ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY

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S.A.R. TEST REPORT

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1.0 Introduction

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 Portable Radio model number PMUF1033A (FCC ID: AZ489FT5795)**.** The test results included herein demonstrate that the SAR levels are within the FCC limit of 8.0 W/kg for the controlled environment, per the requirements of 47 CFR 2.1093(d)(2).

2.0 Applicable Regulation and Standards

- IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. (Revision of ANSI C95.1-1982)

- IEEE C95.3-1991, IEEE Standard Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. (Replaces ANSI C95.3-1973 and ANSI C95.5-1981)

- FCC 96-326, FCC released report on August 7, 1996 which states their new EME rules for Maximum Permissible Exposure (MPE). (Effective August 7, 1996)

- Australian Communication Authority Radio Communications (Electromagnetic Radiation-Human Exposure) Standard 1999.

- Radio Standard Specification 102 (RSS-102), Issue 1 (Provisional), September 25, 1999, Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields.

3.0 Description of Test Sample

The Portable Radio, model number PMUF1033A is 806-825 MHz, and 851-870 MHz band with a rated power of 2.5W. This radio is marketed as a handheld transceiver capable of operating as a traditional two-way (dispatch) radio.

3.1 Antenna Description:

3.1.1 Antenna type:

Quarter wave and half wave whip antennas.

Monopole	Dipole	Helix	Patch	Other
X				

3.1.2 Antenna Location on Device

Left	Right	Top	Bottom	Front	Back
	X	X			

3.1.3 Antenna Dimensions

	NAF5037 ½ Wave	NAF5042 ¼ Wave
Length - cm (extended)	17.86	8.51
Diameter - cm (at tip of antenna)	0.95	0.95
Diameter - cm (at middle of antenna)	0.56	0.56
Diameter - cm (at base of antenna)	1.42	1.42

3.1.4 Antenna Configuration

Fixed		Retractable		External	X	Other	

3.1.5 Antenna Gain

NAF5037 (1/2 Wave)

Extended	1.1 dBi	Retracted	N/A

NAF5042 (1/4 Wave)

Extended	2.3 dBi	Retracted	N/A

3.2 Test Signal

Test Signal Source:

Test Mode	X	Base Station		Simulator		Other	

Signal Modulation:

CW	**X**
TDMA	
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 (W)
806.025	2.90	2.8
815.525	2.92	2.8
824.975	2.94	2.8
851.025	2.21	2.1
860.575	2.19	2.1
869.975	2.22	2.1

4.0 Description of Test Equipment

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 800MHz. The validation SAR value is 8.9 mW/g normalized to 1 Watt compared to target validation SAR 9.38 mW/g normalized to 1 Watt. This 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 printout of the validation test 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 fiber glass and mounted on a non metallic base or stand.

4.2.1 Full Body Phantom

Abdomen Thickness	0.15 cm
Face Thickness	0.15 cm

4.3 Simulated Tissue Properties:

4.3.1 Type of Simulated Tissue

	Full Body
Muscle	X

4.3.2 Simulated Tissue Composition

	Muscle
	835MHz
Di-Water	53.50 %
Sugar	44.25 %
Salt	1.15 %
HEC	1.00 %
Dowicil75	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 1/25/2000.

	Muscle
	835 MHz
Di-electric Constant	50.4
Conductivity – S/m	1.06

Note: Simulated tissue dielectric constant and conductivity have been rounded off to one and two significant digits after the decimal point respectively, to take into account the tissue's measurement uncertainty.

5.0 Description of Test Procedure

5.1 Description of Test Positions

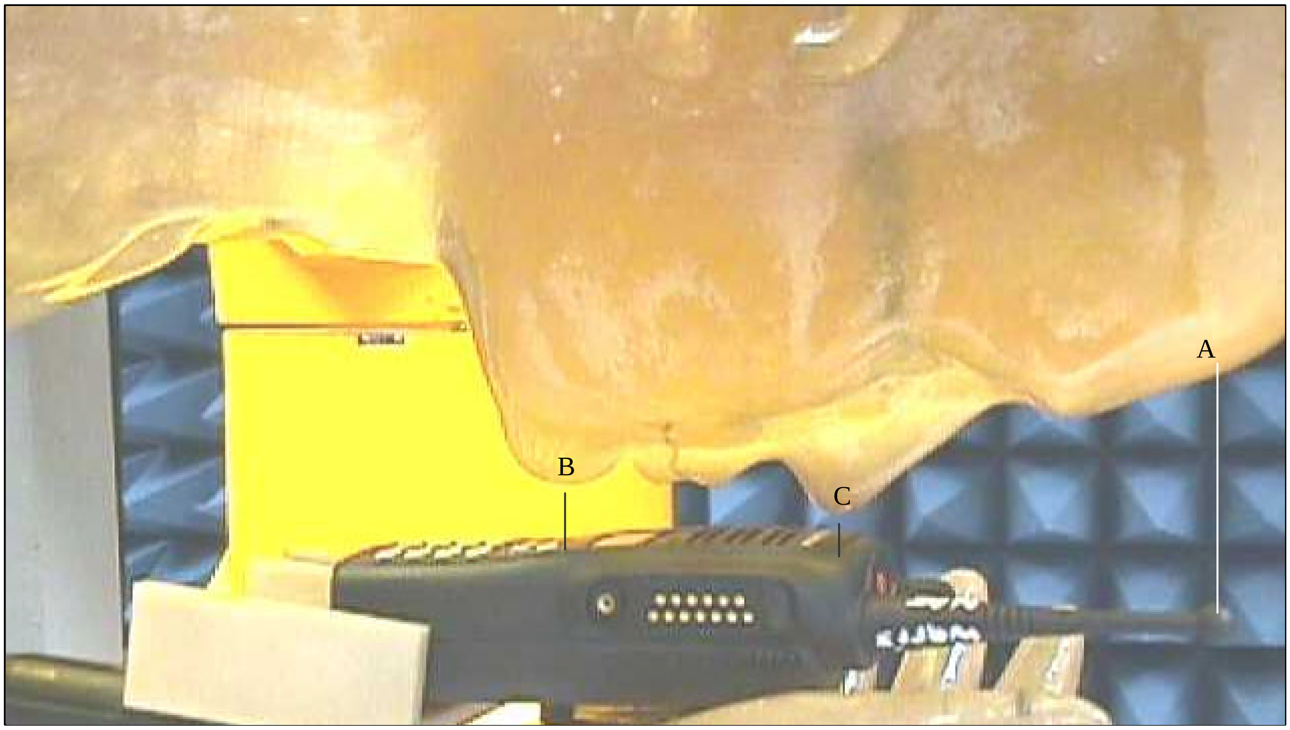
The following describes the test positions used to perform SAR measurements on the portable radio:

Face - The portable radio with affixed beltclip 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 with affixed beltclip/carry case/carry holder is positioned 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 remote speaker microphone is connected to the radio to allow two-way radio operation and the antenna is made to be as parallel as possible to the phantom.

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

Figure 1: Facial Position

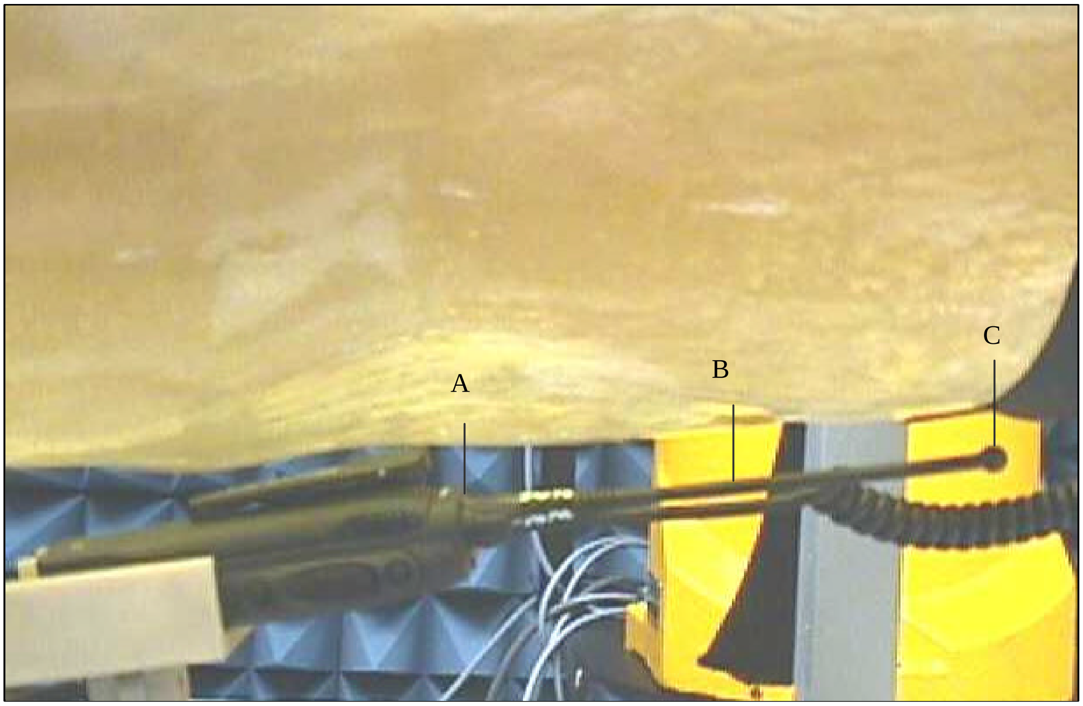


DIM A = Distance from center of phantom's forehead to antenna surface when the antenna is in the retracted position = 52 mm

DIM B = Closest distance between phantom's chin and radio surface = 15 mm

DIM C = Closest distance between phantom's nose tip and radio surface = 5 mm

Figure 2: Abdominal Position



Dim A = Distance from surface of antenna base to phantom surface = 17 mm

Dim B= Distance from surface of antenna center to phantom surface = 17 mm

Dim C= Distance from antenna surface tip to phantom = 23 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	± 10 %
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 %

The Total Measurement Uncertainty is ± 13.5 %. The Expanded Measurement Uncertainty is ± 27 % (k=2)

7.0 SAR Test Results

7.1 Measured SAR

Muscle				
Radio S/N	**Tx Freq. (MHz)**	**Cond. Power (W)**	**Measured SAR (mW/g)**	
			Face	**Abdomen**
749TZW7393	806.025	2.90	2.83	9.68
749TZW7393	815.525	2.92	2.69	9.76
749TZW7393	824.975	2.94	1.58	11.5
749TZW7393	851.025	2.21	≤ 2.83 ([a])	8.17
749TZW7393	860.575	2.19	≤ 2.83 ([a])	6.66
749TZW7393	869.975	2.22	≤ 2.83 ([a])	5.45

Note:
([a]) Other Face measurements indicated that the higher SAR depositions were at 806.025MHz.
Measured 1-gram averaged peak SAR values in the table have been rounded off to two significant digits after the decimal point, to take into account the probe's measurement uncertainty.

7.2 Maximum Calculated SAR by Expected Operating Position and Conditions

MEASUREMENT POSITION	HIGHEST MEASURED SAR DEPOSITION	MAXIMUM OPERATIONAL DUTY CYCLE AND MODE	OPERATIONAL MAXIMUM CALCULATED SAR
Abdomen: with belt clip (minimal body spacing) and audio accy.	11.5 mW/g	50% - 2-way dispatch	6.90 mW/g
Face: with belt clip	2.83 mW/g	50% - 2-way dispatch	1.70 mW/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 for this product is 3.36W. For this reason, the radio Maximum Calculated 1 gram averaged peak SAR becomes:

Maximum Calculated 1-gram Average Peak SAR = SAR_{meas} x [P_{max}÷ P_{end}] x [D1xD2].

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

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

P_{end} = Lowest measured power (at 467.6375 MHz) at end of 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.

Max. Calc. 1-gram Avg Peak SAR = [11.5 mW/g x (3.36W ¸ 2.8W) x (1 x 0.5)]
= 6.9 mW/g

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number PMUF1033A was 6.9 mW/g. This indicated the SAR results are below the maximum levels of 8.0 mW/g.

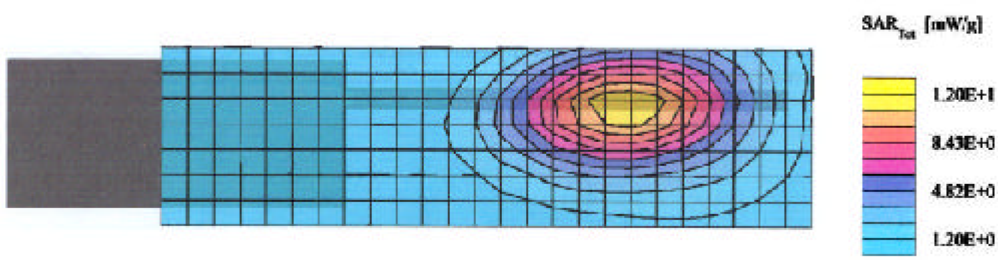
APPENDIX A

DATA RESULTS

HIGHEST MEASURED SAR AT ABDOMEN

Waris 800-pict.

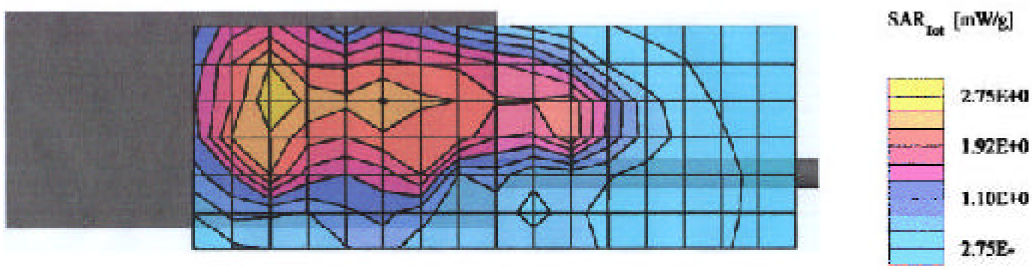
PMUF1033A, Waris 800 Proto, SN: 749TZW7393, Run: 000128-3, Ant: NAF5037A,
Batt: HNN9013, RSM: HMN9052A, Belt Clip: HLN9844
Abd test Phantom; 450 Abd test Section; Position: (90°,90°); Frequency: 825 MHz
Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 1.0; Muscle 835 MHz (Flat): σ = 1.06 mho/m ϵ_r = 50.4 ρ = 1.07 g/cm^3
Cube 5x5x7: SAR (1g): 11.5 mW/g, SAR (10g): 7.81 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0



HIGHEST MEASURED SAR AT FACE

Waris 800-Face

PMUF1033A, Waris 800 Proto, SN: 749TZW7393, Run: 000202-4, Ant: NAF5042A,
Batt: HNN9012, FACE
Abd test Phantom; 450 Abd test Section; Position: (90°,90°); Frequency: 825 MHz
Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 1.0; Muscle 835 MHz (Flat): σ = 1.07 mho/m ε_r = 50.2 ρ = 1.07 g/cm^3
Cube 5x5x7: SAR (1g): 2.83 mW/g, SAR (10g): 1.96 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0



APPENDIX B

DIPOLE VALIDATION DATA RESULTS

835 CGISS Dipole 002

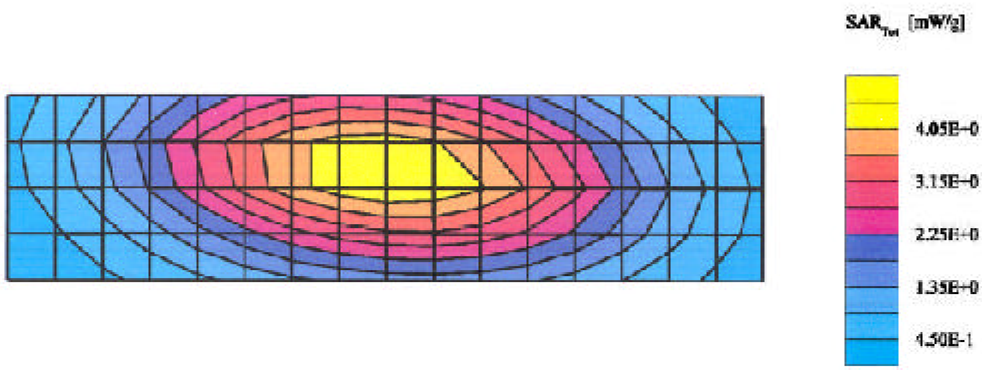
Flat Phantom Phantom; Section; Position: ; Frequency: 835 MHz

Probe: ET3DV6 - SN1383; ConvF(6.49,6.49,6.49); Crest factor: 1.0; Muscle 835 MHz (Flat): σ = 1.08 mho/m ε_r = 51.1 ρ = 1.07 g/cm³

Cube 5x5x7: SAR (1g): 4.45 mW/g, SAR (10g): 2.93 mW/g, (Worst-case extrapolation)

Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0

Powerdrift: 0.01 dB



APPENDIX C

MEASUREMENT PROBE CALIBRATION CERTIFICATE

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8046 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

Certificate

Numerical Assessment of Conversion Factor 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 calibration 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 recalibration schedule of the probe.

Performed by:	Alois Katja
Approved by:	[illegible]

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Dosimetric E-Field Probe ET3DV6 SN:1383

Sensitivity in Tissue Simulating Liquid - Numerical Assessment (FDTD code)

450 MHz	ConvF	**7.17± 10% ***	ε_r = 47.0 σ = 0.63 mho/m (brain tissue)
835 MHz	ConvF	**6.54 ± 10%**	ε_r = 44.0 σ = 0.90 mho/m (brain tissue)
925 MHz	ConvF	**6.36± 10%**	ε_r = 44.0 σ = 0.93 mho/m (brain tissue)
1500 MHz	ConvF	**5.91± 10%**	ε_r = 41.1 σ = 1.00 mho/m (brain tissue)
1900 MHz	ConvF	**5.38 ± 10%**	ε_r = 39.9 σ = 1.42 mho/m (brain tissue)
150 MHz	ConvF	**8.50 ± 10% ***	ε_r = 70.00 σ = 0.75 mho/m (muscle tissue)
450 MHz	ConvF	**7.15 ± 10% ***	ε_r = 58.0 σ = 1.00 mho/m (muscle tissue)
835 MHz	ConvF	**6.49 ± 10%**	ε_r = 52.0 σ = 1.10 mho/m (muscle tissue)
925 MHz	ConvF	**6.34 ± 10%**	ε_r = 52.0 σ = 1.20 mho/m (muscle tissue)
1500 MHz	ConvF	**6.10± 10%**	ε_r = 41.2 σ = 1.48 mho/m (muscle tissue)
1920 MHz	ConvF	**5.13± 10%**	ε_r = 51.5 σ = 1.95 mho/m (muscle tissue)

* this uncertainty is based on the extrapolation from measured value at 900 MHz and may be subject to change when additional experimental investigation is accomplished