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# Test Results: Ford PCM Downloads Compared to Instrumented Vehicle Response in High Slip Angle Turning and other Dynamic Maneuvers

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## ABSTRACT

An instrumented 2005 Ford Explorer was used to evaluate speed data provided from its Powertrain Control Module (PCM) at high slip angles. PCM speed was compared to speed and slip angle collected from a calibrated Datron S-400 velocity sensor. In addition to speed, slip angle and other standard handling test measurements the vehicle brake switch and throttle were recorded so PCM data could be synchronized. After each test run the vehicle ignition was turned off and the PCM was downloaded using commercially available Bosch hardware and software. The principal maneuver was the National Highway Traffic Safety Administration (NHTSA) sine-with-dwell test consisting of a 0.7 HZ sinusoidal steer with a 0.5 second dwell at the steer reversal peak. Runs were conducted with the vehicle's Electronic Stability Control (ESC) disengaged so that the test vehicle would achieve large slip angles. Other dynamic maneuvers included: NHTSA's sine-with-dwell with ESC engaged; 100% accelerator to 80 mph with 0.5G braking to stop; and acceleration to 50 mph with maximum ABS braking to stop. Results demonstrate agreement between the speed recorded by the calibrated instrumentation and speed recorded by the vehicle's PCM for conditions when the vehicle slip angle and rear wheel slip were near zero. PCM speed was lower than instrumented speed in high slip angle maneuvers. PCM on average under-reported during maximum ABS braking and at medium to high speed in 0.5G braking. In acceleration the PCM speed had no detectable under-reporting error except at the highest speeds with accelerator at 100%.

## INTRODUCTION

The primary purpose of the reported tests was to determine the extent to which the Ford Powertrain Control Module (PCM) misstated vehicle speed during high slip-angle maneuvers. Other tests were conducted for insight into the accuracy of the Ford PCM in acceleration and braking maneuvers. Compared to the first vehicle-data recording systems, the Ford PCM provides more information useful to crash analysts. For example, without the necessity of air bag deployment or near deployment, it records and makes available a full array of data for the approximately 25 seconds of vehicle operation leading up to the most recent ignition-off. This data, collected at 0.2 second intervals, includes drive-wheel-indicated speed, accelerator-pedal-depression percentage, engine throttle percentage, brake switch status, and 12 other variables.

## METHOD

The test vehicle was a 2005 Ford Explorer with VIN 1FMZU63W85ZA02141, August 2004 manufacture date and an odometer reading of 51368 miles. The vehicle was equipped with a California emissions 4.6L V-8 engine, 4-speed automatic transmission, AdvanceTrac® with Roll Stability Control ™ (RSC)[1] and 2-wheel drive.

[1] AdvanceTrac® with RSC™ was Ford's second generation ESC and adds a second gyroscopic roll sensor. If this roll rate sensor detects that the vehicle is about to roll, the system automatically applies additional countermeasures – such as reducing engine power 15 percent and/or applying brakes to one or more wheels (Ford, 2006).

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