NEW CAR ASSESSMENT PROGRAM
LANE DEPARTURE WARNING CONFIRMATION TEST
NCAP-DRI-LDW-21-04

2021 Dodge Durango GT Blacktop RWD

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8 April 2021

Final Report

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

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

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16. Abstract These tests were conducted on the subject 2021 Dodge Durango GT Blacktop RWD 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 for all three lane types and directions, except for the dashed right departure, where there were 4 runs where no LDW was presented to the driver. As such, the vehicle failed the LDW test.			
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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 2021 Dodge Durango GT Blacktop RWD. The LDW system provides a visual alert. The vehicle passed the requirements for all three lane types and directions, except for the dashed right departure, where there were 4 runs where no LDW was presented to the driver. As such, the vehicle failed the LDW test.

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)

2021 Dodge Durango GT Blacktop RWD

VIN: *1C4RDHDG8MC51xxxx*

Test Date: *3/18/2021*

Lane Departure Warning setting: *Early*

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

Overall: *Fail*

Notes:

LANE DEPARTURE WARNING

DATA SHEET 2: VEHICLE DATA

(Page 1 of 1)

2021 Dodge Durango GT Blacktop RWD

TEST VEHICLE INFORMATION

VIN: *1C4RDHDG8MC51xxxx*

Body Style: *SUV* Color: *DB Black*

Date Received: *3/8/2021* Odometer Reading: *36 mi*

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: *FCA US LLC*

Date of manufacture: *11-20*

Vehicle Type: *MPV*

DATA FROM TIRE PLACARD

Tires size as stated on Tire Placard: Front: *265/50R20 107T*

Rear: *265/50R20 107T*

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

Rear: *250 kPa (36 psi)*

TIRES

Tire manufacturer and model: *Bridgestone Ecopia H/L 422 Plus*

Front tire size: *265/50R20 107T*

Rear tire size: *265/50R20 107T*

Front tire DOT prefix: *7XUM EC1*

Rear tire DOT prefix: *7XUM EC1*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 1 of 2)

2021 Dodge Durango GT Blacktop RWD

GENERAL INFORMATION

Test date: *3/18/2021*

AMBIENT CONDITIONS

Air temperature: *18.3 C (65 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: *230 kPa (33 psi)*

Rear: *250 kPa (36 psi)*

LANE DEPARTURE WARNING

DATA SHEET 3: TEST CONDITIONS

(Page 2 of 2)

2021 Dodge Durango GT Blacktop RWD

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front:	*589.2 kg (1299 lb)*	Right Front:	*553.8 kg (1221 lb)*
Left Rear:	*598.7 kg (1320 lb)*	Right Rear:	*617.3 kg (1361 lb)*
		Total:	*2359.0 kg (5201 lb)*

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 1 of 3)

2021 Dodge Durango GT Blacktop RWD

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

Lane Departure Warning Plus; it is part of the Technology Group option and available on the Durango, Durango SRT, and Durango Pursuit models.

Type and location of sensor(s) used:

A camera mounted behind the windshield is used for lane for sensing.

Radar is used for lateral control, but the radar itself is not used for lane sensing.

Lane Departure Warning settings used in test:

LaneSense Warning: Early

LaneSense Strength: Low*

How is the Lane Departure Warning presented to the driver? (Check all that apply)	**X**	Warning light
		Buzzer or auditory alarm
		Vibration
	X	Other *

* *the LaneSense system provides a haptic warning in the form of torque applied to the steering wheel to prompt the driver to remain within the lane boundaries.*
The LaneSense Strength setting changes the strength of the steering wheel feedback during a lane departure.

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, auditory, vibration, or combination), etc.

An alert telltale and LDW display in the instrument panel are used to indicate the system status and lane departure warning. The telltale is an overhead view of a vehicle crossing lane lines. The LDW display shows an overhead view of the front portion of a vehicle between lane lines. When the system is on and lane lines are not detected, the telltale is white and the lane lines on the LDW display are shown in gray. When the system is on and lane lines are detected, the telltale is green and the lane lines in the LDW display are shown in white. As a lane line is approached, both the telltale and LDW display change in stages:

- *telltale white, single thin yellow lane line on departure side, vehicle image centered*
- *telltale yellow, wide yellow lane line in addition to thin yellow lane line on departure side, vehicle image centered*
- *telltale off, wide yellow lane line in addition to thin yellow lane line on departure side, vehicle image offset in direction of lane departure*

See Appendix A, Figures A10 and A11.

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.

An LDW on/off switch is located in the center console forward of the gearshift lever. See Appendix A, Figure A12.

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 3 of 3)

2021 Dodge Durango GT Blacktop RWD

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 center-mounted touchscreen is used to interact with the system menus. The hierarchy is:

Vehicle

Settings

Safety & Driving Assistance

LaneSense Warning: select from "Early", Medium", or "Late"

See Appendix A, Figure A9.

System settings are stored across ignition cycles.

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.

LDW is designed to operate under a wide range of visibility and weather conditions. Any conditions which limit the visibility of lane markers may limit the effectiveness of the system. In general, these conditions are similar to the conditions which would limit the ability of the driver to perceive the lane markers. Conditions which may reduce effectiveness include excessively worn lane markings, snow, excessive rainfall, heavy rainfall especially at night, or driving directly toward the sun when the sun is at a low elevation angle and lane markings are worn.

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.

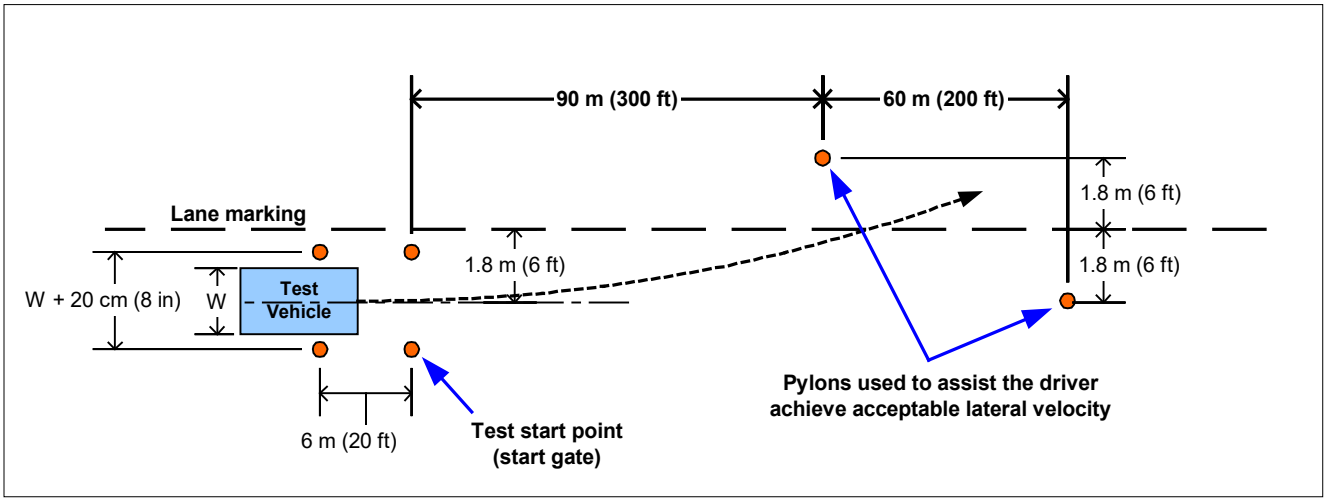


Figure 1. Position of Cones Used to Assist Driver

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.

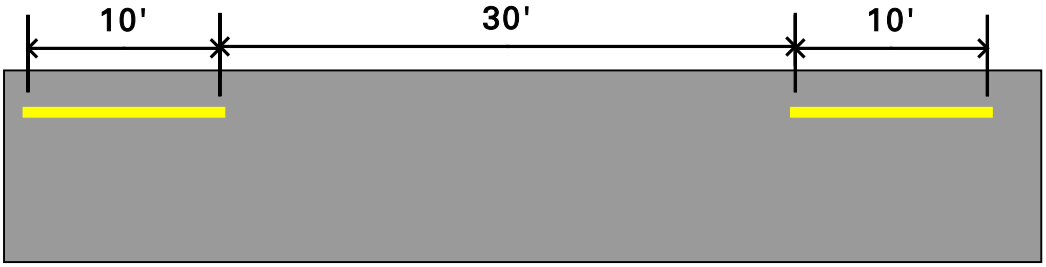


Figure 2. MUTCD Discontinuous Dashed Line Specifications

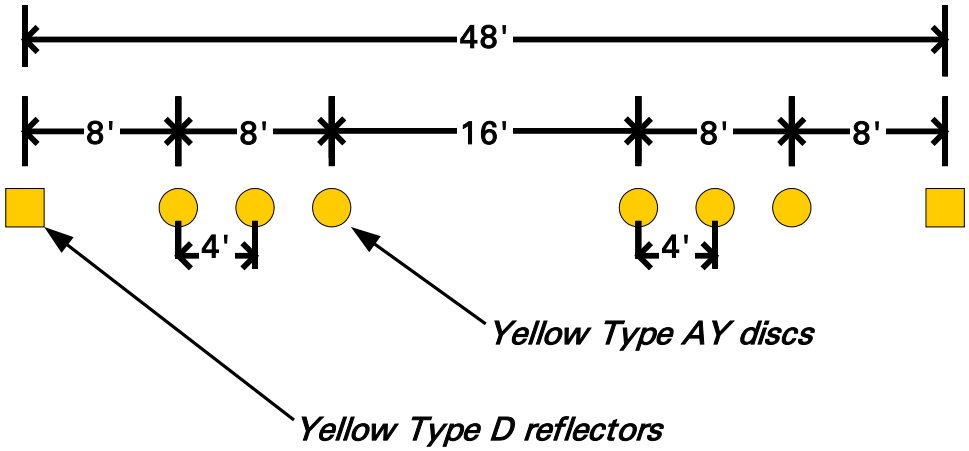


Figure 3. California Standard Plan A20A, Detail 4

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: 8/18/2020 Due: 8/18/2021
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	N/A
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	N/A

[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	N/A	N/A
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor	N/A	N/A
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: 1/6/2021 Due: 1/6/2022

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 auditory or haptic alerts, part of the pre-test instrumentation verification process is to determine the tonal frequency of the auditory 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 auditory 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. Auditory and Tactile Warning Filter Parameters

Warning Type	Filter Order	Peak-to-Peak Ripple	Minimum Stop Band Attenuation	Passband Frequency Range
Auditory	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

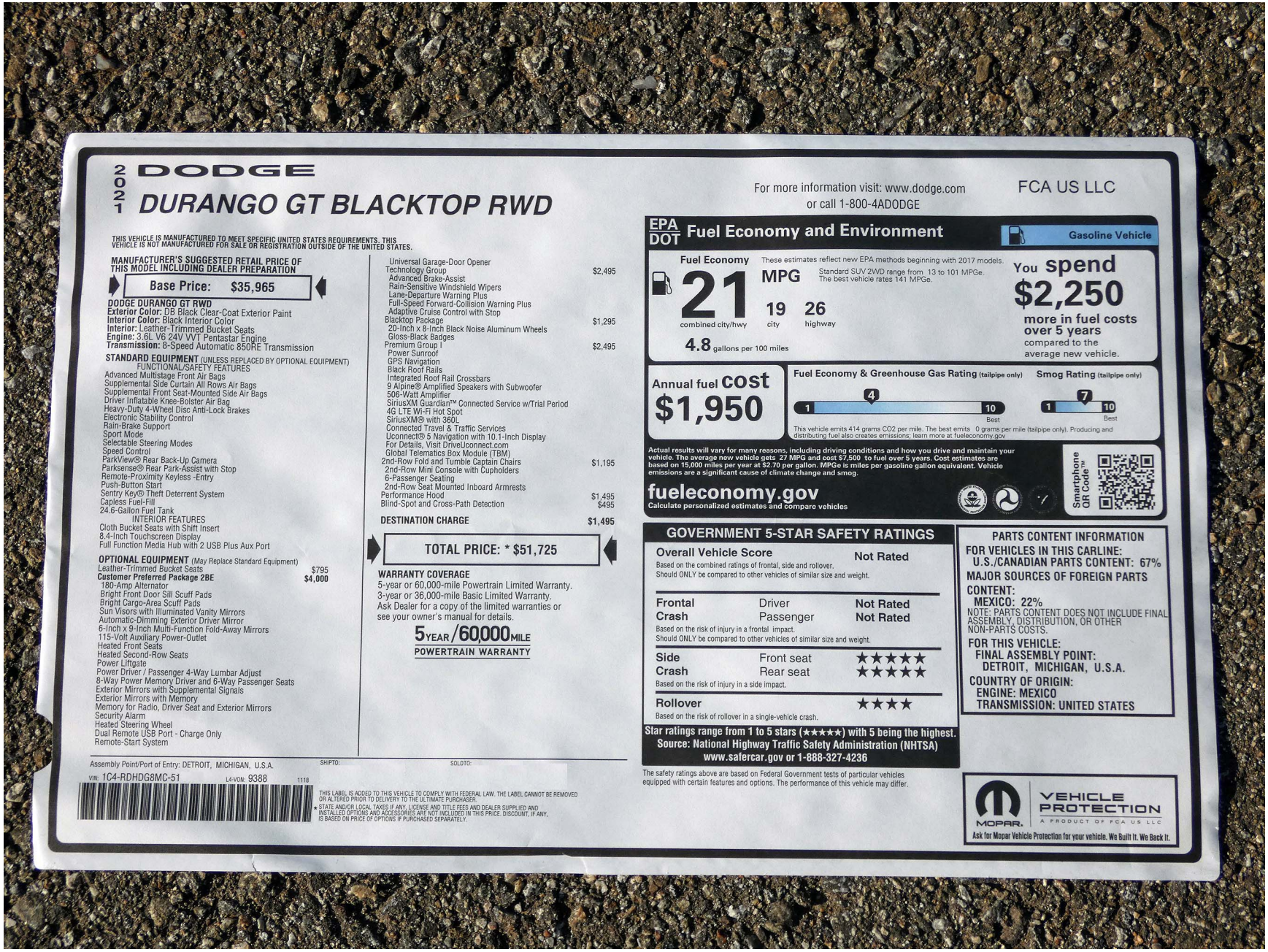


Figure A3. Window Sticker (Monroney Label)

Figure A4. Vehicle Certification Label

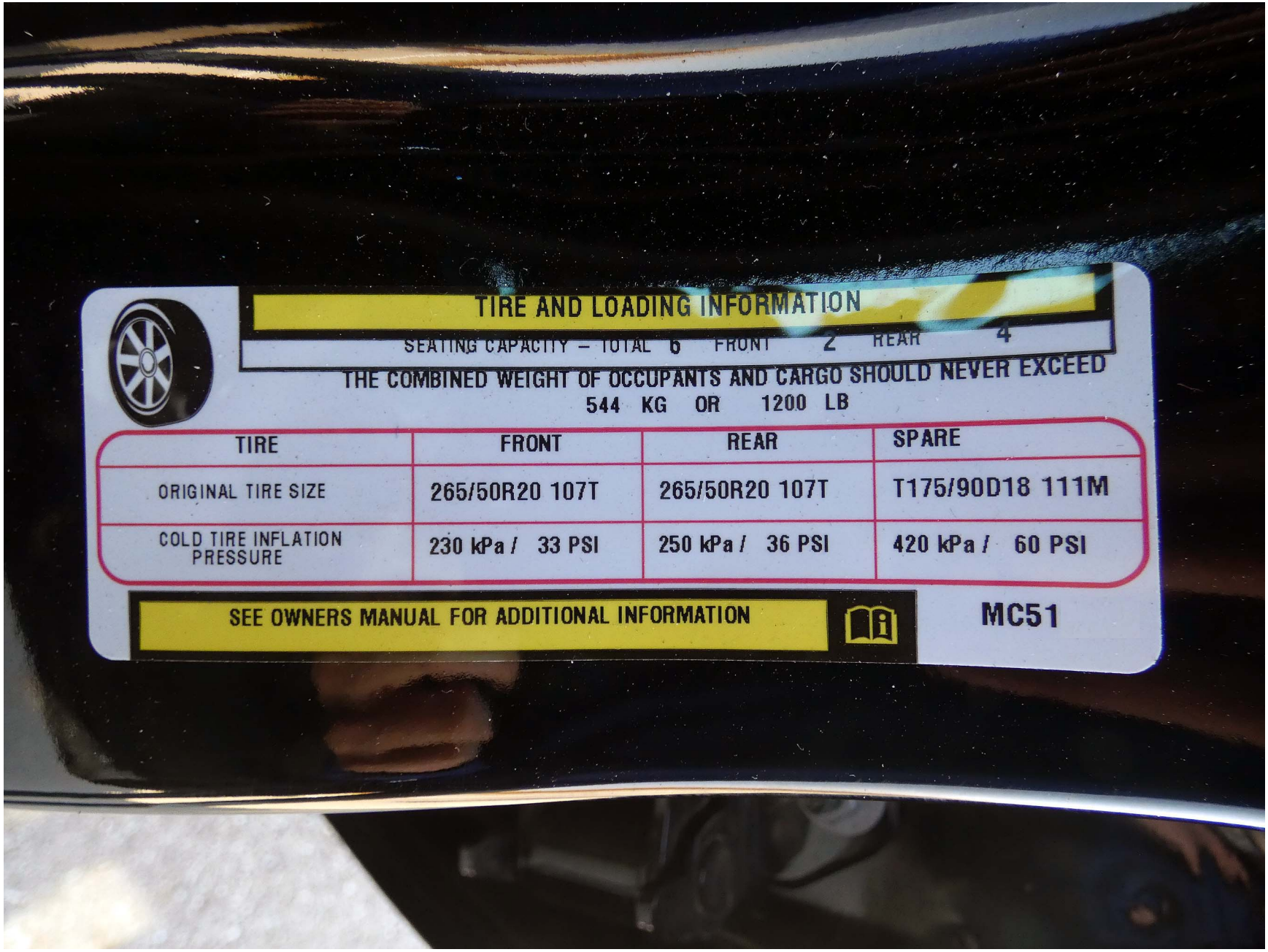


Figure A5. Tire Placard

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

Figure A7. Sensors for Detecting Visual Alerts

Figure A8. Computer Installed in Subject Vehicle

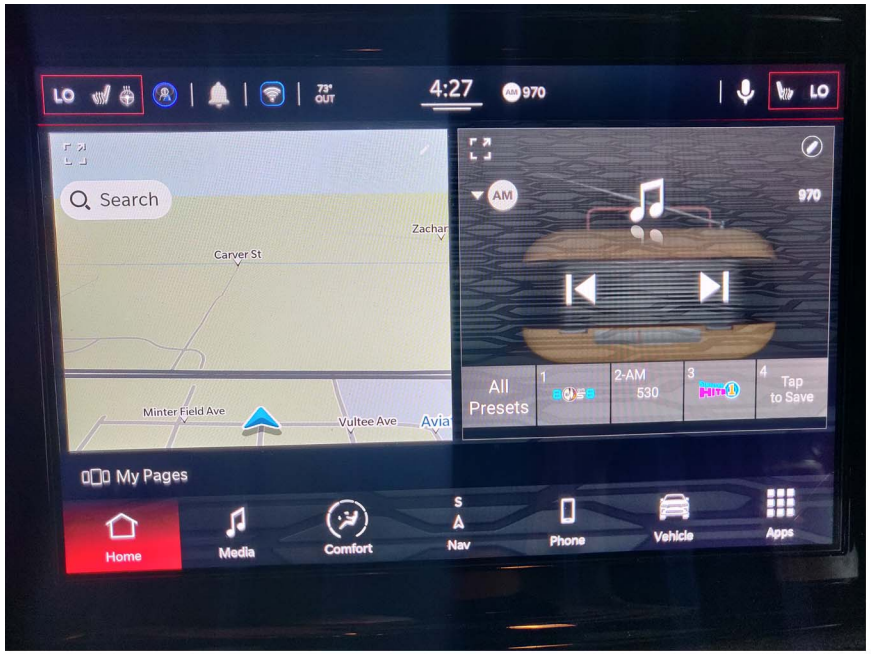


Figure A9. LDW Menus

Figure A10. LDW Status Indicator/Visual Alert (page 1 of 2)

Figure A11. LDW Status Indicator/Visual Alert (page 2 of 2)

Figure A12. LDW On/Off Switch

APPENDIX B

Excerpts from Owner’s Manual

Yellow Warning Lights	
	Service Forward Collision Warning (FCW) Light – If Equipped ➪ page 103
	Service Adaptive Cruise Control Warning Light – If Equipped ➪ page 104
	Service AWD Warning Light – If Equipped ➪ page 104
	Service Stop/Start System Warning Light – If Equipped ➪ page 104
	LaneSense Warning Light – If Equipped ➪ page 104
	Service LaneSense Warning Light – If Equipped ➪ page 104
	Cruise Control Fault Warning Light – If Equipped ➪ page 104

Yellow Indicator Lights	
	Forward Collision Warning (FCW) OFF Indicator Light – If Equipped ➪ page 104
	All Wheel Drive (AWD) Low Indicator Light – If Equipped ➪ page 104
	NEUTRAL Indicator Light – If Equipped ➪ page 104

Green Indicator Lights	
	Adaptive Cruise Control (ACC) Set With Target Light – If Equipped ➪ page 104
	Adaptive Cruise Control (ACC) Set Without Target Light – If Equipped ➪ page 104
	Cruise Control Set Indicator Light – If Equipped ➪ page 105

Green Indicator Lights	
	Front Fog Indicator Light — If Equipped ⇨ page 105
	LaneSense Indicator Light — If Equipped ⇨ page 105
	Park/Headlight On Indicator Light ⇨ page 105
	Snow Mode Indicator Light — If Equipped ⇨ page 105
	Sport Mode Indicator Light ⇨ page 105
	Stop/Start Active Indicator Light — If Equipped ⇨ page 105
	Tow Mode Indicator Light — If Equipped ⇨ page 105

White Indicator Lights	
	Adaptive Cruise Control (ACC) Ready Light — If Equipped ⇨ page 105
	Cruise Control Ready Indicator Light ⇨ page 105

Blue Indicator Lights	
	High Beam Indicator Light ⇨ page 106

Service Adaptive Cruise Control Warning Light — If Equipped

This light will turn on when the Adaptive Cruise Control (ACC) is not operating and needs service ⇨ page 131.

Service AWD Warning Light — If Equipped

This telltale will turn on to indicate the All Wheel Drive (AWD) system is not functioning properly and that service is required. Contact an authorized dealer.

Service Stop/Start System Warning Light — If Equipped

This warning light will illuminate when the Stop/Start system is not functioning properly and service is required. Contact an authorized dealer for service.

LaneSense Warning Light — If Equipped

The LaneSense Warning Light will be solid yellow when the vehicle is approaching a lane marker. The warning light will flash when the vehicle is crossing the lane marker ⇨ page 148.

Service LaneSense Warning Light — If Equipped

This warning light will illuminate when the LaneSense system is not operating and requires service. Please see an authorized dealer.

Cruise Control Fault Warning Light — If Equipped

This warning light will illuminate to indicate the Cruise Control System is not functioning properly and service is required. Contact an authorized dealer.

YELLOW INDICATOR LIGHTS

Forward Collision Warning (FCW) OFF Indicator Light — If Equipped

This indicator light illuminates to indicate that Forward Collision Warning is off ⇨ page 218.

All Wheel Drive (AWD) Low Indicator Light — If Equipped

This light alerts the driver that the vehicle is in the AWD LOW mode. The front and rear driveshafts are mechanically locked together forcing the front and rear wheels to rotate at the same speed. AWD LOW is designed for loose, slippery road surfaces only ⇨ page 121.

NEUTRAL Indicator Light — If Equipped

This light alerts the driver that the 4WD power transfer case is in the NEUTRAL mode and the front and rear driveshafts are disengaged from the powertrain.

GREEN INDICATOR LIGHTS

Adaptive Cruise Control (ACC) Set With Target Light — If Equipped

This will display when the ACC is set and a target vehicle is detected ⇨ page 131.

Adaptive Cruise Control (ACC) Set Without Target Light — If Equipped

This will display when the ACC is set and a target vehicle is not detected ⇨ page 131.

Cruise Control Set Indicator Light — If Equipped

This indicator light will illuminate when the cruise control is set to the desired speed ⇨ page 129.

Front Fog Indicator Light — If Equipped

This indicator light will illuminate when the front fog lights are on ⇨ page 51.

LaneSense Indicator Light — If Equipped

The LaneSense indicator light illuminates solid green when both lane markings have been detected and the system is "armed" and ready to provide visual and torque warnings if an unintentional lane departure occurs ⇨ page 148.

Park/Headlight On Indicator Light

This indicator light will illuminate when the park lights or headlights are turned on ⇨ page 51.

Snow Mode Indicator Light — If Equipped

This light will turn on when Snow Mode is active.

Sport Mode Indicator Light

This light will turn on when Sport Mode is active ⇨ page 121.

Stop/Start Active Indicator Light — If Equipped

This indicator light will illuminate when the Stop/Start function is in "Autostop" mode ⇨ page 126.

Tow Mode Indicator Light — If Equipped

This light will turn on when Tow Mode is active.

Turn Signal Indicator Lights

When the left or right turn signal is activated, the turn signal indicator will flash independently and the corresponding exterior turn signal lamps will flash. Turn signals can be activated when the multifunction lever is moved down (left) or up (right).

NOTE:

- A continuous chime will sound if the vehicle is driven more than 1 mile (1.6 km) with either turn signal on.
- Check for an inoperative outside light bulb if either indicator flashes at a rapid rate.

WHITE INDICATOR LIGHTS

Adaptive Cruise Control (ACC) Ready Light — If Equipped

This light will turn on when ACC has been turned on, but is not set ⇨ page 131.

Cruise Control Ready Indicator Light

This indicator light will illuminate when the cruise control is ready, but not set ⇨ page 129.

LaneSense Indicator Light — If Equipped

When the LaneSense system is ON, but not armed, the LaneSense indicator light illuminates solid white. This occurs when only left, right, or neither lane line has been detected. If a single lane line is detected, the system is ready to provide only visual warnings if an unintentional lane departure occurs on the detected lane line ⇨ page 148.

WARNING!

- Drivers must be careful when backing up even when using ParkSense. Always check carefully behind your vehicle, look behind you, and be sure to check for pedestrians, animals, other vehicles, obstructions, and blind spots before backing up. You are responsible for safety and must continue to pay attention to your surroundings. Failure to do so can result in serious injury or death.
- Before using ParkSense, it is strongly recommended that the ball mount and hitch ball assembly be disconnected from the vehicle when the vehicle is not used for towing. Failure to do so can result in injury or damage to vehicles or obstacles because the hitch ball will be much closer to the obstacle than the rear fascia when the vehicle sounds the continuous tone. Also, the sensors could detect the ball mount and hitch ball assembly, depending on its size and shape, giving a false indication that an obstacle is behind the vehicle.

CAUTION!

- ParkSense is only a parking aid and it is unable to recognize every obstacle, including small obstacles. Parking curbs might be temporarily detected or not detected at all. Obstacles located above or below the sensors will not be detected when they are in close proximity.
- The vehicle must be driven slowly when using ParkSense in order to be able to stop in time when an obstacle is detected. It is recommended that the driver looks over his/her shoulder when using ParkSense.

LANESENSE — IF EQUIPPED

LANESENSE OPERATION

The LaneSense system is operational at speeds above 37 mph (60 km/h) and below 112 mph (180 km/h). The LaneSense system uses a forward looking camera to detect lane markings and measure vehicle position within the lane boundaries.

When both lane markings are detected and the driver drifts out of the lane (no turn signal applied), the LaneSense system provides a haptic warning in the form of torque applied to the steering wheel to prompt the driver to remain within the lane boundaries. If the driver continues to drift out of the lane, the LaneSense system provides a visual warning through the instrument cluster display to prompt the driver to remain within the lane boundaries.

The driver may manually override the haptic warning by applying force into the steering wheel at any time.

When only a single lane marking is detected and the driver drifts across the lane marking (no turn signal applied), the LaneSense system provides visual warnings through the instrument cluster display to prompt the driver to remain within the lane. When only a single lane marking is detected, a haptic or a torque warning will not be provided.

NOTE:
When operating conditions have been met, the LaneSense system will monitor if the driver's hands are on the steering wheel and provide an audible warning to the driver if removed. The system will cancel if the driver does not return their hands to the wheel.

TURNING LANESENSE ON OR OFF

The LaneSense button is located on the switch panel below the Uconnect display.

To turn the LaneSense system on, push the LaneSense button (LED turns off). A "LaneSense On" message is shown in the instrument cluster display.

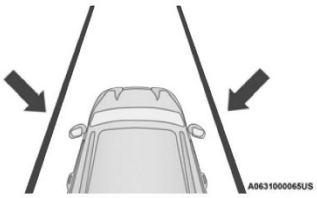
To turn the LaneSense system off, push the LaneSense button once (LED turns on).

NOTE:
The LaneSense system will retain the last system state on or off from the last ignition cycle when the ignition is placed in the ON/RUN position.

LANESENSE WARNING MESSAGE

The LaneSense system will indicate the current lane drift condition through the instrument cluster display.

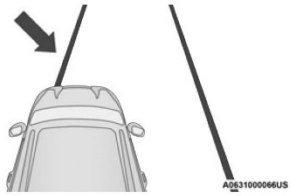
When the LaneSense system is on, the lane lines are gray when both of the lane boundaries have not been detected and the LaneSense telltale is solid white.



System On (Gray Lines) With White Telltale

Left Lane Departure – Only Left Lane Detected

- When the LaneSense system is on, the LaneSense telltale is solid white when only the left lane marking has been detected and the system is ready to provide visual warnings in the instrument cluster display if an unintentional lane departure occurs.
- When the LaneSense system senses the lane has been approached and is in a lane departure situation, the left lane line flashes yellow (on/off), and the LaneSense telltale changes from solid white to flashing yellow.



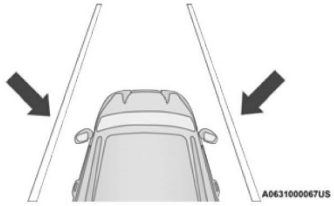
Lane Approached (Flashing Yellow Line With Flashing Yellow Telltale)

NOTE:
The LaneSense system operates with similar behavior for a right lane departure when only the right lane marking has been detected.

Left Lane Departure — Both Lanes Detected

- When the LaneSense system is on, the lane lines turn from gray to white to indicate that both of the lane markings have been detected.

  The LaneSense telltale is solid green when both lane markings have been detected and the system is on to provide visual warnings in the instrument cluster display and a torque warning in the steering wheel if an unintentional lane departure occurs.



Lanes Sensed (White Lines) With Green Telltale

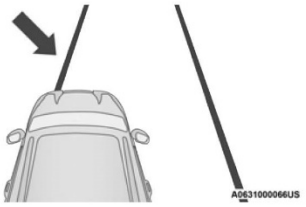
- When the LaneSense system senses a lane drift situation, the left lane line will turn solid yellow. The LaneSense telltale changes from solid green to solid yellow. At this time torque is applied to the steering wheel in the opposite direction of the lane boundary.

  For example: If approaching the left side of the lane the steering wheel will turn to the right.

Lane Sensed (Solid Yellow Line With Solid Yellow Telltale)

- When the LaneSense system senses the lane has been approached and is in a lane departure situation, the left lane line flashes yellow (on/off). The LaneSense telltale changes from solid yellow to flashing yellow. At this time torque is applied to the steering wheel in the opposite direction of the lane boundary.

  For example: If approaching the left side of the lane the steering wheel will turn to the right.



Lane Approached (Flashing Yellow Line With Flashing Yellow Telltale)

NOTE:
The LaneSense system operates with similar behavior for a right lane departure.

CHANGING LANESENSE STATUS

The LaneSense system has settings to adjust the intensity of the torque warning and the warning zone sensitivity (early/late) that you can configure through the Uconnect system ➪ page 175.

NOTE:

- When enabled the system operates above 37 mph (60 km/h) and below 112 mph (180 km/h).
- The warnings are disabled with use of the turn signal.
- The system will not apply torque to the steering wheel whenever a safety system engages (Anti-Lock Brakes, Traction Control System, Electronic Stability Control, Forward Collision Warning, etc.).

PARKVIEW REAR BACK UP CAMERA

Your vehicle is equipped with the ParkView Rear Back Up Camera that allows you to see an on-screen image of the rear surroundings of your vehicle whenever the gear selector is put into REVERSE. The image will be displayed on the Navigation/Multimedia radio display screen along with a caution note to "Check Entire Surroundings" across the top of the screen. After five seconds this note will disappear. The ParkView camera is located on the rear of the vehicle above the rear license plate.

When the vehicle is shifted out of REVERSE (with camera delay turned off), the rear camera mode is exited and the previous screen appears.

Manual Activation Of The Backup Camera

1. Press the "Vehicle Menu" button located at the bottom of the Uconnect display. Then select the "Controls" tab.
2. Press the "Rear View Camera" button to turn the Rear View Camera system on.

NOTE:
The ParkView Rear Back Up Camera has programmable modes of operation that may be selected through the Uconnect system ➪ page 175. In certain radio configurations, these modes of operation will be found in the "Camera" section of the vehicle settings menu.

When the vehicle is shifted out of REVERSE (with camera delay turned off), the rear camera mode is exited and the previous screen appears. When the vehicle is shifted out of REVERSE (with camera delay turned on), the camera image will continue to be displayed for up to 10 seconds after shifting out of REVERSE unless the following conditions occur: the vehicle speed exceeds 8 mph (13 km/h), the vehicle is shifted into PARK, the vehicle's ignition is placed in the OFF position, or the touchscreen button "X" to disable the display of the Rear View Camera is pressed.

When enabled, active guidelines are overlaid on the image to illustrate the width of the vehicle and its projected backup path based on the steering wheel position. A dashed center line overlay indicates the center of the vehicle to assist with parking or aligning to a hitch/receiver. Different colored zones indicate the distance to the rear of the vehicle.

Safety & Driving Assistance

After pressing the Safety & Driving Assistance button on the touchscreen, the following settings will be available:

Setting Name	Description
Automatic Emergency Braking — If Equipped	This setting will take you to the selectable options for "Forward Collision Warning (FCW)" and "Forward Collision Warning Sensitivity".
Forward Collision Warning — If Equipped	This setting will turn the Forward Collision system on or off. The "Off" setting will deactivate the FCW system. The "Warning Only" setting will provide only an audible chime when a collision is detected. The "Warning + Active Braking" setting will provide an audible chime and apply some brake pressure when a collision is detected.
Forward Collision Warning Sensitivity — If Equipped	This setting will change the distance at which the Forward Collision Warning alert sounds. The "Medium" setting will have the FCW system signal when an object is in view, and the possibility of a collision is detected. The "Near" setting will have the FCW system signal when the object is closer to the vehicle. The "Far" setting will have the FCW system signal when an object is at a far distance from the vehicle.
LaneSense Warning — If Equipped	This setting will change the distance at which the steering wheel will provide lane departure feedback. The available settings are "Early", "Medium", and "Late".
LaneSense Strength — If Equipped	This setting will change the strength of the steering wheel feedback during a lane departure. The available settings are "Low", "Medium", and "High".
ParkSense — If Equipped	This setting will change the type of ParkSense alert when a close object is detected and provide both an audible chime and a visual display.
Front ParkSense Volume	This setting adjusts the volume of the Front ParkSense system. The available settings are "Low", "Medium", and "High".
Rear ParkSense Volume	This setting adjusts the volume of the Rear ParkSense system. The available settings are "Low", "Medium", and "High".

APPENDIX C

Run Log

Subject Vehicle: **2021 Dodge Durango GT Blacktop RWD** Test Date: **3/18/2021**

Driver: **A. Ricci** **Note: For Distance at Warning, positive values indicate inside the lane**

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Visual Alert (ft)	Pass/Fail	Notes
1	**Solid**	**Left**	Y	-0.24	Pass	
2			Y	-0.47	Pass	
3			Y	-0.29	Pass	
4			Y		Fail	No Warning
5			Y	-0.30	Pass	
6			Y	-0.30	Pass	
7			Y	-0.31	Pass	
8	**Solid**	**Right**	Y	-0.35	Pass	
9			Y	-0.39	Pass	
10			Y	-0.32	Pass	
11			Y	-0.40	Pass	
12			Y	-0.31	Pass	
13			Y	-0.40	Pass	
14			Y	-0.39	Pass	
15	**Dashed**	**Right**	Y	-0.55	Pass	
16			Y		Fail	No Warning, confirmed system is still working on right departure solid line
17			Y		Fail	No Warning

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Visual Alert (ft)	Pass/Fail	Notes
18	**Dashed**	**Right**	Y		Fail	No Warning
19			Y		Fail	No Warning
20			N			SV Speed
21			Y	-0.38	Pass	
22			Y	-0.45	Pass	
23	**Dashed**	**Left**	Y	-0.24	Pass	
24			Y	-0.41	Pass	
25			Y	-0.53	Pass	
26			Y	-0.30	Pass	
27			Y	-0.35	Pass	
28			Y	-0.43	Pass	
29			Y	-0.45	Pass	
30	**Botts**	**Left**	Y	-0.49	Pass	
31			Y	-0.48	Pass	
32			Y	-0.33	Pass	
33			Y	-0.39	Pass	
34			Y	-0.64	Pass	
35			Y	-0.45	Pass	
36			Y	-0.62	Pass	
37	**Botts**	**Right**	Y	-0.44	Pass	
38			Y	-0.22	Pass	
39			Y	-0.25	Pass	
40			Y	-0.45	Pass	

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Visual Alert (ft)	Pass/Fail	Notes
41	**Botts**	**Right**	Y	-0.28	Pass	
42			Y	-0.40	Pass	
43			Y	-0.21	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.

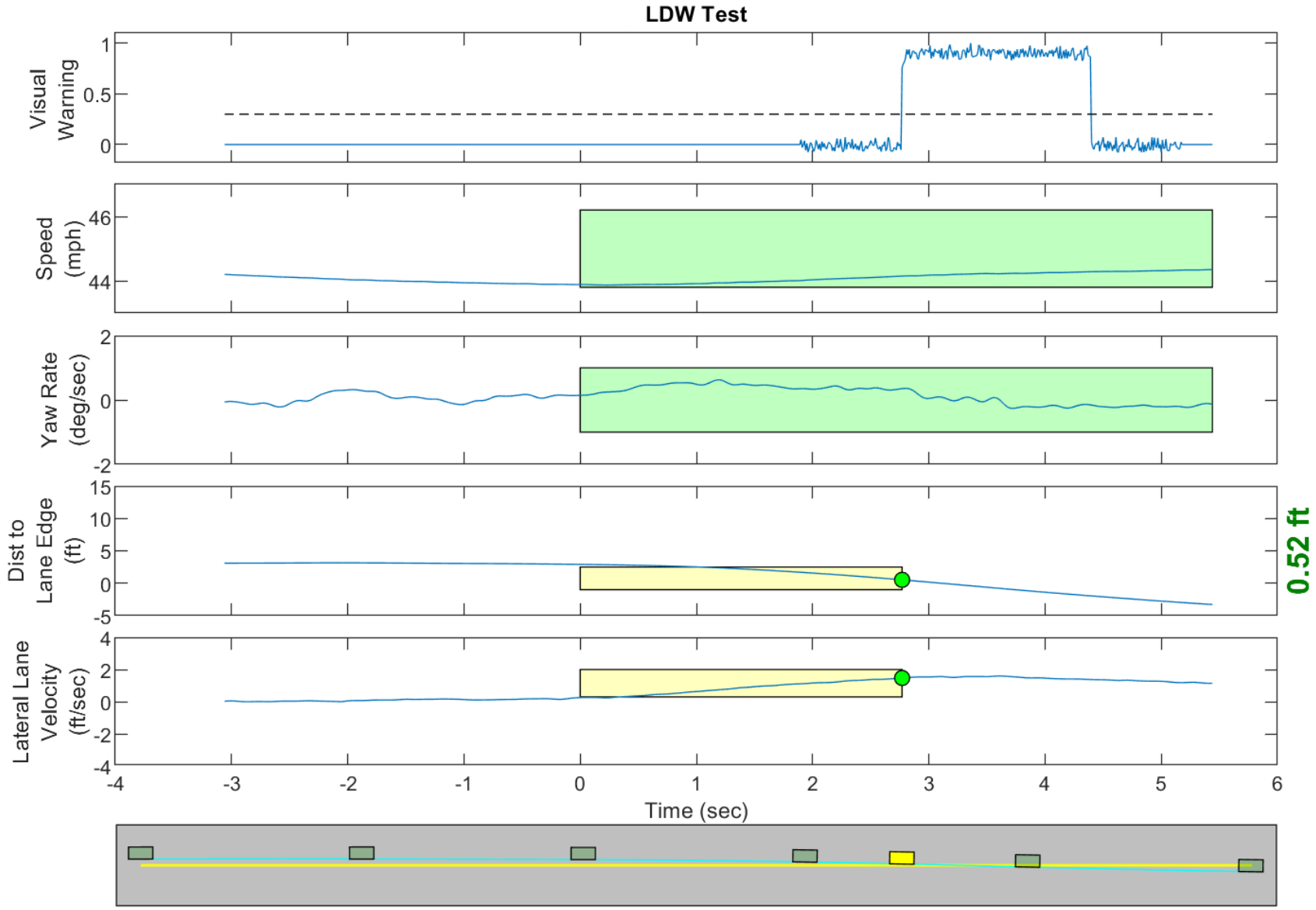


Figure D1. Example Time History for Lane Departure Warning Test, Passing

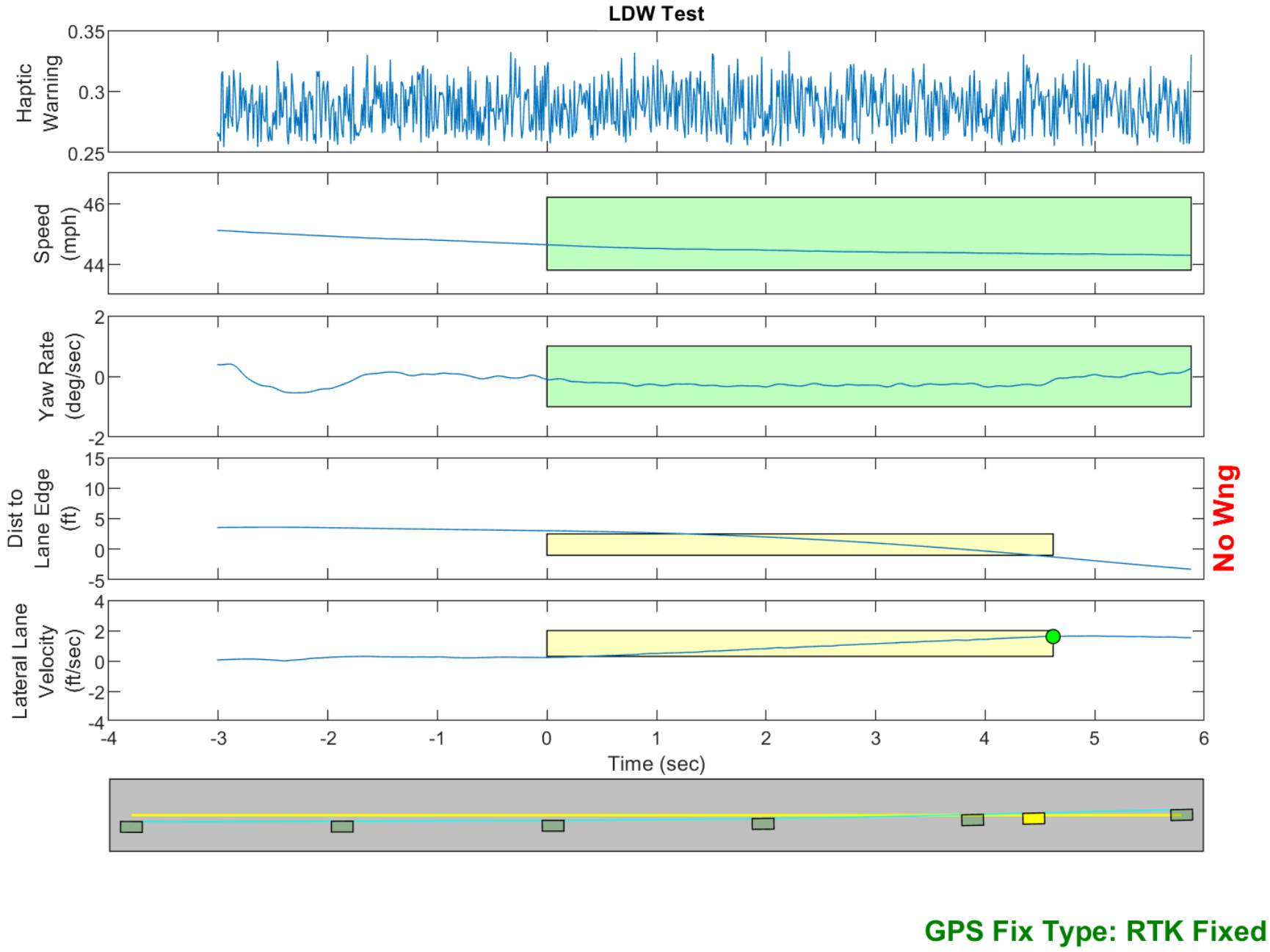


Figure D2. Example Time History for Lane Departure Warning Test, Failing, No Warning Issued

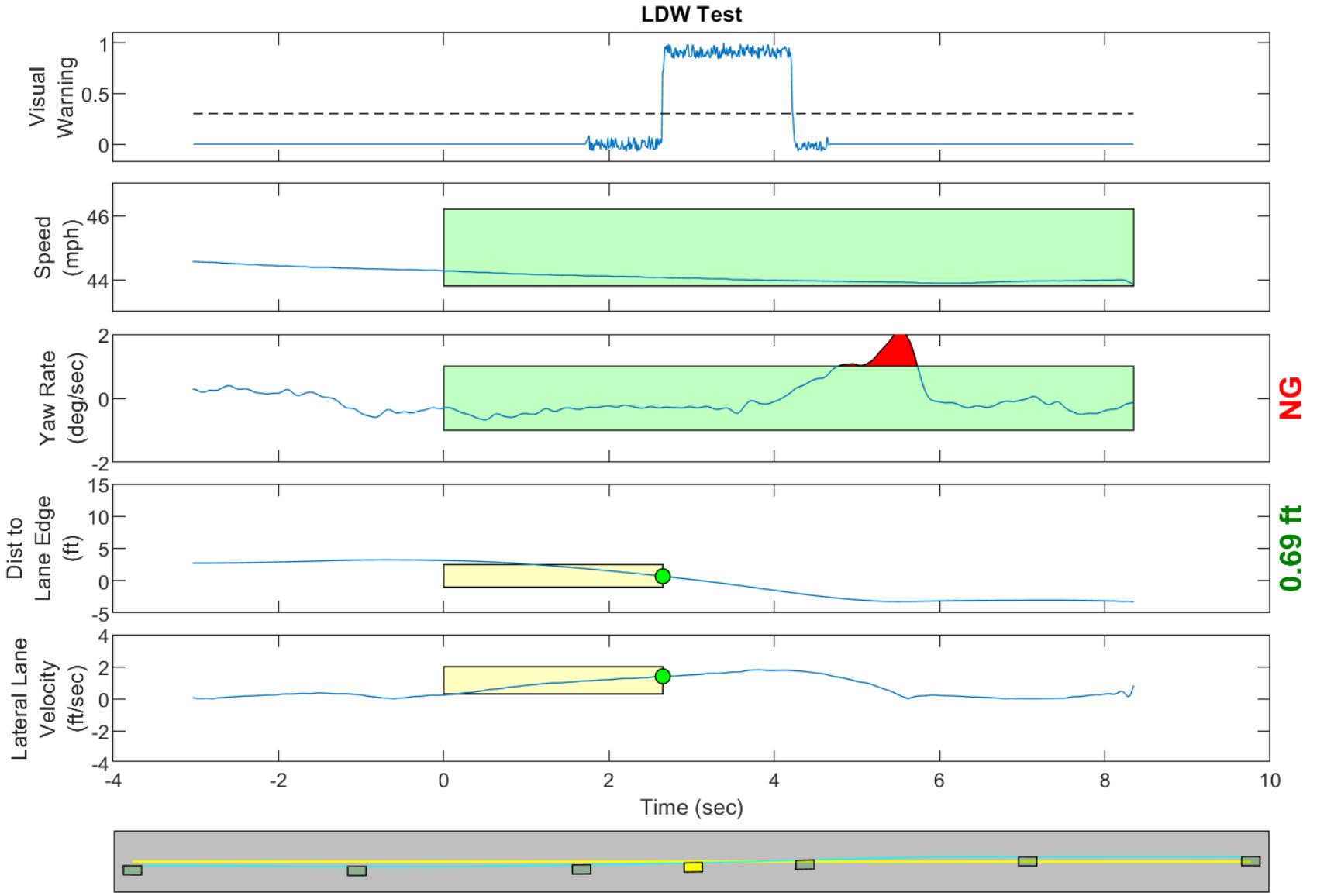


Figure D3. Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate

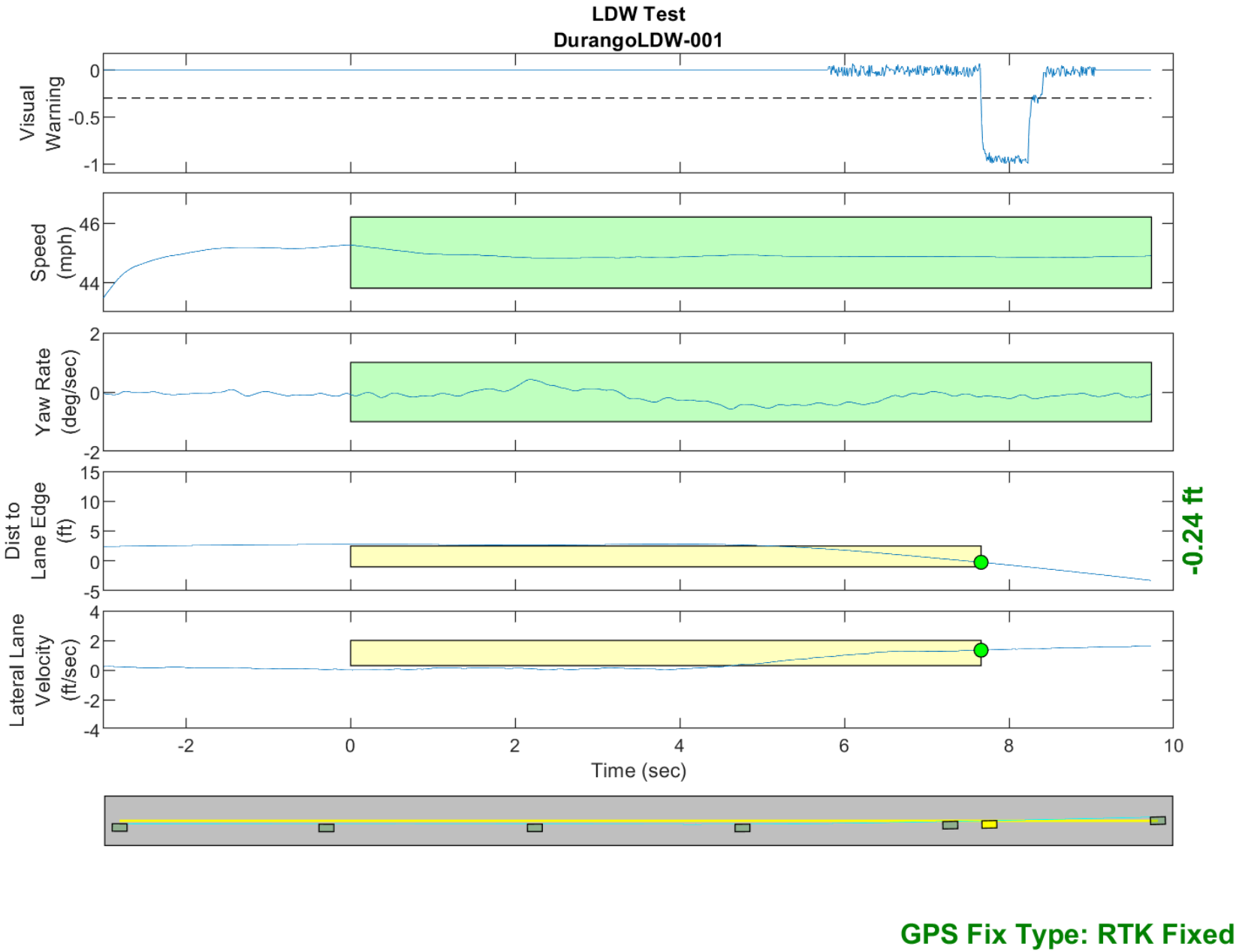


Figure D4. Time History for Run 01, Solid Line, Left Departure, Visual Warning

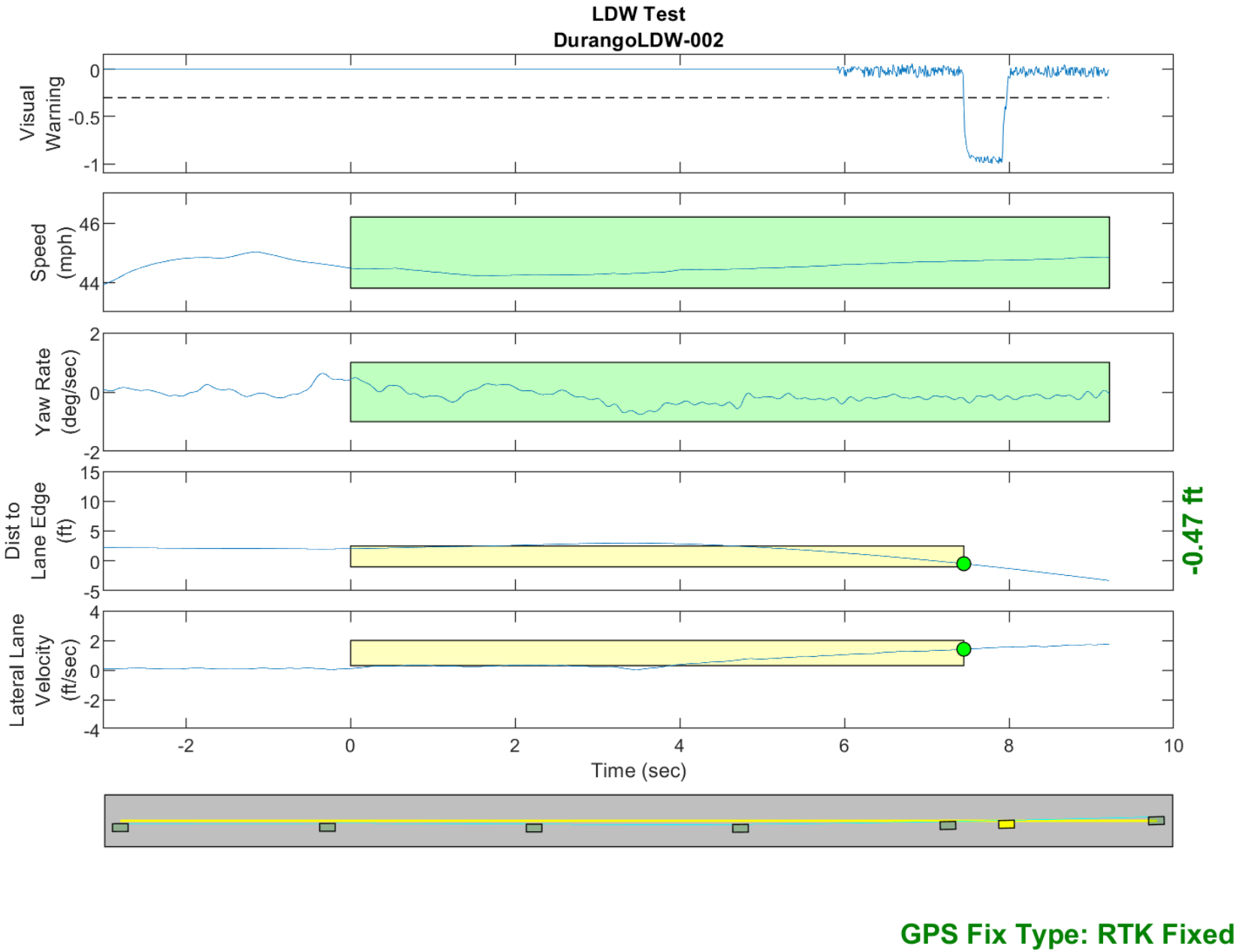


Figure D5. Time History for Run 02, Solid Line, Left Departure, Visual Warning

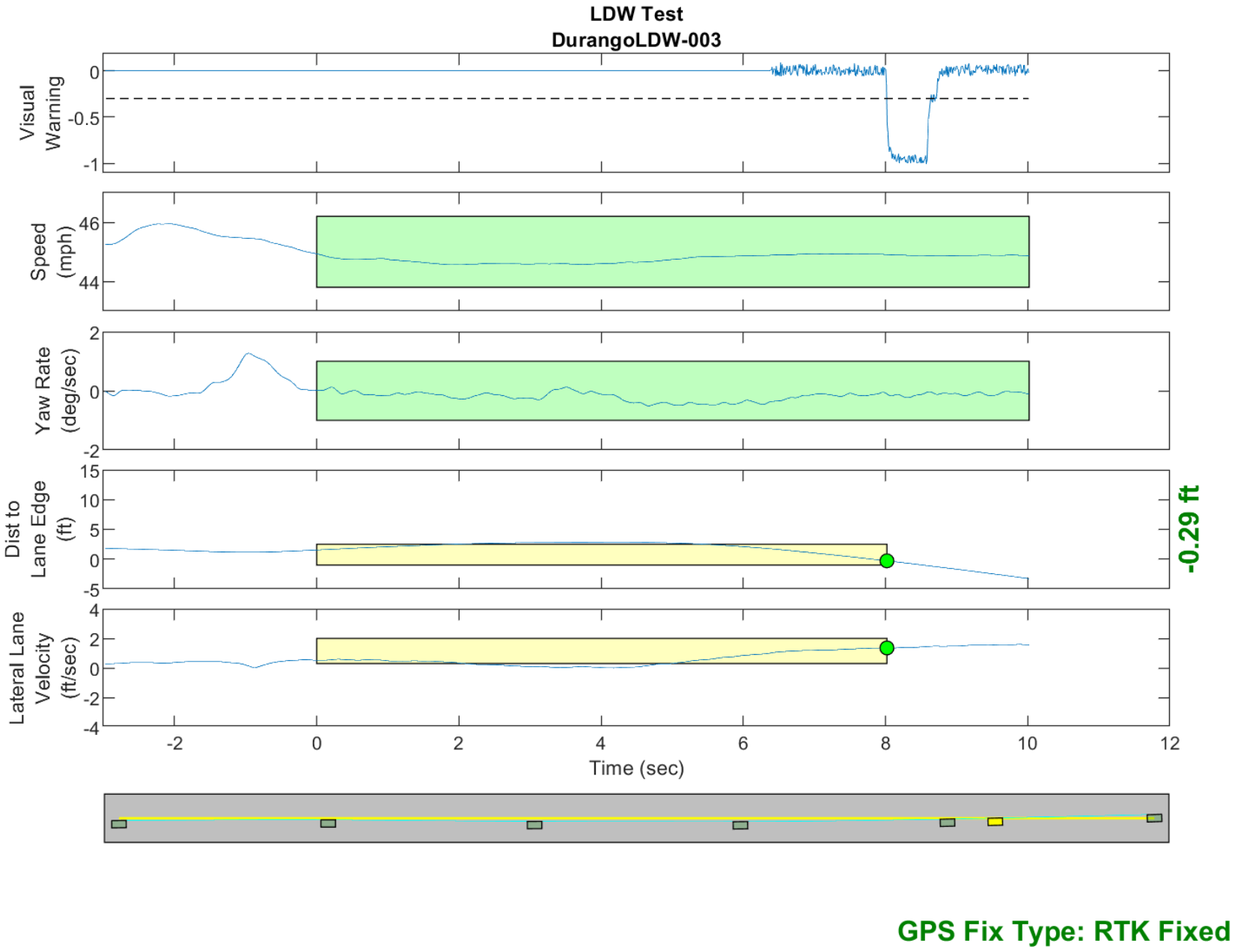


Figure D6. Time History for Run 03, Solid Line, Left Departure, Visual Warning

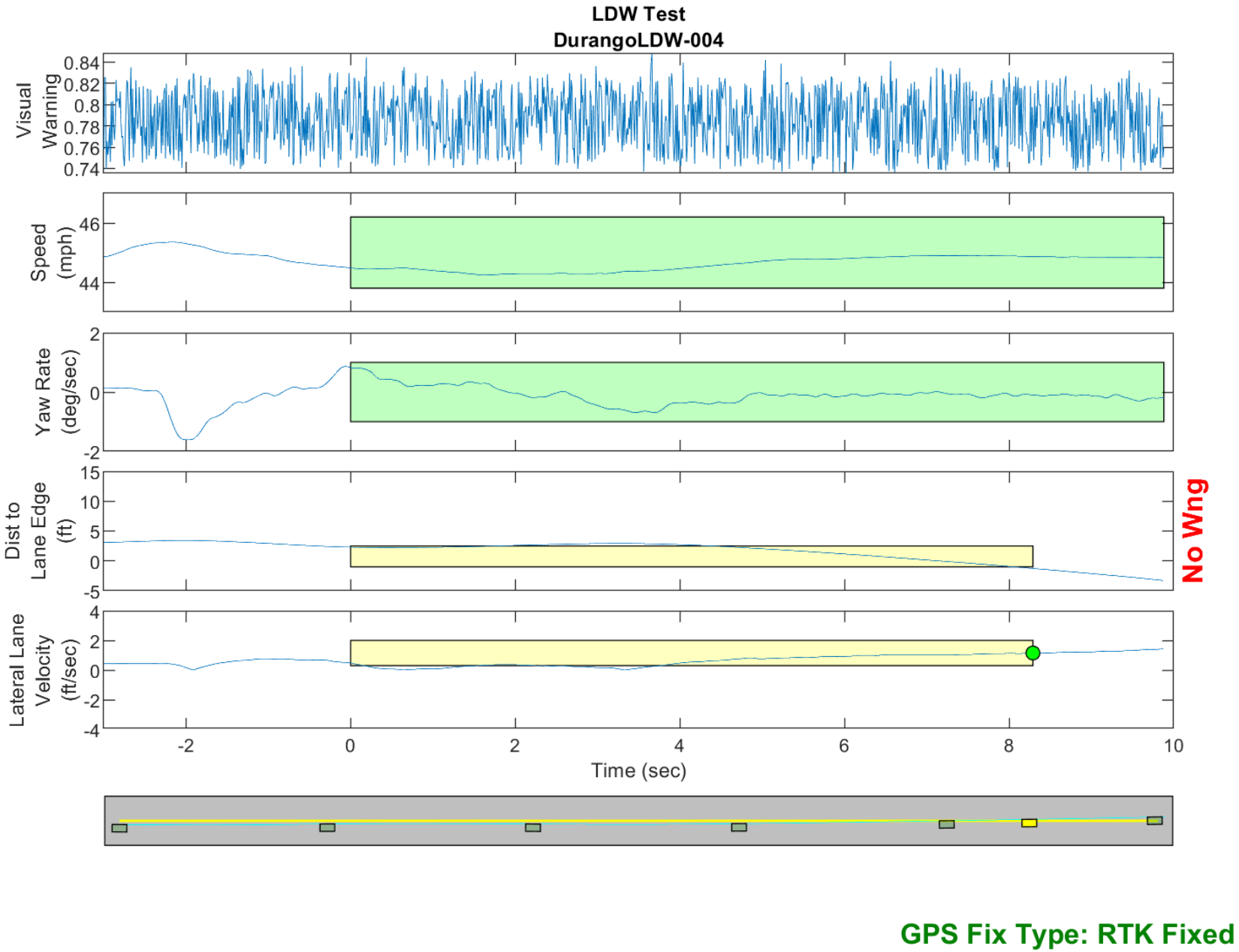


Figure D7. Time History for Run 04, Solid Line, Left Departure, Visual Warning

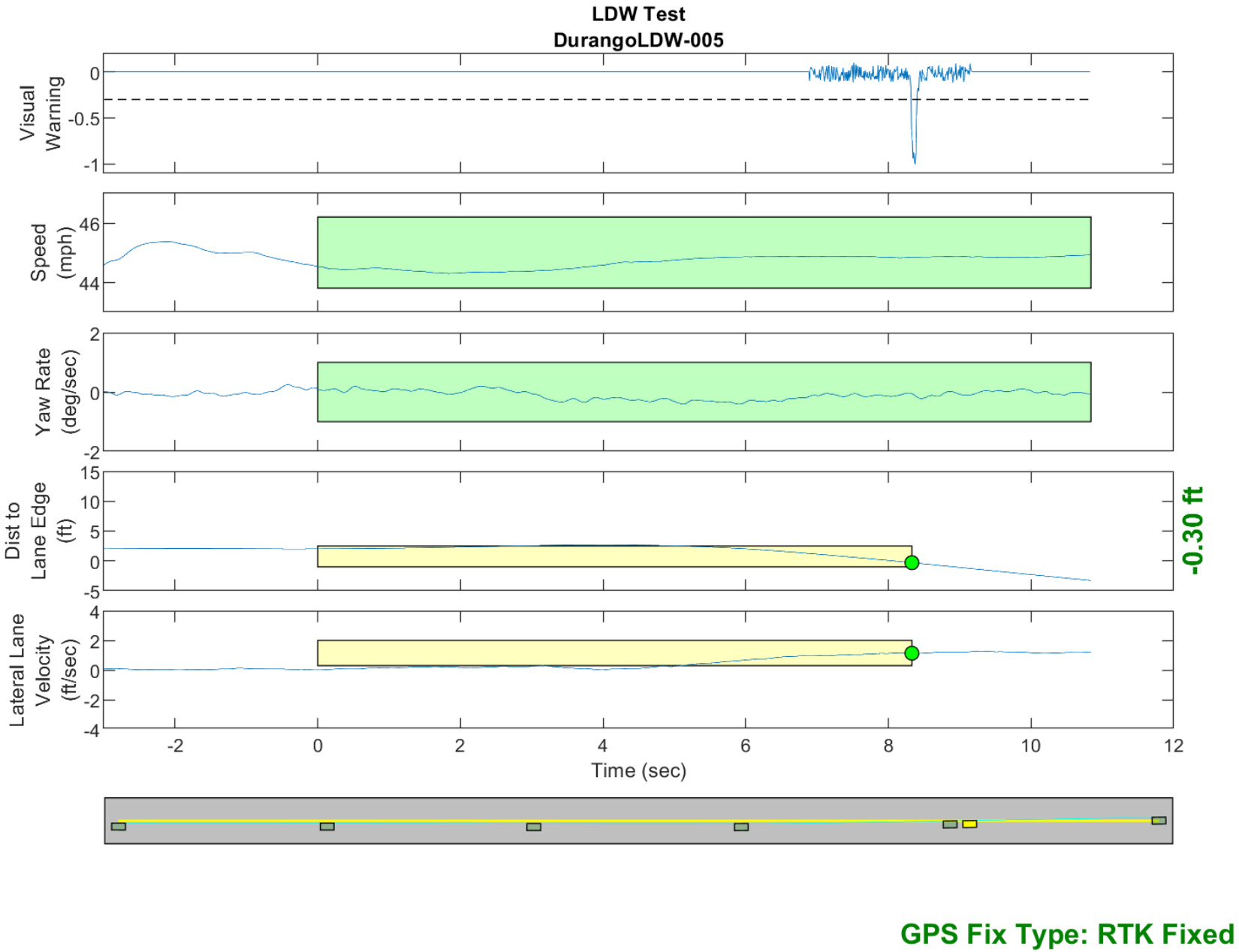


Figure D8. Time History for Run 05, Solid Line, Left Departure, Visual Warning

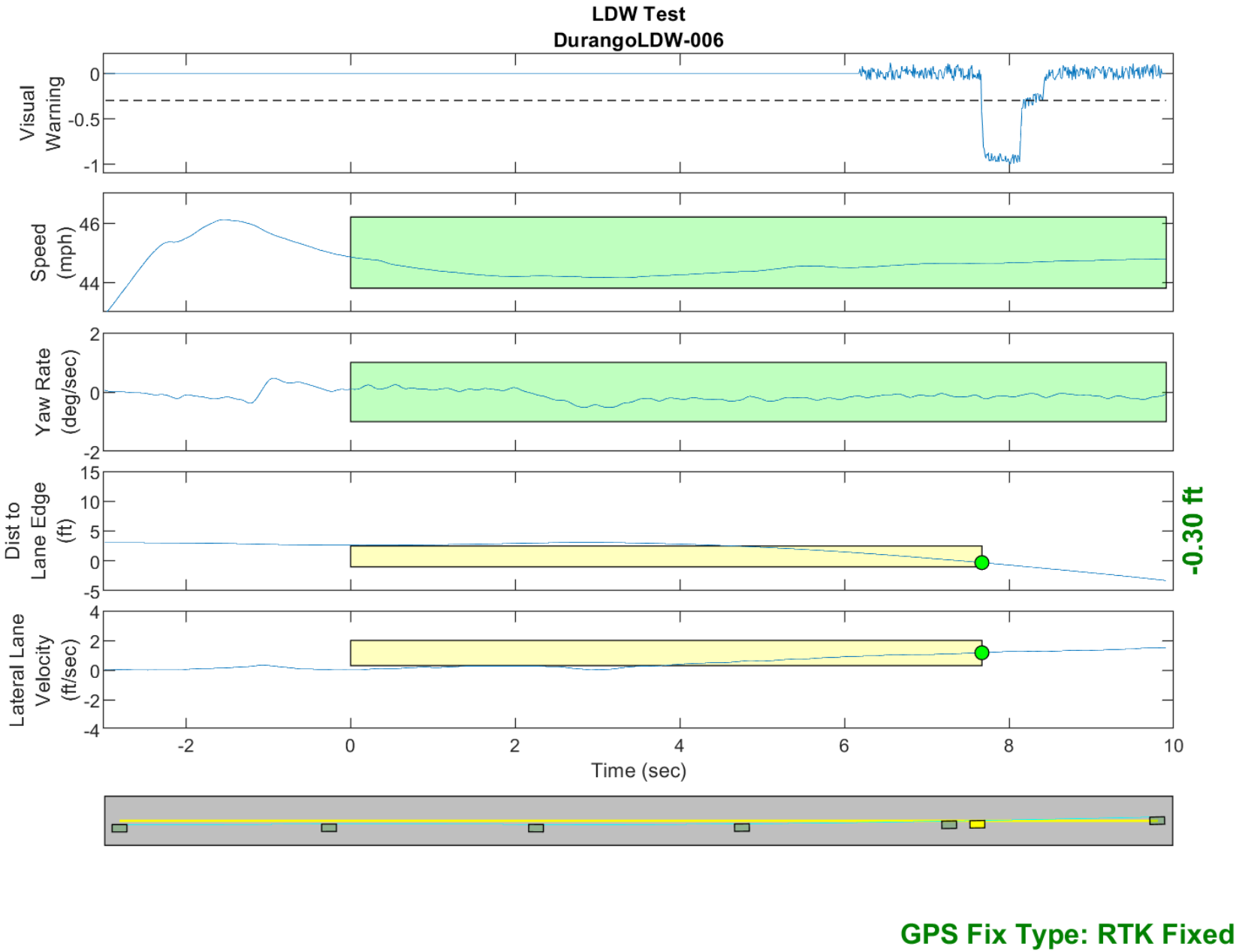


Figure D9. Time History for Run 06, Solid Line, Left Departure, Visual Warning

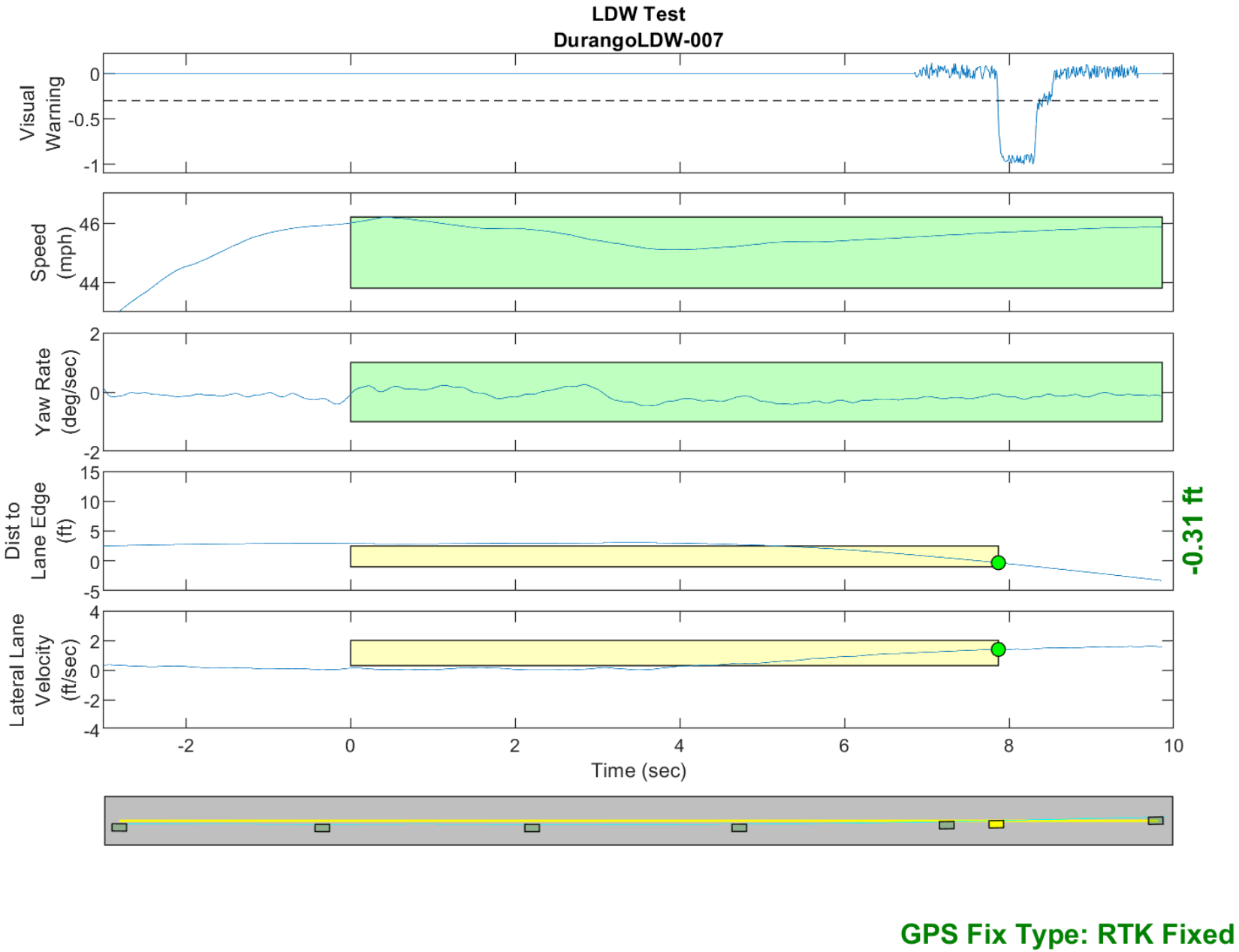


Figure D10. Time History for Run 07, Solid Line, Left Departure, Visual Warning

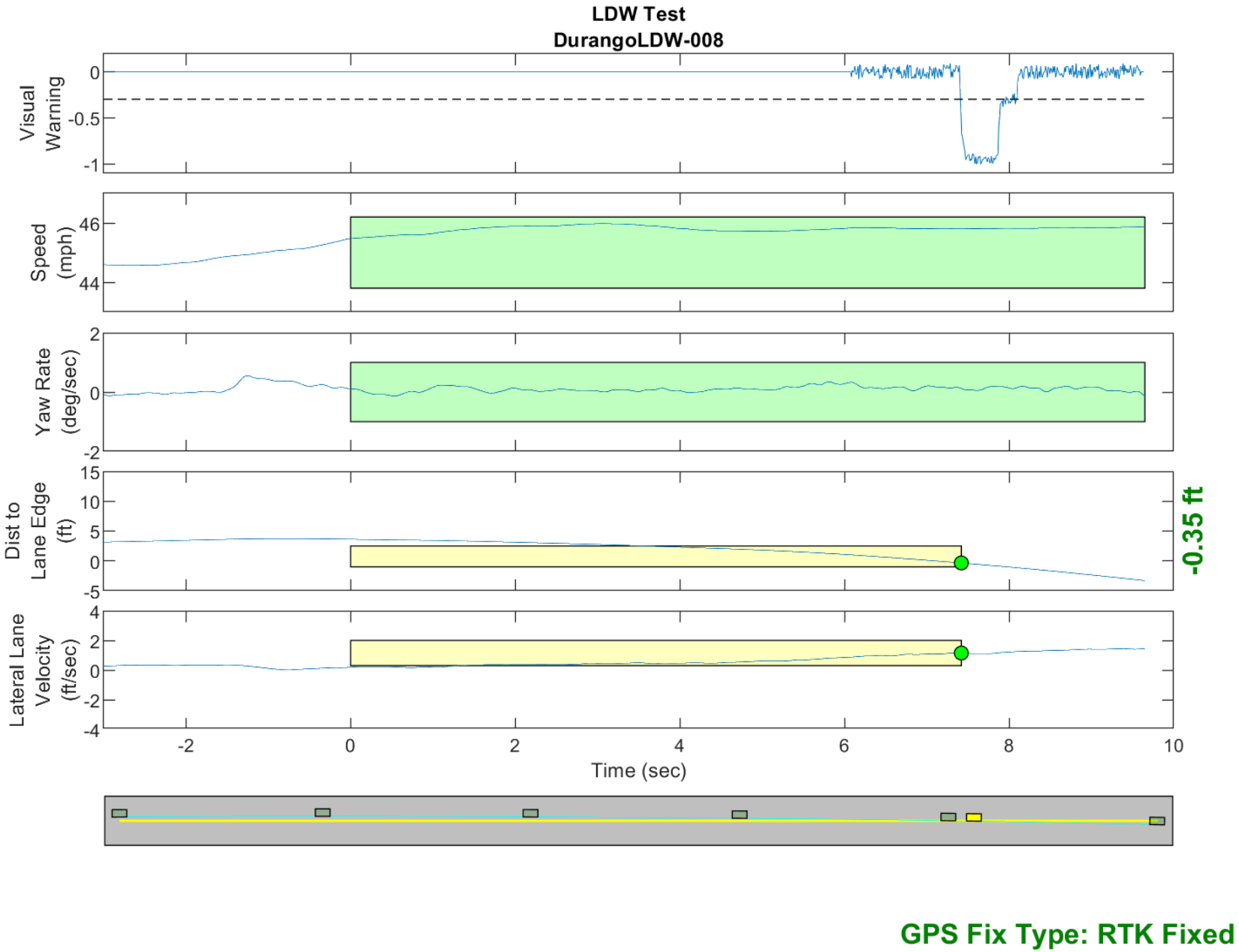


Figure D11. Time History for Run 08, Solid Line, Right Departure, Visual Warning

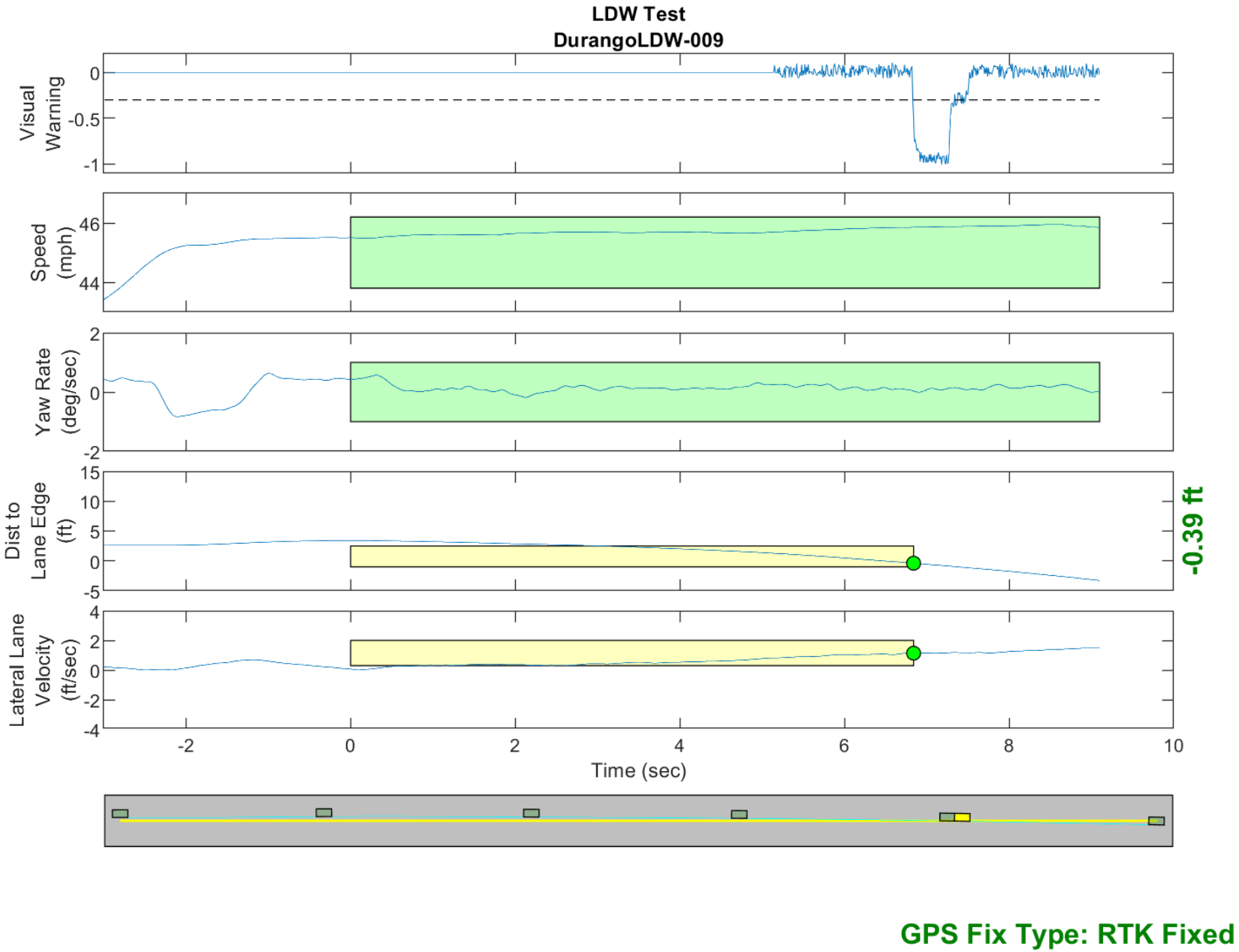


Figure D12. Time History for Run 09, Solid Line, Right Departure, Visual Warning

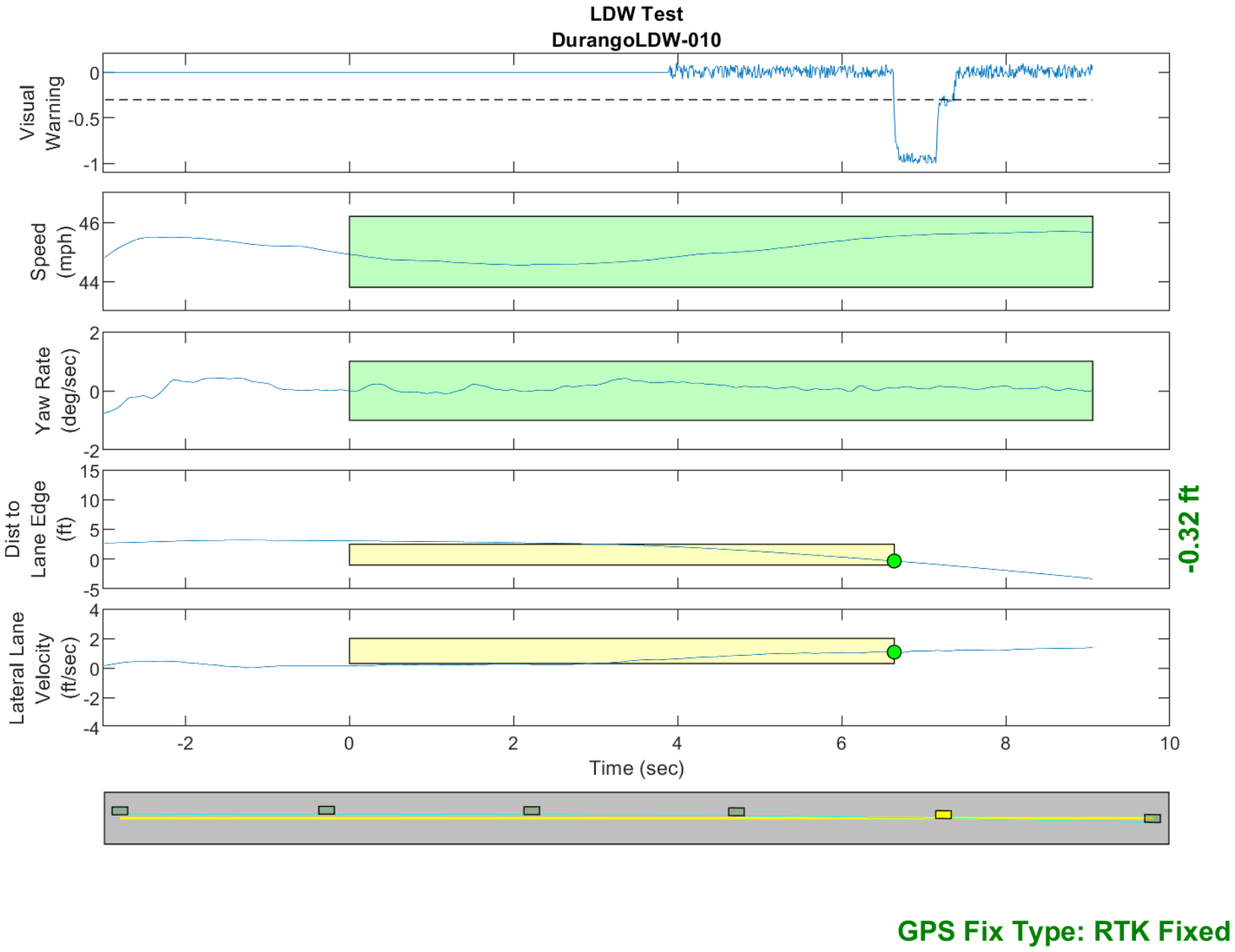


Figure D13. Time History for Run 10, Solid Line, Right Departure, Visual Warning

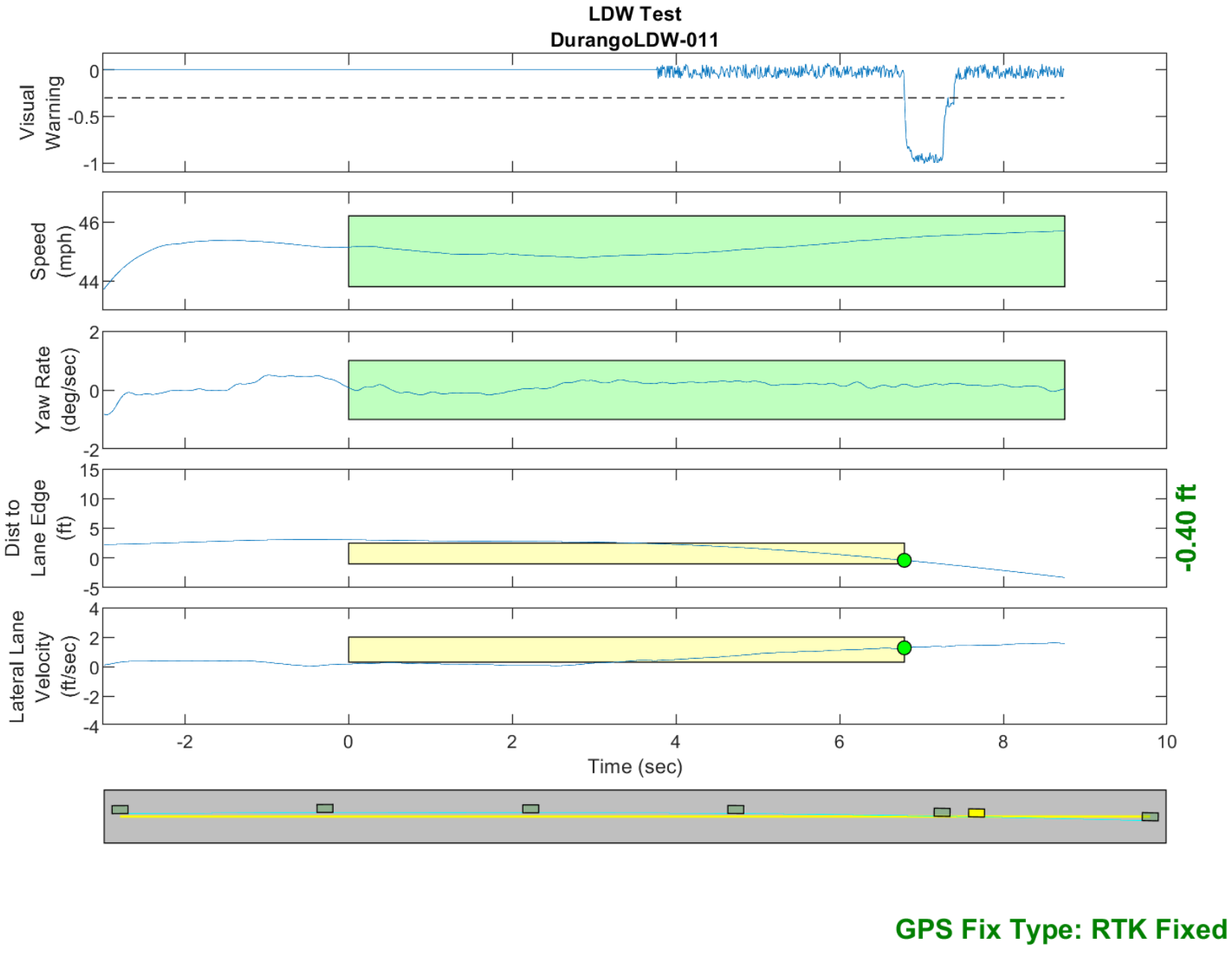


Figure D14. Time History for Run 11, Solid Line, Right Departure, Visual Warning

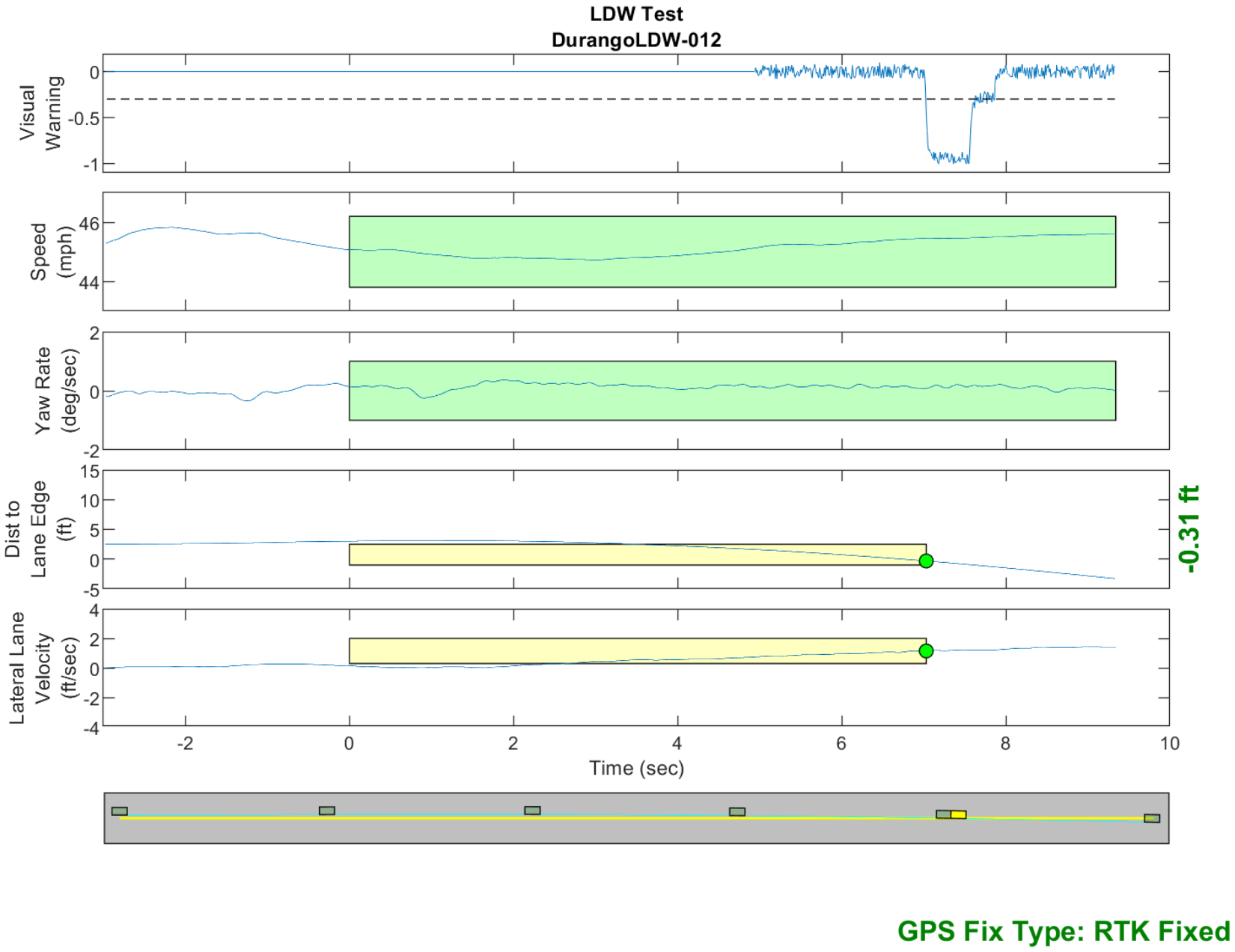


Figure D15. Time History for Run 12, Solid Line, Right Departure, Visual Warning

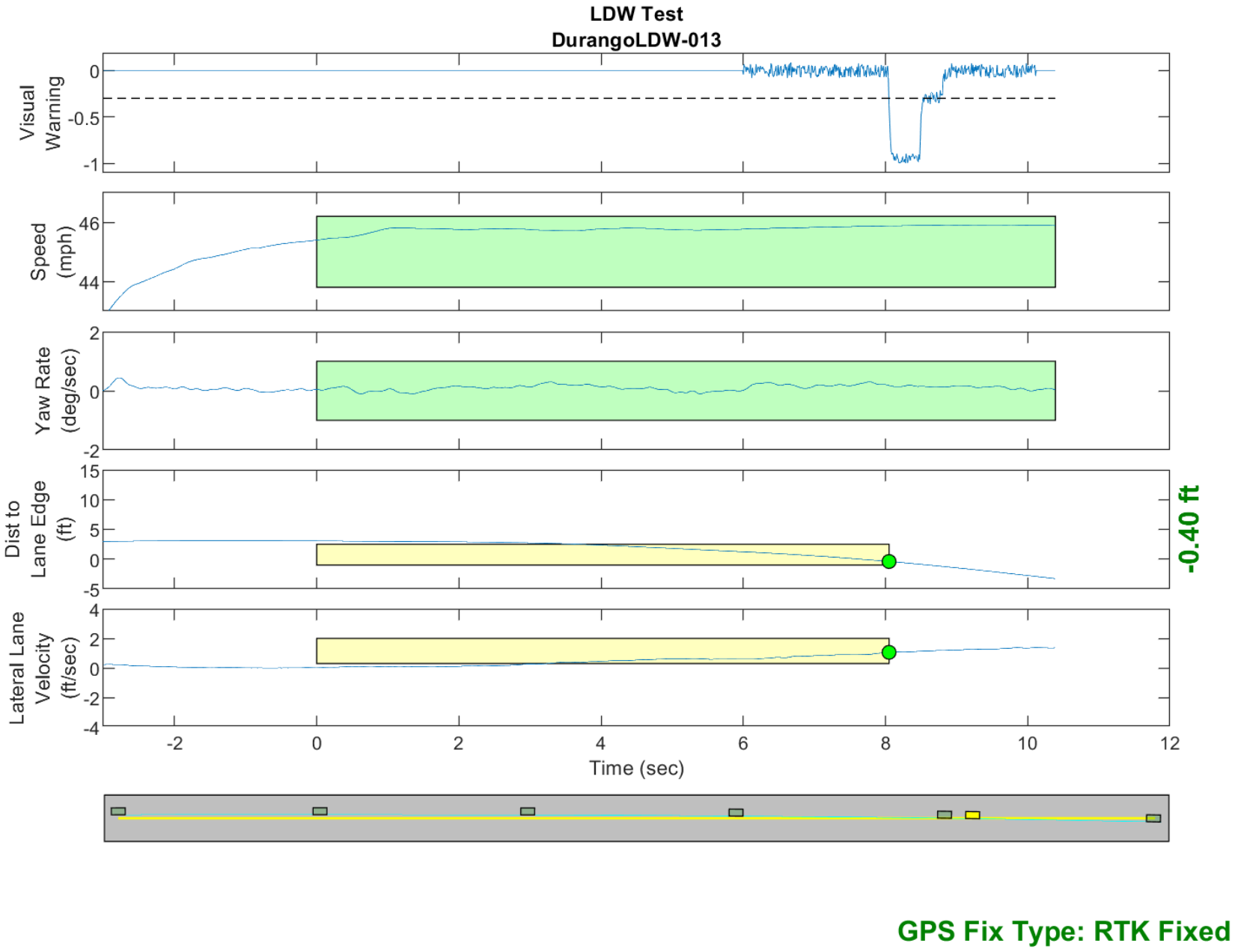


Figure D16. Time History for Run 13, Solid Line, Right Departure, Visual Warning

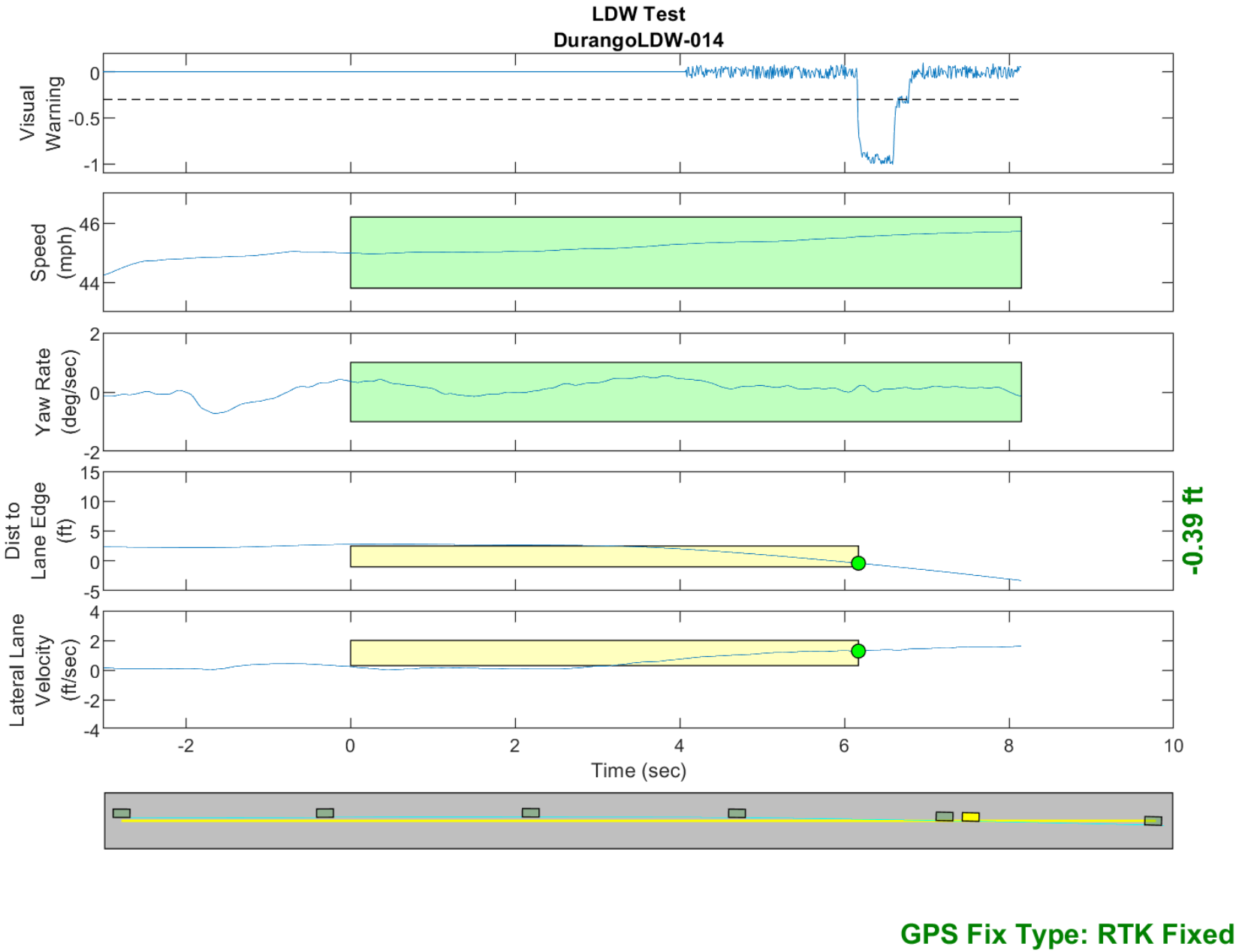


Figure D17. Time History for Run 14, Solid Line, Right Departure, Visual Warning

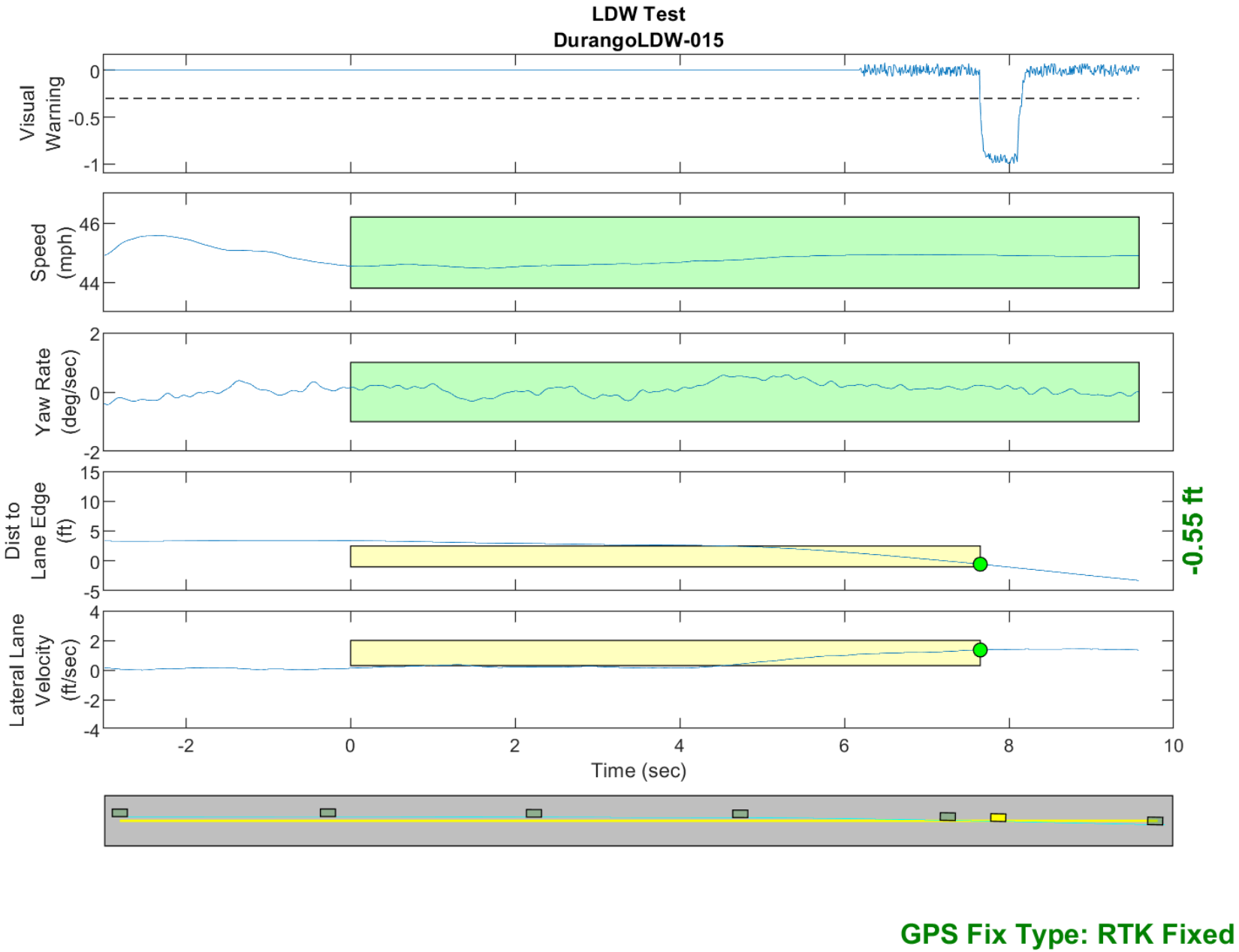


Figure D18. Time History for Run 15, Dashed Line, Right Departure, Visual Warning

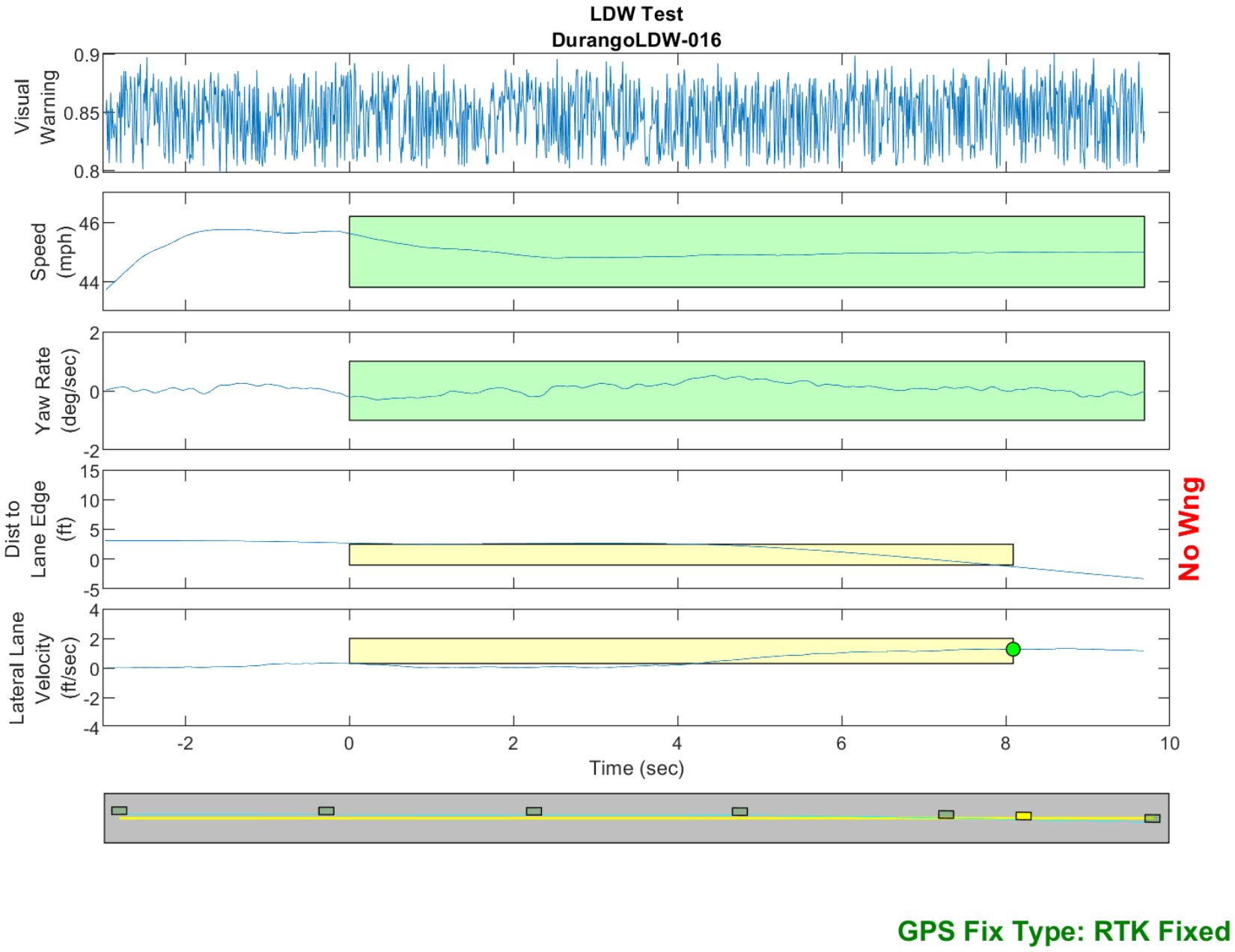


Figure D19. Time History for Run 16, Dashed Line, Right Departure, Visual Warning

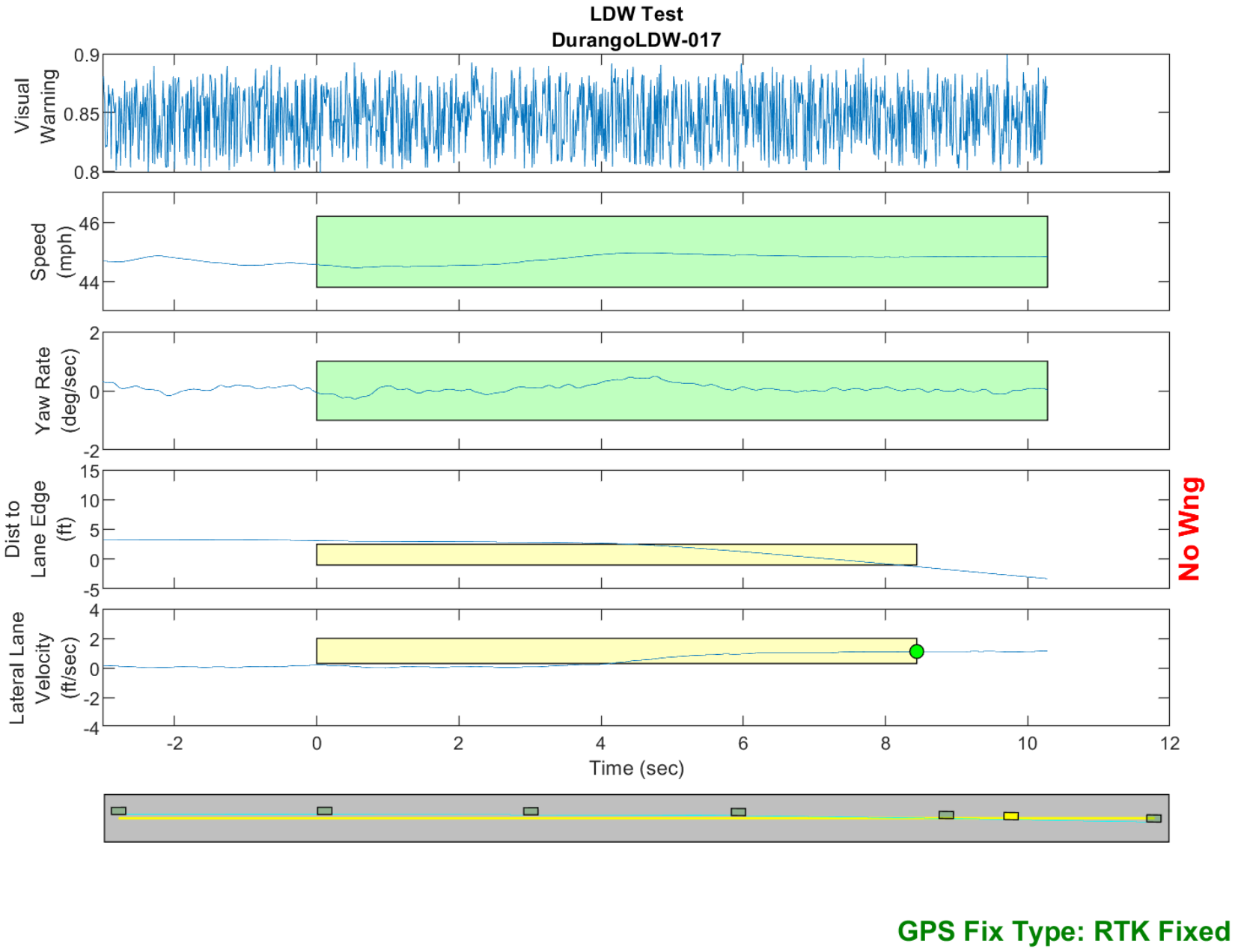


Figure D20. Time History for Run 17, Dashed Line, Right Departure, Visual Warning

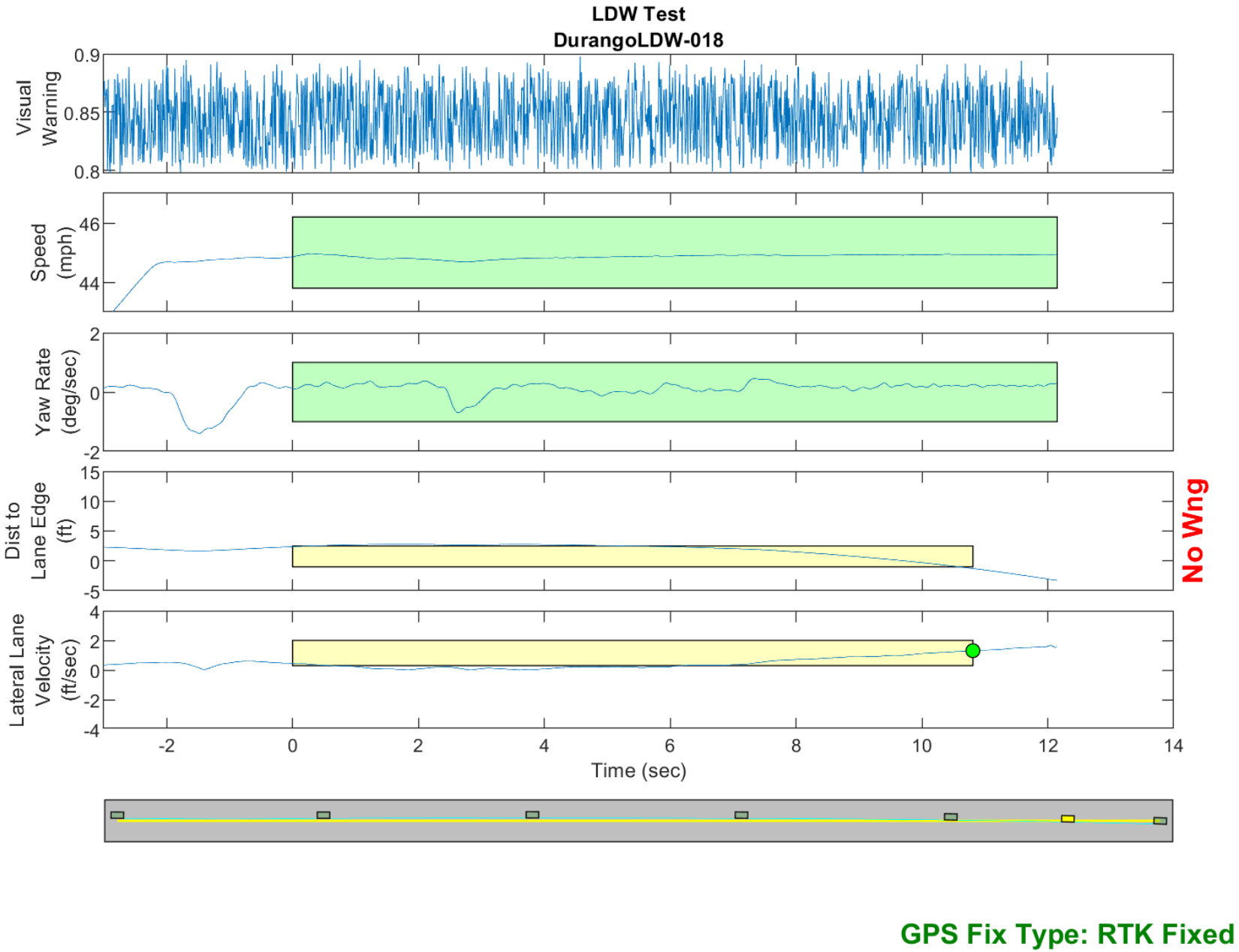


Figure D21. Time History for Run 18, Dashed Line, Right Departure, Visual Warning

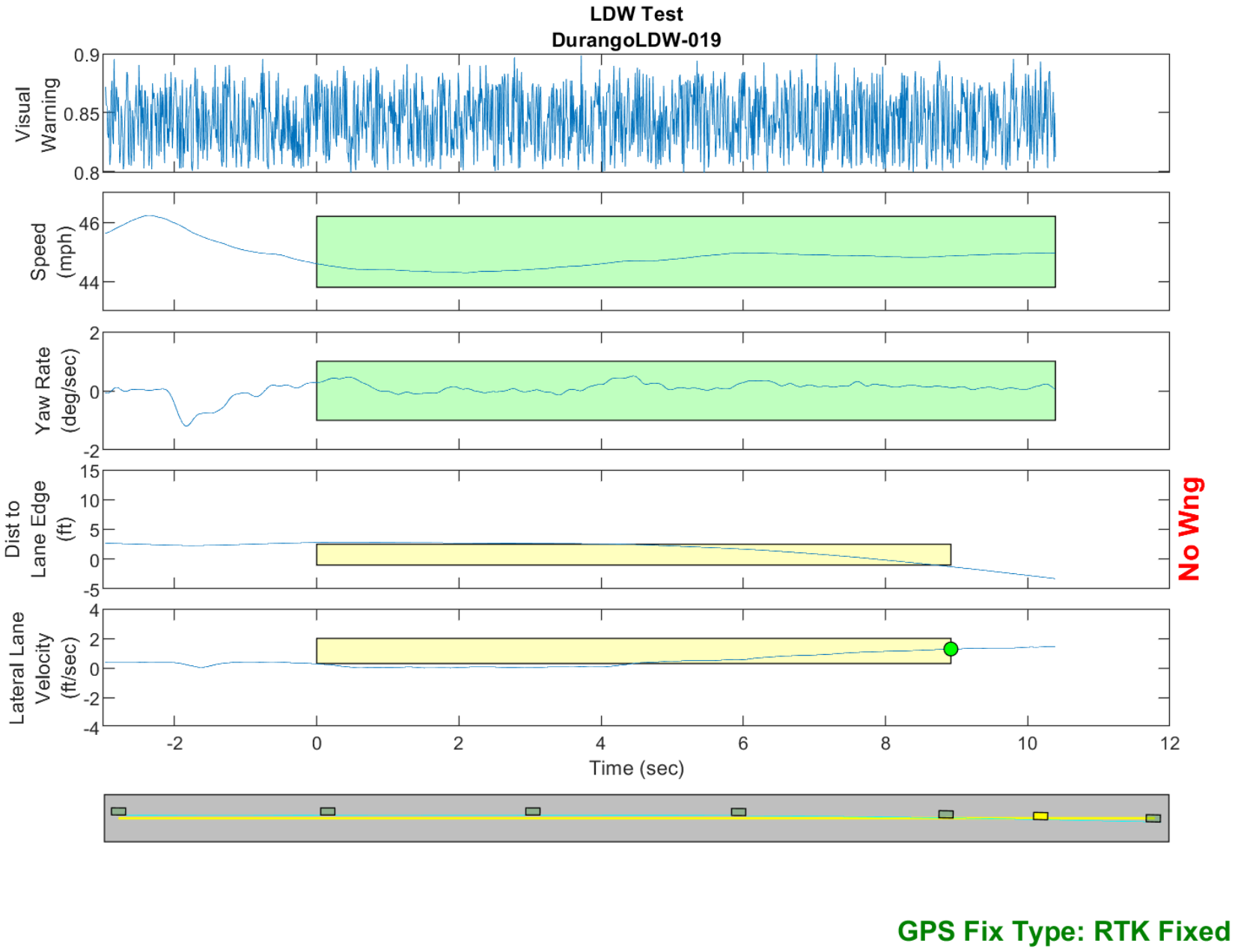


Figure D22. Time History for Run 19, Dashed Line, Right Departure, Visual Warning

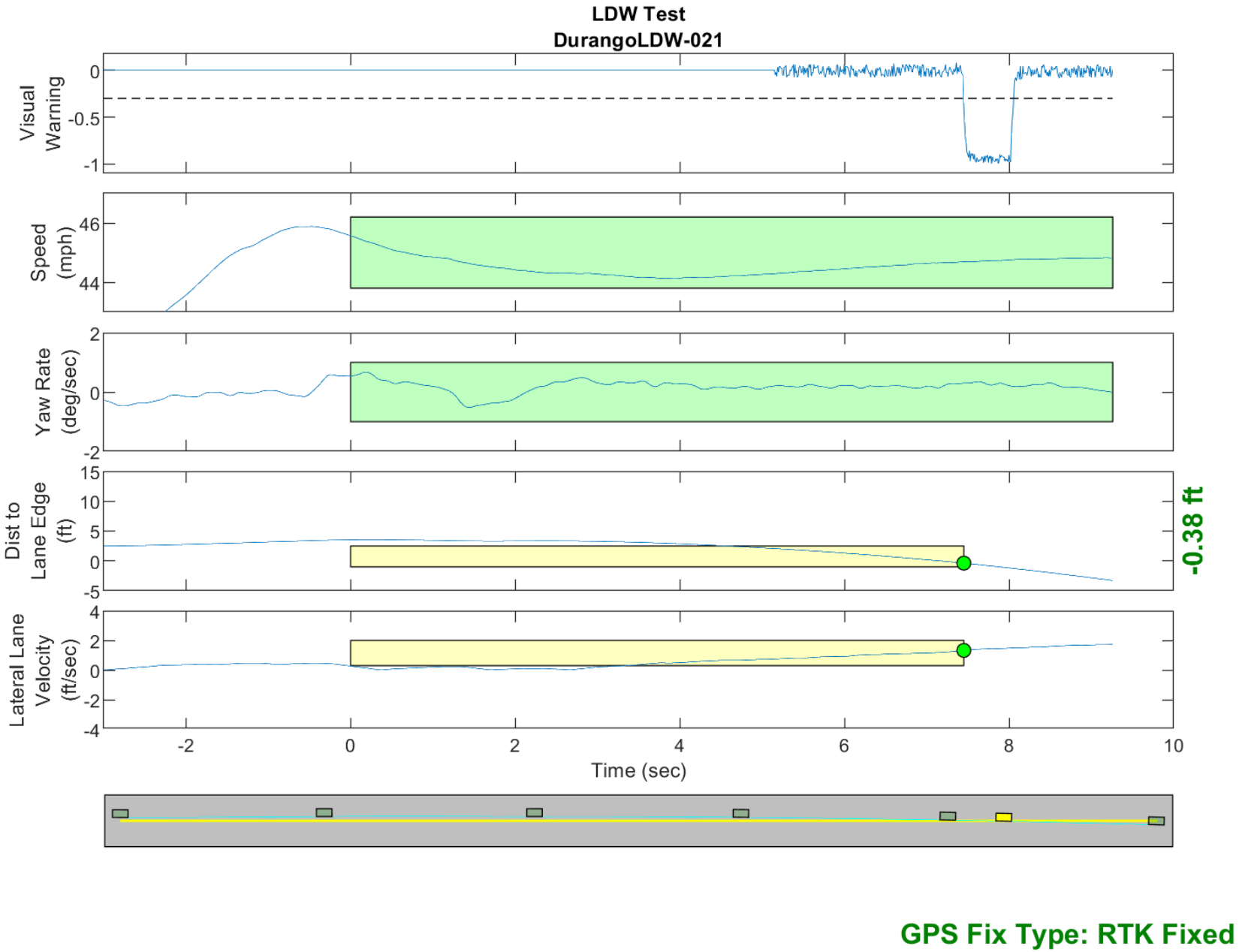


Figure D23. Time History for Run 21, Dashed Line, Right Departure, Visual Warning

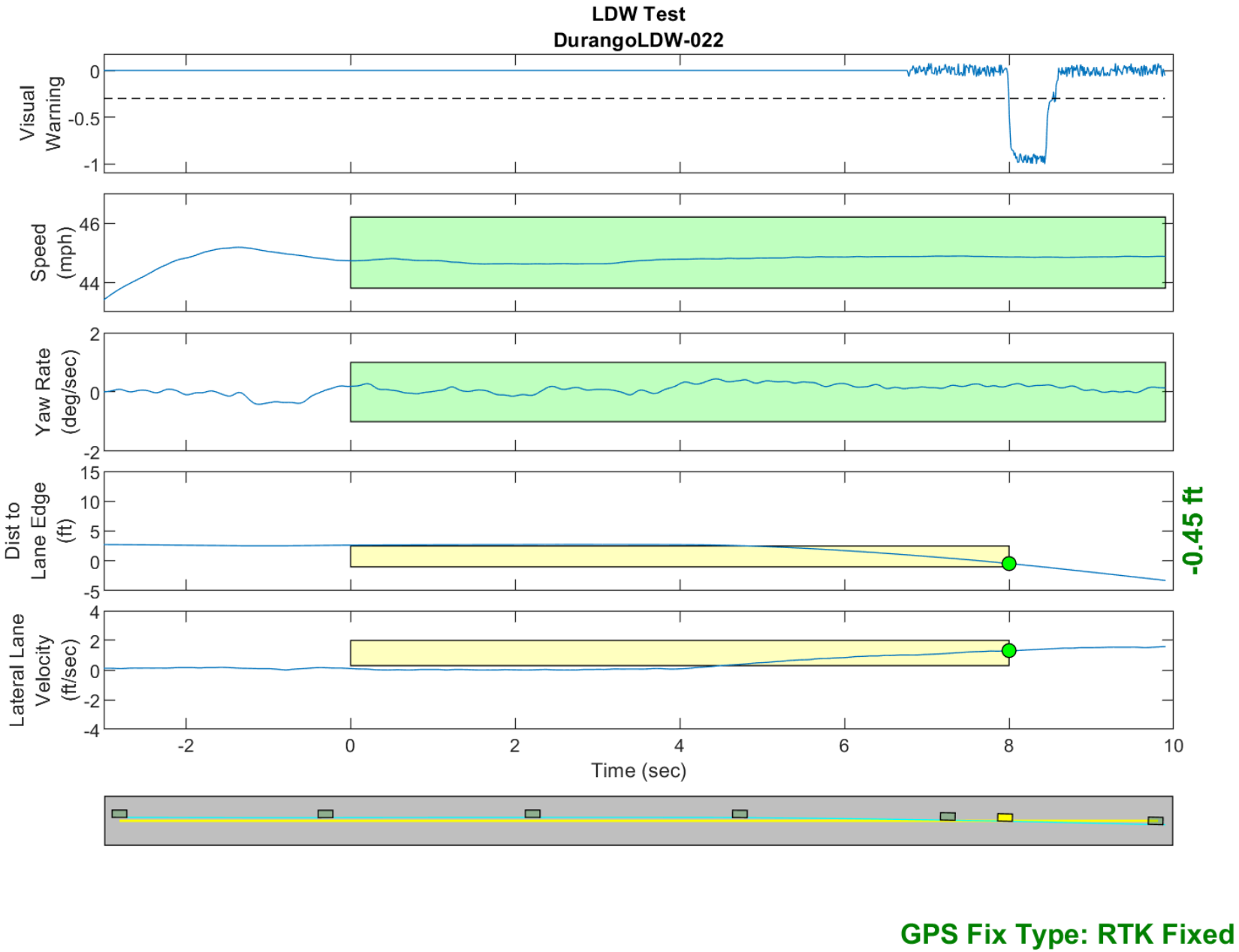


Figure D24. Time History for Run 22, Dashed Line, Right Departure, Visual Warning

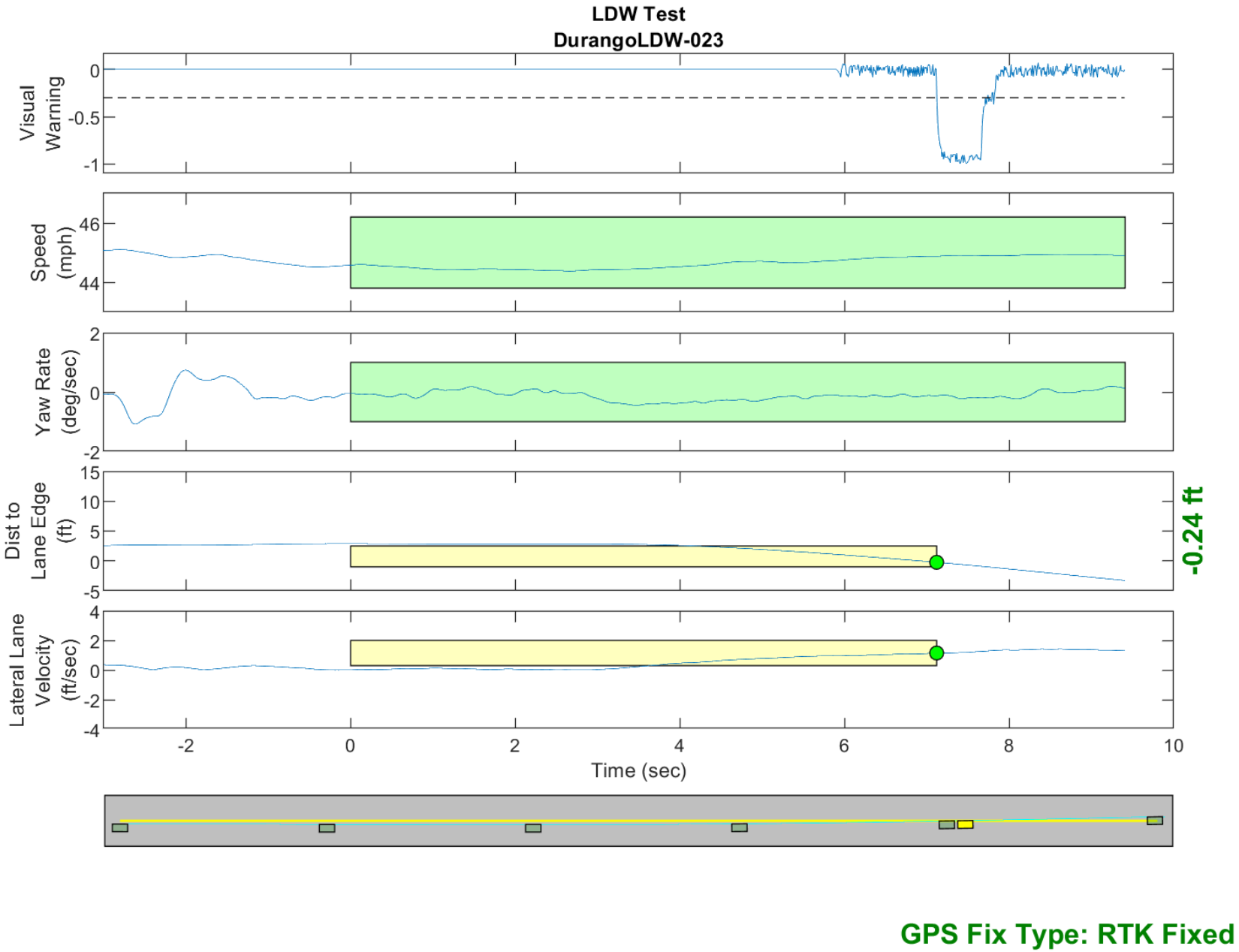


Figure D25. Time History for Run 23, Dashed Line, Left Departure, Visual Warning

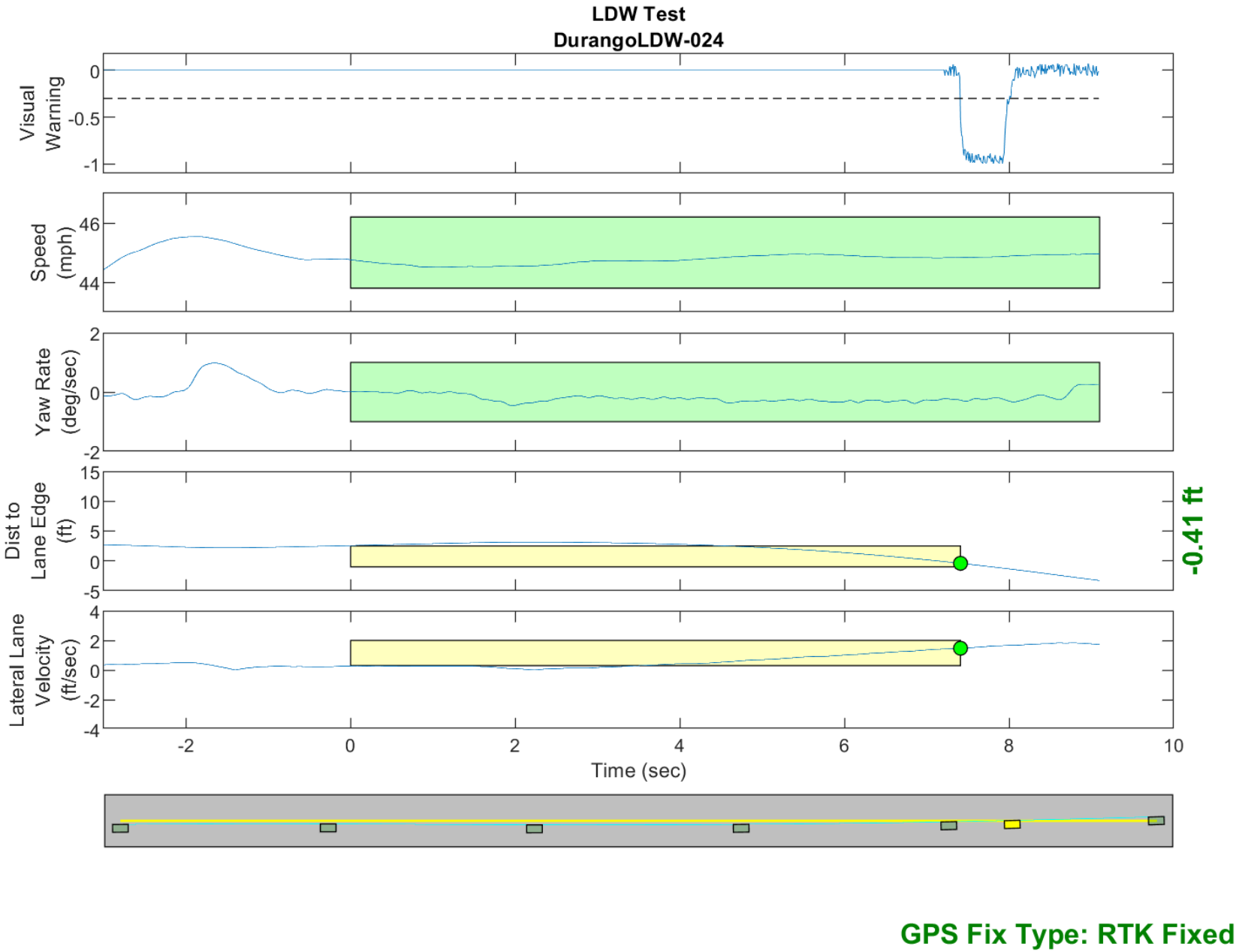


Figure D26. Time History for Run 24, Dashed Line, Left Departure, Visual Warning

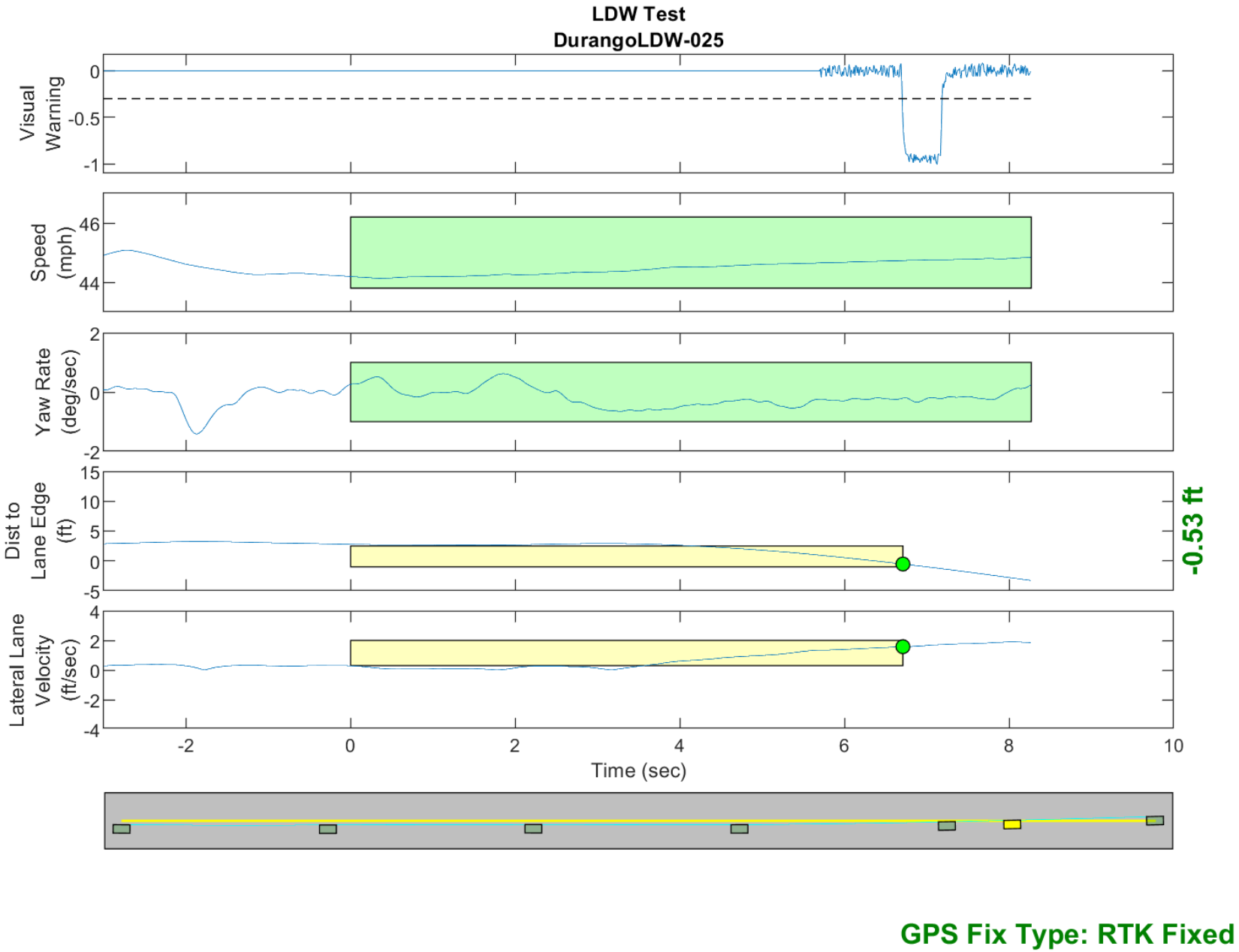


Figure D27. Time History for Run 25, Dashed Line, Left Departure, Visual Warning

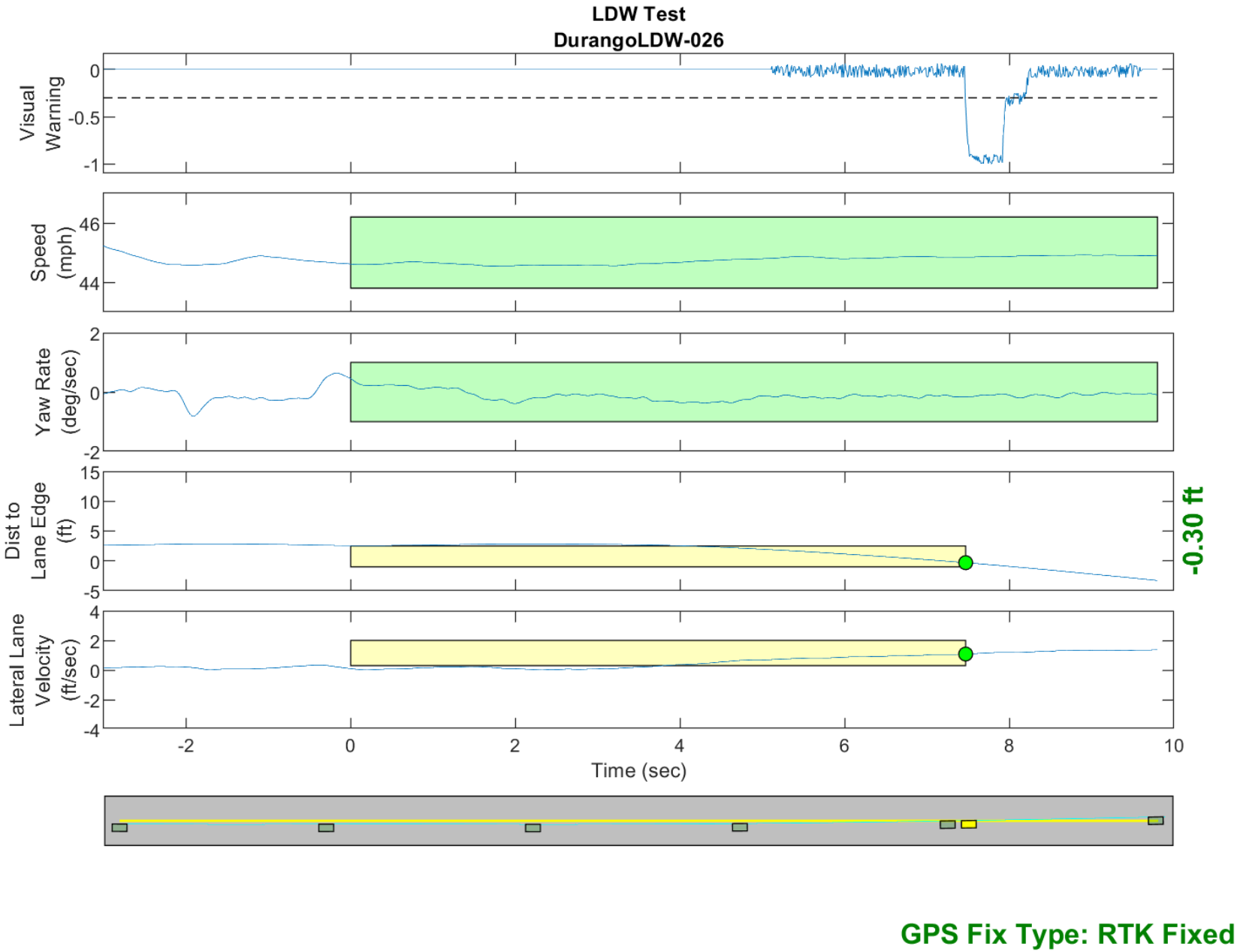


Figure D28. Time History for Run 26, Dashed Line, Left Departure, Visual Warning

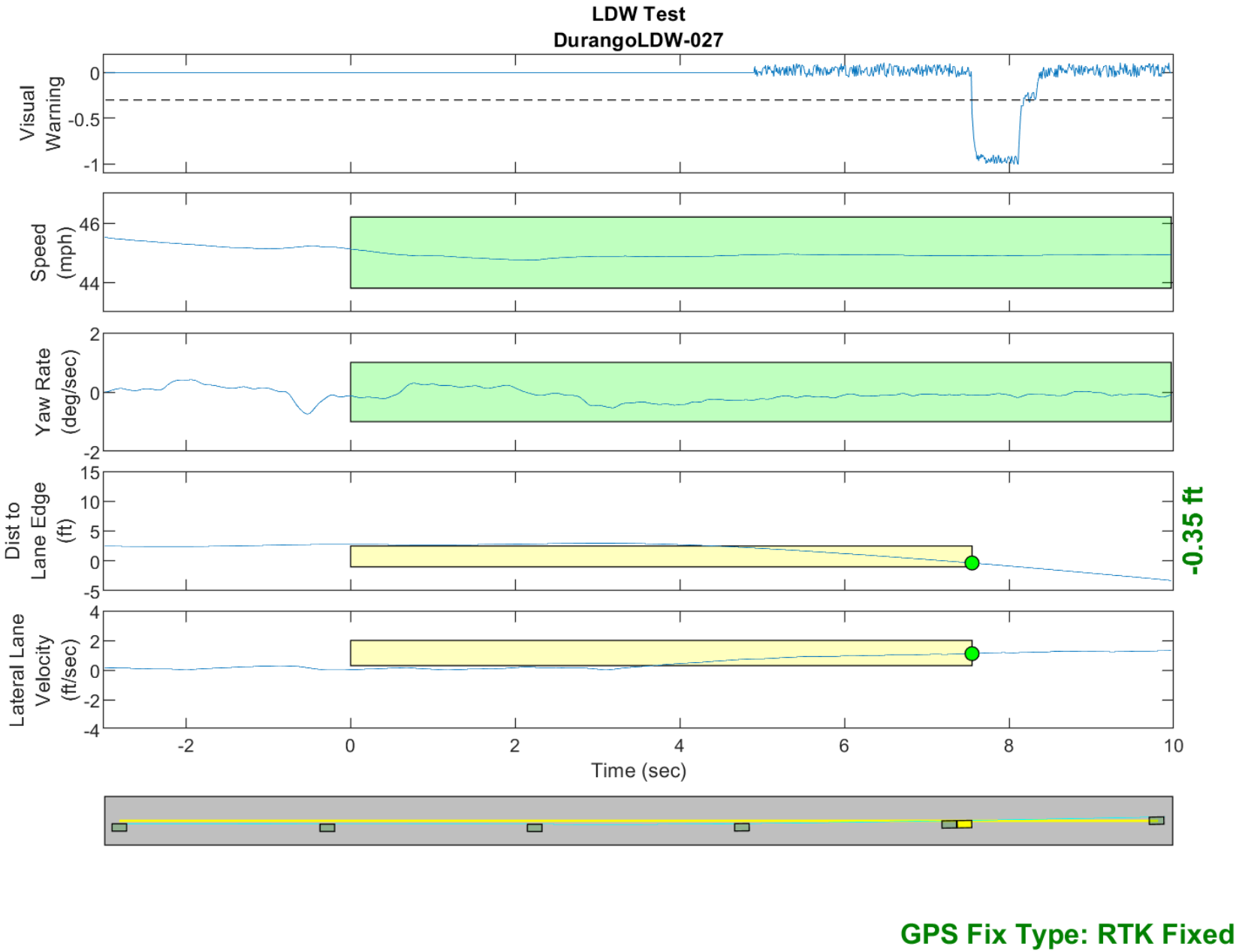


Figure D29. Time History for Run 27, Dashed Line, Left Departure, Visual Warning

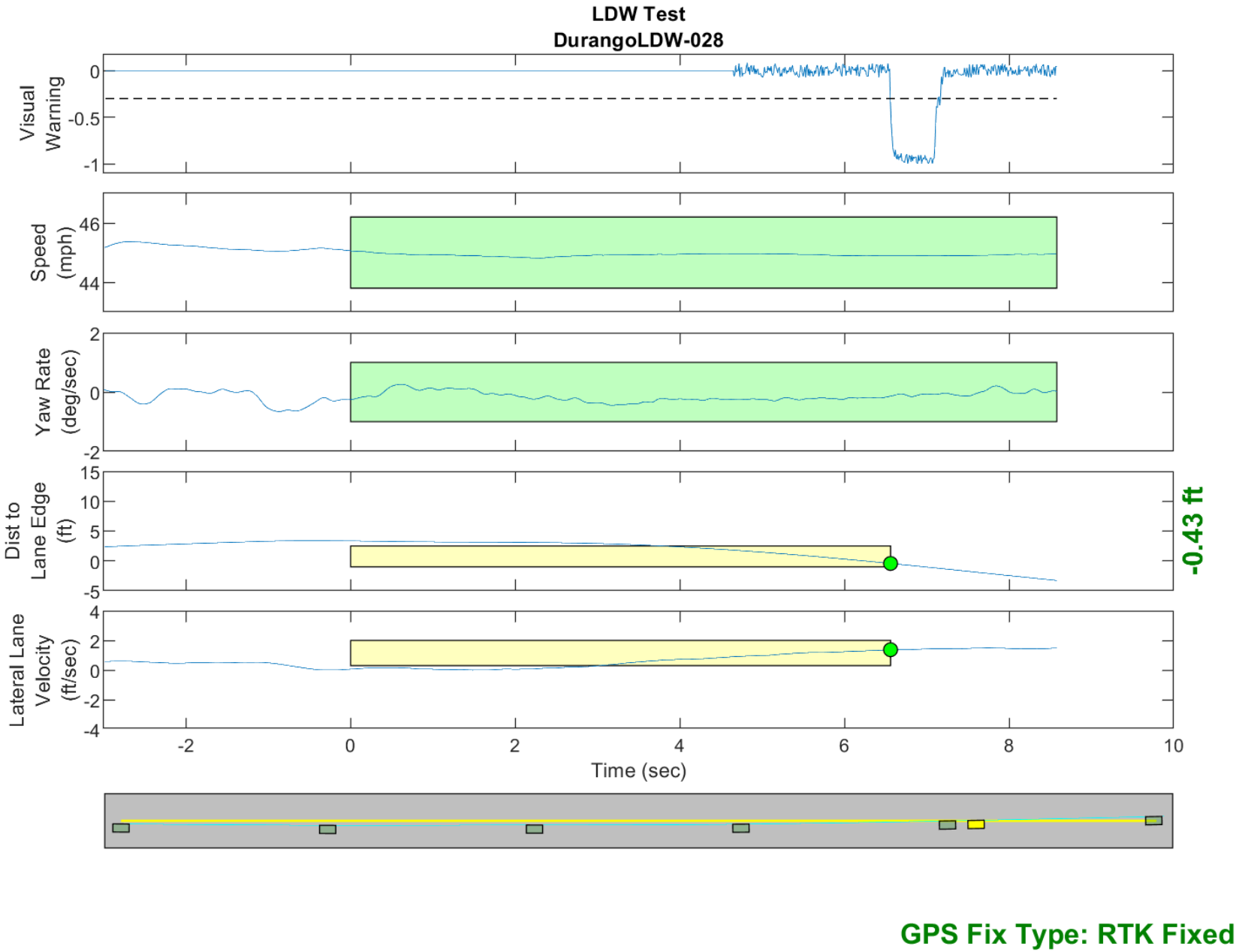


Figure D30. Time History for Run 28, Dashed Line, Left Departure, Visual Warning

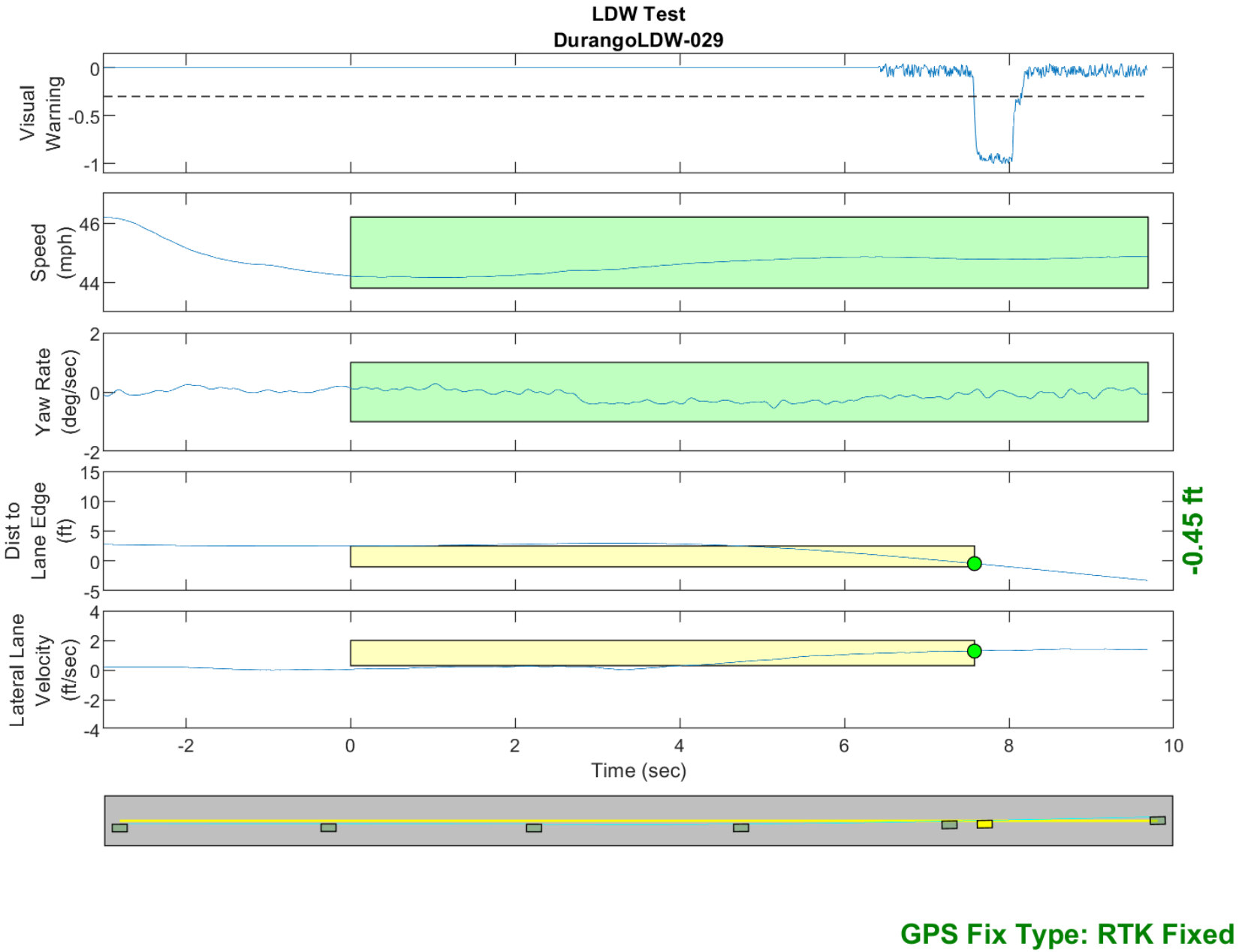


Figure D31. Time History for Run 29, Dashed Line, Left Departure, Visual Warning

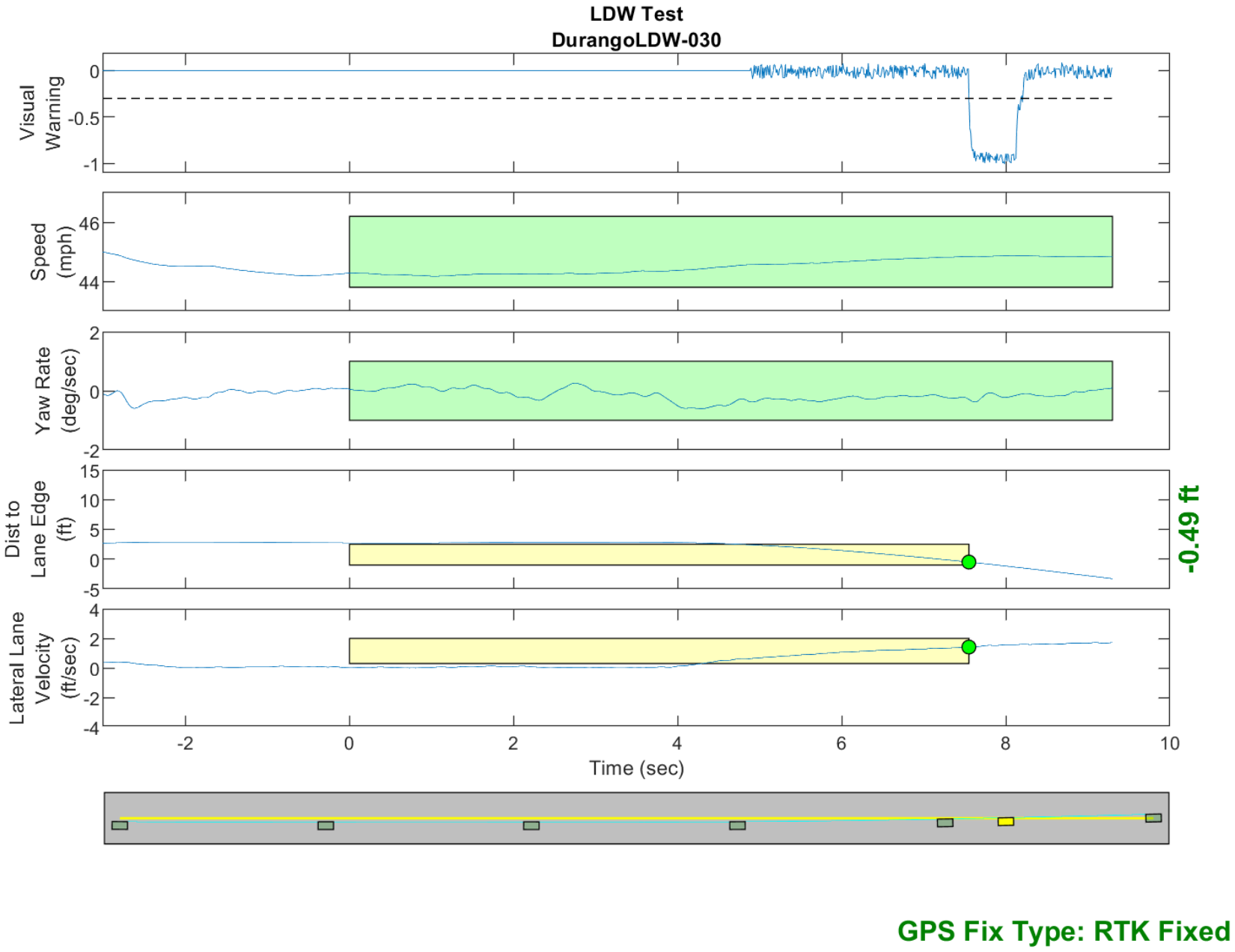


Figure D32. Time History for Run 30, Botts Dots, Left Departure, Visual Warning

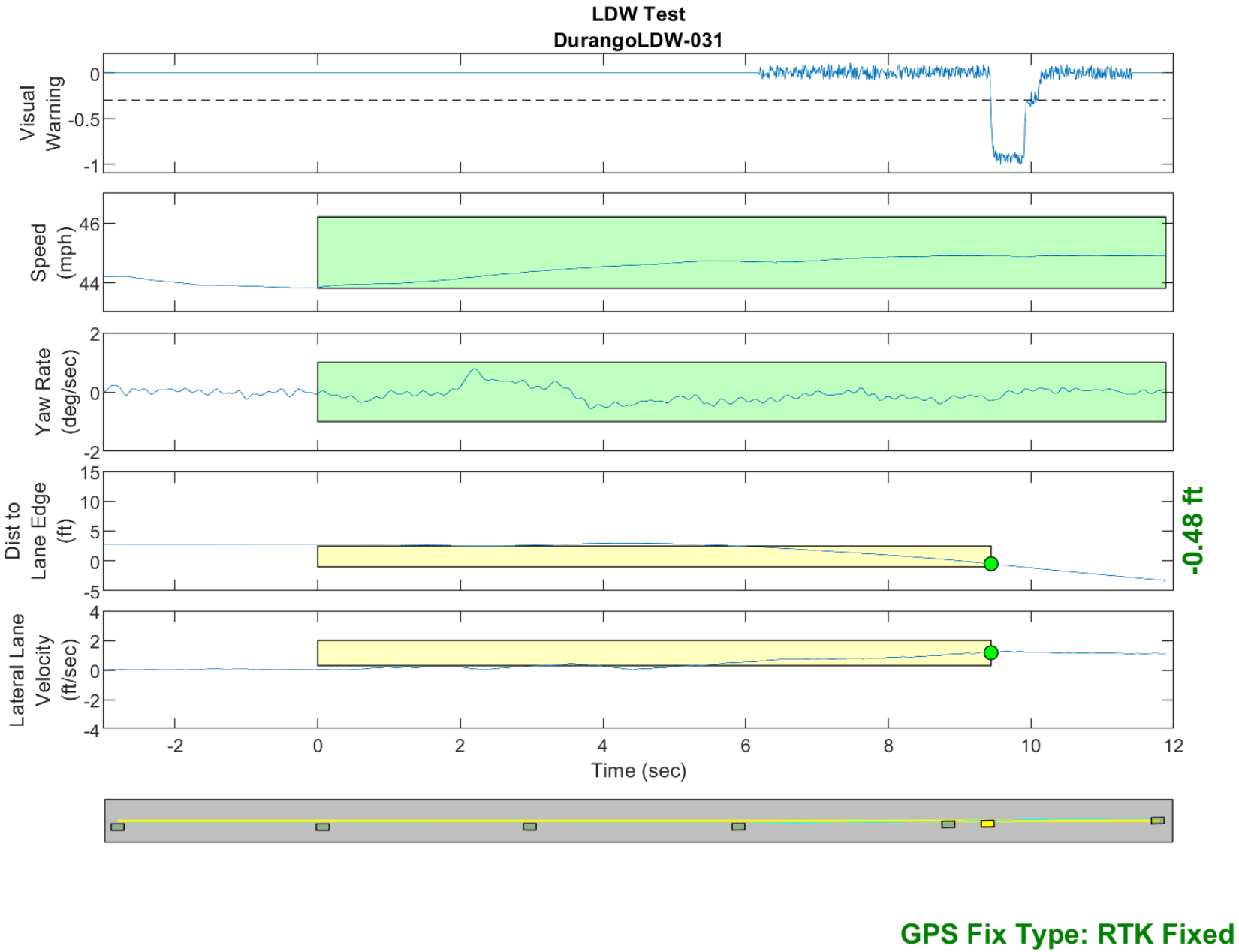


Figure D33. Time History for Run 31, Botts Dots, Left Departure, Visual Warning

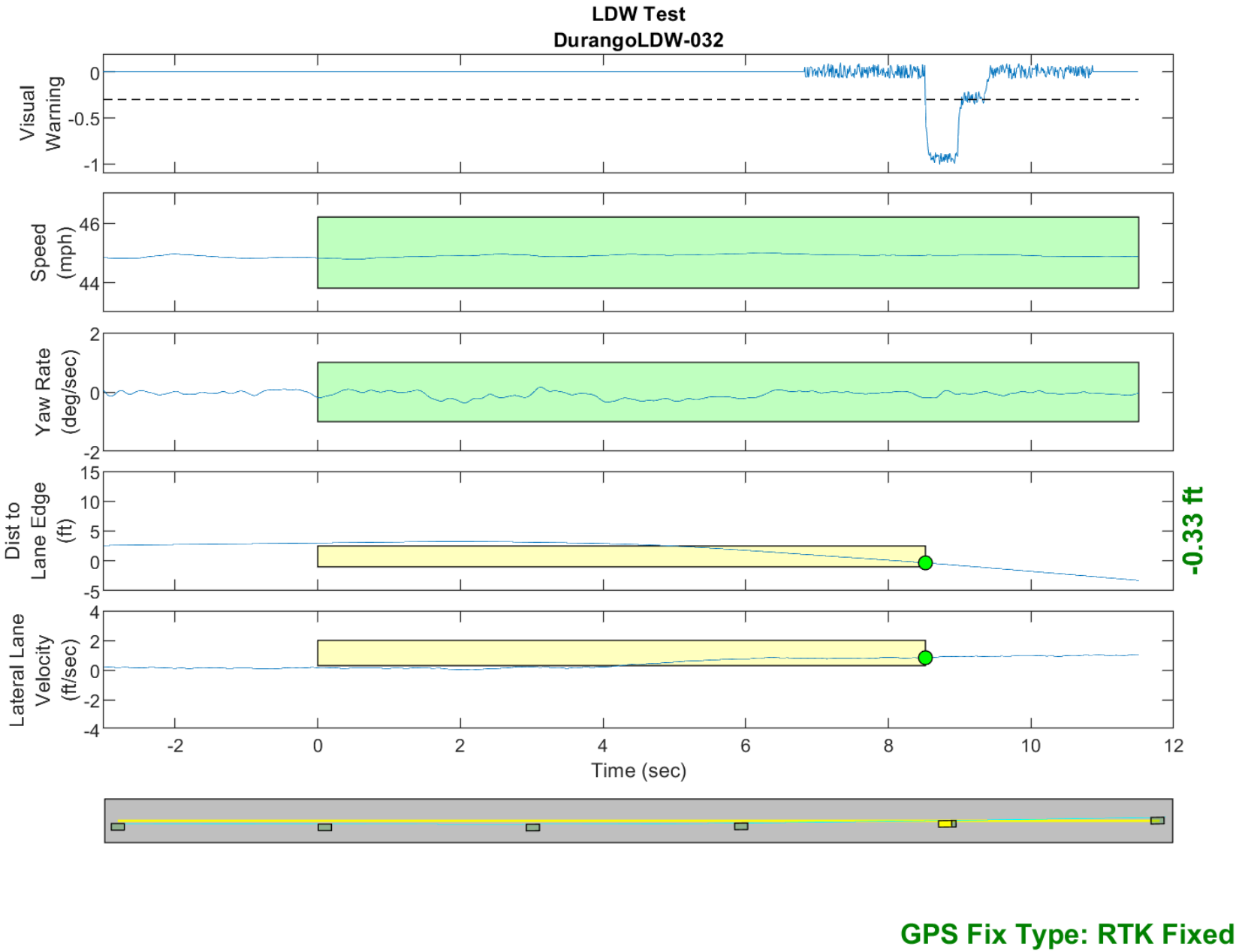


Figure D34. Time History for Run 32, Botts Dots, Left Departure, Visual Warning

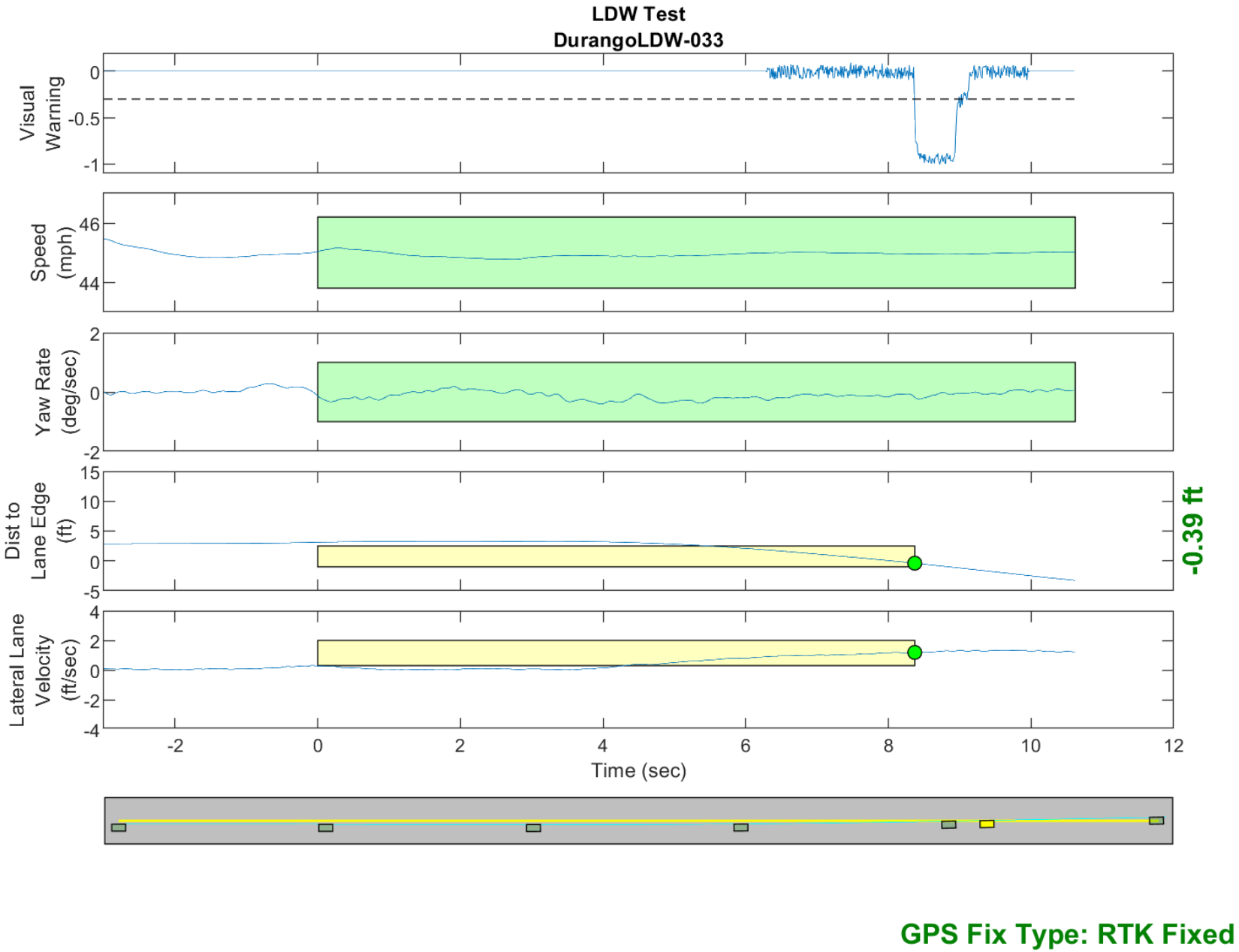


Figure D35. Time History for Run 33, Botts Dots, Left Departure, Visual Warning

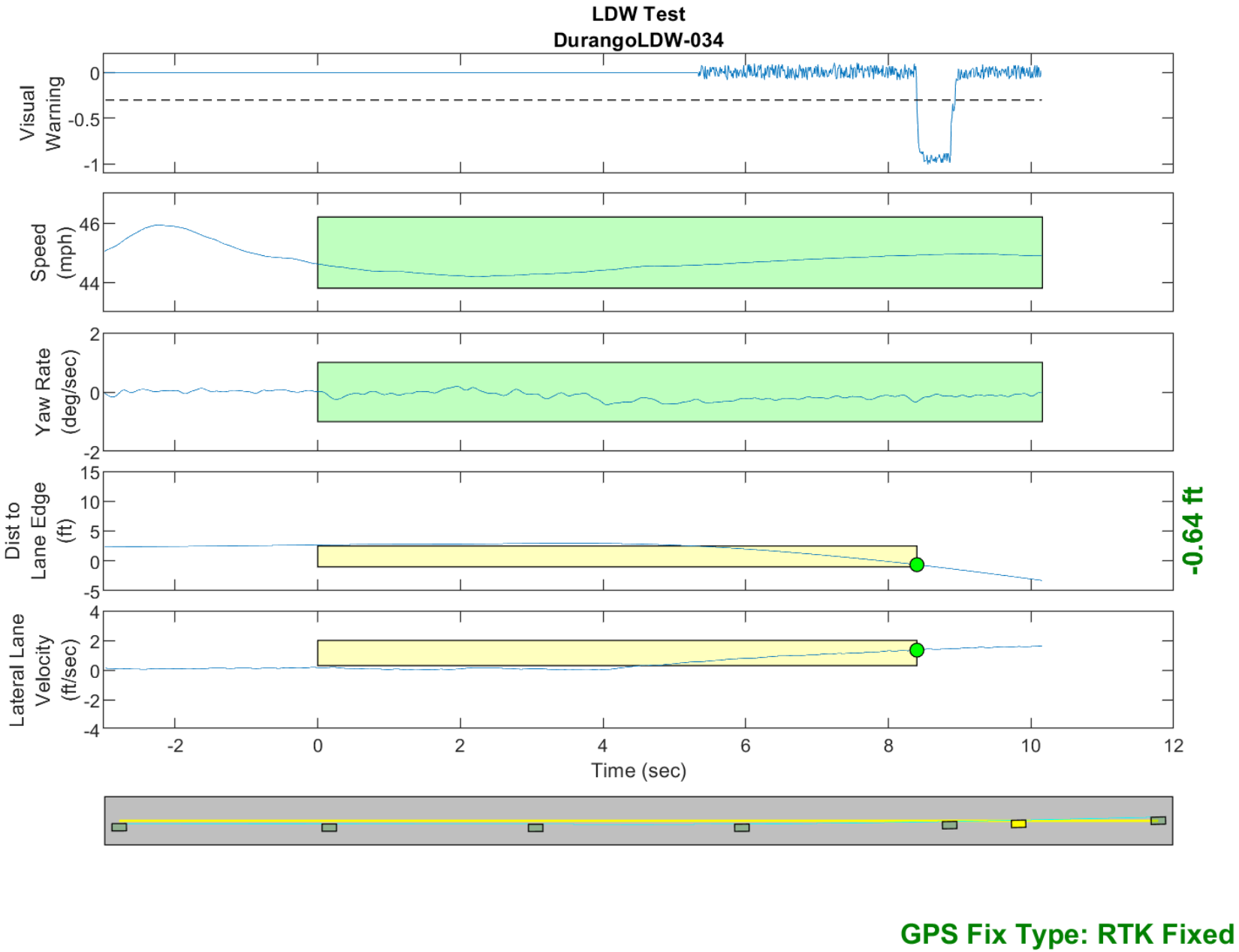


Figure D36. Time History for Run 34, Botts Dots, Left Departure, Visual Warning

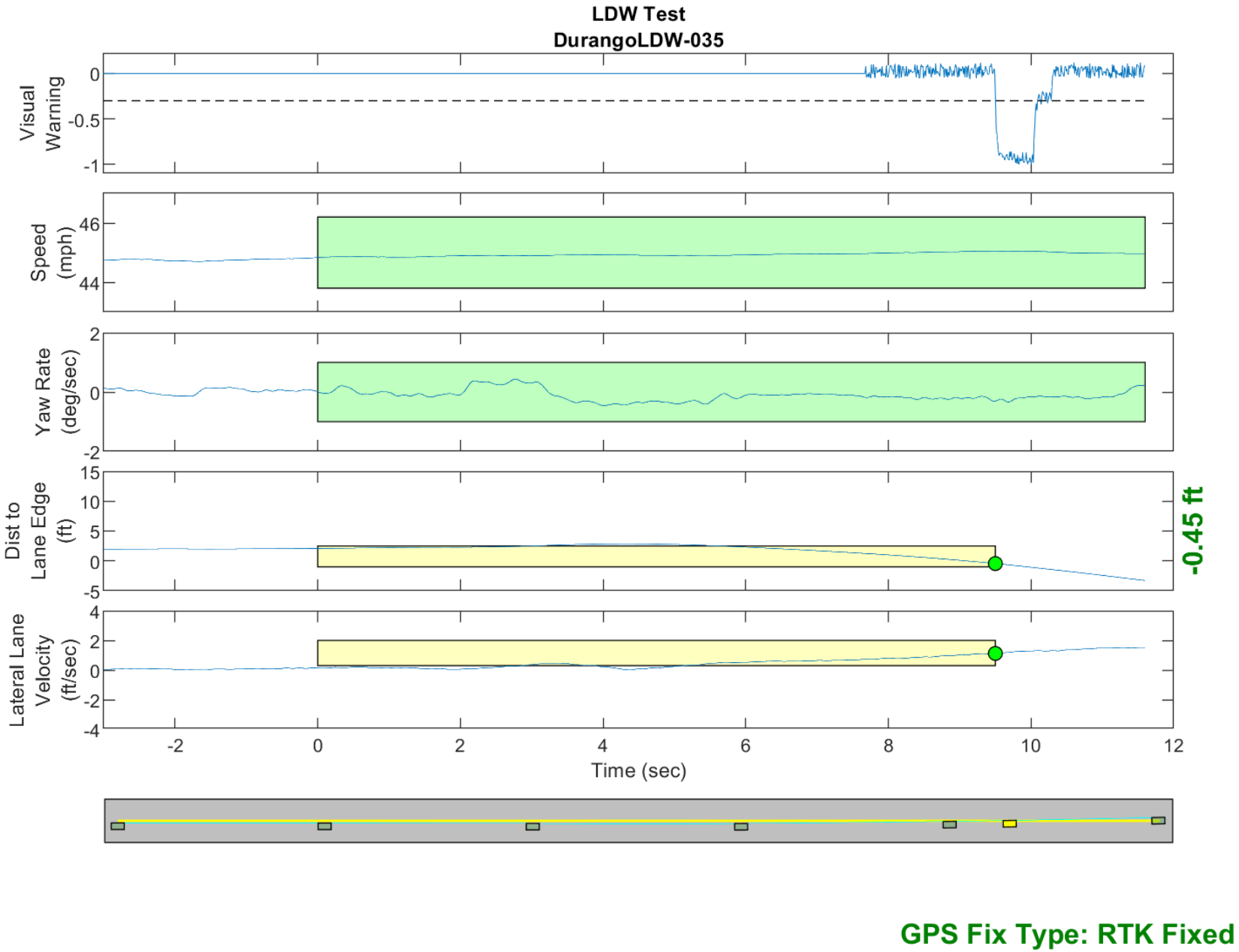


Figure D37. Time History for Run 35, Botts Dots, Left Departure, Visual Warning

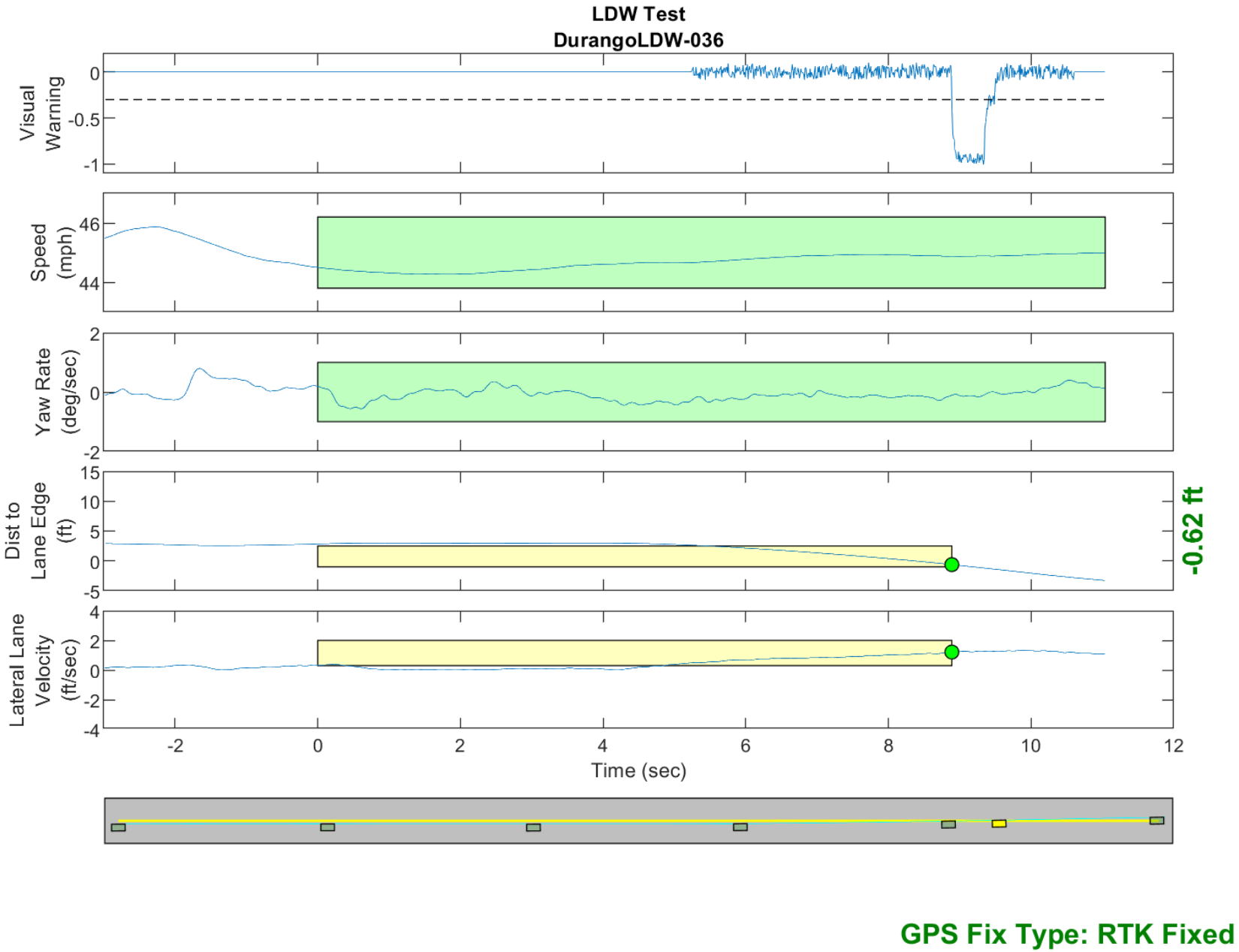


Figure D38. Time History for Run 36, Botts Dots, Left Departure, Visual Warning

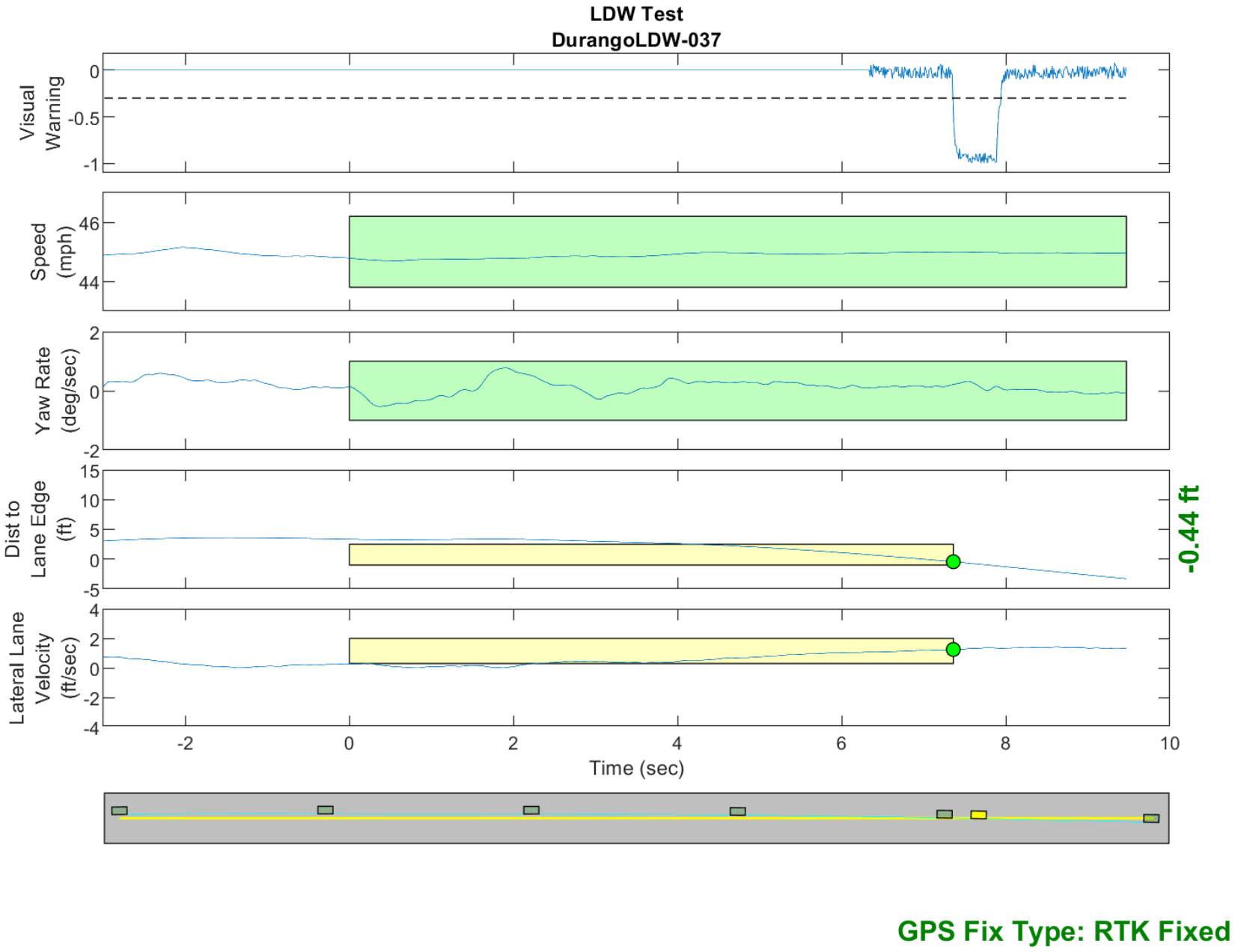


Figure D39. Time History for Run 37, Botts Dots, Right Departure, Visual Warning

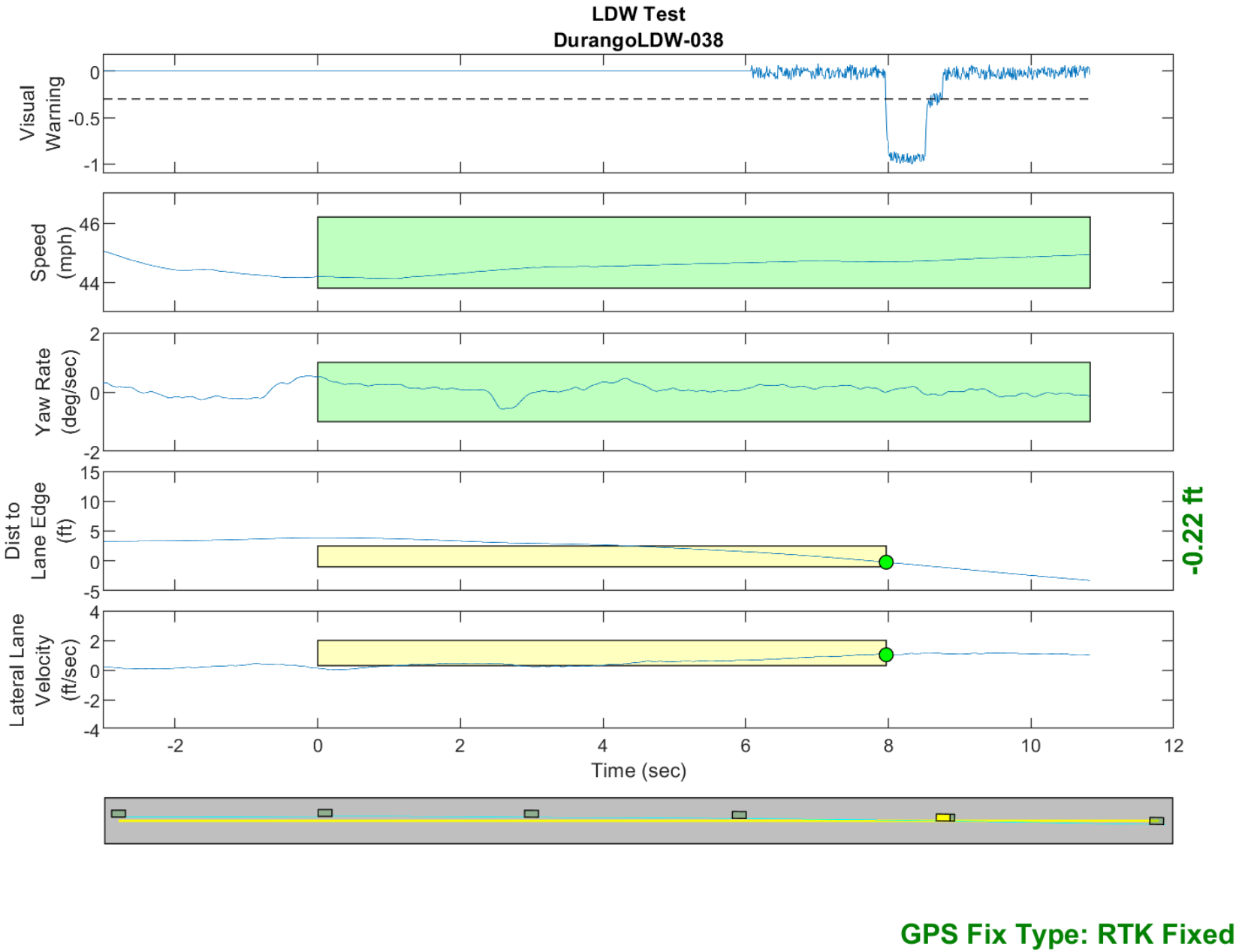


Figure D40. Time History for Run 38, Botts Dots, Right Departure, Visual Warning

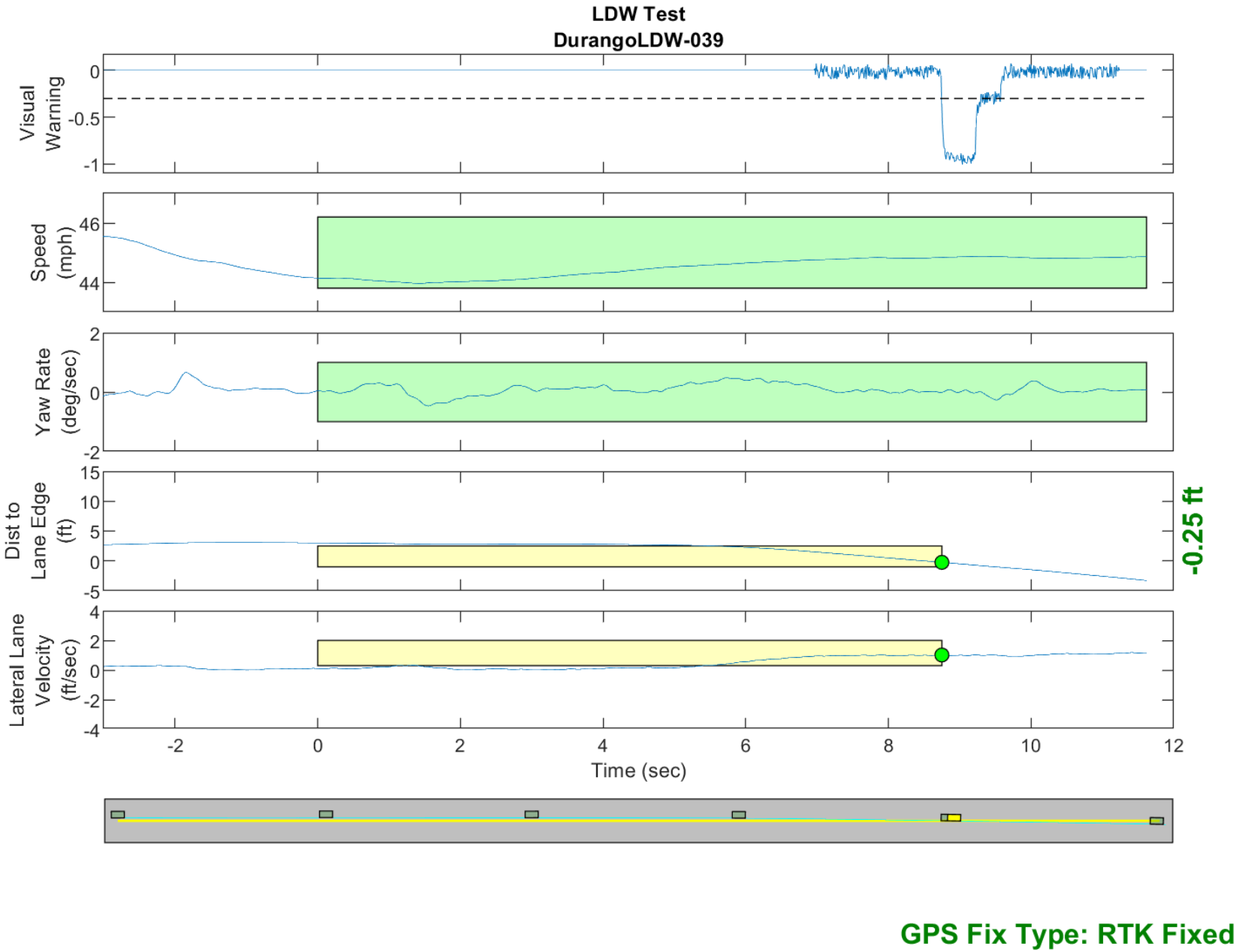


Figure D41. Time History for Run 39, Botts Dots, Right Departure, Visual Warning

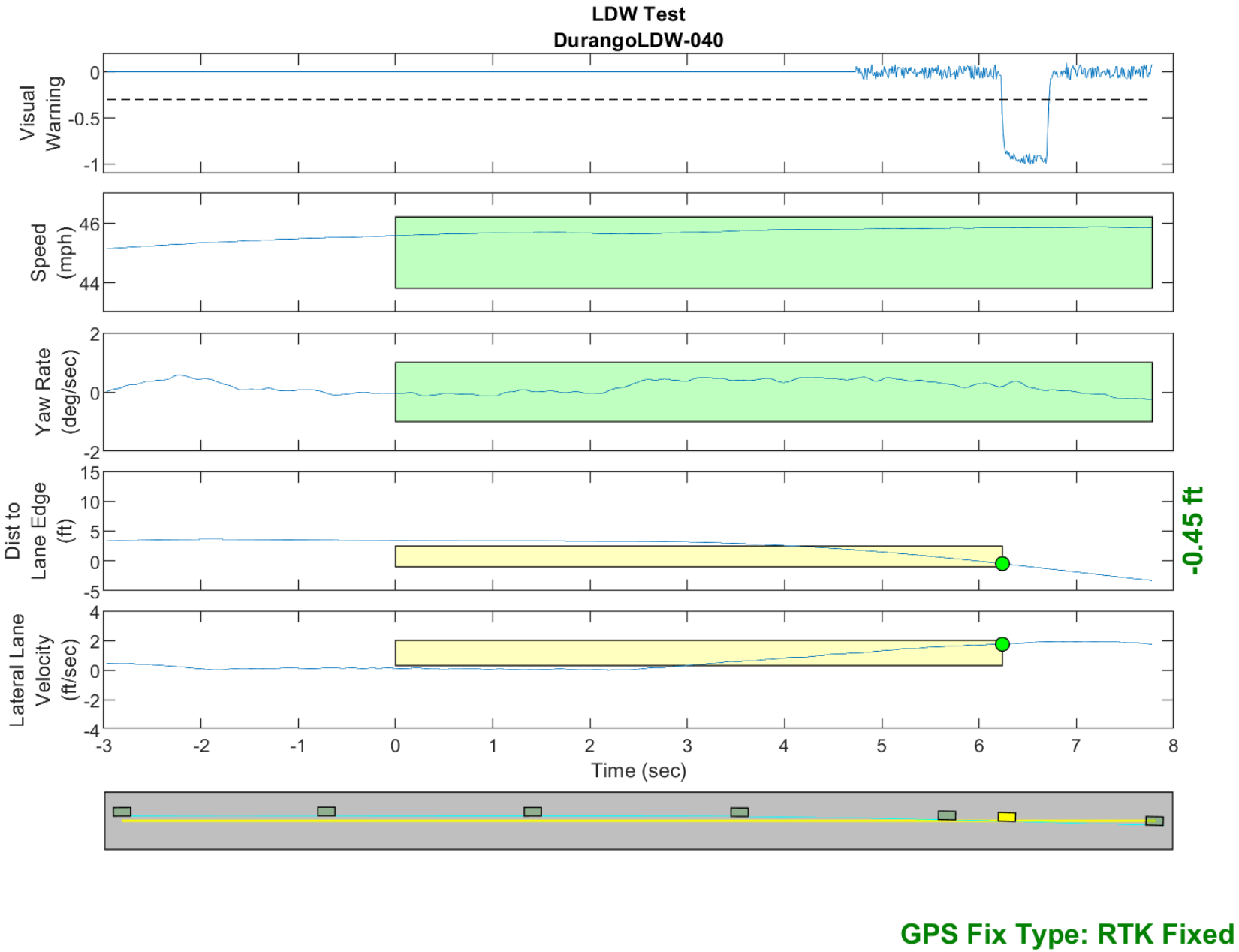


Figure D42. Time History for Run 40, Botts Dots, Right Departure, Visual Warning

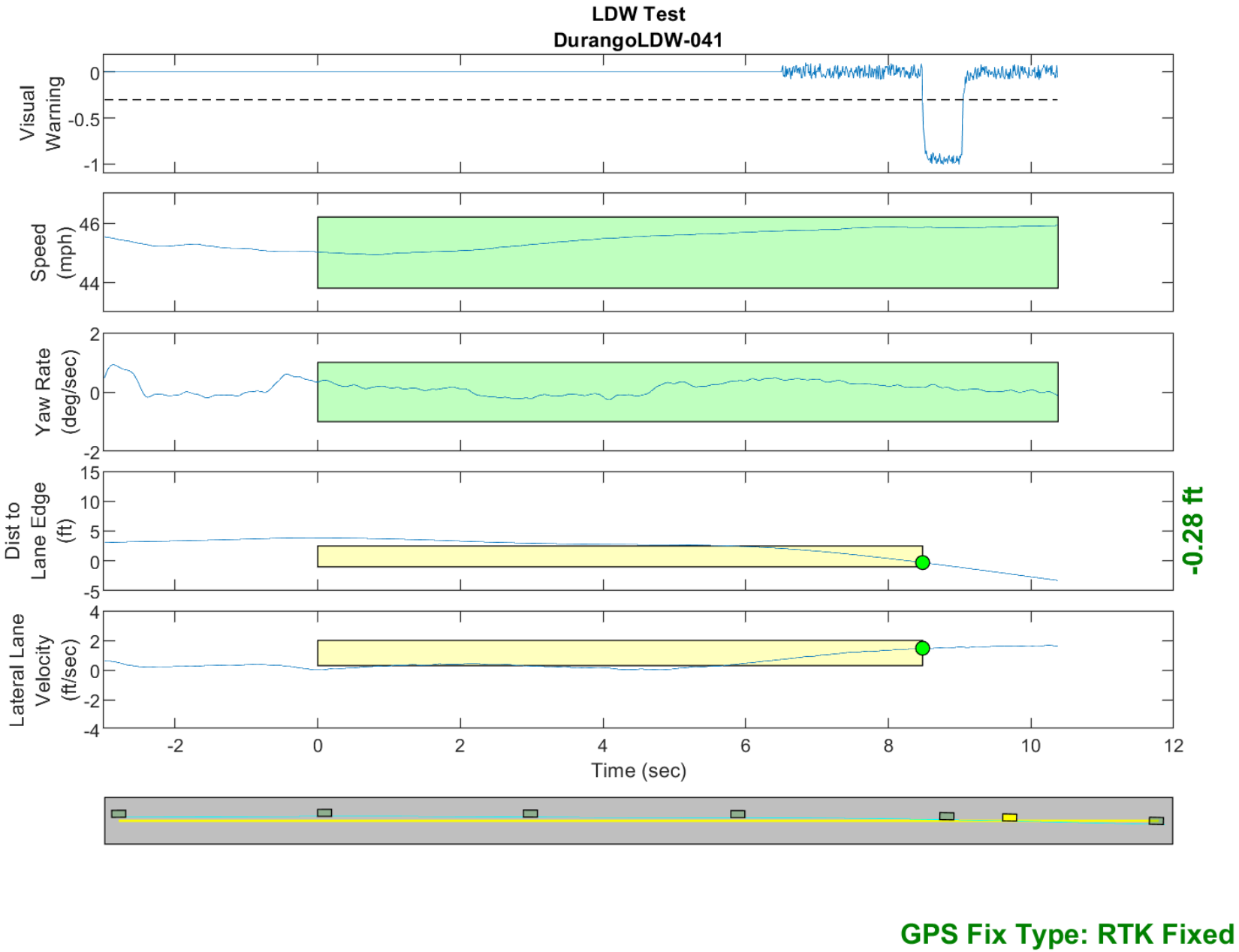


Figure D43. Time History for Run 41, Botts Dots, Right Departure, Visual Warning

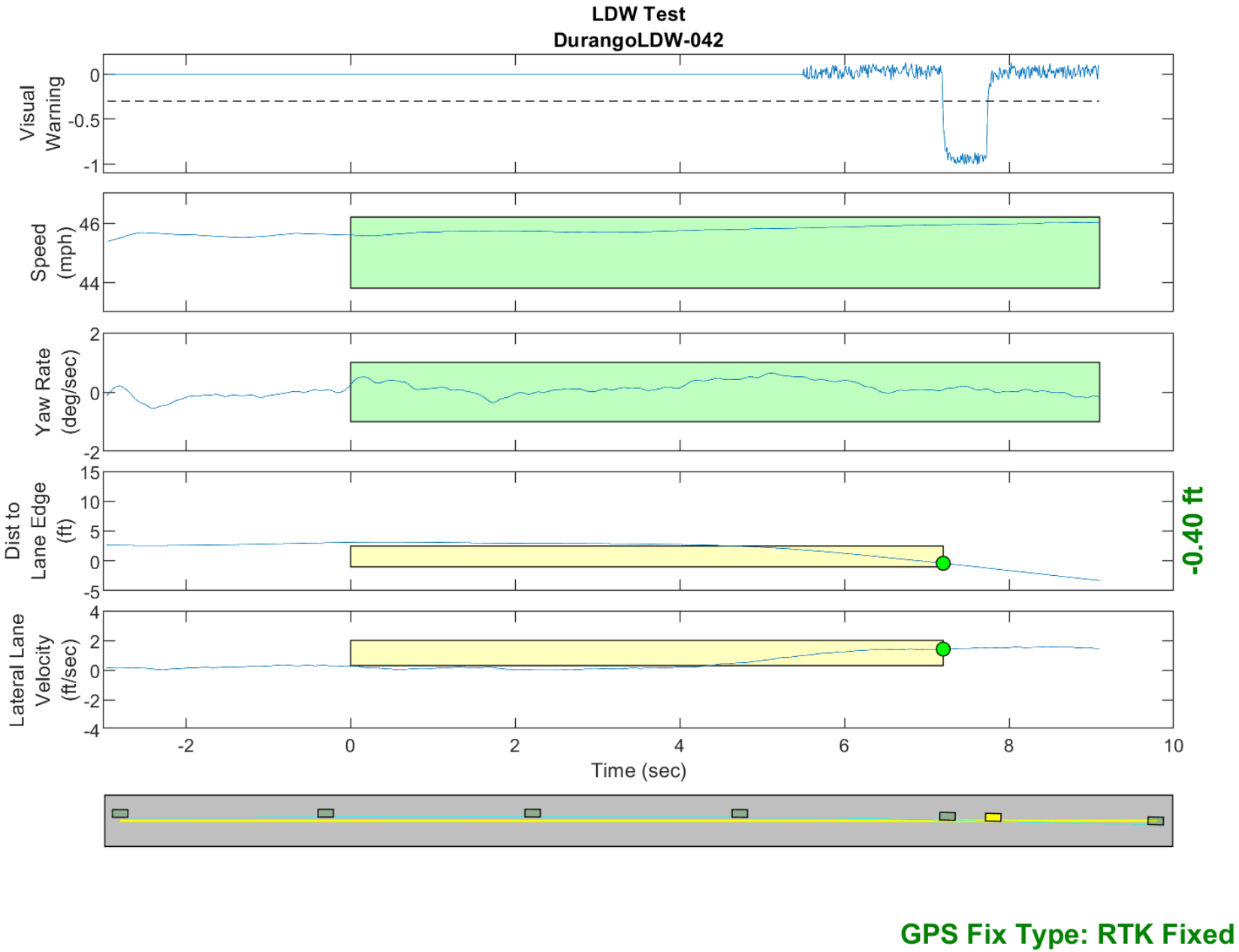


Figure D44. Time History for Run 42, Botts Dots, Right Departure, Visual Warning

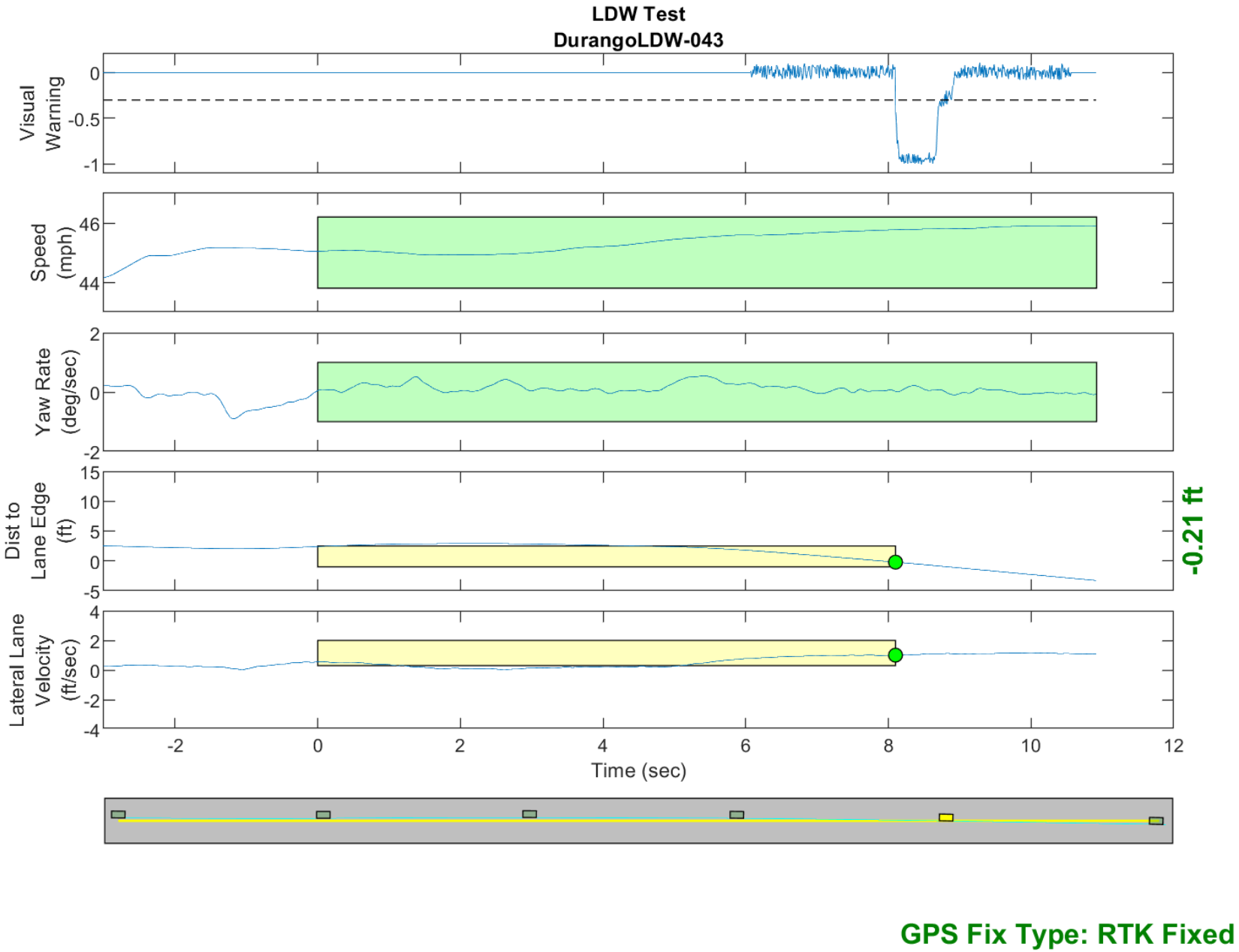


Figure D45. Time History for Run 43, Botts Dots, Right Departure, Visual Warning