NEW CAR ASSESSMENT PROGRAM
LANE DEPARTURE WARNING CONFIRMATION TEST
NCAP-DRI-LDW-20-13

2020 Mazda CX-30

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29 May 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

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16. Abstract These tests were conducted on the subject 2020 Mazda CX-30 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 requiremens of the test for all three lane marking types and for both directions.			
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TABLE OF CONTENTS

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 Mazda CX-30 . The LDW system for this vehicle provides visual, aural, and an optional haptic alert implemented via a vibration felt in the steering wheel. The vehicle passed the requiremens of the test for all three lane 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 Mazda CX-30

VIN: *3MVDMABL6LM10xxxx*

Test Date: *1/21/2020*

Lane Departure Warning setting: *Default – On, Audible + Steering Vibration (see notes)*

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:
Steering vibration was not measured for this test. It is typically the least reliably measured of available warning types.

LANE DEPARTURE WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2020 Mazda CX-30

TEST VEHICLE INFORMATION

VIN: *3MVDMABL6LM10xxxx*

Body Style: *SUV* Color: *Snowflake White Pearl Mc*

Date Received: *1/13/2020* Odometer Reading: *31 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *Mazda Motor Manufacturing De Mexico S.A. De C.V.*

Date of manufacture: *10/19*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *215/65R16*

Rear: *215/65R16*

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

Rear: *250 kPa (36 psi)*

TIRES

Tire manufacturer and model: *Bridgestone Turanza*

Front tire size: *215/65R16 98H*

Rear tire size: *215/65R16 98H*

Front tire DOT prefix: *1V6 6VJBV11*

Rear tire DOT prefix: *1V6 6VJBV11*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2020 Mazda CX-30

GENERAL INFORMATION

Test date: *1/21/2020*

AMBIENT CONDITIONS

Air temperature: *12.8 C (55 F)*

Wind speed: *0.0 m/s (0.0 mph)*

X Wind speed ≤10 m/s (22 mph)

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

X 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: *250 kPa (36 psi)*

Rear: *250 kPa (36 psi)*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2020 Mazda CX-30

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*474.5 kg (1046 lb)*	Right Front:	*455.0 kg (1003 lb)*
Left Rear:	*318.9 kg (703 lb)*	Right Rear:	*291.7 kg (643 lb)*
		Total:	*1539.9 kg (3395 lb)*

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 1 of 3)

2020 Mazda CX-30

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

Lane Departure Warning System (LDWS)

Lane Departure Warning Setting used in test: *Default – On, Audible + Steering Vibration (see notes)*

Type and location of sensor(s) used:

Mono camera located behind the windshield near 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
- **X** Vibration
- _____ Other _____

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

If the system determines that the vehicle may deviate from its lane, a warning (beep sound, steering wheel vibration) is activated and the direction in which the system determines that the vehicle may deviate is indicated on the multi-information display and the active driving display. The display is shown in Figure A13 of Appendix A.
The auditory warning is implemented as a repeated beep centered at 1966 Hz pulsed 7 times/second.

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.

A switch located to the left of the steering column can be used to switch the i-ACTIVESENSE system on and off. As part of the i-ACTIVESENSE system, LDWS is can be disabled or enabled by means of this switch. The switch is shown in Figure A12 of Appendix A.

The system can also be enabled/disabled using the multi-function control located just behind the shift lever (Figure A11).

The hierarchy for enabling/disabling the LDWS is:

Settings

Safety Settings

Safety Alerts

Lane Departure Warning System:

Check box to enable/disable

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.

A multi-function control located just behind the shift lever (Figure A11) is used to access the vehicle settings. The hierarchy for setting the LDWS is:

Settings

Safety Settings

Safety Alerts

Lane Departure Warning System:

Check box to enable/disable

Alert Type; options are:

Audible

Steering Wheel Vibration

Audible + Steering Wheel Vibration

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 3 of 3)

2020 Mazda CX-30

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 detailed in the Owner's Manual pages 4-89 and 4-90 shown in Appendix B Pages B-7 and B-8.

Notes:

Steering vibration was not measured for this test. It is typically the least reliably measured of available warning types.

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.

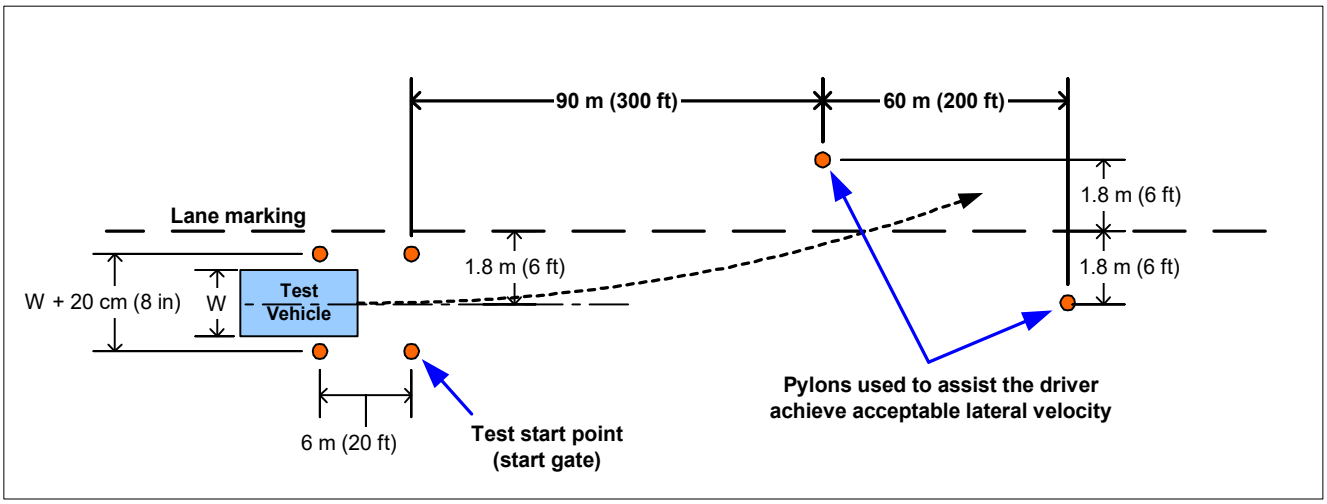


Figure 1. Position of Cones Used to Assist Driver

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.

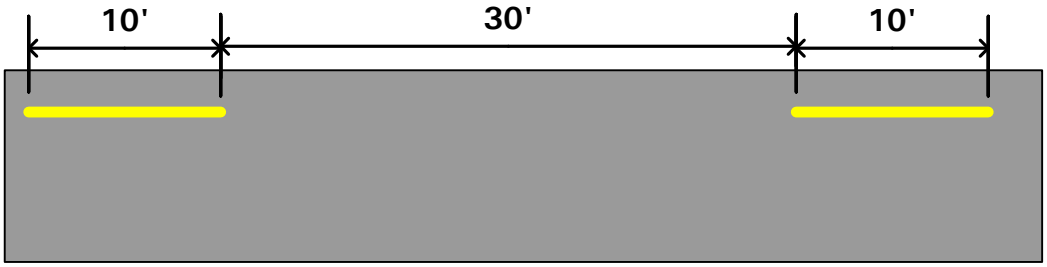


Figure 2. MUTCD Discontinuous Dashed Line Specifications

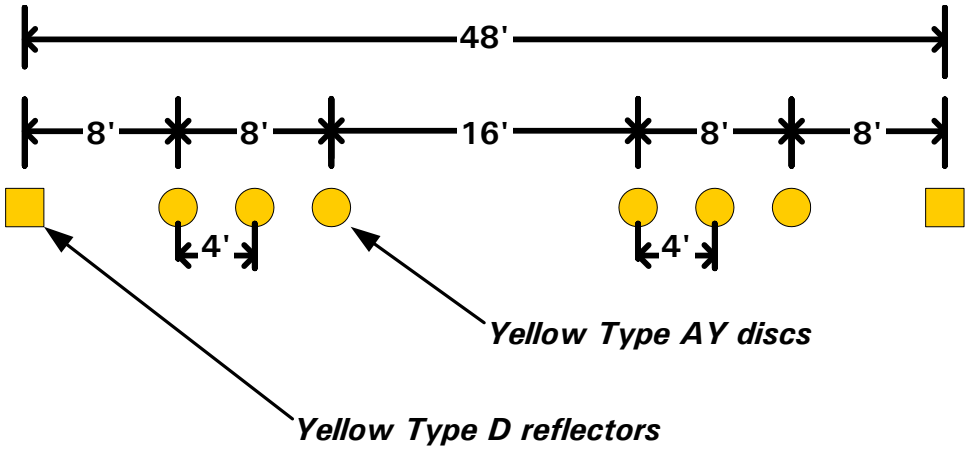


Figure 3. California Standard Plan A20A, Detail 4

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	1110M206352	By: DRI Date: 1/6/2020 Due: 1/6/2021
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

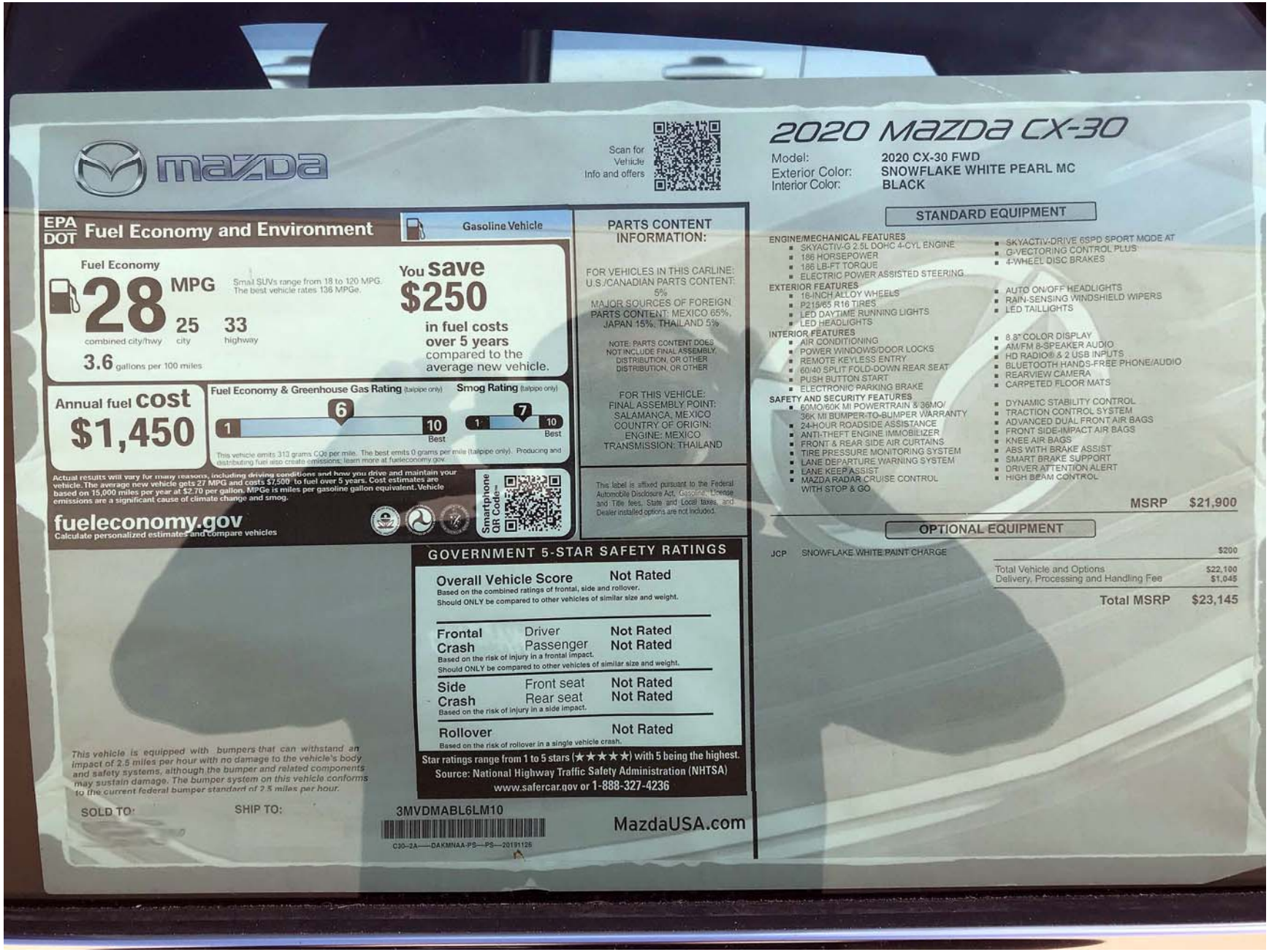


Figure A3. Window Sticker (Monroney Label)

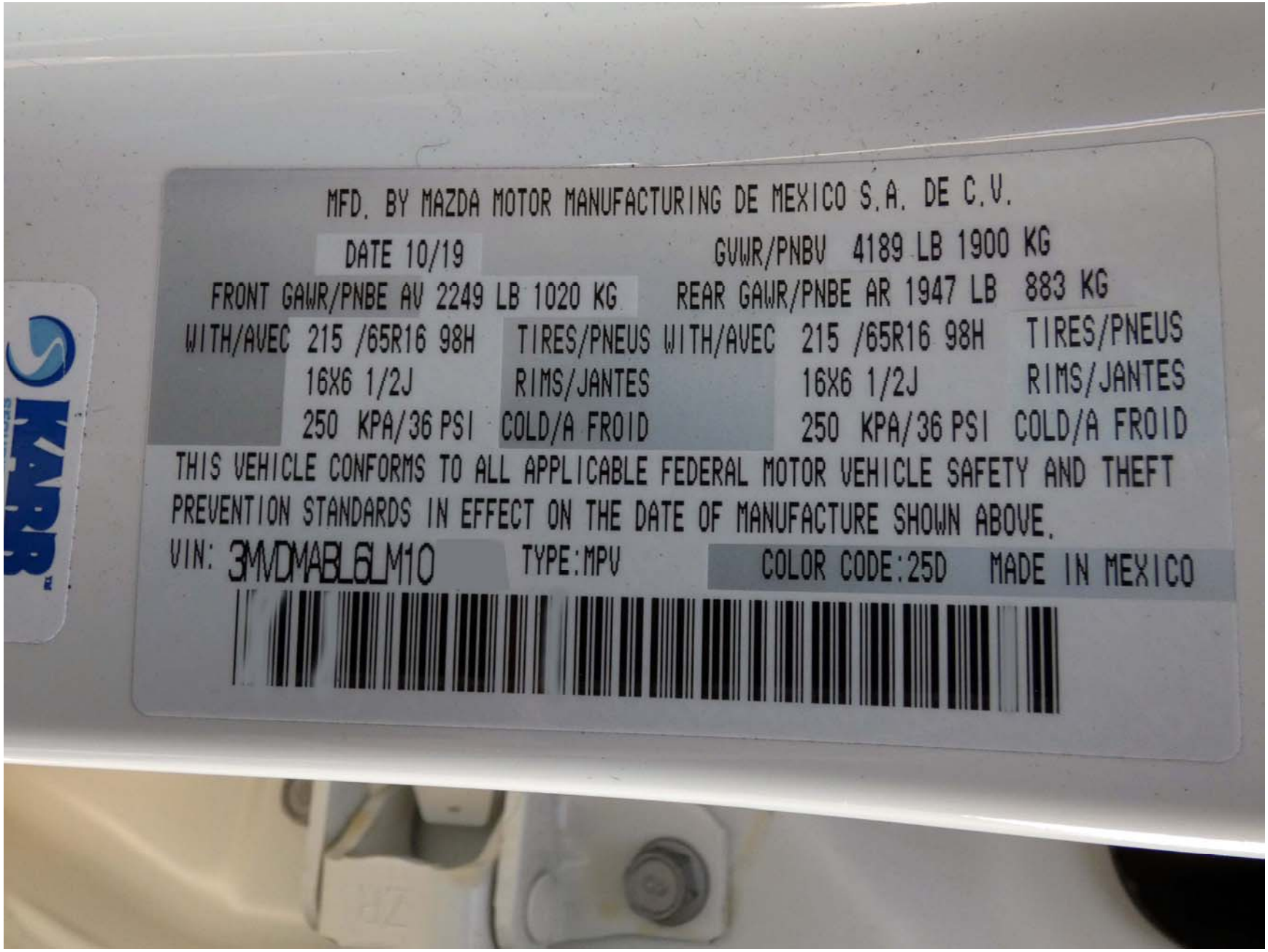


Figure A4. Vehicle Certification Label

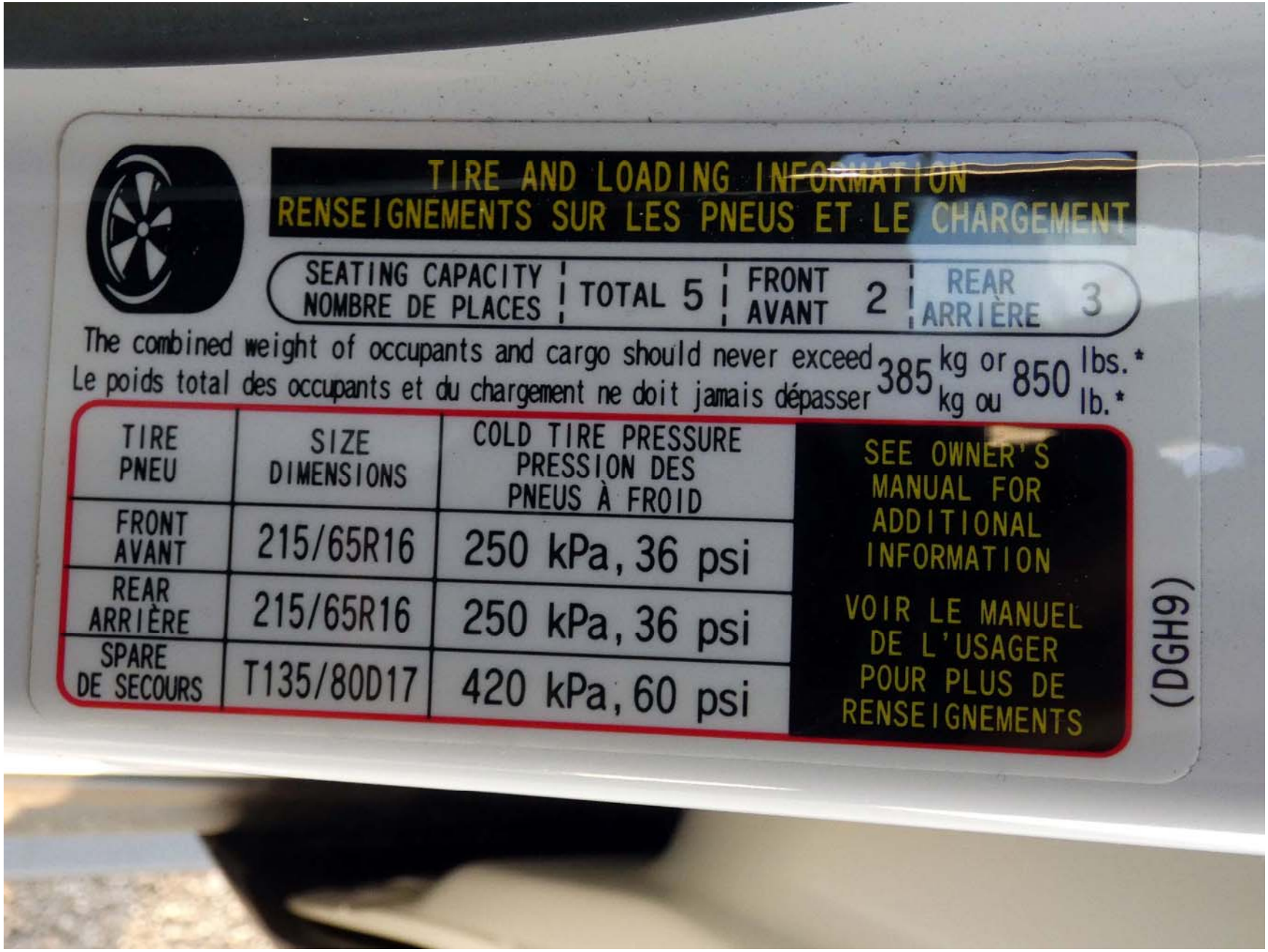


Figure A5. Tire Placard

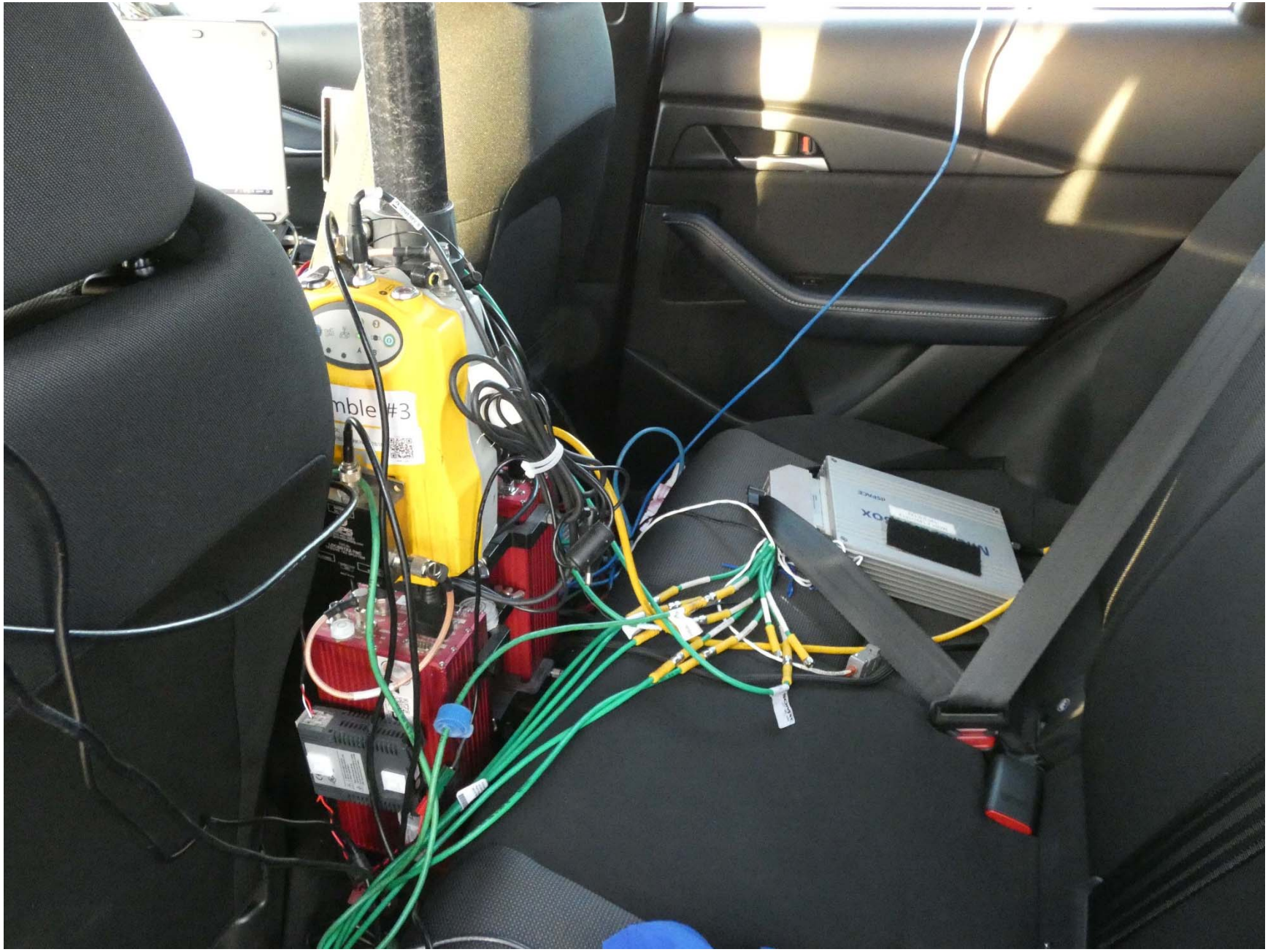


Figure A6. DGPS, Inertial Measurement Unit, and MicroAutoBox Installed in Subject Vehicle

Figure A7. Sensor for Detecting Visual Alerts

Figure A8. Sensor for Detecting Auditory Alerts

Figure A9. Computer Installed in Subject Vehicle

Figure A10. Controls for Interacting with LDW Settings

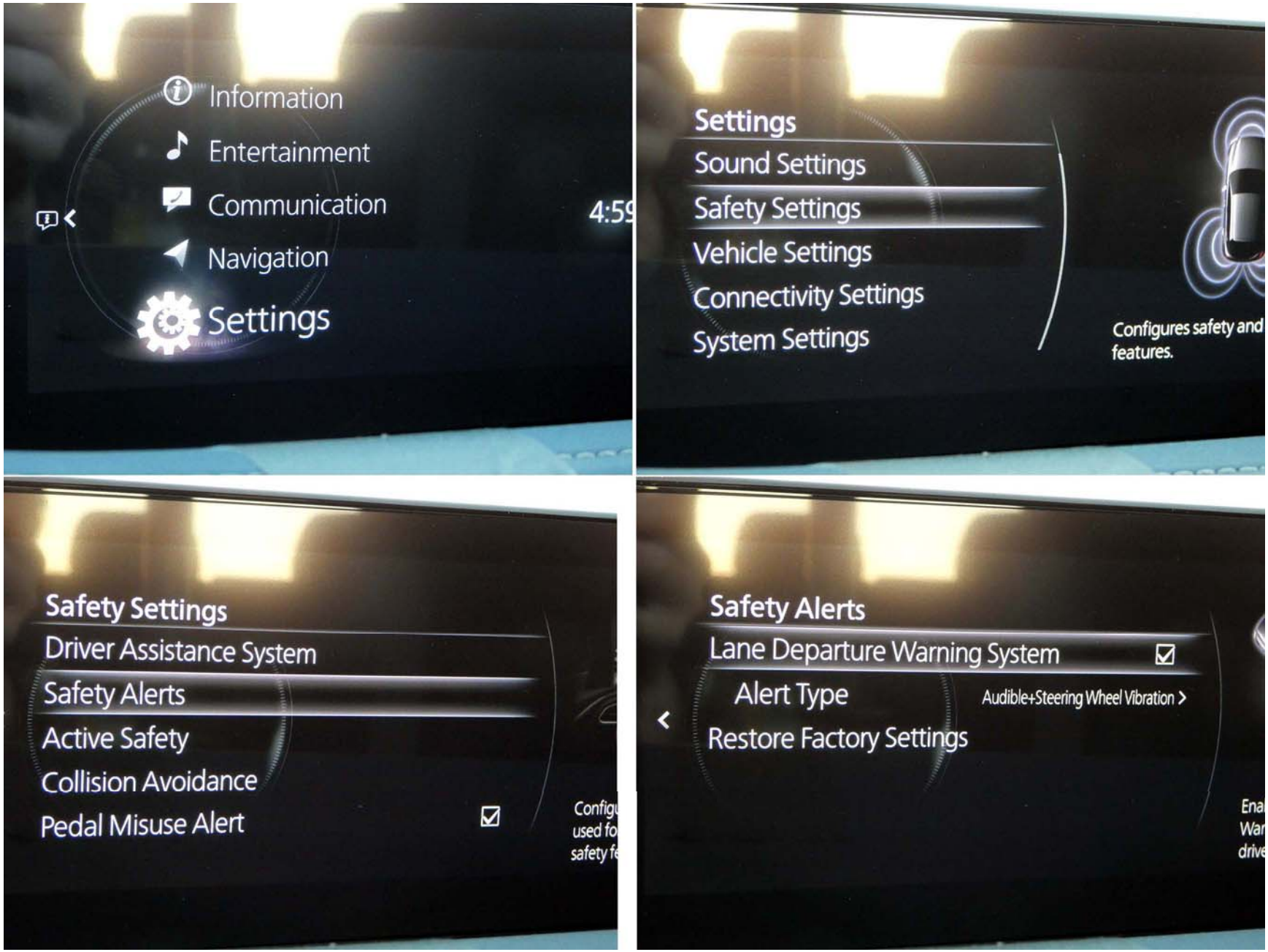


Figure A11. LDW Menus

Figure A12. Switch to Enable/Disable i-ACTIVESENSE System Including LDW

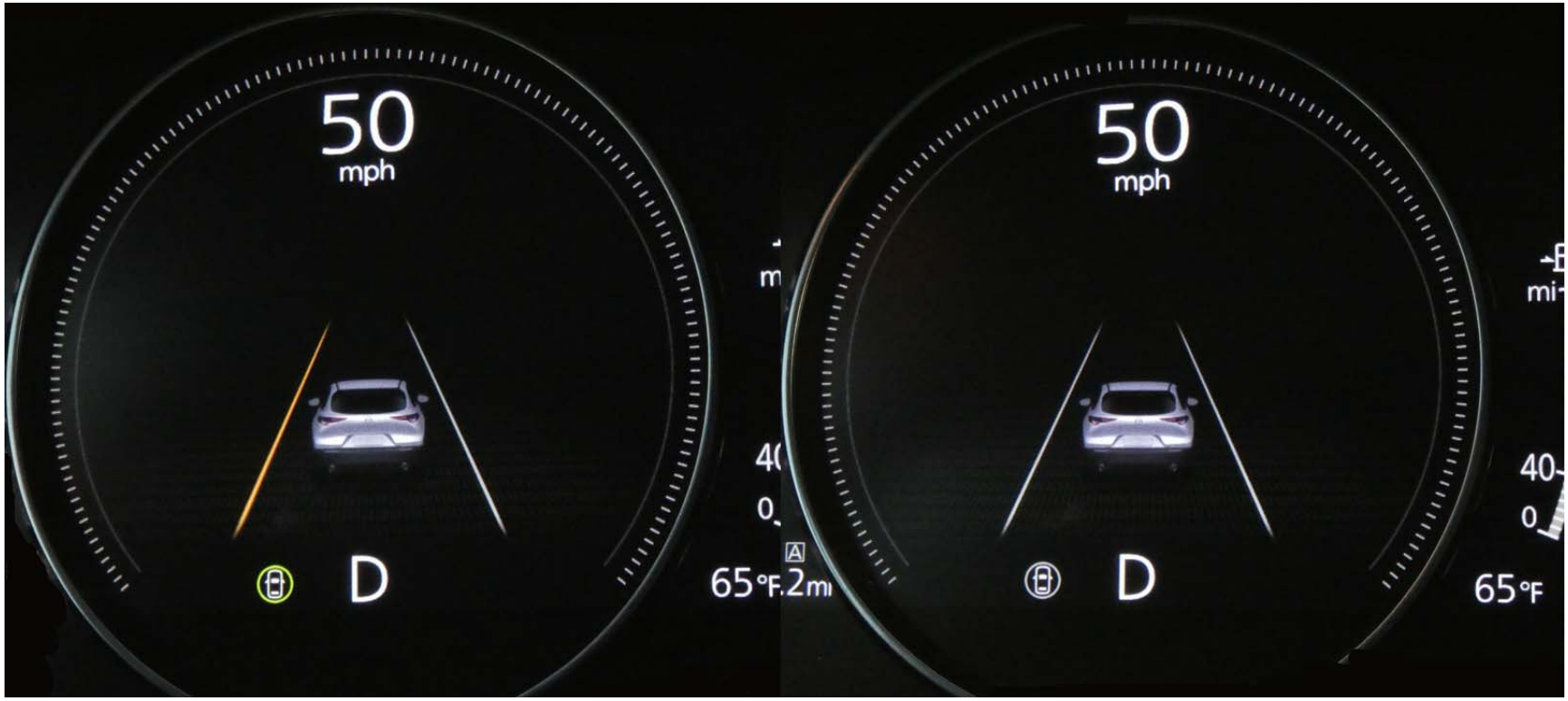


Figure A13. LDW Visual Alert

APPENDIX B

Excerpts from Owner’s Manual

2. Press the AUTO switch.
While in auto mode, the heated steering wheel automatically operates/turns off according to the conditions in the cabin.

NOTE

- If the heated steering wheel switch is pressed during auto mode, the heated steering wheel switches to manual mode. To return to auto mode, press the AUTO switch.
- If the ignition is switched OFF while the heated steering wheel is operating in auto mode, the heated steering wheel operates in auto mode again the next time the ignition is switched ON.

⚠ CAUTION

The following types of persons should be careful not to touch the steering wheel. Otherwise, it could cause a low-temperature burn.

- Infants, small children, elderly people, and physically challenged people
- People with delicate skin
- People who are excessively fatigued
- People who are intoxicated
- People who have taken sleep-inducing medicine such as sleeping pills or cold medicine

Seat Belt Extender

▼ Seat Belt Extender

If your seat belt is not long enough, even when fully extended, a seat belt extender may be available to you at no charge from your Authorized Mazda Dealer.
This extender will be only for you and for the particular vehicle and seat. Even if it plugs into other seat belts, it may not hold in the critical moment of a crash.
When ordering an extender, only order one that provides the necessary additional length to fasten the seat belt properly. Please contact your Authorized Mazda Dealer for more information.

⚠ WARNING

Do not use a seat belt extender unless it is necessary:
Using a seat belt extender when not necessary is dangerous. The seat belt will be too long and not fit properly. In an accident, the seat belt will not provide adequate protection and you could be seriously injured. Only use the extender when it is required to fasten the seat belt properly.

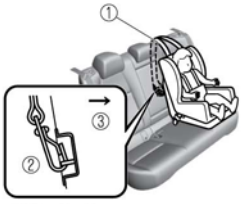
Do not use an improper extender:
Using a seat belt extender that is for another person or a different vehicle or seat is dangerous. The seat belt will not provide adequate protection and the user could be seriously injured in an accident. Only use the extender provided for you and for the particular vehicle and seat. NEVER use the extender in a different vehicle or seat. If you sell your Mazda, do not leave your seat belt extender in the vehicle. It could be used accidentally by the new owner of the vehicle. After removing the seat belt extender, discard it. Never use the seat belt extender in any other vehicle you may own in the future.

Do not use an extender that is too long:
Using an extender that is too long is dangerous. The seat belt will not fit properly. In an accident, the seat belt will not provide adequate protection and you could be seriously injured. Do not use the extender or choose one shorter in length if the distance between the extender's buckle and the center of the user's body is less than 15 cm (6 in).

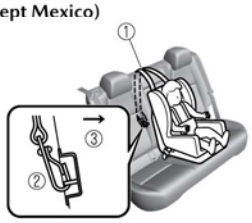
⚠ WARNING

Always attach the tether strap to the correct tether anchor position:
Attaching the tether strap to the incorrect tether anchor position is dangerous. In a collision, the tether strap could come off and loosen the child-restraint system. If the child-restraint system moves it could result in death or injury to the child.

Always remove the head restraint and install child-restraint system:
Installing a child-restraint system without removing the head restraint is dangerous. The child-restraint system cannot be installed correctly which may result in death or injury to the child in a collision.



(Except Mexico)



1. Tether strap
2. Anchor bracket
3. Forward

Always install the head restraint and adjust it to the appropriate position after removing the child-restraint system:
Driving with the head restraint removed is dangerous as impact to the occupant's head cannot be prevented during emergency braking or in a collision, which could result in a serious accident, injury or death.
Refer to Head Restraints on page 2-15.

▼ Using Automatic Locking Mode (Except Mexico)

Follow these instructions when using a child-restraint system, unless you are attaching a LATCH-equipped child-restraint system to the rear LATCH lower anchors. Refer to "Using LATCH Lower Anchor" (page 2-44).

NOTE
Follow the child-restraint system manufacturer's instructions carefully. If you are not sure whether you have a LATCH system or tether, check in the child-restraint system manufacturer's instructions and follow them accordingly. Depending on the type of child-restraint system, it may use LATCH system instead of seat belts or if the belt goes across the child's chest, may recommend against using automatic locking mode.

1. Make sure the seatback is securely latched by pushing it back until it is fully locked.
2. Remove the head restraint. However, when installing a backless booster seat, always install the vehicle head restraint to the seat where the backless booster seat is installed.
Refer to Head Restraints on page 2-15.

Rear/rear corner/rear side ultrasonic sensor

The ultrasonic sensor detects ultrasonic waves reflected off obstructions at the rear sent from the ultrasonic sensors. The following systems use the ultrasonic sensor.

- Smart Brake Support [Rear] (SBS-R)
- Smart Brake Support [Rear Crossing] (SBS-RC)

The ultrasonic sensors are mounted in the rear bumper.
Refer to Rear/Rear corner/Rear Side Ultrasonic Sensor on page 4-199.

Front camera/side cameras/rear camera

The front camera, side cameras, and rear camera shoot images of the area surrounding the vehicle. The 360°View Monitor uses each camera.
Cameras are installed to the front bumper, door mirrors, and liftgate.
Refer to Front Camera/Side Cameras/Rear Camera on page 4-199.

Driver monitoring camera

The driver monitoring camera detects changes in the driver's facial features and estimates the amount of accumulated fatigue and sleepiness of the driver. The following systems use the driver monitoring camera.

- Driver Monitoring (DM)

The driver monitoring camera is mounted in the center display.
Refer to Driver Monitoring Camera on page 4-200.

▼ i-ACTIVSENSE Status Symbol (Warning/Risk Avoidance Support System)*

The system notifies the driver of any of the following system status using the color or OFF indication of the i-ACTIVSENSE status symbol (Warning/risk avoidance support system).

- Lane Departure Warning System (LDWS)
- Blind Spot Monitoring (BSM)
- Distance & Speed Alert (DSA)
- Front Cross Traffic Alert (FCTA)
- Rear Cross Traffic Alert (RCTA)
- Lane-keep Assist System (LAS)

NOTE
The status of the system turned on using the personalization feature is displayed.

i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white)

System stand-by status

If none of the systems are activated or if there is a problem with the system, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white) is displayed.

NOTE
For example, even when the Blind Spot Monitoring (BSM) is operating normally, if the Lane Departure Warning System (LDWS) has a problem, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white) is displayed.

*Some models.

i-ACTIVSENSE status symbol (warning/risk avoidance support system) (green)

System activated status

If any one of the systems is activated, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (green) is displayed.

NOTE
Even if the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (green) is displayed, systems which do not meet the operation conditions will not operate.

i-ACTIVSENSE status symbol (warning/risk avoidance support system) (amber)

System warning status

If any system warning is activated, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (amber) is displayed.

i-ACTIVSENSE OFF symbol (warning/risk avoidance support system)

System OFF status

If all the systems are canceled using the personalization features or the i-ACTIVSENSE switch, the i-ACTIVSENSE OFF symbol (Warning/risk avoidance support system) is displayed.

▼ i-ACTIVSENSE Switch*

When the i-ACTIVSENSE switch is pressed, the following systems are canceled and the i-ACTIVSENSE OFF symbol (Warning/risk avoidance support system) in the instrument cluster is displayed.

- Lane Departure Warning System (LDWS)
- Blind Spot Monitoring (BSM)
- Distance & Speed Alert (DSA)
- Front Cross Traffic Alert (FCTA)
- Rear Cross Traffic Alert (RCTA)
- Lane-keep Assist System (LAS)

i-ACTIVSENSE OFF symbol (Warning/risk avoidance support system)

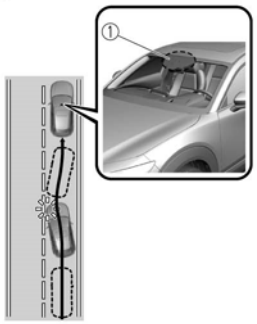
If the i-ACTIVSENSE switch is pressed again, the systems return to their original operation status and the i-ACTIVSENSE OFF symbol (Warning/

*Some models.

Lane Departure Warning System (LDWS)*

▼ Lane Departure Warning System (LDWS)

The LDWS alerts the driver that the vehicle may be deviating from its lane. The system detects the white (yellow) lines on the traffic lane using the forward sensing camera (FSC) and if it determines that the vehicle might be deviating from its lane, it notifies the driver by the LDWS.
Refer to Forward Sensing Camera (FSC) on page 4-190.
Use the LDWS when you drive the vehicle on roads with white (yellow) lines.



1. Forward sensing camera (FSC)

⚠ WARNING

Do not rely completely on the LDWS:

- The LDWS system is not designed to compensate for a driver's lack of caution and relying too much on the system could lead to an accident.
- The functions of the LDWS have limitations. Always stay on course using the steering wheel and drive with care.

⚠ CAUTION

Heed the following cautions so that the LDWS can operate normally.

- Do not modify the vehicle's suspensions.
- Always use wheels of the specified type and size for the front and rear wheels. Consult an Authorized Mazda Dealer for tire replacement.

NOTE

The system may not operate normally under the following conditions.

- The white (yellow) lane lines are less visible because of dirt or paint flaking.
- White (yellow) lane lines are less visible because of bad weather (rain, fog, or snow).
- The vehicle is driven on a temporary lane or section with a closed lane resulting from construction where there might be multiple white (yellow) lane lines, or they are interrupted.
- The camera picks up an obscure line, such as a temporary line being used for construction, or because of shade, unmelted snow, or grooves filled with water.
- The surrounding brightness suddenly changes such as when entering or exiting a tunnel.
- Back-light is reflected off the road surface.
- The road surface is wet and shiny after rain, or there are puddles on the road.

- The width of a lane is excessively narrow.
- The vehicle is driven on roads with tight curves.
- Heavy luggage is loaded in the luggage compartment or on the rear seat causing the vehicle to tilt.
- The vehicle is driven through a fork in the road or a junction.
- The shade of a guardrail parallel to a white (yellow) lane line is cast on the road.
- The illumination of the headlights is weakened because of dirt or the optical axis is deviated at night.
- The road is excessively uneven.
- The vehicle is shaken after hitting a road bump.
- A vehicle in front of your vehicle is running near a white (yellow) lane line making it less visible.
- The windshield is dirty or foggy.
- Strong light is directed from the front of the vehicle (such as sunlight, or headlights (high-beam) of on-coming vehicles).
- The vehicle is driven through an intersection or a roundabout.

▼ When the System Operates

When the ignition is switched ON, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white) turns on and the system goes on standby.

NOTE
If the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white) does not turn on, the system is canceled using the i-ACTIVSENSE switch or the personalization feature.

Operation conditions

When all of the following conditions are met, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) on the multi-information display changes from white to green and the system becomes operational.

- The ignition is switched ON.
- The vehicle speed is about 64 km/h (40 mph) or faster.
- The system detects white (yellow) lane lines.

NOTE
When the system does not detect a white (yellow) lane line on one side only, the system does not operate on the side that is not being detected.

When temporarily canceling the system

The LDWS goes on standby in the following cases: The LDWS operation is automatically restored when the system's operation conditions are met.

- The system cannot detect white (yellow) lane lines.
- The vehicle speed is less than about 56 km/h (35 mph).
- The turn signal lever is operated.
- The accelerator pedal is depressed.
- The steering wheel is operated.

・The brake pedal is operated.

The function is temporarily stopped.

The LDWS stops functioning in the following cases:

・The temperature in the forward sensing camera (FSC) is too high or too low.
・The windshield around the forward sensing camera (FSC) is foggy.
・The windshield around the forward sensing camera (FSC) is blocked by an obstruction, causing poor forward visibility.
・Strong light (such as sunlight, or headlights (high-beam) of on-coming vehicles) is directed at the forward sensing camera (FSC).

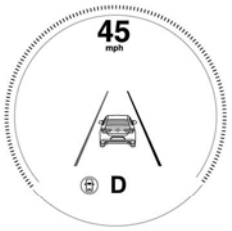
System malfunction

If there is a problem with the system, the i-ACTIVSENSE status symbol (warning/risk avoidance support system) (white) and the i-ACTIVSENSE warning indication/warning light on the multi-information display turns on and a message is indicated.
Refer to i-ACTIVSENSE Status Symbol (Warning/Risk Avoidance Support System) on page 4-84.

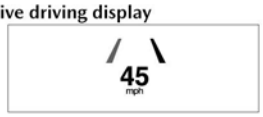
▼ LDWS Warning

If the system determines that the vehicle may deviate from its lane, a warning (beep sound, steering wheel vibration) is activated and the direction in which the system determines that the vehicle may deviate is indicated on the multi-information display and the active driving display.

Multi-information display



Active driving display



NOTE

・The LDWS settings can be changed. Refer to the Settings section in the Mazda Connect Owner's Manual.
・You may not be able to hear the LDWS warning sound depending on the surrounding conditions such as outside noise.
・If you set the LDWS to vibrate the steering wheel, you may not feel the vibrations depending on the road surface conditions.

▼ Canceling the System

The LDWS can be set to inoperable.

・**(If only the LDWS is turned off)** Refer to the Settings section in the Mazda Connect Owner's Manual.
・**(If the LDWS is turned off by operating the i-ACTIVSENSE switch)** Refer to i-ACTIVSENSE Switch on page 4-85.

NOTE
If the ignition is switched OFF while you have canceled the system using the i-ACTIVSENSE switch, the system is automatically enabled the next time the ignition is switched ON. However, if the system is canceled using the personalization features, the system is not automatically enabled.

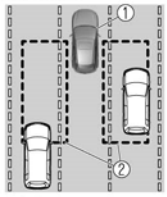
Blind Spot Monitoring (BSM)*

▼ Blind Spot Monitoring (BSM)

The BSM is designed to assist the driver in checking the area to the rear of the vehicle on both sides during lane changes by notifying the driver of the presence of vehicles approaching from the rear in an adjacent lane.

BSM operation

The BSM detects vehicles approaching from the rear while traveling in the forward direction at a speed of 10 km/h (6.3 mph) or faster and notifies the driver by turning on the BSM warning indicator light and displaying the vehicle detection screen.
If the turn signal lever is operated to signal a turn in the direction in which the BSM warning indicator light is illuminated while the approaching vehicle is detected, the BSM notifies the driver of possible danger flashing on the BSM warning indicator light, and by activating the warning sound and the warning screen indicator display.
The detection area on this system covers the driving lanes on both sides of the vehicle and from the rear part of the front doors to about 50 m (164 ft) behind the vehicle.



1. Your vehicle

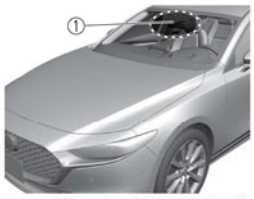
 *Some models.

Forward Sensing Camera (FSC)*

▼ Forward Sensing Camera (FSC)

Your vehicle is equipped with a Forward Sensing Camera (FSC). The Forward Sensing Camera (FSC) is positioned near the rearview mirror and used by the following systems.

- High Beam Control System (HBC)
- Lane Departure Warning System (LDWS)
- Traffic Sign Recognition System (TSR)
- Distance & Speed Alert (DSA)
- Driver Attention Alert (DAA)
- Mazda Radar Cruise Control (MRCC)
- Mazda Radar Cruise Control with Stop & Go function (MRCC with Stop & Go function)
- Lane-keep Assist System (LAS)
- Traffic Jam Assist (TJA)
- Smart Brake Support (SBS)



1. Forward Sensing Camera (FSC)

The Forward Sensing Camera (FSC) determines the conditions ahead of the vehicle while traveling at night and detects traffic lanes. The distance in which the Forward Sensing Camera (FSC) can detect objects varies depending on the surrounding conditions.

⚠ WARNING

Do not modify the suspension:
If the vehicle height or inclination is changed, the system will not be able to correctly detect vehicles ahead. This will result in the system not operating normally or mistakenly operating, which could cause a serious accident.

⚠ CAUTION

- Do not apply accessories, stickers or film to the windshield near the Forward Sensing Camera (FSC). If the area in front of the Forward Sensing Camera (FSC) lens is obstructed, it will cause the system to not operate correctly. Consequently, each system may not operate normally which could lead to an unexpected accident.
- Do not disassemble or modify the Forward Sensing Camera (FSC). Disassembly or modification of the Forward Sensing Camera (FSC) will cause a malfunction or mistaken operation. Consequently, each system may not operate normally which could lead to an unexpected accident.
- Heed the following cautions to assure the correct operation of the Forward Sensing Camera (FSC).
  - Be careful not to scratch the Forward Sensing Camera (FSC) lens or allow it to get dirty.
  - Do not remove the Forward Sensing Camera (FSC) cover.
  - Do not place objects on the dashboard which reflect light.

 *Some models.

Safety Alerts

Configures alert notifications used for i-ACTIVSENSE safety features.

Function	Available setting changes
Front Cross Traffic Alert Enables alerts when a moving object may cross into the vehicle's forward path.	Enable, Disable
Rear Cross Traffic Alert Enables alerts when a moving object may cross into the vehicle's rearward path.	Enable, Disable
Lane Departure Warning System Enables Lane Departure Warning System to alert driver of lane departure risks.	Enable, Disable
Lane Departure Warning System Alert Type Sets the desired notification type for Lane Departure Warning System alerts.	Audible, Steering Wheel Vibration, Audible+Steering Wheel Vibration
Blind Spot Monitoring Selects the desired Blind Spot Monitoring alert notification type.	Visual, Visual + Audible, Off
Blind Spot Monitoring Alert Timing Selects the desired alert timing for Blind Spot Monitoring.	Early, Normal, Late
Restore Factory Settings Restores the safety alert settings to the factory defaults.	—

APPENDIX C

Run Log

Subject Vehicle: **2020 Mazda CX-30** Test Date: **1/21/2020**

Driver: **N. Watanabe** **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**	**Left**	N				Couldn't pick up alert
2			Y	-0.36	-0.55	Pass	
3			Y	-0.12	-0.25	Pass	
4			Y	-0.48	-0.53	Pass	
5			Y	-0.17	-0.23	Pass	
6			Y	-0.40	-0.47	Pass	
7			Y	-0.57	-0.66	Pass	
8			Y	-0.64	-0.82	Pass	
9	**Botts**	**Right**	Y	-0.58	-0.67	Pass	
10			Y	-0.61	-0.71	Pass	
11			N				Lane velocity
12			Y	-0.56	-0.70	Pass	
13			Y	-0.39	-0.50	Pass	
14			Y	-0.49	-0.66	Pass	
15			Y	-0.55	-0.67	Pass	
16			Y	-0.48	-0.60	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
17	**Solid**	**Right**	Y	-0.47	-0.55	Pass	
18			N				Radar blind warning present in IP
19			Y	-0.42	-0.59	Pass	
20			Y	-0.56	-0.70	Pass	
21			N				Speed
22			Y	-0.42	-0.55	Pass	
23			Y	-0.43	-0.56	Pass	
24			Y	-0.50	-0.70	Pass	
25			Y	-0.44	-0.45	Pass	
26	**Solid**	**Left**	Y	-0.65	-0.73	Pass	
27			N				Yaw
28			Y	-0.54	-0.67	Pass	
29			N				Lane velocity
30			Y	-0.72	-0.79	Pass	
31			Y	-0.69	-0.80	Pass	
32			Y	-0.65	-0.75	Pass	
33			Y	-0.69	-0.79	Pass	
34			Y	-0.64	-0.74	Pass	
35	**Dashed**	**Left**	Y	-0.58	-0.70	Pass	
36			Y	-0.40	-0.54	Pass	
37			Y	-0.71	-0.82	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Auditory Alert (ft)	Distance at Visual Alert (ft)	Pass/Fail	Notes
38			Y	-0.51	-0.69	Pass	
39			Y	-0.56	-0.69	Pass	
40			Y	-0.52	-0.64	Pass	
41			Y	-0.52	-0.71	Pass	
42	**Dashed**	**Right**	N				Lateral lane velocity
43			Y	-0.72	-0.94	Pass	
44			Y	-0.47	-0.69	Pass	
45			Y	-0.51	-0.72	Pass	
46			Y	-0.65	-0.70	Pass	
47			Y	-0.71	-0.81	Pass	
48			Y	-0.47	-0.56	Pass	
49			Y	-0.76	-0.80	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.

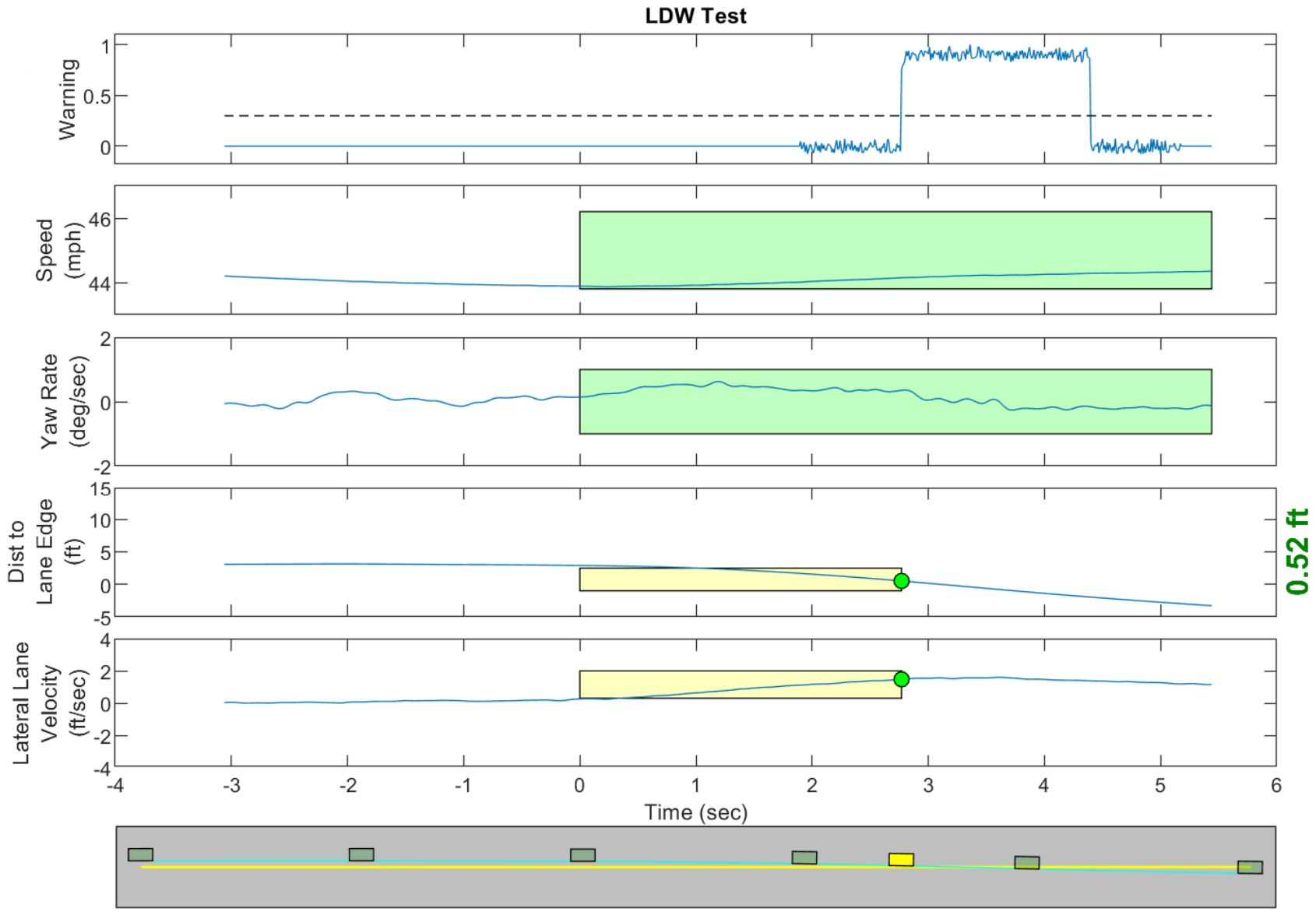


Figure D1. Example Time History for Lane Departure Warning Test, Passing

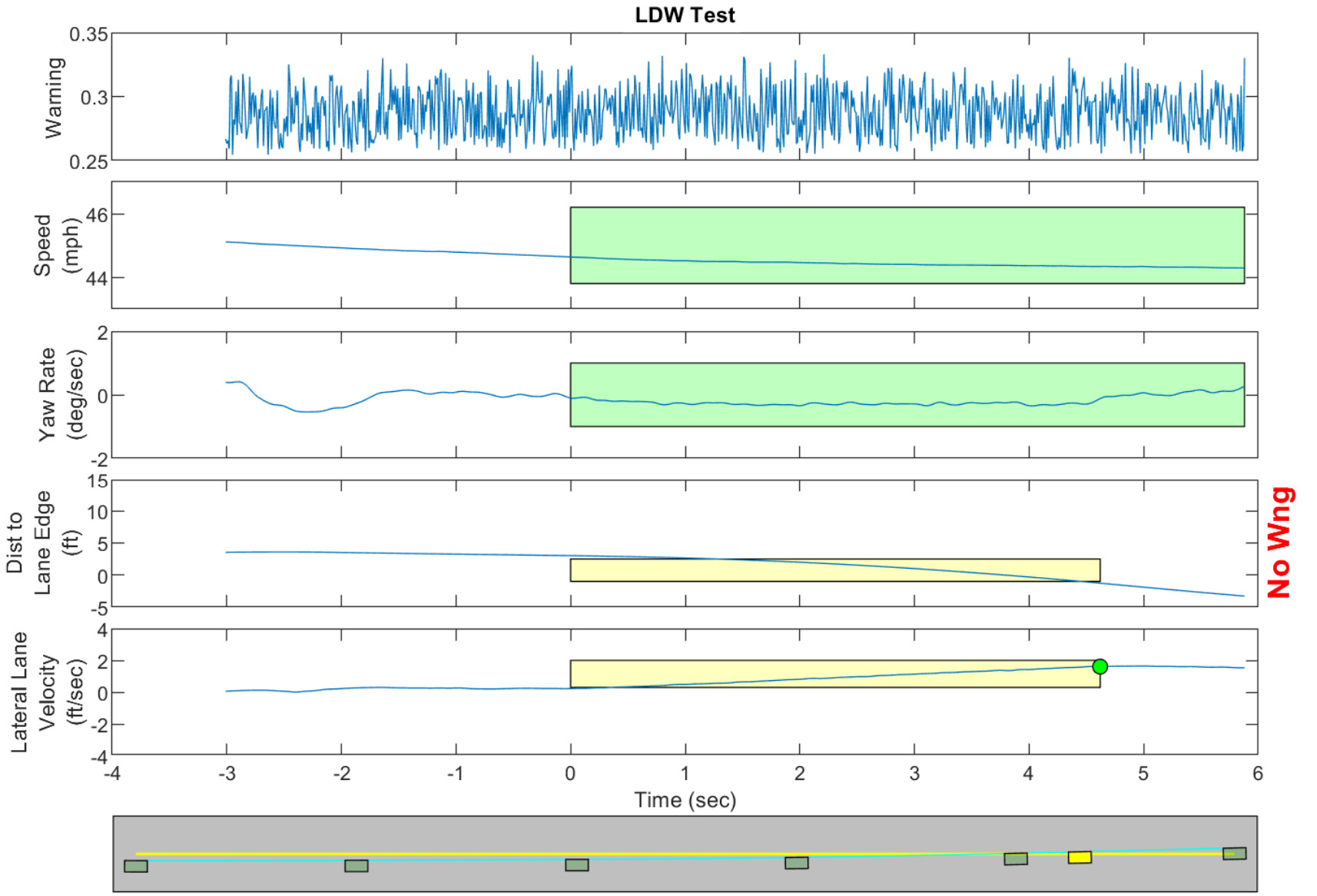


Figure D2. Example Time History for Lane Departure Warning Test, Failing, No Warning Issued

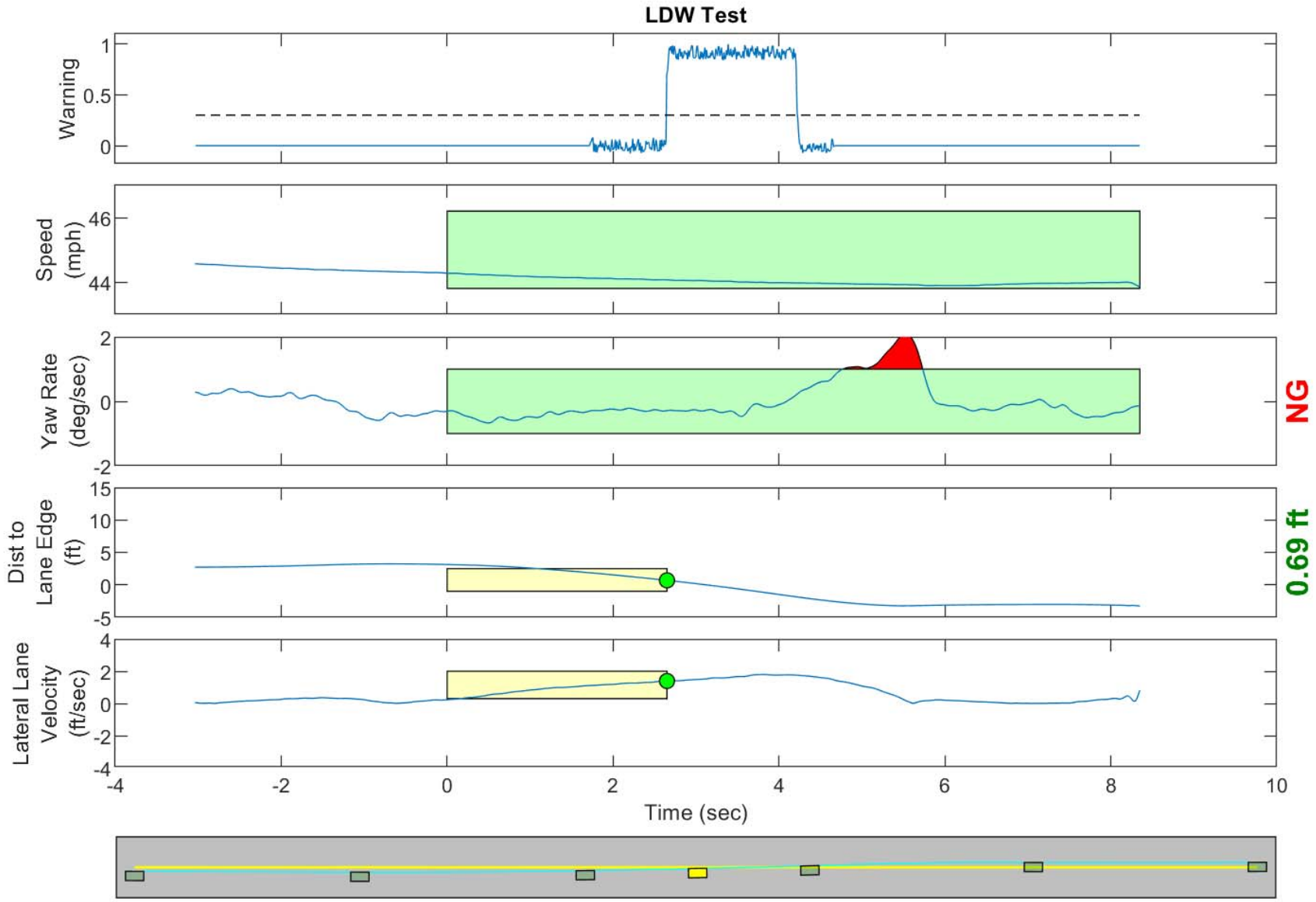


Figure D3. Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate

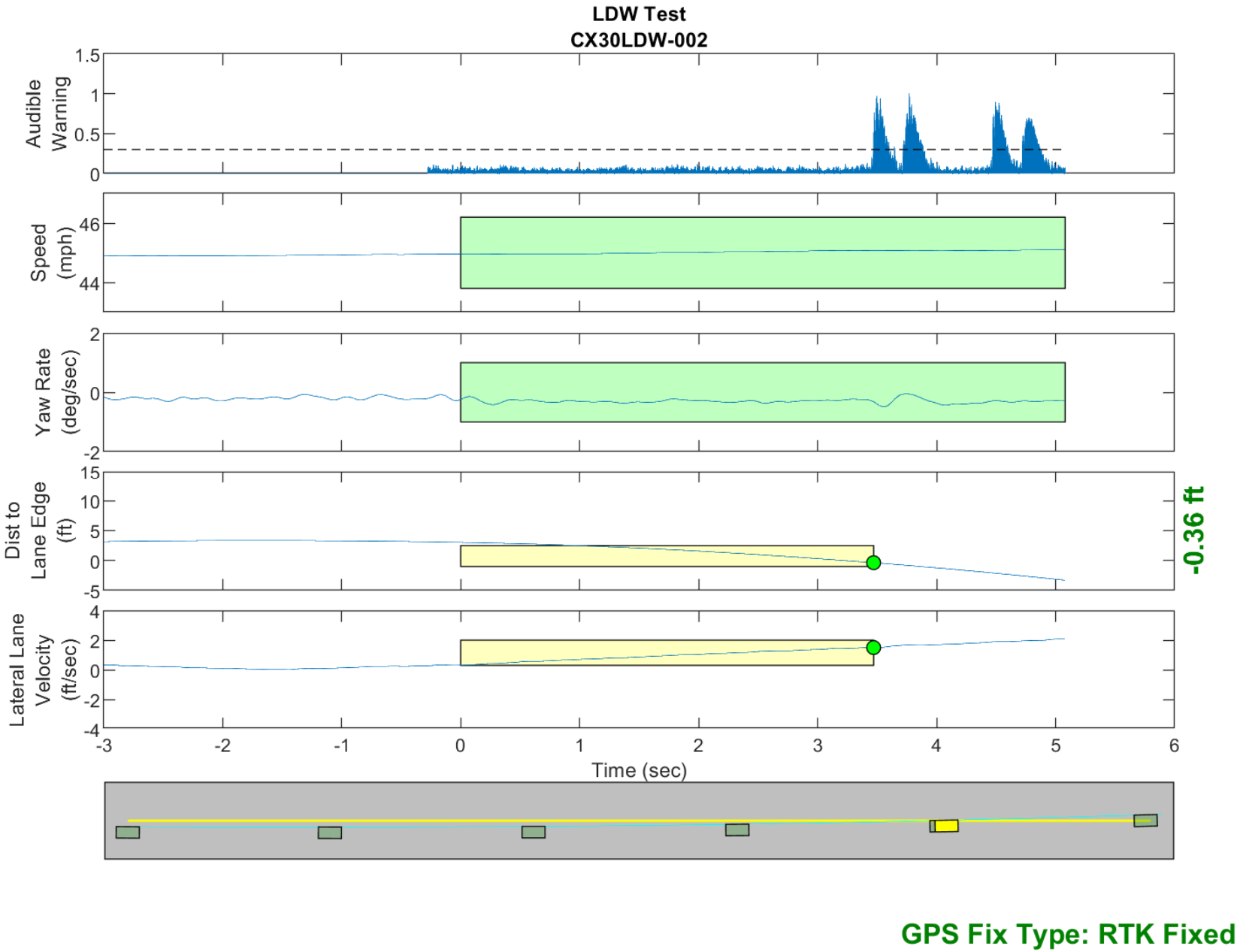


Figure D4. Time History for Run 02, Botts Dots, Left Departure, Audible Warning

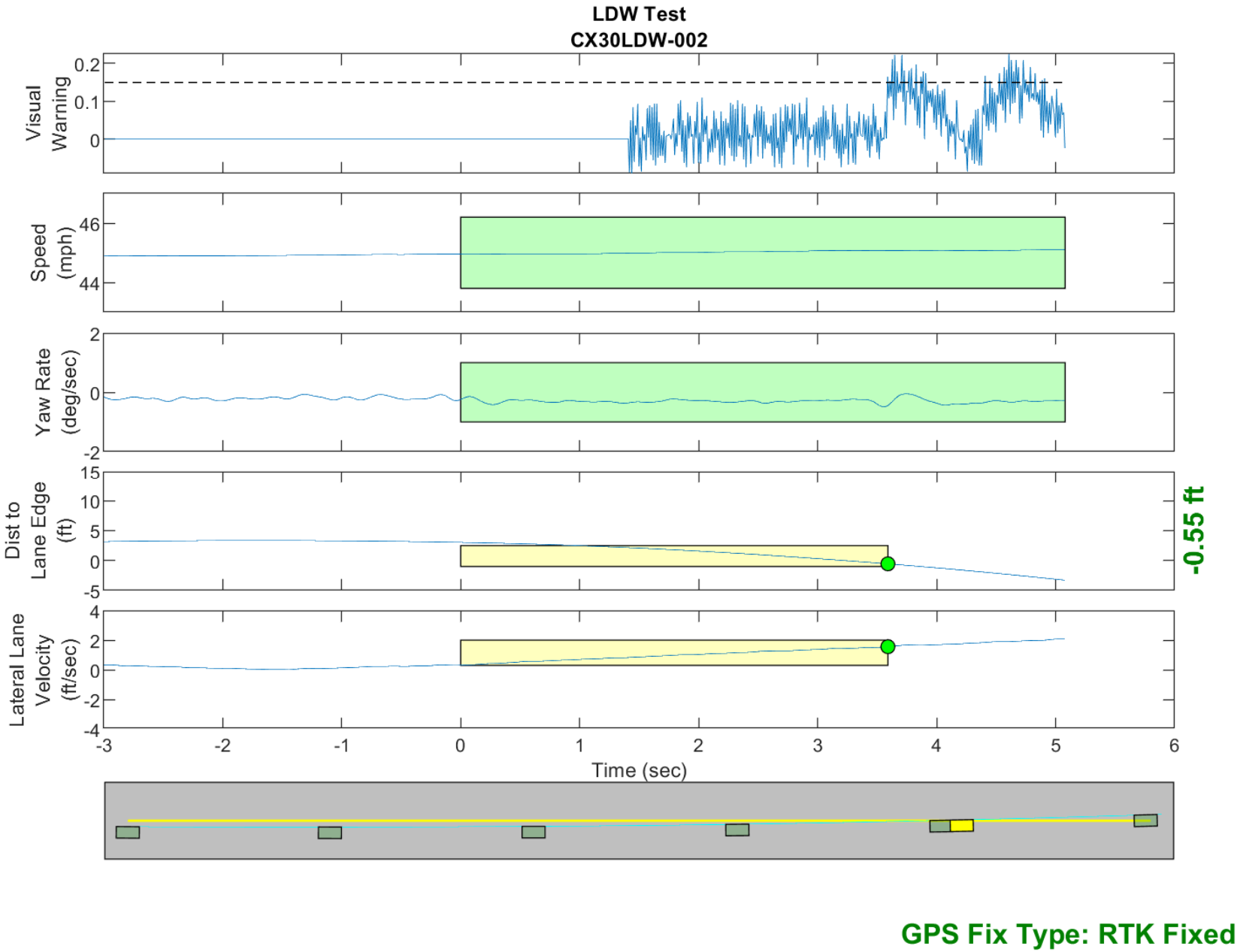


Figure D5. Time History for Run 02, Botts Dots, Left Departure, Visual Warning

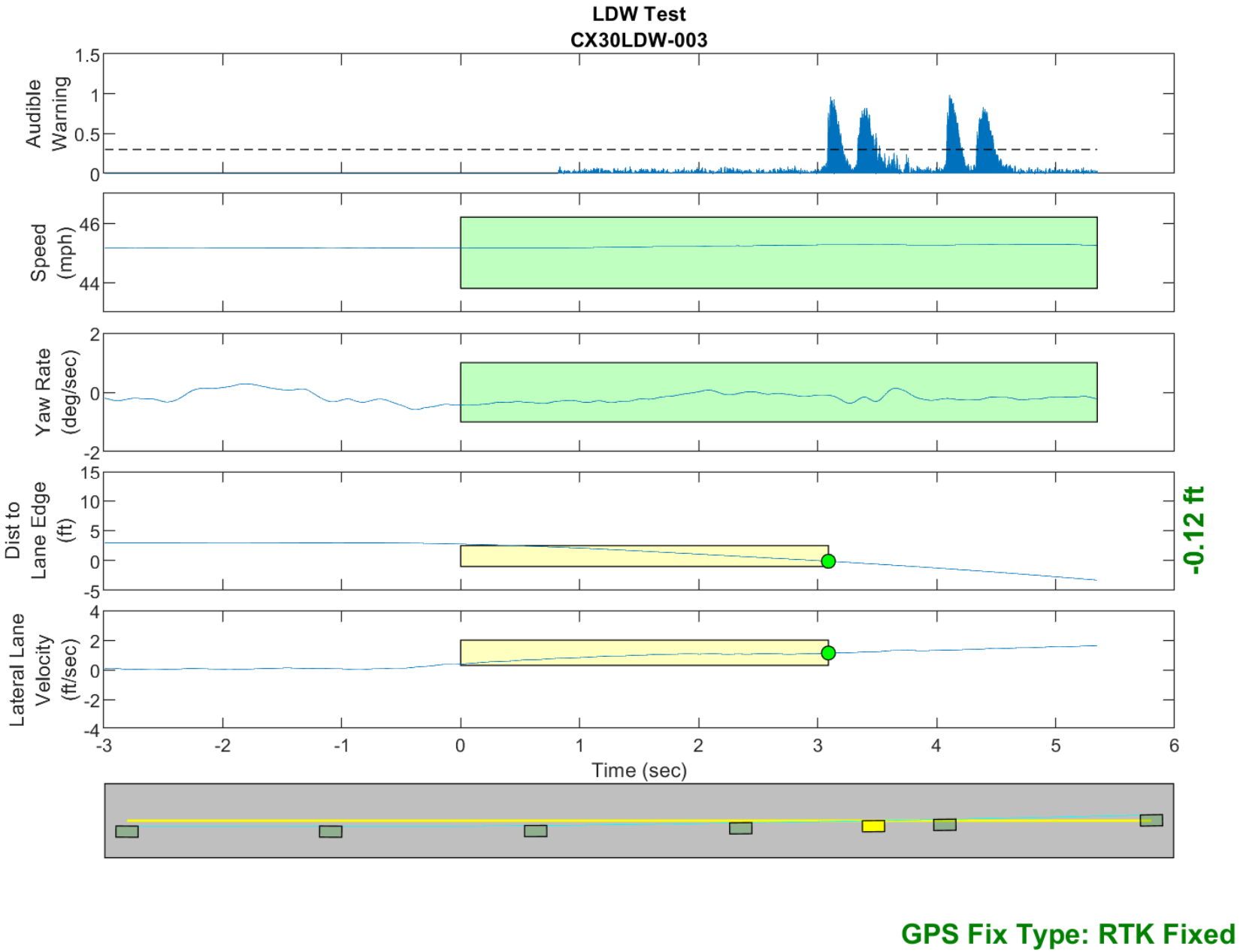


Figure D6. Time History for Run 03, Botts Dots, Left Departure, Audible Warning

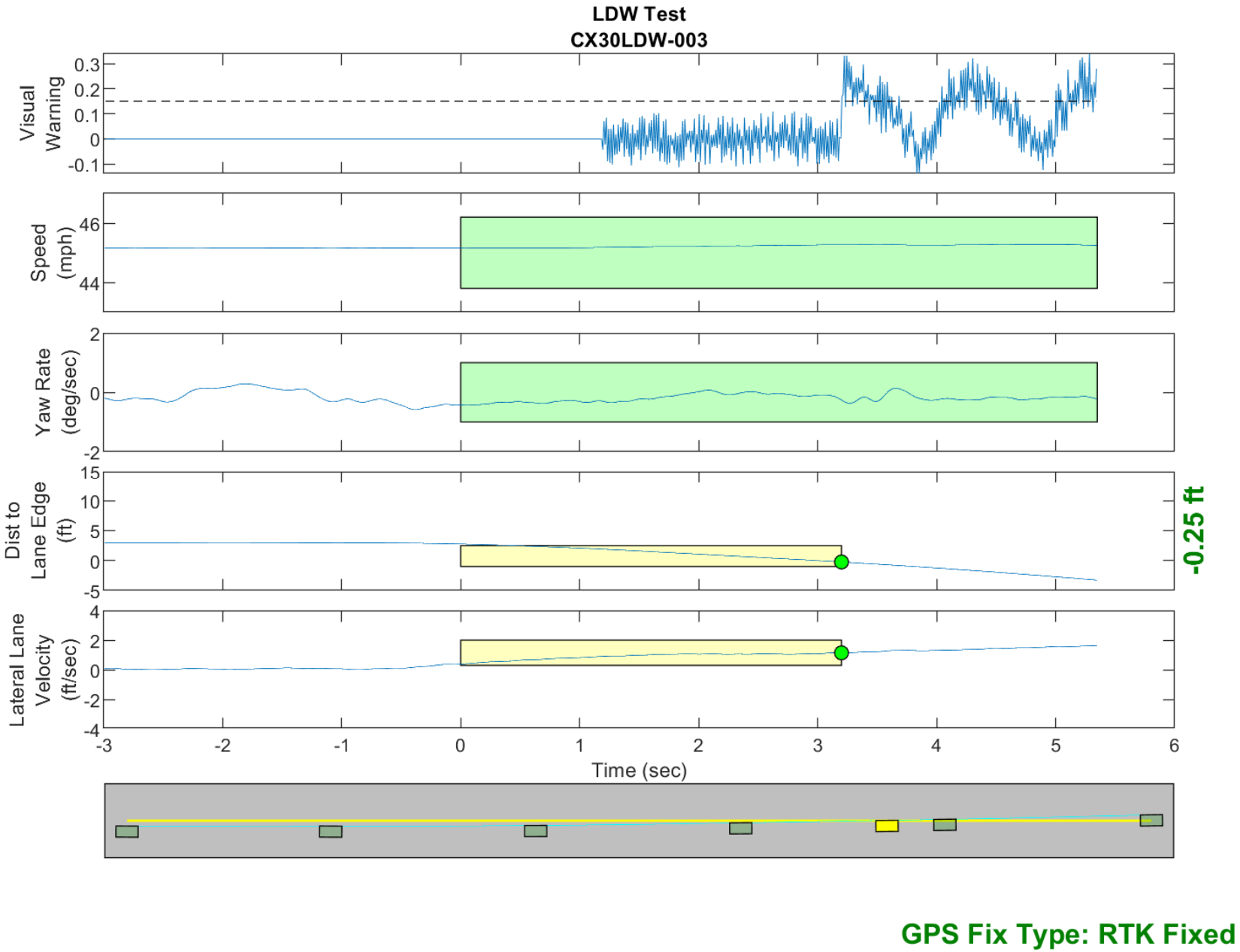


Figure D7. Time History for Run 03, Botts Dots, Left Departure, Visual Warning

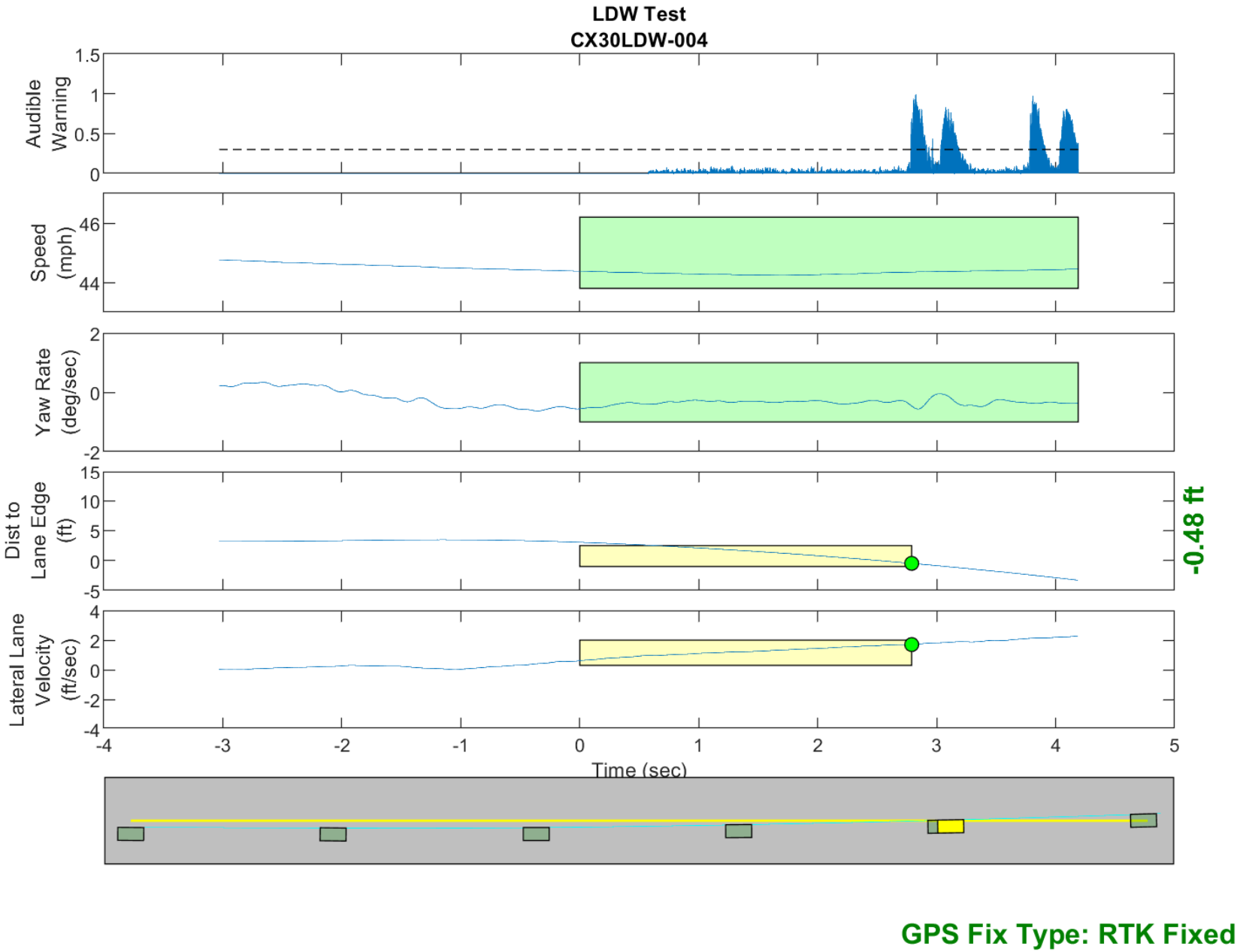


Figure D8. Time History for Run 04, Botts Dots, Left Departure, Audible Warning

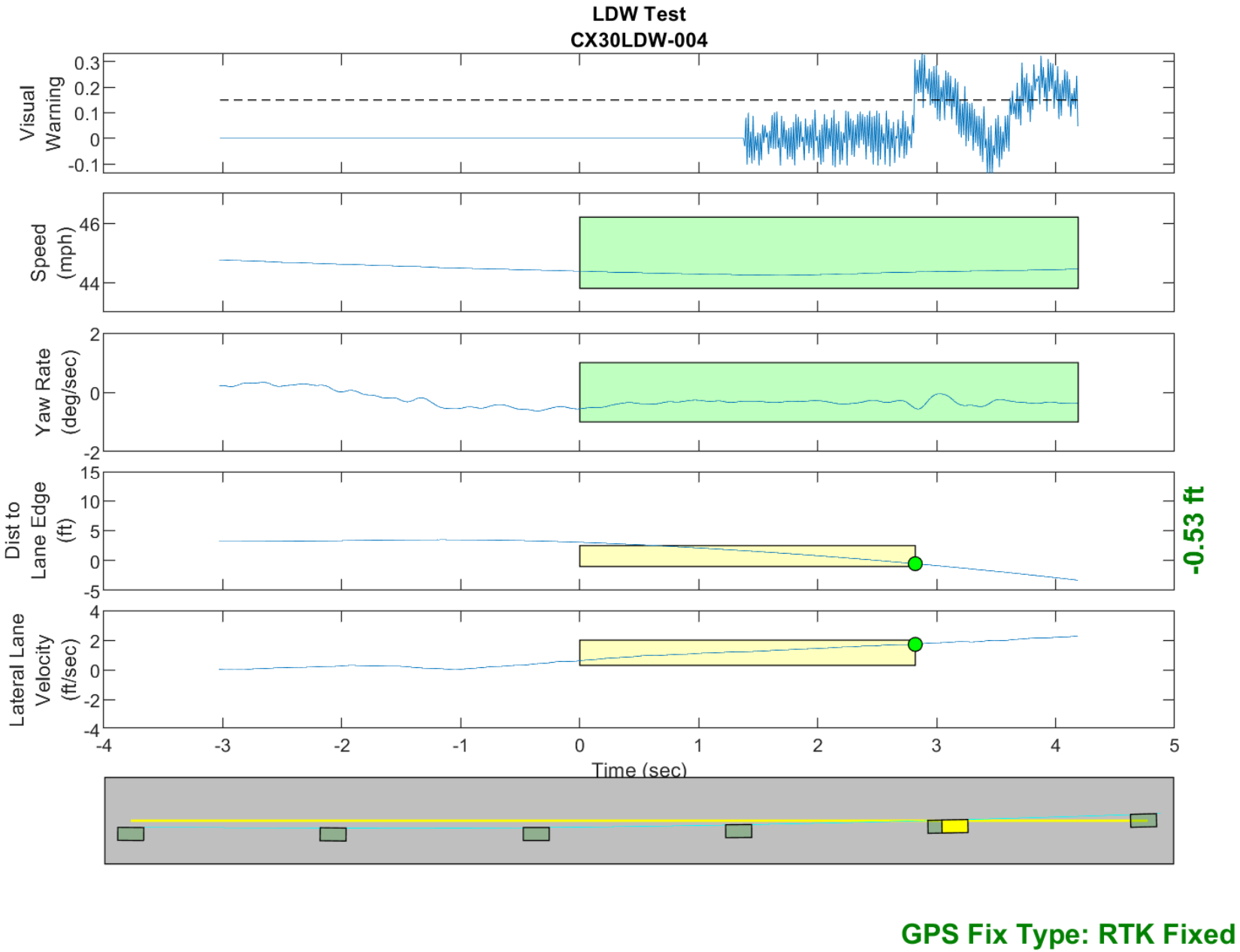


Figure D9. Time History for Run 04, Botts Dots, Left Departure, Visual Warning

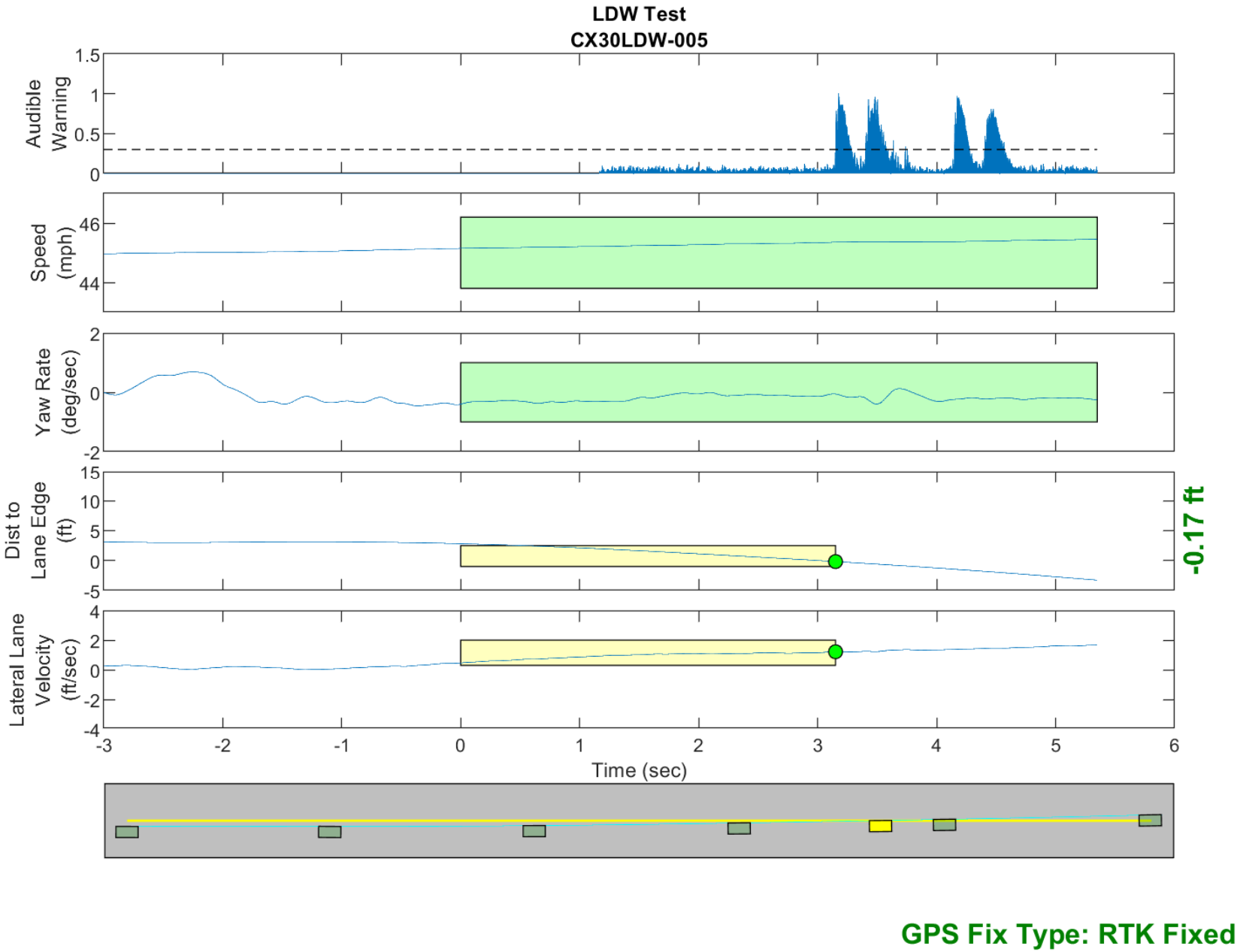


Figure D10. Time History for Run 05, Botts Dots, Left Departure, Audible Warning

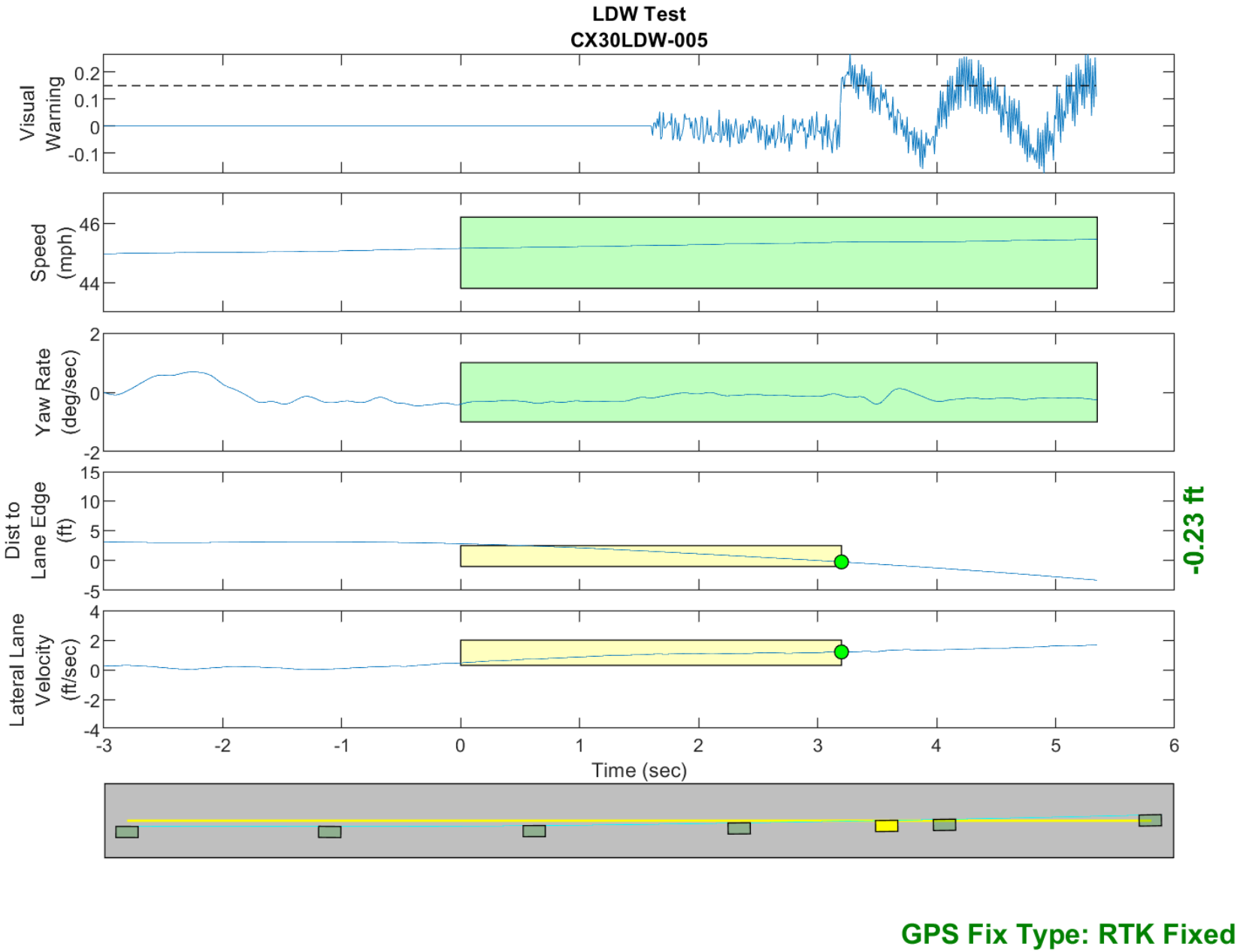


Figure D11. Time History for Run 05, Botts Dots, Left Departure, Visual Warning

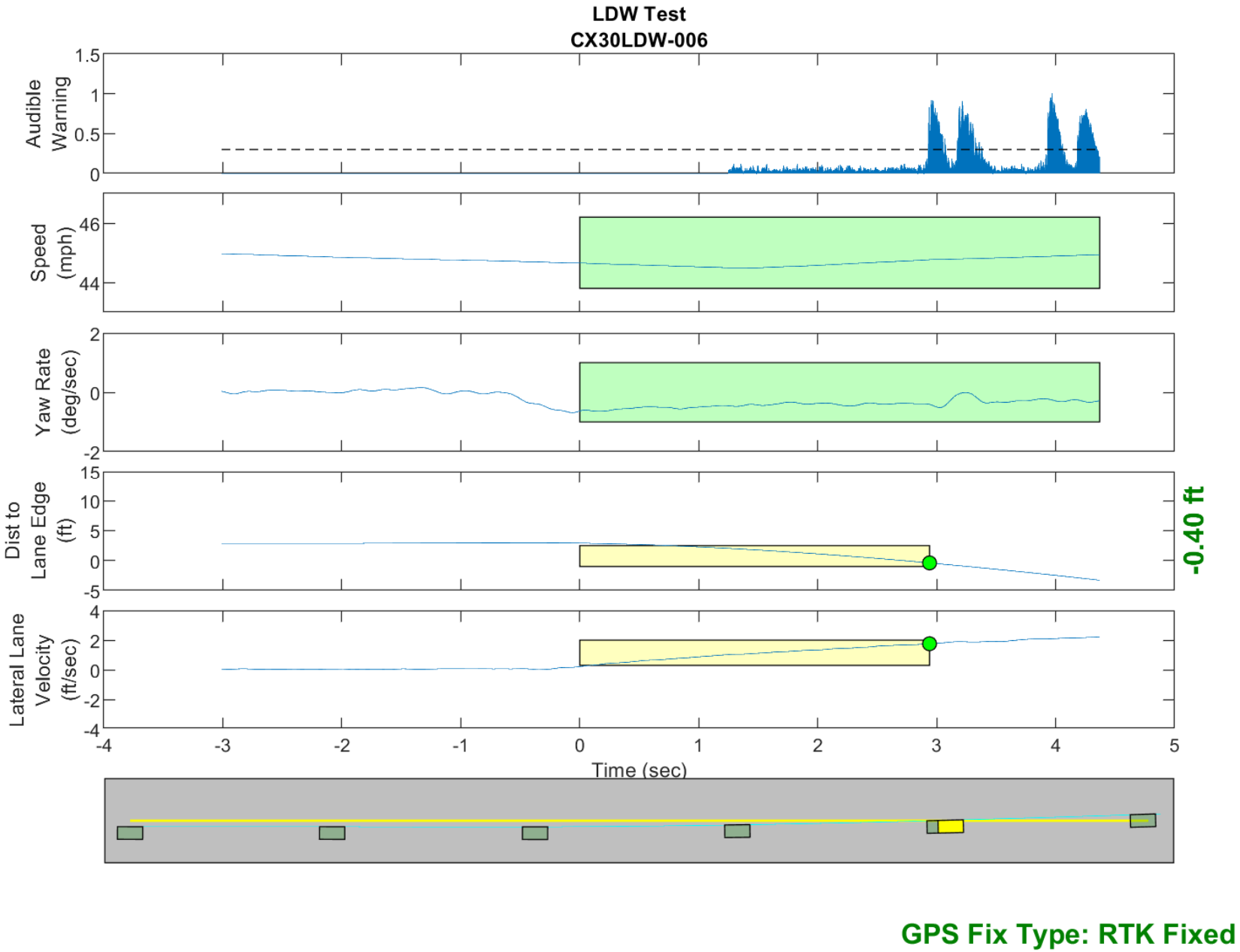


Figure D12. Time History for Run 06, Botts Dots, Left Departure, Audible Warning

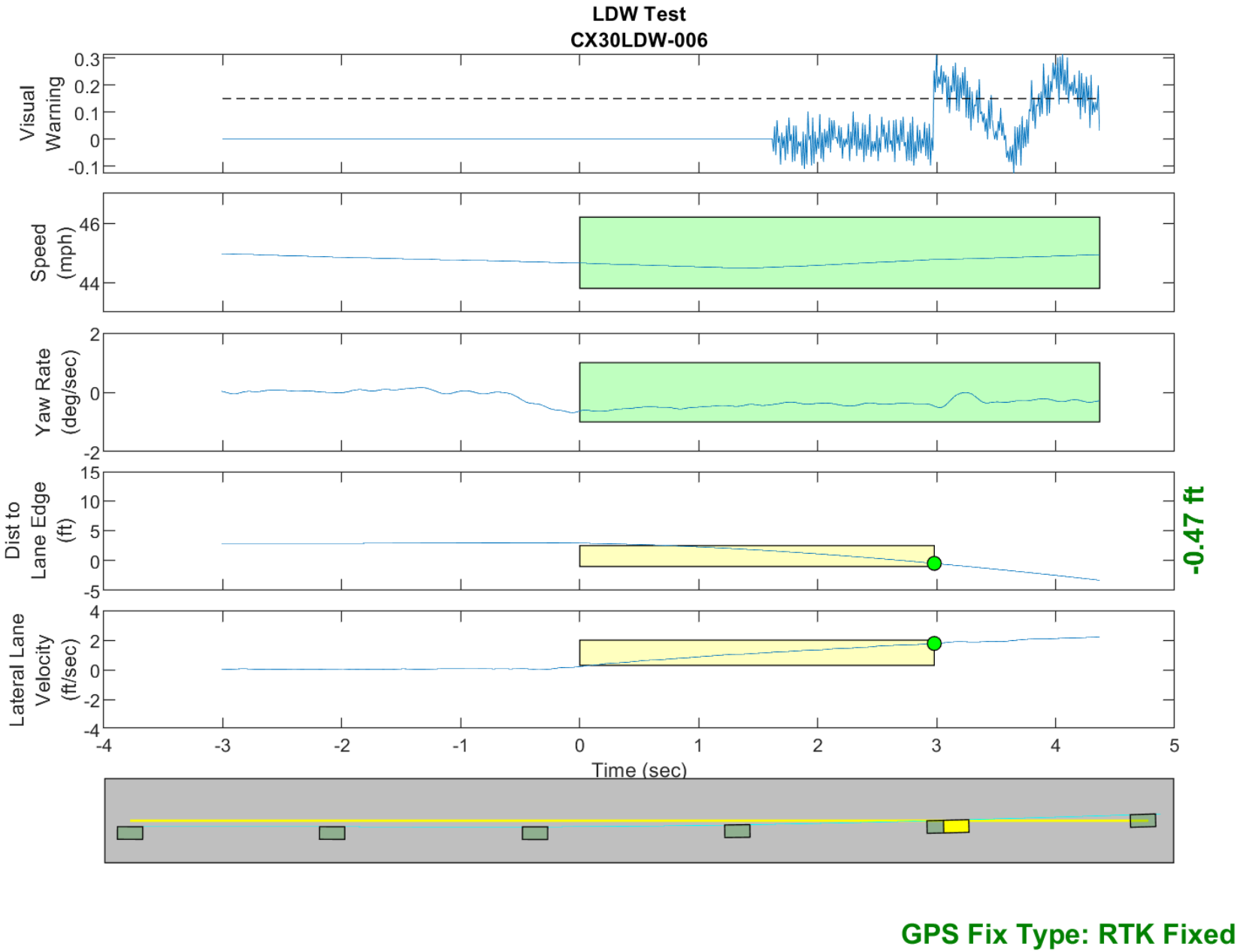


Figure D13. Time History for Run 06, Botts Dots, Left Departure, Visual Warning

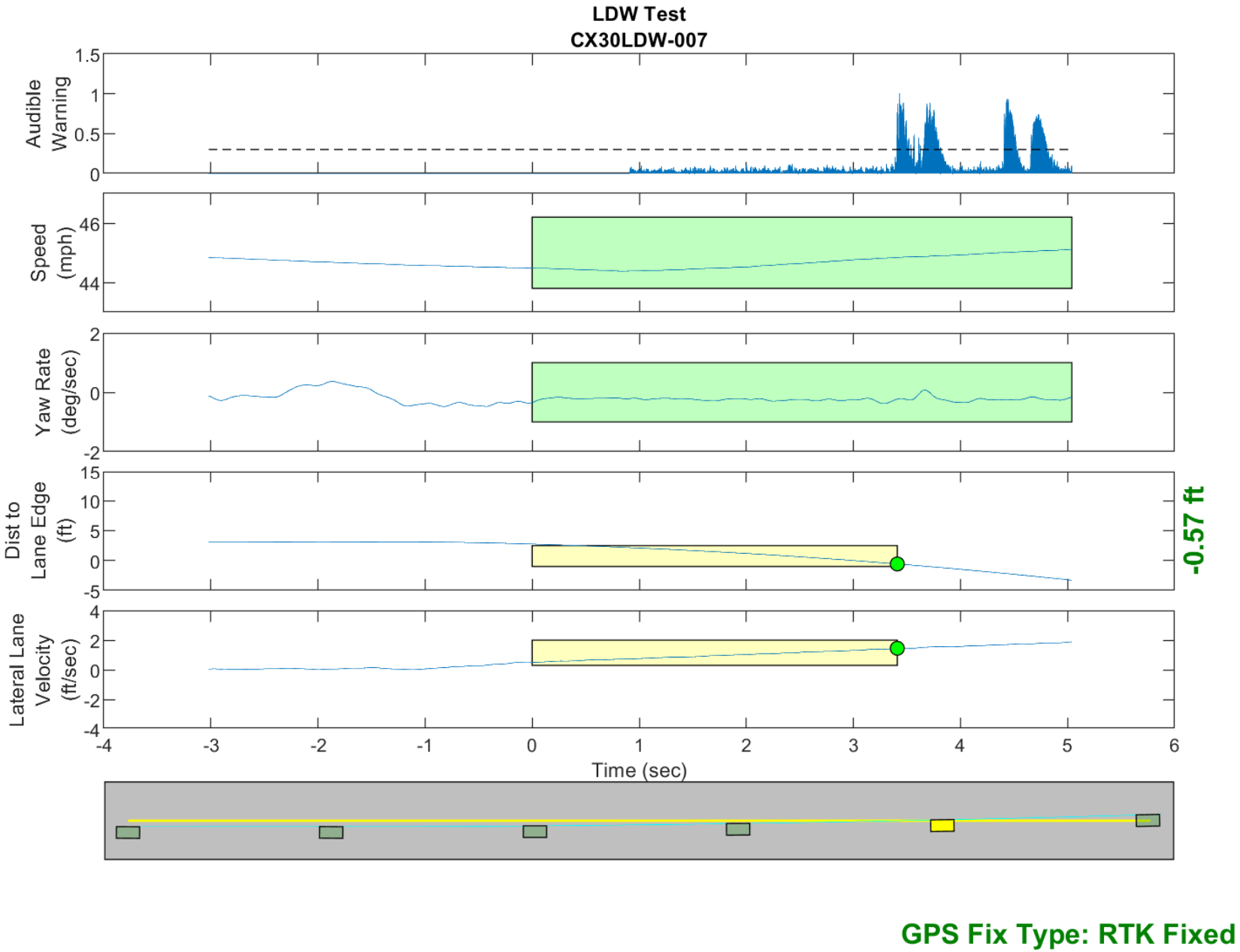


Figure D14. Time History for Run 07, Botts Dots, Left Departure, Audible Warning

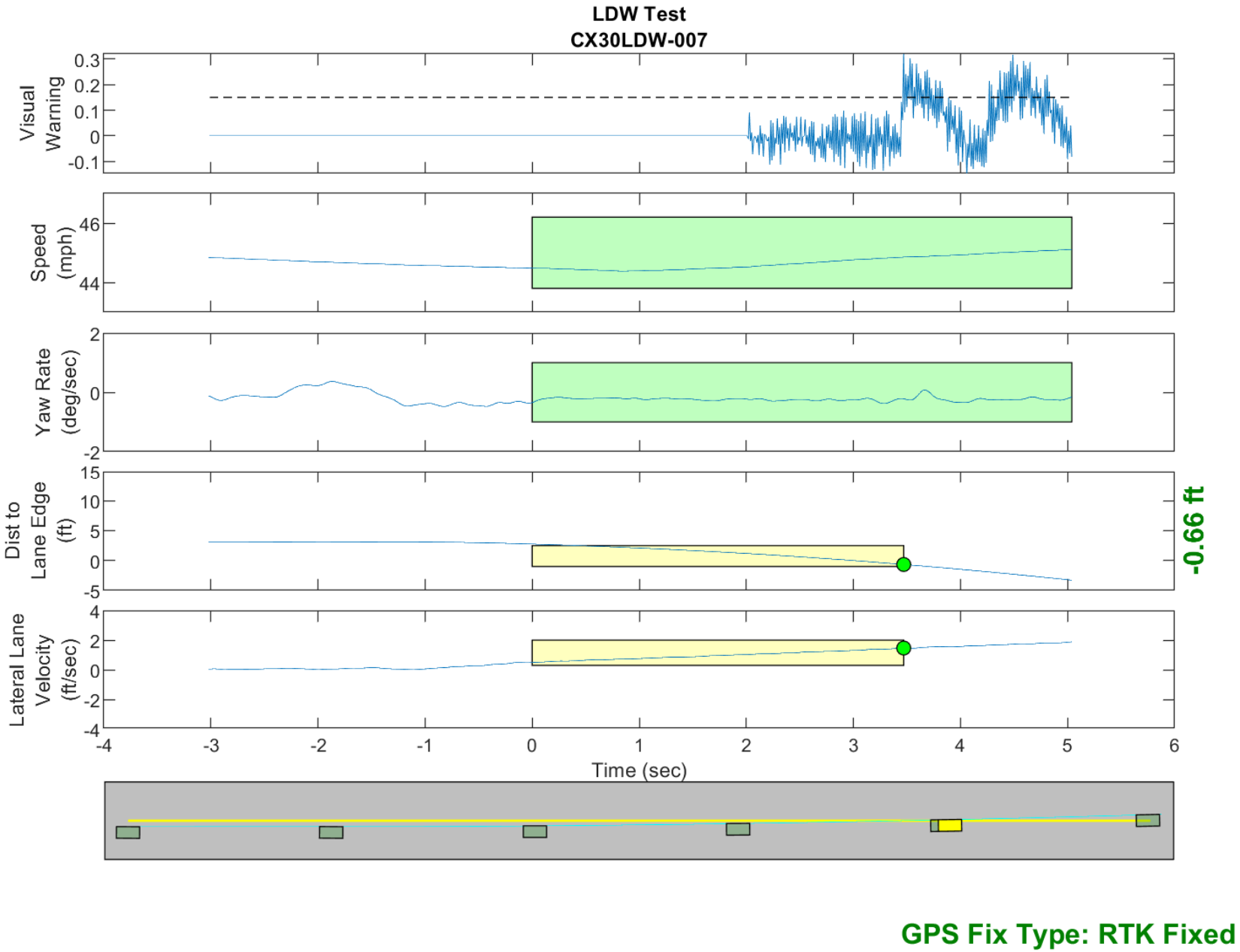


Figure D15. Time History for Run 07, Botts Dots, Left Departure, Visual Warning

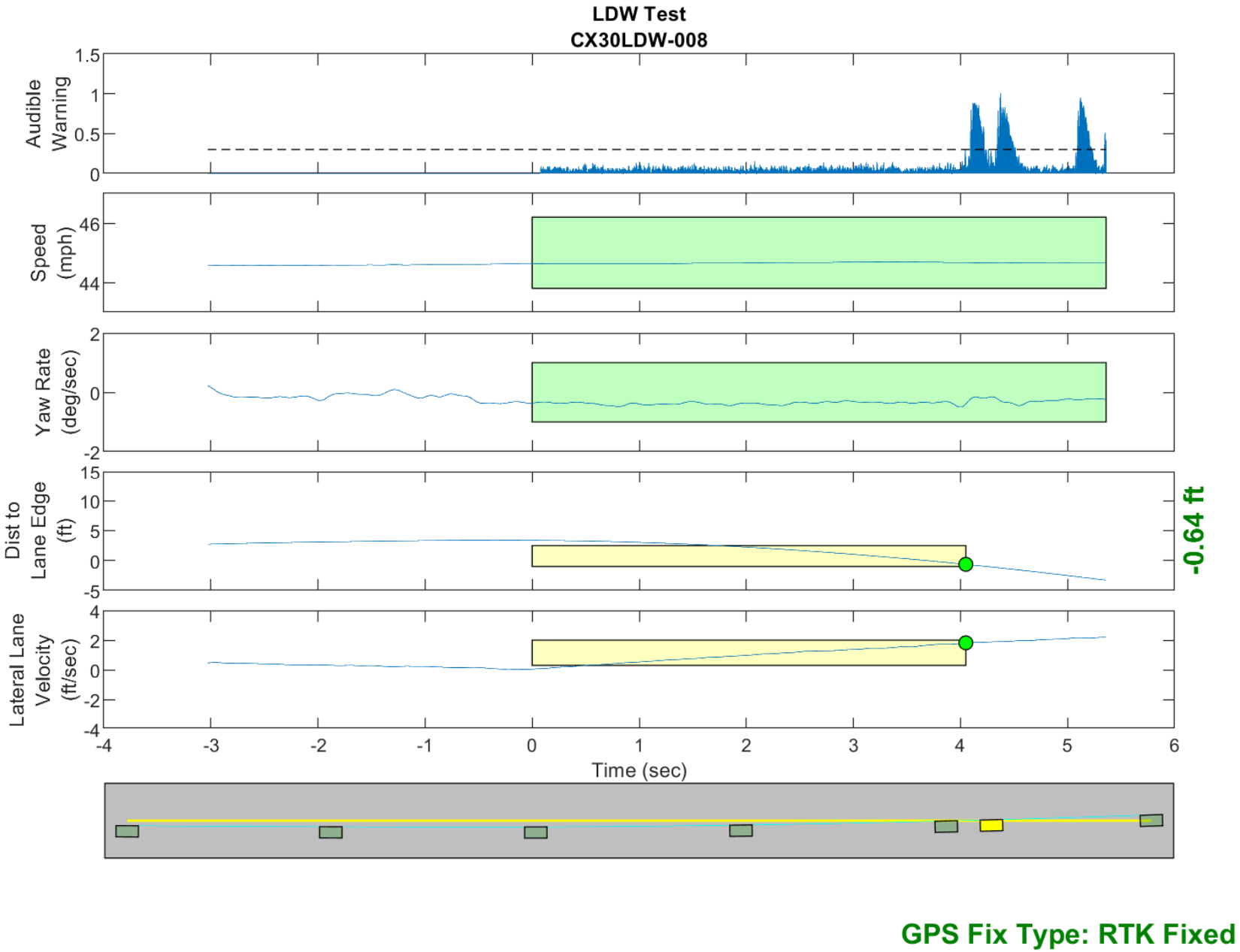


Figure D16. Time History for Run 08, Botts Dots, Left Departure, Audible Warning

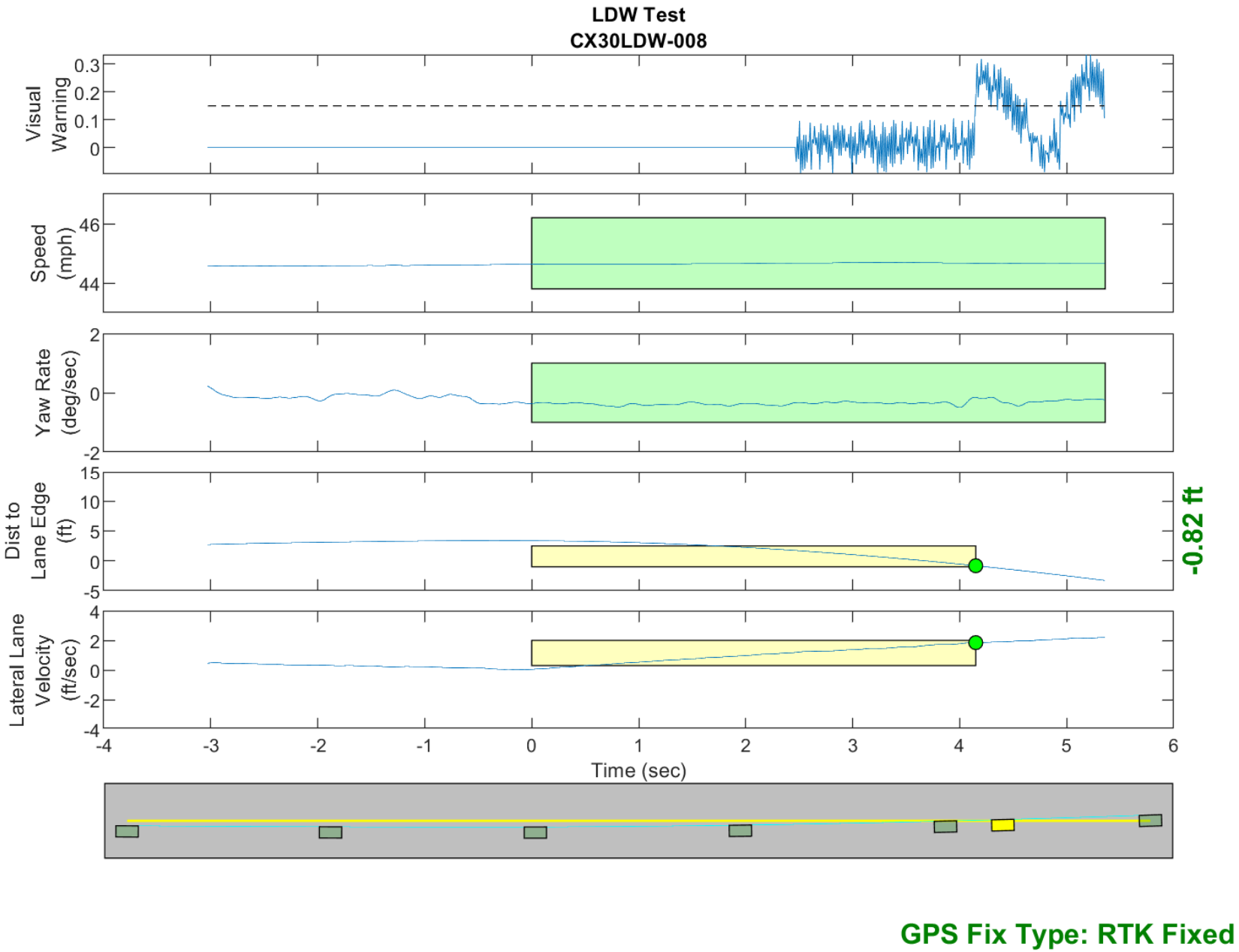


Figure D17. Time History for Run 08, Botts Dots, Left Departure, Visual Warning

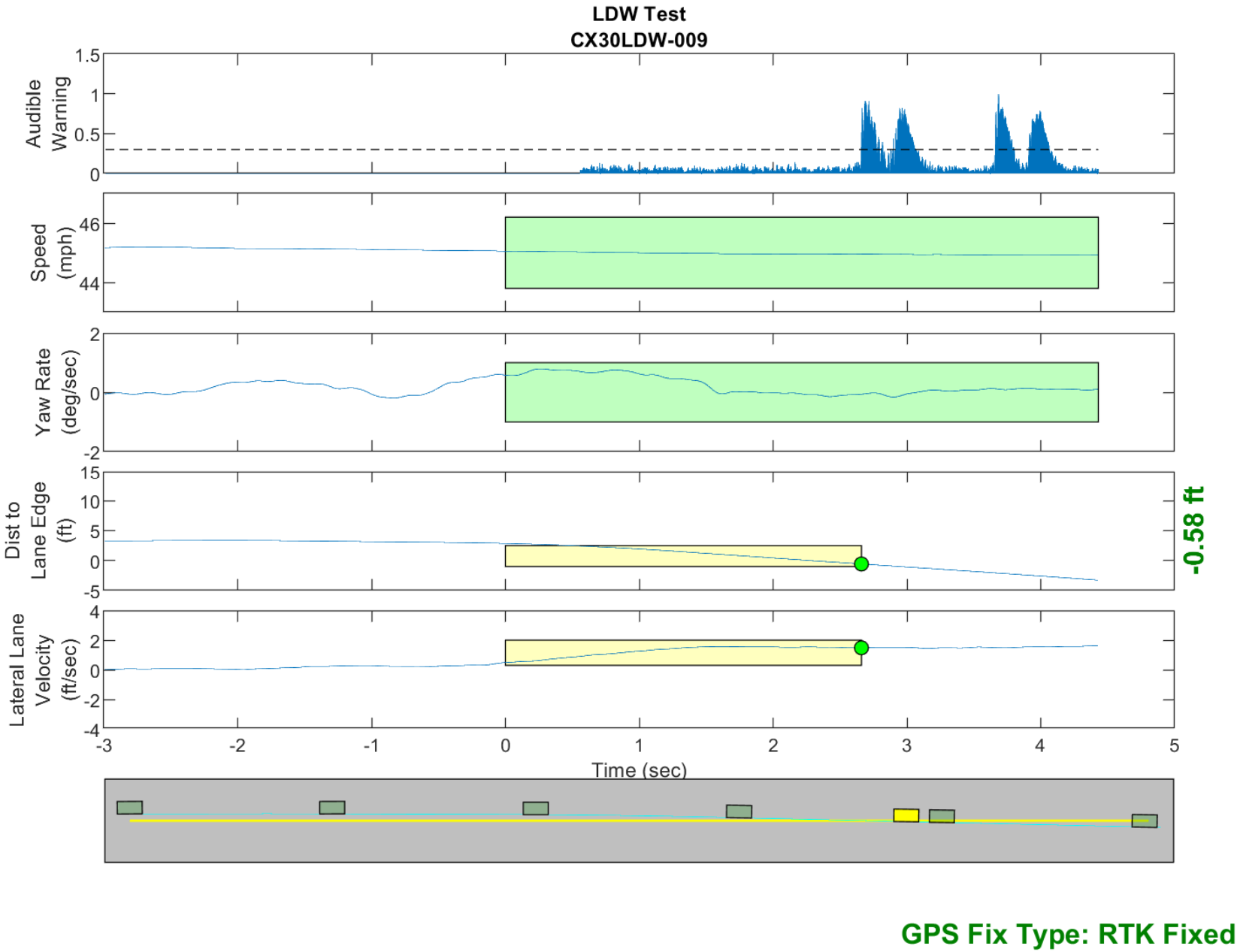


Figure D18. Time History for Run 09, Botts Dots, Right Departure, Audible Warning

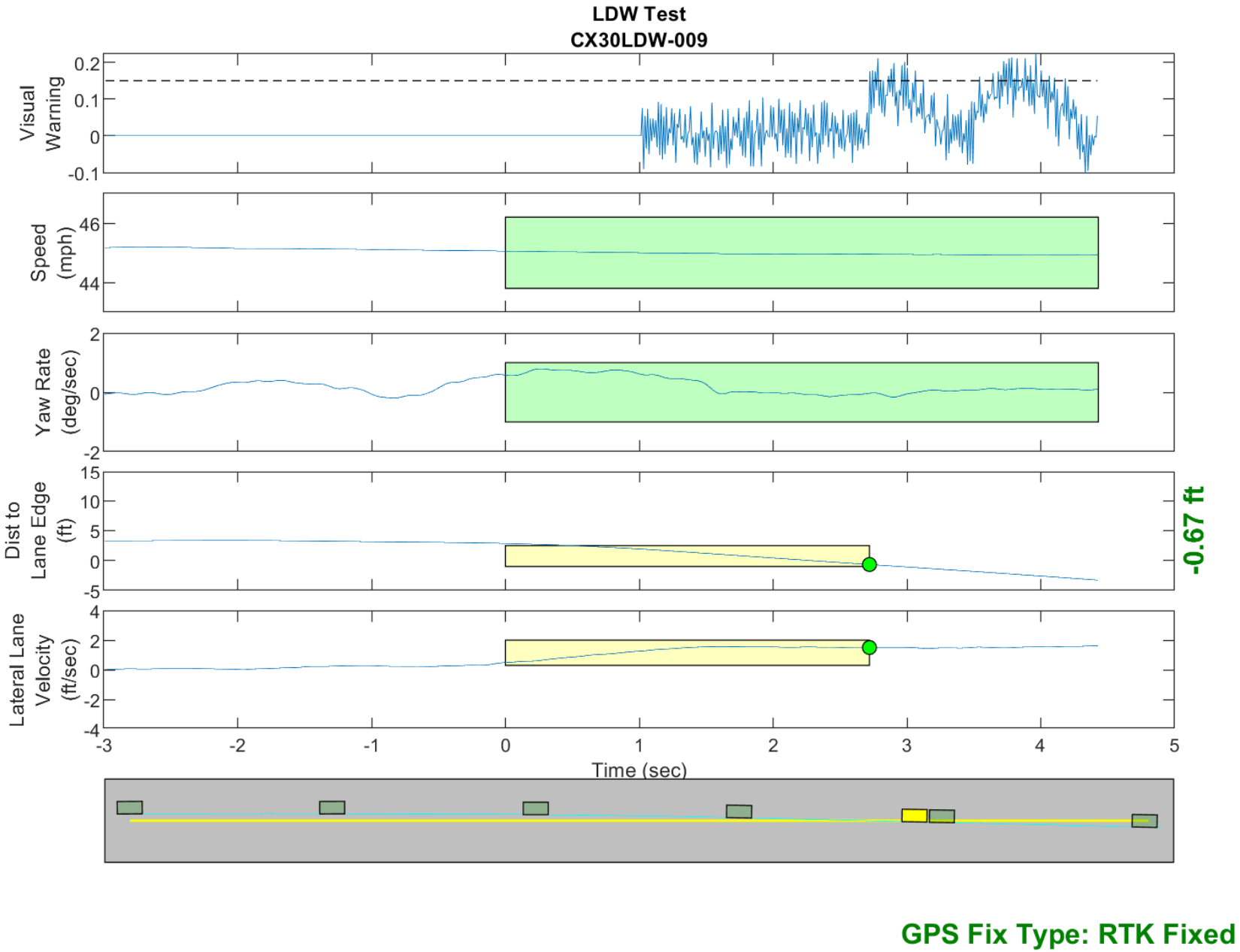


Figure D19. Time History for Run 09, Botts Dots, Right Departure, Visual Warning

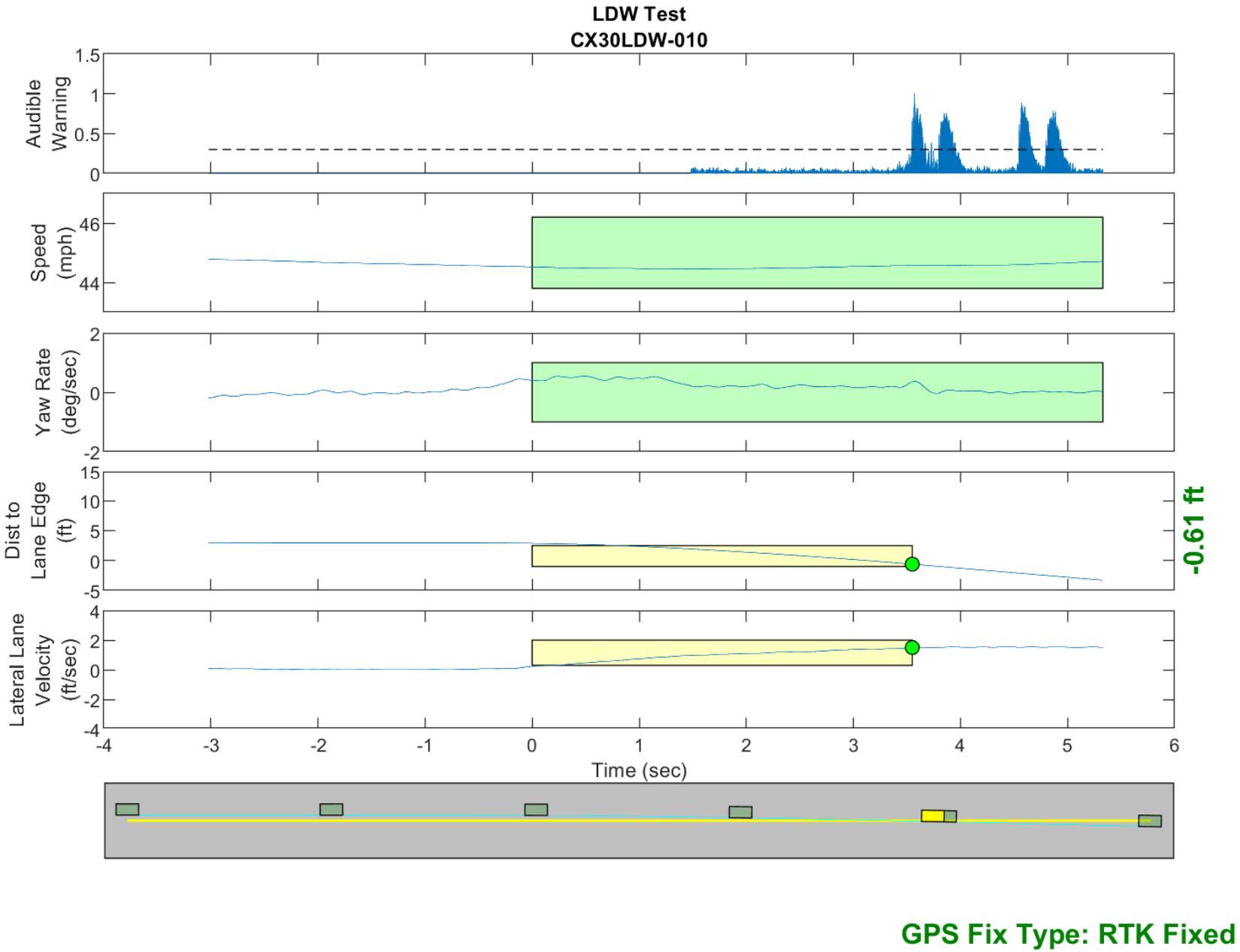


Figure D20. Time History for Run 10, Botts Dots, Right Departure, Audible Warning

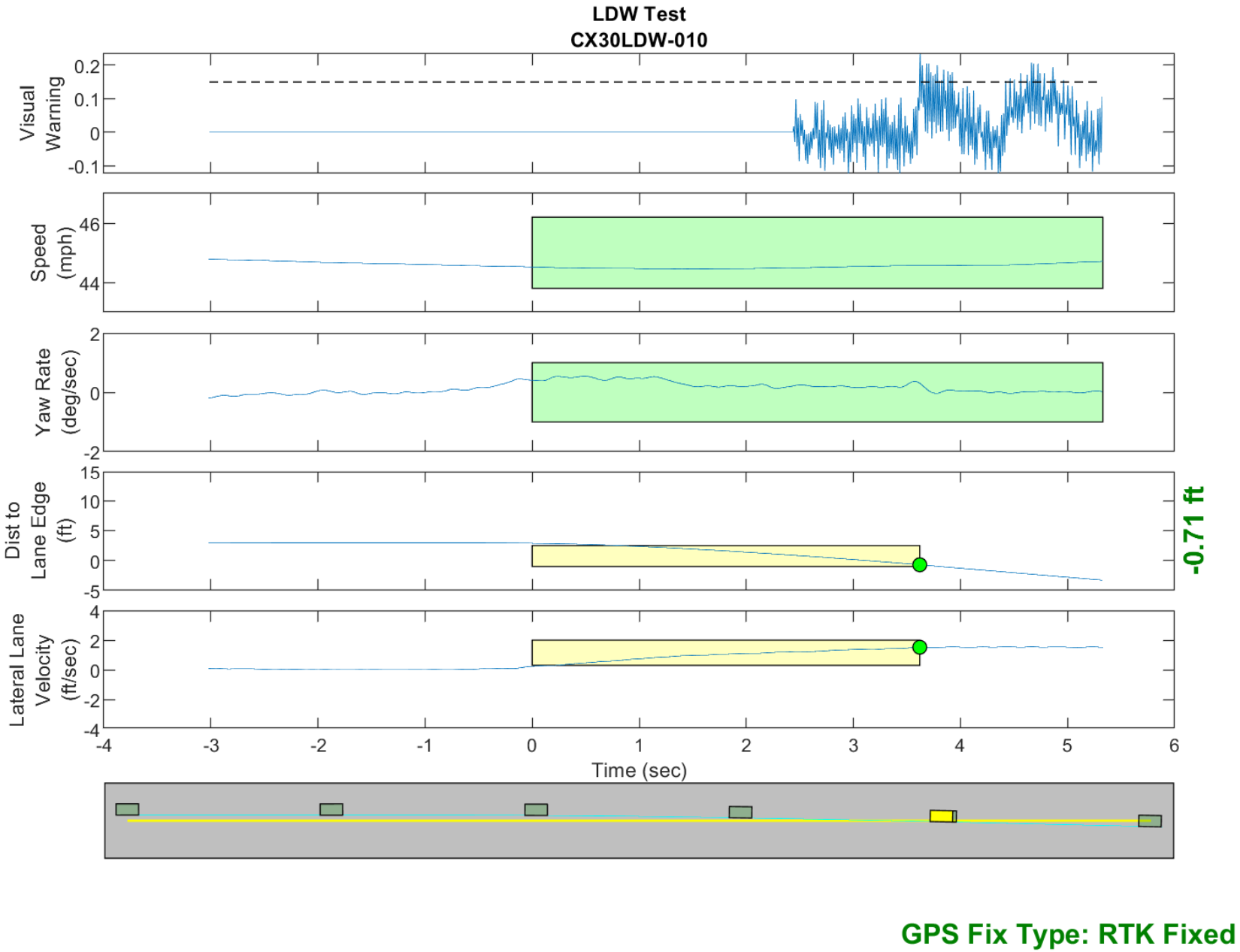


Figure D21. Time History for Run 10, Botts Dots, Right Departure, Visual Warning

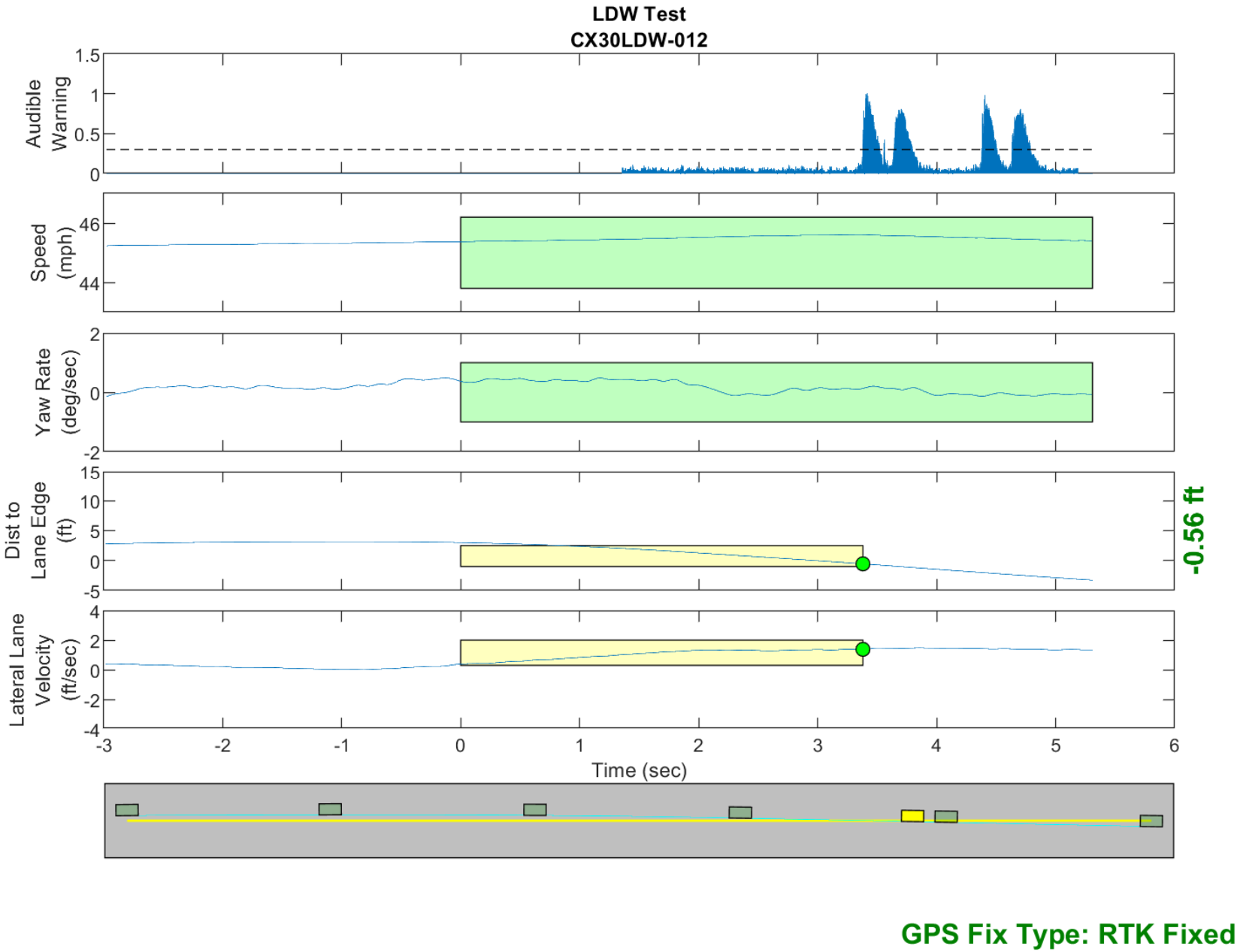


Figure D22. Time History for Run 12, Botts Dots, Right Departure, Audible Warning

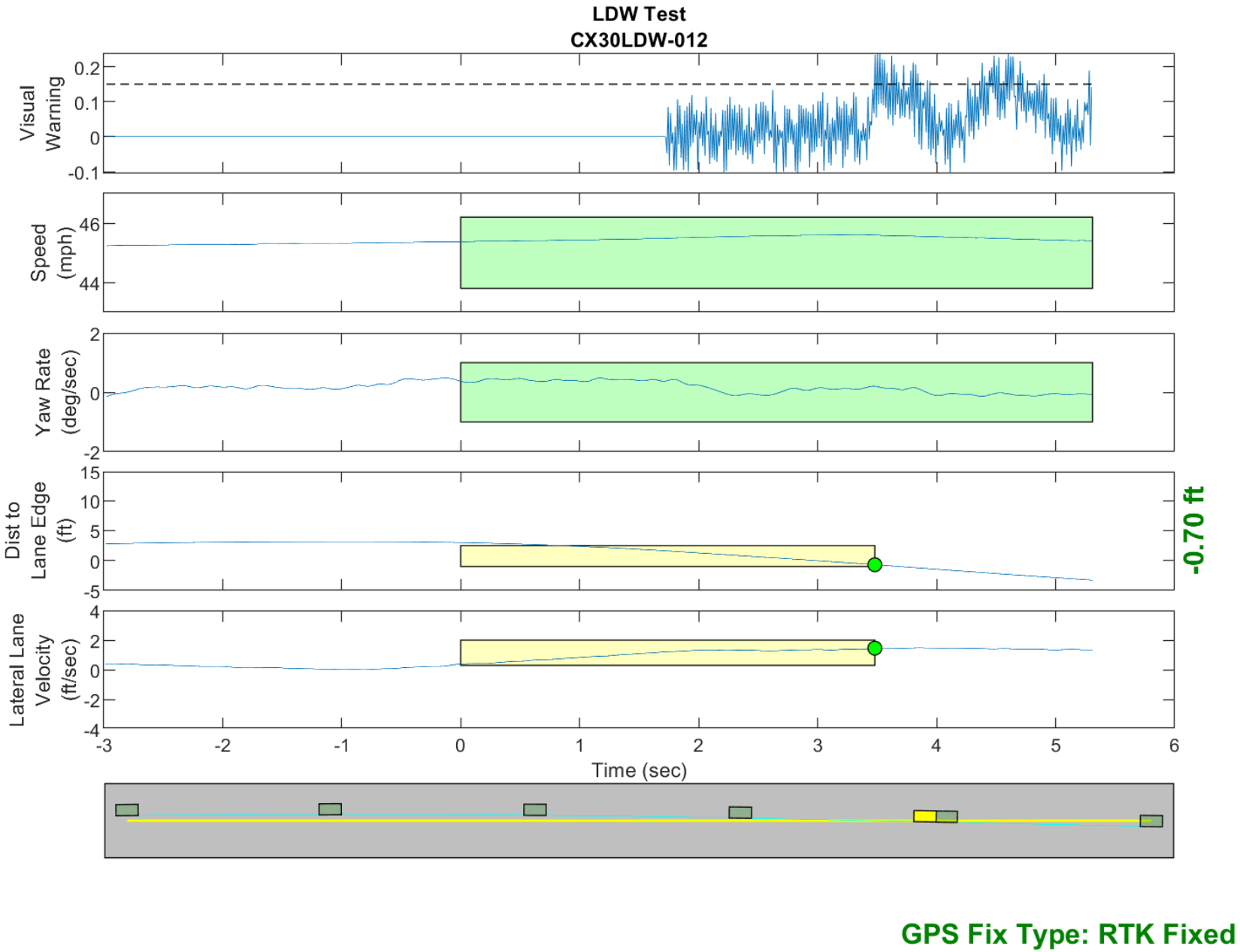


Figure D23. Time History for Run 12, Botts Dots, Right Departure, Visual Warning

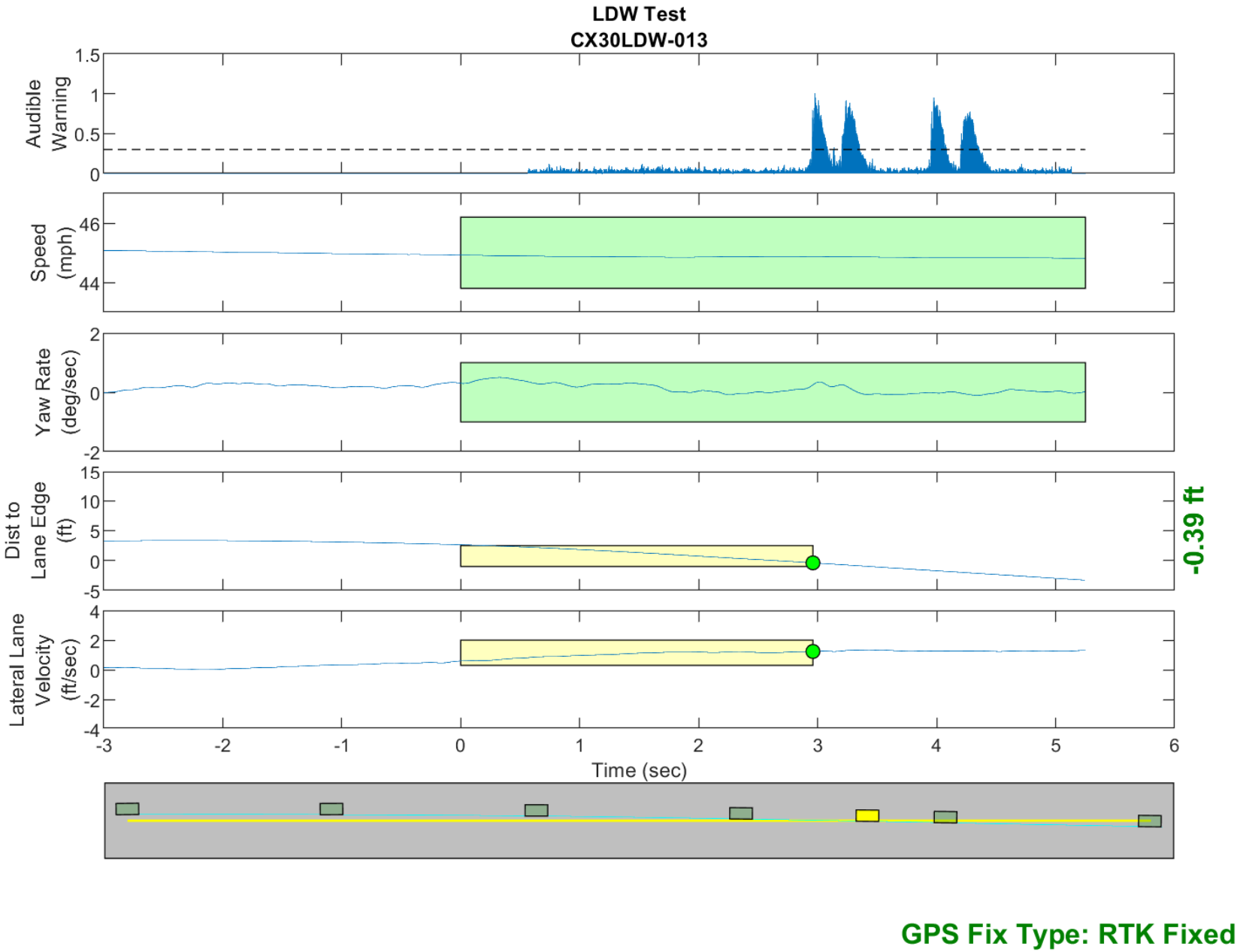


Figure D24. Time History for Run 13, Botts Dots, Right Departure, Audible Warning

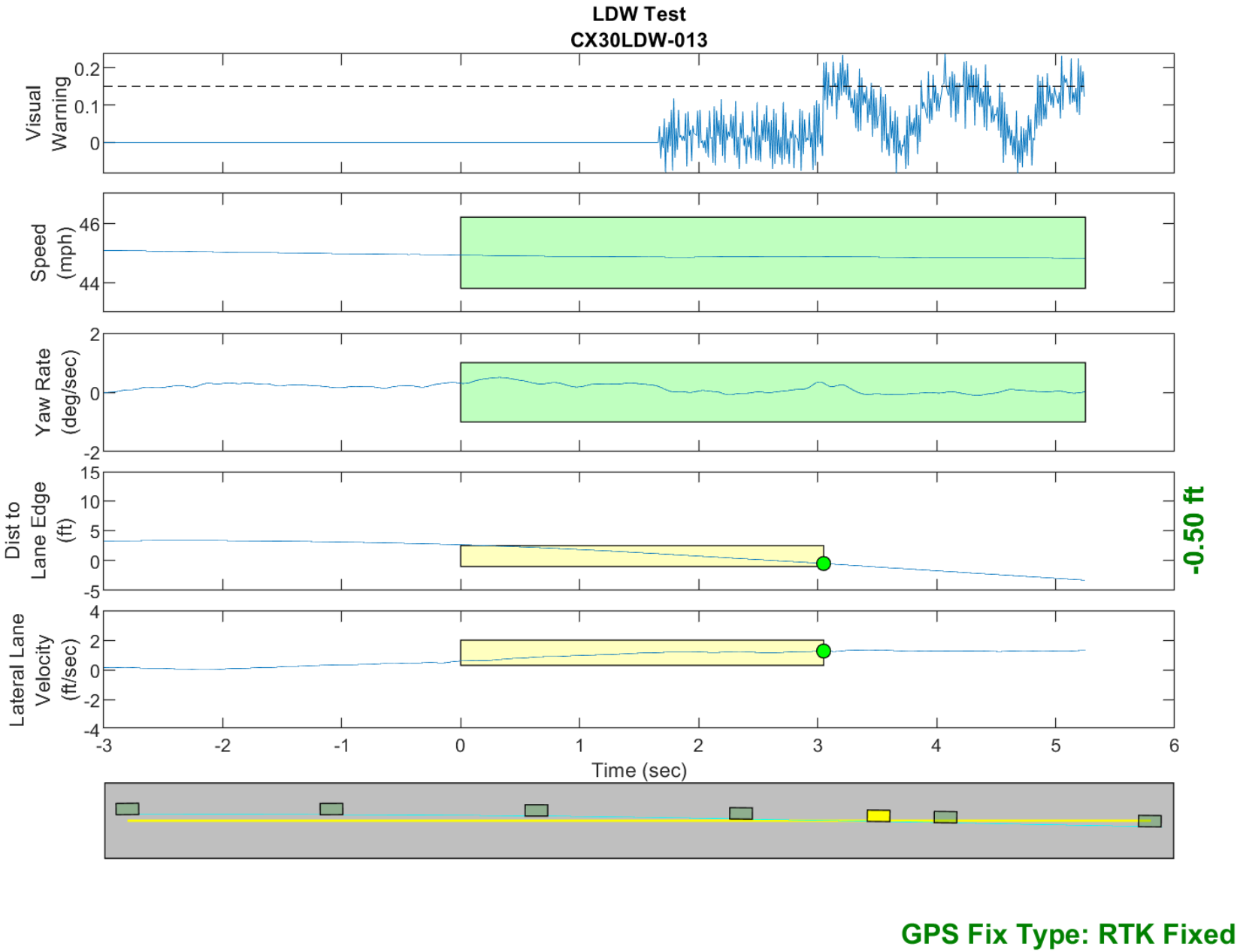


Figure D25. Time History for Run 13, Botts Dots, Right Departure, Visual Warning

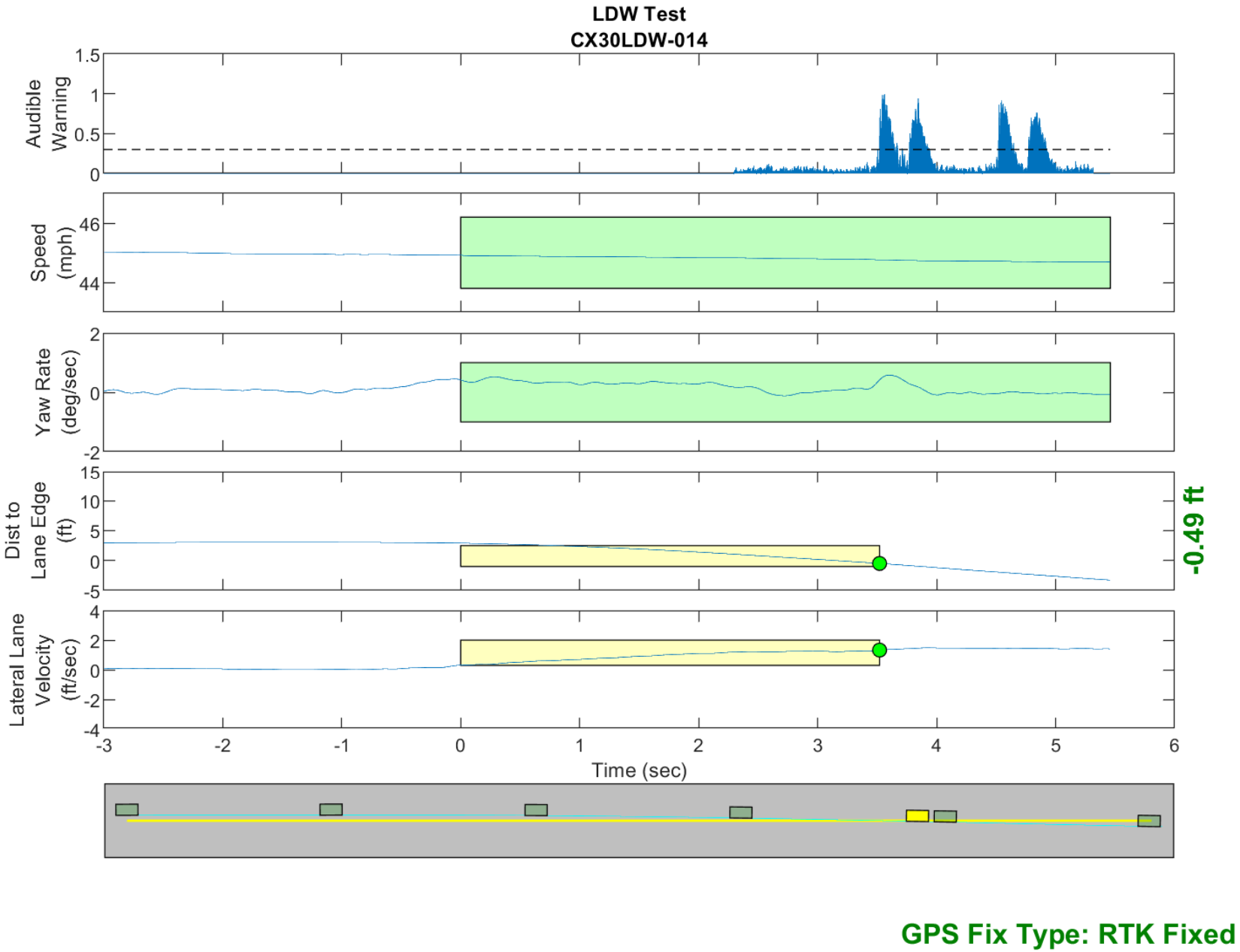


Figure D26. Time History for Run 14, Botts Dots, Right Departure, Audible Warning

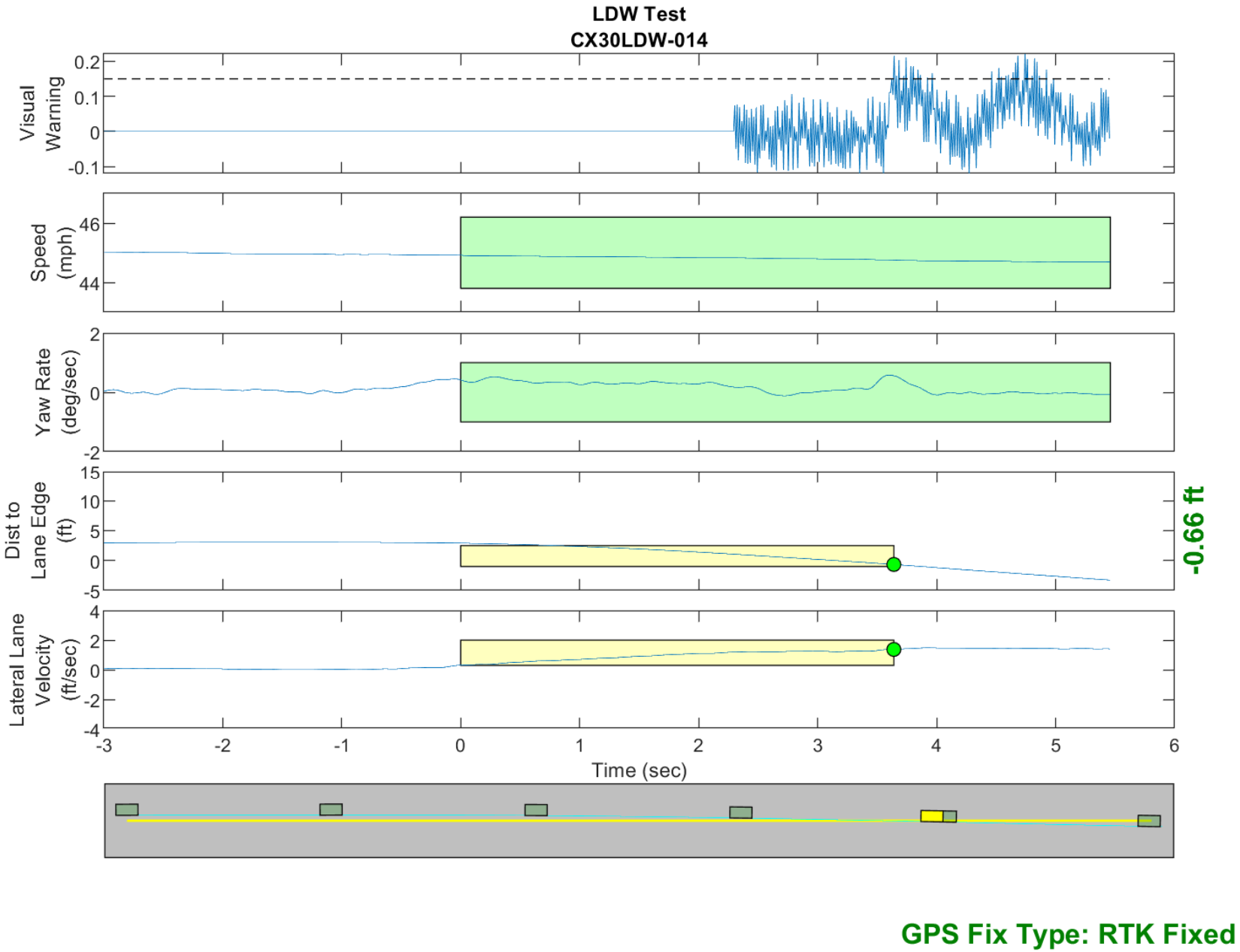


Figure D27. Time History for Run 14, Botts Dots, Right Departure, Visual Warning

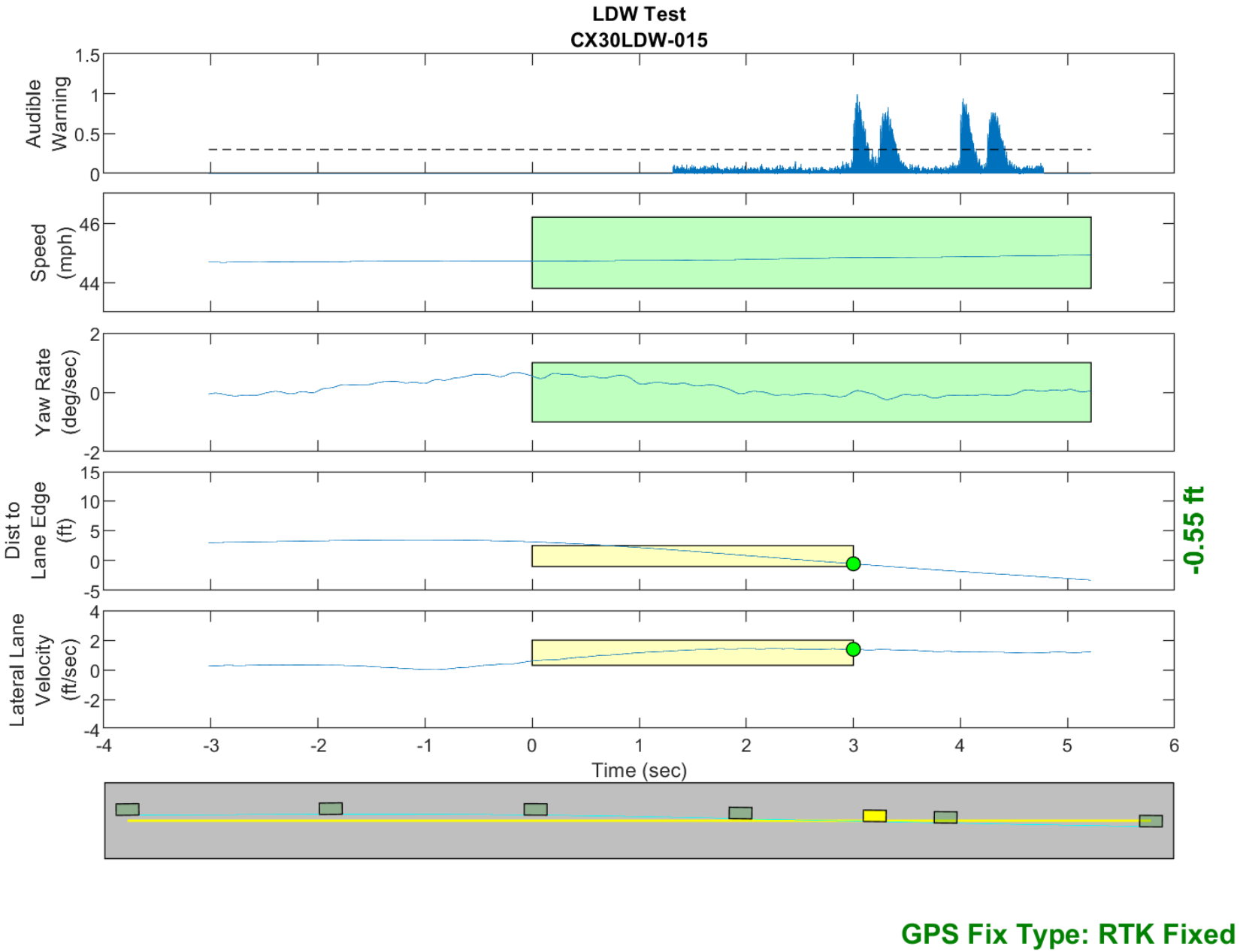


Figure D28. Time History for Run 15, Botts Dots, Right Departure, Audible Warning

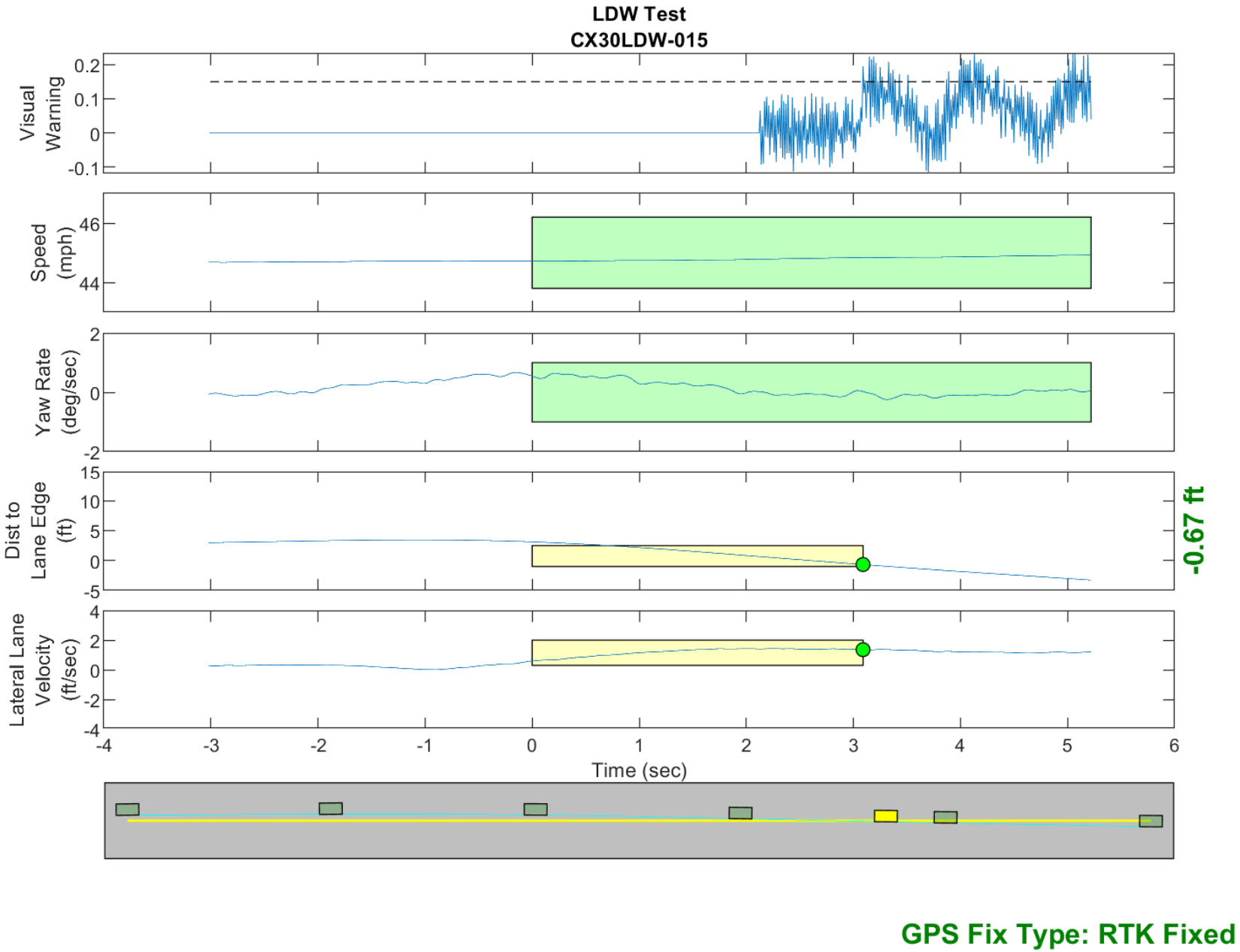


Figure D29. Time History for Run 15, Botts Dots, Right Departure, Visual Warning

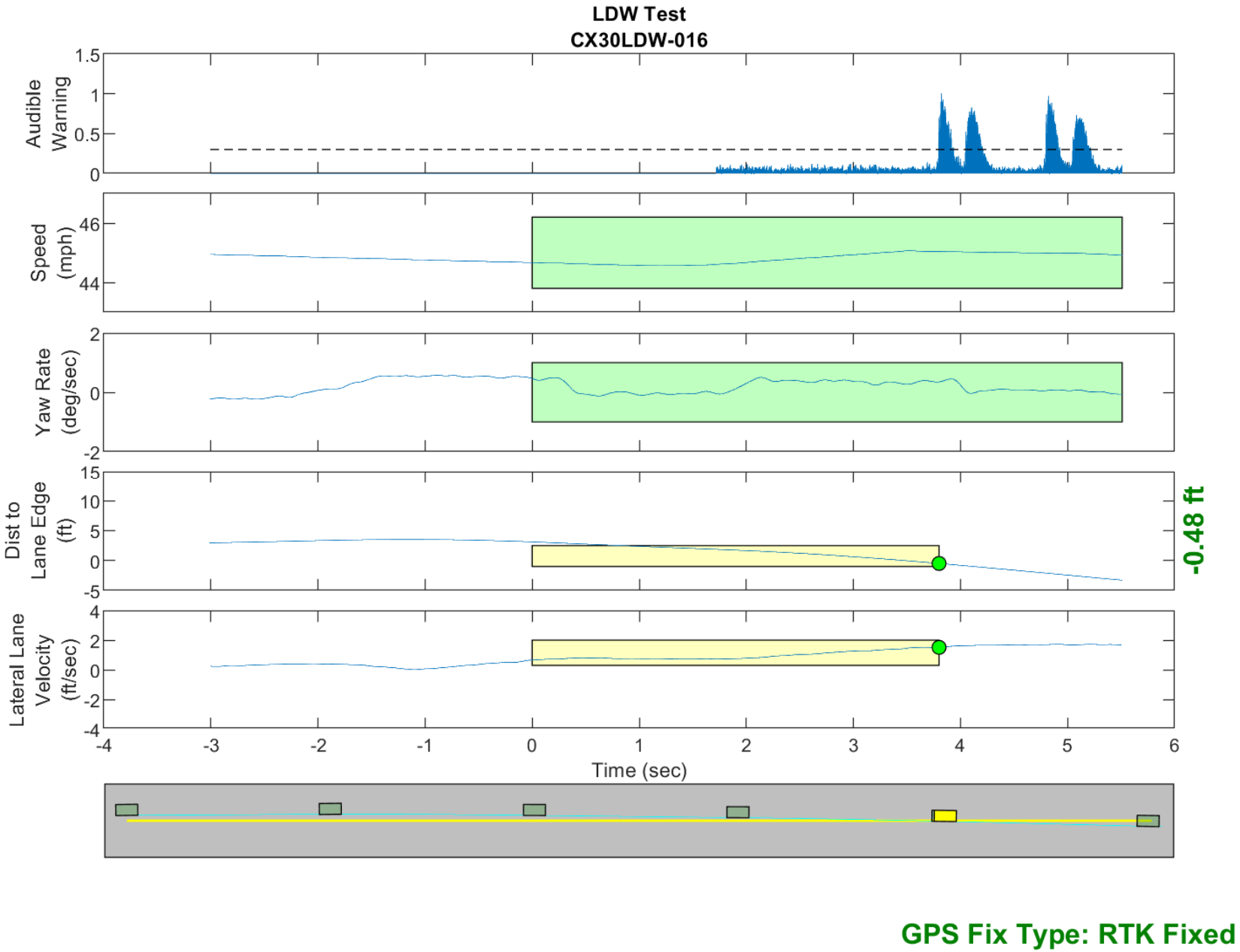


Figure D30. Time History for Run 16, Botts Dots, Right Departure, Audible Warning

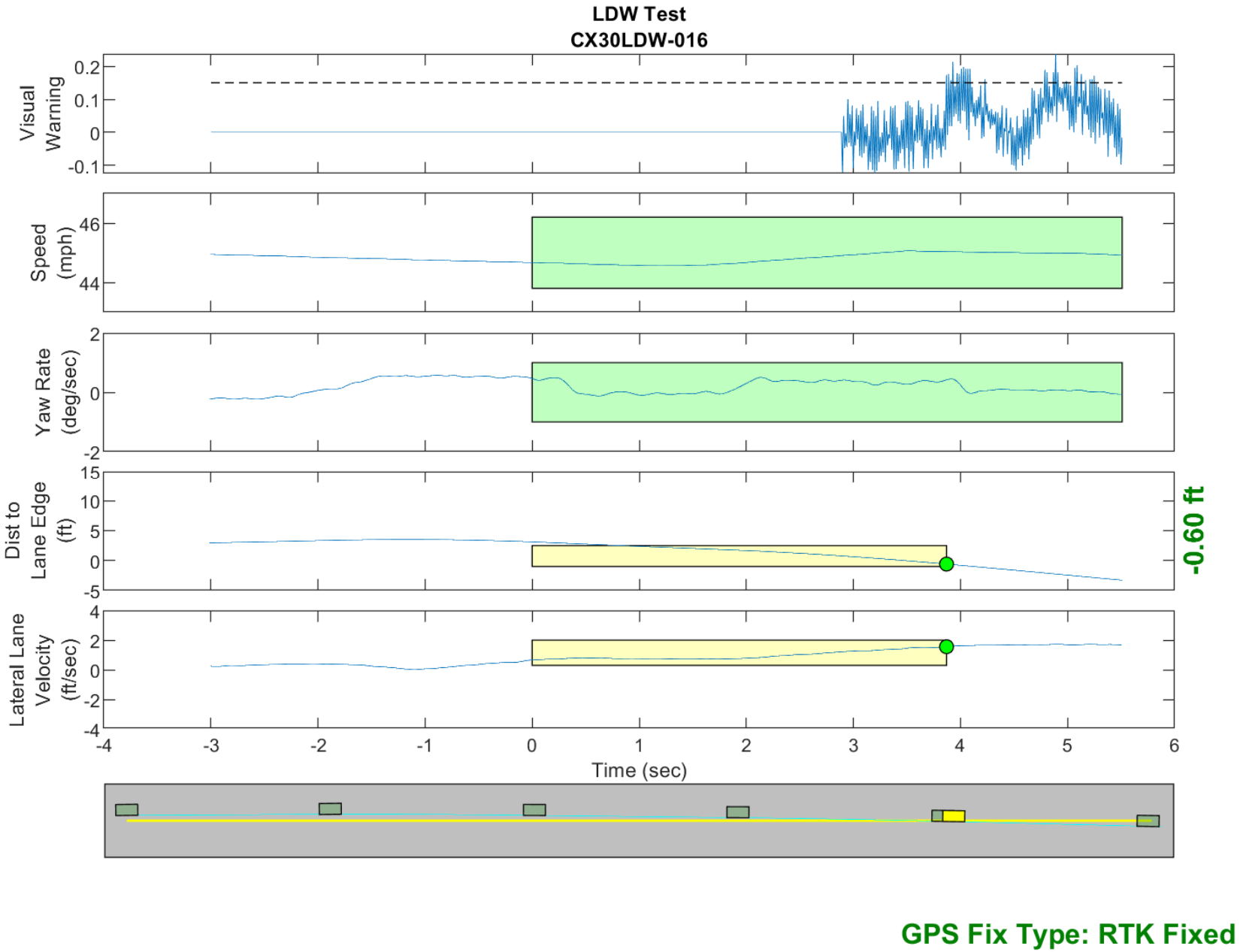


Figure D31. Time History for Run 16, Botts Dots, Right Departure, Visual Warning

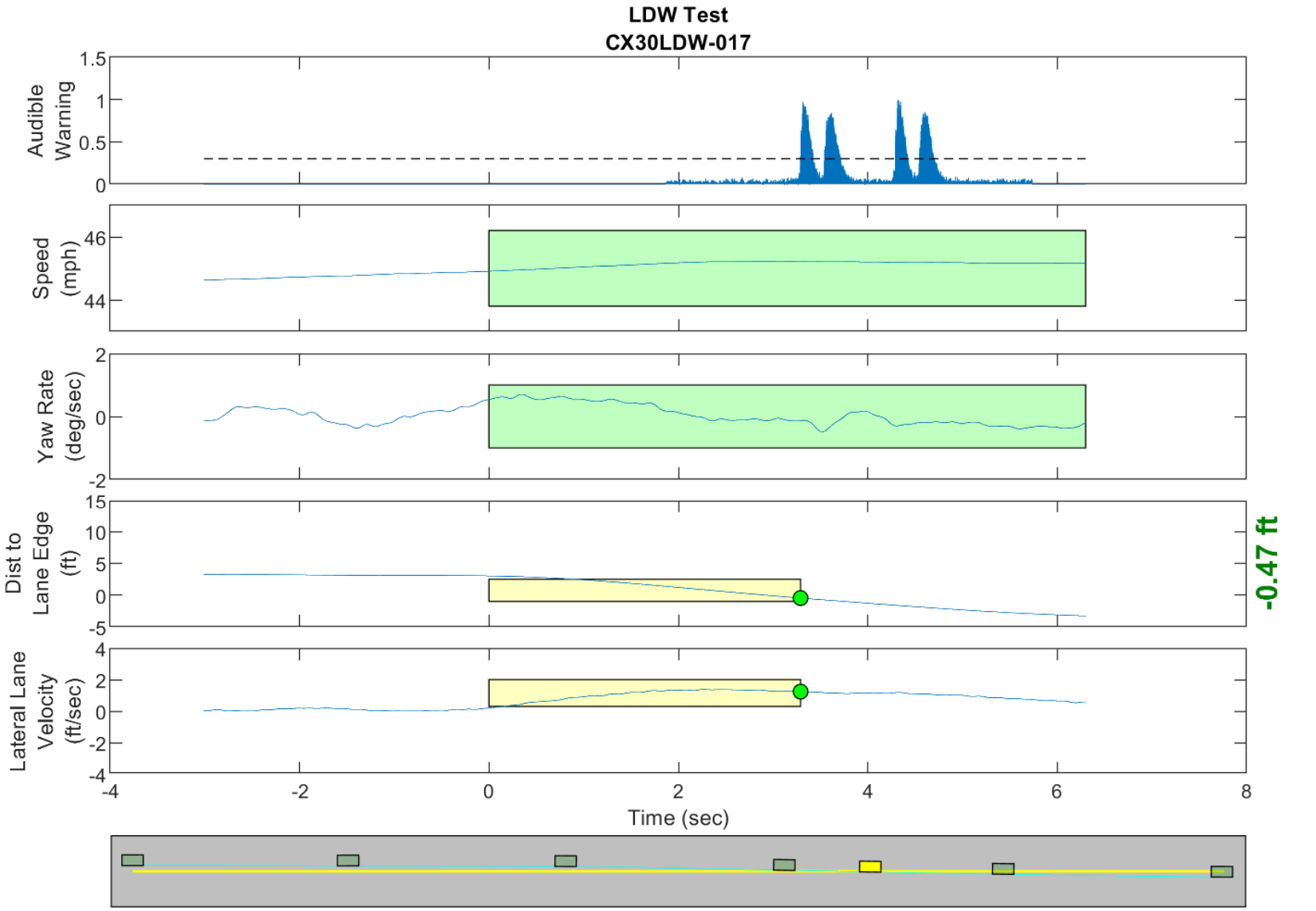


Figure D32. Time History for Run 17, Solid Line, Right Departure, Audible Warning

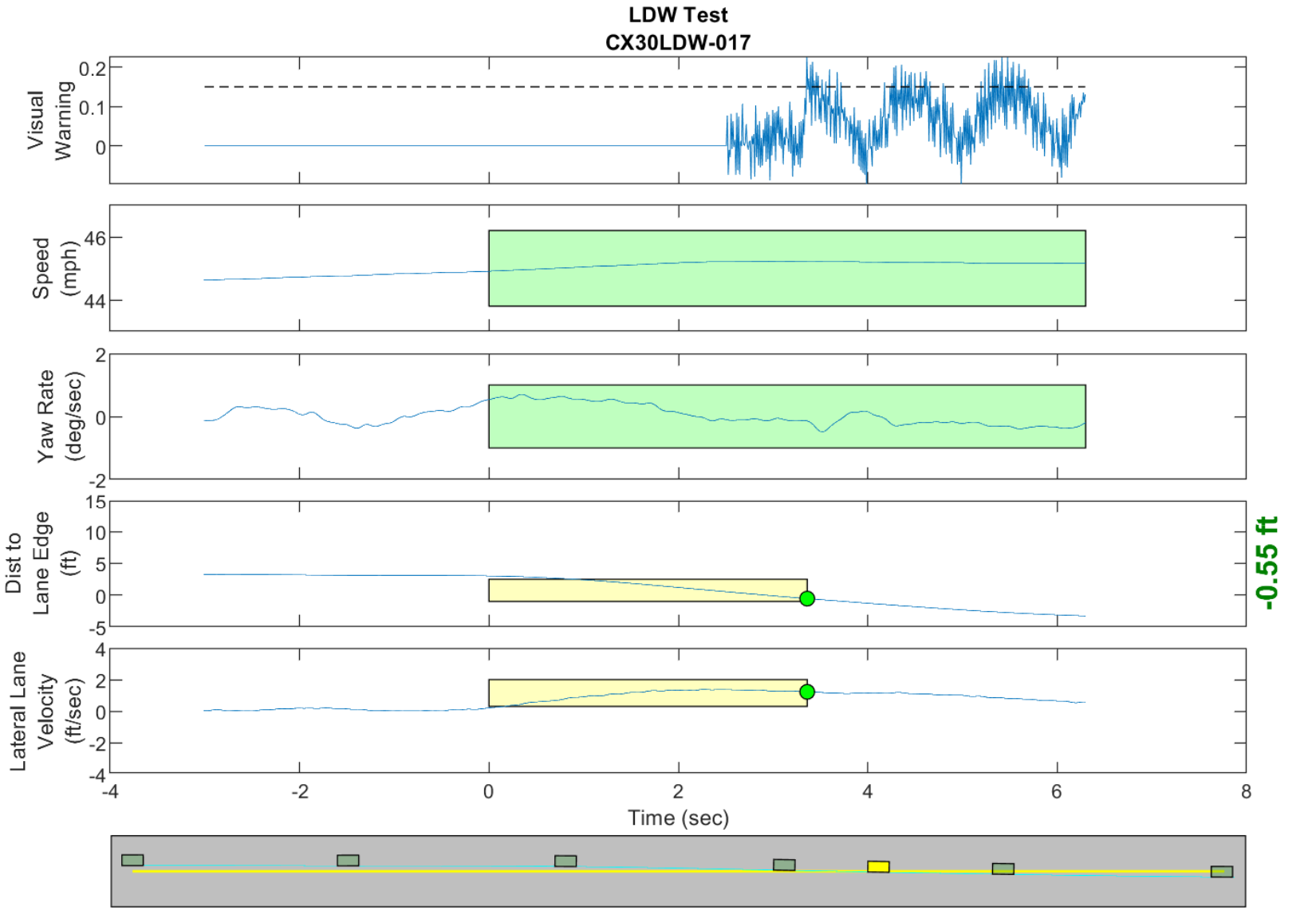


Figure D33. Time History for Run 17, Solid Line, Right Departure, Visual Warning

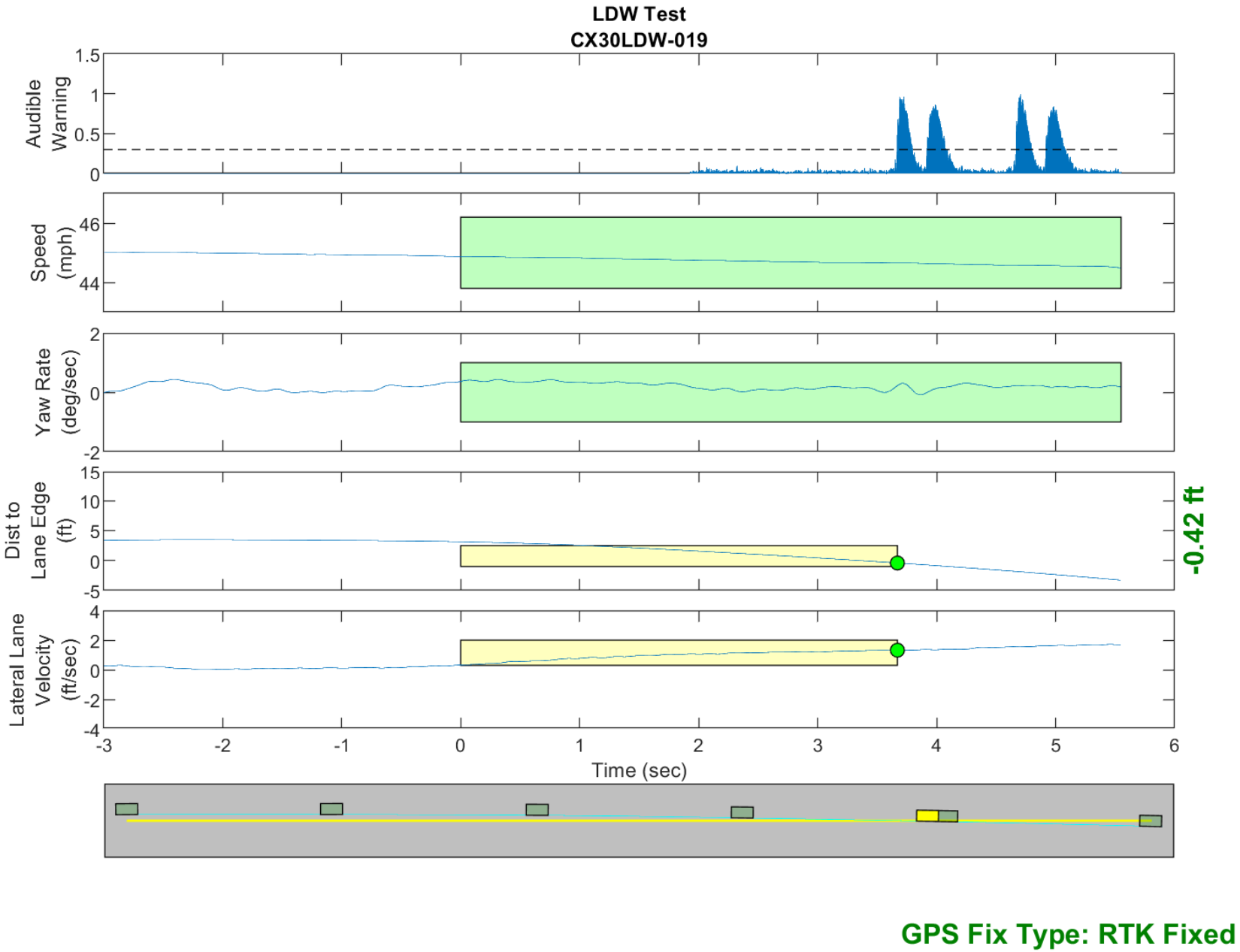


Figure D34. Time History for Run 19, Solid Line, Right Departure, Audible Warning

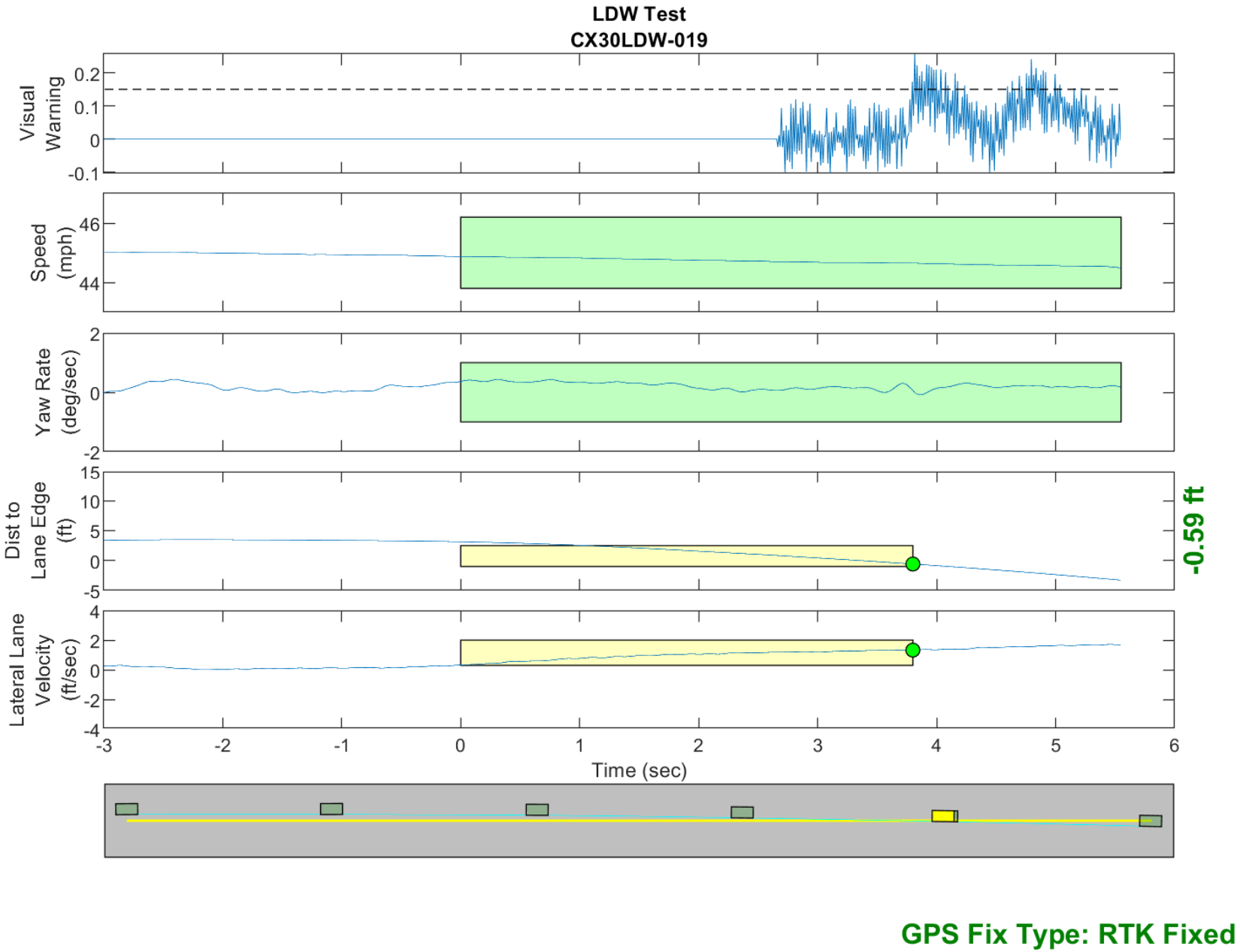


Figure D35. Time History for Run 19, Solid Line, Right Departure, Visual Warning

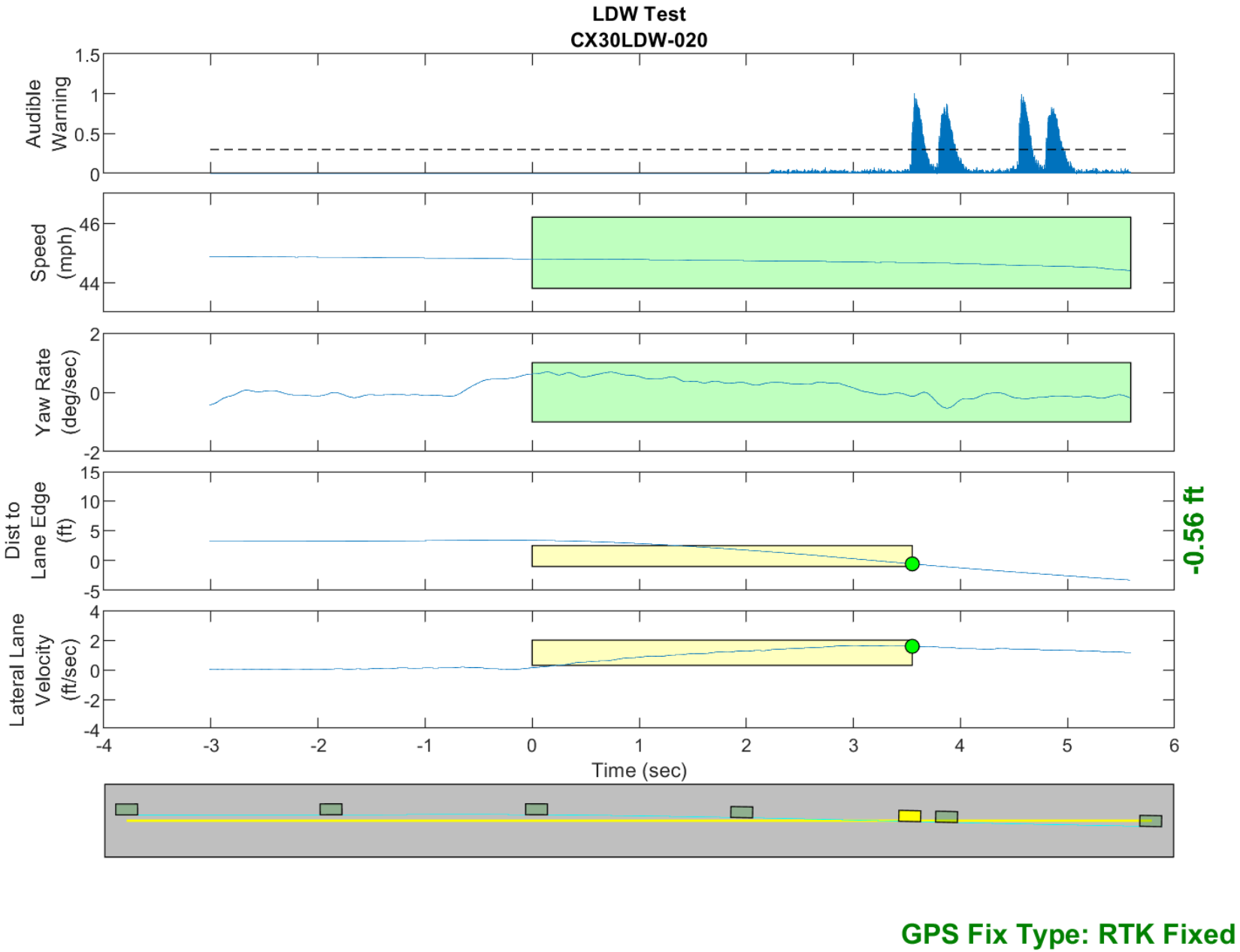


Figure D36. Time History for Run 20, Solid Line, Right Departure, Audible Warning

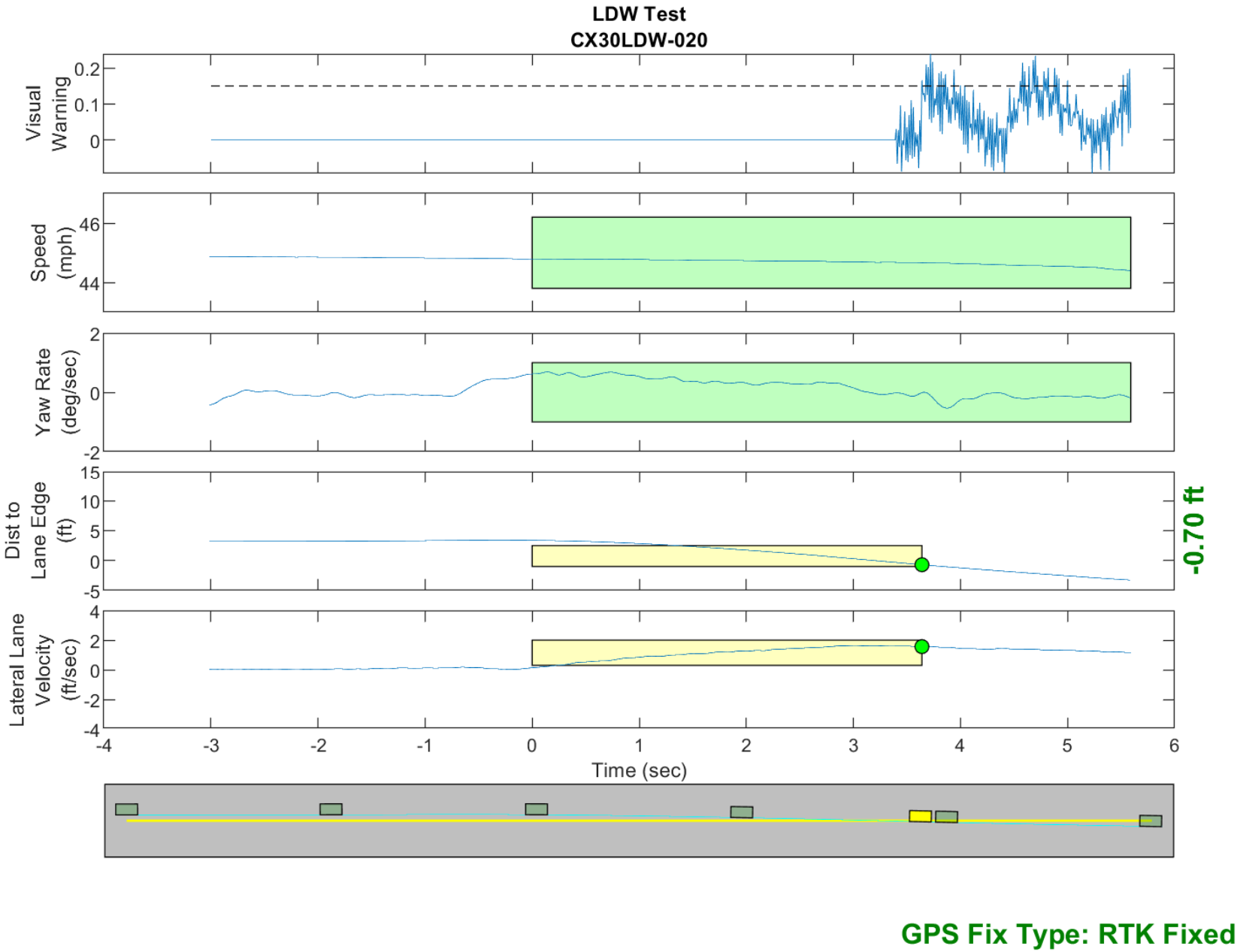


Figure D37. Time History for Run 20, Solid Line, Right Departure, Visual Warning

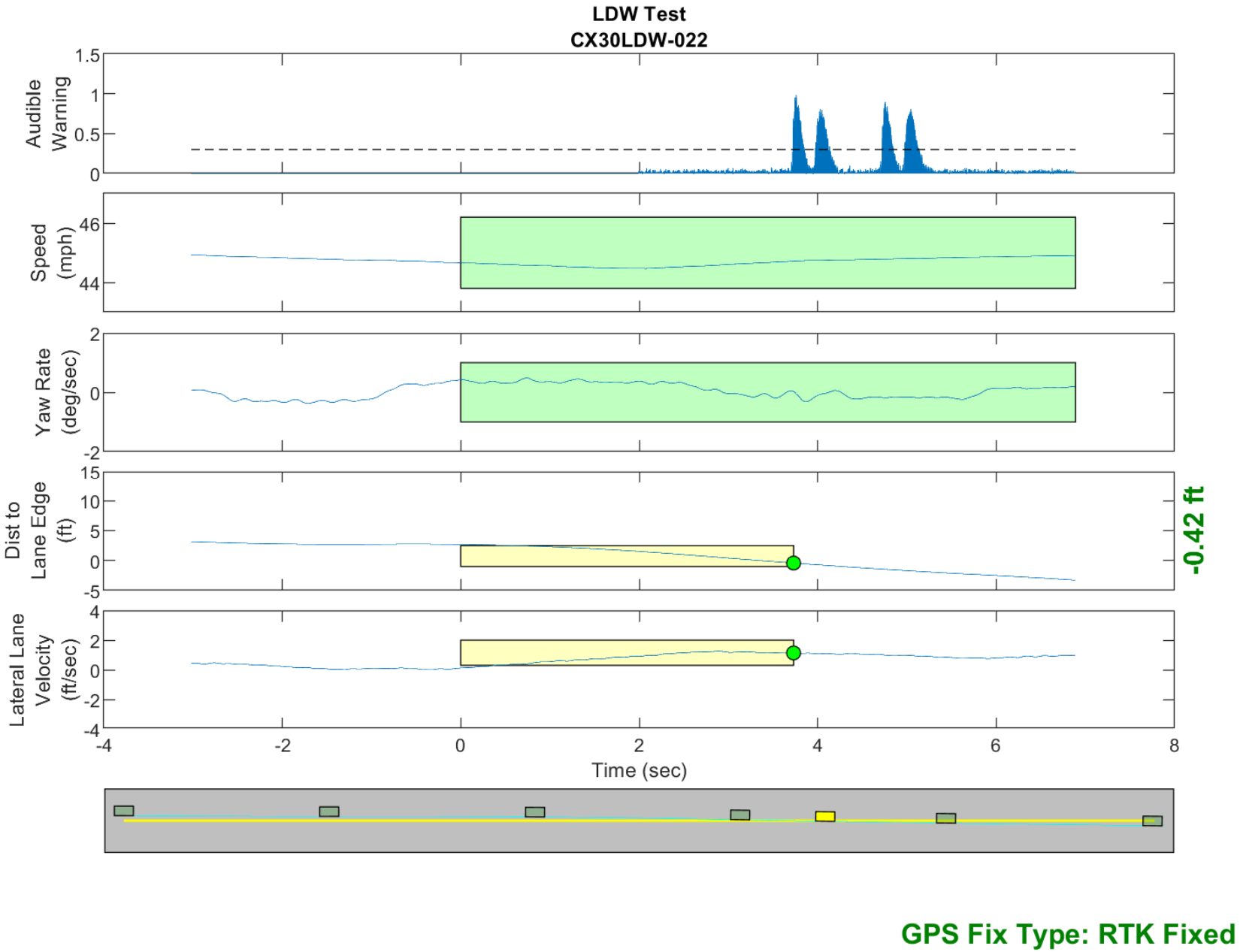


Figure D38. Time History for Run 22, Solid Line, Right Departure, Audible Warning

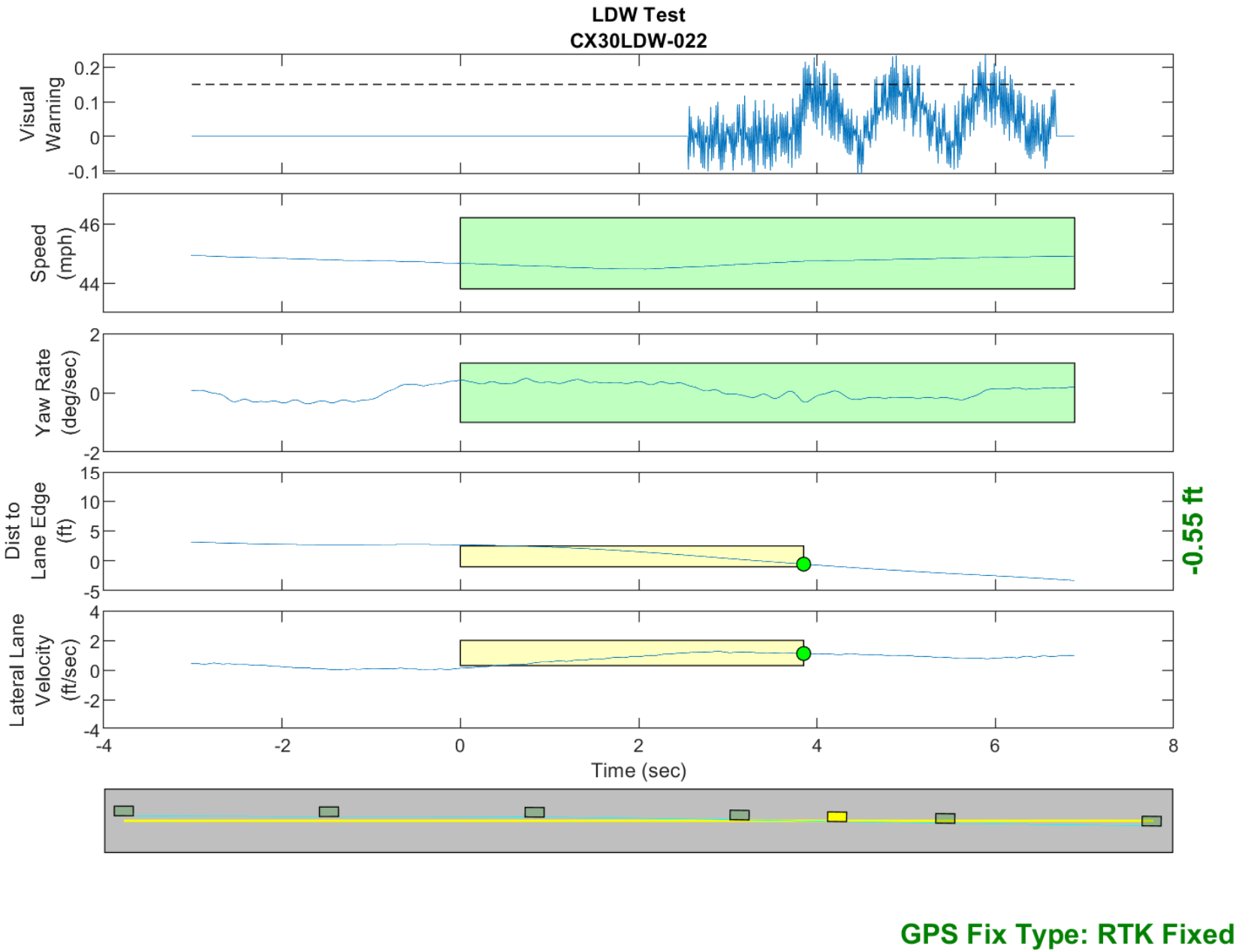


Figure D39. Time History for Run 22, Solid Line, Right Departure, Visual Warning

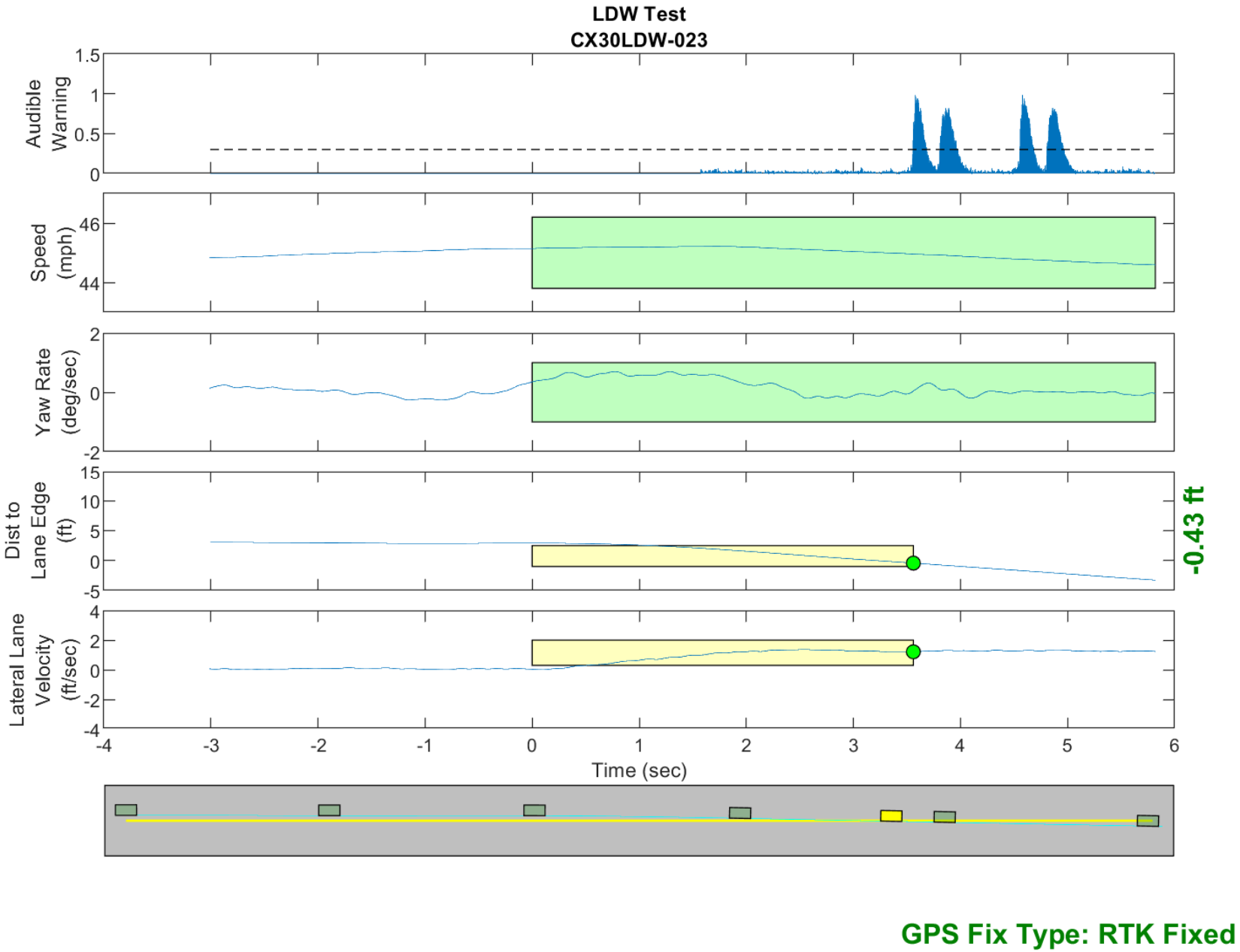


Figure D40. Time History for Run 23, Solid Line, Right Departure, Audible Warning

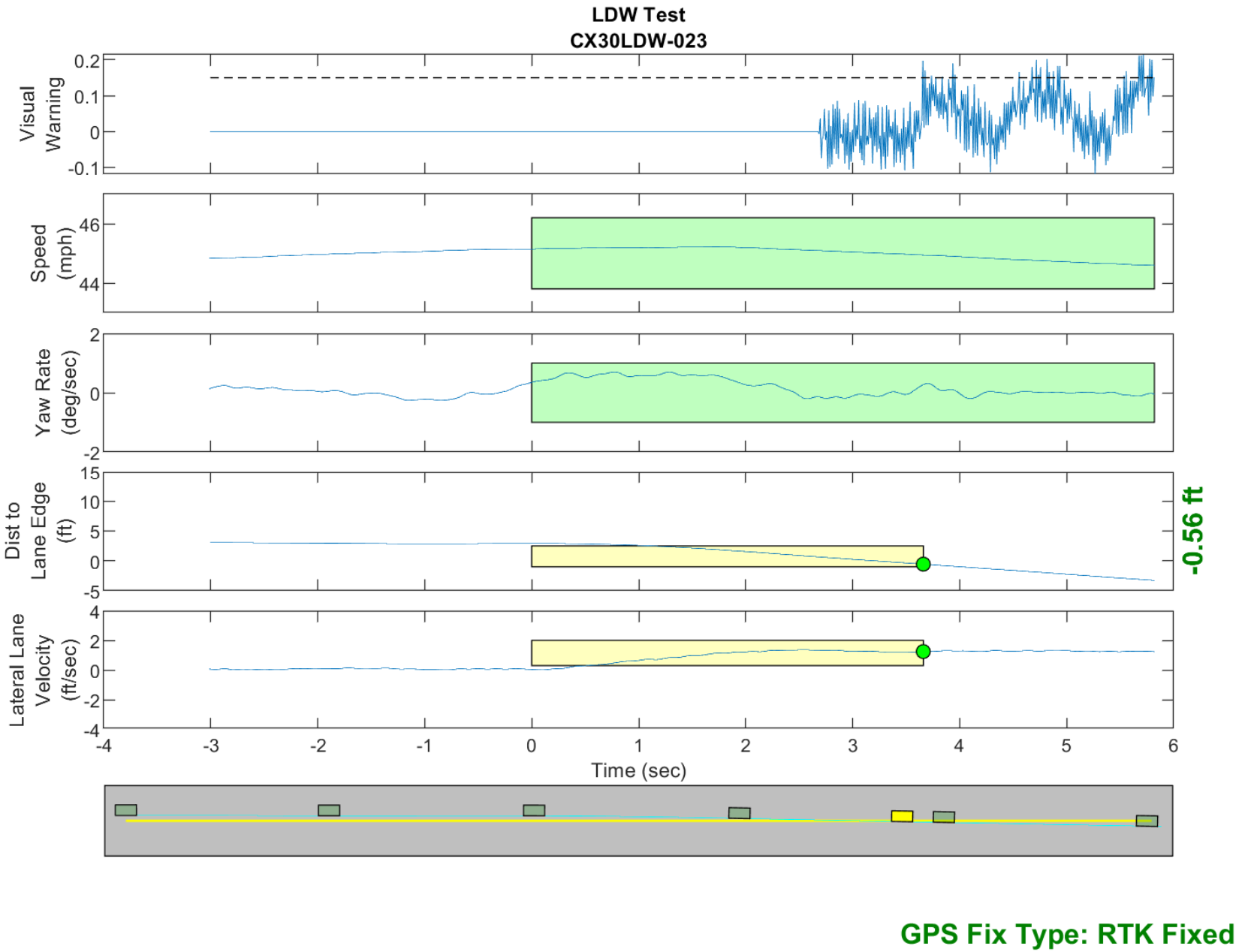


Figure D41. Time History for Run 23, Solid Line, Right Departure, Visual Warning

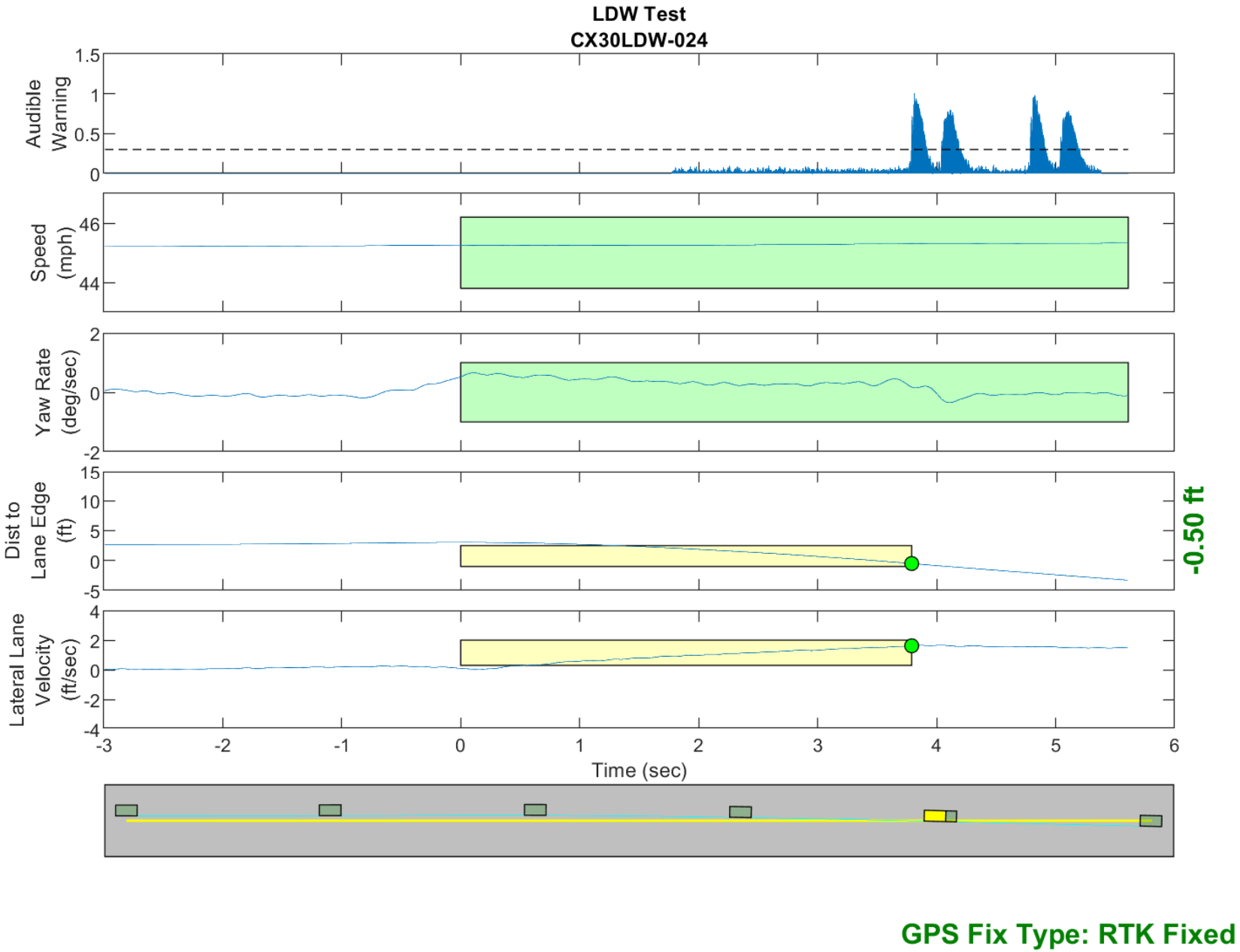


Figure D42. Time History for Run 24, Solid Line, Right Departure, Audible Warning

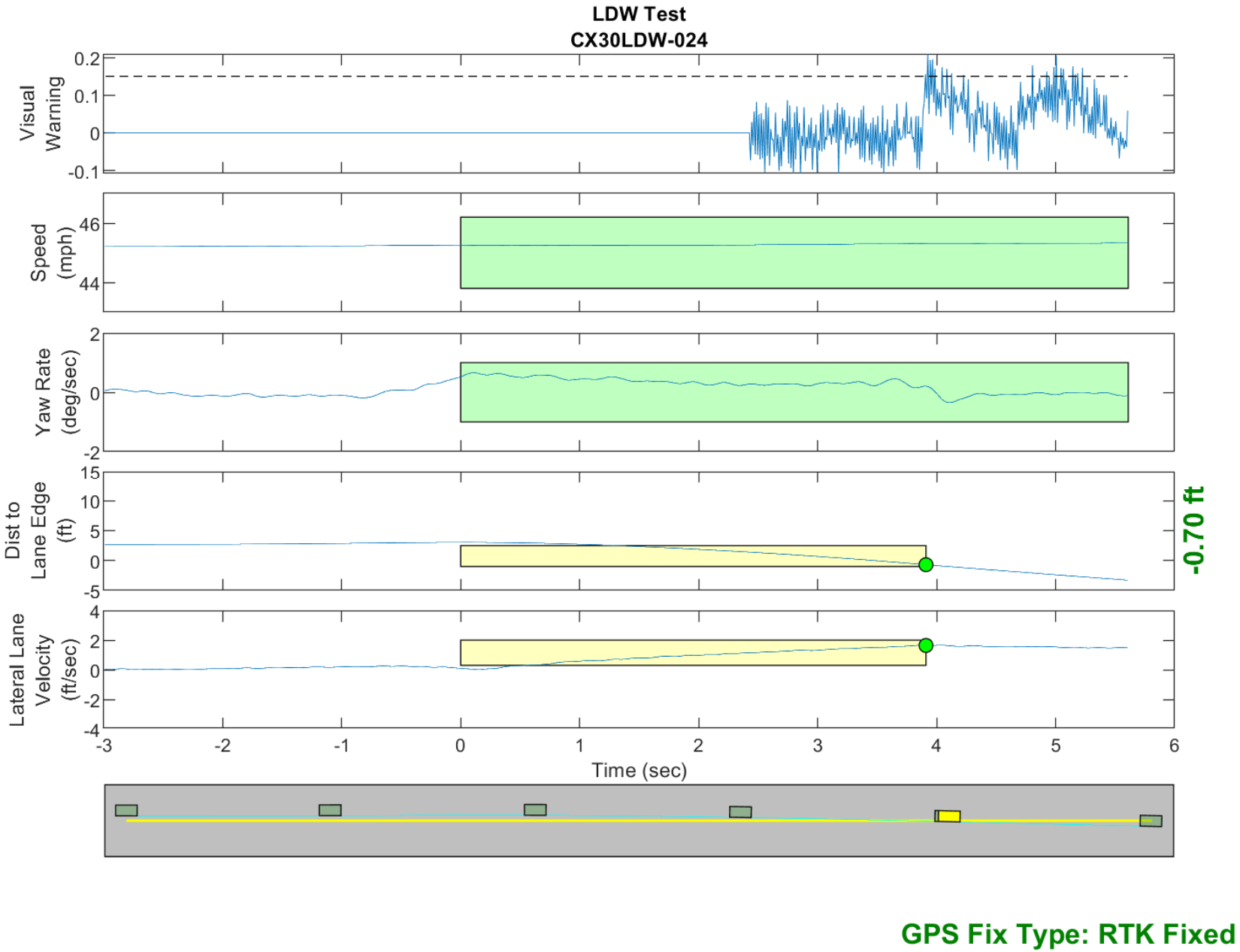


Figure D43. Time History for Run 24, Solid Line, Right Departure, Visual Warning

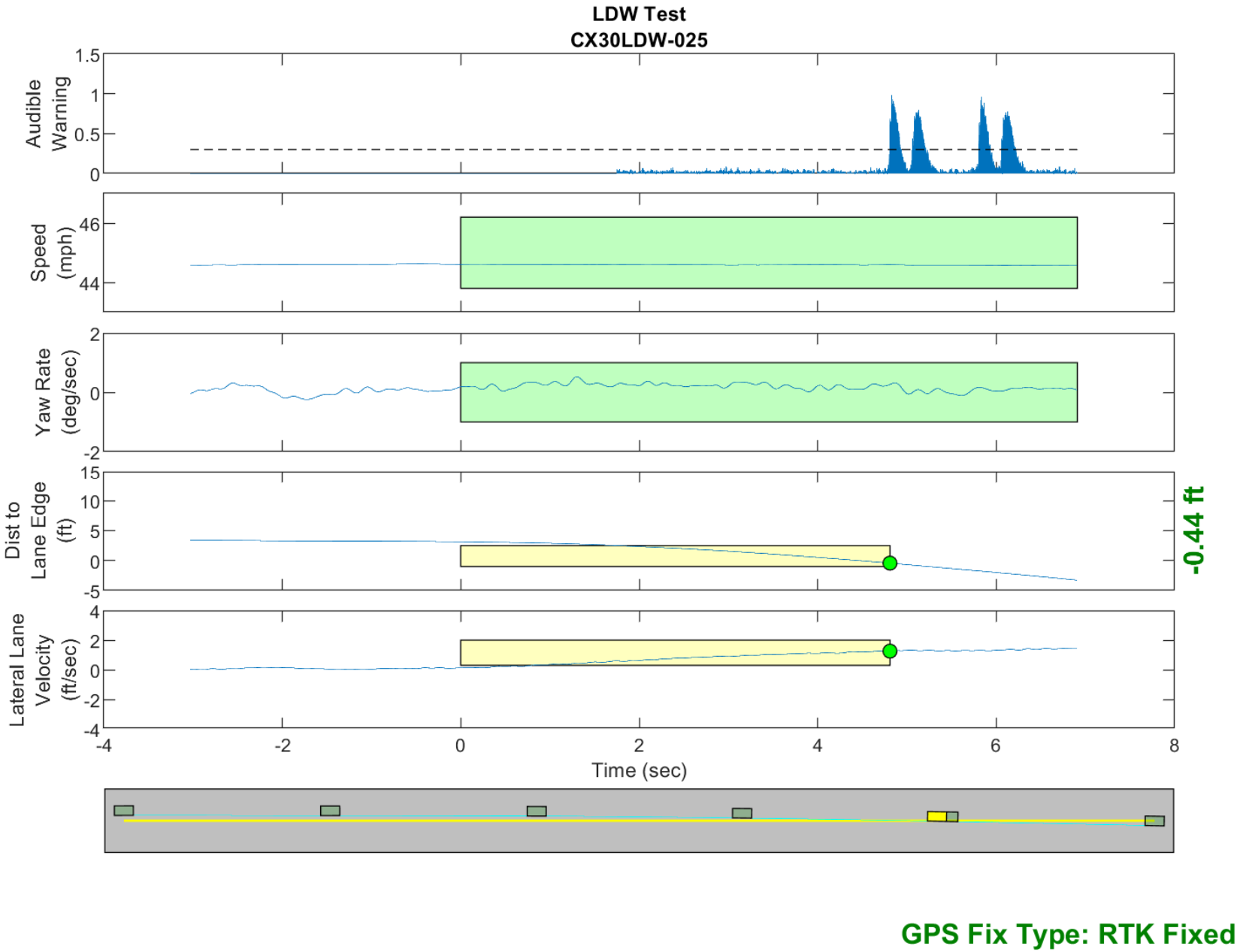


Figure D44. Time History for Run 25, Solid Line, Right Departure, Audible Warning

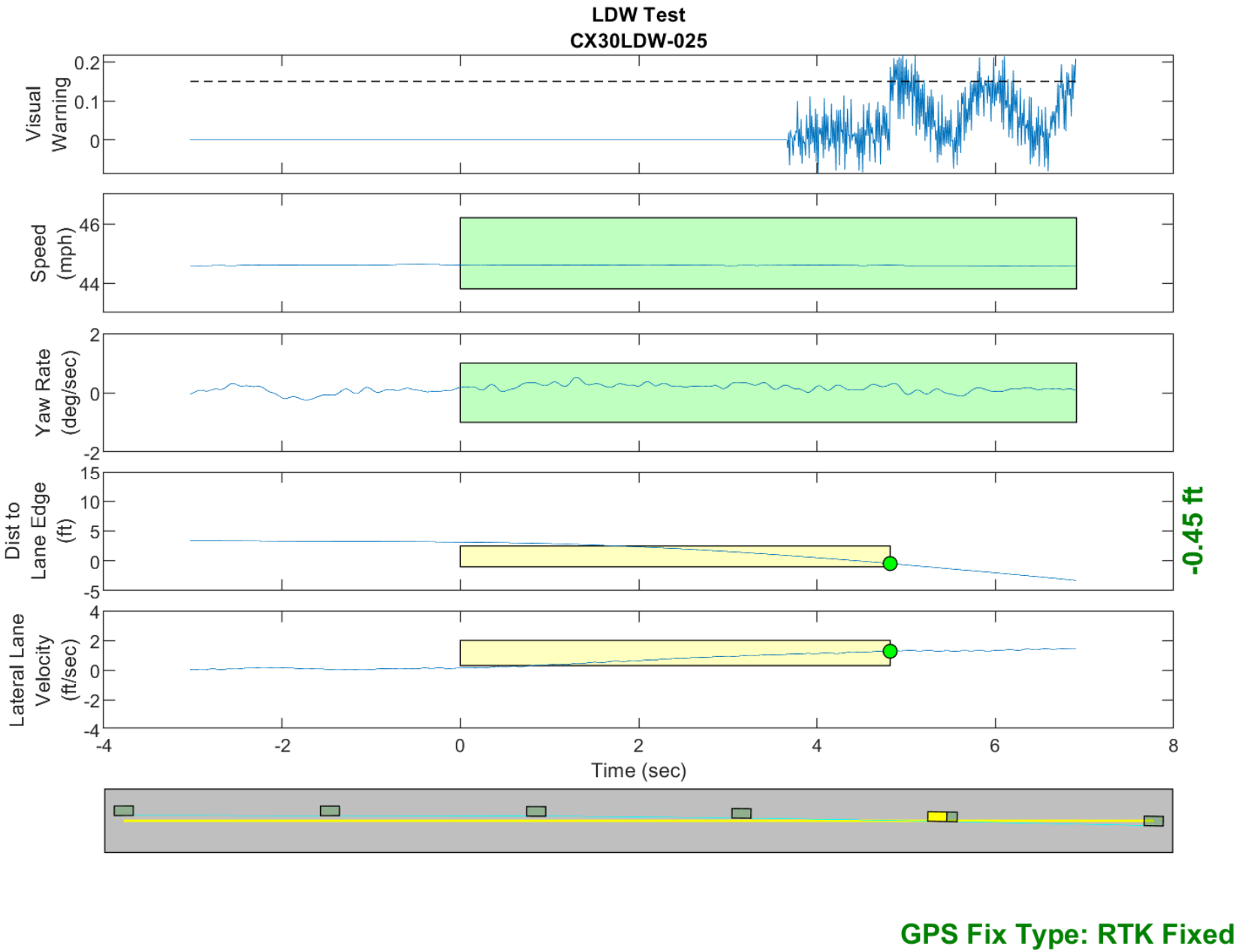


Figure D45. Time History for Run 25, Solid Line, Right Departure, Visual Warning

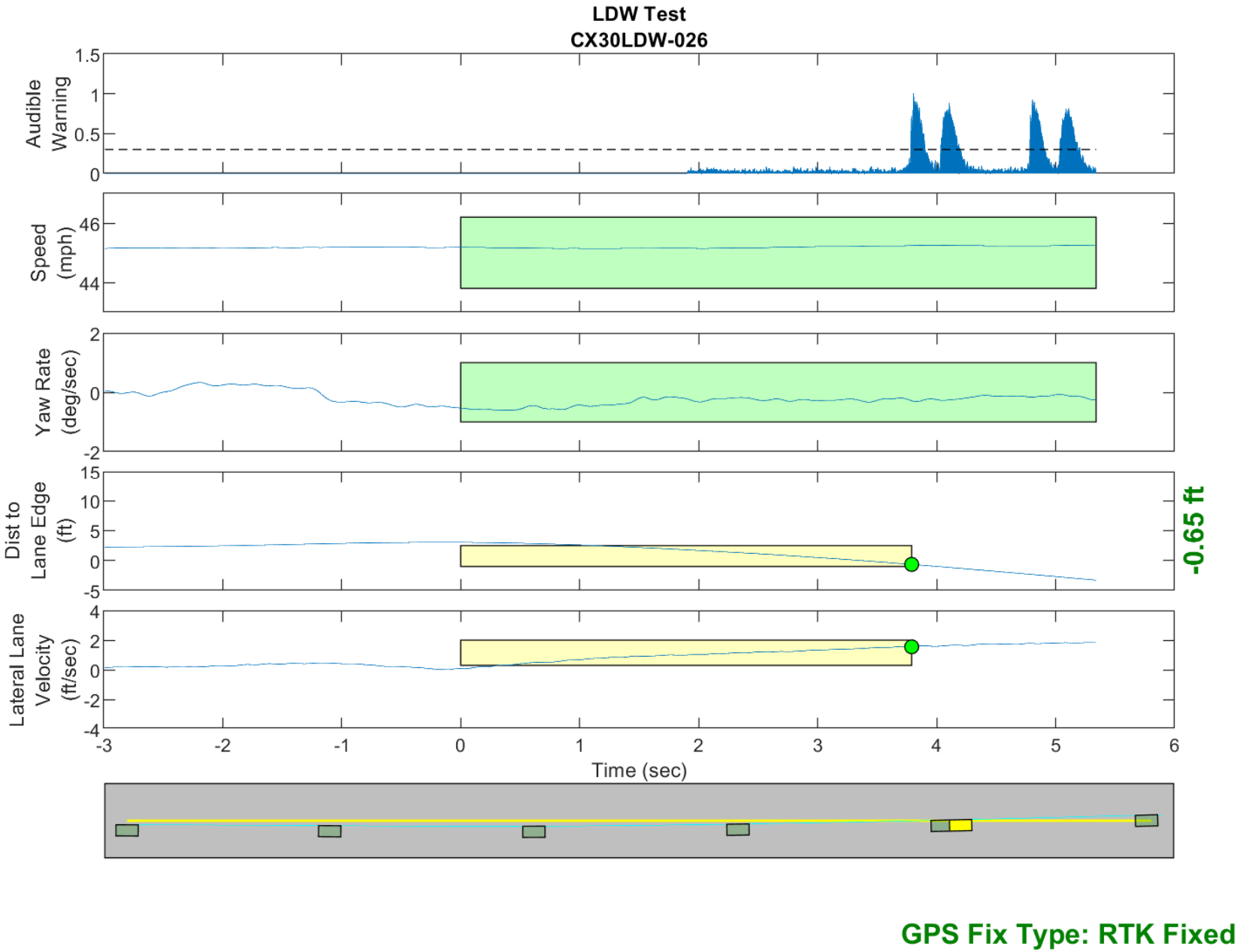


Figure D46. Time History for Run 26, Solid Line, Left Departure, Audible Warning

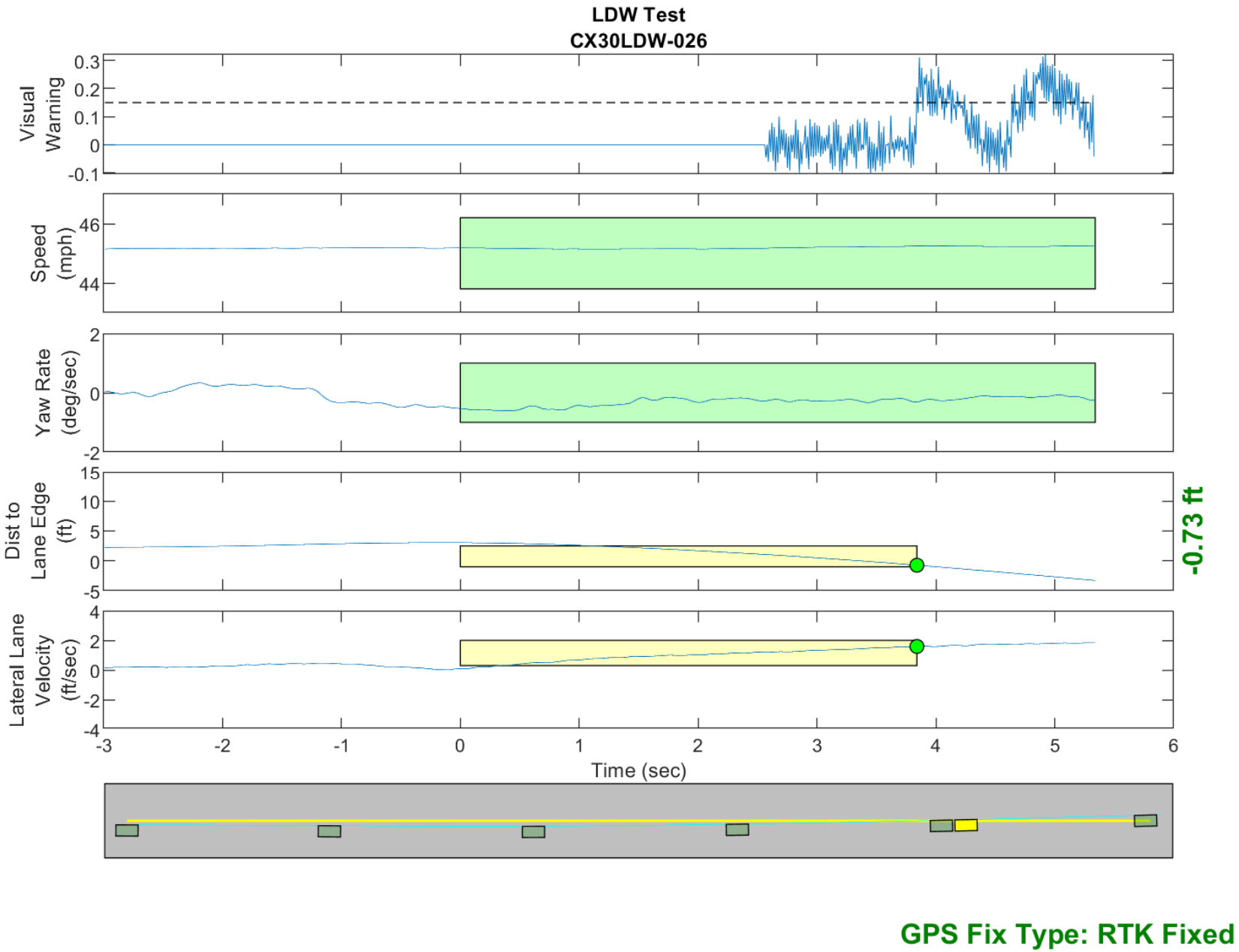


Figure D47. Time History for Run 26, Solid Line, Left Departure, Visual Warning

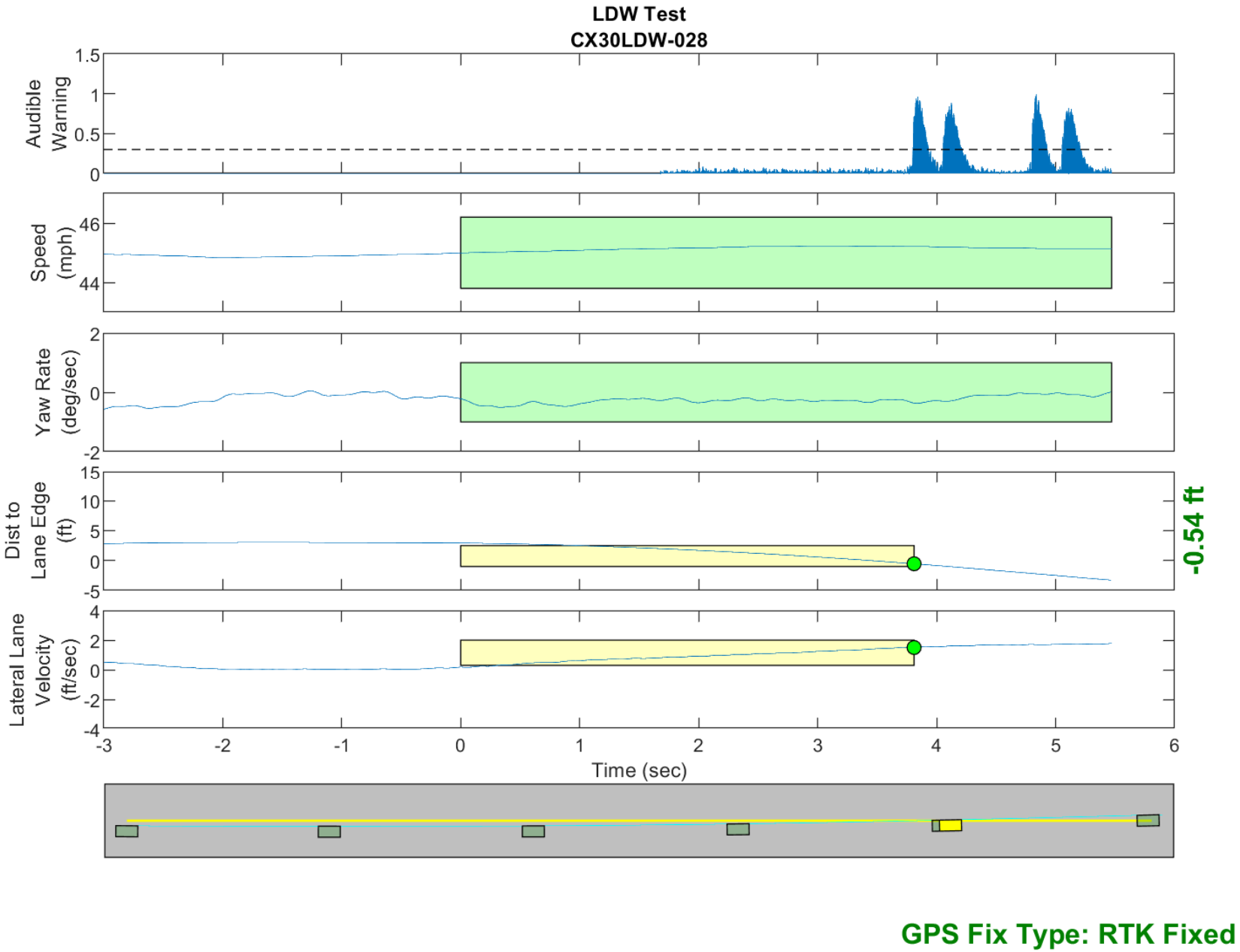


Figure D48. Time History for Run 28, Solid Line, Left Departure, Audible Warning

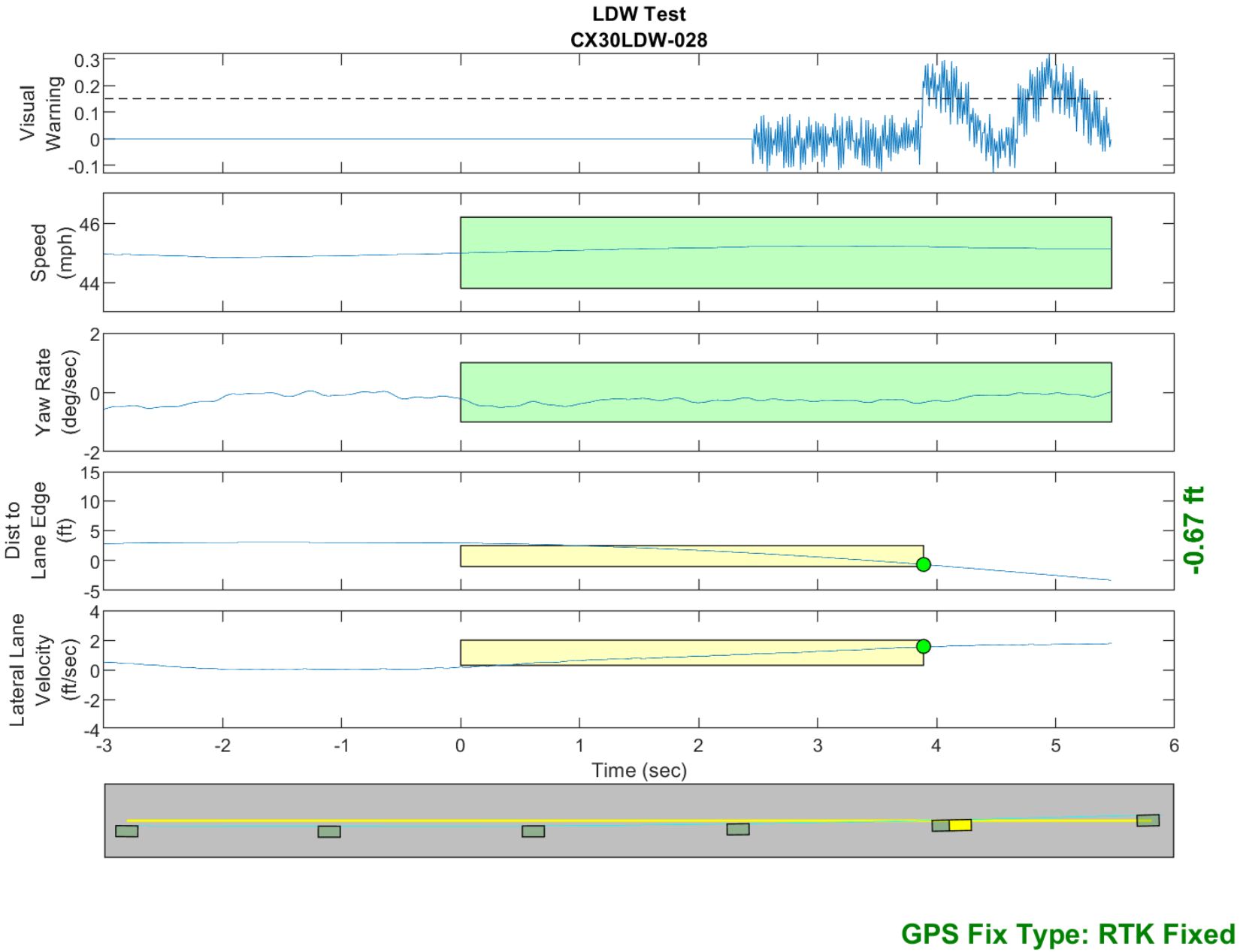


Figure D49. Time History for Run 28, Solid Line, Left Departure, Visual Warning

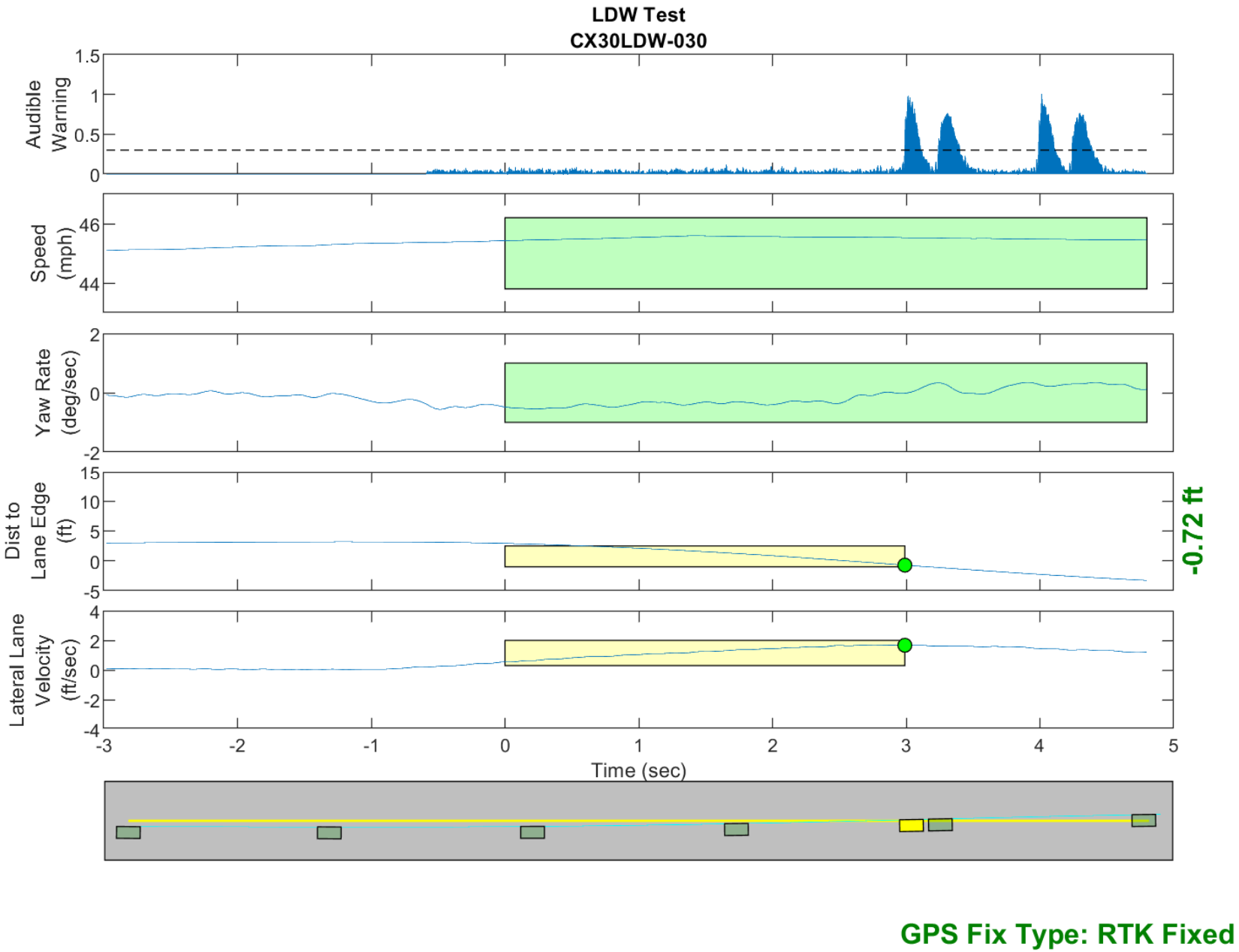


Figure D50. Time History for Run 30, Solid Line, Left Departure, Audible Warning

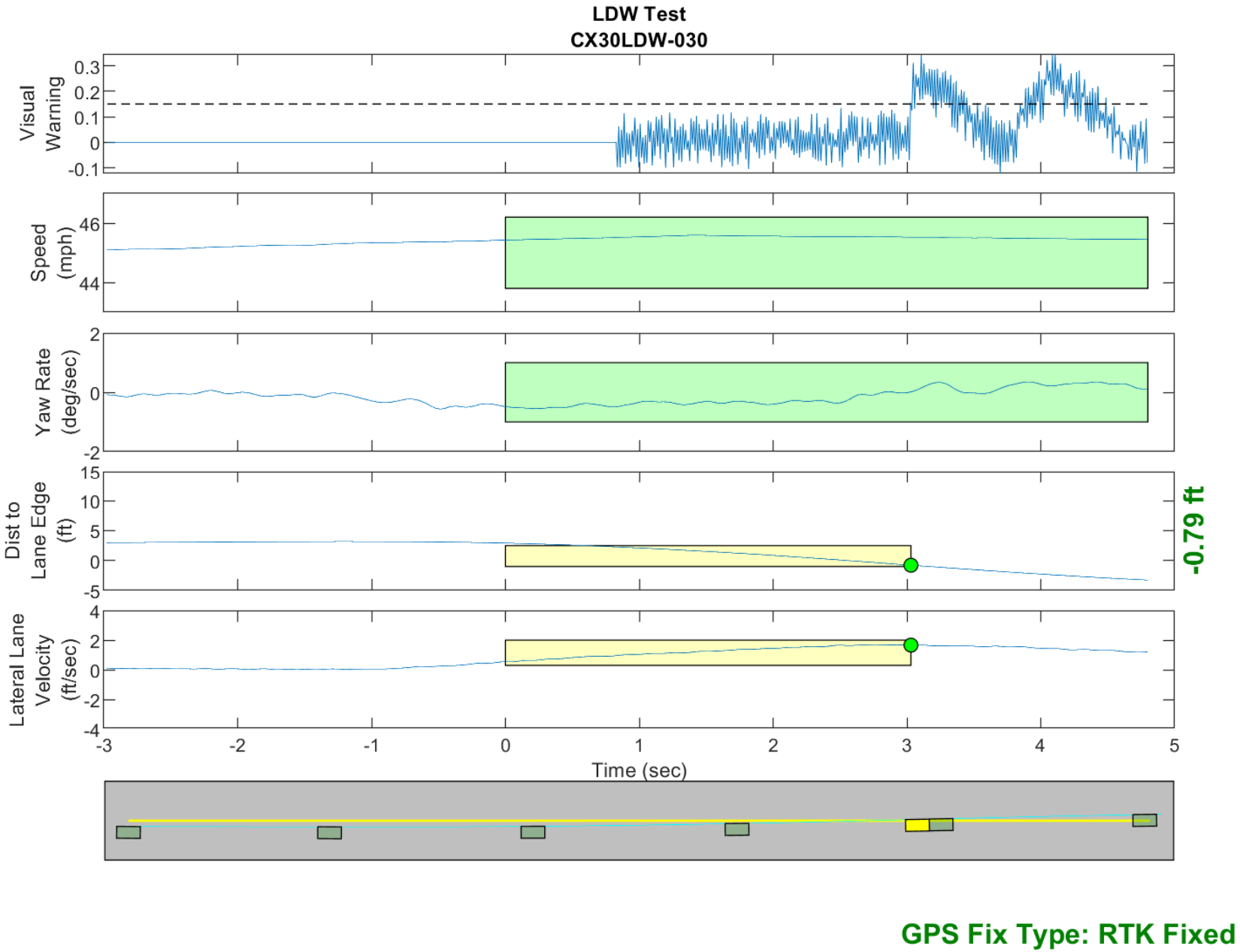


Figure D51. Time History for Run 30, Solid Line, Left Departure, Visual Warning

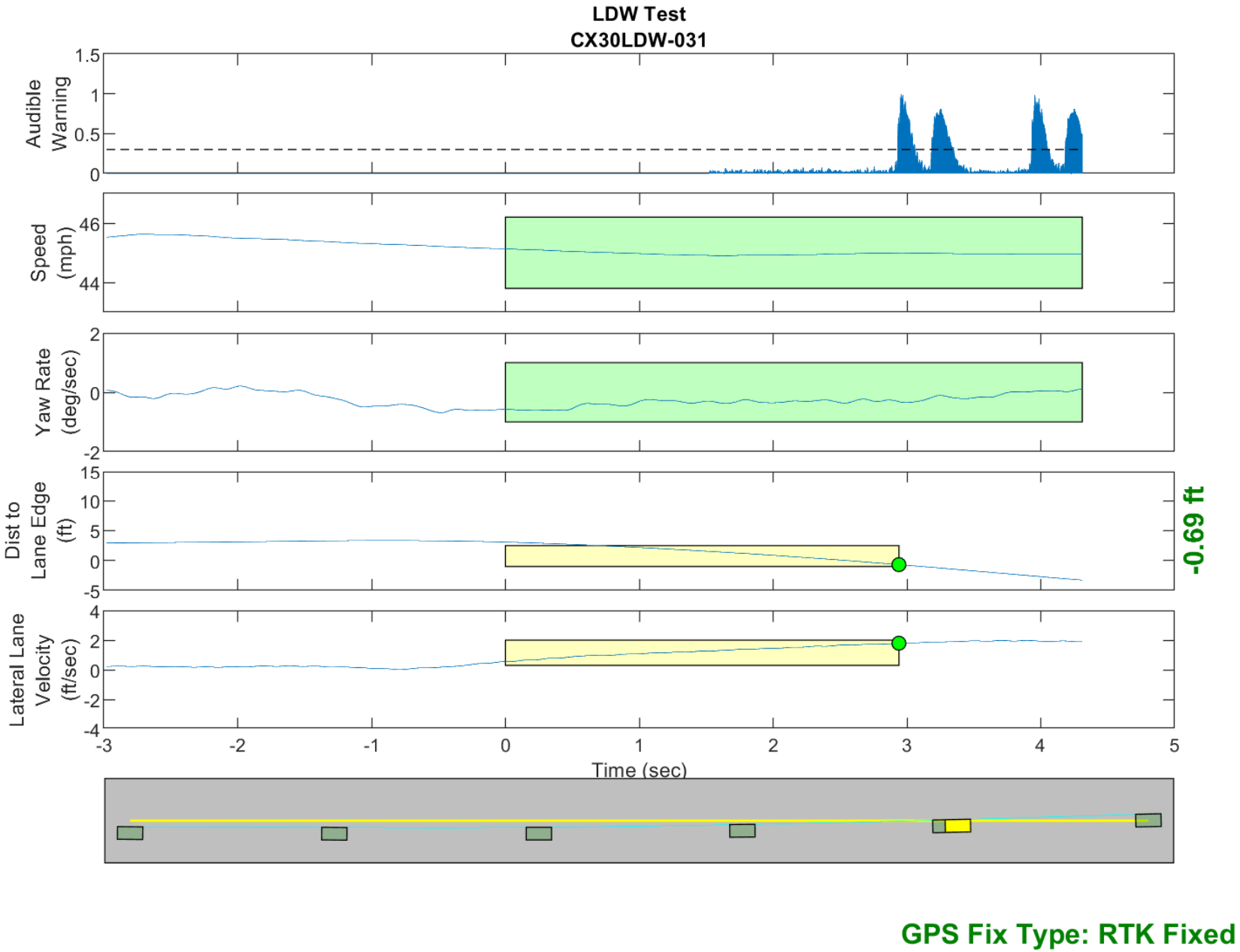


Figure D52. Time History for Run 31, Solid Line, Left Departure, Audible Warning

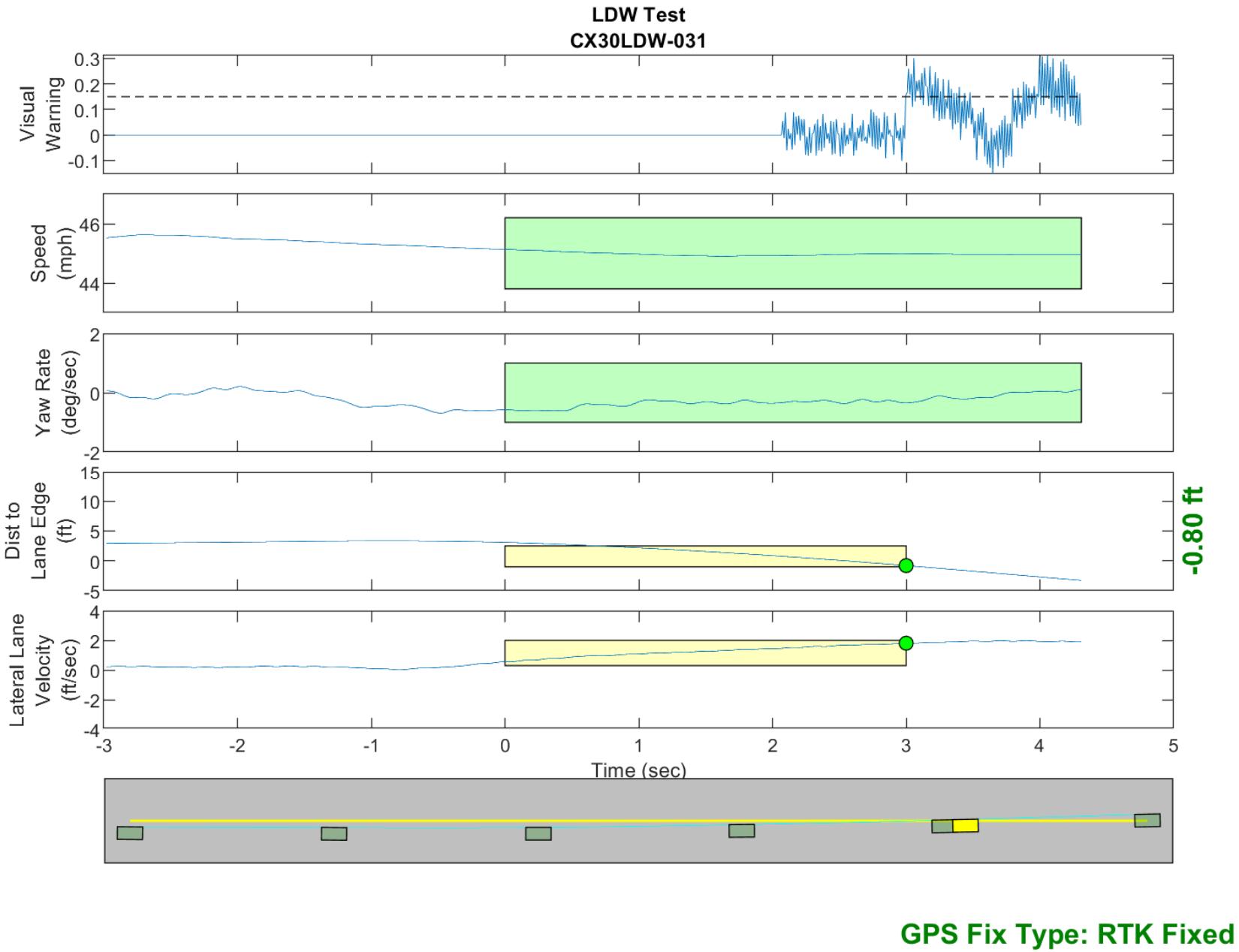


Figure D53. Time History for Run 31, Solid Line, Left Departure, Visual Warning

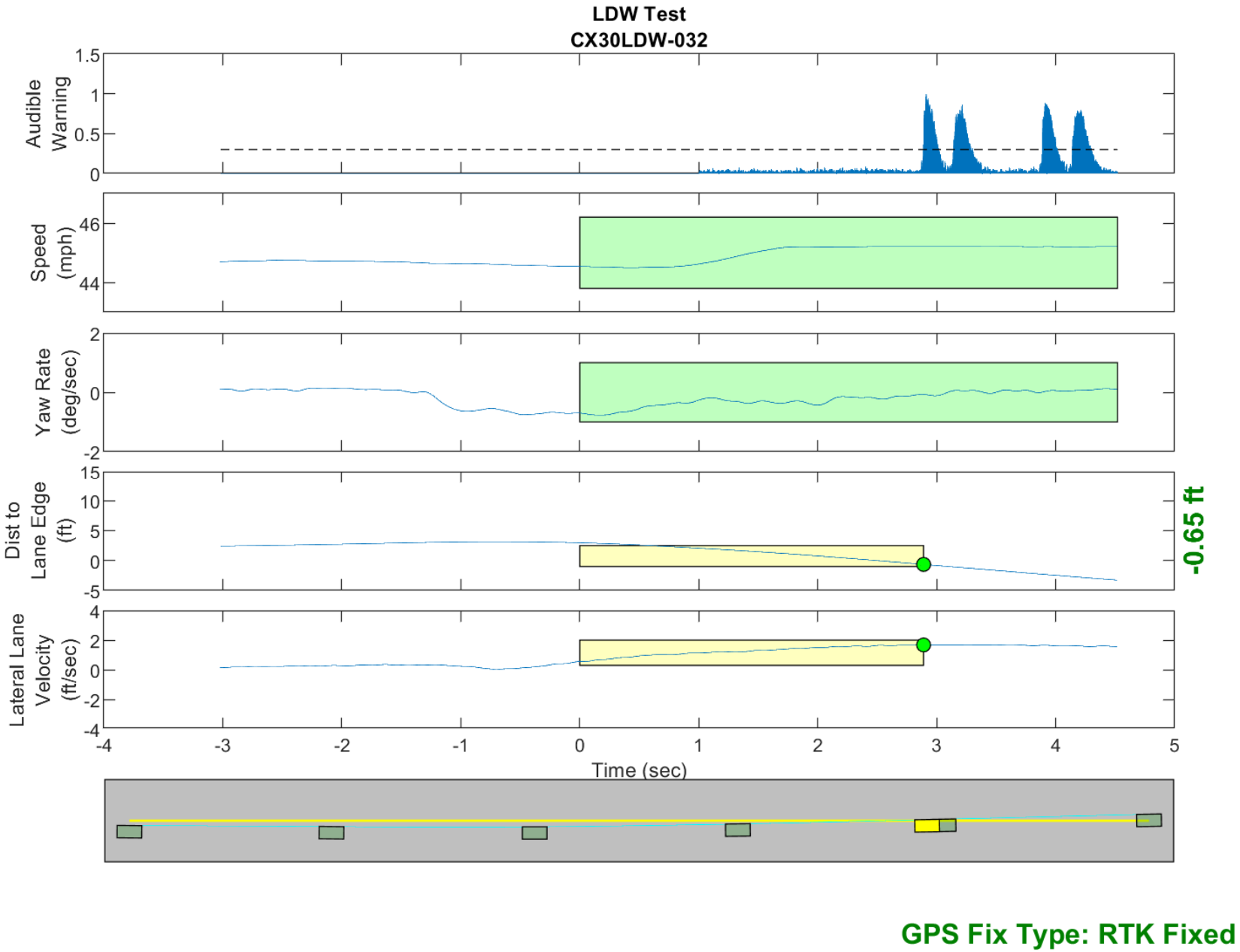


Figure D54. Time History for Run 32, Solid Line, Left Departure, Audible Warning

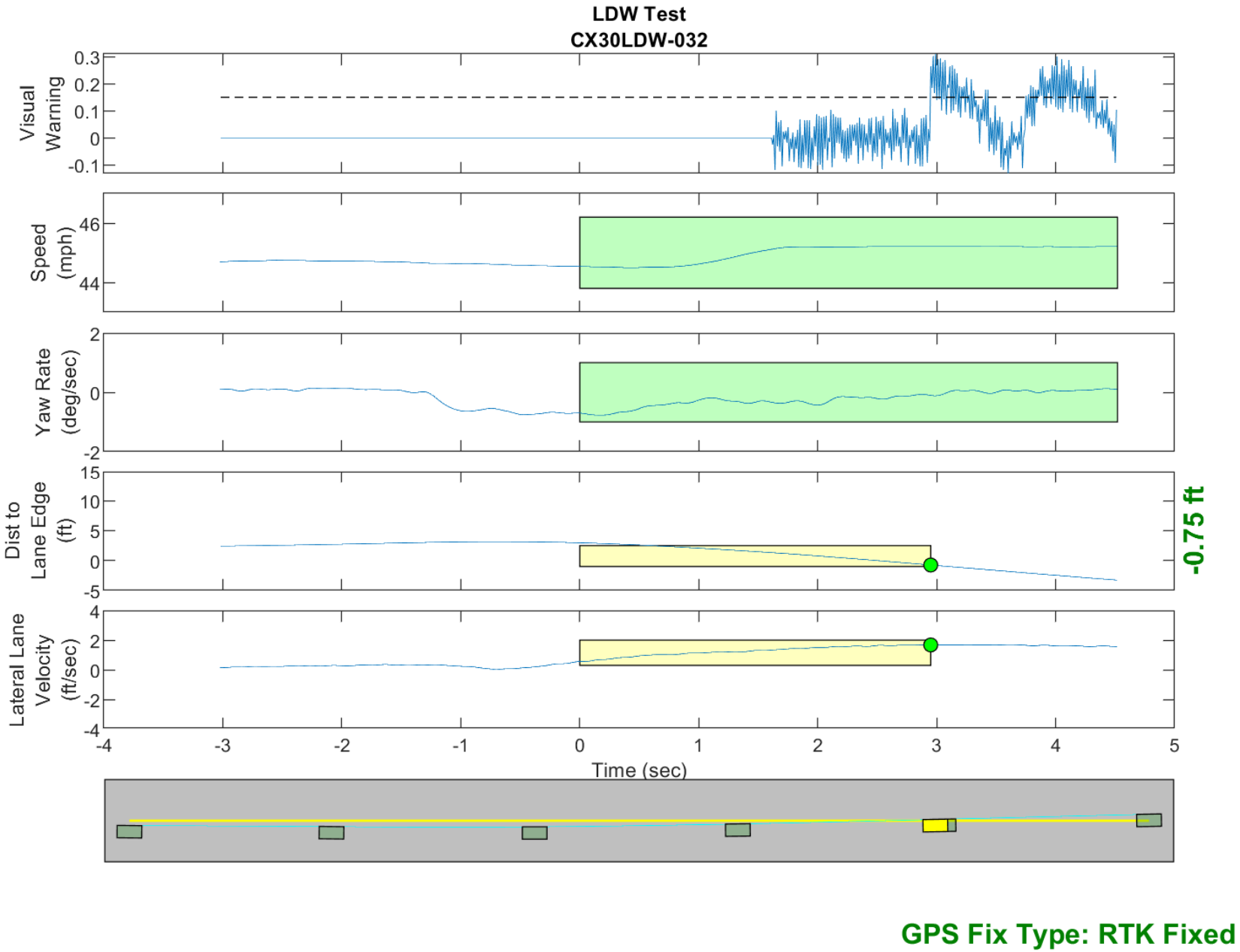


Figure D55. Time History for Run 32, Solid Line, Left Departure, Visual Warning

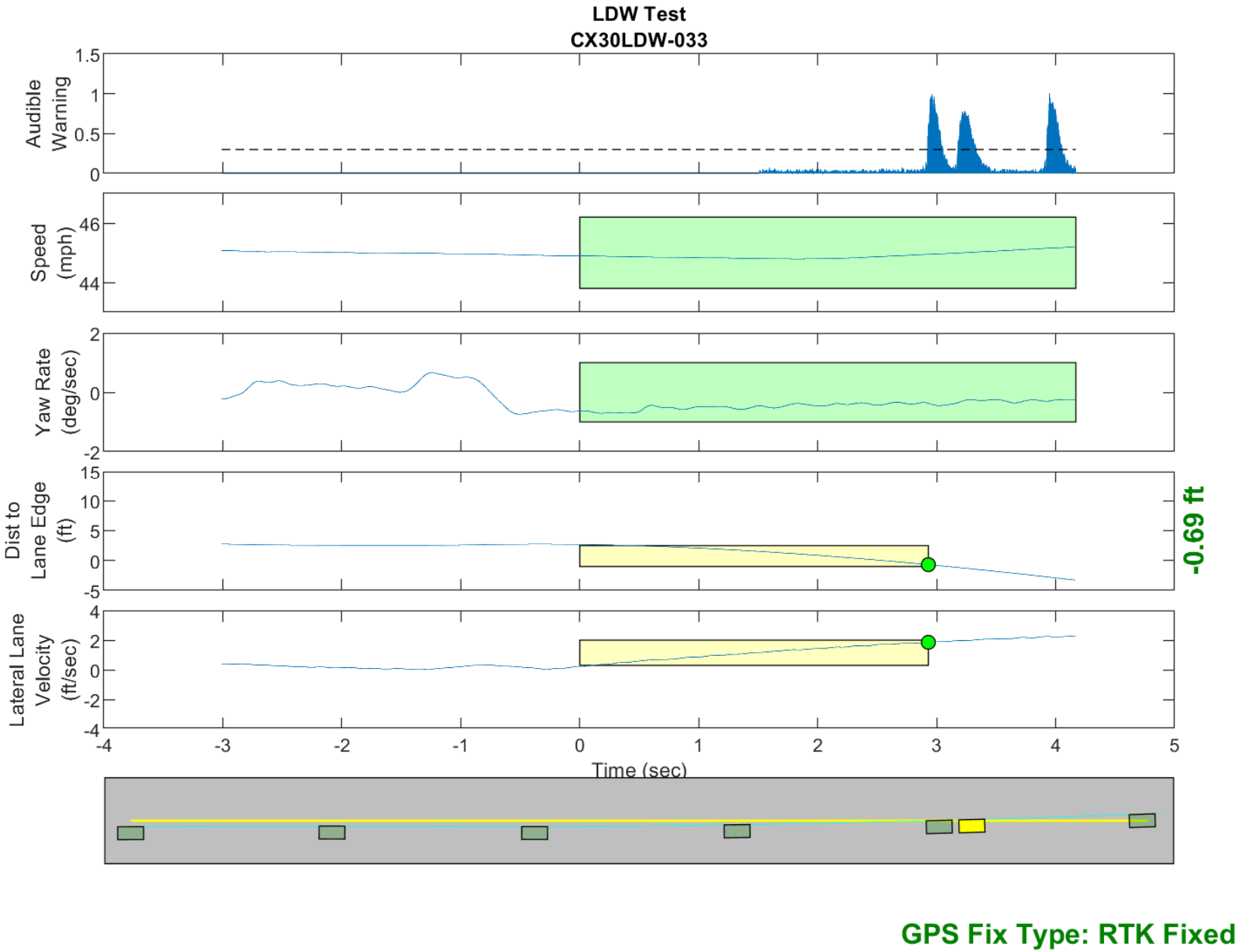


Figure D56. Time History for Run 33, Solid Line, Left Departure, Audible Warning

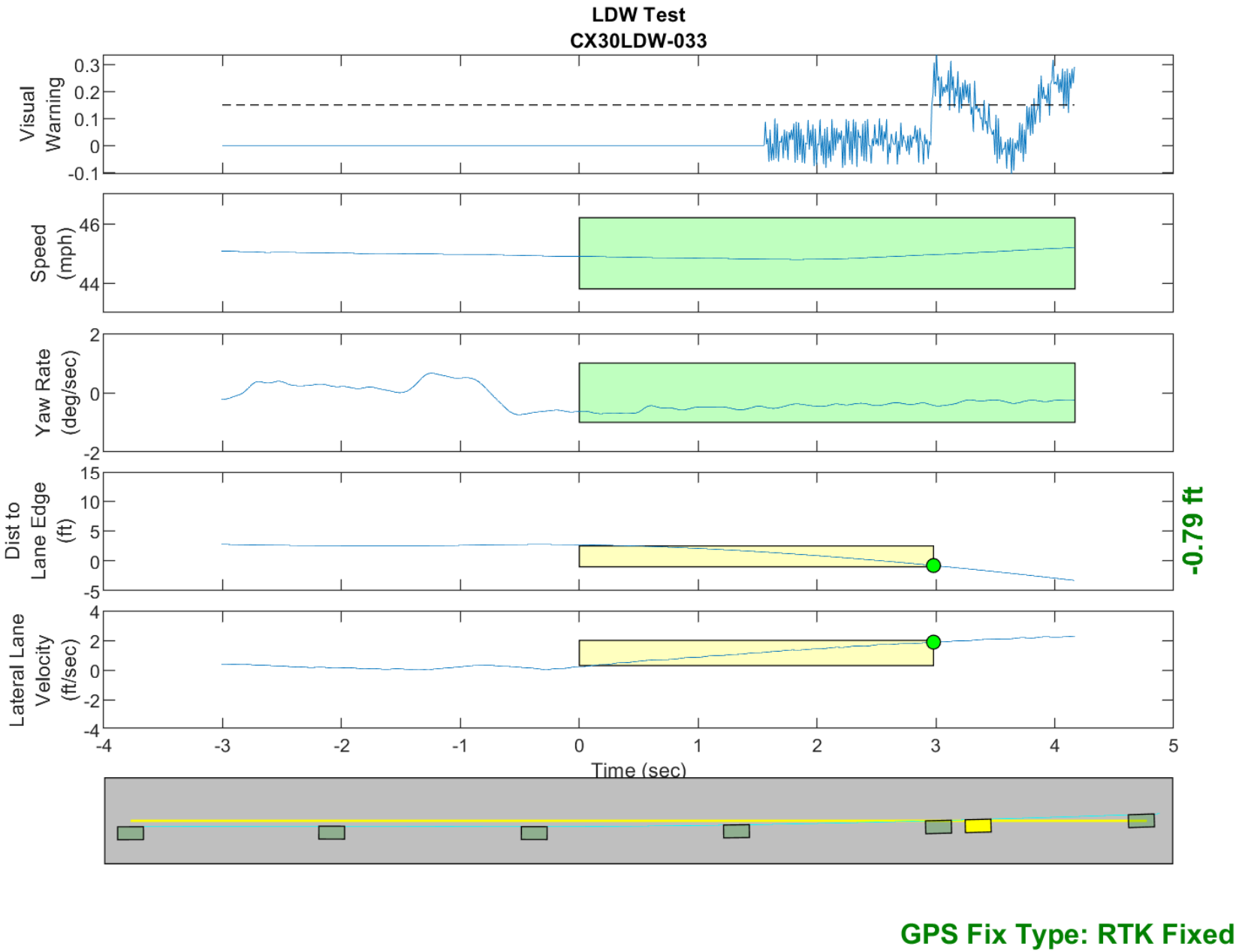


Figure D57. Time History for Run 33, Solid Line, Left Departure, Visual Warning

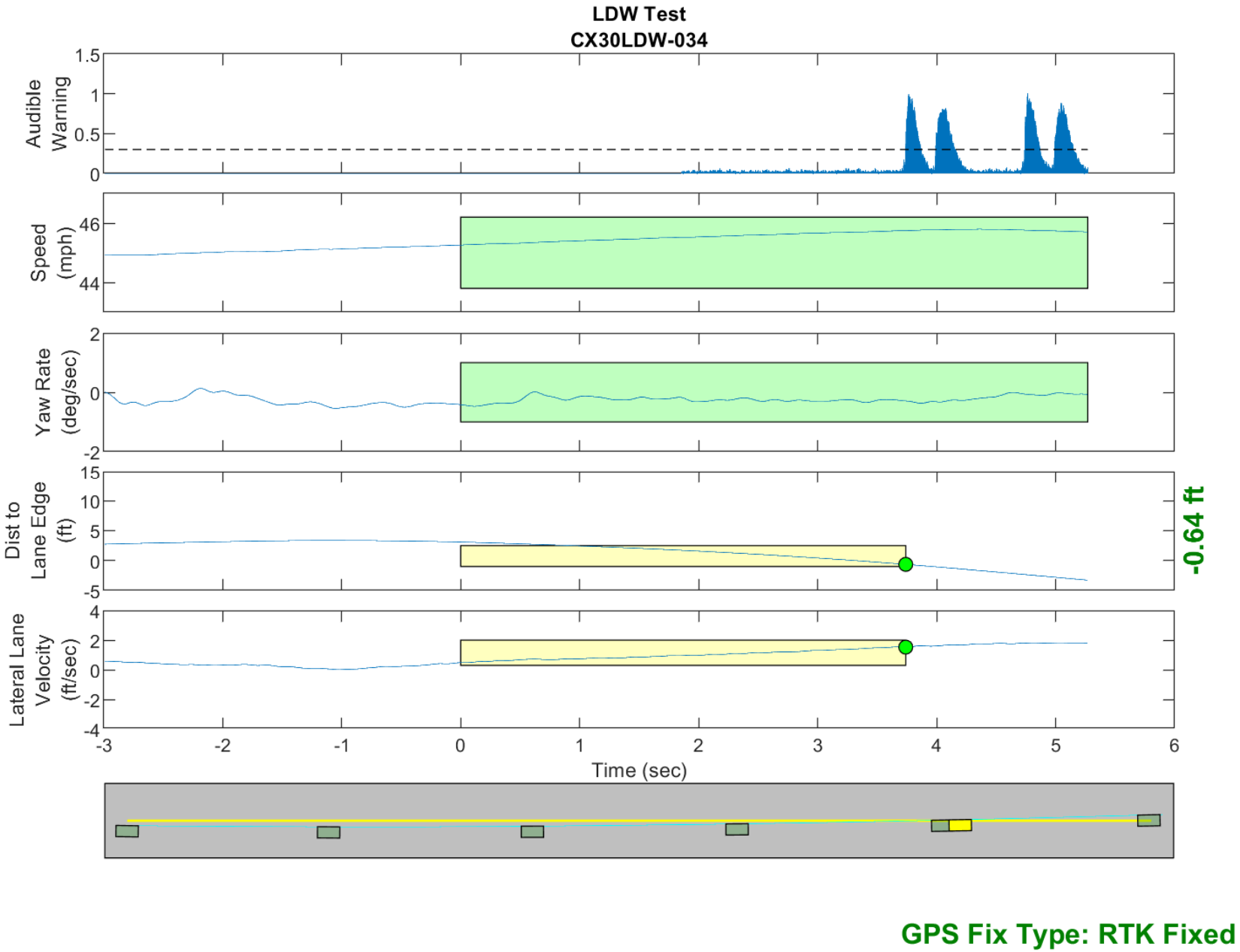


Figure D58. Time History for Run 34, Solid Line, Left Departure, Audible Warning

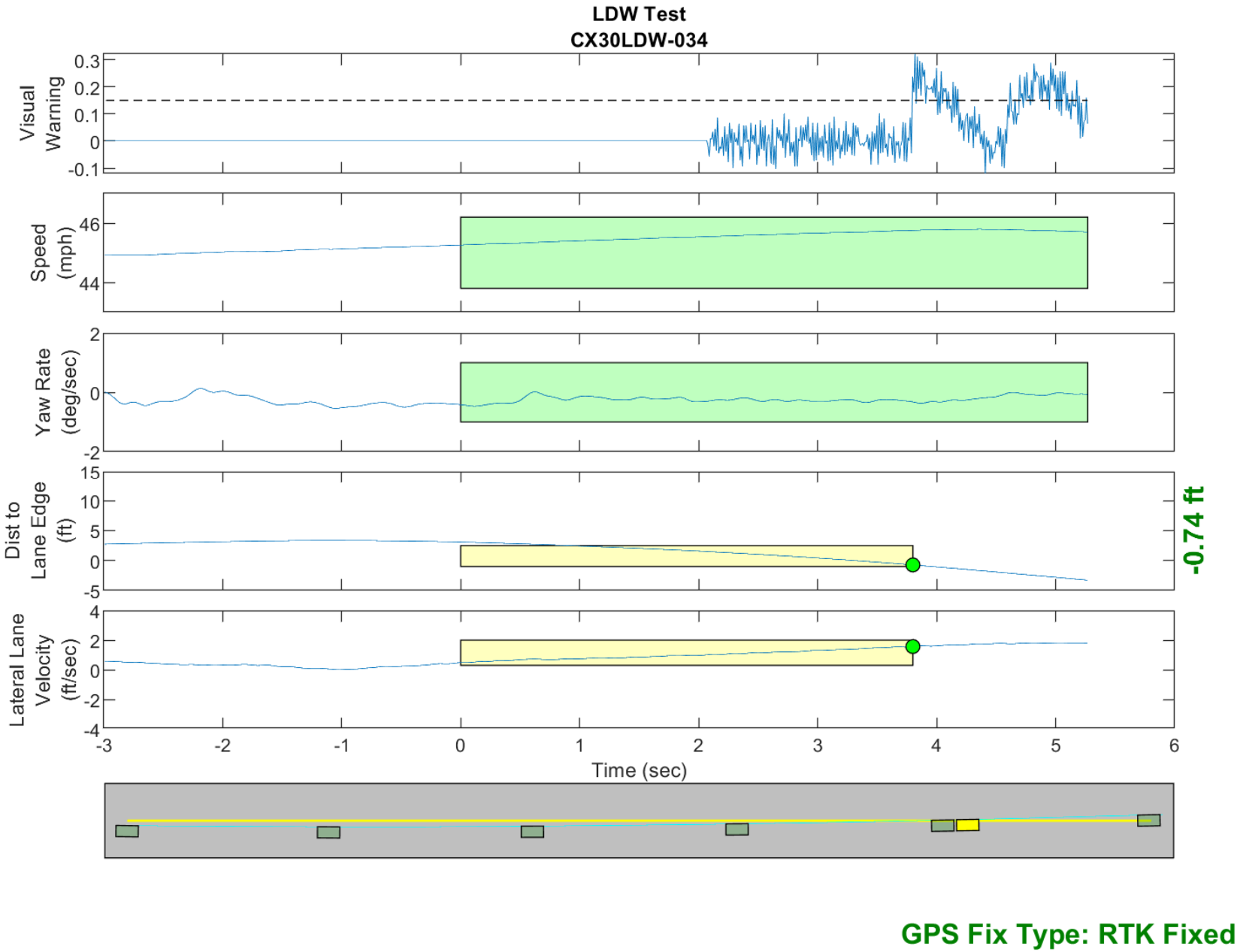


Figure D59. Time History for Run 34, Solid Line, Left Departure, Visual Warning

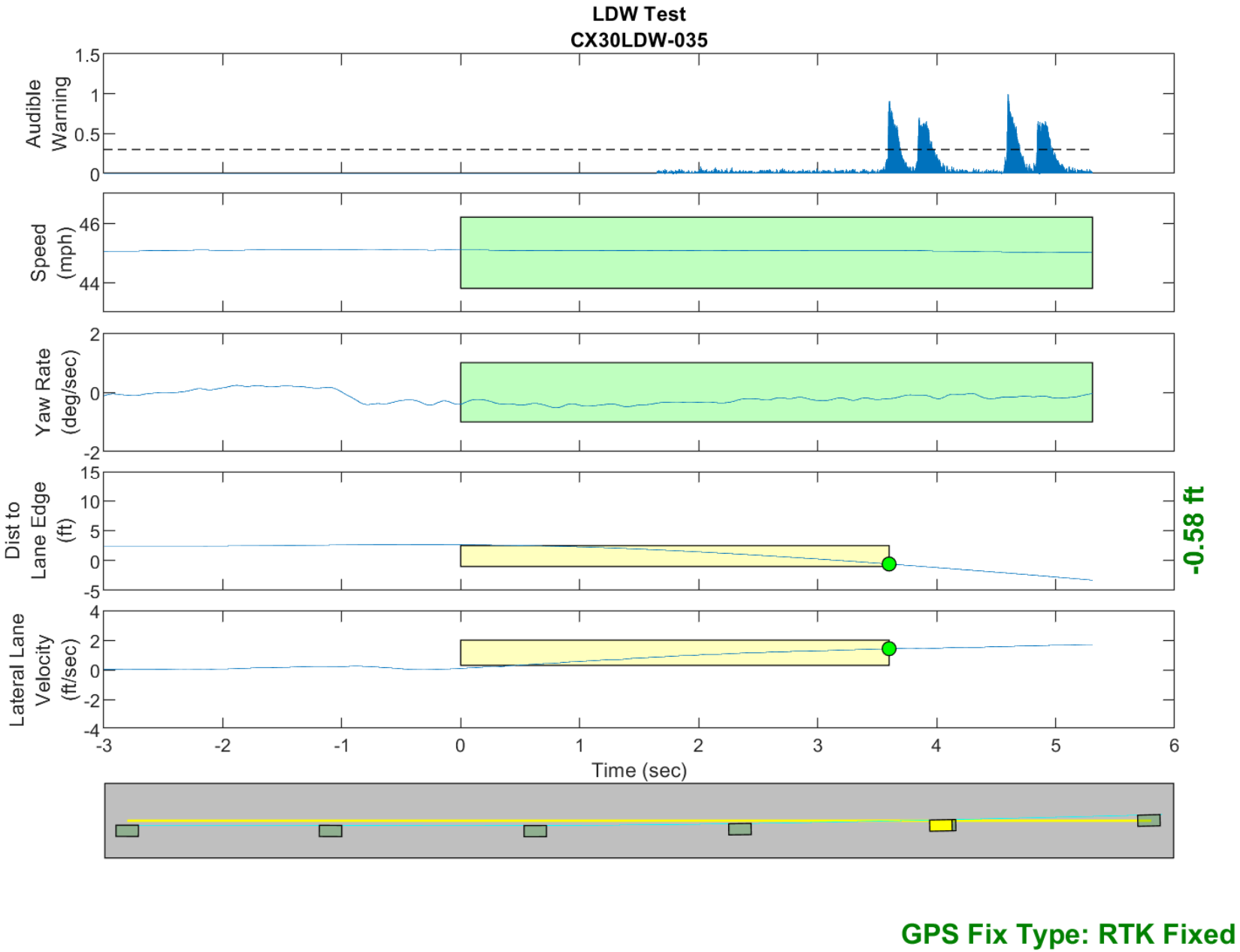


Figure D60. Time History for Run 35, Dashed Line, Left Departure, Audible Warning

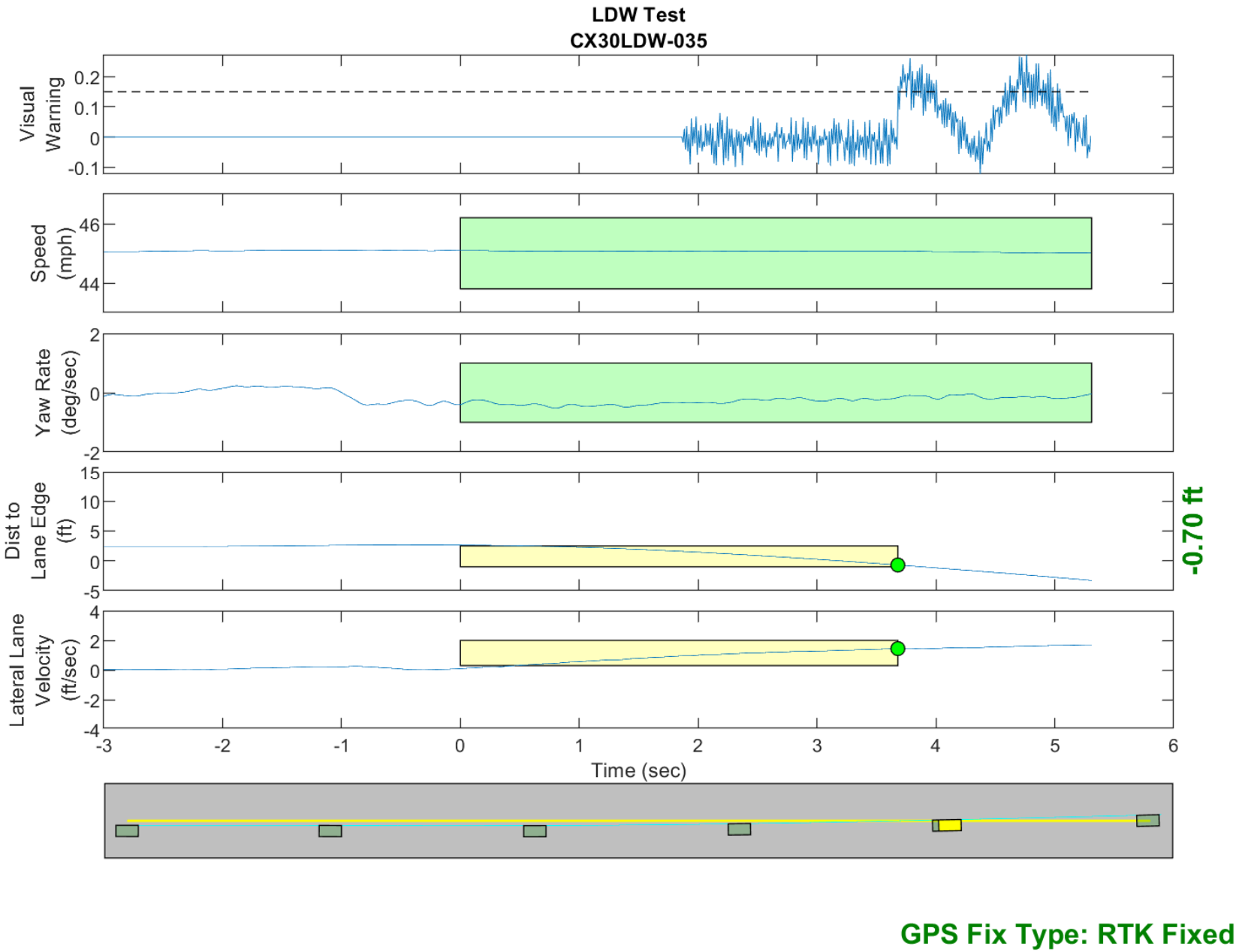


Figure D61. Time History for Run 35, Dashed Line, Left Departure, Visual Warning

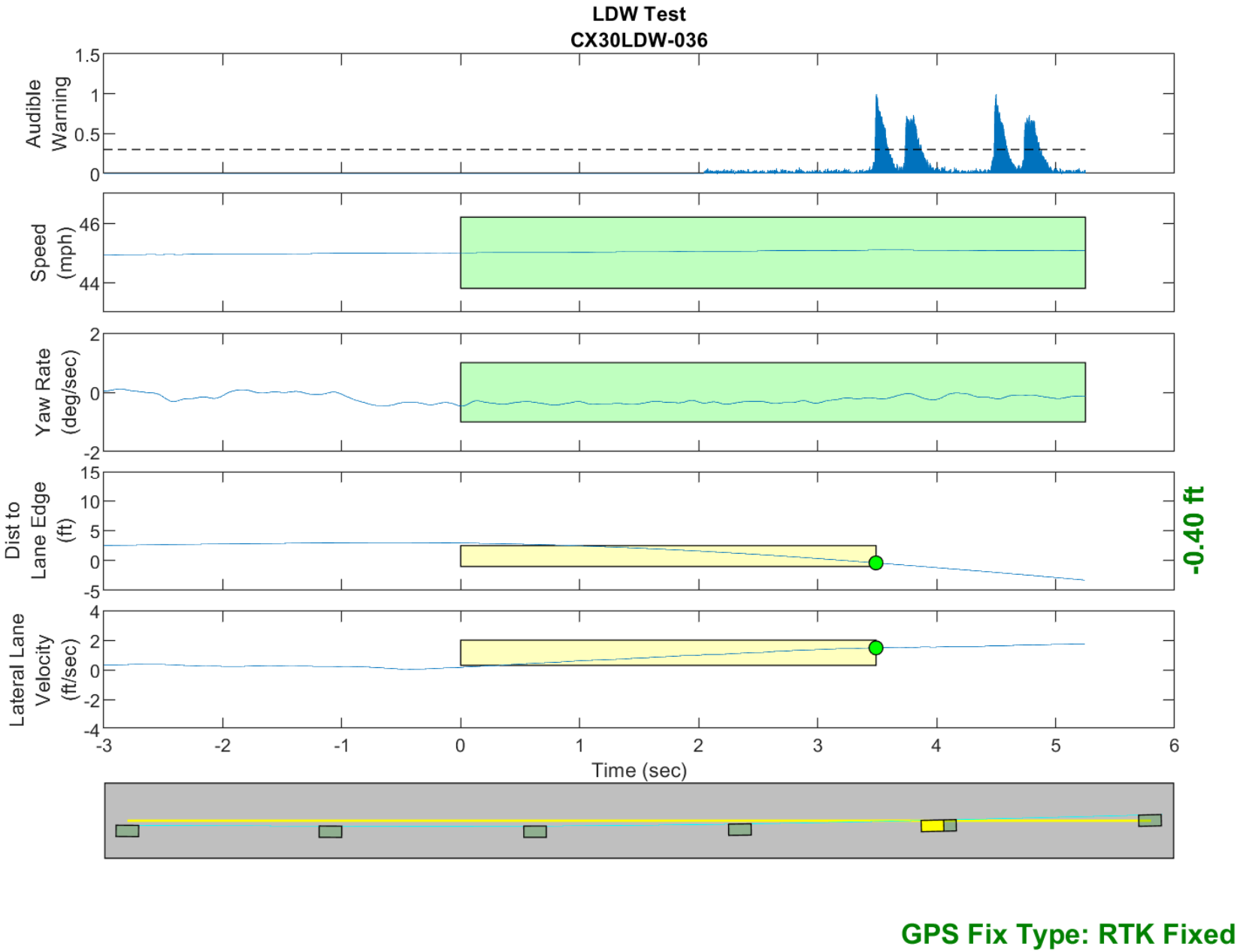


Figure D62. Time History for Run 36, Dashed Line, Left Departure, Audible Warning

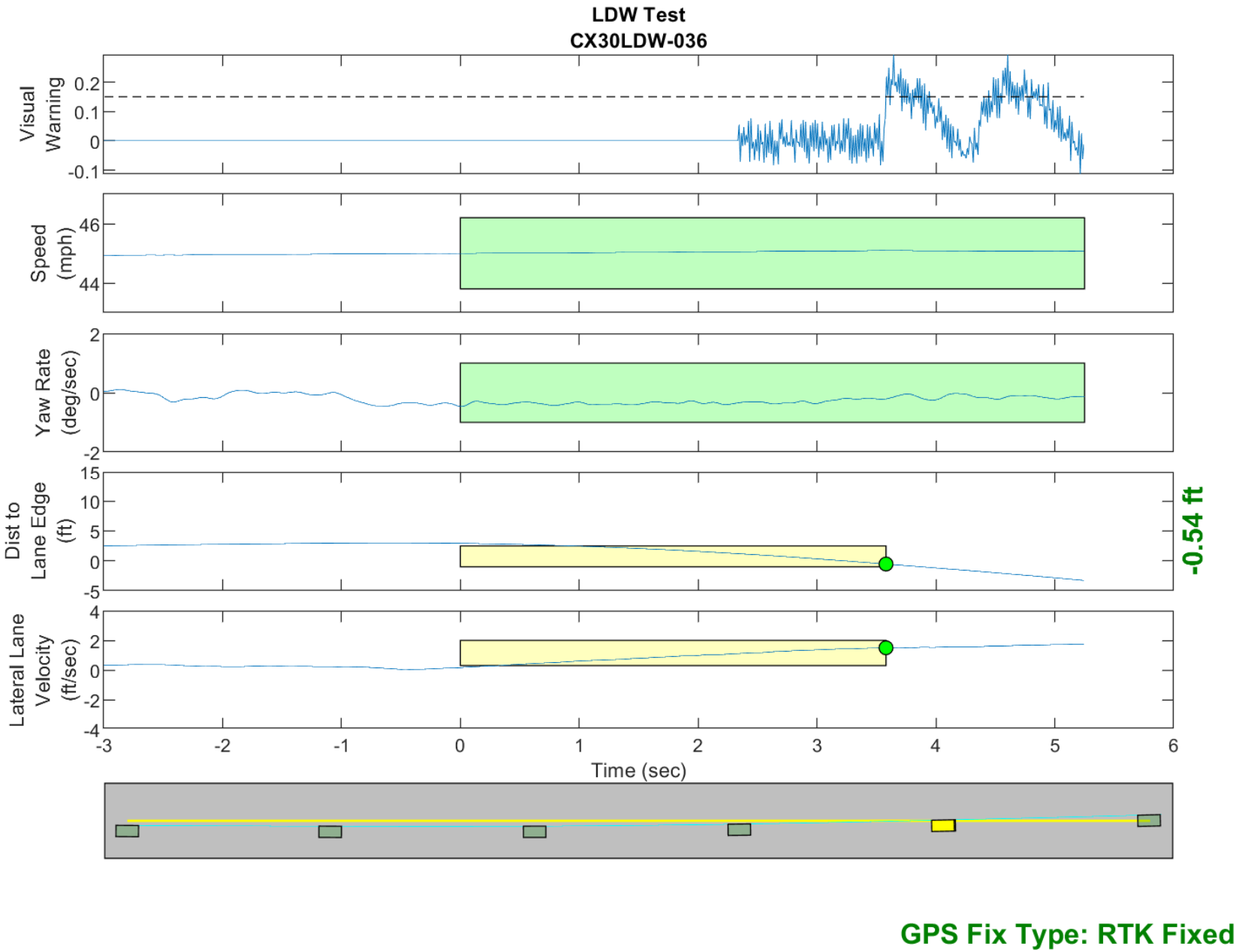


Figure D63. Time History for Run 36, Dashed Line, Left Departure, Visual Warning

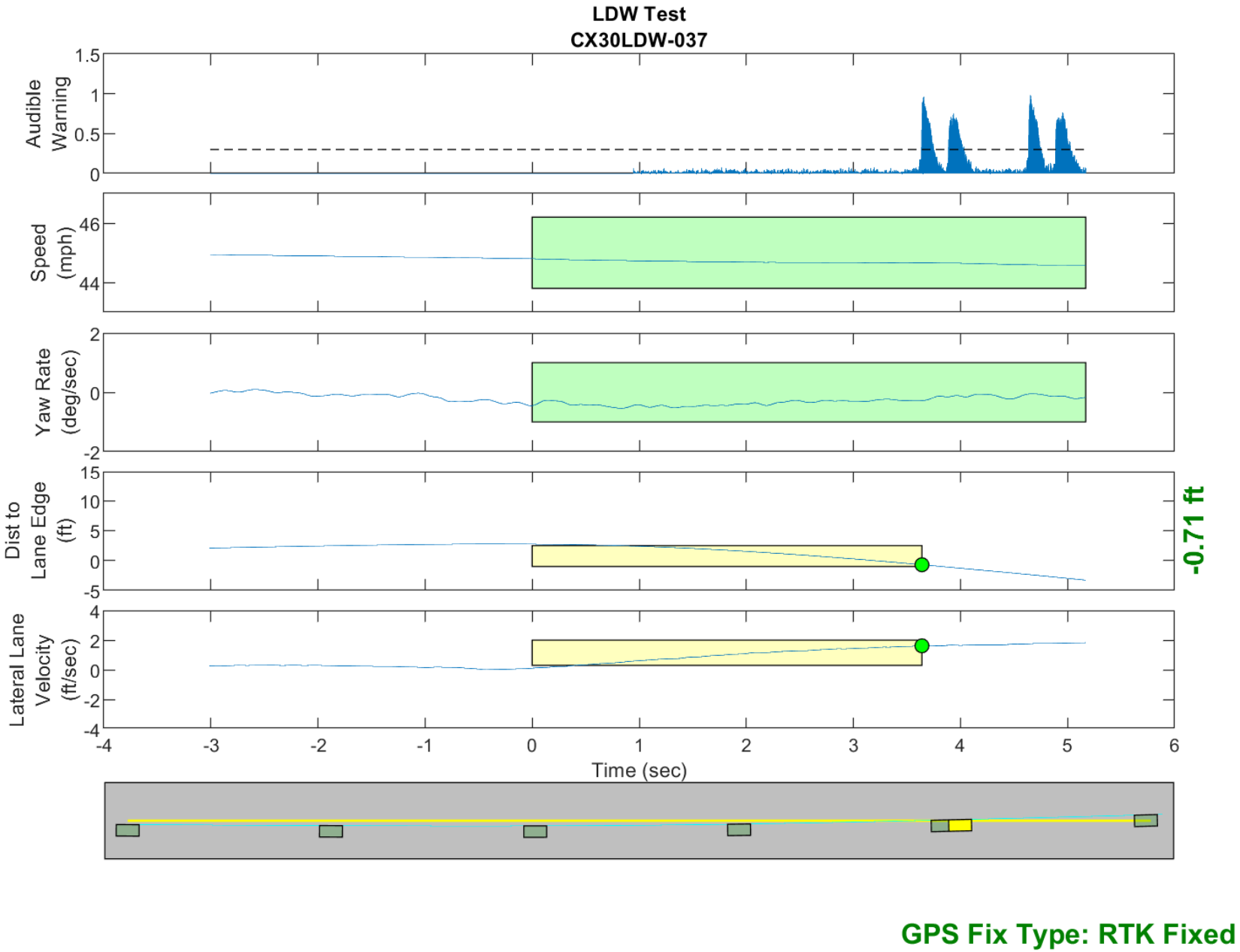


Figure D64. Time History for Run 37, Dashed Line, Left Departure, Audible Warning

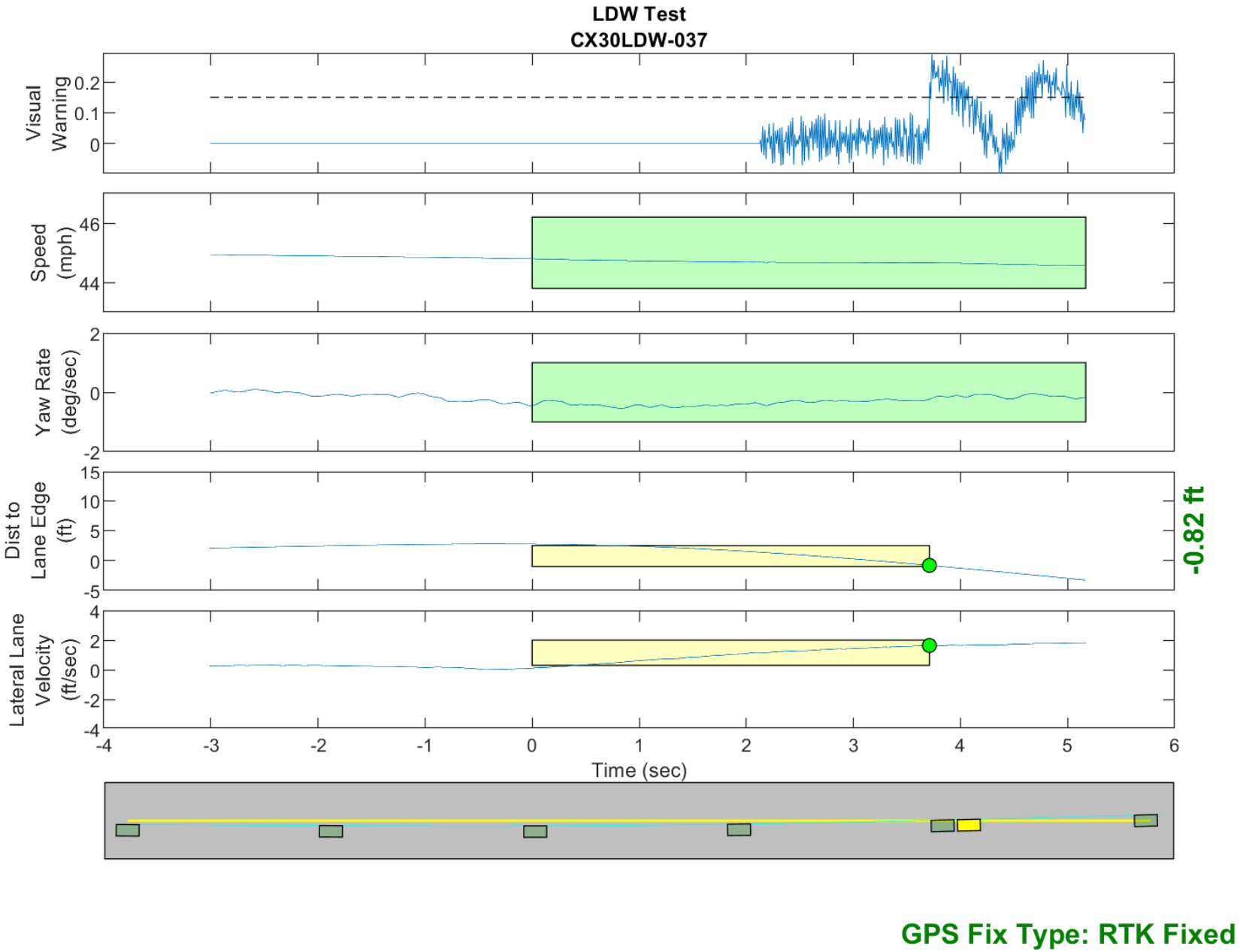


Figure D65. Time History for Run 37, Dashed Line, Left Departure, Visual Warning

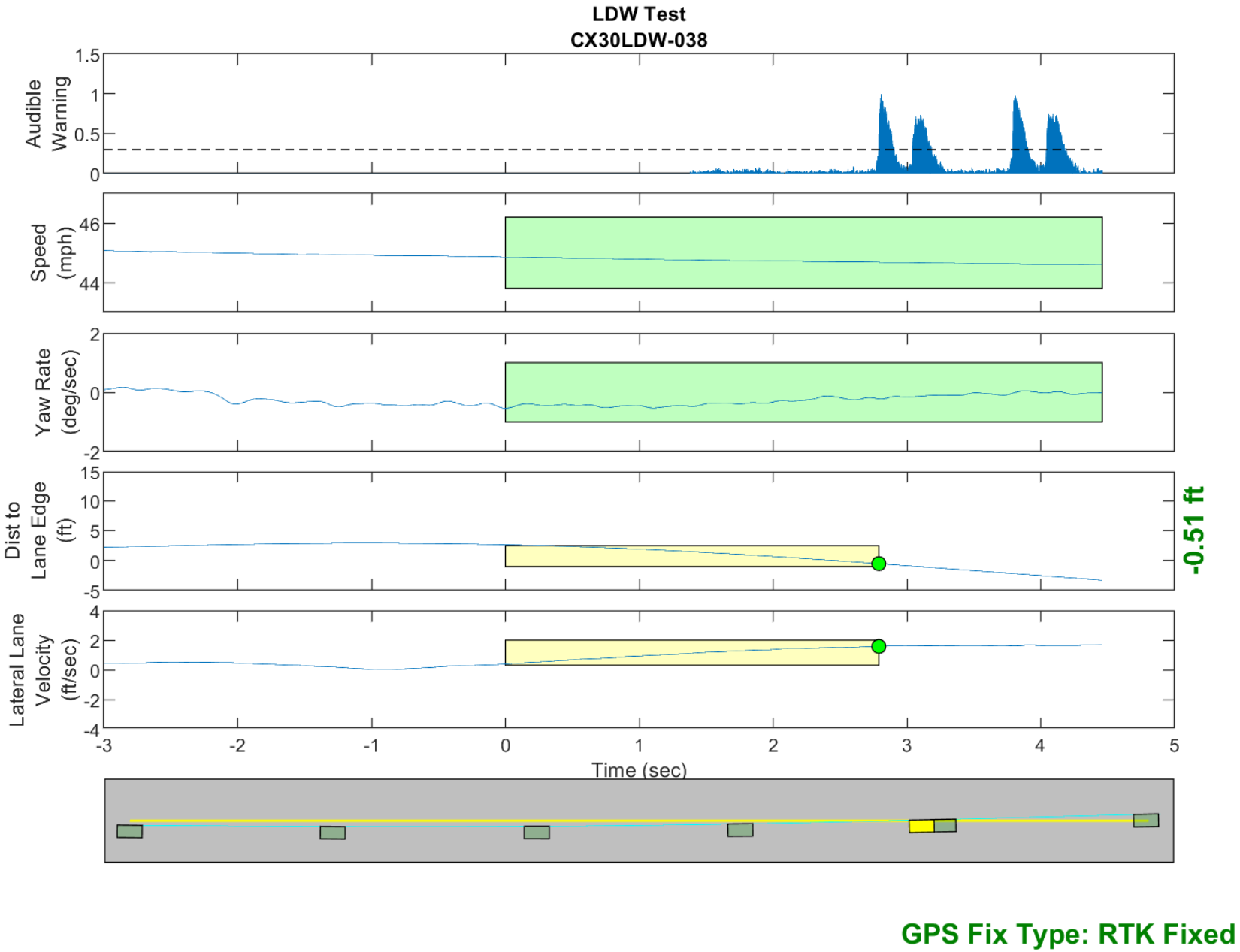


Figure D66. Time History for Run 38, Dashed Line, Left Departure, Audible Warning

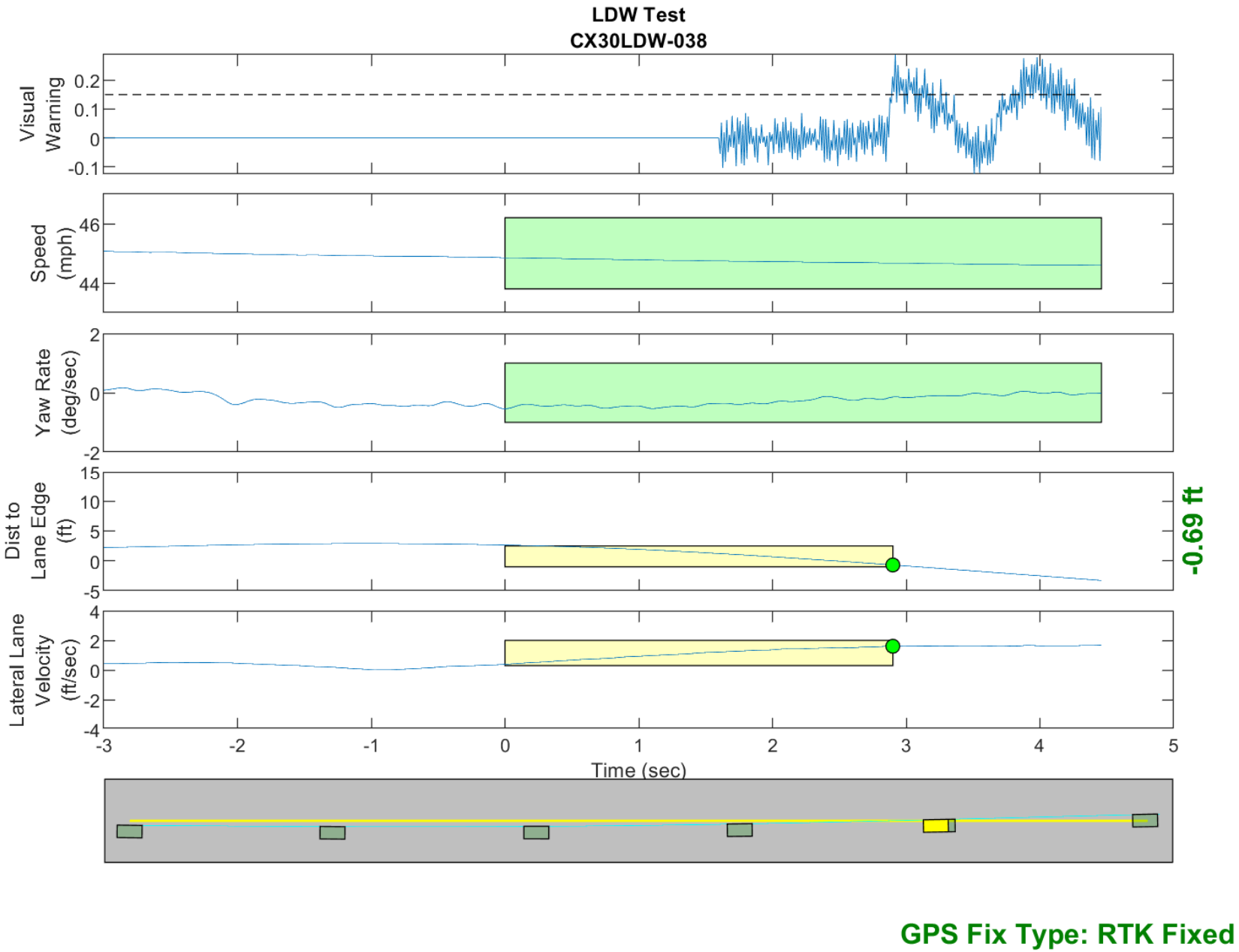


Figure D67. Time History for Run 38, Dashed Line, Left Departure, Visual Warning

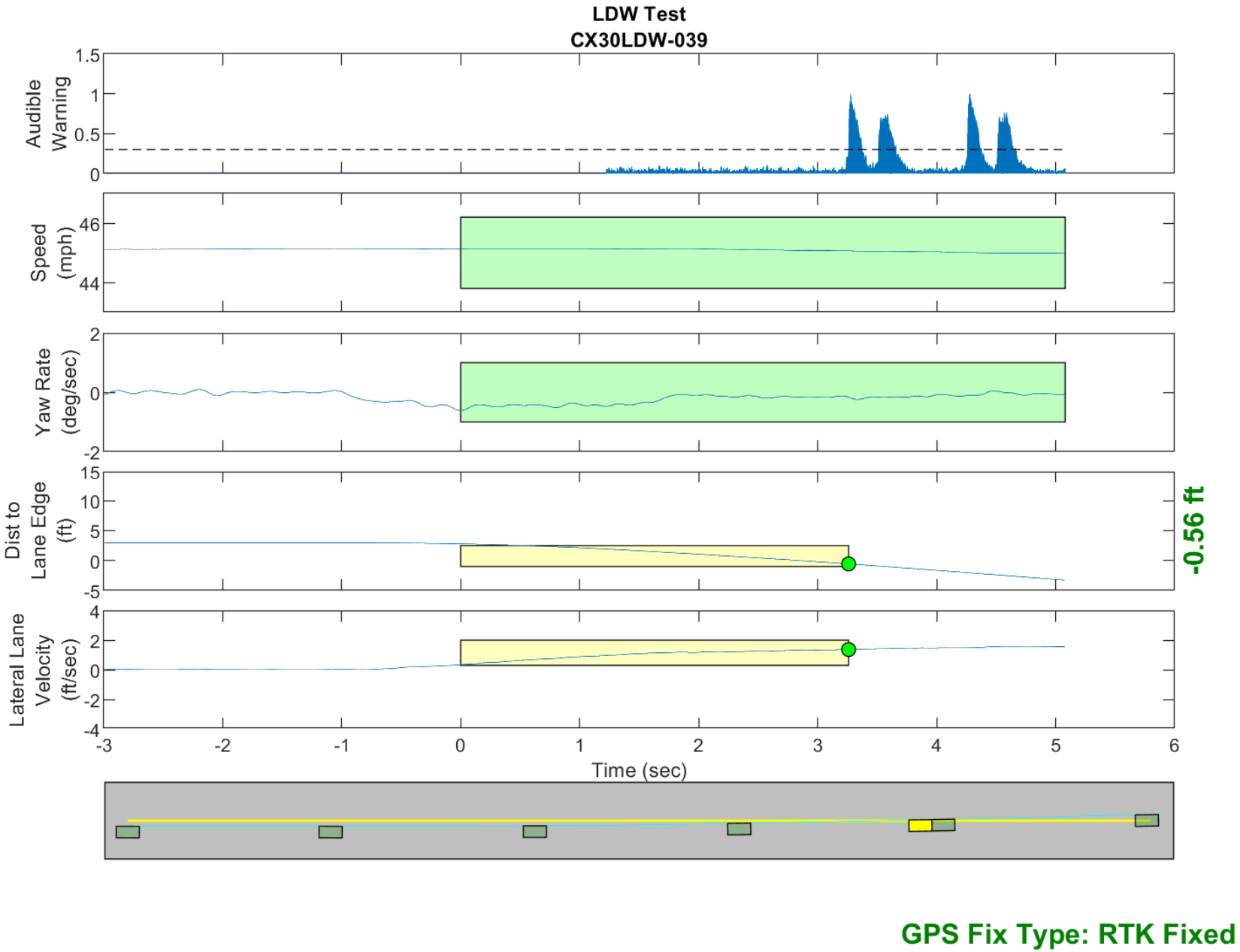


Figure D68. Time History for Run 39, Dashed Line, Left Departure, Audible Warning

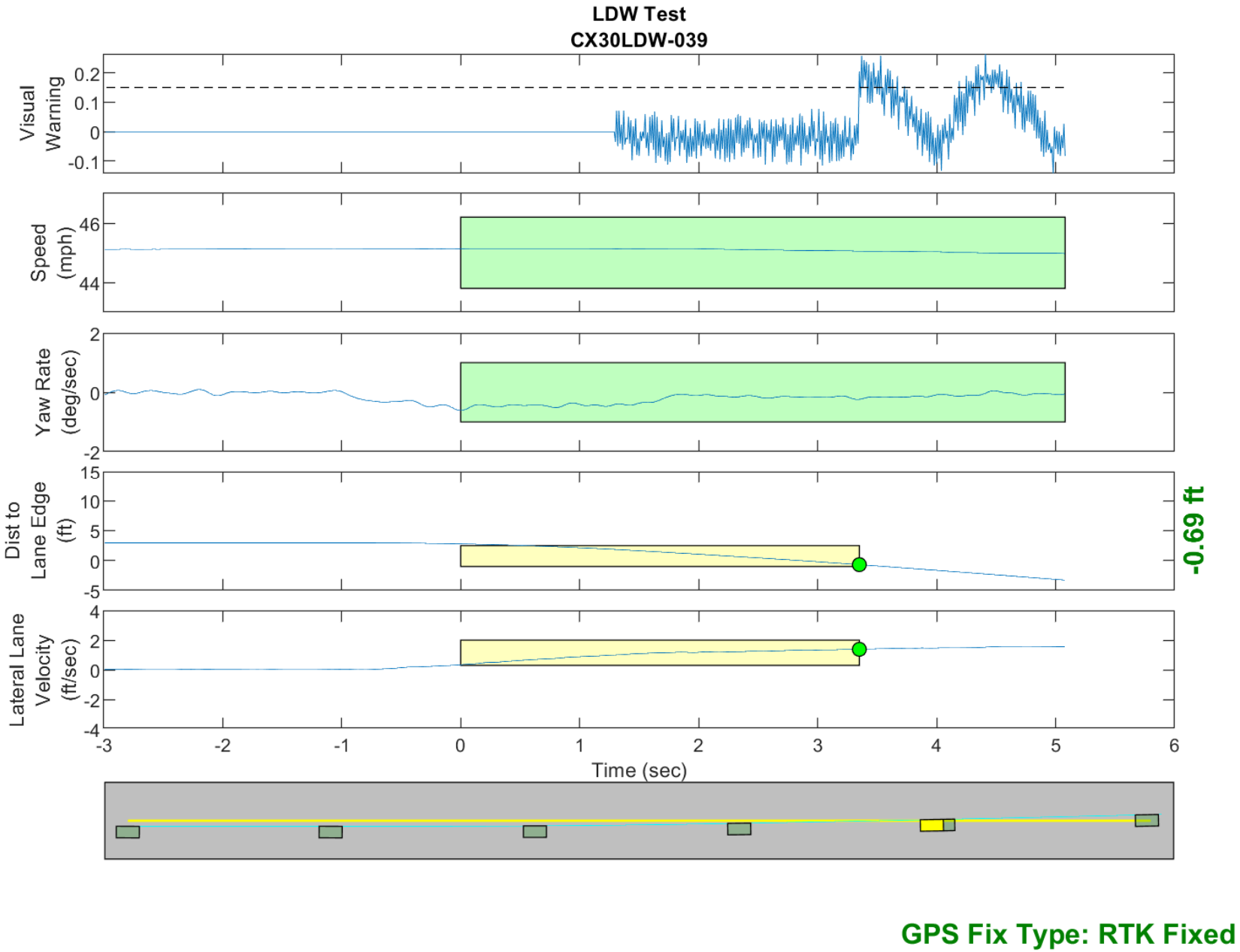


Figure D69. Time History for Run 39, Dashed Line, Left Departure, Visual Warning

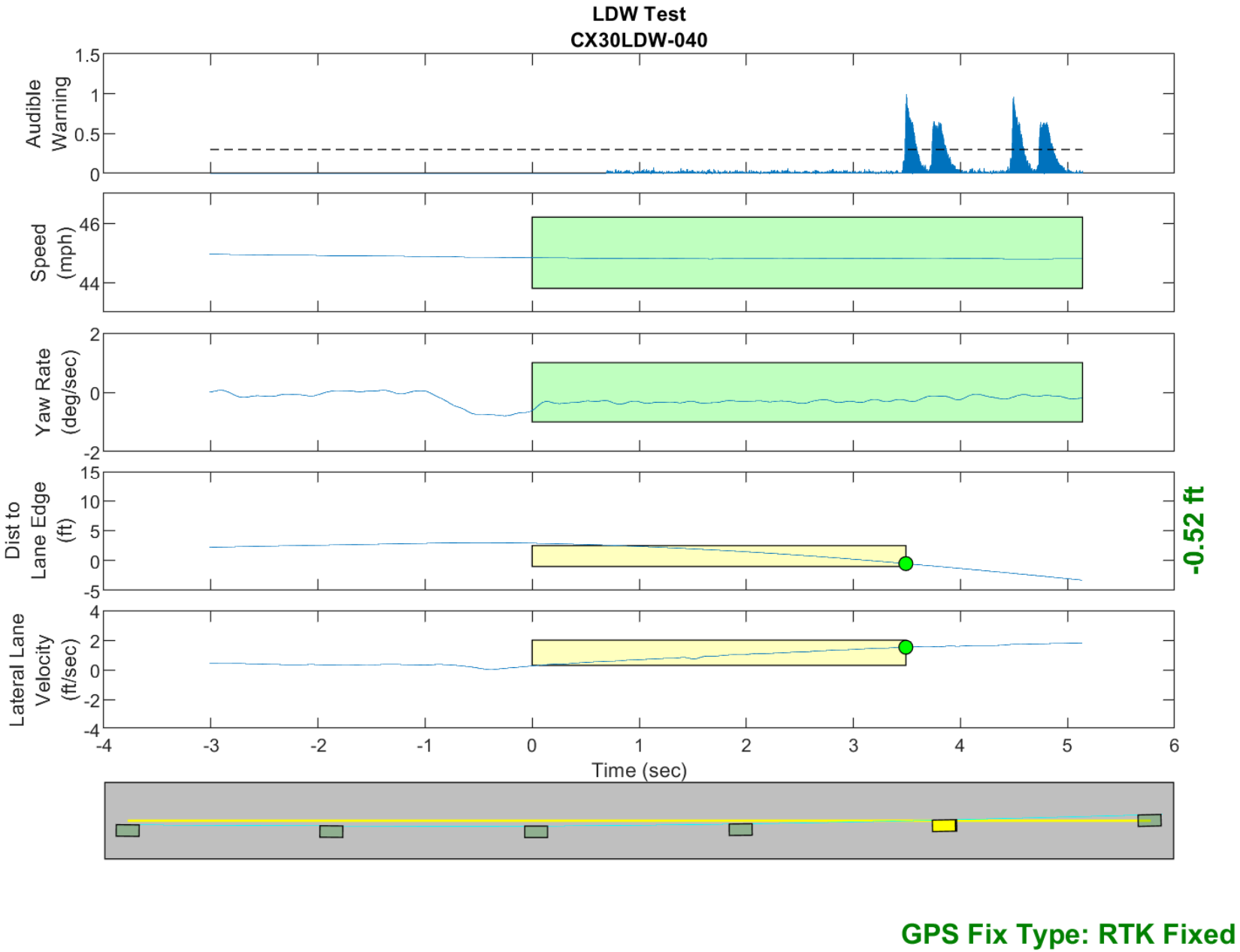


Figure D70. Time History for Run 40, Dashed Line, Left Departure, Audible Warning

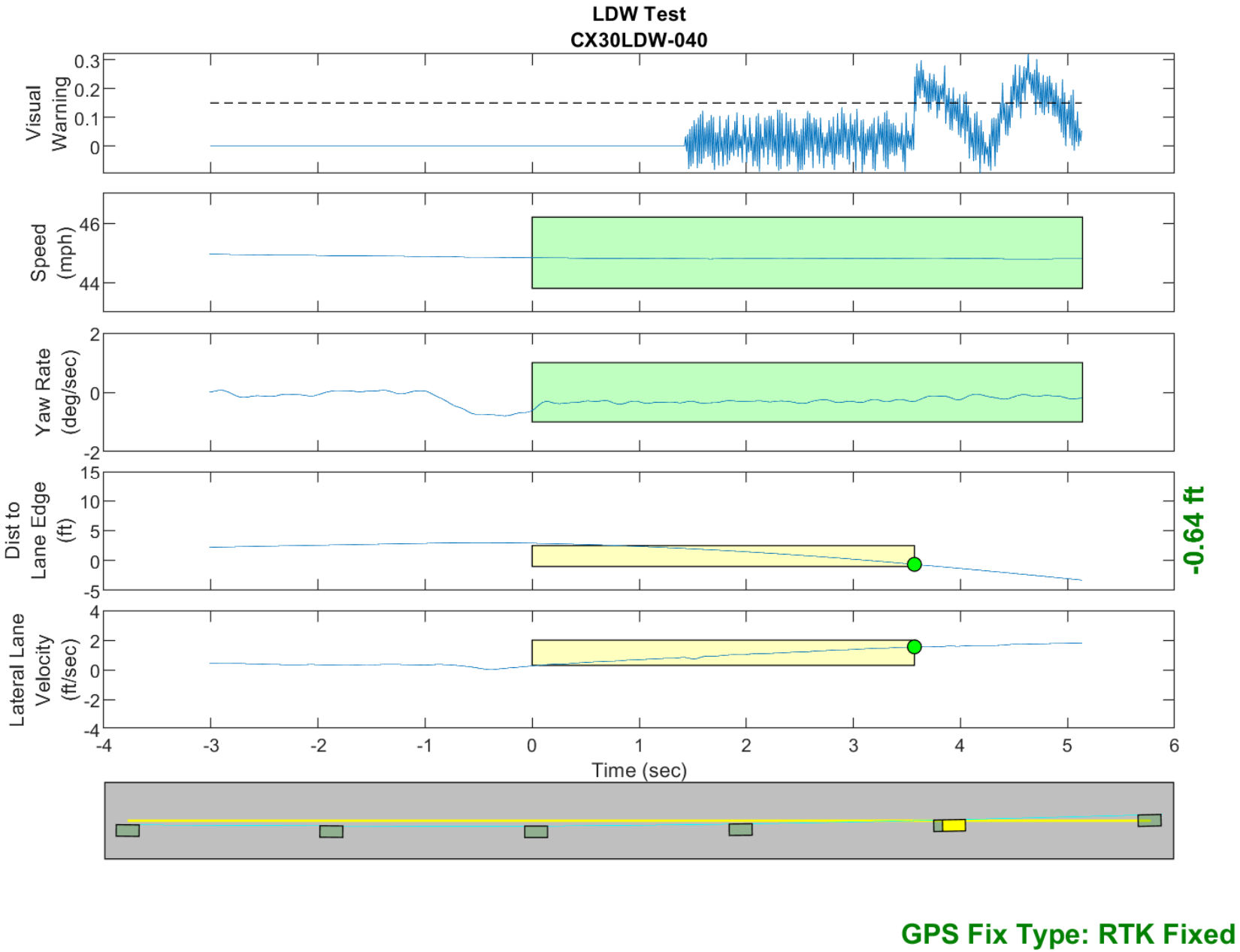


Figure D71. Time History for Run 40, Dashed Line, Left Departure, Visual Warning

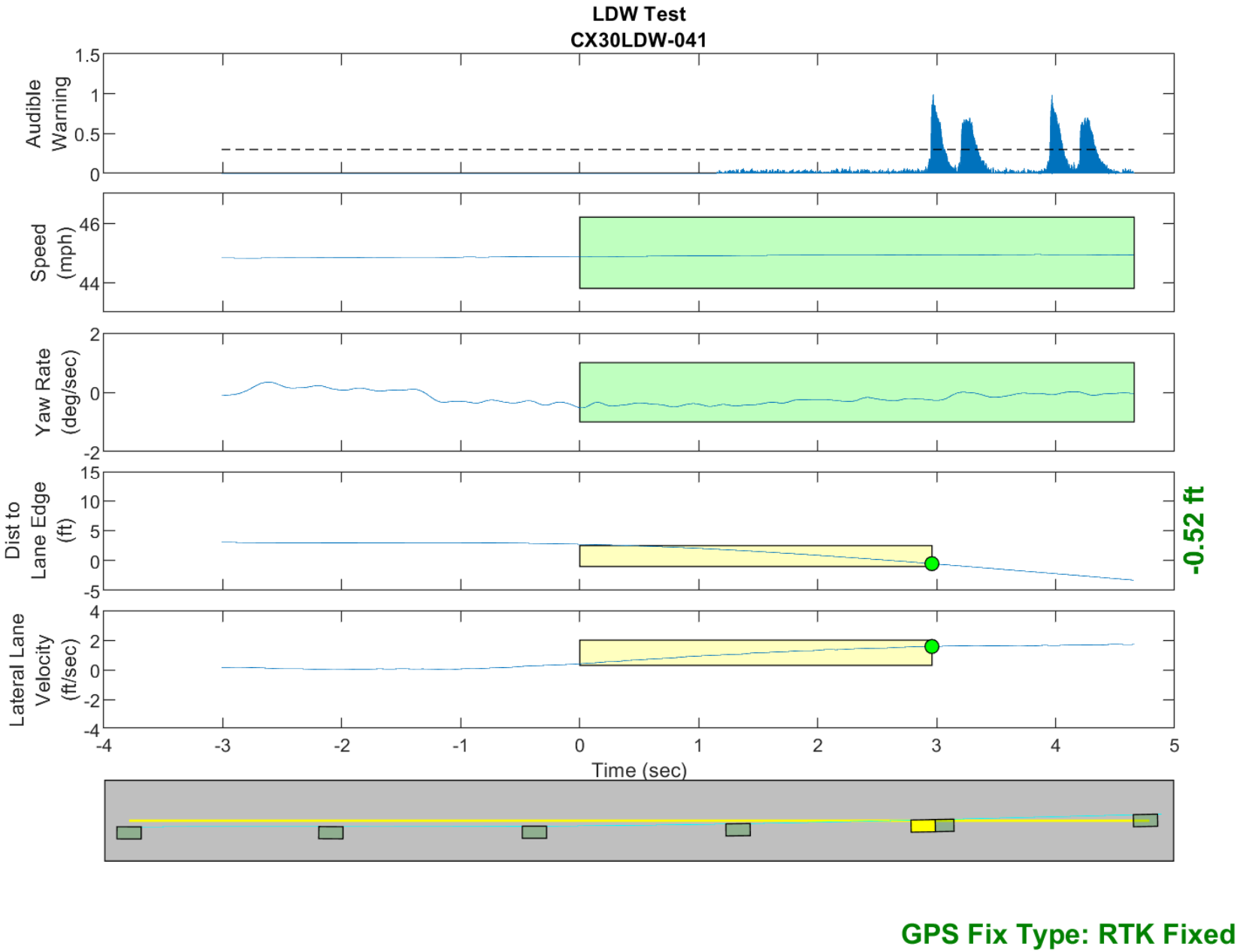


Figure D72. Time History for Run 41, Dashed Line, Left Departure, Audible Warning

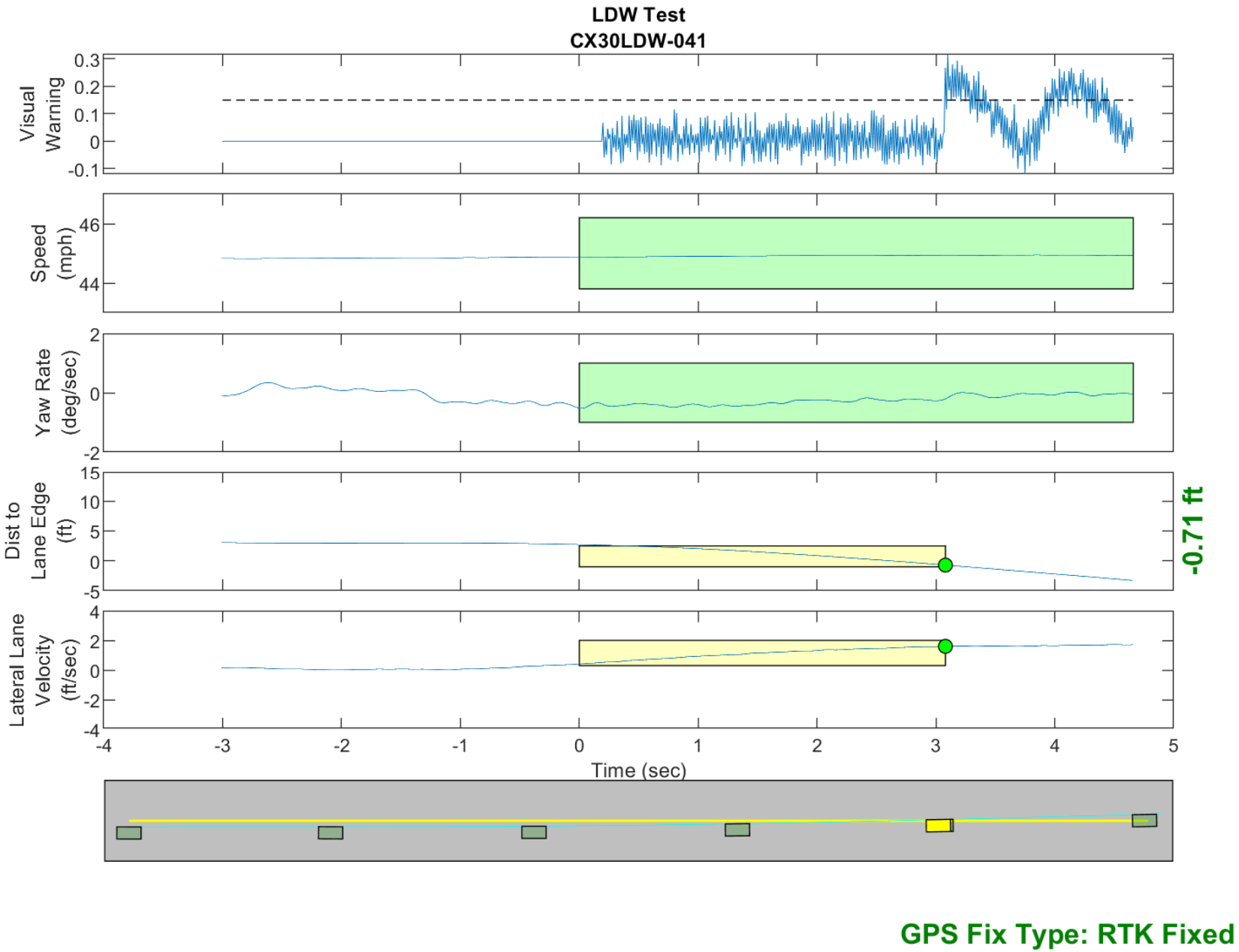


Figure D73. Time History for Run 41, Dashed Line, Left Departure, Visual Warning

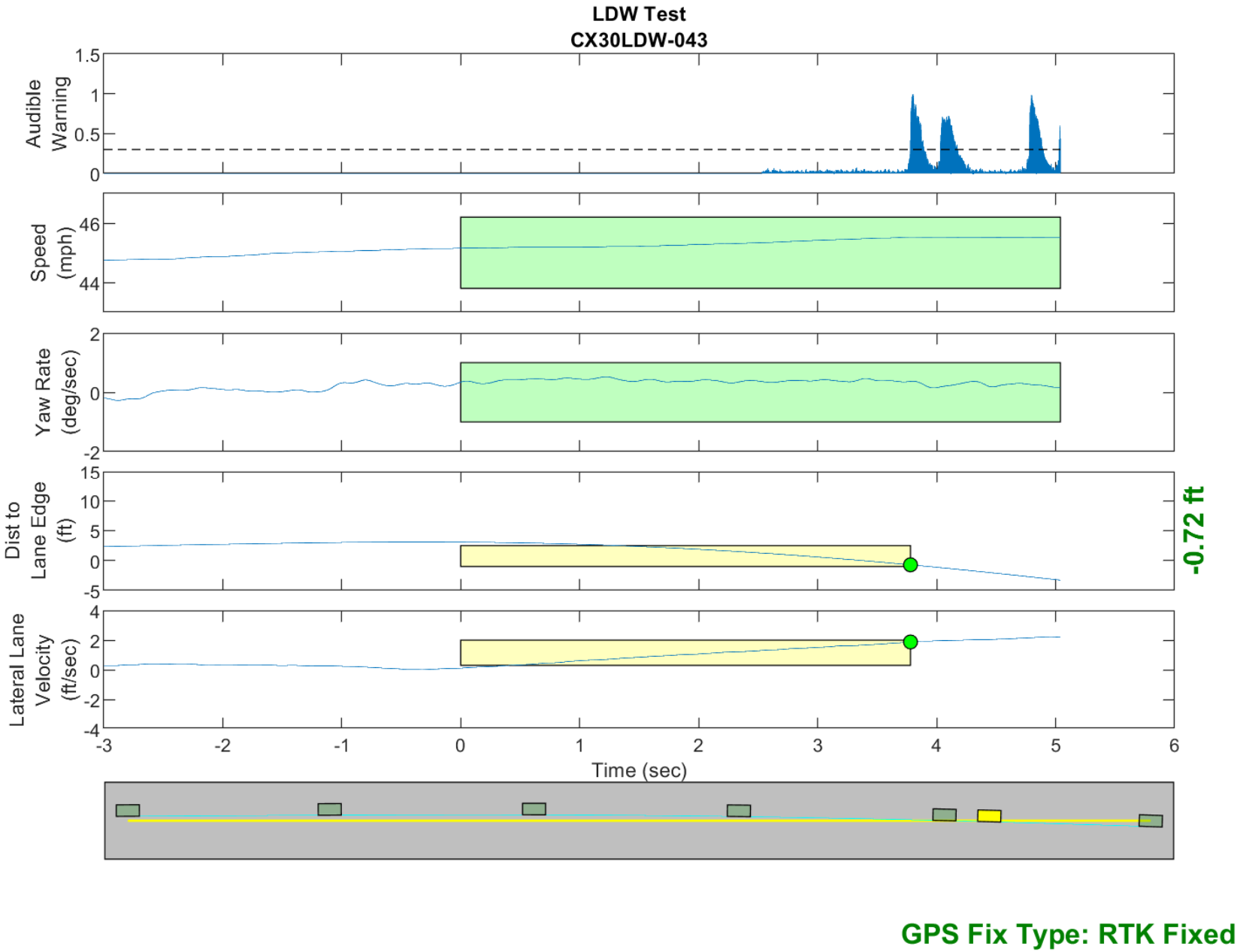


Figure D74. Time History for Run 43, Dashed Line, Right Departure, Audible Warning

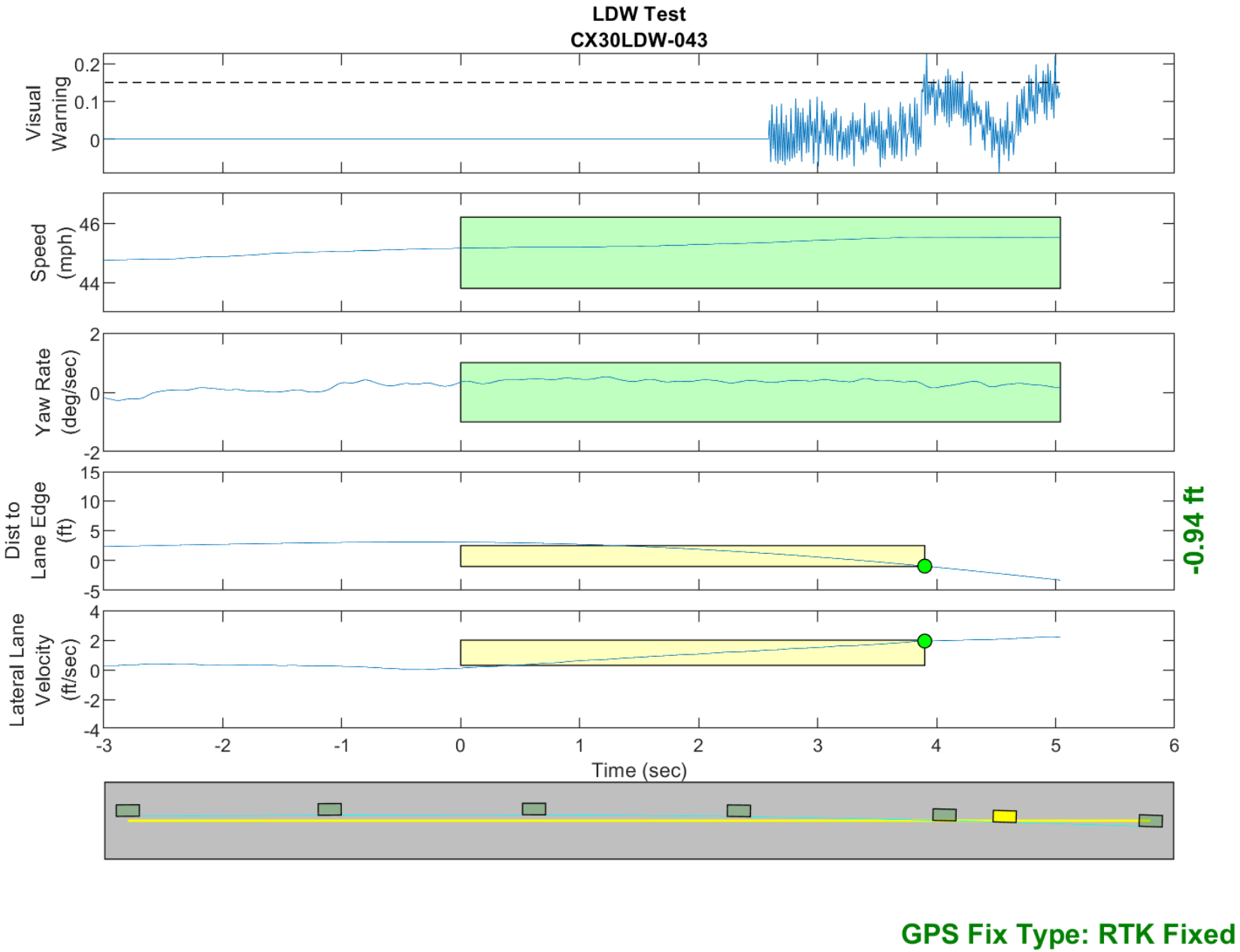


Figure D75. Time History for Run 43, Dashed Line, Right Departure, Visual Warning

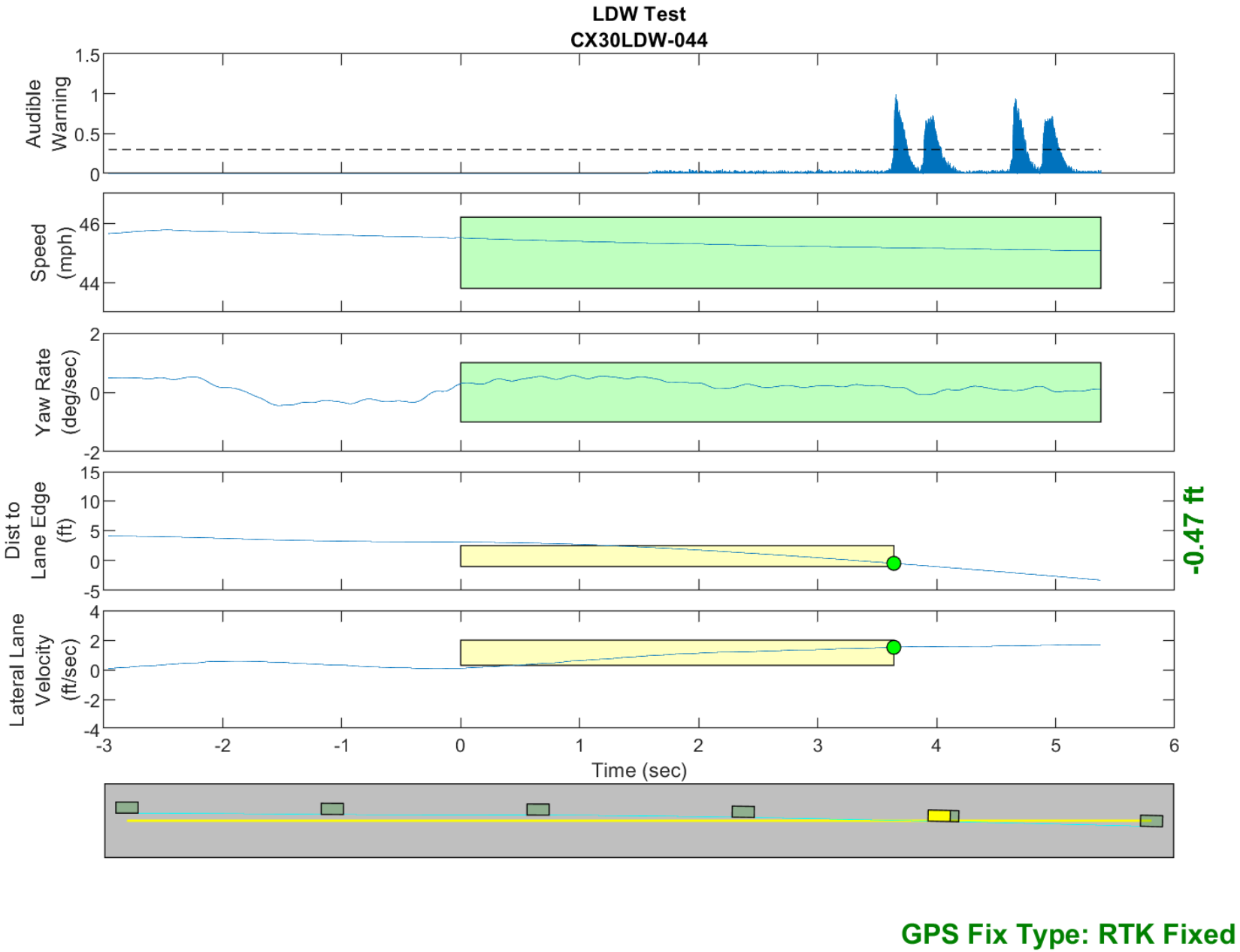


Figure D76. Time History for Run 44, Dashed Line, Right Departure, Audible Warning

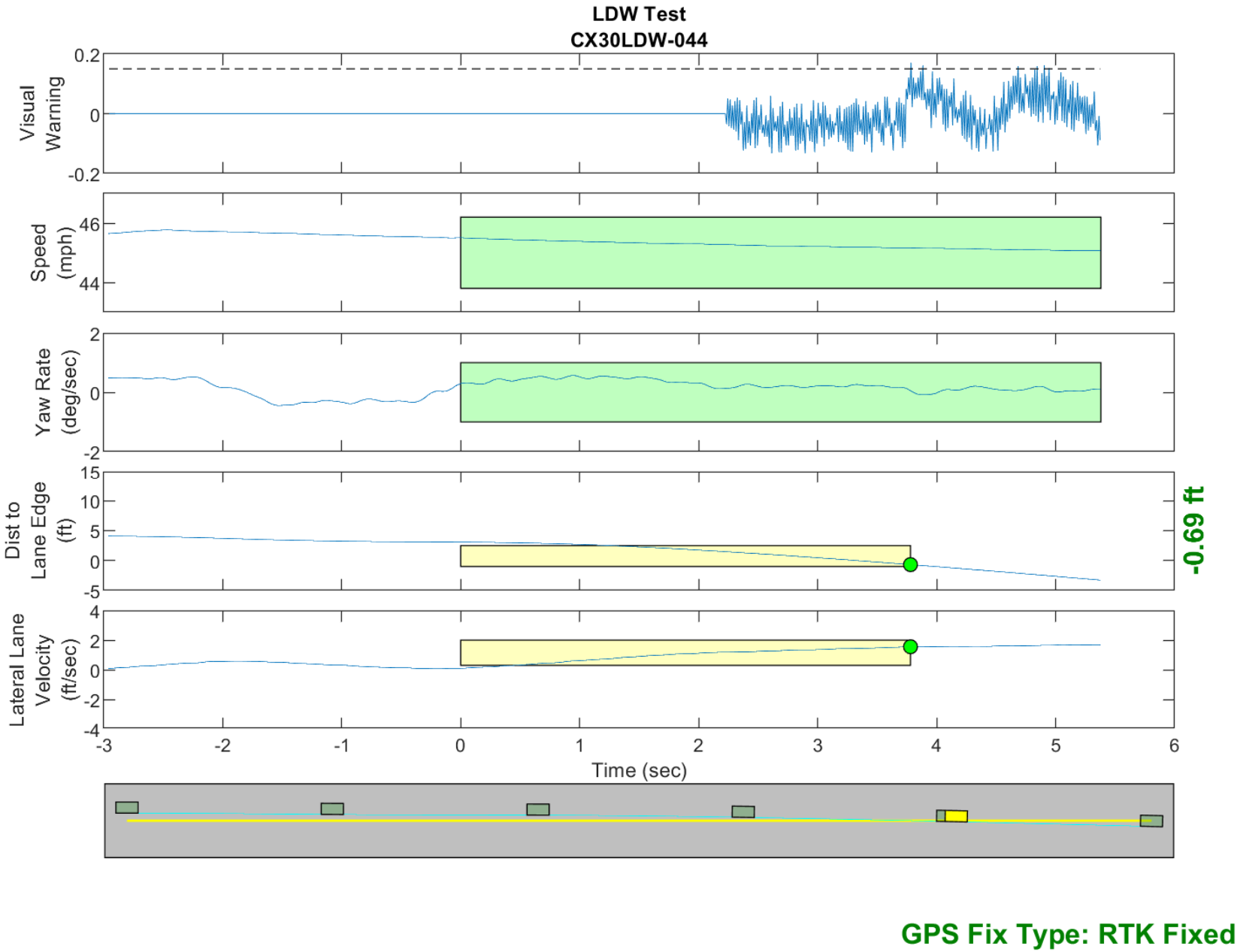


Figure D77. Time History for Run 44, Dashed Line, Right Departure, Visual Warning

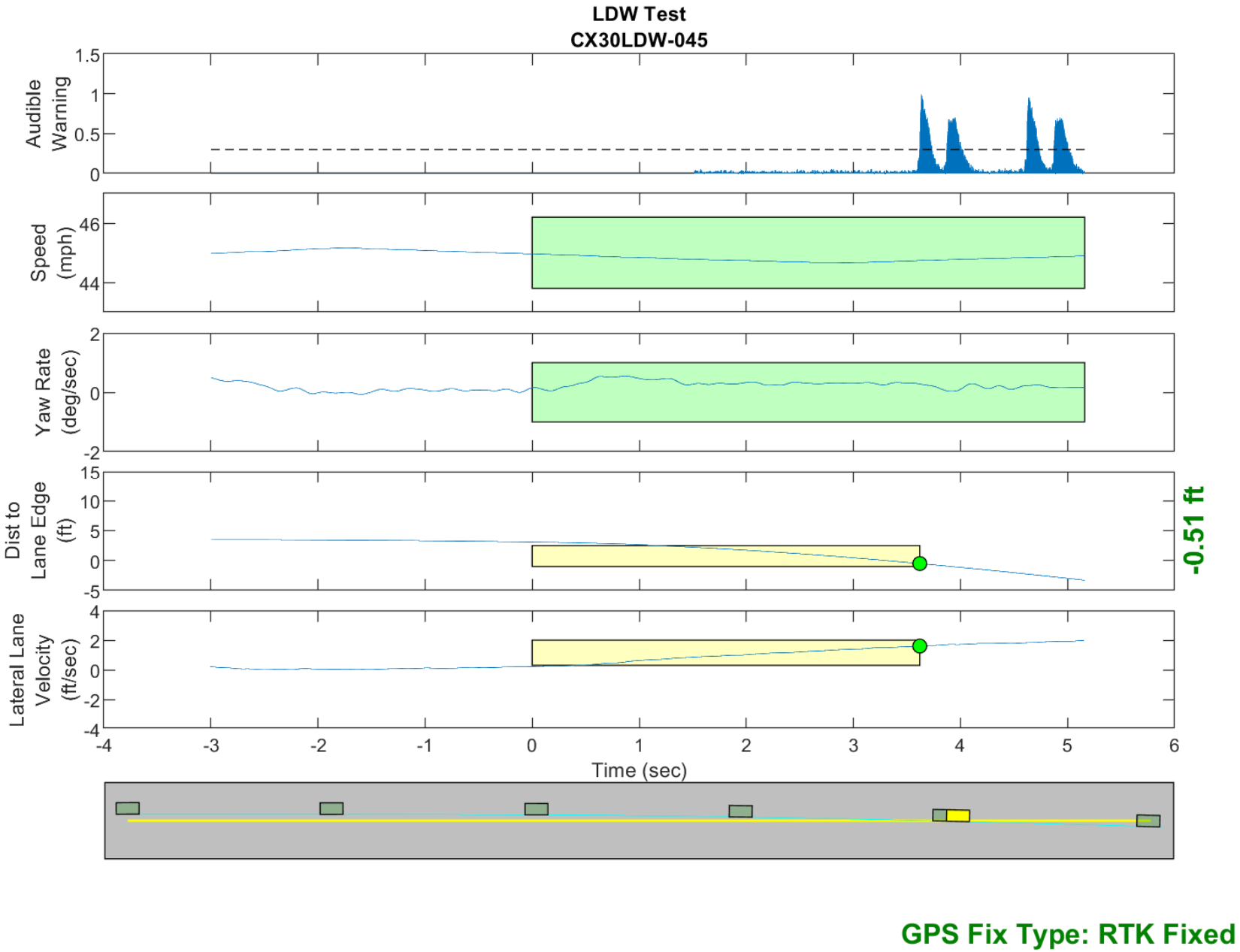


Figure D78. Time History for Run 45, Dashed Line, Right Departure, Audible Warning

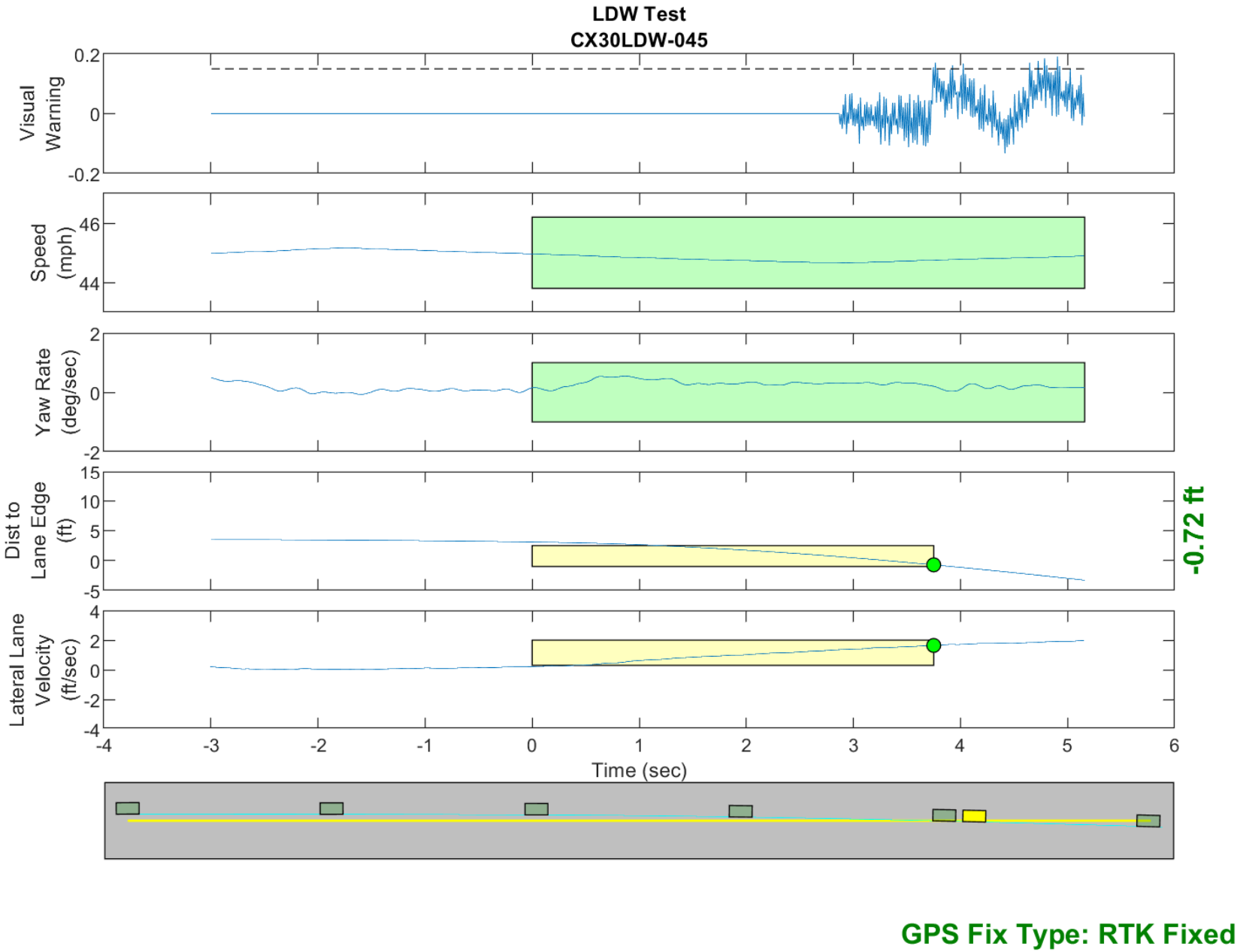


Figure D79. Time History for Run 45, Dashed Line, Right Departure, Visual Warning

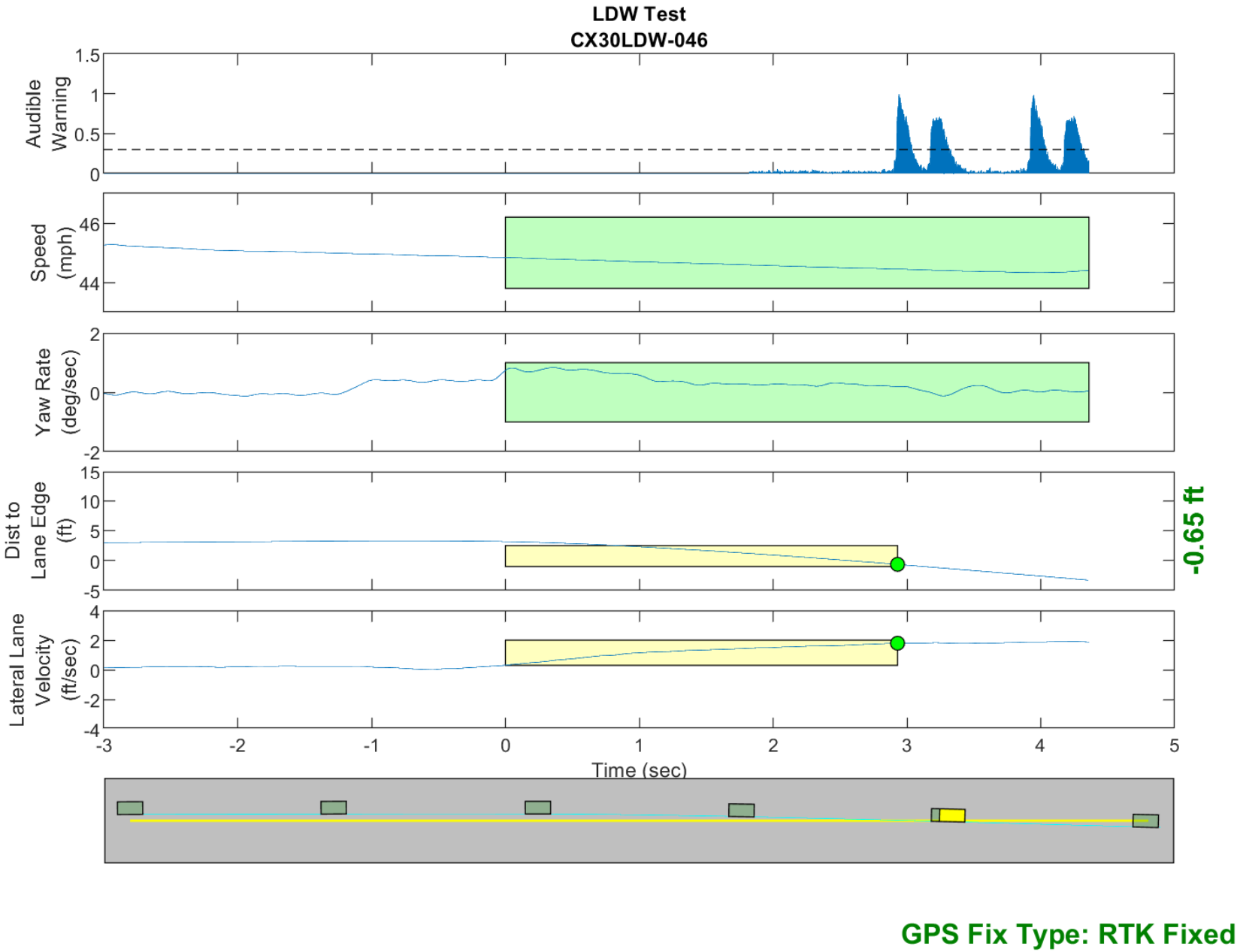


Figure D80. Time History for Run 46, Dashed Line, Right Departure, Audible Warning

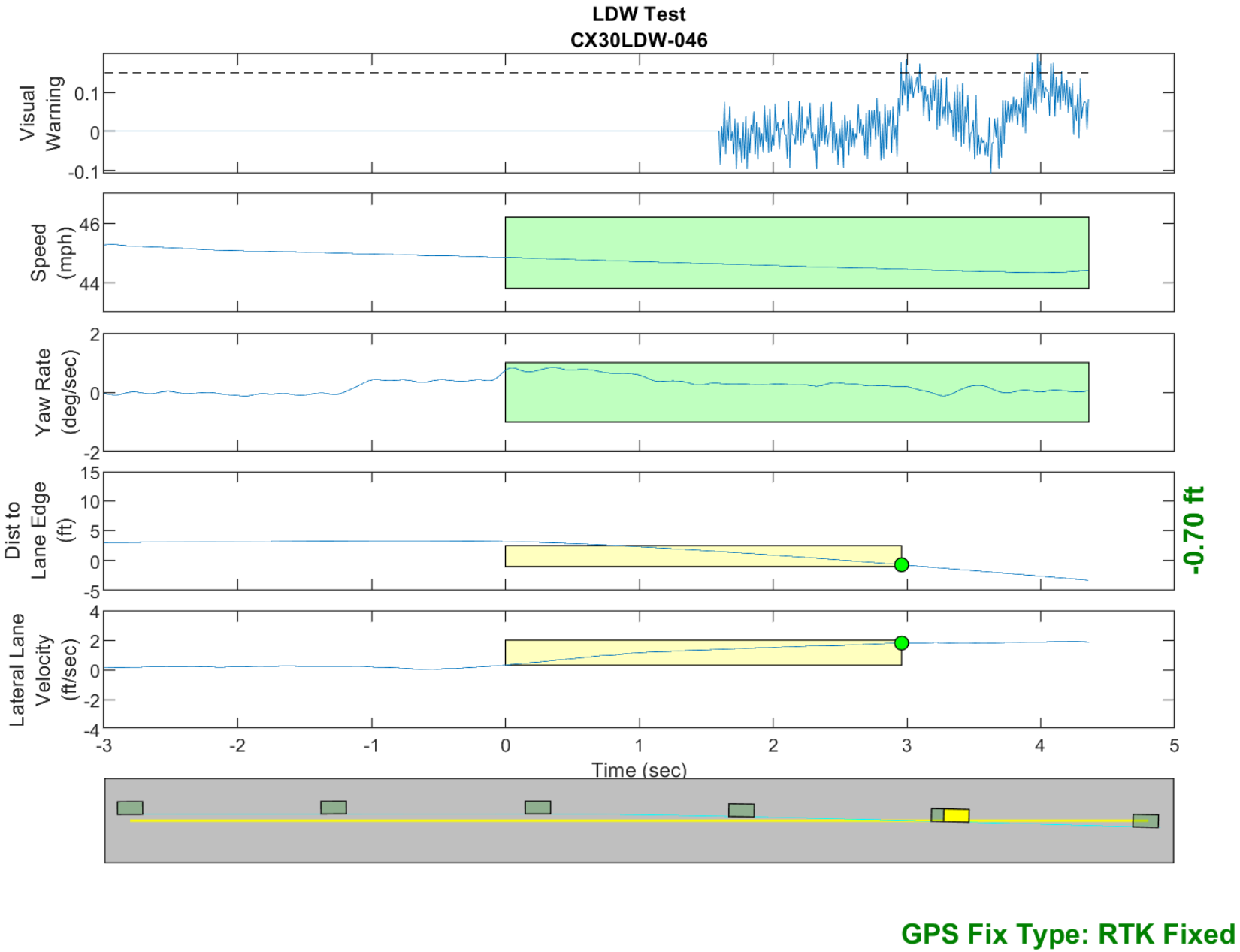


Figure D81. Time History for Run 46, Dashed Line, Right Departure, Visual Warning

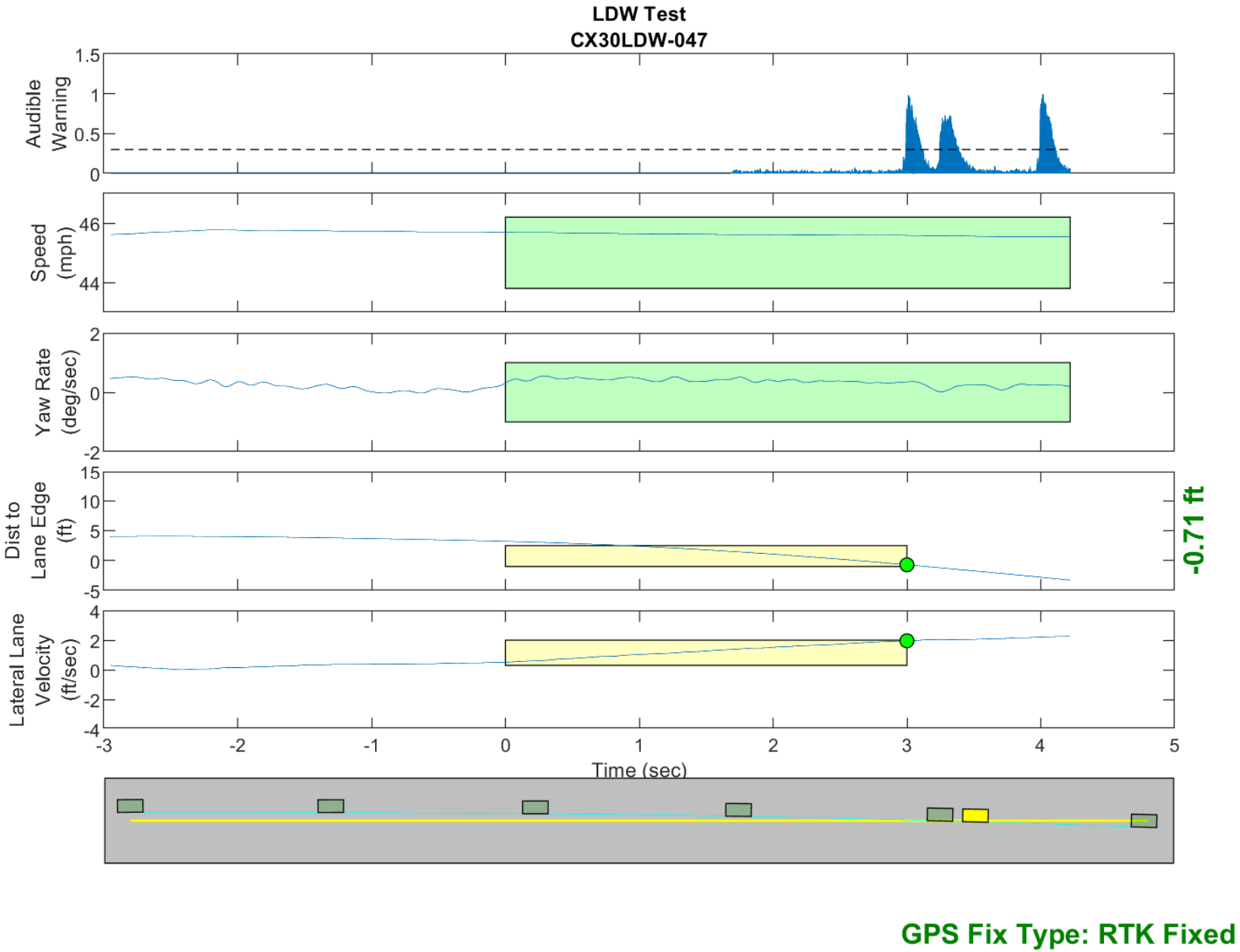


Figure D82. Time History for Run 47, Dashed Line, Right Departure, Audible Warning

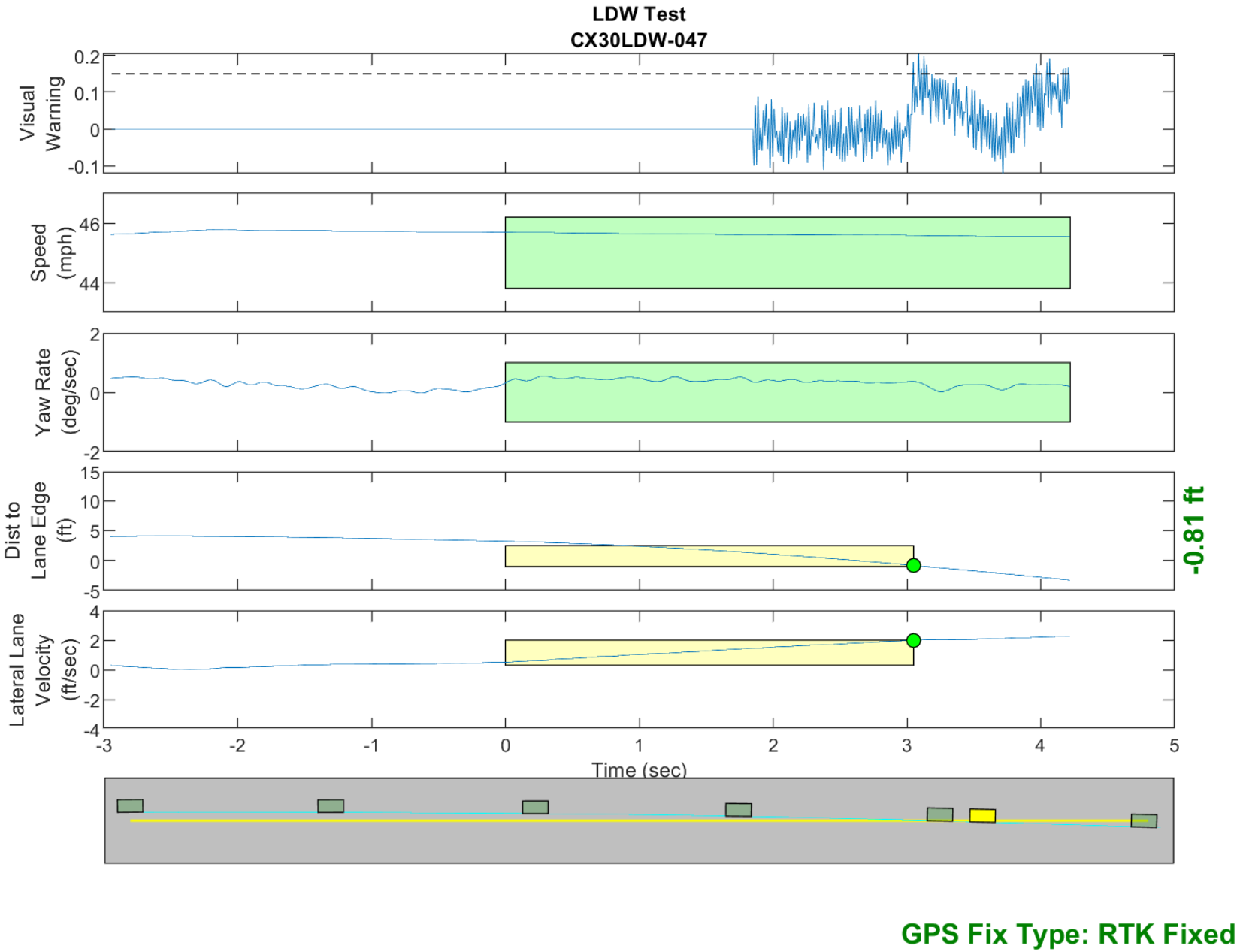


Figure D83. Time History for Run 47, Dashed Line, Right Departure, Visual Warning

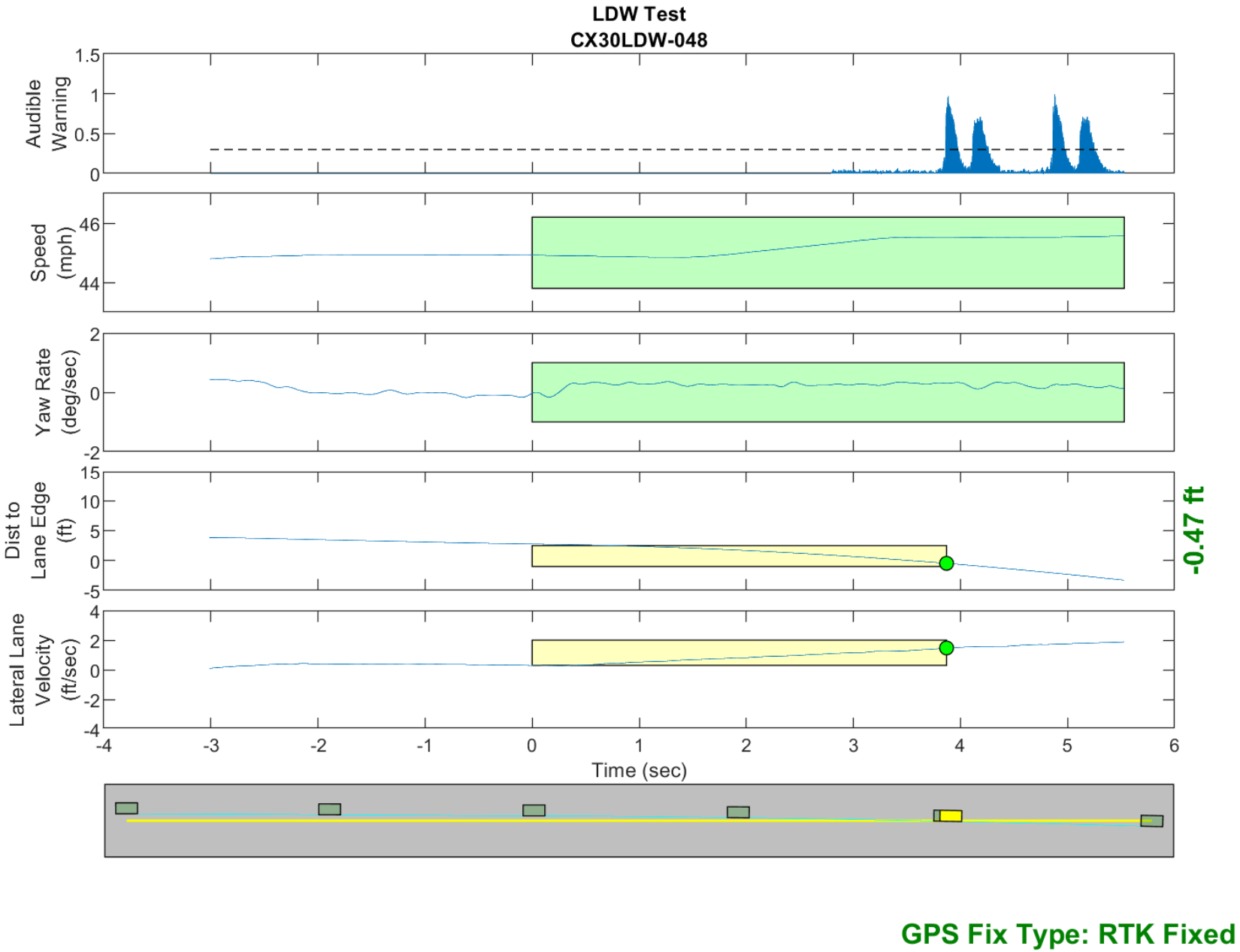


Figure D84. Time History for Run 48, Dashed Line, Right Departure, Audible Warning

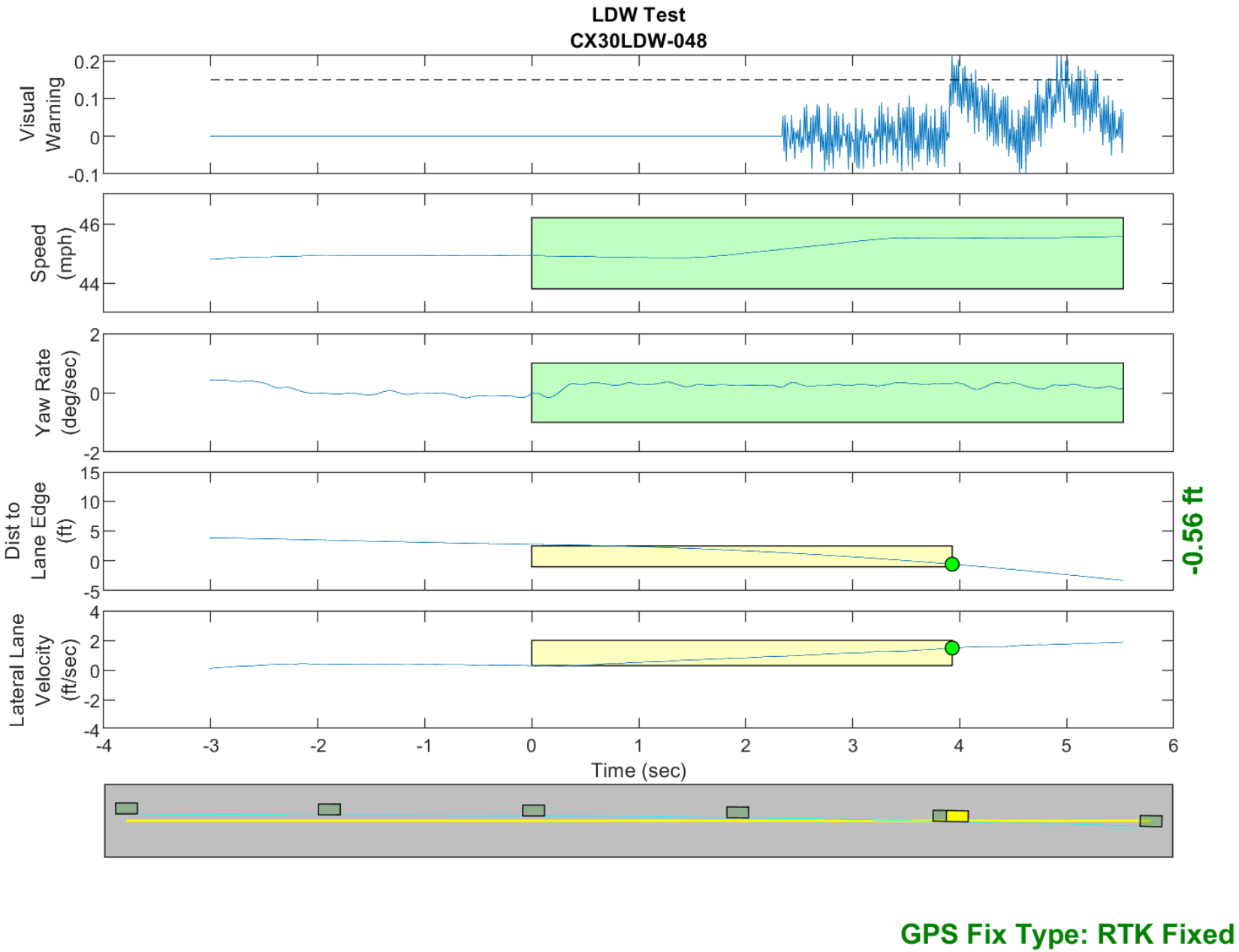


Figure D85. Time History for Run 48, Dashed Line, Right Departure, Visual Warning

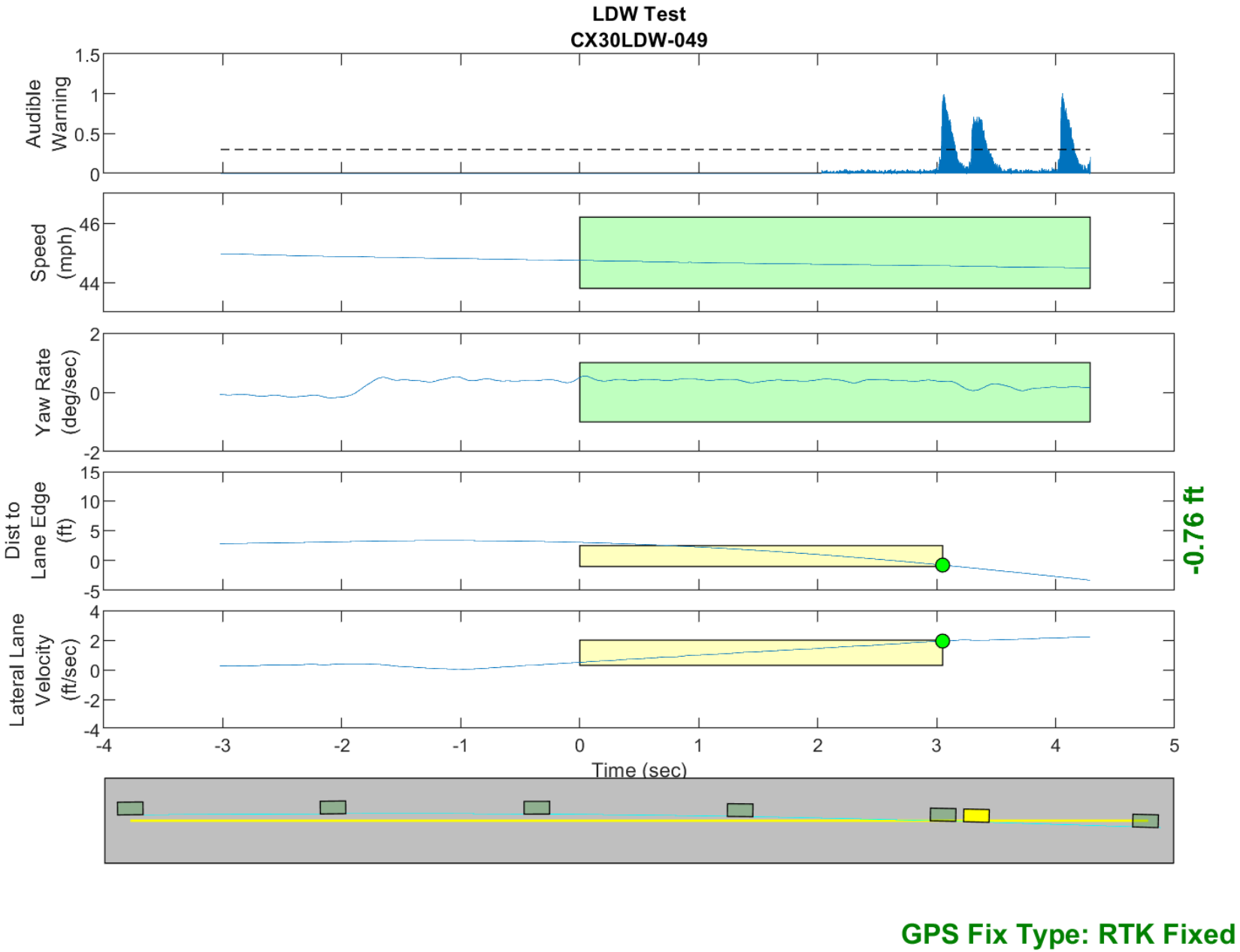


Figure D86. Time History for Run 49, Dashed Line, Right Departure, Audible Warning

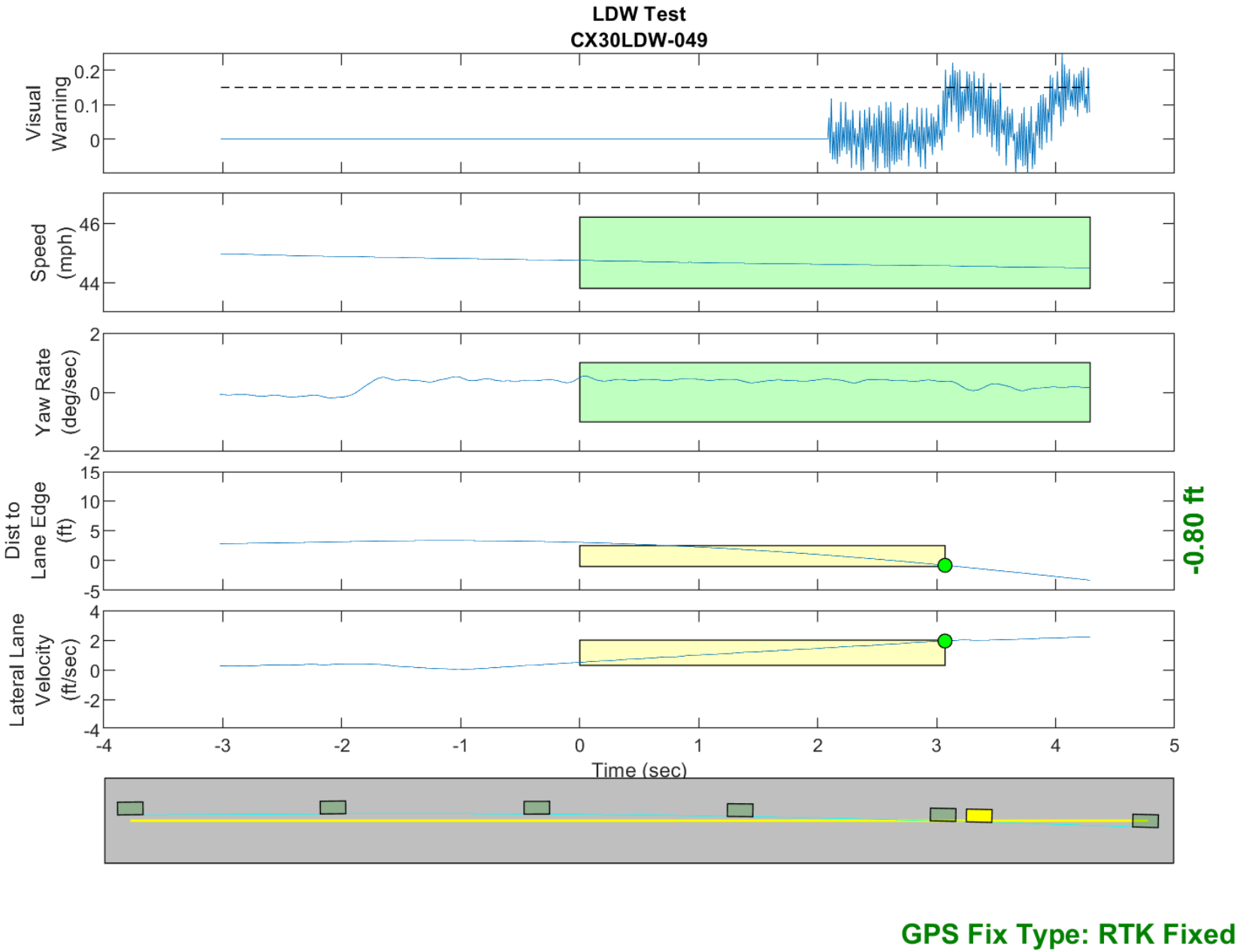


Figure D87. Time History for Run 49, Dashed Line, Right Departure, Visual Warning