VEHICLE SAFETY

Electronic Control Module - The "Flight Recorder" of Heavy Trucks

by Christopher W. Ferrone[1] and John M. Goebelbecker, P.E.[2]

Abstract

A heavy truck manufactured in the mid-1990's is likely to be equipped with an electronic control module (ECM) which has the capability of being the truck's "flight recorder" in a serious accident. Extracting data from the ECM often answers critical questions regarding vehicle speed and the driver's actions leading up to, during and after a vehicle accident.
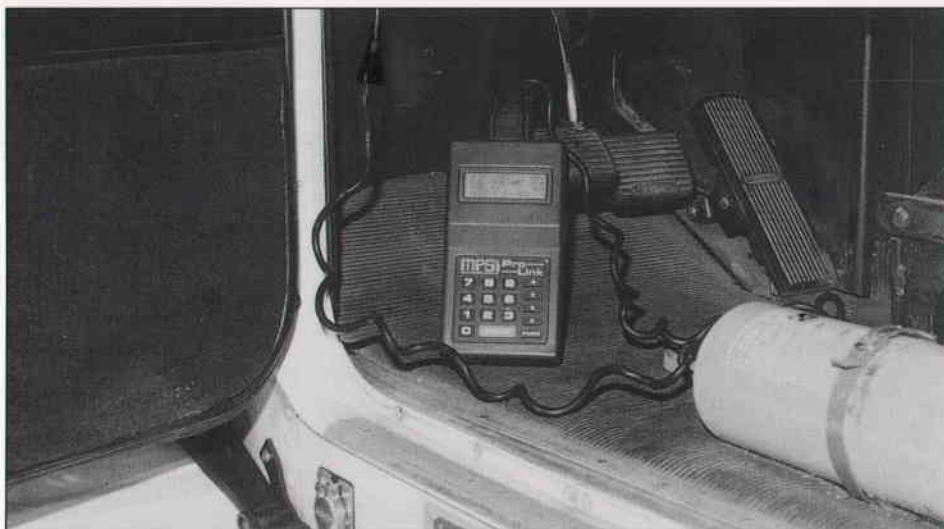
Figure 1 – Electronic Reader Tool

Background

The introduction of electronic engine controls in 1988 enabled engine manufacturers to provide truck owners with historical data regarding an engine's performance. Initially, fleet owners were interested in a vehicle's fuel economy. As the capabilities of the electronic control module increased, the desire for additional historical data grew. Fleet owners began asking for mechanical/maintenance data and data related to driver behavior such as brake usage and vehicle speed. They recognized that how a driver operated the vehicle affected vehicle maintenance, fuel consumption and overall safety. Engine manufacturers responded by adding features such as the ability to record the frequency of engine overspeeds, quick stop occurrences, fuel consumption, diagnostic codes, trip data, engine parameters, throttle position and road speed.

Discussion

The ECM is typically mounted to the engine block and is interfaced using a diagnostic reader tool which plugs into a wire harness in the truck's cab (Figure 1). An internal Ni-Cd battery allows storage of data and communication with the ECM even when the engine is not running and the battery cables have been disconnected. In fact,

---

[1] Senior Mechanical Engineer, Triodyne Inc., Niles, IL., Vehicle and Mobile Equipment Center, ASE Certified Master Truck Technician.

[2] Senior Mechanical Engineer, Triodyne Inc., Niles, IL., Vehicle and Mobile Equipment Center.

– Driving Time	– Vehicle Speed Limit
– Driving Distance	– Throttle Position (%)
– Fuel Consumption	– Vehicle Speed (mph)
– Overall Fuel Economy	– Engine Speed (rpm)
– Avg. Driving Speed	– Brake Switch (on/off)
– Maximum Vehicle Speed	– Clutch Switch (on/off)
– Maximum Engine Speed	– Clock
– Engine Governed Speed	

the entire ECM unit can be removed from the engine and "interrogated" in an office.

The ECM monitors a large number of vehicle parameters by collecting data from sensors approximately once per second. Some typical parameters monitored by the ECM are listed in Table 1. Many parameters are preset at the factory, but several are determined by the end-user. For example, the vehicle's governed road speed can be adjusted electronically by the owner from 75 mph to 62 mph.

Quick Stop Occurrences

A "quick stop occurrence" is an event in which the vehicle's speed drops very quickly. The truck owner may define a quick stop occurrence as being a reduction in speed of 7 mph per second. If the vehicle slows from 55 mph to 30 mph in 3 seconds, for example, the ECM will record a quick stop occurrence. In addition, some ECM's record a vehicle's parameters a preset number of seconds before and after the quick stop occurrence. This data "snapshot"

usually includes vehicle speed, brake condition (on/off), throttle position, position of the cruise control, etc. When the quick stop occurrence is a collision, the ECM holds critical information about driver behavior and vehicle state prior to and subsequent to the accident. By interrogating the ECM, the accident reconstructionist can extract critical data useful in the reconstruction analysis.

Examples

1. Traffic was backed up a mile approaching a road construction zone. A tractor trailer approaching the backup did not see the slowed traffic around a curve in the road. Continuing at highway speed, the truck struck the last car in line pushing it into four other cars. The county coroner measured the skid marks and calculated the truck's speed at 78 mph. An engineer extracted data from the ECM showing that the truck's maximum programmed road speed was 60 mph and there were no engine overspeeds prior to the crash. He concluded that the truck never exceeded 60 mph. The coroner had added his measurements of two different skidmarks.

2. A tractor trailer rear-ended a stopped truck on a highway during a snowstorm. A witness traveling in the opposite direction claimed that the driver "blazed past" other traffic on the road. A reconstructionist extracted data from the ECM which showed that the driver downshifted to reduce speed 15 seconds prior to impact and that the vehicle was traveling only 37 mph at the time of the collision (see Figure 2).
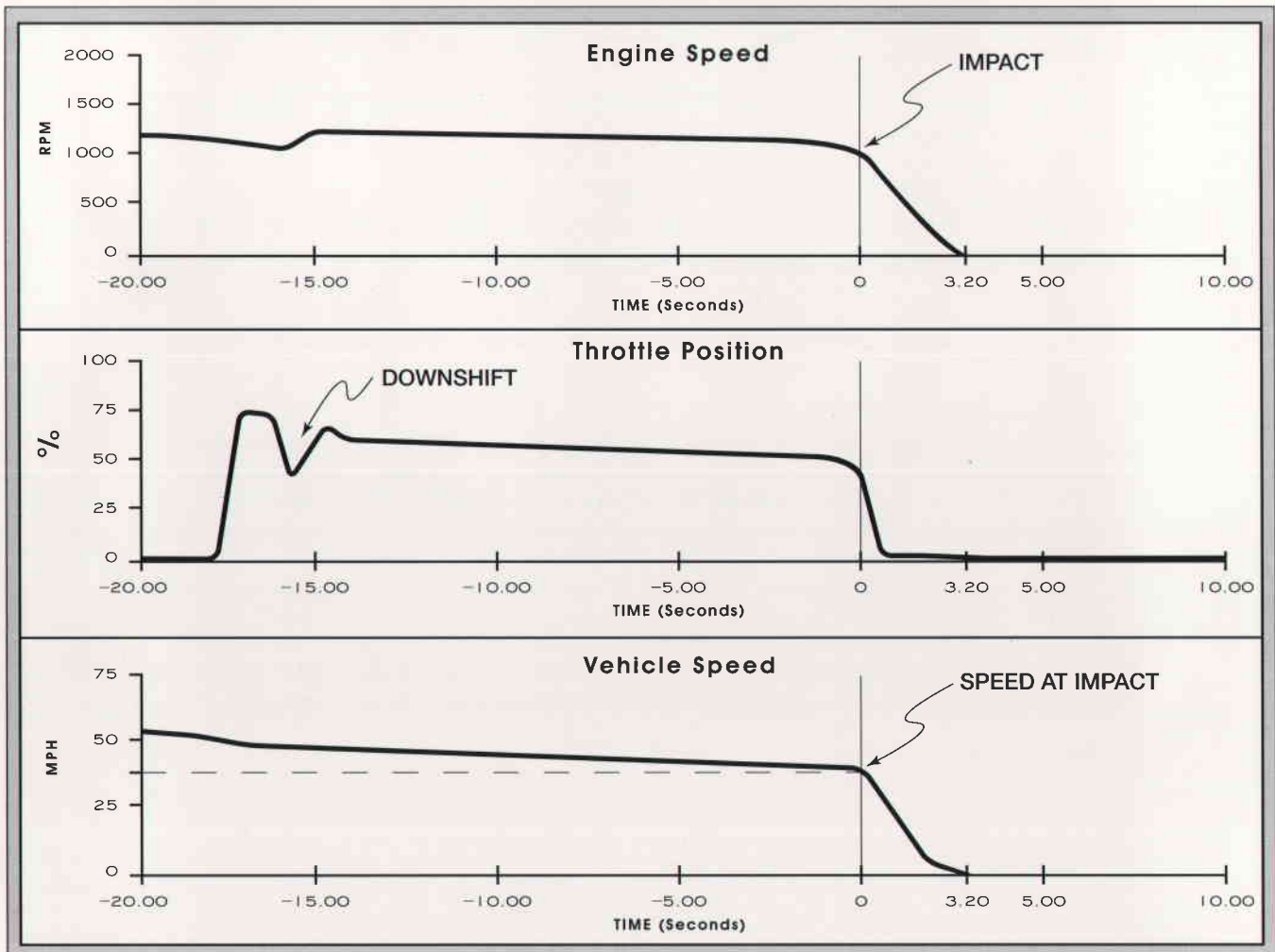

Figure 2 – Typical ECM Output