COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE APX SERIES MODEL M25KSS9PW1BN (PMUD3490A) MOBILE RADIO AND COMPANION DEVICE, DIGITAL VEHICULAR REPEATER (DVR 700), MOBEXCOM DVRS 700 (DQPMDVR7000P)

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Introduction

This report summarizes the computational [numerical modeling] analysis performed to document compliance of the APX Series Model Number M25KSS9PW1BN (PMUD3490A) Mobile Radio interfaced with, and transmitting simultaneously with DVR 700, model # MOBEXCOM DVRS 700 (DQPMDVR7000P) and vehicle-mounted antennas with the United States Federal Communications Commission (FCC) and Innovation, Science and Economic Development (ISED) Canada guidelines for human exposure to radio frequency (RF) emissions. The devices operate in the following frequency bands:

Regions	Device	Bands	Frequency Band (MHz)
FCC US	Mobile APX6500	VHF Band	150.8 – 173.4
	DVR	700	769-775; 799-805
ISED Canada	Mobile APX6500	VHF Band	138-173.4
	DVR	700	769-776, 799-805

This computational analysis supplements the measurements conducted to evaluate the compliance of the exposure from this mobile radio and companion device DVR 700 with respect to applicable *reference levels*, which in the following will be referred to as *maximum permissible* *exposure* (MPE) limits.[1] A total of 36 test conditions that did not conform with FCC MPE limit and 94 test conditions did not conform with ISED MPE limits were considered 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) set forth in FCC guidelines [2] and Health Canada guidelines [1].

Employing SAR simulation reduction considerations[2], a total 8 configurations (requiring a total of 16 numerical simulations) have been performed, all of them addressing the exposure of the back seat passenger to the DVR 700 repeater featuring trunk-mount antennas and the APX6500 mobile radio featuring roof-mount antennas.

For all simulations a commercial code (XFDTD™ v7.6.0, by Remcom Inc, State College, PA, USA) based on the 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 represents the *basic restriction* for RF energy exposure up to 6 GHz and that MPE limits are in fact derived from SAR limits. Accordingly, the SAR computations provide a scientifically valid and more relevant estimate of RF energy exposures.

Method

The XFDTD™ v7.6.0 computational suite enable simulating the heterogeneous full human body model defined according to the IEC/IEEE 62704-2:2017 standard and derived from the so-called Visible Human [3], discretized in 3 mm cubic-edge voxels. The IEC/IEEE 62704-2:2017 dielectric properties for 39 body tissues are automatically assigned by XFDTD™ at the specific simulation frequency. The “seated” man model representing the passenger 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 by Remcom Inc. according to the IEEE/IEC 62704-2:2017 standard requirements is provided in conjunction with this report.

[1] This choice is made for process efficiency, since “MPE” is used in the United States. In this way, chances of making editorial mistakes that may then require extended interactions with the report examiner are reduced.
[2] SAR simulation reduction is described in the SAR Simulations Reduction Considerations section of this report.

The car model has been imported into XFDTD™ from the CAD file of the sedan vehicle defined in the IEEE/IEC 62704-2:2017 standard, 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. Figure 1 below shows both the vehicle CAD model and a picture of the actual vehicle.

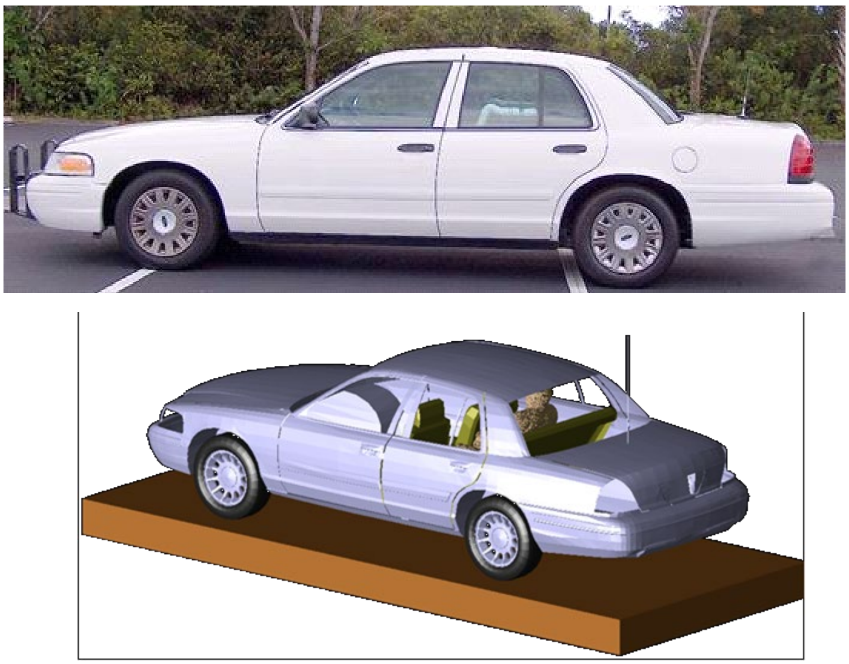
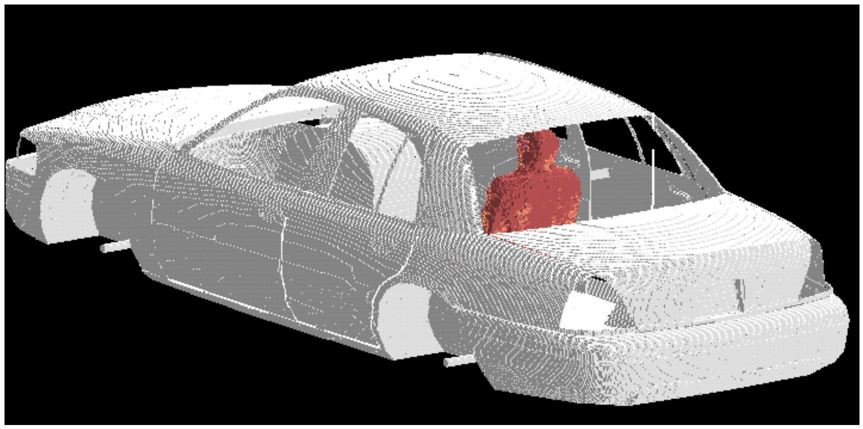


Figure 1: Picture of the vehicle and corresponding CAD model used in XFDTD™ simulations

For back seat passenger exposures, the antenna is positioned on the trunk at 85 cm distance from the passenger model head when the passenger model is located in the center of the back seat, replicating the experimental conditions used in MPE measurements. Figure 2 and Figure 3 shows the XFDTD™ computational models used for passenger exposure to trunk and roof mount antennas.

According to the IEC/IEEE 62704-2:2017 standard a lossy dielectric slab featuring 30 cm thickness, relative dielectric constant 8 and conductivity 0.01 S/m has been introduced in the computational model to properly account for the effect of the ground (pavement) on exposure.

The computational code employs a time-harmonic field excitation to produce a steady-state electromagnetic field in the exposed body model. Subsequently, the corresponding SAR distribution is automatically processed in order to determine the whole-body SAR and peak spatial average SAR distribution.



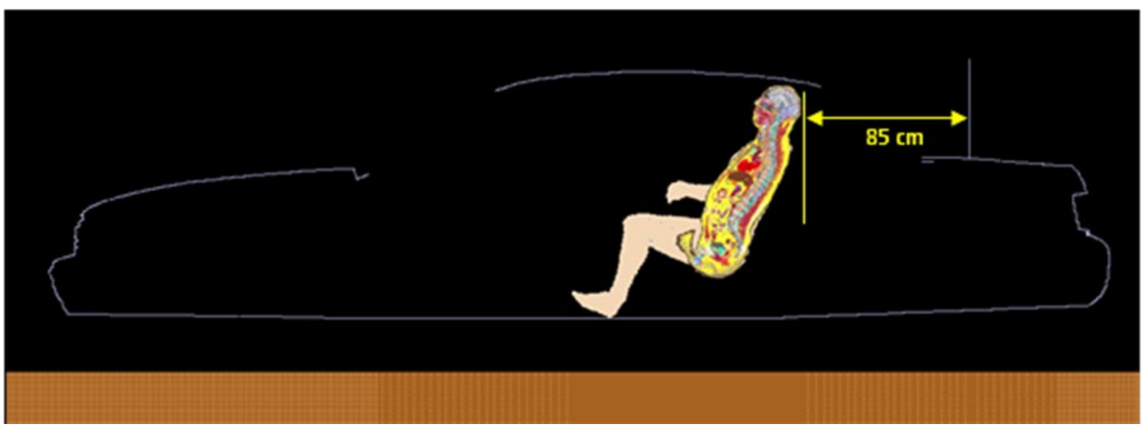


Figure 2: Passenger (back seat) model exposed to a trunk-mount antenna: XFDTD™ geometry. The antenna is installed at 85 cm from the passenger located in the center of the back seat.

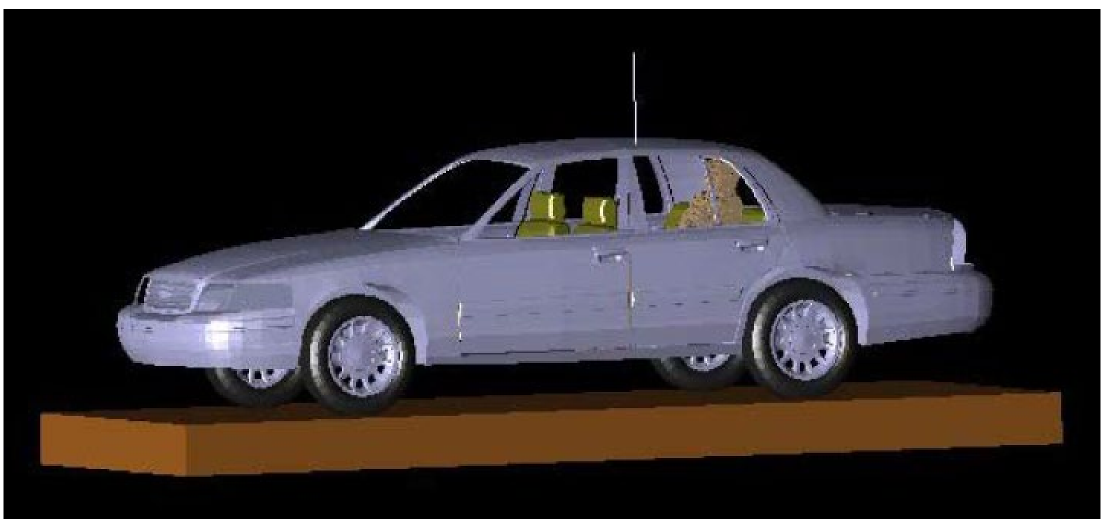


Figure 3: Passenger (back seat) model exposed to a roof-mount antenna: XFDTD™ geometry.

The maximum average output power from mobile radio antenna is 60W (VHF Band), while it is 5 W from the DVR 700 repeater antenna (700 MHz band). Since the ohmic losses in the vehicle materials, as well as the mismatch losses at the antenna feed-point are neglected, while source-based time averaging (50% talk time for to push-to-talk operation) for the APX6500 mobile radio and (100% talk time) for DVR 700 were employed, all computational results are normalized to half of the APX6500 mobile radio maximum average net output power, i.e., 30W (VHF Band) and a full average net output power of the companion device DVR 700 repeater, i.e., 5W (700 MHz band); minus the corresponding minimum insertion loss in excess of 0.5 dB of the feed cables supplied with the antennas, in accordance with the IEC/IEEE 62704-2:2017 standard provisions.

Results of SAR computations for car passengers

The test conditions requiring SAR computations are summarized in Table 1 (APX6500 mobile radio, 50% talk time) and Table 2 (DVR 700, 100% talk time), together with the antenna data, the SAR results, and power density (P.D.) as obtained from the MPE measurements in the corresponding test conditions. The conditions are for antennas mounted on the center of the roof (APX6500 mobile radio) and the center of the trunk (DVR 700). The antenna length listed in the tables includes the height of the 1.8 cm magnetic mount base used in MPE measurements to position the antenna on the vehicle. The same length was then used in the corresponding 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 Tables 1 and 2 have been simulated individually. These tables also include the interpolated adjustment factor and corresponding scaled SAR values following the requirements of the IEC/IEEE 62704-2:2017 standard.

Table 1a: Computed and adjusted SAR results for passenger exposure for APX6500 mobile radio

(Configurations exceeding FCC MPE limits)

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
Roof	HAD4007A, 1/4 Wave (144-150.8 MHz)	50.8	150.8000	0.22	Back Center	0.111	0.004	1.303	1.900	0.144	0.007
					Back Side (Fig. 4 & 5)	0.217	0.004	1.002	2.401	**0.218**	**0.010**
Roof	HAD4008A, 1/4 Wave (150.8-162 MHz)	47.3	162.0000	0.23	Back Center	0.028	0.001	1.352	1.896	0.038	0.003
					Back Side	0.055	0.002	1.028	2.420	0.056	0.004
Roof	HAD4009A, 1/4 Wave (162-174 MHz)	44.8	162.0000	0.21	Back Center	0.028	0.001	1.352	1.896	0.038	0.003
					Back Side	0.055	0.002	1.028	2.420	0.056	0.004
Roof	HAD4016A, 1/4 Wave (136-162 MHz)	53.1	150.8000	0.20	Back Center	0.111	0.004	1.303	1.900	0.145	0.007
					Back Side	0.216	0.004	1.002	2.401	0.217	0.010
Roof	HAD4017A, 1/4 Wave (146-174 MHz)	48.0	165.0125	0.22	Back Center	0.018	0.001	1.365	1.895	0.025	0.002
					Back Side	0.051	0.001	1.035	2.425	0.053	0.003

Note:
Bold Blue – the highest adjusted SAR results for the respective frequency band.

Table 1b: Computed and adjusted SAR results for passenger exposure for APX6500 mobile radio

(Configurations exceeding ISED MPE limits)

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
Roof	HAD4006A, 1/4 Wave (136-144 MHz)	53.8	140.0000	0.22	Back Center (Fig. 6 & 7)	0.252	0.006	1.257	1.771	**0.316**	0.010
					Back Side	0.252	0.006	1.043	2.243	0.263	**0.014**
Roof	HAD4007A, 1/4 Wave (144-150.8 MHz)	50.8	#150.8000	0.22	Back Center	0.111	0.004	1.303	1.900	0.144	0.007
					Back Side	0.217	0.004	1.002	2.401	0.218	0.010
Roof	HAD4008A, 1/4 Wave (150.8-162 MHz)	47.3	#162.0000	0.23	Back Center	0.028	0.001	1.352	1.896	0.038	0.003
					Back Side	0.055	0.002	1.028	2.420	0.056	0.004
Roof	HAD4009A, 1/4 Wave (162-174 MHz)	44.8	#162.0000	0.21	Back Center	0.028	0.001	1.352	1.896	0.038	0.003
					Back Side	0.055	0.002	1.028	2.420	0.056	0.004

Table 1b (continued): Computed and adjusted SAR results for passenger exposure for APX6500 mobile radio

(Configurations exceeding ISED MPE limits)

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
Roof	HAD4016A, 1/4 Wave (136-162 MHz)	53.1	#150.8000	0.20	Back Center	0.111	0.004	1.303	1.900	0.145	0.007
					Back Side	0.216	0.004	1.002	2.401	0.217	0.010
Roof	HAD4017A, 1/4 Wave (146-174 MHz)	48.0	#165.0125	0.22	Back Center	0.018	0.001	1.365	1.895	0.025	0.002
					Back Side	0.051	0.001	1.035	2.425	0.053	0.003
Roof	HAD4021A, 1/4 Wave (136-174 MHz)	53.5	165.0125	0.18	Back Center	0.018	0.001	1.365	1.895	0.025	0.002
					Back Side	0.051	0.001	1.035	2.425	0.053	0.003

Note:
Bold Blue – the highest adjusted SAR results for the respective frequency band.
- Same SAR simulation configuration as Table 1a

Table 2a: Computed and adjusted SAR results for passenger exposure for Companion Device DVR700

(Configurations exceeding FCC MPE limits)

Mount Location	Antenna Kit#	Antenna Length (cm)	Freq (MHz)	P.D. (mW/cm^2)	Exposure Location	Computed SAR (W/kg)		Interpolated Adjustment Factors		Adjusted SAR Results (W/kg)	
						1 g	WB	1 g	WB	1 g	WB
Trunk	HAF4016A, 1/4 Wave (764-870MHz)	10.8	775.0000	0.04	Back Center	0.053	0.002	1.100	2.243	0.059	**0.004**
					Back Side (Fig. 8 & 9)	0.052	0.002	1.443	1.950	**0.075**	0.003

Note:
Bold Blue – the highest adjusted SAR results for the respective frequency band.

Table 2b: Computed and adjusted SAR results for passenger exposure for Companion Device DVR 700

(Configurations exceeding ISED MPE limits)

Mount Location	Antenna Kit#	Antenna Length (cm)	Freq (MHz)	P.D. (mW/cm^2)	Exposure Location	Computed SAR (W/kg)		Interpolated Adjustment Factors		Adjusted SAR Results (W/kg)	
						1 g	WB	1 g	WB	1 g	WB
Trunk	HAF4016A, 1/4 Wave (764-870MHz)	10.8	#775.0000	0.04	Back Center	0.053	0.002	1.100	2.243	0.059	**0.004**
					Back Side (Fig. 8 & 9)	0.052	0.002	1.443	1.950	**0.075**	0.003

Note:
Bold Blue – the highest adjusted SAR results for the respective frequency band.
- Same SAR simulation configuration as Table 2a.

The SAR distribution in the passenger exposure condition that gave highest adjusted 1-g SAR for the APX6500 VHF mobile radio (FCC US) is reported in Figure 4. (150.8000 MHz passenger on the side of the back seat, HAD4007A antenna installed on the roof).

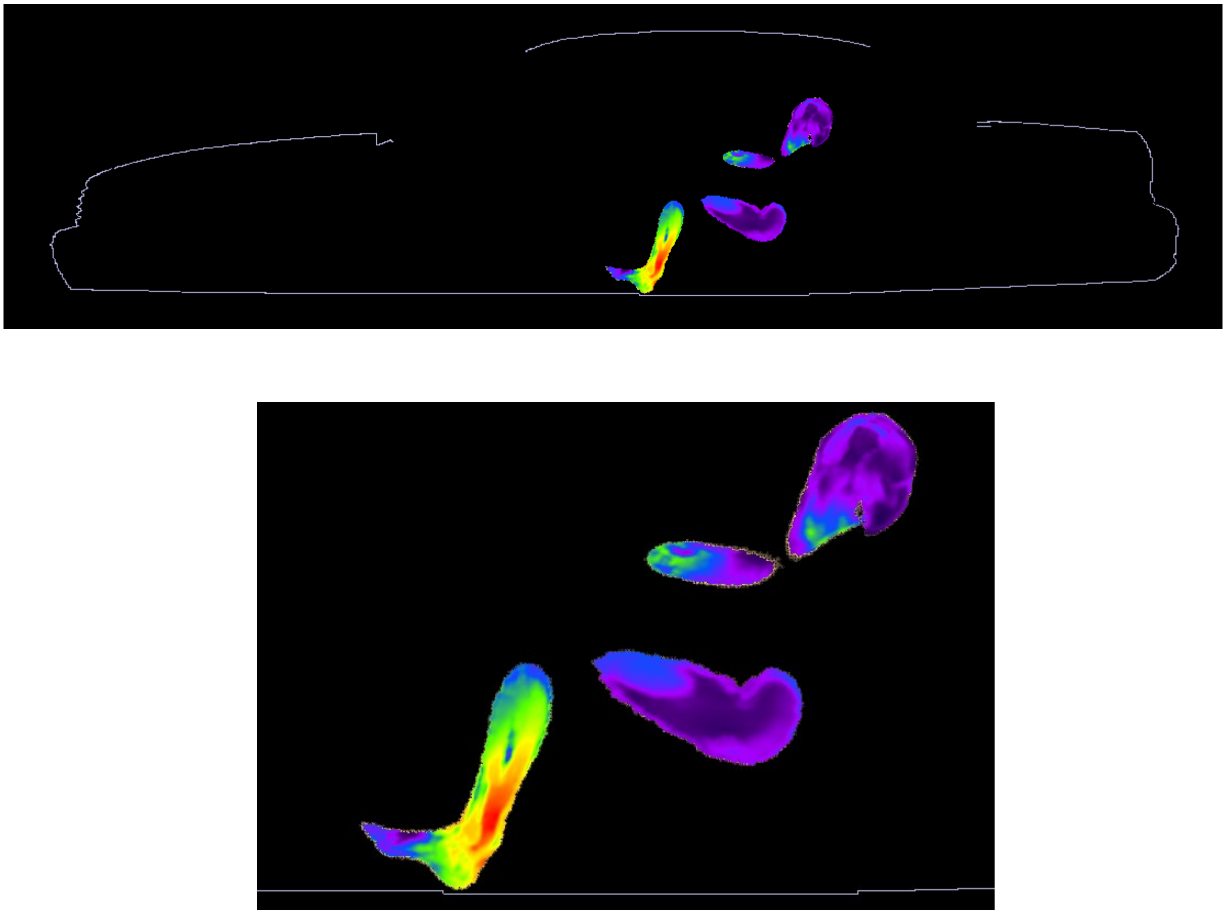
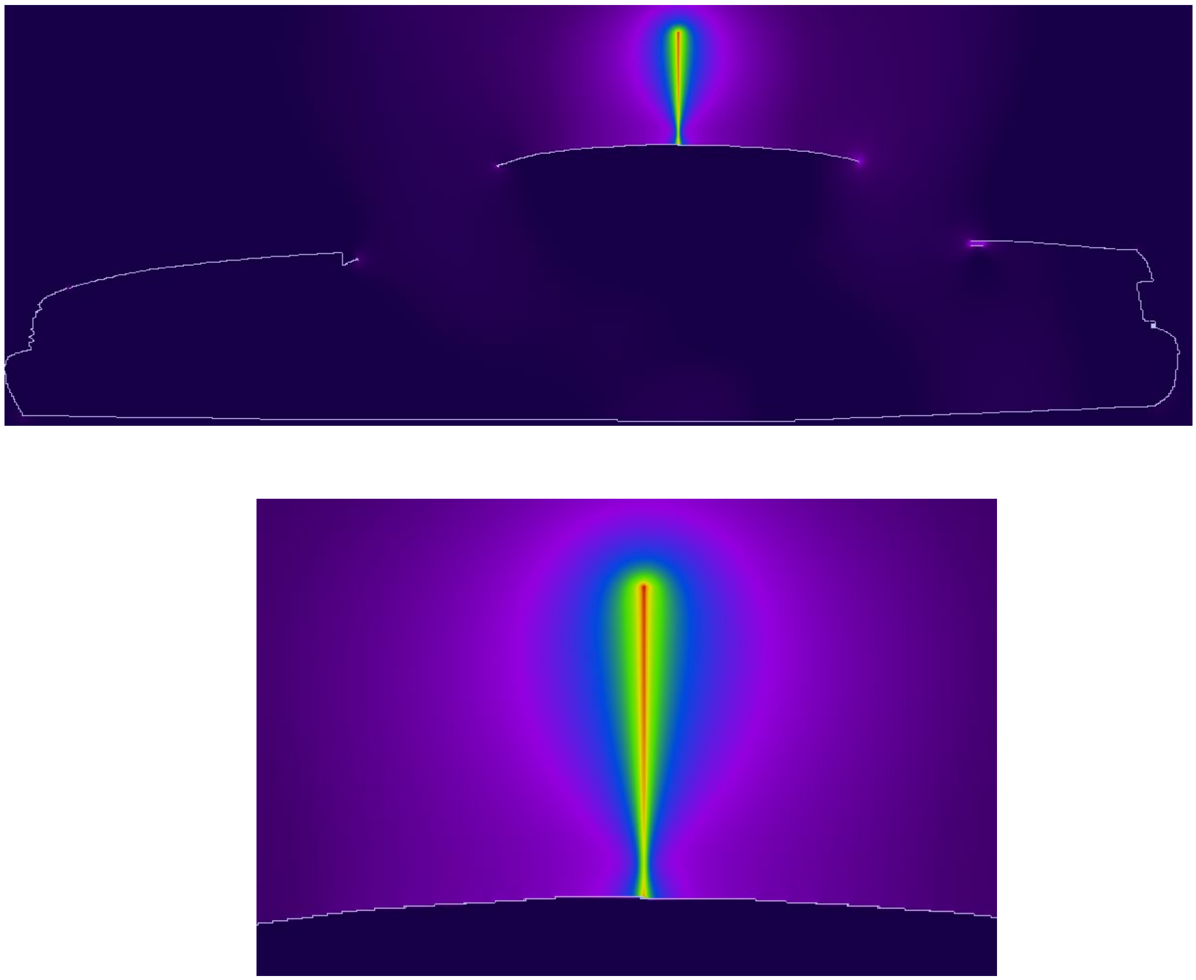
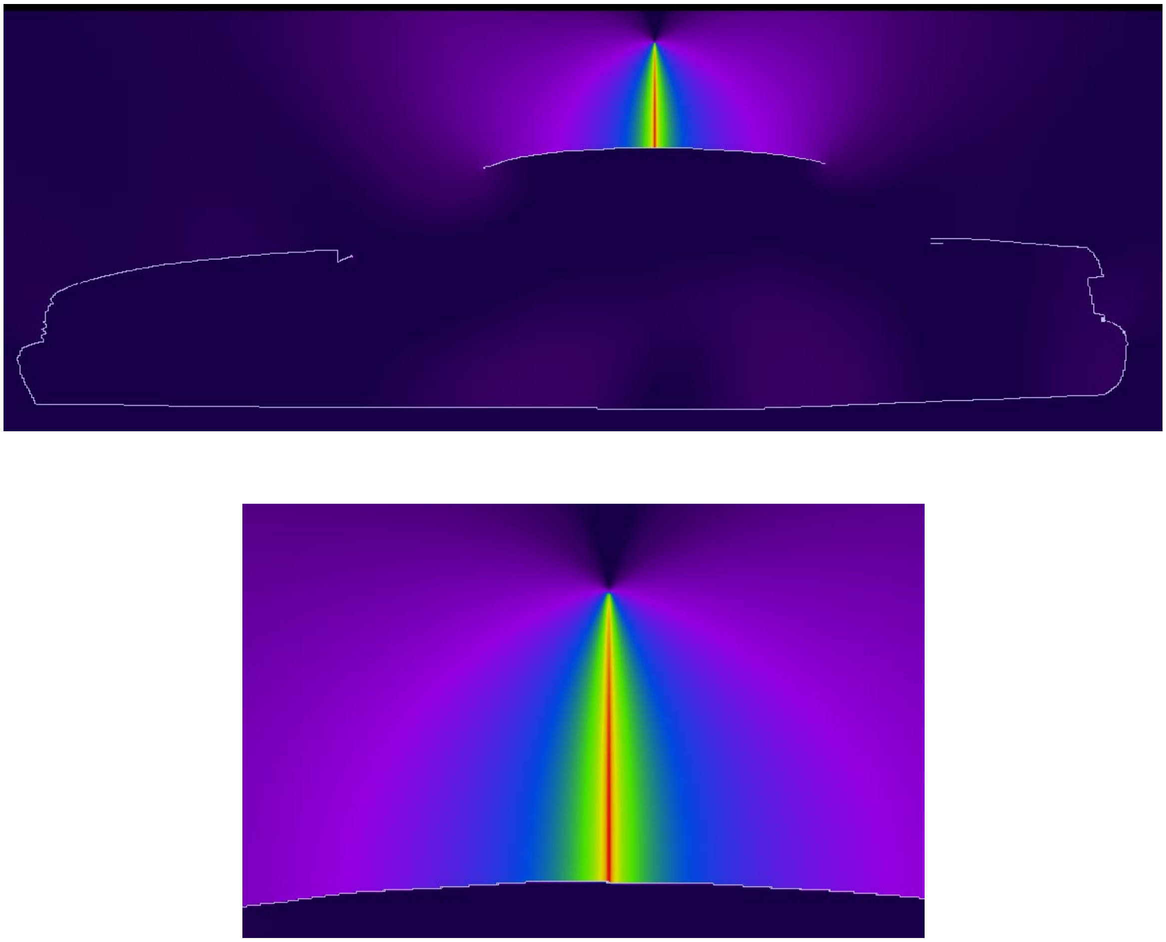


Figure 4. SAR distribution 150.8000 MHz in the passenger model located on the side of the back seat, produced by the roof-mount HAD4007A antenna. The SAR distribution plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The plots in Figure 5 illustrate the E and H field distributions in the plane of the antenna corresponding to the exposure condition resulting in the SAR distribution in Figure 4.



a)



b)

Figure 5. (a) E-field magnitude distribution corresponding to exposure condition of Figure 4, and (b) H-field magnitude distribution corresponding to exposure condition of Figure 4.

The SAR distribution in the passenger exposure condition that gave highest adjusted 1-g SAR for the APX6500 VHF mobile radio (ISED Canada) is reported in Figure 6. (140.0000 MHz, passenger on the center of the back seat, HAD4006A antenna installed on the roof).

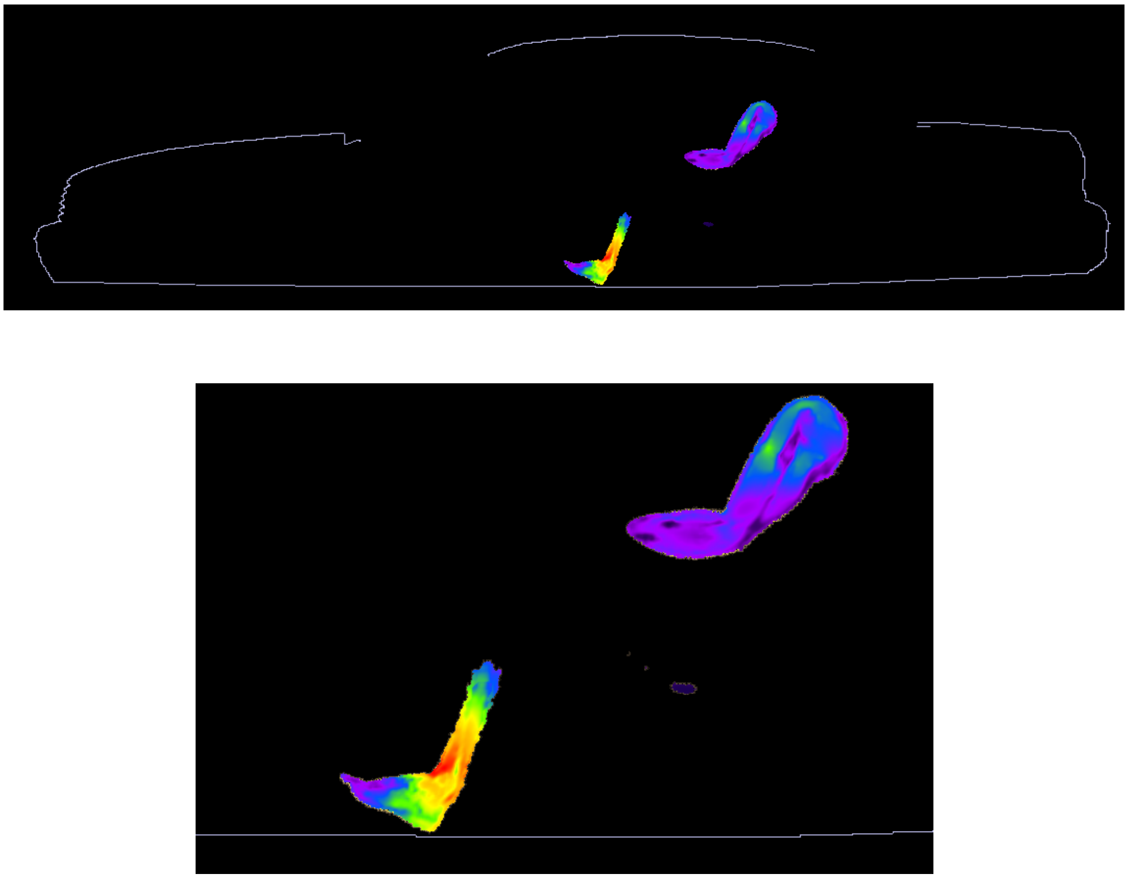
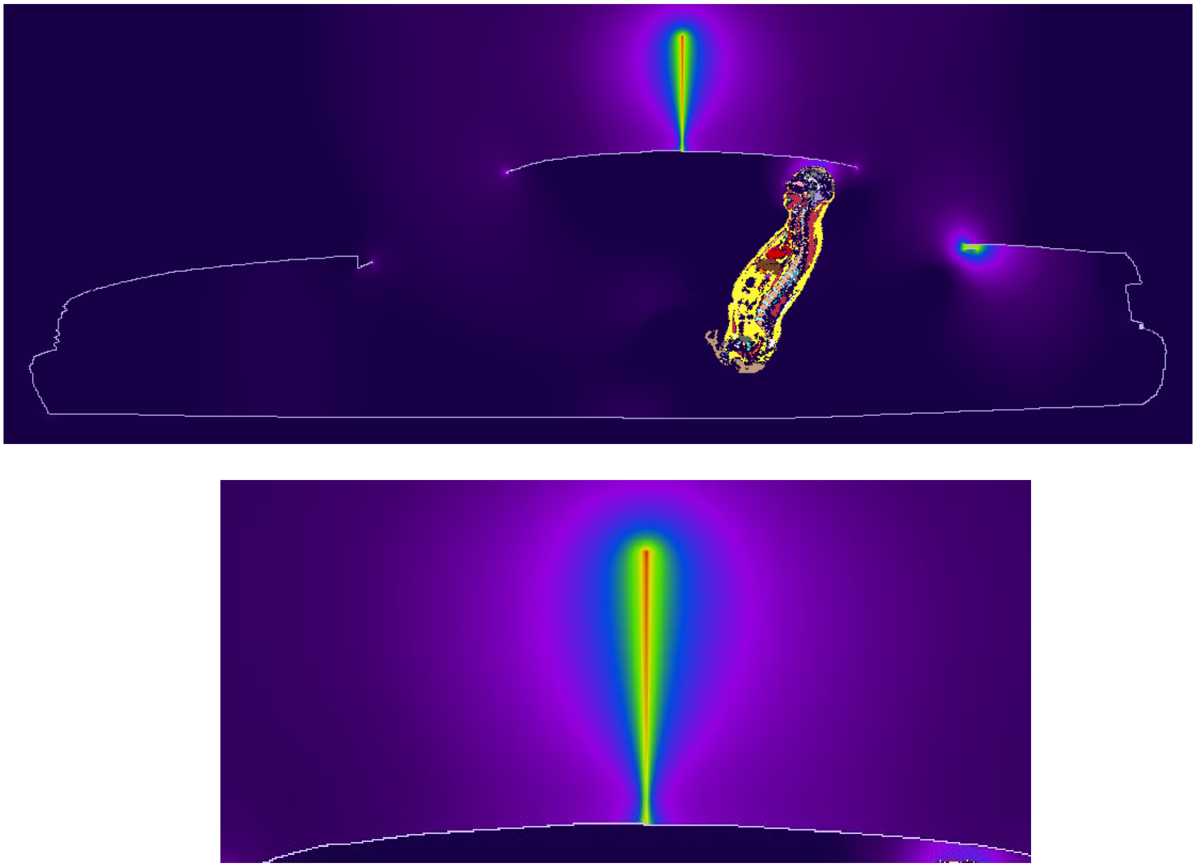
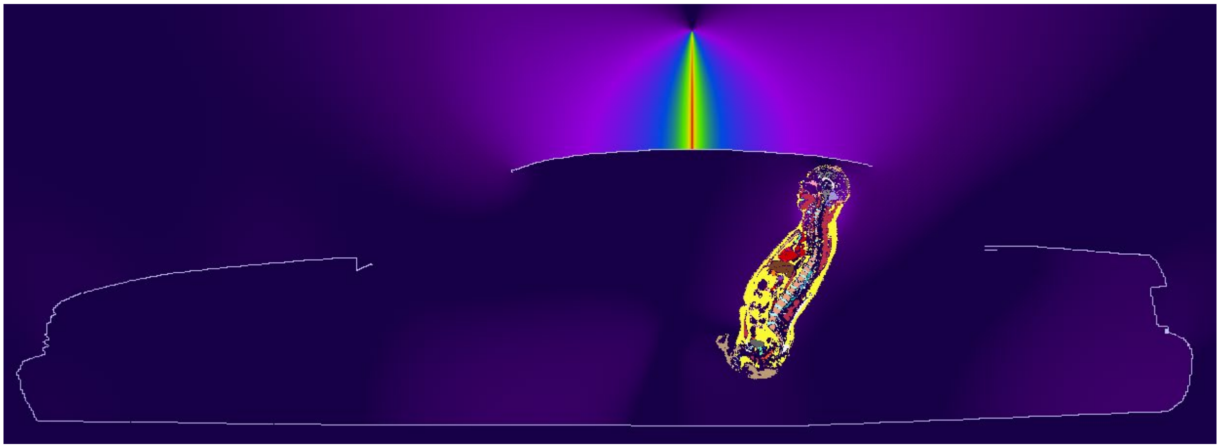


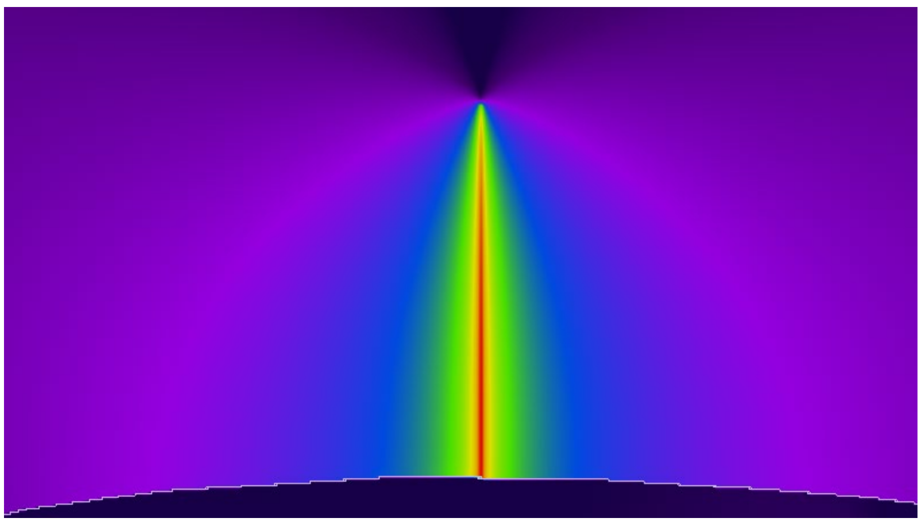
Figure 6. SAR distribution at 140.0000 MHz in the passenger model located on the center of the back seat, produced by the roof-mount HAD4006A antenna. The SAR distribution plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The plots in Figure 7 illustrate the E and H field distributions in the plane of the antenna corresponding to the exposure condition resulting in the SAR distribution in Figure 6.



a)

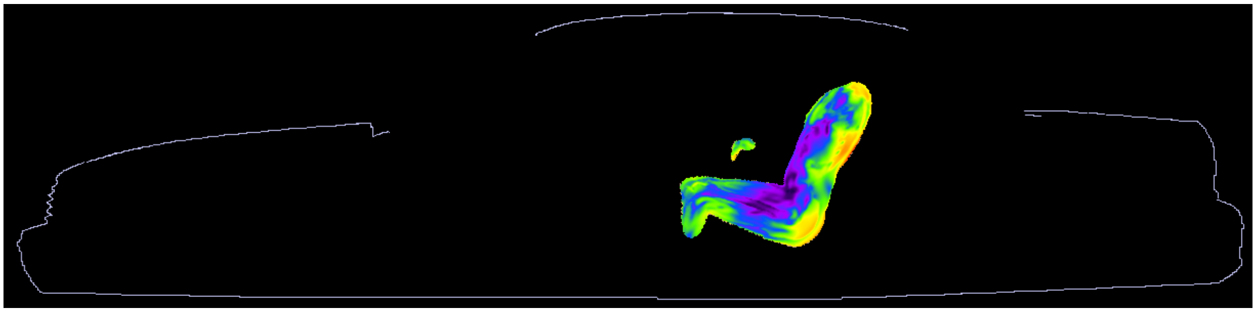




b)

Figure 7. (a) E-field magnitude distribution corresponding to exposure condition of Figure 6, and (b) H-field magnitude distribution corresponding to exposure condition of Figure 6.

The SAR distribution in the passenger exposure condition that produced the highest adjusted 1-g SAR for the DVR 700 is reported in Figure 8. (775.0000 MHz, passenger on the side of the back seat, HAF4016A antenna installed on the trunk).



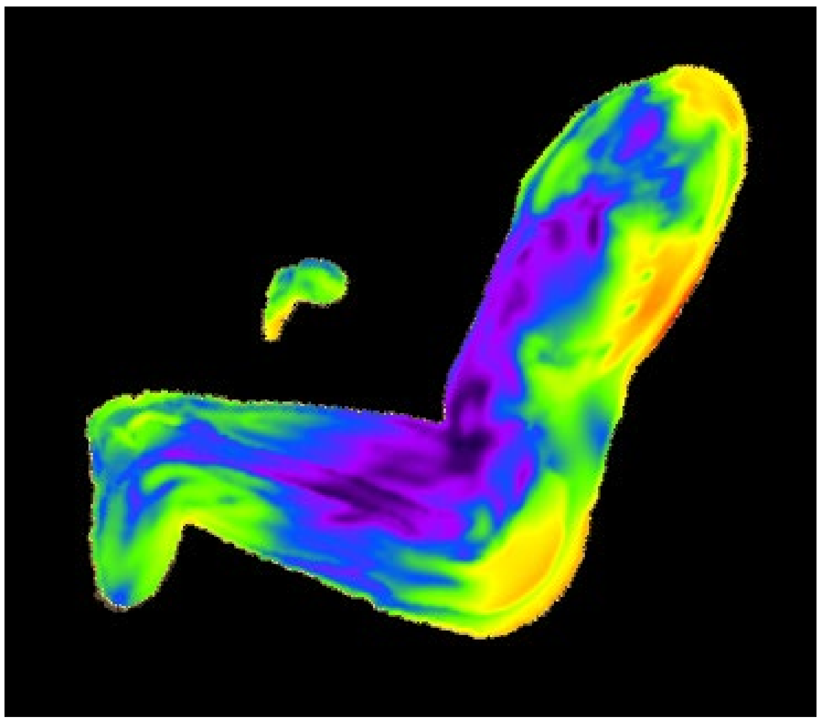
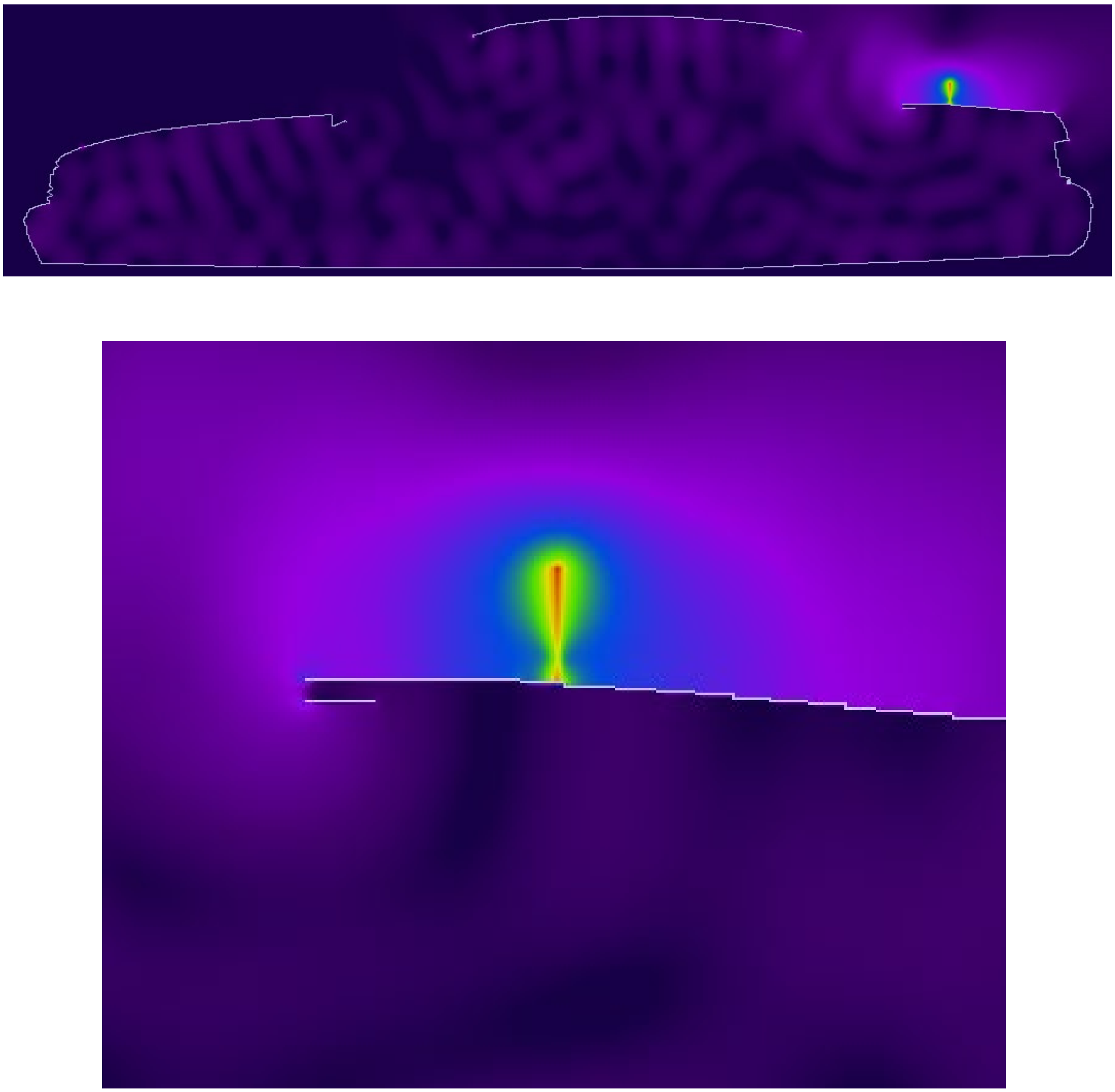
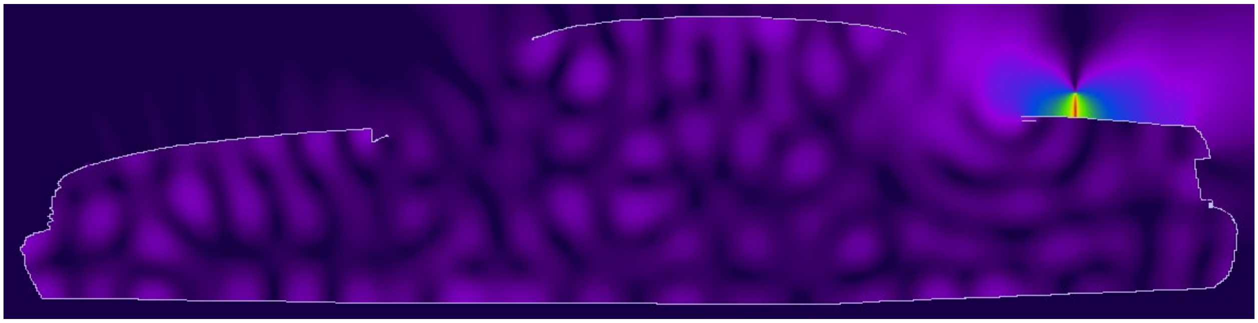


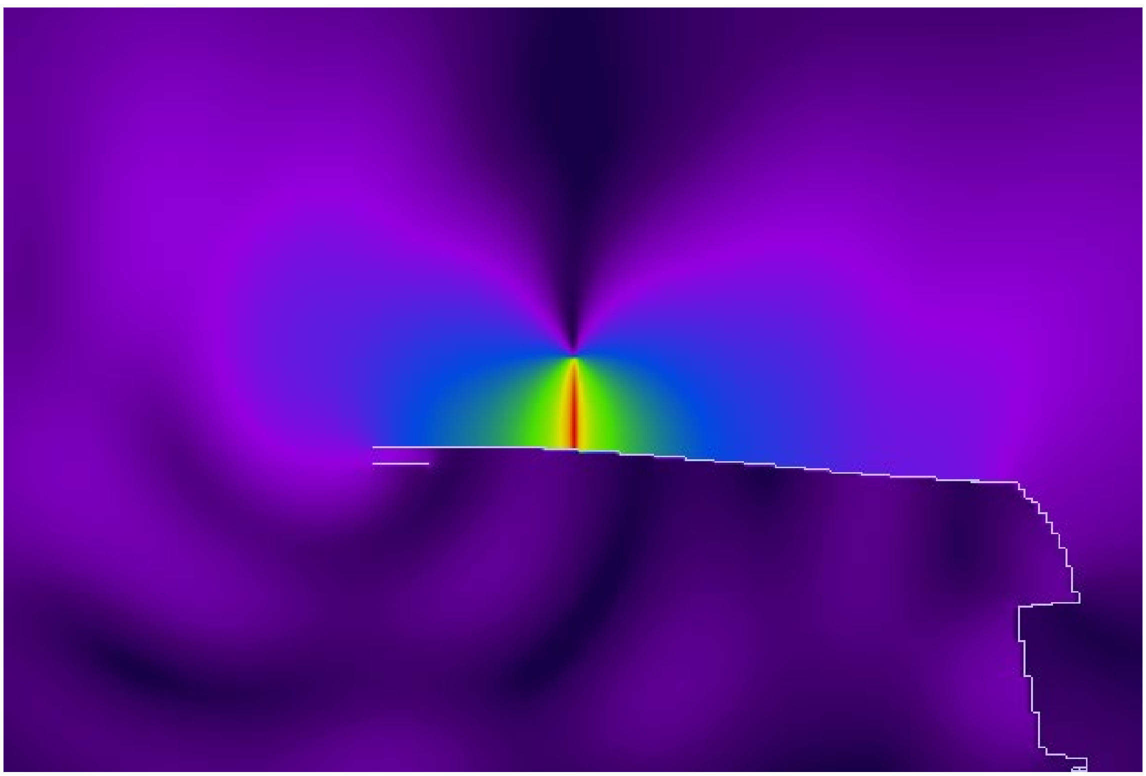
Figure 8. SAR distribution at 775.0000 MHz in the passenger model located on the side of the back seat, produced by the trunk-mount HAF4016A antenna. The SAR distribution plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The plots in Figure 9 illustrate the E and H field distributions in the plane of the antenna corresponding to the exposure condition resulting in the SAR distribution in Figure 8.



a)





b)

Figure 9. (a) E-field magnitude distribution corresponding to exposure condition of Figure 8, and (b) H-field magnitude distribution corresponding to exposure condition of Figure 8.

SAR Simulation Reduction Considerations

Per the Response to Inquiry to FCC Tracking Number 528198, for a particular antenna that has more than one configuration which exceeds the MPE limit, SAR evaluations shall begin with the highest MPE configuration (mount location and frequency channel). If the SAR value is less than 50% of the SAR limit, no further SAR evaluation is needed for that antenna.

If the highest MPE configuration SAR value is above 50% of the SAR limit, a subsequent SAR simulation shall be performed on the subsequent highest MPE configuration (ranked in descending percentage of the MPE limit). If the subsequent adjusted SAR value is below 75% of the limit, no further SAR evaluation is needed for that antenna, otherwise further SAR simulations for the remaining antenna configurations shall continue until the adjusted SAR value is below 75% of the SAR limit.

Table 3 and 4 below lists all the configurations that did not conform to applicable MPE limits (ranked in descending percentage of the MPE limit), to which the aforementioned SAR simulation reduction considerations were applied

Table 3: SAR Simulation Reduction Considerations for Back Seat Passenger (FCC)

DVRS		Mobile		Combine MPE (%)	Exposure Location	DVRS		Mobile		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAF4016A	775.0000	HAD4007A	150.80000	118.0	Back Center	0.059	0.004	0.144	0.007	0.203	0.011	
					Back Side	0.075	0.003	0.218	0.010	0.292	0.013	
HAF4016A	770.0000	HAD4007A	150.80000	117.5								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4007A	150.80000	114.8								
HAF4016A	806.0000	HAD4007A	150.80000	114.5								
HAF4016A	775.0000	HAD4008A	162.00000	123.7	Back Center	0.059	0.004	0.038	0.003	0.096	0.007	
					Back Side	0.075	0.003	0.056	0.004	0.131	0.007	
HAF4016A	770.0000	HAD4008A	162.00000	123.2								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4008A	162.00000	120.5								
HAF4016A	806.0000	HAD4008A	162.00000	120.2								
HAF4016A	775.0000	HAD4008A	156.40000	118.2								
HAF4016A	770.0000	HAD4008A	156.40000	117.7								
HAF4016A	800.0000	HAD4008A	156.40000	115.0								
HAF4016A	806.0000	HAD4008A	156.40000	114.7								
HAF4016A	775.0000	HAD4008A	150.80000	102.6								
HAF4016A	770.0000	HAD4008A	150.80000	102.1								
HAF4016A	775.0000	HAD4009A	162.00000	115.7	Back Center	0.059	0.004	0.038	0.003	0.097	0.007	
					Back Side	0.075	0.003	0.056	0.004	0.131	0.007	
HAF4016A	770.0000	HAD4009A	162.00000	115.2								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	775.0000	HAD4009A	165.01250	112.5								
HAF4016A	800.0000	HAD4009A	162.00000	112.5								
HAF4016A	806.0000	HAD4009A	162.00000	112.2								
HAF4016A	770.0000	HAD4009A	165.01250	112.0								
HAF4016A	800.0000	HAD4009A	165.01250	109.3								
HAF4016A	806.0000	HAD4009A	165.01250	109.0								
HAF4016A	775.0000	HAD4016A	150.80000	106.7	Back Center	0.059	0.004	0.145	0.007	0.203	0.011	
					Back Side	0.075	0.003	0.217	0.010	0.291	0.013	
HAF4016A	770.0000	HAD4016A	150.80000	106.2								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4016A	150.80000	103.5								
HAF4016A	806.0000	HAD4016A	150.80000	103.2								
HAF4016A	775.0000	HAD4016A	156.40000	100.8								
HAF4016A	770.0000	HAD4016A	156.40000	100.3								
HAF4016A	775.0000	HAD4017A	165.01250	118.9	Back Center	0.059	0.004	0.025	0.002	0.084	0.006	
					Back Side	0.075	0.003	0.053	0.003	0.127	0.006	
HAF4016A	770.0000	HAD4017A	165.01250	118.4								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4017A	165.01250	115.7								
HAF4016A	806.0000	HAD4017A	165.01250	115.4								
HAF4016A	775.0000	HAD4017A	158.01250	109.5								
HAF4016A	770.0000	HAD4017A	158.01250	109.0								
HAF4016A	800.0000	HAD4017A	158.01250	106.3								
HAF4016A	806.0000	HAD4017A	158.01250	106.0								

Table 4: SAR Simulation Reduction Considerations for Back Seat Passenger (ISED Canada)

DVRS		Mobile		Combine MPE (%)	Exposure Location	DVRS		Mobile		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAF4016A	775.0000	HAD4006A	140.00000	190.1	Back Center	0.059	0.004	0.316	0.010	0.375	0.014	
					Back Side	0.075	0.003	0.263	0.014	0.338	0.017	
HAF4016A	770.0000	HAD4006A	140.00000	188.9								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4006A	140.00000	183.4								
HAF4016A	806.0000	HAD4006A	140.00000	182.8								
HAF4016A	775.0000	HAD4006A	144.00000	177.7								
HAF4016A	770.0000	HAD4006A	144.00000	176.5								
HAF4016A	800.0000	HAD4006A	144.00000	171.0								
HAF4016A	806.0000	HAD4006A	144.00000	170.4								
HAF4016A	775.0000	HAD4007A	150.80000	187.4	Back Center	0.059	0.004	0.144	0.007	0.203	0.011	
					Back Side	0.075	0.003	0.218	0.010	0.293	0.013	
HAF4016A	770.0000	HAD4007A	150.80000	186.2								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4007A	150.80000	180.7								
HAF4016A	806.0000	HAD4007A	150.80000	180.1								
HAF4016A	775.0000	HAD4007A	144.00000	166.3								
HAF4016A	770.0000	HAD4007A	144.00000	165.1								
HAF4016A	800.0000	HAD4007A	144.00000	159.6								
HAF4016A	806.0000	HAD4007A	144.00000	159.0								
HAF4016A	775.0000	HAD4008A	162.00000	196.3	Back Center	0.059	0.004	0.038	0.003	0.097	0.007	
					Back Side	0.075	0.003	0.056	0.004	0.131	0.007	
HAF4016A	770.0000	HAD4008A	162.00000	195.1								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4008A	162.00000	189.6								
HAF4016A	806.0000	HAD4008A	162.00000	189.0								
HAF4016A	775.0000	HAD4008A	156.40000	187.7								
HAF4016A	770.0000	HAD4008A	156.40000	186.5								
HAF4016A	800.0000	HAD4008A	156.40000	181.0								
HAF4016A	806.0000	HAD4008A	156.40000	180.4								
HAF4016A	775.0000	HAD4008A	150.80000	163.6								
HAF4016A	770.0000	HAD4008A	150.80000	162.4								
HAF4016A	800.0000	HAD4008A	150.80000	156.9								
HAF4016A	806.0000	HAD4008A	150.80000	156.3								
HAF4016A	775.0000	HAD4009A	162.00000	183.8	Back Center	0.059	0.004	0.038	0.003	0.097	0.007	
					Back Side	0.075	0.003	0.056	0.004	0.131	0.007	
HAF4016A	770.0000	HAD4009A	162.00000	182.6								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	775.0000	HAD4009A	165.01250	178.8								
HAF4016A	770.0000	HAD4009A	165.01250	177.6								
HAF4016A	800.0000	HAD4009A	162.00000	177.1								
HAF4016A	806.0000	HAD4009A	162.00000	176.5								
HAF4016A	800.0000	HAD4009A	165.01250	172.1								
HAF4016A	806.0000	HAD4009A	165.01250	171.5								
HAF4016A	775.0000	HAD4009A	173.01250	120.8								
HAF4016A	770.0000	HAD4009A	173.01250	119.6								
HAF4016A	800.0000	HAD4009A	173.01250	114.1								
HAF4016A	806.0000	HAD4009A	173.01250	113.5								

Table 4 (Continued): SAR Simulation Reduction Considerations for Back Seat Passenger (ISED Canada)

DVRS		Mobile		Combine MPE (%)	Exposure Location	DVRS		Mobile		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAF4016A	775.0000	HAD4016A	150.8000	169.9	Back Center	0.059	0.004	0.145	0.007	0.204	0.011	
					Back Side	0.075	0.003	0.217	0.010	0.292	0.013	
HAF4016A	770.0000	HAD4016A	150.8000	168.7								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	775.0000	HAD4016A	144.0000	165.1								
HAF4016A	770.0000	HAD4016A	144.0000	163.9								
HAF4016A	800.0000	HAD4016A	150.8000	163.2								
HAF4016A	806.0000	HAD4016A	150.8000	162.6								
HAF4016A	775.0000	HAD4016A	156.4000	160.8								
HAF4016A	770.0000	HAD4016A	156.4000	159.6								
HAF4016A	800.0000	HAD4016A	144.0000	158.4								
HAF4016A	806.0000	HAD4016A	144.0000	157.8								
HAF4016A	775.0000	HAD4016A	162.0000	156.0								
HAF4016A	770.0000	HAD4016A	162.0000	154.8								
HAF4016A	800.0000	HAD4016A	156.4000	154.1								
HAF4016A	806.0000	HAD4016A	156.4000	153.5								
HAF4016A	800.0000	HAD4016A	162.0000	149.3								
HAF4016A	806.0000	HAD4016A	162.0000	148.7								
HAF4016A	775.0000	HAD4017A	165.0125	188.8	Back Center	0.059	0.004	0.025	0.002	0.084	0.006	
					Back Side	0.075	0.003	0.053	0.003	0.128	0.006	
HAF4016A	770.0000	HAD4017A	165.0125	187.6								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	800.0000	HAD4017A	165.0125	182.1								
HAF4016A	806.0000	HAD4017A	165.0125	181.5								
HAF4016A	775.0000	HAD4017A	158.0125	174.3								
HAF4016A	770.0000	HAD4017A	158.0125	173.1								
HAF4016A	800.0000	HAD4017A	158.0125	167.6								
HAF4016A	806.0000	HAD4017A	158.0125	167.0								
HAF4016A	775.0000	HAD4017A	150.8000	148.7								
HAF4016A	770.0000	HAD4017A	150.8000	147.5								
HAF4016A	800.0000	HAD4017A	150.8000	142.0								
HAF4016A	806.0000	HAD4017A	150.8000	141.4								
HAF4016A	775.0000	HAD4017A	173.0125	116.1								
HAF4016A	770.0000	HAD4017A	173.0125	114.9								
HAF4016A	800.0000	HAD4017A	173.0125	109.4								
HAF4016A	806.0000	HAD4017A	173.0125	108.8								
HAF4016A	775.0000	HAD4017A	146.0000	108.4								
HAF4016A	770.0000	HAD4017A	146.0000	107.2								
HAF4016A	800.0000	HAD4017A	146.0000	101.7								
HAF4016A	806.0000	HAD4017A	146.0000	101.1								
HAF4016A	775.0000	HAD4021A	165.0125	156.4	Back Center	0.059	0.004	0.025	0.002	0.084	0.006	
					Back Side	0.075	0.003	0.053	0.003	0.128	0.006	
HAF4016A	770.0000	HAD4021A	165.0125	155.2								The highest MPE configuration has SAR below 50% of the limit
HAF4016A	775.0000	HAD4021A	158.0125	154.4								
HAF4016A	770.0000	HAD4021A	158.0125	153.2								
HAF4016A	800.0000	HAD4021A	165.0125	149.7								
HAF4016A	806.0000	HAD4021A	165.0125	149.1								
HAF4016A	775.0000	HAD4021A	150.8000	148.2								
HAF4016A	775.0000	HAD4021A	144.0000	148.0								
HAF4016A	800.0000	HAD4021A	158.0125	147.7								
HAF4016A	806.0000	HAD4021A	158.0125	147.1								
HAF4016A	770.0000	HAD4021A	150.8000	147.0								
HAF4016A	770.0000	HAD4021A	144.0000	146.8								
HAF4016A	800.0000	HAD4021A	150.8000	141.5								
HAF4016A	800.0000	HAD4021A	144.0000	141.3								
HAF4016A	806.0000	HAD4021A	150.8000	140.9								
HAF4016A	806.0000	HAD4021A	144.0000	140.7								
HAF4016A	775.0000	HAD4021A	173.0125	102.8								
HAF4016A	770.0000	HAD4021A	173.0125	101.6								

Results of SAR Computations for combined exposure

From all simulated results the highest peak 1-g SAR values were identified for both DVR 700 and APX6500 VHF mobile radio exposures and then summed up to produce the composite combined peak SAR value for corresponding locations of the human body model. Tables 5 and 6 present the highest combined peak 1-g and whole-body SAR values, respectively.

Table 5: Worst case peak 1-g average SAR for passenger exposure conditions and combined 1-g average SAR from simultaneous exposure.

	Passenger location	DVR 700 [W/kg]	Mobile APX6500 [W/kg]	Total 1-g SAR [W/kg]
FCC	Back Center	0.059	0.144	0.203
	Back Side	0.075	0.218	0.293
ISED Canada	Back Center	0.059	0.316	0.375
	Back Side	0.075	0.263	0.338

Table 6: Worst case peak whole body average SAR for passenger exposure conditions and combined whole body average SAR from simultaneous exposure.

	Passenger location	DVR 700 [W/kg]	Mobile APX6500 [W/kg]	Total WB SAR [W/kg]
FCC	Back Center	0.004	0.007	0.011
	Back Side	0.003	0.010	0.013
ISED Canada	Back Center	0.004	0.010	0.014
	Back Side	0.003	0.014	0.017

In summary, the maximum combined peak 1-g SAR is 0.375 W/kg, less than the 1.6 W/kg limit, while the maximum combined whole-body average SAR is 0.017 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 products, the present analysis shows that the computed SAR values are compliant with the FCC and ISED Canada general public SAR limits.

References

[1] Health Canada Safety Code 6 (2015). Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz.

[2] United States Federal Communication Commission, "Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields," OET Bulletin 65 (Ed. 97-01), August 1997.

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

[4] ICNIRP (International Commission on Non-Ionising Radiation Protection) 1998. *Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)*. Health Phys. 74:494–522.

[5] IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz. IEEE Std C95.1-2019 (Revision of IEEE Std C95.1-2005/ Incorporates IEEE Std C95.1-2019/Cor 1-2019) .