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

October 6, 2017

Electronic Devices

Specialist's Factual Report
by Jane Foster

1. EVENT

Location:	Westbound Interstate 10 (I-10) near Palm Springs, California
Vehicle #1:	1996 MCI Motorcoach
Operator #1:	USA Holiday
Vehicle #2:	2015 International Prostar Truck in combination with a 2013 Utility VS2RA Semi-trailer
Operator #2:	TSC, Tri-State Collision, LLC
Date:	October 23, 2016
Time:	5:16 a.m. Pacific Daylight Time (PDT)
NTSB #:	HWY17MH005

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

2. DETAILS OF INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Device 1:	Detroit Diesel DDEC IV
Device 1 Serial Number:	06R0296639
Vehicle:	Vehicle #1
Device 2:	International Engine Control Module (ECM)
Device 2 Serial Number:	126HM2Y4305489
Vehicle:	Vehicle #2
Device 3:	Fleetmatics Data
Device 3 Serial Number:	n/a
Vehicle:	Vehicle #2

2.1. Detroit Diesel DDEC IV Device Description (Vehicle #1)

The Detroit Diesel DDEC IV is an electronic control and data storage system for Detroit Diesel engines. The DDEV IV stores vehicle parameters and has the capability to record trip activity, including daily, monthly, and lifetime engine data. The DDEC IV interfaces with many onboard sensors that help monitor and perform its functions.

2.2. Detroit Diesel DDEC IV Data Recovery (Vehicle #1)

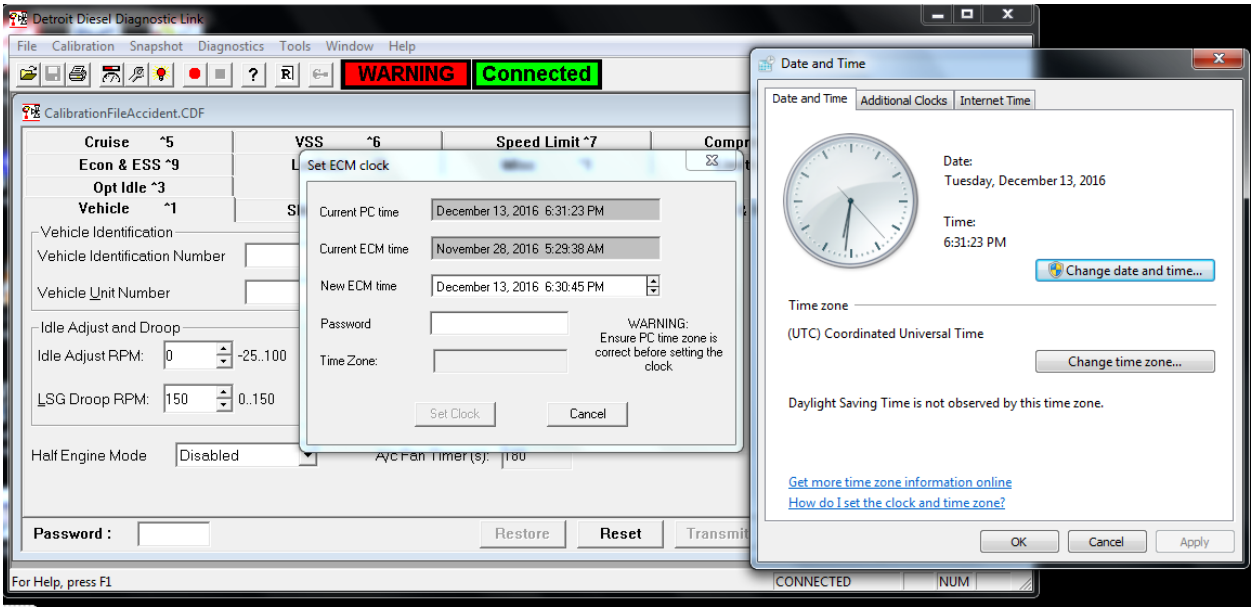
The DDEC IV was removed from the 1996 MCI Motorcoach by on-scene investigators. A diagnostic bench top rig was prepared for the device in Camarillo, CA. The rig was set up to not induce errors or erase any existing data or internal faults, however, an "Oil Pressure Circuit Low" Fault was caused due to the bench top rig. This did not cause any accident pertinent faults to be overwritten. An NTSB investigator imaged the device's internal memory successfully.

2.2.1. Detroit Diesel DDEC IV Data Description (Vehicle #1)

The DDEC IV was imaged using DDDL 6 and DDEC Reports software. The set speed limit was enabled on the vehicle with a set speed limit of 79 miles per hour. The governed RPM[1] is 2110 rpm.

Figure 1 shows the clock of the DDEC IV ECM which was used to calculate the drift of the internal clock. The imaging computer was set to Coordinated Universal Time (UTC). The accident occurred in PDT (-7 UTC). The ECM was programmed in Eastern Standard Time (EST), and the internal clock was determined to be 15 days, 13 hours, 1 minute, 45 seconds slow. To correct for clock drift, 15 days, 13 hours, 1 minute, 45 seconds were added to each of the time-stamped records. Two hours (2:00:00) were then subtracted to adjust for the local time (EST to PDT). In this analysis, local time will be used, with the actual time-stamped record referenced below.

Figure 1. Clock of the DDEC IV.



No hard brake or last stop information was recorded at the time of the accident. Attachment one contains the full DDEC report.

[1] RPM: rotations per minute

2.3. International ECM Description (Vehicle #2)

The International ECM is an electronic control and data storage system for International engines. The ECM stores vehicle parameters and has the capability to record trip activity, including daily, monthly, and lifetime engine data. The ECM interfaces with many onboard sensors that help monitor and perform its functions.

2.3.1. International ECM Data Recovery (Vehicle #2)

The tractor trailer contained an International ECM. The electrical system on the tractor trailer was in good condition and the ECM was imaged normally through the 9-pin Deutsch connector.

2.3.2. International ECM Data Description (Vehicle #2)

The instrument panel was documented when the engine was turned on. Figures 1 and 2 show the instrument panel when the key was turned to the accessory position. Figures 3 through 13 show the cycling through the display on the instrument panel. Figure 3 shows the mileage of the tractor trailer displayed on the instrument panel. The screen read 370190 miles. Figure 4 shows trip miles of the tractor trailer displayed on the instrument panel. The screen read 19771.8 miles. Figure 5 shows the engine hours of the tractor trailer displayed on the instrument panel. The screen read 2520 hours. Figure 6 shows trip engine hours of the tractor trailer displayed on the instrument panel. The screen read 654.7 hours. Figure 7 shows engine PTO hours of the tractor trailer displayed on the instrument panel. The screen read 0.0 hours. Figure 8 shows total engine PTO hours of the tractor trailer displayed on the instrument panel. The screen read 0.0 hours. Figure 9 shows instant miles per gallon (MPG) of the tractor trailer displayed on the instrument panel. The screen read data n/a. Figure 10 shows trip miles per gallon (MPG) of the tractor trailer displayed on the instrument panel. The screen read 7.1 mpg. Figure 11 shows engine PTO Gallons of the tractor trailer displayed on the instrument panel. The screen read 0.0 gallons. Figure 12 shows ENPTO TR gallons of the tractor trailer displayed on the instrument panel. The screen read 0.0 gallons. Figure 13 shows RR thousand pounds of the tractor trailer displayed on the instrument panel. The screen read approx. 4.9 thousand pounds.

Figure 2. Left side of instrument panel on tractor trailer.

Figure 3. Right side of instrument panel on tractor trailer.

Figure 4. Mileage of the tractor trailer displayed on the instrument panel. The screen read 370190 miles.

Figure 5. Trip Miles of the tractor trailer displayed on the instrument panel. The screen read 19771.8 miles.

Figure 6. Engine hours of the tractor trailer displayed on the instrument panel. The screen read 2520 hours.

Figure 7. Trip engine hours of the tractor trailer displayed on the instrument panel. The screen read 654.7 hours.

Figure 8. Engine PTO hours of the tractor trailer displayed on the instrument panel. The screen read 0.0 hours.

Figure 9. Total Engine PTO hours of the tractor trailer displayed on the instrument panel. The screen read 0.0 hours.

Figure 10. Instant miles per gallon (MPG) of the tractor trailer displayed on the instrument panel. The screen read data n/a.

Figure 11. Trip miles per gallon (MPG) of the tractor trailer displayed on the instrument panel. The screen read 7.1 mpg.

Figure 12. Engine PTO Gallons of the tractor trailer displayed on the instrument panel. The screen read 0.0 gallons.

Figure 13. ENPTO TR gallons of the tractor trailer displayed on the instrument panel. The screen read 0.0 gallons.

Figure 14. RR thousand pounds of the tractor trailer displayed on the instrument panel. The screen read approx. 4.9 thousand pounds.

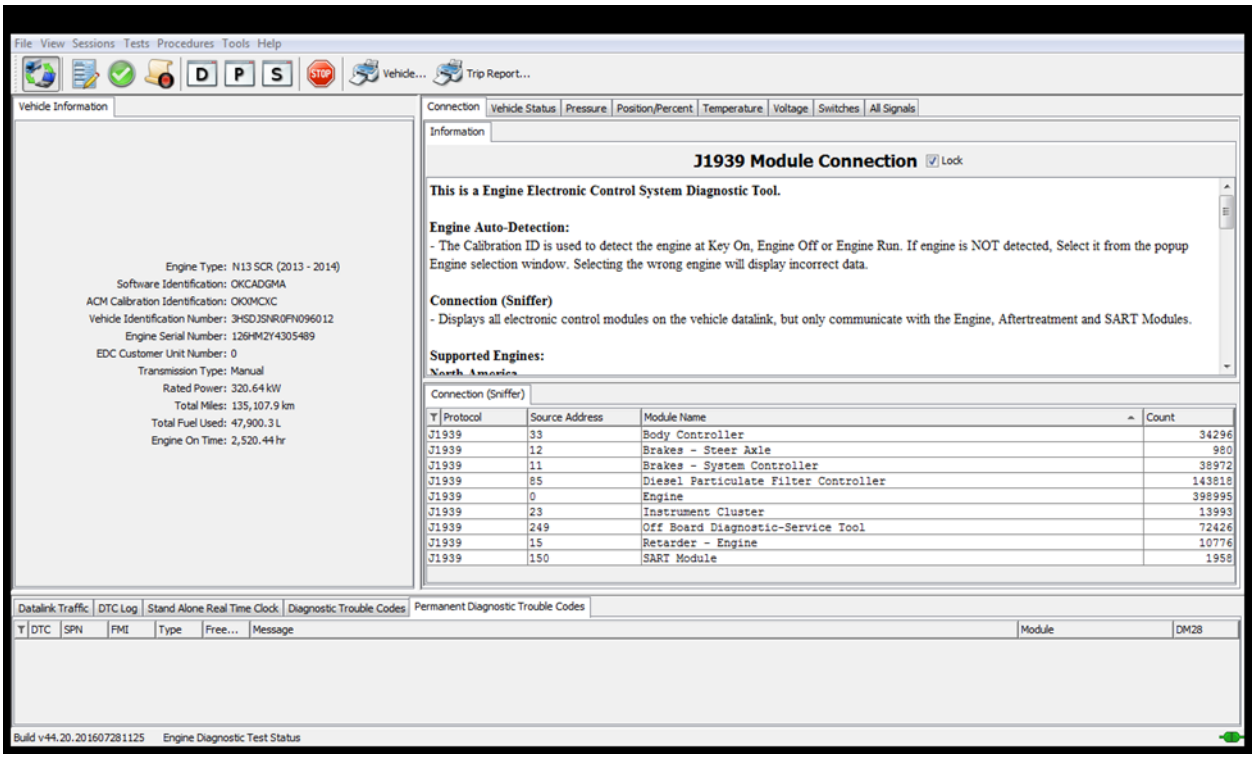
The image of the tractor trailer ECM did not have all the same information as the instrument panel. Table 1 shows the differences in the data. The engine hours were used to help align events when looking at the data.

Table 1. Differences in Instrument Panel display and ECM Image Information.

Parameter	Instrument Panel Display	ECM Image Information
Mileage	370190	83952.2
Engine Hours	2520	2520.44

There were five diagnostic trouble codes found on the vehicle. A snap shot (known as a Freeze Frame) of the different engine parameters was taken at the time each of these diagnostic trouble codes occurred. No diagnostic trouble codes occurred due to the accident. There were no permanent diagnostic codes found on the vehicle. Figure 15 shows the lack of permanent diagnostic codes found on the software.

Figure 15. Permanent diagnostic trouble codes found on the tractor trailer. No codes were displayed



The engine clock was documented for time correlation. Figure 16 shows the system clock and the engine clock. The system clock is also shown on the bottom left hand corner of the screen. This is the computer clock and it is aligned with the correct time in eastern daylight time (EDT). The current SART time is the engine clock, and it differs from the correct time by -58 seconds. Time stamps for recorded events were stored in Coordinated Universal Time (UTC), which was 7 hours ahead of Pacific Daylight Time (PDT). Therefore, reported times were corrected for clock drift by adding 58 seconds and for time zone by subtracting 7 hours.

Figure 16. Clock screenshot for time alignment purposes.

The tractor trailer ECM was equipped with an Event Data Recorder (EDR). This EDR records two hard acceleration or deceleration events and two last stop events. Events are overwritten as only the two most recent events are stored in memory. The EDR stores its timestamps in UTC. There were no hard acceleration or deceleration events recorded at the time of this crash. Hard acceleration or deceleration events are recorded when this vehicle increases or decreases speed at a rate of 7.4 miles per hour per second. Last stop events are recorded when the truck stops and idles for 2 minutes or when the truck stops and is powered off. Only one last stop event was pertinent to the accident. The accident pertinent last stop data shows the tractor trailer slowing from 59.03 mph to stopping during the first 105 seconds of pre-event data. The tractor trailer stopped at engine hour 2,519.79 and at about 05:12:29 PDT on October 23, 2016. The tractor trailer idled for the next 15 seconds of recorded data after the last stop event. Attachment 2 contains an image of the last stop data.

2.4. Fleetmatics Device Description (Vehicle #2)

The Fleetmatics system uses a Sierra Wireless GNX-5P unit to record the GPS position of the vehicle. The GNX-5P has internal cellular and GPS antennas and a three-axis accelerometer to collect GPS data.

2.4.1. Fleetmatics Data Recovery (Vehicle #2)

The Fleetmatics data was transferred to the NTSB from the operator of the truck tractor trailer. Fleetmatics customer service confirmed that the timestamps of the data were in central daylight time (CDT). The device was undamaged by the crash.

2.4.2. Fleetmatics Data Description (Vehicle #2)

The data extracted included GPS information from September 24, 2016 through October 23, 2016, and showed the tractor trailer stopped at 12:01 PM PDT. The last data point for the tractor trailer occurs on October 23, 2016.

2.4.3. Parameters Provided (Vehicle #2)

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Speed and Location are derived from the recorded parameters. The time, recorded in CDT, was converted to PDT by subtracting 2 hours from the recorded time.

Table 2: GPS Data Parameters

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time (CDT) for recorded data point (HH:MM)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
Location	Description of the location of the vehicle
Speed	Derived speed (miles per hour)

2.4.4. Overlays and Tabular Data (Vehicle #2)

Figure 17 is a graphical overlay generated using Google Earth for the day of the crash starting at 2:00 AM PDT. The weather, traffic, and lighting conditions in Google Earth are not necessarily the weather, traffic, and lighting conditions present at the time of the recording.

Figure 18 is a graphical overlay generated using Google Earth zoomed in on the time of the crash. The vehicle stops at 5:13 AM PDT on the highway and then is impacted at 5:16 AM PDT. The final data point for October 23, 2016 is at 12:01 PM PDT.

Tabular data used to generate figures 17 and 18 are included as Attachment 3. This attachment is provided in electronic comma-delimited (.CSV) format.

Figure 17. Graphical overlay generated using Google Earth for the day of the crash starting at 2:00 AM PDT.

Figure 18: Graphical overlay generated using Google Earth during the timeframe of the crash.