Certificate Number: 1449-01

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

MPE/SAR Compliance Test Report

Date of Report:	January 13, 2005
Report Revision(s):	Rev. A
Device Manufacturer:	Motorola
Device Description:	XTL5000; UHF 380-470 MHz automobile mobile transceiver; 25-100watts
Classification:	Occupational/Controlled Exposure
FCC ID:	AZ492FT4870
Device Model:	M20QTS9PW1AN

Test Period:	8/11/04-8/12/04
Responsible Engineer:	Stephen Whalen (Sr. EME Engineer)
Test Engineer:	Stephen Whalen (Sr. EME Engineer)
Author:	Michael Sailsman (Global EME Regulatory Affairs Liaison)

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 all applicable national and international reference standards and guidelines.

Signature on file — 1/13/05

Ken Enger
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Date Approved

TABLE OF CONTENTS

REVISION HISTORY

Date	Revision	Comments
9/28/04	O	Release of Prototype Results
1/13/05	A	The following sections were changed per FCC correspondence 28283; section 11.1 tables 33-54, and Appendix D

1.0 Product Description

FCC ID: AZ492FT4870, model M20QTS9PW1AN is a mobile transceiver that utilizes frequency modulation (FM) half duplex transmission technology. The modulation could be conventional analog voice, trunked analog voice, tone PL or C4FM modulation. The control data rates are 3600 and 9600 baud on the C4FM constant envelope carrier. The maximum duty cycle varies dependent on the loading of the system. The data mode characteristic of the device is packet based with a maximum packet size of 1500 bytes. The actual duty cycle performance will always be less than 10% due to the system's design restrictions and normal operating parameters of the device. Note that the device and the systems in which it operates do not allow streaming data as an intended functionality. Furthermore, the transmission signal in data mode uses standard APCO signaling as specified in TIA/EIA 102.CAAA paragraph 1.3.3.5 with C4FM modulation. This device is Project 25 compliant.
The intended use of the radio is Push-To-Talk (PTT) while the device is properly installed in a vehicle with the offered external antennas 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. Motorola also makes available to its customers training classes on the proper use of two-way radios and wireless data devices. This device 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. The transmit frequency band is 380-470 MHz. The nominal power of the device is 25-100 watts with a maximum conducted power output of 120 watts.
(Note that "By-standers" as used herein mean people other than operator)

2.0 Offered Options and Accessories

Antenna

RAE4014ARB	455-470 MHz 5/8 wave 7.15dBi antenna; 92.5cm
HAE4011A	449-470 MHz ½ wave 5.65dBi antenna; 73.1cm
HAE4003A	450-470 MHz ¼ wave 2.15dBi antenna; 16.2cm
HAE6012A	380-433 MHz ¼ wave 2.15dBi antenna; 18.2cm
HAE6011A	380-433 MHz 5/8 wave 7.15dBi antenna; 91.0cm
HAE6013A	380-470 MHz ½ wave 4.15dBi antenna; 28.4cm
HAE6010A	380-433 MHz ½ wave 5.65dBi antenna; 63.0cm

3.0 Measurement Standards

Measurements were performed according to FCC Limits Per 47 CFR 2.1091 (d) for General Population/Uncontrolled RF Exposure as well as with the recommended guidelines in IEEE/ANSI C95.1-1999.

For frequencies ranging from 380-470 MHz the MPE (Maximum Permissible Exposure) limit to electromagnetic energy in an equivalent plane wave free-space power density ranges from 0.25-0.31mW/cm^2.

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 vehicle running at idle and the vehicle battery measuring 14.0 volts.

5.0 Measurement System Uncertainty Levels

The information below presents an estimate of the possible errors that are associated with the measurement system.

Description	Error
NARDA Survey Meter	**± 3%**
Repeatability Accuracy	**± 7%**

6.0 Method of Measurement

6.1 EME measurements made on trunk mounted antennas

(For reference, see Antenna Location Layout drawings in Appendix)

6.1.1 External vehicle EME measurement

(Antenna mounted at trunk center)

MPE measurements for by-stander conditions are determined by taking the average of (10) measurements in a 2m vertical line directly behind the vehicle with 20cm increments at the standard test distance of 90cm from each of the ½ wave and 5/8 wave antennas. 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.

Each of the offered antennas mounted at the center of the trunk were assessed for the following (3) by-stander conditions while maintaining a twenty (20) centimeter separation distance between the probe sensor and vehicle body: (1) directly behind the vehicle, (2) 45º radial at the corner of the vehicle, and (3) 90º radial at the side of the trunk. The worst case test condition from above was then assessed at the transmit band edges.

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 64cm (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 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, both front and back seating areas, using each of the antennas tested herein at the trunk, to ascertain the highest level in each location. After the highest level is found, scans were performed vertically making two (2) additional measurements within an area approximately 40 cm 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 on center roof mounted antennas

(For reference, see Antenna Location Layout drawings in Appendix)

6.2.1 External vehicle EME measurement

(Antenna mounted at roof center)

MPE measurements for by-stander conditions are determined by taking the average of (10) measurements in a 2m vertical line directly beside the vehicle with 20cm increments at the standard test distance of 90cm from each of the applicable antennas. 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 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, using each of the antennas tested herein at the roof, to ascertain the highest level in each location. After the highest level is found, scans were performed vertically making two (2) additional measurements within an area approximately 40 cm 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 Commercial Government Industrial Solution Sector (CGISS) world wide electromagnetic exposure (EME) open area test site located at 8000 W. Sunrise Blvd., Plantation, FL. 33322.

8.0 Measurement System/Equipment

The minimum equipment required will mainly consist of a test vehicle, radio frequency radiation test set consisting of an Electromagnetic Radiation Survey Meter, E/H-Field Test Probes, and typical antenna configurations.
Below are the test equipment used to assess compliance:

a) Automobile: 1991 Ford Taurus, 4-Door

b) Survey Meter - NARDA Model 8718 (01108); Cal. date: 4/7/04

c) E-Field (Electric Field) Probe - NARDA Model 8722B (13001); Cal. date: 6/10/04

d) Antennas – (¼ wave 2.15dBi, ½ wave 5.65dBi and 4.15dBi gain antennas, and 5/8 wave 7.15dBi gain antennas)

9.0 Test Unit Description

Power density measurements were performed on a representative sample of model number M20QTS9PW1AN. The serial number of the tested radio was U2A024. The frequency band of the DUT is 380-470 MHz; the tested frequencies were 380.0125, 425.0125, 450.0125, 460.0125, 469.9875 MHz. The ¼ wave 2.15dBi antennas, ½ wave 5.15dBi and 4.15dBi gain antennas, and 5/8 wave 7.15dBi antennas listed in section 2.0 were used to assess compliance to the applicable MPE limits.

10.0 Test Set-Up Description

The following are the standard mobile antenna test configurations used for this product. (For reference, see Antenna Location Layout drawings in the Appendix A)

a) The ¼ wave 2.15dBi antenna models HAE4003A and HAE6012A, ½ wave 5.65dBi and 4.15dBi gain antenna models HAE4011A, HAE6013A, and HAE6010A, as well as 5/8 wave 7.15dBi antenna models RAE4014ARB and HAE6011A were mounted at the center of the roof of the test vehicle.
b) The ½ wave 5.65dBi and 4.15dBi gain antenna models HAE6013A, HAE6010A and 5/8 wave 7.15dBi antennas were assessed while mounted at the trunk.
Assessments were made internal and external to the test vehicle at the specified distances and locations stated in sections 6.0, 11.0, and the APPENDIX A. Note that the ¼ wave antennas are restricted to roof mount operations for this filing.

11.0 Test Results Summary

Table A

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Int./Ext.	Max Calc Pwr Density	% of Uncontrolled limit
Table 1	RAE4014ARB	Roof	470	E	Ext	0.019	6.13
Table 2	RAE4014ARB	Roof	470	E	Int	0.001	0.32
Table 3	HAE6011A	Roof	380	E	Ext	0.112	44.80
Table 4	HAE6011A	Roof	380	E	Int	0.012	4.80
Table 5	HAE6011A	Roof	425	E	Ext	0.084	30.00
Table 6	HAE6011A	Roof	425	E	Int	0.022	7.86
Table 7	HAE4003A	Roof	470	E	Ext	0.181	58.39
Table 8	HAE4003A	Roof	470	E	Int	0.179	57.74
Table 9	HAE6012A	Roof	380	E	Ext	0.218	87.20
Table 10	HAE6012A	Roof	380	E	Int	0.095	38.00
Table 11	HAE6012A	Roof	425	E	Ext	0.160	57.14
Table 12	HAE6012A	Roof	425	E	Int	0.121	43.21
Table 13	HAE4011A	Roof	460	E	Ext	0.164	52.90
Table 14	HAE4011A	Roof	460	E	Int	0.030	9.68
Table 15	HAE6013A	Roof	380	E	Ext	0.198	79.20
Table 16	HAE6013A	Roof	380	E	Int	0.086	34.40
Table 17	HAE6013A	Roof	425	E	Ext	0.208	74.29
Table 18	HAE6013A	Roof	425	E	Int	0.175	62.50
Table 19	HAE6013A	Roof	470	E	Ext	0.183	59.03
Table 20	HAE6013A	Roof	470	E	Int	0.174	56.13
Table 21	HAE6010A	Roof	380	E	Ext	0.106	42.40
Table 22	HAE6010A	Roof	380	E	Int	0.074	29.60
Table 23	HAE6010A	Roof	425	E	Ext	0.121	43.21
Table 24	HAE6010A	Roof	425	E	Int	0.159	56.79

Table A (continued)

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Int./Ext.	Max Calc Pwr Density	% of Uncontrolled limit
Table 25	HAE6011A	Trunk	425	E	Ext	0.138	49.29
Table 26	HAE6011A	Trunk	425	E	Int.	0.173	61.79
Table 27	HAE4011A	Trunk	460	E	Ext	0.220	70.97
Table 28*	HAE4011A	Trunk	460	E	Int.	0.375	120.97
Table 29*	HAE6013A	Trunk	425	E	Ext	0.309	110.36
Table 30*	HAE6013A	Trunk	425	E	Int.	0.785	280.36
Table 31	HAE6010A	Trunk	425	E	Ext	0.204	72.86
Table 32*	HAE6010A	Trunk	425	E	Int.	0.516	184.29
By-stander assessment at 45º radial from the trunk mount antenna							
Table 33	HAE6011A	Trunk	425	E	Ext	0.154	55.00
Table 34	HAE4011A	Trunk	460	E	Ext	0.292	94.19
Table 35*	HAE6013A	Trunk	425	E	Ext	0.421	150.36
Table 36	HAE6010A	Trunk	425	E	Ext	0.252	90.00
By-stander assessment at 90º radial from the trunk mount antenna							
Table 37	HAE6011A	Trunk	425	E	Ext	0.122	43.57
Table 38	HAE4011A	Trunk	460	E	Ext	0.238	76.77
Table 39*	HAE6013A	Trunk	425	E	Ext	0.319	113.93
Table 40	HAE6010A	Trunk	425	E	Ext	0.204	72.86
Assessment at the band edges w/ worst case configuration from above							
Table 41	RAE4014ARB	Trunk	470	E	Ext	0.048	15.48
Table 42	RAE4014ARB	Trunk	470	E	Int.	0.014	4.52
Table 43	HAE6011A	Trunk	380	E	Ext	0.231	92.40
Table 44	HAE6011A	Trunk	380	E	Int.	0.109	43.60
Table 45	HAE4011A	Trunk	450	E	Ext	0.247	82.33
Table 46*	HAE4011A	Trunk	450	E	Int.	0.330	110.00
Table 47	HAE4011A	Trunk	470	E	Ext	0.266	85.81

Table A (continued)

Tables	Antenna Model	Antenna Location	Test Frequency (MHz)	E/H Field	Int./Ext.	Max Calc Pwr Density	% of Uncontrolled limit
Table 48	HAE4011A	Trunk	470	E	Int.	0.304	98.06
Table 49*	HAE6013A	Trunk	380	E	Ext	0.334	133.60
Table 50*	HAE6013A	Trunk	380	E	Int.	0.402	160.80
Table 51**	HAE6013A	Trunk	470	E	Ext	0.426	137.42
Table 52*	HAE6013A	Trunk	470	E	Int.	0.657	211.94
Table 53*	HAE6010A	Trunk	380	E	Ext	0.292	116.80
Table 54*	HAE6010A	Trunk	380	E	Int.	0.327	130.80

Note: * = Results exceeding applicable limits; ** = Worst case configuration external to vehicle

11.1 Test Results

Presented below is a summary of the tested frequencies and associated power outputs, measurement probe parameters and exposure conditions, results calculation methodology, applicable reference standards, as well as tables of the raw MPE data for all measured grid points.
The maximum calculated final results presented in the tables are based on a 50% duty cycle with the radio operating in accordance with the User Manual instructions. The bolded power density results represent the highest MPE results observed.

Raw MPE Data test frequencies and measured Po (W):
380.0125 MHz (Po=122.0), 425.0125 MHz (Po=123.0), 450.0125 MHz (Po=121.0), 460.0125 MHz (Po=123.0), 469.9875 MHz (Po=123.0)

Meter reads in % of controlled limit; controlled limit = f/300 for 300-1500 MHz (Cal factors presented herein are automatically accounted for in the meter used for assessments) General Population MPE limits = 0.25-0.31 mW/cm^2

External Vehicle Power Density (Pwr. Den. (cal.)) = average over body/2
Internal Vehicle Power Density (Pwr. Den. (cal.)) = average over (head/chest/lower trunk)/2
If initial power < RF Po max then Pwr Density Max Calc. = (RF Po Max/Initial Power)*Pwr Density Calc.

Note: The average over the body test methodology is consistent with IEEE/ANSI C95.1-1999 guidelines

Table 1

External Vehicle MPE Assessment @ 469.9875 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)	RAE4014ARB	7.15	90	E	1.11	0.038	123.0	0.019	0.019
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.0%		6	120	0.9%		1.57	0.31
2	40	0.0%		7	140	1.8%			
3	60	0.0%		8	160	3.0%			
4	80	0.0%		9	180	5.9%			**RF Po (*Max)**
5	100	1.0%		10	200	11.8%			120

Table 2

Internal Vehicle MPE Assessment @ 469.9875 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)	RAE4014ARB	7.15	Highest Reading	E	1.11	0.003	0.001	123.0	0.001	0.001
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%		0.0%		0.0%		IEEE Uncontrolled Limit:		0.31
Front Seat		0.2%		0.0%		0.0%			**RF Po (*Max):**	120

Table 3

External Vehicle MPE Assessment @ 380.0125 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)	HAE6011 A	7.15	90	E	1.1	0.224	122.0	0.112	0.112
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.0%		6	120	6.3%		1.27	0.25
2	40	0.0%		7	140	18.5%			
3	60	0.0%		8	160	40.2%			
4	80	1.1%		9	180	57.3%			**RF Po (*Max)**
5	100	3.3%		10	200	50.5%			120

Table 4

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6011 A	7.15	Highest Reading	E	1.1	0.024	0.021	122.0	0.012	0.012

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.27
Back Seat	1.8%	2.1%	1.7%	IEEE Uncontrolled Limit:	0.25
Front Seat	1.9%	1.4%	1.6%	**RF Po (*Max):**	120

Table 5

External Vehicle MPE Assessment @ 425.0125 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)	HAE6011A	7.15	90	E	1.1	0.168	123.0	0.084	0.084
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.0%		6	120	4.2%		1.42	0.28
2	40	0.0%		7	140	11.3%			
3	60	0.0%		8	160	25.1%			
4	80	2.4%		9	180	38.4%			**RF Po (*Max)**
5	100	3.3%		10	200	33.7%			120

Table 6

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6011A	7.15	Highest Reading	E	1.1	0.045	0.023	123.0	0.022	0.022
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.42
Back Seat		2.7%		5.3%		1.5%		IEEE Uncontrolled Limit:		0.28
Front Seat		1.1%		2.3%		1.4%			**RF Po (*Max):**	120

Table 7

External Vehicle MPE Assessment @ 469.9875 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	1.11	0.363	123.0	0.181	0.181
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	15.3%		1.57	0.31
2	40	2.8%		7	140	31.4%			
3	60	5.3%		8	160	53.6%			
4	80	7.4%		9	180	56.3%			**RF Po (*Max)**
5	100	8.2%		10	200	48.7%			120

Table 8

Internal Vehicle MPE Assessment @ 469.9875 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	1.11	0.358	0.170	123.0	0.179	0.179

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.57
Back Seat	18.6%	31.4%	18.5%	IEEE Uncontrolled Limit:	0.31
Front Seat	6.9%	5.5%	20.1%	**RF Po (*Max):**	120

Table 9

External Vehicle MPE Assessment @ 380.0125 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)	HAE6012A	2.15	90	E	1.1	0.437	122.0	0.218	0.218
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	38.4%		1.27	0.25
2	40	3.1%		7	140	42.3%			
3	60	9.9%		8	160	61.7%			
4	80	13.1%		9	180	68.4%			**RF Po (*Max)**
5	100	27.5%		10	200	77.5%			120

Table 10

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6012A	2.15	Highest Reading	E	1.1	0.189	0.140	122.0	0.095	0.095
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.27
Back Seat		20.2%		14.3%		10.3%		IEEE Uncontrolled Limit:		0.25
Front Seat		15.6%		8.4%		9.1%			**RF Po (*Max):**	120

Table 11

External Vehicle MPE Assessment @ 425.0125 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)	HAE6012 A	2.15	90	E	1.1	0.321	123.0	0.160	0.160
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**	**Test Position**	**Height (cm)**	**% of Control Limit**	IEEE Controlled Limit	IEEE Uncontrolled Limit		
1	20	2.0%	6	120	19.9%	1.42	0.28		
2	40	2.1%	7	140	30.6%				
3	60	6.3%	8	160	45.1%				
4	80	11.7%	9	180	46.3%		**RF Po (*Max)**		
5	100	18.4%	10	200	44.1%		120		

Table 12

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6012 A	2.15	Highest Reading	E	1.1	0.243	0.089	123.0	0.121	0.121
Measurement Grid										
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.42					
Back Seat	18.2%	24.5%	8.7%	IEEE Uncontrolled Limit:	0.28					
Front Seat	1.9%	8.2%	8.8%	**RF Po (*Max):**	120					

Table 13

External Vehicle MPE Assessment @ 460.0125 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)	HAE4011 A	2.15	90	E	1.11	0.329	123.0	0.164	0.164
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.0%		6	120	4.7%		1.53	0.31
2	40	0.0%		7	140	23.4%			
3	60	2.1%		8	160	60.3%			
4	80	3.3%		9	180	70.1%			**RF Po (*Max)**
5	100	3.8%		10	200	46.7%			120

Table 14

Internal Vehicle MPE Assessment @ 460.0125 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)	HAE4011 A	2.15	Highest Reading	E	1.11	0.061	0.037	123.0	0.030	0.030
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.53
Back Seat		3.3%		5.9%		2.7%		IEEE Uncontrolled Limit:		0.31
Front Seat		2.1%		1.5%		3.6%			**RF Po (*Max):**	120

Table 15

External Vehicle MPE Assessment @ 380.0125 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)	HAE6013A	4.15	90	E	1.1	0.396	122.0	0.198	0.198

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	32.3%	1.27	0.25
2	40	3.3%	7	140	39.1%		
3	60	9.3%	8	160	56.3%		
4	80	12.4%	9	180	61.3%		**RF Po (*Max)**
5	100	25.1%	10	200	70.5%		120

Table 16

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6013A	4.15	Highest Reading	E	1.1	0.172	0.119	122.0	0.086	0.086

Measurement Grid

Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk		
				IEEE Controlled Limit:	1.27
Back Seat	17.3%	13.4%	10.1%	IEEE Uncontrolled Limit:	0.25
Front Seat	13.8%	8.3%	6.2%	**RF Po (*Max):**	120

Table 17

External Vehicle MPE Assessment @ 425.0125 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)	HAE6013 A	4.15	90	E	1.1	0.417	123.0	0.208	0.208
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.9%		6	120	28.3%		1.42	0.28
2	40	3.0%		7	140	39.4%			
3	60	8.1%		8	160	61.7%			
4	80	16.5%		9	180	58.7%			**RF Po (*Max)**
5	100	24.1%		10	200	51.3%			120

Table 18

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6013 A	4.15	Highest Reading	E	1.1	0.350	0.116	123.0	0.175	0.175
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.42
Back Seat		18.3%		44.9%		10.9%		IEEE Uncontrolled Limit:		0.28
Front Seat		3.1%		9.9%		11.5%			**RF Po (*Max):**	120

Table 19

External Vehicle MPE Assessment @ 469.9875 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)	HAE6013 A	4.15	90	E	1.11	0.366	123.0	0.183	0.183
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	18.3%		1.57	0.31
2	40	2.1%		7	140	35.4%			
3	60	5.6%		8	160	60.7%			
4	80	8.1%		9	180	52.3%			**RF Po (*Max)**
5	100	9.2%		10	200	39.7%			120

Table 20

Internal Vehicle MPE Assessment @ 469.9875 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)	HAE6013 A	4.15	Highest Reading	E	1.11	0.348	0.158	123.0	0.174	0.174

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.57
Back Seat	15.8%	41.0%	9.9%	IEEE Uncontrolled Limit:	0.31
Front Seat	6.9%	10.1%	13.3%	**RF Po (*Max):**	120

Table 21

External Vehicle MPE Assessment @ 380.0125 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)	HAE6010A	5.65	90	E	1.1	0.212	122.0	0.106	0.106
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	24.3%		1.27	0.25
2	40	2.8%		7	140	22.1%			
3	60	9.3%		8	160	19.9%			
4	80	13.4%		9	180	19.0%			**RF Po (*Max)**
5	100	20.1%		10	200	33.5%			120

Table 22

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6010A	5.65	Highest Reading	E	1.1	0.149	0.123	122.0	0.074	0.074
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.27
Back Seat		16.4%		11.5%		7.3%		IEEE Uncontrolled Limit:		0.25
Front Seat		14.3%		5.6%		9.2%			**RF Po (*Max):**	120

Table 23

External Vehicle MPE Assessment @ 425.0125 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)	HAE6010A	5.65	90	E	1.1	0.242	123.0	0.121	0.121
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	24.6%		1.42	0.28
2	40	4.9%		7	140	28.6%			
3	60	9.5%		8	160	24.3%			
4	80	15.1%		9	180	13.4%			**RF Po (*Max)**
5	100	25.7%		10	200	21.7%			120

Table 24

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6010A	5.65	Highest Reading	E	1.1	0.318	0.103	123.0	0.159	0.159

Measurement Grid						
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:		1.42
Back Seat	19.9%	40.2%	7.2%	IEEE Uncontrolled Limit:		0.28
Front Seat	2.2%	10.9%	8.7%		**RF Po (*Max):**	120

Table 25

External Vehicle MPE Assessment @ 425.0125 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)	HAE6011 A	7.15	90	E	1.1	0.277	123.0	0.138	0.138
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	4.8%		6	120	34.1%		1.42	0.28
2	40	5.3%		7	140	54.7%			
3	60	9.3%		8	160	34.9%			
4	80	10.2%		9	180	14.3%			**RF Po (*Max)**
5	100	18.7%		10	200	9.2%			120

Table 26

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6011 A	7.15	Highest Reading	E	1.1	0.346	0.161	123.0	0.173	0.173
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.42
Back Seat		37.5%		25.6%		10.1%		IEEE Uncontrolled Limit:		0.28
Front Seat		14.7%		12.9%		6.4%			**RF Po (*Max):**	120

Table 27

External Vehicle MPE Assessment @ 460.0125 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)	HAE4011 A	2.15	90	E	1.11	0.440	123.0	0.220	0.220
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	74.8%		1.53	0.31
2	40	2.2%		7	140	83.7%			
3	60	4.4%		8	160	30.4%			
4	80	11.6%		9	180	17.3%			**RF Po (*Max)**
5	100	37.9%		10	200	22.5%			120

Table 28

Internal Vehicle MPE Assessment @ 460.0125 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)	HAE4011 A	2.15	Highest Reading	E	1.11	0.750	0.528	123.0	0.375	0.375
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.53
Back Seat		54.8%		63.5%		28.5%		IEEE Uncontrolled Limit:		0.31
Front Seat		33.9%		42.7%		26.7%			**RF Po (*Max):**	120

Table 29

External Vehicle MPE Assessment @ 425.0125 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)	HAE6013 A	4.15	90	E	1.1	0.618	123.0	0.309	0.309
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	17.3%		6	120	67.5%		1.42	0.28
2	40	18.4%		7	140	60.1%			
3	60	47.7%		8	160	43.5%			
4	80	59.8%		9	180	28.7%			**RF Po (*Max)**
5	100	67.7%		10	200	25.4%			120

Table 30

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6013 A	4.15	Highest Reading	E	1.1	1.570	0.782	123.0	0.785	0.785

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.42
Back Seat	198.9%	88.9%	44.7%	IEEE Uncontrolled Limit:	0.28
Front Seat	90.7%	58.1%	16.8%	**RF Po (*Max):**	120

Table 31

External Vehicle MPE Assessment @ 425.0125 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)	HAE6010A	5.65	90	E	1.1	0.407	123.0	0.204	0.204
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	17.8%		6	120	10.6%		1.42	0.28
2	40	18.9%		7	140	12.8%			
3	60	24.1%		8	160	34.9%			
4	80	23.9%		9	180	54.3%			**RF Po (*Max)**
5	100	24.7%		10	200	65.5%			120

Table 32

Internal Vehicle MPE Assessment @ 425.0125 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)	HAE6010A	5.65	Highest Reading	E	1.1	1.031	0.346	123.0	0.516	0.516
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.42
Back Seat		101.8%		90.1%		26.5%		IEEE Uncontrolled Limit:		0.28
Front Seat		37.8%		26.5%		8.9%			**RF Po (*Max):**	120

Table 33

External Vehicle MPE Assessment @ 425.0125 MHz									Assessment at 45º
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)	HAE6011 A	7.15	99.5	E	1.1	0.309	123.0	0.154	0.154
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	45.1%		1.42	0.28
2	40	2.7%		7	140	56.7%			
3	60	6.5%		8	160	43.8%			
4	80	12.3%		9	180	21.7%			**RF Po (*Max)**
5	100	22.3%		10	200	4.2%			120

Table 34

External Vehicle MPE Assessment @ 460.0125 MHz									Assessment at 45º
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)	HAE4011 A	2.15	99.5	E	1.11	0.584	123.0	0.292	0.292
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	2.9%		6	120	101.7%		1.53	0.31
2	40	2.8%		7	140	105.1%			
3	60	6.3%		8	160	57.3%			
4	80	16.5%		9	180	17.5%			**RF Po (*Max)**
5	100	56.9%		10	200	13.6%			120

Table 35

External Vehicle MPE Assessment @ 425.0125 MHz								Assessment at 45º	
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)	HAE6013 A	4.15	99.5	E	1.1	0.843	123.0	0.421	0.421
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	9.2%		6	120	132.7%		1.42	0.28
2	40	8.8%		7	140	107.5%			
3	60	33.4%		8	160	67.8%			
4	80	68.7%		9	180	32.1%			**RF Po (*Max)**
5	100	114.3%		10	200	20.5%			120

Table 36

External Vehicle MPE Assessment @ 425.0125 MHz								Assessment at 45º	
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)	HAE6010 A	5.65	99.5	E	1.1	0.504	123.0	0.252	0.252
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	11.3%		6	120	43.5%		1.42	0.28
2	40	10.8%		7	140	18.9%			
3	60	32.1%		8	160	25.7%			
4	80	51.6%		9	180	44.6%			**RF Po (*Max)**
5	100	65.7%		10	200	51.7%			120

Table 37

External Vehicle MPE Assessment @ 425.0125 MHz								Assessment at 90º	
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)	HAE6011 A	7.15	104	E	1.1	0.244	123.0	0.122	0.122
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	32.5%		1.42	0.28
2	40	1.7%		7	140	45.7%			
3	60	4.5%		8	160	36.3%			
4	80	6.4%		9	180	18.8%			**RF Po (*Max)**
5	100	16.5%		10	200	7.9%			120

Table 38

External Vehicle MPE Assessment @ 460.0125 MHz								Assessment at 90º	
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)	HAE4011 A	2.15	104	E	1.11	0.475	123.0	0.238	0.238
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	4.1%		6	120	53.7%		1.53	0.31
2	40	3.3%		7	140	78.9%			
3	60	11.5%		8	160	67.6%			
4	80	16.3%		9	180	27.5%			**RF Po (*Max)**
5	100	36.7%		10	200	10.2%			120

Table 39

External Vehicle MPE Assessment @ 425.0125 MHz Assessment at 90º									
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)	HAE6013A	4.15	104	E	1.1	0.637	123.0	0.319	0.319
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	13.9%		6	120	88.1%		1.42	0.28
2	40	12.1%		7	140	76.5%			
3	60	34.3%		8	160	59.5%			
4	80	51.1%		9	180	25.6%			**RF Po (*Max)**
5	100	69.3%		10	200	19.3%			120

Table 40

External Vehicle MPE Assessment @ 425.0125 MHz Assessment at 90º									
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)	HAE6010A	5.65	104	E	1.1	0.407	123.0	0.204	0.204
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	9.1%		6	120	24.3%		1.42	0.28
2	40	7.7%		7	140	15.7%			
3	60	23.5%		8	160	31.6%			
4	80	28.7%		9	180	53.4%			**RF Po (*Max)**
5	100	28.9%		10	200	64.5%			120

Table 41

External Vehicle MPE Assessment @ 469.9875 MHz Assessment at 45º									
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)	RAE4014ARB	7.15	99.5	E	1.11	0.096	123.0	0.048	0.048
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	0.0%		6	120	2.1%		1.57	0.31
2	40	0.0%		7	140	7.5%			
3	60	1.2%		8	160	18.9%			
4	80	1.1%		9	180	18.5%			**RF Po (*Max)**
5	100	1.8%		10	200	10.1%			120

Table 42

Internal Vehicle MPE Assessment @ 469.9875 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)	RAE4014 ARB	7.15	Highest Reading	E	1.11	0.029	0.016	123.0	0.014	0.014
Measurement Grid										
Test Position		**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:		1.57
Back Seat		2.1%		2.4%		1.0%		IEEE Uncontrolled Limit:		0.31
Front Seat		1.2%		0.9%		1.0%			**RF Po (*Max):**	120

Table 43

External Vehicle MPE Assessment @ 380.0125 MHz								Assessment at 45º	
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)	HAE6011 A	7.15	99.5	E	1.1	0.462	122.0	0.231	0.231

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	80.3%	1.27	0.25
2	40	1.7%	7	140	102.3%		
3	60	8.2%	8	160	71.9%		
4	80	17.4%	9	180	29.8%		**RF Po (*Max)**
5	100	40.1%	10	200	10.6%		120

Table 44

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6011 A	7.15	Highest Reading	E	1.1	0.217	0.075	122.0	0.109	0.109

Measurement Grid					
Test Position	% of Control Limit Head	% of Control Limit Chest	% of Control Limit Lower Trunk	IEEE Controlled Limit:	1.27
Back Seat	23.4%	11.8%	16.2%	IEEE Uncontrolled Limit:	0.25
Front Seat	9.2%	4.4%	4.1%	**RF Po (*Max):**	120

Table 45

External Vehicle MPE Assessment @ 450.0125 MHz								Assessment at 45º	
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)	HAE4011 A	2.15	99.5	E	1.11	0.494	121.0	0.247	0.247
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	80.1%		1.50	0.30
2	40	1.3%		7	140	90.5%			
3	60	9.9%		8	160	45.7%			
4	80	23.4%		9	180	13.1%			**RF Po (*Max)**
5	100	52.3%		10	200	11.7%			120

Table 46

Internal Vehicle MPE Assessment @ 450.0125 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)	HAE4011 A	2.15	Highest Reading	E	1.11	0.659	0.328	121.0	0.330	0.330

Measurement Grid					
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:	1.50
Back Seat	60.1%	49.5%	22.2%	IEEE Uncontrolled Limit:	0.30
Front Seat	29.7%	21.2%	14.6%	**RF Po (*Max):**	120

Table 47

External Vehicle MPE Assessment @ 469.9875 MHz								Assessment at 45º	
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)	HAE4011 A	2.15	99.5	E	1.11	0.532	123.0	0.266	0.266
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	1.4%		6	120	79.6%		1.57	0.31
2	40	1.7%		7	140	115.2%			
3	60	7.9%		8	160	43.5%			
4	80	18.3%		9	180	15.1%			**RF Po (*Max)**
5	100	45.1%		10	200	12.0%			120

Table 48

Internal Vehicle MPE Assessment @ 469.9875 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)	HAE4011 A	2.15	Highest Reading	E	1.11	0.492	0.608	123.0	0.304	0.304
Measurement Grid										
Test Position	**% of Control Limit Head**		**% of Control Limit Chest**		**% of Control Limit Lower Trunk**		IEEE Controlled Limit:			1.57
Back Seat	47.8%		36.3%		10.2%		IEEE Uncontrolled Limit:			0.31
Front Seat	46.1%		44.7%		25.7%				**RF Po (*Max):**	120

Table 49

External Vehicle MPE Assessment @ 380.0125 MHz									Assessment at 45º
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)	HAE6013 A	4.15	99.5	E	1.1	0.669	122.0	0.334	0.334
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	16.7%		6	120	105.1%		1.27	0.25
2	40	15.8%		7	140	86.7%			
3	60	29.3%		8	160	68.4%			
4	80	54.1%		9	180	43.5%			RF Po (*Max)
5	100	77.3%		10	200	31.2%			120

Table 50

Internal Vehicle MPE Assessment @ 380.0125 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)	HAE6013 A	4.15	Highest Reading	E	1.1	0.804	0.221	122.0	0.402	0.402
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.27
Back Seat		87.3%		56.1%		47.1%		IEEE Uncontrolled Limit:		0.25
Front Seat		19.8%		18.3%		14.2%			RF Po (*Max):	120

Table 51

External Vehicle MPE Assessment @ 469.9875 MHz								Assessment at 45º	
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)	HAE6013 A	4.15	99.5	E	1.11	0.852	123.0	0.426	0.426
Measurement Grid									
Test Position	Height (cm)	% of Control Limit		Test Position	Height (cm)	% of Control Limit		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	8.5%		6	120	123.6%		1.57	0.31
2	40	10.2%		7	140	91.4%			
3	60	28.3%		8	160	53.3%			
4	80	56.4%		9	180	36.5%			RF Po (*Max)
5	100	115.1%		10	200	20.4%			120

Table 52

Internal Vehicle MPE Assessment @ 469.9875 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)	HAE6013 A	4.15	Highest Reading	E	1.11	1.314	1.166	123.0	0.657	0.657
Measurement Grid										
Test Position		% of Control Limit Head		% of Control Limit Chest		% of Control Limit Lower Trunk		IEEE Controlled Limit:		1.57
Back Seat		117.8%		95.4%		38.4%		IEEE Uncontrolled Limit:		0.31
Front Seat		65.1%		93.1%		65.1%			RF Po (*Max):	120

Table 53

External Vehicle MPE Assessment @ 380.0125 MHz Assessment at 45°									
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)	HAE6010A	5.65	99.5	E	1.1	0.585	122.0	0.292	0.292
Measurement Grid									
Test Position	**Height (cm)**	**% of Control Limit**		**Test Position**	**Height (cm)**	**% of Control Limit**		IEEE Controlled Limit	IEEE Uncontrolled Limit
1	20	19.3%		6	120	40.8%		1.27	0.25
2	40	15.7%		7	140	40.3%			
3	60	32.4%		8	160	61.5%			
4	80	47.6%		9	180	75.6%			**RF Po (*Max)**
5	100	46.3%		10	200	82.3%			120

Table 54

Internal Vehicle MPE Assessment @ 380.0125 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	Average over Head, Chest, Lower Trunk Back/Front seats (mW/cm^2) Front	Initial Power (W)	Pwr. Density Calc. (mW/cm^2)	Pwr. Density Max Calc. (mW/cm^2)
Trunk (cnt)	HAE6010A	5.65	Highest Reading	E	1.1	0.654	0.130	122.0	0.327	0.327

Measurement Grid						
Test Position	**% of Control Limit Head**	**% of Control Limit Chest**	**% of Control Limit Lower Trunk**	IEEE Controlled Limit:		1.27
Back Seat	72.1%	45.7%	37.2%	IEEE Uncontrolled Limit:		0.25
Front Seat	13.8%	12.1%	4.8%		**RF Po (*Max):**	120

12.0 Conclusion

Depending on the test frequency, compliance assessments were performed with an output power range of 121.0W to 123.0W. The maximum RF power allowable will be equal to the upper limit of the final test factory transmit power specification of 120.0W. The highest power density result scaled to the maximum allowable power output is 0.79mW/cm^2 internal to the vehicle and 0.43mW/cm^2 external to the vehicle.

The MPE results presented herein demonstrate compliance to the applicable Occupational/Controlled exposure limit of f/300 mW/cm^2 for the frequency range of 300-1500MHz.

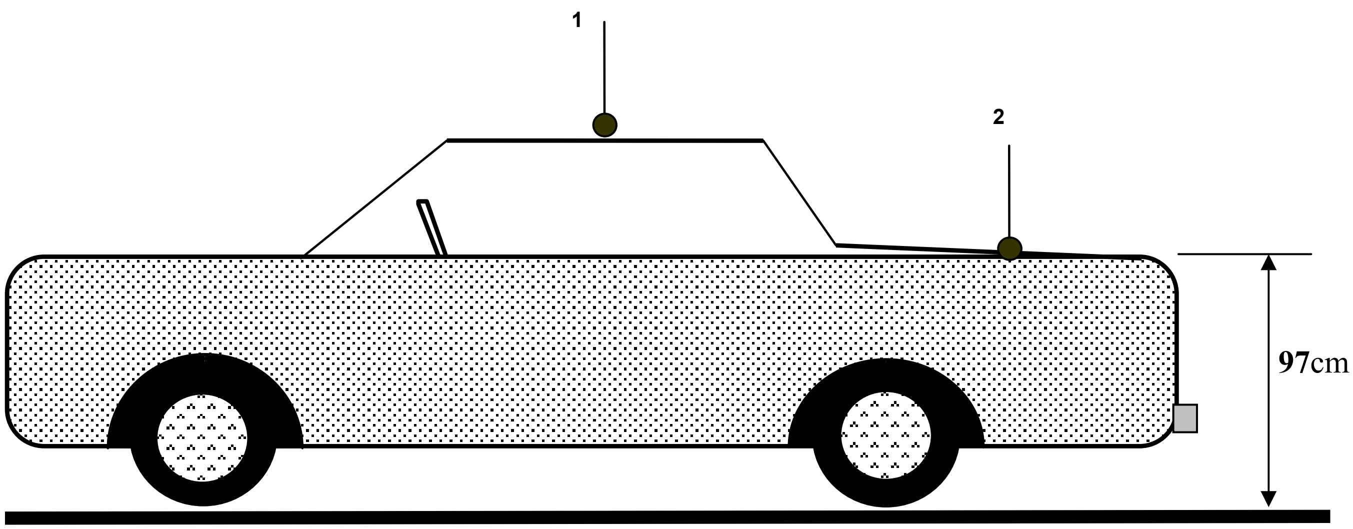
Compliance to the General population/Uncontrolled limits is demonstrated by S.A.R. computational assessments of specific MPE non-compliant passenger and by-stander test conditions* (see section 11.0). APPENDIX D presents computational S.A.R. results demonstrating compliance to the applicable General Population/Uncontrolled S.A.R. exposure limit of 1.6mW/g and therefore also demonstrates compliance to the MPE General Population/Uncontrolled limits.

The computational results show that this device, when used with the offered antennas in accordance with the user manual instructions, exhibits a maximum peak 1-g average S.A.R. of 0.90mW/g for passengers internal to the vehicle and a maximum peak 1-g average S.A.R. of 1.03mW/g for by-standers external to the vehicle.

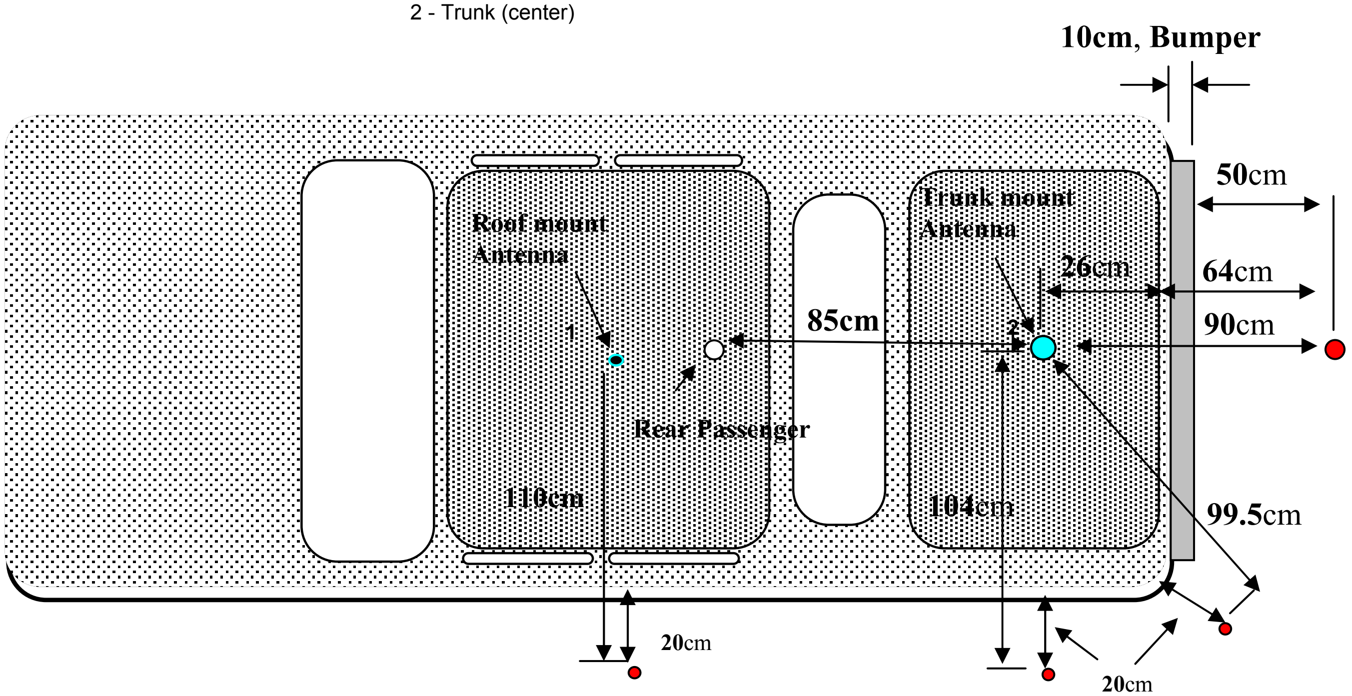
Notes:
1) Tables 28, 29, 30, 32, 35, 39, 46, 49, 50, 51, 52, 53, and 54 reflect the worst-case passenger and by-stander test configuration conditions that exceed the applicable MPE power density specification limits. The test conditions were analyzed computationally to assess performance to the applicable S.A.R. exposure specification limit. APPENDIX D of this report presents computational EME compliance assessment results for FCC ID: AZ492FT4870 performed by the Motorola Corporate Research Lab located in Plantation Florida using a commercial code based on FDTD (Finite Difference Time Domain) methodology. The computational results are provided herein in order to demonstrate the EME compliance of this device with respect to the IEEE Std C95.1-1999 specific absorption rate (S.A.R.) exposure limit.

APPENDIX A

Antenna Location Drawing with Test Locations Identified



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



APPENDIX B

Meter/Probe Calibration Certificates

L-3 communications
Narda Microwave-East

RFNR A002

Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced RF Radiation Hazard monitoring equipment has been calibrated in accordance with MIL-STD-45662A, ANSI Z540, ISO 10012 and ISO 9001: 2000.

The measured values were determined by comparison with our standards, which are traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facilities.

Certificate #: 44172 1

Customer: MOTOROLA INC
FORT LAUDERDALE, FL 33322

Model #: 8718-10

Serial #: 01108

Description: METER W/CABLE

PO #: NP1160429-V3

Date Calibrated: 04/07/2004

R.O. #: 44172

Vince Donovan
Manager of Instruments Assembly and Test

John C. Stine
Director of Quality Assurance

L-3 communications
Narda Microwave-East

Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced RF Radiation Hazard monitoring equipment has been calibrated in accordance with MIL-STD-45662A, ANSI Z540, ISO 10012 and ISO 9001: 2000.

The measured values were determined by comparison with our standards, which are traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facilities.

Customer: MOTOROLA
SCHAUMBURG, IL 60168-0429

Certificate #: 46078 2

Model #: 8722B

Serial #: 13001

Description: RAD MONITOR 8722B

PO #: NP1244927

Date Calibrated: 06/10/2004

R.O. #: 46078

Vince Donovan
Manager of Instruments Assembly and Test

John C. Stine
Director of Quality Assurance

narda microwave-east
an L3 communications company

DATE 06-May-2003
REL HUMIDITY 26%

RELEASE # R35740
TEMP 25 DEG. C

NARDA MICROWAVE - EAST

MODEL # 8722B
SERIAL # 13001

Recal Probe - Date of Previous Probe Data = 03/28/2002

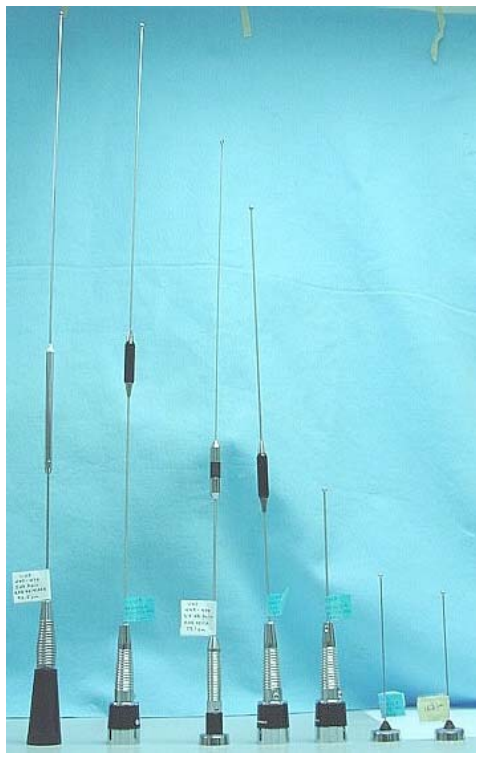
FREQ MHZ	PRE-CAL DATA	FINAL CAL DATA	ELLIPSE RATIO, dB	FINAL CORR. FACTOR	DEVIATION DELTA DB	PREVIOUS FINAL CORR
.30	0.72	0.77	+/- 0.40	1.30	-2.58	* 0.77
3.00	1.24	1.33	+/- 0.21	0.75	-0.43	0.73
10.00	0.86	0.92	+/- 0.20	1.08	-0.04	1.15
30.00	0.70	0.75	+/- 0.09	1.34	+0.06	1.46
100.00	1.23	1.32	+/- 0.14	0.76	-0.04	0.80
300.00	0.91	0.98	+/- 0.14	1.02	+0.38	1.20
750.00	1.16	1.24	+/- 0.19	0.80	-0.35	0.80
1000.00	1.25	1.34	+/- 0.24	0.75	-0.67	0.69
1700.00	0.97	1.04	+/- 0.45	0.96	+1.09	1.33
2450.00	1.09	0.99	+/- 0.40	1.01	+1.16	1.20
4000.00	1.03	0.93	+/- 0.21	1.07	+1.35	1.33
8200.00	1.21	1.09	+/- 0.69	0.91	+1.08	1.06
10000.00	1.16	1.05	+/- 0.63	0.96	+0.90	1.07
18000.00	1.38	1.25	+/- 0.83	0.80	+0.18	0.75
26500.00	1.25	1.13	+/- 0.98	0.89	+0.45	0.89
40000.00	0.89	0.80	+/- 0.92	1.25	+0.06	1.15

LOW FREQUENCY MULTIPLIER = 1.073 HIGH FREQUENCY MULTIPLIER = 0.905
FREQ. DEV. (3-40000 MHZ) = 2.549 DB
FREQ. DEV. (0.3-40000 MHZ) = 2.55 DB
MAX. ELLIPSE RATIO (0.3-40000 MHZ) = +/- 0.98 DB
PRE-CAL DATA REFLECTS THE MEAN ELLIPSE RATIO OF PROBE AS RECEIVED BY NARDA CALIBRATION DEPARTMENT, OR IS THE INITIAL, UN-ADJUSTED RATIO.
(PRE-CAL x OLD CORR. FACTOR) - 1 = DEVIATION FROM PREVIOUS (OLD) CALIBRATION DATA. NOTE: NOT APPLICABLE FOR NEW PROBES.
FINAL CAL DATA IS THE RATIO OF THE DISPLAYED TO THE APPLIED FIELD STRENGTH.
FINAL CORR. FACTOR IS THE RECIPROCAL OF FINAL CAL DATA.
FINAL CORR. FACTOR MULTIPLIED BY THE DISPLAYED FIELD STRENGTH READING GIVES THE ACTUAL ("CORRECTED") FIELD STRENGTH.
ELLIPSE RATIO IS EXPRESSED IN dB DEVIATION FROM THE MEAN DATA
RMS Uncertainty = +/- 0.5db. ATP # = 502120 REV J

TESTER V.M. Q.A. APPROVAL QA 9 NARDA

APPENDIX C

Photos of Assessed Antennas



Antenna kit numbers, from left to right; RAE4014ARB, HAE6011A, HAE4011A, HAE6010A, HAE6013A, HAE6012A, HAE4003A

APPENDIX D

Computational EME SAR Compliance Assessment

COMPUTATIONAL EME COMPLIANCE ASSESSMENT OF THE XTL5000 UHF MOBILE RADIO, MODEL # M20QTS9PW1AN, FCC ID AZ492FT4870

September 17, 2004 - Revised January 11, 2005

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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 XTL5000 UHF, Model Number M20QTS9PW1AN, 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 380 - 470 MHz frequency band.

This computational analysis supplements the measurements conducted to evaluate the FCC *maximum permissible exposure* (MPE) limits for this mobile device. All test conditions (19 in total) that did not conform with applicable MPE limits were subdivided into two groups — bystander exposures and passenger exposures — and analyzed to determine whether those conditions complied with the *specific absorption rate* (SAR) limits for general public exposure (1.6 W/kg averaged over 1 gram of tissue and 0.08 W/kg averaged over the whole body) set forth in FCC guidelines, which are based on the IEEE C95.1-1999 standard [1]. For both groups, 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 accurate estimate of human exposure to RF energy.

Method

The simulation code employed is XFDTD™ v5.3, 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 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 trunk mounted antennas, the wheels and part of the hood were omitted in order to fit within the computational memory (3 GB) available. For roof mounted antennas, part of the trunk had to be removed while maintaining the integrity of the roof connection with the car body. These omissions would not be expected to affect the exposure calculations in any event.

For bystander exposure, the antenna position is 26 cm from the end of the trunk, so as to replicate the experimental conditions used in MPE measurements. For passenger exposure, the distance of trunk mounted antennas from the passenger head was set at 85 cm, so as to replicate the experimental conditions used in MPE measurements. Figures 1 shows one of the XFDTD™ computational models used for bystander exposure. Figures 2 shows one of the XFDTD™ computational models used for passenger exposure to trunk mounted antenna.

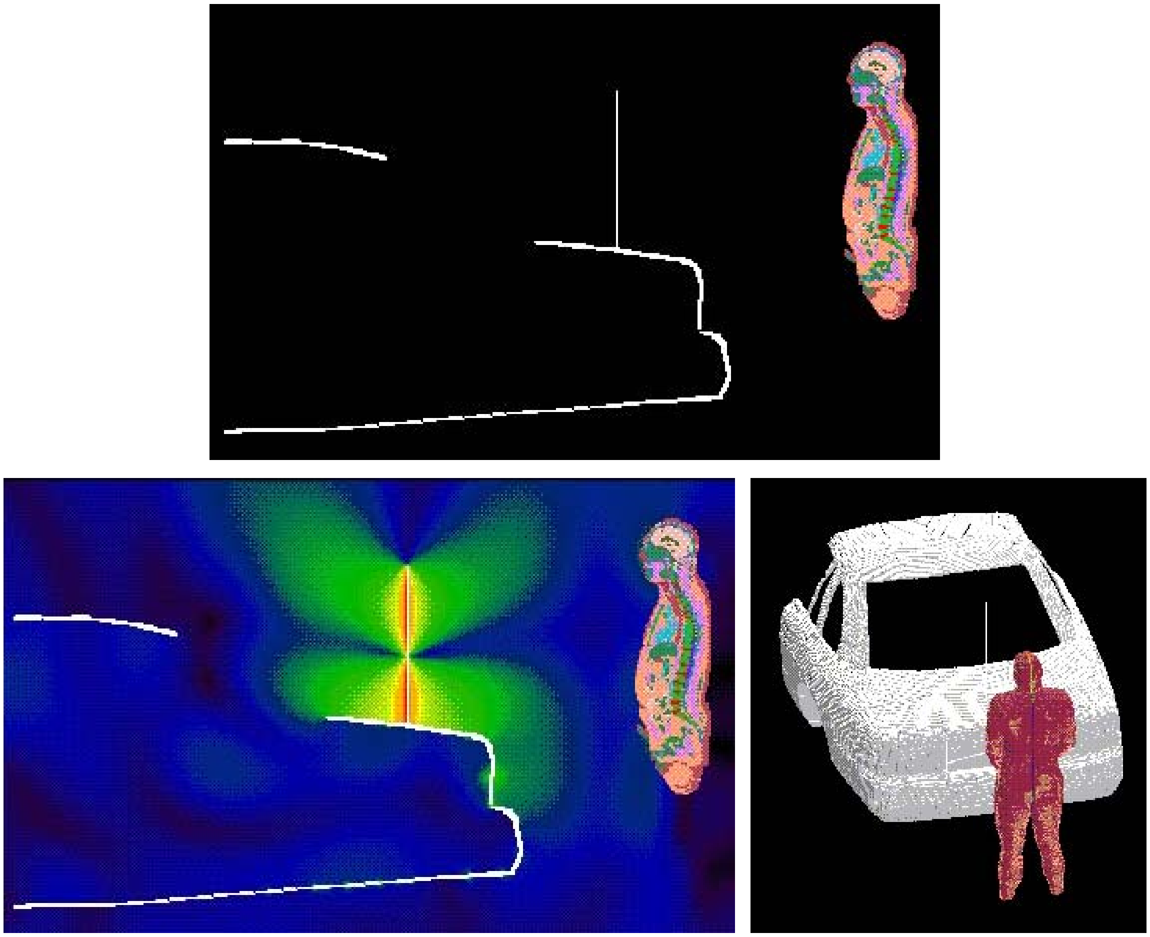


Figure 1: Bystander model exposed to a trunk-mount gain antenna (63.5 cm) operating at 380 MHz: XFDTD geometry, H-field and SAR distribution. The antenna is mounted in the center of the trunk.

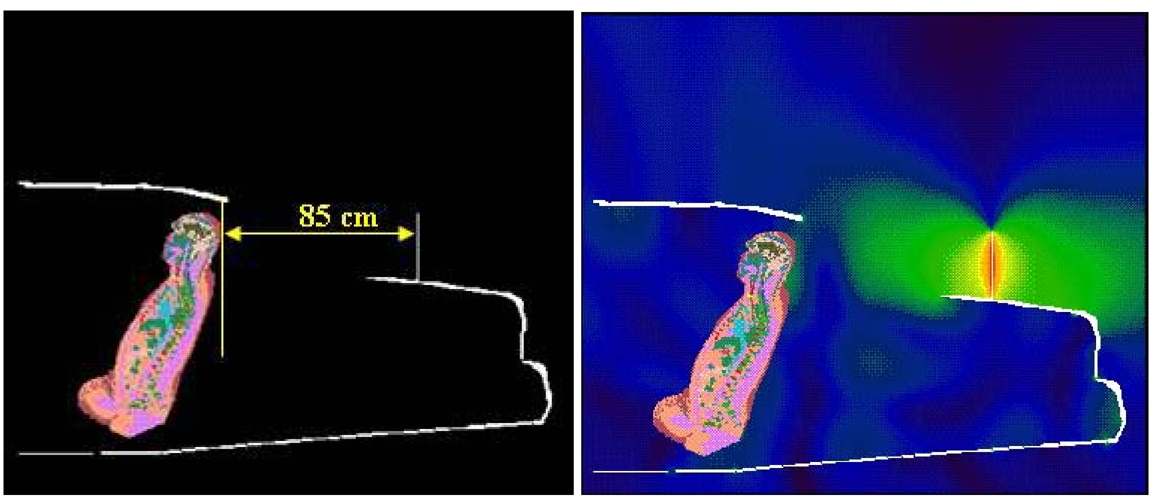


Figure 2: Passenger model exposed to a trunk-mount antenna (29 cm) operating at 470 MHz: XFDTD geometry and H-field distribution. The antenna is mounted at 85 cm from the passenger.

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 product maximum output power is 120 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., 60 W *rms* net output power.

Results of SAR computations for bystanders

The test conditions requiring SAR computations are summarized in Tables I, together with other relevant information and the SAR results. With trunk mount antennas, the bystander is placed next to the trunk of the car, straight back, at 45 degrees from the longitudinal car centerline, and at 90 degrees from it, at a distance of 90 cm from the antenna while maintaining at least 20 cm from the vehicle body, so as to replicate the conditions used in MPE measurements. Twelve cases of bystander - facing towards to or away from the car - were simulated individually.

Table I: Results of the SAR computations for bystander exposure (50% talk-time) behind the car at a separation distance of 90 cm from the trunk-mount antenna while maintaining at least 20 cm from the vehicle body.

MPE Table #	Antenna Kit #	Antenna length		Freq [MHz]	Bystander exposure	Exposure angle	SAR [W/kg]	
		Physical	XFDTD				1-g	WB
29	**HAE6013A**	29 cm	29 cm	425	Front	0 deg	1.00	0.021
29	**HAE6013A**	29 cm	29 cm	425	Back	0 deg	0.66	0.023
35	**HAE6013A**	29 cm	29 cm	425	Front	45 deg	1.03	0.024
35	**HAE6013A**	29 cm	29 cm	425	Back	45 deg	0.72	0.025
39	**HAE6013A**	29 cm	29 cm	425	Front	90 deg	0.99	0.015
39	**HAE6013A**	29 cm	29 cm	425	Back	90 deg	0.55	0.016
49	**HAE6013A**	29 cm	29 cm	380	Front	45 deg	0.87	0.024
49	**HAE6013A**	29 cm	29 cm	380	Back	45 deg	0.95	0.025
51	**HAE6013A**	29 cm	29 cm	470	Front	45 deg	0.93	0.021
51	**HAE6013A**	29 cm	29 cm	470	Back	45 deg	0.69	0.021
53	**HAE6010A**	63.5 cm	63.5 cm	380	Front	45 deg	0.89	0.019
53	**HAE6010A**	63.5 cm	63.5 cm	380	Back	45 deg	0.54	0.020

The SAR distribution for the exposure condition (425 MHz, bystander at 45 degrees facing the car, trunk-mount HAE6013A antenna) that produced the highest peak 1-g SAR average is shown in Fig. 3.
The SAR distribution for the exposure condition (380 MHz, bystander at 45 degrees facing back to the car, trunk-mount HAE6013A antenna) that produced the highest whole body SAR average is shown in Fig. 4.

The overall maximum peak 1-g SAR is 1.03 W/kg, less than the 1.6 W/kg limit, while the maximum whole-body average SAR is 0.025 W/kg, less than the 0.08 W/kg limit.

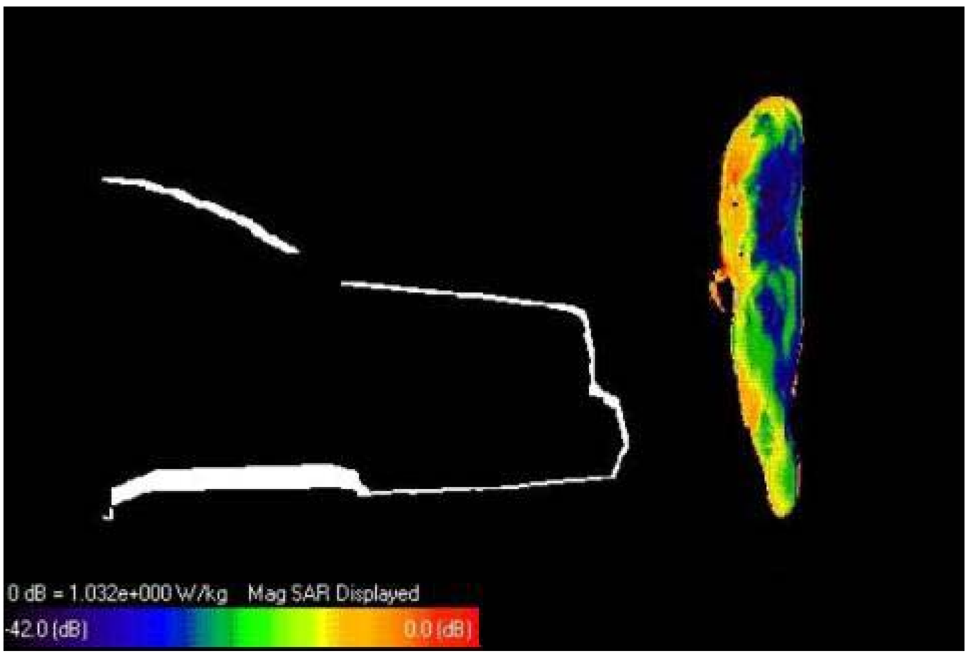


Figure 3. SAR distribution at 425 MHz for the bystander at 90 cm from the HAE6013A antenna, placed in the center of the trunk, when facing the car at 45 degrees. The contour plot in the figure is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

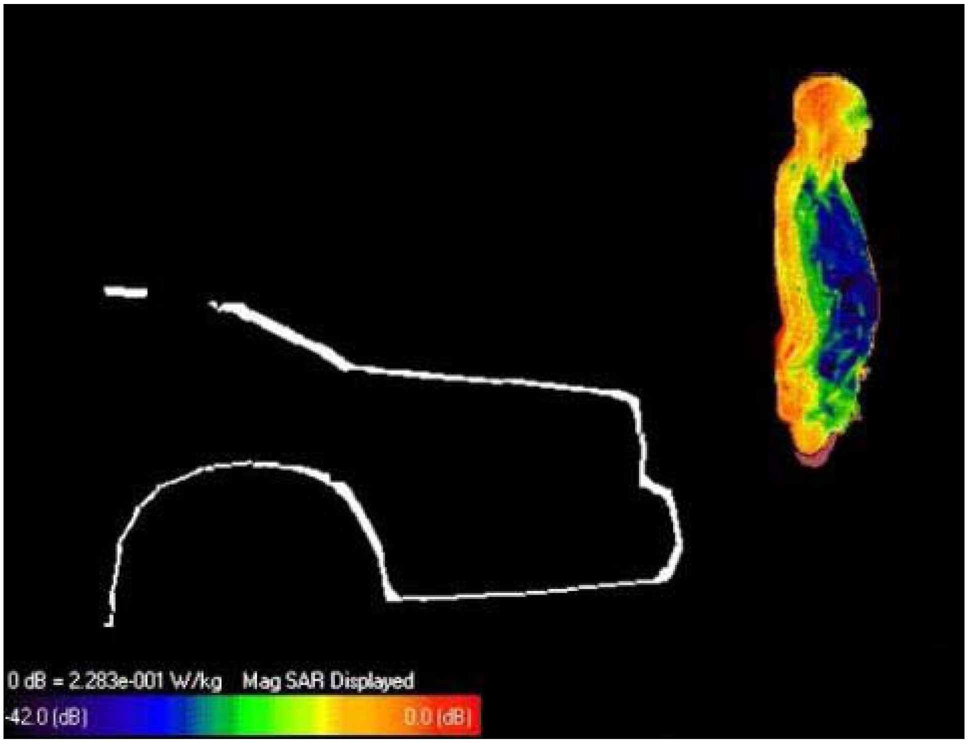


Figure 4. SAR distribution at 380 MHz for the bystander at 90 cm from the HAE6013A antenna, placed in the center of the trunk, when facing back to the car at 45 degrees. This is the condition with the overall maximum whole body average SAR for the bystander exposure. The contour plot in the figure is relative to the middle cut plane of the bystander.

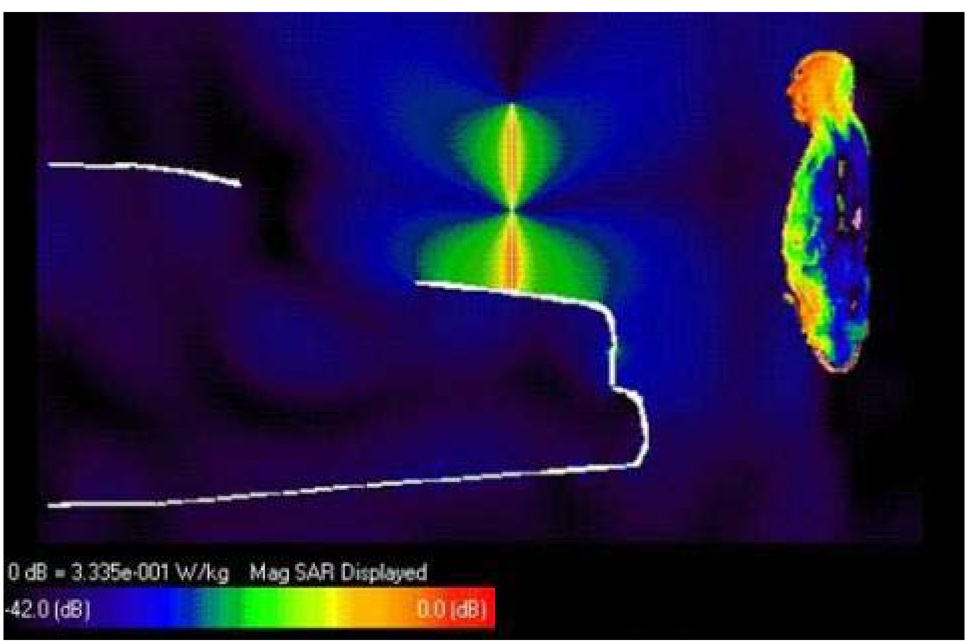


Figure 5. SAR and H field distribution at 380 MHz for the bystander at 90 cm from the HAE6010A antenna, placed in the center of the trunk, when facing the car at 0 degrees.

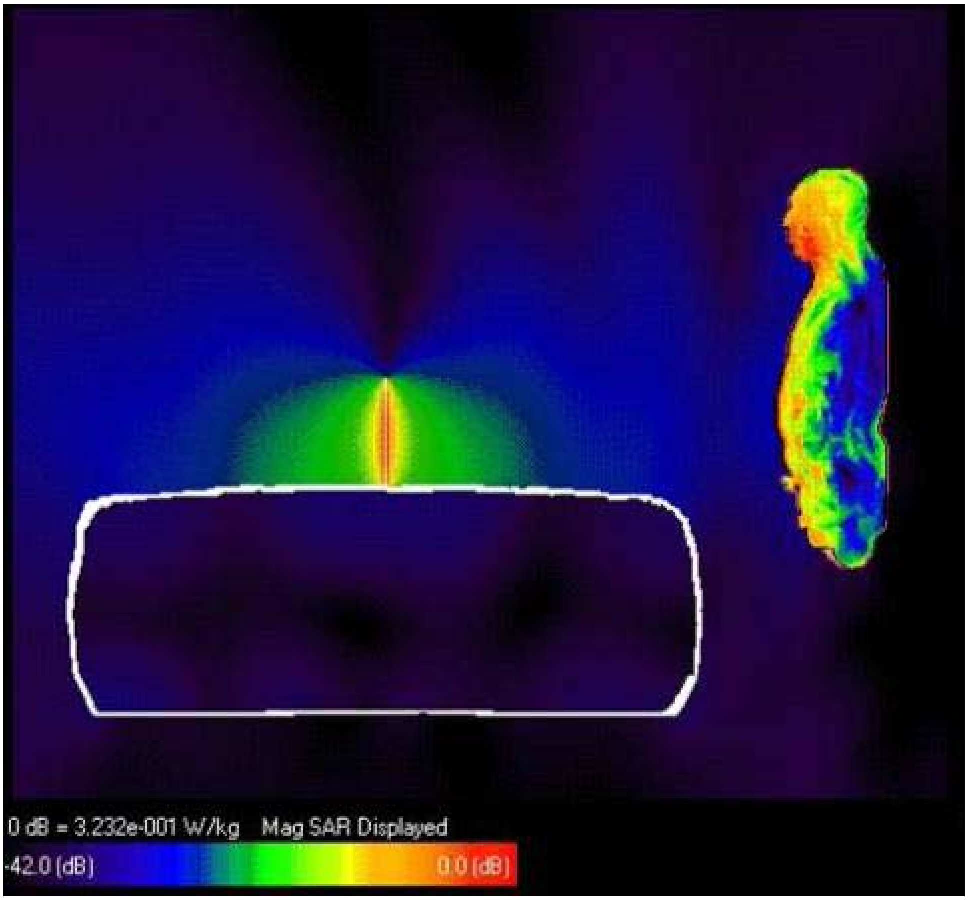


Figure 6. SAR and H field distribution at 425 MHz for the bystander at 90 cm from the HAE6013A antenna, placed in the center of the trunk, when facing the car at 90 degrees.

Results of SAR computations for car passengers

The 14 test conditions requiring SAR computations are summarized in Table III, together with the antenna data and the SAR results. The conditions are 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 II have been simulated individually. The maximum peak 1-g SAR is 0.9 W/kg, while the maximum whole-body average SAR is 0.032 W/kg.

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

MPE Table #	Mount location	Antenna Kit #	Antenna length		Freq [MHz]	Exposure location	SAR [W/kg]	
			Physical	XFDTD			1-g	WB
28	Trunk	**HAE4011A**	72.7 cm	72.5 cm	460	center	0.28	0.010
46	Trunk	**HAE4011A**	72.7 cm	72.5 cm	450	center	0.43	0.014
32	Trunk	**HAE6010A**	63.5 cm	63.5 cm	425	center	0.42	0.020
54	Trunk	**HAE6010A**	63.5 cm	63.5 cm	380	center	0.41	0.021
30	Trunk	**HAE6013A**	29 cm	29 cm	425	center	0.52	0.022
50	Trunk	**HAE6013A**	29 cm	29 cm	380	center	0.53	0.026
52	Trunk	**HAE6013A**	29 cm	29 cm	470	center	0.51	0.018
28	Trunk	**HAE4011A**	72.7 cm	72.5 cm	460	side	0.45	0.009
46	Trunk	**HAE4011A**	72.7 cm	72.5 cm	450	side	0.50	0.013
32	Trunk	**HAE6010A**	63.5 cm	63.5 cm	425	side	0.51	0.021
54	Trunk	**HAE6010A**	63.5 cm	63.5 cm	380	side	0.55	0.022
30	Trunk	**HAE6013A**	29 cm	29 cm	425	side	0.62	0.028
50	Trunk	**HAE6013A**	29 cm	29 cm	380	side	0.90	0.032
52	Trunk	**HAE6013A**	29 cm	29 cm	470	side	0.71	0.025

The SAR distribution in the passenger model in the exposure condition that gave highest 1-g SAR is reported in Fig. 7 (380 MHz, passenger in the side of the back seat, HAE6013A antenna). The same condition produced highest whole body average SAR.

Figure 7. SAR distribution at 380 MHz in the passenger located in the side of the back seat, produced by the trunk-mount HAE6013A antenna. The contour plot in the figure is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

The SAR distributions for the passenger in the center of the back seat for different types of simulated antennas (HAE6013A, HAE6010A and HAE4011A) are shown in Fig. 8,

Fig. 9 and Fig. 10. Fig. 9 and Fig. 10 also show the H field amplitude distribution relative to the plane where antenna is located.

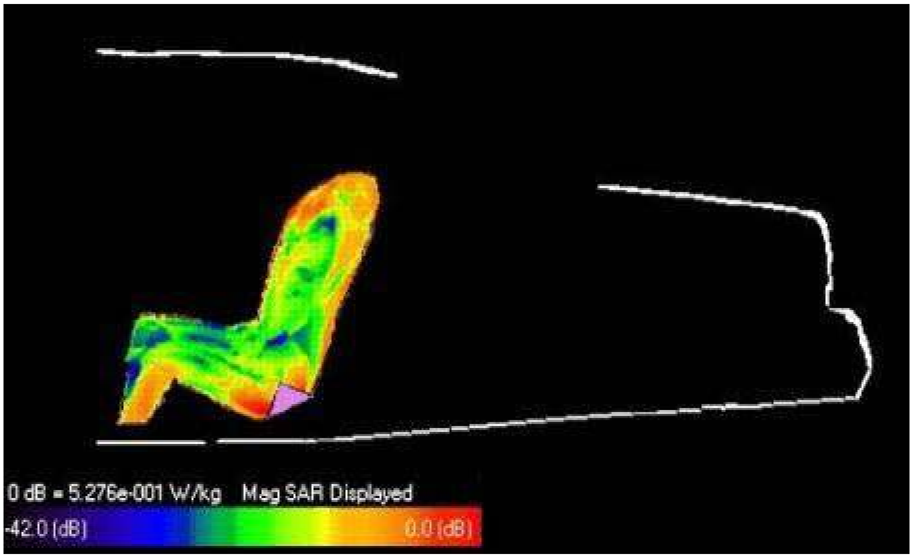


Figure 8. SAR distribution at 380 MHz in the passenger located in the center of the back seat, produced by the trunk-mount HAE6013A antenna. The contour plot in the figure is relative to the plane where the peak 1-g average SAR for this exposure condition occurs.

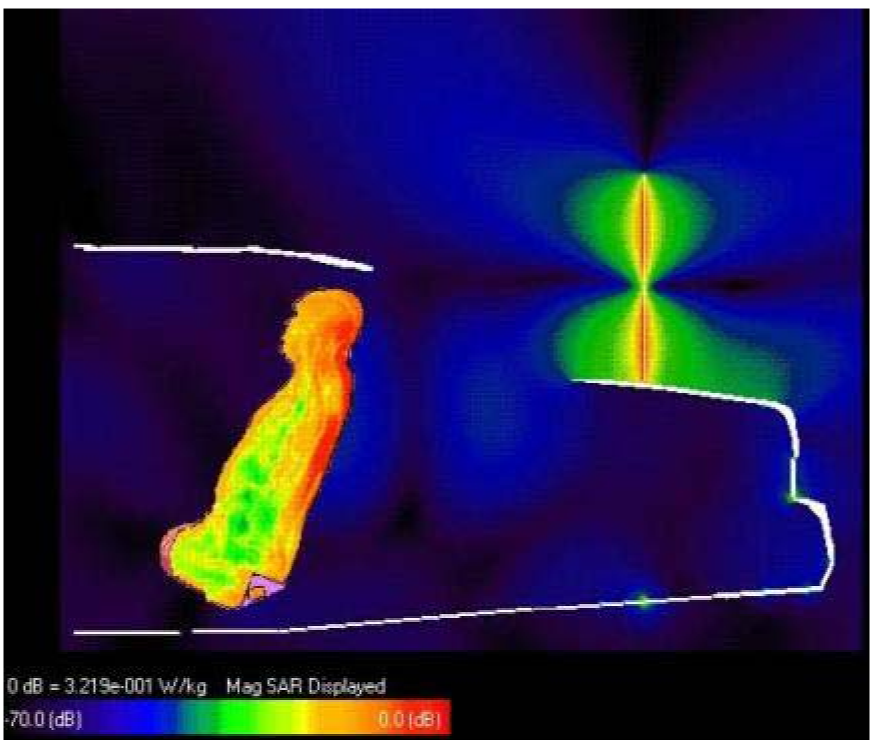


Figure 9. SAR and H field distribution at 380 MHz in the passenger located in the center of the back seat, produced by the trunk-mount HAE6010A antenna.

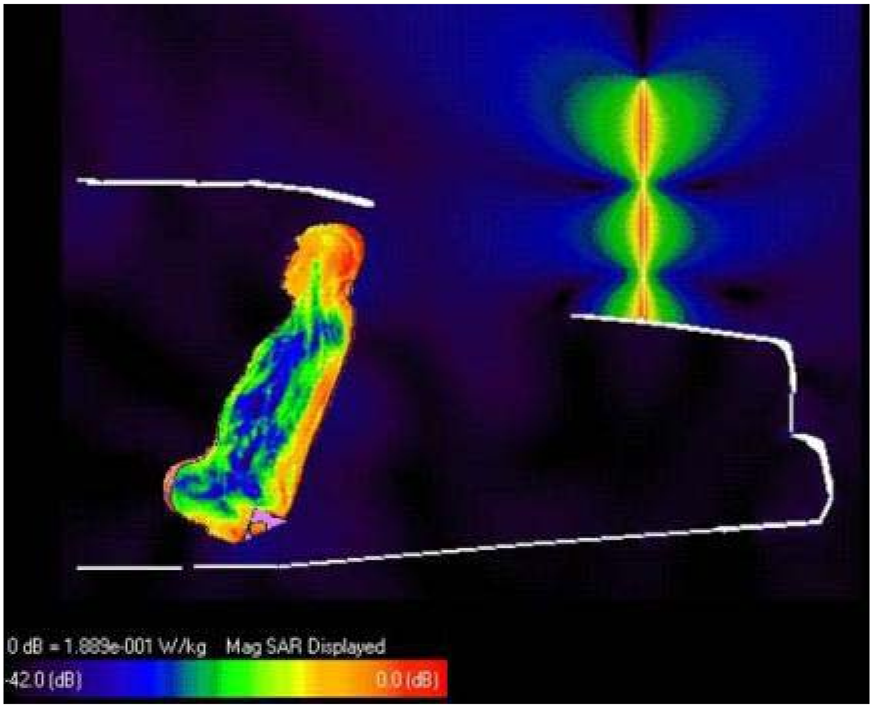


Figure 10. SAR and H field distribution at 450 MHz in the passenger located in the center of the back seat, produced by the trunk-mount HAE4011A antenna.

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 XFDTD™ v5.3 User Manual. Remcom Inc., owner of XFDTD™, is kindly acknowledged for the help provided.

1) Computational resources

a) A four-processor server (Mod. PowerEdge 6650, by Dell Computers Inc.) equipped with four 1.4 GHz Xeon microprocessors and 4 GB D-RAM (3 GB available for running applications) was employed for all simulations.

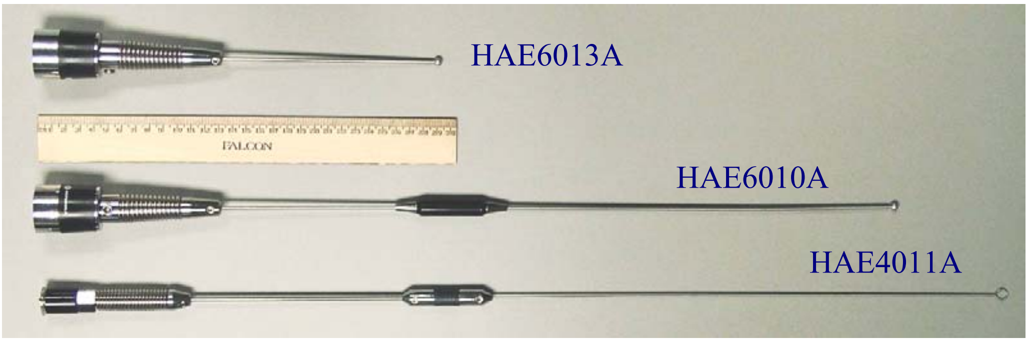
b) The memory requirement was between 2 GB and 3 GB in all cases. Using the above-mentioned server with all four processors operating concurrently, the typical simulation would run for 22 hours.

2) FDTD algorithm implementation and validation

a) We employed a commercial code (XFDTD™ v5.3, by Remcom Inc.) that implements the classical 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

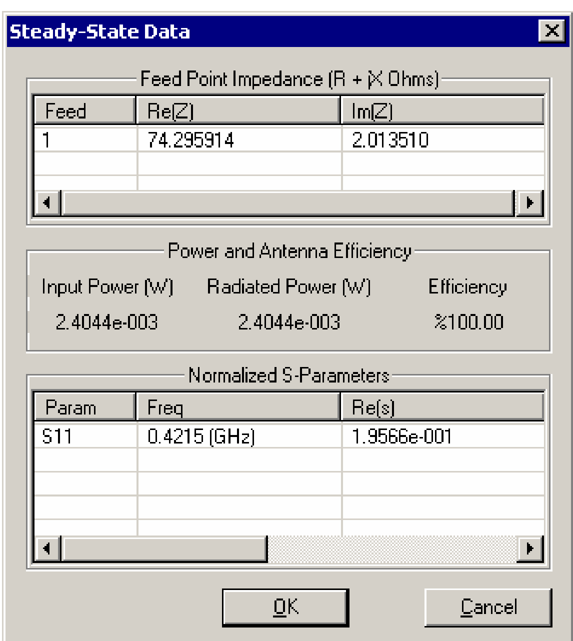
"Thin Wire materials may be used in special situations where a wire with a radius much smaller than the cell size is required… in cases where the wire radius is important to the calculation and is less than approximately 1/5 the cell size, the thin wire material may be used to accurately simulate the 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. Pictures of the HAE6013A, HAE6010A and HAE4011A antennas are presented below.

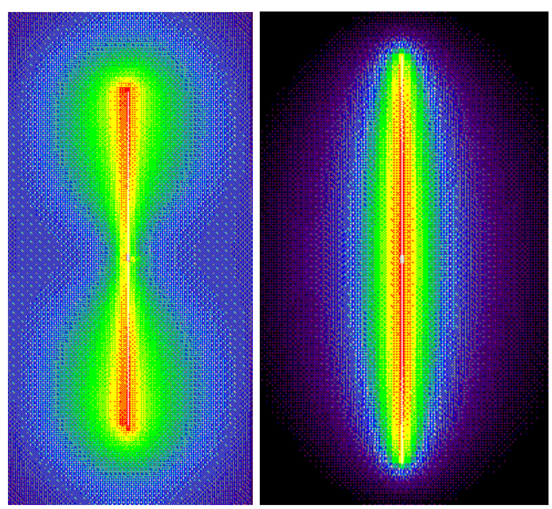


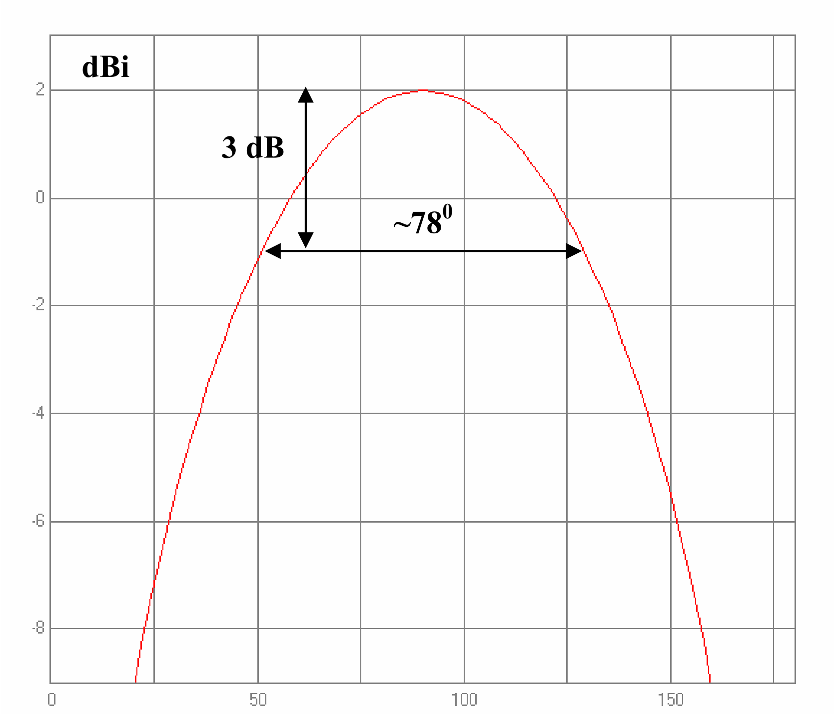
b) XFDTD™ is one of the most widely employed commercial codes for electromagnetic simulations. It has gone through extensive validation and has proven its accuracy over time in many different applications. One example is provided in [3].

We carried out a validation of the code algorithm by running the canonical test case involving a half-wave wire dipole. The dipole is 0.47 times the free space wavelength at 421.5 MHz, i.e., 33.5 cm long. The discretization used in the model was uniform in all directions and equal to 5 mm, so the dipole was 67 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 (74.3 + j 2.0 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 beam width is about 78 degrees.



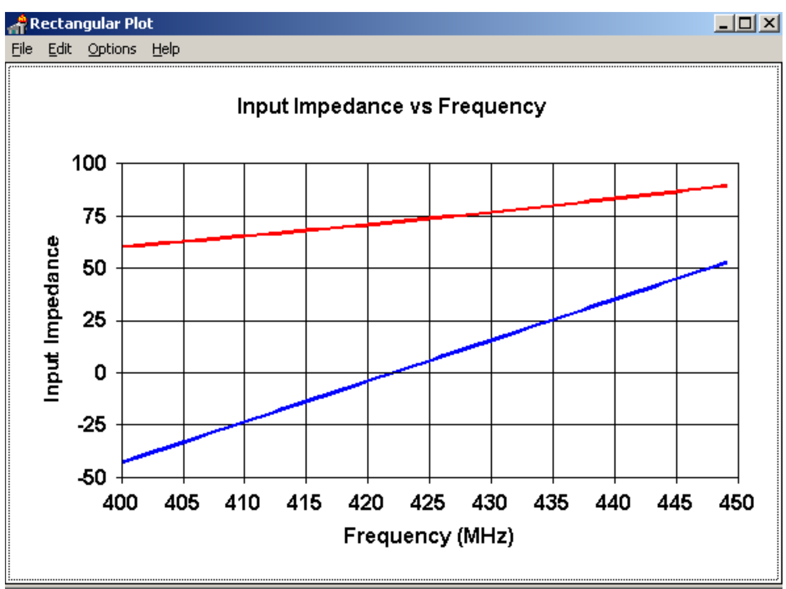
Total E-field **Total H-field**





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 33.5 cm, and the discretization is 5 mm. The corresponding input impedance at 421.5 MHz is 71.7-j1.0 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 bystander computations (in voxels), (for 0 degree and 45 degree bystander position)	407	476	430
Maximum domain dimensions employed for bystander computations (in voxels), (for 90 degree bystander position)	507	365	432
Maximum domain dimensions employed for passenger computations (in voxels)	400	489	419
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	At least 4000 in all simulations		
Number of time steps for bystander	4000 in all simulations		
Excitation	Sinusoidal (approx. 18 periods)		

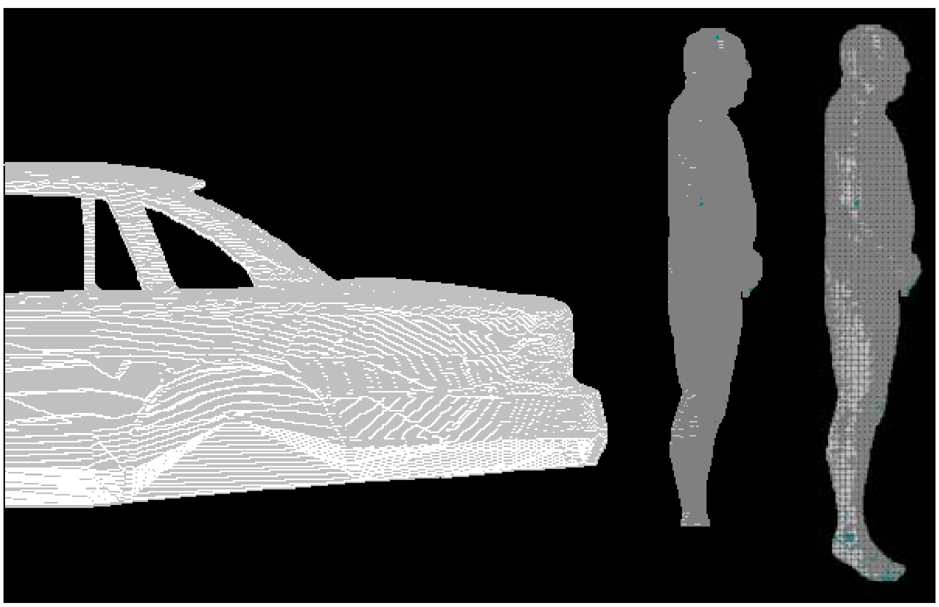
b) In order to fit the model within a grid size that would not use up the available memory, we chopped the hood of the car and the feet of the human model.

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).

In order to fit the car and bystander model within the volume allowed by the available RAM, the feet of the XFDTD™ High Fidelity Body Mesh were cut away, thereby reducing the model length by about 16 cm (32 voxels). Notice that the original model's feet are not flat and parallel to ground as if he were standing, but are inclined downwards. Therefore, we estimated that the actual reduction in body length is 9 cm. The following figure shows the cross section of the model used in the bystander computations, compared with the original XFDTD™ High Fidelity Body Mesh.



b) 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.

c) 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 (mid-band for this VHF mobile radio product).

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

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

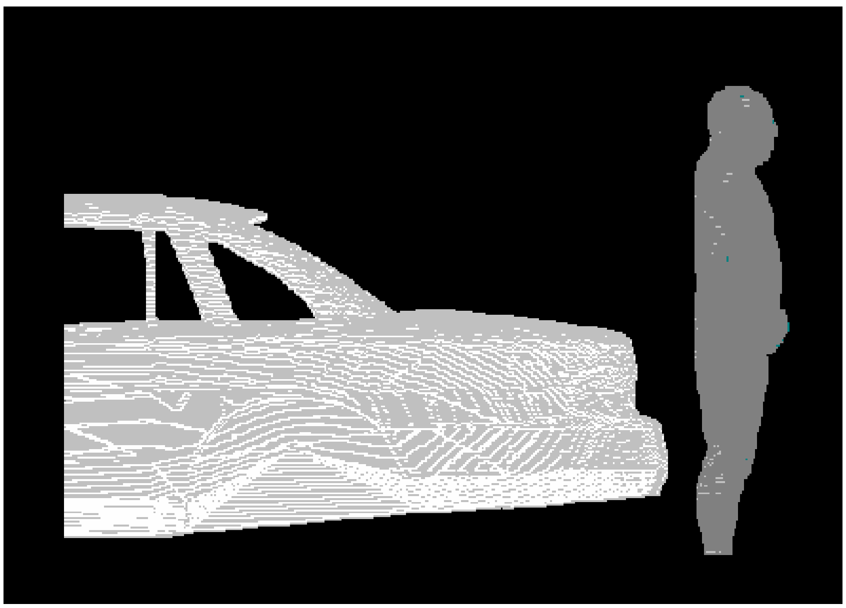
c) The tabulated list of the dielectric parameters used in phantom models is provided at point 5(a). As regards the device (car plus antenna), we used perfect electric conductors.

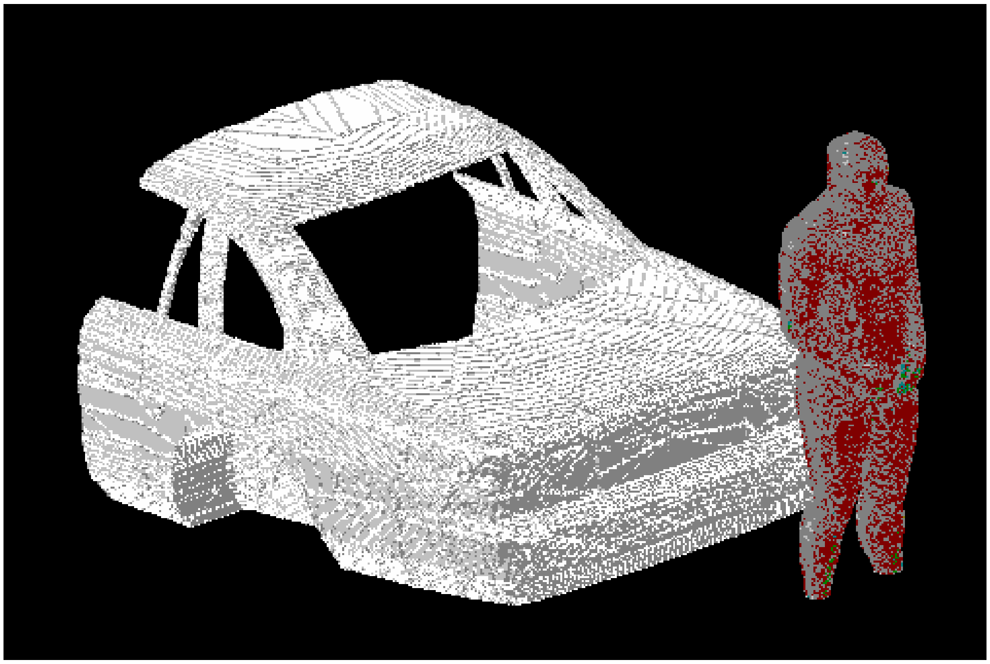
6) Transmitter model implementation and validation

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

- Car body. We developed one very similar to the car used for MPE measurements, so as to be able to correlate measured and simulated field values. The model was imported in XFDTD™ from a CAD model that is commercially available at http://www.3dcadbrowser.com/

- Antenna. We used a straight wire in all cases, even though 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.
- 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).



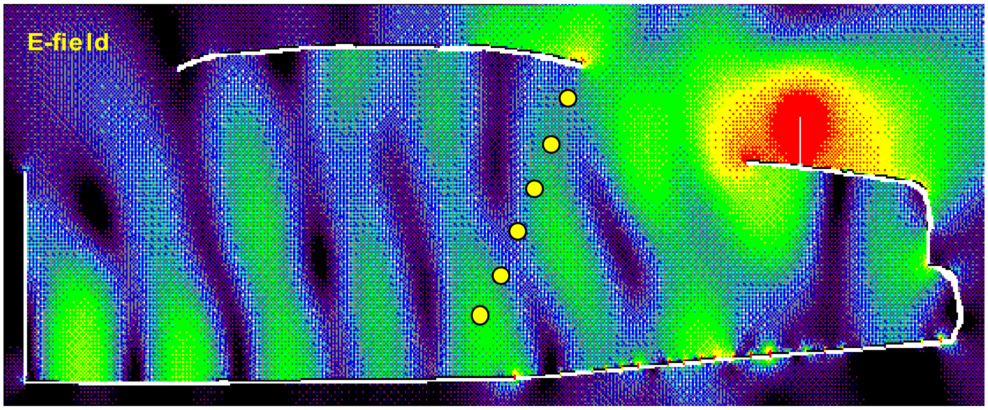


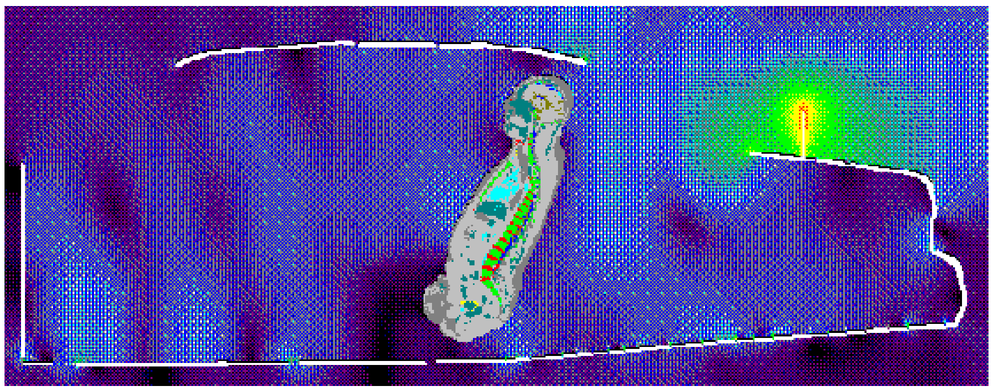
The car model is constituted by perfect electric conductor and does not include wheels in order to reduce its complexity. The passenger model is surrounded by air, as the seat, which is made out of poorly conductive fabrics, is not included in the computational model. The pavement has not been included 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):

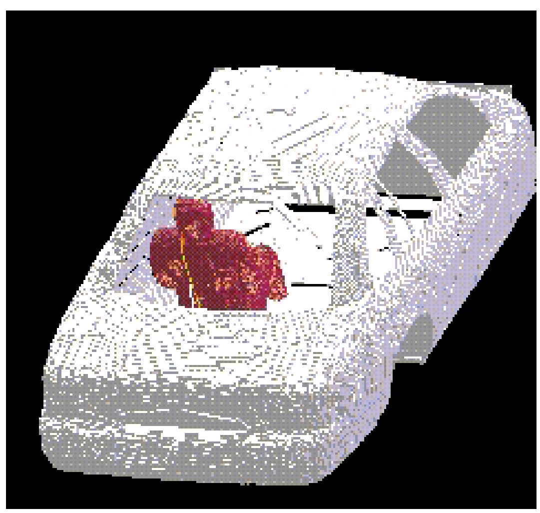
$$S_E = \frac{|\mathbf{E}|^2}{2\eta}, \quad S_H = \frac{\eta}{2}|\mathbf{H}|^2, \quad \eta = 377\,\Omega$$

<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%).

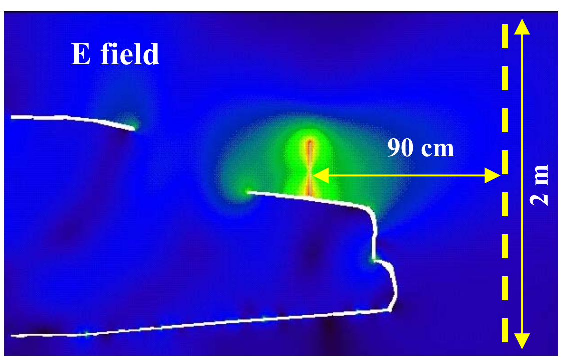
b) Descriptions and illustrations showing the correspondence between the modeled test device and the actual device, with respect to shape, size, dimensions and near-field radiating characteristics, are found in the main report.

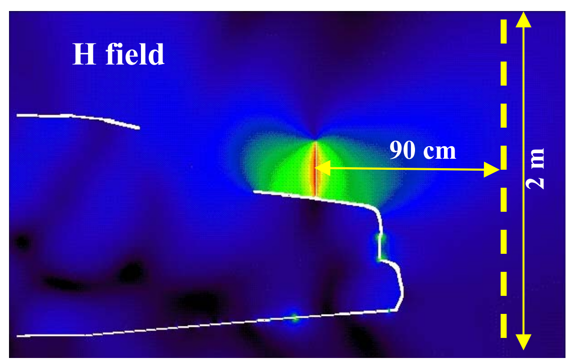
c) Verification that the test device model is equivalent to the actual device for predicting the SAR distributions descends from the fact that the car and antenna size and location in the numerical model correspond to those used in the measurements.

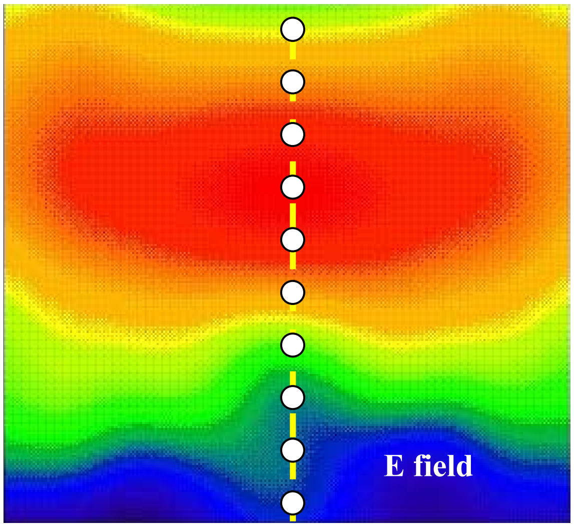
d) The peak SAR is in the neck region for the passenger, which is in line with MPE measurements and predictions.

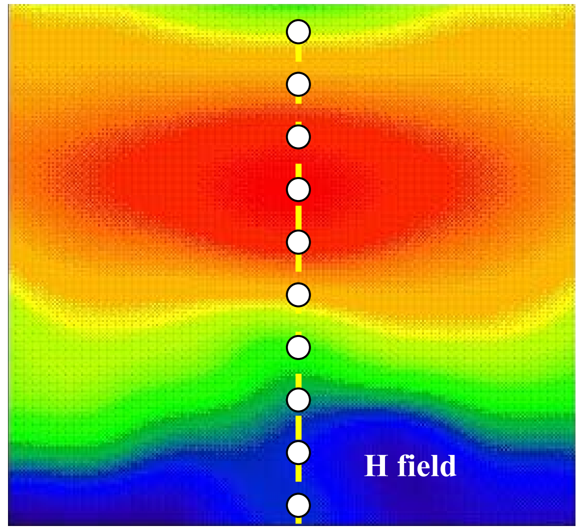
Bystander with 29 cm monopole antenna (HAE6013A 425 MHz)

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.





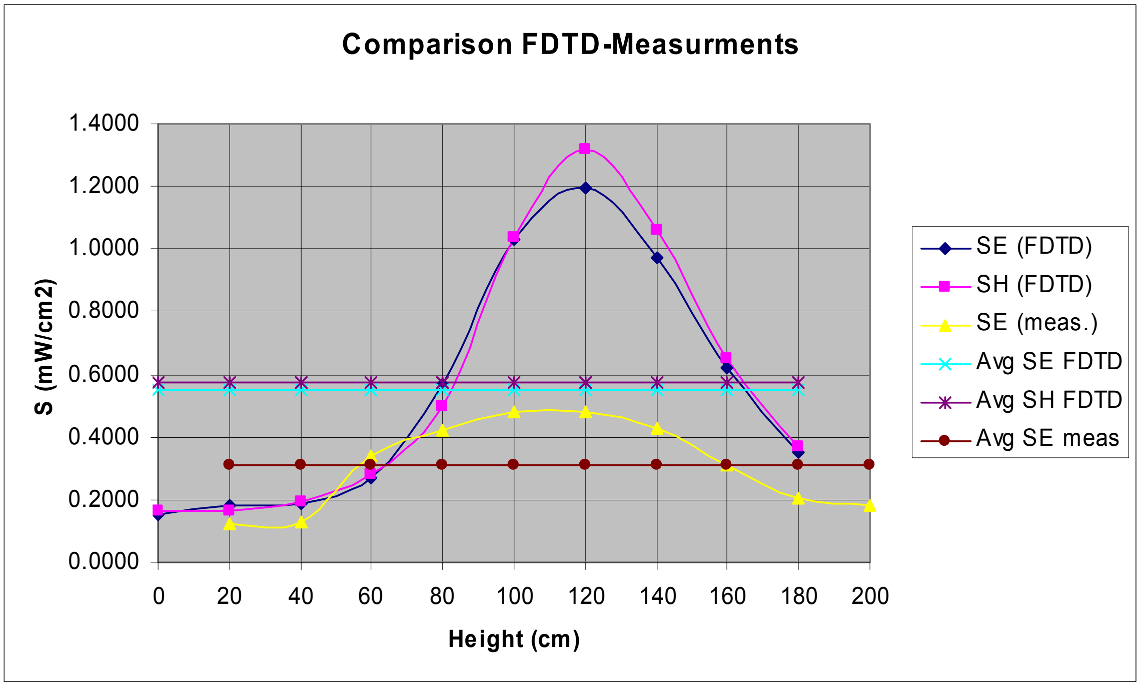




The following table reports the field values computed by XFDTD™ and the corresponding power density values. The average exposure levels are computed as well.

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**

The calculated power density was scaled up for 60 W radiated power. 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 60 W radiated power are 5.53 W/m^2 (E), and 5.74 W/m^2 (H), that correspond to 0.55 mW/cm^2 (E), and 0.57 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 60 W radiated power.



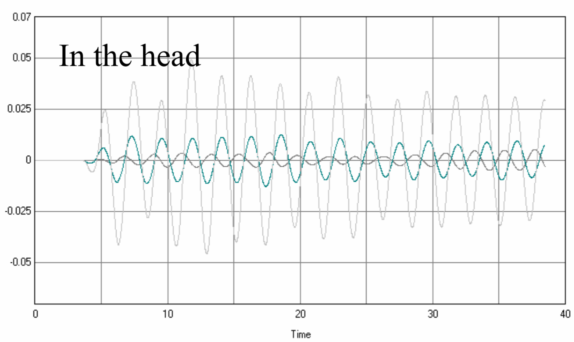
7) Test device positioning

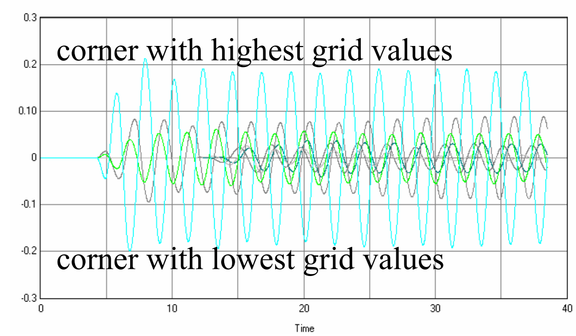
a) A description of the device test positions used in the SAR computations is provided in the SAR report.

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

8) Steady state termination procedures

a) The criteria used to determine that sinusoidal steady-state conditions have been reached throughout the computational domain for terminating the computations are based on the monitoring of field points to make sure they converge. 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 head and in two opposite points in the computational domain. In the latter case, 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.





b) 4000 time steps were used, with a time step approximately equal to 10 *ps* (meeting the Courant criterion), which corresponds to 18 wave periods at 450 MHz.

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 up to 80%. 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.

REFERENCES

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

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

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

Remcom.pdf

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

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

Collins & Smith.pdf

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

Ericsson.pdf

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

Furse & Gandhi.pdf

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