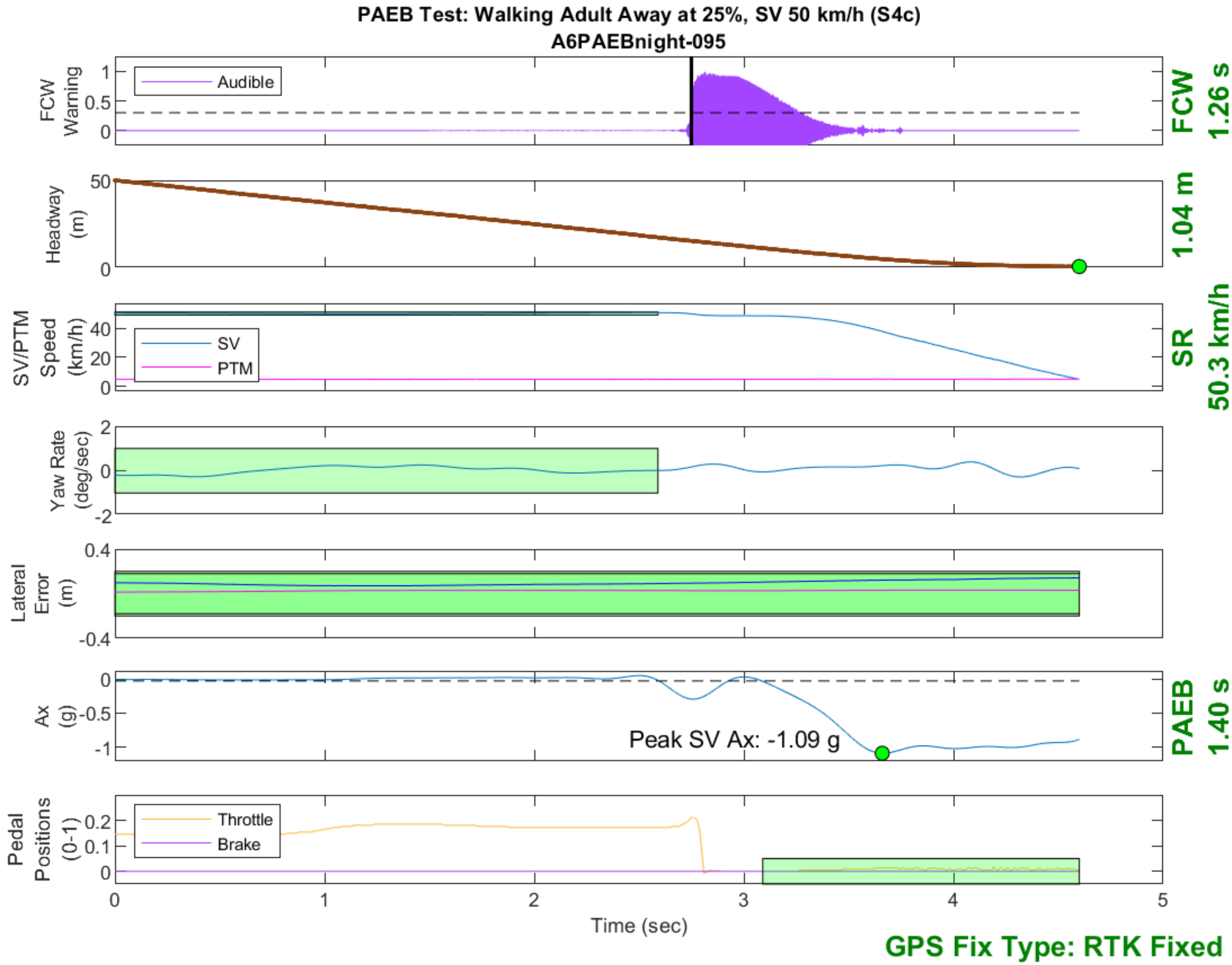


Figure D326. Time History for PAEB Run 95, S4c, Night, Low Beam, 50 km/h

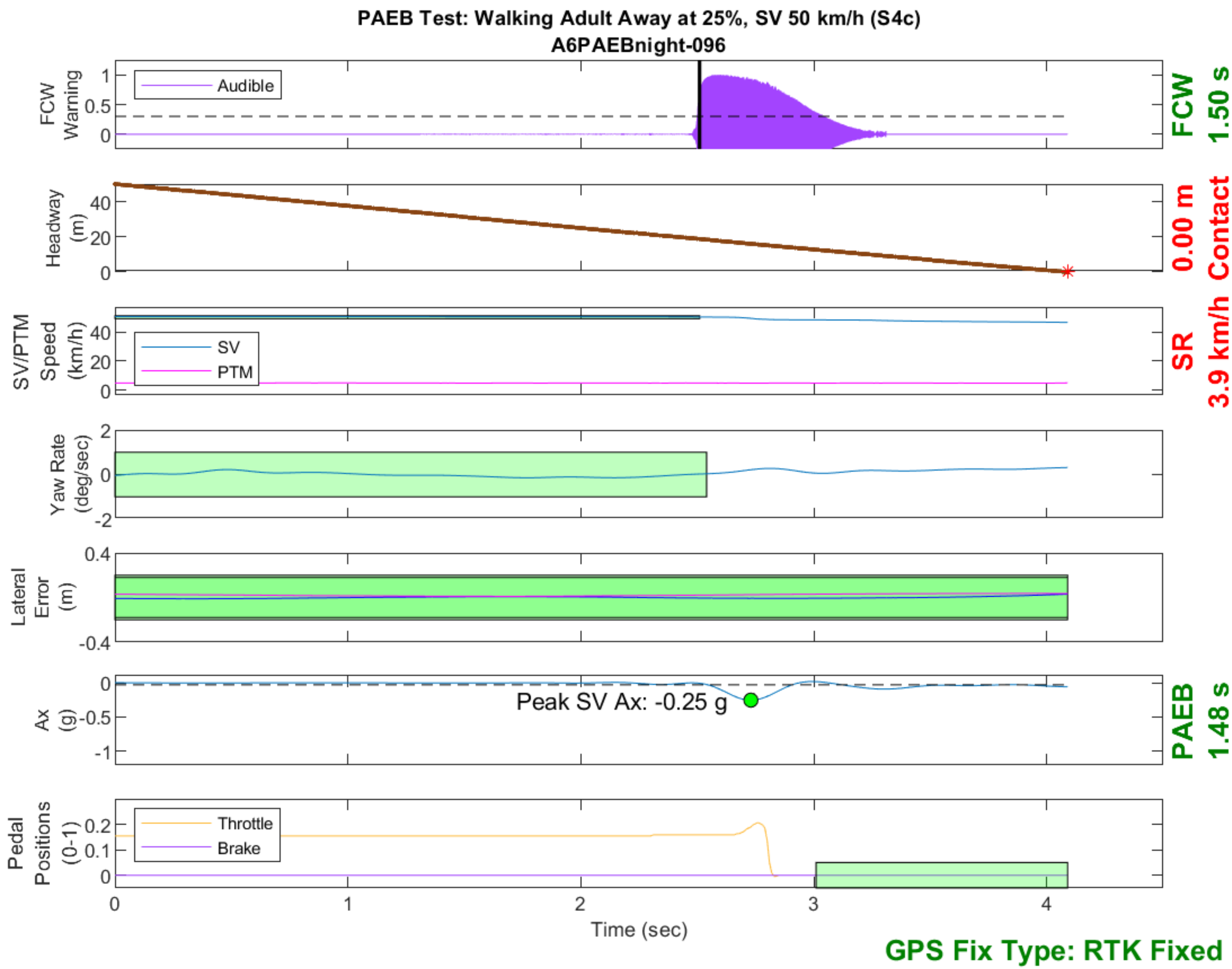


Figure D327. Time History for PAEB Run 96, S4c, Night, Low Beam, 50 km/h

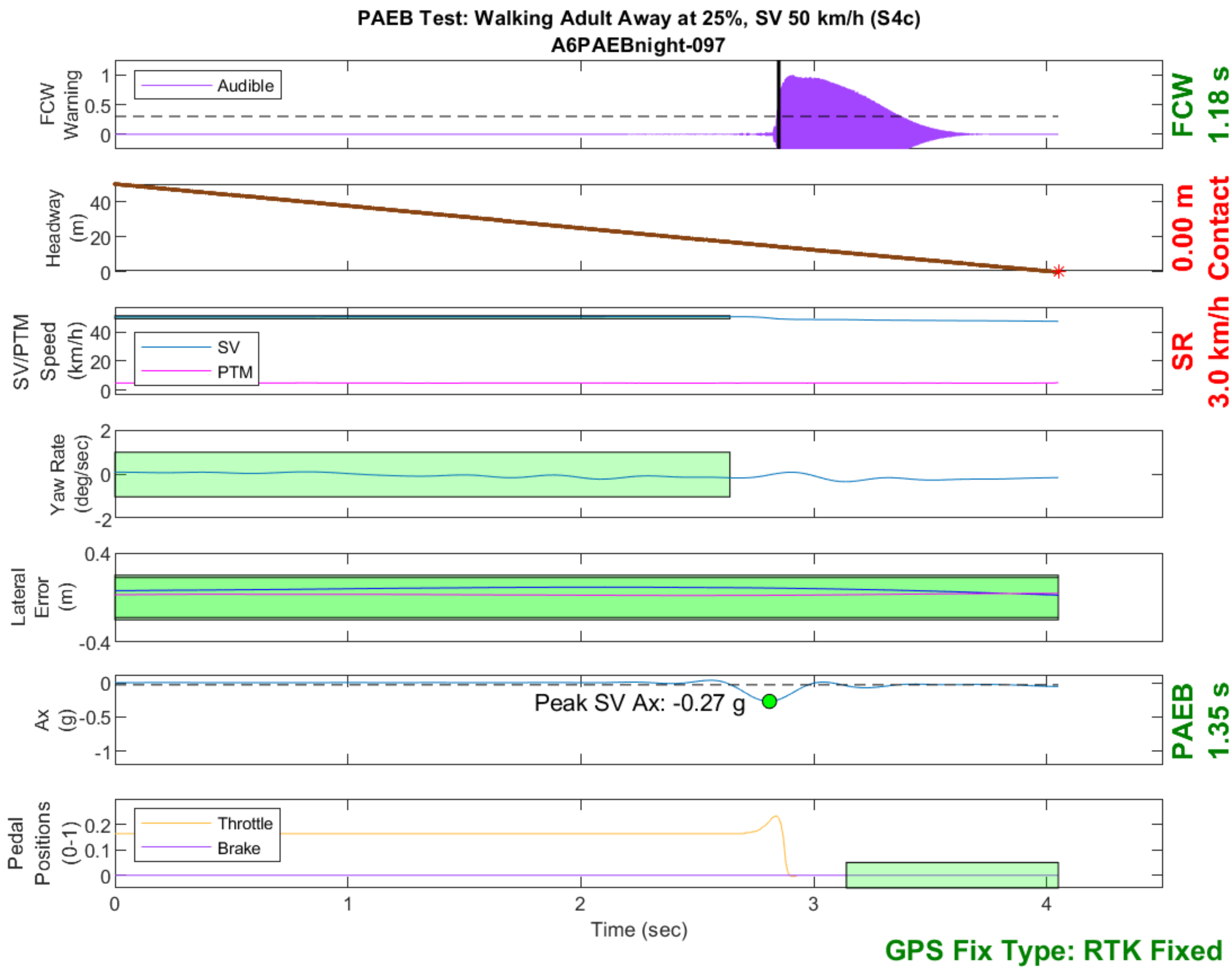


Figure D328. Time History for PAEB Run 97, S4c, Night, Low Beam, 50 km/h

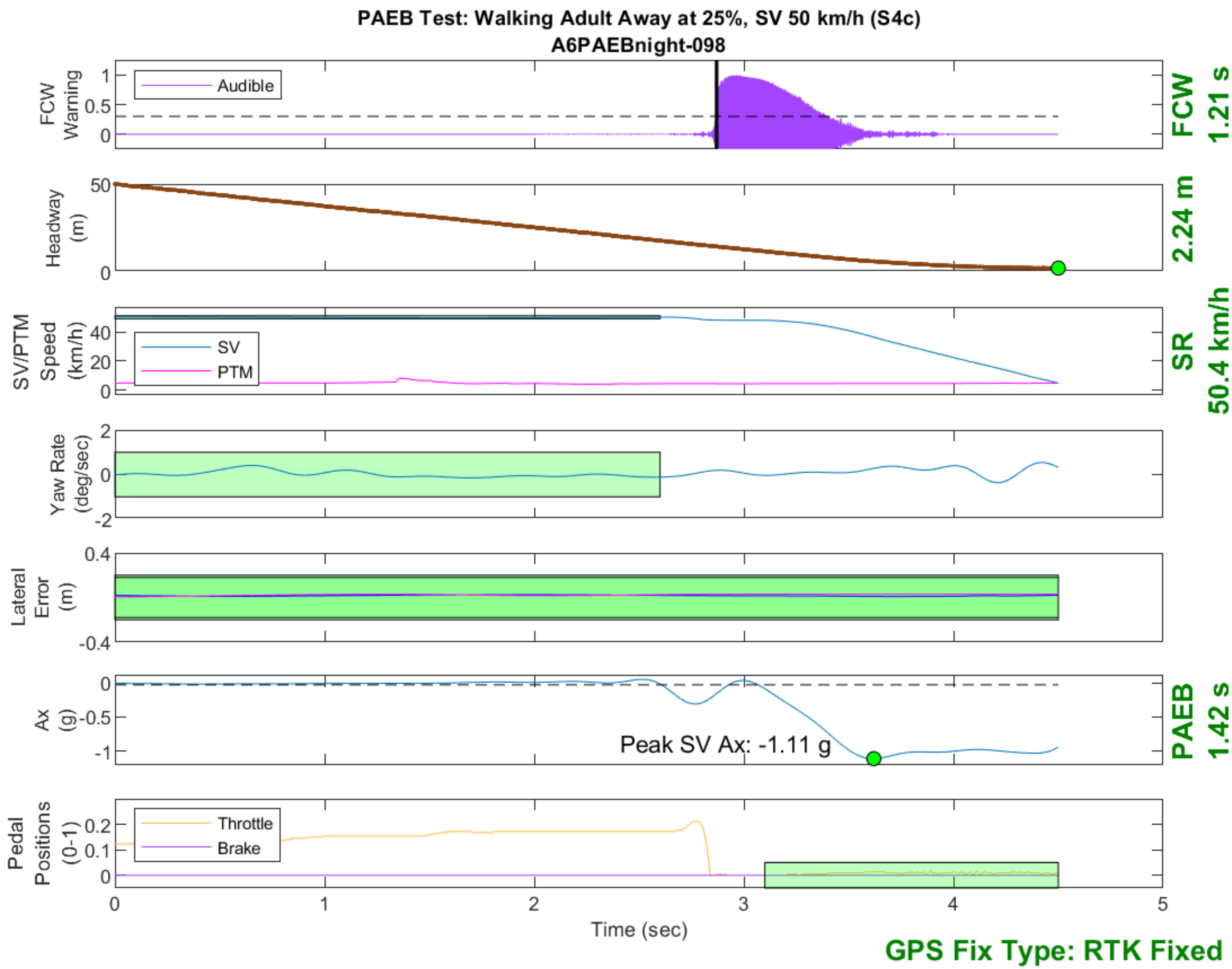


Figure D329. Time History for PAEB Run 98, S4c, Night, Low Beam, 50 km/h

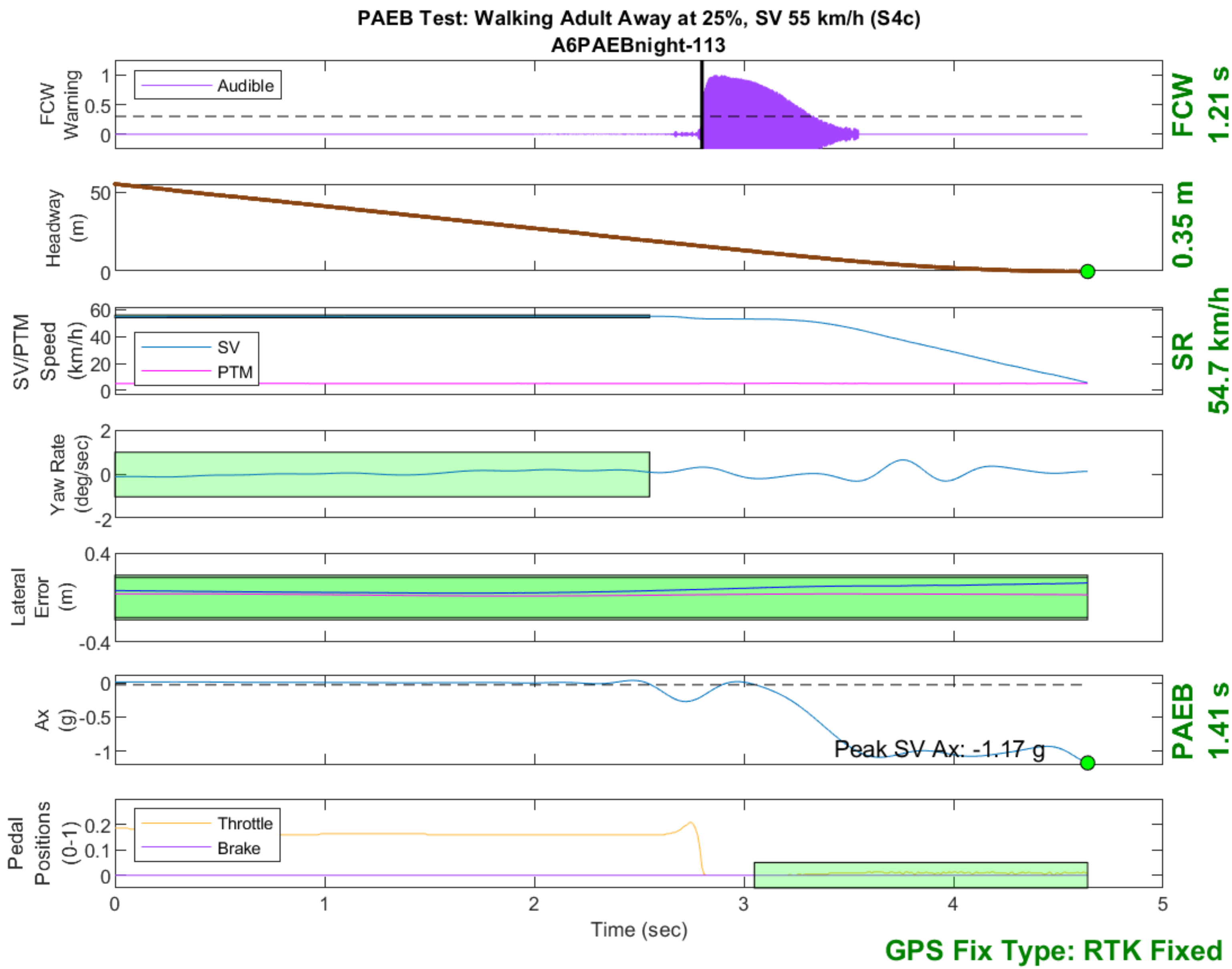


Figure D330. Time History for PAEB Run 113, S4c, Night, Low Beam, 55 km/h

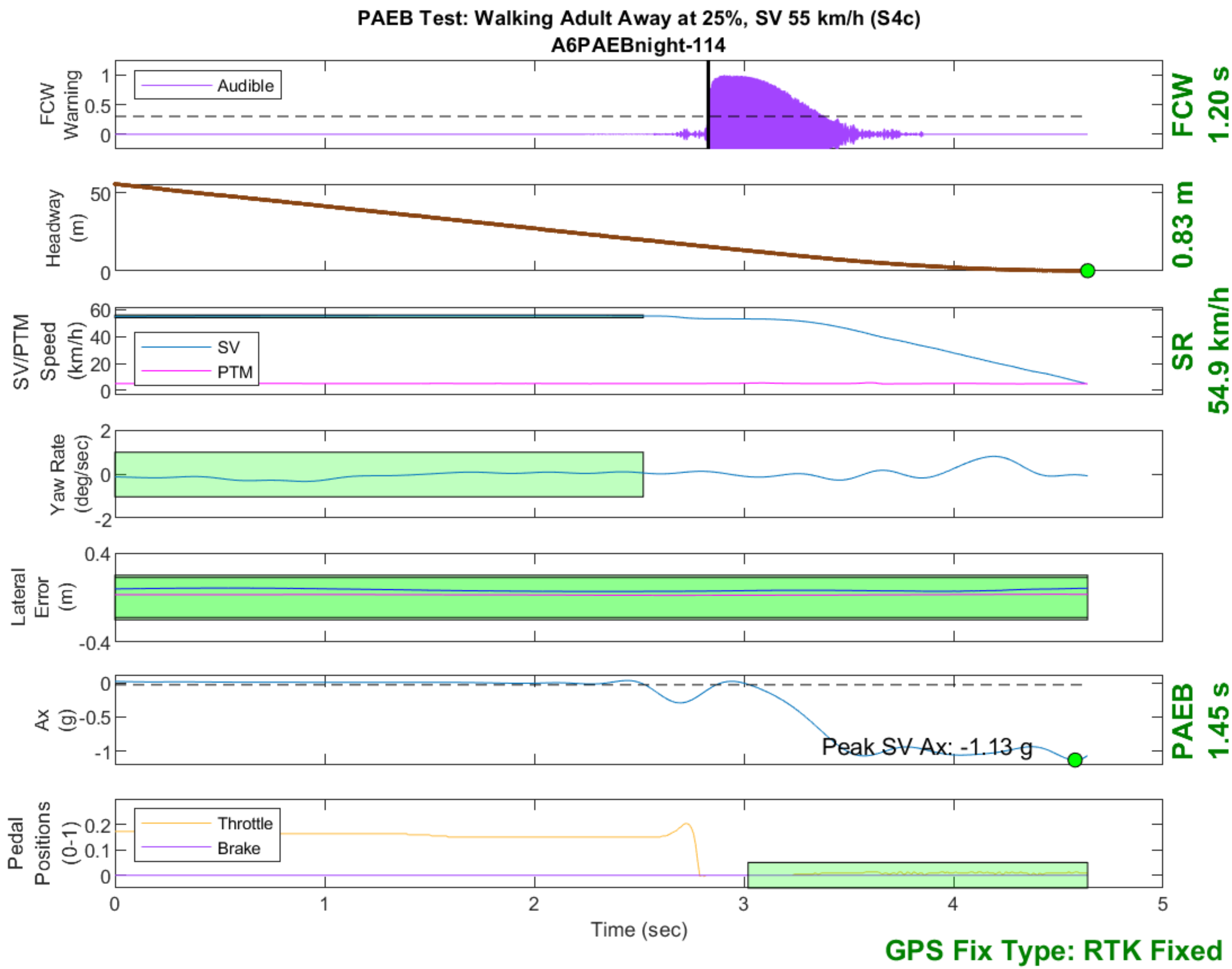


Figure D331. Time History for PAEB Run 114, S4c, Night, Low Beam, 55 km/h

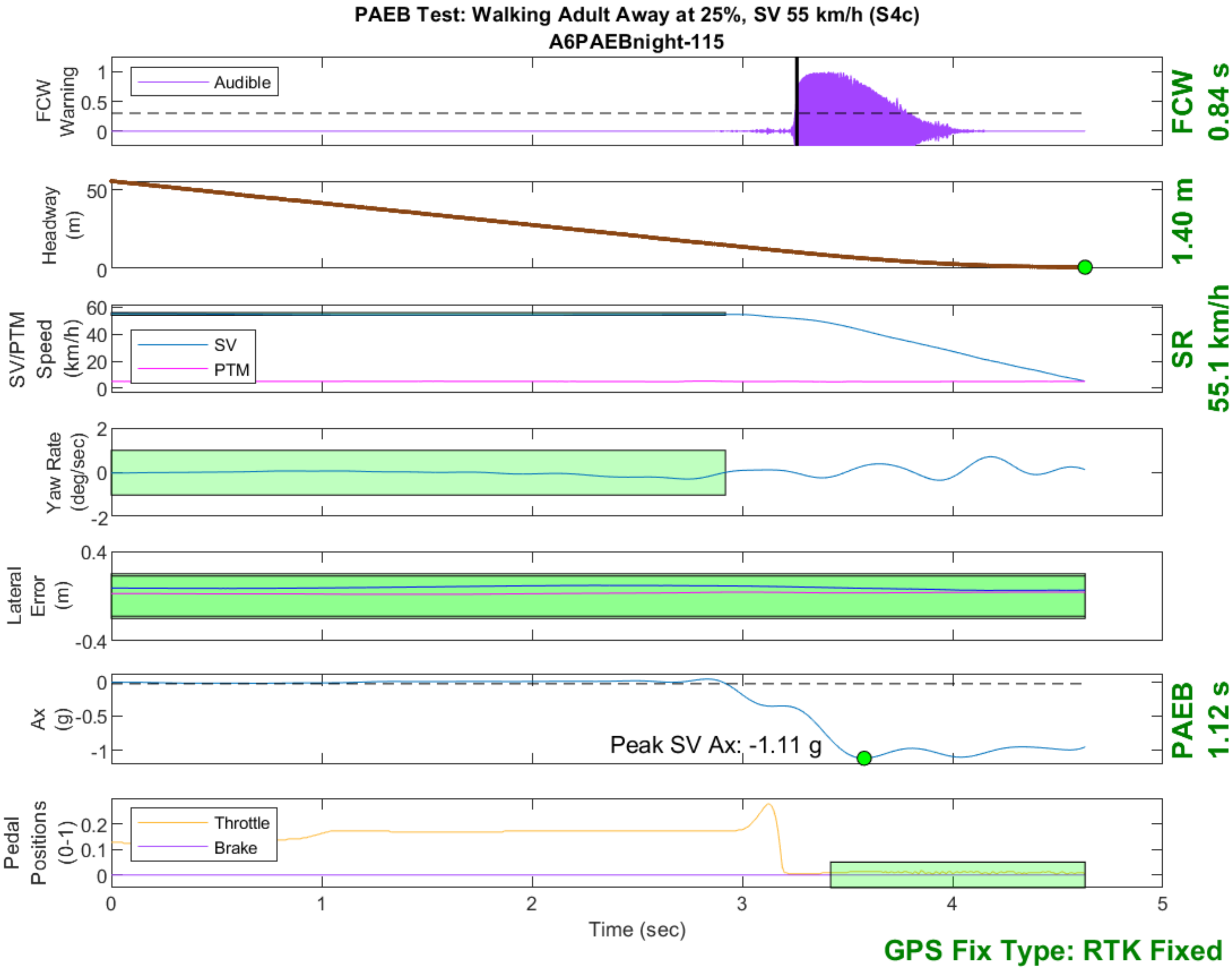


Figure D332. Time History for PAEB Run 115, S4c, Night, Low Beam, 55 km/h

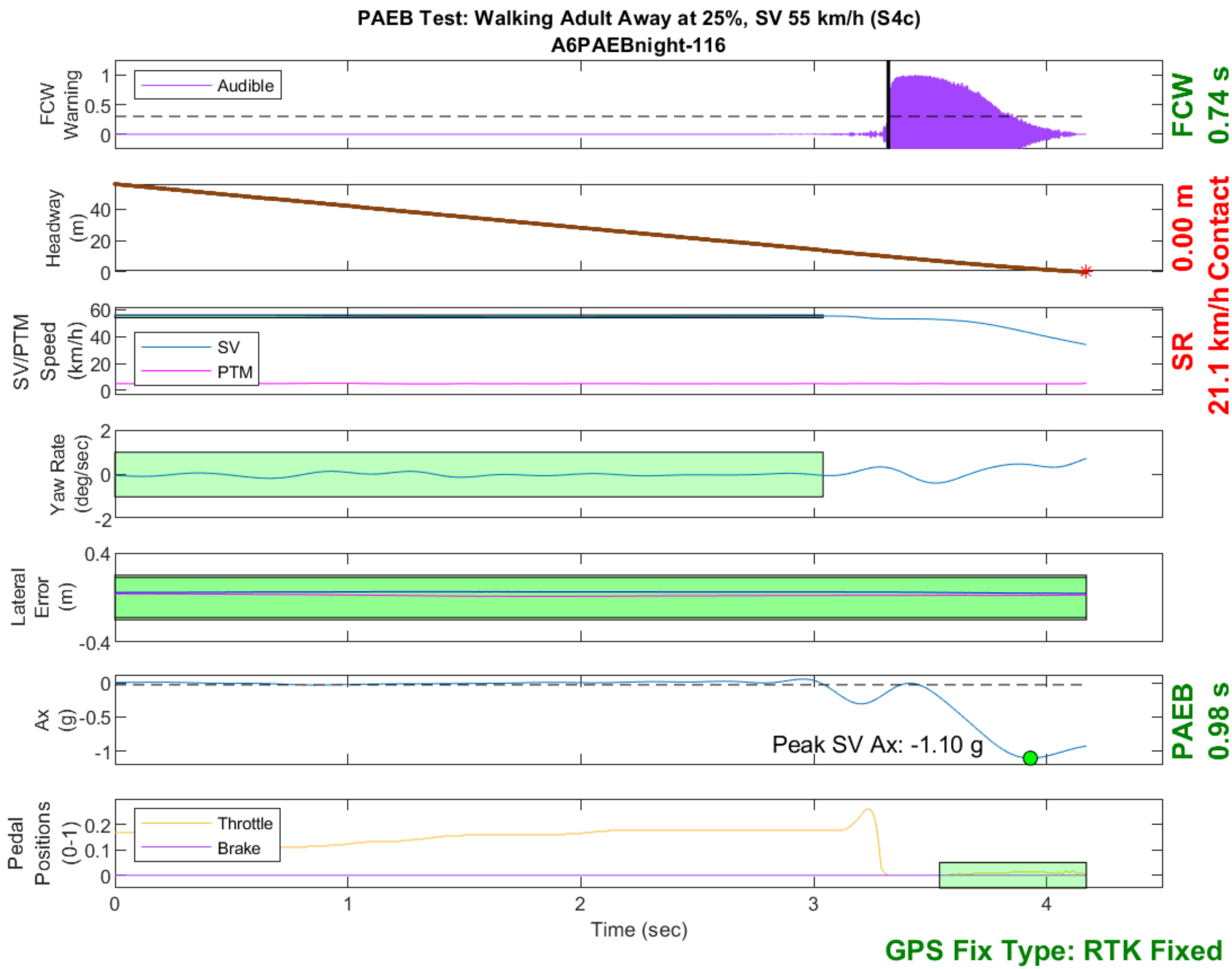


Figure D333. Time History for PAEB Run 116, S4c, Night, Low Beam, 55 km/h

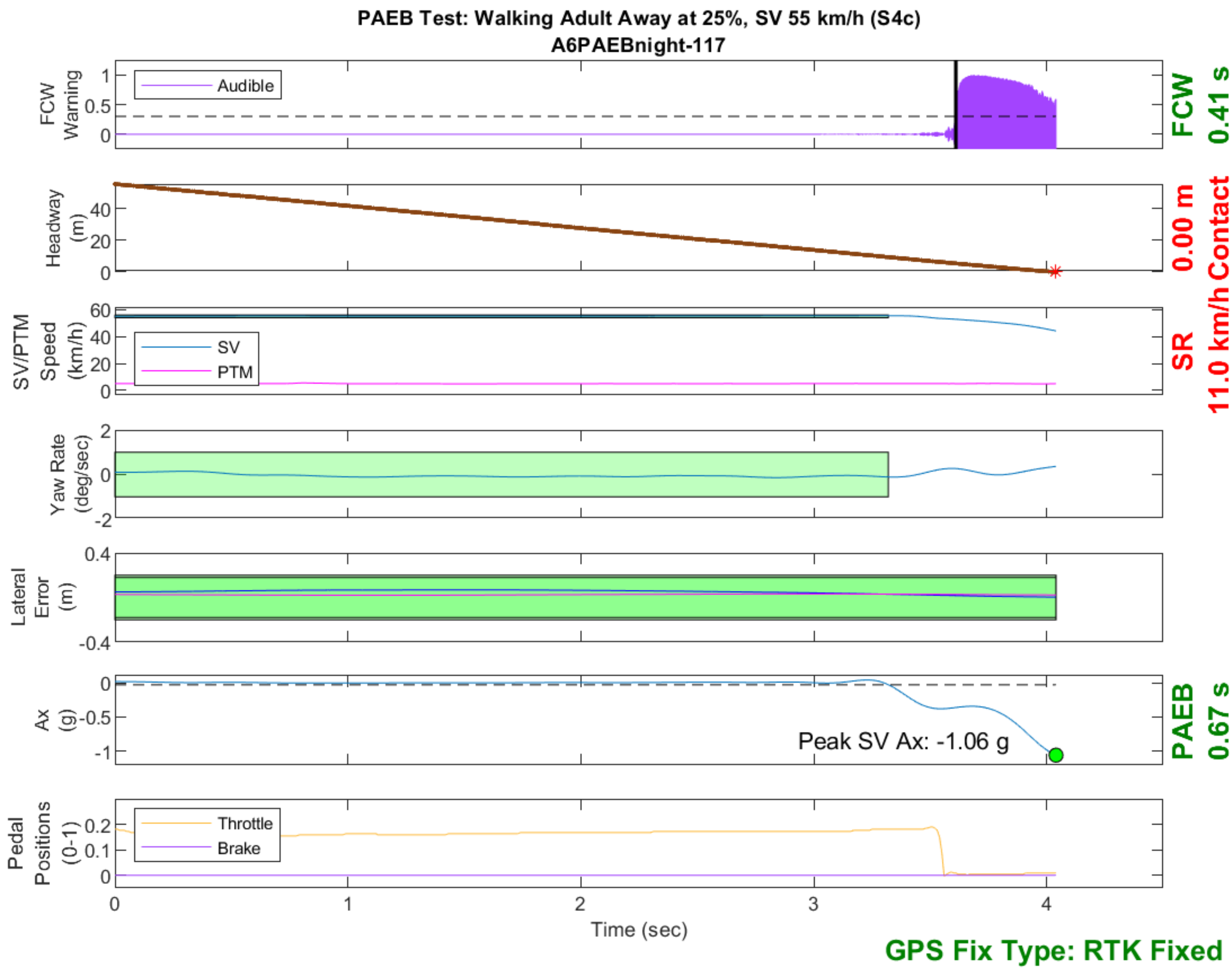


Figure D334. Time History for PAEB Run 117, S4c, Night, Low Beam, 55 km/h

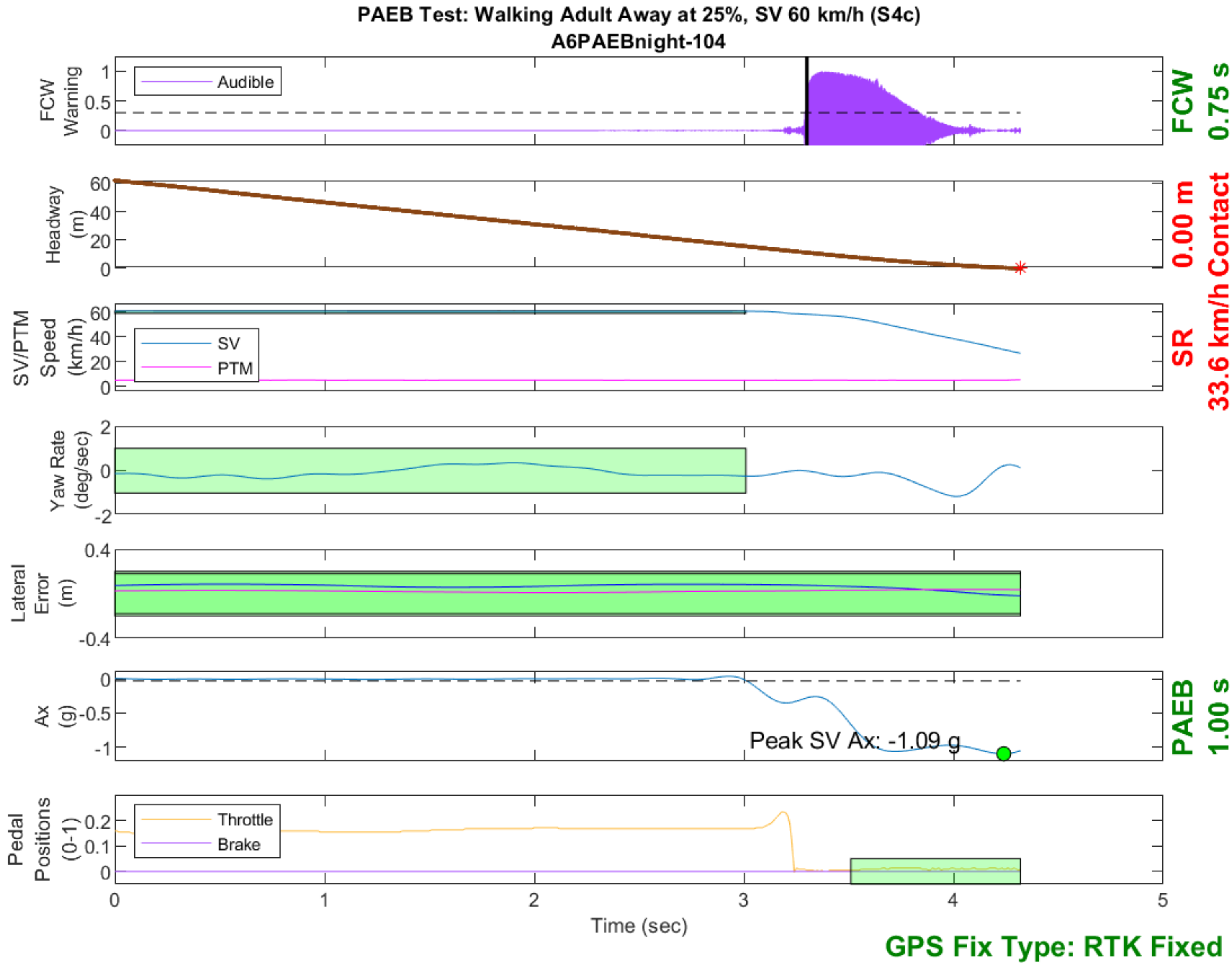


Figure D335. Time History for PAEB Run 104, S4c, Night, Low Beam, 60 km/h

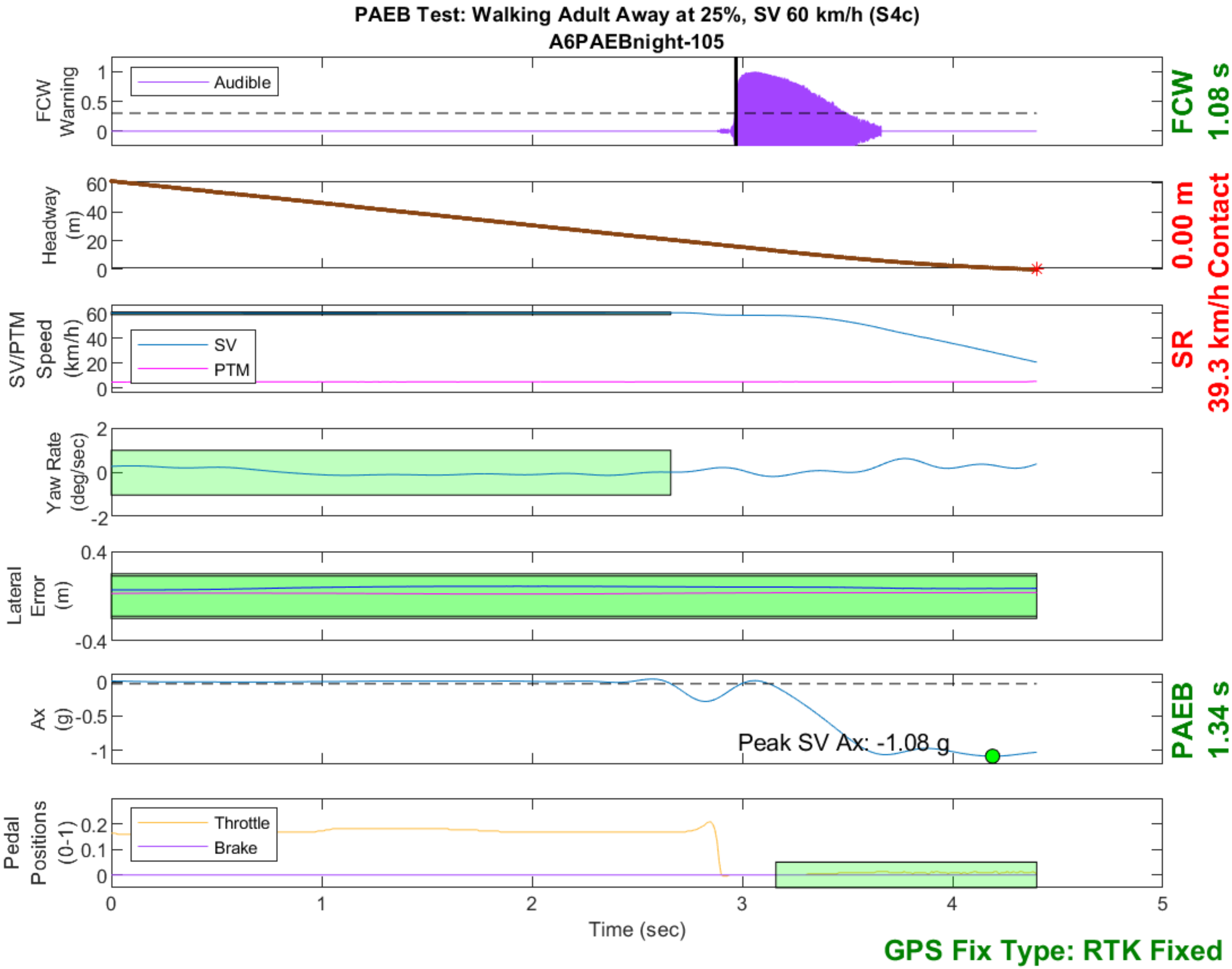


Figure D336. Time History for PAEB Run 105, S4c, Night, Low Beam, 60 km/h

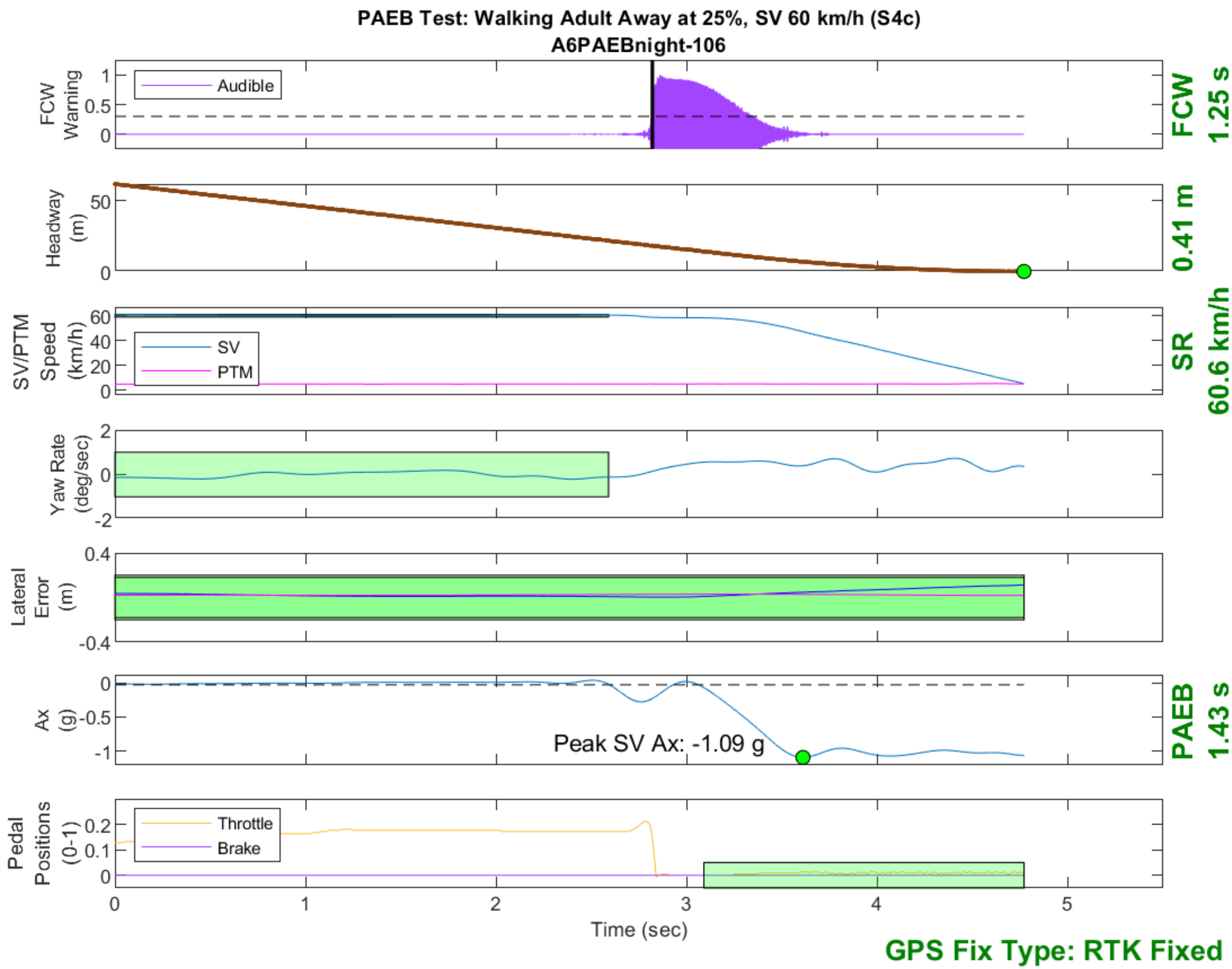


Figure D337. Time History for PAEB Run 106, S4c, Night, Low Beam, 60 km/h

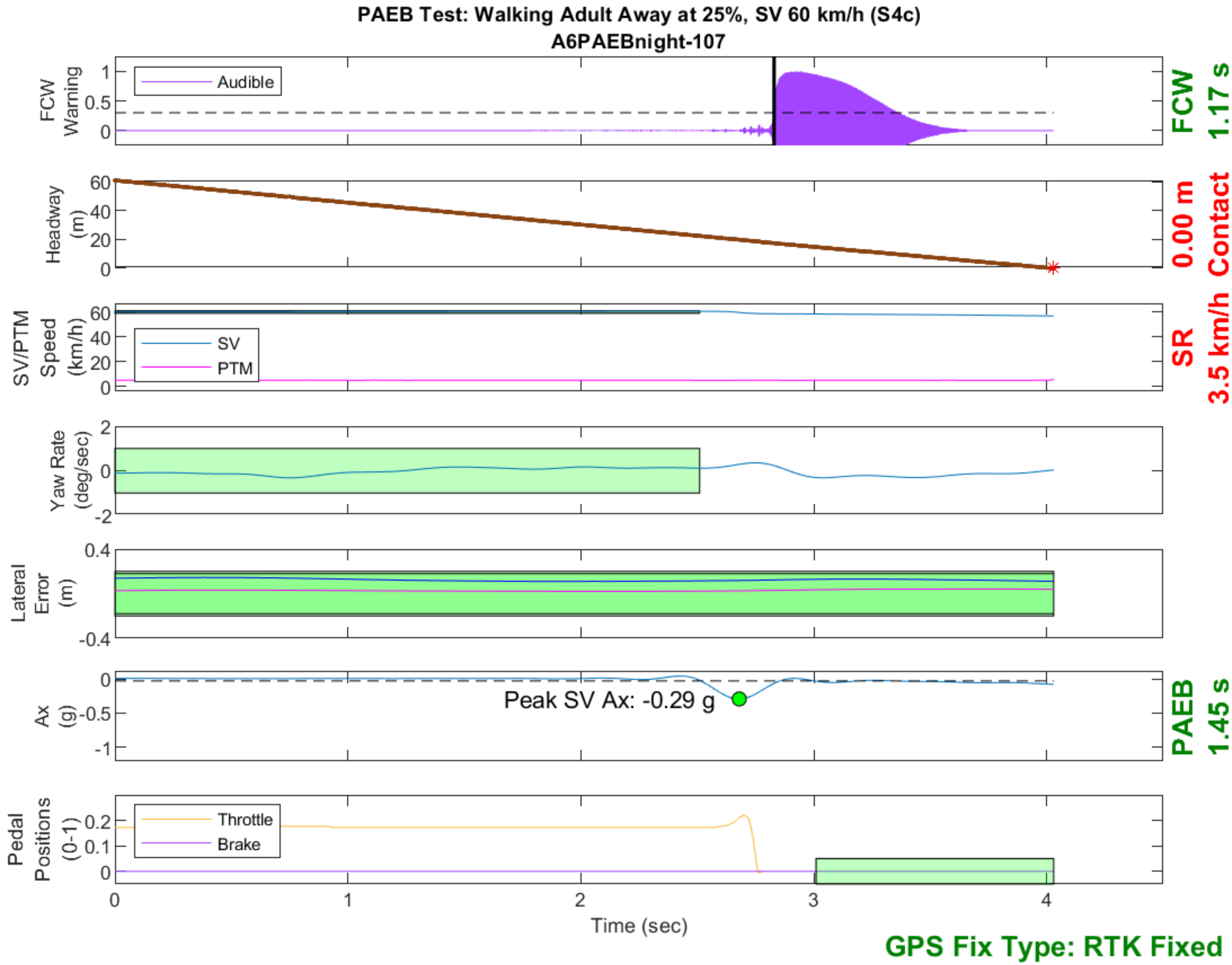


Figure D338. Time History for PAEB Run 107, S4c, Night, Low Beam, 60 km/h