Introduction

Overview of FutureTruck

FutureTruck is a competition sponsored by the Department of Energy and Ford motor company. It is an intercollegiate competition to build a clean, fuel efficient SUV that maintains the utility and performance of the stock Ford Explorer. The Cal Poly team designed a series hybrid electric vehicle, powered by a VW TDI turbo diesel engine, which drives a Westinghouse generator. The generator charges a 288V nominal 16Ahr battery pack. Power to the wheels is provided by a modified Kostov DC electric motor. It was rewound and the brush timing was altered by Netgain Inc to give a possible torque of 450ft-lbf of torque at 0 RPM.

Purpose of project

At the beginning of the 03/04 school year, the members of the Cal Poly FutureTruck team decided that the automatic transmission that was installed in the vehicle was not necessary and in fact was a source of inefficiency. The transmission was a General Motors 4L60E automatic transmission using a stock type torque converter.

The main efficiency drain was the torque converter. It was intended for an IC engine which makes almost no usable torque until approximately 1000 RPM. The torque converter allows the engine to idle, and spin almost freely until this RPM range is exceeded, when through a fluid coupling, torque is transferred across it. This low RPM range is where electric motors make most of their torque. The motor installed in the FutureTruck, makes constant torque from 0-2000 RPM. A torque converter is inefficient, even when it is at a higher RPM due to the lack of mechanical connection there is a small amount of slip, allowing a torque converter to be only 90-95% efficient for most of its range. The 4L60E has a lock-up torque converter, where a small clutch is engaged once the speeds of the two sides of the torque are nearly equalized. This improves the efficiency to nearly 100% once it is engaged, but the inefficiencies at the lower speeds remain. Engaging the TCC at low speeds resulted in harsh shifting.

The transmission is also a source of inefficiency, since it has three planetary gear sets in a row which each have their own inefficiencies. The clutching of gearshifts causes more power loss. The transmission, including torque converter weighs about 150lbs, most of which can be eliminated by using a single speed reduction. The transmission was unnecessary, because of the high initial torque of the electric motor could provide the off line acceleration for the vehicle, while maintaining high efficiency at highway speeds.
Figure 10. Assembled drivetrain.