

IEEE VPPC 2010

Vehicle Power and Propulsion Conference
September 1-3, 2010 – Lille, France

Clean Tech for Transportation

<http://www.vppc2010.org/>



Tutorial on

ELECTROMAGNETIC INTERFERENCE (EMI) IN HYBRID VEHICLES

Professor James Gover, IEEE Fellow, Kettering University, (USA)

Email: jgover@kettering.edu

Abstract

Hybrid Electric Vehicles (HEVs) that have both a DC-DC converter and three phase inverter have four pairs of switches, usually IGBTs, that are the sole means of controlling vehicle speed and torque when the HEV is in the electric drive mode only. These switches are also the primary source of heat generation in HEV power electronics and high frequency electromagnetic noise that can propagate throughout the vehicle as conduction currents and electromagnetic waves and interfere with vehicle control. Harmonics of the ripple voltage from DC-DC converters are also a source of electromagnetic noise. The aim of this tutorial is to describe the sources of EMI in hybrid vehicles, how the EMI can affect vehicle operation and how shielding, grounding and filtering may be used to avoid EMI problems. Contrary to popular opinion, these topics can and will be addressed as scientific disciplines, not black art. Only lumped circuit models are addressed.

Topics which will be presented:

- Conduction current cross-talk
- Electric field and magnetic field cross talk
- Determining if noise is due to magnetic field or electric field coupling
- Frequency spectrum from IGBT switching
- Using grounding, shielding and filtering to reduce EMI in hybrid vehicles.

Biography of the Speaker



James Gover earned the pre-engineering degree from University of the Cumberlands, the BSEE from the University of Kentucky and the MSEE and Ph.D. in nuclear engineering from the University of New Mexico. In 1998 he retired from Sandia National Laboratories after 35 years. Much of his technical work was devoted to the study of radiation effects in weapons systems, included those due to electromagnetic fields generated by X-rays and gamma rays (IEMP and SGEMP). He was also engaged in the development and manufacturing of power electronics. He has been Professor of Electrical Engineering at Kettering University, Flint, MI, USA, since 1998 where his primary interest has been hybrid electric vehicles. He is past Vice-President of Motor Vehicles for the IEEE Vehicular Technology Society Board of Governors and he was Vice-Chair of the 2009 VPPC.