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

February 14, 2013

# Locomotive Event Recorder

**Specialist's Factual Report**
**By Cassandra Johnson**

## 1. EVENT SUMMARY

| | |
|---|---|
| Location: | Midland, Texas |
| Date: | November 15, 2012 |
| Company: | Union Pacific (UP) Railroad |
| Train ID: | ZLCAI-14 |
| Lead Locomotive #: | 7877 |
| Trailing Locomotive #: | 7653 |
| NTSB Number: | HWY13MH003 |

## 2. LOCOMOTIVE EVENT RECORDER GROUP

A locomotive event recorder group was not convened.

## 3. DETAILS OF RECORDER INVESTIGATION

The locomotive event recorders from both the UP train ZLCAI-14's lead locomotive 7877 and UP train ZLCAI-14's trailing distributed power (DP) locomotive 7653 were downloaded on scene[1]. The files were readout and evaluated by the National Transportation Safety Board's Vehicle Recorder Division.

### 3.1. Locomotive Event Recorder Recording Description and Wheel Size

For most locomotive event recorders, the actual speed and distance values are not recorded but rather the number of drive wheel rotations (or fraction thereof) are stored in memory. At the time the data is extracted, a wheel size (diameter) is manually entered into the readout station or computer. Wheel size, number of rotations, and time are then used by the program to calculate distance traveled, where the derived distance traveled does not account for any wheel skidding or slipping that could have occurred. Then the calculated distance traveled and time data are used to calculate speed. The wheel sizes measured were 43 inches and 42.75 inches for UP 7877 and UP 7653, respectively.

Using the wheel sizes measured, the locomotive event recorder data from both UP 7877 and UP 7653 were extracted using the Wabtec Railway Electronics Event Recorder Data Analysis

[1] For the rest of this report, UP train ZLCAI-14's lead locomotive 7877 and UP train ZLCAI-14's trailing DP locomotive 7653 will be referred as UP 7877 and UP 7653, respectively.

Software. The data exported has a sampling rate of one second. Therefore, the data has an accuracy of +/- 1 second.

### 3.2. Parameters

Table A-1 lists the parameters from both UP 7877's and UP 7653's locomotive event recorders that were verified and provided in this report. Additionally, table A-2 contains the unit and discrete state abbreviations for the parameters.

#### 3.2.1. Distance Traveled

The default output for the distance traveled is the distance decreasing in time. Therefore, the distance traveled began with a very large value and continually decreased to 0 feet.

#### 3.2.2. Derived Milepost

Milepost was not a recorded parameter but was derived by using miles traveled, milepost location of where the locomotive event recorder was downloaded, and the locomotive direction of travel. UP 7877's locomotive event recorder was downloaded at milepost 554 and UP 7653's locomotive event recorder was downloaded at milepost 555.35. Additionally, milepost was decreasing in value for both locomotives since the train was traveling east.

### 3.3. Event Recorder Timing

Each set of locomotive event recorder data from UP 7877 and UP 7653 are independently time stamped. As a consequence of the independent time stamping, recorded times may not reflect the actual time of the day. Therefore, common events on each locomotive event recorder may not be sampled by both recorders at precisely the same time. To provide a common time base, the locomotive event recorder data was correlated to UP 7877's video recorder data[2], which was referenced to GPS time and reports as local time in central standard time (CST).

#### 3.3.1. Lead Locomotive Timing Correlation Details

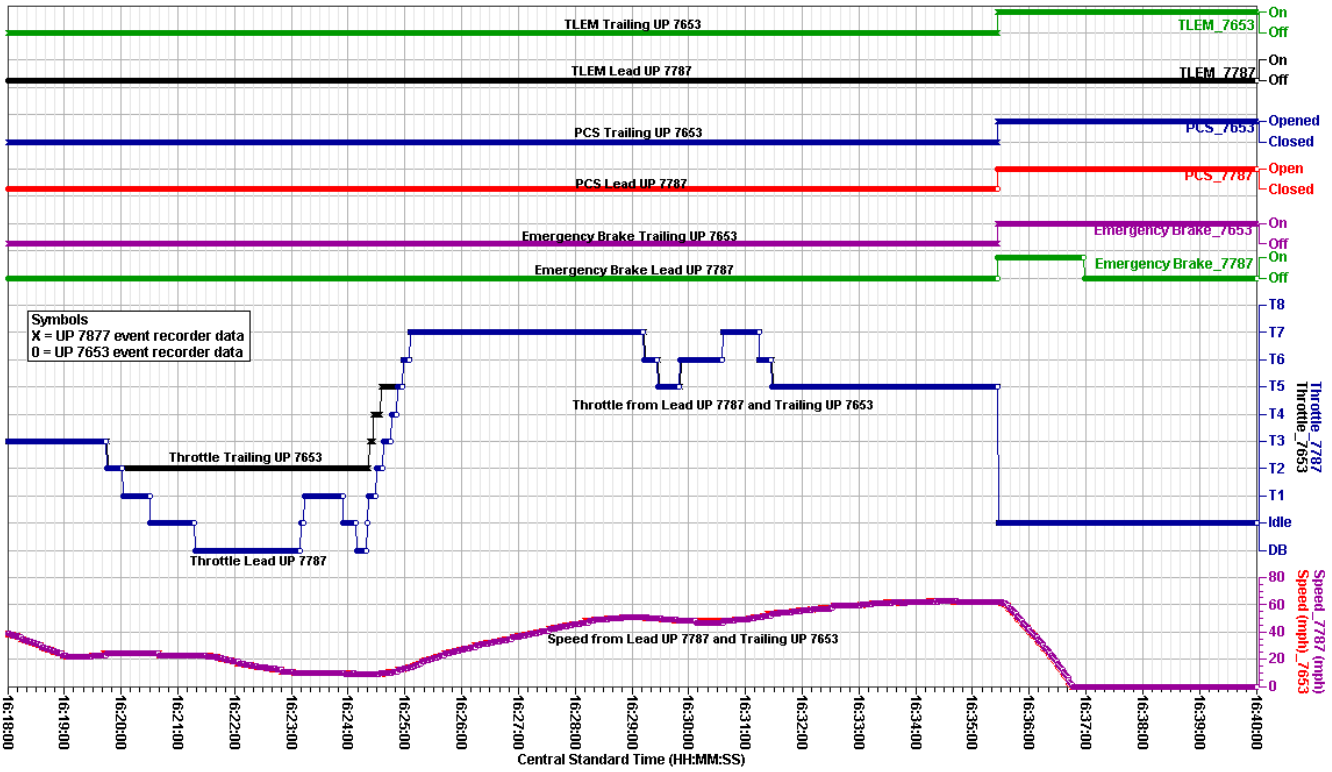
The video recorder data from UP 7877 recorded the horn, providing a common parameter between UP 7877's locomotive event recorder data and video recorder data. The video from UP 7877 recorded the horn starting at 16:35:23 CST and stopping at 1635:27 CST. The locomotive event recorder data recorded the horn "On" at 16:35:28 event recorder time and then transitioned to "Off" at 16:35:32 event recorder time. Therefore, an offset of 5 seconds was subtracted from UP 7877's event recorder data to align the UP 7877 event and video recordings.

#### 3.3.2. UP 7877 and UP 7653 Timing Correlation Details

UP 7653's locomotive event recorder data was correlated to UP 7877's locomotive event recorder data by aligning the following parameters: TLEM, speed, PCS, Emergency Brake, and Throttle. To align the two sets of data, a 1 second offset was added to UP 7653's locomotive event recorder data as shown in figure 1.

[2] Refer to the National Transportation Safety Board's On Board Video Recorder Factual Report.

**Figure 1. Time comparison between UP 7877 and UP 7653.**




Therefore, for the rest of this report, all times are referenced as CST.

### 3.4. Plots and Corresponding Tabular Data

Figures 2 to 4 and figures 5 to 7 contain UP 7877's and UP 7653's locomotive event recorder data, respectively, during the November 15, 2012 event. All the parameters listed in table A-1 are plotted except feet traveled. Figures 2 and 5 cover the entire last two movements including the event (the scale is from 14:00:00 CST to 16:45:00 CST). Figures 3 and 6 cover the last movement including the event (the scale is from 15:35:00 CST to 16:43:00 CST). Lastly, figures 4 and 7 have an expanded time scale from 16:32:00 CST to 16:38:30 CST.

In summary, the locomotive event recorder data from UP 7877's indicated the following:

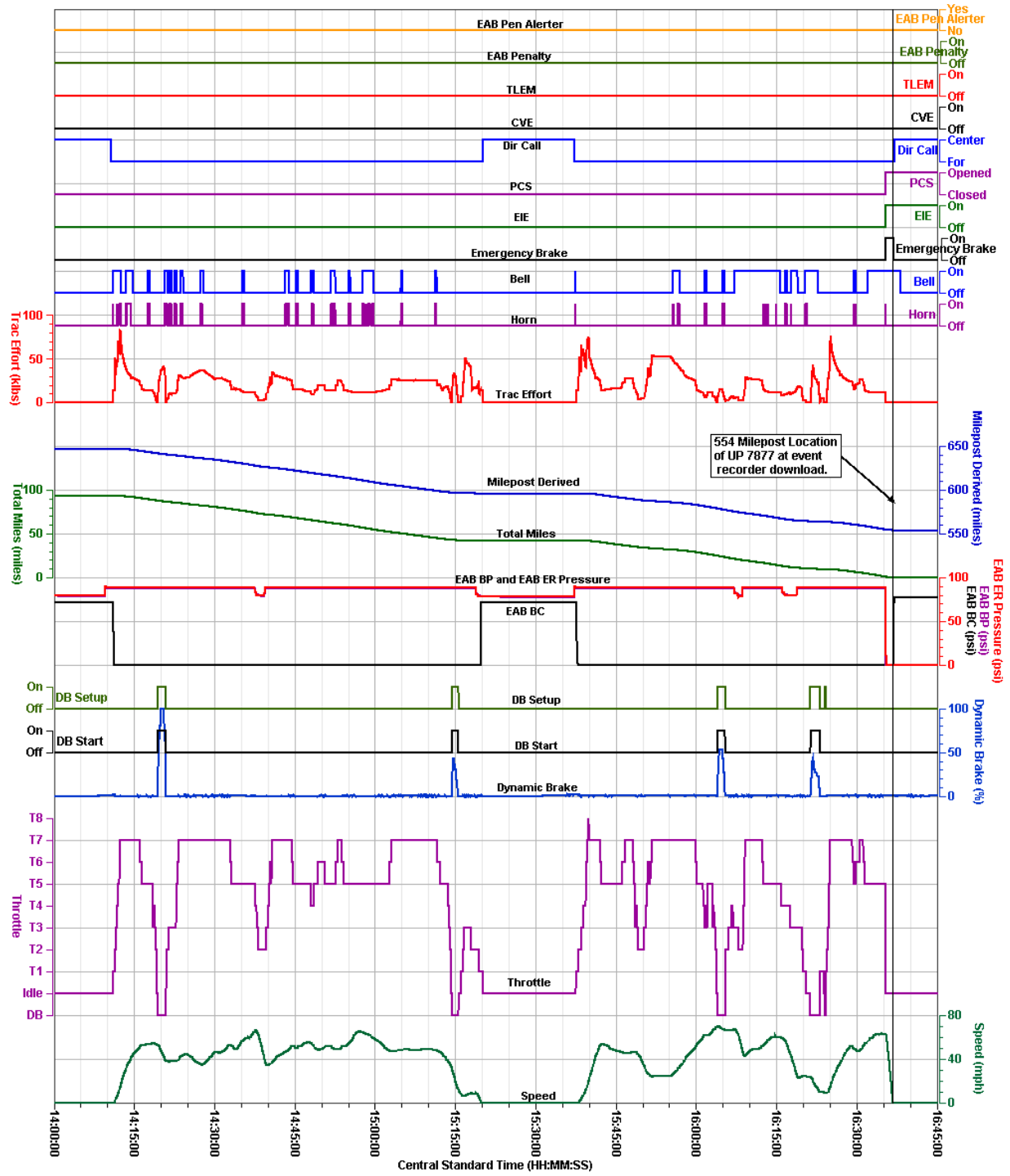
- At about 14:11:24 CST, the train departed. At this time the derived milepost was 647.12 and there were 93.12 miles until download.
- About 1 hour and 8 minutes later at 15:19:47 CST, the train stopped. At this time, the derived milepost was 595.97 and there were 41.97 miles until download.
- About 19 minutes later at 15:38:14 CST, the train started moving.
- About 57 minutes later at 16:35:23 CST, the horn transitioned to "On". At this time, the derived milepost was 554.85, the throttle was "T5", and there were 0.85 miles until download.
- About 4 seconds later at 16:35:27 CST, the horn transitioned to "Off". At this time, the derived milepost was 554.78 and there were 0.78 miles until download. Also at this

time, the EIE transitioned to “On”, PCS transitioned to “Opened”, and Emergency Brake transitioned to “On”.

- One second later at 16:35:27 CST, the throttle transitioned from “T5” to “Idle”.
- About 1 minute and 18 seconds later at 16:36:46 CST, the train came to a complete stop. At this time, the milepost was 554.

All of the corresponding tabular data from UP 7877’s event recorder used to create figures 2 through 4 including feet traveled are provided in electronic comma separated value (*.csv) format as attachment 1 to this factual report. Additionally, the corresponding tabular data from UP 7653’s event recorder used to create figures 5 to 7 including feet traveled are provided in electronic comma separated value (*.csv) format as attachment 2 to this factual report.

**Figure 2: UP 7877's locomotive event recorder parameters during last two movements.**




Revised: 11 February 2013 | Lead UP 7877 - Last Two Movements Including Event | National Transportation Safety Board

**Figure 3: UP 7877's locomotive event recorder parameters during last movement.**

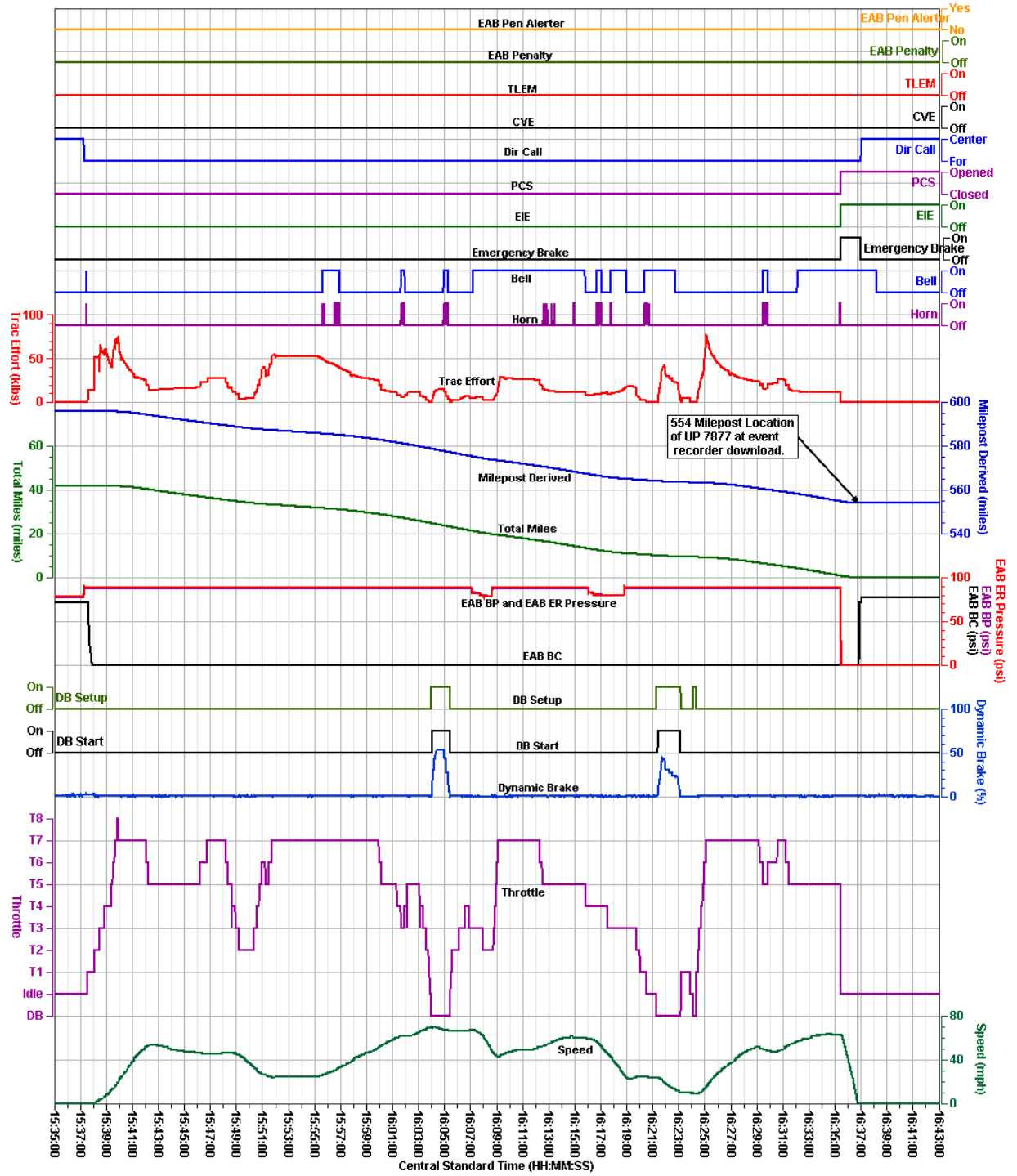



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**Figure 4: UP 7877's locomotive event recorder parameters expanded scale.**

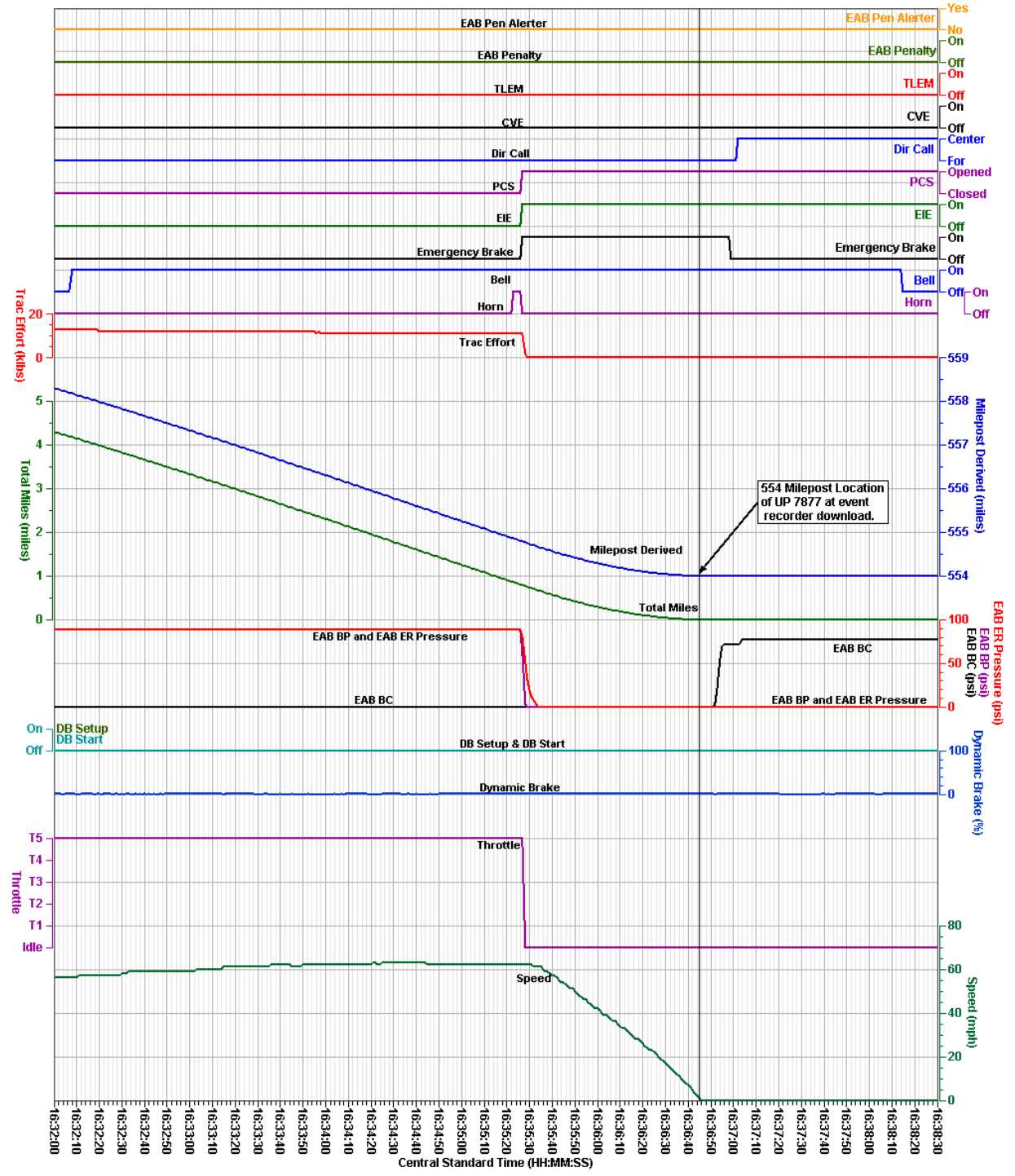


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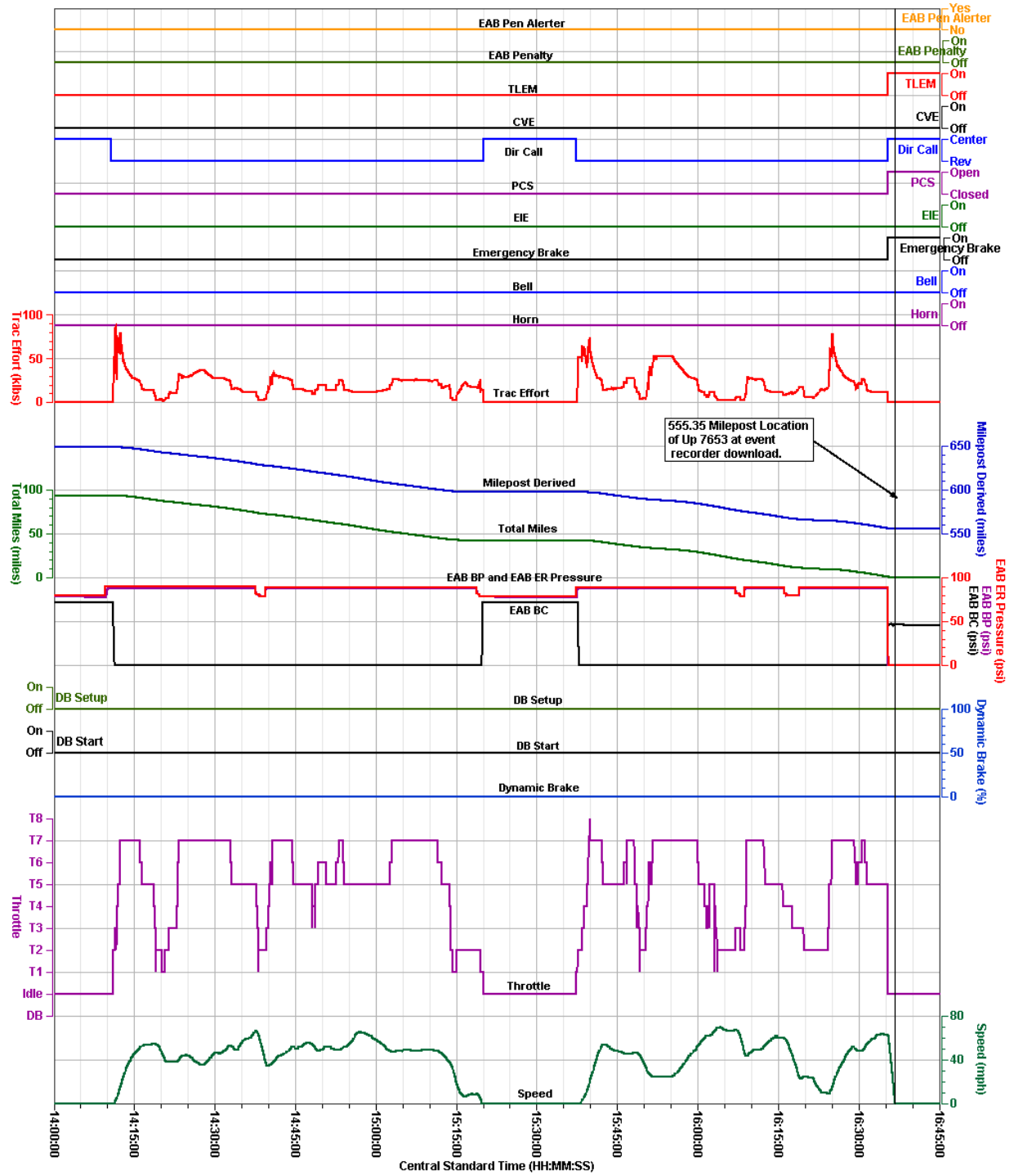
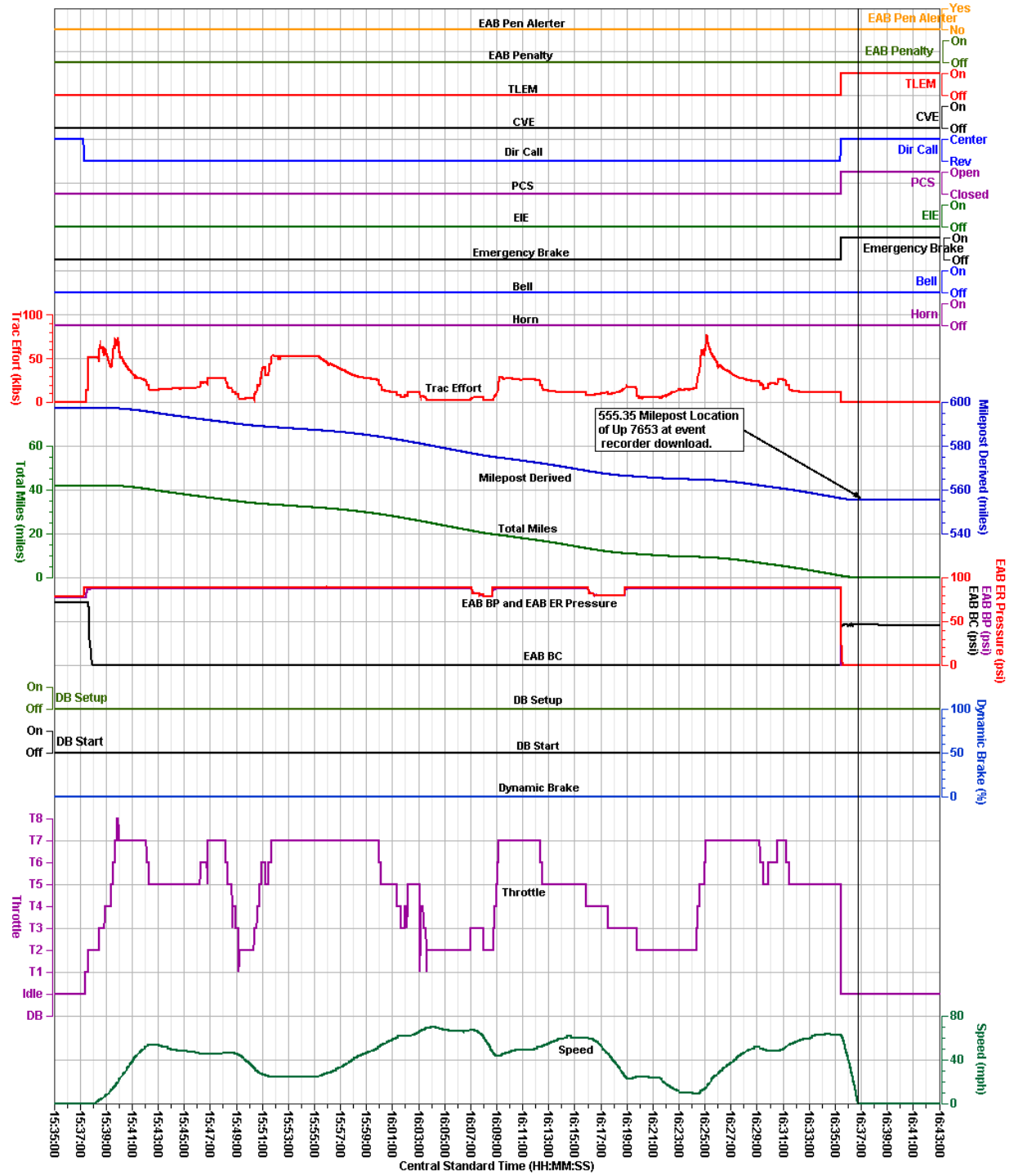
**Figure 5: UP 7653's locomotive event recorder parameters during last two movements.**



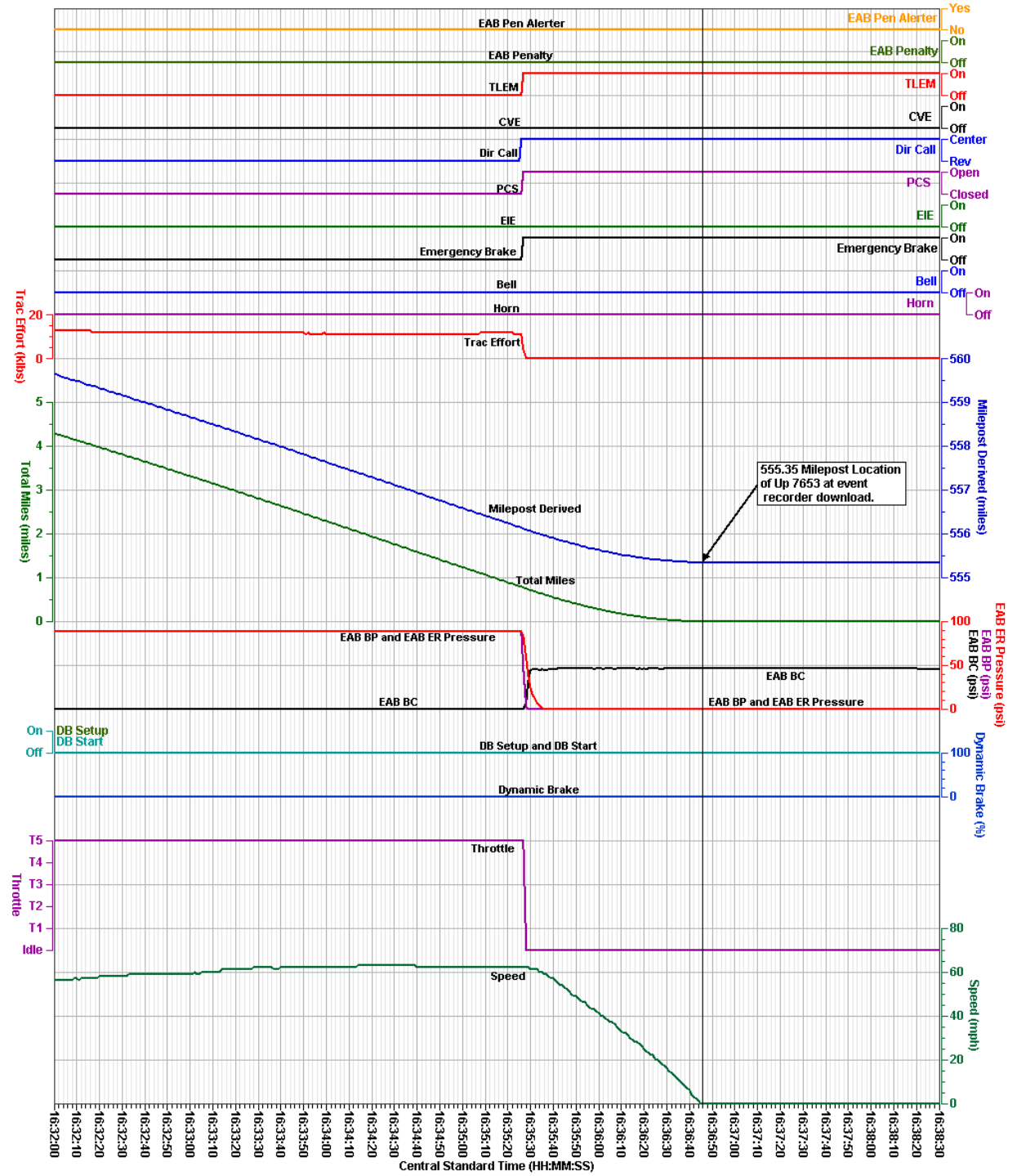

Revised: 11 February 2013 | Trailing UP 7653 - Last Two Movements Including Event | National Transportation Safety Board

**Figure 6. UP 7653's locomotive event recorder data during last movement.**




Revised: 11 February 2013 | Trailing UP 7653 - Last Movement Including Event | National Transportation Safety Board

**Figure 7. UP 7653's locomotive event recorder parameters expanded scale.**




Revised: 11 February 2013 Trailing UP 7653 - Expanded Scale (6.5 Min) National Transportation Safety Board

## APPENDIX A

This appendix describes the locomotive event recorder parameters provided and verified in this report. Table A-1 lists the parameters for both UP 7877 and UP 7653. Table A-2 describes the unit abbreviations.

**Table A-1. UP 7877 and UP 7653 verified and provided locomotive event recorder parameters.**

| Parameter Name | Parameter Description |
|---|---|
| 1. Bell (discrete) | Bell |
| 2. CVE (discrete) | Conductor Valve Emergency |
| 3. DB Setup (discrete) | Dynamic Brake Setup |
| 4. DB Start (discrete) | Dynamic Brake Start |
| 5. Dir Call (discrete) | Direction of Travel |
| 6. Dynamic Brake (%) | Dynamic Brake |
| 7. EAB BC (psi) | Electronic Air Brake Brake Cylinder Pressure |
| 8. EAB BP (psi) | Electronic Air Brake Brake Pressure |
| 9. EAB ER Pressure (psi) | Electronic Air Brake Equalizing Reservoir Pressure |
| 10. EAB Pen Alerter (discrete) | Electronic Air Brake Penalty Alerter |
| 11. EAB Penalty (discrete) | Electronic Air Brake Penalty |
| 12. EIE (discrete) | Engineer Induced Emergency |
| 13. Emergency Brake (discrete) | Emergency Brake |
| 14. Horn (discrete) | Horn |
| 15. Milepost Derived (miles) | Derived Milepost Location |
| 16. PCS (discrete) | Pneumatic Control Switch |
| 17. Speed (mph) | Speed |
| 18. Throttle (discrete) | Throttle Position |
| 19. TLEM (discrete) | Train Line Emergency |
| 20. Total Feet (ft) | Feet Traveled |
| 21. Total Miles (miles) | Total Miles Traveled |
| 22. Trac Effort (klbs) | Traction Effort |

**Table A-2. Unit and discrete state abbreviations.**

| Unit and Discrete State Abbreviations | Description |
|---|---|
| % | percent |
| DB | Dynamic Brake |
| discrete | discrete |
| For | Forward |
| ft | feet |
| klbs | kilo pounds |
| miles | miles |
| mph | miles per hour |
| psi | pounds per square inch |

| Unit and Discrete State Abbreviations | Description |
|---|---|
| T1 | Throttle 1 |
| T2 | Throttle 2 |
| T3 | Throttle 3 |
| T4 | Throttle 4 |
| T5 | Throttle 5 |
| T6 | Throttle 6 |
| T7 | Throttle 7 |
| T8 | Throttle 8 |

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.