



MOTOROLA

ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY
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S.A.R. TEST REPORT
FCC ID #: AZ489FT5798
(Waris – PMUF1064A)

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1.0 Introduction

This report is a revision of the previous SAR report for Portable Radio, model number PMUF1064A (FCC ID: AZ489FT5798) dated 9/15/00. The purpose for this revision is to complete kit number for the accessories listed in section 3.

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 Waris Portable Radio, model number PMUF1064A (FCC ID: AZ489FT5798) and evaluated to Occupational/Controlled Exposure limit of 8.0 mW/g.

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 PMUF1064A 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 (Push-To-Talk) radio.

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

- Spring belt clip for 1.5" belt width (kit # HLN9844A)
- Belt clip (kit # HLN9714A)
- Belt clip carry holder (kit # HLN9952A)
- Case, Std Leather, short, DTMF, belt loop, thin batt's (kit # HLN9677A)
- Case, Std Leather, short, DTMF, swivel, thin batt's (kit # HLN9690A)
- Case, Nylon w/ belt loop (kit # HLN9701B)
- Carry strap (kit # NTN5243A)
- Remote Speaker Microphone (kit # HMN9052A)
- Light Weight headset with PTT (kit # RMN4018A).
- Audio accessory adaptor (kit # HLN9716A).
- Remote Speaker Microphone (kit # HMN9725D).

3.1 Antenna Description:

3.1.1 Antenna type:

Quarter wave and half wave whip antennas.

Monopole Dipole Helix Patch Other

3.1.2 Antenna Location on Device

Left Right Top Bottom Front Back

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 Other

3.1.5 Antenna Gain

NAF5037 (1/2 Wave)

Extended Retracted

NAF5042 (1/4 Wave)

Extended Retracted

3.2 Test Signal

Test Signal Source:

Test Mode 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 Conducted Other

Output Power measured with:

Power meter Base Station Simulator Spectrum Analyzer Other

Test Frequency (MHz)	Measured Power before SAR	Measured Power after SAR
806.025	2.79 W	-0.40 dB
815.525	2.79 W	-0.40 dB
824.975	2.79 W	-0.40 dB
860.575	2.21 W	-0.40 dB

4.0 Description of Test Equipment

The laboratory utilizes a Dosimetric Assessment System (DASYTM) SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAGTM), 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 1384. It was calibrated at SPEAGTM, and has a calibration date June 1, 2000 . 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 9.04 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 $\pm 10\%$ (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 9/6/2000.

	Muscle
	835 MHz
Di-electric Constant	51.9
Conductivity – S/m	1.08

5.0 Description of Test Procedure

5.1 Description of Test Positions

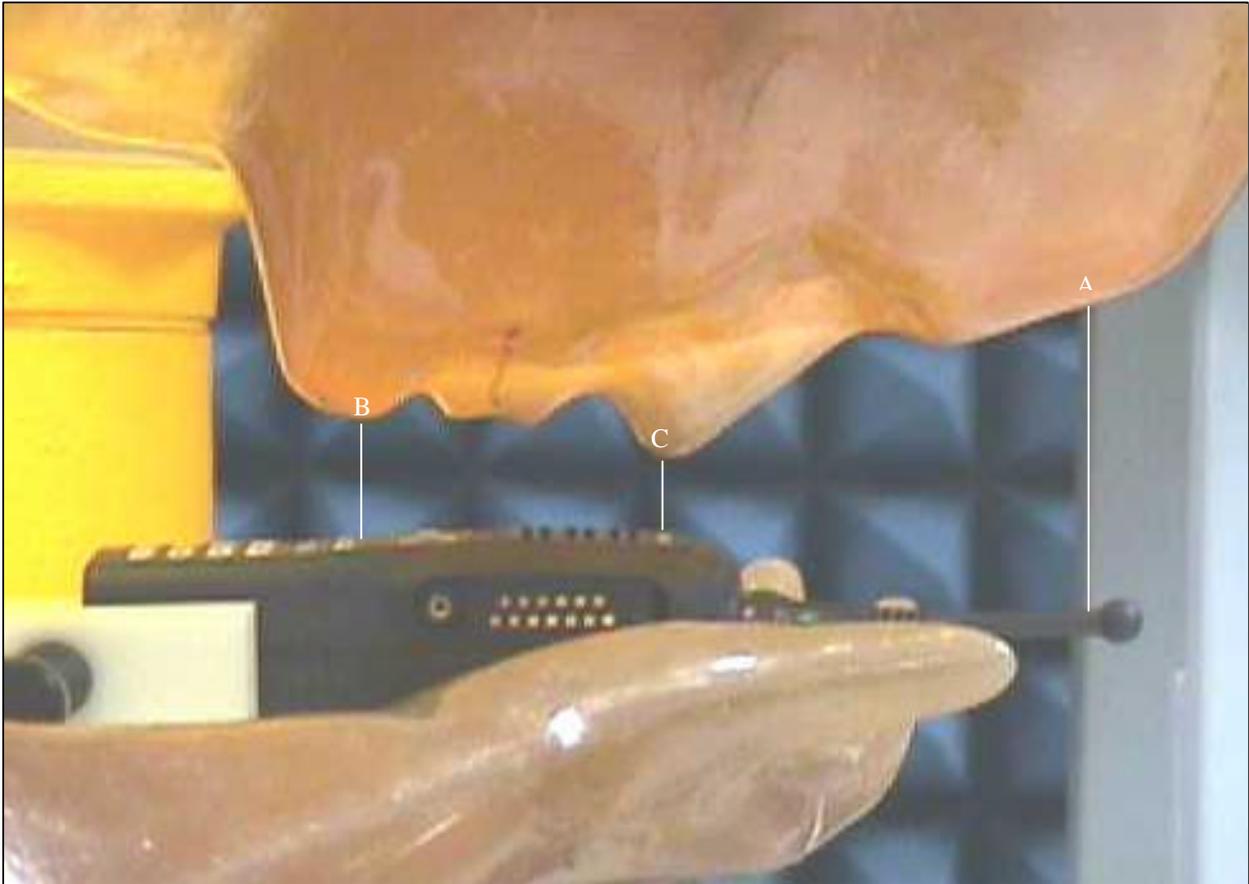
The following describes the test positions used to perform SAR measurements on the portable radio:

Face - The portable radio 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(s)/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.

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 = 65 mm

DIM B = Distance between phantom's chin and radio surface = 27 mm

DIM C = Closest distance between phantom's nose tip and radio surface = 17 mm

Figure 2: Abdominal Position



Dim A = Distance from surface of antenna base to phantom surface = 21 mm

Dim B= Distance from surface of antenna center to phantom surface = 24 mm

Dim C= Distance from antenna surface tip to phantom = 27 mm

5.2 Probe Scan Procedures :

The E-field probe is scanned in a coarse grid over a large area inside the phantom in order to locate an area of highest SAR distributions. 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 to reference 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	$\pm 2.4 \%$
- Spherical Isotropy	$\pm 4.8 \%$
- Spatial Resolution	$\pm 0.5 \%$
- Linearity Error	$\pm 2.7 \%$
- Calibration Error	$\pm 8 \%$
Evaluation Uncertainty	
- Data Acquisition Error	$\pm 0.60 \%$
- ELF and RF Disturbances	$\pm 0.25 \%$
- Conductivity Assessment	$\pm 5 \%$
Spatial Peak SAR Evaluation Uncertainty	
- Extrapolation and boundary effects	$\pm 3\%$
- Probe positioning	$\pm 1 \%$
- Integration and cube orientation	$\pm 3 \%$
- Cube shape inaccuracies	$\pm 1.2 \%$
- Device positioning	$\pm 1.0 \%$

The Total Measurement Uncertainty is $\pm 12.1 \%$. The Expanded Measurement Uncertainty is $\pm 24.2 \%$ ($k=2$)

7.0 SAR Test Results

7.1 Measured SAR

Muscle				
Radio S/N	Tx Freq. (MHz)	Cond. Power	Highest Measured SAR By Body Position and Frequency (mW/g)	
			Face	Abdomen
WQ3SNOYA	806.025	2.79W	1.2	6.8
WQ3SNOYA	815.525	2.79W	1.2	6.4
WQ3SNOYA	824.975	2.79W	1.3	6.2
WQ3SNOYA	860.575	2.21W	1.1	5.9

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 HLN9844 (minimal body spacing) and audio accessory	6.8 mW/g	50% - Push-To-Talk	4.5 mW/g
Face	1.3 mW/g	50% - Push-To-Talk	0.9 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 806-825MHz, and 2.6W for 851-870MHz. For this reason, the radio Maximum Calculated 1 gram averaged peak SAR becomes:

$$\text{Maximum Calculated 1-gram Average Peak SAR} = \text{SAR}_{\text{meas}} \times [P_{\text{max}} \div P_{\text{end}}] \times [D1 \times D2].$$

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 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.

$$\text{Maximum Calculated 1-gram Average Peak SAR for 806-825MHz} = 6.8 \text{ mW/g} \times [3.36\text{W} \div 2.54\text{W}] \times [1 \times 0.5] = 4.5 \text{ mW/g}.$$

$$\text{Maximum Calculated 1-gram Average Peak SAR for 851-870MHz} = 5.9 \text{ mW/g} \times [2.6\text{W} \div 2.0\text{W}] \times [1 \times 0.5] = 3.8 \text{ mW/g}.$$

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number PMUF1064A was 4.5 mW/g. This indicated the SAR results are below the Occupational/Controlled Exposure limit of 8.0 mW/g.

APPENDIX A
DATA RESULTS

Waris 9cm Whip Ant- Face; Test Date:09/12/00

Run #: PMUF1064A_ 00091204, Time: 27 min.

Model #: PMUF1064A, S/N: WQ35N0YA,

Meas Power: 2.79W, Tx_Freq: 824.975 MHz,

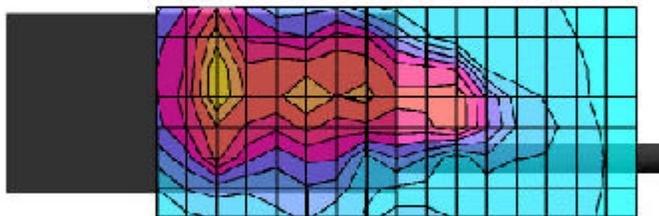
Batt: HNN9008, Ant: NAF5042A,

Full bodyPhantom; Full Body _Face

Probe: ET3DV6 - SN1384; ConvF(6.45,6.45,6.45); Crest factor: 1.0; Muscle 835

MHz : $s = 1.08$ mho/m $\epsilon_r = 51.9$ $\rho = 1.07$ g/cm³

Cube 5x5x7:SAR (1g): 1.29 mW/g, (Worst-case extrapolation)



Waris 9cm Whip Ant- Abd; Test Date:09/11/00

Run #: PMUF1064A_ 00091108, Time: 29 min.

Model #: PMUF1064A, S/N: WQ35N0YA,

Meas Power: 2.79W, Tx_Freq: 806.025 MHz,

Batt: HNN9013B, Ant: NAF5042A,

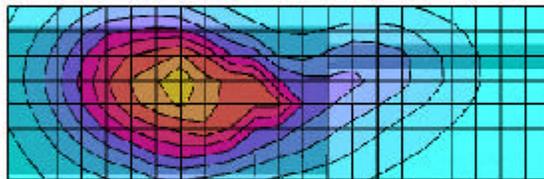
Belt Clip: HLN9844, RSM: HMN9052

Full bodyPhantom; Full Body_Abdomen

Probe: ET3DV6 - SN1384; ConvF(6.45,6.45,6.45); Crest factor: 1.0; Muscle 835

MHz : $s = 1.08 \text{ mho/m}$ $\epsilon_r = 51.9$ $\rho = 1.07 \text{ g/cm}^3$

Cube 5x5x7:SAR (1g): 6.77 mW/g, (Worst-case extrapolation)



APPENDIX B
DIPOLE VALIDATION DATA RESULTS

835 CGISS Dipole 002; Test Date:09/06/00

Flat Phantom;

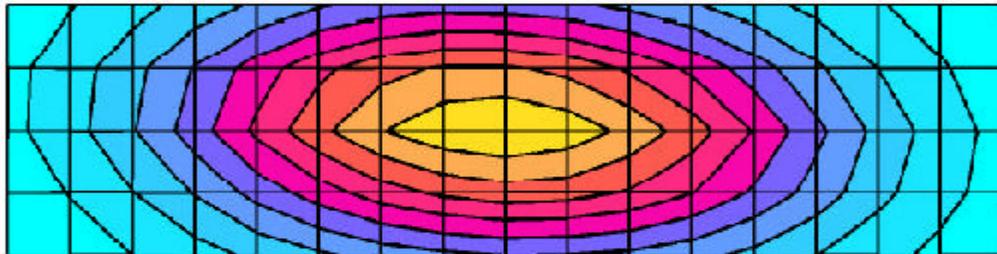
Probe: ET3DV6 - SN1384; ConvF(6.45,6.45,6.45); Crest factor: 1.0; Muscle 835

MHz : $s = 1.08 \text{ mho/m}$ $\epsilon_r = 54.6$ $\rho = 1.07 \text{ g/cm}^3$

Cube 5x5x7: SAR (1g): 4.50 mW/g, SAR (10g): 2.95 mW/g, (Worst-case extrapolation), Peak: 6.95 mW/g,

Penetration depth: 12.7 (11.4, 14.2) [mm]

Powerdrift: -0.02 dB



APPENDIX C

MEASUREMENT PROBE CALIBRATION CERTIFICATE

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1384

Place of Calibration:

Zurich

Date of Calibration:

June 1, 2000

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:

Heinz Klatzer

Approved by:

Thomas Schmid

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland. Phone +41 1 245 97 00. Fax +41 1 245 97 79

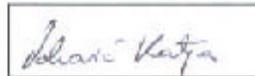
Certificate

Numerical Assessment of Conversion Factor for Dosimetric E-Field Probe

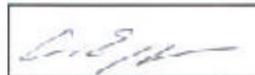
Type:	ET3DV6
Serial Number:	1384
Place of Assessment:	Zurich
Date of Assessment:	June 2, 2000
Probe Calibration Due Date:	June 1, 2001

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:



Approved by:



Dosimetric E-Field Probe ET3DV6 SN:1384

Conversion factor (\pm standard deviation)

450 MHz	ConvF	7.14 \pm 8%	$\epsilon_r = 47.0$ $\sigma = 0.63$ mho/m (brain tissue)
835 MHz	ConvF	6.50 \pm 8%	$\epsilon_r = 44.0$ $\sigma = 0.90$ mho/m (brain tissue)
925 MHz	ConvF	6.33 \pm 8%	$\epsilon_r = 44.0$ $\sigma = 0.93$ mho/m (brain tissue)
1500 MHz	ConvF	6.00 \pm 8%	$\epsilon_r = 41.1$ $\sigma = 1.00$ mho/m (brain tissue)
1900 MHz	ConvF	5.46 \pm 8%	$\epsilon_r = 39.9$ $\sigma = 1.42$ mho/m (brain tissue)
150 MHz	ConvF	8.46 \pm 8%	$\epsilon_r = 70.00$ $\sigma = 0.75$ mho/m (muscle tissue)
450 MHz	ConvF	7.12 \pm 8%	$\epsilon_r = 58.0$ $\sigma = 1.00$ mho/m (muscle tissue)
835 MHz	ConvF	6.45 \pm 8%	$\epsilon_r = 52.0$ $\sigma = 1.10$ mho/m (muscle tissue)
925 MHz	ConvF	6.31 \pm 8%	$\epsilon_r = 52.0$ $\sigma = 1.20$ mho/m (muscle tissue)
1500 MHz	ConvF	6.18 \pm 8%	$\epsilon_r = 41.2$ $\sigma = 1.48$ mho/m (muscle tissue)
1920 MHz	ConvF	5.20 \pm 8%	$\epsilon_r = 51.5$ $\sigma = 1.95$ mho/m (muscle tissue)