NATIONAL TRANSPORTATION SAFETY BOARD
Investigative Hearing

Washington Metropolitan Area Transit Authority Metrorail train 302 that encountered heavy smoke in the tunnel between the L'Enfant Plaza Station and the Potomac River Bridge on January 12, 2015

Agency / Organization

NTSB

Title

On-Board Data Recorders Group Factual Report

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

April 16, 2015

On-Board Data Recorders

Group Chairman's Factual Report
By Cassandra Johnson

1. EVENT SUMMARY

Location:	L'Enfant Plaza, Washington, District of Columbia
Date:	January 12, 2015
Company:	Washington Metropolitan Area Transit Authority
Train:	302
NTSB Number:	DCA15FR004

On January 12, 2015, about 3:15 p.m., eastern standard time (EST), Washington Metropolitan Area Transit Authority (WMATA) Metrorail train 302 stopped after encountering an accumulation of heavy smoke while traveling southbound in a tunnel between the L'Enfant Plaza Station and the Potomac River Bridge. After stopping, the rear car of the train was about 386 feet from the south end of the L'Enfant Plaza Station platform. The train operator contacted the Operation Control Center (OCC) and announced that the train was stopped due to heavy smoke.

A following train (train 510), stopped at the L'Enfant Plaza Station at about 3:25 p.m., and was also affected by the heavy smoke. This train stopped about 100 feet short of the south end of the platform. Passengers of both trains, as well as passengers on the station platforms, were exposed to the heavy smoke. Train 510 was evacuated while it was stopped at the station platform. Some passengers aboard train 302 began to self-evacuate as it remained in the tunnel. Emergency responders were dispatched to the scene and an evacuation of the train and station area ensued. As a result of the smoke, 86 passengers were transported to local medical facilities for treatment. There was one passenger fatality. Initial damages were estimated by WMATA at $120,000.00.

The parties to the investigation include the Washington Metropolitan Area Transit Authority, the Federal Transit Administration, the Tri-State Oversight Committee, the Amalgamated Transit Union 689, the International Fire Fighters Association 36, the District of Columbia Fire and EMS, the Metropolitan Police Department, and the Bureau of Alcohol, Tobacco, Firearms and Explosives.

2. RECORDER GROUP

On January 20, 2015, a recorder group was established.

Chairman: Cassandra Johnson
                    Mechanical Engineer
                    National Transportation Safety Board

Member: Michael Lohman
            Assistant Manager - CENV
            Washington Metropolitan Area Transit Authority

3. DETAILS OF RECORDER INVESTIGATION

Table 1 lists the recorder data from Metrorail train 302 that the National Transportation Safety Board (NTSB) Vehicle Recorder Division received:

Table 1. Data recorder files description.

Recorder Location	Recorder Type
Train 302 Car 6134	Federal Rail Administration (FRA)[1] Recorder
Train 302 Car 6134	Data Acquisition Module (DAM)
Train 302 Car 6135	DAM
Train 302 Car 3030	FRA Recorder
Train 302 Car 3030	DAM
Train 302 Car 3031	DAM

3.1.   On Board Recorder Recording Description

The Washington Metropolitan Area Transit Authority (WMATA) Metrorail train 302 was configured with three sets of cars (six cars total): car 6134 with car 6135, car 1284 with car 1285, and car 3030 with car 3031. At the time of the accident, car 6134 was the lead car and car 3031 was the trailing car. Therefore, the train consist was: car 6134 (lead) - car 6135 - car 1285 - car 1284 - car 3030 - car 3031 (trailing). Each car except the 1000 series cars (cars 1284 and 1285) have recording devices.

A WMATA Metrorail train is configured with an even number of cars, where each pair of cars is comprised of an A car and a B car. The A car is the even numbered car of the set and the B car is the odd numbered car. Except for the 1000 series cars, each married pair has one Federal Railroad Administration (FRA) recorder and each car has a Data Acquisition Module (DAM).

Each pair of cars has a Vehicle Monitoring System (VMS) which is composed of one VMS Central Unit (VCU), one Fault Display Unit (FDU) from Car A, one FDU from Car B, one DAM from Car A (referred to as DAMA), and one DAM from car B (referred to as DAMB).

The VCU is the main component of the VMS system and is responsible for monitoring, analyzing, and recording data from each major system (propulsion, friction, brake, automatic train control (ATC), doors, heating ventilation and air conditioning (HVAC), auxiliary power supply (APS)), detecting faults and recording train data in the FRA recorder. The FRA recorder is a microprocessor-based memory-based hardened module that communicates with the VCU control unit exchanging commands and receiving data to record.

---

[1] WMATA uses the terminology Federal Railroad Administration (FRA) to describe the recording system; however, this should not be confused with the Federal Railroad Administration Agency.

The DAM records analog and digital data and provides that data to the VCU for monitoring. It also calculates train speed and distance covered.

The FDU supports the man-machine interface with the operator, displaying information on detected faults, and accepting Operator commands. The FDU is mounted in the operator's console of both Car A and Car B on the vehicle.

The VMS performs the following functions:

- Monitors the major train systems: ATC, APS, doors, brakes, propulsion, and HVAC.
- Supports maintenance personnel activities by monitoring on-line train variables (for example, the analysis/identification of detected train state).
- Detects faults and warnings and provides information to the operator about those faults and warnings.
- Records train events information and corresponding train environment variables of the recorded events.
- Records train variables (FRA signal data) for further analysis by investigators in the event of an accident (Recorder Functionality).

For each set of cars except the 1000 series cars, both DAMA and DAMB can be downloaded to obtain their information, and the VMS can be downloaded to obtain the FRA recorder data. Additionally, there is redundancy in the FRA recorder data because it also records some of the DAMA and DAMB data. However, the FRA recorder records other data, specifically the ATC information (for example, regulated speed and limited speed) but the ATC data is only active and recorded in the lead cars' FRA recorder. In conclusion, Metrorail train 302 had a total of two FRA recorders, two DAMAs, and two DAMBs that were available for downloading. For simplicity, the six sources of data will be referred as: FRA 6134, DAMA 6134, DAMB 6135, FRA 3030, DAMA 3030, and DAMB 3031.

3.2. Parameters

Table A-1 lists the data recorder parameters verified and provided in this report for Metrorail train 302's six sources of recorder data (FRA 6134, DAMA 6134, DAMB 6135, FRA 6134, DAMA 6134, and DAMB 6135). Additionally, table A-2 contains the unit abbreviations for the parameters. There were not any parameters that recorded the 3rd rail voltage or individual door openings.

3.2.1. Door Closed Parameters

The door closed parameters are DoorClosed_A_2b and DoorClosed_A_5b. The door closed parameters are only connected on the A car to the DAMA module and are active if either car A or car B is the operating car. For example, when car 6134 is occupied (for example, CabOccu_A_1b has a value of 1), then the DoorClosed_A_2b parameter would be active. The door closed parameter will have a value of 1 when all passenger doors are closed. Alternatively, the door closed parameter will have a value of 0 if one or more doors anywhere in the Metrorail train are opened.

3.2.2. Door Command Parameters

The right door open command parameter (TL1_2_A), right door close command parameter (TL1_2_B), left door open command parameter (TL3_4_A), and left door close command parameter (TL3_4_B) are triggered when the operator commands the doors to open or close. When stopped at a platform, the operator may open and close the doors a few times before moving. This is common as the operator is attempting to get the doors closed with the customers trying to board the train as the doors are closing.

Additionally, the door close commands are triggered for both left and right side doors after the train begins to move. This is normal because the ATC system is programmed to send close commands down the trainlines each time the train starts moving.

3.2.3. TL45 and TL75 Environmental Control Trainline Parameters

The TL45 parameter is the Environmental Control On Trainline. This parameter indicates the status of trainline 45. This trainline is used to command the HVAC systems in each car of the train to turn on. This trainline should be active (value of 1) when any car in the train is activated (the operator turns the train on).

The TL75 parameter is the Environmental Control Off Trainline This parameter indicates the status of trainline 75. This trainline is used to command all HVAC systems in each car of the train to turn off.

3.2.4. TL46_TL47 and TL41_TL42 Audio Parameters

The TL46_TL47 public address audio parameters and the TL41_TL42 intercom audio parameters have a sampling rate of 40 samples per second (Hz) and did not yield any useful audio. However, these parameters indicate that communication was occurring on either the public address system or the intercom system.

3.3. Time Correlation

All six sources of recorder data from Metrorail train 302 are independently time stamped and, consequently, the times may not reflect the actual time of day. To time align the six sets of data, the speed data from all six data sources were compared. Using speed from FRA 6134 as the baseline, as shown in figure 1, the following time offsets were needed: +228.8 applied to DAMA 6134 data, +17.5 seconds applied to DAMB 6135 data, -114.3 seconds applied to FRA 3030 data, -80.3 seconds applied to DAMA 3030 data, and -77.2 seconds applied to DAMB 3031 data. However, due to the accuracy of the speed data, the time adjustment accuracy is +/- 1 second.

Figure 1. Time correlation of Metrorail train 302's six sources of data.

Revised: 26 March 2015   National Transportation Safety Board
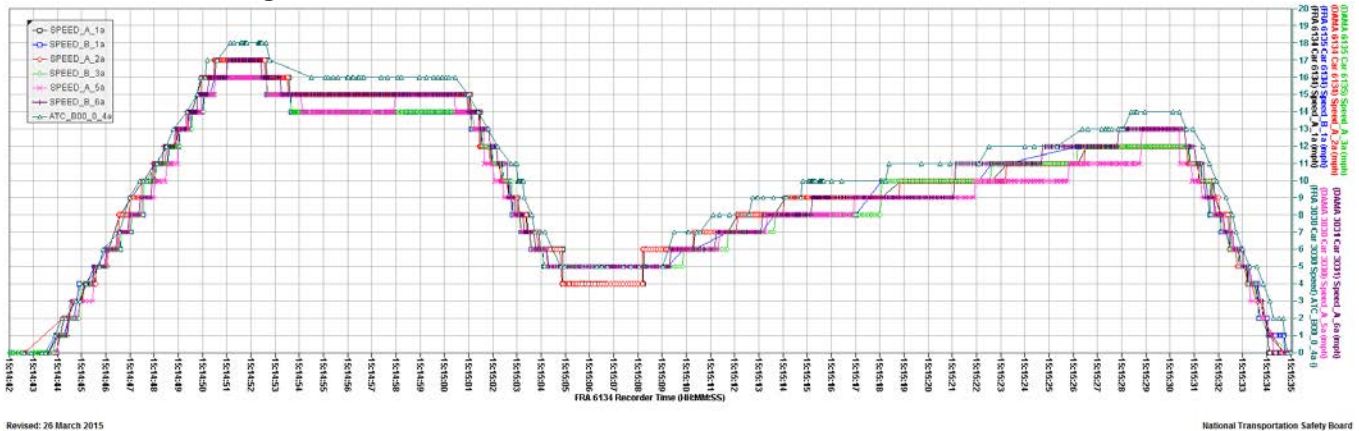
To convert the time to EST, the speed data was correlated to Metrorail train 302's movement at the L'Enfant Plaza station as captured by the WMATA security video recorders[2]. Thus, an offset of -19 seconds was applied to the recorder data in order to align it to the movement of Metrorail train 302. For the rest of this report, all times are referenced as EST.

3.4.   Plots and Corresponding Tabular Data

Figures 2 to 16 contain Metrorail train 302's recorder data recorded during the January 12, 2015 event. All the parameters listed in table A-1 are included except ATC_B00_0_4b (actual vehicle speed for car 3030), which is only plotted in figure 1.

Figures 2 to 6 cover 15:13:30 EST to 15:15:18 EST, which includes Metrorail train 302 arriving at L'Enfant Plaza Station, then departing L'Enfant Plaza Station, and then coming to a complete stop. Figures 7 to 11 cover 15:14:23 EST to 15:15:19 EST, which includes Metrorail train 302 departing L'Enfant Plaza Station then coming to a complete stop. Lastly, figures 12 to 16 cover 15:14:40 EST to 15:53:40 EST, which includes Metrorail train 302 having already departed L'Enfant Plaza Station until the FRA data ends.

Figures 2, 7, and 12 contain the car occupied, speed, doors closed, battery voltage, and distance parameters. Figures 3, 8, and 13 contain the car occupied, doors closed, speed, and door command parameters. Figures 4, 9, and 14 contain the car occupied, speed, battery voltage, and audio parameters. Figures 5, 10, and 15 contain the car occupied, speed, battery voltage, and brake parameters. Lastly, figures 6, 11, and 16 contain the car occupied, environmental control on/off, emergency stop, interior lights, and white light relay parameters.

In summary, Metrorail train 302's recorder data indicated the following:

- At 15:14:25 EST, Metrorail train 302 departed L'Enfant Plaza Station with car 6134 (lead car) occupied[3] (CabOccu_A_1b has a value of 1) and all passenger doors closed (DoorClosed_A_2b has a value of 1).

---

[2] Refer to the National Transportation Safety Board's Security Video Recorders – Group Chairman's Factual Report.
[3] A car being occupied means the operator has entered and activated the car. The operator is located in the cab of the car.

- Fifty seconds later, at 15:15:15 EST, Metrorail train 302 came to a complete stop, and based on the DAMA 6134 distance data (Distance_A_2a), the train had moved approximately 791 feet (ft).
- One minute and 20 seconds later, at 15:16:35 EST, car 6134 was not occupied (CabOccu_A_1b transitioned from 1 to 0). Also at this time, DoorClosed_A_2b transitioned from 1 to 0 because neither car 6134 or car 6135 were occupied.
- Two minutes and 10 seconds later, at 15:18:45 EST, car 3031 (trailing car) was occupied (CabOccu_B_6b transitioned from 0 to 1), and all passenger doors were closed (DoorClosed_A_5b transitioned from 0 to 1).
- Two minutes and 44 seconds later, from 15:21:29 EST to 15:21:31 EST, the DoorClosed_A_5b parameter briefly transitioned from 1 to 0 back to 1 indicating one or more passenger doors were opened for about 2 seconds.
- Seventeen minutes and 21 seconds later, at 15:38:52 EST, car 3031 was not occupied (CabOccu_B_6b transitioned from 1 to 0). Also at this time, DoorClosed_A_5b transitioned from 1 to 0 because neither car 3031 or car 3030 were occupied.
- Nine minutes and 50 seconds later, at 15:48:42 EST, car 3030 (the car adjacent to the trailing car) was occupied (CabOccu_A_5b transitioned from 0 to 1). However, DoorClosed_A_5b remained at a value of 0 indicating one or more passenger doors were opened.
- Four minutes and 5 seconds later at 15:52:47 EST, car 3030 was not occupied (CabOccu_A_5b transitioned from 1 to 0).
- Thirty seconds later, at 15:53:17 EST, the FRA data ends.

All of the corresponding tabular data used to create figures 1 to 16 are provided in electronic (.csv) format as attachment 1 to this factual report.

Figure 2: Car Occupied, Speed, Door Closed, Battery Voltage, and Distance Parameters (Arrive and Leave L'Enfant to Complete Stop)
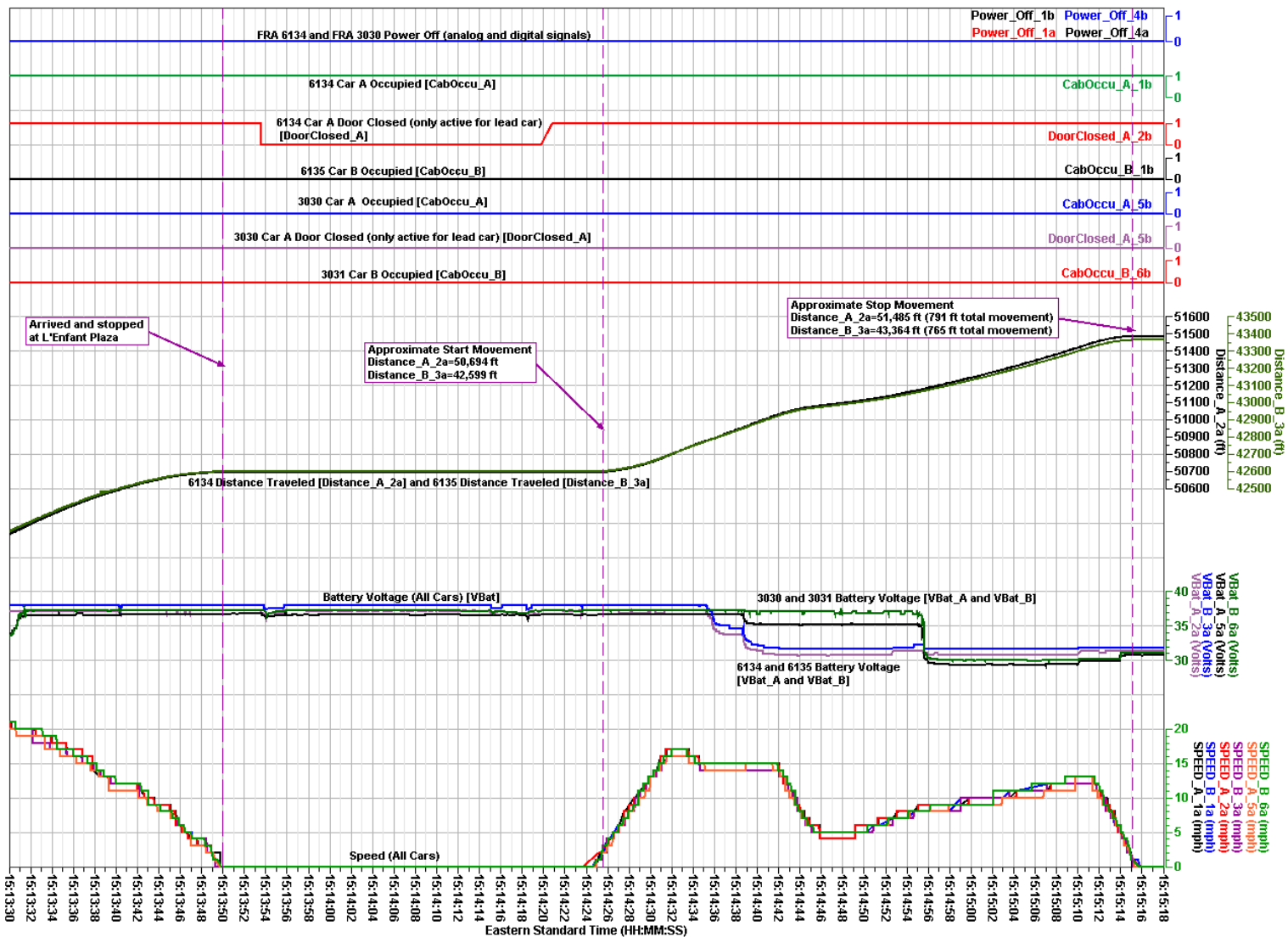
Revised: 16 April 2015   Car Occupied, Distance, Speed (Arrive & Leave L'Enfant - Complete Stop)   National Transportation Safety Board

DCA15FR004
On-Board Data Recorders Factual Report, page 7 of 21

Figure 3: Car Occupied, Door Closed, Speed, and Doors Command Parameters (Arrive and Leave L'Enfant to Complete Stop)

Figure 4: Car Occupied, Speed, Battery Voltage, and Audio Parameters (Arrive and Leave L'Enfant to Complete Stop)

Figure 5: Car Occupied, Speed, Battery Voltage, and Brake Parameters (Arrive and Leave L'Enfant to Complete Stop)

FRA 6134 and FRA 3030 Power Off (analog and digital signals)

6134 Car A Occupied [CabOccu_A]

6135 Car B Occupied [CabOccu_B]

3030 Car A Occupied [CabOccu_A]

3031 Car B Occupied [CabOccu_B]

6134 and 6135 Brake Pipe Pressure Switch [BRKPipSW]

3030 and 3031 Brake Pipe Pressure Switch [BRKPipSW]

Air Recharge Trainline (All Cars) [TL51]

PRA_B02_0_1a = 6134 Car A Truck 1 effort achieved feedback
PRA_B03_0_1a = 6134 Car A Truck 2 effort achieved feedback
PRB_B02_0_1a = 6135 Car B Truck 1 effort achieved feedback
PRB_B03_0_1a = 6135 Car B Truck 2 effort achieved feedback

BRRA_B02_0_1a = 6134 Car A Brakes A car rear (Truck 2)
BRRB_B02_0_1a = 6135 Car B Brakes B car rear (Truck 2)

BRFA_B03_0_1a = 6134 Car A Truck 1 Brake cylinder transducer pressure
BRRA_B03_0_1a = 6134 Car A Truck 2 Brake cylinder transducer pressure
BRFB_B03_0_1a = 6135 Car B Truck 1 Brake cylinder transducer pressure
BRRB_B03_0_1a = 6135 Car B Truck 2 Brake cylinder transducer pressure

BRFA_B00_0_1a = 6134 Car A Truck 1 Electric brake achieved
BRRA_B00_0_1a =6134 Car A Truck 2 Electric brake achieved
BRFB_B00_0_1a = 6135 Car B Truck 1 Electric brake achieved
BRRB_B00_0_1a =6135 Car B Truck 2 Electric brake achieved

Battery Voltage (All Cars) [VBat]

Battery Voltage Cars 3030 and 3031 [VBat_A and VBat_B]

Battery Voltage Cars 6134 and 6135 [VBat_A and VBat_B]

Speed (All Cars)

Eastern Standard Time (HH:MM:SS)

Brakes (Arrive & Leave L'Enfant - Complete Stop)

National Transportation Safety Board

Figure 6: Environmental, Emergency Stop, Interior Lights, White Light Relay Parameters (Arrive and Leave L'Enfant to Complete Stop)

Power_Off_1b Power_Off_4b
Power_Off_1a Power_Off_4a

FRA 6134 and FRA 3030 Power Off (analog and digital signals)

6134 Car A Car Occupied [CabOccu_A]   CabOccu_A_1b

6134 Car A Door Closed (only active for lead car) [DoorClosed_A]   DoorClosed_A_2b

6135 Car B Occupied [CabOccu_B]   CabOccu_B_1b

3030 Car A Car Occupied [CabOccu_A]   CabOccu_A_5b

3030 Car A Door Closed (only active for lead car) [DoorClosed_A]   DoorClosed_A_5b

3031 Car B Occupied [CapOccu_B]   CabOccu_B_6b

Environmental Control On Trainline (All Cars) [TL75]

6134 Environmental Control Off Trainline [TL45_A]   TL45_A_2b

6135 Environmental Control Off Trainline [TL45_B]   TL45_B_3b

3030 Environmental Control Off Trainline [TL45_A]   TL45_A_5b

3031 Environmental Control Off Trainline [TL45_B]   TL45_B_6b

6134 Emergency Stop Trainline [TL82_A]   TL82_A_2b

6135 Emergency Stop Trainline [TL82_B]   TL82_B_3b

3030 Emergency Stop Trainline [TL82_A]   TL82_A_5b

3031 Emergency Stop Trainline [TL82_B]   TL82_B_6b

6134 Passenger (interior) Lights Off [IntLights_A]   IntLights_A_2b

3030 Passenger (interior) Lights Off [IntLights_A]   IntLights_A_5b

6134 White Light Relay [WLRelay_A]   WLRelay_A_2b

3030 White Light Relay [WLRelay_A]   WLRelay_A_5b

Speed (All Cars)
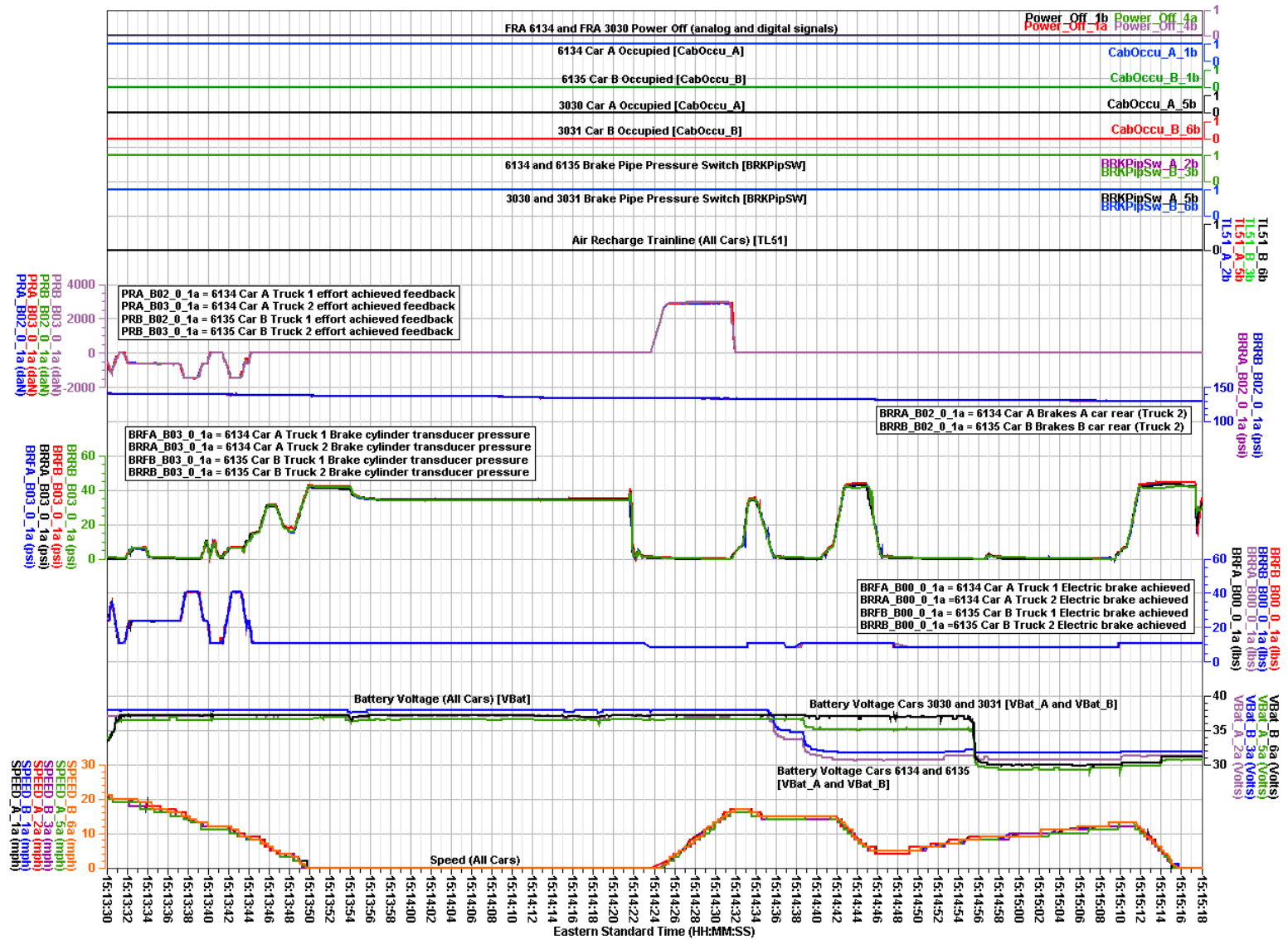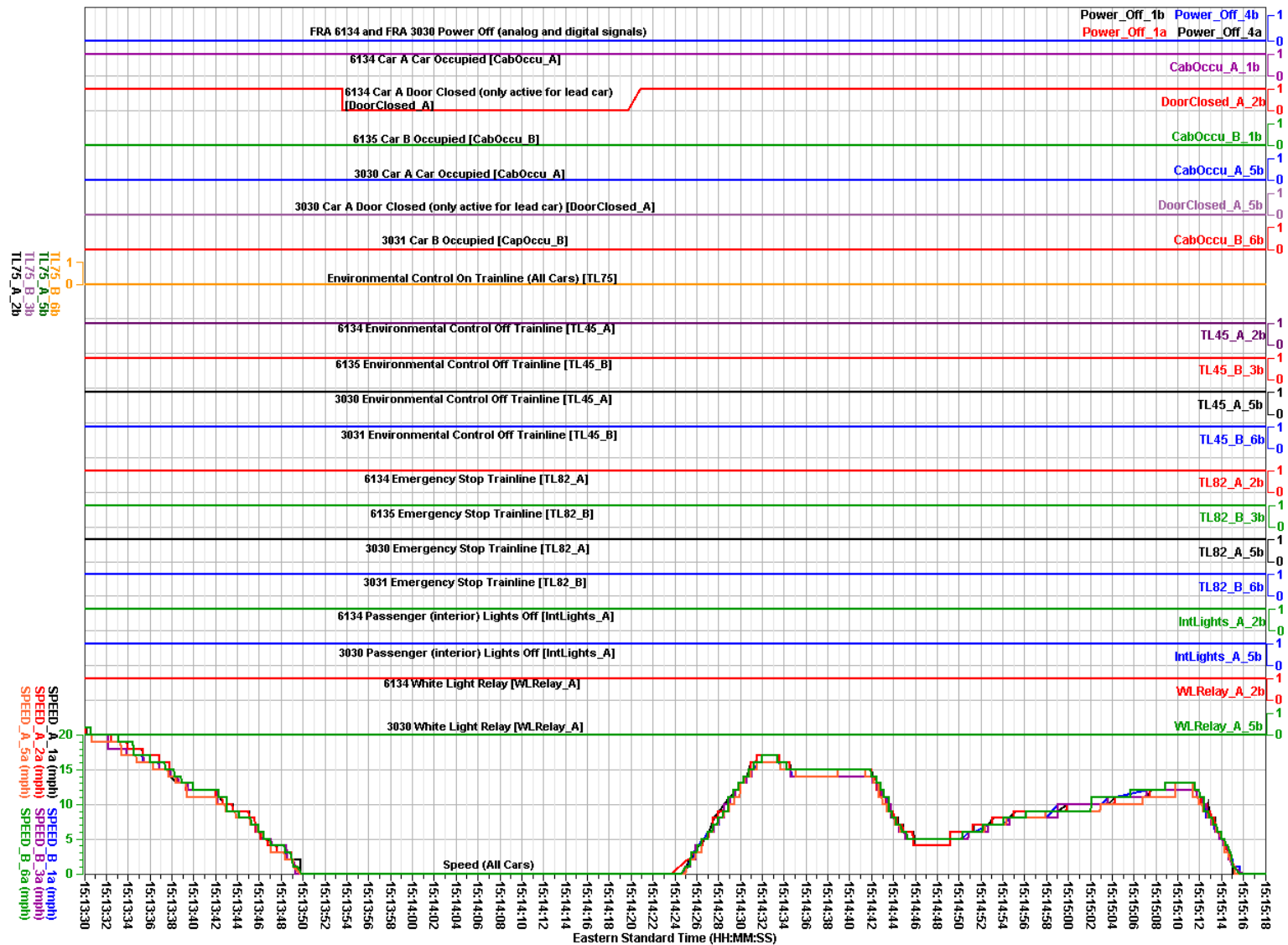
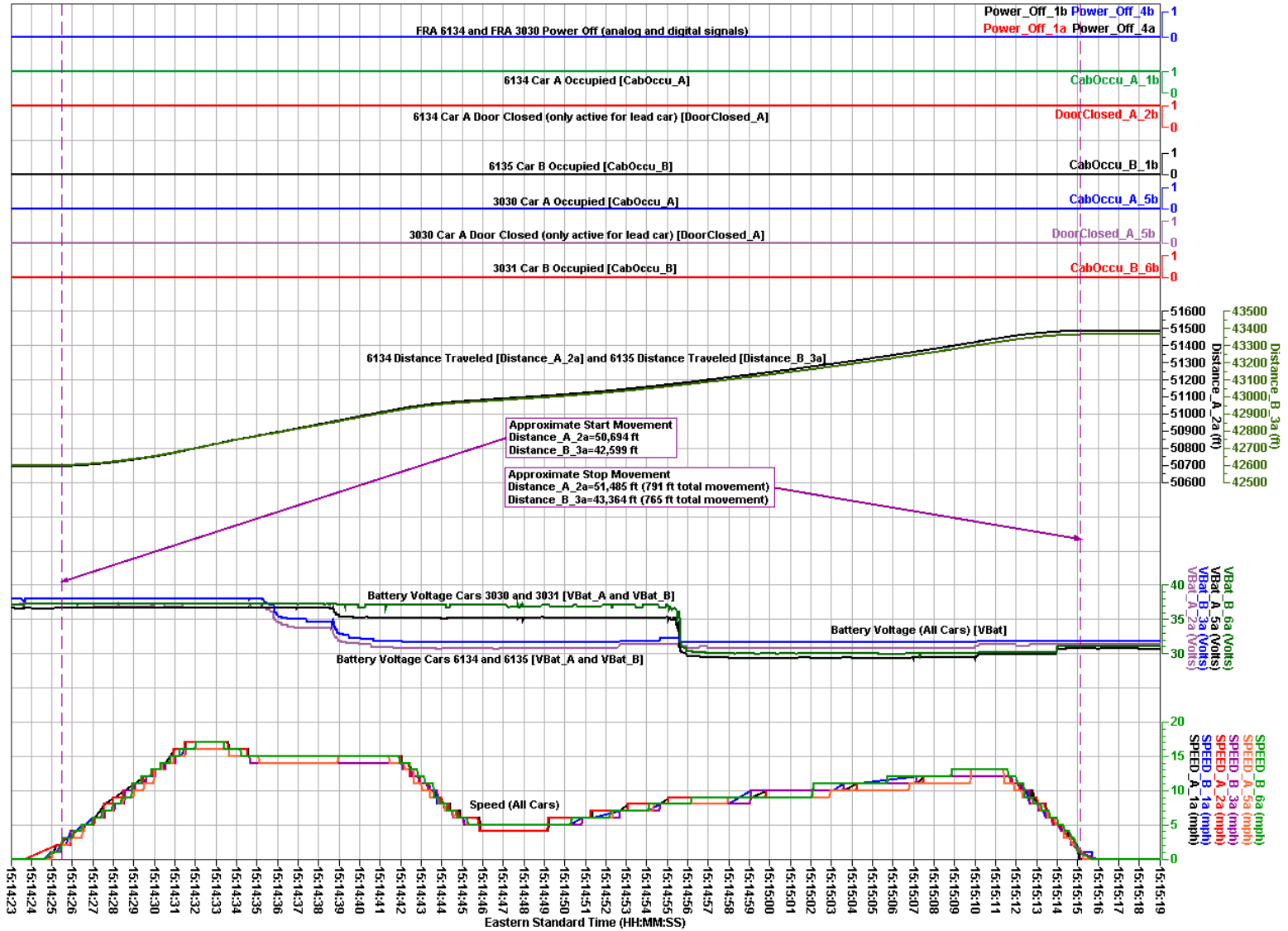Eastern Standard Time (HH:MM:SS)

Revised: 9 April 2015   TL45, TL75, TL82, WLRelay (Arrive & Leave L'Enfant - Complete Stop)   National Transportation Safety Board

Figure 7: Car Occupied, Speed, Door Closed, Battery Voltage, and Distance Parameters (Leave L'Enfant to Complete Stop)

FRA 6134 and FRA 3030 Power Off (analog and digital signals)

6134 Car A Occupied [CabOccu_A]

6134 Car A Door Closed (only active for lead car) [DoorClosed_A]

6135 Car B Occupied [CabOccu_B]

3030 Car A Occupied [CabOccu_A]

3030 Car A Door Closed (only active for lead car) [DoorClosed_A]

3031 Car B Occupied [CabOccu_B]

6134 Distance Traveled [Distance_A_2a] and 6135 Distance Traveled [Distance_B_3a]

Approximate Start Movement
Distance_A_2a=50,694 ft
Distance_B_3a=42,599 ft

Approximate Stop Movement
Distance_A_2a=51,485 ft (791 ft total movement)
Distance_B_3a=43,364 ft (765 ft total movement)

Battery Voltage Cars 3030 and 3031 [VBat_A and VBat_B]

Battery Voltage (All Cars) [VBat]

Battery Voltage Cars 6134 and 6135 [VBat_A and VBat_B]

Speed (All Cars)
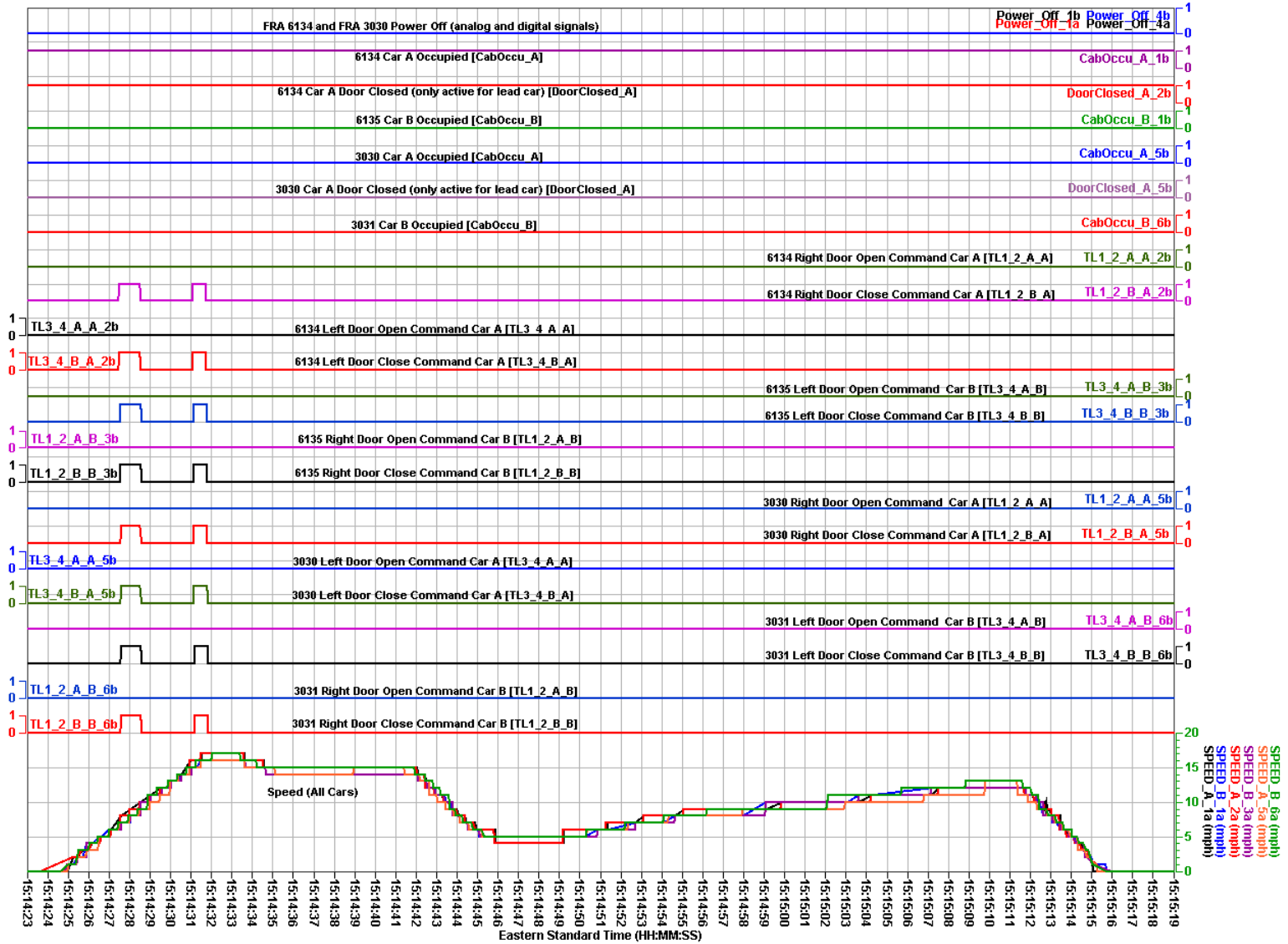
Eastern Standard Time (HH:MM:SS)

Revised: 16 April 2015   Car Occupied, Distance, Speed (Leave L'Enfant - Complete Stop)   National Transportation Safety Board

Figure 8: Car Occupied, Door Closed, Speed, and Doors Command Parameters (Leave L'Enfant to Complete Stop)
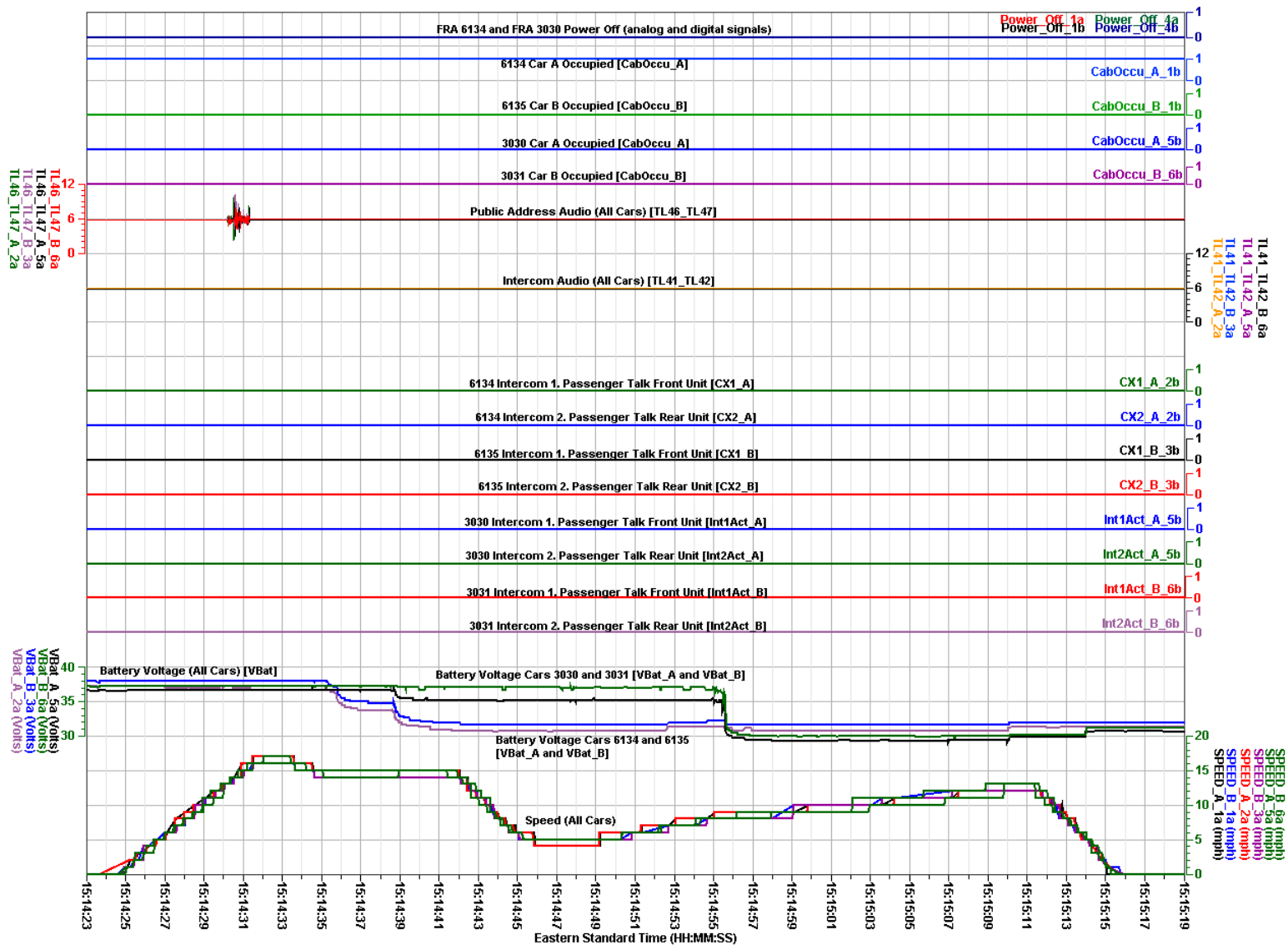

Car Occupied, Speed, & Doors (Leave L'Enfant - Complete Stop)

Figure 9: Car Occupied, Speed, Battery Voltage, and Audio Parameters (Leave L'Enfant to Complete Stop)

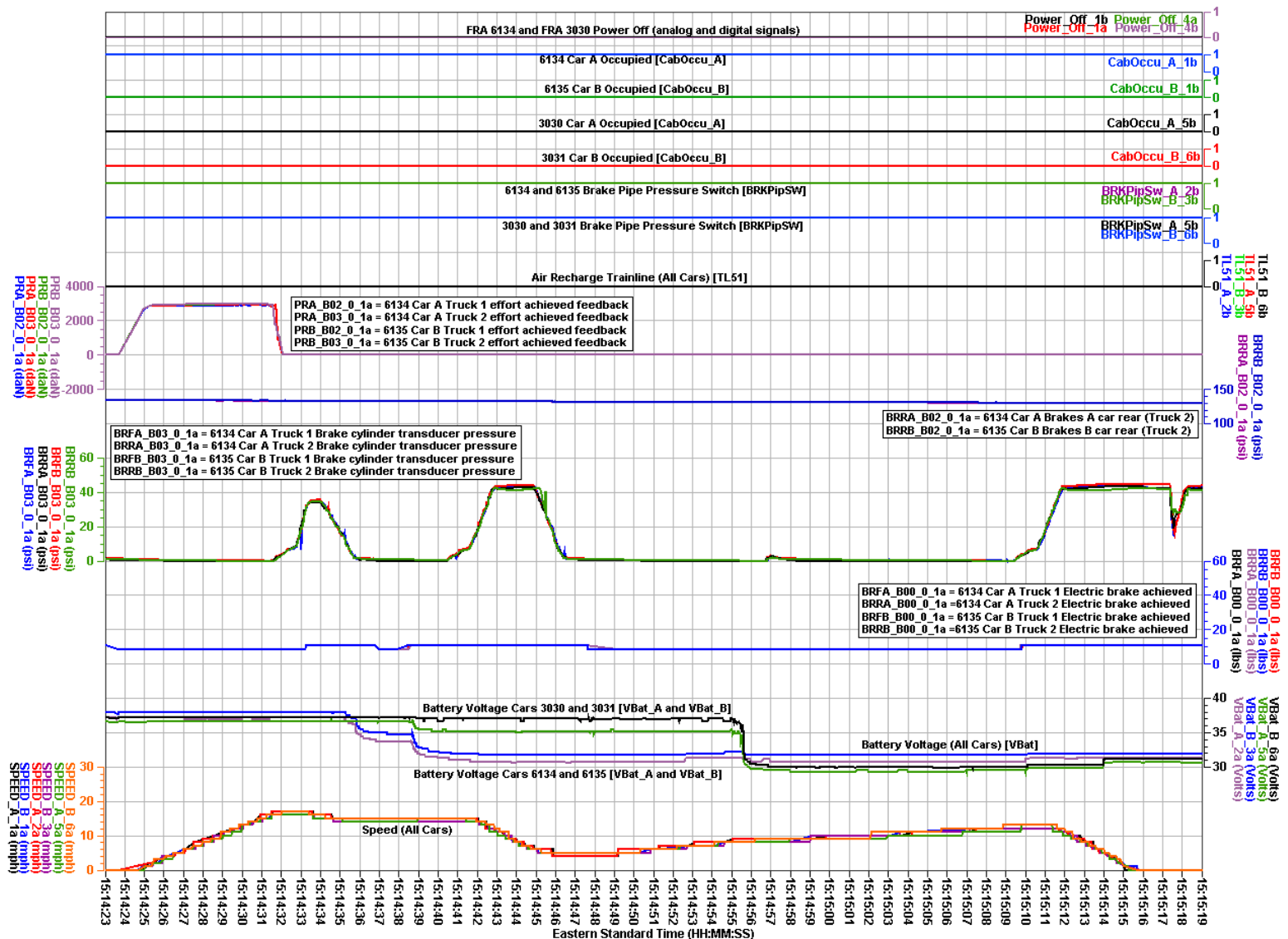**Figure 10: Car Occupied, Speed, Battery Voltage, and Brake Parameters (Leave L'Enfant to Complete Stop)**

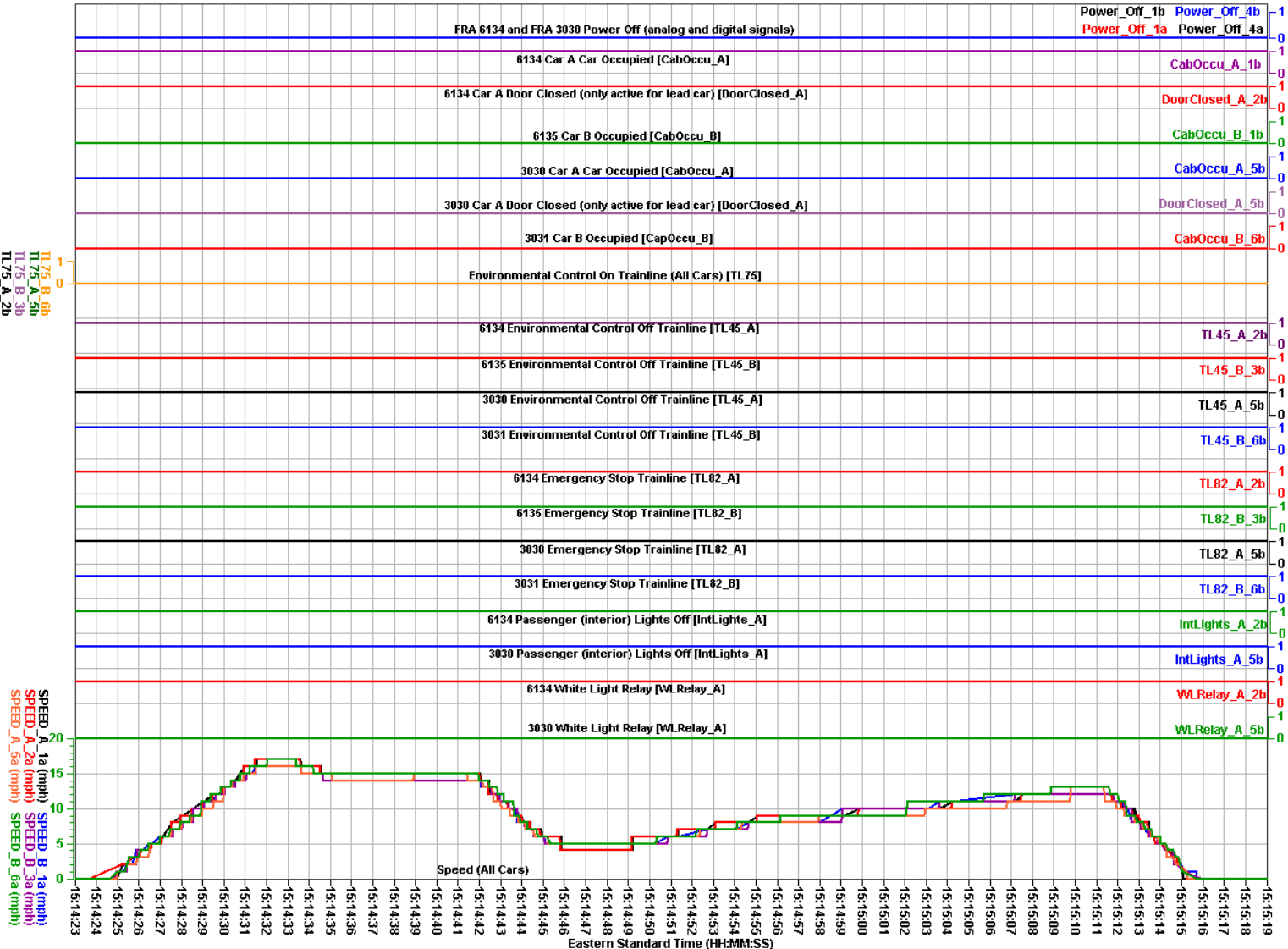**Figure 11: Environmental, Emergency Stop, Interior Lights, and White Light Relay Parameters (Leave L'Enfant to Complete Stop)**

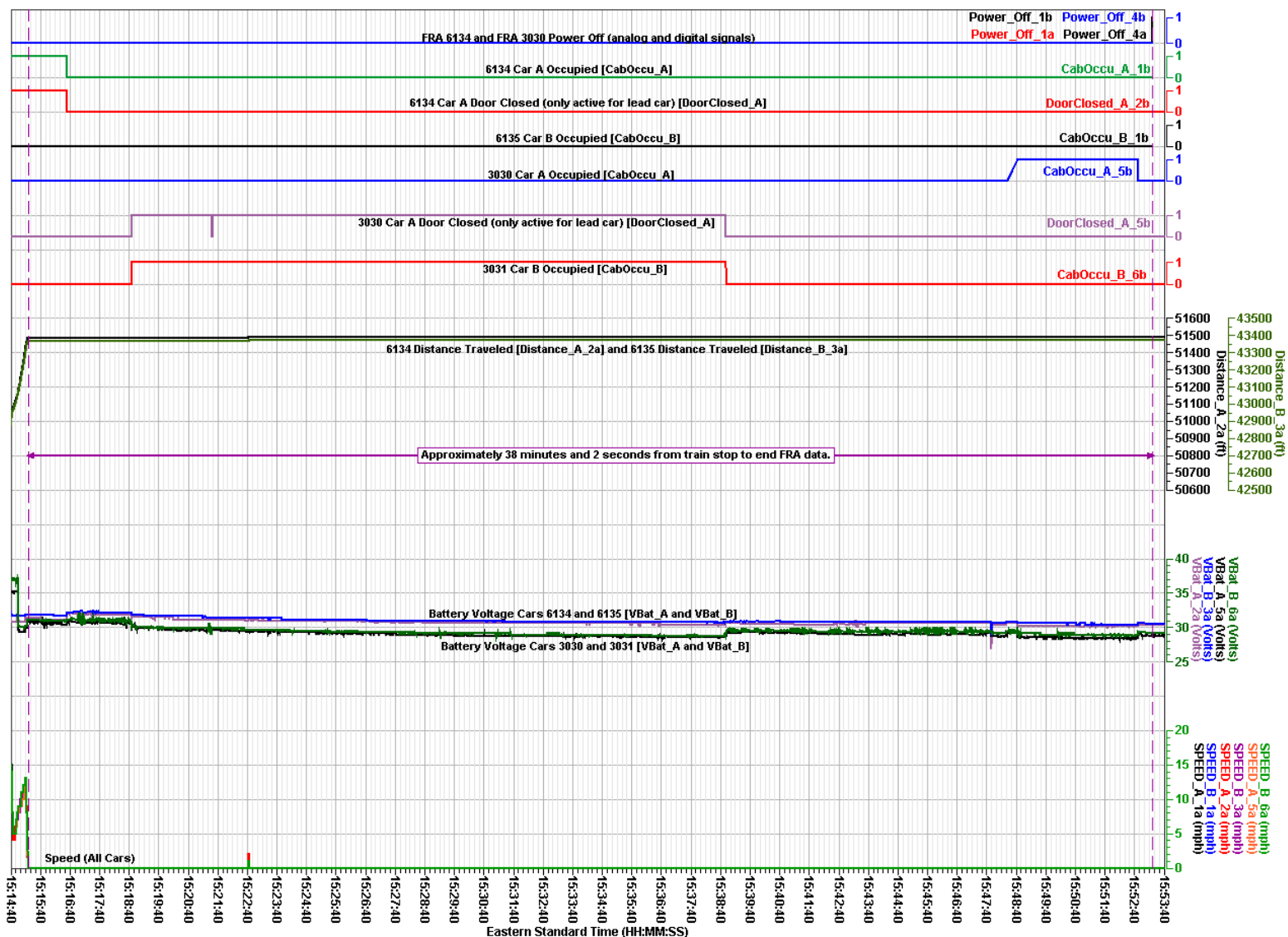# Figure 12: Car Occupied, Speed, Door Closed, Battery Voltage, and Distance Parameters (Left L'Enfant to End FRA Data)

Revised: 9 April 2015

Car Occupied, Distance, Speed (Left L'Enfant - End FRA Data)

National Transportation Safety Board

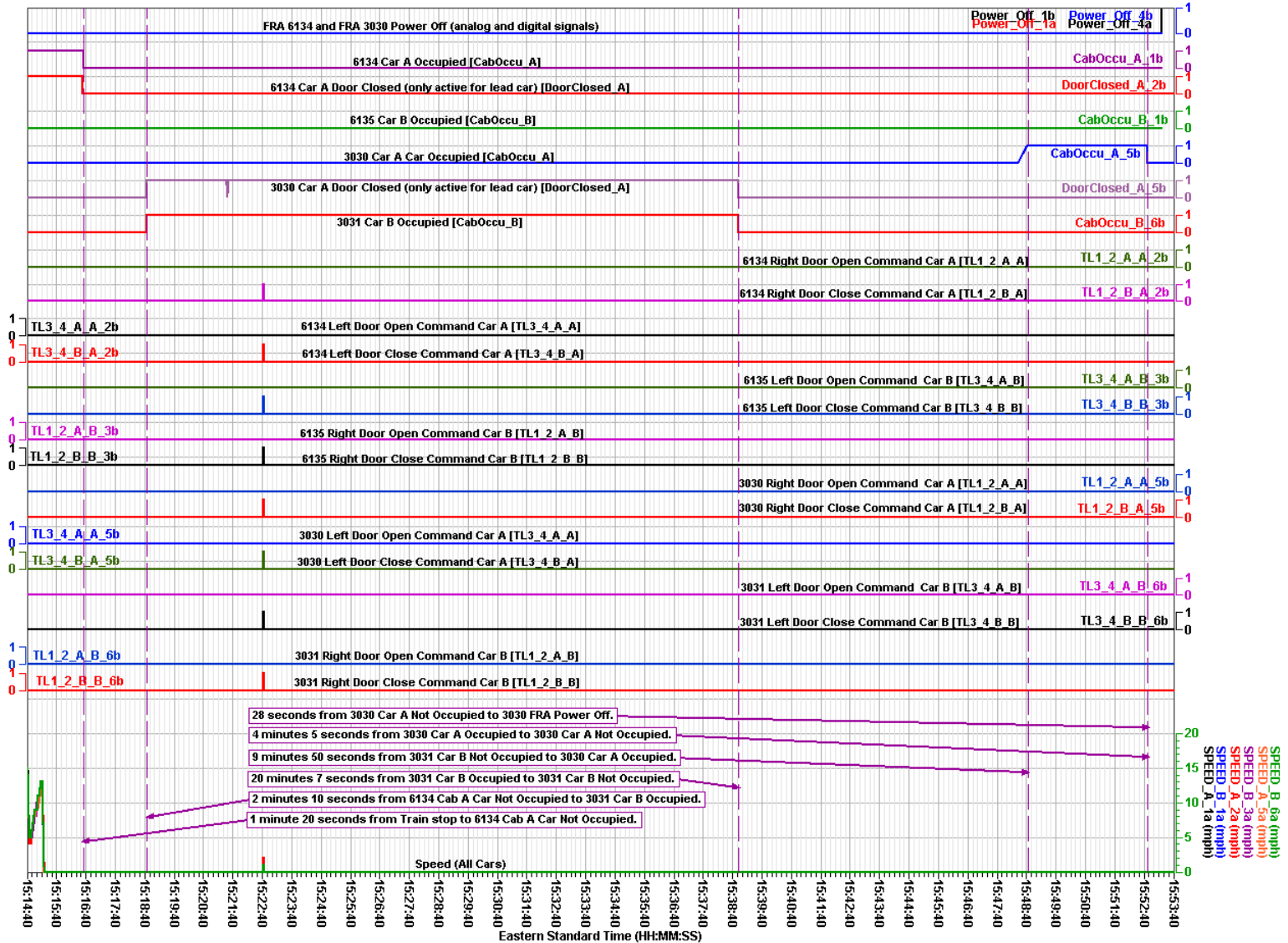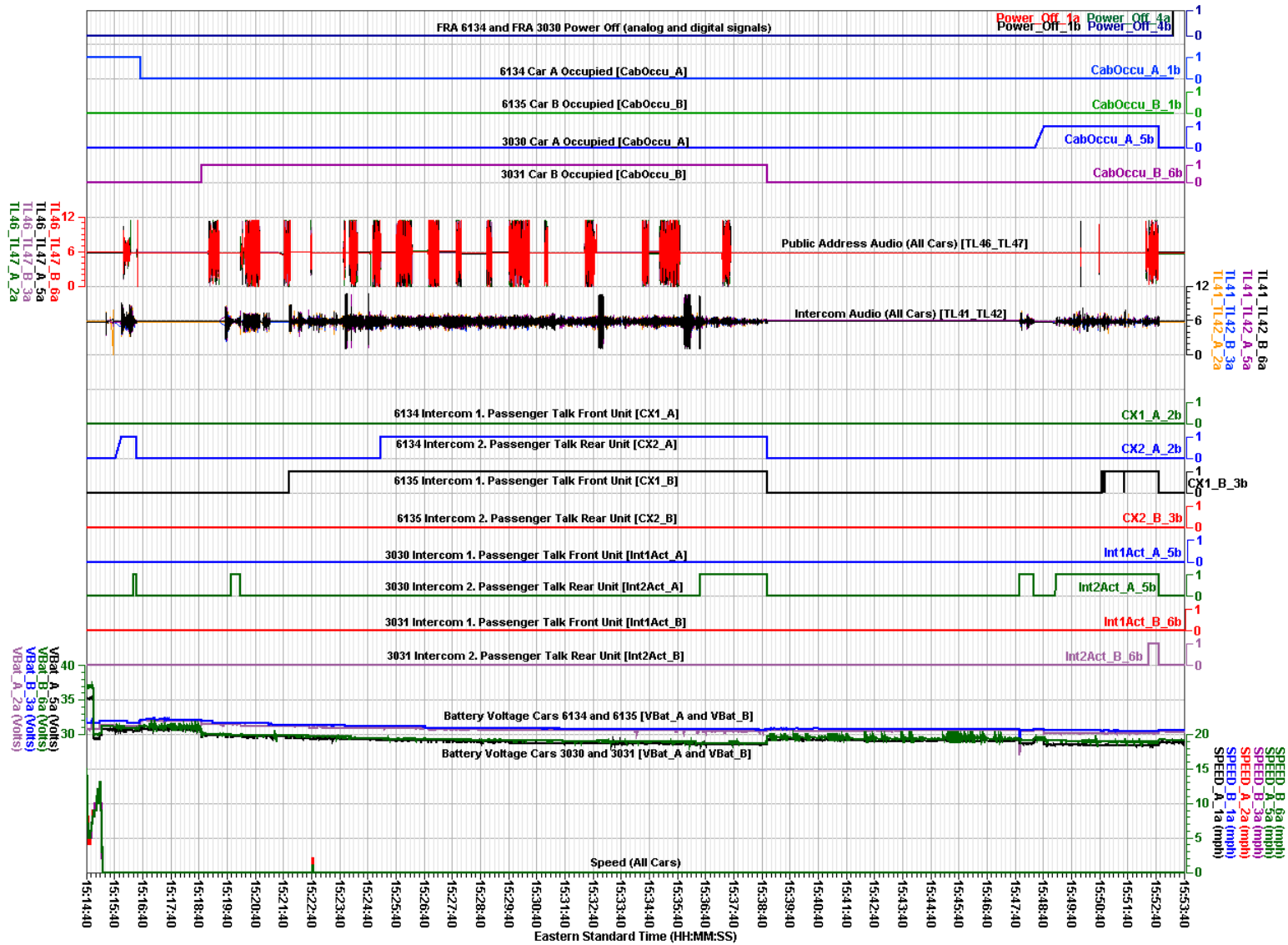# Figure 13: Car Occupied, Door Closed, Speed, and Doors Command Parameters (Left L'Enfant to End FRA Data)

FRA 6134 and FRA 3030 Power Off (analog and digital signals)
Power_Off_1b   Power_Off_4b
Power_Off_1a   Power_Off_4a

6134 Car A Occupied [CabOccu_A]   CabOccu_A_1b

6134 Car A Door Closed (only active for lead car) [DoorClosed_A]   DoorClosed_A_2b

6135 Car B Occupied [CabOccu_B]   CabOccu_B_1b

3030 Car A Car Occupied [CabOccu_A]   CabOccu_A_5b

3030 Car A Door Closed (only active for lead car) [DoorClosed_A]   DoorClosed_A_5b

3031 Car B Occupied [CabOccu_B]   CabOccu_B_6b

6134 Right Door Open Command Car A [TL1_2_A_A]   TL1_2_A_A_2b

6134 Right Door Close Command Car A [TL1_2_B_A]   TL1_2_B_A_2b

TL3_4_A_A_2b   6134 Left Door Open Command Car A [TL3_4_A_A]

TL3_4_B_A_2b   6134 Left Door Close Command Car A [TL3_4_B_A]

6135 Left Door Open Command Car B [TL3_4_A_B]   TL3_4_A_B_3b

6135 Left Door Close Command Car B [TL3_4_B_B]   TL3_4_B_B_3b

TL1_2_A_B_3b   6135 Right Door Open Command Car B [TL1_2_A_B]

TL1_2_B_B_3b   6135 Right Door Close Command Car B [TL1_2_B_B]

3030 Right Door Open Command Car A [TL1_2_A_A]   TL1_2_A_A_5b

3030 Right Door Close Command Car A [TL1_2_B_A]   TL1_2_B_A_5b

TL3_4_A_A_5b   3030 Left Door Open Command Car A [TL3_4_A_A]

TL3_4_B_A_5b   3030 Left Door Close Command Car A [TL3_4_B_A]

3031 Left Door Open Command Car B [TL3_4_A_B]   TL3_4_A_B_6b

3031 Left Door Close Command Car B [TL3_4_B_B]   TL3_4_B_B_6b

TL1_2_A_B_6b   3031 Right Door Open Command Car B [TL1_2_A_B]

TL1_2_B_B_6b   3031 Right Door Close Command Car B [TL1_2_B_B]

28 seconds from 3030 Car A Not Occupied to 3030 FRA Power Off.

4 minutes 5 seconds from 3030 Car A Occupied to 3030 Car A Not Occupied.

9 minutes 50 seconds from 3031 Car B Not Occupied to 3030 Car A Occupied.

20 minutes 7 seconds from 3031 Car B Occupied to 3031 Car B Not Occupied.

2 minutes 10 seconds from 6134 Cab A Car Not Occupied to 3031 Car B Occupied.

1 minute 20 seconds from Train stop to 6134 Cab A Car Not Occupied.

Speed (All Cars)

SPEED_B_6a (mph)
SPEED_A_5a (mph)
SPEED_B_3a (mph)
SPEED_A_2a (mph)
SPEED_B_1a (mph)
SPEED_A_1a (mph)

Eastern Standard Time (HH:MM:SS)

Figure 14: Car Occupied, Speed, Battery Voltage, and Audio Parameters (Left L'Enfant to End FRA Data)

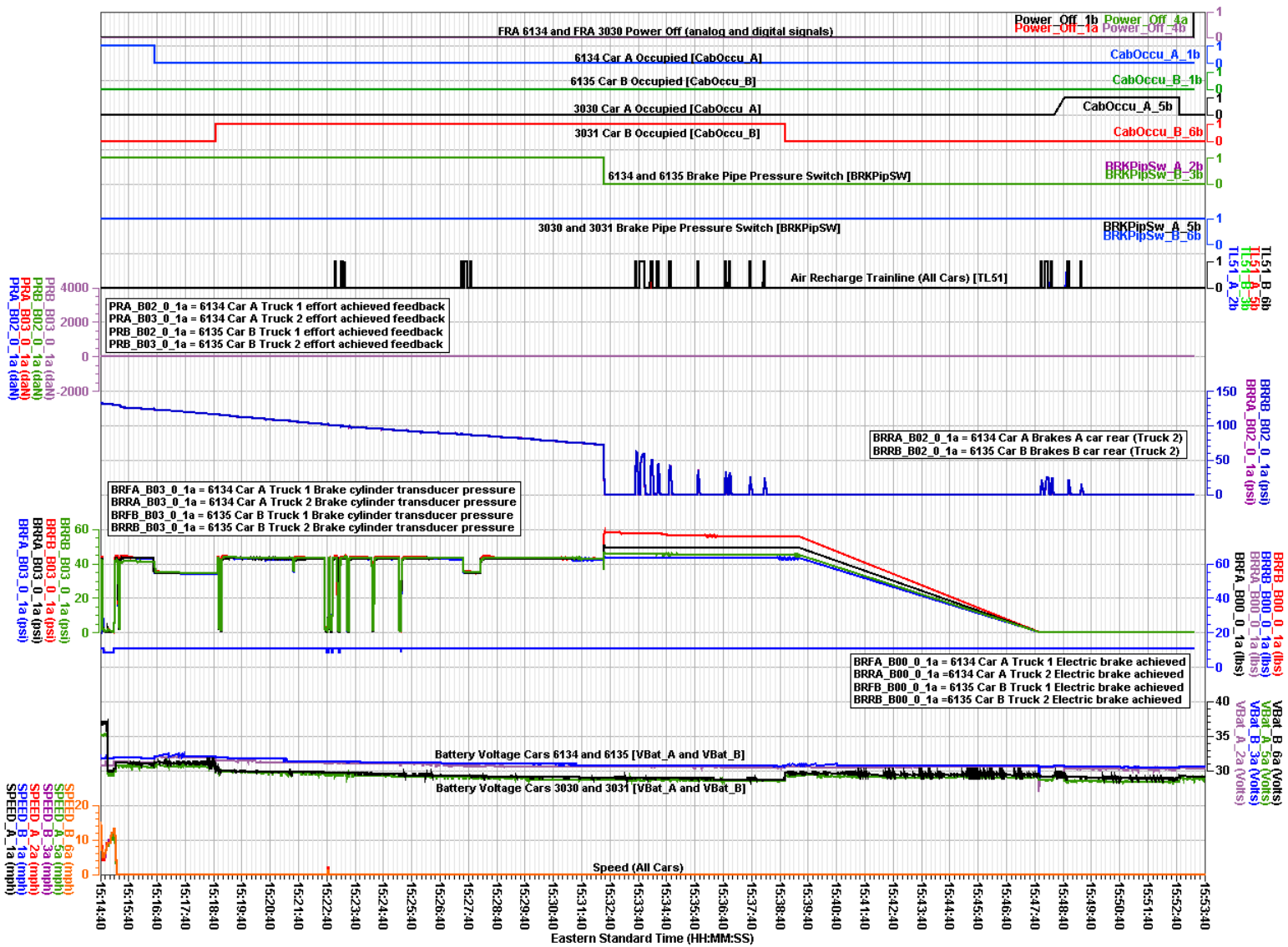# Figure 15: Car Occupied, Speed, Battery Voltage, and Brake Parameters (Left L'Enfant to End FRA Data)

Brakes (Left L'Enfant - End FRA Data)
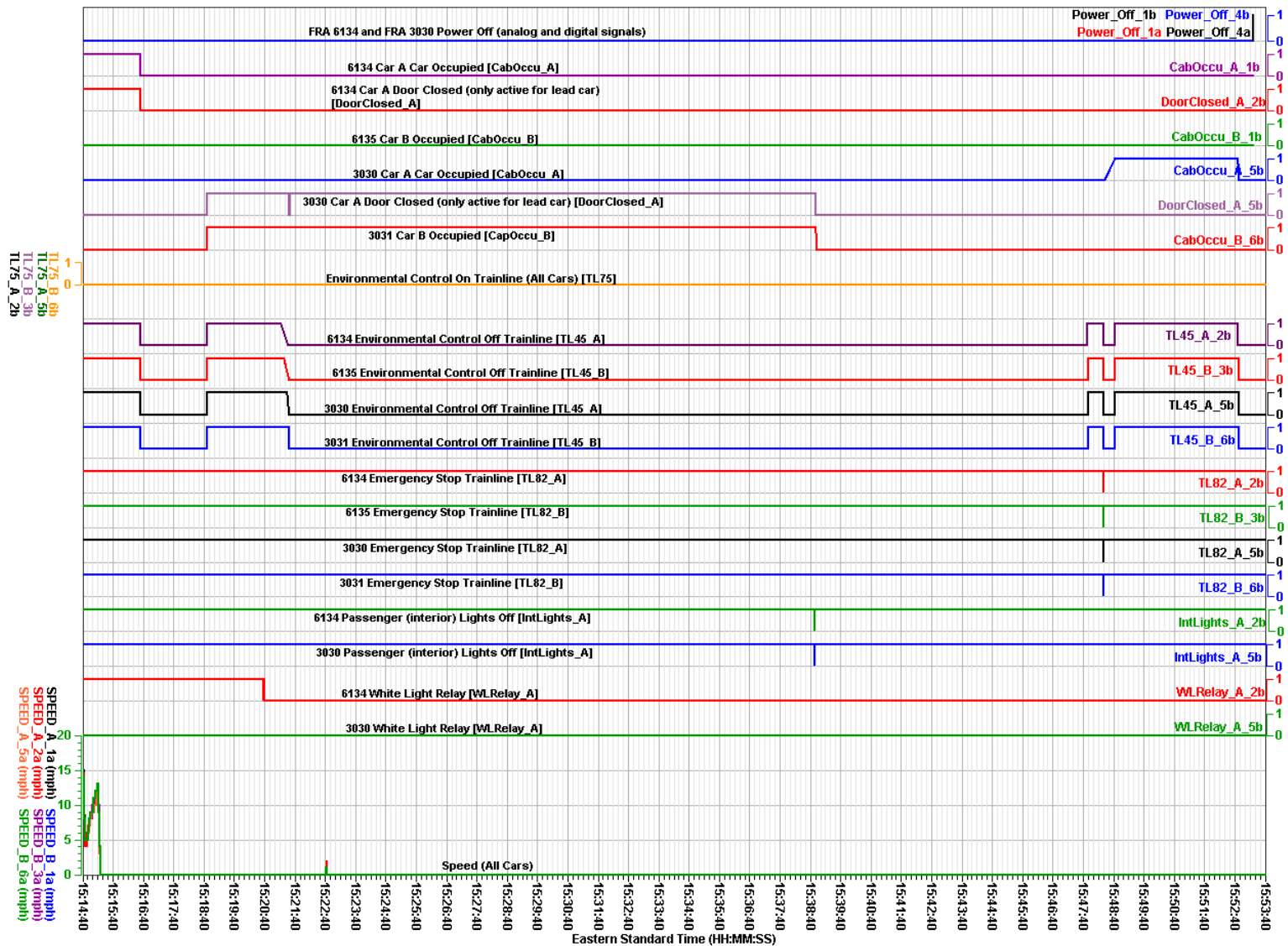
Figure 16: Environmental, Emergency Stop, Interior Lights, and White Light Relay Parameters (Left L'Enfant to End FRA Data)

APPENDIX A

This appendix describes the parameters provided and verified in this report for Metrorail train 302's six sources of recorder data. Table A-1 lists the parameters and table A-2 contains the unit abbreviations for the parameters.

Table A-2. Verified and provided data recorder parameters.

Parameter Name	Recorder Source	Parameter Description
1. ATC_B00_0_4a (mph)	FRA 3030	Car 3030 Actual Vehicle Speed
2. BRFA_B00_0_1a (lbs)	FRA 6134	Car 6134 Truck 1 Electric Brake Achieved
3. BRFA_B03_0_1a (psi)	FRA 6134	Car 6134 Truck 1 Brake Cylinder Transducer Pressure
4. BRFB_B00_0_1a (lbs)	FRA 6134	Car 6135 Truck 1 Electric Brake Achieved
5. BRFB_B03_0_1a (psi)	FRA 6134	Car 6135 Truck 1 Brake Cylinder Transducer Pressure
6. BRKPipSw_A_2b (discrete)	DAMA 6134	DAMA 6134 Brake Pipe Pressure Switch
7. BRKPipSw_A_5b (discrete)	DAMA 3030	DAMA 3030 Brake Pipe Pressure Switch
8. BRKPipSw_B_3b (discrete)	DAMB 6135	DAMB 6135 Brake Pipe Pressure Switch
9. BRKPipSw_B_6b (discrete)	DAMB 3031	DAMB 3031 Brake Pipe Pressure Switch
10. BRRA_B00_0_1a (lbs)	FRA 6134	Car 6134 Truck 2 Electric Brake Achieved
11. BRRA_B02_0_1a (psi)	FRA 6134	Car 6134 Brakes Rear (Truck 2)
12. BRRA_B03_0_1a (psi)	FRA 6134	Car 6134 Truck 2 Brake Cylinder Transducer Pressure
13. BRRB_B00_0_1a (lbs)	FRA 6134	Car 6135 Truck 2 Electric Brake Achieved
14. BRRB_B02_0_1a (psi)	FRA 6134	Car 6135 Brakes Rear (Truck 2)
15. BRRB_B03_0_1a (psi)	FRA 6134	Car 6135 Truck 2 Brake Cylinder Transducer Pressure
16. CabOccu_A_1b (discrete)	FRA 6134	Car 6134 Cab Occupied
17. CabOccu_A_5b (discrete)	DAMA 3030	Car 3030 Cab Occupied
18. CabOccu_B_1b (discrete)	FRA 6134	Car 6135 Cab Occupied
19. CabOccu_B_6b (discrete)	DAMB 3031	Car 3031 Cab Occupied
20. CX1_A_2b (discrete)	DAMA 6134	DAMA 6134 Intercom 1. Passenger Talk Front Unit
21. CX1_B_3b (discrete)	DAMB 6135	DAMB 6135 Intercom 1. Passenger Talk Front Unit
22. CX2_A_2b (discrete)	DAMA 6134	DAMA 6134 Intercom 2. Passenger Talk Rear Unit
23. CX2_B_3b (discrete)	DAMB 6135	DAMB 6135 Intercom 2. Passenger Talk Rear Unit
24. Distance_A_2b (ft)	DAMA 6134	Car 6134 Distance Traveled
25. Distance_B_3a (ft)	DAMB 6135	Car 6135 Distance Traveled
26. DoorClosed_A_2b (discrete)	DAMA 6134	Car 6134 Door Closed
27. DoorClosed_A_5b (discrete)	DAMA 3030	Car 3030 Door Closed
28. Int1Act_A_5b (discrete)	DAMA 3030	DAMA 3030 Intercom 1. Passenger Talk Front Unit
29. Int1Act_B_6b (discrete)	DAMB 3031	DAMB 3031 Intercom 1. Passenger Talk Front Unit
30. Int2Act_A_5b (discrete)	DAMA 3030	DAMA 3030 Intercom 2. Passenger Talk Rear Unit
31. Int2Act_B_6b (discrete)	DAMB 3031	DAMB 3031 Intercom 2. Passenger Talk Rear Unit
32. IntLights_A_2b (discrete)	DAMA 6134	Car 6134 Passenger (interior) Lights Off
33. IntLights_A_5b (discrete)	DAMA 3030	Car 3030 Passenger (interior) Lights Off

Parameter Name	Recorder Source	Parameter Description
34. Power_Off_1a (discrete)	FRA 6134	FRA 6134 Power Off
35. Power_Off_1b (discrete)	FRA 6134	FRA 6134 Power Off
36. Power_Off_4a (discrete)	FRA 3030	FRA 3030 Power Off
37. Power_Off_4b (discrete)	FRA 3030	FRA 3030 Power Off
38. PRA_B02_0_1a (daN)	FRA 6134	Car 6134 Truck 1 effort achieved feedback
39. PRA_B03_0_1a (daN)	FRA 6134	Car 6134 Truck 2 effort achieved feedback
40. PRB_B02_0_1a (daN)	FRA 6134	Car 6135 Truck 1 effort achieved feedback
41. PRB_B03_0_1a (daN)	FRA 6134	Car 6135 Truck 2 effort achieved feedback
42. SPEED_A_1a (mph)	FRA 6134	Car 6134 Speed
43. SPEED_A_2a (mph)	DAMA 6134	Car 6134 Speed
44. SPEED_A_5a (mph)	DAMA 3030	Car 3030 Speed
45. SPEED_B_1a (mph)	FRA 6134	Car 6135 Speed
46. SPEED_B_3a (mph)	DAMB 6135	Car 6135 Speed
47. SPEED_B_6a (mph)	DAMB 3031	Car 3031 Speed
48. TL1_2_A_A_2b (discrete)	DAMA 6134	Car 6134 Right Door Open Command
49. TL1_2_A_A_5b (discrete)	DAMA 3030	Car 3030 Right Door Open Command
50. TL1_2_A_B_3b (discrete)	DAMB 6135	Car 6135 Right Door Open Command
51. TL1_2_A_B_6b (discrete)	DAMB 3031	DAMB 3031 Right Door Open Command
52. TL1_2_B_A_2b (discrete)	DAMA 6134	DAMA 6134 Right Door Close Command
53. TL1_2_B_A_5b (discrete)	DAMA 3030	DAMA 3030 Right Door Close Command
54. TL1_2_B_B_3b (discrete)	DAMB 6135	DAMB 6135 Right Door Close Command
55. TL1_2_B_B_6b (discrete)	DAMB 3031	DAMB 3031 Right Door Close Command
56. TL3_4_A_A_2b (discrete)	DAMA 6134	DAMA 6134 Left Door Open Command
57. TL3_4_A_A_5b (discrete)	DAMA 3030	DAMA 3030 Left Door Open Command
58. TL3_4_A_B_3b (discrete)	DAMB 6135	DAMB 6135 Left Door Open Command
59. TL3_4_A_B_6b (discrete)	DAMB 3031	DAMB 3031 Left Door Open Command
60. TL3_4_B_A_2b (discrete)	DAMA 6134	DAMA 6134 Left Door Close Command
61. TL3_4_B_A_5b (discrete)	DAMA 3030	DAMA 3030 Left Door Close Command
62. TL3_4_B_B_3b (discrete)	DAMB 6135	DAMB 6135 Left Door Close Command
63. TL3_4_B_B_6b (discrete)	DAMB 3031	DAMB 3031 Left Door Close Command
64. TL41_TL42_A_2a (undefined)	DAMA 6134	DAMA 6134 Intercom Audio
65. TL41_TL42_A_5a (undefined)	DAMA 3030	DAMA 3030 Intercom Audio
66. TL41_TL42_B_3a (undefined)	DAMB 6135	DAMB 6135 Intercom Audio
67. TL41_TL42_B_6a (undefined)	DAMB 3031	DAMB 3031 Intercom Audio
68. TL45_A_2b (discrete)	DAMA 6134	Car 6134 Environmental Control Off
69. TL45_A_5b (discrete)	DAMA 3030	Car 3030 Environmental Control Off
70. TL45_B_3b (discrete)	DAMB 6135	Car 6135 Environmental Control Off
71. TL45_B_6b (discrete)	DAMB 3031	Car 3031 Environmental Control Off

Parameter Name	Recorder Source	Parameter Description
72. TL46_TL47_A_2a (undefined)	DAMA 6134	DAMA 6134 Public Address Audio
73. TL46_TL47_A_5a (undefined)	DAMA 3030	DAMA 3030 Public Address Audio
74. TL46_TL47_B_3a (undefined)	DAMB 6135	DAMB 6135 Public Address Audio
75. TL46_TL47_B_6a (undefined)	DAMB 3031	DAMB 3031 Public Address Audio
76. TL51_A_2b (discrete)	DAMA 6134	Car 6134 Air Recharge Trainline
77. TL51_A_5b (discrete)	DAMA 3030	Car 3030 Air Recharge Trainline
78. TL51_B_3b (discrete)	DAMB 6135	Car 6135 Air Recharge Trainline
79. TL51_B_6b (discrete)	DAMB 3031	Car 3031 Air Recharge Trainline
80. TL75_A_2b (discrete)	DAMA 6134	Car 6134 Environmental Control On
81. TL75_A_5b (discrete)	DAMA 3030	Car 3030 Environmental Control On
82. TL75_B_3b (discrete)	DAMB 6135	Car 6135 Environmental Control On
83. TL75_B_6b (discrete)	DAMB 3031	Car 3031 Environmental Control On
84. TL82_A_2b (discrete)	DAMA 6134	Car 6134 Emergency Stop Trainline
85. TL82_A_5b (discrete)	DAMA 3030	Car 3030 Emergency Stop Trainline
86. TL82_B_3b (discrete)	DAMB 6135	Car 6135 Emergency Stop Trainline
87. TL82_B_6b (discrete)	DAMB 3031	Car 3031 Emergency Stop Trainline
88. VBat_A_2a (Volts)	DAMA 6134	Car 6134 Battery Voltage
89. VBat_A_5a (Volts)	DAMA 3030	Car 3030 Battery Voltage
90. VBat_B_3a (Volts)	DAMB 6135	Car 6135 Battery Voltage
91. VBat_B_6a (Volts)	DAMB 3031	Car 3031 Battery Voltage
92. WLRelay_A_2b (discrete)	DAMA 6134	Car 6134 White Light Relay
93. WLRelay_A_5b (discrete)	DAMA 3030	Car 3030 White Light Relay

Table A-2. Unit and discrete state abbreviations.

Units Abbreviation	Description
daN	deca Newton
discrete	discrete
lbs	pounds
mph	miles per hour
psi	pounds per square inch
Undefined	units not defined in WMATA's documentation
Volts	Volts

NOTE: For parameters with a unit description of discrete, a discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.