

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division
Washington, D.C. 20594

September 18, 2017

Electric Multi-Unit M7 Event Recorder

Specialist's Factual Report
By Bill Tuccio, Ph.D.

1. EVENT SUMMARY

Location: Queens Village, New York
Date: June 10, 2017
Company: Long Island Rail Road (LIRR)
Train: 7623
MU¹ Pair ID: 7695-96 (lead MU)
NTSB Number: DCA17FR009

For a summary of the accident, refer to the Accident Summary report, within this docket.

2. ELECTRIC MULTI-UNIT CAR EVENT RECORDER GROUP

An electric multi-unit (EMU) car event recorder group was not convened.

3. DETAILS OF RECORDER INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received a compact flash card from the following MU pair:

MU Pair ID: 7695-96 (lead MU)

3.1. EMU M7 Event Recorder Recording Description

The compact flash card was part of a crash hardened Bach-Simpson M7 Event Recorder System (ERS).² Each LIRR M7 car is part of a paired set referred to as an "A" and "B" car; the recorder was installed in the A car and recorded data from the A and B car.

Using 7696's wheel size of 36.0 inches as provided by investigators, 7696's event recorder data were extracted from the compact flash card file using the Bach-Simpson WinDAS Software version 4.06. The software outputted the event recorder parameters including speed.

¹ MU means "Multiple Unit." MU cars are semi-permanently coupled and share some components. In this report, the MU pairing is referred to by a dashed reference, for example, "7695-96" meaning "7695" (B car) and "7696" (A car). A further description of the operating design of EMU M7 cars is provided elsewhere in the investigative docket.

² As described in "LIRR/MNR M-7 Passenger Cars Event Recorder System (ERS) System Functional Description (SFD) Network Downloading" (Document 878-BSC-0000, Revision K), May 5, 2008.

The ERS uses a change-based algorithm to record data, based on an underlying sampling rate between 20 to 125 milliseconds. This algorithm records a baseline of all parameters and, if a parameter's value changes, then that parameter is recorded. If another parameter's value changes within the same period, then that parameter is recorded along with all other parameters and output as one line (a "record"). A consequence of this algorithm is that the exported data has repeated times.

3.2. Parameters

Table A-1 lists the parameters verified and provided in this report for MU 7695-96's recorded data. Additionally, table A-2 contains the unit and discrete state abbreviations for the parameters.

3.2.1. Distance Traveled (Feet Remaining)

It was not possible to export distance traveled from the WinDAS software; as such, speed was discretely integrated over each time interval to determine total distance traveled. The starting point of the integration was when the train came to a stop after it struck the worker. This method resulted in distance traveled being expressed as feet remaining and continually decreasing to 0 feet.³

3.2.2. Emergency Brake Trainline

When the train is in motion, the Emergency Brake Trainline (EBT) is charged and recorded as "On." When EBT transitions to "Off," a valve opens allowing Brake Pipe Pressure to exhaust to the atmosphere, reducing Brake Pipe Pressure, and resulting in brake application.

3.3. Event Recorder Timing

The ERS records three times: (a) an elapsed recorder time per record, which started at 32,309.9 for the 7695-96 exported data; (b) a date/time per record, which corresponds to Universal Coordinated Time (UTC); and (c) a sampling of network time taken at irregular intervals. Using this information, and in agreement with the LIRR and the Investigator-in-Charge, it was determined that time (b) required a correction of -4 hours, -7 minutes, and 0 seconds to convert to local eastern daylight time (EDT). Further, elapsed seconds (a) of 32,729.9 corresponded to time (b) on the accident day of 14:07:00.0. Using this information, 3,270.1 seconds were added to elapsed recorder time to convert to local EDT. Therefore, for the rest of this report times are expressed as EDT.

3.4. Plots and Corresponding Tabular Data

Figures 1 through 3 contain event recorder data from MU 7695-96 recorded during the event on June 10, 2017, by car 7696. The direction of travel of MU 7695-96 was such that 7695 was the lead car of the MU pair. All figures contain the same parameters listed in table A-1, with differing time scales (from a wide-view time range to a narrow-view time range).

Collectively the figures show:

- Headlight was set to Dim.

³ This report did not determine the physical location of 0 feet relative to where the worker was struck.

- The last recorded horn⁴ was activated 3.7 seconds before the Emergency Brake Trainline state changed, which occurred at 10:12:28.3 EDT.
- The train was travelling at 78 mph when the last recorded horn activation began.
- The Train P-Wire began to decrease about 2.5 seconds before the Emergency Brake Trainline state changed, which was just after the recorded horn application.
- The Brake Cylinder Pressures began to rise slightly about 1.5 seconds before the Emergency Brake Trainline state changed.
- The distance from the start of the last recorded horn application until the Emergency Brake Trainline state changed was 422 feet.

All of the corresponding tabular data used to create figures 1 through 3 are provided in electronic separated value (.csv) format as attachment 1 to this factual report.

⁴ According to LIRR, after the accident the horn pressure switch was removed; although on-board static and dynamic tests indicated no failures, bench testing of the switch revealed intermittent failures of the electrical contacts. Given this intermittent behavior, it is possible the recorded horn activations differed from physical reality.

Figure 1. 7695-96 basic parameters – wide view prior to event.

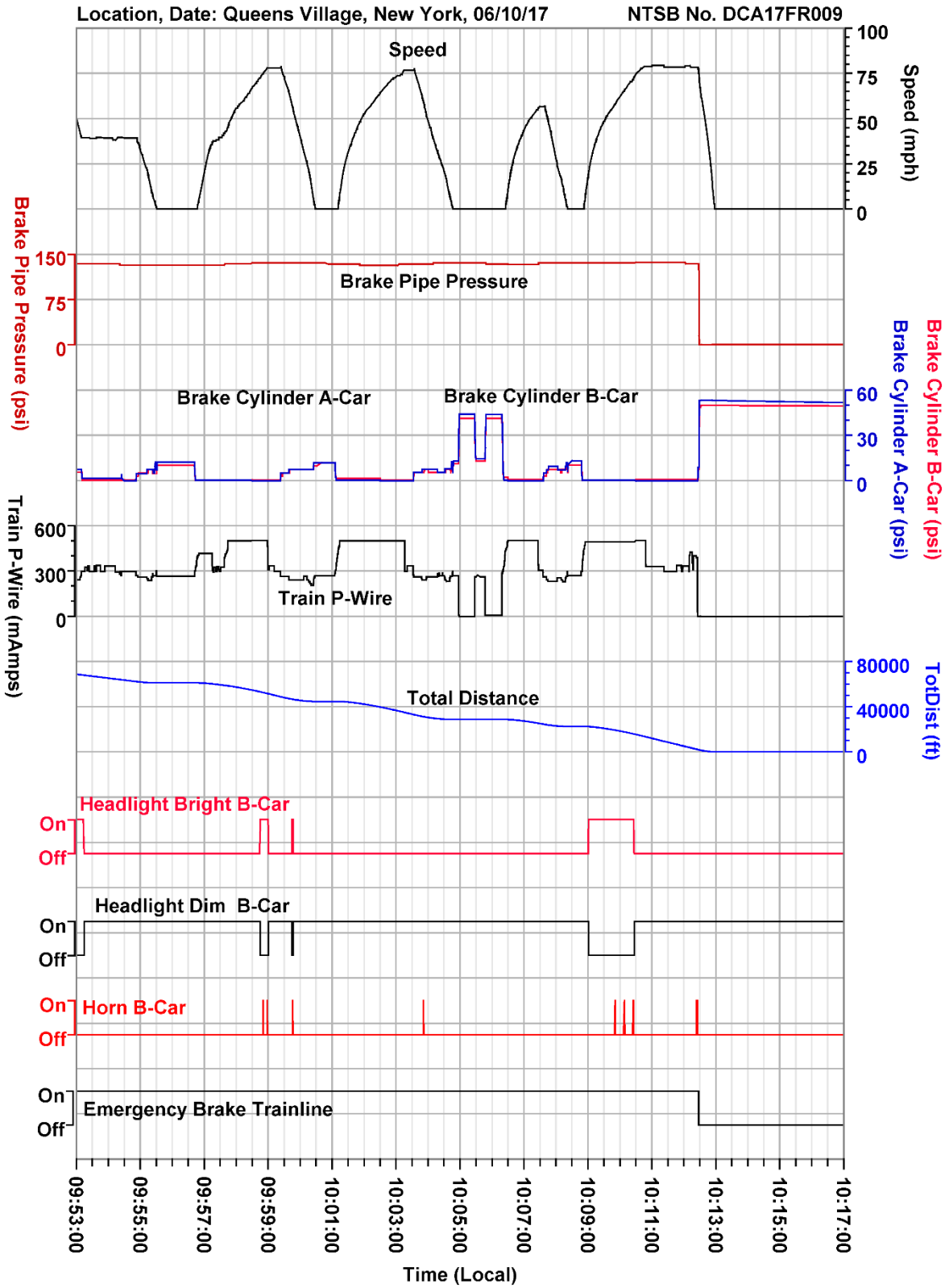


Figure 2. 7695-96 basic parameters – medium view surrounding event.

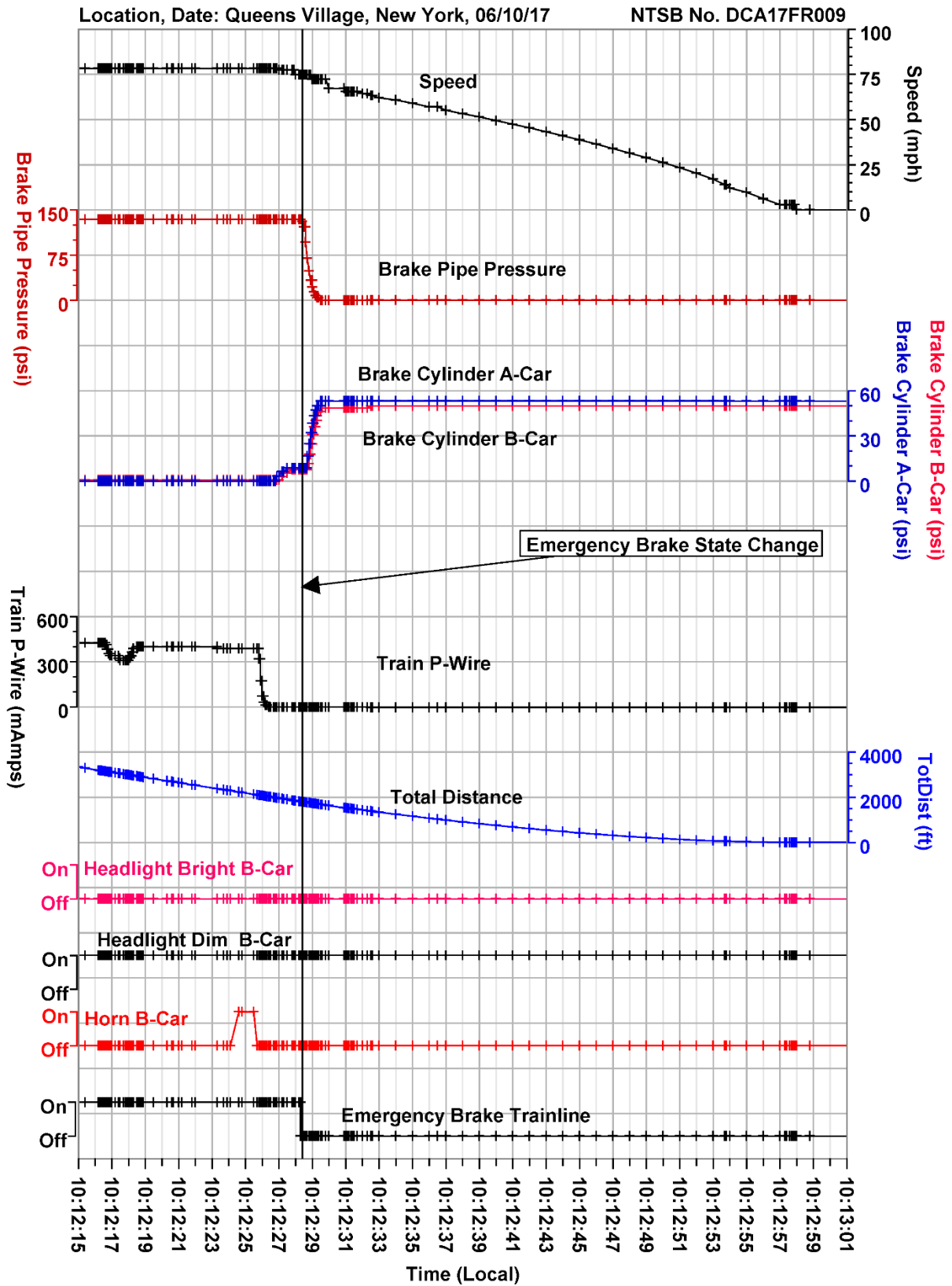
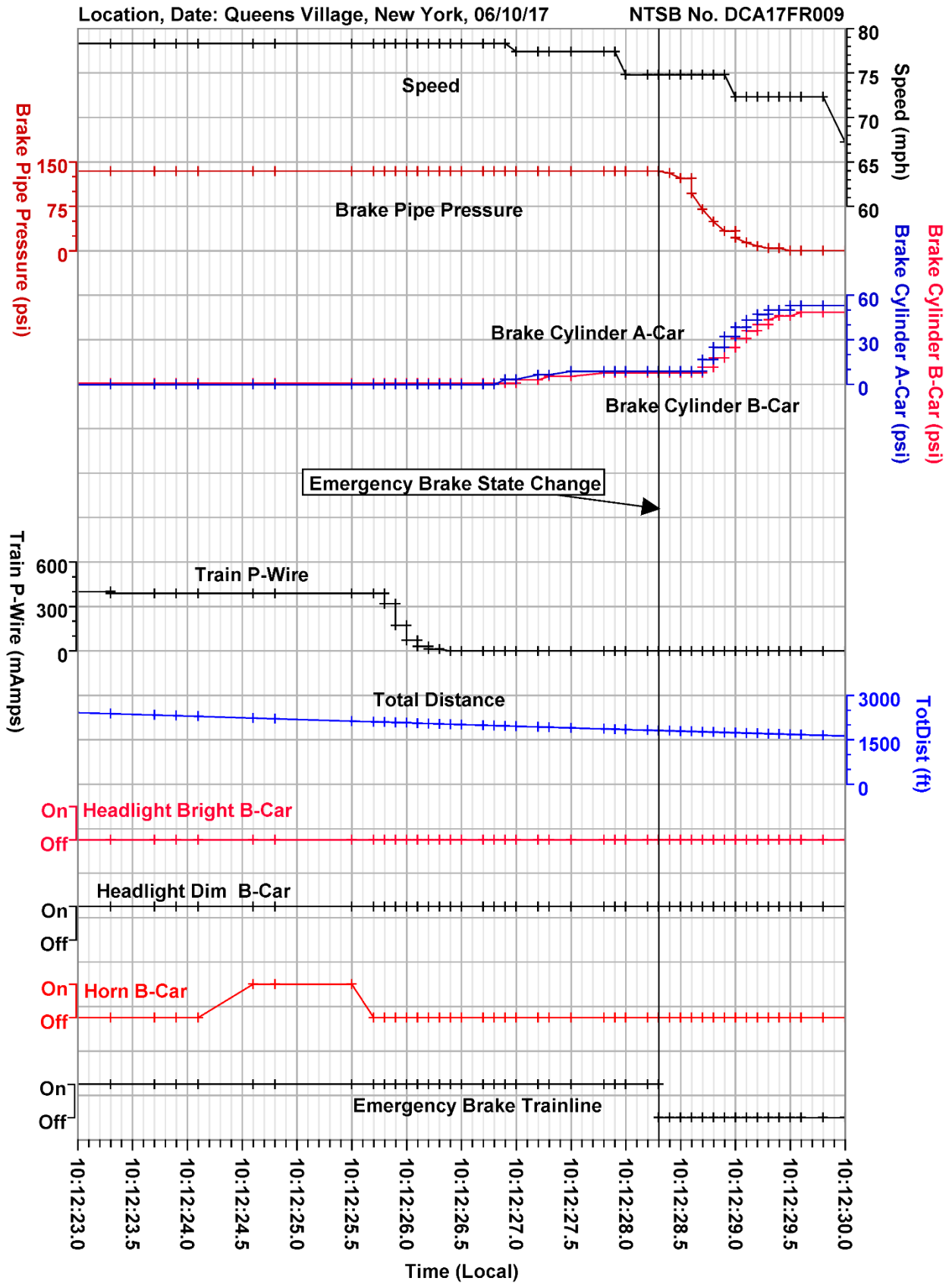


Figure 3. 7695-96 basic parameters – narrow view surrounding event.



APPENDIX A

This appendix describes the event recorder parameters provided and verified in this report for MU 7695-96, recorded by car 7696 (“A” car). 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 event recorder parameters for MU 7695-96.

Name	Symbol	Description
1. Brake Cylinder A-Car (psi)	BCA	A-Car Brake Cylinder Pressure
2. Brake Cylinder B-Car (psi)	BCB	B-Car Brake Cylinder Pressure
3. Brake Pipe Pressure (psi)	BPP	Brake Pipe Pressure
4. Emergency Brake Trainline (discrete)	EBT	Emergency Brake Trainline
5. Headlight Bright B-Car (discrete)	HBB	B-Car Headlight Bright
6. Headlight Dim B-Car (discrete)	HDB	B-Car Headlight Dim
7. Horn B-Car (discrete)	HRB	B-Car Horn
8. Speed (mph)	-	Speed
9. TotDist (ft)	-	Feet Remaining
10. Train P-Wire (mAmps)	TPW	Train P-Wire ⁵

Table A-2. Unit and discrete state abbreviations.

Units Abbreviation	Description
discrete	discrete
ft	feet
mAmps	milliamperes
mph	miles per hour
psi	pounds per square inch

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.

⁵ Train P-Wire is proportional to throttle position; 0 being emergency brake up to 515 mAmps for maximum power.