MOTOROLA SOLUTIONS

MS ISO/IEC 17025
TESTING
SAMM No.0826

DECLARATION OF COMPLIANCE: PCII report

Motorola Solutions
EME Test Laboratory
Motorola Solutions Malaysia Sdn Bhd (Innoplex)
Plot 2A, Medan Bayan Lepas,
Mukim 12 SWD 11900 Bayan Lepas Penang, Malaysia.

Date of Report: 7/20/2018
Report Revision: A

Responsible Engineer:	Saw Sun Hock (EME Engineer)
Report author:	Saw Sun Hock (EME Engineer)
Date(s) Assessment:	7/13/2018-7/17/2018
Manufacturer:	Motorola Solutions
DUT Description:	XPR 2500 UHF 1 403-470 MHz, 25-40 W, with an alphanumeric display control head
Test TX mode(s):	CW
Max. Power output:	48 W
TX Frequency Bands:	403-470 MHz
Model(s) Tested:	PMUE4164A
Model(s) Certified:	AAM01QPC9JC1AN, AAM01QPH9JC1AN, AAM01QPC9JA1AN, AAM02QPH9JA1AN, AAM01QPH9JA1AN
Classification:	Occupational/Controlled Environment
IC:	109AB-99FT4093

Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 3.0 of this report. This report shall not be reproduced without written approval from an officially designated representative of the Motorola Solutions Inc. EME Laboratory.
I attest to the accuracy of the data and assume full responsibility for the completeness of these measurements.
This reporting format is consistent with the suggested guidelines of the TIA TSB-159 April 2006
The results and statements contained in this report pertain only to the device(s) evaluated herein.

Tiong

Tiong Nguk Ing

Digitally signed by Tiong Nguk Ing
Date: 2018.07.20 22:55:25 +08'00'

Tiong Nguk Ing
Deputy Technical Manager (Approved Signatory)
Approval Date: 7/20 /2018

Document Revision History

Date	Revision	Comments
7/20/2018	A	Initial release of PCII report

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1.0 Introduction

Part changes on pre-driver, driver and final power amplifier for this device due to current parts End of Life. The new parts are pin-to pin compatible and have same function as previous part.

Transmitter characteristic has been assessed on this design changes, the performance are comparable with the device on filed.

Original ISED filing happened in year 2013 with reference standard RSS-102 (Issue 4). For this PCII filing, SAR computational analysis required to evaluate the compliance of SAR as the “basic restriction” for the configuration exceeding the MPE limits as per latest standard RSS-102 (Issue 5) which have more stringent MPE limit compare to RSS-102 (Issue 4).

2.0 Conclusion

The highest power density results reported in ISED filing exceed MPE limit as per latest standard RSS-102 (Issue 5).

Table 1: Maximum MPE RF Exposure Summary

Exposure Condition	Maximum MPE (mW/cm²)	% To RSS-102 (Issue 4) limit	% To RSS-102 (Issue 5) limit
Passenger	0.22	81 %	*137.4 %
Bystander	0.13	46 %	79.2 %

Note:* Required computational SAR simulation.

Although MPE is a convenient method of demonstrating RF Exposure requirements, SAR is recognized as the “basic restriction”. For configuration with ‘*”, compliance to General Population /Uncontrolled SAR 1g limit of 1.6 W/kg is demonstrated through the computational SAR simulation results according latest released IEC/IEEE 62704-2-2017 shown in table below.

Table 2: Maximum Average SAR Summary

Designator	Frequency (MHz)	SAR 1g (W/kg)	SAR WB (W/kg)
ISED, Canada	406.1-430 450-470	0.93	0.033

Appendix – SAR Simulation Report

COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE XPR 2500 MODEL PMUE4164A MOBILE RADIO.

July 17, 2018

Saw Sun Hock, Giorgi Bit-Babik, Ph.D., and Antonio Faraone, Ph.D.
Motorola Solutions EME Research Lab, Plantation, Florida

Introduction

This report summarizes the computational [numerical modeling] analysis performed to document compliance of the XPR 2500 Model Number PMUE4164A Mobile Radio and vehicle-mounted antennas with the Innovation, Science and Economic Development (ISED) Canada guidelines for human exposure to radio frequency (RF) emissions.

This computational analysis supplements the measurements conducted to evaluate the compliance of the exposure from this mobile radio with respect to applicable *maximum permissible exposure* (MPE) limits. All test conditions (3 in total) that did not conform with applicable MPE limits as per latest standard RSS-102 (issue 5) were analyzed to determine whether those conditions complied with the *specific absorption rate* (SAR) limits for general public exposure (1.6 W/kg averaged over 1 gram of tissue and 0.08 W/kg averaged over the whole body). In total 6 independent simulations had been performed addressing exposure of passenger to the UHF R1 mobile radio with trunk-mount antennas.

For all simulations a commercial code based on Finite-Difference-Time-Domain (FDTD) methodology was employed to carry out the computational analysis. It is well established and recognized within the scientific community that SAR is the primary dosimetric quantity used to evaluate the human body's absorption of RF energy and that MPE limits are in fact derived from SAR. Accordingly, the SAR computations provide a scientifically valid and more relevant estimate of human exposure to RF energy.

Method

The simulation code employed is XFDTD™ v7.6.0, by Remcom Inc., State College, PA. This computational suite provides means to simulate the heterogeneous full human body model defined according to the IEC/IEEE 62704-2-2017 standard and derived from the so-called Visible Human [2], discretized in 3 mm voxels. The IEC/IEEE 62704-2-2017 standard dielectric properties of 39 body tissues are automatically assigned by XFDTD™ at any specific frequency. The “seated” man model was obtained from the standing model by modifying the articulation angles at the hips and the knees. Details of the computational method and model are provided in the Appendix A to this report. The evaluation of the computational uncertainties and results of the benchmark validations are provided in the Appendix B attached to this report. The XFDTD code validation performed according to IEEE/IEC 62704-1:2017 standard by Remcom Inc. is provided in conjunction with this report.

The car model has been imported into XFDTD™ from the CAD file of a sedan car having dimensions 4.98 m (L) x 1.85 m (W) x 1.18 m (H), and discretized with the minimum resolution of 3 mm and the maximum resolution of 8 mm. The Figure 1 below shows both the CAD model and the photo of the actual car. This CAD model has been incorporated into the IEC/IEEE 62704-2-2017 standard.

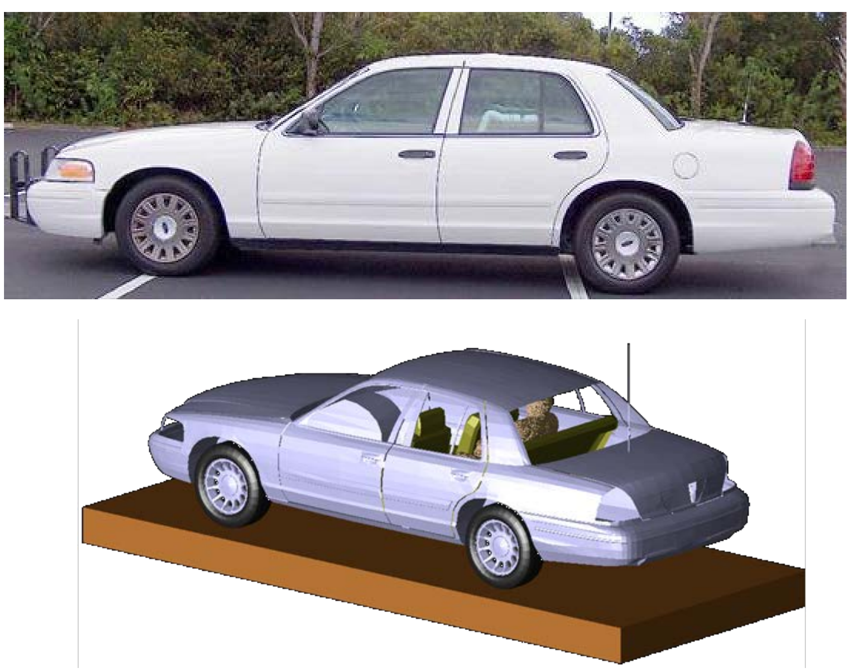


Figure 1: The photo picture of the car and the corresponding CAD model used in simulations

Figure 2 shows some of the XFDTD™ computational models used for passenger exposure to trunk mounted antennas.

According to the IEC/IEEE 62704-2-2017 for exposure simulations from vehicle mount antennas the lossy dielectric slab with 30 cm thickness, dielectric constant of 8 and conductivity of 0.01 S/m has been introduced in the computational model to properly account for the effect of the ground (pavement) on exposure.

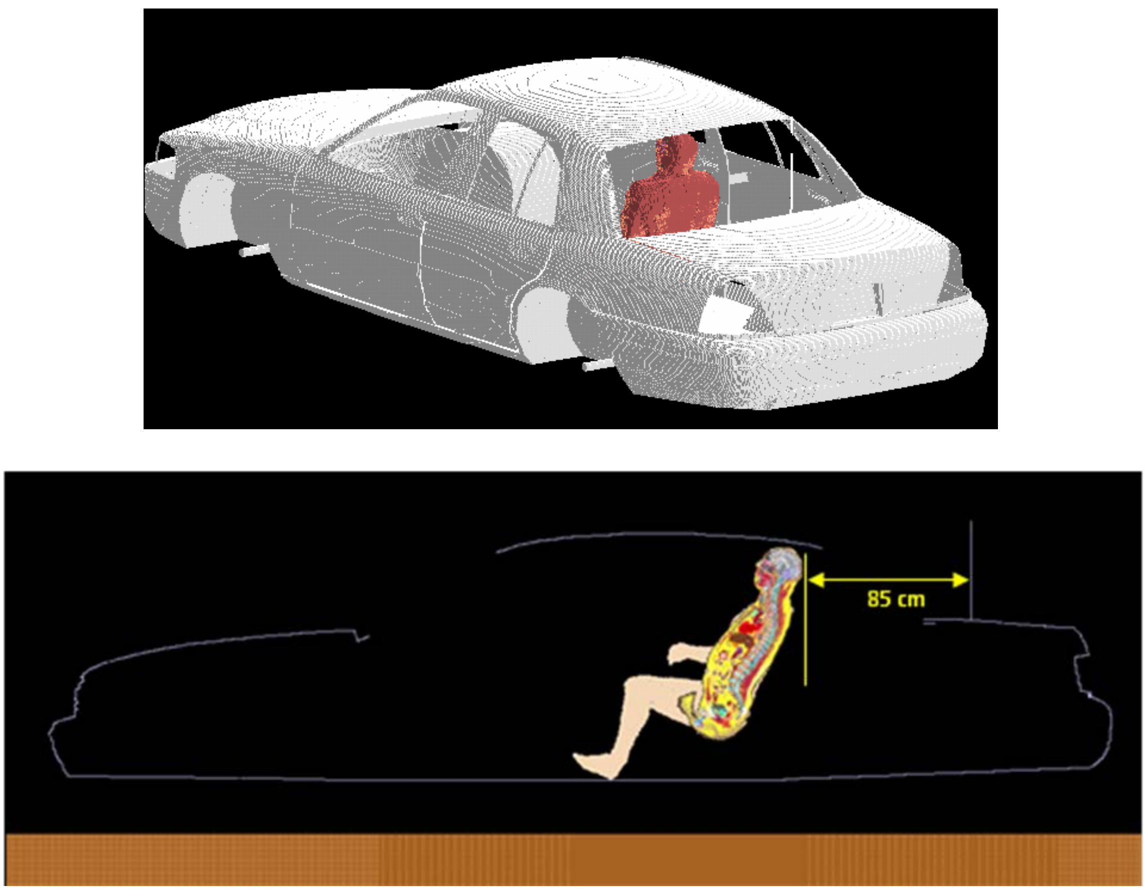


Figure 2: Passenger model exposed to a trunk-mount antenna: XFDTD geometry.
The antenna is mounted at 85 cm from the passenger located in the center of the back seat.

The computational code employs a time-harmonic excitation to produce a steady state electromagnetic field in the exposed body. Subsequently, the corresponding SAR distribution is automatically processed in order to determine the whole-body and 1-g average SAR. The maximum average output power from mobile radio antenna is 48W (403-470MHz). Since the ohmic losses in the car materials, as well as the mismatch losses at the antenna feed-point are neglected, and source-based time averaging (50% talk time) were employed, all computational results are normalized to half of it, i.e., 24W (403-470MHz) average net output power; less the corresponding minimum insertion loss in excess of 0.5 dB of the feed cables supplied with the antennas. This power normalization is in accordance with the IEC/IEEE 62704-2-2017.

Results of SAR computations for car passengers

The test conditions requiring SAR computations are summarized in Table 1 together with the antenna data, the SAR results, and power density (P.D.) as obtained from the measurements in the corresponding test conditions. The conditions are for antennas mounted on the trunk. The antenna length in table includes the 1.8 cm magnetic mount base used in measurements to position the antenna on the vehicle. The same length was used in simulation model.

The passenger is located in the center or on the side of the rear seat corresponding to the respective configurations defined in the IEC/IEEE 62704-2-2017 standard.

All the transmit frequency, antenna length, and passenger location combinations reported in Table 1 has been simulated individually. This table also includes the interpolated adjustment factor and corresponding SAR scaled values following requirement of the IEC/IEEE 62704-2-2017 standard.

Table 1: Results of the Computations and Adjusted SAR for Passenger exposure

Mount Location	Antenna Kit#	Antenna Length (cm)	Freq (MHz)	P.D. (mW/cm^2)	Exposure Location	Computations SAR (W/kg)		Interpolated Adjustment Factors		Adjusted SAR Results (W/kg)	
						1 g	WB	1 g	WB	1 g	WB
Trunk	HAE4011A, 5/8 wave (450-470MHz)	75	450.1250	0.178	Back Center	0.19	0.006	2.40	2.80	0.45	0.018
					Back Side	0.18	0.006	2.00	2.60	0.36	0.015
Trunk	HAE6022A, 1/2 Wave (403-527MHz)	29.6	406.1250	0.218	Back Center	0.38	0.012	2.33	2.74	0.88	**0.033**
					Back Side (Figure 3 & 4)	0.40	0.010	2.32	2.66	**0.93**	0.027
			422.0938	0.200	Back Center	0.16	0.010	2.35	2.76	0.37	0.026
					Back Side	0.22	0.010	2.20	2.64	0.49	0.028

Note:
Bold Blue – the highest SAR results computed for the respective frequency bands

The SAR distribution in the passenger exposure condition that gave highest adjusted 1-g SAR is reported in Figure 3. (406.125 MHz, passenger on the side of the back seat, HAE6022A antenna).

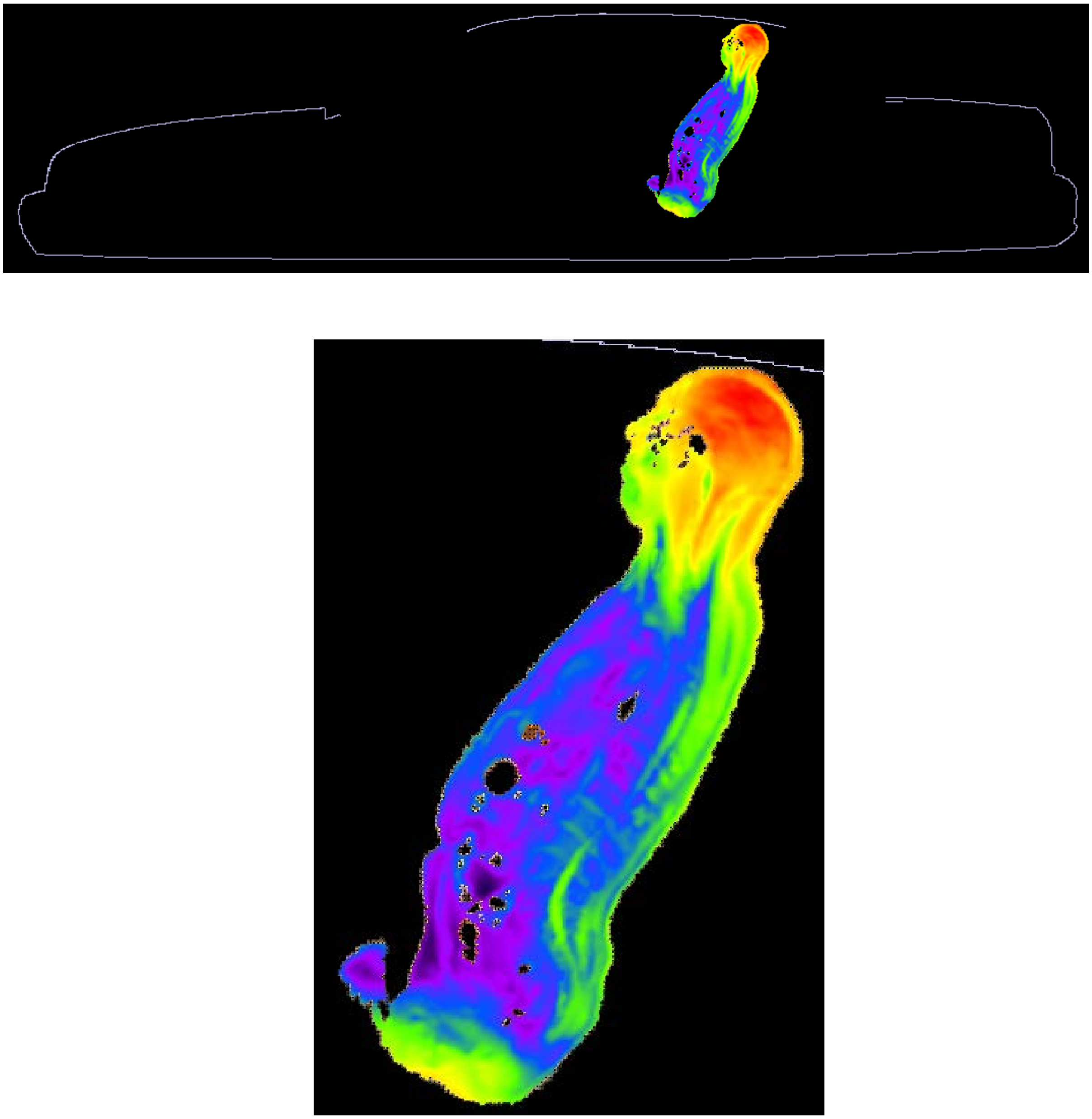
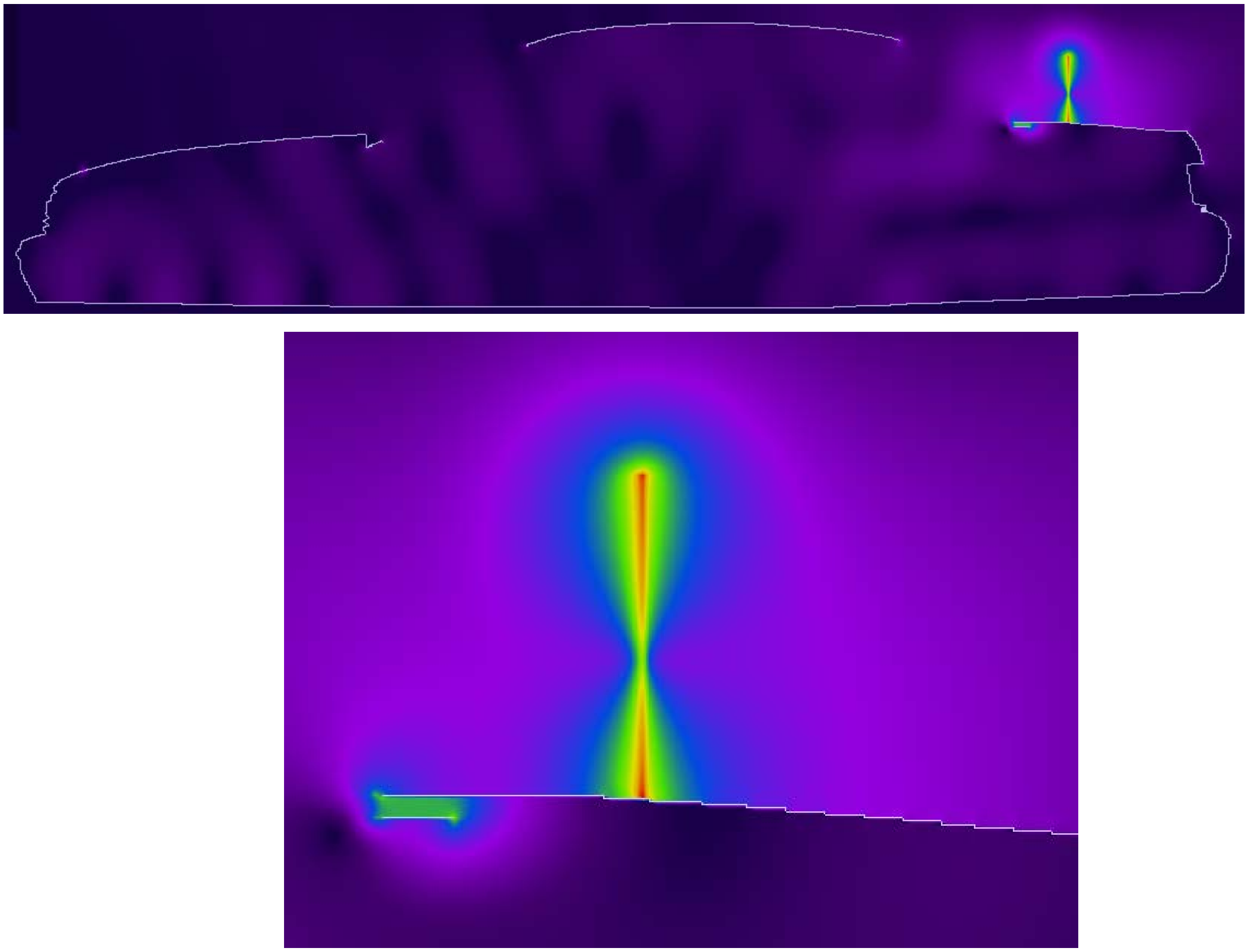
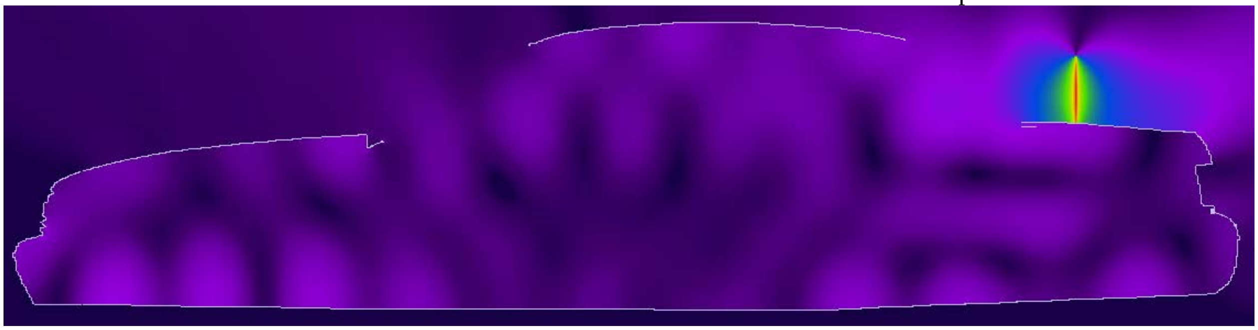


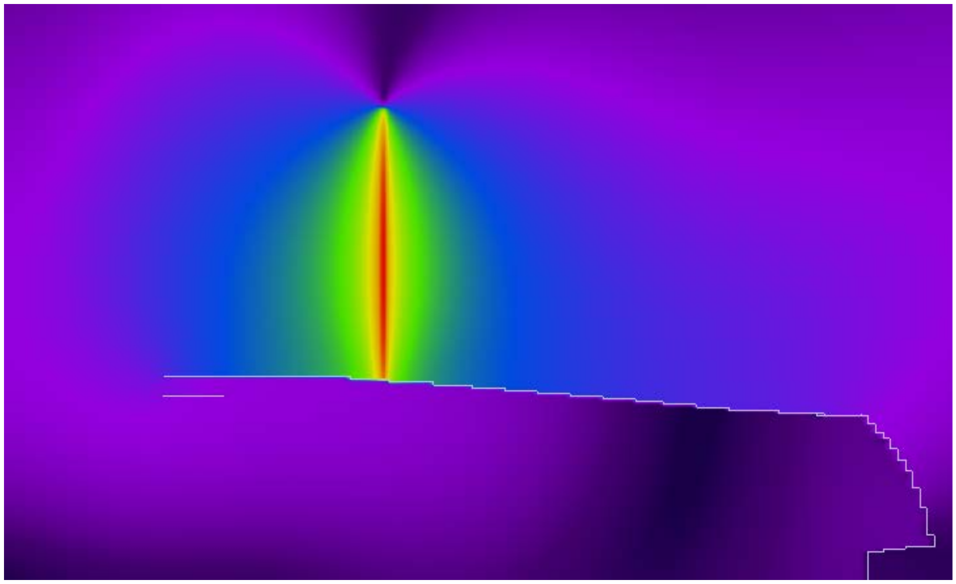
Figure 3. SAR distribution at 406.125 MHz in the passenger model located on the side of the back seat, produced by the trunk-mount HAE6022A antenna. The contour plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The pictures below show the E and H field distributions in the plane of the antenna corresponding to the condition in Figure 3.



a)





b)

Figure 4. (a) E-field magnitude distribution corresponding to exposure condition of Figure 3, and (b) H-field magnitude distribution corresponding to exposure condition of Figure 3.

The highest adjusted 1-g SAR was produced in the passenger exposure condition with HAE6022A antenna at 406.125 MHz (passenger on the side of the back seat).

Results of SAR Computations

The overall simulated results the worst case peak SAR values were identified and SAR value in corresponding locations of the human body model. The maximum peak 1-g SAR is 0.93 W/kg, less than the 1.6 W/kg limit. The maximum whole-body average SAR for is 0.033 W/kg, less than the 0.08 W/kg limit.

Conclusions

Under the test conditions described for evaluating passenger exposure to the RF electromagnetic fields emitted by vehicle-mounted antennas used in conjunction with these mobile radio products, the present analysis shows that the computed SAR values are compliant with the ISED Canada exposure limits for the general public.

References

[1] IEEE Standard C95.1-1999. *IEEE Standard for Safety Levels with Respect to Human Exposure to RF Electromagnetic Fields*, 3 kHz to 300 GHz.

[2] http://www.nlm.nih.gov/research/visible/visible_human.html

[3] Simon,W., Bit-Babik, G., “Effect of the variation in population on the whole-body average 1379 SAR of persons exposed to vehicle mounted antennas W. Simon”, ICEAA September 2-7, 2012, Cape 1380 Town.