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

January 26, 2017

Locomotive Event Recorder

Specialist's Factual Report
By Charles Cates

1. EVENT SUMMARY

Location:	Chester, Pennsylvania
Date:	April 3, 2016
Company:	Amtrak
Train ID/Locomotive:	Siemens ACS-64 #627 (lead)
NTSB Number:	DCA16FR007
Summary:	Refer to the Accident Summary report, within this docket.

2. LOCOMOTIVE EVENT RECORDER GROUP

A locomotive event recorder group was not convened.

3. DETAILS OF RECORDER INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following locomotive event recorder:

Device:	**Wabtec Train Trax Event Recorder**
Serial Number:	**0831193**
Locomotive ID:	**ACS-64 #627**

3.1. Locomotive Event Recorder Condition

The recorder was in good condition and the data were extracted normally using the Wabtec Railway Electronics Event Recorder Data Analysis Software (WREDAS) and NTSB equipment.

Figure 1. Photos of Wabtec Train Trax Event Recorder from ACS-64 #627

3.2. Locomotive Event Recorder Recording Description

Using the wheel size of 43.75 inches as provided by investigators, ACS-64 #627 locomotive event recorder data were extracted using WREDAS. The software outputted the locomotive event recorder parameters including distance and speed. The exported data have a sampling rate of one second; therefore, the data has an accuracy of +/- 1 second. Because of the sampling rate, the final recorded data point comes within one second prior to the collision, which stopped the recording. Only the data relevant to this event are provided in this report.

3.3. Parameters

Table A-1 lists the parameters verified and provided in this report. Additionally, table A-2 contains the unit and discrete state abbreviations for the parameters.

3.3.1. Distance Traveled

The default output for the distance traveled is the distance decreasing in time. In this installation, miles and feet are recorded as separate parameters. Distance traveled in miles started at a very large value at the beginning of the downloaded data and decreased to 0 miles. Distance traveled in feet decreased from 5,279 to 0 feet and then reset at each whole

mile change, counting down the number of feet until the next whole mile change.

3.4. Time Correlation

The recorded time from ACS-64 #627's locomotive event recorder data and on-board forward facing video recorder[1] are independently time stamped and, consequently, the times may not reflect the actual time of day. When the event recorder was downloaded using WREDAS, the event recorder time was correlated to real time. It was determined that no time offset was needed to be applied to ACS-64 #627's event recorder data. Therefore, for the rest of the report, all times are referenced as eastern daylight time (EDT).

3.5. Plots and Corresponding Tabular Data

Figures 2 to 8 contain locomotive event recorder data from ACS-64 #627 recorded during the event on April 3, 2016. All the parameters listed in table A-1 were plotted. The final data point at 0749:40 comes within one second of the collision, however the collision stopped the recording. No data of the exact moment of the collision or subsequent to it was recorded.

Figure 2 has distance, speed, throttle, horn, and engineer induced emergency (EIE) parameters for the time period from departure of New York Penn Station until the accident at 0749 EDT.

Figure 3 contains the same parameters as Figure 2 for the time period from departure of the final stop at Philadelphia 30th Street Station until the accident.

Figure 4 shows the cab signals recorded from the time period of the departure from New York Penn Station until the accident at 0749.

Figure 5 contains the same parameters for an expanded time scale from departure of Philadelphia 30th Street Station until the accident.

Figure 6 shows braking parameters for the train from the time period of the departure from New York Penn Station until the accident at 0749.

Figure 7 contains the same parameters for an expanded time scale from departure of Philadelphia 30th Street Station until the accident.

Figure 8 shows performance and system parameters of interest in the final 40 seconds of data leading up to the time of the crash.

In summary, the data shows that the train departed New York Penn Station at about 0606:30 EDT. It made four stops prior to the accident. Speed reached a peak of 124 mph and the train complied with all cab signals. Throttle, brakes, horn, and dynamic braking were all used during the trip.

[1] Refer to the National Transportation Safety Board's Forward Facing Video Recorder Factual Report.

Following the departure of Philadelphia 30th Street Station at about 0738:30, the train accelerated to a maximum speed of 109 mph. The events within 40 seconds of the end of the data (from 0749:00 to 0749:40) can be seen in Figure 8 and are summarized as follows:

- At 0749:00, the train was steady at 107 mph. The throttle was in position T6, and the train was 6,272 ft from the final data point. The cab signal was Clear 125 mph, and remained at this signal setting through the end of the recording.

- At 0749:02, the throttle was moved to the T5 position. Parameters were then stable for the next 28 seconds.

- At 0749:31, the throttle was moved to the Idle position with the train 1,387 ft from the final recorded point.

- At 0749:32, the horn was sounded, and it stayed active until the end of the recording. Distance to the end of the recording was 1,230 ft.

- At 0749:33, speed dropped one mph, to 106 mph.

- At 0749:34, electronic air brake brake pipe pressure (EAB BP) began to decrease, indicative of the brakes being applied. It reached 0 psi in 2 seconds.

- At 0749:35, 760 feet from the final recorded point, electronic air brake brake cylinder pressure (EAB BC) began to rise, and an engineer induced emergency (EIE) was activated. The train was still moving at 106 mph, but subsequently began to decelerate.

- At 0749:40, the final recorded data point, speed was 99 mph, brake pipe pressure was 0 psi, and brake cylinder pressure was 75 psi. The horn was still recorded as being active at this time.

- The locomotive manufacturer has identified a power interruption to the recorder as the reason that the recorder stopped at this time.

All of the corresponding tabular data used to create figures 2 to 8 are provided in electronic separated value (.csv) format as attachment 1 to this factual report.

Figure 2: ACS-64 #627's speed, throttle, and distance parameters from New York Penn Station to accident site.

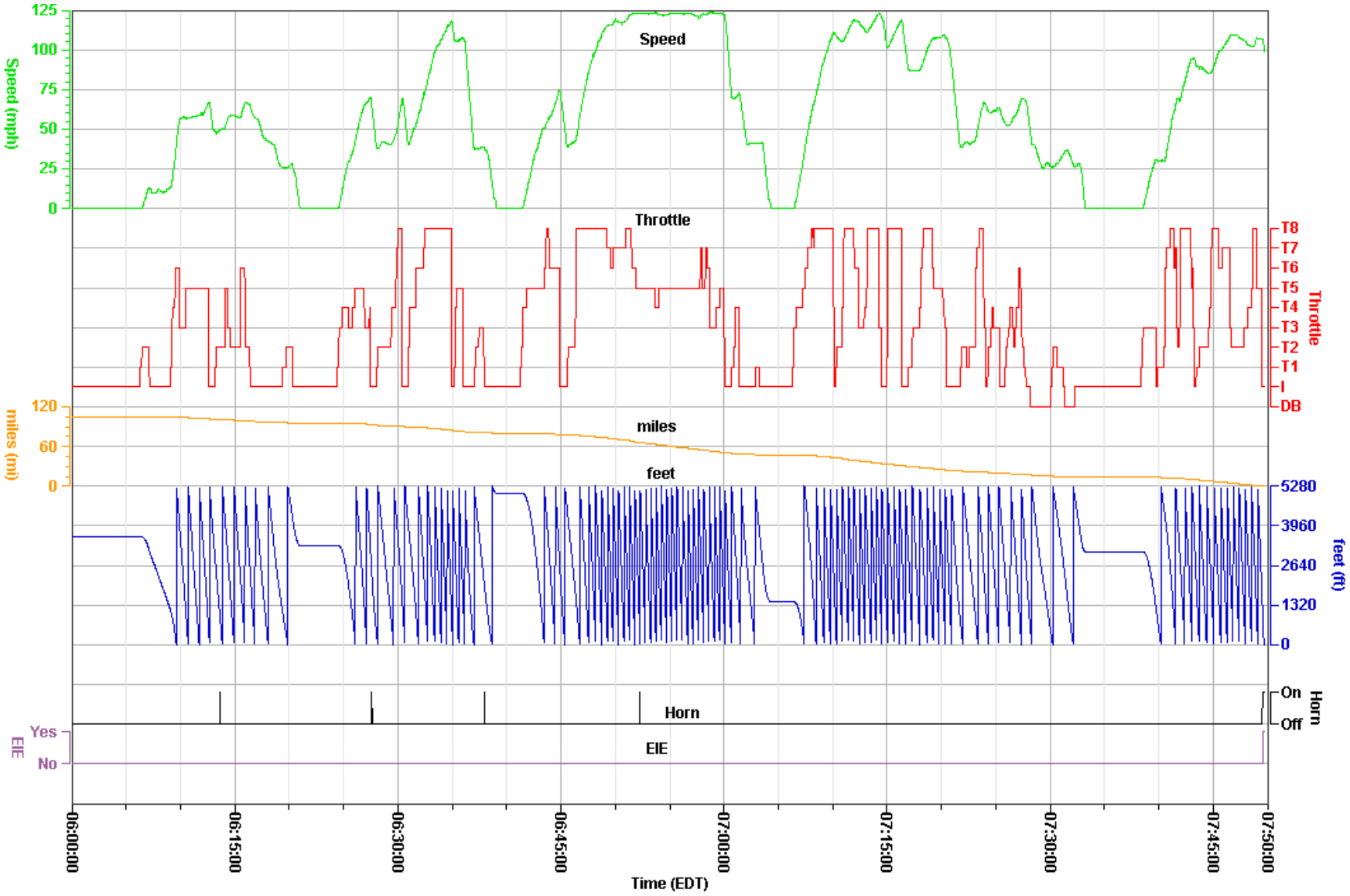


Figure 3: ACS-64 #627's speed, throttle, and distance parameters from Philadelphia 30th Street Station to accident site.

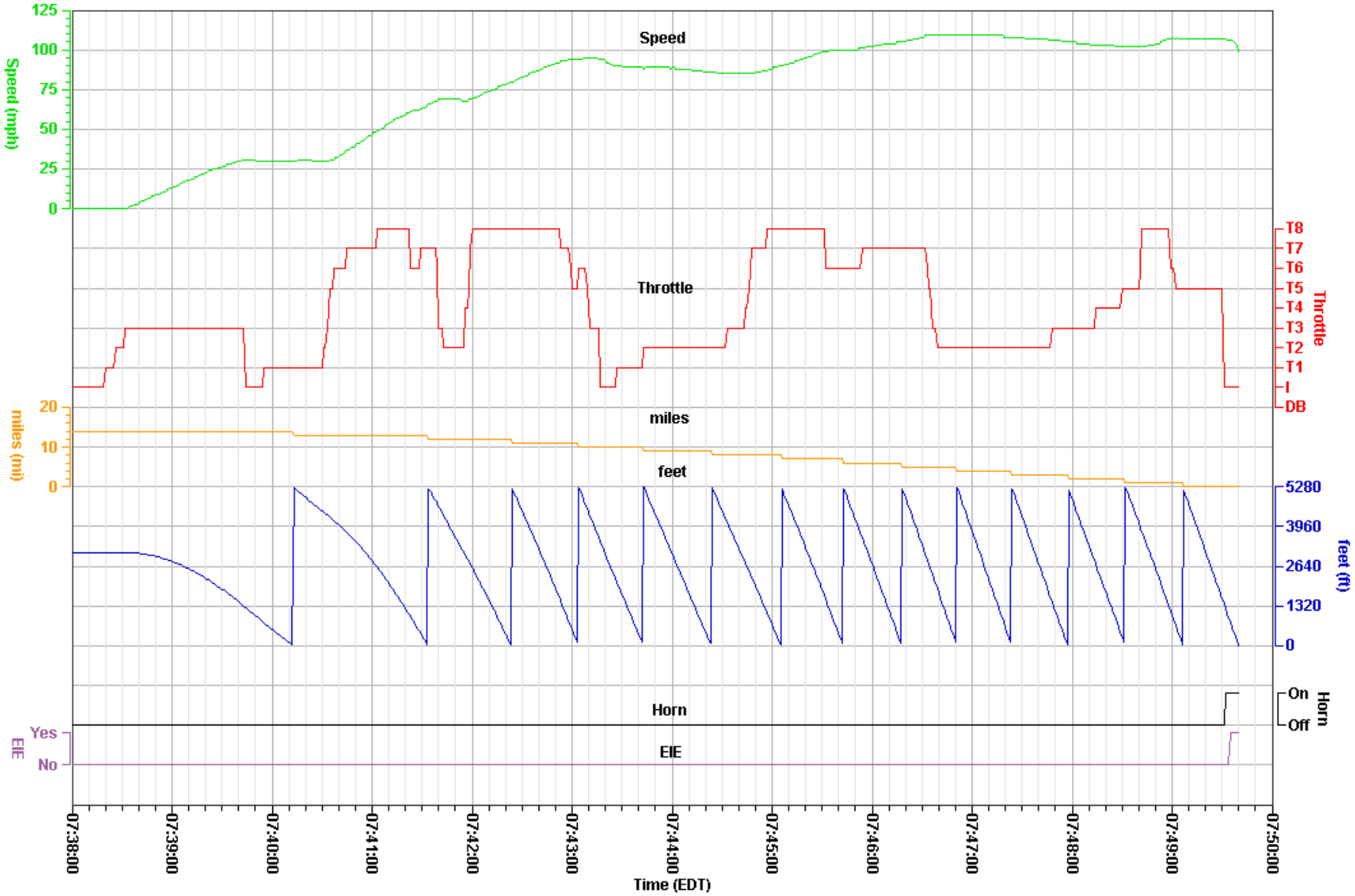


Figure 4. ACS-64 #627's recorded cab signals from New York Penn Station to accident site.

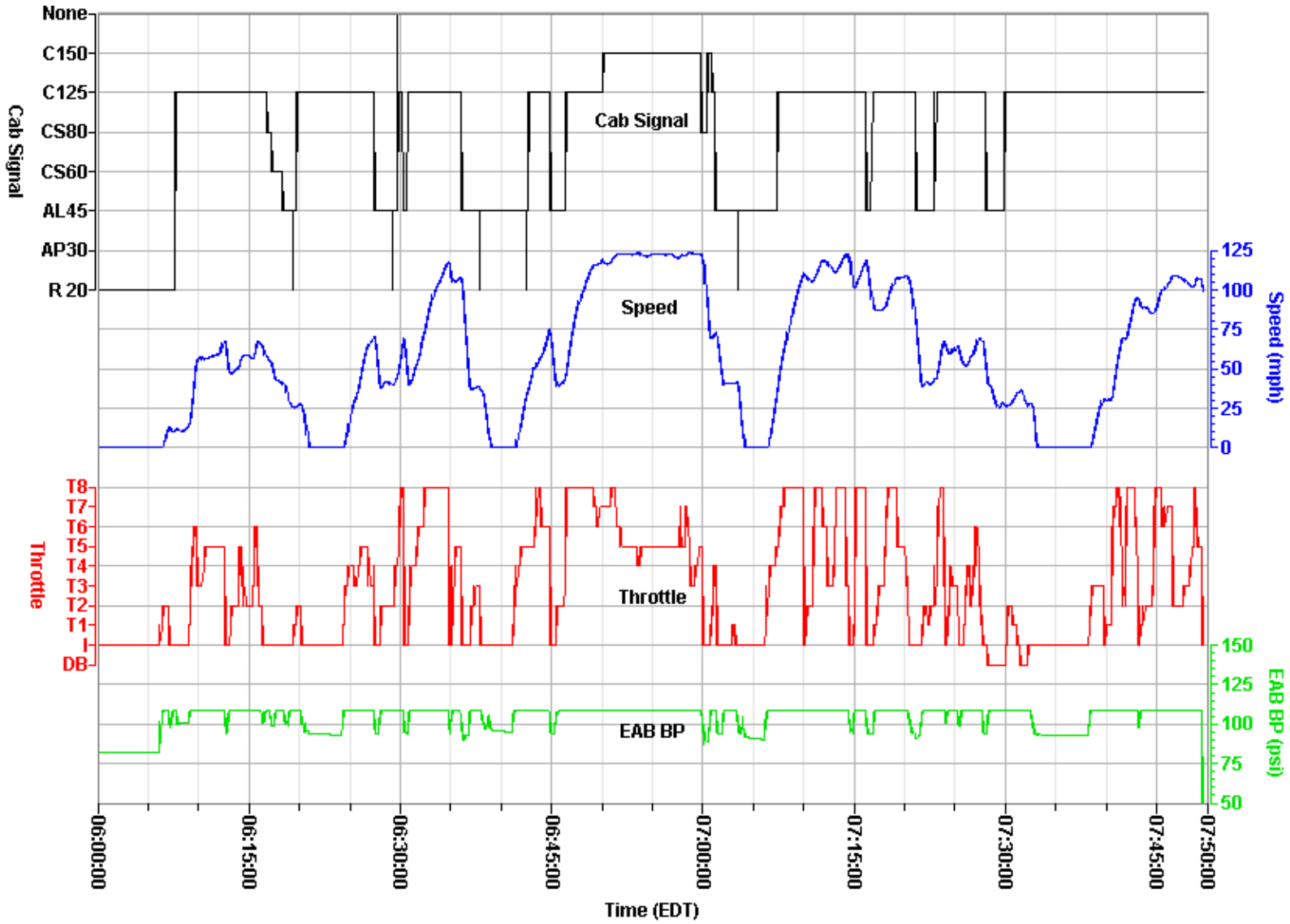


Figure 5. ACS-64 #627's recorded cab signals from Philadelphia 30th Street Station to accident site.

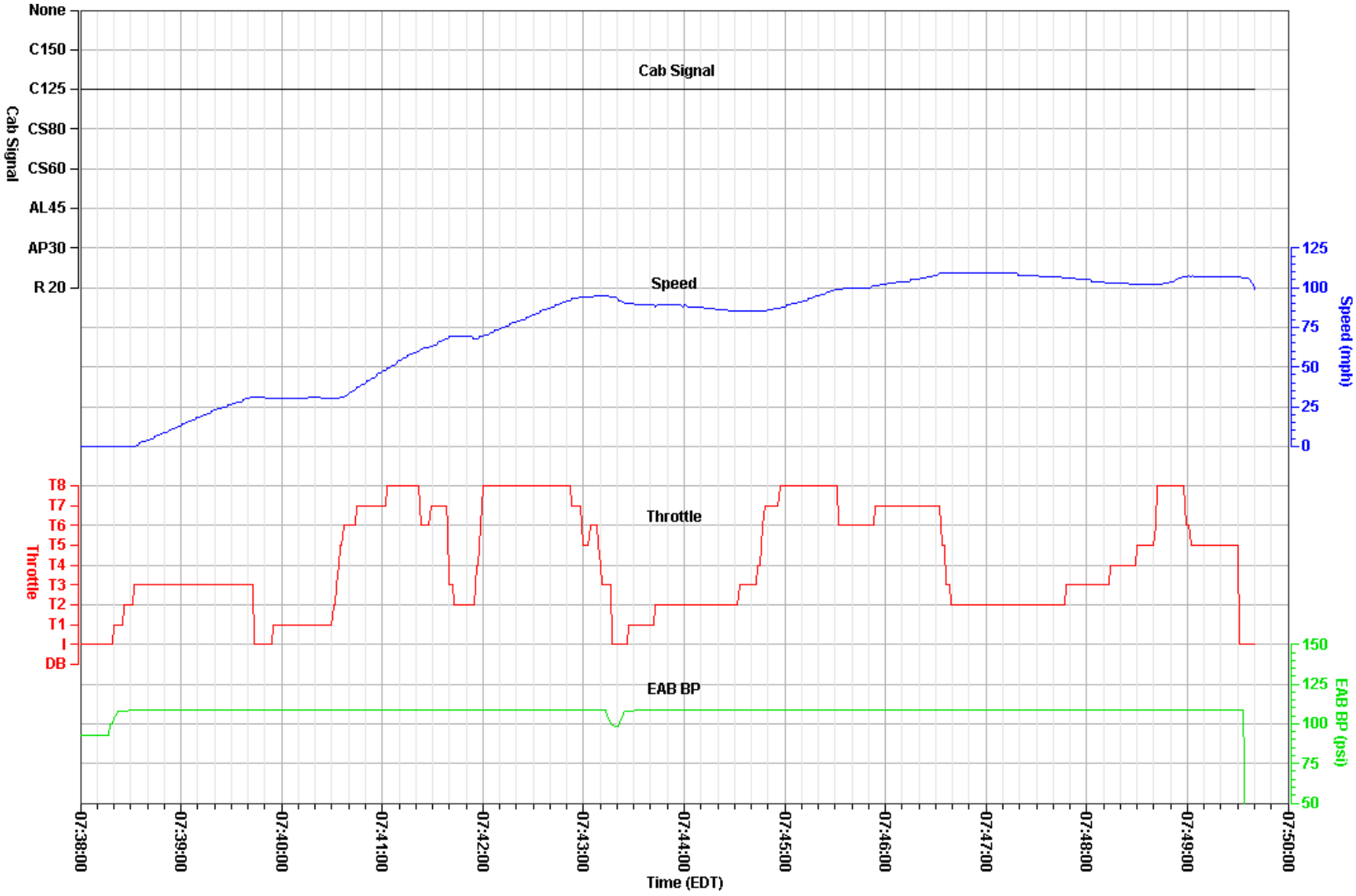


Figure 6. ACS-64 #627's braking related parameters from New York Penn Station to accident site.

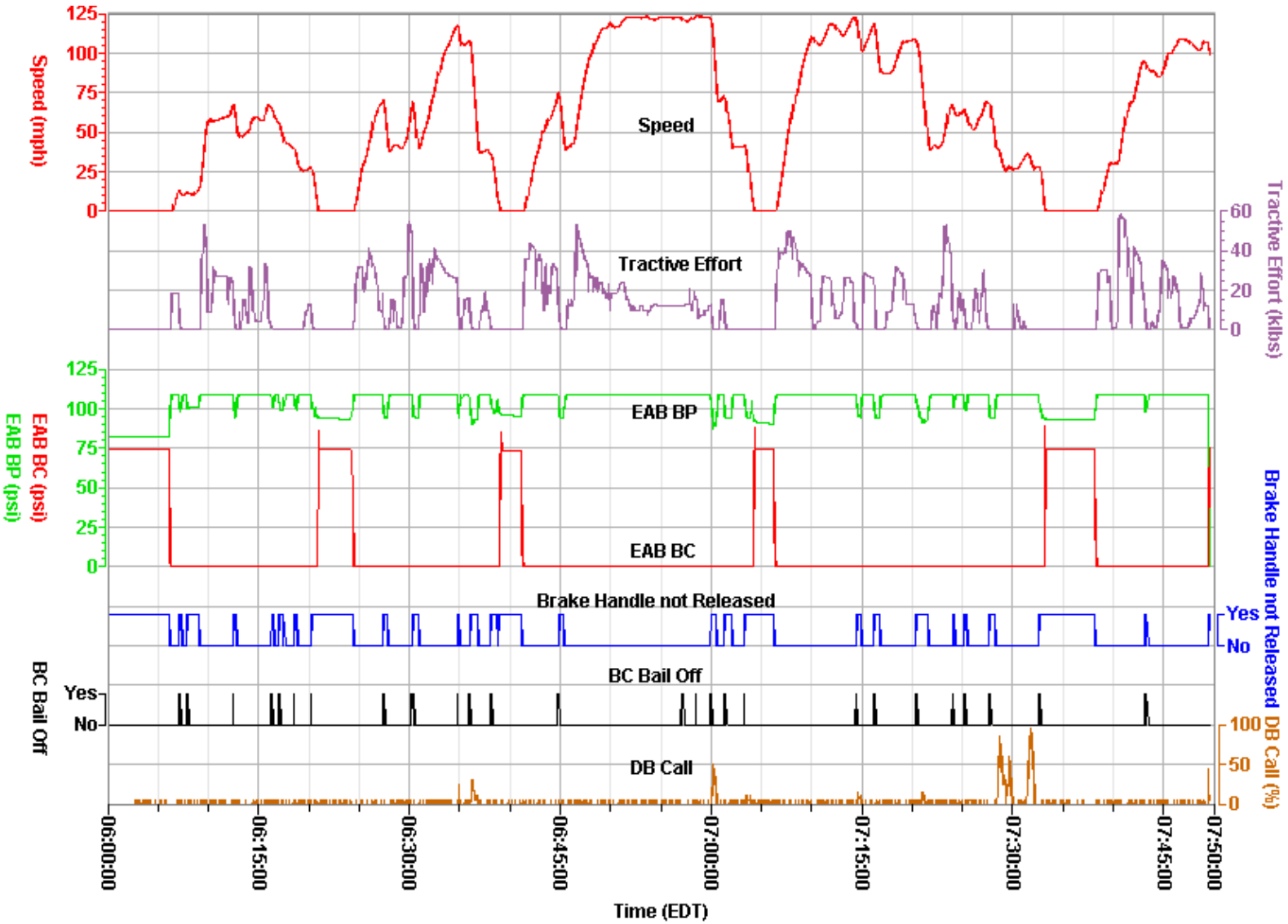


Figure 7. ACS-64 #627's braking parameters from Philadelphia 30th Street Station to accident site.

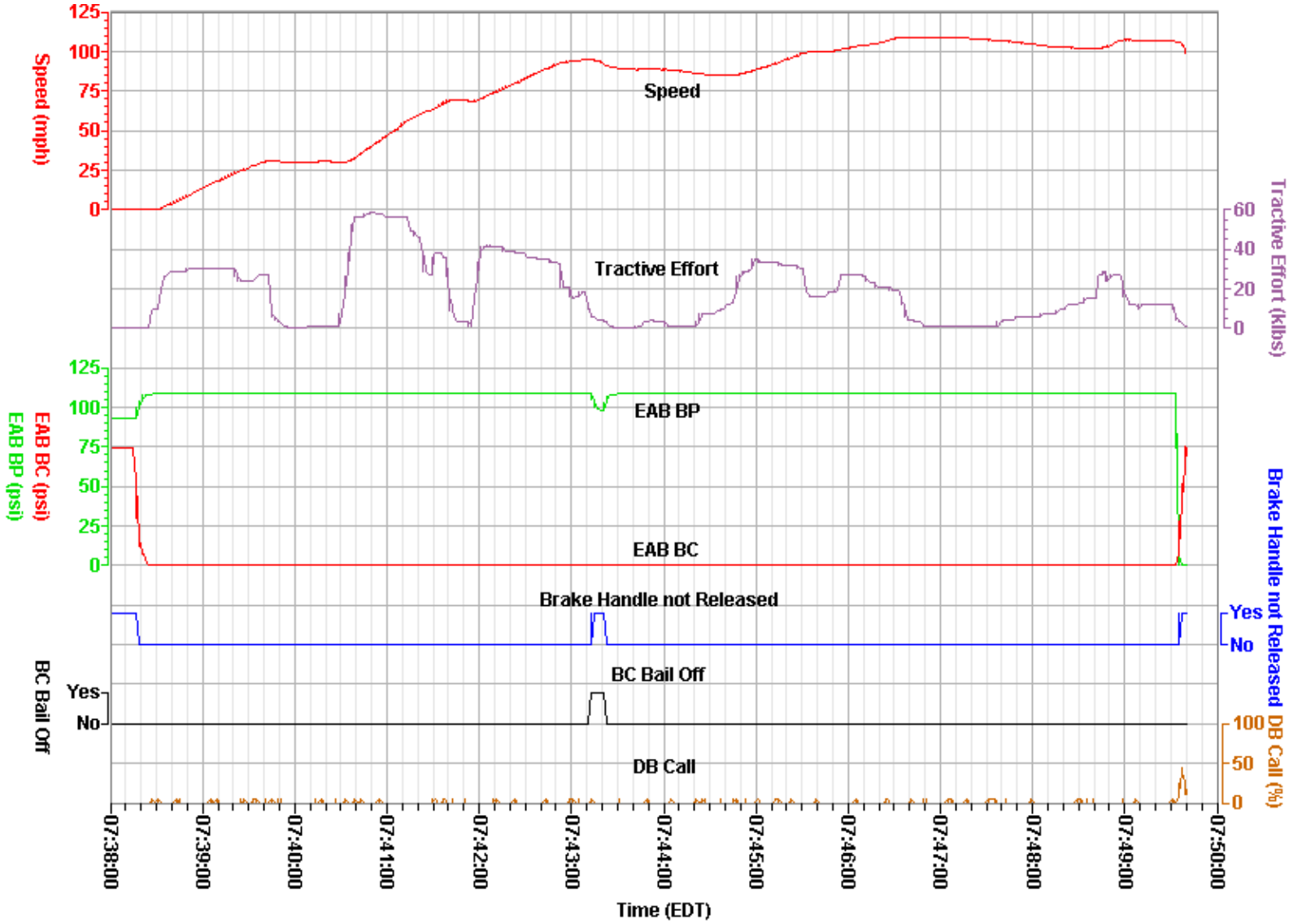
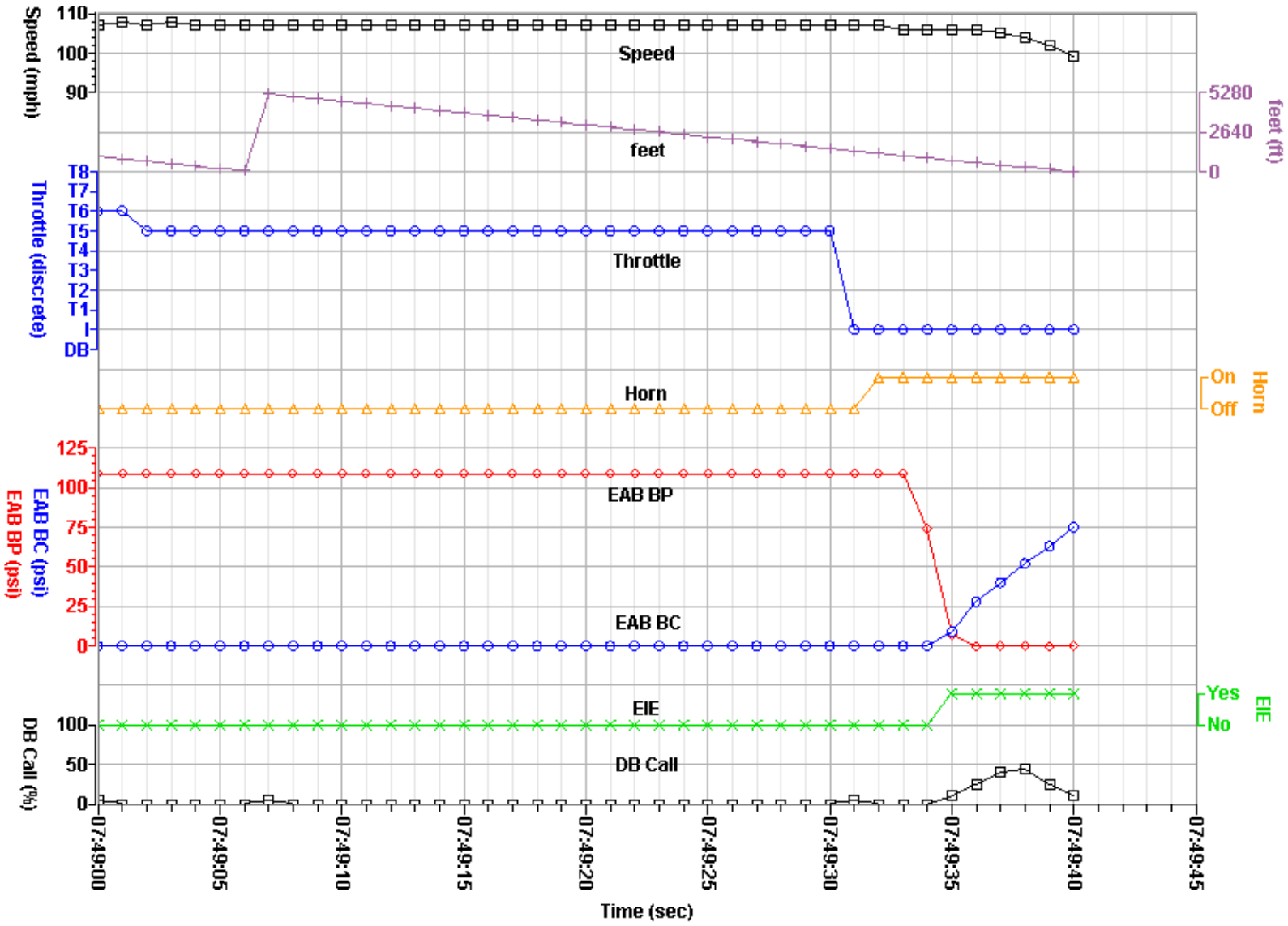


Figure 8. ACS-64 #627 expanded time scale of final 40 seconds of recorded data.



APPENDIX A

This appendix describes the locomotive event recorder parameters provided and verified in this report for ACS-64 #627. Table A-1 lists the parameters and table A-2 contains the unit and discrete state abbreviations for the parameters.

Table A-1. Verified and provided locomotive event recorder parameters ACS-64 #627

Parameter Name	Parameter Description	Figure(s)
1. Brake Handle not Released (discrete)	Brake Handle Position	6, 7
2. Cab Signal (discrete)	Cab Signal	4, 5
3. DB Call (%)	Dynamic Brake Effort	6, 7, 8
4. EAB BC (psi)	Electronic Air Brake - Brake Cylinder Pressure	6, 7, 8
5. EAB BP (psi)	Electronic Air Brake - Brake Pipe Pressure	4, 5, 8
6. EIE (discrete)	Engineer Induced Emergency	2, 3, 8
7. feet (feet)	Feet Traveled	2, 3, 8
8. Horn (discrete)	Horn Active	2, 3, 8
9. miles (miles)	Miles Traveled	2, 3
10. Speed (mph)	Speed	2, 3, 4, 5, 6, 7, 8
11. Throttle (discrete)	Throttle Position	2, 3, 4, 5, 8
12. Tractive Effort (klbs)	Locomotive Tractive Effort	6, 7

Table A-2. Unit and discrete state abbreviations.

Units Abbreviation	Units Description
AL45	Approach Limited 45 mph
AP30	Approach 30 mph
C125	Clear 125 mph
C150	Clear 150 mph
CS60	Cab Speed 60 mph
CS80	Cab Speed 80 mph
DB	Dynamic Brake
I	Idle
klbs	thousand pounds
mph	miles per hour
psi	pounds per square inch
R20	Restricting 20 mph
T1-T8	Throttle positions

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.