MOTOROLA SOLUTIONS

ACCREDITED
TESTING CERT # 2518.01

DECLARATION OF COMPLIANCE: MPE/SAR ASSESSMENT Part 1 of 2

EME Test Laboratory
8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

Date of Report: June 30, 2011
Report Revision: O
Report ID: SR9295_MPE rpt_APX7500_UHF R2_45W & VHF_50W_Mobile_Rev O_06302011

Responsible Engineer:	Stephen C. Whalen (Principal Staff EME Test Engineer)
Report author:	Stephen C. Whalen (Principal Staff EME Test Engineer)
Date(s) Tested:	11/07/2010 – 11/12/2010 & 8/20/09-8/21/09, 5/14/2011 - 5/15/2011, 5/20/2011, 6/13/2011 & 6/14/2011
Manufacturer/Location:	Motorola, Schaumburg, IL
Date submitted for test:	03/01/2011
DUT Description:	APX7500 Dual Band UHF R2 45W (450 - 485MHz), 40W (485-512MHz), 25W (512-520MHz) & VHF 50W (136-174MH)
Test TX mode(s):	CW
Max. Power output:	54W (450-485MHz), 48W (485-512MHz), 30W (512-520MHz) and 60W (136-174MHz)
TX Frequency Bands:	450-520MHz & 136-174MHz
Signaling type:	Analog, APCO 25, and TDMA 1:2 (F2)
Model(s) Tested	M30SSS9PW1AN & M30KSS9PW1AN
Model(s) Certified:	M30TSS9PW1AN (MHUT1010A)
Serial Number(s):	QMKNJ033 & QM0KW063
Classification:	Occupational/Controlled Environment
FCC ID: AZ492FT7047	Part 22 & 90 UHF (450-512MHz) & VHF (150.8-173.4MHz) MPE results outside of Part 90 & 22 are not applicable for FCC compliance demonstration.
IC: 109U-92FT7047	UHF (450-470MHz) & VHF (138-174MHz)

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.

Signature on file
Deanna Zakharia
EME Lab Senior Resource Manager and Laboratory Director

Approval Date: 06/30/2011

Certification Date: 06/30/2011

Certification No.: L1110645P

Document Revision History

Date	Revision	Comments
06/30/2011	O	Initial release

Part 1 of 2: MPE Assessment for 450-520MHz
Part 2 of 2: MPE Assessment for 136-174MHz

Part 1 of 2

Table of Contents

1.0 Introduction

This report details the test setup, test equipment and test results of Maximum Permissible Exposure (MPE) performed at Motorola's outside test site and Specific Absorption Rate (SAR) simulations for product model M30TSS9PW1AN (MHUT1010A).

2.0 Abbreviations / Definitions

APCO: Association of Public-Safety Communications Officials
BS: Bystander
C4FM: Compatible 4-Level Frequency Modulation
CNR: Calibration Not Required
CQPSK: Compatible Quadrature Phase Shift Keying
CW: Continues Wave
DUT: Device Under Test
EME: Electromagnetic Energy
F2: 2 slot Time Division Multiple Access
FM: Frequency Modulation
MPE: Maximum Permissible Exposure
NA: Not Applicable
PB: Passenger Backseat
PF: Passenger Front seat
PTT: Push to Talk
SAR: Specific Absorption Rate
TDMA: Time Division Multiple Access

3.0 Referenced Standards and Guidelines

This product is designed to comply with the following applicable national and international standards and guidelines.

- United States Federal Communications Commission, Code of Federal Regulations; Rule Part 47CFR § 1.1310, § 2.1091 (d) and § 2.1093 for RF Exposure, where applicable.
- Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1999
- American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE) C95. 1-1992. Specific to FCC rules and regulations.
- Institute of Electrical and Electronics Engineers (IEEE) C95.3-2002
- Ministry of Health (Canada) Safety Code 6 (2009), Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz

4.0 Power Density Limits

Table 1 – Occupational / Controlled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65 Supplement C mW/cm^2	IEEE C95.1 1992/1999 mW/cm^2	RSS 102 issue 4 - 2010 W/m^2
30 - 300	1.0		*10.0
10 - 400			
100 - 300		1.0	
300 - 1,500	f/300		f/30
300 - 3,000		f/300	
400 - 2,000			
1,500 - 15,000			50.0
1,500 - 100,000	5.0		
2,000 – 300,000			
3,000 - 300,000		10.0	

*Power density limit is applicable at frequencies greater than 100MHz

Table 2 – General Population / Uncontrolled Exposure Limits

Frequency Range (MHz)	FCC OET Bulletin 65 Supplement C mW/cm^2	IEEE C95.1 1992/1999 mW/cm^2	RSS 102 issue 4 – 2010 W/m^2
30 – 300	0.2		*2.0
10 – 400			
100 – 300		0.2	
100 – 400			
300 – 1,500	f/1,500		f/150
400 – 2,000			
300 – 15,000		f/1,500	
1,500 – 15,000			10.0
1,500 – 100,000	1.0		
2,000 – 100,000			
2,000 – 300,000			

*Power density limit is applicable at frequencies greater than 100MHz

5.0 N_c Test Channels

The number of test channels are determined by using Equation 1 below. This equation is available in FCC's KDB 447498. The test channels are appropriately spaced across the antenna's frequency range.

Equation 1 – Number of test channels
$N_c = \text{Round}\{[100(f_{high} - f_{low})/f_c]^{0.5} \times (f_c / 100)^{0.2}\}$

where N_c is the number of test channels, f_{high} and f_{low} are the highest and lowest frequencies within the transmission band, f_c is the mid-band frequency, and frequencies are in MHz.

6.0 Measurement Equipment

Table 3 - Equipment

Equipment Type	Model #	SN	Calibration Date	Calibration Due Date
Automobile	2003 Ford Crown Victoria, 4-Door	NA	NA	NA
Survey Meter Probe – E-Field	ETS Model HI-2200 ETS Model E100	00086887 00126277	07/15/2010	07/15/2011

E-field measurements are in mW/cm^2.

7.0 Measurement System Uncertainty Levels

Table 4 - Uncertainty Budget for Near Field Probe Measurements

	Tol. (± %)	Prob. Dist.	Divisor	u_i (±%)	v_i
Measurement System					
Probe Calibration	6.0	N	1.00	6.0	∞
Survey Meter Calibration	3.0	N	1.00	3.0	∞
Hemispherical Isotropy	8.0	R	1.73	4.6	∞
Linearity	5.0	R	1.73	2.9	∞
Pulse Response	1.0	R	1.73	0.6	∞
RF Ambient Noise	3.0	R	1.73	1.7	∞
RF Reflections	8.0	R	1.73	4.6	∞
Probe Positioning	10.0	R	1.73	5.8	∞
Test sample Related					
Antenna Positioning	3.0	N	1.00	3.0	∞
Power drift	5.0	R	1.73	2.9	∞
Combined Standard Uncertainty		RSS		12.2	∞
Expanded Uncertainty (95% CONFIDENCE LEVEL)		*k*=2		24	

8.0 Product and System Description

Model M30TSS9PW1AN (MHUT1010A) is a mobile transceiver that utilizes analog, APCO 25 & F2 digital two-way radio communications. The analog modulation scheme uses Frequency Modulation (FM). APCO 25 & F2 digital modes use C4FM of CQPSK family of modulation (Compatible 4-Level Frequency Modulation of Compatible Quadrature Phase Shift Keying). F2 is a TDMA 1:2 protocol that allocates portions of the RF signal by dividing time into two slots (2 slots TDMA). Transmission from a unit or base station is accommodated in time-slot lengths of 30 milliseconds and frame lengths of 60 milliseconds. This product supports voice in analog mode, and both voice and data modes in digital mode.

The maximum duty cycle for TDMA is 1:2 (50%) and is controlled by software. The FM signal is continuous. However, because of hand shaking or Push-To-Talk (PTT) between users and/or base stations a conservative 50% duty cycle is applied. The TDMA mode was not tested because its duty cycle is inherently 50% and would include an additional 50% duty cycle for PTT.

The intended use of the radio is PTT while the device is properly installed in a vehicle with an external antenna mounted at the roof or trunk.

This device will be marketed to and used by employees solely for work-related operations, such as public safety agencies, e.g. police, fire and emergency medical. User training is the responsibility of these agencies which can be expected to employ the usage instructions, safety information and operational cautions set forth in the user's manual, instructional sessions or other means.

Accordingly this product is classified as Occupational/Controlled Exposure. However, in accordance with FCC requirements, the passengers inside the vehicle and the bystanders external to the vehicle are evaluated to the General Population/Uncontrolled Exposure Limits.

(Note that “Bystanders” as used herein are people other than operator)

9.0 Additional Options and Accessories

Refer to Table 5 for complete list of tested antennas.

10.0 Test Set-Up Description

Assessments were performed with mobile radio installed in the test vehicle while engine was at idle, at the specified distances and test locations indicated in sections 11.0, 12.0 and Appendix A.

All antennas described in Table 5 were considered in order to develop the test plan for this product. Antennas were installed and tested per their appropriate mount locations (Roof / Trunk) and defined test channels.

11.0 Method of Measurement with trunk mounted antenna(s)

11.1 External/Bystander vehicle MPE measurements

Antenna is located at the center of the trunk. Refer to Appendix A for antenna location and distance.

MPE measurements for bystander (BS) conditions are determined by taking the average of (10) measurements in a 2 m vertical line for each of the (3) bystander test locations indicated in Appendix A with 20 cm height increments, with antenna to probe sensor separation distances of 90 cm directly behind vehicle (450-512MHz) and 62cm directly behind the vehicle (512-520MHz), 104 cm (45 degree radial) and 110.5 cm (90 degree radial). The separation distance used for testing is defined from the antenna where as the RF safety booklet defines the same distance from the vehicle body to ensure that the assessment is applicable to other vehicles The measurement probe is positioned orthogonal to antenna (typically parallel to ground with a vertically mounted antenna) and aimed directly at the antenna's axis. These measurements are representative of persons other than the operator standing next to the vehicle.

Each of the offered antennas mounted at the center of the trunk were assessed at the rear of the vehicle while maintaining a minimum of twenty (20) centimeter separation distance between the probe sensor and vehicle body. The worst case antenna was then tested at a 45º radial at the corner of the trunk, and 90º radial at the side of the trunk.

Note: The distance from the centered trunk-mounted antenna to the rear edge of the vehicle is 42cm and the distance from the rear edge of the vehicle to the survey probe sensor is 48cm. The 62cm includes the same 42cm to the rear edge of the vehicle but only 20cm to the survey probe sensor.

11.2 Internal/Passenger vehicle MPE measurements

Antenna is located toward the center of the trunk at a minimum 85cm from backseat passenger. Users are instructed, per installation manual, to mount antennas on the roof only if a minimum 85cm cannot be achieved. Refer to Appendix A for antenna location and distance.

MPE measurements for passenger front seat (PF) and backseat (PB) conditions are determined by taking the average of the (3) measurements (Head, Chest, and Lower Trunk) inside the vehicle for both the front and back seats.

The backseat is a bench seat and therefore each position (Head, Chest & Lower Trunk) were scanned across (horizontally) the seat starting from the middle of the seat to the edge of the seat stopping 20 cm from the vehicle door. Similar process was used in the front bucket seat.

The probe handle is oriented parallel (horizontal) to the ground and pointed towards the back of the vehicle. The probe handle is not oriented normal to the seat surface. The probe head (incorporating the field sensors) is scanned continuously (using the max-hold function available in the meter) along three test axes which are parallel to the seat angle (intended as the line determined by the intersection of the plane of the seat and the plane of the backrest) and are 20 cm from the seat surface. One test axis is at the Head height, another is at the Chest height, and another is at the Lower Trunk height. The maximum field level value recorded for each test axis is logged. The MPE is determined by averaging these three maximum values regardless of the geometrical location where they were observed. For instance, the locations of the three maxima may lie on different vertical (relative to ground) lines.

This approach leads to results that are representative of the exposure of vehicle occupants since it is based on an average across the body portions closest to the antenna for both trunk and roof mount positions, and is conservatively biased because the highest results for each test axis are combined, e.g. the highest head exposure could be in the middle of the seat while the highest lower trunk exposure could be closer to the door.

12.0 Method of Measurement with roof mounted antenna(s)

12.1 External/Bystander vehicle MPE measurements

Antenna is located at the center of the roof. Refer to Appendix A for antenna location and distance.

MPE measurements for bystander (BS) conditions are determined by taking the average of (10) measurements in a 2m vertical line for the test location indicated in Appendix A with 20cm increments at the test distance of 117cm from the antenna under test. The measurement probe is positioned orthogonal to antenna (typically parallel to ground with a vertically mounted antenna) and aimed directly at the antenna’s axis. These measurements are representative of persons other than the operator standing next to the vehicle.

Note: Actual test distance was approximately 117cm from centered roof-mounted antenna to the probe element (97cm from antenna to edge of car door and 20cm from the edge of the car door to the survey probe sensor); this is the closest distance that can be achieved to a centered roof-mounted antenna used for MPE compliance assessment herein.

12.2 Internal/Passenger vehicle MPE measurements

Antenna is located at the center of the roof. Refer to Appendix A for antenna location and distance.

MPE measurements for passenger front seat (PF) and backseat (PB) conditions are determined by taking the average of the (3) measurements (Head, Chest, and Lower Trunk) inside the vehicle for both the front and back seats.

The backseat is a bench seat and therefore each position (Head, Chest & Lower Trunk) were scanned across (horizontally) the seat starting from the middle of the seat to the edge of the seat stopping 20 cm from the vehicle door. Similar process was used in the front bucket seat.

The probe handle is oriented parallel (horizontal) to the ground and pointed towards the back of the vehicle. The probe handle is not oriented normal to the seat surface. The probe head (incorporating the field sensors) is scanned continuously (using the max-hold function available in the meter) along three test axes which are parallel to the seat angle (intended as the line determined by the intersection of the plane of the seat and the plane of the backrest) and are 20 cm from the seat surface. One test axis is at the Head height, another is at the Chest height, and another is at the Lower Trunk height. The maximum field level value recorded for each test axis is logged. The MPE is determined by averaging these three maximum values regardless of the geometrical location where they were observed. For instance, the locations of the three maxima may lie on different vertical (relative to ground) lines.

This approach leads to results that are representative of the exposure of vehicle occupants since it is based on an average across the body portions closest to the antenna for both trunk and roof mount positions, and is conservatively biased because the highest results for each test axis are combined, e.g. the highest head exposure could be in the middle of the seat while the highest lower trunk exposure could be closer to the door.

13.0 MPE Calculations

The final MPE results for this mobile radio are presented in section 15.0 Tables 6 - 9. These results are based on 50% duty cycle for PTT.

Below is an explanation of how the MPE results are calculated. Refer to Appendix D for MPE measurement results and calculations.

External to vehicle (Bystander) - 10 measurements are averaged over the body (*Avg_over_body*).
Internal to vehicle (Passengers) - 3 measurements are averaged over the body (*Avg_over_body*).

The Average over Body test methodology is consistent with IEEE/ANSI C95.3-2002 guidelines.

Therefore;

Equation 2 – Power Density Calculation *(Calc._P.D.)*

$$Calc.\_P.D. = (Avg\_over\_body) * (probe\_frequency\_cal\_factor) * (duty\_cycle)$$

Note1: The highest "average" cal factors from the calibration certificates were selected for the applicable frequency range. Linear interpretation was used to determine "probe_frequency_cal_factor" for the specific test frequencies.

Note 2: The E-field probe calibration certificate's frequency cal factors were determined by measuring V/m. The survey meter's results were measured in power density (mW/cm^2) and therefore the "probe_frequency_cal_factor" was squared in equation 2 to account for these results.

Note 3: The H-field probe calibration certificate's frequency cal factors were determined by measuring A/m. The survey meter's results were measured in A/m and therefore the "Avg_over_body" A/m results were converted to power density (mW/cm^2) using the equation 3. H-field measurements are only applicable to frequencies below 300MHz.

Equation 3 – Converting A/m to mW/cm^2

$$mW / cm\hat{}2 = (A / m)\hat{}2 * 37.699$$

Equation 4 – Power Density Maximum Calculation

$$Max\_Calc.\_P.D. = P.D.\_calc * \frac{\max\_output\_power}{initial\_output\_power}$$

Note 4: For initial output power> max_output_power; max_output_power / initial output power = 1

14.0 Antenna Summary

Table 5 below summarizes the tested antennas, mount location (roof/trunk), overlap of FCC bands and the number of test channels per FCC KDB 447498. This information was used to determine the test configurations presented in this report.

Table 5

#	Antenna Model	Frequency Range (MHz)	Physical Length (cm)	Gain (dBi)	Remarks	Mount Location (Roof/Trunk)	Overlap FCC Bands	N_c Test Channels (KDB447498)
1	HAE4003A	450-470	16.0	2.15	1/4 wave, wire	R/T	450-470	3
2	HAE4004A	470-512	15.0	2.15	1/4 wave, wire	R/T	470-512	4
3	HAE6016A	450 - 512	8.3	2.15	1/4 wave, cylinder	R/T	450-512	5
4	HAE4011A	450-470	73.2	5.65	1/2 wave, trap-loaded	R/T	450-470	3
5	HAE4012A	470-495	68.5	5.65	1/2 wave, trap-loaded	R/T	470-495	3
6	HAE4013A	494-512	64.2	5.65	1/2 wave, trap-loaded	R/T	494-512	3
7	*RAE4014ARB	445 - 470	92.7 90.5 89.0	7.15	5/8 wave, trap-loaded	R/T	450-470	3
8	*RAE4015ARM	470 - 494	89.0 86.3 85.0	7.15	5/8 wave, trap-loaded	R/T	450-494	3
9	*RAE4016ARB	494 - 512	85.7 83.6 83.3	7.15	5/8 wave, trap-loaded	R/T	494-512	3
10	HAE6015A	450 - 520	26.2	4.15	1/2 wave, wire	R/T	450-512	5
11	HAE6031A	380 - 520	28.0	4.15	1/2 wave, wire	R/T	450-512	5

* Antennas trimmed per test frequency.

15.0 Test Results Summary

The following tables below summarize the MPE results for each test configuration: antenna location, test positions (BS-Bystander, PB-Passenger Backseat, PF-Passenger Front seat), E/H field measurements, angle, antenna model & freq. range, maximum output power, initial power, TX frequency, max calculated power density results, applicable FCC/IEEE specification limits and % of the applicable specification limits.

Table 6

Bystander MPE assessment to General Pop. / Uncontrolled Exposure Limits for trunk mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Trunk	BS	E	0	HAE4003A, 450-470MHz	54	53.8	450.0125	0.13	0.30	43
					54	53.8	460	0.14	0.31	46
					54	53.7	469.9875	0.13	0.31	40
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.13	0.31	42
					54	53.7	482.5	0.10	0.32	33
					48	46.9	498	0.10	0.33	29
					48	47.3	511.9875	0.13	0.34	39
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.11	0.30	37
					54	53.7	465.5	0.14	0.31	45
					54	53.7	482.5	0.11	0.32	34
					48	46.9	496.5	0.10	0.33	29
					48	47.3	511.9875	0.14	0.34	41
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.10	0.30	32
					54	53.8	460	0.08	0.31	27
					54	53.7	469.9875	0.06	0.31	19
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.09	0.31	29
					54	53.7	482.5	0.08	0.32	26
					48	47.2	494.9875	0.06	0.33	18
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.08	0.33	24
					48	47	503	0.09	0.34	27
					48	47.3	511.9875	0.10	0.34	28
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.08	0.30	26
					54	53.8	460	0.08	0.31	27
					54	53.7	469.9875	0.09	0.31	27
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.07	0.31	23
					54	53.7	482.5	0.07	0.32	23
					48	47.1	493.9875	0.07	0.33	21
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.07	0.33	20
					48	47	503	0.07	0.34	22
					48	47.3	511.9875	0.08	0.34	24
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.14	0.30	45
					54	53.7	465.5	0.15	0.31	47
					54	53.7	482.5	0.11	0.32	33
					48	46.9	496.5	0.10	0.33	31
					48	47.3	511.9875	0.15	0.34	45
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.13	0.30	44
					54	53.7	465.5	0.14	0.31	46
					54	53.7	482.5	0.10	0.32	31
					48	46.9	496.5	0.10	0.33	29
					48	47.3	511.9875	0.15	0.34	43
			45	HAE6015A, 450 - 520MHz	54	53.7	465.5	0.11	0.31	36
			90	HAE6015A, 450 - 520MHz	54	53.7	465.5	0.09	0.31	28

Table 6 (continued)

Bystander MPE assessment to General Pop. / Uncontrolled Exposure Limits for trunk mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Trunk	BS	E	0	HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.14	0.34	40
					30	29.3	516.0125	0.13	0.34	38
					30	29.2	519.9875	0.12	0.35	35
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.13	0.34	38
					30	29.3	516.0125	0.12	0.34	35
					30	29.2	519.9875	0.11	0.35	32
			45	HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.05	0.34	14
			90	HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.05	0.34	14

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

Table 7

Passenger MPE assessment to General Pop. / Uncontrolled Exposure Limits for trunk mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Trunk	PB	E	NA	HAE4003A, 450-470MHz	54	53.8	450.0125	0.37	0.30	124*
					54	53.8	460	0.34	0.31	111*
					54	53.7	469.9875	0.20	0.31	64
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.21	0.31	66
					54	53.7	482.5	0.23	0.32	72
					48	46.9	498	0.26	0.33	79
					48	47.3	511.9875	0.24	0.34	70
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.28	0.30	92
					54	53.7	465.5	0.23	0.31	74
					54	53.7	482.5	0.20	0.32	62
					48	46.9	496.5	0.23	0.33	69
					48	47.3	511.9875	0.26	0.34	77
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.19	0.30	65
					54	53.8	460	0.13	0.31	42
					54	53.7	469.9875	0.10	0.31	33
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.14	0.31	45
					54	53.7	482.5	0.14	0.32	43
					48	47.2	494.9875	0.13	0.33	40
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.22	0.33	66
					48	47	503	0.23	0.34	67
					48	47.3	511.9875	0.17	0.34	50
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.06	0.30	21
					54	53.8	460	0.07	0.31	23
					54	53.7	469.9875	0.06	0.31	18
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.02	0.31	6
					54	53.7	482.5	0.06	0.32	19
					48	47.1	493.9875	0.08	0.33	24
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.05	0.33	16
					48	47	503	0.09	0.34	26
					48	47.3	511.9875	0.08	0.34	22
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.35	0.30	115*
					54	53.7	465.5	0.26	0.31	83
					54	53.7	482.5	0.24	0.32	73
					48	46.9	496.5	0.27	0.33	83
					48	47.3	511.9875	0.28	0.34	83
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.33	0.30	111*
					54	53.7	465.5	0.25	0.31	80
					54	53.7	482.5	0.23	0.32	71
					48	46.9	496.5	0.27	0.33	83
					48	47.3	511.9875	0.31	0.34	91
				HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.19	0.34	56
					30	29.3	516.0125	0.20	0.34	57
					30	29.2	519.9875	0.20	0.35	58
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.20	0.34	57
					30	29.3	516.0125	0.19	0.34	55
					30	29.2	519.9875	0.18	0.35	51

* Test configuration exceeds MPE FCC spec limit.

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

Table 7 (continued)

Passenger MPE assessment to General Pop. / Uncontrolled Exposure Limits for trunk mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Trunk	PF	E	NA	HAE4003A, 450-470MHz	54	53.8	450.0125	0.11	0.30	38
					54	53.8	460	0.10	0.31	34
					54	53.7	469.9875	0.09	0.31	28
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.09	0.31	28
					54	53.7	482.5	0.12	0.32	38
					48	46.9	498	0.13	0.33	40
					48	47.3	511.9875	0.12	0.34	36
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.07	0.30	23
					54	53.7	465.5	0.09	0.31	28
					54	53.7	482.5	0.11	0.32	34
					48	46.9	496.5	0.09	0.33	28
					48	47.3	511.9875	0.11	0.34	33
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.07	0.30	24
					54	53.8	460	0.06	0.31	18
					54	53.7	469.9875	0.03	0.31	11
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.05	0.31	15
					54	53.7	482.5	0.06	0.32	19
					48	47.2	494.9875	0.05	0.33	16
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.08	0.33	25
					48	47	503	0.09	0.34	27
					48	47.3	511.9875	0.06	0.34	19
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.02	0.30	7
					54	53.8	460	0.03	0.31	9
					54	53.7	469.9875	0.02	0.31	5
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.01	0.31	3
					54	53.7	482.5	0.02	0.32	7
					48	47.1	493.9875	0.02	0.33	7
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.02	0.33	6
					48	47	503	0.04	0.34	11
					48	47.3	511.9875	0.03	0.34	8
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.07	0.30	25
					54	53.7	465.5	0.09	0.31	29
					54	53.7	482.5	0.11	0.32	33
					48	46.9	496.5	0.14	0.33	41
					48	47.3	511.9875	0.16	0.34	46
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.07	0.30	25
					54	53.7	465.5	0.08	0.31	26
					54	53.7	482.5	0.10	0.32	31
					48	46.9	496.5	0.11	0.33	32
					48	47.3	511.9875	0.15	0.34	43
				HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.10	0.34	29
					30	29.3	516.0125	0.09	0.34	27
					30	29.2	519.9875	0.09	0.35	26
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.09	0.34	25
					30	29.3	516.0125	0.09	0.34	25
					30	29.2	519.9875	0.08	0.35	22

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

Table 8

Bystander MPE assessment to General Pop. / Uncontrolled Exposure Limits for roof mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Roof	BS	E	NA	HAE4003A, 450-470MHz	54	53.8	450.0125	0.06	0.30	20
					54	53.8	460	0.06	0.31	20
					54	53.7	469.9875	0.06	0.31	20
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.07	0.31	21
					54	53.7	482.5	0.07	0.32	22
					48	46.9	498	0.06	0.33	19
					48	47.3	511.9875	0.06	0.34	17
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.05	0.30	17
					54	53.7	465.5	0.06	0.31	19
					54	53.7	482.5	0.07	0.32	21
					48	46.9	496.5	0.06	0.33	18
					48	47.3	511.9875	0.06	0.34	17
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.05	0.30	18
					54	53.8	460	0.05	0.31	16
					54	53.7	469.9875	0.04	0.31	12
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.05	0.31	18
					54	53.7	482.5	0.05	0.32	17
					48	47.2	494.9875	0.04	0.33	12
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.06	0.33	17
					48	47	503	0.05	0.34	16
					48	47.3	511.9875	0.04	0.34	13
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.04	0.30	13
					54	53.8	460	0.04	0.31	13
					54	53.7	469.9875	0.04	0.31	14
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.03	0.31	11
					54	53.7	482.5	0.04	0.32	13
					48	47.1	493.9875	0.04	0.33	11
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.04	0.33	11
					48	47	503	0.04	0.34	11
					48	47.3	511.9875	0.03	0.34	10
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.07	0.30	22
					54	53.7	465.5	0.07	0.31	22
					54	53.7	482.5	0.07	0.32	22
					48	46.9	496.5	0.07	0.33	21
					48	47.3	511.9875	0.07	0.34	20
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.07	0.30	22
					54	53.7	465.5	0.07	0.31	21
					54	53.7	482.5	0.07	0.32	22
					48	46.9	496.5	0.07	0.33	20
					48	47.3	511.9875	0.07	0.34	19
				HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.04	0.34	12
					30	29.3	516.0125	0.04	0.34	12
					30	29.2	519.9875	0.04	0.35	12
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.04	0.34	12
					30	29.3	516.0125	0.04	0.34	11
					30	29.2	519.9875	0.04	0.35	11

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

Table 9

Passenger MPE assessment to General Pop. / Uncontrolled Exposure Limits for roof mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Roof	PB	E	NA	HAE4003A, 450-470MHz	54	53.8	450.0125	0.03	0.30	10
					54	53.8	460	0.03	0.31	10
					54	53.7	469.9875	0.03	0.31	9
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.03	0.31	10
					54	53.7	482.5	0.03	0.32	11
					48	46.9	498	0.05	0.33	16
					48	47.3	511.9875	0.03	0.34	8
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.03	0.30	9
					54	53.7	465.5	0.02	0.31	8
					54	53.7	482.5	0.04	0.32	11
					48	46.9	496.5	0.06	0.33	18
					48	47.3	511.9875	0.02	0.34	7
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.00	0.30	1
					54	53.8	460	0.01	0.31	2
					54	53.7	469.9875	0.01	0.31	2
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.01	0.31	4
					54	53.7	482.5	0.01	0.32	4
					48	47.2	494.9875	0.02	0.33	7
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.03	0.33	10
					48	47	503	0.03	0.34	8
					48	47.3	511.9875	0.01	0.34	3
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.00	0.30	1
					54	53.8	460	0.01	0.31	2
					54	53.7	469.9875	0.01	0.31	2
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.00	0.31	0
					54	53.7	482.5	0.00	0.32	1
					48	47.1	493.9875	0.01	0.33	3
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.00	0.33	1
					48	47	503	0.00	0.34	1
					48	47.3	511.9875	0.00	0.34	1
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.06	0.30	19
					54	53.7	465.5	0.03	0.31	8
					54	53.7	482.5	0.06	0.32	19
					48	46.9	496.5	0.05	0.33	16
					48	47.3	511.9875	0.03	0.34	10
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.06	0.30	20
					54	53.7	465.5	0.03	0.31	8
					54	53.7	482.5	0.06	0.32	18
					48	46.9	496.5	0.05	0.33	16
					48	47.3	511.9875	0.03	0.34	10
				HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.02	0.34	6
					30	29.3	516.0125	0.02	0.34	6
					30	29.2	519.9875	0.02	0.35	5
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.02	0.34	6
					30	29.3	516.0125	0.02	0.34	6
					30	29.2	519.9875	0.02	0.35	6

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

Table 9 (continued)

Passenger MPE assessment to General Pop. / Uncontrolled Exposure Limits for roof mounted antennas

Trunk/ Roof	Test Position	E/H Field	Angle (Degree)	Antenna Model	Max Pwr (W)	Initial Pwr (W)	Tx Freq (MHz)	Max Calc. P.D. (mW/ cm^2)	FCC Limit	% To Spec Limit
Roof	PF	E	NA	HAE4003A, 450-470MHz	54	53.8	450.0125	0.02	0.30	6
					54	53.8	460	0.02	0.31	7
					54	53.7	469.9875	0.02	0.31	5
				HAE4004A, 470-512MHz	54	53.7	470.0125	0.02	0.31	5
					54	53.7	482.5	0.01	0.32	4
					48	46.9	498	0.02	0.33	5
					48	47.3	511.9875	0.02	0.34	5
				HAE6016A, 450 - 512MHz	54	53.8	450.0125	0.02	0.30	6
					54	53.7	465.5	0.02	0.31	8
					54	53.7	482.5	0.01	0.32	4
					48	46.9	496.5	0.01	0.33	4
					48	47.3	511.9875	0.02	0.34	5
				HAE4011A, 450-470MHz	54	53.8	450.0125	0.00	0.30	1
					54	53.8	460	0.00	0.31	1
					54	53.7	469.9875	0.00	0.31	1
				HAE4012A, 470-495MHz	54	53.7	470.0125	0.01	0.31	2
					54	53.7	482.5	0.00	0.32	1
					48	47.2	494.9875	0.00	0.33	0
				HAE4013A, 494-512MHz	48	47.2	494.9875	0.01	0.33	2
					48	47	503	0.00	0.34	1
					48	47.3	511.9875	0.00	0.34	0
				RAE4014ARB, 445 - 470MHz	54	53.8	450.0125	0.00	0.30	0
					54	53.8	460	0.00	0.31	1
					54	53.7	469.9875	0.00	0.31	1
				RAE4015ARM, 470 - 494MHz	54	53.7	470.0125	0.00	0.31	0
					54	53.7	482.5	0.00	0.32	0
					48	47.1	493.9875	0.00	0.33	0
				RAE4016ARB, 494 - 512MHz	48	47.2	494.9875	0.00	0.33	0
					48	47	503	0.00	0.34	0
					48	47.3	511.9875	0.00	0.34	0
				HAE6015A, 450 - 520MHz	54	53.8	450.0125	0.02	0.30	7
					54	53.7	465.5	0.02	0.31	7
					54	53.7	482.5	0.02	0.32	5
					48	46.9	496.5	0.02	0.33	5
					48	47.3	511.9875	0.02	0.34	5
				HAE6031A, 380 - 520MHz	54	53.8	450.0125	0.02	0.30	7
					54	53.7	465.5	0.02	0.31	8
					54	53.7	482.5	0.01	0.32	4
					48	46.9	496.5	0.02	0.33	5
					48	47.3	511.9875	0.02	0.34	5
				HAE6015A, 450 - 520MHz	30	29.2	512.0125	0.01	0.34	3
					30	29.3	516.0125	0.01	0.34	3
					30	29.2	519.9875	0.01	0.35	3
				HAE6031A, 380 - 520MHz	30	29.2	512.0125	0.01	0.34	3
					30	29.3	516.0125	0.01	0.34	3
					30	29.2	519.9875	0.01	0.35	2

Note that the test frequencies that are outside the relevant FCC frequency allocations are presented in blue font.

16.0 Conclusion

The assessments for this device were performed with an output power range as indicated in section 15.0 Tables 6 - 9. The maximum allowable output power is equal to the upper limit of the final test factory transmit power specification of 54W (450 - 485MHz), 48W (485-512MHz) and 30W (512-520MHz). The highest power density results for the mobile device scaled to the maximum allowable power output are indicated in the Tables 10 and 11 for internal/passenger to the vehicle, and external/bystander to the vehicle.

Table 10: RF Exposure Results for FCC Part 90 (450-512MHz)

	UHF R2 Band
Passenger - Max Calculated Power Density	*0.37mW/cm²
Bystander - Max Calculated Power Density	0.15mW/cm²

Table 11: RF Exposure Results (450-520MHz)

	UHF R2 Band
Passenger - Max Calculated Power Density	*0.37mW/cm²
Bystander - Max Calculated Power Density	0.15mW/cm²

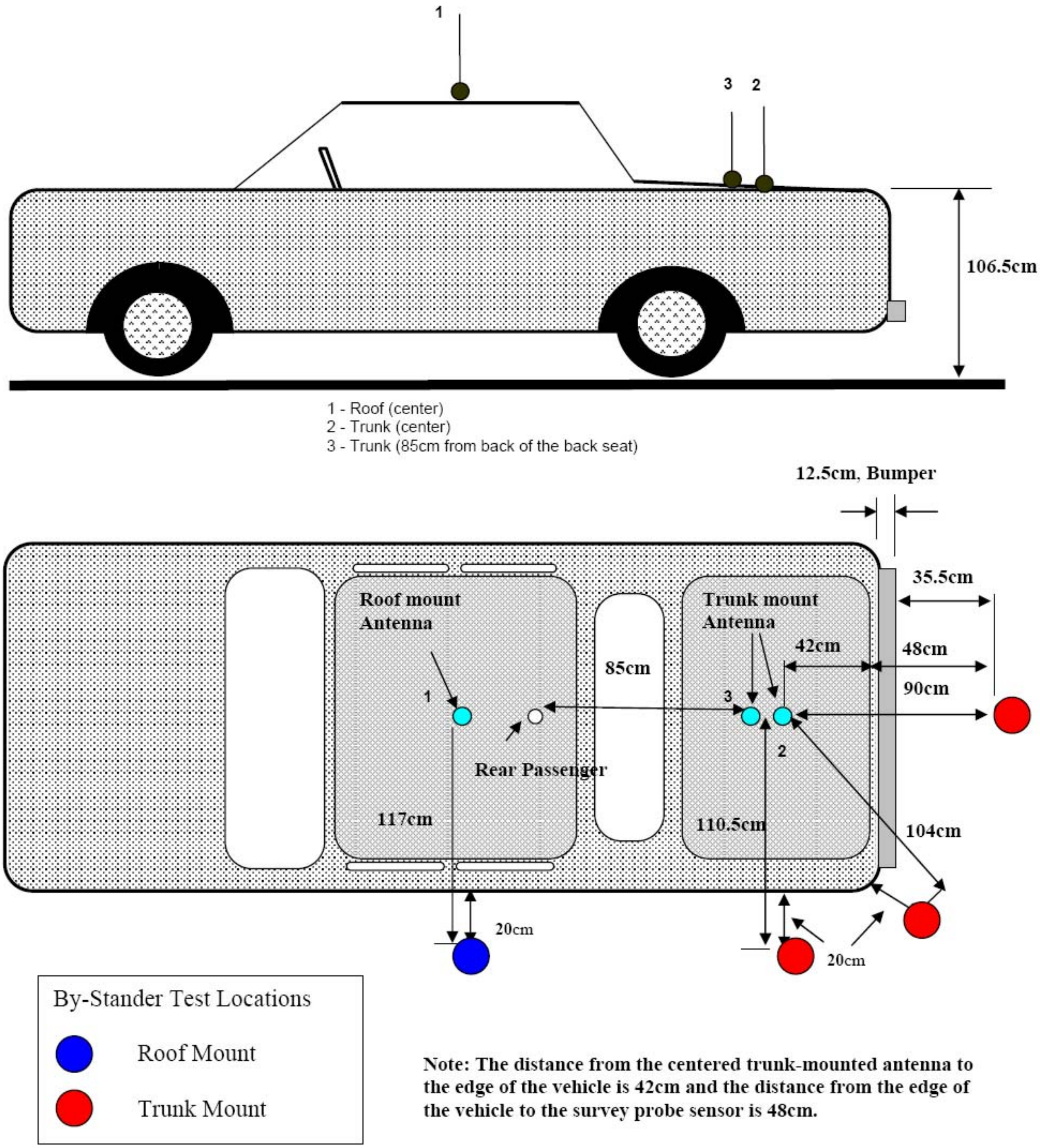
These MPE results herein demonstrate compliance to the FCC/IEEE Occupational/Controlled Exposure limit. FCC rules require compliance for Passengers and Bystanders to the FCC General Population/Uncontrolled limits. Although MPE is a convenient method of demonstrating compliance, SAR is recognized as the "basic restriction". For those configurations exceeding the MPE limit noted * in section 15 Tables 6 thru 9, compliance to the FCC SAR General Population/ Uncontrolled limit of 1.6mW/g is demonstrated in Appendix E via SAR computational analysis.

The computational results show that this device, when used with the offered antennas in accordance with the user manual instructions, exhibits the maximum peak 1-g average SAR values as indicated in the table below.

Maximum peak 1g average SAR	
RF Exposure Results for FCC Part 90 (450-512MHz)	0.41mW/g

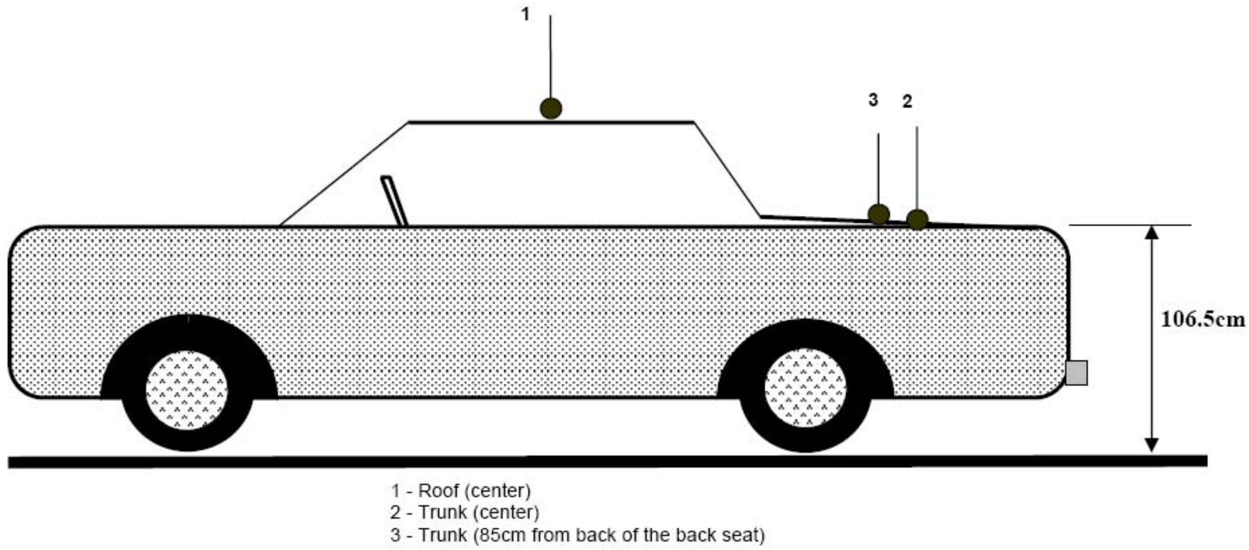
Appendix A - Illustration of Antenna Locations and Test Distances

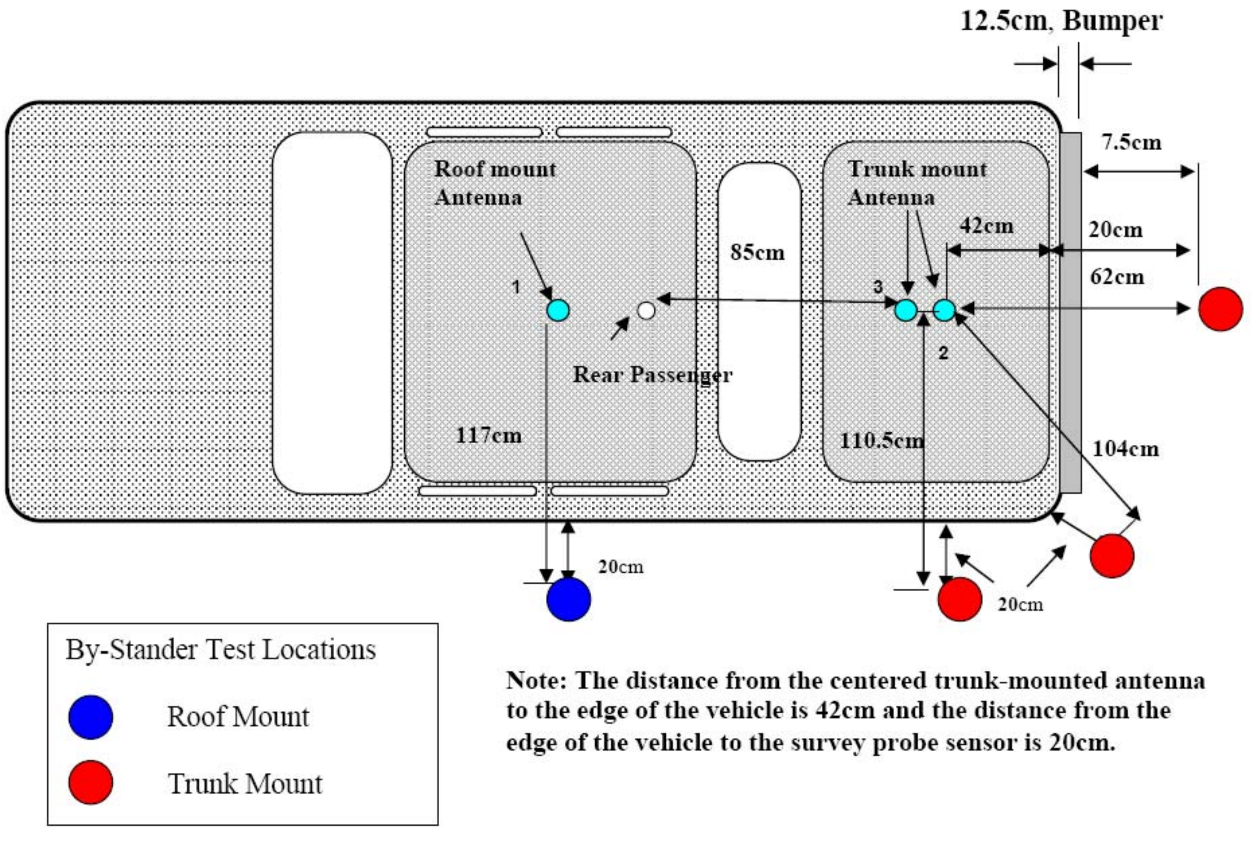
90cm Trunk Distance



Note: The distance from the centered trunk-mounted antenna to the edge of the vehicle is 42cm and the distance from the edge of the vehicle to the survey probe sensor is 48cm.

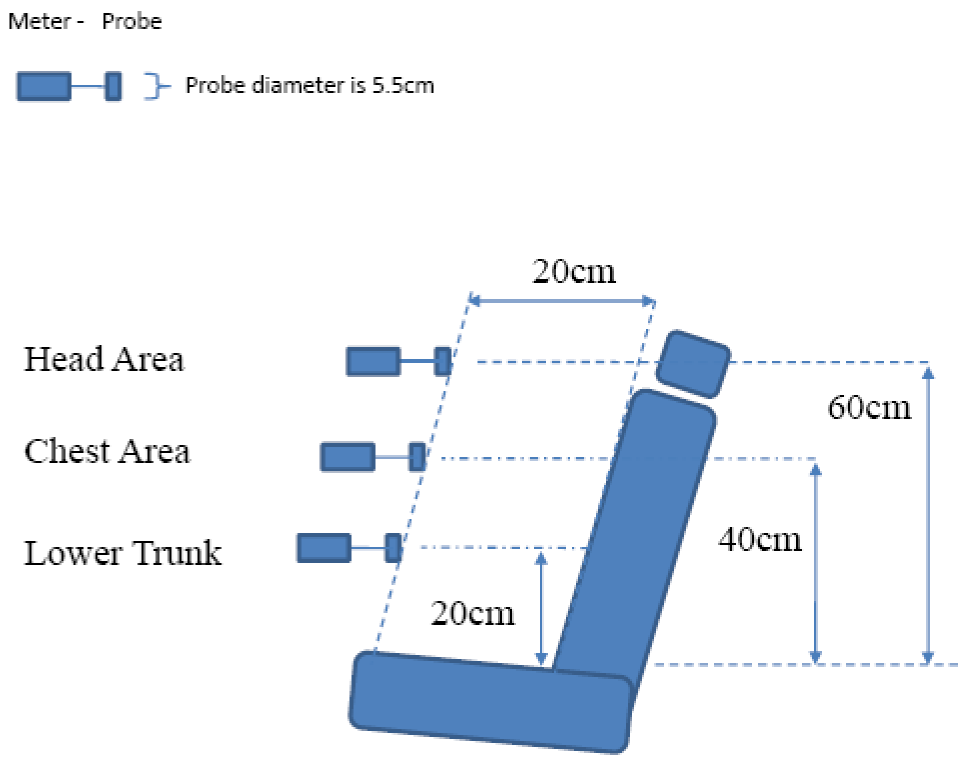
62cm Trunk Distance





Note: The distance from the centered trunk-mounted antenna to the edge of the vehicle is 42cm and the distance from the edge of the vehicle to the survey probe sensor is 20cm.

Seat scan areas
(Applicable to both front and back seats)



Appendix B - Probe Calibration Certificates

ACCREDITED
Lab ID:1207.01-Calibration

Cert I.D.: 79630

ETS·LINDGREN
An ESCO Technologies Company
1301 Arrow Point Drive
Cedar Park, Texas 78613
(512) 531-6498

ETS·LINDGREN
An ESCO Technologies Company
Track# S000019628 Ltd Cal ☐
By AS Date 15-Jul-10
Next Cal Due
www.ets-lindgren.com

Certificate of Calibration Conformance

Page 1 of 4

CALIBRATION
BY AS DATE 7-15-10
DUE 7-15-11 ID S19628

The instrument identifed below has been individually calibrated in compliance with the following standard(s):

IEEE 1309 - 2005, Institute of Electrical and Electronics Engineers, Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas from 9 kHz to 40 GHz

Environment: Laboratory MTE is maintained in a temperature controlled environment with ambient conditions from 18 to 28 C, relative humidity less than 90%. The instrument under test has been calibrated in a suitable environment using an EMCO TEM Cell 5101C, GTEM! 5305 and an RF Shielded EMC Chamber which is conducive to maintaining accurate and reliable measurement quality.

Manufacturer:	ETS-Lindgren	**Operating Range:**	100kHz - 5GHz
Model Number:	E100	**Instrument Type:**	Isotropic Probe > 1 GHz
Serial Number/ ID:	*00126277*	**Date Code:**	
Tracking Number:	**S000019628**	**Alternate ID:**	
Date Completed:	15-Jul-10	**Customer:**	AGILENT/MOTOROLA (FL)
Test Type:	Standard Field, Field Strength		

Calibration Uncertainty: Std Field Method 10kHz - 18000 MHz, +/-0.7 dB, 26.5GHz - 40GHz,+/- 0.95 dB
k=2, (95% Confidence Level)

Test Remarks: Replaced broken probe head sn 00083370 with sn 00126277. Provided customer specified frequencies.

Calibration Traceability: All Measuring and Test Equipment (M/TE) identified below are traceable to the National Institute for Standards and Technology (NIST). Calibration Laboratory and Quality System controls are compliant with ISO/IEC 17025-2005.

Standards and Equipment Used:
Make / Model / Name / S/N / Recall Date

Hewlett Packard	437B	HP Power Meter	3125U12370	15-Jun-11
Fluke	6060B	RF Signal Generator	5690204	15-Jun-11
Marconi	2022	Signal Generator	119019/077	25-Sep-10
Agilent	E4419B	Power Meter	MY45104171	16-Jun-11
Rohde & Schwarz	857.8008.02	Power Meter NRVD	100451	11-Mar-11
Hewlett Packard	83620B	Signal Generator	3722A00541	25-Sep-10

Condition of Instrument Upon Receipt:
INOP

On Release:
In Tolerance to Internal Quality Standards

Calibration Completed By
Alan Schifferdecker, Calibration Technician

Attested and Issued on 15-Jul-10
Richard Goodlow, Calibration Supervisor

ETS·LINDGREN™

Frequency Response Calibration Factors
Model E100 Serial Number 00126277
Date of Calibration 14 Jul 2010

Frequency (MHz)	Applied V/m	Probe Reading X	Probe Reading Y	Probe Reading Z	Correction Factor X	Correction Factor Y	Correction Factor Z	Correction Factor Avg
1.00	7.99	6.73	6.65	6.64	1.19	1.20	1.20	1.20
1.00	19.86	16.88	16.46	16.75	1.18	1.21	1.19	1.19
1.00	69.83	58.57	57.16	57.94	1.19	1.22	1.21	1.21
1.00	124.10	104.33	101.84	103.29	1.19	1.22	1.20	1.20
15.00	7.98	7.87	7.89	7.76	1.01	1.01	1.03	1.02
15.00	20.02	19.90	19.66	19.57	1.01	1.02	1.02	1.02
15.00	69.73	68.75	68.03	67.93	1.01	1.02	1.03	1.02
15.00	125.10	123.58	122.44	121.98	1.01	1.02	1.03	1.02
30.00	7.98	8.00	8.02	7.92	1.00	0.99	1.01	1.00
30.00	20.13	20.26	20.02	19.95	0.99	1.01	1.01	1.00
30.00	70.33	69.96	69.20	69.16	1.01	1.02	1.02	1.01
30.00	125.54	125.61	124.27	124.22	1.00	1.01	1.01	1.01
75.00	8.00	8.02	8.09	7.92	1.00	0.99	1.01	1.00
75.00	19.99	20.13	19.98	19.76	0.99	1.00	1.01	1.00
75.00	70.36	69.86	69.30	68.86	1.01	1.02	1.02	1.01
75.00	125.15	125.40	124.63	123.68	1.00	1.00	1.01	1.00
100.00	7.96	7.97	8.01	7.88	1.00	0.99	1.01	1.00
100.00	19.88	19.91	19.74	19.61	1.00	1.01	1.01	1.01
100.00	69.57	69.51	68.99	68.72	1.00	1.01	1.01	1.01
100.00	124.96	124.36	123.49	122.96	1.00	1.01	1.02	1.01
150.00	8.01	8.06	8.15	7.96	0.99	0.98	1.01	0.99
150.00	19.95	20.28	20.15	19.91	0.98	0.99	1.00	0.99
150.00	69.89	69.62	69.33	68.78	1.00	1.01	1.02	1.01
150.00	124.33	125.18	124.63	123.79	0.99	1.00	1.00	1.00
200.00	8.00	8.45	8.63	8.33	0.95	0.93	0.96	0.95
200.00	20.01	21.13	21.27	20.72	0.95	0.94	0.97	0.95
200.00	69.87	73.33	73.78	72.18	0.95	0.95	0.97	0.96
200.00	124.17	129.74	130.72	127.78	0.96	0.95	0.97	0.96
250.00	8.01	8.19	8.12	8.13	0.98	0.99	0.99	0.98
250.00	20.01	20.51	20.01	20.27	0.98	1.00	0.99	0.99
250.00	69.83	71.26	69.62	70.60	0.98	1.00	0.99	0.99
250.00	125.43	127.92	125.29	127.07	0.98	1.00	0.99	0.99
300.00	8.01	8.15	8.10	8.06	0.98	0.99	0.99	0.99
300.00	19.94	20.39	20.06	20.16	0.98	0.99	0.99	0.99
300.00	69.60	70.46	69.32	69.88	0.99	1.00	1.00	1.00
300.00	125.08	126.92	124.75	125.61	0.99	1.00	1.00	0.99
400.00	8.02	8.14	8.13	8.06	0.98	0.99	0.99	0.99
400.00	19.87	20.24	19.93	19.94	0.98	1.00	1.00	0.99
400.00	69.66	70.49	69.46	69.77	0.99	1.00	1.00	1.00
400.00	124.99	127.20	125.29	125.73	0.98	1.00	0.99	0.99
500.00	8.04	8.01	8.13	7.92	1.00	0.99	1.02	1.00
500.00	19.98	19.97	19.95	19.63	1.00	1.00	1.02	1.01
500.00	70.28	69.96	69.96	69.11	1.00	1.00	1.02	1.01
500.00	124.86	124.41	124.25	122.86	1.00	1.00	1.02	1.01
600.00	8.00	7.72	7.73	7.65	1.04	1.04	1.05	1.04
600.00	19.95	19.30	19.03	19.07	1.03	1.05	1.05	1.04
600.00	69.83	67.03	64.80	65.25	1.04	1.08	1.07	1.06
600.00	125.49	121.42	119.78	120.36	1.03	1.05	1.04	1.04

Page 2 of 4

ETS·LINDGREN

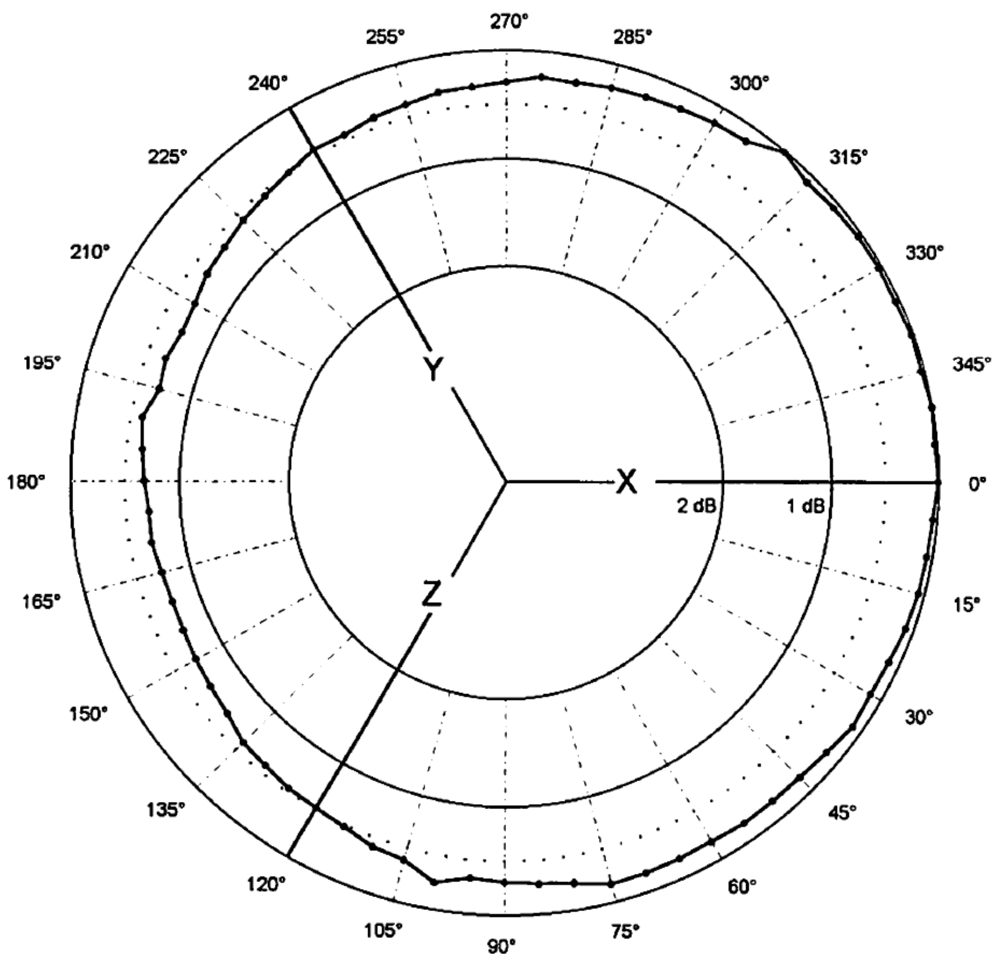
Frequency Response Calibration Factors
Model E100 Serial Number 00126277
Date of Calibration 14 Jul 2010

Frequency (MHz)	Applied V/m	Probe Reading X	Probe Reading Y	Probe Reading Z	Correction Factor X	Correction Factor Y	Correction Factor Z	Correction Factor Avg
700.00	8.06	7.63	7.53	7.57	1.06	1.07	1.06	1.06
700.00	20.05	18.94	18.46	18.74	1.06	1.09	1.07	1.07
700.00	70.48	66.13	64.14	65.29	1.07	1.10	1.08	1.08
700.00	124.23	117.32	114.56	116.78	1.06	1.08	1.06	1.07
800.00	7.97	7.37	7.39	7.27	1.08	1.08	1.10	1.09
800.00	19.93	18.50	18.31	18.29	1.08	1.09	1.09	1.09
800.00	69.90	64.64	64.92	64.77	1.08	1.08	1.08	1.08
800.00	124.55	115.81	114.68	114.76	1.08	1.09	1.09	1.08
900.00	8.01	7.85	7.93	7.71	1.02	1.01	1.04	1.02
900.00	19.90	19.74	19.73	19.30	1.01	1.01	1.03	1.02
900.00	70.29	69.02	68.60	67.71	1.02	1.02	1.04	1.03
900.00	124.72	123.49	122.93	121.00	1.01	1.01	1.03	1.02
1000.00	8.00	8.16	8.06	8.08	0.98	0.99	0.99	0.99
1000.00	19.91	20.37	19.74	20.07	0.98	1.01	0.99	0.99
1000.00	69.79	70.93	68.52	69.98	0.98	1.02	1.00	1.00
1000.00	124.52	127.44	123.83	125.80	0.98	1.01	0.99	0.99
2000.00	20.07	19.68	19.26	19.58	1.02	1.04	1.03	1.03
2450.00	20.02	19.58	19.47	18.99	1.02	1.03	1.05	1.03
3000.00	19.99	20.23	18.92	20.34	0.99	1.06	0.98	1.01
3500.00	20.03	20.44	20.24	20.40	0.98	0.99	0.98	0.98
4000.00	20.47	20.59	19.87	20.88	0.99	1.03	0.98	1.00
5000.00	20.07	14.70	15.34	16.37	1.37	1.31	1.23	1.30
5500.00	19.74	15.36	15.43	14.11	1.28	1.28	1.40	1.32
6000.00	19.94	13.34	15.14	14.53	1.49	1.32	1.37	1.39

ETS·LINDGREN™
An ESCO Technologies Company

PROBE ROTATIONAL RESPONSE

Model	E100
S/N	00126277
Date	15-Jul-2010
Time	19:04:45
Variation	0.75 dB



• Isotropic response measured in a 20 V/m field at 400 MHz

Page 4 of 4

Appendix C - Photos of Assessed Antennas

(Refer to Exhibit 7B)

Appendix D – MPE Measurement Results

MPE measurement data for Bystander

D.U.T. Info.							Probe Info.			Bystander (BS) Positions													
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Trunk	HAE4003A, 450-470MHz	2.15	450.013	54.0	53.8	CW	E	1.01	BS	0.04	0.03	0.11	0.17	0.31	0.41	0.49	0.44	0.32	0.21	0.5	0.253	0.128	0.13
Trunk	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	BS	0.04	0.04	0.12	0.19	0.34	0.48	0.55	0.47	0.33	0.21	0.5	0.277	0.140	0.14
Trunk	HAE4003A, 450-470MHz	2.15	469.988	54.0	53.7	CW	E	1.01	BS	0.03	0.03	0.10	0.16	0.29	0.38	0.47	0.43	0.34	0.25	0.5	0.248	0.125	0.13
Trunk	HAE4004A, 470-512MHz	2.15	470.013	54.0	53.7	CW	E	1.01	BS	0.03	0.04	0.10	0.17	0.29	0.41	0.49	0.45	0.36	0.27	0.5	0.261	0.132	0.13
Trunk	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	BS	0.02	0.04	0.09	0.15	0.24	0.34	0.38	0.33	0.26	0.19	0.5	0.204	0.104	0.10
Trunk	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	BS	0.02	0.04	0.09	0.13	0.21	0.34	0.36	0.30	0.20	0.14	0.5	0.183	0.093	0.10
Trunk	HAE4004A, 470-512MHz	2.15	511.988	48.0	47.3	CW	E	1.03	BS	0.02	0.05	0.09	0.15	0.30	0.48	0.54	0.45	0.29	0.16	0.5	0.253	0.130	0.13
Trunk	HAE6016A, 450 - 512MHz	2.15	450.013	54.0	53.8	CW	E	1.01	BS	0.03	0.03	0.09	0.14	0.26	0.35	0.42	0.39	0.30	0.20	0.5	0.221	0.112	0.11
Trunk	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	BS	0.03	0.04	0.11	0.17	0.31	0.44	0.53	0.49	0.38	0.27	0.5	0.277	0.140	0.14
Trunk	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	BS	0.02	0.04	0.09	0.15	0.24	0.34	0.39	0.36	0.29	0.22	0.5	0.214	0.109	0.11
Trunk	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	BS	0.02	0.04	0.08	0.13	0.20	0.32	0.36	0.31	0.23	0.17	0.5	0.186	0.095	0.10
Trunk	HAE6016A, 450 - 512MHz	2.15	511.988	48.0	47.3	CW	E	1.03	BS	0.02	0.05	0.09	0.15	0.29	0.49	0.57	0.49	0.33	0.19	0.5	0.267	0.138	0.14
Trunk	HAE4011A, 450-470MHz	5.65	450.013	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.05	0.23	0.51	0.56	0.33	0.09	0.10	0.5	0.188	0.095	0.10
Trunk	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.19	0.43	0.48	0.29	0.09	0.10	0.5	0.163	0.082	0.08
Trunk	HAE4011A, 450-470MHz	5.65	469.988	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.14	0.30	0.34	0.20	0.07	0.09	0.5	0.119	0.060	0.06

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.								Probe Info.		Bystander (BS) Positions										DUT			
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Trunk	HAE4012A, 470-495MHz	5.65	470.013	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.02	0.09	0.26	0.47	0.50	0.26	0.08	0.14	0.5	0.182	0.092	0.09
Trunk	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.02	0.07	0.21	0.42	0.47	0.27	0.07	0.10	0.5	0.163	0.083	0.08
Trunk	HAE4012A, 470-495MHz	5.65	494.988	48.0	47.2	CW	E	1.02	BS	0.00	0.00	0.01	0.03	0.13	0.30	0.35	0.20	0.05	0.06	0.5	0.113	0.058	0.06
Trunk	HAE4013A, 494-512MHz	5.65	494.988	48.0	47.2	CW	E	1.02	BS	0.00	0.00	0.02	0.06	0.19	0.40	0.50	0.26	0.05	0.06	0.5	0.154	0.079	0.08
Trunk	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	BS	0.00	0.01	0.02	0.05	0.21	0.47	0.56	0.31	0.06	0.03	0.5	0.172	0.088	0.09
Trunk	HAE4013A, 494-512MHz	5.65	511.988	48.0	47.3	CW	E	1.03	BS	0.00	0.01	0.03	0.07	0.24	0.50	0.57	0.31	0.08	0.04	0.5	0.185	0.095	0.10
Trunk	RAE4014ARB, 445 - 470MHz	7.15	450.013	54.0	53.8	CW	E	1.01	BS	0.01	0.00	0.02	0.01	0.03	0.26	0.47	0.43	0.20	0.09	0.5	0.152	0.077	0.08
Trunk	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	BS	0.01	0.01	0.02	0.02	0.08	0.31	0.49	0.43	0.18	0.06	0.5	0.161	0.081	0.08
Trunk	RAE4014ARB, 445 - 470MHz	7.15	469.988	54.0	53.7	CW	E	1.01	BS	0.01	0.01	0.03	0.05	0.14	0.35	0.49	0.40	0.16	0.05	0.5	0.169	0.085	0.09
Trunk	RAE4015ARM, 470 - 494MHz	7.15	470.013	54.0	53.7	CW	E	1.01	BS	0.00	0.01	0.01	0.00	0.04	0.24	0.44	0.40	0.18	0.08	0.5	0.140	0.071	0.07
Trunk	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.01	0.01	0.02	0.09	0.30	0.45	0.38	0.15	0.04	0.5	0.145	0.074	0.07
Trunk	RAE4015ARM, 470 - 494MHz	7.15	493.988	48.0	47.1	CW	E	1.02	BS	0.00	0.01	0.01	0.02	0.09	0.25	0.42	0.36	0.15	0.02	0.5	0.133	0.068	0.07
Trunk	RAE4016ARB, 494 - 512MHz	7.15	494.988	48.0	47.2	CW	E	1.02	BS	0.01	0.01	0.02	0.01	0.03	0.21	0.40	0.36	0.14	0.08	0.5	0.127	0.065	0.07
Trunk	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	BS	0.01	0.02	0.02	0.02	0.07	0.30	0.48	0.36	0.10	0.04	0.5	0.142	0.072	0.07
Trunk	RAE4016ARB, 494 - 512MHz	7.15	511.988	48.0	47.3	CW	E	1.03	BS	0.01	0.02	0.02	0.02	0.10	0.34	0.51	0.40	0.12	0.02	0.5	0.156	0.080	0.08

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.								Probe Info.			Bystander (BS) Positions												
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Trunk	HAE6015A, 450 - 520MHz	4.15	450.013	54.0	53.8	CW	E	1.01	BS	0.04	0.04	0.12	0.20	0.37	0.48	0.53	0.44	0.30	0.17	0.5	0.269	0.136	0.14
Trunk	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.04	0.04	0.13	0.21	0.39	0.51	0.57	0.46	0.32	0.20	0.5	0.287	0.145	0.15
Trunk	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	BS	0.03	0.05	0.11	0.18	0.29	0.39	0.40	0.30	0.19	0.12	0.5	0.206	0.105	0.11
Trunk	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	BS	0.02	0.05	0.10	0.17	0.27	0.40	0.41	0.29	0.15	0.08	0.5	0.194	0.099	0.10
Trunk	HAE6015A, 450 - 520MHz	4.15	511.988	48.0	47.3	CW	E	1.03	BS	0.03	0.07	0.12	0.20	0.38	0.62	0.66	0.48	0.26	0.12	0.5	0.294	0.151	0.15
Trunk	HAE6031A, 380 - 520MHz	4.15	450.013	54.0	53.8	CW	E	1.01	BS	0.05	0.04	0.12	0.19	0.37	0.48	0.51	0.41	0.28	0.16	0.5	0.261	0.132	0.13
Trunk	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.04	0.04	0.12	0.22	0.40	0.51	0.56	0.45	0.30	0.18	0.5	0.282	0.142	0.14
Trunk	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	BS	0.03	0.05	0.11	0.18	0.29	0.37	0.38	0.28	0.17	0.09	0.5	0.195	0.099	0.10
Trunk	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	BS	0.02	0.05	0.10	0.16	0.25	0.39	0.40	0.29	0.14	0.06	0.5	0.186	0.095	0.10
Trunk	HAE6031A, 380 - 520MHz	4.15	511.988	48.0	47.3	CW	E	1.03	BS	0.03	0.06	0.12	0.20	0.38	0.60	0.62	0.43	0.24	0.11	0.5	0.279	0.144	0.15
45 degree																							
Trunk	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.06	0.08	0.16	0.12	0.25	0.41	0.45	0.34	0.20	0.11	0.5	0.218	0.110	0.11
90 degree																							
Trunk	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.07	0.04	0.07	0.06	0.16	0.31	0.37	0.31	0.20	0.13	0.5	0.172	0.087	0.09

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.							Probe Info.													DUT			
Ant Loc.	**Ant. Model/ Desc.**	**Ant. Gain (dBi)**	**Tx Freq (MHz)**	**Max Pwr (W)**	**Initial Pwr (W)**	**Test Mode**	**E/H Field**	**Probe Cal. Factor**	**Test Pos.**	**Bystander (BS) Positions 20 cm**	**40 cm**	**60 cm**	**80 cm**	**100 cm**	**120 cm**	**140 cm**	**160 cm**	**180 cm**	**200 cm**	**Max. TX Factor**	**Avg. over Body (mW/ cm2)**	**Calc. P.D. (mW/ cm2)**	**Max Calc. P.D. (mW/ cm2)**
Trunk	HAE6015A, 450 - 520MHz	4.15	512.013	30.0	29.2	CW	E	1.03	BS	0.01	0.03	0.07	0.13	0.49	0.79	0.65	0.30	0.10	0.02	0.5	0.259	0.133	0.14
Trunk	HAE6015A, 450 - 520MHz	4.15	516.013	30.0	29.3	CW	E	1.04	BS	0.01	0.03	0.06	0.12	0.47	0.74	0.61	0.29	0.10	0.03	0.5	0.246	0.128	0.13
Trunk	HAE6015A, 450 - 520MHz	4.15	519.988	30.0	29.2	CW	E	1.04	BS	0.01	0.03	0.05	0.11	0.43	0.68	0.56	0.27	0.10	0.03	0.5	0.227	0.118	0.12
Trunk	HAE6031A, 380 - 520MHz	4.15	512.013	30.0	29.2	CW	E	1.03	BS	0.01	0.03	0.06	0.12	0.46	0.74	0.61	0.30	0.11	0.04	0.5	0.248	0.128	0.13
Trunk	HAE6031A, 380 - 520MHz	4.15	516.013	30.0	29.3	CW	E	1.04	BS	0.01	0.03	0.05	0.11	0.42	0.66	0.55	0.27	0.11	0.04	0.5	0.225	0.117	0.12
Trunk	HAE6031A, 380 - 520MHz	4.15	519.988	30.0	29.2	CW	E	1.04	BS	0.01	0.03	0.05	0.10	0.38	0.59	0.49	0.25	0.11	0.05	0.5	0.206	0.107	0.11
45 degree																							
Trunk	HAE6015A, 450 - 520MHz	4.15	512.013	30.0	29.2	CW	E	1.03	BS	0.02	0.02	0.03	0.04	0.14	0.21	0.20	0.13	0.06	0.03	0.5	0.088	0.045	0.05
90 degree																							
Trunk	HAE6015A, 450 - 520MHz	4.15	512.013	30.0	29.2	CW	E	1.03	BS	0.02	0.01	0.01	0.05	0.12	0.18	0.19	0.15	0.10	0.06	0.5	0.089	0.046	0.05

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions						
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Trunk	HAE4003A, 450-470MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PB	1.15	0.57	0.49	0.5	0.737	0.372	0.37
Trunk	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	PB	1.16	0.32	0.54	0.5	0.673	0.340	0.34
Trunk	HAE4003A, 450-470MHz	2.15	469.9875	54.0	53.7	CW	E	1.01	PB	0.54	0.40	0.25	0.5	0.397	0.200	0.20
Trunk	HAE4004A, 470-512MHz	2.15	470.0125	54.0	53.7	CW	E	1.01	PB	0.57	0.42	0.24	0.5	0.410	0.207	0.21
Trunk	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PB	0.31	0.74	0.31	0.5	0.453	0.231	0.23
Trunk	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	PB	0.63	0.70	0.17	0.5	0.500	0.255	0.26
Trunk	HAE4004A, 470-512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.80	0.38	0.20	0.5	0.460	0.237	0.24
Trunk	HAE6016A, 450 - 512MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.90	0.33	0.40	0.5	0.543	0.274	0.28
Trunk	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	PB	0.72	0.29	0.35	0.5	0.453	0.229	0.23
Trunk	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PB	0.31	0.61	0.25	0.5	0.390	0.199	0.20
Trunk	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	PB	0.53	0.63	0.15	0.5	0.437	0.223	0.23
Trunk	HAE6016A, 450 - 512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.78	0.38	0.34	0.5	0.500	0.258	0.26
Trunk	HAE4011A, 450-470MHz	5.65	450.0125	54.0	53.8	CW	E	1.01	PB	0.70	0.27	0.18	0.5	0.383	0.194	0.19
Trunk	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	PB	0.36	0.21	0.19	0.5	0.253	0.128	0.13
Trunk	HAE4011A, 450-470MHz	5.65	469.9875	54.0	53.7	CW	E	1.01	PB	0.24	0.17	0.21	0.5	0.207	0.104	0.10

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Trunk	HAE4012A, 470-495MHz	5.65	470.0125	54.0	53.7	CW	E	1.01	PB	0.31	0.25	0.27	0.5	0.277	0.140	0.14
Trunk	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	PB	0.28	0.41	0.12	0.5	0.270	0.138	0.14
Trunk	HAE4012A, 470-495MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PB	0.31	0.35	0.11	0.5	0.257	0.131	0.13
Trunk	HAE4013A, 494-512MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PB	0.47	0.57	0.22	0.5	0.420	0.214	0.22
Trunk	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	PB	0.56	0.54	0.20	0.5	0.433	0.221	0.23
Trunk	HAE4013A, 494-512MHz	5.65	511.9875	48.0	47.3	CW	E	1.03	PB	0.55	0.24	0.19	0.5	0.327	0.168	0.17
Trunk	RAE4014ARB, 445 - 470MHz	7.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.24	0.07	0.06	0.5	0.123	0.062	0.06
Trunk	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	PB	0.24	0.07	0.10	0.5	0.137	0.069	0.07
Trunk	RAE4014ARB, 445 - 470MHz	7.15	469.9875	54.0	53.7	CW	E	1.01	PB	0.14	0.11	0.09	0.5	0.113	0.057	0.06
Trunk	RAE4015ARM, 470 - 494MHz	7.15	470.0125	54.0	53.7	CW	E	1.01	PB	0.06	0.03	0.03	0.5	0.040	0.020	0.02
Trunk	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	PB	0.13	0.17	0.05	0.5	0.117	0.060	0.06
Trunk	RAE4015ARM, 470 - 494MHz	7.15	493.9875	48.0	47.1	CW	E	1.02	PB	0.17	0.20	0.08	0.5	0.150	0.077	0.08
Trunk	RAE4016ARB, 494 - 512MHz	7.15	494.9875	48.0	47.2	CW	E	1.02	PB	0.15	0.14	0.02	0.5	0.103	0.053	0.05
Trunk	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	PB	0.23	0.24	0.04	0.5	0.170	0.087	0.09
Trunk	RAE4016ARB, 494 - 512MHz	7.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.23	0.12	0.09	0.5	0.147	0.076	0.08

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions			DUT			
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk	Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Trunk	HAE6015A, 450 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PB	1.16	0.40	0.49	0.5	0.683	0.345	0.35
Trunk	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PB	0.73	0.37	0.42	0.5	0.507	0.256	0.26
Trunk	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PB	0.32	0.75	0.31	0.5	0.460	0.235	0.24
Trunk	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PB	0.64	0.77	0.17	0.5	0.527	0.269	0.27
Trunk	HAE6015A, 450 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.94	0.36	0.32	0.5	0.540	0.278	0.28
Trunk	HAE6031A, 380 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PB	1.14	0.39	0.44	0.5	0.657	0.332	0.33
Trunk	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PB	0.70	0.34	0.43	0.5	0.490	0.247	0.25
Trunk	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PB	0.30	0.74	0.30	0.5	0.447	0.228	0.23
Trunk	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PB	0.60	0.80	0.17	0.5	0.523	0.267	0.27
Trunk	HAE6031A, 380 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.99	0.36	0.43	0.5	0.593	0.306	0.31
Trunk	HAE6015A, 450 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PB	0.59	0.26	0.24	0.5	0.363	0.187	0.19
Trunk	HAE6015A, 450 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PB	0.72	0.19	0.19	0.5	0.367	0.191	0.20
Trunk	HAE6015A, 450 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PB	0.78	0.17	0.17	0.5	0.373	0.194	0.20
Trunk	HAE6031A, 380 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PB	0.60	0.25	0.26	0.5	0.370	0.191	0.20
Trunk	HAE6031A, 380 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PB	0.64	0.18	0.24	0.5	0.353	0.184	0.19
Trunk	HAE6031A, 380 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PB	0.69	0.15	0.16	0.5	0.333	0.173	0.18

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Trunk	HAE4003A, 450-470MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.40	0.12	0.15	0.5	0.223	0.113	0.11
Trunk	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	PF	0.30	0.12	0.20	0.5	0.207	0.104	0.10
Trunk	HAE4003A, 450-470MHz	2.15	469.9875	54.0	53.7	CW	E	1.01	PF	0.21	0.09	0.22	0.5	0.173	0.088	0.09
Trunk	HAE4004A, 470-512MHz	2.15	470.0125	54.0	53.7	CW	E	1.01	PF	0.18	0.09	0.24	0.5	0.170	0.086	0.09
Trunk	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PF	0.20	0.13	0.38	0.5	0.237	0.121	0.12
Trunk	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	PF	0.29	0.19	0.29	0.5	0.257	0.131	0.13
Trunk	HAE4004A, 470-512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.34	0.16	0.20	0.5	0.233	0.120	0.12
Trunk	HAE6016A, 450 - 512MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.17	0.09	0.14	0.5	0.133	0.067	0.07
Trunk	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	PF	0.24	0.08	0.20	0.5	0.173	0.088	0.09
Trunk	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PF	0.19	0.15	0.30	0.5	0.213	0.109	0.11
Trunk	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	PF	0.26	0.10	0.18	0.5	0.180	0.092	0.09
Trunk	HAE6016A, 450 - 512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.31	0.14	0.19	0.5	0.213	0.110	0.11
Trunk	HAE4011A, 450-470MHz	5.65	450.0125	54.0	53.8	CW	E	1.01	PF	0.14	0.18	0.10	0.5	0.140	0.071	0.07
Trunk	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	PF	0.08	0.11	0.14	0.5	0.110	0.056	0.06
Trunk	HAE4011A, 450-470MHz	5.65	469.9875	54.0	53.7	CW	E	1.01	PF	0.04	0.05	0.11	0.5	0.067	0.034	0.03

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Trunk	HAE4012A, 470-495MHz	5.65	470.0125	54.0	53.7	CW	E	1.01	PF	0.05	0.06	0.16	0.5	0.090	0.045	0.05
Trunk	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	PF	0.10	0.06	0.19	0.5	0.117	0.060	0.06
Trunk	HAE4012A, 470-495MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PF	0.09	0.10	0.11	0.5	0.100	0.051	0.05
Trunk	HAE4013A, 494-512MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PF	0.18	0.16	0.13	0.5	0.157	0.080	0.08
Trunk	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	PF	0.19	0.16	0.18	0.5	0.177	0.090	0.09
Trunk	HAE4013A, 494-512MHz	5.65	511.9875	48.0	47.3	CW	E	1.03	PF	0.13	0.10	0.14	0.5	0.123	0.064	0.06
Trunk	RAE4014ARB, 445 - 470MHz	7.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.04	0.05	0.04	0.5	0.043	0.022	0.02
Trunk	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	PF	0.03	0.07	0.06	0.5	0.053	0.027	0.03
Trunk	RAE4014ARB, 445 - 470MHz	7.15	469.9875	54.0	53.7	CW	E	1.01	PF	0.02	0.01	0.07	0.5	0.033	0.017	0.02
Trunk	RAE4015ARM, 470 - 494MHz	7.15	470.0125	54.0	53.7	CW	E	1.01	PF	0.00	0.02	0.03	0.5	0.017	0.008	0.01
Trunk	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	PF	0.03	0.03	0.08	0.5	0.047	0.024	0.02
Trunk	RAE4015ARM, 470 - 494MHz	7.15	493.9875	48.0	47.1	CW	E	1.02	PF	0.03	0.04	0.07	0.5	0.047	0.024	0.02
Trunk	RAE4016ARB, 494 - 512MHz	7.15	494.9875	48.0	47.2	CW	E	1.02	PF	0.02	0.04	0.05	0.5	0.037	0.019	0.02
Trunk	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	PF	0.06	0.05	0.11	0.5	0.073	0.037	0.04
Trunk	RAE4016ARB, 494 - 512MHz	7.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.04	0.05	0.07	0.5	0.053	0.027	0.03

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger Positions			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Trunk	HAE6015A, 450 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.19	0.12	0.13	0.5	0.147	0.074	0.07
Trunk	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PF	0.24	0.14	0.16	0.5	0.180	0.091	0.09
Trunk	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PF	0.22	0.14	0.27	0.5	0.210	0.107	0.11
Trunk	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PF	0.37	0.15	0.26	0.5	0.260	0.133	0.14
Trunk	HAE6015A, 450 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.38	0.21	0.31	0.5	0.300	0.155	0.16
Trunk	HAE6031A, 380 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.22	0.11	0.11	0.5	0.147	0.074	0.07
Trunk	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PF	0.20	0.13	0.14	0.5	0.157	0.079	0.08
Trunk	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PF	0.19	0.13	0.26	0.5	0.193	0.099	0.10
Trunk	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PF	0.27	0.10	0.24	0.5	0.203	0.104	0.11
Trunk	HAE6031A, 380 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.37	0.18	0.29	0.5	0.280	0.144	0.15
Trunk	HAE6015A, 450 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PF	0.25	0.12	0.20	0.5	0.190	0.098	0.10
Trunk	HAE6015A, 450 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PF	0.20	0.12	0.20	0.5	0.173	0.090	0.09
Trunk	HAE6015A, 450 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PF	0.17	0.13	0.20	0.5	0.167	0.087	0.09
Trunk	HAE6031A, 380 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PF	0.19	0.13	0.17	0.5	0.163	0.084	0.09
Trunk	HAE6031A, 380 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PF	0.21	0.10	0.17	0.5	0.160	0.083	0.09
Trunk	HAE6031A, 380 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PF	0.17	0.10	0.16	0.5	0.143	0.075	0.08

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.								Probe Info.			Bystander (BS) Positions												
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE4003A, 450-470MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.06	0.10	0.15	0.22	0.30	0.33	0.5	0.121	0.061	0.06
Roof	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.06	0.10	0.14	0.22	0.29	0.33	0.5	0.119	0.060	0.06
Roof	HAE4003A, 450-470MHz	2.15	469.9875	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.03	0.05	0.09	0.14	0.22	0.32	0.35	0.5	0.121	0.061	0.06
Roof	HAE4004A, 470-512MHz	2.15	470.0125	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.03	0.05	0.10	0.15	0.24	0.34	0.38	0.5	0.130	0.066	0.07
Roof	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.02	0.05	0.07	0.10	0.16	0.27	0.35	0.36	0.5	0.138	0.070	0.07
Roof	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	BS	0.00	0.01	0.03	0.06	0.06	0.08	0.13	0.22	0.29	0.30	0.5	0.118	0.060	0.06
Roof	HAE4004A, 470-512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.01	0.03	0.06	0.06	0.07	0.13	0.20	0.26	0.27	0.5	0.109	0.056	0.06
Roof	HAE6016A, 450 - 512MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.00	0.03	0.05	0.09	0.13	0.19	0.25	0.29	0.5	0.103	0.052	0.05
Roof	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.06	0.08	0.13	0.21	0.30	0.36	0.5	0.119	0.060	0.06
Roof	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.02	0.05	0.06	0.09	0.15	0.25	0.34	0.37	0.5	0.133	0.068	0.07
Roof	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	BS	0.00	0.01	0.03	0.06	0.06	0.07	0.13	0.21	0.29	0.30	0.5	0.116	0.059	0.06
Roof	HAE6016A, 450 - 512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.01	0.03	0.05	0.05	0.07	0.13	0.21	0.27	0.28	0.5	0.110	0.057	0.06
Roof	HAE4011A, 450-470MHz	5.65	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.00	0.01	0.01	0.04	0.11	0.23	0.35	0.31	0.5	0.106	0.054	0.05
Roof	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.02	0.04	0.09	0.21	0.32	0.30	0.5	0.098	0.049	0.05
Roof	HAE4011A, 450-470MHz	5.65	469.9875	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.16	0.24	0.24	0.5	0.073	0.037	0.04

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.							Probe Info.			Bystander (BS) Positions													
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE4012A, 470-495MHz	5.65	470.0125	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.00	0.01	0.02	0.04	0.10	0.23	0.36	0.32	0.5	0.108	0.055	0.05
Roof	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.00	0.01	0.01	0.03	0.10	0.22	0.35	0.33	0.5	0.105	0.054	0.05
Roof	HAE4012A, 470-495MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	BS	0.00	0.00	0.00	0.01	0.01	0.02	0.08	0.16	0.25	0.23	0.5	0.076	0.039	0.04
Roof	HAE4013A, 494-512MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	BS	0.00	0.00	0.01	0.03	0.02	0.05	0.14	0.26	0.33	0.27	0.5	0.111	0.057	0.06
Roof	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	BS	0.00	0.00	0.00	0.02	0.02	0.04	0.13	0.22	0.31	0.28	0.5	0.102	0.052	0.05
Roof	HAE4013A, 494-512MHz	5.65	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.00	0.00	0.01	0.02	0.04	0.09	0.18	0.26	0.24	0.5	0.084	0.043	0.04
Roof	RAE4014ARB, 445 - 470MHz	7.15	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.13	0.27	0.34	0.5	0.076	0.038	0.04
Roof	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.28	0.36	0.5	0.079	0.040	0.04
Roof	RAE4014ARB, 445 - 470MHz	7.15	469.9875	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.14	0.30	0.36	0.5	0.084	0.042	0.04
Roof	RAE4015ARM, 470 - 494MHz	7.15	470.0125	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.09	0.24	0.32	0.5	0.066	0.033	0.03
Roof	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.15	0.30	0.33	0.5	0.081	0.041	0.04
Roof	RAE4015ARM, 470 - 494MHz	7.15	493.9875	48.0	47.1	CW	E	1.02	BS	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.14	0.25	0.25	0.5	0.069	0.035	0.04
Roof	RAE4016ARB, 494 - 512MHz	7.15	494.9875	48.0	47.2	CW	E	1.02	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11	0.26	0.30	0.5	0.068	0.035	0.04
Roof	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.13	0.27	0.29	0.5	0.072	0.037	0.04
Roof	RAE4016ARB, 494 - 512MHz	7.15	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.24	0.27	0.5	0.064	0.033	0.03

MPE calculations are defined in section 13.0.

MPE measurement data for Bystander

D.U.T. Info.							Probe Info.			Bystander (BS) Positions													
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	20 cm	40 cm	60 cm	80 cm	100 cm	120 cm	140 cm	160 cm	180 cm	200 cm	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE6015A, 450 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.03	0.06	0.12	0.17	0.25	0.32	0.33	0.5	0.129	0.065	0.07
Roof	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.05	0.07	0.09	0.15	0.25	0.33	0.37	0.5	0.132	0.067	0.07
Roof	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.02	0.05	0.07	0.10	0.18	0.29	0.36	0.34	0.5	0.141	0.072	0.07
Roof	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	BS	0.00	0.01	0.03	0.07	0.07	0.10	0.16	0.26	0.31	0.29	0.5	0.130	0.066	0.07
Roof	HAE6015A, 450 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.01	0.04	0.06	0.07	0.09	0.16	0.27	0.31	0.28	0.5	0.129	0.066	0.07
Roof	HAE6031A, 380 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	BS	0.00	0.00	0.01	0.03	0.06	0.13	0.18	0.26	0.31	0.33	0.5	0.131	0.066	0.07
Roof	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	BS	0.00	0.00	0.01	0.04	0.07	0.10	0.15	0.25	0.32	0.34	0.5	0.128	0.065	0.07
Roof	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	BS	0.00	0.00	0.02	0.06	0.07	0.09	0.18	0.29	0.35	0.33	0.5	0.139	0.071	0.07
Roof	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	BS	0.00	0.01	0.03	0.07	0.07	0.10	0.17	0.26	0.31	0.27	0.5	0.129	0.066	0.07
Roof	HAE6031A, 380 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	BS	0.00	0.02	0.04	0.07	0.07	0.10	0.17	0.25	0.30	0.25	0.5	0.127	0.065	0.07
Roof	HAE6015A, 450 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	BS	0.00	0.01	0.02	0.04	0.04	0.06	0.10	0.16	0.19	0.18	0.5	0.080	0.041	0.04
Roof	HAE6015A, 450 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	BS	0.00	0.01	0.02	0.04	0.03	0.05	0.11	0.16	0.19	0.17	0.5	0.078	0.041	0.04
Roof	HAE6015A, 450 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	BS	0.00	0.01	0.02	0.05	0.03	0.05	0.10	0.16	0.17	0.16	0.5	0.075	0.039	0.04
Roof	HAE6031A, 380 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	BS	0.00	0.01	0.02	0.04	0.04	0.05	0.11	0.16	0.18	0.16	0.5	0.077	0.040	0.04
Roof	HAE6031A, 380 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	BS	0.00	0.01	0.03	0.04	0.04	0.05	0.10	0.15	0.17	0.15	0.5	0.074	0.038	0.04
Roof	HAE6031A, 380 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	BS	0.00	0.01	0.03	0.04	0.04	0.04	0.10	0.15	0.15	0.13	0.5	0.069	0.036	0.04

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC) Positions						
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk	DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE4003A, 450-470MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.02	0.04	0.11	0.5	0.057	0.029	0.03
Roof	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	PB	0.06	0.07	0.06	0.5	0.063	0.032	0.03
Roof	HAE4003A, 450-470MHz	2.15	469.9875	54.0	53.7	CW	E	1.01	PB	0.04	0.07	0.06	0.5	0.057	0.029	0.03
Roof	HAE4004A, 470-512MHz	2.15	470.0125	54.0	53.7	CW	E	1.01	PB	0.04	0.07	0.07	0.5	0.060	0.030	0.03
Roof	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PB	0.04	0.12	0.04	0.5	0.067	0.034	0.03
Roof	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	PB	0.05	0.20	0.06	0.5	0.103	0.053	0.05
Roof	HAE4004A, 470-512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.05	0.09	0.02	0.5	0.053	0.027	0.03
Roof	HAE6016A, 450 - 512MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.02	0.03	0.11	0.5	0.053	0.027	0.03
Roof	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	PB	0.05	0.04	0.05	0.5	0.047	0.024	0.02
Roof	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PB	0.05	0.12	0.04	0.5	0.070	0.036	0.04
Roof	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	PB	0.07	0.20	0.07	0.5	0.113	0.058	0.06
Roof	HAE6016A, 450 - 512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.05	0.07	0.02	0.5	0.047	0.024	0.02
Roof	HAE4011A, 450-470MHz	5.65	450.0125	54.0	53.8	CW	E	1.01	PB	0.00	0.01	0.00	0.5	0.003	0.002	0.00
Roof	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	PB	0.02	0.01	0.01	0.5	0.013	0.007	0.01
Roof	HAE4011A, 450-470MHz	5.65	469.9875	54.0	53.7	CW	E	1.01	PB	0.01	0.01	0.01	0.5	0.010	0.005	0.01

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC)			DUT			
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk	Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE4012A, 470-495MHz	5.65	470.0125	54.0	53.7	CW	E	1.01	PB	0.02	0.02	0.03	0.5	0.023	0.012	0.01
Roof	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	PB	0.02	0.03	0.02	0.5	0.023	0.012	0.01
Roof	HAE4012A, 470-495MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PB	0.02	0.09	0.02	0.5	0.043	0.022	0.02
Roof	HAE4013A, 494-512MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PB	0.03	0.13	0.03	0.5	0.063	0.032	0.03
Roof	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	PB	0.04	0.09	0.02	0.5	0.050	0.026	0.03
Roof	HAE4013A, 494-512MHz	5.65	511.9875	48.0	47.3	CW	E	1.03	PB	0.02	0.03	0.00	0.5	0.017	0.009	0.01
Roof	RAE4014ARB, 445 - 470MHz	7.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.00	0.00	0.01	0.5	0.003	0.002	0.00
Roof	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	PB	0.01	0.01	0.01	0.5	0.010	0.005	0.01
Roof	RAE4014ARB, 445 - 470MHz	7.15	469.9875	54.0	53.7	CW	E	1.01	PB	0.01	0.01	0.01	0.5	0.010	0.005	0.01
Roof	RAE4015ARM, 470 - 494MHz	7.15	470.0125	54.0	53.7	CW	E	1.01	PB	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	PB	0.00	0.01	0.00	0.5	0.003	0.002	0.00
Roof	RAE4015ARM, 470 - 494MHz	7.15	493.9875	48.0	47.1	CW	E	1.02	PB	0.01	0.03	0.01	0.5	0.017	0.009	0.01
Roof	RAE4016ARB, 494 - 512MHz	7.15	494.9875	48.0	47.2	CW	E	1.02	PB	0.00	0.02	0.00	0.5	0.007	0.003	0.00
Roof	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	PB	0.01	0.01	0.00	0.5	0.007	0.003	0.00
Roof	RAE4016ARB, 494 - 512MHz	7.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.01	0.01	0.00	0.5	0.007	0.003	0.00

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC)			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Roof	HAE6015A, 450 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.10	0.08	0.16	0.5	0.113	0.057	0.06
Roof	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PB	0.06	0.06	0.03	0.5	0.050	0.025	0.03
Roof	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PB	0.06	0.23	0.06	0.5	0.117	0.060	0.06
Roof	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PB	0.06	0.17	0.07	0.5	0.100	0.051	0.05
Roof	HAE6015A, 450 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.06	0.10	0.03	0.5	0.063	0.033	0.03
Roof	HAE6031A, 380 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PB	0.09	0.09	0.17	0.5	0.117	0.059	0.06
Roof	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PB	0.06	0.06	0.03	0.5	0.050	0.025	0.03
Roof	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PB	0.06	0.22	0.05	0.5	0.110	0.056	0.06
Roof	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PB	0.07	0.17	0.07	0.5	0.103	0.053	0.05
Roof	HAE6031A, 380 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PB	0.06	0.10	0.03	0.5	0.063	0.033	0.03
Roof	HAE6015A, 450 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PB	0.04	0.06	0.02	0.5	0.040	0.021	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PB	0.04	0.06	0.02	0.5	0.040	0.021	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PB	0.04	0.04	0.02	0.5	0.033	0.017	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PB	0.03	0.07	0.02	0.5	0.040	0.021	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PB	0.04	0.06	0.02	0.5	0.040	0.021	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PB	0.04	0.05	0.02	0.5	0.037	0.019	0.02

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC)			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Roof	HAE4003A, 450-470MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.06	0.02	0.02	0.5	0.033	0.017	0.02
Roof	HAE4003A, 450-470MHz	2.15	460	54.0	53.8	CW	E	1.01	PF	0.06	0.01	0.06	0.5	0.043	0.022	0.02
Roof	HAE4003A, 450-470MHz	2.15	469.9875	54.0	53.7	CW	E	1.01	PF	0.06	0.01	0.02	0.5	0.030	0.015	0.02
Roof	HAE4004A, 470-512MHz	2.15	470.0125	54.0	53.7	CW	E	1.01	PF	0.06	0.01	0.02	0.5	0.030	0.015	0.02
Roof	HAE4004A, 470-512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PF	0.03	0.03	0.02	0.5	0.027	0.014	0.01
Roof	HAE4004A, 470-512MHz	2.15	498	48.0	46.9	CW	E	1.02	PF	0.03	0.03	0.03	0.5	0.030	0.015	0.02
Roof	HAE4004A, 470-512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.03	0.02	0.04	0.5	0.030	0.015	0.02
Roof	HAE6016A, 450 - 512MHz	2.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.04	0.04	0.02	0.5	0.033	0.017	0.02
Roof	HAE6016A, 450 - 512MHz	2.15	465.5	54.0	53.7	CW	E	1.01	PF	0.06	0.01	0.07	0.5	0.047	0.024	0.02
Roof	HAE6016A, 450 - 512MHz	2.15	482.5	54.0	53.7	CW	E	1.02	PF	0.03	0.03	0.02	0.5	0.027	0.014	0.01
Roof	HAE6016A, 450 - 512MHz	2.15	496.5	48.0	46.9	CW	E	1.02	PF	0.03	0.03	0.02	0.5	0.027	0.014	0.01
Roof	HAE6016A, 450 - 512MHz	2.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.03	0.02	0.04	0.5	0.030	0.015	0.02
Roof	HAE4011A, 450-470MHz	5.65	450.0125	54.0	53.8	CW	E	1.01	PF	0.01	0.00	0.00	0.5	0.003	0.002	0.00
Roof	HAE4011A, 450-470MHz	5.65	460	54.0	53.8	CW	E	1.01	PF	0.00	0.00	0.01	0.5	0.003	0.002	0.00
Roof	HAE4011A, 450-470MHz	5.65	469.9875	54.0	53.7	CW	E	1.01	PF	0.00	0.00	0.01	0.5	0.003	0.002	0.00

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC)			DUT			
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk	Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Roof	HAE4012A, 470-495MHz	5.65	470.0125	54.0	53.7	CW	E	1.01	PF	0.01	0.01	0.02	0.5	0.013	0.007	0.01
Roof	HAE4012A, 470-495MHz	5.65	482.5	54.0	53.7	CW	E	1.02	PF	0.00	0.00	0.01	0.5	0.003	0.002	0.00
Roof	HAE4012A, 470-495MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	HAE4013A, 494-512MHz	5.65	494.9875	48.0	47.2	CW	E	1.02	PF	0.01	0.01	0.01	0.5	0.010	0.005	0.01
Roof	HAE4013A, 494-512MHz	5.65	503	48.0	47.0	CW	E	1.02	PF	0.01	0.00	0.00	0.5	0.003	0.002	0.00
Roof	HAE4013A, 494-512MHz	5.65	511.9875	48.0	47.3	CW	E	1.03	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4014ARB, 445 - 470MHz	7.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4014ARB, 445 - 470MHz	7.15	460	54.0	53.8	CW	E	1.01	PF	0.01	0.00	0.01	0.5	0.007	0.003	0.00
Roof	RAE4014ARB, 445 - 470MHz	7.15	469.9875	54.0	53.7	CW	E	1.01	PF	0.01	0.00	0.01	0.5	0.007	0.003	0.00
Roof	RAE4015ARM, 470 - 494MHz	7.15	470.0125	54.0	53.7	CW	E	1.01	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4015ARM, 470 - 494MHz	7.15	482.5	54.0	53.7	CW	E	1.02	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4015ARM, 470 - 494MHz	7.15	493.9875	48.0	47.1	CW	E	1.02	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4016ARB, 494 - 512MHz	7.15	494.9875	48.0	47.2	CW	E	1.02	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4016ARB, 494 - 512MHz	7.15	503	48.0	47.0	CW	E	1.02	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00
Roof	RAE4016ARB, 494 - 512MHz	7.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.00	0.00	0.00	0.5	0.000	0.000	0.00

MPE calculations are defined in section 13.0.

MPE measurement data for Passenger

D.U.T. Info.							Probe Info.			Passenger/Operator (MC)			DUT Max. TX Factor	Avg. over Body (mW/ cm2)	Calc. P.D. (mW/ cm2)	Max Calc. P.D. (mW/ cm2)
Ant Loc.	Ant. Model/ Desc.	Ant. Gain (dBi)	Tx Freq (MHz)	Max Pwr (W)	Initial Pwr (W)	Test Mode	E/H Field	Probe Cal. Factor	Test Pos.	Head	Chest	Lower Trunk				
Roof	HAE6015A, 450 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.05	0.06	0.02	0.5	0.043	0.022	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PF	0.06	0.01	0.06	0.5	0.043	0.022	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PF	0.04	0.04	0.02	0.5	0.033	0.017	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PF	0.04	0.02	0.03	0.5	0.030	0.015	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.03	0.02	0.05	0.5	0.033	0.017	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	450.0125	54.0	53.8	CW	E	1.01	PF	0.06	0.04	0.02	0.5	0.040	0.020	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	465.5	54.0	53.7	CW	E	1.01	PF	0.06	0.02	0.06	0.5	0.047	0.024	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	482.5	54.0	53.7	CW	E	1.02	PF	0.03	0.03	0.02	0.5	0.027	0.014	0.01
Roof	HAE6031A, 380 - 520MHz	4.15	496.5	48.0	46.9	CW	E	1.02	PF	0.03	0.04	0.03	0.5	0.033	0.017	0.02
Roof	HAE6031A, 380 - 520MHz	4.15	511.9875	48.0	47.3	CW	E	1.03	PF	0.03	0.02	0.05	0.5	0.033	0.017	0.02
Roof	HAE6015A, 450 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PF	0.02	0.01	0.03	0.5	0.020	0.010	0.01
Roof	HAE6015A, 450 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PF	0.02	0.01	0.02	0.5	0.017	0.009	0.01
Roof	HAE6015A, 450 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PF	0.02	0.01	0.02	0.5	0.017	0.009	0.01
Roof	HAE6031A, 380 - 520MHz	4.15	512.0125	30.0	29.2	CW	E	1.03	PF	0.02	0.01	0.03	0.5	0.020	0.010	0.01
Roof	HAE6031A, 380 - 520MHz	4.15	516.0125	30.0	29.3	CW	E	1.04	PF	0.02	0.01	0.02	0.5	0.017	0.009	0.01
Roof	HAE6031A, 380 - 520MHz	4.15	519.9875	30.0	29.2	CW	E	1.04	PF	0.01	0.01	0.02	0.5	0.013	0.007	0.01

MPE calculations are defined in section 13.0.

Appendix E - SAR Simulation Report

COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE APX7500 SINGLE BAND UHF R2, MODEL #M30SSS9PW1AN MOBILE RADIO

December 12, 2010

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

Introduction

This report summarizes the computational [numerical modeling] analysis performed to document compliance of the APX7500 Single Band UHF R2, Model Number M30SSS9PW1AN, Mobile Radio and vehicle-mounted antennas with the Federal Communications Commission (FCC) guidelines for human exposure to radio frequency (RF) emissions. The radio operates in the 450 - 520 MHz frequency band.

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 (4 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]. In total 8 independent simulations have been performed, addressing exposure of passenger to the UHF 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 MPEs 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™ v6.4, by Remcom Inc., State College, PA. This computational suite features a heterogeneous full body standing model (High Fidelity Body Mesh), derived from the so-called Visible Human [4], discretized in 5 mm voxels. The dielectric properties of 23 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 to 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 in 5mm voxels. The Figure 1 below show both the CAD model and the photo of the actual car This CAD model has been incorporated into the IEEE 1528.2 draft standard.

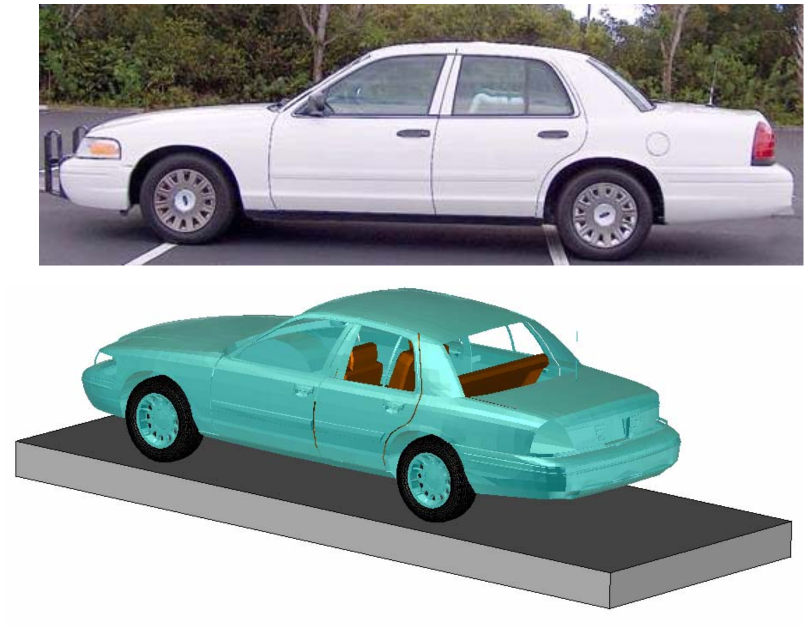


Figure 1: The photo picture of the car used in field measurements and the corresponding CAD model used in simulations

For passenger exposure, the antenna position is on the trunk of the vehicle. The distance 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 exposure to trunk mounted antennas.

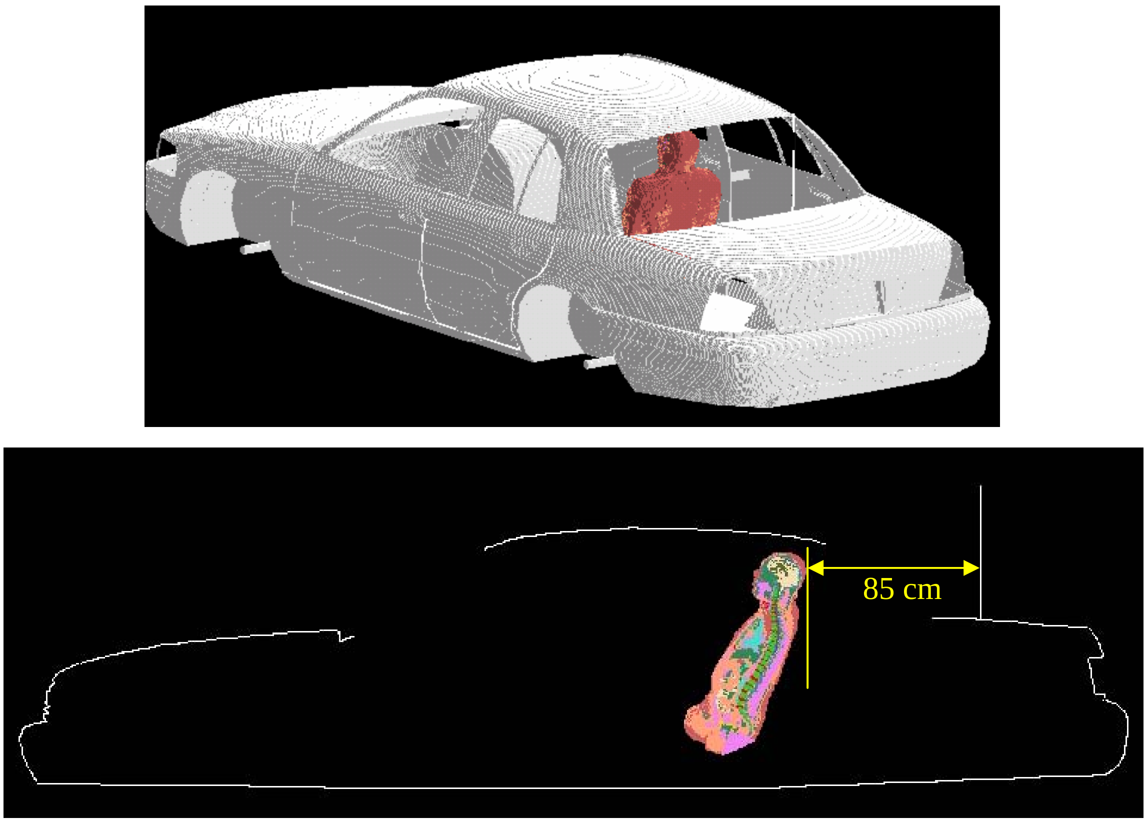


Figure 2: Passenger model exposed to a trunk-mount antenna: XFDTD geometry.
The antenna is mounted at 85 cm from the passenger located in the center of the back seat.

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 54 W. Since the ohmic losses in the cable and 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) is employed, all computational results are normalized to half of it, i.e., 27 W average net output power.

Results of SAR computations for car passengers

The test conditions requiring SAR computations are summarized in Table I, 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 I includes the 1.8 cm magnetic mount base used in measurements to position the antenna on the vehicle. The passenger is located in the center or on the side of the rear seat. The passenger model is surrounded by air, as the seat, which is made out of poorly conductive fabrics, is not included in the computational model. All the transmit frequency, antenna length, and passenger location combinations reported in Table I have been simulated individually.

Table I: Results of the SAR computations for passenger exposure (50% talk-time).

<table>
<tr><th rowspan="2">Mount location</th><th rowspan="2">Antenna Kit #</th><th colspan="2">Antenna length with mag. mount base</th><th rowspan="2">Freq [MHz]</th><th rowspan="2">Max P.D. [mW/cm^2]</th><th rowspan="2">Exposure location</th><th colspan="2">SAR [W/kg]</th></tr>
<tr><th>Physical</th><th>XFDTD</th><th>1-g</th><th>WB</th></tr>
<tr><td rowspan="4">Trunk</td><td rowspan="4">HAE4003A</td><td rowspan="4">17.8 cm</td><td rowspan="4">18 cm</td><td rowspan="2">450
Fig. 5</td><td rowspan="2">0.37</td><td>Center</td><td>0.353</td><td>0.0162</td></tr>
<tr><td>Side</td><td>0.408</td><td>0.0115</td></tr>
<tr><td rowspan="2">460</td><td rowspan="2">0.34</td><td>Center</td><td>0.159</td><td>0.0112</td></tr>
<tr><td>Side</td><td>0.320</td><td>0.0146</td></tr>
<tr><td rowspan="2">Trunk</td><td rowspan="2">HAE6015A</td><td rowspan="2">28.0 cm</td><td rowspan="2">28 cm</td><td rowspan="2">450</td><td rowspan="2">0.35</td><td>Center</td><td>0.379</td><td>0.0171</td></tr>
<tr><td>Side</td><td>0.249</td><td>0.0068</td></tr>
<tr><td rowspan="2">Trunk</td><td rowspan="2">HAE6031A</td><td rowspan="2">29.8 cm</td><td rowspan="2">30 cm</td><td rowspan="2">450
Fig. 3 & 4</td><td rowspan="2">0.33</td><td>Center</td><td>0.382</td><td>0.0173</td></tr>
<tr><td>Side</td><td>0.412</td><td>0.0122</td></tr>
</table>

The SAR distribution in the passenger model in the exposure condition that gave highest 1-g SAR is reported in Figure 3 (450 MHz, passenger on the side of the back seat, HAE6031A antenna).

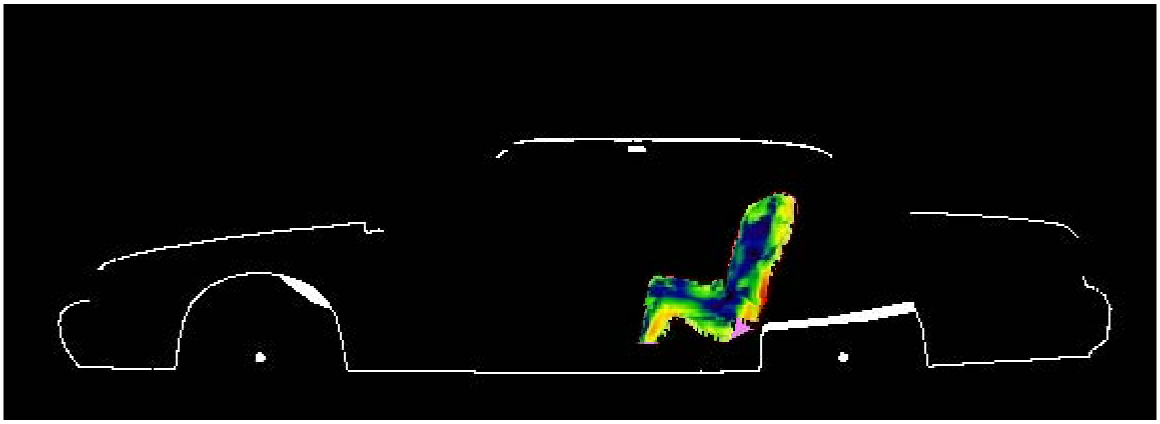
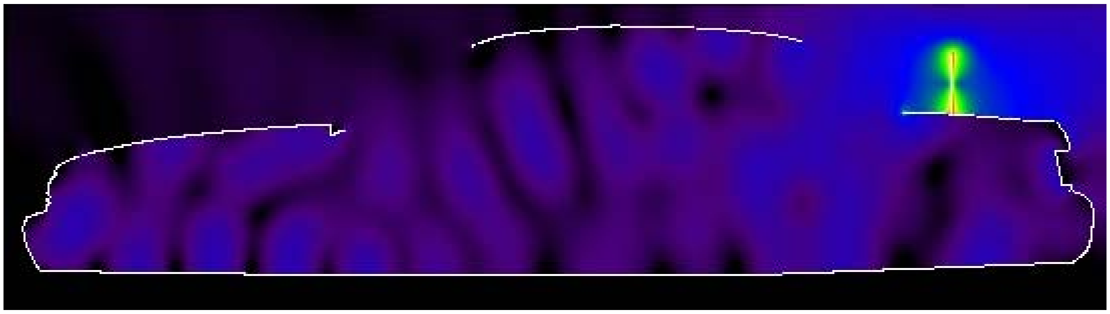
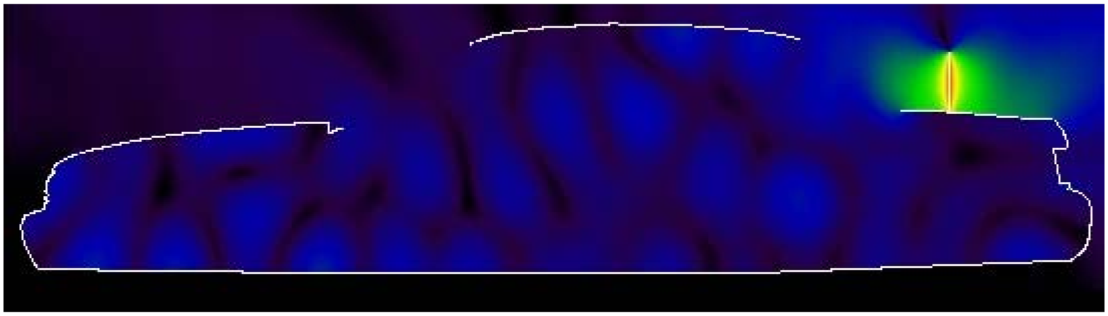


Figure 3: SAR distribution at 450 MHz in the passenger located on the side of the back seat, produced by the trunk-mount HAE6031A antenna. The contour plot in the figure is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

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.



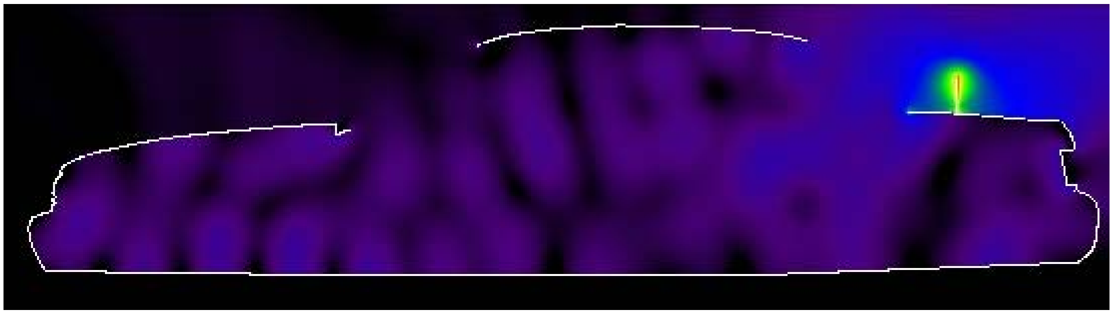
a)



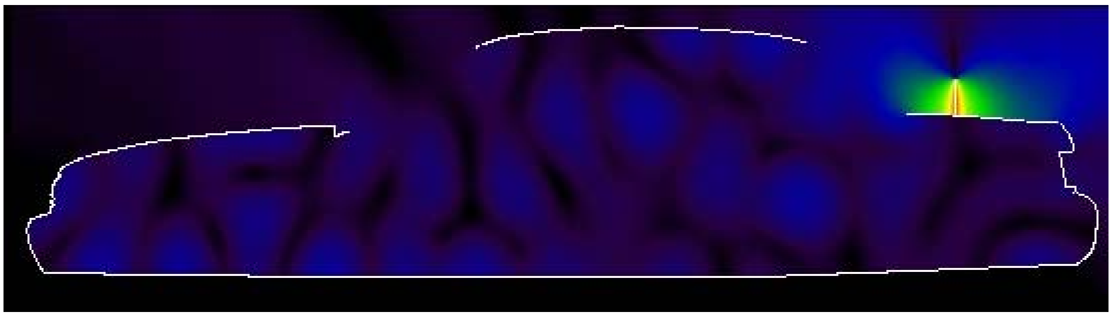
b)

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

The electric and magnetic field distributions for the passenger exposure configuration and different type of simulated antenna (HAE4003A, quarter wave monopole)) relative to the plane where antenna is located are shown in Figure 5



a)



b)

Figure 5 (a) E-field distribution and (b) H-field distribution in the plane of the trunk mounted antenna (HAE4003A antenna at 450 MHz) corresponding to the passenger exposure condition

The overall maximum peak 1-g SAR in all simulated conditions is 0.412 W/kg, less than the 1.6 W/kg limit, while the maximum whole-body average SAR is 0.0173 W/kg, less than the 0.08 W/kg limit.

Conclusions

Under the test conditions described for evaluating passenger and bystander exposure to the RF electromagnetic fields emitted by vehicle-mounted antennas used in conjunction with this mobile radio product, the present analysis shows that the computed SAR values are compliant with the 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

APPENDIX: SPECIFIC INFORMATION FOR SAR COMPUTATIONS

This appendix follows the structure outlined in Appendix B.III of the Supplement C to the FCC OET Bulletin 65. Most of the information regarding the code employed to perform the numerical computations has been adapted from the draft IEEE 1528.1 and 1528.2 standards, and from the XFDTD™ v5.3 and v6.4. User Manuals. Remcom Inc., owner of XFDTD™, is kindly acknowledged for the help provided.

1) Computational resources

a) A multiprocessor system equipped with two Intel Xeon X5570 quad-core CPUs was employed for all simulations.

b) The memory requirement was from 7 GB to 10 GB. Using the above-mentioned system with 8-cores operating concurrently, the typical simulation would run for 3-5 hours.

2) FDTD algorithm implementation and validation

a) We employed a commercial code (XFDTD™ v6.4, by Remcom Inc.) that implements the Yee's FDTD formulation [1]. The solution domain was discretized according to a rectangular grid with a uniform 5 mm step in all directions. Sub-gridding was not used. Liao's absorbing boundary conditions [2] are set at the domain boundary to simulate free space radiation processes. The excitation is a lumped voltage generator with 50-ohm source impedance. The code allows selecting *wire objects* without specifying their radius. We used a wire to represent the antenna. The car body is modeled by solid metal. We did not employ the "thin wire" algorithm in XFDTD™ since the antenna radius was never smaller than one-fifth the voxel dimension. In fact, the XFDTD™ manual specifies that "Thin Wire materials may be used in special situations where a wire with a radius much smaller than the cell size is required… in cases where the wire radius is important to the calculation and is less than approximately 1/5 the cell size, the thin wire material may be used to accurately simulate the correct wire dimensions." The voxel size in all our simulations was 5 mm, and the antenna radius is always at least 1 mm (1 mm for the short quarter-wave antennas and 1.5 mm for the long gain antennas), so there was no need to specify a "thin wire" material. Because the field impinges on the bystander or passenger model at a distance of several tens of voxels from the antenna, the details of antenna wire modeling are not expected to have significant impact on the exposure level.

b) XFDTD™ is one of the most widely employed commercial codes for electromagnetic simulations. It has gone through extensive validation and has proven its accuracy over time in many different applications. One example is provided in [3].

We carried out a validation of the code algorithm by running the canonical test case involving a half-wave wire dipole. The dipole is 0.475 times the free space wavelength at 400 MHz, i.e., about 35.5 cm long. The discretization used in the model was uniform in all directions and equal to 5 mm, so the dipole was 71 cells long. Also in this case, the “thin wire” model was not needed. The following picture shows XFDTD™ outputs regarding the antenna feed-point impedance (75.20 + j 11.8 ohm), as well as qualitative distributions of the total E and H fields near the dipole. The radiation pattern is shown as well (one lobe in elevation). As expected, the 3 dB beamwidth is about 78 degrees.

Complex Feed Point Impedance (Ohms)

Feed	Real	Imaginary	
1	75.253304	11.832200	

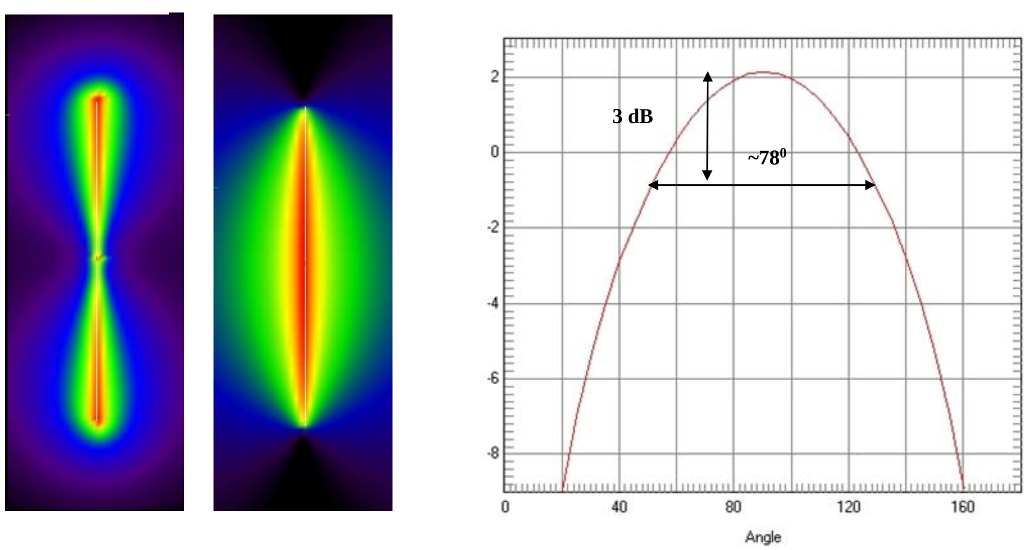
The computed results are in good agreement with the known analytical results for the half -wave dipole antenna which could be found in [10].

This validation ensures that the input impedance calculation is carried out correctly in XFDTD™, thereby enabling accurate estimates of the radiated power. It further ensures that the wire model employed in XFDTD™, which we used to model the antennas, produces physically meaningful current and fields distributions. Both these aspects ensure that the field quantities are correctly computed both in terms of absolute amplitude and relative distribution.

3) Computational parameters

a) The following table reports the main parameters of the FDTD model employed to

Total E-field **Total H-field**



perform our computational analysis:

PARAMETER	X	Y	Z
Voxel size	5 mm	5 mm	5 mm
Maximum domain dimensions employed for passenger computations with the trunk-mount antennas	425	1104	289
Maximum domain dimensions employed for bystander computations with the trunk-mount antennas	434	1243	580
Time step	Exactly equal to Courant limit (typically 10 *ps* at this frequency, with the body model)		
Objects separation from FDTD boundary (voxels)	>10	>10	>10
Number of time steps for passenger	Enough to reach at least -40 dB convergence		
Excitation	Sinusoidal (not less than 10 periods)		

4) Phantom model implementation and validation

a) The FDTD mesh of a male human body was created using digitized data in the form of transverse color images. The data is from the *visible human project* sponsored by the National Library of Medicine (NLM) and is available via the Internet (http://www.nlm.nih.gov/research/visible/visible_human.html). The male data set consists of MRI, CT and anatomical images. Axial MRI images of the head and neck and longitudinal sections of the rest of the body are available at 4 mm intervals. The MRI images have 256 pixel by 256 pixel resolution. Each pixel has 12 bits of gray tone resolution. The CT data consists of axial CT scans of the entire body taken at 1 mm intervals at a resolution of 512 pixels by 512 pixels where each pixel is made up of 12 bits of gray tone. The axial anatomical images are 2048 pixels by 1216 pixels where each pixel is defined by 24 bits of color. The anatomical cross sections are also at 1 mm intervals and coincide with the CT axial images. There are 1871 cross sections. The XFDTD™ High Fidelity Body Mesh uses 5x5x5 mm cells and has dimensions 136 x 87 x 397. Dr. Michael Smith and Dr. Chris Collins of the Milton S. Hershey Medical Center, Hershey, Pa, created the High Fidelity Body mesh. Details of body model creation are given in the *methods* section in [5]. The body mesh contains 23 tissues materials. Measured values for the tissue parameters for a broad frequency range are included with the mesh data. The correct values are interpolated from the table of measured data and entered into the appropriate mesh variables. The tissue conductivity and permittivity variation *vs.* frequency is included in the XFDTD™ calculation by a multiple-pole approximation to the Cole-Cole approximated tissue parameters reported by Camelia Gabriel, Ph.D., and Sami Gabriel, M. Sc. (http://www.brooks.af.mil/AFRL/HED/hedr/reports/dielectric/home.html).

a) The XFDTD™ High Fidelity Body Mesh model correctly represents the anatomical structure and the dielectric properties of body tissues, so it is appropriate for determining the highest exposure expected for normal device operation.

b) One example of the accuracy of XFDTD™ for computing SAR has been provided in [6]. The study reported in [6] is relative to a large-scale benchmark of measurement and computational tools carried out within the IEEE Standards Coordinating Committee 34, Sub-Committee 2.

5) Tissue dielectric parameters

a) The following table reports the dielectric properties used by XFDTD™ for the 23 body tissue materials in the High Fidelity Body Mesh at 450 MHz.

#	Tissue	ε_r	σ (S/m)	Density (kg/m^3)
1	skin	41.5	0.57	1125
2	tendon, pancreas, prostate, aorta, liver, other	50.3	0.76	1151
3	fat, yellow marrow	5.02	0.05	943
4	cortical bone	13.4	0.11	1850
5	cancellous bone	21.0	0.23	1080
6	blood	57.2	1.72	1057
7	muscle, heart, spleen, colon, tongue	63.5	0.99	1059
8	gray matter, cerebellum	54.1	0.88	1035.5
9	white matter	39.7	0.54	1027.4
10	CSF	68.9	2.32	1000
11	sclera/cornea	54.4	1.04	1151
12	vitreous humor	68.3	1.56	1000
13	bladder	17.6	0.31	1132
14	nerve	35.5	0.50	1112
15	cartilage	43.4	0.66	1171
16	gall bladder bile	76.5	1.62	928
17	thyroid	59.8	0.82	1035.5
18	stomach/esophagus	74.4	1.13	1126
19	lung	52.8	0.72	563
20	kidney	57.0	1.16	1147
21	testis	65.2	1.13	1158
22	lens	51.9	0.71	1163
23	small intestine	73.7	2.07	1153

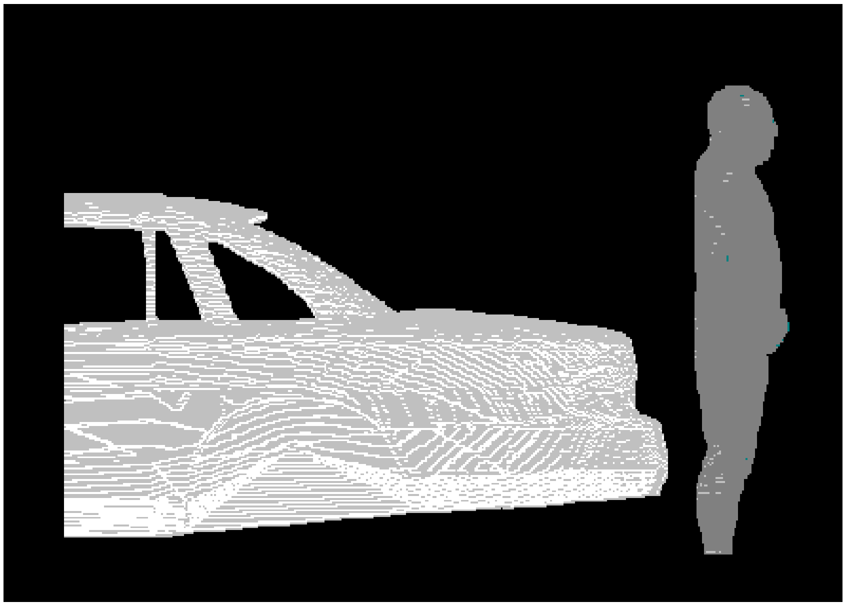
b) The tissue types and dielectric parameters used in the SAR computation are appropriate for determining the highest exposure expected for normal device operation, because they are derived from measurements performed on real biological tissues (http://www.brooks.af.mil/AFRL/HED/hedr/reports/dielectric/home.html).

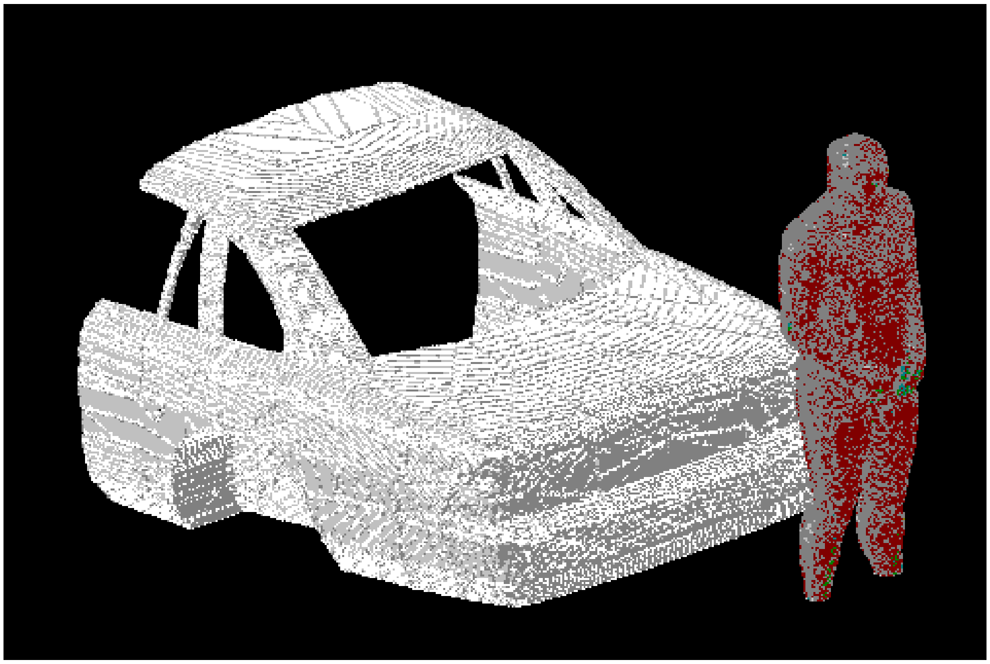
c) The tabulated list of the dielectric parameters used in phantom models is provided at point 5(a). As regards the device (car plus antenna), we used perfect electric conductors.

6) Transmitter model implementation and validation

a) The essential features that must be modeled correctly for the particular test device model to be valid are:

- Car body. We developed one very similar to the car used for MPE measurements, so as to be able to correlate measured and simulated field values. The model was imported in XFDTD™ from a CAD model that is commercially available at http://www.3dcadbrowser.com/
- Antenna. We used a straight wire, even when the gain antenna has a base coil for tuning. All the coil does is compensating for excess capacitance due to the antenna being slightly longer than half a wavelength. We do not need to do that in the model, as we used normalization with respect to the net radiated power, which is determined by the input resistance only. In this way, we neglect mismatch losses and artificially produce an overestimation of the SAR, thereby introducing a conservative bias in the model. In case of low profile vertical monopole antenna (HAE6016A) which has an additional horizontal metal circular disk at the tip, the disk was included in the model and well represented in 5 mm resolution mesh.
- Antenna location. We used the same location, relative to the edge of the car trunk, the backseat, or the roof, used in the MPE measurements. The following pictures show a lateral and a perspective view of the whole model (XFDTD™ does not show wires in this type of view, that is why the antenna is not visible).



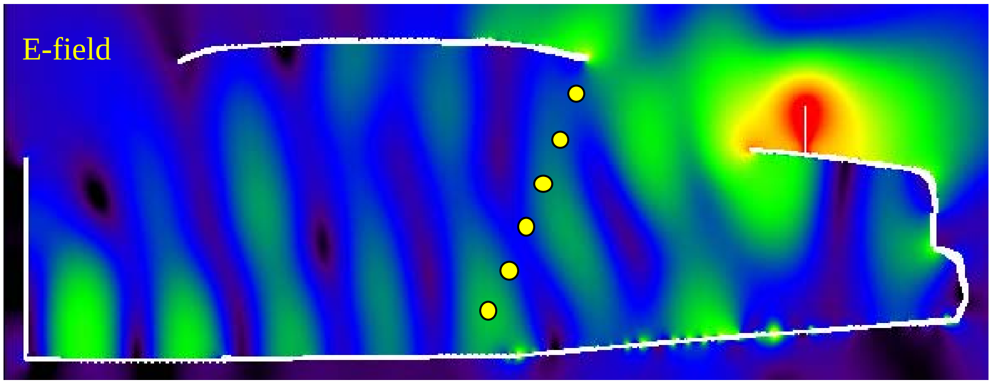


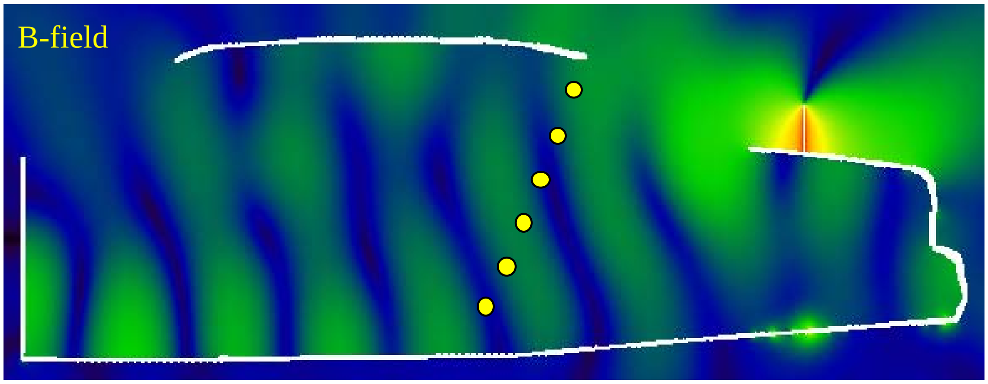
The car model is constituted by perfect electric conductor and does not include wheels in order to reduce its complexity. The passenger model is surrounded by air, as the seat, which is made out of poorly conductive fabrics, is not included in the computational model. The passenger and bystander models were validated for similar antenna and frequency conditions by comparing the MPE measurements at UHF frequencies (421.5 MHz and 425 MHz) for similar antennas used for a UHF mobile radio. The comparison results are presented below, according to following definitions for the equivalent power densities (based on E or H-field):

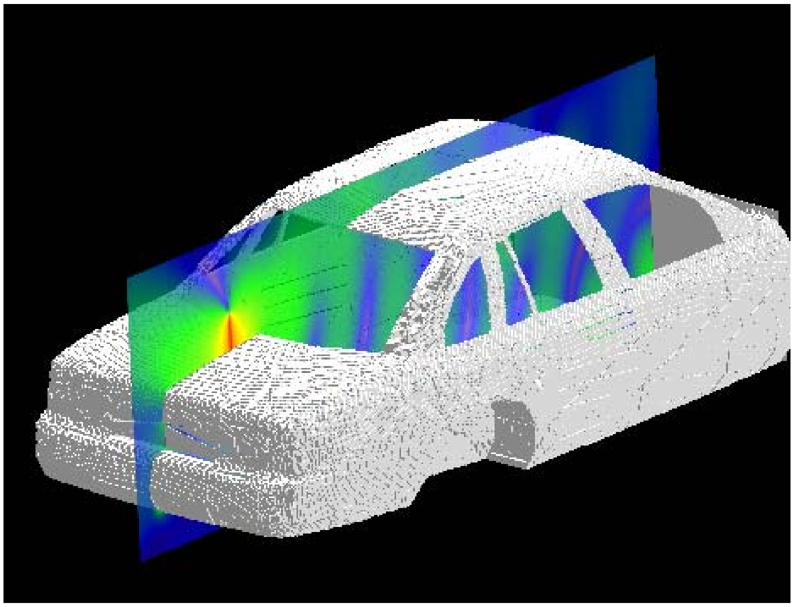
$$S_E = \frac{|\mathbf{E}|^2}{2\eta}, \quad S_H = \frac{\eta}{2}|\mathbf{H}|^2, \quad \eta = 377\ \Omega$$

Passenger with 17.5 cm monopole antenna (HAE4002A 421.5 MHz)

The following figure of the test model shows the car model, where the yellow dots individuate the back seat, as it can be observed from the other figure showing the cross section of the passenger. The comparison has been performed by taking the average of the computed steady-state field values at the six dotted locations, corresponding to the head, chest, and legs along the yellow dots line, and comparing them with the average of the MPE measurements performed at the head, chest and legs locations. Such a comparison is carried out at the same average power level (22 W, including the 50% duty factor) used in the MPE measurements.







The equivalent power density (S) is computed from the E-field and the H-field separately. The following table reports the E-field values computed by XFDTD™ at the six locations, and the corresponding power density.

Location Number	E-field, V/m	Eq. Power Density 1.0 V source	Scaled Power Dens. 22 W output, mW/cm^2
1	5.83E-01	4.51E-04	4.41E-01
2	6.31E-01	5.28E-04	5.16E-01
3	6.50E-01	5.60E-04	5.48E-01
4	5.50E-01	4.01E-04	3.92E-01
5	4.50E-01	2.69E-04	2.63E-01
6	7.80E-01	8.07E-04	7.89E-01
Equivalent average Power Density			**4.92E-01**

Location Number	B-field, Weber/m2	Eq. Power Density 1.0 V source	Scaled Power Dens. 22 W output, mW/cm^2
1	2.26E-09	0.00061	5.96E-01
2	9.00E-10	0.00010	9.45E-02
3	1.20E-09	0.00017	1.68E-01
4	2.20E-09	0.00058	5.65E-01
5	1.90E-09	0.00043	4.21E-01
6	9.00E-10	0.00010	9.45E-02
Equivalent average Power Density			**3.23E-01**

The input impedance is 36.2+j24.8 ohm, therefore the radiated power (considering the mismatch to the 50 ohm unitary voltage source) is 2.25E-3 W, therefore a factor equal to 9779 is required to scale up to 22 W radiated. The corresponding scaled-up power densities are reported in the tables above, which show that the simulation overestimates the average power density from the MPE measurements (0.29 mW/cm^2), as derived from the measured E-field reported in the following table:

Position	**SE (meas), 22 W output mW/cm^2**
Head	0.38
Chest	0.33
Lower Trunk	0.16

The simulations tend to overestimate the average power density levels, which is understandable since there are no ohmic losses and perfect impedance matching is enforced in the computational models. Based on these results, we conclude that the simulation will produce slight exposure overestimates (about12%).

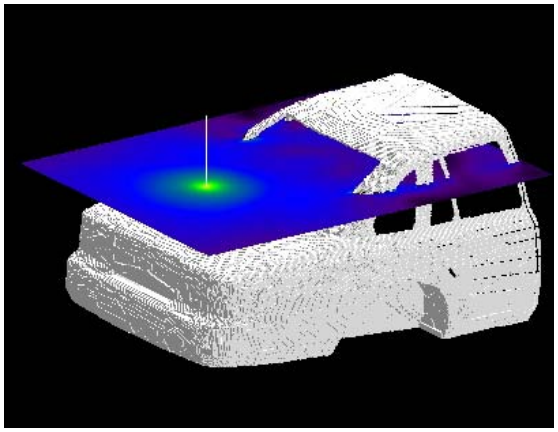
b) Descriptions and illustrations showing the correspondence between the modeled test device and the actual device, with respect to shape, size, dimensions and near-field radiating characteristics, are found in the main report.

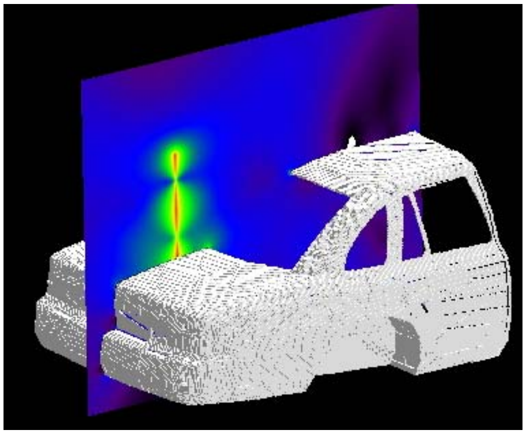
c) Verification that the test device model is equivalent to the actual device for predicting the SAR distributions descends from the fact that the car and antenna size and location in the numerical model correspond to those used in the measurements.

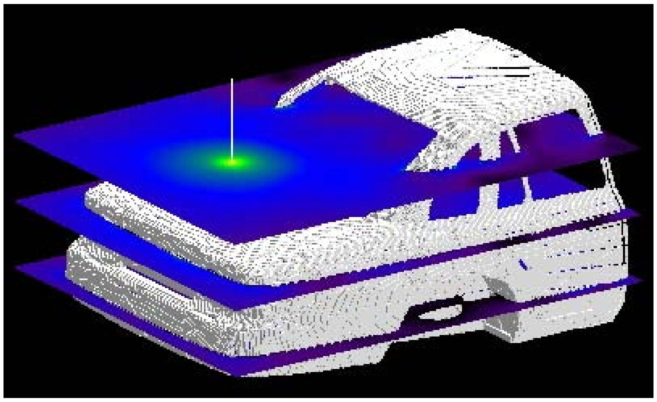
d) The peak SAR is in the neck region for the passenger, which is in line with MPE measurements and predictions.

Passenger with 63.5 cm monopole antenna (HAE6010A 425 MHz)

The following figures show the car model with the field distribution in the horizontal planes where the MPE measurements have been performed. The comparison has been performed by taking the average of the computed steady-state field values at the three locations, corresponding to the head, chest, and lower trunk, and comparing them with the average of the MPE measurements performed at the head, chest and lower trunk locations. Such a comparison is carried out at the same average power level (61.5 W, including the 50% duty factor) used in the MPE measurements.







The equivalent power density (S) is computed from the E-field. The following table reports the E-field values computed by XFDTD™ at the three locations, and the corresponding power density.

Location Number	E-field, V/m	Eq. Power Density 1.0 V source	Scaled Power Dens. 61.5 W output, mW/cm^2
1	2.10E-01	5.85E-05	0.561
2	3.66E-01	1.78E-04	1.70
3	1.72E-01	3.92E-04	0.376
Equivalent average Power Density			**0.88**

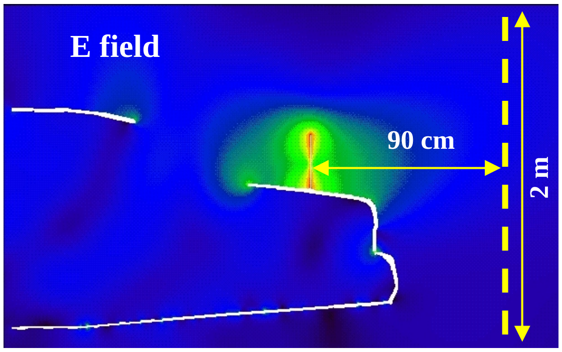
The corresponding scaled-up power densities are reported in the tables above, which show that the simulation overestimates the average power density from the MPE measurements (0.52 mW/cm^2), as derived from the measured E-field reported in the following table:

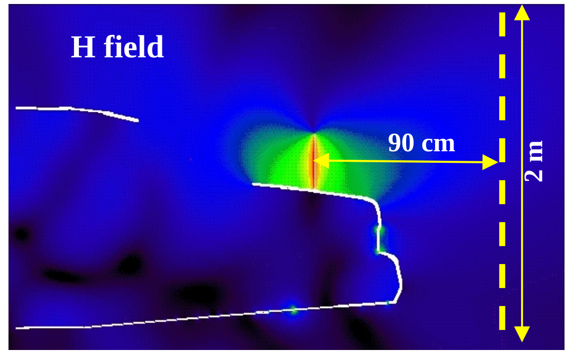
Position	**SE (meas), 60 W output mW/cm^2**
Head	0.72
Chest	0.64
Lower Trunk	0.19

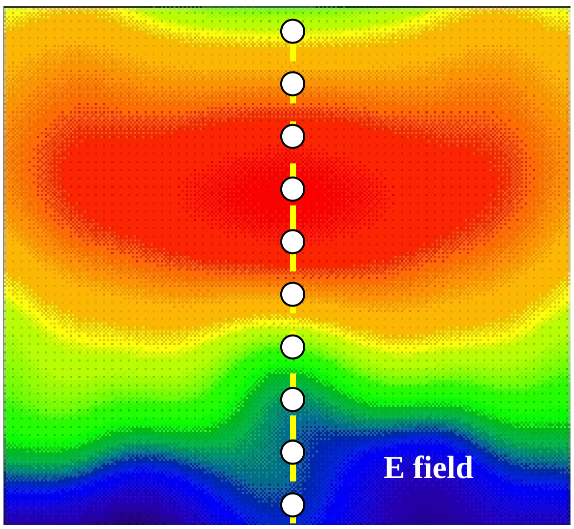
The simulations tend to overestimate the average power density levels, which is understandable since there are no ohmic losses and perfect impedance matching is enforced in the computational models. Based on these results, we conclude that the simulation will produce exposure overestimates (about 69%).

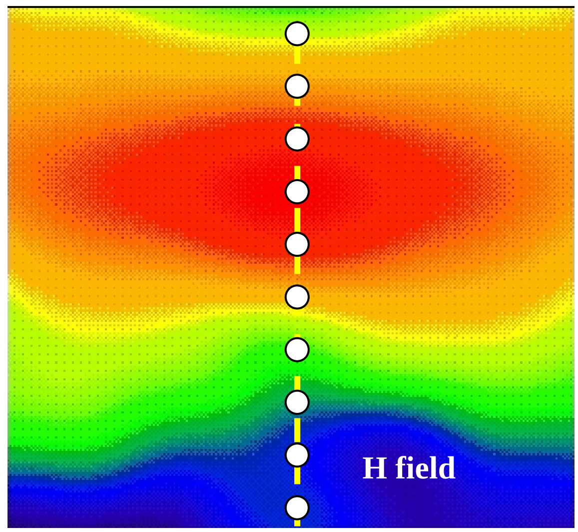
Bystander with 29 cm monopole antenna (HAE6013A 425 MHz)

The following figures show the E-field and H-field distributions across a vertical plane passing for the antenna and cutting the car in half. As done in the measurements, the MPE is computed from both E-field and H-field distributions, along the yellow dotted line at 10 points spaced 20 cm apart from each other up to 2 m in height. These lines and the field evaluation points are approximately indicated in the figures. The E-field and H-field distributions in the vertical plane placed at 90 cm from the antenna, behind the case, are shown as well. The points where the fields are sampled to determine the equivalent power density (S) are approximately indicated by the white dots. A picture of the antenna is not reported because it is identical to the HAE6013A.





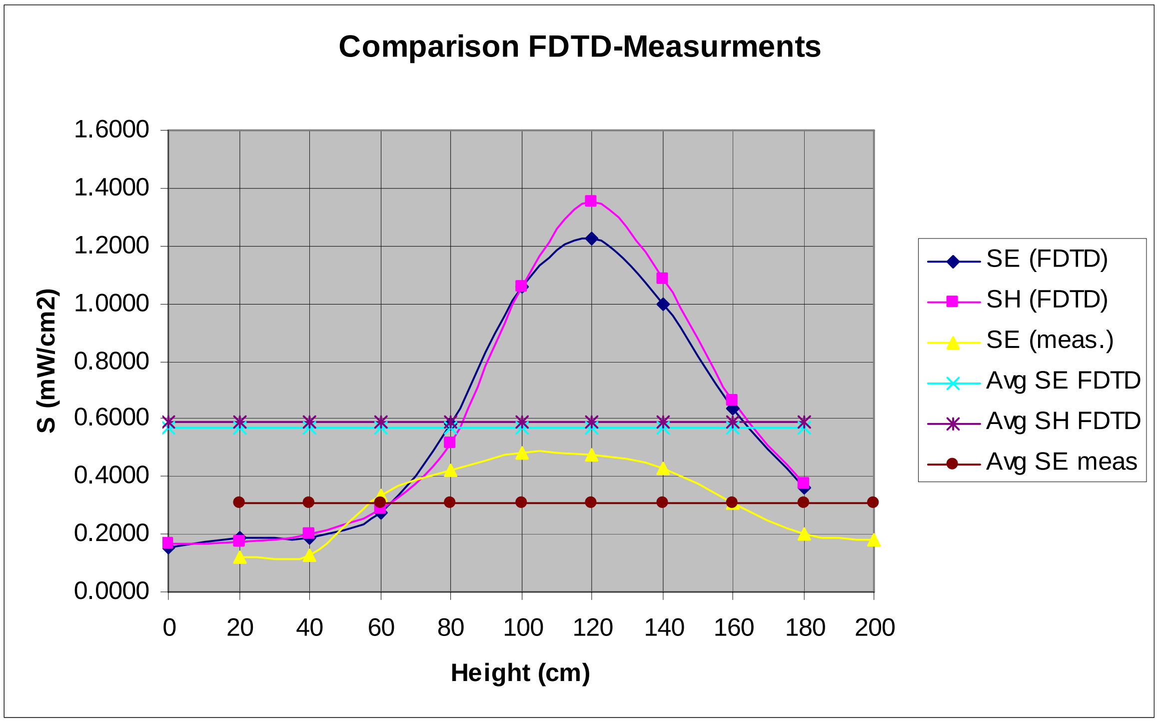




The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

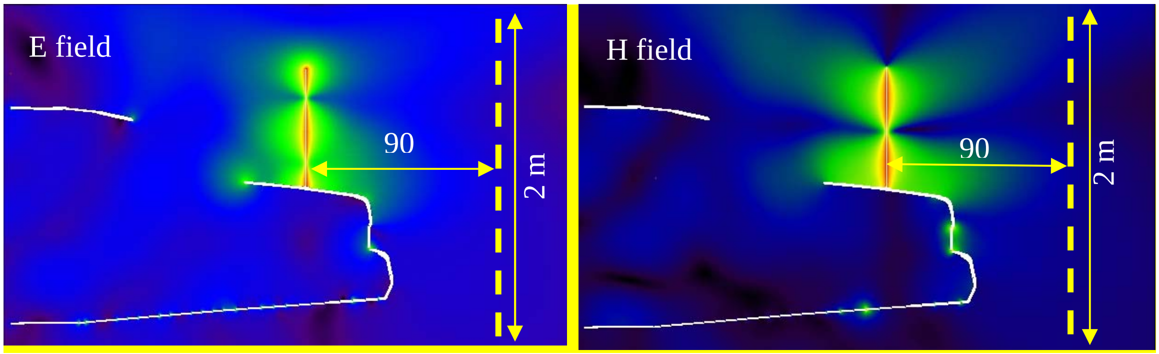
Height (cm)	E (V/m)	S_E (W/m^2)	H (A/m)	S_H (W/m^2)
0	1.05E-01	1.46E-05	2.90E-05	1.589E-05
20	1.14E-01	1.72E-05	2.90E-05	1.598E-05
40	1.16E-01	1.78E-05	3.14E-05	1.871E-05
60	1.39E-01	2.56E-05	3.75E-05	2.669E-05
80	2.03E-01	5.47E-05	5.03E-05	4.795E-05
100	2.73E-01	9.88E-05	7.23E-05	9.923E-05
120	2.94E-01	1.15E-04	8.17E-05	1.266E-04
140	2.65E-01	9.31E-05	7.32E-05	1.016E-04
160	2.12E-01	5.96E-05	5.73E-05	6.219E-05
180	1.60E-01	3.40E-05	4.32E-05	3.531E-05
Average S_E		**5.302E-05**	**Average S_H**	**5.501E-05**

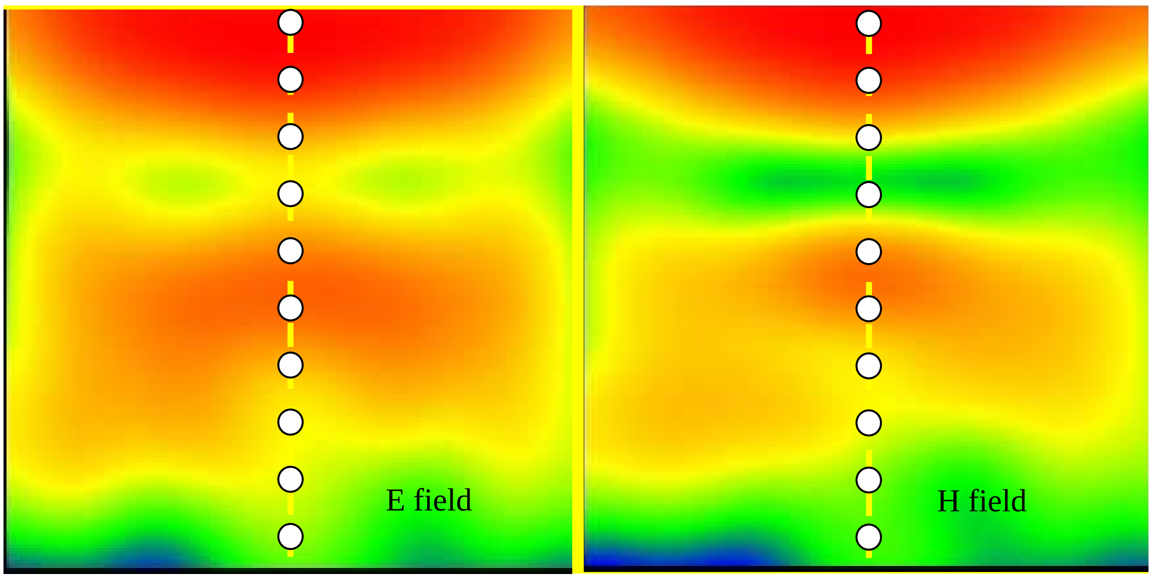
Since the conducted power during the MPE measurement was 123 W the calculated power density was then scaled up for 61.5 W radiated power (taking into account 50% talk time). This model does not include the mismatch loss, loss in the cable and finite conductivity of the car surface and as represents a conservative model for exposure assessment. The scaled-up power density values for 61.5 W radiated power are 5.67 W/m^2 (E), and 5.88 W/m^2 (H), that correspond to 0.57 mW/cm^2 (E), and 0.59 mW/cm^2 (H). Measurements yielded average power density of 0.309 mW/cm^2 (E), which shows that the calculated power density is overestimated. The following graph shows a comparison between the measured power density and the simulated one, based on E or H fields, normalized to 61.5 W radiated power.



<u>Bystander with 63.5 cm monopole antenna (HAE6010A 425 MHz)</u>

The following figures show the E-field and H-field distributions across a vertical plane passing for the antenna and cutting the car in half. As done in the measurements, the MPE is computed from both E-field and H-field distributions, along the yellow dotted line at 10 points spaced 20 cm apart from each other up to 2 m in height. These lines and the field evaluation points are approximately indicated in the figures. The E-field and H-field distributions in the vertical plane placed at 90 cm from the antenna, behind the case, are shown as well. The points where the fields are sampled to determine the equivalent power density (S) are approximately indicated by the white dots. A picture of the antenna is not reported because it is identical to the HAE6010A.

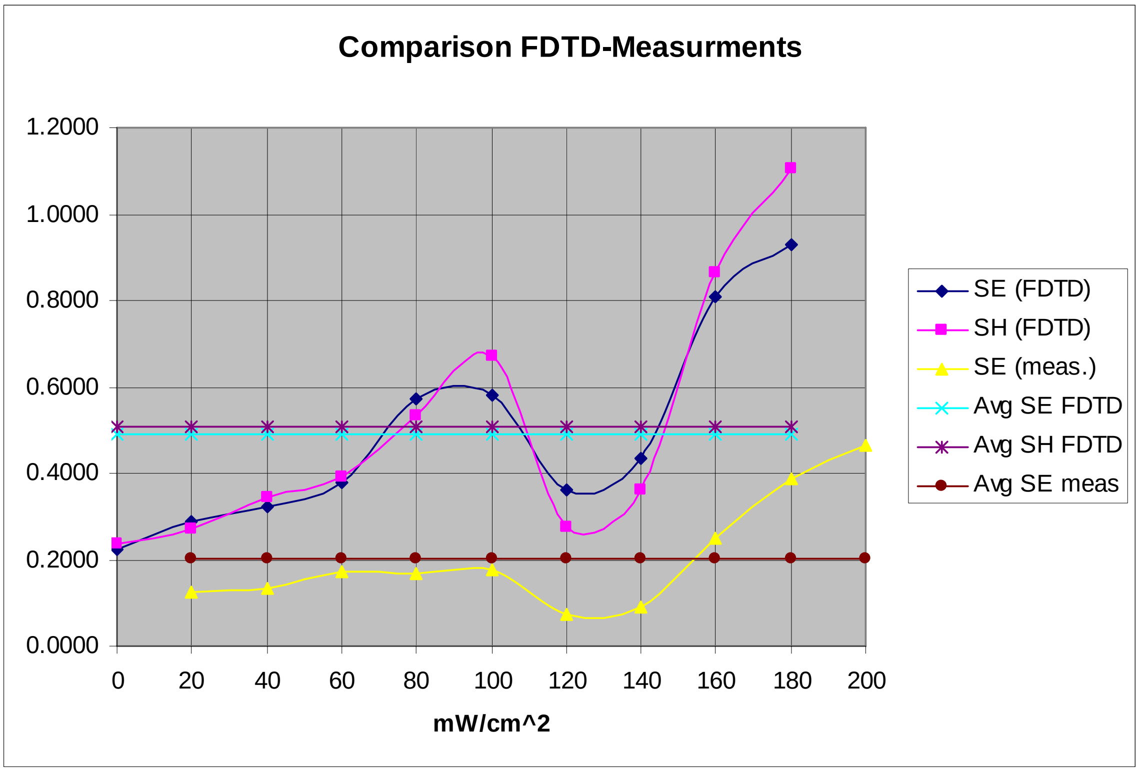




The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

Height (cm)	E (V/m)	S_E (W/m^2)	H (A/m)	S_H (W/m^2)
0	1.32E-01	2.31E-05	4.51E-10	2.43E-05
20	1.49E-01	2.94E-05	4.82E-10	2.77E-05
40	1.58E-01	3.31E-05	5.44E-10	3.53E-05
60	1.71E-01	3.88E-05	5.79E-10	4.00E-05
80	2.10E-01	5.85E-05	6.78E-10	5.48E-05
100	2.12E-01	5.96E-05	7.60E-10	6.89E-05
120	1.67E-01	3.70E-05	4.86E-10	2.82E-05
140	1.83E-01	4.44E-05	5.57E-10	3.70E-05
160	2.50E-01	8.29E-05	8.62E-10	8.86E-05
180	2.68E-01	9.53E-05	9.75E-10	1.13E-04
Average S_E		**5.38E-05**	**Average S_H**	**5.18E-05**

Since the conducted power during the MPE measurement was 123 W the calculated power density was then scaled up for 61.5 W radiated power (taking into account 50% talk time). This model does not include the mismatch loss, loss in the cable and finite conductivity of the car surface and as represents a conservative model for exposure assessment. The scaled-up power density values for 61.5 W radiated power are 5.25 W/m^2 (E), and 5.06 W/m^2 (H), that correspond to 0.52 mW/cm^2 (E), and 0.51 mW/cm^2 (H). Measurements yielded average power density of 0.204 mW/cm^2 (E), which shows that the calculated power density is overestimated. The following graph shows a comparison between the measured power density and the simulated one, based on E or H fields, normalized to 61.5 W radiated power.



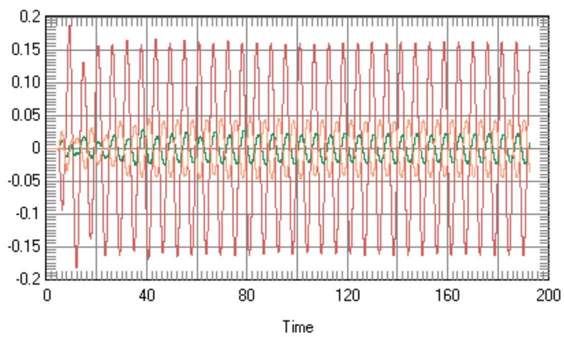
7) Test device positioning

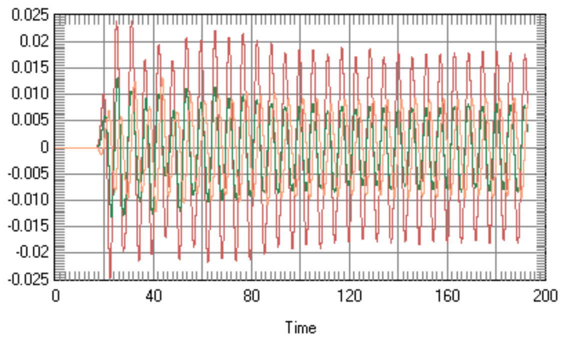
a) A description of the device test positions used in the SAR computations is provided in the SAR report.

b) Illustrations showing the separation distances between the test device and the phantom for the tested configurations are provided in the SAR report.

8) Steady state termination procedures

a) The criteria used to determine that sinusoidal steady-state conditions have been reached throughout the computational domain for terminating the computations are based on the monitoring of field points to make sure they converge. The simulation projects were set to automatically track the field values throughout computational domain by means of XFDTD simulation control feature which ensures that "*convergence is reached when near-zone data shows a constant amplitude sine wave – when all transients have died down and the only variation left is sinusoidal. In this case "convergence" is tested on the average electric field in the space for its deviation from a pure sine wav. XFDTD automatically places points throughout the space for this purpose*." [XFDTD Reference Manual, version. 6.4]. This convergence threshold was set to -40 dB.
In addition for at least one passenger and one bystander exposure condition, we placed one "field sensor" near the antenna, others between the body and the domain boundary at different locations, and one inside the head of the model. In all simulations, isotropic E-field sensors were placed at opposite corners of the computational domain. We used isotropic E and H field "sensors", meaning that all three components of the fields are monitored at these points. The following figures show an example of the time waveforms at the field point sensors in the in two opposite points in the computational domain. We selected points near the lowest and highest grid index points. They are shown together in the figure. The highest field levels are observed for the higher index point, as it is closer to the antenna. In all cases, the field reaches the steady-state after a few cycles.





c) The XFDTD™ algorithm determines the field phasors by using the so-called "two-equations two-unknowns" method. Details of the algorithm are explained in [7].

9) Computing peak SAR from field components

a) The twelve E-field phasors at the edges of each Yee voxel are combined to yield the SAR associated to that voxel. In particular, the average is performed on the SAR values computed at the 12 edges of each voxel. Notice that in XFDTD™ the dielectric tissue properties are assigned to the voxel edges, thereby allowing said averaging procedure.

b) The IEEE Standards Coordinating Committee 34, Sub-Committee 2 draft standard P1529 (June 2000) discusses several algorithms for volumetric SAR averaging. It states that "It is observed that while the 12 components algorithm is the most appropriate from the mathematical point of view, the differences in 1g SAR calculated with either the 12 or 6 component methods are negligible for practical mesh resolutions (below 5mm). On the other hand, it is shown that the 3 components approach may lead to significant errors." XFDTD™ employs the 12-component method, which is the one recommended in the draft standard, thus providing the best achievable accuracy.

10) One-gram averaged SAR procedures

a) XFDTD™ computes the Specific Absorption Rate (SAR) in each complete cell containing lossy dielectric material and with a non-zero material density. To be considered a complete cell, the twelve cell edges must belong to lossy dielectric materials. The averaging calculation uses an interpolation scheme for finding the averages. Cubical spaces centered on a cell are formed and the mass and average SAR of the sample cubes are found. The size of the sample cubes increases until the total mass of the enclosed exceeds either 1 or 10 grams. The mass and average SAR value of each cube is saved and used to interpolate the average SAR values at either 1 or 10 grams. The interpolation is performed using two methods (polynomial fit and rational function fit) and the one with the lowest error is chosen. The sample cube must meet some conditions to be considered valid. The cube may contain some non-tissue cells, but some checks are performed on the distribution of the non-tissue cells. A valid cube will not contain an entire side or corner of non-tissue cells.

b) The sample cube increases in odd-numbered steps (1x1x1, 3x3x3, 5x5x5, etc) to remain centered on the desired cell. Since the visible human model employed herein has 5 mm resolution, the one-gram SAR is computed by averaging first over 1x1x1 voxels, corresponding to 0.125 cm^3 (not enough yet), and then over a 3x3x3 voxel cube, corresponding to about 3.4 cm^3, which is enough to include 1-g, and finally over a 5x5x5 voxel cube, corresponding to about 15.6 cm^3, which includes 10-g. The 1-g average SAR is computed by interpolating these three data points. This procedure is repeated in the surroundings of each voxel that is constituted by lossy materials, so as to determine the 1-g and/or 10-g SAR distributions.

c) As mentioned at points 10(a) and 10(b), the 1- gram average SAR is determined by interpolating the average SAR for the 1x1x1 , 3x3x3, and the 5x5x5 data points, corresponding to 0.125 cm^3, 3.4 cm^3, and 15.6 cm^3, respectively. Because the interpolation is carried out across three data points, the error introduced should be negligible because the interpolating curve crosses exactly the data points.

11) Total computational uncertainty – We derived an estimate for the uncertainty of FDTD methods in evaluating SAR by referring to [6]. In Fig. 7 in [6] it is shown that the deviation between SAR estimates using the XFDTD™ code and those measured with a compliance system are typically within 10% when the probe is away from the phantom surface so that boundary effects are negligible. In that example, the simulated SAR always exceeds the measured SAR.

As discussed in 6(a), a conservative bias has been introduced in the model so as to reduce concerns regarding the computational uncertainty related to the car modeling, antenna modeling, and phantom modeling. The results of the comparison between measurements and simulations presented in 6(a) suggest that the present model produces an overestimate of the exposure between 4% and 36%. Such a conservative bias should eliminate the need for including uncertainty considerations in the SAR assessment.

12) Test results for determining SAR compliance

a) Illustrations showing the SAR distribution of dominant peak locations produced by the test transmitter, with respect to the phantom and test device, are provided in the SAR report.

b) The input impedance and the total power radiated under the impedance match conditions that occur at the test frequency are provided by XFDTD™. XFDTD™ computes the input impedance by following the method outlined in [8], which consists in performing the integration of the steady-state magnetic field around the feed point edge to compute the steady-state feed point current (I), which is then used to divide the feed-gap steady-state voltage (V). The net average radiated power is computed as

$$P_{XFDTD} = \frac{1}{2}\operatorname{Re}\left\{VI^*\right\}$$

Both the input impedance and the net average radiated power are provided by XFDTD™ at the end of each individual simulation.

We normalize the SAR to such a power, thereby obtaining SAR per radiated Watt (*normalized SAR*) values for the whole body and the 1-g SAR. Finally, we multiply such normalized SAR values times the max power rating of the device under test. In this way, we obtain the exposure metrics for 100% talk-time, i.e., without applying source-based time averaging.

c) For mobile radios, 50% source-based time averaging is applied by multiplying the SAR values determined at point 12(b) times a 0.5 factor.

REFERENCES

[1] K. S. Yee, "Numerical Solution of Initial Boundary Value Problems Involving Maxwell's Equations in Isotropic Media," *IEEE Transactions on Antennas and Propagation*, vol. 14, no. 3, 302-307, March 1966.

[2] Z. P. Liao, H. L. Wong, G. P. Yang, and Y. F. Yuan, "A transmitting boundary for transient wave analysis," Scientia Sinica, vol. 28, no. 10, pp 1063-1076, Oct. 1984.

[3] Validation exercise: Mie sphere. Remcom Inc. (enclosed PDF)

Remcom.pdf

[4] NEC-Win PRO ™ v 1.1, Nittany Scientific, Inc., Riverton, UT.

[5] C. M. Collins and M. B. Smith, "Calculations of B1 distribution, SNR, and SAR for a surface coil against an anatomically-accurate human body model," *Magn. Reson. Med.*, 45:692-699, 2001. (enclosed TIF)

Collins & Smith.pdf

[6] Martin Siegbahn and Christer Törnevik, "Measurements and FDTD Computations of the IEEE SCC 34 Spherical Bowl and Dipole Antenna," Report to the IEEE Standards Coordinating Committee 34, Sub-Committee 2, 1998. (enclosed PDF)

Ericsson.pdf

[7] C. M. Furse and O. P. Gandhi, "Calculation of electric fields and currents induced in a millimeter-resolution human model at 60 Hz using the FDTD method with a novel time-to-frequency-domain conversion**,"** Antennas and Propagation Society International Symposium, 1996. (enclosed PDF)

Furse & Gandhi.pdf

[8] *The Finite Difference Time Domain Method for Electromagnetics*, Chapter 14.2, by K. S. Kunz and R. J. Luebbers, CRC Press, Boca Raton, Florida, 1993.

[9] *Validation of Mobile Antenna Modeling by Comparison with Near-field Measurements*," Report to the IEEE Standards Coordinating Committee 34, Sub-Committee 2, 2006. (enclosed PDF)

IEEE1528_2_vld.pdf

[10] *Antenna Theory: analysis and design*, Chapter 4, by C. A. Balanis, 2nd ed. John Wiley & Sons, Inc.