Human Exposure to RF Emissions

Client: IP Mobile Net
EUT: INVADER IP8HPV Data Transceiver
Fundamental Frequency Range: (806MHz - 821MHz)

Test performed on:
November 01, 2001

Typical Installation of the EUT:
The EUT is mounted on the rooftop of a police vehicle. The rooftop is approximately 62" x 42" and the transmit antenna is mounted 10" from the rear edge of the roof. A person standing next to the car would be approximately 39" from the antenna. The manufacture has determined the minimum separation distance for compliance for the intended use and installation of the device to be 39 inches.

Classification of the EUT:
The installation of the EUT will normally maintain a separation distance of at least 20 centimeters between the transmitter's radiating structures and the body of the user or nearby persons; therefore, the EUT was classified as a mobile device. (Reference 47 CFR §2.1091)

Test requirement:
Human exposure to RF emissions from mobile devices can be evaluated with respect to Maximum Permissible Exposure (MPE) limits for field strength or power density or with respect to SAR limits; whichever is most appropriate (Reference 47 CFR §2.1091). For RF exposure compliance, the EUT was evaluated with respect to MPE limits based on power density.

Power Density Predicted:
Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by the following equation, (Reference OET Bulletin 65, edition 97-01)

$$S = (P*G) / (4\eth R^2)$$

where: S=power density (in appropriate units, e.g. mW/cm²)
P=power input to the antenna (in appropriate units, e.g. mW/cm²)
G=power gain of the antenna in the direction of interest relative to an isotropic radiator (numeric Gain)
R=distance to the center of radiation of the antenna (appropriate units, e.g. cm)

The antenna of the EUT has a 3dB gain (numeric 1.9952623). The distance between the antenna and a person standing next to the antenna R = 39" = 99.06cm. The power input to the antenna P = 15.85W = 15,850mW. The predicted power density level is,

$$S = (15{,}850\text{mW} * 1.9952623) / (4\eth * (99.06\text{cm})^2) = 0.2564\ \text{mW/cm}^2$$

A person standing R= 39" = 99.06cm away from the transmit antenna is in the far field region of the antenna for any frequency within the 806-821MHz band as determined by the following,

If $R > (\ddot{e} / 2\eth)$ then R is in the far field region

Power Density Measured:
In the far-field region of a transmitting antenna, where the electric field vector (E), the magnetic filed vector (H), and the direction of propagation can be considered to be all mutually orthogonal ("Plane wave" conditions), these quantities are related by the following equation. (Reference OET Bulletin 65, edition 97-01)

$$S = E^2 / 3770 = 37.7*H^2$$

Where, S=power density (mW/cm^2)
E=electric field strength (V/m)
H=magnetic field strength (A/m)

* The field strength was measure using an Amplifier Research Electric Field Sensor model; FP2000 serial number 17351, Calibration due date of 17-July, 2002 with a 1-year calibration cycle.
The maximum power level was used to determine compliance.

The maximum measured power level was found to be: 27.2 V/m

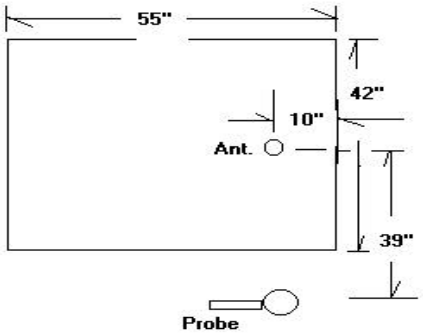
$$S = E^2 / 3770 = (27.20)^2 / 3770 = 0.19624 \text{ mW/cm}^2$$

Limit for Maximum Permissible Exposure (MPE) (Reference 47 CFR §1.1310)

Frequency Range (MHz)	**Power density Limit (mW/cm^2)**	**Power density Measured (mW/cm^2)**	**below the limit**
Limit for Occupational/Controlled Exposure			
300 – 1500	806/300 = 2.6867	0.19624	**- 2.4905**
Limit for General population/ Uncontrolled Exposure			
300 – 1500	806/1500 = 0.5373	0.19624	**- 0.3410**

Test Setup:
During the MPE measurements, the Antenna was mounted a copper sheet metal to simulate the rooftop of a vehicle. The copper plane was grounded and not grounded during the test to determine a worst-case power density field; it was found that the copper plane not grounded produced a worst-case power density field. See figure 1 for setup measurements.

Fig. 1



Conclusion:
The INVADER IP8HPV Data Transceiver (EUT) was subjected to routine environmental evaluation for RF exposure as specified in 47 CFR §2.1091, Radiofrequency radiation exposure evaluation: mobile devices and has been found to in compliance with the limits specified in 47 CFR §2.1310, Radiofrequency radiation exposure limits.