



**COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE DIGITAL
VEHICULAR REPEATER (DVR UHF), MOBEXCOM DVRS UHF
(DQPM DVR4000P, DQPM DVR5000P, DQPM DVR6000P)
AND COMPANION APX SERIES MODEL M37TSS9PW1AN MOBILE RADIO.**

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Introduction

This report summarizes the computational [numerical modeling] analysis performed to document compliance of the DVR UHF, model # MOBEXCOM DVRS UHF (DQPM DVR4000P, DQPM DVR5000P, DQPM DVR6000P) with FCC ID# LO6-DVRSUHF interfaced with, and transmitting simultaneously with Companion mobile radio, model # M37TXS9PW1AN (HUW1001A) and vehicle-mounted antennas with the US Federal Communications Commission (FCC) 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	DVR UHF	UHF Band	406.1 – 512
	Companion Mobile	LMR VHF	150.8 – 173.4
		LMR UHF1	406.1 – 470
		LMR UHF2	450 -512
		LMR 7/800	769-775; 799-824; 851-869

This computational analysis supplements the measurements conducted to evaluate the compliance of the exposure from this DVR and Companion mobile radio with respect to applicable *maximum permissible exposure* (MPE) limits. All test conditions (240 in total) that did not conform with applicable MPE limits 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) set forth in FCC guidelines, which are based on the IEEE C95.1-1999 standard [1]. With SAR simulation reduction consideration, total 25 test conditions (with 50 independent simulations) had been performed addressing exposure of back seat passenger to the DVR UHF repeater with trunk-mounted antennas and Companion mobile radio (VHF, UHF R1, UHF R2 and 7/800) with roof-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 8mm. The Figure 1 below show 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.

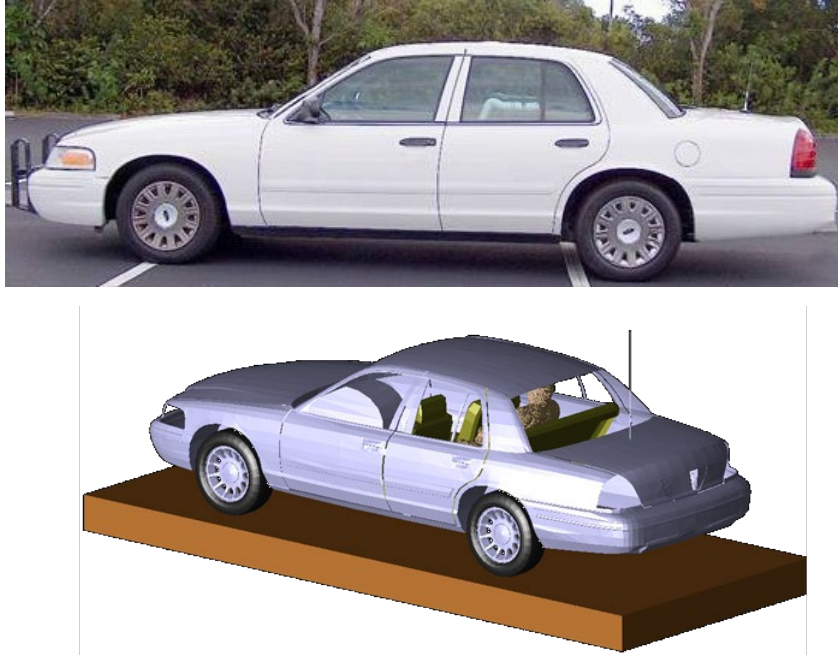


Figure 1: The photo picture of the car used in field measurements and the corresponding CAD model used in simulations

For passenger exposure, Companion mobile antenna position is on the roof and DVR UHF repeater antenna position is on the trunk. The distance of trunk mounted antenna from the passenger head when the passenger is located in the center of the back seat was set at 85 cm, to replicate the experimental conditions used in MPE measurements. Figure 2 shows some of the XFDTD™ computational models used for passenger (back seat) exposure to trunk mounted antennas. Figure 3 shows XFDTD™ computational models used for passenger (front seat) exposure to roof mounted antennas.

According to the IEC/IEEE 62704-2-2017 standard 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.

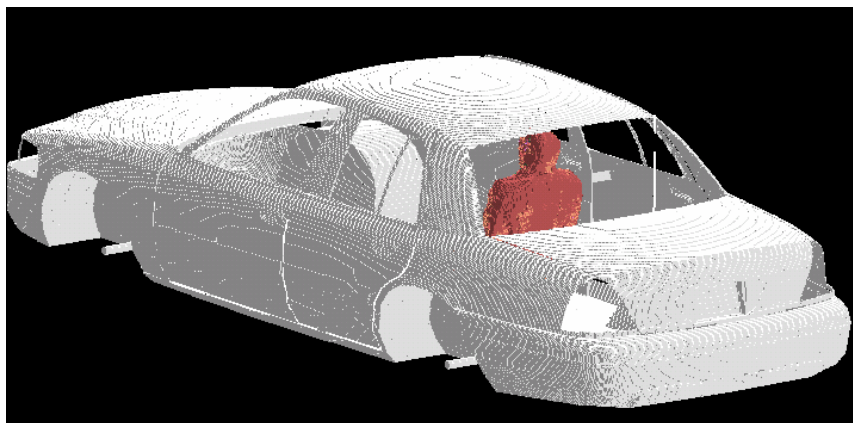


Figure 2: Passenger (back seat) model exposed to a trunk-mount antenna: XFDTD geometry.
The antenna is mounted at 85 cm from the passenger located in the center of the back seat.

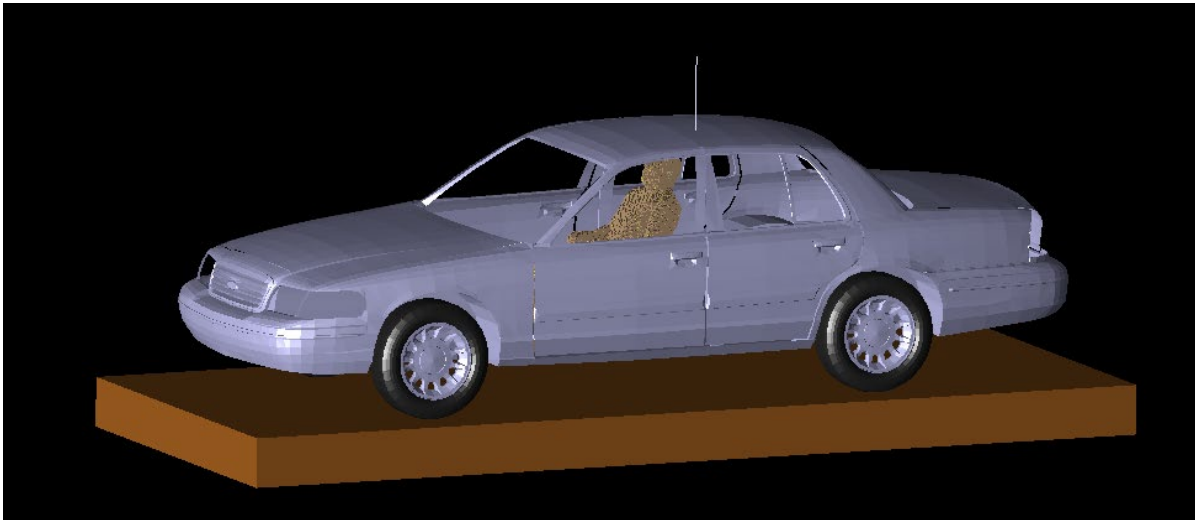


Figure 3: Passenger (front seat) model exposed to a roof-mount antenna: XFDTD geometry.

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 DVR UHF repeater is 10W (380-512 MHz) and Companion mobile radio antenna is 120W (136-174MHz) and (380-484MHz). 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 (100% talk time) for DVR UHF repeater and (50% talk time) for Companion mobile radio were employed, all computational results are normalized to full average net output power of DVR UHF repeater, i.e, 10W (380-512 MHz) and half the average net output power of Companion radio, i.e., 60W (136-174 MHz) and (380-484 MHz); 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 standard.

Results of SAR computations for car passengers

The test conditions requiring SAR computations are summarized in Table 1 (DVR UHF, 100% talk time) and Table 2 (Companion mobile, 50% talk time), 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 (DVR UHF) and on the roof (Companion mobile). The antenna length in Table 1&2 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, driver or passenger side of the front 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 & 2 have been simulated individually. These tables also include the interpolated adjustment factor and corresponding SAR scaled values following requirement of the IEC/IEEE 62704-2-2017 standard.

Table 1a (configurations exceed FCC MPE limits):
Results of the Computations and Adjusted SAR for passenger (back seat) exposure of
DVR UHF repeater (100% talk-time)

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	HAE6012A, 1/4 Wave (380-433MHz)	20.0	406.5000	0.10	Back Center	0.16	0.005	2.33	2.74	0.38	0.015
					Back Side Fig 4 & 5	0.18	0.005	2.32	2.66	0.41	0.012
			417.5000	0.09	Back Center	0.08	0.004	2.35	2.76	0.18	0.011
					Back Side	0.13	0.005	2.24	2.64	0.29	0.013
			429.9875	0.07	Back Center	0.07	0.004	2.37	2.77	0.16	0.012
					Back Side	0.12	0.004	2.15	2.63	0.26	0.010
Trunk	HAE4003A, 1/4 Wave (450-470MHz)	17.8	450.0000	0.15	Back Center	0.11	0.006	2.40	2.80	0.27	0.016
					Back Side	0.10	0.005	2.00	2.60	0.20	0.013
			460.0000	0.16	Back Center	0.06	0.005	2.36	2.78	0.14	0.013
					Back Side	0.12	0.005	1.98	2.58	0.24	0.013
			470.0000	0.12	Back Center	0.09	0.004	2.32	2.77	0.21	0.011
					Back Side	0.07	0.004	1.97	2.56	0.14	0.010
Trunk	HAE4004A, 1/4 Wave (470-512MHz)	16.8	470.0000	0.14	Back Center	0.09	0.004	2.32	2.77	0.21	0.011
					Back Side	0.07	0.004	1.97	2.56	0.14	0.010
			484.0000	0.16	Back Center	0.06	0.004	2.26	2.74	0.14	0.011
					Back Side	0.10	0.005	1.94	2.53	0.20	0.012
			498.0000	0.10	Back Center	0.07	0.003	2.21	2.72	0.15	0.009
					Back Side	0.08	0.004	1.92	2.50	0.15	0.010
			512.0000	0.14	Back Center	0.10	0.004	2.15	2.69	0.22	0.012
					Back Side	0.07	0.004	1.89	2.48	0.14	0.009

Note:

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

Table 1b (configurations exceed FCC MPE limits):

Results of the Computations and Adjusted SAR for passenger (front seat) exposure of
DVR UHF repeater (100% talk-time)

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	HAE6012A, 1/4 Wave (380-433MHz)	20.0	406.5000	0.27	Driver	0.13	0.003	1.43	2.51	0.18	0.008
					Front Side	0.09	0.003	1.43	2.51	0.13	0.008

Table 2a (configurations exceed FCC MPE limits):

Results of the Computations and Adjusted SAR for passenger (back seat) exposure of
Companion mobile radio (50% talk-time)

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	AN000131A01, 1/4 wave (136-870MHz)	57.5	158.0125	0.37	Back Center	0.26	0.005	1.33	1.90	0.34	0.010
					Back Side	0.56	0.005	1.02	2.41	0.57	0.012
	HAD4022A, 5/8 Wave (132-174MHz)	115.8	150.8000	0.11	Back Center	0.16	0.004	1.30	1.90	0.21	0.007
					Back Side	0.28	0.004	1.00	2.40	0.28	0.010
		104.5	158.0125	0.15	Back Center	0.12	0.004	1.33	1.90	0.16	0.007
					Back Side	0.17	0.003	1.02	2.41	0.18	0.006
		98.3	165.0125	0.17	Back Center	0.05	0.003	1.37	1.89	0.07	0.005
					Back Side	0.14	0.003	1.04	2.43	0.15	0.008
		91.7	173.0125	0.09	Back Center	0.24	0.005	1.40	1.89	0.33	0.009
					Back Side	0.37	0.010	1.05	2.44	0.39	0.025
	RAD4010ARB, 1/2 Wave (136-174MHz)	118.3	158.0125	0.09	Back Center	0.10	0.003	1.33	1.90	0.13	0.006
					Back Side	0.11	0.002	1.02	2.41	0.11	0.004
	HAD4016A, 1/4 Wave (136-162MHz)	53.1	162.0000	0.34	Back Center	0.06	0.003	1.35	1.90	0.08	0.006
					Back Side	0.21	0.004	1.03	2.42	0.22	0.009

Table 2a Continued (configurations exceed FCC MPE limits):
Results of the Computations and Adjusted SAR for passenger (back seat) exposure of
Companion mobile radio (50% talk-time)

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	HAD4017A, 1/4 Wave (146-174MHz)	48.0	165.0125	0.42	Back Center	0.05	0.003	1.37	1.89	0.07	0.005
					Back Side	0.18	0.004	1.04	2.43	0.19	0.010
	HAD4021A, 1/4 Wave (136-174MHz)	53.5	158.0125	0.33	Back Center	0.17	0.004	1.33	1.90	0.22	0.008
					Back Side	0.28	0.004	1.02	2.41	0.29	0.010
	HAD4007A, 1/4 Wave (144-150.8MHz)	50.8	150.8000	0.37	Back Center	0.25	0.006	1.30	1.90	0.32	0.012
					Back Side	0.53	0.008	1.00	2.40	0.54	0.020
	HAD4008A, 1/4 Wave (150.8-162MHz)	47.3	162.0000	0.36	Back Center	0.06	0.003	1.35	1.90	0.08	0.006
					Back Side	0.22	0.004	1.03	2.42	0.22	0.009
	HAD4009A, 1/4 Wave (162-174MHz)	44.8	165.0125	0.35	Back Center	0.05	0.003	1.37	1.89	0.07	0.005
					Back Side	0.18	0.004	1.04	2.43	0.19	0.010
	HAE6010A, 1/2 Wave (380-433MHz)	65.3	406.5000	0.12	Back Center	0.33	0.009	2.41	1.81	0.80	0.017
					Back Side Fig 6 & 7	0.51	0.010	1.60	2.83	0.81	0.027

Note:

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

Table 2b Continued (configurations exceed FCC MPE limits):
Results of the Computations and Adjusted SAR for passenger (Front seat) exposure of
Companion mobile radio (50% talk-time)

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	HAD4009A, 1/4 Wave (162-174MHz)	44.8	165.0125	0.18	Driver	0.11	0.005	1.07	1.65	0.12	0.009
					Front Side	0.13	0.006	1.07	1.65	0.13	0.009

The SAR distribution in the exposure condition that gave highest adjusted 1-g SAR for DVR UHF is reported in Figure 4. (406.5000 MHz, passenger on the side of the back seat, HAE6012A antenna).

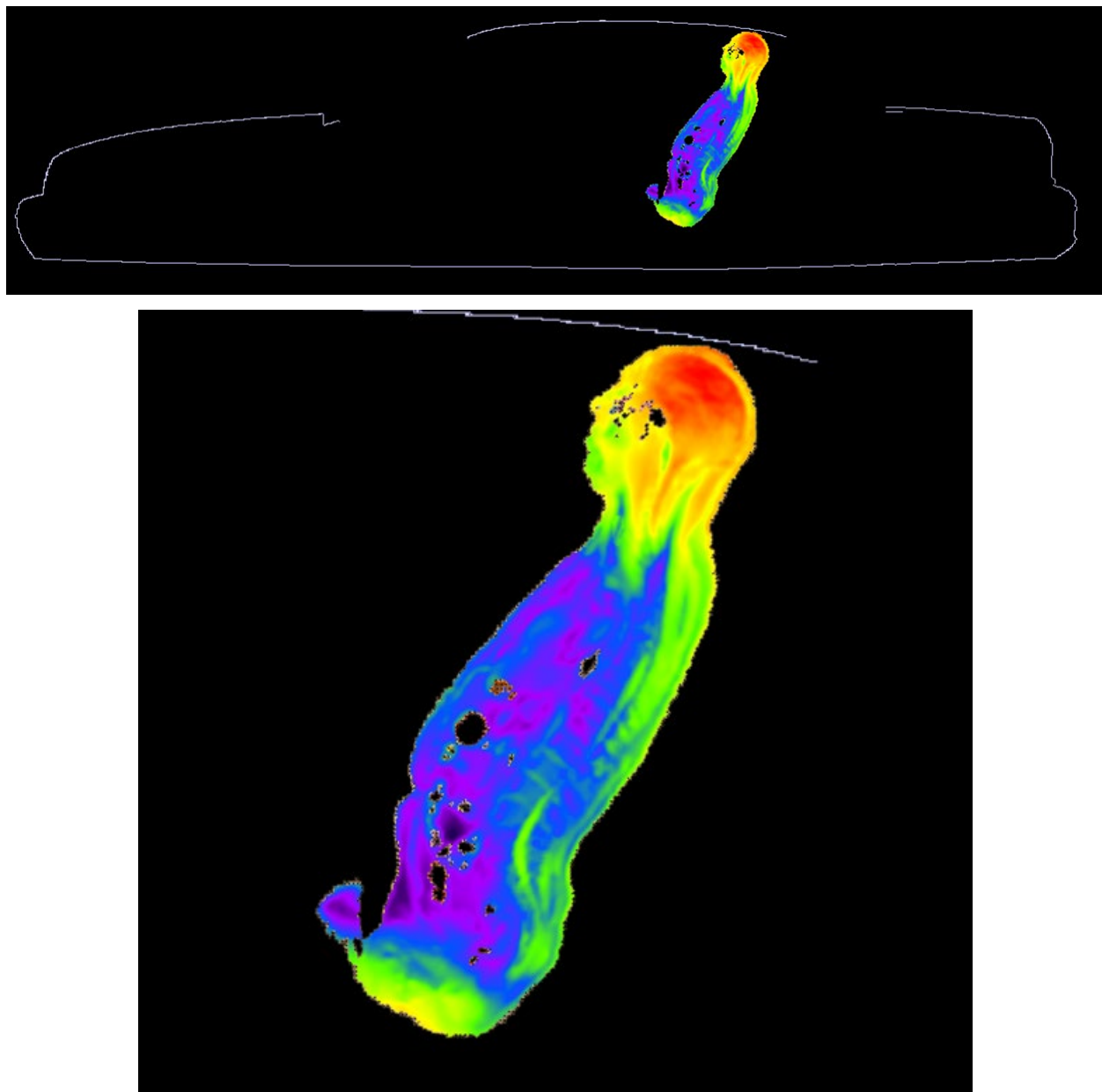
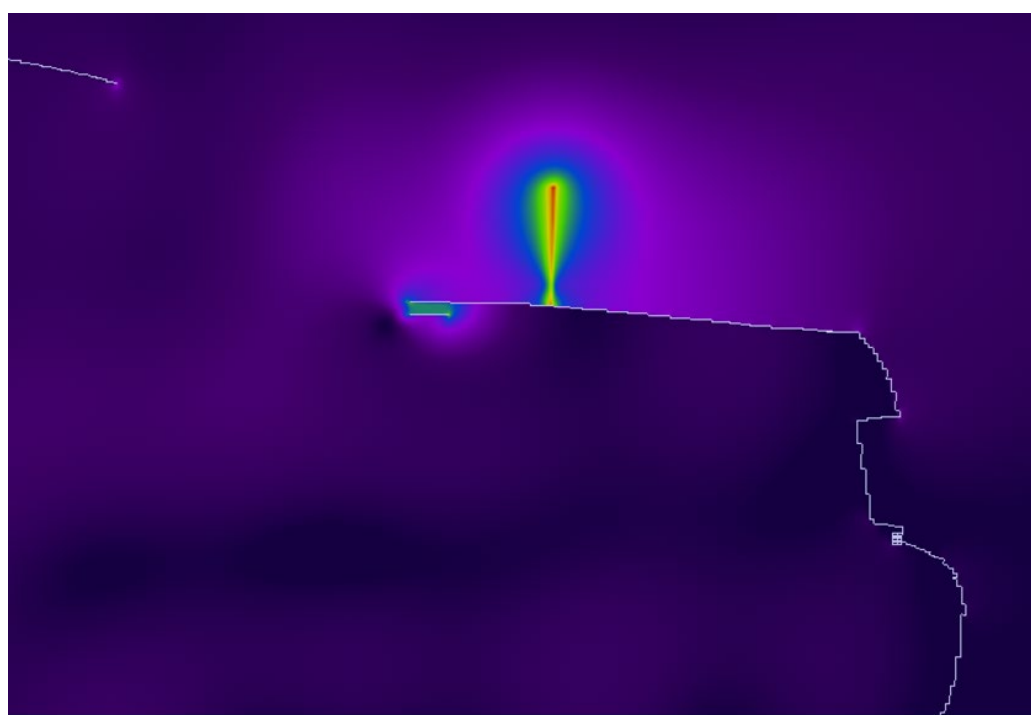
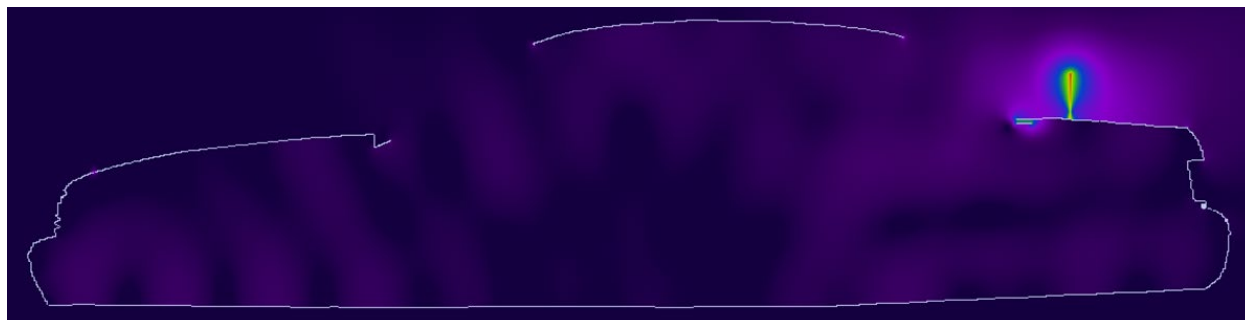


Figure 4. SAR distribution at 406.5000 MHz in the passenger model located on the side of the back seat, produced by the trunk-mount HAE6012A antenna. The contour plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The two pictures below in Figure 4. show the E and H field distributions in the plane of the antenna corresponding to the condition in Figure 3.



a)

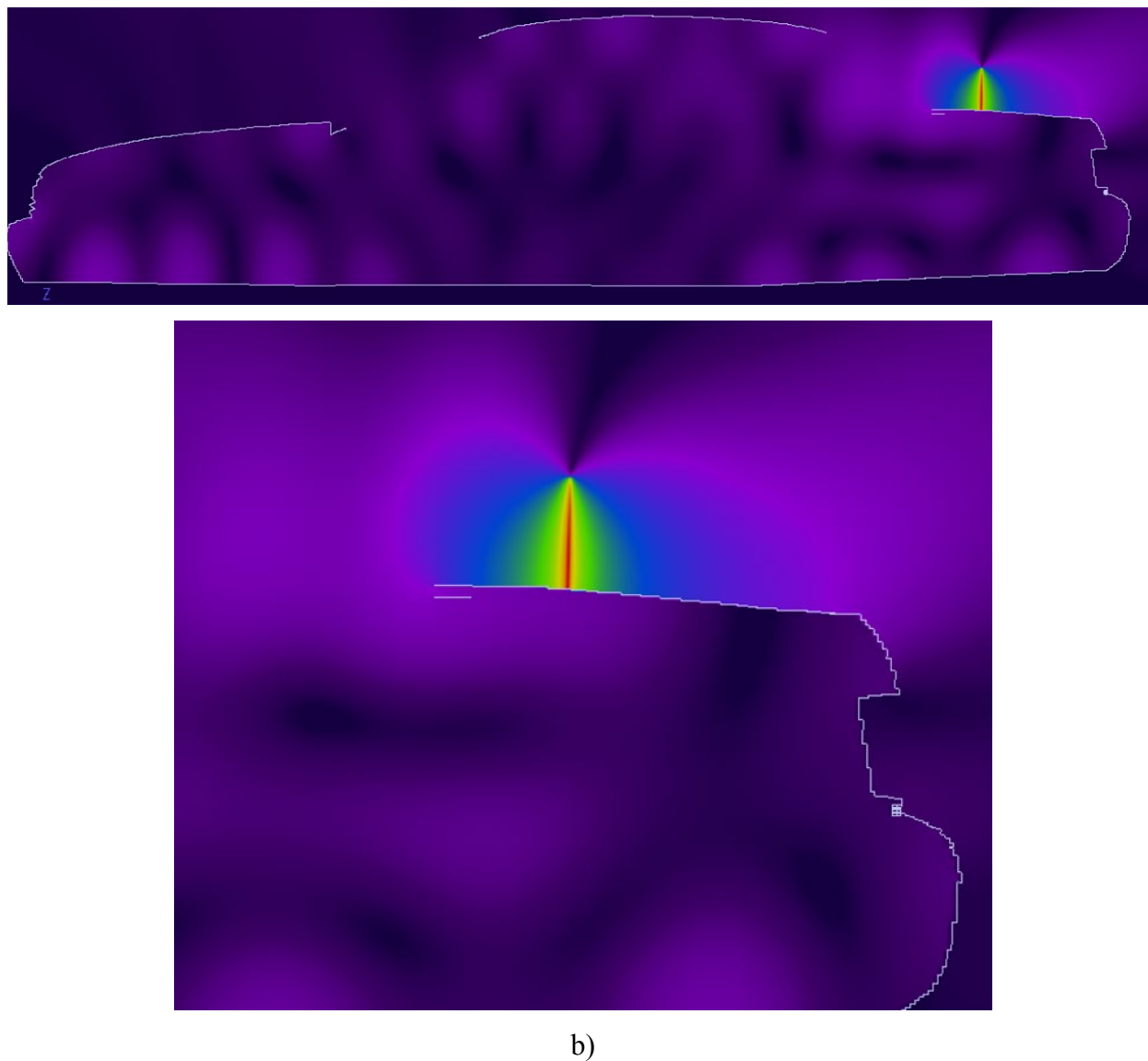


Figure 5. (a) E-field magnitude distribution corresponding to exposure condition of Figure 4, and (b) H-field magnitude distribution corresponding to exposure condition of Figure 4.

The highest adjusted 1-g SAR was produced in the passenger exposure condition with HAE6012A antenna at 406.5000 MHz (passenger on the side of the back seat).

The SAR distribution in the exposure condition that gave highest adjusted 1-g SAR for Companion mobile radio is reported in Figure 6. 406.5000 MHz, passenger on the side of the back seat, HAE6010A antenna).

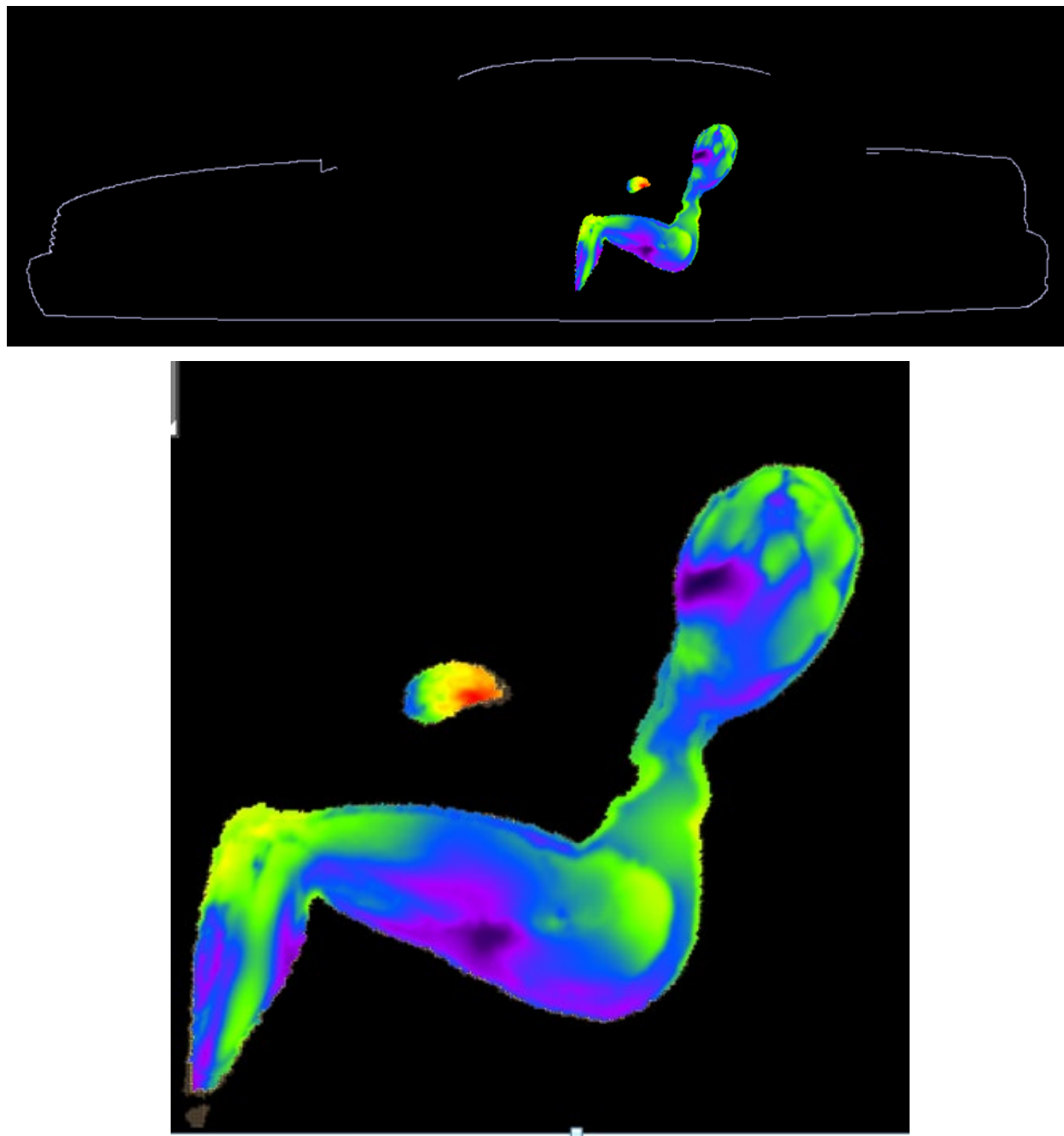
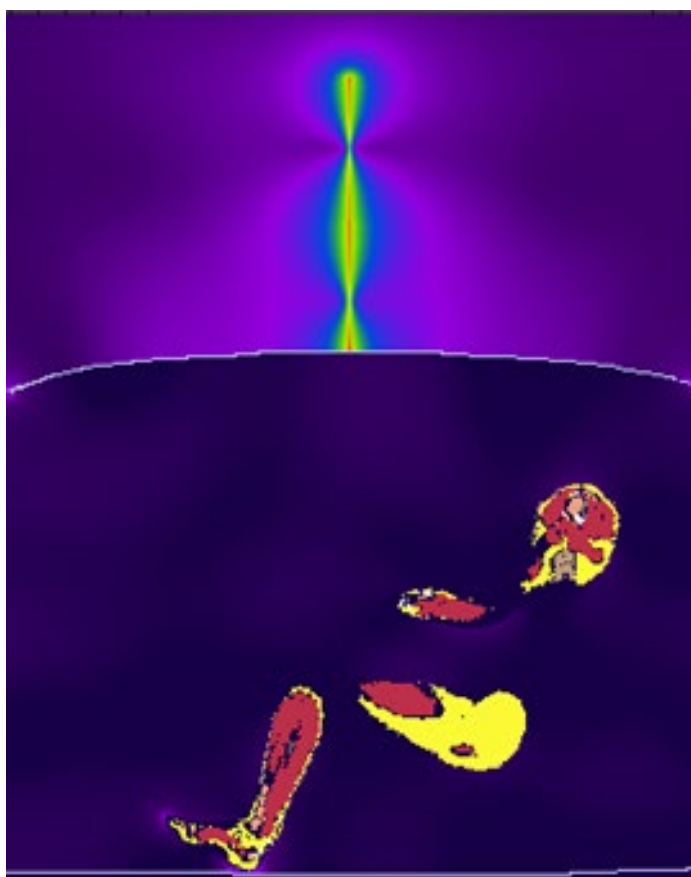
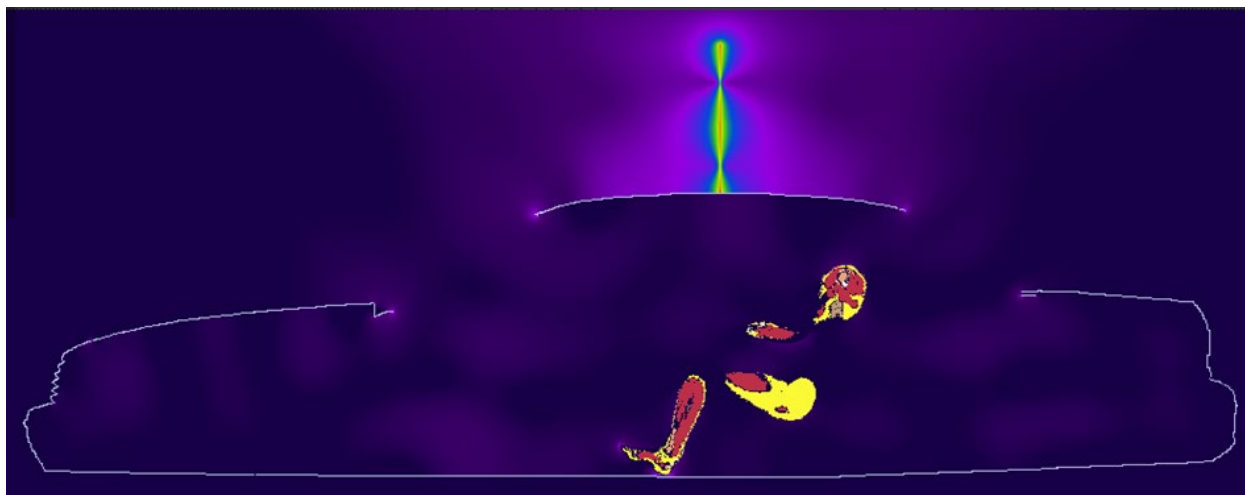
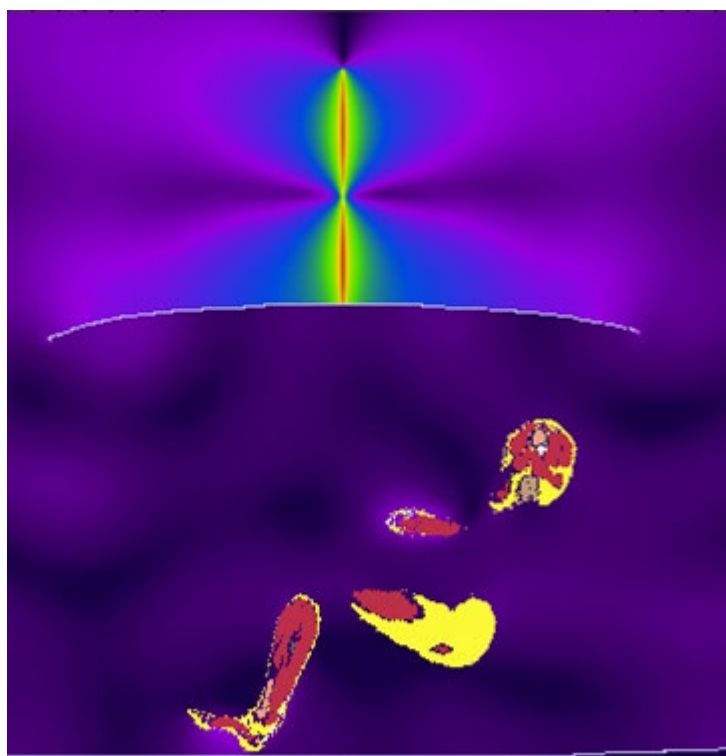
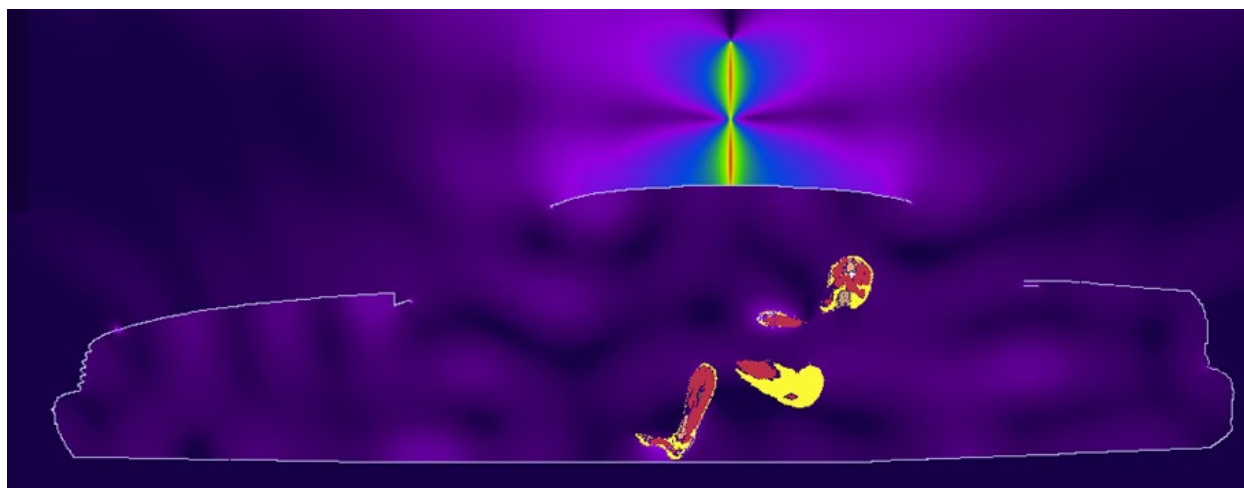


Figure 6. SAR distribution at 406.5000 MHz in the passenger model located on the side of the back seat, produced by the roof-mount HAE6010A antenna. The contour plot is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The pictures below in Figure 6 show the E and H field distributions in the plane of the antenna corresponding to the condition in Figure 5.



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 highest adjusted 1-g SAR was produced in the passenger exposure condition with HAE6010A antenna at 406.5000 MHz (passenger on the side of the back seat).

SAR Simulation Reduction Considerations

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

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

Table 3 below list all the configurations that did not conform to applicable MPE limits (ranked in descending MPE percentage to limit) and apply SAR simulation reduction consideration as mentioned above.

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE6012A	406.5000	AN000131A01	158.0125	227.11	Back Center	0.38	0.015	0.34	0.010	0.72	0.025	The 2nd highest MPE configuration has SAR below 75% of the limit
					Back Side	0.41	0.012	0.57	0.012	0.98	0.024	
	417.5000		158.0125	221.61	Back Center	0.18	0.011	0.34	0.010	0.52	0.021	
					Back Side	0.29	0.013	0.57	0.012	0.86	0.025	
	406.5000		165.0125	216.61								
	429.9875		158.0125	211.21								
	417.5000		165.0125	211.11								
	429.9875		165.0125	200.71								
	406.5000		150.8000	184.11								
	417.5000		150.8000	178.61								
	429.9875		150.8000	168.21								
	406.5000		173.0125	104.21								
HAE6012A	406.5000	*HAD4022A	165.0125	126.41	Back Center	0.38	0.015	0.07	0.005	0.45	0.02	
					Back Side	0.41	0.012	0.15	0.008	0.56	0.02	
	417.5000		165.0125	120.91	Back Center	0.18	0.011	0.07	0.005	0.25	0.016	
					Back Side	0.29	0.013	0.15	0.008	0.44	0.021	
	406.5000		158.0125	115.41	Back Center	0.38	0.015	0.16	0.007	0.54	0.022	
					Back Side	0.41	0.012	0.18	0.006	0.59	0.018	
HAE6012A	429.9875		165.0125	110.51	Back Center	0.16	0.012	0.07	0.005	0.23	0.017	
					Back Side	0.26	0.010	0.15	0.008	0.41	0.018	
	417.5000		158.0125	109.91	Back Center	0.18	0.011	0.16	0.007	0.34	0.018	
					Back Side	0.29	0.013	0.18	0.006	0.47	0.019	

Note:

* Antenna length trimmed to frequency.

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE6012A	406.5000	HAD4021A	158.0125	206.31	Back Center	0.38	0.015	0.22	0.008	0.60	0.023	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.41	0.012	0.29	0.010	0.70	0.022	
	417.5000		158.0125	200.81								
	406.5000		150.8000	199.51								
	417.5000		150.8000	194.01								
	429.9875		158.0125	190.41								
	429.9875		150.8000	183.61								
	406.5000		165.0125	180.11								
	417.5000		165.0125	174.61								
	429.9875		165.0125	164.21								
HAE6012A	406.5000	HAD4017A	165.0125	253.51	Back Center	0.38	0.015	0.07	0.005	0.45	0.02	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.41	0.012	0.19	0.010	0.60	0.022	
	417.5000		165.0125	248.01								
	429.9875		165.0125	237.61								
	406.5000		158.0125	220.41								
	417.5000		158.0125	214.91								
	429.9875		158.0125	204.51								
	406.5000		150.8000	149.31								
	417.5000		150.8000	143.81								
	429.9875		150.8000	133.41								
	406.5000		173.0125	114.51								
	417.5000		173.0125	109.01								
HAE6012A	406.5000	HAD4016A	162.0000	212.41	Back Center	0.38	0.015	0.08	0.006	0.46	0.021	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.41	0.012	0.22	0.009	0.63	0.021	
	417.5000		162.0000	206.91								
	406.5000		156.4000	202.21								
	417.5000		156.4000	196.71								
	429.9875		162.0000	196.51								
	406.5000		150.8000	192.21								
	417.5000		150.8000	186.71								
	429.9875		156.4000	186.31								
	429.9875		150.8000	176.31								
HAE6012A	406.5000	HAD4007A	150.8000	226.31	Back Center	0.38	0.015	0.32	0.012	0.70	0.027	The 2nd highest MPE configuration has SAR below 75% of the limit.
					Back Side	0.41	0.012	0.54	0.020	0.95	0.032	
	417.5000		150.8000	220.81	Back Center	0.18	0.011	0.32	0.012	0.50	0.023	
					Back Side	0.29	0.013	0.54	0.020	0.83	0.033	
	429.9875		150.8000	210.41								
HAE6012A	406.5000	HAD4008A	162.0000	223.41	Back Center	0.38	0.015	0.08	0.006	0.46	0.021	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.41	0.012	0.22	0.009	0.63	0.021	
	417.5000		162.0000	217.91								
	406.5000		156.4000	216.21								
	417.5000		156.4000	210.71								
	429.9875		162.0000	207.51								
	429.9875		156.4000	200.31								
	406.5000		150.8000	166.51								
	417.5000		150.8000	161.01								
	429.9875		150.8000	150.61								
HAE6012A	406.5000	HAD4009A	165.0125	214.51	Back Center	0.38	0.015	0.07	0.005	0.45	0.02	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.41	0.012	0.19	0.010	0.60	0.022	
	417.5000		165.0125	209.01								
	429.9875		165.0125	198.61								
	406.5000		162.0000	185.21								
	417.5000		162.0000	179.71								
	429.9875		162.0000	169.31								

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE4003A	460.0000	AN000131A01	158.0125	241.71	Back Center	0.14	0.013	0.34	0.010	0.48	0.023	The 2nd highest MPE configuration has SAR below 75% of the limit
					Back Side	0.24	0.013	0.57	0.012	0.81	0.025	
	450.0000		158.0125	239.81	Back Center	0.27	0.016	0.34	0.010	0.61	0.026	
					Back Side	0.2	0.013	0.57	0.012	0.77	0.025	
	460.0000		165.0125	231.21								
	450.0000		165.0125	229.31								
	470.0000		158.0125	227.21								
	470.0000		165.0125	216.71								
	460.0000		150.8000	198.71								
	450.0000		150.8000	196.81								
	470.0000		150.8000	184.21								
	460.0000		173.0125	118.81								
HAE4003A	450.0000	*HAD4022A	173.0125	116.91								
	470.0000		173.0125	104.31								
	460.0000		165.0125	141.01	Back Center	0.14	0.013	0.07	0.005	0.21	0.018	
					Back Side	0.24	0.013	0.15	0.008	0.39	0.021	
	450.0000		165.0125	139.11	Back Center	0.27	0.016	0.07	0.005	0.34	0.021	
					Back Side	0.20	0.013	0.15	0.008	0.35	0.021	
	460.0000		158.0125	130.01	Back Center	0.14	0.013	0.16	0.007	0.30	0.02	
					Back Side	0.24	0.013	0.18	0.006	0.42	0.019	
	450.0000		158.0125	128.11	Back Center	0.27	0.016	0.16	0.007	0.43	0.023	
					Back Side	0.20	0.013	0.18	0.006	0.38	0.019	
	470.0000		165.0125	126.51	Back Center	0.21	0.011	0.07	0.005	0.28	0.016	
					Back Side	0.14	0.010	0.15	0.008	0.29	0.018	
HAE4003A	470.0000		158.0125	115.51	Back Center	0.21	0.011	0.16	0.007	0.37	0.018	
					Back Side	0.14	0.010	0.18	0.006	0.32	0.016	
	460.0000		150.8000	111.81	Back Center	0.14	0.013	0.21	0.007	0.35	0.02	
					Back Side	0.24	0.013	0.28	0.010	0.52	0.023	
	450.0000		150.8000	109.91	Back Center	0.27	0.016	0.21	0.007	0.48	0.023	
					Back Side	0.20	0.013	0.28	0.010	0.48	0.023	
	460.0000		173.0125	100.11	Back Center	0.14	0.013	0.33	0.009	0.47	0.022	
					Back Side	0.24	0.013	0.39	0.025	0.63	0.038	
HAE4003A	460.0000	*RAD4010ARB	158.0125	101.61	Back Center	0.14	0.013	0.13	0.006	0.27	0.019	
					Back Side	0.24	0.013	0.11	0.004	0.35	0.017	
HAE4003A	460.0000	HAD4021A	158.0125	220.91	Back Center	0.14	0.013	0.22	0.008	0.36	0.021	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.24	0.013	0.29	0.010	0.53	0.023	
	450.0000		158.0125	219.01								
	460.0000		150.8000	214.11								
	450.0000		150.8000	212.21								
	470.0000		158.0125	206.41								
	470.0000		150.8000	199.61								
	460.0000		165.0125	194.71								
	450.0000		165.0125	192.81								
	470.0000		165.0125	180.21								
	460.0000		173.0125	105.51								
	450.0000		173.0125	103.61								
HAE4003A	460.0000	HAD4017A	165.0125	268.11	Back Center	0.14	0.013	0.07	0.005	0.21	0.018	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.24	0.013	0.19	0.010	0.43	0.023	
	450.0000		165.0125	266.21								
	470.0000		165.0125	253.61								
	460.0000		158.0125	235.01								
	450.0000		158.0125	233.11								
	470.0000		158.0125	220.51								
	460.0000		150.8000	163.91								
	450.0000		150.8000	162.01								
	470.0000		150.8000	149.41								
	460.0000		173.0125	129.11								
	450.0000		173.0125	127.21								
	470.0000		173.0125	114.61								

Note:

* Antenna length trimmed to frequency.

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE4003A	460.0000	HAD4016A	162.0000	227.01	Back Center Back Side	0.14 0.24	0.013 0.013	0.08 0.22	0.006 0.009	0.22 0.46	0.019 0.022	The highest MPE configuration has SAR below 50% of the limit.
	450.0000		162.0000	225.11								
	460.0000		156.4000	216.81								
	450.0000		156.4000	214.91								
	470.0000		162.0000	212.51								
	460.0000		150.8000	206.81								
	450.0000		150.8000	204.91								
	470.0000		156.4000	202.31								
	470.0000		150.8000	192.31								
HAE4003A	460.0000	HAD4007A	150.8000	240.91	Back Center Back Side	0.14 0.24	0.013 0.013	0.32 0.54	0.012 0.020	0.46 0.78	0.025 0.033	The highest MPE configuration has SAR below 50% of the limit.
	450.0000		150.8000	239.01								
	470.0000		150.8000	226.41								
HAE4003A	460.0000	HAD4008A	162.0000	238.01	Back Center Back Side	0.14 0.24	0.013 0.013	0.08 0.22	0.006 0.009	0.22 0.46	0.019 0.022	The highest MPE configuration has SAR below 50% of the limit.
	450.0000		162.0000	236.11								
	460.0000		156.4000	230.81								
	450.0000		156.4000	228.91								
	470.0000		162.0000	223.51								
	470.0000		156.4000	216.31								
	460.0000		150.8000	181.11								
	450.0000		150.8000	179.21								
	470.0000		150.8000	166.61								
HAE4003A	460.0000	HAD4009A	165.0125	229.11	Back Center Back Side	0.14 0.24	0.013 0.013	0.07 0.19	0.005 0.010	0.21 0.43	0.018 0.023	The highest MPE configuration has SAR below 50% of the limit.
	450.0000		165.0125	227.21								
	470.0000		165.0125	214.61								
	460.0000		162.0000	199.81								
	450.0000		162.0000	197.91								
	470.0000		162.0000	185.31								
	460.0000		173.0125	112.21								
	450.0000		173.0125	110.31								
HAE4004A	484.0000	AN000131A01	158.0125	237.71	Back Center Back Side	0.14 0.20	0.011 0.012	0.34 0.57	0.010 0.012	0.48 0.77	0.021 0.024	The highest MPE configuration has SAR below 50% of the limit.
	470.0000		158.0125	232.01								
	512.0000		158.0125	230.81								
	484.0000		165.0125	227.21								
	470.0000		165.0125	221.51								
	512.0000		165.0125	220.31								
	498.0000		158.0125	217.31								
	498.0000		165.0125	206.81								
	484.0000		150.8000	194.71								
	470.0000		150.8000	189.01								
	512.0000		150.8000	187.81								
	498.0000		150.8000	174.31								
	484.0000		173.0125	114.81								
	470.0000		173.0125	109.11								
	512.0000		173.0125	107.91								
HAE4004A	484.0000	*HAD4022A	165.0125	137.01	Back Center Back Side	0.14 0.20	0.011 0.012	0.07 0.15	0.005 0.008	0.21 0.35	0.016 0.02	
	470.0000		165.0125	131.31	Back Center Back Side	0.21 0.14	0.011 0.010	0.07 0.15	0.005 0.008	0.28 0.29	0.016 0.018	
	512.0000		165.0125	130.11	Back Center Back Side	0.22 0.14	0.012 0.009	0.07 0.15	0.005 0.008	0.29 0.29	0.017 0.017	
	484.0000		158.0125	126.01	Back Center Back Side	0.14 0.20	0.011 0.012	0.16 0.18	0.007 0.006	0.30 0.38	0.018 0.018	
	470.0000		158.0125	120.31	Back Center Back Side	0.21 0.14	0.011 0.010	0.16 0.18	0.007 0.006	0.37 0.32	0.018 0.016	
	512.0000		158.0125	119.11	Back Center Back Side	0.22 0.14	0.012 0.009	0.16 0.18	0.007 0.006	0.38 0.32	0.019 0.015	
	498.0000		165.0125	116.61	Back Center Back Side	0.15 0.15	0.009 0.010	0.07 0.15	0.005 0.008	0.22 0.30	0.014 0.018	
	484.0000		150.8000	107.81	Back Center Back Side	0.14 0.20	0.011 0.012	0.21 0.28	0.007 0.010	0.35 0.48	0.018 0.022	
	498.0000		158.0125	105.61	Back Center Back Side	0.15 0.15	0.009 0.010	0.16 0.18	0.007 0.006	0.31 0.33	0.016 0.016	
	470.0000		150.8000	102.11	Back Center Back Side	0.21 0.14	0.011 0.010	0.21 0.28	0.007 0.010	0.42 0.42	0.018 0.02	
	512.0000		150.8000	100.91	Back Center Back Side	0.22 0.14	0.012 0.009	0.21 0.28	0.007 0.010	0.43 0.42	0.019 0.019	

Note:

* Antenna length trimmed to frequency.

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE4004A	484.0000	HAD4021A	158.0125	216.91	Back Center	0.14	0.011	0.22	0.008	0.36	0.019	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.20	0.012	0.29	0.010	0.49	0.022	
	470.0000		158.0125	211.21								
	484.0000		150.8000	210.11								
	512.0000		158.0125	210.01								
	470.0000		150.8000	204.41								
	512.0000		150.8000	203.21								
	498.0000		158.0125	196.51								
	484.0000		165.0125	190.71								
	498.0000		150.8000	189.71								
	470.0000		165.0125	185.01								
	512.0000		165.0125	183.81								
	498.0000		165.0125	170.31								
	484.0000		173.0125	101.51								
HAE4004A	484.0000	HAD4017A	165.0125	264.11	Back Center	0.14	0.011	0.07	0.005	0.21	0.016	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.20	0.012	0.19	0.010	0.39	0.022	
	470.0000		165.0125	258.41								
	512.0000		165.0125	257.21								
	498.0000		165.0125	243.71								
	484.0000		158.0125	231.01								
	470.0000		158.0125	225.3								
	512.0000		158.0125	224.1								
	498.0000		158.0125	210.6								
	484.0000		150.8000	159.9								
	470.0000		150.8000	154.2								
	512.0000		150.8000	153.0								
	498.0000		150.8000	139.5								
	484.0000		173.0125	125.1								
	470.0000		173.0125	119.4								
	512.0000		173.0125	118.2								
	498.0000		173.0125	104.7								
HAE4004A	484.0000	HAD4016A	162.0000	223.01	Back Center	0.14	0.011	0.08	0.006	0.22	0.017	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.20	0.012	0.22	0.009	0.42	0.021	
	470.0000		162.0000	217.31								
	512.0000		162.0000	216.11								
	484.0000		156.4000	212.81								
	470.0000		156.4000	207.11								
	512.0000		156.4000	205.91								
	484.0000		150.8000	202.81								
	498.0000		162.0000	202.61								
	470.0000		150.8000	197.11								
	512.0000		150.8000	195.91								
	498.0000		156.4000	192.41								
	484.0000		150.8000	182.41								
HAE4004A	484.0000	HAD4007A	150.8000	236.91	Back Center	0.14	0.011	0.32	0.012	0.46	0.023	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.20	0.012	0.54	0.020	0.74	0.032	
	470.0000		150.8000	231.21								
	512.0000		150.8000	230.01								
HAE4004A	484.0000	HAD4008A	162.0000	234.01	Back Center	0.14	0.011	0.08	0.006	0.22	0.017	The highest MPE configuration has SAR below 50% of the limit.
					Back Side	0.20	0.012	0.22	0.009	0.42	0.021	
	470.0000		162.0000	228.31								
	512.0000		162.0000	227.11								
	484.0000		156.4000	226.81								
	470.0000		156.4000	221.11								
	512.0000		156.4000	219.91								
	498.0000		162.0000	213.61								
	498.0000		156.4000	206.41								
	484.0000		150.8000	177.11								
	470.0000		150.8000	171.41								
	512.0000		150.8000	170.21								
	498.0000		150.8000	156.71								

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

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE4004A	484.0000	HAD4009A	165.0125	225.11	Back Center	0.14	0.011	0.07	0.005	0.21	0.016	
	470.0000		165.0125	219.41	Back Side	0.20	0.012	0.19	0.010	0.39	0.022	
	512.0000		165.0125	218.21								
	498.0000		165.0125	204.71								
	484.0000		162.0000	195.81								
	470.0000		162.0000	190.11								
	512.0000		162.0000	188.91								
	498.0000		162.0000	175.41								
	484.0000		173.0125	108.21								
	470.0000		173.0125	102.51								
	512.0000		173.0125	101.31								
HAE4003A	460.0000	HAE6010A	406.5000	101.41	Back Center Back Side	0.14 0.24	0.013 0.013	0.8 0.81	0.017 0.027	0.94 1.05	0.030 0.040	

Note:

Blue – the highest SAR results computed for passenger (Back Seat)**Table 3b: SAR Simulation Reduction Considerations for Passenger (Front Seat)**

DVRS UHF		APX 8500 HP Mobile		Combine MPE (%)	Exposure Location	DVRS UHF Adjusted SAR Results (W/kg)		APX 8500 HP Mobile Adjusted SAR Results (W/kg)		Combine Adjusted SAR Results (W/kg)		SAR Simulation Reduction
Antenna Kit#	Freq (MHz)	Antenna Kit#	Freq (MHz)			1g	WB	1g	WB	1g	WB	
HAE6012A	406.5000	HAD4009A	165.0125	107.11	Driver	0.18	0.008	0.12	0.009	0.30	0.02	The highest MPE configuration has SAR below 50% of the limit.
	429.9875		165.0125	103.21	Front Side	0.13	0.008	0.13	0.009	0.26	0.02	
	417.5000		165.0125	101.21								
HAE4003A	460.0000	HAD4009A	165.0125	105.01	Driver	0.17	0.010	0.12	0.009	0.29	0.02	The highest MPE configuration has SAR below 50% of the limit.
	450.0000		165.0125	103.53	Front Side	0.14	0.009	0.13	0.009	0.27	0.02	
	470.0000		165.0125	103.51								
HAE4004A	512.0000	HAD4009A	165.0125	101.81	Driver	0.12	0.010	0.12	0.009	0.24	0.02	The highest MPE configuration has SAR below 50% of the limit.
	498.0000		165.0125	101.01	Front Side	0.12	0.010	0.13	0.009	0.25	0.02	
	470.0000		165.0125	100.71								

Note:

Blue – the highest SAR results computed for passenger (Front Seat)

Results of SAR computations for combined exposure

From all simulated results the worst case peak SAR values were identified for both DVR UHF and Companion mobile radio exposure and then combined to produce the composite peak SAR value in corresponding locations of the human body model. Table 4 and Table 5 present the worst case composite peak SAR value.

Table 4: Worst case peak 1-g average SAR for passenger exposure conditions and composite 1-g average SAR from simultaneous exposure.

	Passenger location	DVR UHF [W/kg]	Mobile radio [W/kg]	Total [W/kg]
FCC US	Back Center	0.14	0.80	0.94
	Back Side	0.21	0.81	1.05
	Driver	0.18	0.12	0.30
	Front Side	0.14	0.13	0.27

Table 5: Worst case peak whole body average SAR for passenger exposure conditions and composite whole body average SAR from simultaneous exposure.

	Passenger location	DVR UHF [W/kg]	Mobile radio [W/kg]	Total [W/kg]
FCC US	Back Center	0.013	0.017	0.030
	Back Side	0.013	0.027	0.040
	Driver	0.010	0.009	0.019
	Front Side	0.010	0.009	0.019

From Table 4 and Table 5 the maximum combined peak 1-g SAR is 1.05 W/kg, less than the 1.6 W/kg limit, while the maximum combined whole-body average SAR is 0.04 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 US FCC 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.