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EMI testing of the police cruiser equipment

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Task Overview

Interference generated by electronic equipment inside a vehicle can interfere with radio reception even though that equipment is in compliance with FCC standards. The result of that interference is an undesired reduction in radio coverage at frequencies where the interference exists.

The objective of this task is to develop an approach for measuring electromagnetic interference (EMI) generated by in-vehicle electronic equipment without requiring the measurements to be made inside a shielded anechoic chamber. Such measurements are straightforward in a shielded chamber since interfering signals from external radiation sources do not confound the measurement process. The objective of the work to be performed is to define a method for measuring EMI when external radiation is present. The basic approach is to identify regions in the spectrum where externally-generated signals exist and then to bypass those regions when measuring interference from in-vehicle-equipment. Because external interference can come from unlicensed as well as licensed sources, using the FCC database of licensed radiation sources to identify the regions to bypass will not achieve the desired goal. Rather, an analysis of the received spectrum is used to assess the presence of signals. Tradeoffs between measurement accuracy and the time to perform the measurements are being studied, along with information on measurement repeatability.

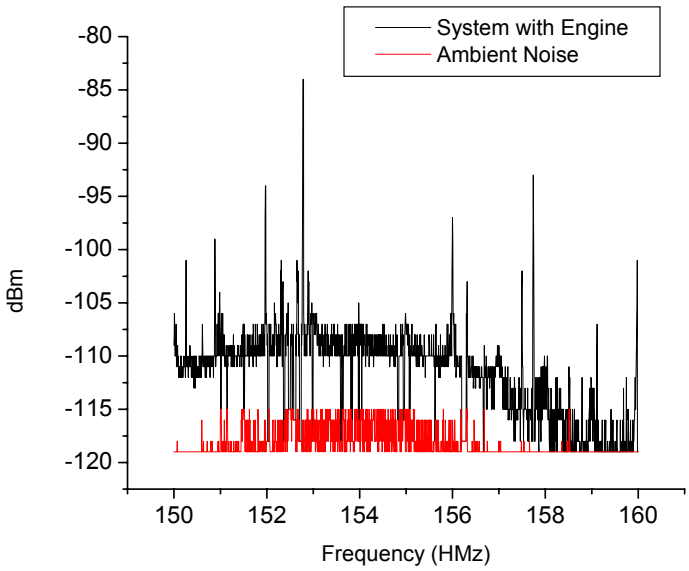
Task Status Specifics

Significant progress has been made in the development of an automated system to measure EMI created by electronic devices inside the cruiser. That system is comprised of a radio that measure signal strength that is controlled by a standard PC. The total cost of the equipment, pictured in Figure 1, is around $3,500. At this point in time, the system is capable of performing EMI measurements, and current work is focused on determining measurement repeatability and accuracy in addition to making the system user-friendly. Expectations are that a prototype of the system will be available for external testing and review by the end of the summer.

Figure 1 Equipment Used to Perform EMI Measurements

An example of the type of information collected by the EMI measurement equipment is shown in Figure 2. The red trace in this figure represents the spectrum

Figure 2 Spectrum of Ambient Noise and the Spectrum of the Interference Caused By In-Cruiser Equipment and the Engine.



measured through the police radio antenna when none of the equipment in the cruiser is turned on. The spectrum was created by bypassing frequencies where external radiation sources were found to exist. The black trace is the spectrum measured when all of the in-cruiser equipment is turned on and the engine is running. The difference between these two spectra represents the electromagnetic interference (EMI) generated by the in-cruiser equipment and the engine.

The data presented in Figure 2 can be processed to yield a single number indicating the degree of EMI over the frequency range. This numerical value is calculated from the difference between the average signal level of the ambient noise and the average signal level of the interfering signal. An example of these values is given in Table 1 below for a number of electronic devices present in the cruiser.

Device	Relative Noise Level (above ambient noise), dB	Absolute Noise Level, dBm
Computer and Monitor	10.95	-106.23
Radio Control Head	2.25	-112.81
Light bar	12.30	-105.65
Entire System	7.72	-107.65
Entire System w. Engine Running	10.97	-106.08

Table 1 Preliminary EMI Values For Various Devices Average Over the Police Band**.**

The types of data presented in Table 1 will be useful in identifying devices that could potentially interfere with radio reception, and it will be instrumental in certifying devices for in-cruiser use.