ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY
8000 West Sunrise Blvd.
Fort-Lauderdale, Florida

S.A.R. TEST REPORT

FCC ID # AZ489FT5800
(r750-N2043A)

September 15, 2000 – Rev. A

Tested/Prepared By: Kim Uong,
Lead Engineer

Reviewed/Approved By: Ken Enger,
Senior Resource Manager
Product Safety and EME Director

TABLE OF CONTENTS

1.0 Introduction

2.0 Applicable Regulations

3.0 Description of Test Sample

3.1 Antenna Description

3.1.1 Antenna Type

3.1.2 Antenna Location

3.1.3 Antenna Dimensions

3.1.4 Antenna Configuration

3.1.5 Antenna Gain

3.2 Test Signal

3.3 Test Frequency and Output Power

4.0 Description of Test Equipment

4.1 Measurement System Description

4.2 Description of Phantom

4.2.1 Full Body Phantom

4.2.2 Half body Phantom

4.3 Simulated Tissue Properties

4.3.1 Type of Simulated Tissue

4.3.2 Simulated Tissue Composition

5.0 Description of Test Procedure

5.1 Description of Test Positions

5.2 Probe Scan Procedures

6.0 Measurement Uncertainty

7.0 SAR Test Results

7.1 Measured SAR

7.2 Maximum Calculated SAR by Expected Operating Position and Conditions

TABLE OF CONTENTS (Cont.)

8.0 Conclusion

Appendix A: Data Results

Appendix B: Dipole Validation Data Result

Appendix C: Measurement Probe Calibration Certificate

1.0 Introduction

This report is a revision of the previous SAR report for r750 Portable Radio, model number N2043A (FCC ID: AZ489FT5800) which dated 7/21/2000. The purpose for this revision is to update antenna gain per Design Engineering input 9/6/00.

This report details the test setup, test equipment, and test results of the Specific Absorption Rate (SAR) measurement performed at CGISS EME laboratory for the iDen r750 Radio Product Portable, model number N2043A (FCC ID: AZ489FT5800).

2.0 Applicable Regulations and Standards

- United States Federal Communications Commission, Code of Federal Regulations; 47 CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- National Council on Radiation Protection and Measurements (NCRP) of the United States, Report 86, 1986
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- National Radiological Protection Board of the United Kingdom 1995
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 1999 (applicable to wireless phones only)

3.0 Description of Test Sample

The Portable Radio, Model number N2043A operates in 806-825 MHz band with a rated conducted power of 1W pulse average. This radio is marketed as a handheld transceiver capable of operating as a telephone, traditional two-way (dispatch) radio, or RF modem (packet data mode). An associated base station allocates a number of 15 msec. Time Division Multiplex (TDM) time slots in which the transceiver transmits depending on the service mode. The trunking system protocol for voice transmission uses a 90 msec. frame divided into six 15 msec. time slots. PSTN (phone mode) interconnect calls utilize 2 time slots (2/6 multiplexing) with a 33.33% duty cycle. Two-way radio dispatch transmissions are accomplished using one time slot (1/6 multiplexing) with a 16.67% duty cycle. In the packet data mode, the protocol uses a multiple of voice/circuit data mode frames with a duty cycle that varies with the RF environment. The worst case duty cycle of 67.5% occurring with 81/120 time slots.

3.1 Antenna Description:

3.1.1 Antenna type: ½ wave antenna

Monopole	X	Dipole		Helix		Patch		Other	

3.1.2 Antenna Location on Device

Left		Right	X	Top	X	Bottom		Front		Back	

3.1.3 Antenna Dimensions

Length - cm (extended)	15.2
Diameter - cm (at tip of antenna)	0.775
Diameter - cm (at middle of antenna)	0.559
Diameter - cm (at base of antenna)	1.422

3.1.4 Antenna Configuration

Fixed	X	Retractable		External	X	Other	

3.1.5 Antenna Gain: +0.05dBd (2.2dBi)

3.2 Test Signal

Test Signal Source:

Test Mode	X	Base Station		Simulator		Other	

Signal Modulation:

CW	
TDMA	**16.67%**
Other	

3.3 Test Frequency and Output Power

Output power measurement conditions:

Free Space Radiated		SAR test configuration	X	Conducted	X	Other	

Output Power measured with:

Power meter [X] Base Station Simulator [ ] Spectrum Analyzer [ ] Other [ ]

Test Frequency (MHz)	Measured Power before SAR (W)	Measured Power after SAR (dB)
806.0125	0.913	- 0.11
813.5625	0.903	- 0.11
820.9875	0.953	- 0.11
824.9875	0.959	- 0.11

4.0 Description of Test Equipment

4.1 Descriptions of SAR Measurement System

The laboratory utilizes a Dosimetric Assessment System (DASY™™) SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. This system utilizes a computer controlled six axis robot to move a measurement probe to measure the SAR. The SAR measurements were conducted with the probe ET3DV6 serial number 1383. It was calibrated at SPEAG™, and has a calibration date August 17, 1999. A copy of the calibration certificate is included as appendix C. Dipole Validation Kit type 835MHz (serial number 835-002) was used to validate the system accuracy at 835MHz. The Dipole validation results is 9.95 mW/g when normalized to 1W compared to the target of 9.38 mW/g, which is within the required accuracy of ± 10% (Dipole SAR Validation Certificate for Dipole S/N 835-002), and thus the measured SAR values are considered correct. See appendix B for print out of the validation test results from the DASY™ measurement system.

The DASY™ system is operated per the instructions in the DASY™ Users Manual. The entire manual is available directly from SPEAG™.

4.2 Description of Phantom

Human shaped, solid shell device made of fiberglass and mounted on a nonmetallic base or stand.

4.2.1 Full Body Phantom

Abdomen Thickness	0.15 cm
Face Thickness	0.15 cm

4.2.2 Half Body Phantom

Left Ear

Shell Thickness	0.15 cm
Ear Spacer Thickness	0.50 cm

Right Ear

Shell Thickness	0.15 cm
Ear Spacer Thickness	0.50 cm

4.3 Simulated Tissue Properties:

4.3.1 Type of Simulated Tissue

	Full Body	Half Body
Muscle	X	
Brain		X

4.3.2 Simulated Tissue Composition

	Muscle	**Brain**
	835MHz	**838MHz**
Di-Water	53.50 %	43.75 %
Sugar	44.25 %	54.00 %
Salt	1.15 %	1.15 %
HEC	1.00 %	1.00 %
Dowicil75	0.10 %	0.10 %

Note: HEC (HYDROXYETHYL CELLULOSE) is a gelling agent and Dowicil 75 is anti bacterial compound.

Characterization of Simulated tissue materials and ambient conditions:
Simulated tissue prepared for SAR measurements are measured at room temperature and verified to be in spec prior to actual SAR measurements by filling a coaxial slotted line with the tissue and probing the amplitude and phase changes versus distance in the simulated tissue. A HP8753D Network Analyzer is used to perform the measurements.
Measured simulated tissue dielectric constant and conductivity used in SAR runs as of 7/11/00 and 7/13/00.

	Muscle	**Brain**
	835 MHz	**835 MHz**
Di-electric Constant	50.7	46.2
Conductivity – S/m	1.06	0.90

5.0 Description of Test Procedure

Several accessories are available which influence possible operating conditions of this handheld transceiver. These include a leather carry case with belt clip which is intended to be attached to a user's belt, and various audio accessories with interconnecting cable. The combination of carrying case and audio accessory/data cable devices when worn on the body permits the handheld transceiver to be operated in iDen mode as a telephone with a 33.33% duty cycle, or as two-way radio with a 16.67% duty cycle, or RF modem (packet data mode) with 67.5% duty cycle .

The following accessories tested include body attach accessories and representative data cables and audio accessory cables:

- Belt clips (kit # HLN9714, HLN9844)
- D_Clip (kit # NTN1535)
- Carry case (kit # FLN9580)
- Remote Speaker Phone (kit # FLN2800)
- Data cable (kit # NKN6522)
- Audio Adapter (kit # FLN2854) , and lightweight head set (kit # NTN8496)

All SAR measurements performed with the radio positioned in the described test positions and test modes were done while the radio was operating in iDen mode as a 16.67% duty cycle for 806-825MHz.

5.1 Description of Test Positions

The following describes the three test positions used to perform SAR measurements on the portable radio:

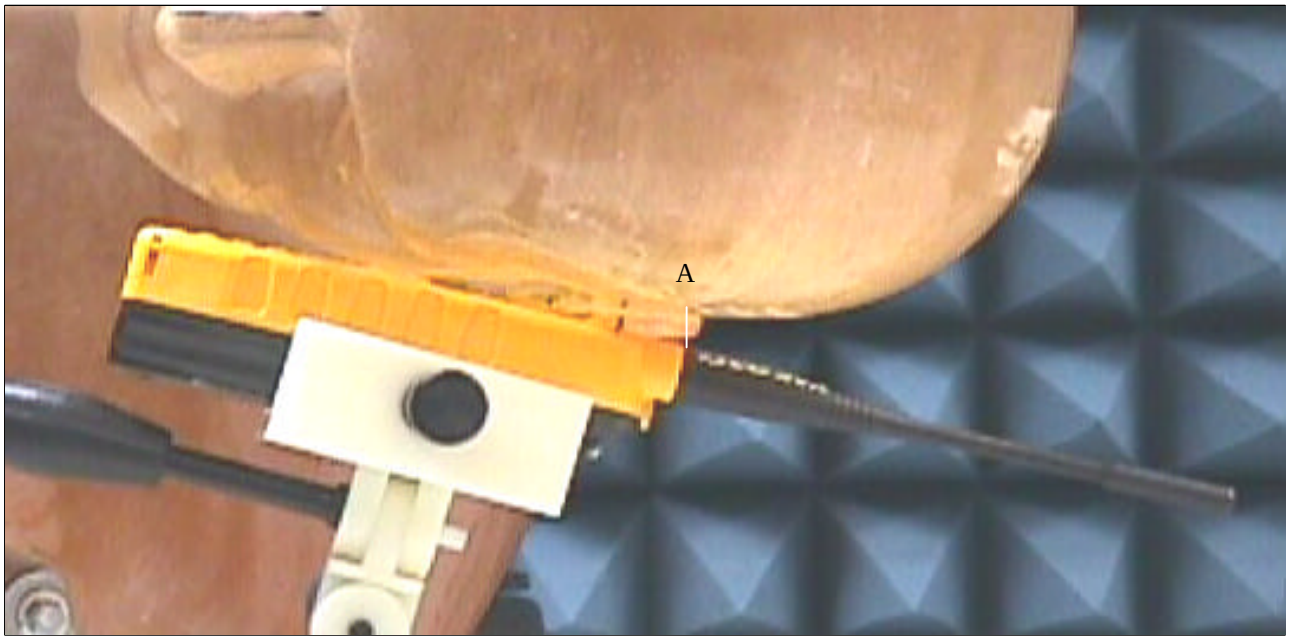
Head - The portable radio is positioned in a normal telephone operating position by aligning the axis of the radio with a line from the center of the ear to the corner of the lips, center the listening area of the test radio over the ear canal. Next, position the radio as close as possible to the phantom, preferably with three points of contact with the phantom to allow for best coupling to the simulated tissue.

Face - The portable radio is positioned in the right hand of a full body phantom in a normal two-way radio operating position and the radio's normal speaking area is aligned the center of the phantom's mouth.

Abdomen - The portable radio is positioned in a leather carry case with belt clip attached beneath the abdomen of the full body phantom with the back of the radio facing the abdomen, the keypad/display facing the floor. An interface cable between the radio connector and a head set or data cable is connected to the radio to allow telephone or two-way radio or RF modem (packet data mode) operation.

Reference figures: 1, 2, and 3 for portable radio antenna orientation and distances relative to phantoms

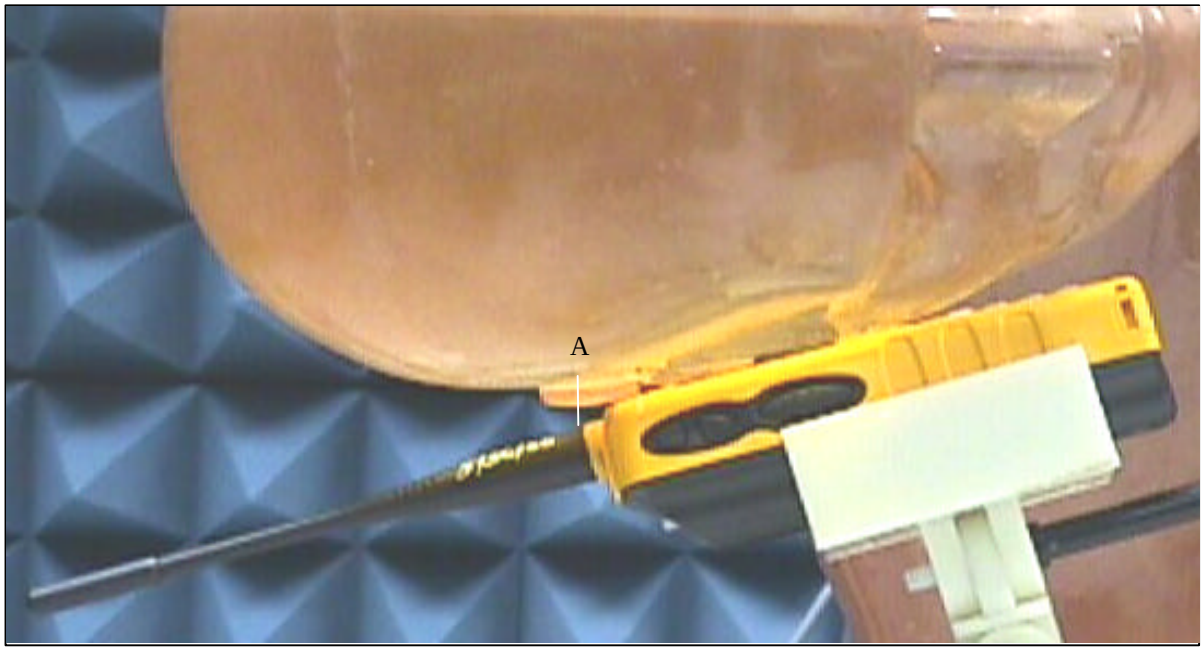
Figure 1a: Head Position – Left Ear.



DIM A = Distance from surface of antenna base to phantom head = 10 mm

DIM B = Distance from surface of antenna tip to phantom head = N/A

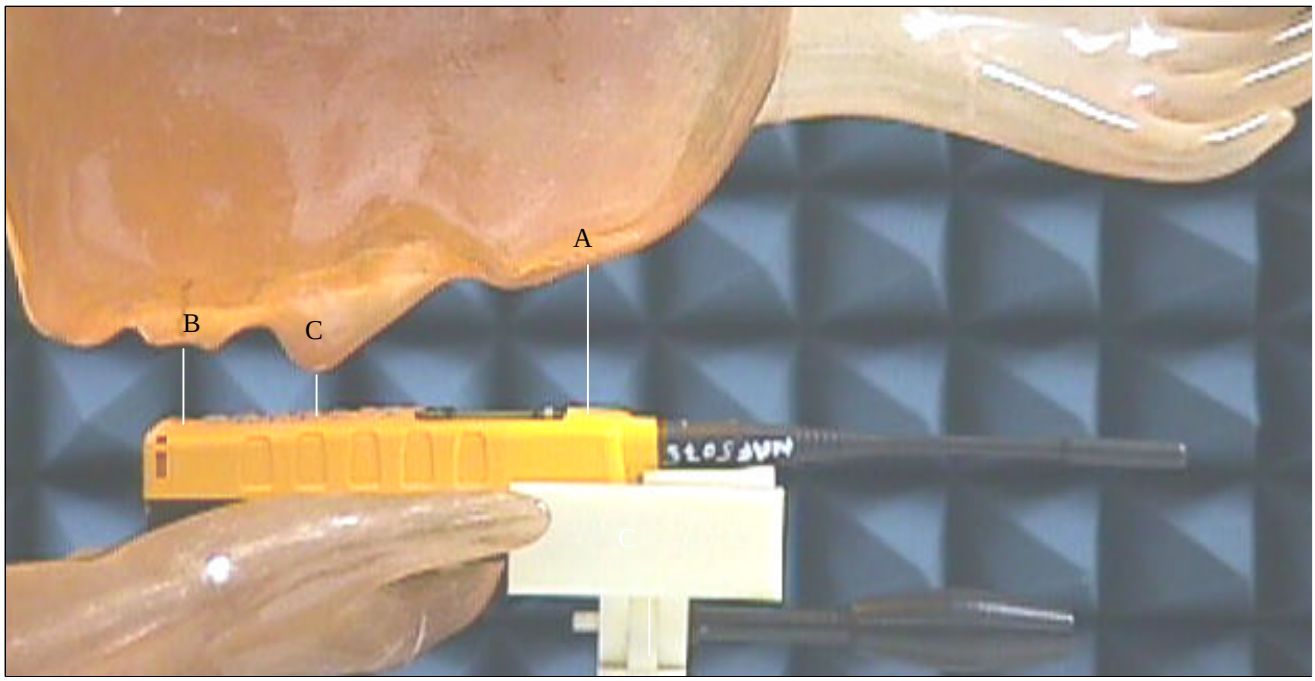
Figure 1b: Head Position - Right Ear.



DIM A = Distance from surface of antenna base to phantom head = 15mm

DIM B = Distance from surface of antenna tip to phantom head = N/A

Figure 2: Facial Position

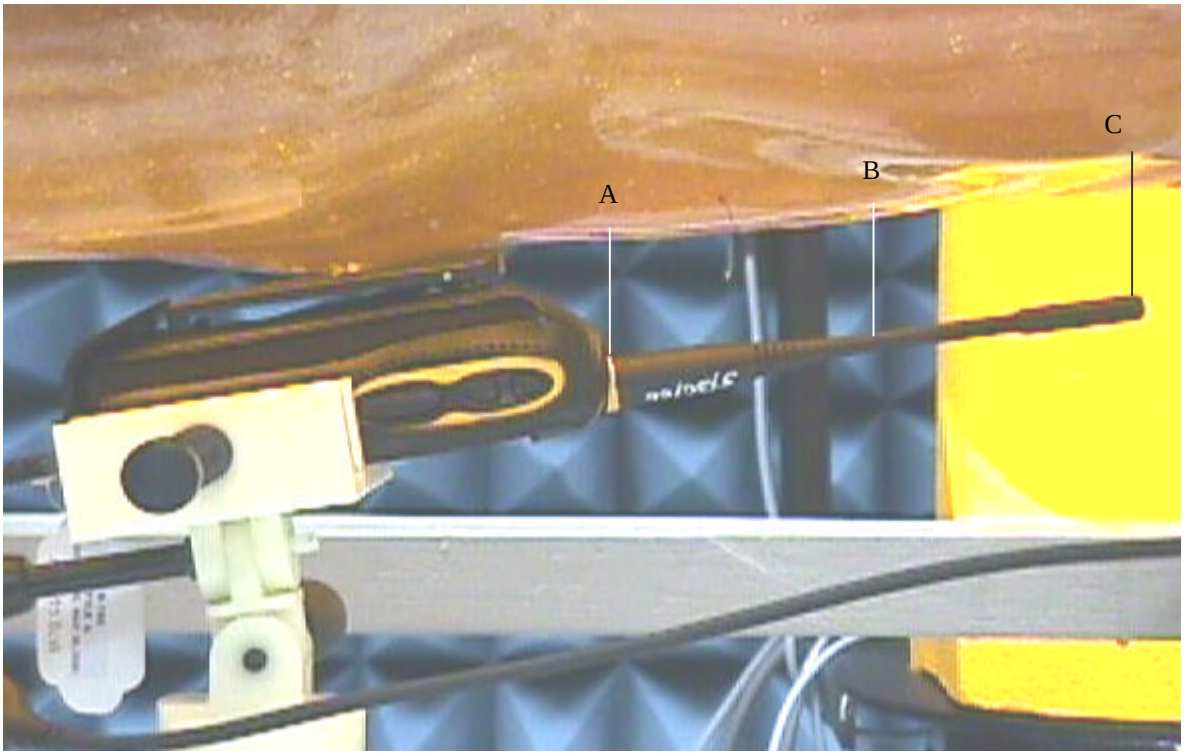


DIM A = Distance from center of phantom's forehead to radio surface = 45 mm

DIM B = Distance between phantom's mouth and radio surface = 25 mm

DIM C = Closest distance between phantom's nose tip and radio surface = 13 mm

Figure 3: Abdominal Position



Dim A = Distance from surface of antenna base to phantom surface = 35 mm

Dim B= Distance from surface of antenna center to phantom surface = 35 mm

Dim C= Distance from antenna surface tip to phantom = 39 mm

5.2 Probe Scan Procedures

The E-field probe is first scanned in a coarse grid over a large area inside the phantom in order to locate the maximum for most SAR distributions even with relatively large grid spacing. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference for a finer resolution grid or the cube evaluations.

6.0 Measurement Uncertainty:

The table below list an estimate of the possible errors that are associated with the measurement system.

Uncertainty Description	Standard Uncertainty
Probe Uncertainty	
- Axial Isotropy	± 2.4 %
- Spherical Isotropy	± 4.8 %
- Spatial Resolution	± 0.5 %
- Linearity Error	± 2.7 %
- Calibration Error	± 8 %
Evaluation Uncertainty	
- Data Acquisition Error	± 0.60 %
- ELF and RF Disturbances	± 0.25 %
- Conductivity Assessment	± 5 %
Spatial Peak SAR Evaluation Uncertainty	
- Extrapolation and boundary effects	± 3%
- Probe positioning	± 1 %
- Integration and cube orientation	± 3 %
- Cube shape inaccuracies	± 1.2 %
- Device positioning	± 1.0 %

The Total Measurement Uncertainty is ± 12.1 %. The Expanded Measurement Uncertainty is ± 24.2 % (k=2)

7.0 SAR Test Results

7.1 Measured SAR in 6:1 mode:

Muscle					
Radio S/N	**Antenna Position**	**Tx Freq. (MHz)**	**Cond. Power (W)**	**Measured SAR (mW/g)**	
				Face	**Abdomen**
831SAG0183	Fix	806.0625	0.913	0.07	0.18
831SAG0183	Fix	813.5625	0.903	0.06	0.21
831SAG0183	Fix	820.9875	0.953	0.05	0.25
831SAG0183	Fix	824.9875	0.959	0.05	0.24

Brain					
Radio S/N	**Antenna Position**	**Transmit Frequency (MHz)**	**Cond. Power (W)**	**Measured SAR (mW/g)**	
				Left	**Right**
831SAG0183	Fix	813.5625	0.913	0.17	0.15
831SAG0183	Fix	806.0125	0.903	0.17	0.13
831SAG0183	Fix	824.9875	0.953	0.13	0.16
831SAG0183	Fix	813.5625	0.959	0.10	0.11

7.2 Maximum Calculated SAR by Expected Operating Position and Conditions

MEAS. POSITION	HIGHEST MEASURED SAR DEPOSITION (1/6 Duty cycle)	MAXIMUM TRANMISSION DUTY CYCLE (MODE and/or PTT)	OPERATIONAL MAXIMUM CALCULATED SAR
Abdomen: with leather carry case and belt clip (minimal body spacing) & audio accessory	0.21 mW/g	iDen 3:1 Mode (33.33%) - with attached accessory cable for remote earpiece/microphone	0.59mW/g
Abdomen: with leather carry case and belt clip (minimal body spacing) & Data cable	0.25 mW/g	iDen 81/120 Mode (67.5%) - with attached Data cable	1.35mW/g
Face	0.07 mW/g	iDen 6:1 Mode (16.67%)– 2 way dispatch	0.10mW/g
Head: at left ear	0.17 mW/g	iDen 3:1 Mode (33.33%)– Telephone	0.48mW/g

The calculated maximum 1 gram averaged SAR value is determined by scaling up the SAR by the same ratio as the maximum power delivered to the radio antenna connector under any conditions of permissible tuning, frequency, voltage and temperature; which is 1.25W average pulse power in this case. For this reason, the radio Maximum Calculated 1 gram averaged peak SAR becomes:

$$\text{Maximum Calculated 1-gram Average Peak SAR} = \frac{P_{max}}{P(0)} \times \frac{P(0)}{P_{end}} \times \frac{P(0)+P(30)}{2xP(0)} \times (D1xD2) \times SAR_{meas}.$$

P_{max} = Maximum power delivered to the antenna connector under any conditions of permissible tuning, frequency, voltage and temperature.

P(0) = Measured power before SAR testing.

P(30) = measured power at 30 minutes of continuous transmit.

P_{end} = Lowest measured power at end of SAR.

SAR_{meas}. = Measured 1 gram averaged peak SAR .

D1 = the transmission mode duty cycle, i.e., the ratio of the service mode and the tested mode.

D2 = the Push To Talk duty cycle.
For two-way radio (dispatch for controlled environment) = 0.5,
For two-way radio (dispatch for uncontrolled/ general population) = 1,
For data and telephony = 1.

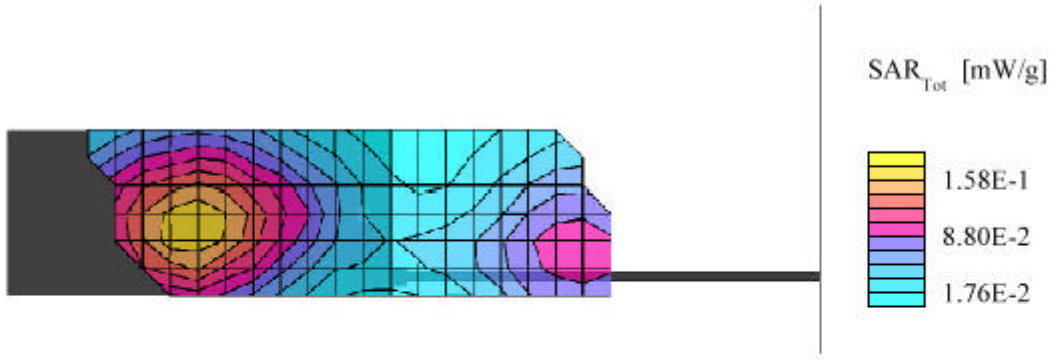
$$\textbf{Maximum Calculated 1-gram Average Peak SAR} = \frac{1.25\text{ W}}{0.953\text{W}} \times \frac{0.953\text{W}}{0.930\text{W}} \times \frac{0.953\text{W} + 0.936\text{W}}{(2 \times 0.953\text{W})} \times \left(\left(\frac{67.5\%}{16.67\%}\right) \times 1\right) \times 0.25\text{ mW/g} = 1.35\text{mW/g}$$

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number N2043A was 1.35 mW/g. This indicated the SAR results are below the maximum levels of 1.6 mW/g.

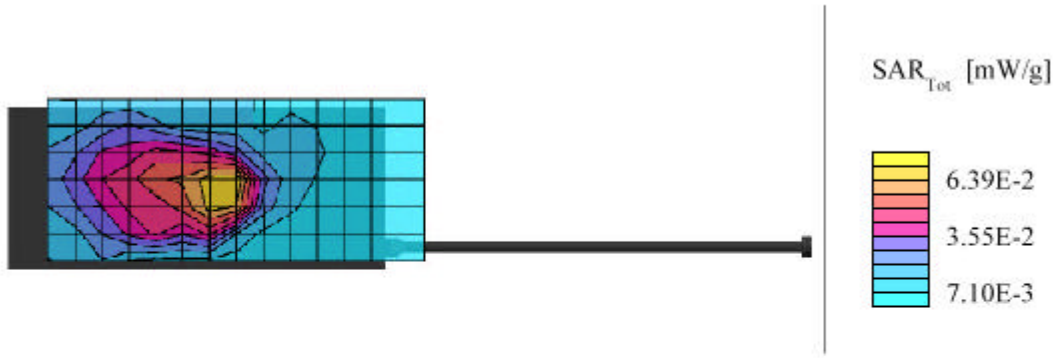
Appendix A: Data Results

r750_Phone_Left Ear_1/2W ant; Test Date:07/14/00
Run #: R750_00071407. Time: 26-31 min
Model #: N2043, S/N: 831SAG0183.
Meas Power:0.913W, Tx_Freq: 806.0625MHz
Batt: NTN9037A, Ant: NAF5075 (1/2W),
Left Head 1Phantom; r750
Probe: ET3DV6 - SN1383; ConvF(6.54,6.54,6.54); Crest factor: 6.0; Brain 835 MHz: **s** = 0.90 mho/m **e**r = 46.2 **r** = 1.04 g/cm 3
Cube 5x5x7:SAR (1g): 0.173 mW/g, (Worst-case extrapolation)



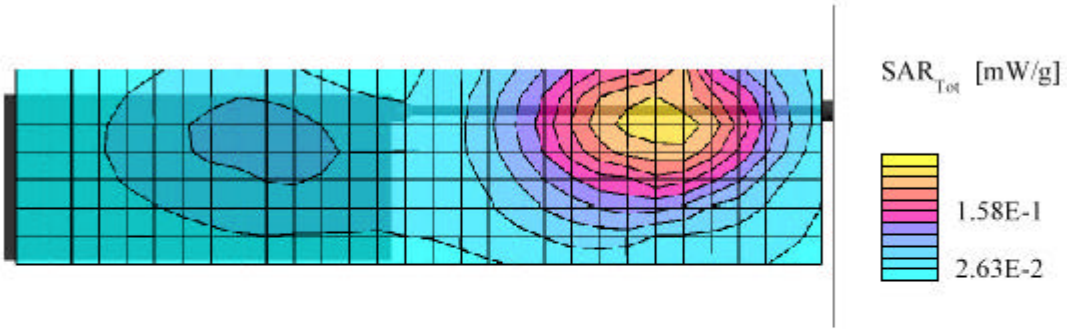
Motorola CGISS EME Lab

r750_1/2W Ant_Face; Test Date:07/13/00
Run #: R750_00071307. Time: 25 min
Model #: N2043, S/N: 831SAG0183.
Meas Power:0.913W, Tx_Freq: 806.0625MHz
Batt: NTN9037A, Ant: NAF5075 (1/2W),
Full bodyPhantom; Full Body _Face
Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 6.0; Muscle 835 MHz : **s** = 1.06 mho/m **e**r = 50.7 **r** = 1.07 g/cm 3
Cube 5x5x7:SAR (1g): 0.0727 mW/g, (Worst-case extrapolation)



Motorola CGISS EME Lab

r750_1/2W Ant_Abdomen; Test Date:07/12/00
Run #: R750_00071208. Time: 39 min
Model #: N2043, S/N: 831SAG0183.
Meas Power:0.913W, Tx_Freq: 820.9875MHz
Batt: NTN9037A, Ant: NAF5075 (1/2W), Data Cable: NKN6522, Belt clip: HLN9714, carry case: FLN9580
Full bodyPhantom; Full Body_Abdomen
Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 6.0; Muscle 835 MHz : **s** = 1.06 mho/m **e**r = 50.7 **r** = 1.07 g/cm 3
Cube 5x5x7:SAR (1g): 0.249 mW/g, (Worst-case extrapolation)

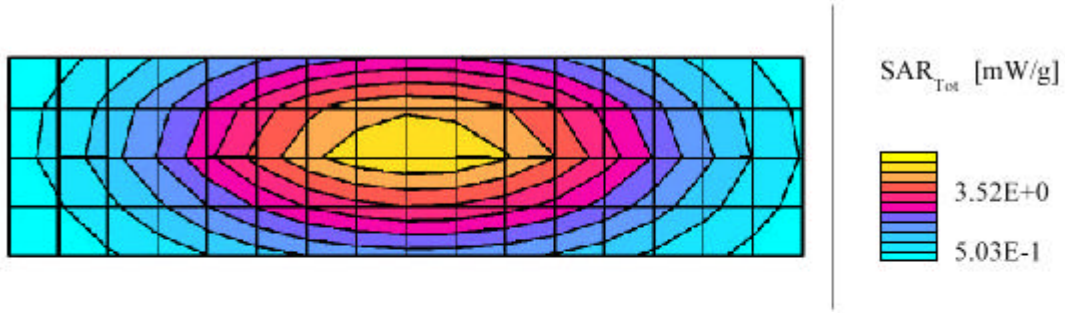


Motorola CGISS EME Lab

Appendix B: Dipole Validation Data Results

835 CGISS Dipole 002; Test Date:07/11/00

835 Dipole Validation. Input power = 0.5W. Target = 9.38mW/g @ 1W
Flat PhantomPhantom;
Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 1.0; Muscle 835 MHz : **s** = 1.07 mho/m **e**r = 53.0 **r** = 1.07 g/cm 3
Cube 5x5x7:SAR (1g): 4.93 mW/g, (Worst-case extrapolation)
Powerdrift: 0.04 dB



Motorola CGISS EME Lab

Appendix C: Measurement Probe Calibration Certificate

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

Calibration Certificate

Dosimetric E-Field Probe

Type:	ET3DV6
Serial Number:	1383
Place of Calibration:	Zurich
Date of Calibration:	August 17, 1999
Calibration Interval:	12 months

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	
Approved by:	Thomas Schmid

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	ET3DV6
Serial Number:	1383
Place of Assessment:	Zurich
Date of Assessment:	Dec. 6, 1999
Probe Calibration Due Date:	Aug. 17, 2000

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Approved by: Schmid Katja

Dosimetric E-Field Probe ET3DV6 SN:1383

Conversion factor (± standard deviation)

450 MHz	ConvF	**7.17± 8%**	ε_r = **47.0** σ = **0.63 mho/m** (brain tissue)
835 MHz	ConvF	**6.54 ± 8%**	ε_r = **44.0** σ = **0.90 mho/m** (brain tissue)
925 MHz	ConvF	**6.36± 8%**	ε_r = **44.0** σ = **0.93 mho/m** (brain tissue)
1500 MHz	ConvF	**5.91± 8%**	ε_r = **41.1** σ = **1.00 mho/m** (brain tissue)
1900 MHz	ConvF	**5.38 ± 8%**	ε_r = **39.9** σ = **1.42 mho/m** (brain tissue)
150 MHz	ConvF	**8.50 ± 8%**	ε_r = **70.00** σ = **0.75 mho/m** (muscle tissue)
450 MHz	ConvF	**7.15 ± 8%**	ε_r = **58.0** σ = **1.00 mho/m** (muscle tissue)
835 MHz	ConvF	**6.49 ± 8%**	ε_r = **52.0** σ = **1.10 mho/m** (muscle tissue)
925 MHz	ConvF	**6.34 ± 8%**	ε_r = **52.0** σ = **1.20 mho/m** (muscle tissue)
1500 MHz	ConvF	**6.10± 8%**	ε_r = **41.2** σ = **1.48 mho/m** (muscle tissue)
1920 MHz	ConvF	**5.13± 8%**	ε_r = **51.5** σ = **1.95 mho/m** (muscle tissue)