

OCAS-DRI-LDW-13-007

NCAP LANE DEPARTURE WARNING CONFIRMATION TEST

2013 Ford Fusion

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20 March 2013

Final Report

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16. Abstract These tests were conducted on the subject 2013 Ford Fusion in accordance with the specifications of the Office of Crash Avoidance Standards most current Test Procedure in docket NHTSA-2006-26555 to confirm the performance of a lane departure warning system. The vehicle passed the requirements of the test for all three lane marking types and for both directions.			
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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 2013 Ford Fusion. The LDW system for this vehicle provides a tactile alert implemented via a vibration felt in the steering wheel.. The vehicle passed the requirements of the test for all three lane marking types and for both directions..

The test procedure is described in detail in the NHTSA Document "LANE DEPARTURE WARNING SYSTEM CONFIRMATION TEST" from March of 2010. Its purpose is to confirm the performance of Lane Departure Warning (LDW) systems installed on light vehicles with gross vehicle weight ratings (GVWR) of up to 10,000 lb. 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 or 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, infra red, 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 SUMMARY
2013 Ford Fusion

VIN: 3FA6POH99DR2xxxx

Test Date: 3/5/2013

Lane Departure Warning setting: High

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

LANE DEPARTURE WARNING
DATA SHEET 2: GENERAL TEST AND VEHICLE PARAMETER DATA
(Page 1 of 2)
2013 Ford Fusion

TEST VEHICLE INFORMATION

VIN: 3FA6P0H99DR2xxxx

Body Style: Passenger Car

Color: White

Date Received: 2/26/2013

Odometer Reading: 312 mi

Engine: 2 L Inline 4

Transmission: Automatic

Final Drive: FWD

Is the vehicle equipped with:

ABS X Yes No

Adaptive Cruise Control X Yes No

Collision Mitigating Brake System Yes X No

DATA FROM VEHICLE'S CERTIFICATON LABEL

Vehicle manufactured by: Ford Motor Company

Date of manufacture: 12/12

DATA FROM TIRE PLACARD:

Tires size as stated on Tire Placard: Front: 235/45R18 94V

Rear: 235/45R18 94V

Recommended cold tire pressure: Front: 235 kPa (34 psi)

Rear: 235 kPa (34 psi)

LANE DEPARTURE WARNING
DATA SHEET 2: GENERAL TEST AND VEHICLE PARAMETER DATA
(Page 2 of 2)
2013 Ford Fusion

TIRES

Tire manufacturer and model: Goodyear Eagle LS2

Front tire size: 235/45R18

Rear tire size: 235/45R18

VEHICLE ACCEPTANCE

Verify the following before accepting the vehicle

- X All options listed on the "window sticker" are present on the test vehicle
- X Tires and wheel rims are the same as listed.
- X There are no dents or other interior or exterior flaws.
- X The vehicle has been properly prepared and is in running condition.
- X Verify that spare tire, jack, lug wrench, and tool kit (if applicable) is located in the vehicle cargo area.

LANE DEPARTURE WARNING
DATA SHEET 3: TEST CONDITIONS (Page 1 of 2)
2013 Ford Fusion

GENERAL INFORMATION

Test date: 3/5/2013

AMBIENT CONDITIONS

Air temperature: 18.9 C (66 F)

Wind speed: 1.5 m/s (3.5 mph)

X Wind speed $\leq$ 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: 235 kPa (34 psi)

Rear: 235 kPa (34 psi)

LANE DEPARTURE WARNING
DATA SHEET 3: TEST CONDITIONS (Page 2 of 2)
2013 Ford Fusion

WEIGHT

Weight of vehicle as tested including driver and instrumentation

Left Front: 520.7 kg (1148 lb)

Right Front 506.2 kg (1116 lb)

Left Rear 369.7 kg (815 lb)

Right Rear 341.6 kg (753 lb)

Total: 1738.2 kg (3832 lb)

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 1 of 3)

2013 Ford Fusion

How is the Forward Collision Warning presented to the driver? _____ Warning light
(Check all that apply) _____ 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 constant beep or a repeated beep. If it is a vibration, describe where it is felt (e.g., pedals, steering wheel), the dominant frequency (and possibly magnitude).the type of warning (light, audible, vibration, or combination) etc.

The haptic alert consists of three vibrations whose frequency is approximately 19 Hz. The vibrations can be felt in the steering wheel.

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

2013 Ford Fusion

The LDW system can be adjusted through the menu settings operated by using a directional pad on the left side of the steering wheel. The haptic warning can be adjusted between "High", "Normal", and "Low" intensity settings. This can be found through: Settings --> Driver Assist--> Lane Keeping Sys--> Intensity--> High/Normal/Low.

LANE DEPARTURE WARNING

DATA SHEET 4: LANE DEPARTURE WARNING SYSTEM OPERATION

(Page 3 of 3)

2013 Ford Fusion

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.

- If the vehicle is under the activation speed.
- The turn indicator is active.
- The vehicle is in a dynamic maneuver.
- The road as no or poor lane markings in the camera field-of-view.
- The camera is obscured or unable to detect the lane markings due to environmental conditions (significant sun angles or shadows, snow, heavy rain, fog), traffic conditions (following a large vehicle that is blocking or shadowing the lane), or vehicle conditions (poor headlamp illumination)

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 Fig 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.

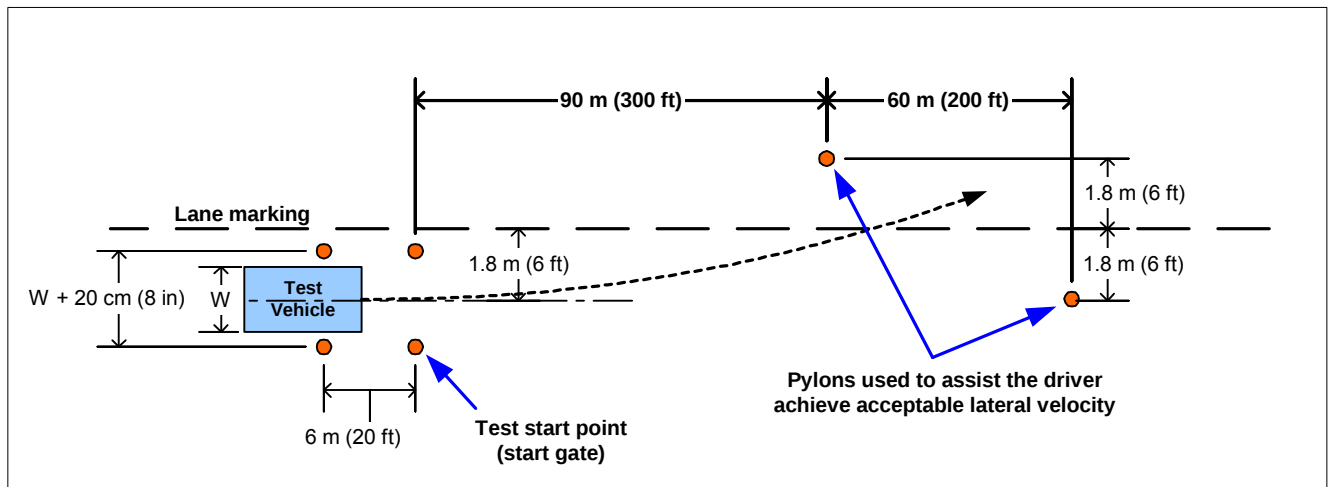


Figure 1. Position of Cones Used to Assist Driver

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 Office of Crash Avoidance Standards' Test Procedure for the confirmation of a lane departure warning system contains a requirement that all lane markings meet 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 Manual on Uniform Traffic Control Devices (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.

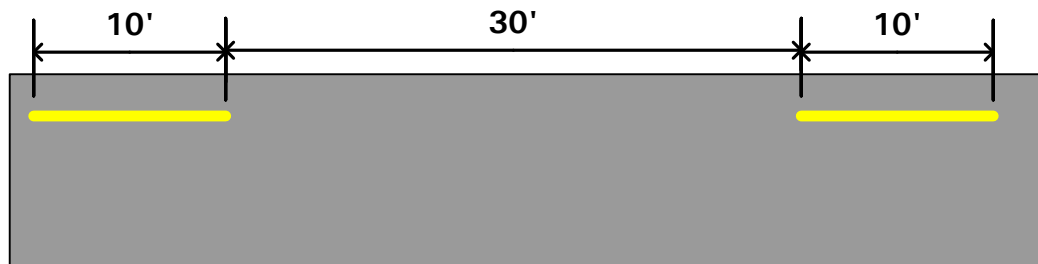


Figure 2. MUTCD Discontinuous Dashed Line Specifications

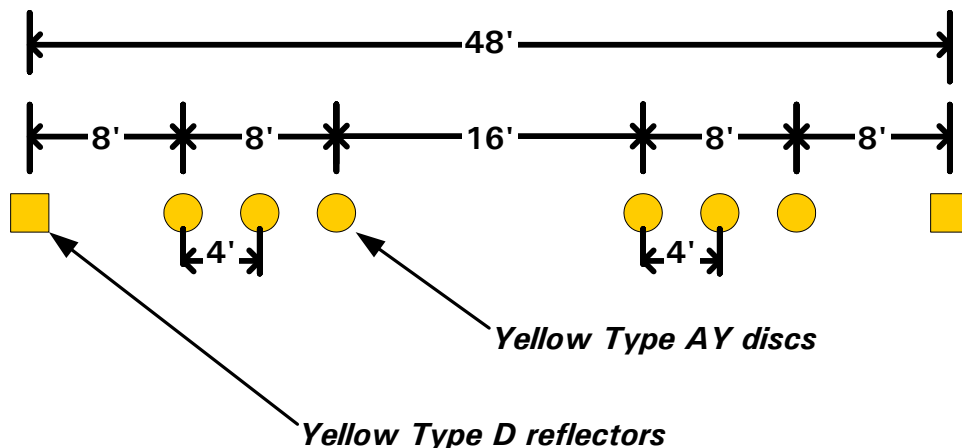


Figure 3. California Standard Plan A20A, Detail 4

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 closed 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 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":

- o Test speed, lateral velocity, and yaw rate validity conditions must be satisfied.
- o 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).

- o 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 percent), and pass 20 of the 30 trials overall (66 percent).

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
Tire Pressure Gauge	Vehicle Tire Pressure	0-100 psi 0-690 kPa	0.5 psi 3.45 kPa	Ashcroft, D1005PS
Platform Scales	Vehicle Total, Wheel, and Axle Load	8000 lb 35.6 kN	± 1.0% of applied load	Intercomp, SWII
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)
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 +
Real-Time Calculation of Position and Velocity Relative to Lane Markings (LDW) and POV (FCW)	Distance and Velocity to lane markings (LDW) and POV (FCW)	Lateral Lane Dist: ± 30 m Lateral Lane Velocity: ± 20 m/sec Longitudinal Range to POV: ± 200 m Longitudinal Range Rate: ± 50 m/sec	Lateral Distance to Lane Marking: ± 2 cm Lateral Velocity to Lane Marking: ± 0.02m/sec Longitudinal Range: ± 3 cm Longitudinal Range Rate: ± 0.02 m/sec	Oxford Technical Solutions (OXTS), RT-Range

Table 2. Test Instrumentation and Equipment (Cont'd)

Type	Output	Range	Accuracy, Other Primary Specs	Mfr, Model
Data Acquisition System [Includes amplification, anti-aliasing, and analog to digital conversion.]	Record Time; Position; Velocity; Distance to lane markings; Headway distance; Closing Velocity; Lateral, Longitudinal, and Vertical Accels; Roll, Yaw, and Pitch Rates; Roll, Yaw and Pitch Angles.	Sufficient to meet or exceed individual sensors	Sound digitized at 10 kHz, all other channels digitized at 100 Hz. Accuracy is sufficient to meet or exceed individual sensors	SoMat, eDaq ECPU processor
				SoMat, High level Board EHLS
Microphone	Sound (to measure time at alert)	Max SPL: 139 dB/SPL Frequency Response: 40 Hz – 20 kHz	≤ 3 dB over Freq. Resp. Range	Sennheiser, e614
Light Sensor	Light intensity (to measure time at alert)	Spectral Bandwidth: 440-800 nm	Rise time < 10 msec	DRI designed and developed Light Sensor
Accelerometer	Acceleration (to measure time at alert)	± 5g	≤ 3% of full range	Silicon Designs, 2210-005
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

As part of the pre-test instrumentation verification process, the tonal frequency of the audible warning or the vibration frequency of the tactile warning (if present) was determined through use of the PSD (Power Spectral Density) function in Matlab. This was accomplished in order to identify the center frequency around which a band-pass filter was applied to subsequent audible or tactile warning data so that the beginning of such warnings could be programmatically determined. The bandpass filter used for these warning signals was 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	Pass-Band Frequency Range
Audible	5 th	3 dB	60 dB	Identified Center Frequency $\pm$ 5%
Tactile	5 th	3 dB	60 dB	Identified Center Frequency $\pm$ 20%

APPENDIX A

Photographs

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Figure A1. Front View of Subject Vehicle



Figure A2. Rear View of Subject Vehicle

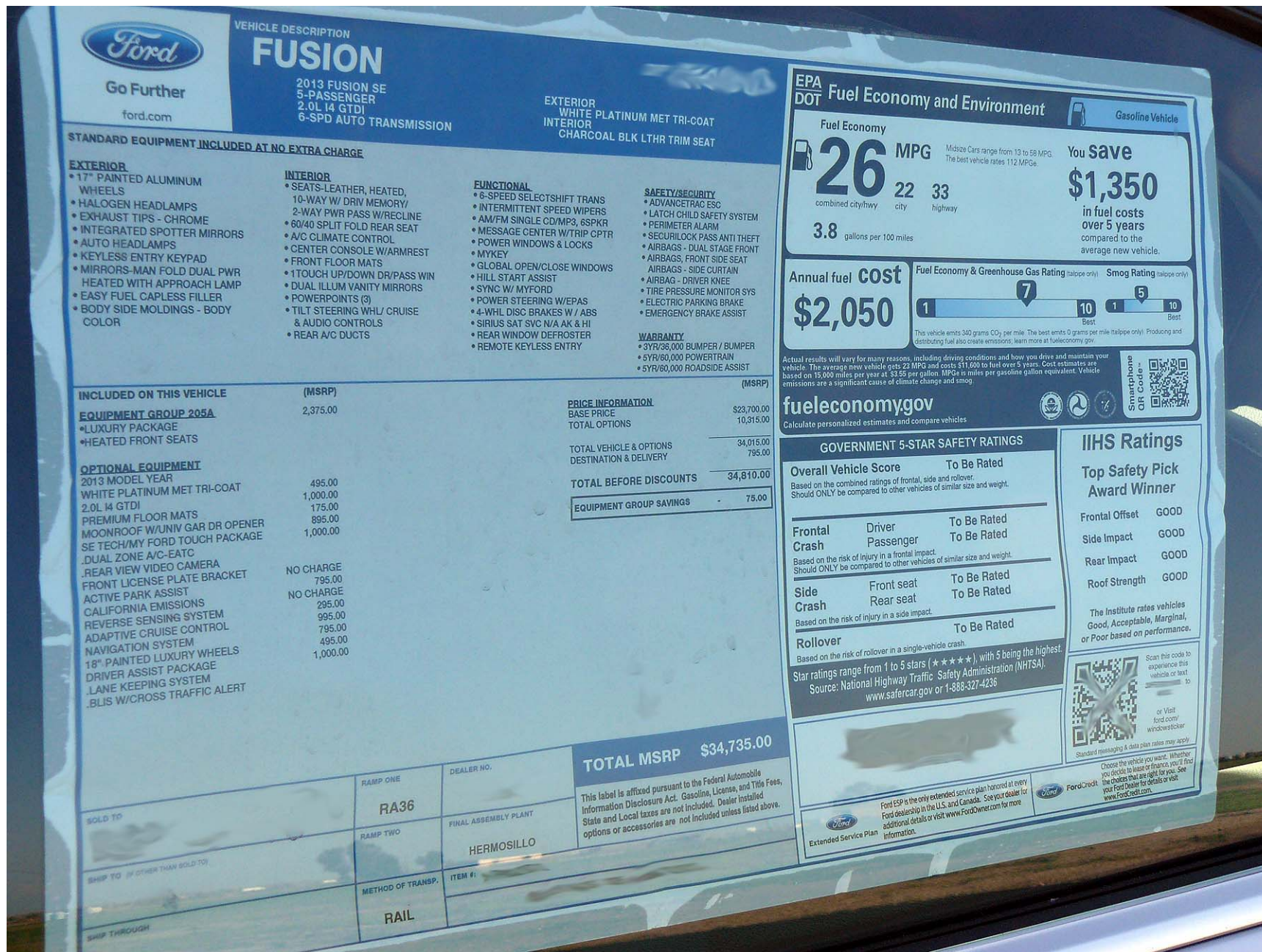


Figure A3. Window Sticker (Monroney Label)

MFD. BY FORD MOTOR CO.

DATE: 12/12

GVWR: 2059 KG (4540 LB)

FRONT GAWR: 1093 KG (2410 LB)

REAR GAWR: 971 KG (2140 LB)

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.

VIN: 3FA6POH99DR216093

TYPE: Passenger Car

MAXIMUM LOAD = OCCUPANTS + LUGGAGE = 385KG/ 850LB

OCCUPANTS = 5 TOTAL; 2 FRONT, 3 REAR

TIRE (FR): 235/45R18 94V

RIMS (FR): 18x8.0J

(RR): 235/45R18 94V

(RR): 18x8.0J

PRESSURE (FR): 235 kPa/ 34 PSI COLD (RR): 235 kPa/ 34 PSI COLD

3FA6POH99DR21

TRAILER TOWING - SEE OWNER GUIDE

EXT PNT: UG

RC: 71

DSO:

INT TR

TP/PS

R

AXLE

TR

SPR

BW

B

32

W

GGFF

F0034

R0052

CMC

▽5U5A-5420472-AA

Figure A4. Vehicle Certification Label

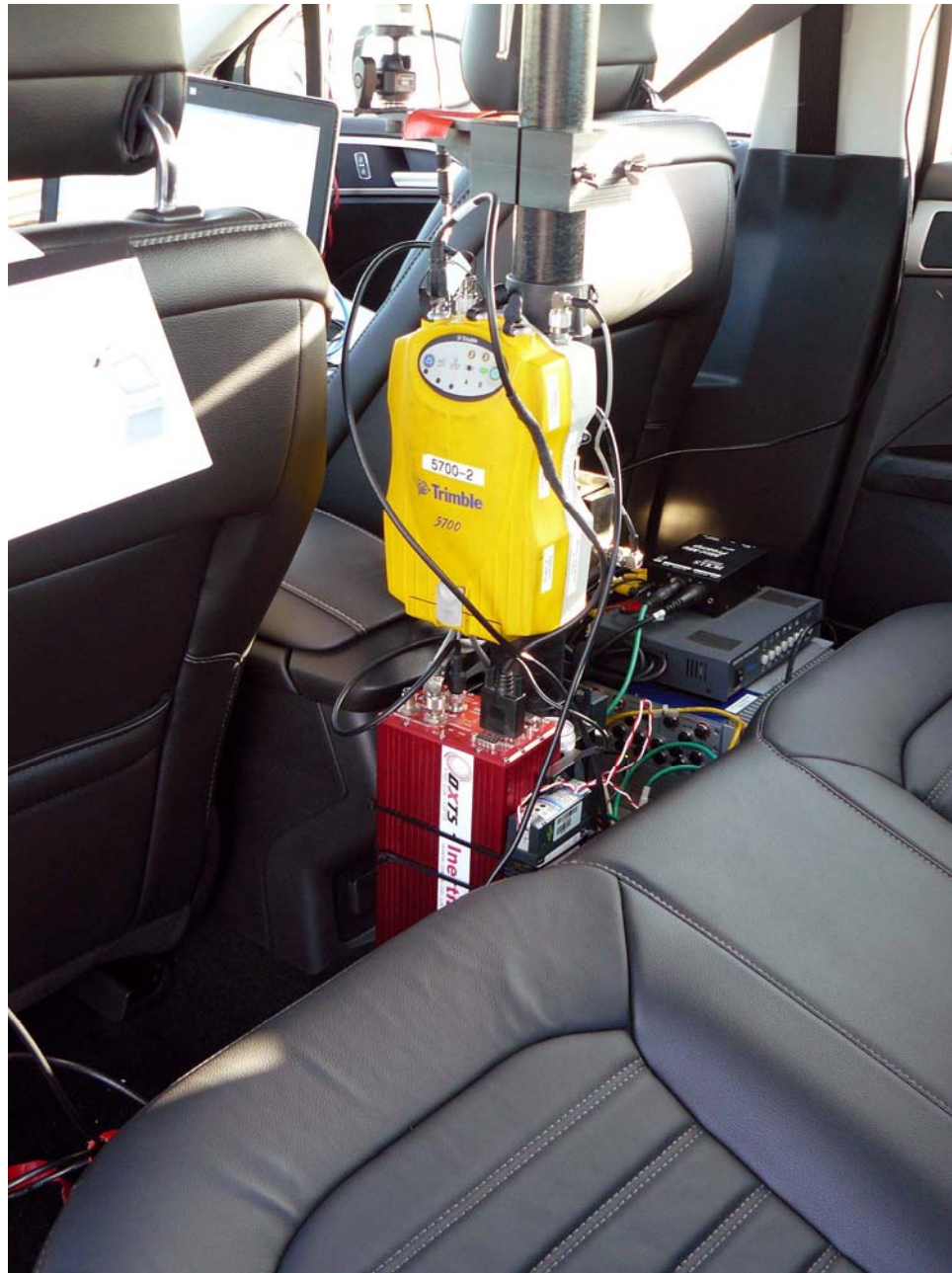


Figure A5. DGPS and Inertial Measurement Unit Installed in Subject Vehicle

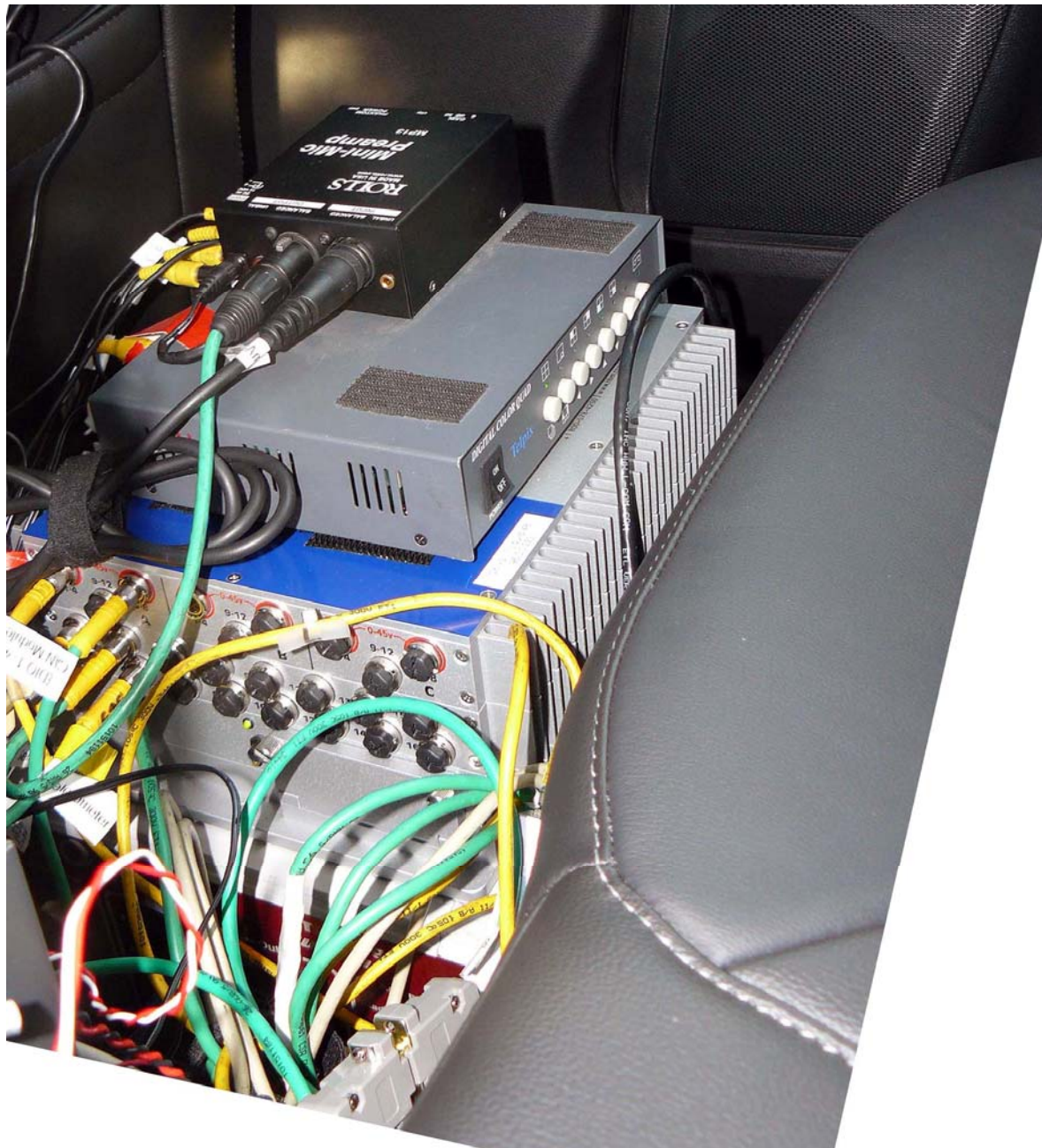


Figure A6. Data Acquisition System Installed in Subject Vehicle



Figure A7. Computer Installed in Subject Vehicle



Figure A8. Sensors for Haptic Alert



Figure A9. LDW On-Off Switch



Figure A10. Adjustment of LDW Settings



Figure A11. Adjustment of LDW Settings (cont.)

APPENDIX B

Excerpts from Owner's Manual

Instrument Cluster

Heads Up Display (If Equipped)



A red beam of lights will illuminate on the windshield in certain instances when using adaptive cruise control and/or the collision warning system. It will also illuminate momentarily when you start your vehicle to make sure the display works.

High Beam



It will illuminate when you switch the high beam headlamps on. It will flash when you use the headlamp flasher.

Hood Ajar



Displays when the ignition is on and the hood is not completely closed.

Lane Keeping Aid (If Equipped)



Illuminates when the lane keeping system is activated.

Low Fuel Level



It will illuminate when the fuel level is low or the fuel tank is nearly empty. Refuel as soon as possible.

Low Tire Pressure Warning



It will illuminate when your tire pressure is low. If the lamp remains on with the engine running or when driving, check your tire pressure as soon as possible.

It will also illuminate momentarily when you switch the ignition on to confirm the lamp is functional. If it does not illuminate when you switch the ignition on, or begins to flash at any time, have the system checked by your authorized dealer.

Parking Lamps



It will illuminate when you switch the parking lamps on.

Powertrain Fault



Illuminates when a powertrain or an AWD fault has been detected. Contact your authorized dealer as soon as possible.

Service Engine Soon



If the service engine soon indicator light stays illuminated after the engine is started, it indicates that the On Board Diagnostics system (OBD) has detected a malfunction of the vehicle emissions control system. Refer to On board diagnostics (OBD) in the Fuel and Refueling chapter for more information about having your vehicle serviced. See **Emission Control System** (page 155).

If the light is blinking, engine misfire is occurring which could damage your catalytic converter. Drive in a moderate fashion (avoid heavy acceleration and deceleration) and have your vehicle serviced immediately.

Note: Under engine misfire conditions, excessive exhaust temperatures could damage the catalytic converter or other vehicle components.

Information Displays

Info



In this mode, you can view different vehicle system information and perform a system check.

Information	
Auto Stop/Start	Available Auto Start-Stop messaging will provide details about what is happening with your system. See Information Messages (page 90).
Driver Alert	-
MyKey	-
System Check	All active warnings will display first if applicable. The system check menu may appear different based upon equipment options and current vehicle status. Use the up/down arrow buttons to scroll through the list.

Settings

Note: Some items are optional and may not appear.



In this mode, you can configure different driver setting choices.

Settings			
Driver Assist	Traction Ctrl	On / Off	
	Blindspot	On (default on key cycle) / Off	
	Collision Warning	Sensitivity	High / Normal / Low
		Distance Alert	On / Off
		Warn	On (default on key cycle) / Off
	Cruise Control	Adaptive (default on key cycle) or Normal	
	Cross Traffic	On (default on key cycle) / Off	
	Driver Alert	On (default on key cycle) / Off	
	Hill start	On / Off	

Information Displays

Settings (cont'd)			
Driver Assist (cont'd)	Lane Keeping System	Mode	Alert / Aid / Both
		Intensity	High / Normal / Low
	Front Park Aid	On (default on key cycle) / Off	
	Rear Park Aid	On (default on key cycle) / Off	
Vehicle	Auto Engine Off	On (default on key cycle) / Off	
	Easy Entry/Exit	On / Off	
	Lighting	Auto Highbeam	
		Autolamp Delay	Off or XX Seconds
	Locks	Autolock	On / Off
		Autounlock	On / Off
		Mislock	On / Off
		Remote Unlocking	All doors / Driver's door
	Oil Life Reset	Set to XXX %	

Settings (cont'd)			
Vehicle (cont'd)	Remote Start	Climate Control (using this feature allows you to select different climate control modes when the vehicle is started using the remote start feature)	Heater – A/C: Auto / Last Settings
			Front Defrost: Auto / Off
			Rear Defrost: Auto / Off
			Driver Seat: Auto / Off
			Passenger Seat: Auto / Off
		Duration	5 / 10 /15 minutes
		Quiet Start	On / Off
		System	Enable / Disable

Information Displays

Message	Action
Key Program Failure	Displayed during spare key programming, when an intelligent access key has failed to be programmed.
Max Number of Keys Learned	Displayed during spare key programming when the maximum number of keys have been programmed.
Not Enough Keys Learned	Displayed during spare key programming when not enough keys have been programmed.
Key Battery Low Replace Soon	Displays when the key battery is low. Change the battery as soon as possible.
Could Not Program Integrated Key	Displayed when an attempt is made to program a spare key using two existing keys.
Engine On	Displays to inform the driver that they are exiting the vehicle and the engine is on.

Lane Keeping System

Message	Action
Lane Keeping Sys. Malfunction Service Required	The system has malfunctioned. Contact your authorized dealer as soon as possible.
Front Camera Temporarily Not Available	The system has detected a condition that has caused the system to be temporarily unavailable.
Front Camera Low Visibility Clean Screen	The system has detected a condition the requires the windshield to be cleaned to operate properly.
Front Camera Malfunction Service Required	The system has malfunctioned. Contact your authorized dealer as soon as possible.
Keep Hands on Steering Wheel	Displayed when the system requests the driver to keep their hands on the steering wheel.

Driving Aids (If Equipped)

System Limitations

WARNING



The collision warning system's brake support can only help reduce the speed at which a collision occurs if the driver applies the vehicle's brakes. The brake pedal must be pressed just like any typical braking situation.

Due to the nature of radar technology, there may be certain instances where vehicles do not provide a collision warning. These include:

- Stationary vehicles or vehicles moving below 6 mph (10 km/h).
- Pedestrians or objects in the roadway.
- Oncoming vehicles in the same lane.
- Severe weather conditions (see blocked sensor section).
- Debris build-up on the grille near the headlamps (see blocked sensor section).
- Small distance to vehicle ahead.
- Steering wheel and pedal movements are large (very active driving style).
-

Certain conditions may reduce the visibility of the warning lamp; therefore, it is recommended to keep the audible warning on.

If the front end of the vehicle is hit or damaged, the radar sensing zone may be altered causing missed or false collision warnings. See your authorized dealer to have your collision warning radar checked for proper coverage and operation.

LANE KEEPING SYSTEM (IF EQUIPPED)

WARNING



The system is designed to aid the driver. It is not intended to replace the driver's attention and judgment. The driver is still responsible to drive with due care and attention.

Note: The system needs to be activated by the driver at each key cycle.

Note: The system works above 40 mph (64 km/h).

Note: The system works as long as one lane marking can be detected by the camera.

Note: If the camera is blocked or if the windshield is damaged, the system may not function.

Note: When Aid mode is on and the system detects no driver steering activity for a short continuous period of time, the system alerts the driver to put their hands on the steering wheel. The system may detect a light grip/touch on the steering wheel as hands off driving.

The system detects unintentional drifting toward the outside of the lane and alerts and/or aids the driver to stay in the lane through the steering system and instrument cluster display. The system automatically detects and tracks the road lane markings using a camera that is mounted behind the interior rear view mirror.

Switching the System On and Off

Note: The system defaults to off each time the vehicle is started, unless a MyKey® is detected. If a MyKey® is detected, the system is defaulted to on and the Alert mode is automatically selected.

Driving Aids (If Equipped)

Note: If a MyKey® is detected, pressing the button will not affect the on/off status of the system. Only the Mode, Sensitivity and Intensity settings can be changed when a MyKey® is present.



To turn the system on, press the button located on the left steering wheel stalk. The button must be pressed each time the vehicle is started. The system can be turned off by pressing the button again.

System Settings

The system has three optional setting menus available. To view or adjust them, select Settings > Vehicle Settings > Driver Assist > Lane Keeping Sys in the left-hand instrument cluster display using the OK button on the steering wheel. The last-known selection for each of these settings is stored by the system. You do not need to readjust your settings each time you turn on the system.

Mode: This setting allows the driver to select which of the system features will be enabled and turned on when the button is pressed.

- Alert only – Provides a steering wheel vibration when an unintended lane departure is detected.
- Aid only – Provides a steering input toward the lane center when an unintended lane departure is detected.
- Both Alert + Aid

Intensity: This setting affects the intensity of the steering wheel vibration used for the alert and alert + aid modes. This setting does not impact the aid mode.

- Low
- Medium
- High

System Display



E151660

When the system is turned on, an overhead graphic of a vehicle with lane markings will be displayed in the left-hand instrument cluster display. If the aid mode is selected when the system is turned on, a separate white icon will also appear in the instrument cluster.

When the system is turned off, the lane marking graphics will not be displayed.

Note: The overhead vehicle graphic may still be displayed if adaptive cruise control is enabled.

While the system is on, the color of the lane markings will change to indicate the system status.

Gray: Indicates that the system is temporarily unable to provide a warning or intervention on the indicated side(s). This may be because:

- the vehicle is under the activation speed
- the turn indicator is active
- the vehicle is in a dynamic maneuver

Driving Aids (If Equipped)

- the road has no or poor lane markings in the camera field-of-view
- the camera is obscured or unable to detect the lane markings due to environmental conditions (e.g. significant sun angles or shadows, snow, heavy rain, fog), traffic conditions (e.g. following a large vehicle that is blocking or shadowing the lane), or vehicle conditions (e.g. poor headlamp illumination).

See **Troubleshooting** for additional information.

Green: Indicates that the system is available or ready to provide a warning or intervention, on the indicated side(s).

Yellow: Indicates that the system is providing or has just provided a lane keeping aid intervention.

Red: Indicates that the system is providing or has just provided a lane keeping alert warning.

The system can be temporarily suppressed at any time by the following:

- Quick braking
- Fast acceleration
- Using the turn signal indicator
- Evasive steering maneuver

Troubleshooting

Why is the feature not available (line markings are gray) when I can see the lane markings on the road?
Vehicle speed is outside the operational range of the feature
Sun is shining directly into the camera lens
Quick intentional lane change
Staying too close to the lane marking
Driving at high speeds in curves
Previous feature activation happened within the last one second
Ambiguous lane markings (mainly in construction zones)
Rapid transition from light to dark or vice versa

Why is the feature not available (line markings are gray) when I can see the lane markings on the road?
Sudden offset in lane markings
ABS or AdvanceTrac activation
Camera blockage due to dirt, grime, fog, frost or water on the windshield
Too close to the vehicle in front of you

APPENDIX C

Run Log

Subject Vehicle: **2013 Ford Fusion**

Date: 3/5/2013

Driver: N Wong

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Tactile Alert (ft)	Distance at Tactile Alert CAN Request (ft)	Pass/Fail	Notes
1	Solid	Left	N				Working out system
2			N				Data problem
3			Y	0.10	0.26	Pass	
4			Y	-0.39	-0.19	Pass	
5			Y	-0.43	-0.21	Pass	
6			Y	0.01	0.17	Pass	
7			Y	0.06	0.25	Pass	
8			Y	0.13	0.29	Pass	
9			Y	0.11	0.28	Pass	
10	Solid	Right	Y	0.10	0.32	Pass	
11			N				Hit cone
12			Y	0.05	0.25	Pass	
13			Y	-0.09	0.12	Pass	
14			Y	-0.02	0.16	Pass	
15			Y	0.02	0.22	Pass	
16			Y	-0.05	0.17	Pass	
17			Y	0.04	0.29	Pass	

Driver: N Wong

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Tactile Alert (ft)	Distance at Tactile Alert CAN Request (ft)	Pass/Fail	Notes
18	Dashed	Right	Y	-0.39	-0.20	Pass	
19			N				Yaw rate high
20			Y	-0.47	-0.22	Pass	
21			Y	-0.42	-0.19	Pass	
22			Y	-0.39	-0.16	Pass	
23			Y	-0.36	-0.21	Pass	
24			Y	-0.45	-0.20	Pass	
25			Y	-0.30	-0.14	Pass	
26	Dashed	Left	Y	-0.28	-0.09	Pass	
27			N				Started braking too early
28			Y	-0.12	0.14	Pass	
29			N				GPS Fix low
30			Y	-0.16	0.06	Pass	
31			Y	0.02	0.17	Pass	
32			Y	0.03	0.24	Pass	
33			Y	-0.12	0.08	Pass	
34			Y	0.04	0.27	Pass	

Driver: N Wong

Run	Lane Marking Type	Departure Direction	Valid Run?	Distance at Tactile Alert (ft)	Distance at Tactile Alert CAN Request (ft)	Pass/Fail	Notes
35	Botts	Left	Y	-0.57	-0.27	Pass	
36			Y	-0.63	-0.30	Pass	
37			Y	-0.61	-0.29	Pass	
38			Y	-0.54	-0.24	Pass	
39			Y	-0.36	-0.36	Pass	
40			Y	-0.74	-0.32	Pass	
41			Y	-0.58	-0.19	Pass	
42	Botts	Right	N				Yaw rate high
43			Y	-0.15	0.12	Pass	
44			Y	-0.01	0.23	Pass	
45			N				hit cone
46			Y	-0.23	0.17	Pass	
47			Y	-0.09	0.17	Pass	
48							skipped number
49			Y	-0.10	0.20	Pass	
50			N				yaw rate high
51			Y	-0.15	0.11	Pass	
52			N				hit cone
53			Y	-0.08	0.22	Pass	

APPENDIX D

Time History Plots

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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:

- Event – 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,:
 - o Filtered and rectified sound signal
 - o Filtered and rectified acceleration (e.g., steering wheel vibration)
 - o Light sensor signal
 - o Discrete on/off value
- Speed (mph) – speed of the Subject Vehicle
- Yaw Rate (deg/sec) – yaw rate of the Subject Vehicle
- Dist 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)
- Lateral 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.

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

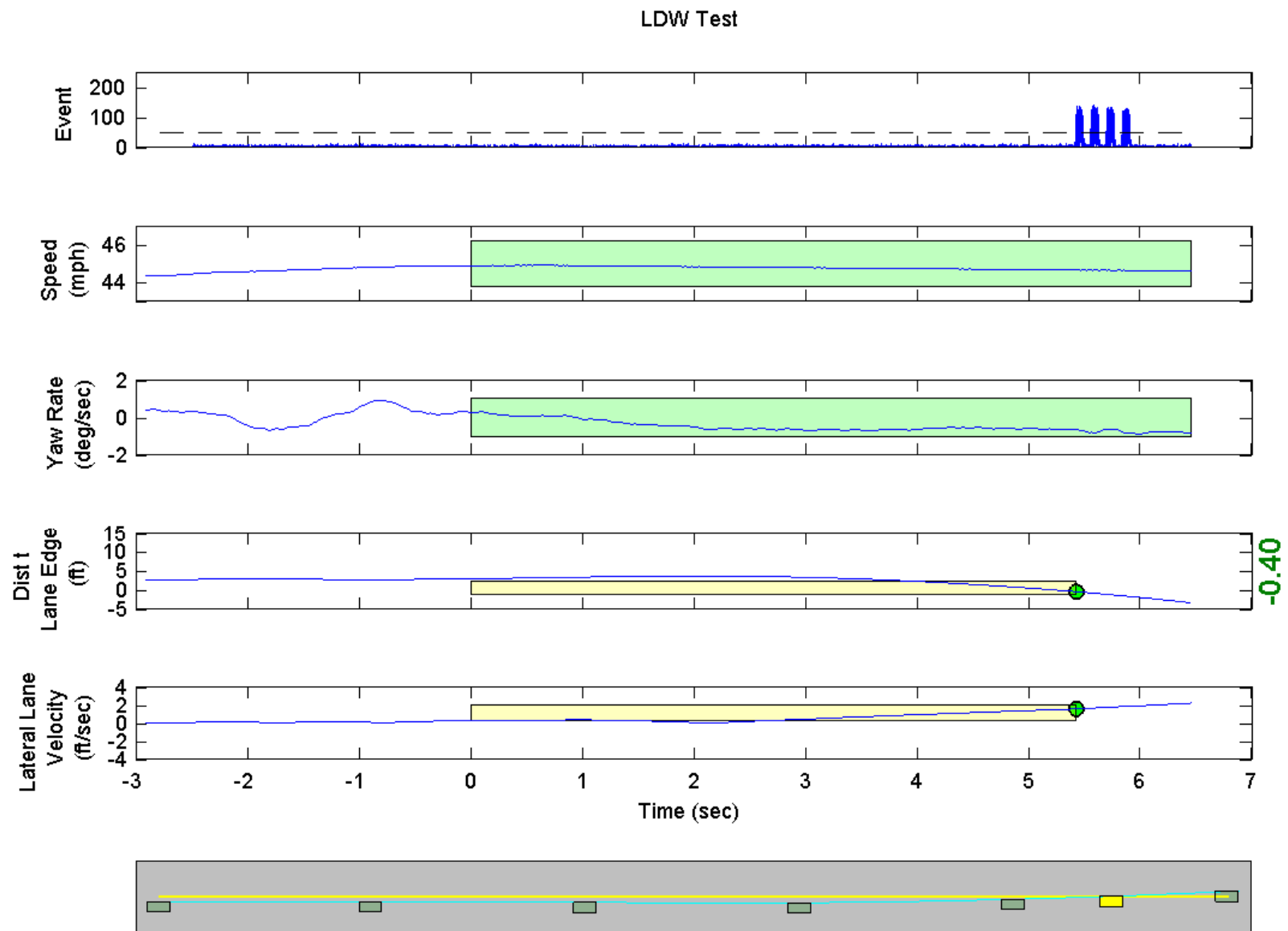
2. Instantaneous sampling color codes:

- 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:

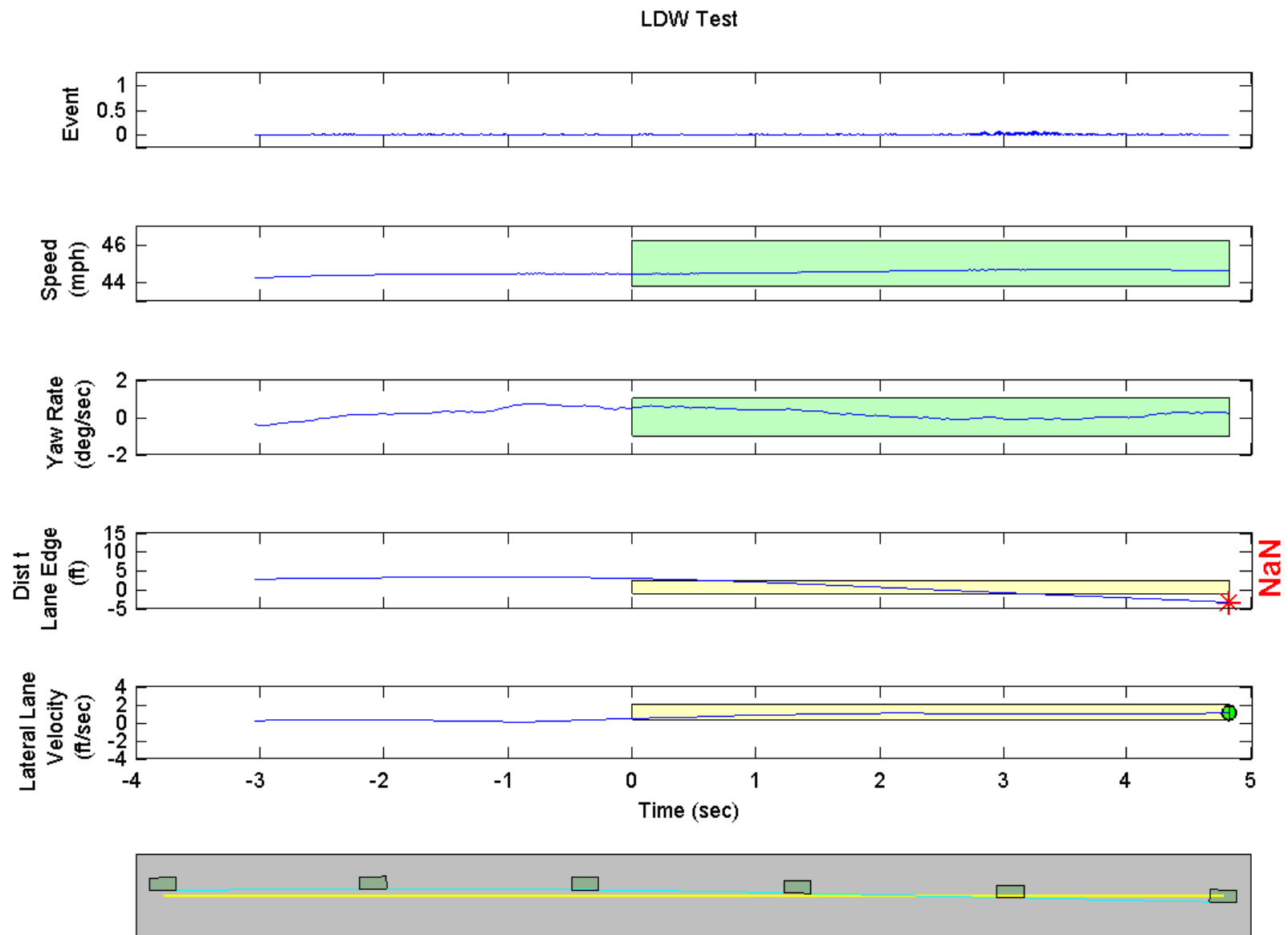
- Green = passing or valid value
- Red = failing or invalid value

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.



GPS Fix Type: RTK Fixed

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



GPS Fix Type: RTK Fixed

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

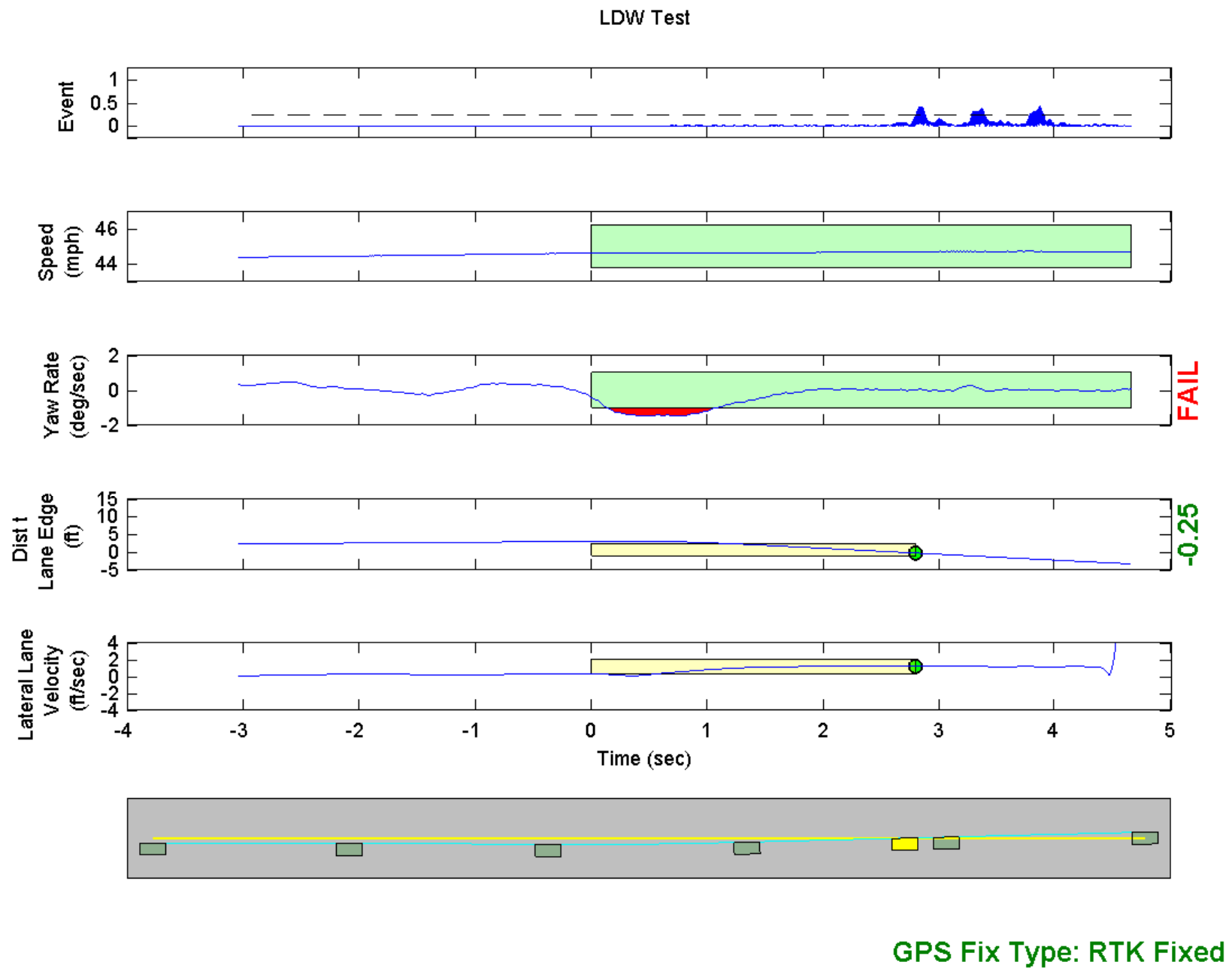
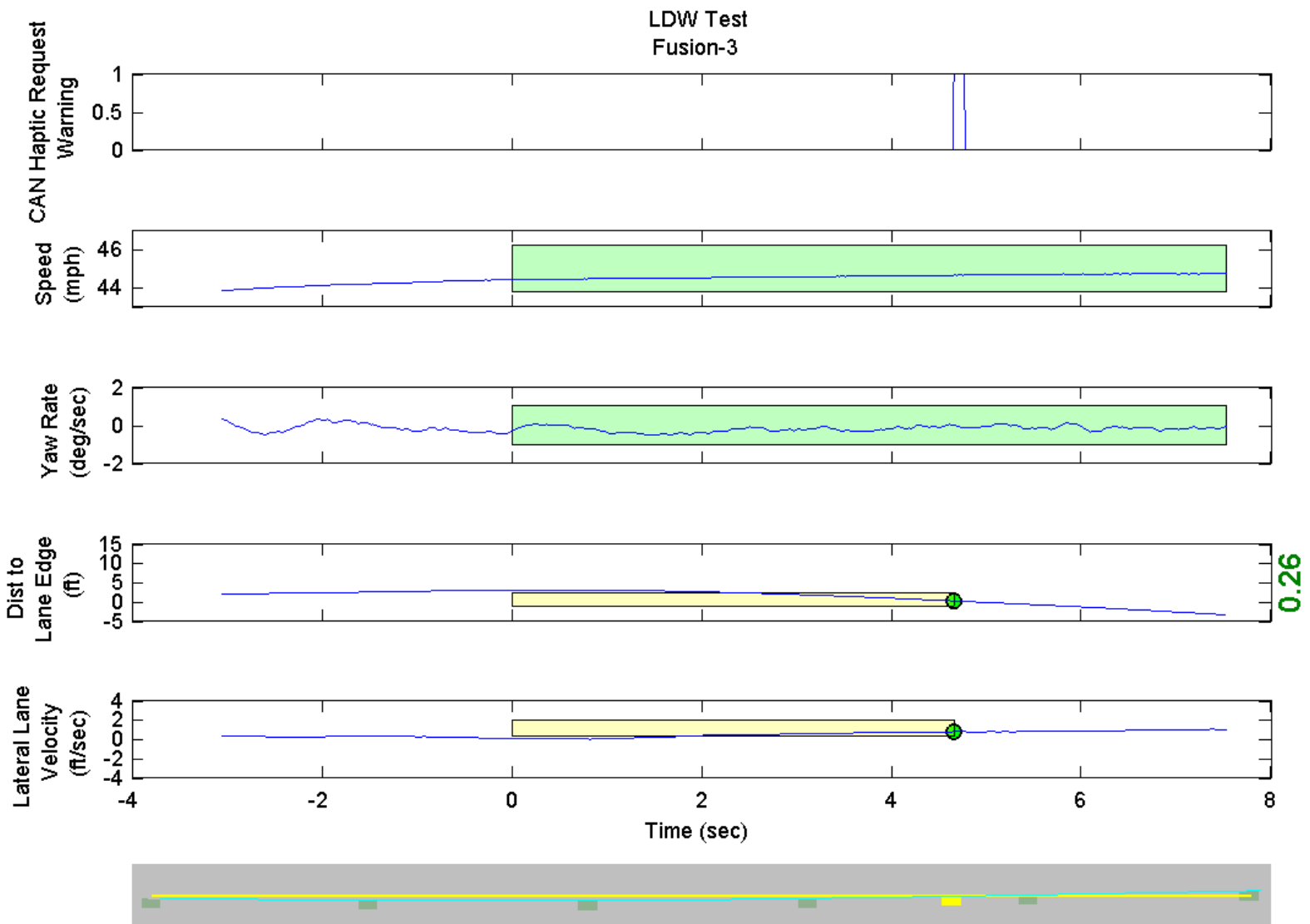
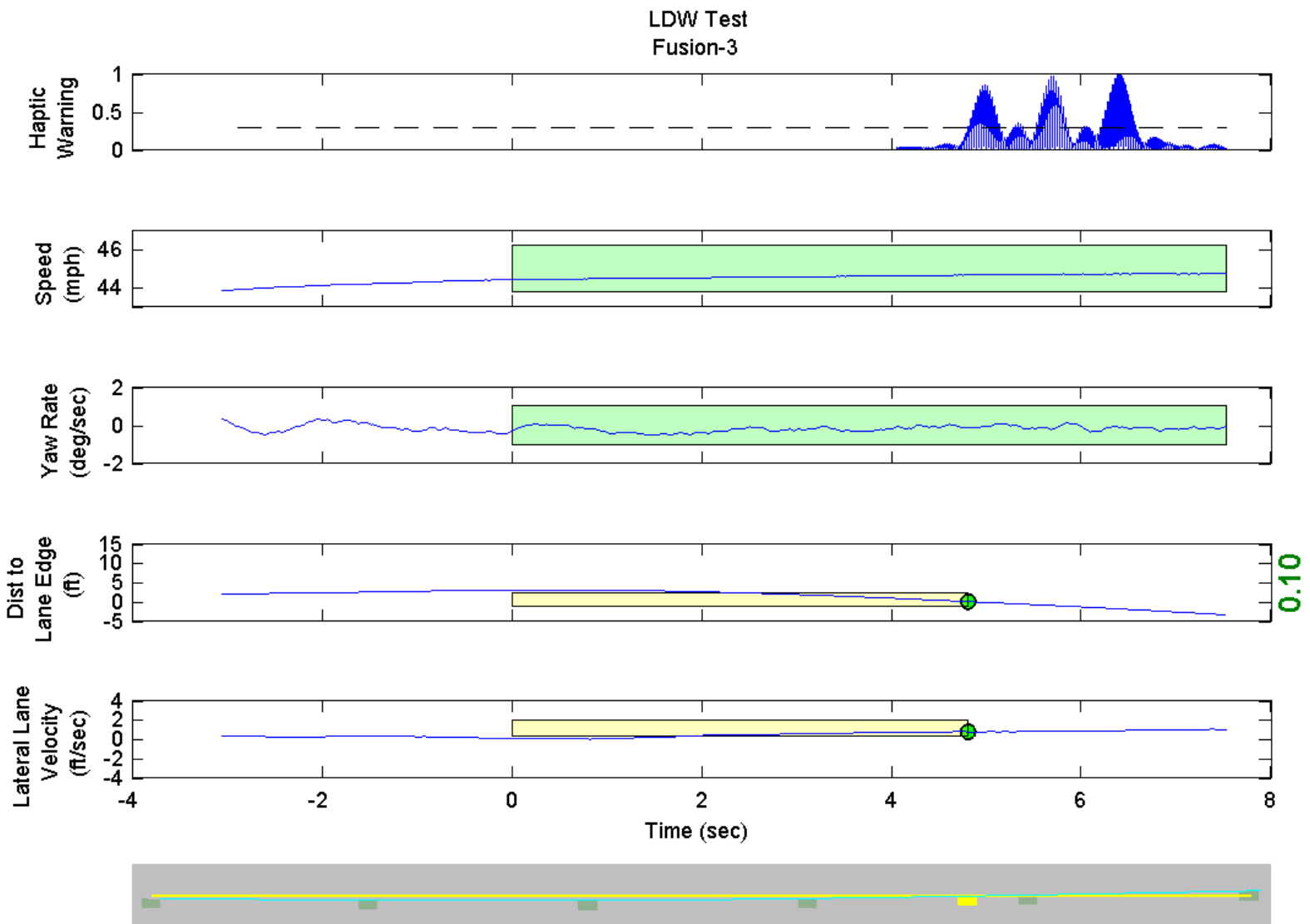


Figure D3. Example Time History for Lane Departure Warning Test, Invalid Run Due to Subject Vehicle Yaw Rate



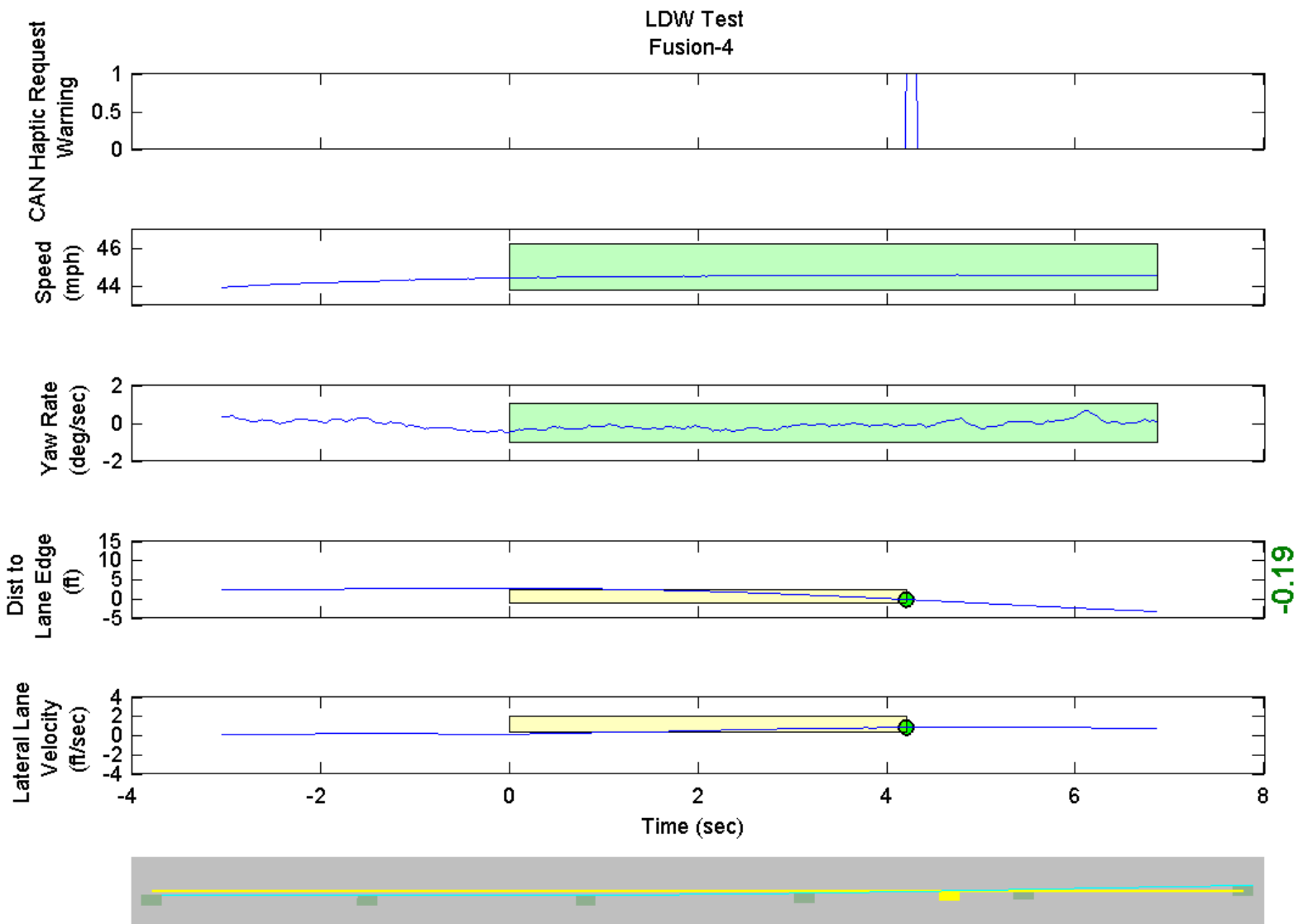
GPS Fix Type: RTK Fixed

Figure D4. Time History for Run 3, Solid Line, Left Departure, CAN Haptic Warning Request



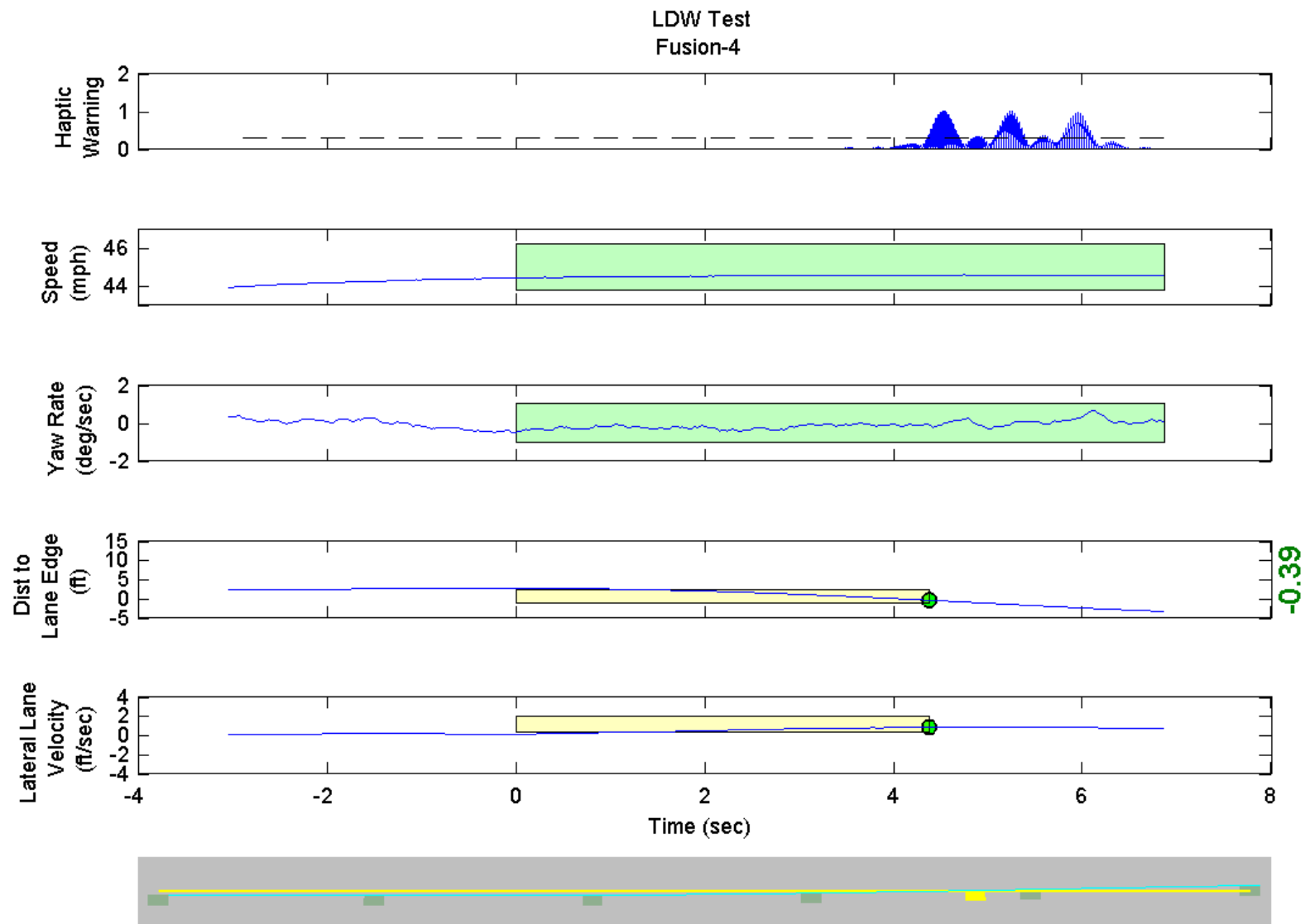
GPS Fix Type: RTK Fixed

Figure D5. Time History for Run 3, Solid Line, Left Departure, Haptic Warning



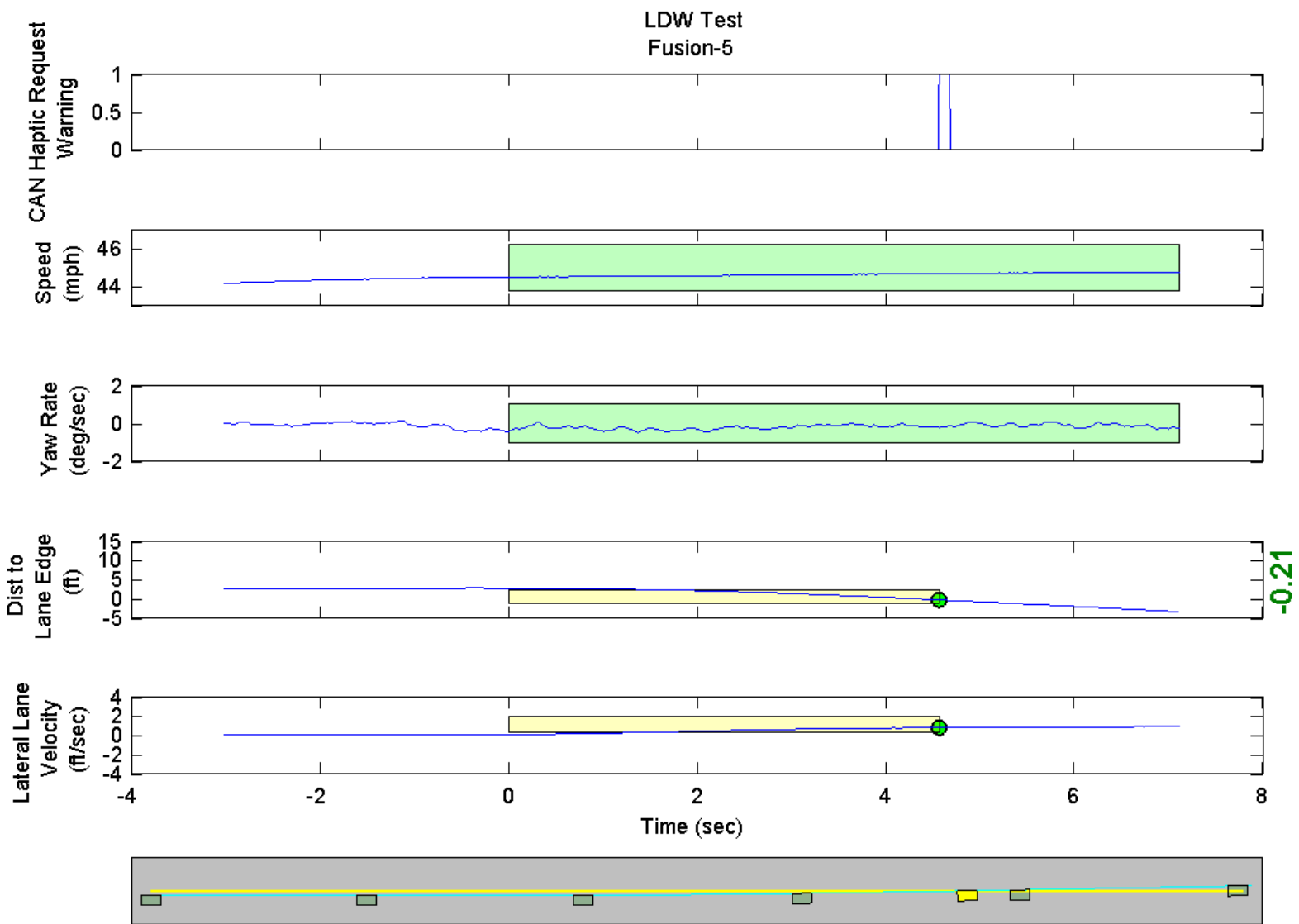
GPS Fix Type: RTK Fixed

Figure D6. Time History for Run 4, Solid Line, Left Departure, CAN Haptic Warning Request



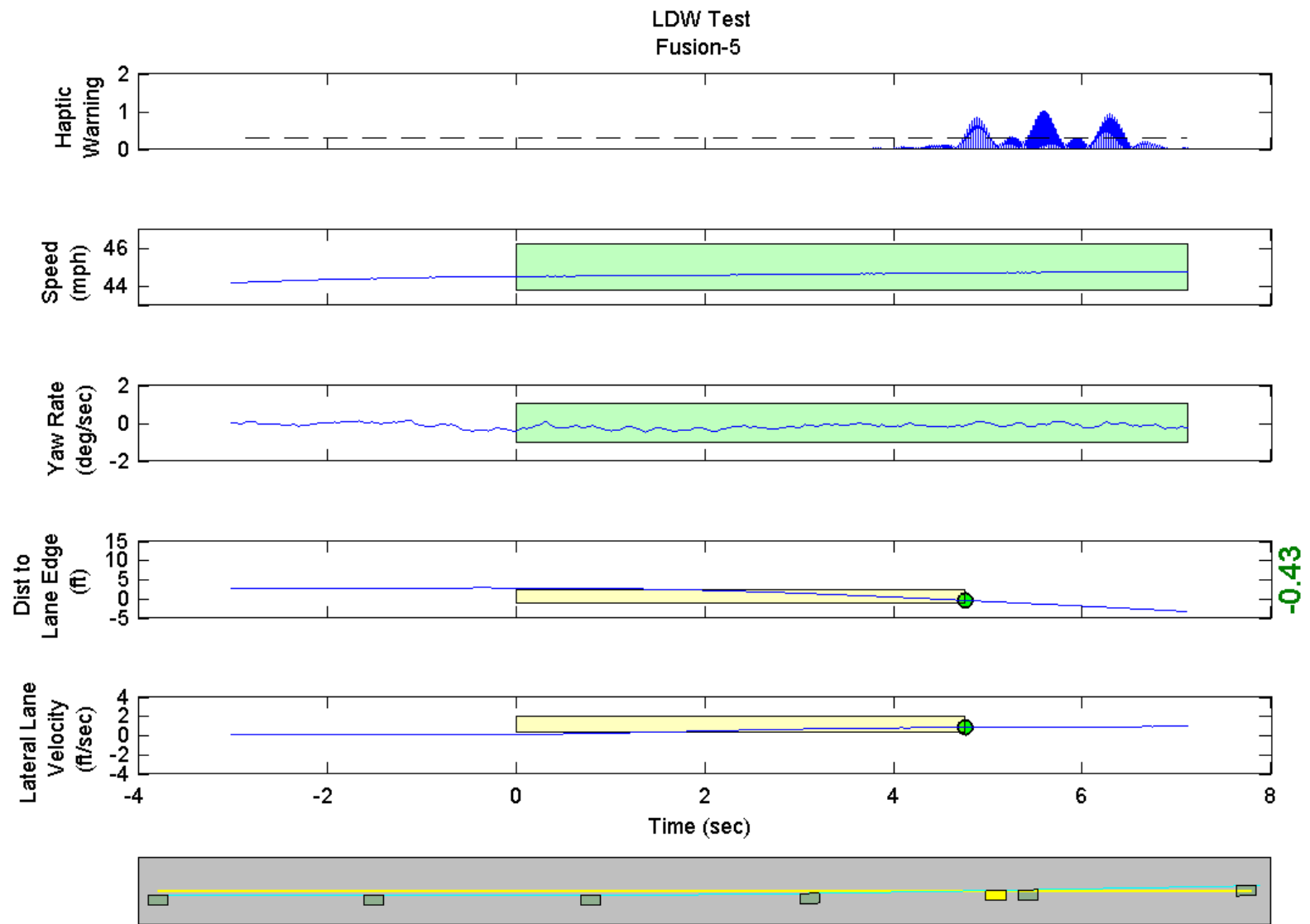
GPS Fix Type: RTK Fixed

Figure D7. Time History for Run 4, Solid Line, Left Departure, Haptic Warning



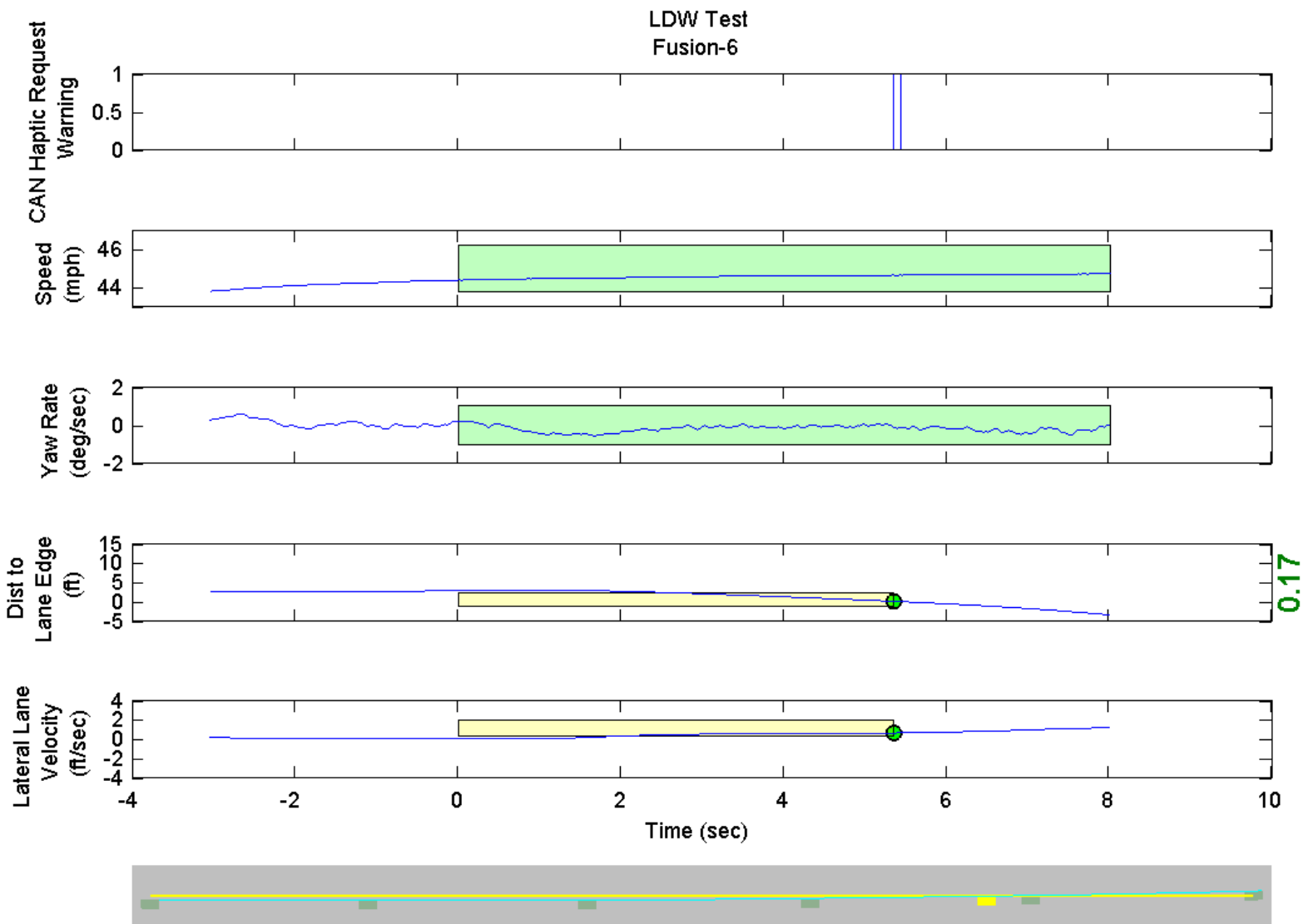
GPS Fix Type: RTK Fixed

Figure D8. Time History for Run 5, Solid Line, Left Departure, CAN Haptic Warning Request



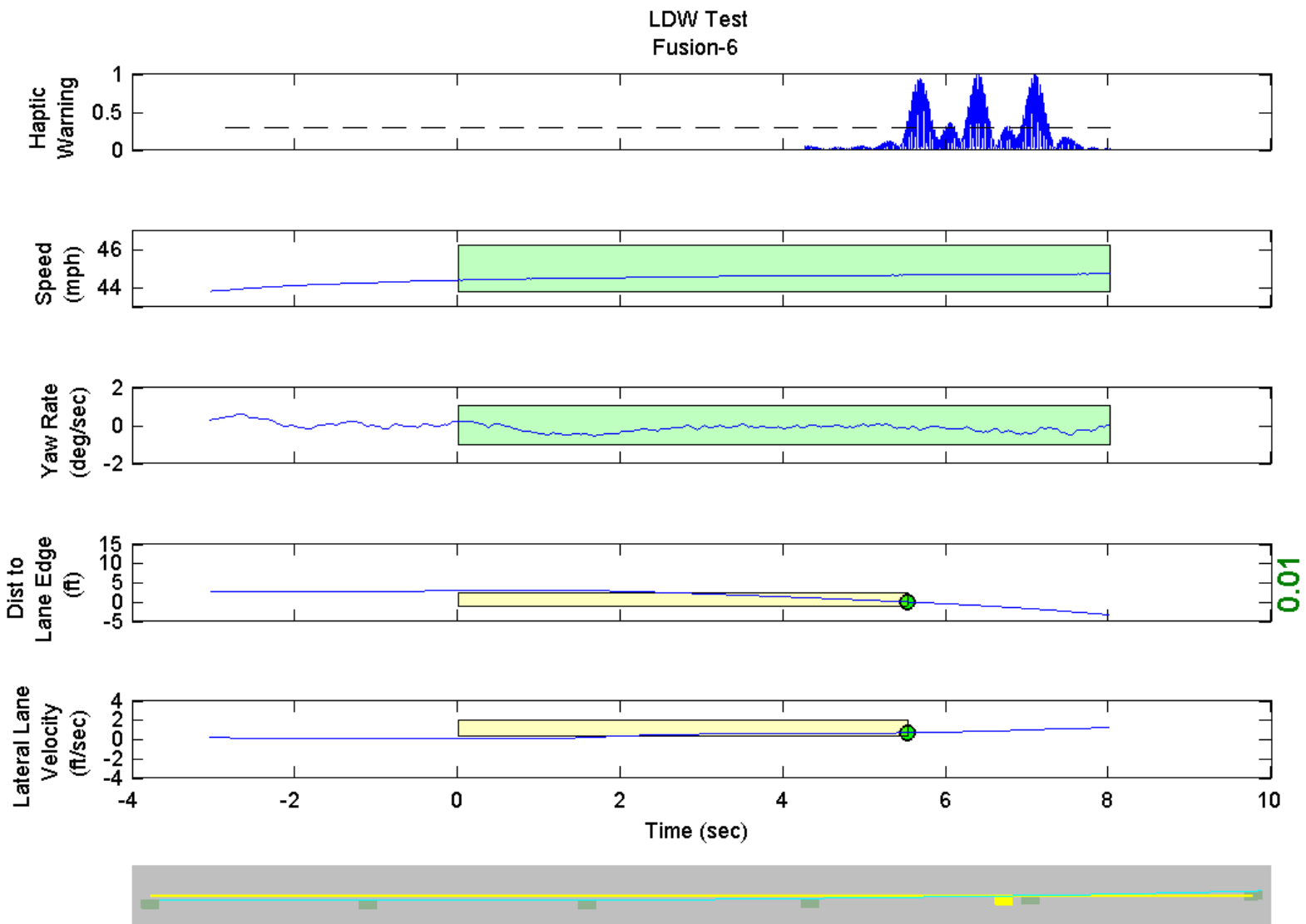
GPS Fix Type: RTK Fixed

Figure D9. Time History for Run 5, Solid Line, Left Departure, Haptic Warning



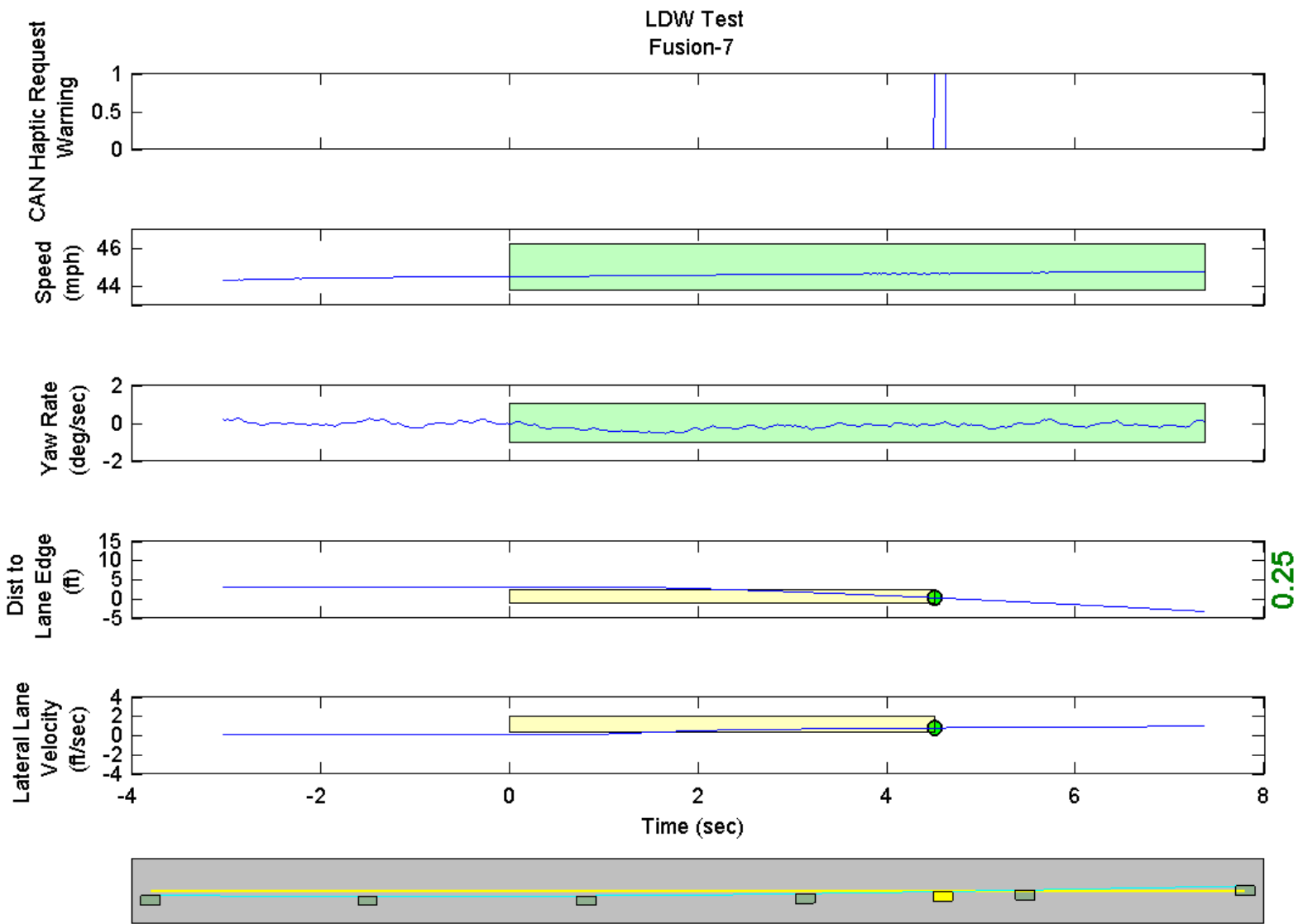
GPS Fix Type: RTK Fixed

Figure D10. Time History for Run 6, Solid Line, Left Departure, CAN Haptic Warning Request



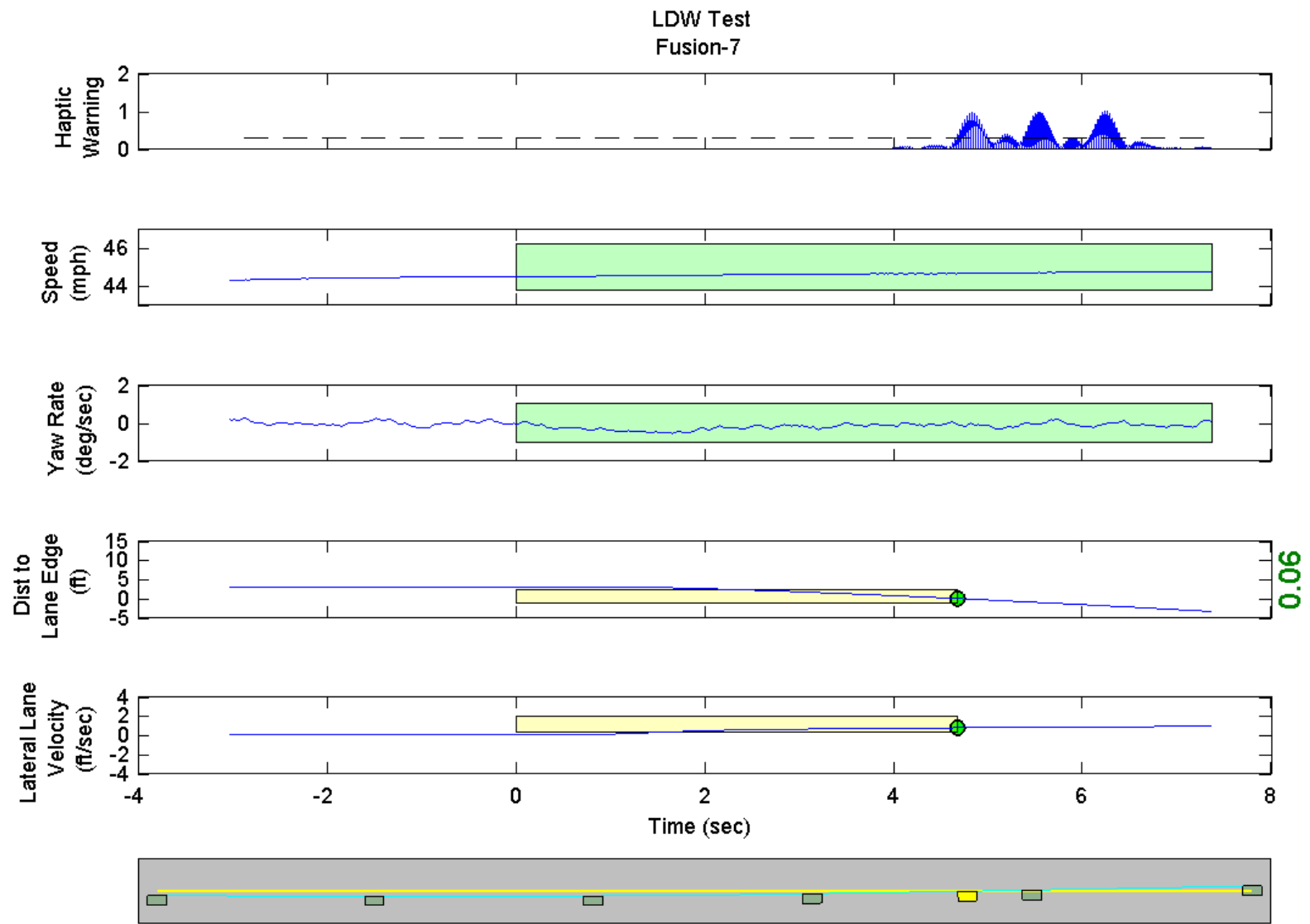
GPS Fix Type: RTK Fixed

Figure D11. Time History for Run 6, Solid Line, Left Departure, Haptic Warning



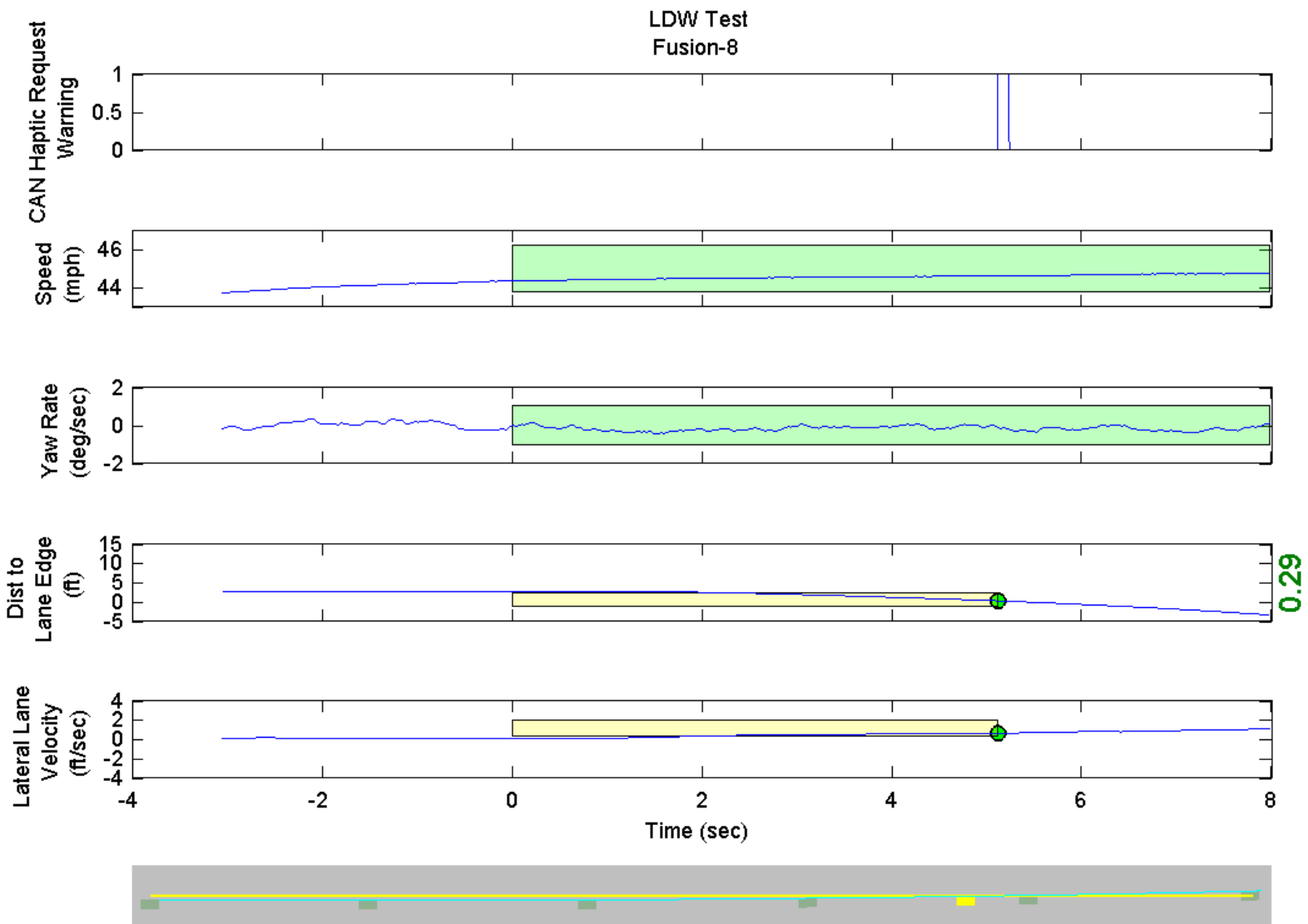
GPS Fix Type: RTK Fixed

Figure D12. Time History for Run 7, Solid Line, Left Departure, CAN Haptic Warning Request



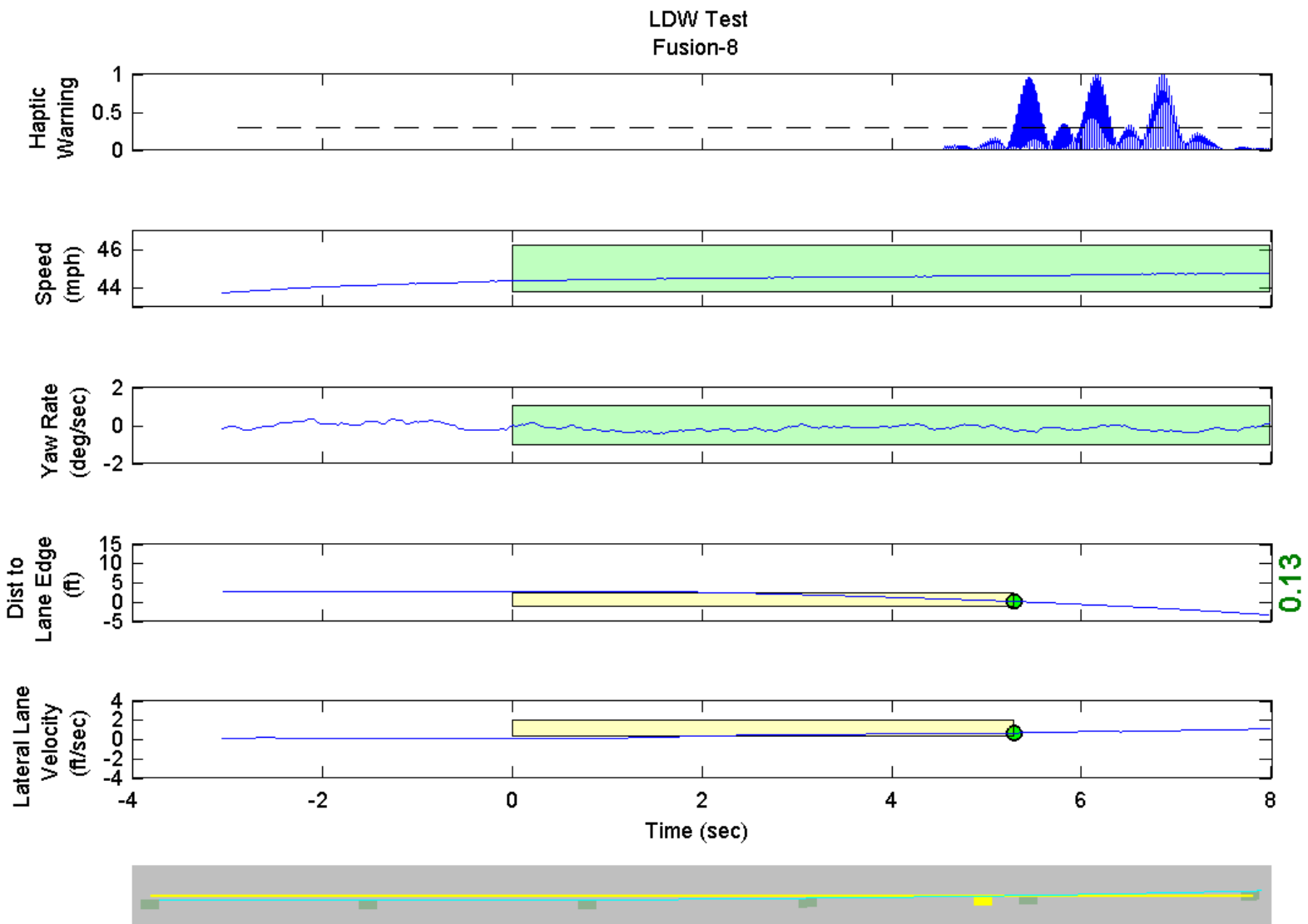
GPS Fix Type: RTK Fixed

Figure D13. Time History for Run 7, Solid Line, Left Departure, Haptic Warning



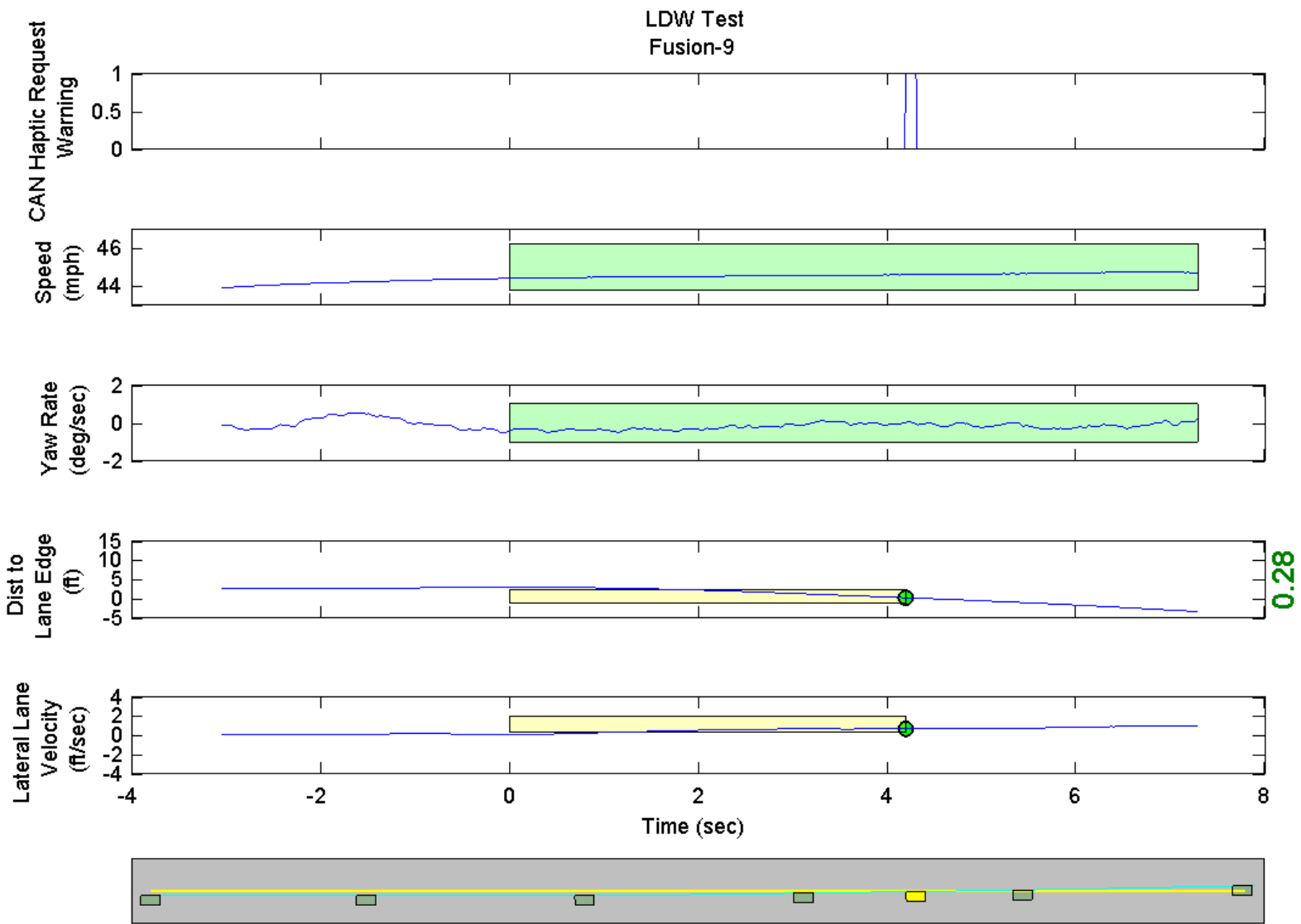
GPS Fix Type: RTK Fixed

Figure D14. Time History for Run 8, Solid Line, Left Departure, CAN Haptic Warning Request



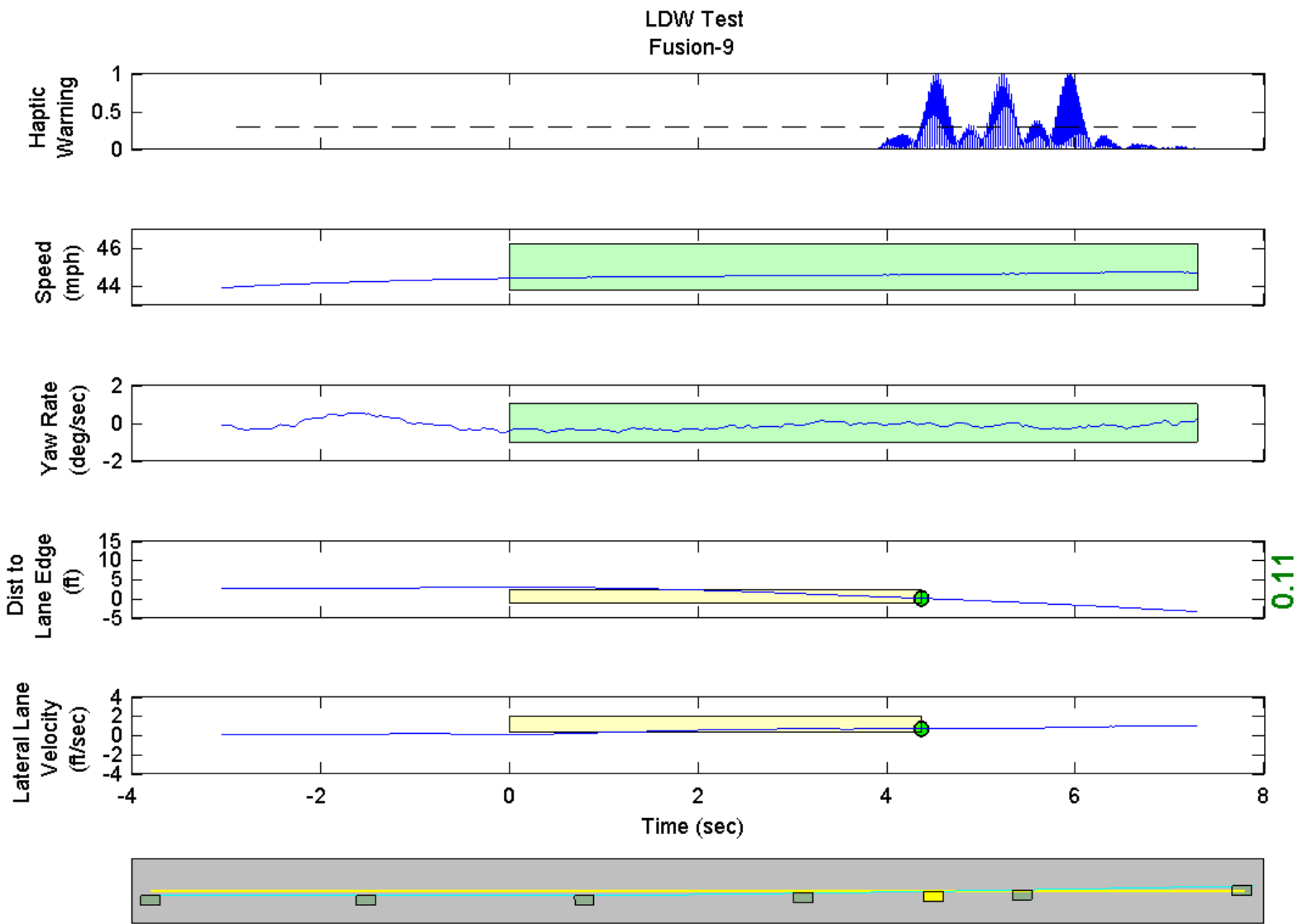
GPS Fix Type: RTK Fixed

Figure D15. Time History for Run 8, Solid Line, Left Departure, Haptic Warning



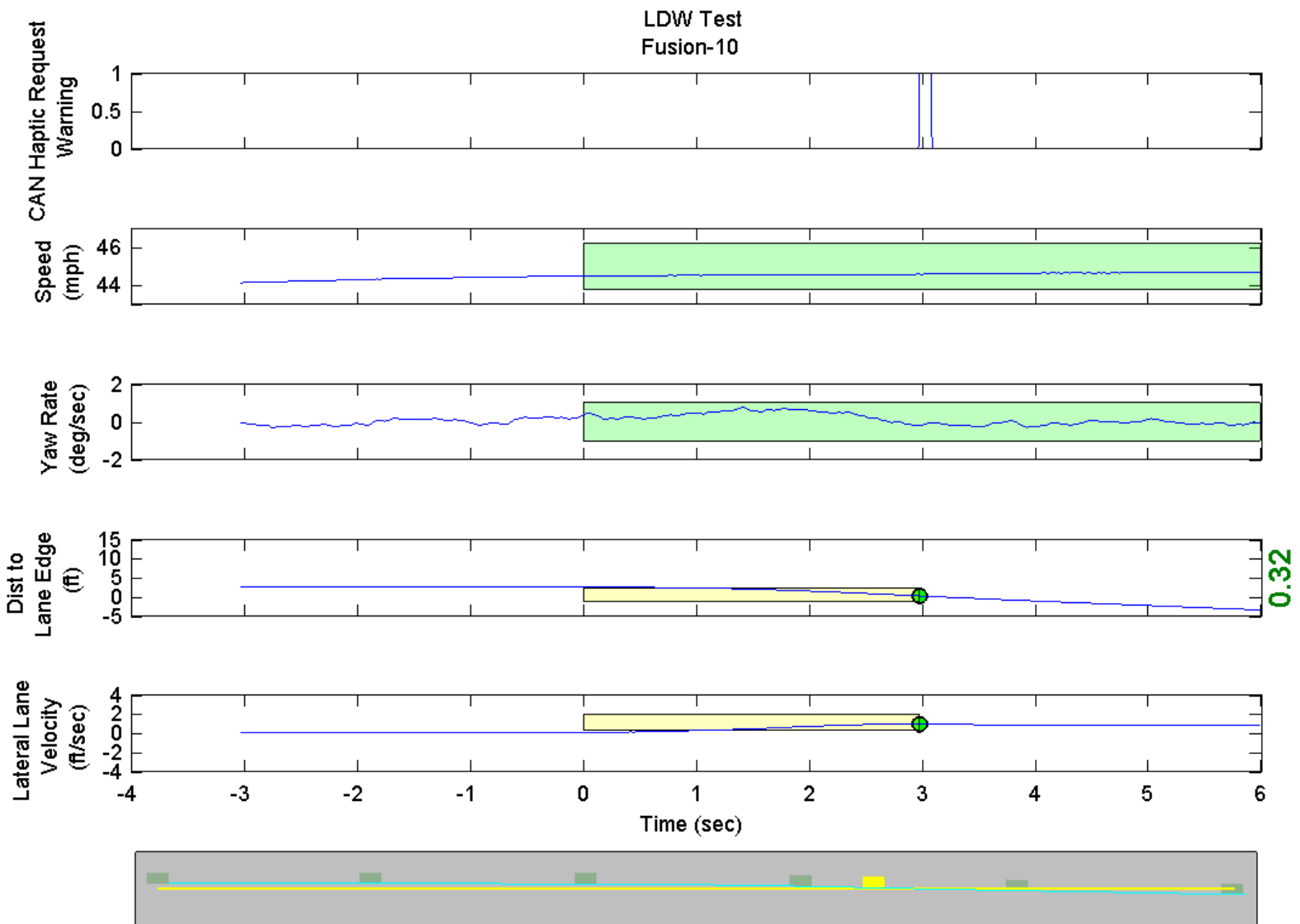
GPS Fix Type: RTK Fixed

Figure D16. Time History for Run 9, Solid Line, Left Departure, CAN Haptic Warning Request



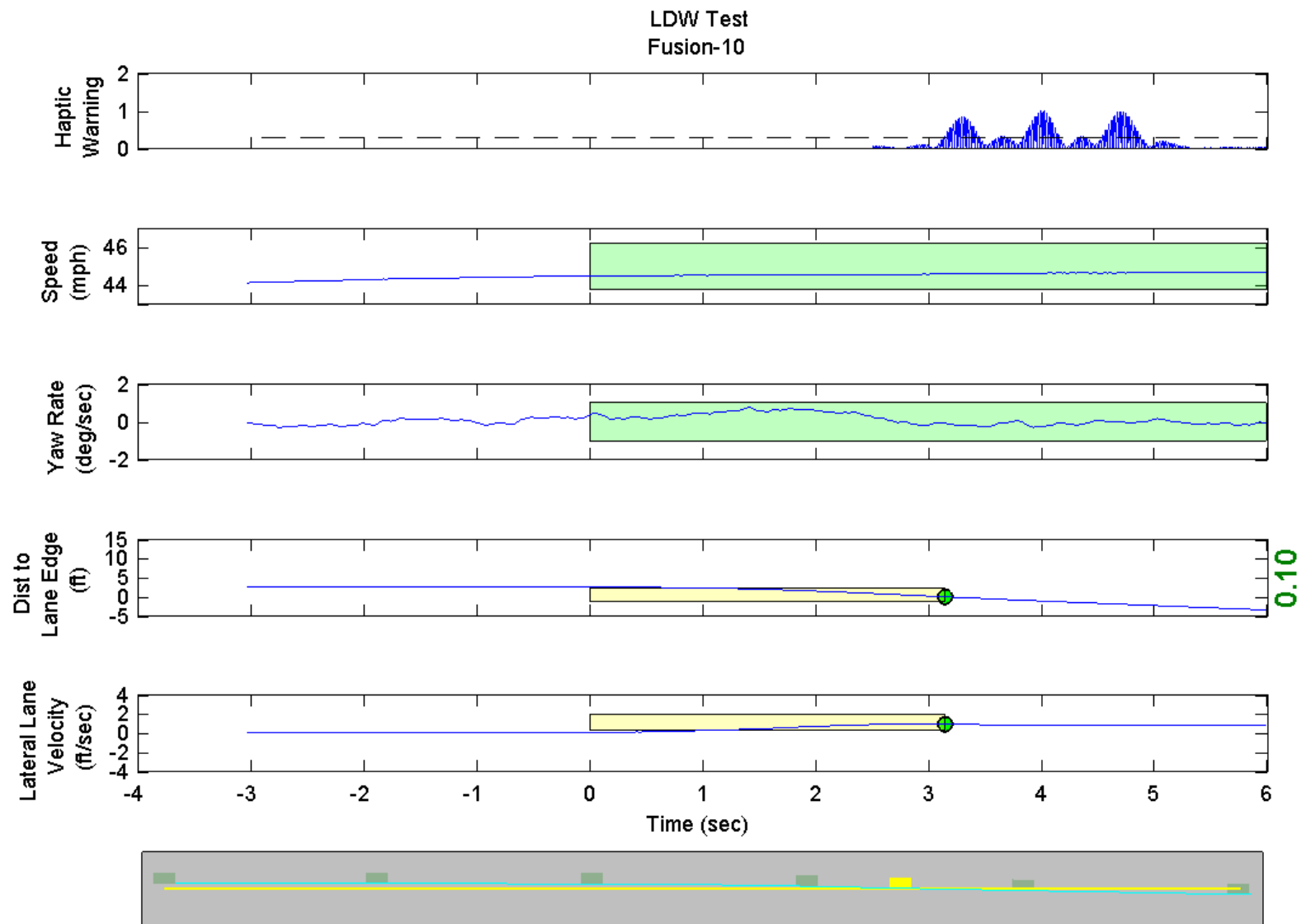
GPS Fix Type: RTK Fixed

Figure D17. Time History for Run 9, Solid Line, Left Departure, Haptic Warning



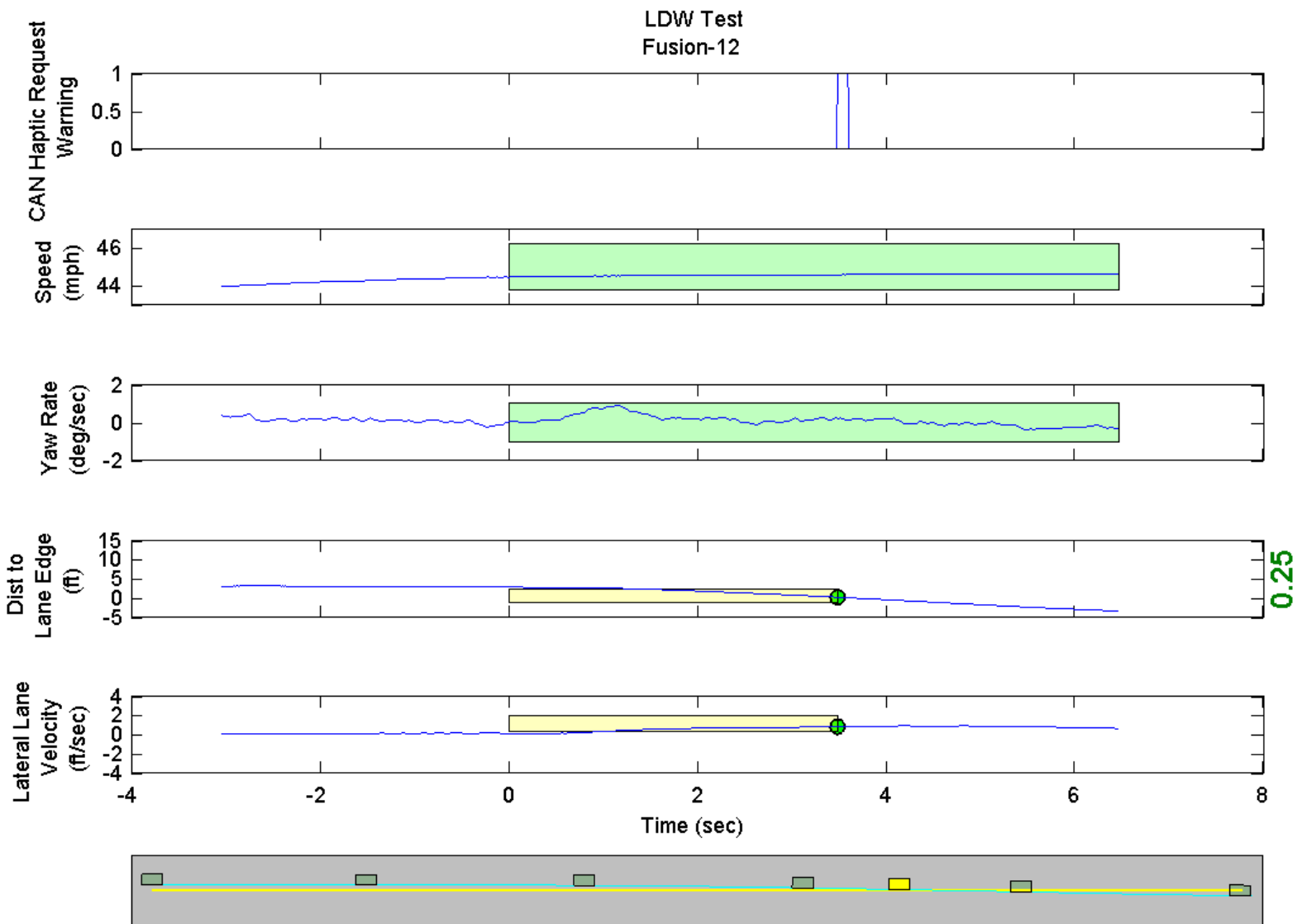
GPS Fix Type: RTK Fixed

Figure D18. Time History for Run 10, Solid Line, Right Departure, CAN Haptic Warning Request



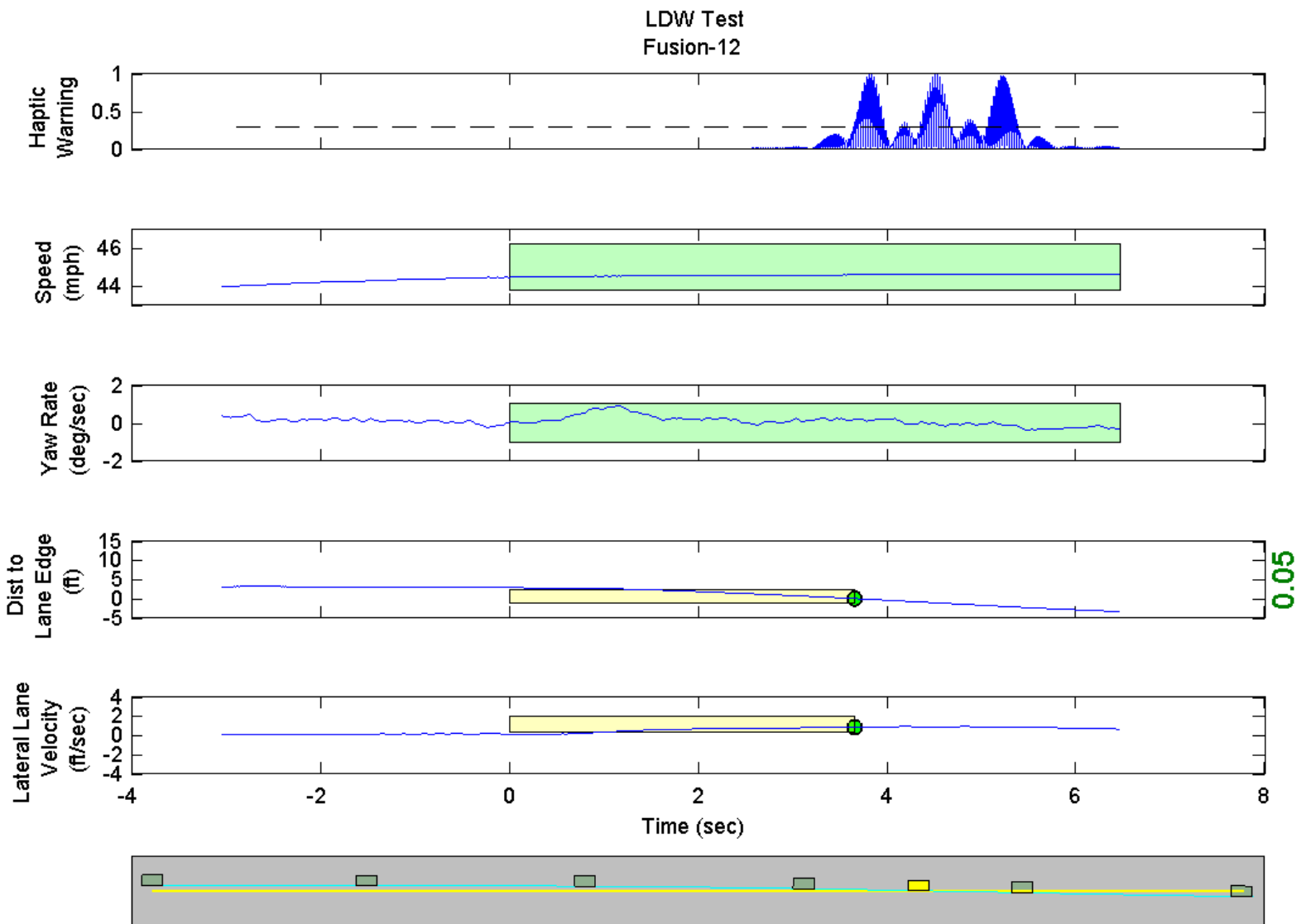
GPS Fix Type: RTK Fixed

Figure D19. Time History for Run 10, Solid Line, Right Departure, Haptic Warning



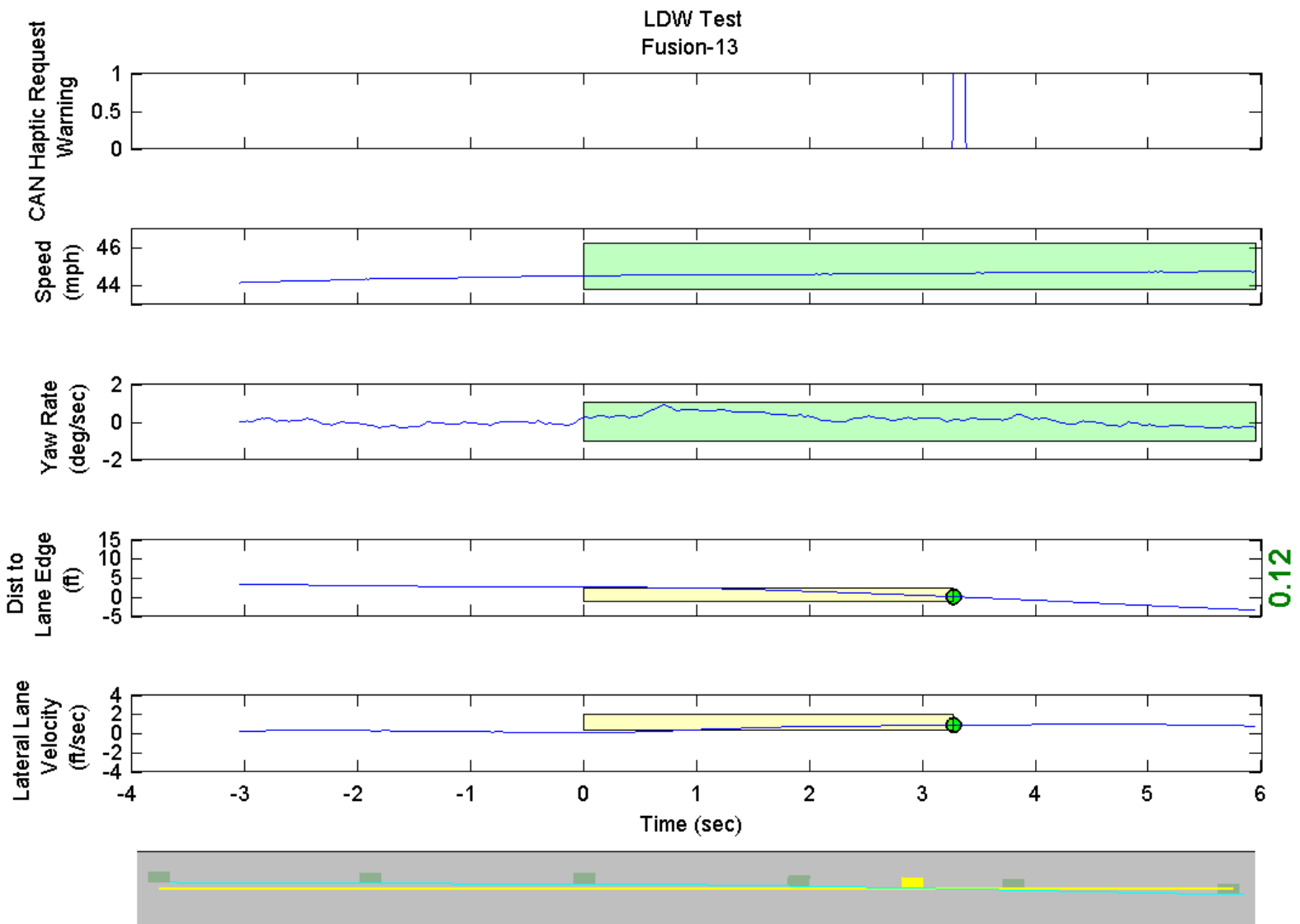
GPS Fix Type: RTK Fixed

Figure D20. Time History for Run 12, Solid Line, Right Departure, CAN Haptic Warning Request



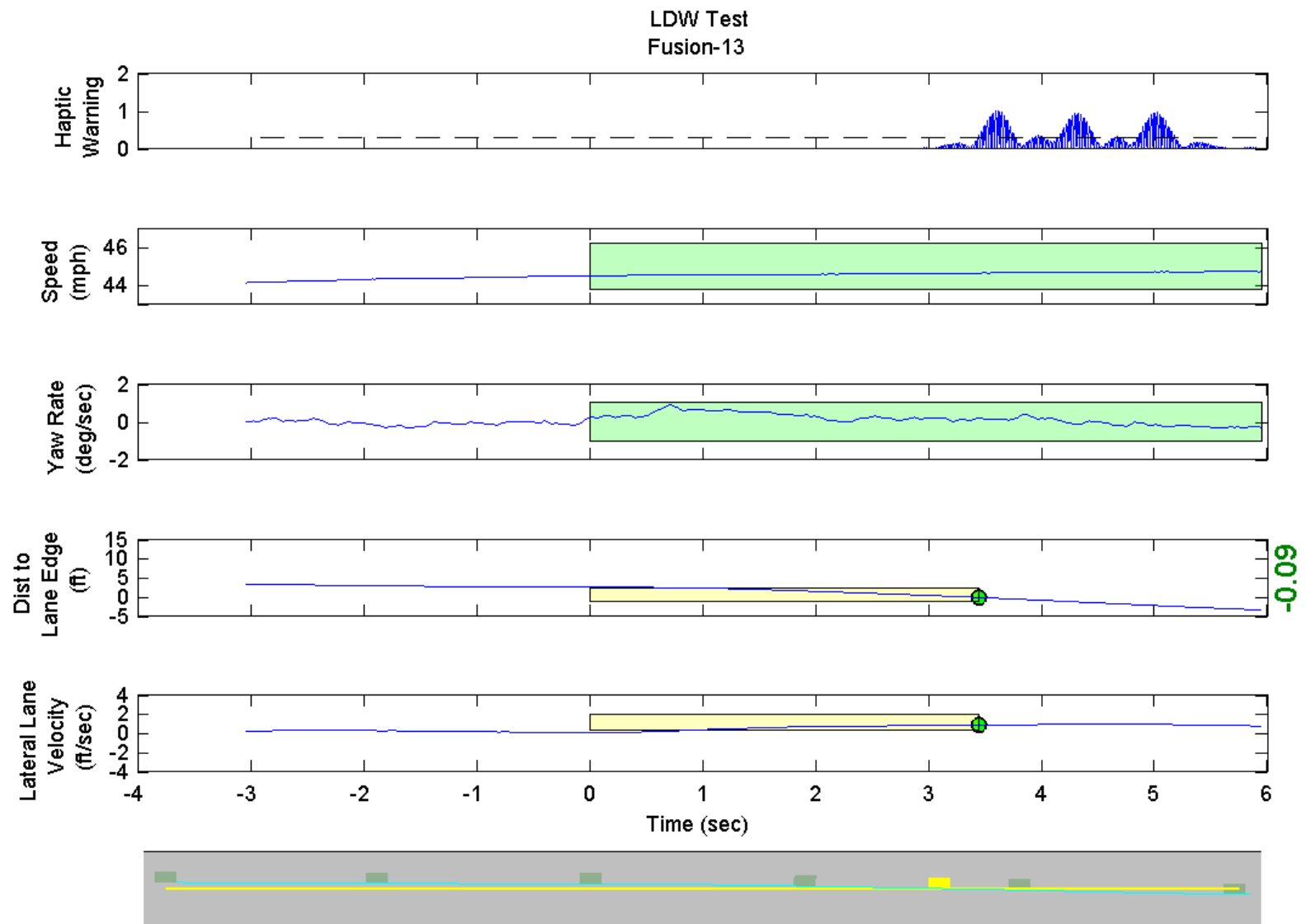
GPS Fix Type: RTK Fixed

Figure D21. Time History for Run 12, Solid Line, Right Departure, Haptic Warning



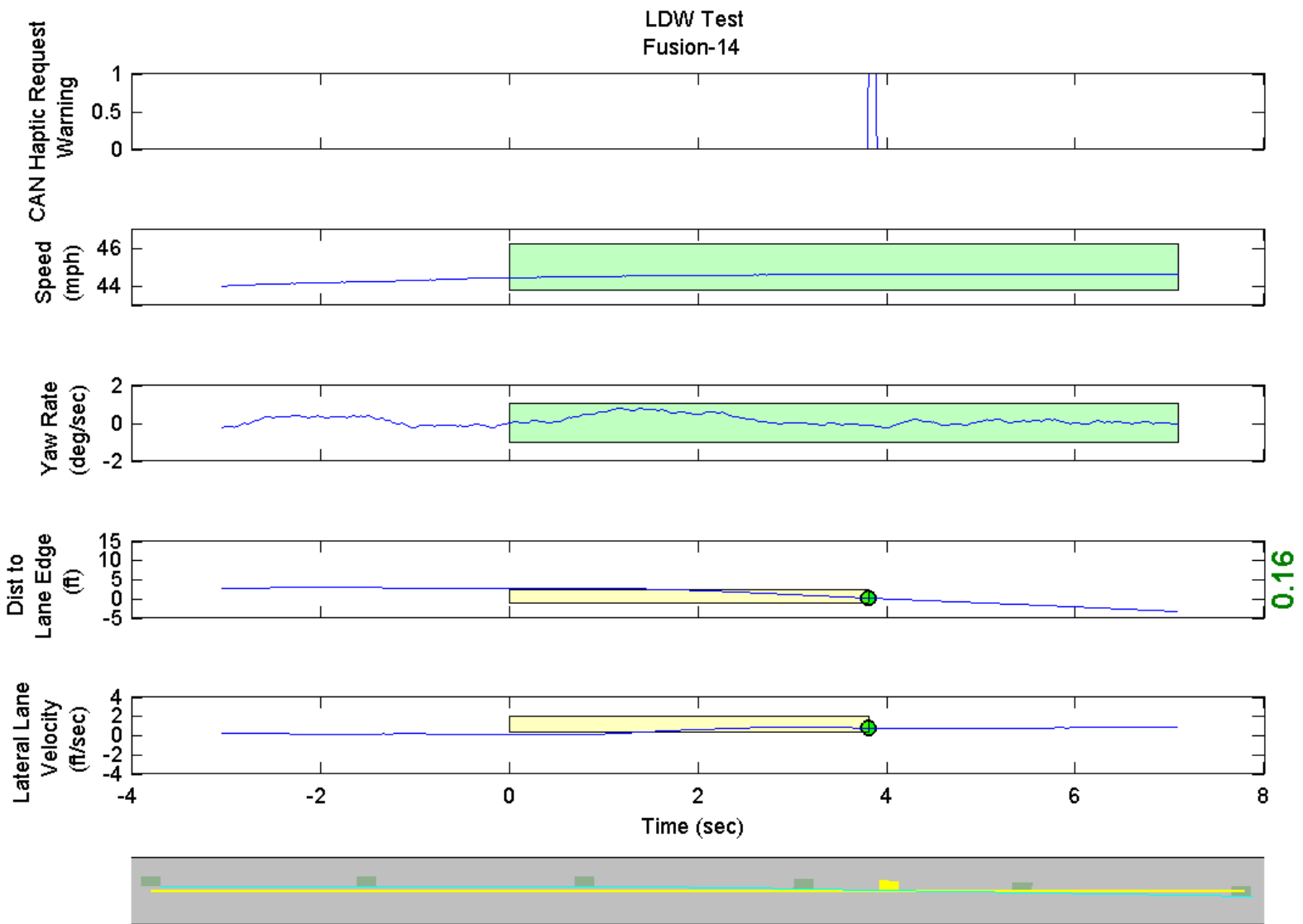
GPS Fix Type: RTK Fixed

Figure D22. Time History for Run 13, Solid Line, Right Departure, CAN Haptic Warning Request



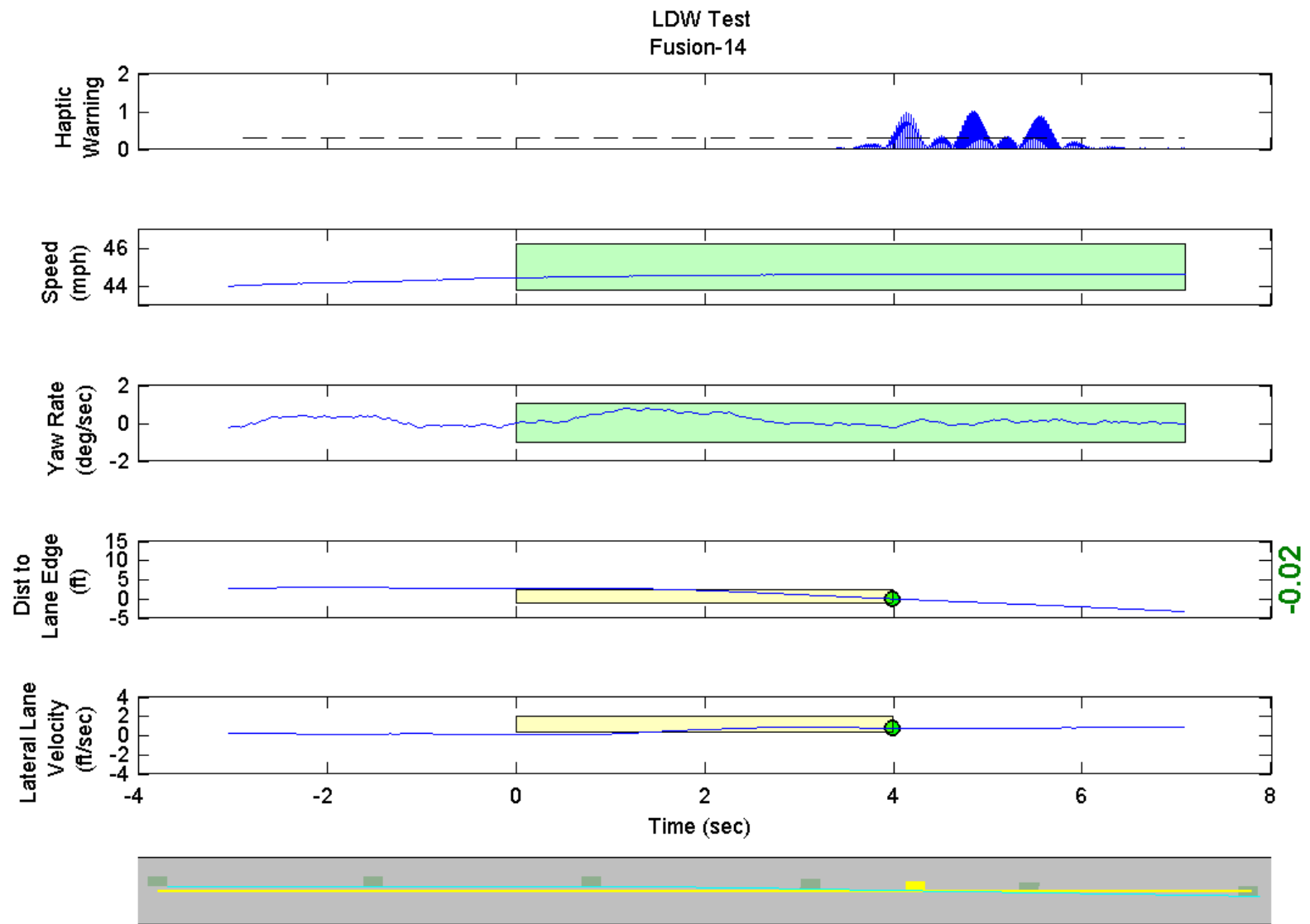
GPS Fix Type: RTK Fixed

Figure D23. Time History for Run 13, Solid Line, Right Departure, Haptic Warning



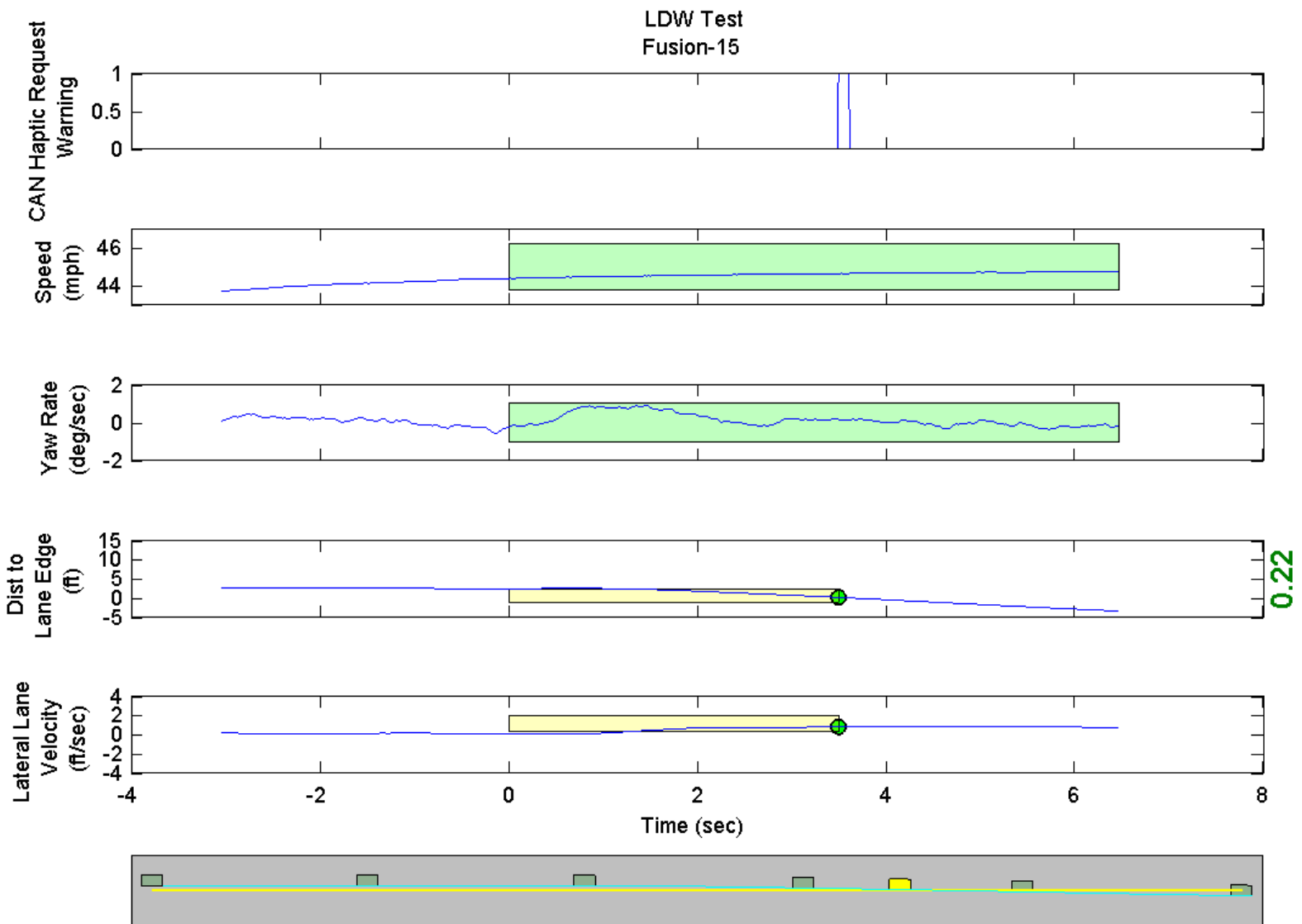
GPS Fix Type: RTK Fixed

Figure D24. Time History for Run 14, Solid Line, Right Departure, CAN Haptic Warning Request



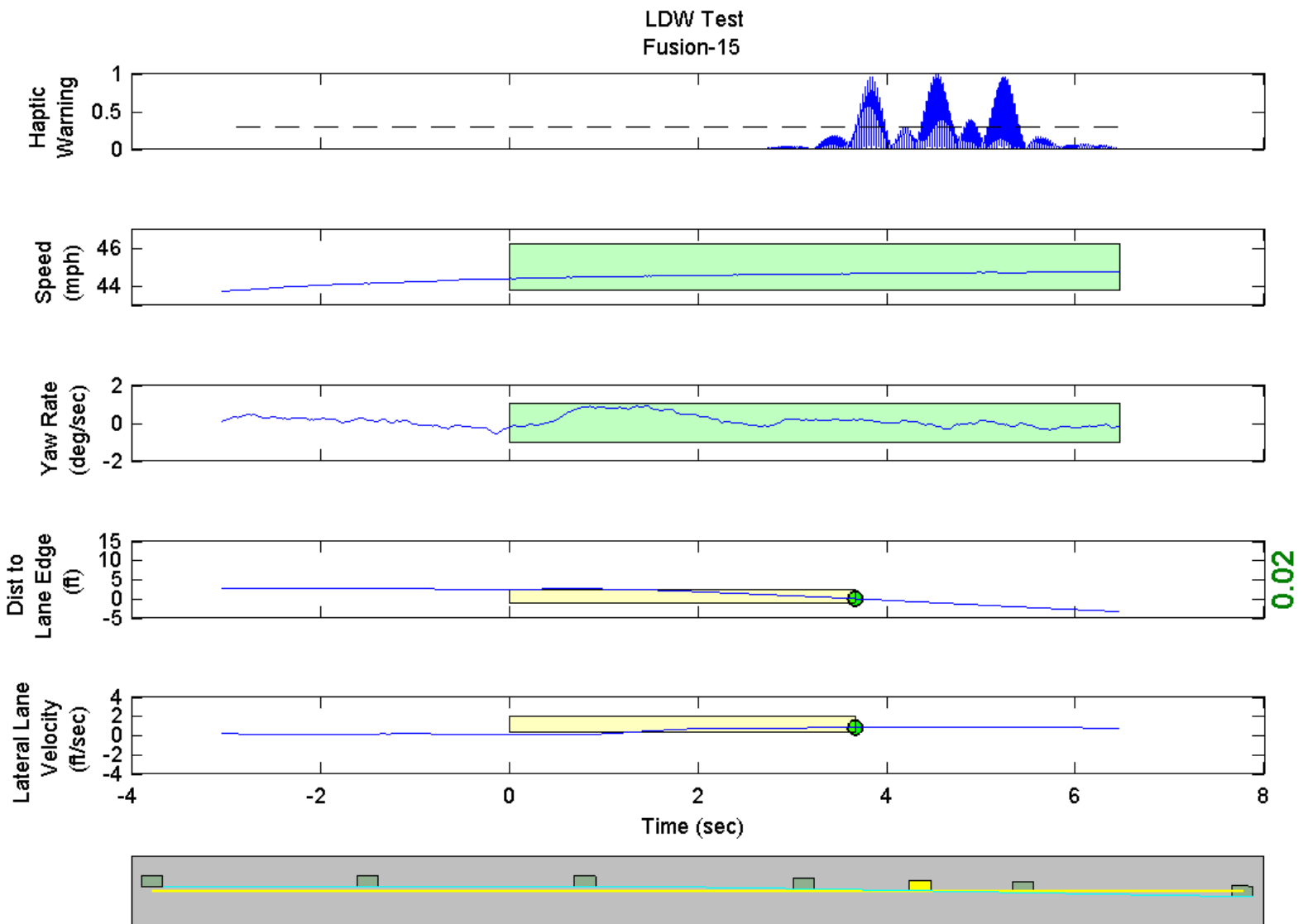
GPS Fix Type: RTK Fixed

Figure D25. Time History for Run 14, Solid Line, Right Departure, Haptic Warning



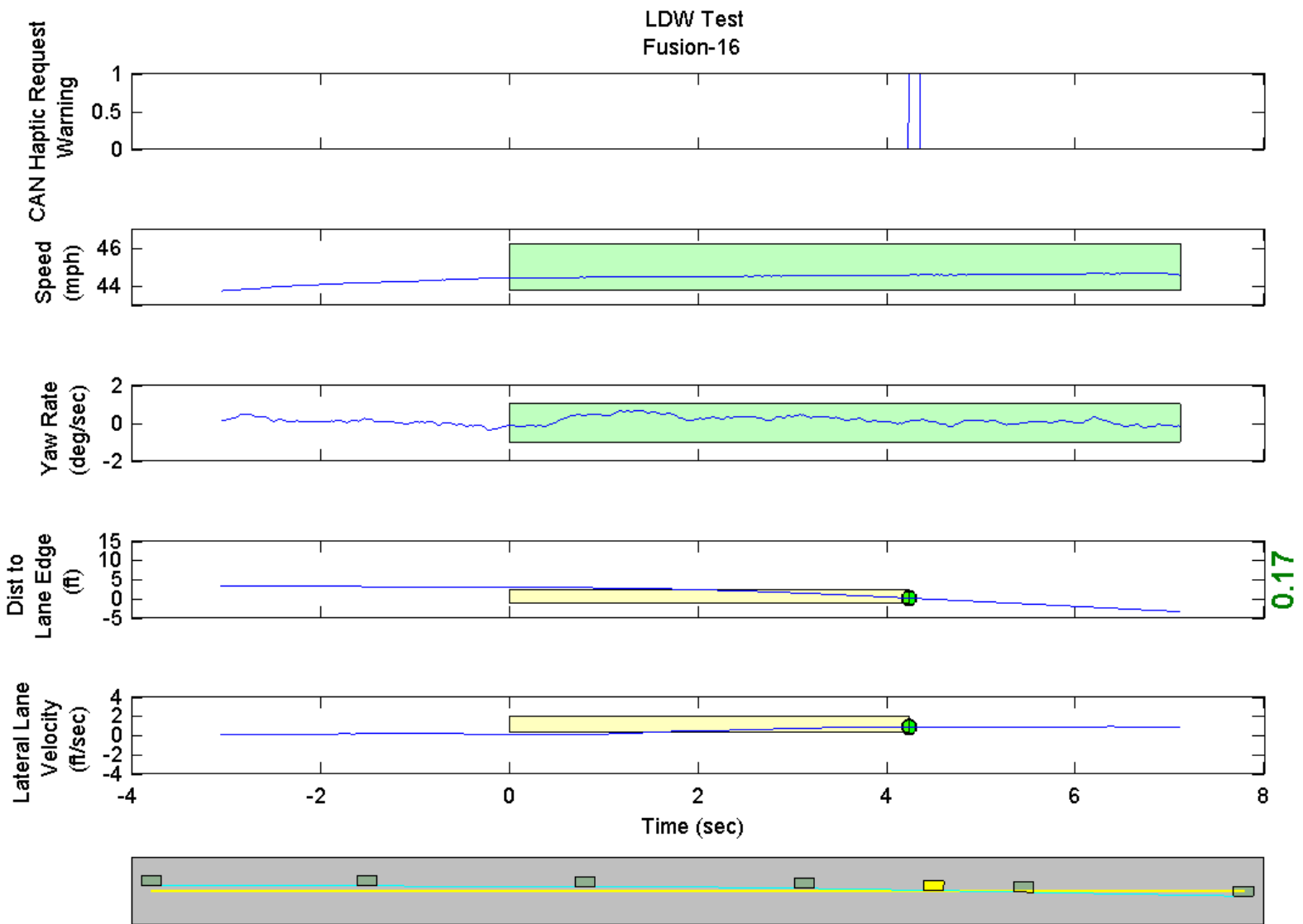
GPS Fix Type: RTK Fixed

Figure D26. Time History for Run 15, Solid Line, Right Departure, CAN Haptic Warning Request



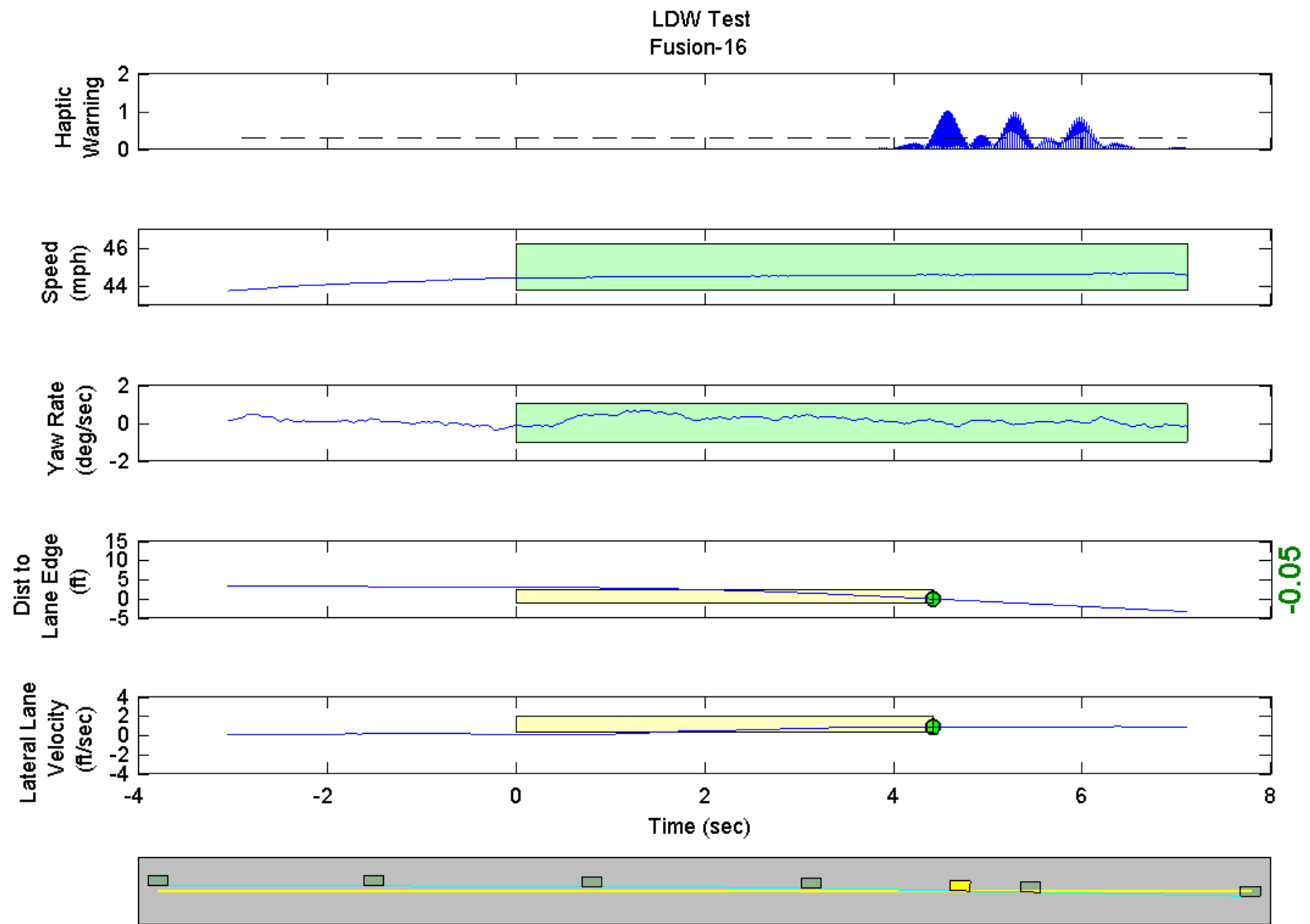
GPS Fix Type: RTK Fixed

Figure D27. Time History for Run 15, Solid Line, Right Departure, Haptic Warning



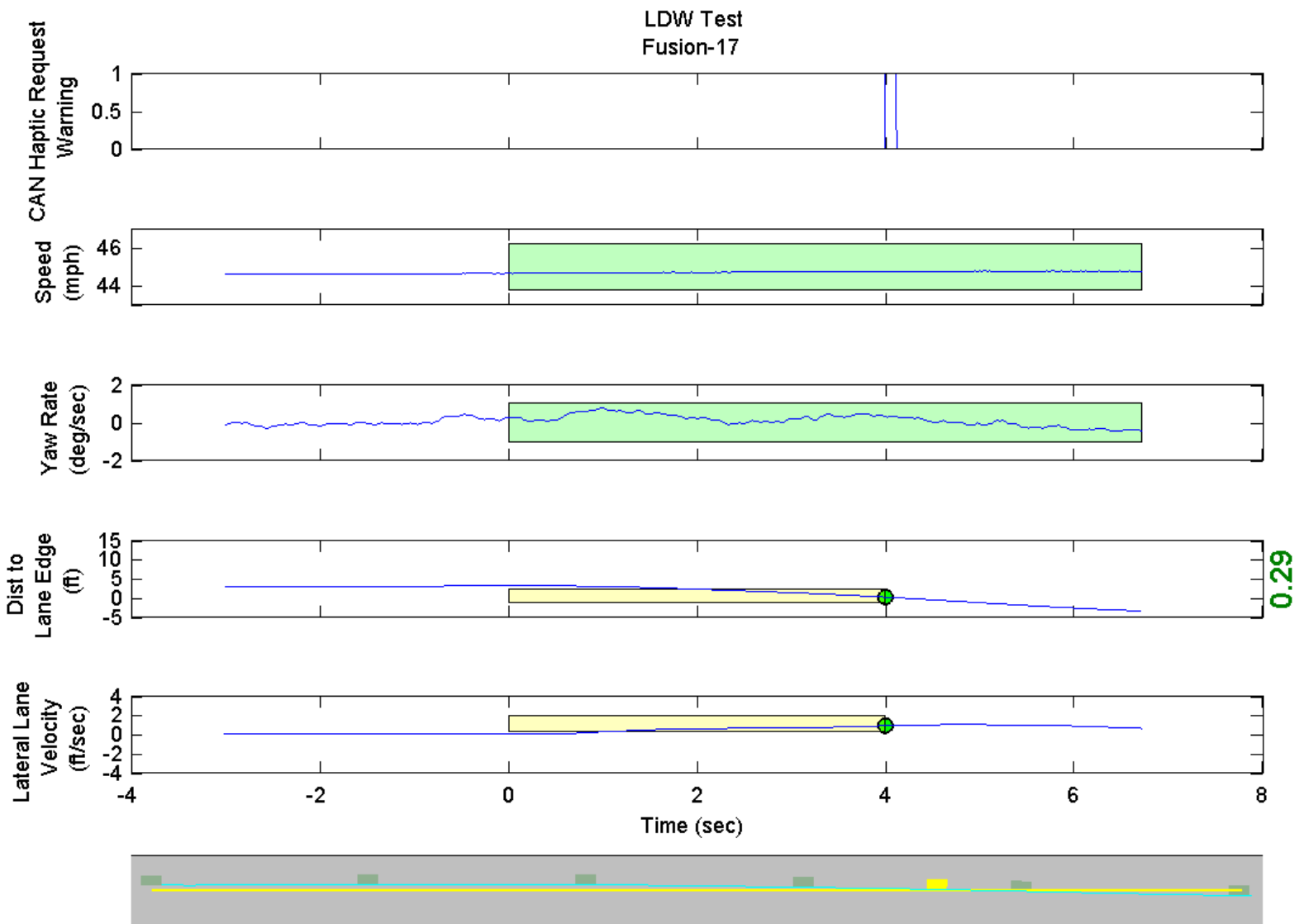
GPS Fix Type: RTK Fixed

Figure D28. Time History for Run 16, Solid Line, Right Departure, CAN Haptic Warning Request



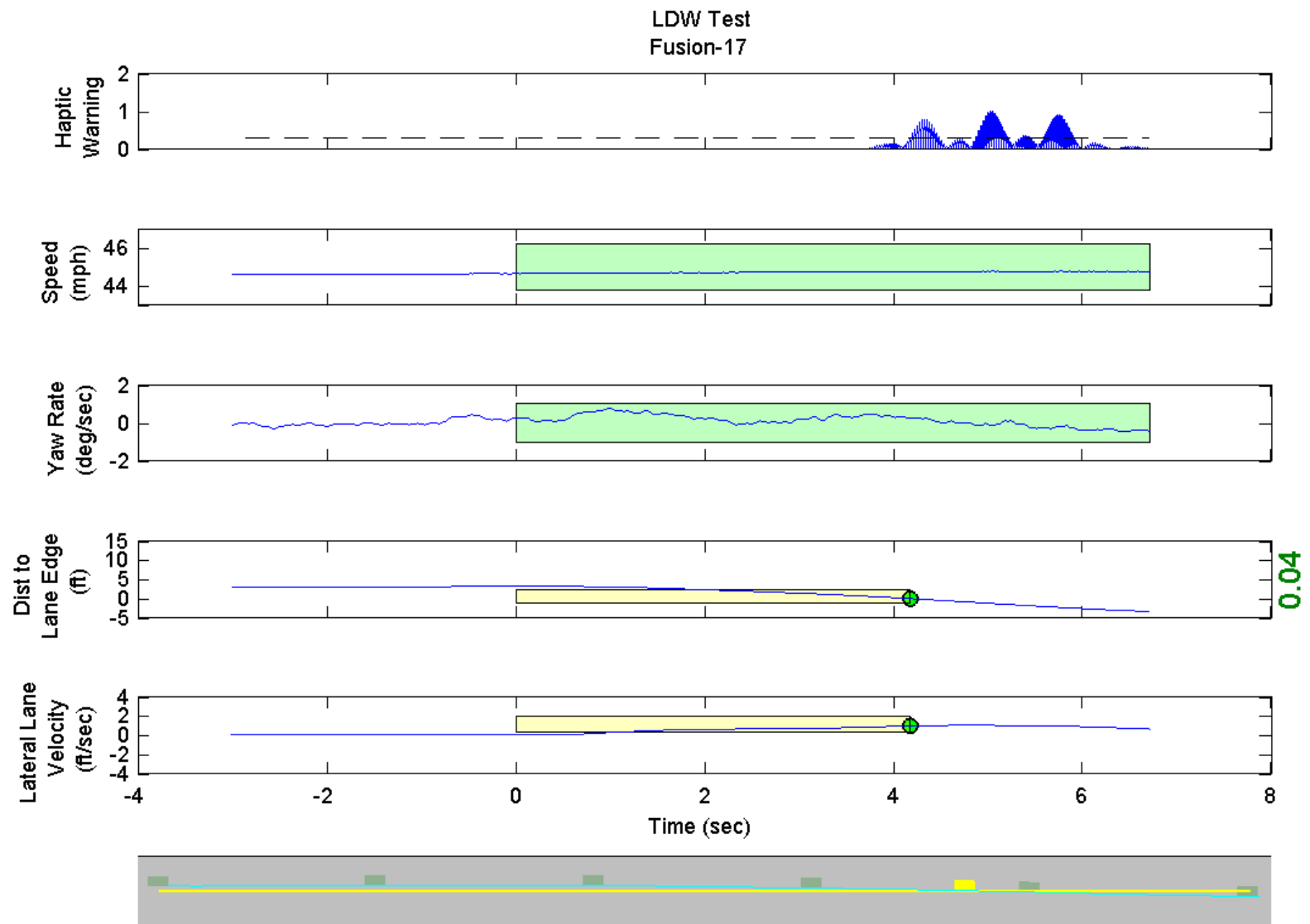
GPS Fix Type: RTK Fixed

Figure D29. Time History for Run 16, Solid Line, Right Departure, Haptic Warning



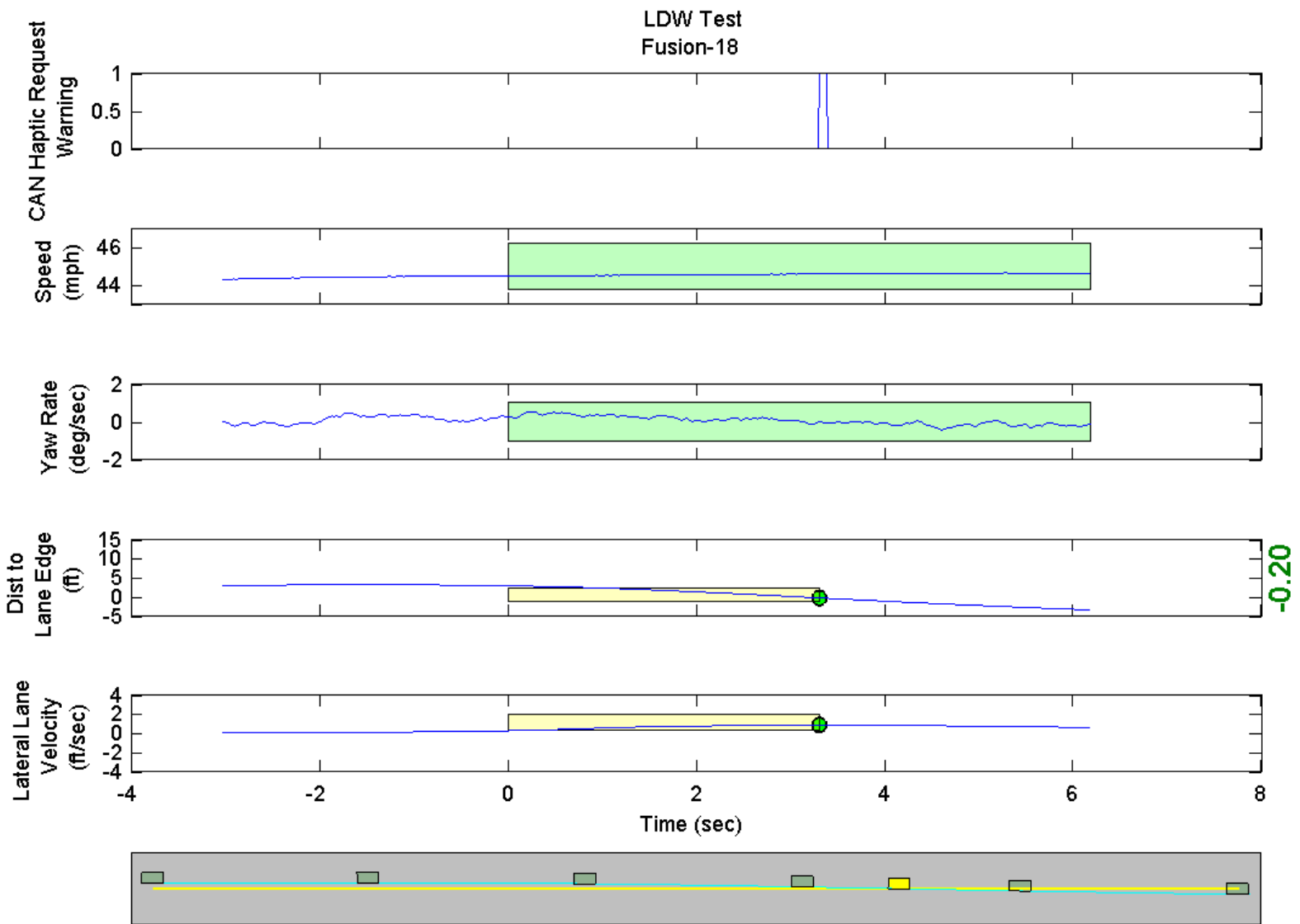
GPS Fix Type: RTK Fixed

Figure D30. Time History for Run 17, Solid Line, Right Departure, CAN Haptic Warning Request



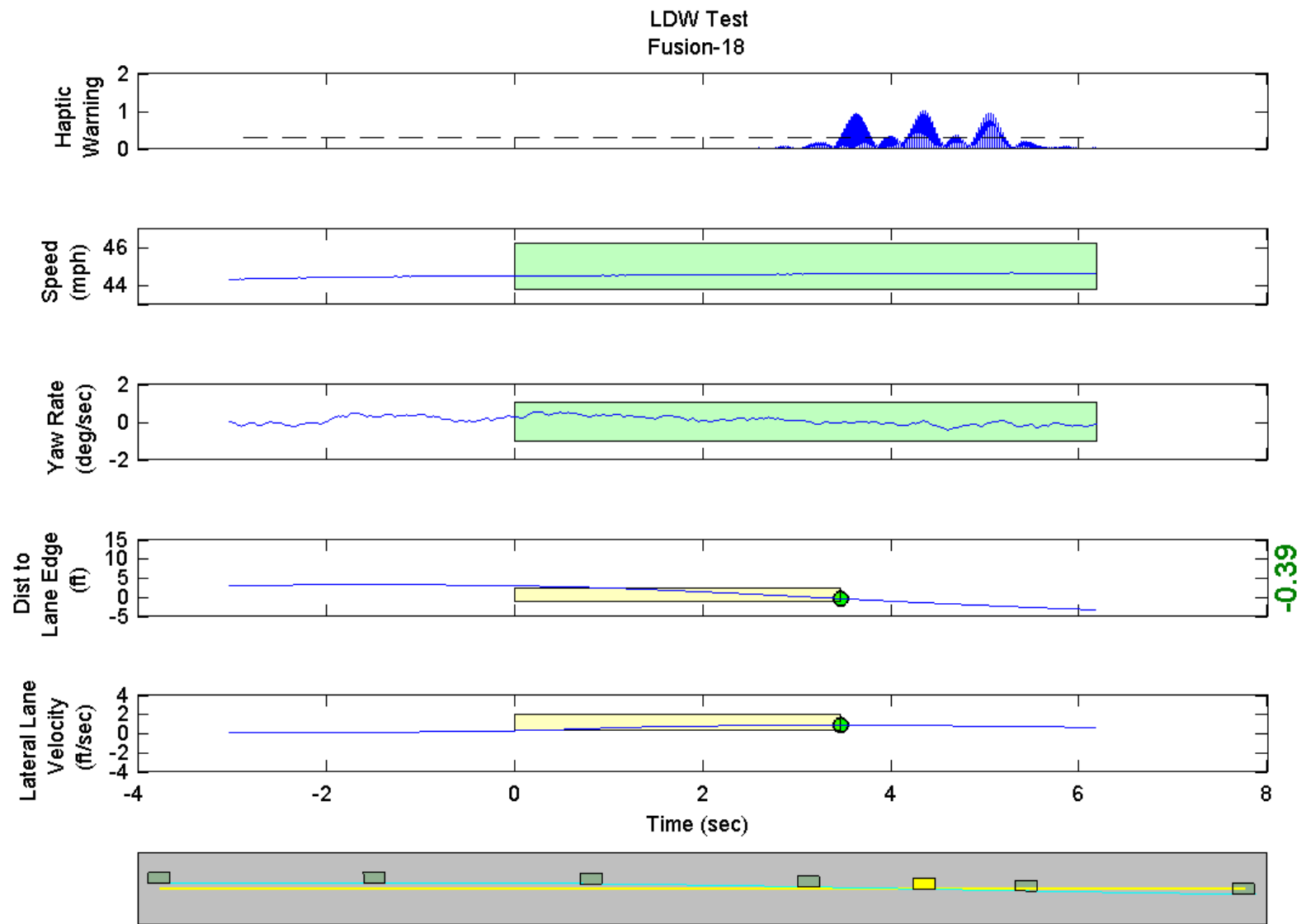
GPS Fix Type: RTK Fixed

Figure D31. Time History for Run 17, Solid Line, Right Departure, Haptic Warning



GPS Fix Type: RTK Fixed

Figure D32. Time History for Run 18, Dashed Line, Right Departure, CAN Haptic Warning Request



GPS Fix Type: RTK Fixed

Figure D33. Time History for Run 18, Dashed Line, Right Departure, Haptic Warning

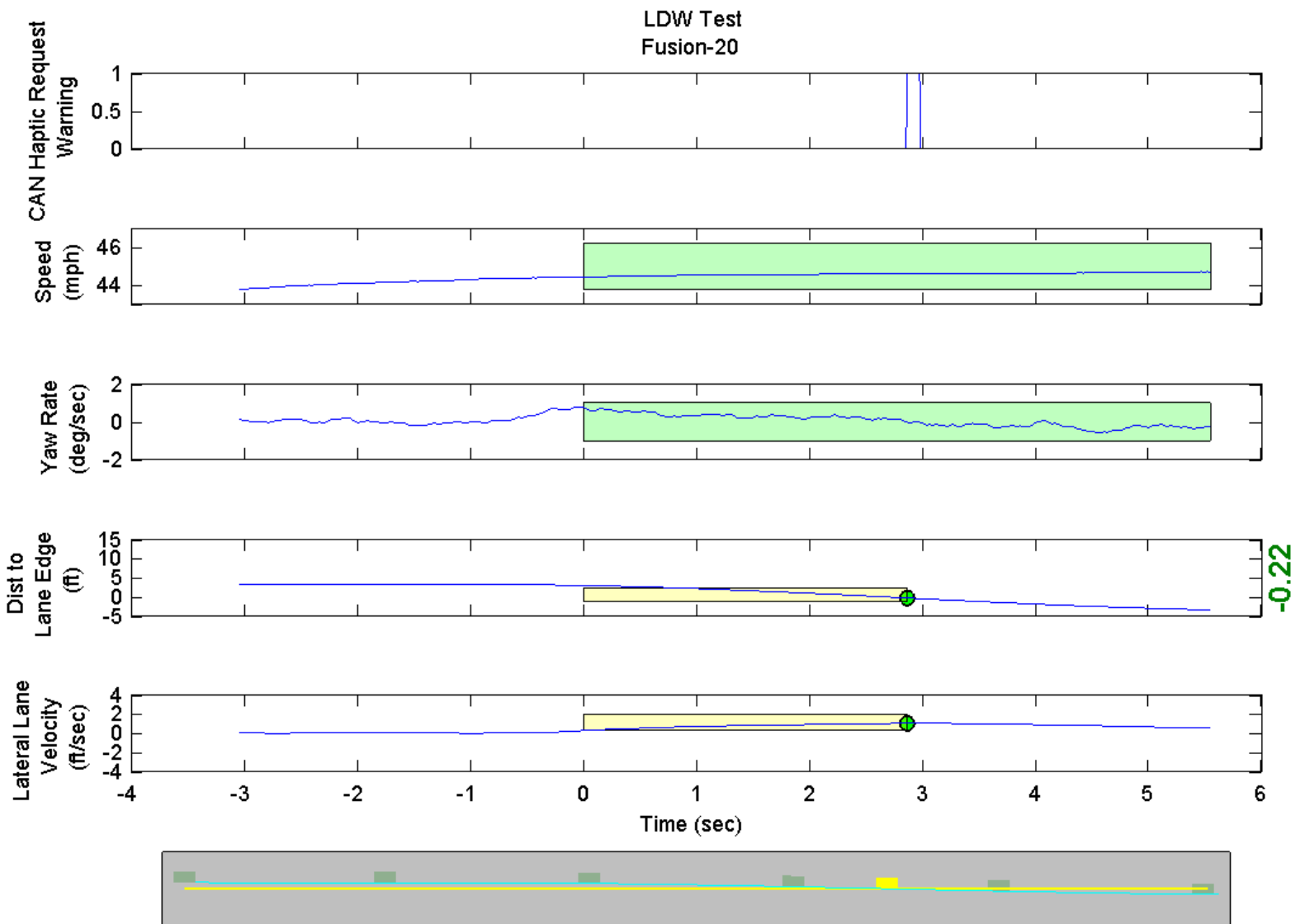
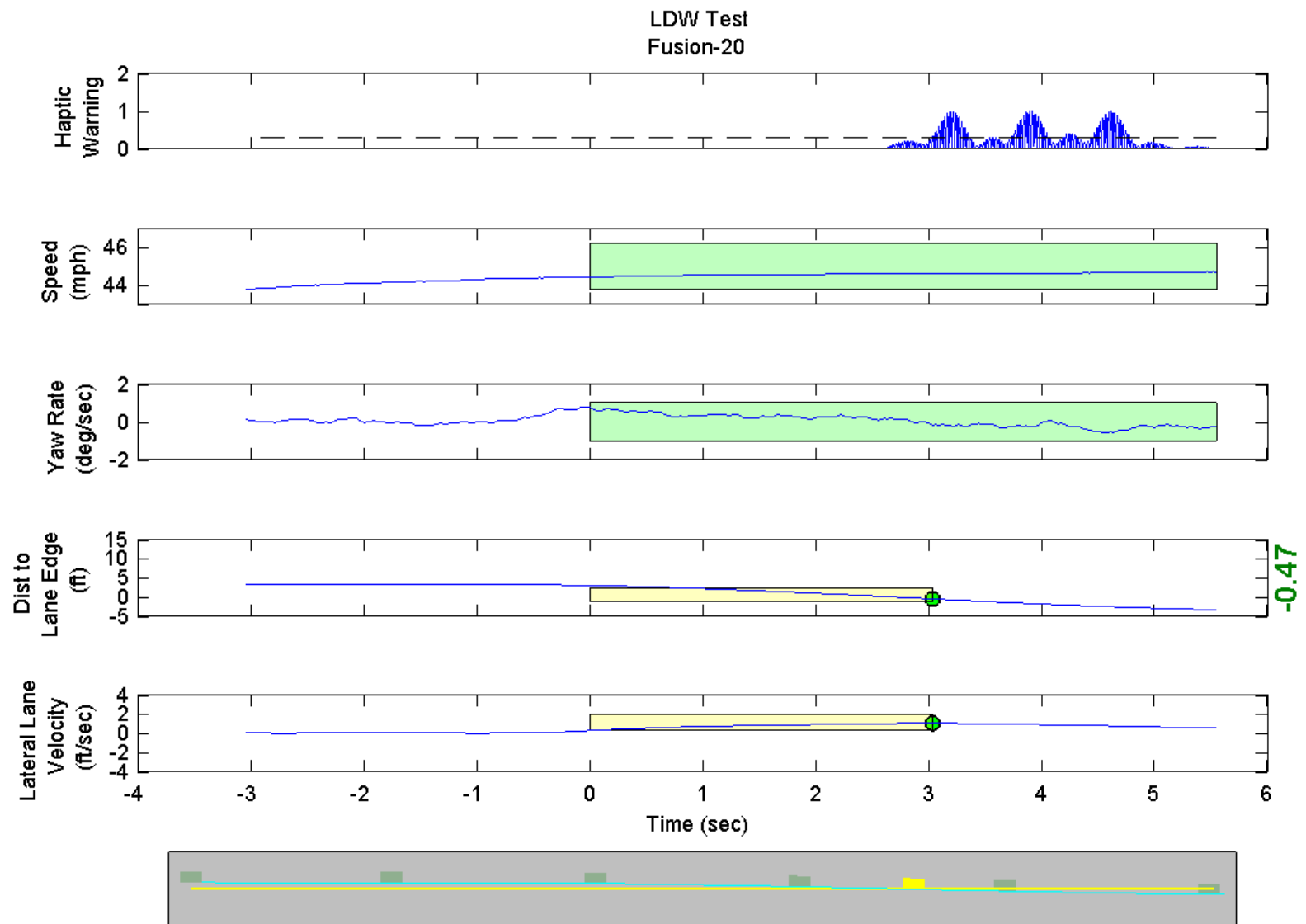
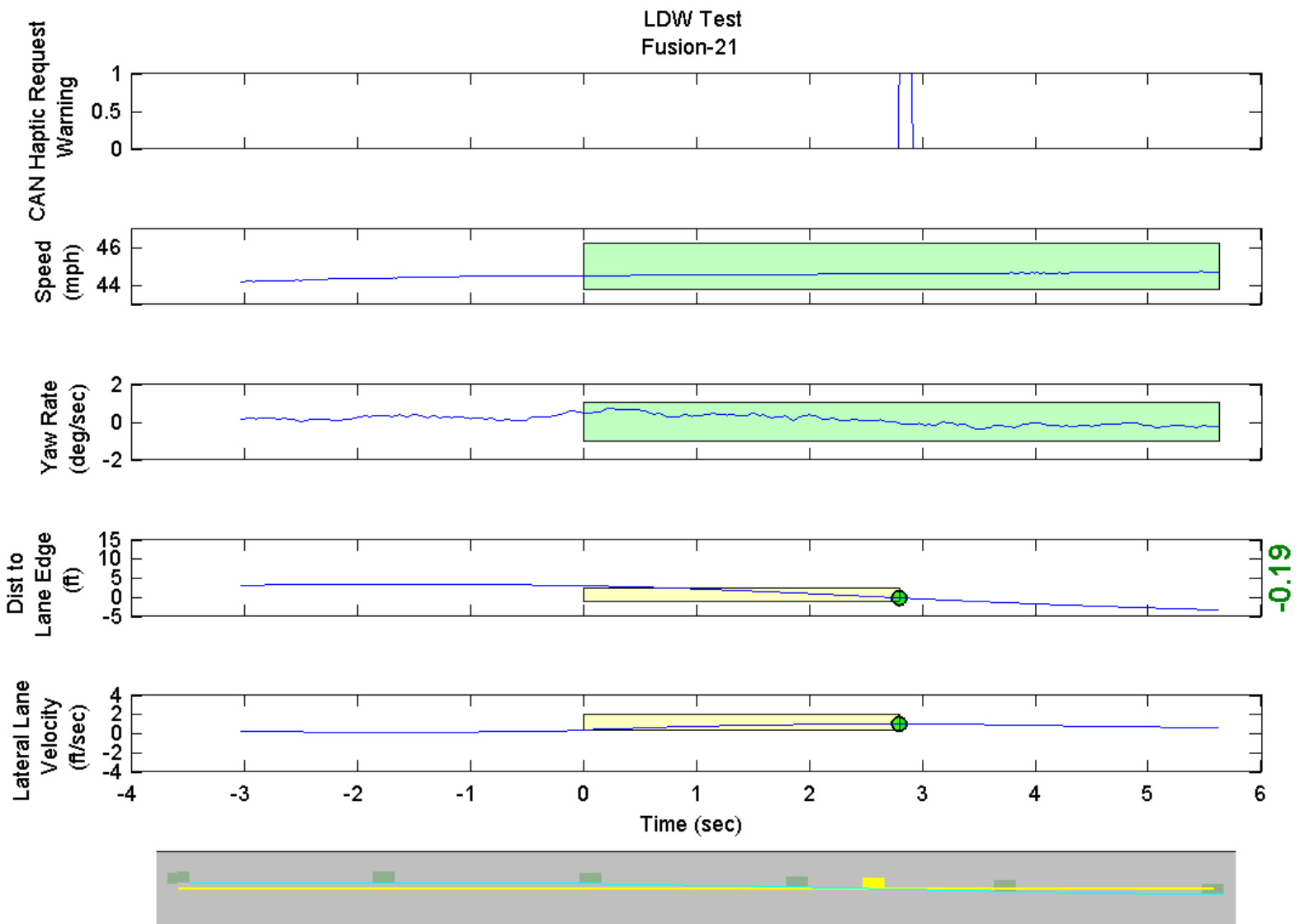


Figure D34. Time History for Run 20, Dashed Line, Right Departure, CAN Haptic Warning Request



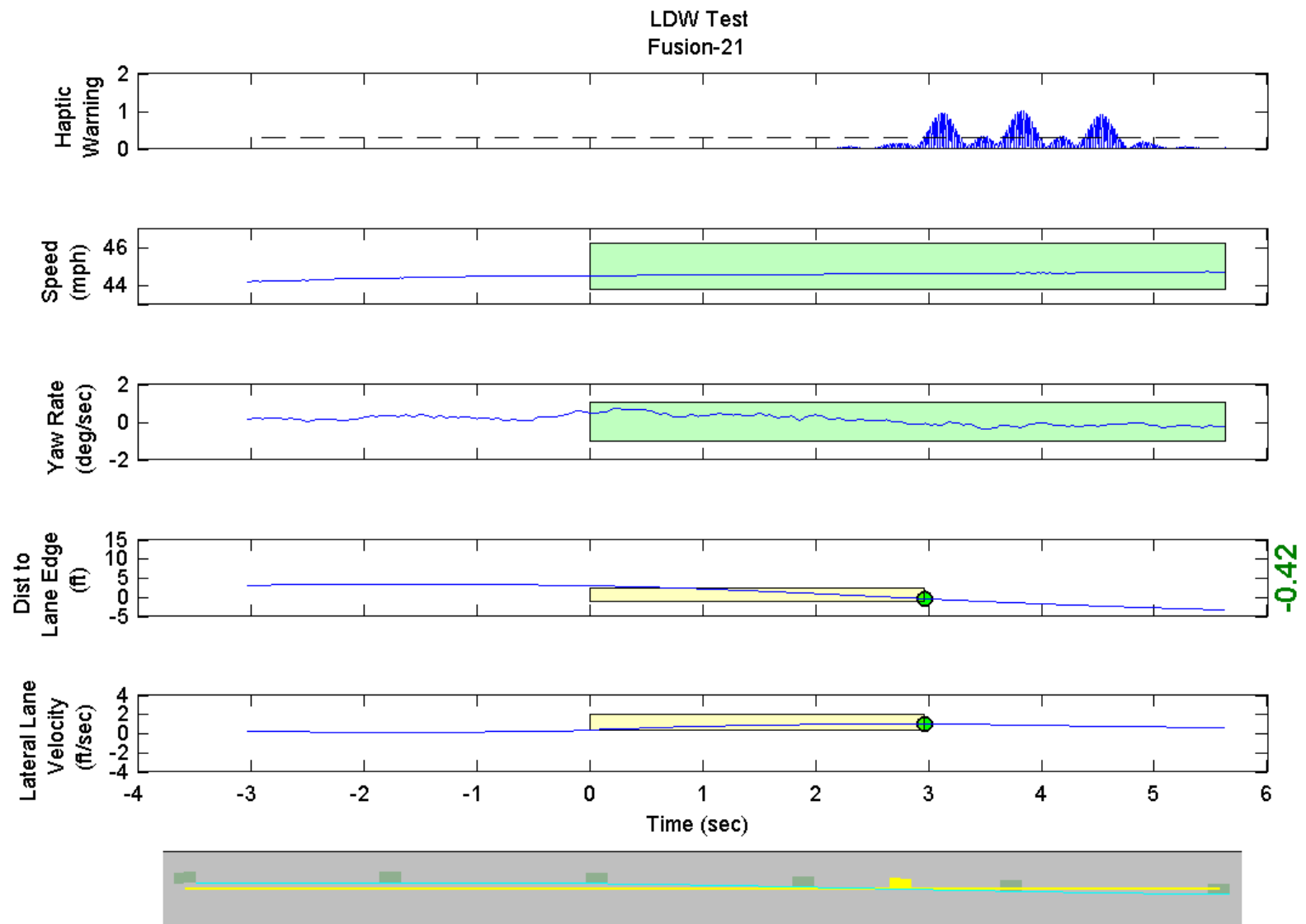
GPS Fix Type: RTK Fixed

Figure D35. Time History for Run 20, Dashed Line, Right Departure, Haptic Warning



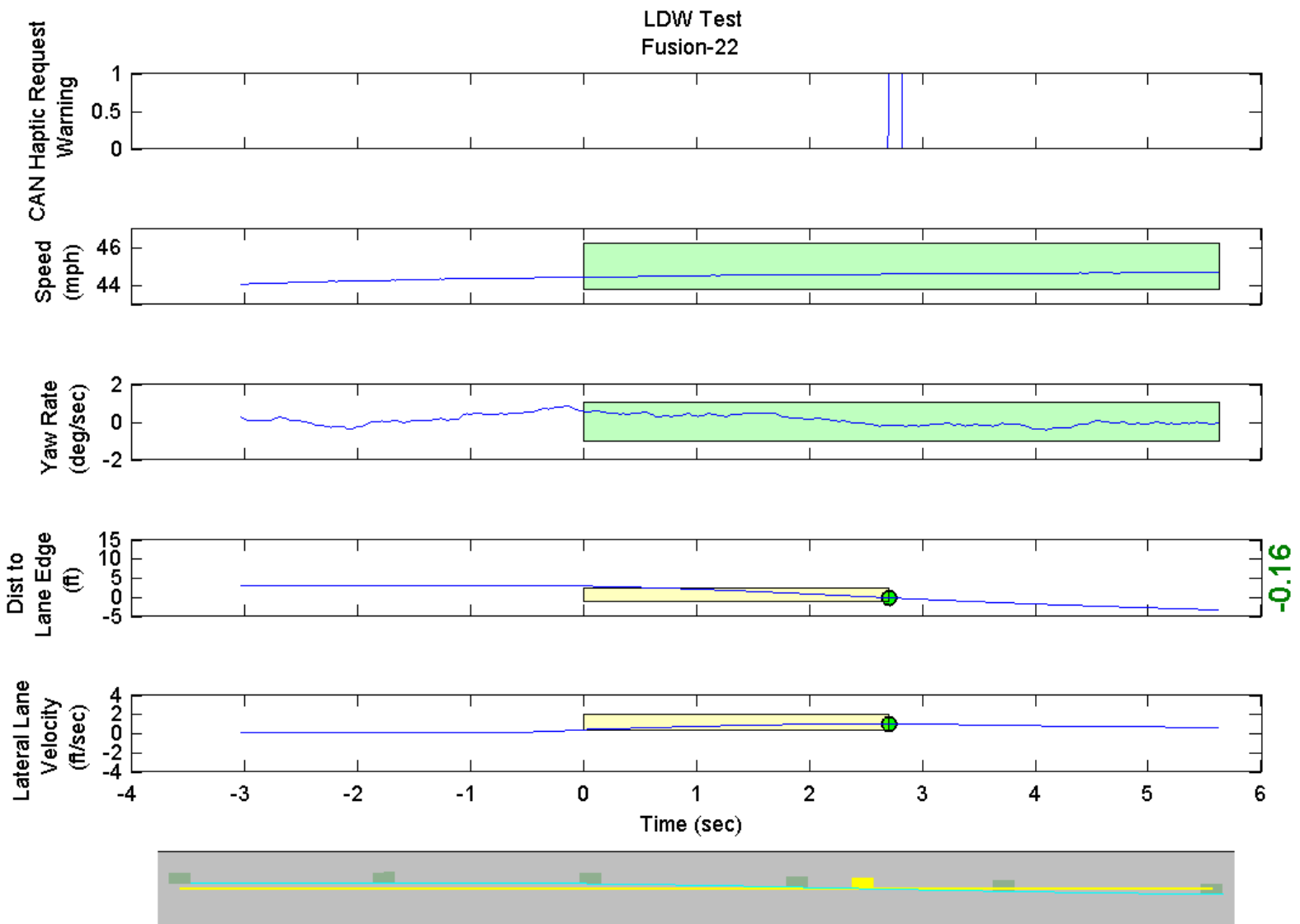
GPS Fix Type: RTK Fixed

Figure D36. Time History for Run 21, Dashed Line, Right Departure, CAN Haptic Warning Request



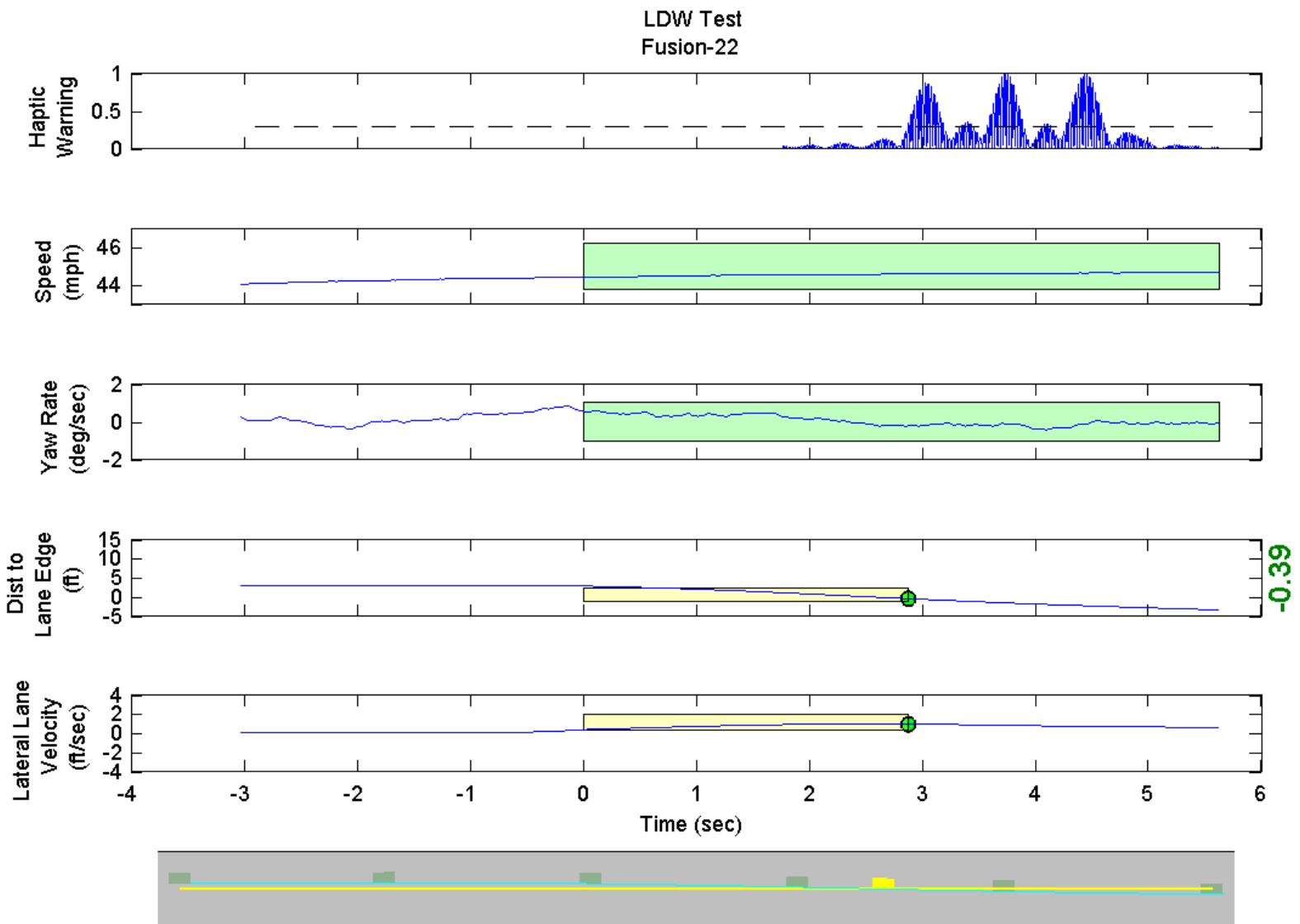
GPS Fix Type: RTK Fixed

Figure D37. Time History for Run 21, Dashed Line, Right Departure, Haptic Warning



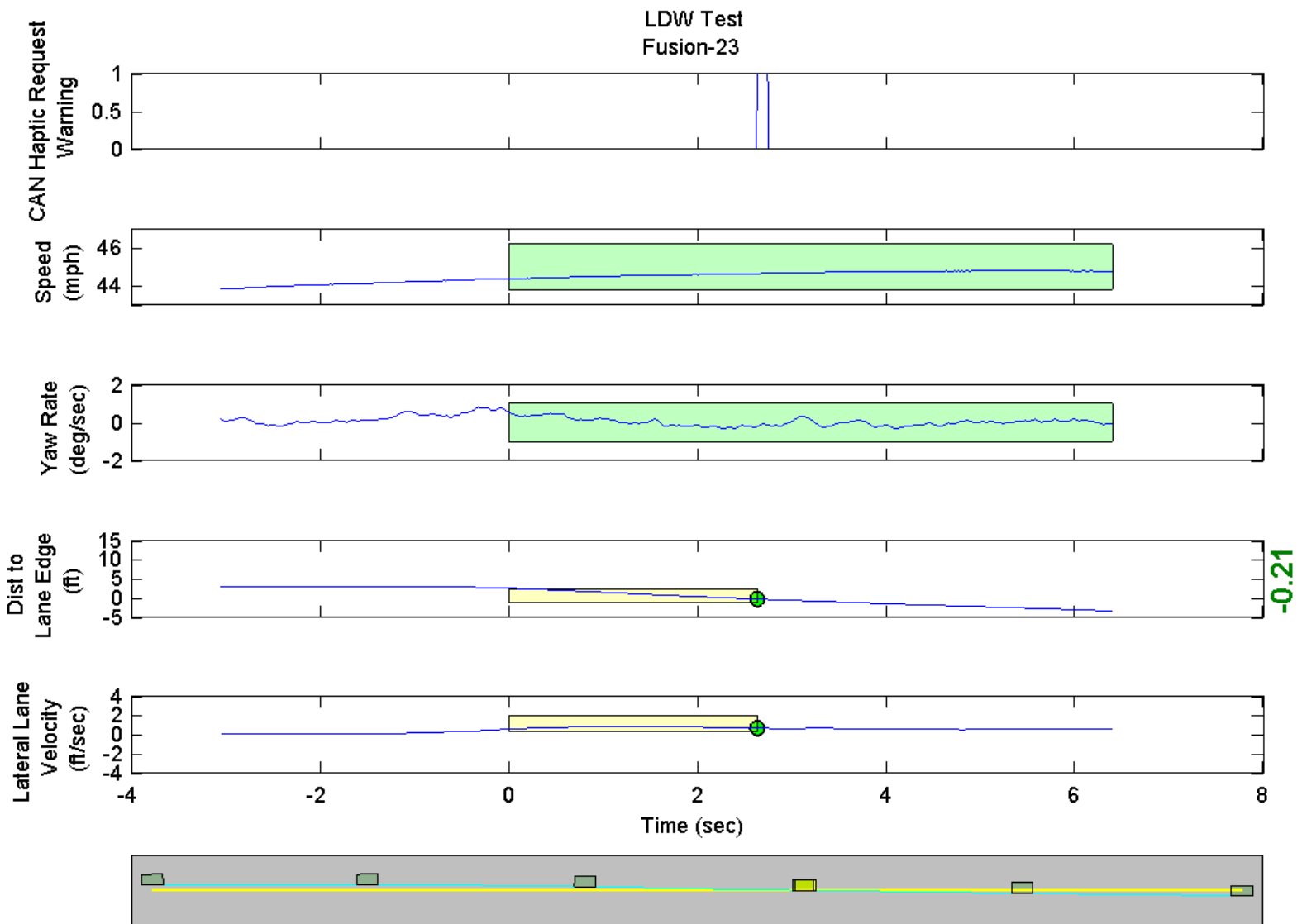
GPS Fix Type: RTK Fixed

Figure D38. Time History for Run 22, Dashed Line, Right Departure, CAN Haptic Warning Request



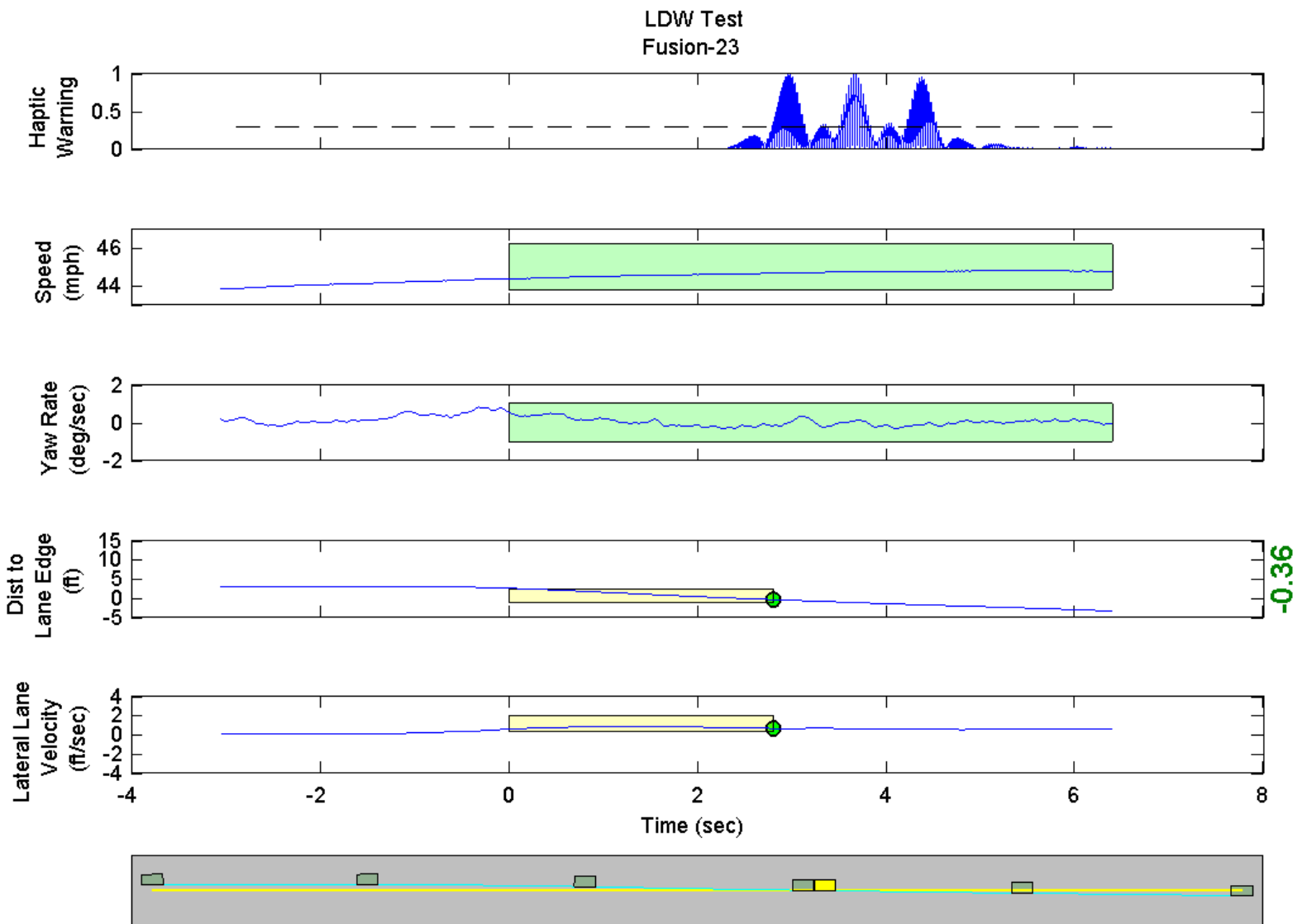
GPS Fix Type: RTK Fixed

Figure D39. Time History for Run 22, Dashed Line, Right Departure, Haptic Warning



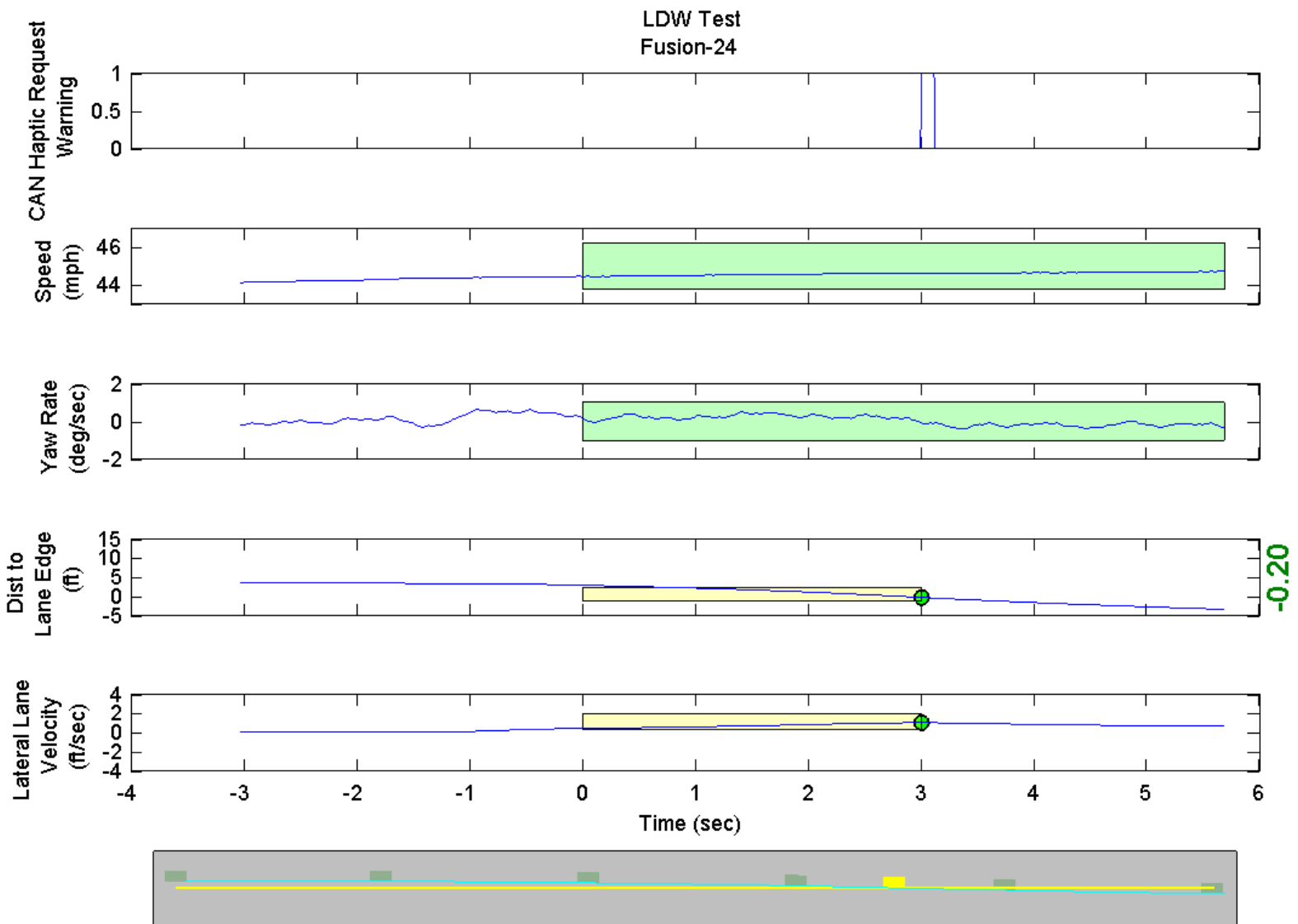
GPS Fix Type: RTK Fixed

Figure D40. Time History for Run 23, Dashed Line, Right Departure, CAN Haptic Warning Request



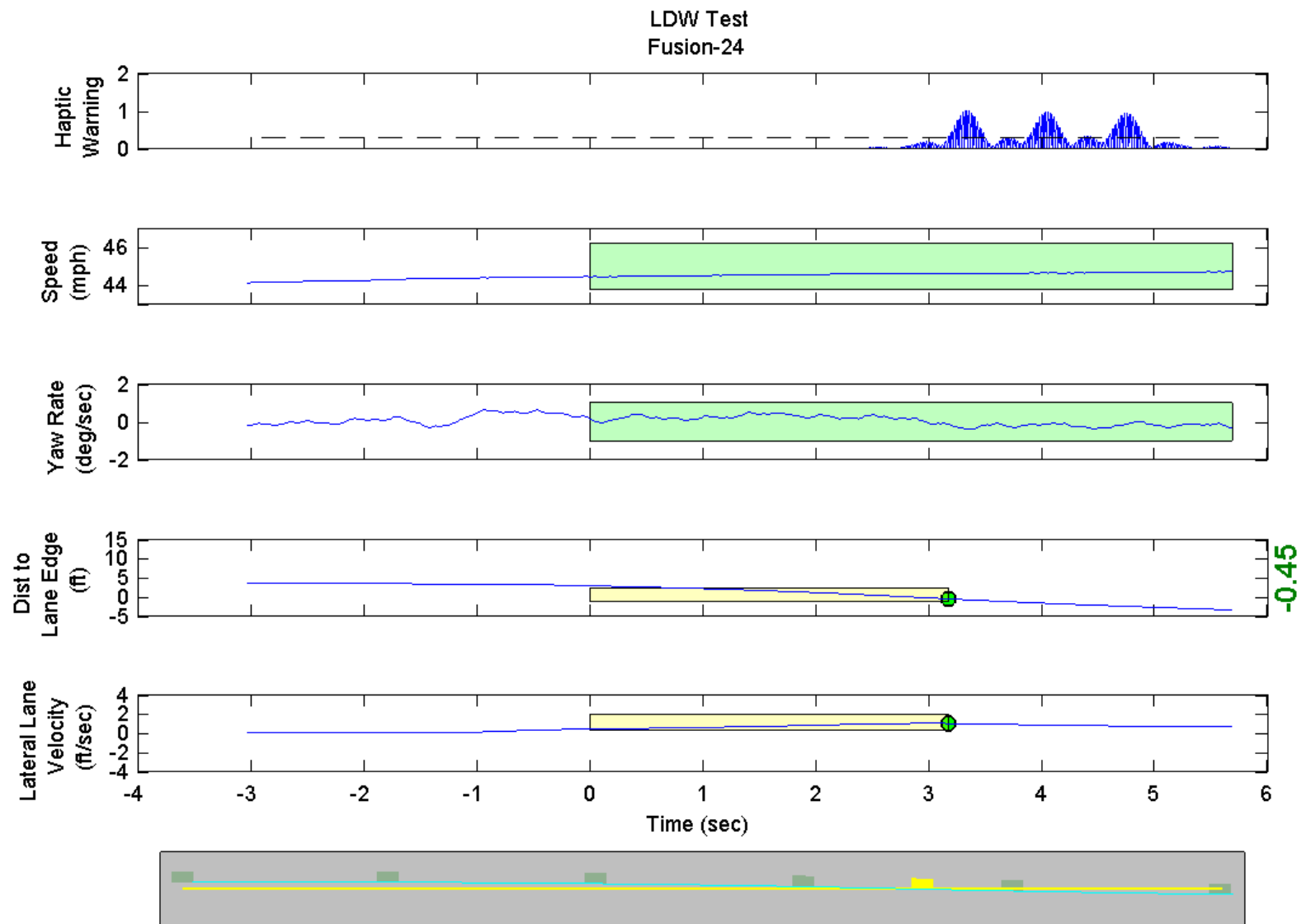
GPS Fix Type: RTK Fixed

Figure D41. Time History for Run 23, Dashed Line, Right Departure, Haptic Warning



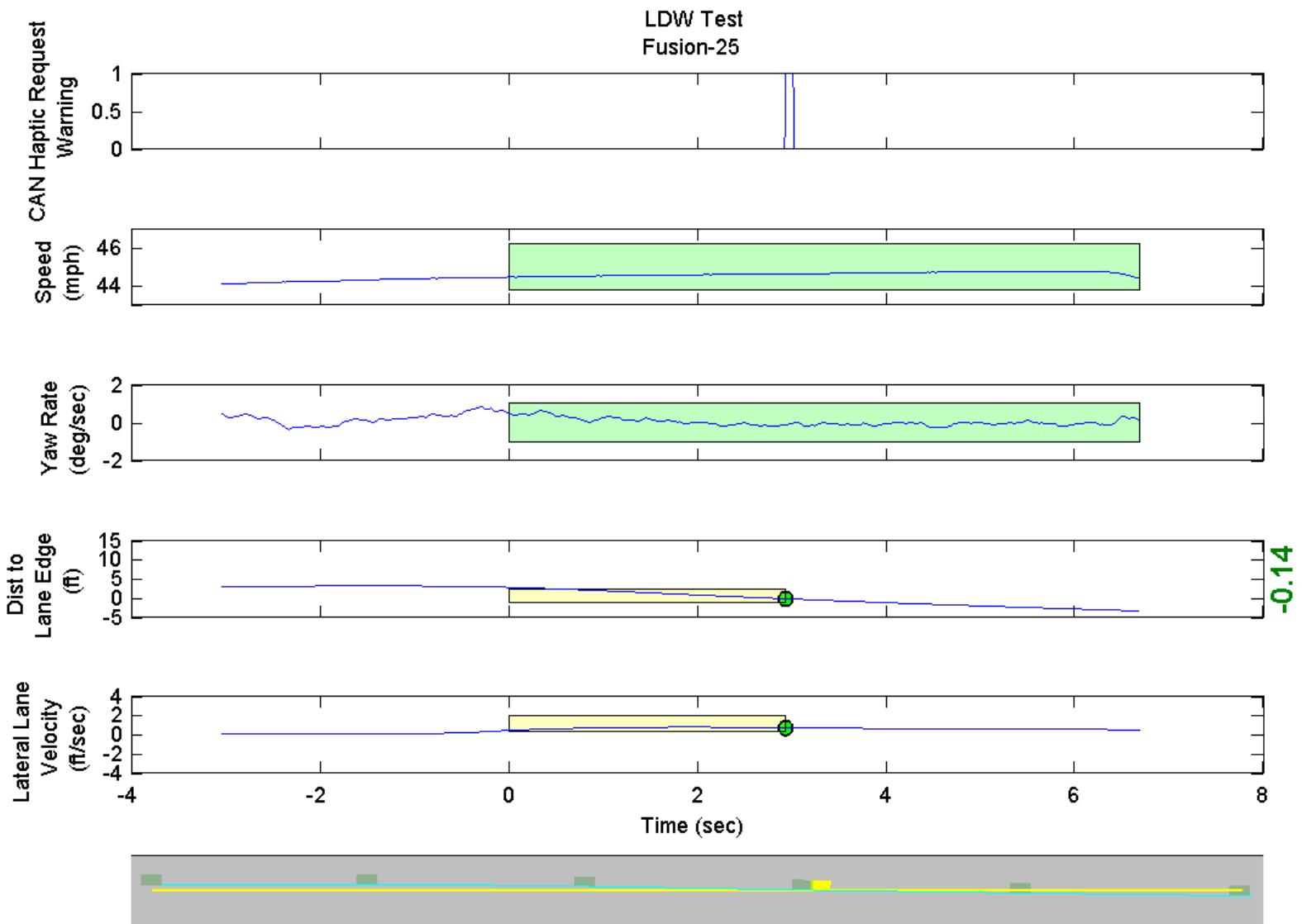
GPS Fix Type: RTK Fixed

Figure D42. Time History for Run 24, Dashed Line, Right Departure, CAN Haptic Warning Request



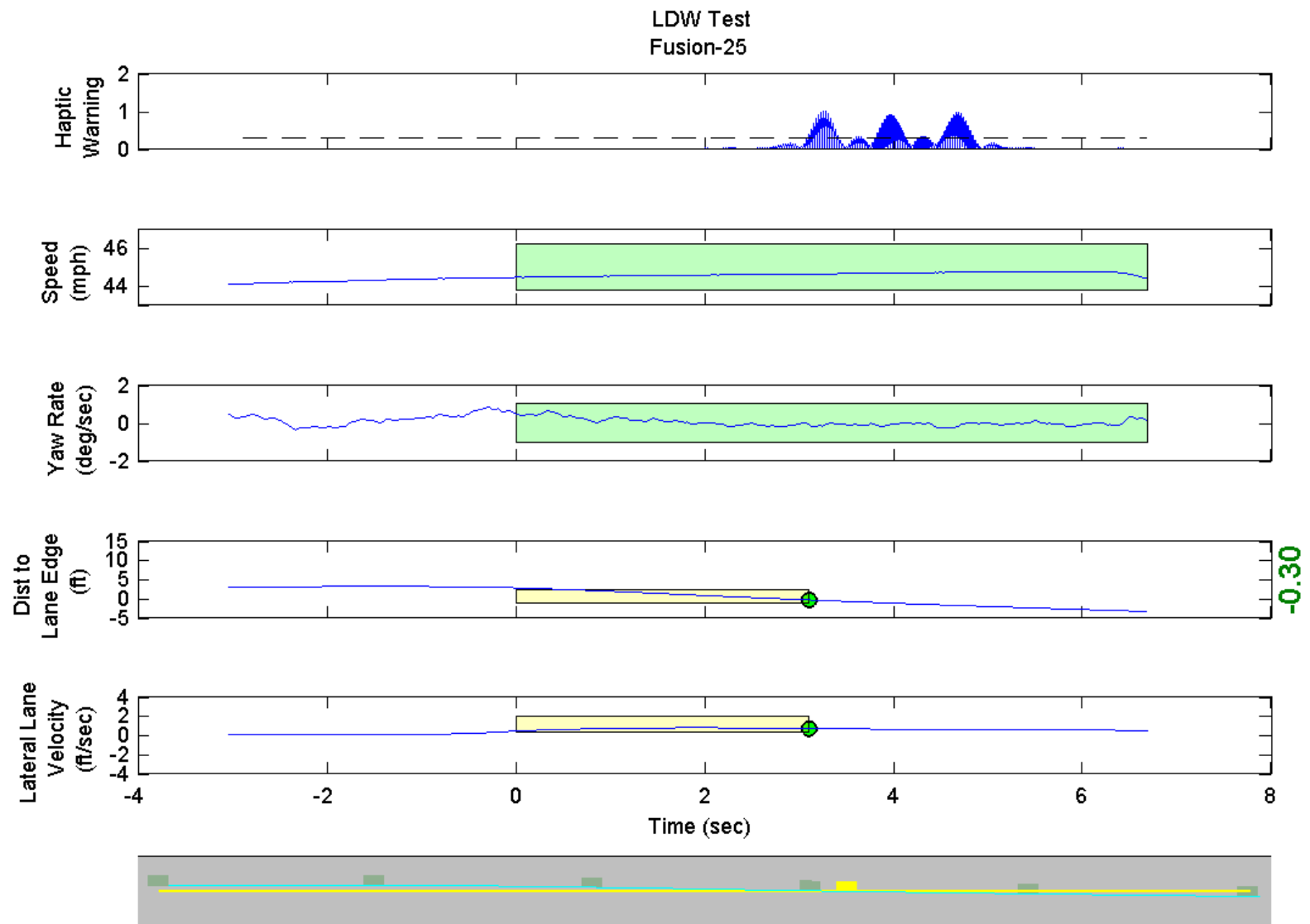
GPS Fix Type: RTK Fixed

Figure D43. Time History for Run 24, Dashed Line, Right Departure, Haptic Warning



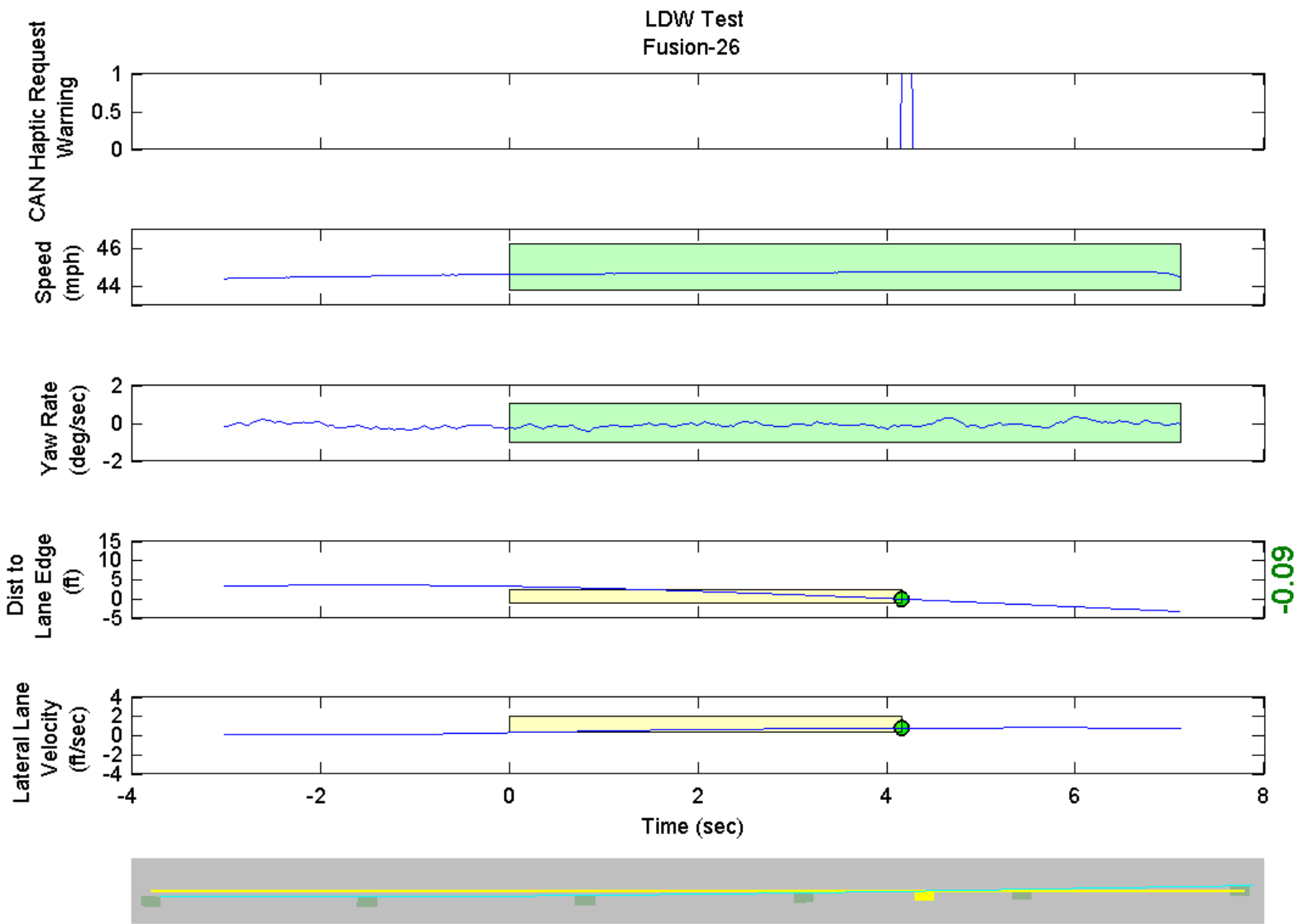
GPS Fix Type: RTK Fixed

Figure D44. Time History for Run 25, Dashed Line, Right Departure, CAN Haptic Warning Request



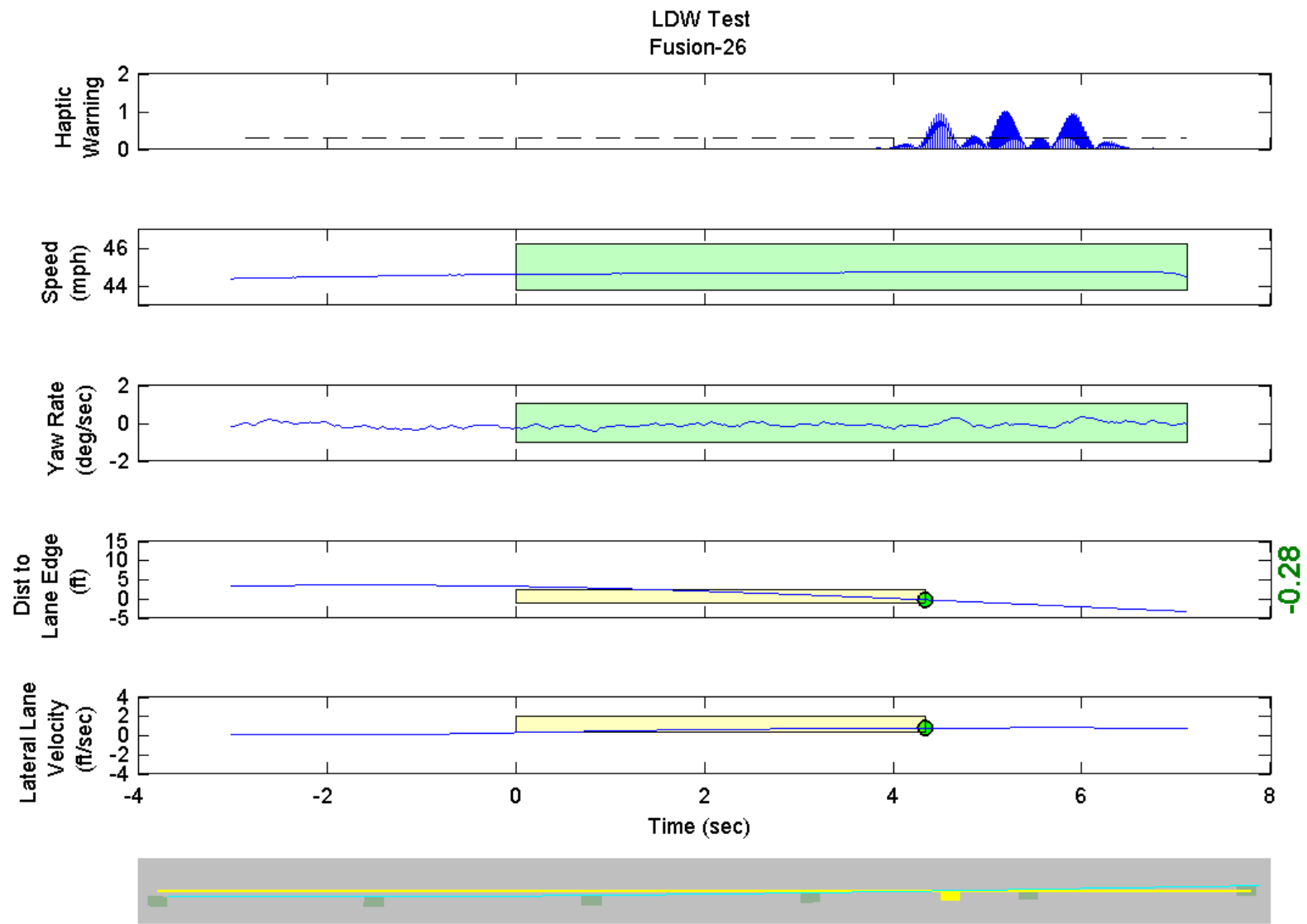
GPS Fix Type: RTK Fixed

Figure D45. Time History for Run 25, Dashed Line, Right Departure, Haptic Warning



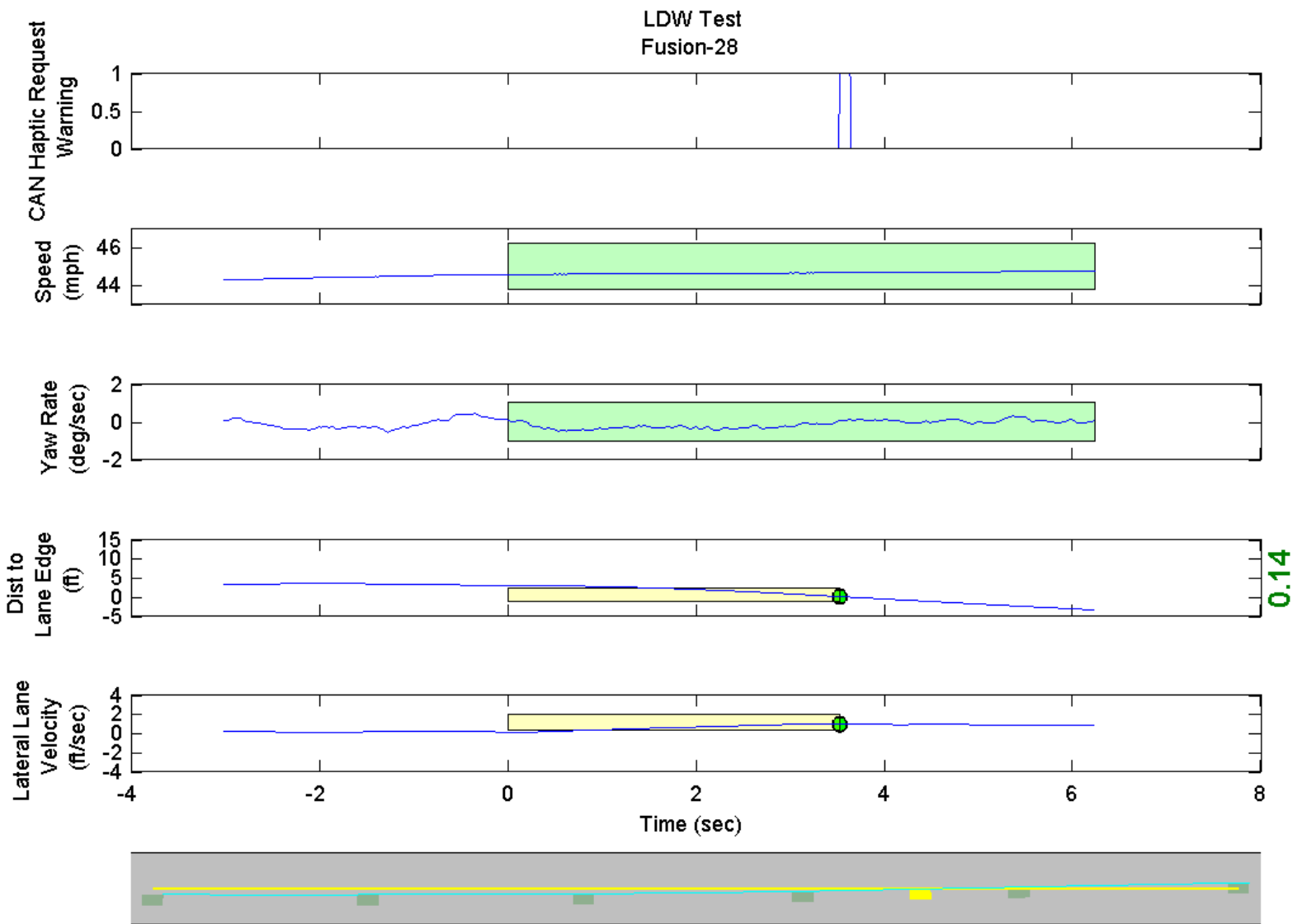
GPS Fix Type: RTK Fixed

Figure D46. Time History for Run 26, Dashed Line, Left Departure, CAN Haptic Warning Request



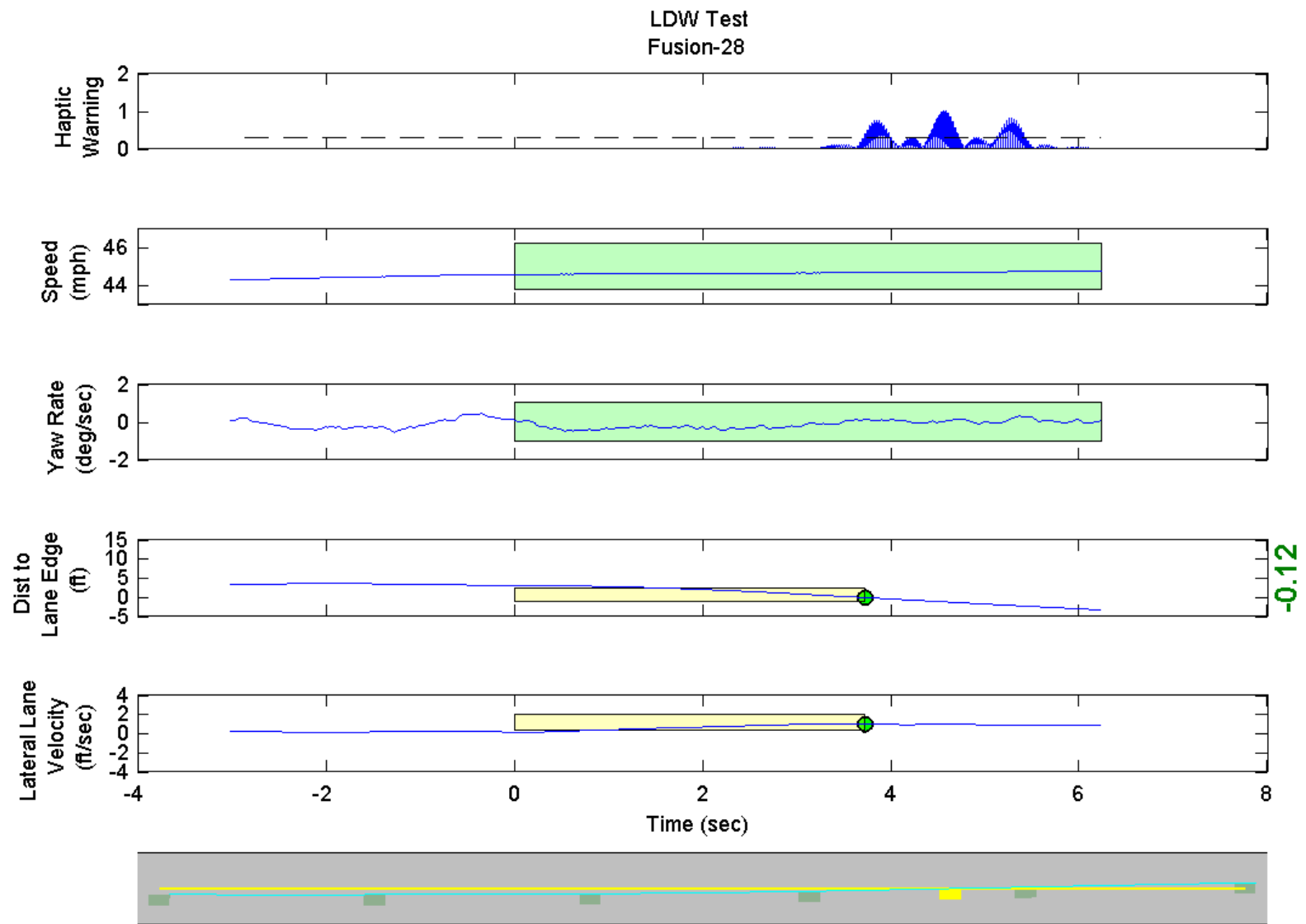
GPS Fix Type: RTK Fixed

Figure D47. Time History for Run 26, Dashed Line, Left Departure, Haptic Warning



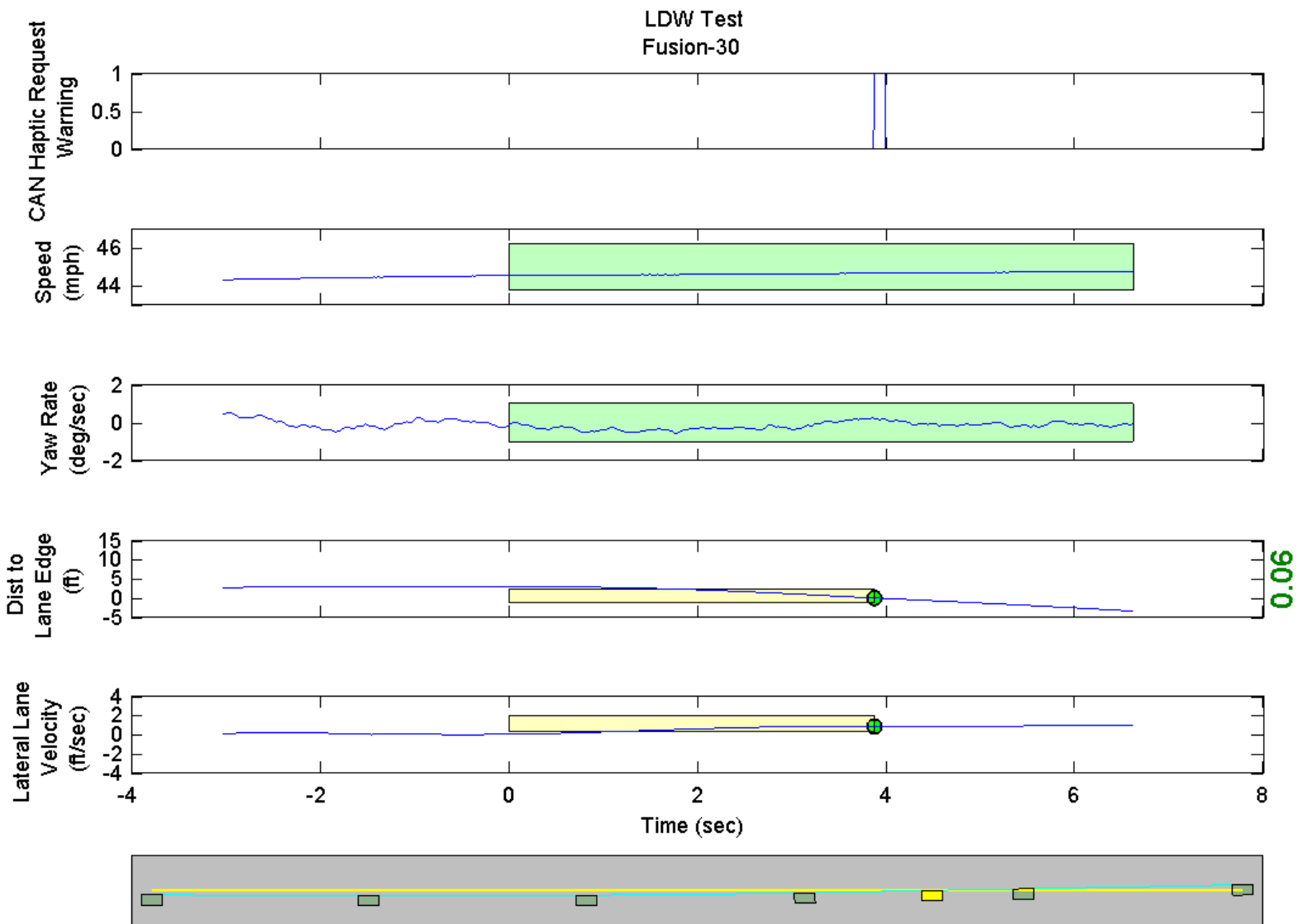
GPS Fix Type: RTK Fixed

Figure D48. Time History for Run 28, Dashed Line, Left Departure, CAN Haptic Warning Request



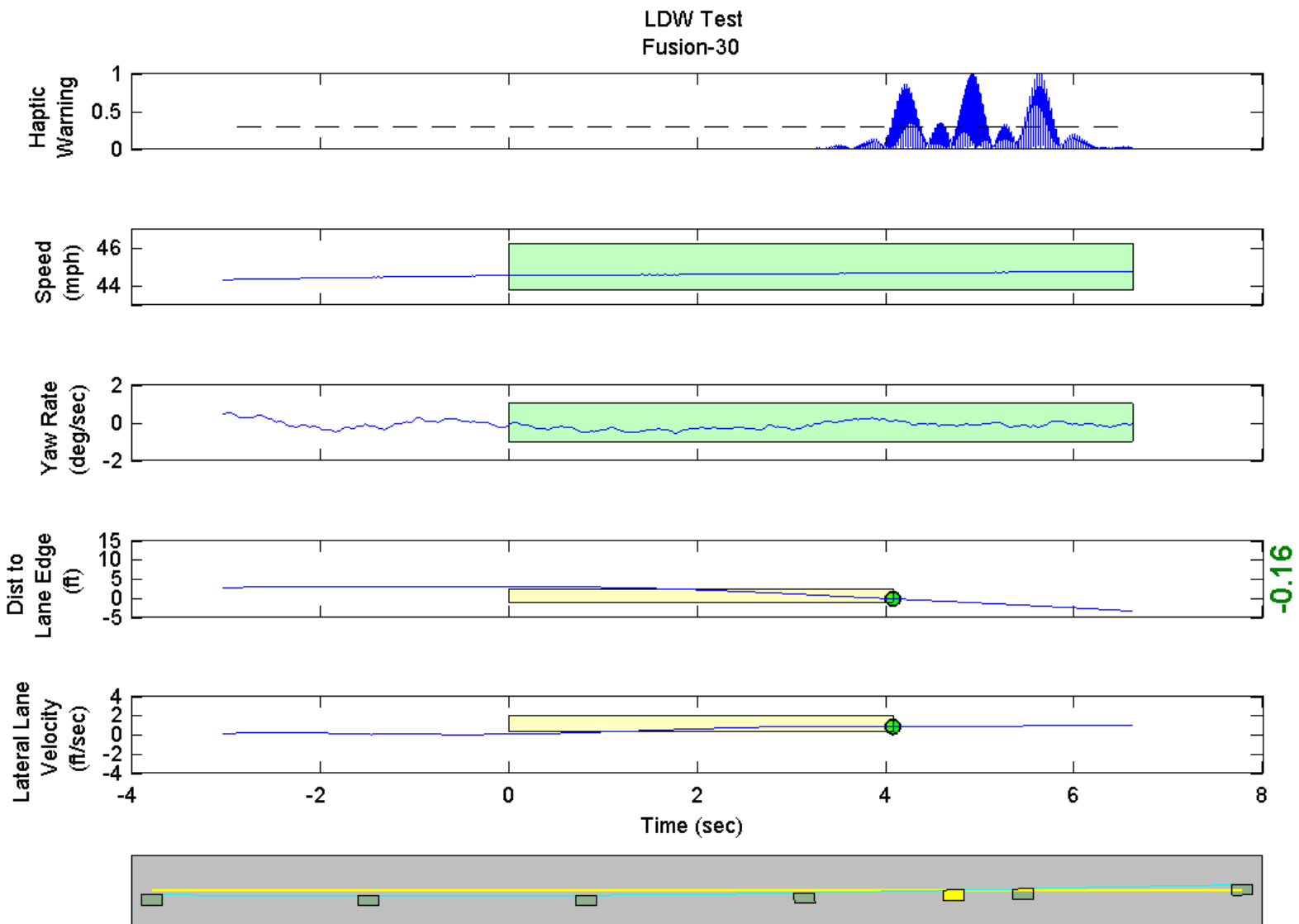
GPS Fix Type: RTK Fixed

Figure D49. Time History for Run 28, Dashed Line, Left Departure, Haptic Warning



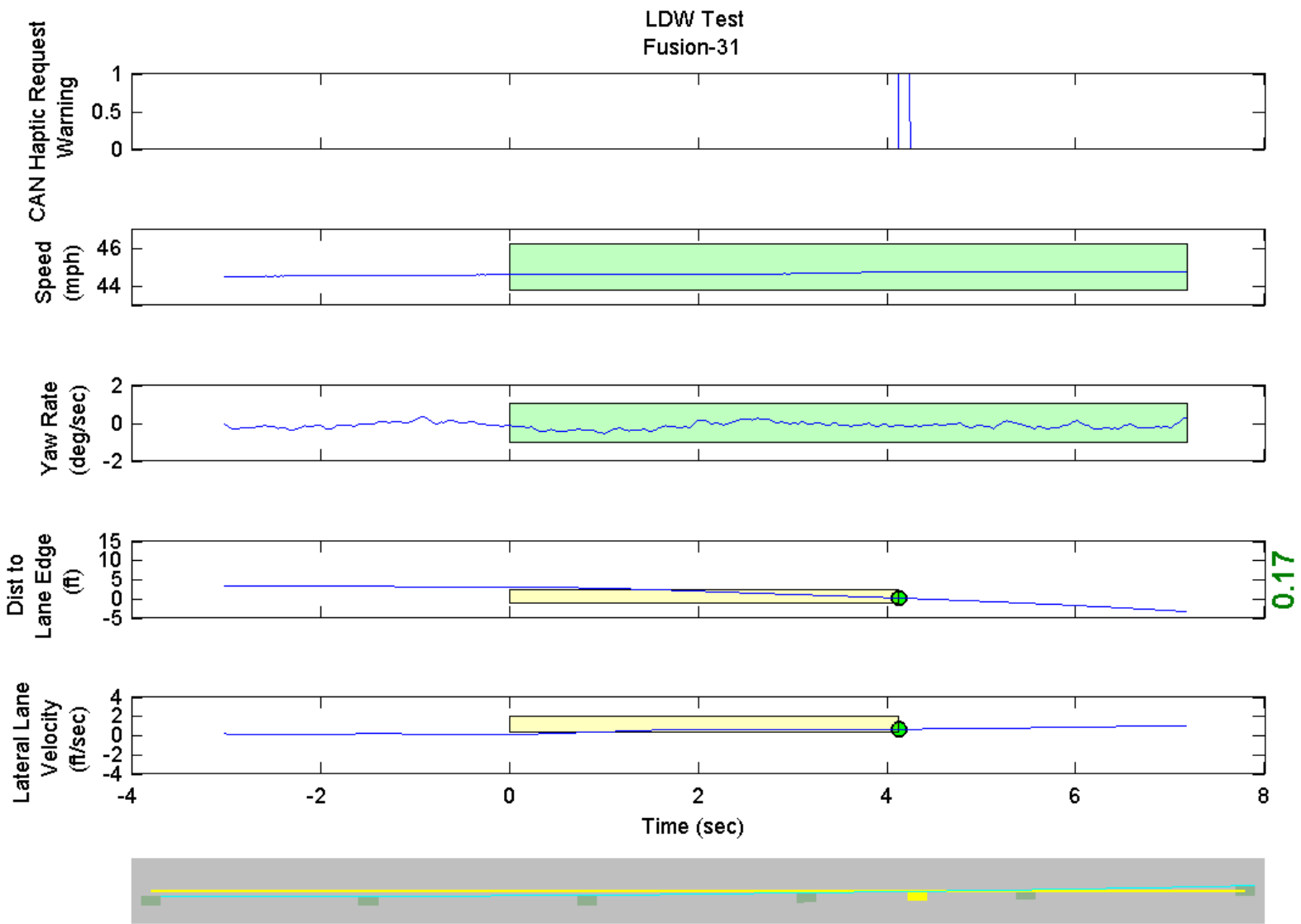
GPS Fix Type: RTK Fixed

Figure D50. Time History for Run 30, Dashed Line, Left Departure, CAN Haptic Warning Request



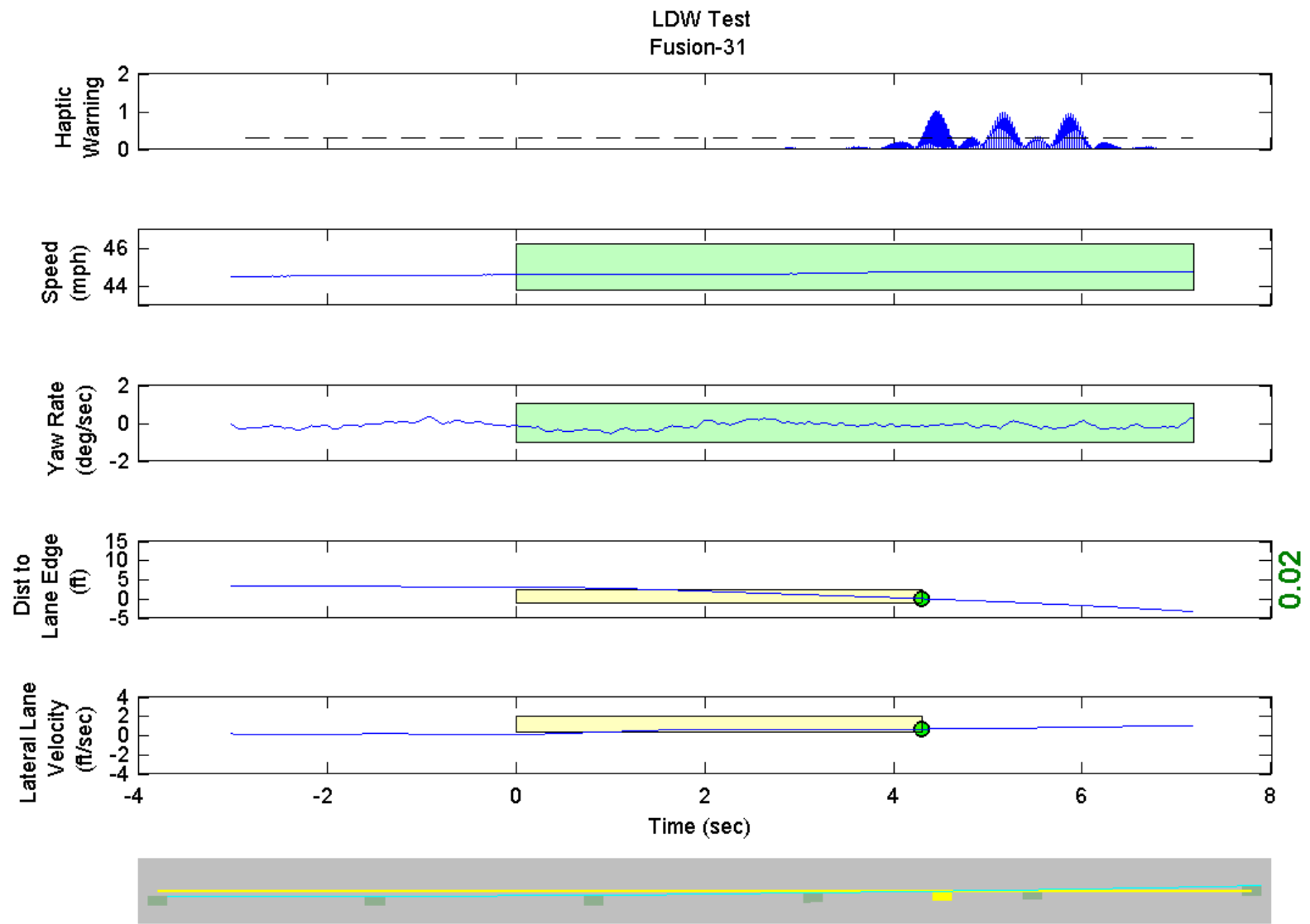
GPS Fix Type: RTK Fixed

Figure D51. Time History for Run 30, Dashed Line, Left Departure, Haptic Warning



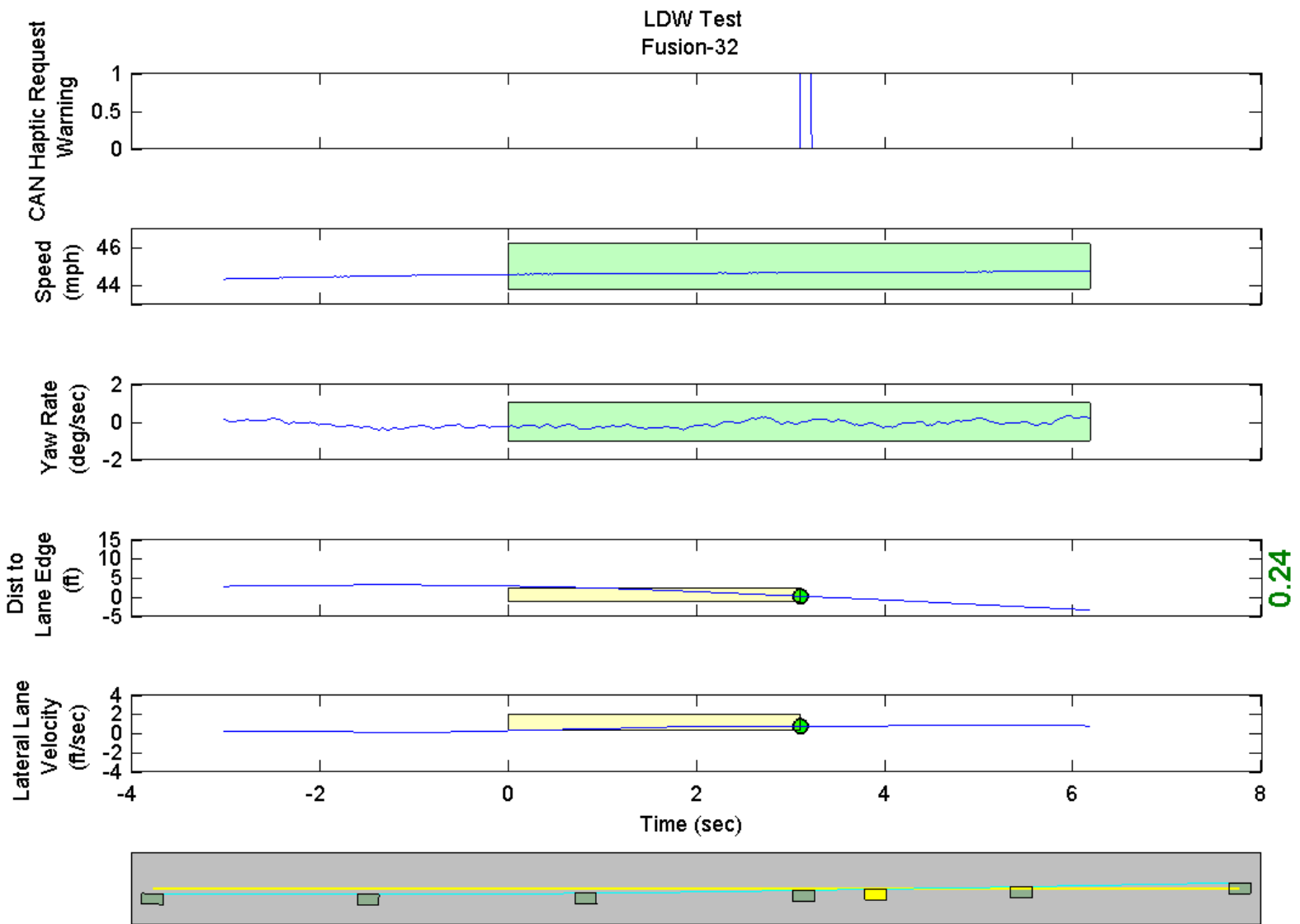
GPS Fix Type: RTK Fixed

Figure D52. Time History for Run 31, Dashed Line, Left Departure, CAN Haptic Warning Request



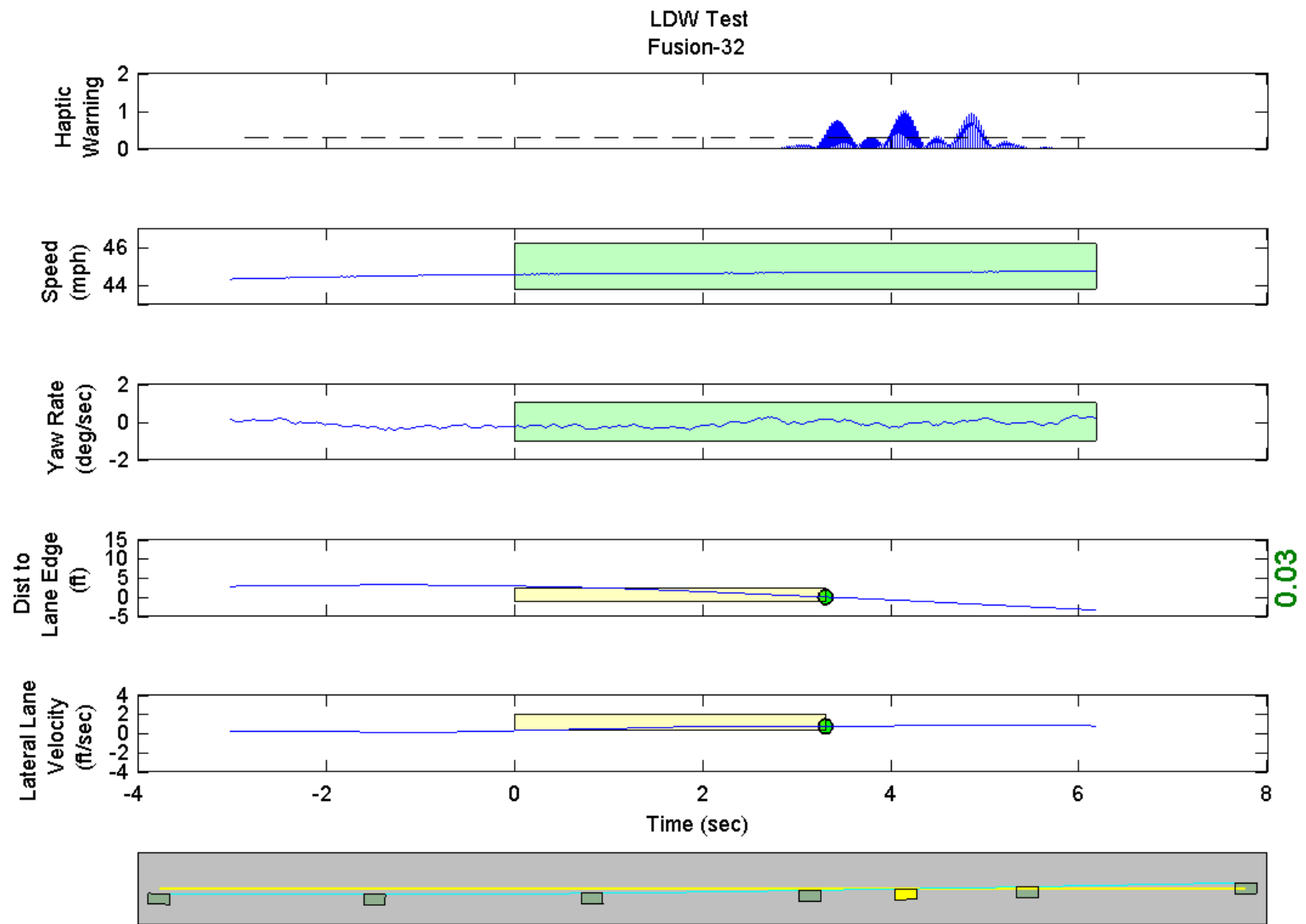
GPS Fix Type: RTK Fixed

Figure D53. Time History for Run 31, Dashed Line, Left Departure, Haptic Warning



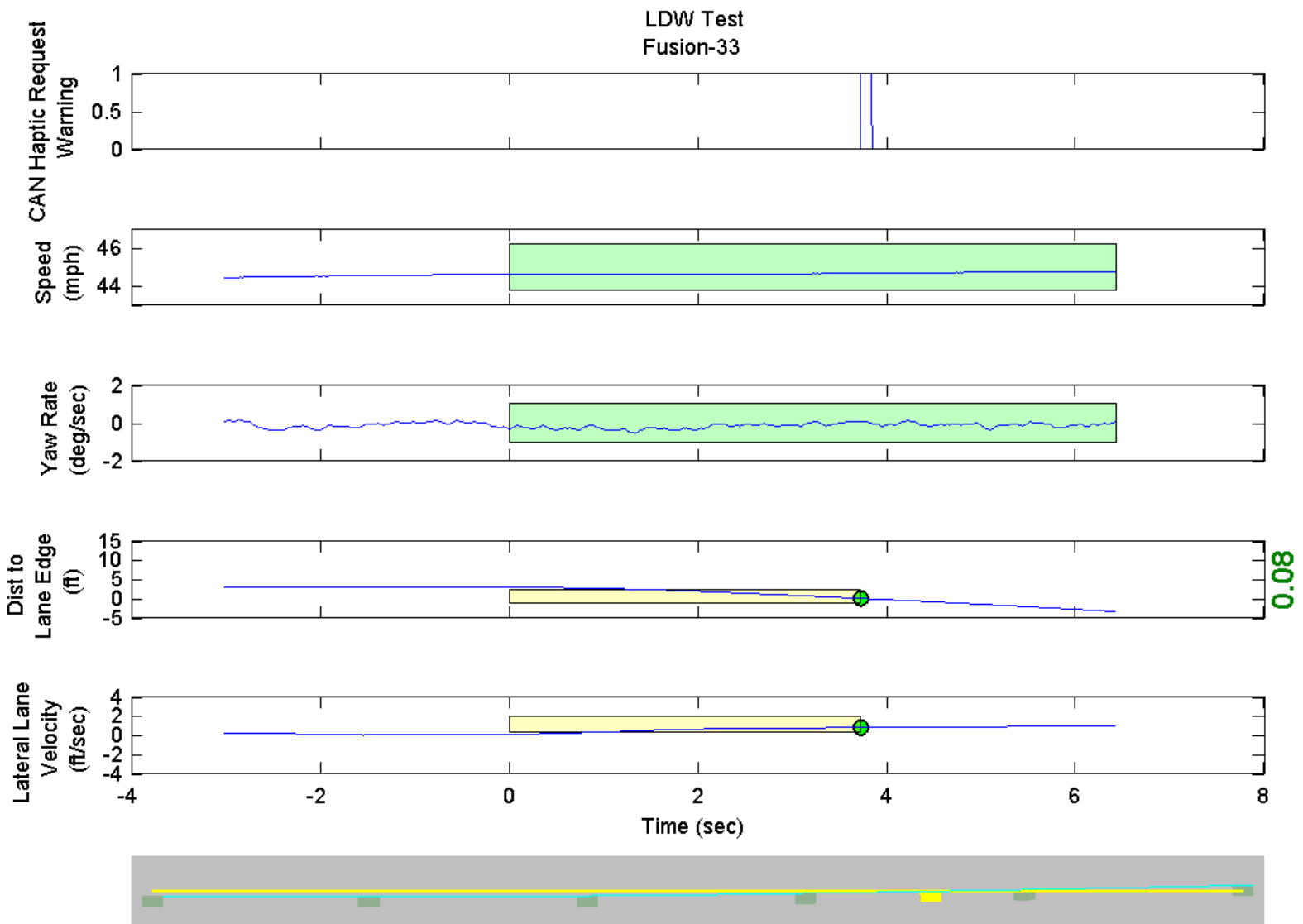
GPS Fix Type: RTK Fixed

Figure D54. Time History for Run 32, Dashed Line, Left Departure, CAN Haptic Warning Request



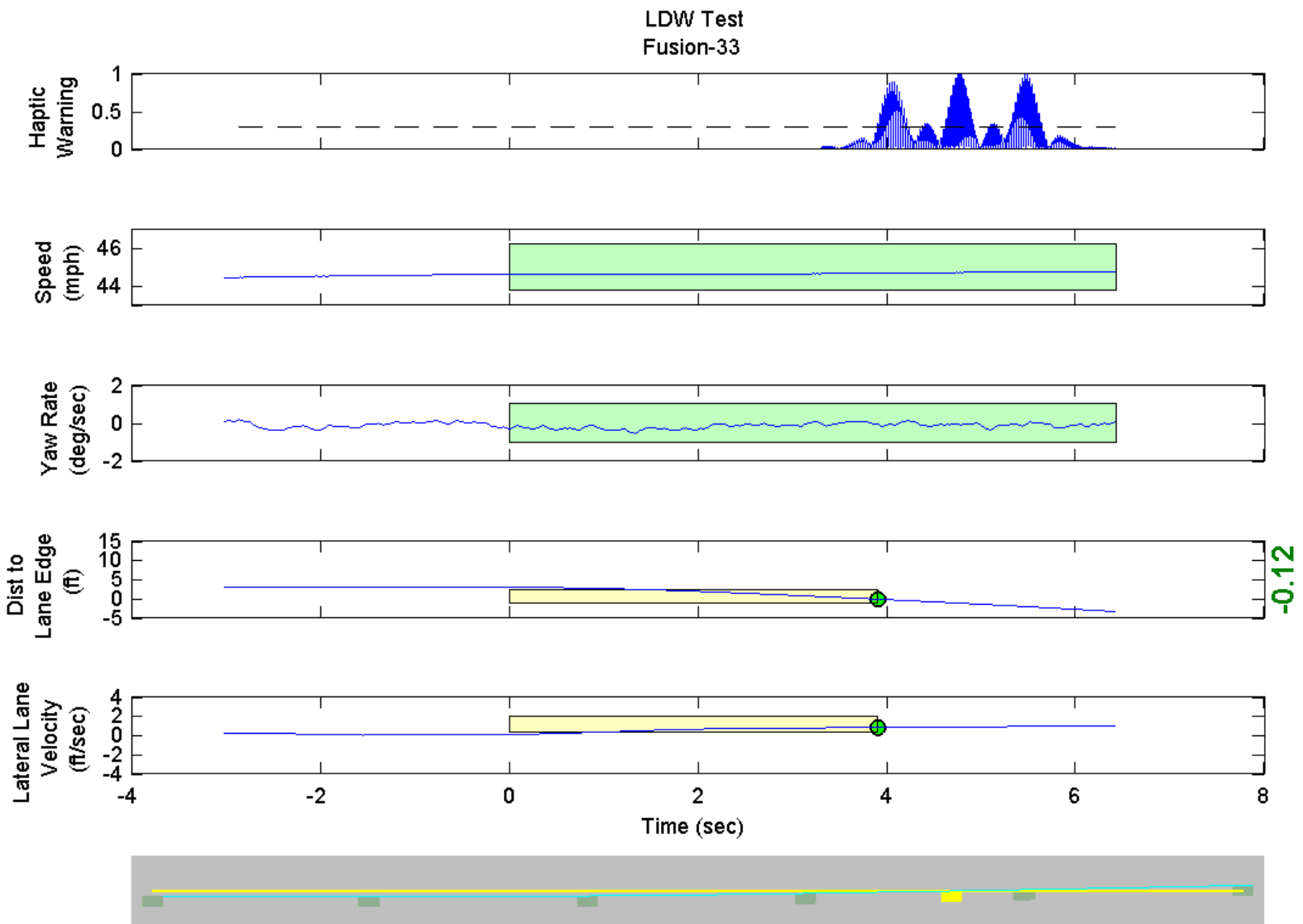
GPS Fix Type: RTK Fixed

Figure D55. Time History for Run 32, Dashed Line, Left Departure, Haptic Warning



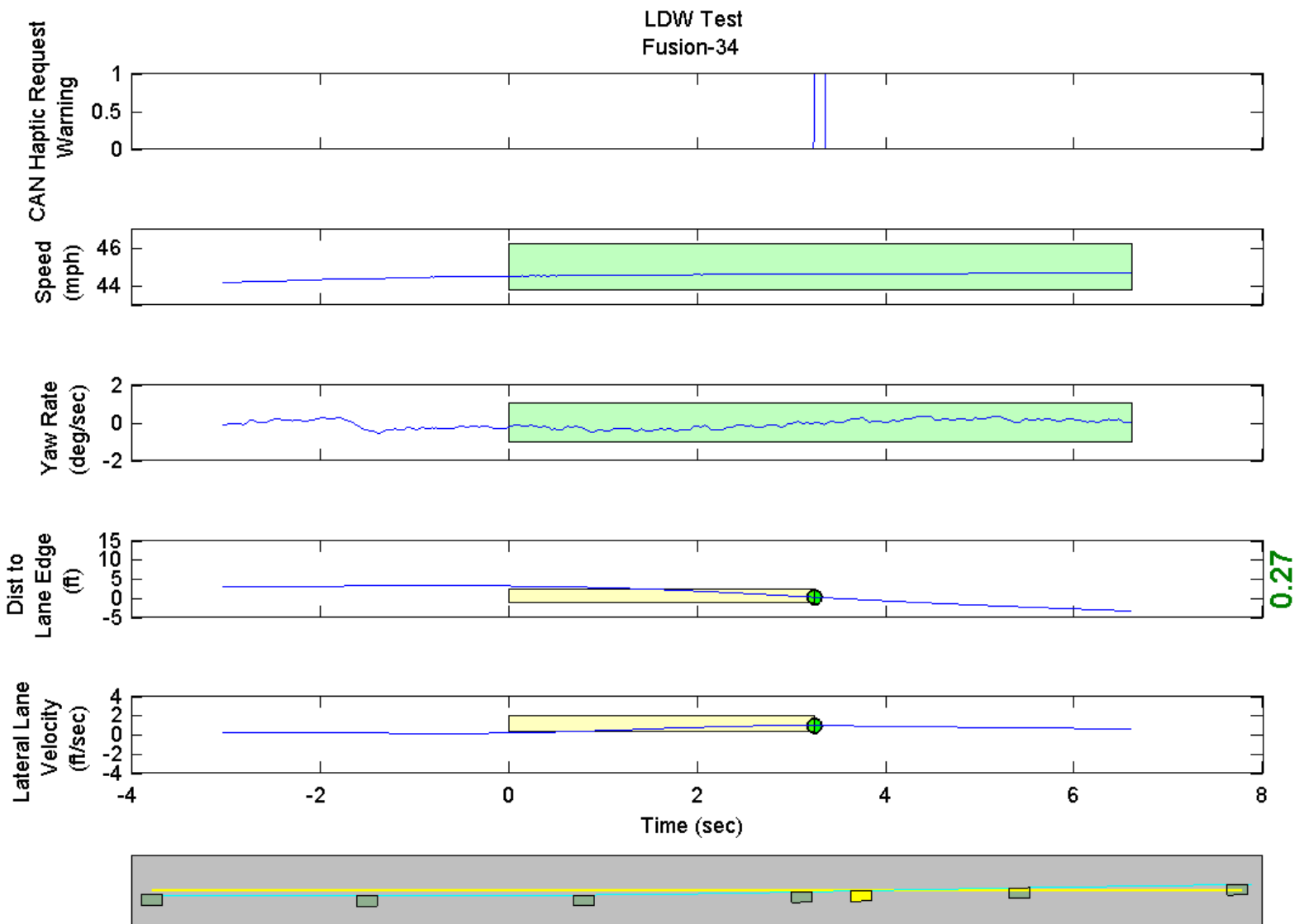
GPS Fix Type: RTK Fixed

Figure D56. Time History for Run 33, Dashed Line, Left Departure, CAN Haptic Warning Request



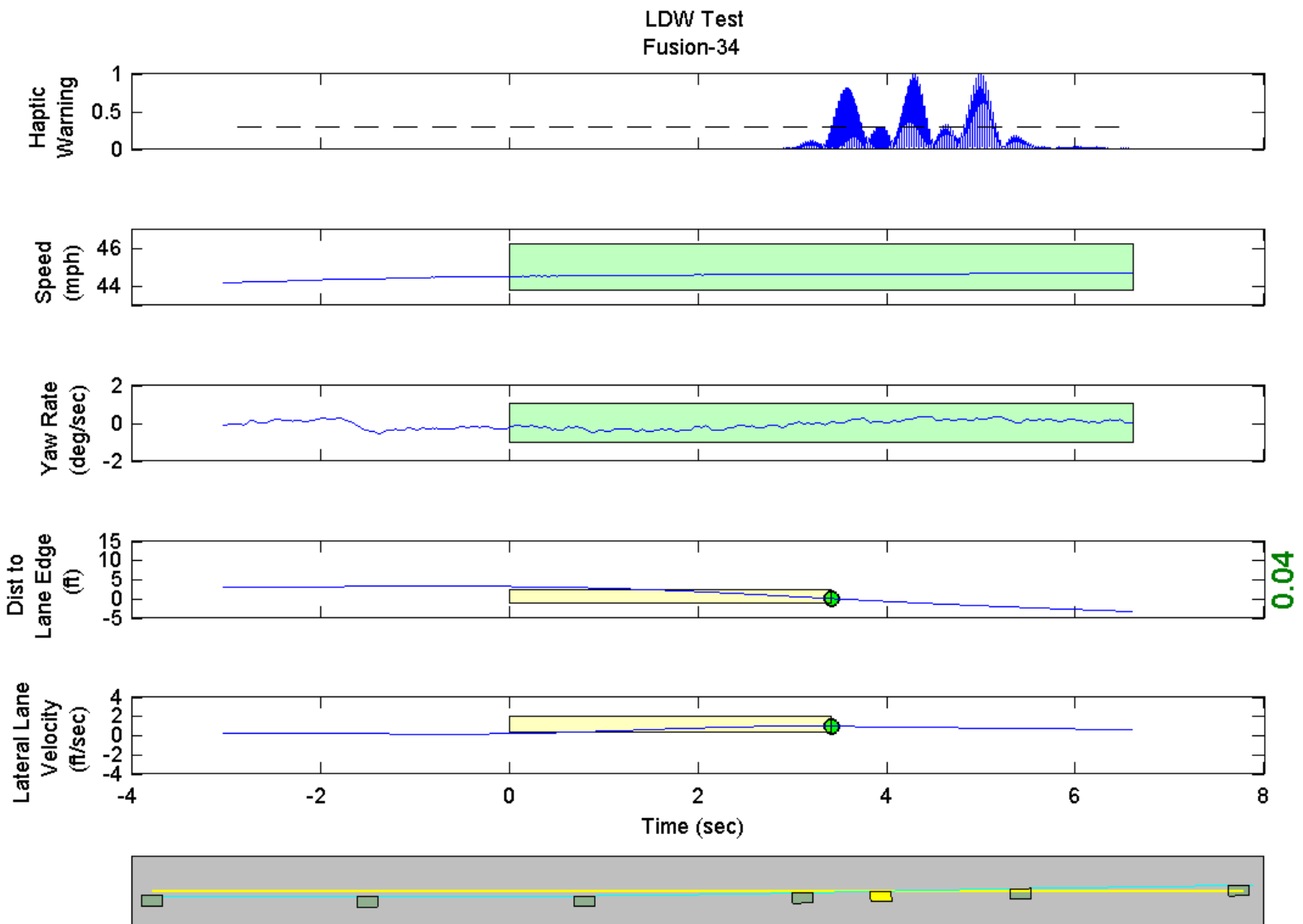
GPS Fix Type: RTK Fixed

Figure D57. Time History for Run 33, Dashed Line, Left Departure, Haptic Warning



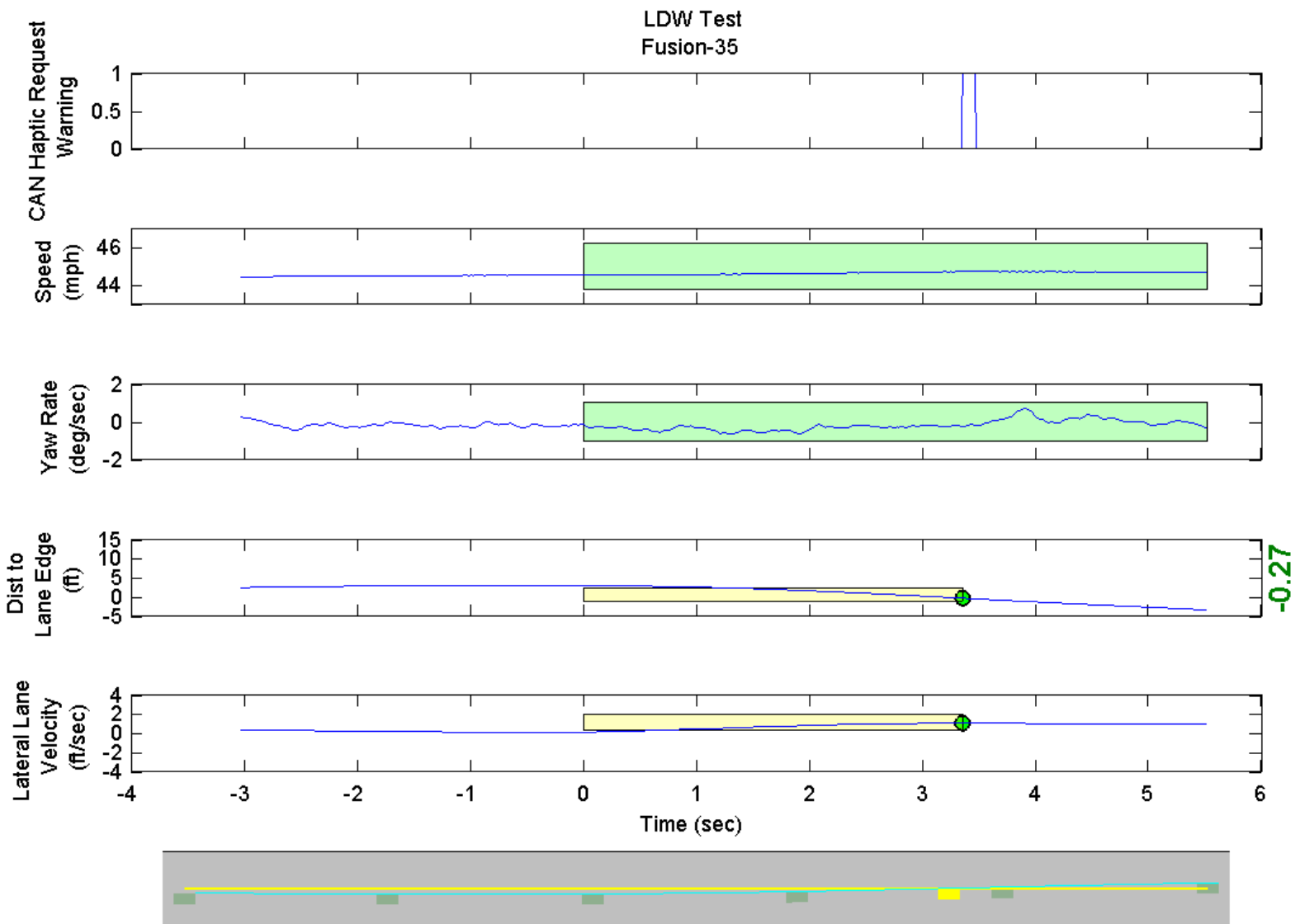
GPS Fix Type: RTK Fixed

Figure D58. Time History for Run 34, Dashed Line, Left Departure, CAN Haptic Warning Request



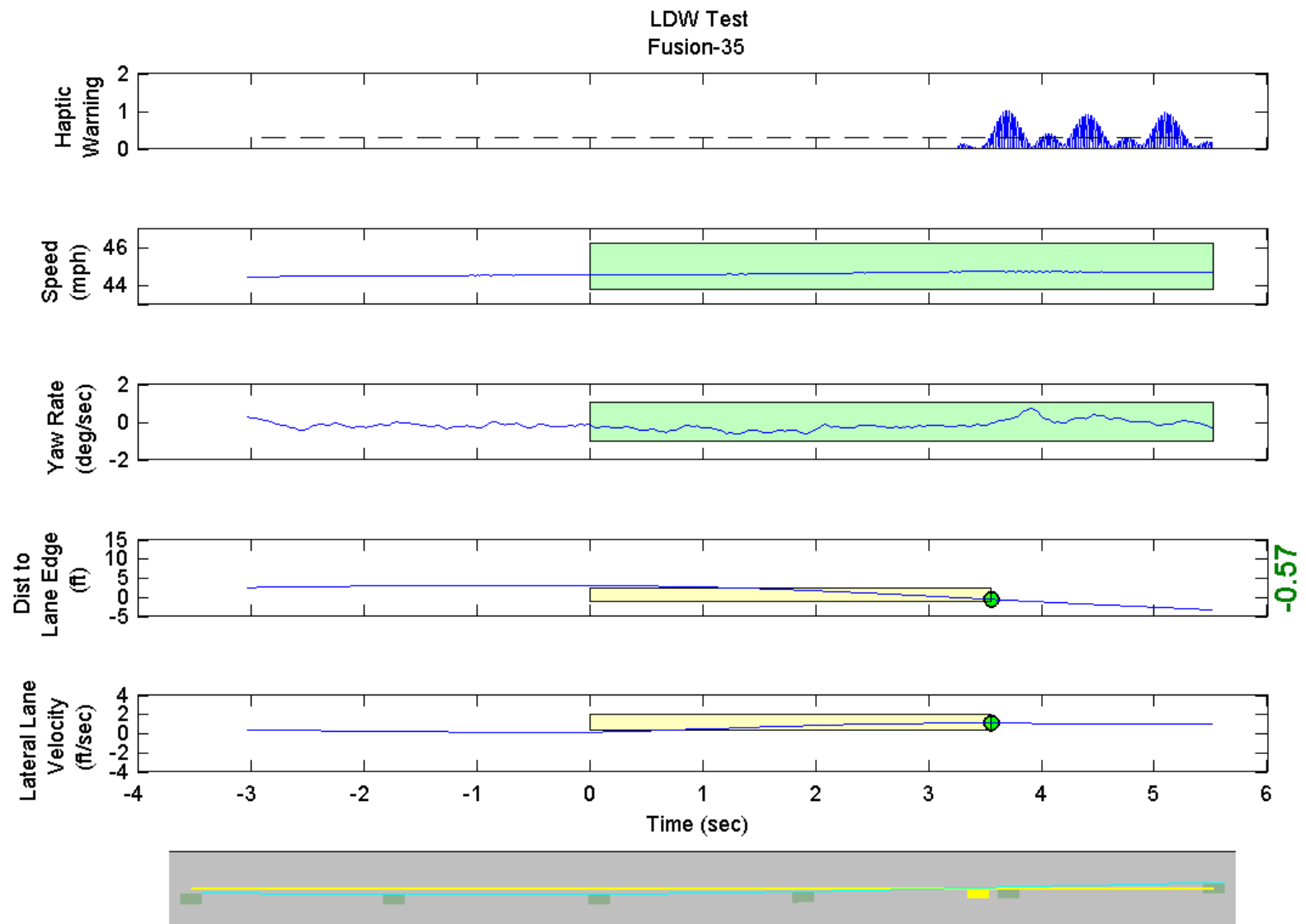
GPS Fix Type: RTK Fixed

Figure D59. Time History for Run 34, Dashed Line, Left Departure, Haptic Warning



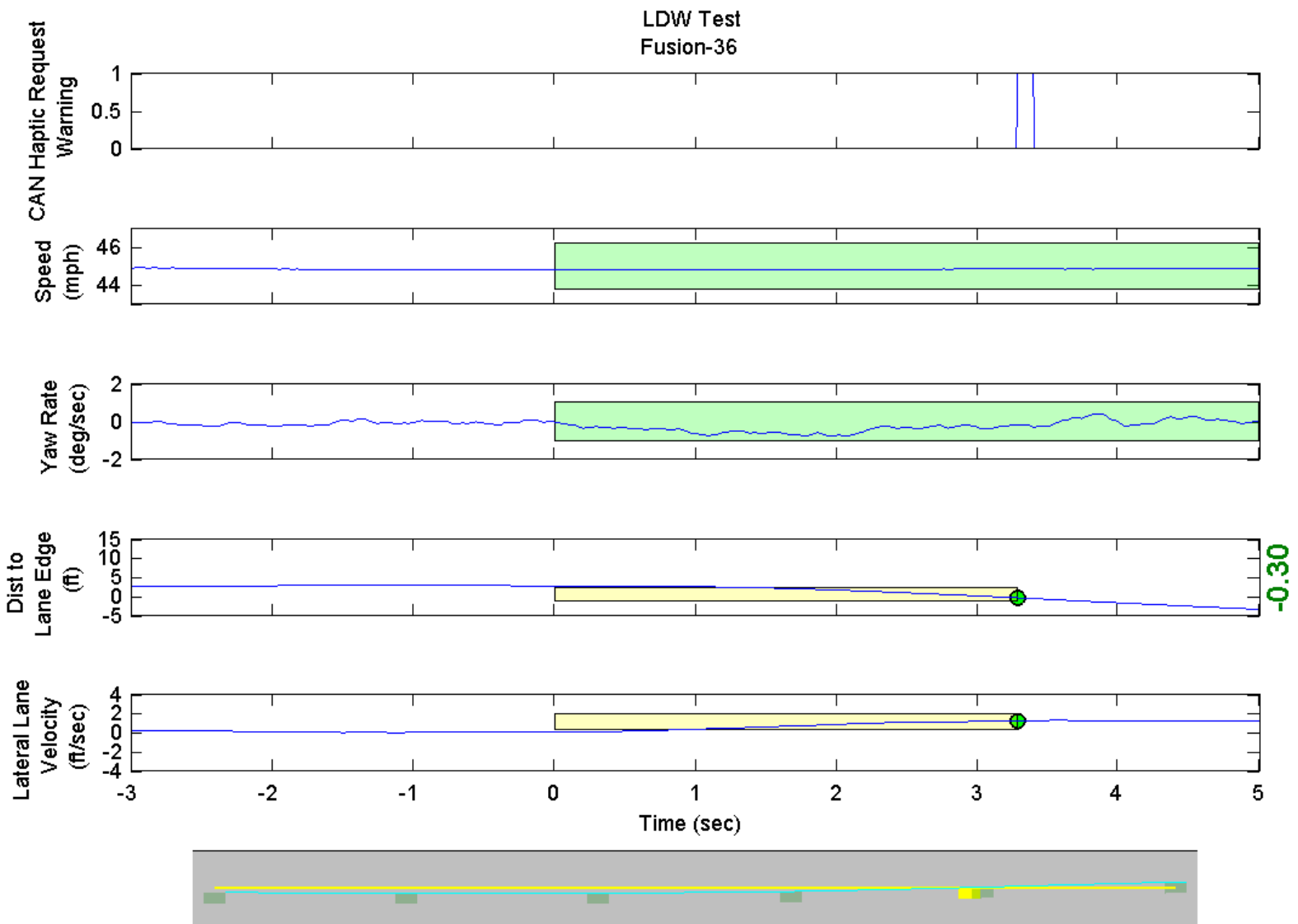
GPS Fix Type: RTK Fixed

Figure D60. Time History for Run 35, Botts Dots, Left Departure, CAN Haptic Warning Request



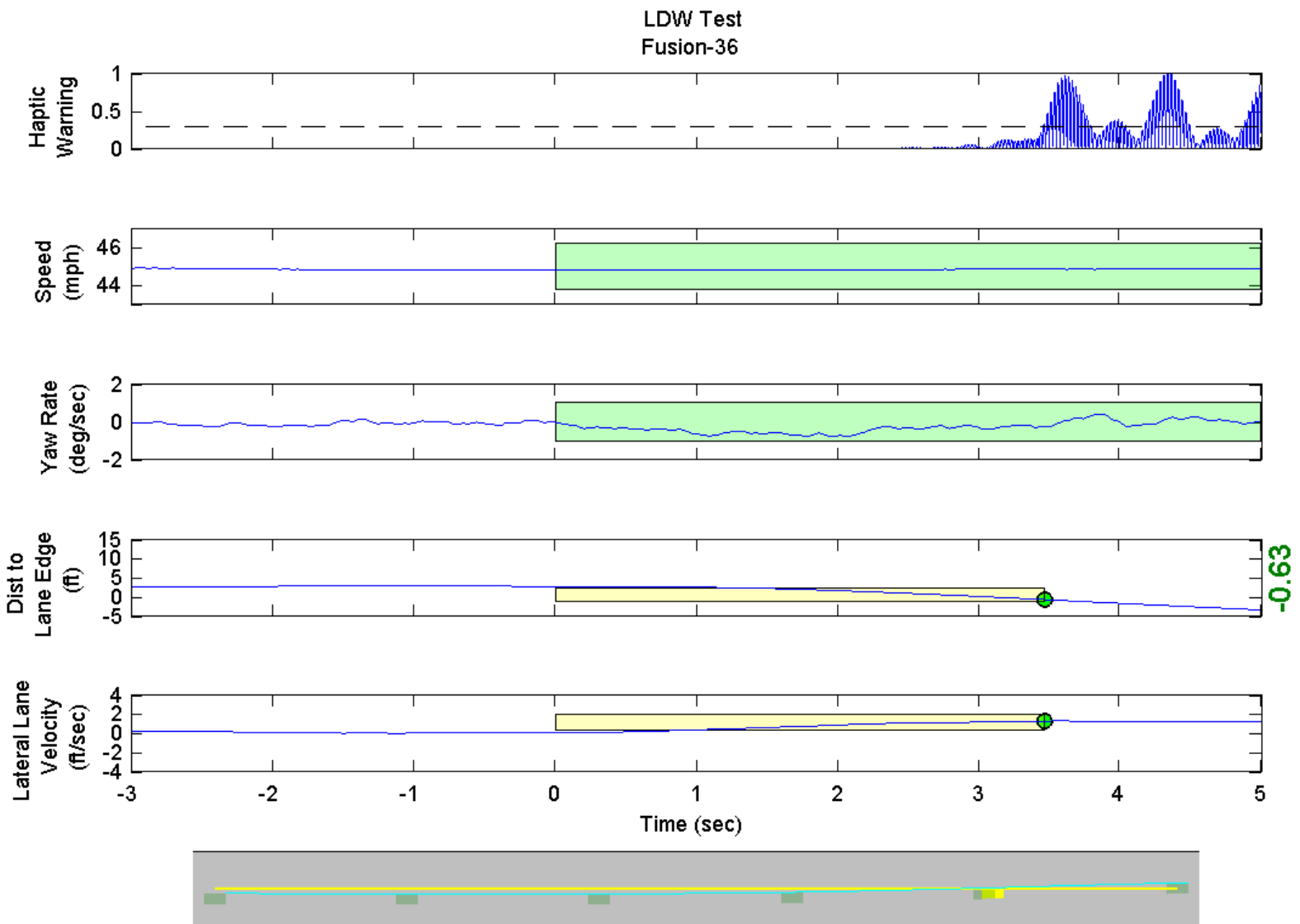
GPS Fix Type: RTK Fixed

Figure D61. Time History for Run 35, Botts Dots, Left Departure, Haptic Warning



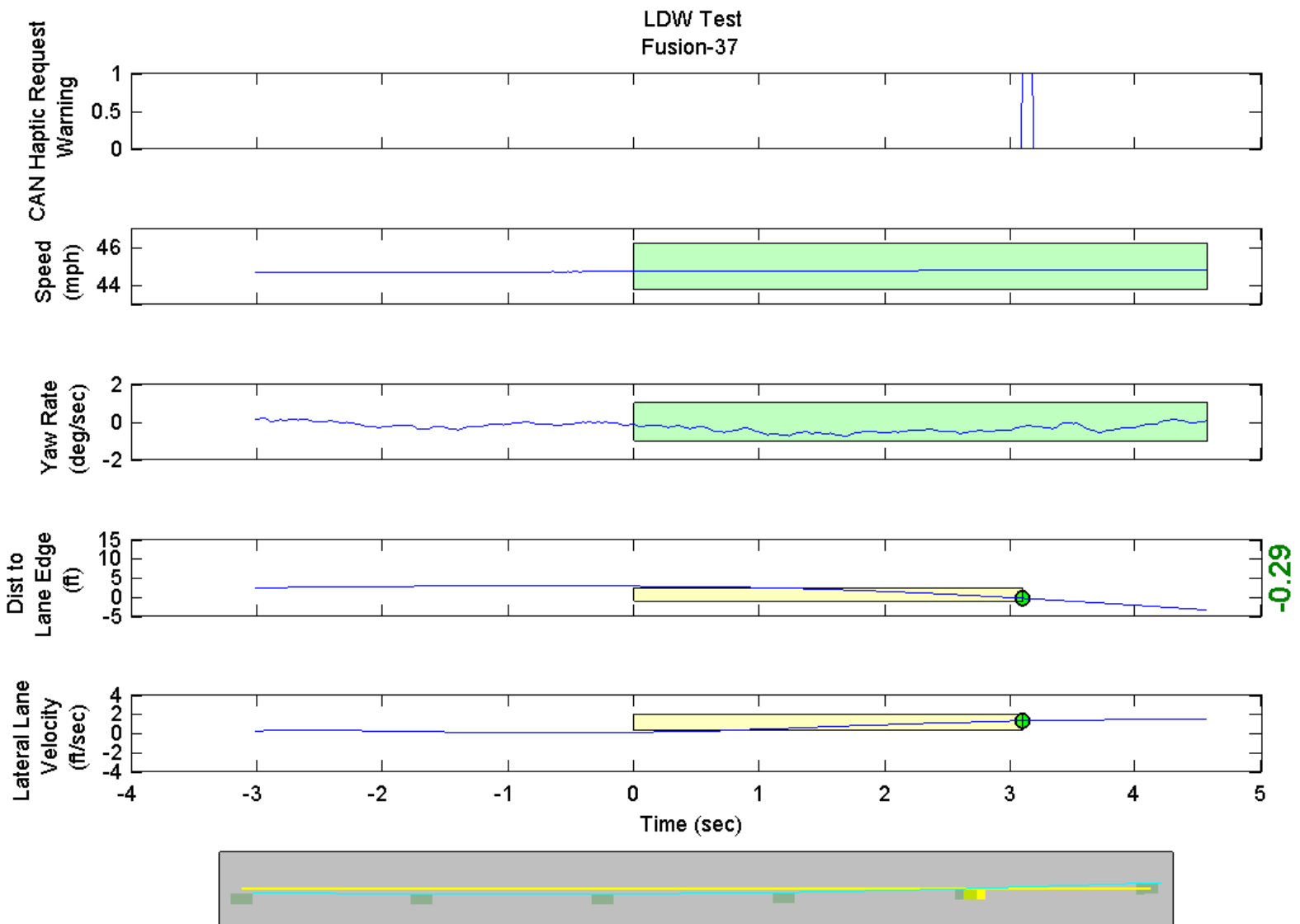
GPS Fix Type: RTK Fixed

Figure D62. Time History for Run 36, Botts Dots, Left Departure, CAN Haptic Warning Request



GPS Fix Type: RTK Fixed

Figure D63. Time History for Run 36, Botts Dots, Left Departure, Haptic Warning



GPS Fix Type: RTK Fixed

Figure D64. Time History for Run 37, Botts Dots, Left Departure, CAN Haptic Warning Request

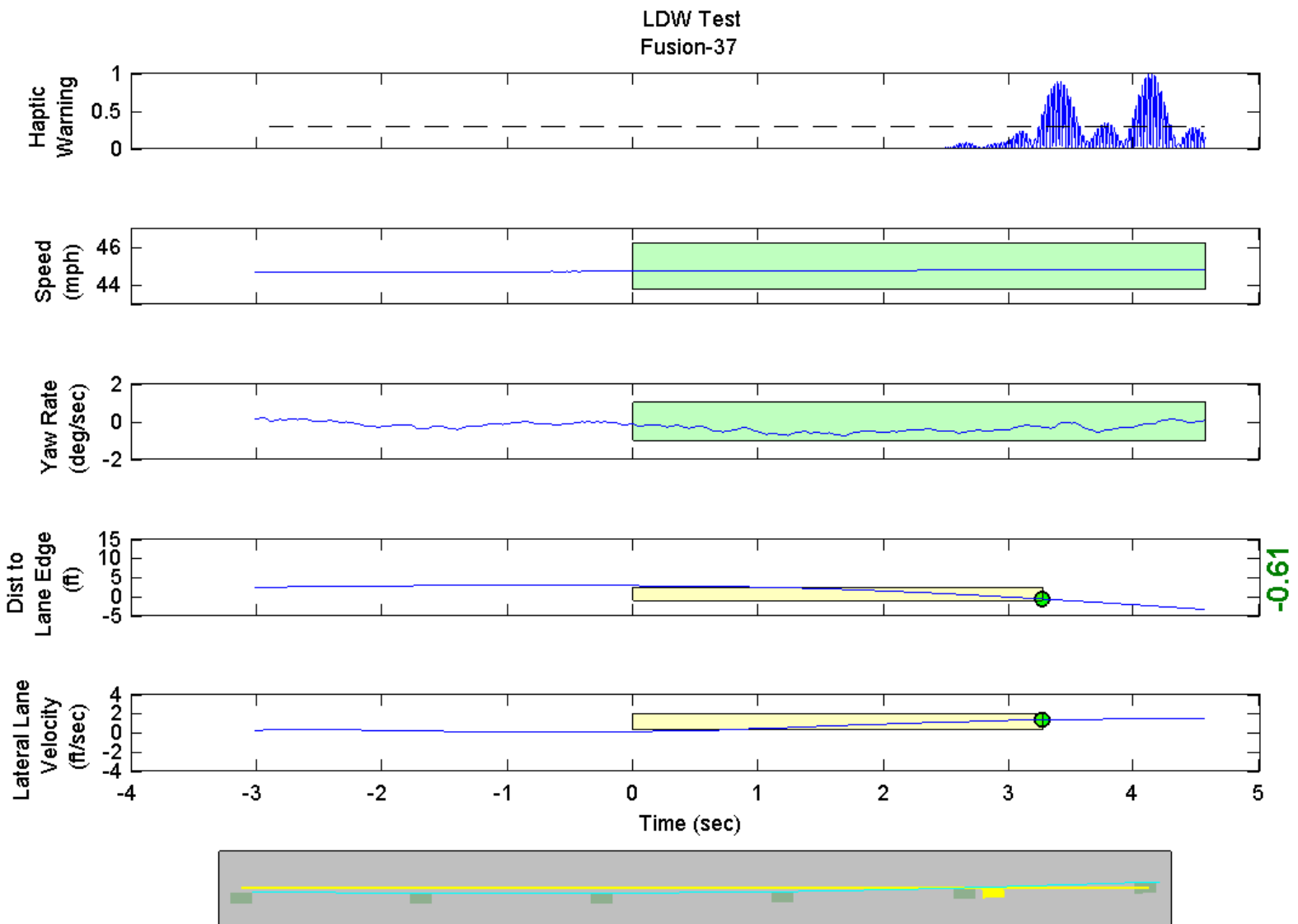
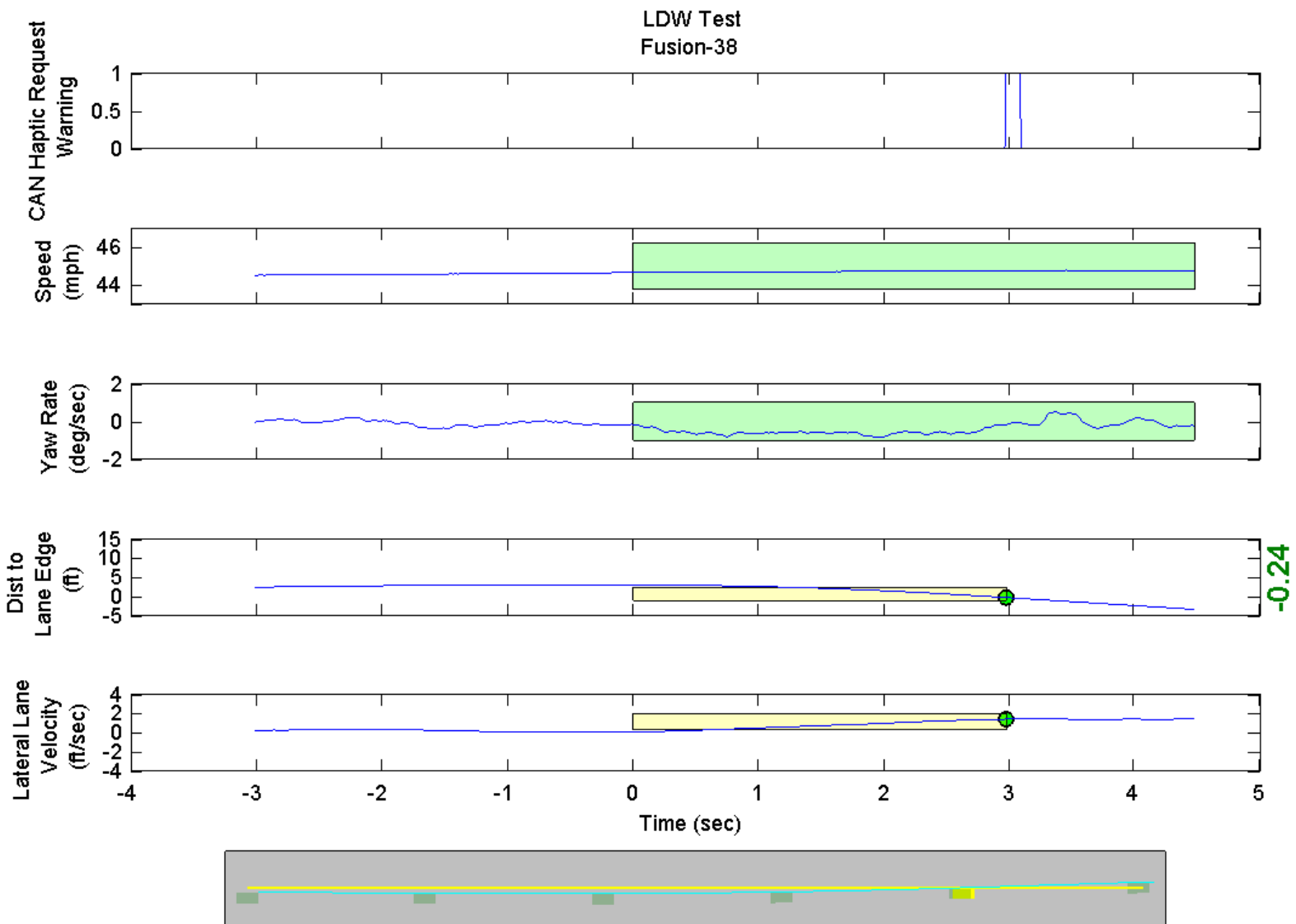
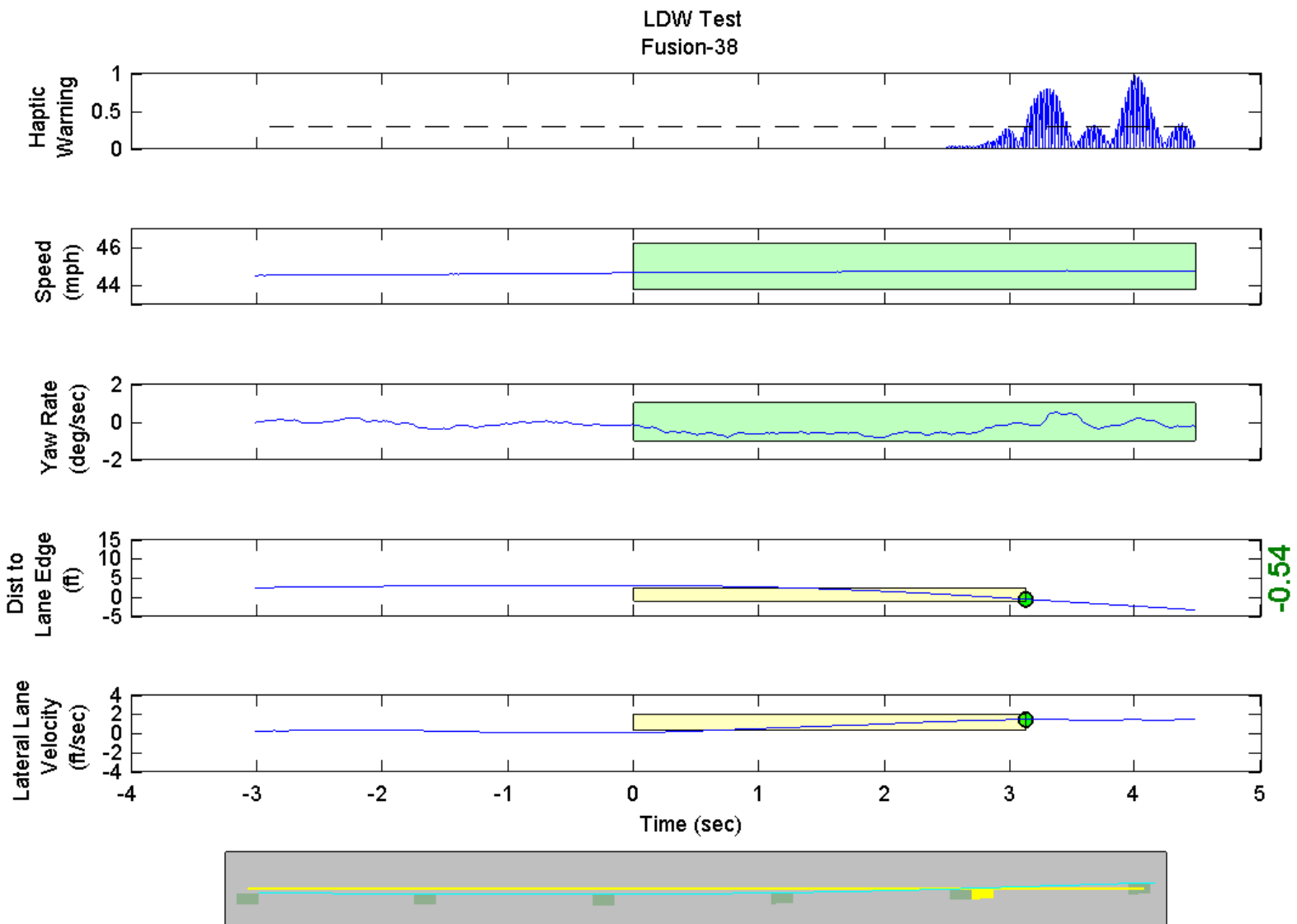


Figure D65. Time History for Run 37, Botts Dots, Left Departure, Haptic Warning



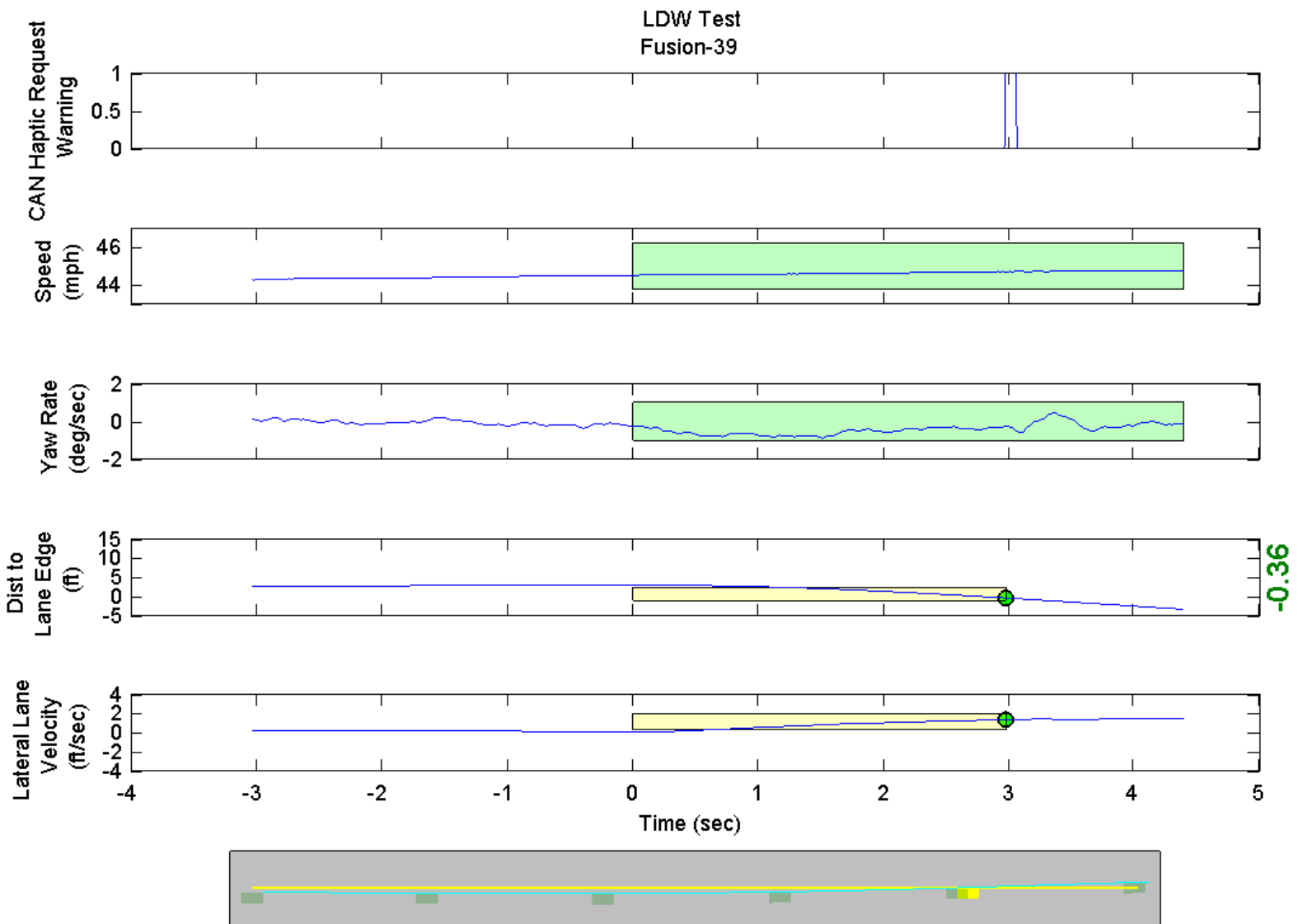
GPS Fix Type: RTK Fixed

Figure D66. Time History for Run 38, Botts Dots, Left Departure, CAN Haptic Warning Request



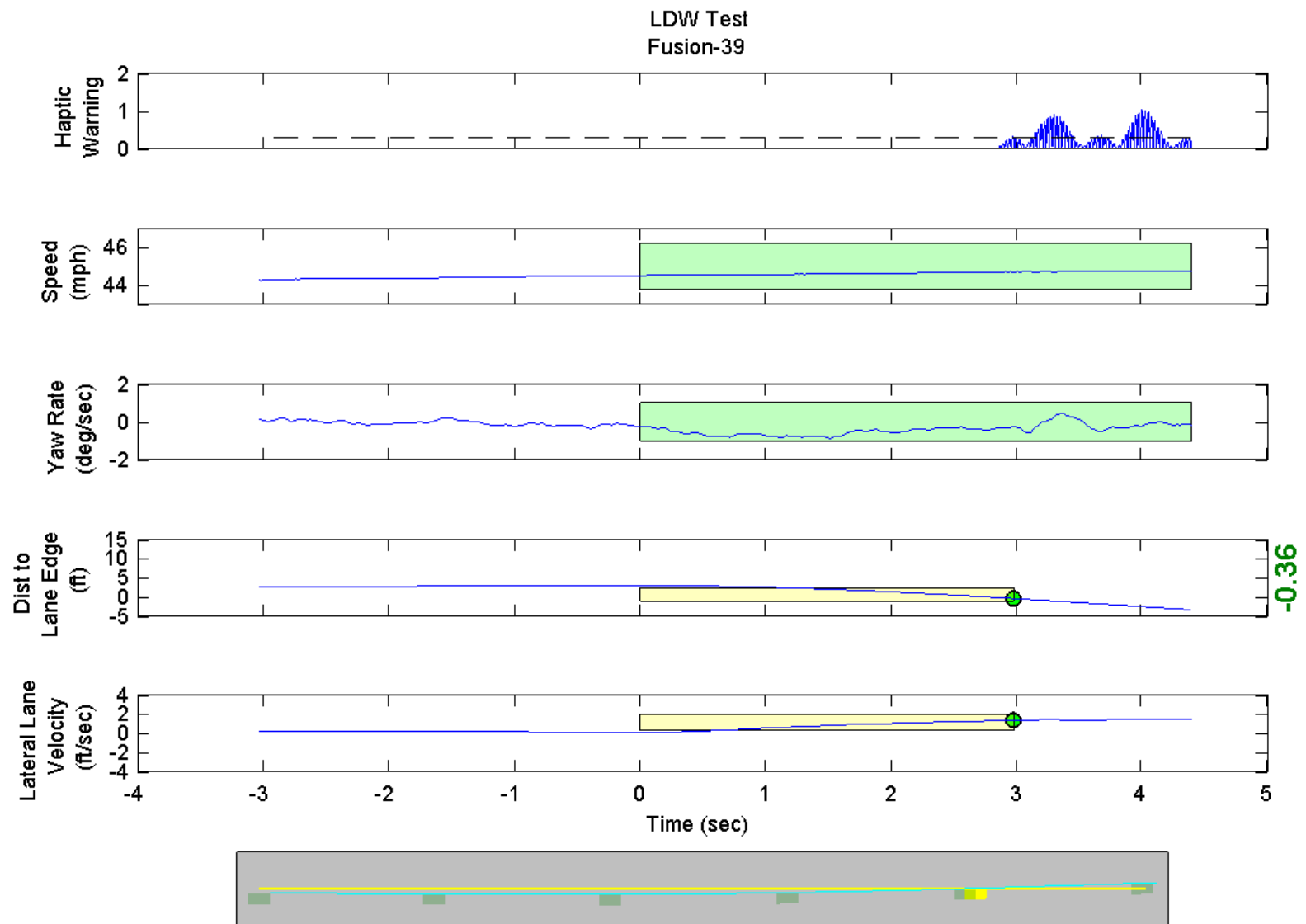
GPS Fix Type: RTK Fixed

Figure D67. Time History for Run 38, Botts Dots, Left Departure, Haptic Warning



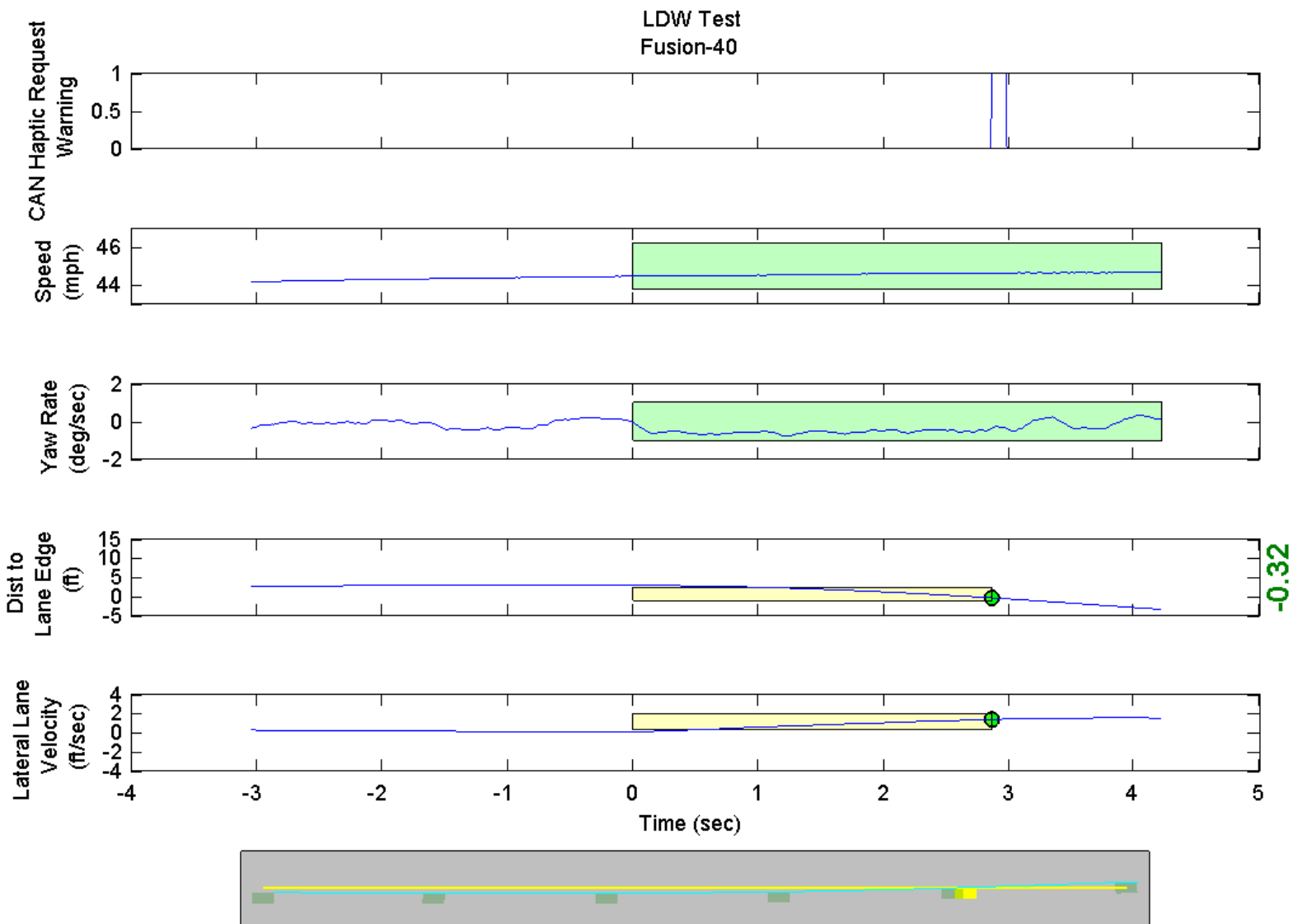
GPS Fix Type: RTK Fixed

Figure D68. Time History for Run 39, Botts Dots, Left Departure, CAN Haptic Warning Request



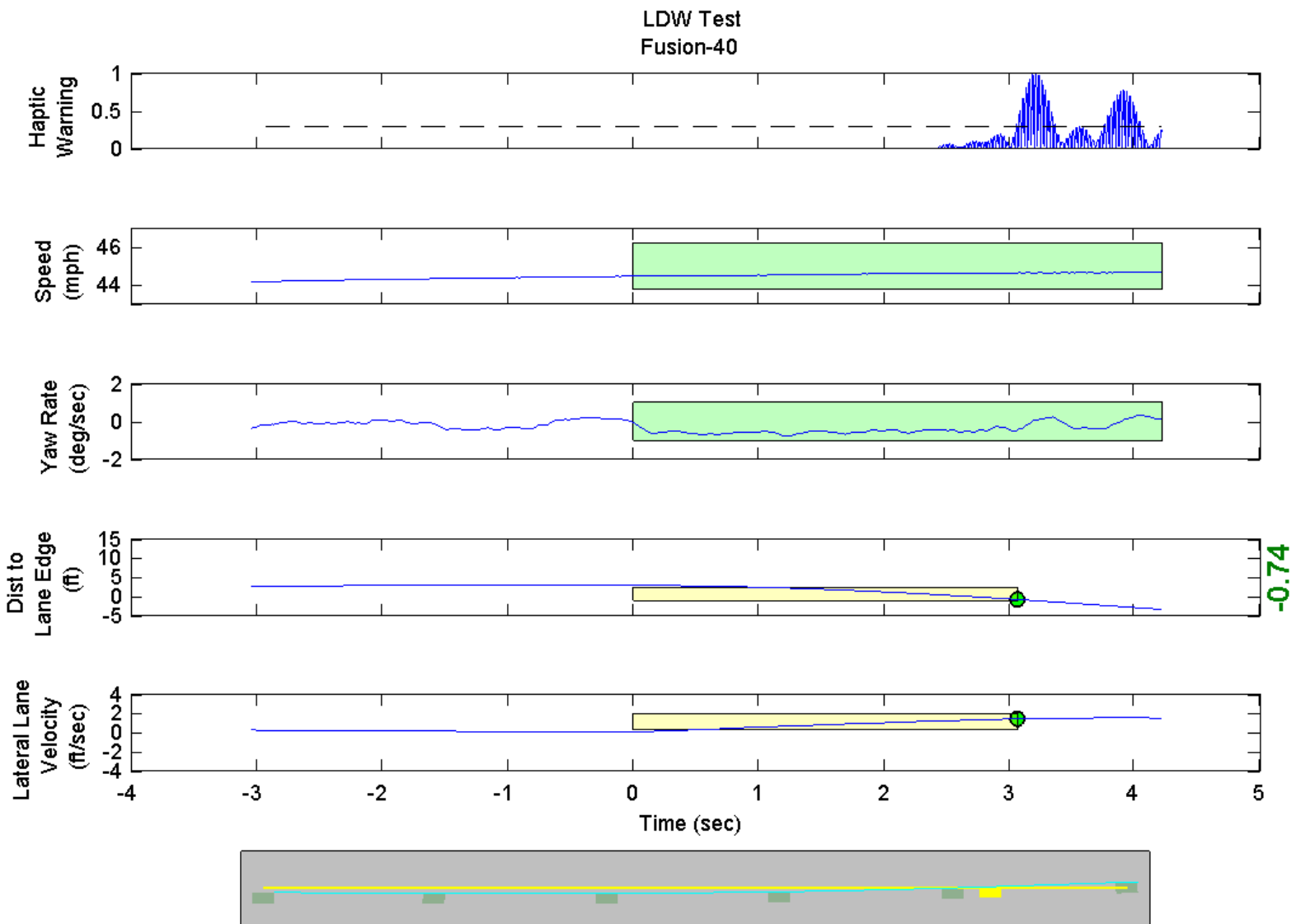
GPS Fix Type: RTK Fixed

Figure D69. Time History for Run 39, Botts Dots, Left Departure, Haptic Warning



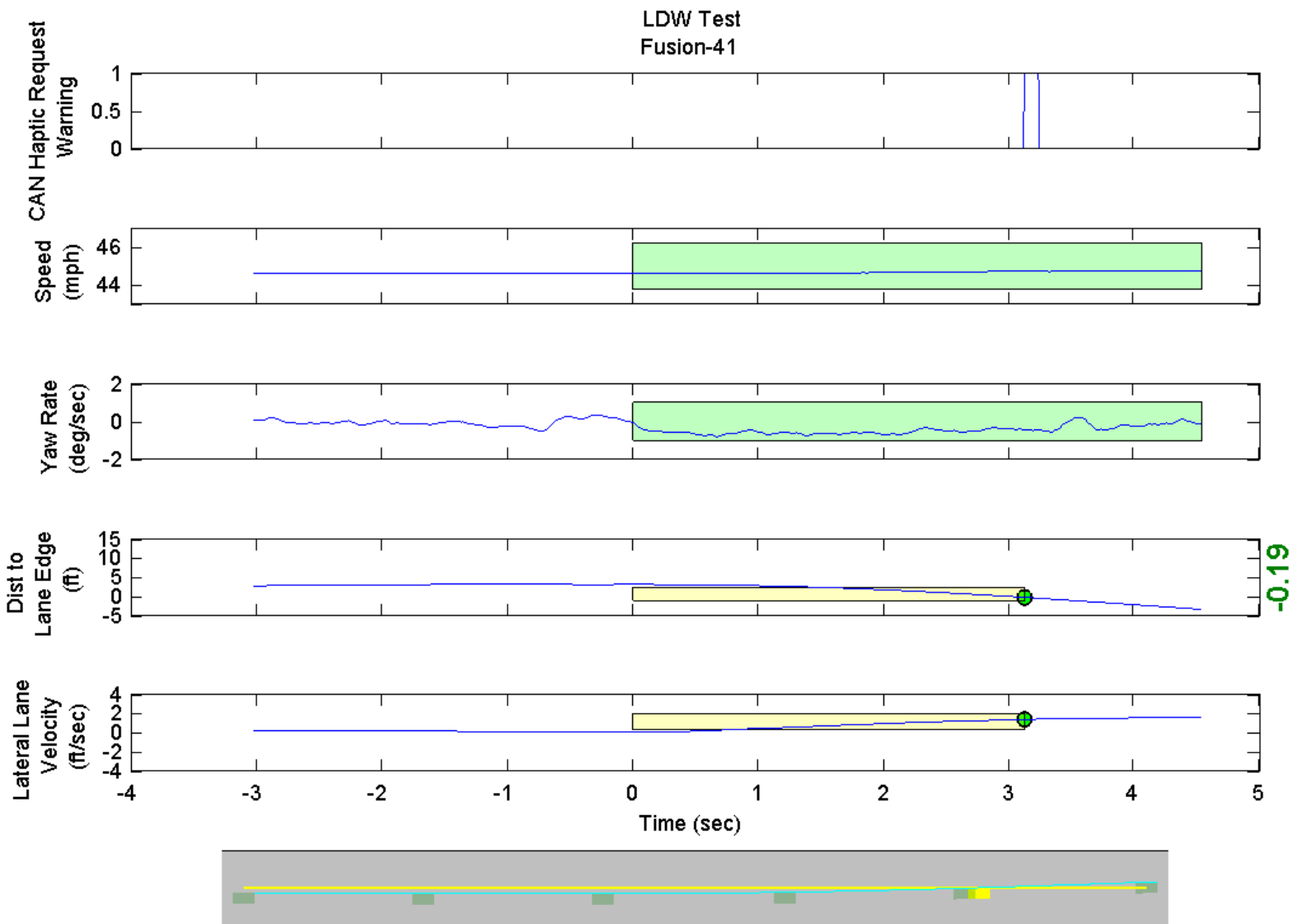
GPS Fix Type: RTK Fixed

Figure D70. Time History for Run 40, Botts Dots, Left Departure, CAN Haptic Warning Request



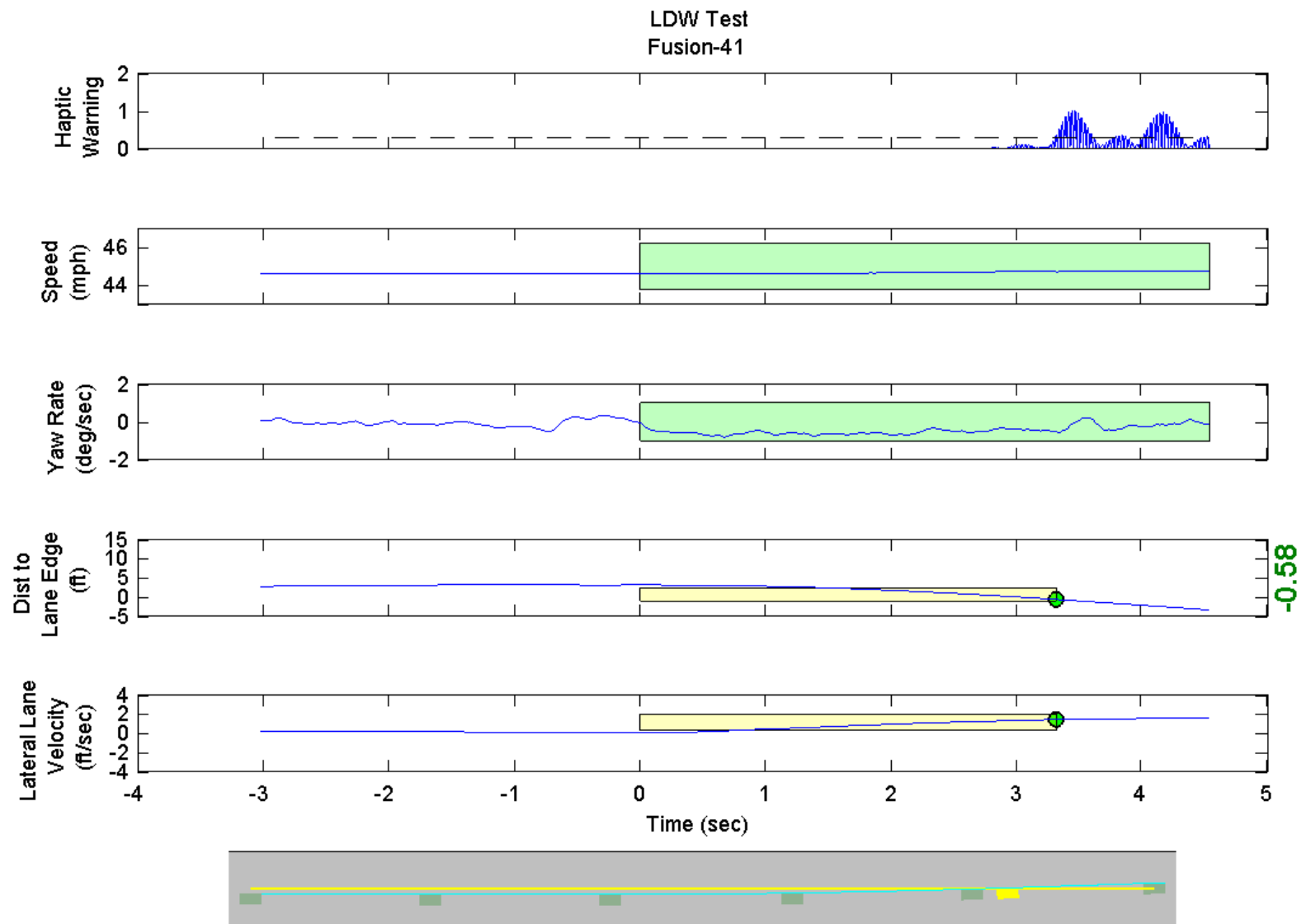
GPS Fix Type: RTK Fixed

Figure D71. Time History for Run 40, Botts Dots, Left Departure, Haptic Warning



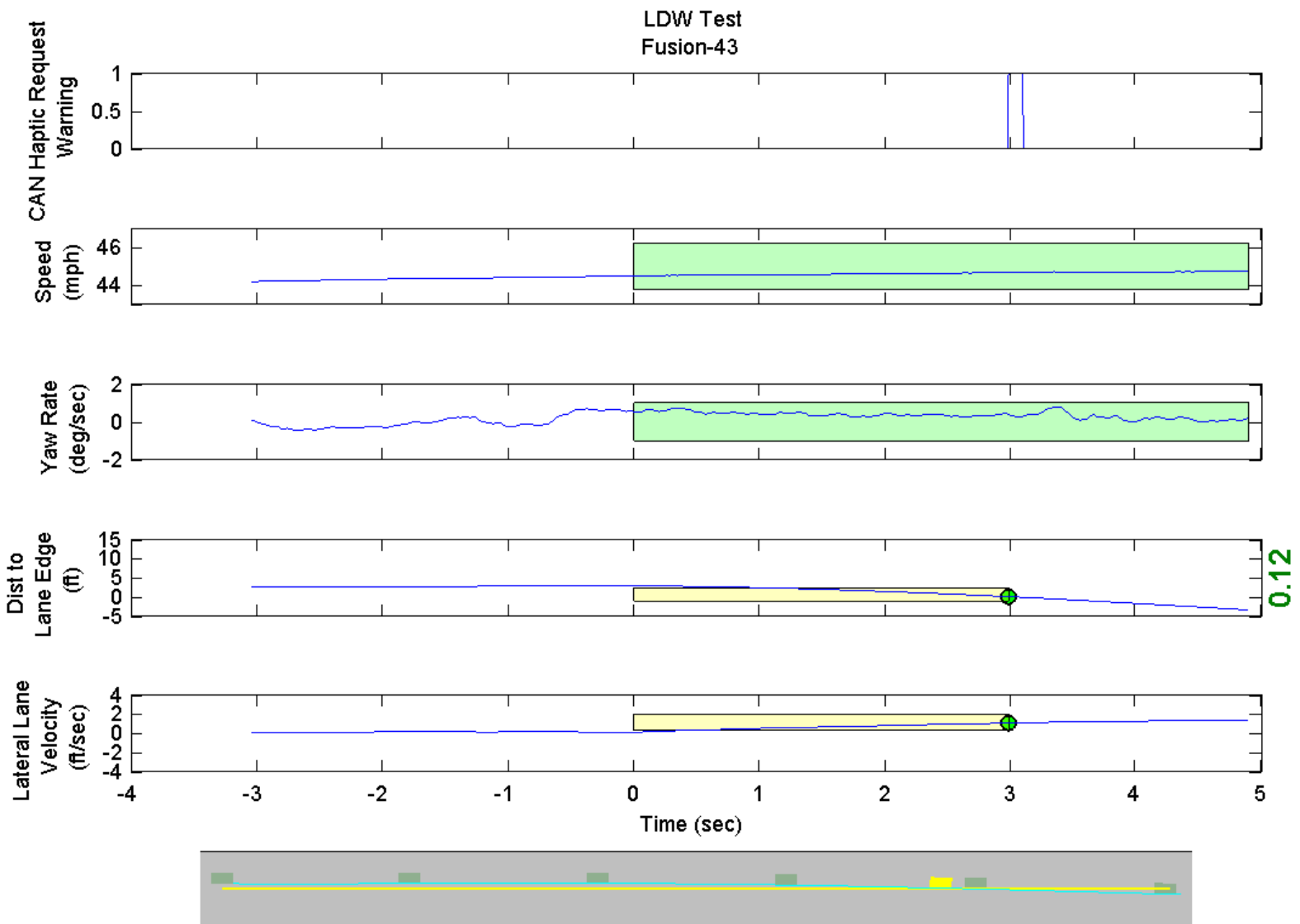
GPS Fix Type: RTK Fixed

Figure D72. Time History for Run 41, Botts Dots, Left Departure, CAN Haptic Warning Request



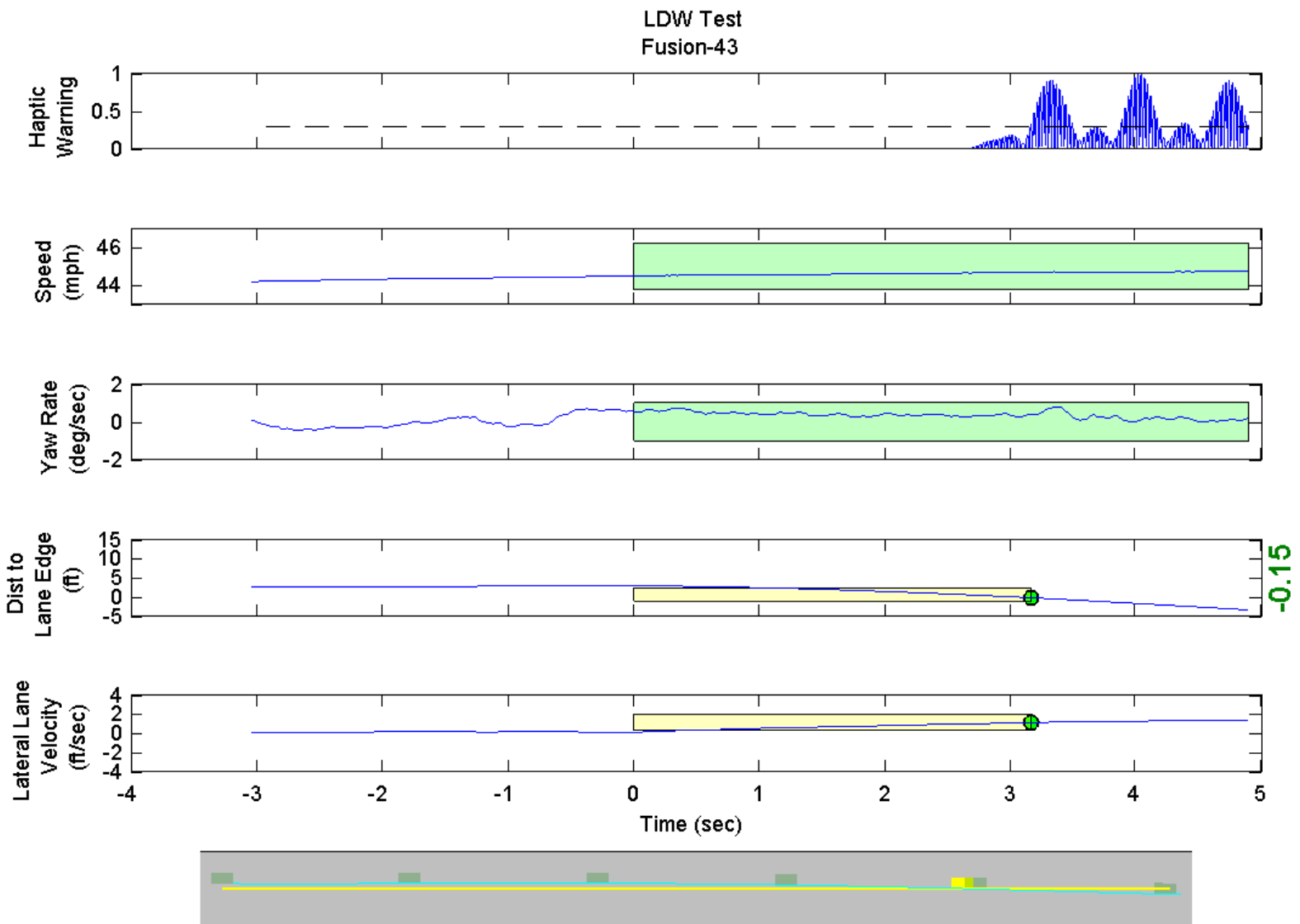
GPS Fix Type: RTK Fixed

Figure D73. Time History for Run 41, Botts Dots, Left Departure, Haptic Warning



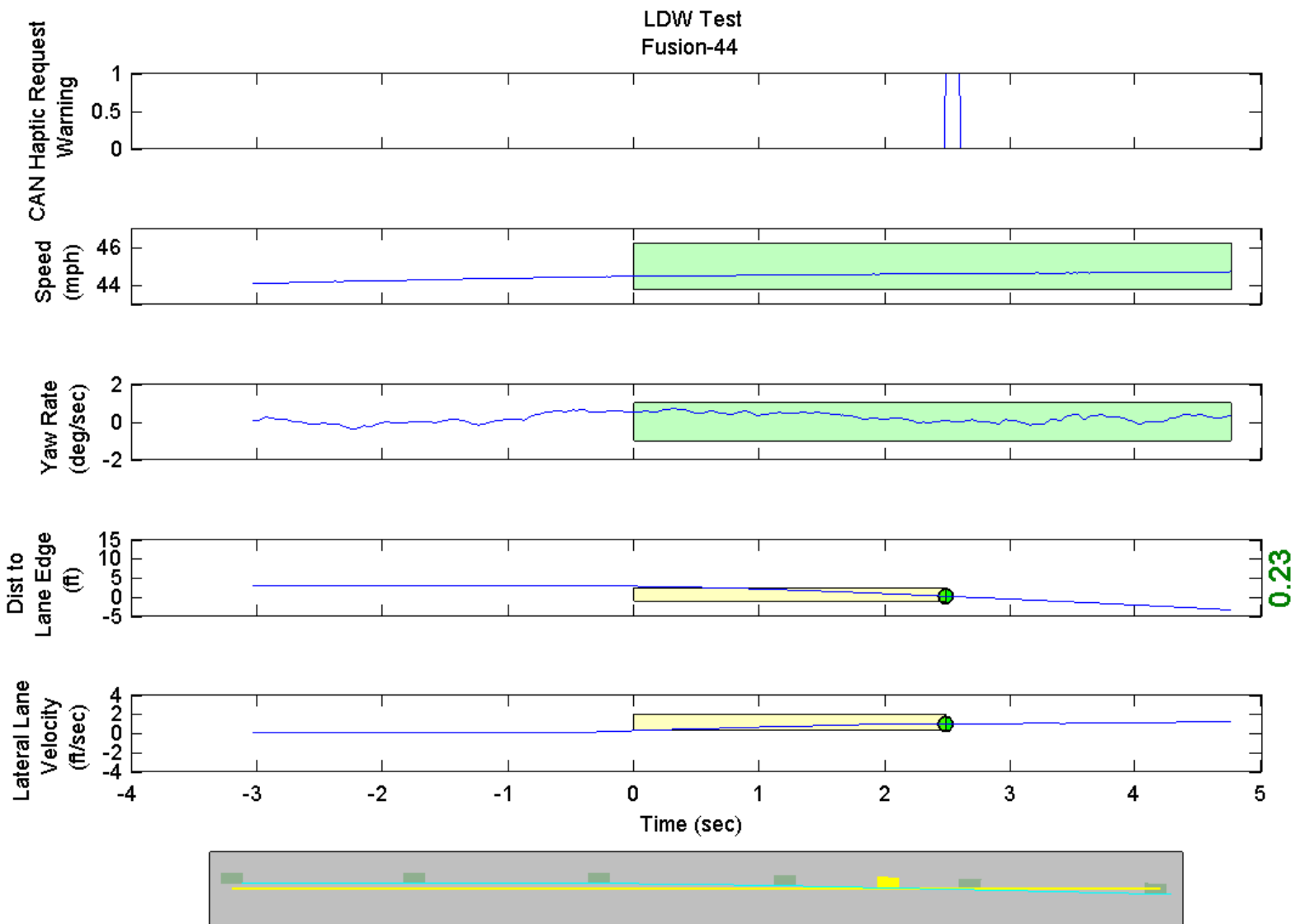
GPS Fix Type: RTK Fixed

Figure D74. Time History for Run 43, Botts Dots, Right Departure, CAN Haptic Warning Request



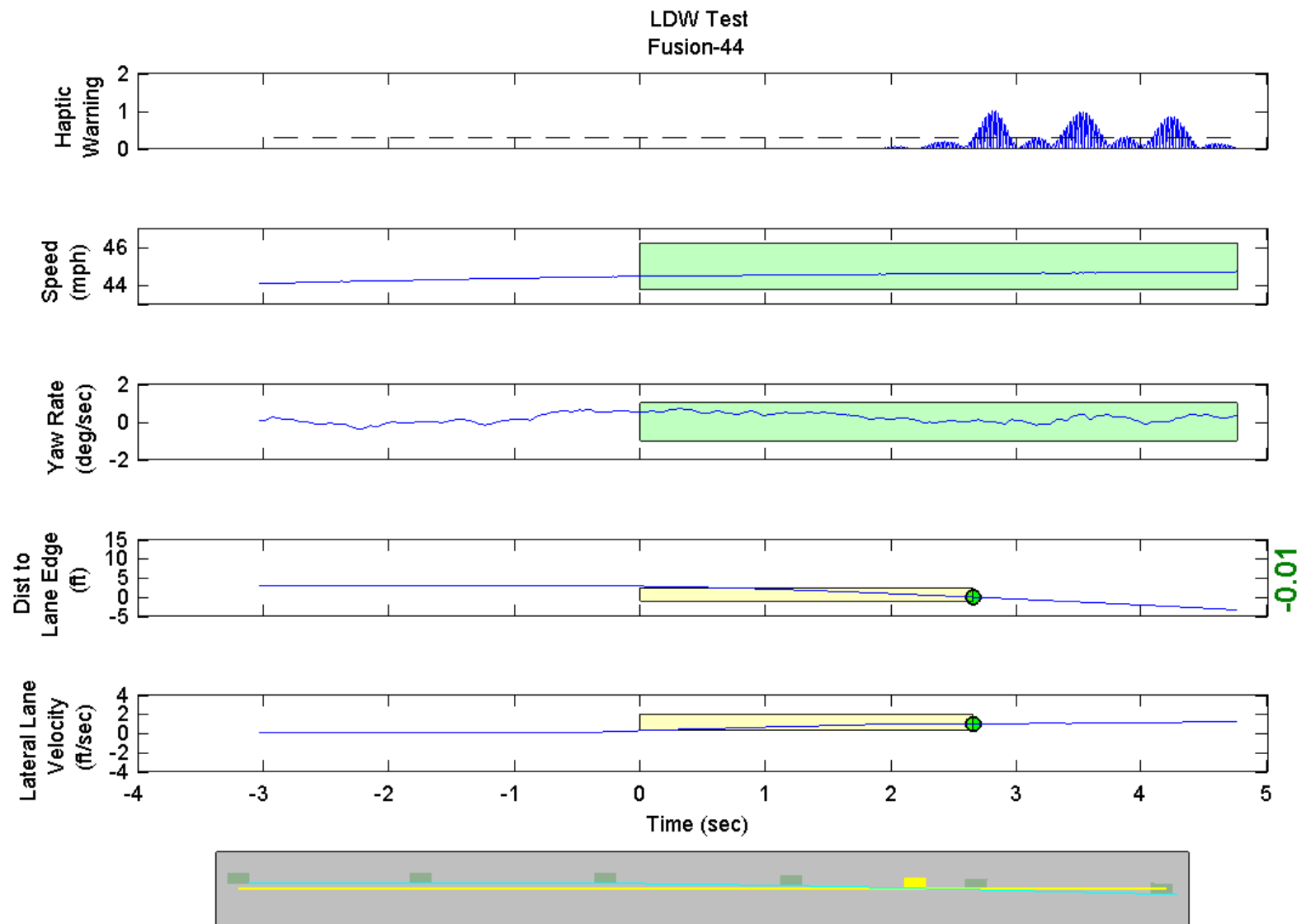
GPS Fix Type: RTK Fixed

Figure D75. Time History for Run 43, Botts Dots, Right Departure, Haptic Warning



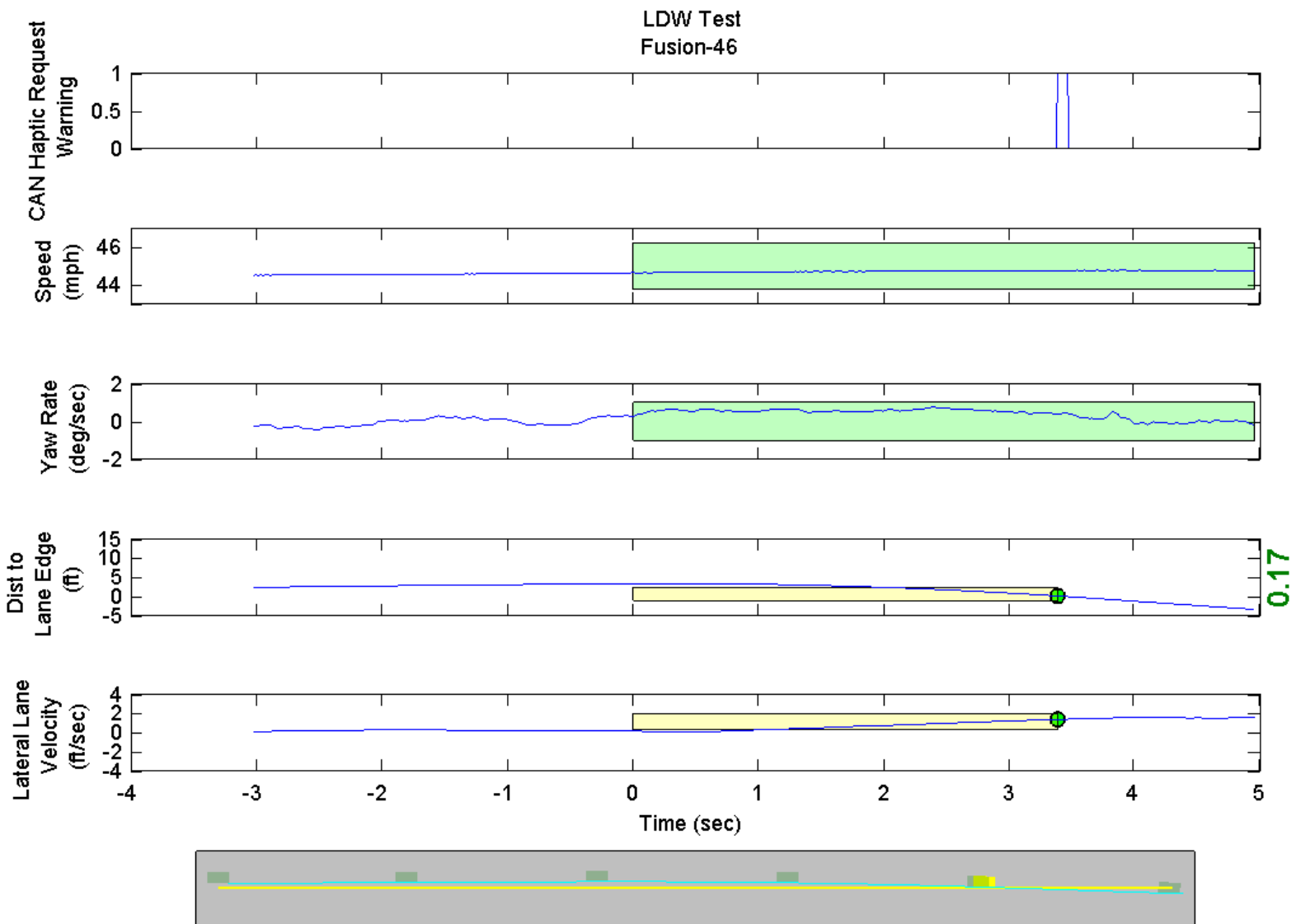
GPS Fix Type: RTK Fixed

Figure D76. Time History for Run 44, Botts Dots, Right Departure, CAN Haptic Warning Request



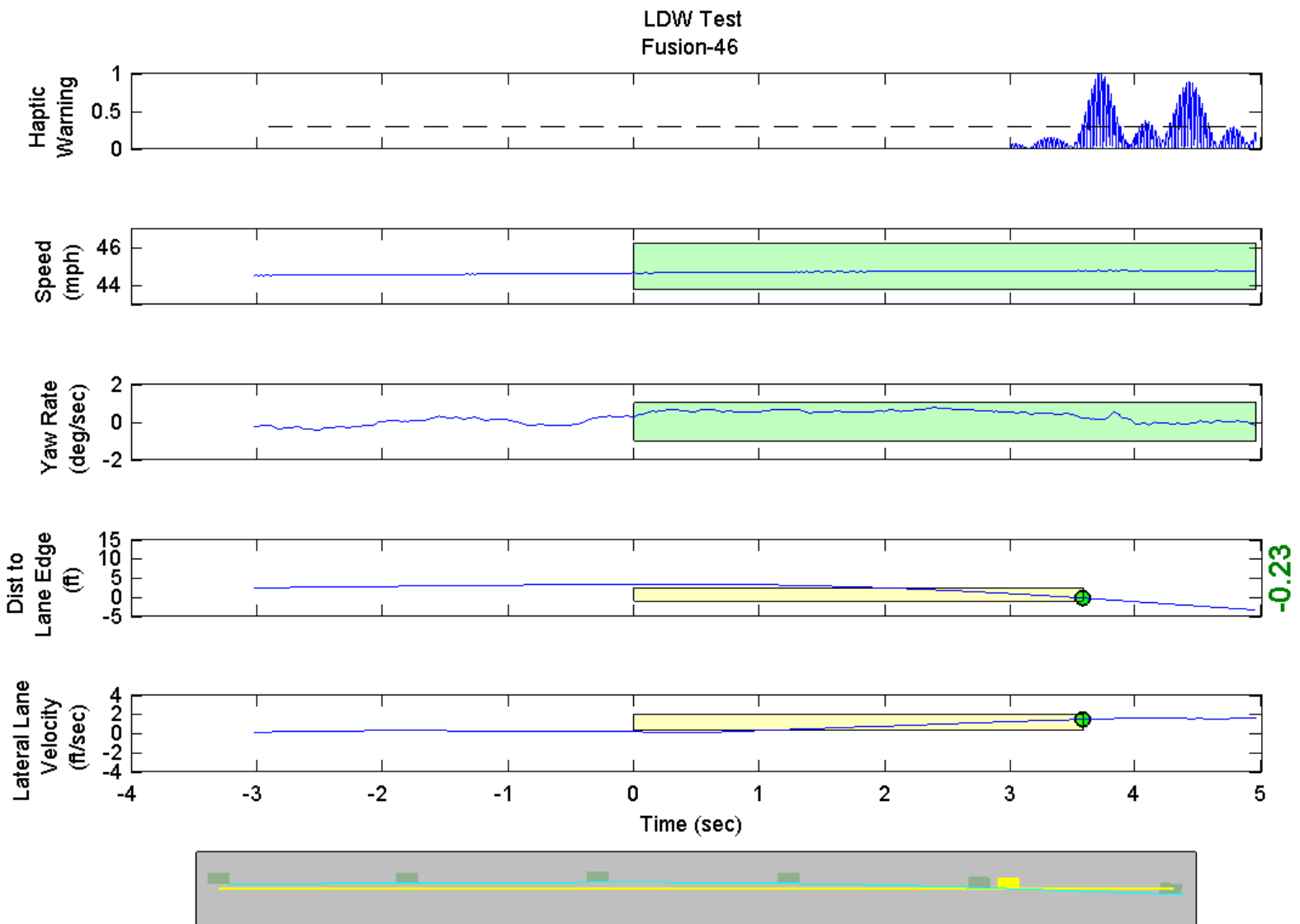
GPS Fix Type: RTK Fixed

Figure D77. Time History for Run 44, Botts Dots, Right Departure, Haptic Warning



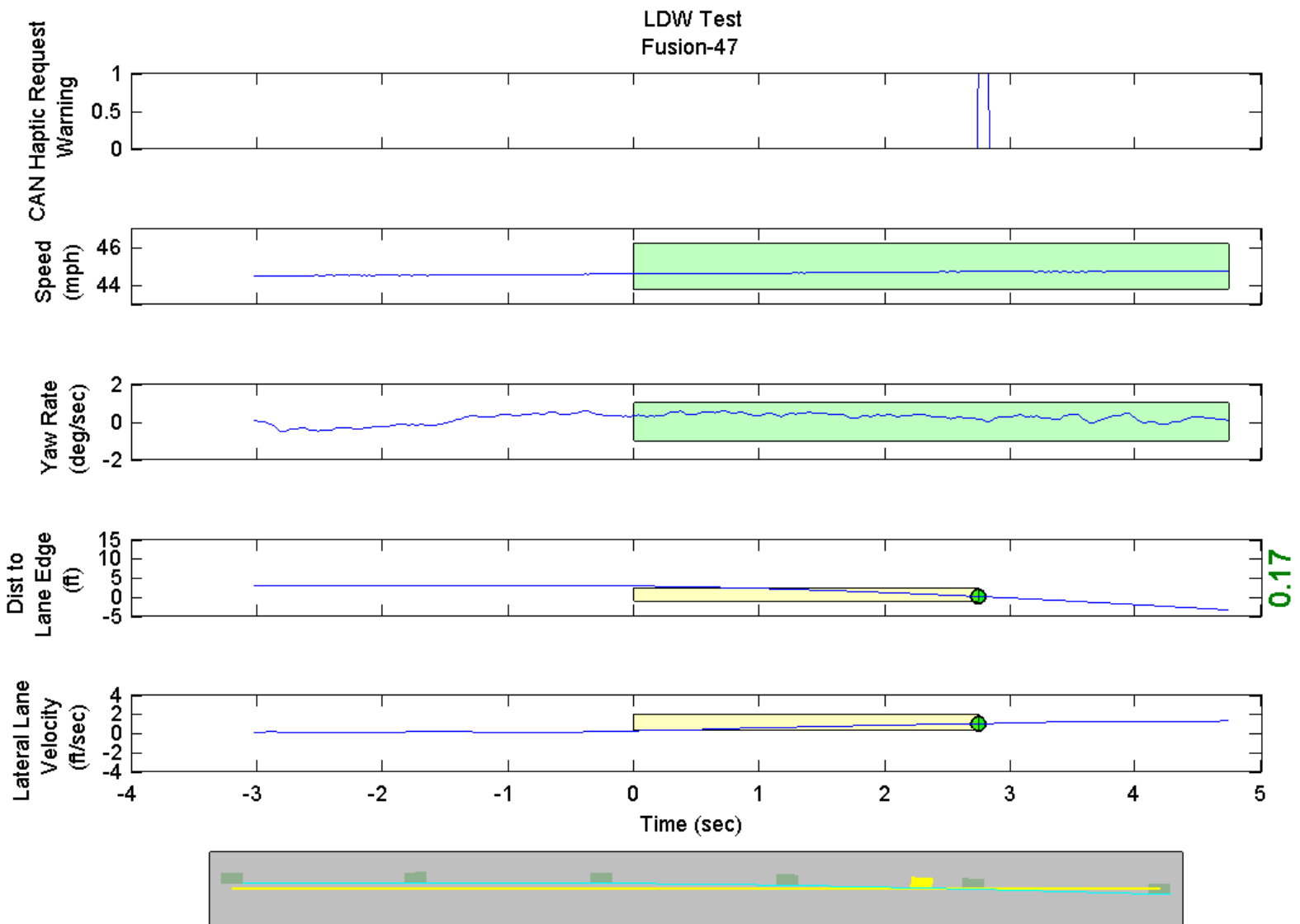
GPS Fix Type: RTK Fixed

Figure D78. Time History for Run 46, Botts Dots, Right Departure, CAN Haptic Warning Request



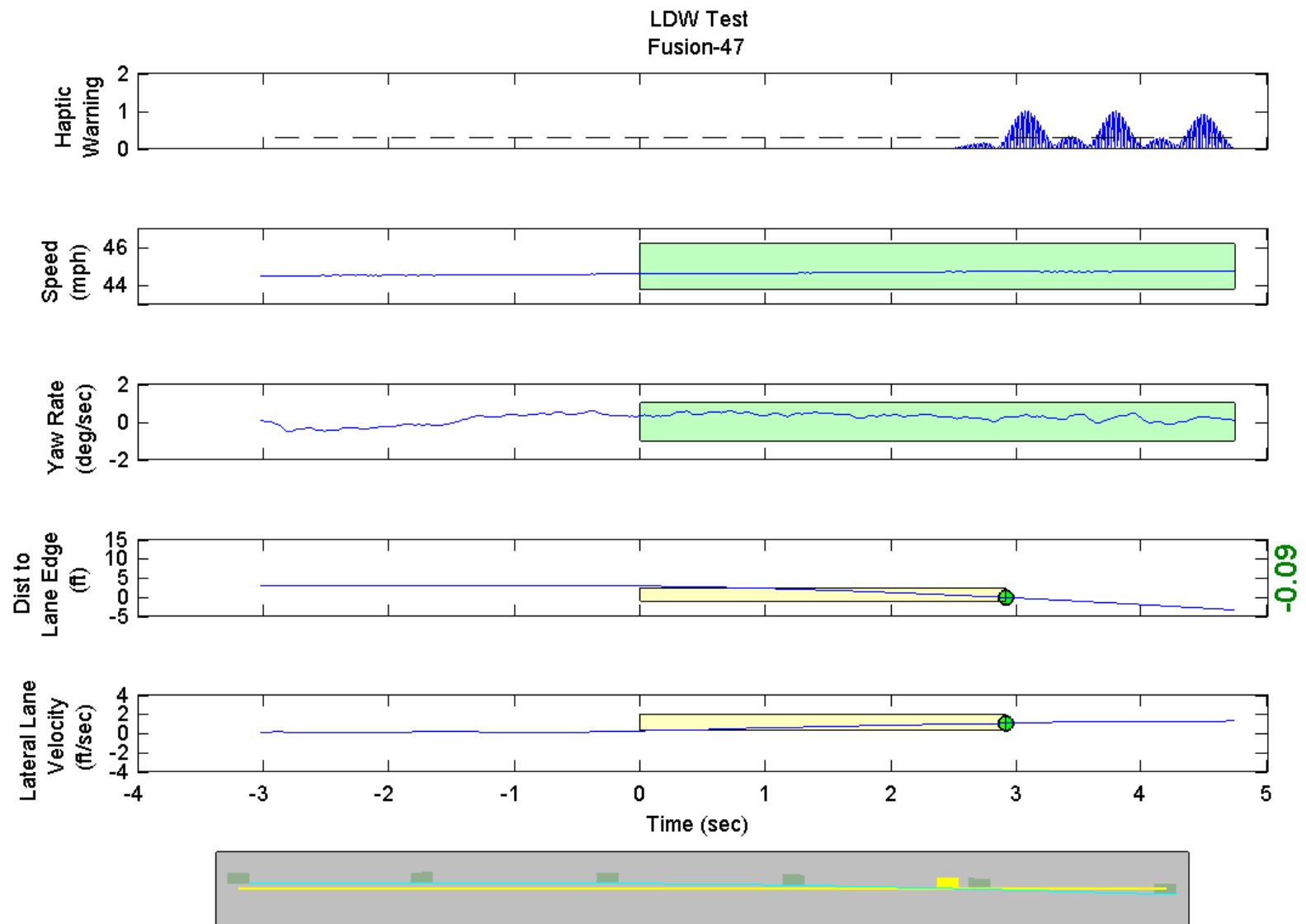
GPS Fix Type: RTK Fixed

Figure D79. Time History for Run 46, Botts Dots, Right Departure, Haptic Warning



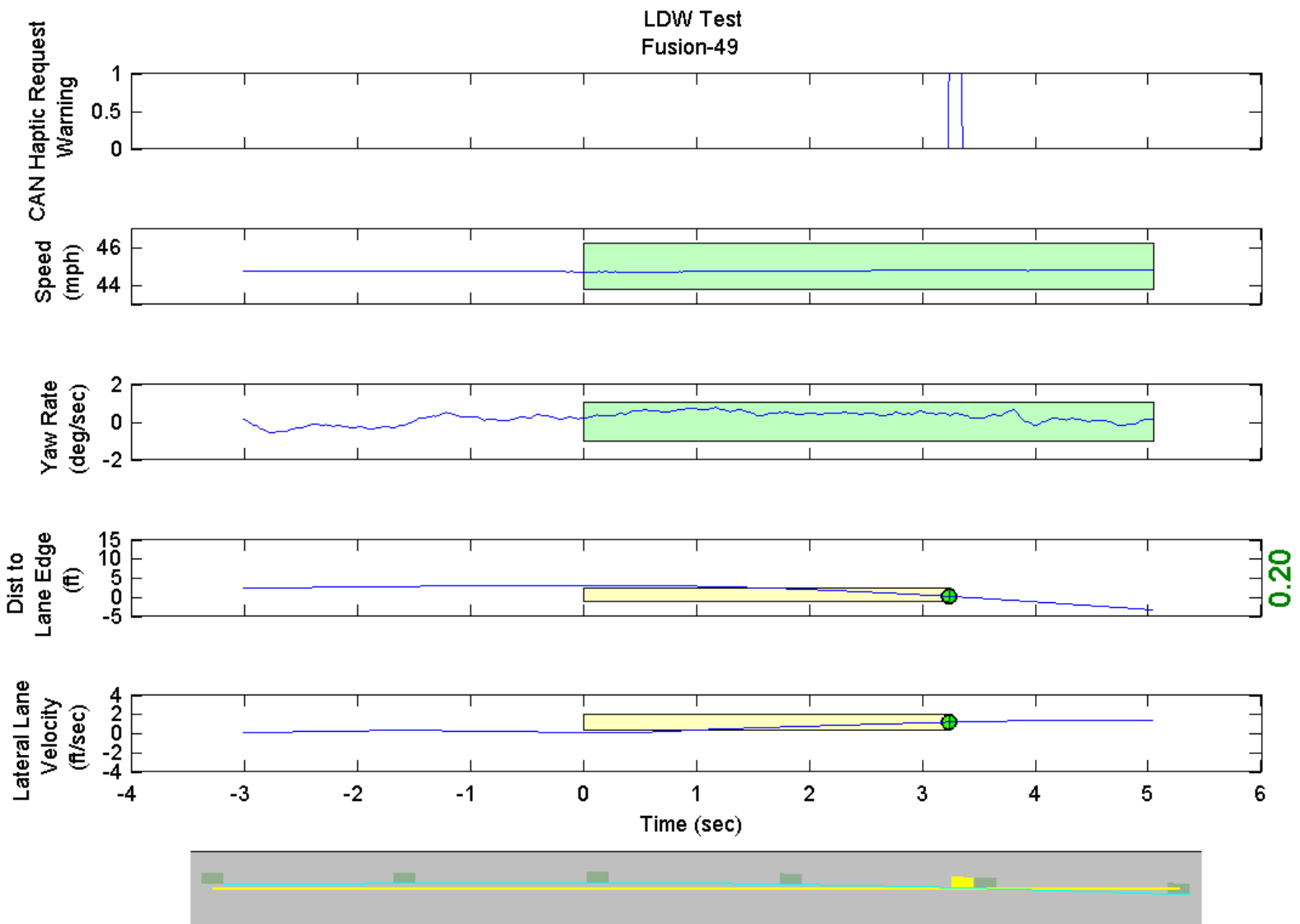
GPS Fix Type: RTK Fixed

Figure D80. Time History for Run 47, Botts Dots, Right Departure, CAN Haptic Warning Request



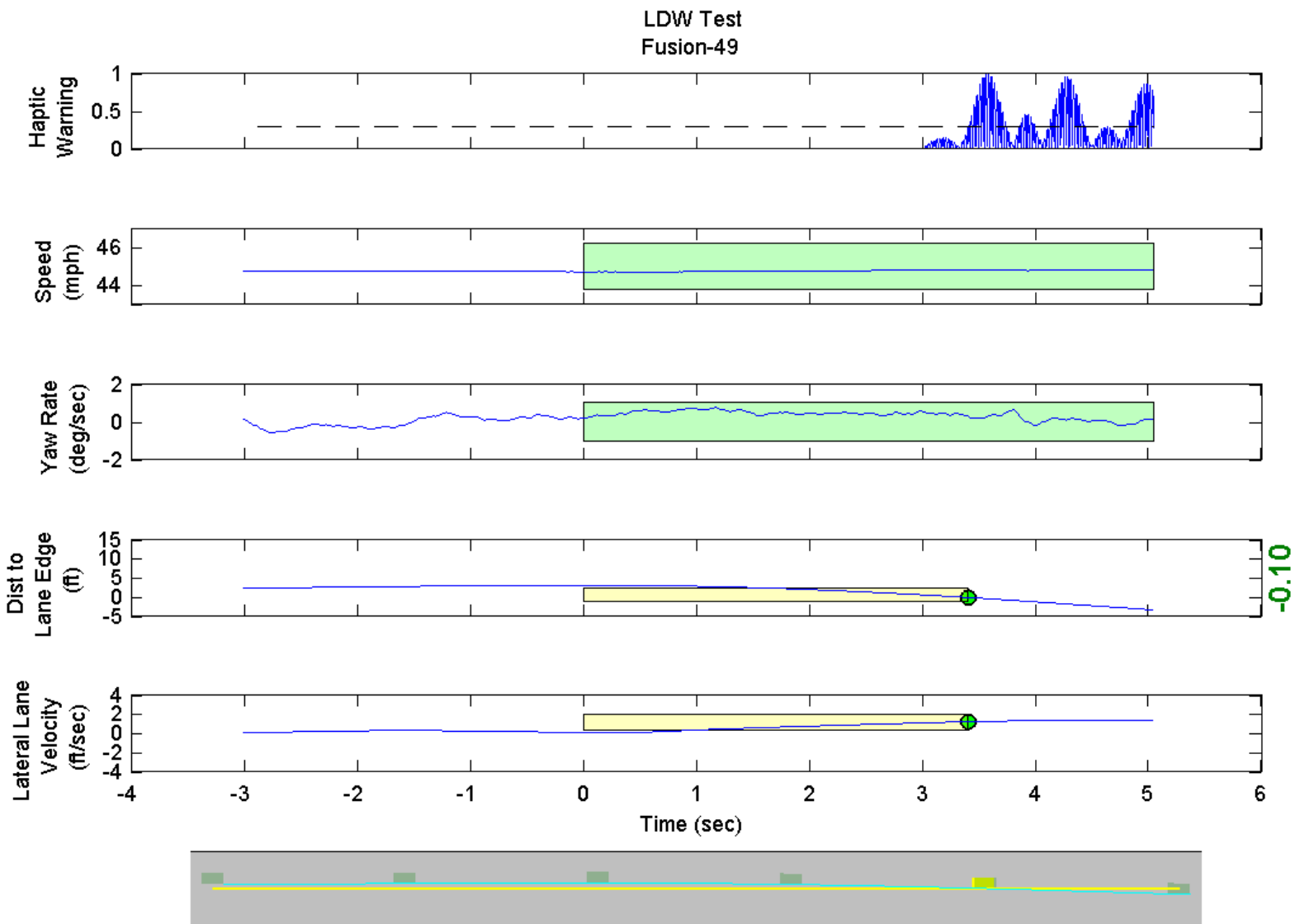
GPS Fix Type: RTK Fixed

Figure D81. Time History for Run 47, Botts Dots, Right Departure, Haptic Warning



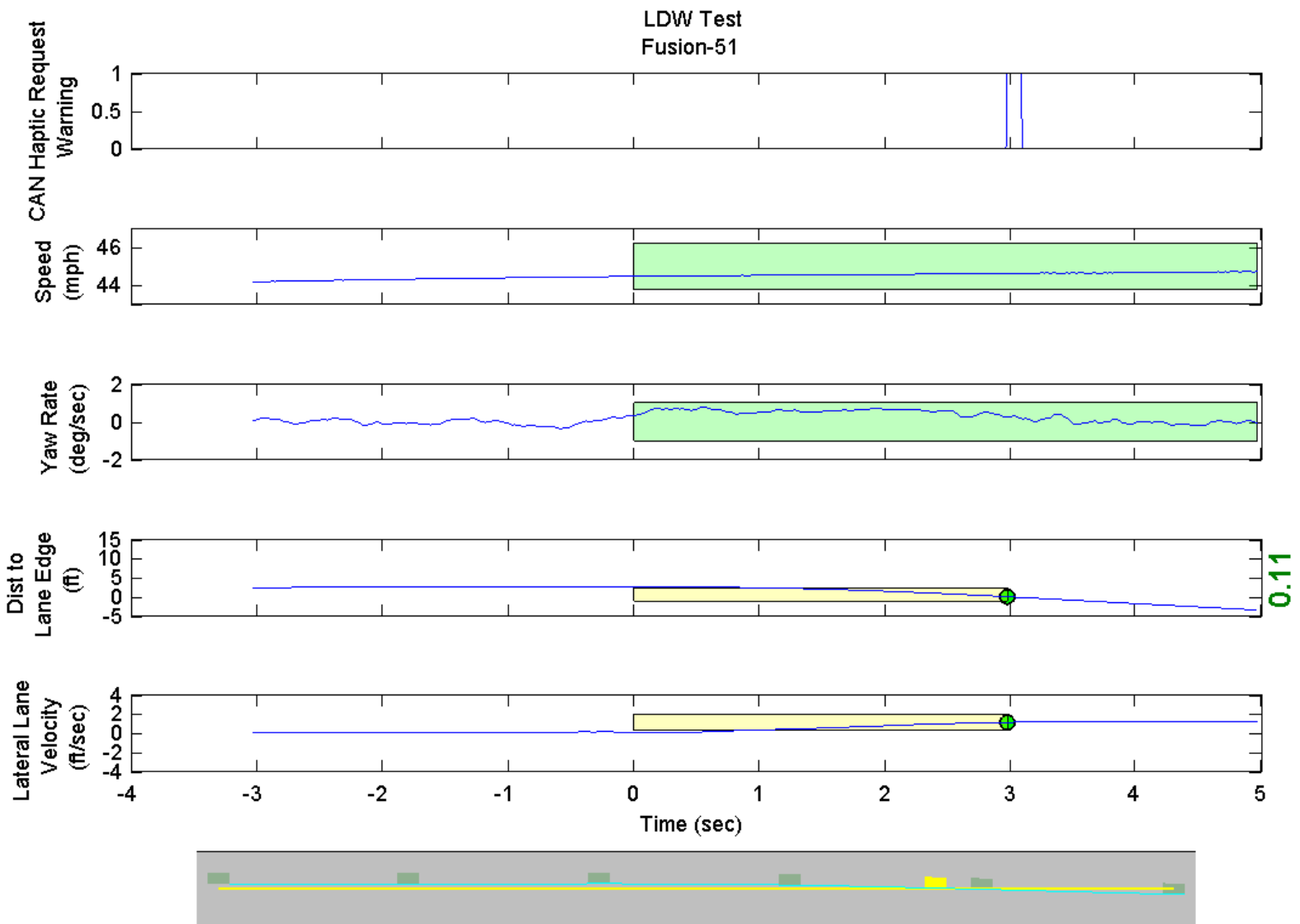
GPS Fix Type: RTK Fixed

Figure D82. Time History for Run 49, Botts Dots, Right Departure, CAN Haptic Warning Request



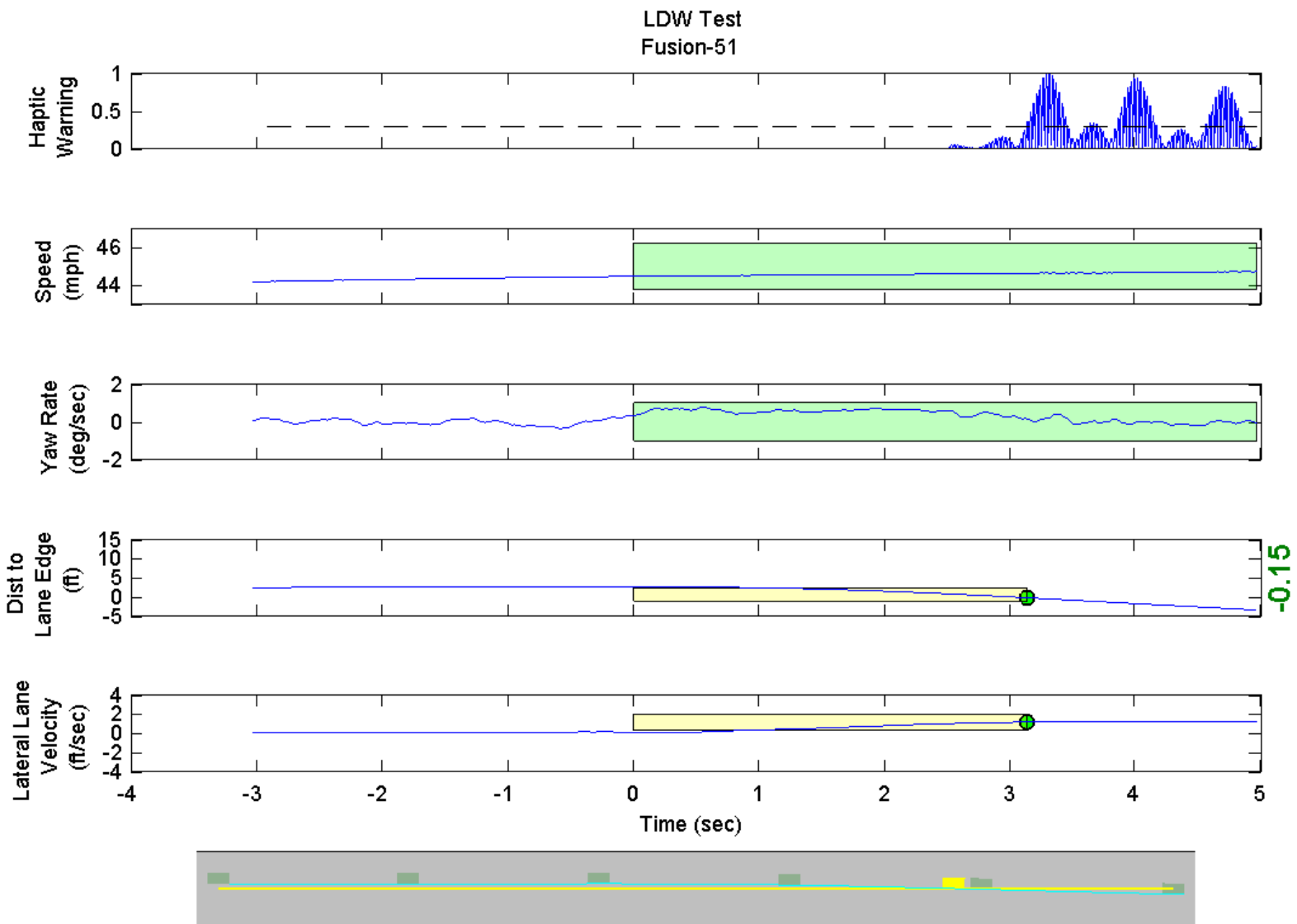
GPS Fix Type: RTK Fixed

Figure D83. Time History for Run 49, Botts Dots, Right Departure, Haptic Warning



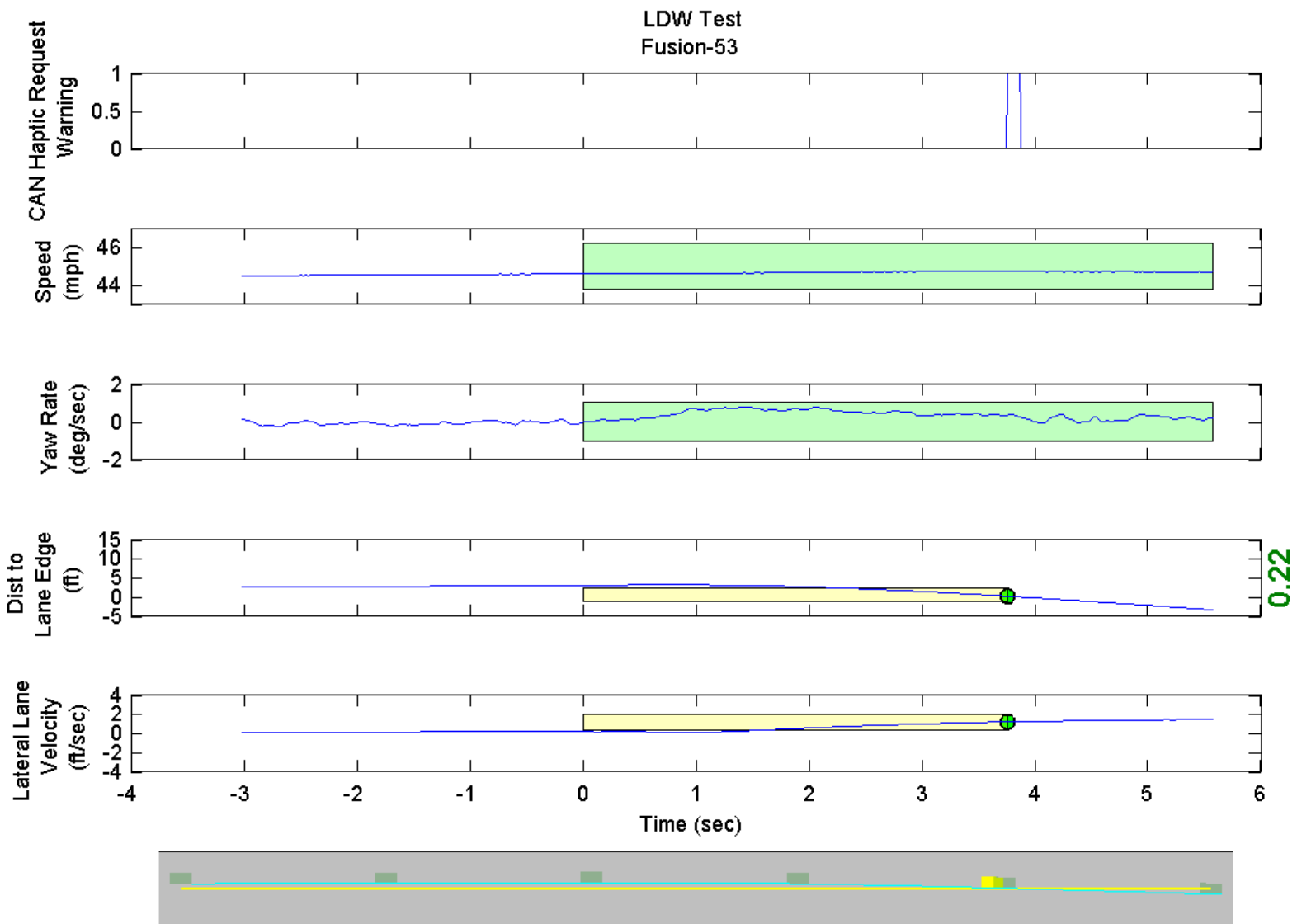
GPS Fix Type: RTK Fixed

Figure D84. Time History for Run 51, Botts Dots, Right Departure, CAN Haptic Warning Request



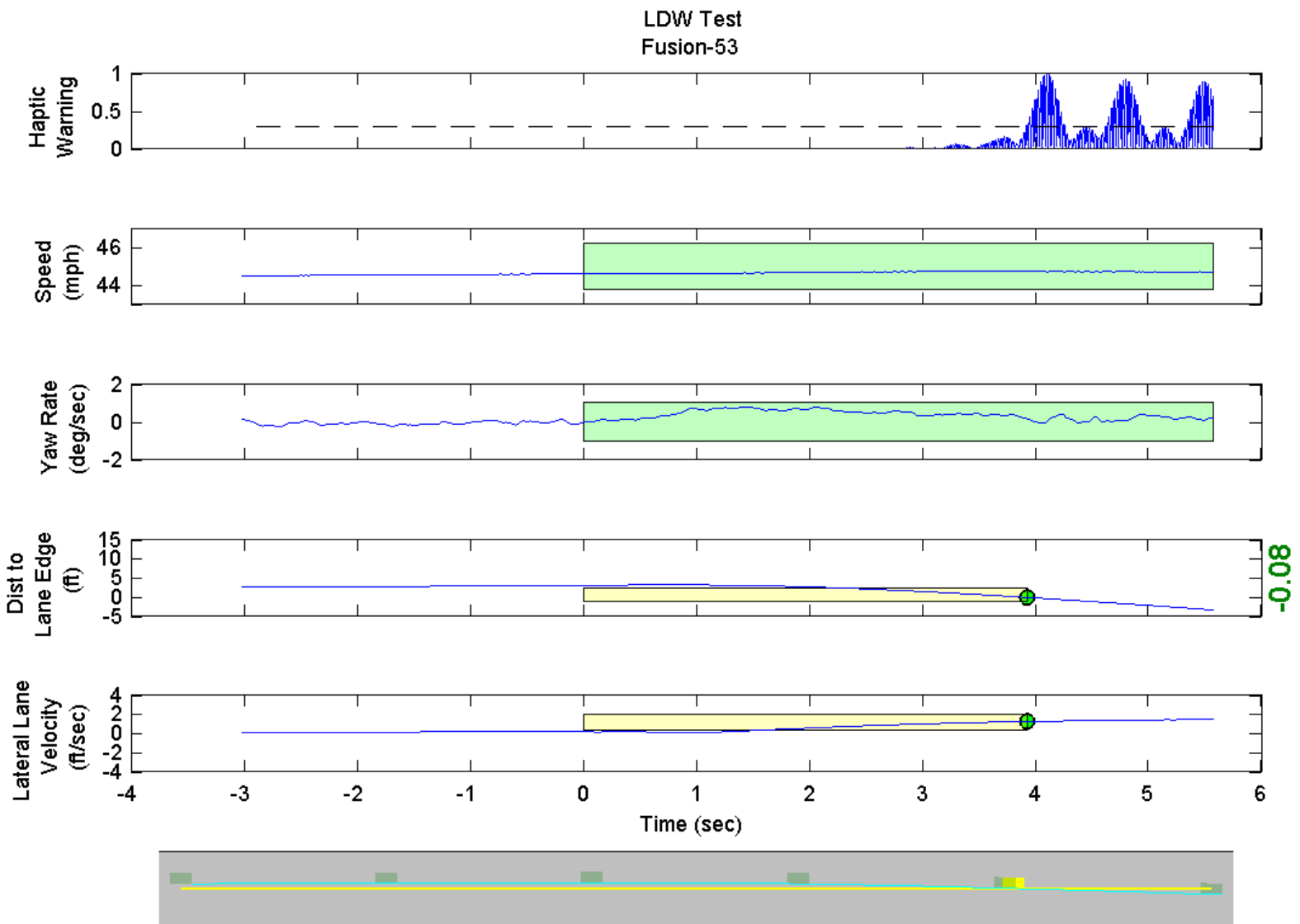
GPS Fix Type: RTK Fixed

Figure D85. Time History for Run 51, Botts Dots, Right Departure, Haptic Warning



GPS Fix Type: RTK Fixed

Figure D86. Time History for Run 53, Botts Dots, Right Departure, CAN Haptic Warning Request



GPS Fix Type: RTK Fixed

Figure D87. Time History for Run 53, Botts Dots, Right Departure, Haptic Warning