PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM RESEARCH TEST
NCAP-DRI-PAEB-20-07

2020 Mercedes-Benz GLC 300 4Matic SUV

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Final Report

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16. Abstract These research tests were conducted on the subject 2020 Mercedes-Benz GLC 300 4Matic SUV 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.			
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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 2020 Mercedes-Benz GLC 300 4Matic SUV. 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

(Page 1 of 10)

2020 Mercedes-Benz GLC 300 4Matic SUV

VIN: *WDC0G8EB8LF72xxxx*

Day Test Date: *6/17/2020*

Night Test Date: *6/16/2020*

System Setting: *Early*

Upper Capabilities

Scenario	Maximum Test Speed Without Consistent SV-to-PTM Contact[1]		
	Daytime (km/h)	Night-High Beam (km/h)	Night-Low Beam (km/h)
S1a	11		
S1b	45	35	40
S1c	40		
S1d	35	35	35
S1e	35	40	45
S1f			
S1g			
S4a	*	50	*
S4b	*		
S4c	*	55	16

* 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.

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	
11	6	6	11.0						
16	4	0	1.4						
40	4	0	13.3						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

(Page 3 of 10)

2020 Mercedes-Benz GLC 300 4Matic SUV

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	5	3	14.8	5	5	16.1	5	5	16.1
20	5	5	19.9	5	5	20.2	5	5	20.1
30	5	4	28.6	5	4	29.9	5	5	30.1
35				5	5	35.2			
40	5	3	29.2	4	1	33.8	5	3	38.1
45	5	3	39.6				5	1	34.3
50	4	0	35.9						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	6	6	16.0						
40	5	5	34.8						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	
16	7	4	9.4	5	5	16.0	5	5	15.9
20	5	3	14.5	5	4	19.2	5	5	20.0
30	5	3	24.6	5	5	29.8	5	5	30.0
35	5	5	35.1	5	5	33.3	5	4	32.0
40	4	0	26.5	4	1	29.7	4	1	30.4

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	5	36.0						
40	7	2	26.2	6	6	39.7	6	6	40.5
45							6	5	40.1
50				7	4	38.1	3	0	28.4
55				5	2	31.2			

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	0.96	0.01
2	1.02	0.01
3	1.00	0.21
4	0.98	0.06
5	0.99	0.01

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

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2020 Mercedes-Benz GLC 300 4Matic SUV

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	
11	3	0	0.1				3	0	0.0
16	3	0	0.3	5	2	7.0	3	0	0.2
40	2	0	0.8	5	5	40.0	1	0	0.3
50				5	3	43.4			
55				3	0	22.3			
60				2	0	30.6			

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM

DATA SHEET 1: TEST RESULTS SUMMARY

2020 Mercedes-Benz GLC 300 4Matic SUV

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	3	0	0.4						
40	3	0	1.1						

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 1: TEST RESULTS SUMMARY

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2020 Mercedes-Benz GLC 300 4Matic SUV

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	
11	4	1	3.1						
16	3	0	0.2	5	5	16.2	4	4	16.2
35							3	0	4.1
40	3	0	0.1	6	6	40.0	3	0	12.6
50				5	5	50.0			
55				5	4	51.1			
60				4	1	42.0			

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2020 Mercedes-Benz GLC 300 4Matic SUV

TEST VEHICLE INFORMATION

VIN: *WDC0G8EB8LF72xxxx*

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

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

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Daimler AG Stuttgart*

Date of manufacture: *09/19*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

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

Rear: *235/60R18*

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

Rear: *320 kPa (46 psi)*

TIRES

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

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

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

Front tire DOT prefix: *93 K3 T899*

Rear tire DOT prefix: *93 K3 T899*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 5)

2020 Mercedes-Benz GLC 300 4Matic SUV

DAYTIME TEST GENERAL INFORMATION

Test date: *6/17/2020*

AMBIENT CONDITIONS

Air temperature: *22.2 C (72 F)*

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

X Wind speed ≤ 10 m/s (22 mph)

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

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

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 SYSTEM

DATA SHEET 3: TEST CONDITIONS

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2020 Mercedes-Benz GLC 300 4Matic SUV

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: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 3: TEST CONDITIONS

(Page 3 of 5)

2020 Mercedes-Benz GLC 300 4Matic SUV

NIGHTTIME TEST GENERAL INFORMATION

Test date: *6/16/2020*

AMBIENT CONDITIONS

Air temperature: *17.8 C (64 F)*

Wind speed: *0.0 m/s (0.0 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

(Page 4 of 5)

2020 Mercedes-Benz GLC 300 4Matic SUV

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: *270 kPa (39 psi)*

Rear: *320 kPa (46 psi)*

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 3: TEST CONDITIONS

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2020 Mercedes-Benz GLC 300 4Matic SUV

WEIGHT

Weight of vehicle as tested including driver and instrumentation

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

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 4: PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM OPERATION

(Page 1 of 4)

2020 Mercedes-Benz GLC 300 4Matic SUV

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

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

Type and location of sensors the system uses:

Radar, located behind the star emblem in the front grille.

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

Settings

Assistance

Active Brake Assist.

Select Early – Medium (default) – Late – Off

See Appendix A, Figures A13 and 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

____ Other

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

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

The auditory warning is a pulsed 2000 Hz tone.

Does the vehicle system require an initialization sequence/procedure? **X** Yes

____ No

If yes, please provide a full description.

Manufacturer specified proprietary calibration procedure (confidential).

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

Minimum: *7 km/h (4 mph) (Per manufacturer supplied information)*

Maximum: *250 km/h (155 mph) for vehicles travelling in front*

100 km/h (62 mph) for stationary vehicles

80 km/h (50 mph) for moving pedestrians, cyclists travelling in front

70 km/h (43 mph) for crossing vehicles, stationary pedestrians, and stationary cyclists

80 km/h (50 mph) for moving pedestrians and cyclists travelling in front (Per manufacturer supplied information)

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 4: PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM OPERATION

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2020 Mercedes-Benz GLC 300 4Matic SUV

Will the system deactivate due to repeated PAEB activations, impacts or near-misses? **X** Yes ____ No

If yes, please provide a full description.

Hard impacts might misalign the radar sensor, which may impact the overall performance.

In the event that system function is temporarily limited, the multifunction display will present a message stating "Active Brake Assist Function Currently Limited". If the system function is compromised and needs repair, the message will state "Active Brake Assist Functions Limited".

If the system function is temporarily limited, stop the vehicle and restart the engine. If the system function is compromised due to impact that alters alignment of the radar, then the vehicle must be serviced at the dealership.

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.

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

Settings

Assistance

Active Brake Assist.

Select "Off" to disable

See Appendix A, Figures A13 and A14

PEDESTRIAN AUTOMATIC EMERGENCY BRAKING

DATA SHEET 4: PEDESTRIAN AUTOMATIC EMERGENCY BRAKING SYSTEM OPERATION

(Page 4 of 4)

2020 Mercedes-Benz GLC 300 4Matic SUV

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

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

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

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.

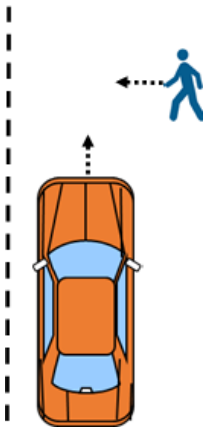


Figure 1. Scenarios S1a, b, c; Nearside Crossing Adult Pedestrian Walking 25/50/75% Overlap

- 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.

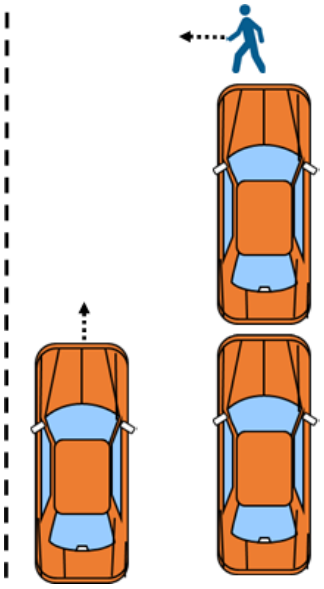


Figure 2. Scenario S1d; Nearside Obstructed Crossing Child Running, 50% Overlap

- 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.

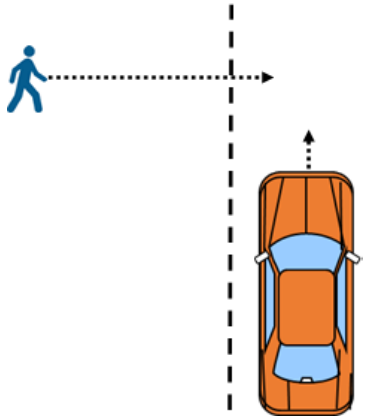


Figure 3. Scenario S1e; Offside Crossing Adult Running 50% Overlap

- 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.

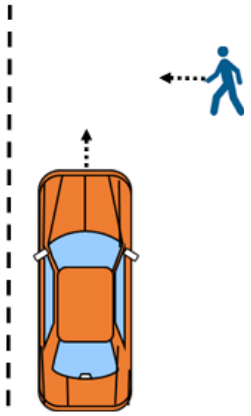


Figure 4. Scenario S1f; Nearside Crossing Adult Walking Stops Short

- 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.

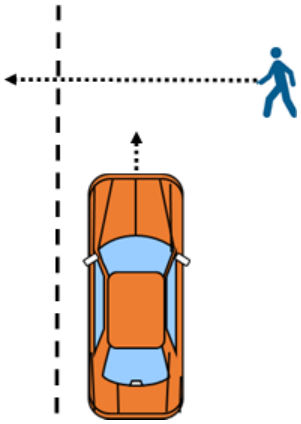


Figure 5. Scenario S1g; Nearside Crossing Adult Walking Clears Path

- 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).

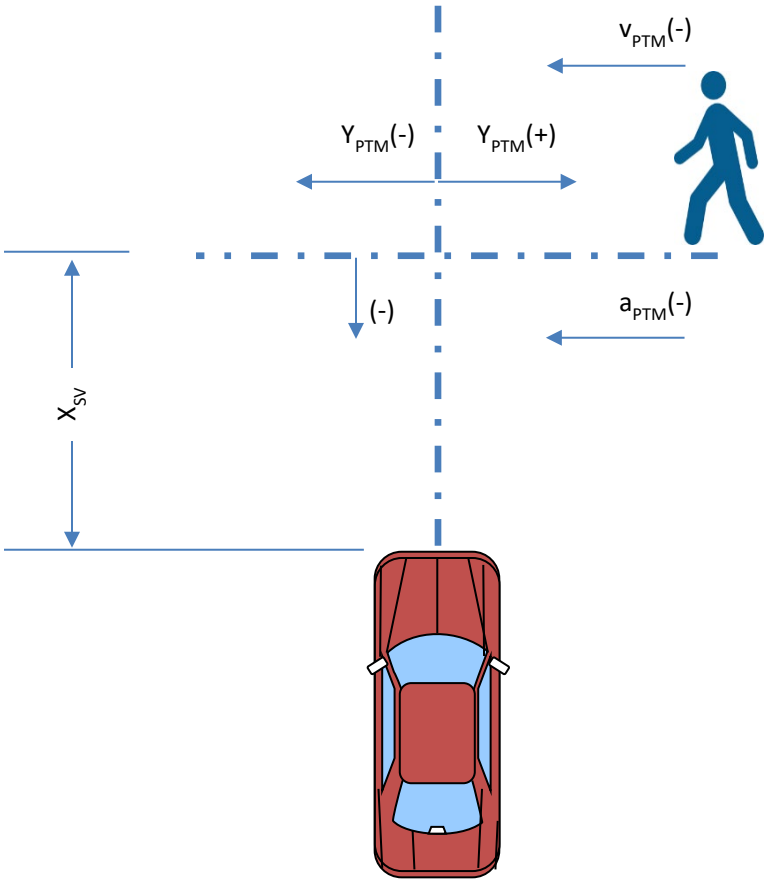


Figure 6. Coordinate System for Validation of Scenario 1

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.

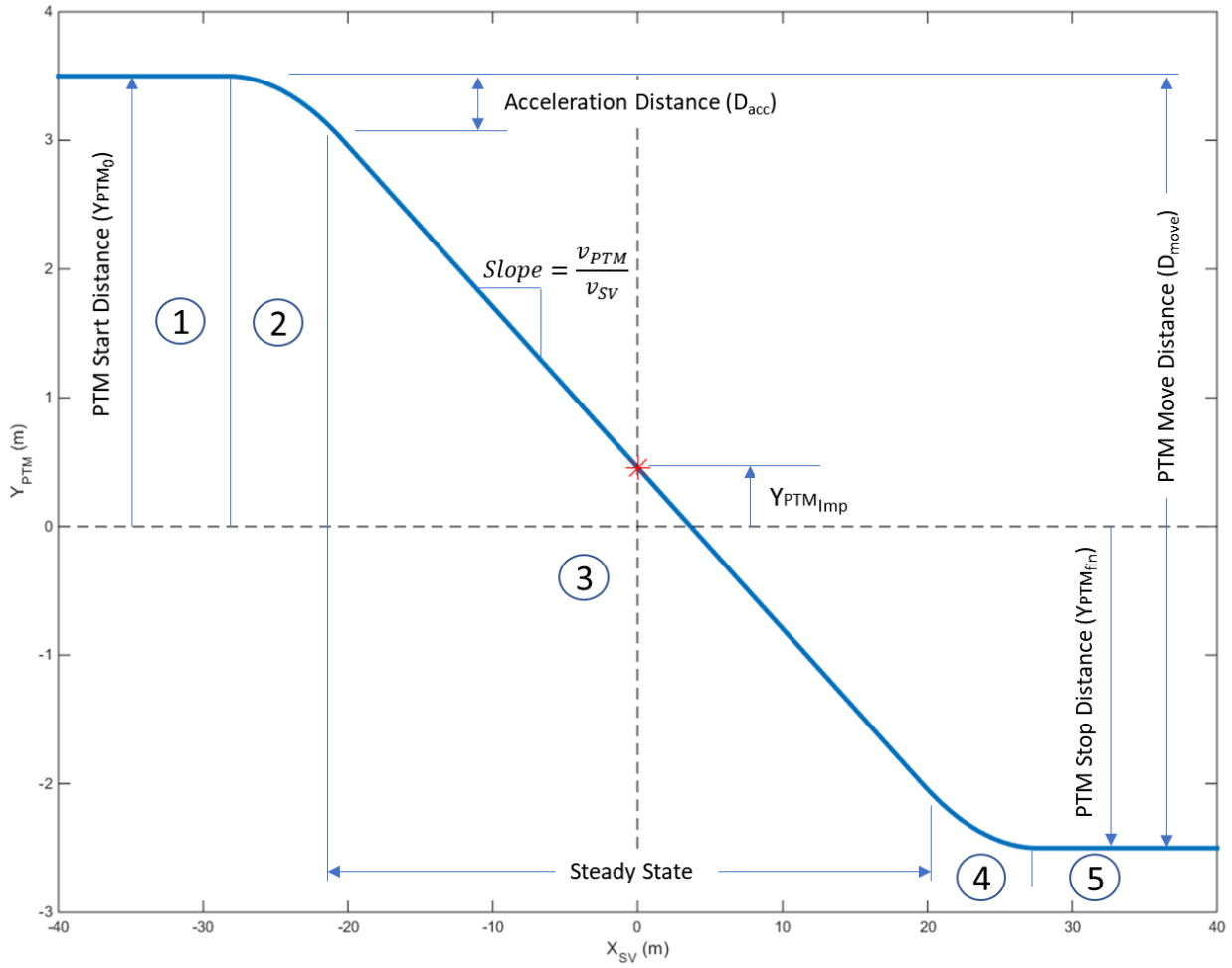


Figure 7. PTM Lateral Lane Position as a Function of SV Longitudinal Lane Position

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):

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

Domain 2 (Acceleration):

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

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.
- 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.

[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 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 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 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.

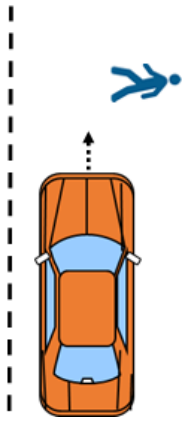


Figure 8. Scenario S4a; Nearside Standing Adult Facing Away From SV, 25% Overlap

- 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.

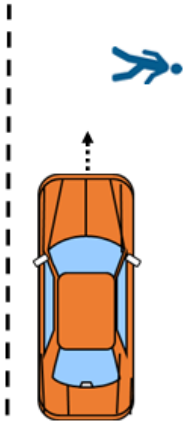


Figure 9. Scenario S4b; Nearside Standing Adult Facing Towards SV, 25% Overlap

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

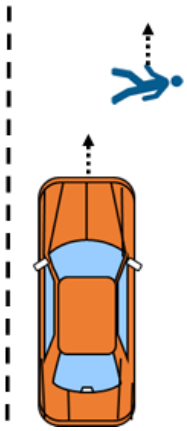


Figure 10. Scenario S4c; Nearside Walking Adult Away From SV, 25% Overlap

- 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).

[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.

- 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 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 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 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):
    - Scenarios 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.

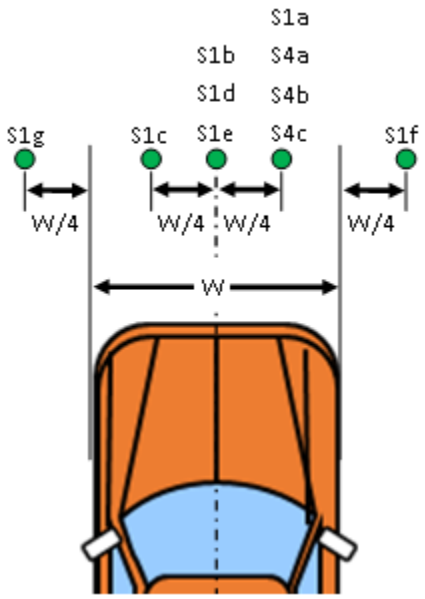


Figure 11. Offset Conditions

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

PTM Type	Adult (S1a-b-c-f-g) Child (S1d)		**Drawing illustrates setup but is not to scale**
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		

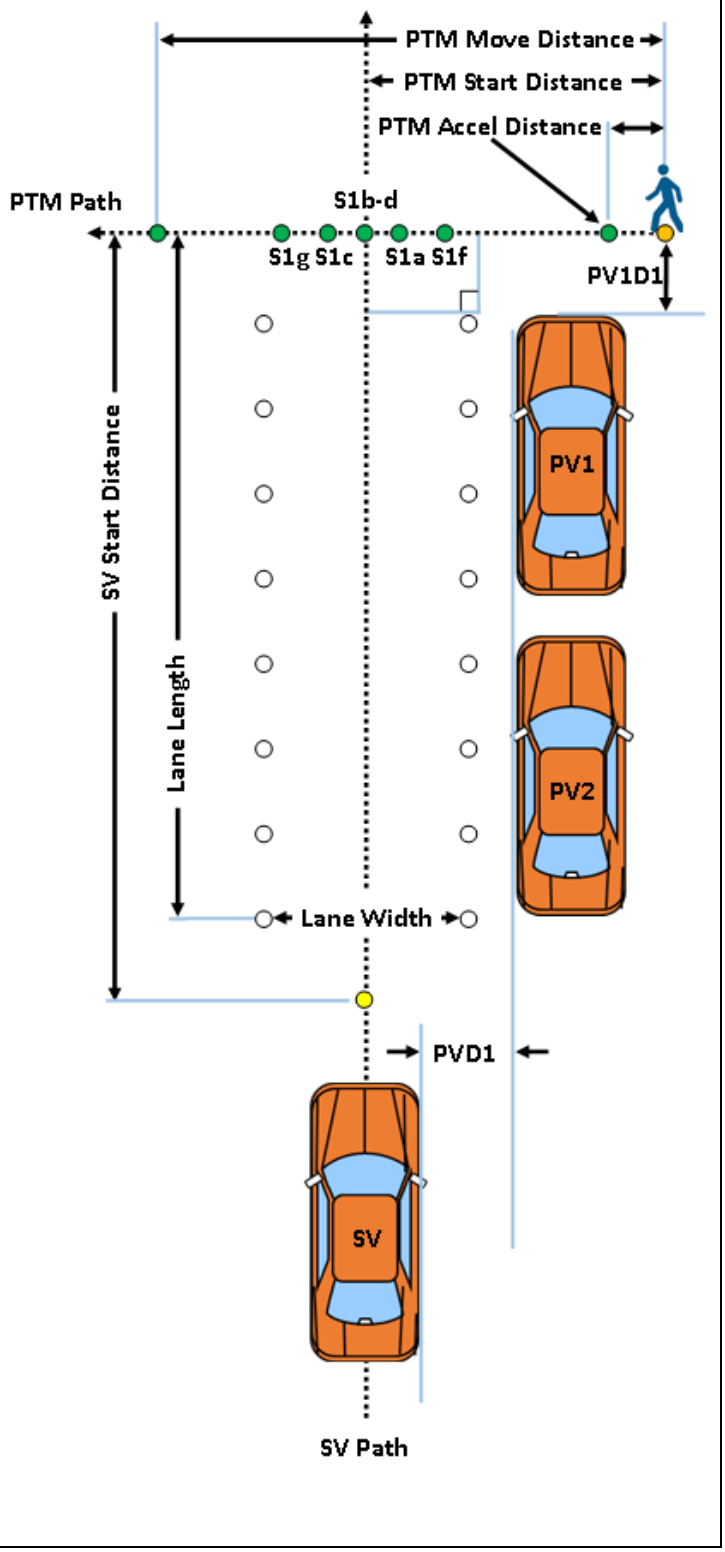


Table 4. Summary of S1e Scenario Setup

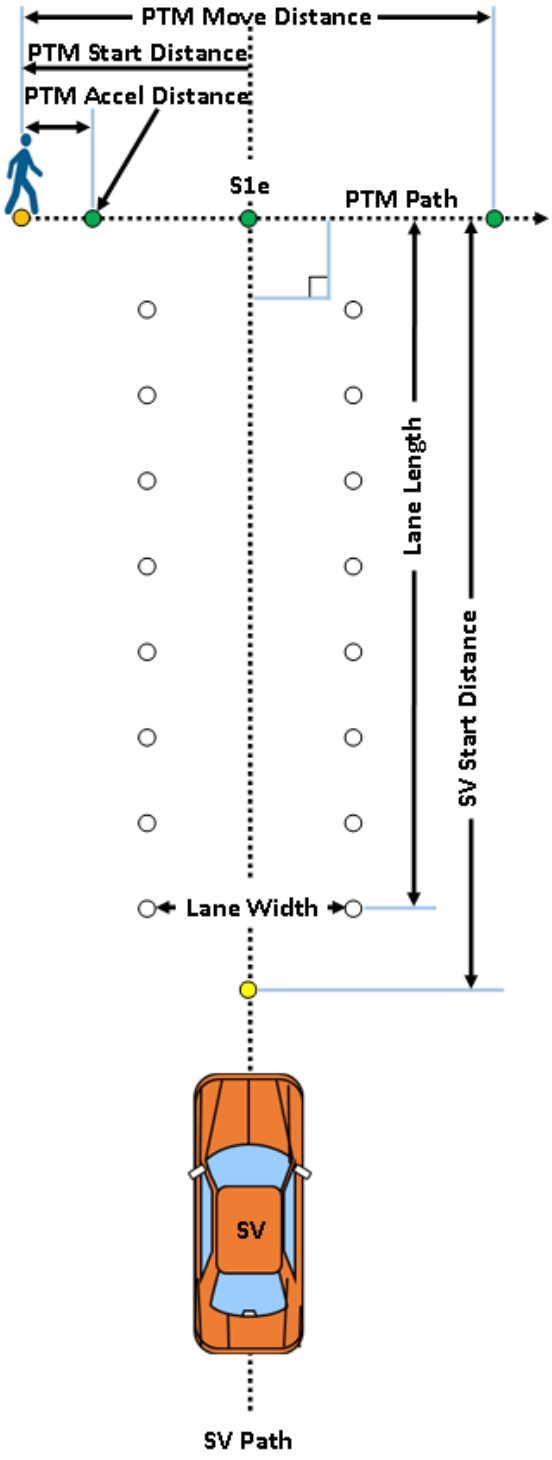
PTM Type	Adult	**Drawing illustrates setup but is not to scale**
PTM Location	Offside	
PTM Action	Crossing SV Path	
PTM Move Distance	9 m (29.5 ft)	
PTM Start Distance	5.5 m (18 ft)	
PTM Acceleration Distance	1.0 m (3.2 ft)	
Overlap *(Determined from the SV width. Measurement transferred to the location 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

PTM Type	Adult		**Drawing illustrates setup but is not to scale**
PTM Location	Nearside In-Path		
PTM Action	S4a	Stationary Facing Away	
	S4b	Stationary Facing Towards	
PTM Move Distance	N/A		
PTM Start Distance	N/A		
PTM Acceleration Distance	N/A		
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)		

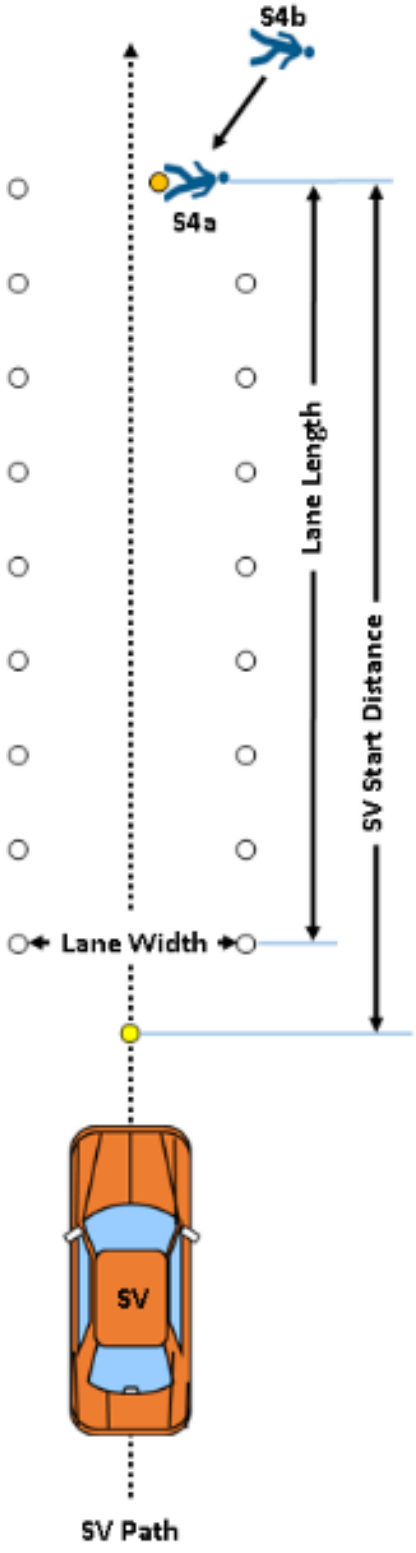
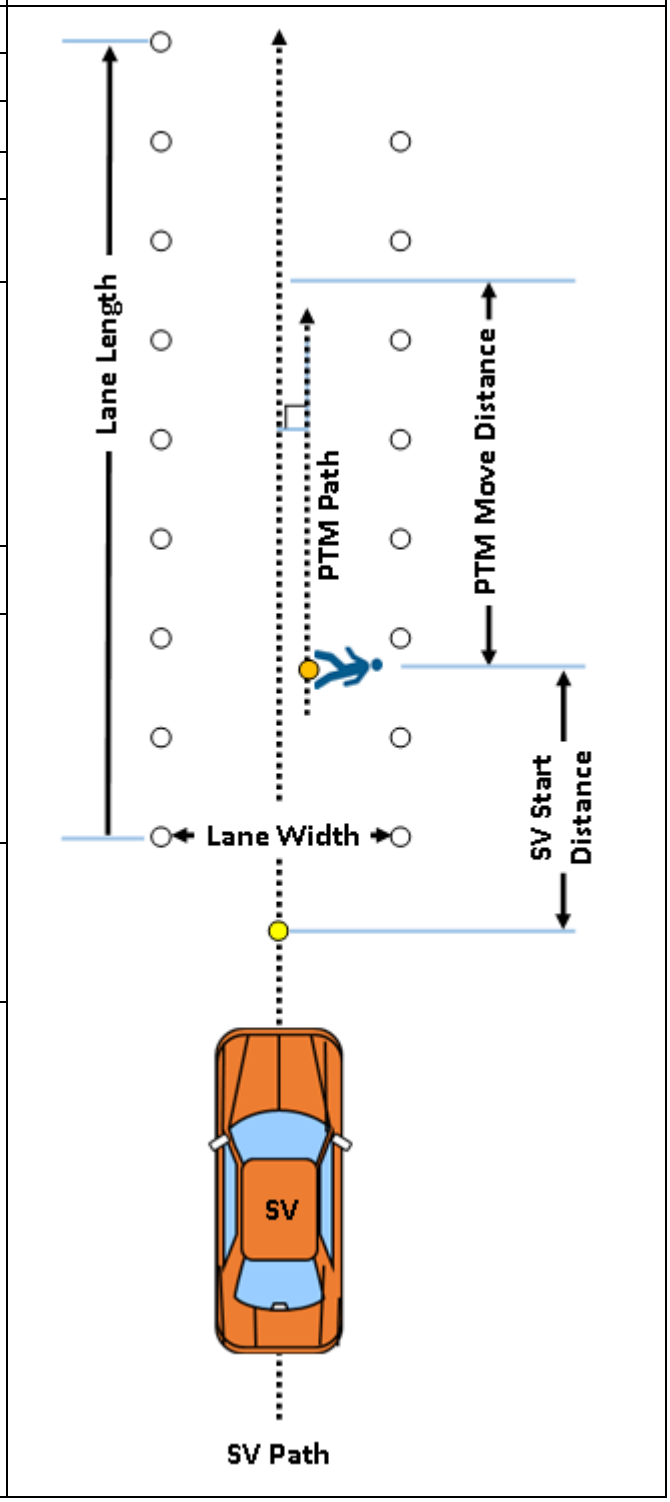


Table 6. Summary of S4c Scenario Setup

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	1m (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 50th 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

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	< 1% error between 20 and	Omega DPG8001	17042707002	By: DRI Date: 8/18/2020 Due: 8/18/2021
Platform Scales	Vehicle Total, Wheel, and Axle Load	1500 lb/platform	0.5% of applied load	Intercomp SW500	0410MN20001	By: DRI Date: 4/20/2020 Due: 4/20/2021
Linear (string) encoder	Throttle pedal travel	10 in 254 mm	0.1 in 2.54 mm	UniMeasure LX-EP	49041189	By: DRI Date: 5/22/2020 Due: 5/22/2021
SV Multi-Axis Inertial Sensing System	Position; Longitudinal, Lateral, and Vertical Accels; Lateral, Longitudinal and Vertical Velocities; Roll, Pitch, Yaw Rates; Roll, Pitch, Yaw Angles	Latitude: ±90º Longitude: ±180º Altitude: 0-18 km Velocity: 0-1000 knots Accel: ±5g Angular Rate: ±300 º/s Angular Disp: ±180º	Position: ±2 cm Velocity: 0.1 km/h Accel: ≤ 0.05% Angular Rate: ≤ 0.05% Roll/Pitch Angle: ±0.05º Heading Angle: ±0.1º	Oxford xNAV 550	015386	By: Oxford Technical Solutions Date: 8/8/2019 Due: 8/8/2021
PTT Multi-Axis Inertial Sensing System					015102	By: Oxford Technical Solutions Date: 3/6/2020 Due: 3/6/2022

Table 7. Test Instrumentation and Equipment (continued)

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

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

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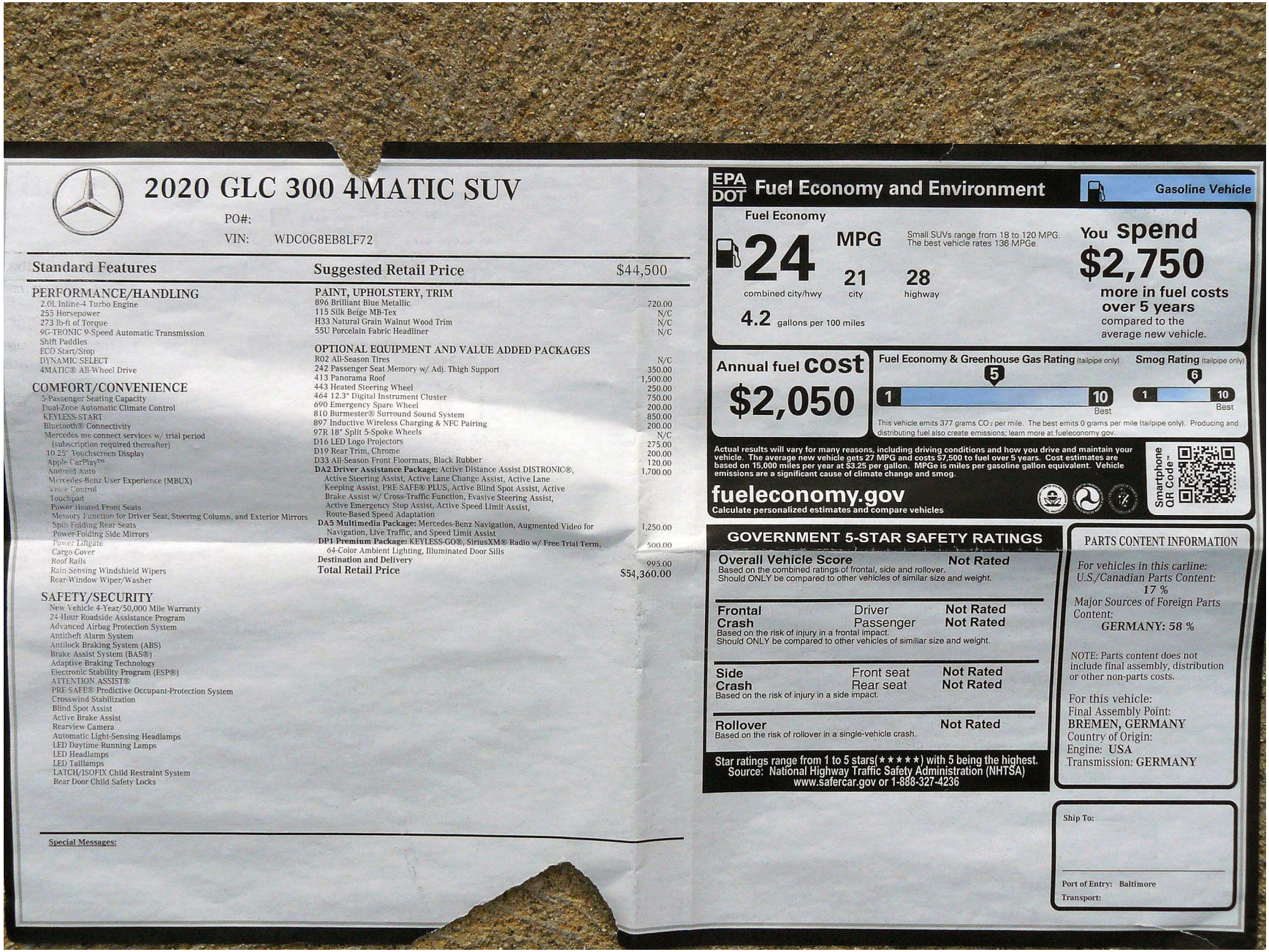
Figure A1. Front View of Subject Vehicle As-Delivered

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



2020 GLC 300 4MATIC SUV

PO#:

VIN: WDC0G8EB8LF72

Standard Features

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

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

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

Suggested Retail Price $44,500

PAINT, UPHOLSTERY, TRIM

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

OPTIONAL EQUIPMENT AND VALUE ADDED PACKAGES

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

Special Messages:

EPA DOT Fuel Economy and Environment

Gasoline Vehicle

Fuel Economy

24 MPG combined city/hwy

21 city

28 highway

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

4.2 gallons per 100 miles

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

Annual fuel cost $2,050

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

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

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

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

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score Not Rated
Based on the combined ratings of frontal, side and rollover.
Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash — Driver: Not Rated; Passenger: Not Rated
Based on the risk of injury in a frontal impact.
Should ONLY be compared to other vehicles of similiar size and weight.

Side Crash — Front seat: Not Rated; Rear seat: Not Rated
Based on the risk of injury in a side impact.

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

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

PARTS CONTENT INFORMATION

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

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

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

Ship To:

Port of Entry: Baltimore
Transport:

Figure A5. Window Sticker (Monroney Label)

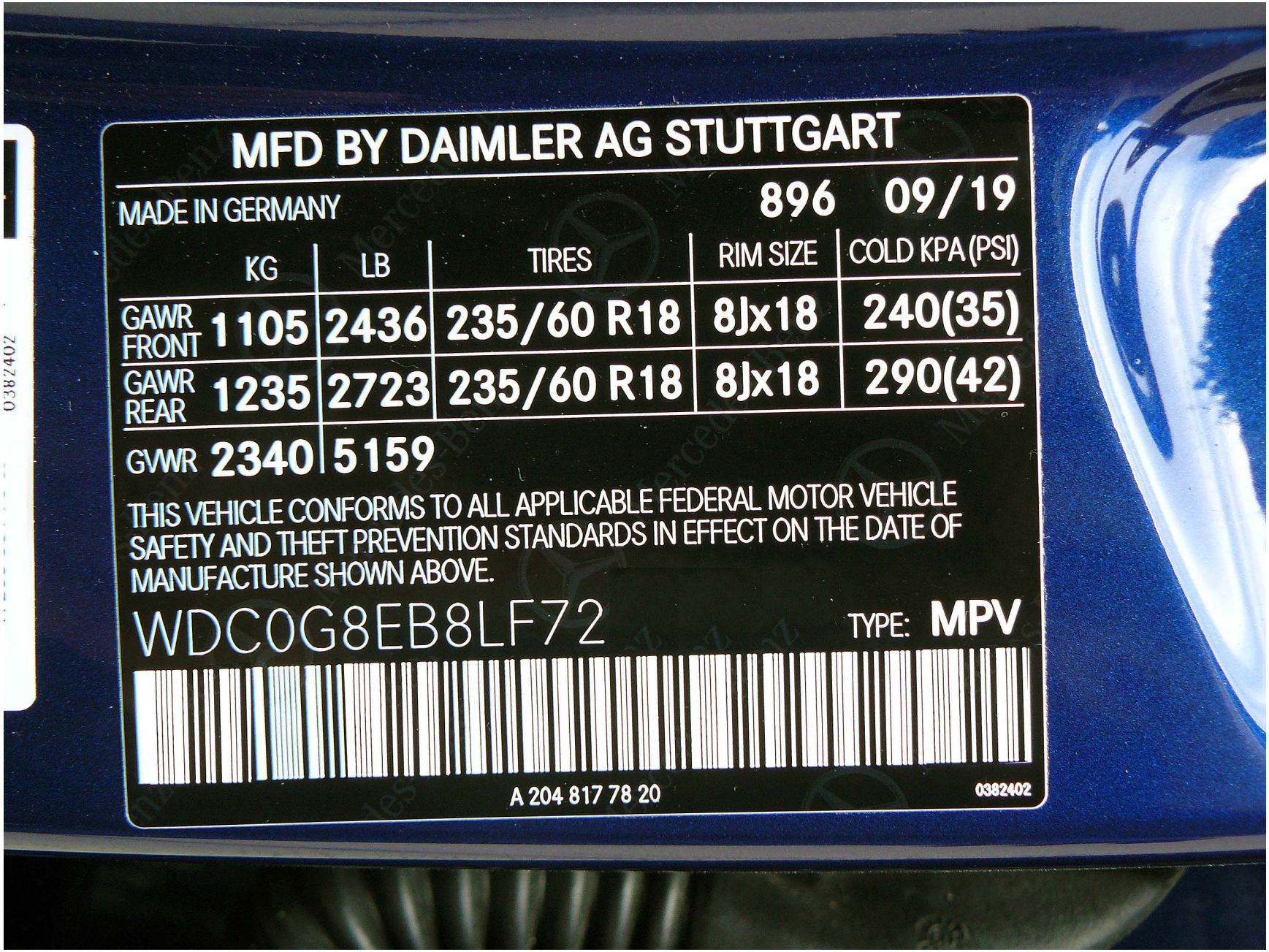


Figure A6. Vehicle Certification Label

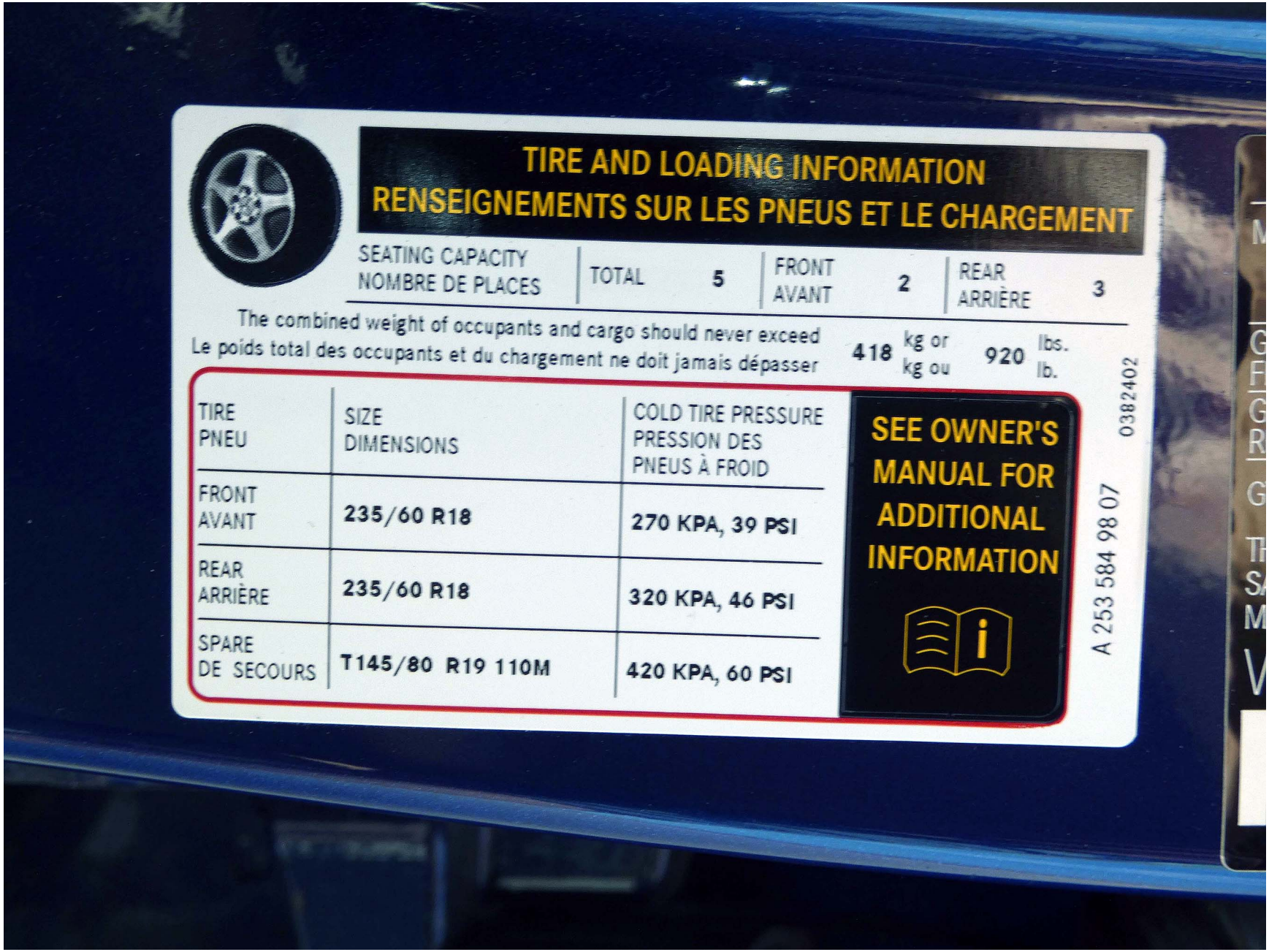


Figure A7. Tire Placard

Figure A8. Adult and Child Pedestrian Surrogates and Motion Platform

Figure A9. Obstruction Vehicles

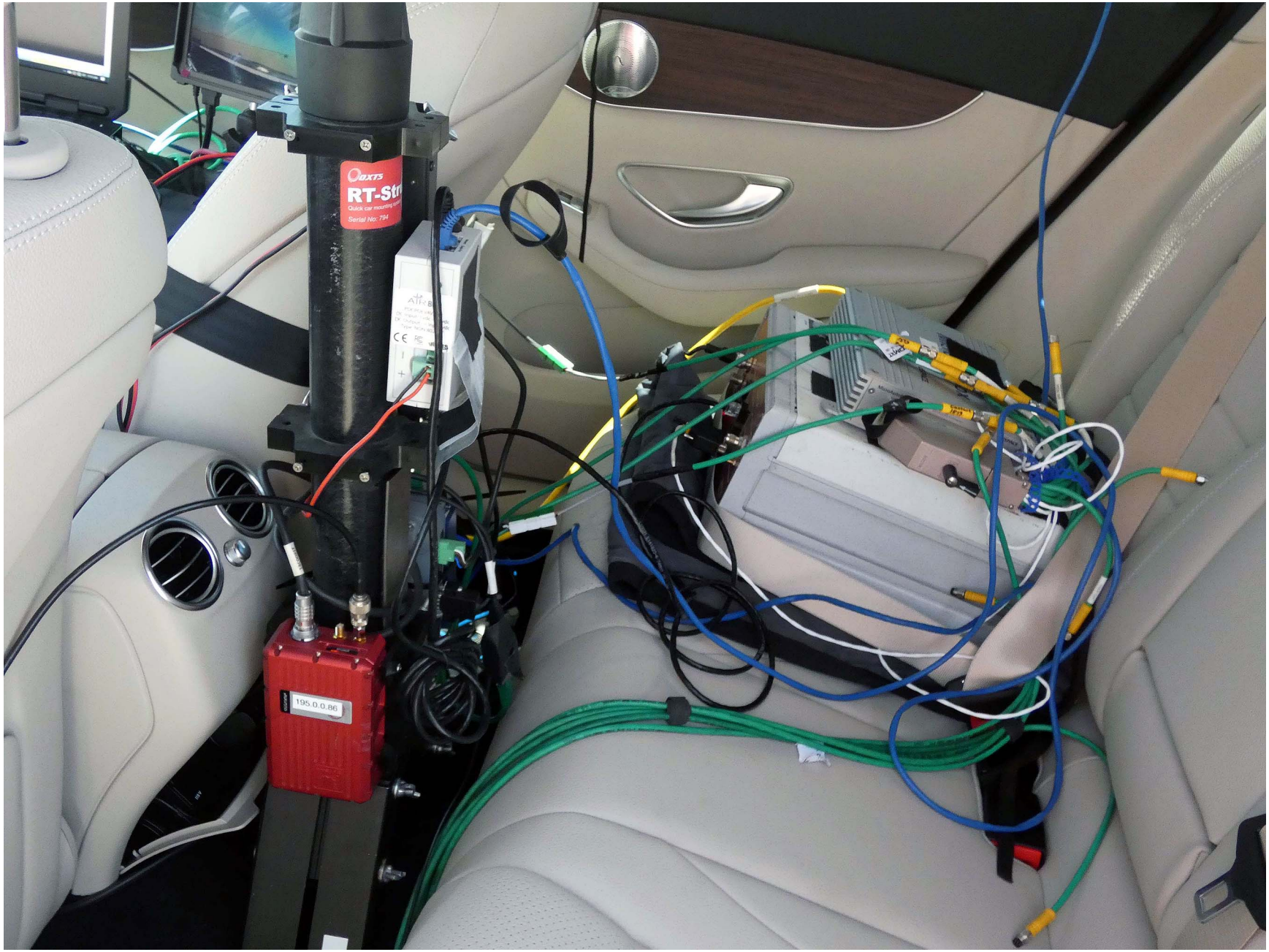


Figure A10. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A11. Sensors for Detecting Auditory and Visual Alerts

Figure A12. Computer Installed in Subject Vehicle

Figure A13. System Setup Menus

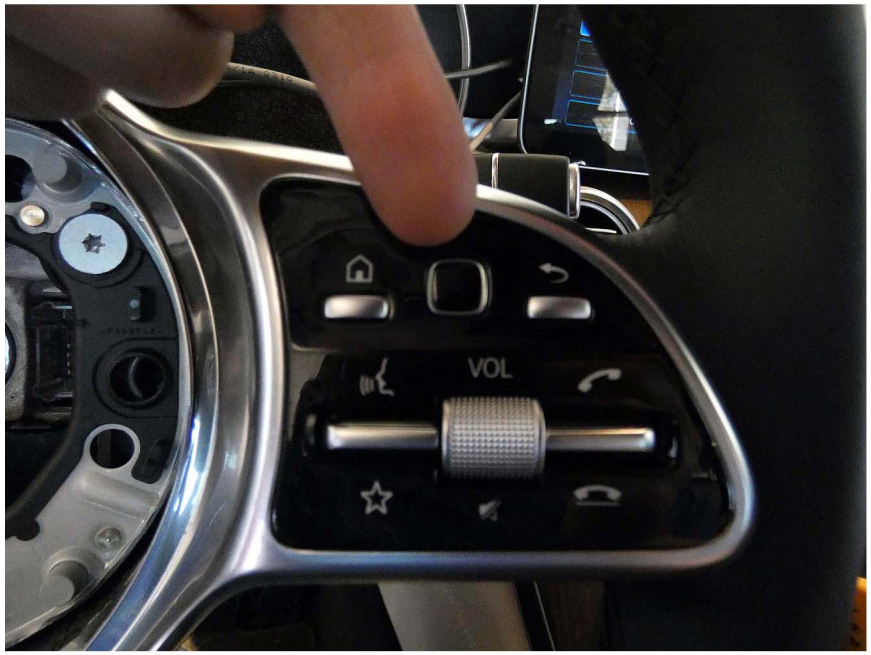
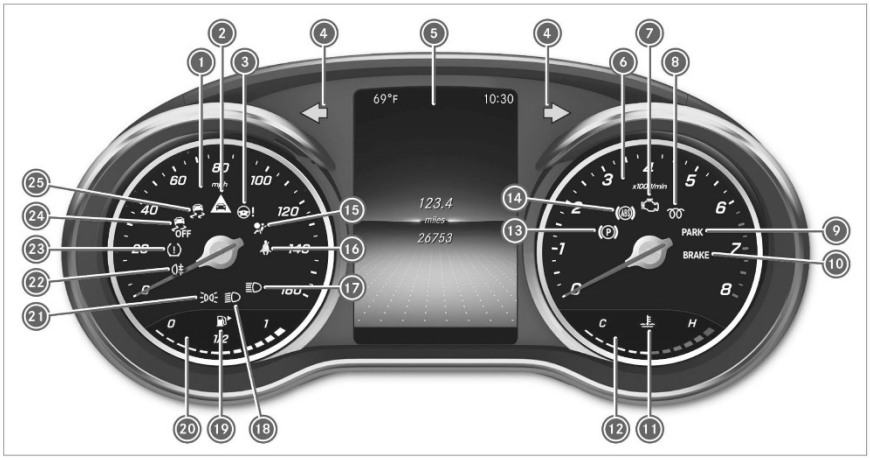


Figure A14. Controls for System Setup

Figure A15. Visual Alert

APPENDIX B

Excerpts from Owner’s Manual



Instrument Display (standard)

- The engine is switched off.

Multimedia system:

→ ⌂ ▸▸ Settings ▸▸ Vehicle

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

▶ Select Yes.
Standby mode is activated.

Driving and driving safety systems

Driving systems and your responsibility

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

Information on radar and ultrasonic sensors

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

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

Overview of driving systems and driving safety systems

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

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

Function of ESP® trailer stabilization

WARNING Risk of accident in poor road and weather conditions

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

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

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

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

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

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

Function of EBD (electronic brake force distribution)

EBD is characterized by the following:

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

Function of STEER CONTROL

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

This steering recommendation is given particularly in the following situations:

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

System limits

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

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

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

Function of Active Brake Assist

Active Brake Assist consists of the following functions:

- Distance warning function
- Autonomous braking function

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

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

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

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

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

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

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

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

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

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

In such cases, Active Brake Assist might:

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

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

▶ Be prepared to brake or swerve if necessary.

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

Also observe the system limits of Active Brake Assist.

The individual subfunctions are available in the following speed ranges:

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

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

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

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

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

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

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

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

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

Canceling a brake application of Active Brake Assist

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

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

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

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

Evasive Steering Assist (only vehicles with Driving Assistance Package)

Evasive Steering Assist has the following characteristics:

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

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

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

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

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

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

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

In such cases Evasive Steering Assist can:

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

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

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

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

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

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

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

Setting Active Brake Assist

Requirements:

- The ignition is switched on.

Multimedia system:

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

The following settings are available:

- Early
- Medium
- Late

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

Deactivating Active Brake Assist

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

▶ Select Off.
The distance warning function, the autonomous braking function and the Evasive Steering Assist are deactivated.

When the vehicle is next started, the middle setting is automatically selected.

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

Speed control cruise control

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

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

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

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

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

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

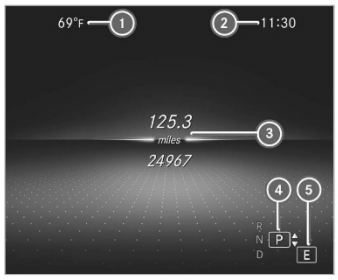
The following display content can be selected in the Classic and Sport designs:

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

The following content can be selected in the Progressive design:

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

Overview of displays on the multifunction display



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

Further displays on the multifunction display:

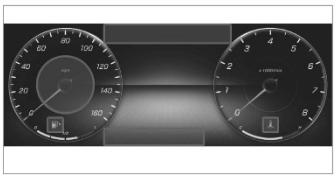
- Gearshift recommendation (→ page 171)
- Active Parking Assist activated (→ page 234)
- Parking Assist PARKTRONIC deactivated (→ page 224, 223, 224)
- Cruise control (→ page 197)
- DSR (→ page 199)
- Active Distance Assist DISTRONIC (→ page 201)
- Active Brake Assist(→ page 197)
- Active Steering Assist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

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

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

Instrument Display (standard)

Widescreen Cockpit Instrument Display



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

Indicator and warning lamps:

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

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

Driving systems

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

PARK Turn On the Ignition to Release the Parking Brake 526
Vehicle Ready to Drive Switch the Ignition Off Before Exiting 514
Vehicle Rising Please Wait 531
Vehicle Rising 529
Warning Tire Malfunction 548
Wheel Sensor(s) Missing 547
Active Blind Spot Assist Currently Unavailable See Operator's Manual 533
Active Blind Spot Assist Inoperative 534
Active Blind Spot Asst. Not Available When Towing a Trailer See Operator's Manual 534
Active Brake Assist Functions Currently Limited See Operator's Manual 542
Active Brake Assist Functions Limited See Operator's Manual 542
Active Distance Assist Currently Unavailable See Operator's Manual 536
Active Distance Assist Inoperative 536
Active Distance Assist Now Available 536
Active Lane Keeping Assist Currently Unavailable See Operator's Manual 532
Active Lane Keeping Assist Inoperative 533
Active Parking Assist and PARKTRONIC Inoperative See Operator's Manual 528
Active Steering Assist Currently Unavailable Due to Multiple Emergency Stops 532
Active Steering Assist Currently Unavailable See Operator's Manual 531
Active Steering Assist Inoperative 531
Adaptive Highbeam Assist Camera View Restricted See Operator's Manual 513
Adaptive Highbeam Assist Currently Unavailable See Operator's Manual 513
Adaptive Highbeam Assist Inoperative 513
Apply Brake to Shift from 'P' 519
Apply Brake to Shift to 'R' 520
Auxiliary Battery Malfunction 522
Beginning Emergency Stop 531
Blind Spot Assist Currently Unavailable See Operator's Manual 533
Blind Spot Assist Inoperative 533
Blind Spot Assist Not Available When Towing a Trailer See Operator's Manual 533
Check Tire Pressure Soon 549
Check Tire Pressure Then Restart Run Flat Indicator 550

APPENDIX C

Run Log

Run Log for Daytime Tests

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

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 (1m)										
42	S1a	11	Day	Y	0.49	0.67	10.9	1.22	0.50	NC	6/18/22, 32 C, 7 knots
43				Y	0.30	0.04	11.3	1.20	0.30	NC	
44				Y	0.37	0.25	10.8	1.19	0.38	NC	
45				Y	0.33	0.15	11.0	1.18	0.34	NC	
46				Y	0.44	0.50	11.5	1.18	0.46	NC	
47				Y	0.39	0.32	10.7	1.18	0.41	NC	
33	S1a	16	Day	Y	0.06	0.00	0.5	0.27	0.08	Contact	Very late braking applied by AEB system
34				Y	0.23	0.00	3.7	0.87	0.22	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
35	S1a	16	Day	Y	0.60	0.00	0.8	0.04		Contact	PTM leg fell off,[4] no AEB
36				Y	-0.15	0.00	0.5	0.03		Contact	FCW after impact, no AEB
37	S1a	40	Day	Y	0.66	0.00	20.3	1.05	0.61	Contact	
38				Y	0.62	0.00	20.4	1.08	0.60	Contact	PTM leg fell off[4]
39				Y	0.50	0.00	11.5	0.91	0.44	Contact	
40				Y	0.38	0.00	0.8	0.16	0.34	Contact	
1	Static Run (1 m)										
2	S1b	16	Day	Y	0.46	0.39	16.3	1.07	0.46	NC	
3				Y	0.33	0.00	10.5	0.96	0.33	Contact	
4				Y	0.40	0.00	15.3	1.07	0.36	Contact	
5				Y	0.49	0.59	15.7	1.06	0.50	NC	
6				Y	0.37	0.16	16.2	1.07	0.39	NC	
22	S1b	20	Day	Y	0.71	1.12	19.6	1.02	0.64	NC	
23				Y	0.69	1.03	19.9	1.07	0.63	NC	
24				Y	0.74	0.98	19.9	1.06	0.67	NC	
25				Y	0.70	0.96	20.3	0.99	0.61	NC	
26				Y	0.62	1.01	19.6	0.98	0.63	NC	

[4] For several runs the notes indicate the PTM leg fell off. If the leg fell off after the point of interest (e.g. near the end of the run) the runs were considered valid. Runs in which the leg fell off prior to the point of interested were considered invalid.

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
27	S1b	30	Day	Y	0.64	0.04	30.0	1.02	0.61	NC	
28				Y	0.87	0.84	29.5	1.04	0.81	NC	
29				Y	0.64	0.00	24.3	1.01	0.59	Contact	
30				Y	0.83	0.71	29.6	1.03	0.77	NC	
31				Y	0.69	0.12	29.8	1.00	0.61	NC	
32	Static Run (1m)										
7	S1b	40	Day	Y	0.26	0.00	1.7	0.65	0.18	Contact	
8				Y	0.86	0.72	39.4	1.04	0.81	NC	
9				Y	0.95	1.15	39.6	1.04	0.90	NC	
10				Y	1.02	0.31	39.5	1.07	0.95	NC	
11				Y	0.73	0.00	25.9	1.01	0.68	Contact	
16	S1b	45	Day	Y	0.89	0.13	44.5	1.01	0.83	NC	
17				Y	0.92	0.00	33.5	0.99	0.79	Contact	
18				Y	1.02	1.25	44.7	1.01	0.94	NC	
19				Y	0.83	0.00	30.9	1.01	0.76	Contact	
20				N							PTM leg fell off
21				Y	0.96	1.23	44.2	1.06	0.89	NC	
12	S1b	50	Day	Y	0.95	0.00	43.1	1.09	0.88	Contact	
13				Y	0.91	0.00	36.0	1.06	0.83	Contact	
14				Y	0.88	0.00	27.2	1.11	0.75	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
15	S1b	50	Day	Y	0.92	0.00	37.4	1.00	0.85	Contact	Due to 3 runs with contact, decrease speed to 45 km/h
48	Static Run (1m)										
49	S1c	16	Day	Y	0.58	0.67	16.2	1.05	0.52	NC	
50				N							SV speed
51				Y	0.60	0.65	15.9	1.05	0.54	NC	
52				Y	0.57	0.48	16.4	1.01	0.50	NC	
53				Y	0.61	0.72	15.8	1.09	0.53	NC	
54				Y	0.61	0.70	15.5	1.04	0.52	NC	
55				Y	0.61	0.74	16.4	1.06	0.54	NC	
56	S1c	40	Day	N							Yaw rate
57				Y	1.02	0.33	35.3	1.09	0.97	NC	
58				Y	1.02	0.51	36.6	1.03	0.94	NC	
59				Y	1.04	0.47	35.4	1.04	0.98	NC	
60				Y	0.99	0.28	33.5	1.09	0.95	NC	
61				Y	1.00	0.39	33.1	1.09	0.95	NC	
127	Static Run										
128	S1d	16	Day	N							Driver hit brakes

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
129	S1d	16	Day	Y		0.00	0.4	0.02		Contact	No warning, no AEB
130				Y		0.00	0.5	0.02		Contact	No warning, no AEB
131				Y		0.00	0.3	0.04		Contact	PTM legs not moving[5], no warning, no AEB
132				Y	0.59	1.01	16.7	1.06	0.59	NC	
133				Y	0.64	0.77	15.9	1.03	0.55	NC	19-Jun. 33 C, 9 knots
134				Y	0.56	0.77	15.9	1.09	0.52	NC	
135				Y	0.45	0.36	16.3	1.08	0.43	NC	
141	S1d	20	Day	Y	0.40	0.00	6.8	0.92	0.27	Contact	
142				Y	0.70	1.00	20.1	1.02	0.62	NC	
143				Y	0.74	1.20	20.1	1.08	0.66	NC	
144				Y	0.36	0.00	5.2	0.94	0.24	Contact	
145				Y	0.71	1.17	20.1	1.10	0.64	NC	
146	S1d	30	Day	Y	0.47	0.00	12.6	0.93	0.42	Contact	
147				Y	0.57	0.00	20.4	0.95	0.55	Contact	
148				Y	0.72	0.03	30.3	1.03	0.61	NC	
149				Y	0.86	0.68	30.0	1.11	0.77	NC	
150				Y	0.79	0.20	29.9	1.08	0.65	NC	

[5] For several runs the PTM legs were not moving. When this did not appear to affect the outcome of the run these runs were considered valid. If the outcome appeared to be affected by the absence of leg movement the runs were considered invalid.

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
151	S1d	35	Day	Y	0.97	0.58	34.2	1.01	0.88	NC	
152				Y	0.95	0.41	35.1	1.04	0.88	NC	
153				Y	0.95	1.02	35.1	1.04	0.83	NC	
154				Y	0.90	0.75	35.6	1.06	0.79	NC	
155				Y	0.95	0.28	35.5	1.09	0.88	NC	
156	Static Run (1m)										
136	S1d	40	Day	Y	0.87	0.00	32.0	1.03	0.73	Contact	
137				Y	0.77	0.00	24.9	1.03	0.65	Contact	
138				N							PTM lateral error
139				Y	0.74	0.00	23.2	1.03	0.64	Contact	PTM legs not moving[5]
140				Y	0.80	0.00	25.8	0.95	0.67	Contact	
87	S1e	35	Day	Y	0.82	0.70	35.9	1.03	0.77	NC	
88				Y	0.86	0.44	35.6	1.09	0.81	NC	
89				Y	0.77	0.43	35.0	1.05	0.72	NC	
90				Y	0.73	0.35	36.7	1.01	0.69	NC	
91				N							Aborted run
92				Y	0.81	0.62	36.7	1.08	0.75	NC	
79	Static Run										
80	S1e	40	Day	Y	0.82	0.19	37.8	1.00	0.75	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	S1e	40	Day	Y	0.90	0.52	37.9	1.02	0.81	NC	
82				N							AEB warning appeared halfway thru AEB braking
83				Y	0.81	0.00	27.3	1.11	0.68	Contact	
84				Y	1.59	0.00	19.0	0.93	0.58	Contact	
85				Y	0.69	0.00	19.0	0.93	0.59	Contact	
86				Y	0.59	0.00	16.2	0.93	0.55	Contact	Due to 3 runs with contact, step down to 35 km/h
93	Static Run (1m)										
62	Static Run (1m)										
63	S1f	40	Day	Y	0.63	0.00	13.9	0.96	0.58	NC	AEB intervention
64				Y	0.90	0.00	22.0	1.02	0.85	NC	AEB intervention
65				N							PTM lateral error
66				N							PTM lateral error
67				N							Comm dropout
68				N							Driver hit brakes
69				Y	0.81	0.00	13.7	1.00	0.72	NC	AEB intervention
70				Y	0.86	0.00	17.6	0.98	0.79	NC	AEB intervention
71				Y	0.75	0.00	12.5	0.99	0.68	NC	AEB intervention

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
72	Static Run (1 m)										
73	S1g	40	Day	Y		0.00	0.4	0.01		NC	No warning, no AEB
74				Y		0.00	0.3	0.01		NC	No warning, no AEB
75				Y	0.11	0.00	0.9	0.21	0.15	NC	
76				Y	0.12	0.00	0.4	0.06		NC	Warning, no AEB
77				Y		0.00	0.5	0.01		NC	No warning, no AEB
78	Static Run (1m)										
114	S4a	11	Day	Y		0.00	0.1	0.01		Contact	No warning, no AEB
115				Y		0.00	0.1	0.00		Contact	No warning, no AEB
116				Y		0.00	0.1	0.02		Contact	No warning, no AEB
106	Static Run (1 m)										
107	S4a	16	Day	Y		0.00	0.4	0.02		Contact	No warning, no AEB
108				Y		0.00	0.1	0.04		Contact	No warning, no AEB
109				Y		0.00	0.3	0.03		Contact	No warning, no AEB
110	S4a	40	Day	N						Contact	Driver hit brake
111				N							Throttle drop

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
112	S4a	40	Day	Y	2.24	0.00	1.2	0.05		Contact	No AEB
113				Y		0.00	0.3	0.04		Contact	No warning, no AEB
117	Static Run (1m)										
118	S4b	16	Day	Y		0.00	0.1	0.02		Contact	No warning, no AEB
119				Y		0.00	0.7	0.03		Contact	No warning, no AEB
120				Y		0.00	0.3	0.03		Contact	No warning, no AEB
121	S4b	40	Day	N							Driver hit brakes
122				N							Lateral offset
123				Y	2.28	0.00	1.4	0.05		Contact	No AEB
124				Y	2.27	0.00	1.6	0.06		Contact	No AEB
125				Y	2.27	0.00	0.4	0.04		Contact	No AEB
126	Static Run (1m)										
102	S4c	11	Day	Y		0.00	0.1	0.02		Contact	No warning, no AEB
103				Y	0.98	0.54	11.0	1.12	0.56	NC	
104				Y		0.00	0.0	0.00		Contact	No warning, no AEB
105				Y	0.58	0.00	1.2	0.57	0.14	Contact	
94	Static Run (1m)										

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
95	S4c	16	Day	Y		0.00	0.2	0.03		Contact	No warning, no AEB
96				Y		0.00	0.0	0.01		Contact	No warning, no AEB
97				Y		0.00	0.3	0.02		Contact	No warning, no AEB
98	S4c	40	Day	Y		0.00	0.2	0.04		Contact	No warning, no AEB
99				N							Driver hit brake early
100				Y		0.00	0.0	0.03		Contact	No warning, no AEB
101				Y		0.00	0.1	0.03		Contact	No warning, no AEB

Run Log for Nighttime Tests

Subject Vehicle: *2020 Mercedes-Benz GLC 300 4Matic SUV*

Test Date: *6/16/2020*

Adult Pedestrian Test Mannequin: *Articulated 4A Adult*

Test Driver: *N. Watanabe*

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
7	S1b	16	NHB	Y	0.58	0.61	16.3	1.00	0.51	NC	
8				Y	0.61	0.85	16.3	1.09	0.56	NC	
9				Y	0.64	0.87	16.0	1.03	0.56	NC	
10				Y	0.58	0.77	15.7	1.08	0.55	NC	
11				Y	0.55	0.70	16.2	1.06	0.52	NC	
26	S1b	20	NHB	Y	0.72	1.23	20.1	1.05	0.64	NC	
27				Y	0.75	1.28	20.1	1.09	0.66	NC	
28				Y	0.73	1.24	20.3	1.05	0.65	NC	
29				Y	0.73	1.22	20.0	1.07	0.65	NC	
30				Y	0.62	1.11	20.3	1.04	0.62	NC	
36	S1b	30	NHB	Y	0.62	0.18	30.5	1.07	0.60	NC	
37				Y	0.69	0.35	30.1	1.05	0.63	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	NHB	Y	0.61	0.16	30.3	1.05	0.60	NC	
39				Y	0.68	0.00	28.6	1.12	0.61	Contact	
40				Y	0.70	0.33	30.2	1.07	0.63	NC	
41	S1b	35	NHB	Y	0.76	0.02	35.1	1.13	0.67	NC	
42				Y	0.86	0.73	35.0	1.04	0.83	NC	
43				Y	0.81	0.27	35.3	1.12	0.70	NC	
44				Y	0.71	0.45	35.6	1.07	0.70	NC	
45				Y	0.77	0.47	35.0	1.03	0.71	NC	
17	S1b	40	NHB	Y	0.73	0.00	30.0	1.02	0.71	Contact	
18				Y	0.86	0.71	39.8	1.02	0.80	NC	
19				Y	0.77	0.00	35.7	1.00	0.73	Contact	
20				Y	0.76	0.00	29.6	0.94	0.71	Contact	
165	S1d	16	NHB	Y	0.62	0.89	16.0	1.05	0.56	NC	
166				Y	0.61	0.78	16.2	1.08	0.53	NC	
167				Y	0.69	0.98	16.0	1.07	0.58	NC	
168				Y	0.81	0.33	16.0	1.16	0.59	NC	
169				Y	0.84	0.89	16.0	1.06	0.56	NC	
184	S1d	20	NHB	Y	0.63	1.12	19.9	1.04	0.62	NC	
185				Y	0.81	1.27	19.9	1.05	0.68	NC	
186				Y	0.84	1.27	19.9	1.10	0.68	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
187	S1d	20	NHB	Y	0.41	0.00	16.7	0.98	0.42	Contact	
188				Y	0.83	1.31	19.8	1.05	0.69	NC	
194	S1d	30	NHB	Y	0.75	0.52	29.8	1.08	0.66	NC	
195				Y	0.90	0.68	29.2	1.18	0.81	NC	
196				Y	0.86	0.91	30.1	1.08	0.80	NC	
197				Y	0.94	1.01	30.2	1.12	0.82	NC	
198				Y	0.75	0.37	29.8	1.05	0.61	NC	
199	S1d	35	NHB	Y	0.93	0.07	27.0	1.04	0.82	NC	
200				Y	0.92	0.77	34.9	1.16	0.85	NC	
201				Y	0.88	0.69	34.7	1.16	0.83	NC	
202				Y	0.90	0.81	35.1	1.14	0.87	NC	
203				Y	0.80	0.80	34.9	1.09	0.73	NC	
174	S1d	40	NHB	Y	0.71	0.00	25.4	1.07	0.66	Contact	
175				Y	0.89	0.32	39.6	1.04	0.77	NC	
176				Y	0.71	0.00	25.7	1.00	0.67	Contact	
177				N							PTM error
178				Y	0.74	0.00	28.2	1.11	0.68	Contact	
59	S1e	40	NHB	Y	.95	1.02	41.6	1.04	0.84	NC	
60				N							PTM lateral error

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
61	S1e	40	NHB	Y	0.85	0.50	35.4	1.06	0.80	NC	
62				Y	0.87	0.11	40.1	1.06	0.77	NC	
63				Y	0.80	0.34	39.5	1.15	0.75	NC	
64				Y	0.94	1.13	40.3	1.09	0.89	NC	
65				Y	0.91	1.11	41.3	1.07	0.84	NC	
69	S1e	50	NHB	Y	1.03	0.00	33.7	1.11	0.81	Contact	
70				Y	1.01	0.76	45.2	1.13	0.94	NC	
71				Y	0.91	-0.12	42.4	1.06	0.85	NC	
72				Y	0.91	0.00	34.7	1.08	0.80	Contact	
73				Y	0.66	0.00	23.8	1.14	0.65	Contact	
74				Y	1.15	0.95	43.6	1.04	0.96	NC	
75				Y	1.08	0.45	43.0	1.10	0.90	NC	
76	S1e	55	NHB	Y	1.00	0.11	43.5	1.11	0.93	NC	
77				Y	0.88	0.00	33.3	1.07	0.82	Contact	
78				N							PTM lateral error
79				Y	0.80	0.00	23.9	1.00	0.70	Contact	
80				Y	1.14	3.14	30.1	1.10	1.05	NC	
81				Y	0.74	0.00	25.2	1.01	0.71	Contact	
129	S4a	16	NHB	Y	1.91	0.88	16.1	1.09	0.55	NC	
130				Y	1.88	0.76	16.2	1.09	0.52	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
131	S4a	16	NHB	Y	1.87	0.00	1.0	0.02		Contact	No AEB
132				Y	1.85	0.00	0.5	0.03		Contact	No AEB
133				Y	1.86	0.00	1.1	0.03		Contact	No AEB
137	S4a	40	NHB	Y	1.84	0.35	39.9	1.09	1.03	NC	
138				Y	2.28	0.17	40.1	1.09	1.06	NC	
139				Y	2.28	0.22	39.6	1.13	1.04	NC	
140				Y	1.72	0.18	40.0	1.06	1.05	NC	
141				Y	2.27	0.37	40.4	1.14	1.04	NC	
145	S4a	50	NHB	Y	2.38	1.49	50.0	1.16	1.05	NC	
146				Y	0.82	0.00	34.1	1.13	0.80	Contact	
147				N							Lateral error
148				Y	2.41	0.00	32.5	1.09	0.76	Contact	
149				N							Micro started wandering
150				Y	1.00	0.54	50.1	1.18	0.92	NC	
151				Y	1.27	1.75	50.1	1.17	1.12	NC	
156	S4a	55	NHB	Y	2.34	0.00	25.5	1.08	0.68	Contact	
157				Y	2.35	0.00	1.9	0.06		Contact	No AEB
158				Y	0.88	0.00	39.5	1.20	0.88	Contact	
152	S4a	60	NHB	Y	2.27	0.00	29.1	1.18	0.76	Contact	
153				Y	0.83	0.00	32.0	1.20	0.82	Contact	
154				N							Lateral error

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
155	S4a	60	NHB	N							Throttle drop
94	S4c	16	NHB	Y	2.12	0.50	16.2	0.96	0.45	NC	
95				Y	1.42	0.94	16.4	1.06	0.60	NC	
96				Y	2.61	0.88	16.1	0.97	0.59	NC	
97				Y	2.23	0.88	16.1	1.01	0.58	NC	
98				Y	2.27	0.87	16.3	1.02	0.57	NC	
102	S4c	40	NHB	Y	1.29	1.27	40.1	1.10	1.26	NC	
103				Y	1.96	2.25	40.2	1.09	1.07	NC	
104				Y	1.99	2.77	39.6	1.10	1.16	NC	
105				Y	1.33	1.83	39.8	1.07	1.03	NC	
106				Y	1.87	2.33	40.1	1.05	1.08	NC	
107				Y	1.39	1.79	40.1	1.13	1.14	NC	
111	S4c	50	NHB	Y	0.91	0.97	50.3	1.15	0.89	NC	
112				Y	1.18	3.39	49.8	1.15	1.12	NC	
113				Y	1.87	3.01	50.2	1.06	1.22	NC	
114				Y	1.89	2.99	50.0	1.06	1.29	NC	
115				Y	1.60	2.76	49.8	1.07	1.26	NC	
120	S4c	55	NHB	Y	1.02	1.88	54.6	1.16	0.99	NC	
121				Y	0.82	0.00	35.5	1.16	0.80	Contact	
122				Y	1.48	2.65	55.3	1.09	1.29	NC	
123				Y	1.28	3.39	55.2	1.10	1.21	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
124	S4c	55	NHB	Y	1.59	2.78	55.0	1.06	1.22	NC	
116	S4c	60	NHB	Y	0.91	0.10	60.2	1.16	0.96	NC	
117				Y	0.93	0.00	46.8	1.20	0.92	Contact	
118				Y	0.87	0.00	37.1	1.16	0.87	Contact	
119				Y	0.68	0.00	23.9	1.16	0.70	Contact	
1	Static Run										
2	S1b	16	NLB	Y	0.58	0.83	15.9	1.04	0.56	NC	
3				Y	0.64	0.86	15.7	1.01	0.55	NC	
4				Y	0.55	0.76	16.2	1.06	0.53	NC	
5				Y	0.60	0.86	16.4	1.03	0.55	NC	
6				Y	0.42	0.25	16.1	1.02	0.42	NC	
21	S1b	20	NLB	Y	0.64	1.19	20.2	1.01	0.64	NC	
22				Y	0.73	1.11	19.8	1.02	0.62	NC	
23				Y	0.73	1.26	20.0	1.06	0.65	NC	
24				Y	0.65	1.23	19.9	1.04	0.63	NC	
25				Y	0.75	1.19	20.4	1.02	0.67	NC	
31	S1b	30	NLB	Y	0.65	0.09	30.1	1.18	0.59	NC	
32				Y	0.68	0.28	30.2	1.06	0.61	NC	
33				Y	0.66	0.15	30.3	1.03	0.58	NC	
34				Y	0.66	0.22	30.1	1.04	0.59	NC	
35				Y	0.68	0.30	30.0	1.07	0.60	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
12	S1b	40	NLB	Y	0.77	0.00	39.1	1.11	0.73	Contact	
13				Y	0.89	1.05	39.5	1.14	0.85	NC	
14				Y	0.81	0.20	40.3	1.03	0.76	NC	
15				Y	0.93	1.03	39.8	1.08	0.85	NC	
16				Y	0.79	0.00	32.0	1.02	0.74	Contact	
46	S1b	45	NLB	Y	0.80	0.00	30.1	1.04	0.75	Contact	
47				Y	0.83	0.00	34.6	1.03	0.76	Contact	
48				Y	0.93	0.00	41.5	1.11	0.81	Contact	
49				Y	0.90	0.15	44.6	1.03	0.84	NC	
50				Y	0.69	0.00	20.9	1.01	0.62	Contact	
159	Static Run										
160	S1d	16	NLB	Y	0.67	0.77	15.9	1.05	0.55	NC	
161				Y	0.76	0.70	16.0	1.16	0.51	NC	
162				Y	0.80	0.84	15.9	1.04	0.58	NC	
163				Y	0.81	0.61	15.8	1.06	0.50	NC	
164				Y	0.81	0.85	15.9	1.05	0.55	NC	
179	S1d	20	NLB	Y	0.84	0.54	20.1	1.14	0.73	NC	
180				Y	0.84	1.17	19.7	1.04	0.65	NC	
181				Y	0.85	1.22	19.9	1.09	0.74	NC	
182				Y	0.78	0.93	20.1	1.09	0.73	NC	
183				Y	0.72	0.81	20.0	1.13	0.66	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
189	S1d	30	NLB	Y	0.74	0.23	29.8	1.10	0.63	NC	
190				Y	0.84	0.91	29.6	1.07	0.72	NC	
191				Y	0.78	0.63	30.0	1.05	0.71	NC	
192				Y	0.88	0.87	30.0	1.11	0.82	NC	
193				Y	0.74	0.37	30.4	1.04	0.65	NC	
204	S1d	35	NLB	Y	0.81	0.00	19.7	0.96	0.57	Contact	
205				Y	0.79	0.59	34.8	1.09	0.71	NC	
206				Y	0.91	0.39	34.7	1.12	0.86	NC	
207				Y	0.90	0.78	35.2	1.13	0.79	NC	
208				Y	0.87	0.89	35.4	1.05	0.85	NC	
209	Static Run										
170	S1d	40	NLB	Y	0.92	0.59	39.3	1.13	0.78	NC	
171				Y	0.66	0.00	17.3	0.97	0.56	Contact	
172				Y	0.80	0.00	31.7	1.14	0.71	Contact	
173				Y	0.73	0.00	33.3	1.04	0.70	Contact	
51	Static Run										
52	S1e	40	NLB	Y	0.91	1.22	41.1	1.11	0.84	NC	
53				N							Lost power
54				Y	0.98	0.51	39.3	1.04	0.92	NC	
55				Y	0.93	0.85	41.5	1.02	0.83	NC	
56				Y	0.98	1.43	41.6	1.04	0.90	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
57	S1e	40	NLB	Y	0.91	1.00	40.1	1.08	0.82	NC	
58				Y	0.87	0.48	39.4	1.04	0.78	NC	
82	S1e	45	NLB	Y	0.87	0.22	40.4	1.09	0.81	NC	
83				Y	0.83	0.00	34.8	1.05	0.78	Contact	
84				Y	0.98	0.66	42.0	1.10	0.95	NC	
85				Y	0.78	0.13	40.3	1.07	0.80	NC	
86				Y	0.95	0.57	41.2	1.08	0.88	NC	
87				Y	0.81	0.08	41.8	1.11	0.80	NC	
66	S1e	50	NLB	Y	0.81	0.00	29.7	1.12	0.76	Contact	
67				Y	0.84	0.00	32.2	1.14	0.79	Contact	
68				Y	0.68	0.00	23.2	1.14	0.66	Contact	
142	S4a	11	NLB	Y		0.00	0.0	0.01		Contact	No warning, no AEB
143				Y		0.00	0.0	0.00		Contact	No warning, no AEB
144				Y		0.00	0.0	0.01		Contact	No warning, no AEB
125	Static Run										
126	S4a	16	NLB	Y		0.00	0.5	0.03		Contact	No warning, no AEB
127				Y		0.00	0.1	0.03		Contact	No warning, no AEB

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
128	S4a	16	NLB	Y		0.00	0.1	0.03		Contact	No warning, no AEB
134	S4a	40	NLB	N							Throttle drop
135				N							Throttle drop
136				Y		0.00	0.3	0.03		Contact	No warning, no AEB
88	Static Run										
89	S4c	16	NLB	N							Throttle drop
90				Y	1.53	0.80	16.2	1.06	0.57	NC	
91				Y	1.25	1.34	16.1	1.03	0.71	NC	
92				Y	1.14	0.78	16.2	1.04	0.54	NC	
93				Y	1.36	0.96	16.3	1.01	0.59	NC	
108	S4c	35	NLB	Y		0.00	0.2	0.02		Contact	No warning, no AEB
109				Y	0.43	0.00	11.5	0.98	0.40	Contact	
110				Y	0.11	0.00	0.6	0.49	0.12	Contact	
99	S4c	40	NLB	Y	0.64	0.00	31.3	1.06	0.64	Contact	
100				Y	0.22	0.00	4.6	0.90	0.23	Contact	
101				Y	0.17	0.00	2.0	0.75	0.17	Contact	

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Time History Plots

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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.

  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.

  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.

- 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.

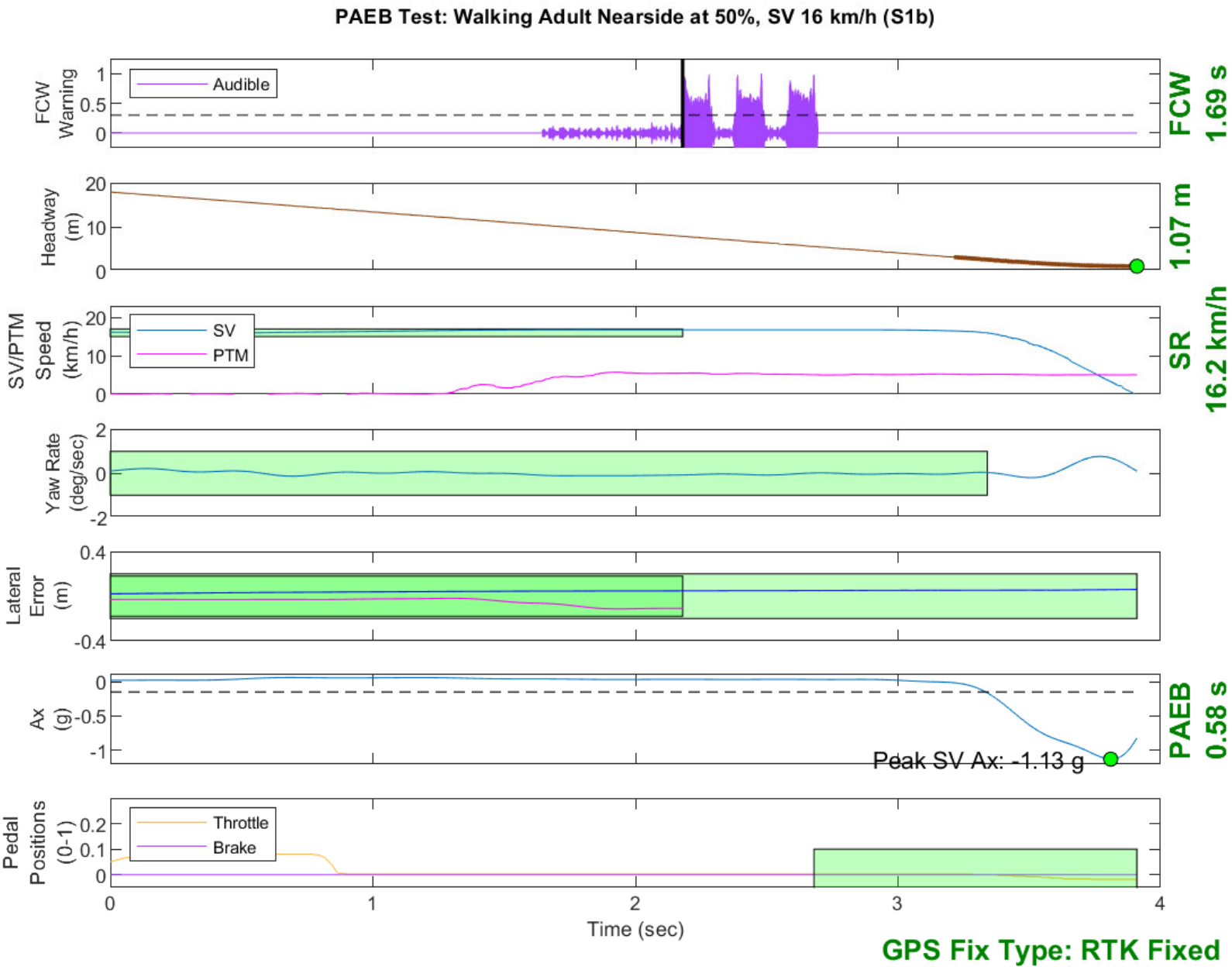

Figure D1. Example Time History for a Passing Run

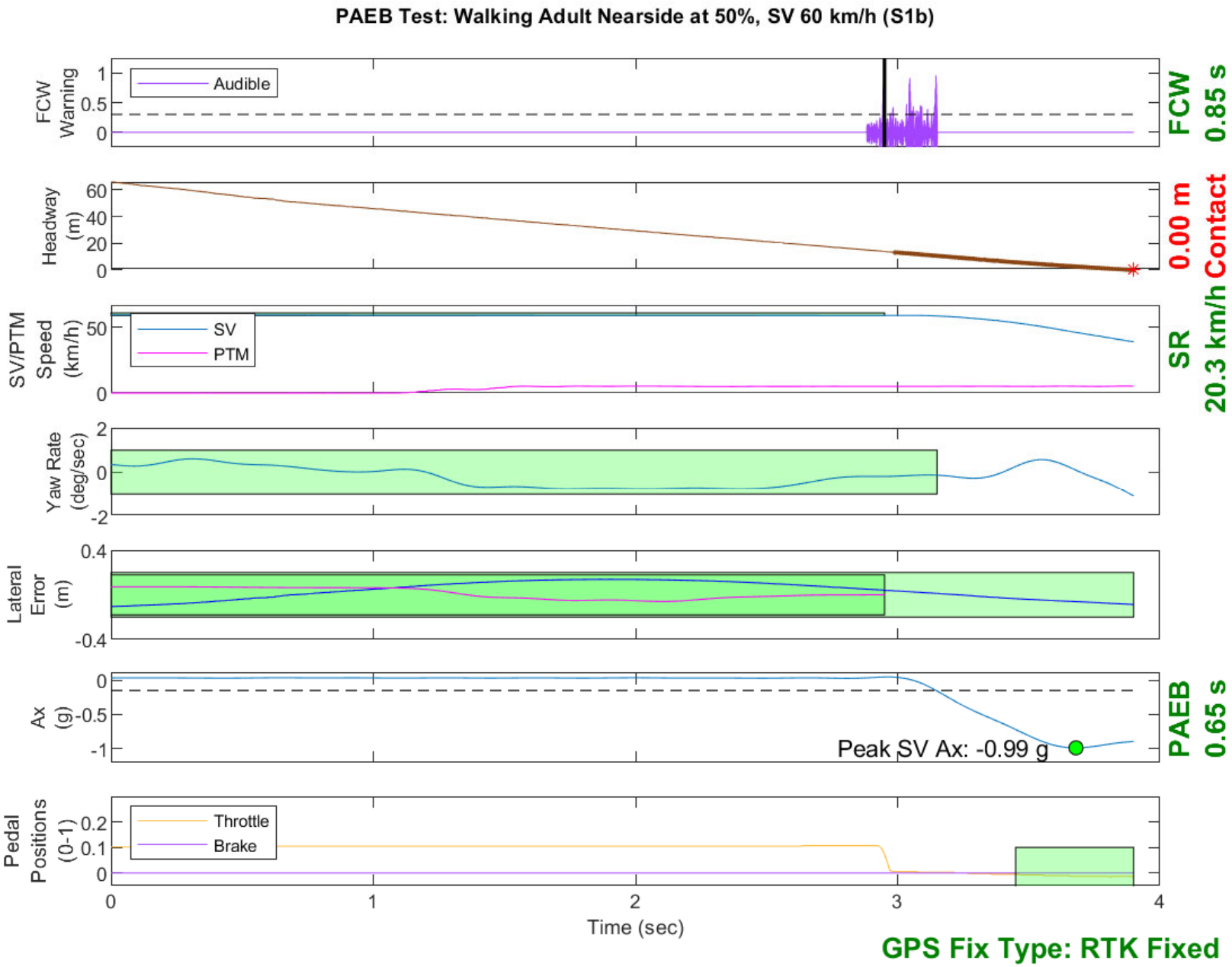

Figure D2. Example Time History for a Failed Run

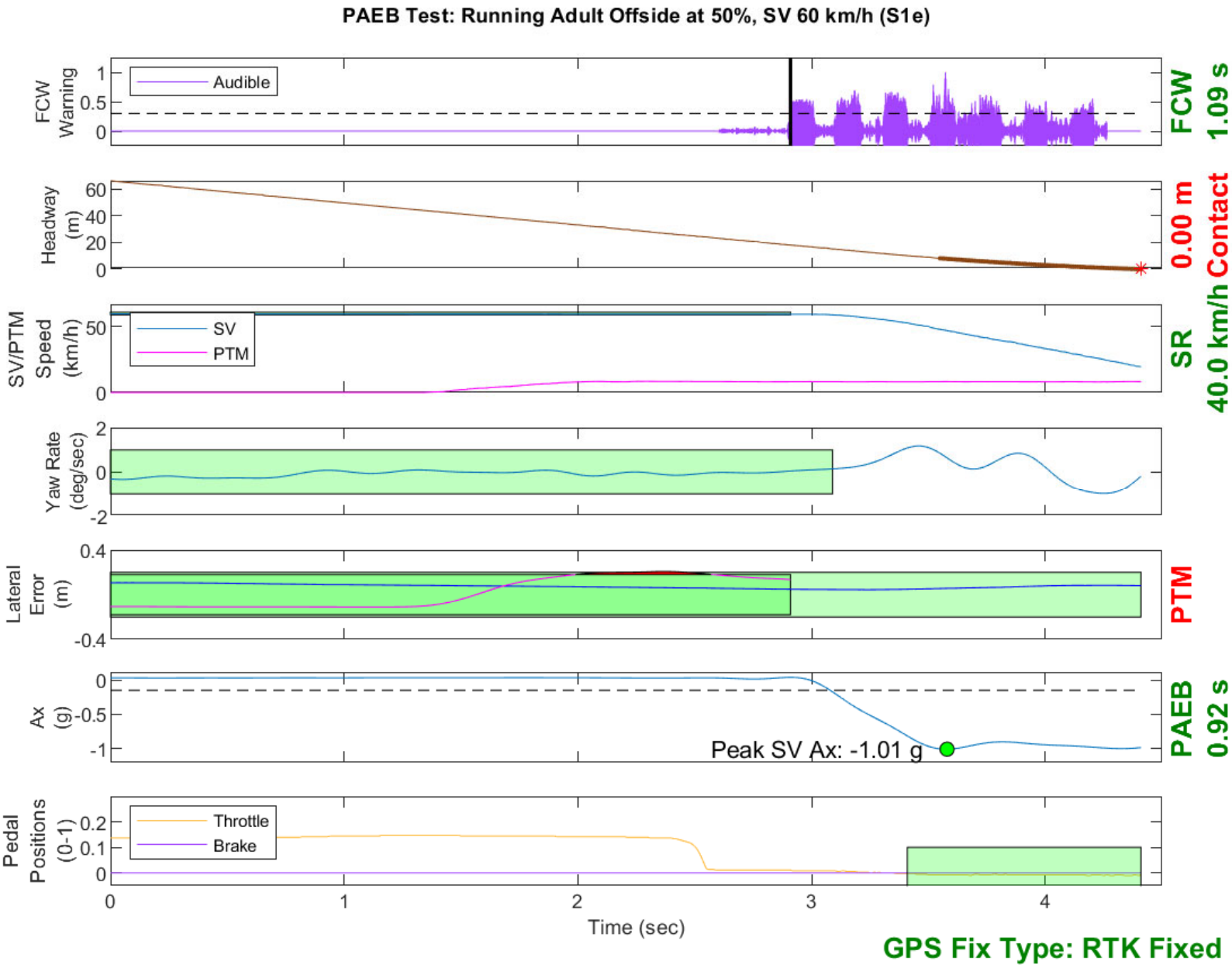

Figure D3. Example Time History for an Invalid Run Due to PTM Lateral Error

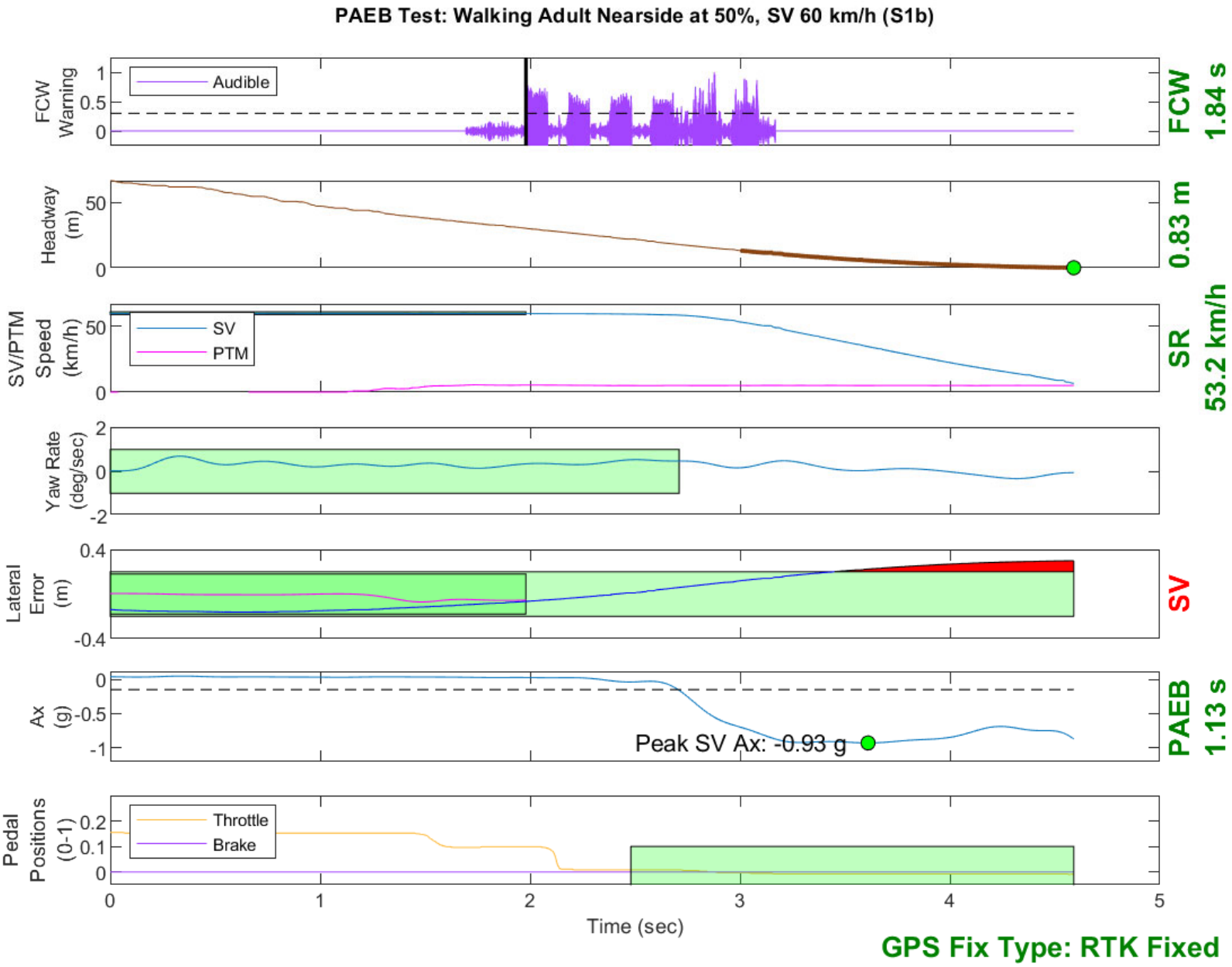

Figure D4. Example Time History for an Invalid Run Due to SV Lateral Error

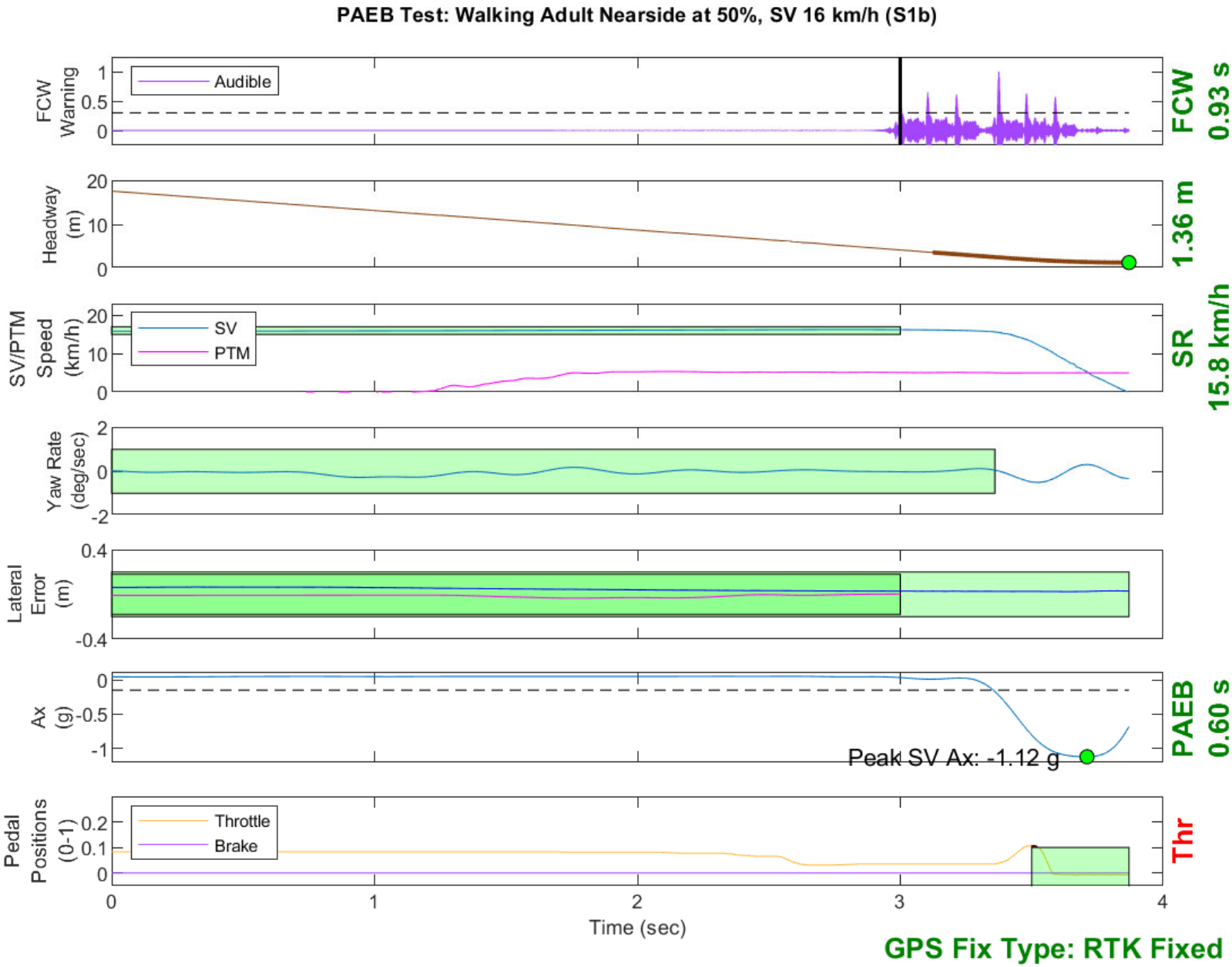

Figure D5. Example Time History for an Invalid Run Due to Throttle Error

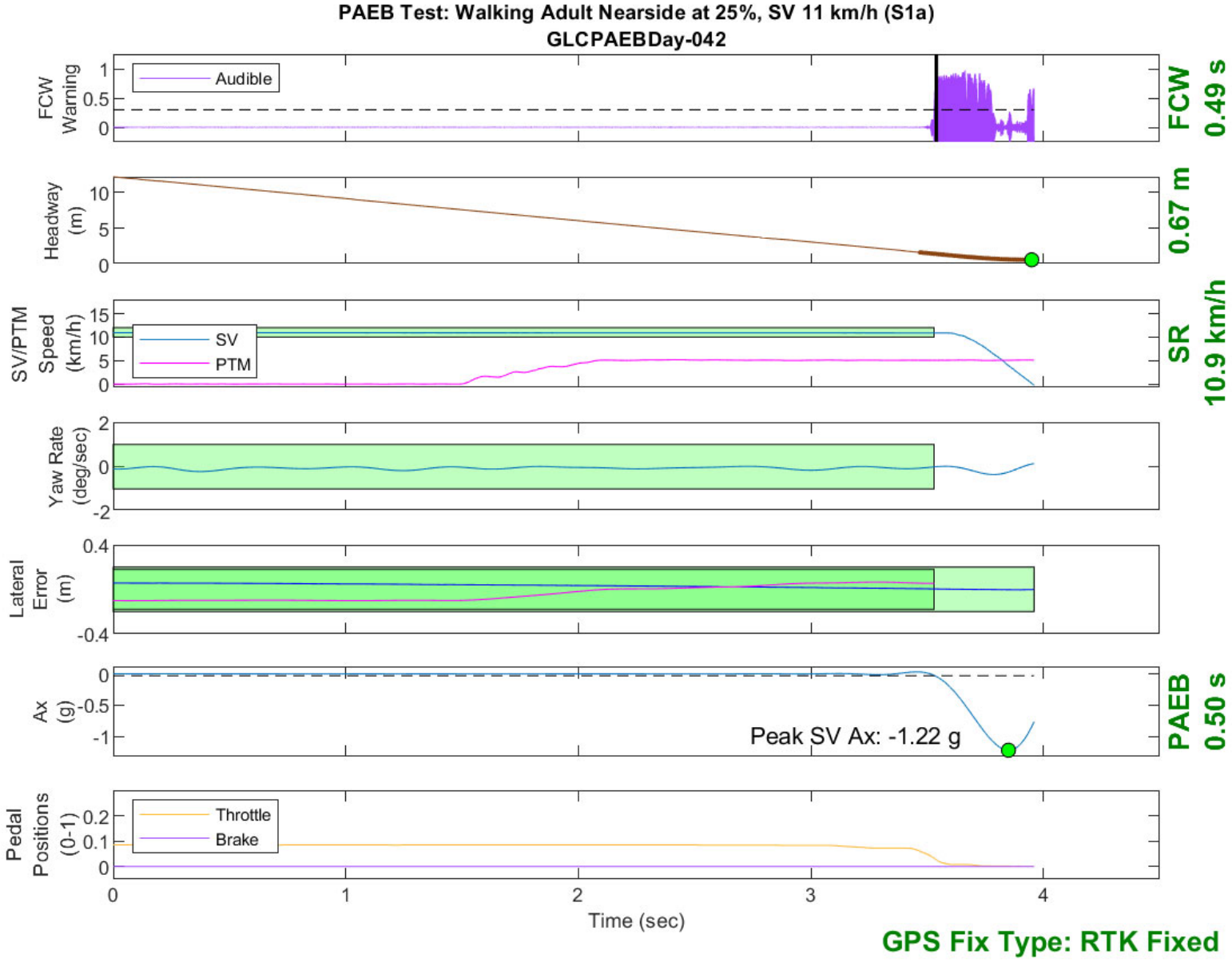

Figure D6. Time History for PAEB Run 42, S1a, Daytime, 11 km/h

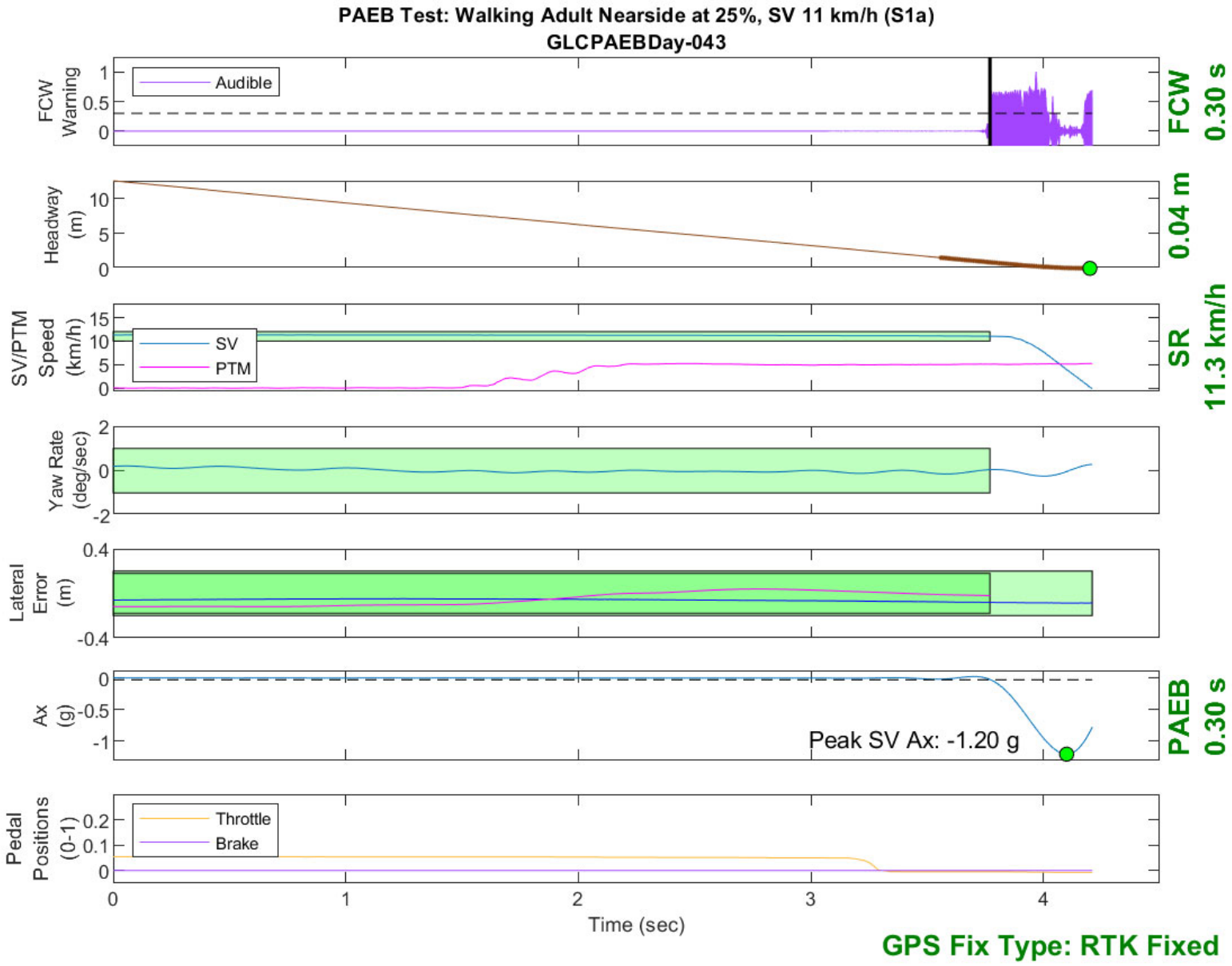

Figure D7. Time History for PAEB Run 43, S1a, Daytime, 11 km/h

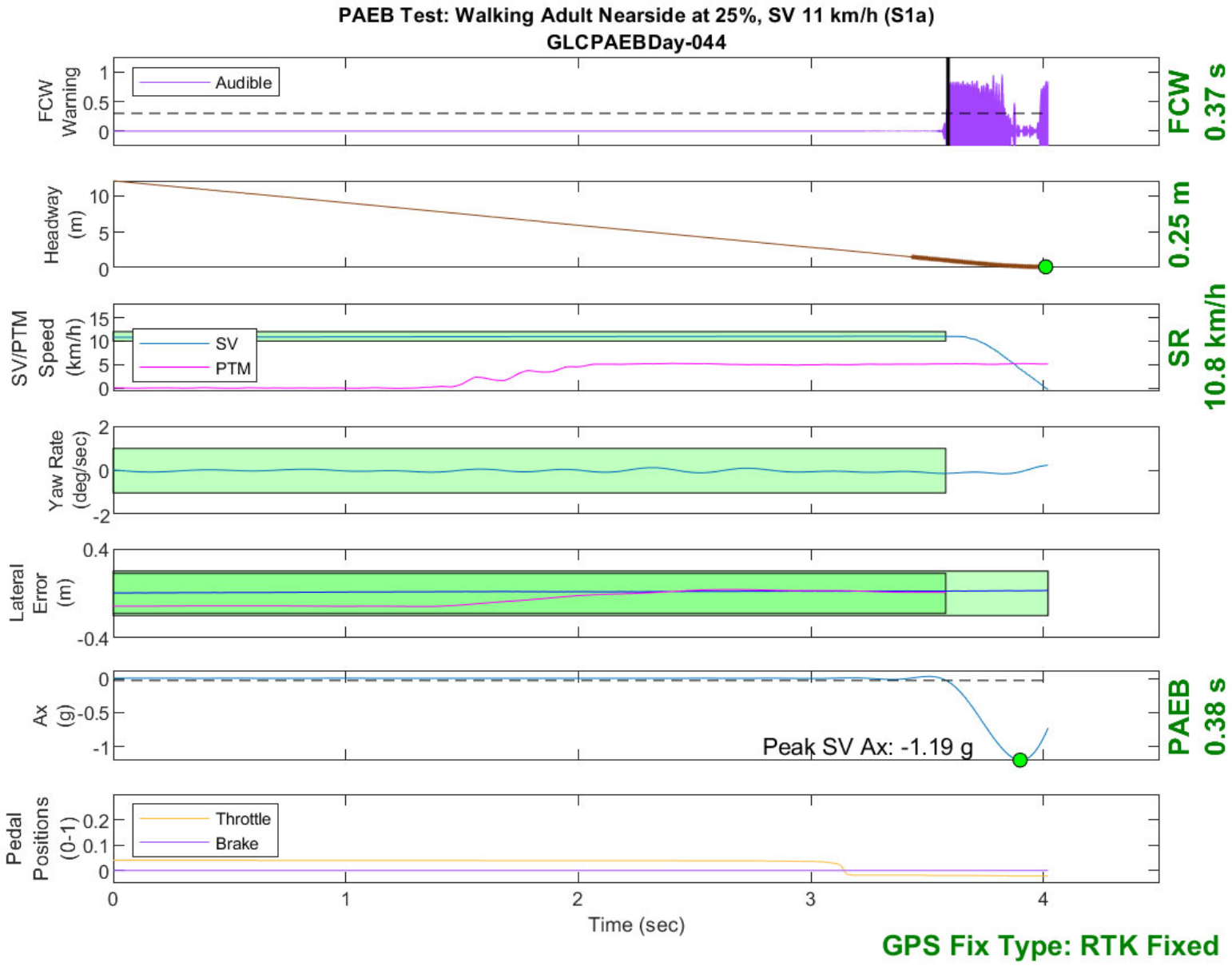

Figure D8. Time History for PAEB Run 44, S1a, Daytime, 11 km/h

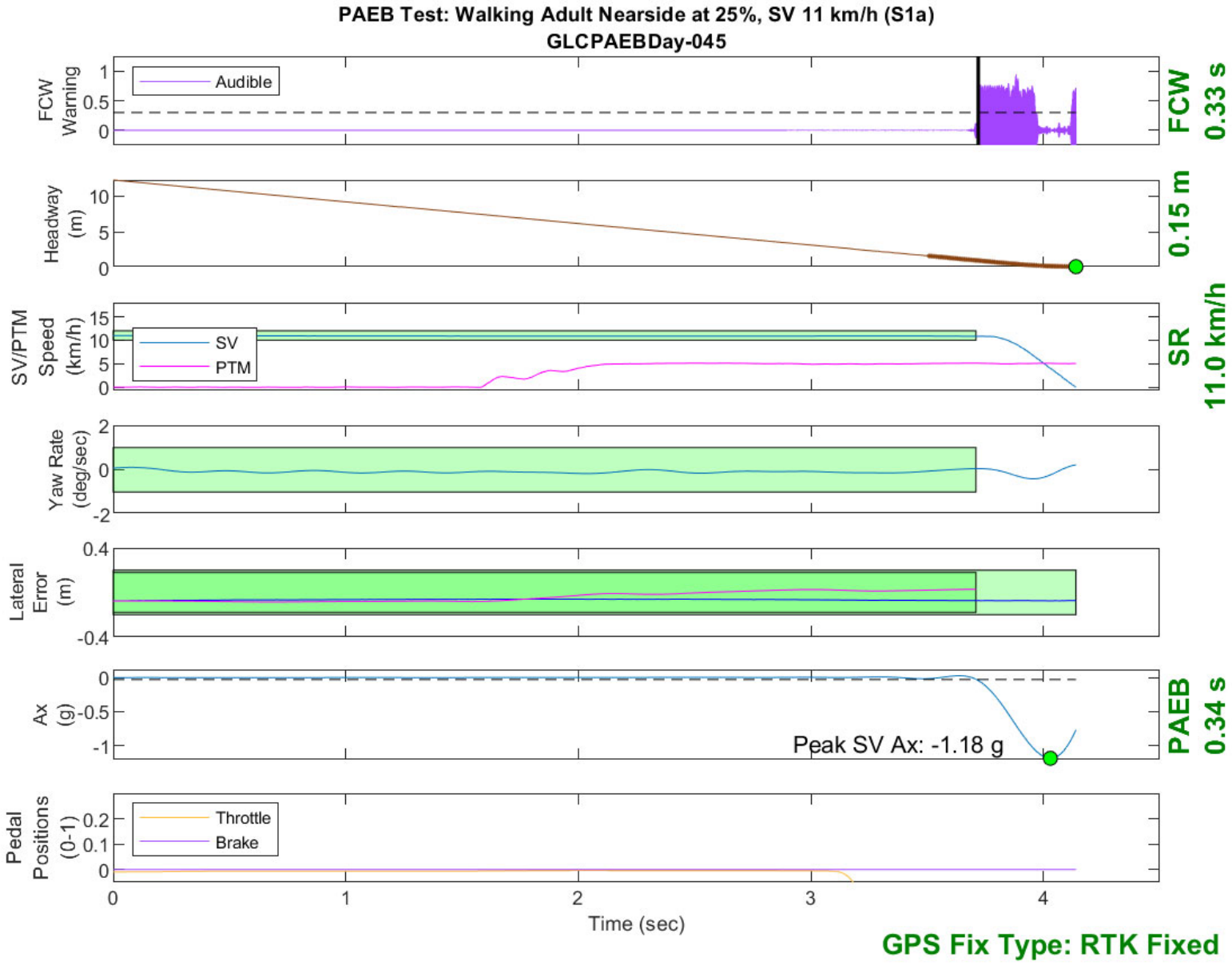

Figure D9. Time History for PAEB Run 45, S1a, Daytime, 11 km/h

Figure D10. Time History for PAEB Run 46, S1a, Daytime, 11 km/h

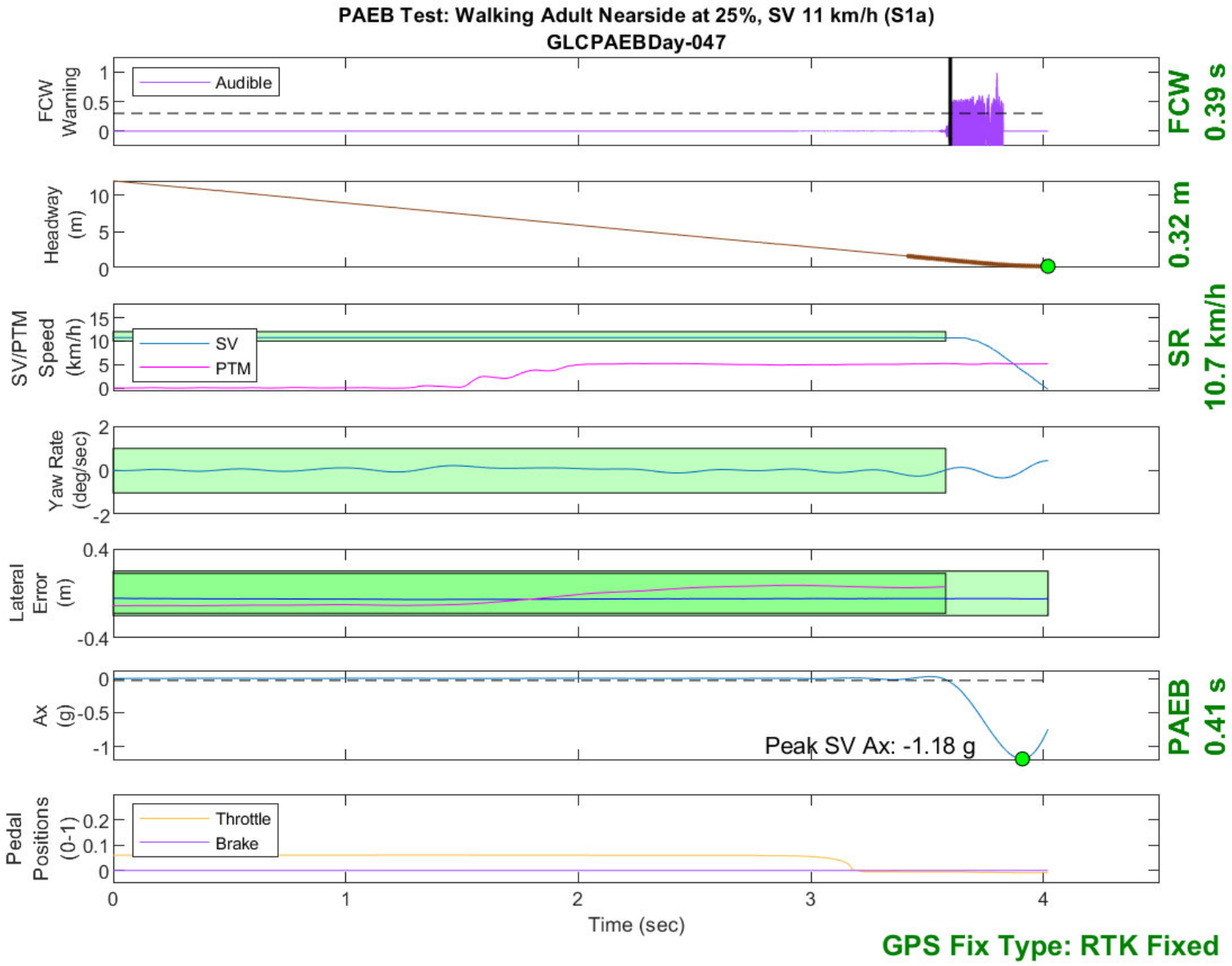

Figure D11. Time History for PAEB Run 47, S1a, Daytime, 11 km/h

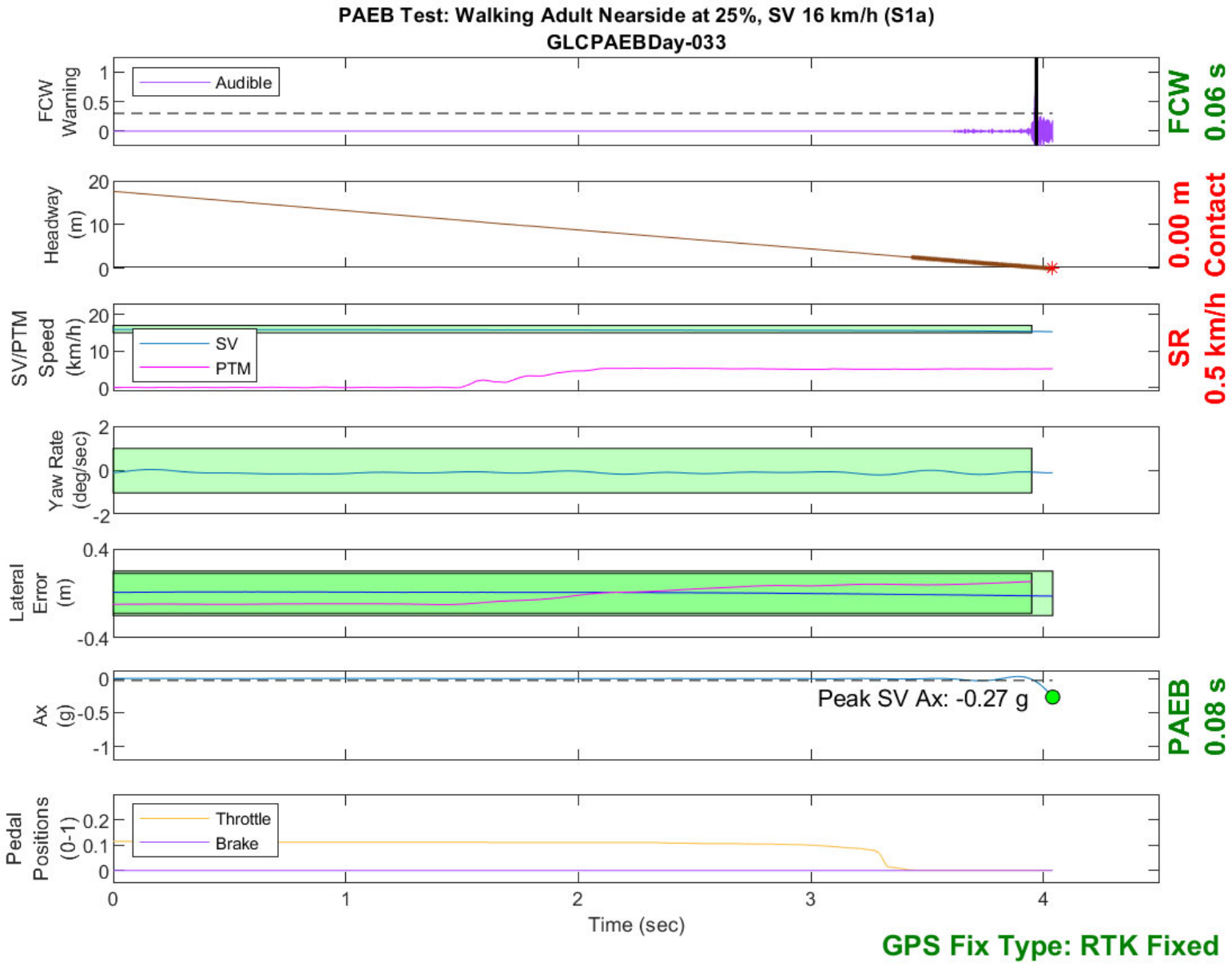

Figure D12. Time History for PAEB Run 33, S1a, Daytime, 16 km/h

Figure D13. Time History for PAEB Run 34, S1a, Daytime, 16 km/h

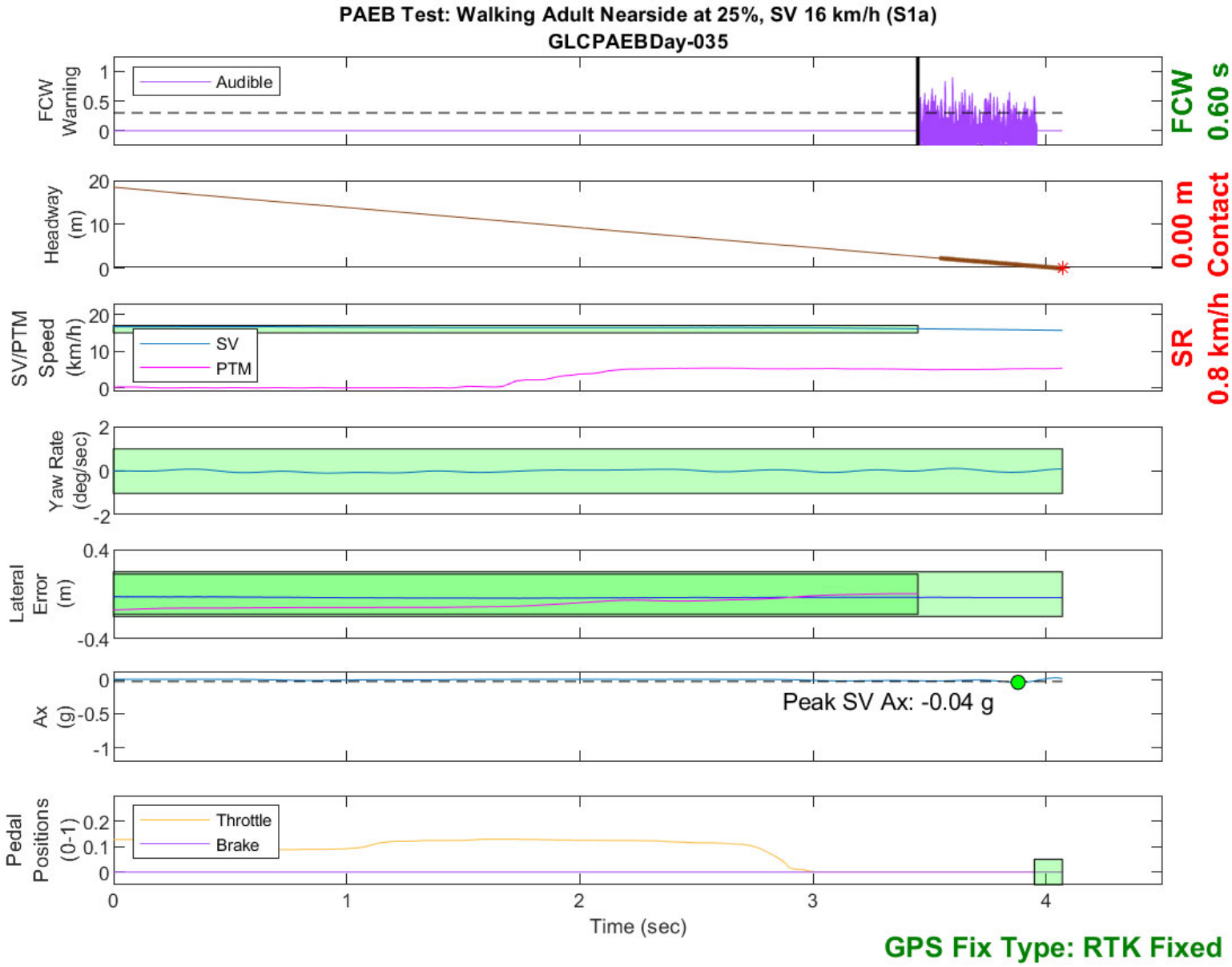

Figure D14. Time History for PAEB Run 35, S1a, Daytime, 16 km/h

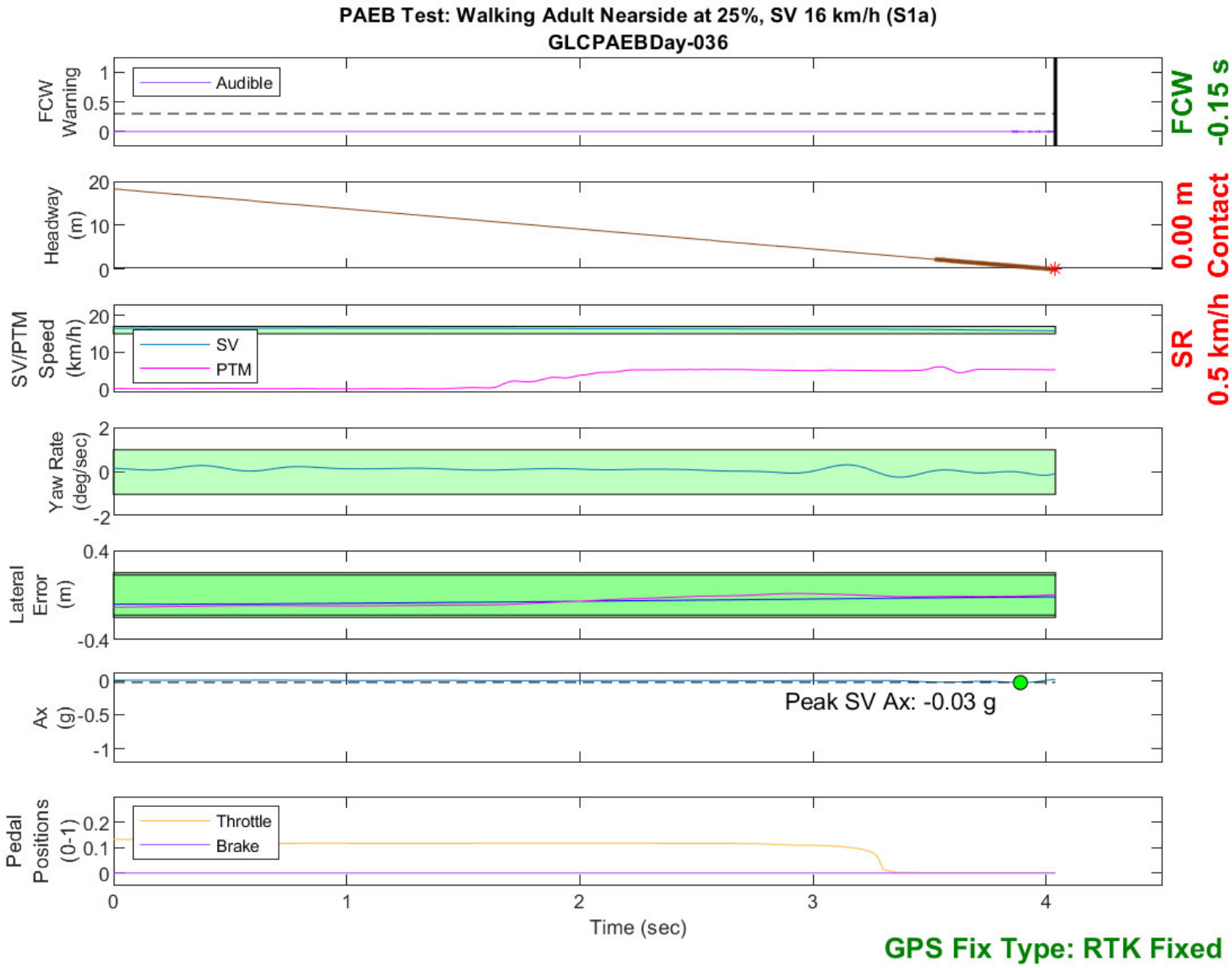

Figure D15. Time History for PAEB Run 36, S1a, Daytime, 16 km/h

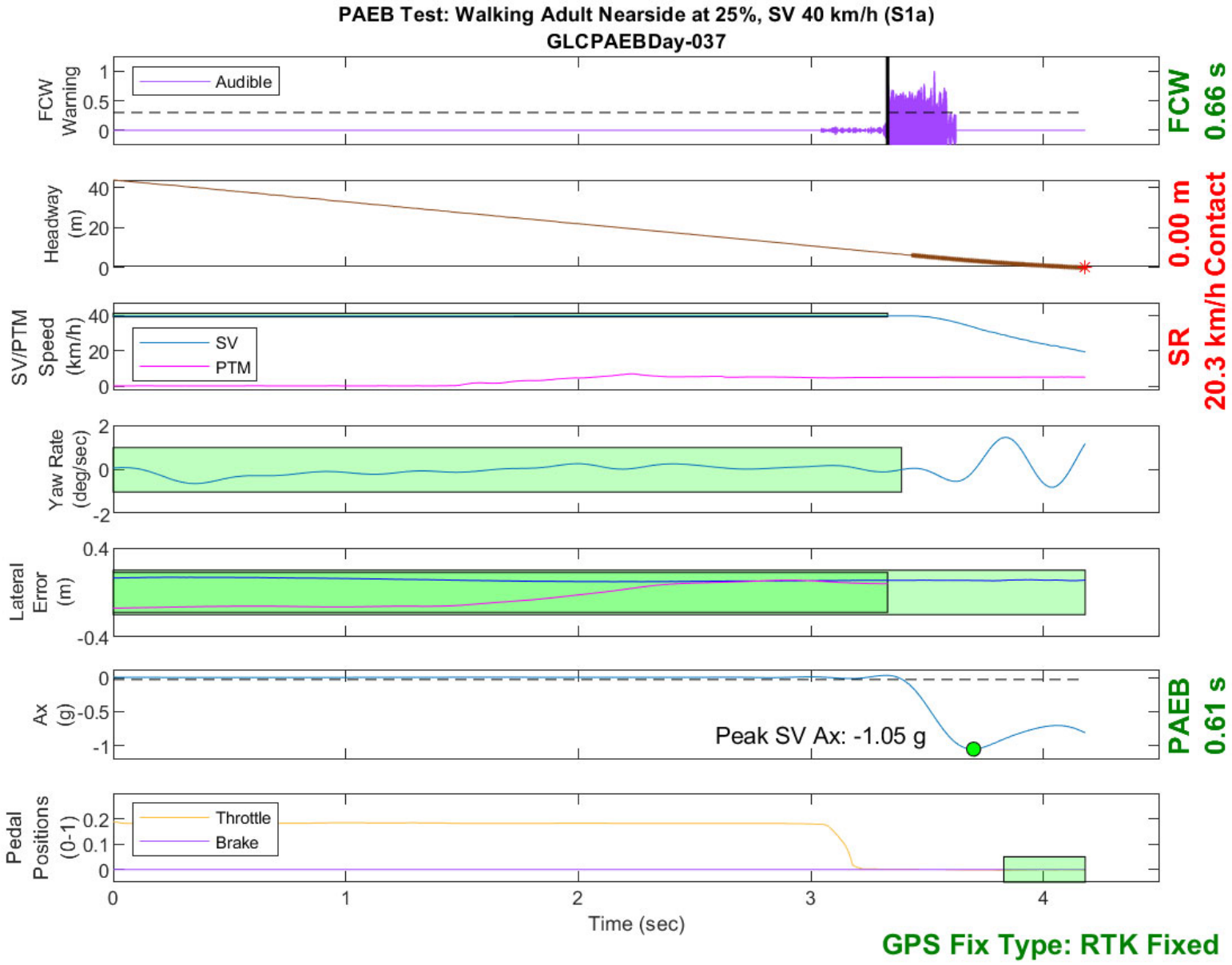

Figure D16. Time History for PAEB Run 37, S1a, Daytime, 40 km/h

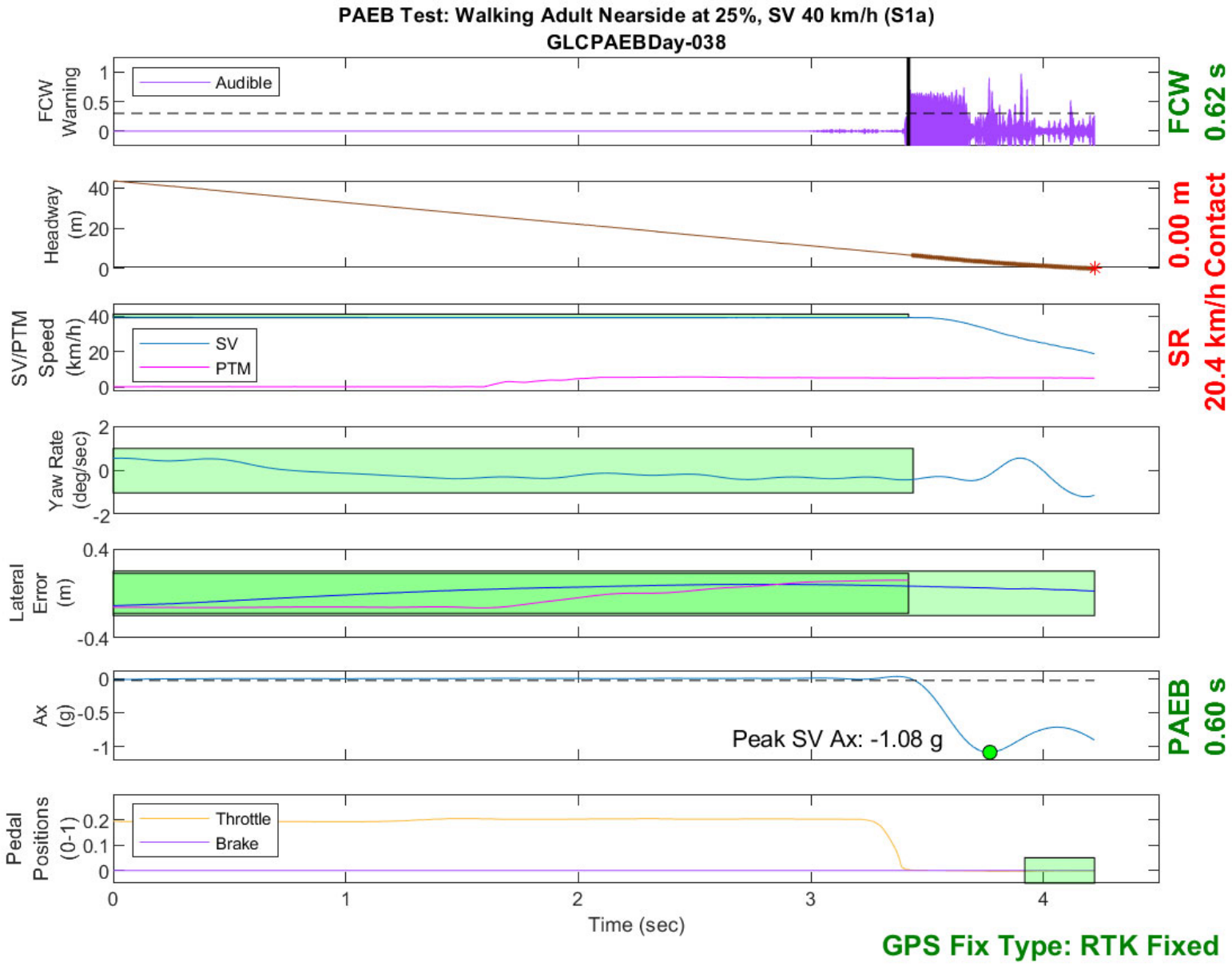

Figure D17. Time History for PAEB Run 38, S1a, Daytime, 40 km/h

Figure D18. Time History for PAEB Run 39, S1a, Daytime, 40 km/h

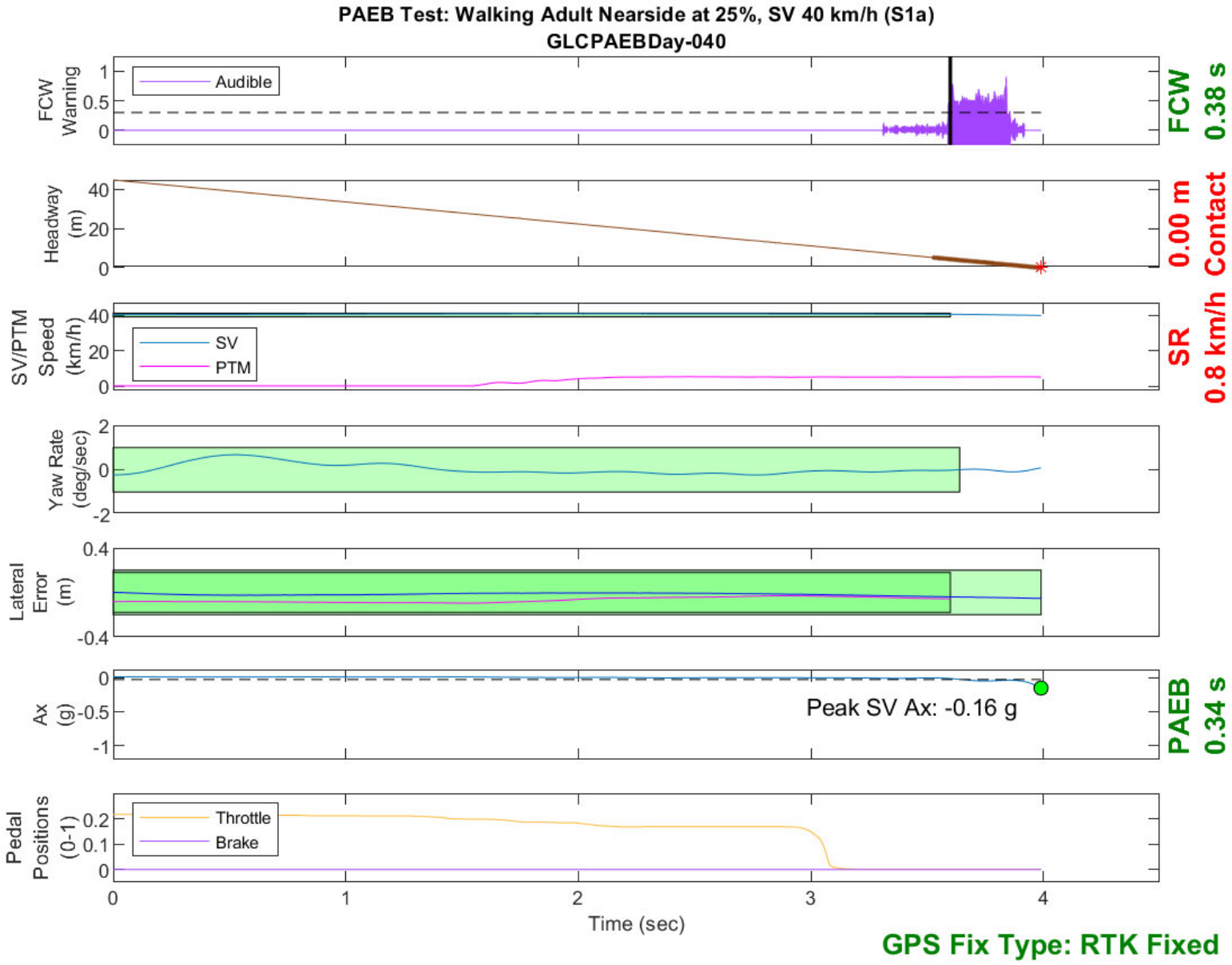

Figure D19. Time History for PAEB Run 40, S1a, Daytime, 40 km/h

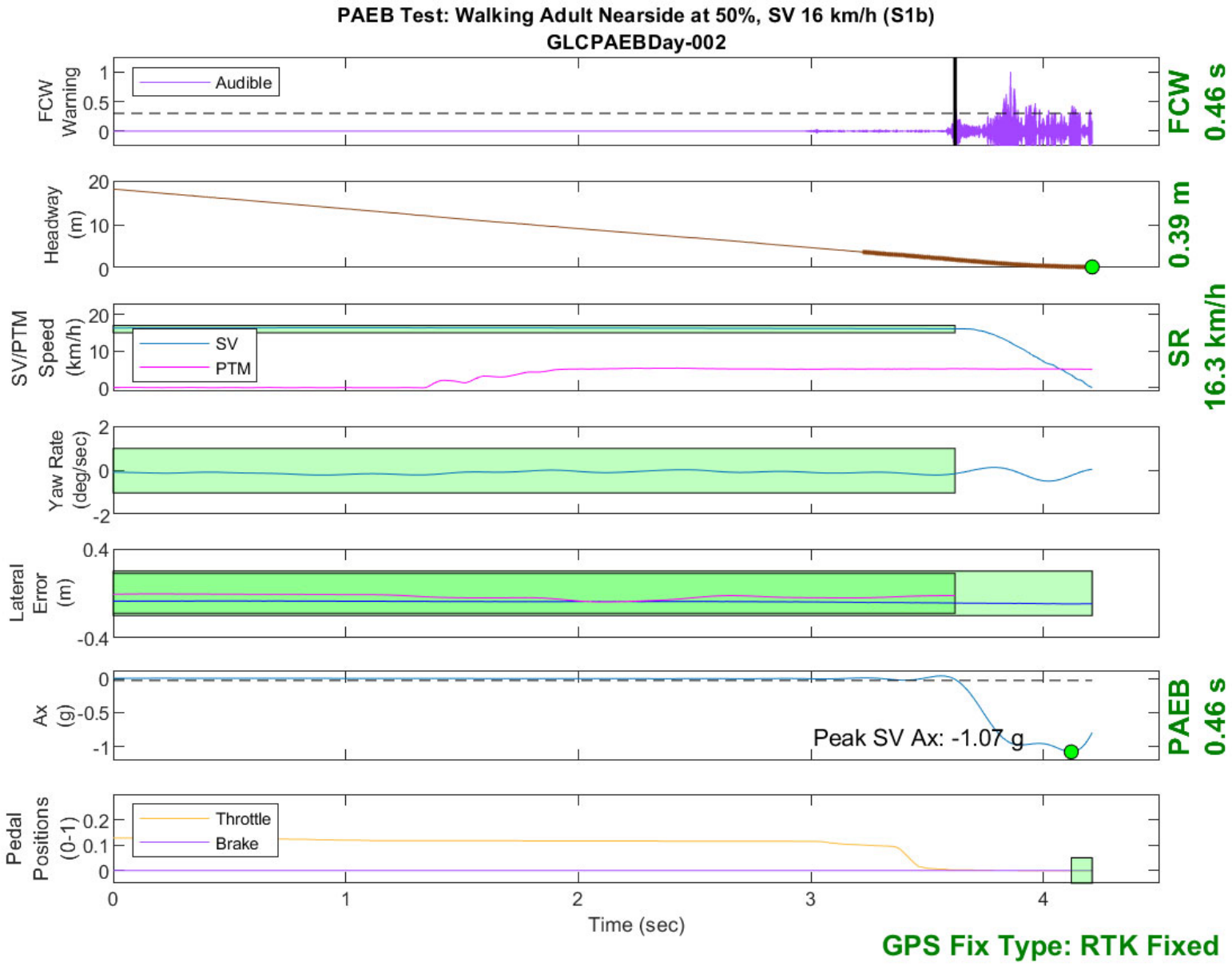

Figure D20. Time History for PAEB Run 2, S1b, Daytime, 16 km/h

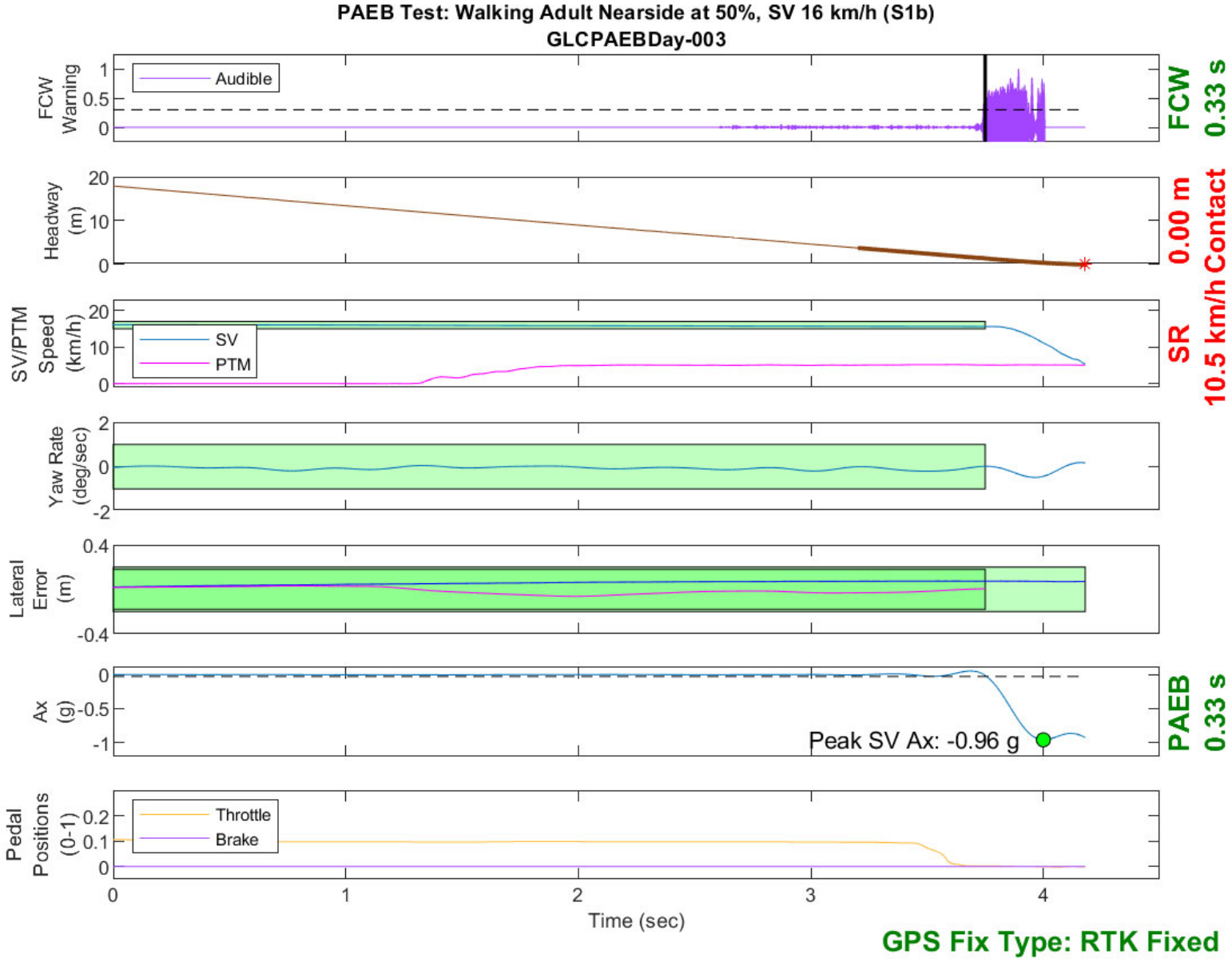

Figure D21. Time History for PAEB Run 3, S1b, Daytime, 16 km/h

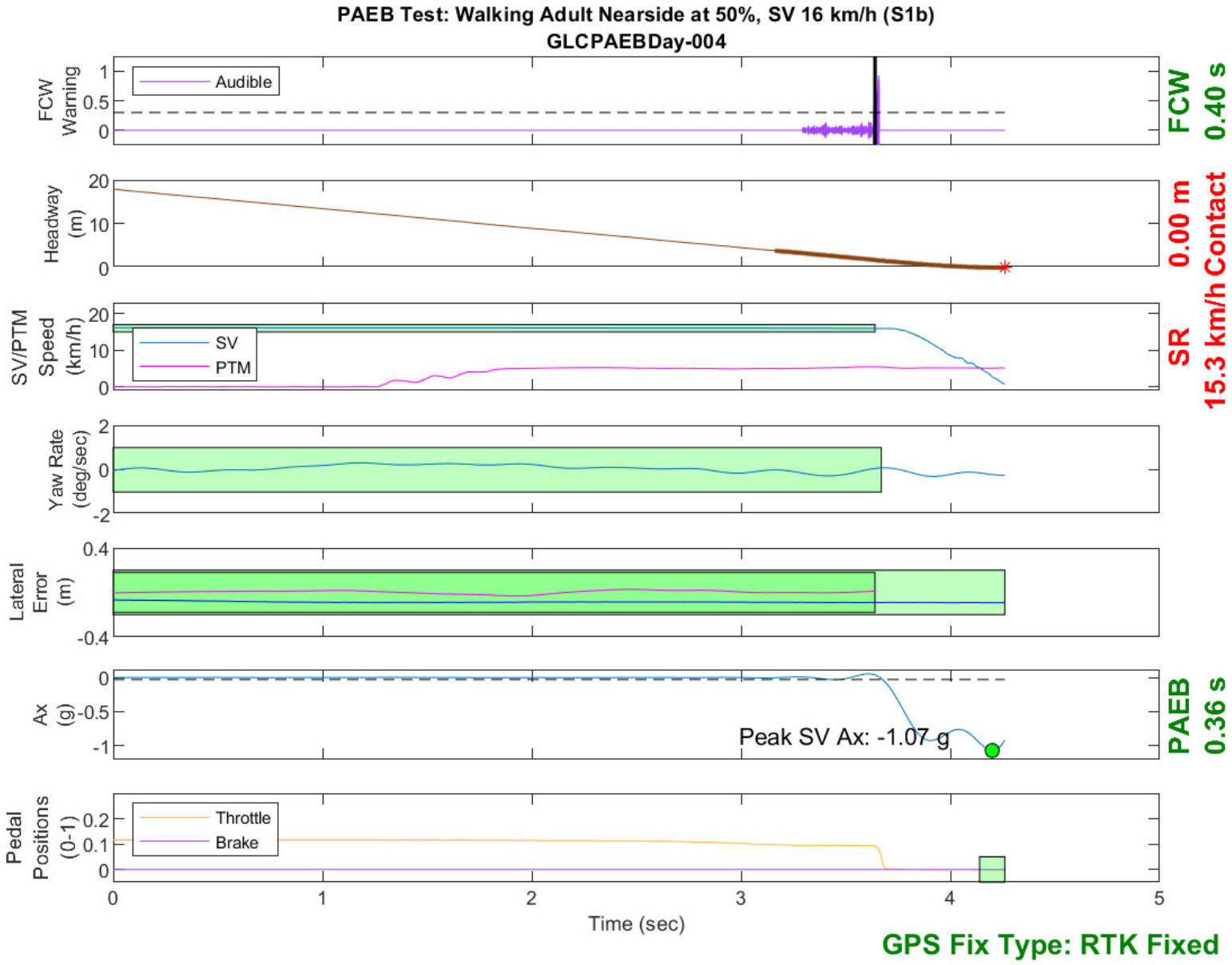

Figure D22. Time History for PAEB Run 4, S1b, Daytime, 16 km/h

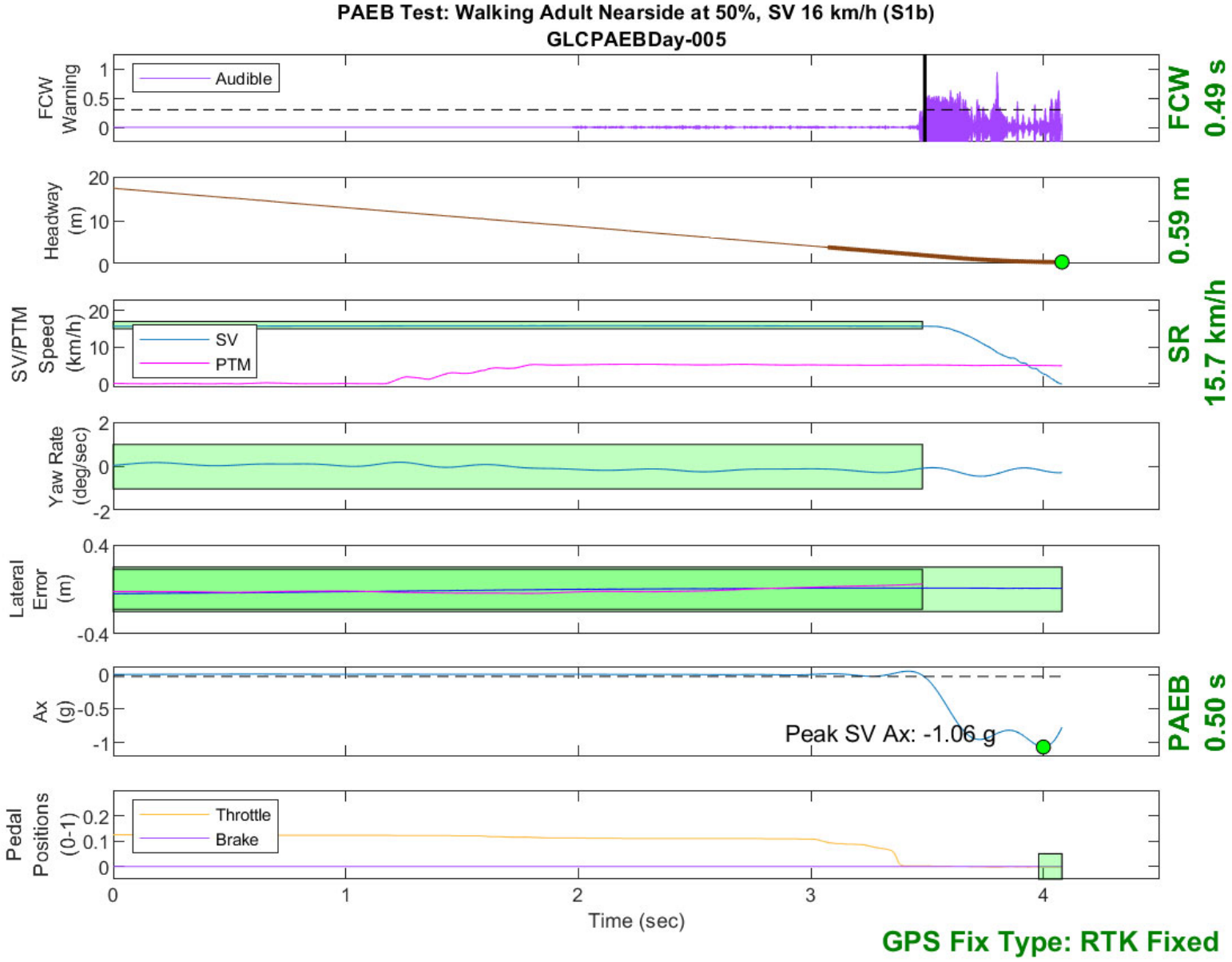

Figure D23. Time History for PAEB Run 5, S1b, Daytime, 16 km/h

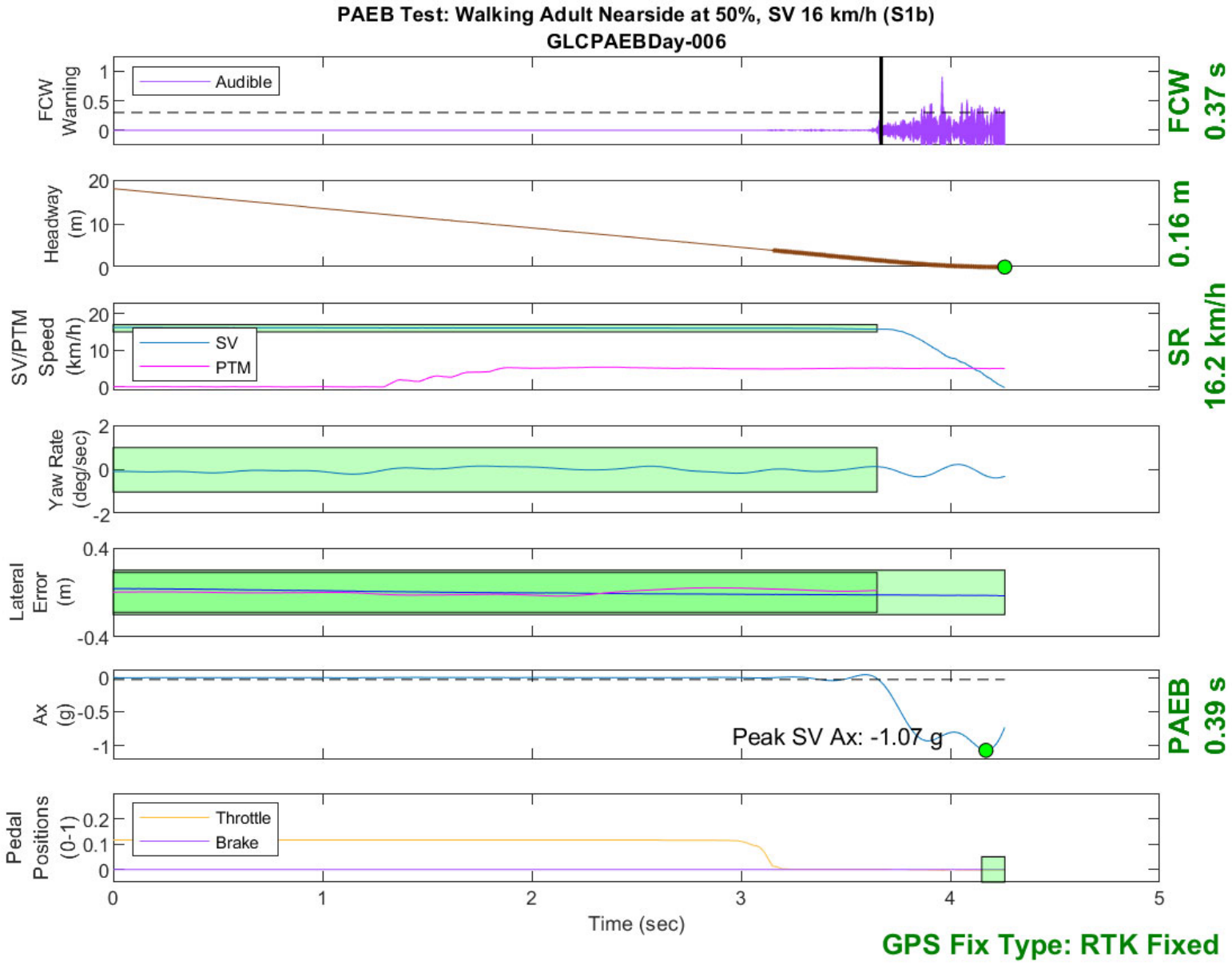

Figure D24. Time History for PAEB Run 6, S1b, Daytime, 16 km/h

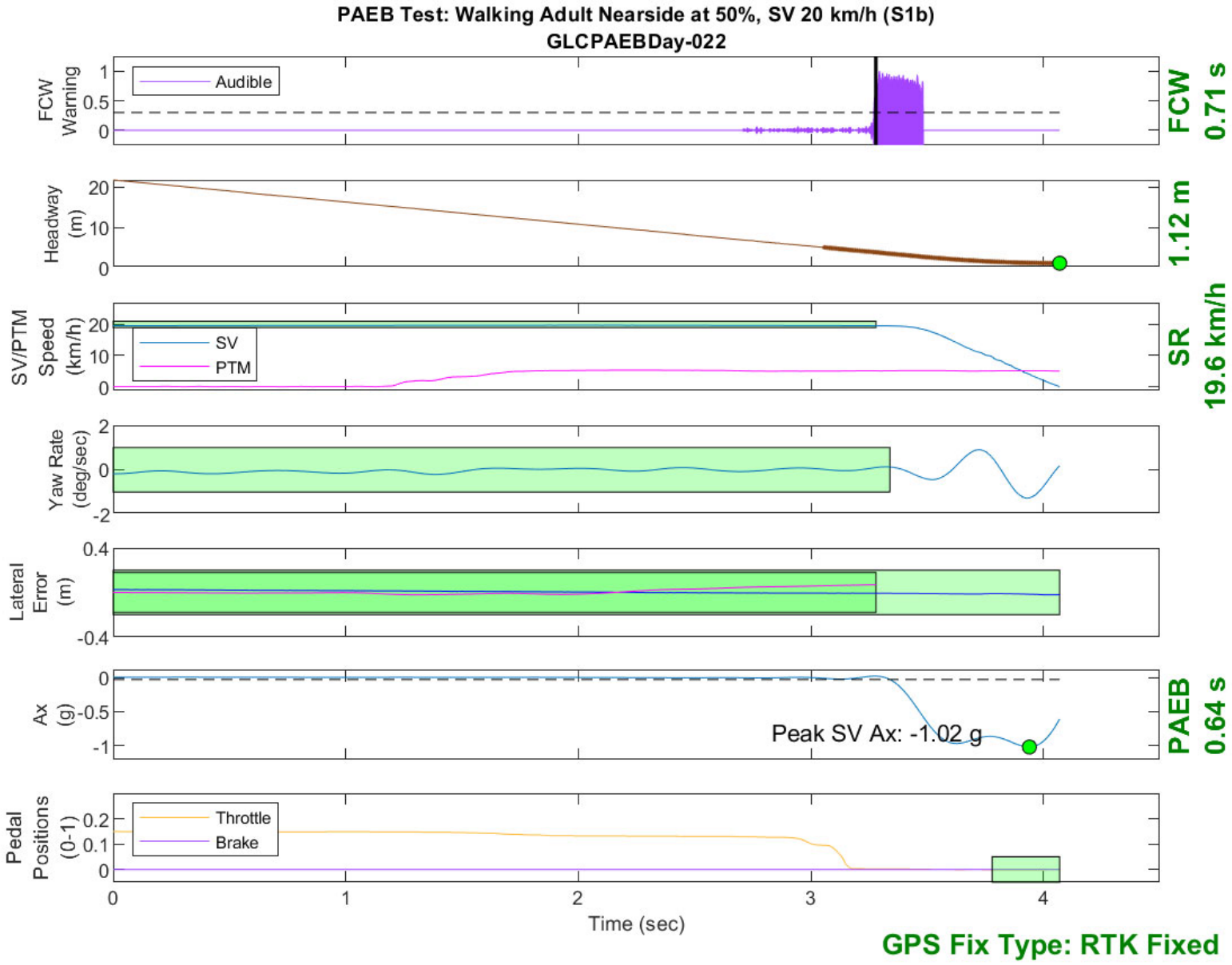

Figure D25. Time History for PAEB Run 22, S1b, Daytime, 20 km/h

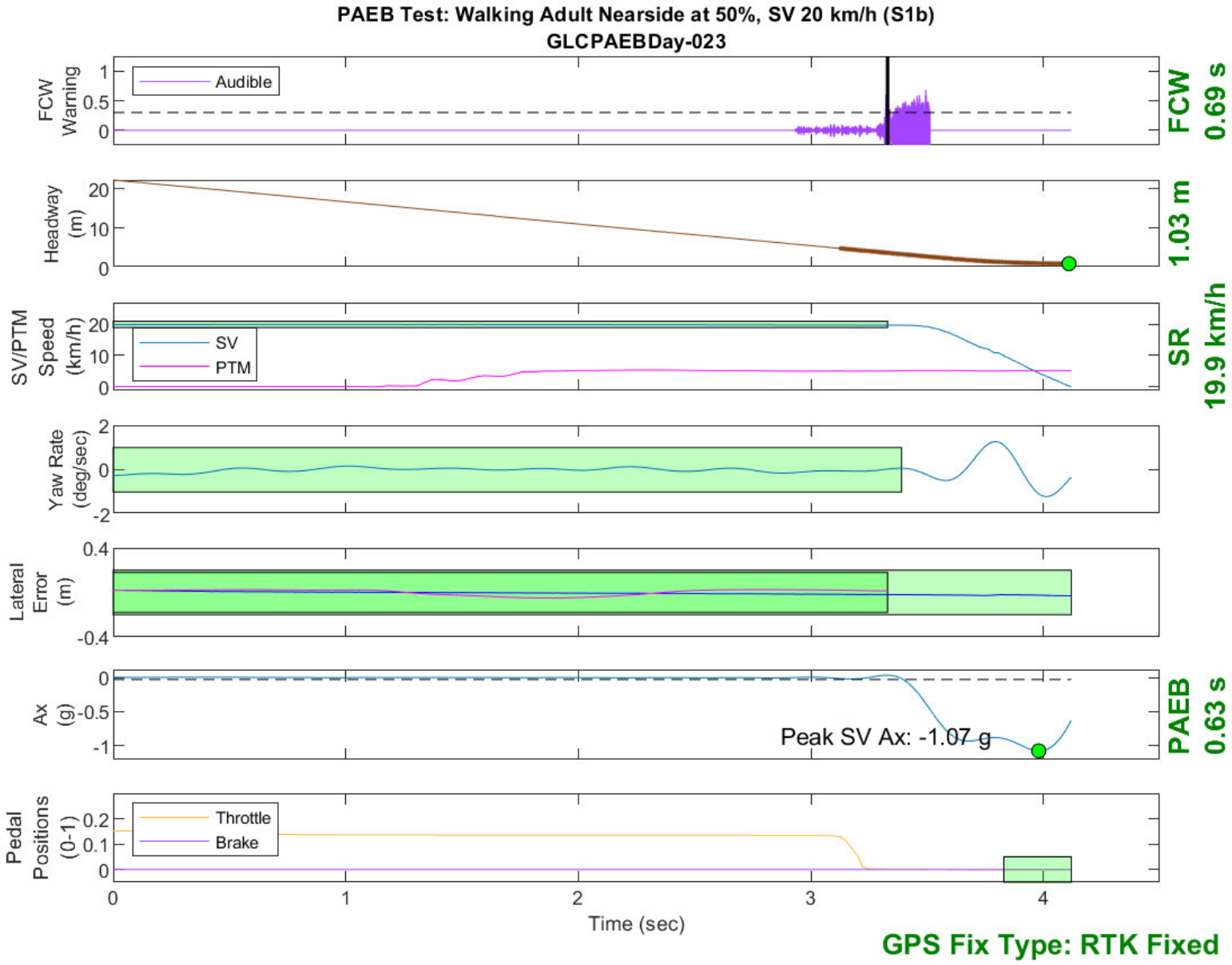

Figure D26. Time History for PAEB Run 23, S1b, Daytime, 20 km/h

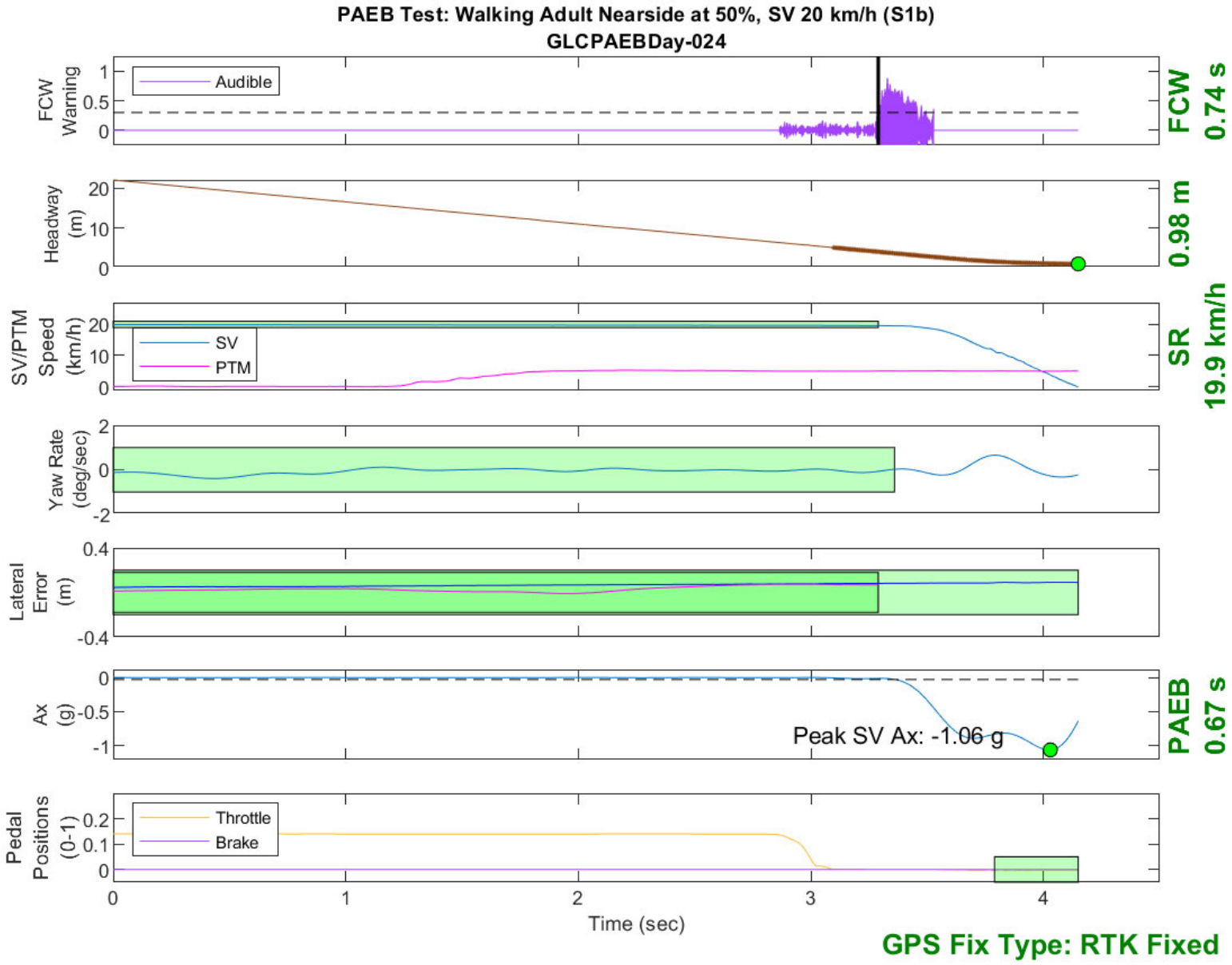

Figure D27. Time History for PAEB Run 24, S1b, Daytime, 20 km/h

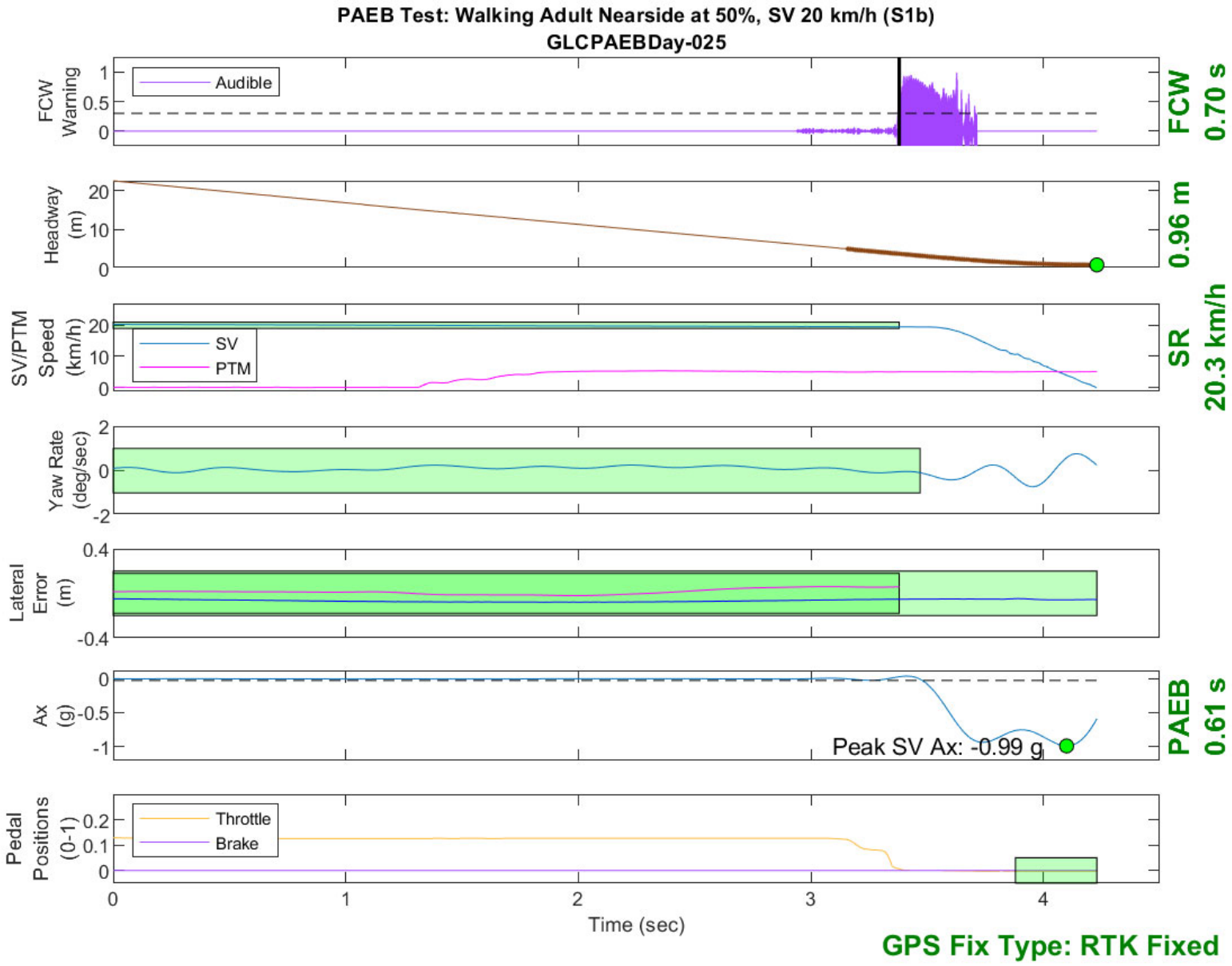

Figure D28. Time History for PAEB Run 25, S1b, Daytime, 20 km/h

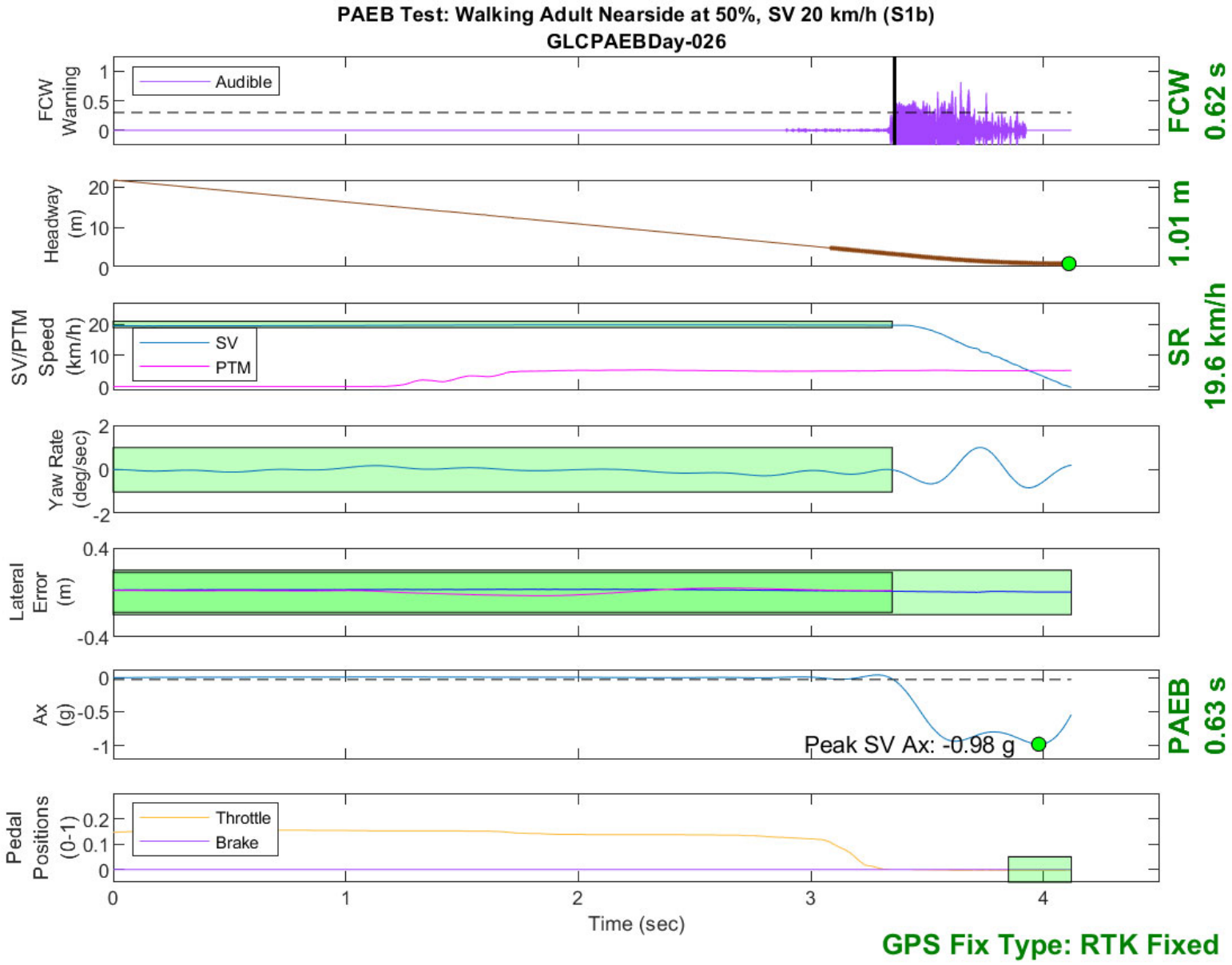

Figure D29. Time History for PAEB Run 26, S1b, Daytime, 20 km/h

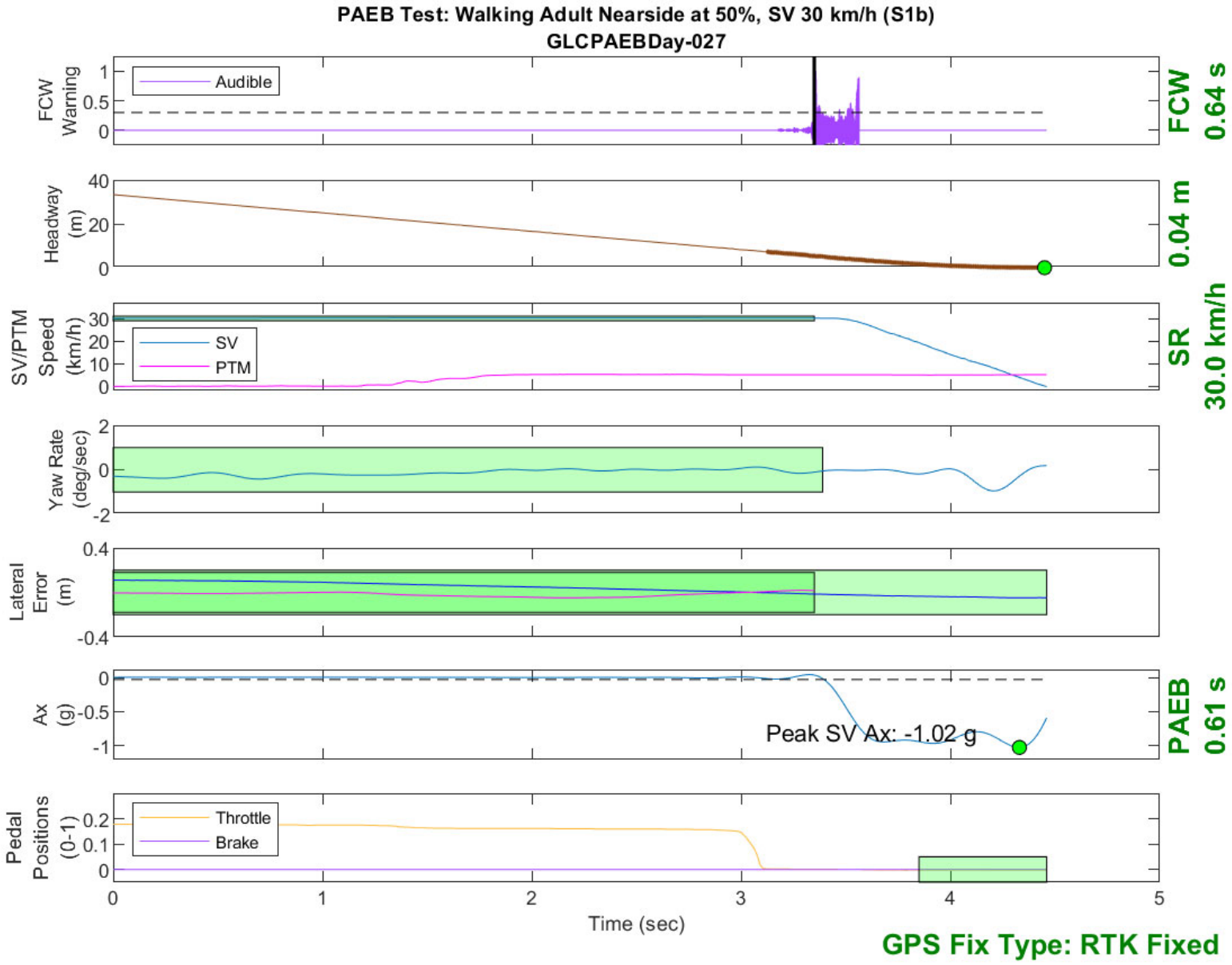

Figure D30. Time History for PAEB Run 27, S1b, Daytime, 30 km/h

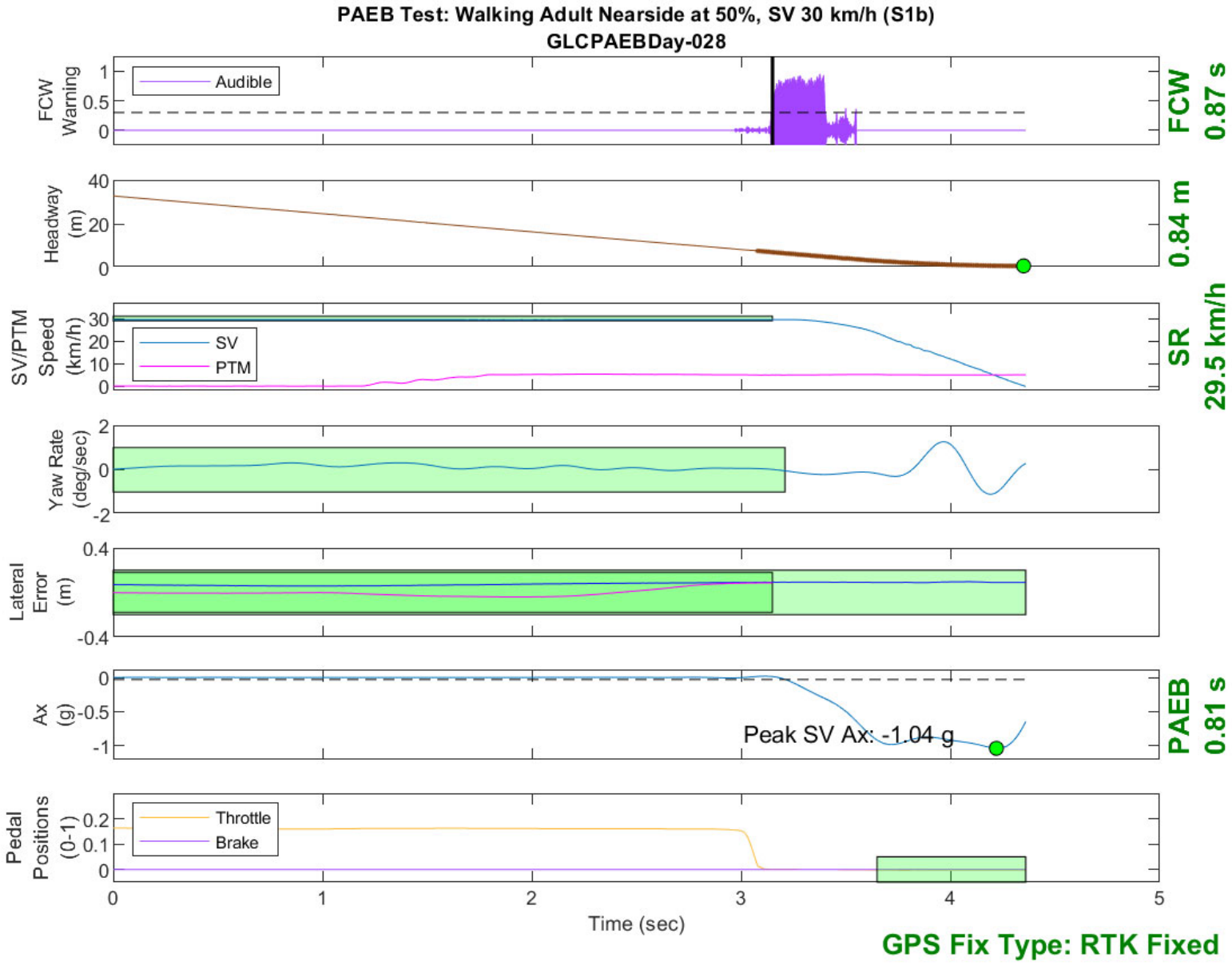

Figure D31. Time History for PAEB Run 28, S1b, Daytime, 30 km/h

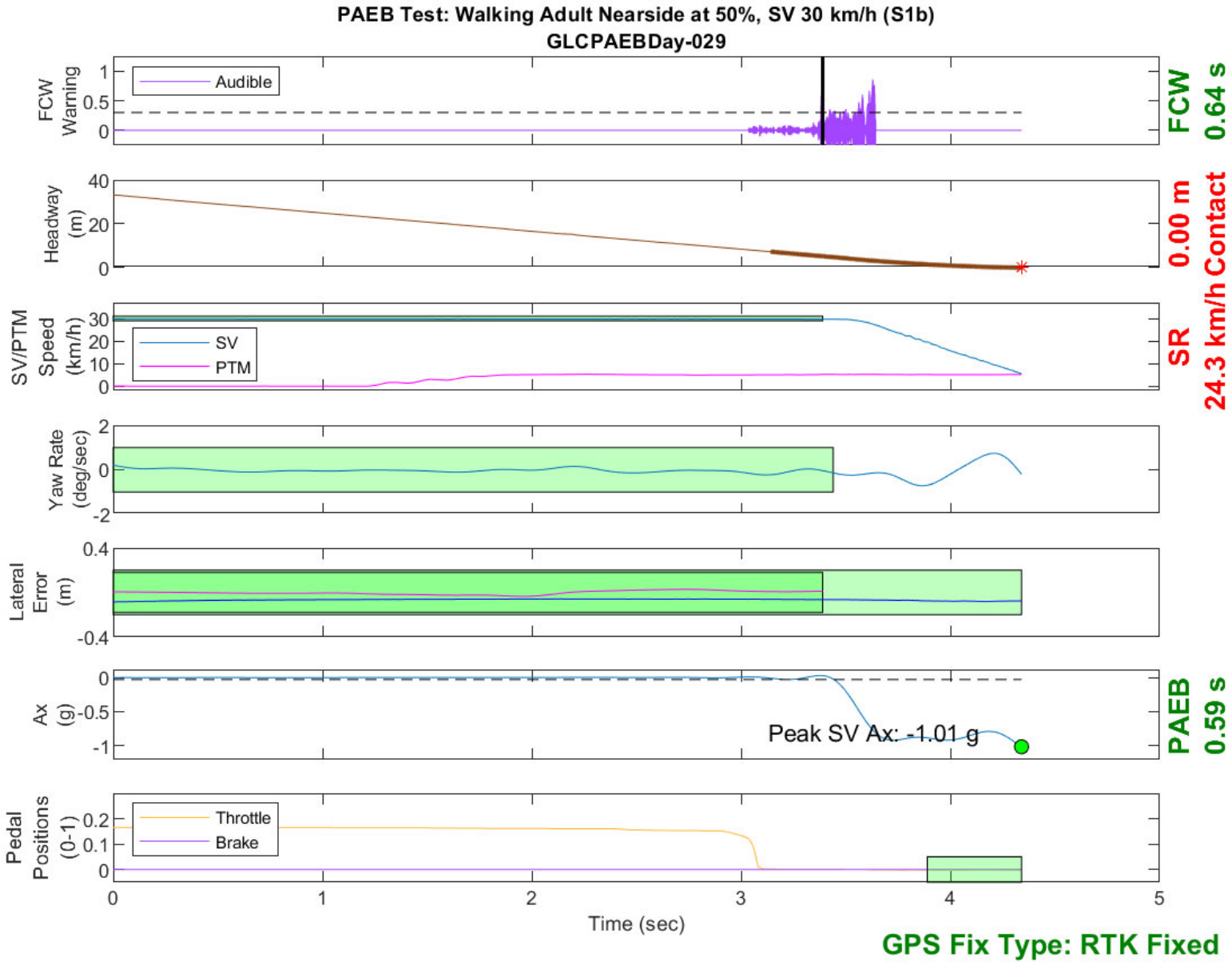

Figure D32. Time History for PAEB Run 29, S1b, Daytime, 30 km/h

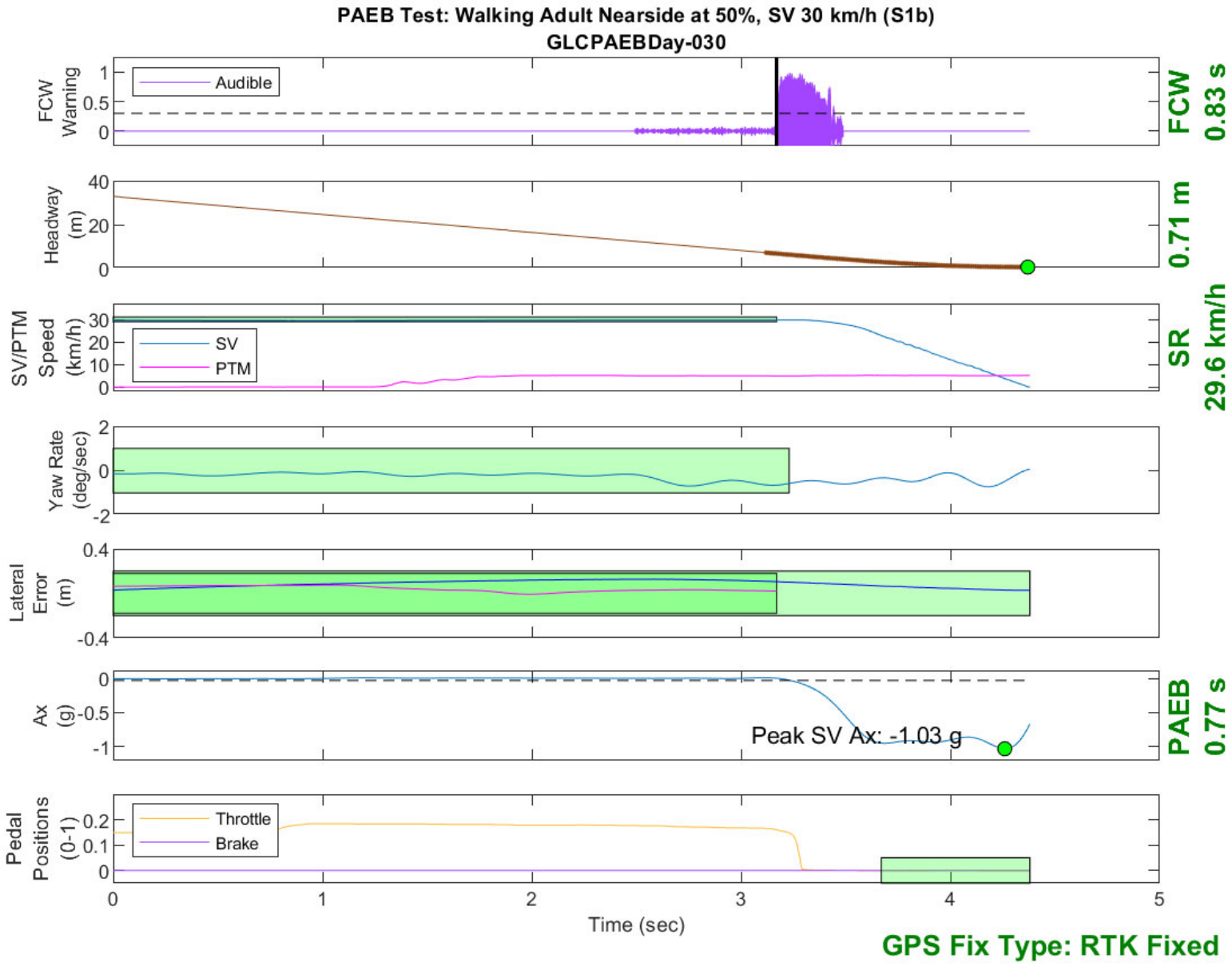

Figure D33. Time History for PAEB Run 30, S1b, Daytime, 30 km/h

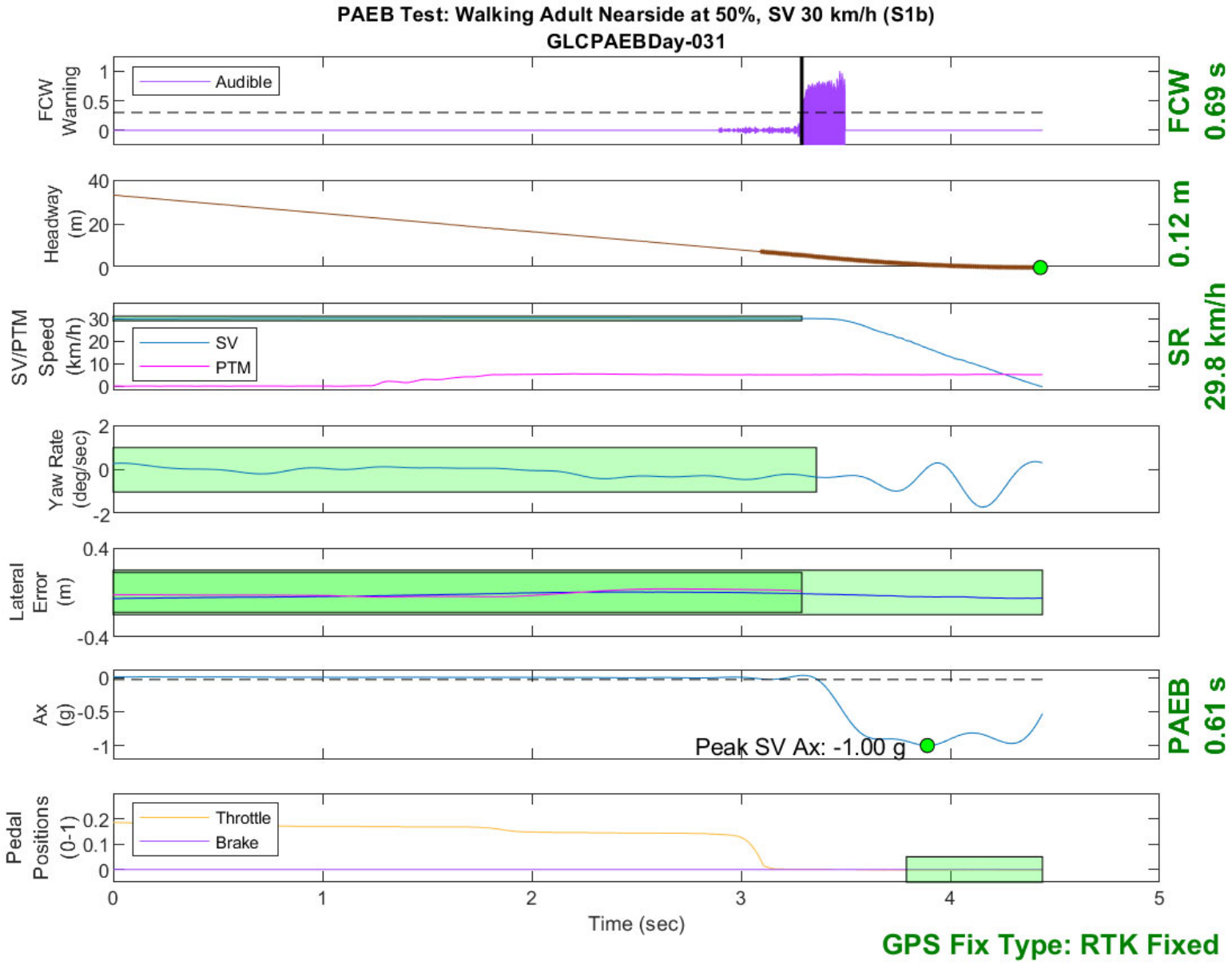

Figure D34. Time History for PAEB Run 31, S1b, Daytime, 30 km/h

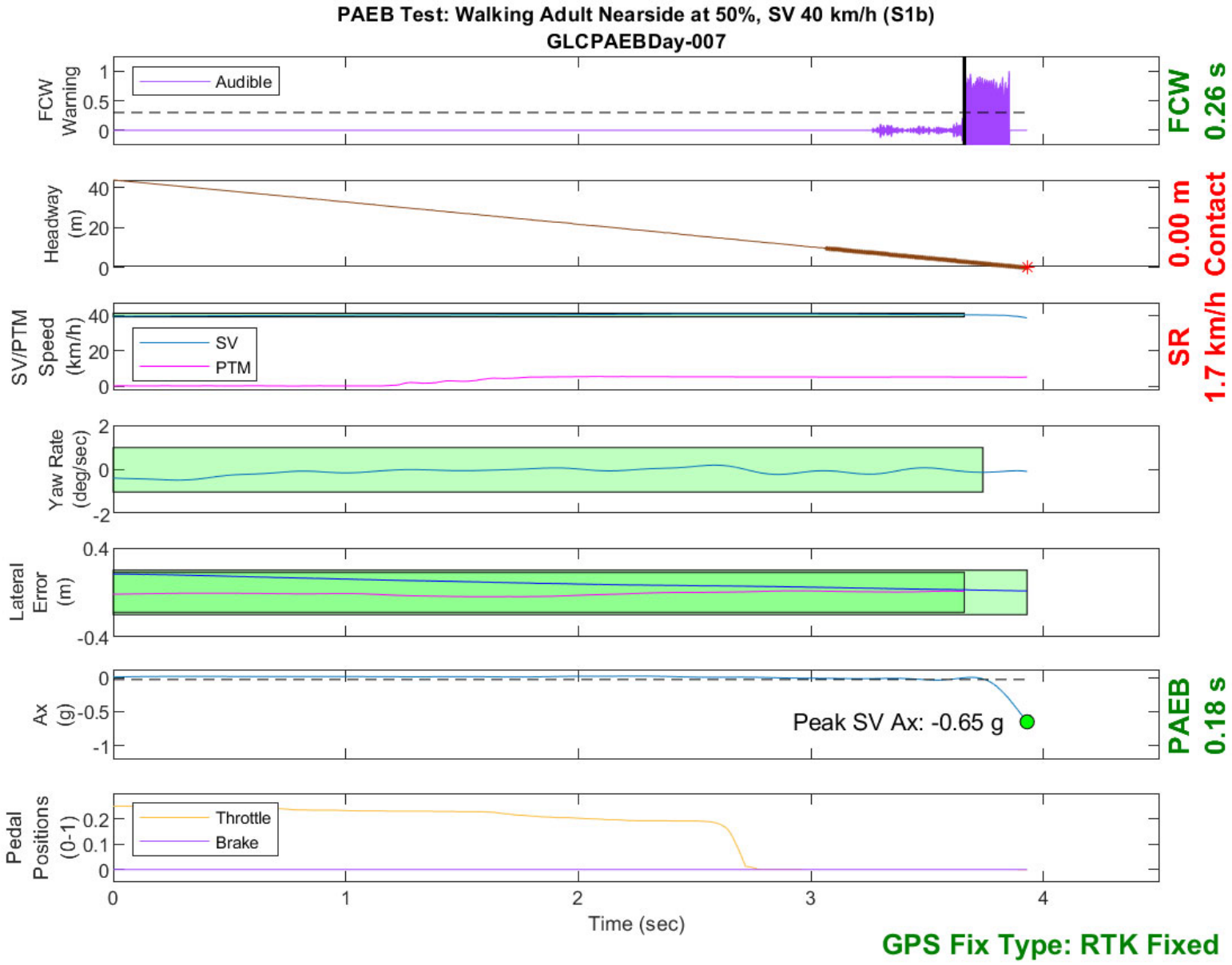

Figure D35. Time History for PAEB Run 7, S1b, Daytime, 40 km/h

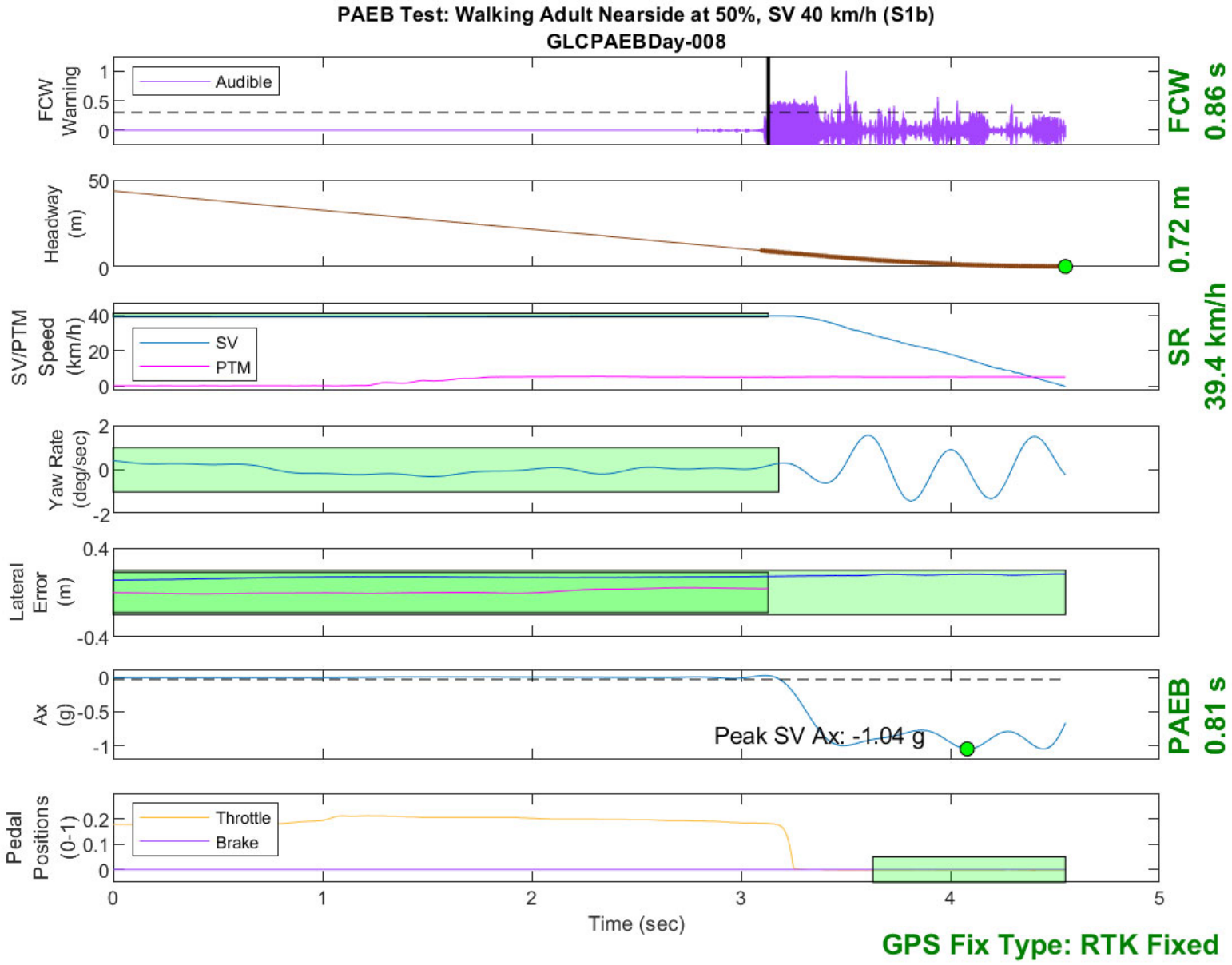

Figure D36. Time History for PAEB Run 8, S1b, Daytime, 40 km/h

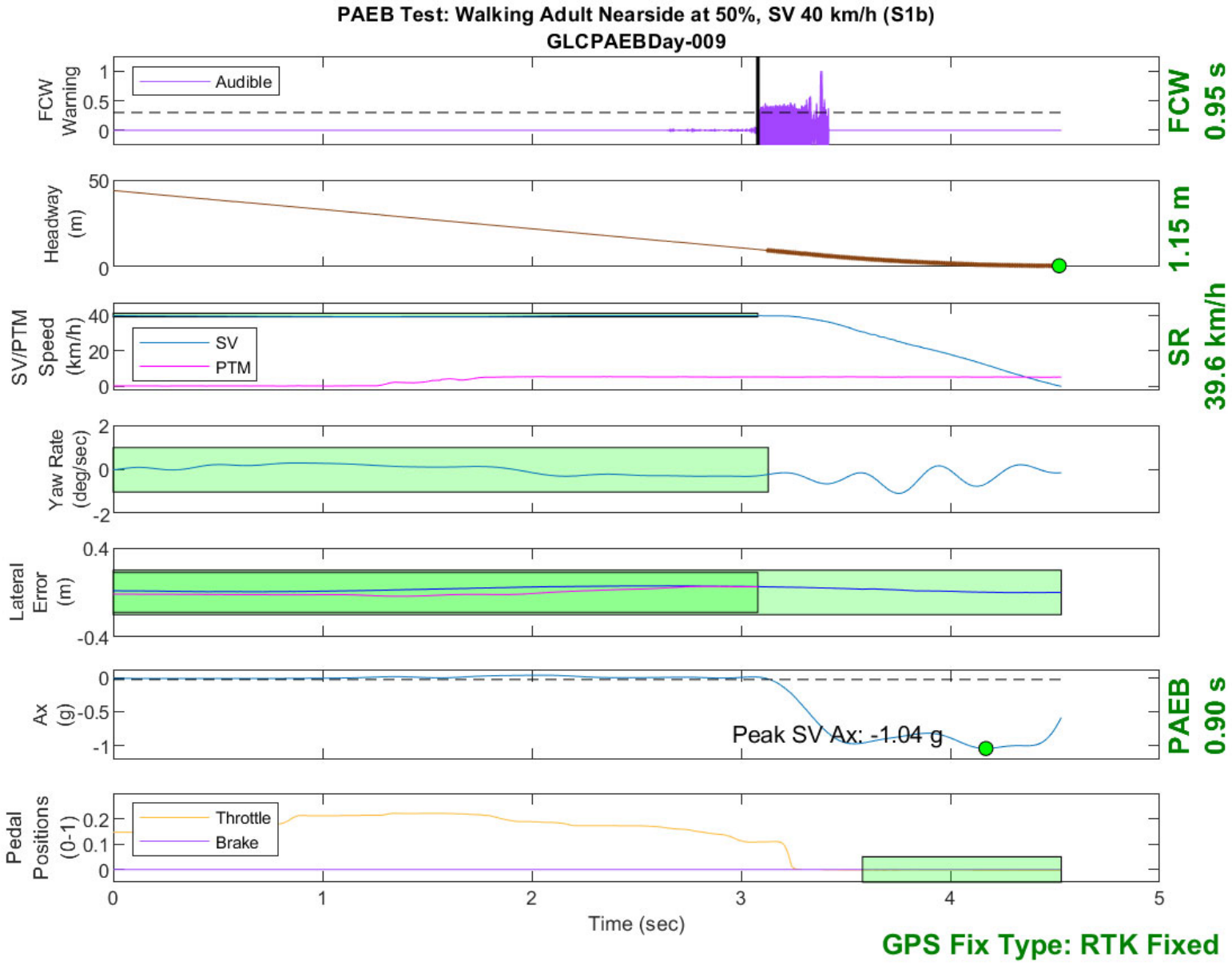

Figure D37. Time History for PAEB Run 9, S1b, Daytime, 40 km/h

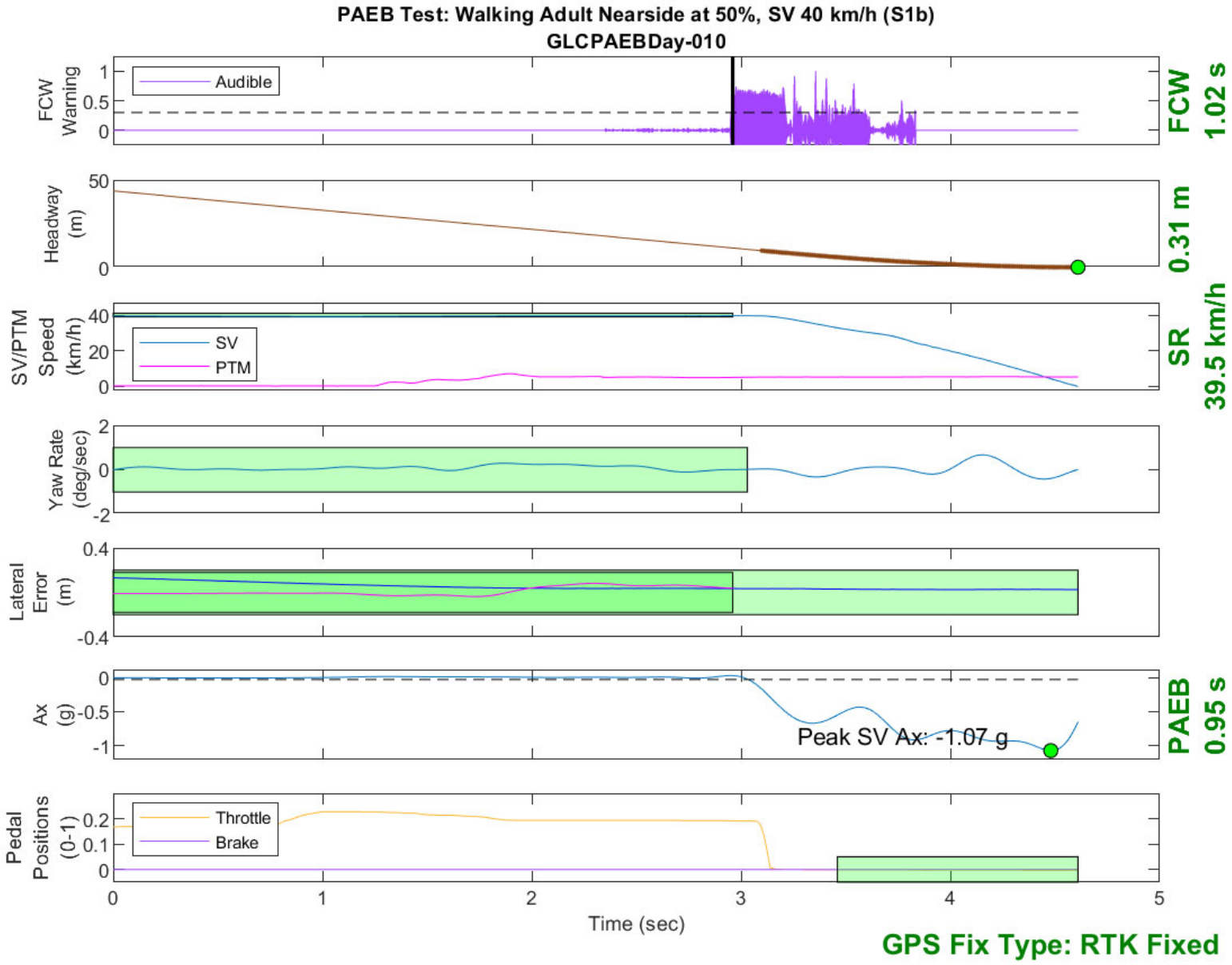

Figure D38. Time History for PAEB Run 10, S1b, Daytime, 40 km/h

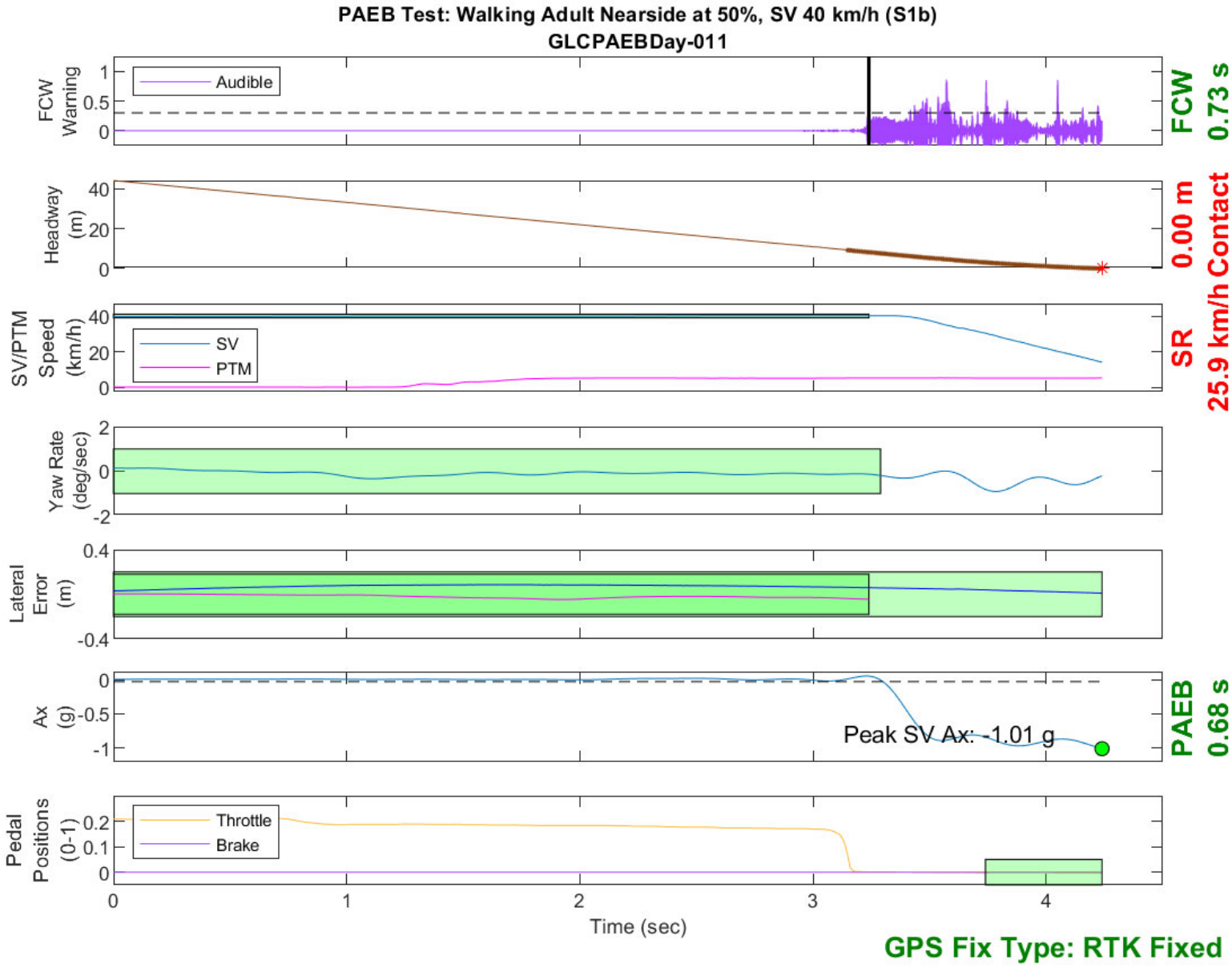

Figure D39. Time History for PAEB Run 11, S1b, Daytime, 40 km/h

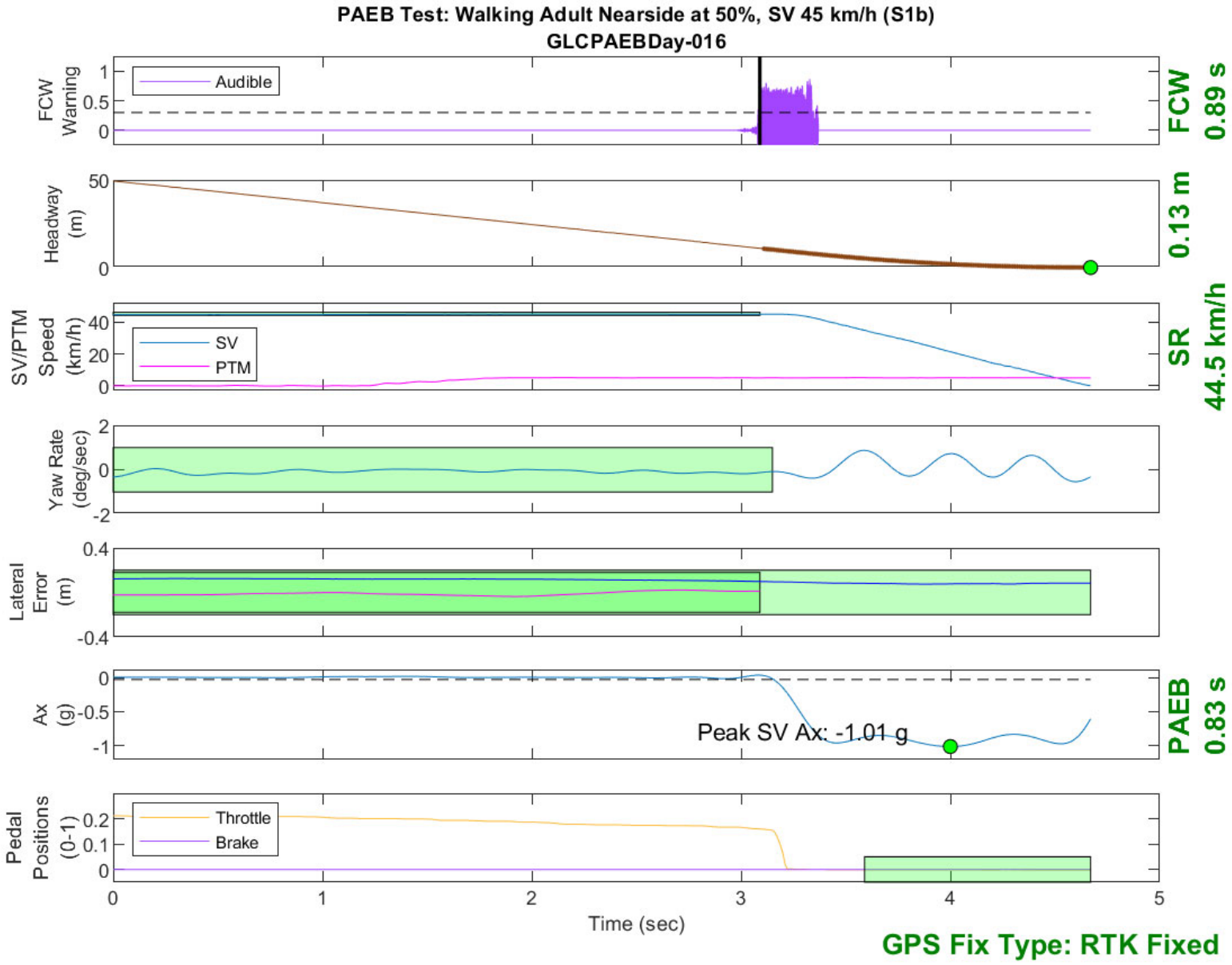

Figure D40. Time History for PAEB Run 16, S1b, Daytime, 45 km/h

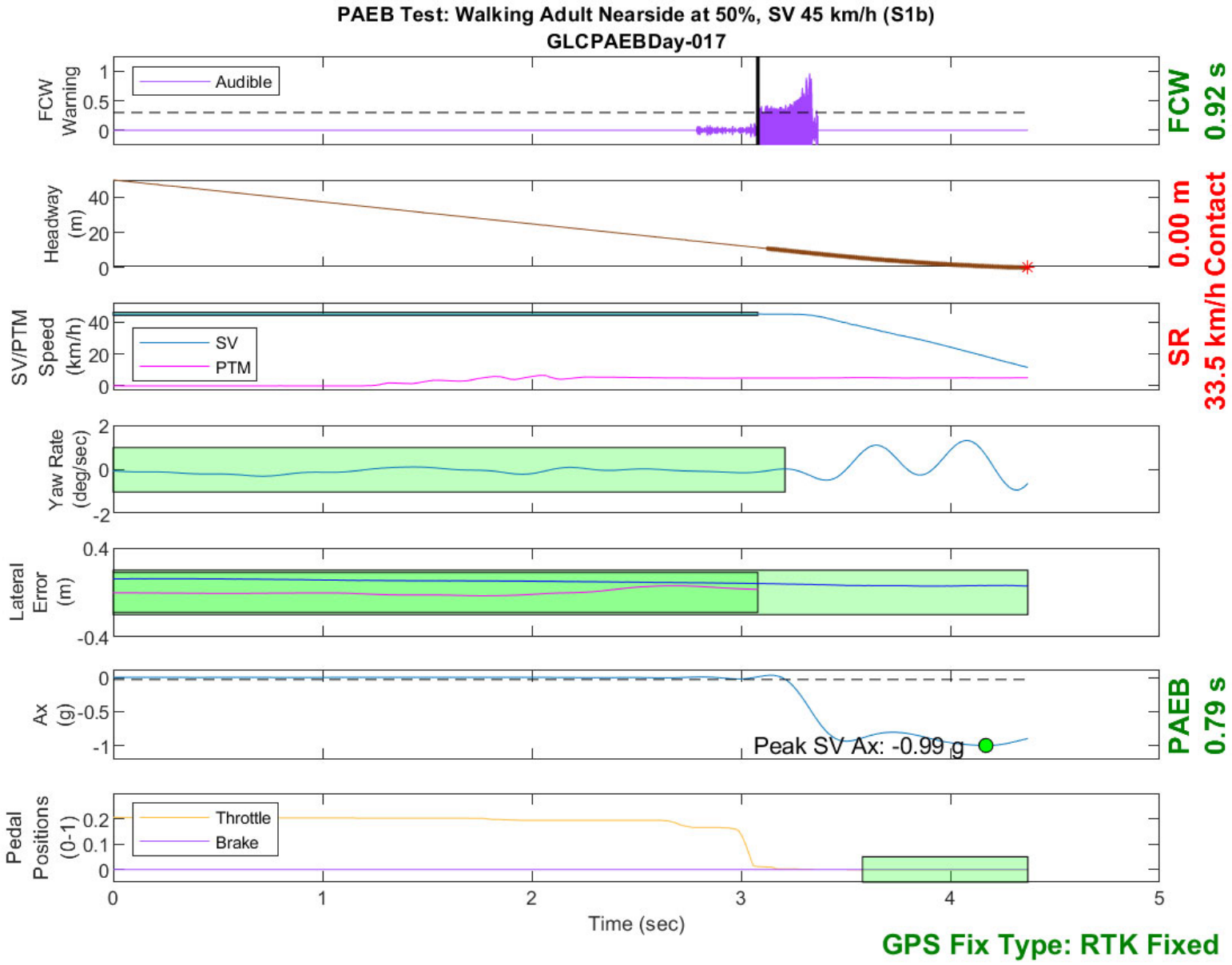

Figure D41. Time History for PAEB Run 17, S1b, Daytime, 45 km/h

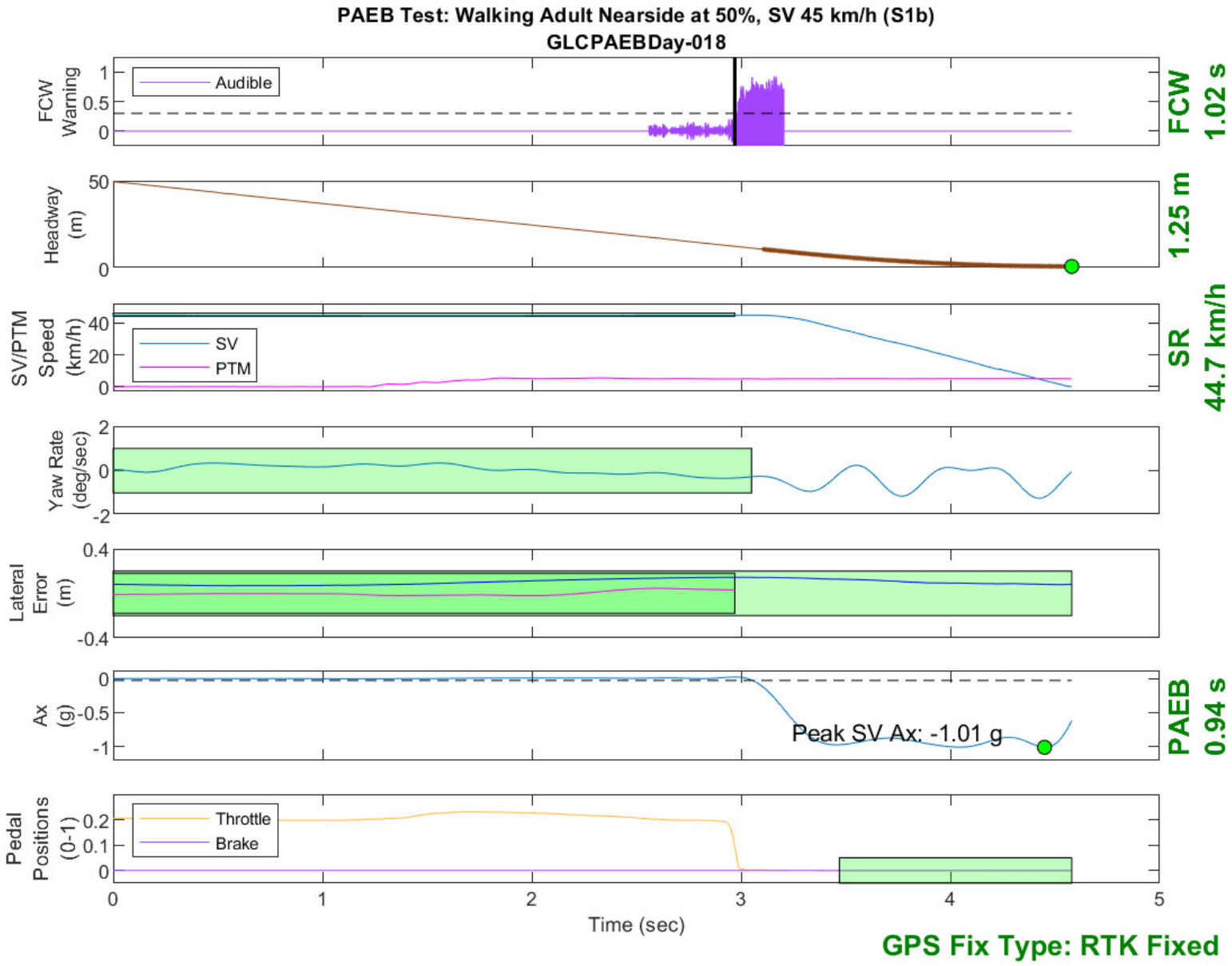

Figure D42. Time History for PAEB Run 18, S1b, Daytime, 45 km/h

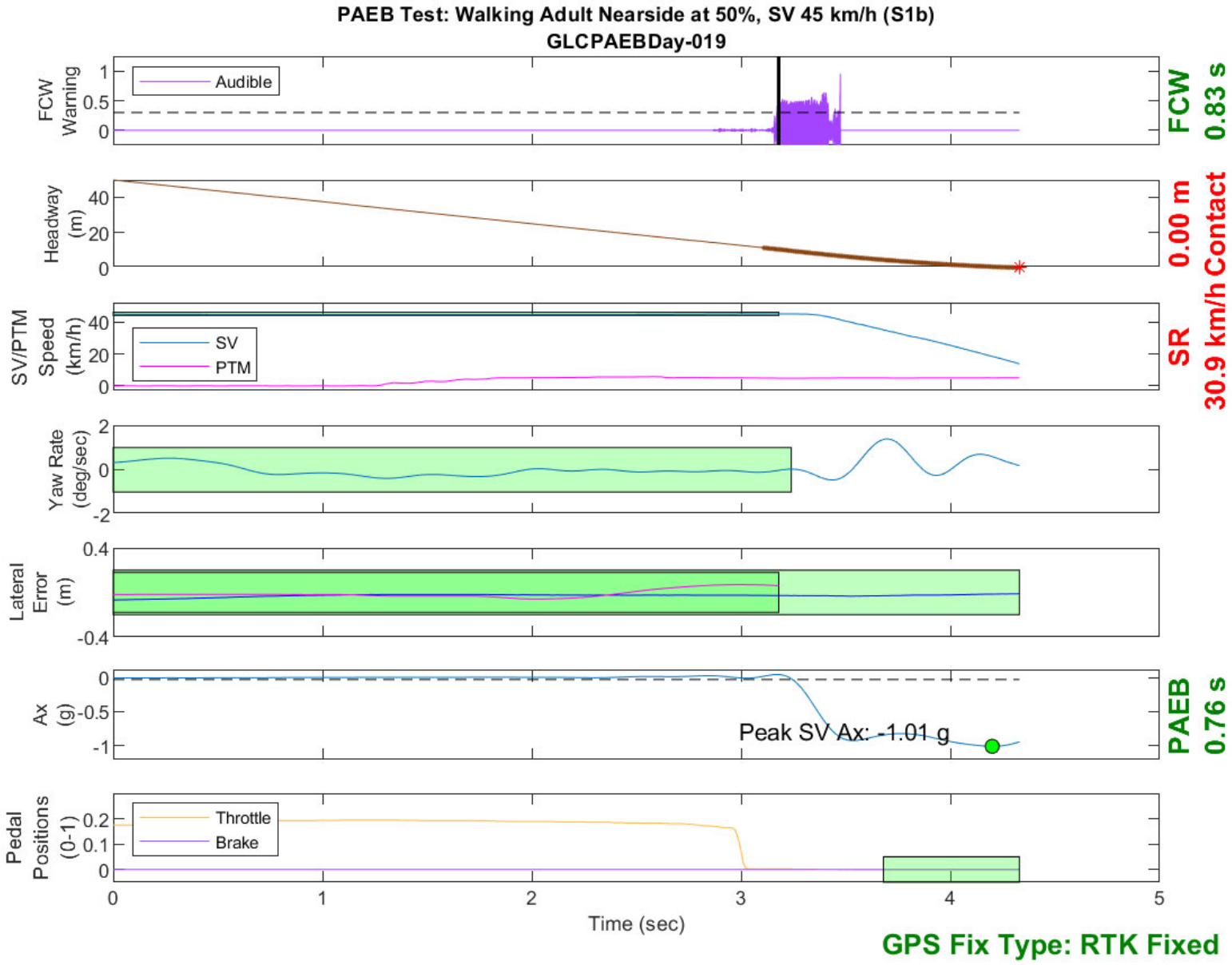

Figure D43. Time History for PAEB Run 19, S1b, Daytime, 45 km/h

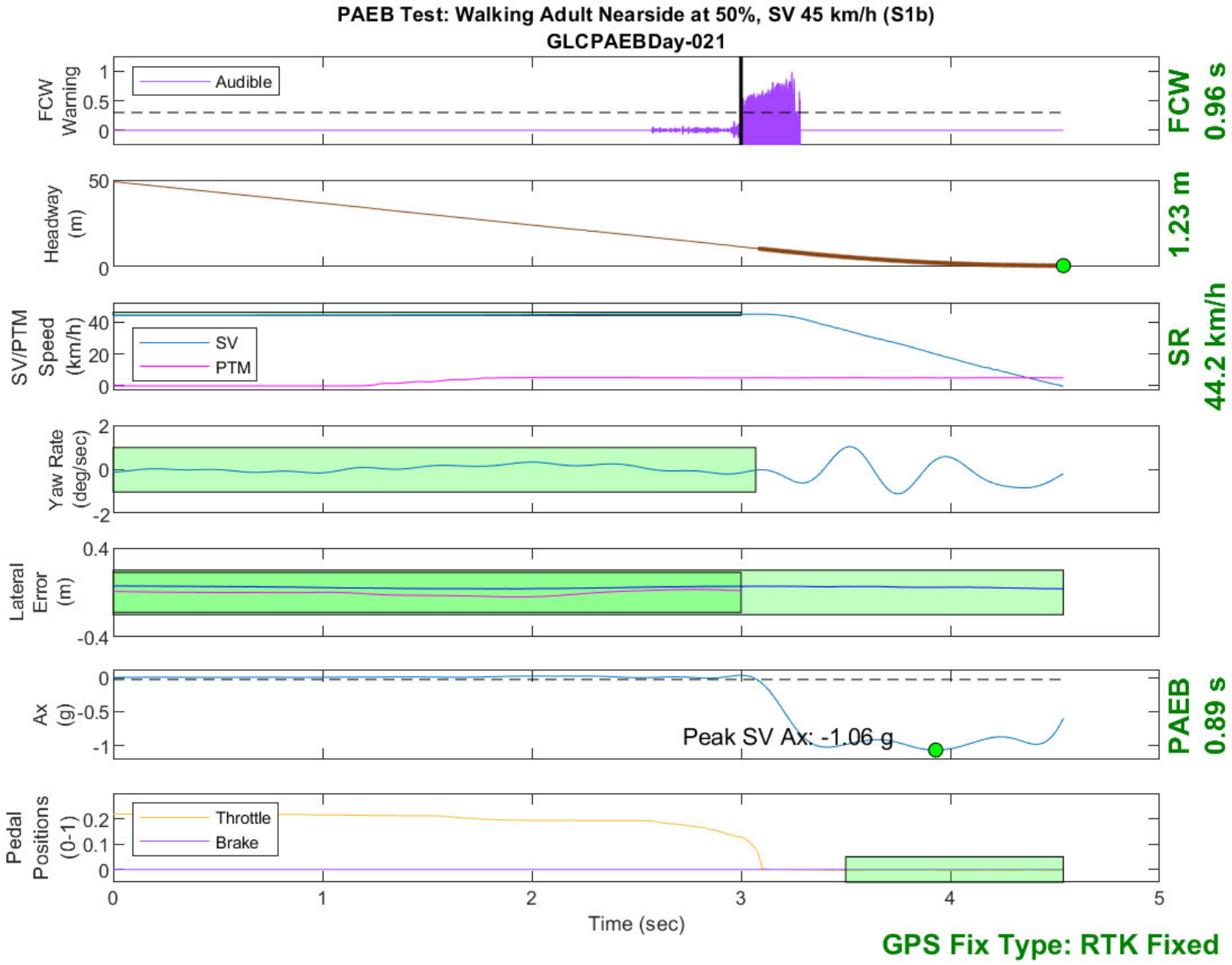

Figure D44. Time History for PAEB Run 21, S1b, Daytime, 45 km/h

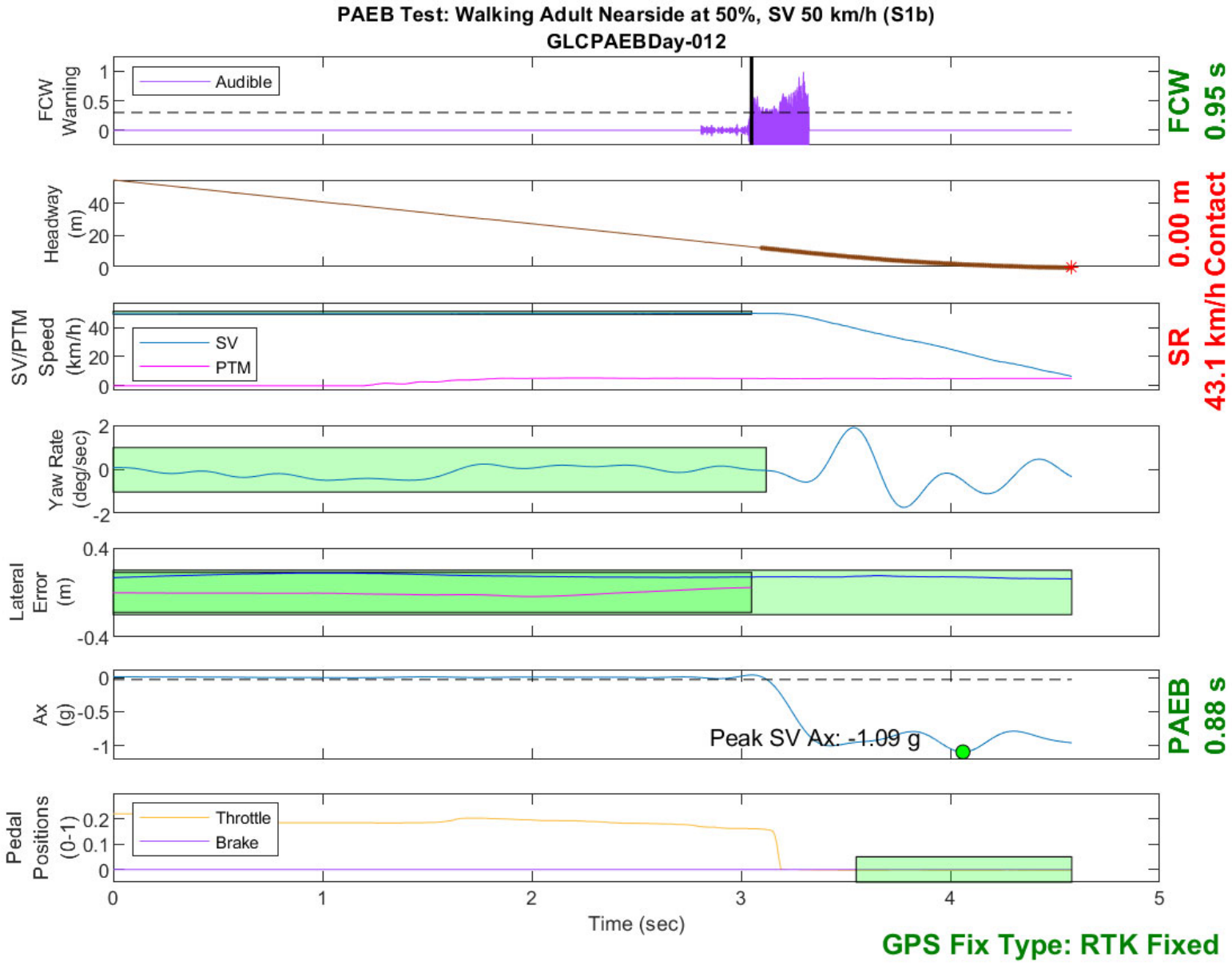

Figure D45. Time History for PAEB Run 12, S1b, Daytime, 50 km/h

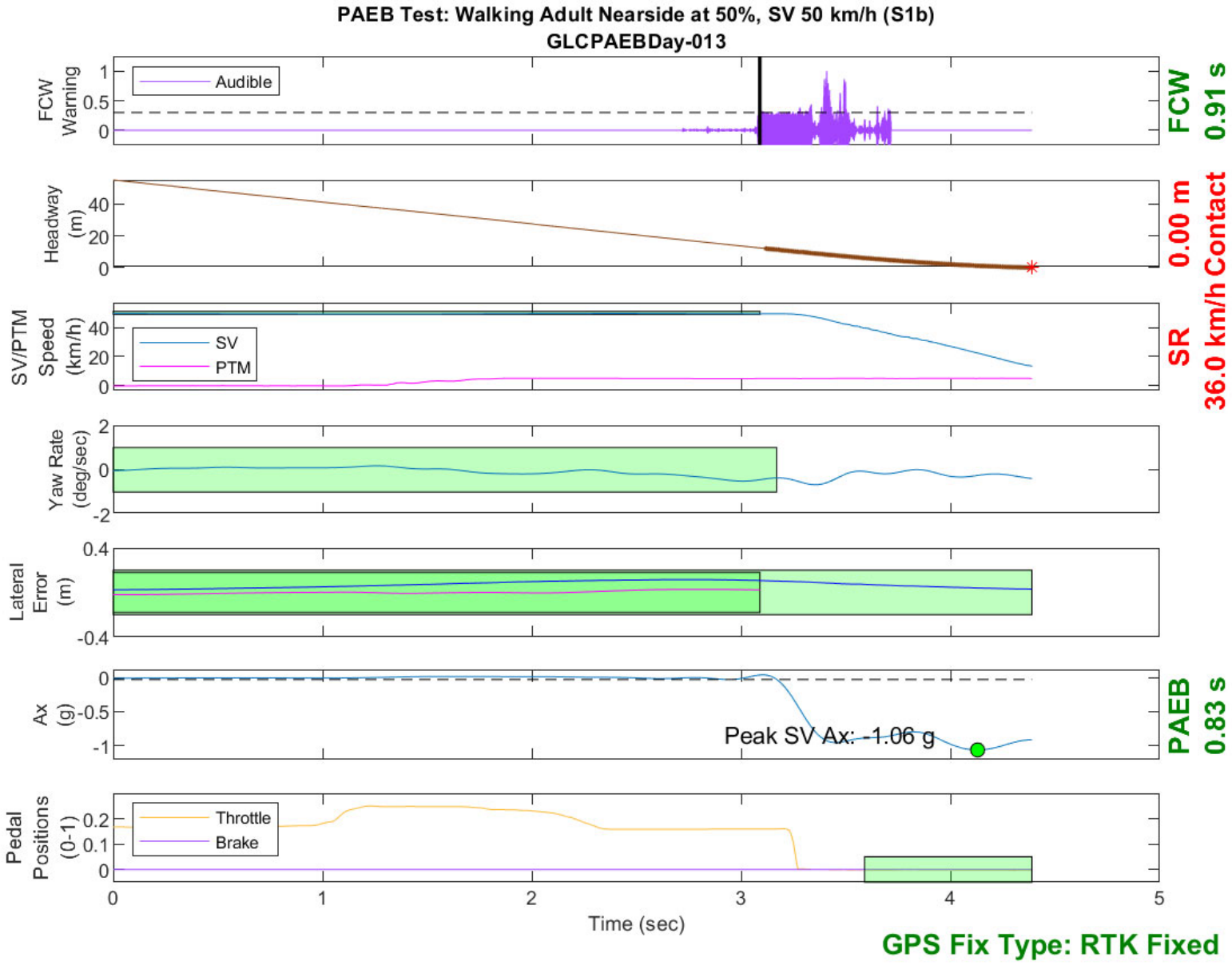

Figure D46. Time History for PAEB Run 13, S1b, Daytime, 50 km/h

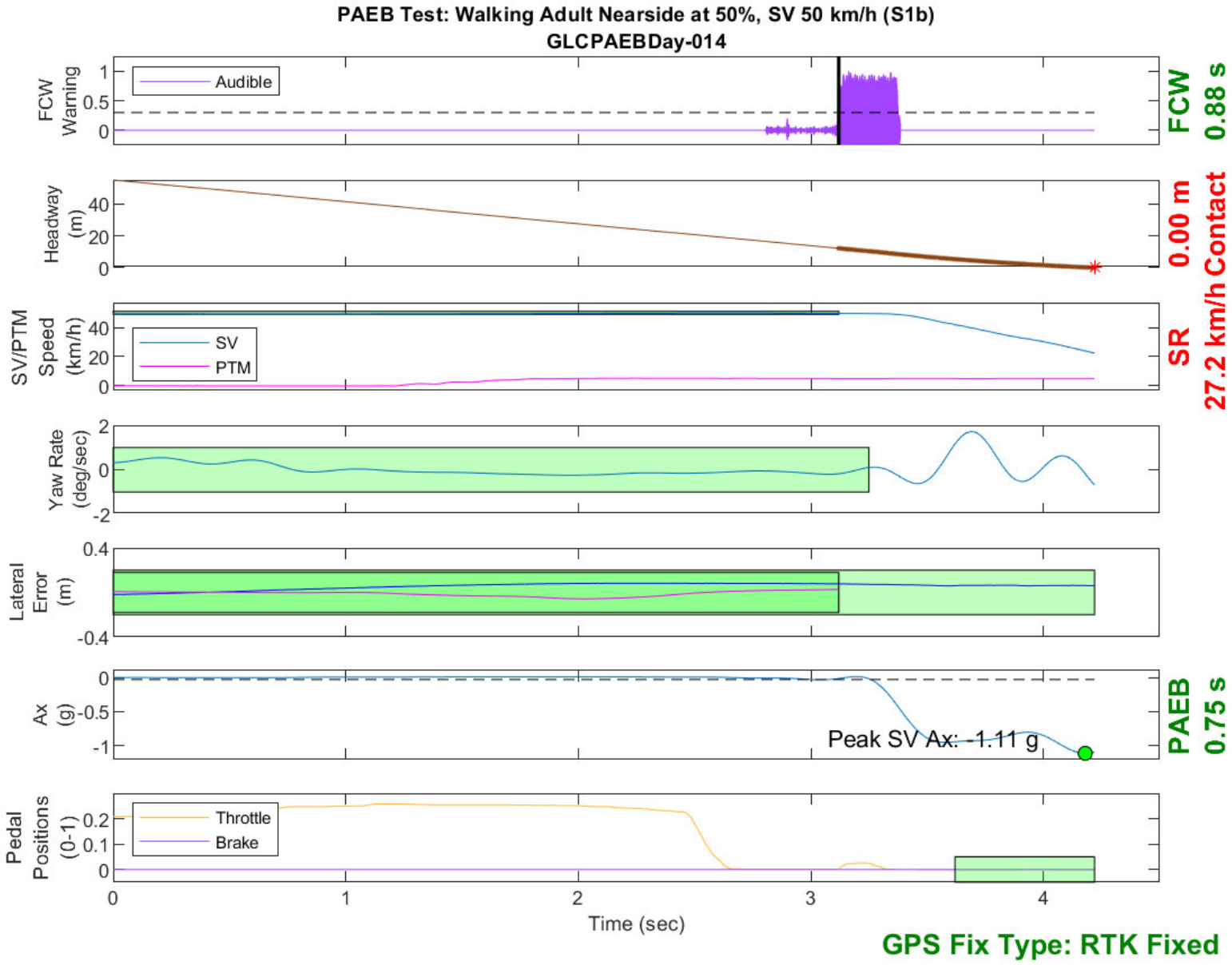

Figure D47. Time History for PAEB Run 14, S1b, Daytime, 50 km/h

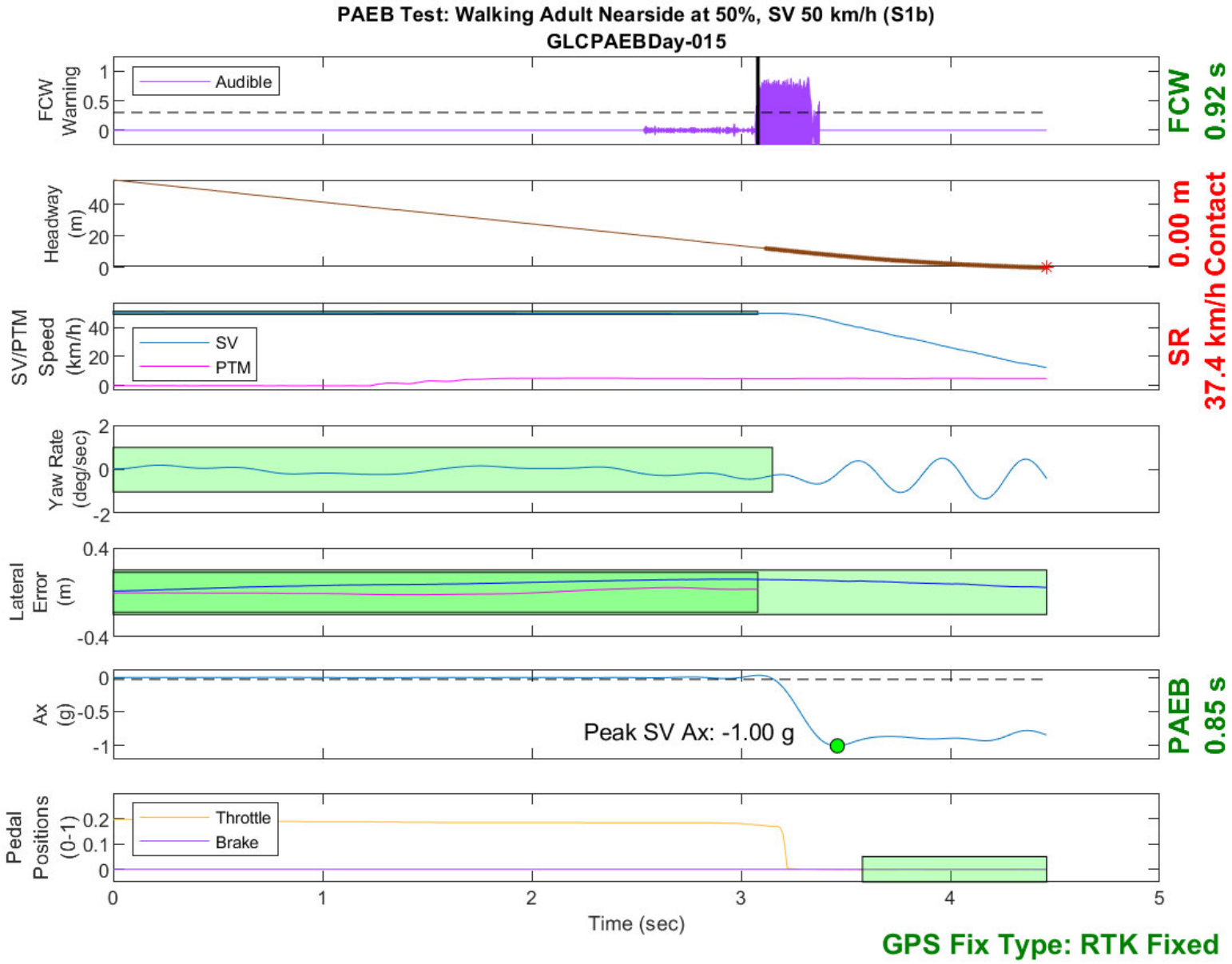

Figure D48. Time History for PAEB Run 15, S1b, Daytime, 50 km/h

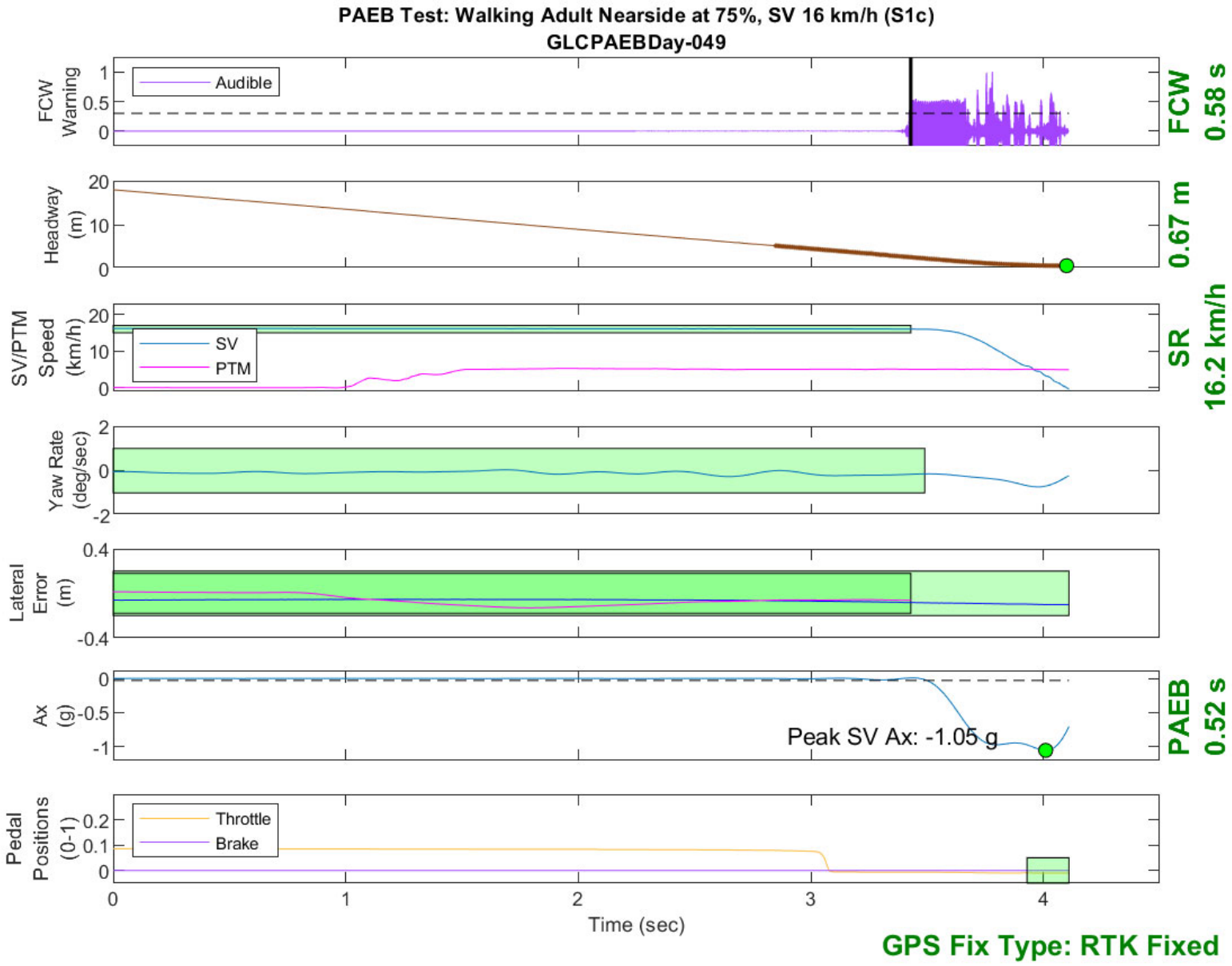

Figure D49. Time History for PAEB Run 49, S1c, Daytime, 16 km/h

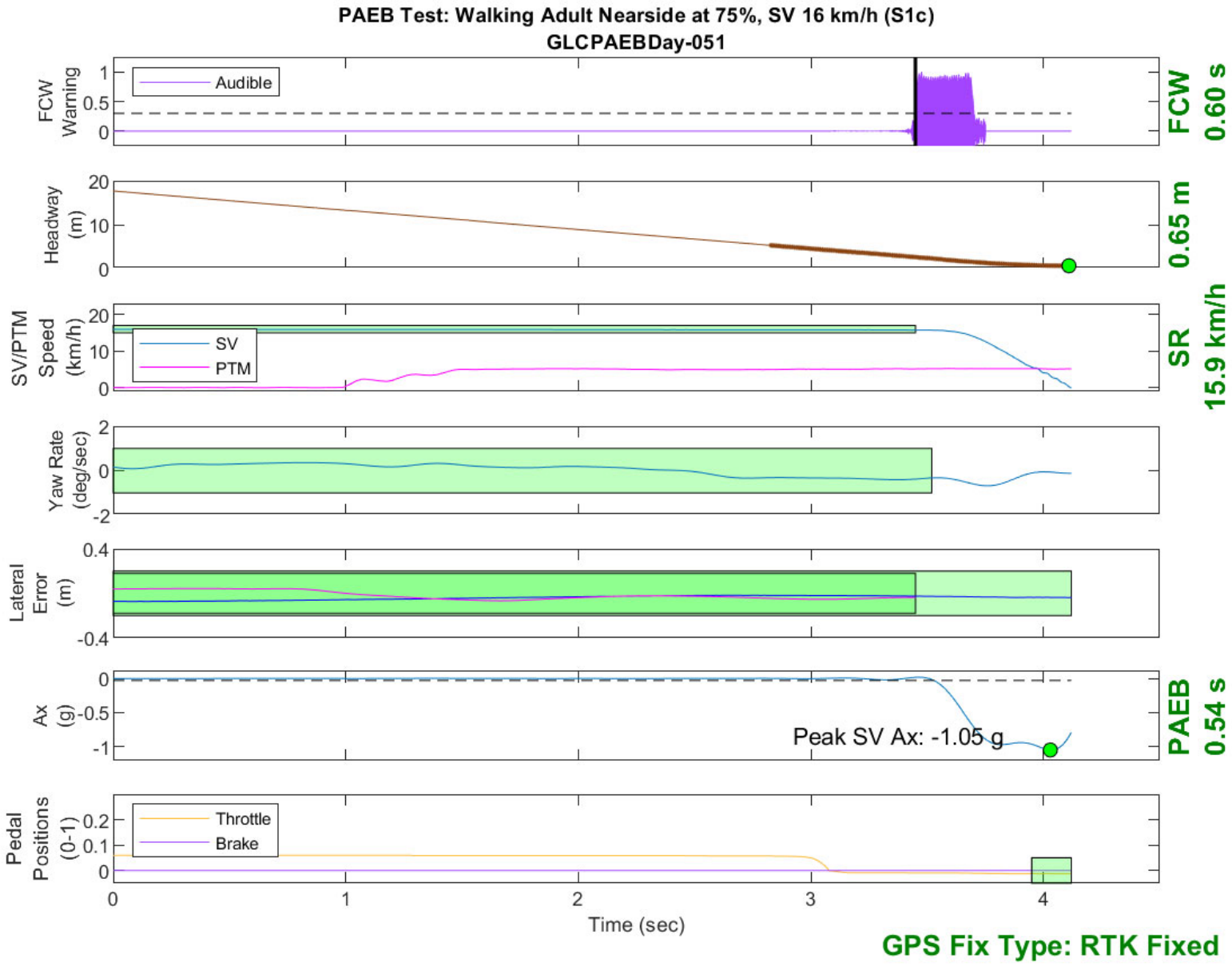

Figure D50. Time History for PAEB Run 51, S1c, Daytime, 16 km/h

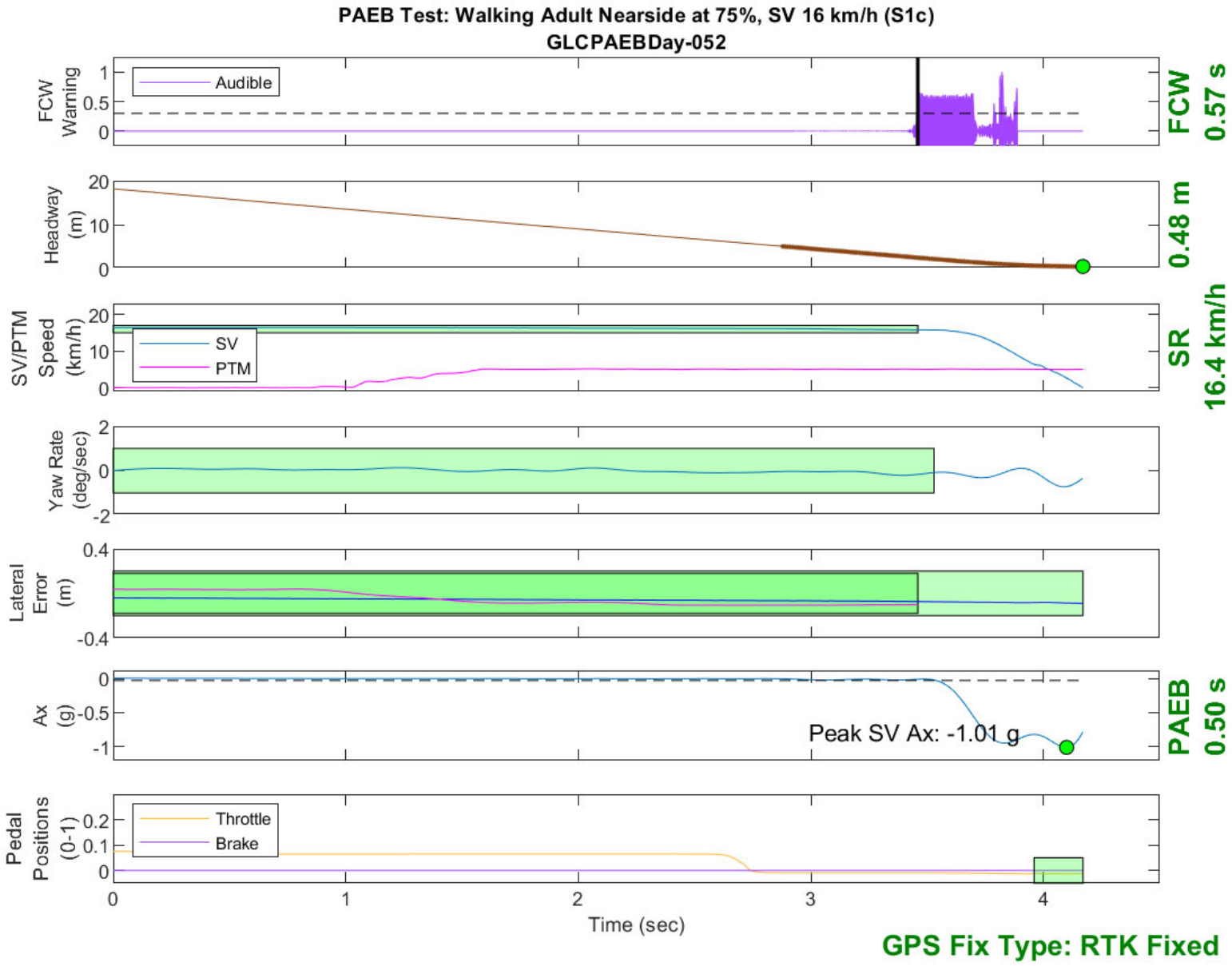

Figure D51. Time History for PAEB Run 52, S1c, Daytime, 16 km/h

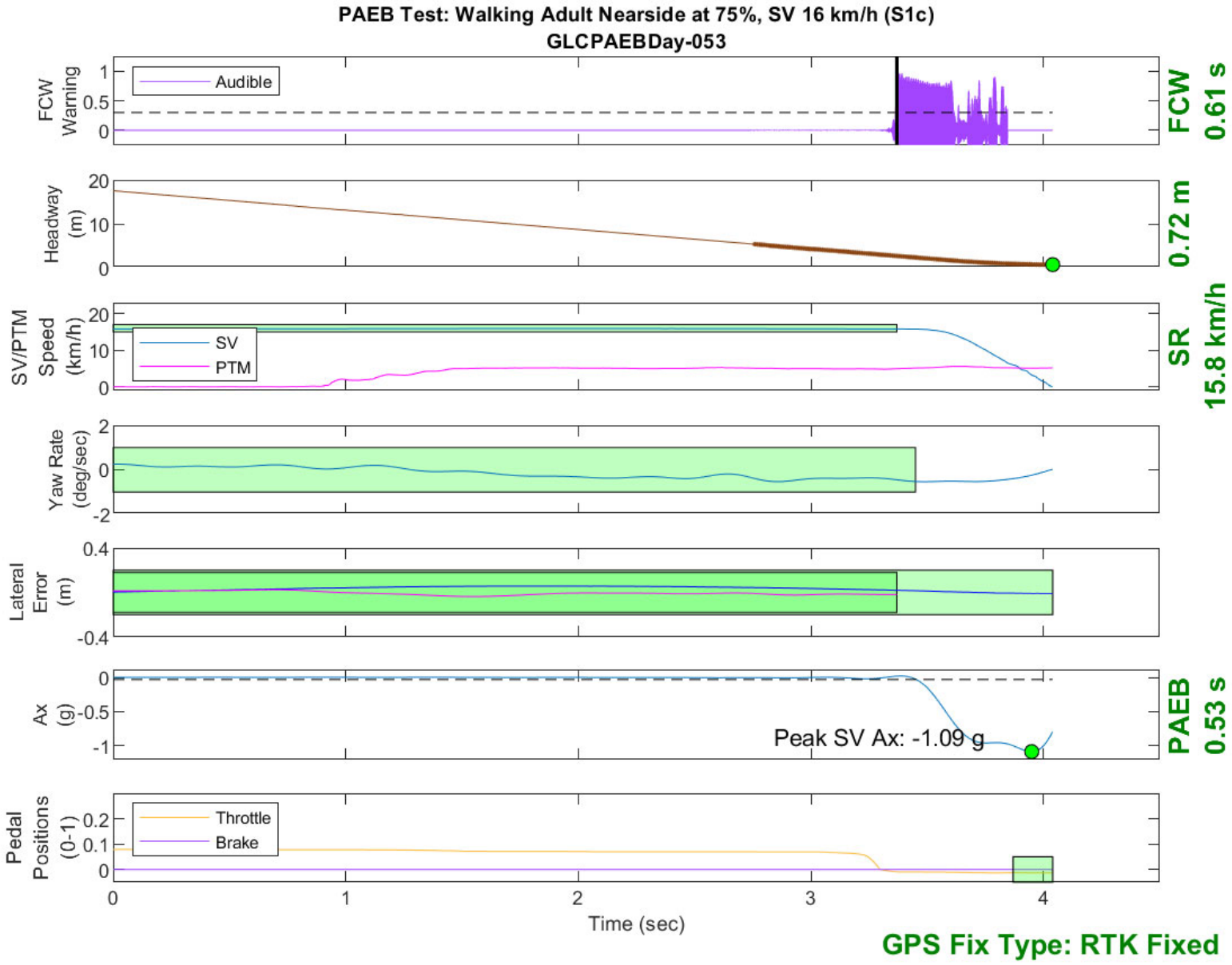

Figure D52. Time History for PAEB Run 53, S1c, Daytime, 16 km/h

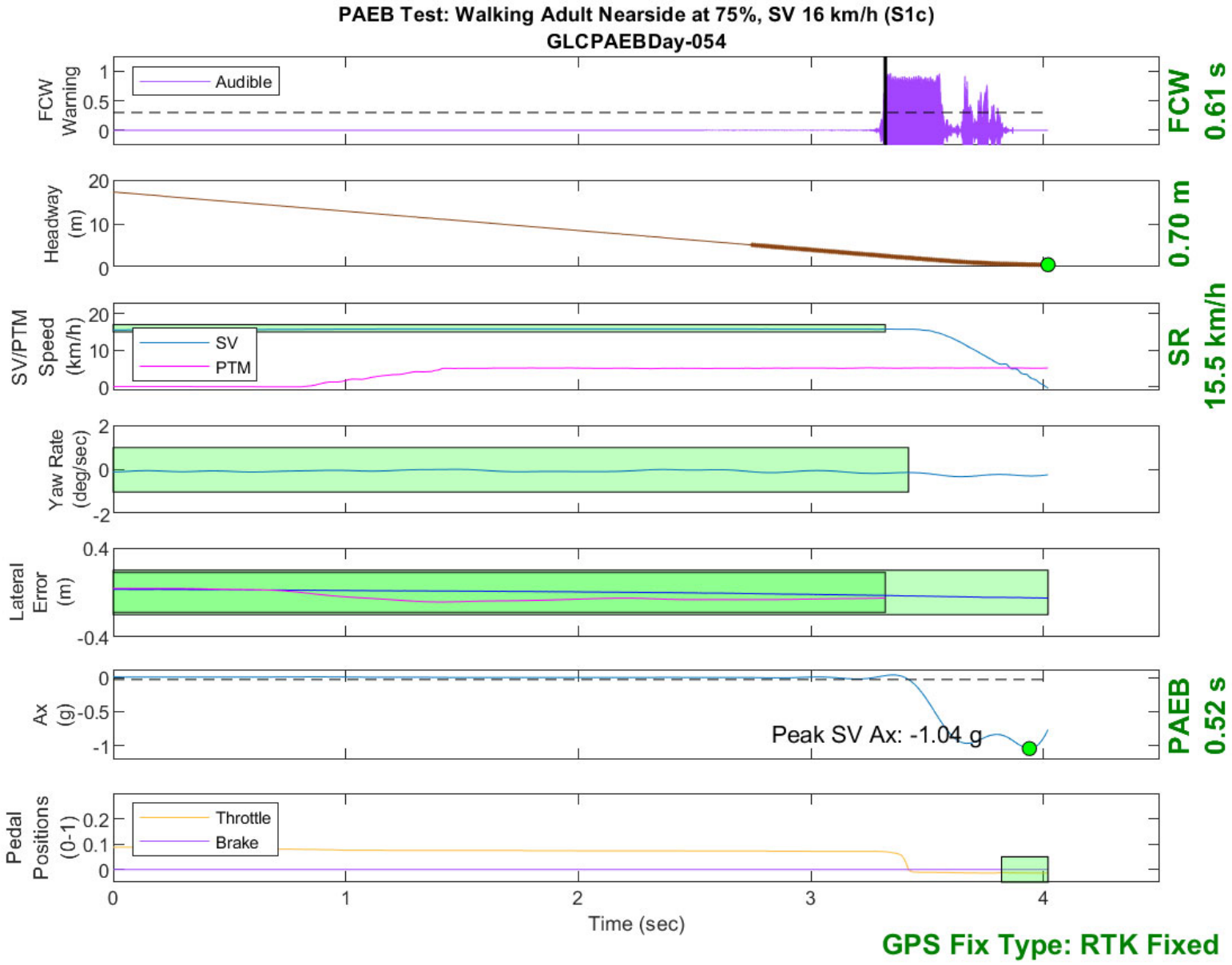

Figure D53. Time History for PAEB Run 54, S1c, Daytime, 16 km/h

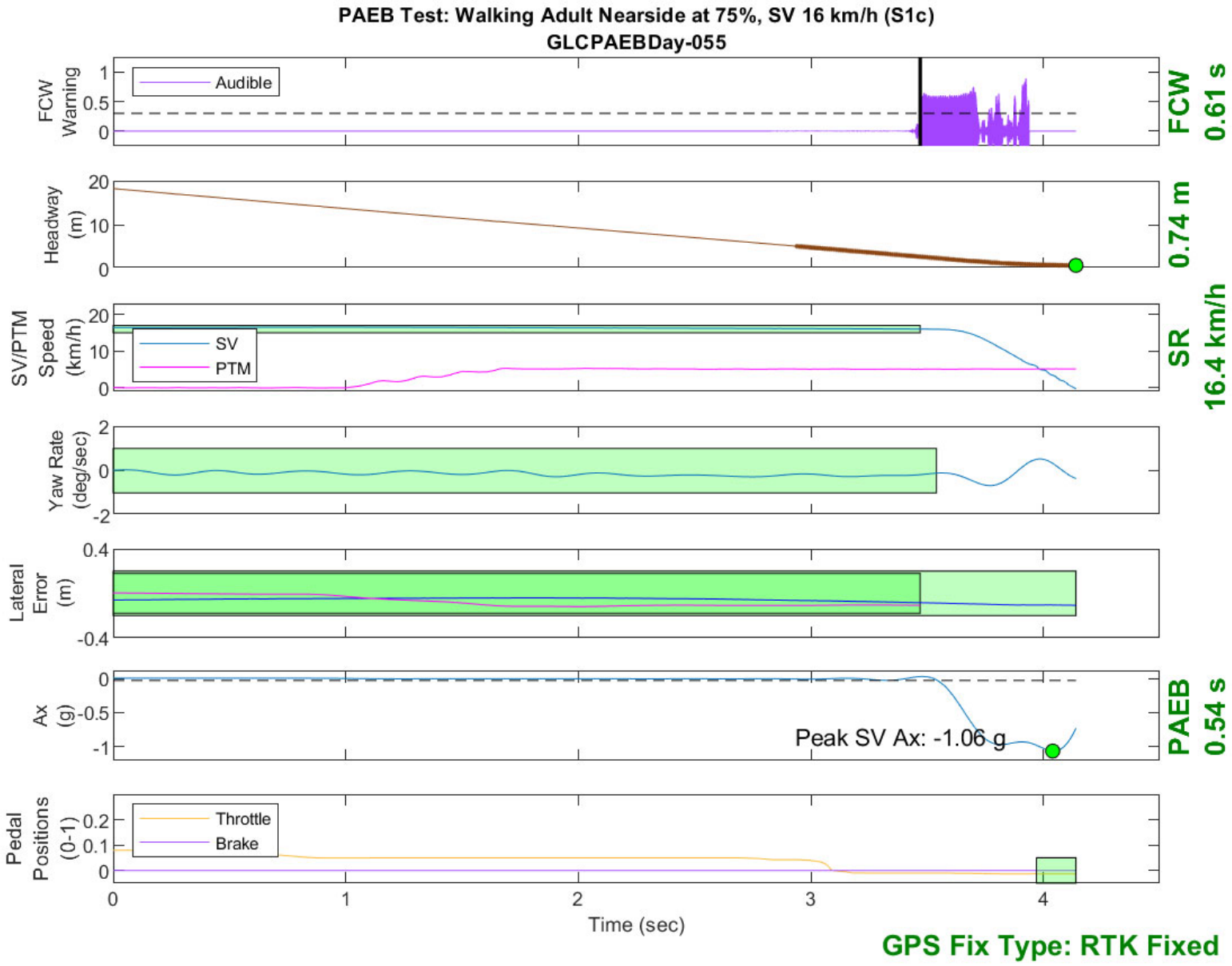

Figure D54. Time History for PAEB Run 55, S1c, Daytime, 16 km/h

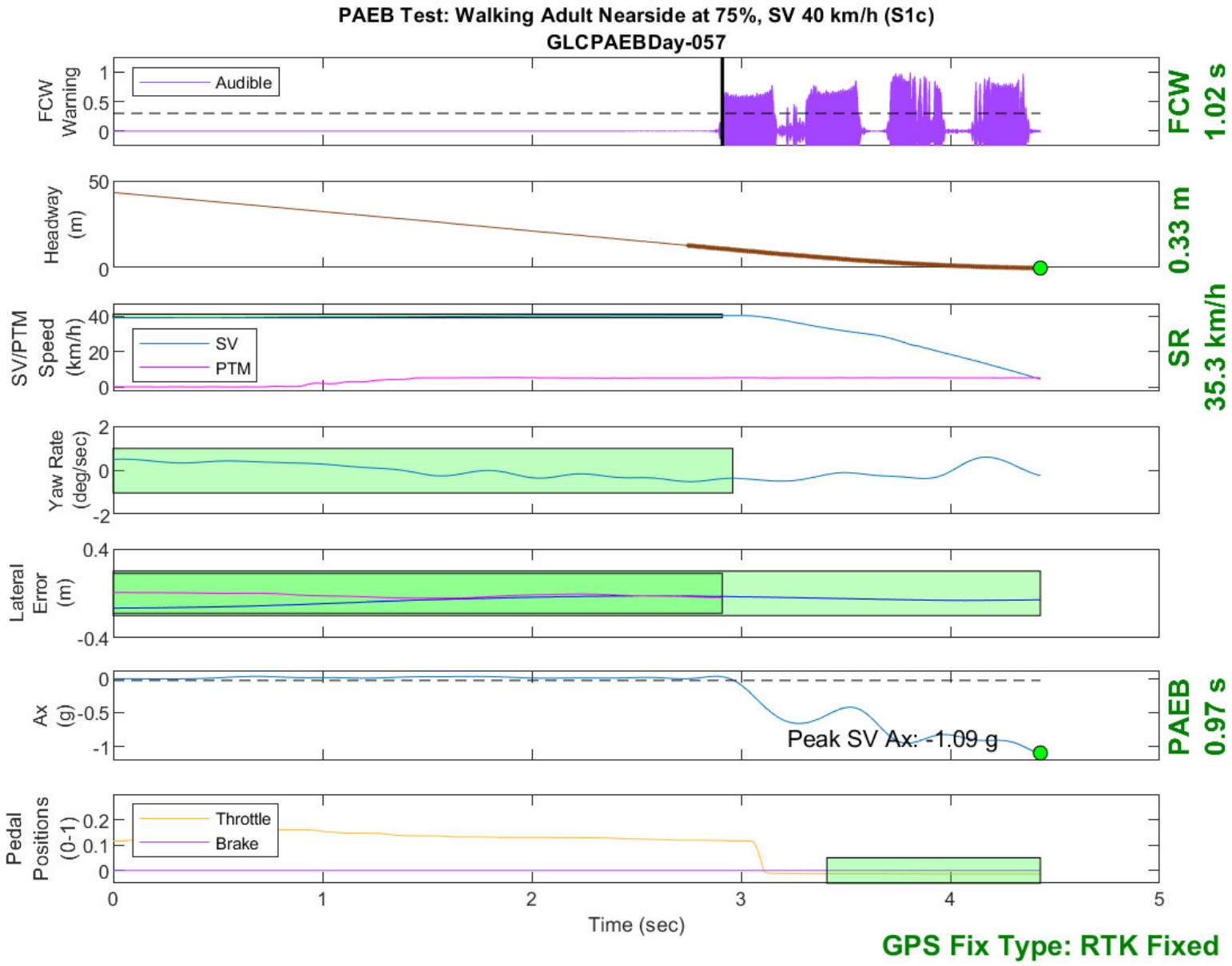

Figure D55. Time History for PAEB Run 57, S1c, Daytime, 40 km/h

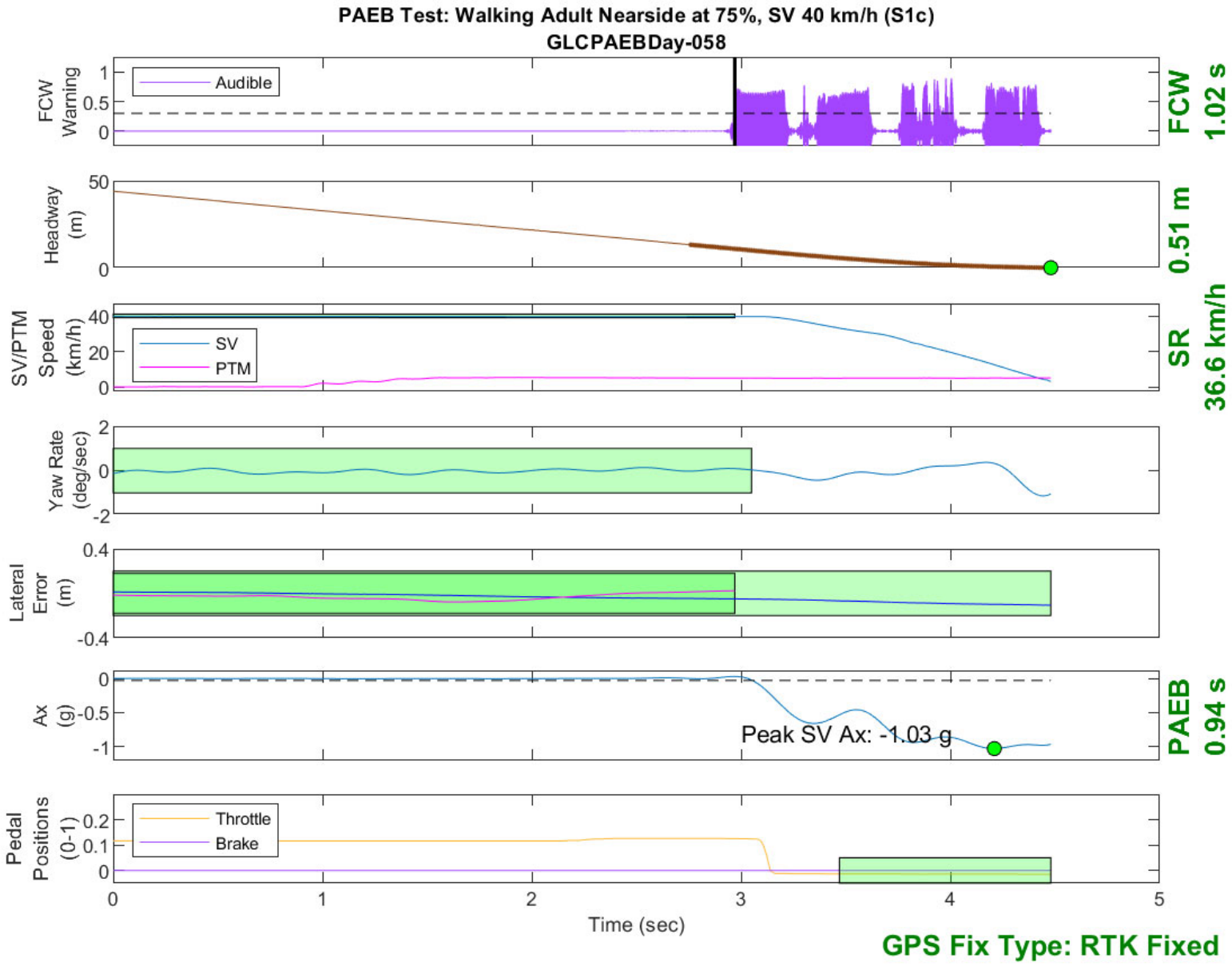

Figure D56. Time History for PAEB Run 58, S1c, Daytime, 40 km/h

Figure D57. Time History for PAEB Run 59, S1c, Daytime, 40 km/h

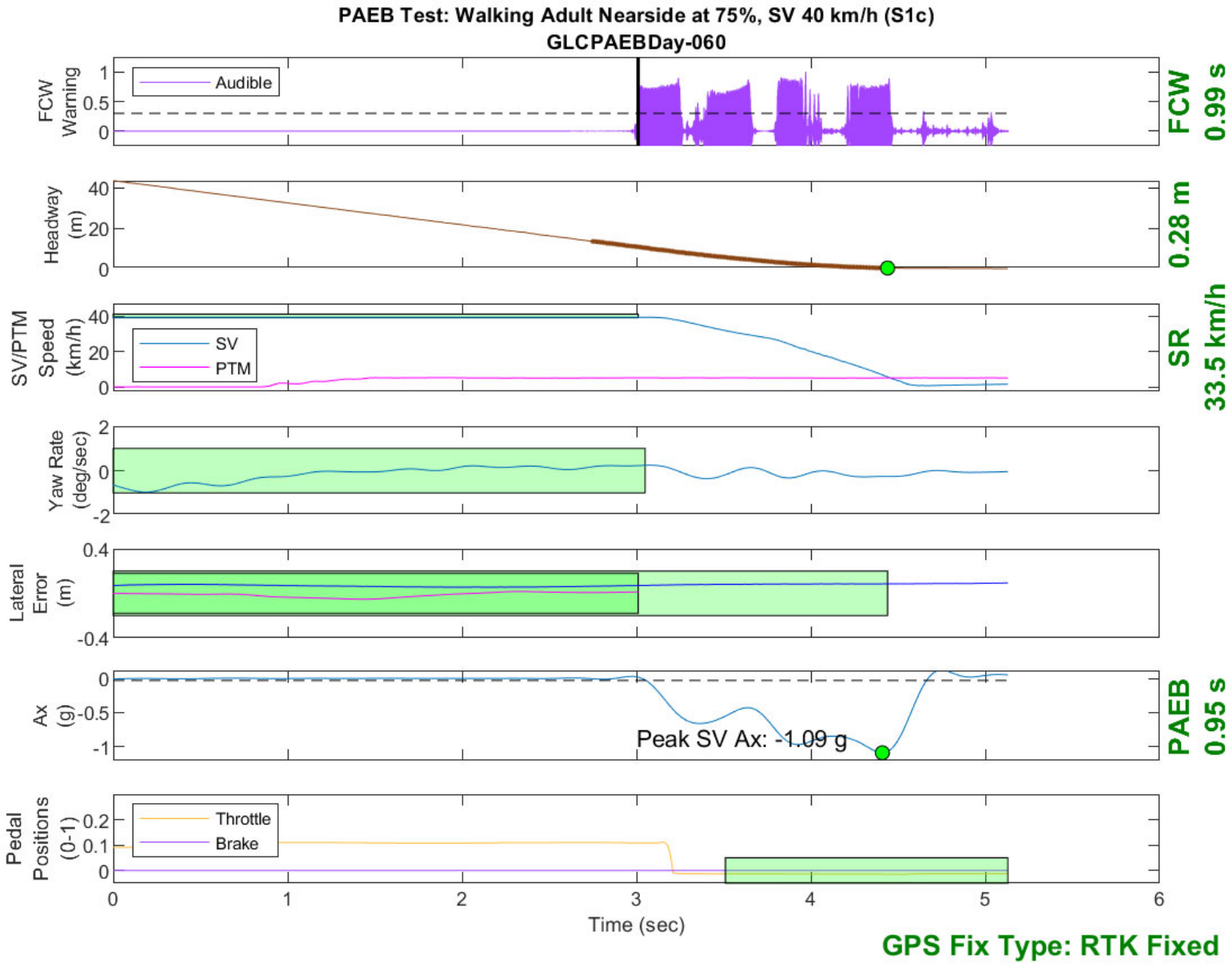

Figure D58. Time History for PAEB Run 60, S1c, Daytime, 40 km/h

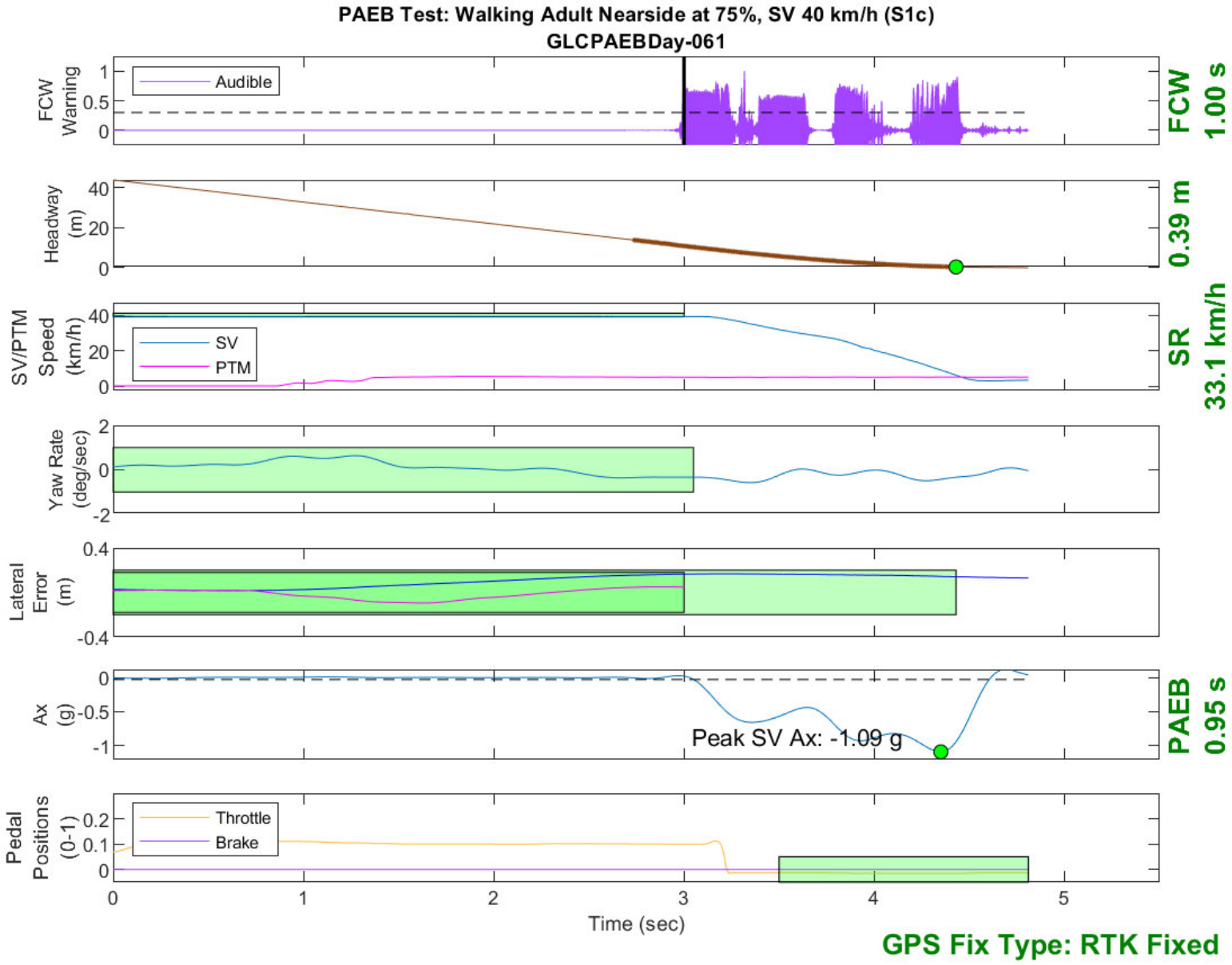

Figure D59. Time History for PAEB Run 61, S1c, Daytime, 40 km/h

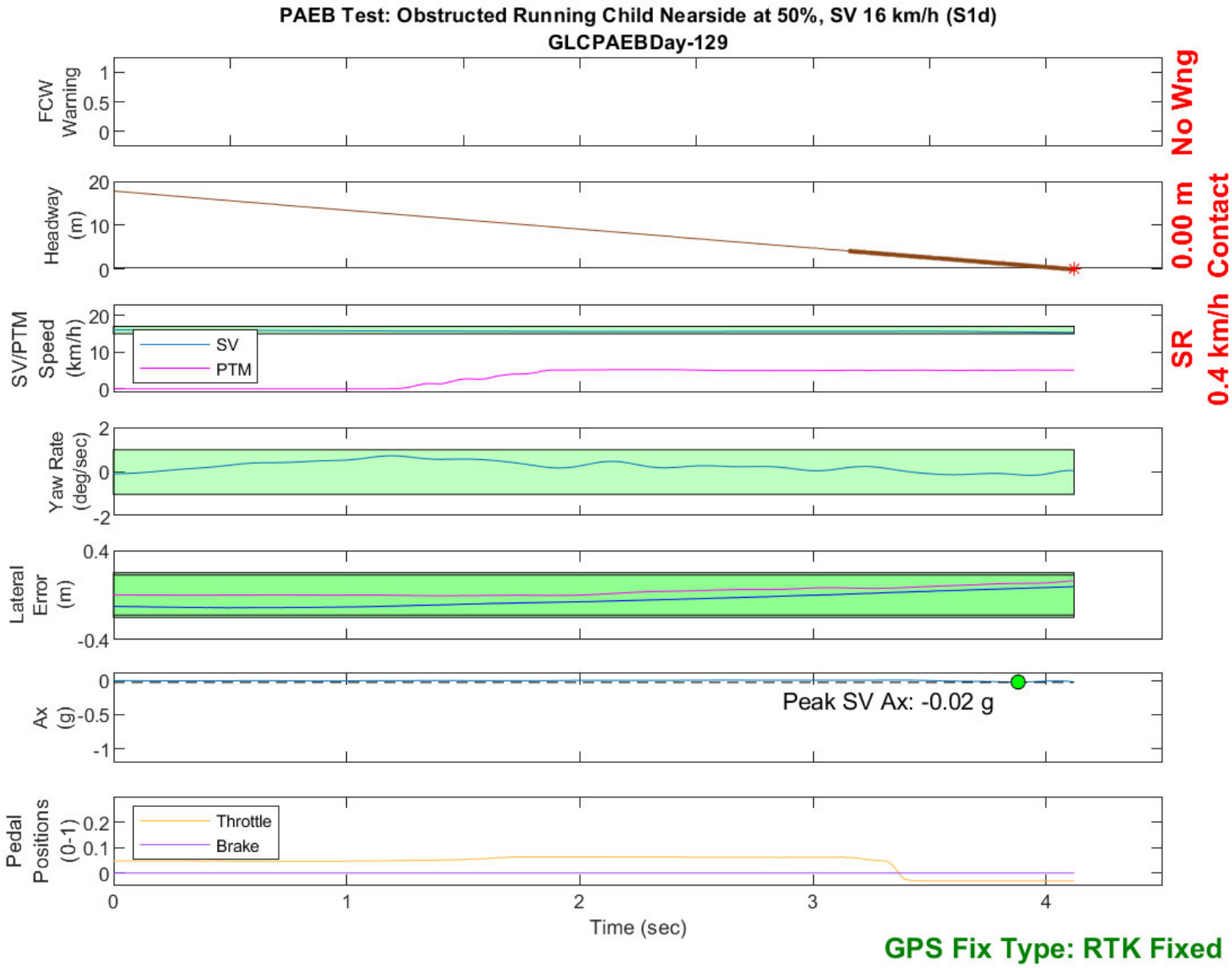

Figure D60. Time History for PAEB Run 129, S1d, Daytime, 16 km/h

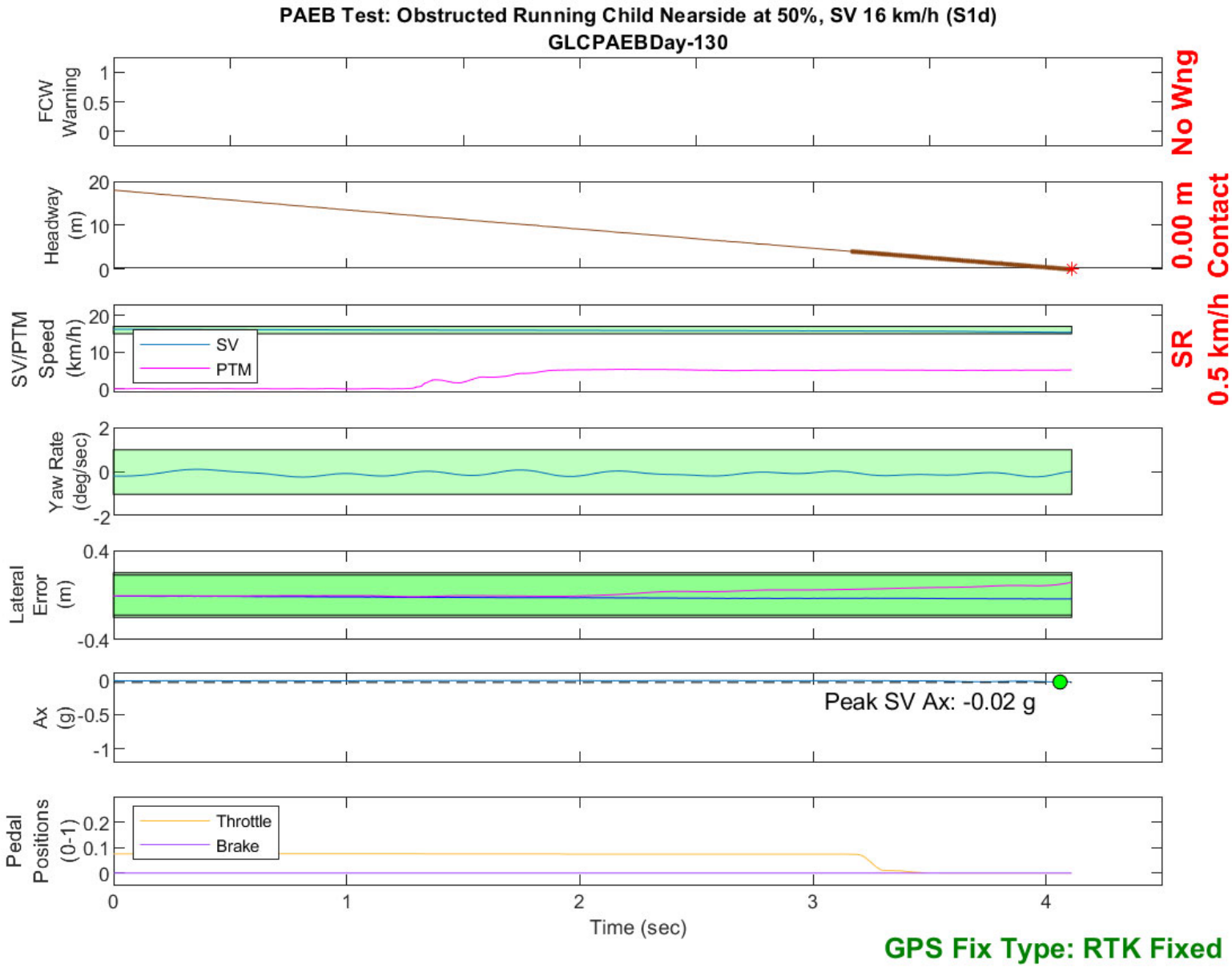

Figure D61. Time History for PAEB Run 130, S1d, Daytime, 16 km/h

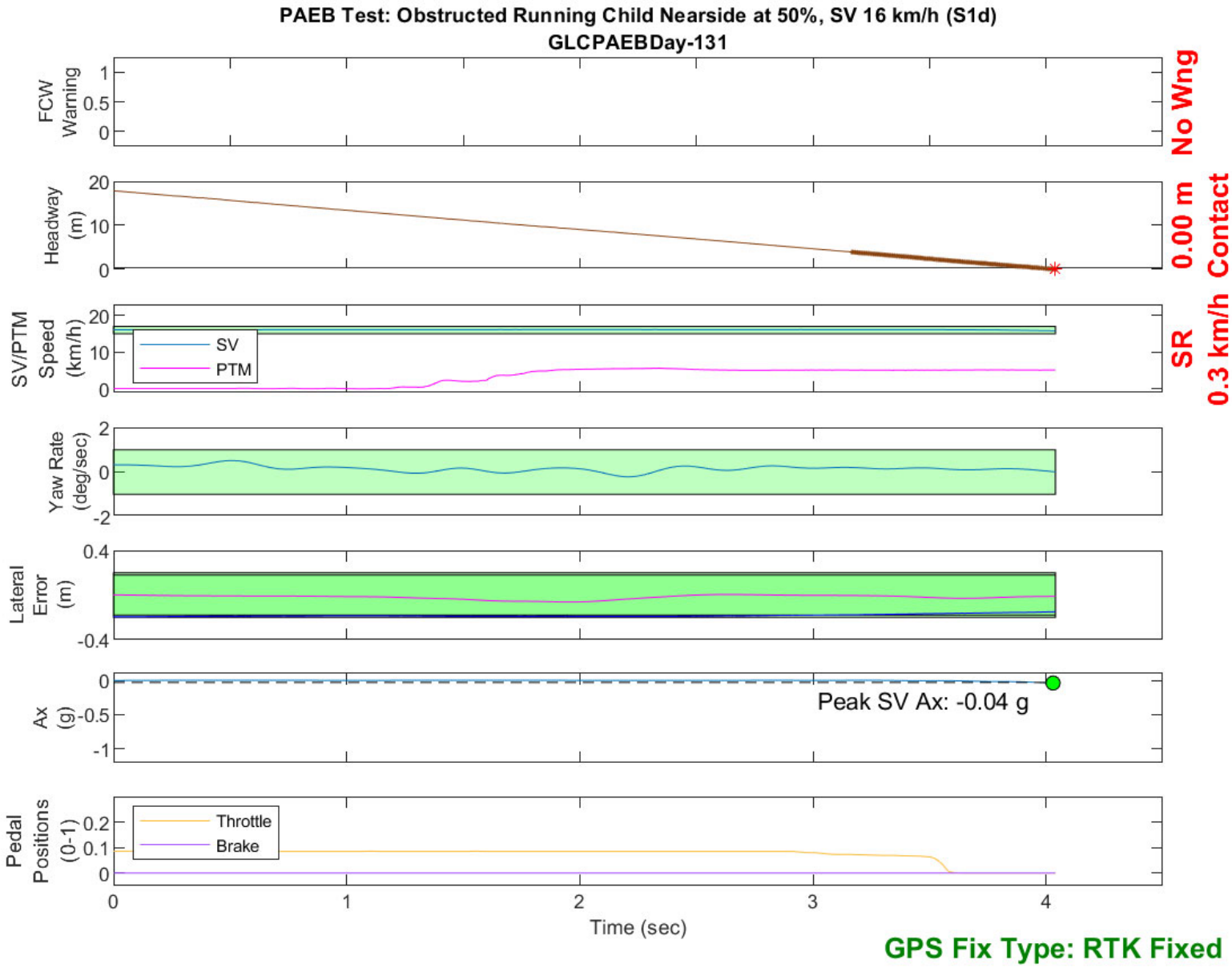

Figure D62. Time History for PAEB Run 131, S1d, Daytime, 16 km/h

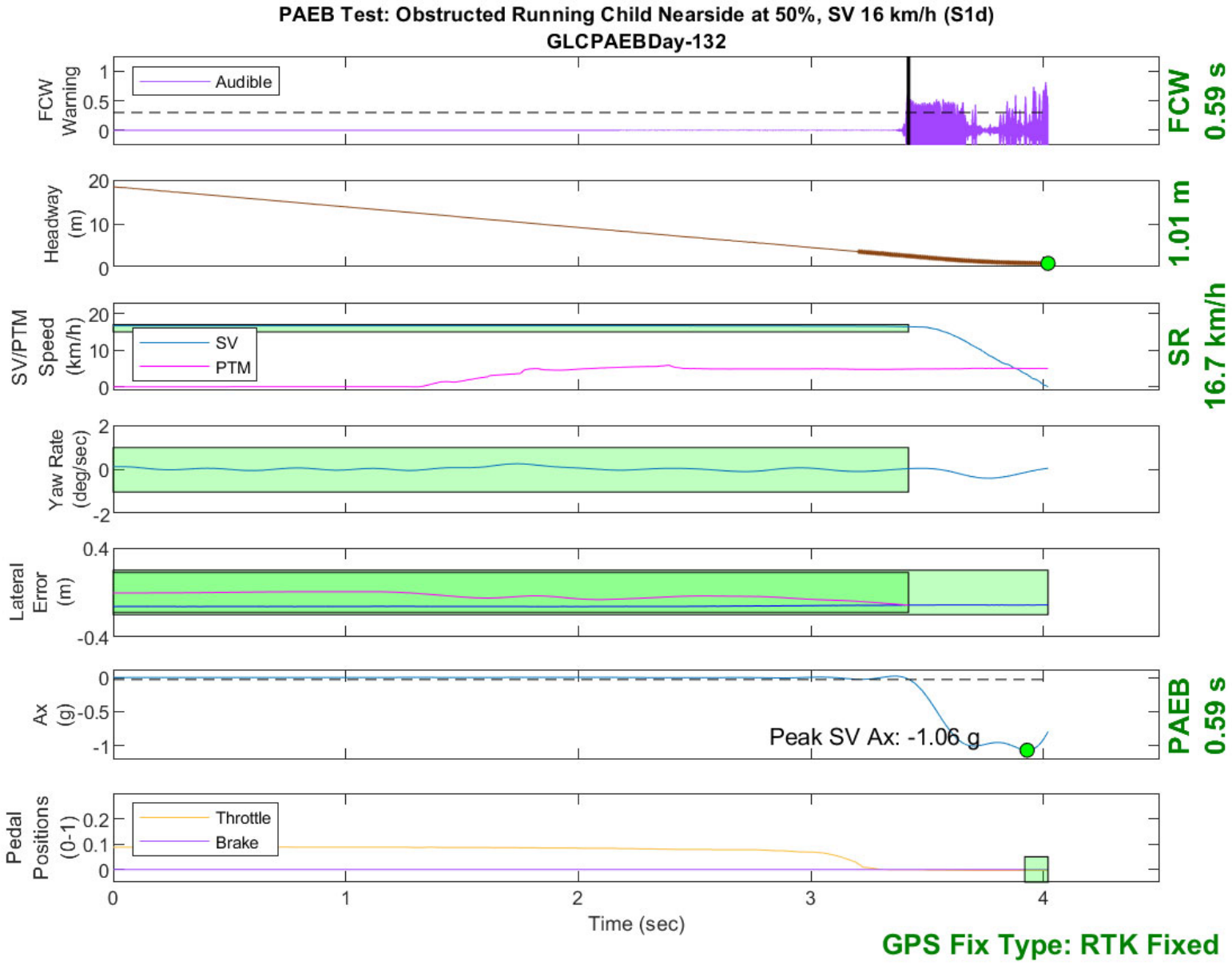

Figure D63. Time History for PAEB Run 132, S1d, Daytime, 16 km/h

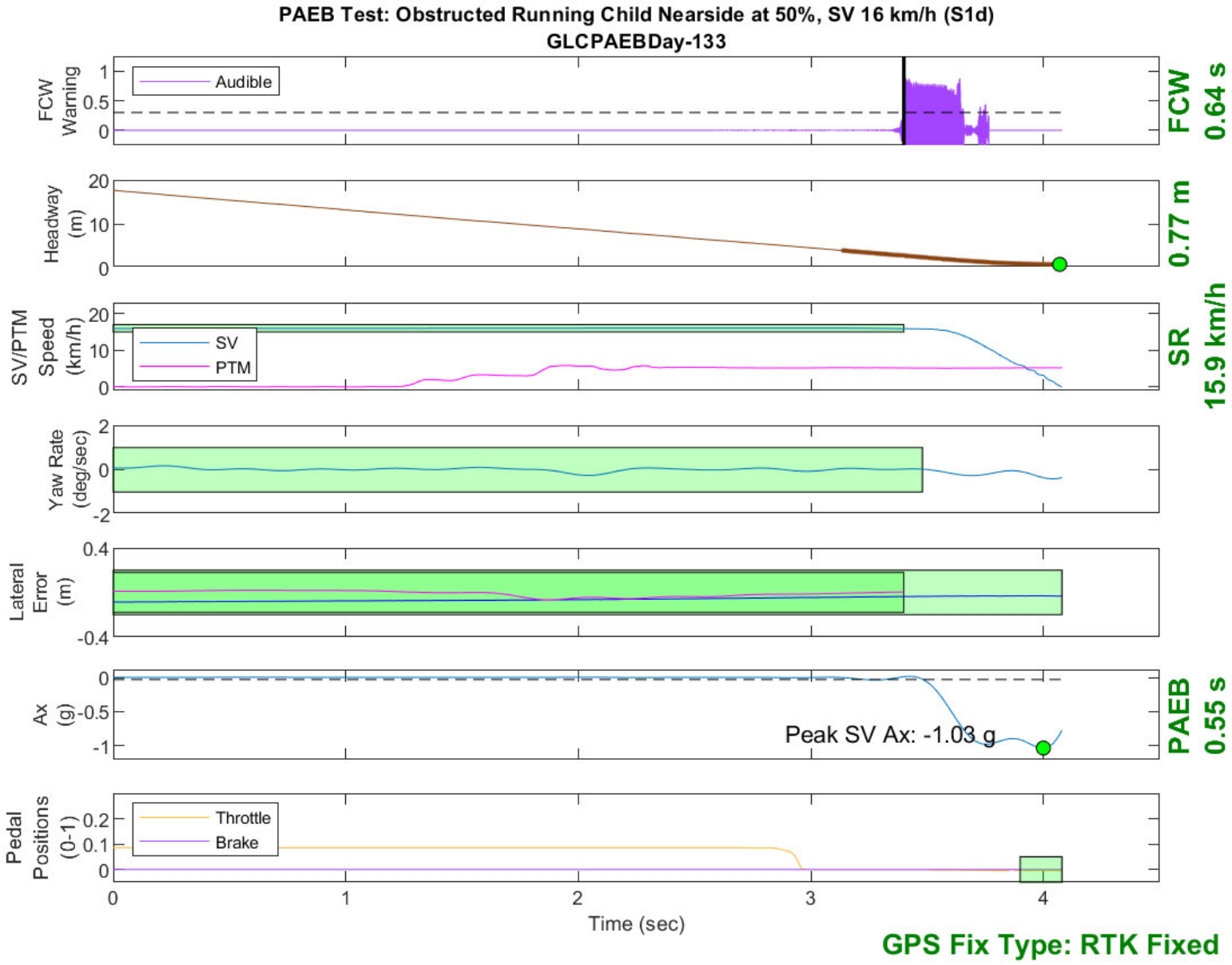

Figure D64. Time History for PAEB Run 133, S1d, Daytime, 16 km/h

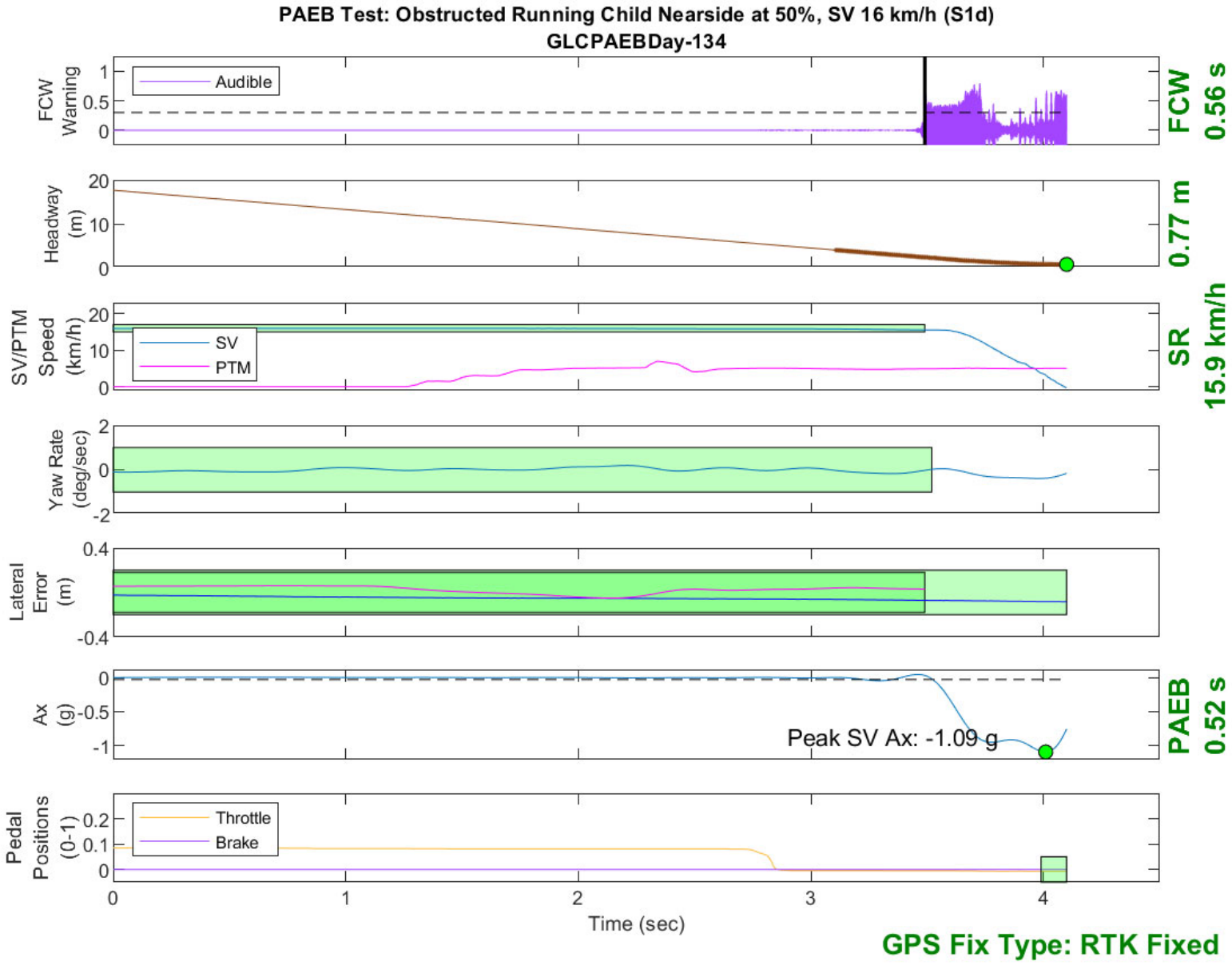

Figure D65. Time History for PAEB Run 134, S1d, Daytime, 16 km/h

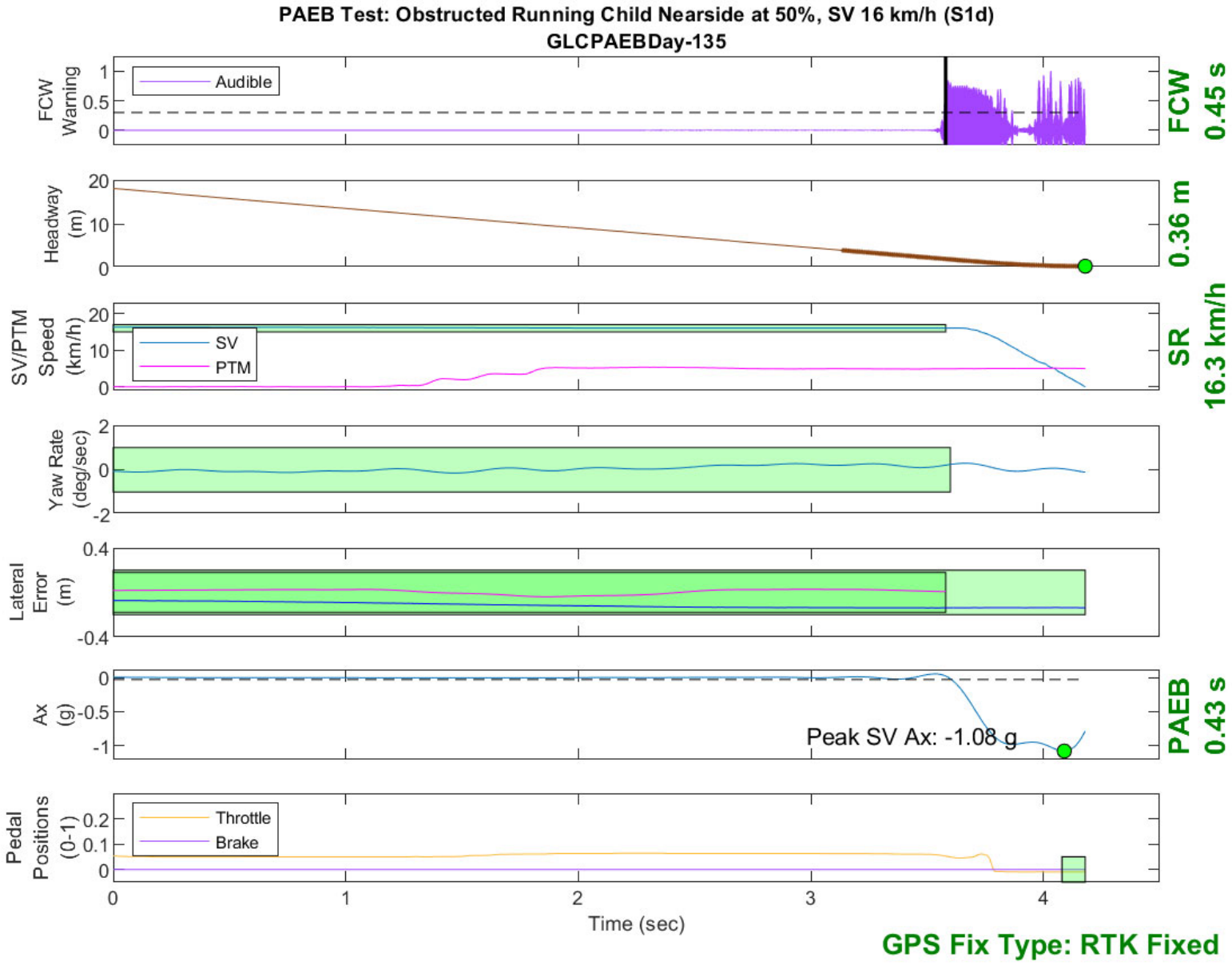

Figure D66. Time History for PAEB Run 135, S1d, Daytime, 16 km/h

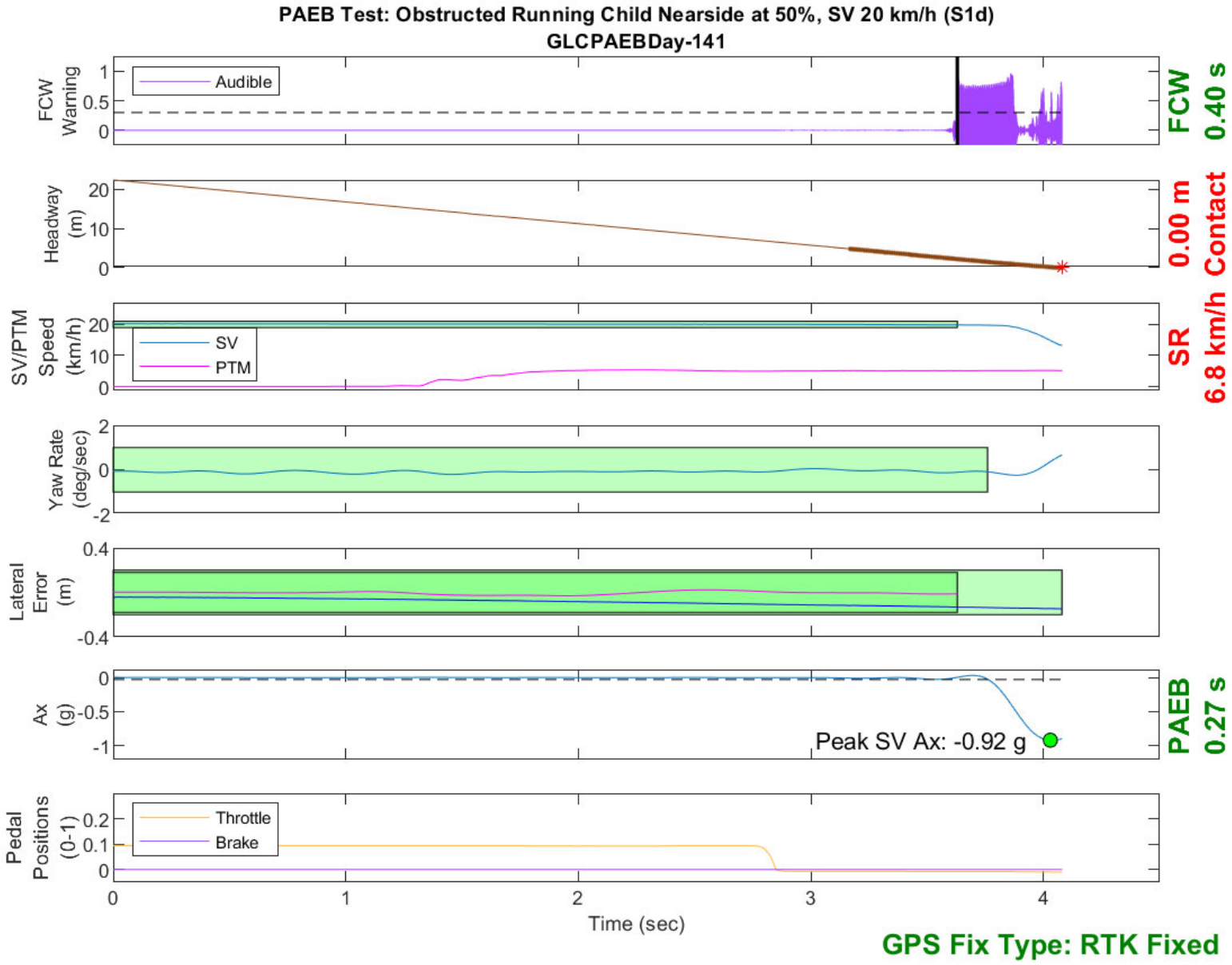

Figure D67. Time History for PAEB Run 141, S1d, Daytime, 20 km/h

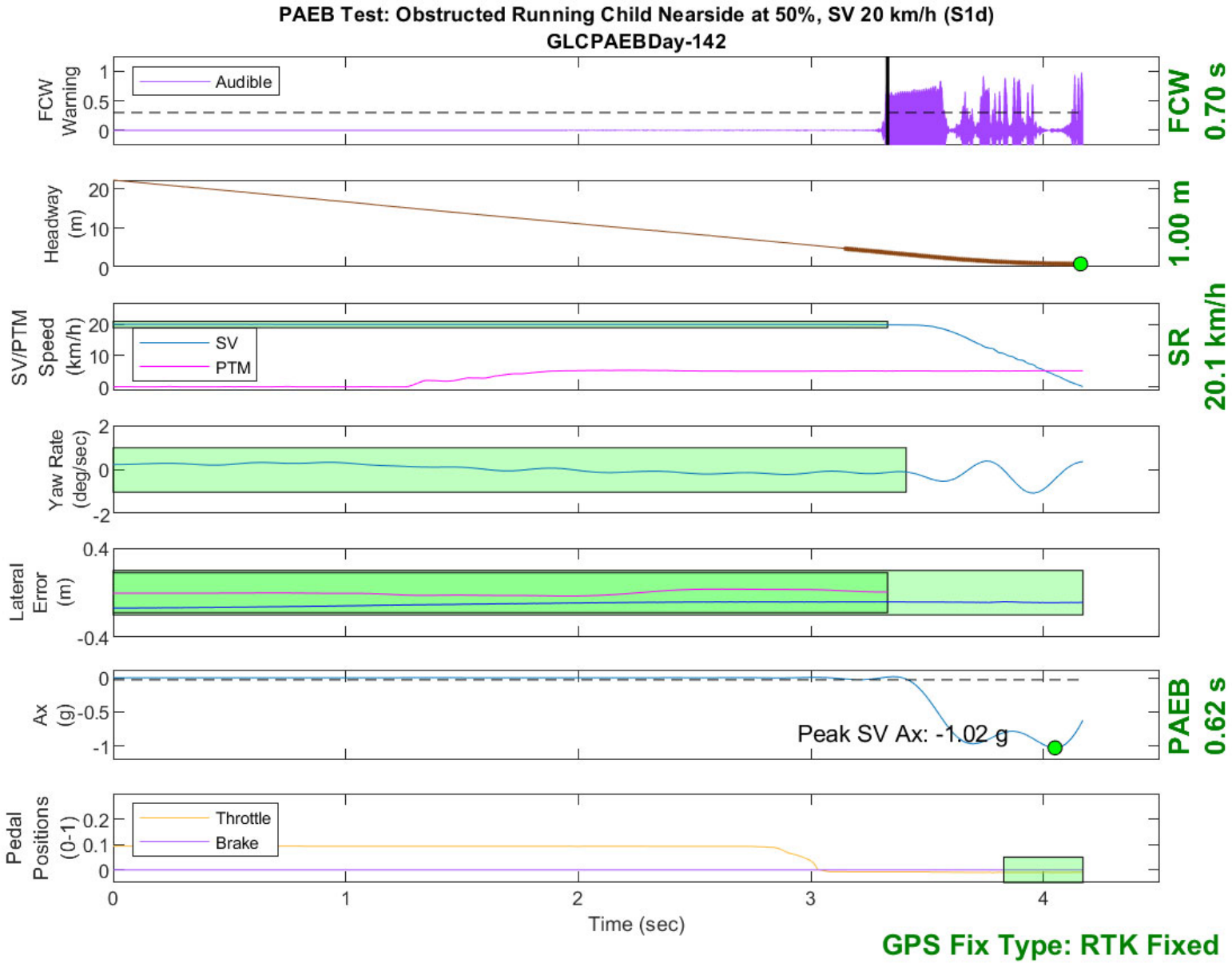

Figure D68. Time History for PAEB Run 142, S1d, Daytime, 20 km/h

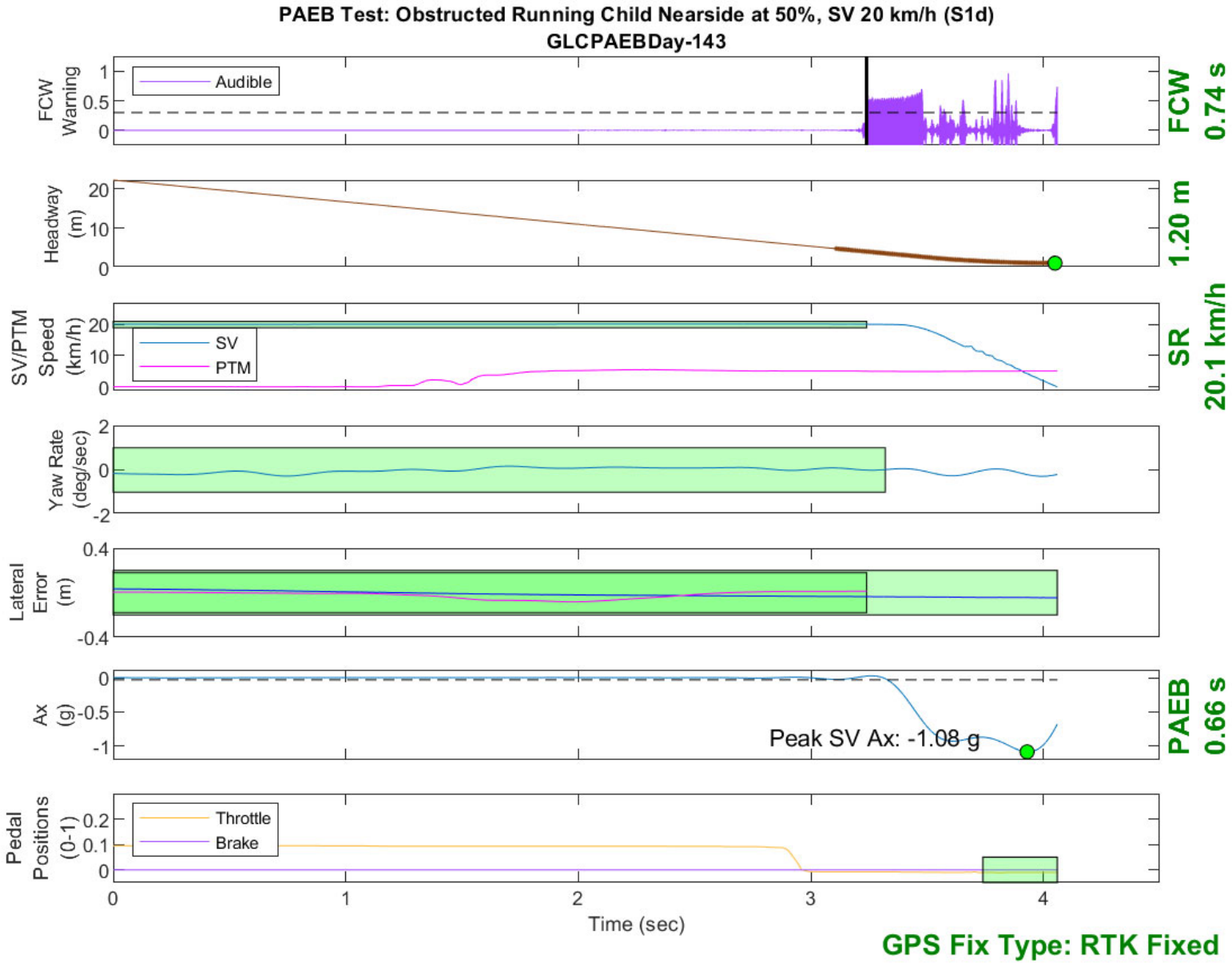

Figure D69. Time History for PAEB Run 143, S1d, Daytime, 20 km/h

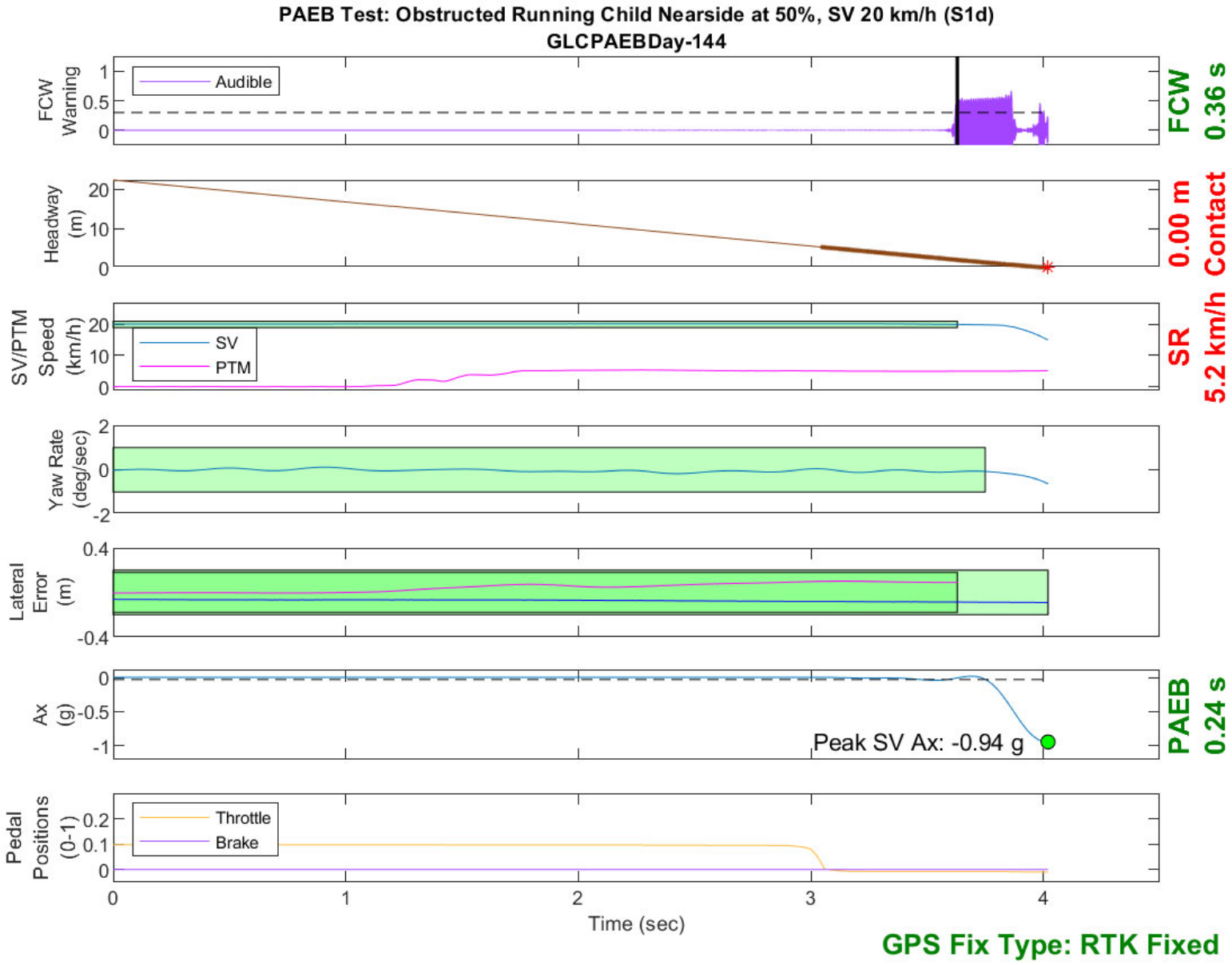

Figure D70. Time History for PAEB Run 144, S1d, Daytime, 20 km/h

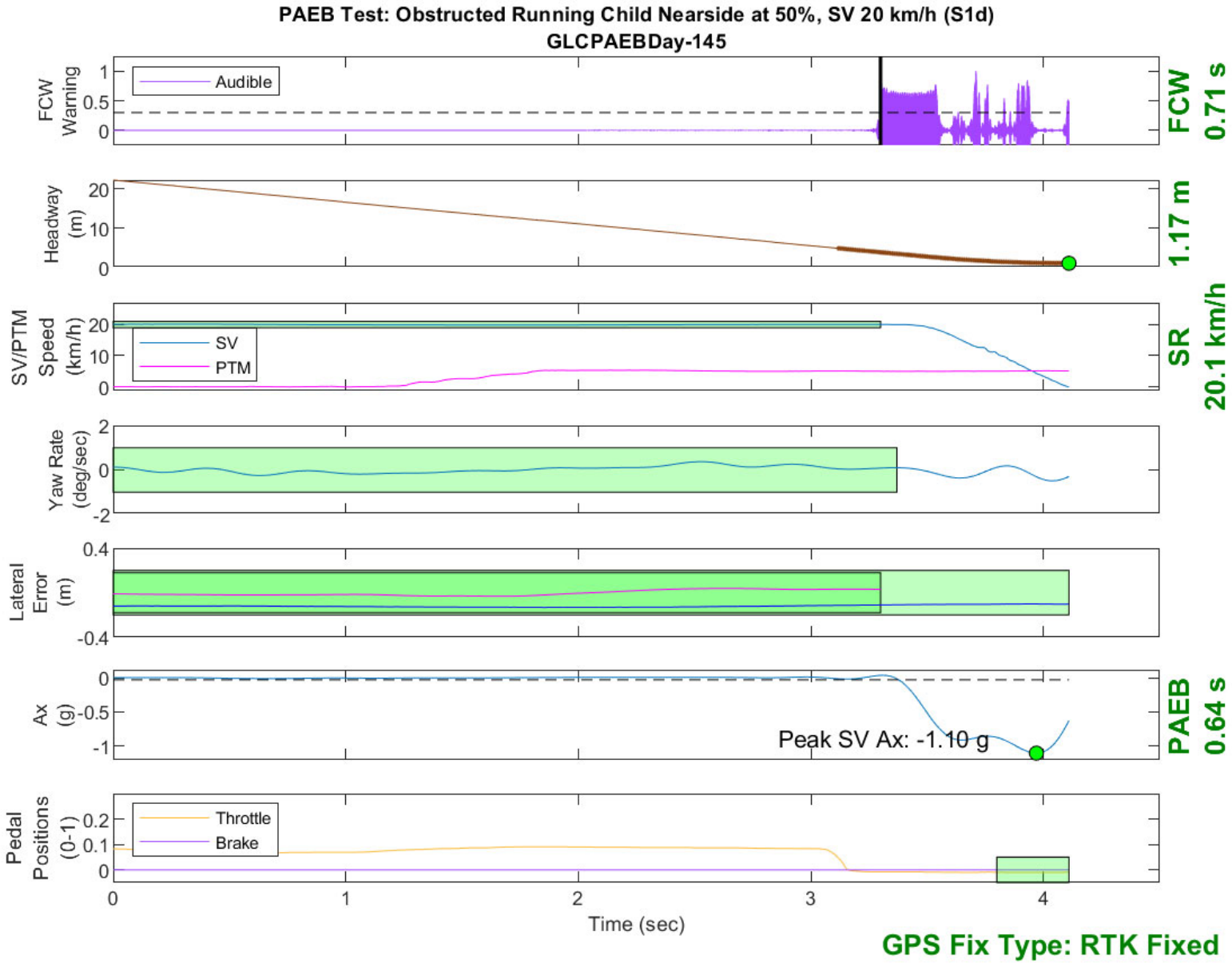

Figure D71. Time History for PAEB Run 145, S1d, Daytime, 20 km/h

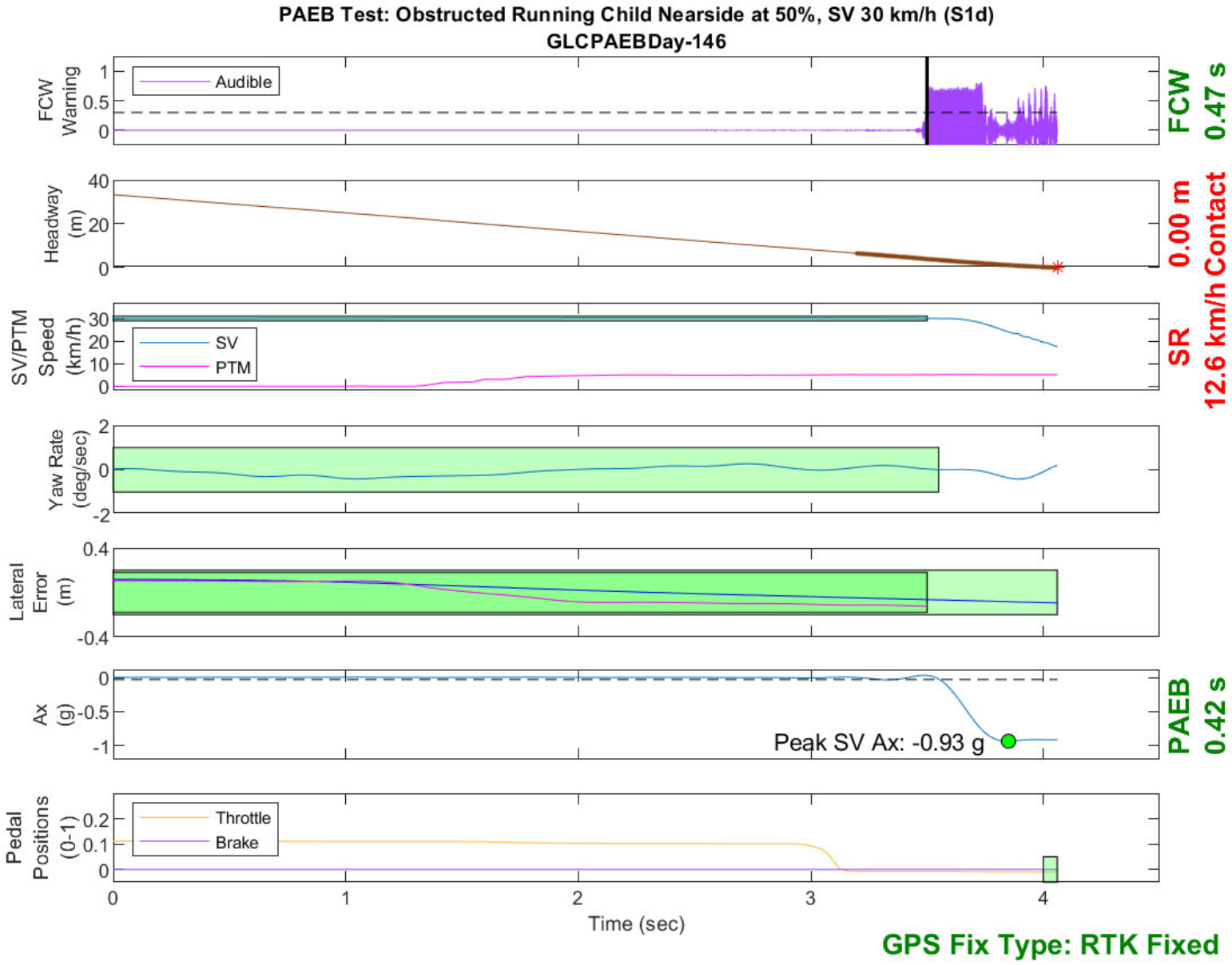

Figure D72. Time History for PAEB Run 146, S1d, Daytime, 30 km/h

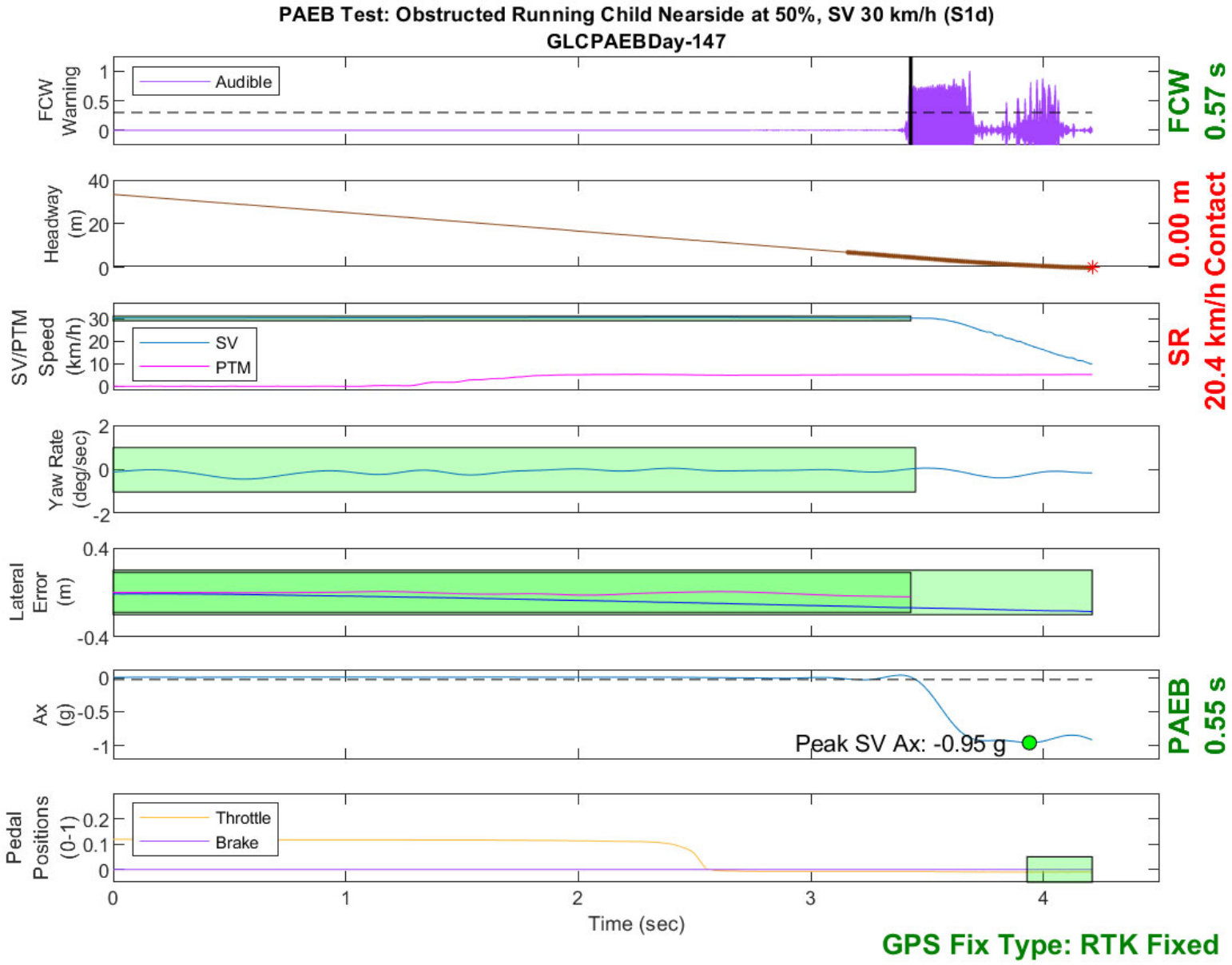

Figure D73. Time History for PAEB Run 147, S1d, Daytime, 30 km/h

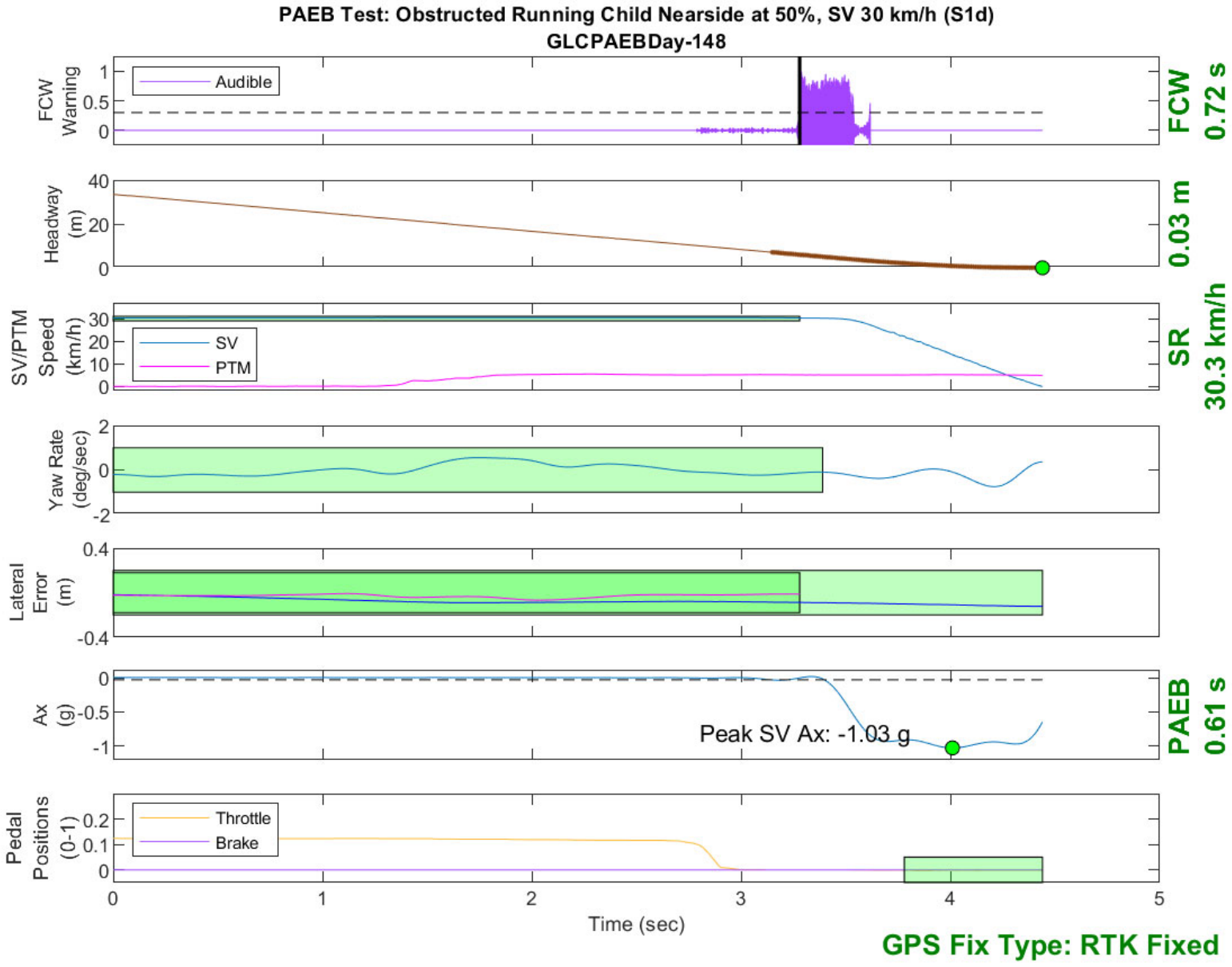

Figure D74. Time History for PAEB Run 148, S1d, Daytime, 30 km/h

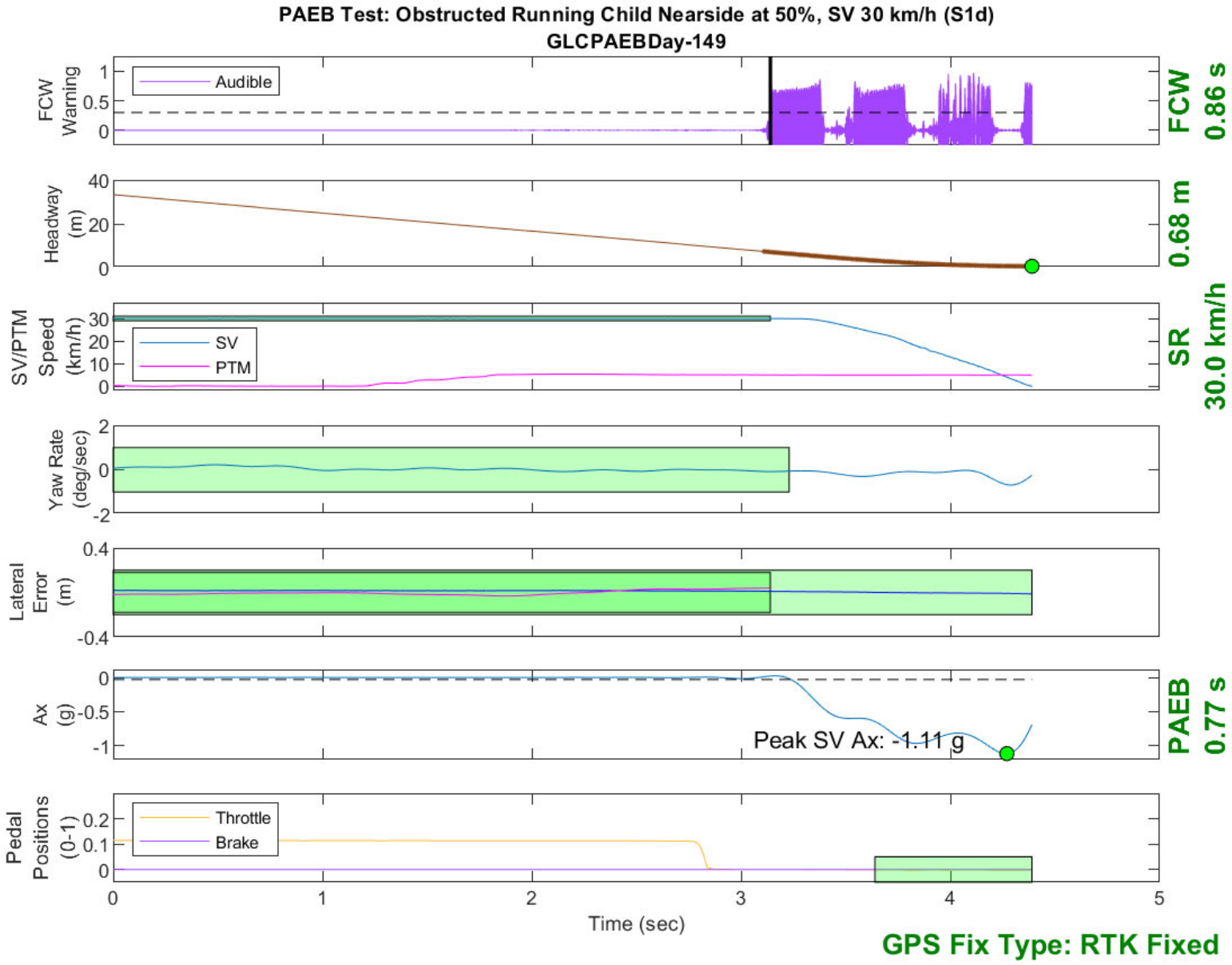

Figure D75. Time History for PAEB Run 149, S1d, Daytime, 30 km/h

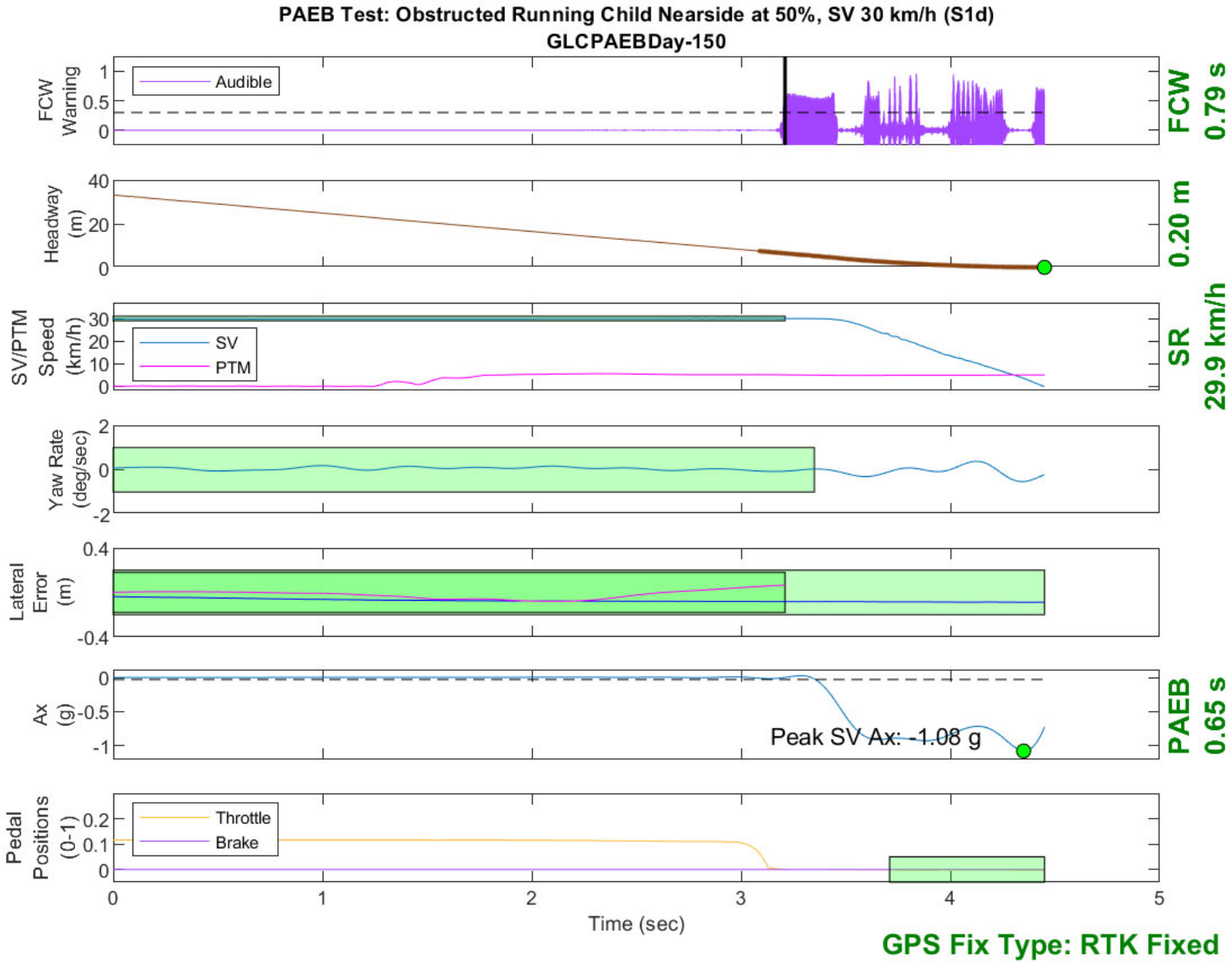

Figure D76. Time History for PAEB Run 150, S1d, Daytime, 30 km/h

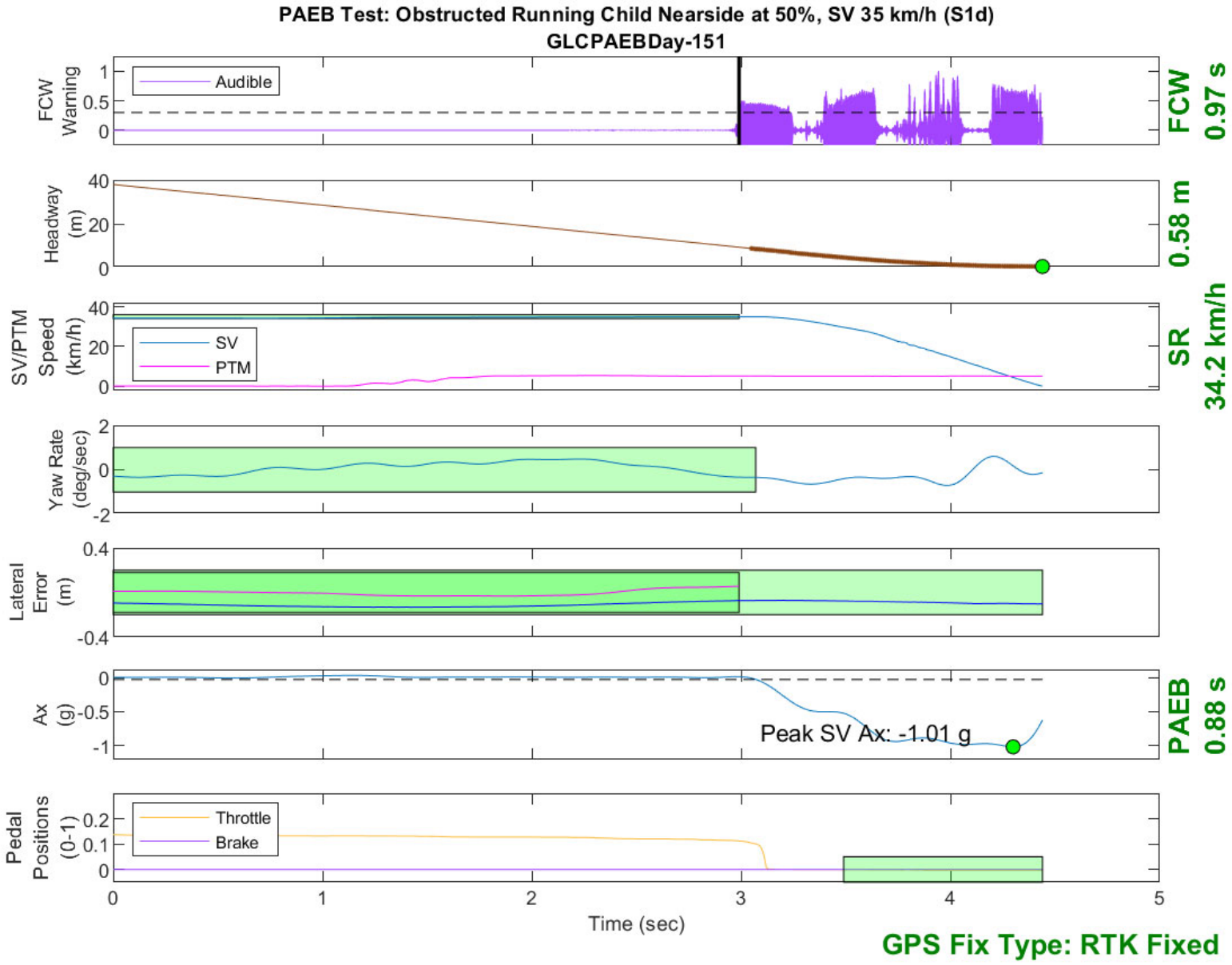

Figure D77. Time History for PAEB Run 151, S1d, Daytime, 35 km/h

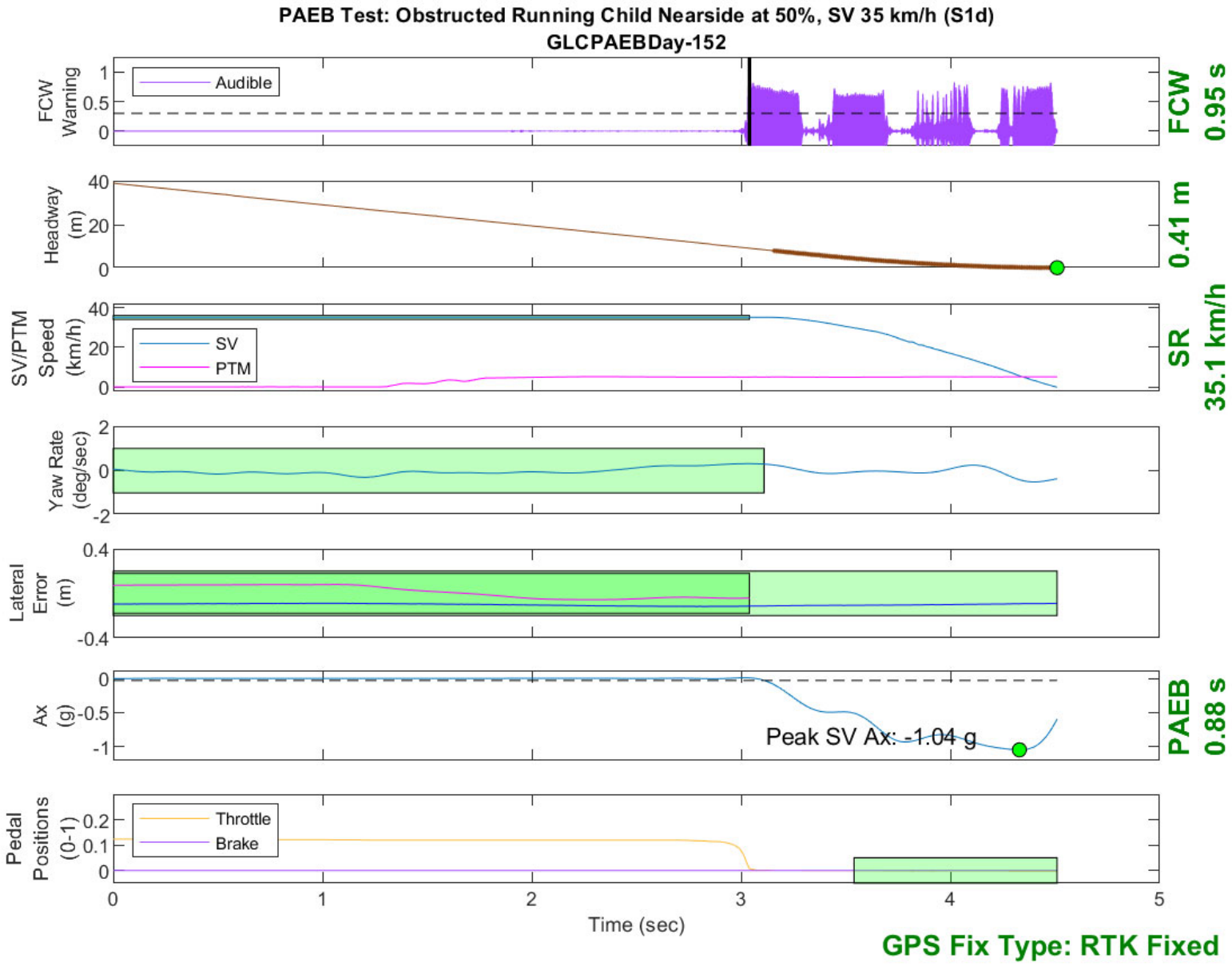

Figure D78. Time History for PAEB Run 152, S1d, Daytime, 35 km/h

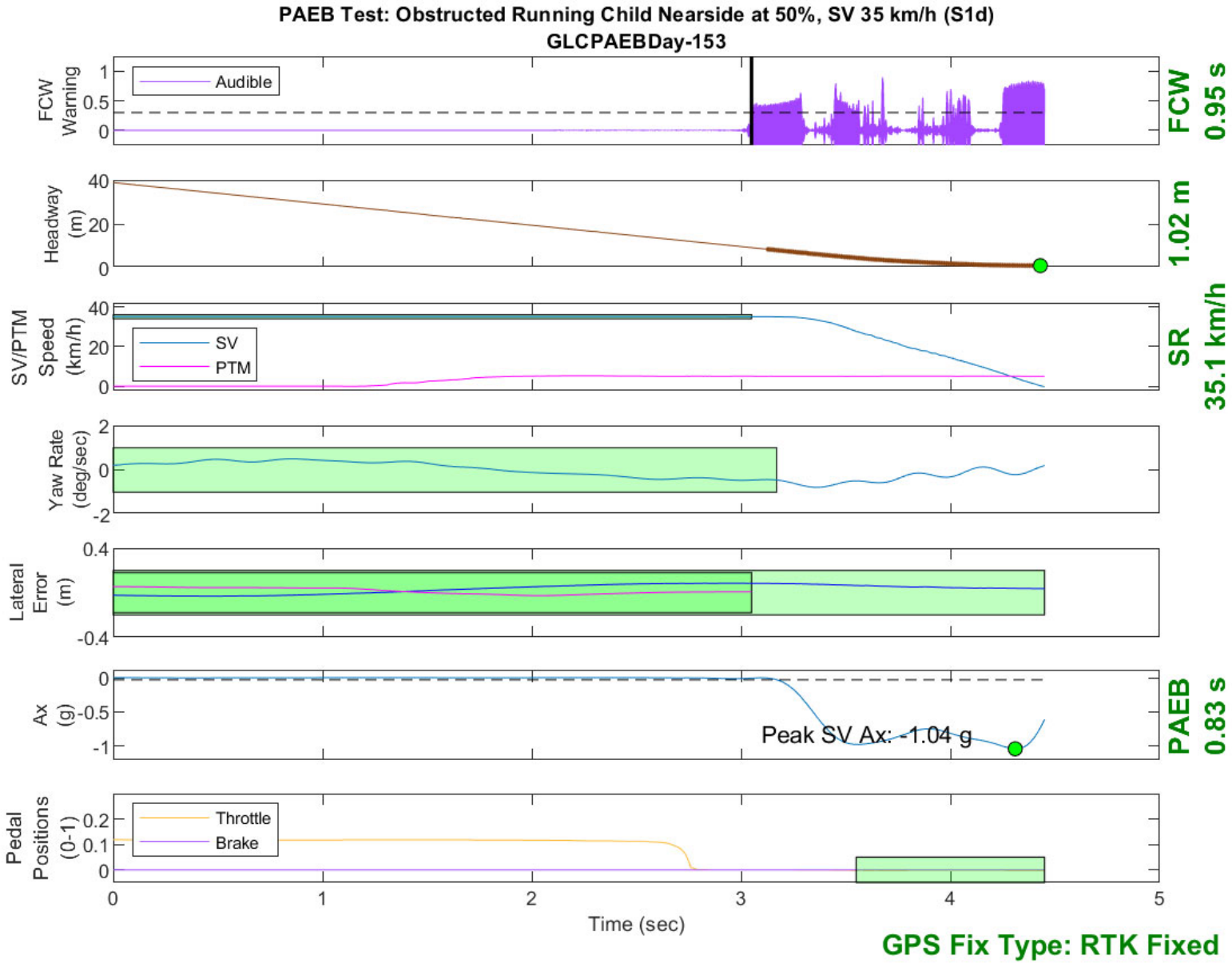

Figure D79. Time History for PAEB Run 153, S1d, Daytime, 35 km/h

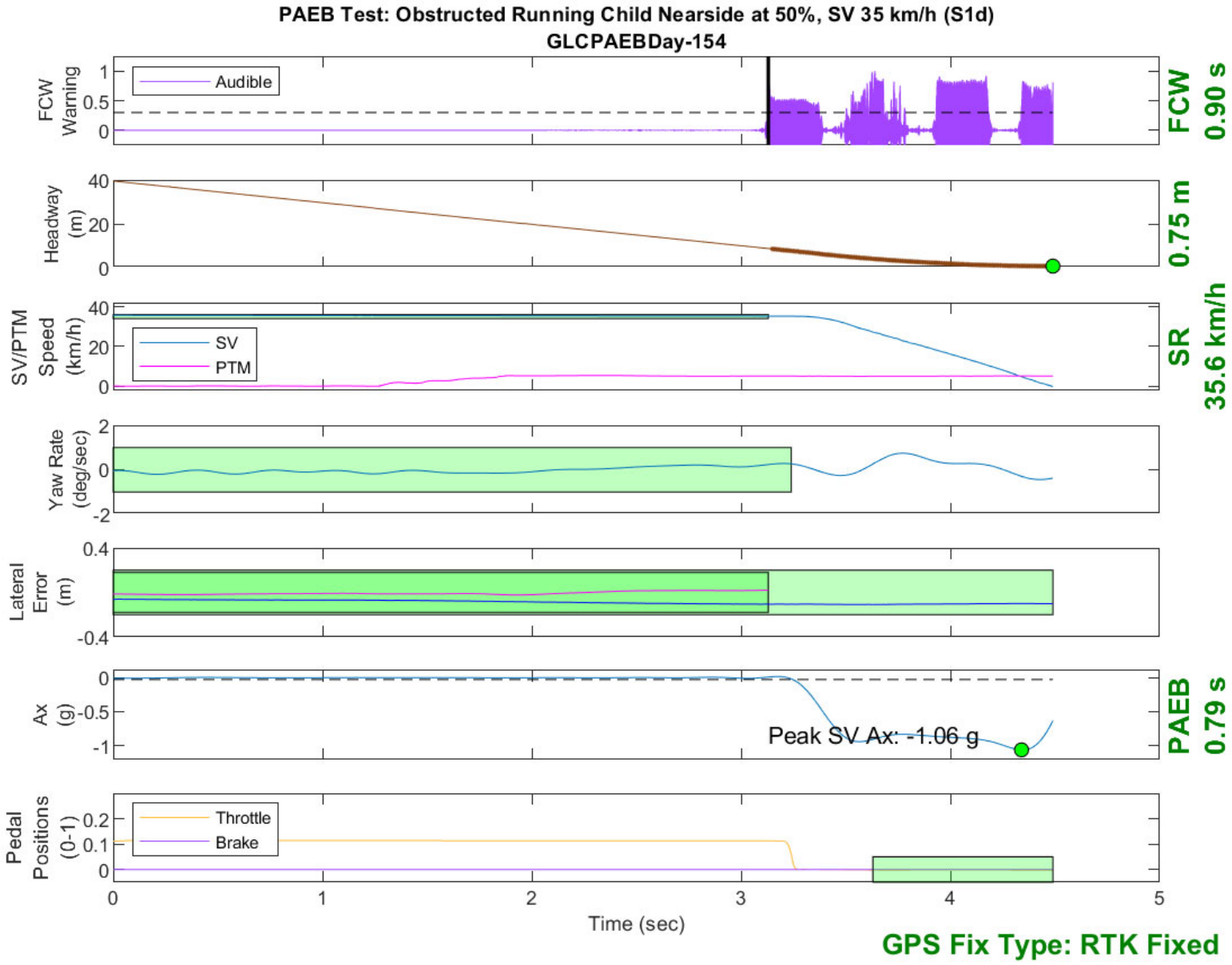

Figure D80. Time History for PAEB Run 154, S1d, Daytime, 35 km/h

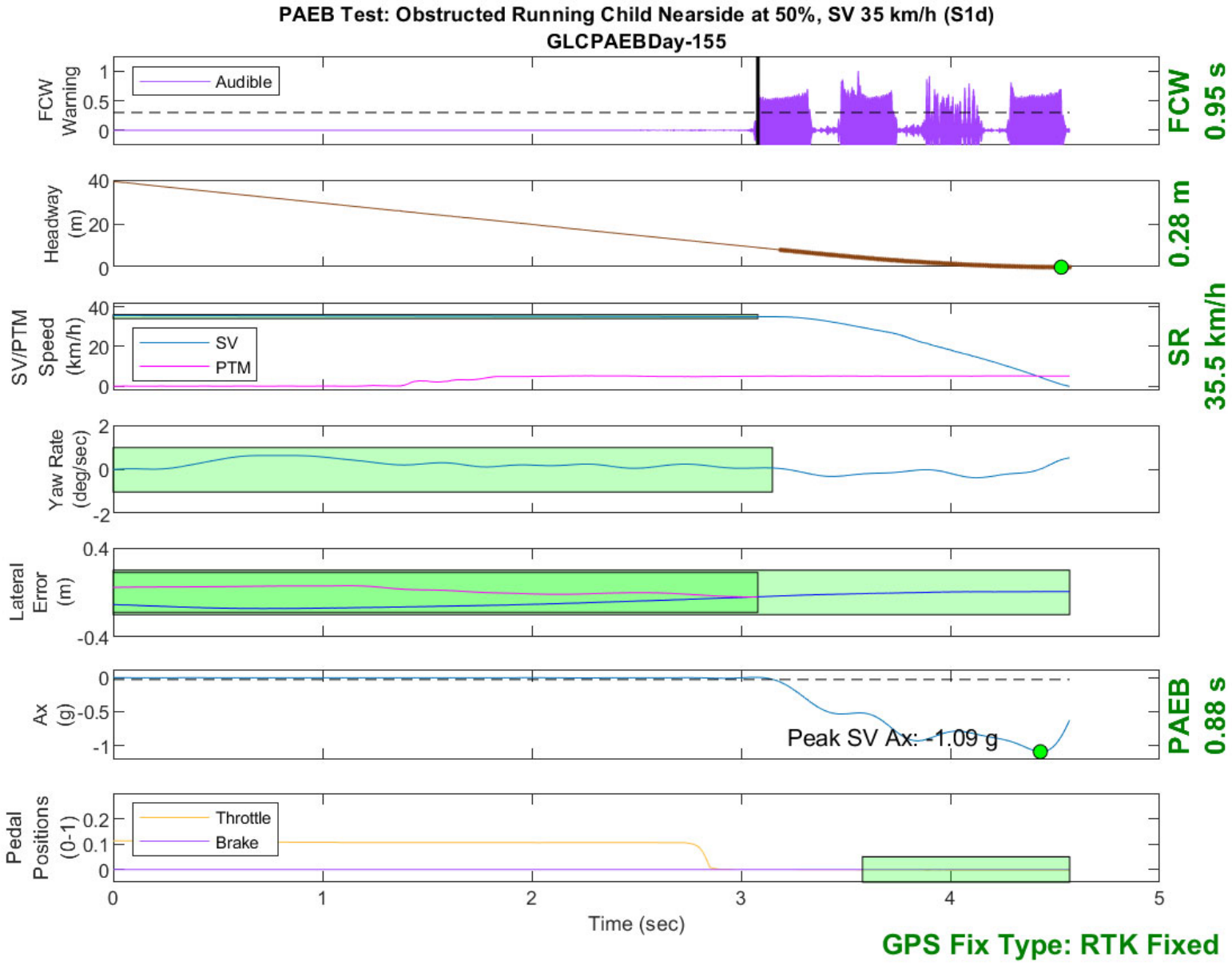

Figure D81. Time History for PAEB Run 155, S1d, Daytime, 35 km/h

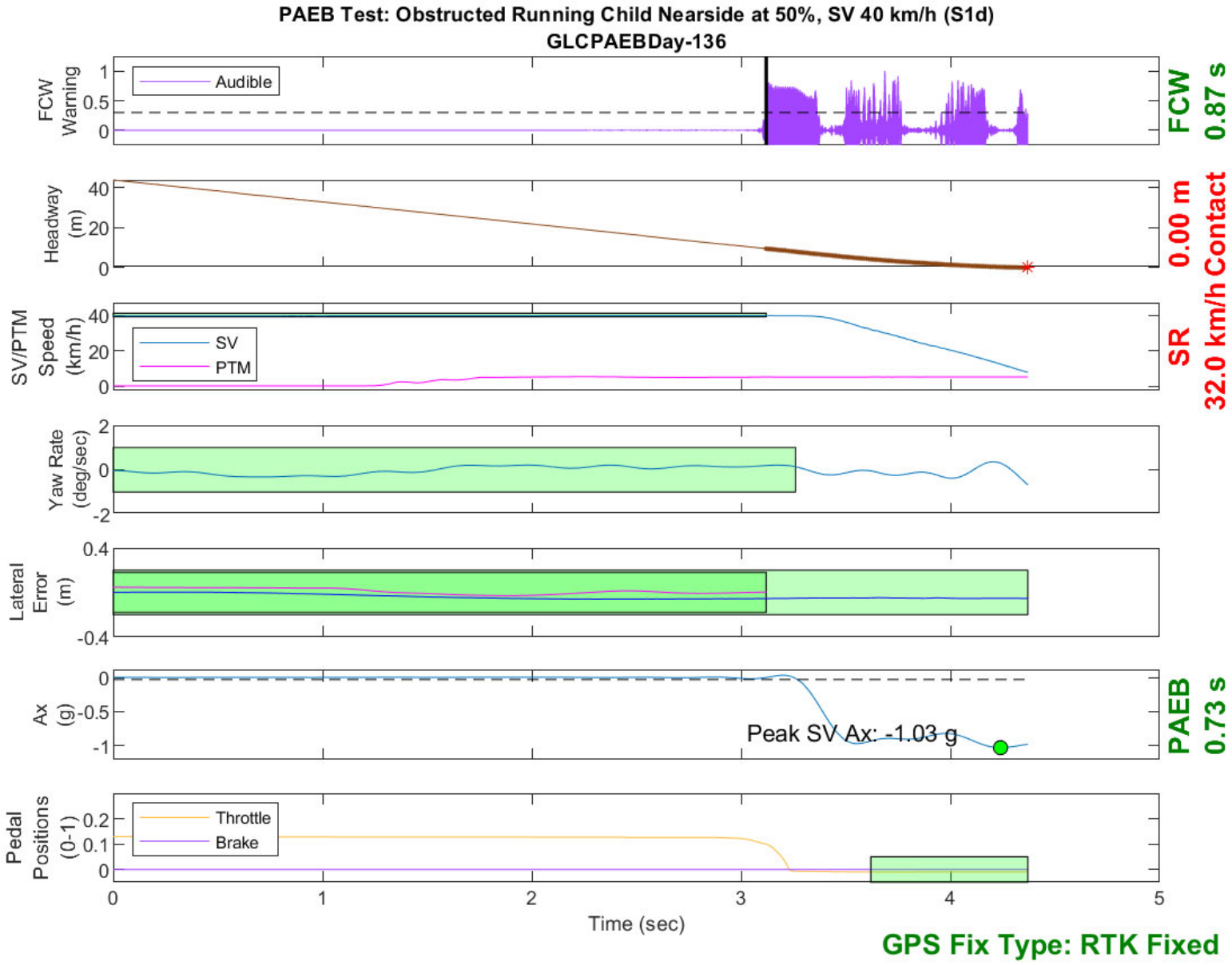

Figure D82. Time History for PAEB Run 136, S1d, Daytime, 40 km/h

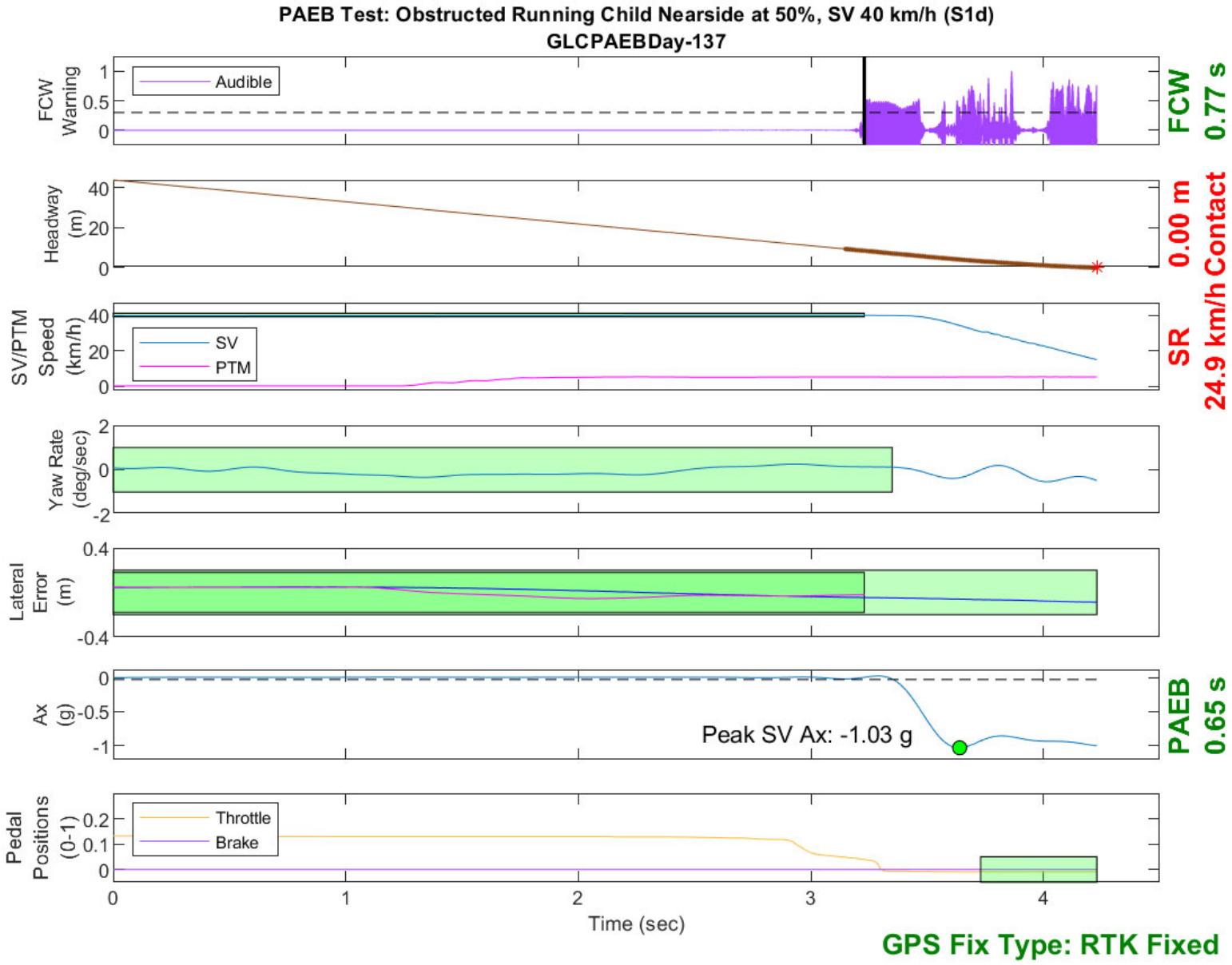

Figure D83. Time History for PAEB Run 137, S1d, Daytime, 40 km/h

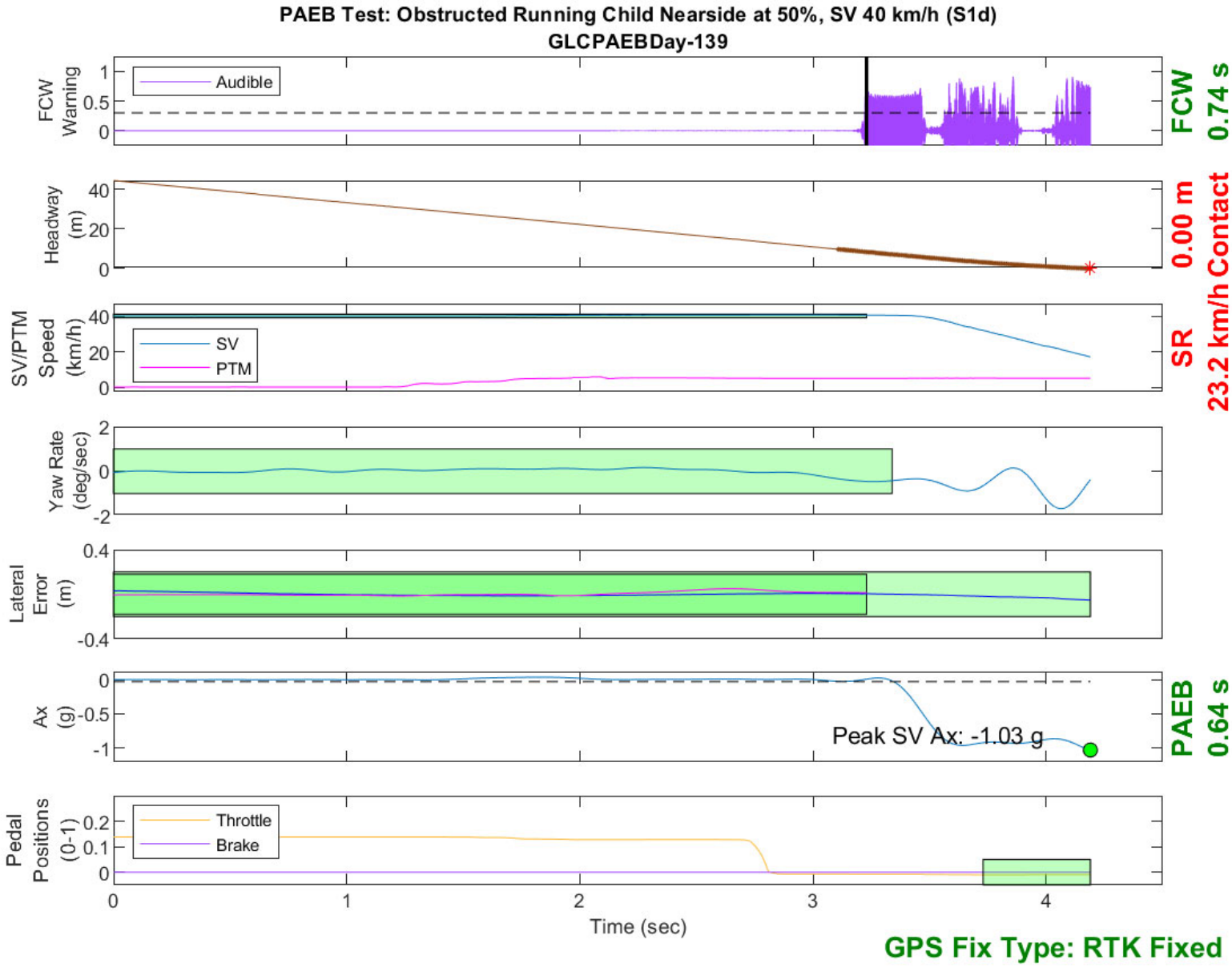

Figure D84. Time History for PAEB Run 139, S1d, Daytime, 40 km/h

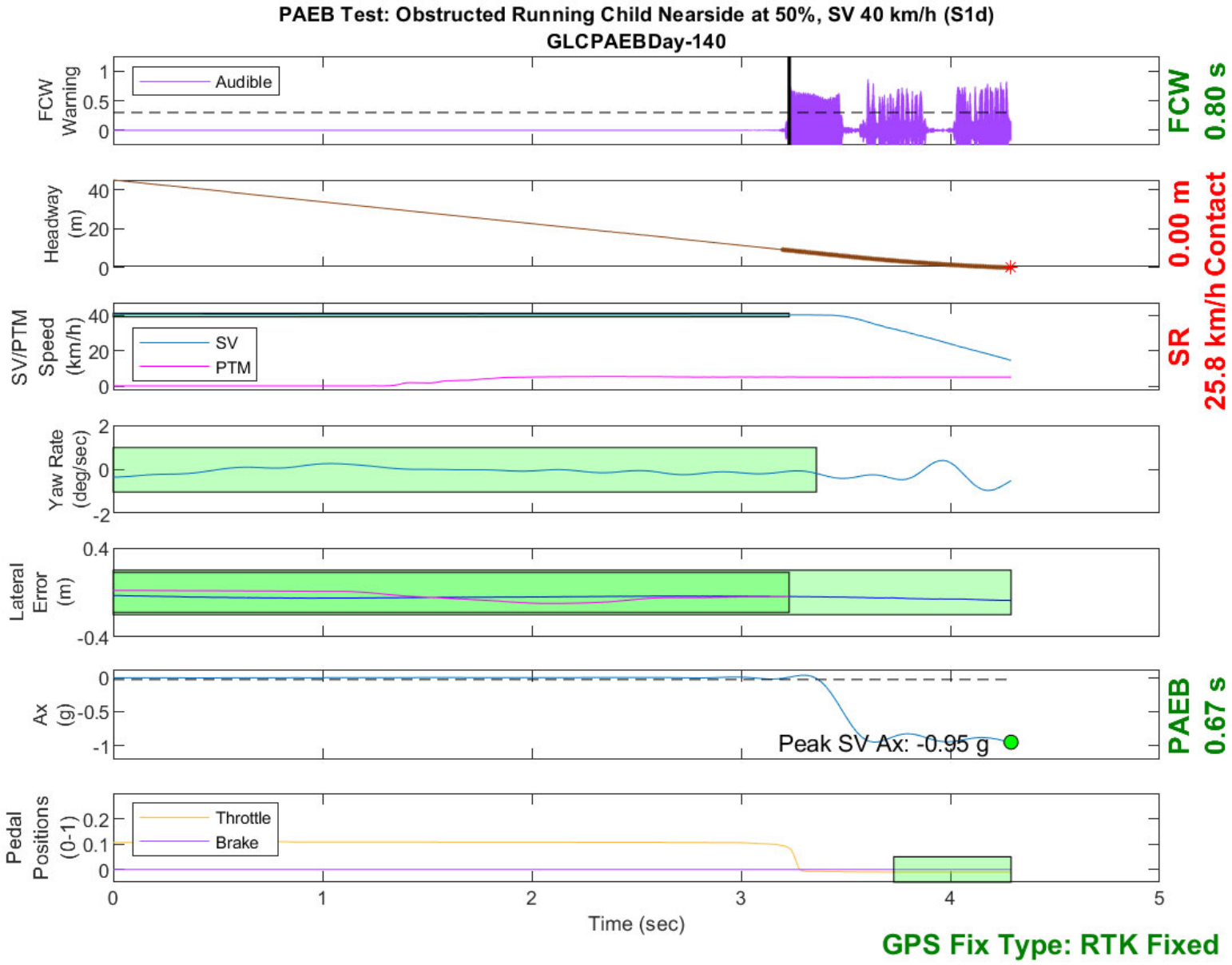

Figure D85. Time History for PAEB Run 140, S1d, Daytime, 40 km/h

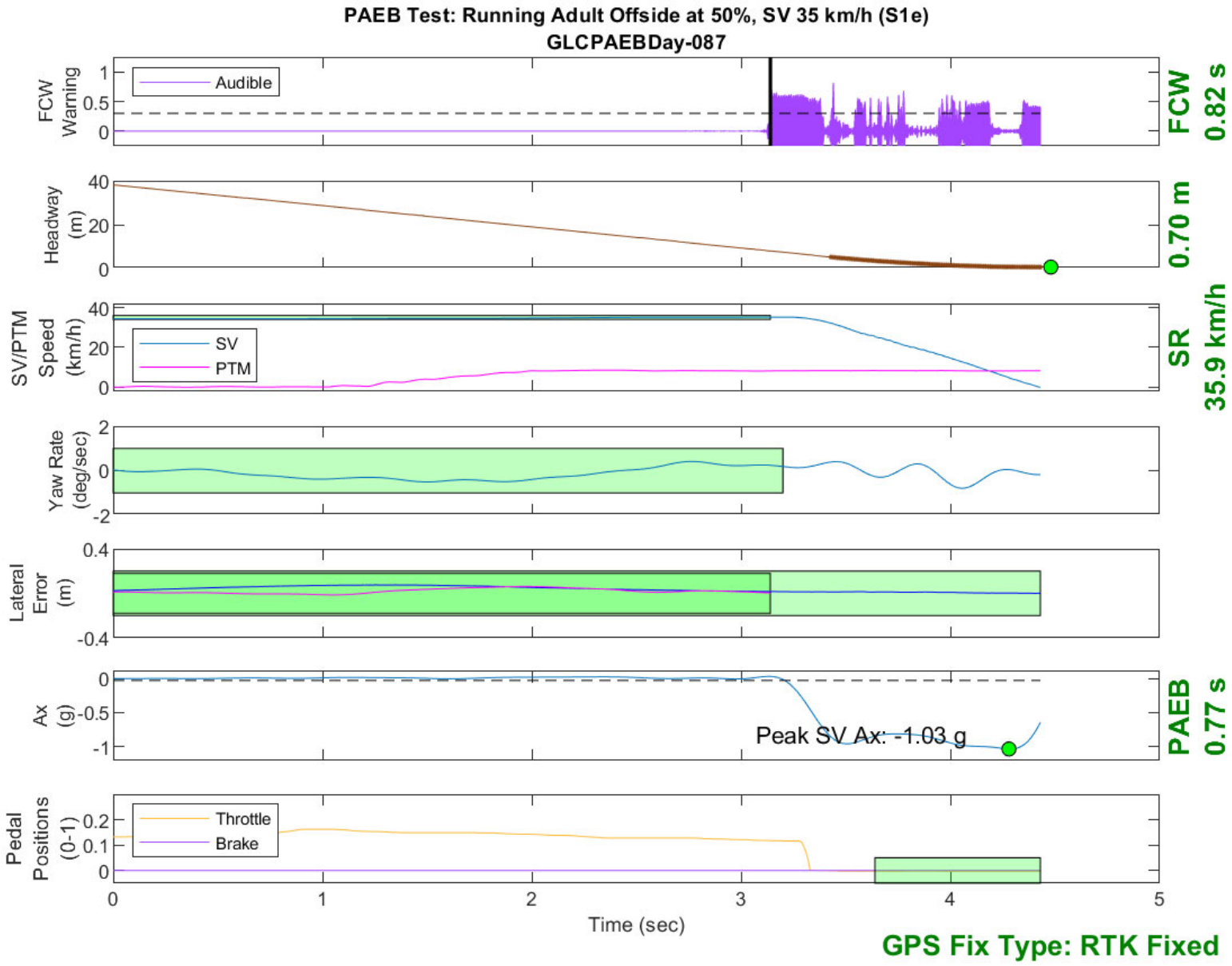

Figure D86. Time History for PAEB Run 87, S1e, Daytime, 35 km/h

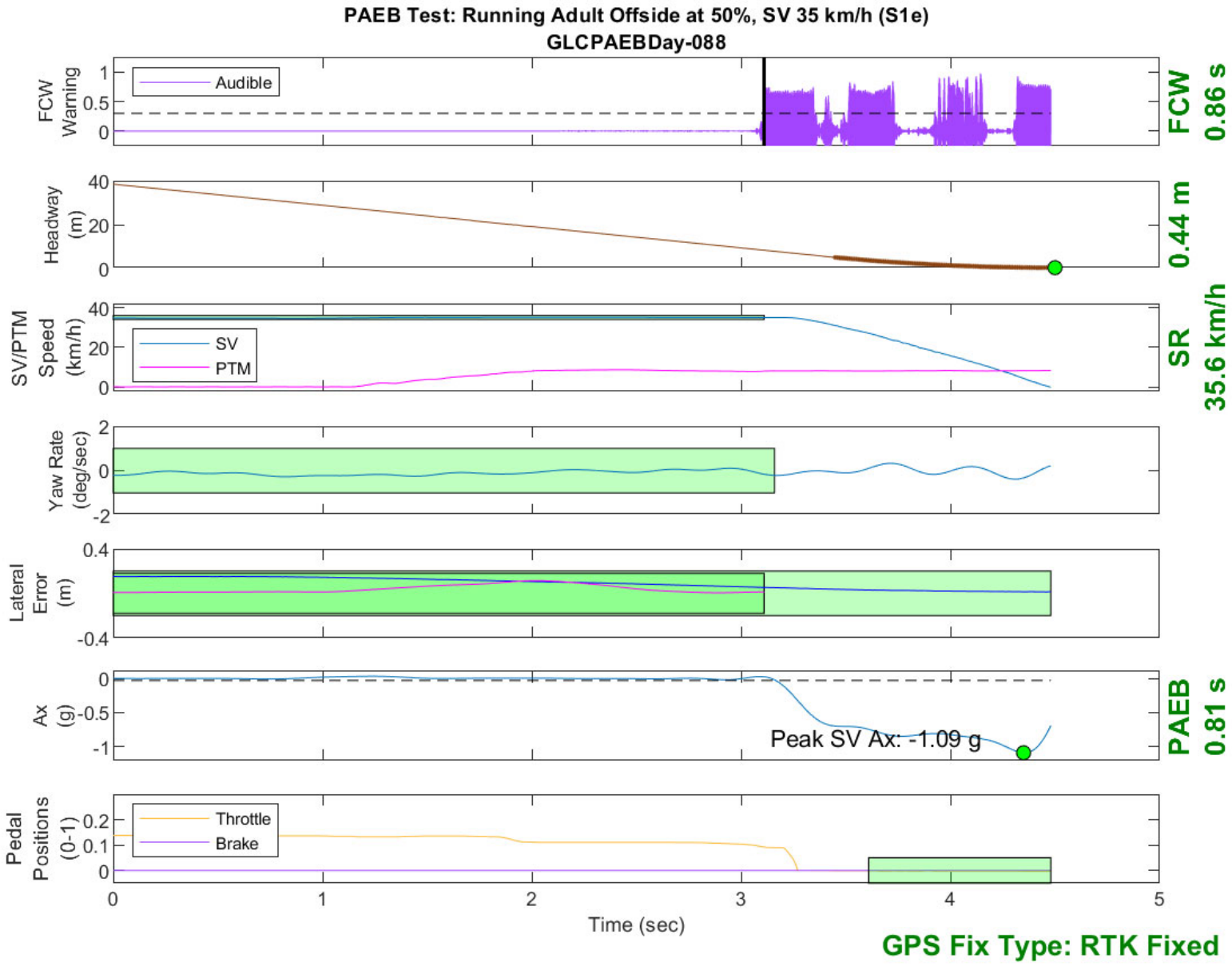

Figure D87. Time History for PAEB Run 88, S1e, Daytime, 35 km/h

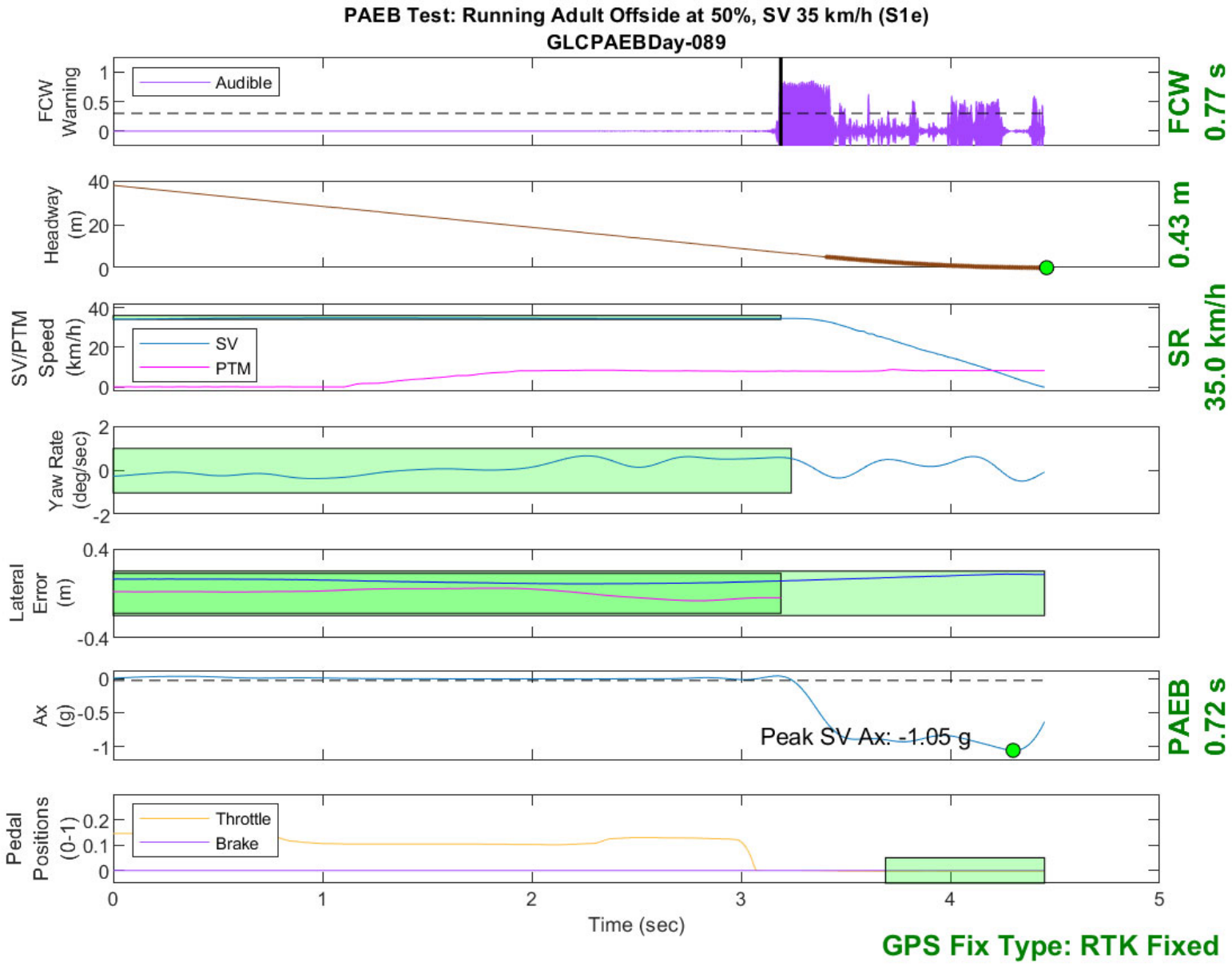

Figure D88. Time History for PAEB Run 89, S1e, Daytime, 35 km/h

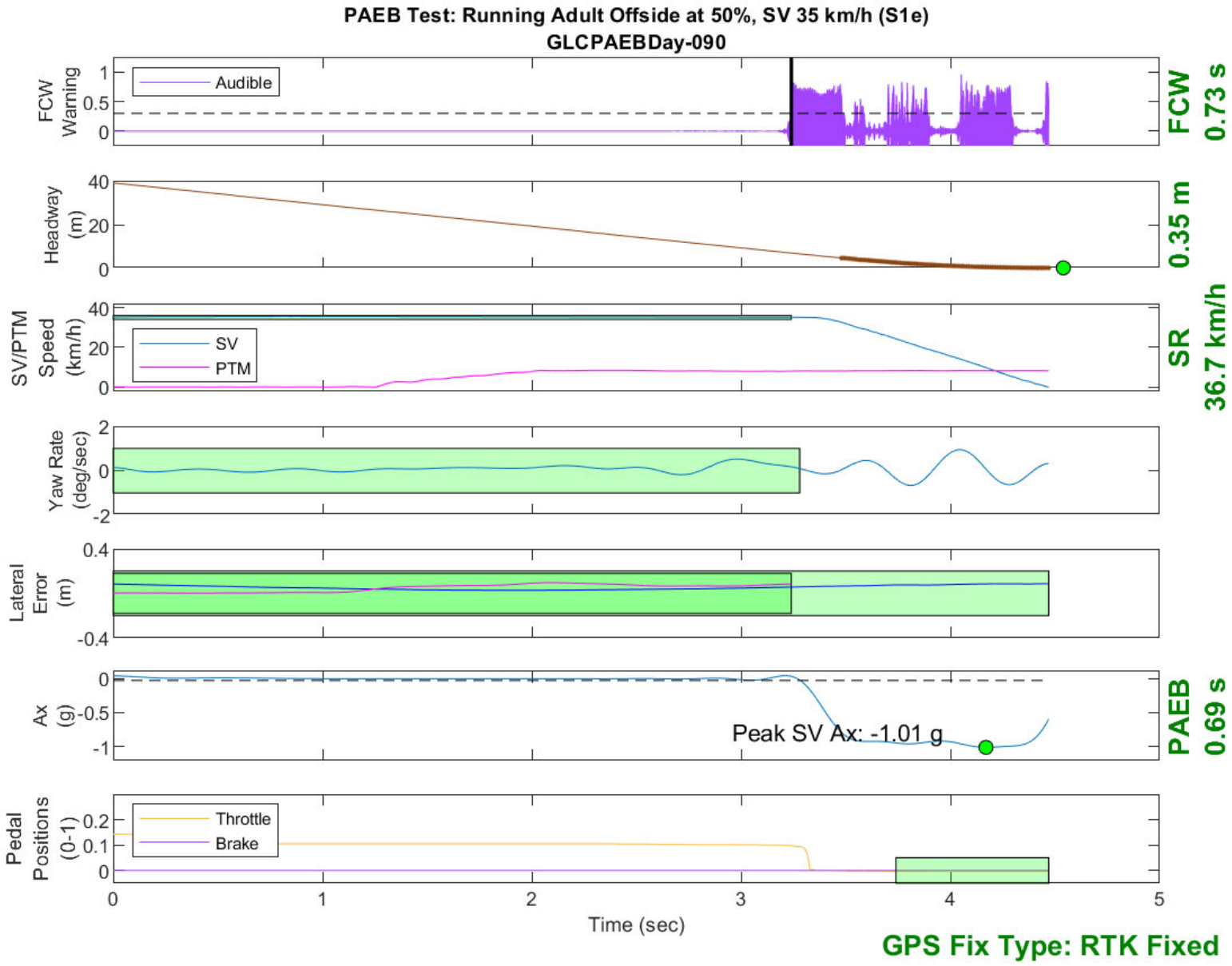

Figure D89. Time History for PAEB Run 90, S1e, Daytime, 35 km/h

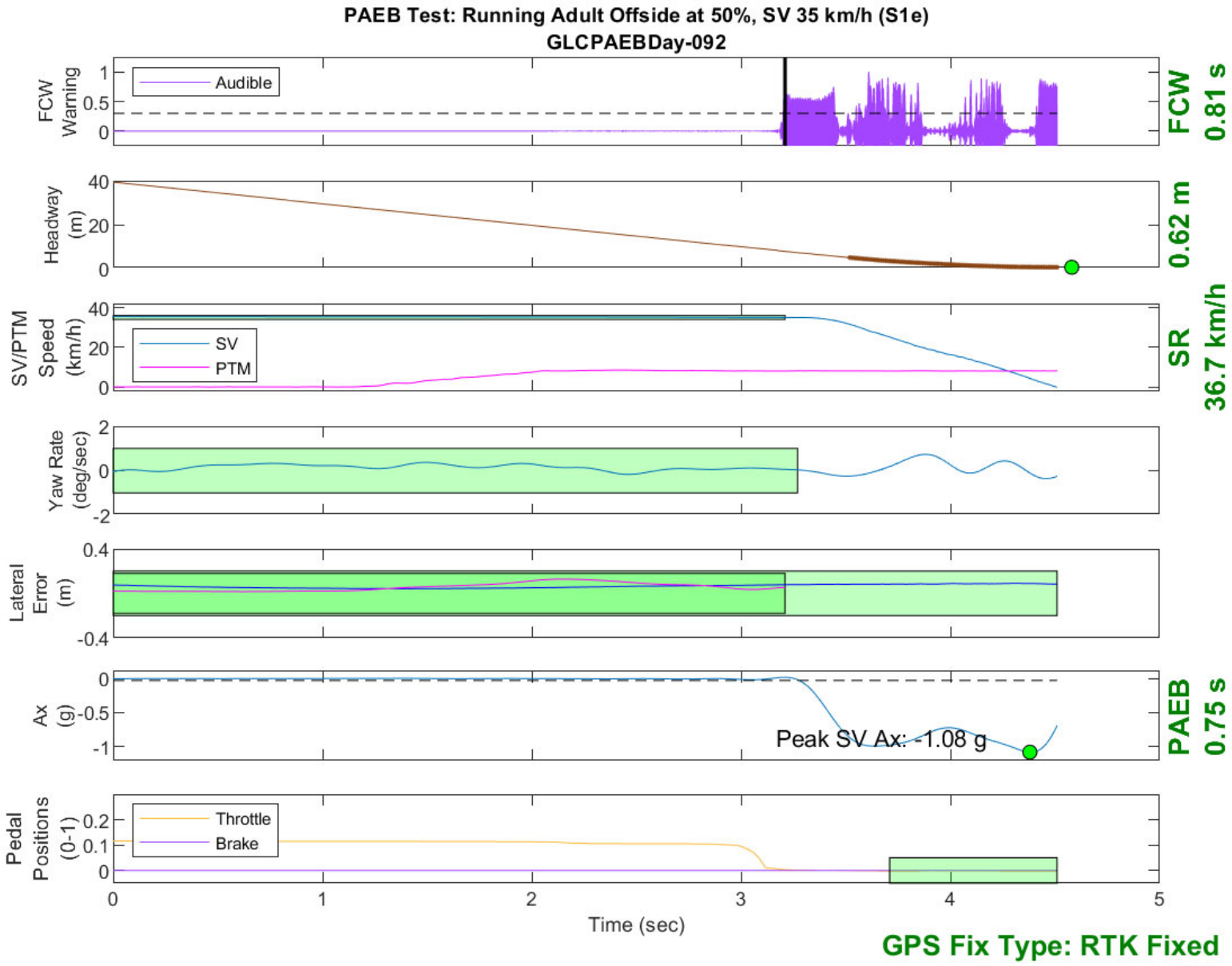

Figure D90. Time History for PAEB Run 92, S1e, Daytime, 35 km/h

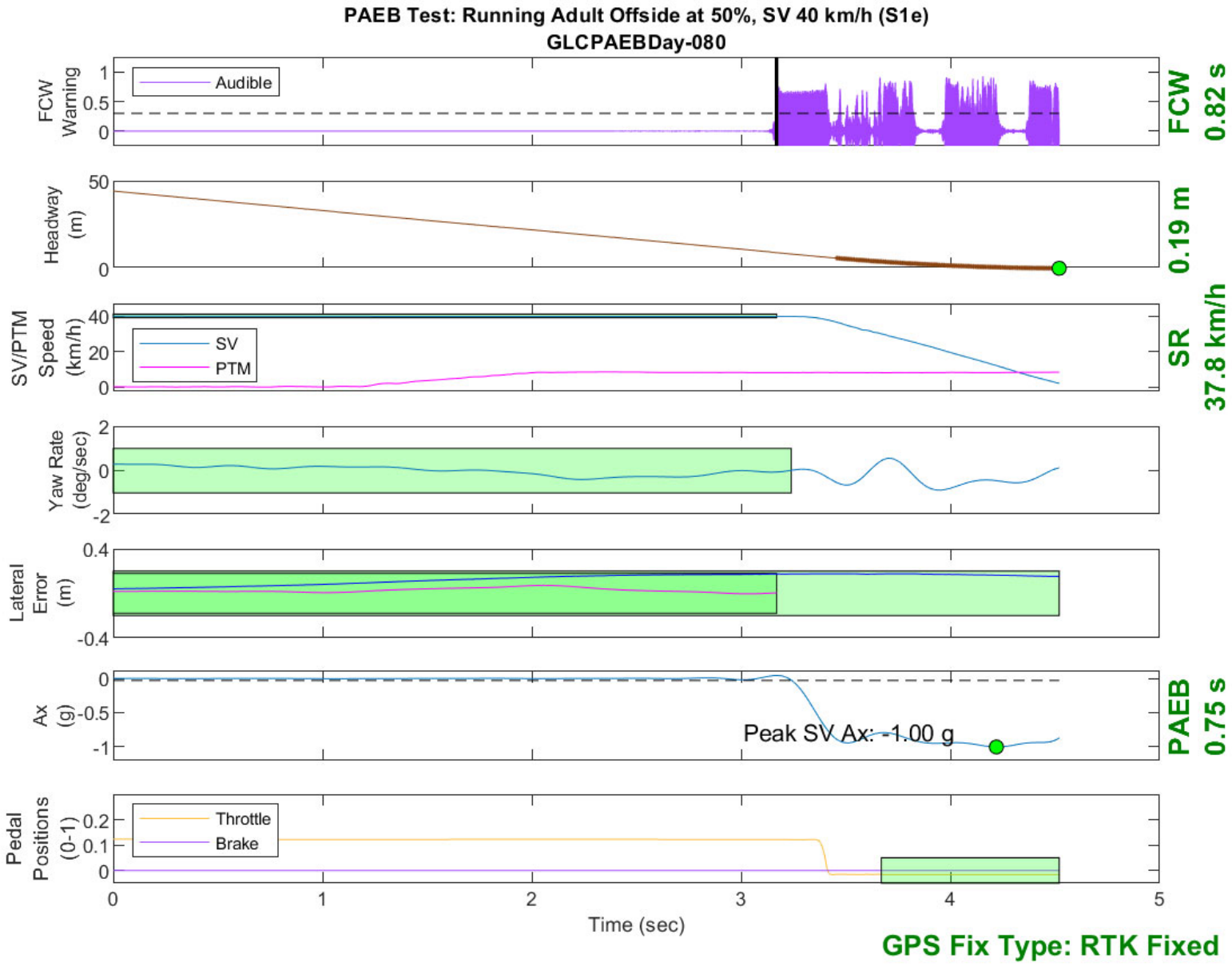

Figure D91. Time History for PAEB Run 80, S1e, Daytime, 40 km/h

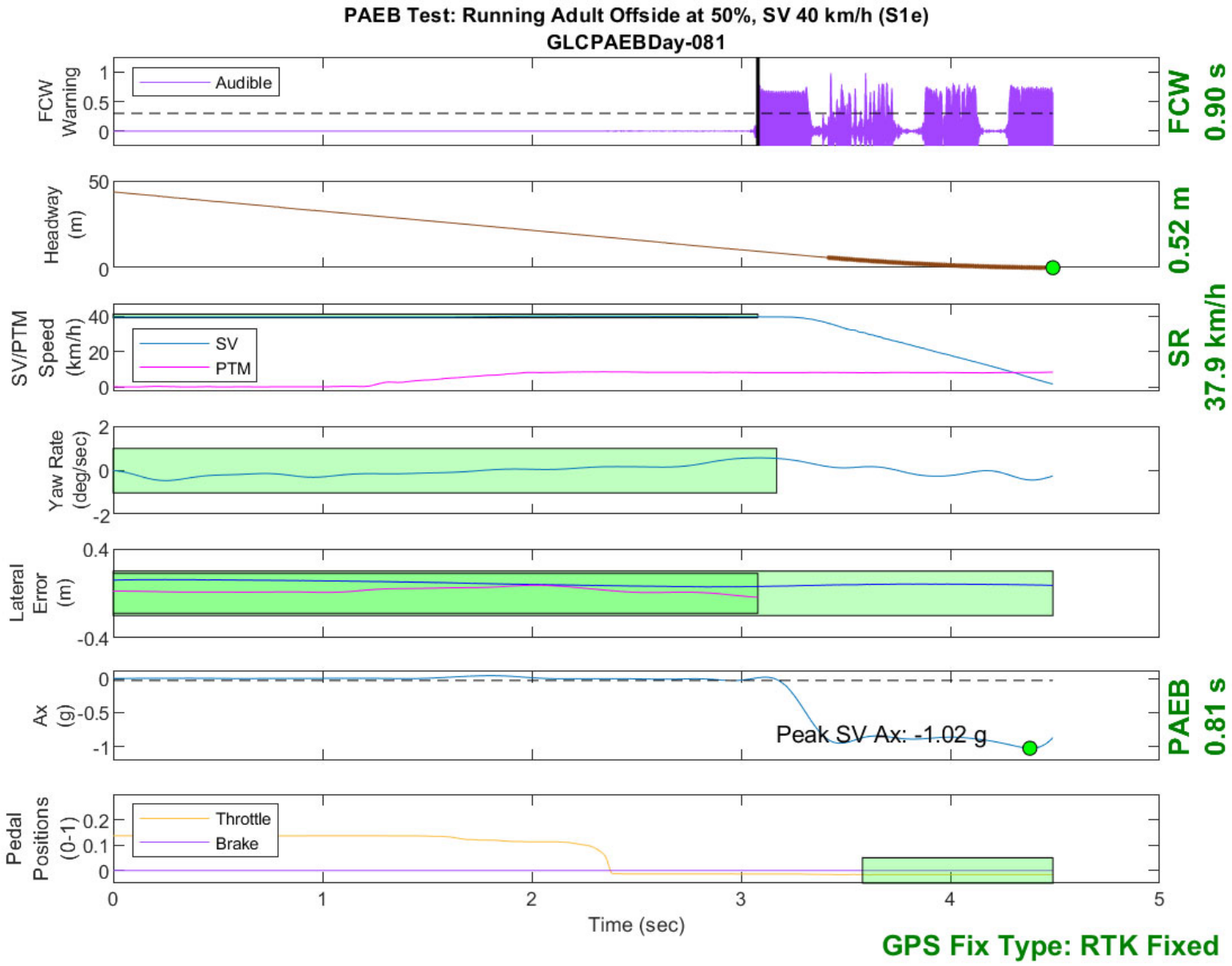

Figure D92. Time History for PAEB Run 81, S1e, Daytime, 40 km/h

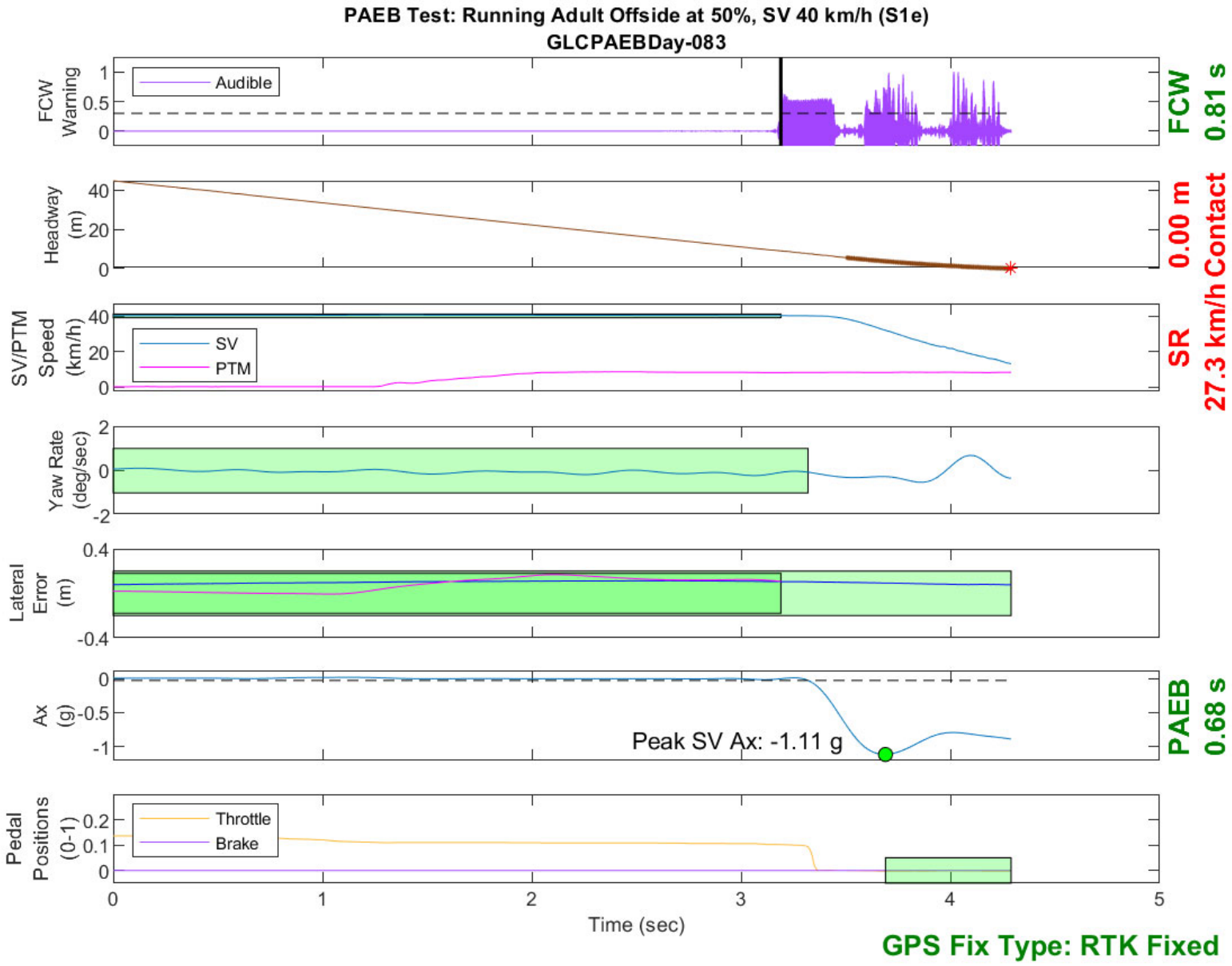

Figure D93. Time History for PAEB Run 83, S1e, Daytime, 40 km/h

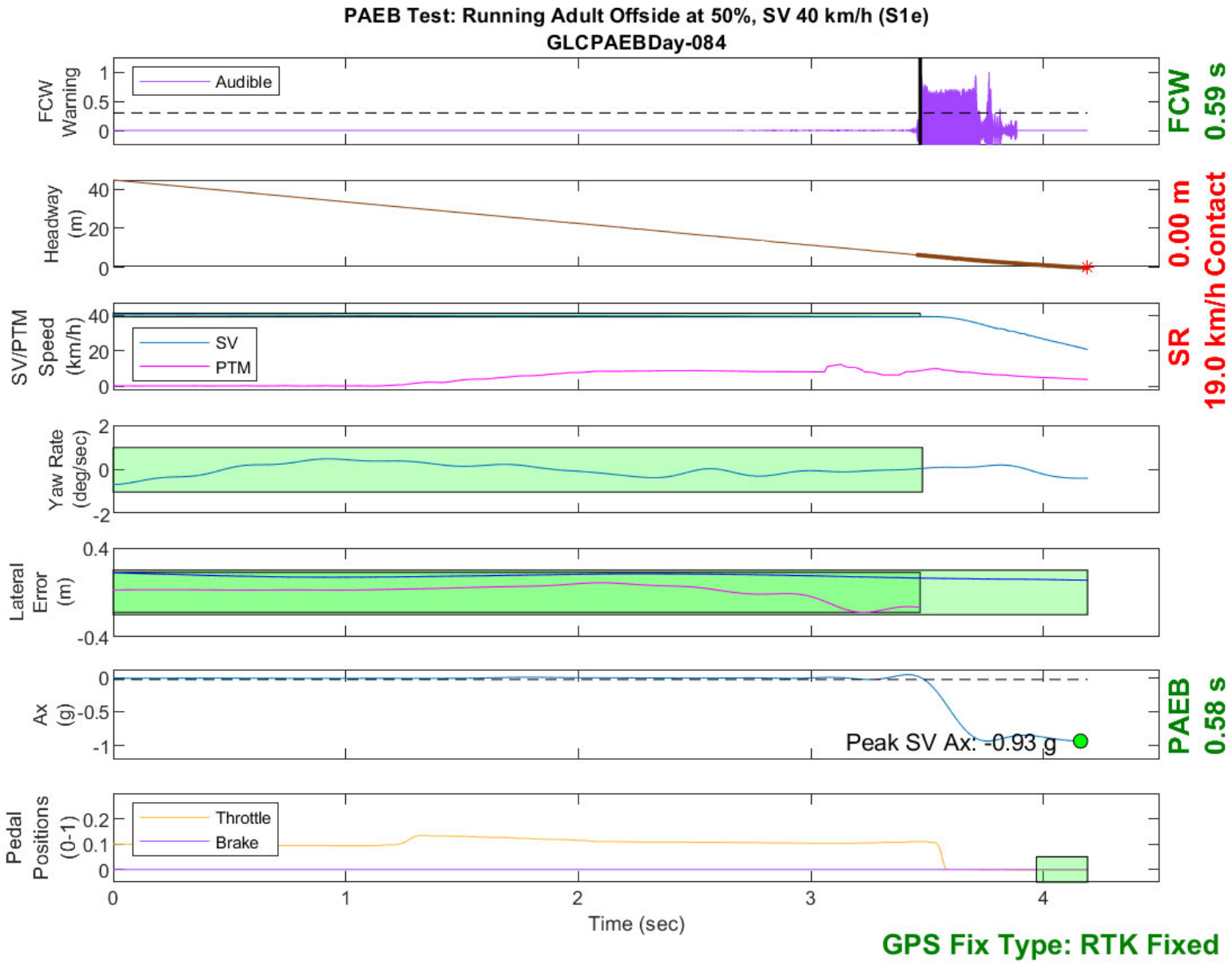

Figure D94. Time History for PAEB Run 84, S1e, Daytime, 40 km/h

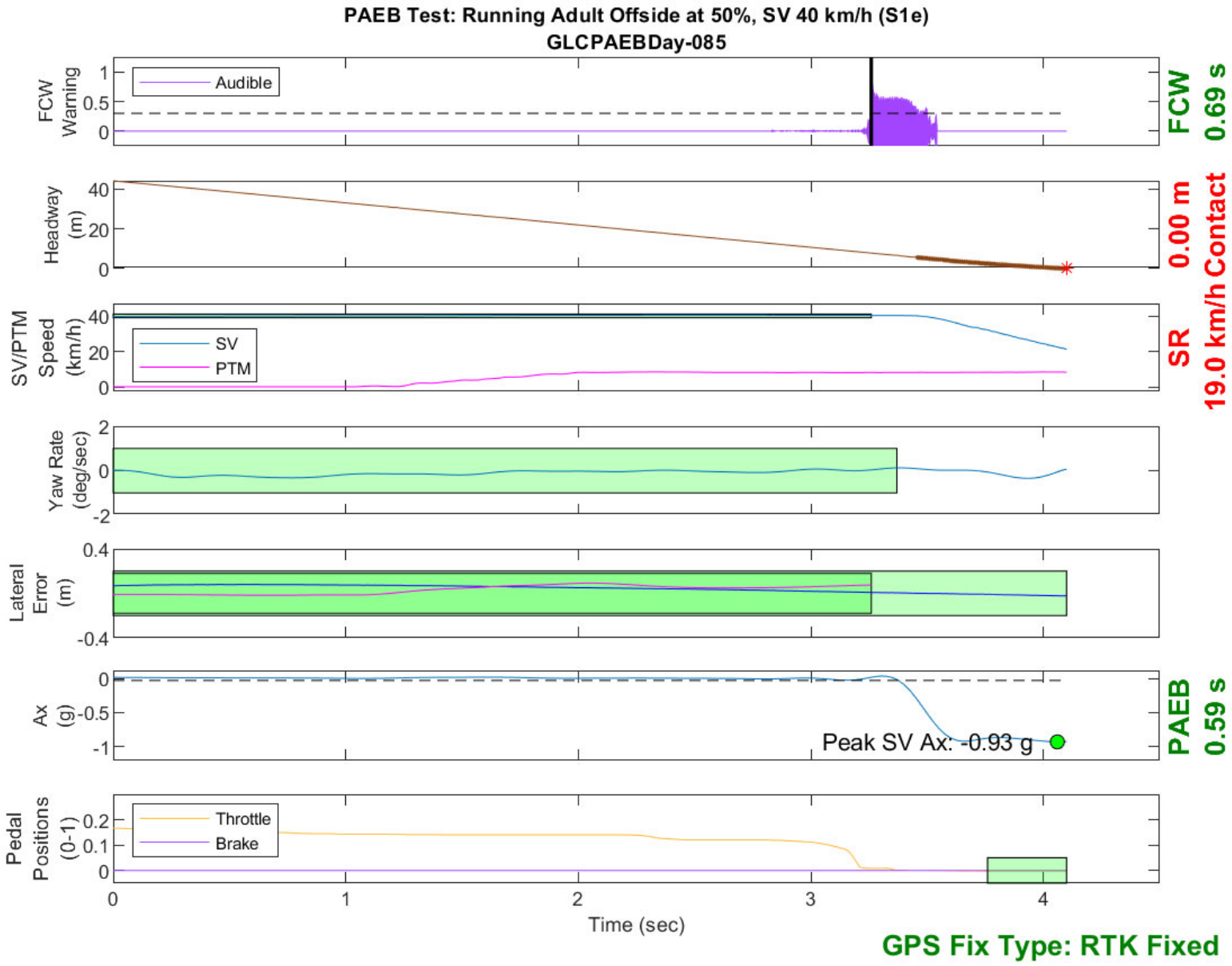

Figure D95. Time History for PAEB Run 85, S1e, Daytime, 40 km/h

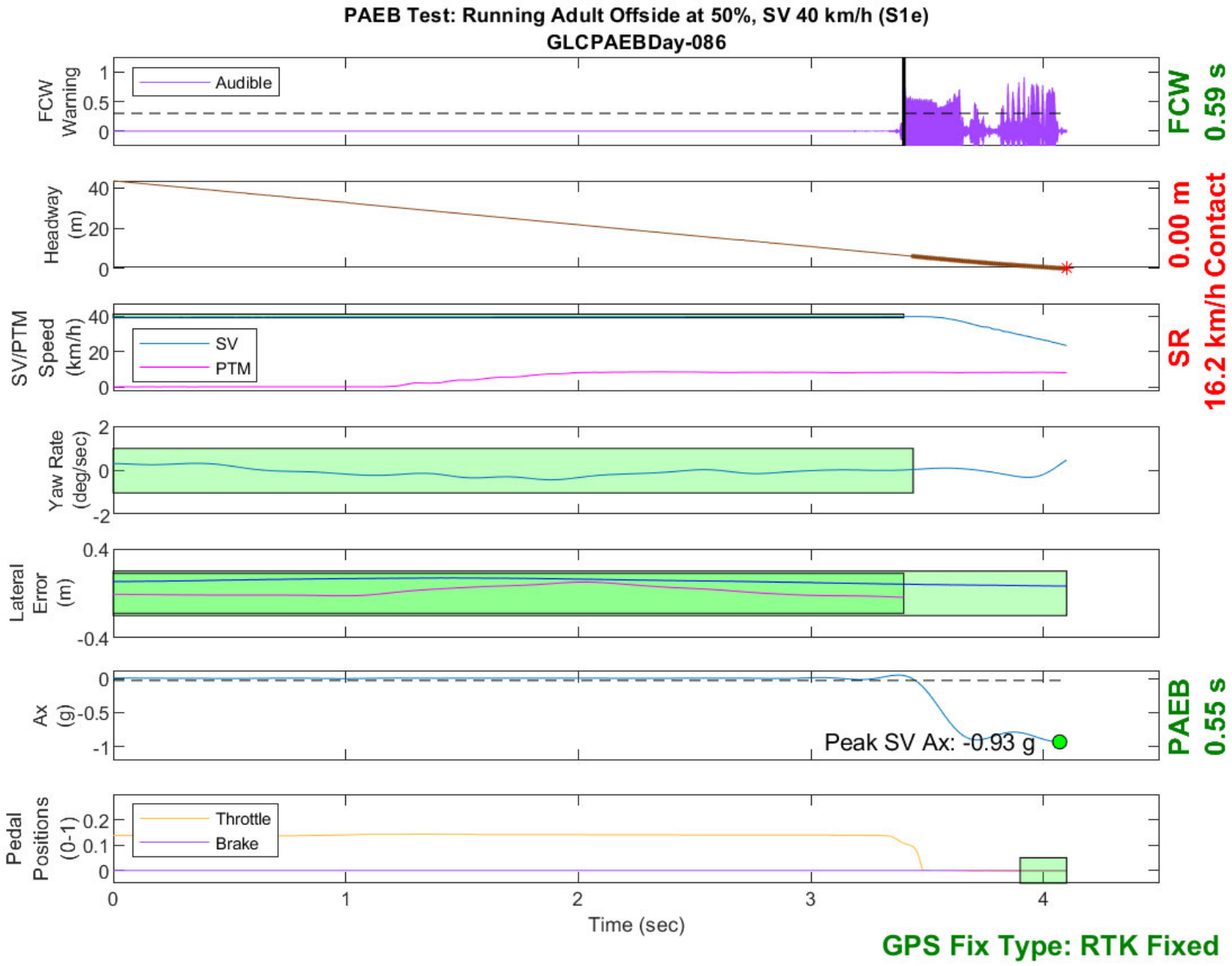

Figure D96. Time History for PAEB Run 86, S1e, Daytime, 40 km/h

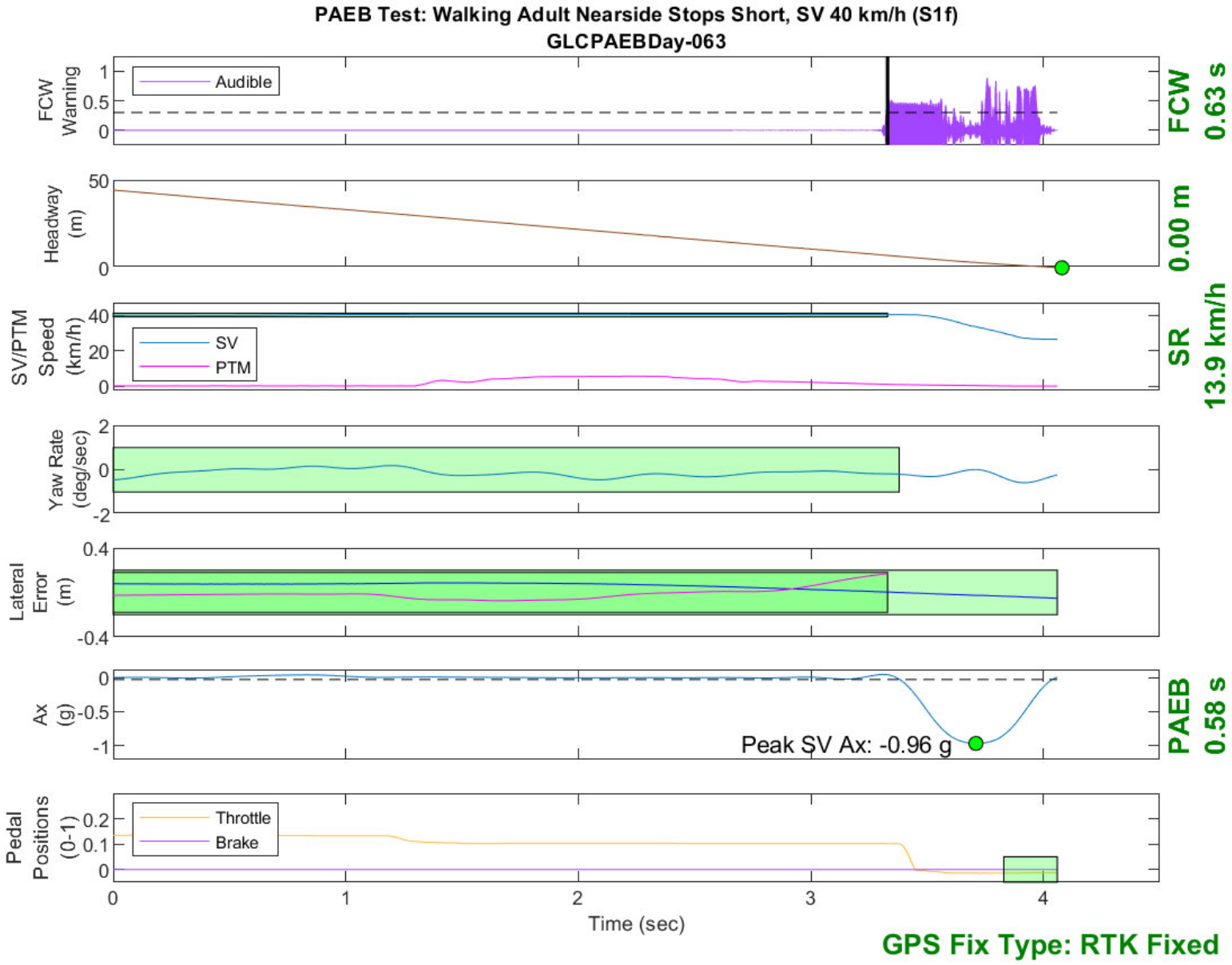

Figure D97. Time History for PAEB Run 63, S1f, Daytime, 40 km/h

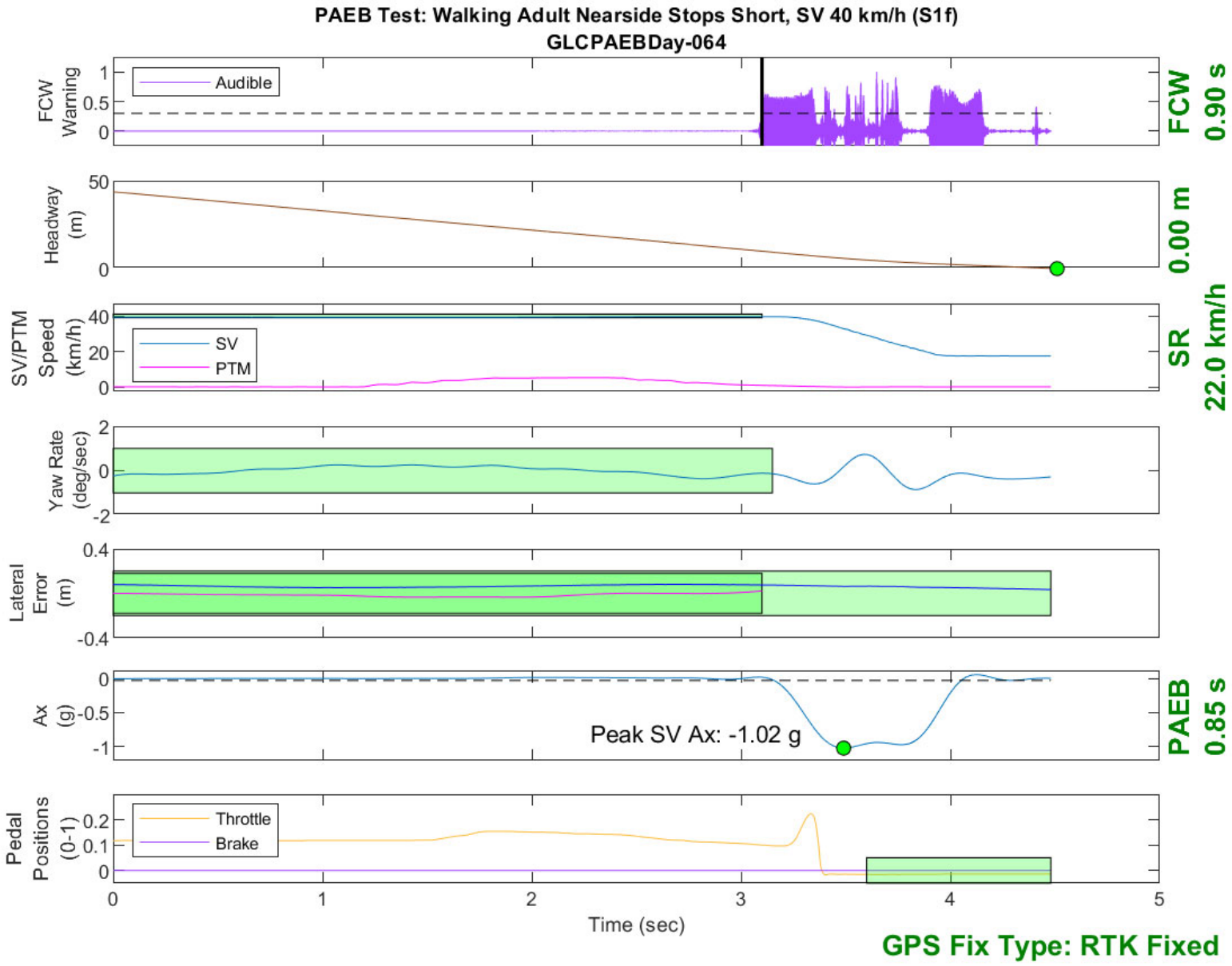

Figure D98. Time History for PAEB Run 64, S1f, Daytime, 40 km/h

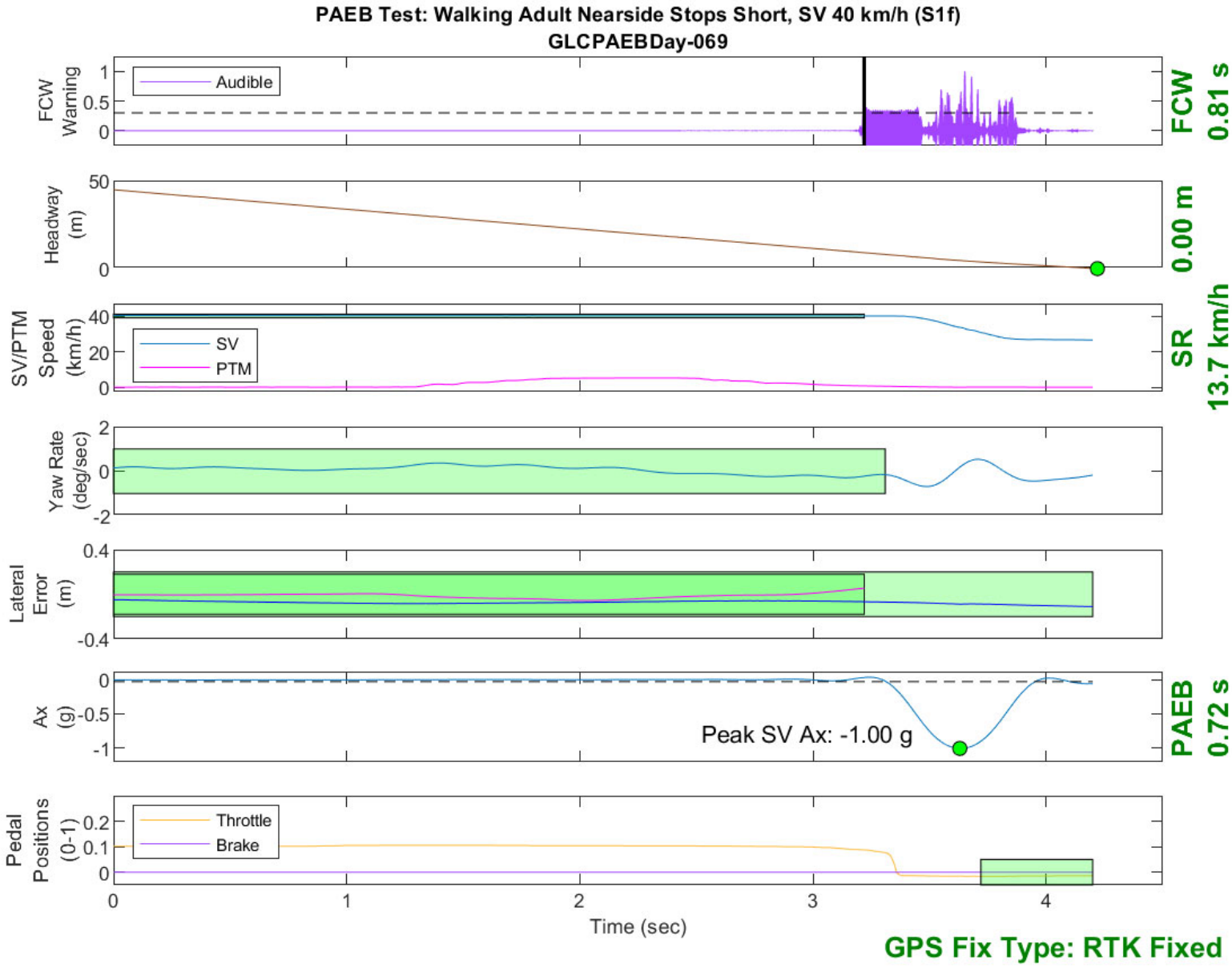

Figure D99. Time History for PAEB Run 69, S1f, Daytime, 40 km/h

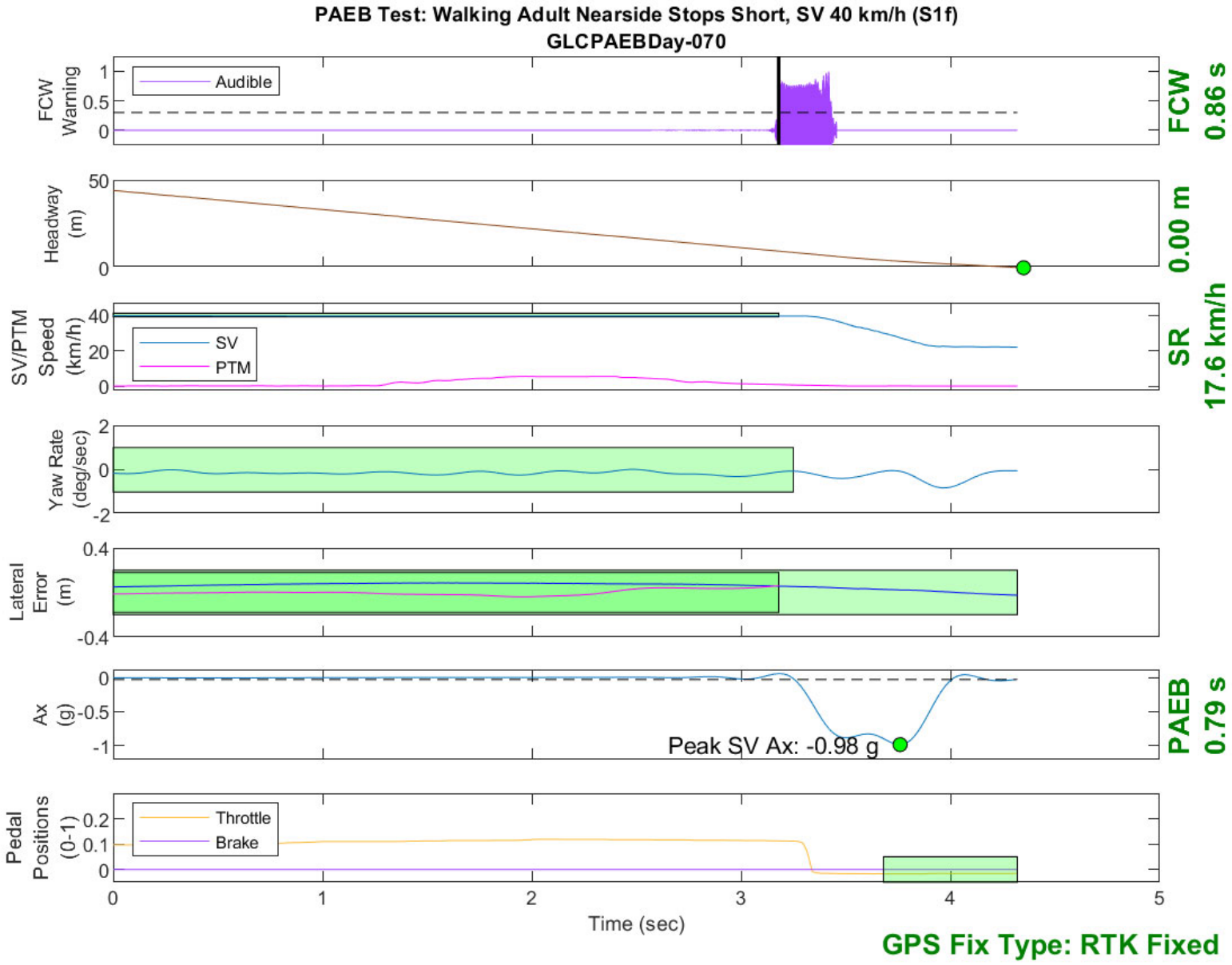

Figure D100. Time History for PAEB Run 70, S1f, Daytime, 40 km/h

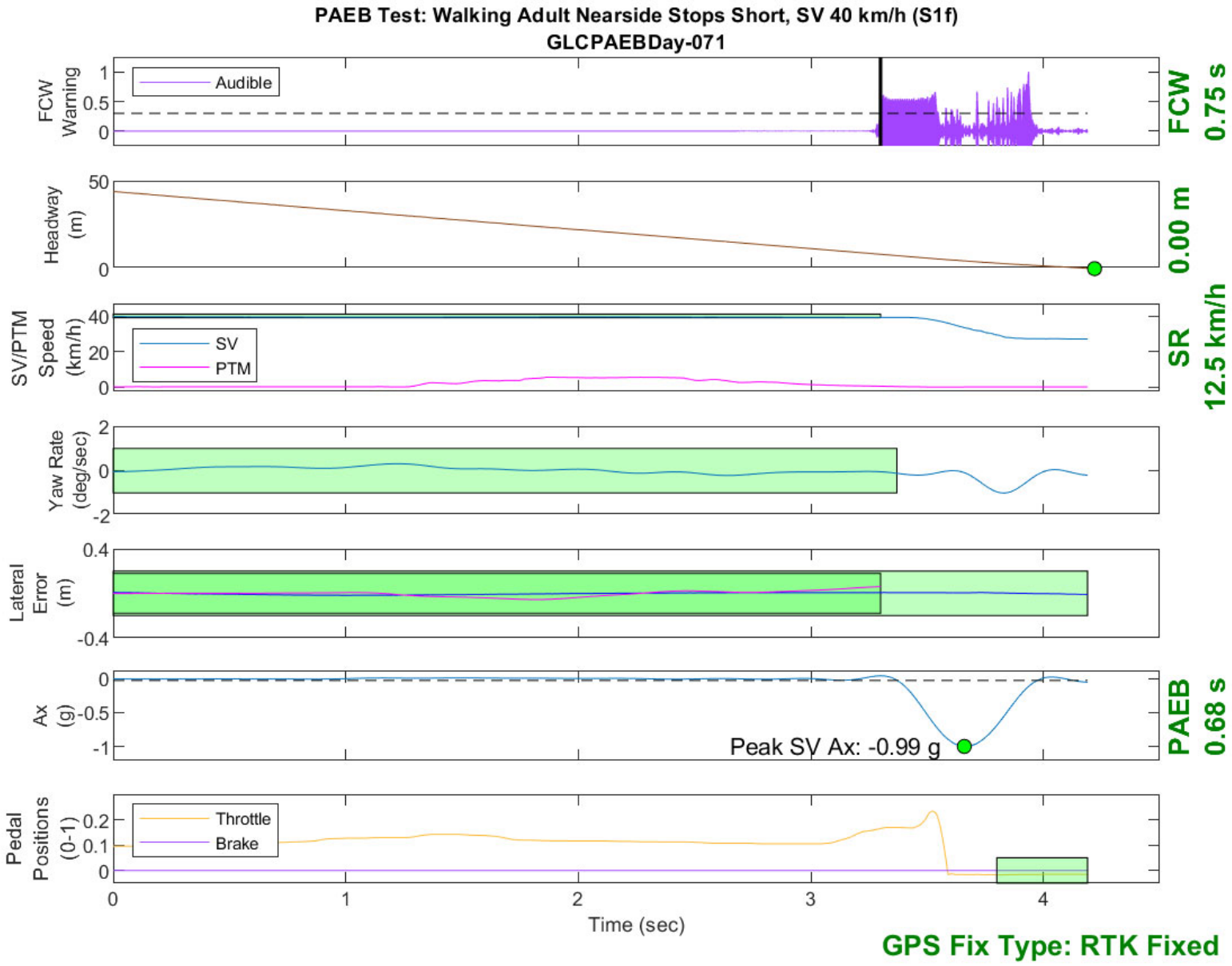

Figure D101. Time History for PAEB Run 71, S1f, Daytime, 40 km/h

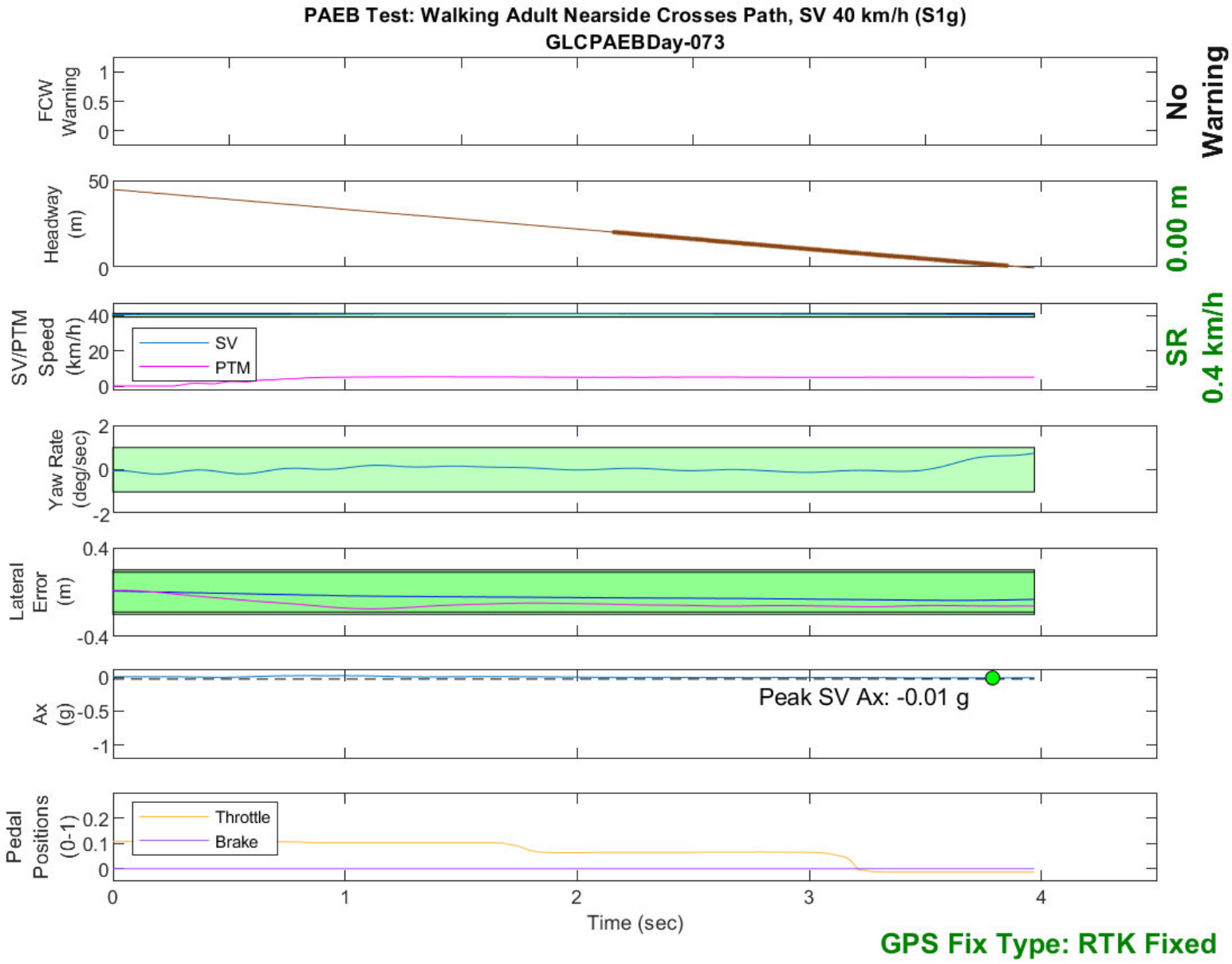

Figure D102. Time History for PAEB Run 73, S1g, Daytime, 40 km/h

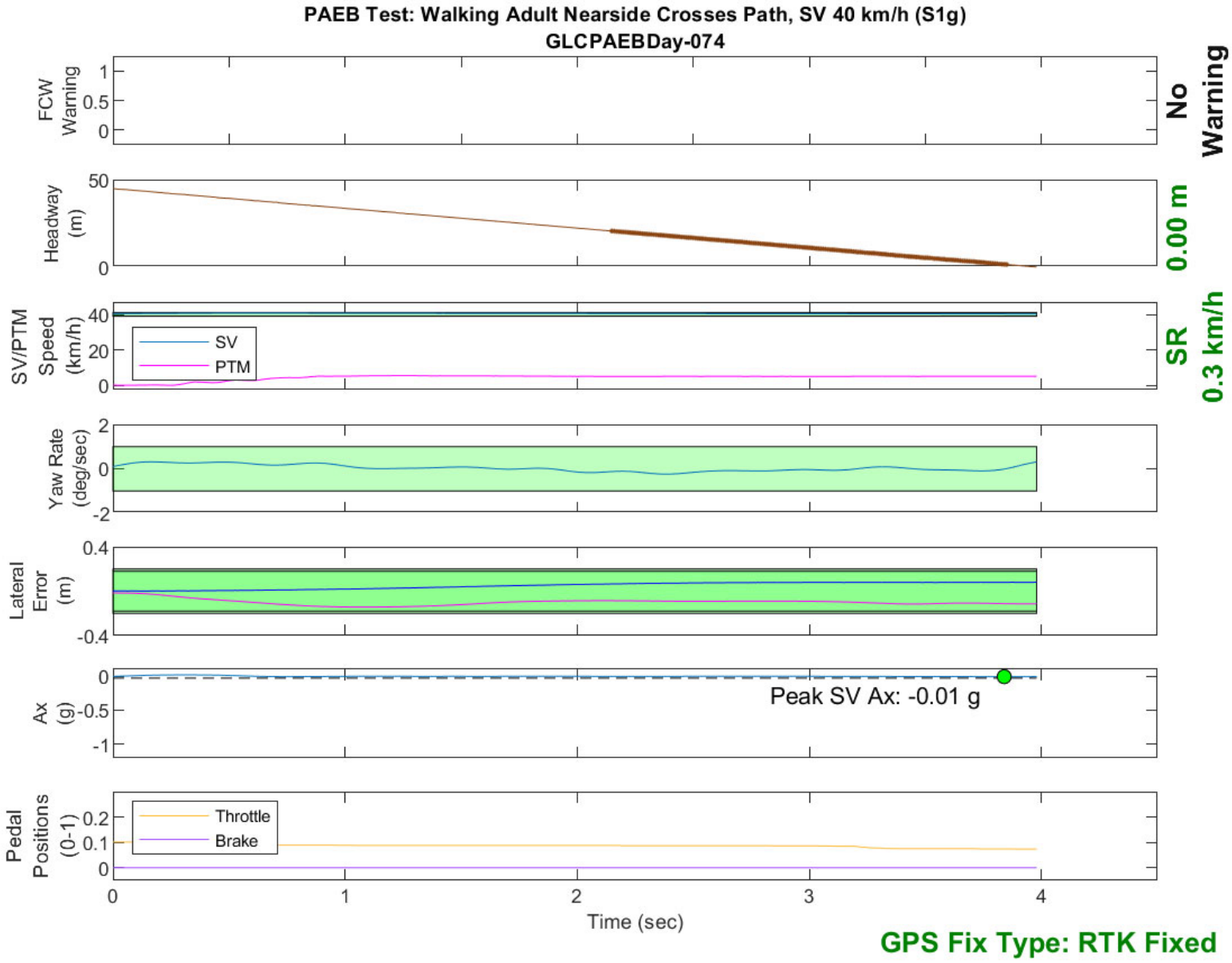

Figure D103. Time History for PAEB Run 74, S1g, Daytime, 40 km/h

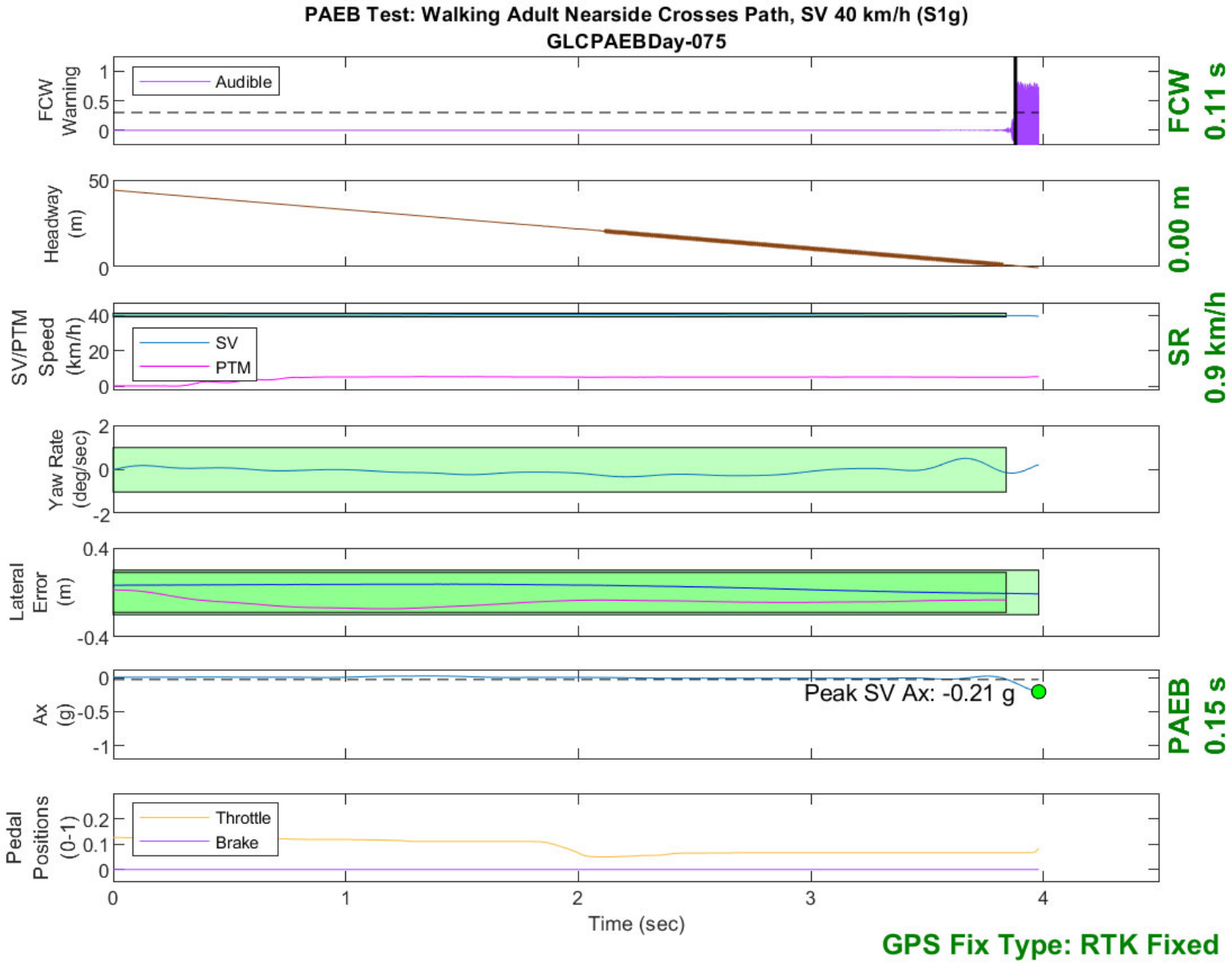

Figure D104. Time History for PAEB Run 75, S1g, Daytime, 40 km/h

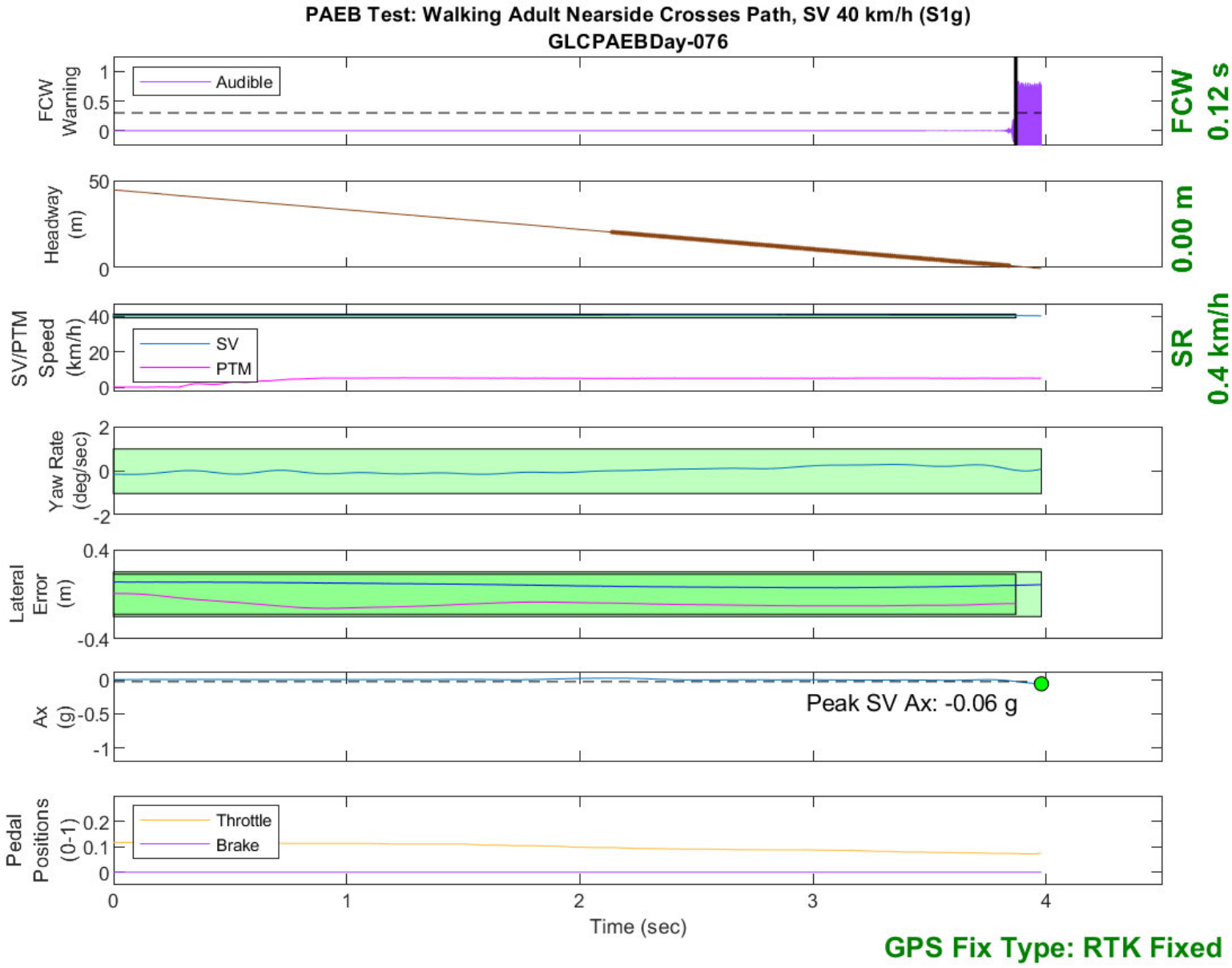

Figure D105. Time History for PAEB Run 76, S1g, Daytime, 40 km/h

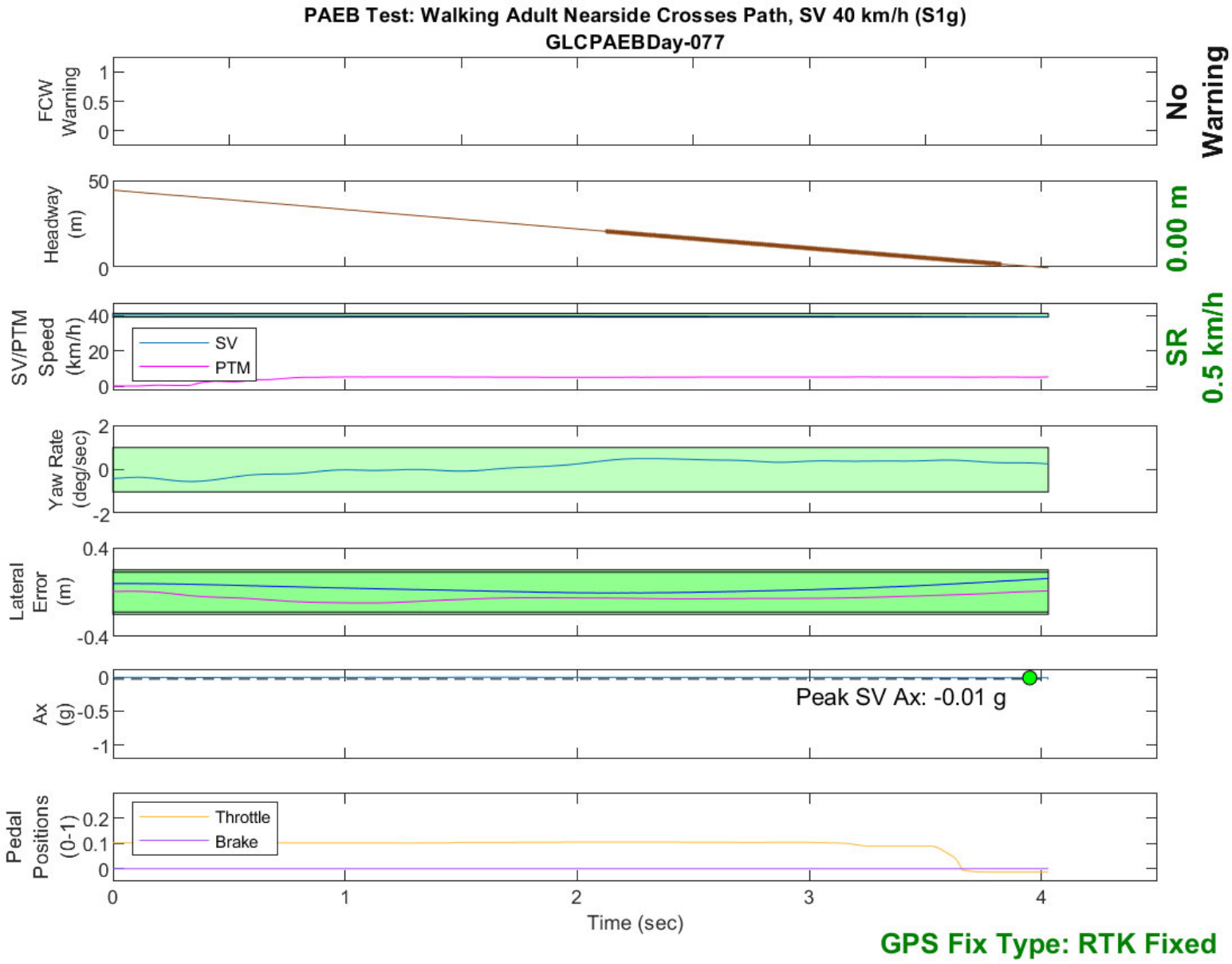

Figure D106. Time History for PAEB Run 77, S1g, Daytime, 40 km/h

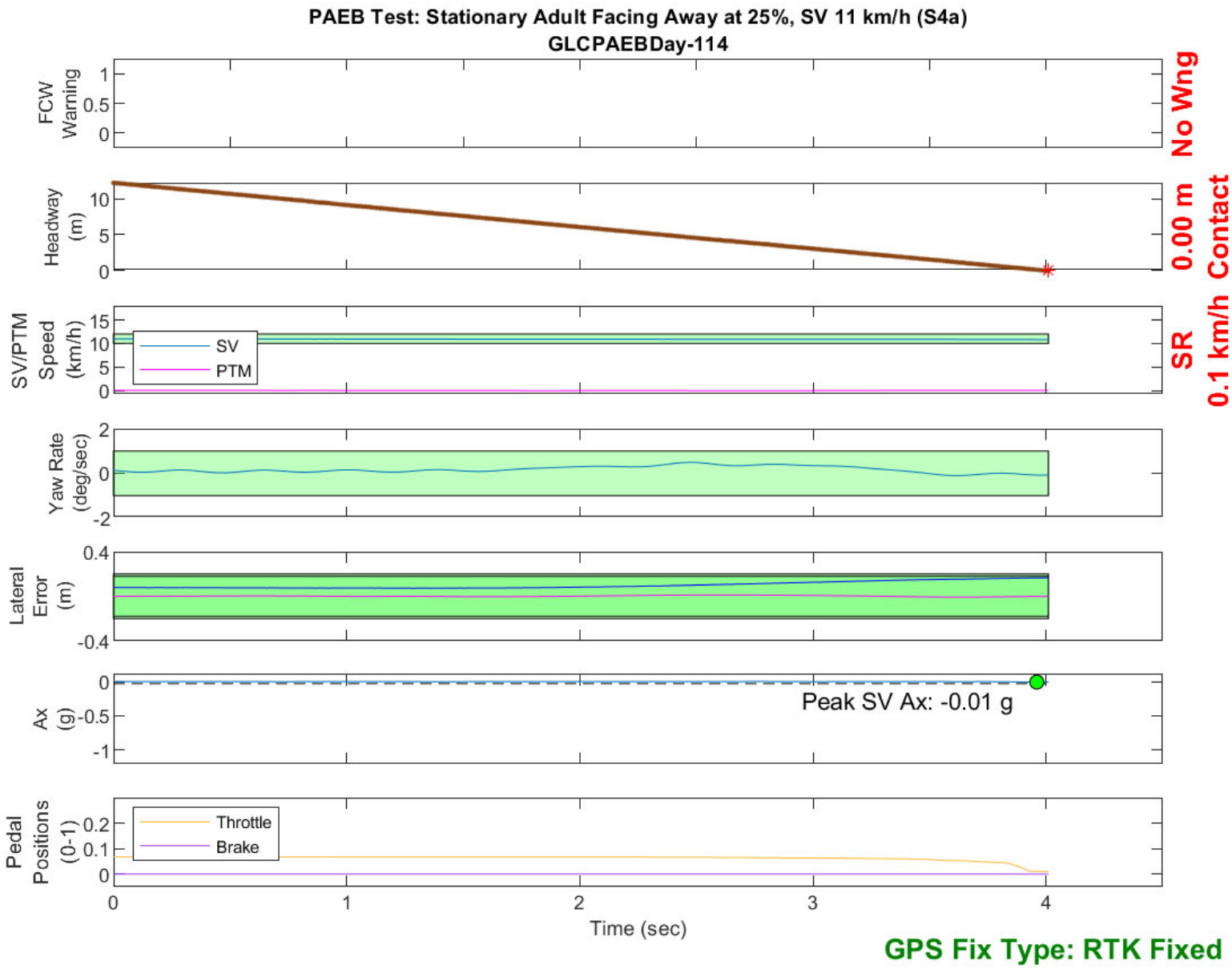

Figure D107. Time History for PAEB Run 114, S4a, Daytime, 11 km/h

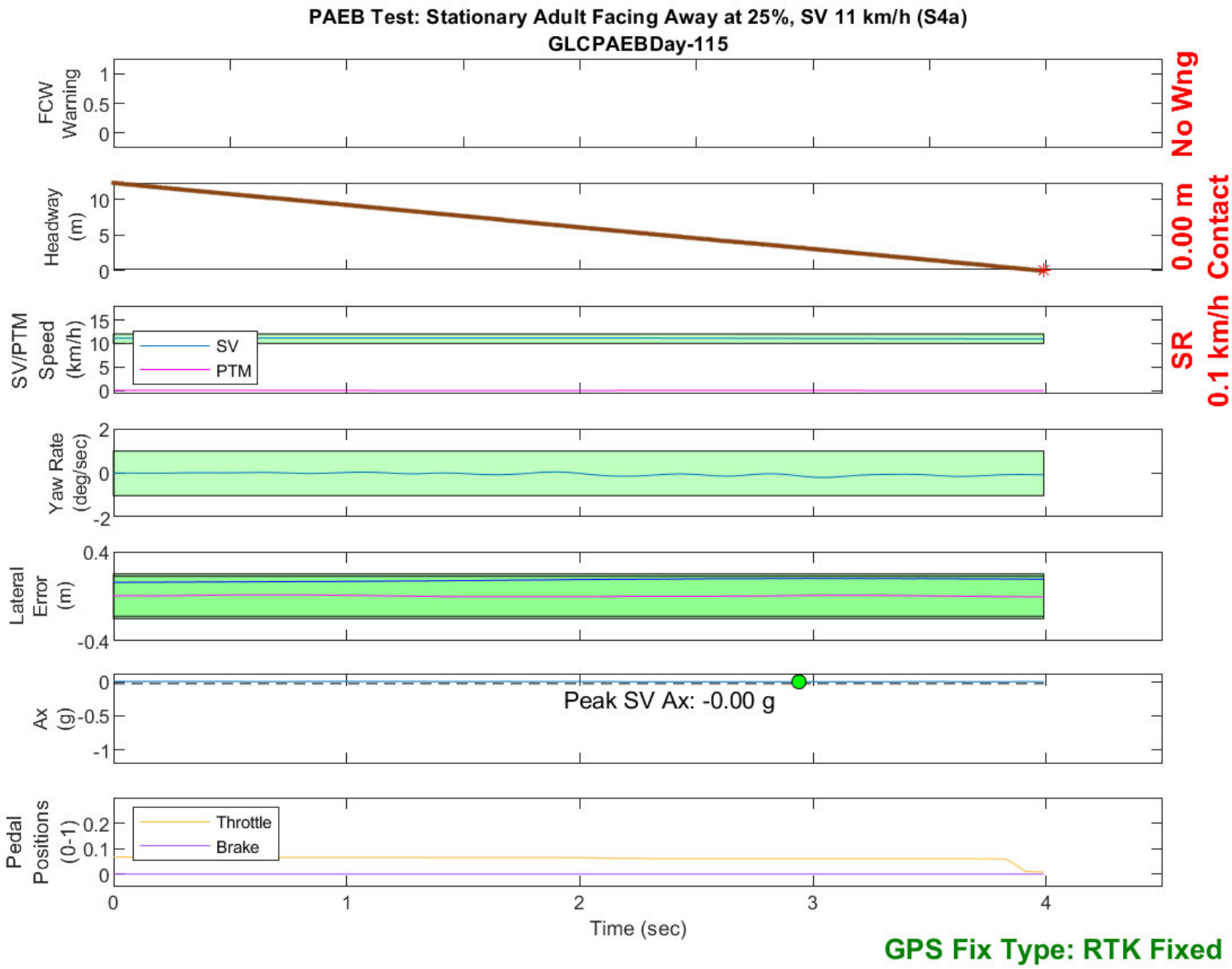

Figure D108. Time History for PAEB Run 115, S4a, Daytime, 11 km/h

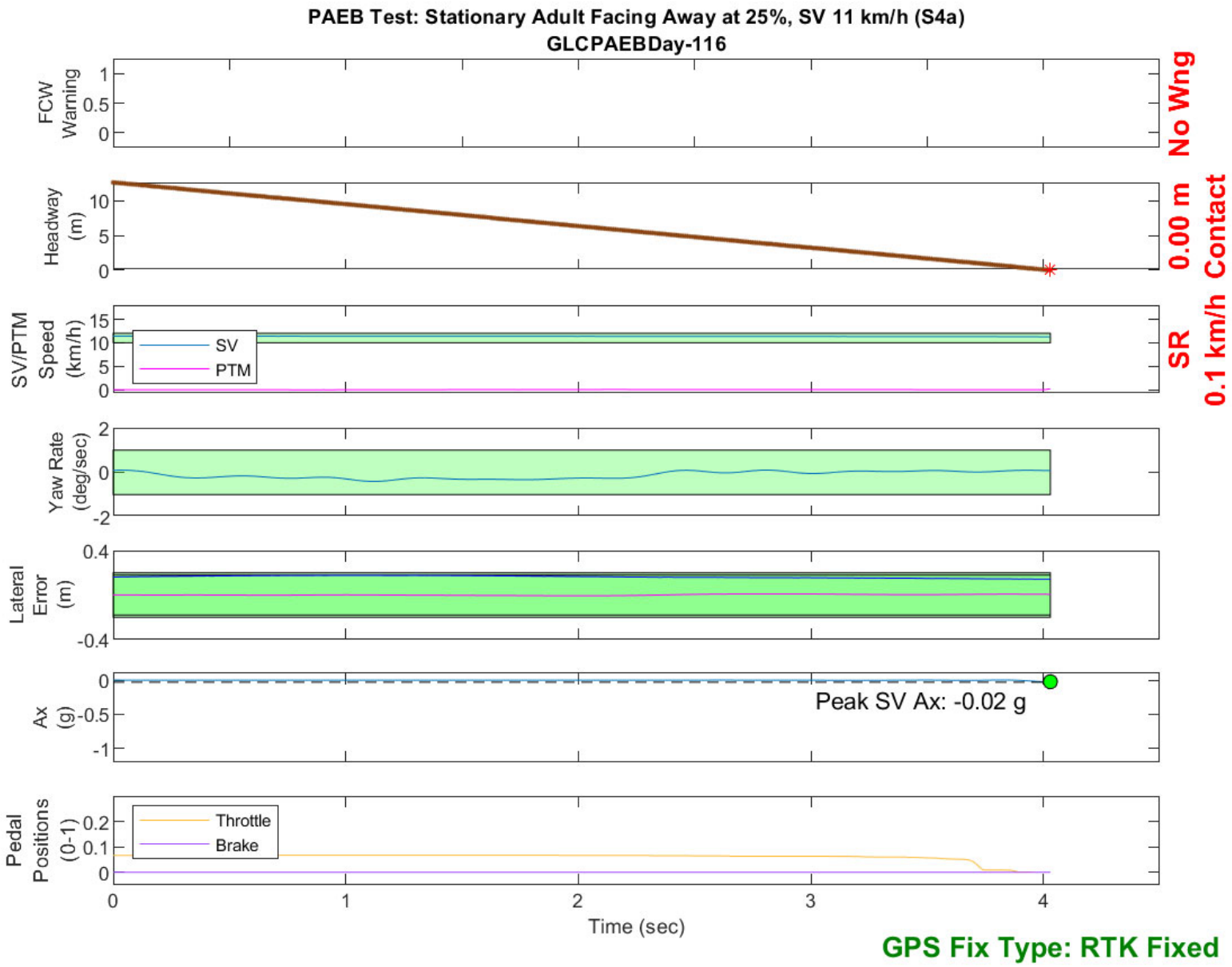

Figure D109. Time History for PAEB Run 116, S4a, Daytime, 11 km/h

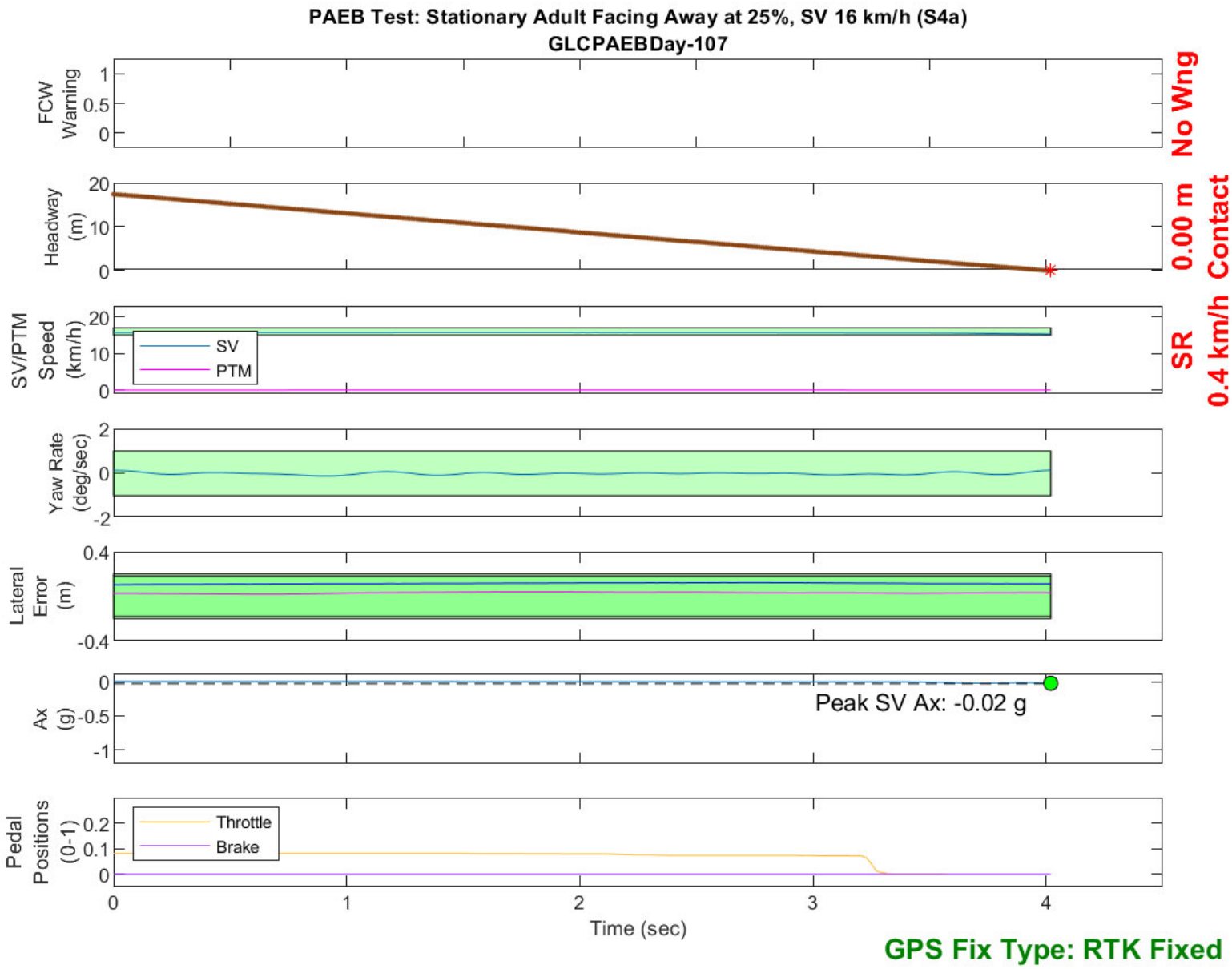

Figure D110. Time History for PAEB Run 107, S4a, Daytime, 16 km/h

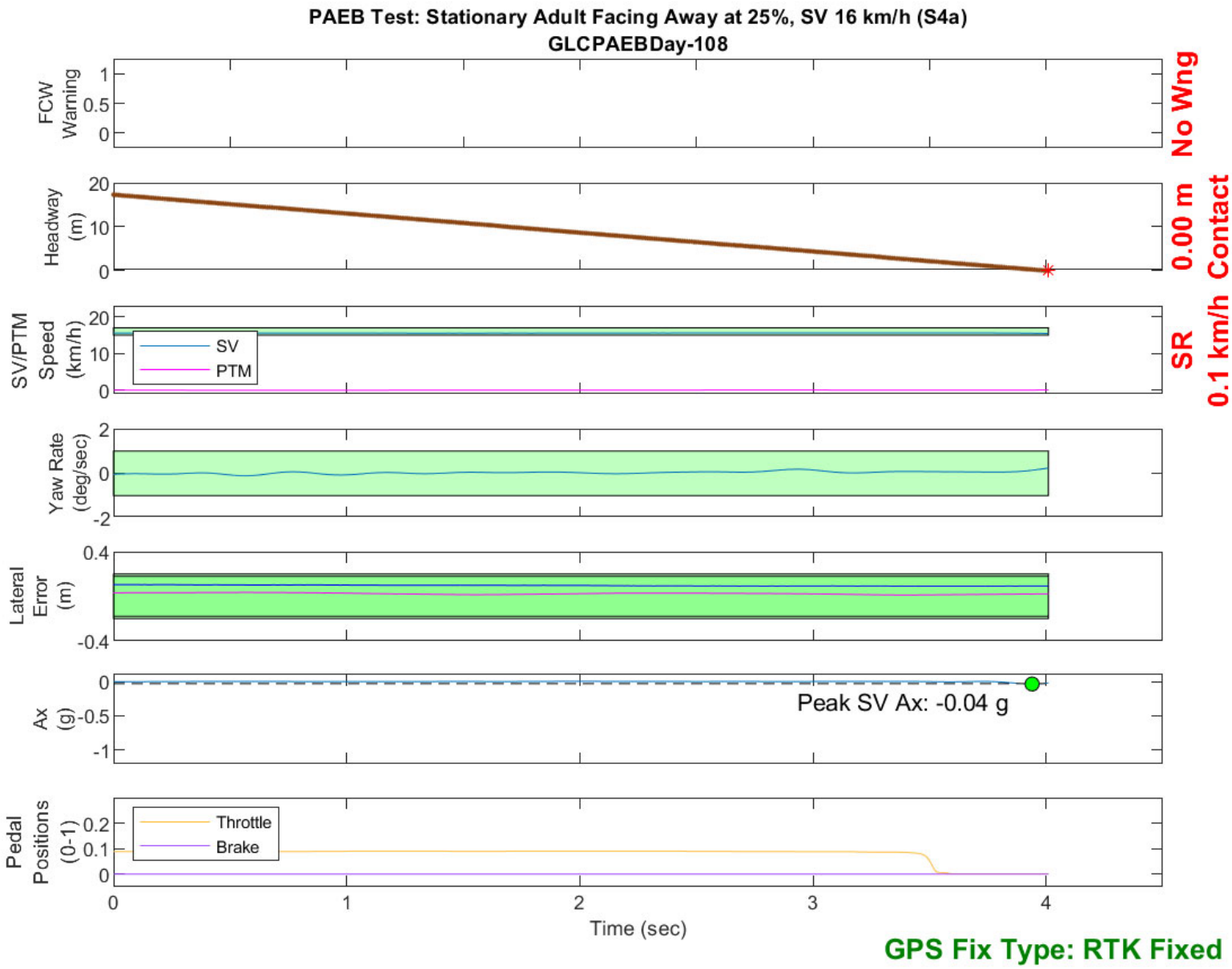

Figure D111. Time History for PAEB Run 108, S4a, Daytime, 16 km/h

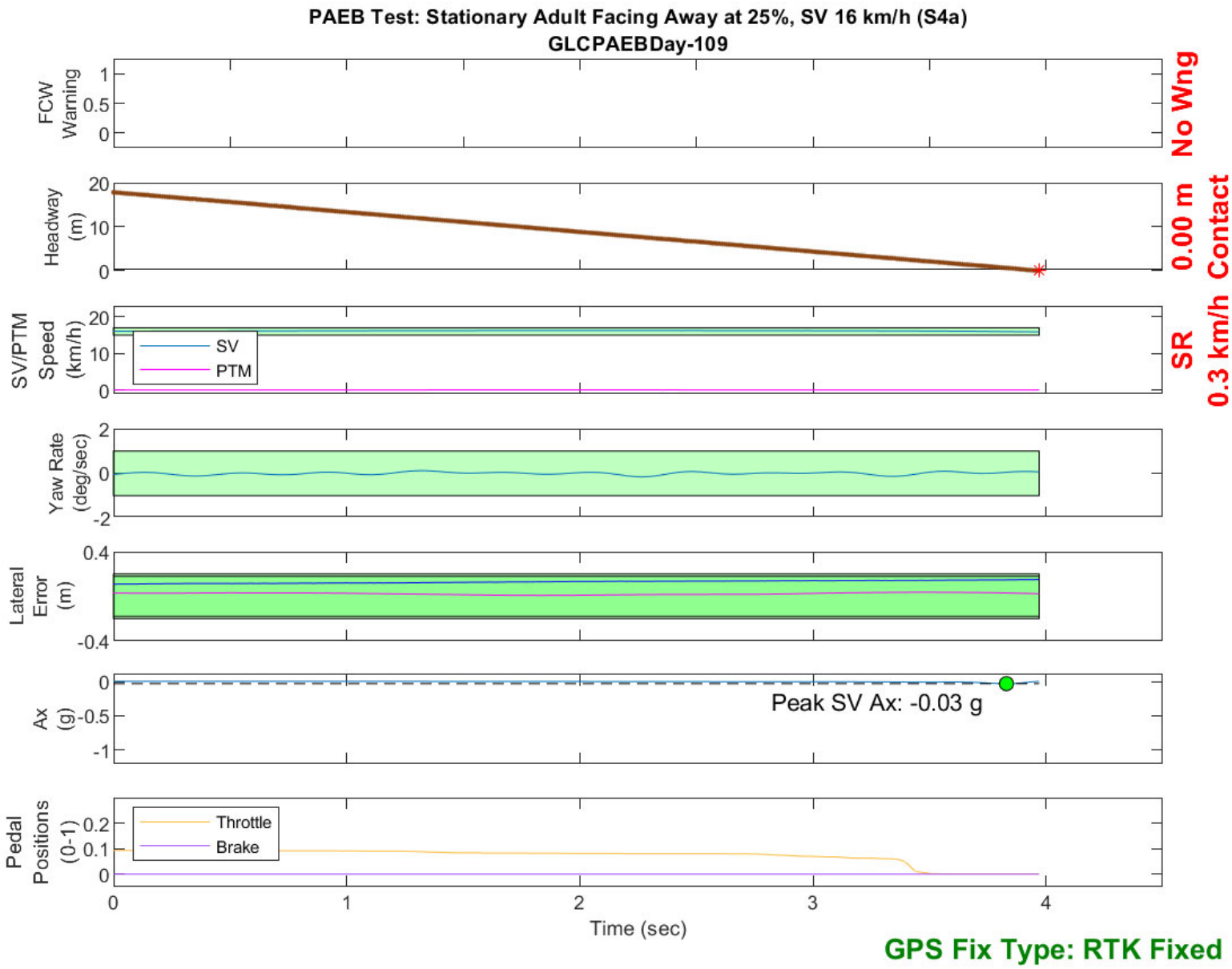

Figure D112. Time History for PAEB Run 109, S4a, Daytime, 16 km/h

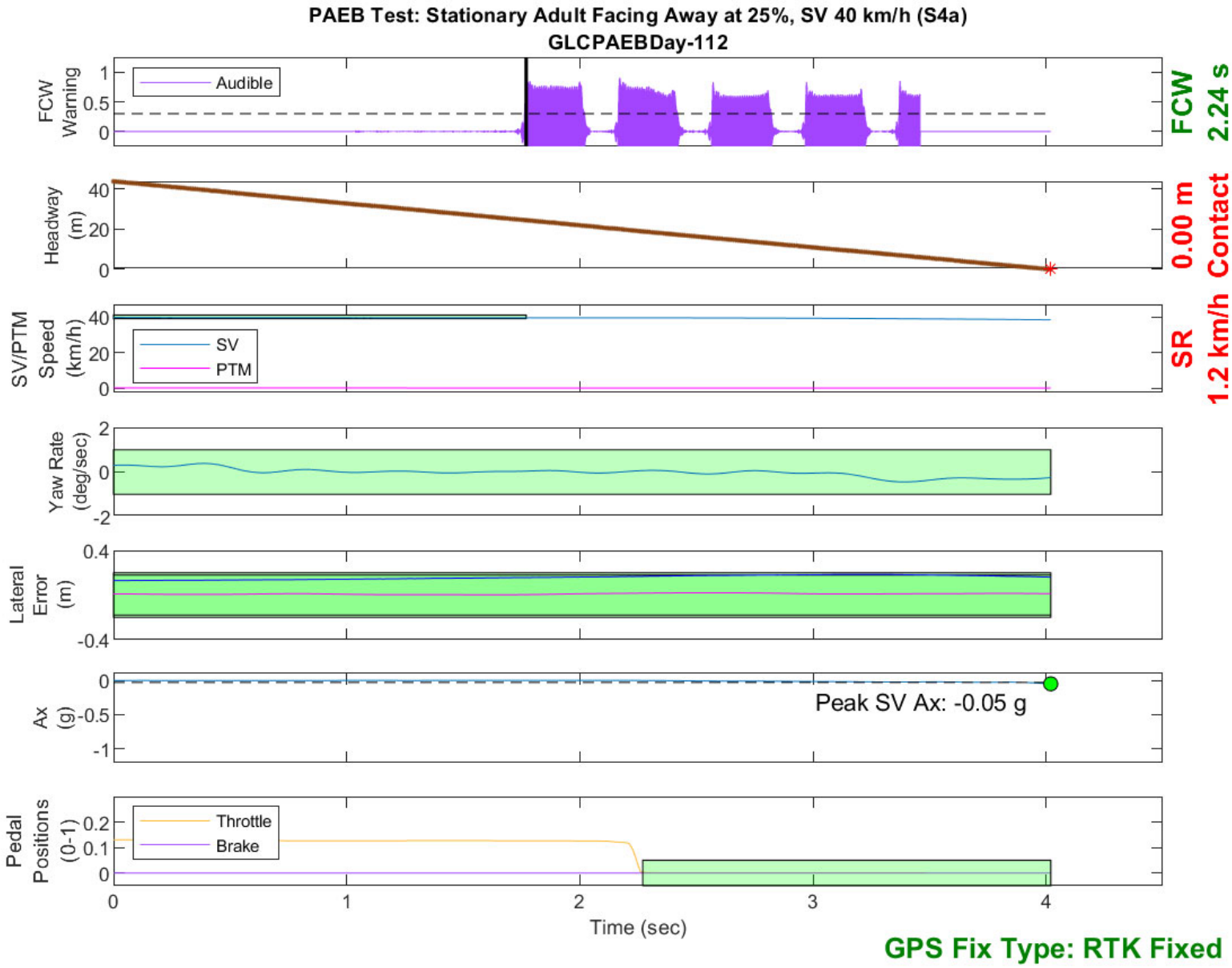

Figure D113. Time History for PAEB Run 112, S4a, Daytime, 40 km/h

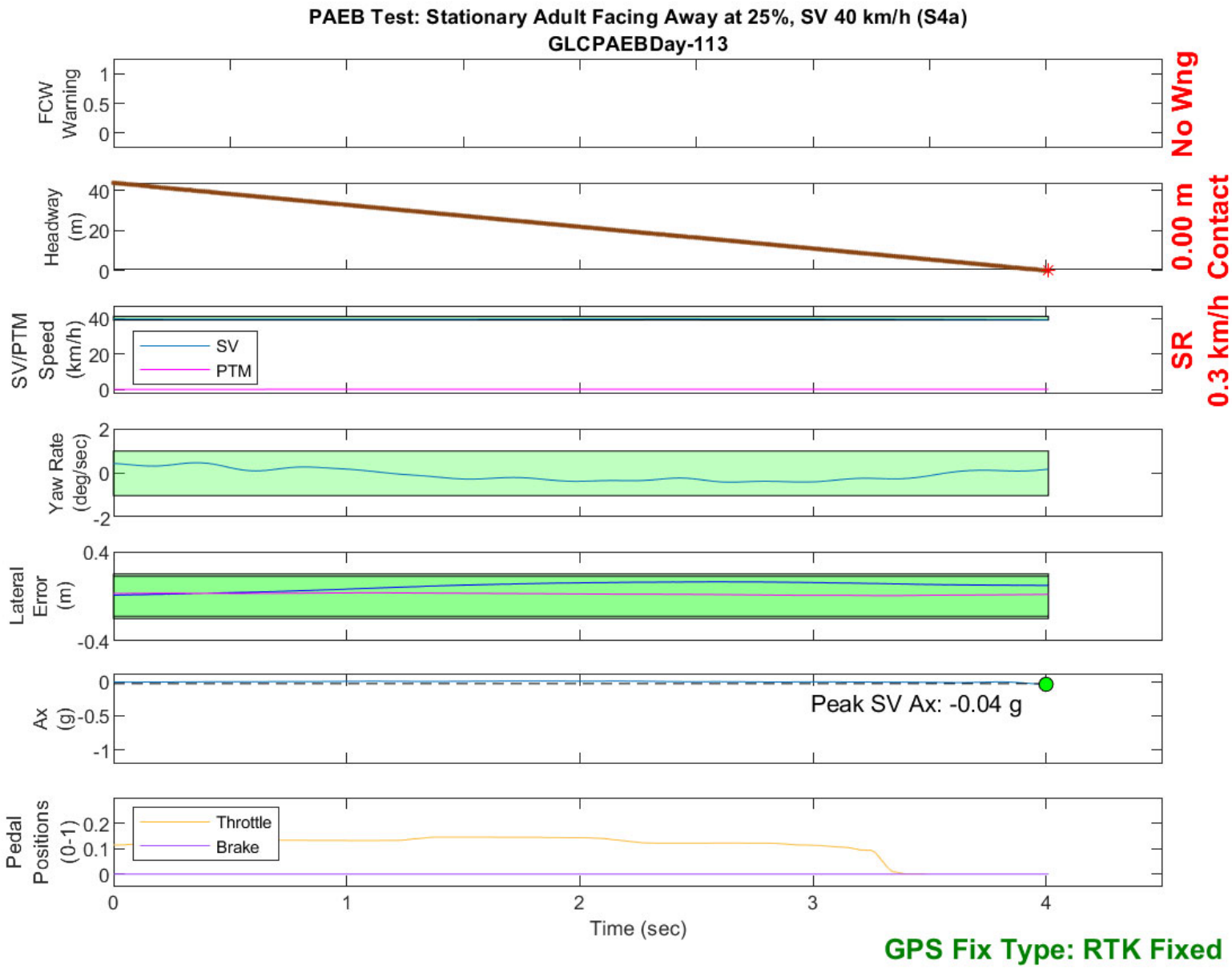

Figure D114. Time History for PAEB Run 113, S4a, Daytime, 40 km/h

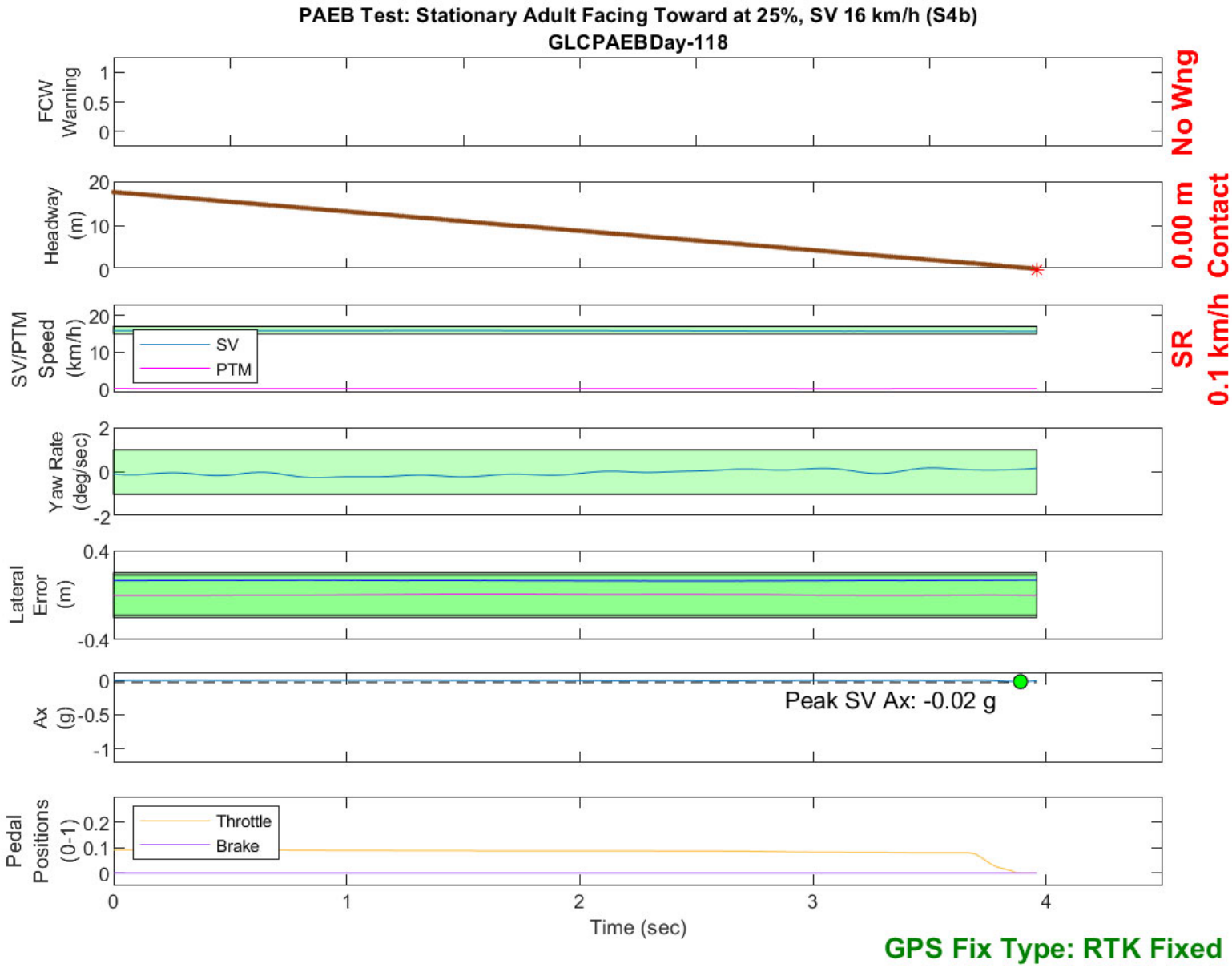

Figure D115. Time History for PAEB Run 118, S4b, Daytime, 16 km/h

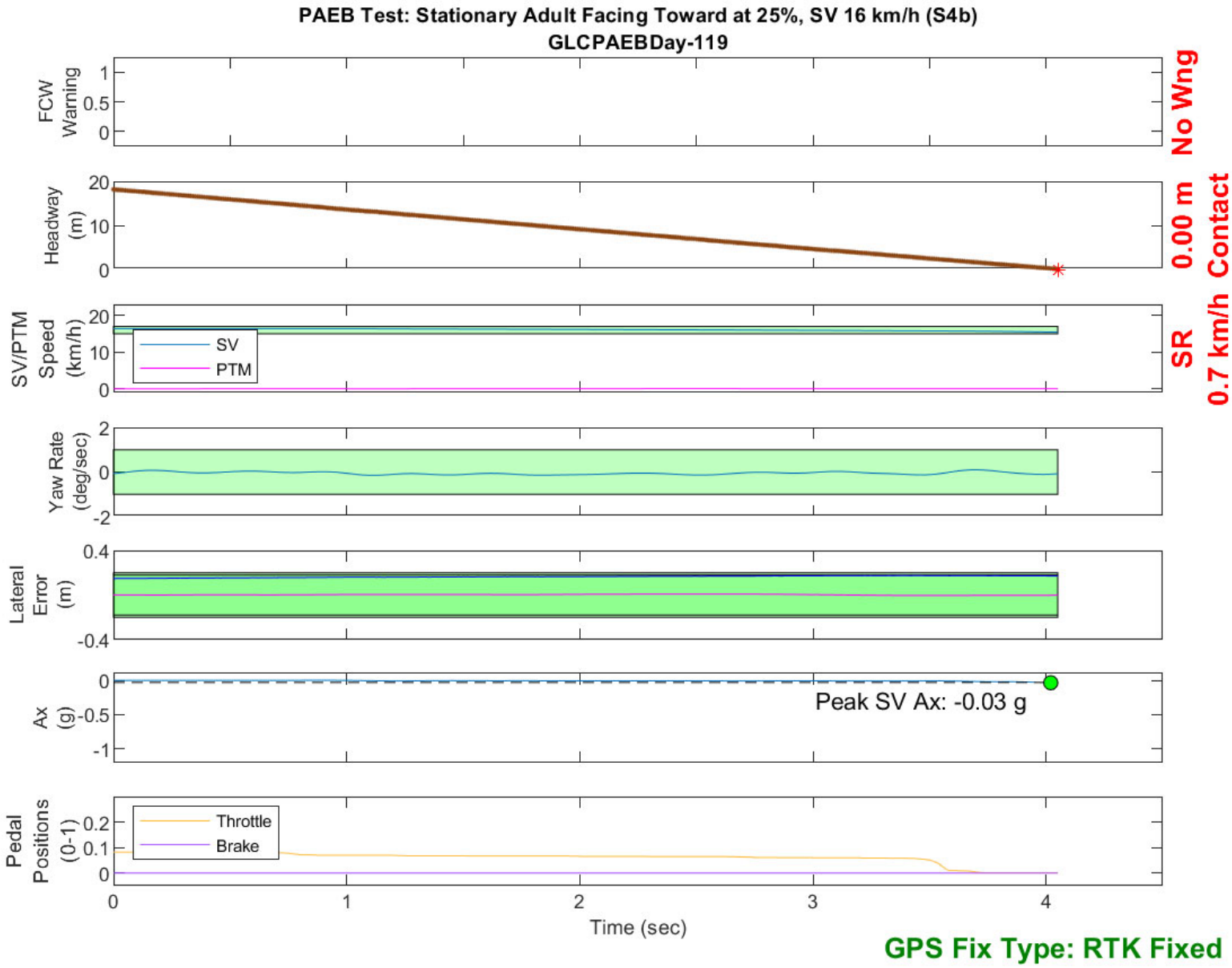

Figure D116. Time History for PAEB Run 119, S4b, Daytime, 16 km/h

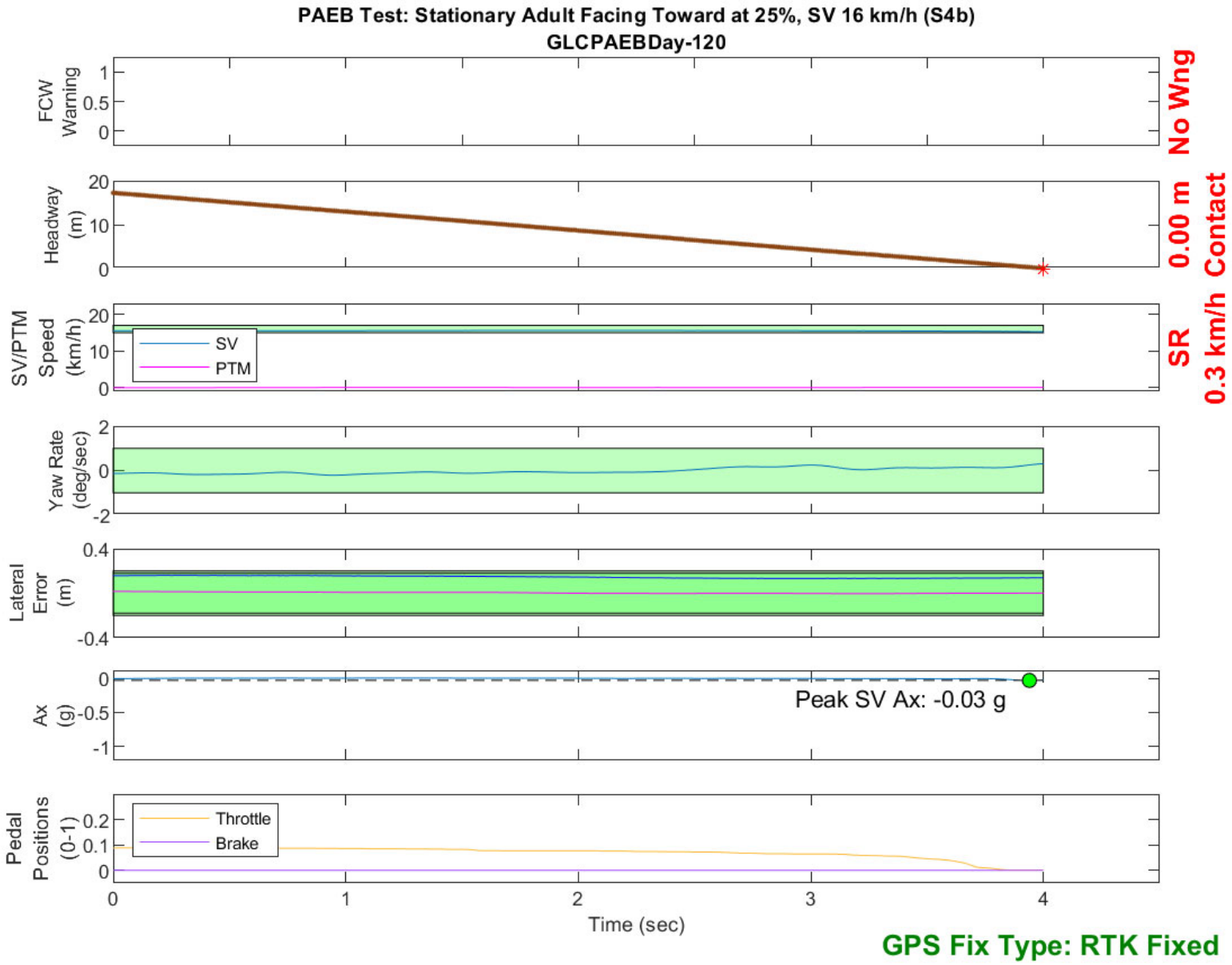

Figure D117. Time History for PAEB Run 120, S4b, Daytime, 16 km/h

Figure D118. Time History for PAEB Run 123, S4b, Daytime, 40 km/h

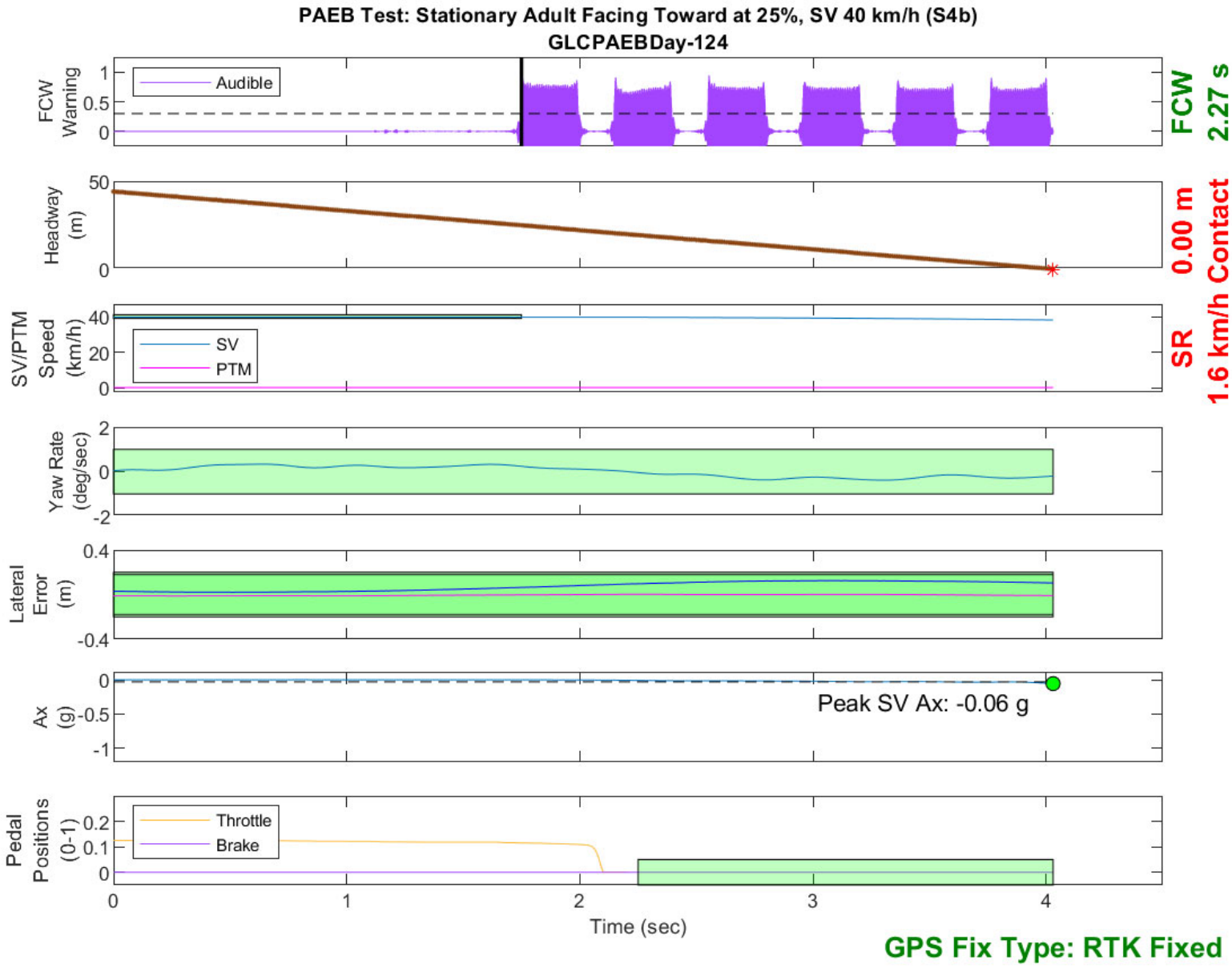

Figure D119. Time History for PAEB Run 124, S4b, Daytime, 40 km/h

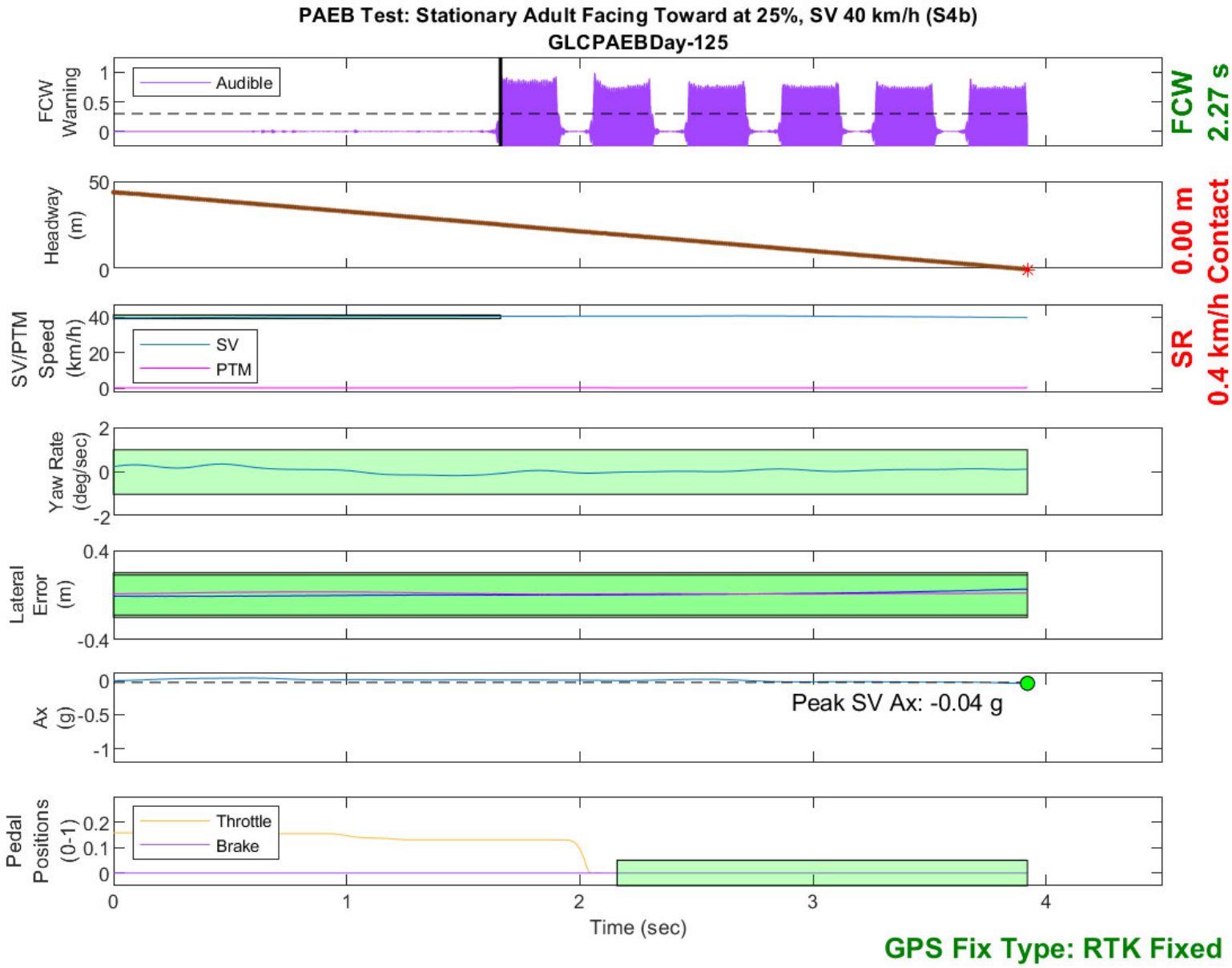

Figure D120. Time History for PAEB Run 125, S4b, Daytime, 40 km/h

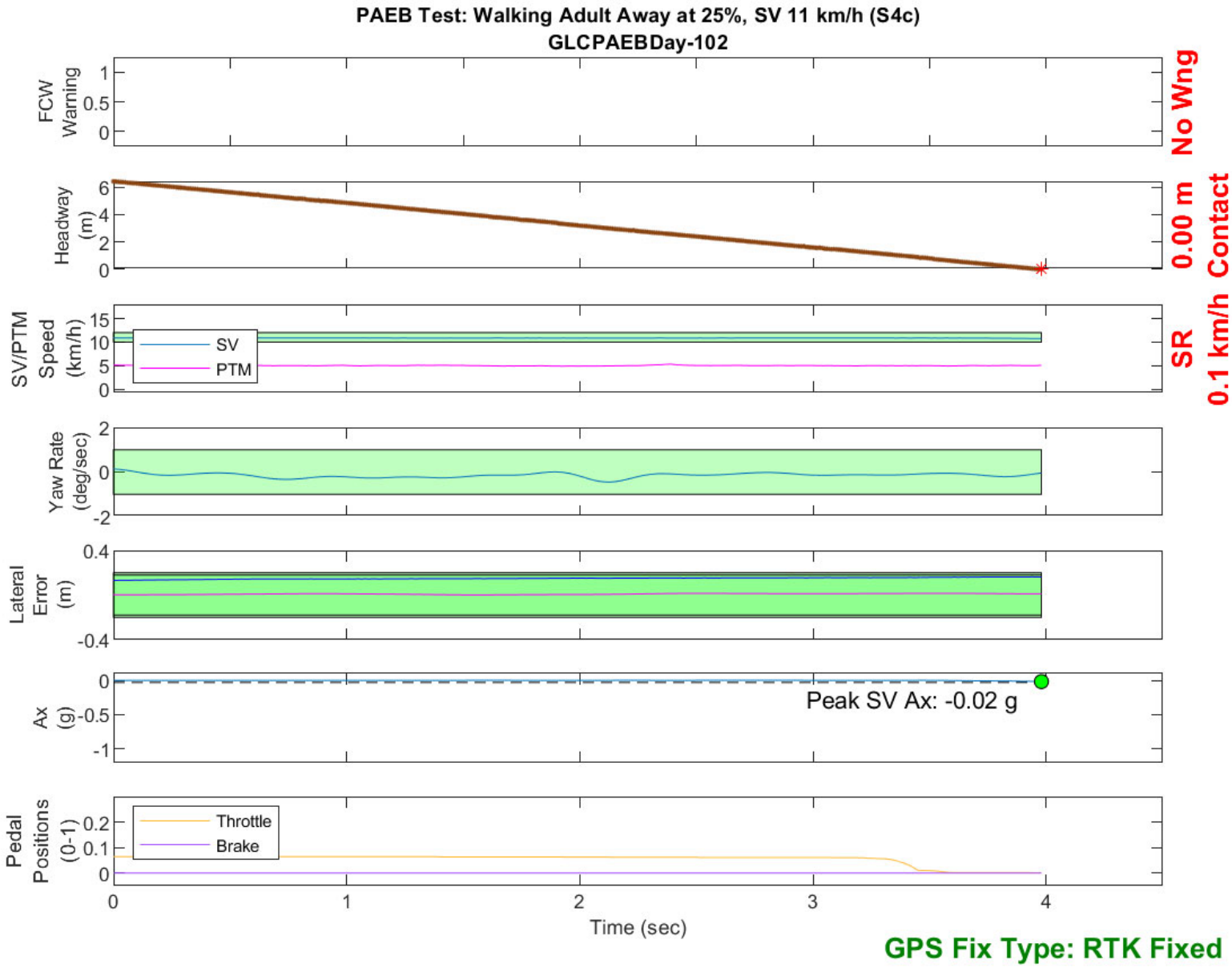

Figure D121. Time History for PAEB Run 102, S4c, Daytime, 11 km/h

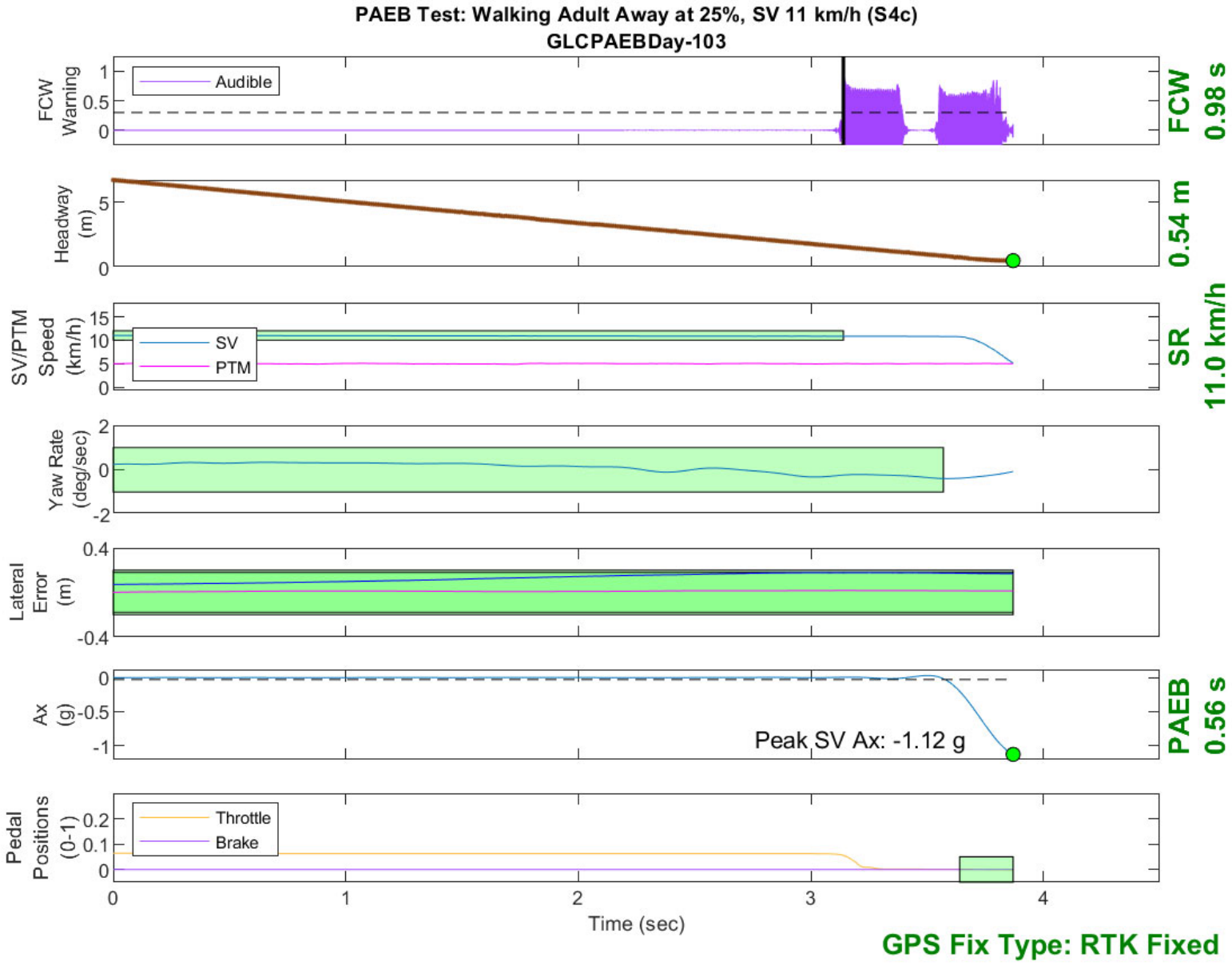

Figure D122. Time History for PAEB Run 103, S4c, Daytime, 11 km/h

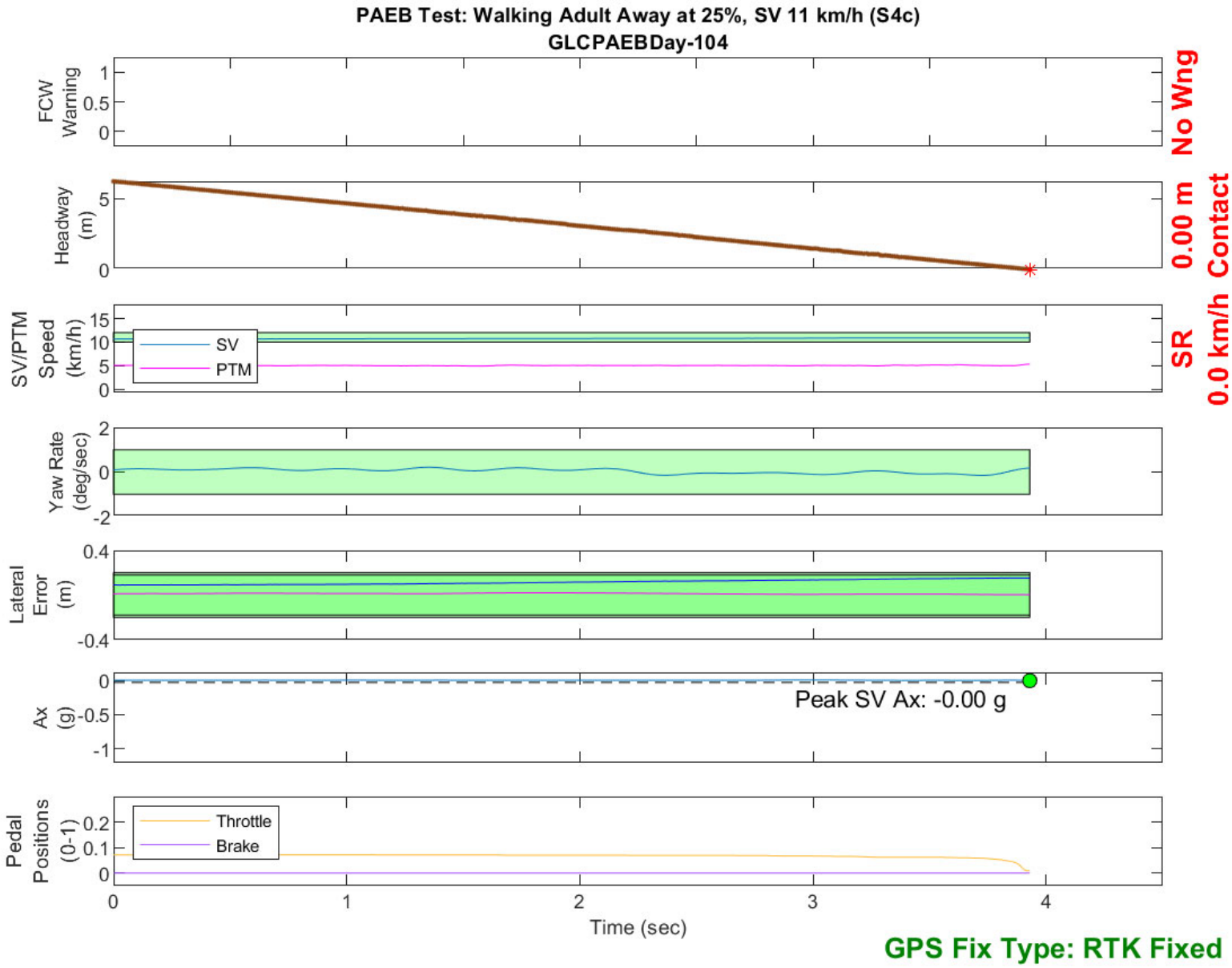

Figure D123. Time History for PAEB Run 104, S4c, Daytime, 11 km/h

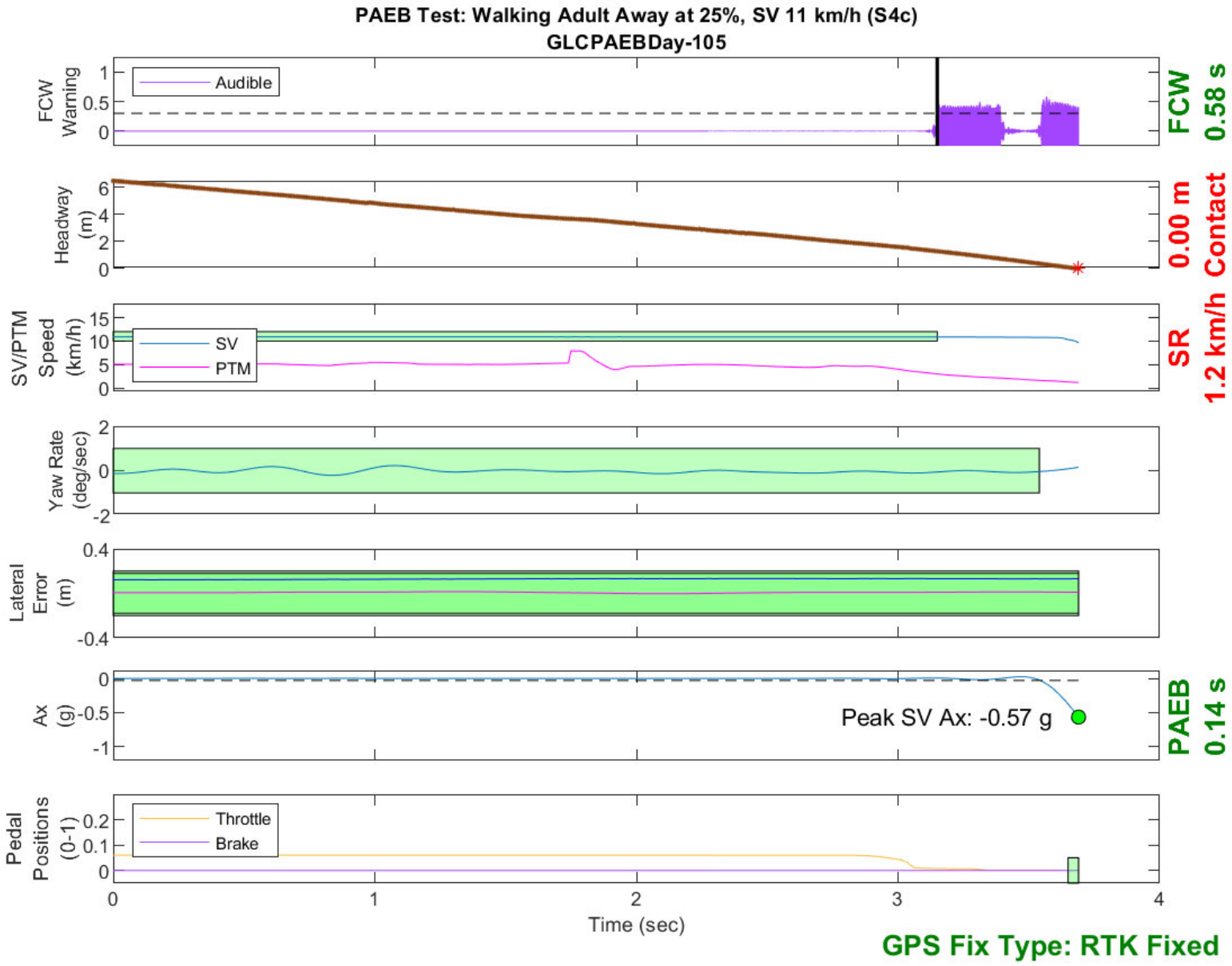

Figure D124. Time History for PAEB Run 105, S4c, Daytime, 11 km/h

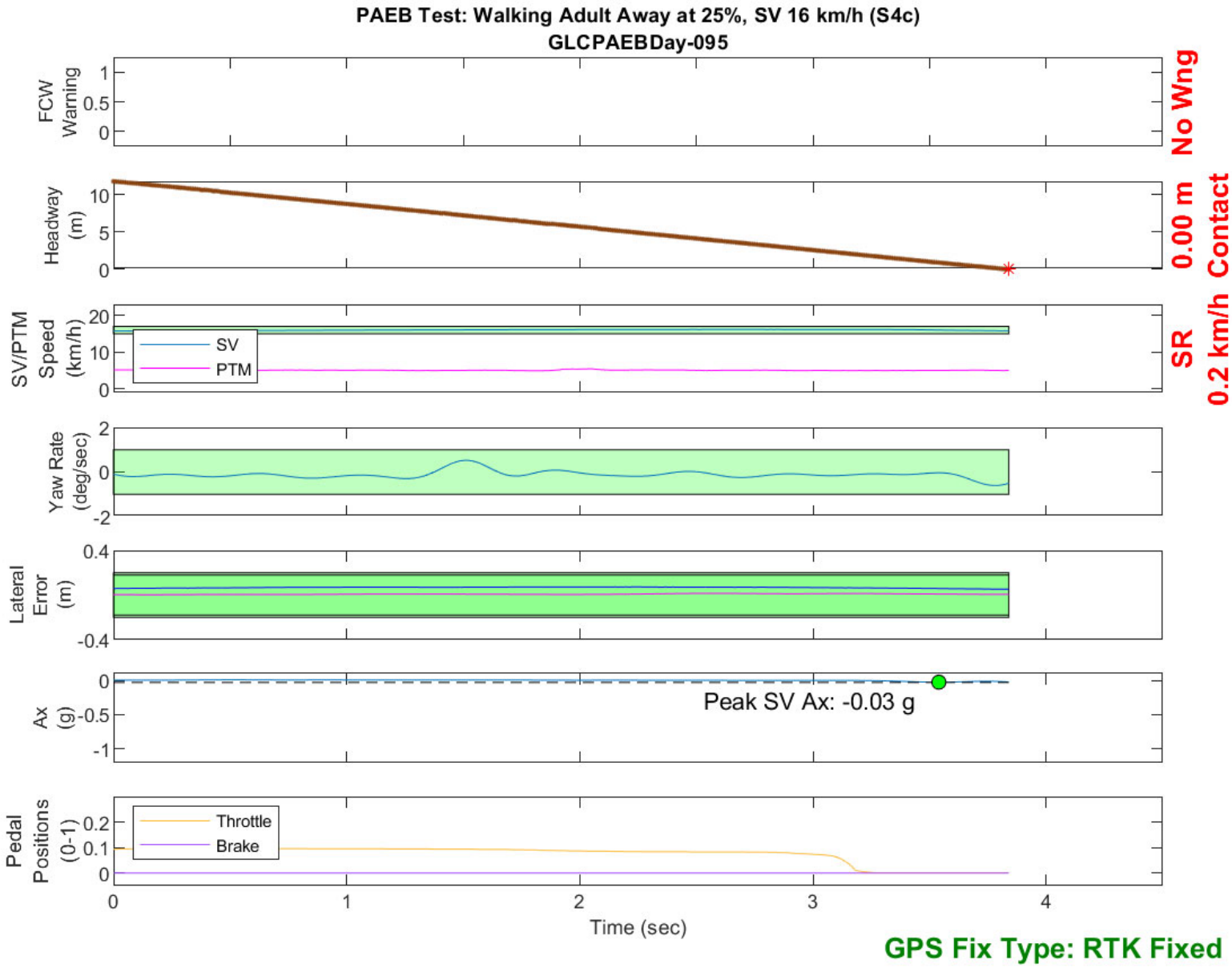

Figure D125. Time History for PAEB Run 95, S4c, Daytime, 16 km/h

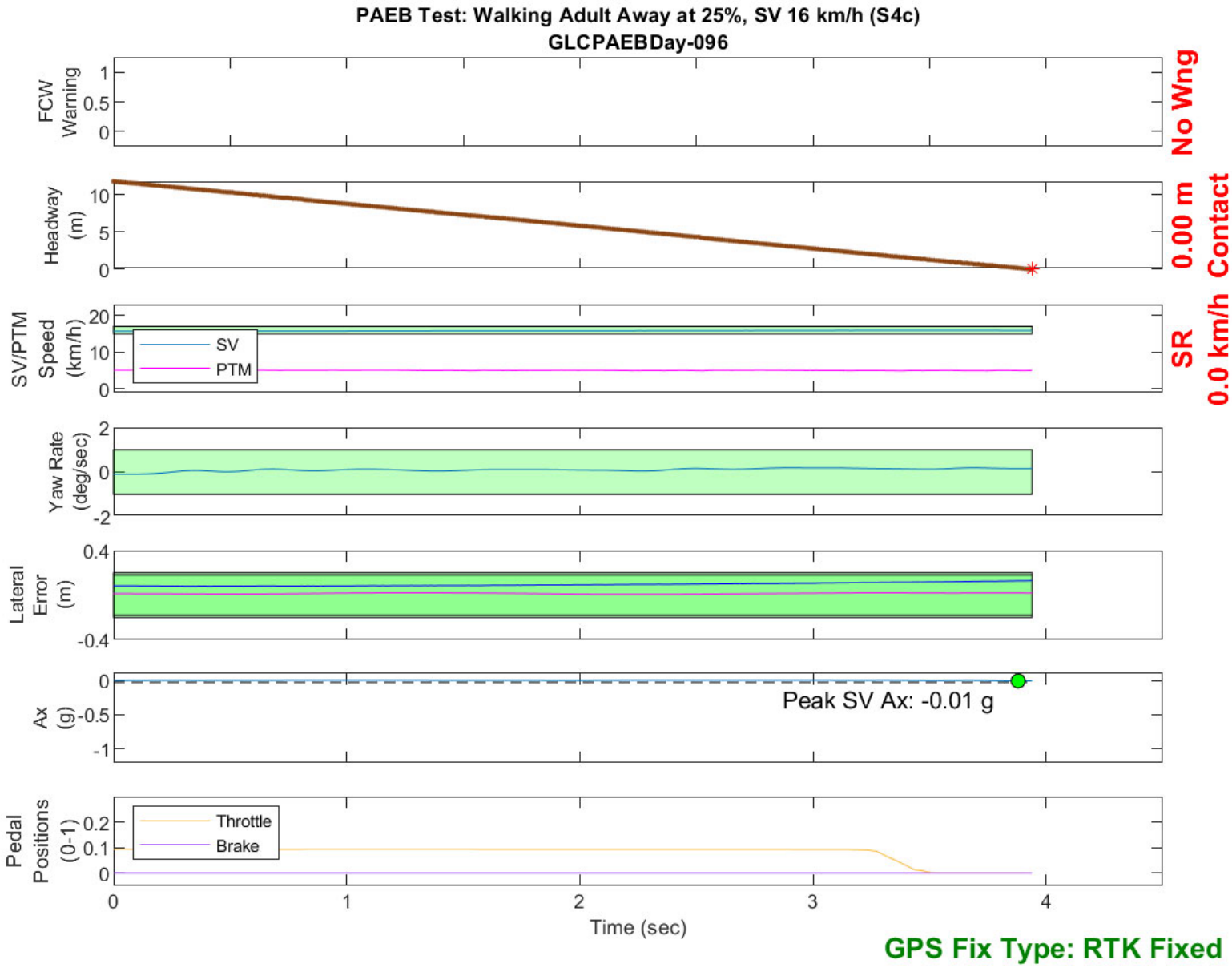

Figure D126. Time History for PAEB Run 96, S4c, Daytime, 16 km/h

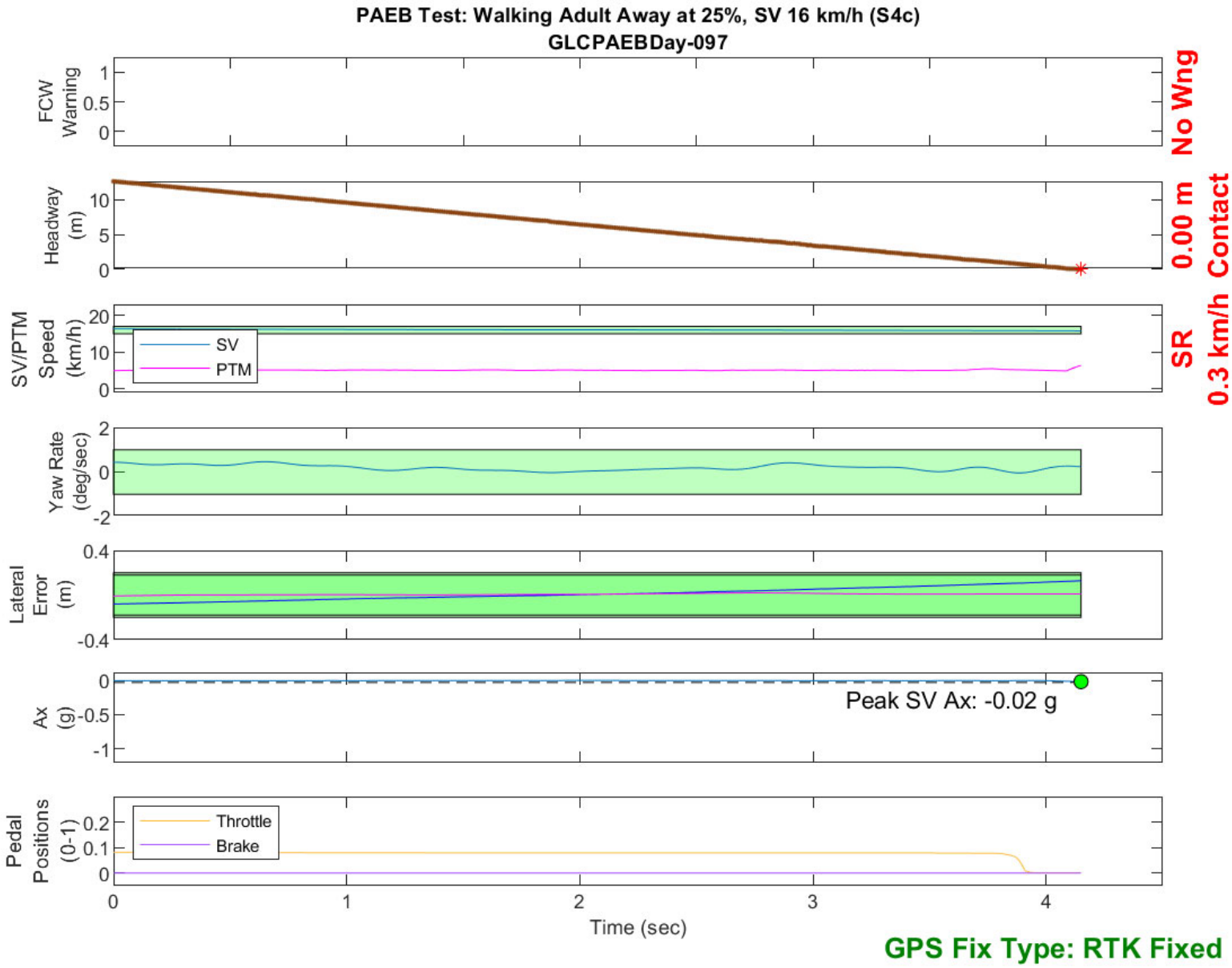

Figure D127. Time History for PAEB Run 97, S4c, Daytime, 16 km/h

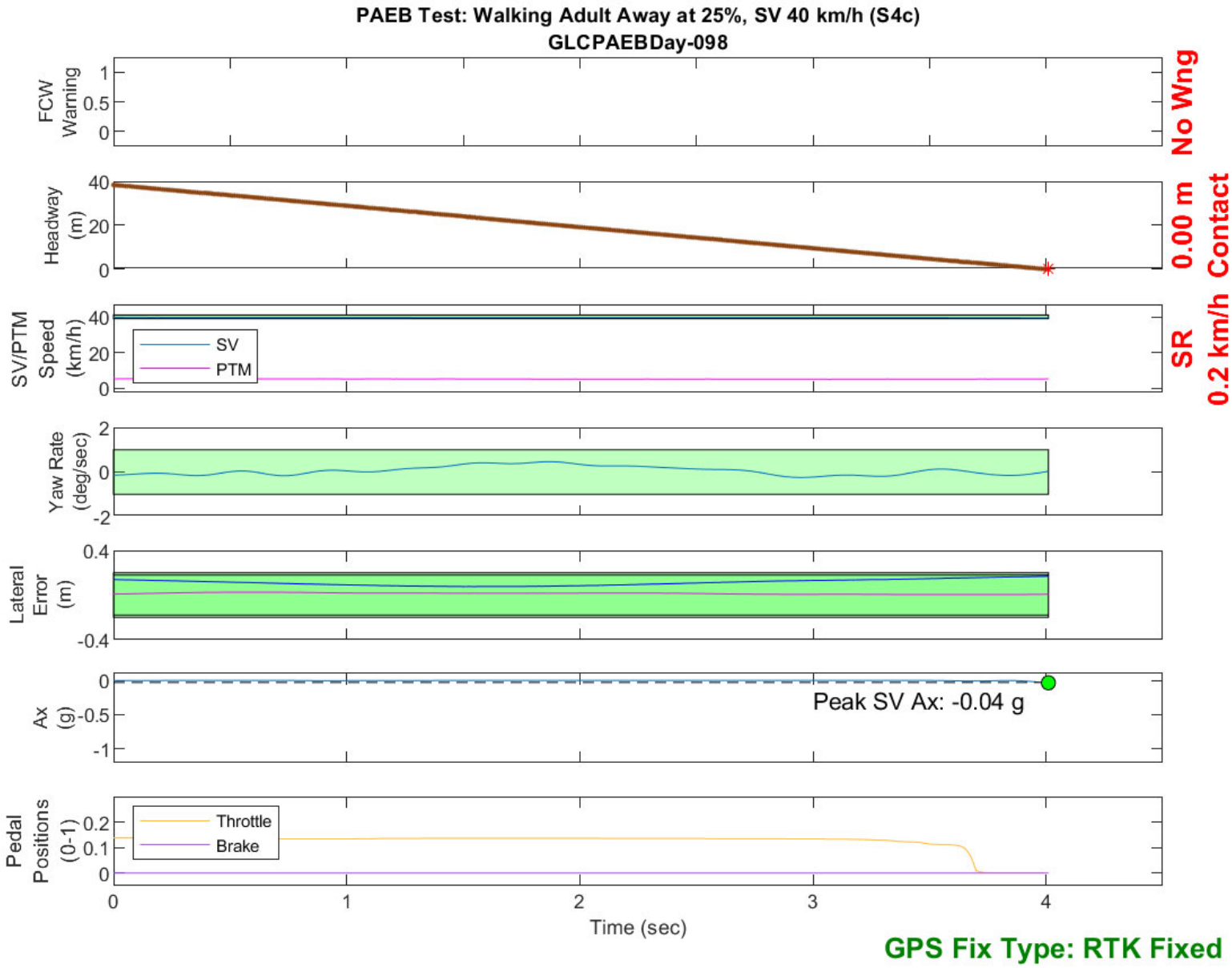

Figure D128. Time History for PAEB Run 98, S4c, Daytime, 40 km/h

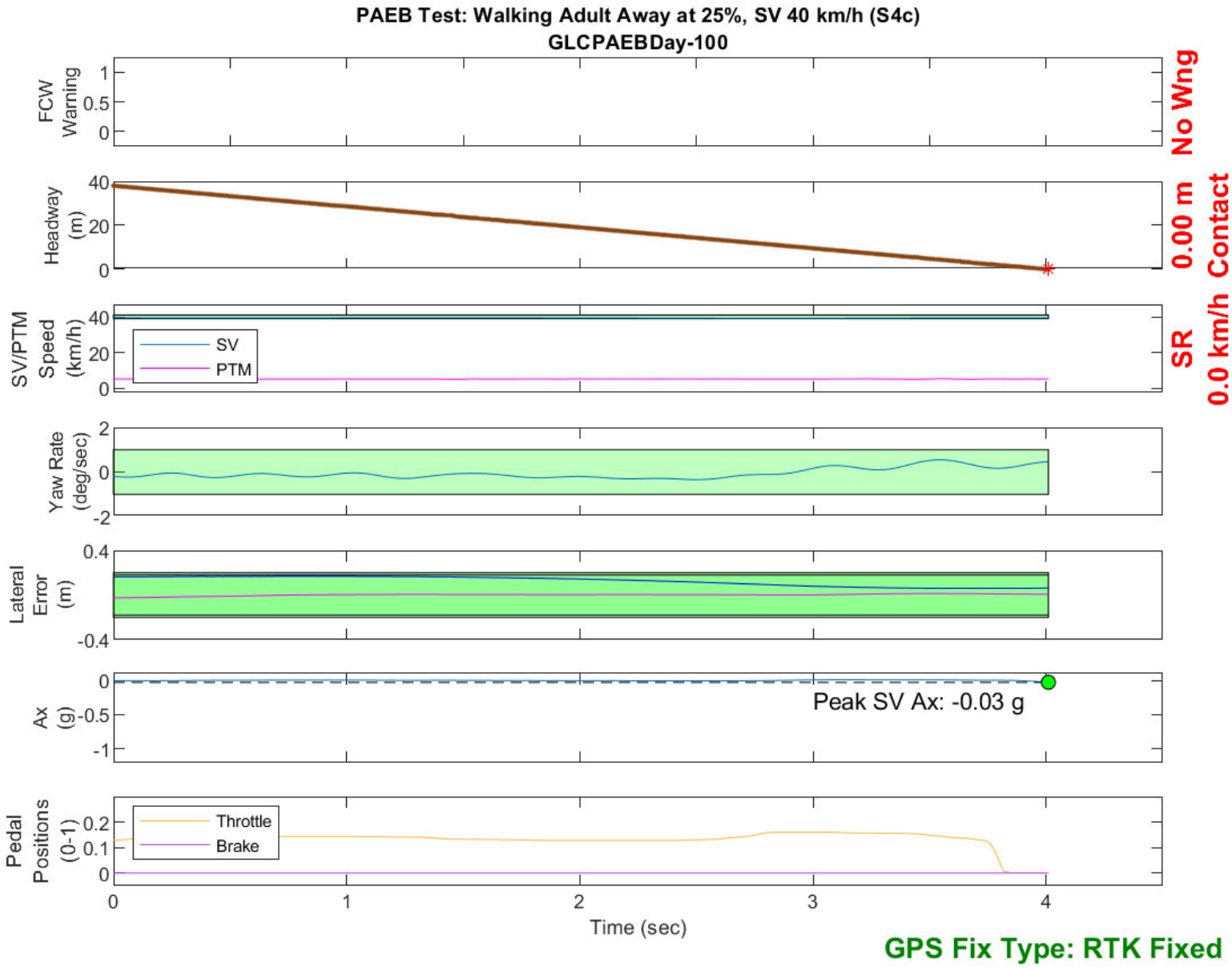

Figure D129. Time History for PAEB Run 100, S4c, Daytime, 40 km/h

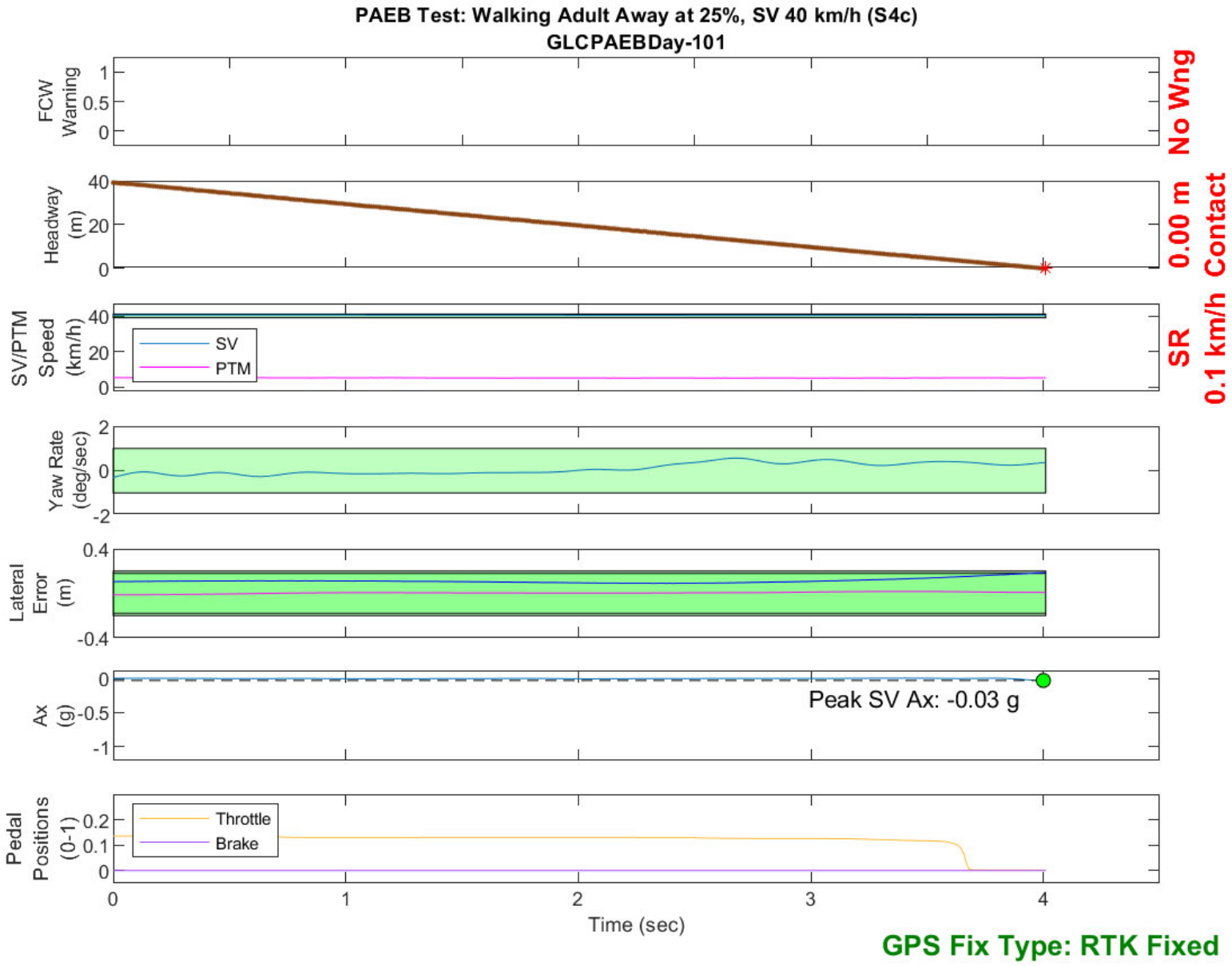

Figure D130. Time History for PAEB Run 101, S4c, Daytime, 40 km/h

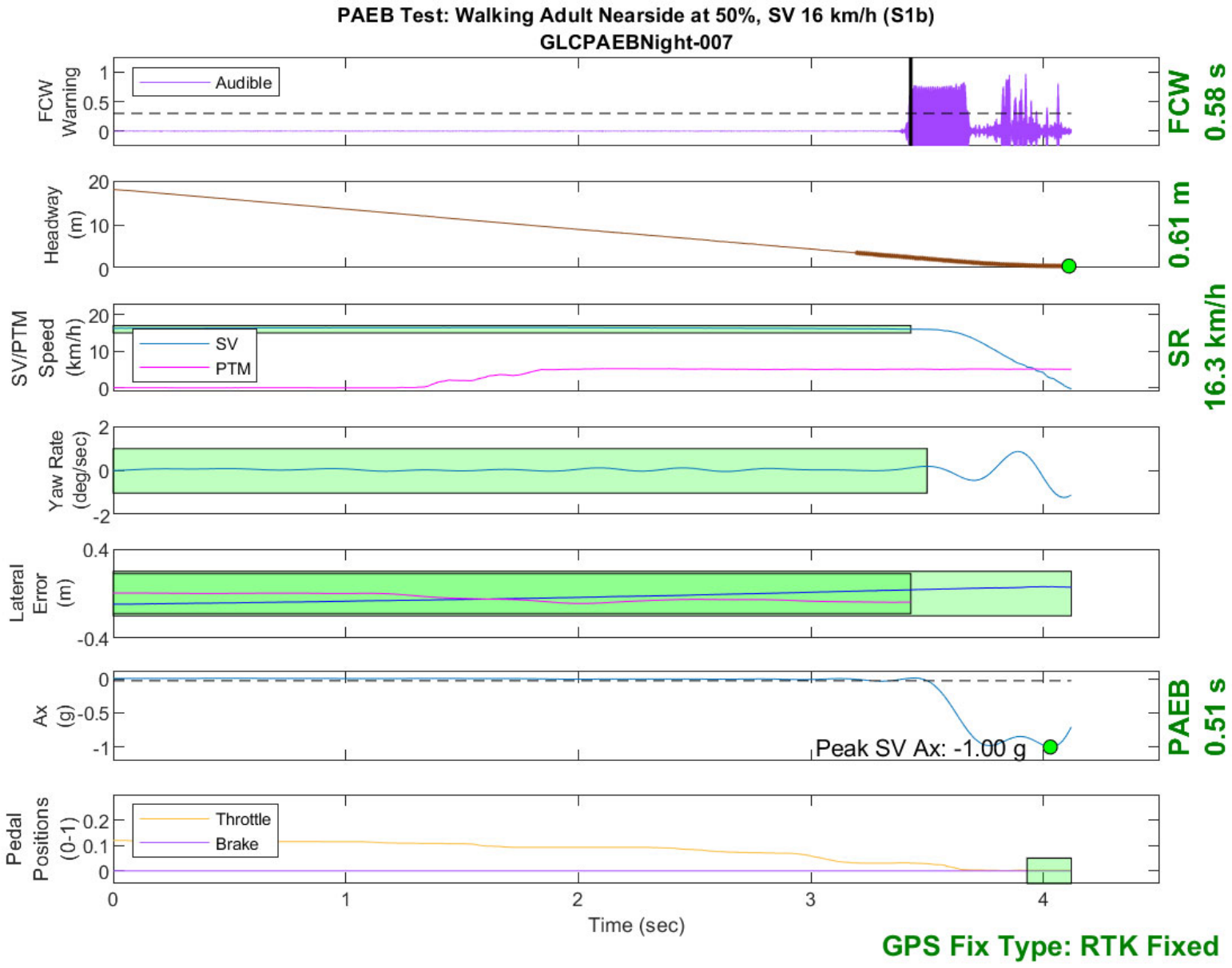

Figure D131. Time History for PAEB Run 7, S1b, Night, High Beam, 16 km/h

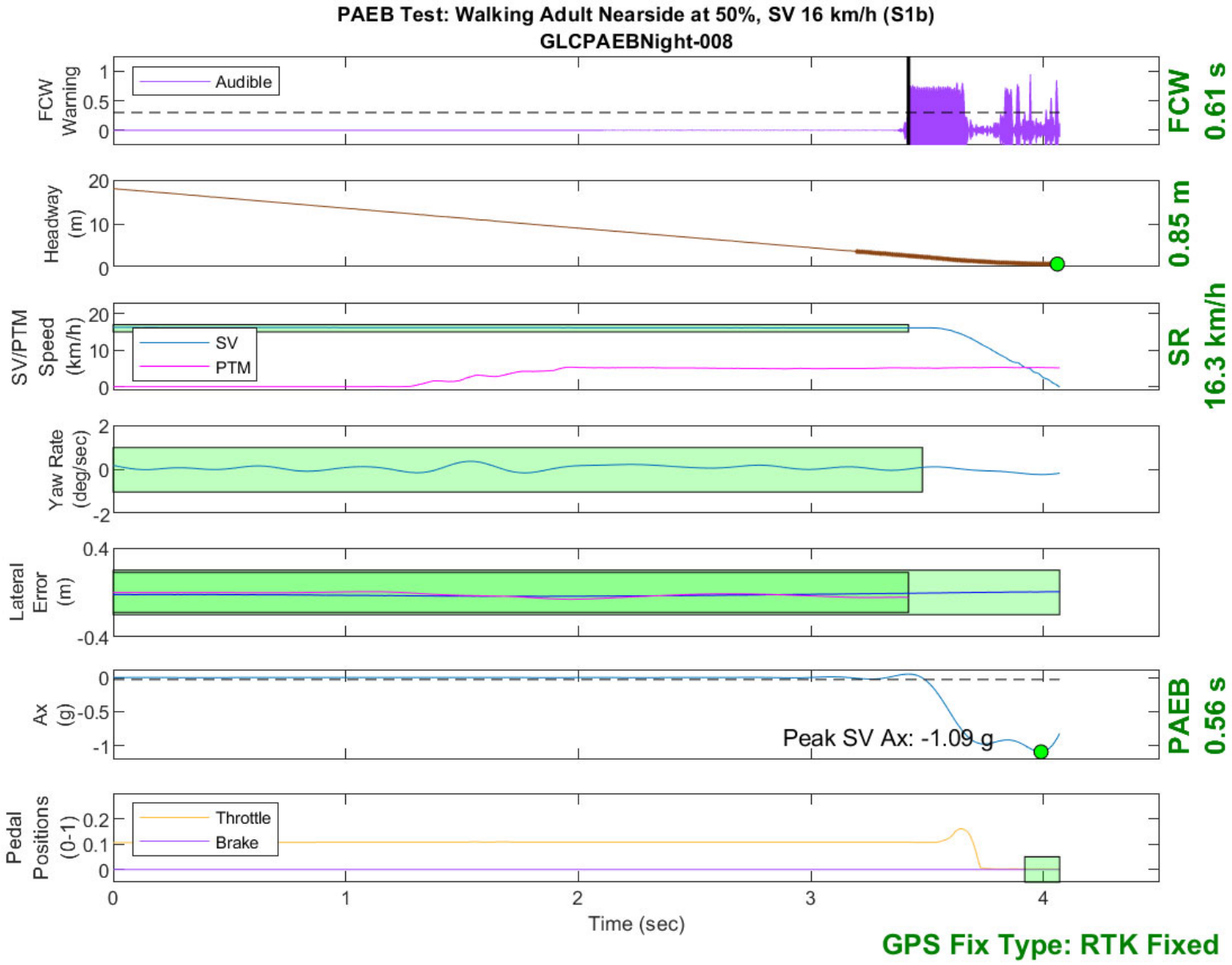

Figure D132. Time History for PAEB Run 8, S1b, Night, High Beam, 16 km/h

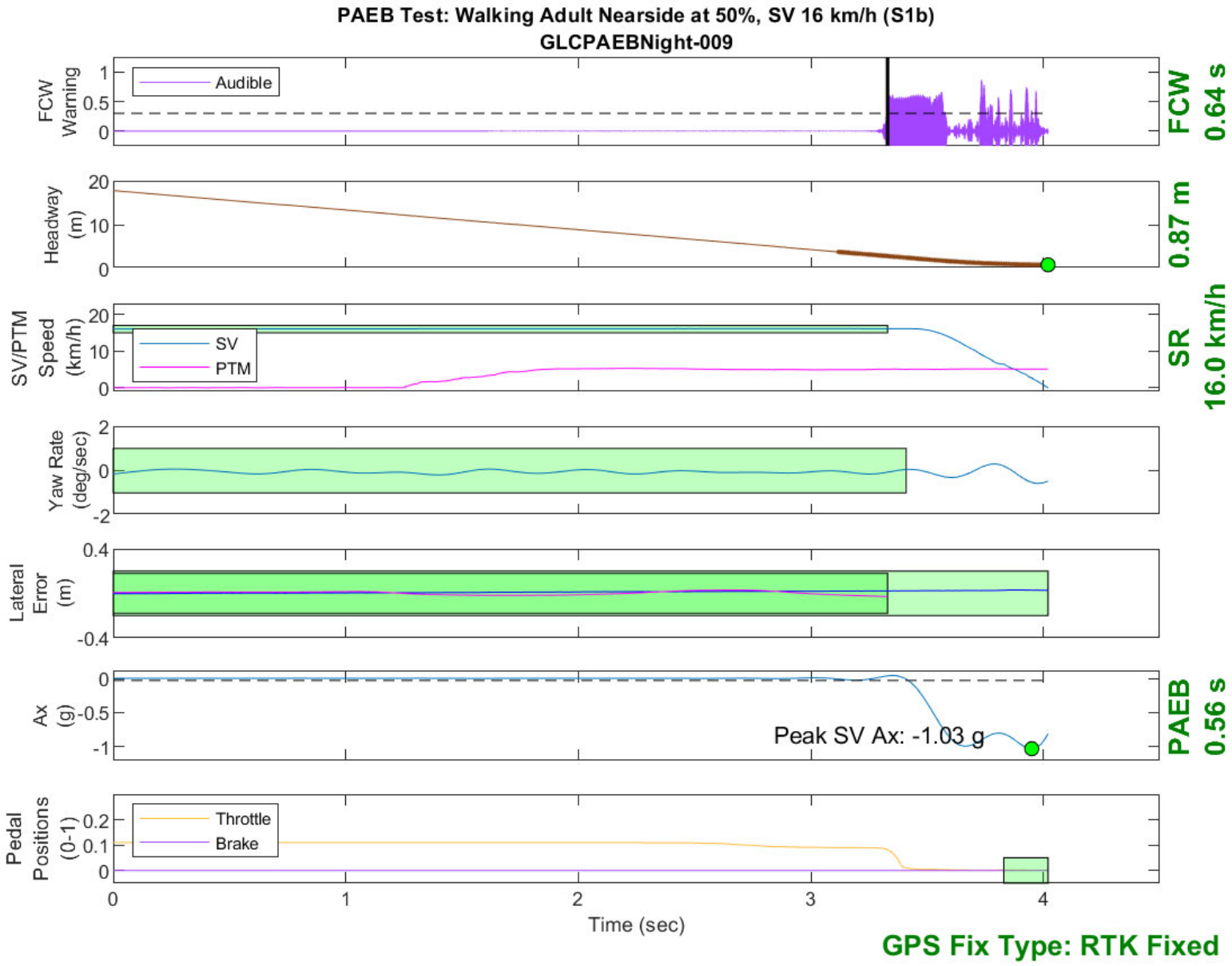

Figure D133. Time History for PAEB Run 9, S1b, Night, High Beam, 16 km/h

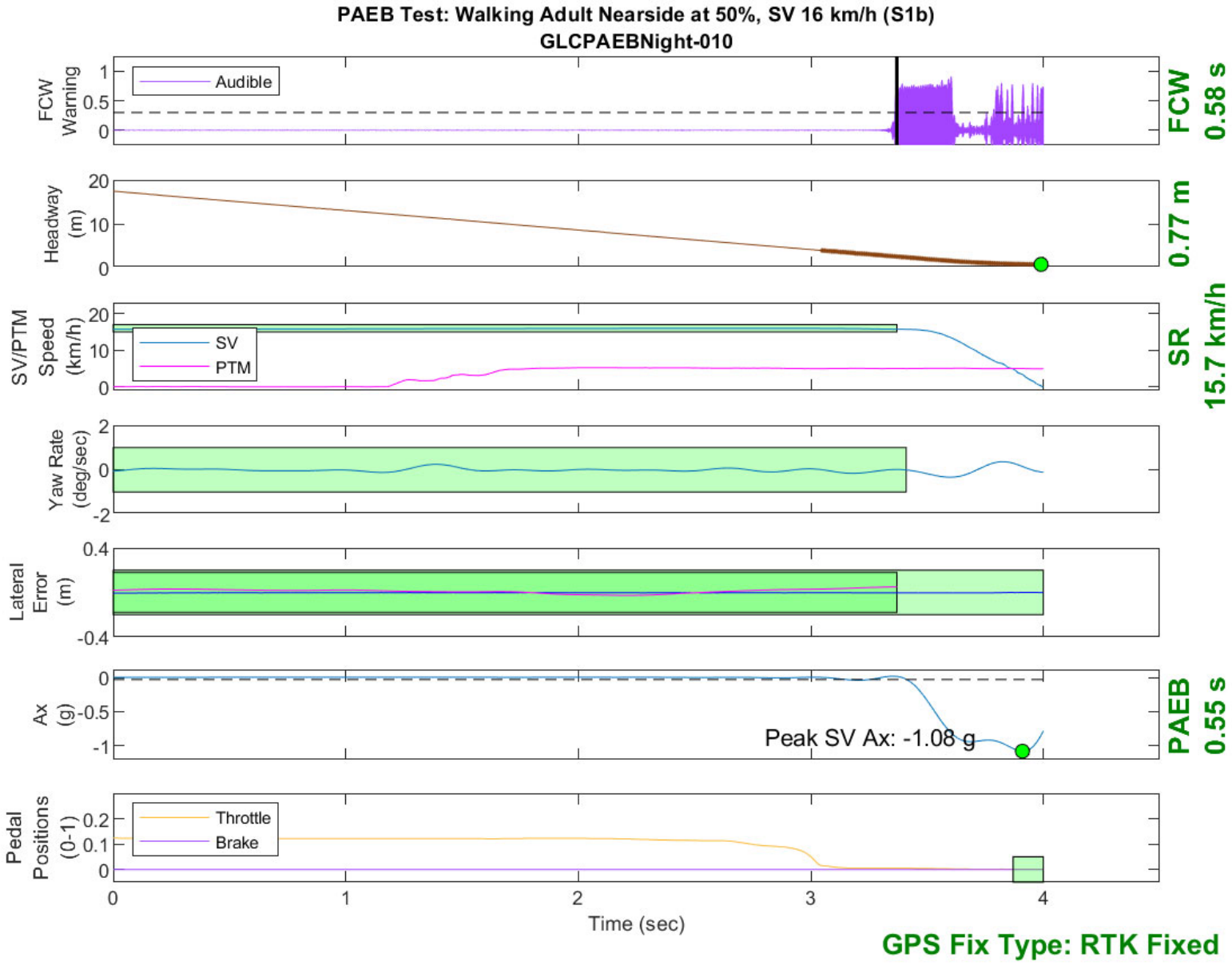

Figure D134. Time History for PAEB Run 10, S1b, Night, High Beam, 16 km/h

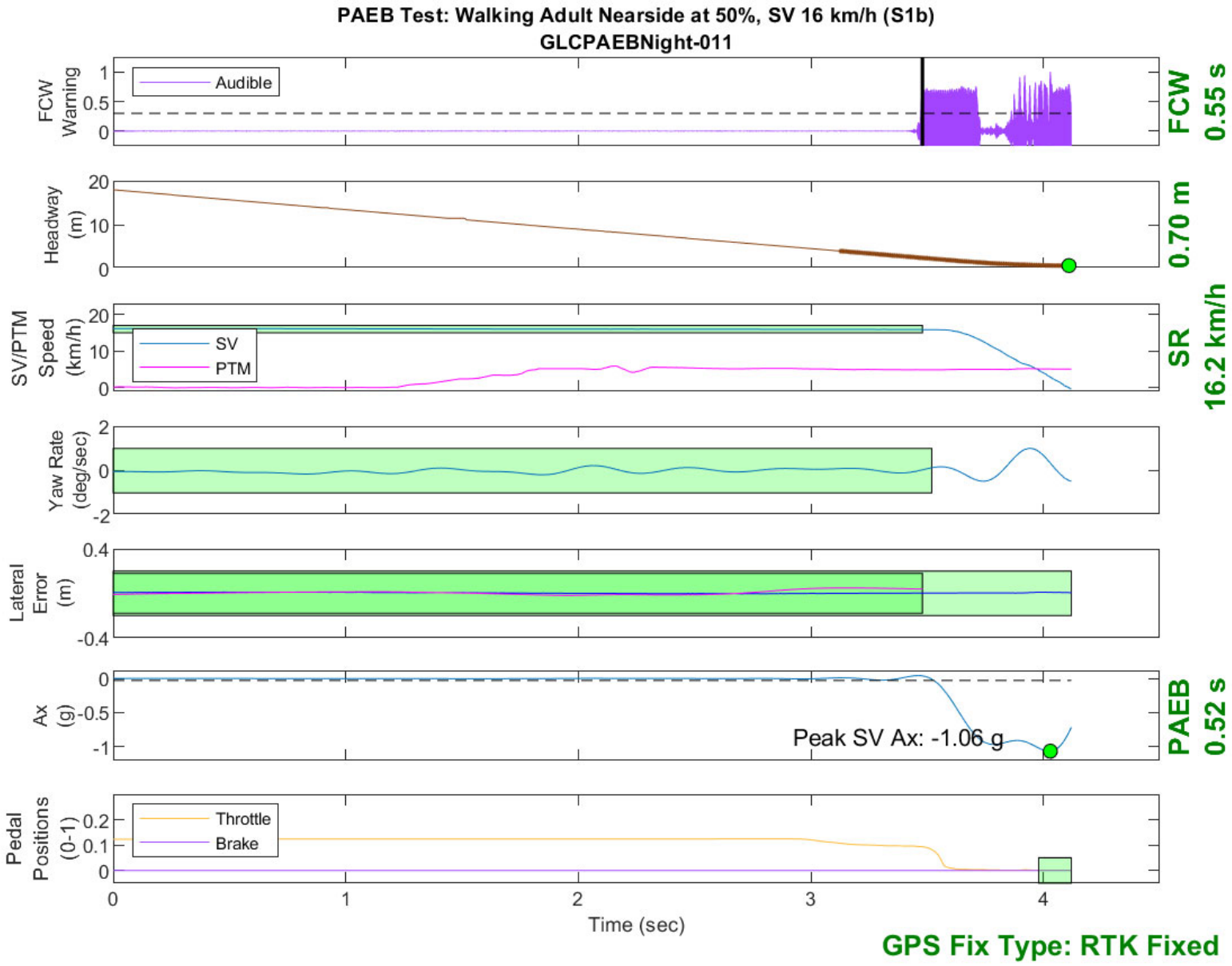

Figure D135. Time History for PAEB Run 11, S1b, Night, High Beam, 16 km/h

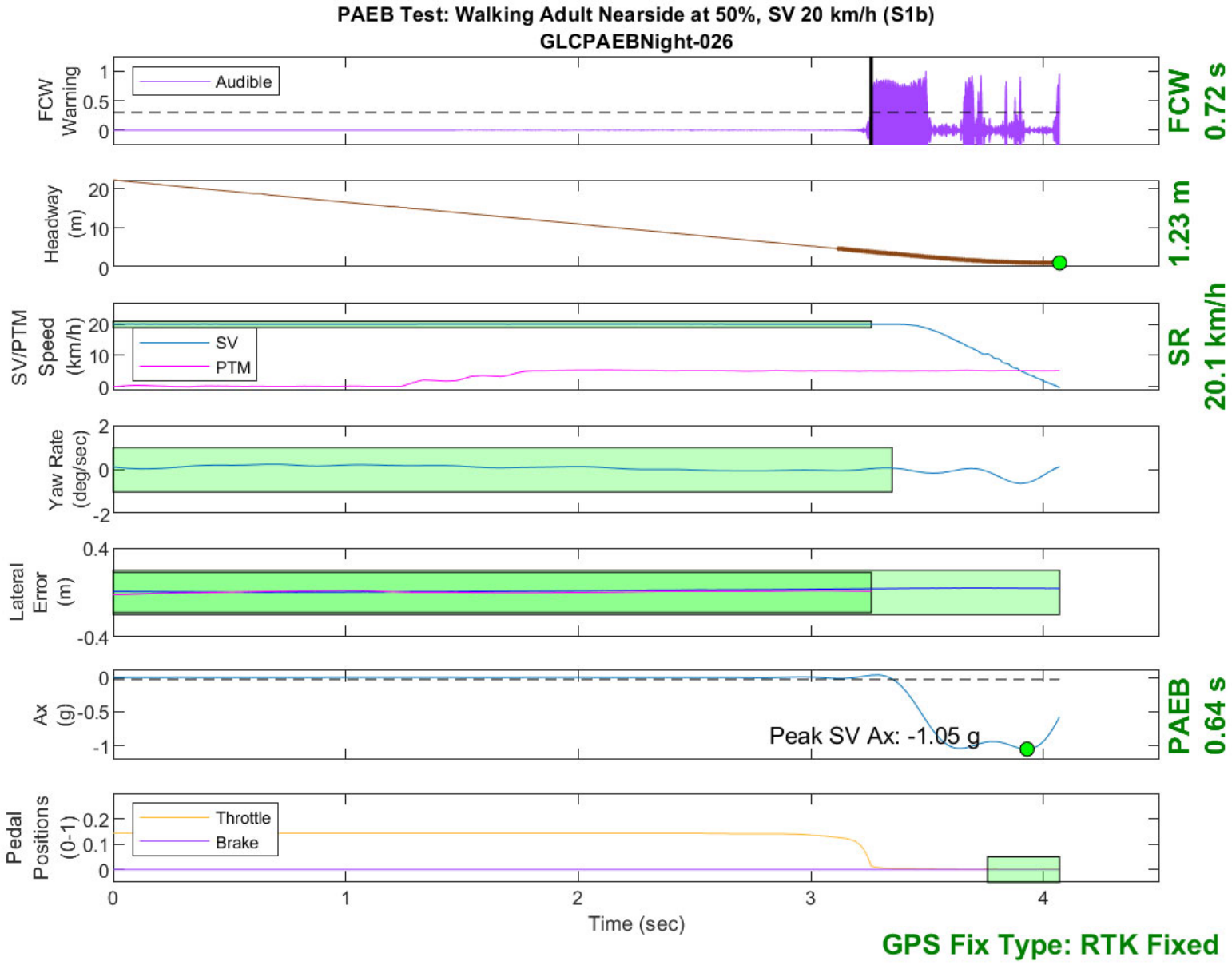

Figure D136. Time History for PAEB Run 26, S1b, Night, High Beam, 20 km/h

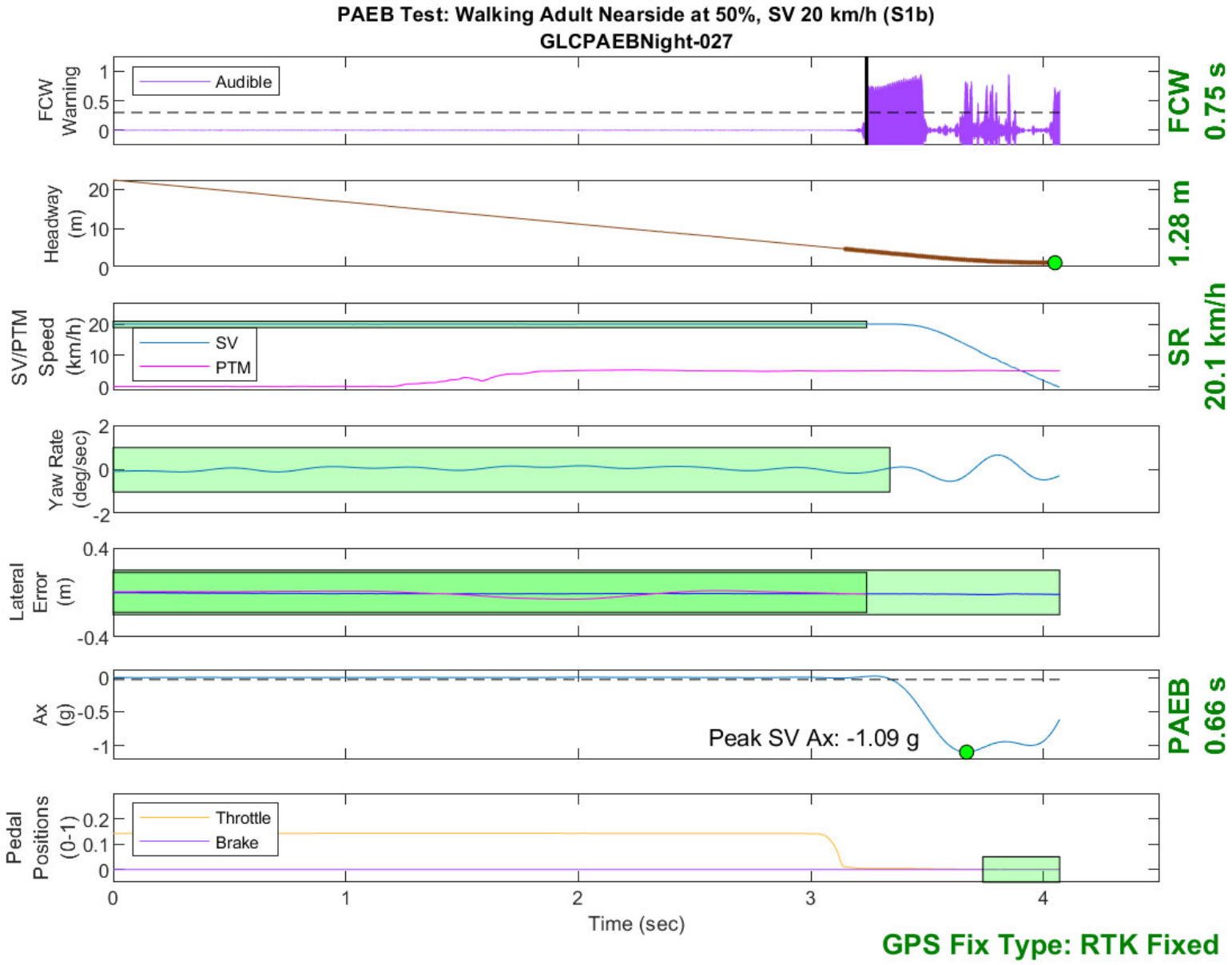

Figure D137. Time History for PAEB Run 27, S1b, Night, High Beam, 20 km/h

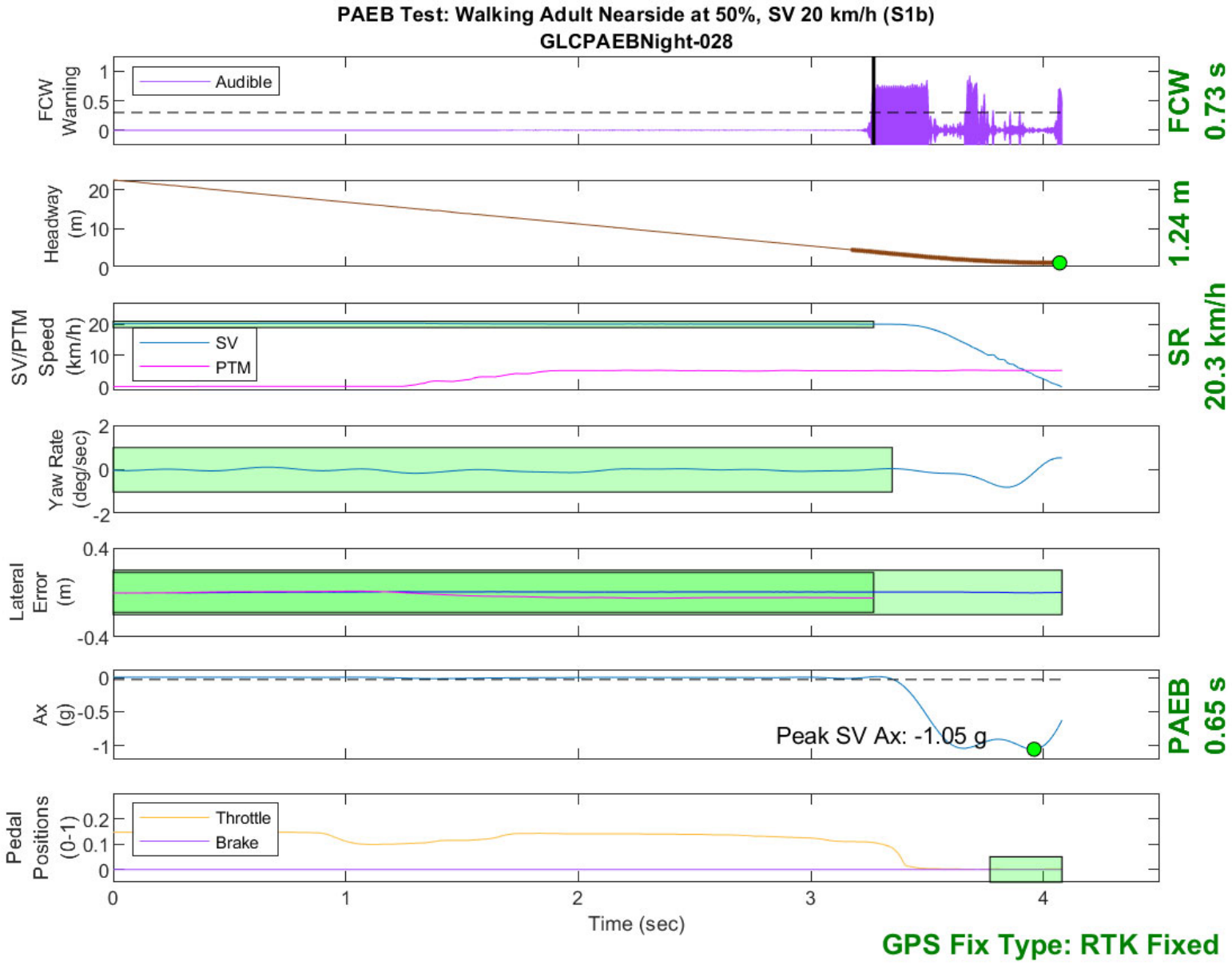

Figure D138. Time History for PAEB Run 28, S1b, Night, High Beam, 20 km/h

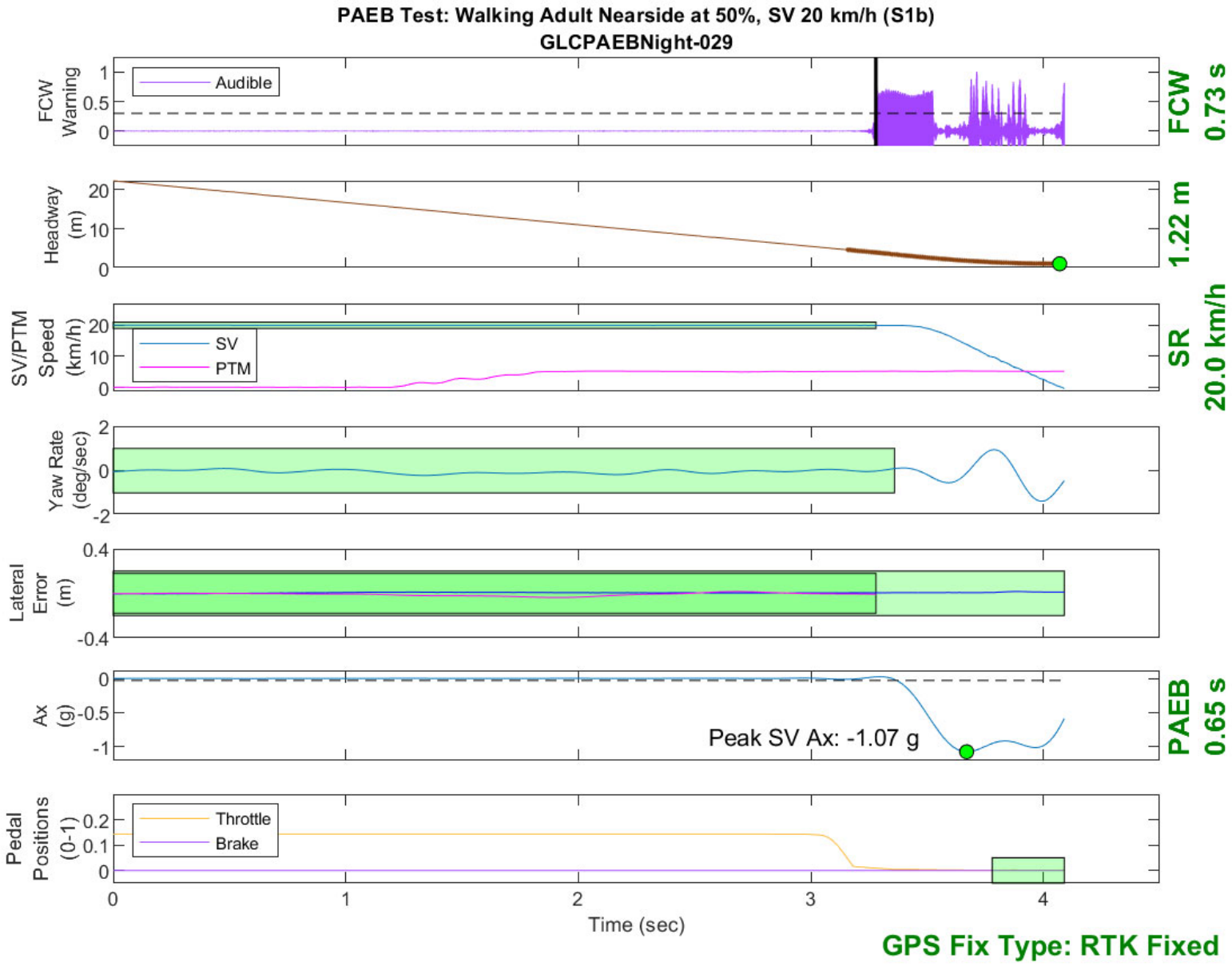

Figure D139. Time History for PAEB Run 29, S1b, Night, High Beam, 20 km/h

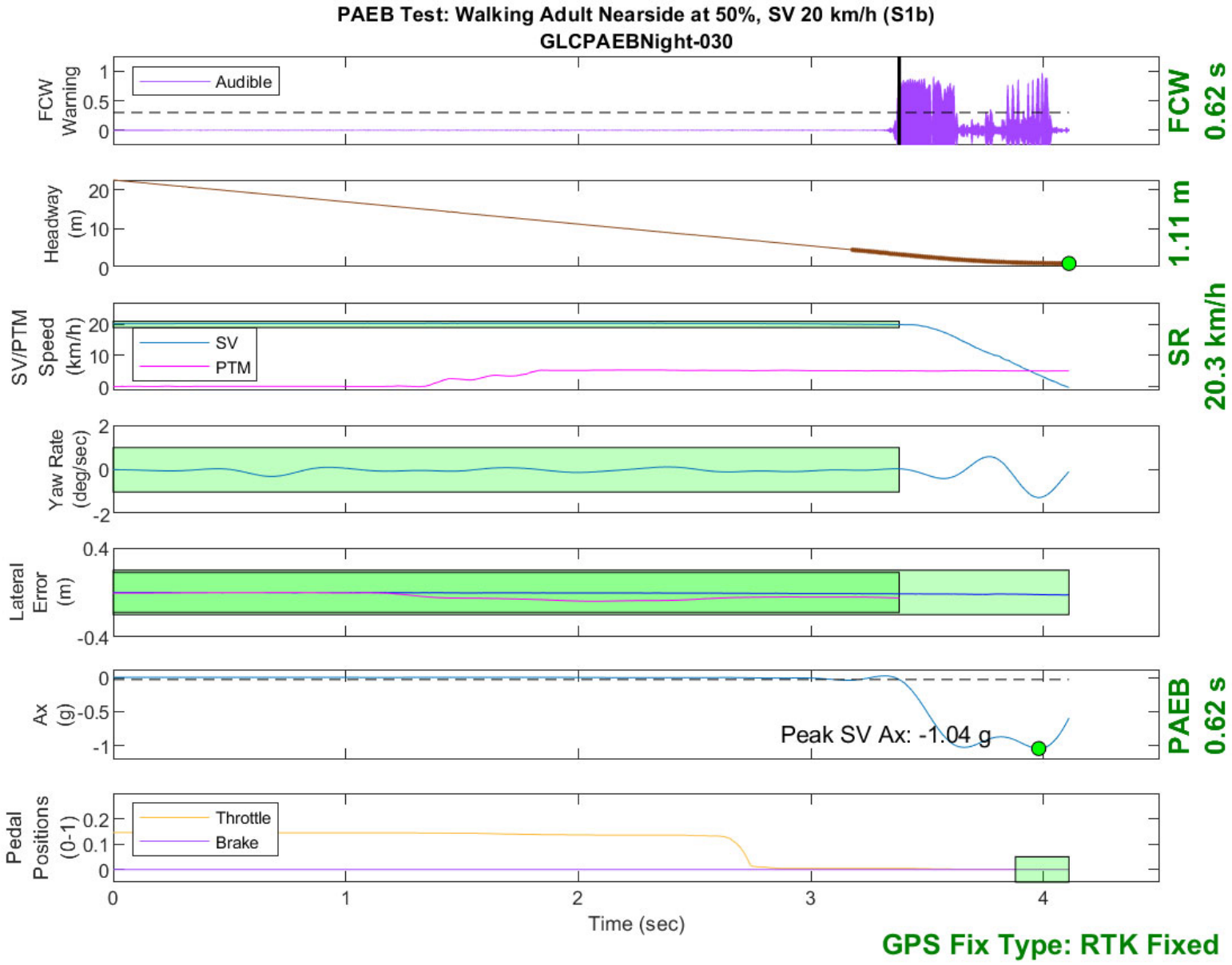

Figure D140. Time History for PAEB Run 30, S1b, Night, High Beam, 20 km/h

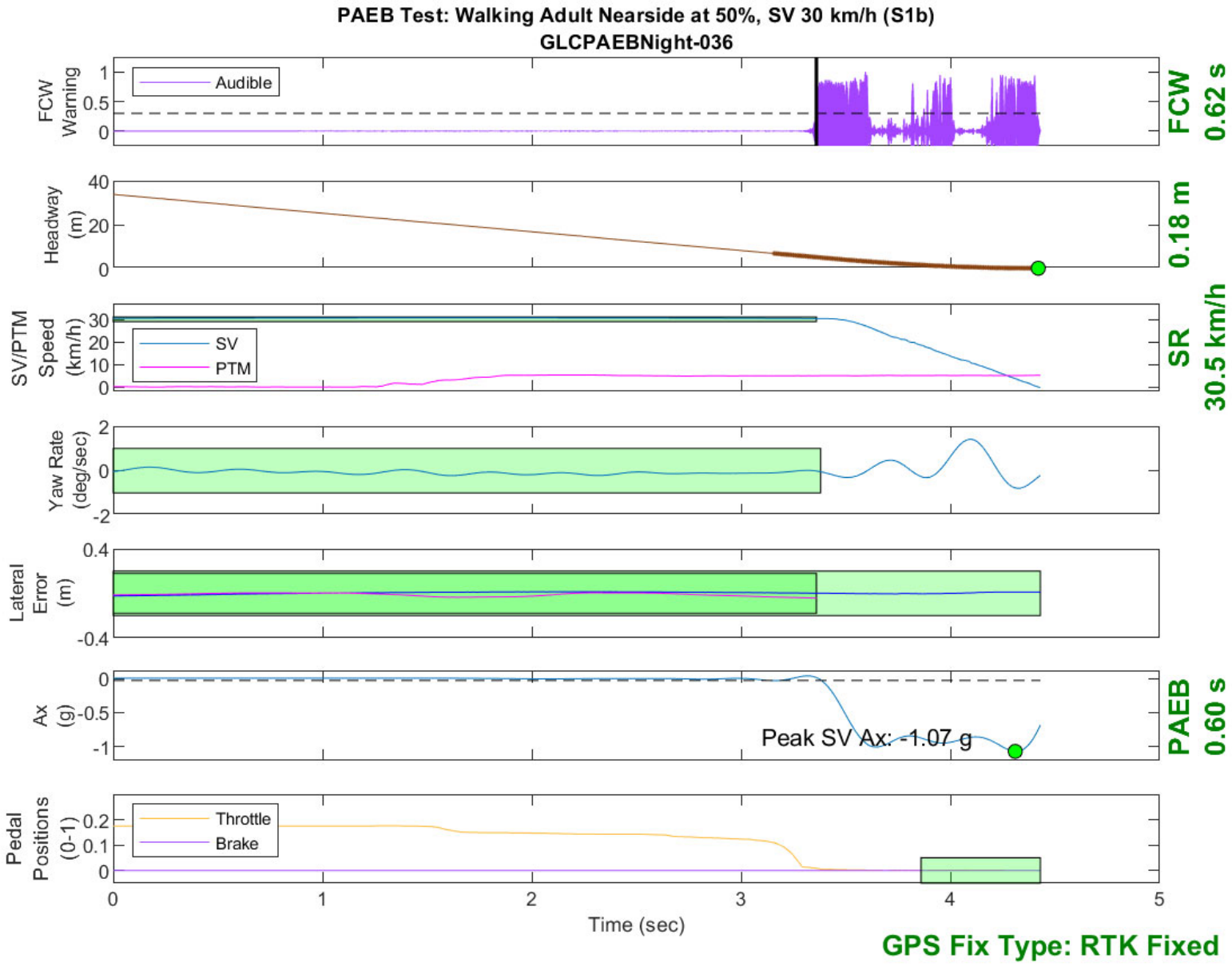

Figure D141. Time History for PAEB Run 36, S1b, Night, High Beam, 30 km/h

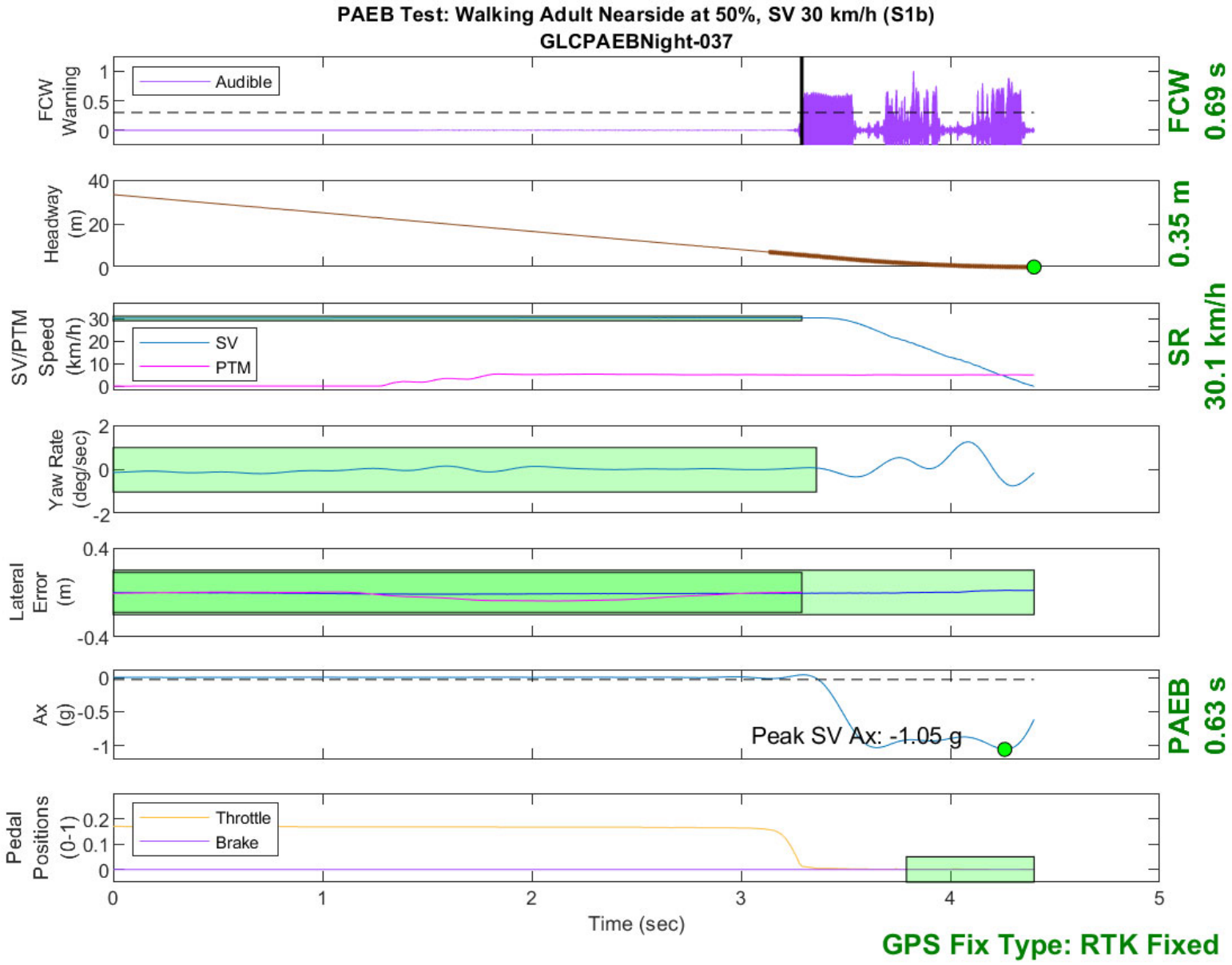

Figure D142. Time History for PAEB Run 37, S1b, Night, High Beam, 30 km/h

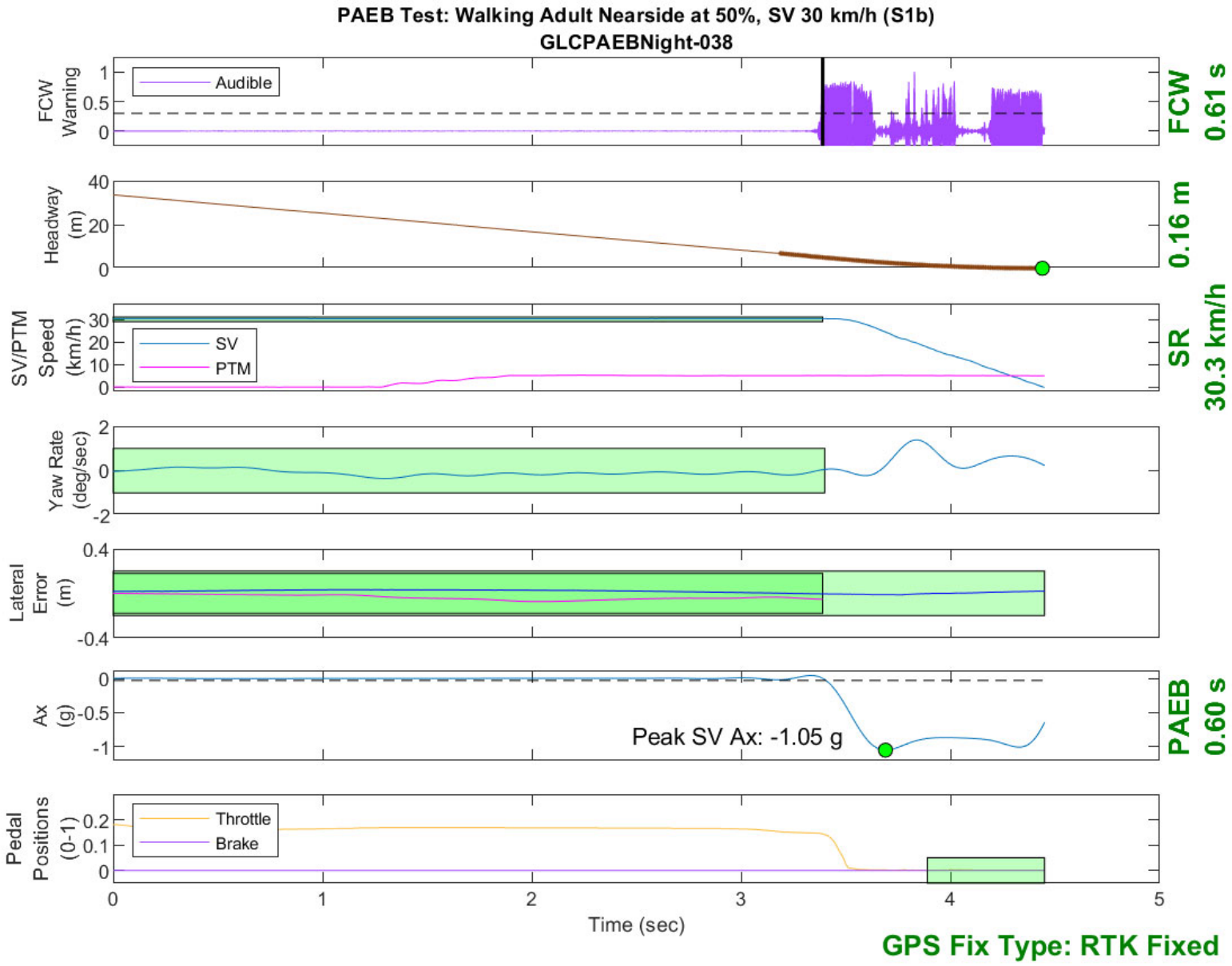

Figure D143. Time History for PAEB Run 38, S1b, Night, High Beam, 30 km/h

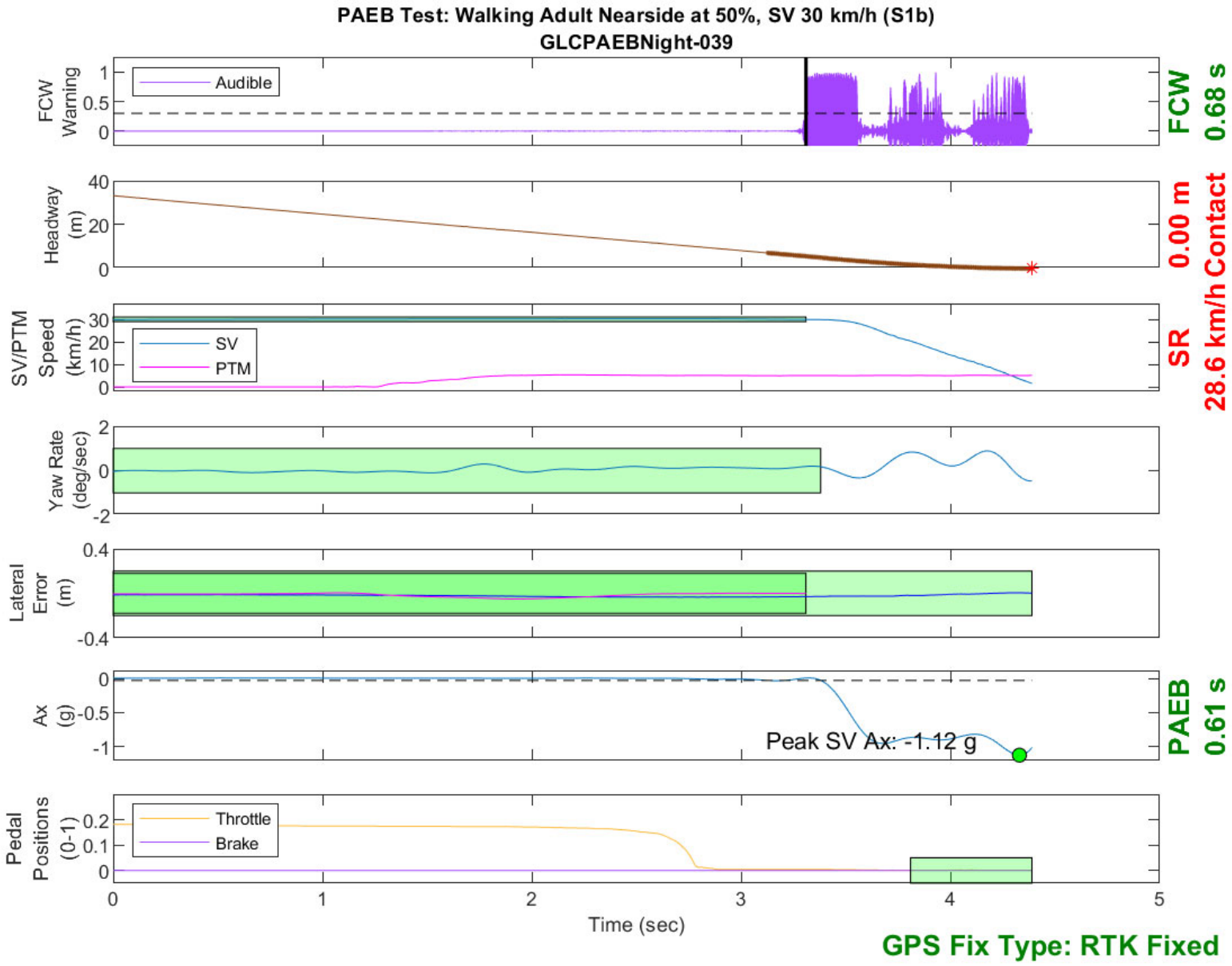

Figure D144. Time History for PAEB Run 39, S1b, Night, High Beam, 30 km/h

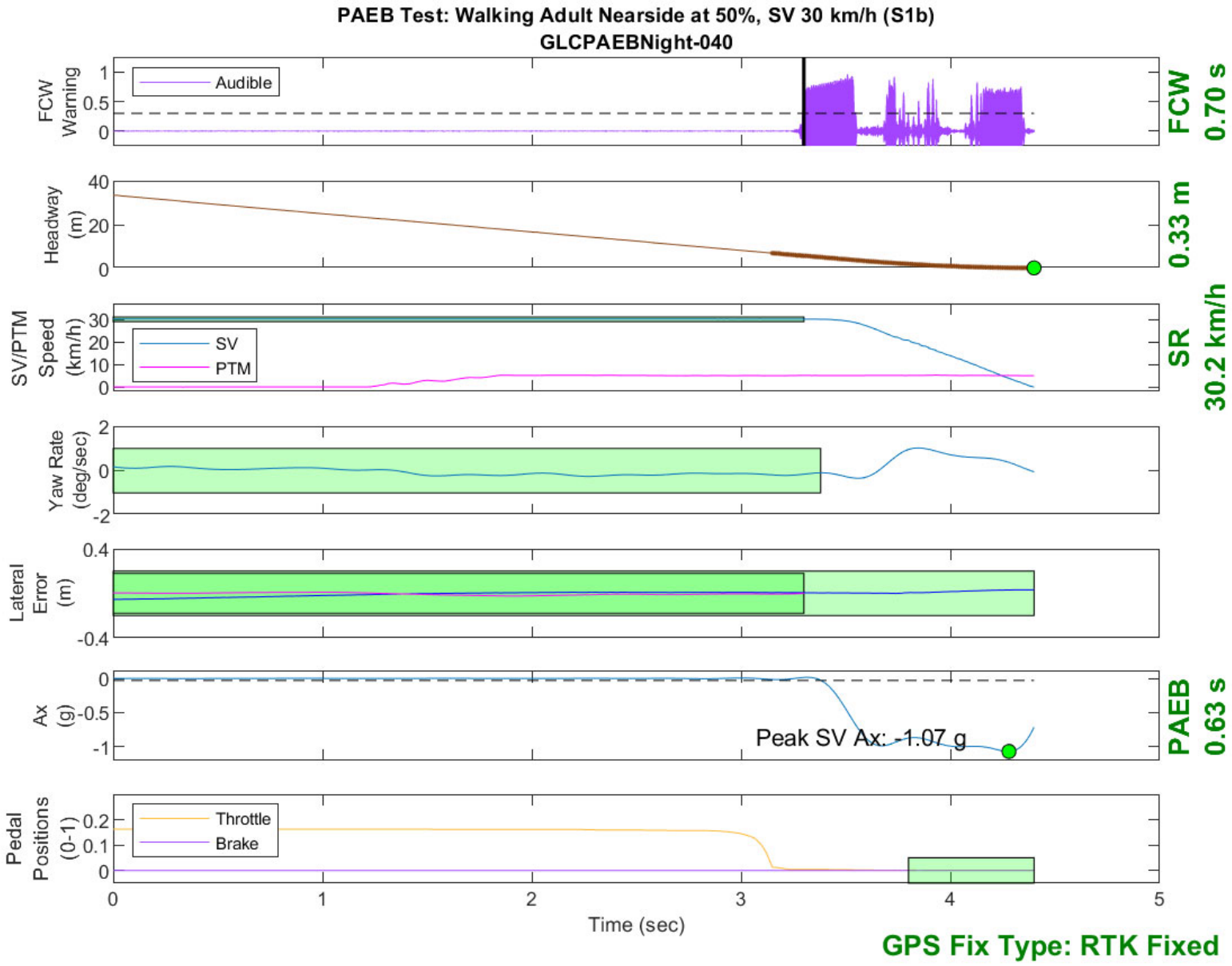

Figure D145. Time History for PAEB Run 40, S1b, Night, High Beam, 30 km/h

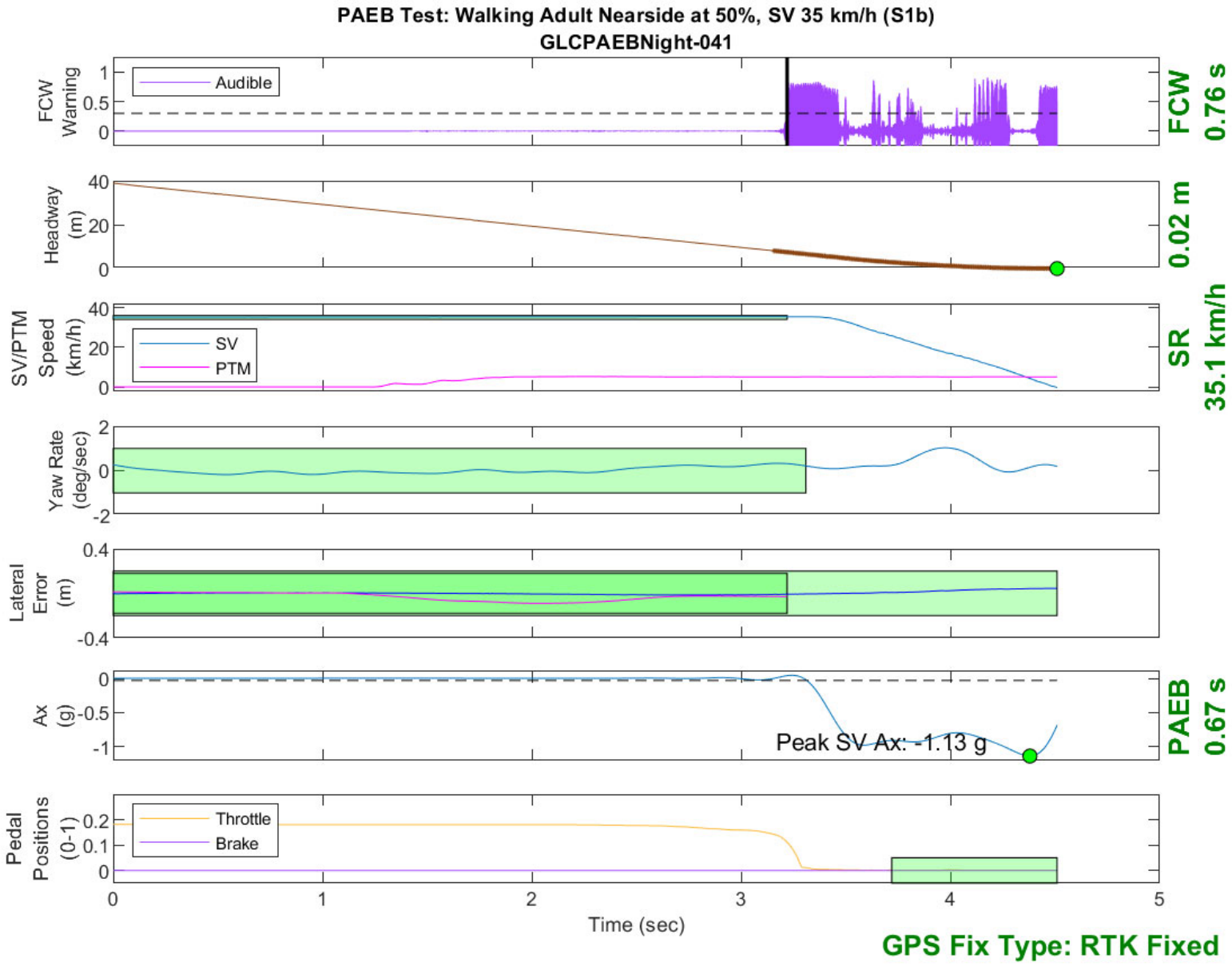

Figure D146. Time History for PAEB Run 41, S1b, Night, High Beam, 35 km/h

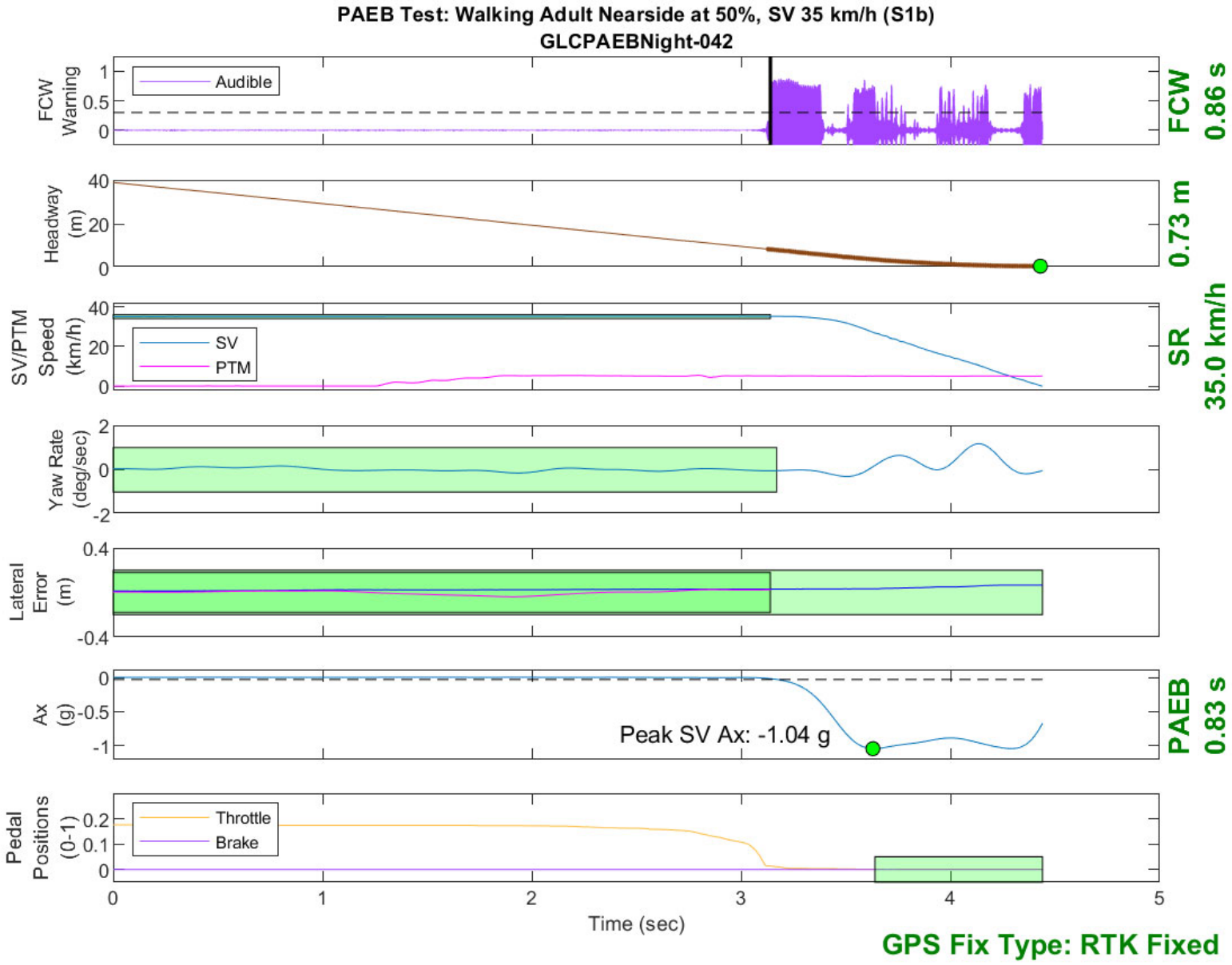

Figure D147. Time History for PAEB Run 42, S1b, Night, High Beam, 35 km/h

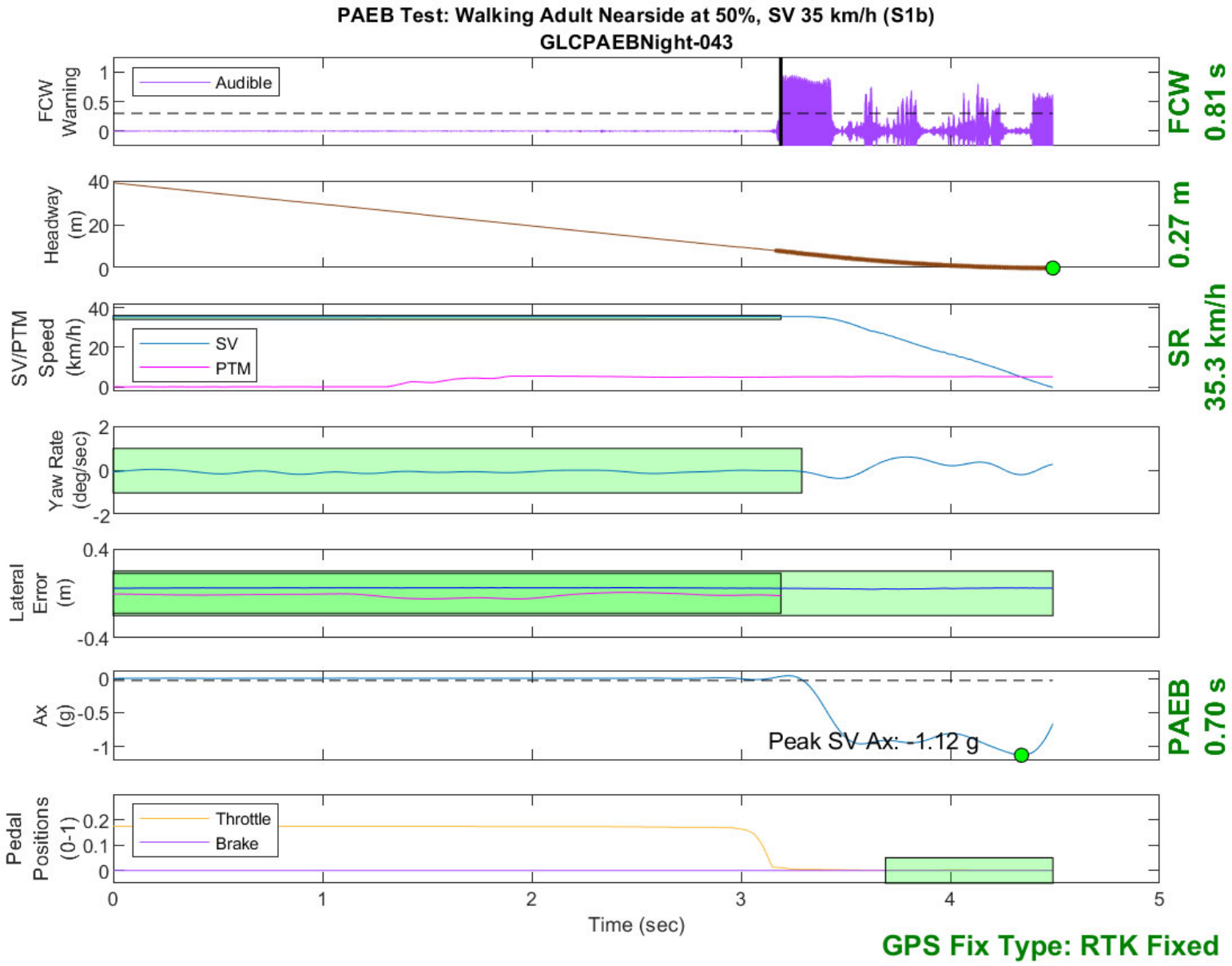

Figure D148. Time History for PAEB Run 43, S1b, Night, High Beam, 35 km/h

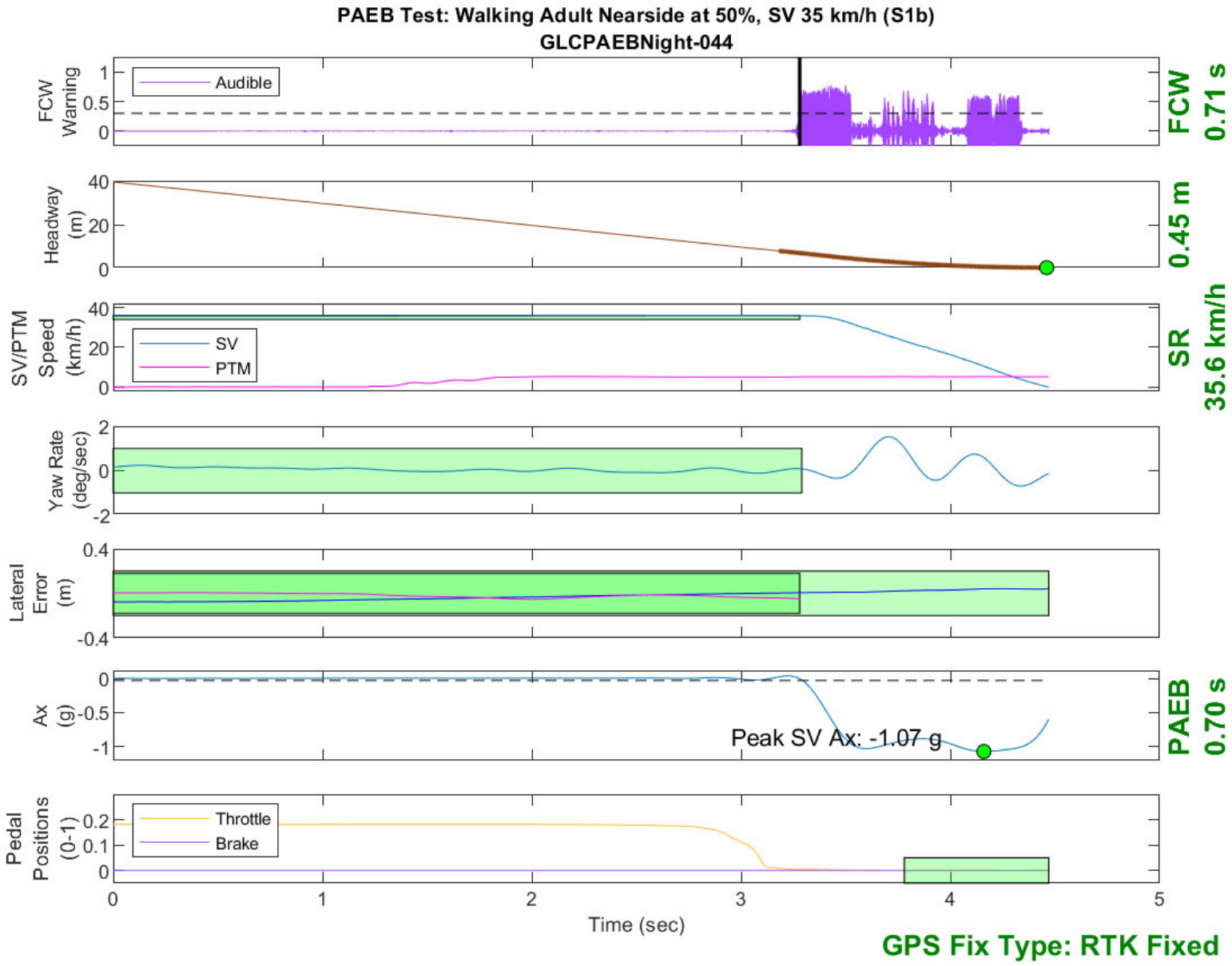

Figure D149. Time History for PAEB Run 44, S1b, Night, High Beam, 35 km/h

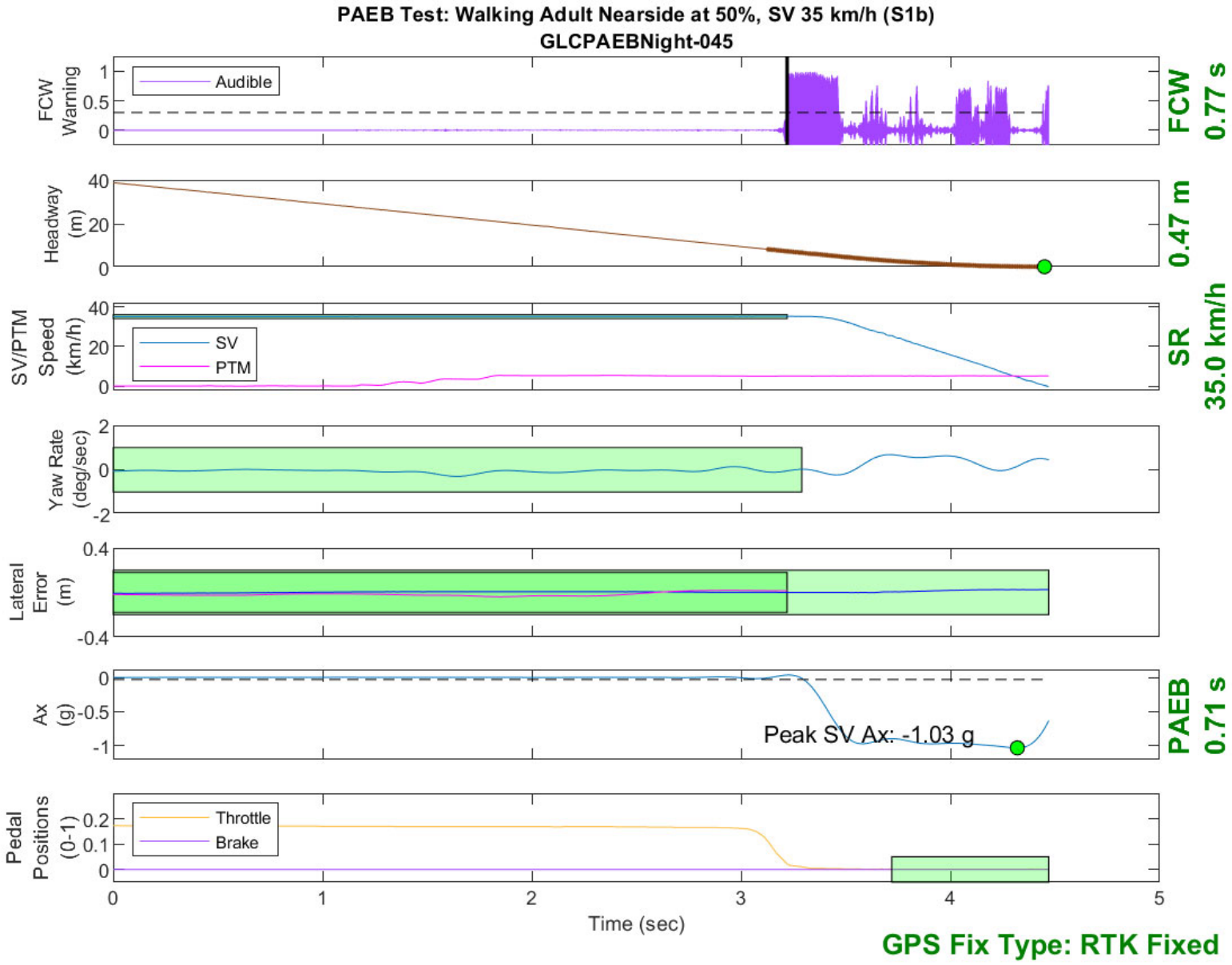

Figure D150. Time History for PAEB Run 45, S1b, Night, High Beam, 35 km/h

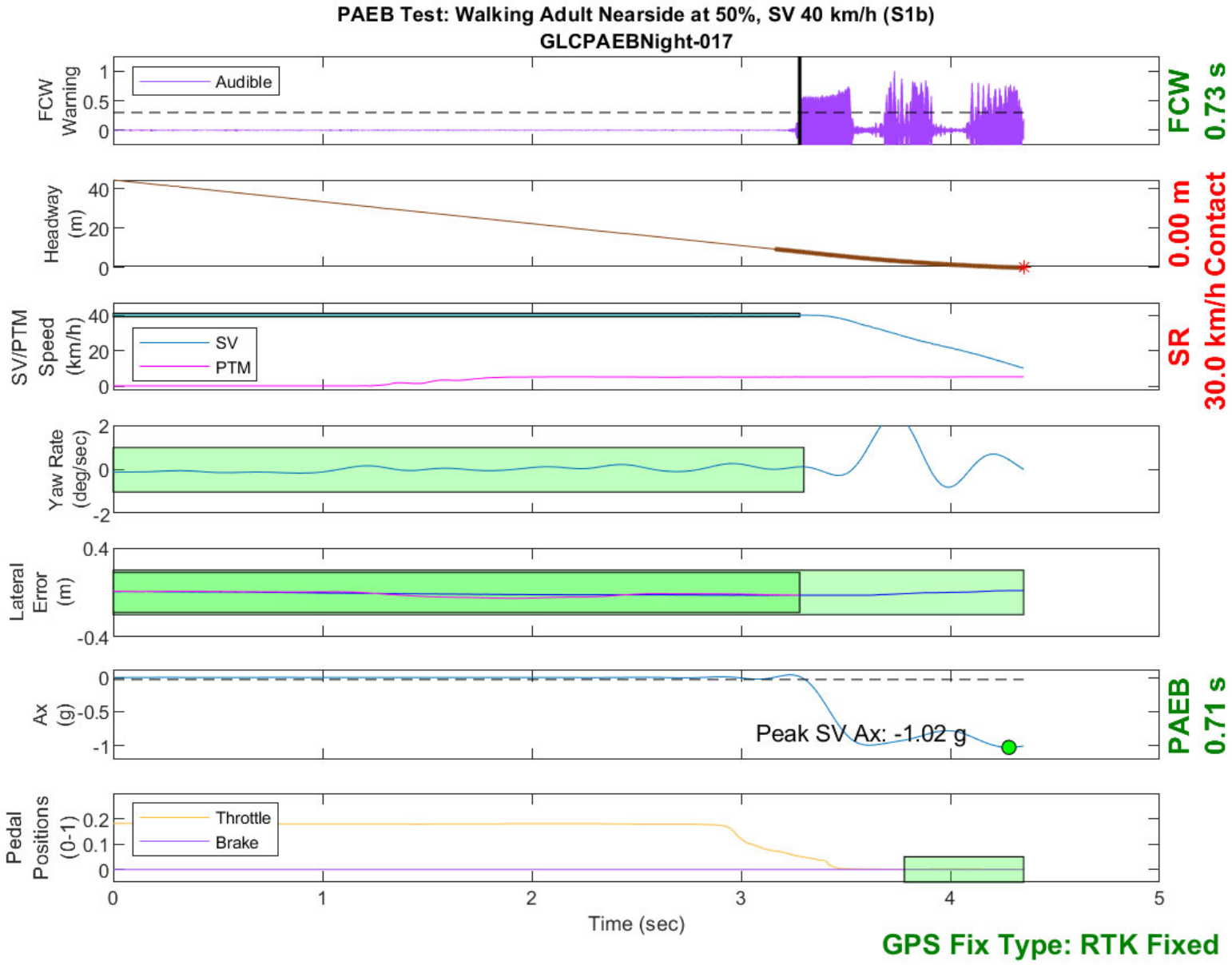

Figure D151. Time History for PAEB Run 17, S1b, Night, High Beam, 40 km/h

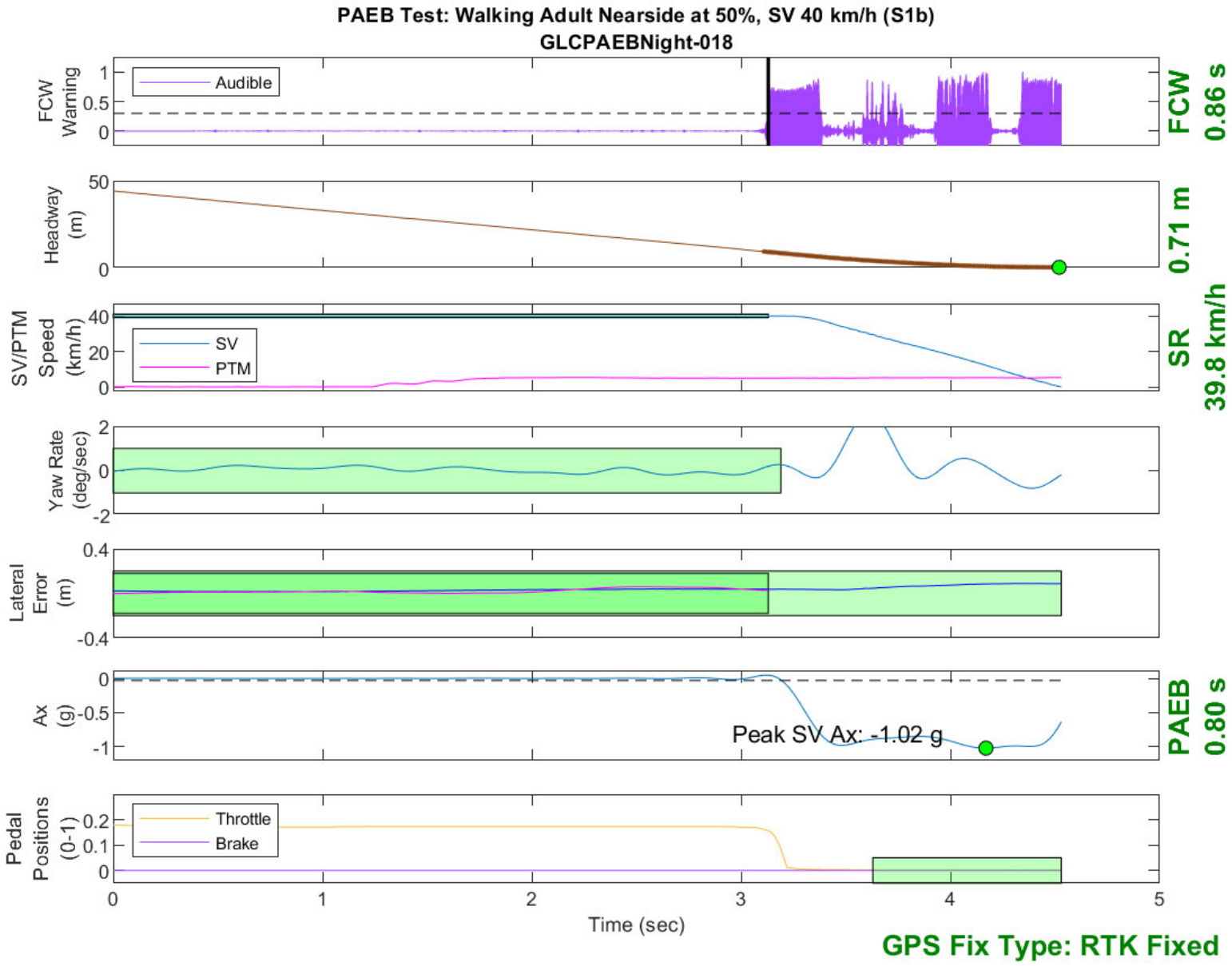

Figure D152. Time History for PAEB Run 18, S1b, Night, High Beam, 40 km/h

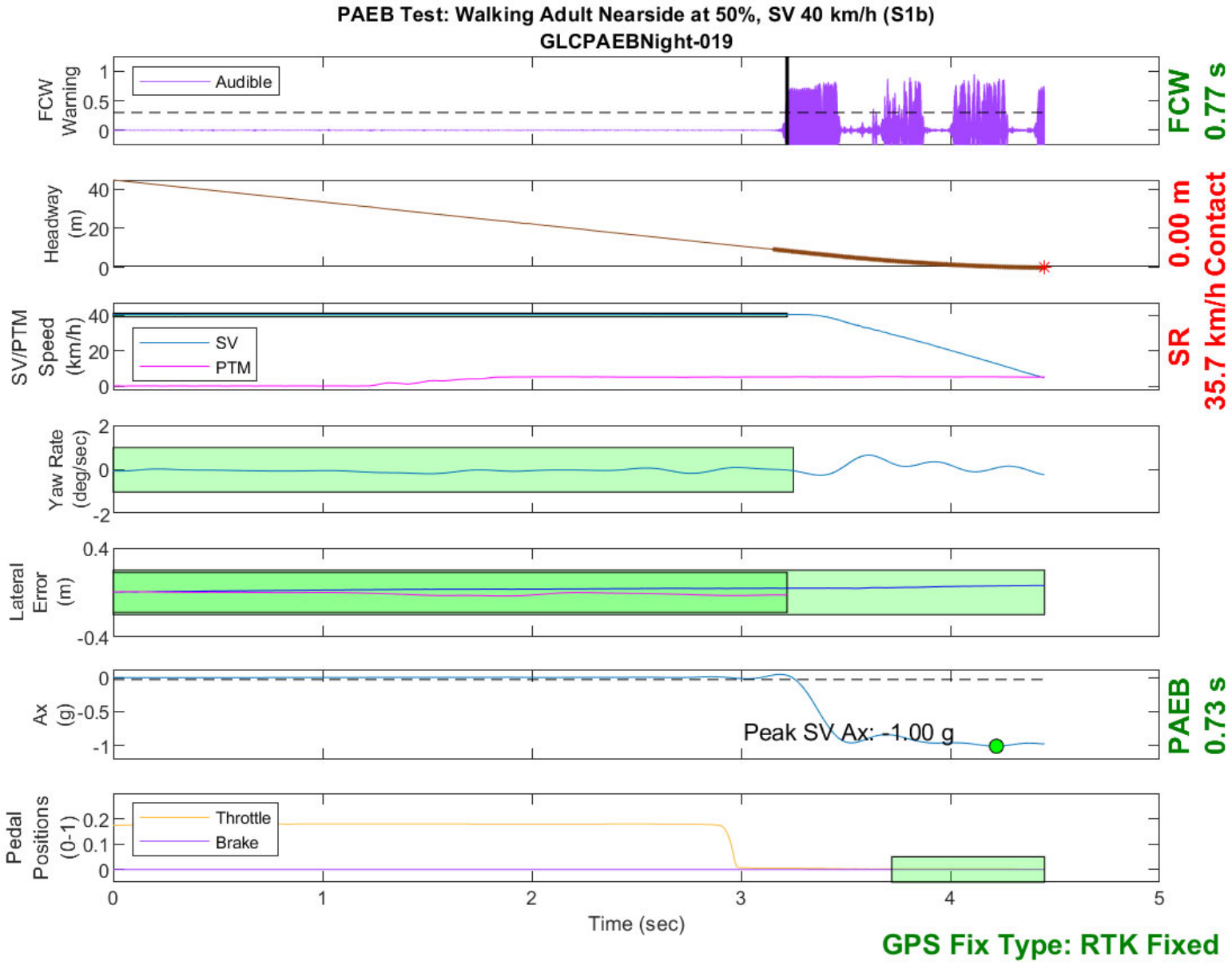

Figure D153. Time History for PAEB Run 19, S1b, Night, High Beam, 40 km/h

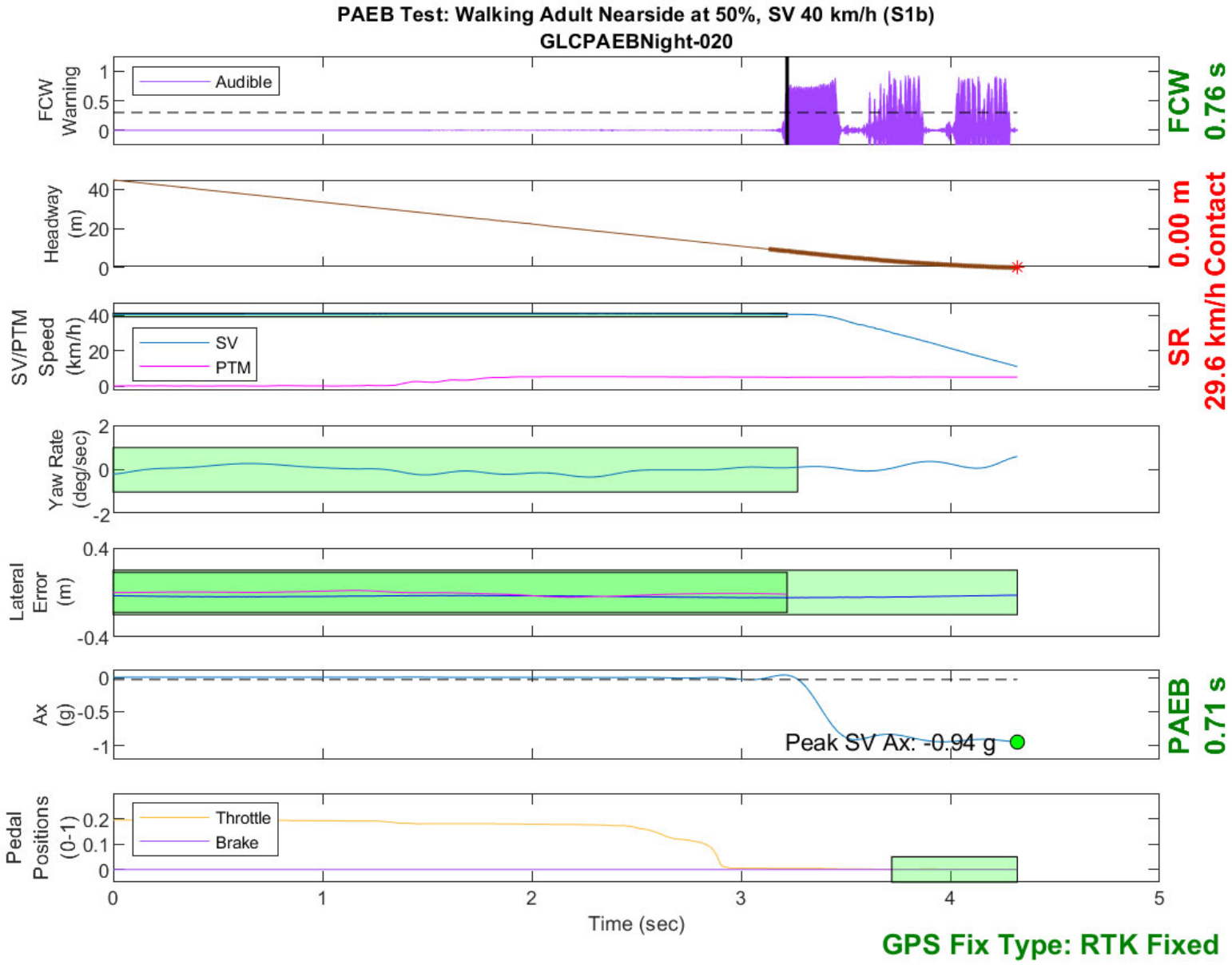

Figure D154. Time History for PAEB Run 20, S1b, Night, High Beam, 40 km/h

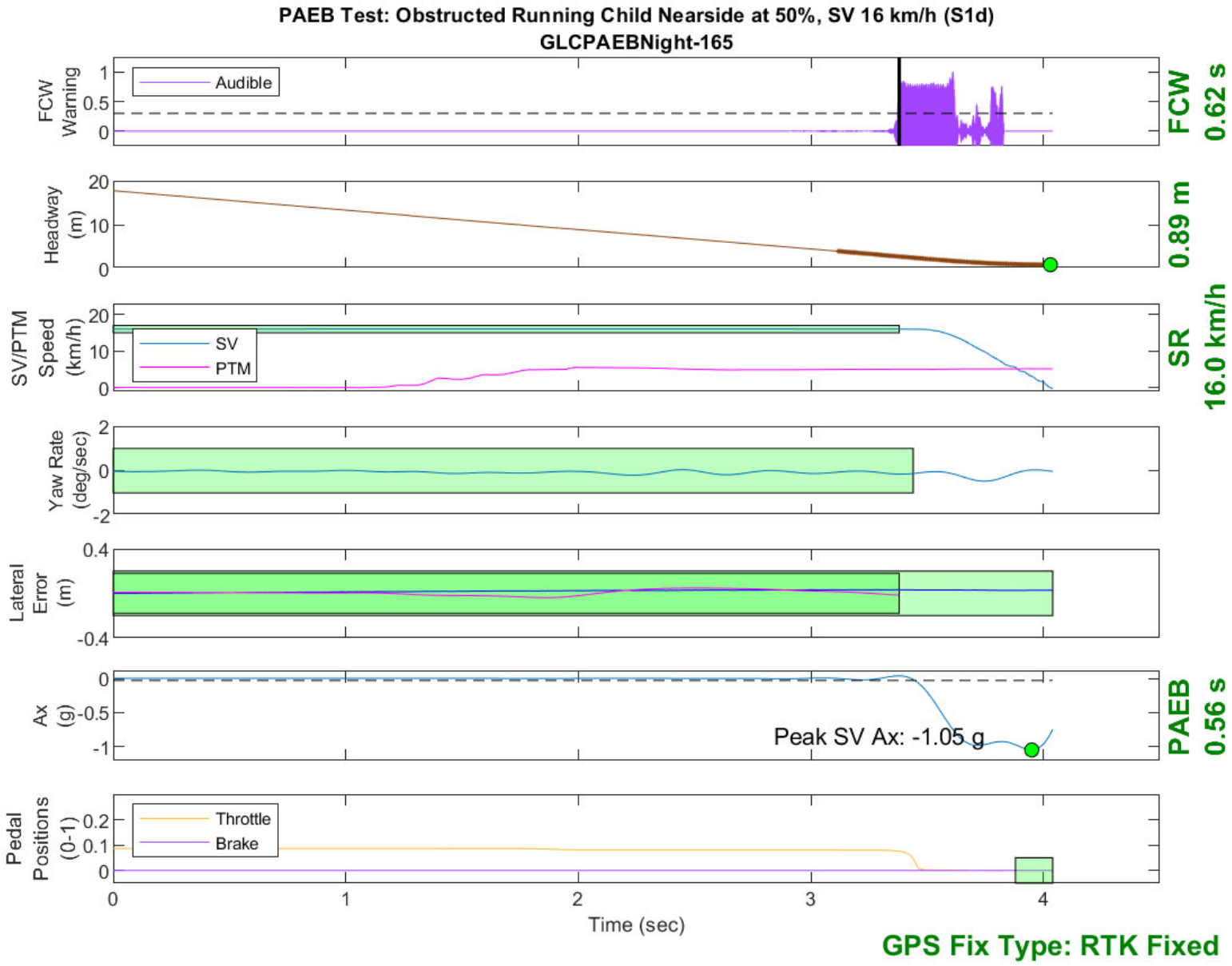

Figure D155. Time History for PAEB Run 165, S1d, Night, High Beam, 16 km/h

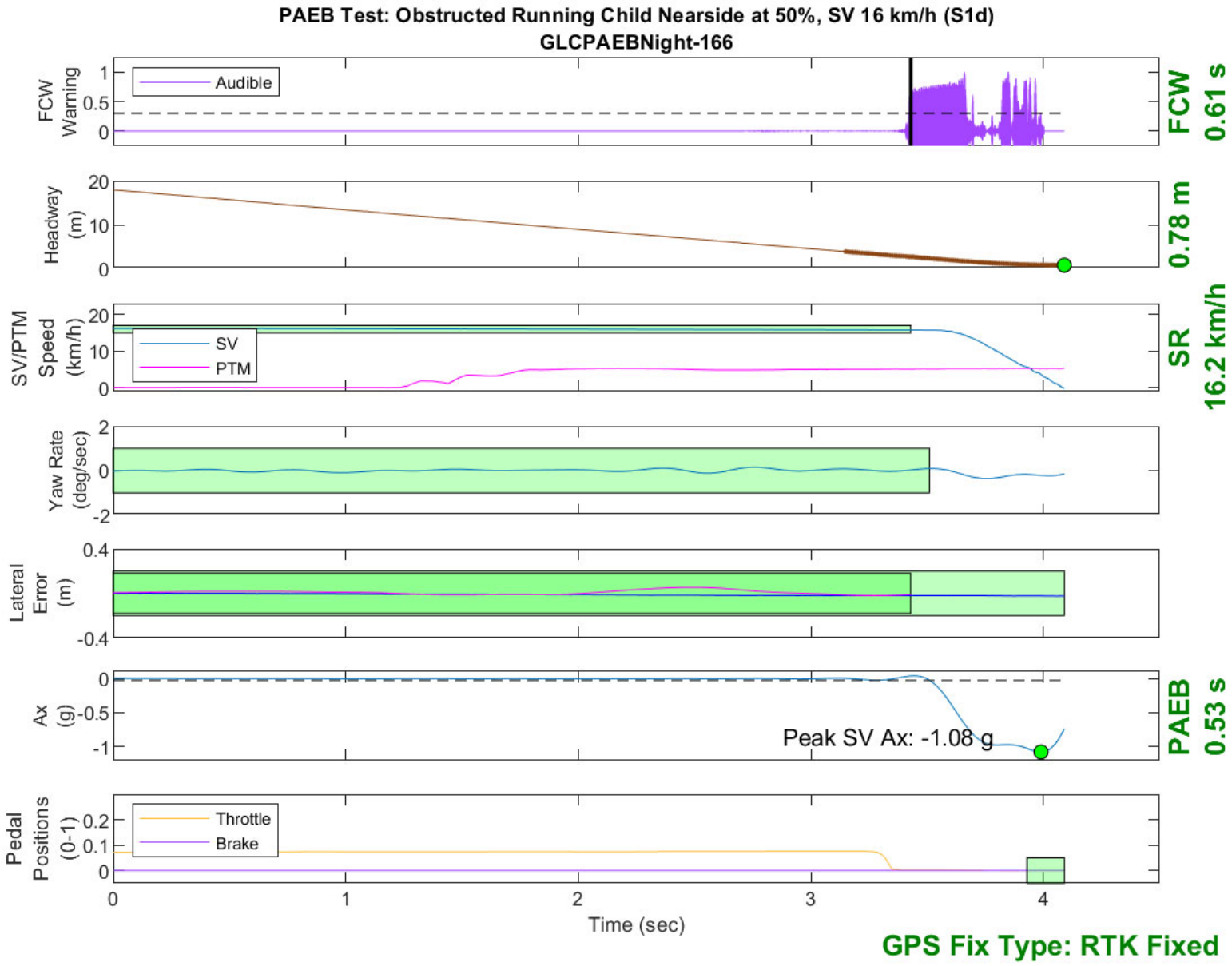

Figure D156. Time History for PAEB Run 166, S1d, Night, High Beam, 16 km/h

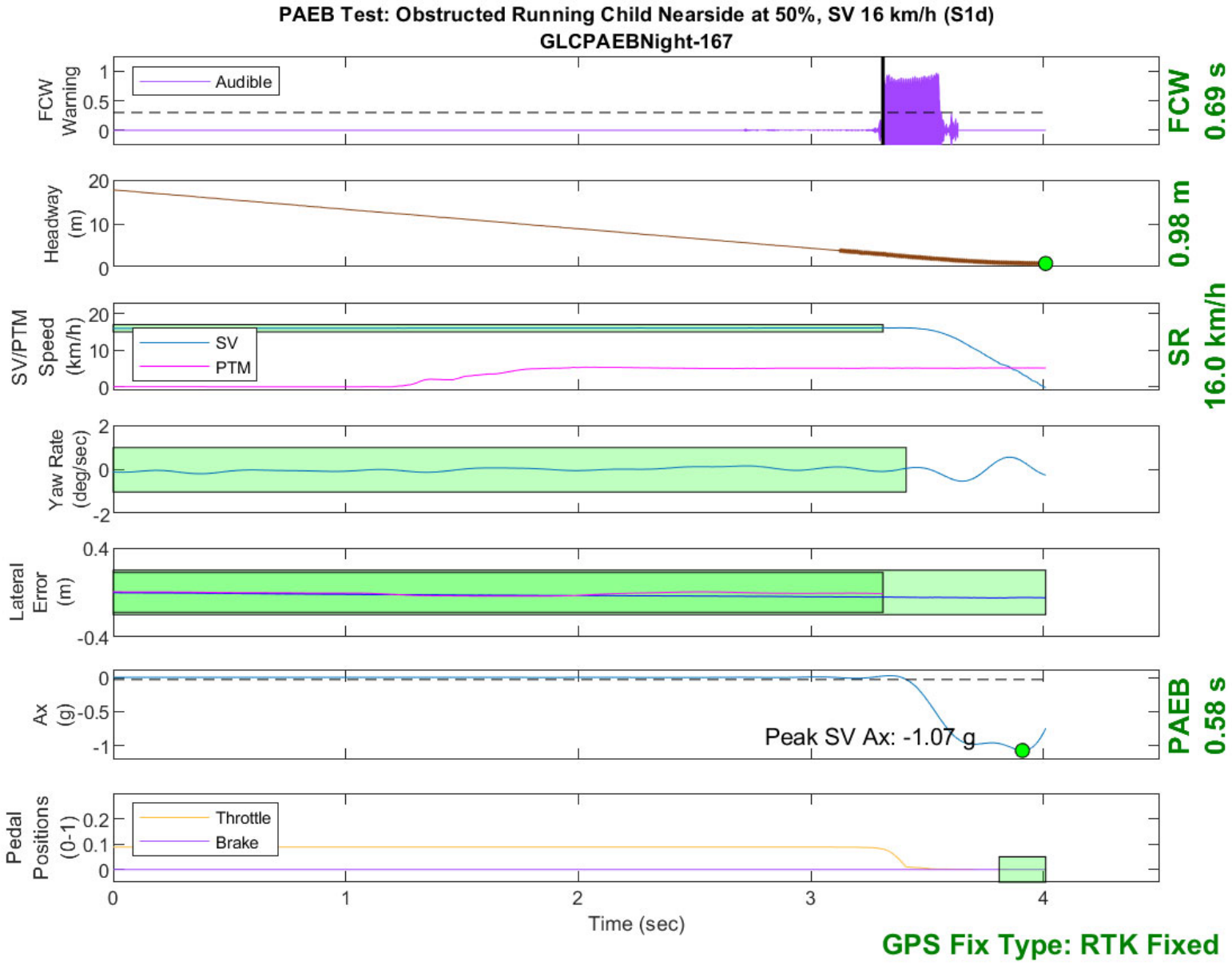

Figure D157. Time History for PAEB Run 167, S1d, Night, High Beam, 16 km/h

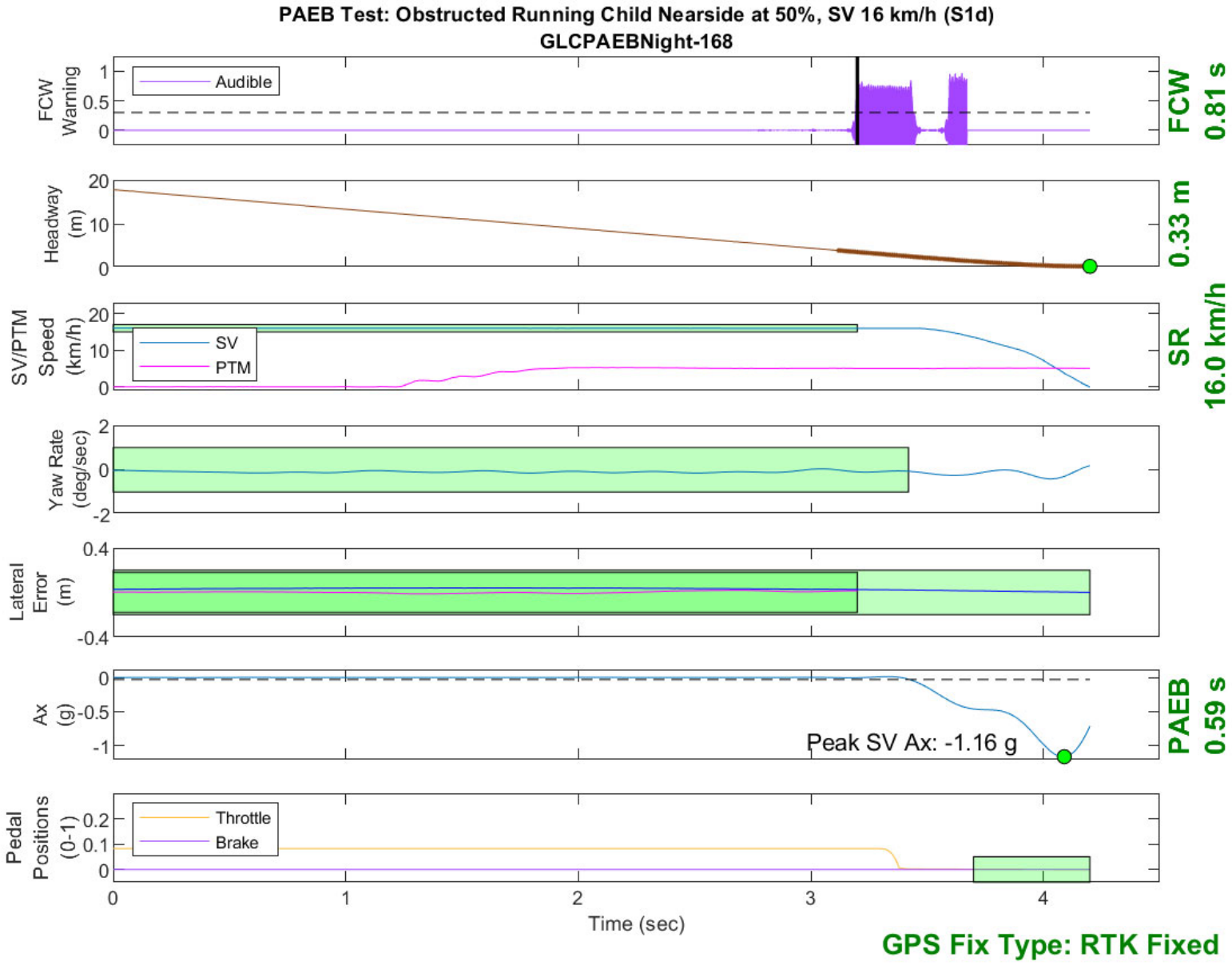

Figure D158. Time History for PAEB Run 168, S1d, Night, High Beam, 16 km/h

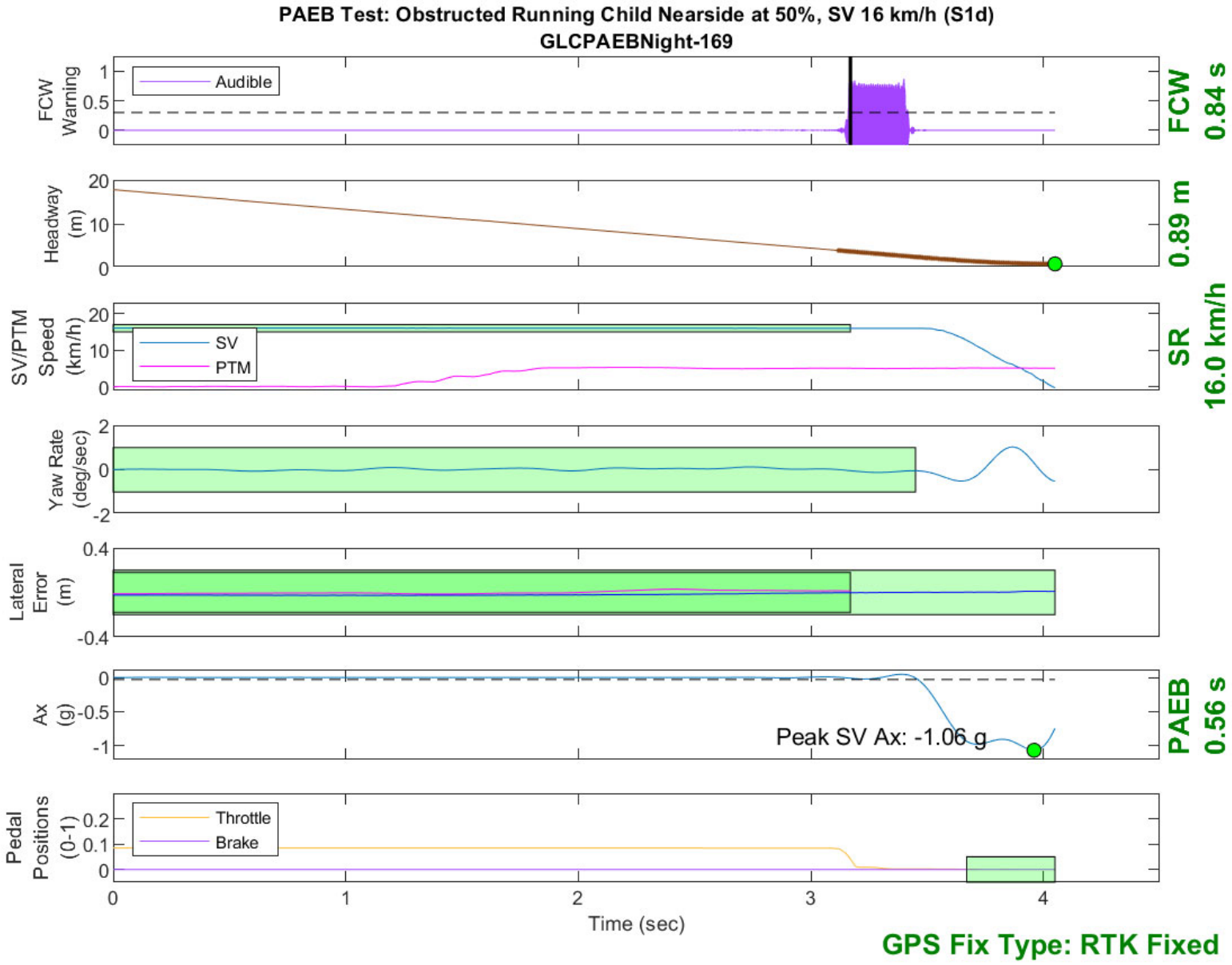

Figure D159. Time History for PAEB Run 169, S1d, Night, High Beam, 16 km/h

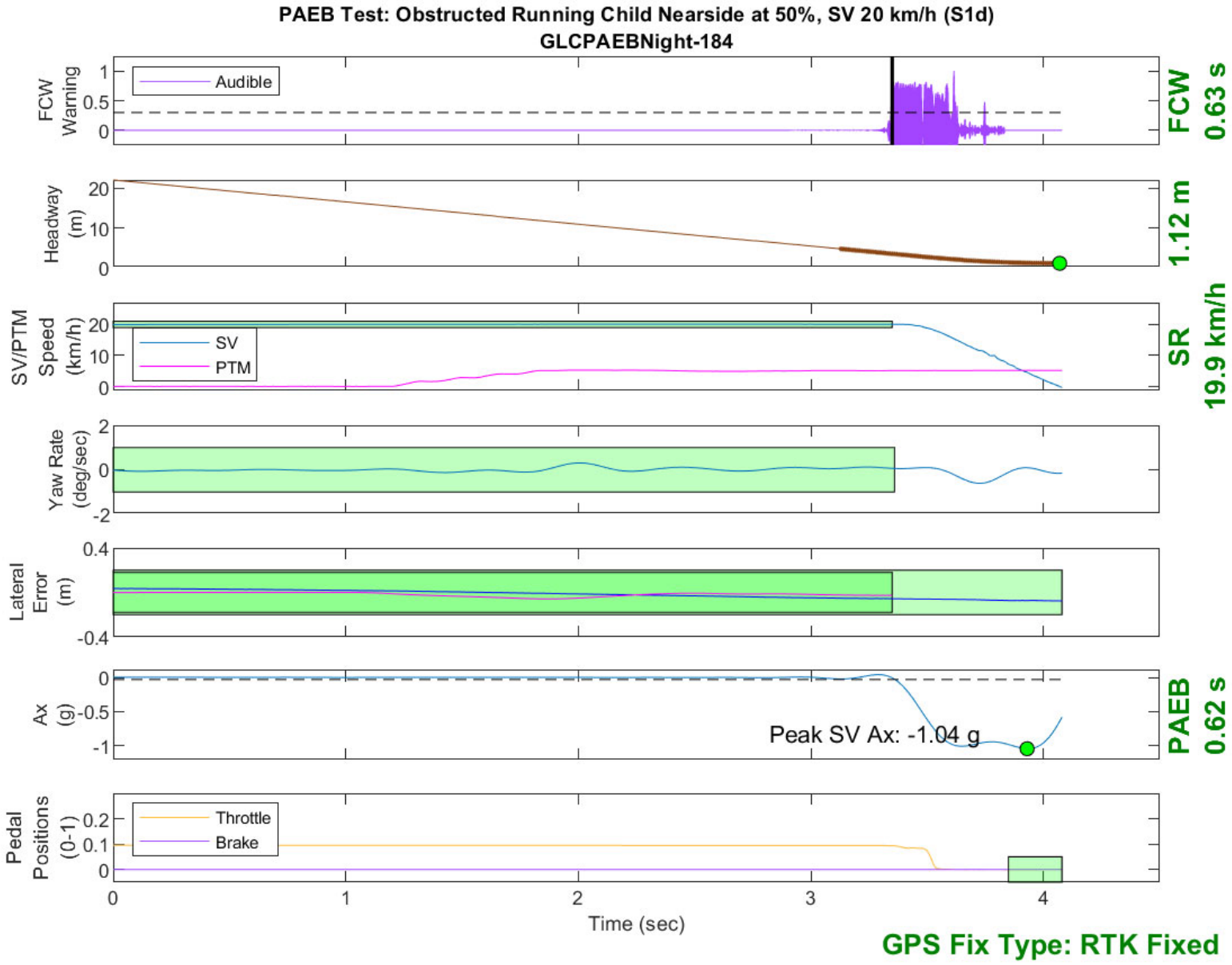

Figure D160. Time History for PAEB Run 184, S1d, Night, High Beam, 20 km/h

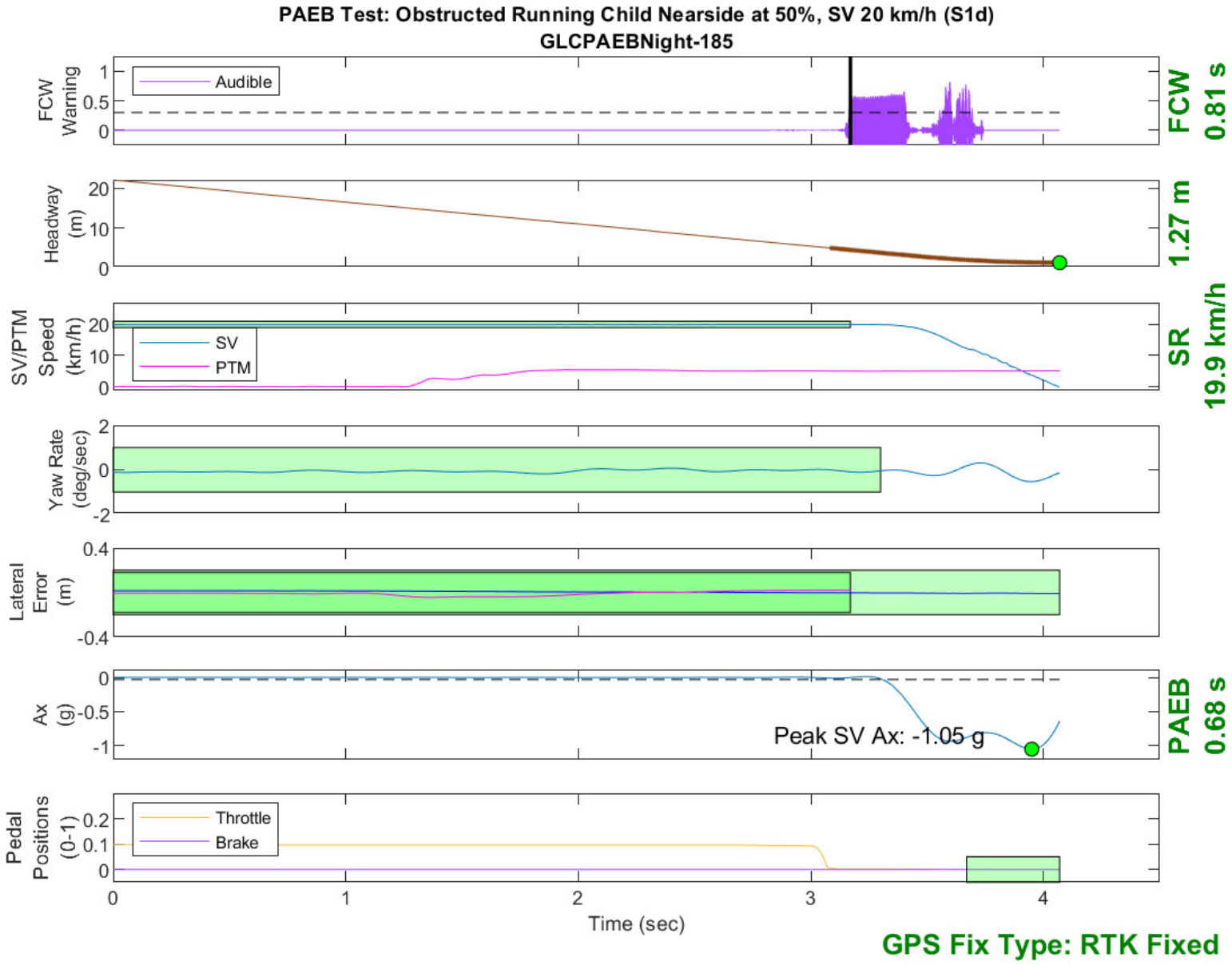

Figure D161. Time History for PAEB Run 185, S1d, Night, High Beam, 20 km/h

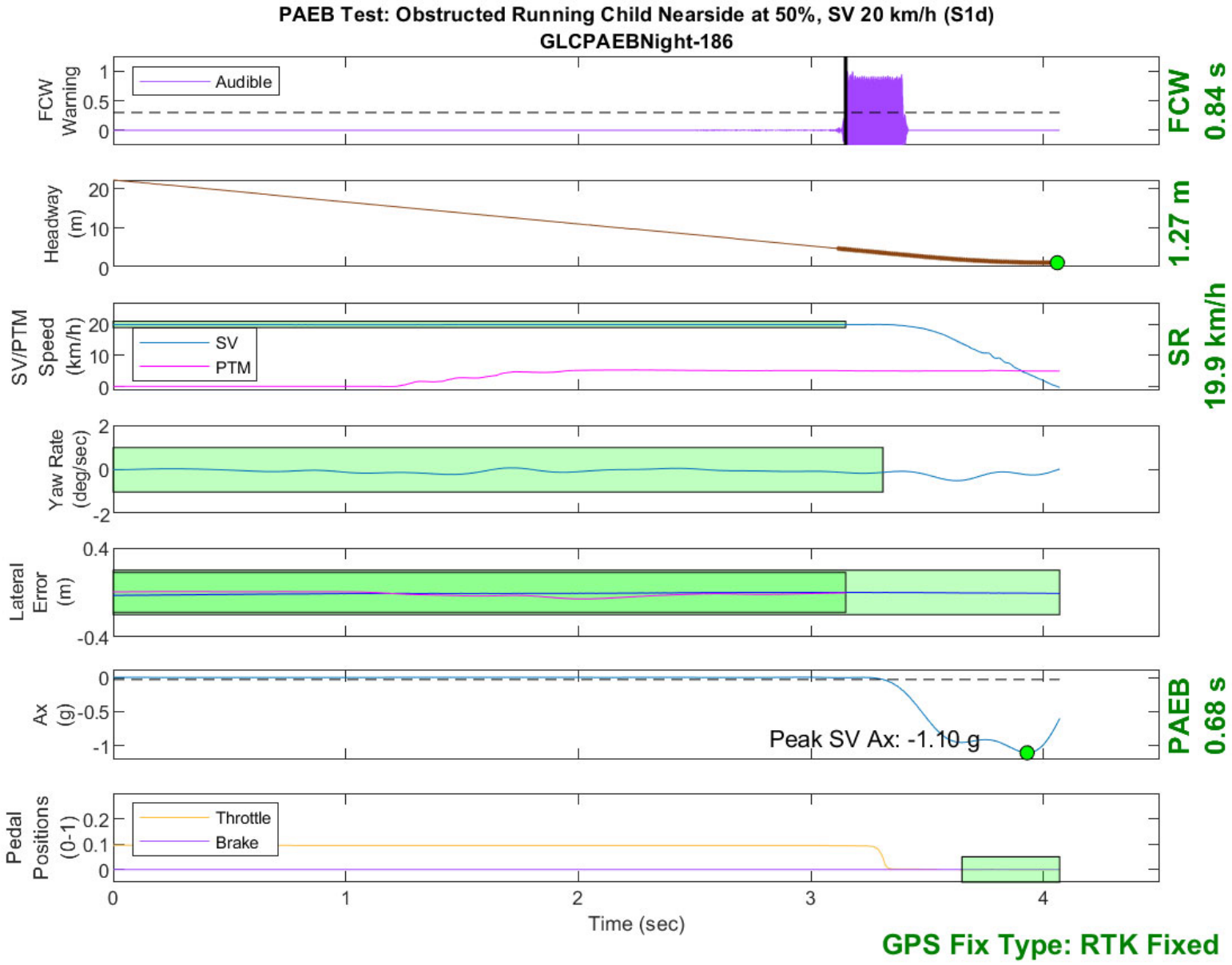

Figure D162. Time History for PAEB Run 186, S1d, Night, High Beam, 20 km/h

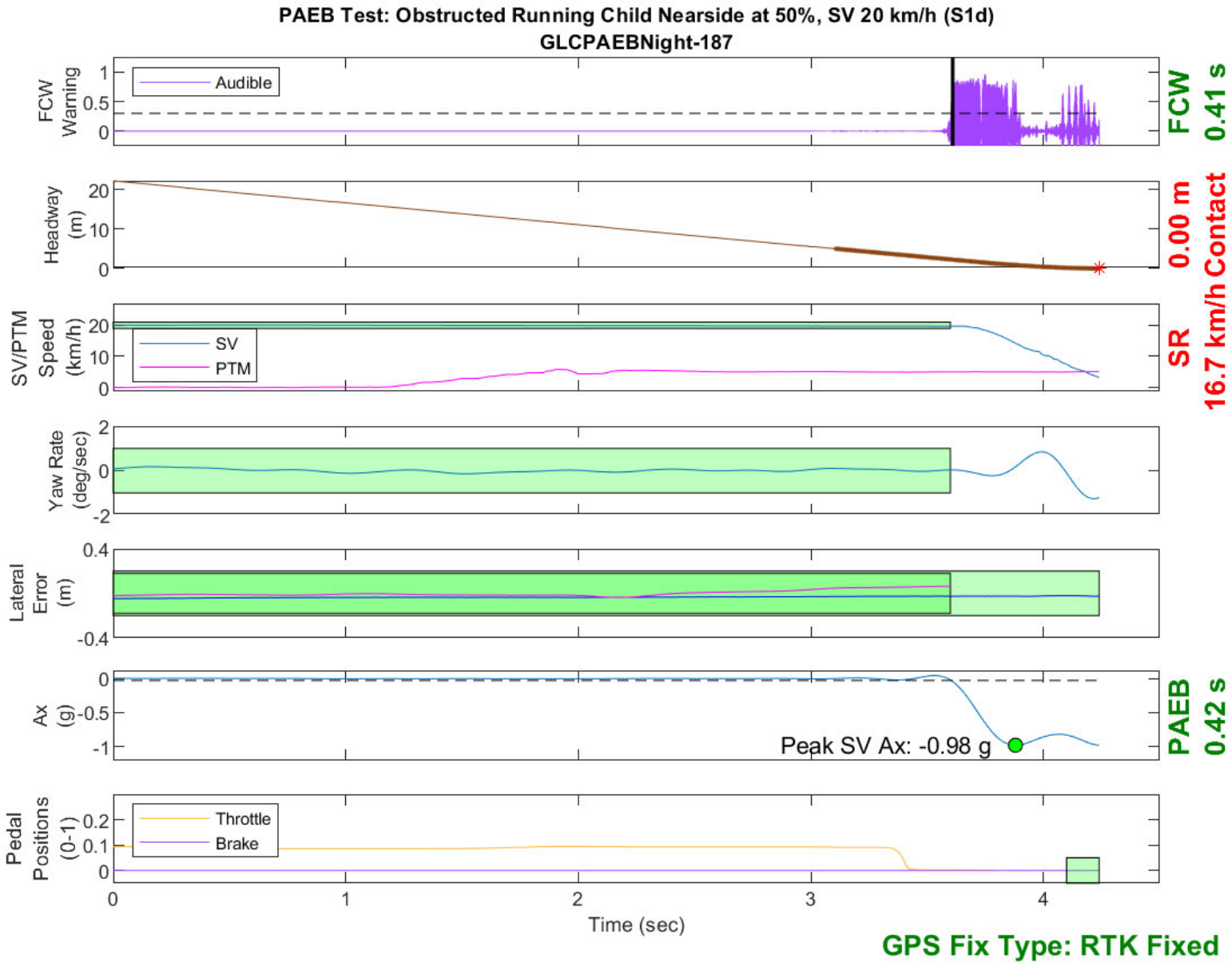

Figure D163. Time History for PAEB Run 187, S1d, Night, High Beam, 20 km/h

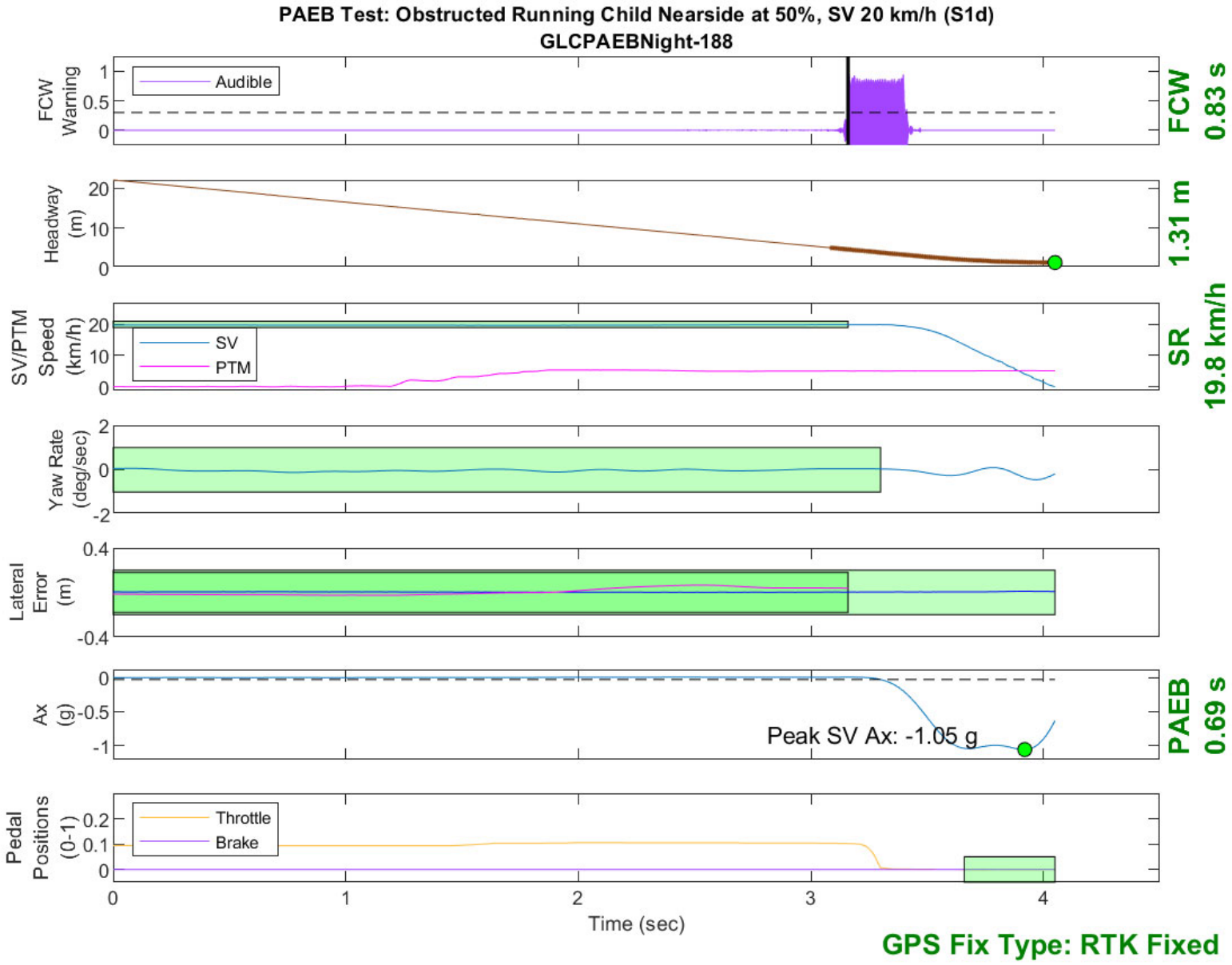

Figure D164. Time History for PAEB Run 188, S1d, Night, High Beam, 20 km/h

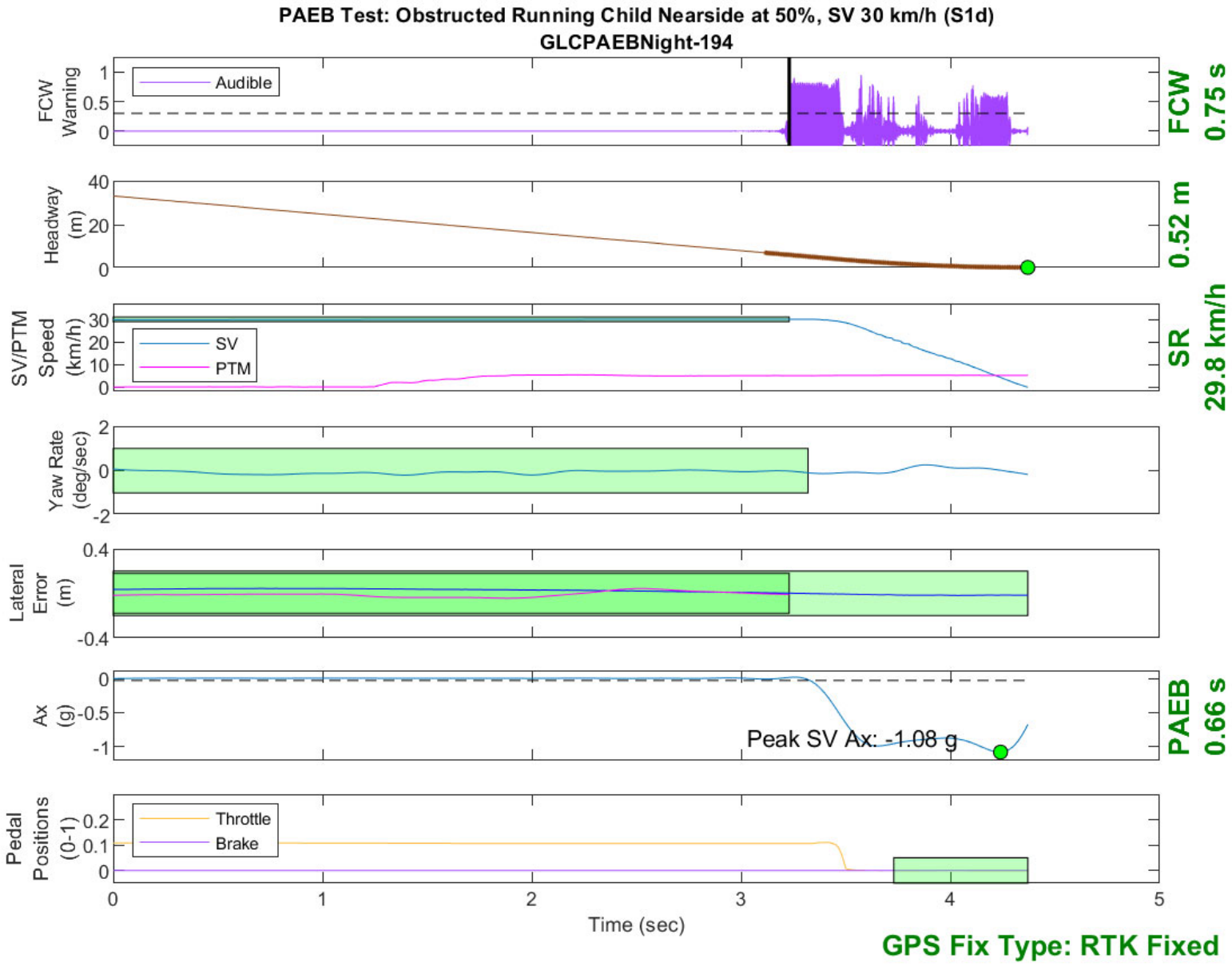

Figure D165. Time History for PAEB Run 194, S1d, Night, High Beam, 30 km/h

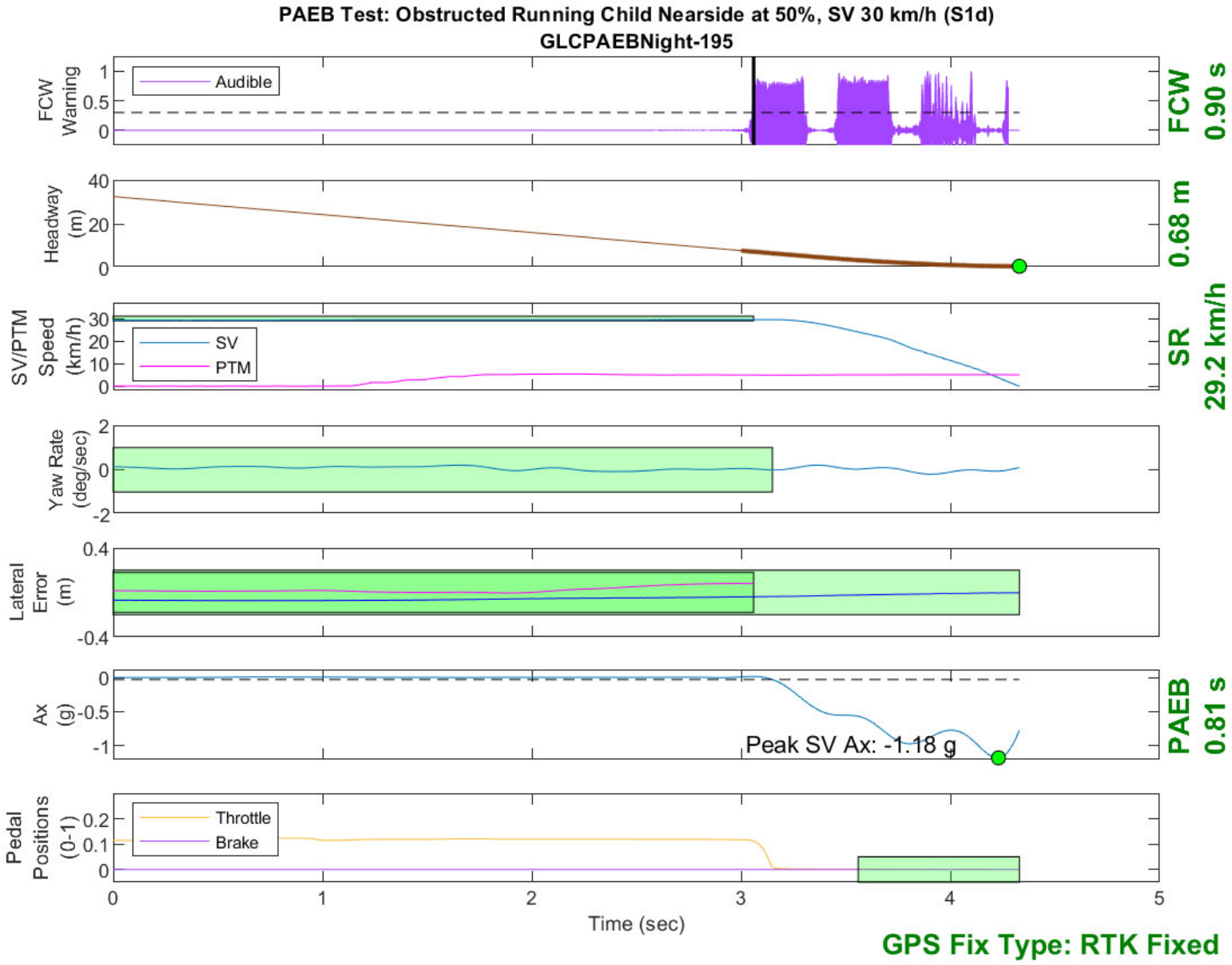

Figure D166. Time History for PAEB Run 195, S1d, Night, High Beam, 30 km/h

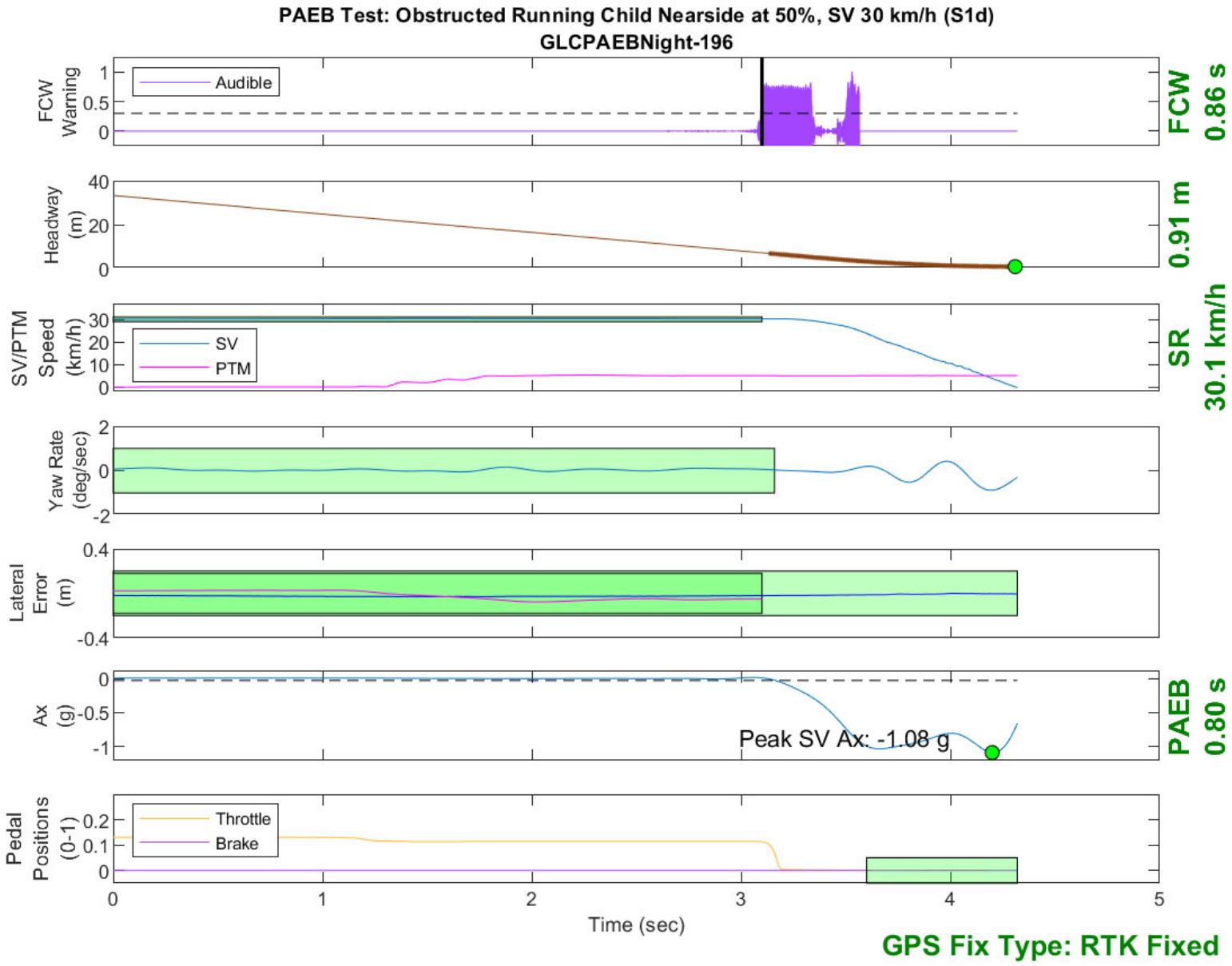

Figure D167. Time History for PAEB Run 196, S1d, Night, High Beam, 30 km/h

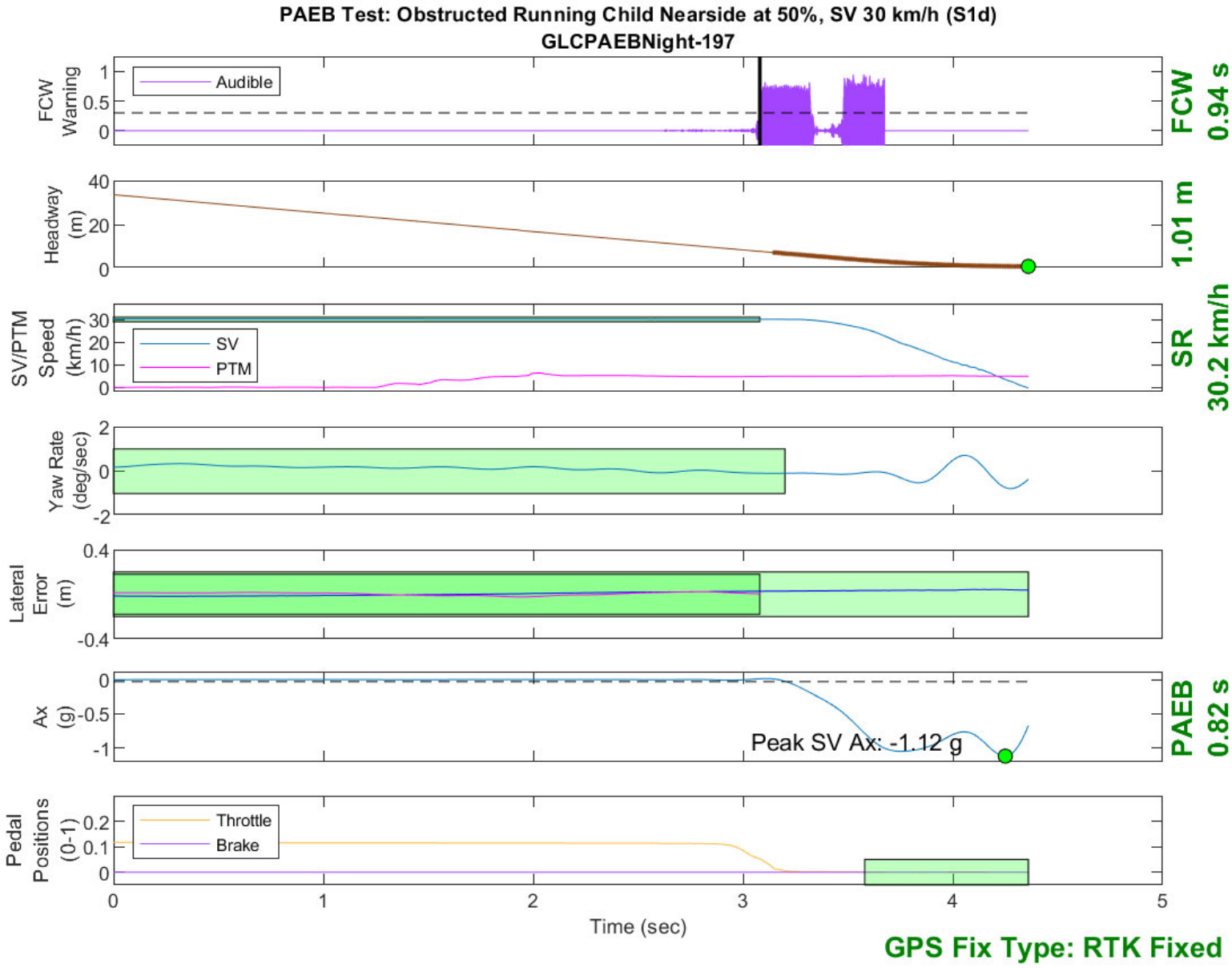

Figure D168. Time History for PAEB Run 197, S1d, Night, High Beam, 30 km/h

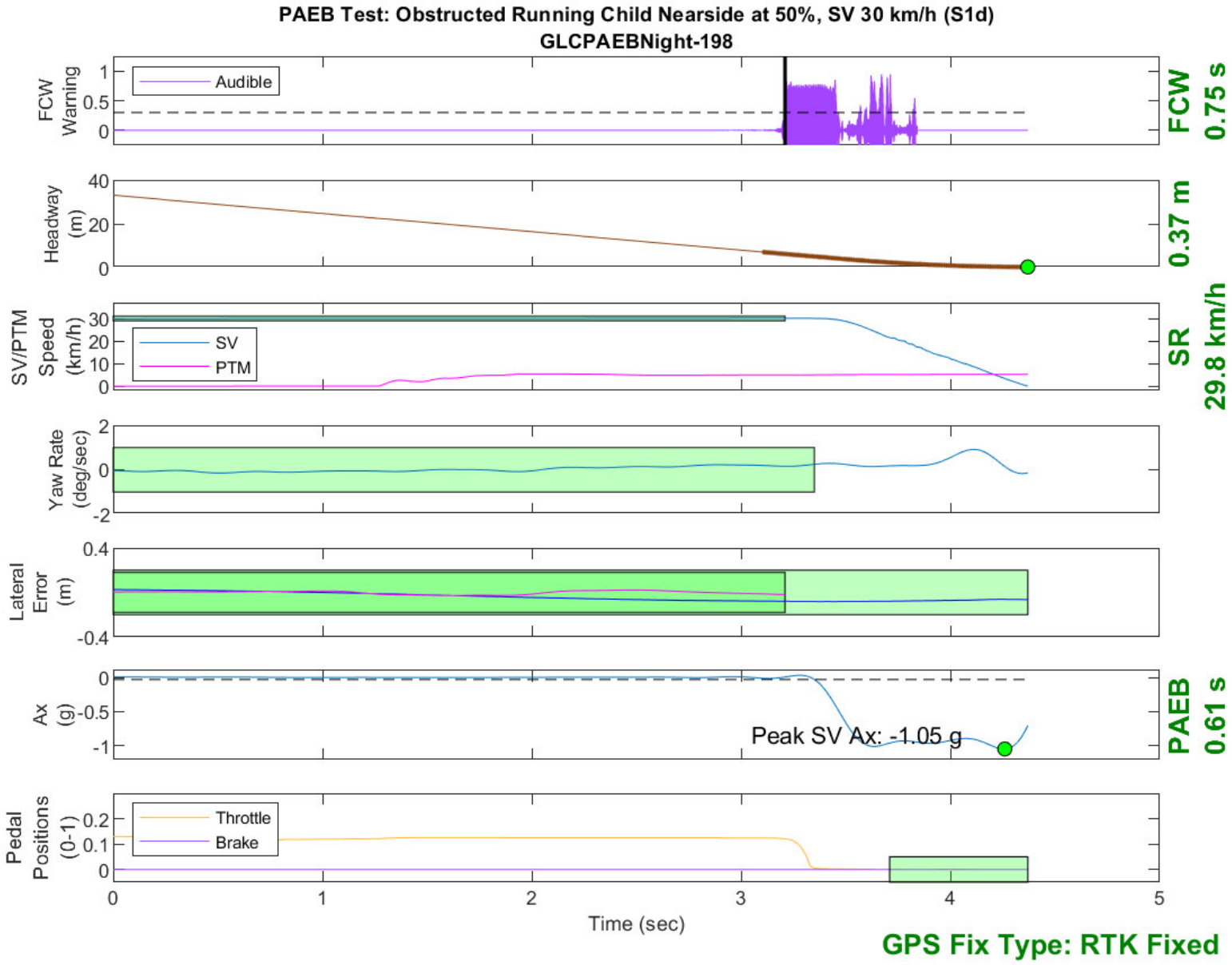

Figure D169. Time History for PAEB Run 198, S1d, Night, High Beam, 30 km/h

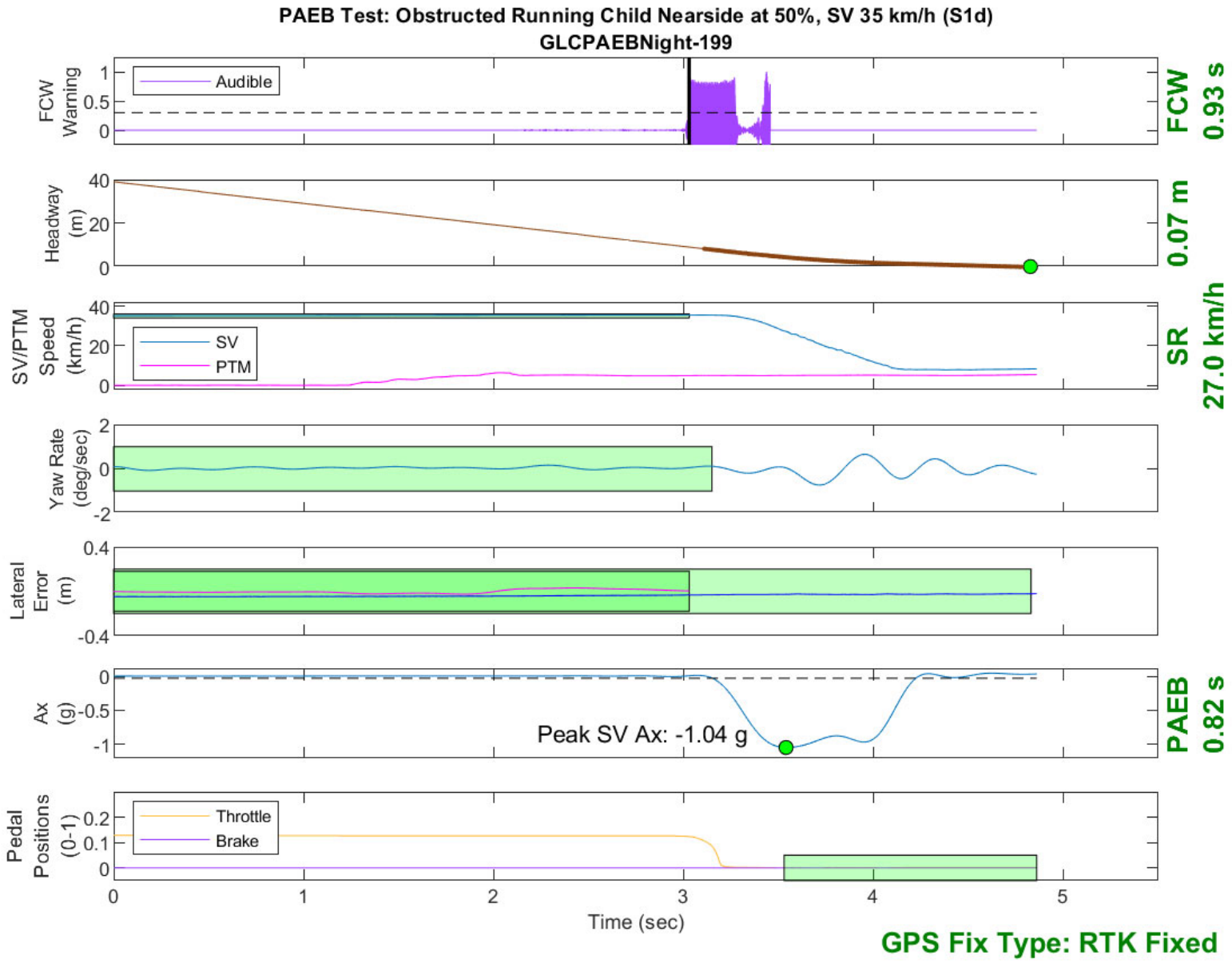

Figure D170. Time History for PAEB Run 199, S1d, Night, High Beam, 35 km/h

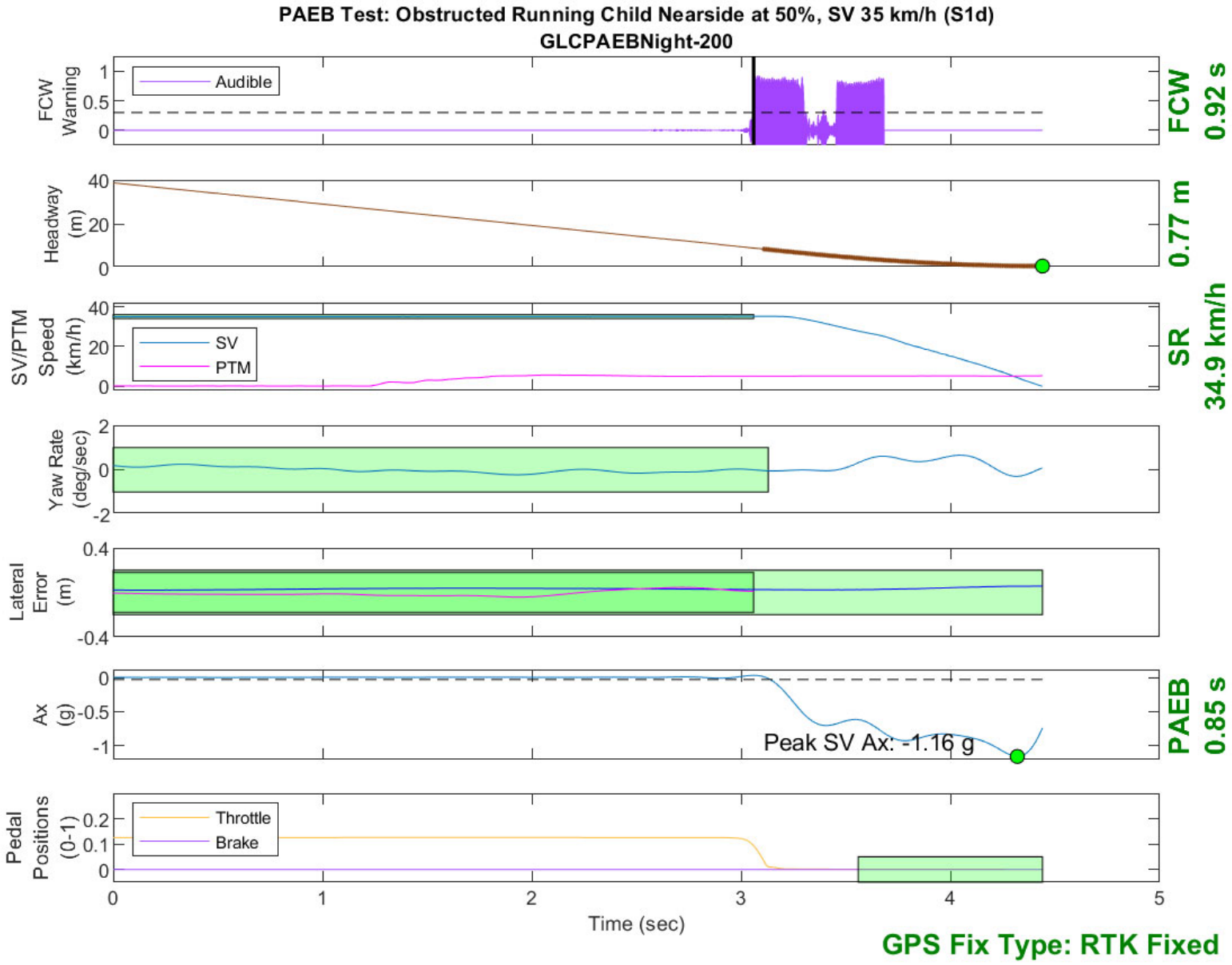

Figure D171. Time History for PAEB Run 200, S1d, Night, High Beam, 35 km/h

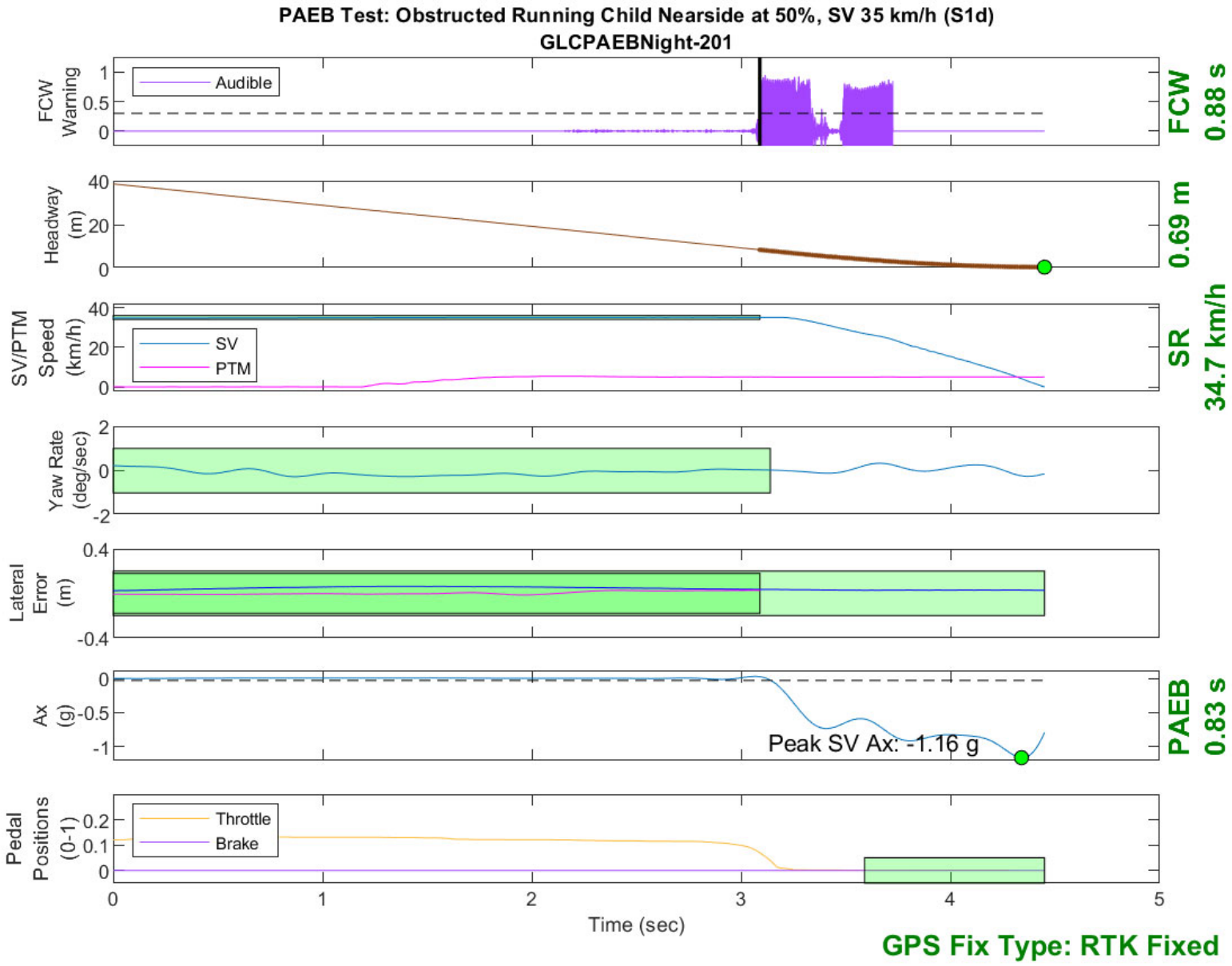

Figure D172. Time History for PAEB Run 201, S1d, Night, High Beam, 35 km/h

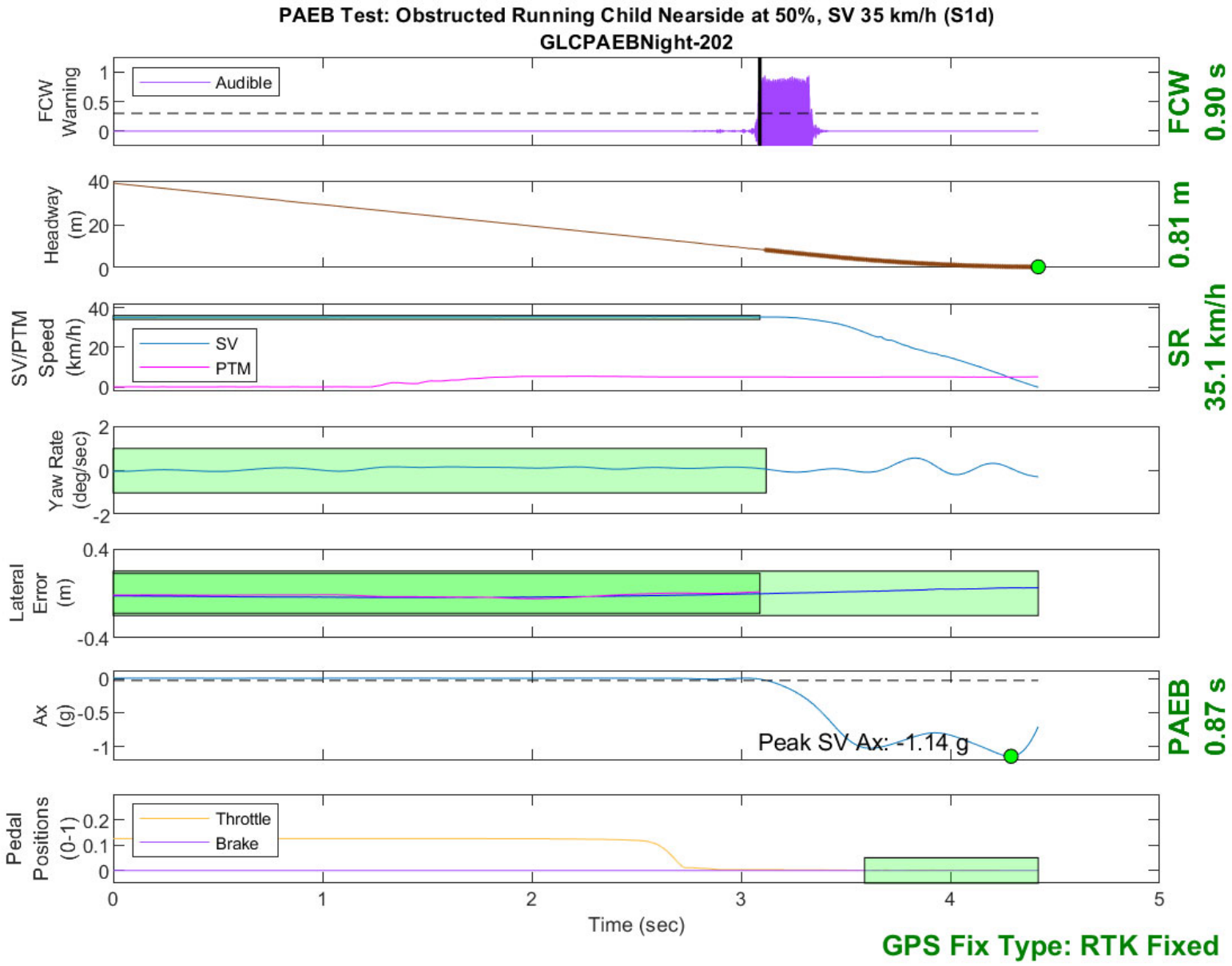

Figure D173. Time History for PAEB Run 202, S1d, Night, High Beam, 35 km/h

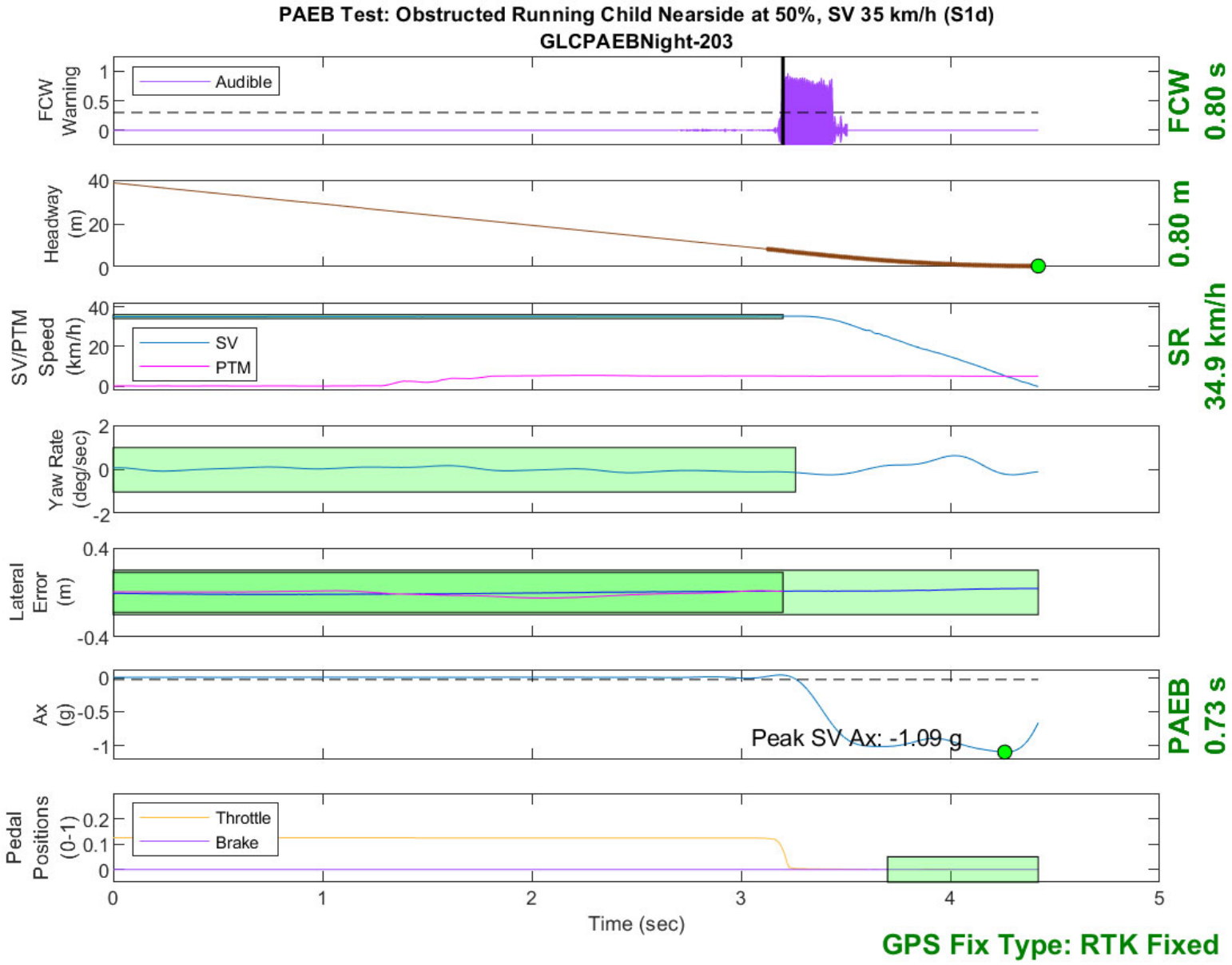

Figure D174. Time History for PAEB Run 203, S1d, Night, High Beam, 35 km/h

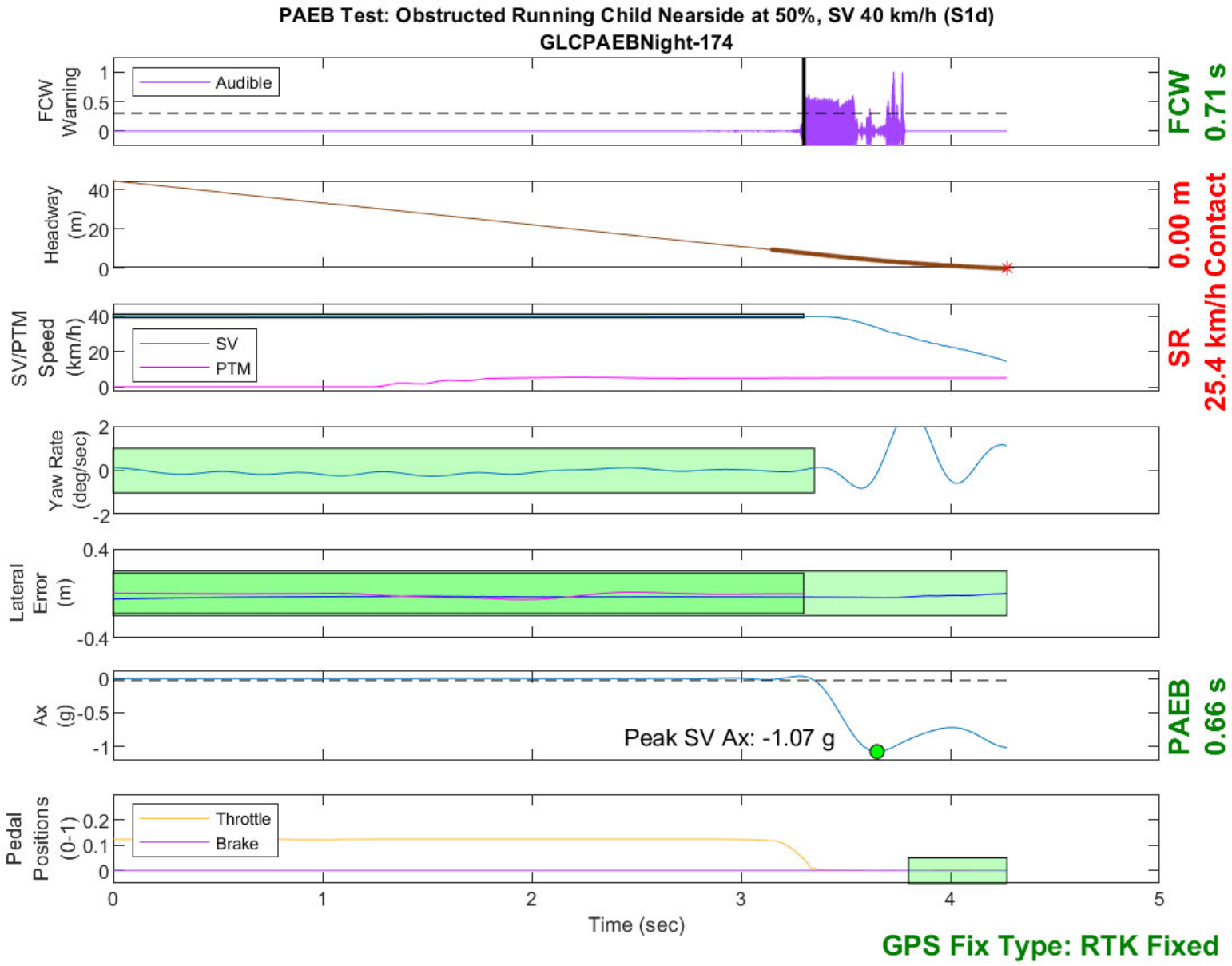

Figure D175. Time History for PAEB Run 174, S1d, Night, High Beam, 40 km/h

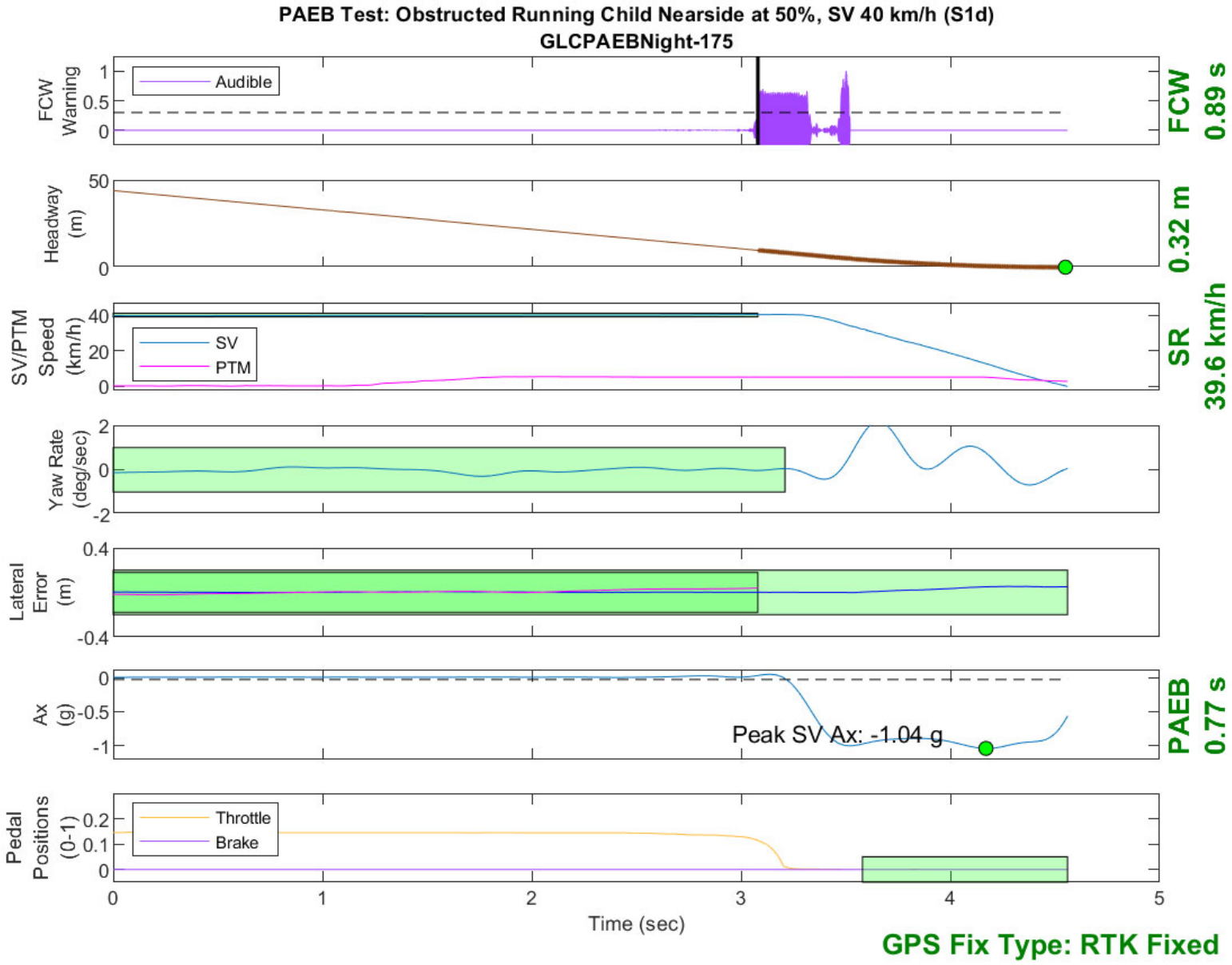

Figure D176. Time History for PAEB Run 175, S1d, Night, High Beam, 40 km/h

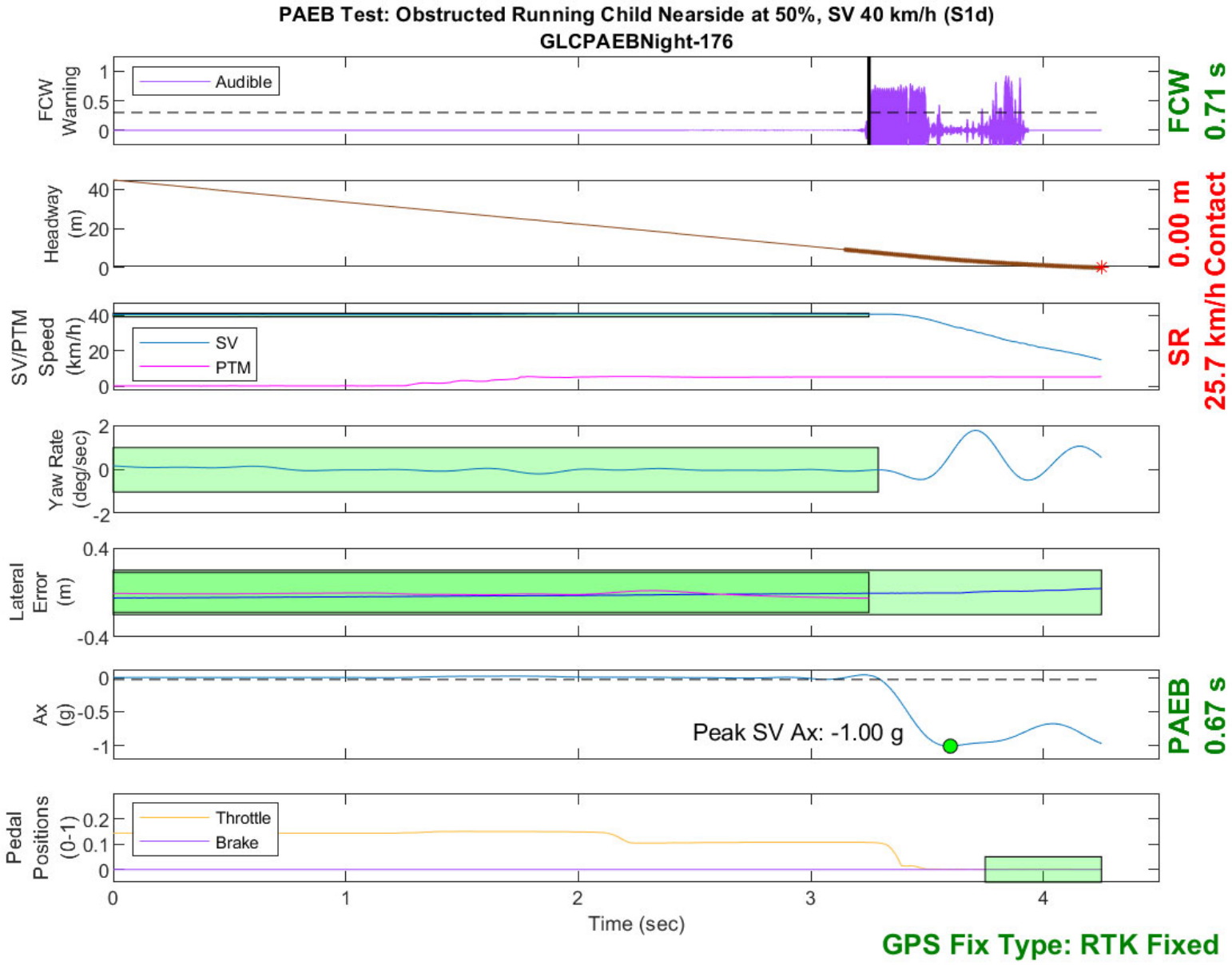

Figure D177. Time History for PAEB Run 176, S1d, Night, High Beam, 40 km/h

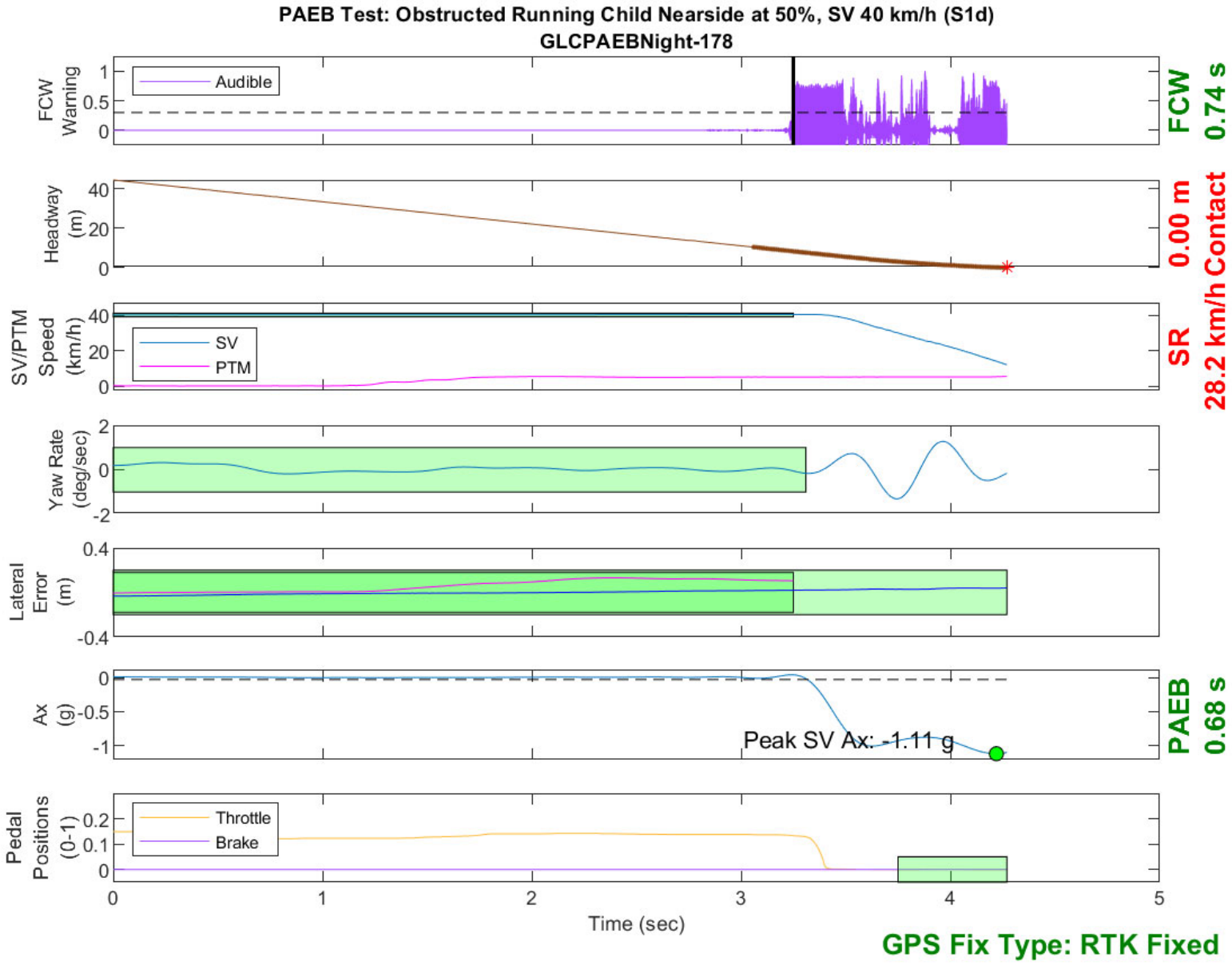

Figure D178. Time History for PAEB Run 178, S1d, Night, High Beam, 40 km/h

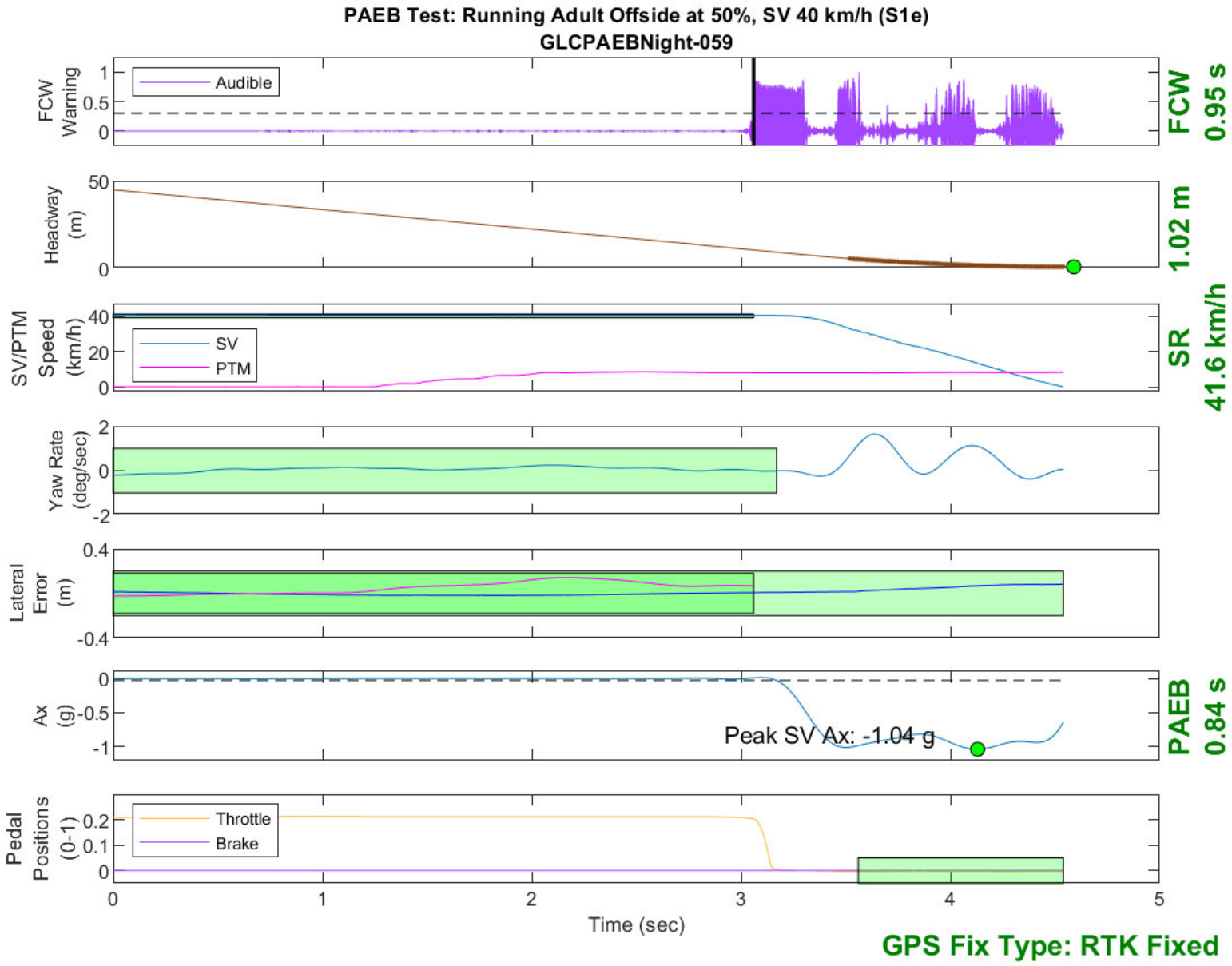

Figure D179. Time History for PAEB Run 59, S1e, Night, High Beam, 40 km/h

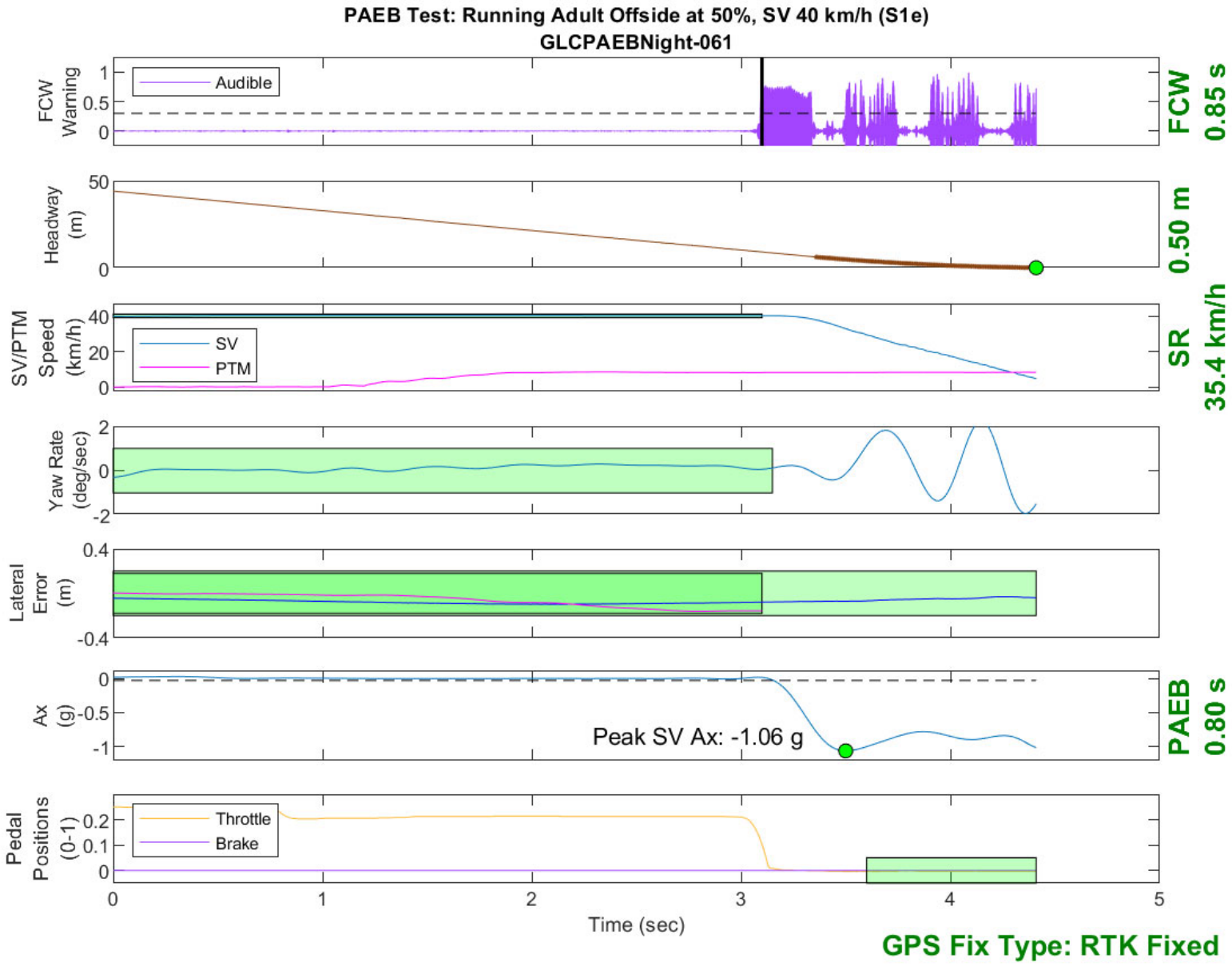

Figure D180. Time History for PAEB Run 61, S1e, Night, High Beam, 40 km/h

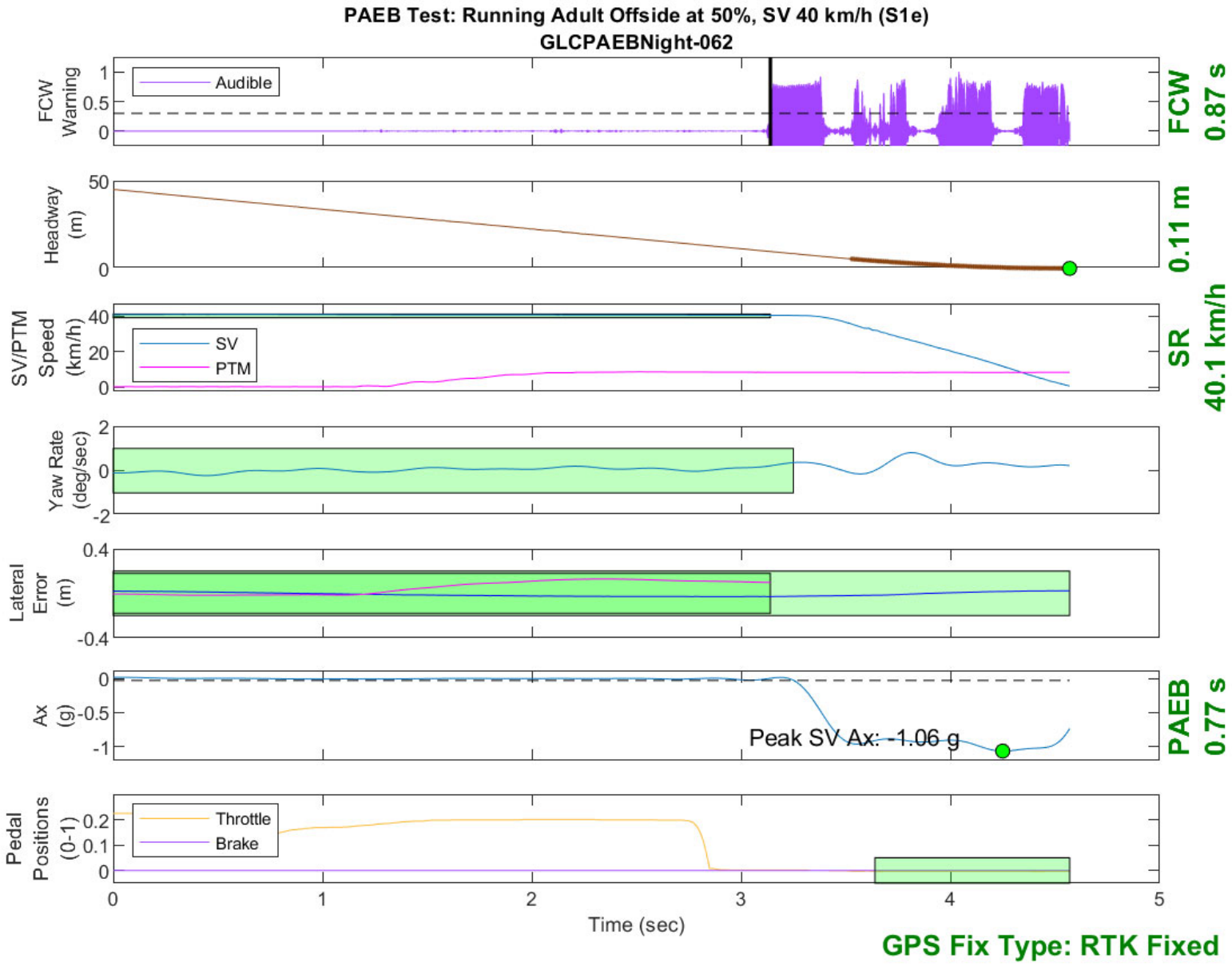

Figure D181. Time History for PAEB Run 62, S1e, Night, High Beam, 40 km/h

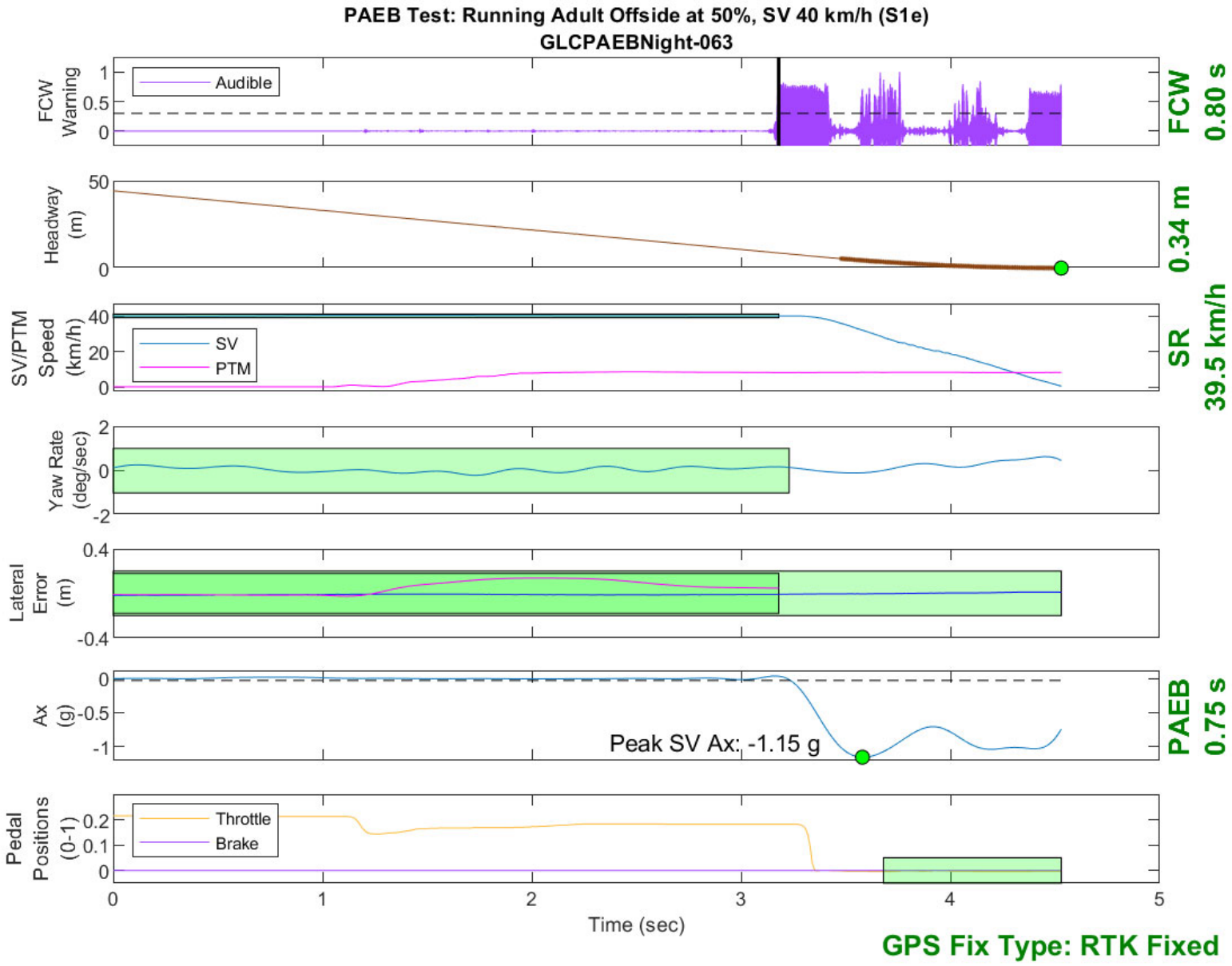

Figure D182. Time History for PAEB Run 63, S1e, Night, High Beam, 40 km/h

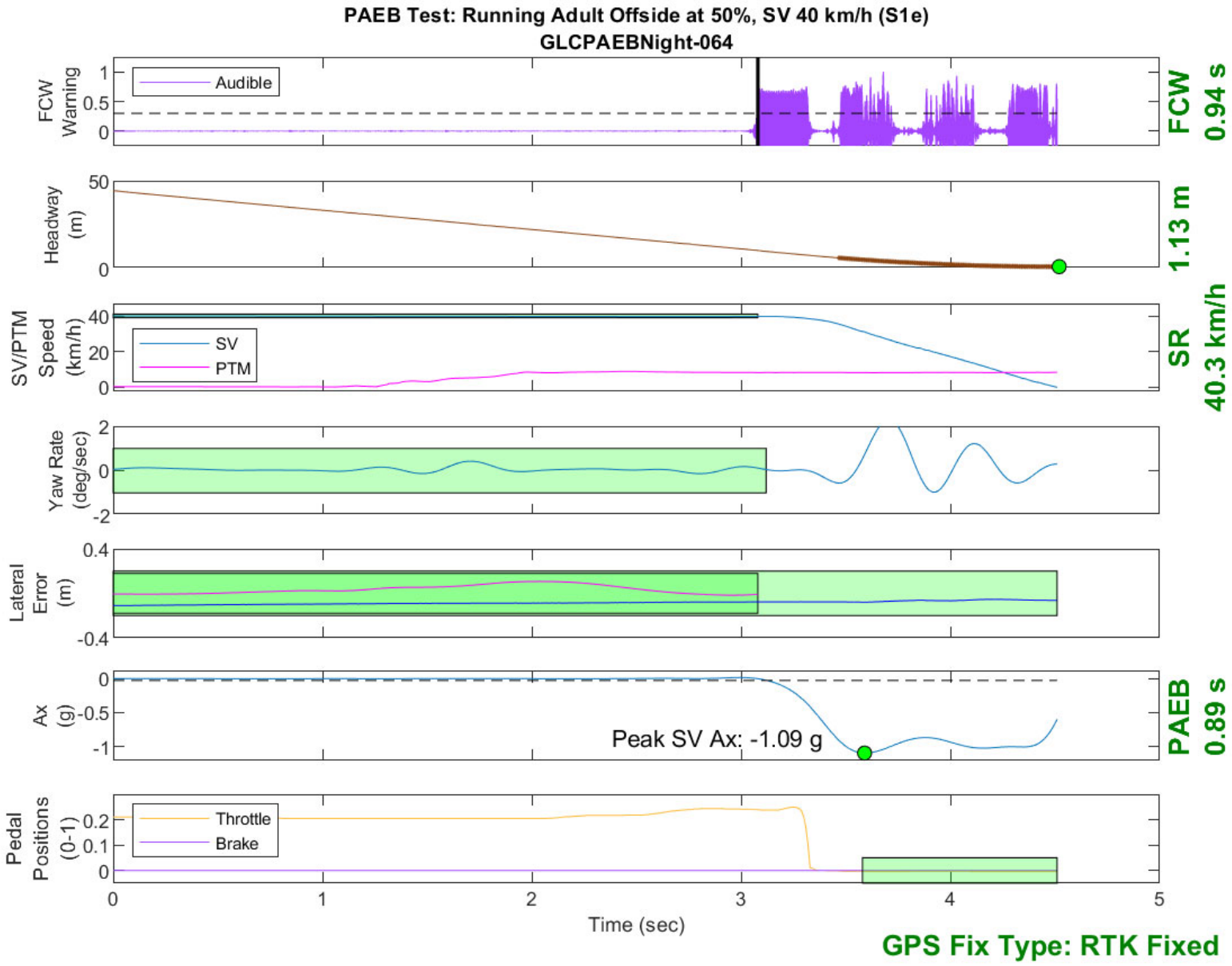

Figure D183. Time History for PAEB Run 64, S1e, Night, High Beam, 40 km/h

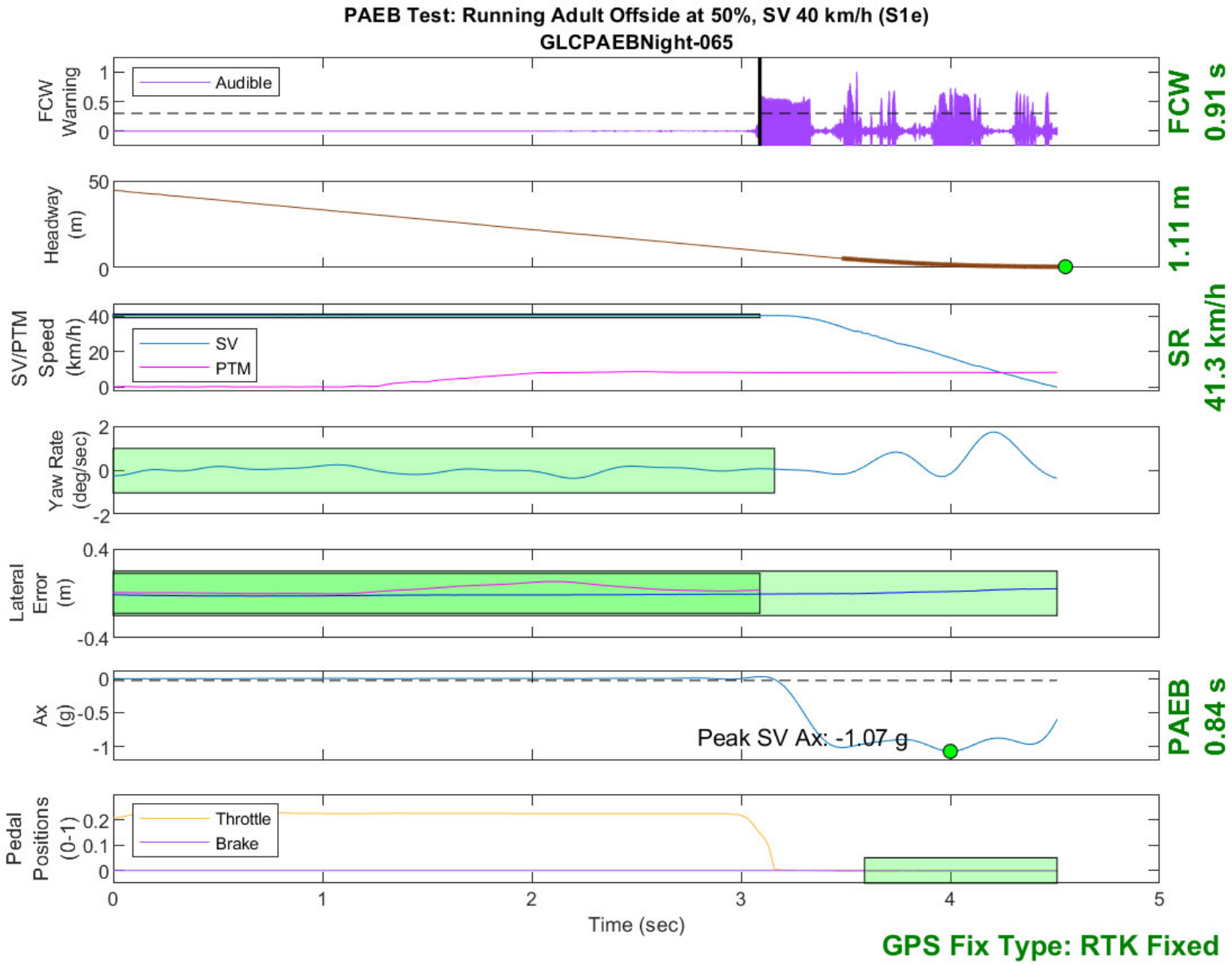

Figure D184. Time History for PAEB Run 65, S1e, Night, High Beam, 40 km/h

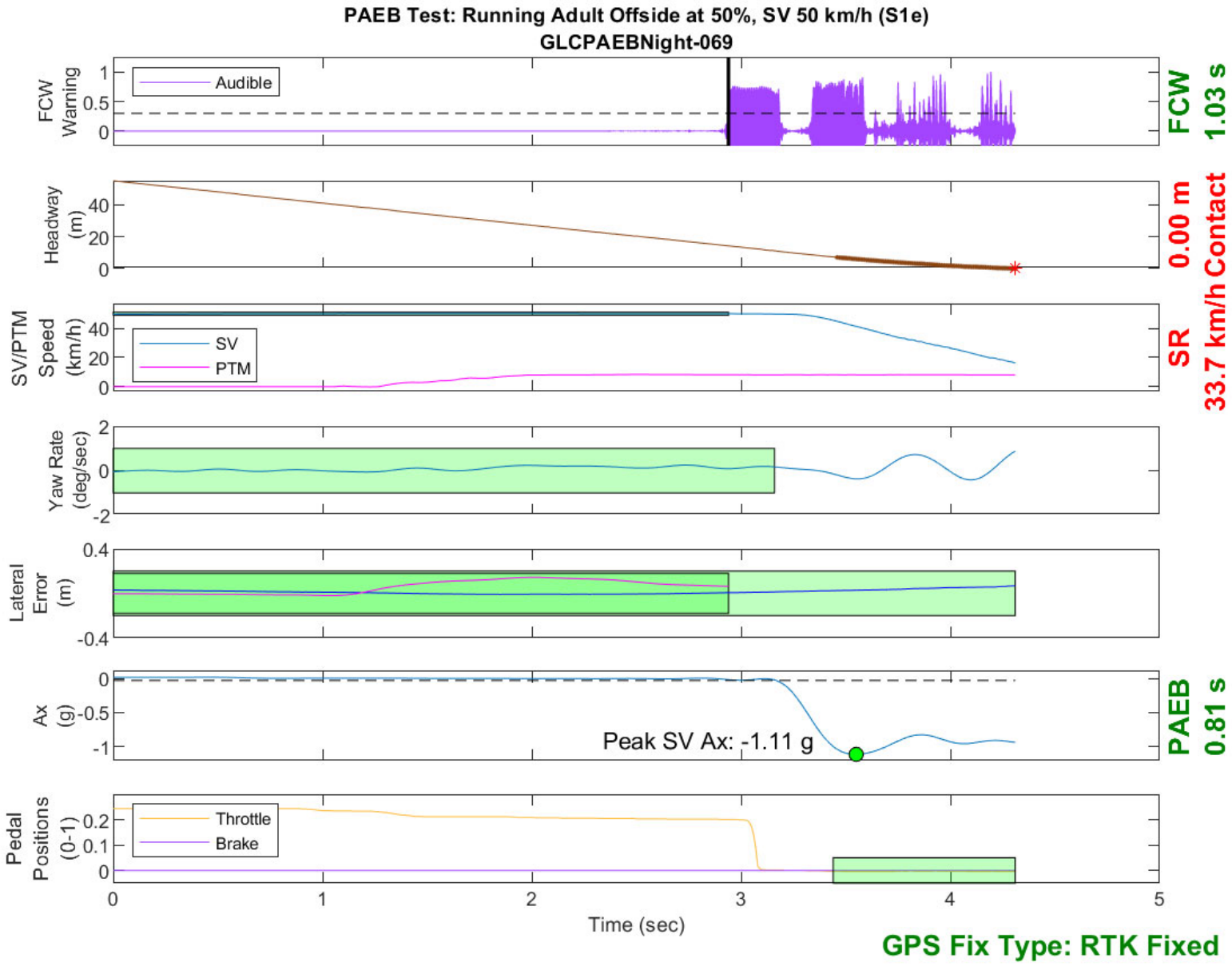

Figure D185. Time History for PAEB Run 69, S1e, Night, High Beam, 50 km/h

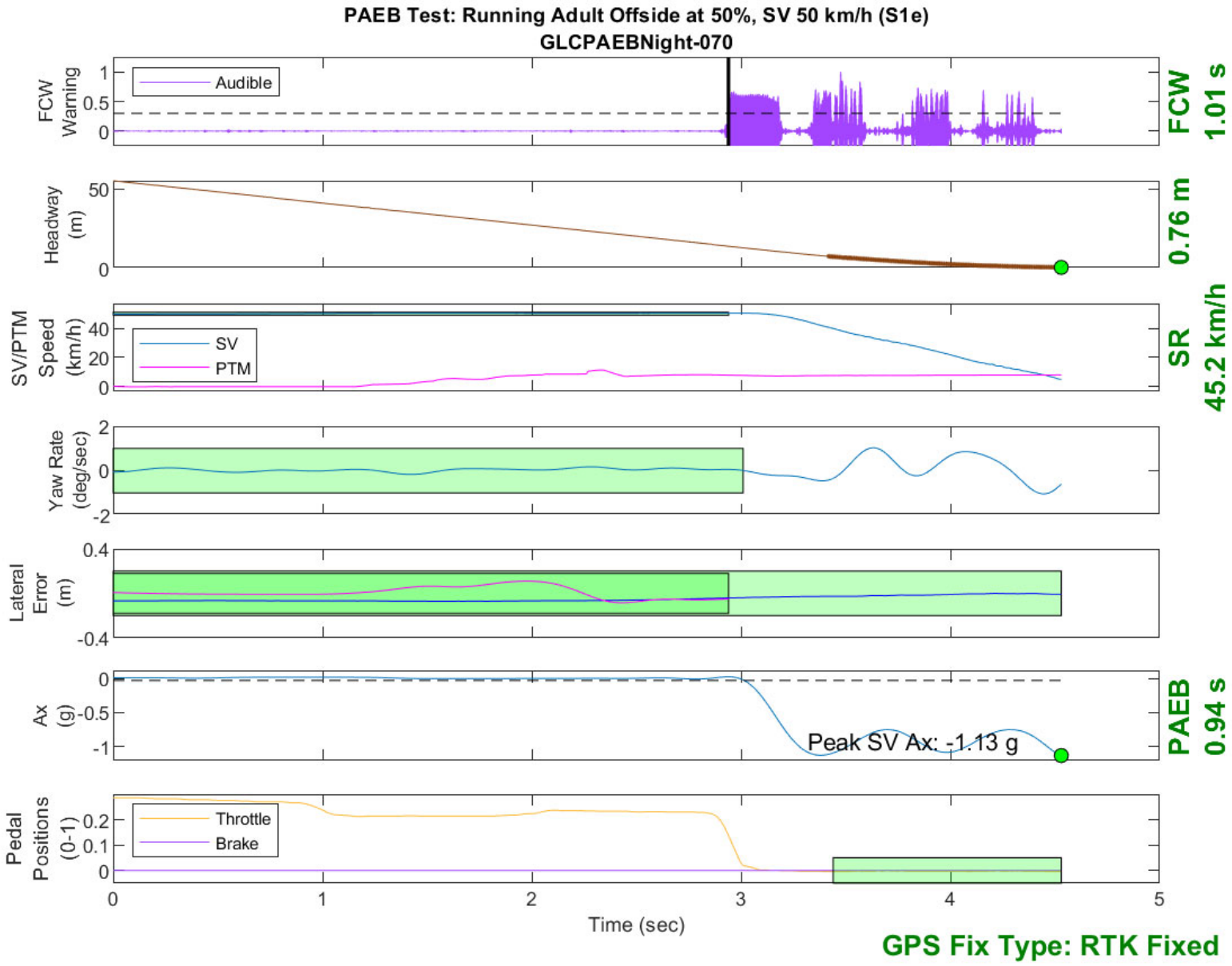

Figure D186. Time History for PAEB Run 70, S1e, Night, High Beam, 50 km/h

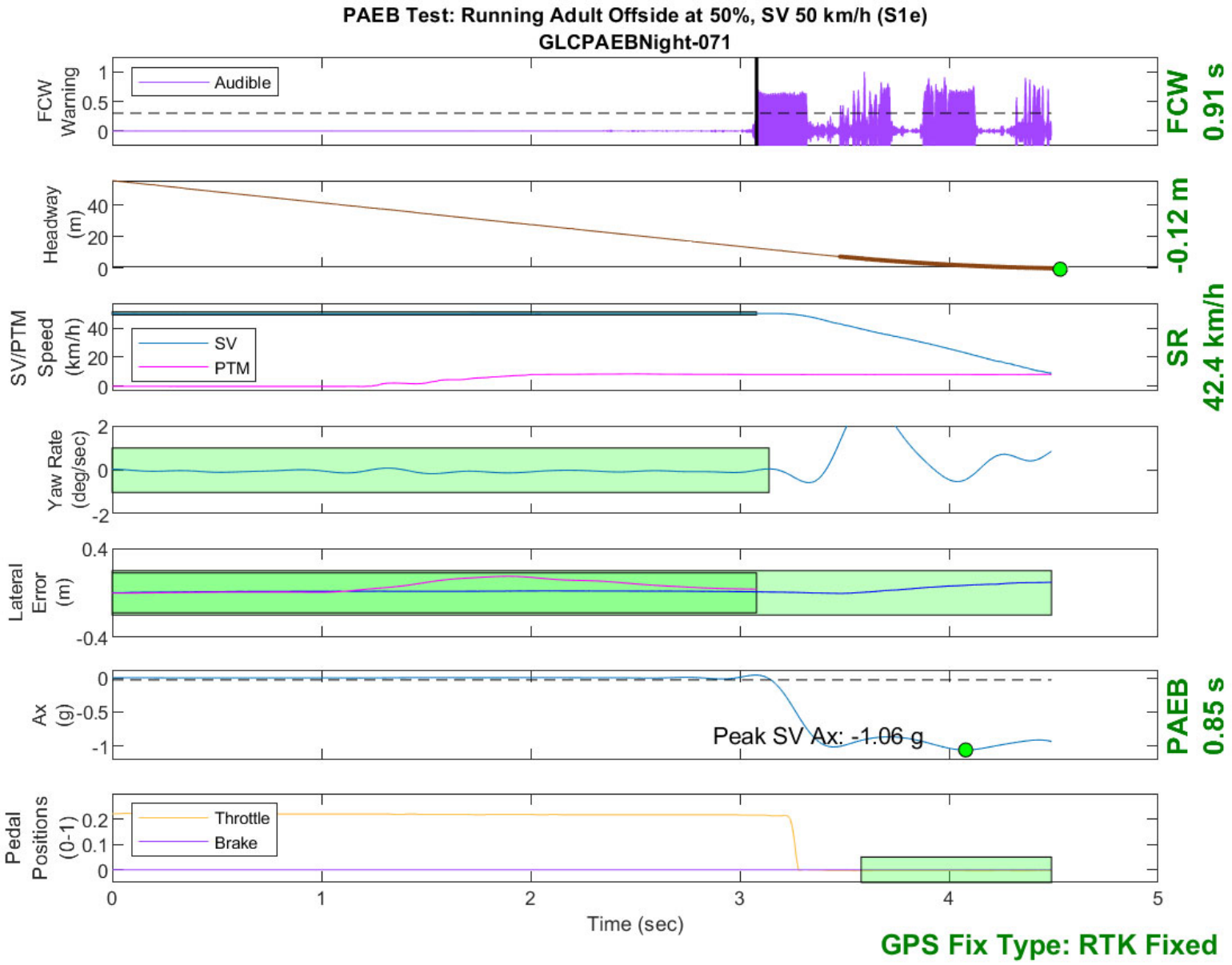

Figure D187. Time History for PAEB Run 71, S1e, Night, High Beam, 50 km/h

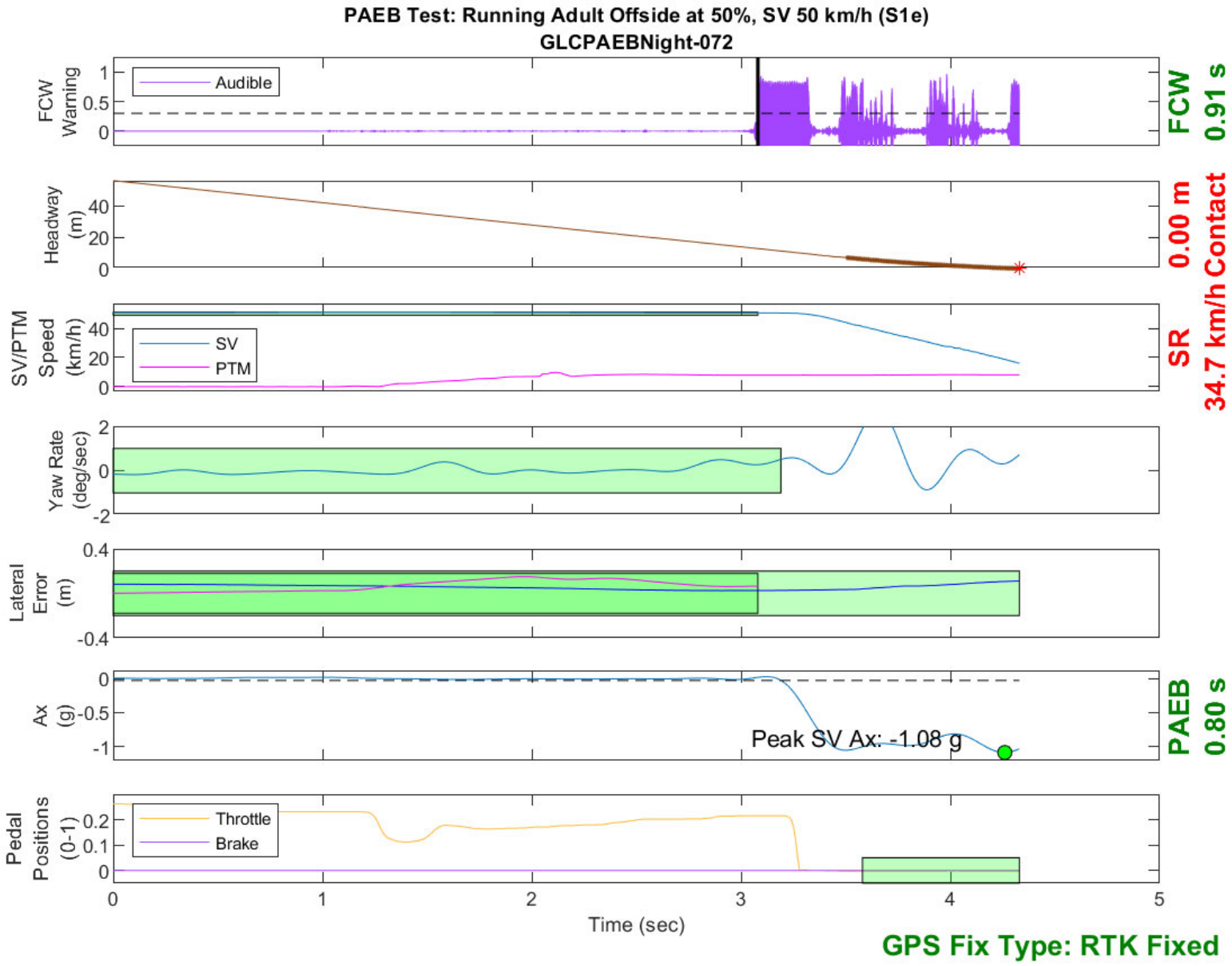

Figure D188. Time History for PAEB Run 72, S1e, Night, High Beam, 50 km/h

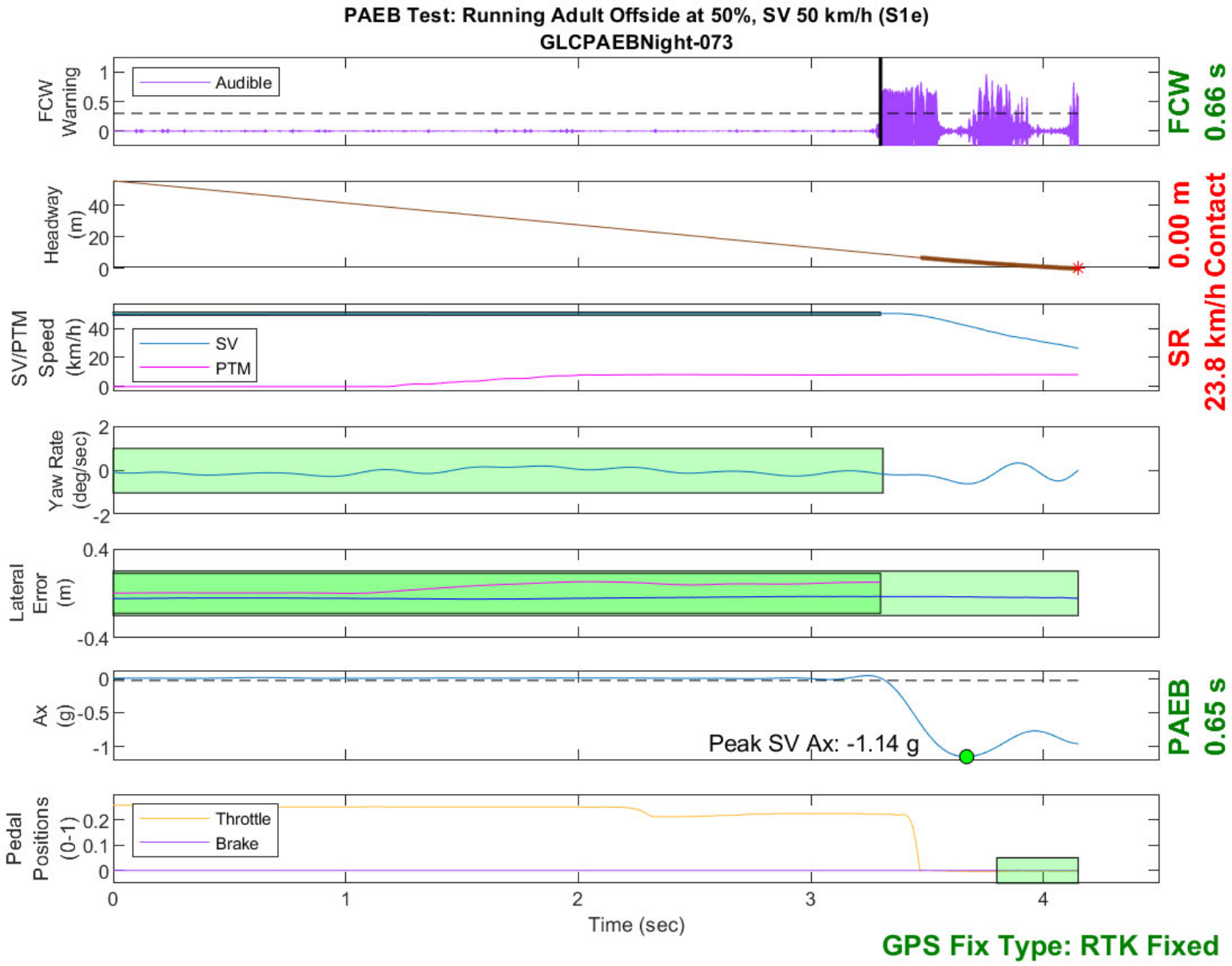

Figure D189. Time History for PAEB Run 73, S1e, Night, High Beam, 50 km/h

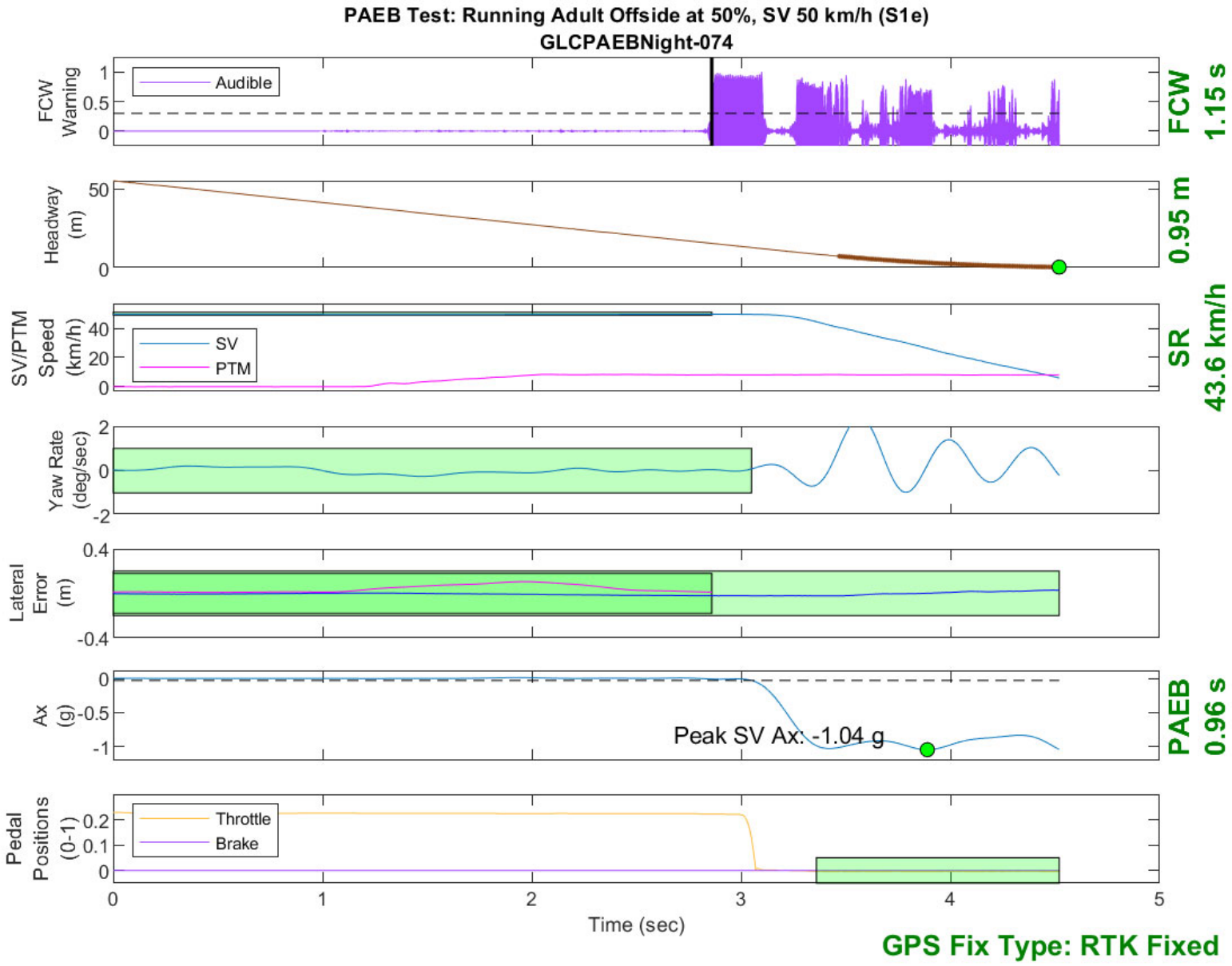

Figure D190. Time History for PAEB Run 74, S1e, Night, High Beam, 50 km/h

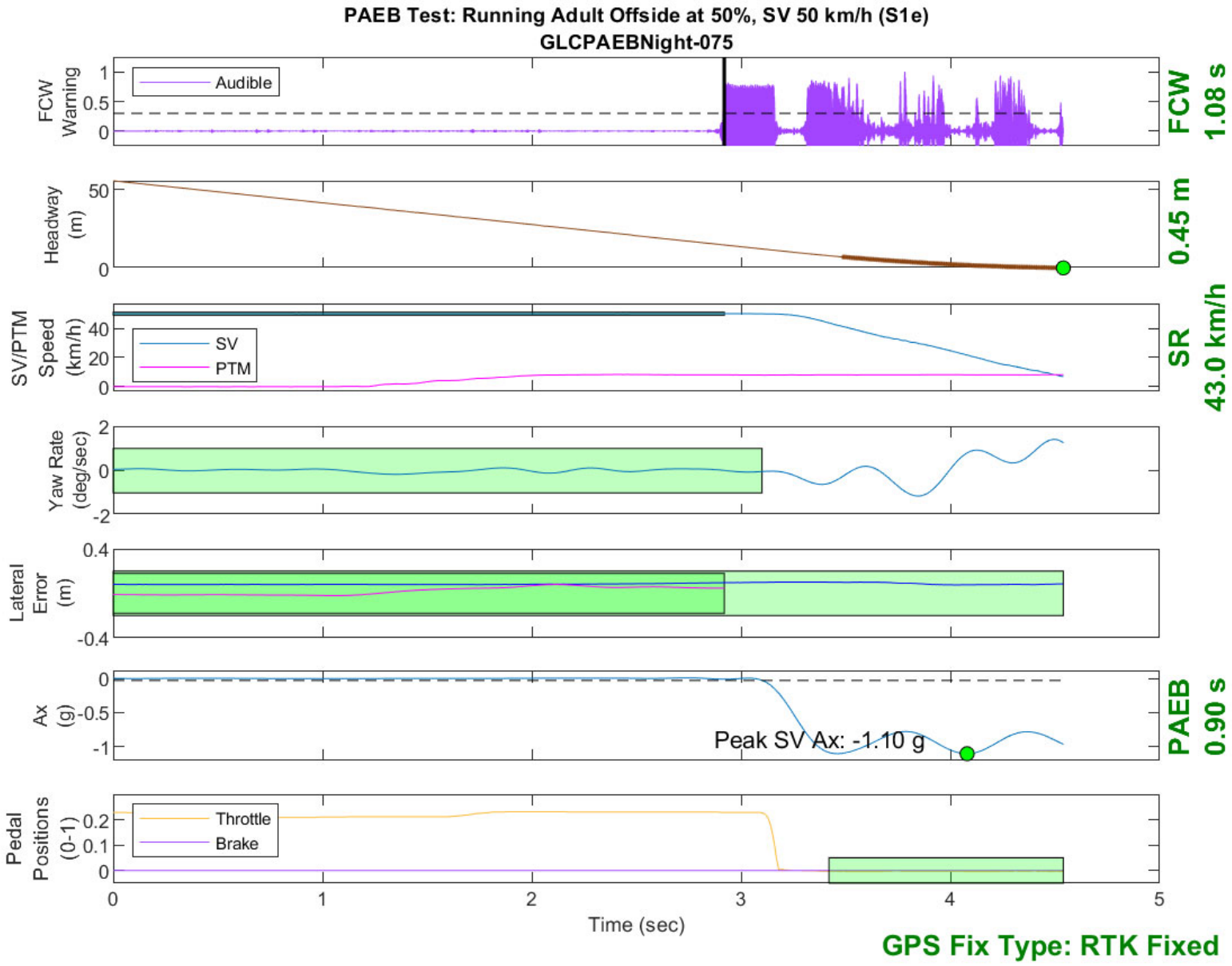

Figure D191. Time History for PAEB Run 75, S1e, Night, High Beam, 50 km/h

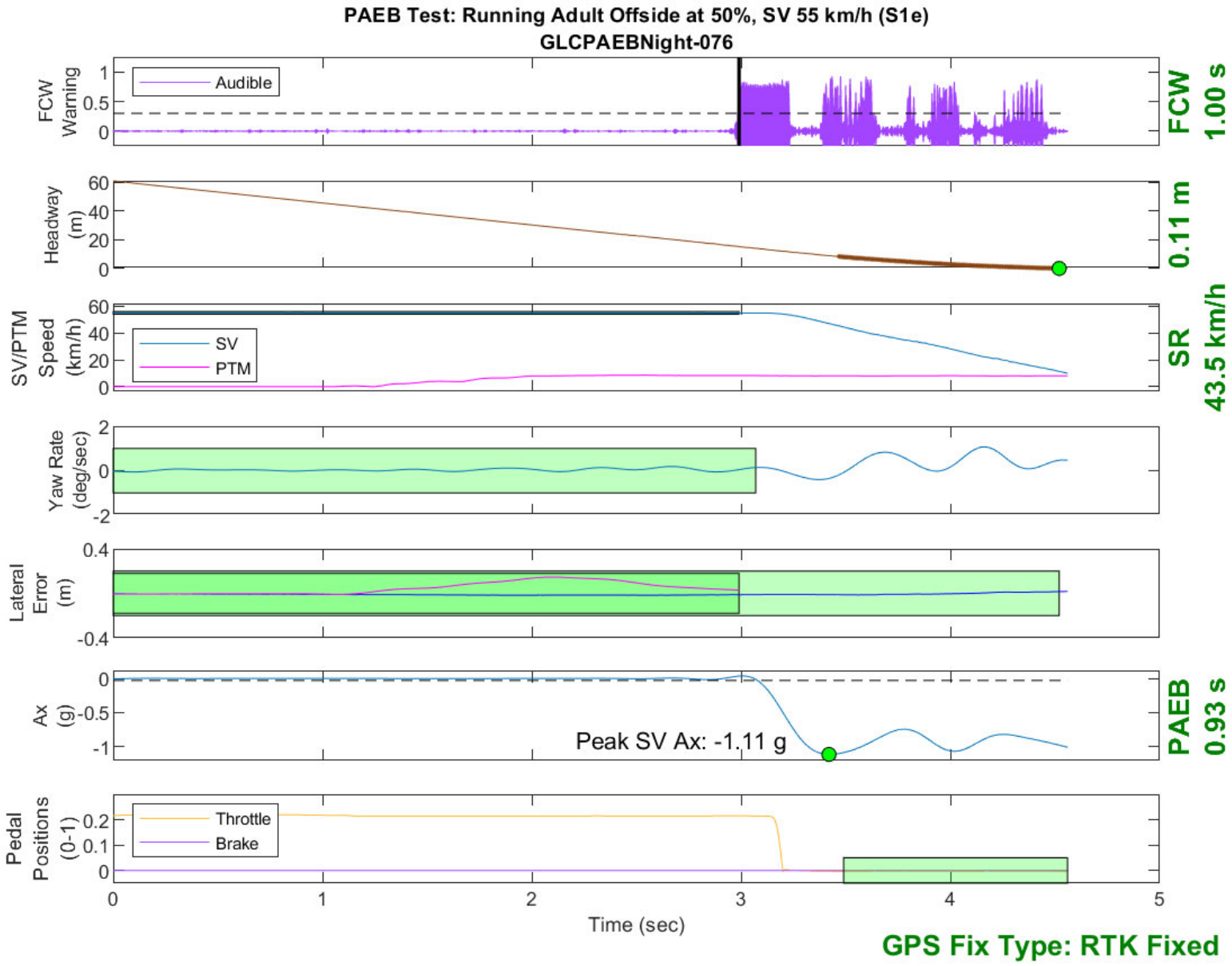

Figure D192. Time History for PAEB Run 76, S1e, Night, High Beam, 55 km/h

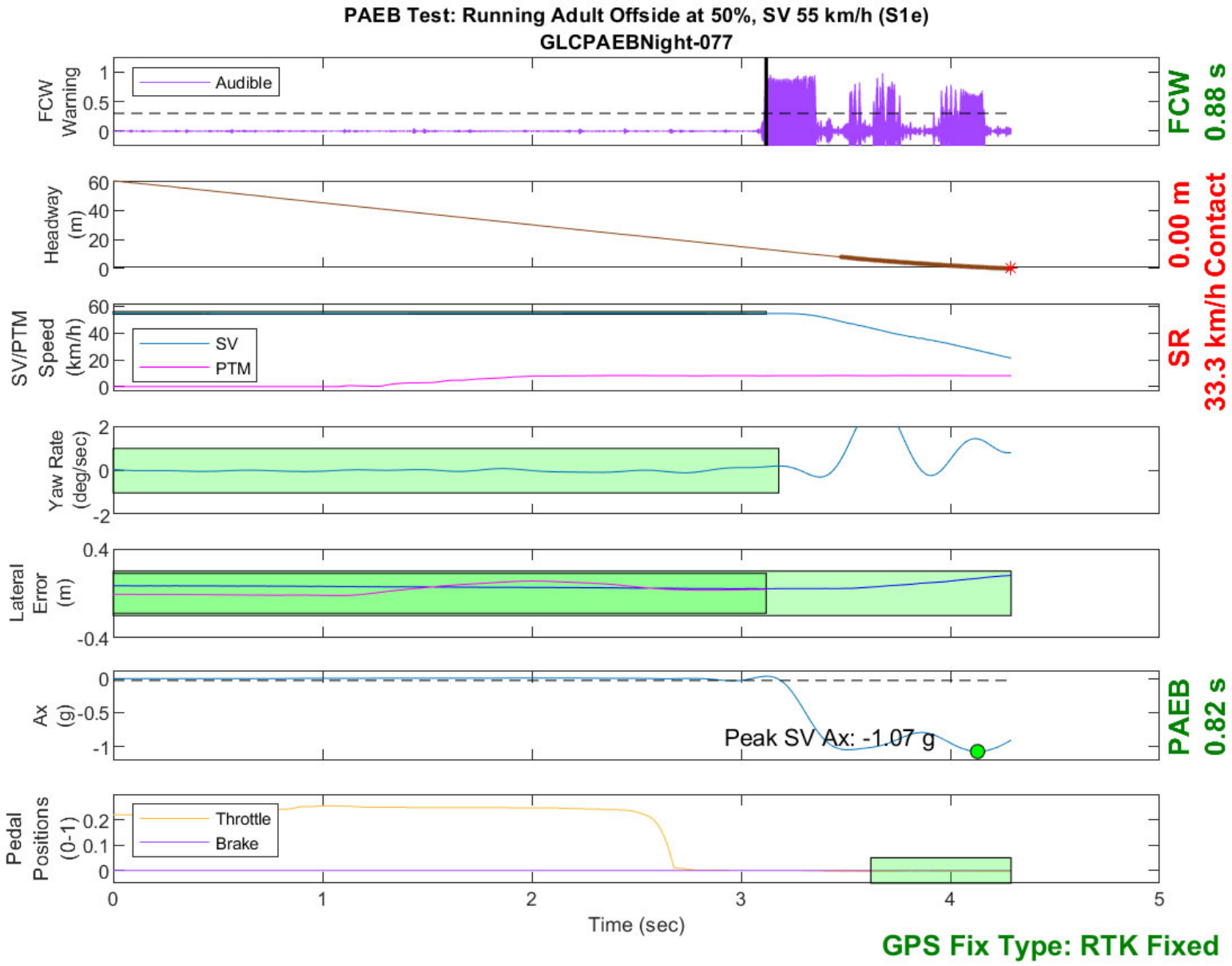

Figure D193. Time History for PAEB Run 77, S1e, Night, High Beam, 55 km/h

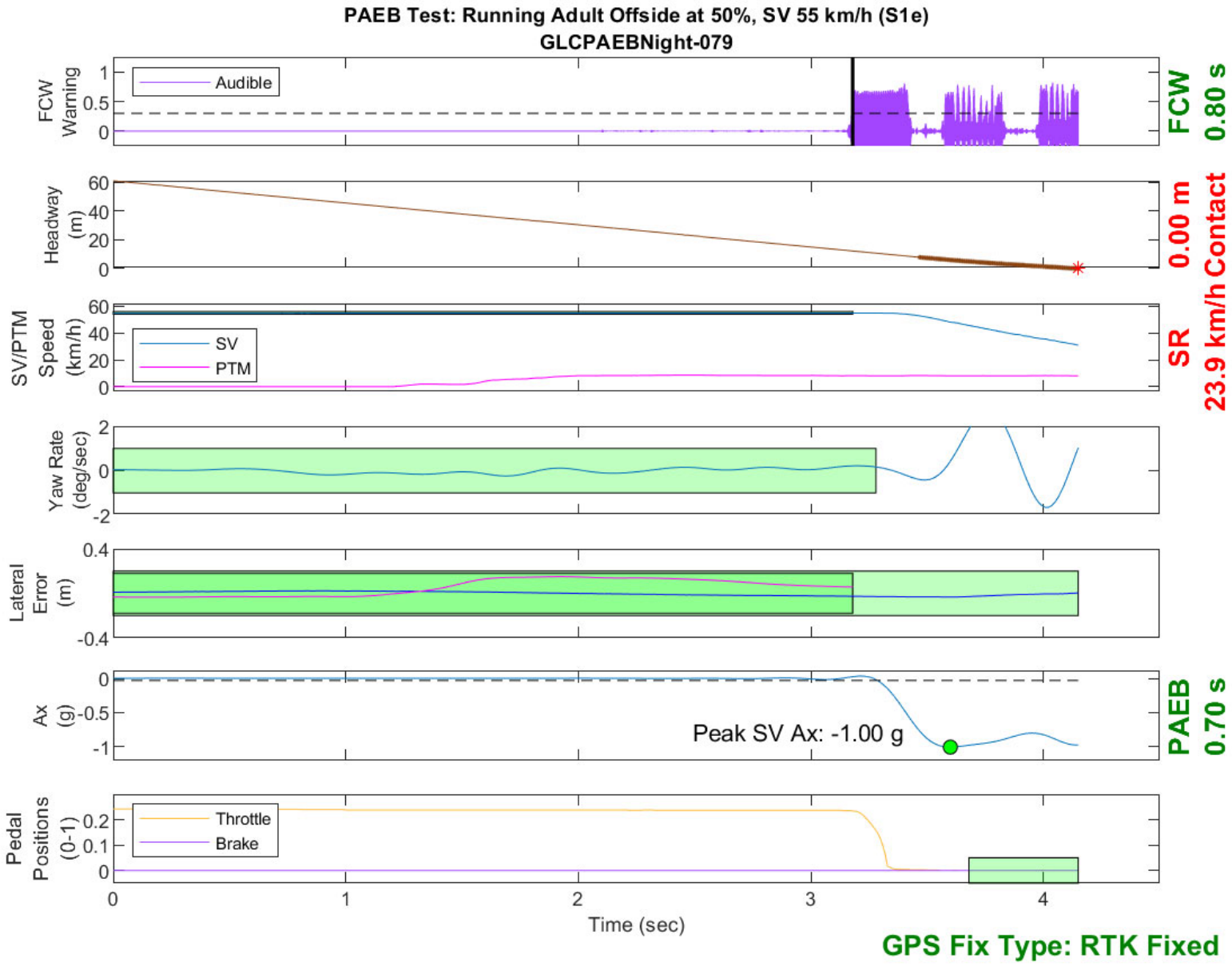

Figure D194. Time History for PAEB Run 79, S1e, Night, High Beam, 55 km/h

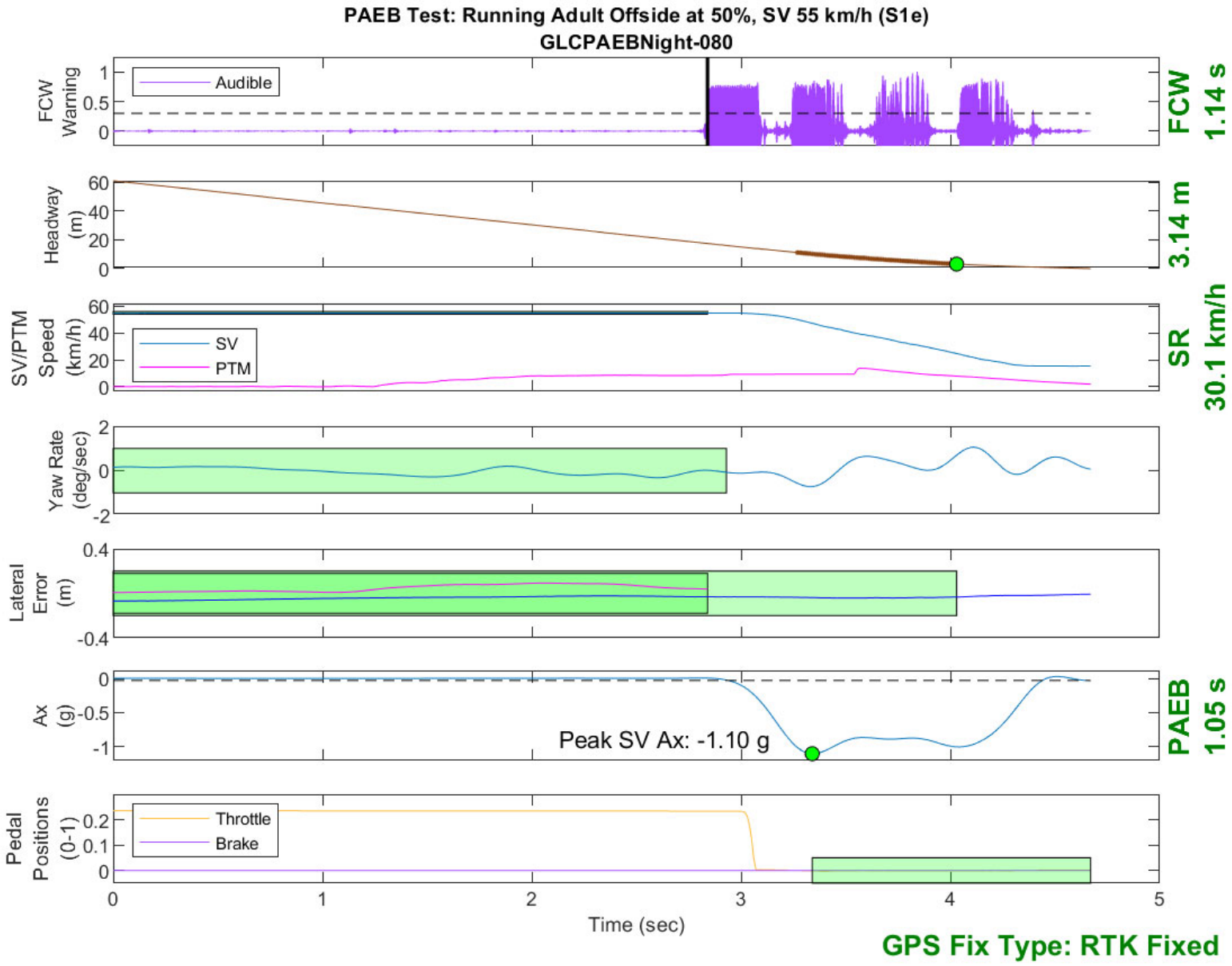

Figure D195. Time History for PAEB Run 80, S1e, Night, High Beam, 55 km/h

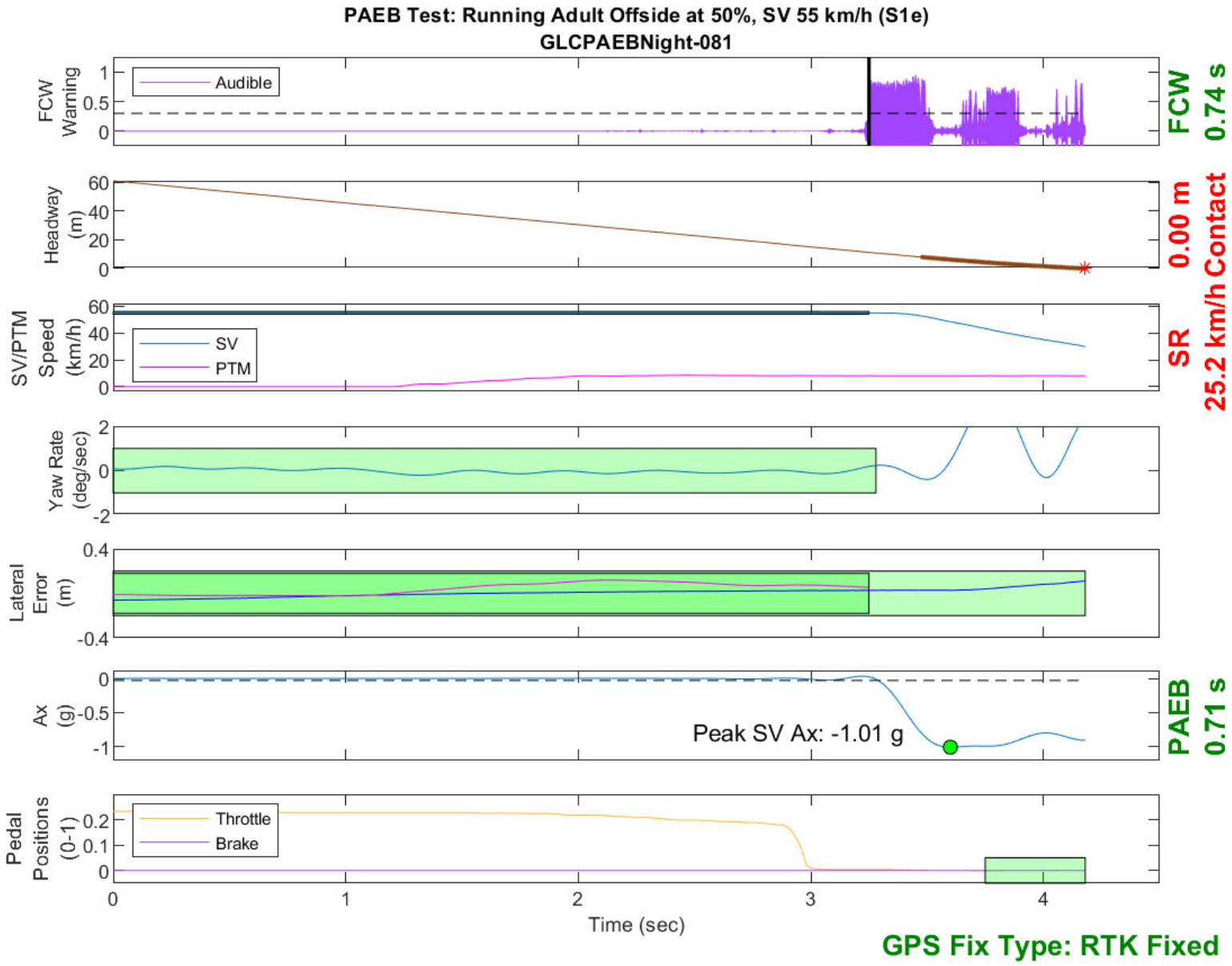

Figure D196. Time History for PAEB Run 81, S1e, Night, High Beam, 55 km/h

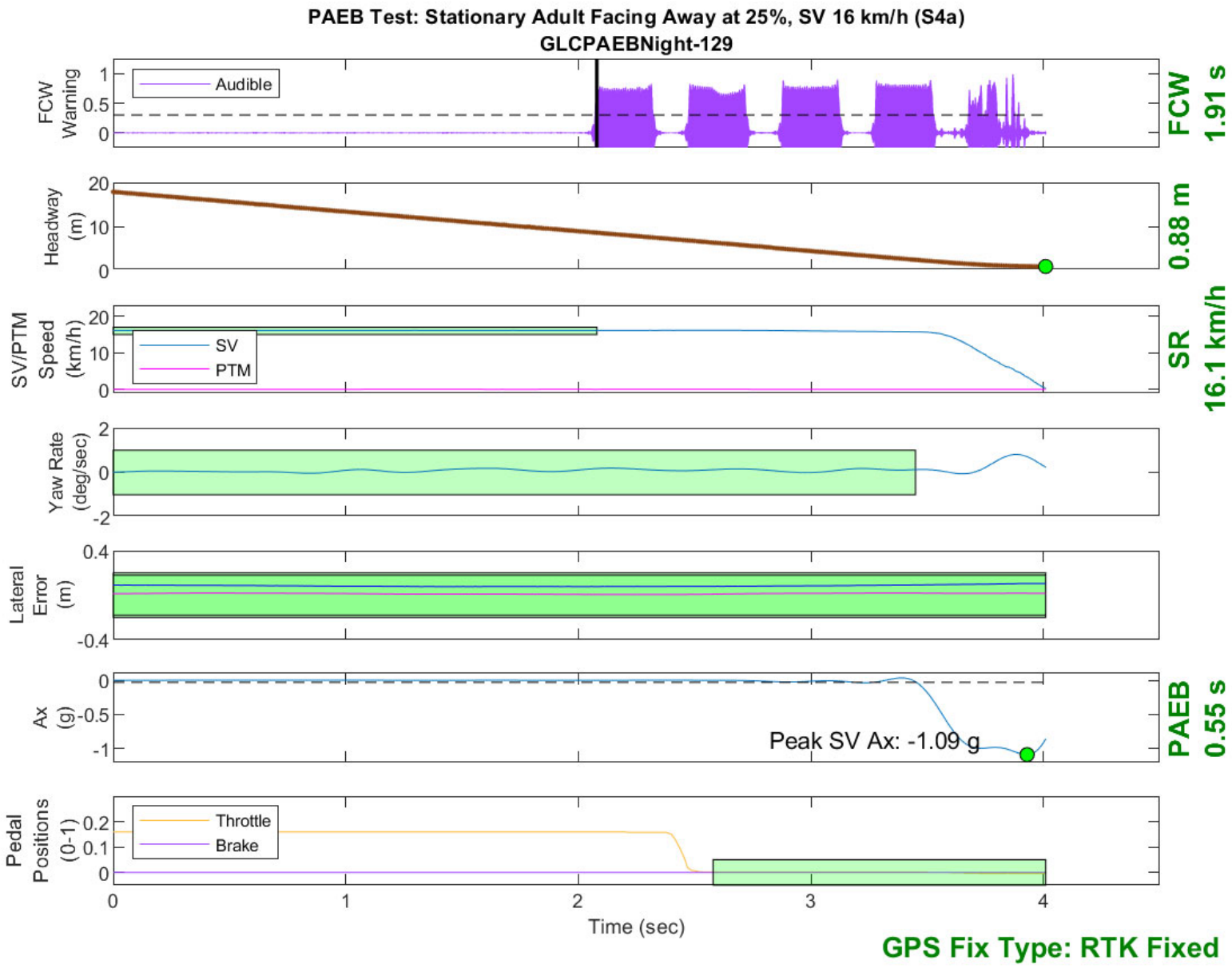

Figure D197. Time History for PAEB Run 129, S4a, Night, High Beam, 16 km/h

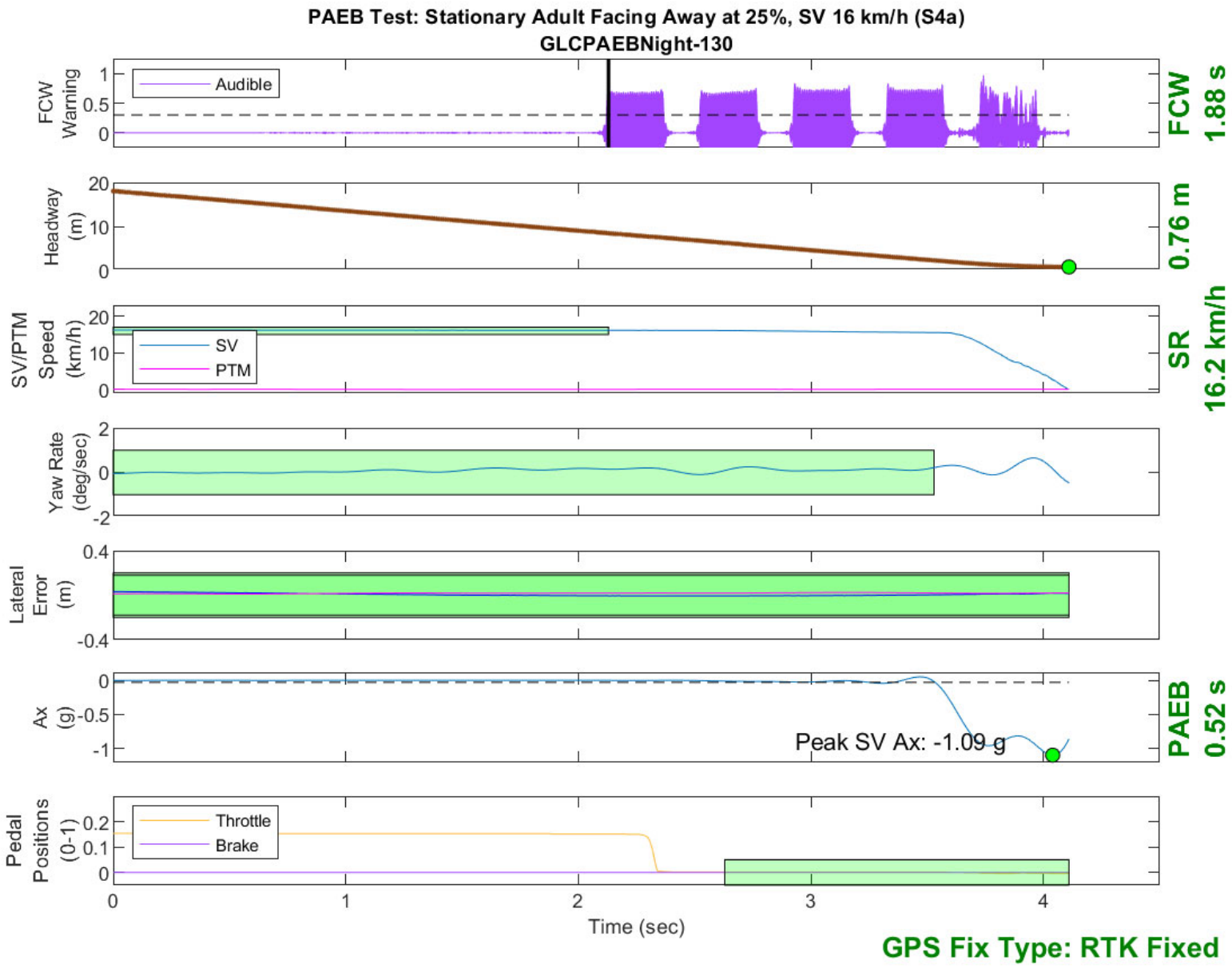

Figure D198. Time History for PAEB Run 130, S4a, Night, High Beam, 16 km/h

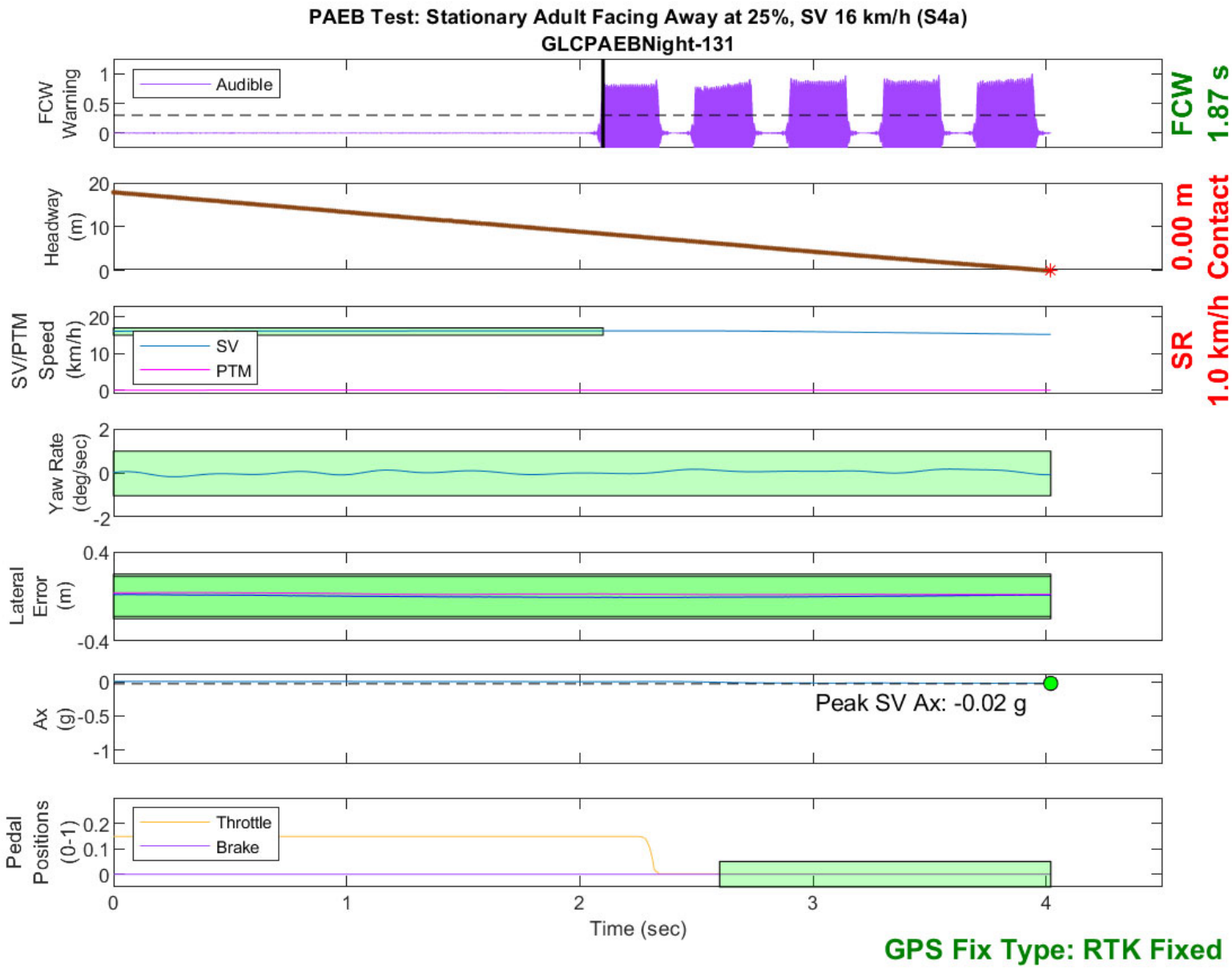

Figure D199. Time History for PAEB Run 131, S4a, Night, High Beam, 16 km/h

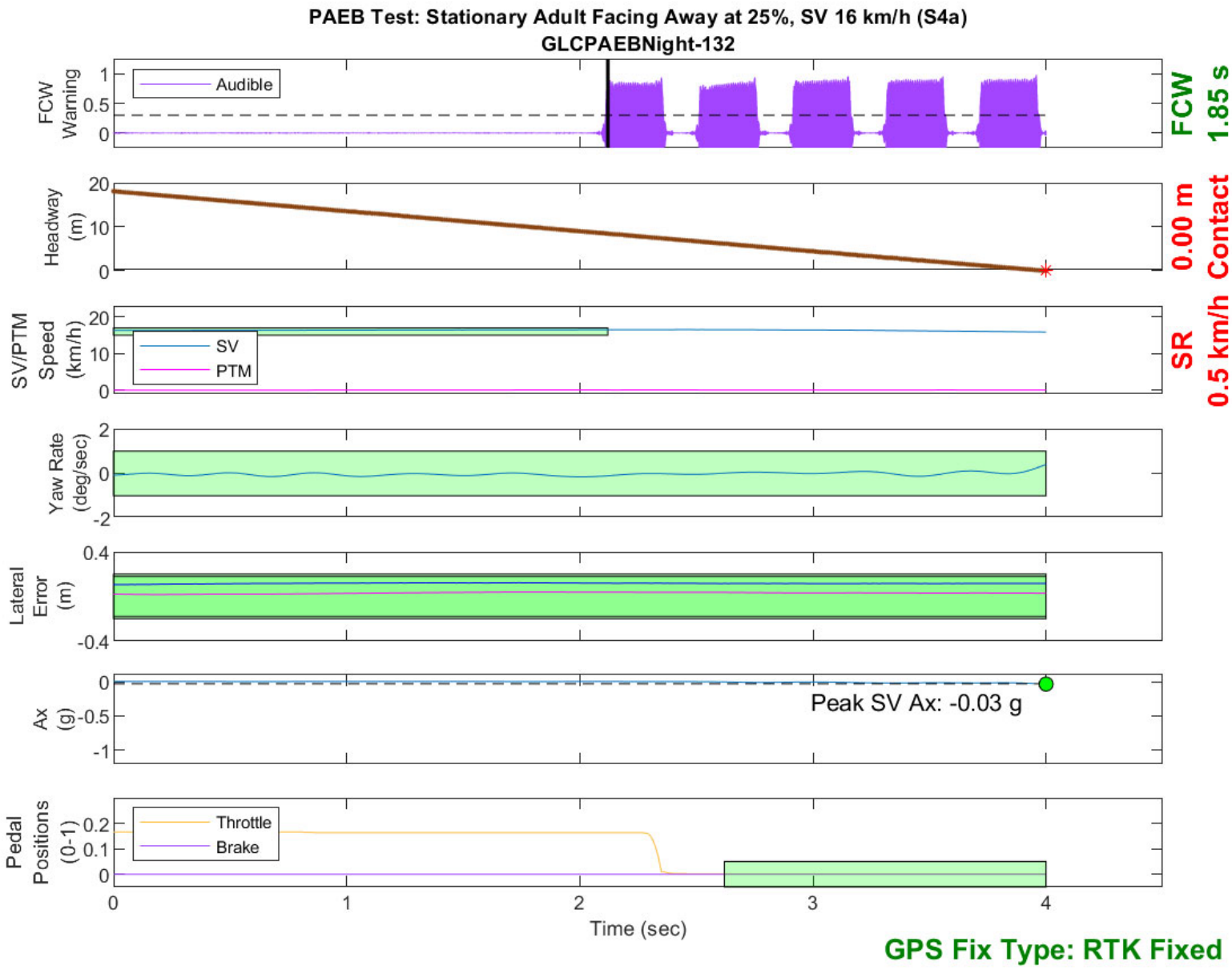

Figure D200. Time History for PAEB Run 132, S4a, Night, High Beam, 16 km/h

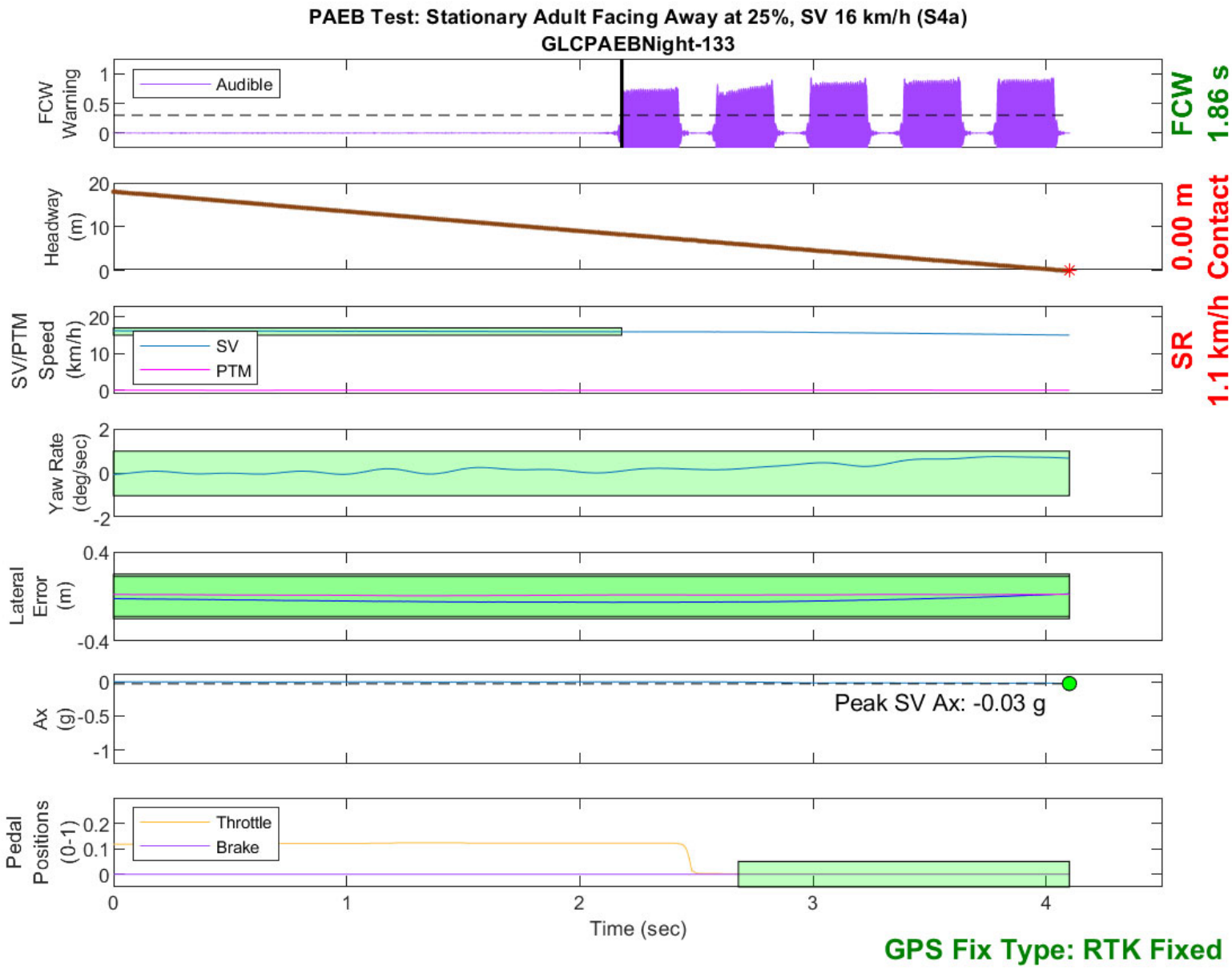

Figure D201. Time History for PAEB Run 133, S4a, Night, High Beam, 16 km/h

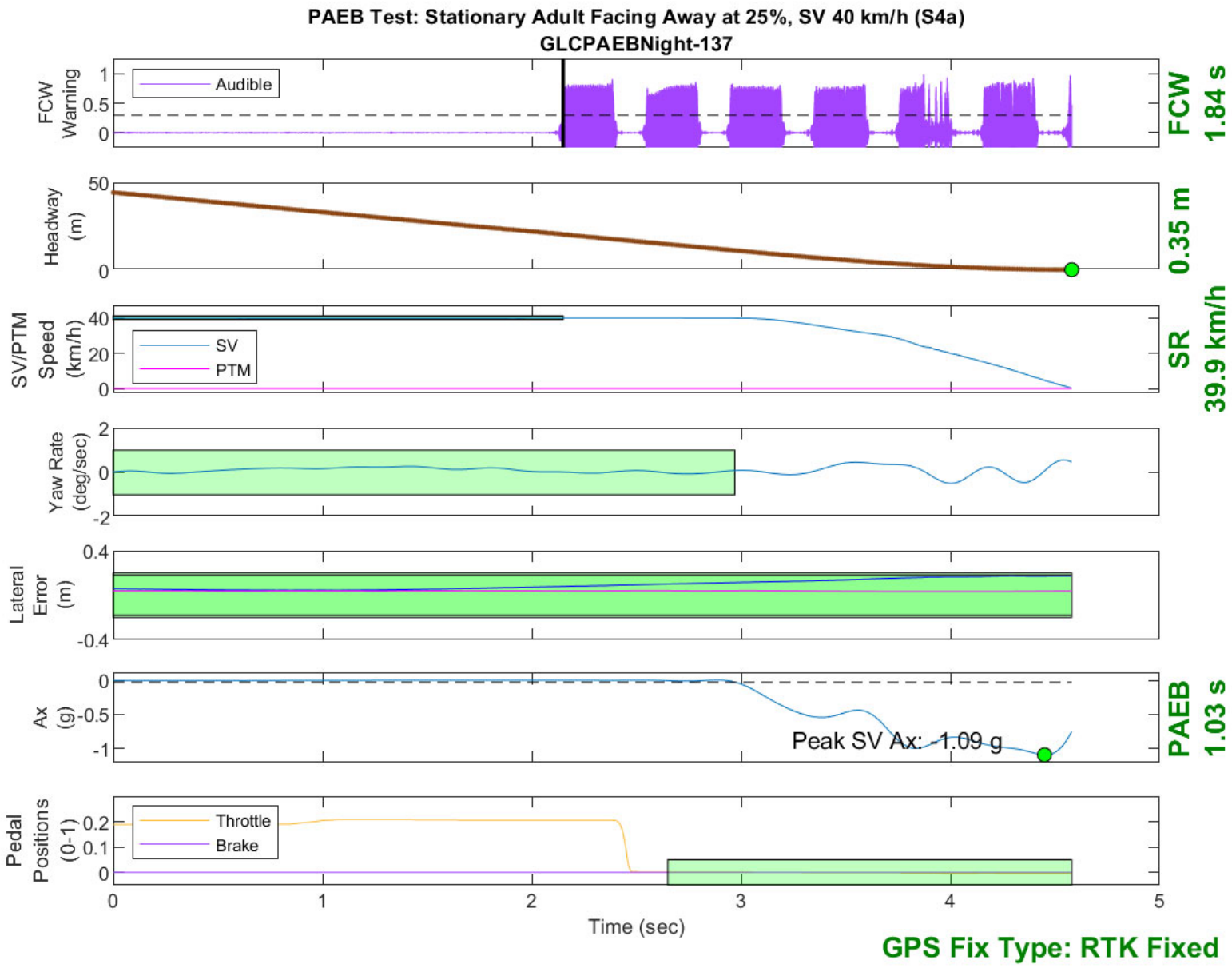

Figure D202. Time History for PAEB Run 137, S4a, Night, High Beam, 40 km/h

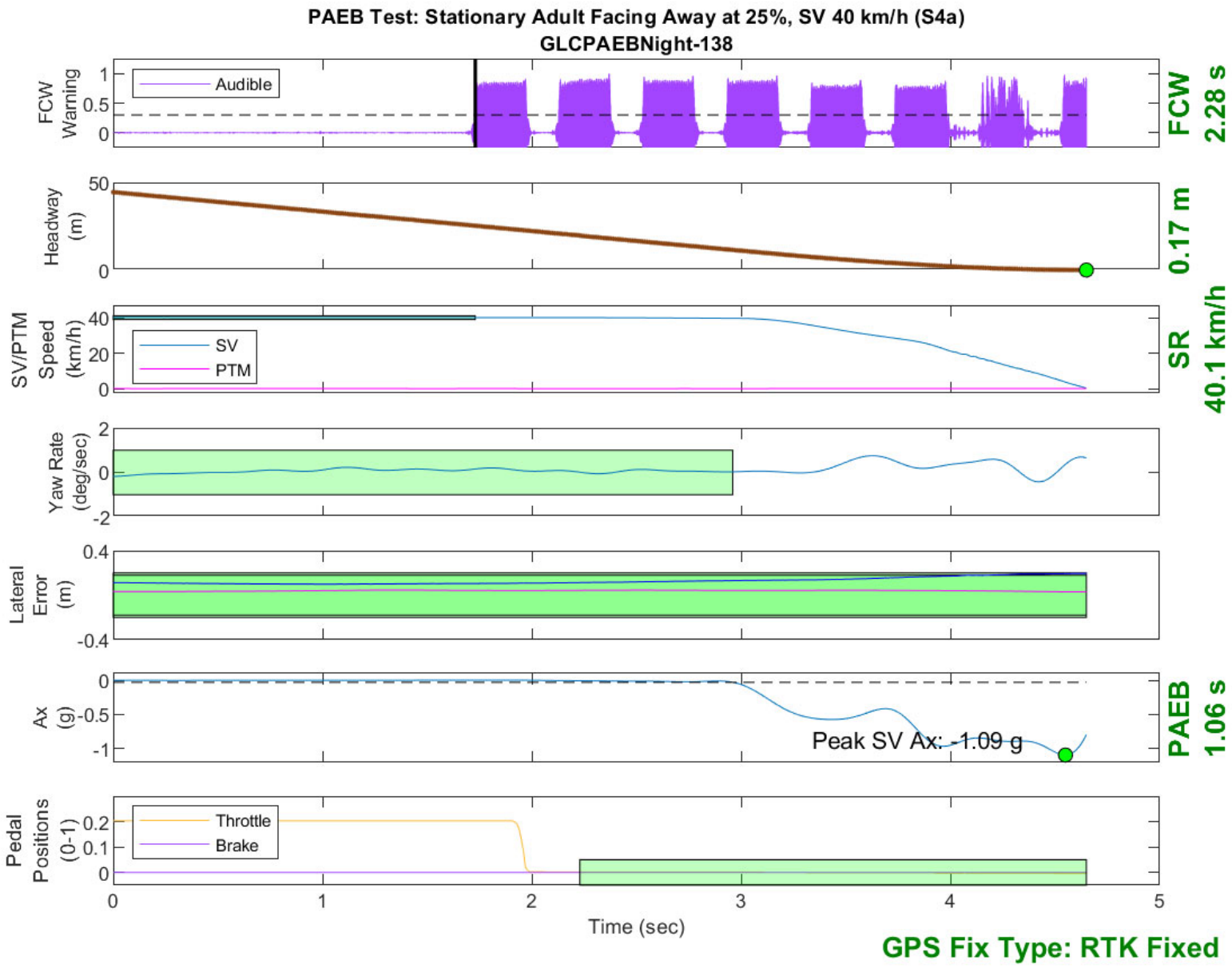

Figure D203. Time History for PAEB Run 138, S4a, Night, High Beam, 40 km/h

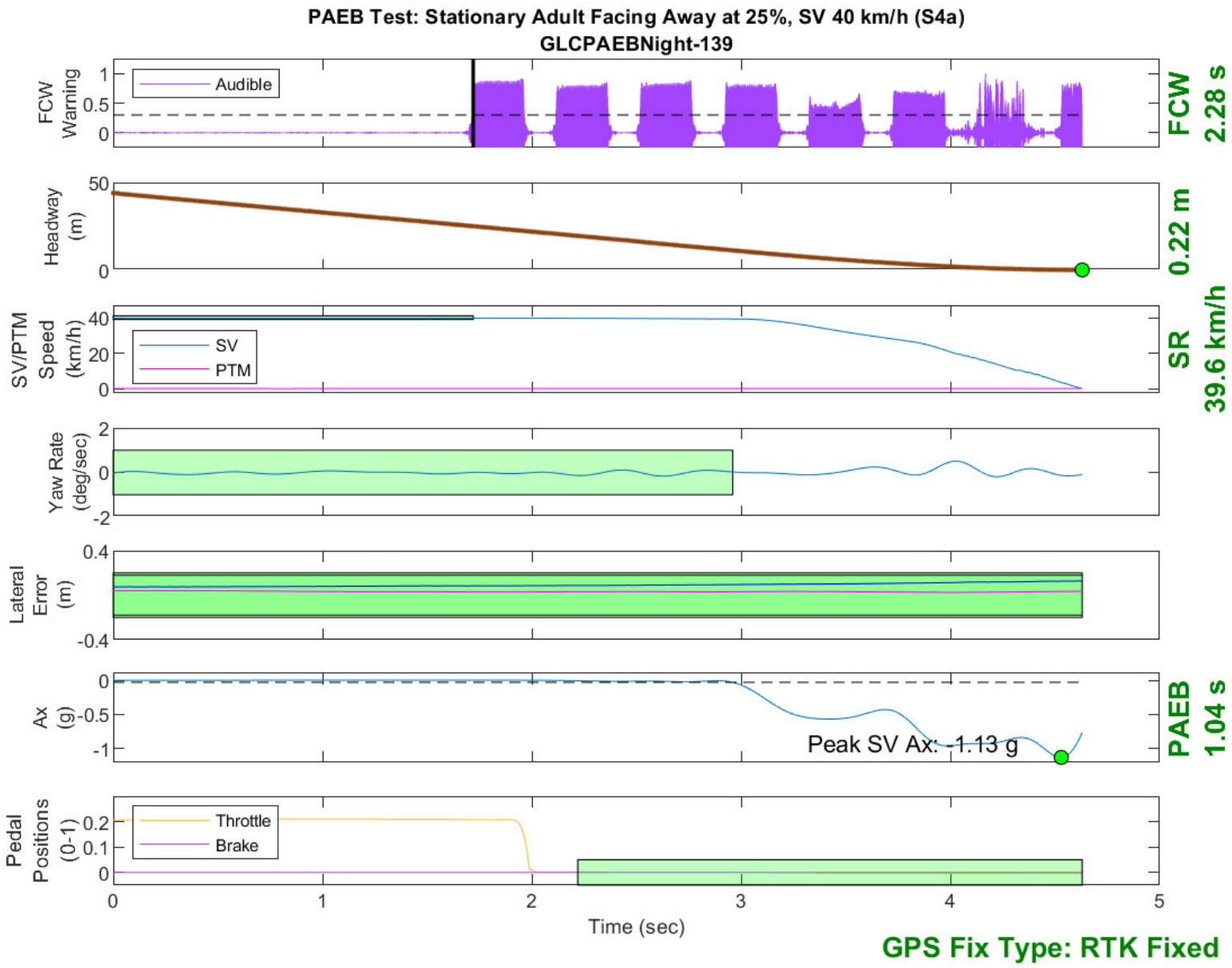

Figure D204. Time History for PAEB Run 139, S4a, Night, High Beam, 40 km/h

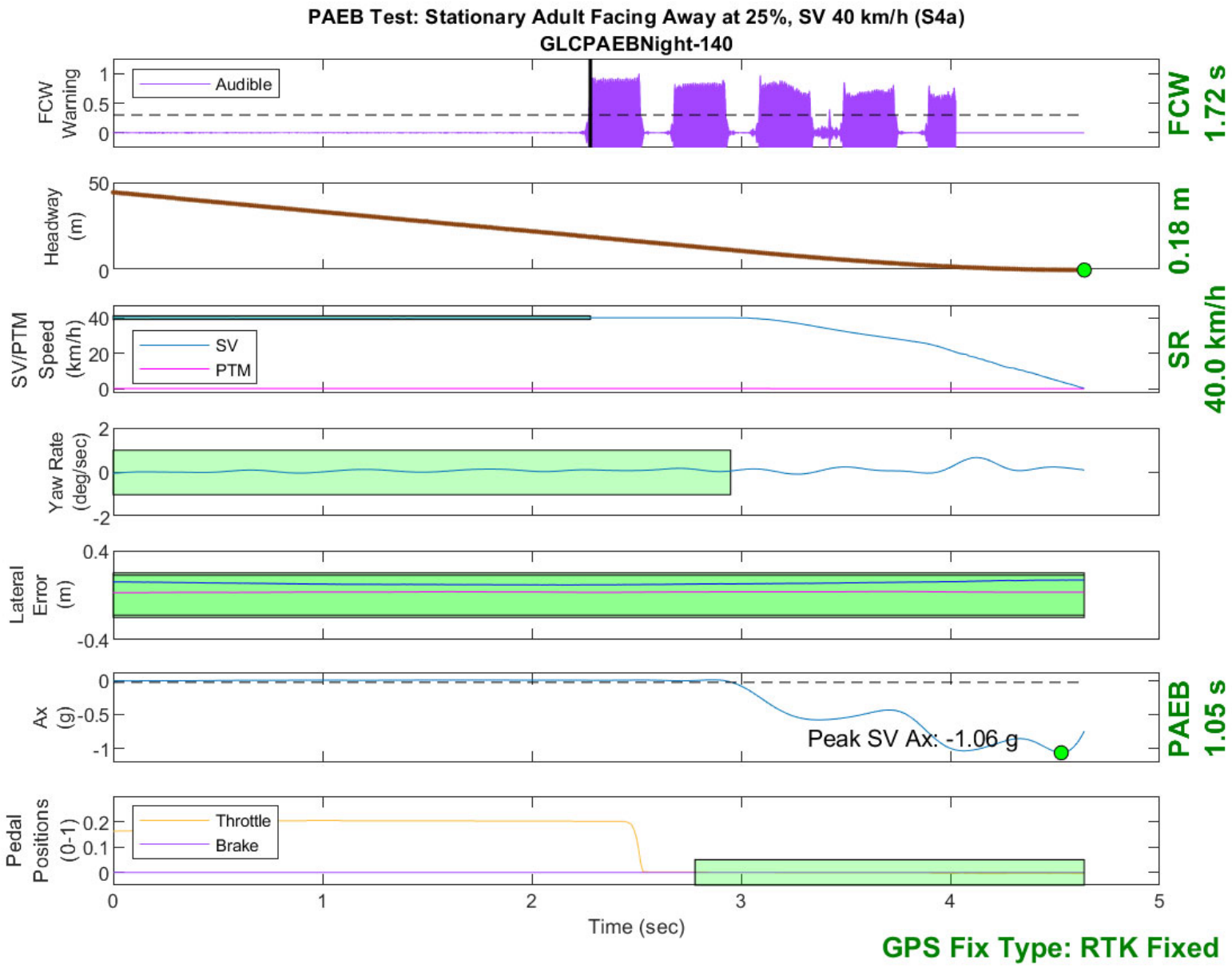

Figure D205. Time History for PAEB Run 140, S4a, Night, High Beam, 40 km/h

Figure D206. Time History for PAEB Run 141, S4a, Night, High Beam, 40 km/h

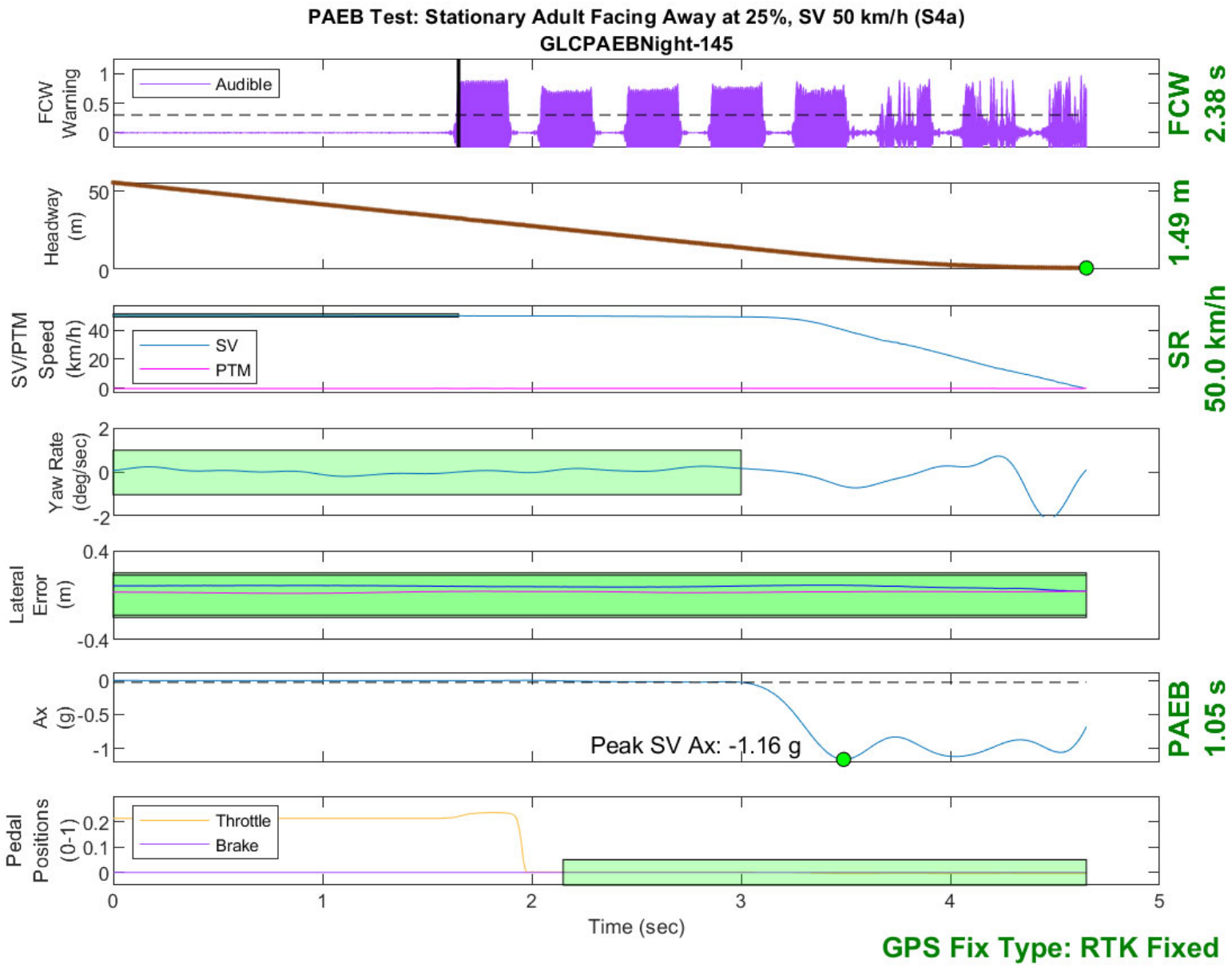

Figure D207. Time History for PAEB Run 145, S4a, Night, High Beam, 50 km/h

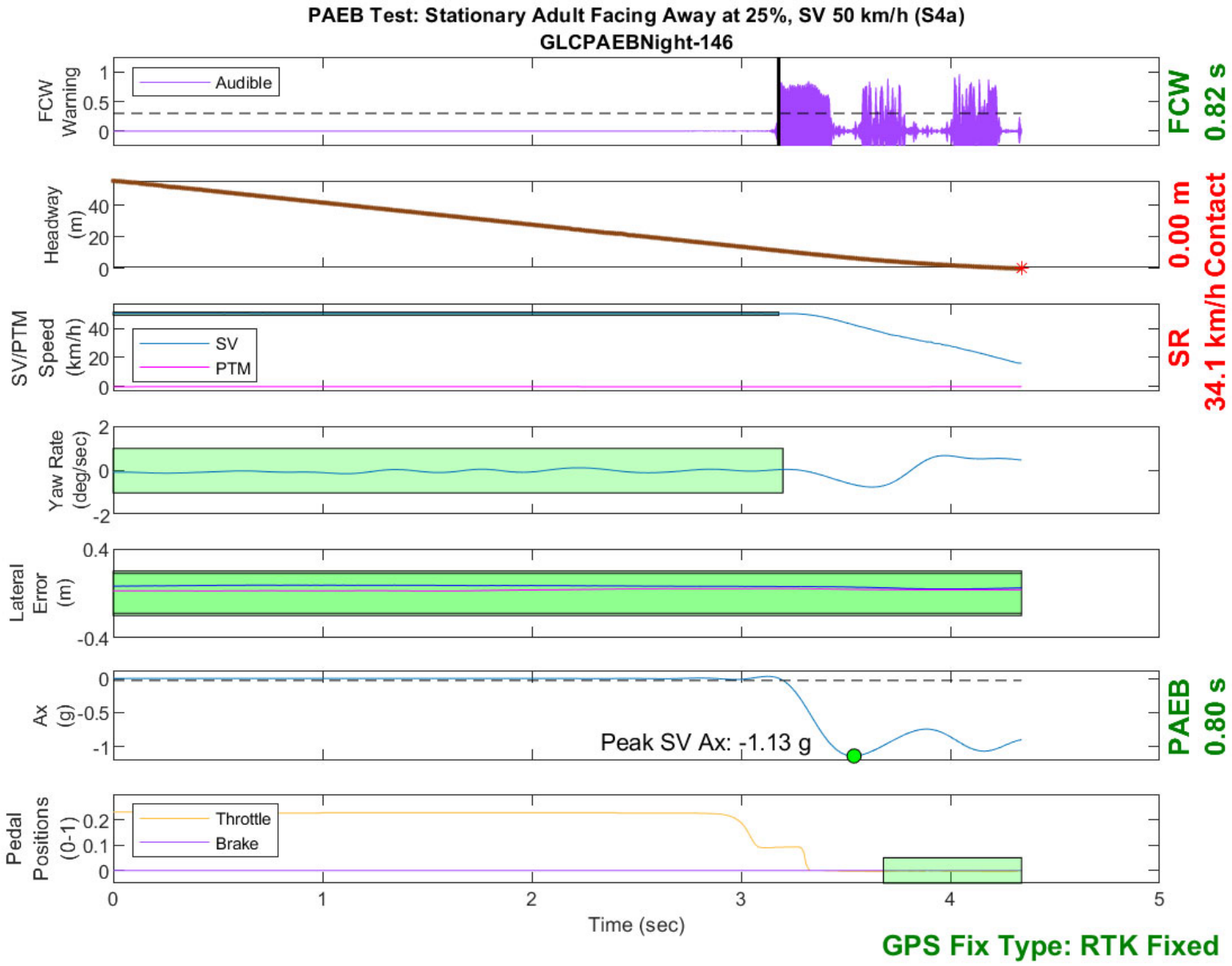

Figure D208. Time History for PAEB Run 146, S4a, Night, High Beam, 50 km/h

Figure D209. Time History for PAEB Run 148, S4a, Night, High Beam, 50 km/h

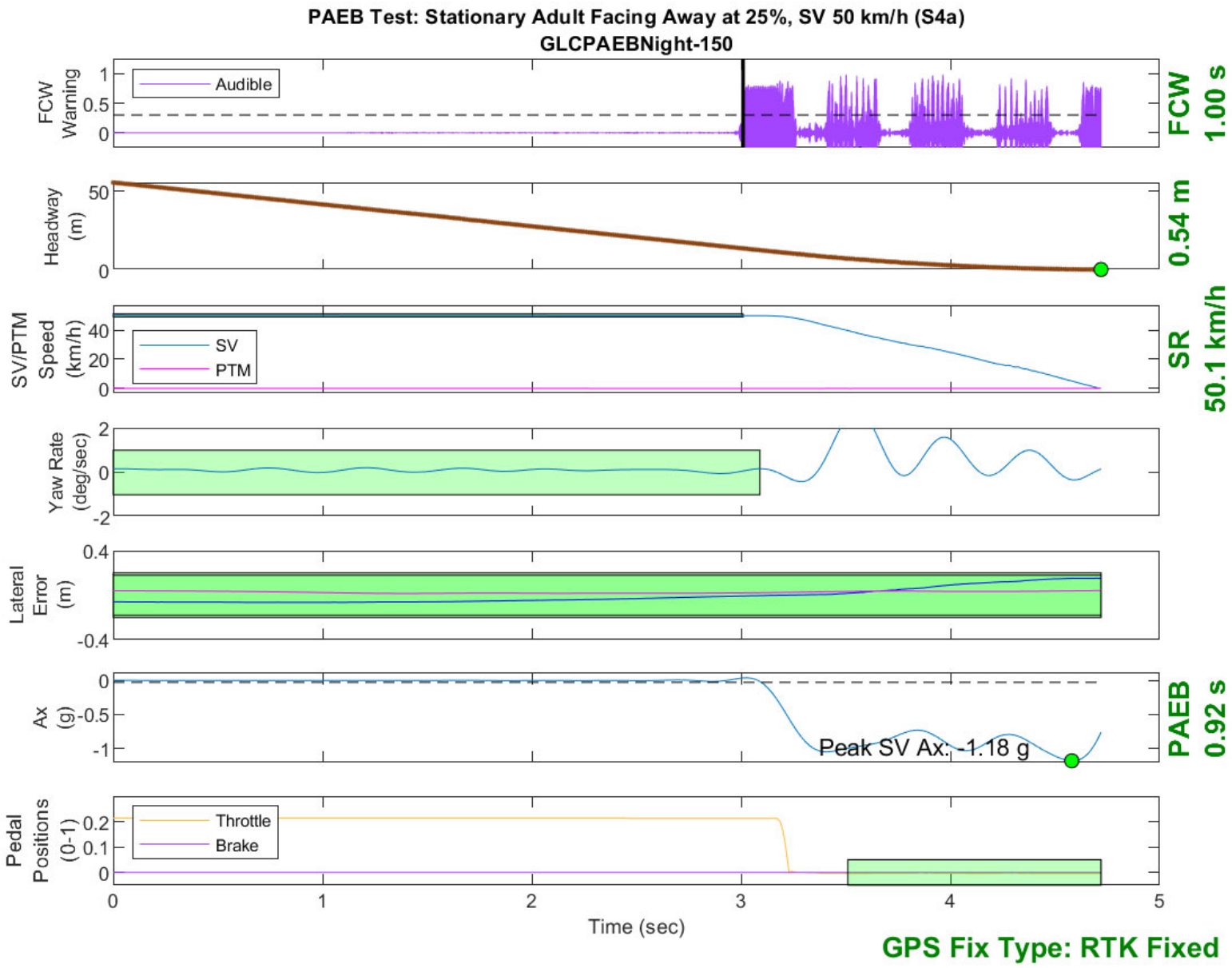

Figure D210. Time History for PAEB Run 150, S4a, Night, High Beam, 50 km/h

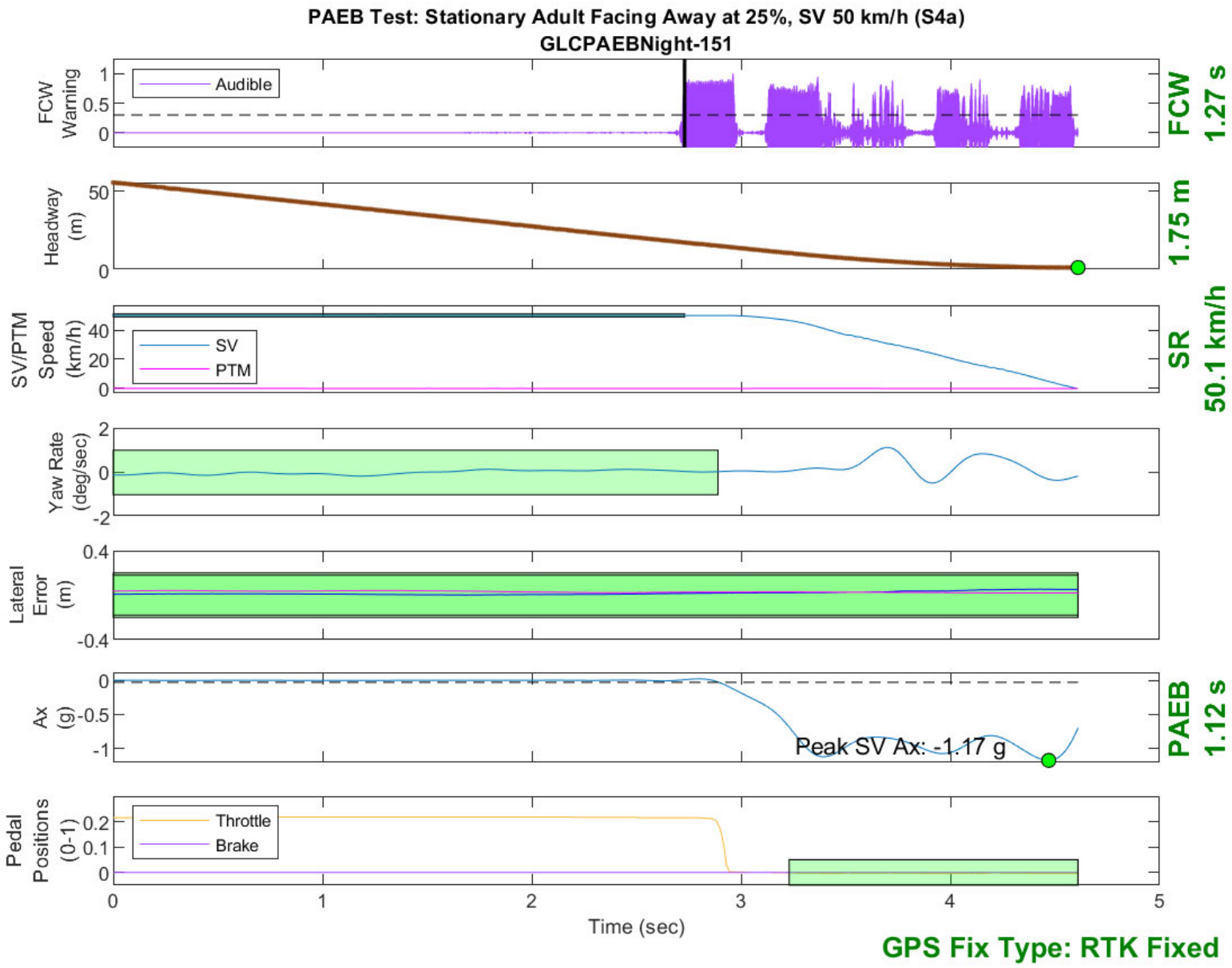

Figure D211. Time History for PAEB Run 151, S4a, Night, High Beam, 50 km/h

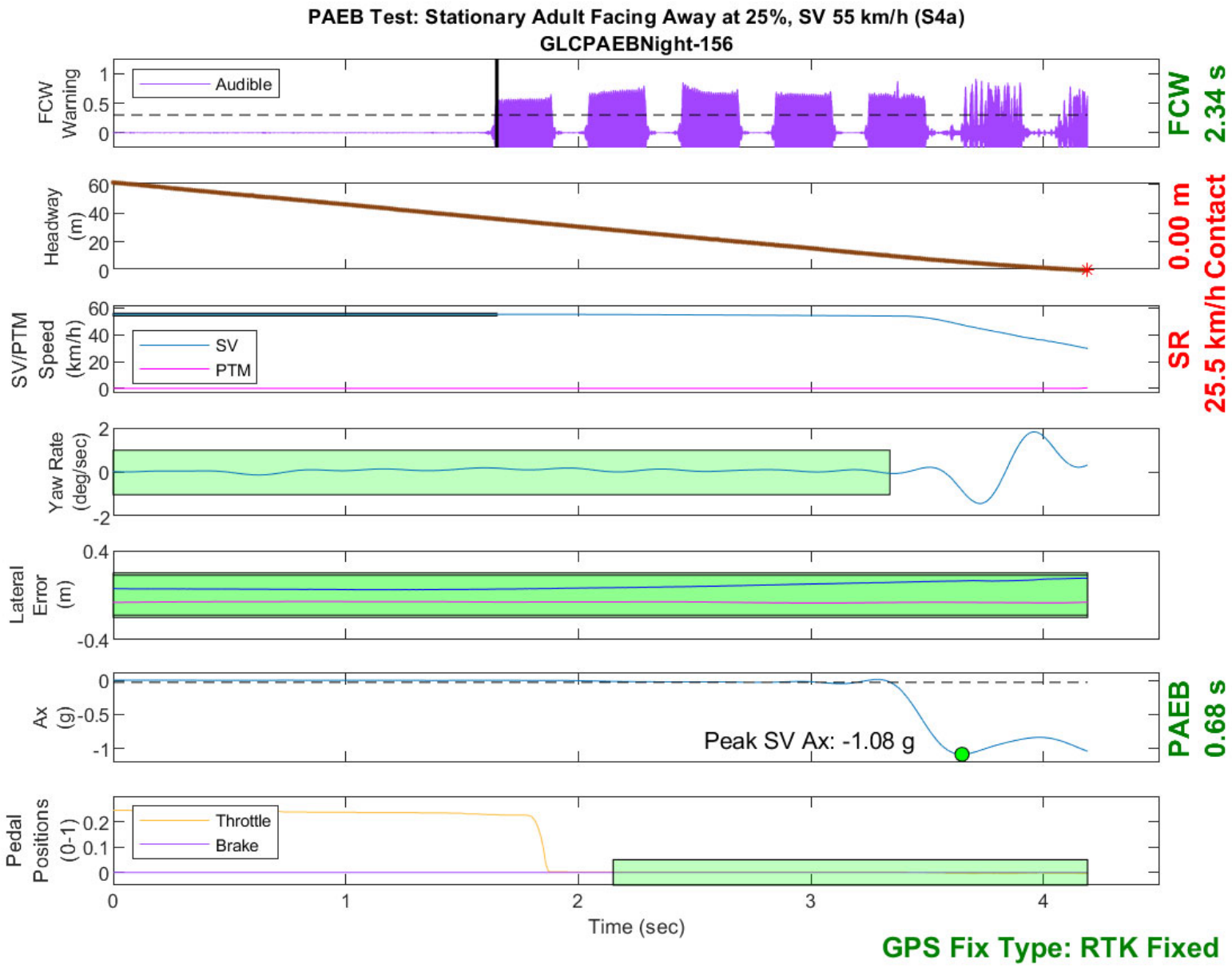

Figure D212. Time History for PAEB Run 156, S4a, Night, High Beam, 55 km/h

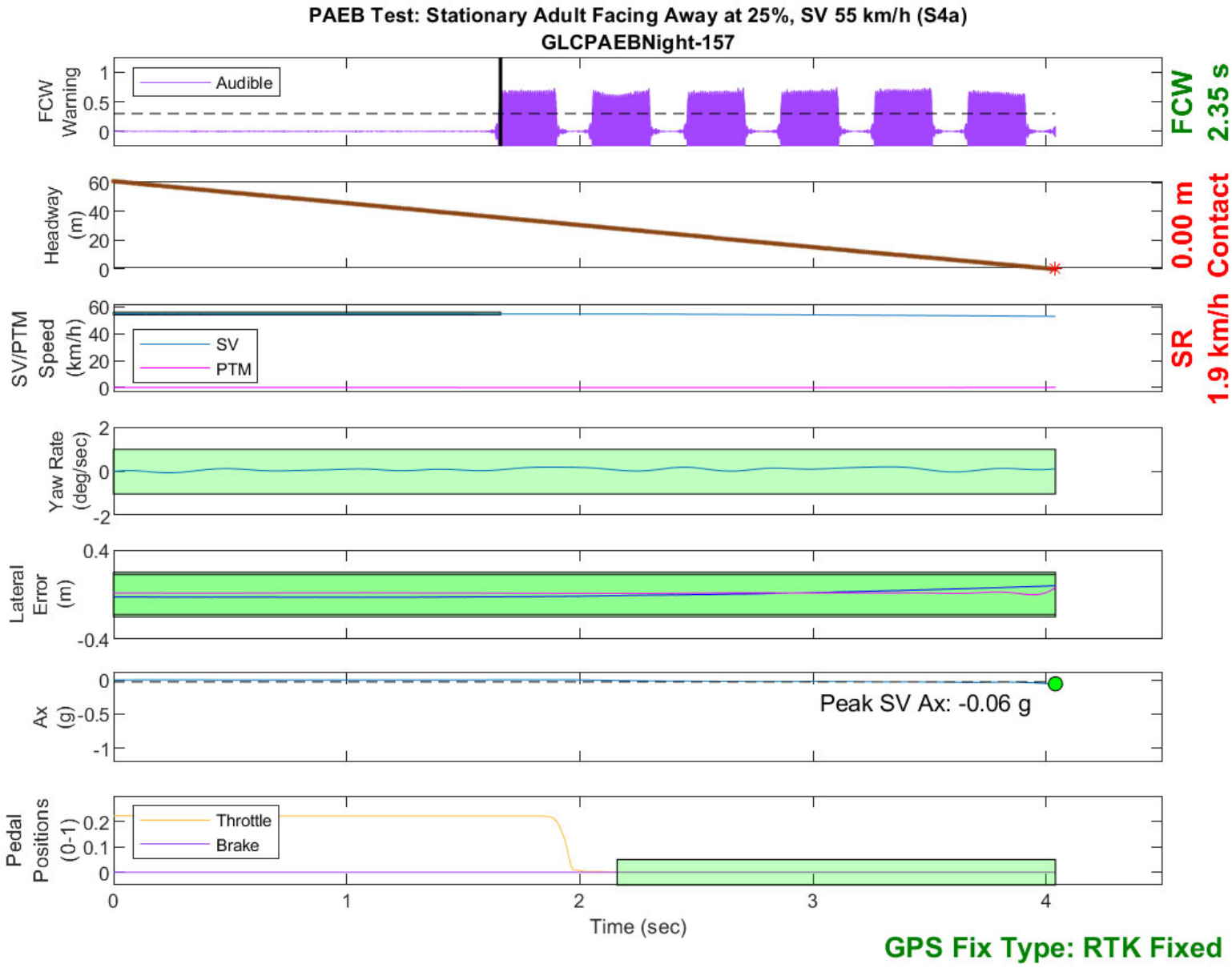

Figure D213. Time History for PAEB Run 157, S4a, Night, High Beam, 55 km/h

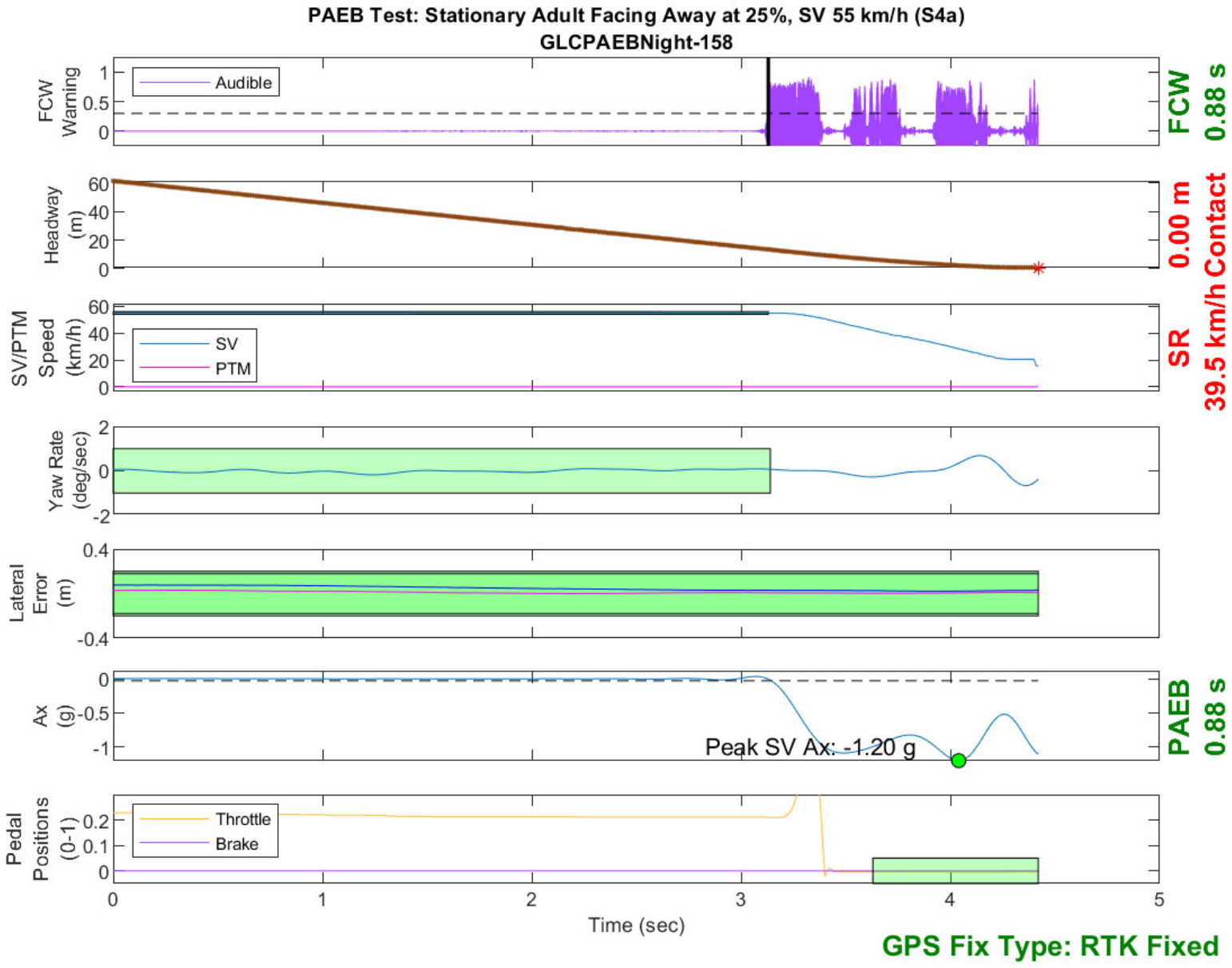

Figure D214. Time History for PAEB Run 158, S4a, Night, High Beam, 55 km/h

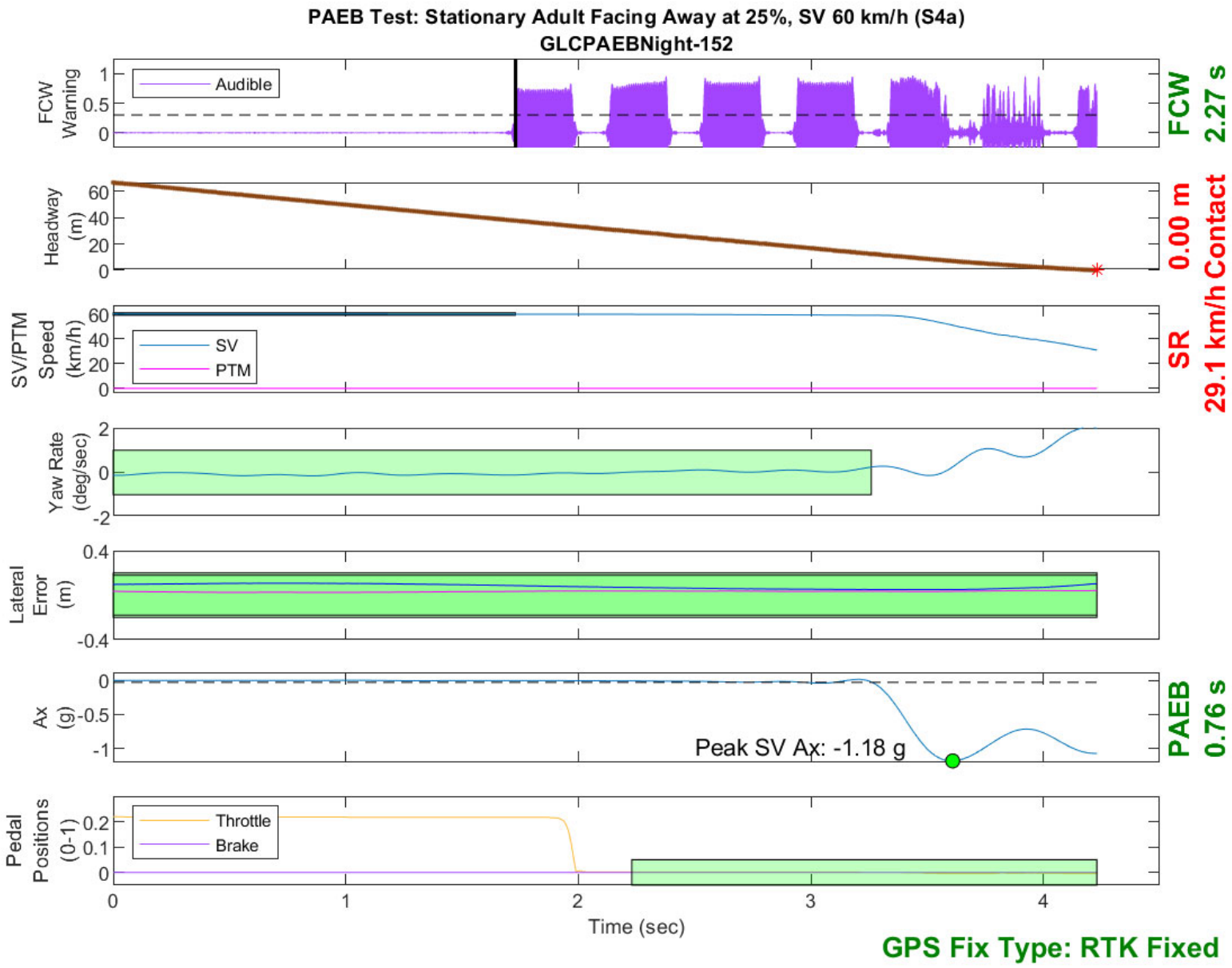

Figure D215. Time History for PAEB Run 152, S4a, Night, High Beam, 60 km/h

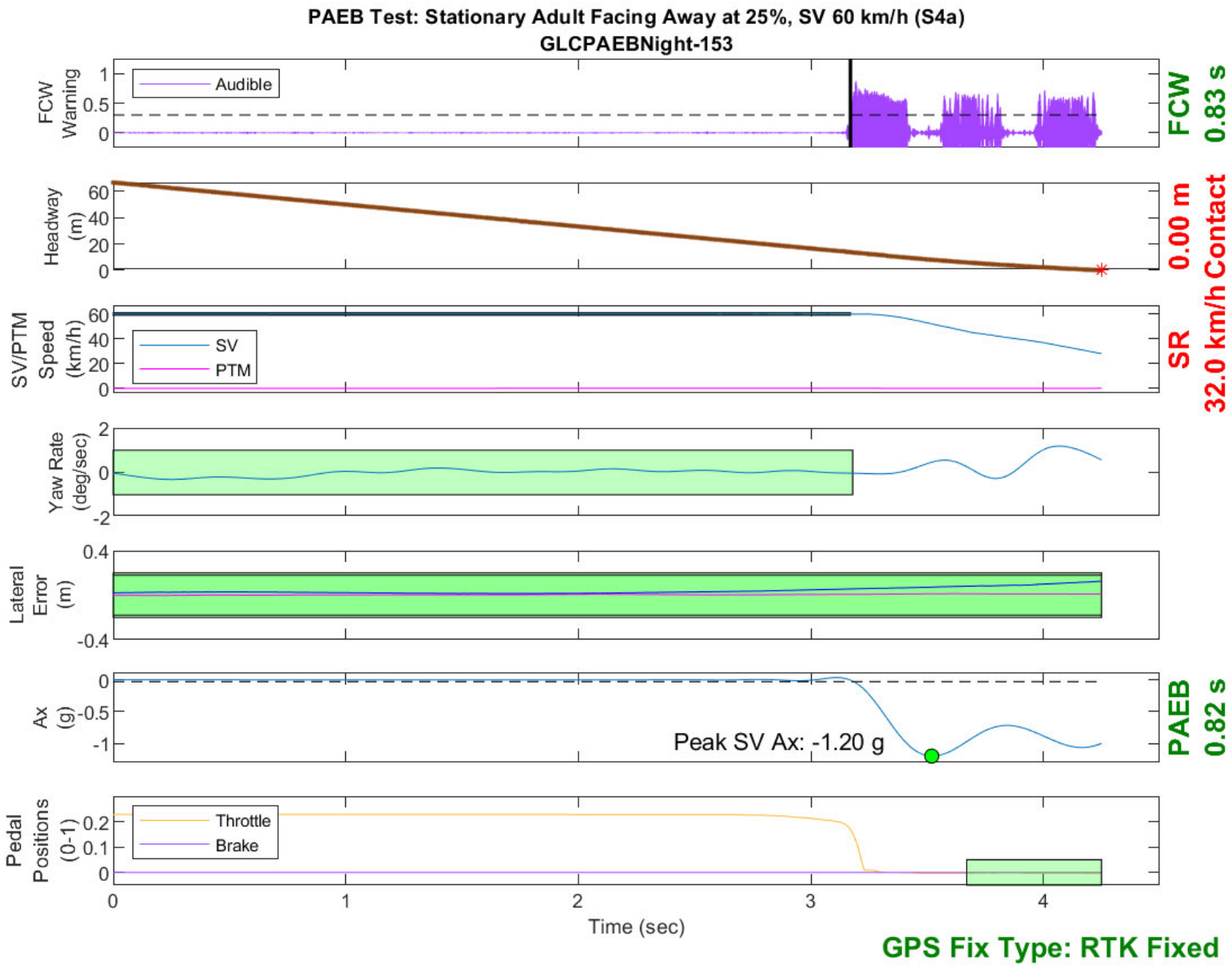

Figure D216. Time History for PAEB Run 153, S4a, Night, High Beam, 60 km/h

Figure D217. Time History for PAEB Run 94, S4c, Night, High Beam, 16 km/h

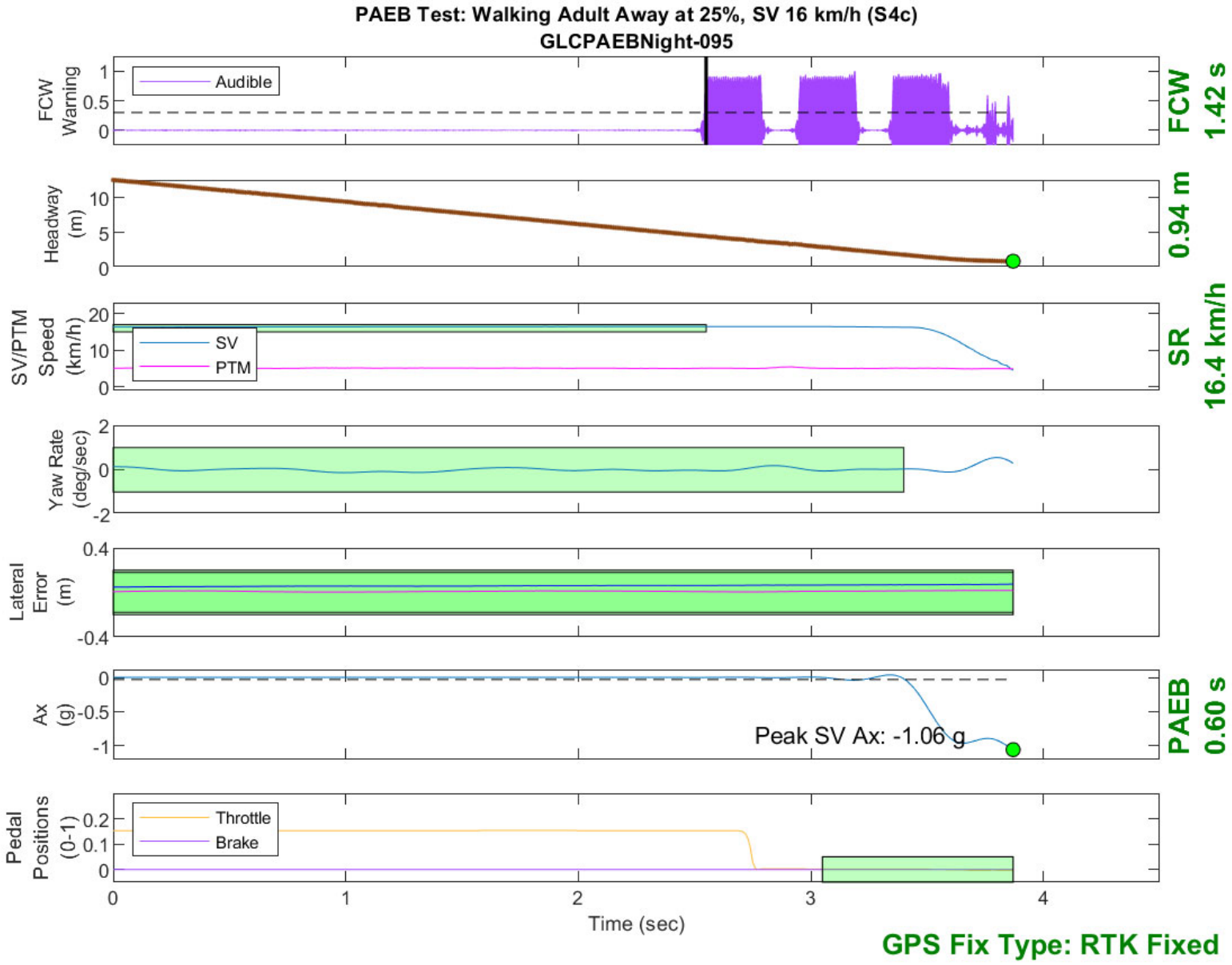

Figure D218. Time History for PAEB Run 95, S4c, Night, High Beam, 16 km/h

Figure D219. Time History for PAEB Run 96, S4c, Night, High Beam, 16 km/h

Figure D220. Time History for PAEB Run 97, S4c, Night, High Beam, 16 km/h

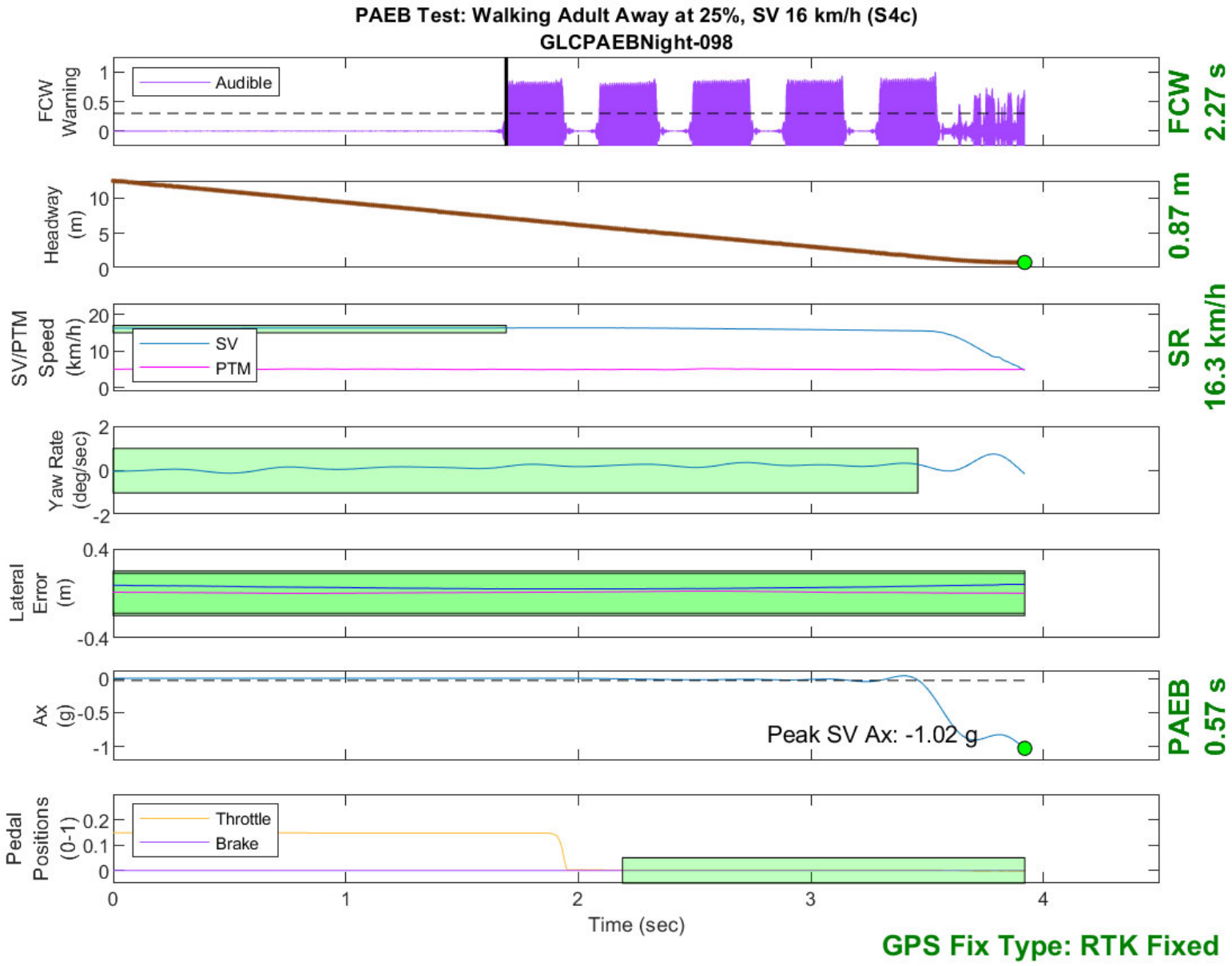

Figure D221. Time History for PAEB Run 98, S4c, Night, High Beam, 16 km/h

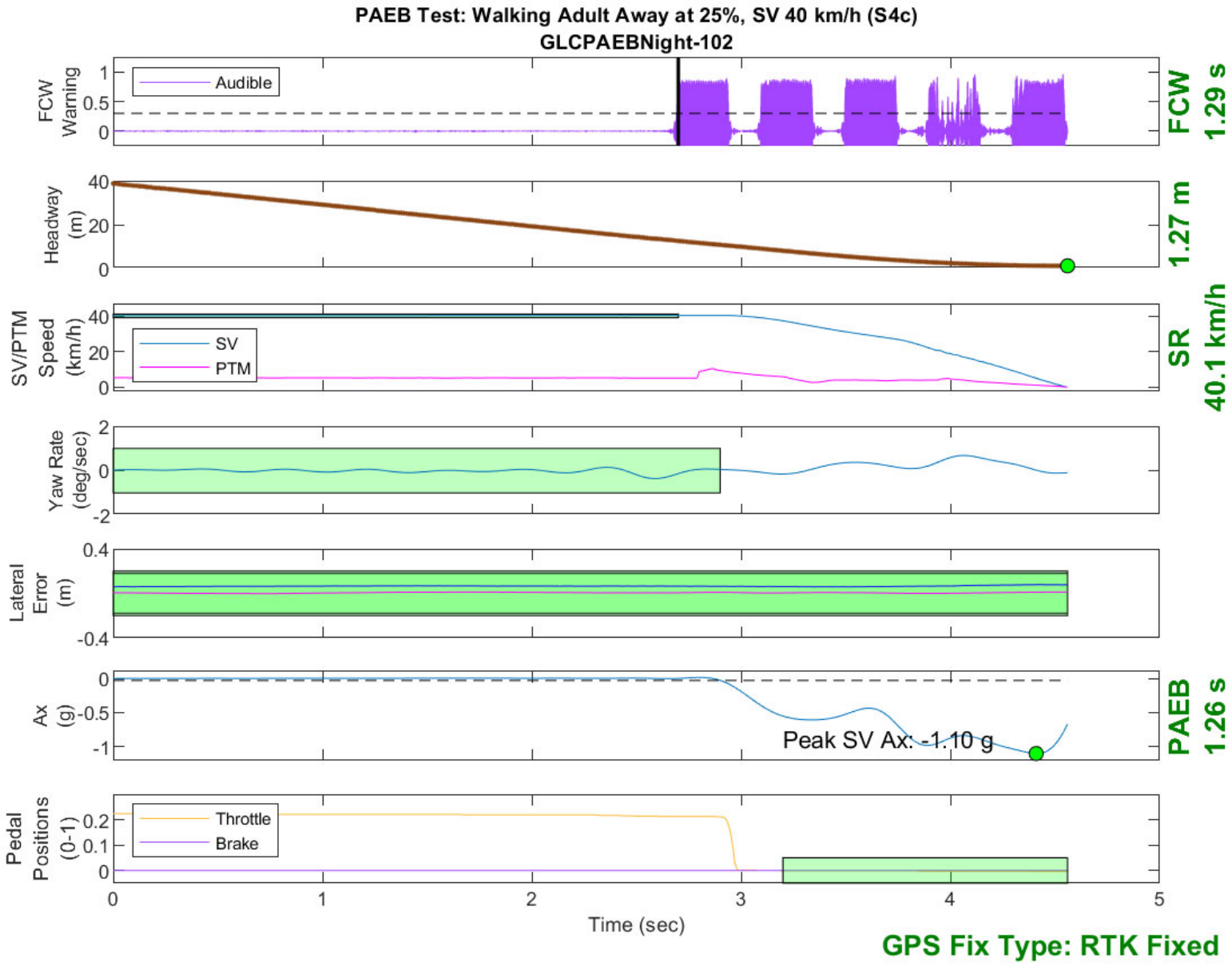

Figure D222. Time History for PAEB Run 102, S4c, Night, High Beam, 40 km/h

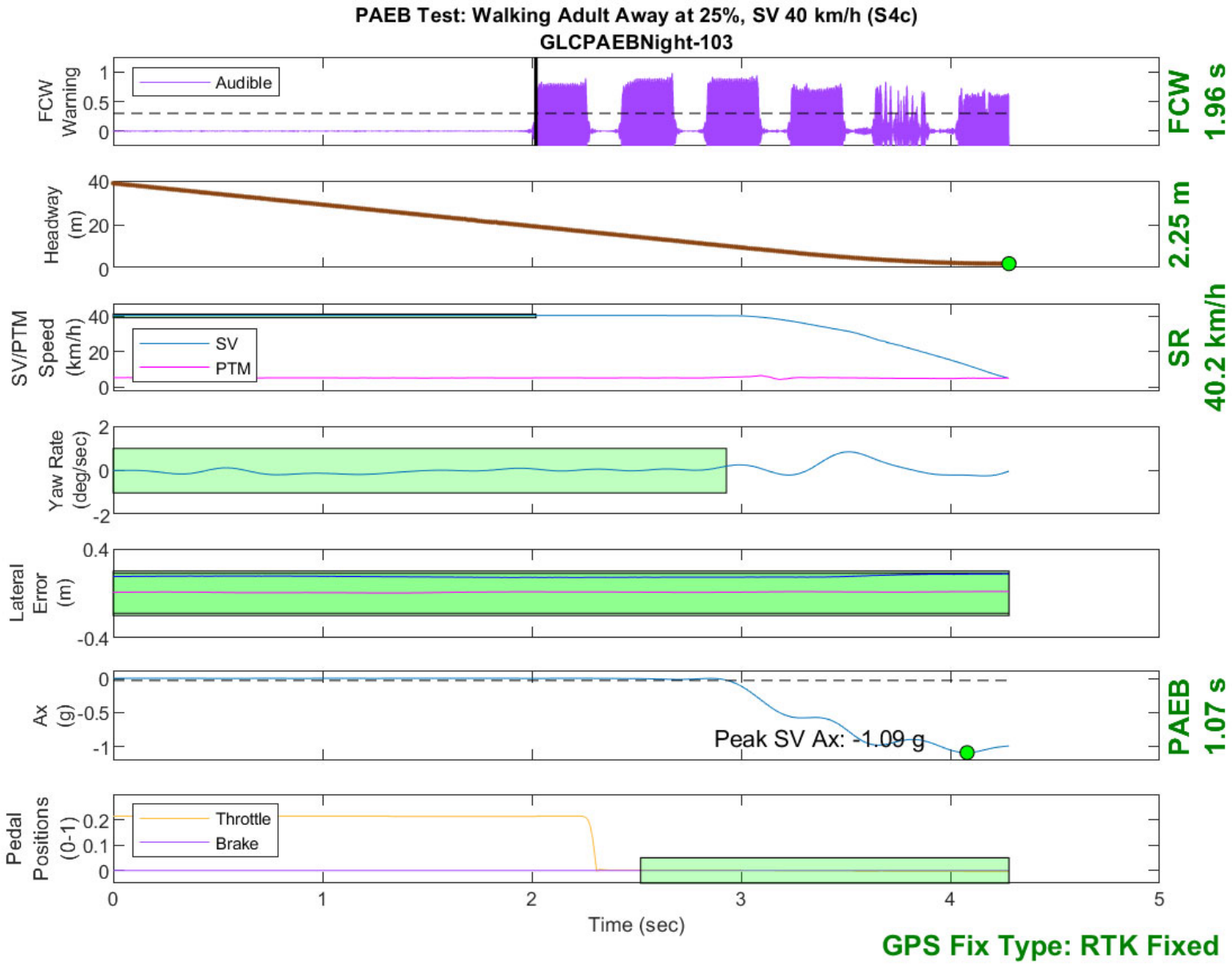

Figure D223. Time History for PAEB Run 103, S4c, Night, High Beam, 40 km/h

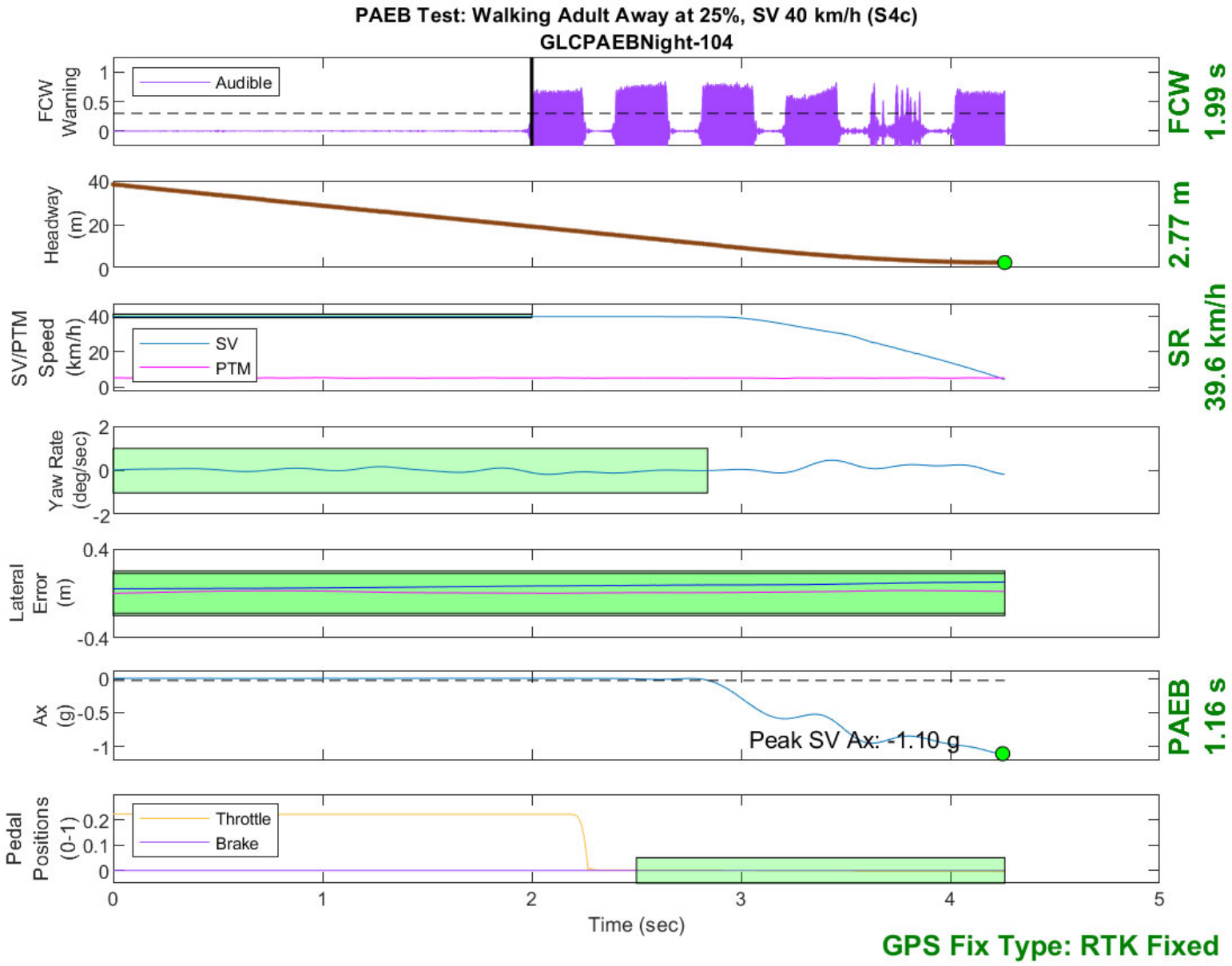

Figure D224. Time History for PAEB Run 104, S4c, Night, High Beam, 40 km/h

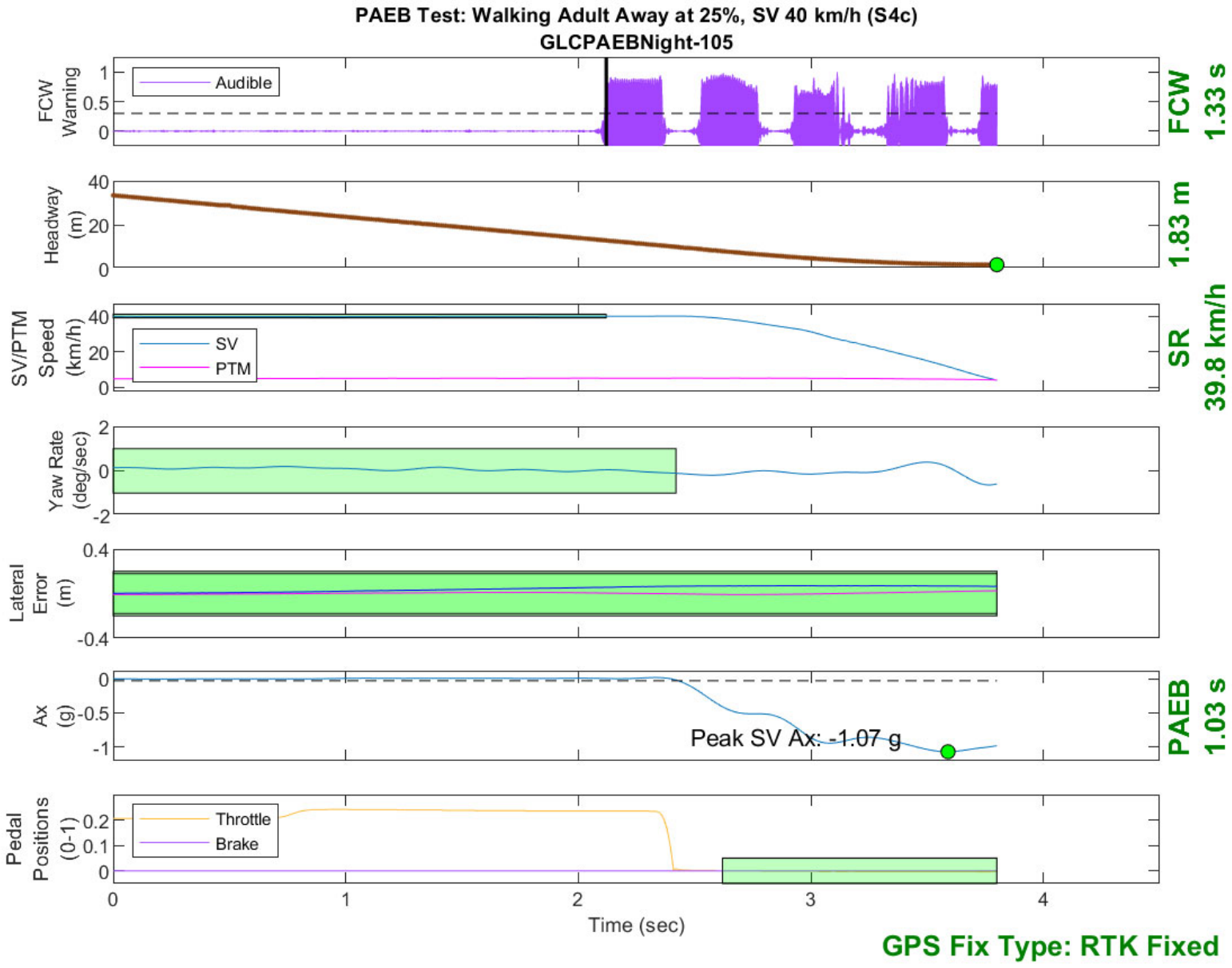

Figure D225. Time History for PAEB Run 105, S4c, Night, High Beam, 40 km/h

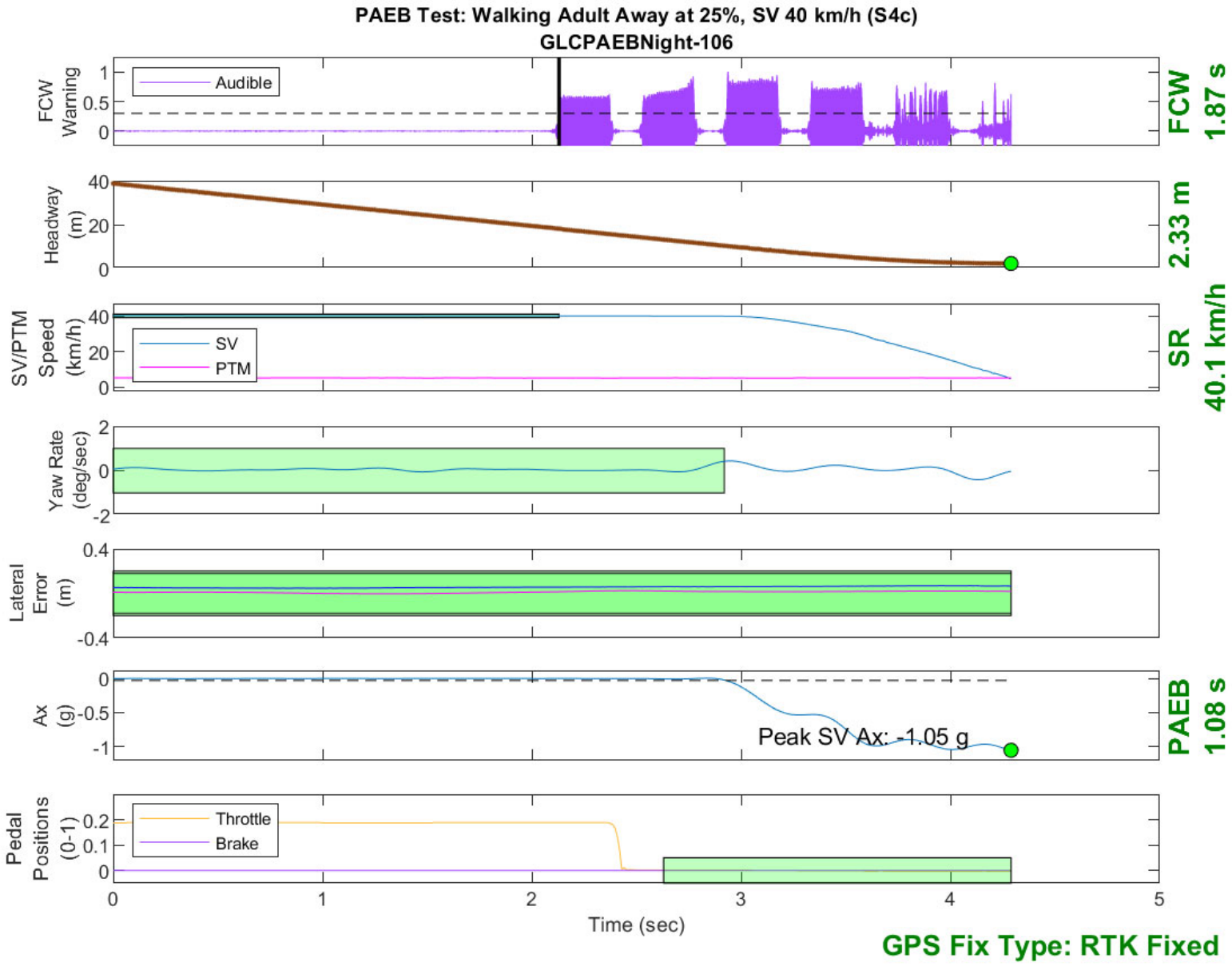

Figure D226. Time History for PAEB Run 106, S4c, Night, High Beam, 40 km/h

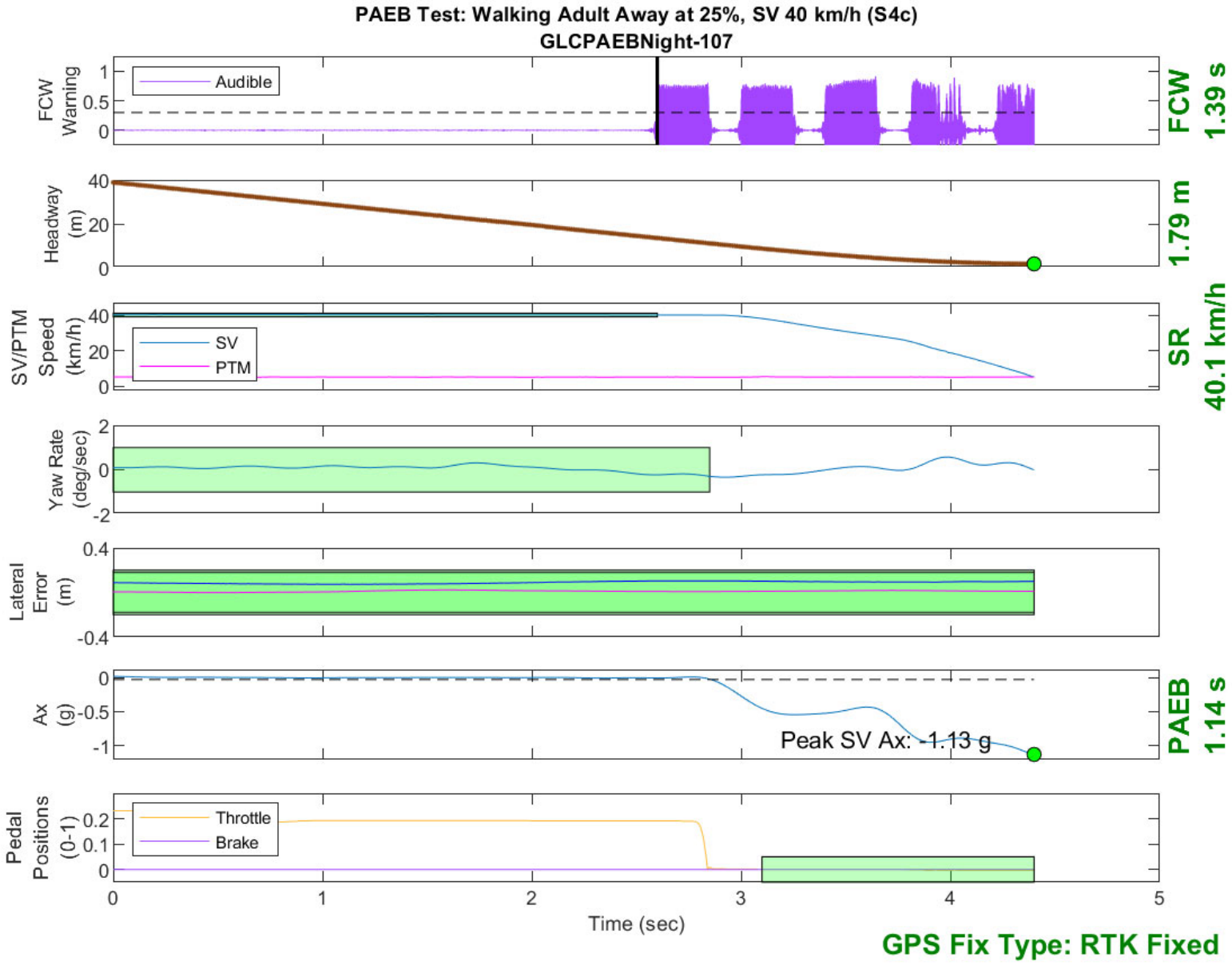

Figure D227. Time History for PAEB Run 107, S4c, Night, High Beam, 40 km/h

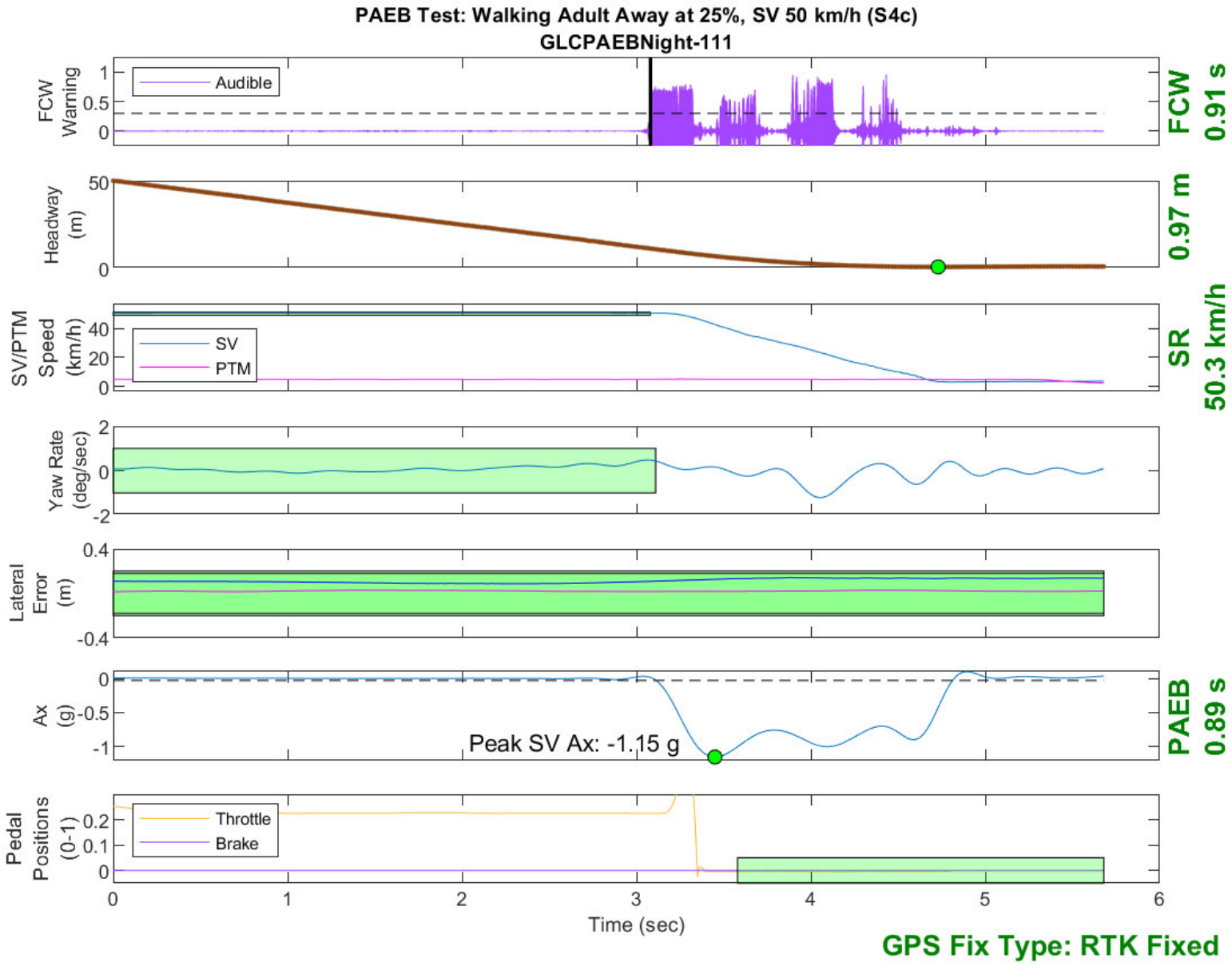

Figure D228. Time History for PAEB Run 111, S4c, Night, High Beam, 50 km/h

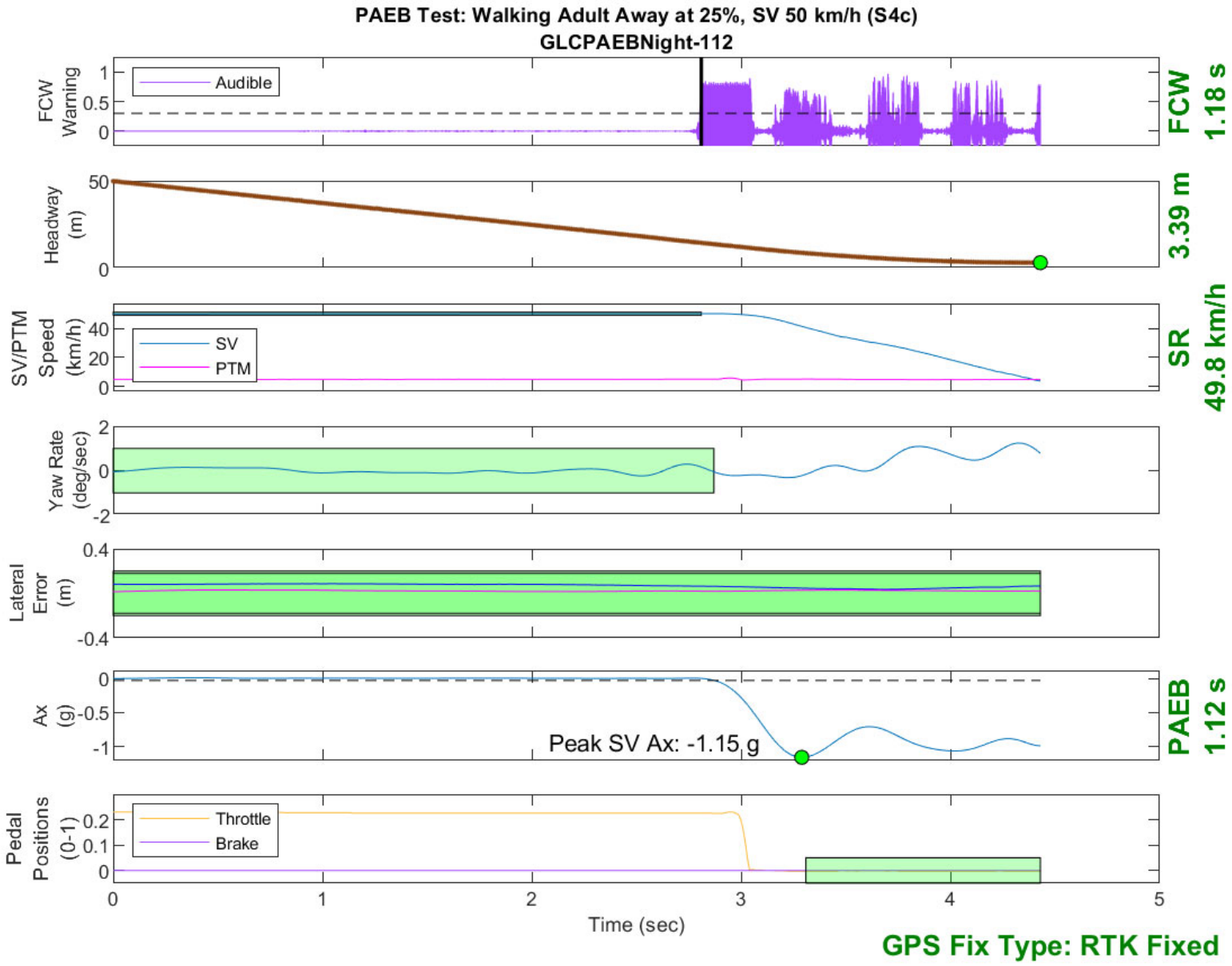

Figure D229. Time History for PAEB Run 112, S4c, Night, High Beam, 50 km/h

Figure D230. Time History for PAEB Run 113, S4c, Night, High Beam, 50 km/h

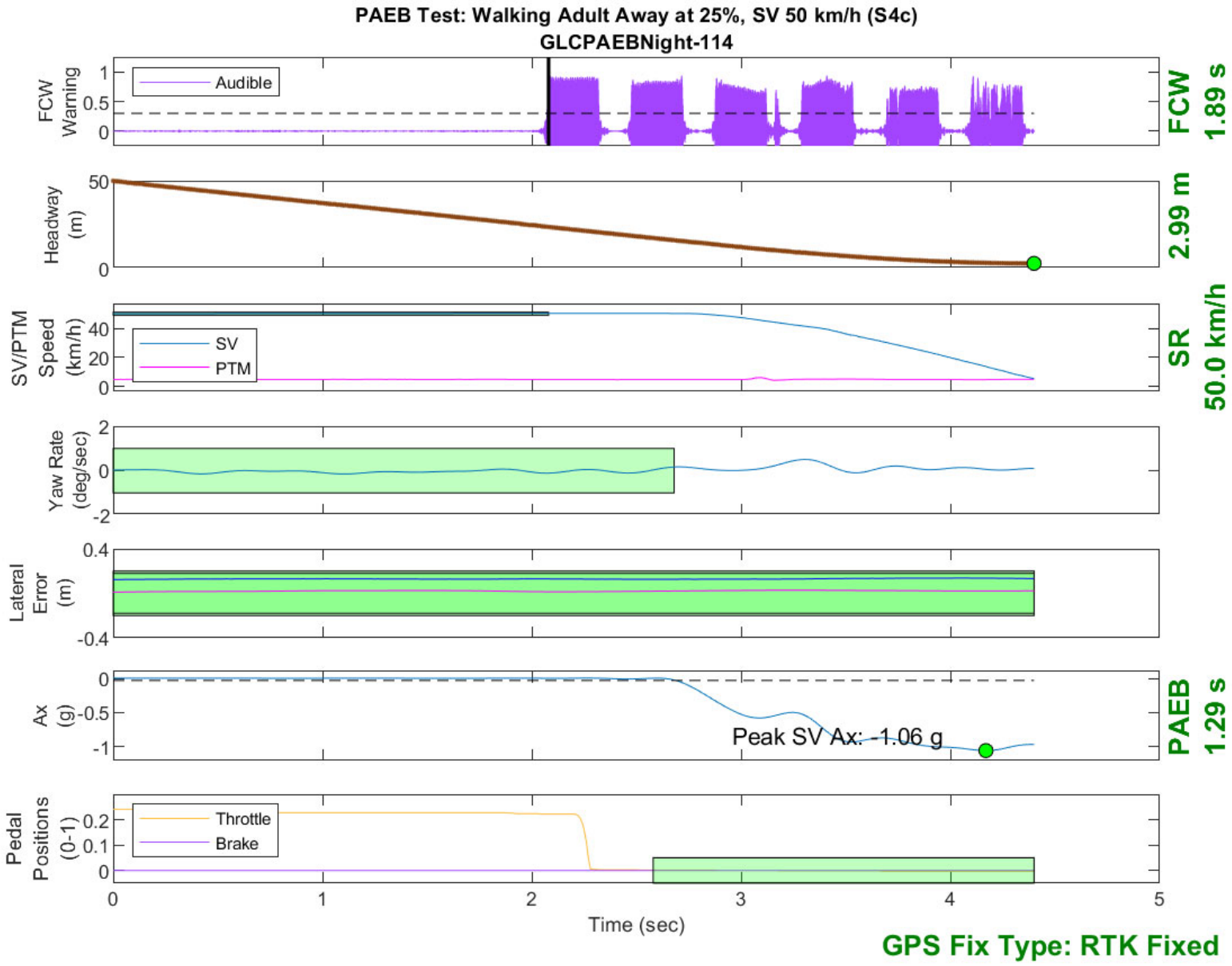

Figure D231. Time History for PAEB Run 114, S4c, Night, High Beam, 50 km/h

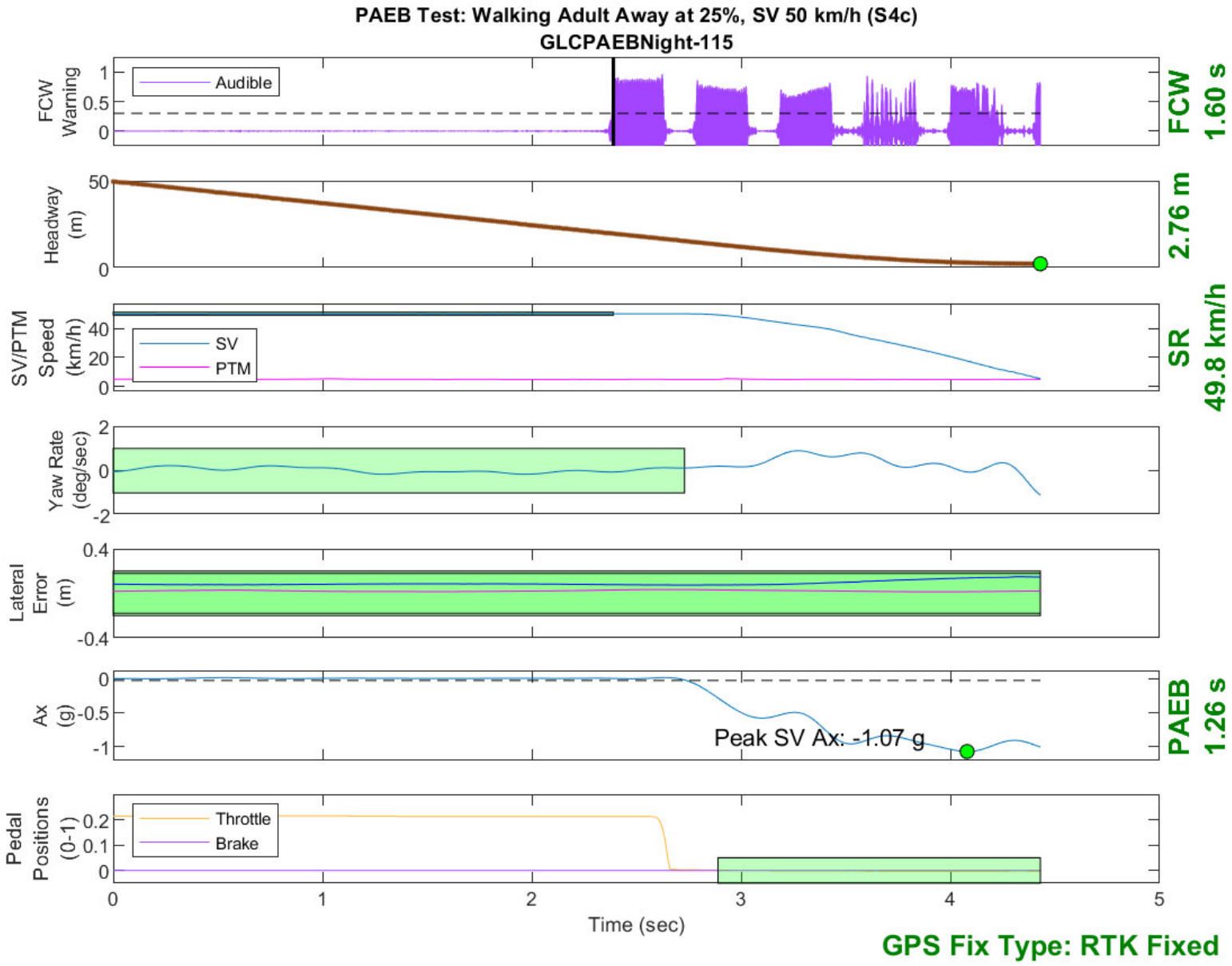

Figure D232. Time History for PAEB Run 115, S4c, Night, High Beam, 50 km/h

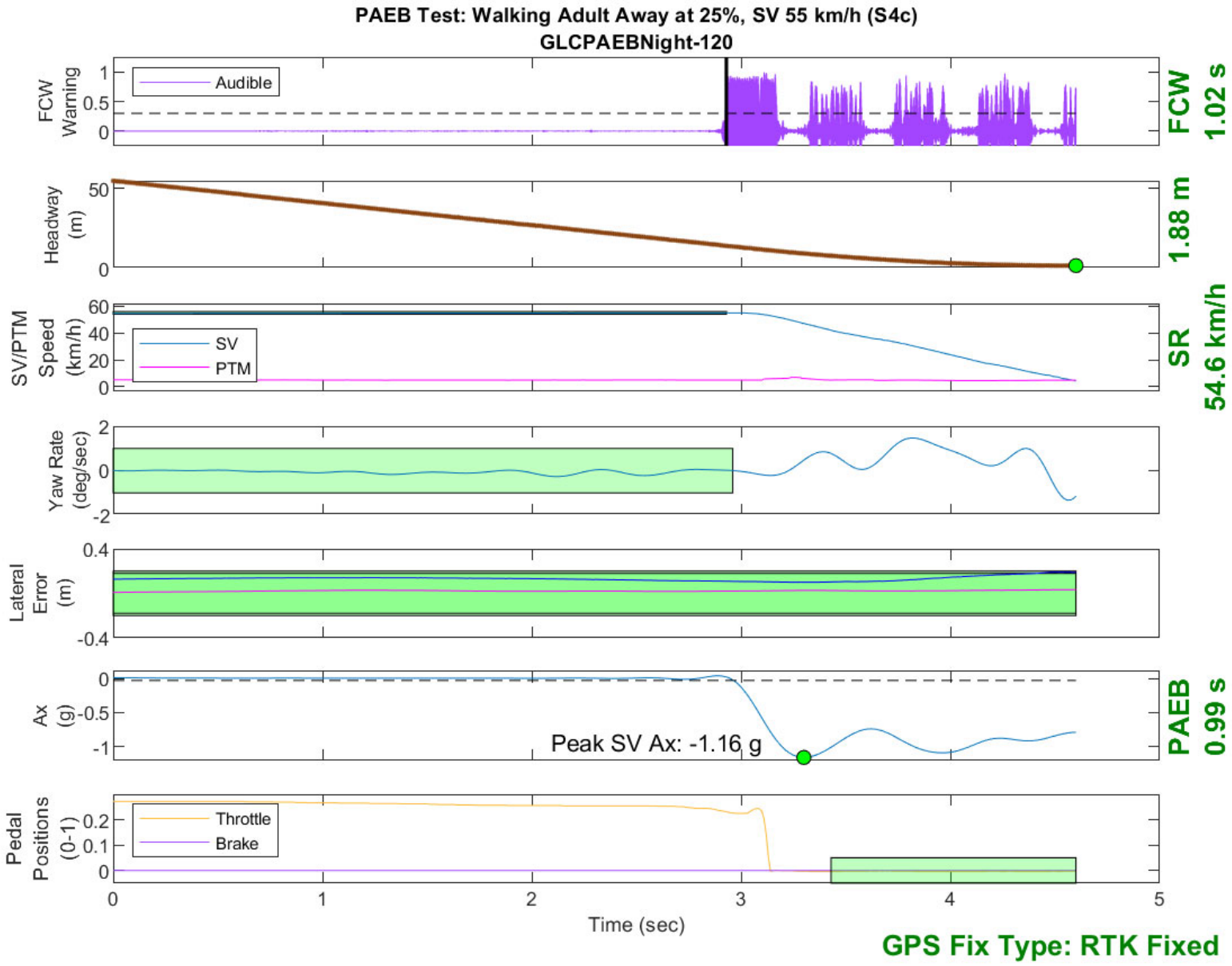

Figure D233. Time History for PAEB Run 120, S4c, Night, High Beam, 55 km/h

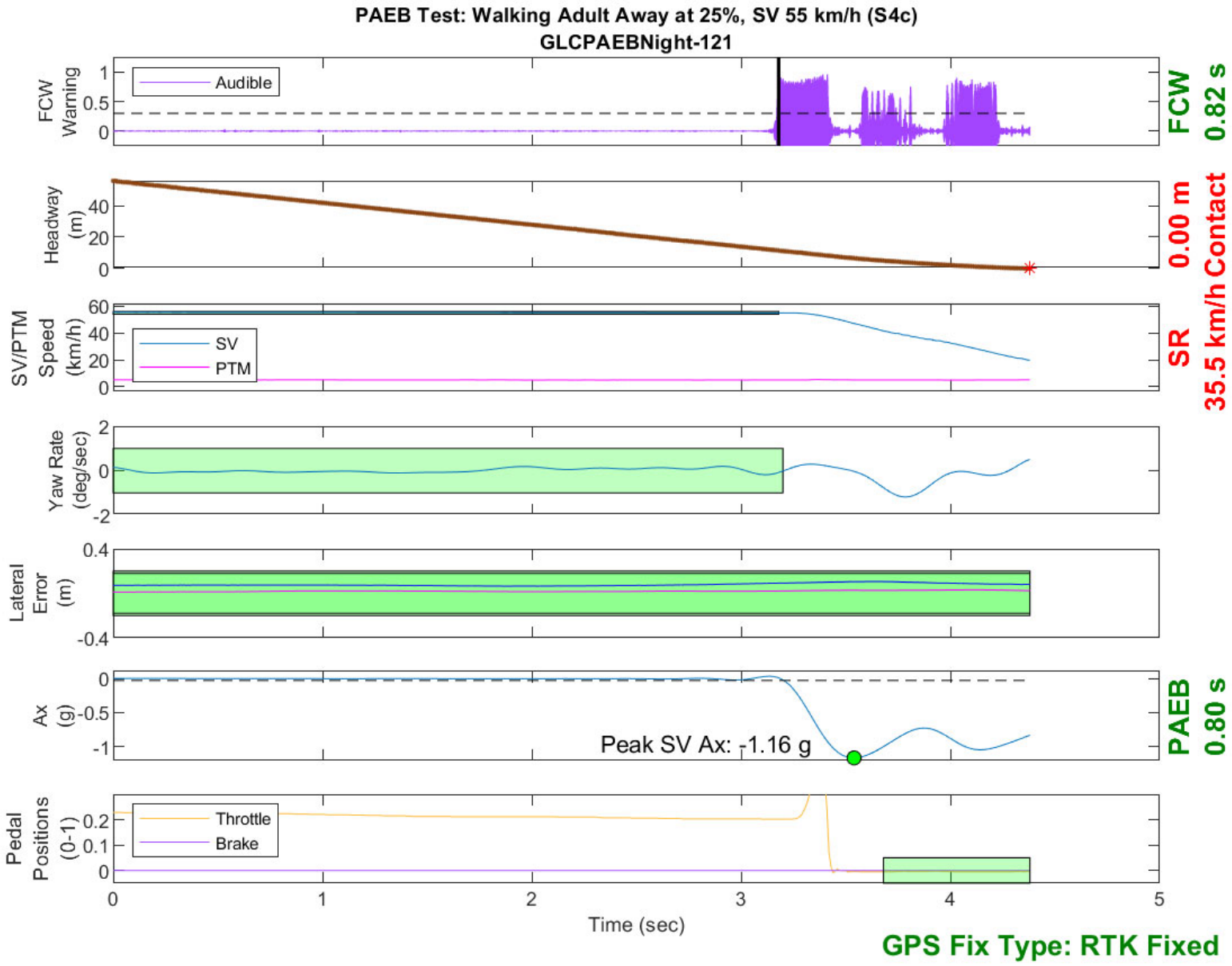

Figure D234. Time History for PAEB Run 121, S4c, Night, High Beam, 55 km/h

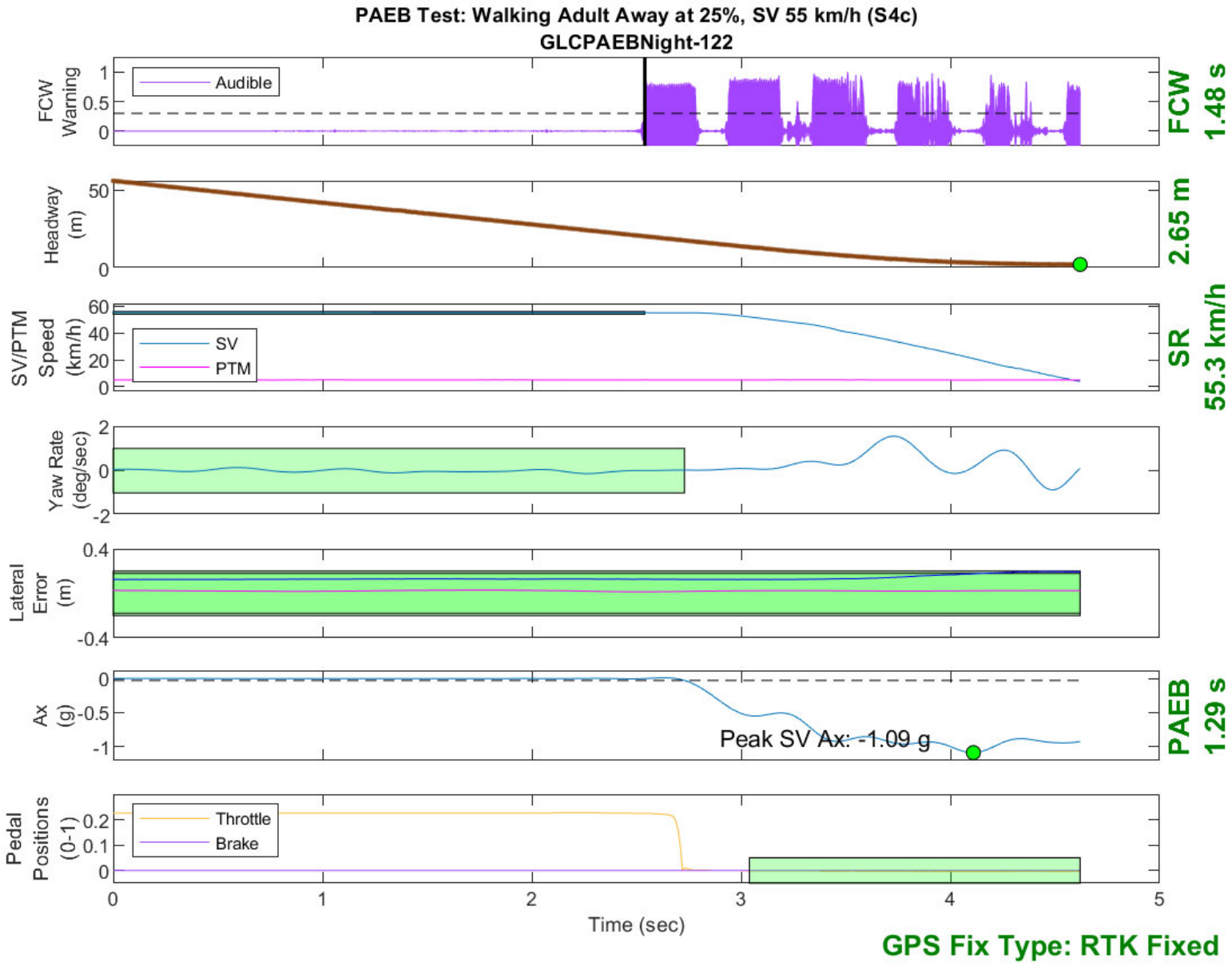

Figure D235. Time History for PAEB Run 122, S4c, Night, High Beam, 55 km/h

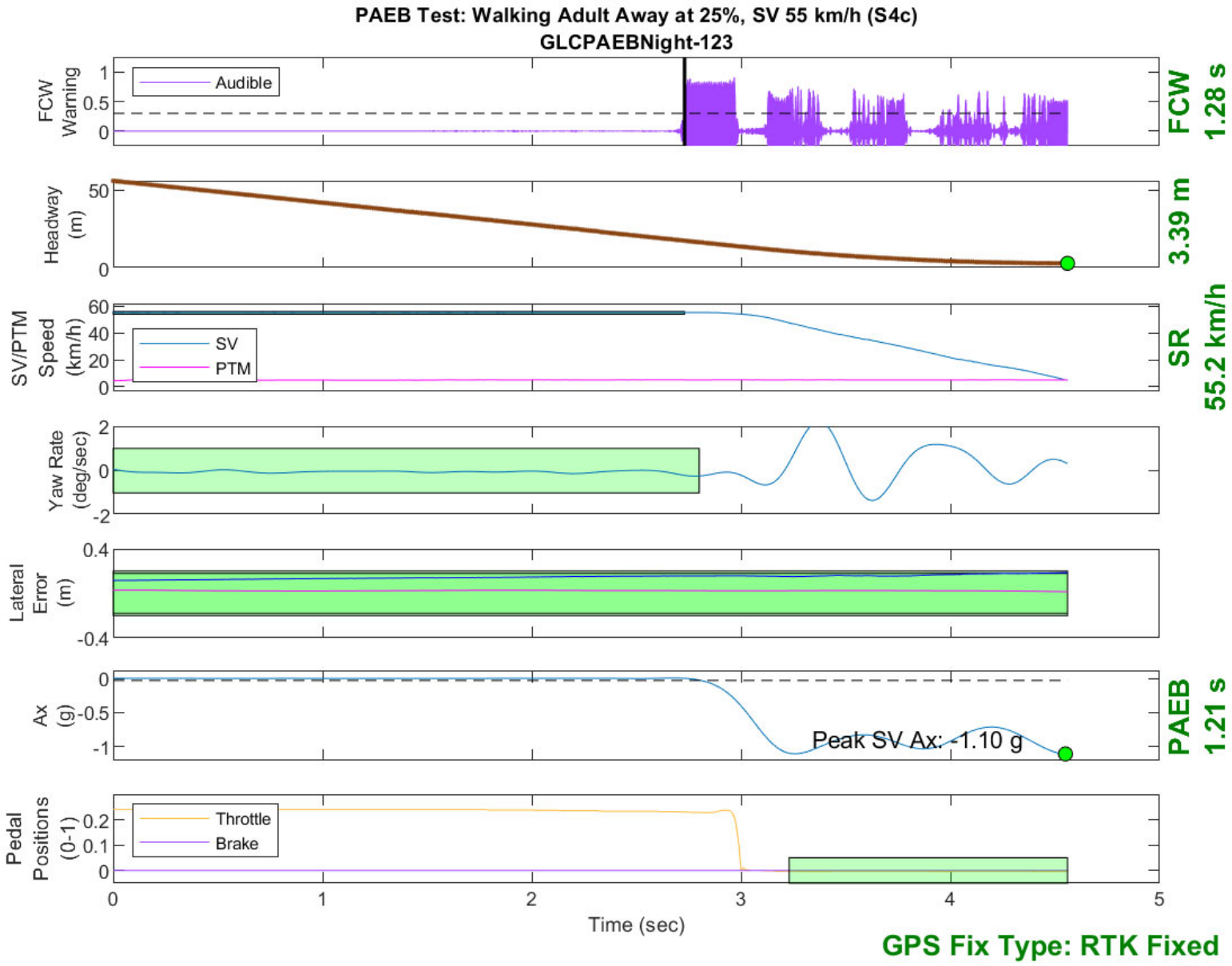

Figure D236. Time History for PAEB Run 123, S4c, Night, High Beam, 55 km/h

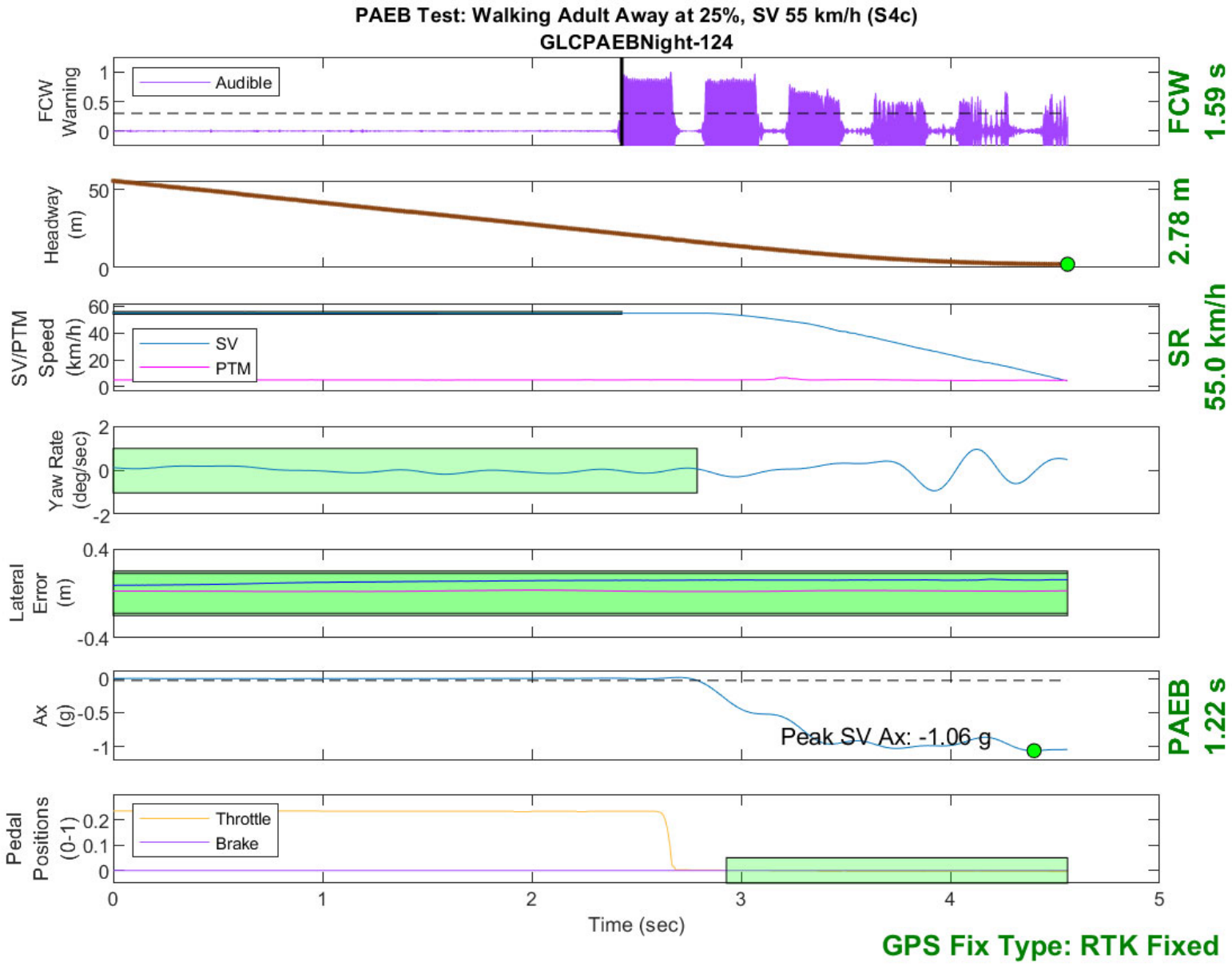

Figure D237. Time History for PAEB Run 124, S4c, Night, High Beam, 55 km/h

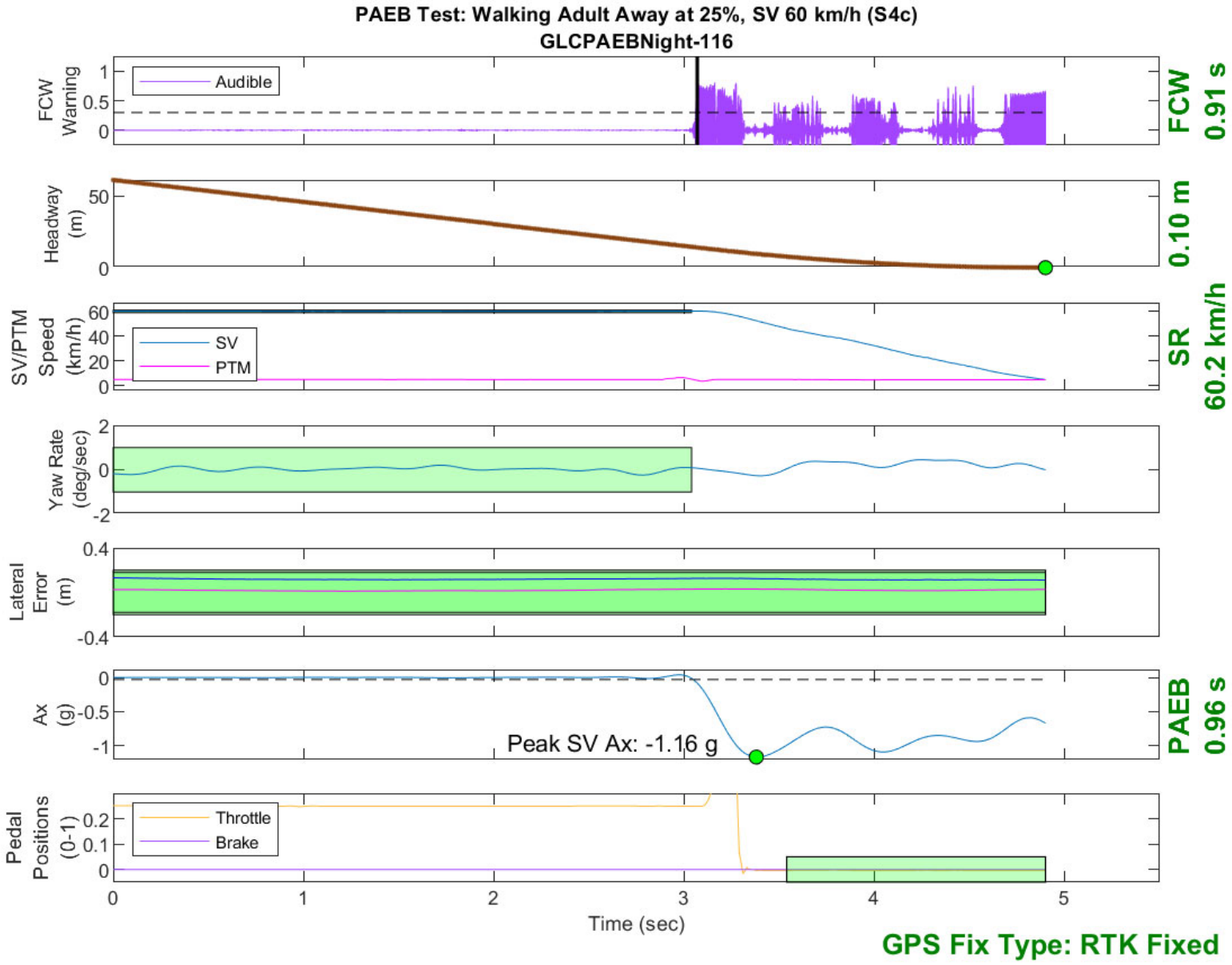

Figure D238. Time History for PAEB Run 116, S4c, Night, High Beam, 60 km/h

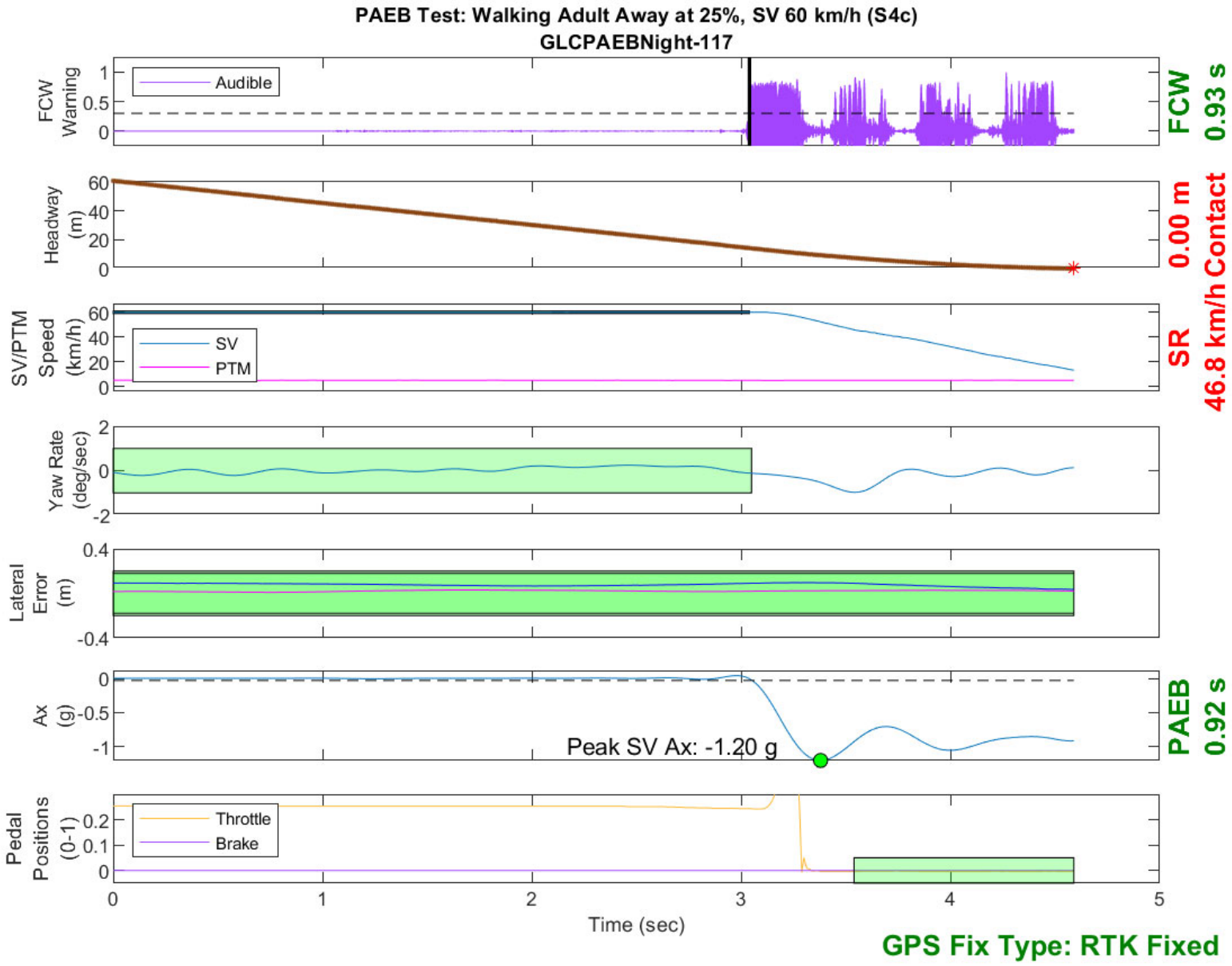

Figure D239. Time History for PAEB Run 117, S4c, Night, High Beam, 60 km/h

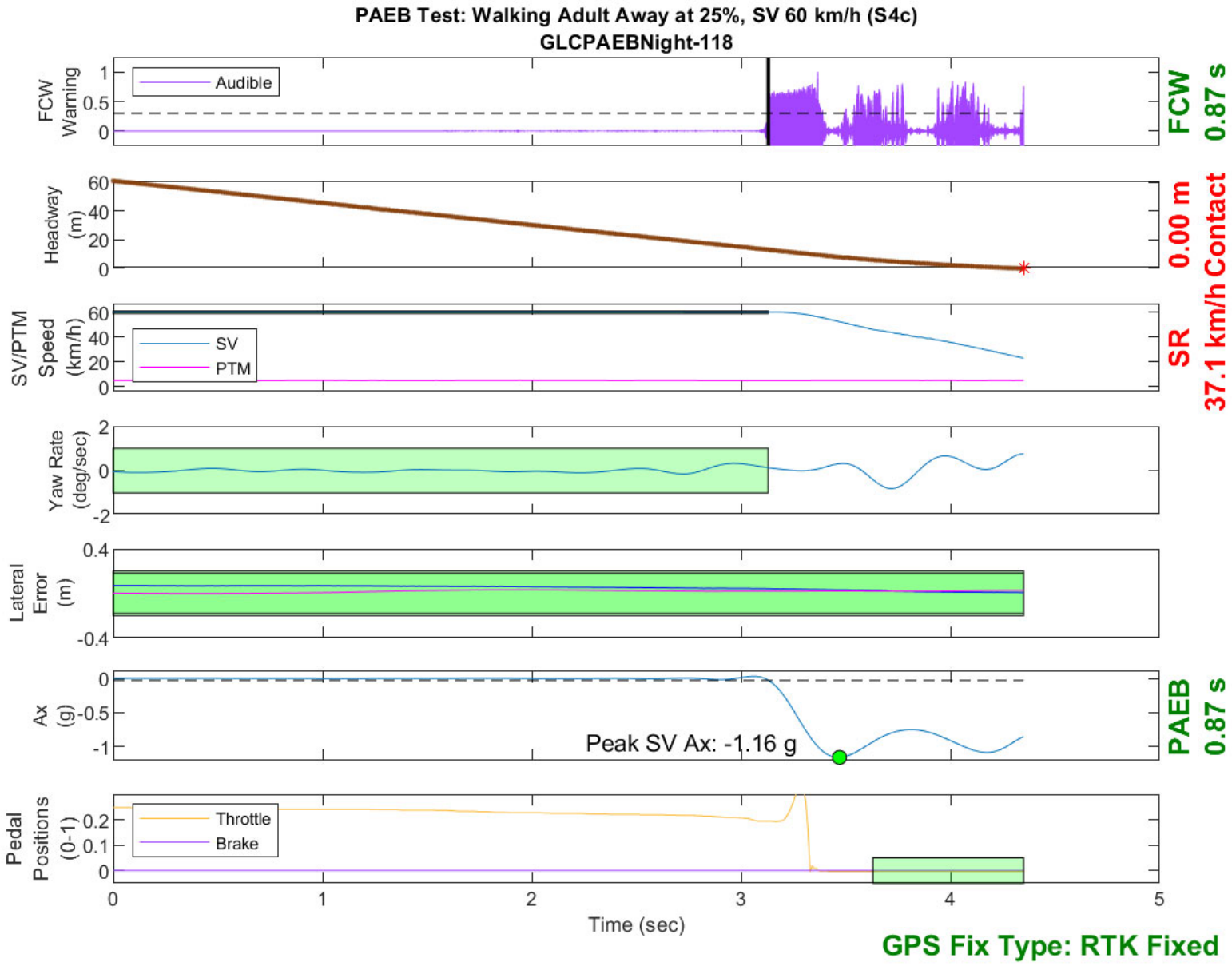

Figure D240. Time History for PAEB Run 118, S4c, Night, High Beam, 60 km/h

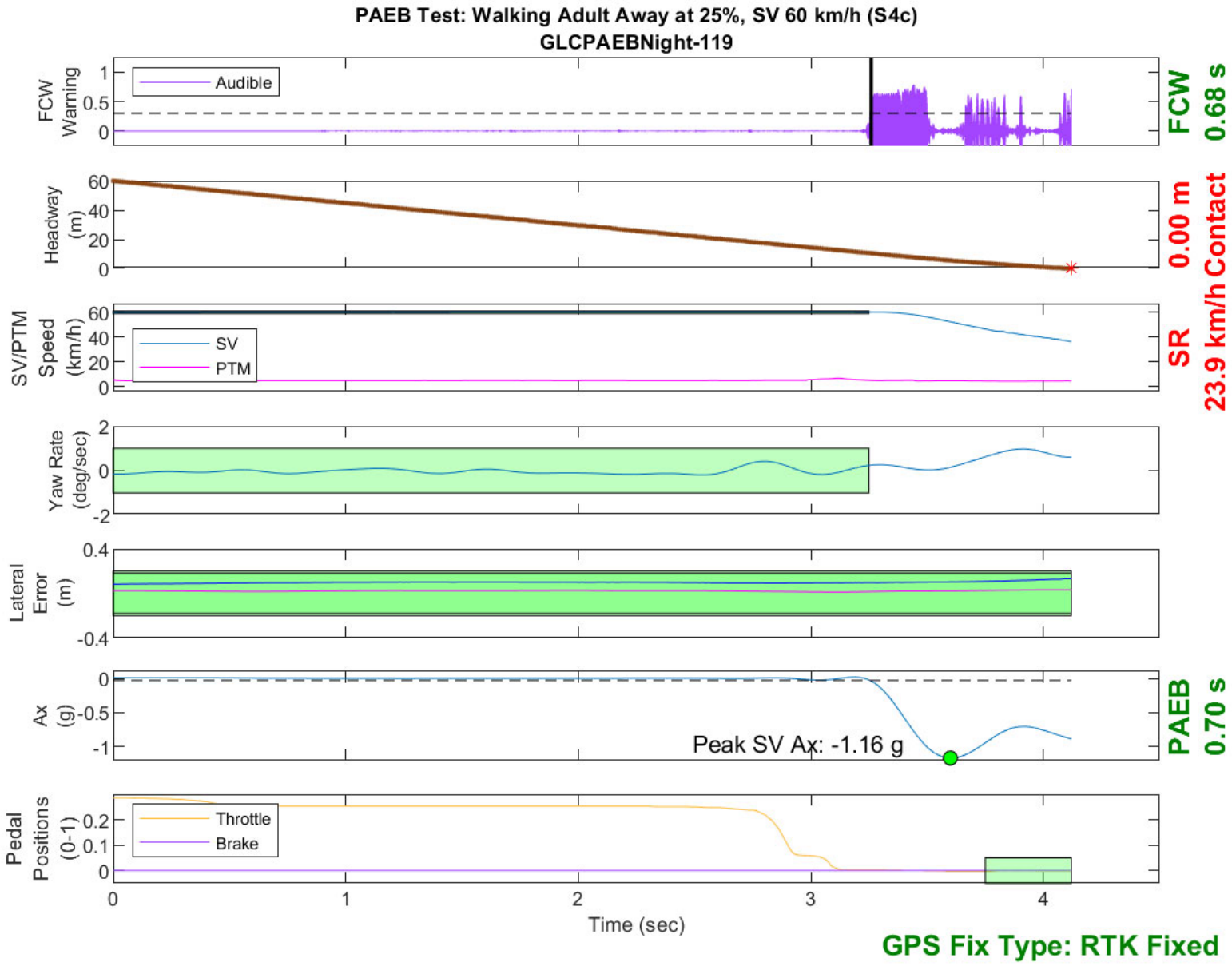

Figure D241. Time History for PAEB Run 119, S4c, Night, High Beam, 60 km/h

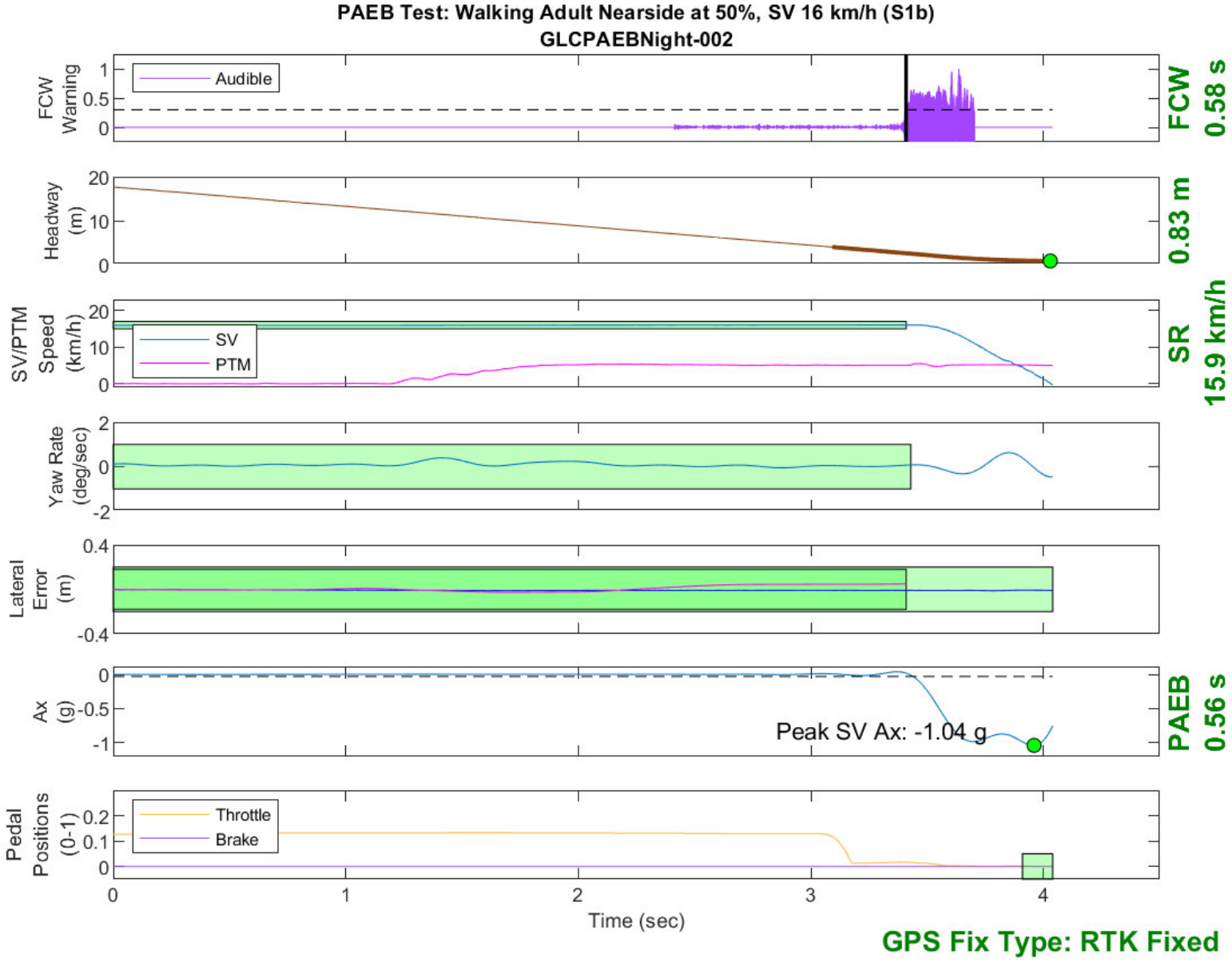

Figure D242. Time History for PAEB Run 2, S1b, Night, Low Beam, 16 km/h

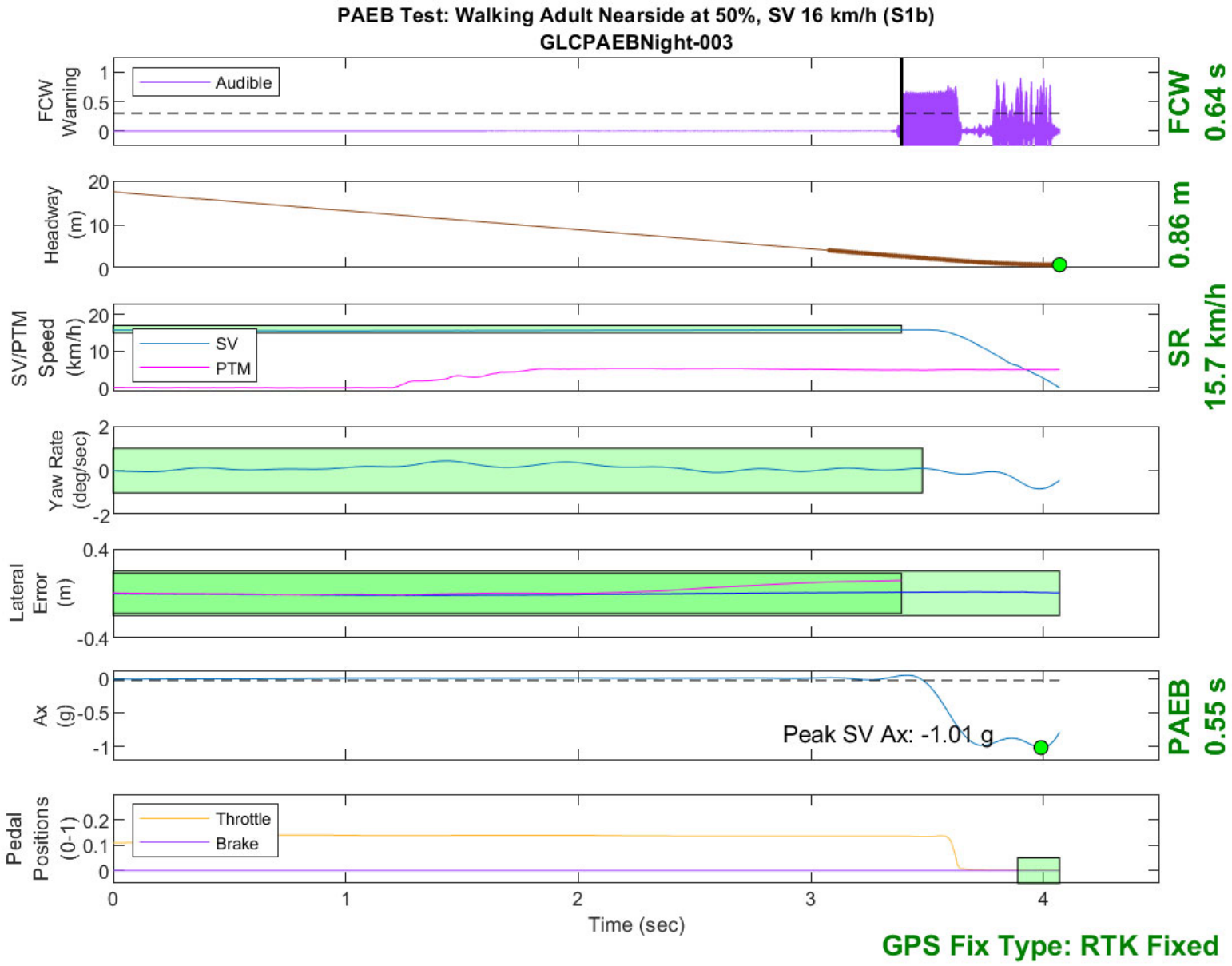

Figure D243. Time History for PAEB Run 3, S1b, Night, Low Beam, 16 km/h

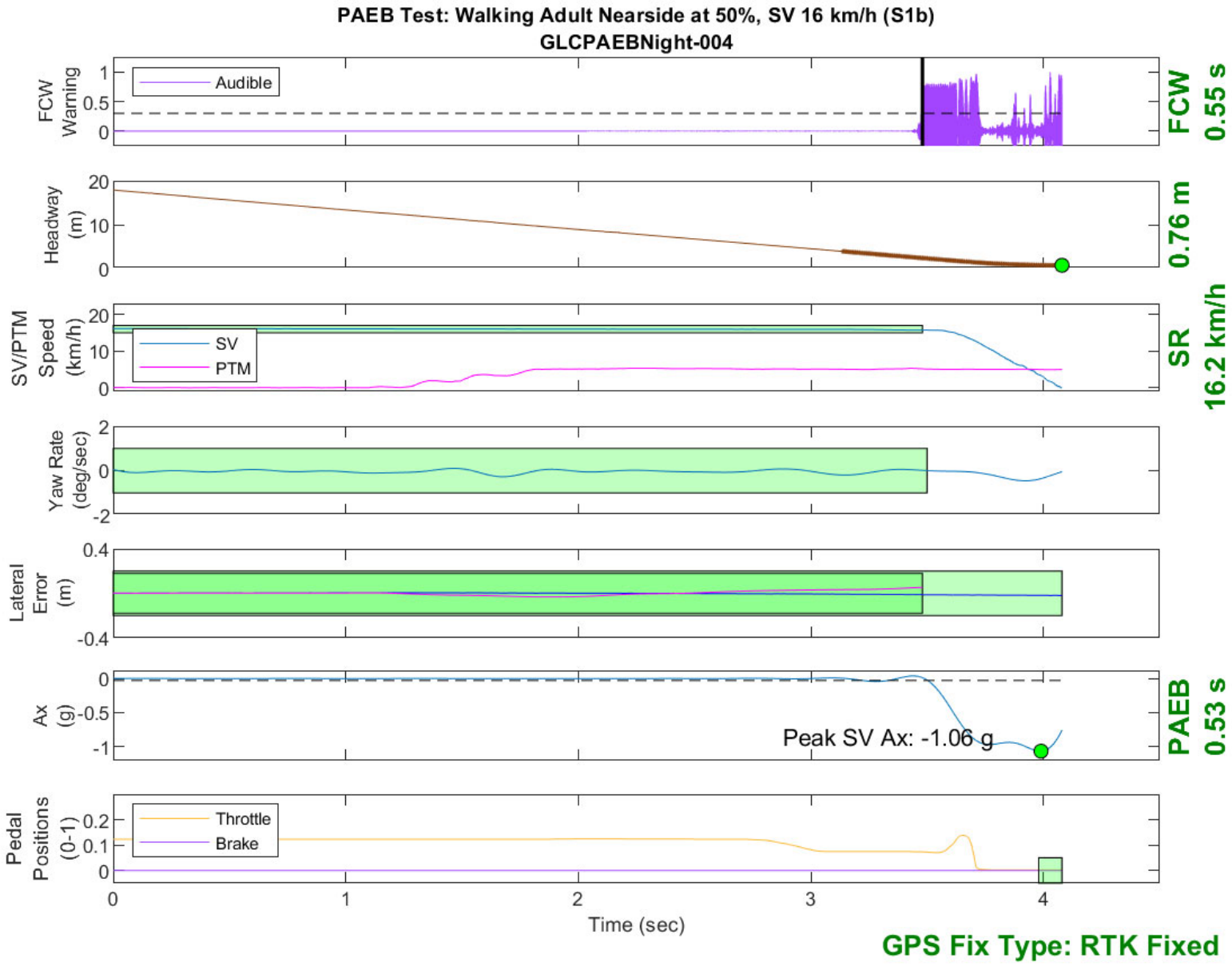

Figure D244. Time History for PAEB Run 4, S1b, Night, Low Beam, 16 km/h

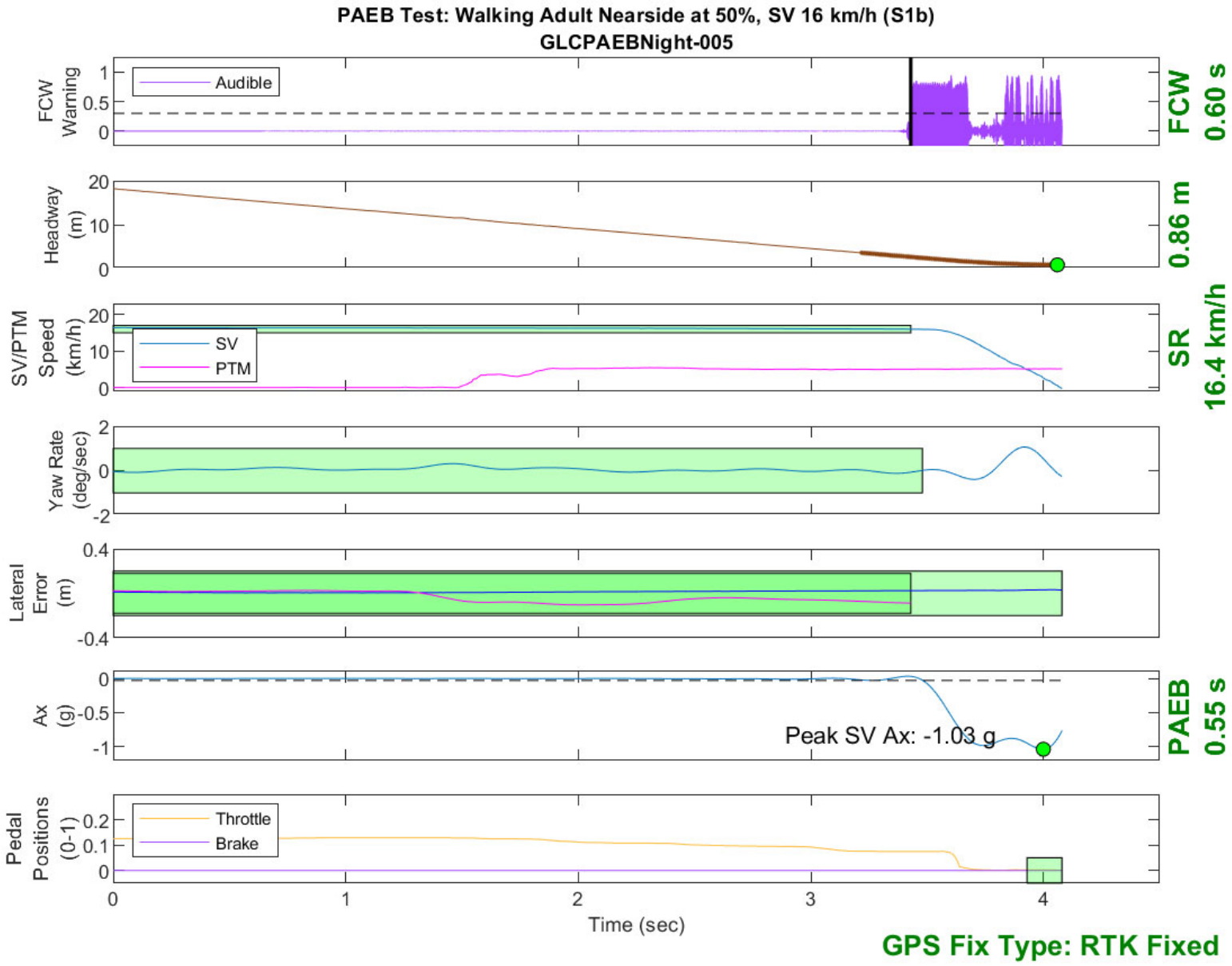

Figure D245. Time History for PAEB Run 5, S1b, Night, Low Beam, 16 km/h

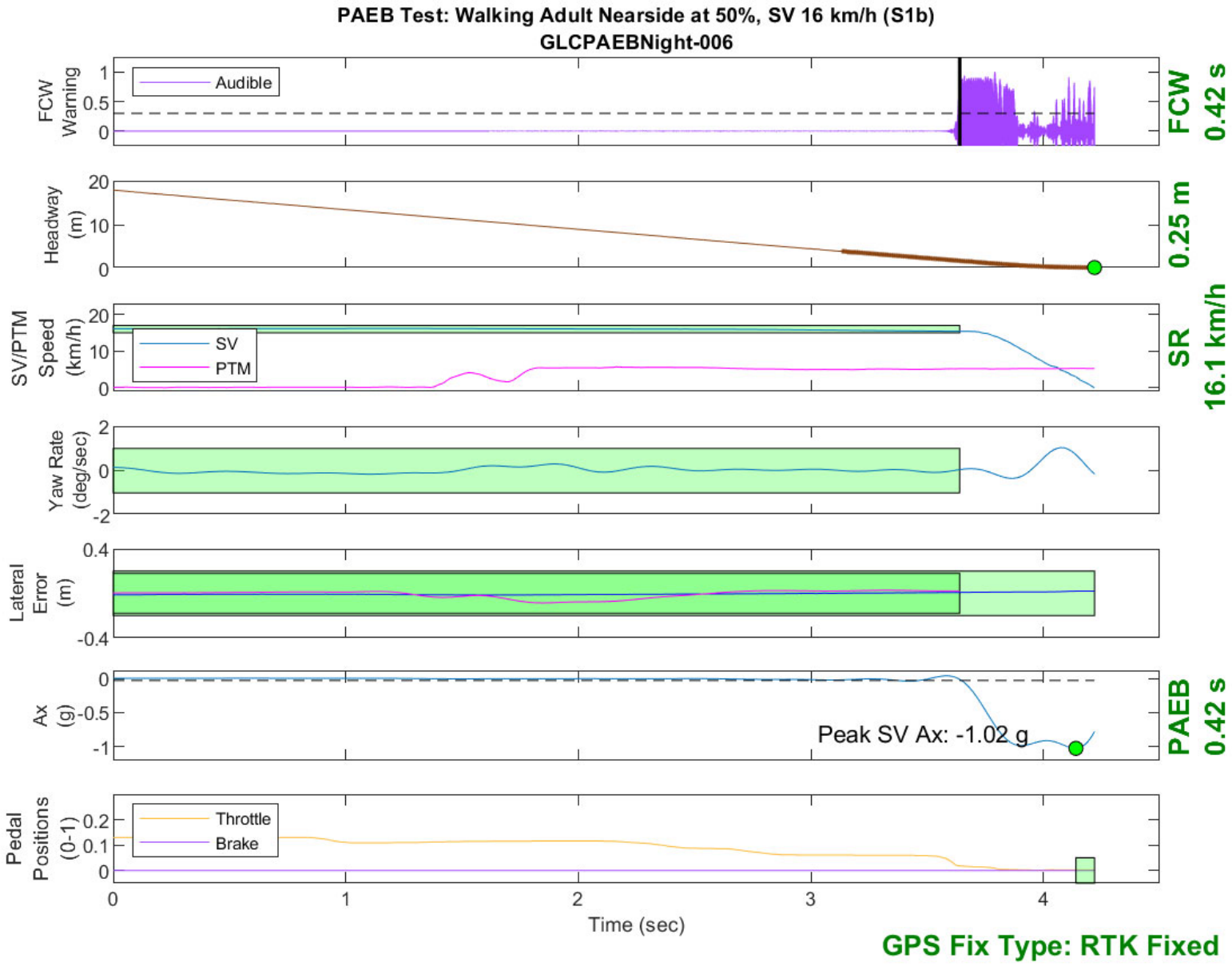

Figure D246. Time History for PAEB Run 6, S1b, Night, Low Beam, 16 km/h

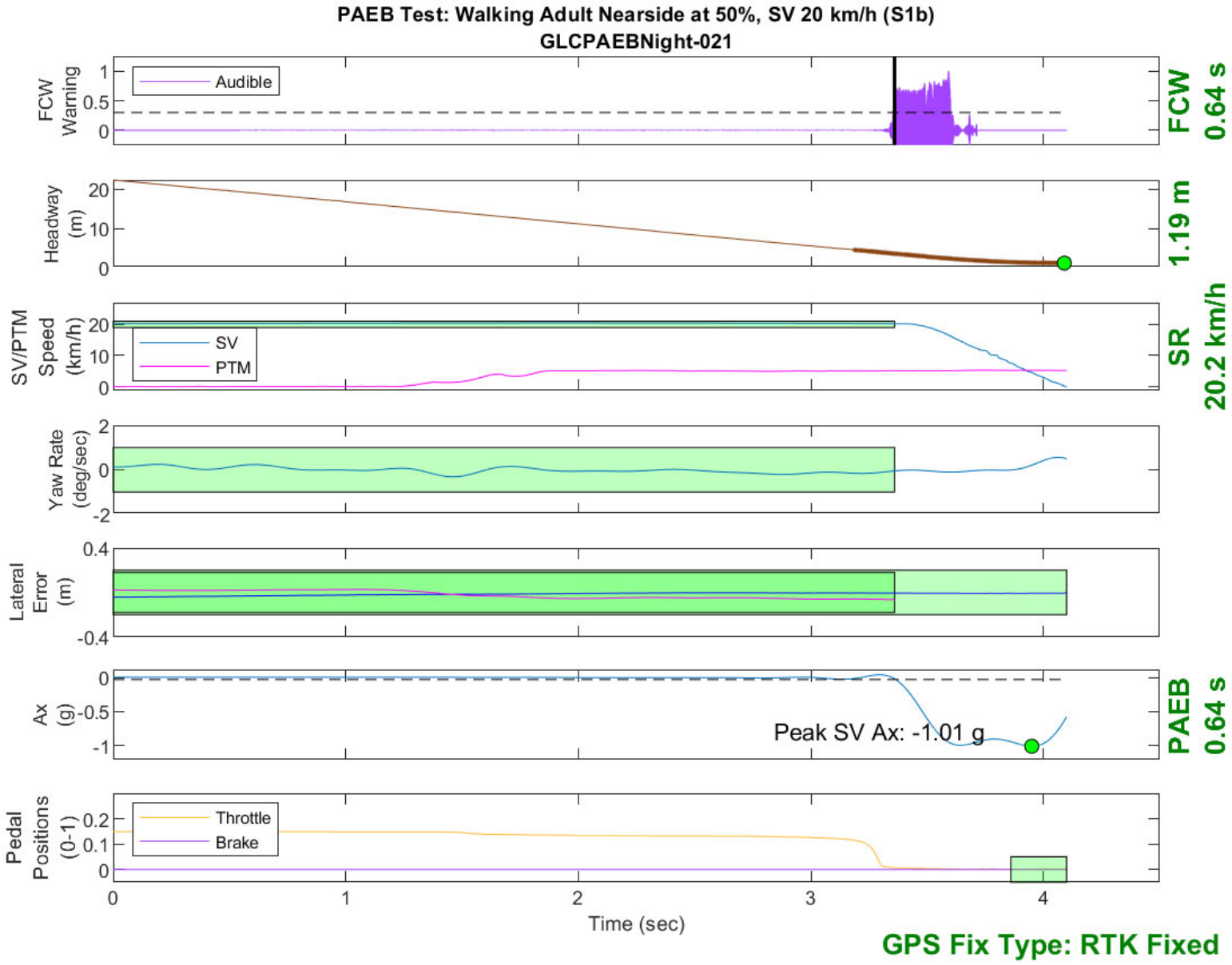

Figure D247. Time History for PAEB Run 21, S1b, Night, Low Beam, 20 km/h

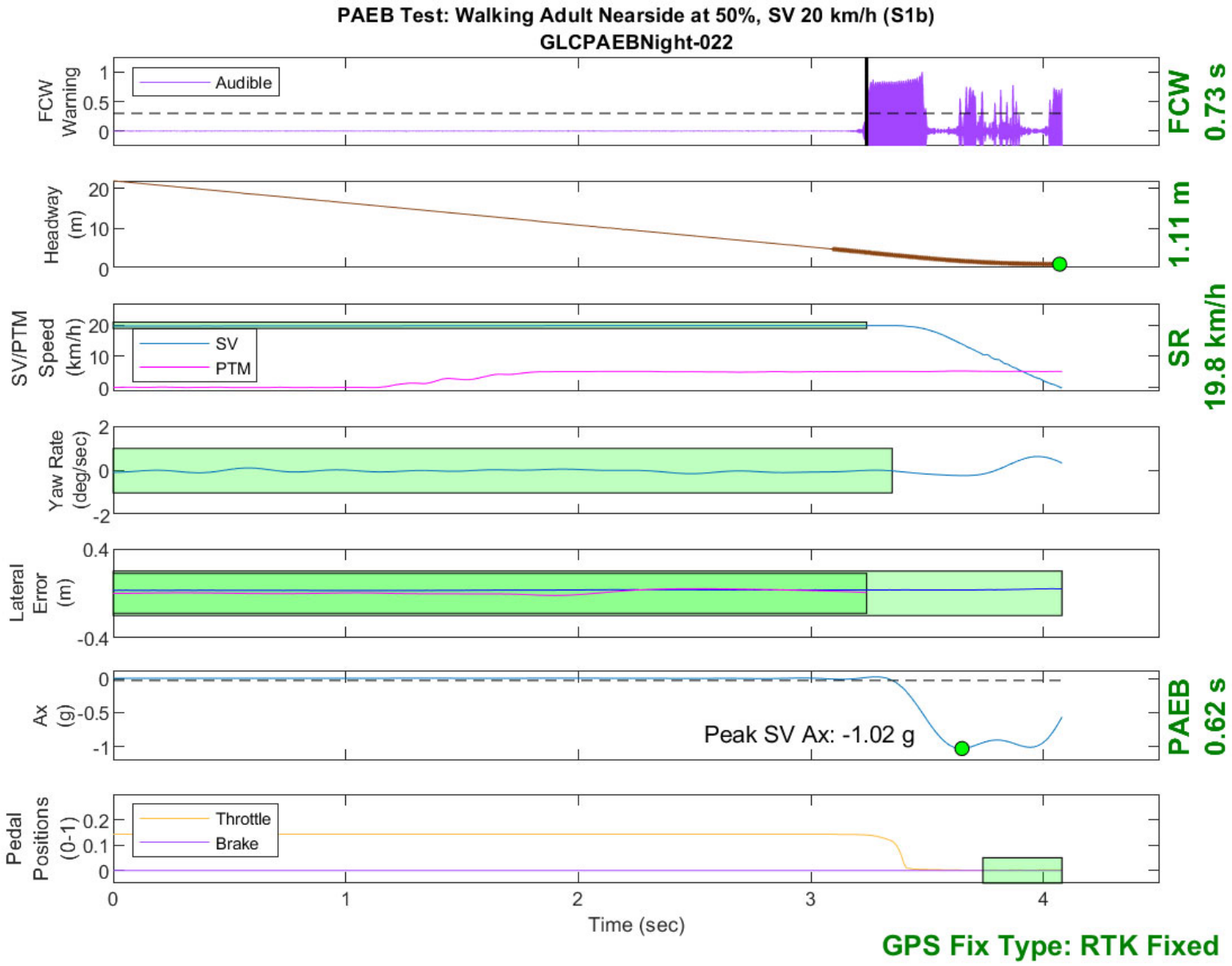

Figure D248. Time History for PAEB Run 22, S1b, Night, Low Beam, 20 km/h

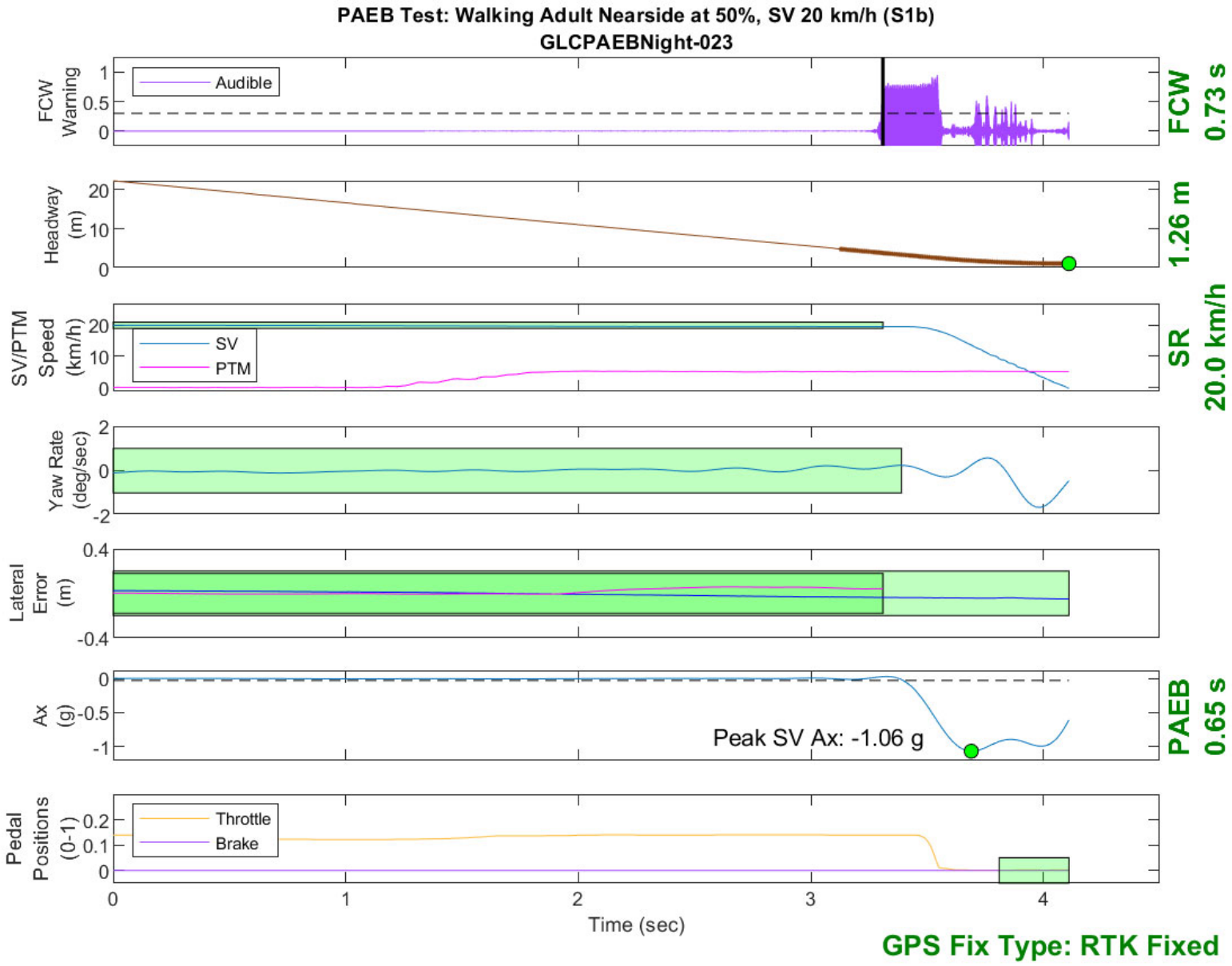

Figure D249. Time History for PAEB Run 23, S1b, Night, Low Beam, 20 km/h

Figure D250. Time History for PAEB Run 24, S1b, Night, Low Beam, 20 km/h

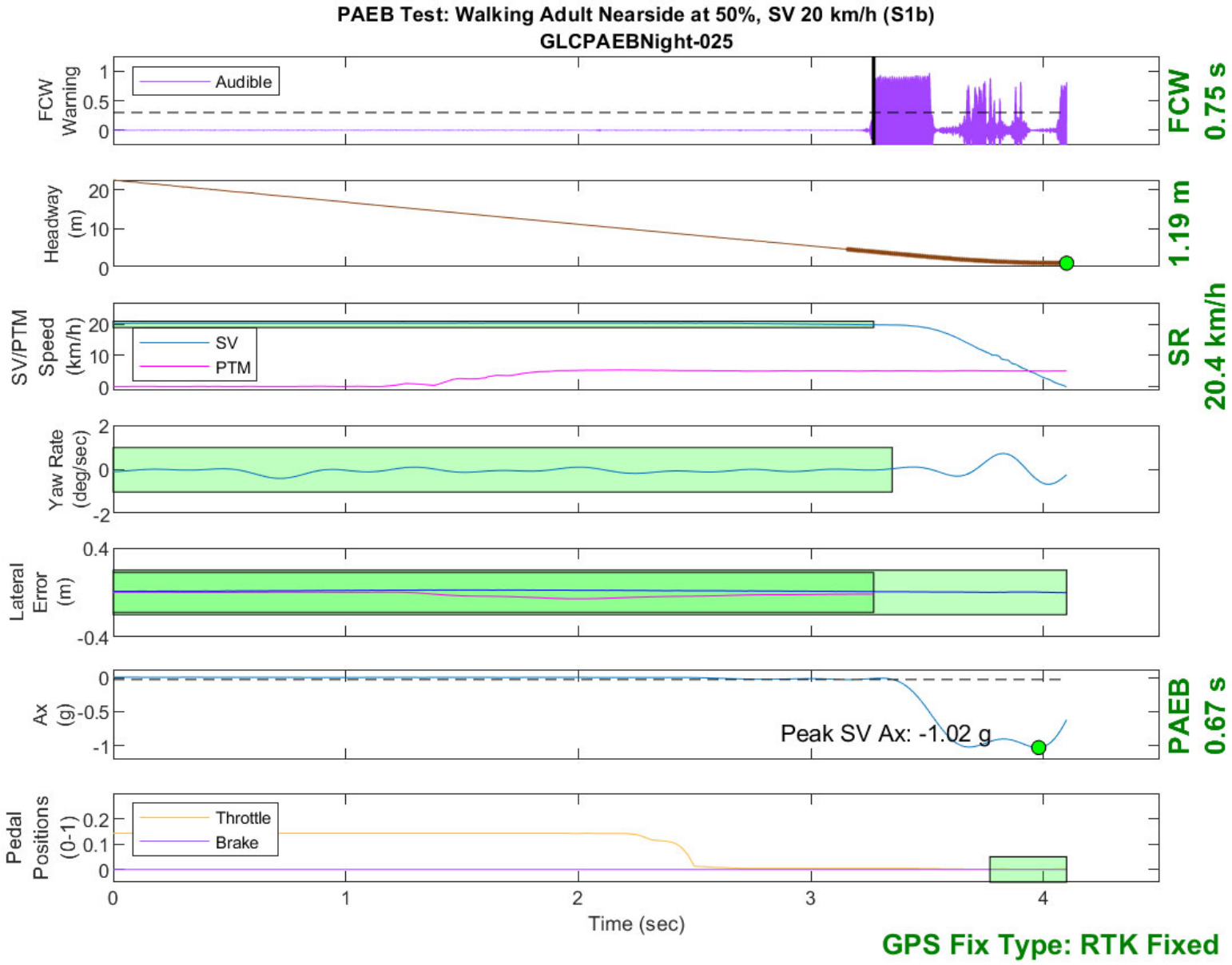

Figure D251. Time History for PAEB Run 25, S1b, Night, Low Beam, 20 km/h

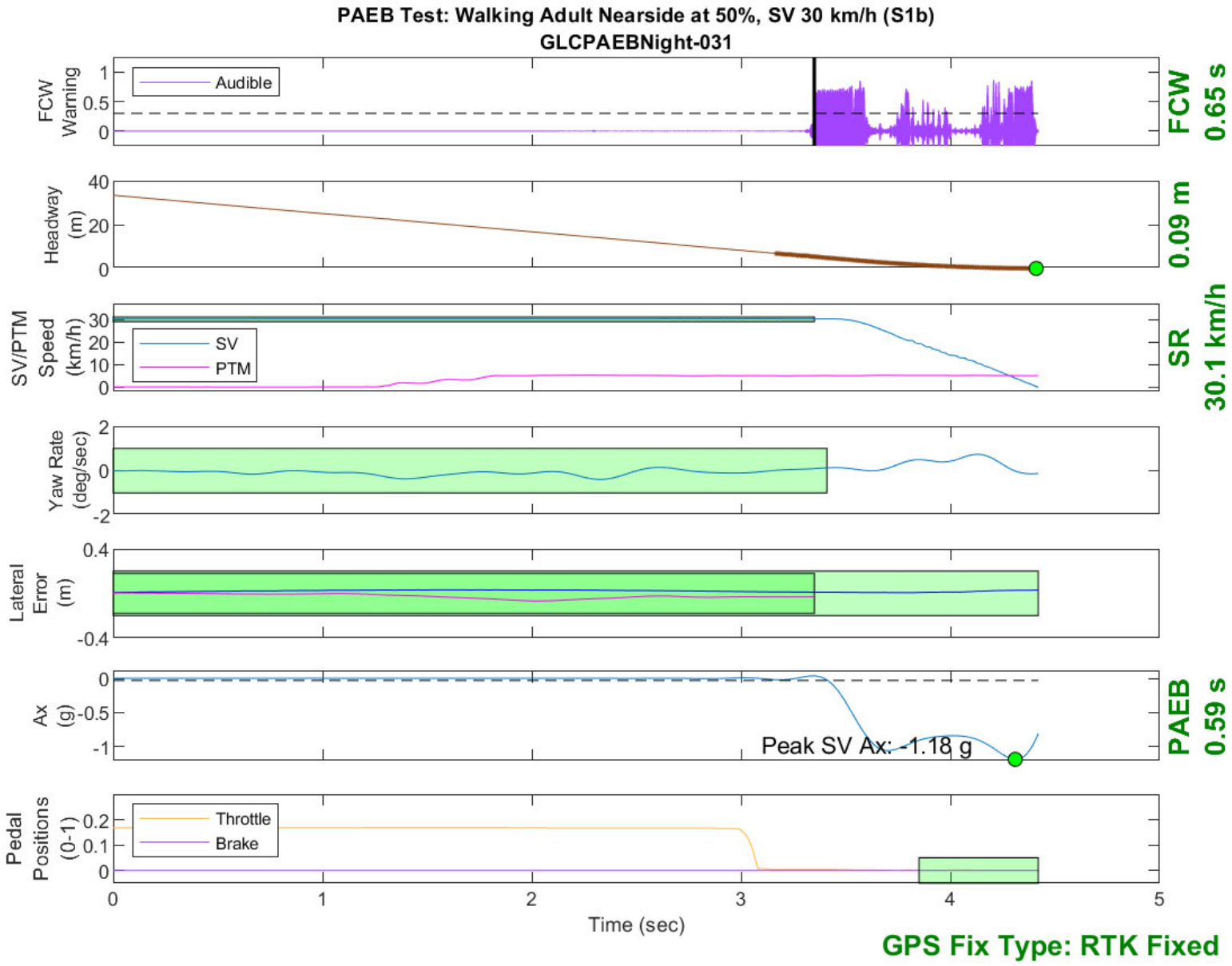

Figure D252. Time History for PAEB Run 31, S1b, Night, Low Beam, 30 km/h

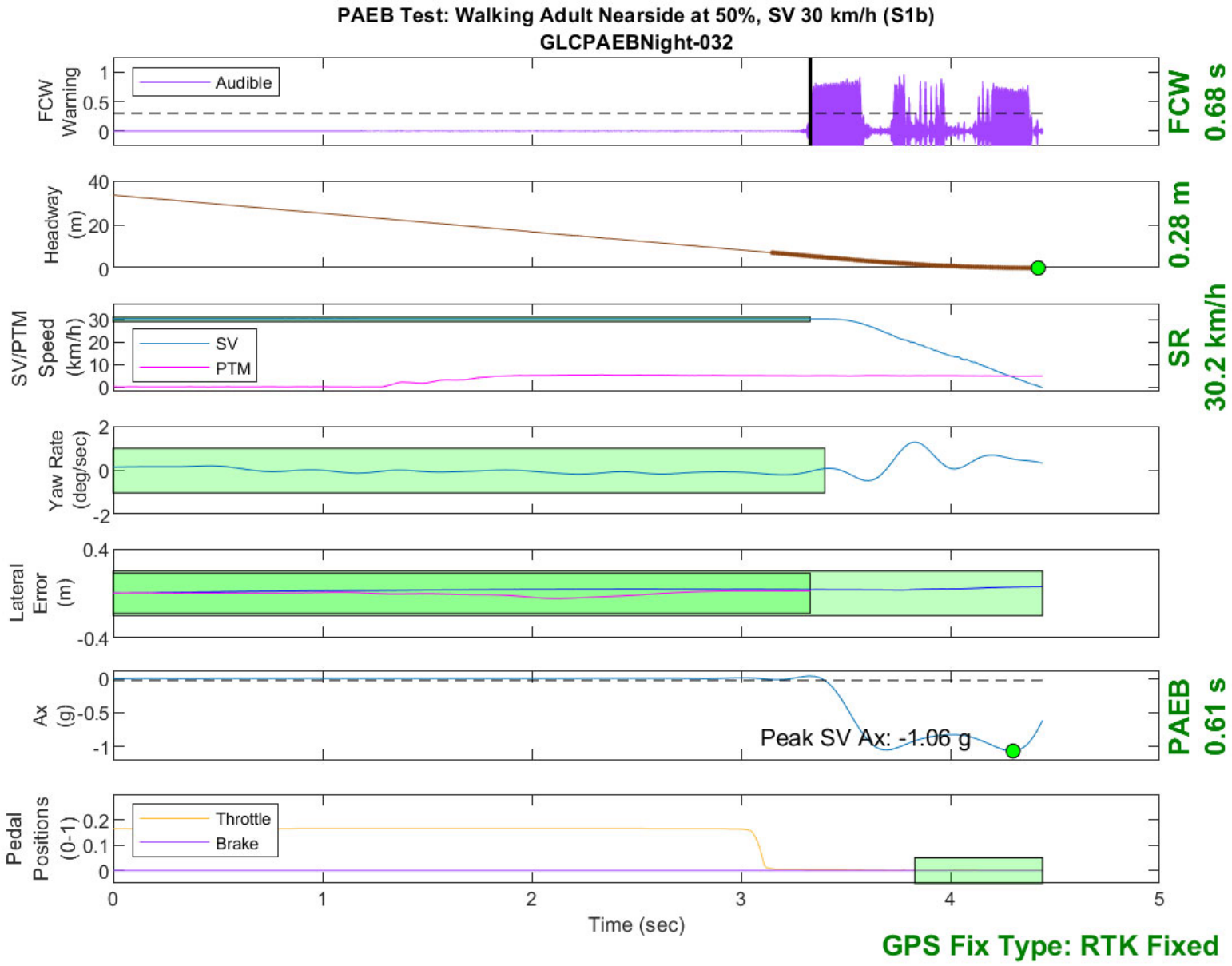

Figure D253. Time History for PAEB Run 32, S1b, Night, Low Beam, 30 km/h

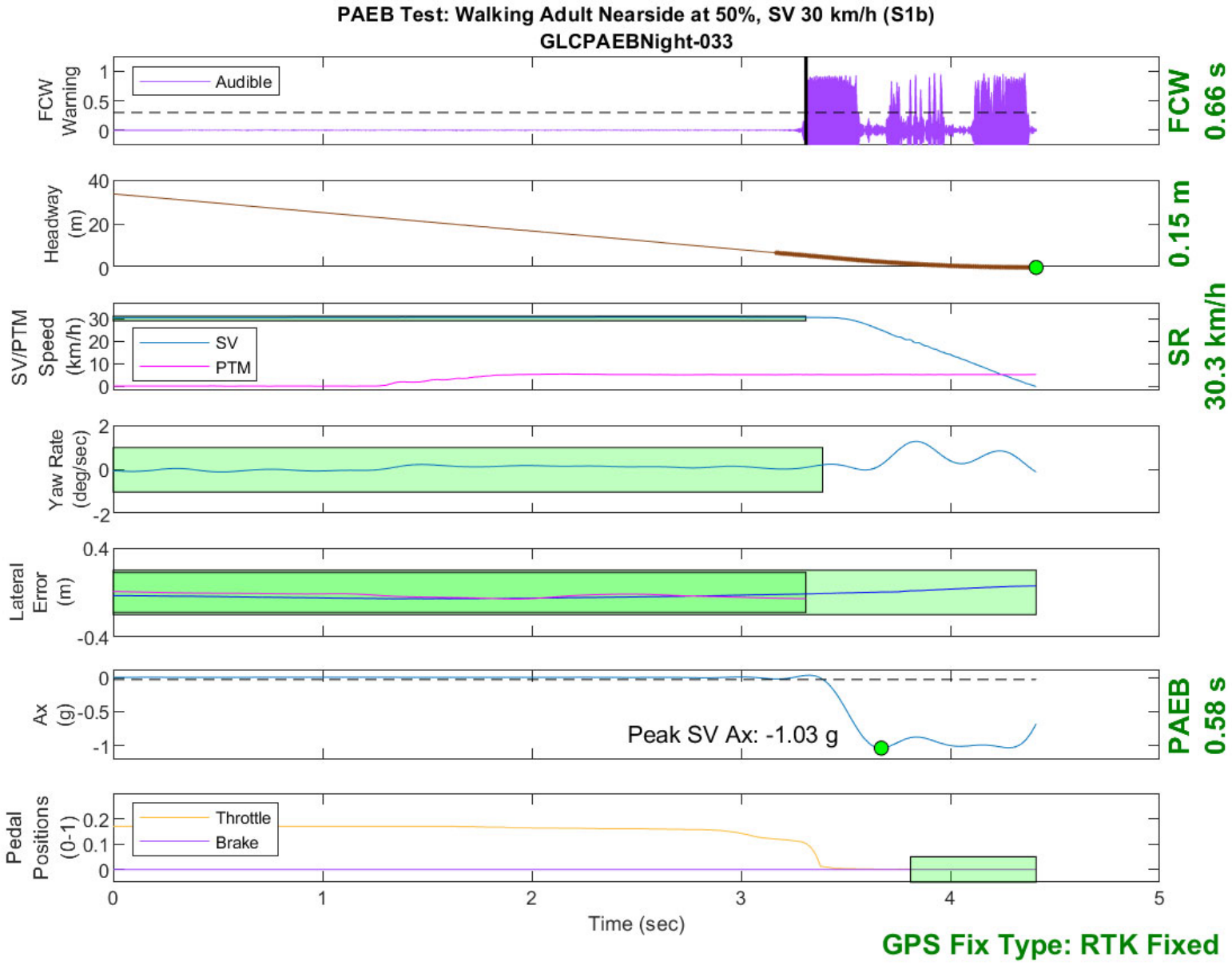

Figure D254. Time History for PAEB Run 33, S1b, Night, Low Beam, 30 km/h

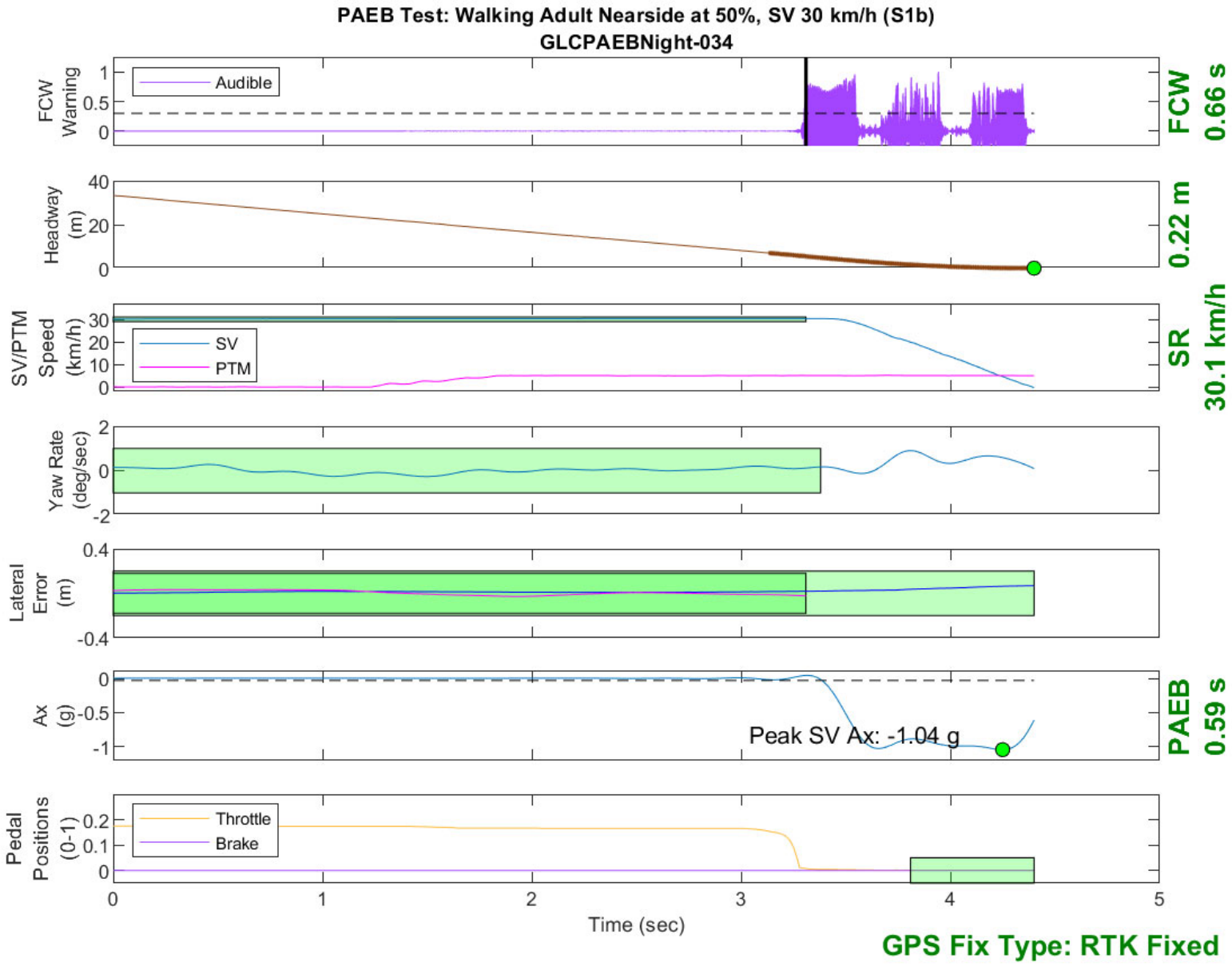

Figure D255. Time History for PAEB Run 34, S1b, Night, Low Beam, 30 km/h

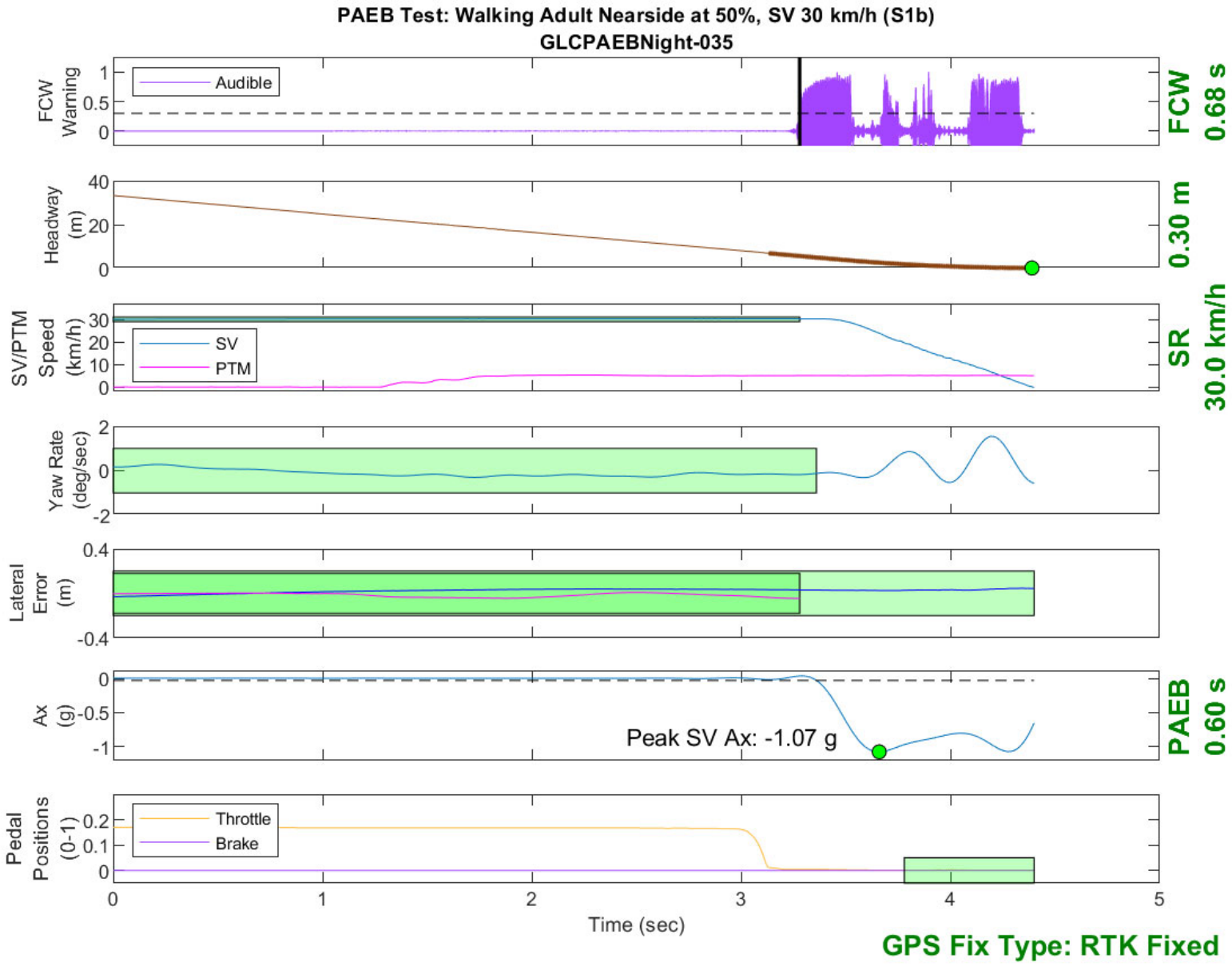

Figure D256. Time History for PAEB Run 35, S1b, Night, Low Beam, 30 km/h

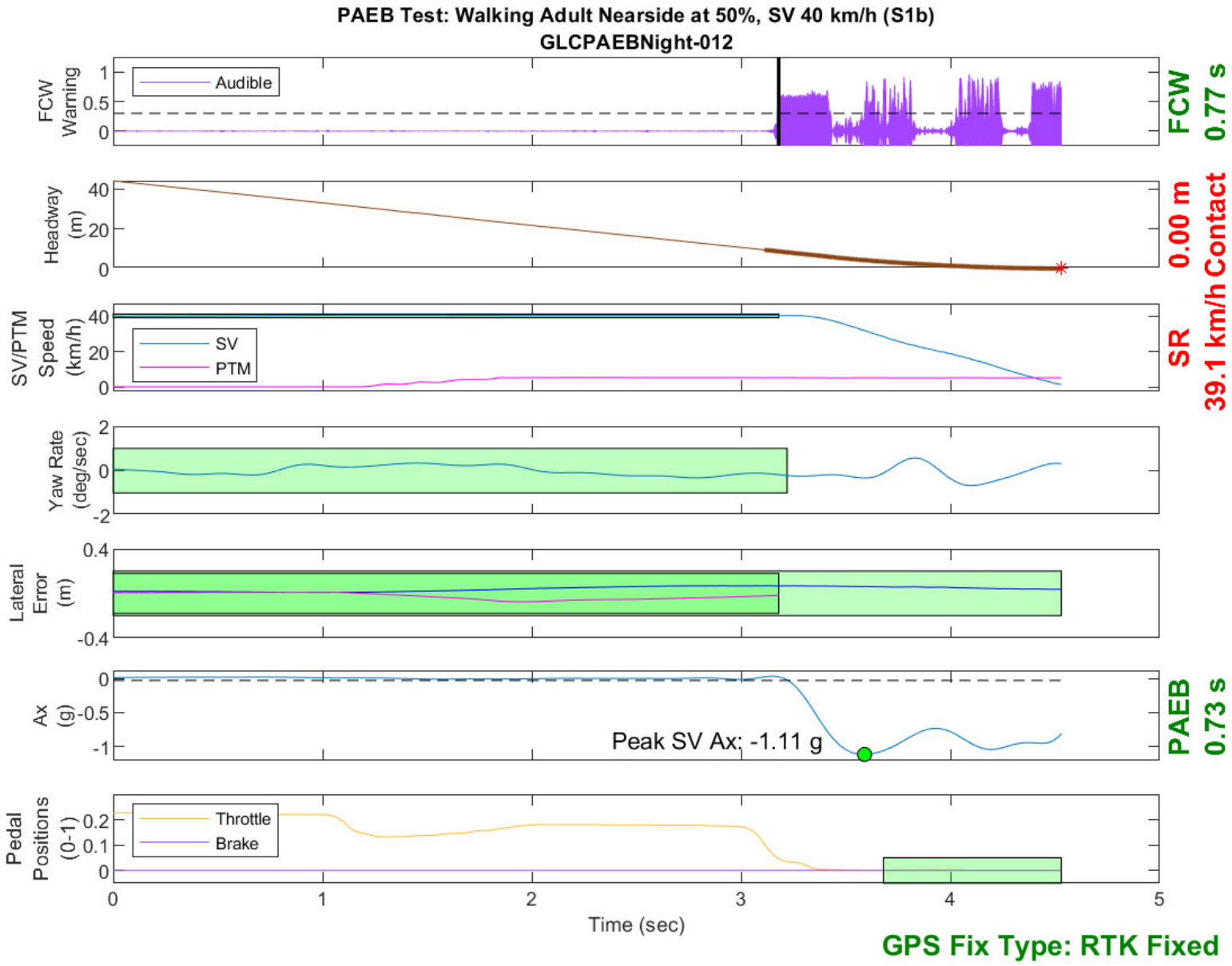

Figure D257. Time History for PAEB Run 12, S1b, Night, Low Beam, 40 km/h

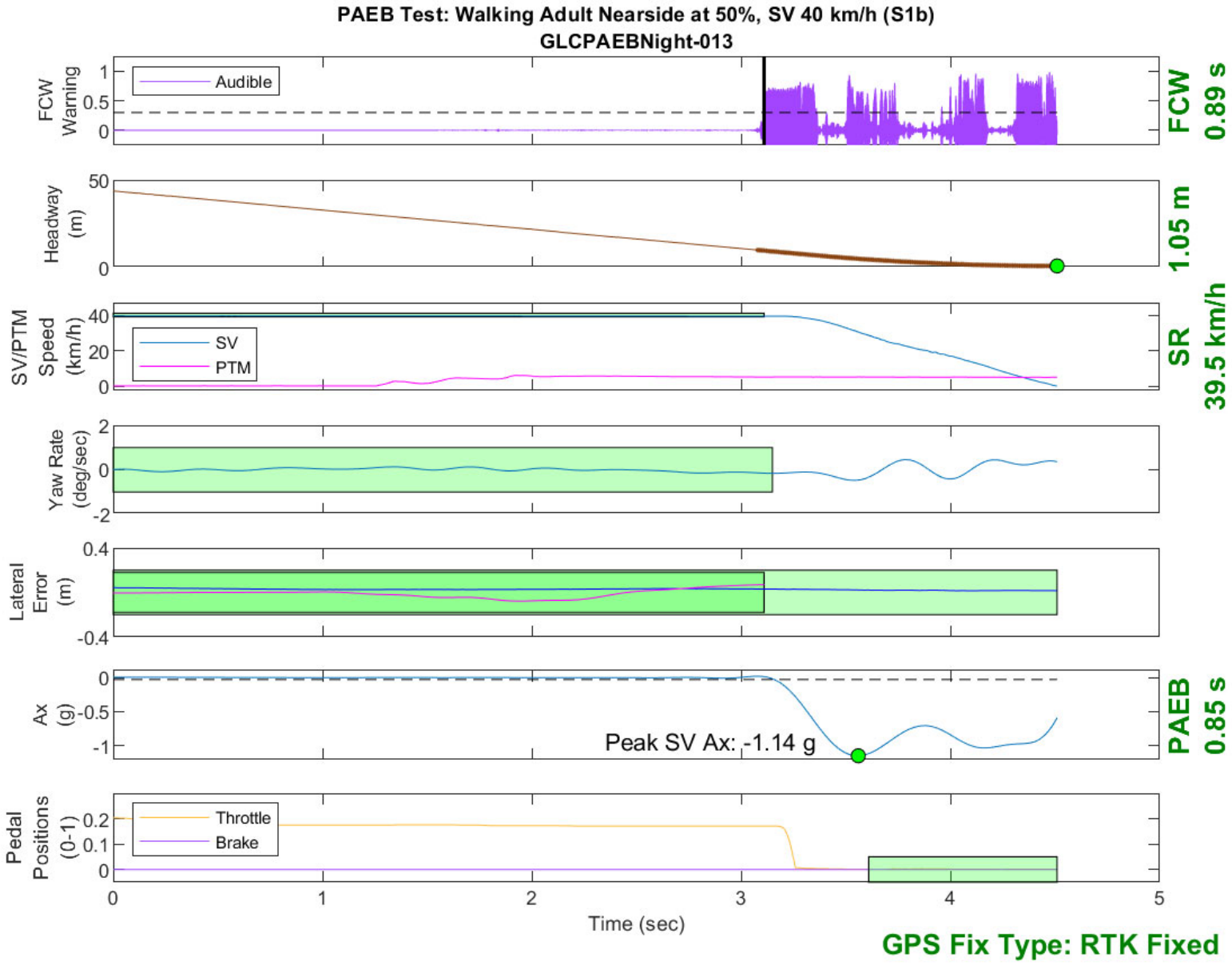

Figure D258. Time History for PAEB Run 13, S1b, Night, Low Beam, 40 km/h

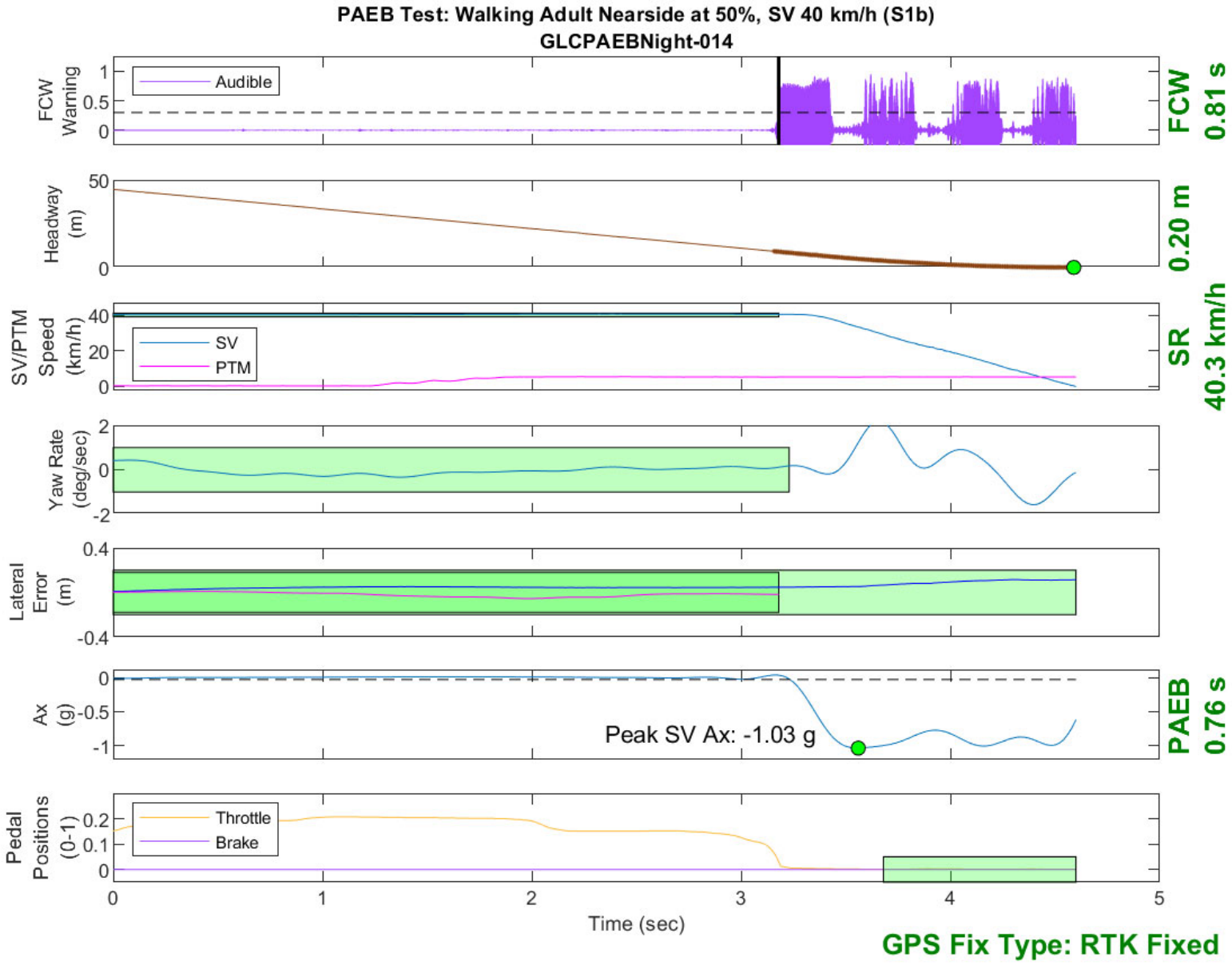

Figure D259. Time History for PAEB Run 14, S1b, Night, Low Beam, 40 km/h

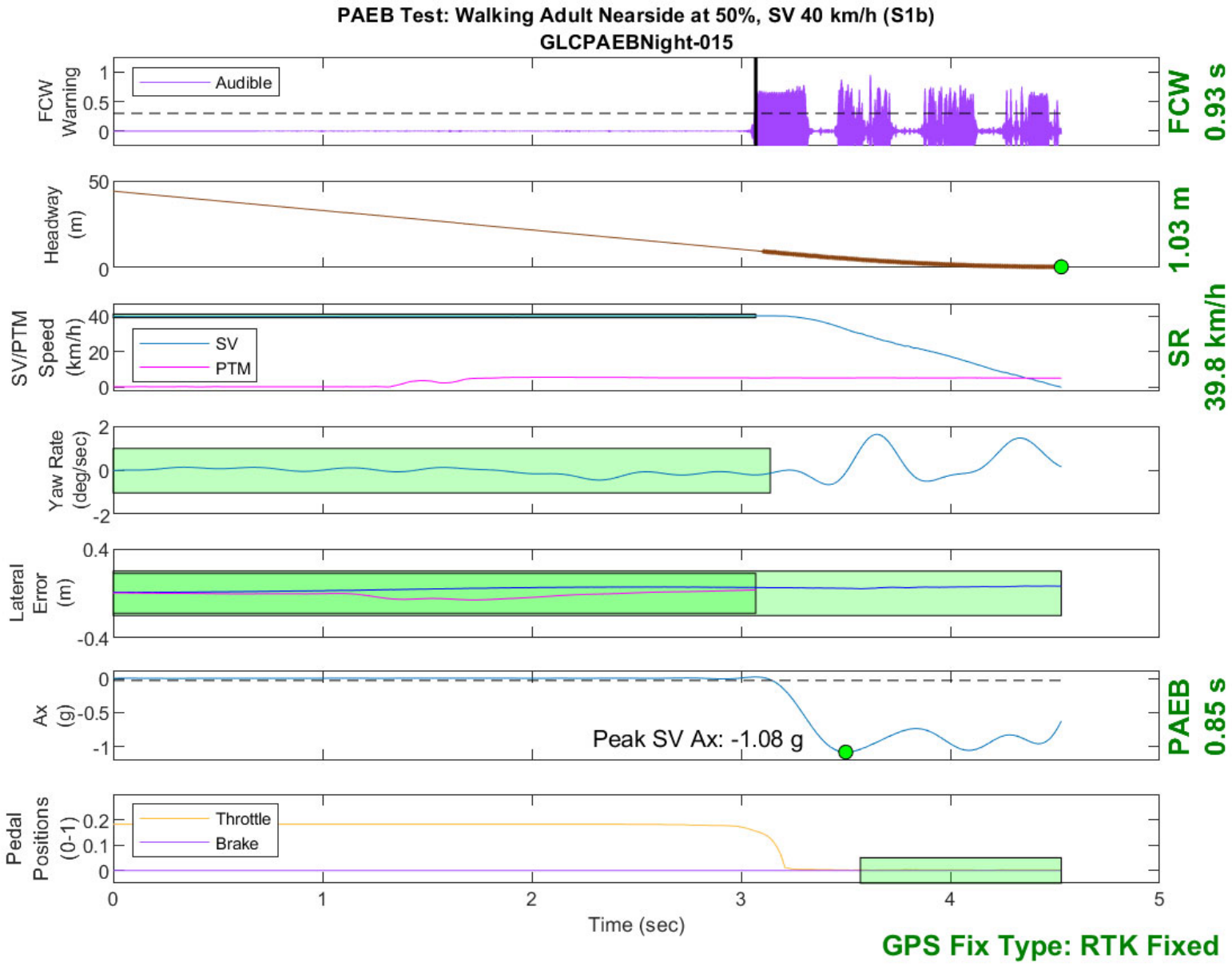

Figure D260. Time History for PAEB Run 15, S1b, Night, Low Beam, 40 km/h

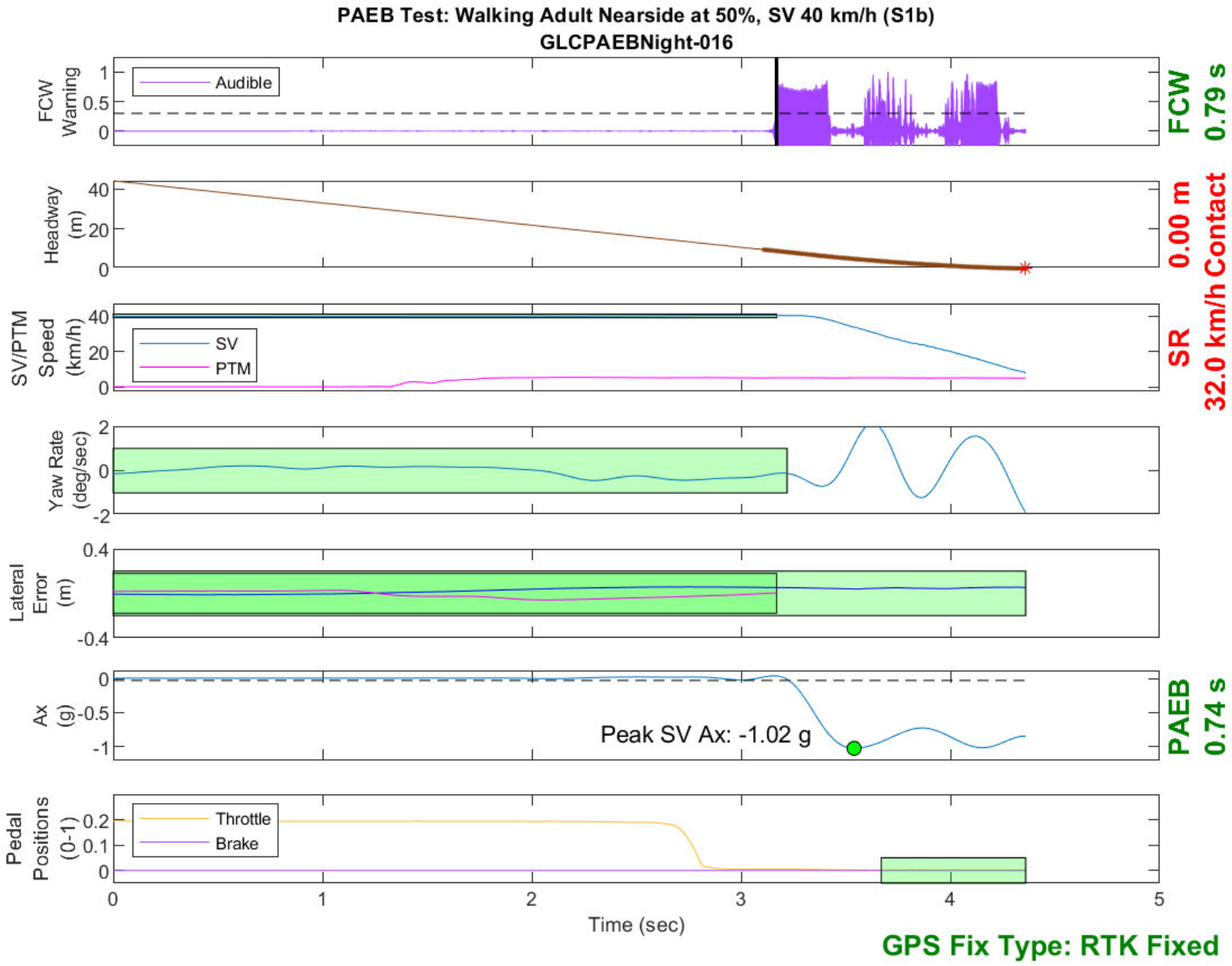

Figure D261. Time History for PAEB Run 16, S1b, Night, Low Beam, 40 km/h

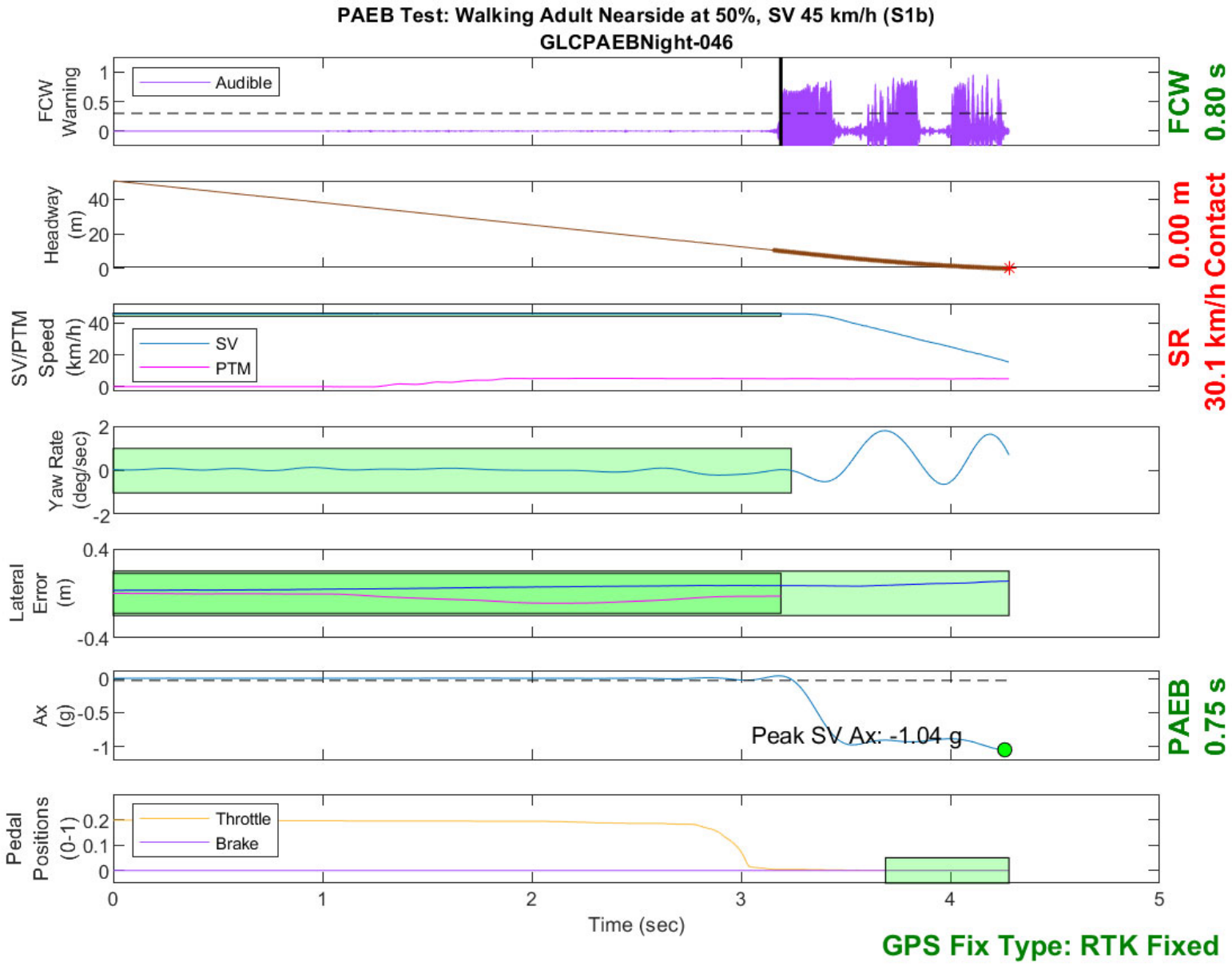

Figure D262. Time History for PAEB Run 46, S1b, Night, Low Beam, 45 km/h

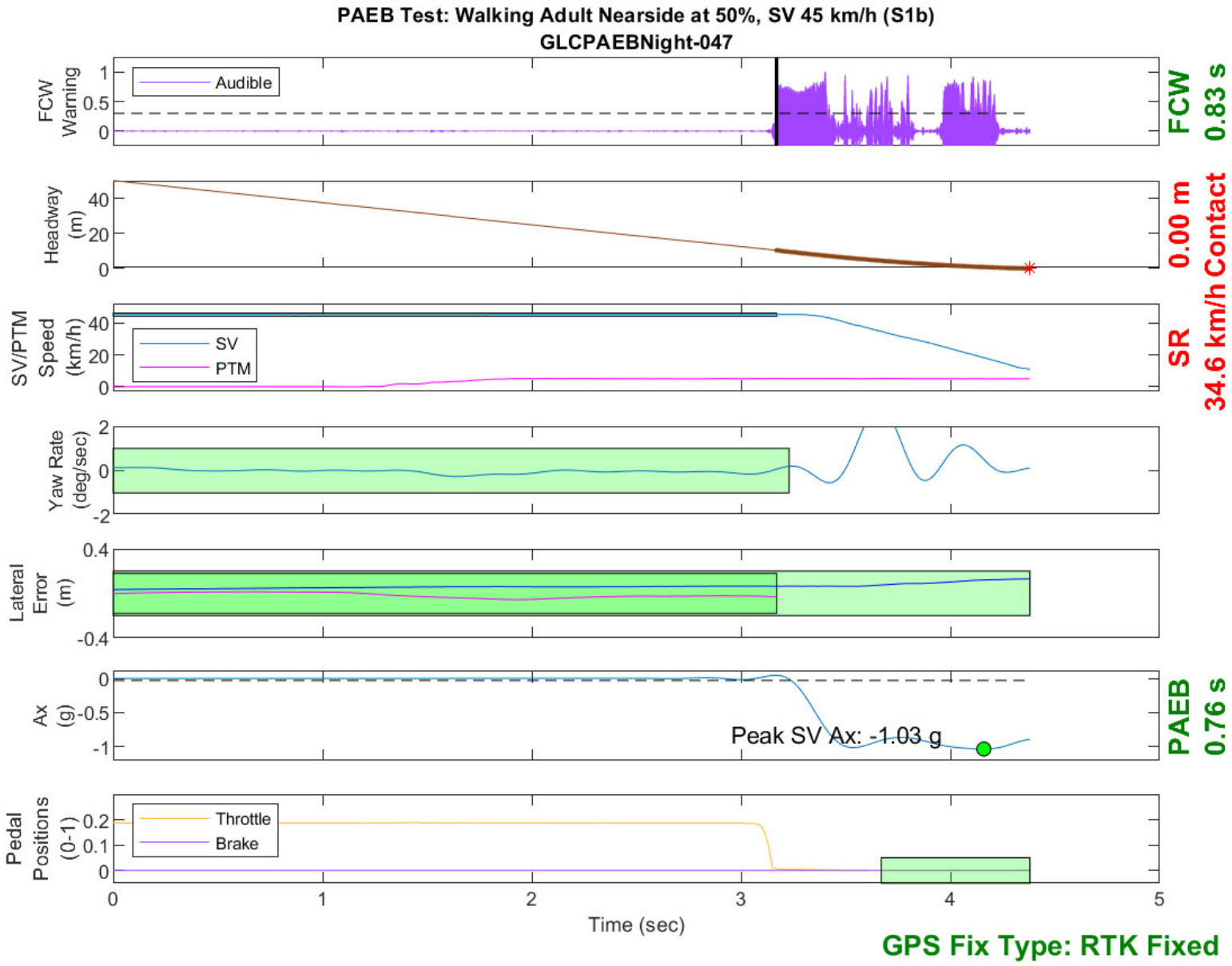

Figure D263. Time History for PAEB Run 47, S1b, Night, Low Beam, 45 km/h

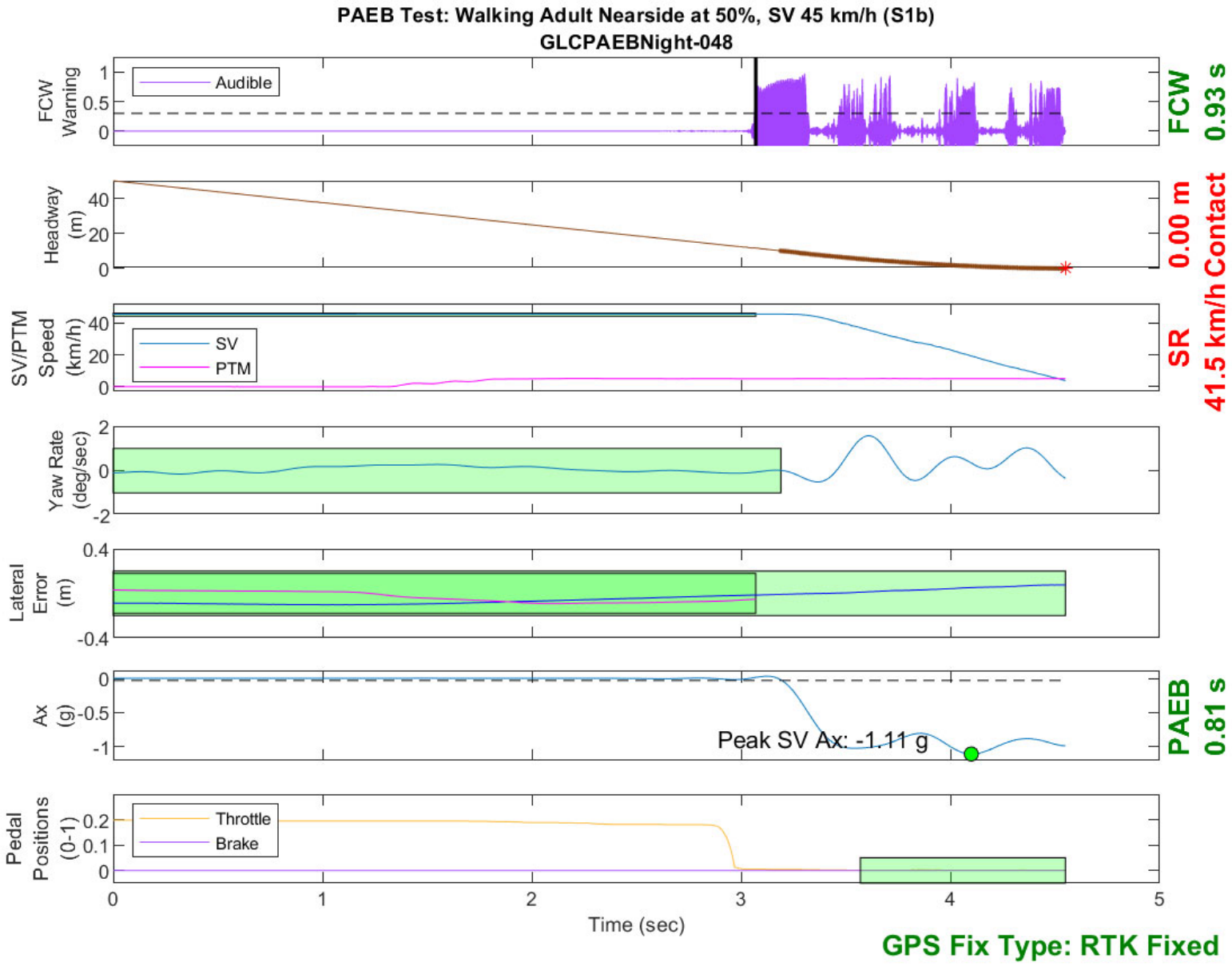

Figure D264. Time History for PAEB Run 48, S1b, Night, Low Beam, 45 km/h

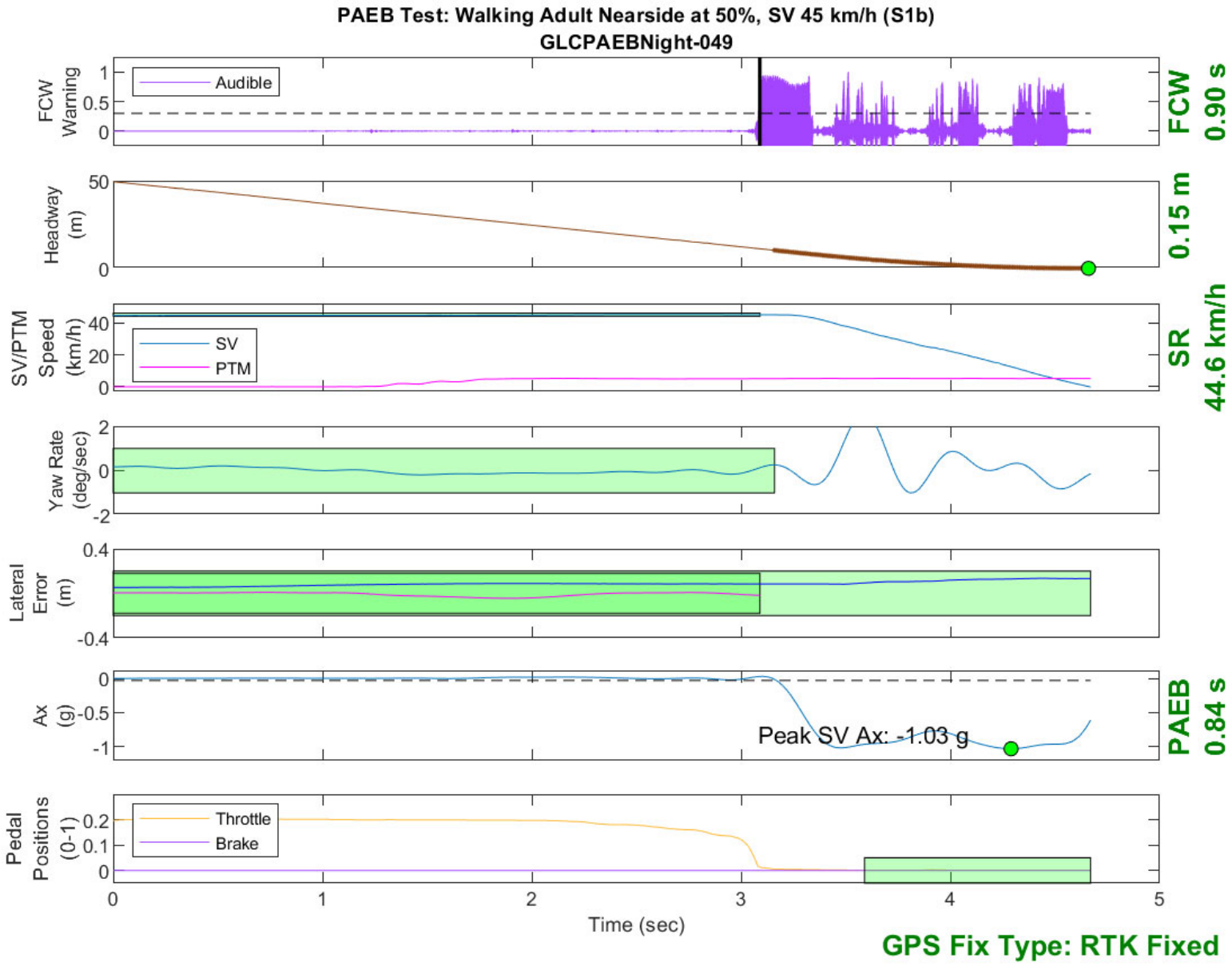

Figure D265. Time History for PAEB Run 49, S1b, Night, Low Beam, 45 km/h

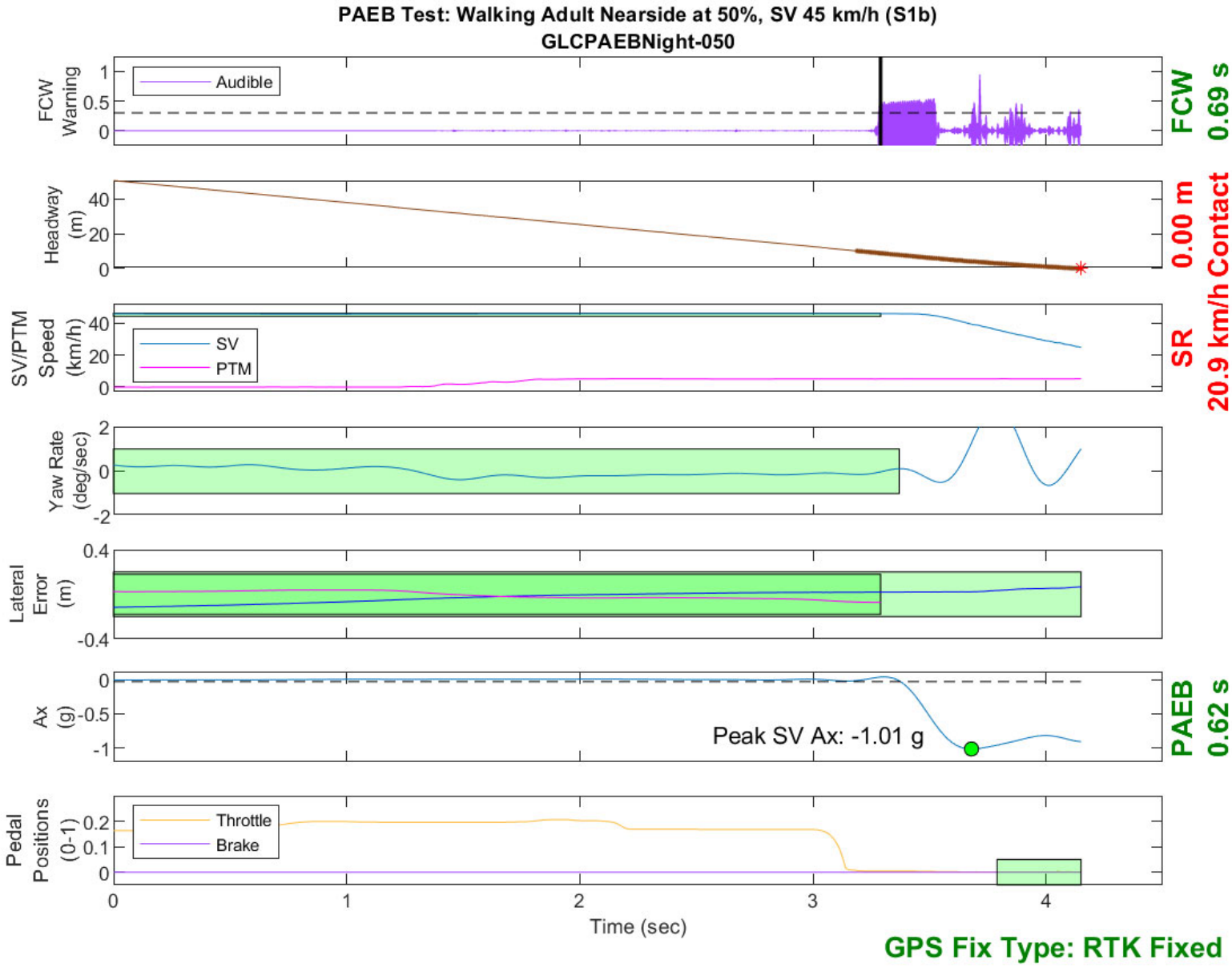

Figure D266. Time History for PAEB Run 50, S1b, Night, Low Beam, 45 km/h

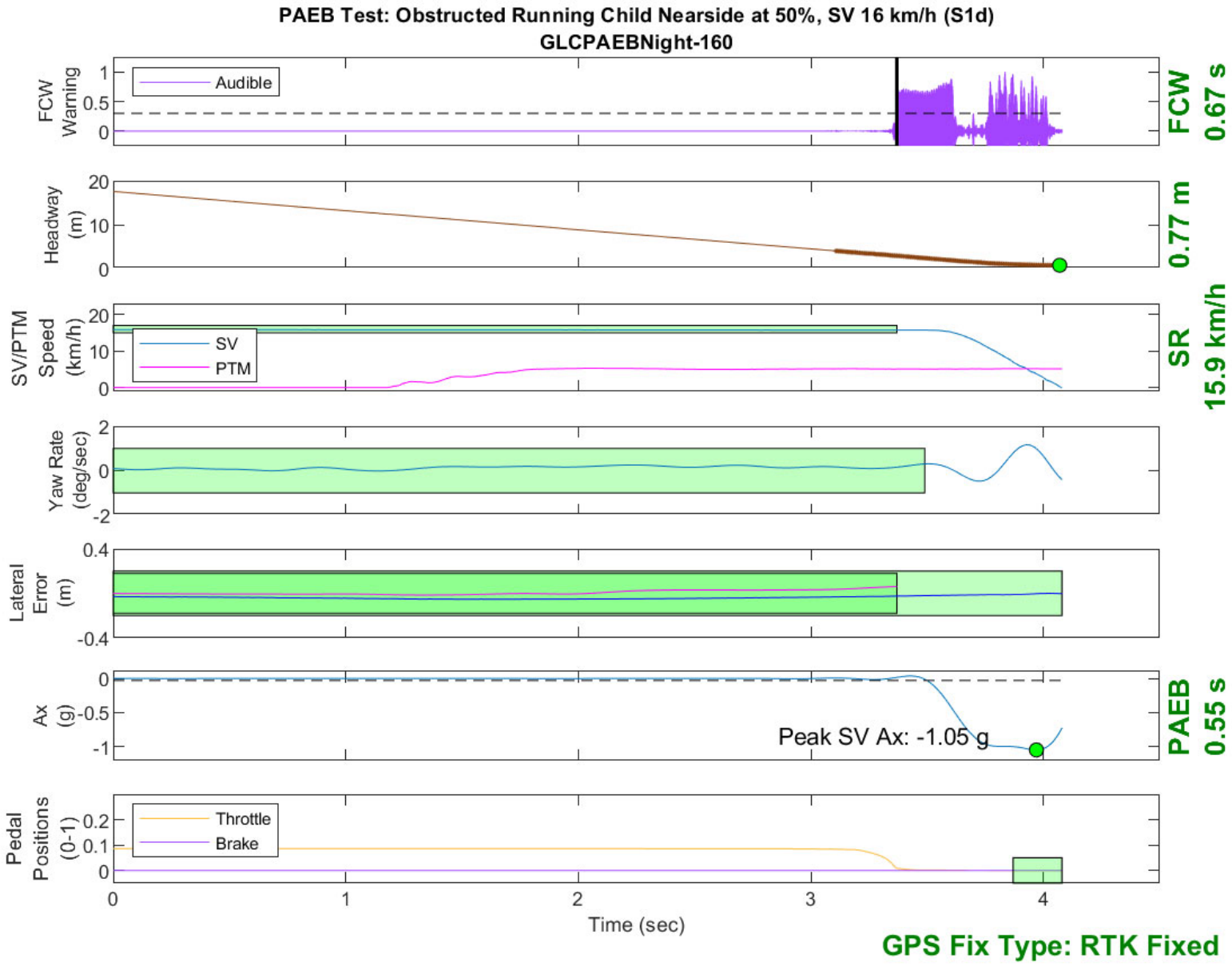

Figure D267. Time History for PAEB Run 160, S1d, Night, Low Beam, 16 km/h

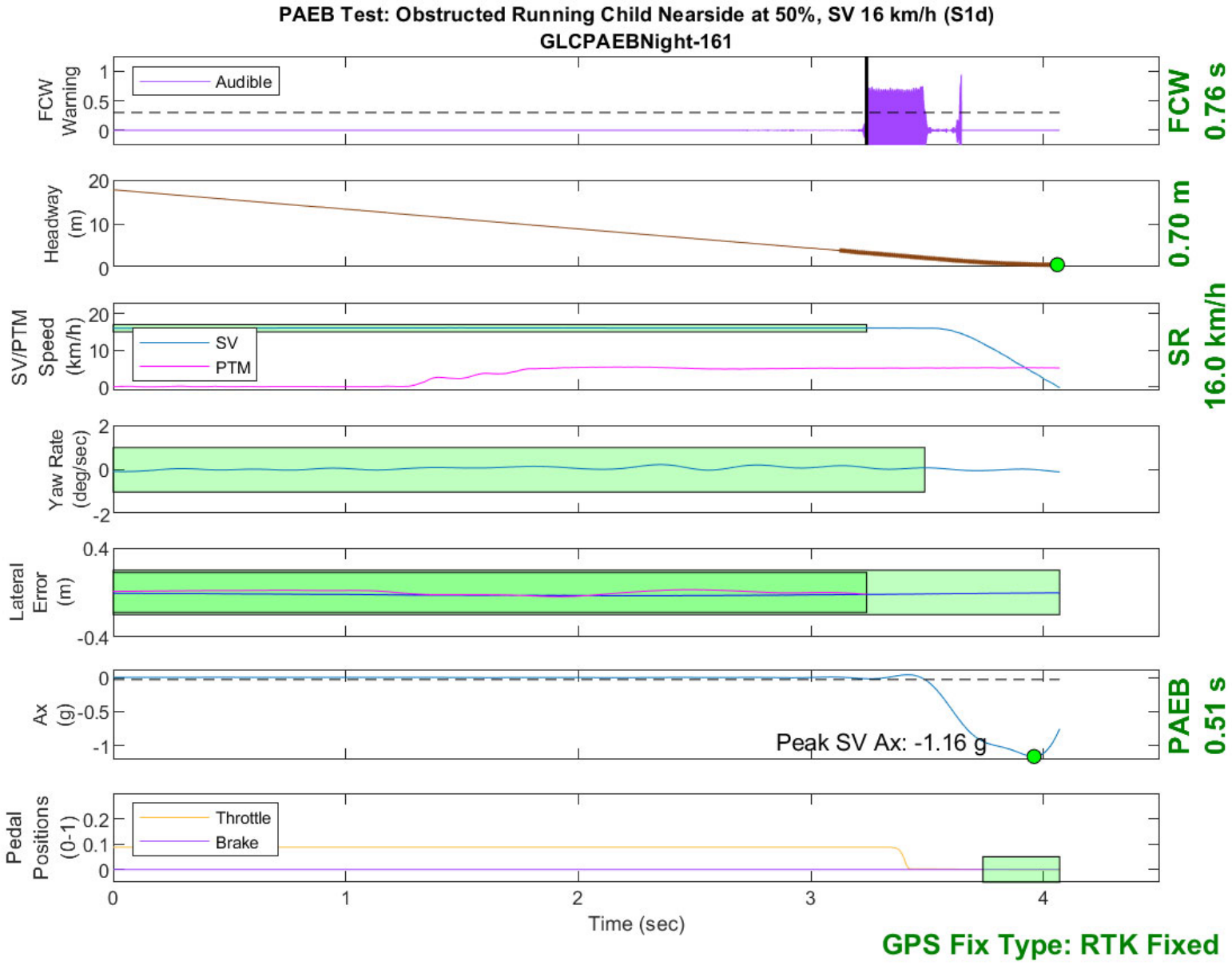

Figure D268. Time History for PAEB Run 161, S1d, Night, Low Beam, 16 km/h

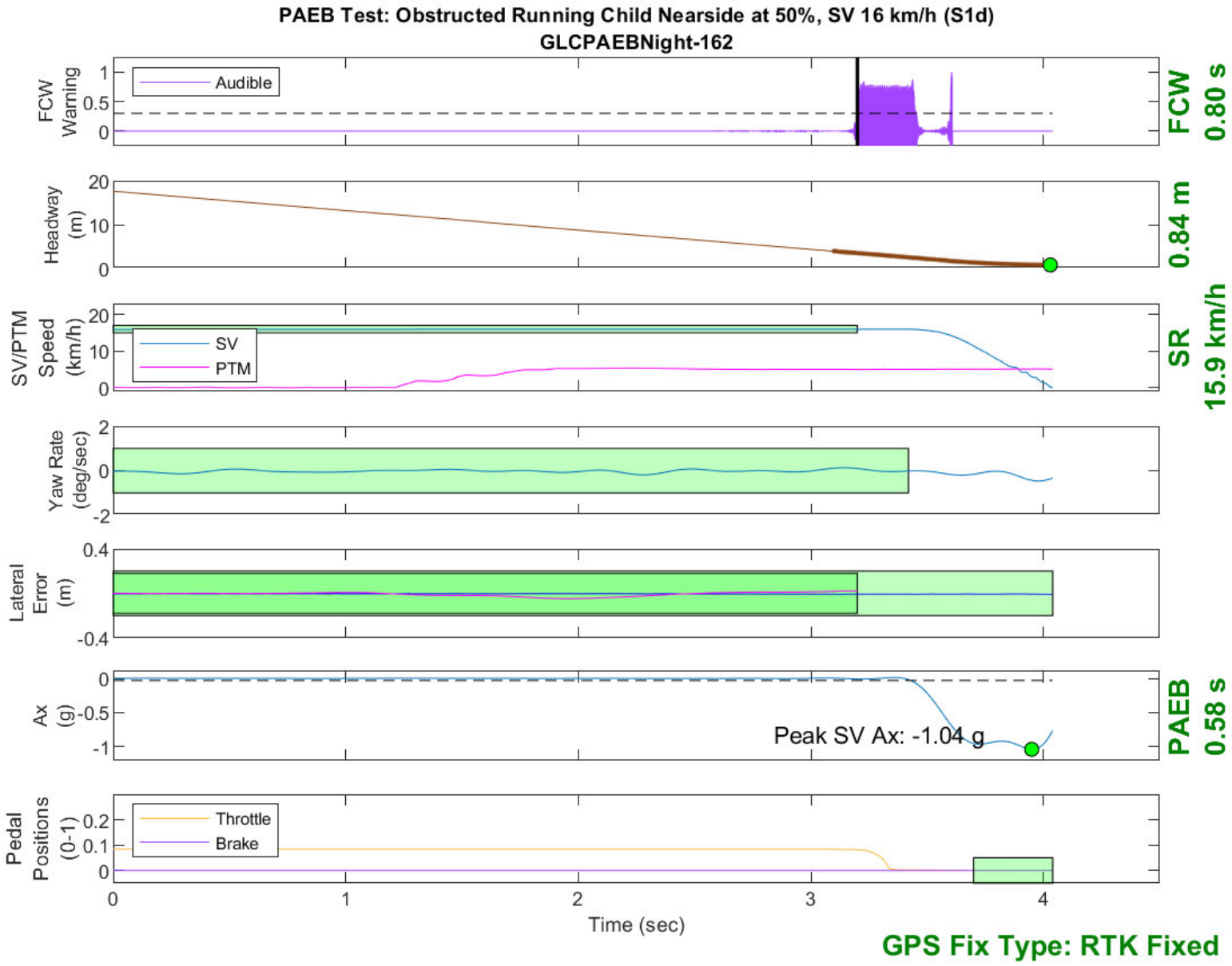

Figure D269. Time History for PAEB Run 162, S1d, Night, Low Beam, 16 km/h

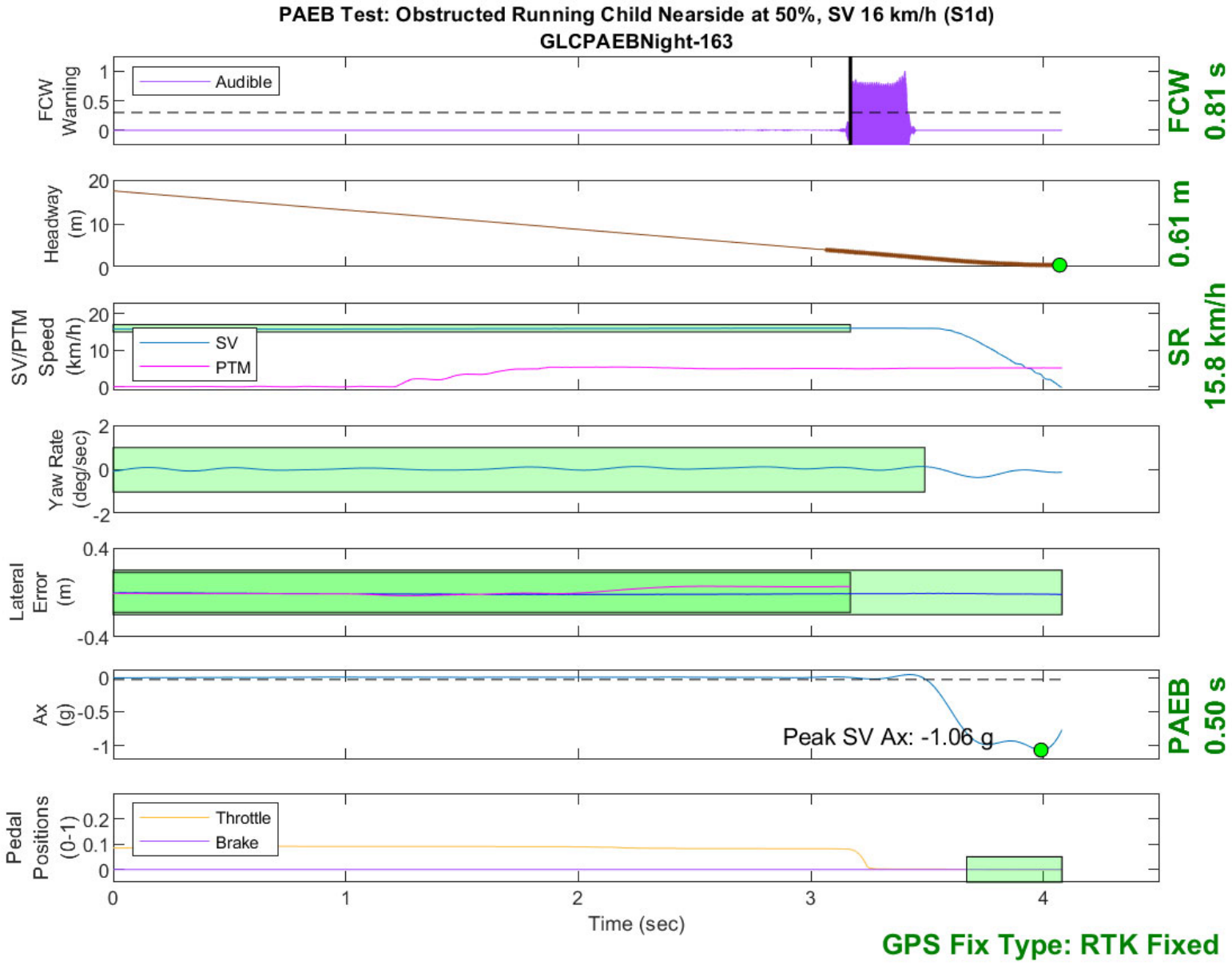

Figure D270. Time History for PAEB Run 163, S1d, Night, Low Beam, 16 km/h

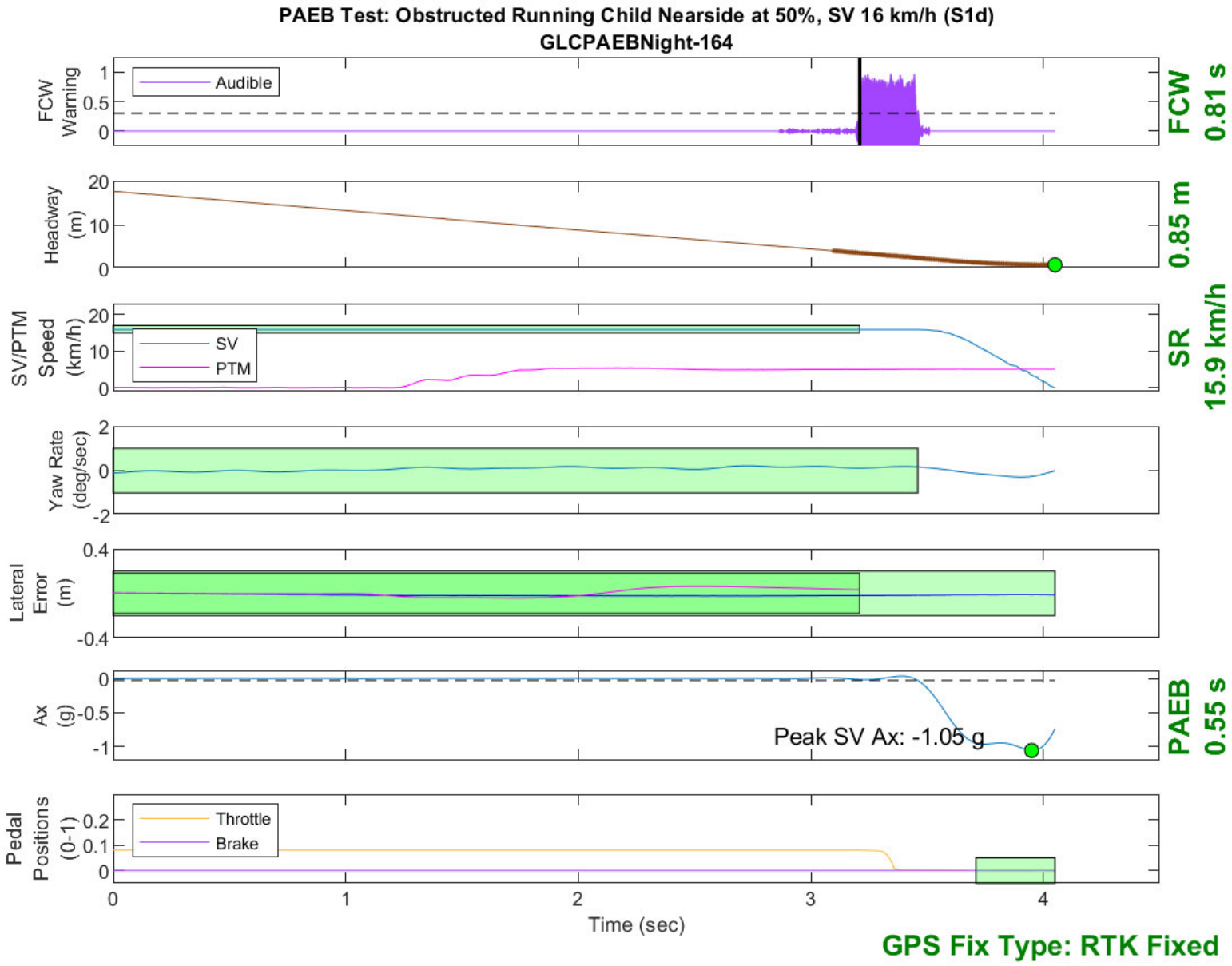

Figure D271. Time History for PAEB Run 164, S1d, Night, Low Beam, 16 km/h

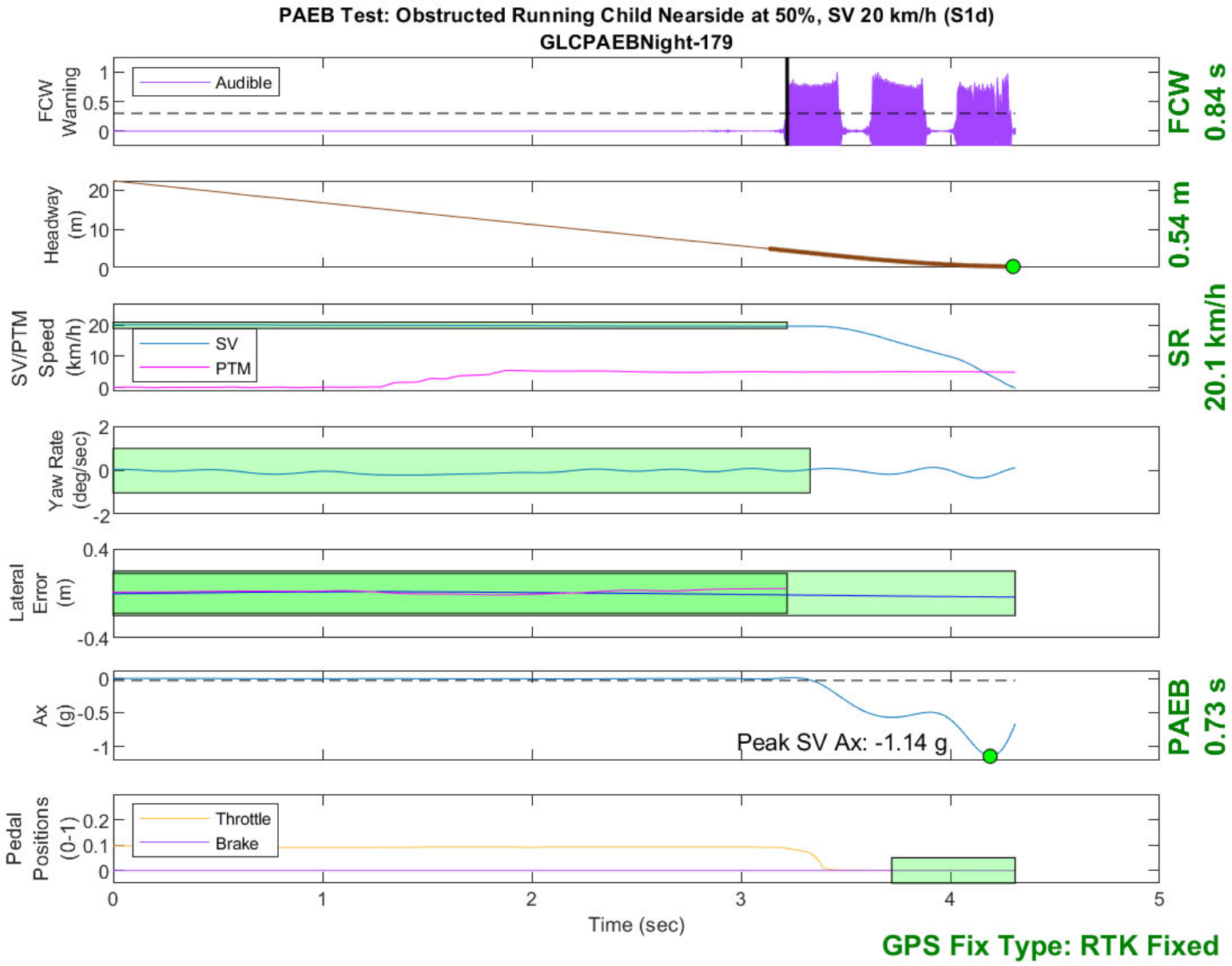

Figure D272. Time History for PAEB Run 179, S1d, Night, Low Beam, 20 km/h

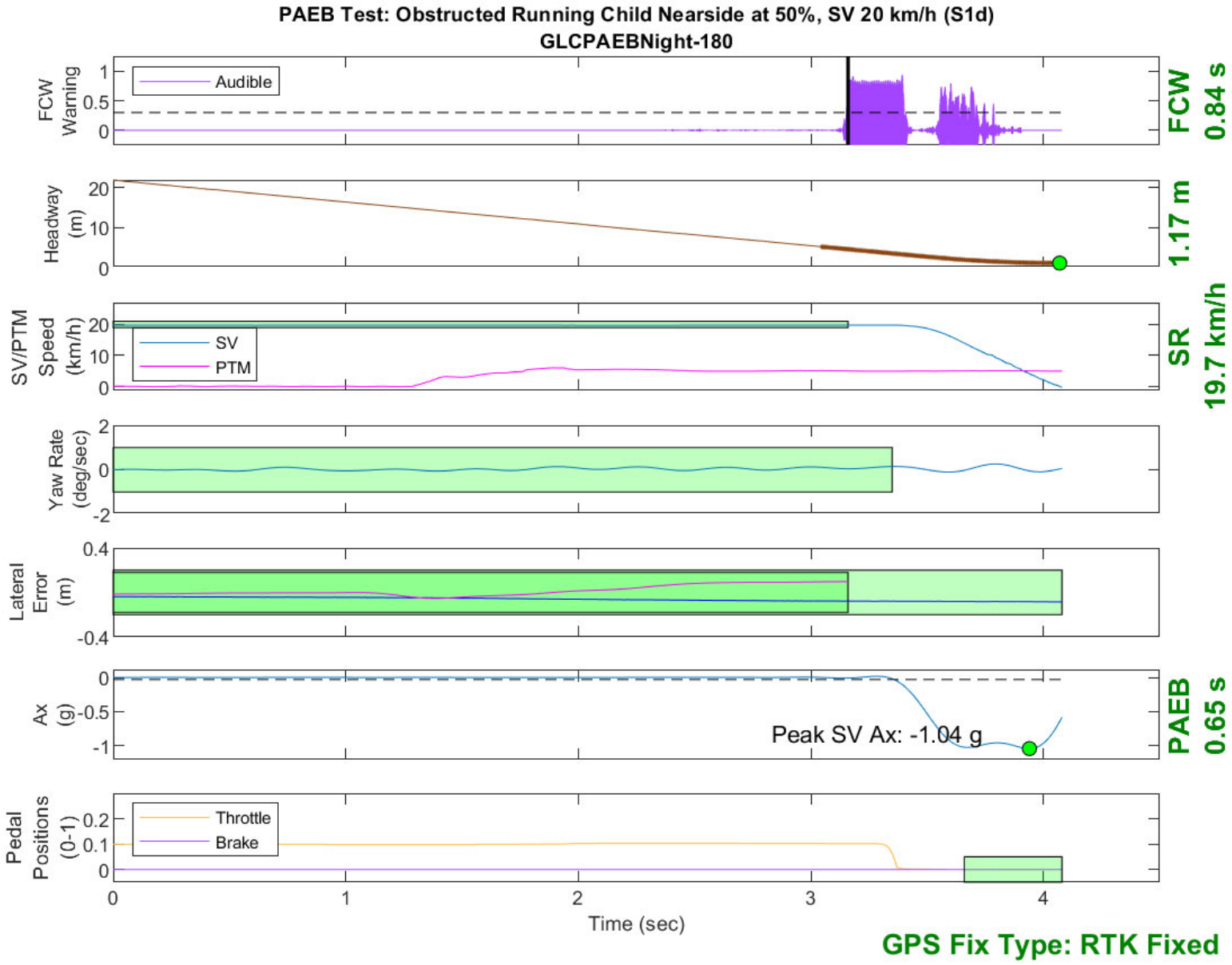

Figure D273. Time History for PAEB Run 180, S1d, Night, Low Beam, 20 km/h

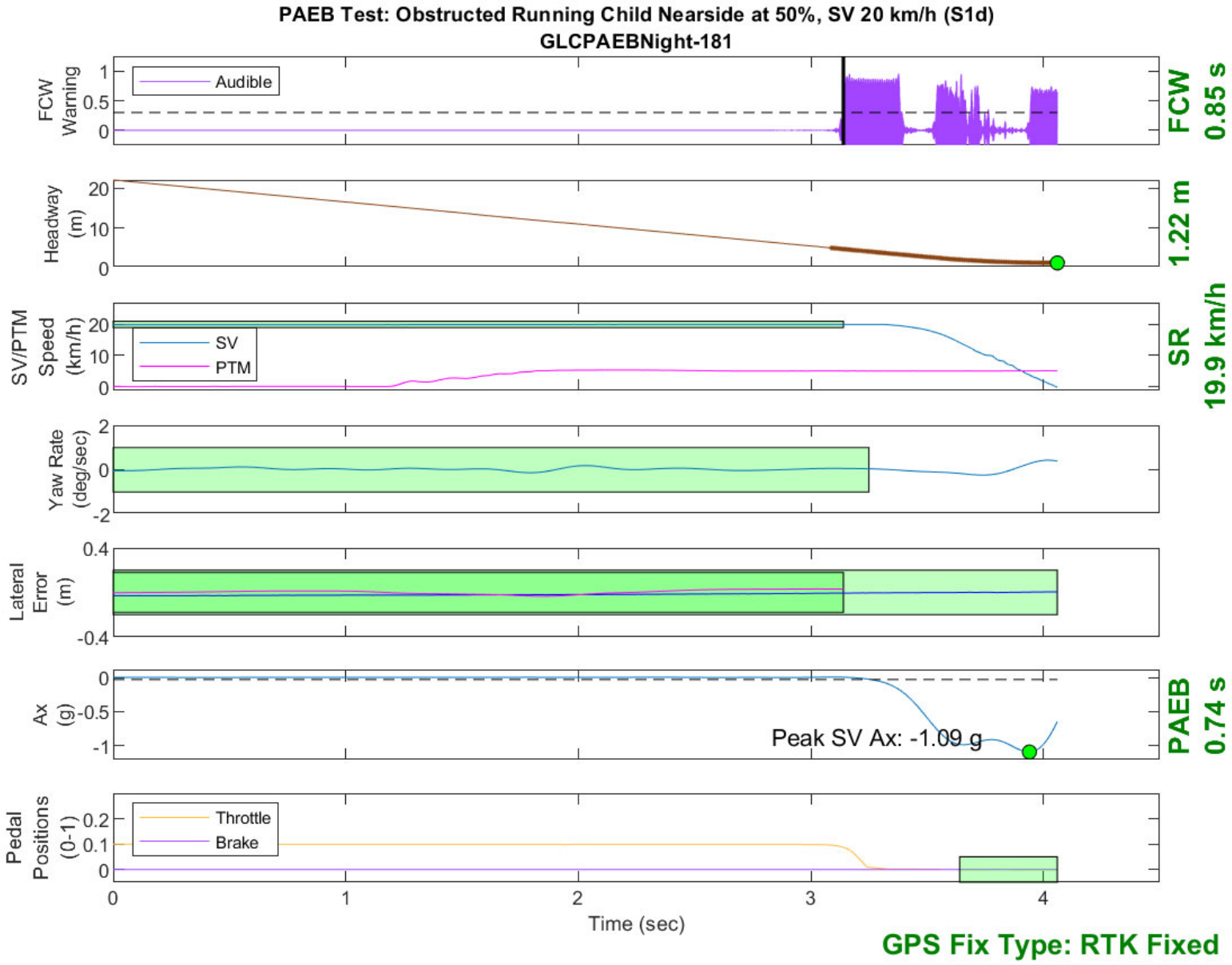

Figure D274. Time History for PAEB Run 181, S1d, Night, Low Beam, 20 km/h

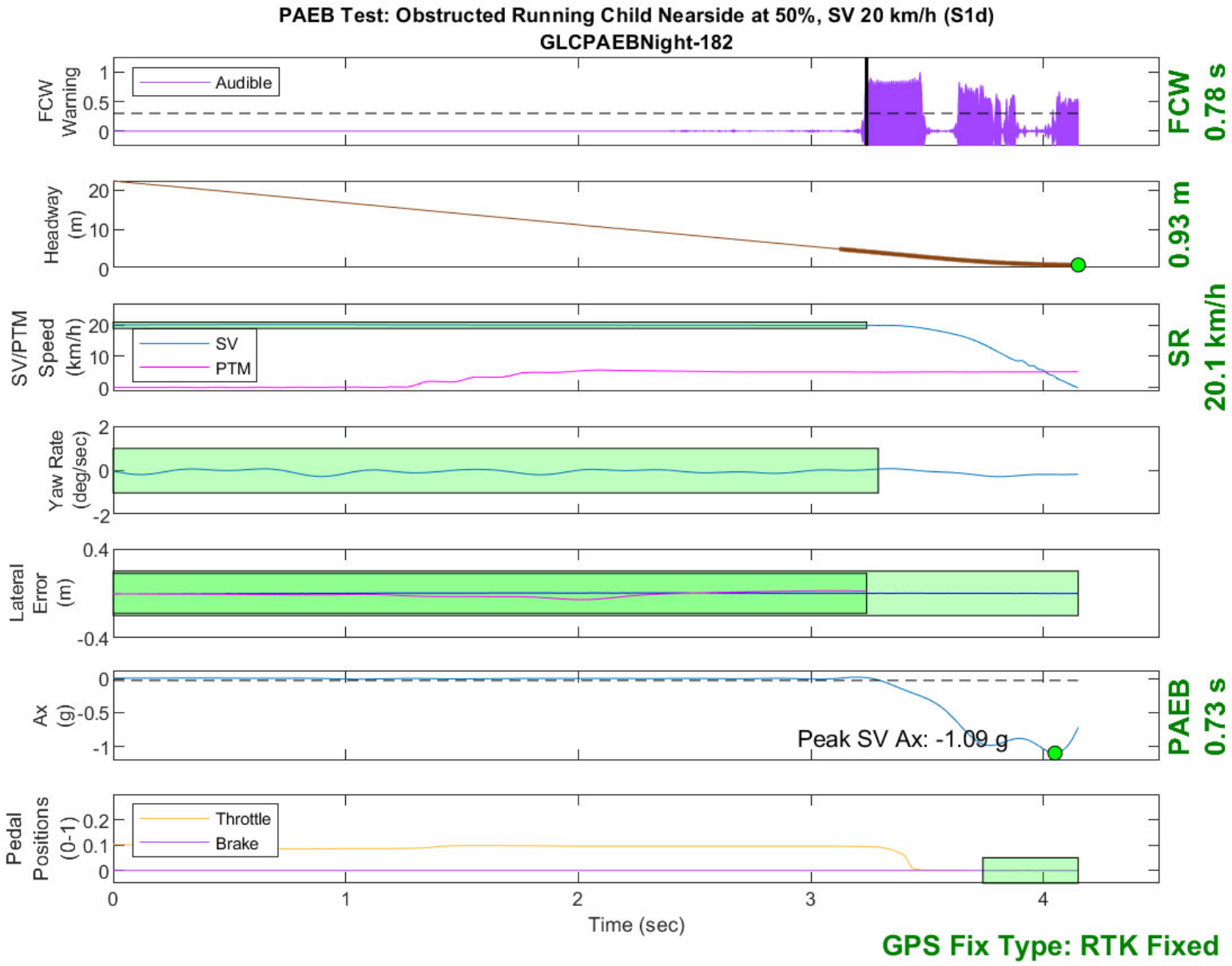

Figure D275. Time History for PAEB Run 182, S1d, Night, Low Beam, 20 km/h

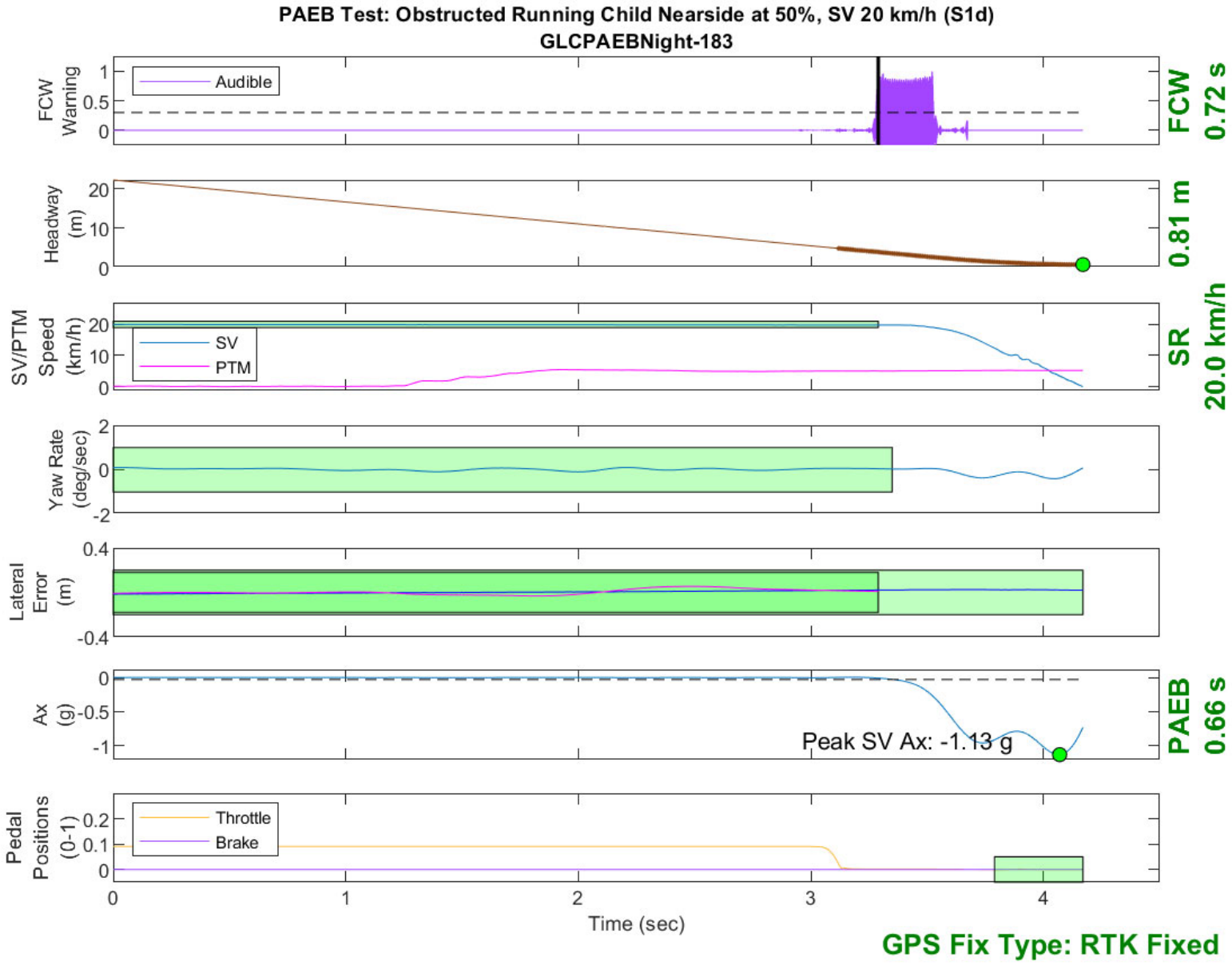

Figure D276. Time History for PAEB Run 183, S1d, Night, Low Beam, 20 km/h

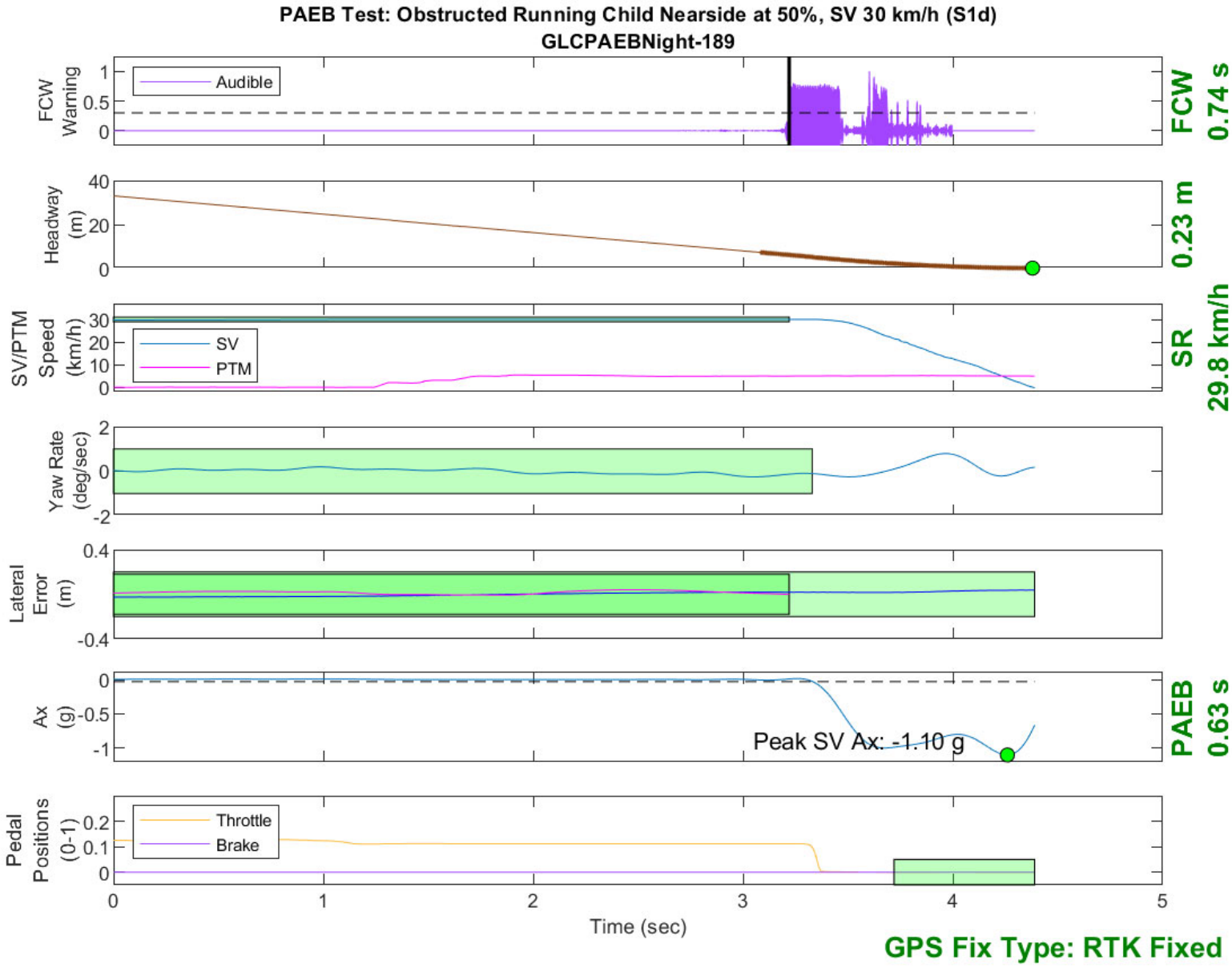

Figure D277. Time History for PAEB Run 189, S1d, Night, Low Beam, 30 km/h

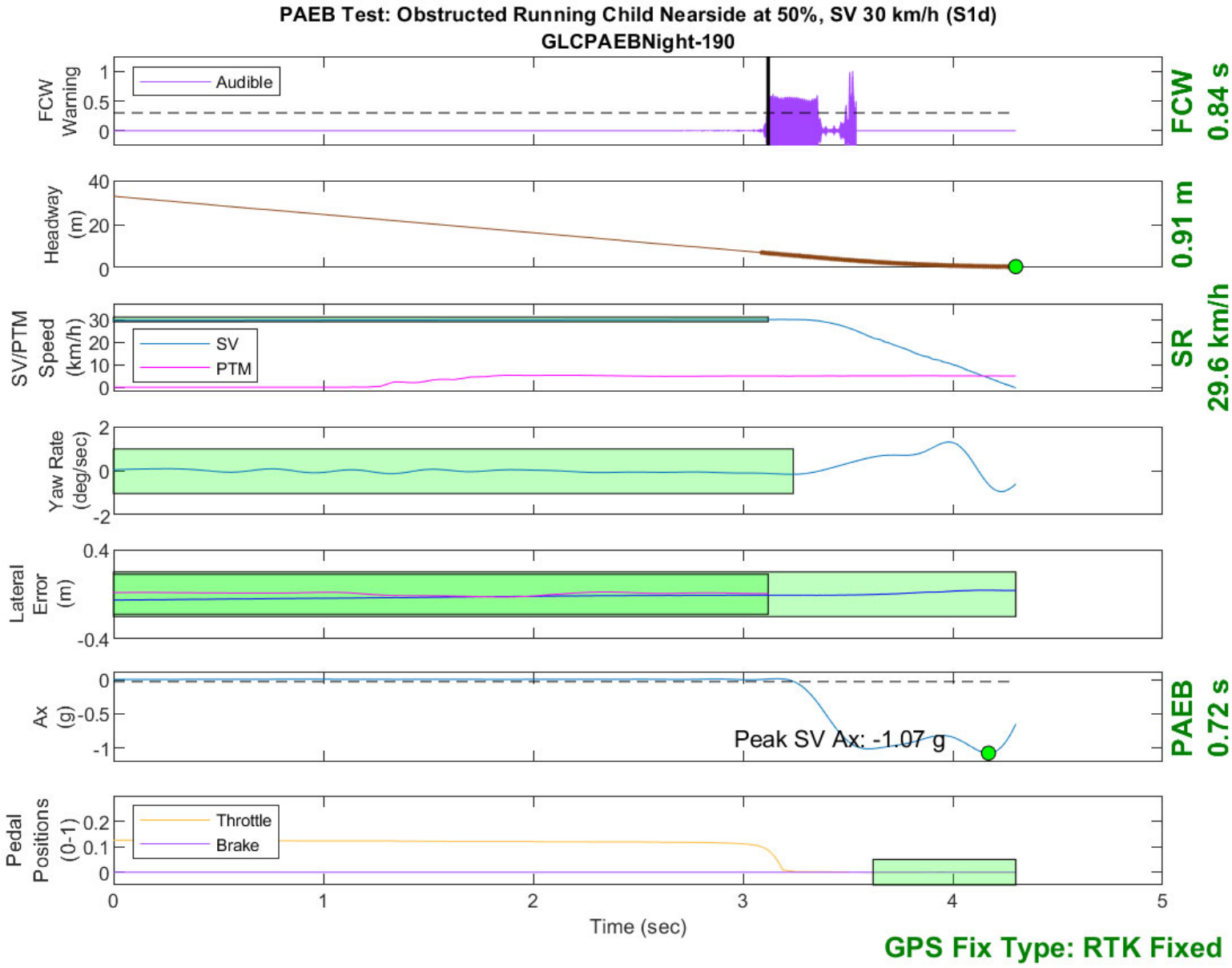

Figure D278. Time History for PAEB Run 190, S1d, Night, Low Beam, 30 km/h

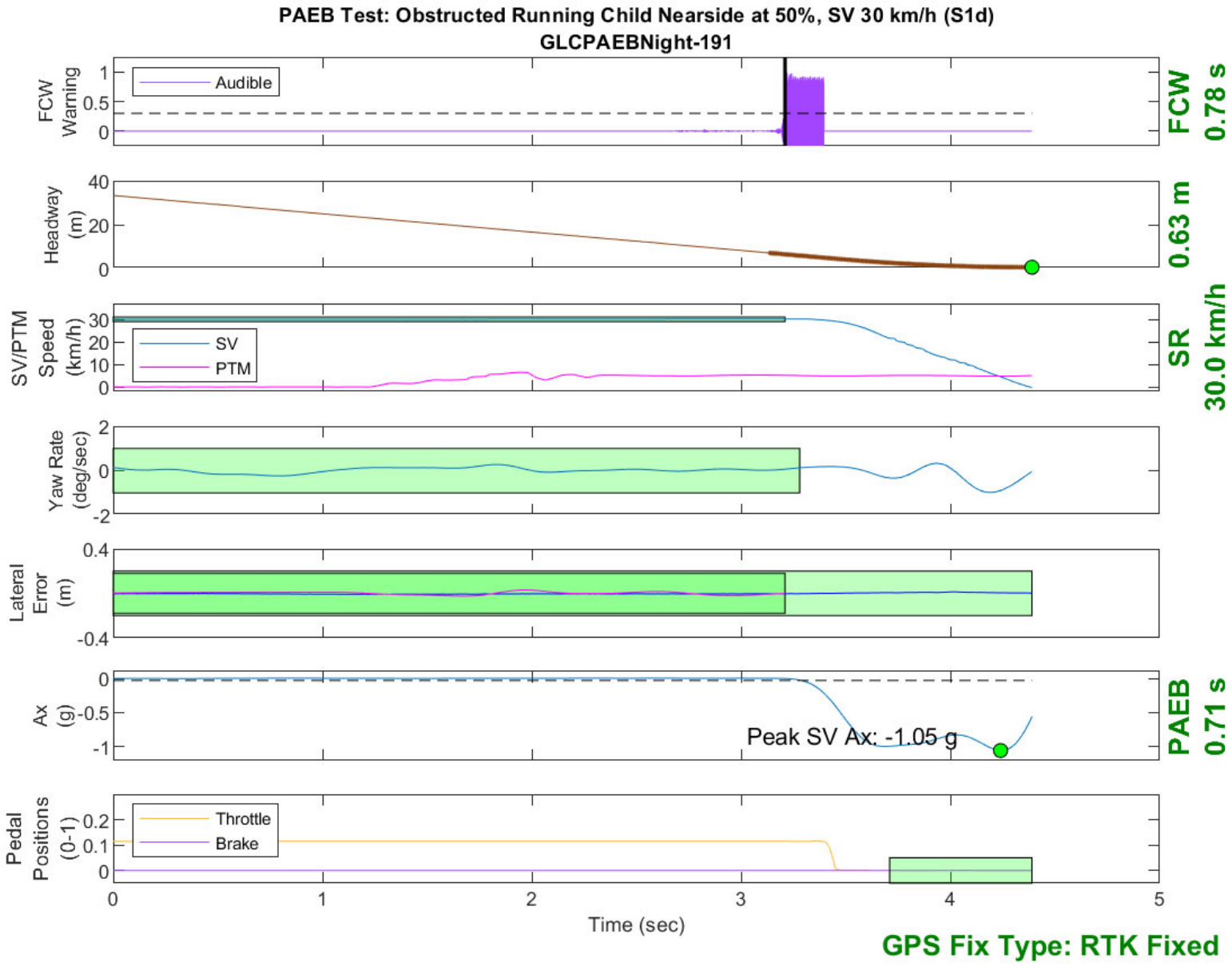

Figure D279. Time History for PAEB Run 191, S1d, Night, Low Beam, 30 km/h

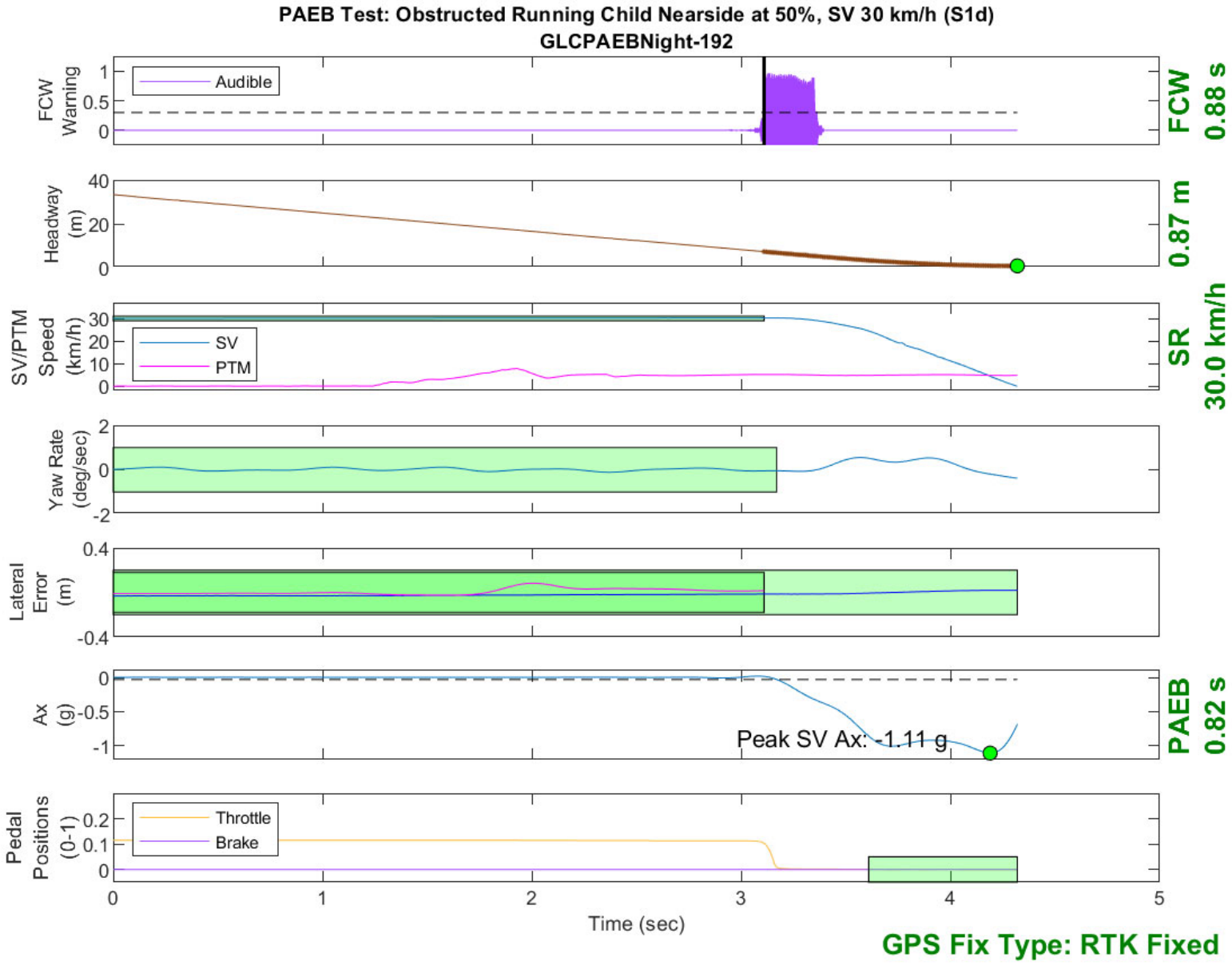

Figure D280. Time History for PAEB Run 192, S1d, Night, Low Beam, 30 km/h

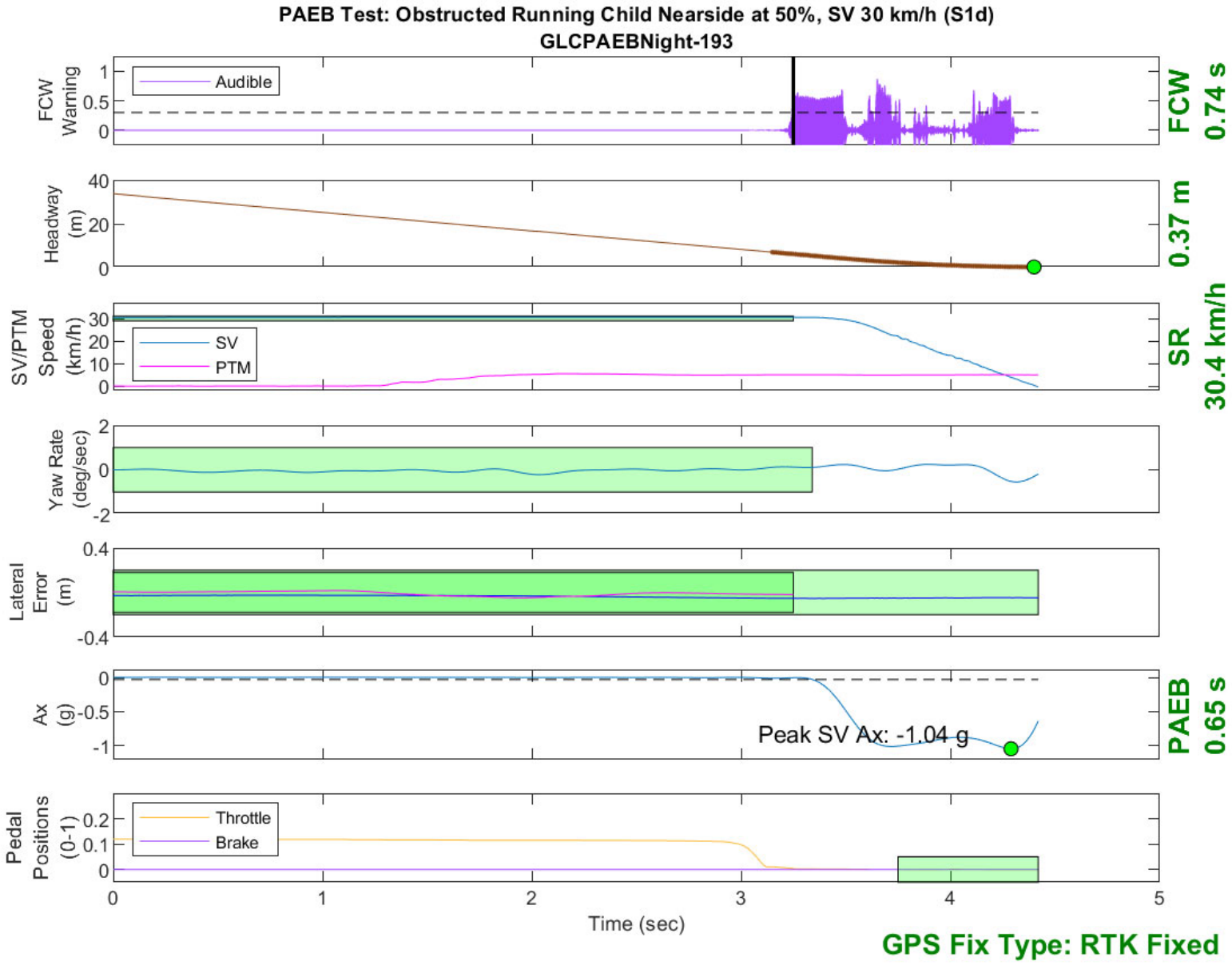

Figure D281. Time History for PAEB Run 193, S1d, Night, Low Beam, 30 km/h

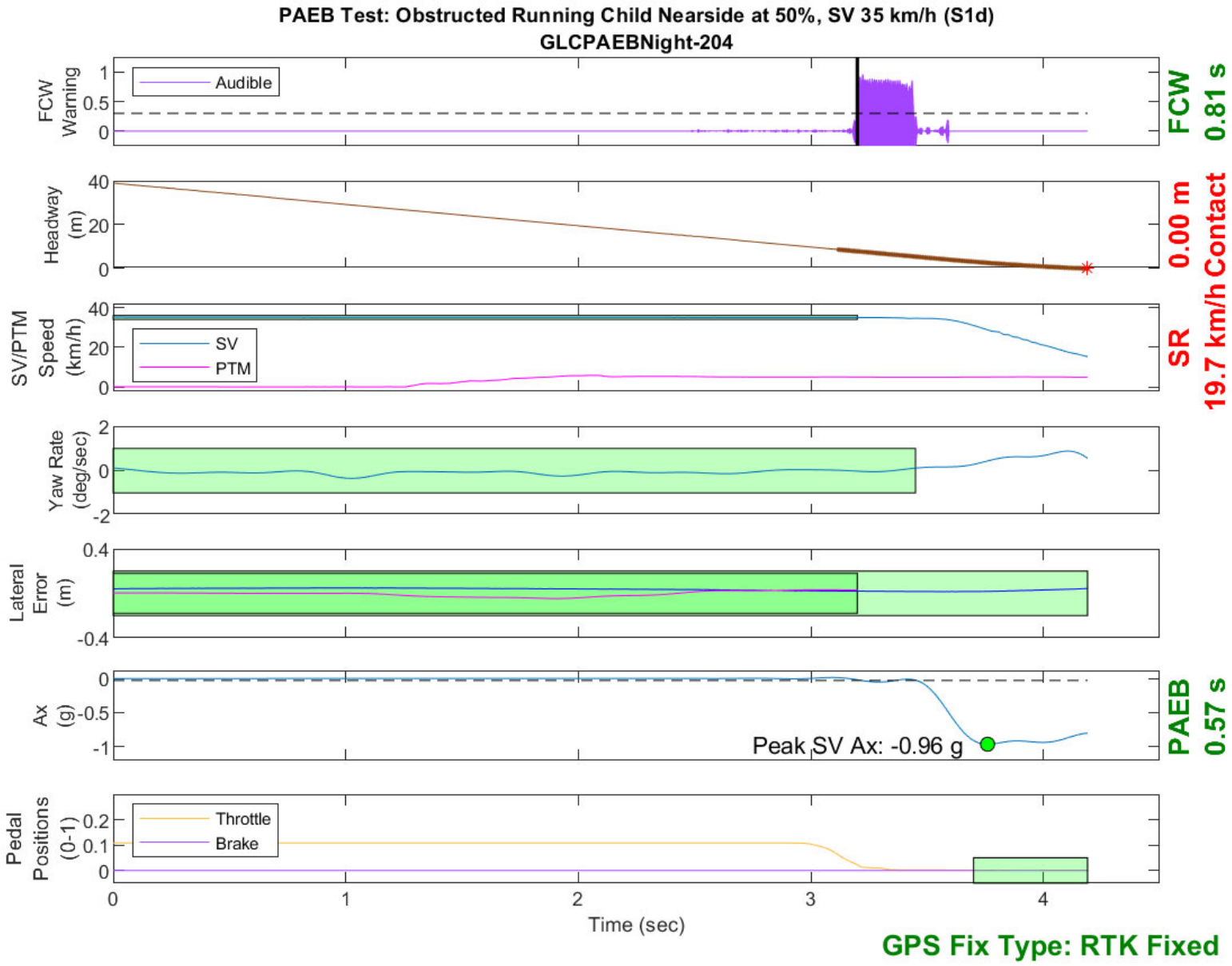

Figure D282. Time History for PAEB Run 204, S1d, Night, Low Beam, 35 km/h

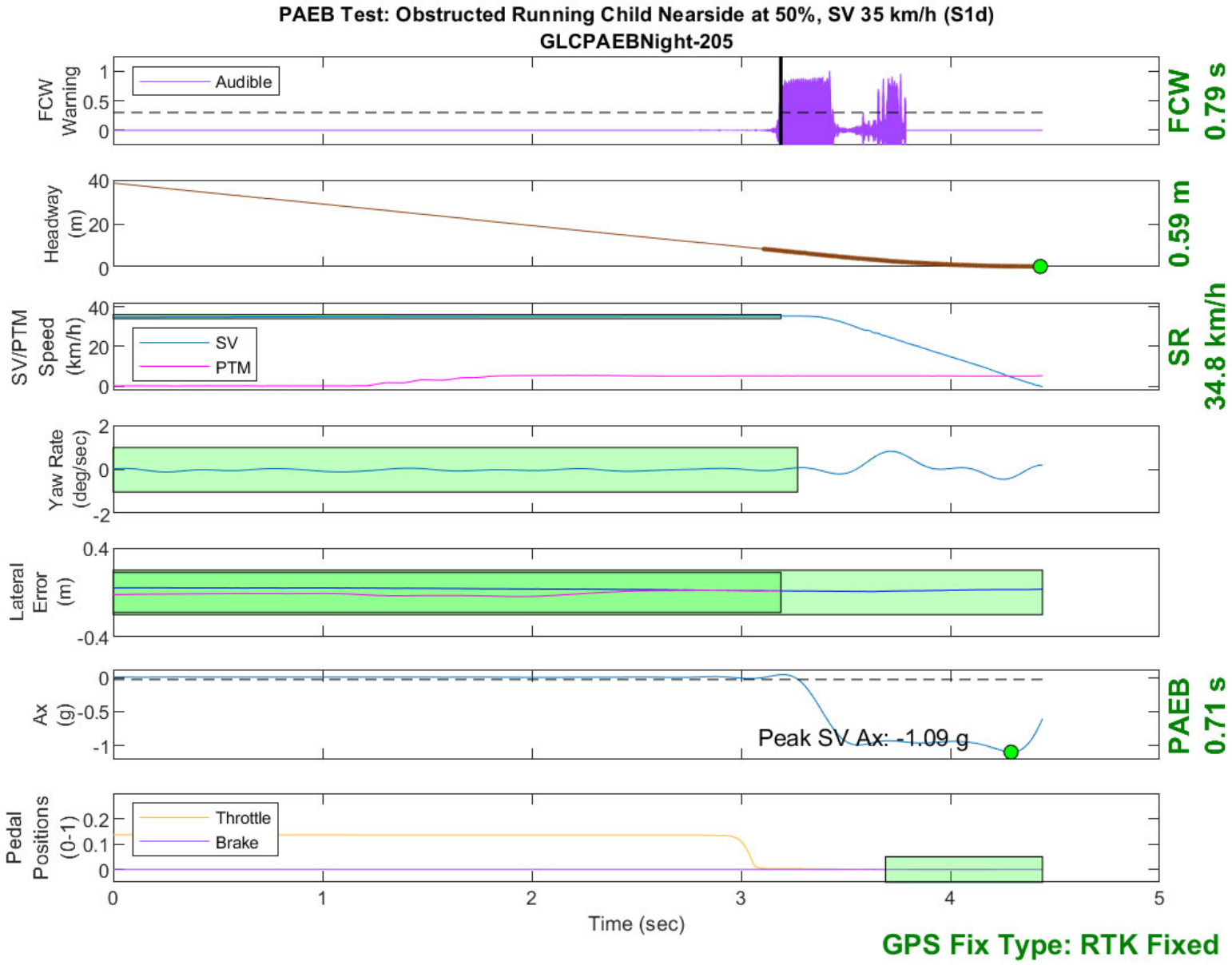

Figure D283. Time History for PAEB Run 205, S1d, Night, Low Beam, 35 km/h

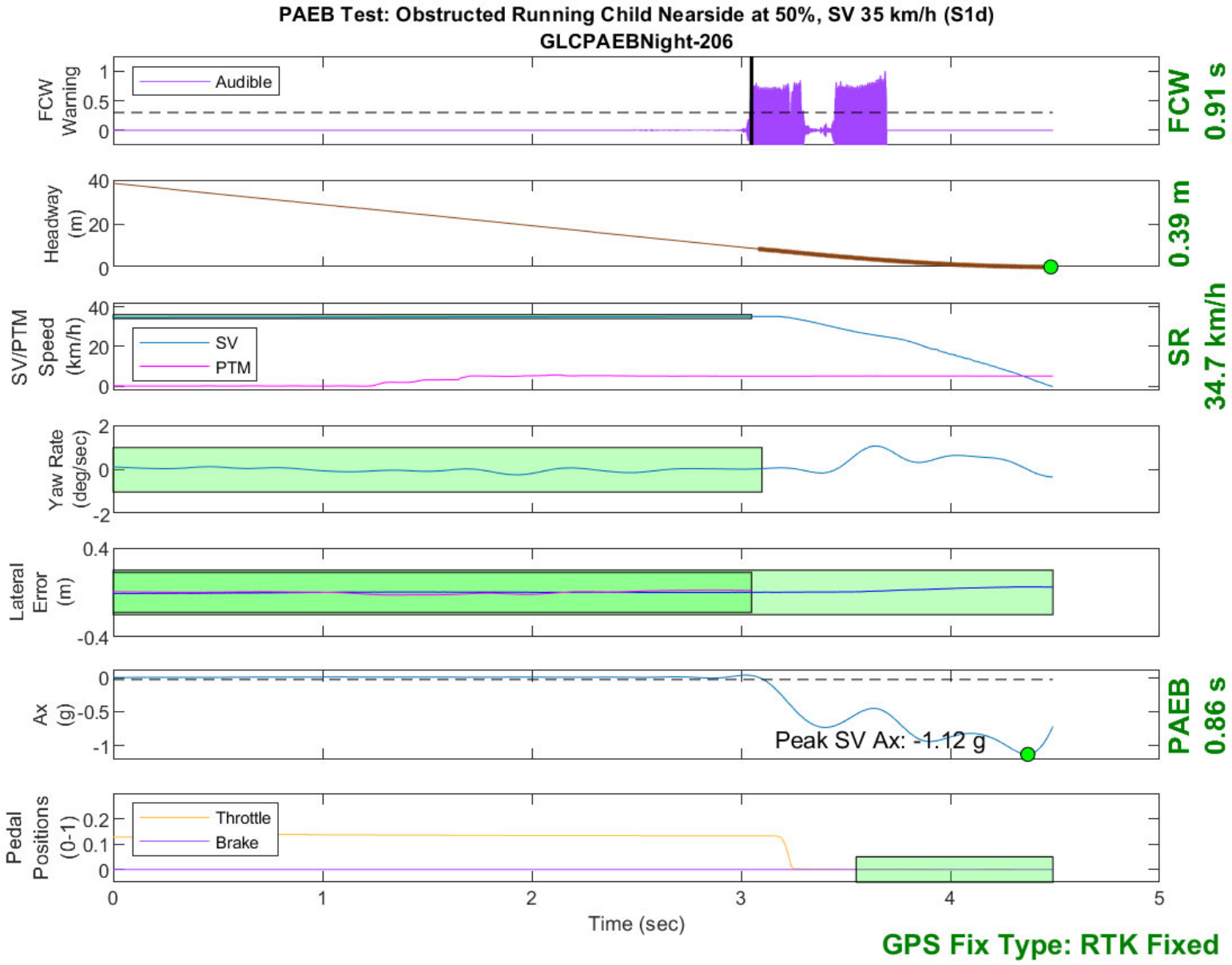

Figure D284. Time History for PAEB Run 206, S1d, Night, Low Beam, 35 km/h

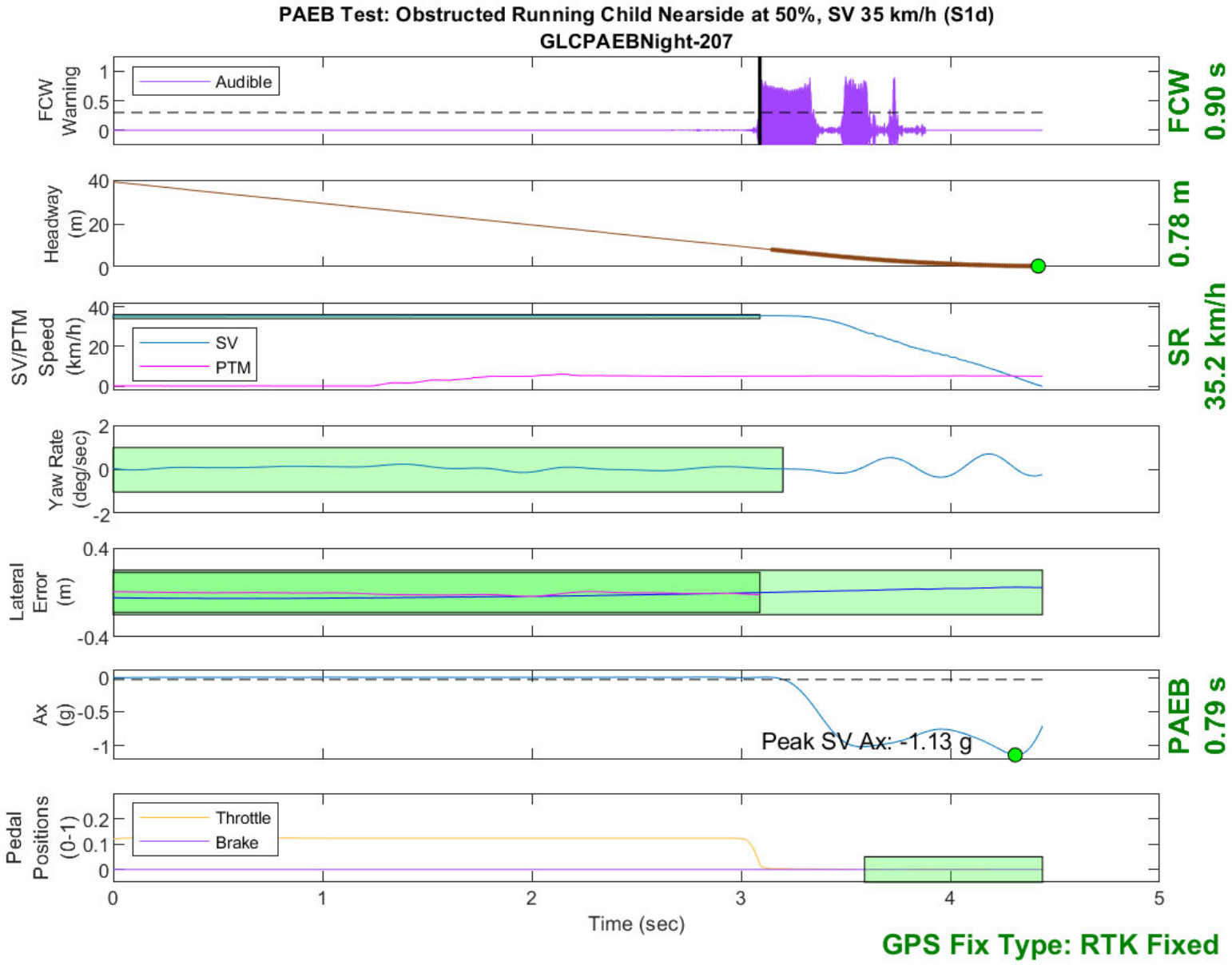

Figure D285. Time History for PAEB Run 207, S1d, Night, Low Beam, 35 km/h

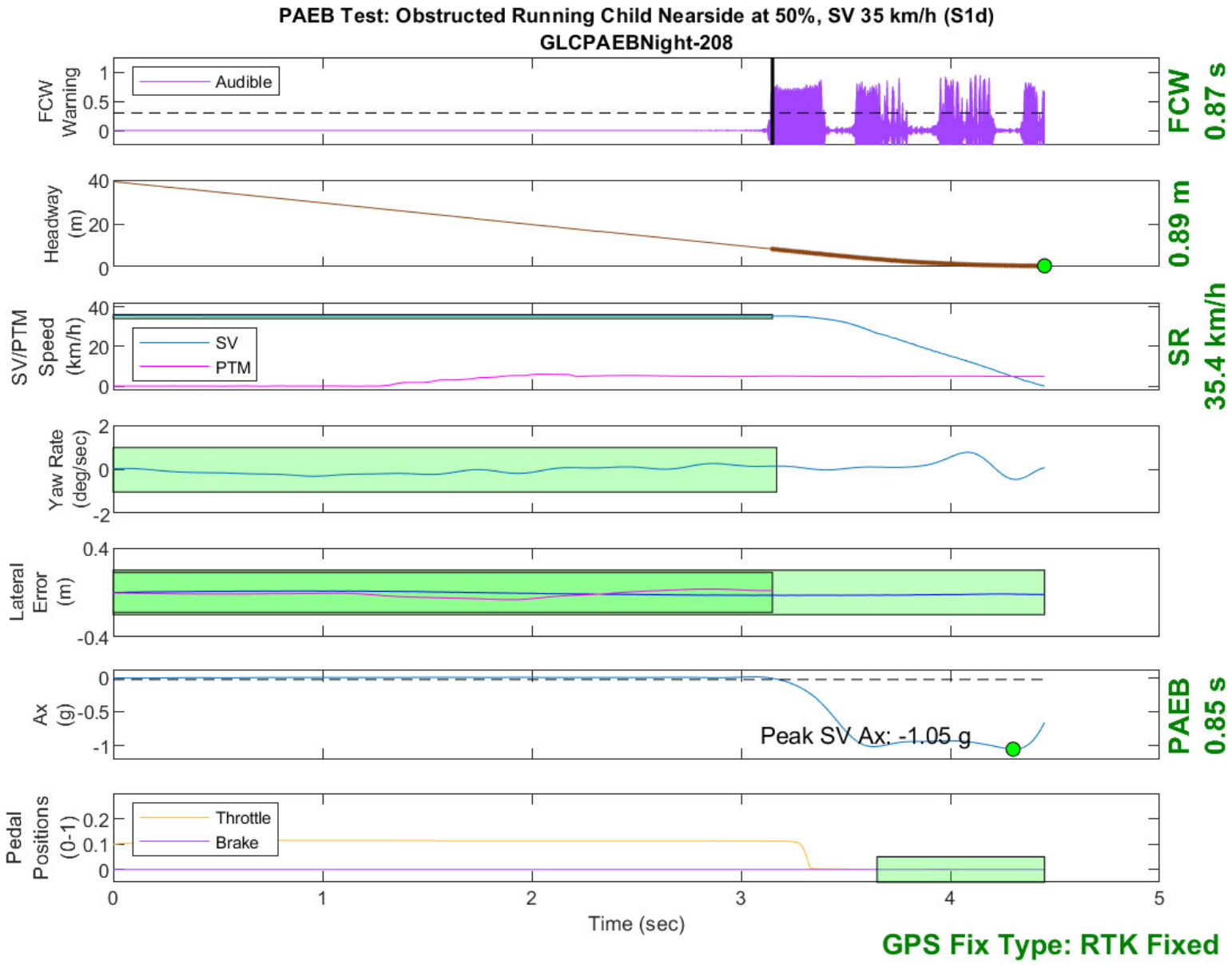

Figure D286. Time History for PAEB Run 208, S1d, Night, Low Beam, 35 km/h

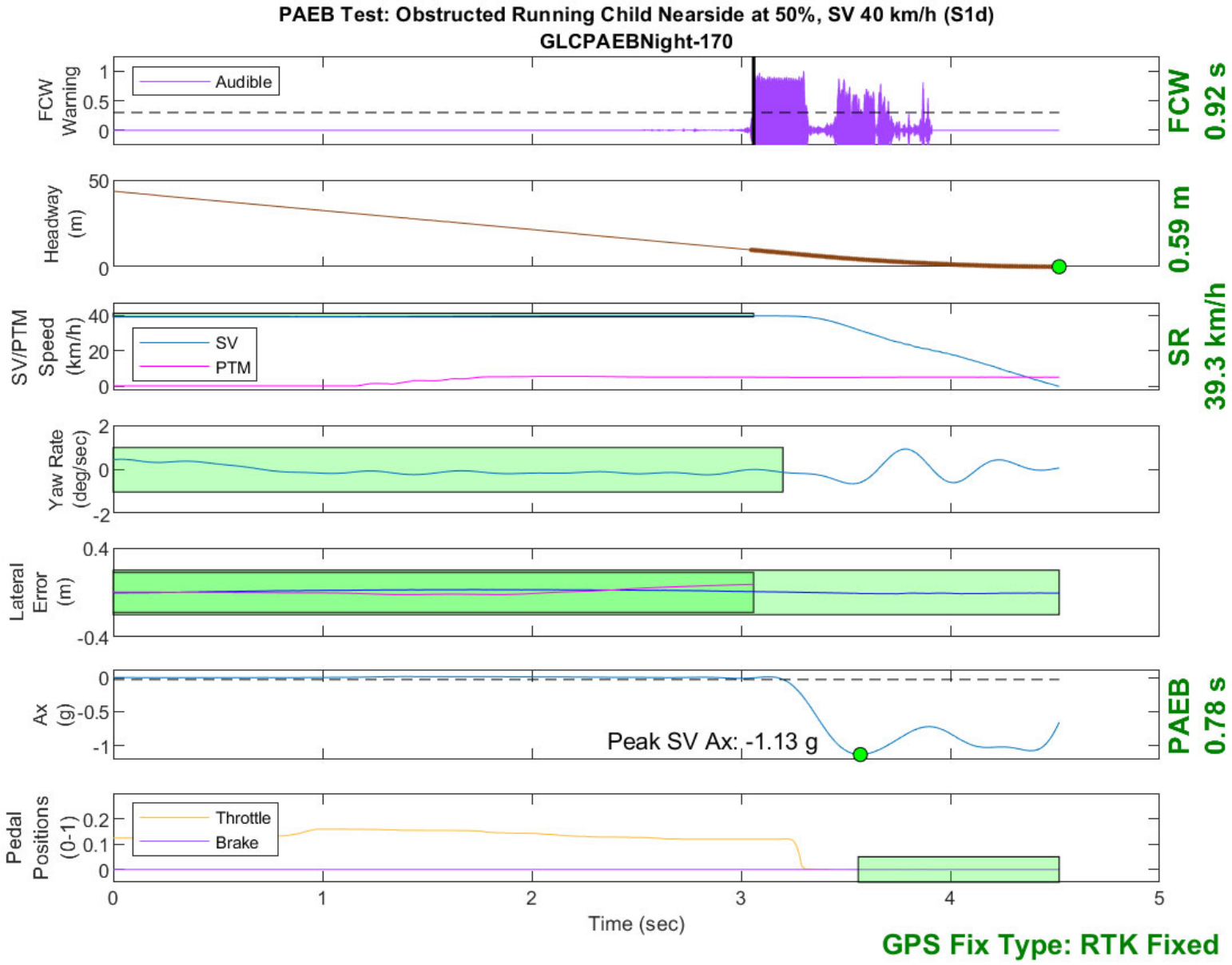

Figure D287. Time History for PAEB Run 170, S1d, Night, Low Beam, 40 km/h

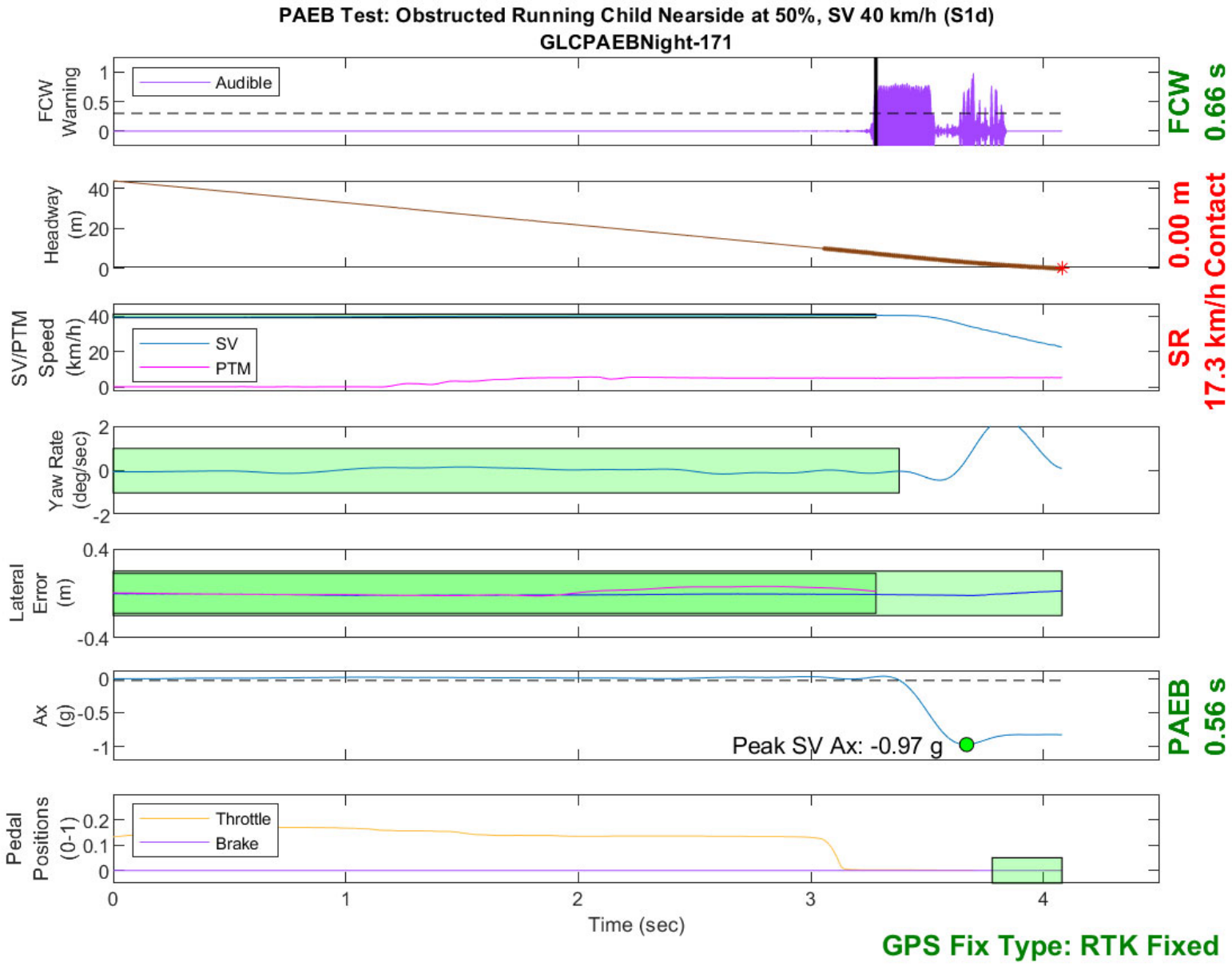

Figure D288. Time History for PAEB Run 171, S1d, Night, Low Beam, 40 km/h

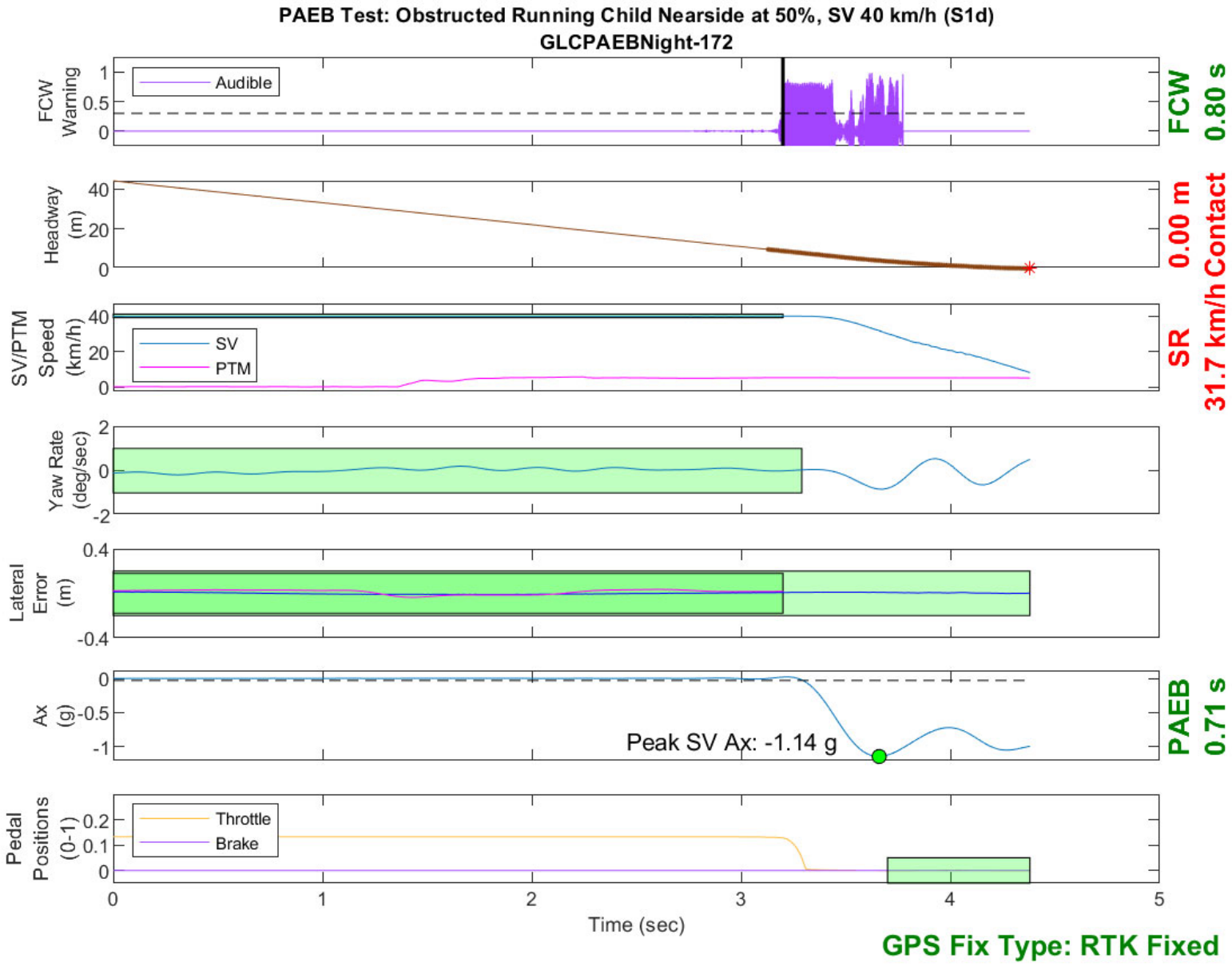

Figure D289. Time History for PAEB Run 172, S1d, Night, Low Beam, 40 km/h

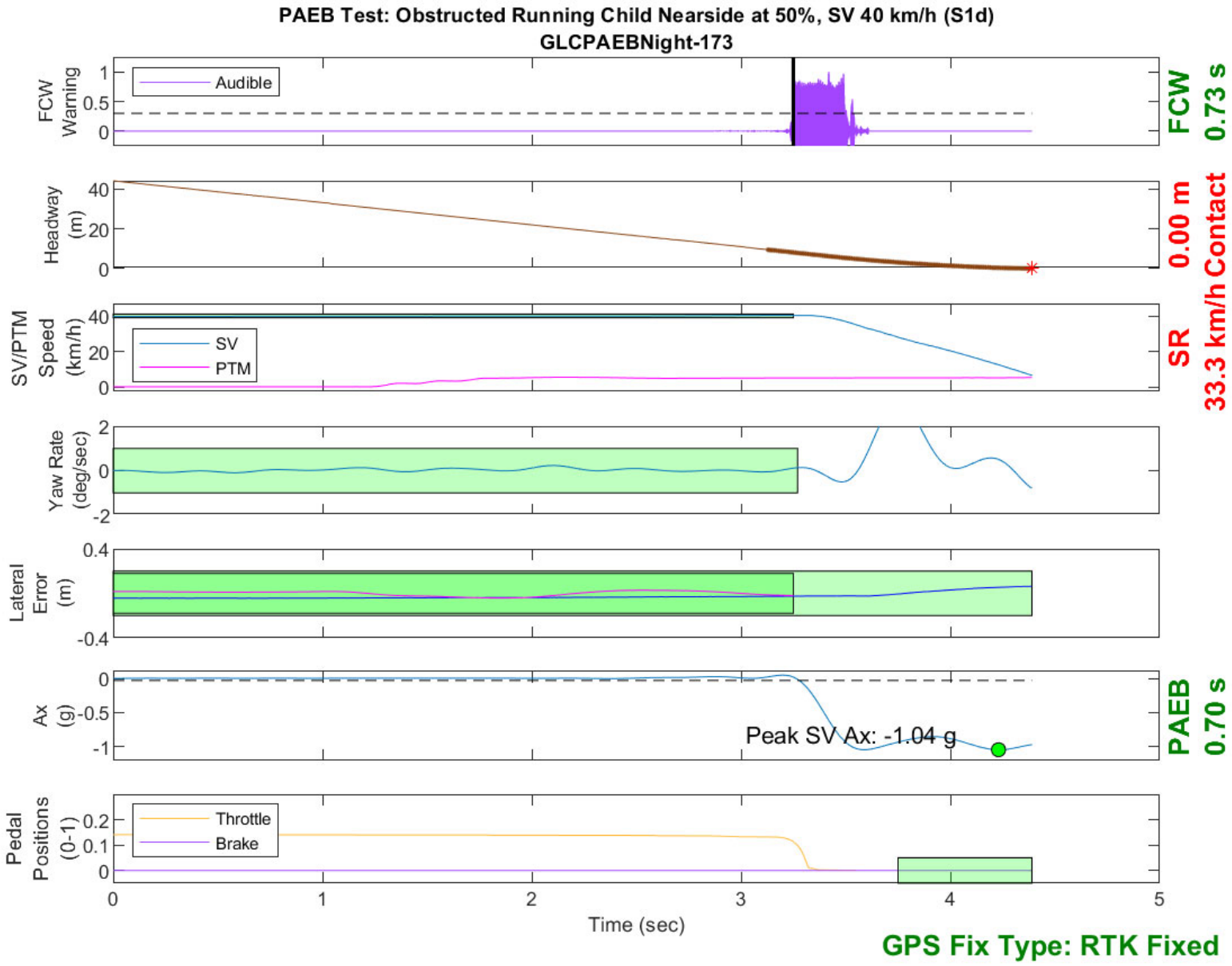

Figure D290. Time History for PAEB Run 173, S1d, Night, Low Beam, 40 km/h

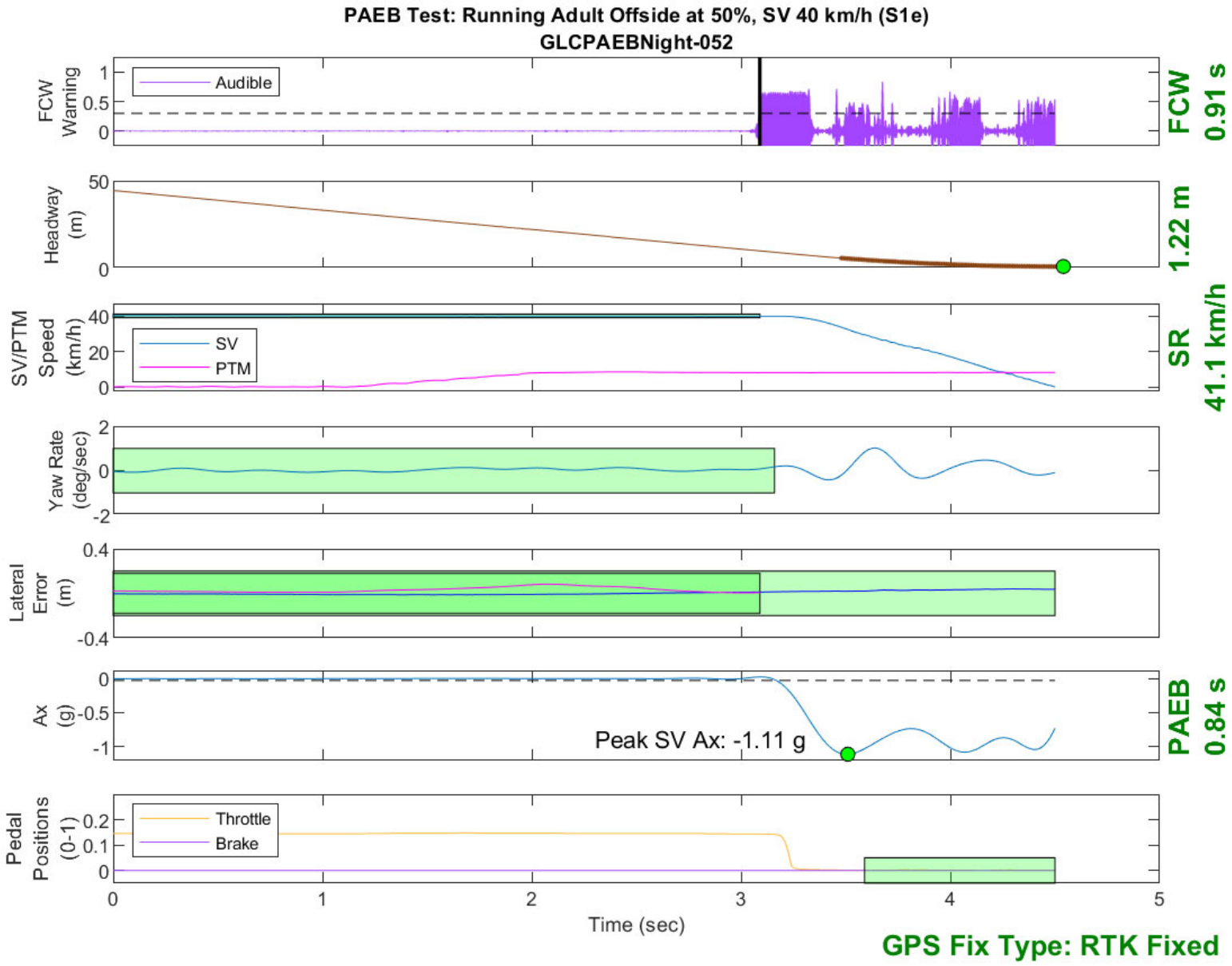

Figure D291. Time History for PAEB Run 52, S1e, Night, Low Beam, 40 km/h

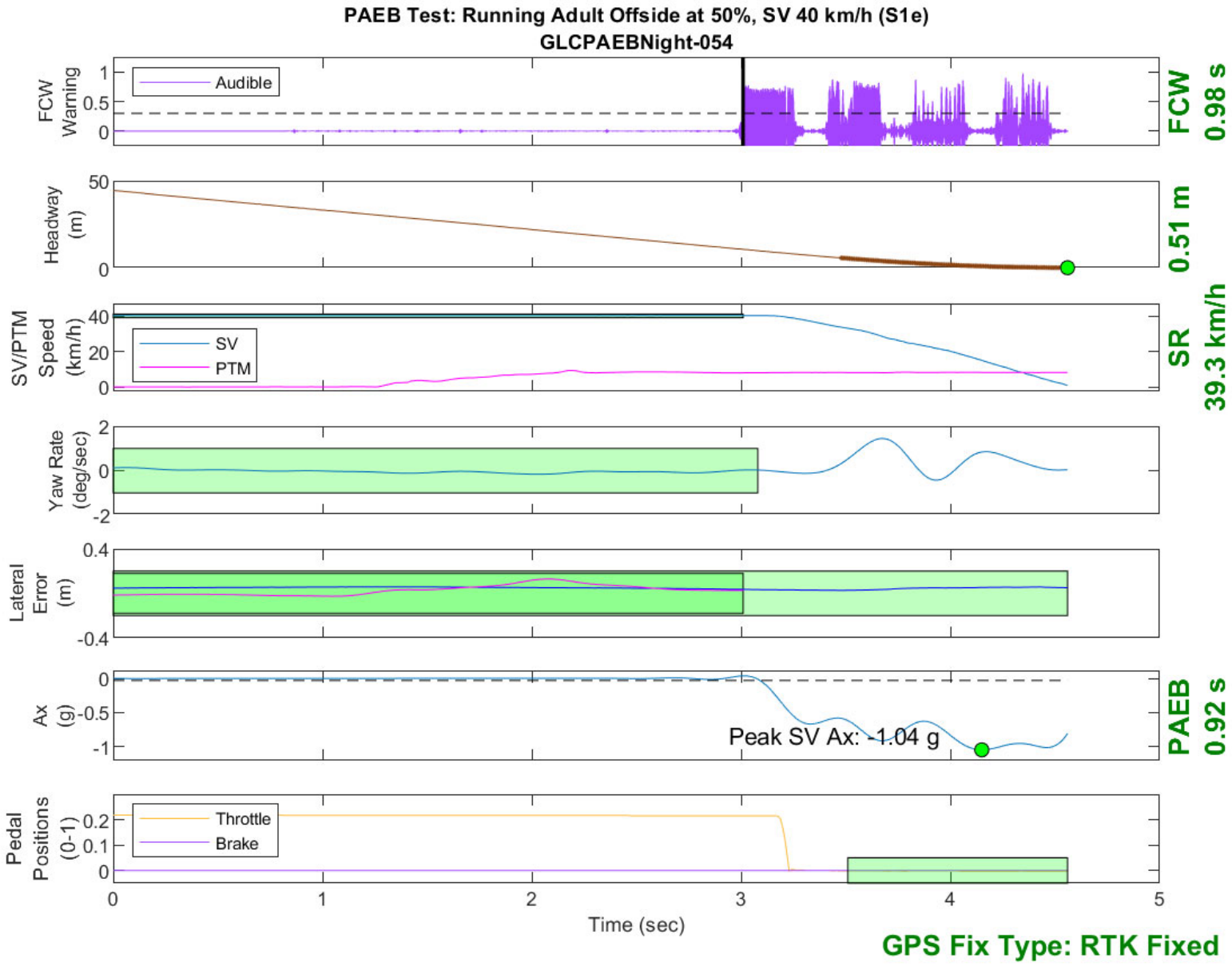

Figure D292. Time History for PAEB Run 54, S1e, Night, Low Beam, 40 km/h

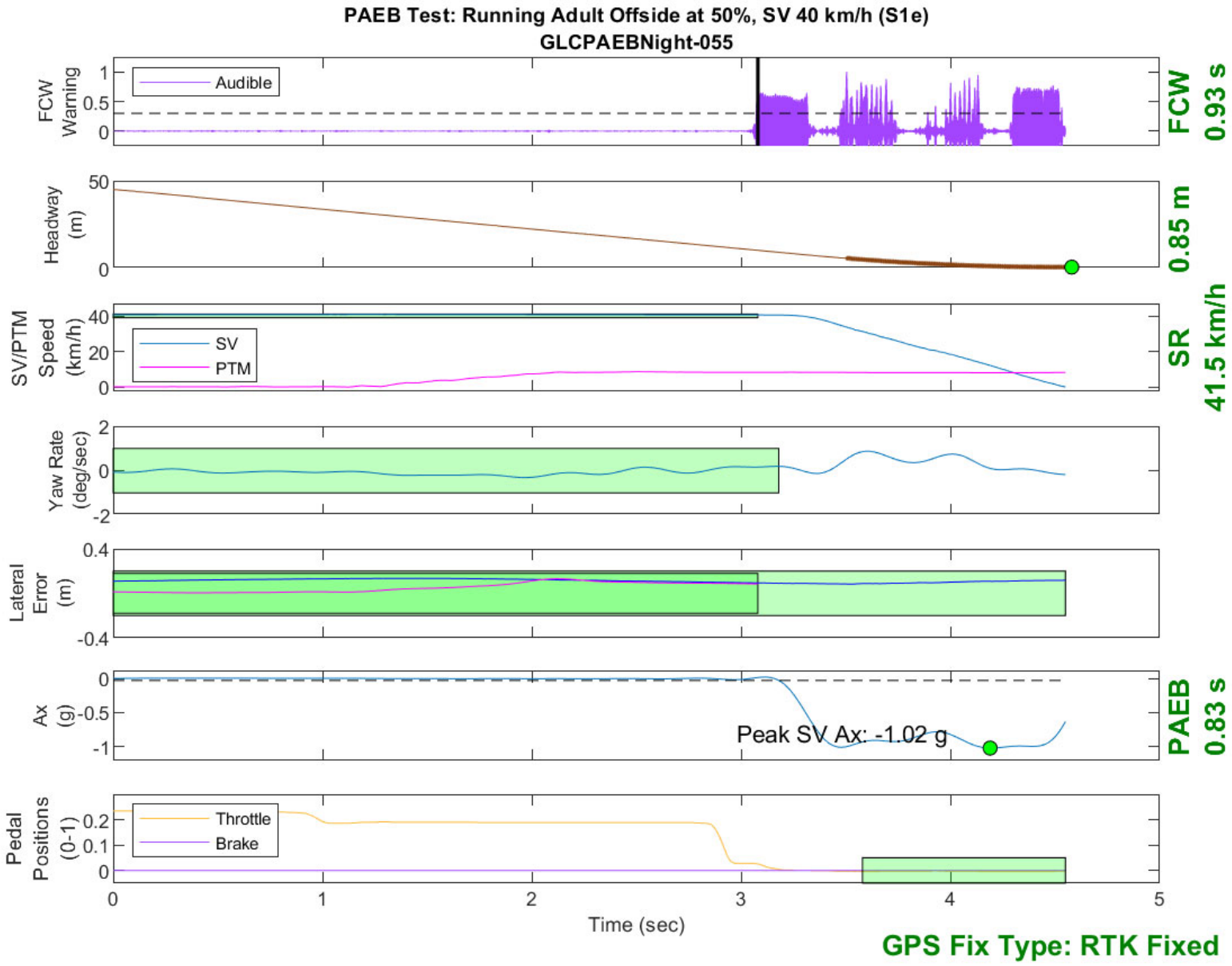

Figure D293. Time History for PAEB Run 55, S1e, Night, Low Beam, 40 km/h

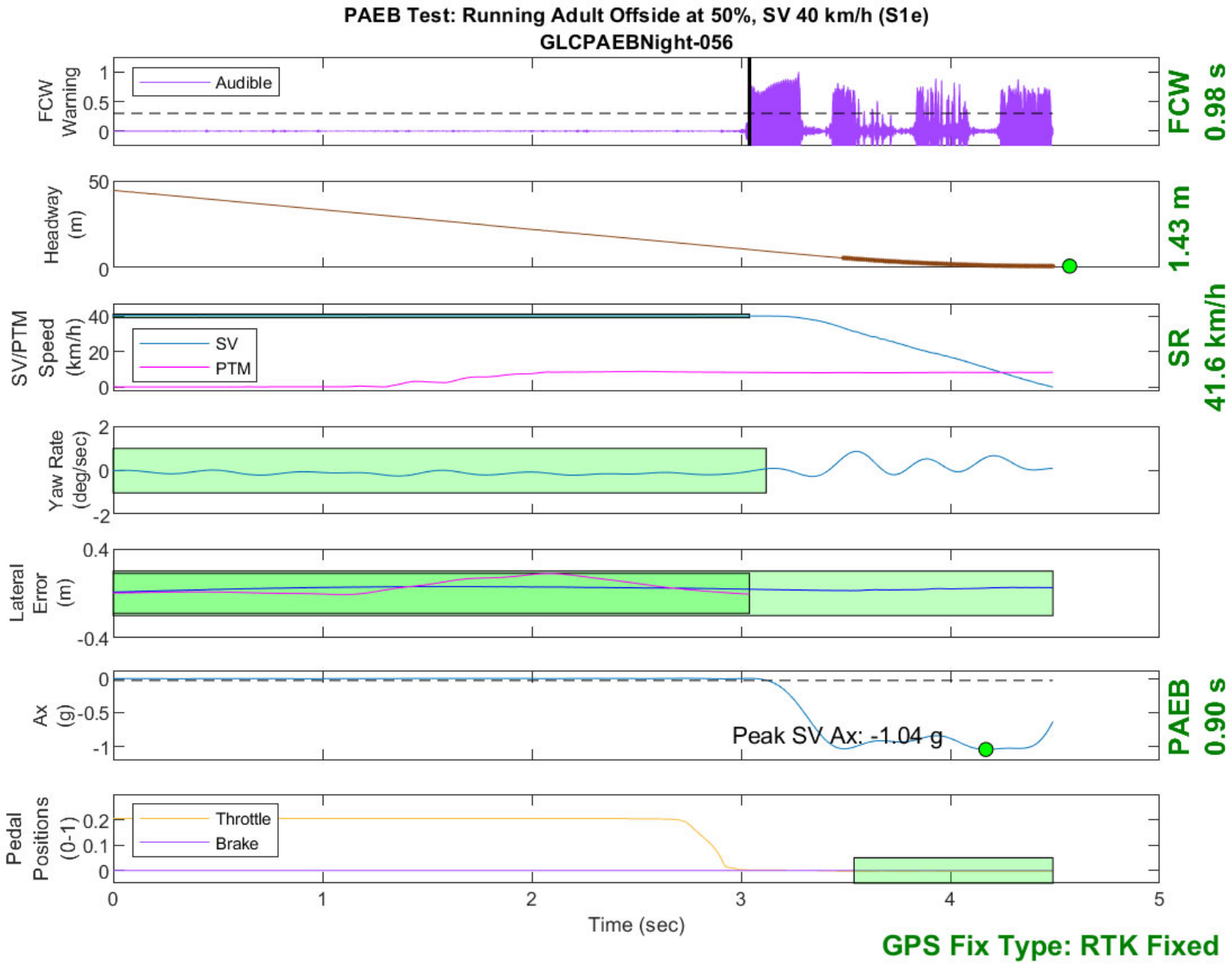

Figure D294. Time History for PAEB Run 56, S1e, Night, Low Beam, 40 km/h

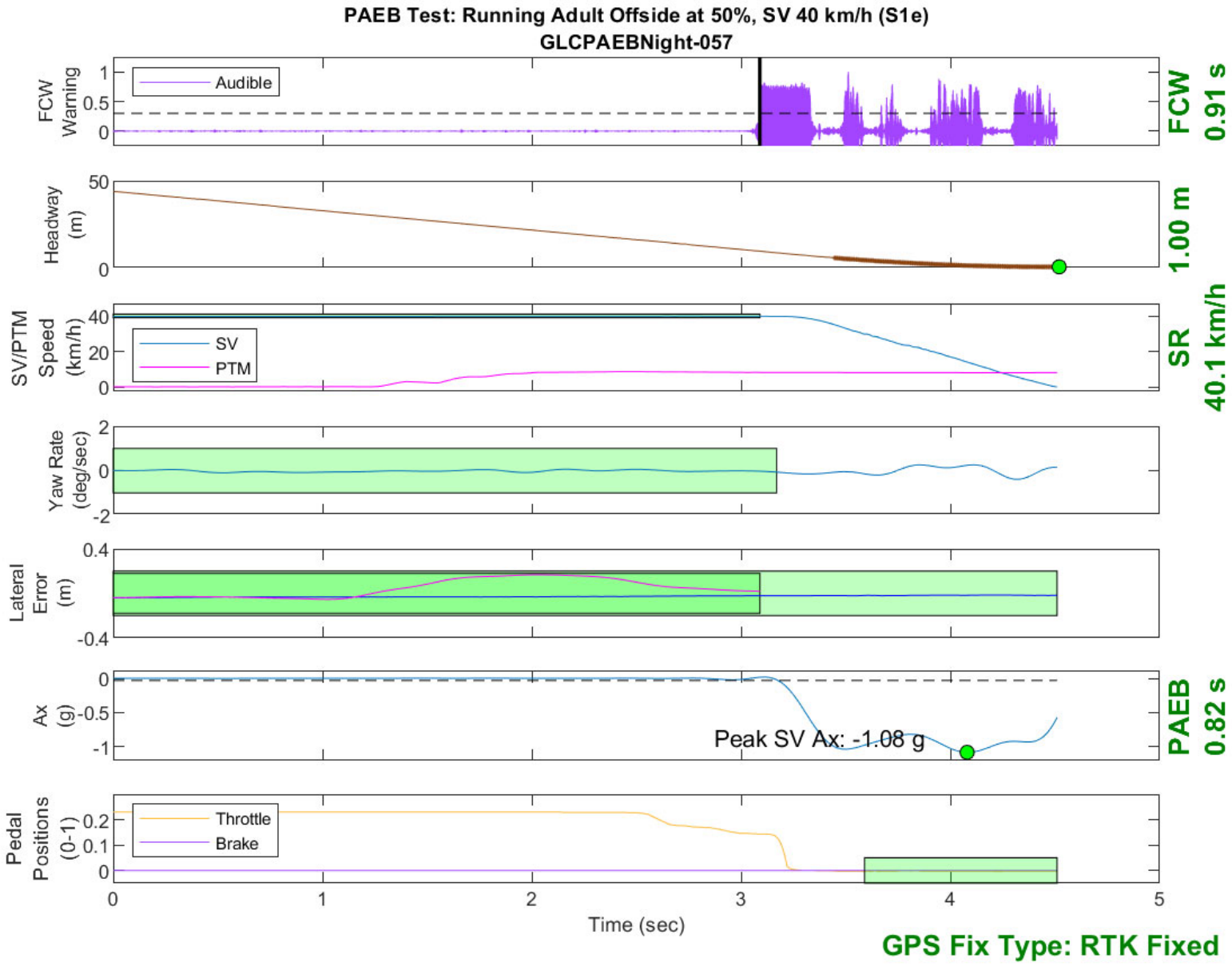

Figure D295. Time History for PAEB Run 57, S1e, Night, Low Beam, 40 km/h

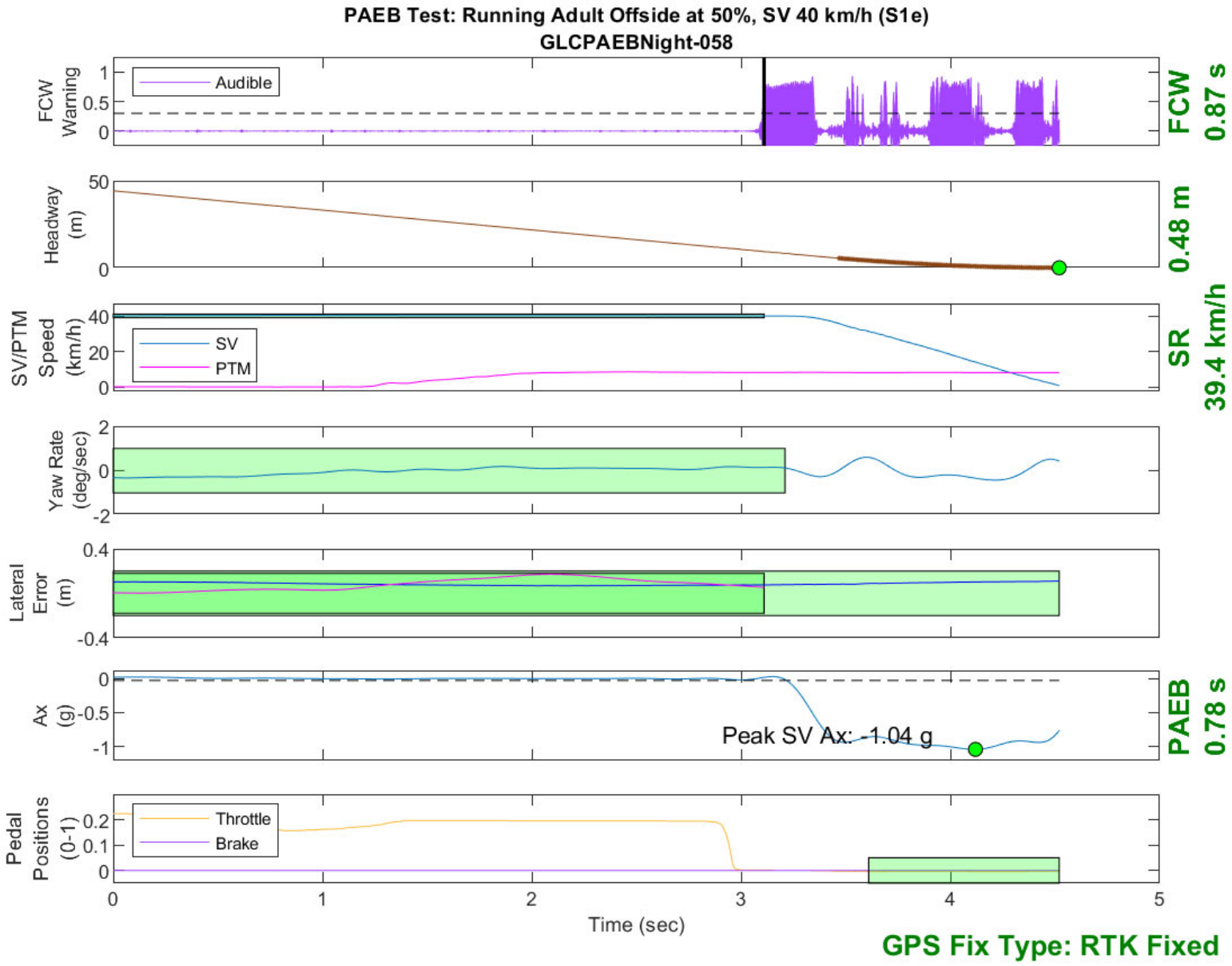

Figure D296. Time History for PAEB Run 58, S1e, Night, Low Beam, 40 km/h

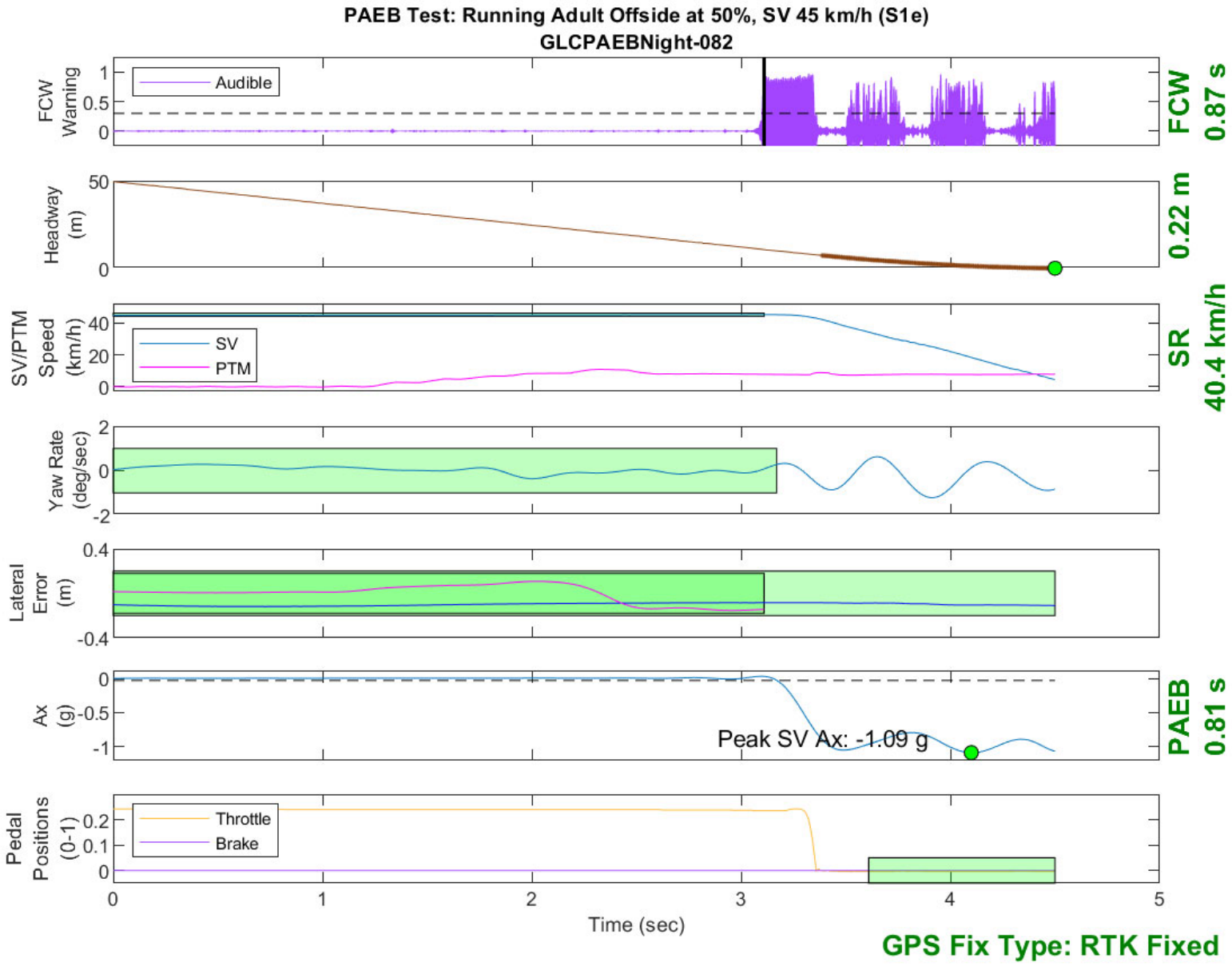

Figure D297. Time History for PAEB Run 82, S1e, Night, Low Beam, 45 km/h

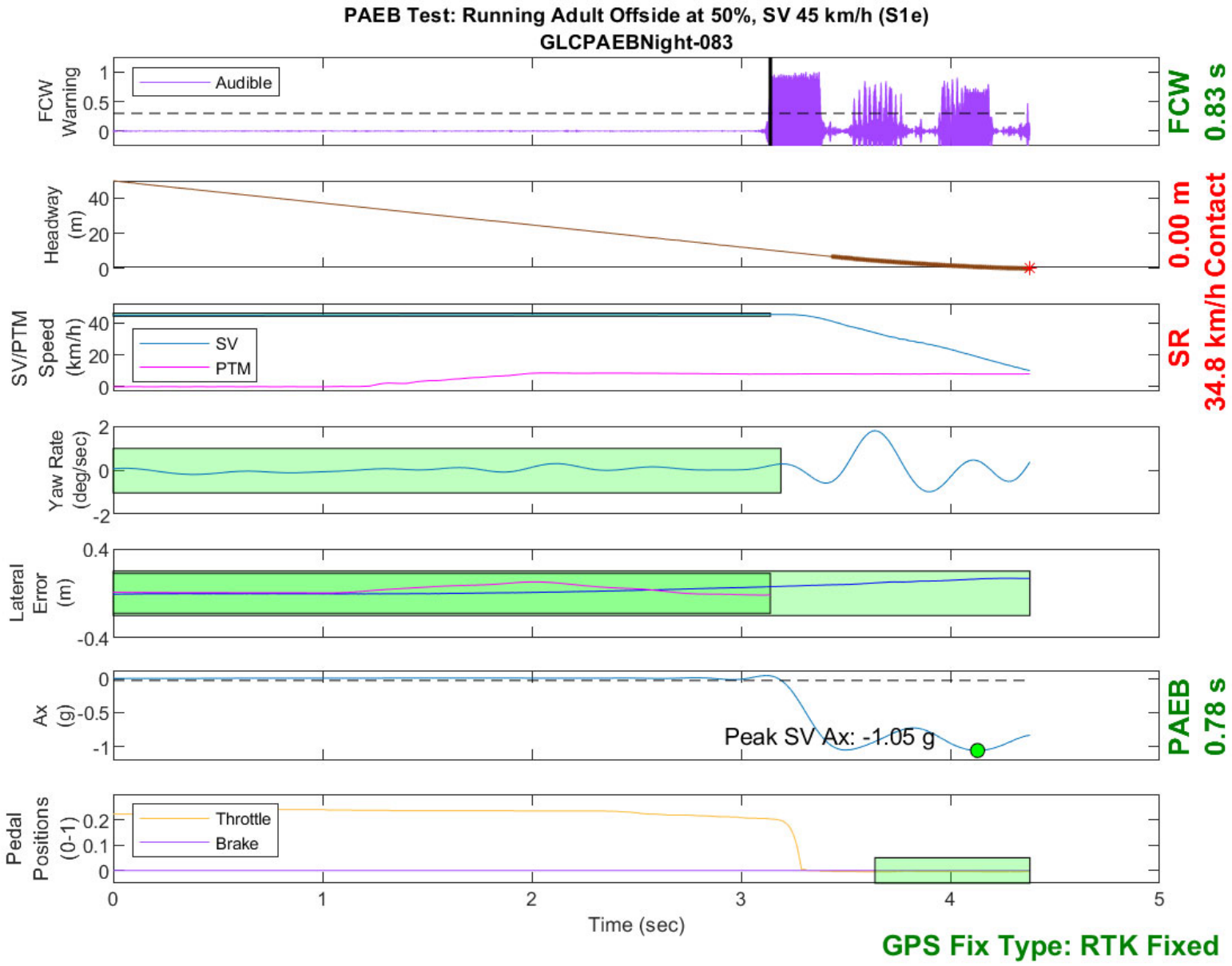

Figure D298. Time History for PAEB Run 83, S1e, Night, Low Beam, 45 km/h

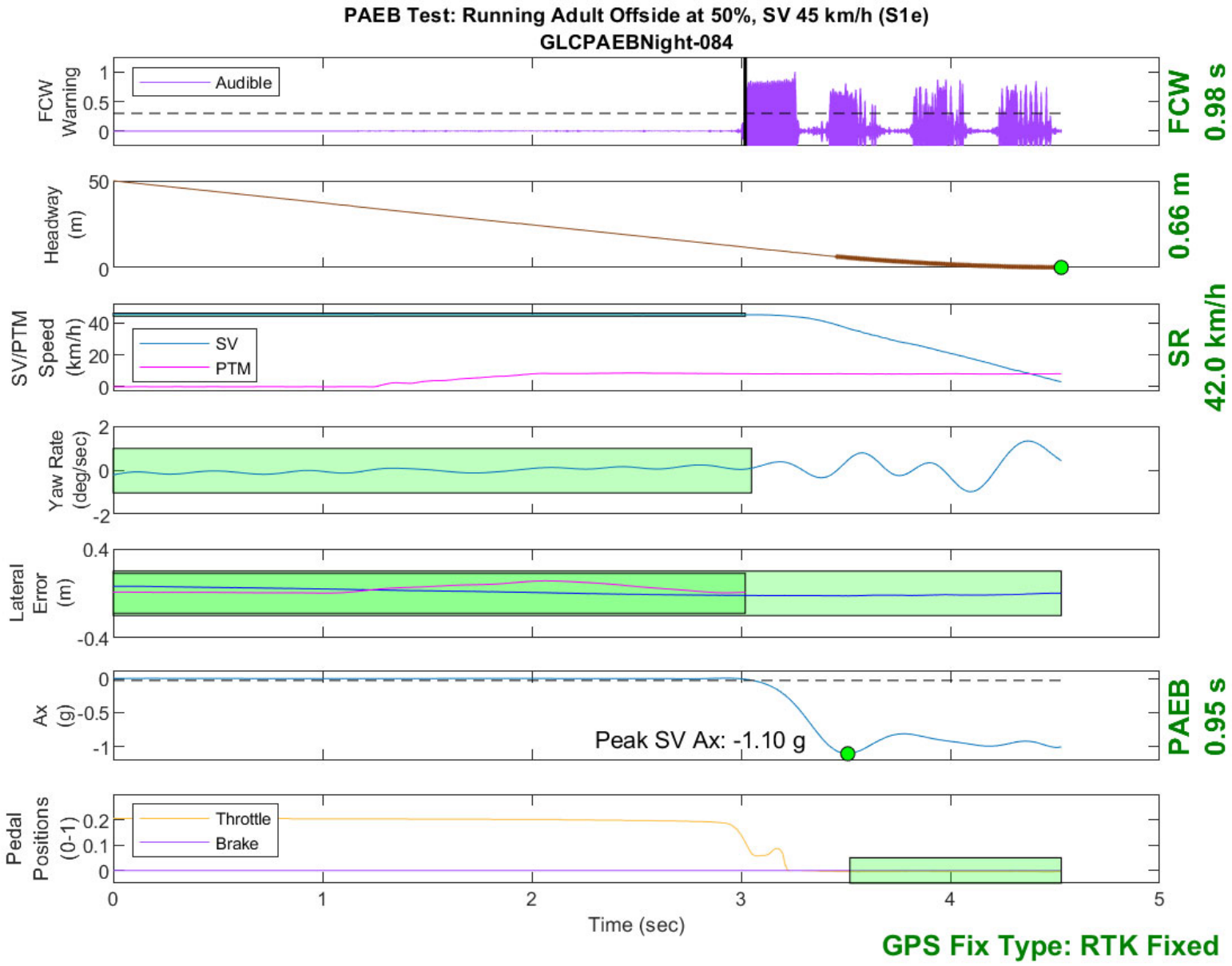

Figure D299. Time History for PAEB Run 84, S1e, Night, Low Beam, 45 km/h

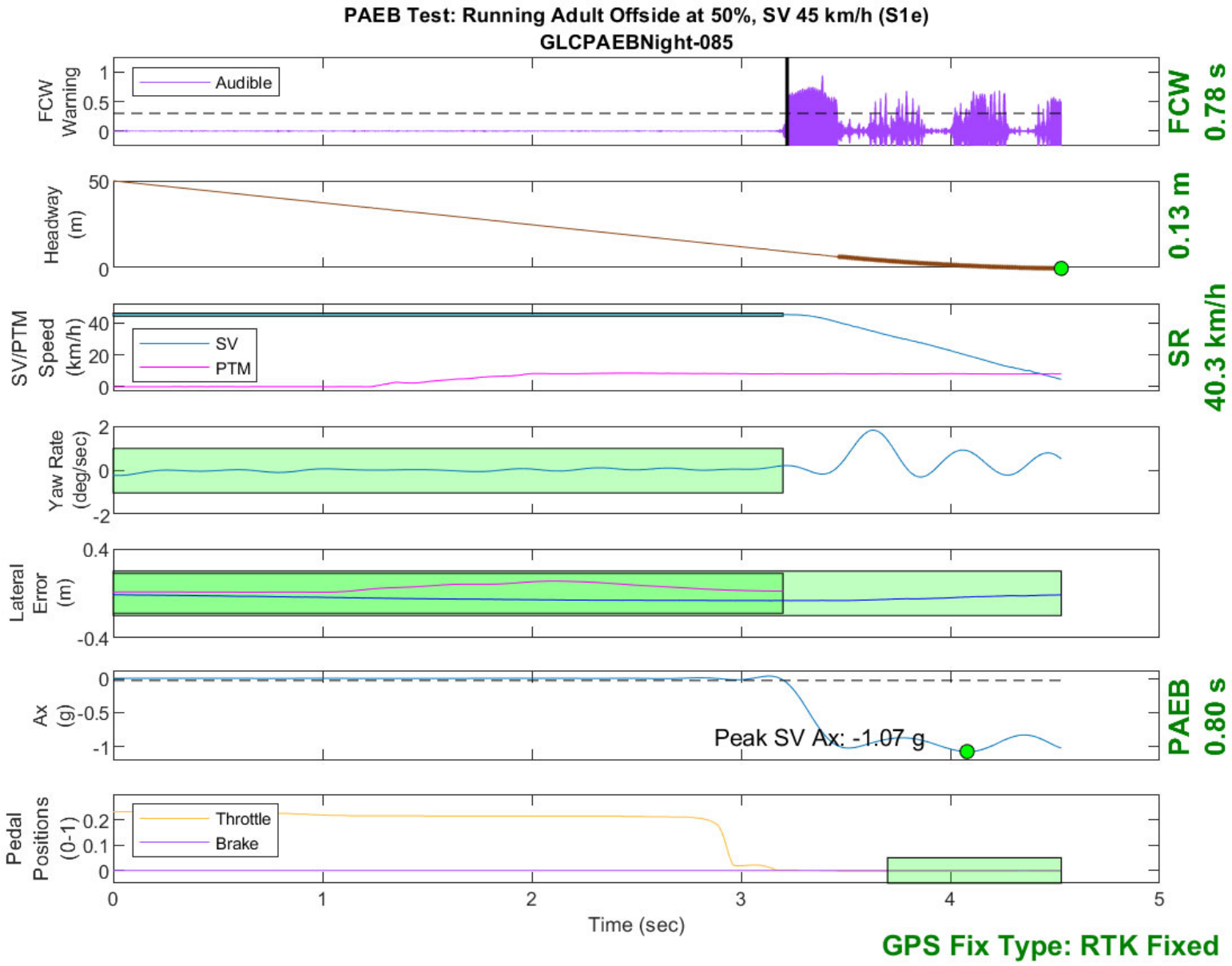

Figure D300. Time History for PAEB Run 85, S1e, Night, Low Beam, 45 km/h

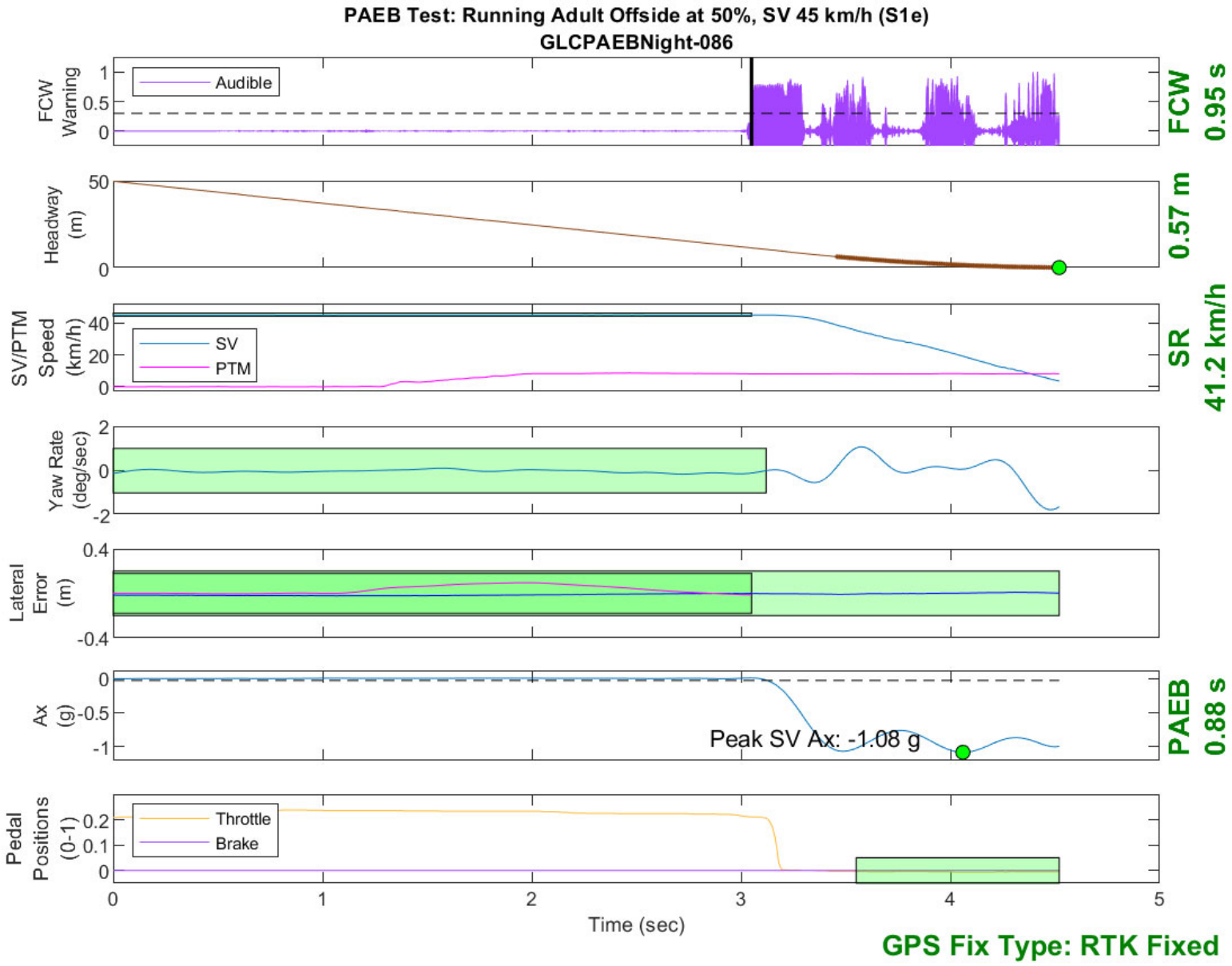

Figure D301. Time History for PAEB Run 86, S1e, Night, Low Beam, 45 km/h

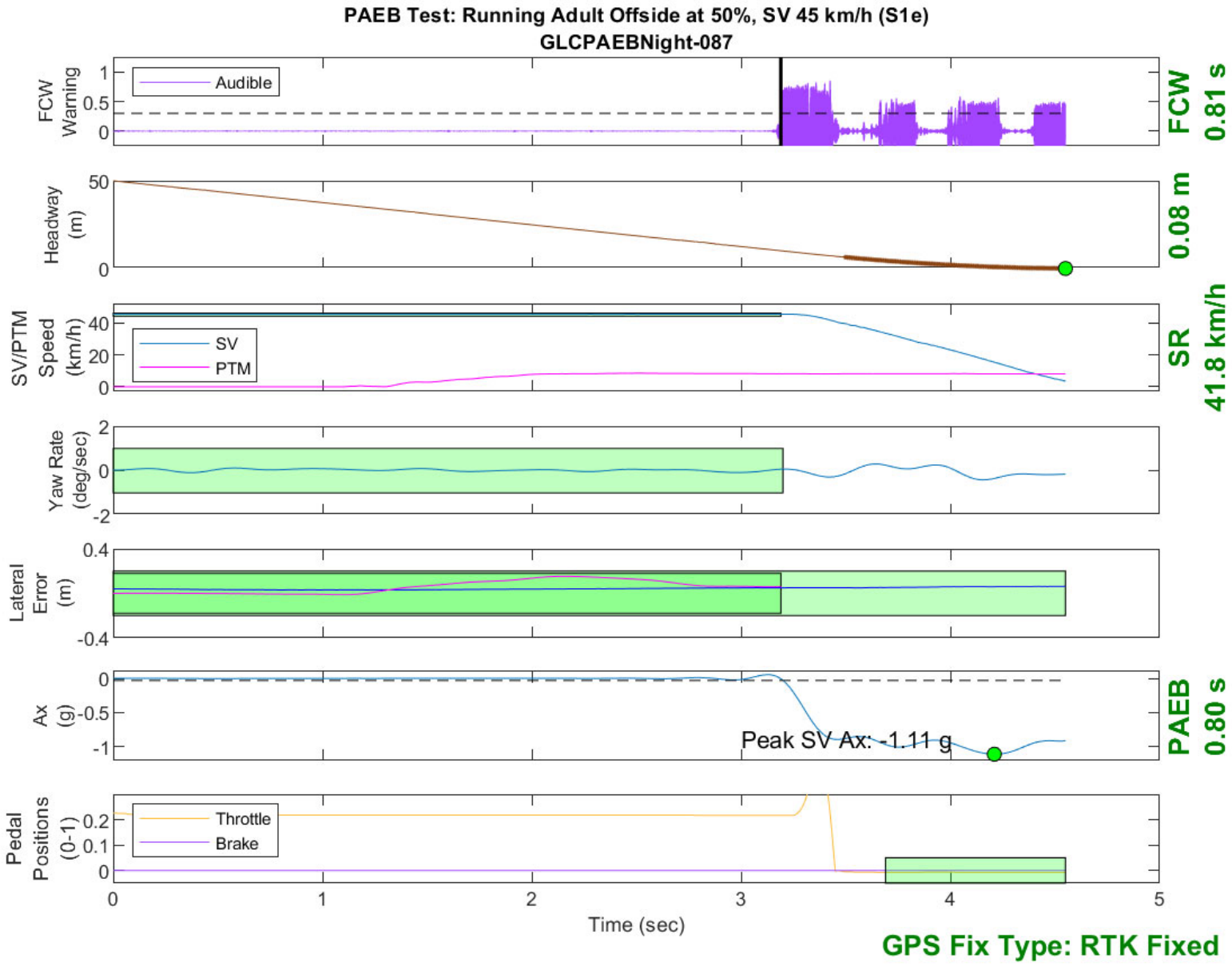

Figure D302. Time History for PAEB Run 87, S1e, Night, Low Beam, 45 km/h

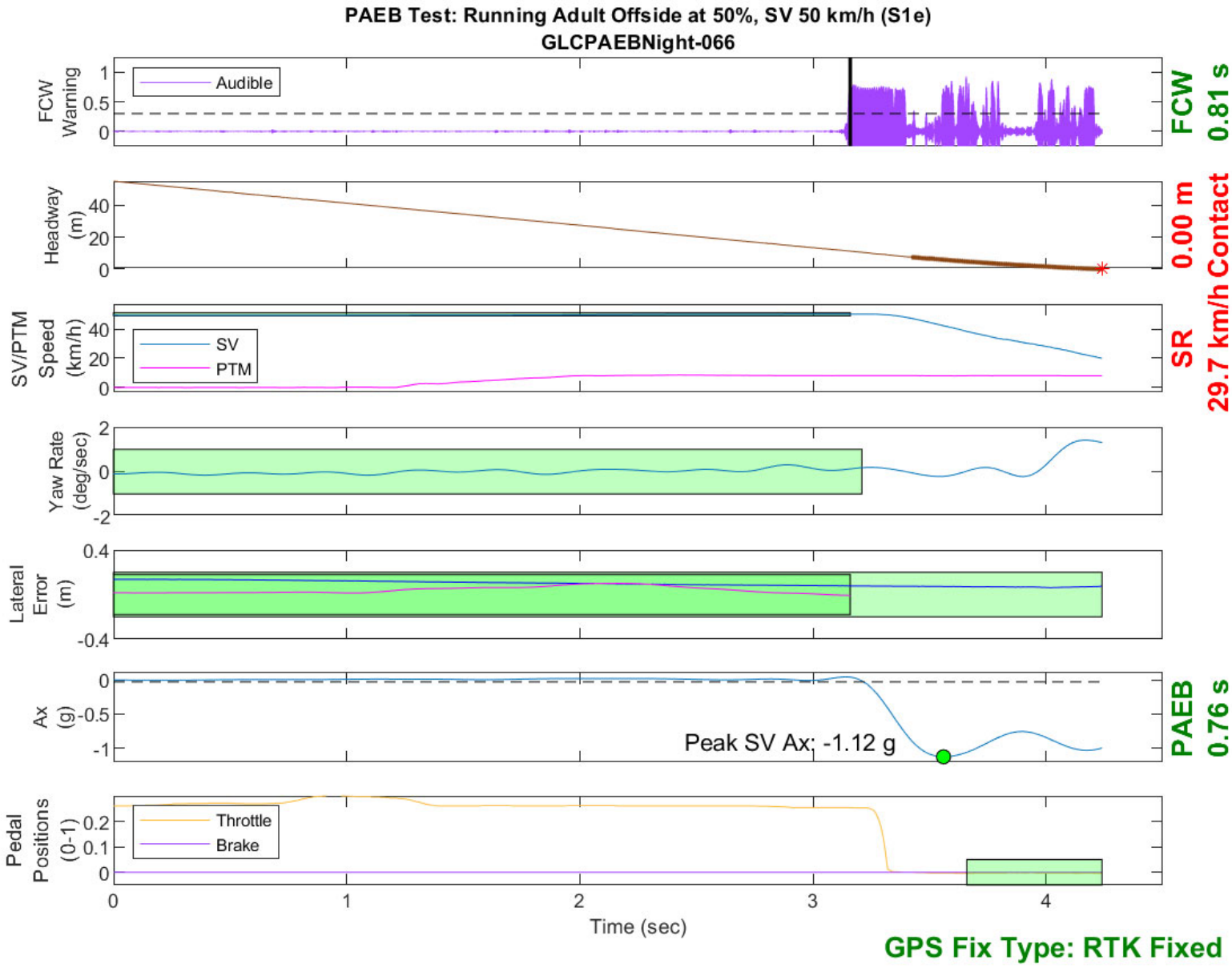

Figure D303. Time History for PAEB Run 66, S1e, Night, Low Beam, 50 km/h

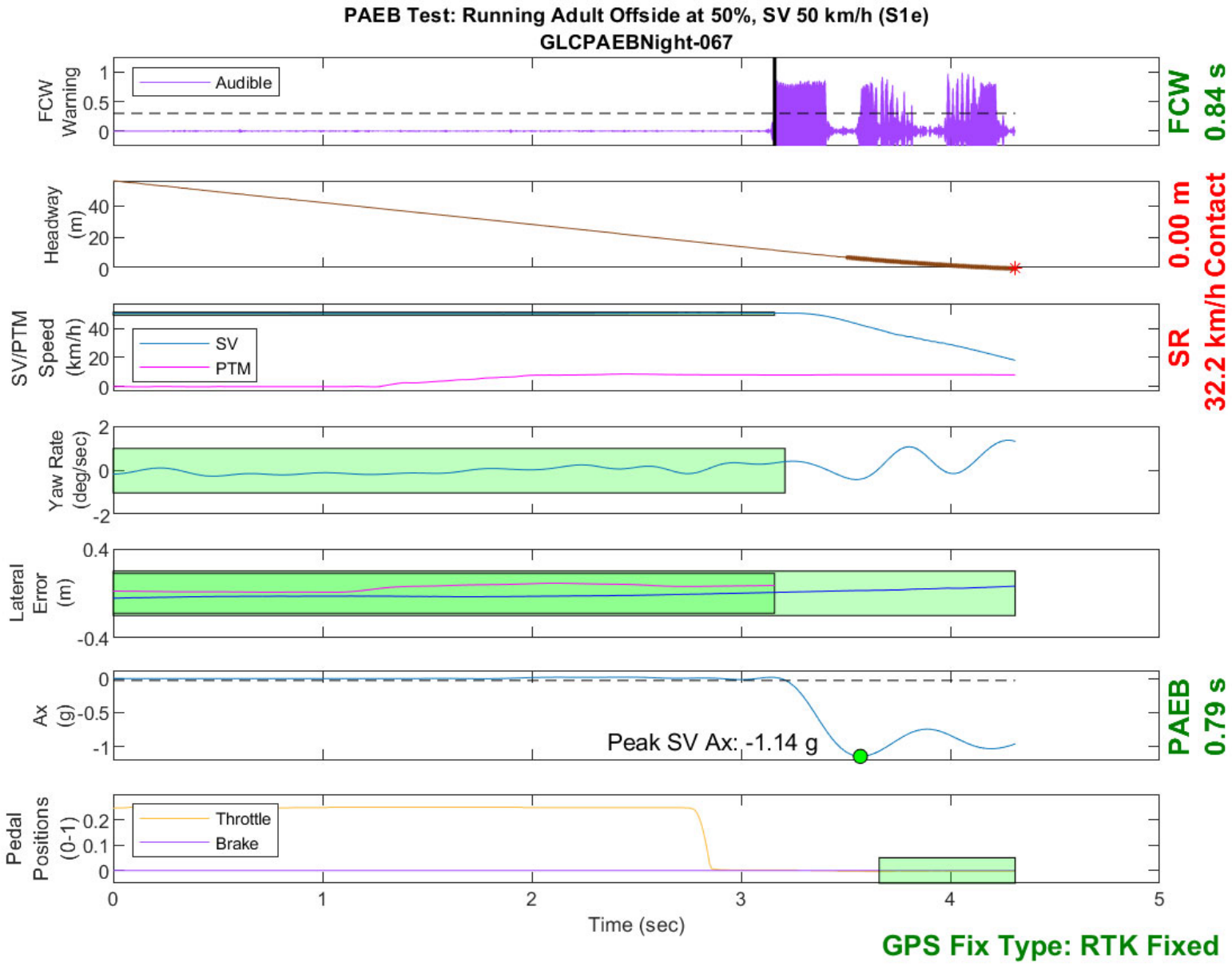

Figure D304. Time History for PAEB Run 67, S1e, Night, Low Beam, 50 km/h

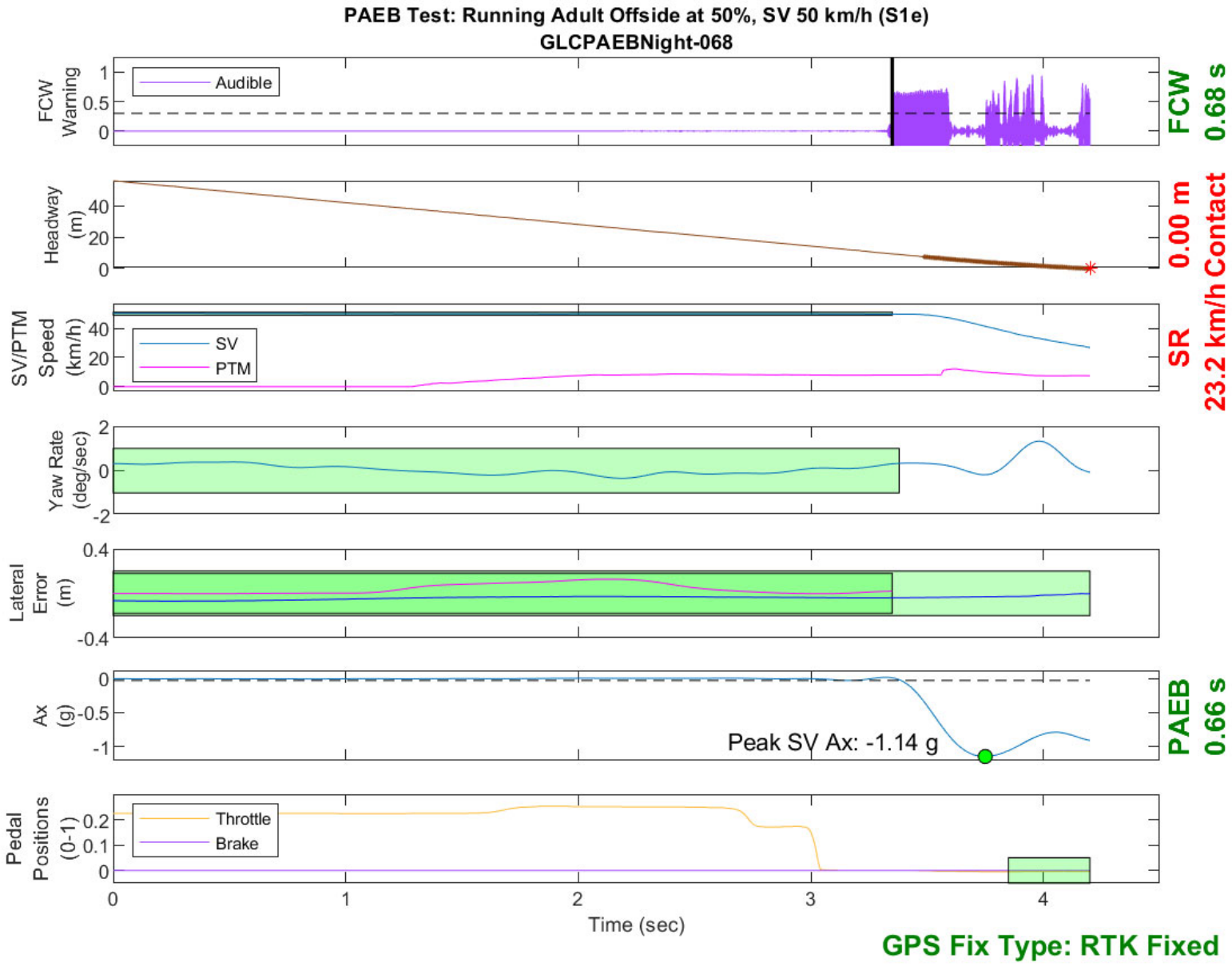

Figure D305. Time History for PAEB Run 68, S1e, Night, Low Beam, 50 km/h

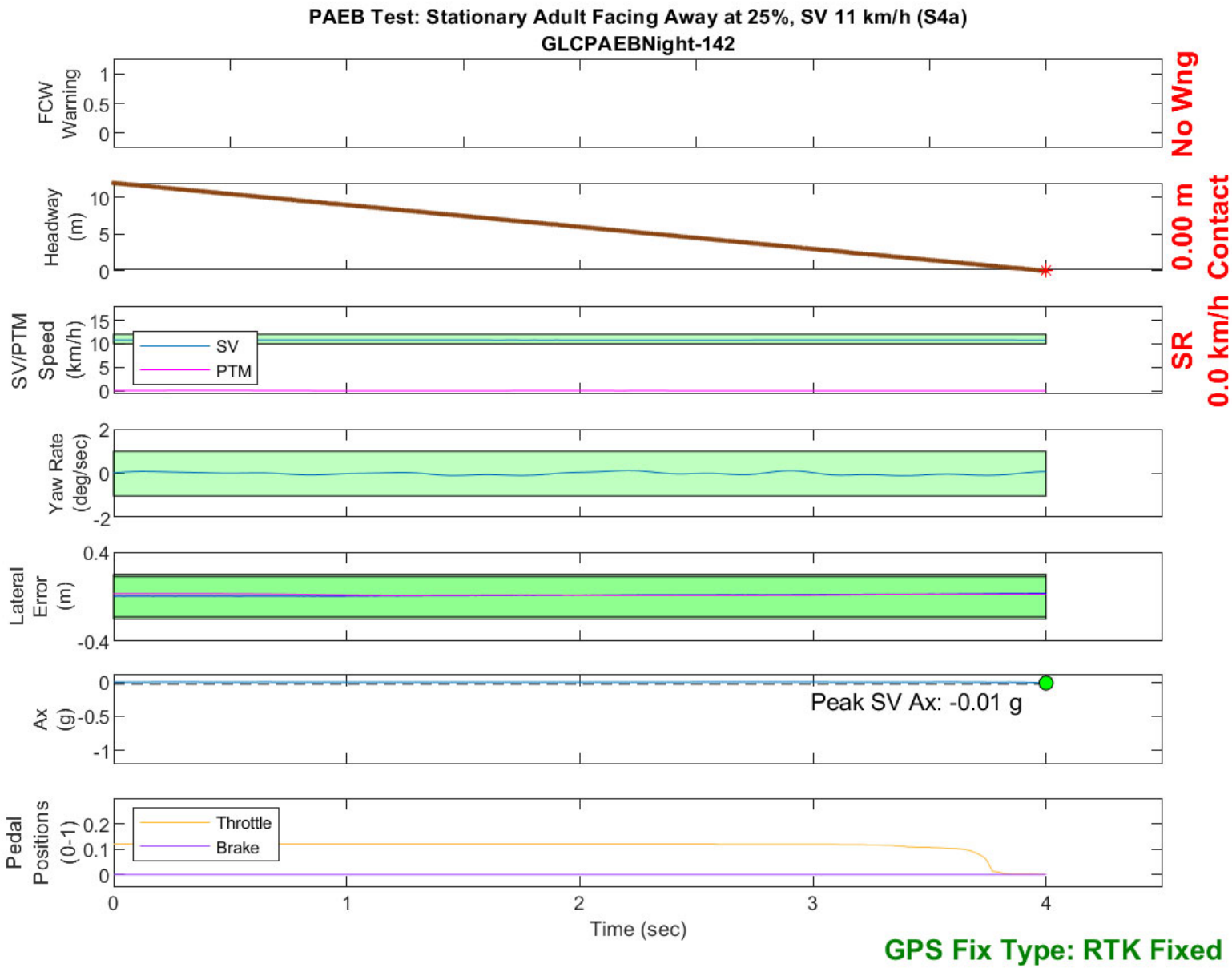

Figure D306. Time History for PAEB Run 142, S4a, Night, Low Beam, 11 km/h

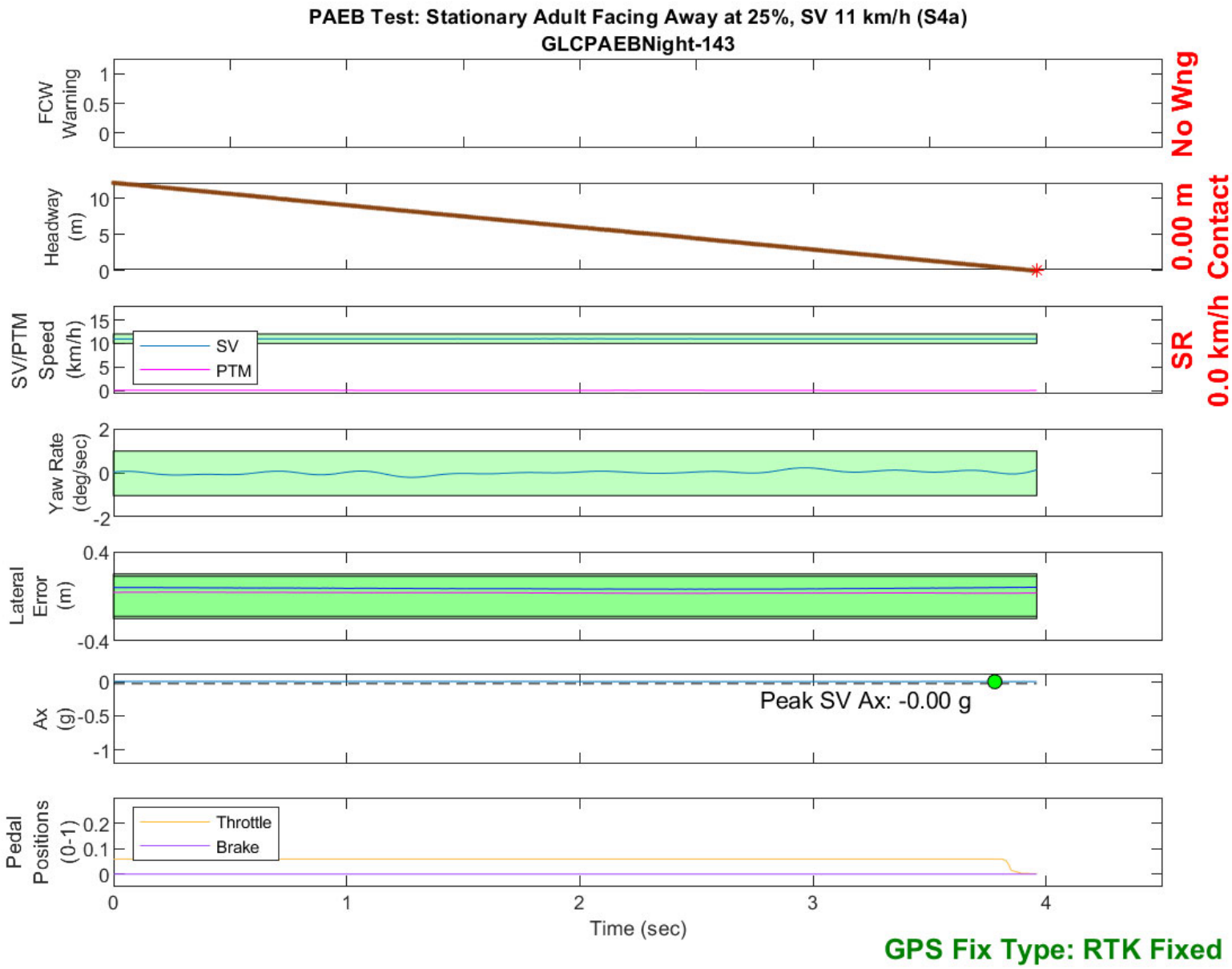

Figure D307. Time History for PAEB Run 143, S4a, Night, Low Beam, 11 km/h

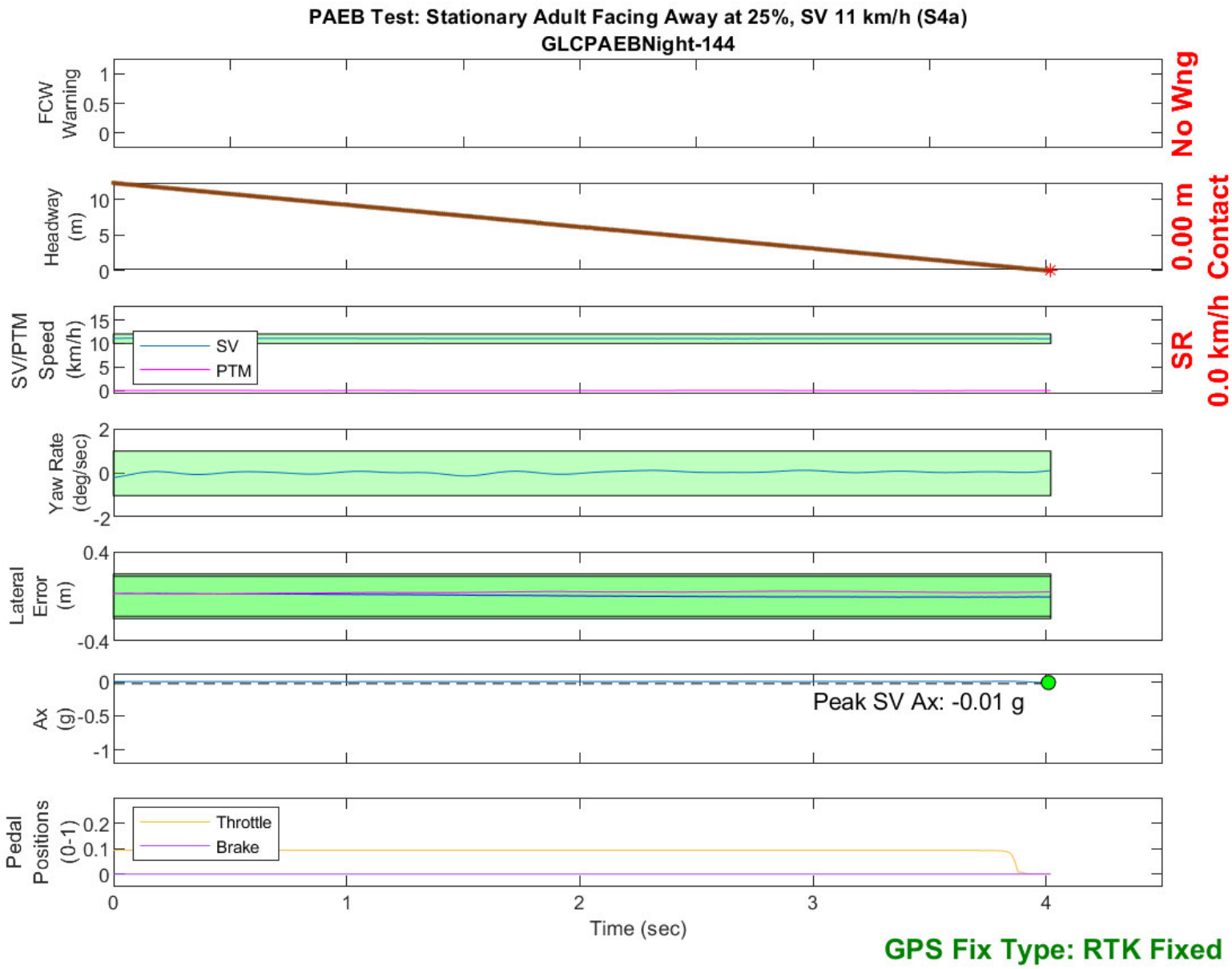

Figure D308. Time History for PAEB Run 144, S4a, Night, Low Beam, 11 km/h

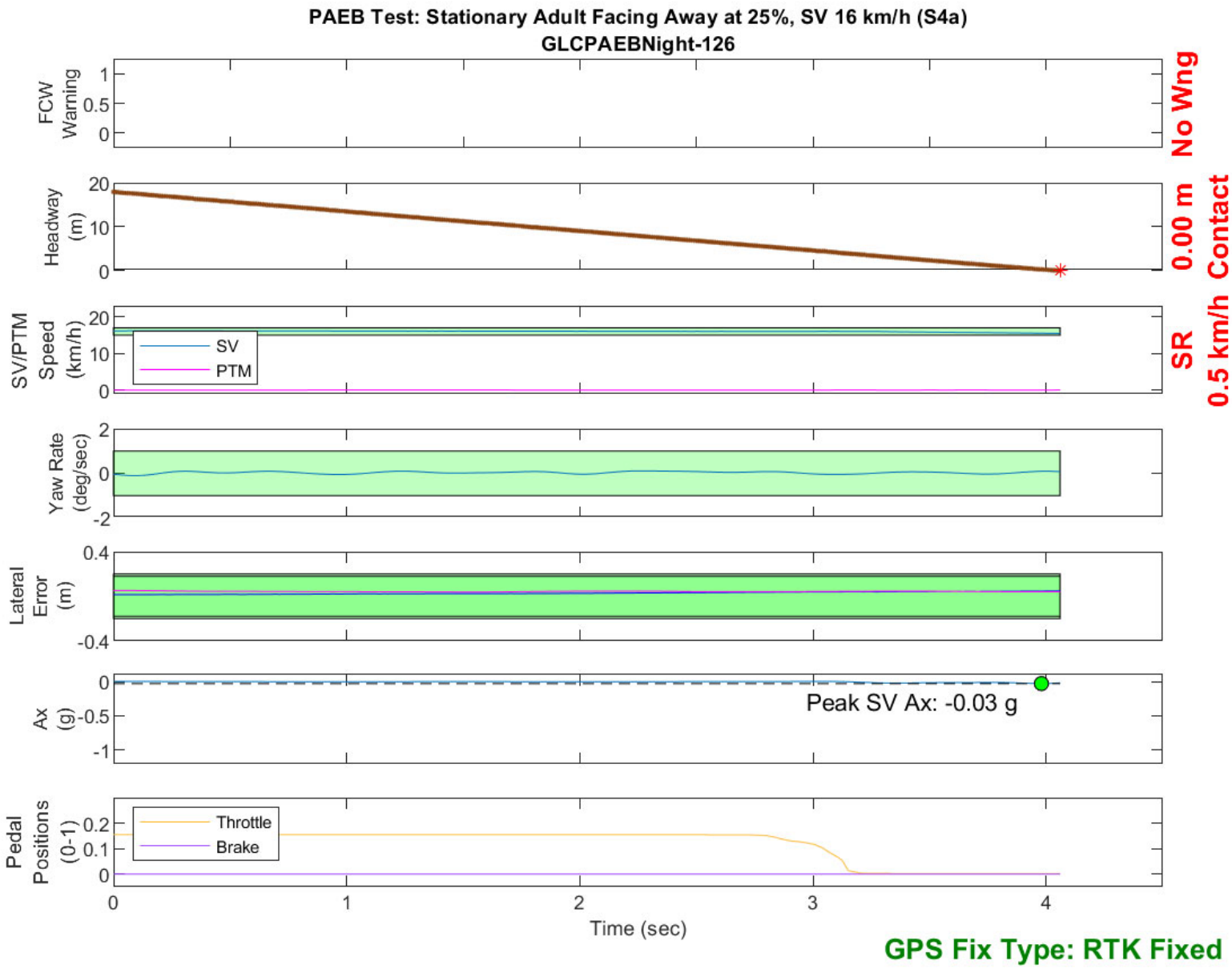

Figure D309. Time History for PAEB Run 126, S4a, Night, Low Beam, 16 km/h

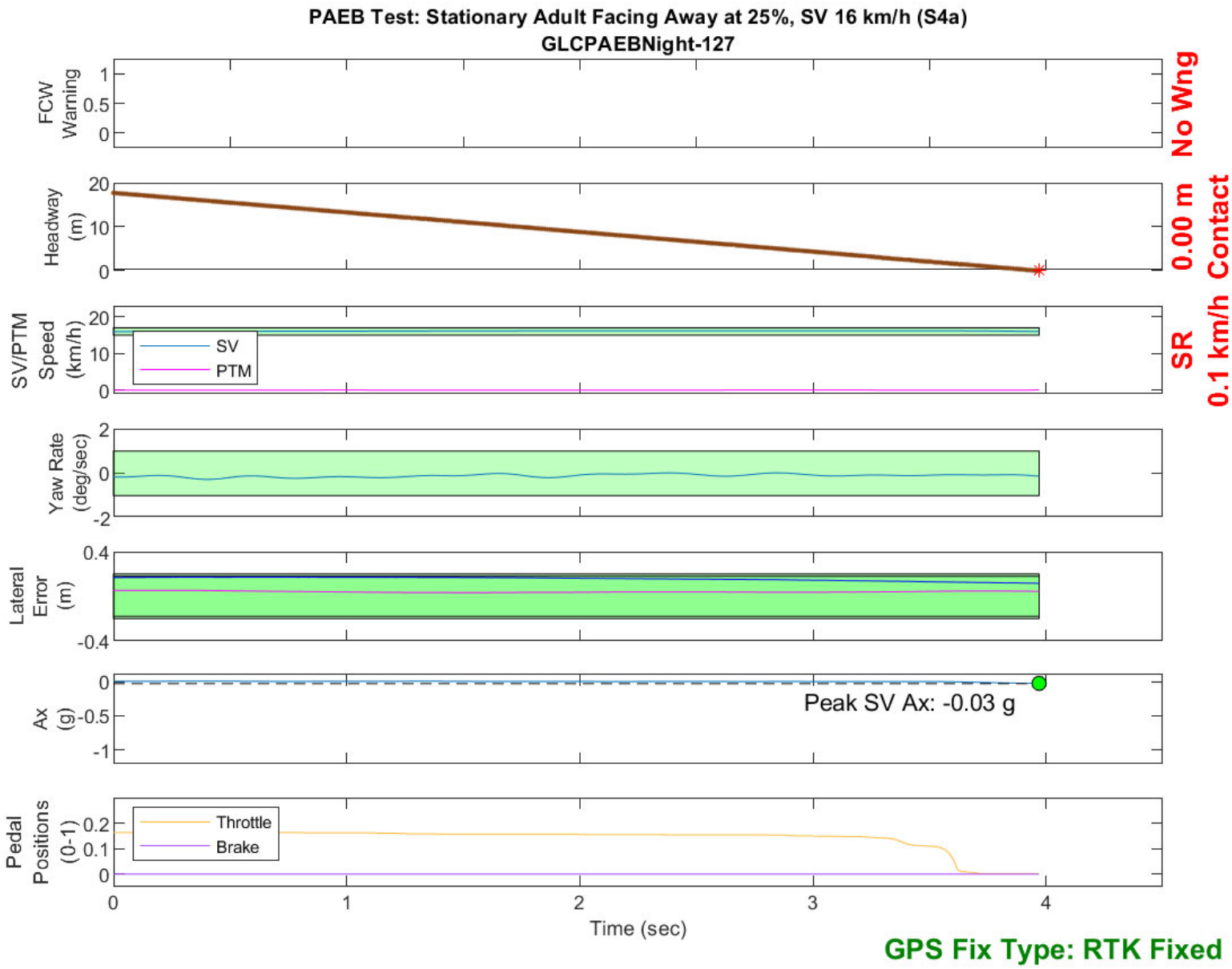

Figure D310. Time History for PAEB Run 127, S4a, Night, Low Beam, 16 km/h

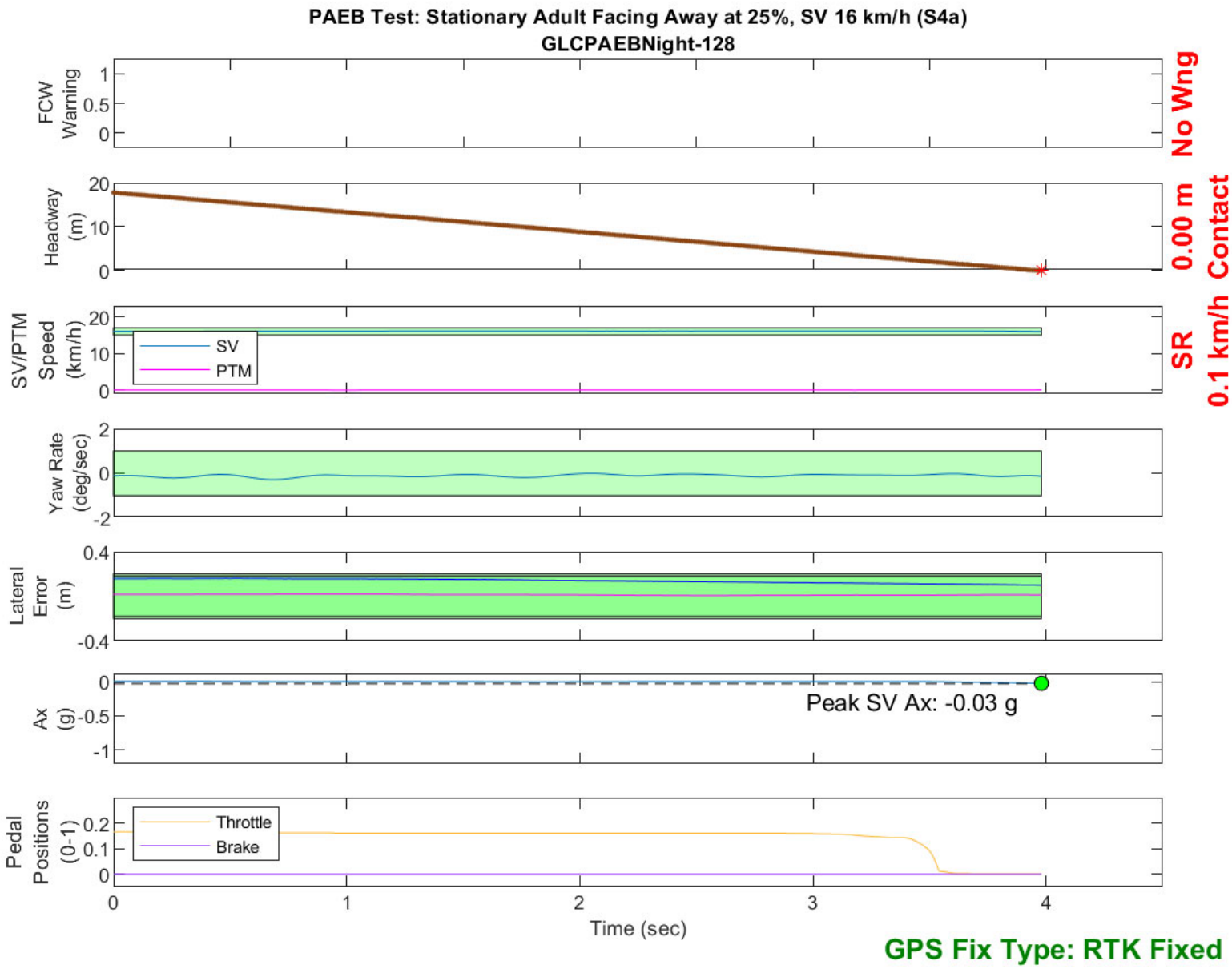

Figure D311. Time History for PAEB Run 128, S4a, Night, Low Beam, 16 km/h

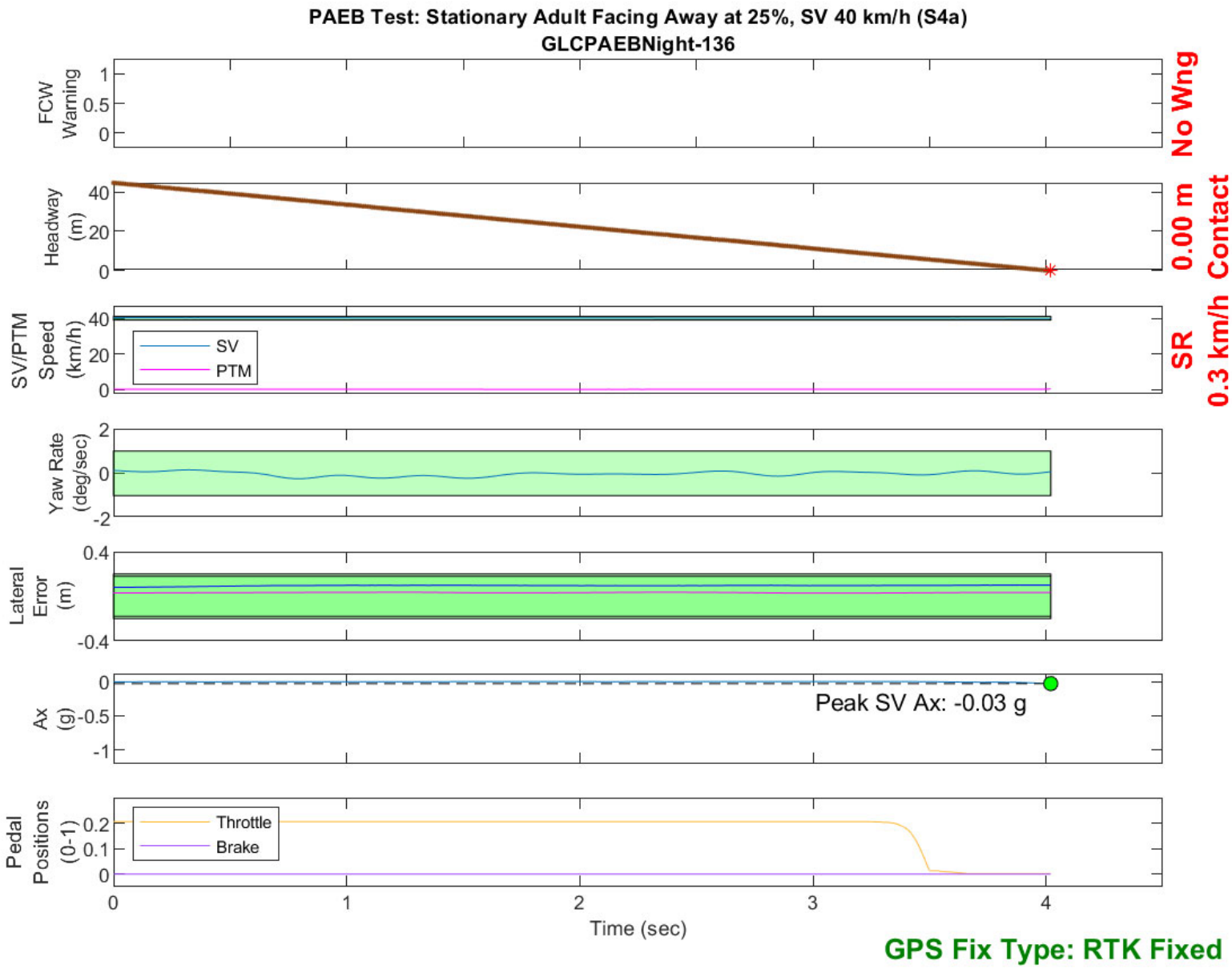

Figure D312. Time History for PAEB Run 136, S4a, Night, Low Beam, 40 km/h

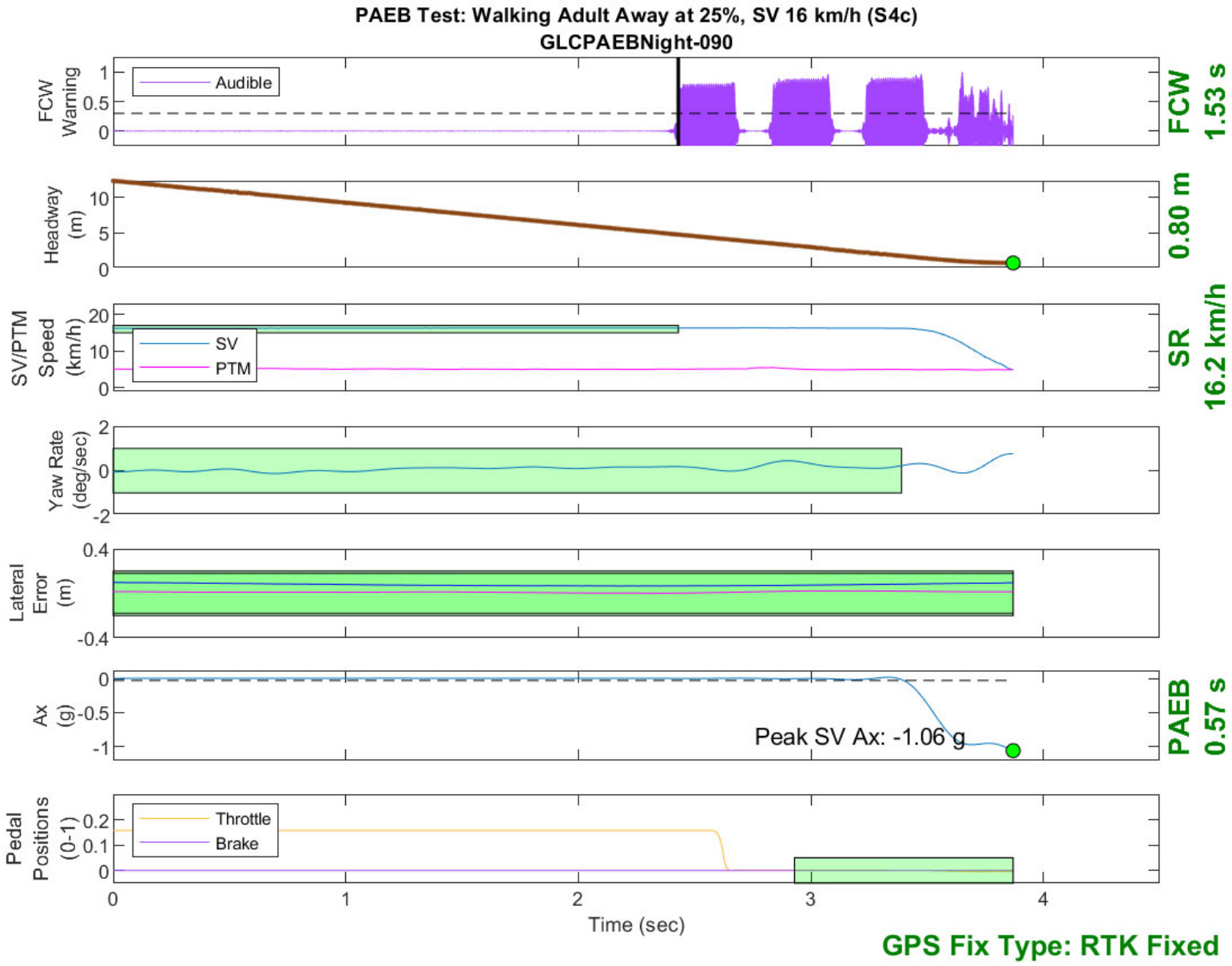

Figure D313. Time History for PAEB Run 90, S4c, Night, Low Beam, 16 km/h

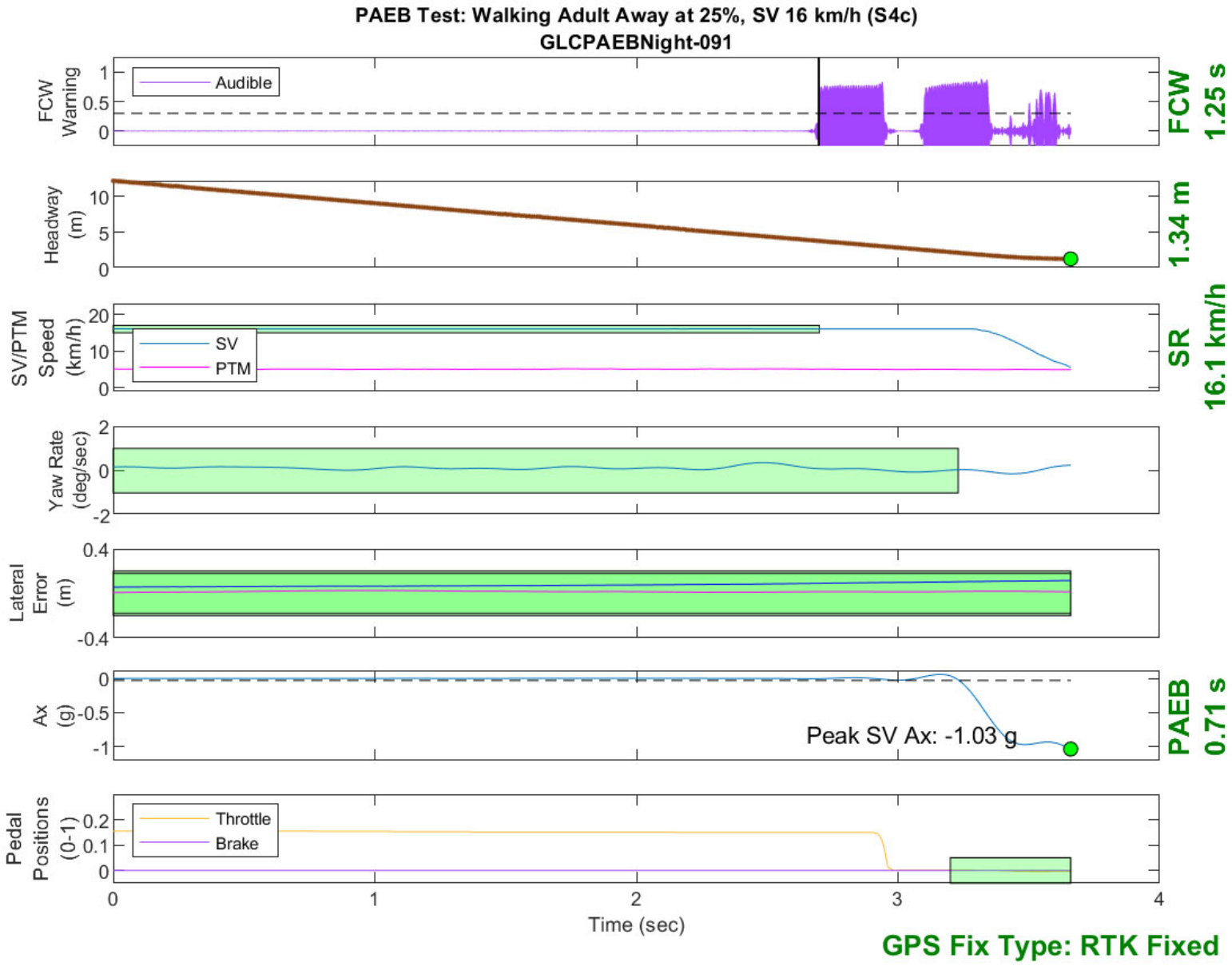

Figure D314. Time History for PAEB Run 91, S4c, Night, Low Beam, 16 km/h

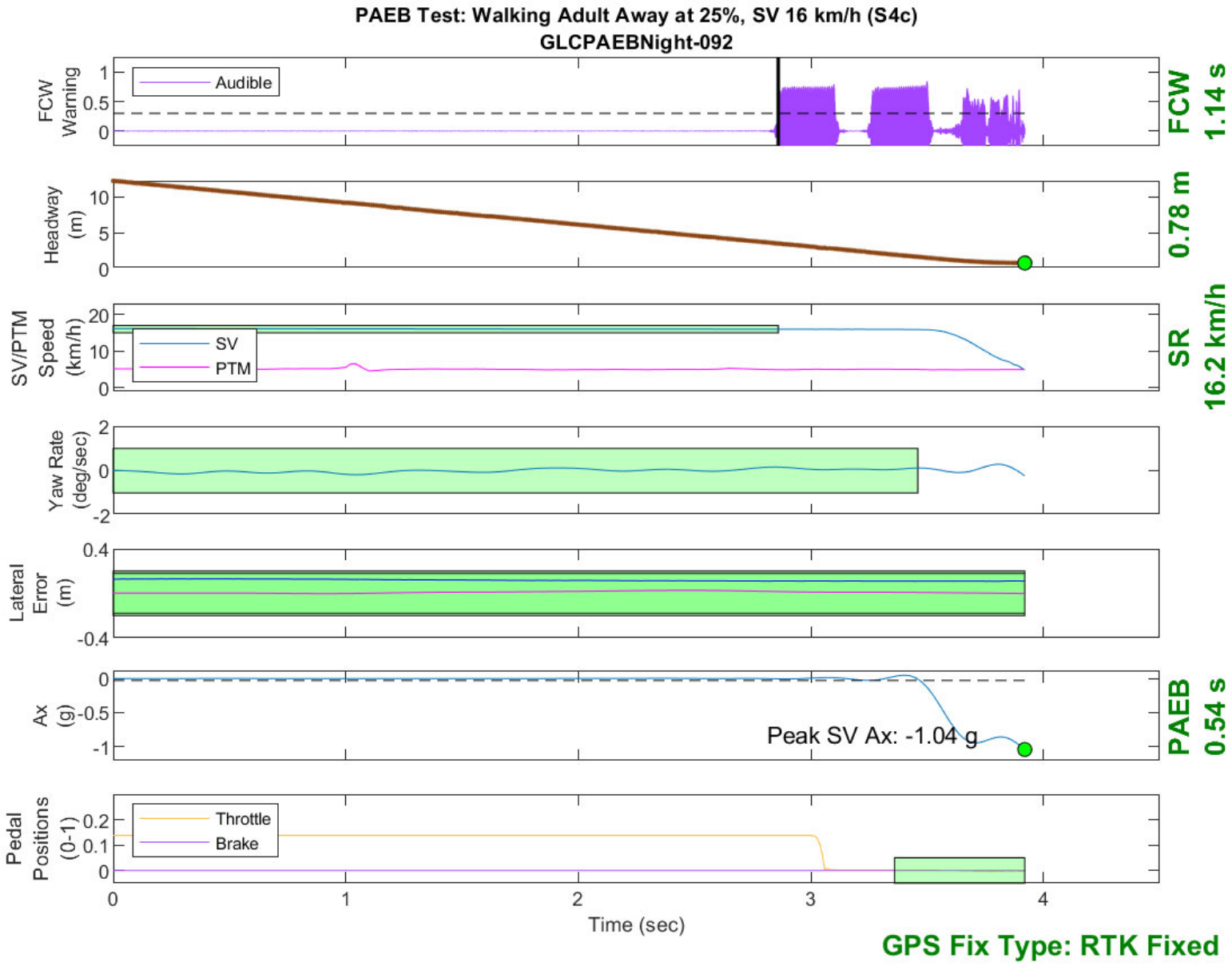

Figure D315. Time History for PAEB Run 92, S4c, Night, Low Beam, 16 km/h

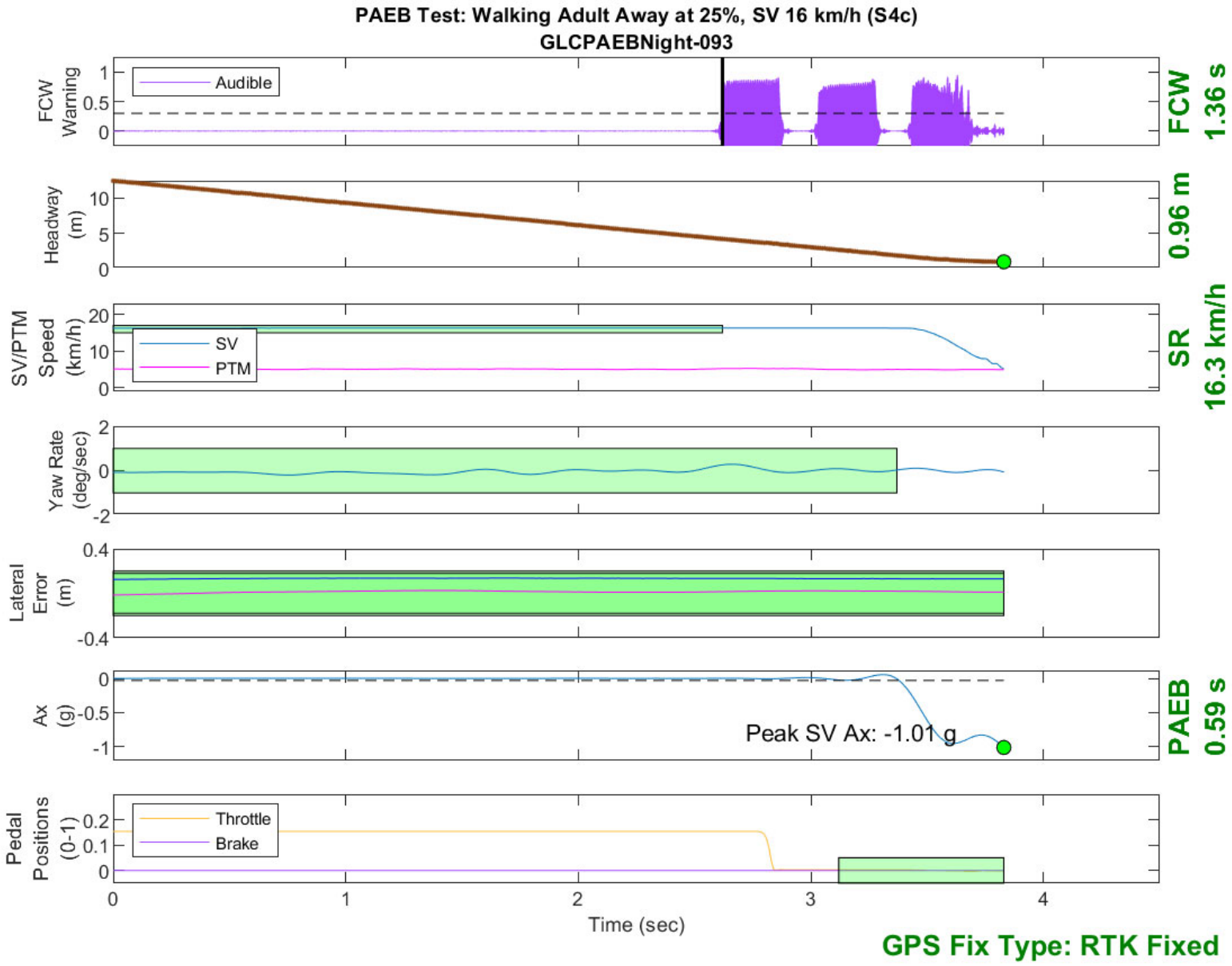

Figure D316. Time History for PAEB Run 93, S4c, Night, Low Beam, 16 km/h

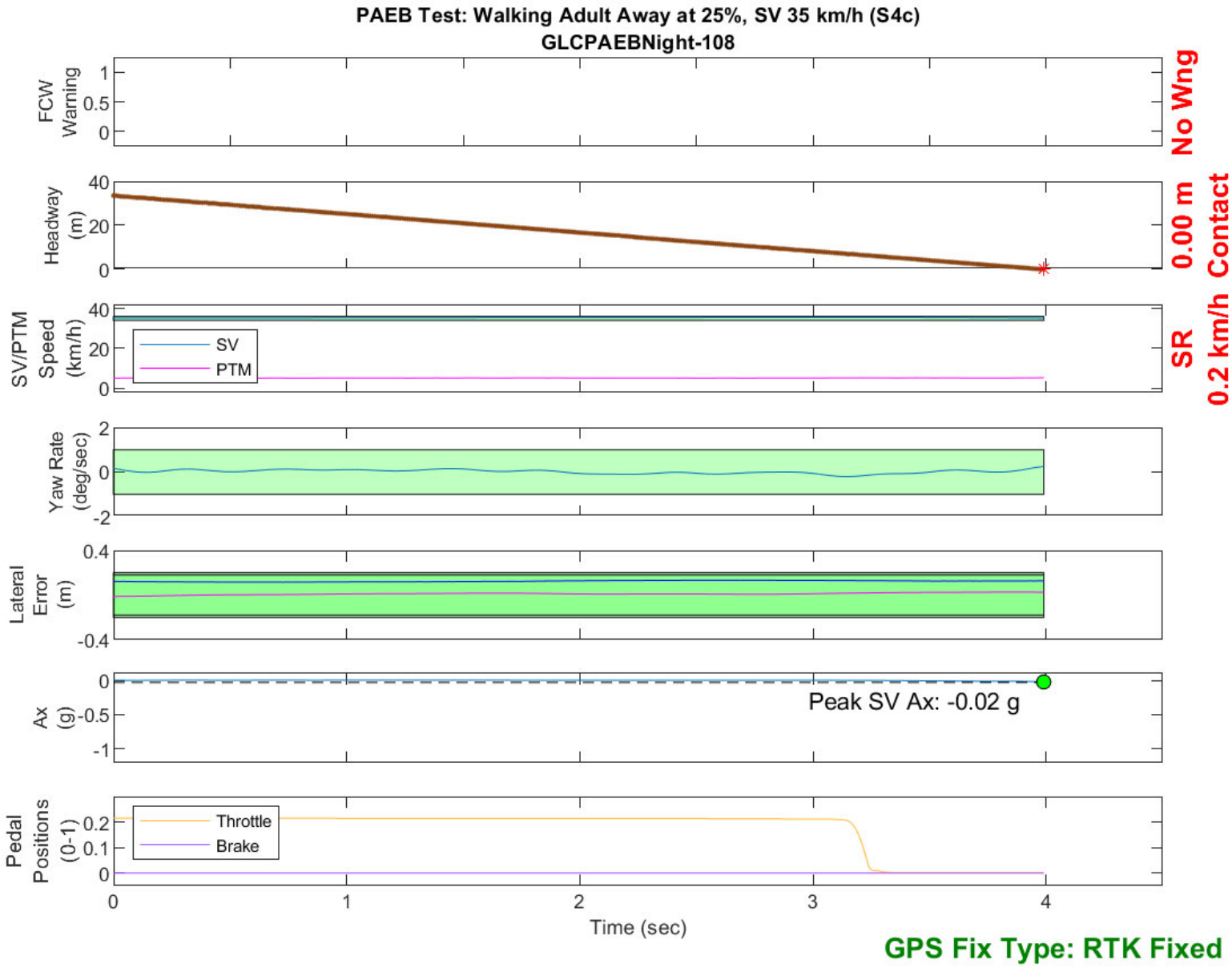

Figure D317. Time History for PAEB Run 108, S4c, Night, Low Beam, 35 km/h

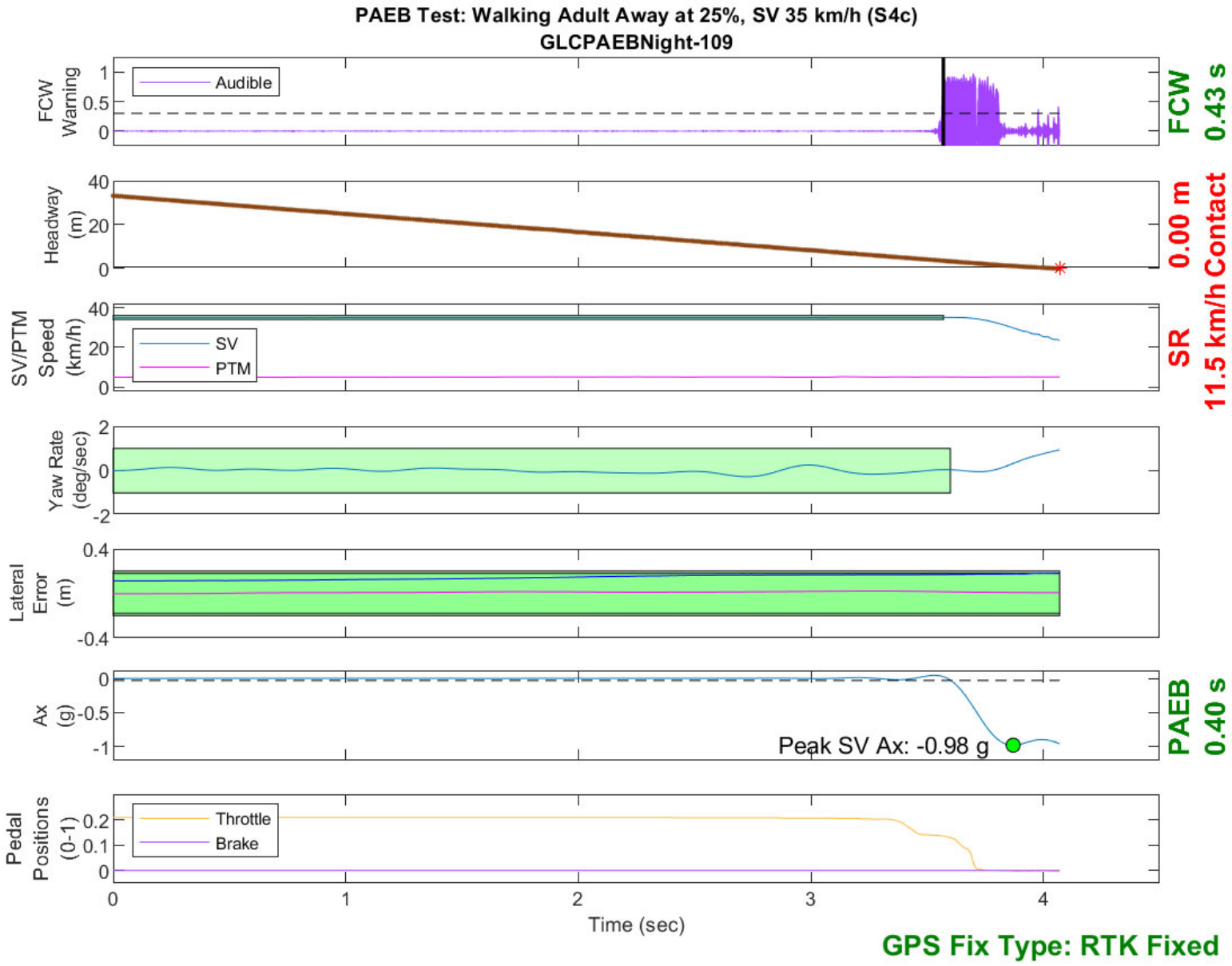

Figure D318. Time History for PAEB Run 109, S4c, Night, Low Beam, 35 km/h

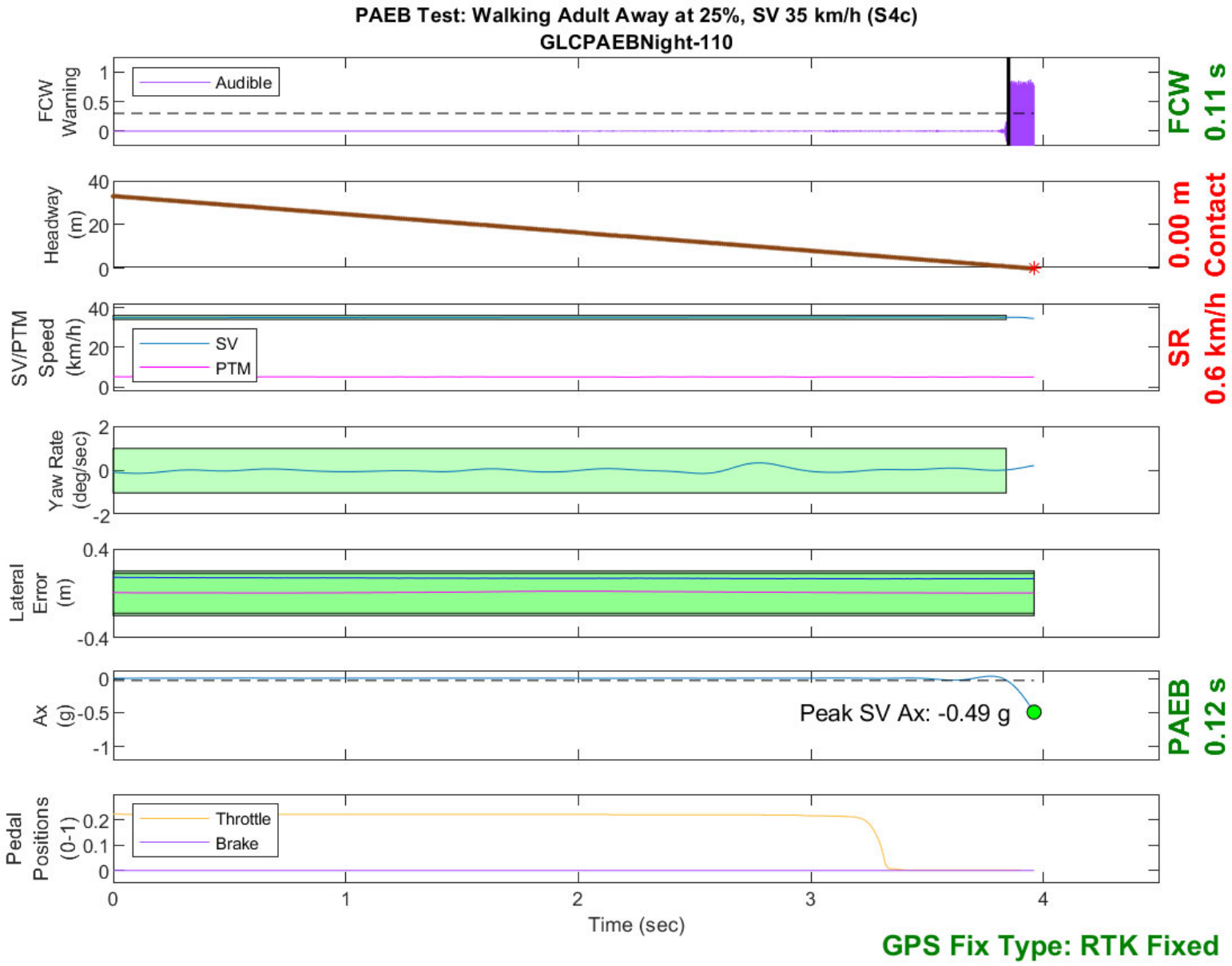

Figure D319. Time History for PAEB Run 110, S4c, Night, Low Beam, 35 km/h

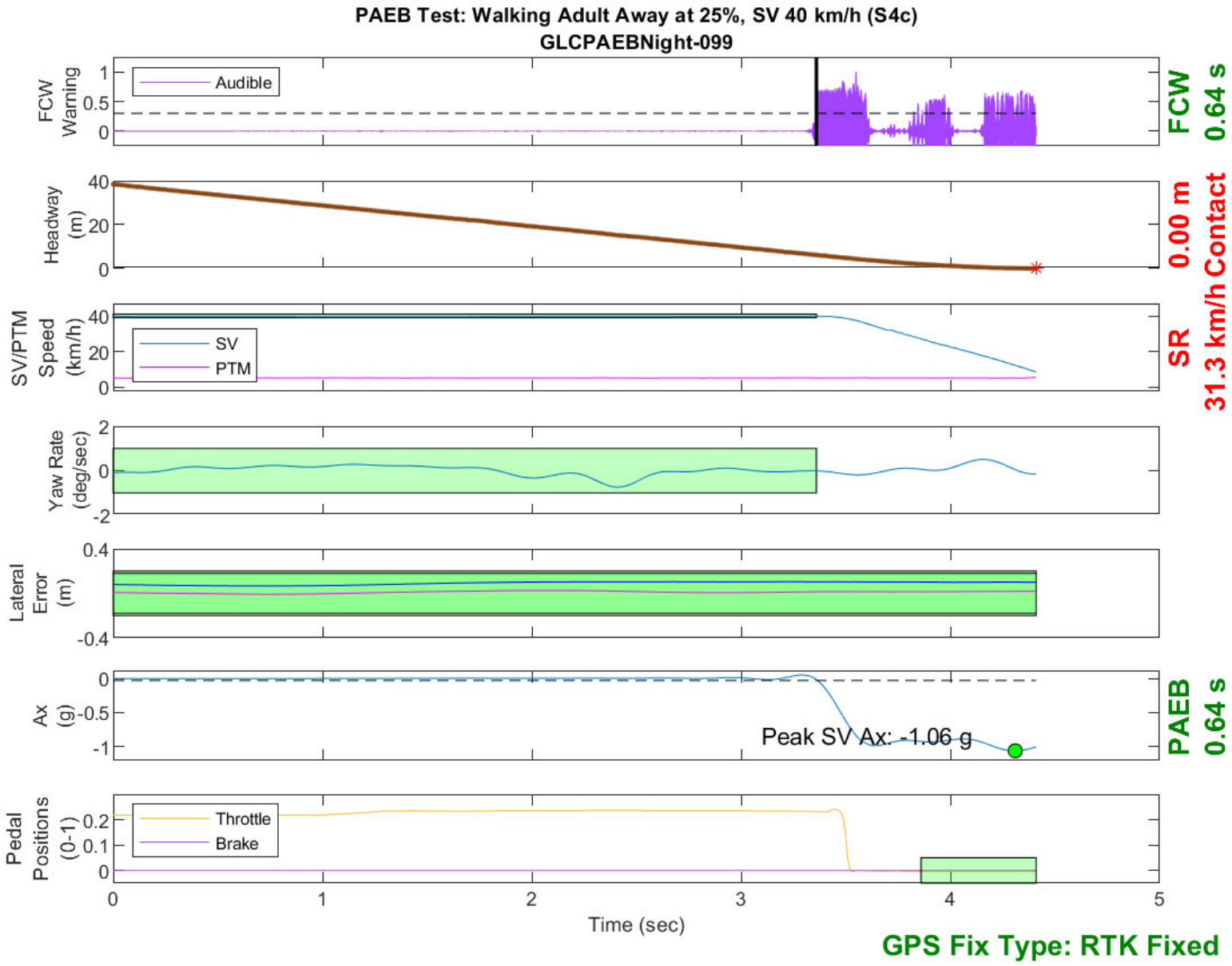

Figure D320. Time History for PAEB Run 99, S4c, Night, Low Beam, 40 km/h

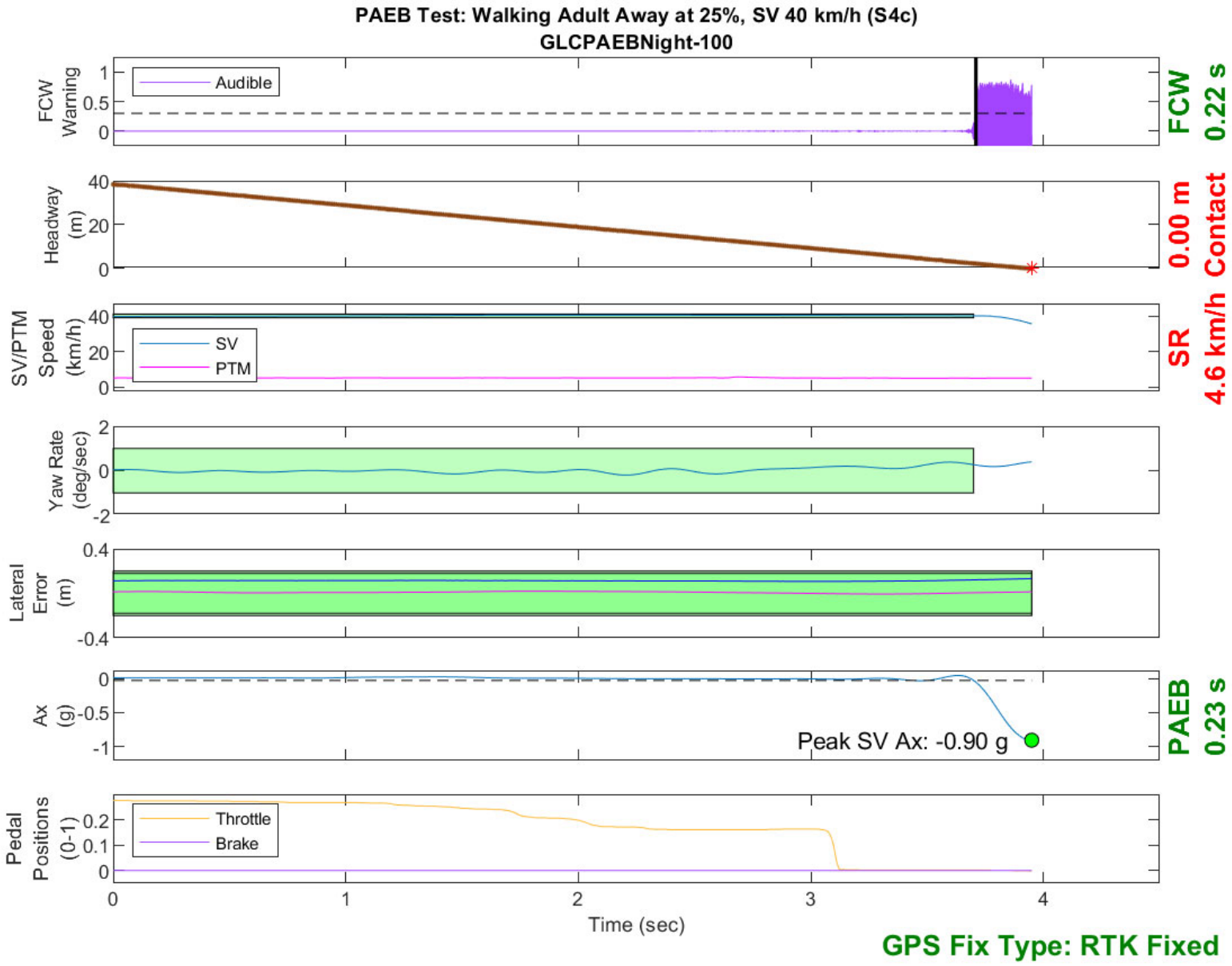

Figure D321. Time History for PAEB Run 100, S4c, Night, Low Beam, 40 km/h

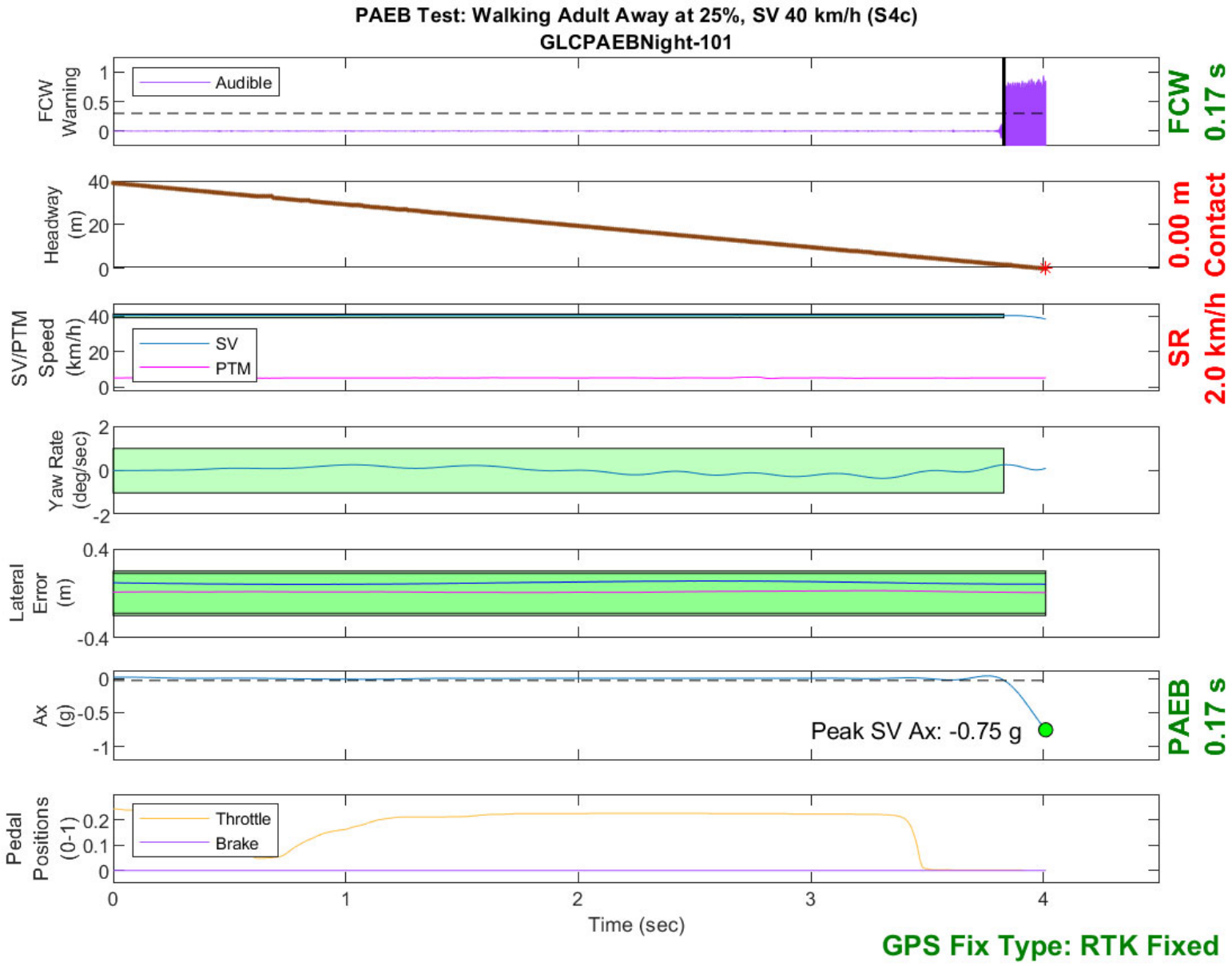

Figure D322. Time History for PAEB Run 101, S4c, Night, Low Beam, 40 km/h