MOTOROLA

ACCREDITED

TESTING CERT # 2518.01

FCC ID: ABZ99FT4083
DECLARATION OF COMPLIANCE: MPE ASSESSMENT

Government & Public Safety
EME Test Laboratory
8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

Date of Report: March 27, 2008
Report Revision: Rev. A
Report ID: FCC MPE rpt_PMUE3076A_UHF_R2_Rev A_080327_SR6161

Responsible Engineer:	Kim Uong (Principle Staff EME Eng.)
Date/s Tested:	3/12/08-3/17/08
Manufacturer/Location:	Penang, Malaysia
Date submitted for test:	2/19/08
DUT Description:	UHF Range 2, 450-527 MHz, 1-40W (limited to 25W above 512 MHz) radio with internal GPS using a mid-tier control head and a mini-U connector
Test TX mode(s):	CW
Max. Power output:	48 Watts (30 Watts above 512 MHz)
TX Frequency Bands:	450-527 MHz
Signaling type:	CW using FM and 2:1 TDMA using 4FSK
Model(s) Tested:	PMUE3076A
Model(s) Certified:	PMUE3076A
Serial Number(s):	038TJA2844
Classification:	Occupational Controlled (Operator); General Population/Uncontrolled (Passengers/Bystanders)
Rule Part(s):	90

DUT Photo
(Refer To
Exhibit 7B)

Approved Accessories:
Antenna(s):
HAE4003A (450-470MHz, 1/4 Wave, 0dBd Gain, Mini-U)
HAE4004A (470-527 MHz, 1/4 Wave, 0dBd Gain, Mini-U)
HAE6022A (403-527 MHz, 1/2 Wave, 2dBd Gain, Mini-U)
HAE4011A (450-470MHz, 5/8 Wave, 3.5dBd Gain, Mini-U)
HAE4012A (470-494 MHz, 5/8 Wave, 3.5dBd Gain, Mini-U)
HAE4013A (494-512 MHz, 5/8 Wave, 3.5dBd Gain, Mini-U)
RAE4004ARB (445-470MHz, 5/8 Wave, 5dBd Gain, Mini-U)

PMAE4031A (450-470 MHz 1/4 Wave, 0dBd Gain, Combo GPS/Mini-U)
HAE6020A (470-527 MHz 1/4 Wave, 0dBd Gain, Combo GPS/Mini-U)
HAE6019A (403-527 MHz 1/2 Wave, 2dBd Gain, Combo GPS/Mini-U)
HAE6024A (470-494 MHz 5/8 Wave, 3.0dBd Gain, Combo GPS/Mini-U)
HAE6026A (494-512 MHz 5/8 Wave, 3.0dBd Gain, Combo GPS/Mini-U)
PMAE4033A (450-470 MHz 5/8 Wave, 3.5dBd Gain, Combo GPS/Mini-U)
PMAE4034A (445-470 MHz 5/8 Wave, 5dBd Gain, Combo GPS/Mini-U)

Final RF Exposure Result:
Max. Calc. : 1-g Avg. SAR: 0.361 W/kg;

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 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 G&PS EME Lab Senior Resource Manager,
Laboratory Director,

Approval Date: 03/27/2008

Certification Date: 03/27/2008

Certification No.: L1080323P

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REVISION HISTORY

Date	Revision	Comments
3/26/08	O	Initial released
3/27/08	A	Cover page, DUT Photo (refer To Exhibit 7B) was not printable in Rev O. Rev A fixed this.

1.0 Product and System Description

FCC ID: ABZ99FT4083, model PMUE3076A is a mobile transceiver that utilizes both analog and digital two-way radio communications and also includes GPS capability. The modulation scheme used for analog is narrowband Frequency Modulation (FM). The modulation scheme used for digital is 4 Level Frequency Shift Keying (4FSK) and 2:1 Time Division Multiple Access (TDMA). TDMA is used to allocate portions of the RF signal by dividing time into two slots. Transmission from a unit or base station is accommodated in time-slot lengths of 30 milliseconds and frame lengths of 60 milliseconds.

The intended use of the radio is Push-To-Talk (PTT) while the device is properly installed in a vehicle with an external antenna mounted at the center of 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 “By-standers” as used herein mean people other than operator)

2.0 Additional Options and Accessories

NA

3.0 Measurement and Limit Standards

Measurements were performed according to the recommended guidelines in IEEE/ANSI C95.3-2002 and compared to FCC Limits Per 47 CFR 2.1091 (d) for General Population/Uncontrolled RF Exposure.

For test frequencies ranging from 450-527MHz the MPE (Maximum Permissible Exposure) limit to electromagnetic energy in equivalent plane wave free-space power density is 0.30-0.35mW/cm^2 and calculated using the formula f/1500.

4.0 Data Collection Consideration

Power density testing was performed with DUT installed in a 1991 Ford Taurus (4-door). Measurement data was taken with the vehicles' electrical system powered by an equivalent source equal to the vehicle running at idle and the vehicle battery measuring 13.8 volts.

5.0 Measurement System Uncertainty Levels

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	

6.0 Method of Measurement

6.1 EME measurements made with trunk mounted antenna(s)

(For reference, see Illustration of antenna location and test distances in APPENDIX A)

6.1.1 External/Bystander vehicle EME measurement

(Antenna mounted at trunk center)

MPE measurements for bystander conditions are determined by taking the average of (10) measurements in a 2m vertical line for each of the (3) test locations indicated in appendix A with 20cm increments at the test distance of 90cm from the antenna under test for frequencies 512MHz and below, and 60cm from the antenna under test for frequencies above 512MHz. The measurement probe sensor is rotated 180° at each of the ten incremental measurements to ensure the highest result is captured. 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 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.

For the current test vehicle, the antenna to probe sensor separation distance is 90cm (directly behind vehicle), 99.5 cm (45 degree radial) and 104 cm (90 degree radial).

Note: the distance from the trunk-mounted antenna to the edge of the vehicle is 26cm and the distance from the edge of the vehicle's trunk to the MPE vertical line assessment is 64 cm (trunk to edge of bumper is 10cm). The radial distance measured at 45˚ from corner of trunk to vertical test line is 99.5cm. The radial distance measured at 90˚ from the side of the trunk is 104cm.

6.1.2 Internal/Passenger vehicle EME measurement

(Antenna mounted at trunk center)

While rotating survey meter probe through 180 degrees to ensure that the highest level is found, scans were performed inside of the vehicle, at both front and back seating areas, across the TX band to ascertain the highest level at the head. After the highest level is found, scans were performed vertically making two (2) additional measurements within an area approximately 40cm wide (representing the width of a person) so as to have a total of three (3) measured points, indicated below, that are averaged.

a) Head area

b) Chest area

c) Lower Trunk area

6.2 EME measurements made with roof mounted antenna(s)

(For reference, see Illustration of antenna location and test distances in APPENDIX A)

6.2.1 External/Bystander vehicle EME measurement

(Antenna mounted at roof center)

MPE measurements for bystander 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 90cm from the antenna under test for frequencies 512MHz and below, and 60cm from the antenna under test for frequencies above 512MHz. The measurement probe sensor is rotated 180º at each of the ten incremental measurements to ensure the highest result is captured. These measurements are representative of persons other than the operator standing next to the vehicle.

Note: Actual test distance was 110cm (60cm from antenna to roof edge; 30cm from roof edge to edge of car door; 20cm vertical test line to car door); this is the closest distance that can be achieved to an antenna mounted to the center of the vehicle used for MPE compliance assessment.

6.2.2 Internal/Passenger vehicle EME measurement
(Antenna mounted at roof center)

While rotating survey meter probe through 180 degrees to ensure that the highest level is found, scans were performed inside of the vehicle, both at the front and back seating areas, across the TX band to ascertain the highest level in each location. After the highest level is found, two (2) additional measurements were performed vertically within an area approximately 40cm wide (representing the width of a person) so as to have a total of three (3) measured points as indicated below that are averaged.

a) Head area

b) Chest area

c) Lower Trunk area

7.0 Test Site

The test site is the Motorola open area test site located at 8000 W. Sunrise Blvd., Plantation, FL. 33322.

8.0 Measurement System/Equipment

Equipment Type	Model #	SN	Calibration Due Date
Automobile	1991 Ford Taurus, 4-Door		
Survey Meter	NARDA Model 8718B	1415	10/12/2008
Probe: E-Field (Electric Field)	NARDA Model 8722D	10014	10/12/2008

9.0 Test Unit Description

Power density measurements were performed on a representative sample of the radio model # PMUE3076A with serial number 038TJA2844. The test frequencies and associated power levels are presented in the table below.

Presented below is a summary of the tested frequencies and associated power outputs.

PMUE3076A	
Frequency (MHz)	**Po (W)**
450	47
460	47
470	47
482	47
488.5	46
494	46
498.5	46
503	48
512	47
527	29

10.0 Test Set-Up Description

The following are the mobile antenna test configurations used for this product.
(for reference, see Illustration of antenna location and test distances in the APPENDIX A)

a) The ¼ wave 0dBd gain antennas (HAE4003A and HAE4004A), ½ wave 2.0dBd gain antenna (HAE6022A), 5/8 wave 3.0dBd and gain antennas (HAE6024A and HAE6026A), 5/8 wave 3.5dBd gain antennas (HAE4011A, HAE4012A, and HAE4013A), and 5/8 wave 5.0dBd gain antenna (RAE4004A) were assessed while mounted at the center of the roof of the test vehicle.

b) The ¼ wave 0dBd gain antennas (HAE4003A and HAE4004A), ½ wave 2.0dBd gain antenna (HAE6022A), 5/8 wave 3.0dBd and gain antennas (HAE6024A and HAE6026A), 5/8 wave 3.5dBd gain antennas (HAE4011A, HAE4012A, and HAE4013A), and 5/8 wave 5.0dBd gain antenna (RAE4004A) were assessed while mounted at the center of the trunk of the test vehicle.

Assessments were made internal and external to the test vehicle at the specified distances and test locations indicated in sections 6.0, 11.0, and appendix A.

The ¼ wave 0dBd gain antennas (PMAE4031A, HAE6020A), ½ wave 2dBd gain antenna (HAE6019A), 5/8 wave 3.5dBd gain antenna (PMAE4033A), and 5/8 wave 5.0dBd gain antenna (PMAE4034A) were not assessed due to the similarity to the above tested antennas except for the combo GPS/Mini-U base.

11.0 Test Results Summary

APPENDIX D presents detailed MPE measurement information for each test configuration; person external or internal to the vehicle, TX frequency, antenna (location, model and gain), distance from antenna to probe sensor, E field measurement, calibration factor, MPE average over body, initial power, power density calc, power density max calc, IEEE/FCC controlled and uncontrolled limits, and maximum output power.

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

Below is an explanation of how the MPE results are calculated.

External to vehicle - 10 measurements are averaged over the body (*Body_Avg*).
Internal to vehicle - 3 measurements are averaged over the body (*Body_Avg*).
Narda Survey Meter measures in percent of the controlled limit. Therefore the averages over the body used in the calculations below reflect percentages.

Therefore;

$$Average\_over\_Body = Body\_Avg * Controlled\_Limit$$

$$Pwr\_Density\_Calc = Average\_over\_Body * \_Duty\_Cycle$$

$$Pwr\_Density\_Max\_Calc = Pwr\_Density\_Calc * \frac{Max\_Output\_Power}{Initial\_Output\_Power}$$

Note; For *Initial Output Power> Max_Output_Power, Max_Output_Power* / *Initial Output Power* = 1

The tables below summarize the highest MPE results of the E field test configurations for the 450-527MHz mobile. See APPENDICES A and D respectively for the indicated test locations and detailed MPE measurement data.

Table 1: MPE assessment while antennas mounted at the center of the roof of the test vehicle.

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Passenger / By-stander	Max Calc Pwr Density (mW/cm^2)	IEEE Uncontrolled Limit	% of Uncontrolled Limit
1	HAE6022A	Roof	450	E	By-stander	0.07	0.30	23%
2	HAE6022A	Roof	450	E	Passenger	0.02	0.30	7%
3	HAE6022A	Roof	488.5	E	By-stander	0.04	0.33	12%
4	HAE6022A	Roof	488.5	E	Passenger	0.02	0.33	6%
5	HAE6022A	Roof	527	E	By-stander	0.04	0.35	11%
6	HAE6022A	Roof	527	E	Passenger	0.02	0.35	6%
7	HAE4003A	Roof	450	E	By-stander	0.06	0.30	20%
8	HAE4003A	Roof	450	E	Passenger	0.02	0.30	7%
9	HAE4003A	Roof	460	E	By-stander	0.06	0.31	20%
10	HAE4003A	Roof	460	E	Passenger	0.03	0.31	10%
11	HAE4003A	Roof	470	E	By-stander	0.06	0.31	19%
12	HAE4003A	Roof	470	E	Passenger	0.03	0.31	10%
13	HAE4004A	Roof	470	E	By-stander	0.07	0.31	22%
14	HAE4004A	Roof	470	E	Passenger	0.03	0.31	10%
15	HAE4004A	Roof	498.5	E	By-stander	0.06	0.33	18%
16	HAE4004A	Roof	498.5	E	Passenger	0.03	0.33	9%
17	HAE4004A	Roof	527	E	By-stander	0.04	0.35	11%
18	HAE4004A	Roof	527	E	Passenger	0.02	0.35	6%
19	HAE4011A	Roof	450	E	By-stander	0.06	0.30	20%
20	HAE4011A	Roof	450	E	Passenger	0.01	0.30	3%
21	HAE4011A	Roof	460	E	By-stander	0.05	0.31	16%
22	HAE4011A	Roof	460	E	Passenger	0.01	0.31	3%
23	HAE4011A	Roof	470	E	By-stander	0.02	0.31	6%
24	HAE4011A	Roof	470	E	Passenger	0.00	0.31	0%
25	HAE4012A	Roof	470	E	By-stander	0.06	0.31	19%
26	HAE4012A	Roof	470	E	Passenger	0.01	0.31	3%
27	HAE4012A	Roof	482	E	By-stander	0.06	0.32	19%
28	HAE4012A	Roof	482	E	Passenger	0.01	0.32	3%
29	HAE4012A	Roof	494	E	By-stander	0.02	0.33	6%
30	HAE4012A	Roof	494	E	Passenger	0.00	0.33	0%
31	HAE4013A	Roof	494	E	By-stander	0.06	0.33	18%
32	HAE4013A	Roof	494	E	Passenger	0.01	0.33	3%
33	HAE4013A	Roof	503	E	By-stander	0.06	0.34	18%
34	HAE4013A	Roof	503	E	Passenger	0.01	0.34	3%
35	HAE4013A	Roof	512	E	By-stander	0.03	0.34	9%
36	HAE4013A	Roof	512	E	Passenger	0.00	0.34	0%

Table 1 (continue)

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Passenger / By-stander	Max Calc Pwr Density (mW/cm^2)	IEEE Uncontrolled Limit	% of Uncontrolled Limit
37	HAE6024A	Roof	470	E	By-stander	0.05	0.31	16%
38	HAE6024A	Roof	470	E	Passenger	0.02	0.31	6%
39	HAE6024A	Roof	482	E	By-stander	0.06	0.32	19%
40	HAE6024A	Roof	482	E	Passenger	0.02	0.32	6%
41	HAE6024A	Roof	494	E	By-stander	0.07	0.33	21%
42	HAE6024A	Roof	494	E	Passenger	0.03	0.33	9%
43	HAE6026A	Roof	494	E	By-stander	0.06	0.33	18%
44	HAE6026A	Roof	494	E	Passenger	0.03	0.33	9%
45	HAE6026A	Roof	503	E	By-stander	0.07	0.34	21%
46	HAE6026A	Roof	503	E	Passenger	0.02	0.34	6%
47	HAE6026A	Roof	512	E	By-stander	0.07	0.34	21%
48	HAE6026A	Roof	512	E	Passenger	0.04	0.34	12%
49	RAE4004A	Roof	450	E	By-stander	0.01	0.30	3%
50	RAE4004A	Roof	450	E	Passenger	0.00	0.30	0%
51	RAE4004A	Roof	460	E	By-stander	0.00	0.31	0%
52	RAE4004A	Roof	460	E	Passenger	0.00	0.31	0%
53	RAE4004A	Roof	470	E	By-stander	0.01	0.31	3%
54	RAE4004A	Roof	470	E	Passenger	0.00	0.31	0%

Table 2: MPE assessment while antennas mounted at the center of the trunk of the test vehicle.

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Passenger / By-stander	Max Calc Pwr Density (mW/cm^2)	IEEE Uncontrolled Limit	% of Uncontrolled Limit
55	HAE6022A	Trunk	450	E	By-stander	0.07	0.30	23%
*56	HAE6022A	Trunk	450	E	Passenger	0.31	0.30	*103%*
57	HAE6022A	Trunk	488.5	E	By-stander	0.05	0.33	15%
58	HAE6022A	Trunk	488.5	E	Passenger	0.11	0.33	34%
59	HAE6022A	Trunk	527	E	By-stander	0.08	0.35	23%
60	HAE6022A	Trunk	527	E	Passenger	0.09	0.35	26%
61	HAE4003A	Trunk	450	E	By-stander	0.08	0.30	27%
62	HAE4003A	Trunk	450	E	Passenger	0.26	0.30	87%
63	HAE4003A	Trunk	460	E	By-stander	0.08	0.31	26%
64	HAE4003A	Trunk	460	E	Passenger	0.30	0.31	98%
65	HAE4003A	Trunk	470	E	By-stander	0.08	0.31	26%
66	HAE4003A	Trunk	470	E	Passenger	0.18	0.31	57%
67	HAE4004A	Trunk	470	E	By-stander	0.09	0.31	29%
68	HAE4004A	Trunk	470	E	Passenger	0.18	0.31	57%
69	HAE4004A	Trunk	498.5	E	By-stander	0.11	0.33	33%
70	HAE4004A	Trunk	498.5	E	Passenger	0.21	0.33	63%
71	HAE4004A	Trunk	527	E	By-stander	0.10	0.35	28%
72	HAE4004A	Trunk	527	E	Passenger	0.10	0.35	28%
73	HAE4011A	Trunk	450	E	By-stander	0.07	0.30	23%
74	HAE4011A	Trunk	450	E	Passenger	0.13	0.30	43%
75	HAE4011A	Trunk	460	E	By-stander	0.05	0.31	16%
76	HAE4011A	Trunk	460	E	Passenger	0.10	0.31	33%
77	HAE4011A	Trunk	470	E	By-stander	0.02	0.31	6%
78	HAE4011A	Trunk	470	E	Passenger	0.03	0.31	10%
79	HAE4012A	Trunk	470	E	By-stander	0.08	0.31	26%
80	HAE4012A	Trunk	470	E	Passenger	0.13	0.31	41%
81	HAE4012A	Trunk	482	E	By-stander	0.07	0.32	22%
82	HAE4012A	Trunk	482	E	Passenger	0.16	0.32	50%
83	HAE4012A	Trunk	494	E	By-stander	0.02	0.33	6%
84	HAE4012A	Trunk	494	E	Passenger	0.05	0.33	15%
85	HAE6024A	Trunk	470	E	By-stander	0.07	0.31	22%
86	HAE6024A	Trunk	470	E	Passenger	0.18	0.31	57%
87	HAE6024A	Trunk	482	E	By-stander	0.10	0.32	31%
88	HAE6024A	Trunk	482	E	Passenger	0.28	0.32	87%
89	HAE6024A	Trunk	494	E	By-stander	0.12	0.33	36%
90	HAE6024A	Trunk	494	E	Passenger	0.29	0.33	88%

* Exceeds MPE General Population/Uncontrolled exposure limit

Table 2 (continue)

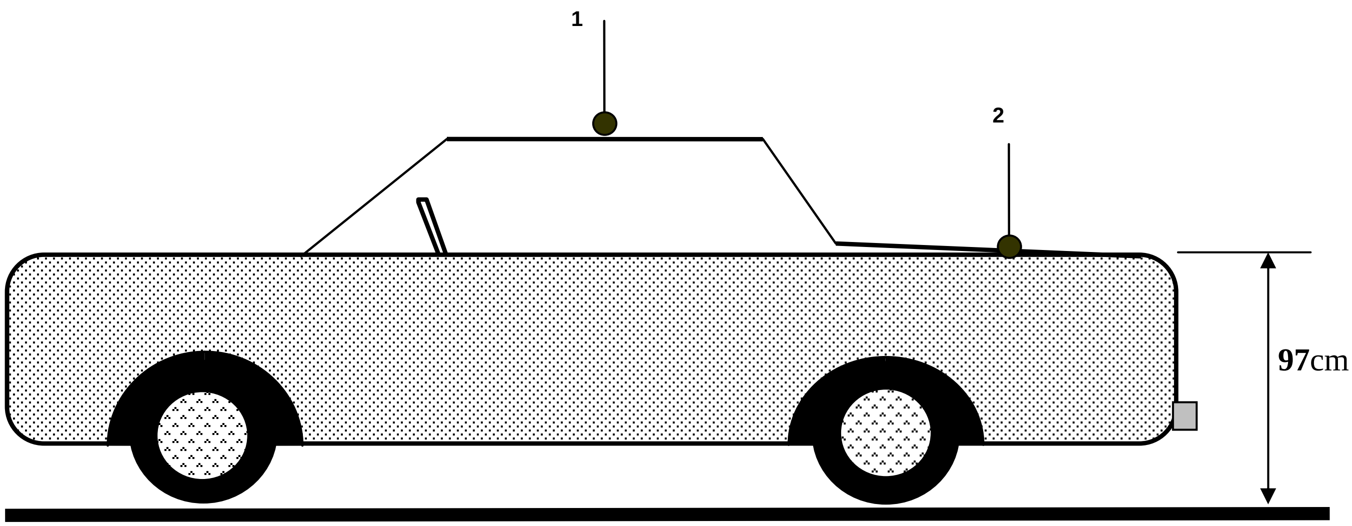
Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Passenger / By-stander	Max Calc Pwr Density (mW/cm^2)	IEEE Uncontrolled Limit	% of Uncontrolled Limit
91	HAE4013A	Trunk	494	E	By-stander	0.08	0.33	24%
92	HAE4013A	Trunk	494	E	Passenger	0.19	0.33	58%
93	HAE4013A	Trunk	503	E	By-stander	0.08	0.34	24%
94	HAE4013A	Trunk	503	E	Passenger	0.17	0.34	51%
95	HAE4013A	Trunk	512	E	By-stander	0.03	0.34	9%
96	HAE4013A	Trunk	512	E	Passenger	0.09	0.34	26%
97	HAE6026A	Trunk	494	E	By-stander	0.10	0.33	30%
98	HAE6026A	Trunk	494	E	Passenger	0.22	0.33	67%
99	HAE6026A	Trunk	503	E	By-stander	0.12	0.34	36%
100	HAE6026A	Trunk	503	E	Passenger	0.21	0.34	63%
101	HAE6026A	Trunk	512	E	By-stander	0.12	0.34	35%
102	HAE6026A	Trunk	512	E	Passenger	0.29	0.34	85%
103	RAE4004A	Trunk	450	E	By-stander	0.06	0.30	20%
104	RAE4004A	Trunk	450	E	Passenger	0.20	0.30	67%
105	RAE4004A	Trunk	460	E	By-stander	0.05	0.31	16%
106	RAE4004A	Trunk	460	E	Passenger	0.21	0.31	68%
107	RAE4004A	Trunk	470	E	By-stander	0.07	0.31	22%
108	RAE4004A	Trunk	470	E	Passenger	0.19	0.31	61%
---------- 45 Degree ---------								
109	HAE6024A	Trunk	494	E	By-stander	0.11	0.33	33%
---------- 90 Degree ---------								
110	HAE6024A	Trunk	494	E	By-stander	0.10	0.33	30%

12.0 Conclusion

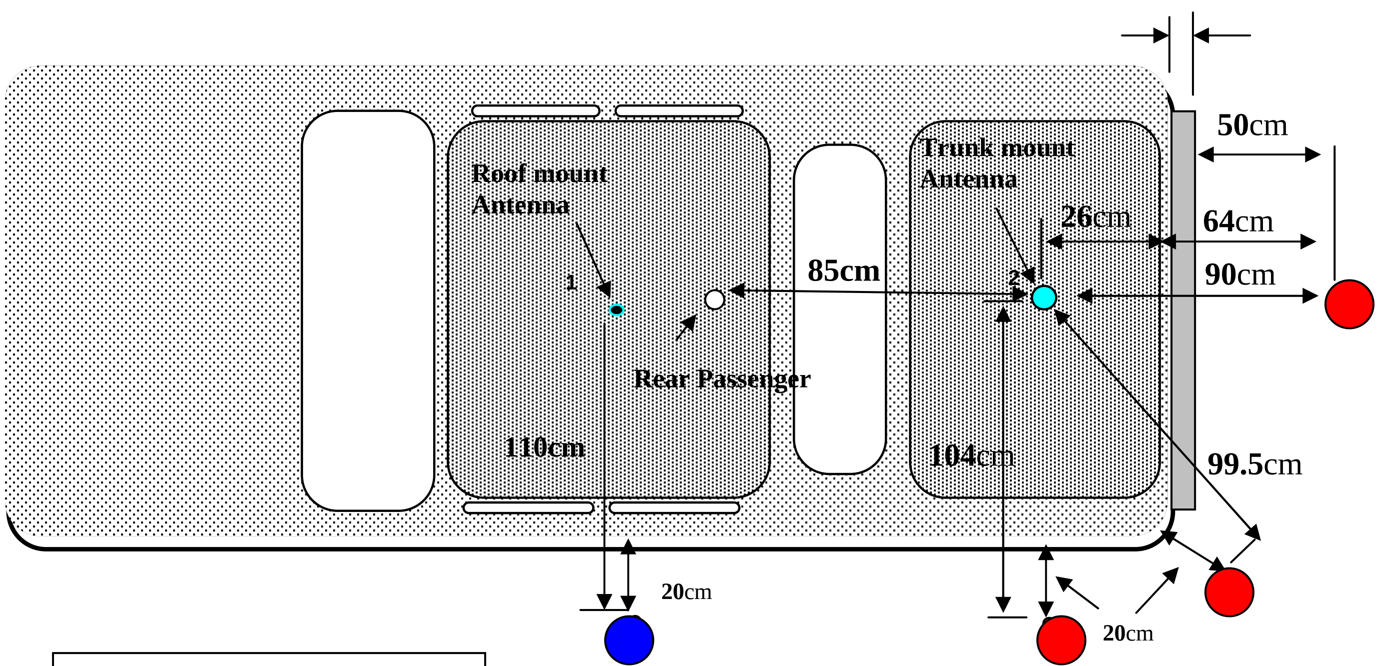
Depending on the test frequency, the PMUE3076A mobile assessments were performed with an output power range of 29.0W – 48.0W. The highest power density results for the PMUE3076A UHF mobile device scaled to the maximum allowable power output is 0.31mW/cm^2 internal to the vehicle and 0.12mW/cm^2 external to the vehicle.
These MPE results 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 the configuration exceeding the MPE limit noted in section 11.0 tables, compliance to the FCC SAR General Population/Uncontrolled limit of 1.6mW/g is demonstrated in Appendix E via SAR computational analysis.

The computation results show that this device, when used with the specified antennas, exhibit a maximum peak 1-g average SAR of 0.361mW/g.

APPENDIX A
Illustration of Antenna Locations and Test Distances



1 - Roof (center)
2 - Trunk (center)



By-Stander Test Locations

Roof Mount

Trunk Mount

Note: Test Locations

APPENDIX B
Meter/Probe Calibration Certificates

CERTIFICATION OF CALIBRATION CONFORMANCE

LIBERTY LABS, INC. 1346 Yellowwood Road Kimballton, IA 51543
EMAIL: mhoward@liberty-labs.com TEL: (712) 773-2199 FAX: (712)773-2299

This probe has been individually calibrated using IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40 GHz; IEEE Std. 1309(1996 and/or 2005). All results of this calibration relate only to the items that were calibrated.

ACCREDITATION NOTES:
A complete copy of the scope of our A2LA accreditation is available upon request.

Instrumentation Environment:	TEMP: 24°C	RH: 36%
Calibration Environment:	TEMP: 24°C	RH: 36%

Barometric Pressure (inches): 30.0
CERTIFICATE NO.: 2007100109
CLIENT: Lockheed Martin IMC, Bldg. 5100, Stennis Space Center, MS, 39529, USA
MANUFACTURER: Narda
MODEL NUMBER: B8722D & 8718B
SERIAL NUMBER: 10014 & 1415
ASSET NUMBER: BBBBC806 & BBBBC708

Liberty Labs, Inc.
(712) 773-2199
Cal By: DSG Date: 10/12/2007
Next Cal Due: 10/12/2008

DATE OF CALIBRATION: Friday, October 12, 2007
NAME OF CALIBRATING ORGANIZATION Liberty Labs, Inc.
CALIBRATED BY: DSG DSG
RE-CERTIFICATION DATE: 1 year from calibration date. This is a recommended recalibration interval but there are any number of factors that may cause the calibration item to drift out of calibration before the recommended interval has expired. Customer has been contacted concerning re-certification interval and documentation has been received and is on file.

RECEIVED STATUS	RETURNED STATUS
Received in tolerance: ✓	Returned in tolerance: ✓
	Returned limited cal.: ☐

NOTES: Below 1 GHz Liberty Labs uses a transfer standard calibrated to IEEE1309 Standards. Liberty Labs uses this transfer standard via the substitute method outlined in IEEE 1309 in a triplate test cell to calibrate probes. The uncertainty between the TEM and Triplate is minimal in this application. Client declined isotropic response testing. In/Out of tolerance based on alignment/mounting position and not on manufacturer's specifications. A probe position document is included with this certificate.

LL, Inc.

Michael W. Howard

ENGINEER IN CHARGE
MICHAEL W. HOWARD
NARTE CERTIFIED EMC ENGINEER, NO. EM C-000102-NE

A2LA ACCREDITED
Certificate Number: 2123.01

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CERTIFICATE NO: 2007100109

IN TOLERANCE/OUT OF TOLERANCE EXPLANATION:

The In Tolerance/Out of Tolerance criteria are based on one of the following conditions, of judgement of this laboratory:

1. If the manufacturer has a specified tolerance for the antenna or item under test, then the calibration results, with our uncertainty value added, are compared to this tolerance, and the combined value must fall within the manufacturer's tolerance. The tolerance may be obtained from the manufacturer's web site, catalogs specification sheets, manuals, etc.
2. In the case where the manufacturer does not have any specified tolerances, the calibration results, with our uncertainty value added, are compared to typical curves provided by the manufacturer or historical in-house data with a +/-3 dB tolerance.
3. Where results are compared to published specifications from a standard, the calibration results, with our uncertainty value added, are compared to this tolerance, and the combined value must fall within the standard's tolerance.
4. In the situation that this laboratory's uncertainty of measurement is larger than the manufacturer's specified tolerance, the comparison criteria will be based on historical in-house data as defined above. This judgement will only be made using accredited calibration methods.

INTERPRETATION TO THE GUIDANCE AND USE OF CALIBRATION DATA:

The calibration values supplied with this certificate apply to measurements made under the physical (geometric) arrangements with respect to the distances to reference points on the probe. Use of these probes under other conditions will result in additional sources of error of which is the responsibility of the user.

CALIBRATION TRACEABILITY:

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request. Measurement procedure per Military Handbook 52A as guidance for Military Standard (MIL-STD) 45662A, ANSI/NCSL Z540-1-1994, ISO/IEC 17025, and Liberty Labs, Inc. procedure CP-10.

ALIGNMENT/MOUNTING POSITION:

This calibration is valid only for the alignment/mounting position specified in this report. Any other alignment/mounting position of this probe will invalidate the correction factors given in this report. We have found the manufacturer's tolerances are only applicable to a very specific alignment/mounting postion at the manufacturer's test frequencies. Alignment/mounting position of this probe is critical and deviation from alignment/mounting position indicated in this report can produce errors in excess of 6 dB.

CERTIFICATE NO: 2007100109

CALIBRATION EQUIPMENT USED

Manufacturer	Model Number	Serial Number	Trace Number	Cal Due Date
Agilent Technologies	E4419B	GB40202746	19802	8/2/2008
Amplifier Research	100W1000	24475	N/A	
Amplifier Research	10ST1G18	306136	N/A	
Amplifier Research	DC7420	306791	2007082201	8/22/2008
Hewlett Packard	83640L	3844A00411	19821	8/14/2008
Hewlett Packard	8481A	331BA91887	18812	2/13/2008
Hewlett Packard	8487A	3318A03296	PSNA001011	6/20/2008
Hewlett Packard	8648B	3623A01961	19481	6/4/2008
Holaday	HI-4422	00052412	700480	6/1/2008
Liberty Labs, Inc.	Triplate #2	002	N/A	
Schwarzbeck	BBHA 9120D	181	2205111111	11/11/2007

FILENAME(S) OF CALIBRATION DATA CONTAINED ON DISKETTE:

A printed copy of the contents of the file names with a * are attached to this certificate.

Probe01.txt* Isotropic Probe Calibration Data, 1-11000 MHz

LL, Inc.

CERTIFICATE NO: 2007100109

Calibration Uncertainty:

Actual uncertainty (Expanded)_____

X Typical uncertainties are shown below and checked for those that apply to this calibration. Best uncertainty equals our typical Muc in most cases. Best uncertainty is based on type A evaluations of at least 10 data sets or more.

	Parameter/Equipment:	Range:	Best Uncertainty*** (+/-):	Comments:
	RF Isotropic Probes*****	10 kHz to 1 GHz	0.71 dB	GTEM/TEM cell
		(0.1 to 18) GHz	0.76 dB	GTEM/Open Ended Wave Guide
X		10 kHz to 1 GHz	1.3 dB	Stripline/Tri-Plate
X		(1 to 40) GHz	1.9 dB	Standard field
		Isotropic Response/ Linearity	0.82 dB	
		Channel Match	0.98 dB	

LL, Inc.

* This laboratory offers commercial calibration service.

** Best Uncertainties represents an expanded uncertainty corresponding to a 95.45 % level of confidence using a coverage factor, k. Values of k other than 2 were approximated by a t-distribution with the effective degrees of freedom, veff, obtained from the Welch-Satterthwaite formula.

*** "Best Uncertainty" is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards of nearly ideal measuring equipment. Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of k = 2. The best uncertainty of a specific calibration performed by the laboratory may be greater than the best uncertainty due to the behavior of the customer's device, to the environment (if the calibration is performed in the field) and to influences from the circumstances of the specific calibration.

**** In the statement of best uncertainty, M is the Mismatch error due to connections of device to other devices in actual use.

***** On-site calibration service is available for this calibration. The uncertainties achievable on a customer's site can normally be expected to be larger than the Best Measurement Capabilities (BMC) that the accredited laboratory has been assigned as Best Uncertainty on the A2LA Scope. Allowance must be made for aspects such as the environment at the place of calibration and for other possible adverse effects such as those caused by transportation of the calibration equipment. The usual allowance for the uncertainty introduced by the item being calibrated, (e.g. resolution) must also be considered and this, on its own, could result in the calibration uncertainty being larger than the BMC.

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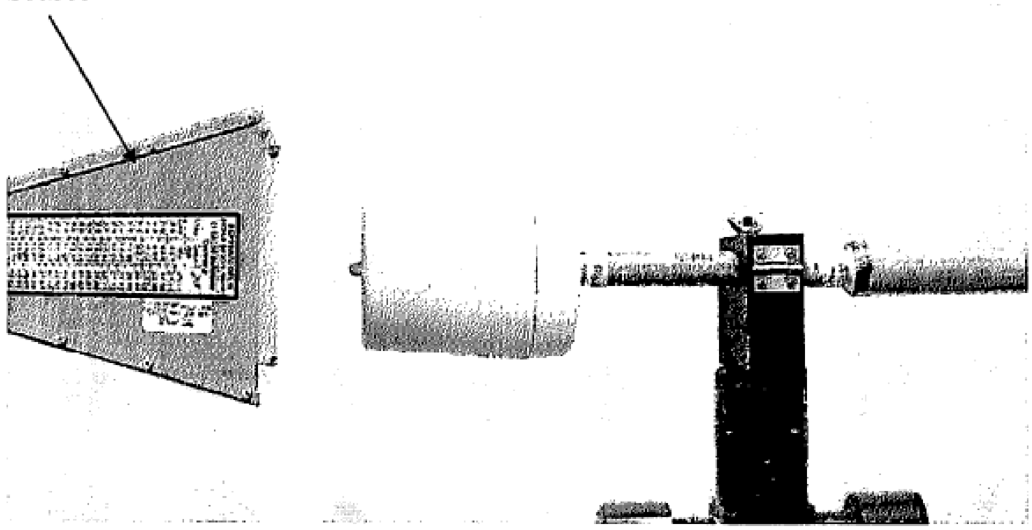
Probe Alignment/Positioning

The alignment/mounting position of the probe is critical. The correction factors given with calibration are valid only for the indicated alignment/mounting position. Deviation from indicated alignment/mounting position of calibration can produce errors in excess of 6 dB. Furthermore, additional errors of 3dB can be seen as the probe is rotated 0° to 360° around its major mounting axis

The probe was positioned with the probe wand in the horizontal position and with the probe head centered in front of the field source and pointing towards the source. The probe wand has been marked indicating the side facing up. The picture below is for probe positioning reference only. The equipment shown does not necessarily indicate the equipment used for calibration.

Source



C:\ANTHOLD\8721 Horz into source.doc

Probe01.txt

Date of Calibration: 12-October-2007
Date Printed: Friday, October 12, 2007
Customer Name: Lockheed Martin IMC
Probe Manufacturer: Narda
Probe Model: 8722B & 8718
Probe Serial No.: 10014 & 1415
Temperature (Deg C): 24
Humidity (%): 36
Notes: Calibrated with 8718 Monitor, s/n 1415.
CAL CERT #: 2007100109

	Correction Factors	
Frequency in MHz	Mutiplier	dB
1	2.04	6.21
15	1.06	0.50
30	0.65	-3.73
75	0.56	-5.10
100	0.56	-5.08
150	0.52	-5.60
200	0.56	-5.02
250	0.61	-4.34
300	0.58	-4.68
400	0.64	-3.93
500	0.80	-1.93
600	0.70	-3.14
700	0.66	-3.62
800	0.94	-0.54
900	0.84	-1.50
1000	1.22	1.69
2000	1.47	3.32
2450	1.55	3.79
3000	1.91	5.61
3500	1.89	5.53
4000	1.73	4.76
5000	0.76	-2.41
5500	0.74	-2.57
6000	0.70	-3.04
7000	1.00	-0.04
10000	1.21	1.66
10500	1.17	1.38
11000	1.34	2.57

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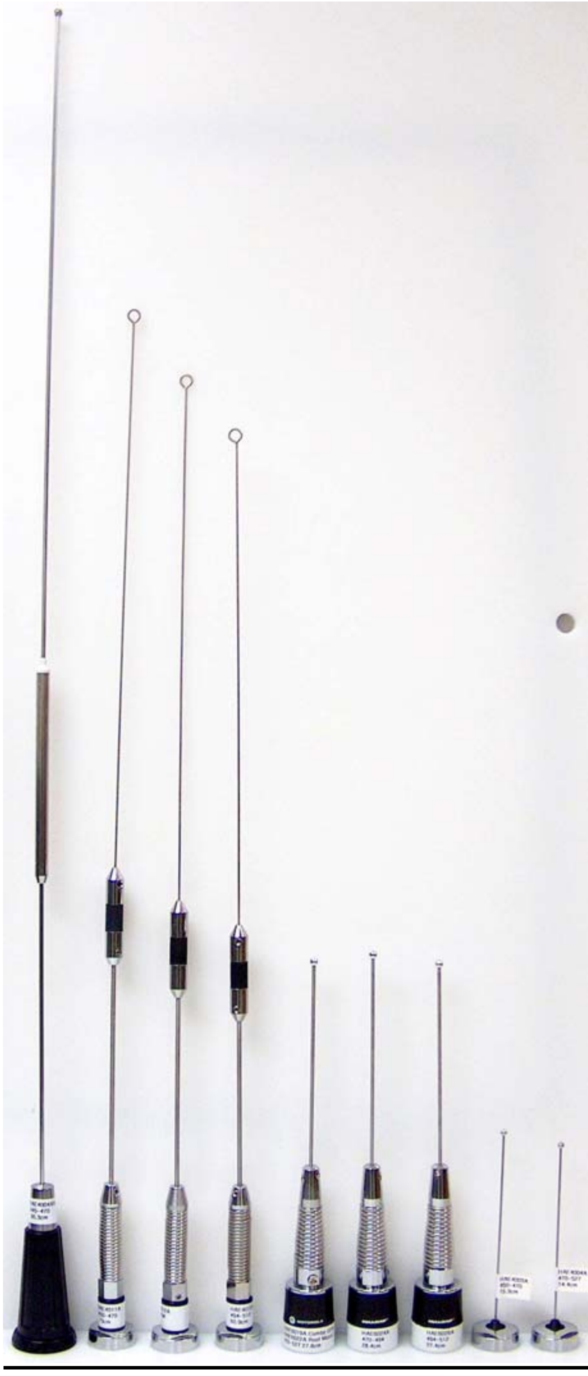
APPENDIX C
Photos of Assessed Antennas



Antenna kit numbers, from left to right;
RAE4004A, HAE4011A, HAE4012A, HAE4013A, HAE6022A, HAE6024A, HAE6026A, HAE4003A, HAE4004A.

APPENDIX D
Detailed MPE Measurement Data

Table 1

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE6022A	4.15	90	E	0.72	0.131	47.0	0.066	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.6%		6	120	5.6%		1.50	0.30
2	40	1.4%		7	140	12.4%			
3	60	3.5%		8	160	19.9%			
4	80	3.5%		9	180	20.4%			**RF Po (*Max)**
5	100	3.7%		10	200	16.6%			48.0

Table 2

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE6022A	4.15	Highest Reading	E	0.72	0.040	0.039	47.0	0.020	0.02
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.50
Back Seat		1.4%		3.4%		3.1%		IEEE Uncontrolled Limit:		0.30
Front Seat		2.3%		2.1%		3.4%			**RF Po (*Max):**	48.0

Table 3

External Vehicle MPE Assessment @ 488.5 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE6022A	4.15	90	E	0.78	0.076	46.0	0.038	0.04
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.6%		6	120	5.5%		1.63	0.33
2	40	0.8%		7	140	8.4%			
3	60	0.8%		8	160	10.3%			
4	80	1.2%		9	180	9.0%			**RF Po (*Max)**
5	100	3.6%		10	200	6.7%			48.0

Table 4

Internal Vehicle MPE Assessment @ 488.5 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6022A	4.15	Highest Reading	E	0.78	0.035	0.022	46.0	0.017	0.02
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.63
Back Seat		1.7%		3.0%		1.7%		IEEE Uncontrolled Limit:		0.33
Front Seat		1.2%		1.3%		1.5%			RF Po (*Max):	48.0

Table 5

External Vehicle MPE Assessment @ 527 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6022A	4.15	60	E	0.77	0.070	29.0	0.035	0.04
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.3%		6	120	3.8%		1.76	0.35
2	40	0.7%		7	140	5.1%			
3	60	0.9%		8	160	7.7%			
4	80	2.5%		9	180	8.6%			RF Po (*Max)
5	100	2.8%		10	200	7.5%			30.0

Table 6

Internal Vehicle MPE Assessment @ 527 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6022A	4.15	Highest Reading	E	0.77	0.040	0.014	29.0	0.020	0.02
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.76
Back Seat		2.0%		2.5%		2.2%		IEEE Uncontrolled Limit:		0.35
Front Seat		0.8%		0.7%		0.9%			RF Po (*Max):	30.0

Table 7

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4003A	2.15	90	E	0.72	0.126	47.0	0.063	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.5%		6	120	6.2%		1.50	0.30
2	40	1.6%		7	140	9.8%			
3	60	2.8%		8	160	17.9%			
4	80	4.1%		9	180	19.6%			**RF Po (*Max)**
5	100	4.4%		10	200	17.0%			48.0

Table 8

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE4003A	2.15	Highest Reading	E	0.72	0.035	0.037	47.0	0.018	0.02
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.50
Back Seat		1.9%		2.4%		2.7%		IEEE Uncontrolled Limit:		0.30
Front Seat		2.0%		2.1%		3.2%			**RF Po (*Max):**	48.0

Table 9

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4003A	2.15	90	E	0.74	0.126	47.0	0.063	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.5%		6	120	6.5%		1.53	0.31
2	40	1.1%		7	140	12.4%			
3	60	2.2%		8	160	19.4%			
4	80	2.3%		9	180	19.2%			**RF Po (*Max)**
5	100	3.3%		10	200	15.2%			48.0

Table 10

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4003A	2.15	Highest Reading	E	0.74	0.032	0.050	47.0	0.025	0.03
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.53
Back Seat		2.1%		1.5%		2.6%		IEEE Uncontrolled Limit:		0.31
Front Seat		3.0%		2.4%		4.3%			RF Po (*Max):	48.0

Table 11

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4003A	2.15	90	E	0.75	0.125	47.0	0.062	0.06
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.4%		6	120	5.7%		1.57	0.31
2	40	0.8%		7	140	12.3%			
3	60	1.6%		8	160	19.7%			
4	80	2.9%		9	180	18.9%			RF Po (*Max)
5	100	3.4%		10	200	14.0%			48.0

Table 12

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4003A	2.15	Highest Reading	E	0.75	0.035	0.056	47.0	0.028	0.03
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.57
Back Seat		2.2%		2.4%		2.1%		IEEE Uncontrolled Limit:		0.31
Front Seat		3.5%		3.0%		4.3%			RF Po (*Max):	48.0

Table 13

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4004A	2.15	90	E	0.75	0.128	47.0	0.064	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.6%		6	120	5.8%		1.57	0.31
2	40	0.8%		7	140	13.8%			
3	60	1.5%		8	160	19.5%			
4	80	2.1%		9	180	18.9%			**RF Po (*Max)**
5	100	4.0%		10	200	14.8%			48.0

Table 14

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE4004A	2.15	Highest Reading	E	0.75	0.044	0.051	47.0	0.026	0.03
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.57
Back Seat		2.9%		3.5%		2.1%		IEEE Uncontrolled Limit:		0.31
Front Seat		3.0%		2.9%		4.0%			**RF Po (*Max):**	48.0

Table 15

External Vehicle MPE Assessment @ 498.5 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4004A	2.15	90	E	0.8	0.124	46.0	0.062	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.5%		6	120	6.1%		1.66	0.33
2	40	1.0%		7	140	10.0%			
3	60	1.1%		8	160	14.3%			
4	80	1.7%		9	180	18.7%			**RF Po (*Max)**
5	100	4.8%		10	200	16.4%			48.0

Table 16

Internal Vehicle MPE Assessment @ 498.5 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4004A	2.15	Highest Reading	E	0.8	0.058	0.032	46.0	0.029	0.03
Measurement Grid										
Test Position		% of Control Limit Head	% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:			1.66
Back Seat		3.8%	4.3%		2.3%		IEEE Uncontrolled Limit:			0.33
Front Seat		1.8%	1.8%		2.2%				RF Po (*Max):	48.0

Table 17

External Vehicle MPE Assessment @ 527 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4004A	2.15	60	E	0.77	0.081	29.0	0.041	0.04
Measurement Grid									
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit	
1	20	0.4%	6	120	3.9%		1.76	0.35	
2	40	1.0%	7	140	5.0%				
3	60	1.6%	8	160	9.9%				
4	80	3.1%	9	180	9.7%			RF Po (*Max)	
5	100	3.1%	10	200	8.6%			30.0	

Table 18

Internal Vehicle MPE Assessment @ 527 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4004A	2.15	Highest Reading	E	0.77	0.039	0.012	29.0	0.019	0.02
Measurement Grid										
Test Position		% of Control Limit Head	% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:			1.76
Back Seat		2.0%	2.7%		1.9%		IEEE Uncontrolled Limit:			0.35
Front Seat		0.9%	0.5%		0.7%				RF Po (*Max):	30.0

Table 19

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4011A	5.65	90	E	0.72	0.113	47.0	0.056	0.06
Measurement Grid									
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit	
1	20	0.2%	6	120	3.9%		1.50	0.30	
2	40	0.4%	7	140	11.1%				
3	60	0.7%	8	160	18.7%				
4	80	1.1%	9	180	21.2%			RF Po (*Max)	
5	100	2.7%	10	200	15.4%			48.0	

Table 20

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4011A	5.65	Highest Reading	E	0.72	0.011	0.013	47.0	0.007	0.01

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.50
Back Seat	1.0%	0.7%	0.6%	IEEE Uncontrolled Limit:	0.30
Front Seat	0.7%	0.9%	1.0%	**RF Po (*Max):**	48.0

Table 21

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4011A	5.65	90	E	0.74	0.095	47.0	0.047	0.05

Measurement Grid							
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit	IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	2.9%	1.53	0.31
2	40	0.2%	7	140	8.1%		
3	60	0.3%	8	160	16.6%		
4	80	0.7%	9	180	19.3%		**RF Po (*Max)**
5	100	1.1%	10	200	12.5%		48.0

Table 22

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4011A	5.65	Highest Reading	E	0.74	0.009	0.014	47.0	0.007	0.01

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.53
Back Seat	0.5%	0.6%	0.8%	IEEE Uncontrolled Limit:	0.31
Front Seat	0.5%	0.8%	1.4%	**RF Po (*Max):**	48.0

Table 23

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4011A	5.65	90	E	0.75	0.039	47.0	0.020	0.02
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	2.1%			1.57	0.31
2	40	0.1%	7	140	4.1%				
3	60	0.2%	8	160	6.7%				
4	80	0.3%	9	180	6.2%				**RF Po (*Max)**
5	100	1.2%	10	200	4.0%				48.0

Table 24

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE4011A	5.65	Highest Reading	E	0.75	0.007	0.006	47.0	0.004	0.00
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**			IEEE Controlled Limit:	1.57
Back Seat		0.2%		0.4%		0.8%			IEEE Uncontrolled Limit:	0.31
Front Seat		0.3%		0.3%		0.6%			**RF Po (*Max):**	48.0

Table 25

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4012A	5.65	90	E	0.75	0.117	47.0	0.059	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	3.2%			1.57	0.31
2	40	0.1%	7	140	10.8%				
3	60	0.4%	8	160	19.7%				
4	80	0.5%	9	180	21.6%				**RF Po (*Max)**
5	100	1.1%	10	200	17.4%				48.0

Table 26

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4012A	5.65	Highest Reading	E	0.75	0.013	0.024	47.0	0.012	0.01
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.57
Back Seat		0.5%		1.1%		0.9%		IEEE Uncontrolled Limit:		0.31
Front Seat		1.0%		1.5%		2.1%			**RF Po (*Max):**	48.0

Table 27

External Vehicle MPE Assessment @ 482 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4012A	5.65	90	E	0.77	0.119	47.0	0.059	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	3.8%		1.61	0.32
2	40	0.1%		7	140	8.8%			
3	60	0.1%		8	160	16.2%			
4	80	0.2%		9	180	24.8%			**RF Po (*Max)**
5	100	0.9%		10	200	19.0%			48.0

Table 28

Internal Vehicle MPE Assessment @ 482 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4012A	5.65	Highest Reading	E	0.77	0.018	0.013	47.0	0.009	0.01
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.61
Back Seat		0.9%		1.4%		1.1%		IEEE Uncontrolled Limit:		0.32
Front Seat		0.3%		0.5%		1.7%			**RF Po (*Max):**	48.0

Table 29

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4012A	5.65	90	E	0.79	0.042	46.0	0.021	0.02
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	1.7%		1.65	0.33
2	40	0.1%		7	140	3.5%			
3	60	0.1%		8	160	6.0%			
4	80	0.2%		9	180	7.7%			**RF Po (*Max)**
5	100	0.3%		10	200	5.8%			48.0

Table 30

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE4012A	5.65	Highest Reading	E	0.79	0.006	0.004	46.0	0.003	0.00
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.65
Back Seat		0.2%		0.6%		0.3%		IEEE Uncontrolled Limit:		0.33
Front Seat		0.1%		0.2%		0.4%			**RF Po (*Max):**	48.0

Table 31

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE4013A	5.65	90	E	0.79	0.108	46.0	0.054	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	5.0%		1.65	0.33
2	40	0.1%		7	140	11.3%			
3	60	0.2%		8	160	14.7%			
4	80	0.6%		9	180	18.3%			**RF Po (*Max)**
5	100	2.1%		10	200	13.1%			48.0

Table 32

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4013A	5.65	Highest Reading	E	0.79	0.019	0.021	46.0	0.011	0.01
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.65
Back Seat		0.9%		1.8%		0.7%		IEEE Uncontrolled Limit:		0.33
Front Seat		0.2%		1.2%		2.5%			RF Po (*Max):	48.0

Table 33

External Vehicle MPE Assessment @ 503 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4013A	5.65	90	E	0.8	0.115	48.0	0.058	0.06
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	4.4%		1.68	0.34
2	40	0.1%		7	140	10.4%			
3	60	0.2%		8	160	17.4%			
4	80	0.5%		9	180	19.5%			RF Po (*Max)
5	100	1.2%		10	200	14.9%			48.0

Table 34

Internal Vehicle MPE Assessment @ 503 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4013A	5.65	Highest Reading	E	0.8	0.016	0.020	48.0	0.010	0.01
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.68
Back Seat		1.0%		1.0%		0.9%		IEEE Uncontrolled Limit:		0.34
Front Seat		0.8%		0.9%		1.8%			RF Po (*Max):	48.0

Table 35

External Vehicle MPE Assessment @ 512 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE4013A	5.65	90	E	0.79	0.058	47.0	0.029	0.03
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	2.5%		1.71	0.34
2	40	0.1%		7	140	4.4%			
3	60	0.3%		8	160	7.3%			
4	80	0.6%		9	180	9.5%			RF Po (*Max)
5	100	1.8%		10	200	7.5%			48.0

Table 36

Internal Vehicle MPE Assessment @ 512 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)		Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
						Back	Front			
Roof (cnt)	HAE4013A	5.65	Highest Reading	E	0.79	0.009	0.009	47.0	0.005	0.00
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk			IEEE Controlled Limit:	1.71
Back Seat		0.6%		0.4%		0.5%			IEEE Uncontrolled Limit:	0.34
Front Seat		0.1%		0.6%		0.9%			RF Po (*Max):	48.0

Table 37

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6024A	5.15	90	E	0.75	0.108	47.0	0.054	0.05
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	7.6%		1.57	0.31
2	40	0.6%		7	140	11.6%			
3	60	1.1%		8	160	16.1%			
4	80	1.8%		9	180	16.0%			RF Po (*Max)
5	100	2.1%		10	200	11.7%			48.0

Table 38

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6024A	5.15	Highest Reading	E	0.75	0.031	0.048	47.0	0.024	0.02
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.57
Back Seat		2.6%		2.2%		1.2%		IEEE Uncontrolled Limit:		0.31
Front Seat		1.6%		2.1%		5.4%			RF Po (*Max):	48.0

Table 39

External Vehicle MPE Assessment @ 482 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6024A	5.15	90	E	0.77	0.117	47.0	0.058	0.06
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	7.3%		1.61	0.32
2	40	0.5%		7	140	12.7%			
3	60	0.9%		8	160	17.7%			
4	80	1.2%		9	180	16.8%			RF Po (*Max)
5	100	3.1%		10	200	12.3%			48.0

Table 40

Internal Vehicle MPE Assessment @ 482 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6024A	5.15	Highest Reading	E	0.77	0.036	0.034	47.0	0.018	0.02
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.61
Back Seat		2.5%		3.8%		0.4%		IEEE Uncontrolled Limit:		0.32
Front Seat		1.7%		1.4%		3.2%			RF Po (*Max):	48.0

Table 41

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE6024A	5.15	90	E	0.79	0.128	46.0	0.064	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**	IEEE Controlled Limit	IEEE Uncontrolled Limit		
1	20	0.1%	6	120	9.5%	1.65	0.33		
2	40	0.2%	7	140	14.4%				
3	60	0.7%	8	160	16.5%				
4	80	2.5%	9	180	16.4%		**RF Po (*Max)**		
5	100	4.9%	10	200	12.6%		48.0		

Table 42

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE6024A	5.15	Highest Reading	E	0.79	0.066	0.038	46.0	0.033	0.03

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.65
Back Seat	3.7%	5.2%	3.1%	IEEE Uncontrolled Limit:	0.33
Front Seat	1.4%	2.3%	3.3%	**RF Po (*Max):**	48.0

Table 43

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE6026A	5.15	90	E	0.79	0.122	46.0	0.061	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**	IEEE Controlled Limit	IEEE Uncontrolled Limit		
1	20	0.1%	6	120	8.3%	1.65	0.33		
2	40	1.3%	7	140	12.9%				
3	60	2.3%	8	160	13.8%				
4	80	2.8%	9	180	15.0%		**RF Po (*Max)**		
5	100	5.2%	10	200	12.2%		48.0		

Table 44

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6026A	5.15	Highest Reading	E	0.79	0.057	0.038	46.0	0.028	0.03
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.65
Back Seat		2.8%		4.7%		2.8%		IEEE Uncontrolled Limit:		0.33
Front Seat		2.0%		1.5%		3.4%			RF Po (*Max):	48.0

Table 45

External Vehicle MPE Assessment @ 503 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6026A	5.15	90	E	0.8	0.135	48.0	0.067	0.07
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.2%		6	120	9.2%		1.68	0.34
2	40	0.7%		7	140	13.7%			
3	60	2.1%		8	160	14.7%			
4	80	3.3%		9	180	14.7%			RF Po (*Max)
5	100	8.5%		10	200	13.3%			48.0

Table 46

Internal Vehicle MPE Assessment @ 503 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	HAE6026A	5.15	Highest Reading	E	0.8	0.045	0.040	48.0	0.022	0.02
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.68
Back Seat		2.9%		1.8%		3.3%		IEEE Uncontrolled Limit:		0.34
Front Seat		2.6%		2.1%		2.4%			RF Po (*Max):	48.0

Table 47

External Vehicle MPE Assessment @ 512 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	HAE6026A	5.15	90	E	0.79	0.132	47.0	0.066	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.8%		6	120	7.7%		1.71	0.34
2	40	1.2%		7	140	12.9%			
3	60	2.2%		8	160	15.4%			
4	80	2.4%		9	180	15.4%			**RF Po (*Max)**
5	100	5.4%		10	200	13.9%			48.0

Table 48

Internal Vehicle MPE Assessment @ 512 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	HAE6026A	5.15	Highest Reading	E	0.79	0.075	0.045	47.0	0.038	0.04
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.71
Back Seat		3.2%		4.4%		5.6%		IEEE Uncontrolled Limit:		0.34
Front Seat		2.6%		2.0%		3.3%			**RF Po (*Max):**	48.0

Table 49

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	RAE4004A	7.15	90	E	0.72	0.027	47.0	0.013	0.01
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	0.5%		1.50	0.30
2	40	0.1%		7	140	1.0%			
3	60	0.1%		8	160	3.5%			
4	80	0.2%		9	180	6.0%			**RF Po (*Max)**
5	100	0.2%		10	200	6.2%			48.0

Table 50

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	RAE4004A	7.15	Highest Reading	E	0.72	0.002	0.002	47.0	0.001	0.00

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.50
Back Seat	0.1%	0.1%	0.2%	IEEE Uncontrolled Limit:	0.30
Front Seat	0.1%	0.1%	0.1%	**RF Po (*Max):**	48.0

Table 51

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Roof (cnt)	RAE4004A	7.15	90	E	0.74	0.006	47.0	0.003	0.00

Measurement Grid							
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**	IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	0.1%	1.53	0.31
2	40	0.1%	7	140	0.2%		
3	60	0.1%	8	160	0.4%		
4	80	0.1%	9	180	1.0%		**RF Po (*Max)**
5	100	0.1%	10	200	1.7%		48.0

Table 52

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Roof (cnt)	RAE4004A	7.15	Highest Reading	E	0.74	0.002	0.002	47.0	0.001	0.00

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.53
Back Seat	0.1%	0.1%	0.1%	IEEE Uncontrolled Limit:	0.31
Front Seat	0.1%	0.1%	0.1%	**RF Po (*Max):**	48.0

Table 53

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Roof (cnt)	RAE4004A	7.15	90	E	0.75	0.010	47.0	0.005	0.01
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	0.6%		1.57	0.31
2	40	0.1%		7	140	1.0%			
3	60	0.3%		8	160	0.9%			
4	80	0.4%		9	180	1.1%			RF Po (*Max)
5	100	0.7%		10	200	1.1%			48.0

Table 54

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)		Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
						Back	Front			
Roof (cnt)	RAE4004A	7.15	Highest Reading	E	0.75	0.002	0.002	47.0	0.001	0.00
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.57
Back Seat		0.1%		0.2%		0.1%		IEEE Uncontrolled Limit:		0.31
Front Seat		0.1%		0.1%		0.1%			RF Po (*Max):	48.0

Table 55

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6022A	4.15	90	E	0.72	0.135	47.0	0.067	0.07
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.5%		6	120	15.8%		1.50	0.30
2	40	4.9%		7	140	15.3%			
3	60	7.6%		8	160	11.4%			
4	80	9.4%		9	180	6.0%			RF Po (*Max)
5	100	13.5%		10	200	3.4%			48.0

Table 56

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6022A	4.15	Highest Reading	E	0.72	0.617	0.310	47.0	0.308	0.31

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.50
Back Seat	72.1%	27.9%	23.3%	IEEE Uncontrolled Limit:	0.30
Front Seat	26.3%	17.1%	18.5%	**RF Po (*Max):**	48.0

Table 57

External Vehicle MPE Assessment @ 488.5 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6022A	4.15	90	E	0.78	0.086	46.0	0.043	0.05

Measurement Grid							
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit	IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.6%	6	120	10.6%	1.63	0.33
2	40	2.0%	7	140	11.5%		
3	60	3.3%	8	160	7.3%		
4	80	4.1%	9	180	4.0%		**RF Po (*Max)**
5	100	8.2%	10	200	1.4%		48.0

Table 58

Internal Vehicle MPE Assessment @ 488.5 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6022A	4.15	Highest Reading	E	0.78	0.219	0.060	46.0	0.110	0.11

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.63
Back Seat	18.0%	12.7%	9.7%	IEEE Uncontrolled Limit:	0.33
Front Seat	3.8%	2.0%	5.2%	**RF Po (*Max):**	48.0

Table 59

External Vehicle MPE Assessment @ 527 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6022A	4.15	60	E	0.77	0.163	29.0	0.081	0.08
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.9%		6	120	23.3%		1.76	0.35
2	40	1.9%		7	140	17.7%			
3	60	4.5%		8	160	9.9%			
4	80	6.5%		9	180	5.7%			**RF Po (*Max)**
5	100	19.4%		10	200	2.9%			30.0

Table 60

Internal Vehicle MPE Assessment @ 527 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE6022A	4.15	Highest Reading	E	0.77	0.180	0.111	29.0	0.090	0.09
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.76
Back Seat		12.8%		11.9%		6.0%		IEEE Uncontrolled Limit:		0.35
Front Seat		9.8%		6.0%		3.1%			**RF Po (*Max):**	30.0

Table 61

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4003A	2.15	90	E	0.72	0.157	47.0	0.078	0.08
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	3.8%		6	120	16.5%		1.50	0.30
2	40	5.0%		7	140	18.0%			
3	60	7.4%		8	160	15.8%			
4	80	10.0%		9	180	10.1%			**RF Po (*Max)**
5	100	10.7%		10	200	7.2%			48.0

Table 62

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4003A	2.15	Highest Reading	E	0.72	0.500	0.291	47.0	0.250	0.26
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.50
Back Seat		59.0%		21.7%		19.2%		IEEE Uncontrolled Limit:		0.30
Front Seat		21.1%		20.1%		17.0%			RF Po (*Max):	48.0

Table 63

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4003A	2.15	90	E	0.74	0.150	47.0	0.075	0.08
Measurement Grid									
Test Position	Height (cm)	2.9		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.9%		6	120	19.4%		1.53	0.31
2	40	4.0%		7	140	15.2%			
3	60	6.7%		8	160	12.5%			
4	80	9.3%		9	180	8.3%			RF Po (*Max)
5	100	13.2%		10	200	6.6%			48.0

Table 64

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4003A	2.15	Highest Reading	E	0.74	0.583	0.418	47.0	0.291	0.30
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.53
Back Seat		54.3%		34.3%		25.4%		IEEE Uncontrolled Limit:		0.31
Front Seat		17.1%		22.5%		42.1%			RF Po (*Max):	48.0

Table 65

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4003A	2.15	90	E	0.75	0.164	47.0	0.082	0.08
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.2%	6	120	21.8%			1.57	0.31
2	40	3.8%	7	140	19.3%				
3	60	7.3%	8	160	11.0%				
4	80	10.5%	9	180	7.1%				**RF Po (*Max)**
5	100	17.9%	10	200	3.8%				48.0

Table 66

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE4003A	2.15	Highest Reading	E	0.75	0.358	0.334	47.0	0.179	0.18
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**			IEEE Controlled Limit:	1.57
Back Seat		32.7%		25.5%		10.4%			IEEE Uncontrolled Limit:	0.31
Front Seat		18.6%		13.0%		32.3%			**RF Po (*Max):**	48.0

Table 67

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4004A	2.15	90	E	0.75	0.171	47.0	0.085	0.09
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.3%	6	120	23.3%			1.57	0.31
2	40	4.2%	7	140	18.6%				
3	60	8.6%	8	160	11.6%				
4	80	10.4%	9	180	5.8%				**RF Po (*Max)**
5	100	20.5%	10	200	3.8%				48.0

Table 68

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4004A	2.15	Highest Reading	E	0.75	0.353	0.279	47.0	0.177	0.18

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.57
Back Seat	27.3%	29.8%	10.5%	IEEE Uncontrolled Limit:	0.31
Front Seat	16.8%	14.8%	21.8%	RF Po (*Max):	48.0

Table 69

External Vehicle MPE Assessment @ 498.5 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4004A	2.15	90	E	0.8	0.202	46.0	0.101	0.11

Measurement Grid							
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit	IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.8%	6	120	22.8%	1.66	0.33
2	40	5.4%	7	140	22.6%		
3	60	9.2%	8	160	16.8%		
4	80	9.2%	9	180	11.0%		RF Po (*Max)
5	100	17.7%	10	200	4.3%		48.0

Table 70

Internal Vehicle MPE Assessment @ 498.5 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4004A	2.15	Highest Reading	E	0.8	0.402	0.160	46.0	0.201	0.21

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.66
Back Seat	31.8%	28.8%	12.0%	IEEE Uncontrolled Limit:	0.33
Front Seat	5.0%	8.2%	15.7%	RF Po (*Max):	48.0

Table 71

External Vehicle MPE Assessment @ 527 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4004A	2.15	60	E	0.77	0.190	29.0	0.095	0.10
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	1.1%	6	120	25.7%			1.76	0.35
2	40	3.0%	7	140	18.9%				
3	60	5.9%	8	160	10.3%				
4	80	11.0%	9	180	5.8%				**RF Po (*Max)**
5	100	23.2%	10	200	3.0%				30.0

Table 72

Internal Vehicle MPE Assessment @ 527 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE4004A	2.15	Highest Reading	E	0.77	0.193	0.117	29.0	0.096	0.10
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.76
Back Seat		15.0%		11.7%		6.2%		IEEE Uncontrolled Limit:		0.35
Front Seat		9.4%		6.8%		3.7%			**RF Po (*Max):**	30.0

Table 73

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4011A	5.65	90	E	0.72	0.133	47.0	0.067	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	26.4%			1.50	0.30
2	40	0.3%	7	140	23.9%				
3	60	1.8%	8	160	5.9%				
4	80	4.6%	9	180	2.6%				**RF Po (*Max)**
5	100	15.4%	10	200	7.7%				48.0

Table 74

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4011A	5.65	Highest Reading	E	0.72	0.247	0.102	47.0	0.123	0.13
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.50
Back Seat		27.5%		12.7%		9.1%		IEEE Uncontrolled Limit:		0.30
Front Seat		6.6%		6.7%		7.0%			RF Po (*Max):	48.0

Table 75

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4011A	5.65	90	E	0.74	0.097	47.0	0.048	0.05
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	20.2%		1.53	0.31
2	40	0.4%		7	140	15.7%			
3	60	1.1%		8	160	5.8%			
4	80	2.3%		9	180	1.7%			RF Po (*Max)
5	100	10.6%		10	200	5.3%			48.0

Table 76

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4011A	5.65	Highest Reading	E	0.74	0.200	0.133	47.0	0.100	0.10
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.53
Back Seat		17.3%		15.6%		6.3%		IEEE Uncontrolled Limit:		0.31
Front Seat		5.9%		7.6%		12.5%			RF Po (*Max):	48.0

Table 77

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4011A	5.65	90	E	0.75	0.034	47.0	0.017	0.02
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	5.8%		1.57	0.31
2	40	0.1%		7	140	6.4%			
3	60	0.2%		8	160	3.2%			
4	80	0.4%		9	180	1.1%			**RF Po (*Max)**
5	100	3.5%		10	200	1.0%			48.0

Table 78

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE4011A	5.65	Highest Reading	E	0.75	0.052	0.028	47.0	0.026	0.03
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.57
Back Seat		4.5%		3.6%		1.8%		IEEE Uncontrolled Limit:		0.31
Front Seat		1.5%		1.2%		2.6%			**RF Po (*Max):**	48.0

Table 79

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4012A	5.65	90	E	0.75	0.162	47.0	0.081	0.08
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	31.5%		1.57	0.31
2	40	0.2%		7	140	31.1%			
3	60	1.0%		8	160	12.6%			
4	80	3.2%		9	180	3.0%			**RF Po (*Max)**
5	100	16.5%		10	200	4.0%			48.0

Table 80

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4012A	5.65	Highest Reading	E	0.75	0.256	0.136	47.0	0.128	0.13

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.57
Back Seat	20.3%	20.8%	8.0%	IEEE Uncontrolled Limit:	0.31
Front Seat	7.0%	6.9%	12.2%	RF Po (*Max):	48.0

Table 81

External Vehicle MPE Assessment @ 482 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4012A	5.65	90	E	0.77	0.142	47.0	0.071	0.07

Measurement Grid							
Test Position	Height (cm)	% of Control Limit	Test Position	Height (cm)	% of Control Limit	IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.3%	6	120	26.2%	1.61	0.32
2	40	1.1%	7	140	25.9%		
3	60	1.7%	8	160	13.0%		
4	80	2.9%	9	180	2.1%		RF Po (*Max)
5	100	12.7%	10	200	2.5%		48.0

Table 82

Internal Vehicle MPE Assessment @ 482 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4012A	5.65	Highest Reading	E	0.77	0.319	0.105	47.0	0.159	0.16

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.61
Back Seat	22.5%	23.0%	14.0%	IEEE Uncontrolled Limit:	0.32
Front Seat	5.8%	4.5%	9.3%	RF Po (*Max):	48.0

Table 83

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4012A	5.65	90	E	0.79	0.044	46.0	0.022	0.02
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%	6	120	7.6%			1.65	0.33
2	40	0.1%	7	140	7.9%				
3	60	0.3%	8	160	3.4%				
4	80	0.9%	9	180	1.1%				**RF Po (*Max)**
5	100	4.5%	10	200	0.7%				48.0

Table 84

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE4012A	5.65	Highest Reading	E	0.79	0.088	0.027	46.0	0.044	0.05
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.65
Back Seat		6.7%		6.8%		2.5%		IEEE Uncontrolled Limit:		0.33
Front Seat		1.8%		1.0%		2.2%			**RF Po (*Max):**	48.0

Table 85

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	90	E	0.75	0.146	47.0	0.073	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.3%	6	120	20.4%			1.57	0.31
2	40	4.0%	7	140	19.2%				
3	60	5.4%	8	160	12.2%				
4	80	7.8%	9	180	5.2%				**RF Po (*Max)**
5	100	14.6%	10	200	1.9%				48.0

Table 86

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back**	**Front**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	Highest Reading	E	0.75	0.358	0.232	47.0	0.179	0.18
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.57
Back Seat		33.2%		23.5%		11.8%		IEEE Uncontrolled Limit:		0.31
Front Seat		14.0%		8.2%		22.3%			**RF Po (*Max):**	48.0

Table 87

External Vehicle MPE Assessment @ 482 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	90	E	0.77	0.202	47.0	0.101	0.10
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.1%		6	120	28.3%		1.61	0.32
2	40	3.5%		7	140	22.2%			
3	60	7.7%		8	160	16.8%			
4	80	12.1%		9	180	7.9%			**RF Po (*Max)**
5	100	21.6%		10	200	3.4%			48.0

Table 88

Internal Vehicle MPE Assessment @ 482 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back**	**Front**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	Highest Reading	E	0.77	0.550	0.167	47.0	0.275	0.28
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.61
Back Seat		41.9%		32.8%		28.0%		IEEE Uncontrolled Limit:		0.32
Front Seat		8.6%		6.3%		16.3%			**RF Po (*Max):**	48.0

Table 89

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	90	E	0.79	0.226	46.0	0.113	0.12
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	3.3%		6	120	27.7%		1.65	0.33
2	40	5.0%		7	140	23.0%			
3	60	8.2%		8	160	17.0%			
4	80	11.4%		9	180	12.8%			**RF Po (*Max)**
5	100	21.8%		10	200	6.9%			48.0

Table 90

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE6024A	5.15	Highest Reading	E	0.79	0.556	0.099	46.0	0.278	0.29
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.65
Back Seat		42.5%		35.3%		23.5%		IEEE Uncontrolled Limit:		0.33
Front Seat		4.3%		5.2%		8.5%			**RF Po (*Max):**	48.0

Table 91

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4013A	5.65	90	E	0.79	0.158	46.0	0.079	0.08
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	29.1%		1.65	0.33
2	40	0.5%		7	140	27.1%			
3	60	1.3%		8	160	10.1%			
4	80	5.1%		9	180	2.7%			**RF Po (*Max)**
5	100	18.9%		10	200	1.1%			48.0

Table 92

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4013A	5.65	Highest Reading	E	0.79	0.364	0.089	46.0	0.182	0.19
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.65
Back Seat		24.7%		30.1%		11.6%		IEEE Uncontrolled Limit:		0.33
Front Seat		5.0%		4.4%		6.8%			RF Po (*Max):	48.0

Table 93

External Vehicle MPE Assessment @ 503 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4013A	5.65	90	E	0.8	0.152	48.0	0.076	0.08
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.2%		6	120	27.1%		1.68	0.34
2	40	0.6%		7	140	25.6%			
3	60	1.7%		8	160	10.9%			
4	80	5.2%		9	180	2.2%			RF Po (*Max)
5	100	16.5%		10	200	0.8%			48.0

Table 94

Internal Vehicle MPE Assessment @ 503 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE4013A	5.65	Highest Reading	E	0.8	0.345	0.146	48.0	0.172	0.17
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.68
Back Seat		28.4%		23.9%		9.4%		IEEE Uncontrolled Limit:		0.34
Front Seat		6.2%		9.4%		10.6%			RF Po (*Max):	48.0

Table 95

External Vehicle MPE Assessment @ 512 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE4013A	5.65	90	E	0.79	0.055	47.0	0.028	0.03
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.1%		6	120	11.2%		1.71	0.34
2	40	0.1%		7	140	8.3%			
3	60	0.3%		8	160	3.3%			
4	80	1.3%		9	180	0.6%			**RF Po (*Max)**
5	100	6.9%		10	200	0.3%			48.0

Table 96

Internal Vehicle MPE Assessment @ 512 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE4013A	5.65	Highest Reading	E	0.79	0.170	0.060	47.0	0.085	0.09
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.71
Back Seat		14.8%		11.9%		3.1%		IEEE Uncontrolled Limit:		0.34
Front Seat		4.9%		2.7%		3.0%			**RF Po (*Max):**	48.0

Table 97

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6026A	5.15	90	E	0.79	0.192	46.0	0.096	0.10
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	3.0%		6	120	22.8%		1.65	0.33
2	40	4.1%		7	140	19.1%			
3	60	7.0%		8	160	16.1%			
4	80	10.3%		9	180	10.7%			**RF Po (*Max)**
5	100	17.9%		10	200	5.7%			48.0

Table 98

Internal Vehicle MPE Assessment @ 494 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6026A	5.15	Highest Reading	E	0.79	0.424	0.111	46.0	0.212	0.22
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.65
Back Seat		30.3%		32.7%		14.2%		IEEE Uncontrolled Limit:		0.33
Front Seat		4.7%		5.4%		10.1%			RF Po (*Max):	48.0

Table 99

External Vehicle MPE Assessment @ 503 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6026A	5.15	90	E	0.8	0.235	48.0	0.117	0.12
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	3.2%		6	120	26.0%		1.68	0.34
2	40	4.8%		7	140	25.0%			
3	60	6.3%		8	160	19.7%			
4	80	12.1%		9	180	14.3%			RF Po (*Max)
5	100	20.1%		10	200	8.4%			48.0

Table 100

Internal Vehicle MPE Assessment @ 503 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6026A	5.15	Highest Reading	E	0.8	0.421	0.167	48.0	0.210	0.21
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.68
Back Seat		33.0%		32.5%		9.8%		IEEE Uncontrolled Limit:		0.34
Front Seat		14.1%		8.8%		7.0%			RF Po (*Max):	48.0

Table 101

External Vehicle MPE Assessment @ 512 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6026A	5.15	90	E	0.79	0.226	47.0	0.113	0.12
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	3.8%		6	120	24.5%		1.71	0.34
2	40	4.5%		7	140	20.8%			
3	60	6.7%		8	160	17.0%			
4	80	12.6%		9	180	14.2%			**RF Po (*Max)**
5	100	20.0%		10	200	8.4%			48.0

Table 102

Internal Vehicle MPE Assessment @ 512 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	HAE6026A	5.15	Highest Reading	E	0.79	0.561	0.205	47.0	0.281	0.29
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**			IEEE Controlled Limit:	1.71
Back Seat		56.1%		30.8%		11.8%			IEEE Uncontrolled Limit:	0.34
Front Seat		16.7%		8.8%		10.6%			**RF Po (*Max):**	48.0

Table 103

External Vehicle MPE Assessment @ 450 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	RAE4004A	7.15	90	E	0.72	0.116	47.0	0.058	0.06
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.1%		6	120	12.4%		1.50	0.30
2	40	2.6%		7	140	13.4%			
3	60	6.2%		8	160	12.6%			
4	80	6.6%		9	180	7.2%			**RF Po (*Max)**
5	100	9.5%		10	200	4.5%			48.0

Table 104

Internal Vehicle MPE Assessment @ 450 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	RAE4004A	7.15	Highest Reading	E	0.72	0.397	0.230	47.0	0.198	0.20
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.50
Back Seat		41.8%		20.0%		17.5%		IEEE Uncontrolled Limit:		0.30
Front Seat		16.0%		14.8%		15.2%			**RF Po (*Max):**	48.0

Table 105

External Vehicle MPE Assessment @ 460 MHz									
Antenna Location	Antenna Model	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Body (mW/cm^2)	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	RAE4004A	7.15	90	E	0.74	0.106	47.0	0.053	0.05
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	1.6%		6	120	11.2%		1.53	0.31
2	40	3.7%		7	140	10.8%			
3	60	6.3%		8	160	8.9%			
4	80	5.9%		9	180	5.4%			**RF Po (*Max)**
5	100	10.7%		10	200	4.6%			48.0

Table 106

Internal Vehicle MPE Assessment @ 460 MHz										
Antenna Location	Antenna	Gain (dBi)	Meas. Distance (cm)	E/H Field	Calibration Factor	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Back	Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	RAE4004A	7.15	Highest Reading	E	0.74	0.419	0.311	47.0	0.210	0.21
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.53
Back Seat		38.4%		28.3%		15.3%		IEEE Uncontrolled Limit:		0.31
Front Seat		13.9%		16.8%		30.2%			**RF Po (*Max):**	48.0

Table 107

External Vehicle MPE Assessment @ 470 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	RAE4004A	7.15	90	E	0.75	0.145	47.0	0.072	0.07
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.2%	6	120	18.9%			1.57	0.31
2	40	4.5%	7	140	17.6%				
3	60	7.1%	8	160	12.6%				
4	80	7.5%	9	180	5.3%				**RF Po (*Max)**
5	100	14.0%	10	200	2.7%				48.0

Table 108

Internal Vehicle MPE Assessment @ 470 MHz										
Antenna Location	**Antenna**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2)**		**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
						Back	**Front**			
Trunk (cnt)	RAE4004A	7.15	Highest Reading	E	0.75	0.374	0.290	47.0	0.187	0.19
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**			IEEE Controlled Limit:	1.57
Back Seat		32.0%		29.3%		10.4%			IEEE Uncontrolled Limit:	0.31
Front Seat		13.7%		12.6%		29.2%			**RF Po (*Max):**	48.0

**************45 degree *****************

Table 109

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	90	E	0.79	0.204	46.0	0.102	0.11
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**			IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.8%	6	120	26.4%			1.65	0.33
2	40	3.7%	7	140	21.7%				
3	60	8.5%	8	160	14.7%				
4	80	10.3%	9	180	10.2%				**RF Po (*Max)**
5	100	19.2%	10	200	6.3%				48.0

****************90 degree *******************

Table 110

External Vehicle MPE Assessment @ 494 MHz									
Antenna Location	**Antenna Model**	**Gain (dBi)**	**Meas. Distance (cm)**	**E/H Field**	**Calibration Factor**	**Average over Body (mW/cm^2)**	**Initial Power (W)**	**Pwr. Density Calc. (mW/cm^2)**	**Pwr. Density Max Calc. (mW/cm^2)**
Trunk (cnt)	HAE6024A	5.15	90	E	0.79	0.191	46.0	0.095	0.10
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	4.2%		6	120	24.9%		1.65	0.33
2	40	4.4%		7	140	22.5%			
3	60	8.1%		8	160	13.8%			
4	80	9.5%		9	180	9.7%			**RF Po (*Max)**
5	100	13.7%		10	200	4.9%			48.0

APPENDIX E
SAR Simulation Report

MOTOROLA LABS

COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE UHF MOBILE RADIO, MODEL #PMUE3076A, FCC ID ABZ99FT4083

March 24, 2008

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Motorola Corporate EME Research Lab, Plantation, Florida

Introduction

This report summarizes the computational [numerical modeling] analysis performed to document compliance of the UHF, Model Number PMUE3076A, 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 - 527 MHz frequency band.

This computational analysis supplements the measurements conducted to evaluate the FCC *maximum permissible exposure* (MPE) limits for this mobile device. The test condition that did not conform with applicable MPE limits was analyzed to determine whether that condition 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 2 independent simulations have been performed addressing exposure of passenger to UHF mobile radios with trunk-mount antenna. For both 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 [2], 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, following the structure outlined in Appendix B.III of the Supplement C to the FCC OET Bulletin 65.

The car model has been imported into XFDTD™ from the IEEE 1528.2 draft standard 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.

For passenger exposure, the distance of trunk mounted antenna from the passenger head was set at 85 cm, so as to replicate the experimental conditions used in MPE measurements. Figure 1 and Figure 2 show the XFDTD™ computational model used for passenger exposure to trunk mounted antenna.

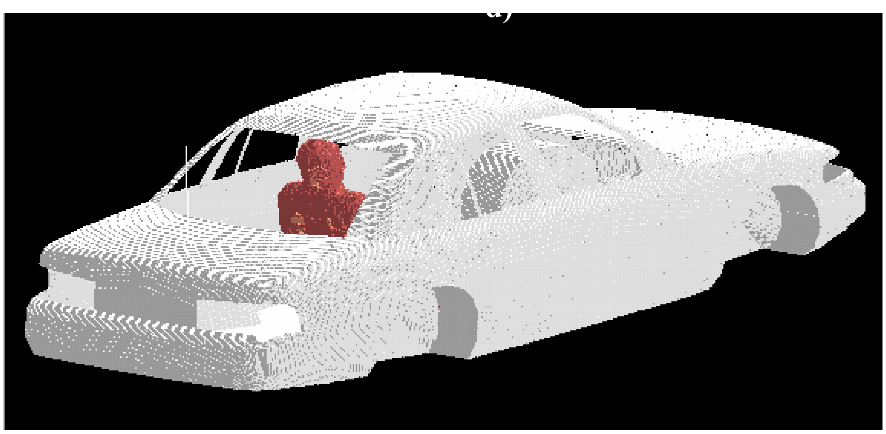


Figure 1: Passenger model exposed to a trunk-mount antenna operating: XFDTD geometry. The antenna is mounted at 85 cm from the passenger.

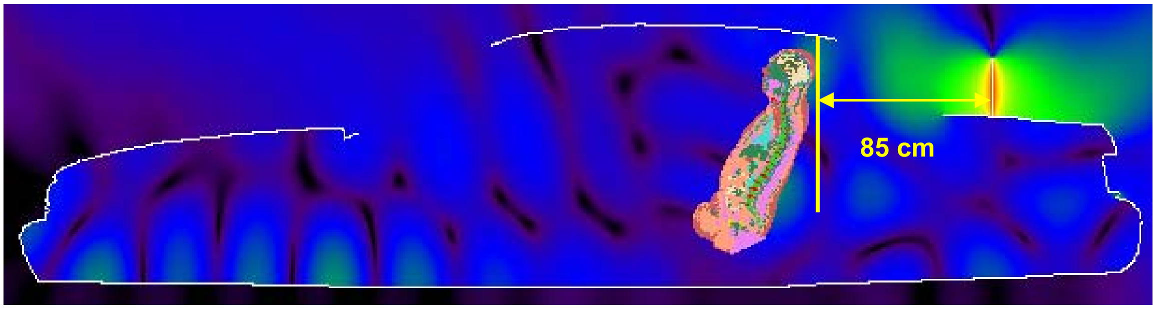


Figure 2: Passenger model exposed to a trunk-mount antenna operating: H-field distribution. The antenna is mounted at 85 cm from the passenger.

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 output power from mobile radio antenna is 48 W *rms*. 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., 24 W *rms* net output power.

Results of SAR computations for car passengers

The test condition requiring SAR computations is summarized in Table I, together with the antenna data and the SAR results. The condition is for antenna mounted on the trunk. 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).

Mount location	Antenna Kit #	Antenna length		Freq [MHz]	Exposure location	SAR [W/kg]	
		Physical	XFDTD			1-g	WB
Trunk	HAE6022A	27.8 cm	28.0 cm	450	center	0.336	0.0152
Trunk	HAE6022A	27.8 cm	28.0 cm	450	side	0.361	0.0103

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, HAE6022A antenna).

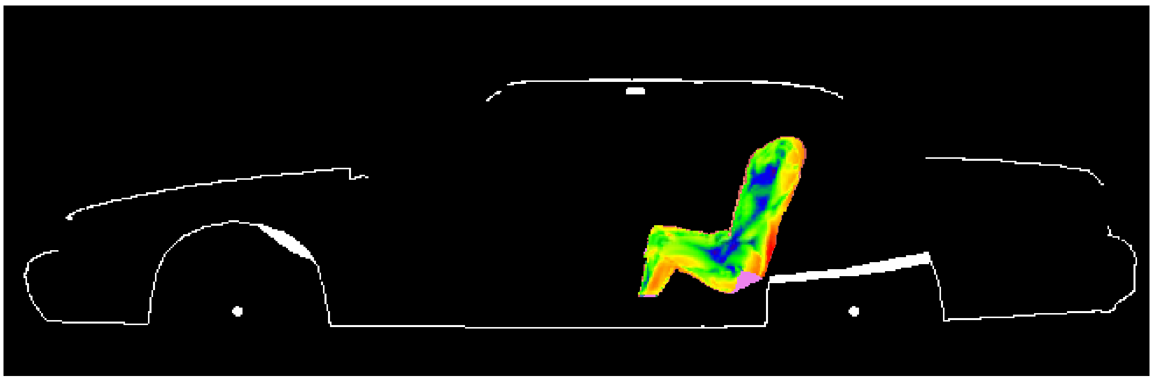
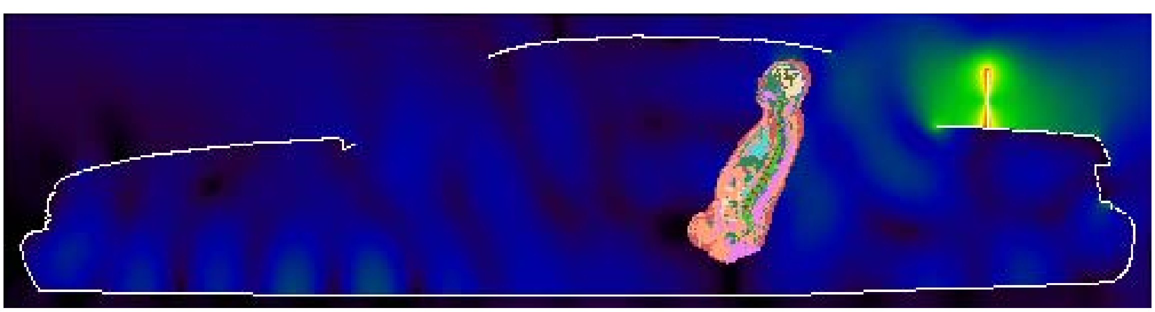
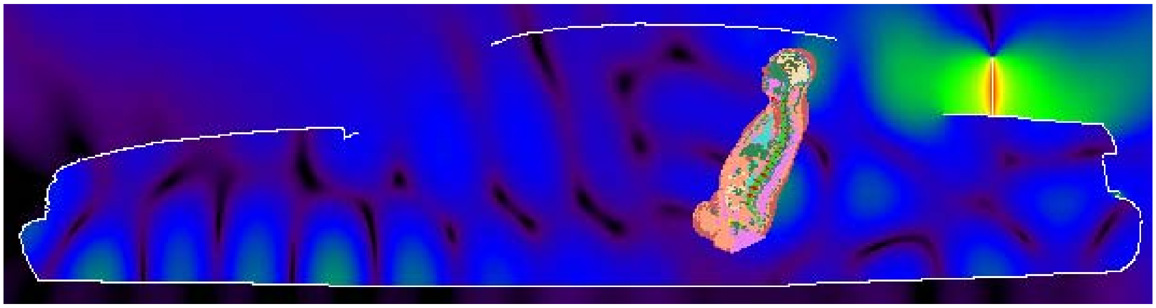


Figure 3. SAR distribution at 450 MHz in the passenger located on the side of the back seat, produced by the trunk-mount HAE6022A antenna (28 cm). The contour plot in the figure is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The two pictures below (Figure 4a and Figure 4b) show the E and H field distributions in the plane of the antenna corresponding to the condition that gave highest whole-body average SAR (450 MHz, passenger in the center of the back seat, HAE6022A antenna).



a)



b)

Figure 4. (a) E-field distribution and (b) H-field distribution corresponding to the exposure condition that gave highest whole-body average SAR.

The overall maximum peak 1-g SAR in all simulated conditions is 0.361 W/kg, less than the 1.6 W/kg limit, while the maximum whole-body average SAR is 0.0152 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 distributed Linux based multi-CPU computer cluster equipped with AMD 64-bit Opteron processors was employed for all simulations.

b) The memory requirement was close to 3 GB in all cases. Using the above-mentioned system with four processors operating concurrently, the typical simulation would run for 3 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.

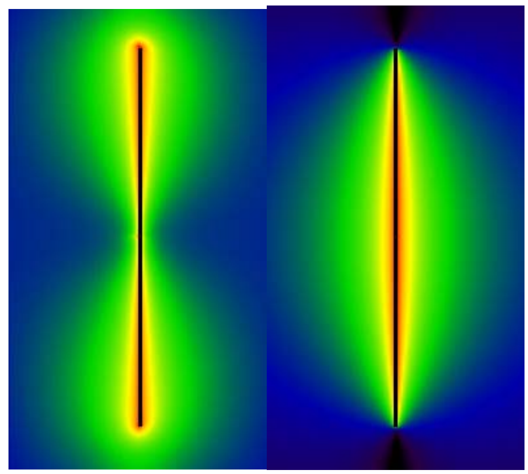
b) XFDTD™ is one of the most widely employed commercial codes for electromagnetic simulations. It has gone through extensive validation and has proven its accuracy over time in many different applications. One example is provided in [3].

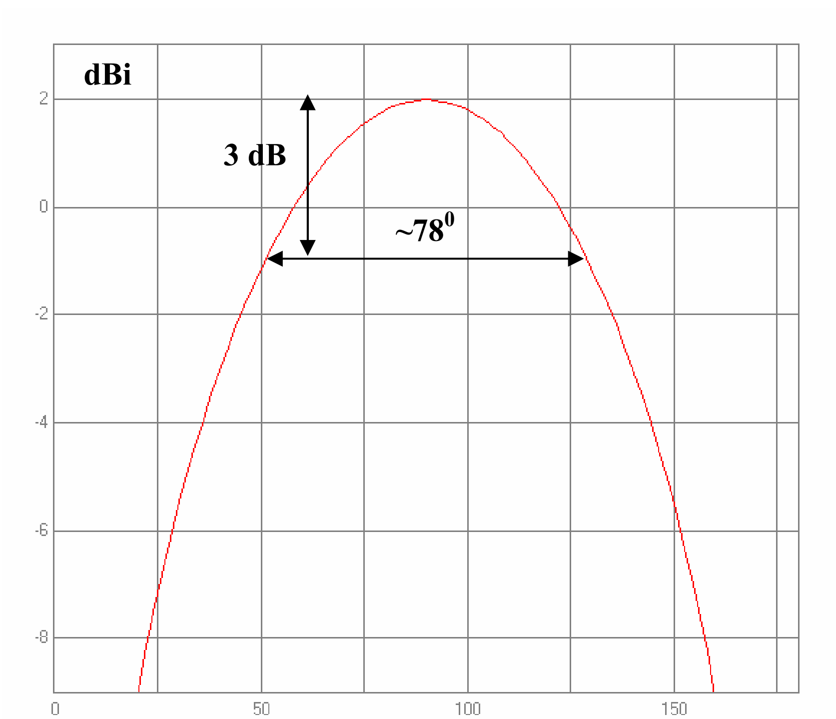
We carried out a validation of the code algorithm by running the canonical test case involving a half-wave wire dipole. The dipole is 0.475 times the free space wavelength at 160 MHz, i.e., 88.5 cm long. The discretization used in the model was uniform in all directions and equal to 5 mm, so the dipole was 177 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 (72.6 – j 11.6 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.

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

Complex Feed Point Impedance (Ohms)

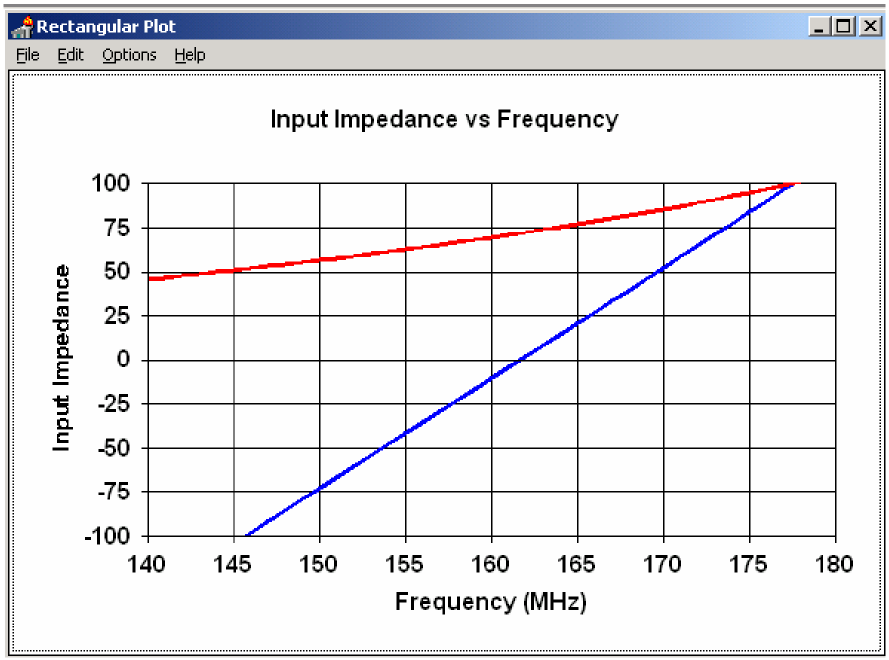
Feed	Real	Imaginary	
1	72.553001	-11.623300	





Elevation Angle [degrees]

We also compared the XFDTD™ result with the results derived from NEC [4], which is a code based on the method of moments. In this case, we used a dipole with radius 1 mm, length 88.5 cm, and the discretization is 5 mm. The corresponding input impedance at 160 MHz is 69.5-j10.5 ohm. Its frequency dependence is reported in the following figure.



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 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
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 -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

Similarly, the table below reports the tissue dielectric properties at 155 MHz (mid-band for this VHF mobile radio product).

#	Tissue	ε_r	σ (S/m)	Density (kg/m^3)
1	skin	50.5	0.49	1125
2	tendon, pancreas, prostate, aorta, liver, other	59.3	0.63	1151
3	fat, yellow marrow	5.8	0.04	943
4	cortical bone	15.5	0.08	1850
5	cancellous bone	26.0	0.17	1080
6	blood	64.5	1.65	1057
7	muscle, heart, spleen, colon, tongue	73.6	0.84	1059
8	gray matter, cerebellum	71.5	0.73	1035.5
9	white matter	51.4	0.41	1027.4
10	CSF	73.9	2.29	1000
11	sclera/cornea	61.8	0.94	1151
12	vitreous humor	68.6	1.52	1000
13	bladder	19.1	0.28	1132
14	nerve	44.0	0.41	1112
15	cartilage	53.8	0.53	1171
16	gall bladder bile	86.6	1.49	928
17	thyroid	65.9	0.71	1035.5
18	stomach/esophagus	78.5	1.03	1126
19	lung	52.3	0.59	563
20	kidney	72.9	1.02	1147
21	testis	72.6	0.99	1158

22	lens	57.3	0.61	1163
23	small intestine	89.5	1.85	1153

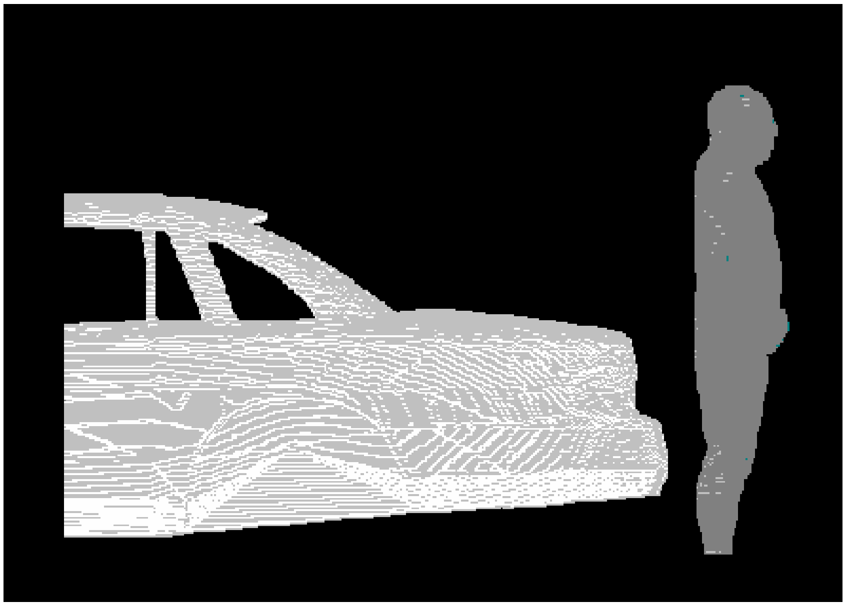
b) The tissue types and dielectric parameters used in the SAR computation are appropriate for determining the highest exposure expected for normal device operation, because they are derived from measurements performed on real biological tissues (http://www.brooks.af.mil/AFRL/HED/hedr/reports/dielectric/home.html).

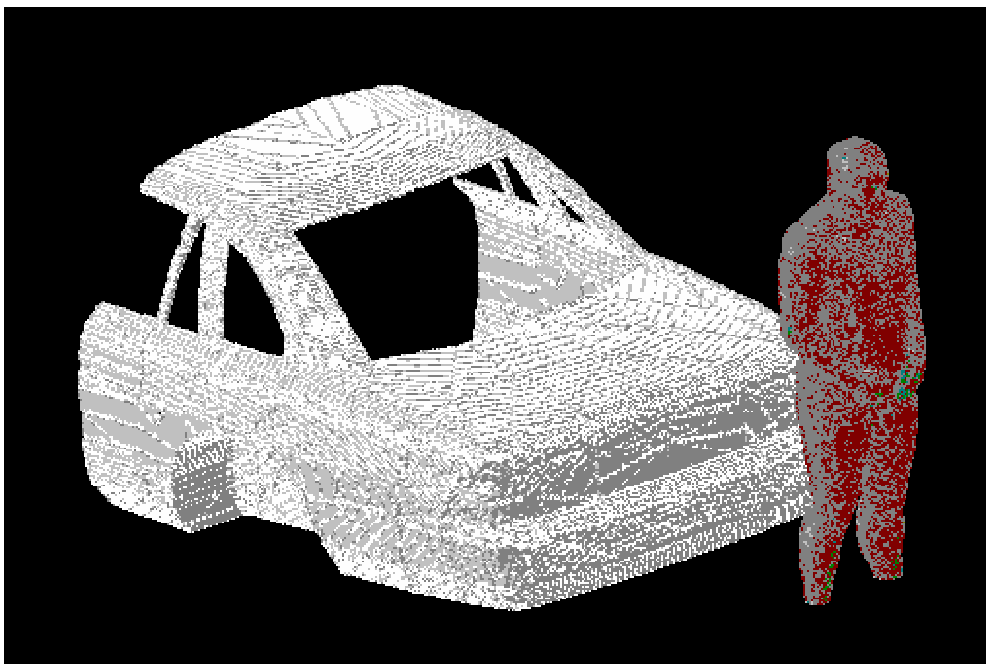
c) The tabulated list of the dielectric parameters used in phantom models is provided at point 5(a). As regards the device (car plus antenna), we used perfect electric conductors.

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).



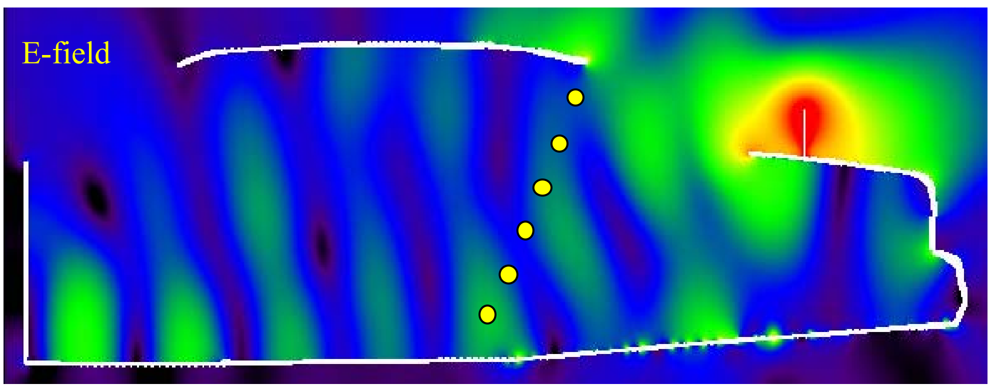


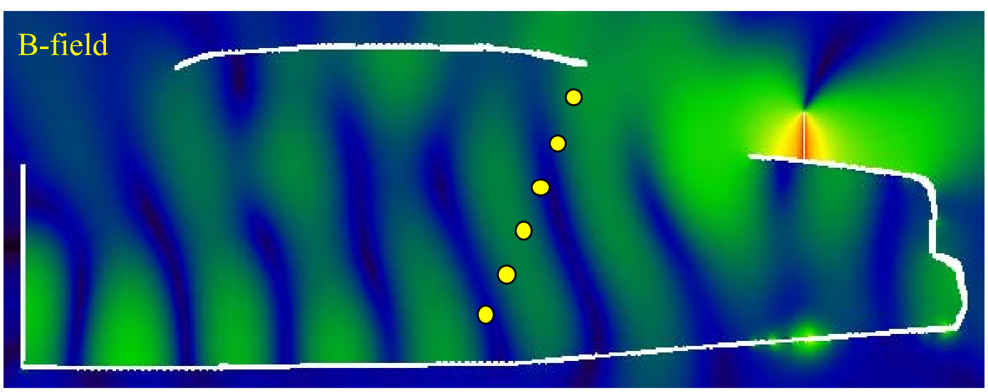
The car model is constituted by perfect electric conductor and does not include wheels in order to reduce its complexity. The passenger model is surrounded by air, as the seat, which is made out of poorly conductive fabrics, is not included in the computational model. The pavement has not been included in the model. The passenger and bystander models were validated for similar antenna and frequency conditions by comparing the MPE measurements at two VHF frequencies (146 MHz and 164 MHz) for antennas used for a VHF mobile radio analyzed previously in 2003 (FCC ID#ABZ99FT3046). The corresponding MPE measurements are reported in the compliance report relative to FCC ID#ABZ99FT3046. The comparison results are presented below, according to following definitions for the equivalent power densities (based on E or H-field):

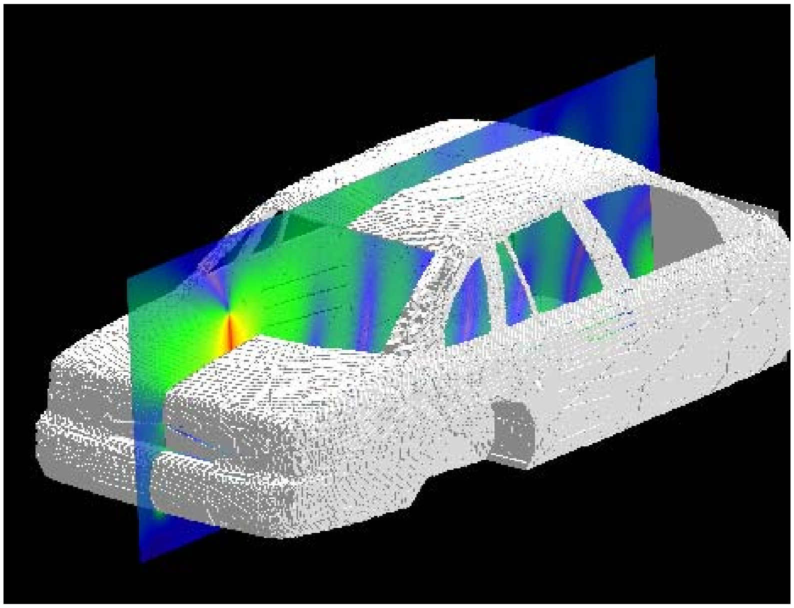
$$S_E = \frac{|\mathbf{E}|^2}{2\eta}, \quad S_H = \frac{\eta}{2}|\mathbf{H}|^2, \quad \eta = 377\,\Omega$$

<u>Passenger with 17.5 cm monopole antenna (HAE4002A 421.5 MHz)</u>

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 rms 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%).

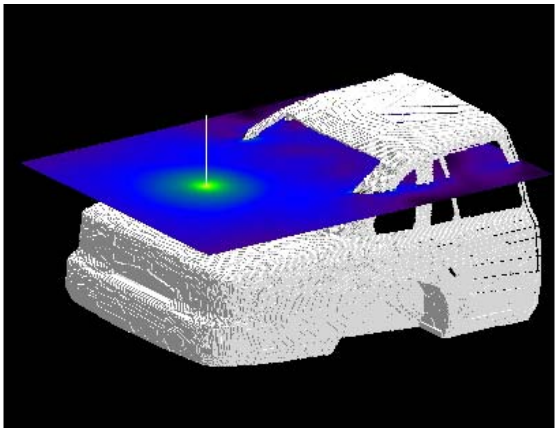
b) Descriptions and illustrations showing the correspondence between the modeled test device and the actual device, with respect to shape, size, dimensions and near-field radiating characteristics, are found in the main report.

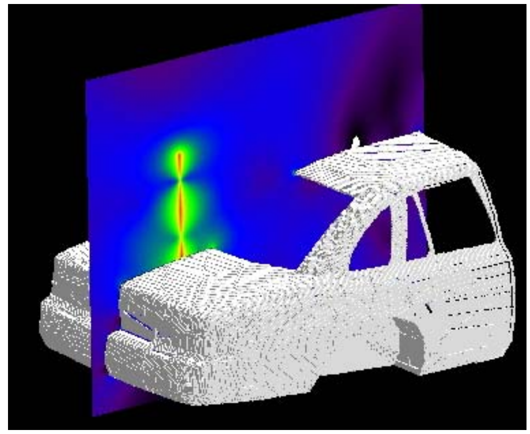
c) Verification that the test device model is equivalent to the actual device for predicting the SAR distributions descends from the fact that the car and antenna size and location in the numerical model correspond to those used in the measurements.

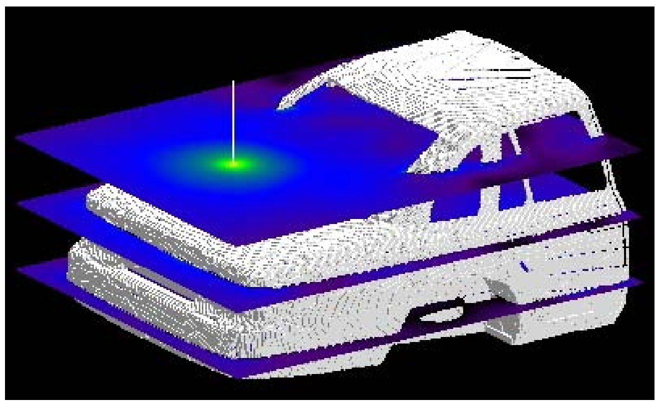
d) The peak SAR is in the neck region for the passenger, which is in line with MPE measurements and predictions.

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

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 rms 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**

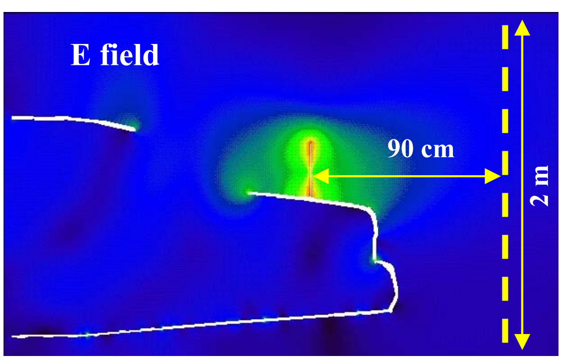
The corresponding scaled-up power densities are reported in the tables above, which show that the simulation overestimates the average power density from the MPE measurements (0.52 mW/cm^2), as derived from the measured E-field reported in the following table:

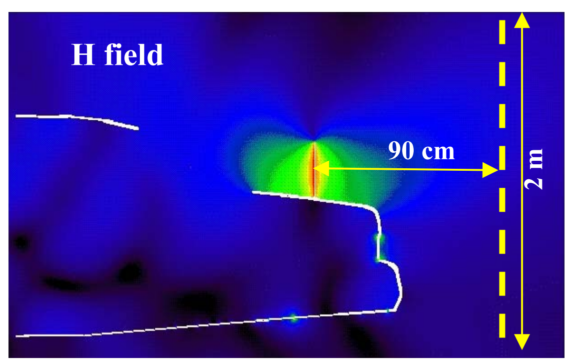
Position	SE (meas), 60 W output mW/cm^2
Head	0.72
Chest	0.64
Lower Trunk	0.19

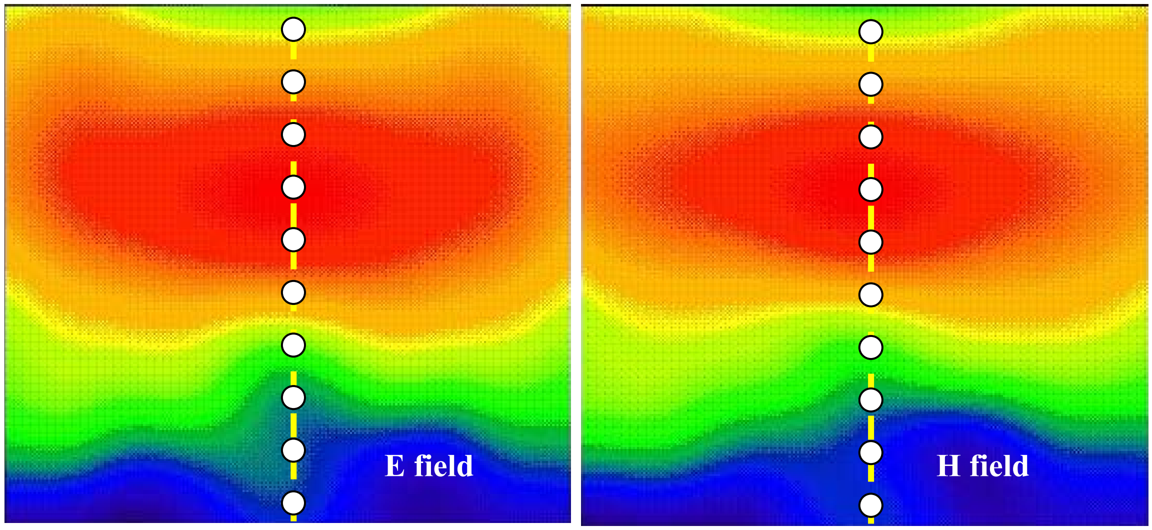
The simulations tend to overestimate the average power density levels, which is understandable since there are no ohmic losses and perfect impedance matching is enforced in the computational models. Based on these results, we conclude that the simulation will produce exposure overestimates (about 69%).

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.



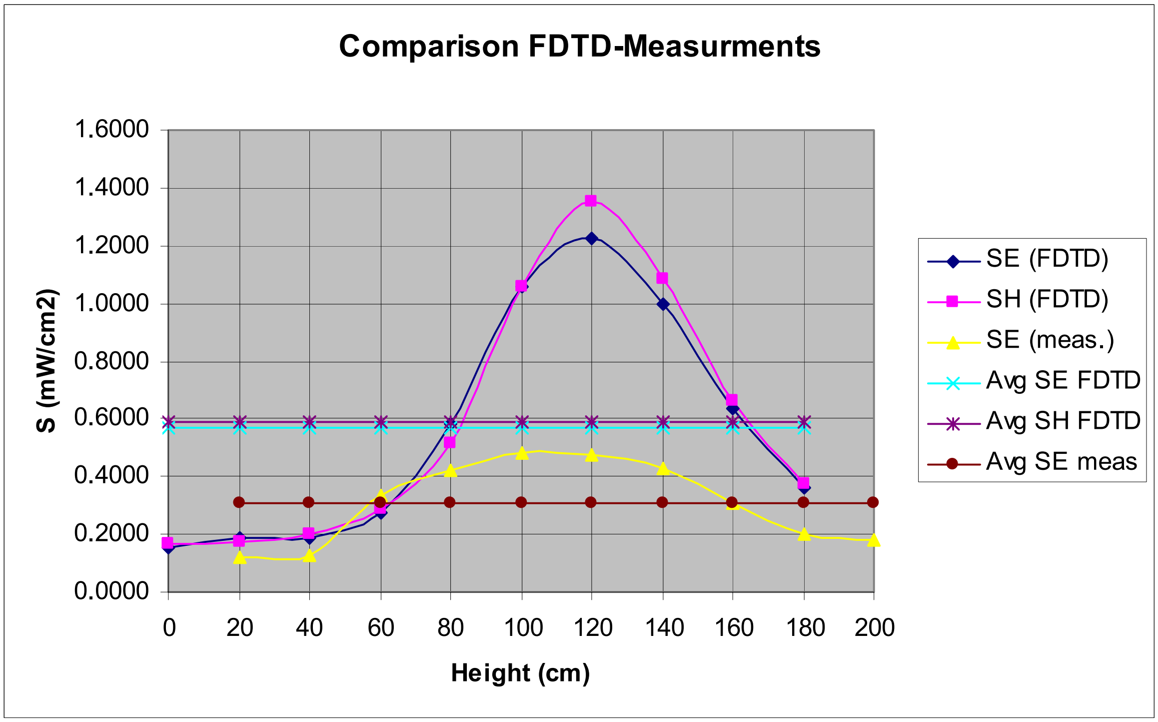




The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

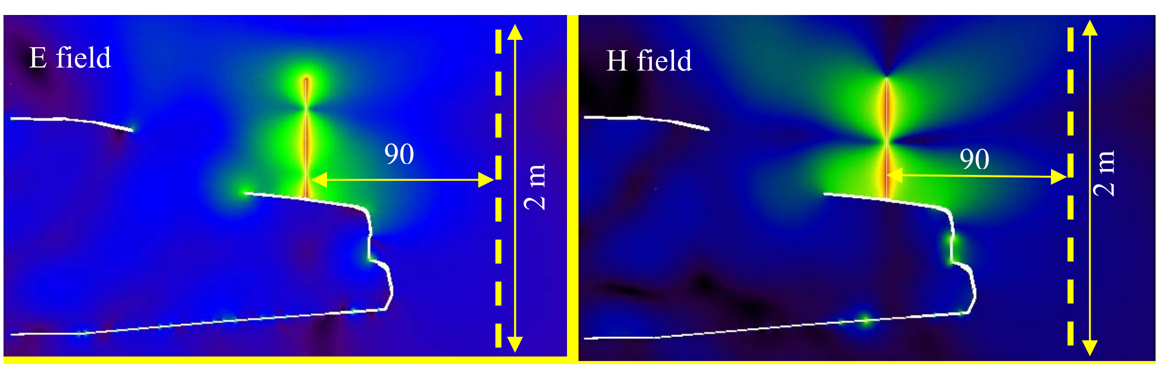
Height (cm)	E (V/m)	S_E (W/m^2)	H (A/m)	S_H (W/m^2)
0	1.05E-01	1.46E-05	2.90E-05	1.589E-05
20	1.14E-01	1.72E-05	2.90E-05	1.598E-05
40	1.16E-01	1.78E-05	3.14E-05	1.871E-05
60	1.39E-01	2.56E-05	3.75E-05	2.669E-05
80	2.03E-01	5.47E-05	5.03E-05	4.795E-05
100	2.73E-01	9.88E-05	7.23E-05	9.923E-05
120	2.94E-01	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**

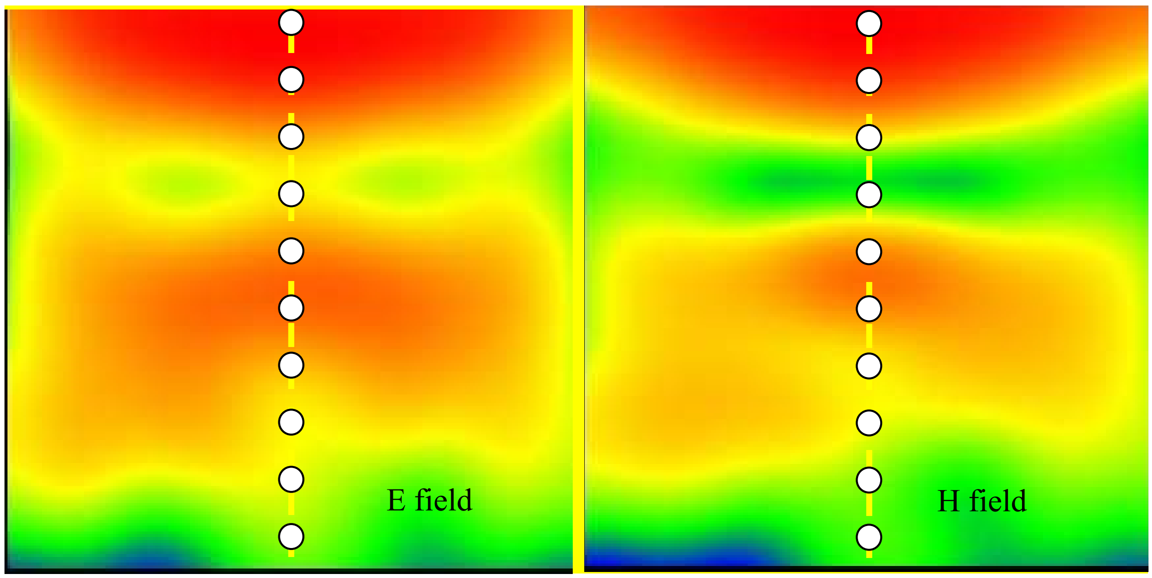
Since the conducted power during the MPE measurement was 123 W the calculated power density was then scaled up for 61.5 W radiated power (taking into account 50% talk time). This model does not include the mismatch loss, loss in the cable and finite conductivity of the car surface and as represents a 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.



Bystander with 63.5 cm monopole antenna (HAE6010A 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 HAE6010A.

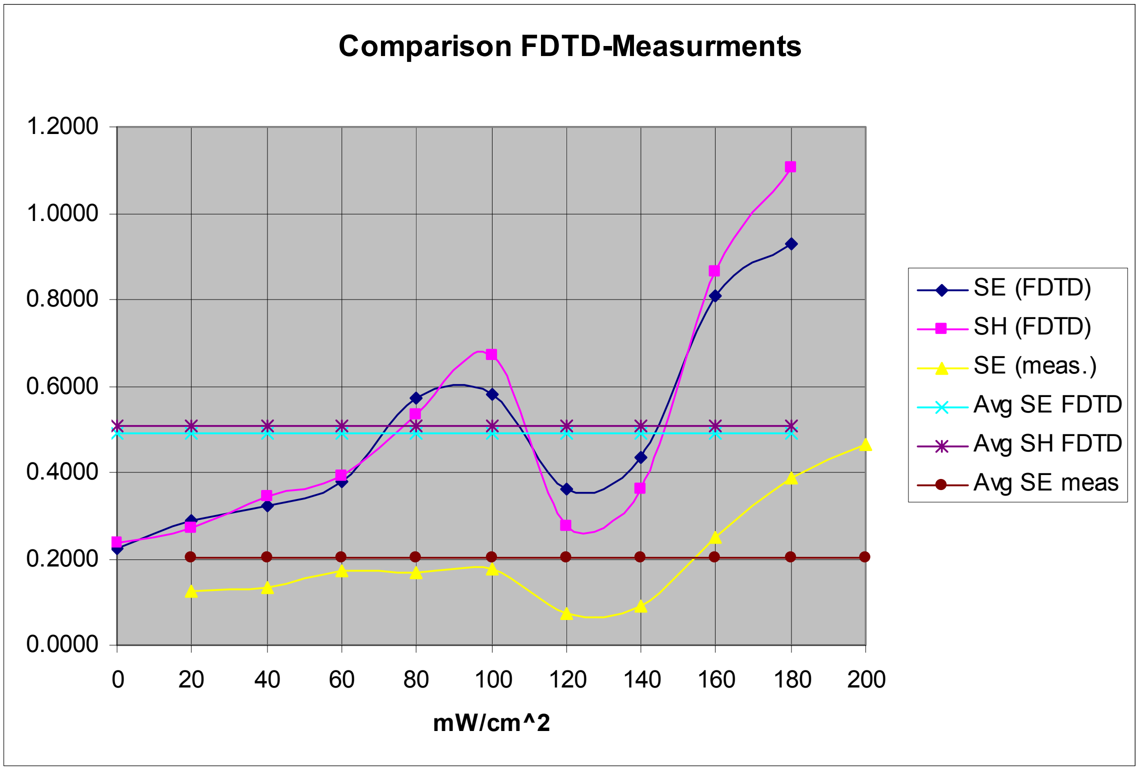




The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

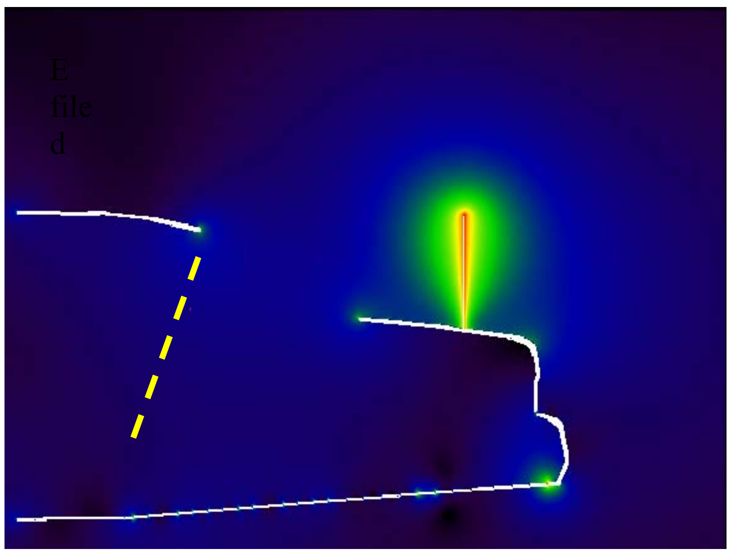
Height (cm)	E (V/m)	S_E (W/m^2)	H (A/m)	S_H (W/m^2)
0	1.32E-01	2.31E-05	4.51E-10	2.43E-05
20	1.49E-01	2.94E-05	4.82E-10	2.77E-05
40	1.58E-01	3.31E-05	5.44E-10	3.53E-05
60	1.71E-01	3.88E-05	5.79E-10	4.00E-05
80	2.10E-01	5.85E-05	6.78E-10	5.48E-05
100	2.12E-01	5.96E-05	7.60E-10	6.89E-05
120	1.67E-01	3.70E-05	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**

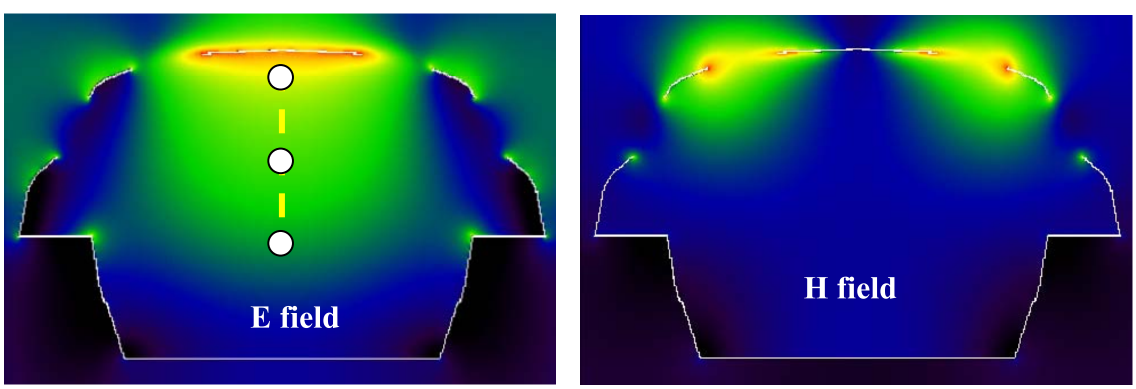
Since the conducted power during the MPE measurement was 123 W the calculated power density was then scaled up for 61.5 W radiated power (taking into account 50% talk time). This model does not include the mismatch loss, loss in the cable and finite conductivity of the car surface and as represents a 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.



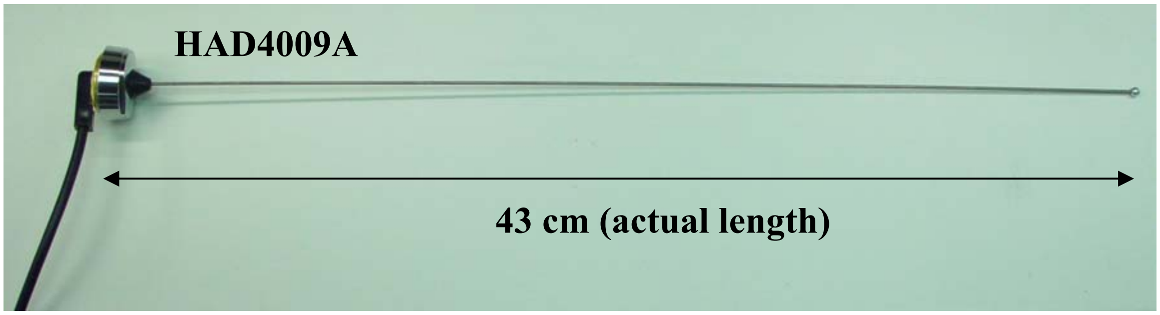
Passenger with 43 cm monopole antenna (HAD4009A 164 MHz)

The following figures of the test model show the empty car model, where the yellow dotted line represents the back seat, as it can be observed from the right-hand side figure showing the passenger. The comparison has been performed by taking the computed steady-state field values at the locations corresponding to the head, chest, and legs along the yellow line and comparing them with the corresponding measurements. Such a comparison is carried out at the same rms power level (56.5 W) used in the measurements. Steady-state E-field and H-field distributions at a vertical plane transverse to the car and crossing the passenger's head are displayed as well. Finally, a picture of the antenna is shown.





The highest exposure occurs in the middle of the backseat, which is also the case in the measurements. Therefore, the field values were determined on the yellow line centered at the middle of the backseat, approximately at the three locations that are shown by white dots. In actuality, the line is inclined so as to follow the inclination of the passenger's back, as shown previously.



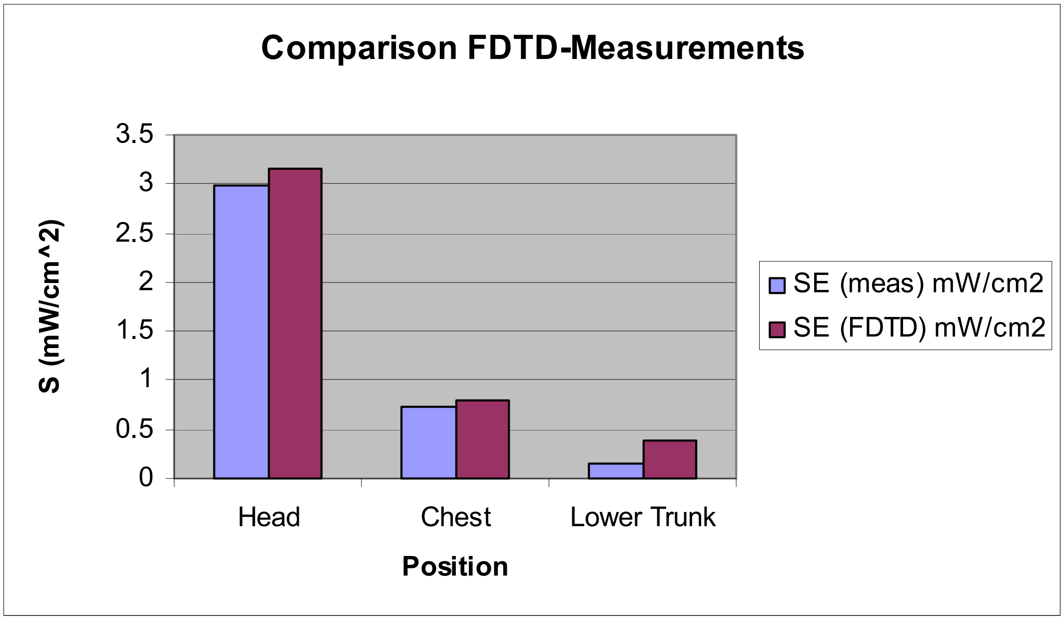
Because the peak exposure occurs in the center of the back seat, that was where we placed the passenger model to perform the SAR evaluations presented in the report. However, it can be observed that the H-field distribution features peaks near the lateral edges of the rear window. That is the reason why we also carried out one SAR computation by placing the passenger laterally in the back seat, in order to determine whether the SAR would be higher in this case.

As done in the measurements, the equivalent power density (S) is computed from the E-field, the H-field being much lower. The following table reports the E-field values computed by XFDTD™ at the three locations, and the corresponding power density.

Location	E-field magnitude (V/m)	S (W/m^2)
Head	1.10	1.33E-03
Chest	0.70	3.32E-04
Lower Trunk area	0.52	1.62E-04
	Average S	**6.07E-04**

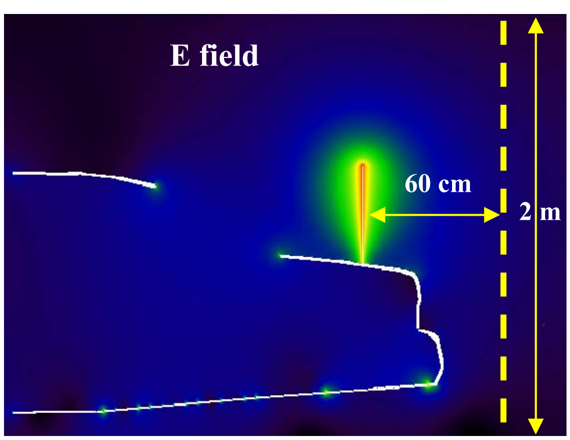
The input impedance is 32.4-j4.8 ohm, therefore the radiated power (considering the mismatch to the 50 ohm unitary voltage source) is 2.38E-3 W. The scaled-up power density for 56.5 W radiated power is 14.4 W/m^2, corresponding to 1.44 mW/cm^2. Measurements gave an average of 1.29 mW/cm^2, which is in agreement considering conservativeness of simulations model. The following table and the graph show a comparison between the simulated power density and the measured one (see also MPE report in FCC ID#ABZ99FT3046, Table 43), normalized to 56.5 W radiated.

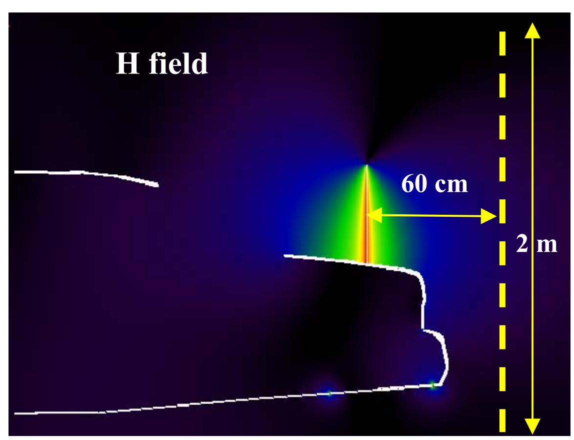
Position	SE (meas) mW/cm^2	SE (FDTD) mW/cm^2
Head	2.98	3.15
Chest	0.74	0.79
Lower Trunk	0.14	0.39

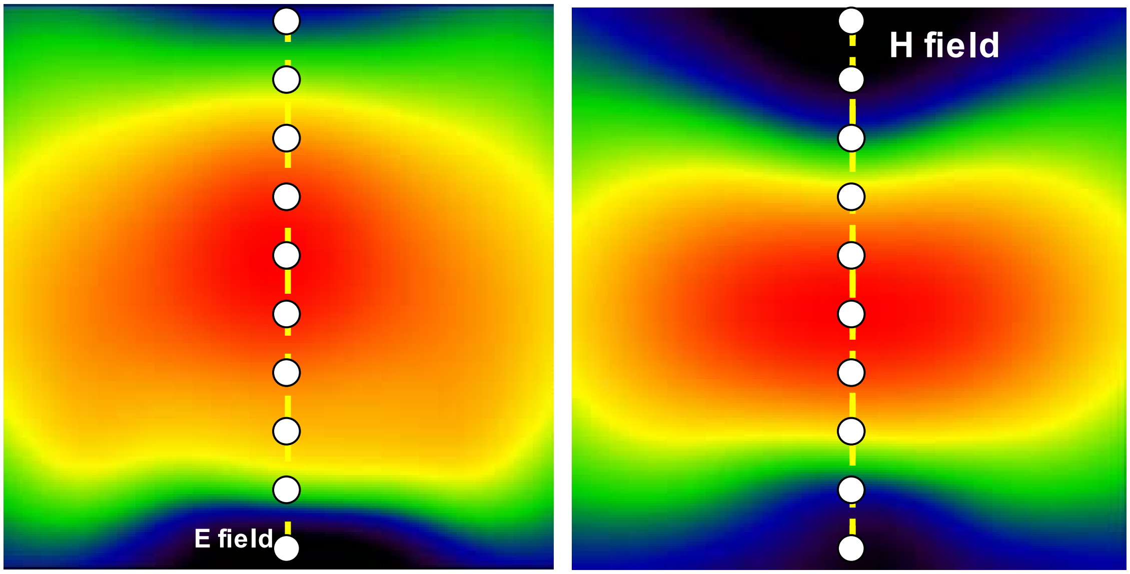


Bystander with 48 cm monopole antenna (HAD4007A 146 MHz)

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 60 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 HAD4009A except for the length.





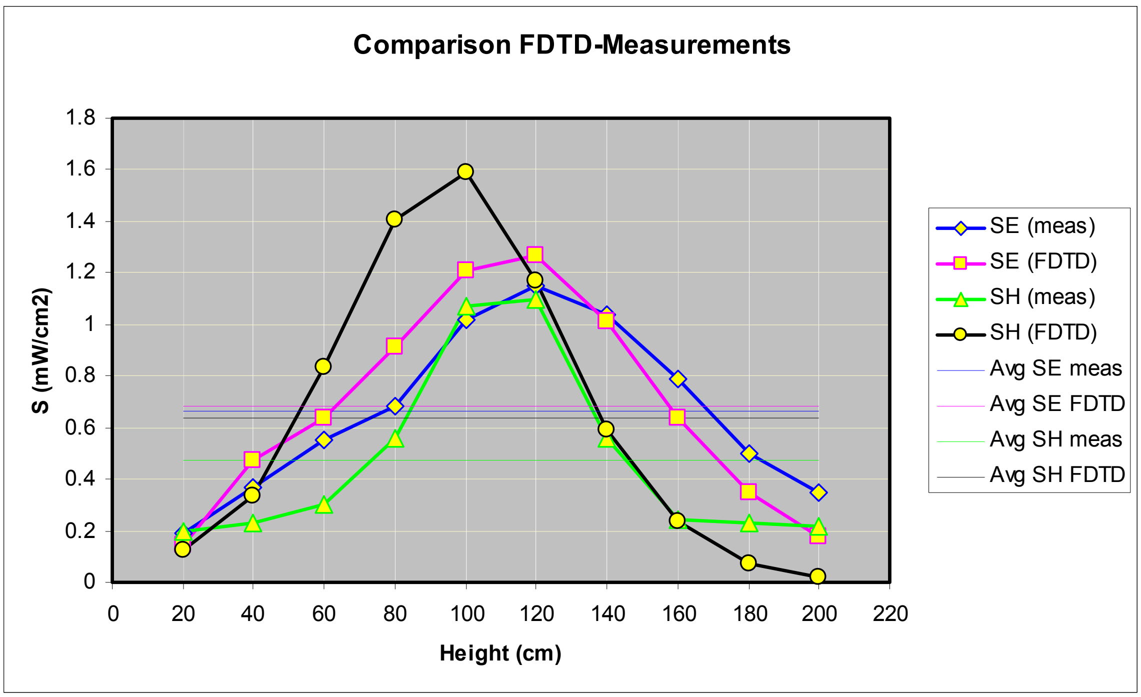


The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

Height (cm)	E (V/m)	S_E (W/m^2)	H (A/m)	S_H (W/m^2)
20	2.12E-01	5.96E-05	5.21E-04	5.12E-05
40	3.86E-01	1.98E-04	8.59E-04	1.39E-04
60	4.48E-01	2.66E-04	1.36E-03	3.49E-04
80	5.36E-01	3.81E-04	1.77E-03	5.88E-04
100	6.17E-01	5.05E-04	1.88E-03	6.65E-04
120	6.32E-01	5.30E-04	1.61E-03	4.87E-04
140	5.65E-01	4.23E-04	1.15E-03	2.48E-04
160	4.47E-01	2.65E-04	7.21E-04	9.80E-05
180	3.30E-01	1.44E-04	4.07E-04	3.13E-05
200	2.35E-01	7.32E-05	1.93E-04	6.99E-06
	Average S_E	2.85E-04	**Average S_H**	2.66E-04

The input impedance is 27.9-j14.3 ohm, therefore the radiated power (considering the mismatch to the 50 ohm unitary voltage source) is 2.22E-3 W. The scaled-up power density values for 53.2 W radiated power are 6.81 W/m^2 (E), and 6.38 W/m^2 (H), that correspond to 0.68 mW/cm^2 (E), and 0.64 mW/cm^2 (H). Measurements yielded average power density of 0.664 mW/cm^2 (E), and 0.471 mW/cm^2 (H), i.e., which are in good agreement with the simulations. The following table and graph show a comparison between the simulated power density and the measured one, based on E (see MPE report in FCC ID#ABZ99FT3046, Table 1) or H fields (see MPE report in FCC ID#ABZ99FT3046, Table 13), normalized to 53.2 W radiated.

Height (cm)	SE (meas) mW/cm^2	SE (FDTD) mW/cm^2	SH (meas) mW/cm^2	SH (FDTD) mW/cm^2	Avg SE meas mW/cm^2	Avg SE FDTD mW/cm^2	Avg SH meas mW/cm^2	Avg SH FDTD mW/cm^2
20	0.19	0.14	0.2	0.12	0.664	0.681	0.471	0.638
40	0.37	0.47	0.23	0.33				
60	0.55	0.64	0.3	0.84				
80	0.68	0.91	0.56	1.41				
100	1.02	1.21	1.07	1.59				
120	1.15	1.27	1.1	1.17				
140	1.04	1.01	0.56	0.59				
160	0.79	0.63	0.24	0.23				
180	0.5	0.35	0.23	0.07				
200	0.35	0.18	0.22	0.02				



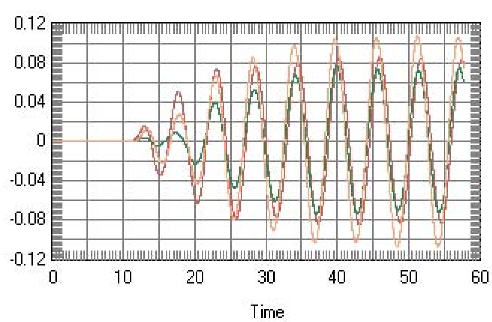
7) Test device positioning

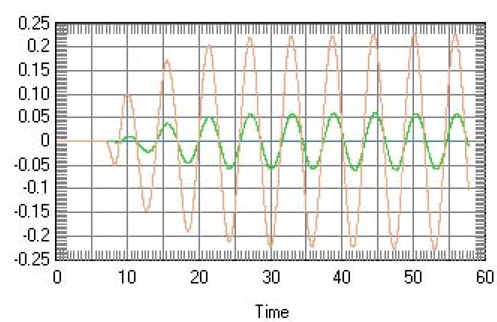
a) A description of the device test positions used in the SAR computations is provided in the SAR report.

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 *rms* radiated power is computed as

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

Both the input impedance and the net rms 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.

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