NEW CAR ASSESSMENT PROGRAM
LANE DEPARTURE WARNING CONFIRMATION TEST
NCAP-DRI-LDW-20-17

2020 Subaru Outback Premium/LDD

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

15 July 2020

Final Report

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

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

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

Prepared By: J. Lenkeit and S. Judy

Program Manager Test Engineer

Date: 15 July 2020

1. Report No. NCAP-DRI-LDW-20-17	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of Lane Departure Warning Confirmation Test of a 2020 Subaru Outback Premium/LDD.		5. Report Date 15 July 2020	
		6. Performing Organization Code DRI	
7. Author(s) J. Lenkeit, Program Manager S. Judy, Test Engineer		8. Performing Organization Report No. DRI-TM-19-205	
9. Performing Organization Name and Address Dynamic Research, Inc. 355 Van Ness Ave, STE 200 Torrance, CA 90501		10. Work Unit No.	
		11. Contract or Grant No. DTNH22-14-D-00333	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration New Car Assessment Program 1200 New Jersey Avenue, SE, West Building, 4th Floor (NRM-110) Washington, DC 20590		13. Type of Report and Period Covered Final Test Report May - July 2020	
		14. Sponsoring Agency Code NRM-110	
15. Supplementary Notes			
16. Abstract These tests were conducted on the subject 2020 Subaru Outback Premium/LDD in accordance with the specifications of the New Car Assessment Program's (NCAP) most current Test Procedure in docket NHTSA-2006-26555-0135 to confirm the performance of a Lane Departure Warning system. The vehicle passed the requirements of the test for all three marking types and for both directions.			
17. Key Words Lane Departure Warning, LDW, New Car Assessment Program, NCAP		18. Distribution Statement Copies of this report are available from the following: NHTSA Technical Reference Division National Highway Traffic Safety Administration 1200 New Jersey Avenue, SE Washington, DC 20590	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 162	22. Price

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Section I

INTRODUCTION

The purpose of the testing reported herein was to confirm the performance of a Lane Departure Warning (LDW) system installed on a 2020 Subaru Outback Premium/LDD. The LDW system for this vehicle provides both visual and auditory alerts. The vehicle passed the requirements of the test for all three marking types and for both directions.

The test procedure is described in detail in the National Highway Traffic Safety Administration (NHTSA) document "LANE DEPARTURE WARNING SYSTEM CONFIRMATION TEST" dated February of 2013 (Docket No. NHTSA-2006-26555-0135). Its purpose is to confirm the performance of LDW systems installed on light vehicles with gross vehicle weight ratings (GVWR) of up to 10,000 lbs. Current LDW technology relies on sensors to recognize a lane delimiting edge line. As such, the test procedures described in the document rely on painted lines, taped lines, or Botts Dots being present on the test course to emulate those found on public roadways. Although it is impossible to predict what technologies could be used by future LDW systems (e.g., magnetic markers, RADAR reflective striping, ultra violet paint, infrared, etc.), it is believed that minor modifications to these procedures, when deemed appropriate, could be used to accommodate the evaluation of alternative or more advanced LDW systems.

Section II

DATA SHEETS

LANE DEPARTURE WARNING

DATA SHEET 1: TEST RESULTS SUMMARY

(Page 1 of 1)

2020 Subaru Outback Premium/LDD

VIN: *4S4BTACC3L319xxxx*

Test Date: *5/28/2020*

Lane Departure Warning setting(s):

Lane Departure Prevention Function: Warning Buzzer Only
Warning Volume: Max

Test 1 – Continuous White Line	Left: *Pass*	Right: *Pass*
Test 2 – Dashed Yellow Line	Left: *Pass*	Right: *Pass*
Test 3 – Botts Dots	Left: *Pass*	Right: *Pass*

Overall: *Pass*

Notes:

LANE DEPARTURE WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2020 Subaru Outback Premium/LDD

TEST VEHICLE INFORMATION

VIN: *4S4BTACC3L319xxxx*

Body Style: *SUV* Color: *Magnetite Gray Metallic*

Date Received: *5/14/2020* Odometer Reading: *114 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Subaru Corporation*

Date of manufacture: *2/20*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *225/65R17*

Rear: *225/65R17*

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

Rear: *230 kPa (33 psi)*

TIRES

Tire manufacturer and model: *Yokohama Avid GT*

Front tire size: *225/65R17 102H*

Rear tire size: *225/65R17 102H*

Front tire DOT prefix: *4UF5 6JK*

Rear tire DOT prefix: *4UF5 6JK*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Subaru Outback Premium/LDD

GENERAL INFORMATION

Test date: *5/28/2020*

AMBIENT CONDITIONS

Air temperature: *38.9 C (102 F)*

Wind speed: *1.0 m/s (2.3 mph)*

X Wind speed ≤10 m/s (22 mph)

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

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

VEHICLE PREPARATION

Verify the following:

All non-consumable fluids at 100% capacity: X

Fuel tank is full: X

Tire pressures are set to manufacturer's recommended cold tire pressure: X

Front: *240 kPa (35 psi)*

Rear: *230 kPa (33 psi)*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

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2020 Subaru Outback Premium/LDD

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*518.9 kg (1144 lb)*	Right Front:	*474.9 kg (1047 lb)*
Left Rear:	*400.1 kg (882 lb)*	Right Rear:	*378.3 kg (834 lb)*
		Total:	*1772.2 kg (3907 lb)*

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 1 of 3)

2020 Subaru Outback Premium/LDD

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

Lane Departure Warning is a subsystem of EyeSight. It is listed on the window sticker (Monroney Label) as Lane Departure and Sway Warning and described in the Eyesight Owner's manual as Lane Departure Warning. .

Lane Departure Warning Setting(s) used in test:

Lane Departure Prevention Function: Warning Buzzer Only

Warning Volume: Max

Type and location of sensor(s) used:

Stereo (2) cameras located behind the windshield on either side of the rearview mirror.

How is the Lane Departure Warning presented to the driver?

(Check all that apply)

- **X** Warning light
- **X** Buzzer or audible alarm
- _____ Vibration
- _____ Other _____

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

The system operates above 50 km/h (30 mph). When the Lane Departure Warning system detects that the vehicle is likely to depart the traffic lane, an alert sounds 3 short beeps and displays a visual alert on the instrument panel as shown in Appendix A, Figure A12.

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

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2020 Subaru Outback Premium/LDD

Is the vehicle equipped with a switch whose purpose is to render LDW inoperable? **X** Yes / ____ No

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

System settings are accessed by means of a touch screen center screen. The hierarchy is:

Settings

Driver Assistance

Lane Departure Prevention Function

Off (select or deselect)

The system is automatically reactivated after cycling the ignition.

Please see EyeSight Owner's Manual, Pages 102, 126 and 127 shown in Appendix B, Pages B-19, B-25 and B-26. See also Appendix A, Figure A10.

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

If yes, please provide a full description.

The warning volume can be adjusted using the system setting menu. The Hierarchy is:

Settings

Others

Warning Volume

Select: Min, Mid, or Max

Please see EyeSight Owner's Manual, Pages 102, 126 and 127 shown in Appendix B, Pages B-19, B-25 and B-26. See also Appendix A, Figure A10 and A11.

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

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2020 Subaru Outback Premium/LDD

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

__X__ Yes

_____ No

If yes, please provide a full description.

Limitations of the system are addressed at length in the EyeSight Owner's Manual, Pages 5 through 9 and Page 101. These are shown in Appendix B, Pages B-2 through B-6 and Page B-18.

Notes:

Section III

TEST PROCEDURES

A. Test Procedure Overview

Each LDW test involved one of three lane marking types: solid white lines, dashed yellow lines, or Botts Dots. Lane departures were done both to the left and to the right, and each test condition was repeated five times, as shown in Table 1.

Table 1. LDW Test Matrix

Lane Geometry	Line Type	Departure Direction	Number of Trials
Straight	Solid	L	5
		R	5
	Dashed	L	5
		R	5
	Botts Dots	L	5
		R	5

Prior to the start of a test series involving a given lane marking type and departure direction combination, the accuracy of the distance to lane marking measurement was verified. This was accomplished by driving the vehicle to the approximate location at which the lane departure would occur and placing the tire at the lane marking edge of interest (i.e., distance to lane marking = 0). The real-time display of distance to the lane marking was then observed to verify that the measured distance was within the tolerance (5 cm). If the measured distance was found to be greater than the tolerance, the instrumentation setup was checked and corrected, if necessary. If the measured distance was found to be within the tolerance, the instrumentation setup was considered appropriate and the test series was begun.

To begin the maneuver, the vehicle was accelerated from rest to a test speed of 72.4 km/h (45 mph), while being driven in a straight line parallel to the lane marking of interest, with the centerline of the vehicle approximately 1.83 m (6.0 ft) from the lane edge (i.e., such that the vehicle would pass through the center of the start gate). The test speed was achieved at least 60 m (200 ft) before the start gate was reached. Striking any start gate cones was not permitted, and any run in which a cone was struck was considered to be invalid. Also, during the initialization and test phases, the test driver avoided using turn signals and avoided applying any sudden acceleration, sudden steering, or sudden braking, and any use of the turn signals, sudden acceleration, sudden steering, or sudden braking invalidated the test trial.

Data collection began with the vehicle at least 60 m (200 ft) from the start gate, which was configured using a pair of non-reflective, low-contrast color traffic cones. A second set of cones, placed 6 m (20 ft) longitudinally before the start gate, was used to guide the driver into the start gate. The lateral width between the cone pairs was 20 cm (8 in) greater than the width of the vehicle, and the centerline of each pair was laterally offset from the lane marking by 1.8 m (6 ft).

Once the driver passed the gate, the driver manually input sufficient steering to achieve a lane departure with a target lateral velocity of 0.5 m/s with respect to the lane line. As shown in Figure 1, two additional non-reflective cones were used to guide the driver in making this steering maneuver. Throughout the maneuver, the driver modulated the throttle or used cruise control, as appropriate, such that vehicle speed remained at constant speed. The test was considered complete when the vehicle crossed at least 1 m (3.3 ft) over the lane edge boundary.

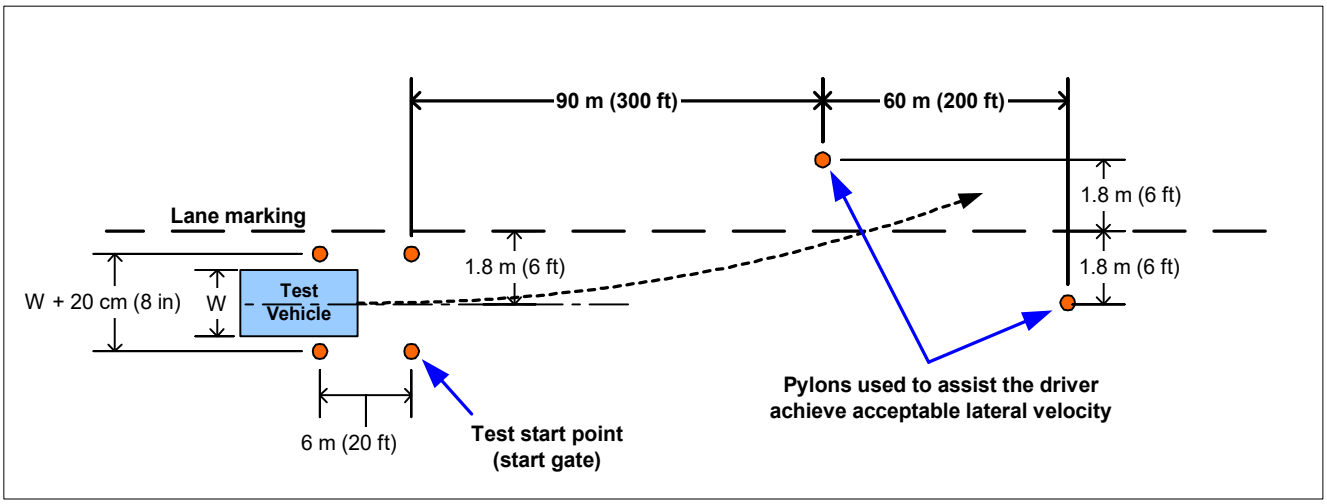


Figure 1. Position of Cones Used to Assist Driver

Data collected included vehicle speed, position, and yaw rate. In addition to cone strikes, vehicle speed and yaw rate data were used to identify invalid runs as described in Section C below. Data from trials where speed or yaw rate were outside of the performance specification were not considered valid.

B. Lane Delineation Markings

The New Car Assessment Program's Test Procedure for the confirmation of a Lane Departure Warning system contains a requirement that all lane markings meet United States Department of Transportation (USDOT) specifications as described in the Manual on Uniform Traffic Control Devices (MUTCD) and be considered in "very good condition".

1. Lane Marker Width

The width of the edge line marker was 10 to 15 cm (4 to 6 in). This is considered to be a normal width for longitudinal pavement markings under Section 3A.05 of the MUTCD.

2. Line Marking Color and Reflectivity

Lane marker color and reflectivity met all applicable standards. These standards include those from the International Commission of Illumination (CIE) for color and the American Society for Testing and Materials (ASTM) on lane marker reflectance.

3. Line Styles

The tests described in this document required the use of three lane line configurations: continuous solid white, discontinuous dashed yellow, and discontinuous with raised pavement markers.

- Continuous White Line

  A continuous white line is defined as a white line that runs for the entire length of the test course.

- Dashed Yellow Line

  As stated in the MUTCD, and as shown in Figure 2, a discontinuous dashed yellow line is defined as by a series of 3 m (10 ft) broken (dashed) yellow line segments, spaced 9.1 m (30 ft) apart.

- Raised Pavement Marker Line (Botts Dots)

  California Standard Plans indicates raised pavement markers are commonly used in lieu of painted strips for marking roads in California. Other states, mainly in the southern part of the United States, rely on them as well. These markers may be white or yellow, depending on the specific application, following the same basic colors of their analogous white and yellow painted lines. Following the California 2006 Standard Plans, three types of raised pavement markings are used to form roadway lines. It is believed that these types of roadway markings are the hardest for an LDW sensor system to process. Type A and Type AY are non-reflective circular domes that are approximately 10 cm (4 in) in diameter and approximately 1.8 cm (0.7 in) high. Type C and D are square markings that are retro reflective in two directions measuring approximately 10 x 10 x 5 cm (4 x 4 x 0.5 in), and Type G and H that are the same as C and D only retro reflective in a single direction.

For the tests described in this document, raised pavement markers were set up following California Standard Plan A20A, Detail 4, as shown in Figure 3. Note that in this figure, the squares are Type D yellow reflectors and the circles are yellow Type AY discs.

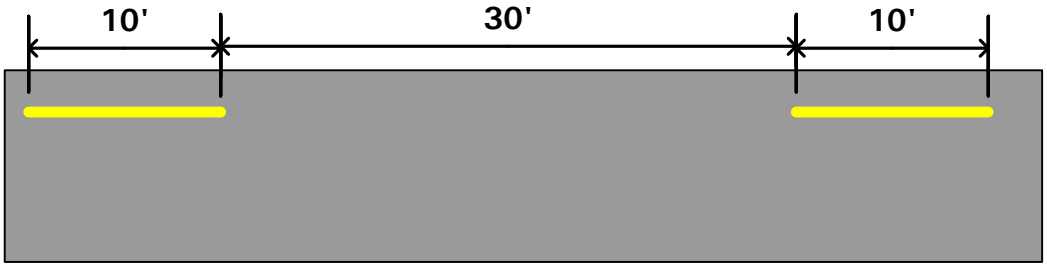


Figure 2. MUTCD Discontinuous Dashed Line Specifications

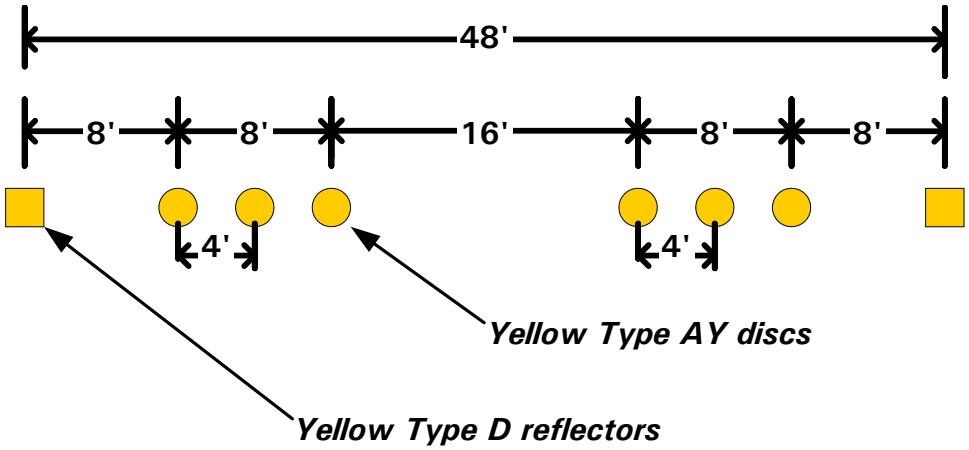


Figure 3. California Standard Plan A20A, Detail 4

C. Test Validity

1. Speed

All LDW tests were conducted at 72.4 km/h (45 mph). Test speed was monitored and a test was considered valid if the test speed remained within ± 2 km/h (± 1.2 mph) of the 72.4 km/h (45 mph) target speed. It was required that the speed must remain within this window from the start of the test until any part of the vehicle crossed a lane line by 1 m (3.3 ft) or more.

2. Lateral Velocity

All tests were conducted with a lateral velocity of 0.1 to 0.6 m/s (0.3 to 2.0 ft/s), measured with respect to the lane line at the time of the alert. To assist the test driver in being able to efficiently establish the target lateral velocity, cones were positioned in the manner shown in Figure 1.

3. Yaw Rate

It was required that the magnitude of the vehicle's yaw rate could not exceed 1.0 deg/sec at any time during lane departure maneuver, from the time the vehicle passes through the start gate to the instant the vehicle has crossed a lane line by 1 m (3.3 ft).

D. Pass/Fail Criteria

The measured test data were used to determine the pass/fail outcome for each trial. The outcome was based on whether the LDW produced an appropriate alert during the maneuver. In the context of this test procedure, a lane departure is said to occur when any part of the two-dimensional polygon used to represent the test vehicle breaches the inboard lane line edge (i.e., the edge of the line close to the vehicle before the departure occurs). In the case of tests performed in this procedure, the front corner of the polygon, defined as the intersection of the center of the front wheels (longitudinally) with the outboard edge of the front tire (laterally), crossed the line edge first. So, for example, if the vehicle departed its lane to the left, the left front corner of the polygon would first breach the lane line edge.

For an individual trial to be considered a "pass":

- Test speed, lateral velocity, and yaw rate validity conditions must be satisfied.
- The LDW alert must not occur when the lateral position of the vehicle is greater than 0.75 m (2.5 ft) from the lane line edge (i.e., prior to the lane departure).
- The LDW alert must occur before the lane departure exceeds 0.3 m (1.0 ft).

For an overall, "Pass" the LDW system must satisfy the pass criteria for 3 of 5 individual trials for each combination of departure direction and lane line type (60%), and pass 20 of the 30 trials overall (66%).

E. Instrumentation

Table 2 lists the sensors, signal conditioning, and data acquisition equipment used for these tests.

Table 2. 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	0.5 psi 3.45 kPa	Ashcroft, D1005PS	17042707002	By: DRI Date: 7/3/2019 Due: 7/3/2020
Platform Scales	Vehicle Total, Wheel, and Axle Load	8000 lb 35.6 kN	±1.0% of applied load	Intercomp, SWII	0410MN20001	By: DRI Date: 4/20/2020 Due: 4/20/2021
Differential Global Positioning System	Position, Velocity	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots	Horizontal Position: ±1 cm Vertical Position: ±2 cm Velocity: 0.05 km/h	Trimble GPS Receiver, 5700 (base station and in-vehicle)	00440100989	NA
Multi-Axis Inertial Sensing System	Position: Longitudinal, Lateral, and Vertical Accels: Lateral, Longitudinal and Vertical Velocities: Roll, Pitch, Yaw Rates: Roll, Pitch, Yaw Angles	Latitude: ±90 deg Longitude: ±180 deg Altitude: 0-18 km Velocity: 0-1000 knots Accel: ±100 m/s^2 Angular Rate: ±100 deg/s Angular Disp: ±180 deg	Position: ±2 cm Velocity: 0.05 km/h Accel: ≤ 0.01% of full range Angular Rate: ≤ 0.01% of full range Roll/Pitch Angle: ±0.03 deg Heading Angle: ±0.1 deg	Oxford Technical Solutions (OXTS), Inertial+	2258	By: Oxford Technical Solutions[1] Date: 5/3/2019 Due: 5/3/2021
Real-Time Calculation of Position and Velocity Relative to Lane Markings	Distance and velocity to lane markings	Lateral Lane Dist: ±30 m Lateral Lane Velocity: ±20 m/sec	Lateral Distance to Lane Marking: ±2 cm Lateral Velocity to Lane Marking: ±0.02m/sec	Oxford Technical Solutions (OXTS), RT-Range	97	NA

[1] Oxford Technical Solutions recommends calibration every two years.

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model	Serial Number	Calibration Dates Last Due
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	NA	NA
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	NA	NA
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

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).	D-Space Micro-Autobox II 1401/1513	
		Base Board	549068
		I/O Board	588523

For systems that implement audible or haptic alerts, part of the pre-test instrumentation verification process is to determine the tonal frequency of the audible warning or the vibration frequency of the tactile warning through use of the PSD (Power Spectral Density) function in Matlab. This is accomplished in order to identify the center frequency around which a band-pass filter is applied to subsequent audible or tactile warning data so that the beginning of such warnings can be programmatically determined. The band-pass filter used for these warning signal types is a phaseless, forward-reverse pass, elliptical (Cauer) digital filter, with filter parameters as listed in Table 3.

Table 3. Audible and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Passband Frequency Range
Audible	5^{th}	3 dB	60 dB	Identified Center Frequency ± 5%
Tactile	5^{th}	3 dB	60 dB	Identified Center Frequency ± 20%

APPENDIX A

Photographs

LIST OF FIGURES

Figure A1. Front View of Subject Vehicle

Figure A2. Rear View of Subject Vehicle

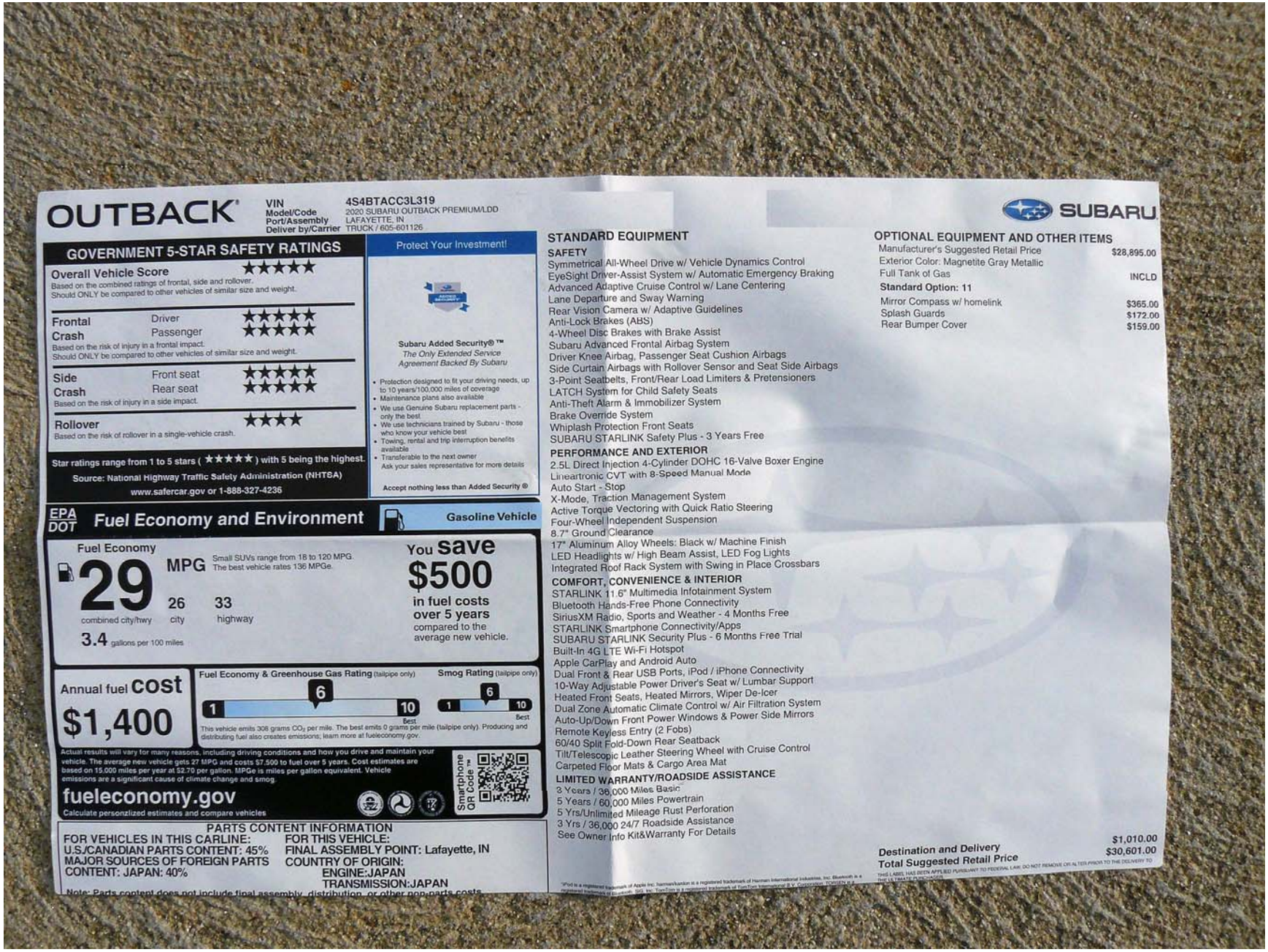


Figure A3. Window Sticker (Monroney Label)

Figure A4. Vehicle Certification Label

Figure A5. Tire Placard

Figure A6. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A7. Sensor for Detecting Auditory Alerts

Figure A8. Sensor for Detecting Visual Alerts

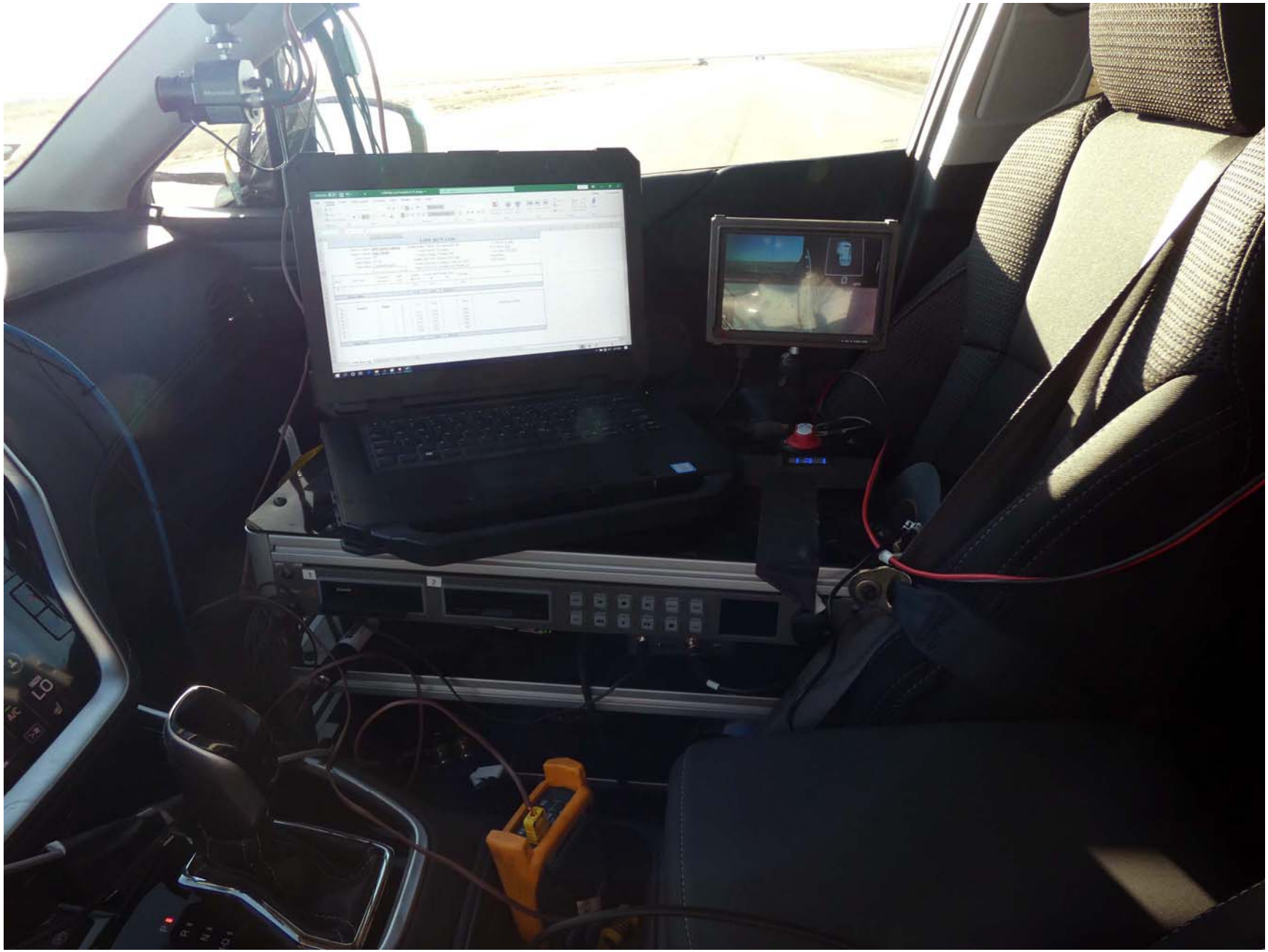


Figure A9. Computer Installed in Subject Vehicle

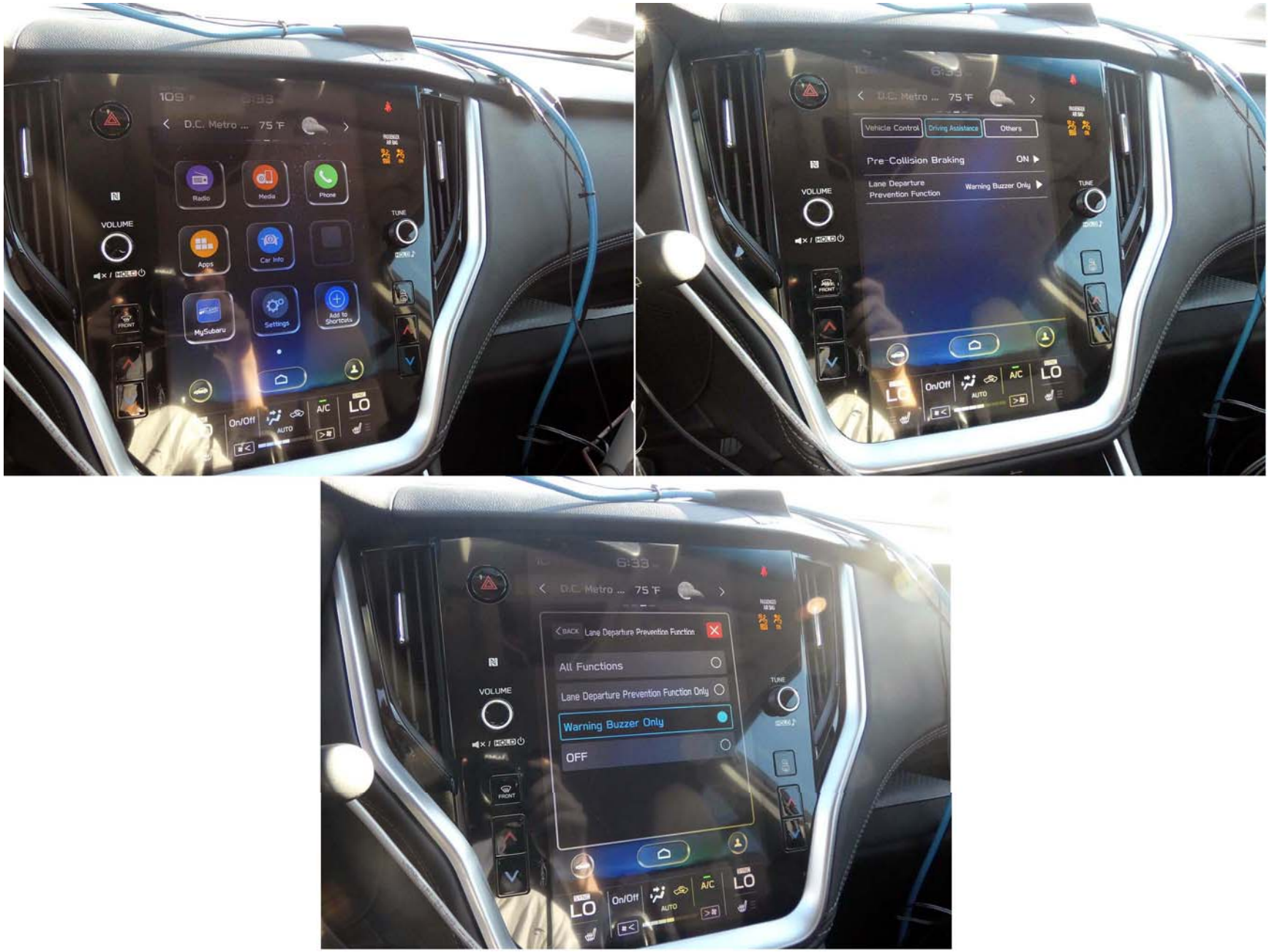


Figure A10. LDW Menus (1 of 2)

Figure A11. LDW Menus (2 of 2)

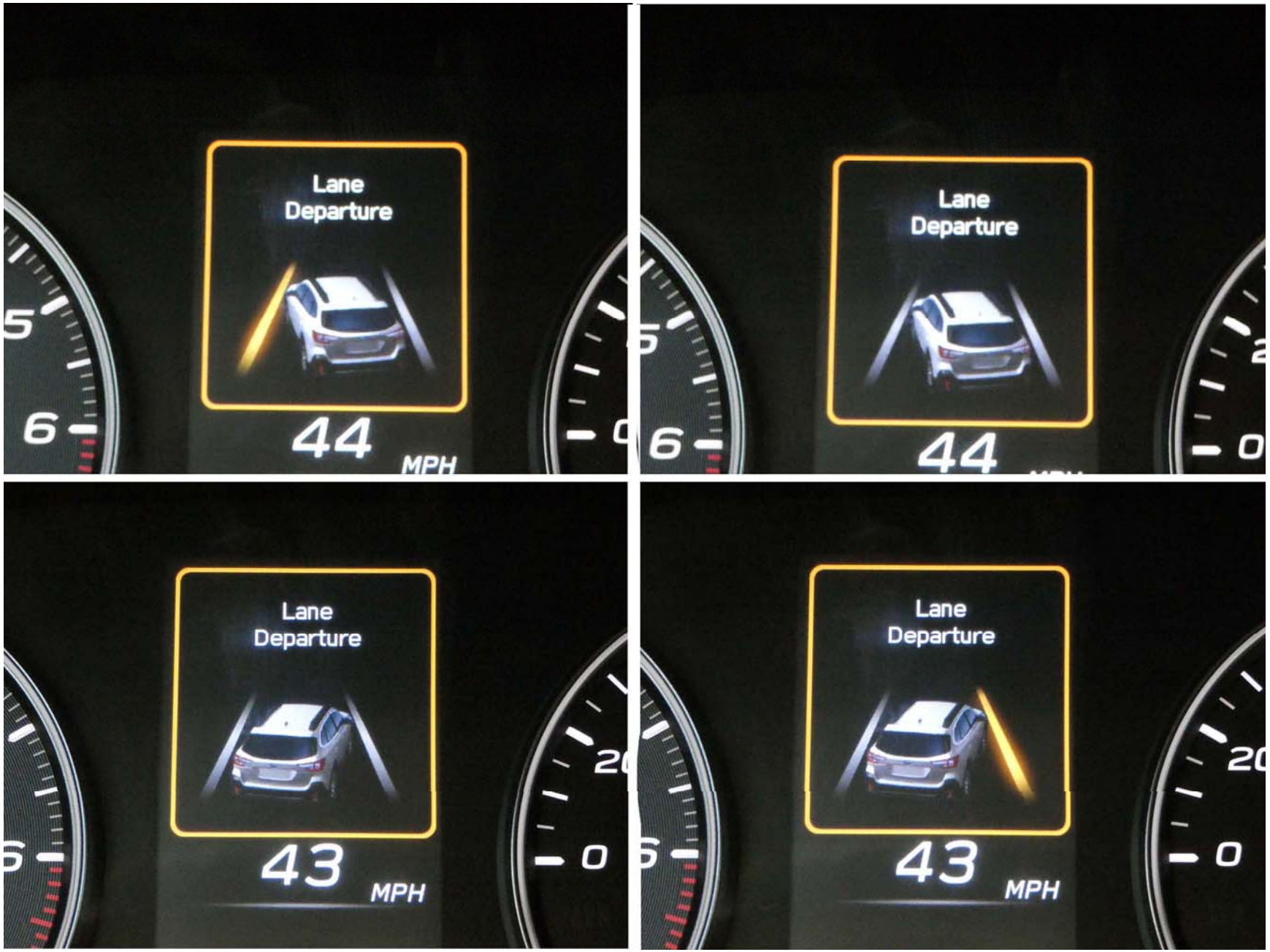


Figure A12. LDW Visual Alert

APPENDIX B

Excerpts from Owner’s Manual

In LHD vehicles, EyeSight is configured for driving on the right-hand side of the road. However, it can be reconfigured by changing the Driving Lane Customize setting for driving on the left-hand side.*
⇒ **Page 126**
If the setting for the traffic lane (driving side of the road) does not match the traffic lane, full EyeSight performance may not be available.
***: Characteristics and settings that are affected by specific differences between RHD and LHD vehicles cannot be changed.**

- The system may not operate correctly under the conditions listed below. When these conditions occur, turn off the Pre-Collision Braking System. Also, do not use Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function or Conventional Cruise Control.
  - The tire pressure is not correct.[*1]
  - The temporary spare tire is installed.[*1]
  - Tires that are unevenly worn or tires with uneven wear patterns are installed.[*1]
  - Tires that are the wrong size are installed.[*1]
  - A flat tire has been fixed temporarily with a tire repair kit.
  - The suspension has been modified (including a genuine SUBARU suspension that has been modified).
  - An object that obstructs the stereo camera's view is installed on the vehicle.
  - The headlights are dirty or they have snow and ice or dirt on them. (Objects are not correctly illuminated and are difficult to detect.)
  - The optical axes are not aligned correctly. (Objects are not correctly illuminated and are difficult to detect.)
  - The lights including headlights and fog lights have been modified.
  - Vehicle operation has become unstable due to an accident or malfunction.
  - The brake system warning light is illuminated in red.[*2]
  - A heavy cargo is loaded onto or inside the vehicle.
  - The maximum number of occupants is exceeded.
  - The combination meter is not operating properly; such as when the lights do not illuminate, the beeps do not sound, the display is different from when it is normal, etc.[*3]

Continued on next page ⇒

⇒ Continued from previous page

- The system will not operate correctly in the following conditions. Do not use Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function or Conventional Cruise Control.
  - The wheels are out of balance (e.g., the balance weight is removed or misaligned).*1
  - The wheels are out of alignment.*1
  - A trailer or another vehicle, etc. is being towed.
- The system may not operate properly under the following conditions. Do not use Lane Centering Function.
  - There is an abnormal vibration in the steering wheel or the steering wheel is heavier than usual.
  - The steering wheel has been replaced with parts other than genuine SUBARU parts.

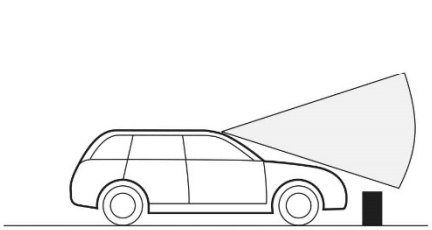
*1: The wheels and tires have functions that are critically important. Be sure to use the correct ones. For details, refer to the Owner's Manual for your vehicle.

*2: If the brake system warning light does not turn off, immediately pull the vehicle over in a safe place and contact a SUBARU dealer to have the system inspected. For details, refer to the Owner's Manual for your vehicle.

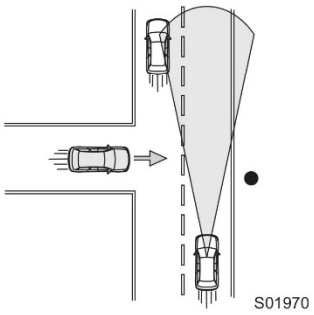
*3: For details about the combination meter, refer to the Owner's Manual for your vehicle.

CAUTION

- The characteristics of the stereo camera are similar to those of human eyes. For this reason, conditions that make it difficult for the driver to see in the forward direction have the same effect on the stereo camera. They also make it difficult for the system to detect vehicles, obstacles, and traffic lanes.
- Detection by the EyeSight system is limited to objects that are within the range of the stereo camera's field of view. Also, after an object enters the range of the camera's field of view, it may take some time for the system to detect it as a controllable target and to warn the driver.



Low objects surrounding the vehicle cannot be detected.



S01970

- Under the conditions listed below, it will become more difficult for the system to detect the vehicle in front, motorcycles, bicycles, pedestrians and obstacles on the road, and lane markers. Also, EyeSight may temporarily stop operating. However, the temporary stop will be canceled once these conditions have improved and the vehicle is driven for a short period of time.
  - Bad weather (for example heavy rain, a blizzard or thick fog). In particular, the system is more likely to temporarily stop operating when there is an oil film adhering to the windshield, a glass coating has been applied, or poorly performing wipers are used.
  - Strong light is coming from the front (sunlight or headlight beams of oncoming traffic, etc.).
  - The windshield washer is in use.
  - Raindrops, water drops, or dirt on the windshield are not wiped off sufficiently.
  - The windshield has become fogged, scratched, or snow, dirt, dust or frost has adhered to it, or it is otherwise affected. These will reduce the stereo camera's field of view.
  - The vehicle is tilted at an extreme angle due to loaded cargo or other factors.

Continued on next page ⇒

⇒ Continued from previous page

- Visibility is poor due to sand, smoke or water vapor blowing in the wind, or the front vision is obscured due to water splashes, snow, dirt or dust stir up generated by the vehicle in front or oncoming traffic.
- The stereo camera's field of view is obstructed (for example by a canoe on the roof of the vehicle).
- Through the entrance or exit of a tunnel
- The rear aspect of the vehicle in front is low, small or irregular (for example a low bed trailer, etc.).
- The obstacle is a fence, a wall or a shutter, etc. with a uniform pattern (a striped pattern, brick, etc.) or with no pattern in front.
- The obstacle is a wall or door made of glass or a mirror in front.
- Driving at night or in a tunnel when there is a vehicle in front that does not have its taillights on
- Driving through a banner or flag, low branches on a tree or thick/tall vegetation
- On steep uphill or downhill grades
- The stereo camera is obstructed by a hand, etc. (If even one of the lenses is obstructed, the system does not operate properly.)
- It is completely dark and no objects are detected.
- The area around the vehicle has a uniform color (such as when completely covered in snow, etc.).
- Accurate detection is not possible due to reflections in the windshield.

• Under the conditions listed below, EyeSight may temporarily stop operating. If this occurs, EyeSight will resume operating when the conditions improve.
- The temperature inside the vehicle is high, such as after the vehicle was left in bright sunshine, or the temperature inside the vehicle is low, such as after the vehicle was left in an extremely cold environment.
- Immediately after the engine starts

• Under the conditions listed below, it is difficult to recognize vehicles in front, motorcycles, pedestrians, obstacles on the road, traffic lanes, etc. Also, the EyeSight system may temporarily stop operating. If the EyeSight system repeatedly stops operating several times, contact a SUBARU dealer and have the system inspected.
- The stereo camera lenses are smeared such as from fingerprints.
- The stereo camera has become misaligned due to a strong impact.

- When there is a malfunction in the EyeSight system, turn off the Pre-Collision Braking System (⇒ page 41) and the Lane Departure Warning (⇒ page 102), and stop using the Adaptive Cruise Control, Lane Centering Function, Lane Departure Prevention Function and Conventional Cruise Control. Contact a SUBARU dealer and have the system inspected.
- When the Vehicle Dynamics Control warning light is illuminated, the Pre-Collision Braking System may not operate properly. If the indicator light is illuminated, turn off the Pre-Collision Braking System. Also, do not use the Adaptive Cruise Control or Conventional Cruise Control.

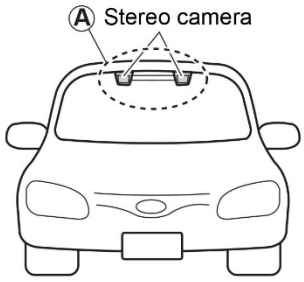
NOTE

EyeSight records and stores the following data when the Pre-Collision Braking System is operated. It does not record conversations or other audio data.

- Stereo camera image data
- Distance from the vehicle in front
- Vehicle speed
- Steering wheel turning angle
- Lateral movement with regards to the direction of travel
- Accelerator pedal operation status
- Brake pedal operation status
- Select lever position
- Odometer reading
- Data related to ABS, Vehicle Dynamics Control and Traction Control Function SUBARU and third parties contracted by SUBARU may acquire and use the recorded data for the purpose of vehicle research and development. SUBARU and third parties contracted by SUBARU will not disclose or provide the acquired data to any other third party except under the following conditions.
  - The vehicle owner has given his/her consent.
  - The disclosure/provision is based on a court order or other legally enforceable request.
  - Data that has been modified so that the user and vehicle cannot be identified is provided to a research institution for statistical processing or similar purposes.

Handling of the Stereo Camera

The stereo camera is located on the front map lights unit.

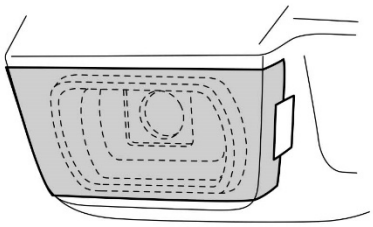


S01107

⚠ CAUTION

- The stereo camera monitors and detects smears or blurs on the front of the camera. However, detection is not 100% accurate.
  Under certain conditions, the function may fail to detect smears or blurs on the front of the stereo camera accurately. In addition, this function may not detect that there is snow or ice on the windshield close to the stereo camera. In such conditions, be sure to keep the windshield clean at all times (indicated by Ⓐ). Otherwise the system may not operate correctly. When this function detects that the front of the stereo camera is smeared or blurred, no EyeSight functions can be activated except for Conventional Cruise Control.
- The stereo camera lenses are precision components. Always observe the following precautions especially when handling them.
  - Never touch the stereo camera lenses, and do not attempt to wipe or clean the lenses. Doing so could damage or soil the lens, and lead to improper system performance.
    If you ever touch a lens for any reason, be sure to contact a SUBARU dealer.

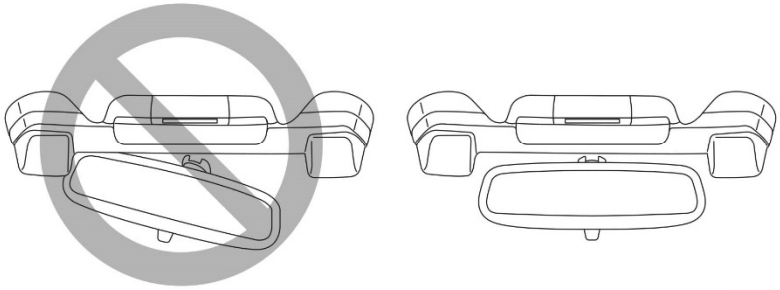
- When cleaning the windshield, cover the front of the camera casing with paper that does not collect dust, such as copy paper. Affix the paper to prevent glass cleaner from getting on the camera lenses. At this point, make sure that the tape's adhesive surface does not come in contact with the windshield or the lens. Be sure to remove the paper after cleaning.



S03066

- When having the inside of windshield cleaned at a service station, etc., be sure to request that the attendant covers the camera covers before washing the vehicle.
- Do not subject the stereo camera to a strong impact.
- Do not remove or disassemble the stereo camera.
- Do not change the positions where the stereo camera is installed or modify any of the surrounding structures.

• Do not install an interior rearview mirror other than a genuine SUBARU rearview mirror (such as a wide-type mirror) and the sun visor. Also, use the rearview mirror so that it does not obstruct the stereo camera. Failure to do so may affect the stereo camera's field of view and could prevent the EyeSight system from functioning properly.



S00509

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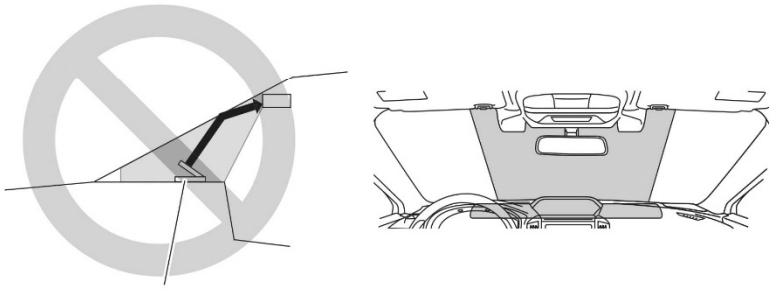
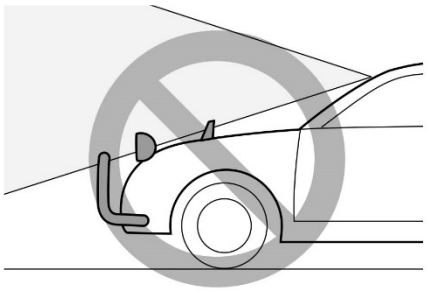
- Do not install any accessories other than the ones designated by SUBARU on the prohibited areas shown in the illustrations (gray zones).
  Even if some accessories are installed on the outside of the prohibited areas, abnormal operation of EyeSight may occur due to the reflection of the light or any objects. In this situation, move the accessories. For details, contact a SUBARU dealer.

Side view **Front view**



- Do not place any objects on top of the instrument panel. The stereo camera may not be able to detect objects accurately and the EyeSight system may not function properly due to reflections in the windshield. For details, contact a SUBARU dealer.
- If the top of the instrument panel is polished with chemicals or other substances, the stereo camera may not be able to detect objects accurately and the EyeSight system may not operate properly due to reflections in the windshield.
- Do not install any wiper blades other than genuine SUBARU wiper blades. Doing so may affect the stereo camera's field of view and could prevent the EyeSight system from functioning properly.
- Replace damaged wiper blades or worn wiper blade rubbers as soon as possible. Using damaged wiper blades or worn wiper blade rubbers may cause streaking on the windshield. The stereo camera may not be able to detect objects accurately and the EyeSight system may not function properly due to streaks or droplets remaining on the windshield.

- Do not install any accessories on the front side such as on the hood or the grille. It may affect the camera view and the system may not operate correctly.
- Make sure that the cargo loaded on the roof does not interfere in the stereo camera's field of view. Obstructing the stereo camera's view may impair the system operation. For details, contact a SUBARU dealer.



S01098

- Keep the windshield (outside and inside) clean at all times. When the windshield has become fogged, or it has a dirt or an oil film on it, the stereo camera may not detect objects accurately and the EyeSight system may not operate correctly. Never mount any device to the center air vent, as any airflow change may impact performance of the EyeSight system.
- Do not place any stickers or accessories on the windshield (outside or inside). If you have to do so (for example, legally required or electronic toll tag), avoid the area directly in front of the camera. Otherwise, it may adversely affect the field of view of the stereo camera and can cause improper operation of the system. For details, contact a SUBARU dealer.
- Do not use any glass coating agents or similar substances on the windshield. Doing so may interfere with the proper operation of the system.
- Do not install any film or an additional layer of glass on the windshield. The system may not operate correctly.
- If there are scratches or cracks on the windshield, contact a SUBARU dealer.
- To have the windshield replaced or repaired, contact a SUBARU dealer. Do not install a windshield other than a genuine SUBARU windshield. The stereo camera may not be able to detect objects accurately and the EyeSight system may not operate properly.

EyeSight Functions

EyeSight includes the following functions.

■ Pre-Collision Braking System

This function uses a following distance warning feature to warn the driver to take evasive action when there is the possibility of a collision with a vehicle or obstacle in front of you. If the driver does not take evasive action, the brakes are applied automatically to help reduce vehicle collision damage or, if possible, help prevent a collision.
⇒ Page 27

■ Advanced Adaptive Cruise Control

Adaptive Cruise Control

This function maintains the set vehicle speed and when there is a vehicle in front in the same traffic lane, it follows the speed of the vehicle in front up to the maximum of the set vehicle speed.
⇒ Page 43

Lane Centering Function

This function helps suppress lane drifting by detecting lane markings (e.g., white lines) and the lead vehicle on expressways, freeways and interstate highways, and by assisting steering operation. Lane Centering Function will work only when the Adaptive Cruise Control is activated.
⇒ Page 71

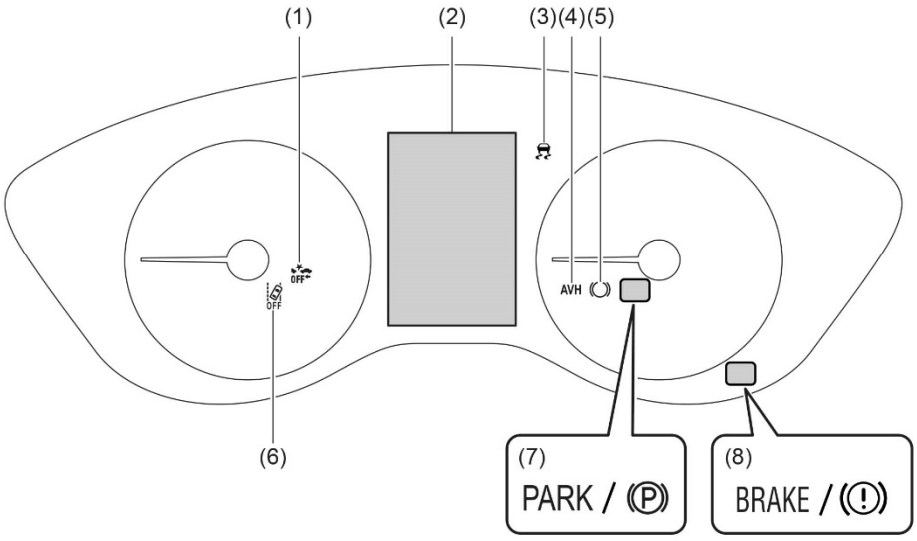
■ Lane Departure Prevention Function

When driving on expressways, freeways, or interstate highways, the system recognizes the lane markings on both sides of the vehicle. If the vehicle appears likely to depart from the lane, the system assists with steering operation in the direction that prevents the lane departure, preventing the vehicle from leaving the lane.
⇒ Page 84

■ Pre-Collision Throttle Management

This function reduces accidental forward movement caused by the select lever being placed in the wrong position or the accelerator pedal being accidentally depressed, or depressed too strongly.
⇒ Page 93

Instrument panel display layout



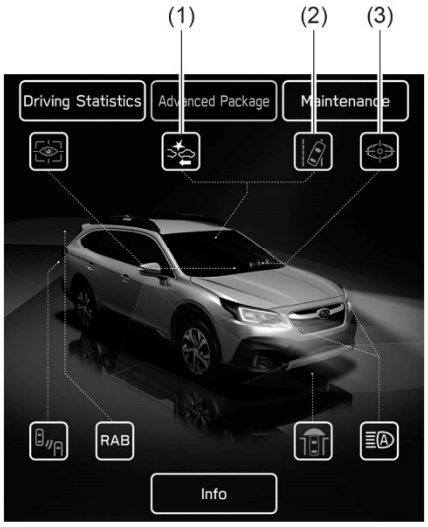
S03537

(1) Pre-Collision Braking System OFF indicator light
(2) Combination meter display
(3) Vehicle Dynamics Control warning light
(4) Auto Vehicle Hold ON indicator light
(5) Auto Vehicle Hold operation indicator light
(6) Lane Departure Warning OFF indicator light
(7) Electronic parking brake indicator light
(8) Brake system warning light

	**Select lever/gear position indicator** This indicator illuminates and shows which position the select lever or the gear is in.
	**EyeSight warning indicator (yellow)** • This indicator illuminates or flashes when a malfunction occurs in the EyeSight system. • When it is illuminated or flashing, none of the EyeSight functions can be used (including Adaptive Cruise Control and the Pre-Collision Braking System, etc.). ⇒ Page 122
	**EyeSight temporary stop indicator (white)** • This indicator illuminates when the EyeSight system is temporarily stopped. • When the ignition switch is placed in the ON position, it will illuminate if the (CRUISE) switch or (Lane Centering) switch is set to ON within approximately 7 seconds of the engine starting. It turns off when approximately 7 seconds have elapsed since the engine started. • When it is illuminated, none of the EyeSight functions can be used except for Conventional Cruise Control. ⇒ Page 124
	**Auto Start Stop indicator (green) (also used as Auto Start Stop warning indicator (yellow))** • This indicator illuminates in yellow when the ignition switch is turned to the ON position, and then it turns off after the engine starts. • It illuminates in green while the Auto Start Stop system operates. It turns off after the engine restarts. • It illuminates in yellow if a malfunction occurs in the Auto Start Stop system.
	**Auto Start Stop OFF indicator** This indicator illuminates when the Auto Start Stop system is turned off. It turns off when the Auto Start Stop system is turned on. ⇒ Refer to the vehicle Owner's Manual for details.
	**Auto Start Stop No Activity Detected indicator light** When a vehicle is stopped, the indicator light illuminates when the operating conditions of the Auto Start Stop system are not met. The light will turn off when the vehicle starts driving.
	**X-MODE indicator (if equipped)** The X-MODE indicator illuminates when the X-MODE is on. ⇒ Refer to the vehicle Owner's Manual for details.

	**Lane Departure Warning OFF indicator light** • This indicator light illuminates when the Lane Departure Warning and Lane Sway Warning are off. • It also illuminates when the ignition switch is turned to the ON position. Approximately 7 seconds after the engine starts, the Lane Departure Warning OFF indicator light will turn off or remain illuminated depending on the current status (ON or OFF). ⇒ Pages 102 and 105
	**Pre-Collision Braking System OFF indicator light** • This indicator light illuminates when the Pre-Collision Braking System and Pre-Collision Throttle Management are off. • It also illuminates when the ignition switch is turned to the ON position, and then turns off approximately 7 seconds after the engine starts. ⇒ Pages 42 and 99
	**Lane indicator** • This indicator illuminates in gray when the Lane Departure Prevention Function is turned on. • It illuminates in white under the following conditions. - The Lane Departure Prevention Function goes into the standby status. - Lane Centering Function is operating by detecting the lane markings. • It illuminates in yellow when the Lane Departure Prevention Function is operating. ⇒ Pages 80 and 89
	**Brake system warning light** If the brake system warning light illuminates when the electronic parking brake is released while driving, turn the Pre-Collision Braking System off. At this time, do not use the Conventional Cruise Control mode or Adaptive Cruise Control mode. If the brake system warning light does not turn off, immediately pull the vehicle over to a safe location. Contact a SUBARU dealer to have the system inspected. ⇒ Refer to the vehicle Owner's Manual for details.
	**Electronic parking brake indicator light** This indicator light illuminates when the electronic parking brake is applied. ⇒ Refer to the vehicle Owner's Manual for details.
	**Your vehicle indicator** When the brake pedal is depressed or the brake control function is activated, the brake indicator light illuminates in red.

Center information display



S03520

(1) Pre-Collision Braking System indicator
(2) Lane Departure/Sway Warning indicator
(3) EyeSight Assist Monitor

The settings of the on-board systems can be changed by operating the center information display.
Warning screens will be displayed on the center information display as needed.

●Pre-Collision Braking System indicator

This indicator illuminates when the Pre-Collision Braking System is on.

●Lane Departure/Sway Warning indicator

This indicator illuminates when the Lane Departure Warning and Lane Sway Warning are on.

●EyeSight Assist Monitor

This indicator illuminates when the EyeSight Assist Monitor is on.

■ Changing settings

The EyeSight settings can be changed by operating the center information display.
⇒ Page 126

The following systems can also be turned ON/OFF by operating the center information display.

- Vehicle Dynamics Control
- X-MODE (if equipped)
- Auto Vehicle Hold (AVH)

⇒ Refer to the vehicle Owner's Manual for details.

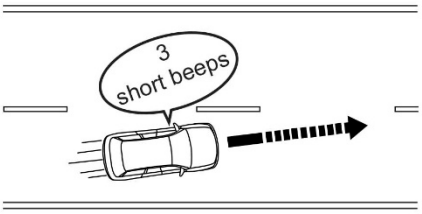
■ Warning screens

The following warning screens will be displayed on the center information display.

Item	Displayed screen
Pre-Collision Braking System warning (first braking and secondary braking)	 S03539
"Obstacle Detected" warning	
Lane Centering Function warning (no-operation of the steering wheel)	 S03540
Lane Centering Function cancellation (no-operation of the steering wheel)	 S03541

Lane Departure Warning

When vehicle speed is approximately 30 mph (50 km/h) or more, this function warns the driver if the system detects that the vehicle is likely to depart the traffic lane.
When the Lane Departure Warning activates, an alert sounds 3 short beeps and an interruption screen will be displayed.



S02416

S03428

*: The illustration depicts a vehicle about to cross the left line.

WARNING

Lane Departure Warning will not operate in all conditions. It also will not automatically return the vehicle to the original lane. If the driver relies only on the Lane Departure Warning to keep the vehicle in the lane, lane departure may occur, resulting in an accident.
The Lane Departure Warning activates when it detects lane markings. However, it is not a function which can detect the edge of a road (shoulders or side ditches, etc.) and warn the driver.

CAUTION

In the following situations, the Lane Departure Warning may not activate:

- Vehicle speed is approximately 30 mph (50 km/h) or less.
- The steering wheel is turned significantly to either side.
- The vehicle is driving around a curve whose radius is 0.18 miles (300 m) or smaller.
- The brake pedal is depressed or immediately after it is depressed.
- The following distance behind a vehicle in front is short.
- The turn signal is operating.
- For approximately 4 seconds after the turn signal lever has returned to its original position
- The vehicle has not returned to the inside of the lane after the Lane Departure Warning has activated.
- The lane is narrow.
- It is difficult for the camera to detect lane markings.
  - There are no lane markings or they are very worn.
  - The lane markings are yellow.
  - The lane markings are similar in color to the road surface.
  - The lane markings are narrow.

NOTE

- The following situations may cause incorrect lane detection and a faulty Lane Departure Warning to occur.
  - There are tire tracks on a wet road or snow-covered road.
  - There are boundaries between snow and asphalt, or marks from road repair, etc.
  - There are the shadows of guardrails.
  - Lane markings are drawn in double.
  - There are some lane markings left from roadwork or markings from the previous road.
- When the Lane Departure Warning OFF indicator light is illuminated, the Lane Departure Warning is inactive.
  ⇒ Page 102

Turning on/off Lane Departure Warning

Operate the center information display to turn on/off the Lane Departure Warning.
This function is turned on by selecting “All Functions” or “Warning Buzzer Only” on the “Lane Departure Prevention Function” screen of the EyeSight settings.
This function is turned off by selecting “Lane Departure Prevention Function Only” or “OFF” on the “Lane Departure Prevention Function” screen of the EyeSight settings.
⇒ Page 126

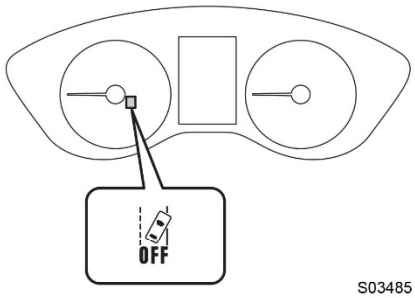
The Lane Departure Warning on/off setting interlocks with the Lane Sway Warning setting.
- When this function is turned off, the Lane Departure Warning OFF indicator light illuminates.
- When this function is turned on, the Lane Departure Warning OFF indicator light turns off.

NOTE

The ON/OFF status of the Lane Departure Warning is restored when you restart the engine.

■ Lane Departure Warning OFF indicator light

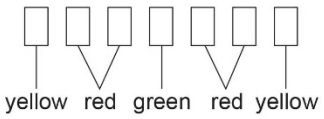
This indicator illuminates when the ignition switch is turned to the ON position, and then approximately 7 seconds after the engine starts, it turns off or remains illuminated depending on the current status (ON or OFF).
It turns on when the Lane Departure Warning and Lane Sway Warning are turned off.
It also illuminates under the following conditions.
- The EyeSight system has a malfunction.
  ⇒ Page 122
- The EyeSight system has stopped temporarily.
  ⇒ Page 124



S03485

EyeSight Assist Monitor Operation

When the ignition switch is turned to the ON position, the LED indicators will illuminate in the order of Yellow → Red → Green.
When EyeSight Assist Monitor customization is turned on they will illuminate twice.
To inform the driver of the operation condition of EyeSight while driving, the LED indicators are illuminated according to the operation condition of EyeSight and the light they emit is projected on the lower part of the windshield.



S02293

Display	Condition
Red indicators flash simultaneously (4 indicators)	• The Following Distance Warning, Pre-Collision Braking System (first braking or secondary braking), Obstacle Detected Warning or Pre-Collision Throttle Management is operating. • Lane Centering Function was canceled when there was no operation of the steering wheel.
Red indicator flashes (one side)	When Lane Centering Function is active and the vehicle appears likely to depart the lane. The side where the vehicle has left its lane flashes, and the side that has not left its lane illuminates.
Yellow indicator flashes (one side)	The Lane Departure Warning is operating. The side where the vehicle has left its lane flashes, and the side that has not left its lane illuminates.
Yellow indicators flash (alternately)	Lane Sway Warning is operating.
Yellow indicators illuminate simultaneously	• Steering wheel operation is not detected for a certain period of time. • Lane Centering Function was canceled automatically by the system (flashing rapidly). • Lane Departure Prevention Function was canceled automatically by the system (flashing rapidly).
Green indicator illuminates	A vehicle is detected ahead while Adaptive Cruise Control is operating.

CAUTION

When shifting the select lever to the [N] position, Conventional Cruise Control will be automatically canceled. Do not shift the lever to the [N] position unless it is an emergency. Otherwise the engine brake may not operate, which could cause an accident.

NOTE

- If EyeSight is malfunctioning, the EyeSight warning indicator is displayed on the combination meter display and the Pre-Collision Braking System OFF indicator light and Lane Departure Warning OFF indicator light illuminate. If this occurs, stop the vehicle in a safe location and then turn off the engine and restart it. If the indicators remain illuminated after restarting the engine, Conventional Cruise Control cannot be used. This will not interfere with ordinary driving. However, the system should be inspected by a SUBARU dealer as soon as possible.
  ⇒ Page 122
- When operation of Conventional Cruise Control has been automatically canceled, perform the set operation again after the condition that caused the cancellation has been resolved. If cruise control cannot be activated even after the condition has been corrected, EyeSight may be malfunctioning. This will not interfere with ordinary driving. However, the system should be inspected by a SUBARU dealer as soon as possible.

List of alert/notification sounds

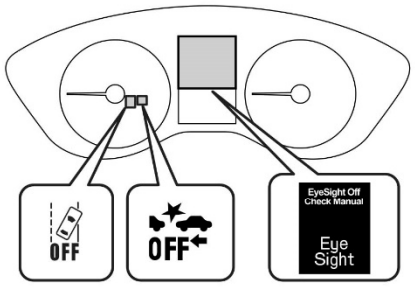
Alert/notification sound	Status	Reference page
Single continuous beep	Pre-Collision Braking System: Secondary Braking is active.	⇒ Page 36
1 short beep and 1 long beep	Adaptive Cruise Control or Conventional Cruise Control is canceled automatically.	⇒ Pages 65 and 117
	The stay-stopped function is canceled and the electronic parking brake is automatically applied.	⇒ Page 65
	Lane Centering Function or Lane Departure Prevention Function is canceled automatically.	⇒ Page 81
1 short beep and 1 long beep (repeated)	Lane Centering Function is automatically canceled because no steering operations are detected for a long period of time.	⇒ Page 82
Repeated short beeps	Pre-Collision Braking System: First Braking is active.	⇒ Page 36
	Pre-Collision Braking System: The following distance warning is active.	
	The “Obstacle Detected” warning from Adaptive Cruise Control is active.	⇒ Page 69
	Pre-Collision Throttle Management is active.	⇒ Page 93
2 short beeps	The system does not detect steering operation by the driver for a certain period of time when Lane Centering Function is operating.	⇒ Page 82
3 short beeps	Lane Centering Function is active and the vehicle appears likely to depart the lane.	⇒ Page 83
	The Lane Departure Warning is active.	⇒ Page 100
	The Lane Sway Warning is active.	⇒ Page 103

EyeSight malfunction and temporary stop

If a malfunction is detected in the EyeSight system, the indicators in the instrument panel and the combination meter display inform the driver of the malfunction. Check the displayed contents and take the appropriate action.

■ Malfunction (including position/angle misalignment of stereo camera)

The alert sounds 1 short beep and the EyeSight warning indicator (yellow) flashes or illuminates. At the same time, the Pre-Collision Braking System OFF indicator light and the Lane Departure Warning OFF indicator light will illuminate. A message will also be displayed on the combination meter display.



S03562

Displayed screen	Cause	Action
EyeSight Off Check Manual S03005	An EyeSight malfunction or position/angle misalignment of stereo camera has occurred.	Inspection and adjustment is necessary. Contact your SUBARU dealer.

CAUTION

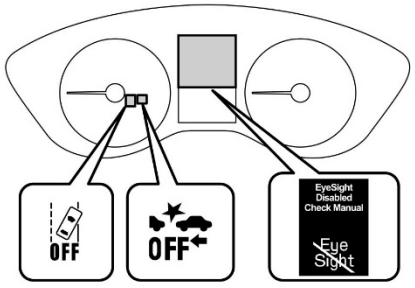
If both the EyeSight warning indicator and the CHECK ENGINE warning light/malfunction indicator light illuminate at the same time while driving, have your vehicle checked/repaired by a SUBARU dealer as soon as possible. EyeSight cannot be used if there is an abnormality with the engine, etc.

■ Temporary stop

The alert will sound one short beep, and the EyeSight temporary stop indicator (white), Pre-Collision Braking System OFF indicator light and Lane Departure Warning OFF indicator light will illuminate at the same time.

A message will also be displayed on the combination meter display.

When the cause has been resolved, temporary stop will be canceled and the EyeSight system will automatically restart.

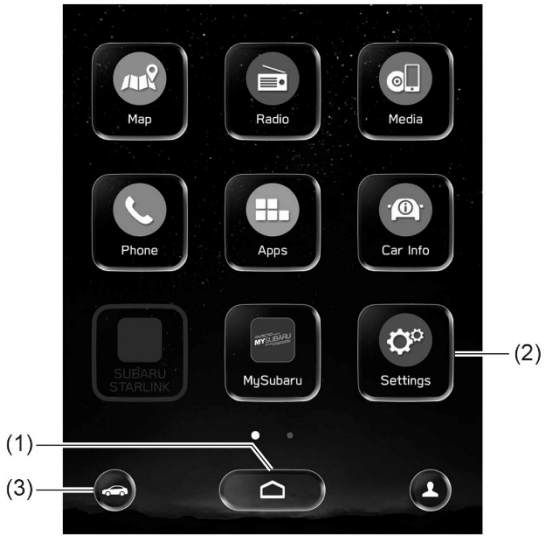


S03563

Displayed screen	Cause	Action
EyeSight Disabled No Camera View S02996	It is difficult for the stereo camera to detect objects in front. • The windshield is dirty or fogged up. • Poor weather conditions • Strong light from the front	• Clean the windshield. • In poor weather conditions or if there is strong light from the front, the EyeSight system will restart once you have driven your vehicle for a period of time and the conditions affecting the system have improved. If the system does not restart, even after the conditions have improved and a period of time has elapsed, contact your SUBARU dealer for an inspection.
EyeSight Disabled Temp Range S02997	In low or high temperatures	The system will restart once the temperature is within the operational range of the EyeSight system. If the system does not restart, even when the temperature inside the vehicle is within the operational range, contact your SUBARU dealer for an inspection.

Changing settings

■ 11.6-inch display models (if equipped)



S03581

(1) HOME icon
(2) Settings icon
(3) Car settings icon

Change the EyeSight system setting as follows:
1. Touch (HOME).
2. → (Settings)
3. → “Car”
4. Select the preferred menu.

The setting adjustments to the following items can be manually changed to meet your personal requirements.

Item		Setting
EyeSight	Pre-Collision Braking	Setting ON/Setting OFF
	Lane Departure Prevention Function	All Functions/ Lane Departure Prevention Function Only/ Warning Buzzer Only/ OFF
	Cruise Control Acceleration Characteristics	Lv. 1 (Eco)/ Lv. 2 (Comfort)/ Lv. 3 (Standard)/ Lv. 4 (Dynamic)
	Select Drive on Left/Drive on Right	Right Lane/ Left Lane
	Lead Vehicle Acquisition Sound	ON/OFF
	Lead Vehicle Moving Monitor	ON/OFF
EyeSight Assist Monitor	Red Indicator	ON/OFF
	Yellow Indicator	ON/OFF
	Green Indicator	ON/OFF
Warning Volume	—	Min/Mid/Max

Touch  (Car settings icon) to display the items that are changeable while driving.
Change the EyeSight system setting as follows:
1. Touch  (Car settings icon).
2. Select the preferred menu.

Item		Setting
Driving Assistance	Pre-Collision Braking	Setting ON/Setting OFF
	Lane Departure Prevention Function	All Functions/ Lane Departure Prevention Function Only/ Warning Buzzer Only/ OFF
Others	Cruise Control Acceleration Characteristics	Lv. 1 (Eco)/ Lv. 2 (Comfort)/ Lv. 3 (Standard)/ Lv. 4 (Dynamic)
	Warning Volume	Min/Mid/Max

●Lead Vehicle Acquisition Sound setting

The Lead Vehicle Acquisition Sound setting can be activated (ON) or deactivated (OFF).

●Lead Vehicle Moving Monitor Function

The Lead Vehicle Start Alert function setting can be activated (ON) or deactivated (OFF).

●EyeSight Assist Monitor

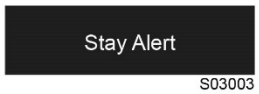
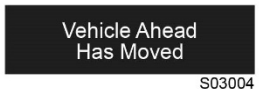
The ON/OFF operation assigned to each EyeSight Assist Monitor LED indicator can be set for color.

Display	Condition
Red indicators flash simultaneously (4 indicators)	• The Following Distance Warning, Pre-Collision Braking System (first braking or secondary braking), Obstacle Detected Warning or Pre-Collision Throttle Management is operating. • Lane Centering Function was canceled when there was no operation of the steering wheel.
Red indicator flashes (one side)	When Lane Centering Function is active and the vehicle appears likely to depart the lane. The side where the vehicle has left its lane flashes, and the side that has not left its lane illuminates.
Yellow indicator flashes (one side)	The Lane Departure Warning is operating. The side where the vehicle has left its lane flashes, and the side that has not left its lane illuminates.
Yellow indicators flash (alternately)	Lane Sway Warning is operating.
Yellow indicators illuminate simultaneously	• Steering wheel operation is not detected for a certain period of time. • Lane Centering Function was canceled automatically by the system (flashing rapidly). • Lane Departure Prevention Function was canceled automatically by the system (flashing rapidly).
Green indicator illuminates	A vehicle is detected ahead while Adaptive Cruise Control is operating.

●Warning Volume setting

The volume can be set to Max/Mid/Min.

■ Message screen list (precautions and notices)

Item	Displayed screen	ⓘ mark	Reference page
Pre-Collision Braking System		None	⇒ Page 36
The “Obstacle Detected” warning	 S02999	None	⇒ Page 69
Pre-Collision Throttle Management		None	⇒ Page 93
Apply Brake	 S03000	None	⇒ Page 39
Lane Departure Warning	 S03002	None	⇒ Page 100
Lane Sway Warning	 S03003	None	⇒ Page 103
Lead vehicle Start Alert	 S03004	None	⇒ Page 106
Steering operation is not detected by Lane Centering Function or Lane Departure Prevention Function	 S03314	None	⇒ Pages 82 and 92

APPENDIX C

Run Log

Subject Vehicle: **2020 Subaru Outback Premium/LDD** Test Date: **5/28/2020**

Driver: **S. Judy** **Note: For 'Distance at Warning', positive values indicate inside the lane**

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
1	**Botts**	**Right**	Y	0.19	0.10	Pass	
2			Y	0.30	0.22	Pass	
3			Y	0.17	0.11	Pass	
4			Y	0.18	0.09	Pass	
5			Y	0.22	0.15	Pass	
6			Y	0.10	0.04	Pass	
7			Y	0.20	0.12	Pass	
8	**Botts**	**Left**	Y	0.03	-0.05	Pass	
9			N				Yaw Rate
10			Y	0.16	0.09	Pass	
11			Y	0.08	-0.03	Pass	
12			Y	-0.02	-0.11	Pass	
13			Y	0.11	0.06	Pass	
14			Y	0.07	0.02	Pass	
15			Y	0.12	0.03	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
16	**Solid**	**Right**	N				Lateral lane velocity
17			N				Yaw rate
18			Y	0.16	0.11	Pass	
19			N				Yaw rate
20			Y	0.22	0.08	Pass	
21			Y	0.16	0.06	Pass	
22			Y	0.11	0.03	Pass	
23			Y	0.18	0.10	Pass	
24			Y	0.18	0.04	Pass	
25			Y	0.30	0.17	Pass	
26	**Solid**	**Left**	N				Speed
27			Y	0.34	0.22	Pass	
28			N				Speed
29			Y	0.17	0.09	Pass	
30			N				Speed
31			N				Speed
32			Y	0.25	0.11	Pass	
33			N				Speed
34			N				Speed
35			Y	0.15	0.07	Pass	
36			Y	0.30	0.24	Pass	
37			Y	0.40	0.29	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
38			Y	0.16	0.08	Pass	
39			N				Yaw
40			Y	0.24	0.14	Pass	
41			N				Yaw
42			N				Yaw
43			Y	0.28	0.21	Pass	
44			Y	0.24	0.13	Pass	
45	**Dashed**	**Left**	Y	0.17	0.07	Pass	
46			Y	0.14	0.00	Pass	
47			Y	0.13	0.07	Pass	
48			N				Yaw
49			N				Speed
50			N				Yaw
51			Y	0.04	-0.04	Pass	
52			Y	0.15	0.02	Pass	
53			N				Lateral lane velocity
54			Y	0.17	0.05	Pass	
55	**Dashed**	**Right**	Y	0.12	0.05	Pass	
56			Y	0.12	0.06	Pass	
57			Y	0.19	0.07	Pass	
58			Y	0.20	0.15	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
59			Y	0.18	0.05	Pass	

APPENDIX D

Time History Plots

LIST OF FIGURES

Description of Time History Plots

A set of time history plots is provided for each valid run in the test series. Each set of plots comprises time varying data from the Subject Vehicle, as well as pass/fail envelopes and thresholds. The following is a description of data types shown in the time history plots, as well as a description of the color code for data envelopes.

Time History Plot Description

Time history figures include the following sub-plots:

- Warning – Indicates timing of warning issued by LDW system. Depending on the type of LDW alert or instrumentation used to measure the alert, this can be any of the following:
    - Filtered and rectified sound signal
    - Filtered and rectified acceleration (e.g., steering wheel vibration)
    - Light sensor signal
    - Discrete on/off value
- Speed (mph) – Speed of the Subject Vehicle
- Yaw Rate (deg/sec) – Yaw rate of the Subject Vehicle
- Distance to Lane Edge (ft) – Lateral distance (in lane coordinates) from the outer front tire bulge to the inside edge of the lane marking of interest for a given test (a positive value indicates the vehicle is completely within the lane while a negative value indicates that the outer front tire bulge has crossed over the inner lane marking edge). The distance to the lane edge at the moment the LDW alert is issued, is displayed to the right of subplot.
- Lateral Lane Velocity (ft/sec) – Lateral velocity (in lane coordinates) of the outer front tire bulge
- Bird's Eye View – Indicates the position of the Subject Vehicle with respect to the lane marking of interest for a given test. Green rectangles represent the Subject Vehicle's position at approximately 2 second intervals, while the yellow rectangle indicates the position of the Subject Vehicle at the time of LDW warning issuance.

Envelopes and Thresholds

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

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

Yellow envelopes indicate that the time-varying data should not exceed the envelope only at the right end. Exceedances at the right extent of a yellow envelope are indicated by red asterisks. Data within the boundaries at the right extent of a yellow envelope are indicated by green circles.

For the warning plot, a dashed black threshold line indicates the threshold used to determine the onset of the LDW alert. The alert is considered on the first time the alert signal crosses this threshold line.

Color Codes

Color codes have been adopted to easily identify the types of data, envelopes, and thresholds used in the plots.

Color codes can be broken into three categories:

1. Validation envelopes and thresholds
2. Instantaneous samplings
3. Text

1. Validation envelope and threshold color codes:
   - Green envelope = time varying data must be within the envelope at all times in order to be valid
   - Yellow envelope = time varying data must be within limits at right end
   - Black threshold (Solid) = time varying data must not exceed this threshold in order to be valid
   - Black threshold (Dashed) = for reference only – this can include warning level thresholds which are used to determine the timing of the alert

2. Instantaneous sampling color codes:
   - Green circle = passing or valid value at a given moment in time
   - Red asterisk = failing or invalid value at a given moment in time

3. Text color codes:
   - Green = passing or valid value
   - Red = failing or invalid value

Other Notations

- NG – Indicates that the value for that variable was outside of bounds and therefore “No Good”.
- No Wng – No warning was detected.

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 (including passing, failing and invalid runs) are shown in Figure D1 through Figure D3. Actual time history data plots for the vehicle under consideration are provided subsequently.

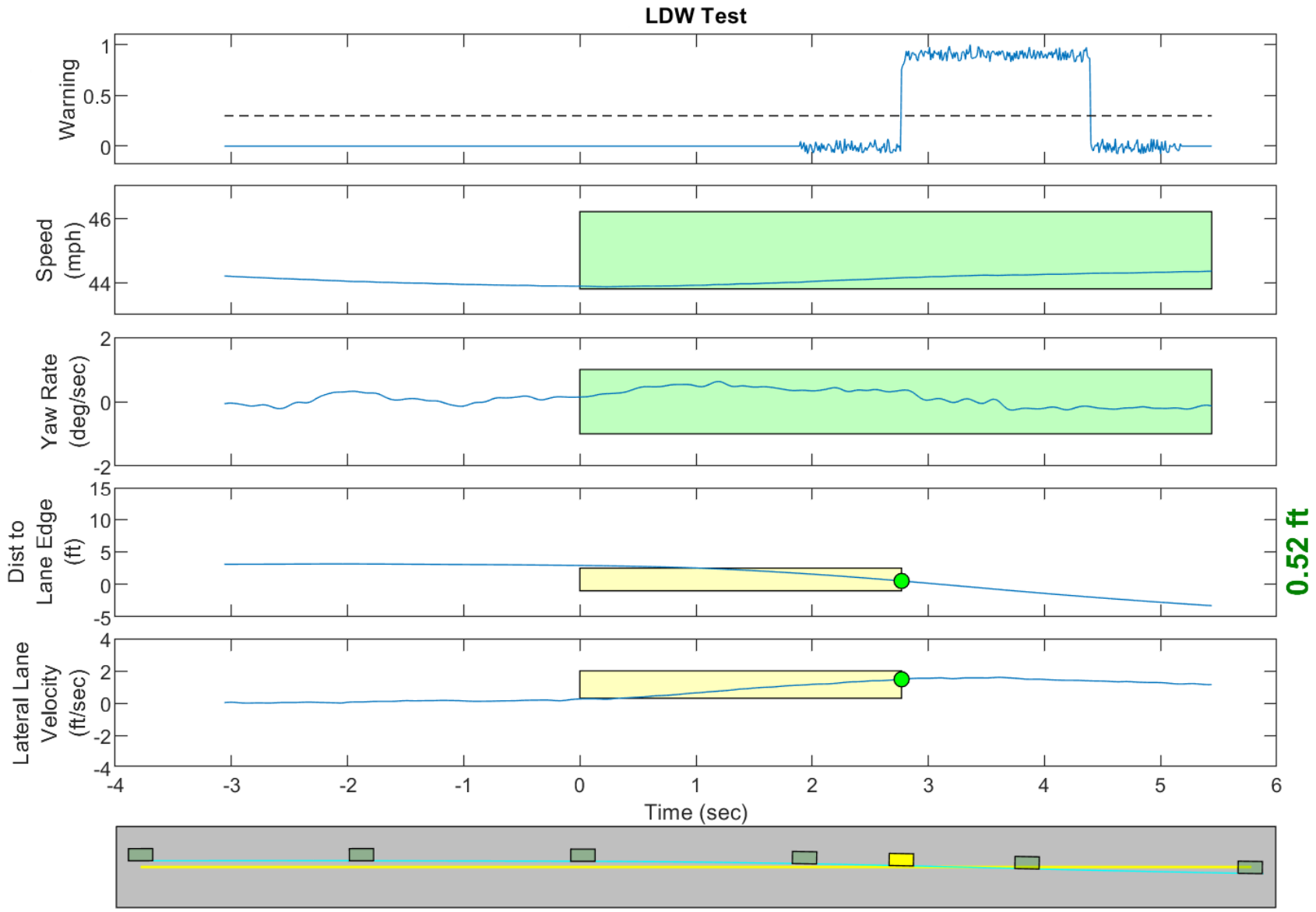


Figure D1. Example Time History for Lane Departure Warning Test, Passing

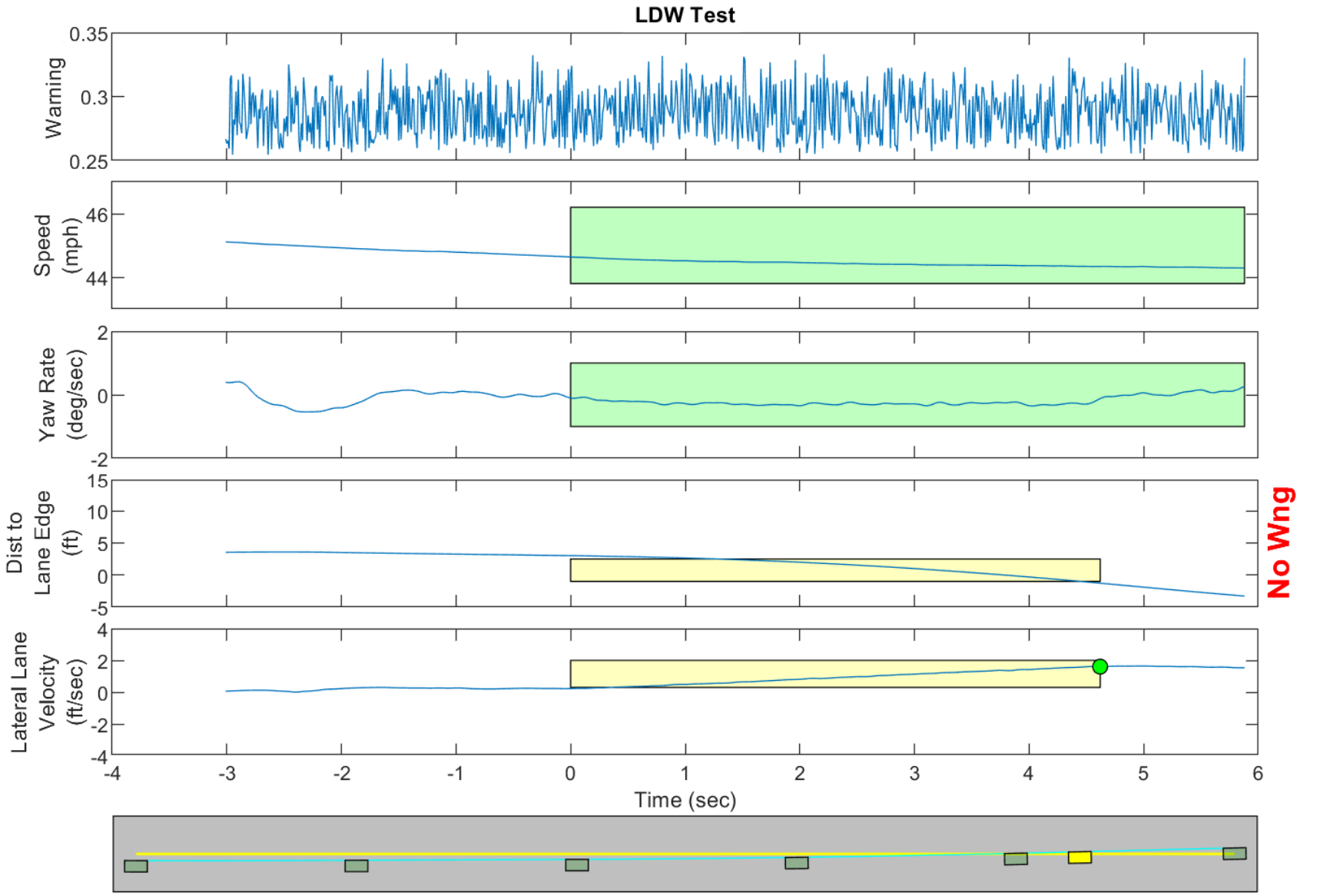


Figure D2. Example Time History for Lane Departure Warning Test, Failing, No Warning Issued

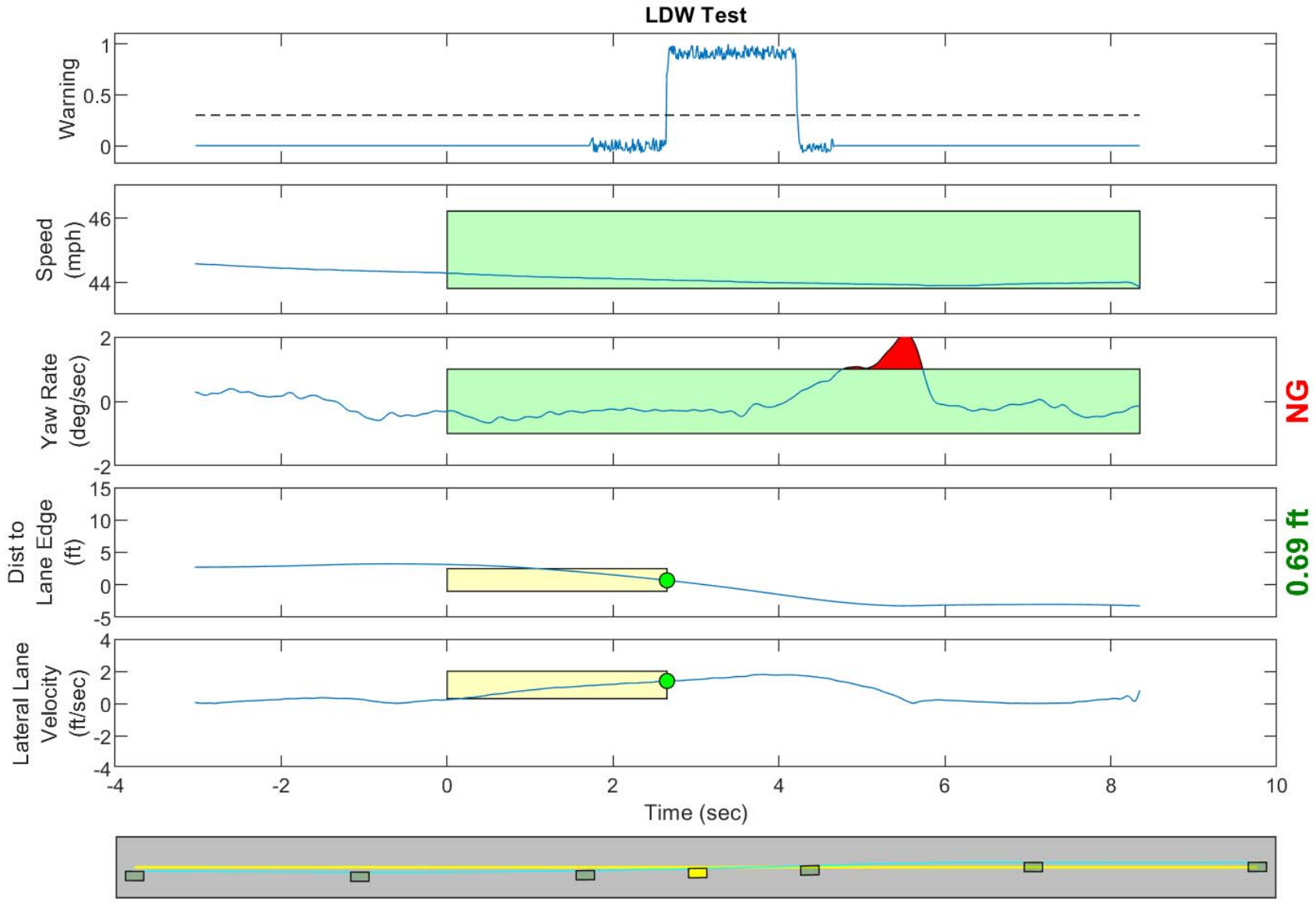


Figure D3. Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate

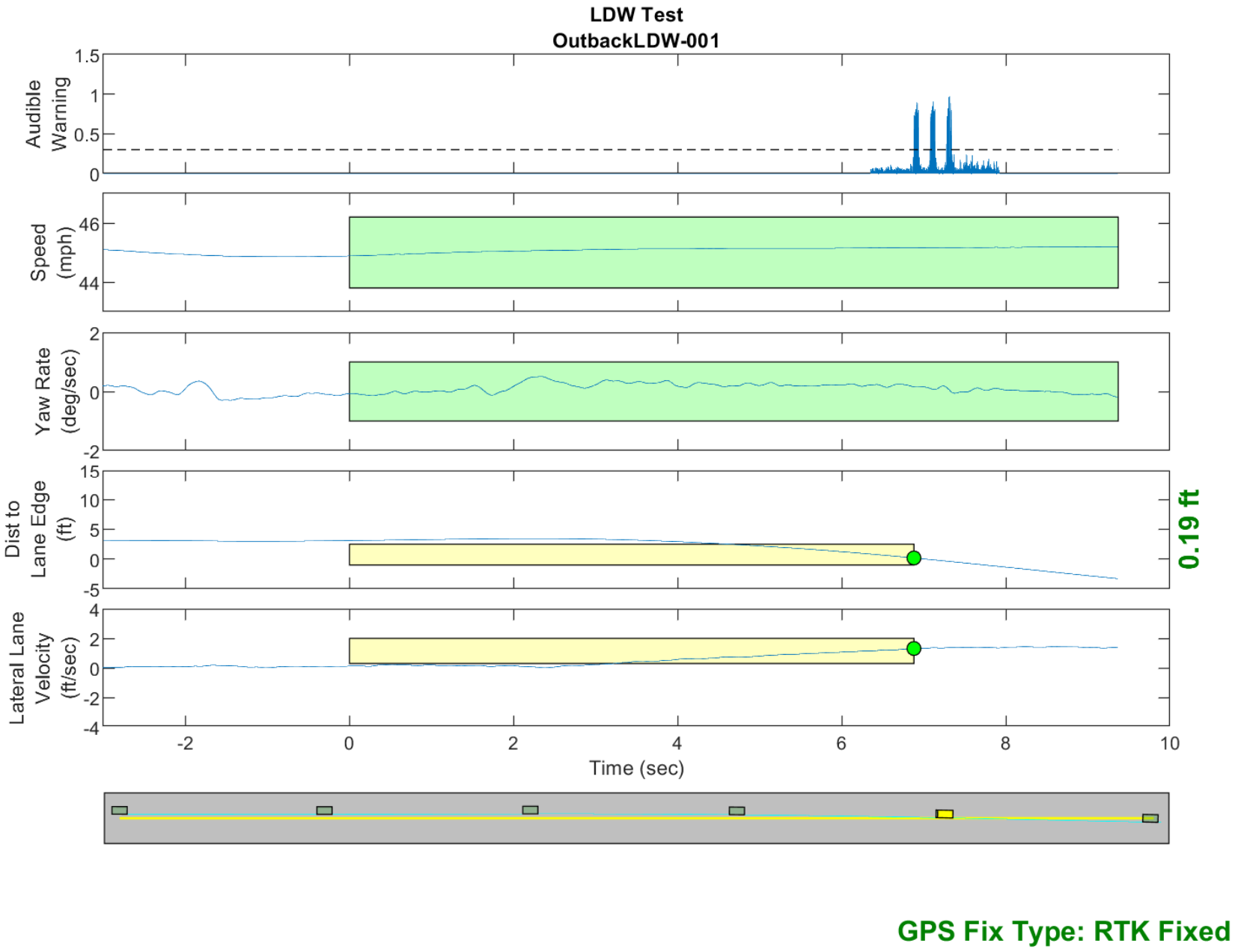


Figure D4. Time History for Run 01, Botts Dots, Right Departure, Audible Warning

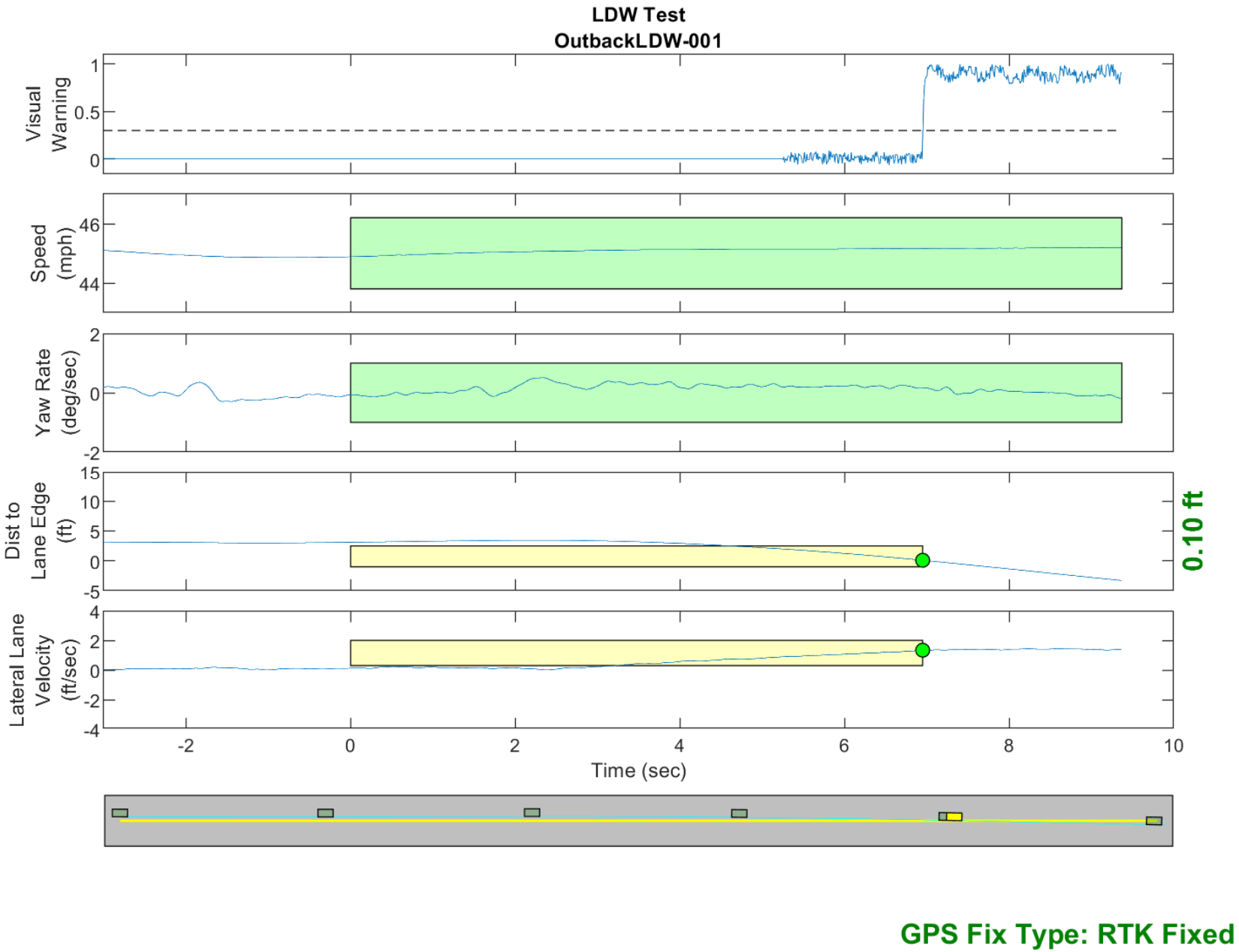


Figure D5. Time History for Run 01, Botts Dots, Right Departure, Visual Warning

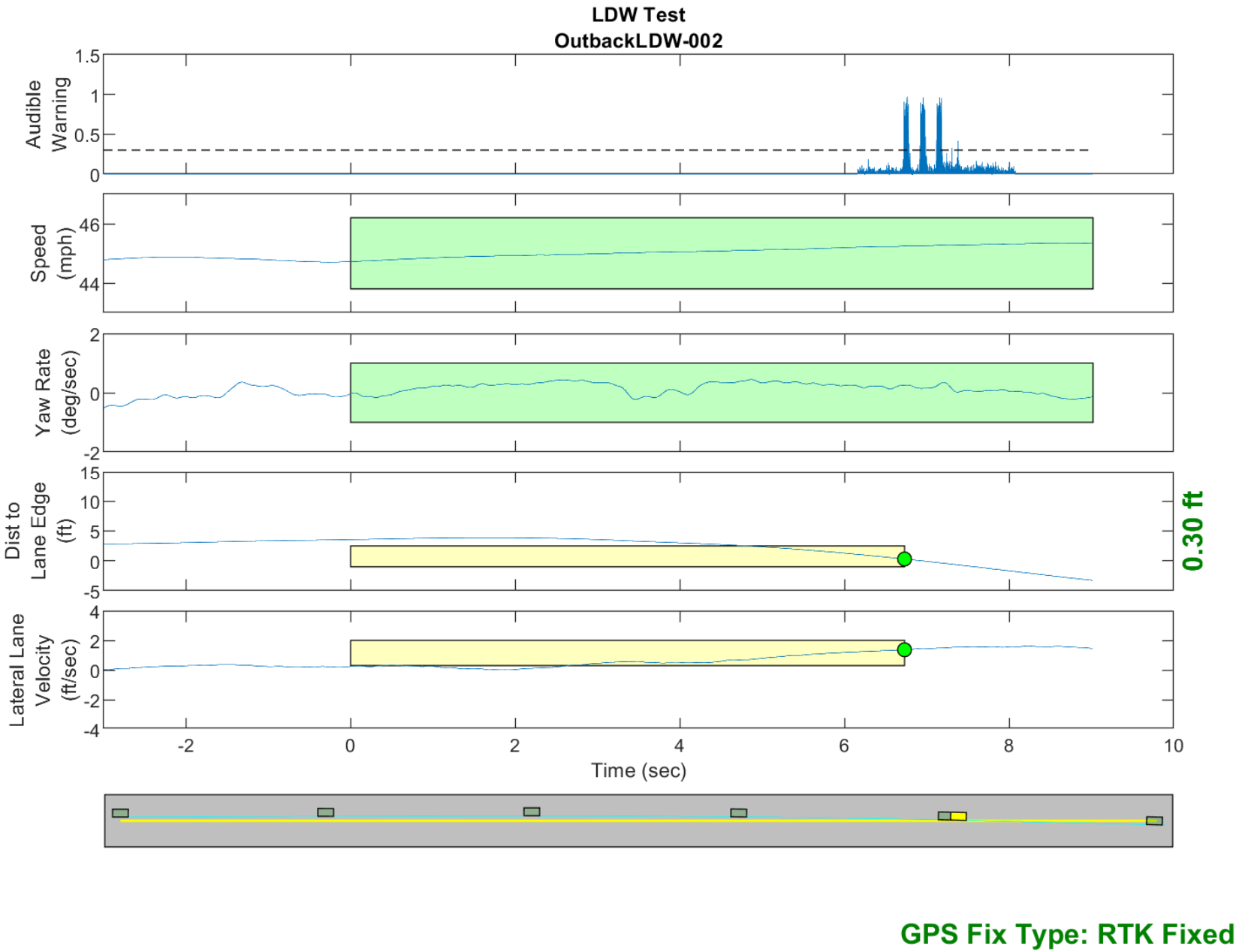


Figure D6. Time History for Run 02, Botts Dots, Right Departure, Audible Warning

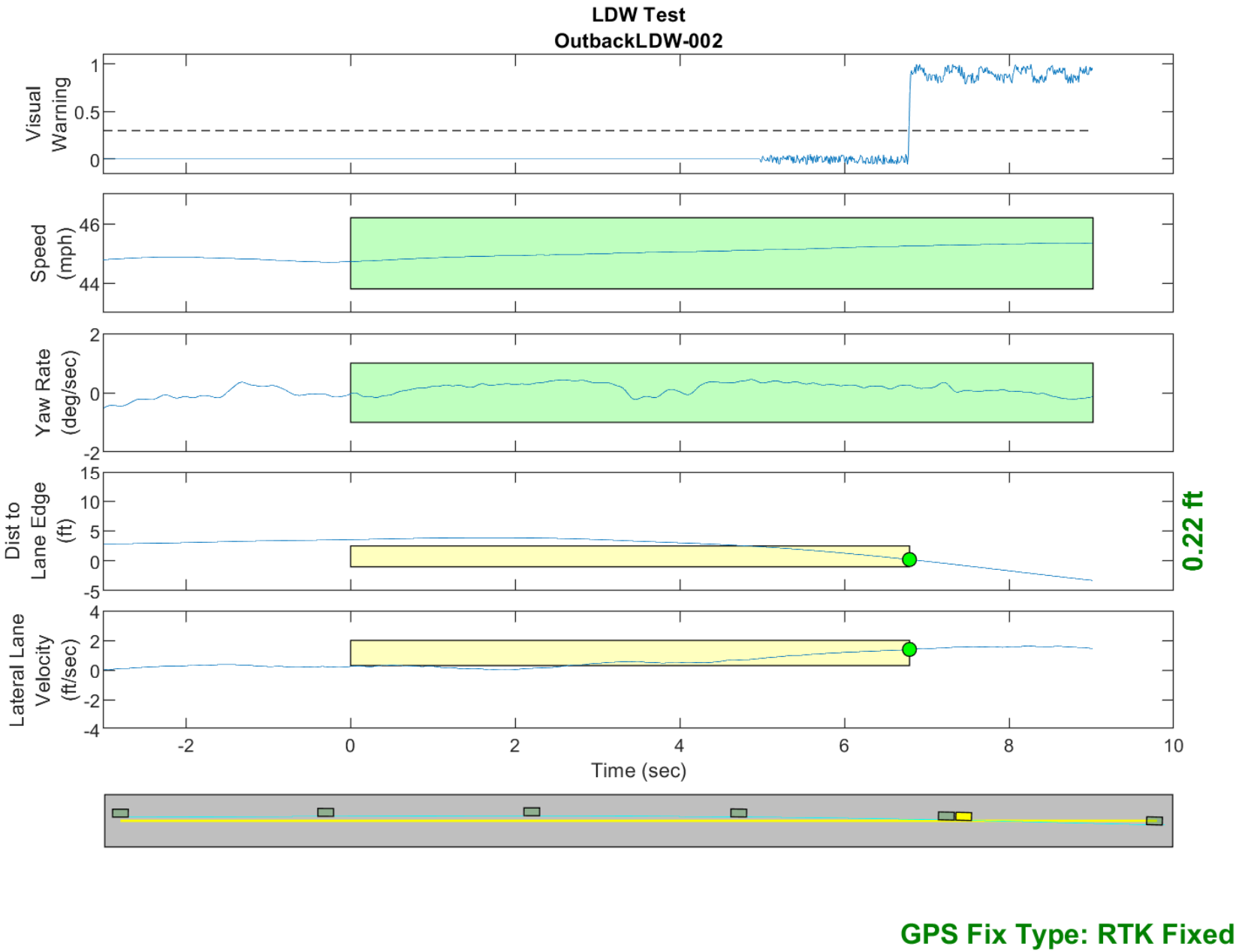


Figure D7. Time History for Run 02, Botts Dots, Right Departure, Visual Warning

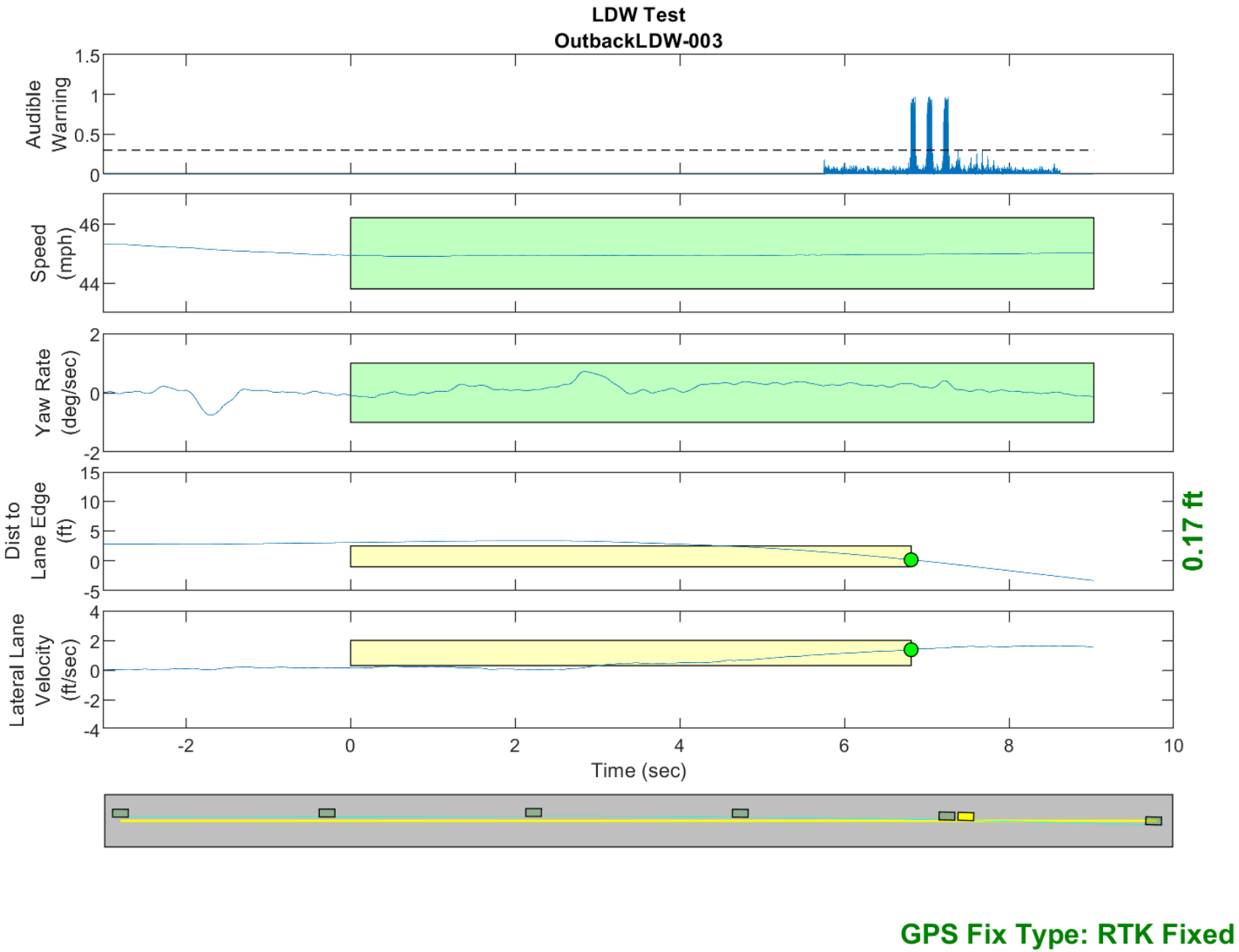


Figure D8. Time History for Run 03, Botts Dots, Right Departure, Audible Warning

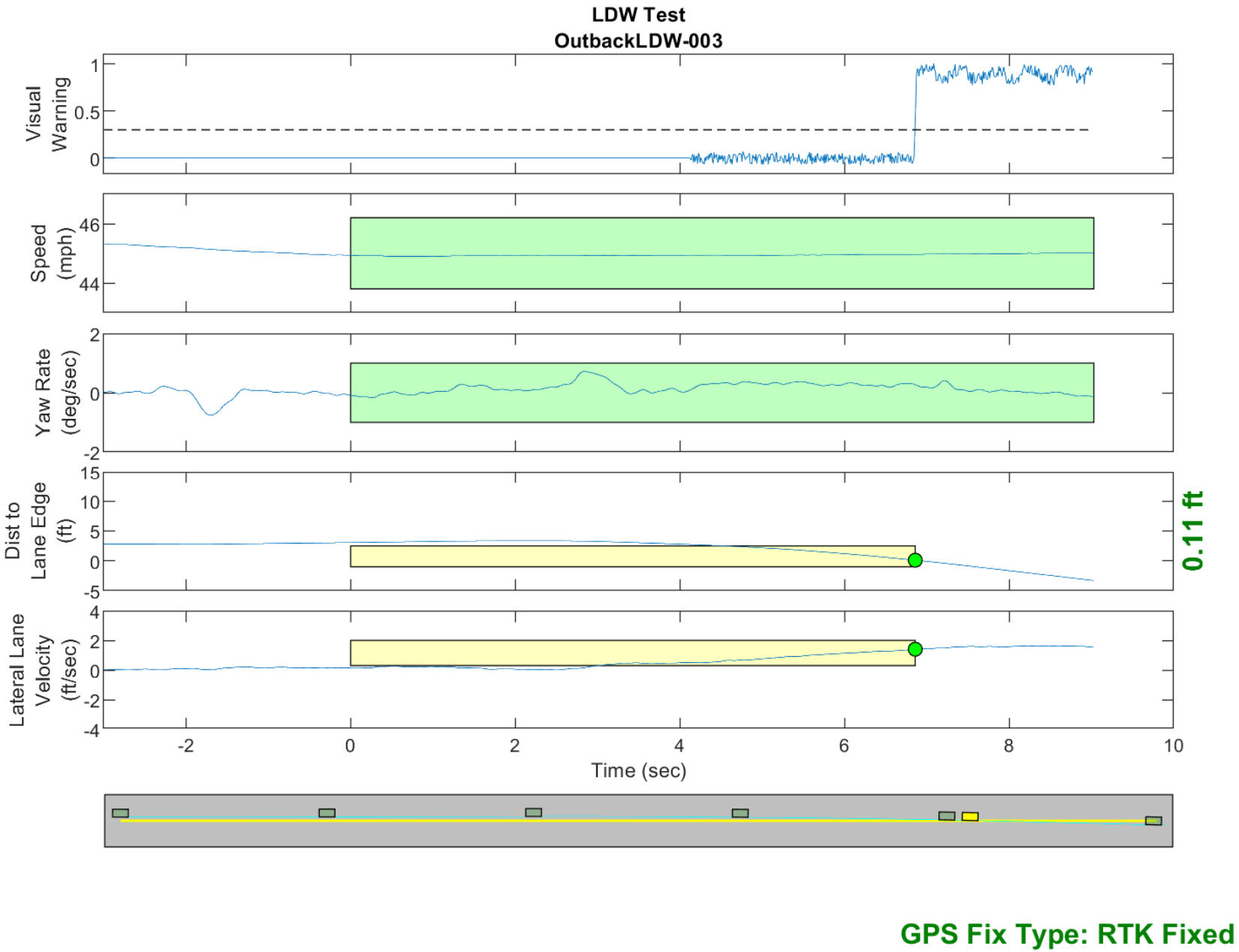


Figure D9. Time History for Run 03, Botts Dots, Right Departure, Visual Warning

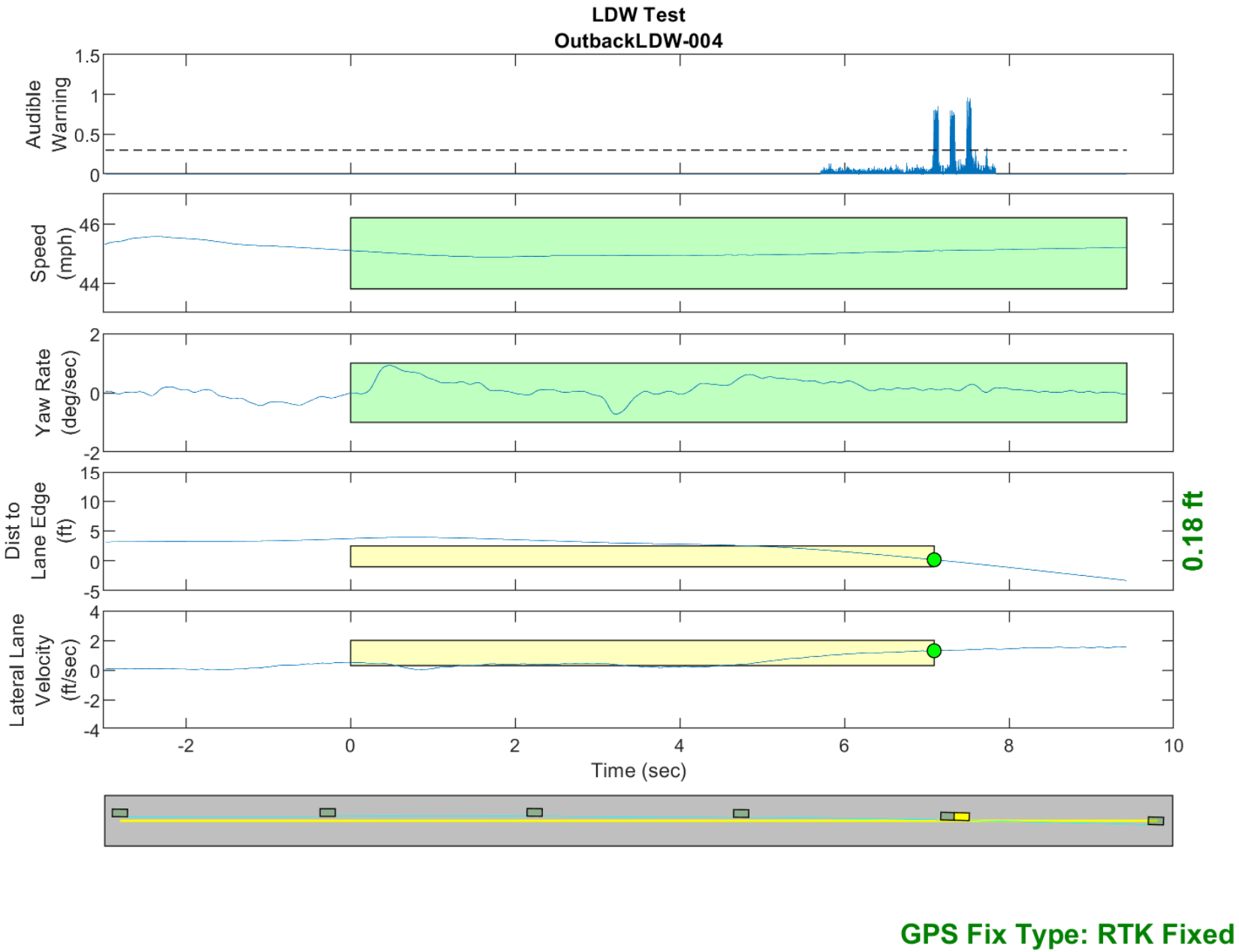


Figure D10. Time History for Run 04, Botts Dots, Right Departure, Audible Warning

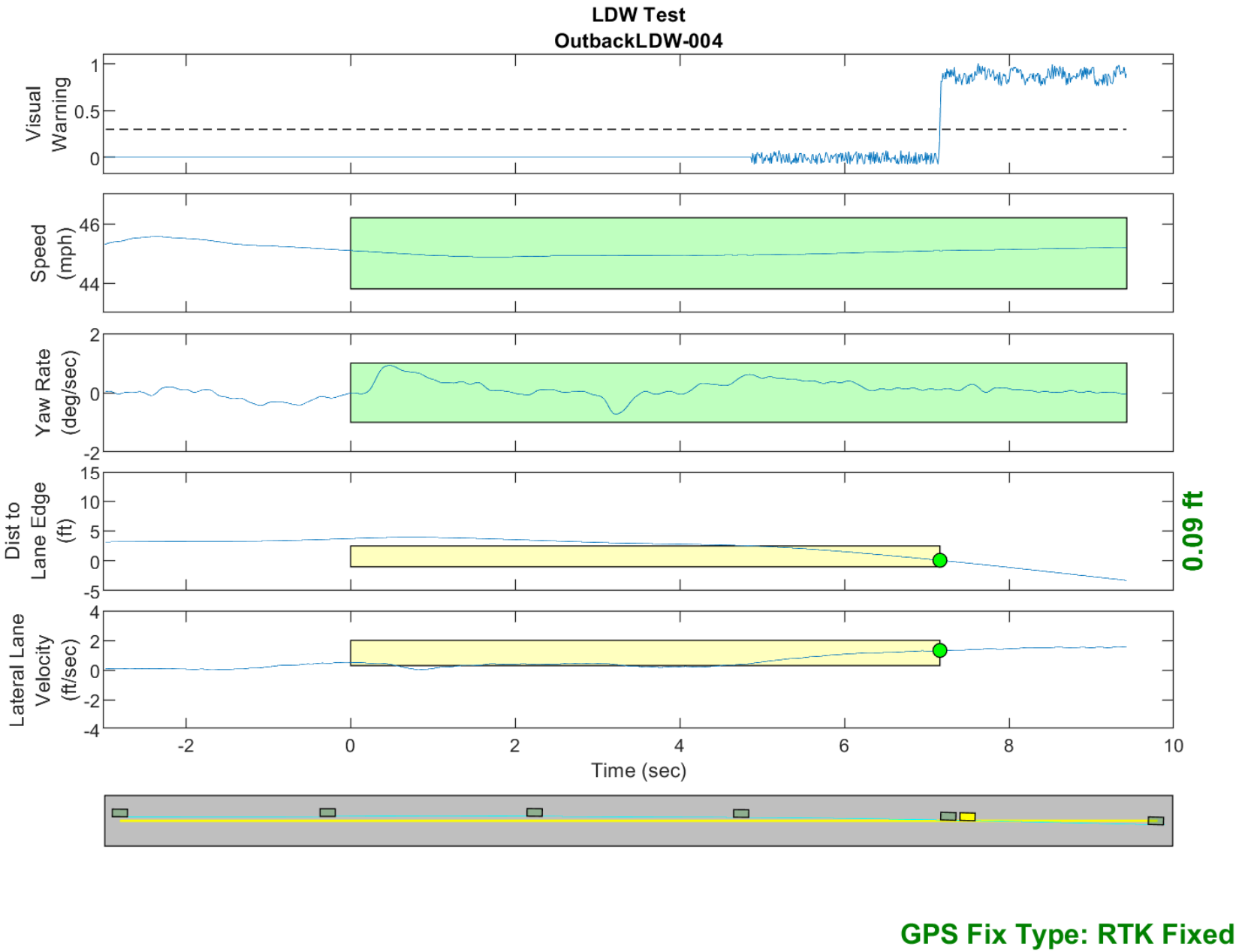


Figure D11. Time History for Run 04, Botts Dots, Right Departure, Visual Warning

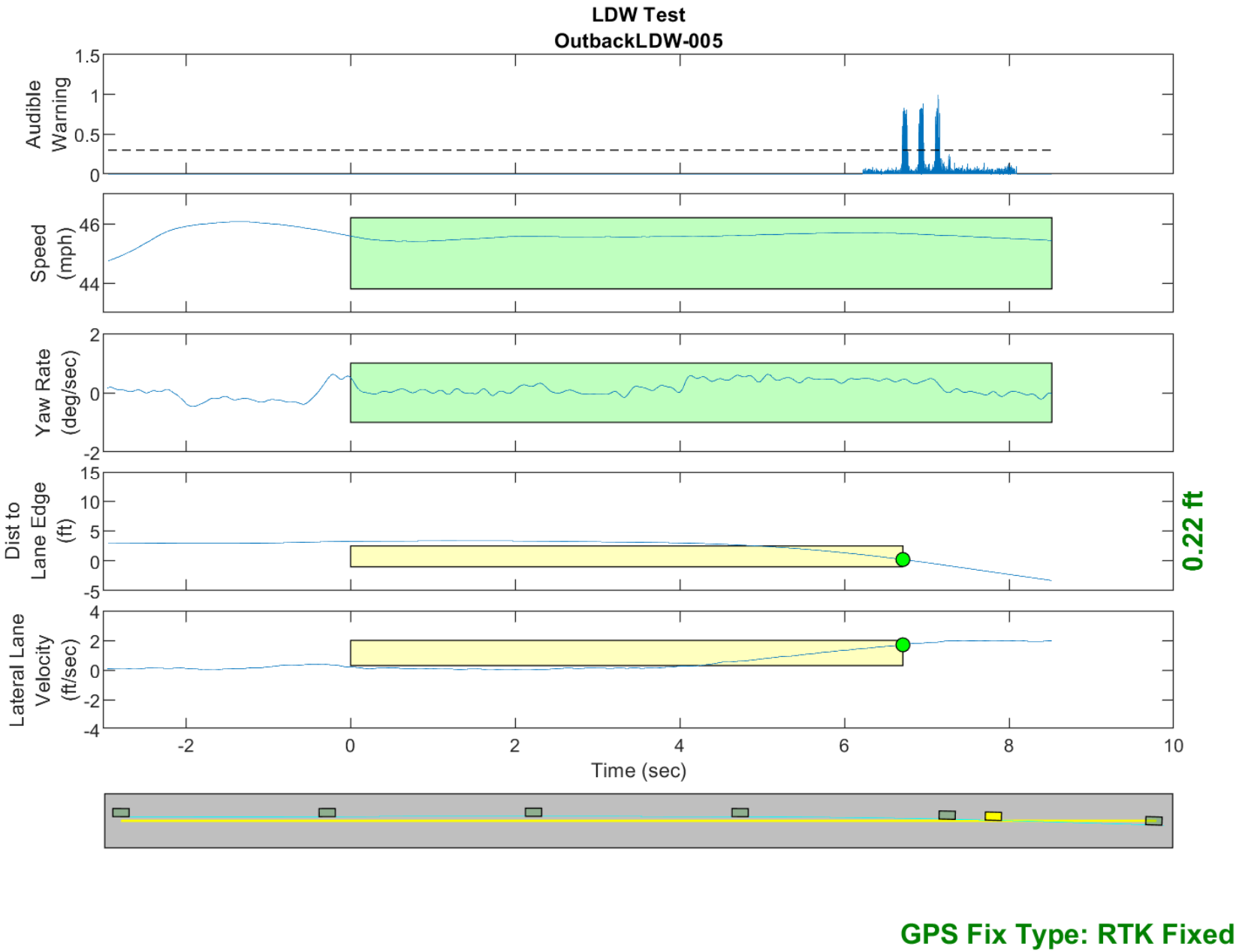


Figure D12. Time History for Run 05, Botts Dots, Right Departure, Audible Warning

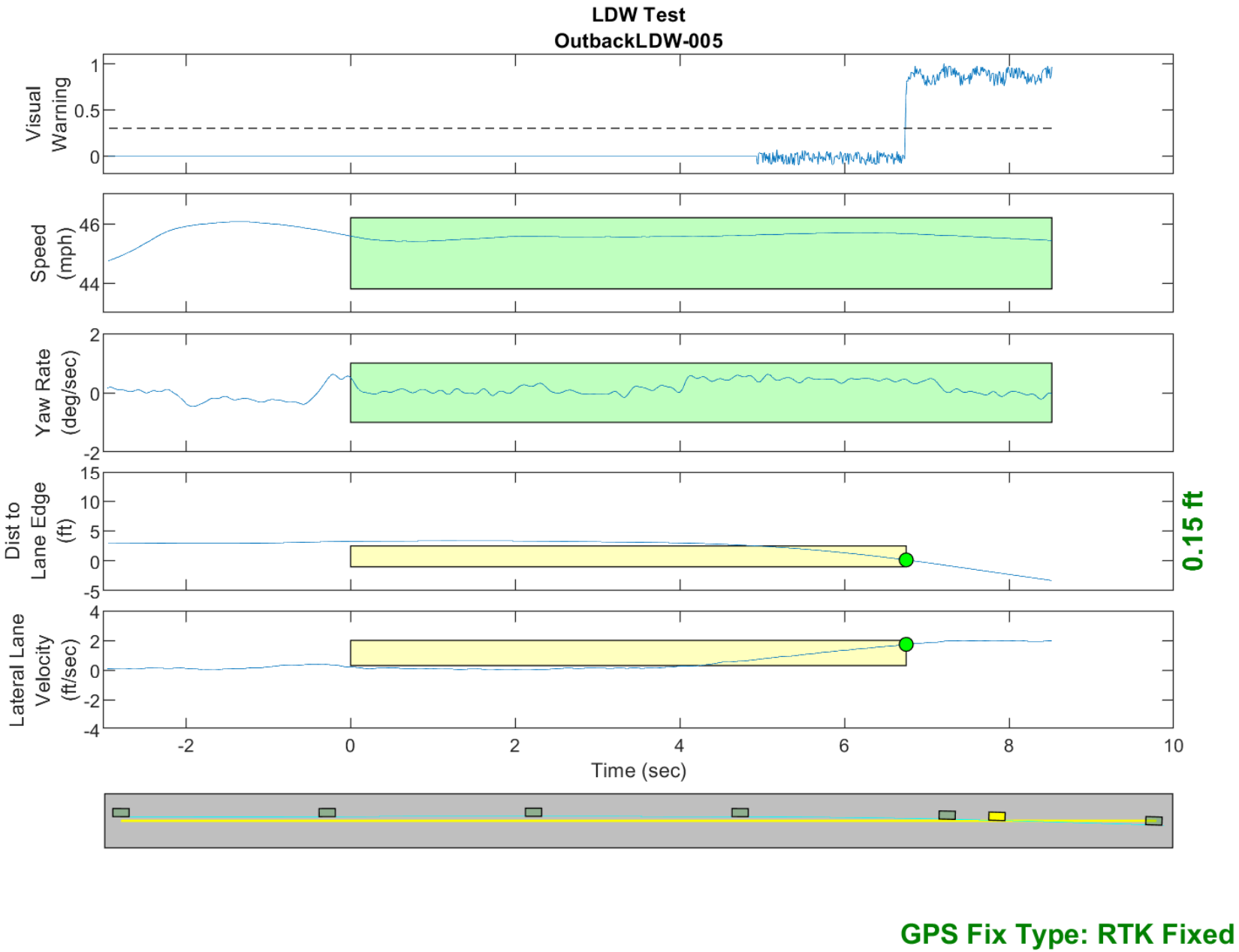


Figure D13. Time History for Run 05, Botts Dots, Right Departure, Visual Warning

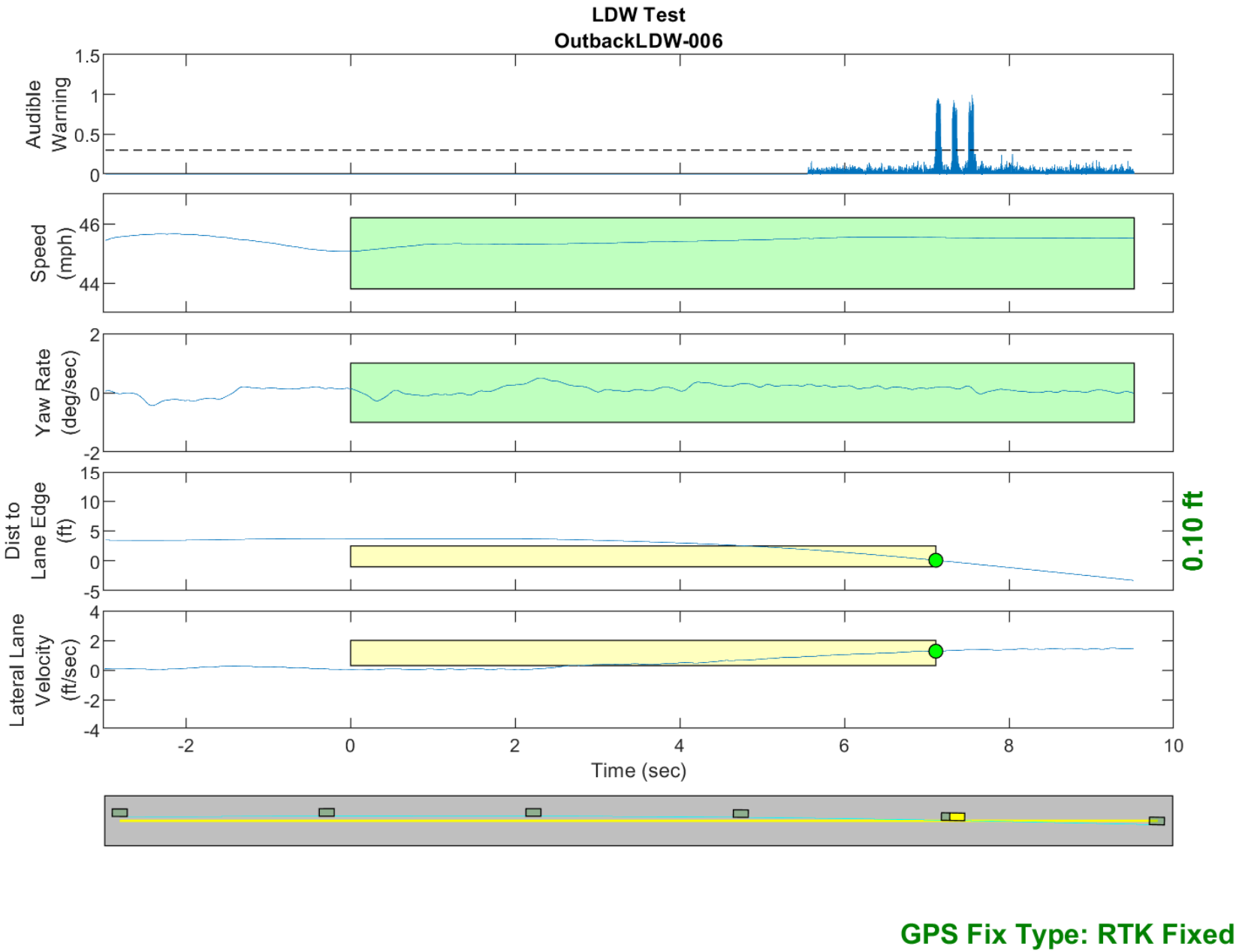


Figure D14. Time History for Run 06, Botts Dots, Right Departure, Audible Warning

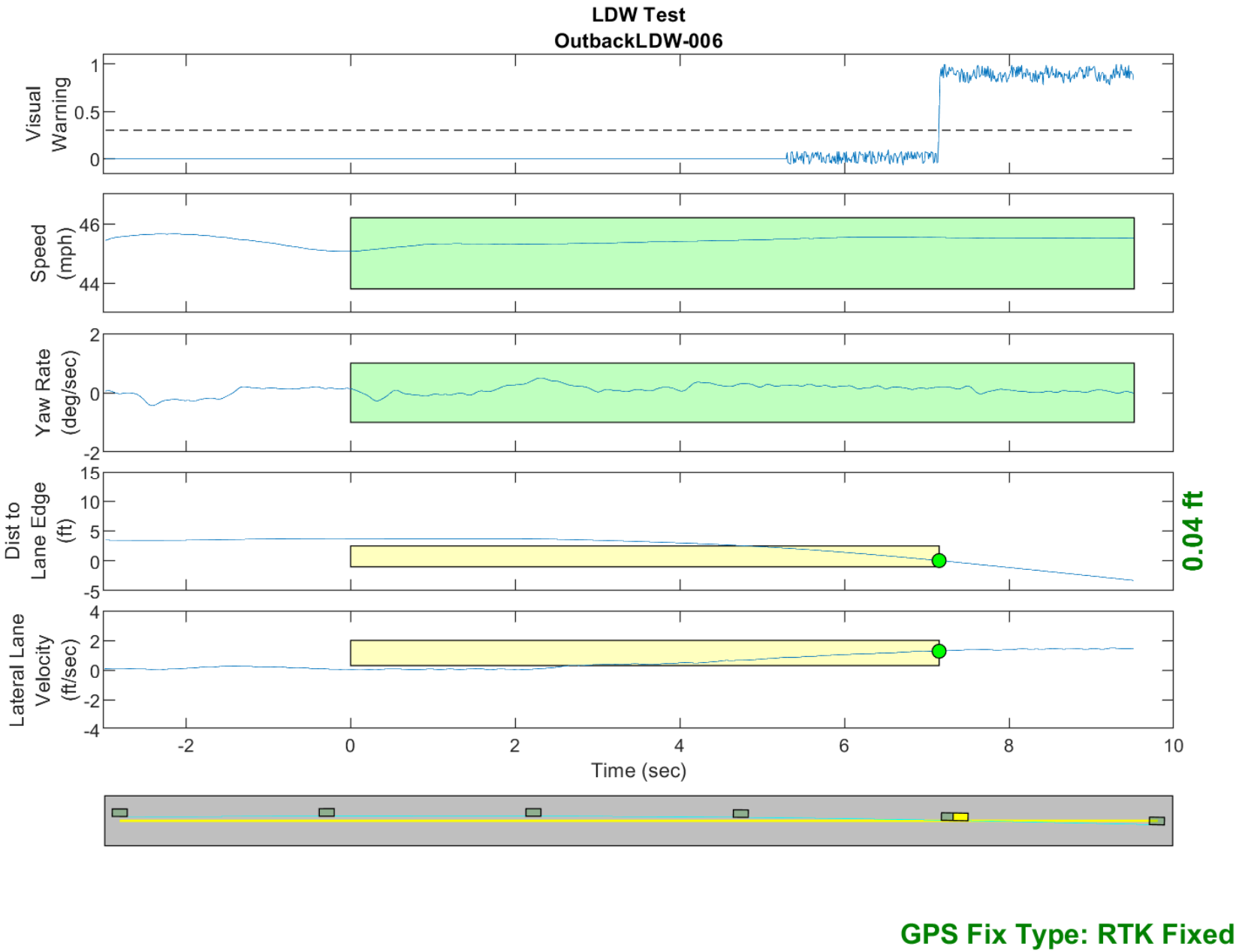


Figure D15. Time History for Run 06, Botts Dots, Right Departure, Visual Warning

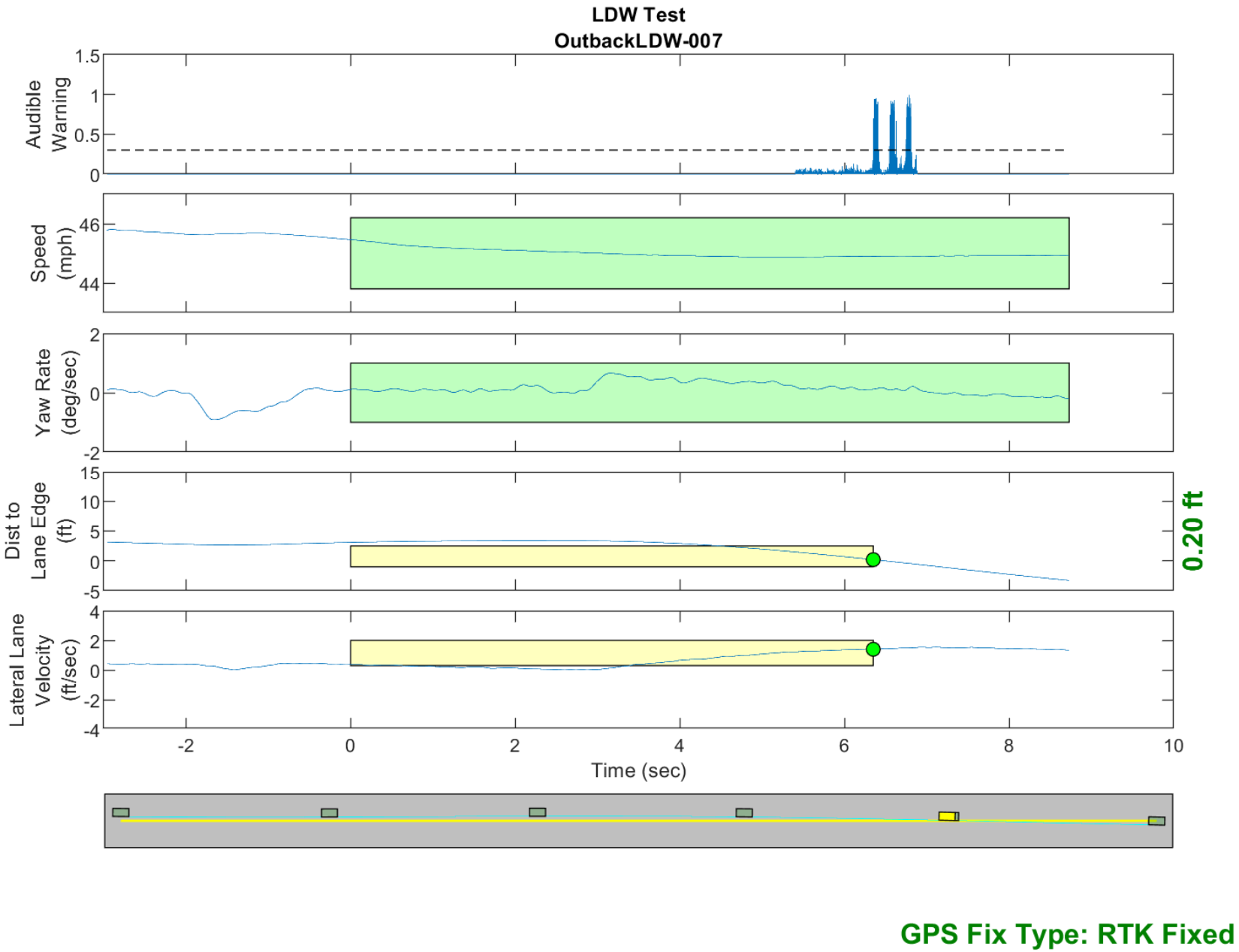


Figure D16. Time History for Run 07, Botts Dots, Right Departure, Audible Warning

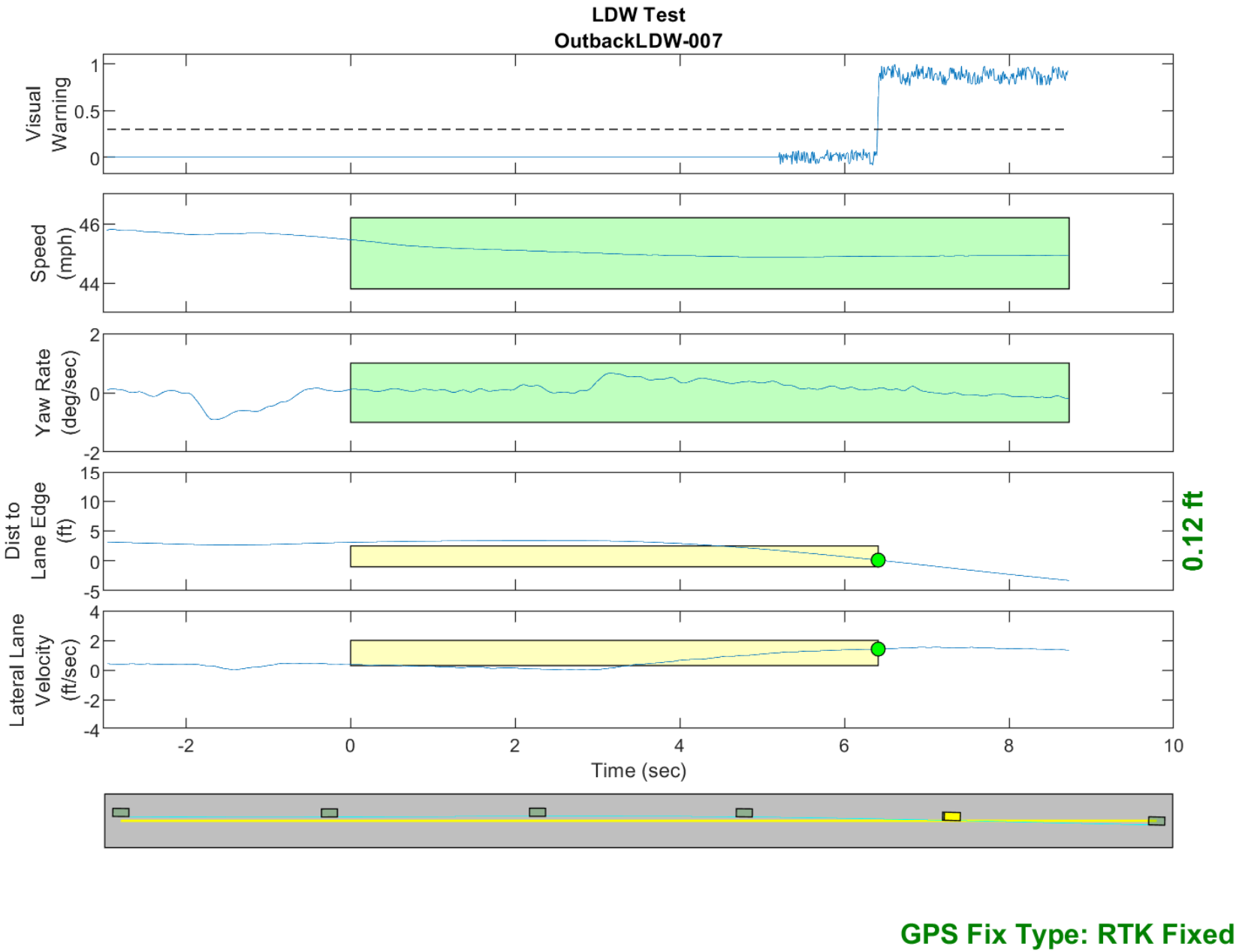


Figure D17. Time History for Run 07, Botts Dots, Right Departure, Visual Warning

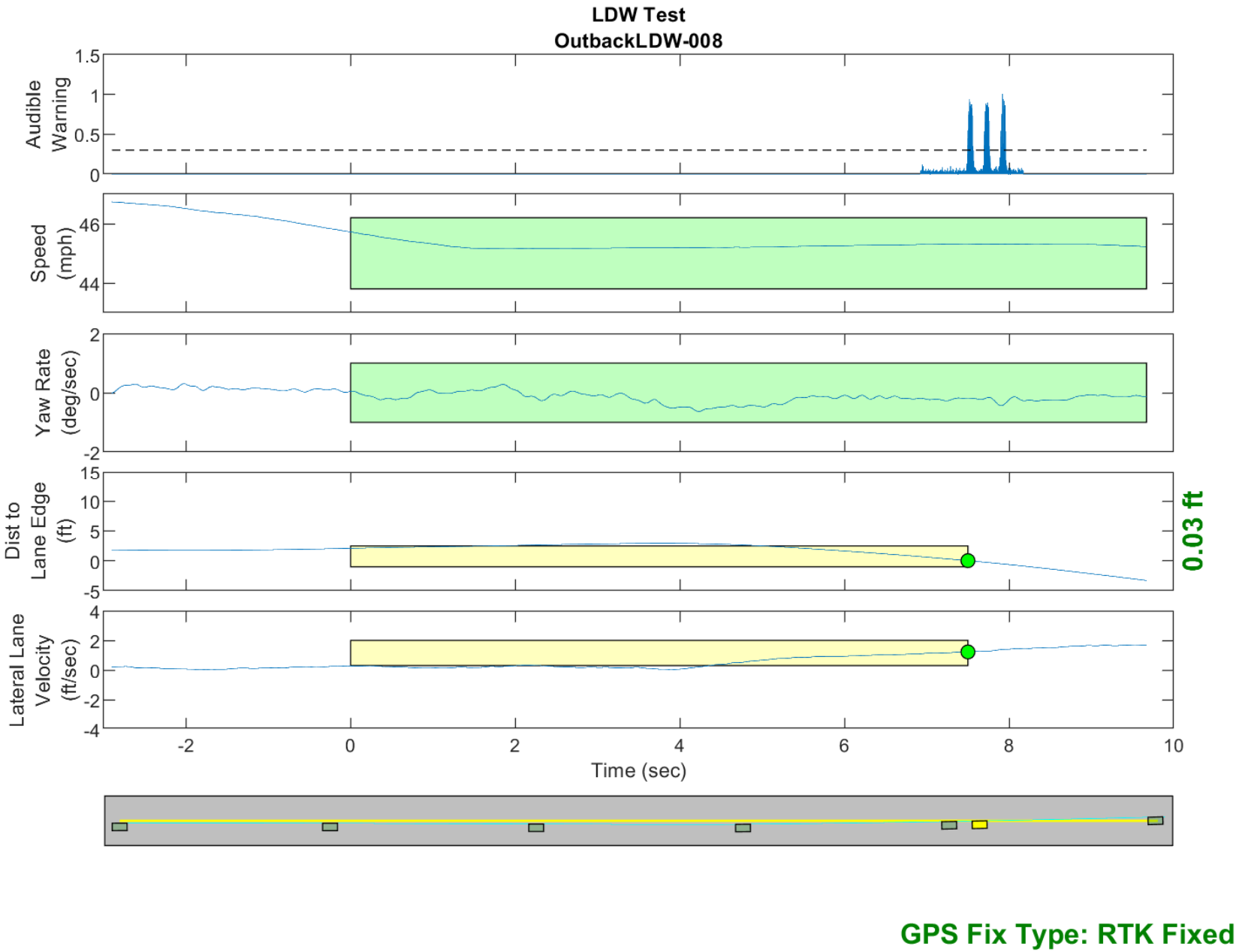


Figure D18. Time History for Run 08, Botts Dots, Left Departure, Audible Warning

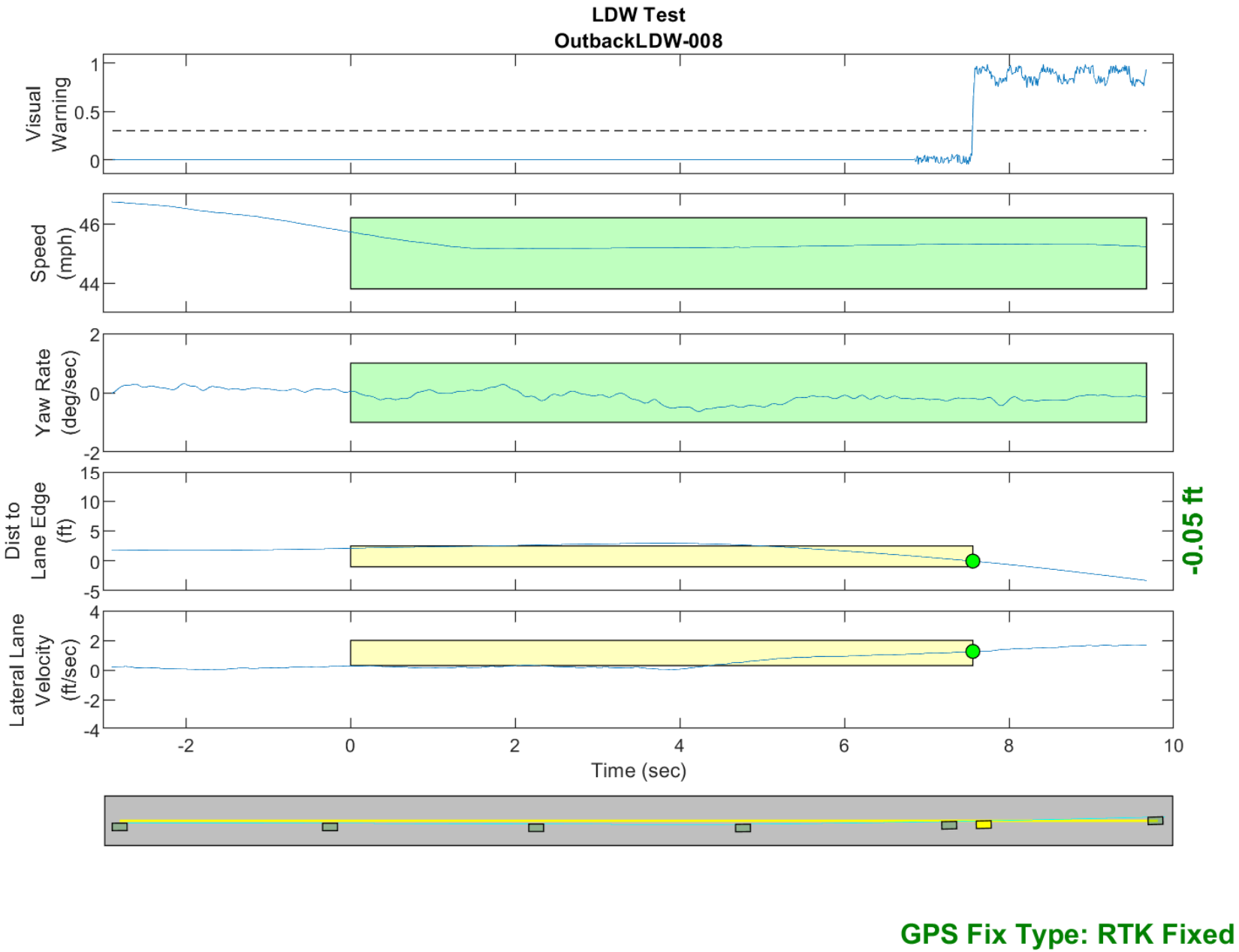


Figure D19. Time History for Run 08, Botts Dots, Left Departure, Visual Warning

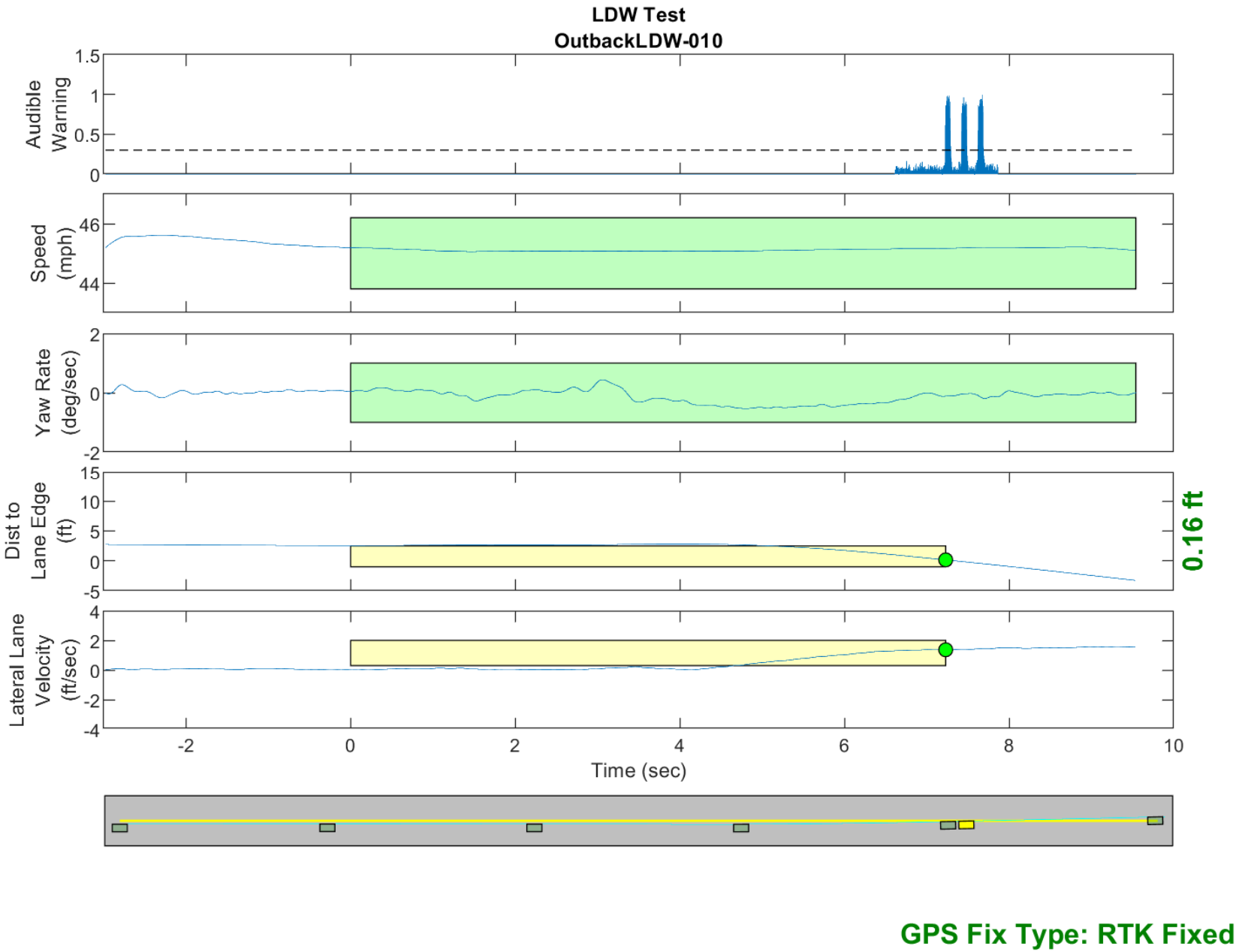


Figure D20. Time History for Run 10, Botts Dots, Left Departure, Audible Warning

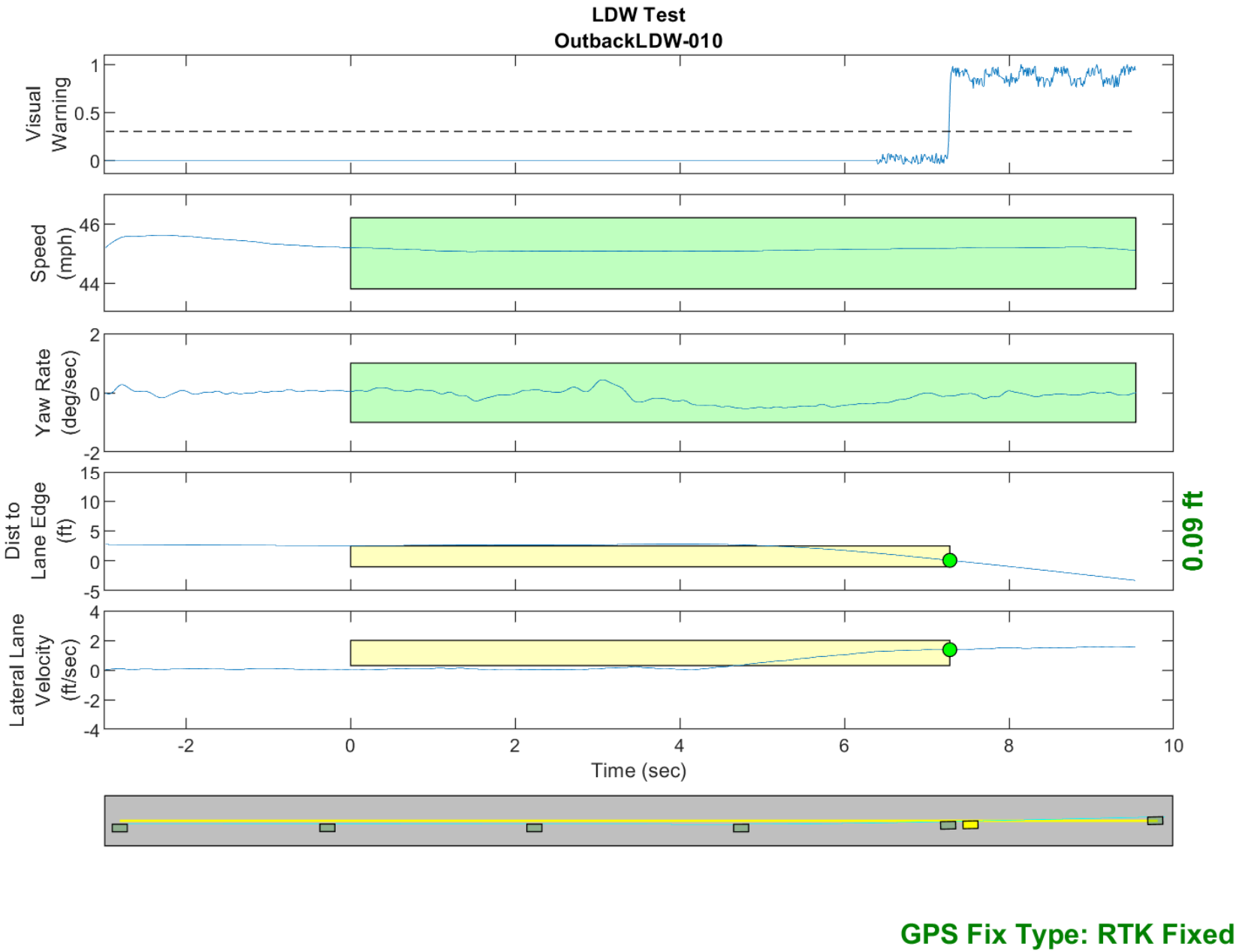


Figure D21. Time History for Run 10, Botts Dots, Left Departure, Visual Warning

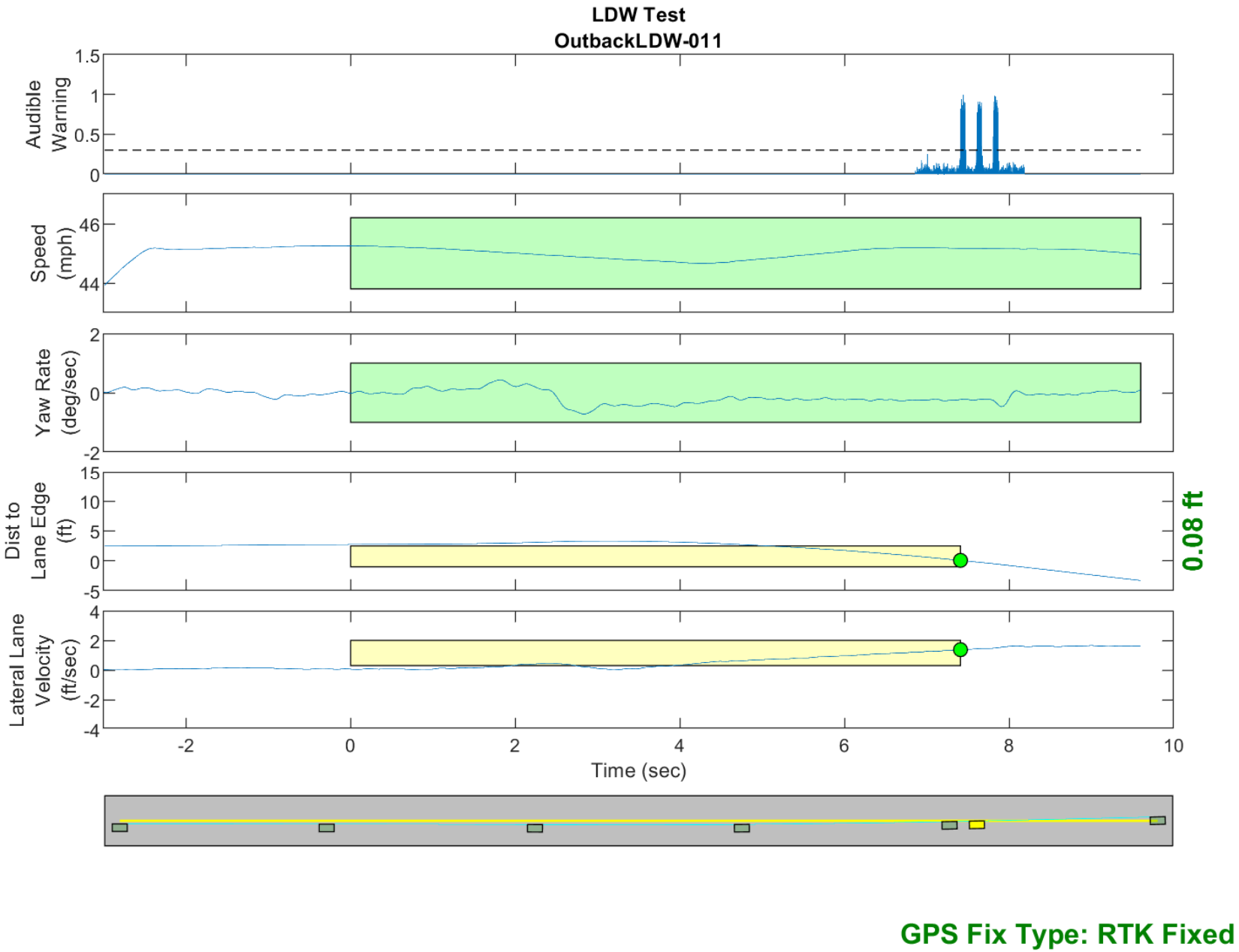


Figure D22. Time History for Run 11, Botts Dots, Left Departure, Audible Warning

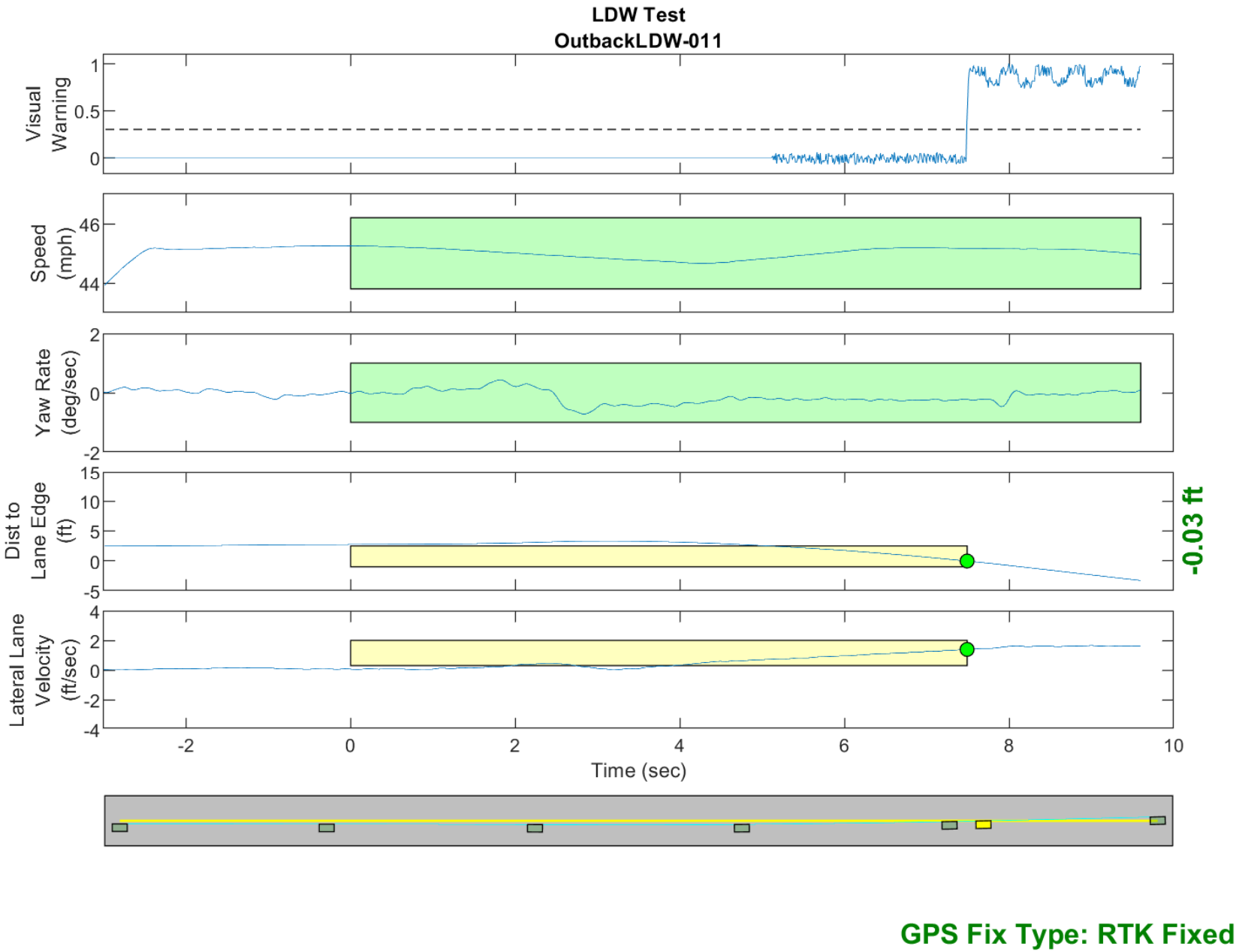


Figure D23. Time History for Run 11, Botts Dots, Left Departure, Visual Warning

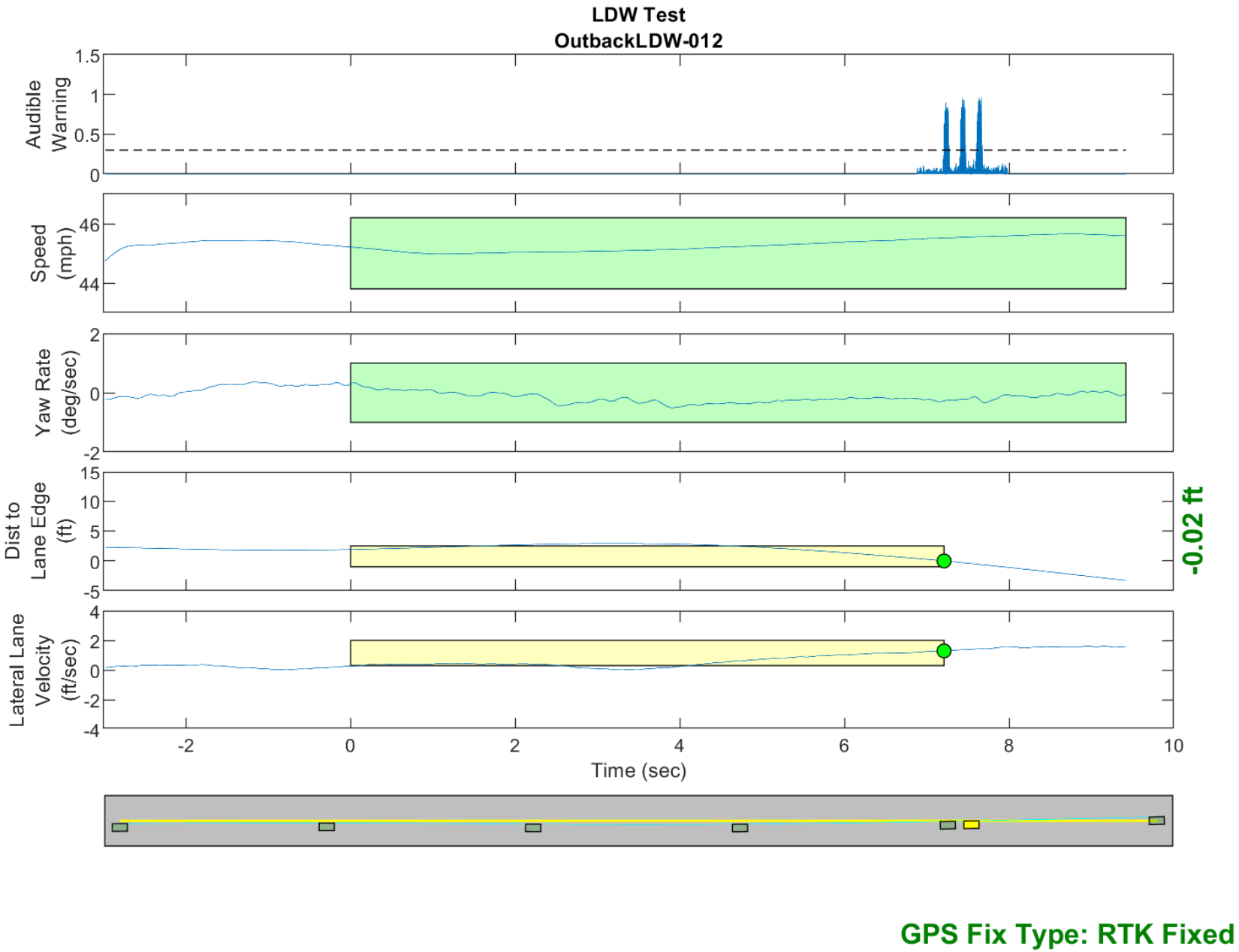


Figure D24. Time History for Run 12, Botts Dots, Left Departure, Audible Warning

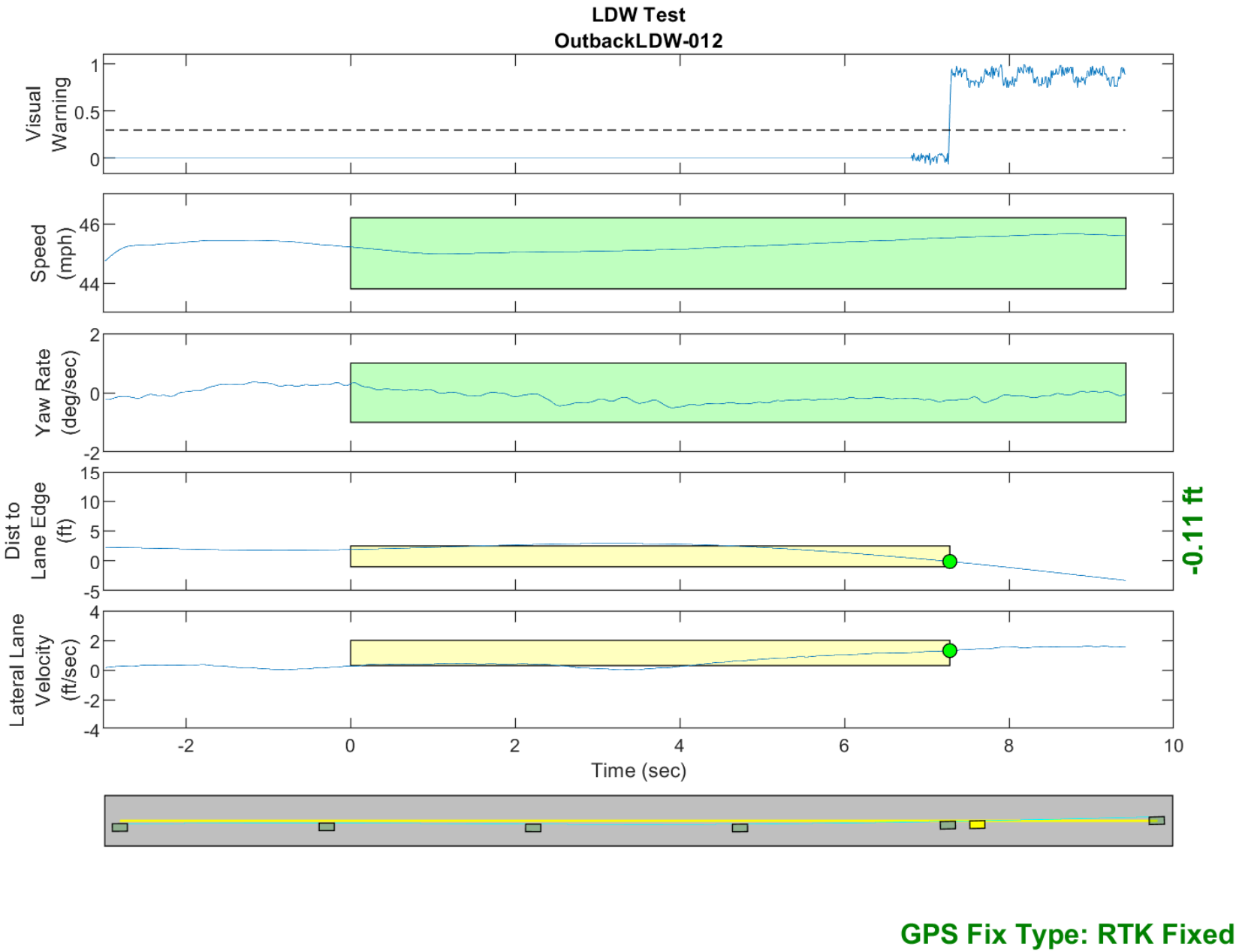


Figure D25. Time History for Run 12, Botts Dots, Left Departure, Visual Warning

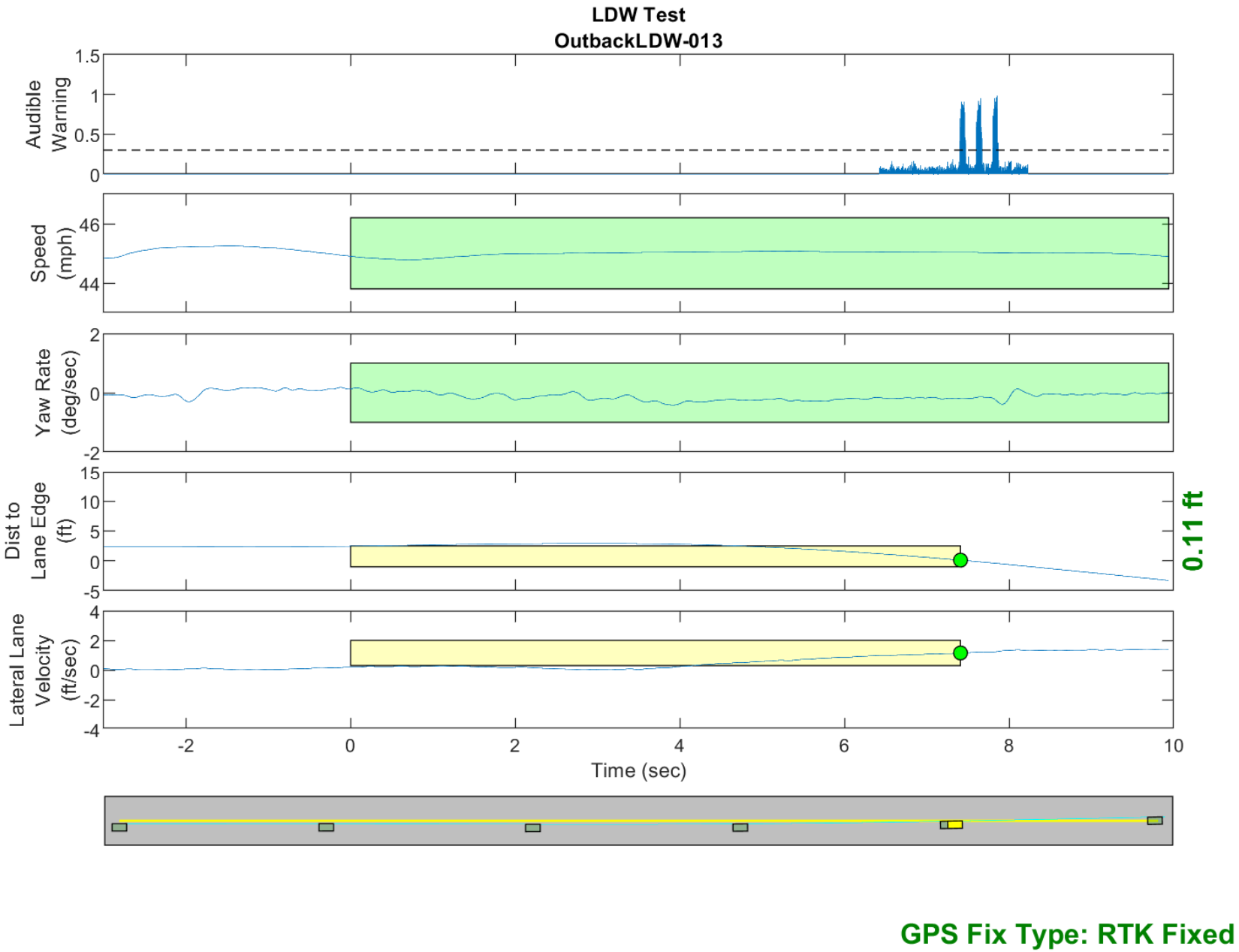


Figure D26. Time History for Run 13, Botts Dots, Left Departure, Audible Warning

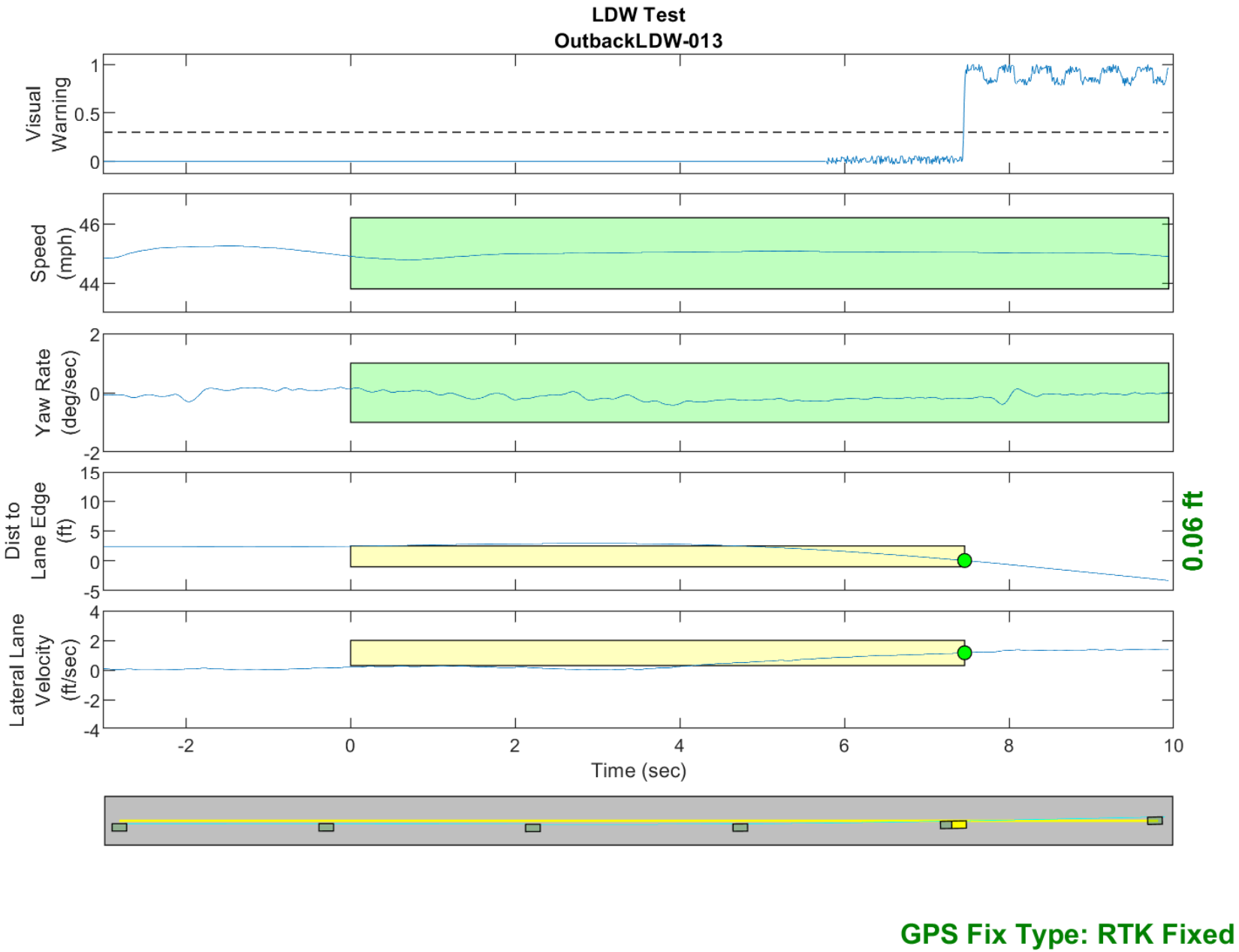


Figure D27. Time History for Run 13, Botts Dots, Left Departure, Visual Warning

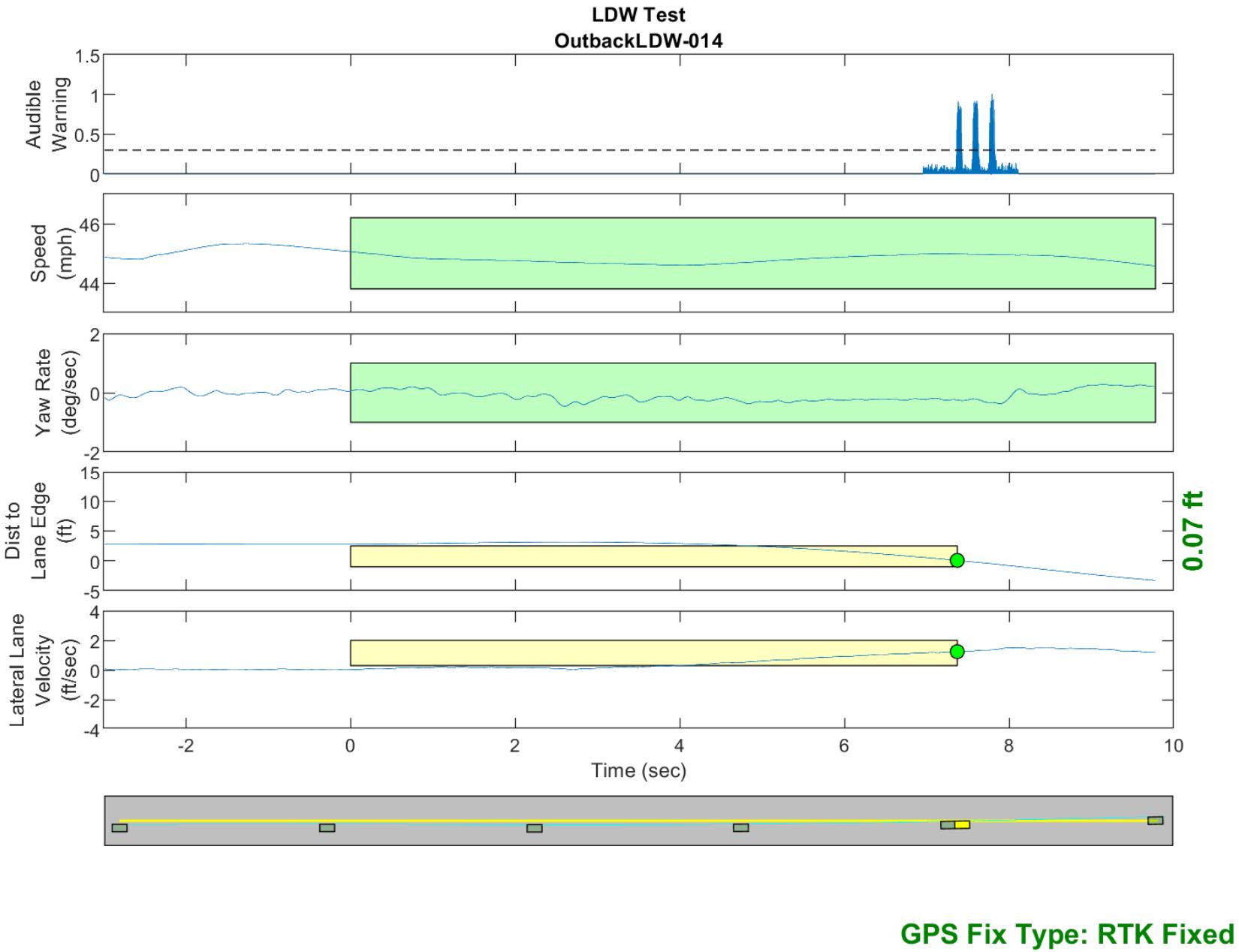


Figure D28. Time History for Run 14, Botts Dots, Left Departure, Audible Warning

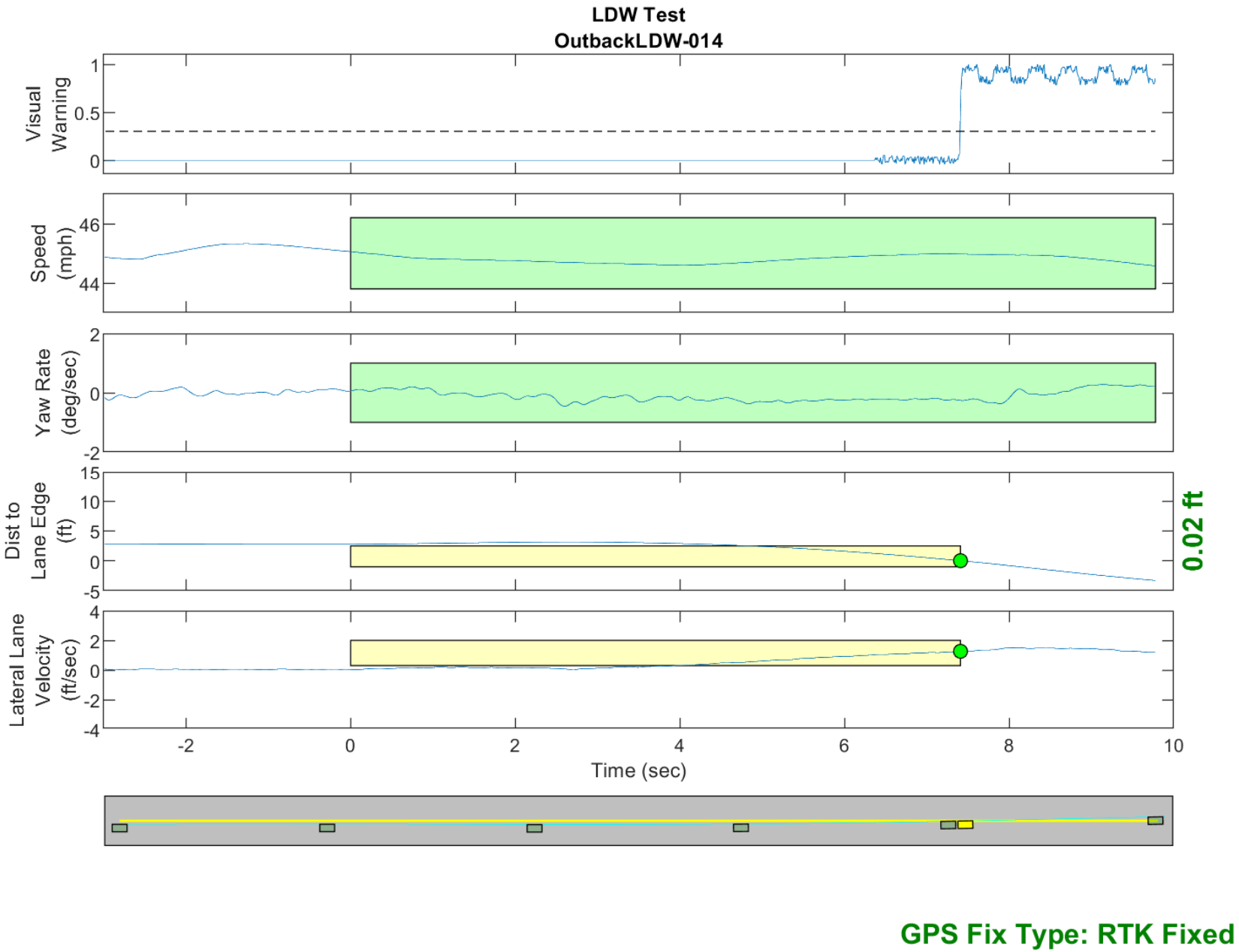


Figure D29. Time History for Run 14, Botts Dots, Left Departure, Visual Warning

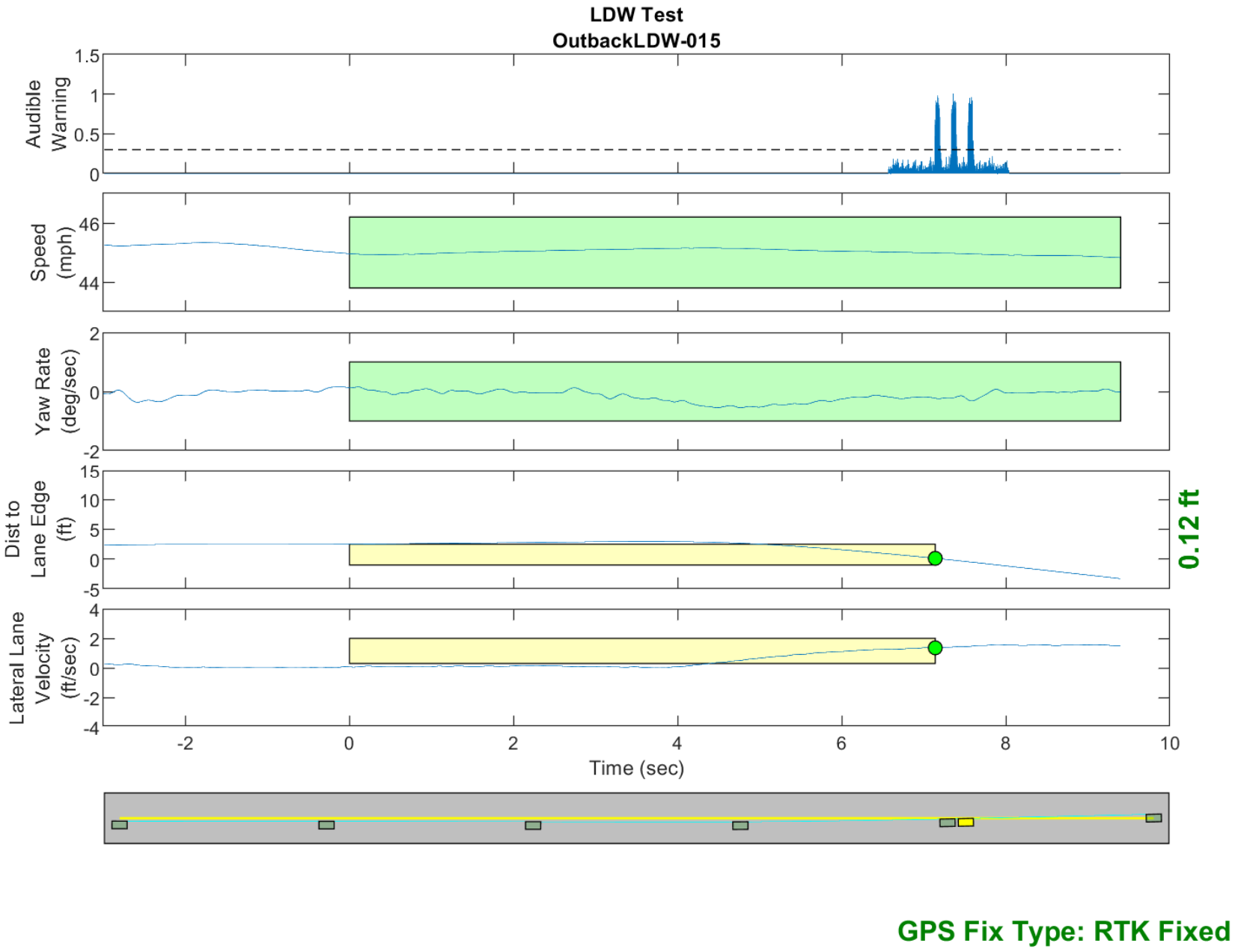


Figure D30. Time History for Run 15, Botts Dots, Left Departure, Audible Warning

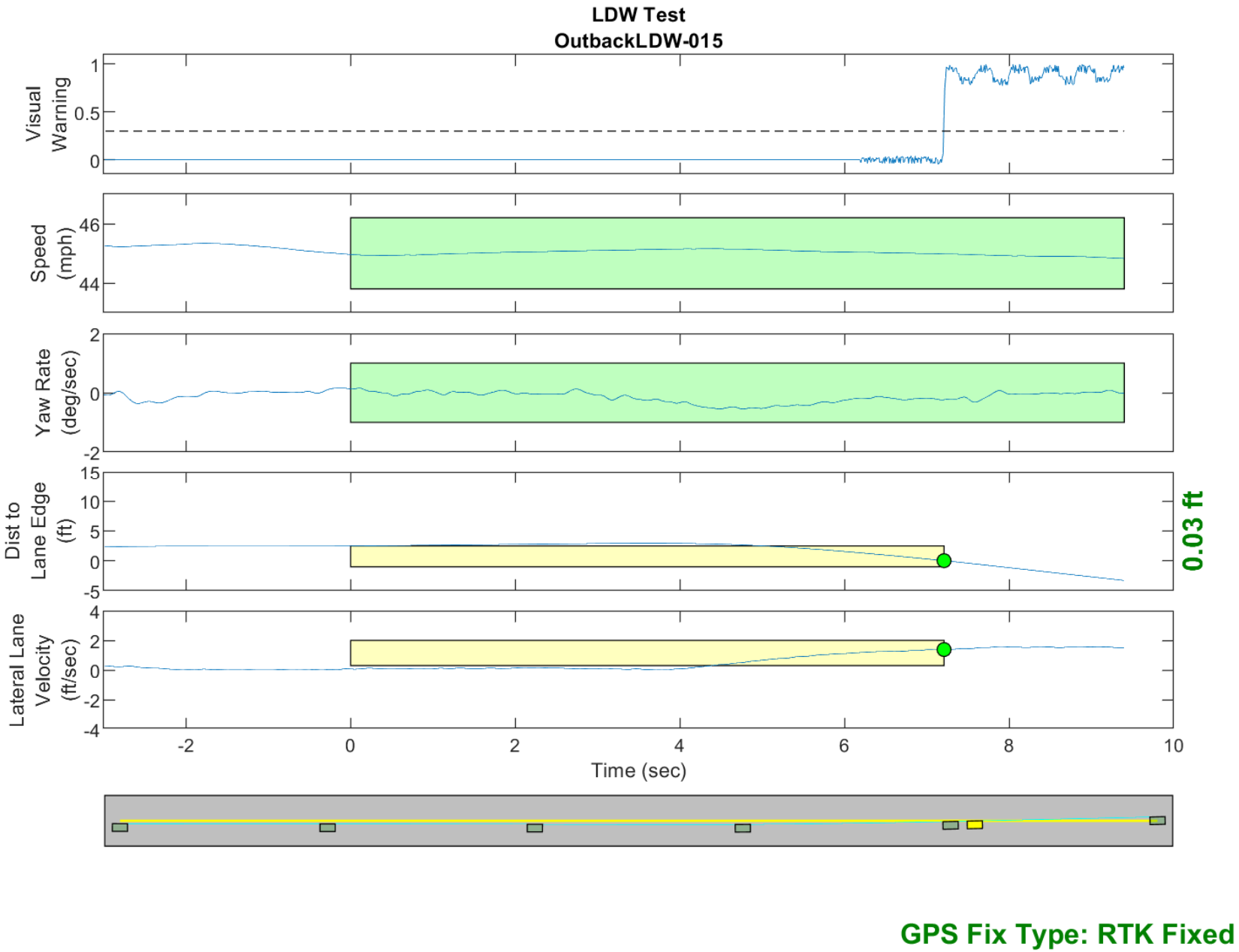


Figure D31. Time History for Run 15, Botts Dots, Left Departure, Visual Warning

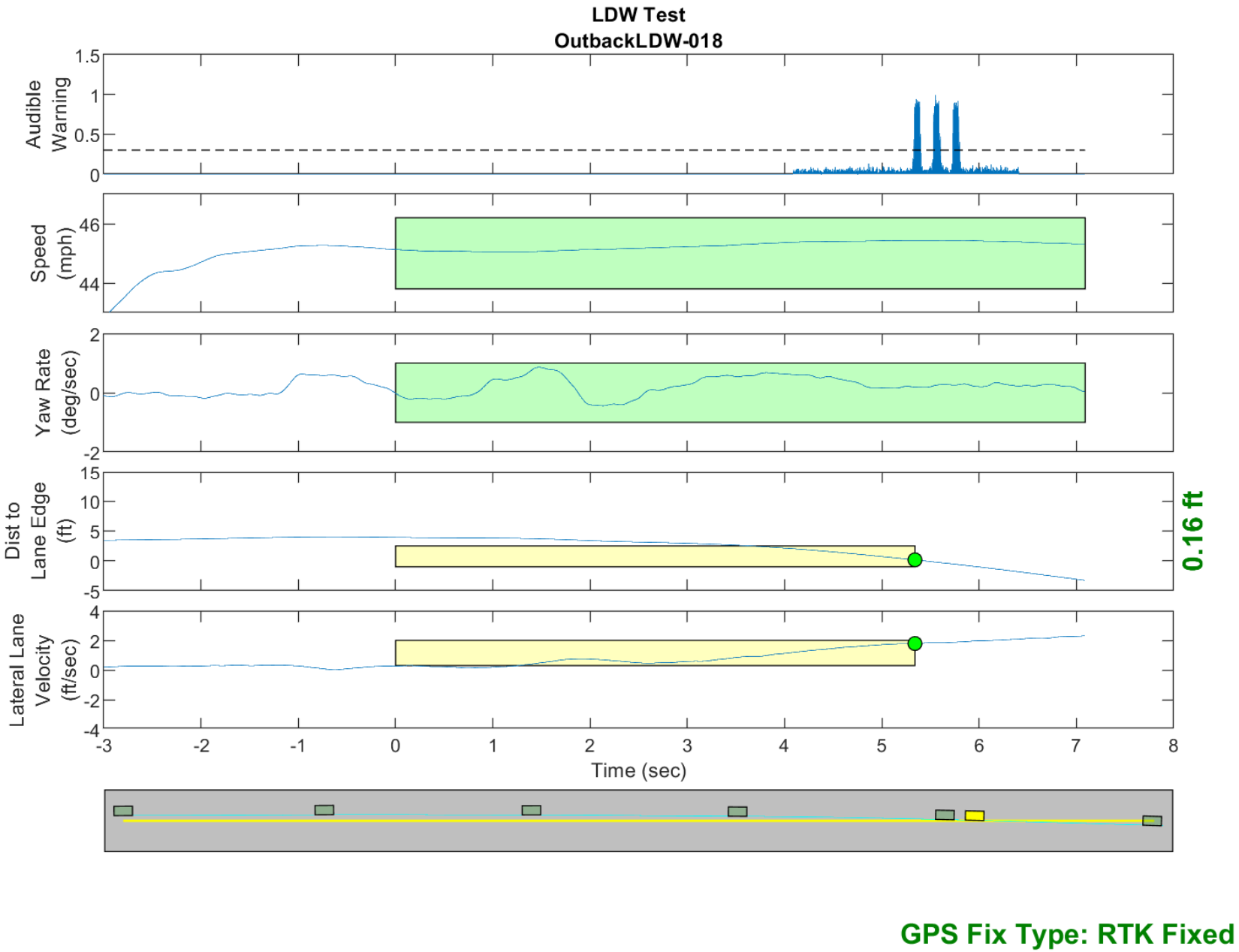


Figure D32. Time History for Run 18, Solid Line, Right Departure, Audible Warning

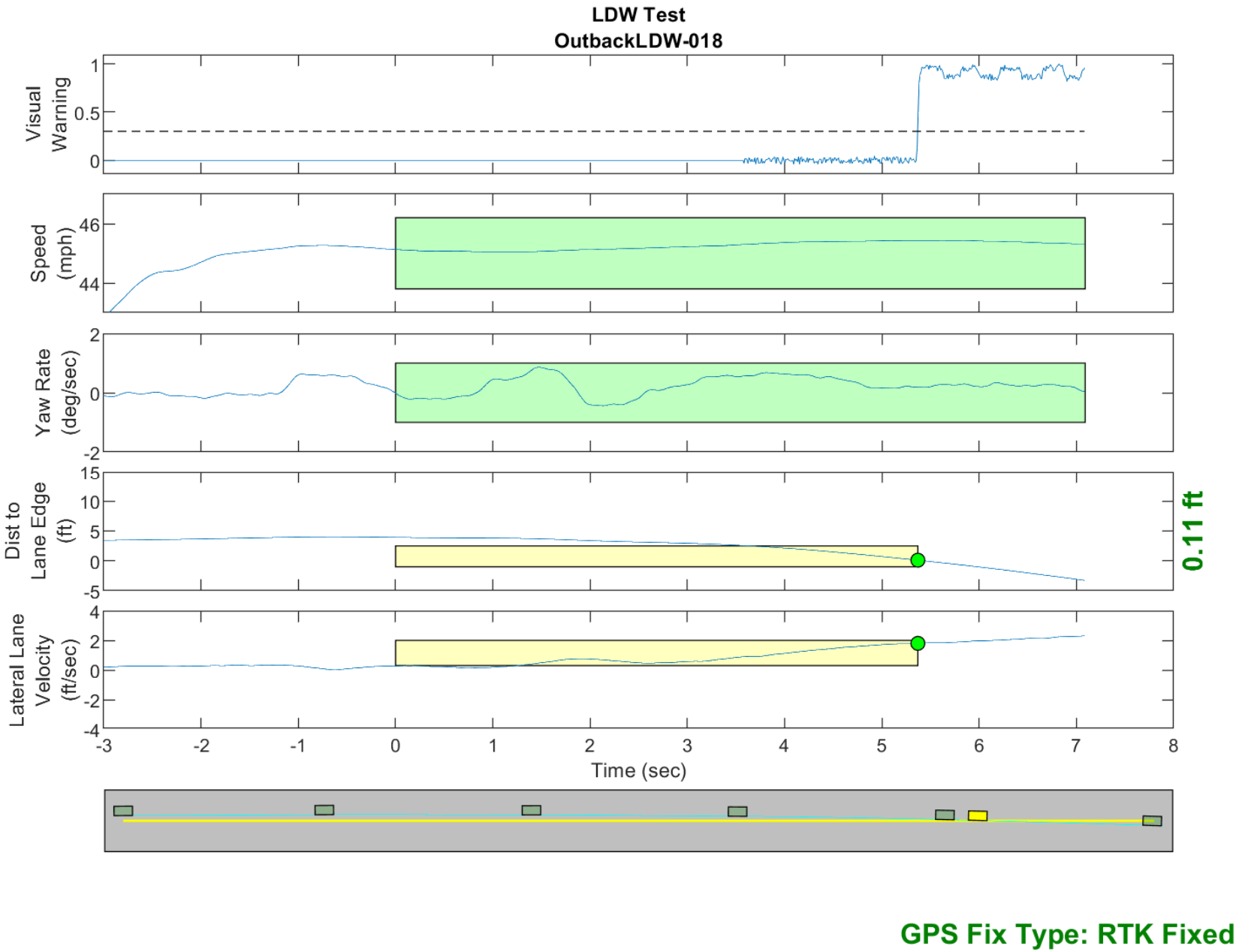


Figure D33. Time History for Run 18, Solid Line, Right Departure, Visual Warning

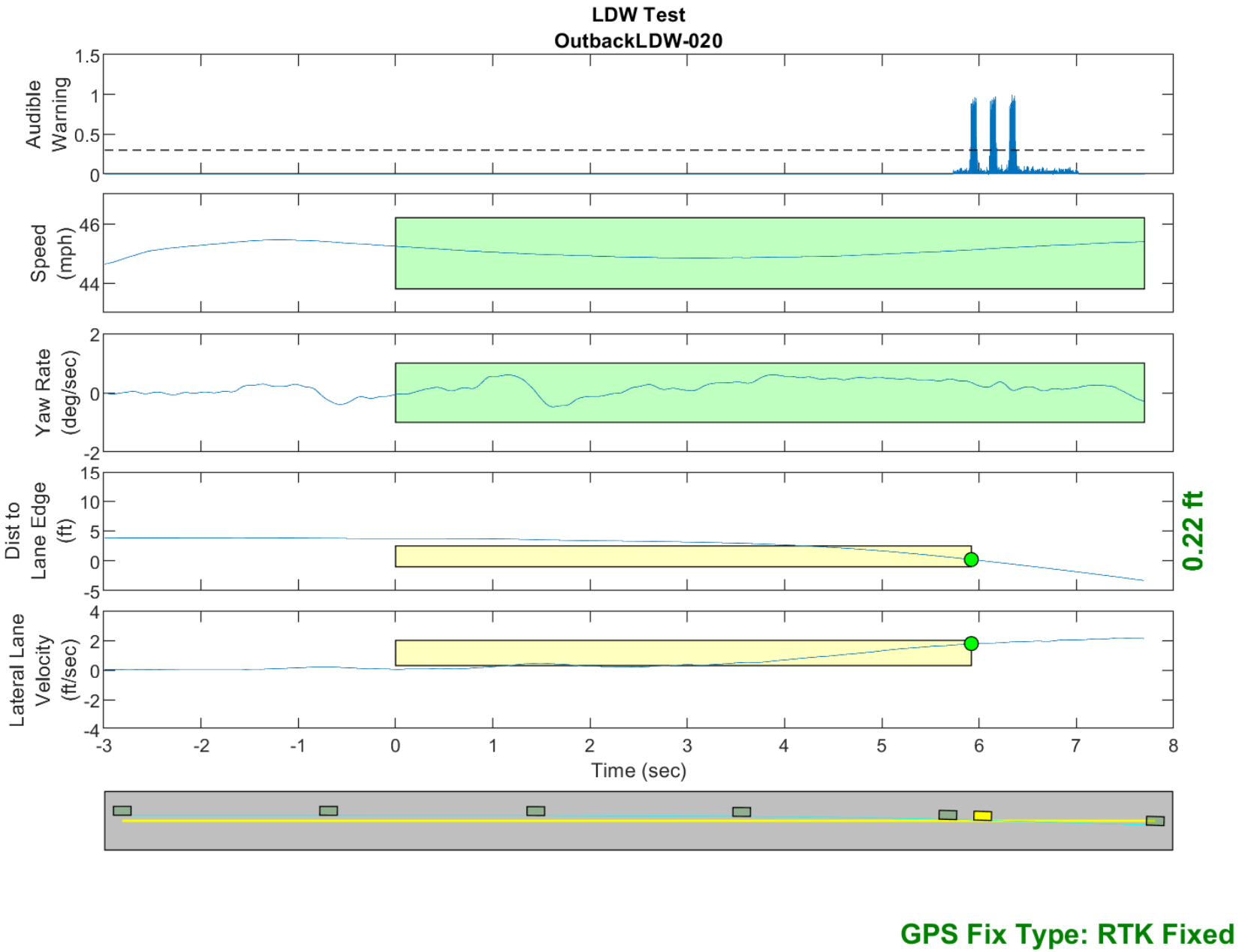


Figure D34. Time History for Run 20, Solid Line, Right Departure, Audible Warning

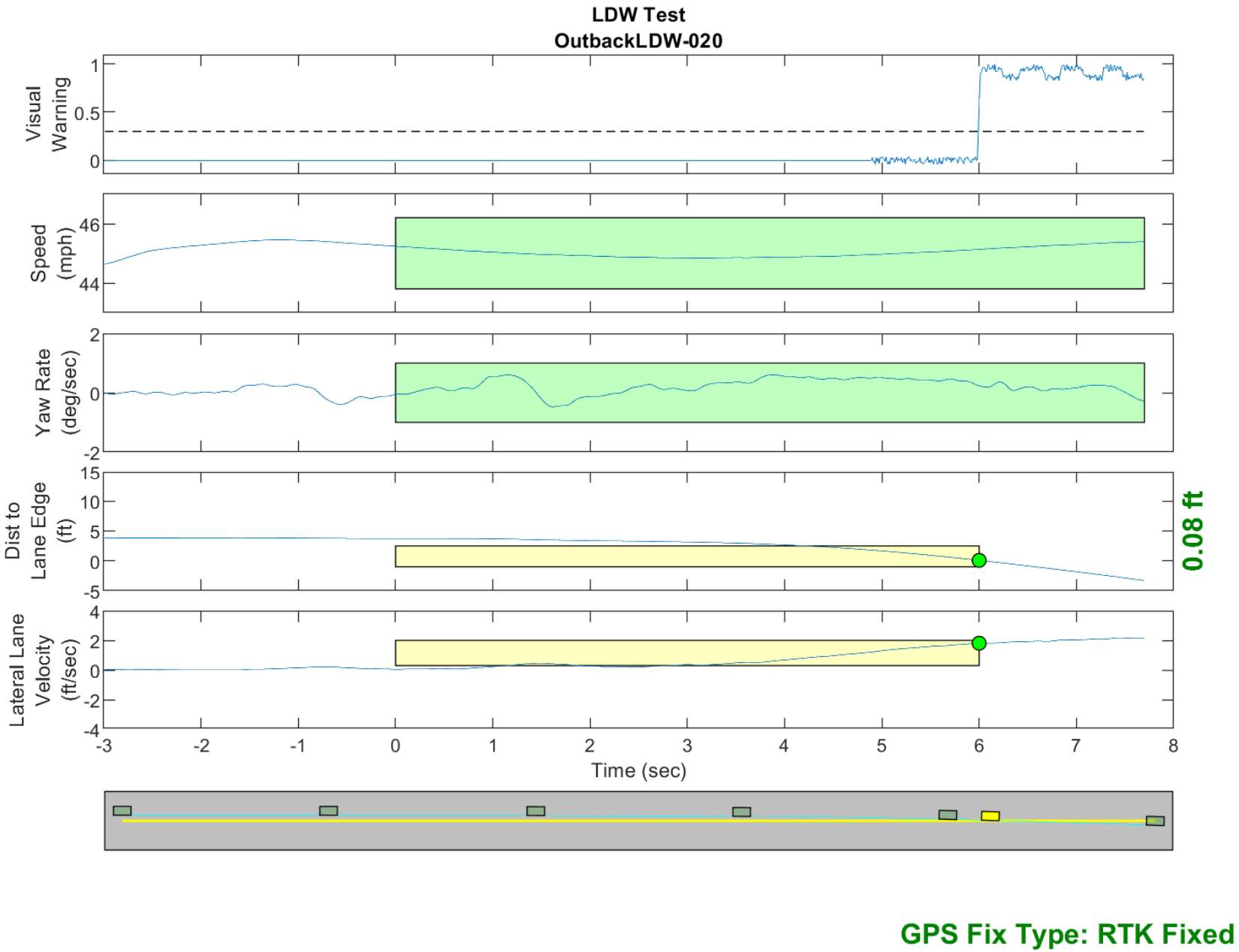


Figure D35. Time History for Run 20, Solid Line, Right Departure, Visual Warning

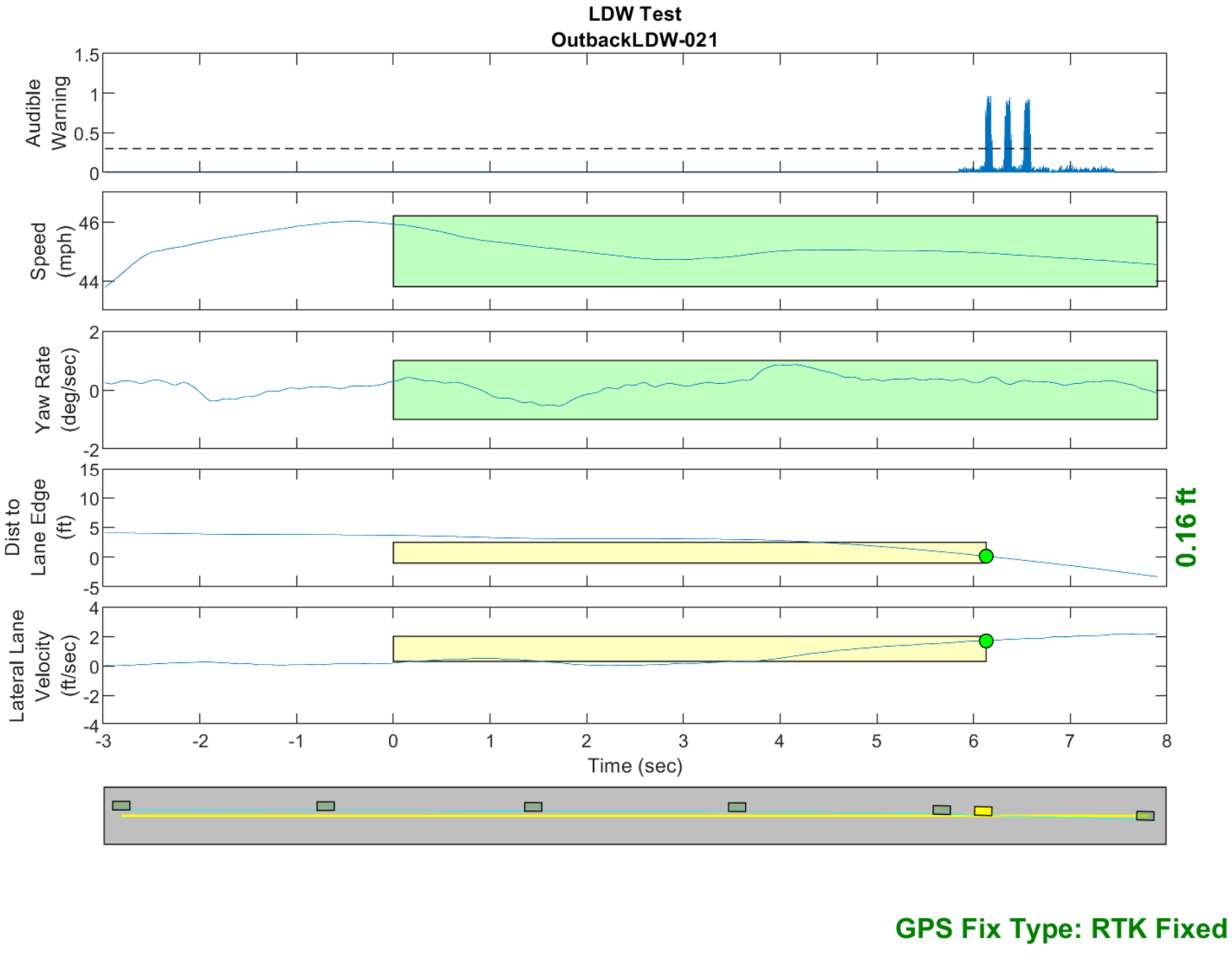


Figure D36. Time History for Run 21, Solid Line, Right Departure, Audible Warning

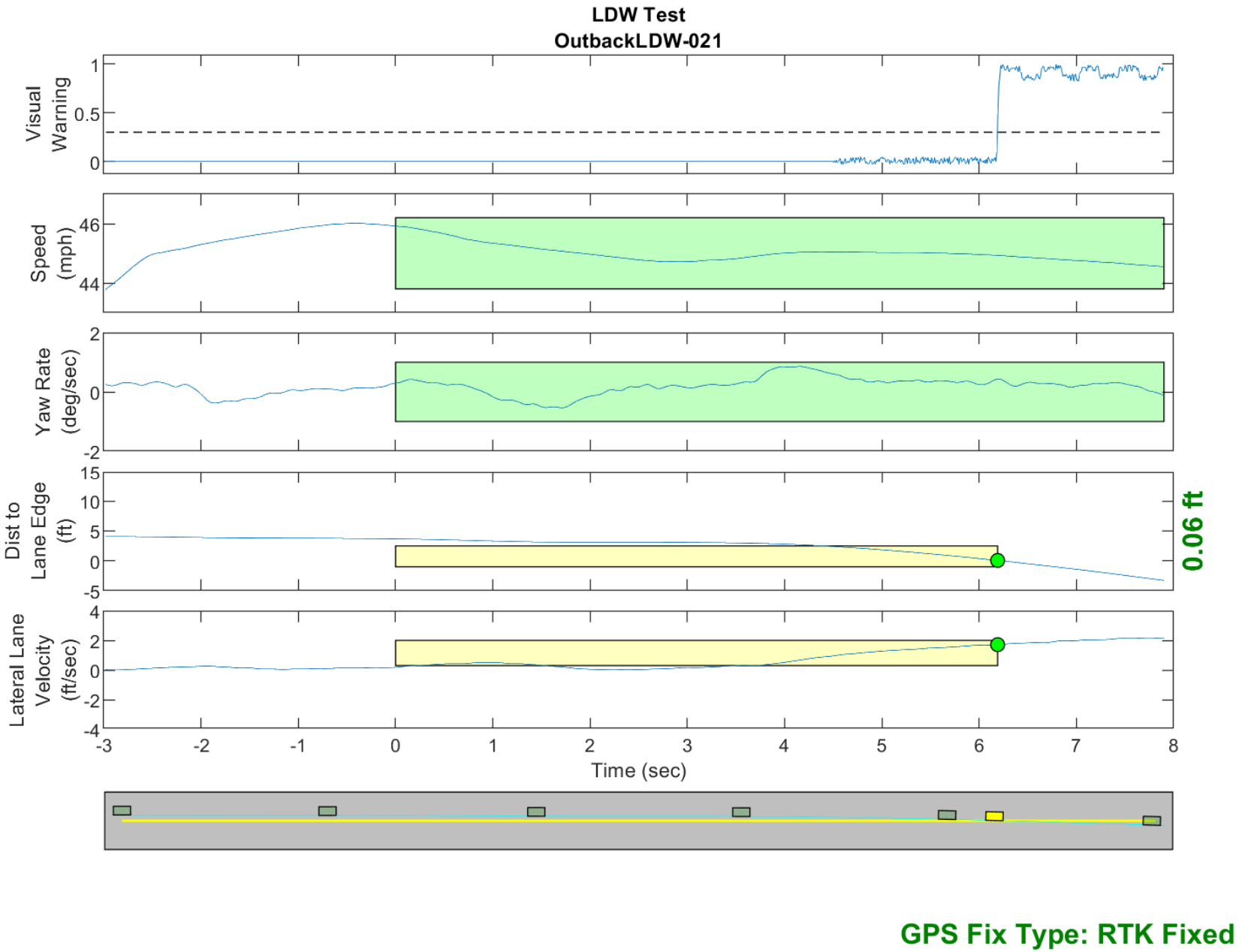


Figure D37. Time History for Run 21, Solid Line, Right Departure, Visual Warning

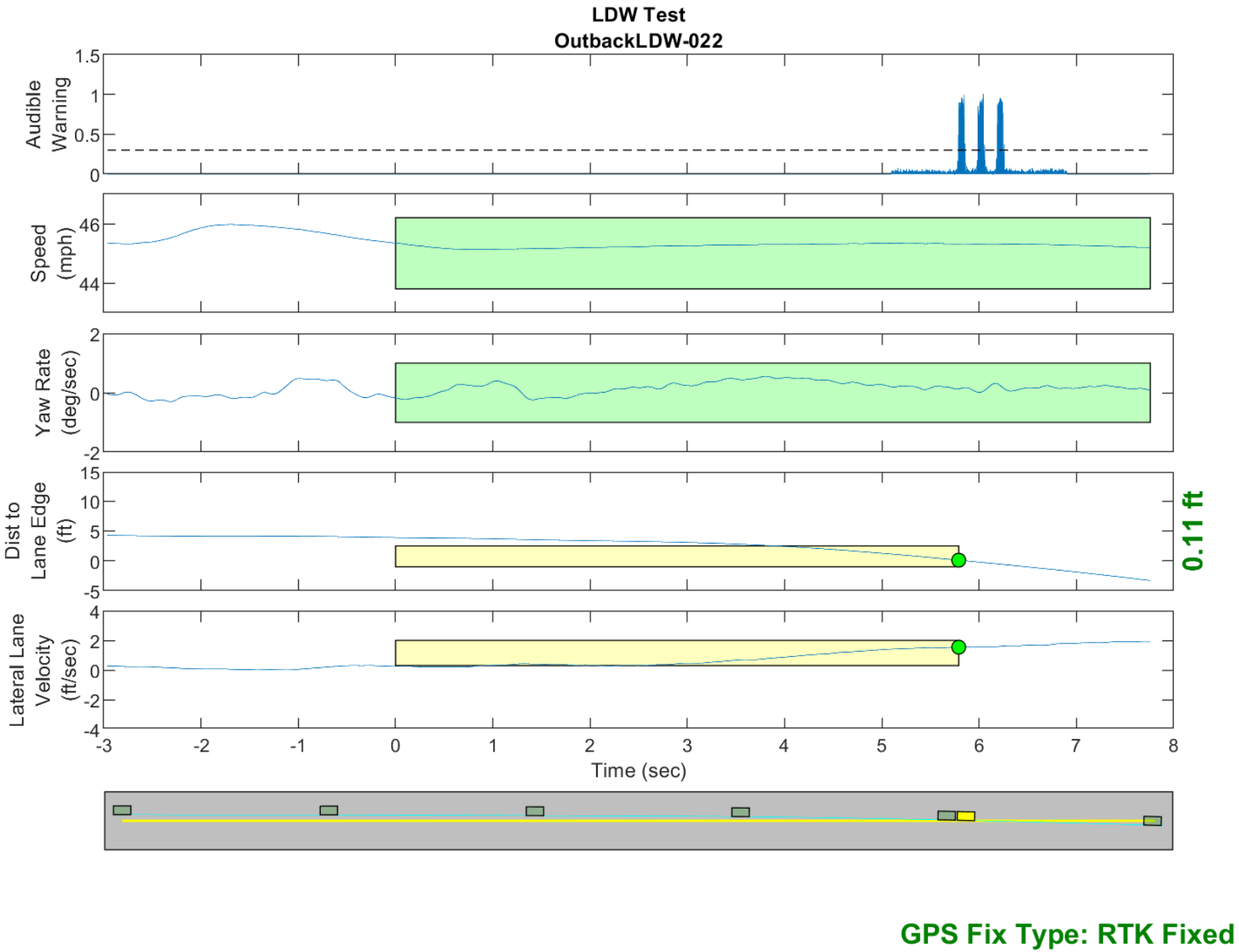


Figure D38. Time History for Run 22, Solid Line, Right Departure, Audible Warning

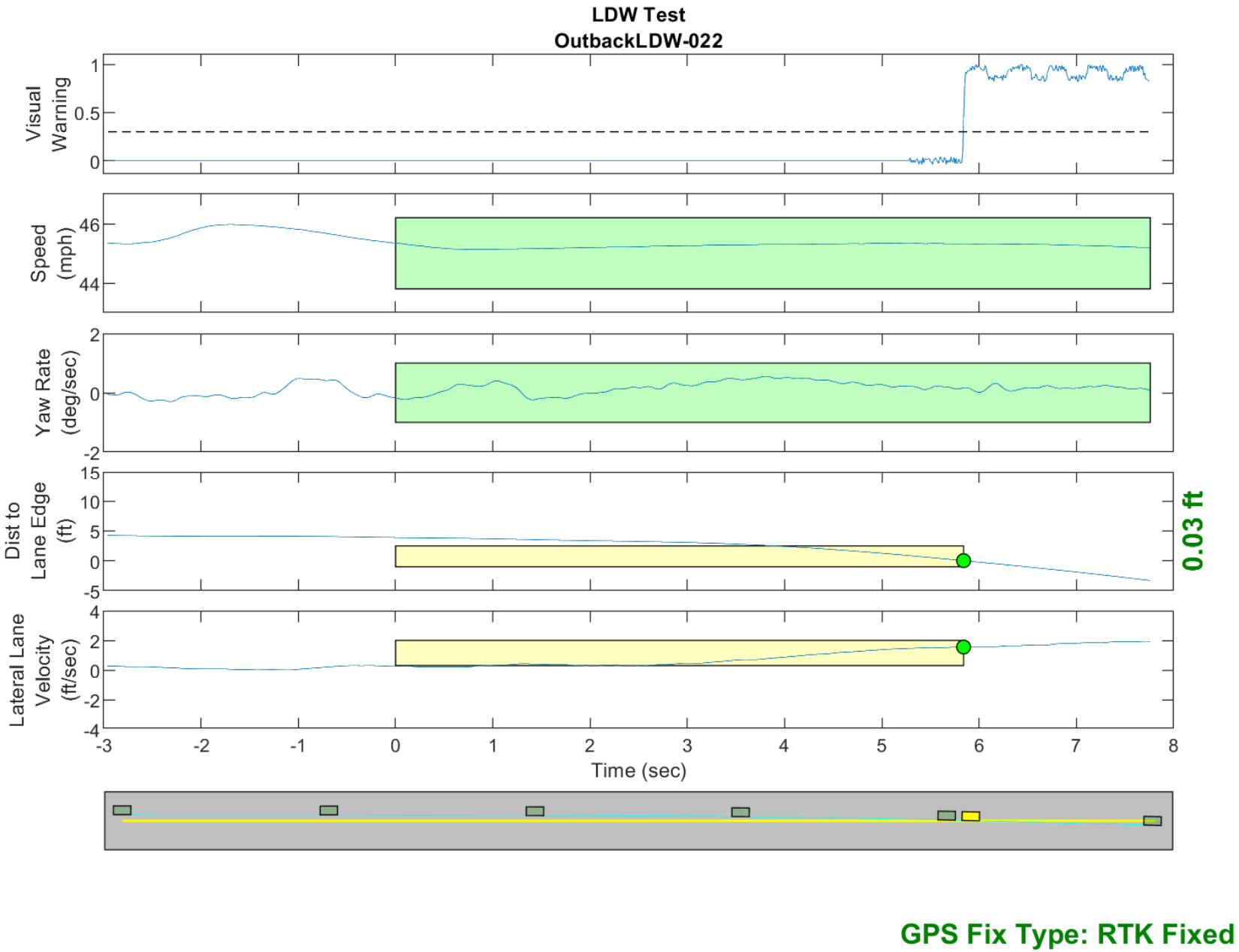


Figure D39. Time History for Run 22, Solid Line, Right Departure, Visual Warning

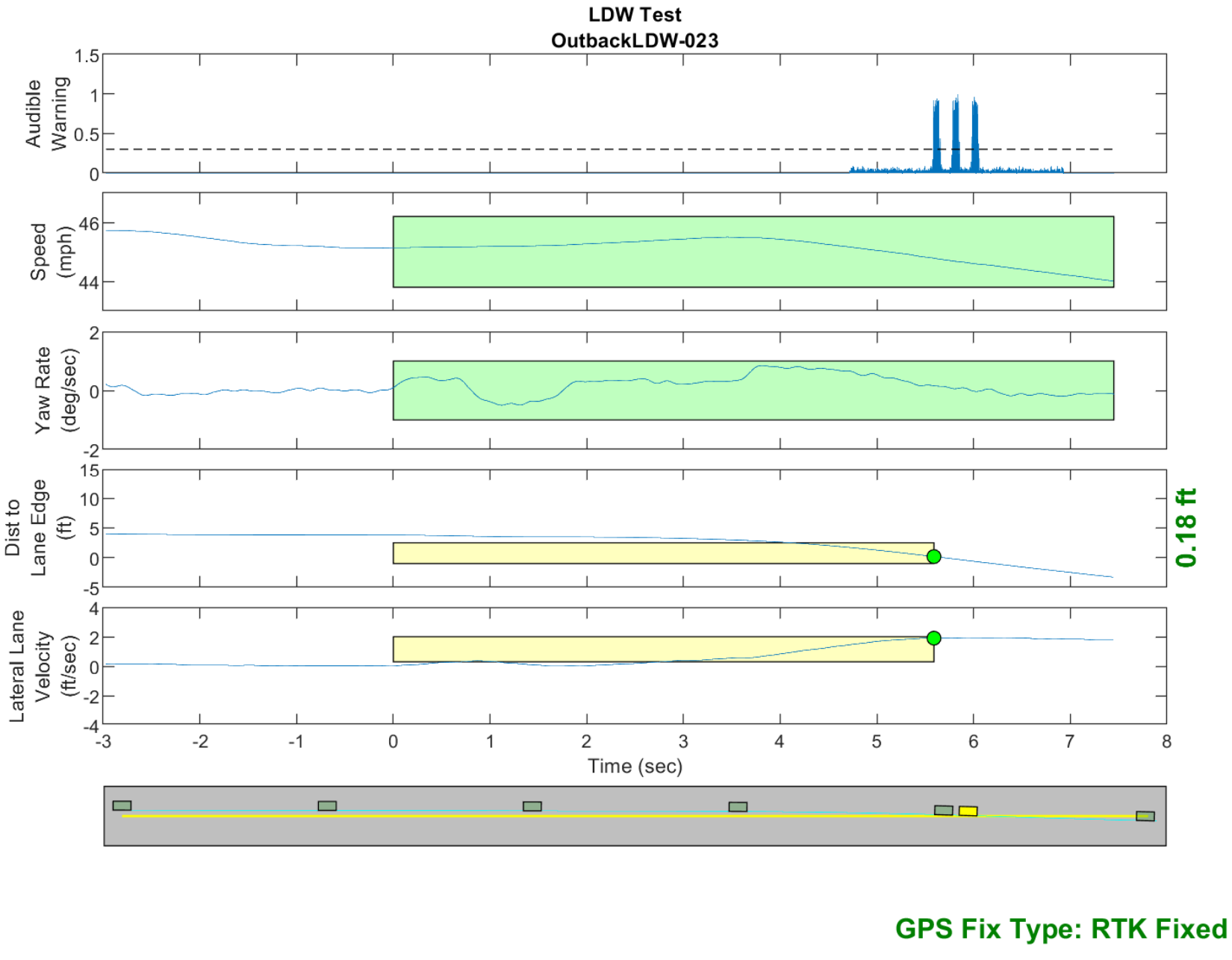


Figure D40. Time History for Run 23, Solid Line, Right Departure, Audible Warning

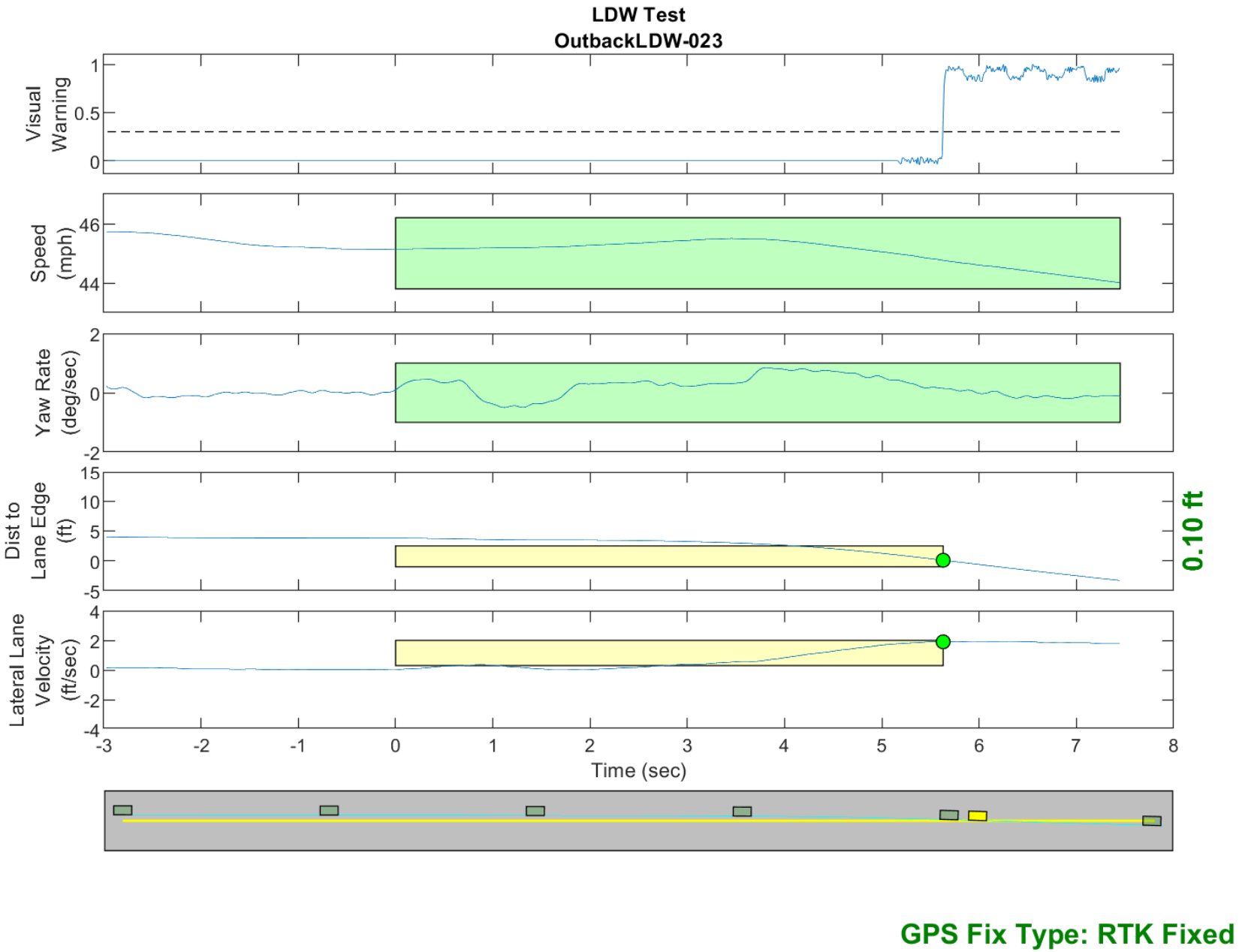


Figure D41. Time History for Run 23, Solid Line, Right Departure, Visual Warning

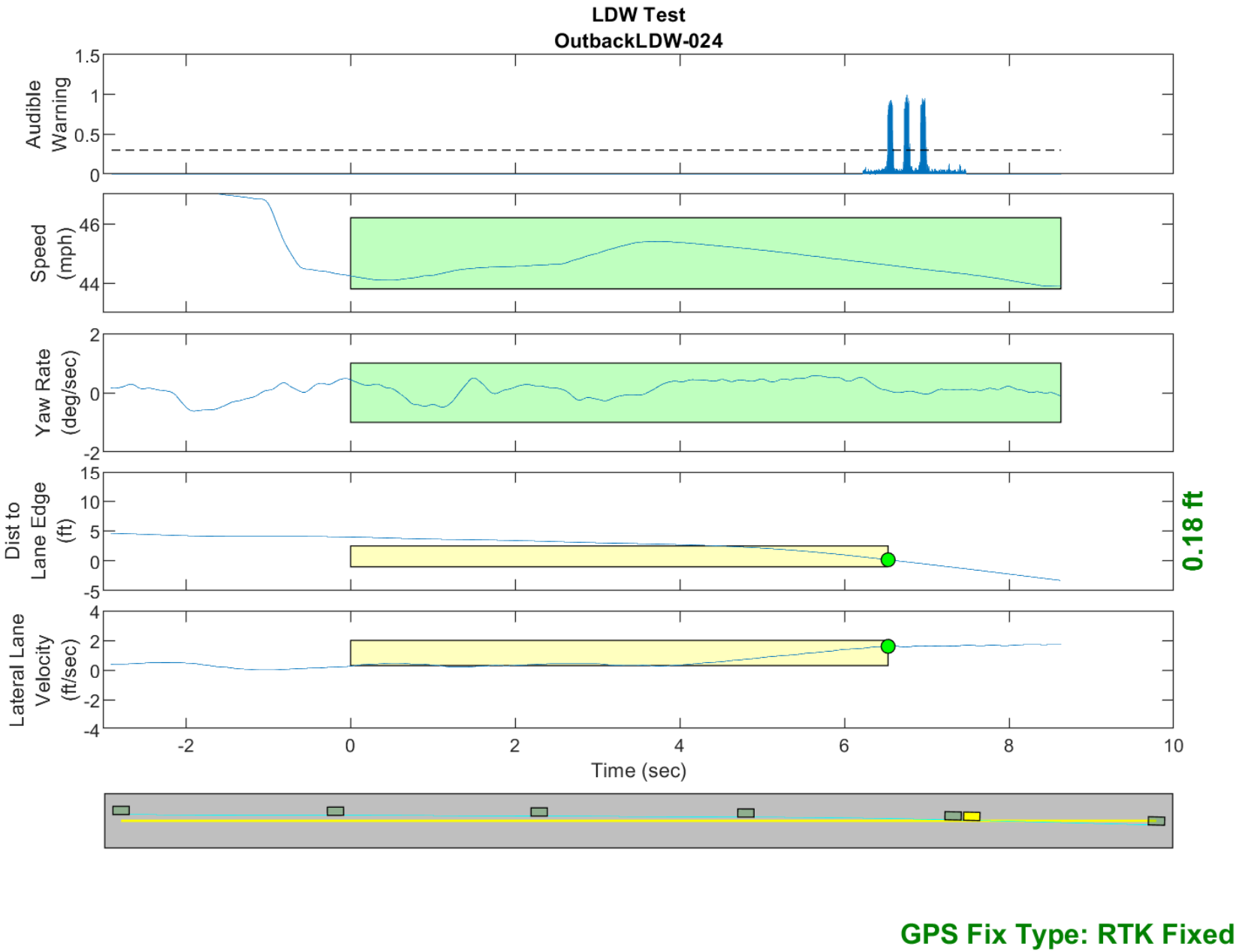


Figure D42. Time History for Run 24, Solid Line, Right Departure, Audible Warning

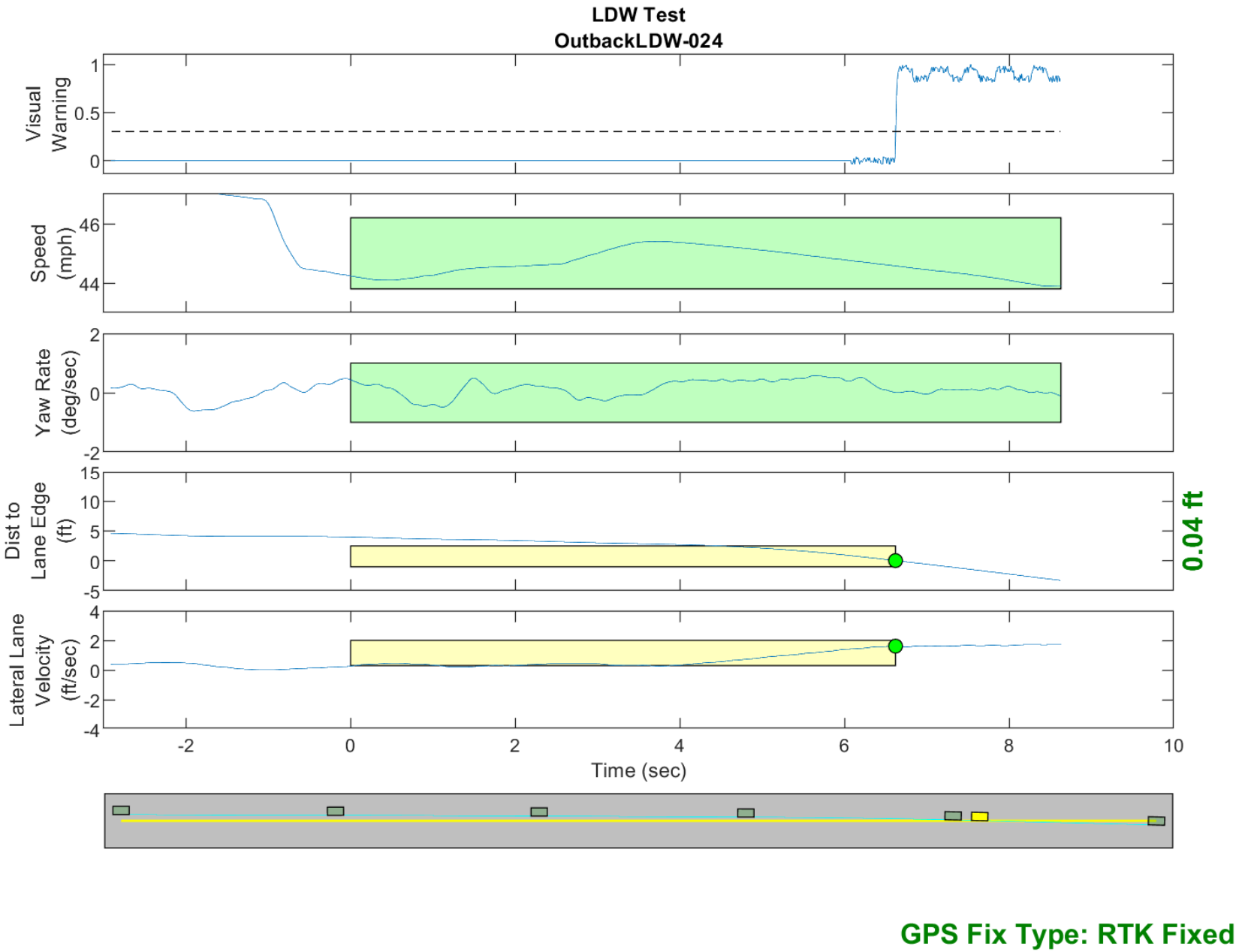


Figure D43. Time History for Run 24, Solid Line, Right Departure, Visual Warning

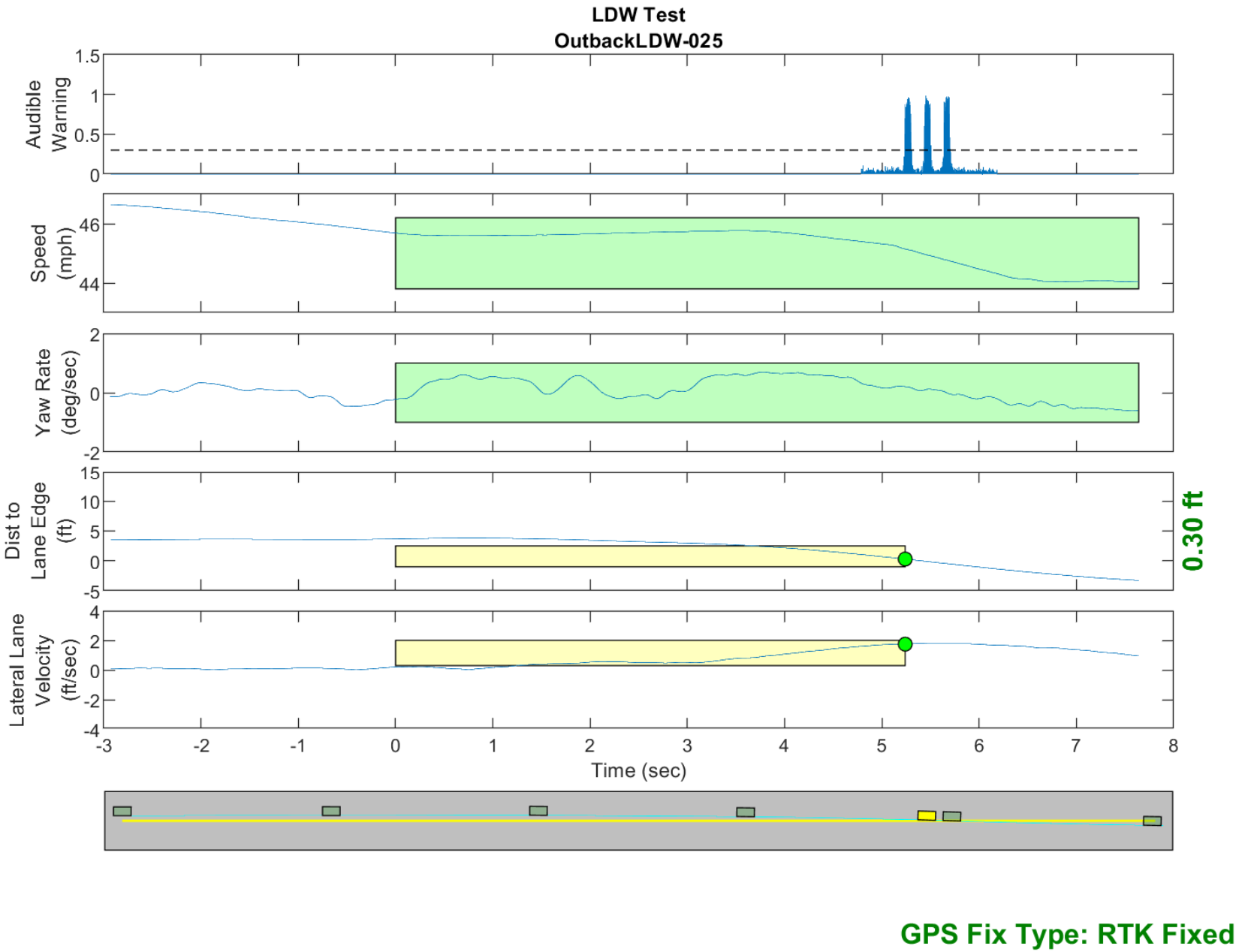


Figure D44. Time History for Run 25, Solid Line, Right Departure, Audible Warning

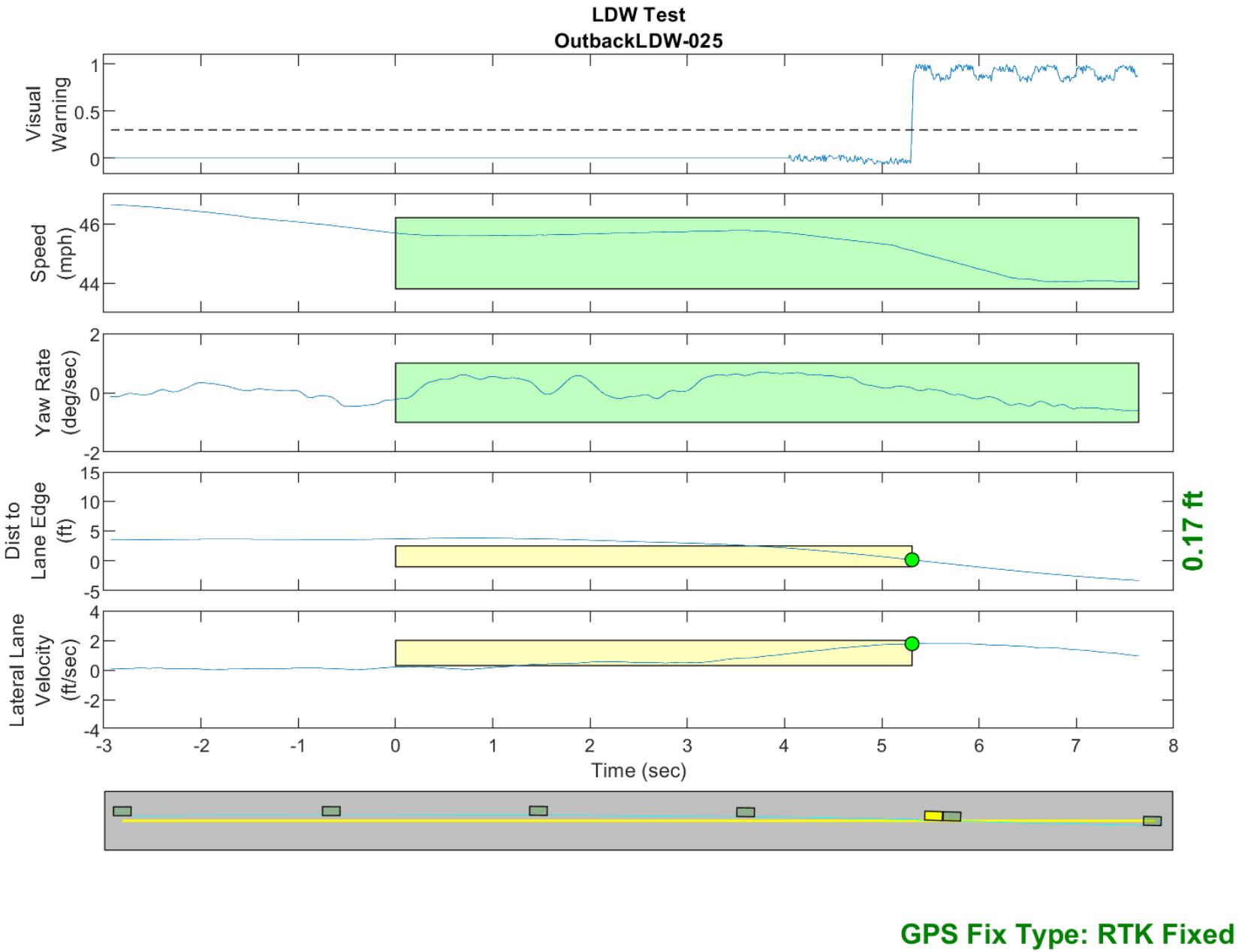


Figure D45. Time History for Run 25, Solid Line, Right Departure, Visual Warning

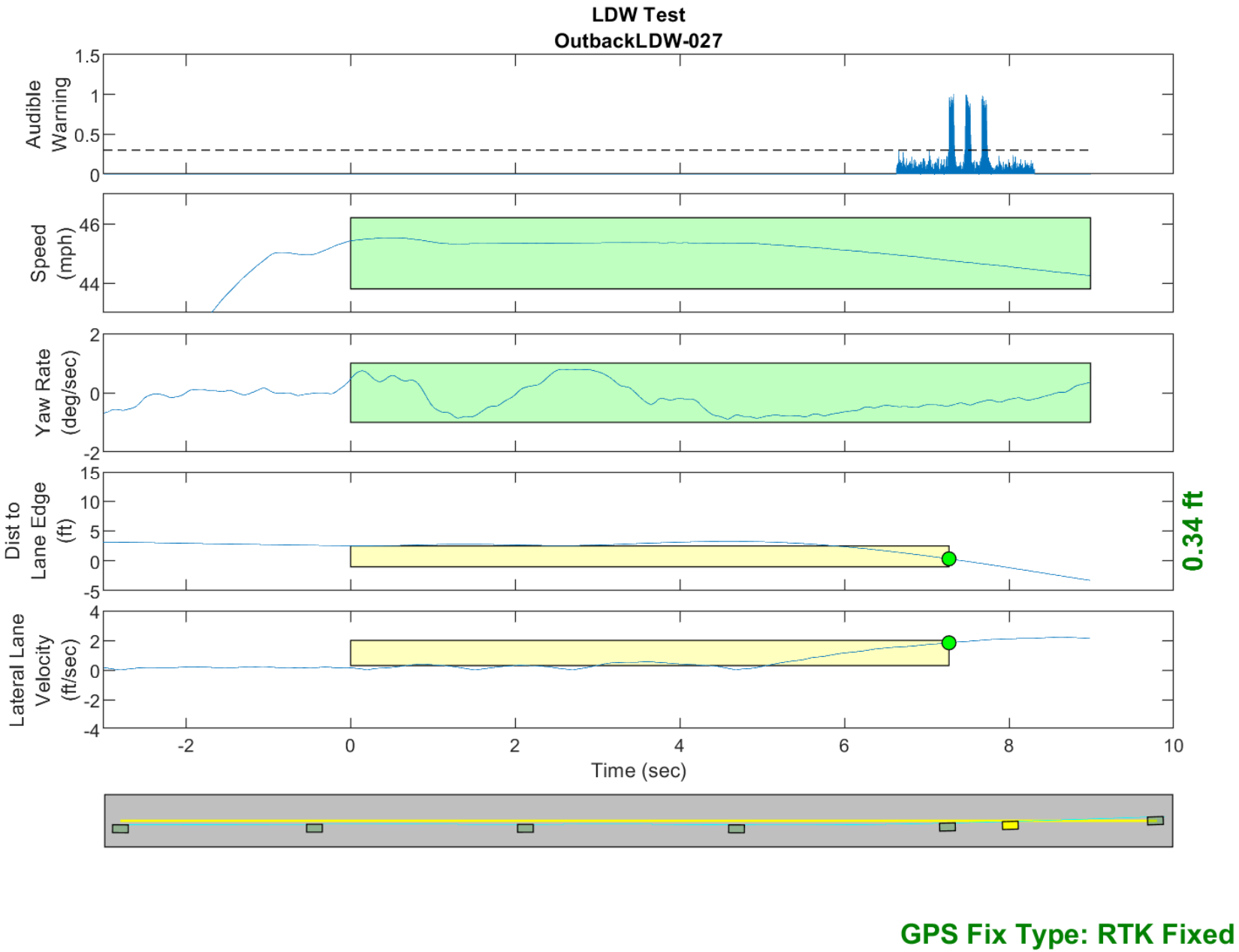


Figure D46. Time History for Run 27, Solid Line, Left Departure, Audible Warning

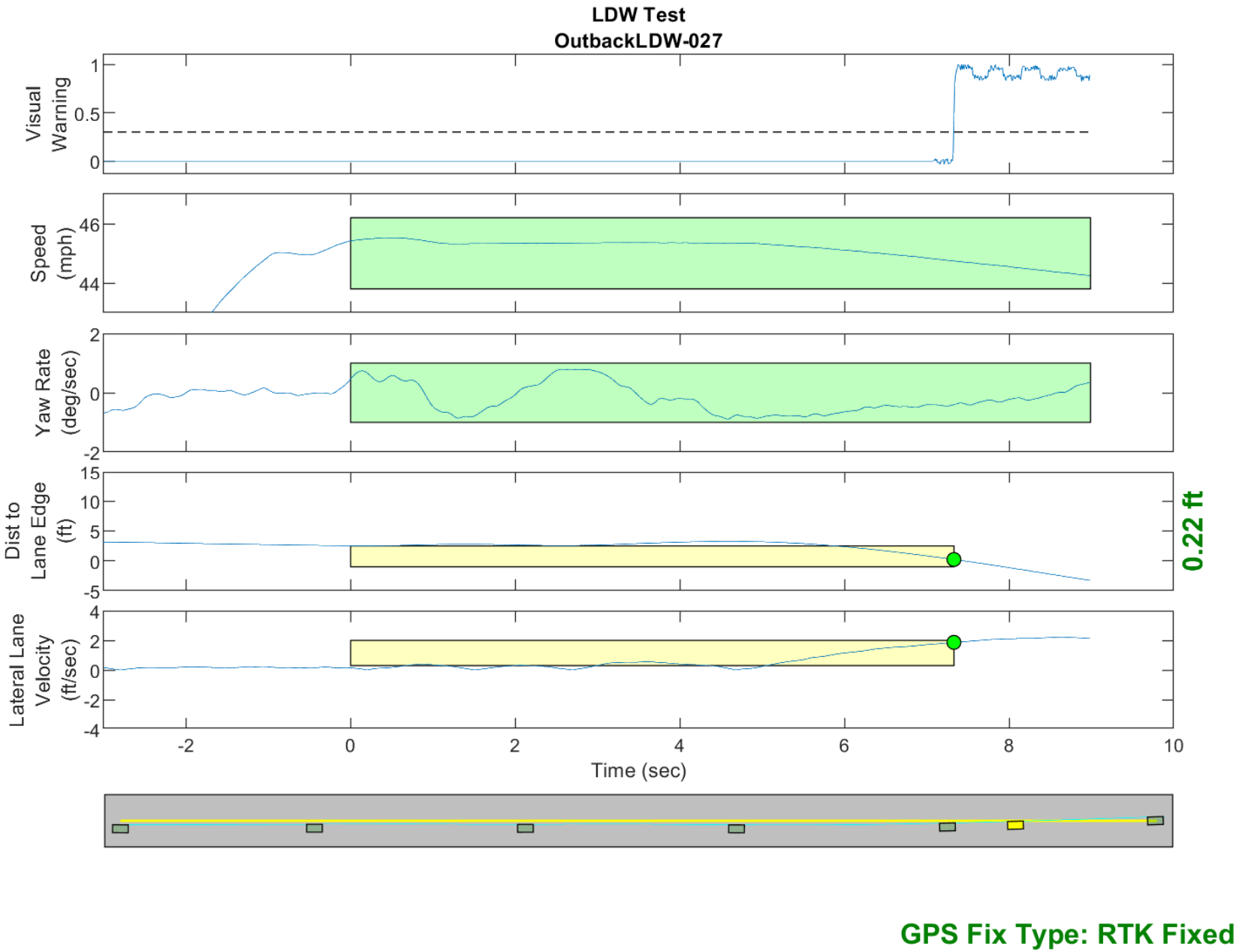


Figure D47. Time History for Run 27, Solid Line, Left Departure, Visual Warning

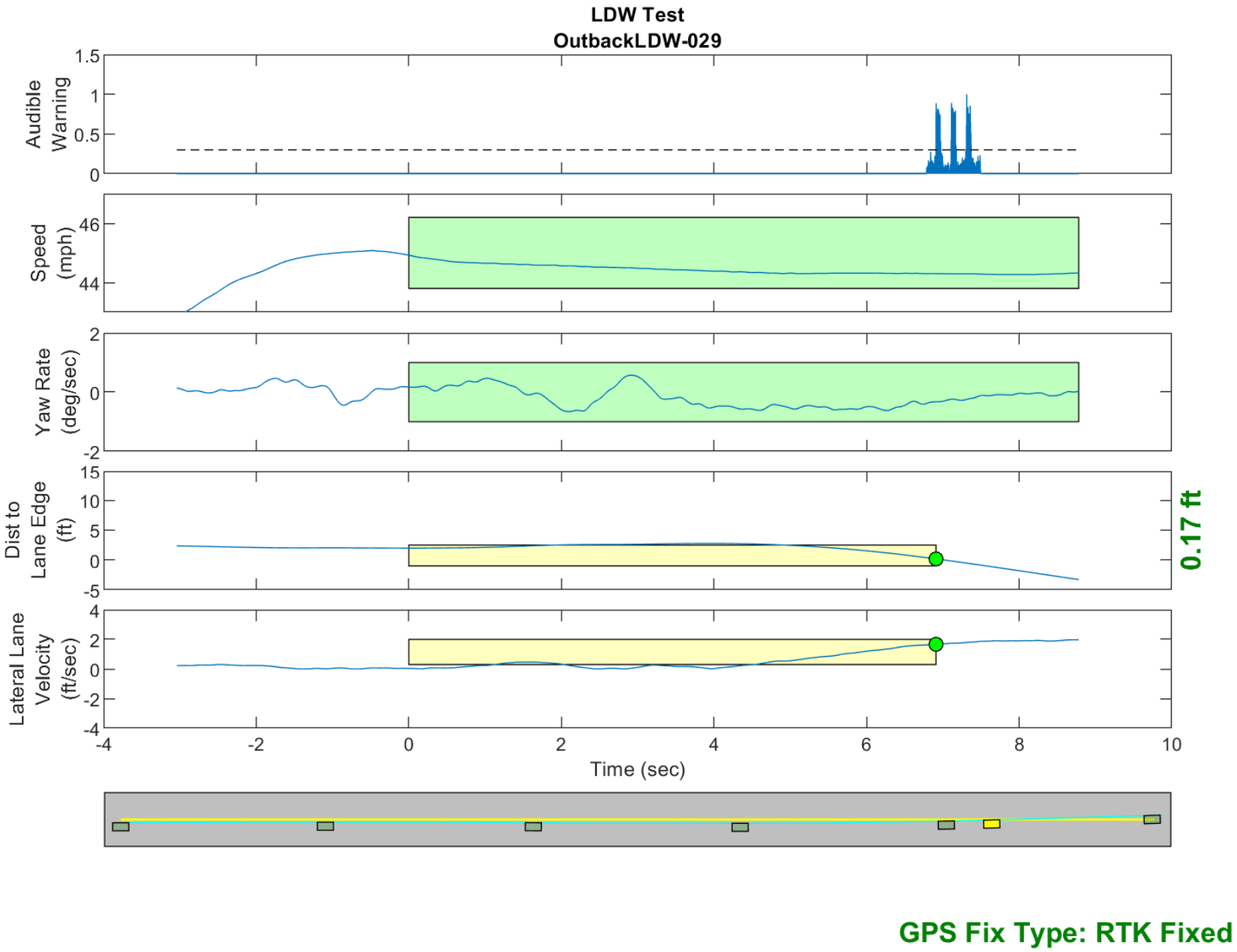


Figure D48. Time History for Run 29, Solid Line, Left Departure, Audible Warning

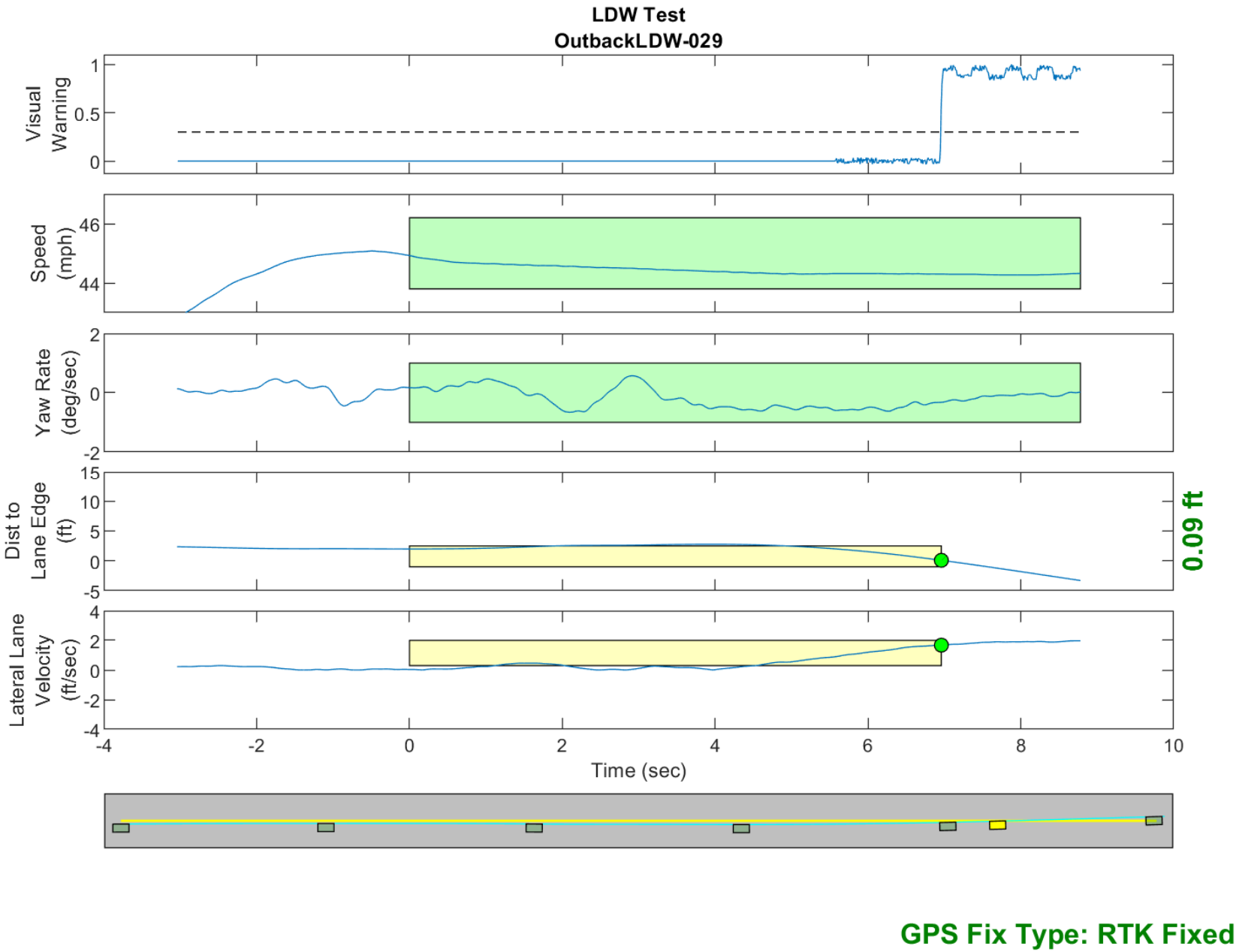


Figure D49. Time History for Run 29, Solid Line, Left Departure, Visual Warning

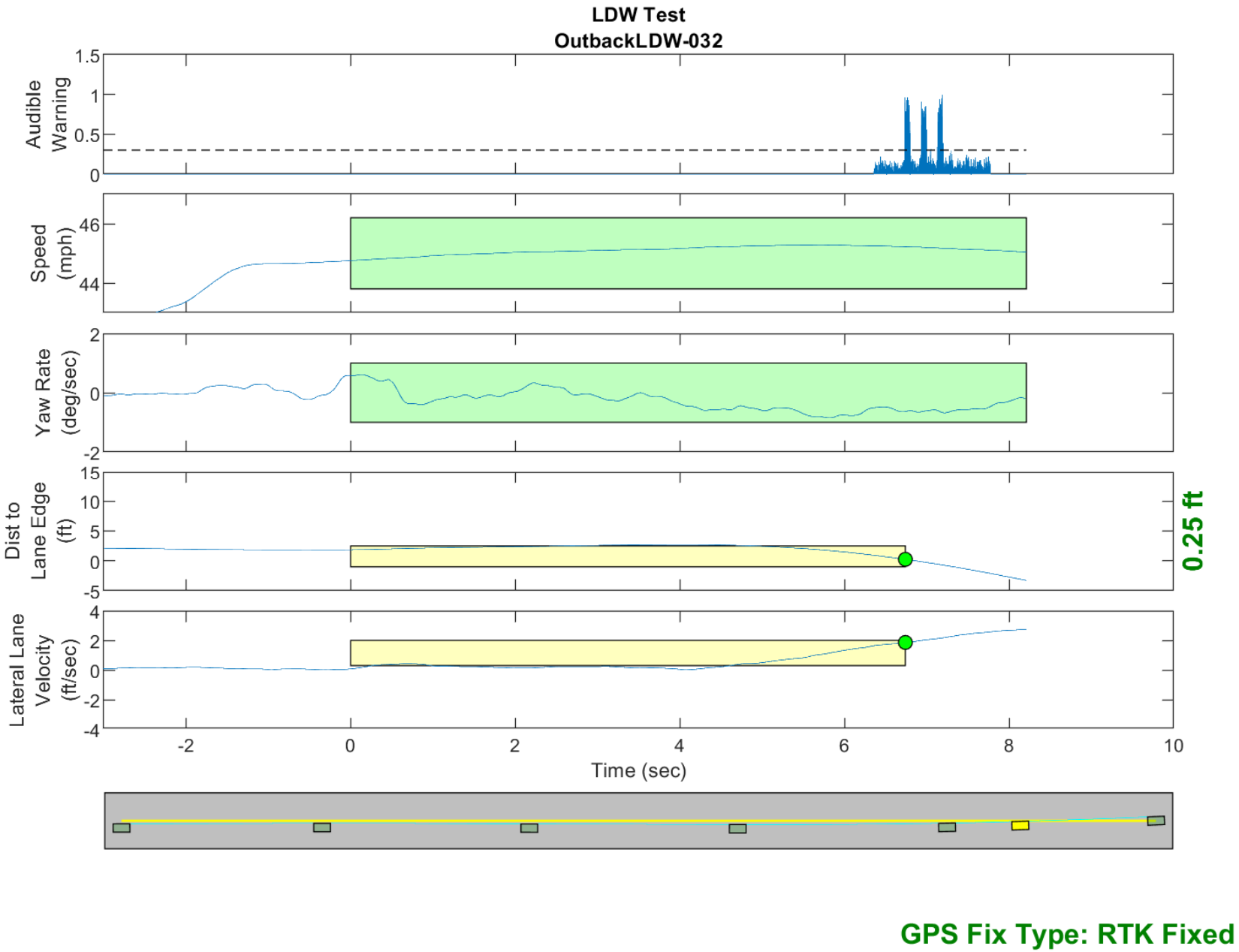


Figure D50. Time History for Run 32, Solid Line, Left Departure, Audible Warning

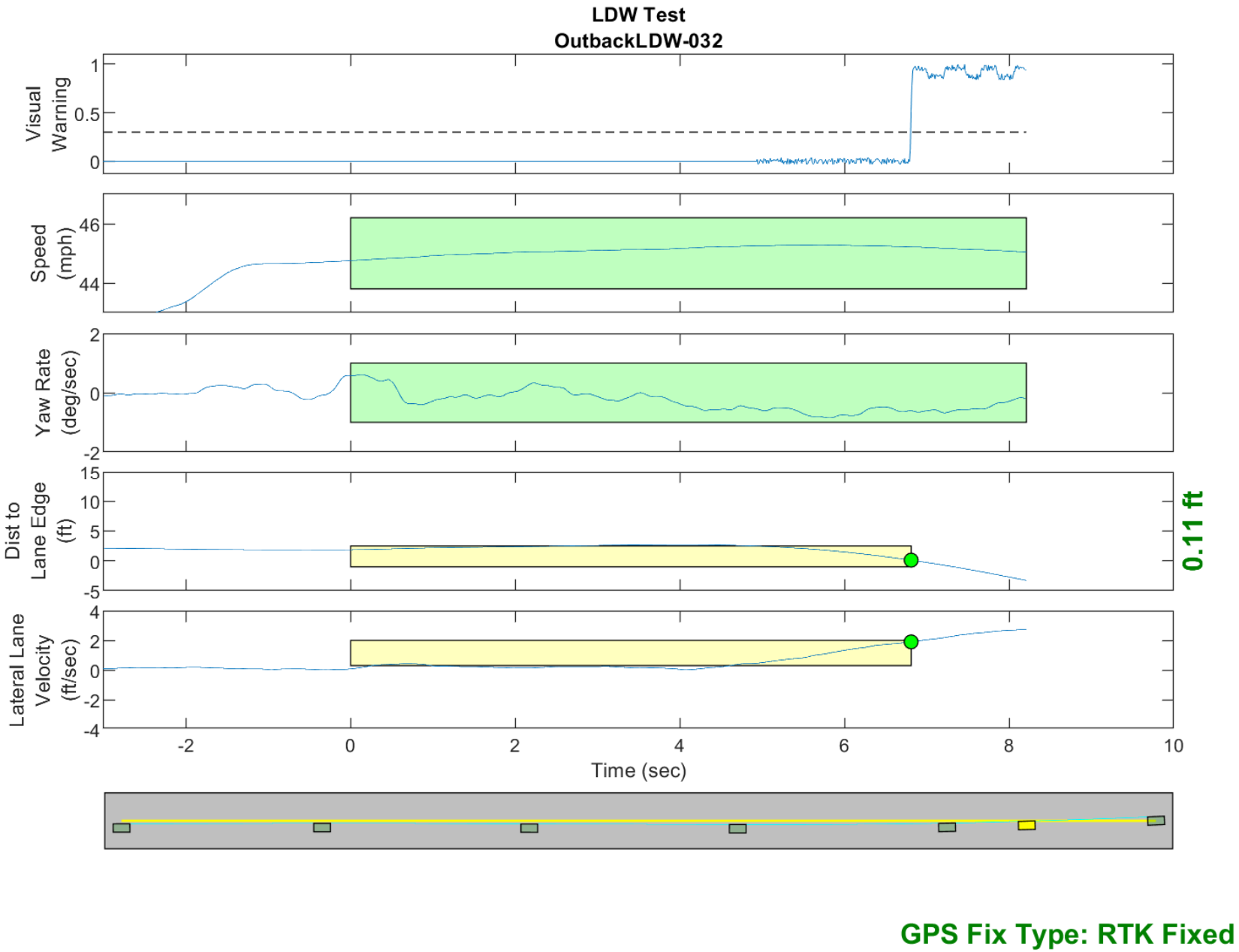


Figure D51. Time History for Run 32, Solid Line, Left Departure, Visual Warning

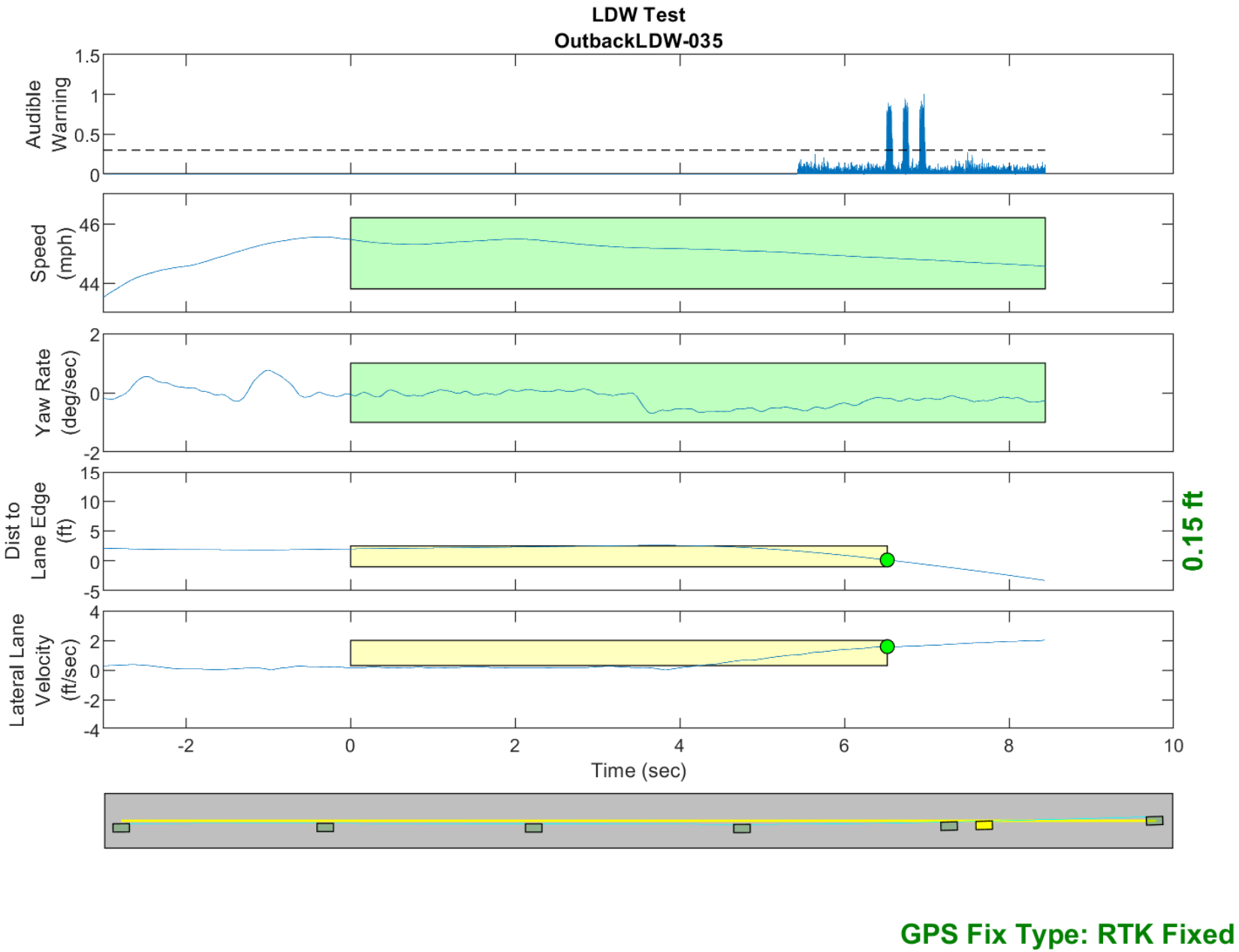


Figure D52. Time History for Run 35, Solid Line, Left Departure, Audible Warning

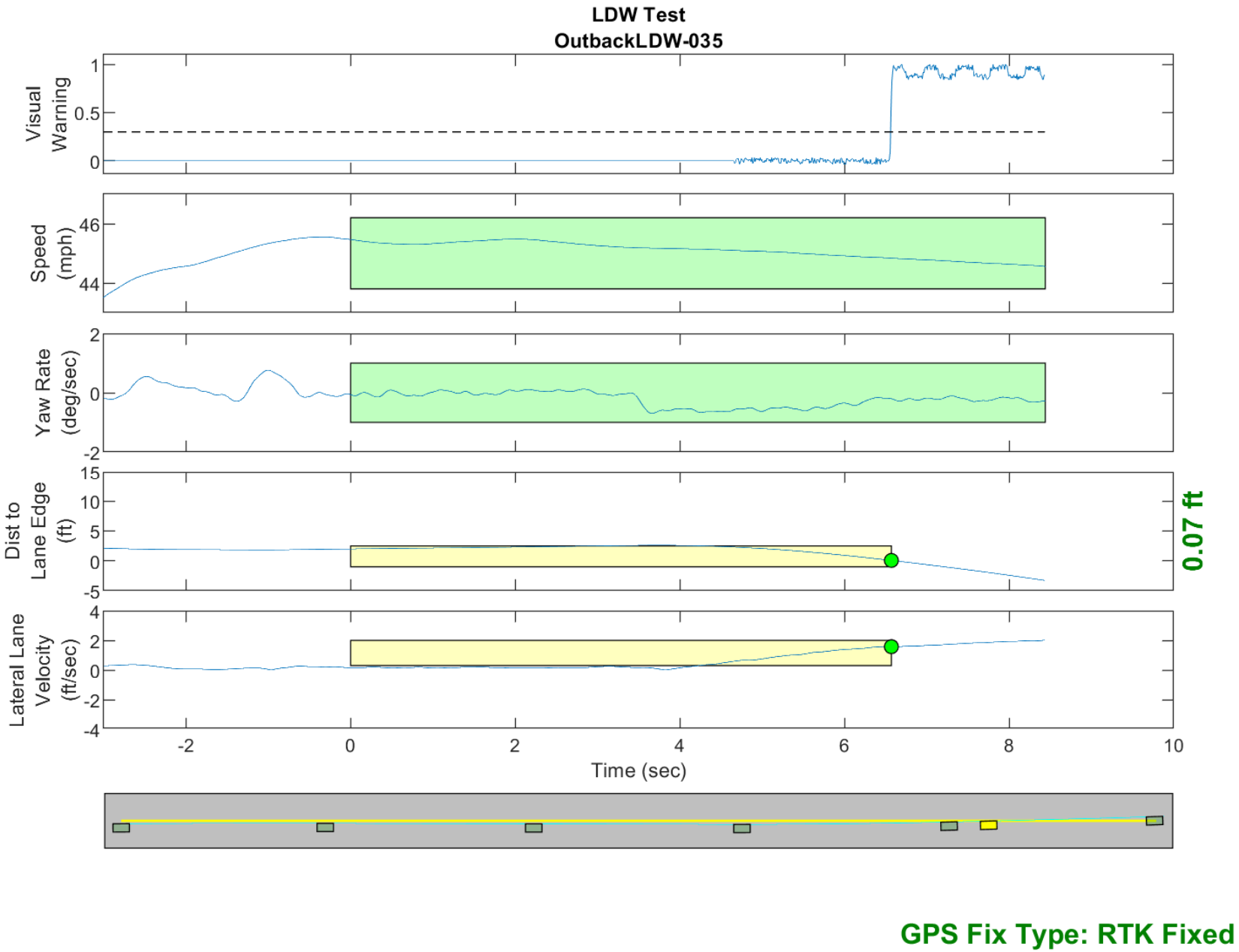


Figure D53. Time History for Run 35, Solid Line, Left Departure, Visual Warning

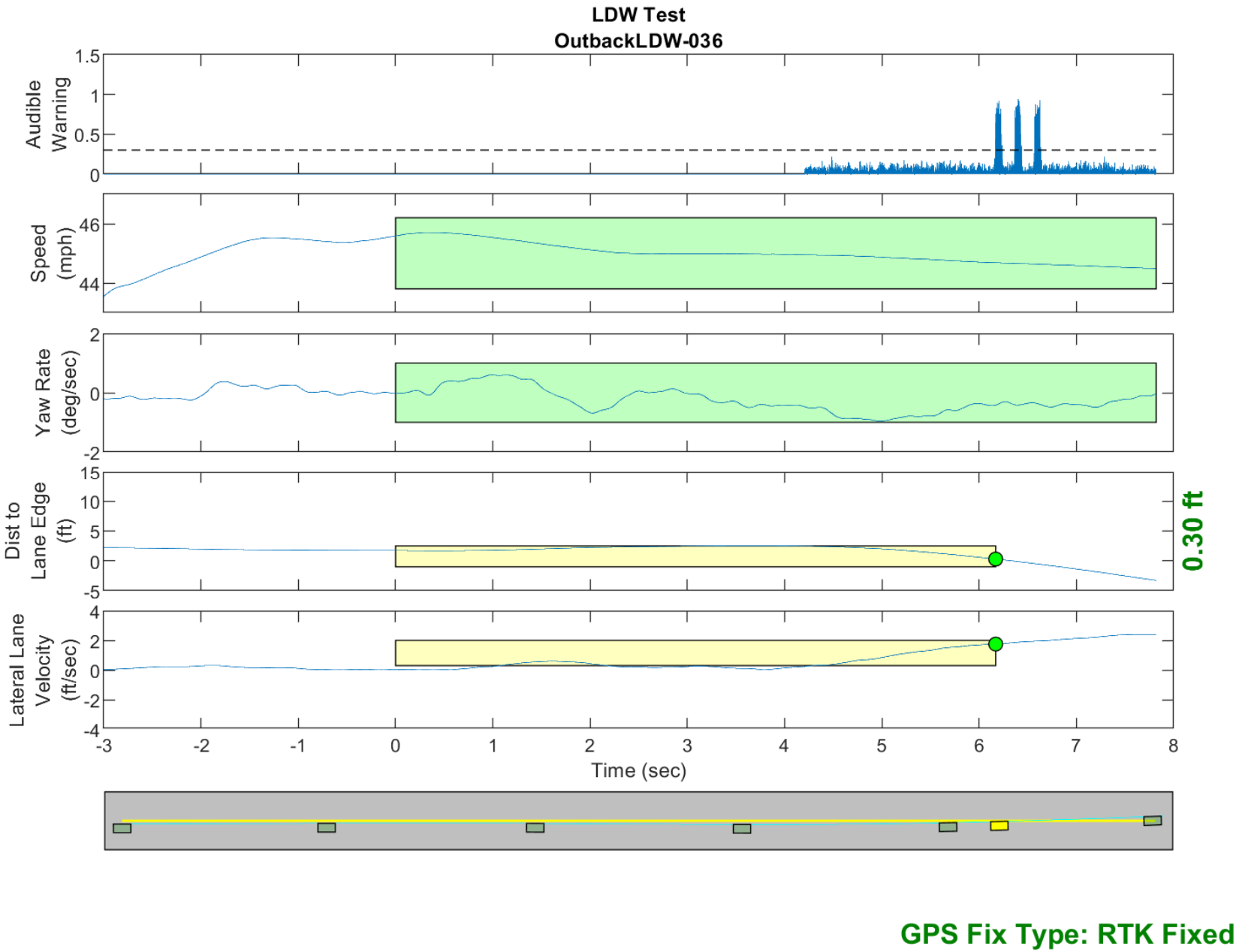


Figure D54. Time History for Run 36, Solid Line, Left Departure, Audible Warning

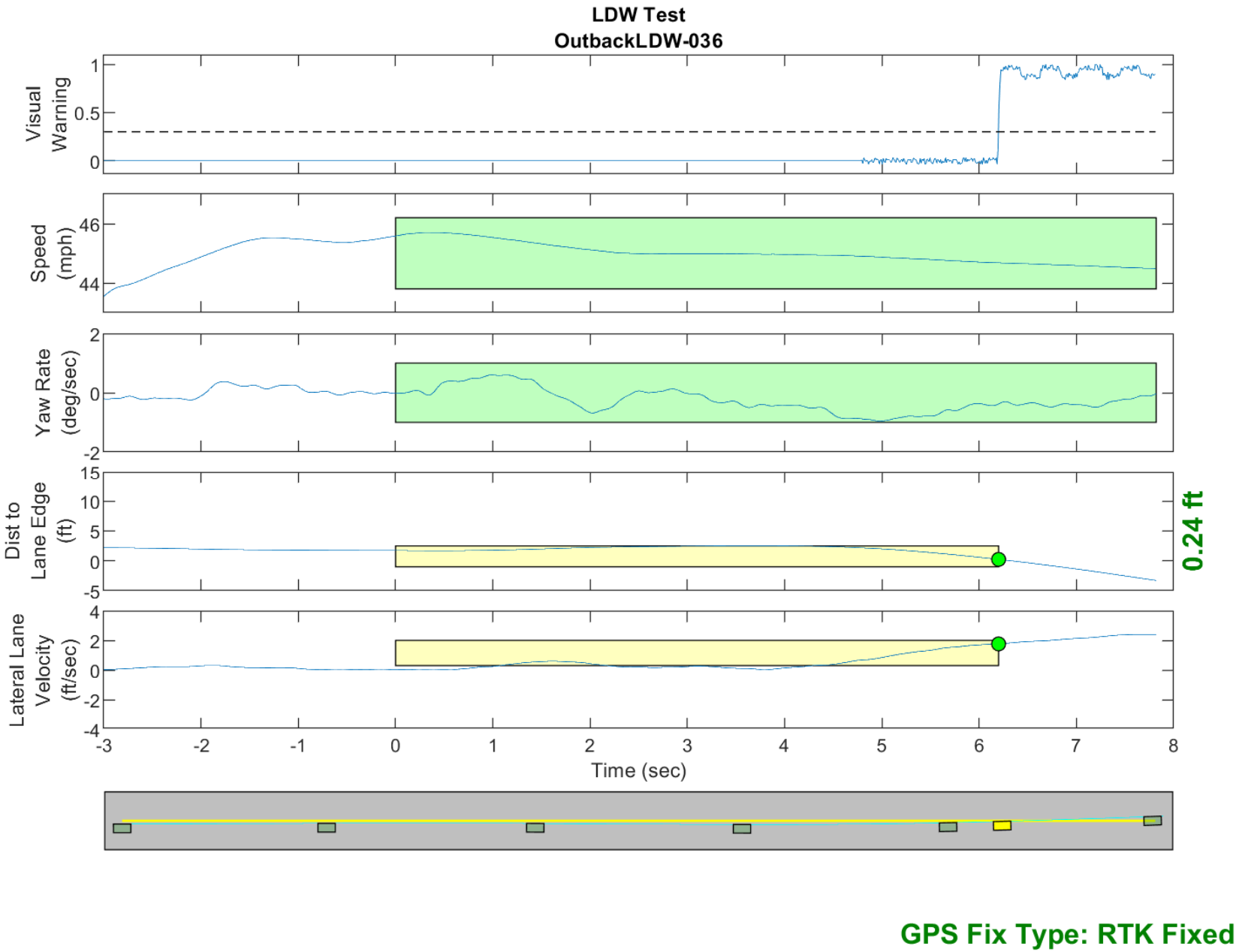


Figure D55. Time History for Run 36, Solid Line, Left Departure, Visual Warning

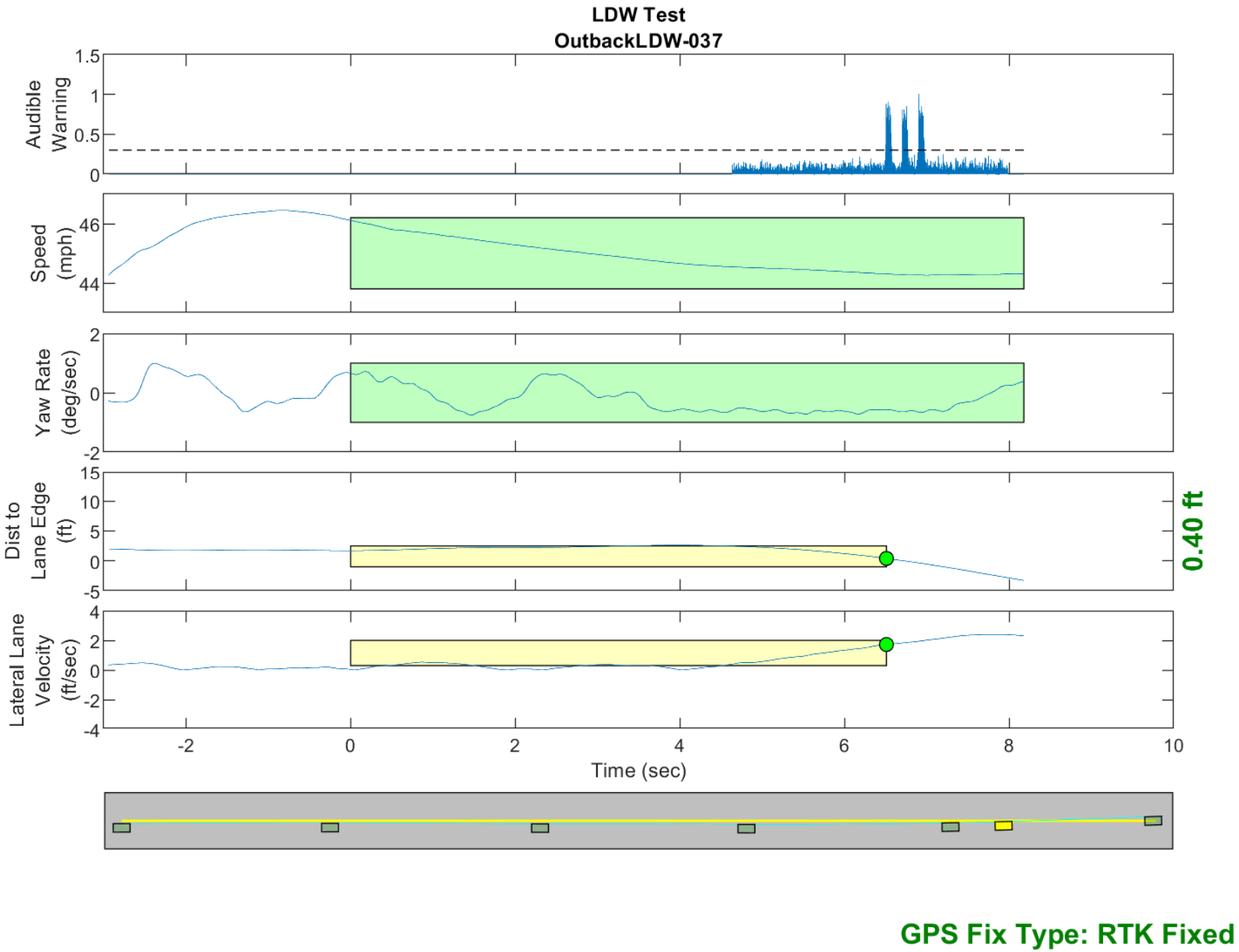


Figure D56. Time History for Run 37, Solid Line, Left Departure, Audible Warning

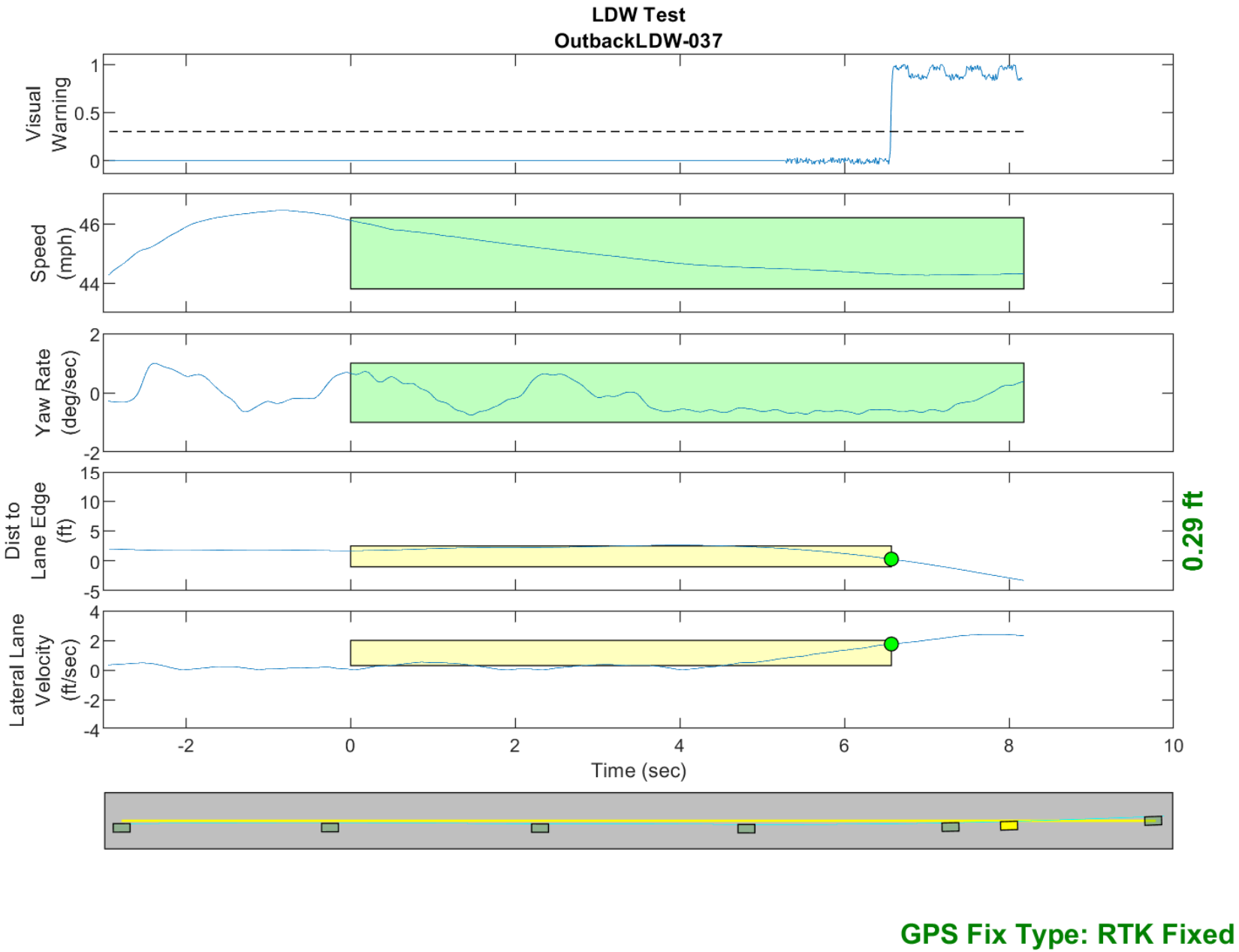


Figure D57. Time History for Run 37, Solid Line, Left Departure, Visual Warning

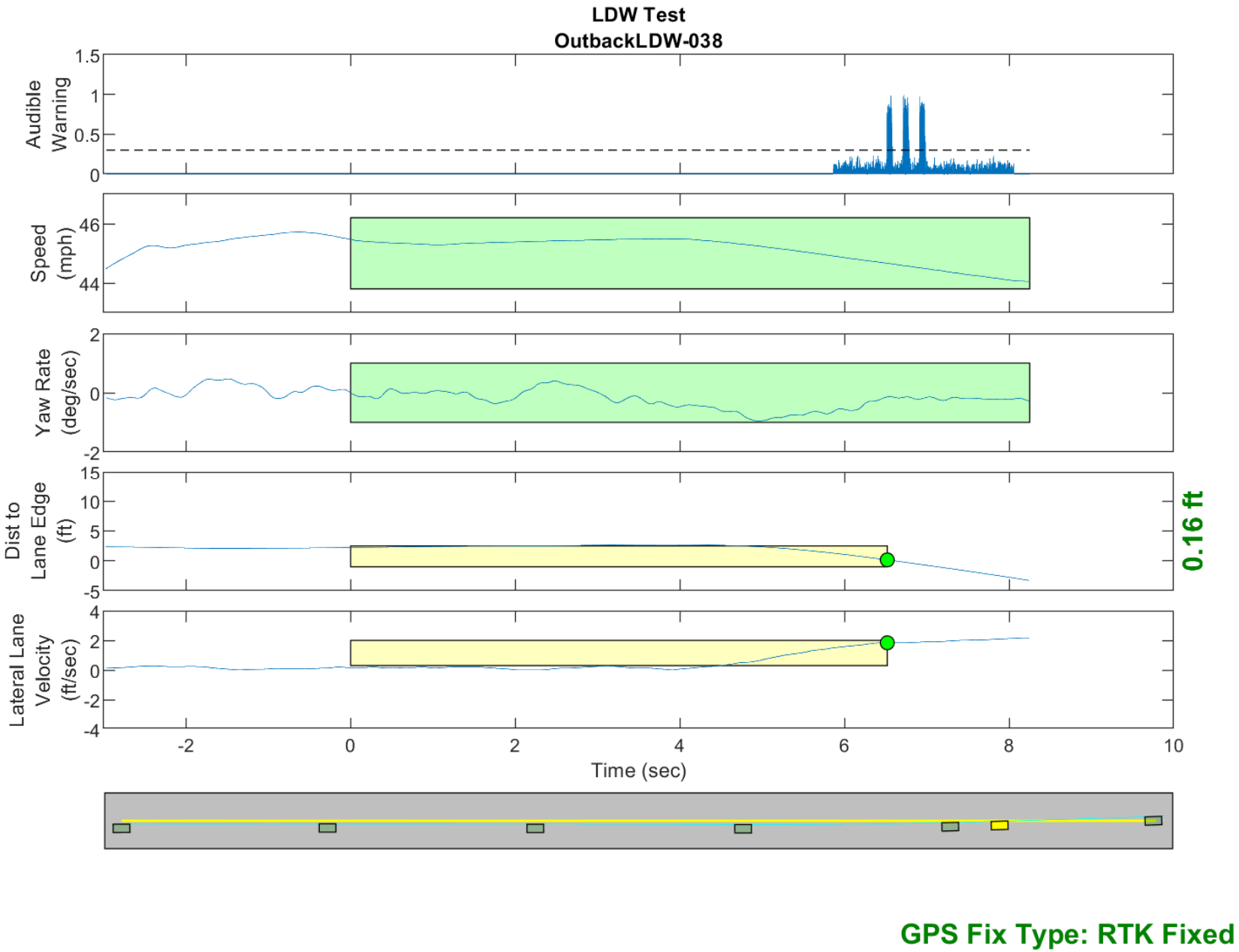


Figure D58. Time History for Run 38, Solid Line, Left Departure, Audible Warning

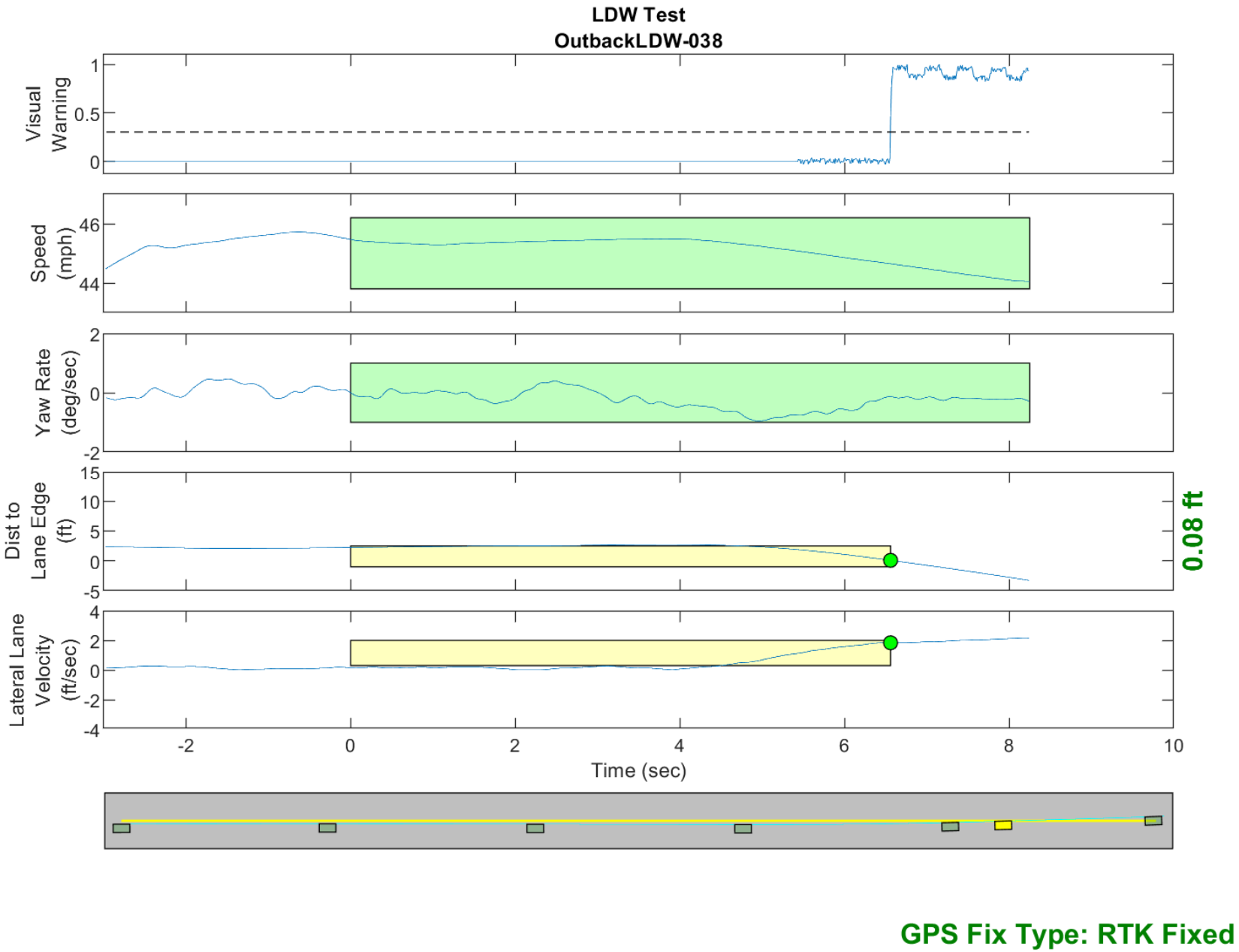


Figure D59. Time History for Run 38, Solid Line, Left Departure, Visual Warning

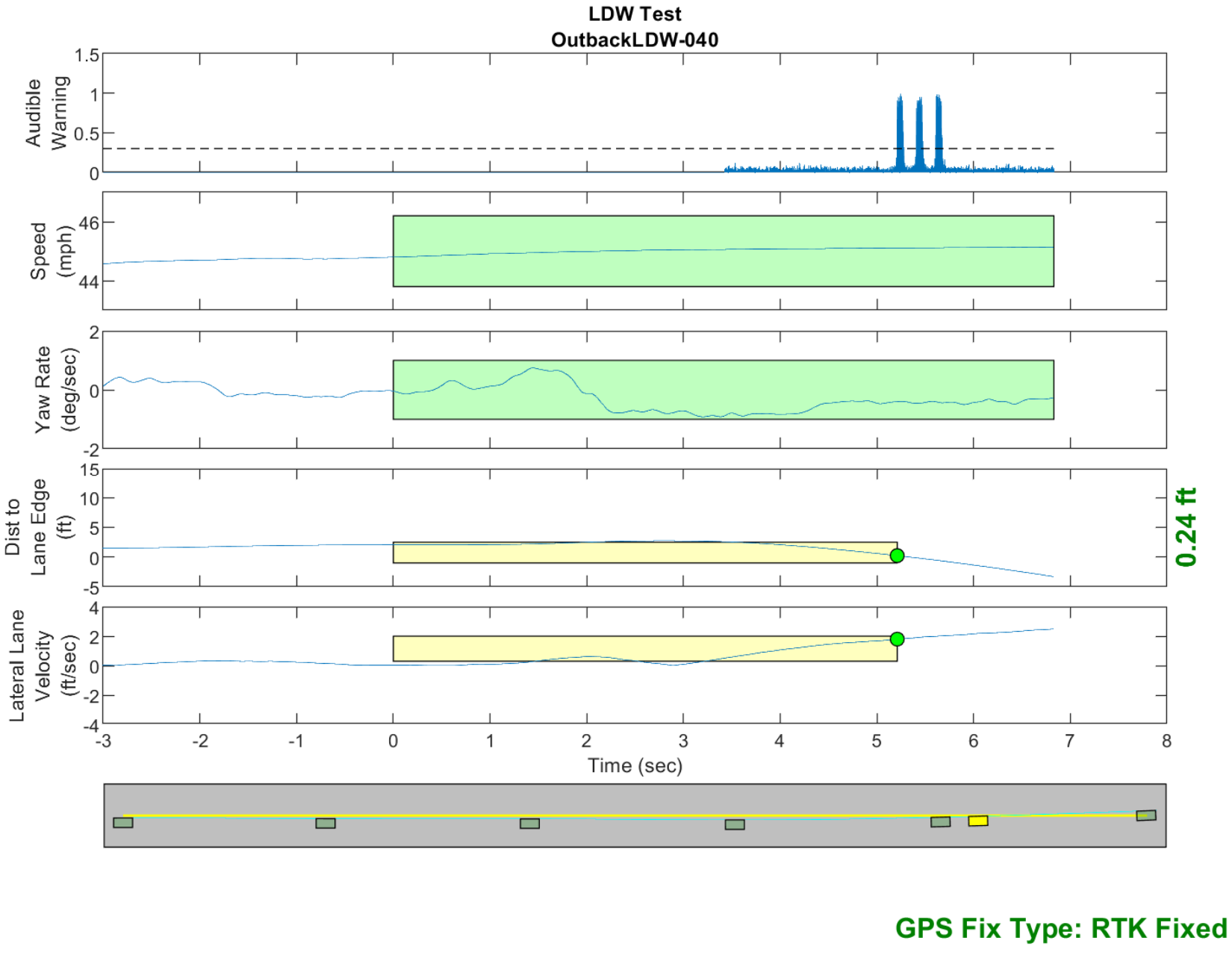


Figure D60. Time History for Run 40, Dashed Line, Left Departure, Audible Warning

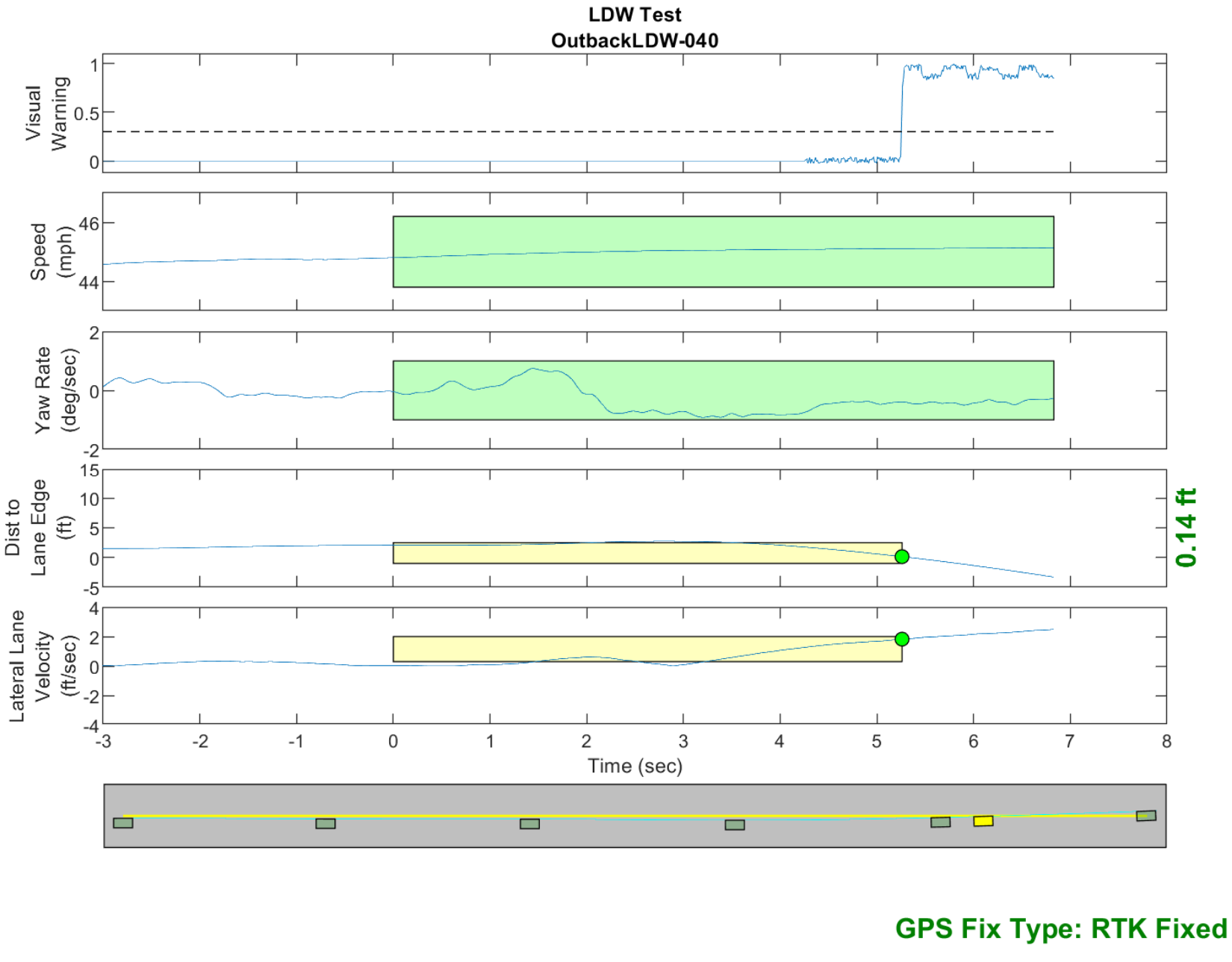


Figure D61. Time History for Run 40, Dashed Line, Left Departure, Visual Warning

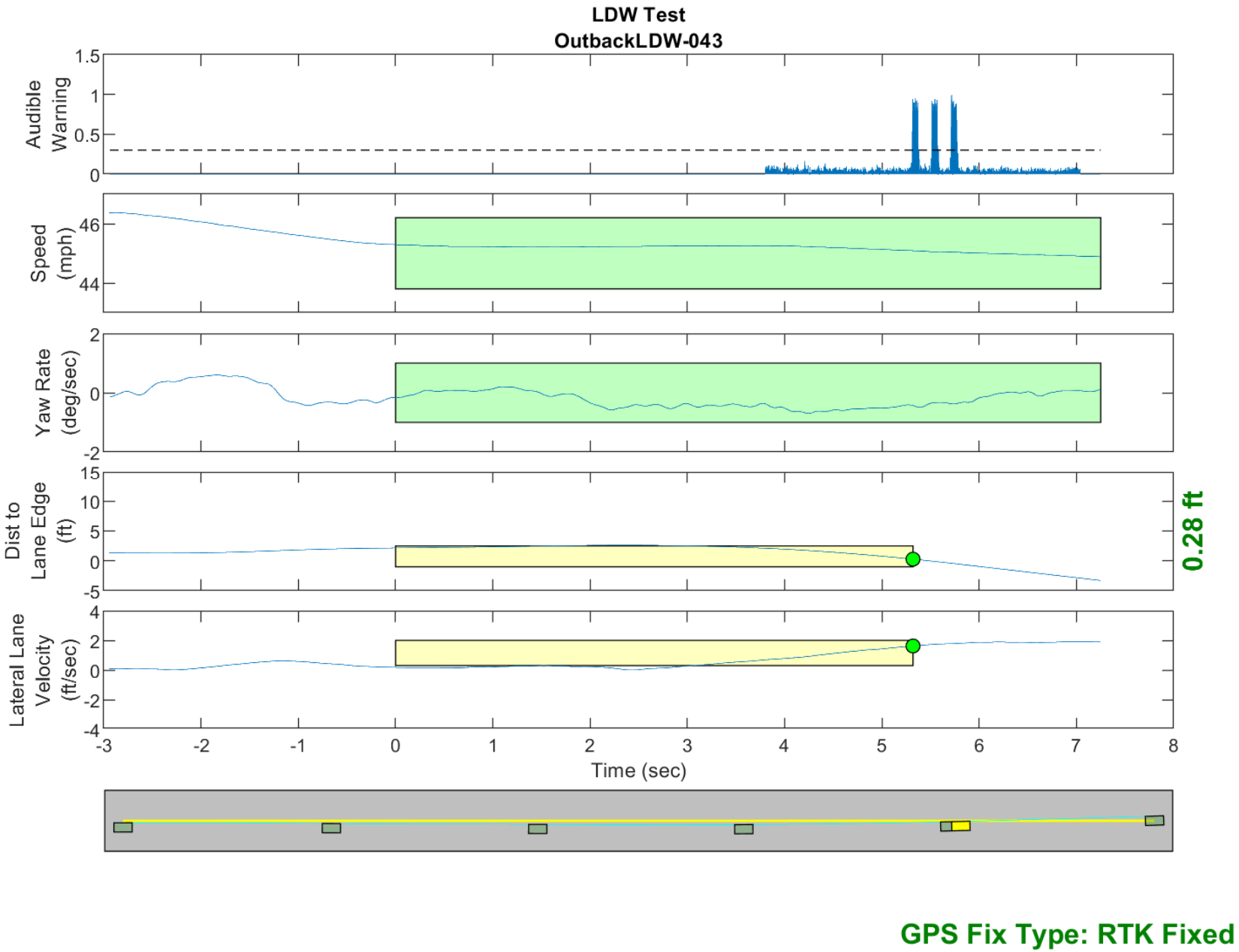


Figure D62. Time History for Run 43, Dashed Line, Left Departure, Audible Warning

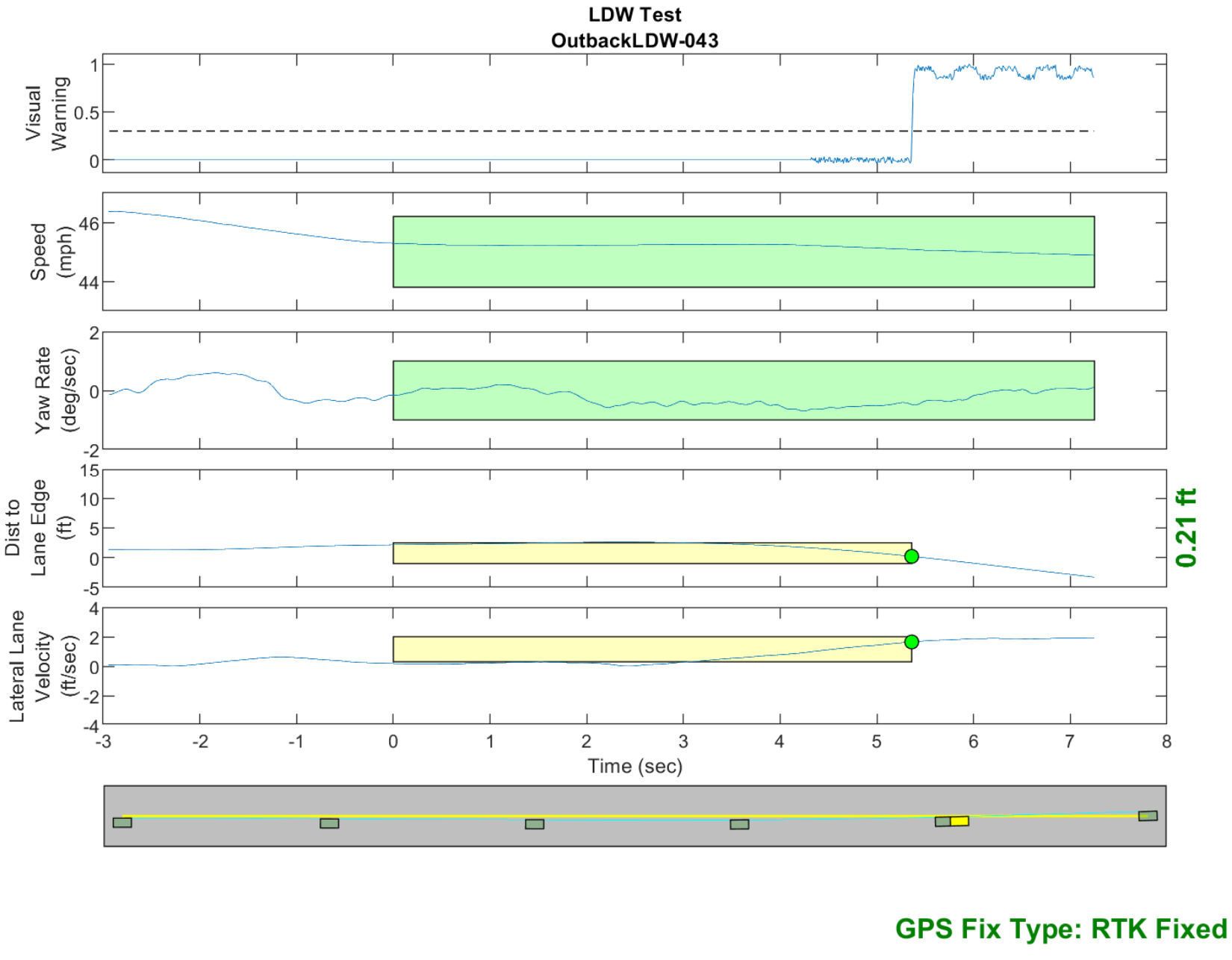


Figure D63. Time History for Run 43, Dashed Line, Left Departure, Visual Warning

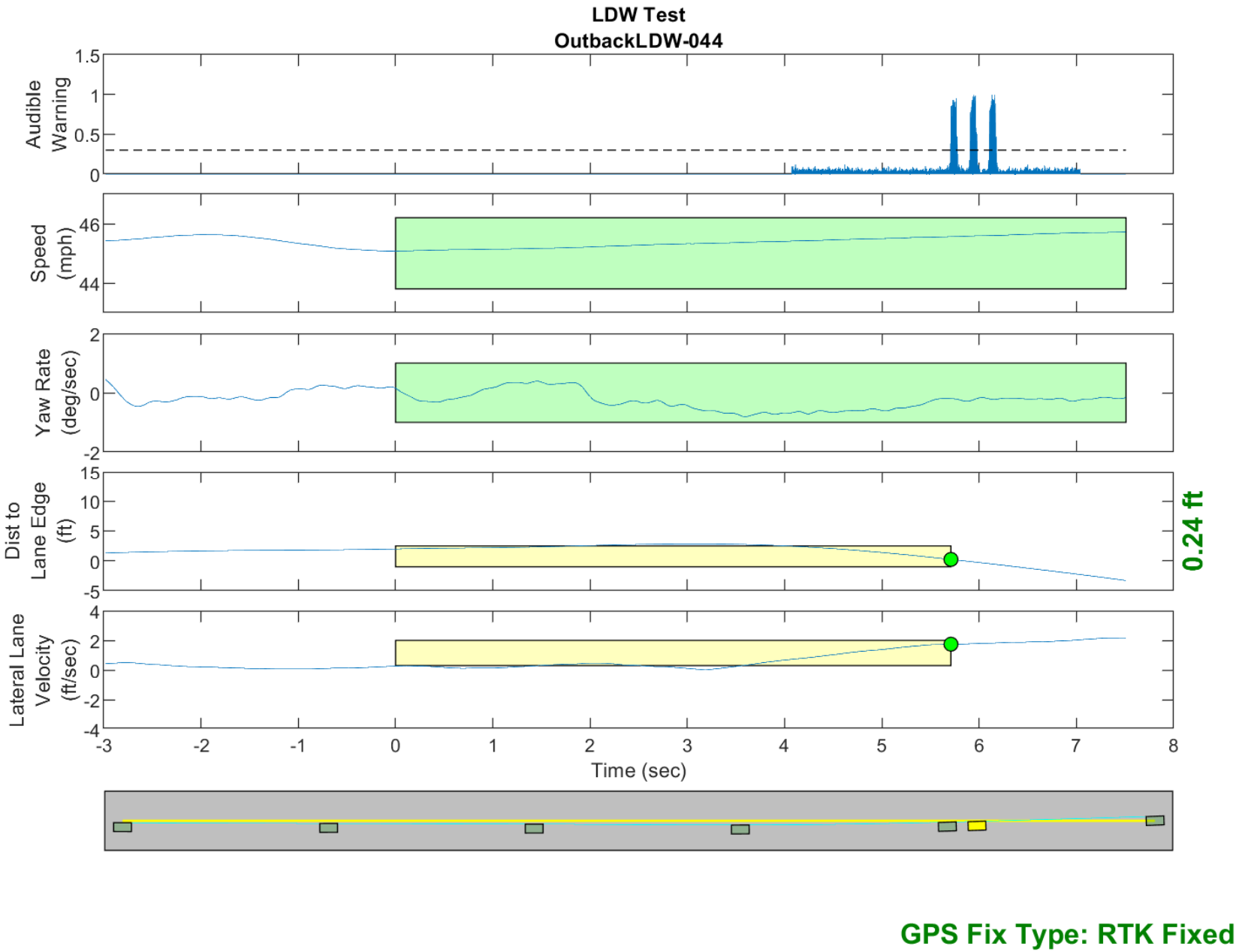


Figure D64. Time History for Run 44, Dashed Line, Left Departure, Audible Warning

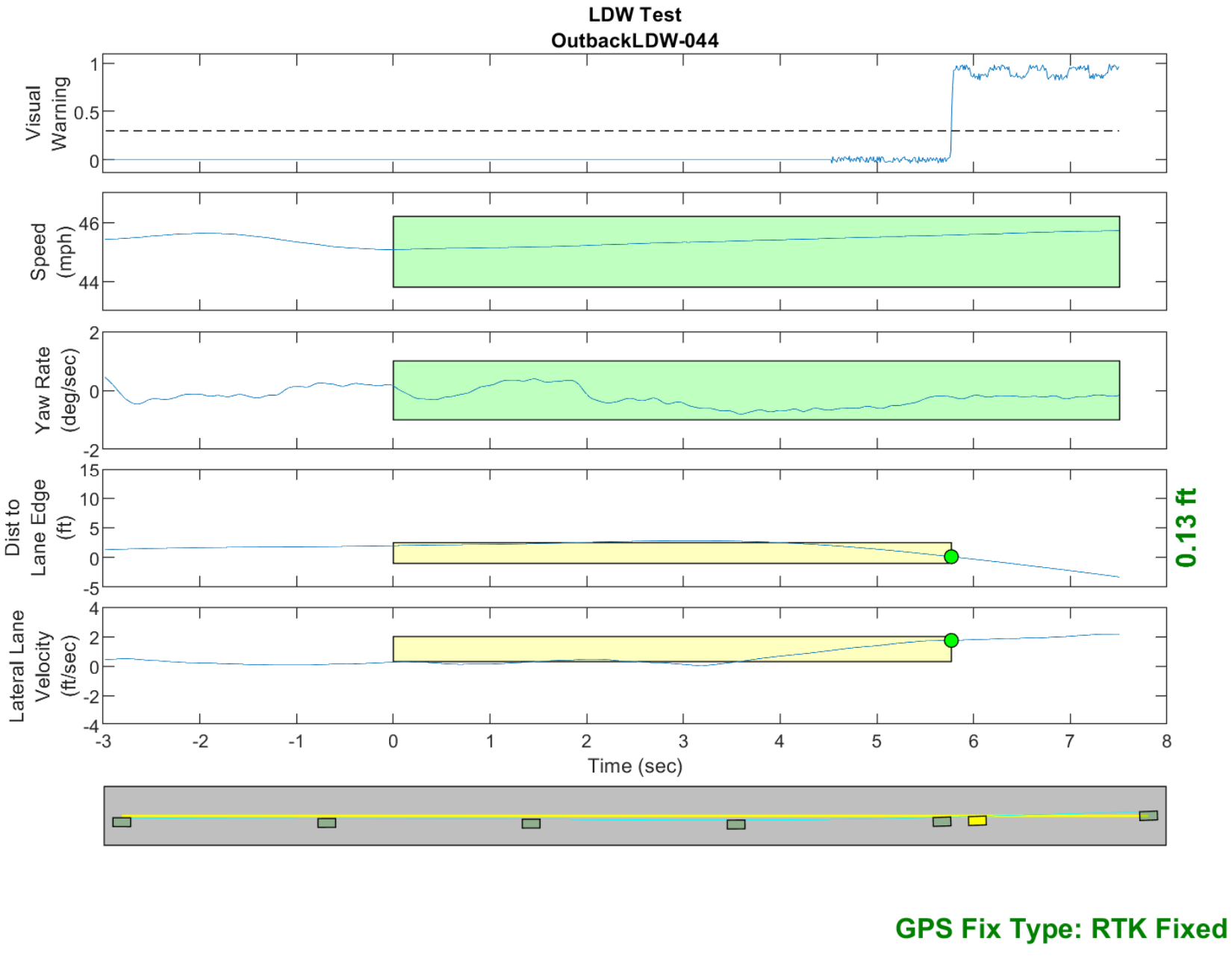


Figure D65. Time History for Run 44, Dashed Line, Left Departure, Visual Warning

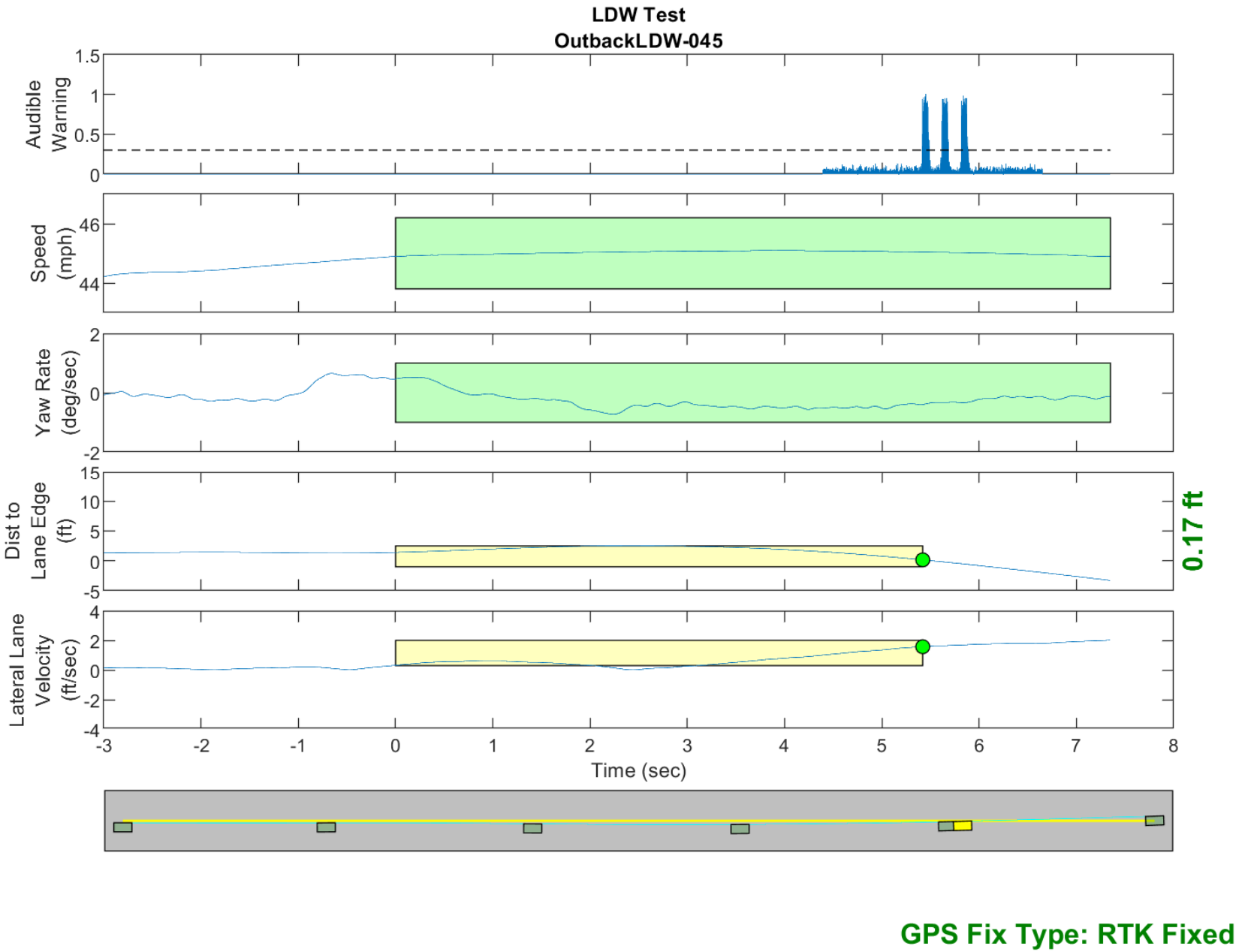


Figure D66. Time History for Run 45, Dashed Line, Left Departure, Audible Warning

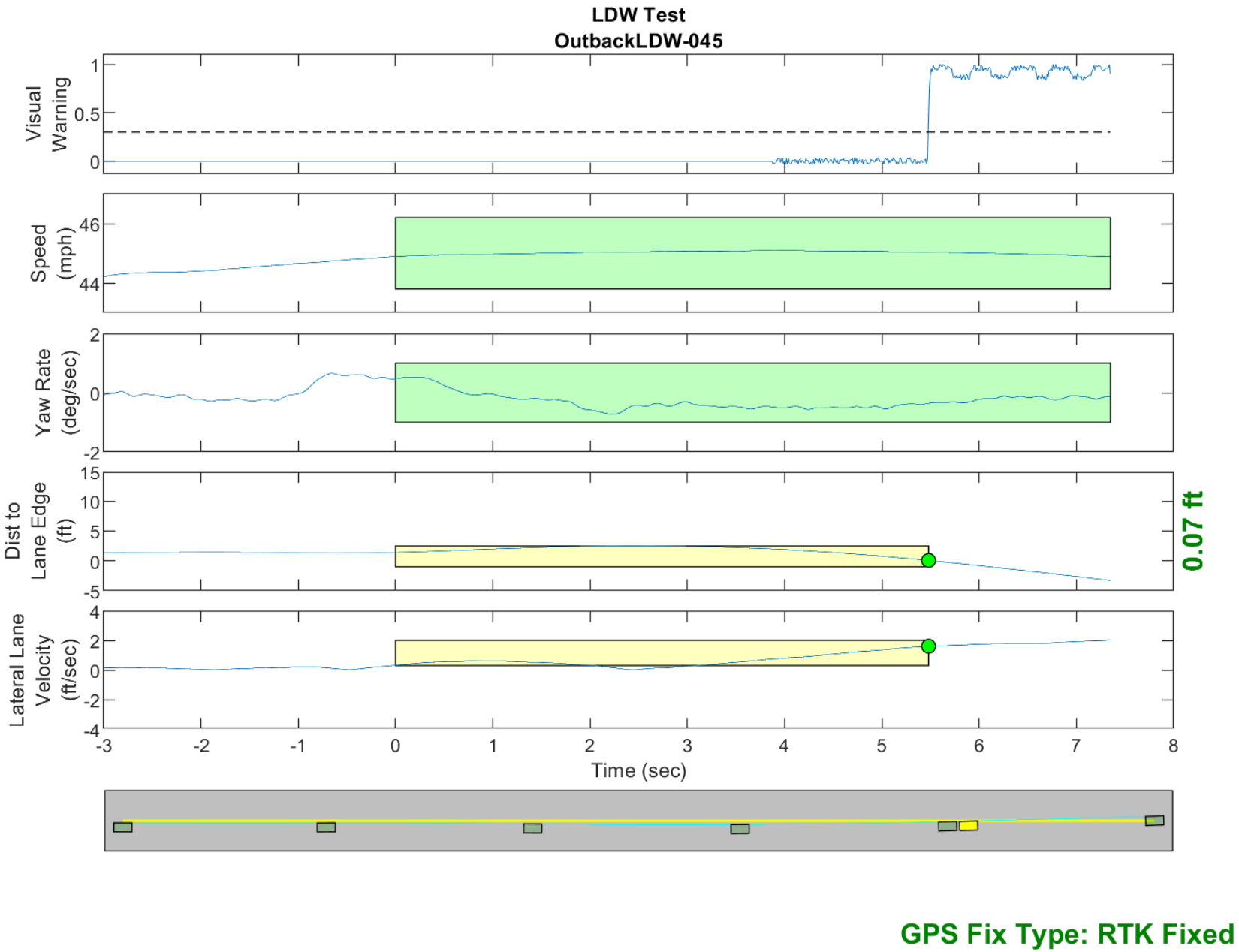


Figure D67. Time History for Run 45, Dashed Line, Left Departure, Visual Warning

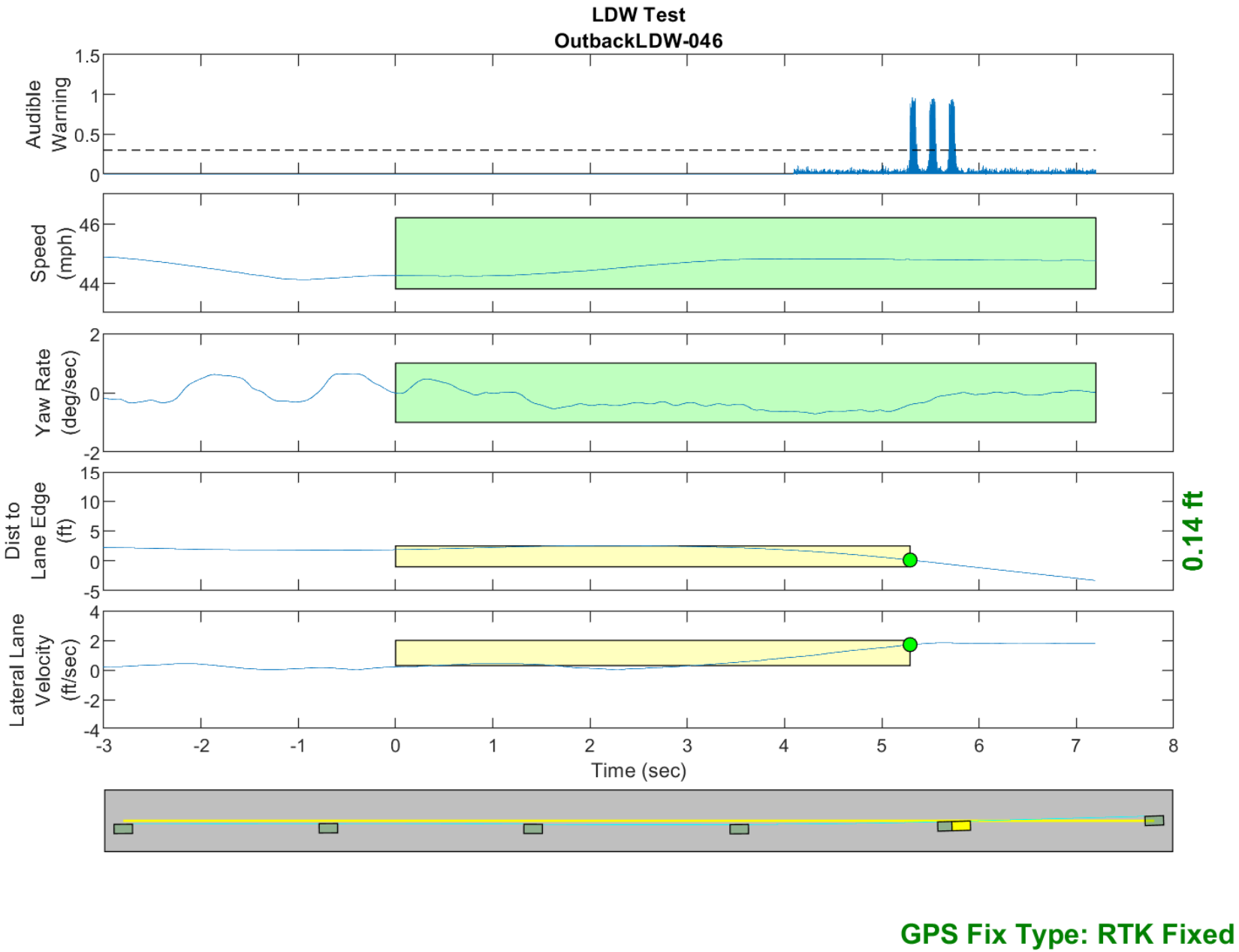


Figure D68. Time History for Run 46, Dashed Line, Left Departure, Audible Warning

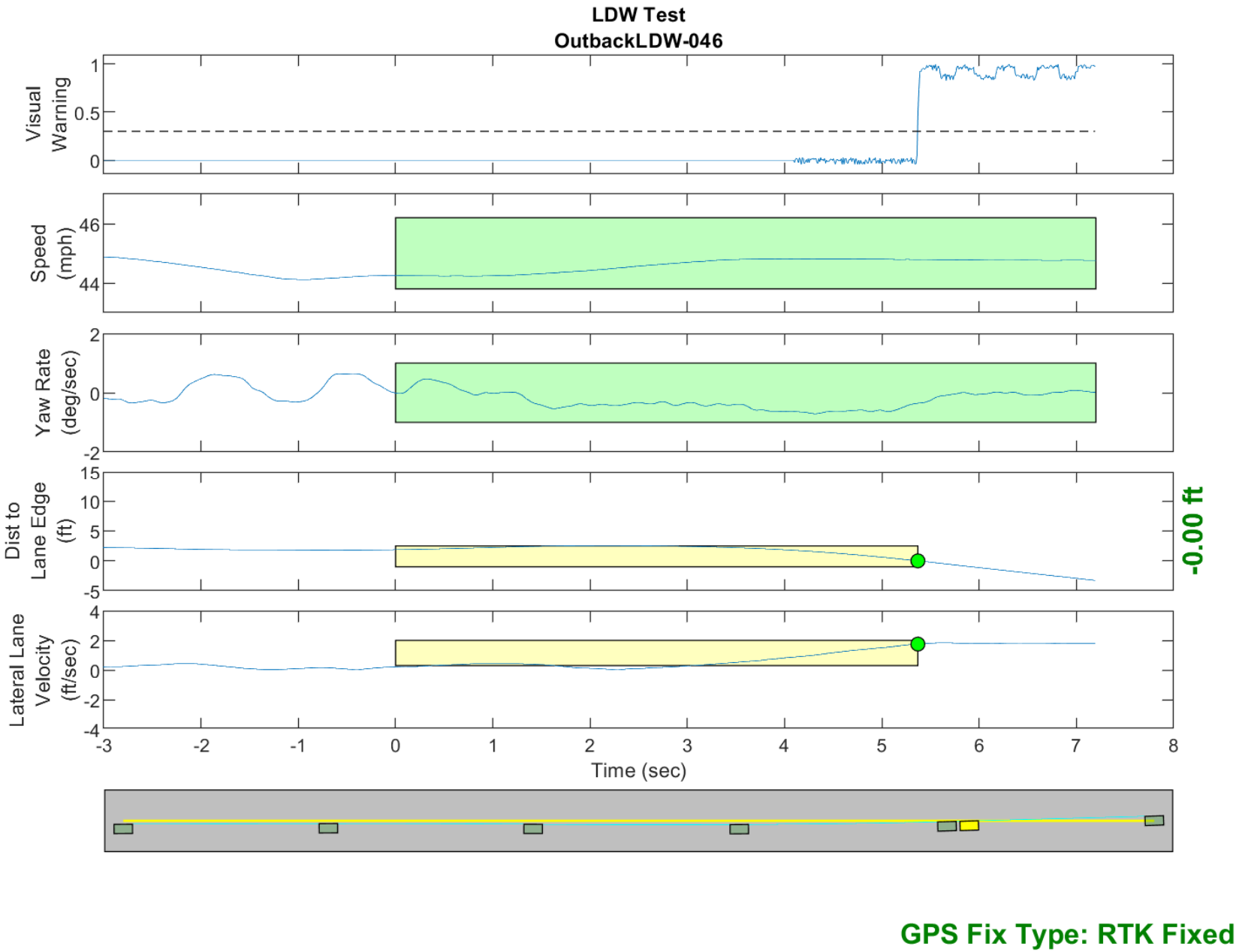


Figure D69. Time History for Run 46, Dashed Line, Left Departure, Visual Warning

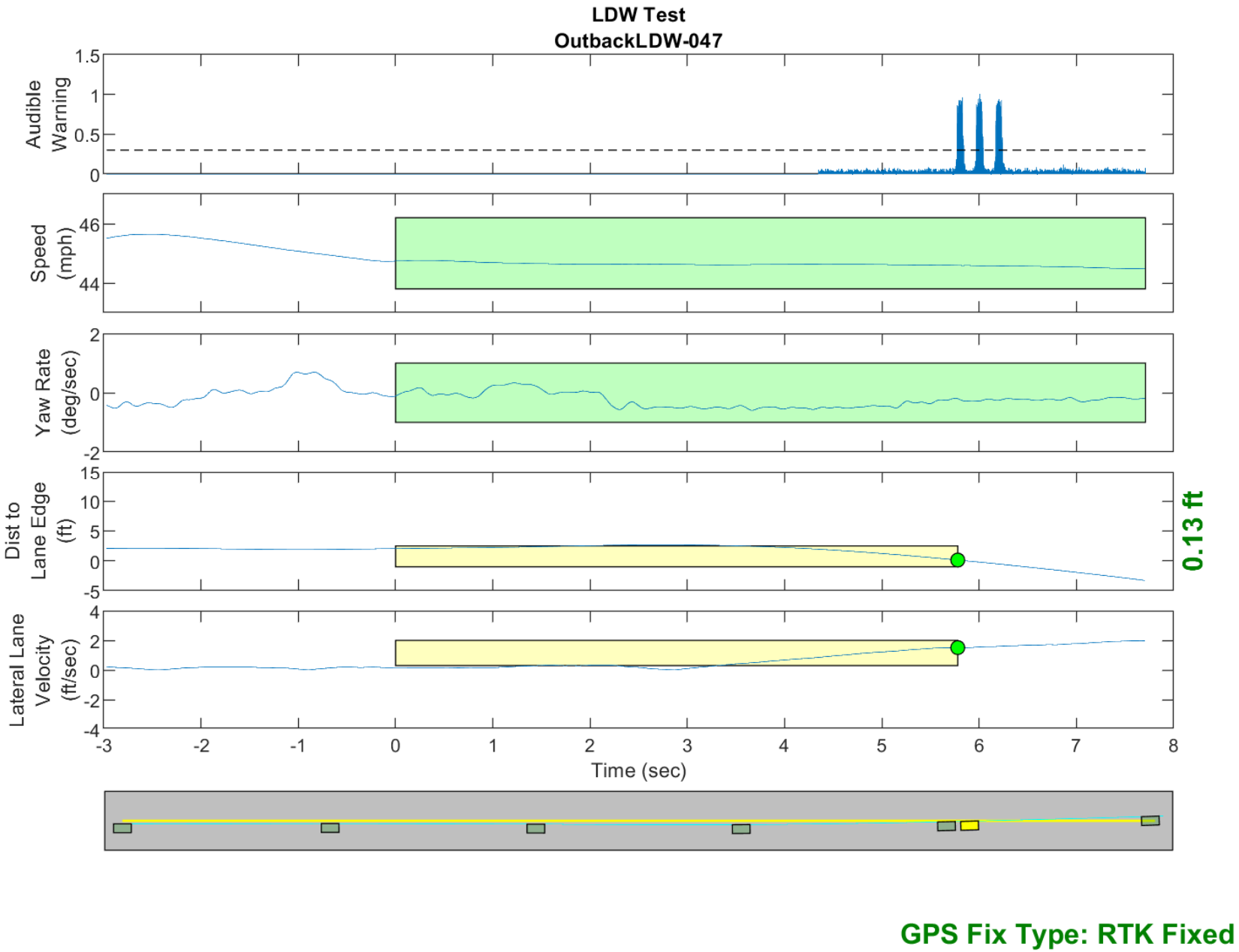


Figure D70. Time History for Run 47, Dashed Line, Left Departure, Audible Warning

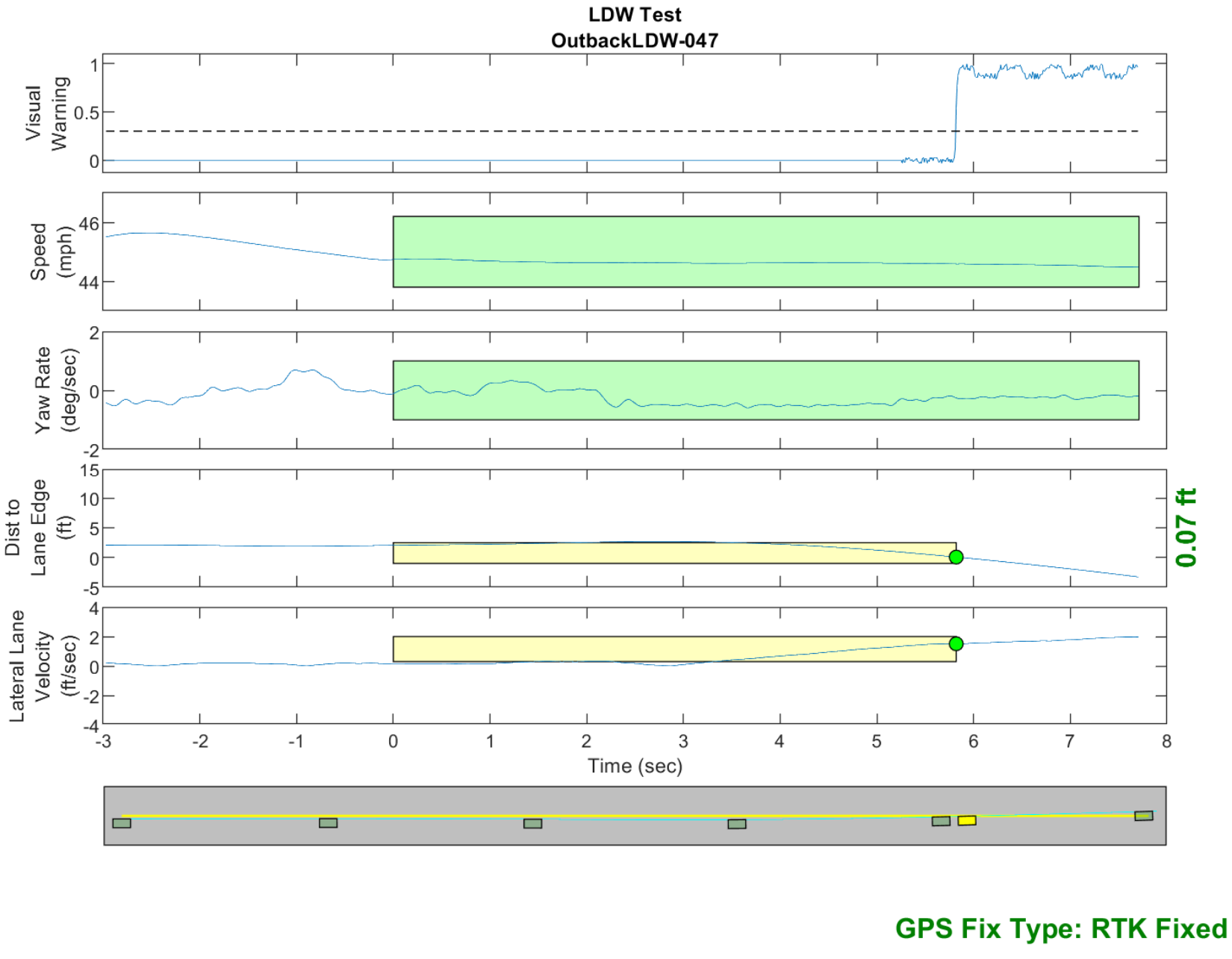


Figure D71. Time History for Run 47, Dashed Line, Left Departure, Visual Warning

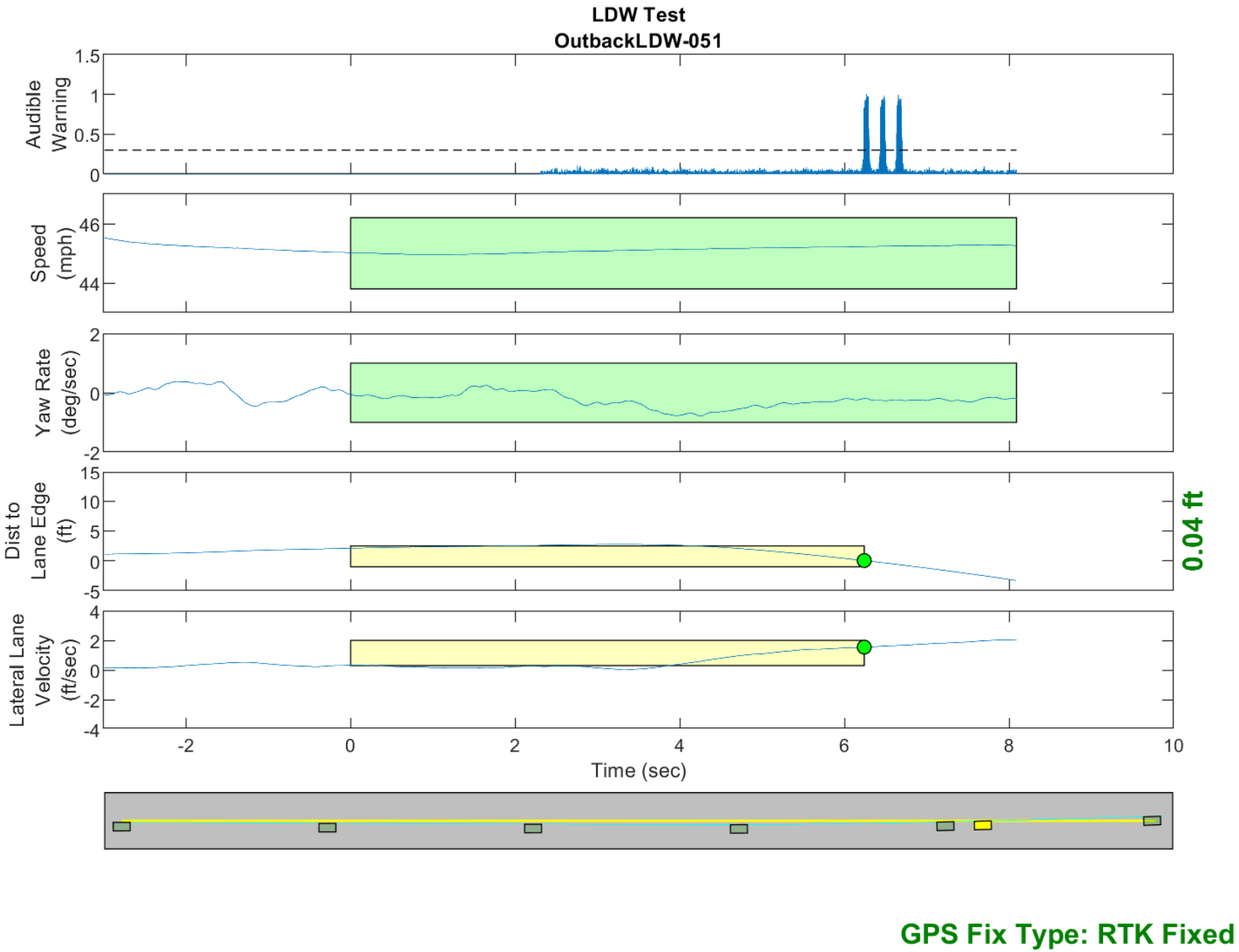


Figure D72. Time History for Run 51, Dashed Line, Left Departure, Audible Warning

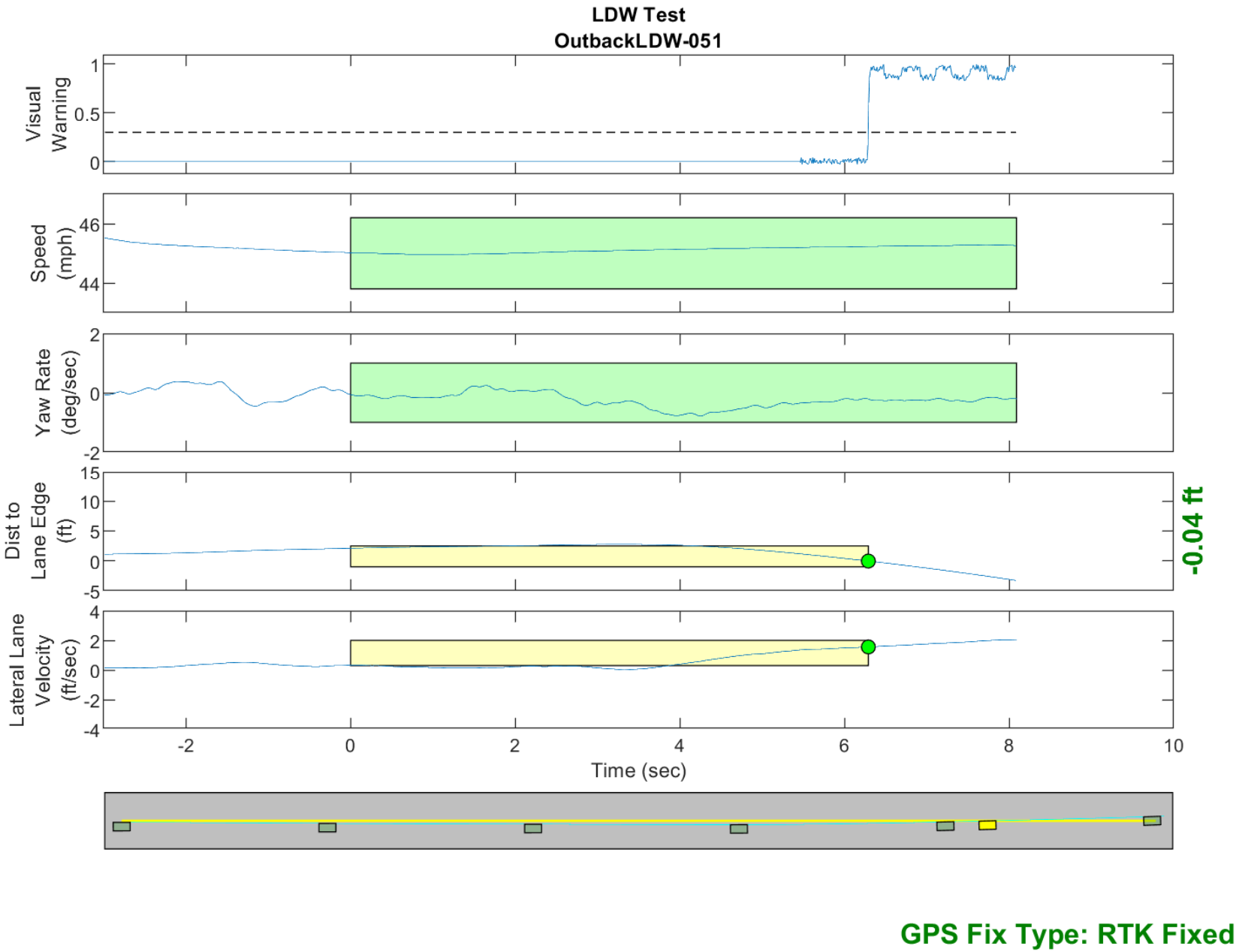


Figure D73. Time History for Run 51, Dashed Line, Left Departure, Visual Warning

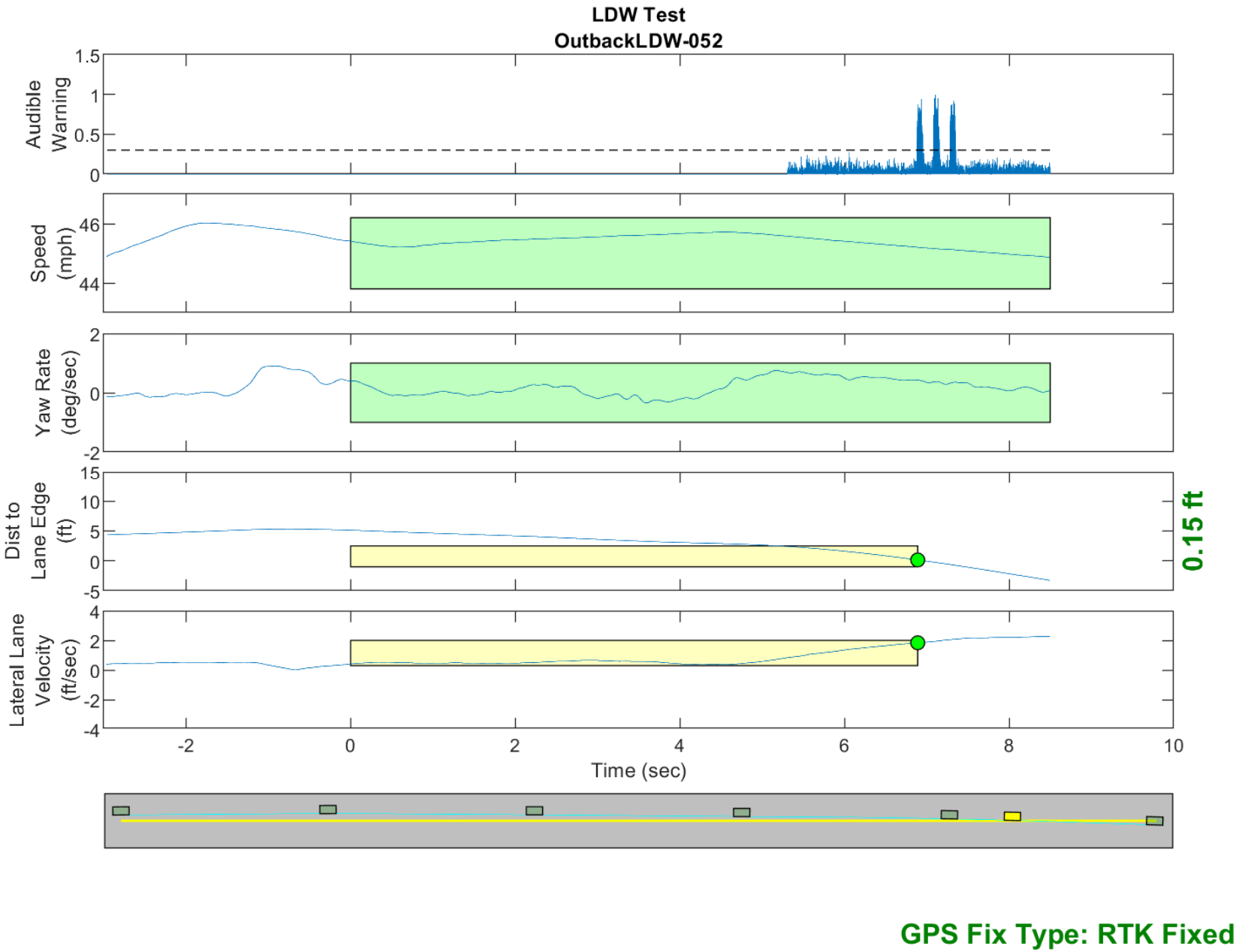


Figure D74. Time History for Run 52, Dashed Line, Right Departure, Audible Warning

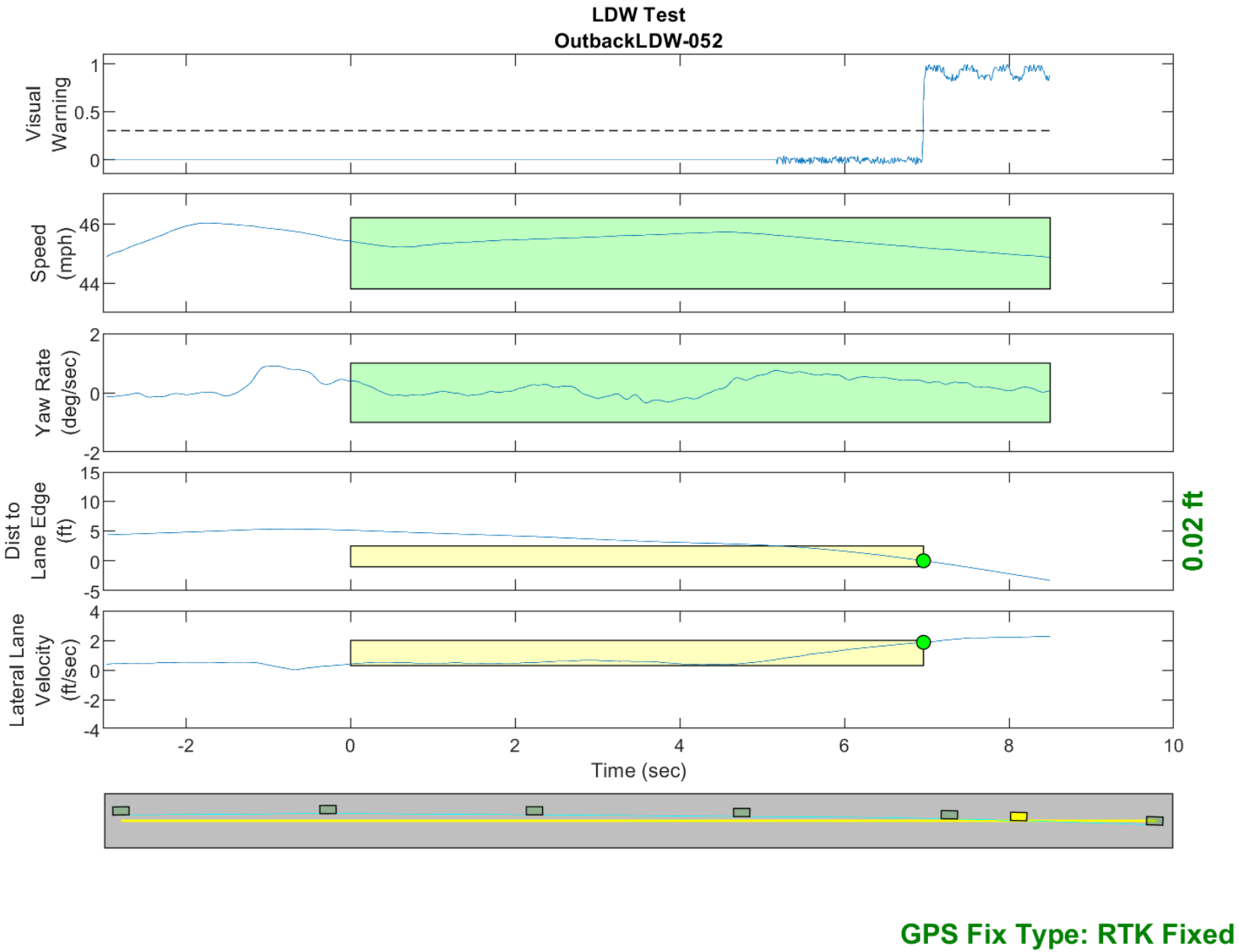


Figure D75. Time History for Run 52, Dashed Line, Right Departure, Visual Warning

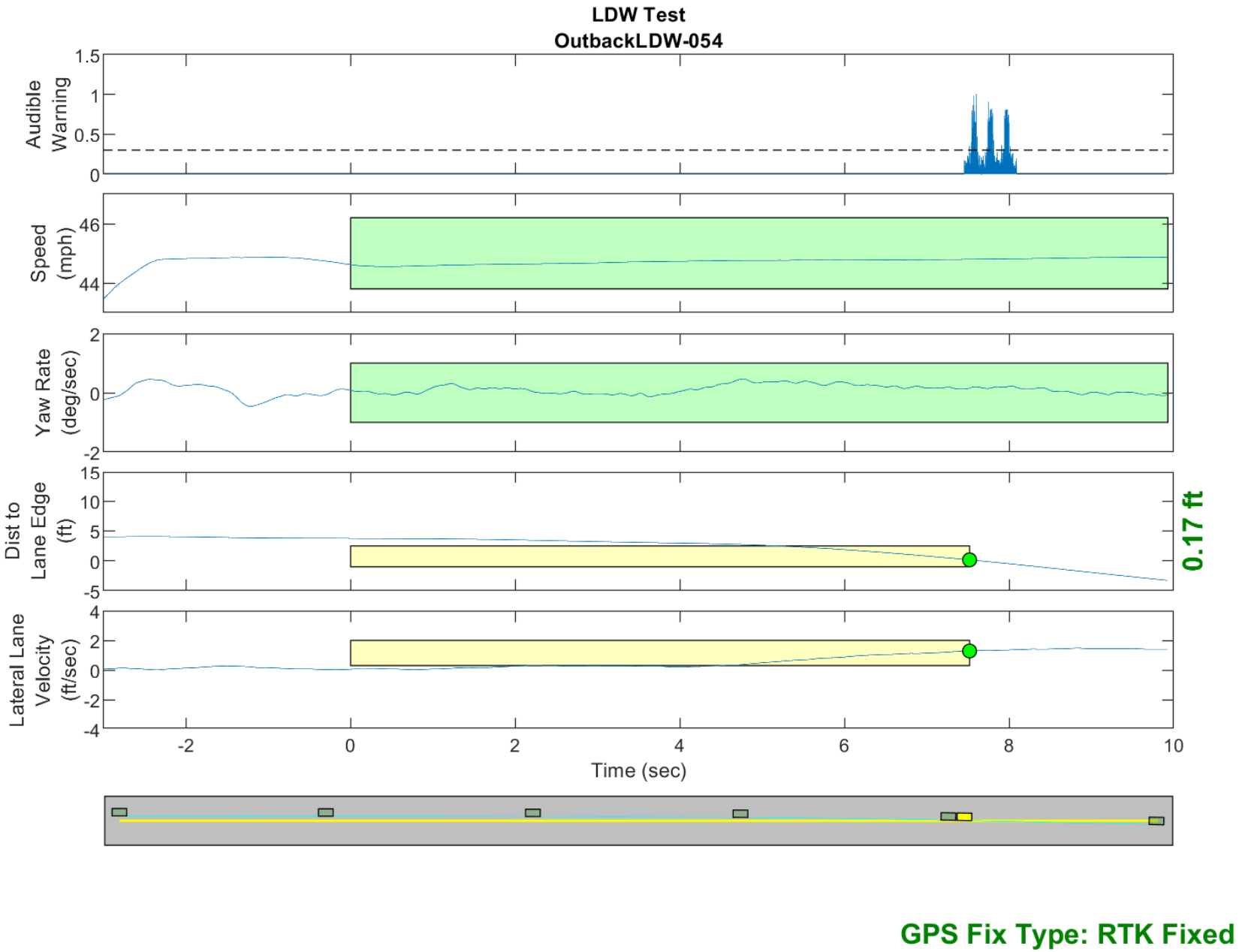


Figure D76. Time History for Run 54, Dashed Line, Right Departure, Audible Warning

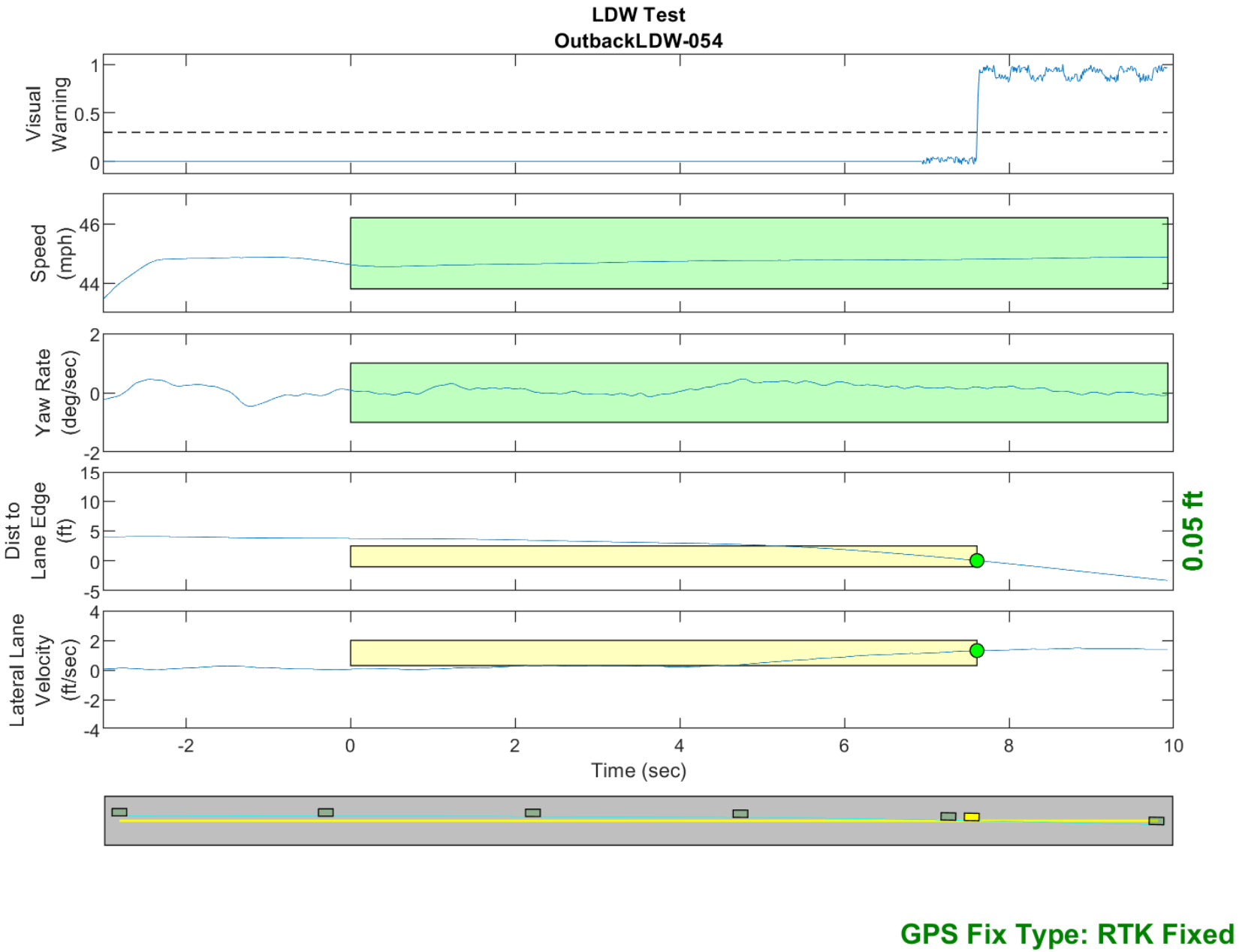


Figure D77. Time History for Run 54, Dashed Line, Right Departure, Visual Warning

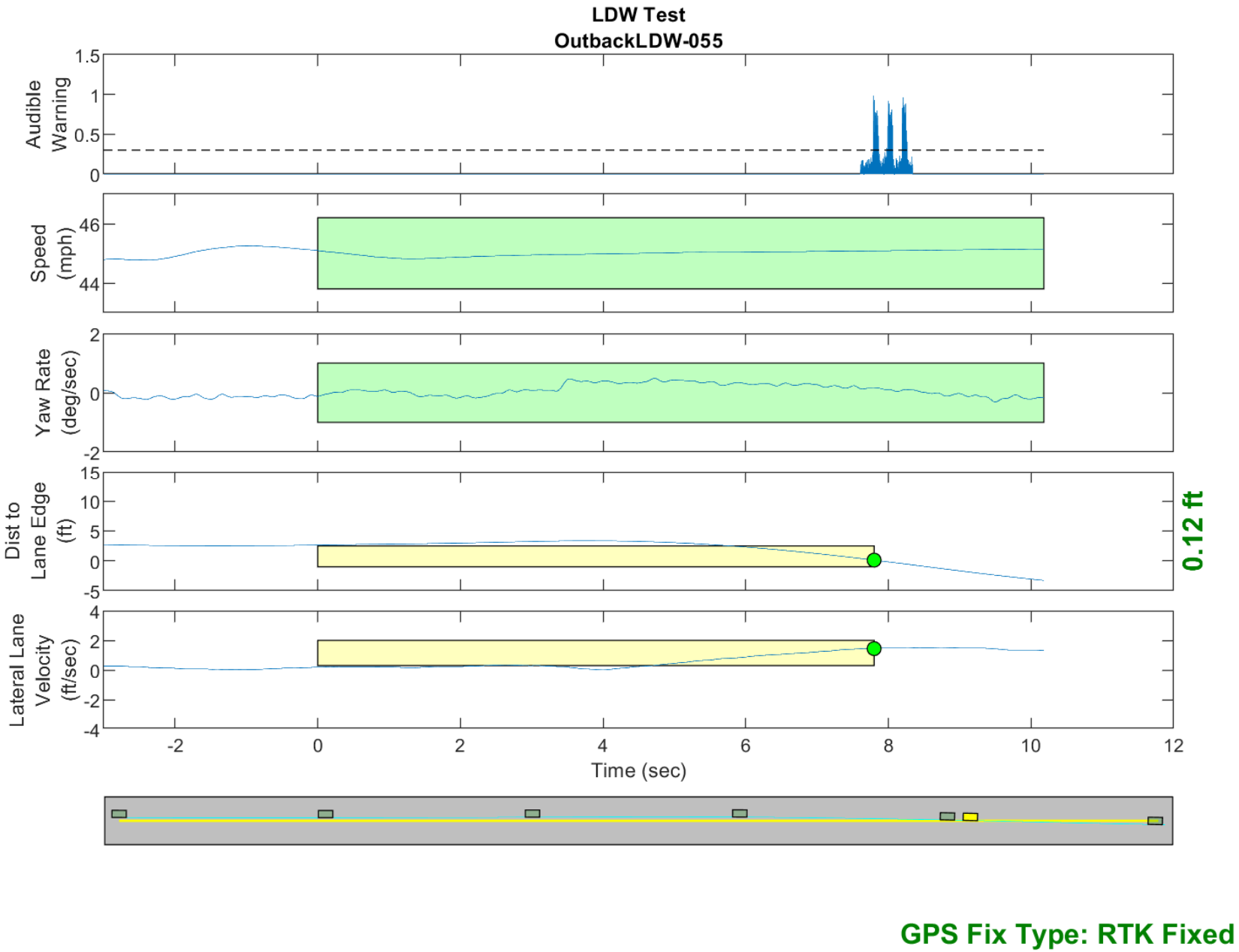


Figure D78. Time History for Run 55, Dashed Line, Right Departure, Audible Warning

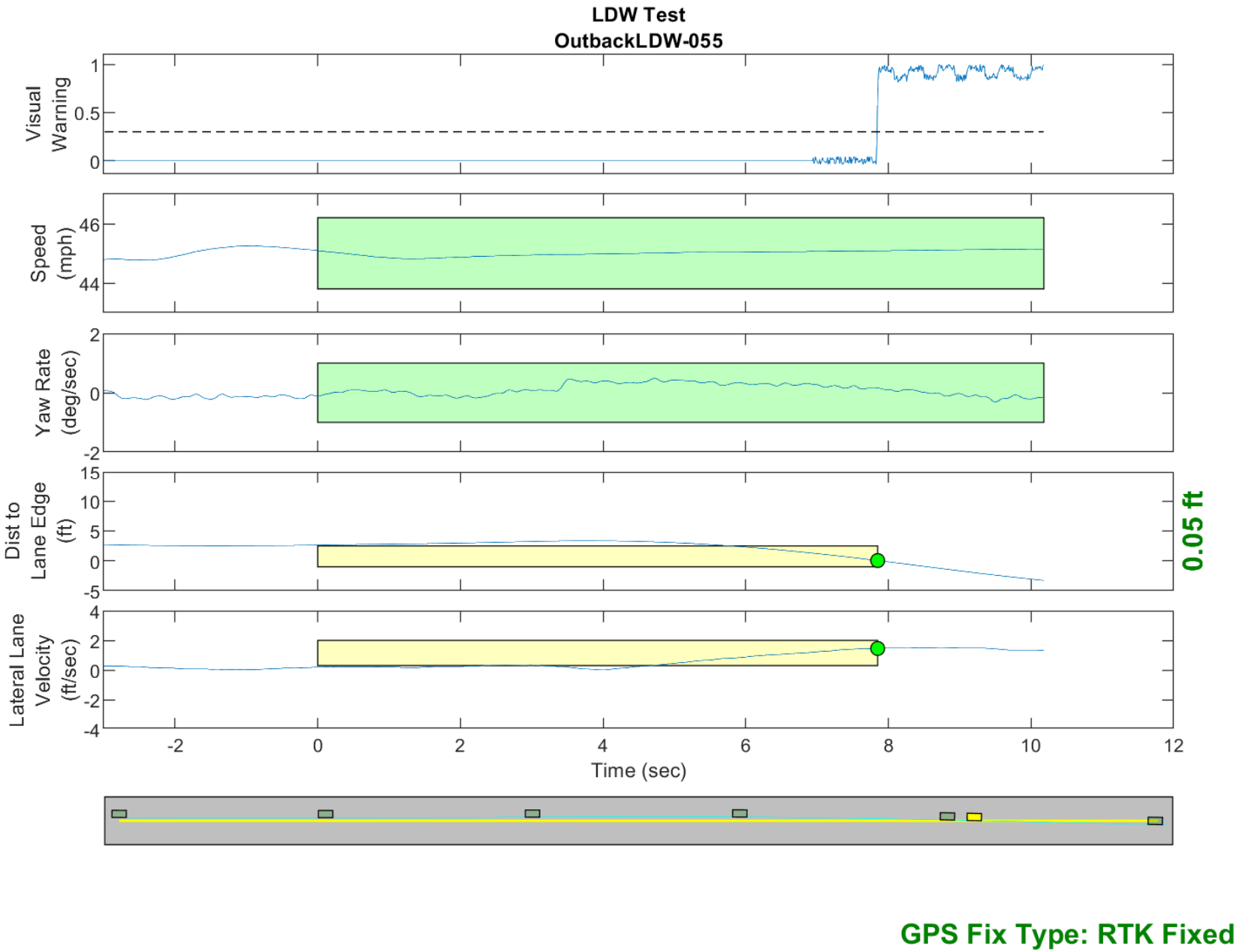


Figure D79. Time History for Run 55, Dashed Line, Right Departure, Visual Warning

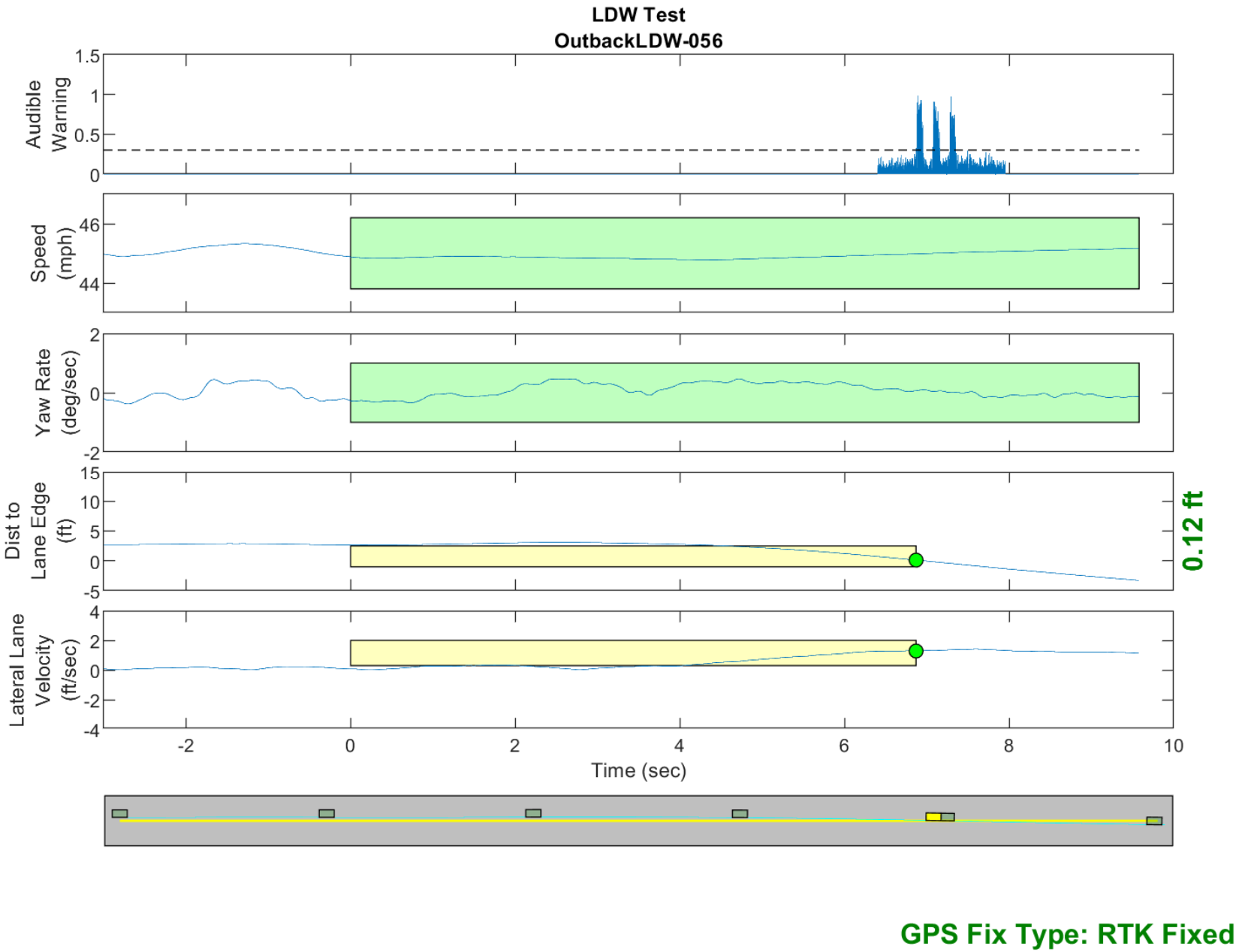


Figure D80. Time History for Run 56, Dashed Line, Right Departure, Audible Warning

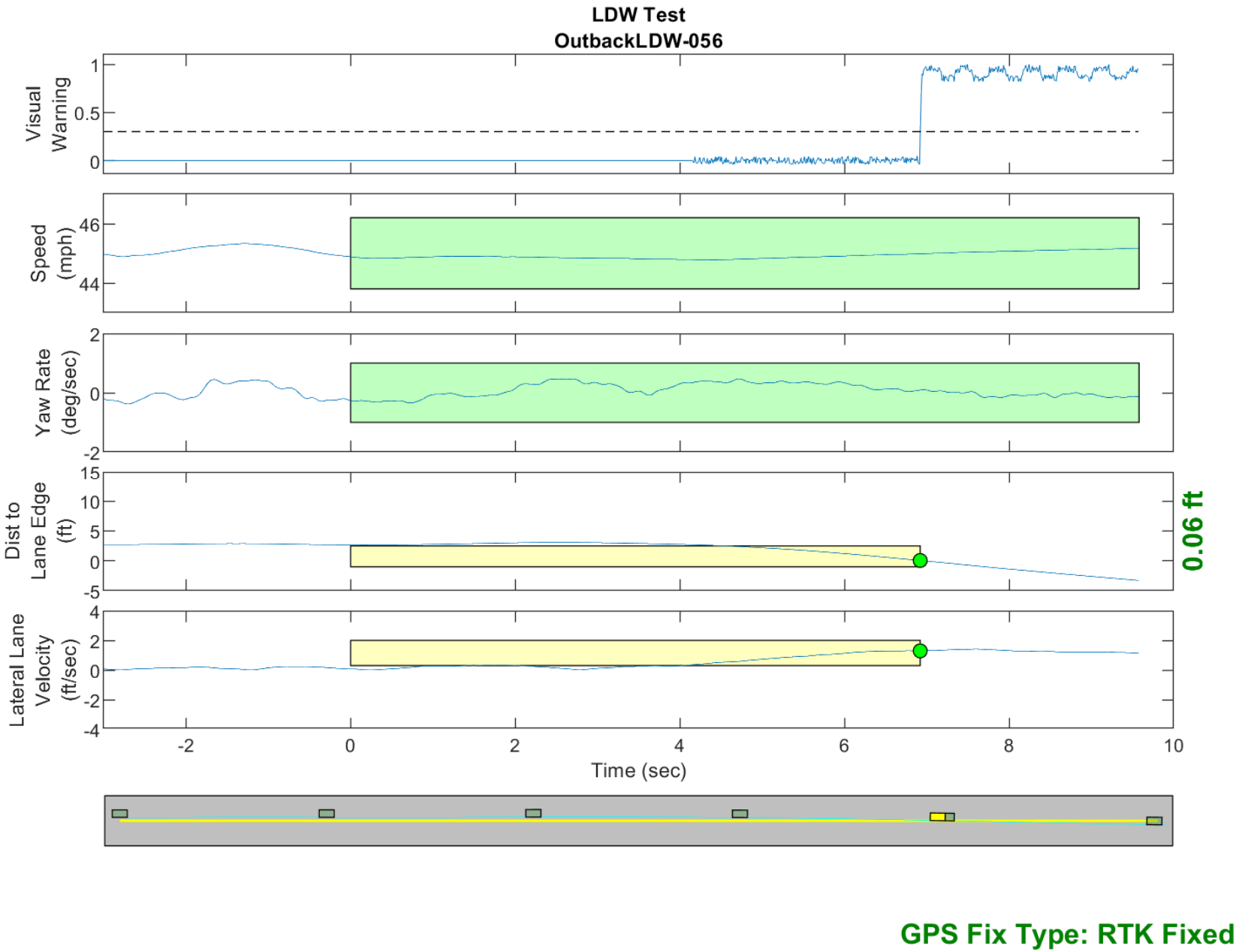


Figure D81. Time History for Run 56, Dashed Line, Right Departure, Visual Warning

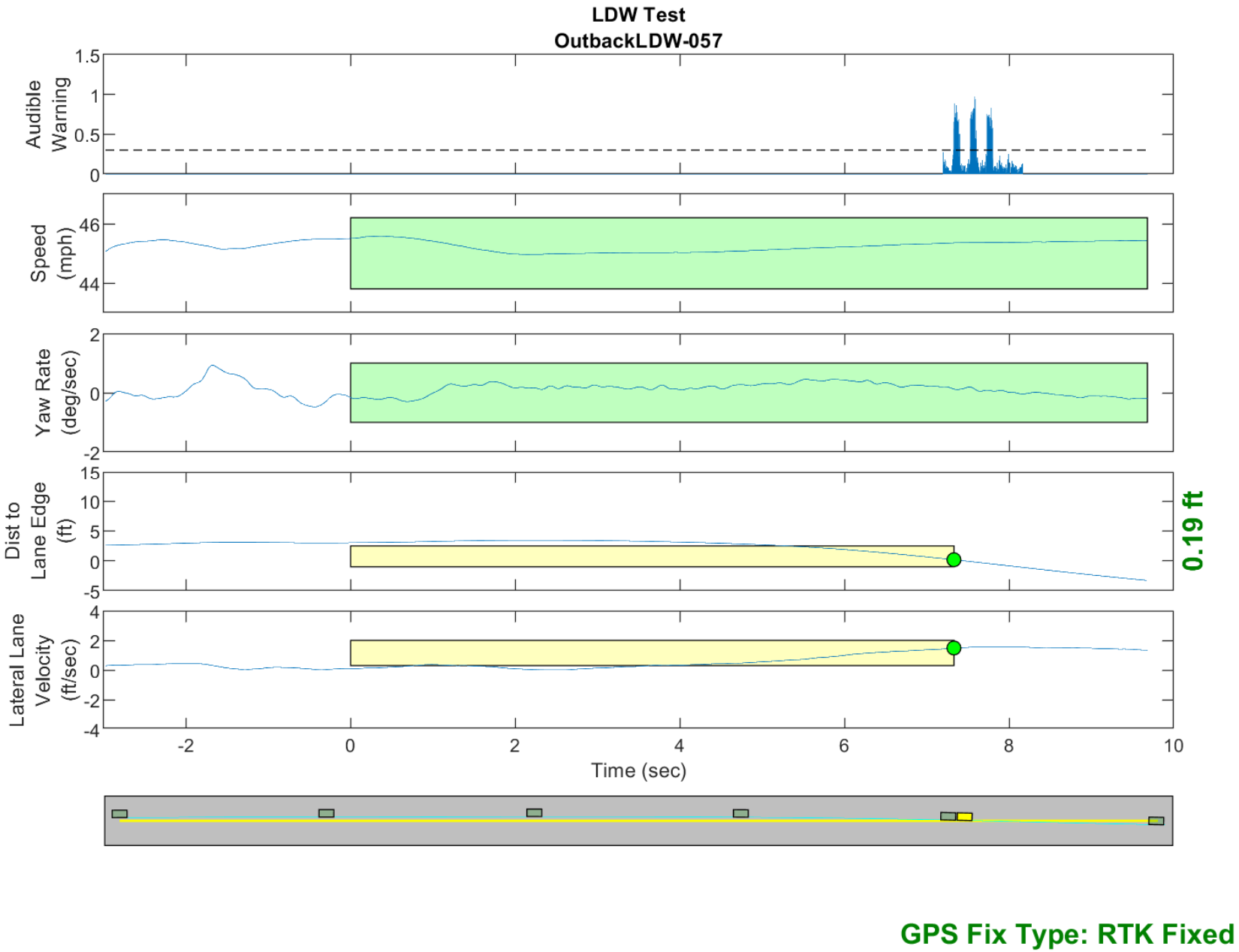


Figure D82. Time History for Run 57, Dashed Line, Right Departure, Audible Warning

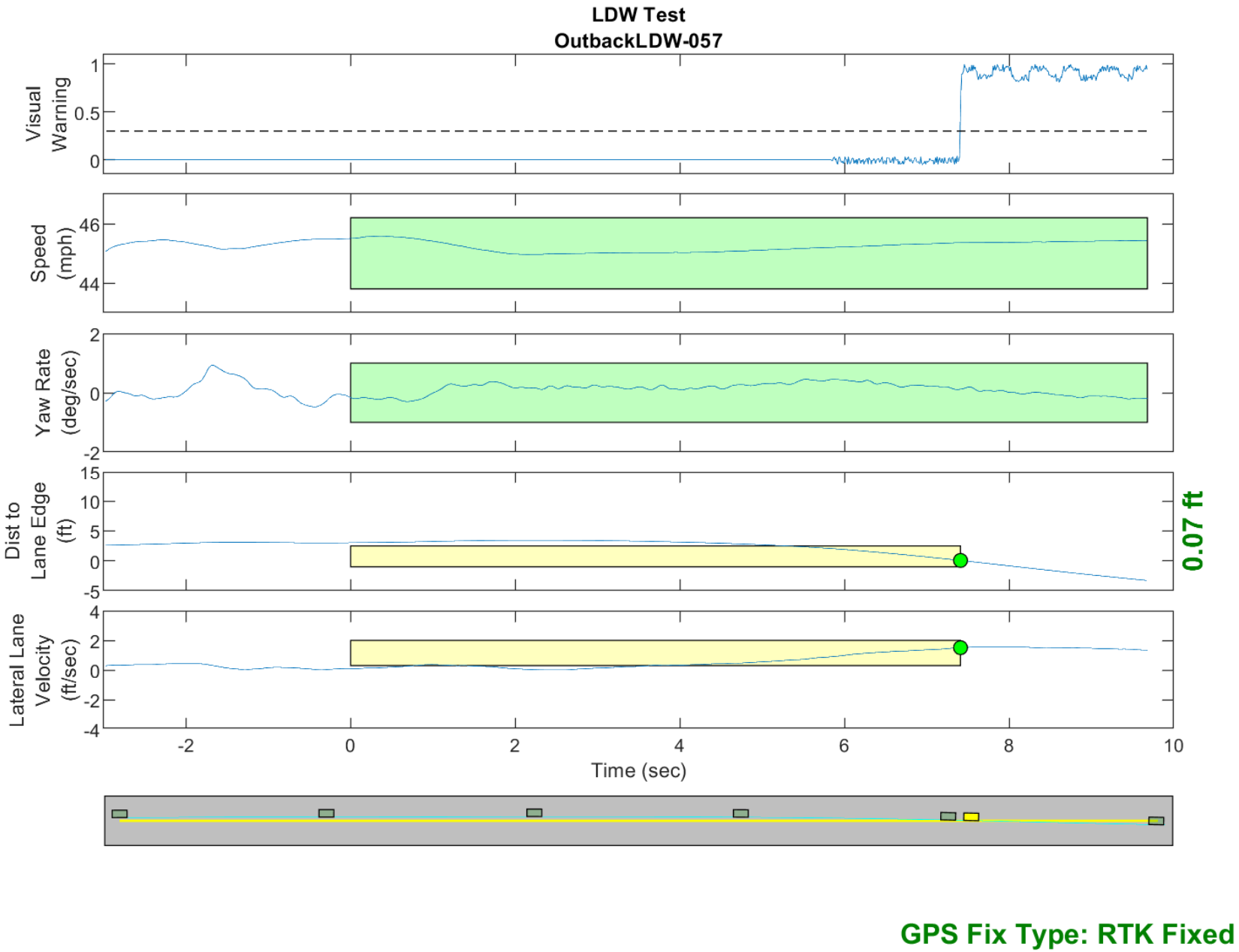


Figure D83. Time History for Run 57, Dashed Line, Right Departure, Visual Warning

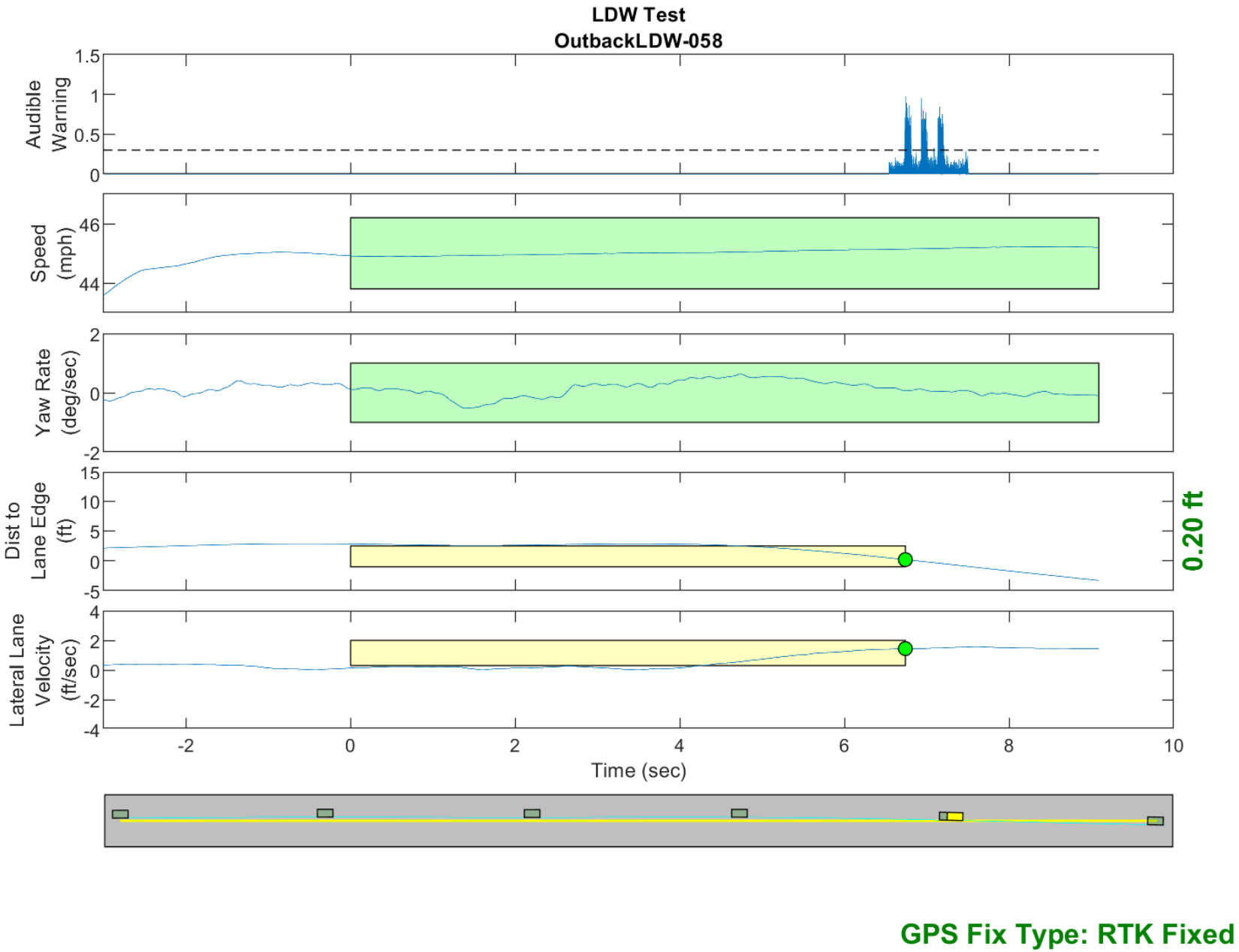


Figure D84. Time History for Run 58, Dashed Line, Right Departure, Audible Warning

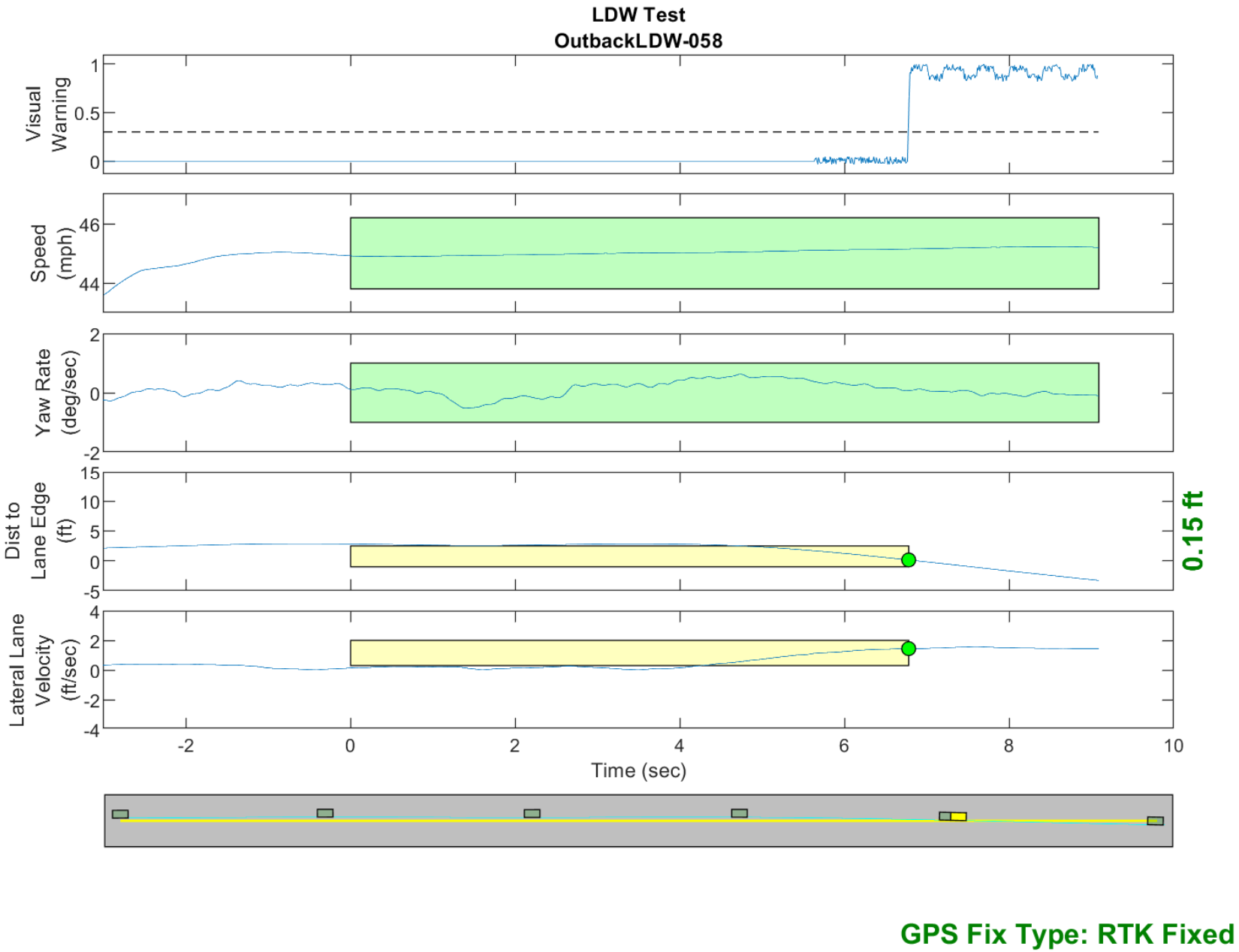


Figure D85. Time History for Run 58, Dashed Line, Right Departure, Visual Warning

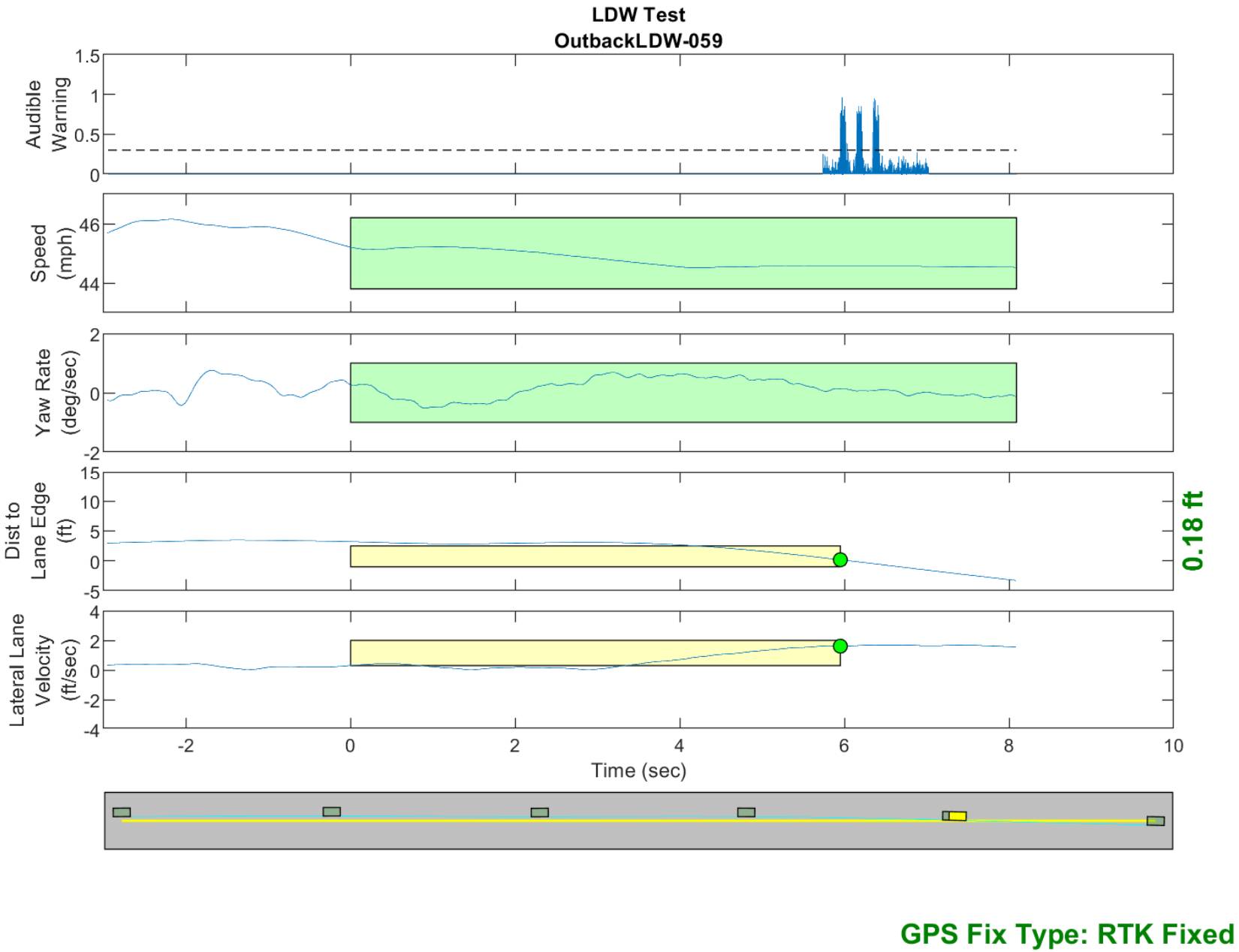


Figure D86. Time History for Run 59, Dashed Line, Right Departure, Audible Warning

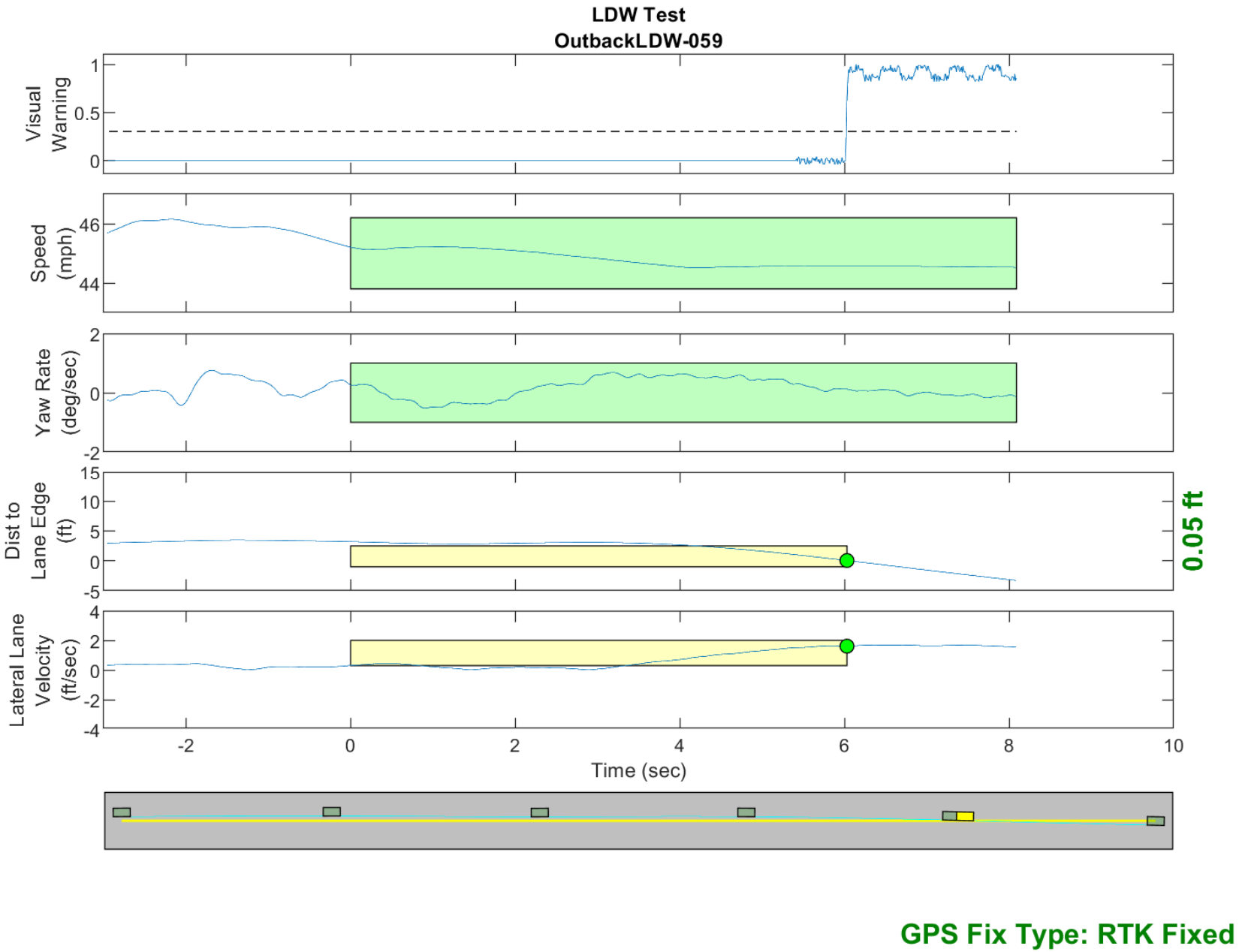


Figure D87. Time History for Run 59, Dashed Line, Right Departure, Visual Warning