



Certificate Number 1449-02



MOTOROLA

**ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY**

8000 West Sunrise Blvd.
Fort-Lauderdale, Florida

S.A.R. TEST REPORT
FCC ID: AZ489FT5803
PMUF1060A

March 21, 2001

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REVISION HISTORY

Date	Revision	Comments
21 March 2001	O	Original release

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 Product, model number PMUF1060A (FCC ID: AZ489FT5803).

2.0 Reference Standards and Guidelines

This product is designed to comply with the following national and international standards and guidelines.

- 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
- 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



PMUF1060A

The FM Portable Radio, Model number PMUF1060A operates in 896-902 and 935-941 MHz band with a rated conducted power of 2.8W. This radio is marketed as a handheld transceiver capable of operating as a traditional two-way (Push-To-Talk) radio with optional antennas, batteries and accessories, listed below. (Refer to appendix D for a complete illustration of Body-worn accessories.)

Antenna:

Form SAR-Rpt-B

NAF5038	½ wave whip
NAF5042	¼ wave whip

Battery:

HNN9008A	NiMH High capacity, thin
HNN9009A	NiMH Ultra high capacity, standard
HNN9010A	NiMH Ultra high capacity factory mutual, standard
HNN9011A	NiCd High capacity factory mutual, standard
HNN9012A	NiCd High capacity, standard
HNN9013B	Lithium Ion High capacity, thin

Body-worn accessories:

HLN9844A	Spring belt clip for 1.5" belt width
HLN9714A	Spring belt clip for 2.5" belt width
HLN9952A	Belt clip carry holder
HLN9701B	Nylon case w/ belt loop
PMLN4280	Full thin leather case
PMLN4281	Basic thin leather case
HLN9690A	Standard leather case, swivel belt loop, thin batteries
HLN9694A	Standard leather case, swivel belt loop, standard batteries
HLN9955A	Standard leather case, swivel belt loop, thin batteries
HLN9998A	Standard leather case, swivel belt loop, standard batteries
HLN9670A	Standard leather case, swivel belt loop, thin batteries
HLN9676A	Standard leather case, swivel belt loop, standard batteries
HLN9677A	Standard leather case, belt loop, thin batteries
HLN9689A	Standard leather case, belt loop, standard batteries
HLN9945A	Standard leather case, belt loop, thin batteries
HLN9946A	Standard leather case, belt loop, standard batteries
HLN9652A	Standard leather case, belt loop, thin batteries
HLN9665A	Standard leather case, belt loop, standard batteries
NTN5243A	Carry strap

Audio: (these are representative samples of available audio accessories.)

HMN9052A	Remote Speaker Microphone
RMN4018A	Light Weight headset with PTT
HLN9716A	Audio accessory adaptor
ENMN4014A	3-Wire min lapel
PMMN4002A	Temco Remote Speaker Microphone, Noise Canceling

3.1 Antenna Description:

3.1.1 Antenna Location on Device

Left ☐ Right ☒ Top ☒ Bottom ☐ Front ☐ Back ☐

3.1.2 Antenna Dimensions

	NAF5042 1/4 Wave	NAF5038 1/2 Wave
Length - cm (extended)	8.5	16.8
Diameter – cm (at tip of antenna)	0.9	0.9
Diameter - cm (at middle of antenna)	0.5	0.5
Diameter - cm (at base of antenna)	1.4	1.4

3.1.3 Antenna Configuration

Fixed ☒ Retractable ☐ External ☒ Internal ☐ Other

3.1.4 Antenna Gain:

NAF5038 (1/2 Wave)

Extended Retracted

NAF5042 (1/4 Wave)

Extended

-2.68 dBi

Retracted

N/A

3.2 Test Signal

Test Signal Source:

Test Mode

☐

Base Station

☐

Simulator

☐

Native Transmission Mode

☒

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)	Initial Measured Power before SAR (W)	dB loss from Initial Power after SAR (dB)
899.025	2.80	-0.39

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. The SAR measurements were conducted with the ET3DV6 serial number 1383 probe. It was calibrated at SPEAG™, and has a calibration date Aug. 30,2000. A copy of the calibration certificate is included as appendix C. Dipole Validation Kit type 925MHz (serial number

925-002) was used to validate the system accuracy at 925 MHz. The Dipole validation result is 11.32mW/g when normalized to 1W compared to the target of 11.98mW/g, which is within the required accuracy of $\pm 10\%$ (Dipole SAR Validation Certificate for Dipole S/N 925-002, 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 (cm)	0.15
Face Thickness (cm)	0.15

4.3 Simulated Tissue Properties:

4.3.1 Type of Simulated Tissue:

Muscle	X
Brain	NA

4.3.2 Simulated Tissue Composition

Percentage by weight

	Frequency (925MHz)	
	Muscle	Brain
Di-Water	53.5	NA
Sugar	44.25	NA
Salt	1.15	NA
HEC	1.00	NA
Dowicil75	0.10	NA

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. This measurement was done 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 02 Jan. 2001.

	925MHz	
	Muscle	Brain
Di-electric Constant	50.6	NA
Conductivity – S/m	1.17	NA

5.0 Description of Test Procedure

All antennas, batteries, and audio accessories listed in section 3.0, plus the following body worn accessories were included in the SAR search pattern to determine the combinations providing the highest measured SAR results.

Body-worn accessories included in the SAR search:

HLN9844A	Spring belt clip for 1.5” belt width
HLN9714A	Spring belt clip for 2.5” belt width
HLN9952A	Belt clip carry holder
HLN9701B	Nylon case w/ belt loop
PMLN4280	Full thin leather case
HLN9694A	Standard leather case, swivel belt loop, standard batteries
HLN9689A	Standard leather case, belt loop, standard batteries
NTN5243A	Carry strap

The balance of the body-worn accessories listed in section 3.0 and described in Appendix D did not require test because they differed from the tested body-worn accessories only by the leather hole cut-out patterns and/or the absence or presence of a clear plastic window.

All SAR measurements were performed with the radio positioned in the described test position and in continuous transmit mode (100% duty cycle).

5.1 Description of Test Positions

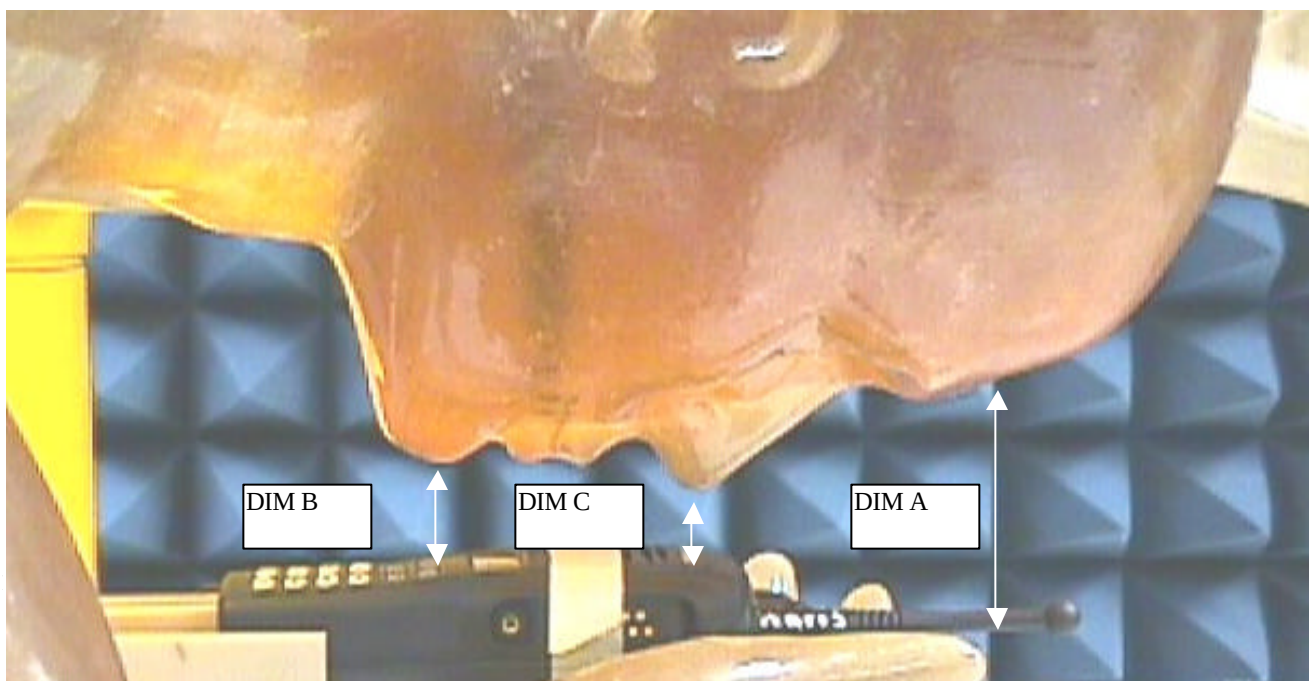
The following describes the test positions used to perform SAR measurements on the portable radio:

Face - The portable radio, without belt clip, 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 carry case and/or belt clip attached beneath the abdomen of the full body phantom with the back of the carry accessory facing and parallel to the abdomen. An interface cable between the radio connector and an audio accessory is connected to the radio to allow two-way radio operation while carried on the user.

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

Figure 1: Facial Position



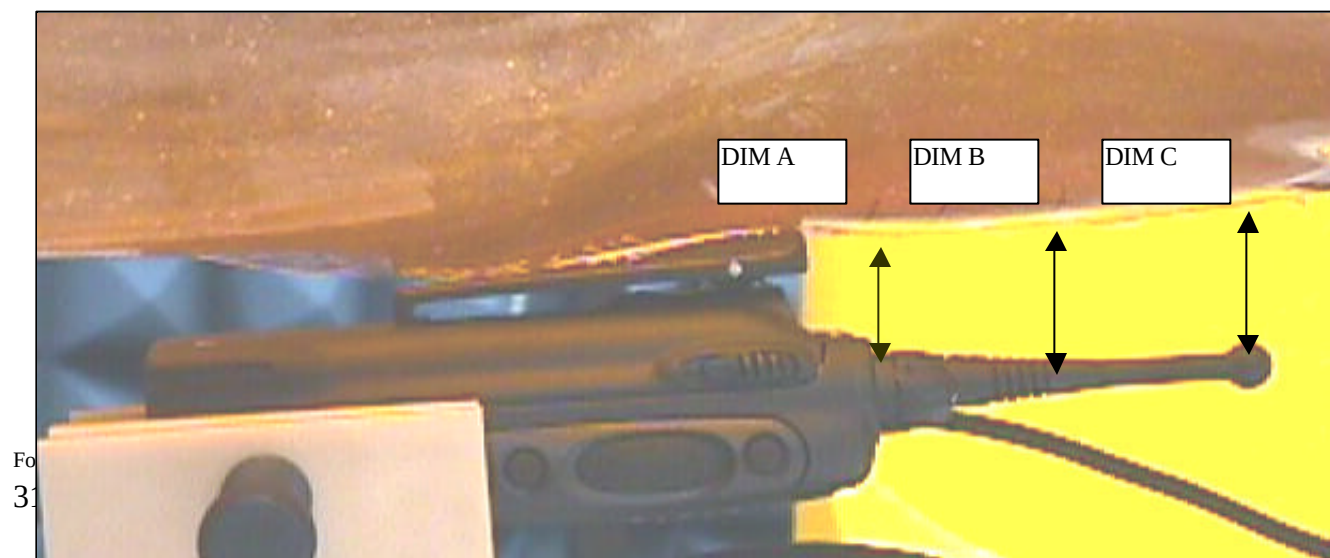
DIM A = Distance from center of phantom's forehead to radio surface = 61mm

DIM B = Distance between phantom's chin and radio surface = 26mm

DIM C = Closest distance between phantom's nose tip and radio surface = 16mm

Note: Radio is positioned with microphone 2.5cm from mouth.

Figure 2: Abdominal Position



Dim A = Distance from surface of antenna base to phantom surface = 24mm

Dim B= Distance from surface of antenna center to phantom surface = 26mm

Dim C= Distance from antenna surface tip to phantom = 28mm

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 interpolated maximum SAR distribution. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The subsequent scan can directly use this position for reference for the cube evaluations.

6.0 Measurement Uncertainty:

The table below list the uncertainty 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

The highest measured and calculated SAR results yielded by the tests described in Section 5.0 are listed in the table below for each body position. The DASY™ measurement system's output files are provided in appendix A.

Transmit Freq. (MHz)	Initial Cond. Power (W)	Highest Measured SAR		Max Calculated SAR	
		Face	Abdomen	Face	Abdomen
899.025	2.8	1.36	6.49	0.86	4.13

The configuration for the abdomen results included the NAF5042A antenna, HNN9008A battery, HLN9844 belt clip. The configuration for the face results included the NAF5042A antenna, HNN9008A battery.

The calculated maximum 1-gram averaged SAR value is determined by scaling up the SAR to adjust for any condition of permissible tuning, frequency, voltage and temperature; which is 3.25W in this case. For this reason, the radio Maximum Calculated 1-gram averaged peak SAR becomes:

$$\text{Maximum Calculated 1-gram Average Peak SAR} = \frac{P_{\max}}{P_{\text{end}}} \times (D1 \times D2) \times \text{SAR}_{\text{meas.}}$$

$P_{\max}$ = 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.

$\text{SAR}_{\text{meas.}}$ = 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.

$$\text{Maximum Calculated 1-gram Average Peak SAR at the abdomen} = \frac{3.25\text{W}}{2.56\text{W}} \times (1 \times 0.5) \times 6.49\text{mW/g} = 4.13\text{mW/g}$$

$$\frac{\text{Maximum Calculated 1-gram Average Peak SAR at the face}}{2.56\text{W}} = \frac{3.25\text{W}}{2.56\text{W}} \times (1 \times 0.5) \times 1.36\text{mW/g} = 0.86\text{mW/g}$$

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number PMUF1060 was 4.13mW/g. These results are fully compliant to the Occupational /Controlled Exposure limit 8.0mW/g.

Appendix A: Data Results

Face;Test Date:01/04/01

Run 01010402, Time: 29 min.

Model #: PMUF1060A, S/N: 921TAS1459,

Tx_Freq: 899.025 MHz,

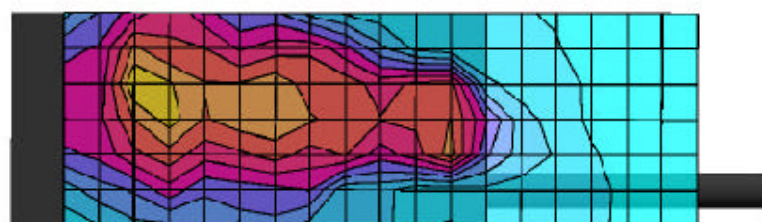
Batt: HNN9008, Ant: NAF5042A

Full body Phantom; Full Body _Face Section;

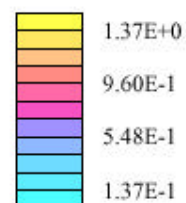
Probe: ET3DV6 - SN1383; ConvF(6.31,6.31,6.31);

Crest factor: 1.0; Muscle 925 MHz : $\sigma = 1.17$ mho/m $\epsilon_r = 50.6$ $\rho = 1.07$ g/cm³

Cube 5x5x7: SAR (1g): 1.36 mW/g, (Worst-case extrapolation)



SAR_{Tot} [mW/g]



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Abdomen;Test Date:01/04/01

Run 01010401, Time: 29 min.

Model #: PMUF1060A, S/N: 921TAS1459,

Tx_Freq: 899.025 MHz, Belt Clip HLN9844

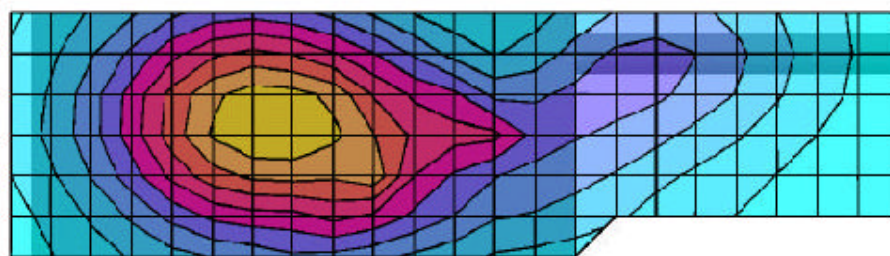
Batt: HNN9008, Ant: NAF5042A,Headset: RMN4018A,

Full body Phantom; WARIS Section;

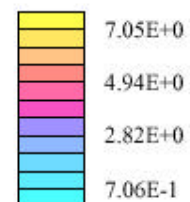
Probe: ET3DV6 - SN1383; ConvF(6.31,6.31,6.31);

Crest factor: 1.0; Muscle 925 MHz : $\sigma = 1.17$ mho/m $\epsilon_r = 50.6$ $\rho = 1.07$ g/cm³

Cube 5x5x7: SAR (1g): 6.49 mW/g, (Worst-case extrapolation)



SAR_{Tot} [mW/g]



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Appendix B: Dipole Validation Data Results

925 CGISS Dipole 002;Test Date:12/28/00

925 Dipole Validation. Input power = 0.5W. Target = 11.98mW/g @ 1W

Flat Phantom Phantom; Section;

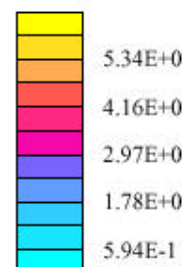
Probe: ET3DV6 - SN1383; ConvF(6.31,6.31,6.31);

Crest factor: 1.0; Muscle 925 MHz : $\sigma = 1.16$ mho/m $\epsilon_r = 51.2$ $\rho = 1.07$ g/cm³

Cube 5x5x7: SAR (1g): 5.66 mW/g, (Worst-case extrapolation)



SAR_{Tot} [mW/g]



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Appendix C: Measurement Probe Calibration Certificate

Schmid & Partner Engineering AG

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

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1383

Place of Calibration:

Zurich

Date of Calibration:

August 30, 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:

Nicolaus Henning

Approved by:

Heinz Kappeler

Schmid & Partner Engineering AG

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

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1383

Place of Assessment:

Zurich

Date of Assessment:

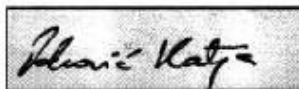
September 20, 2000

Probe Calibration Due Date:

August 30, 2001

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:



Dosimetric E-Field Probe ET3DV6 SN:1383

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	5.89 $\pm$ 8%	$\epsilon_r = 41.1$ $\sigma = 1.00$ mho/m (brain tissue)
1900 MHz	ConvF	5.36 $\pm$ 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	6.07 $\pm$ 8%	$\epsilon_r = 41.2$ $\sigma = 1.48$ mho/m (muscle tissue)
1920 MHz	ConvF	5.11 $\pm$ 8%	$\epsilon_r = 51.5$ $\sigma = 1.95$ mho/m (muscle tissue)

Appendix D: Illustrations of Body-worn Accessories

Body-worn Accessories for Professional Series Radios

The purpose of this appendix is to illustrate the body-worn carry accessories for Professional Series Radios. The radio that is used in the following photos is of the Professional Series type and was used solely to demonstrate the different body-worn carry accessories. There are four types of body-worn carry cases 1) Belt clip 2) Nylon case 3) Thin leather carry case 4) Standard leather belt loop.

1) Belt Clip

Belt clips are available in two styles, spring belt clip 1.5”(HLN9844A) and spring belt clip 2.5”(HLN9714A) refer to photos 1-5 below. A belt clip carry holder (HLN9952A) is an optional nonmetallic holder for which either belt clip can be attached. Photo five illustrates the metallic spring clips for both belt clips.



Photo 1, Side view of HLN9844A



Photo 2, Side view of HLN9714A

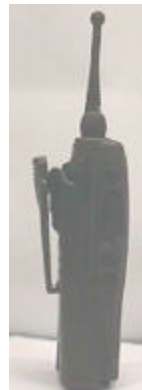


Photo 3, Side view of HLN9952A and HLN9844A



Photo 4, Rear view of HLN9844A, HLN9714A and HLN9952

Metallic spring and clip



Photo 5, Front view of HLN9844A, HLN9714A and HLN9952

2) Nylon Carry Case

The Nylon carry case is only available in one style, Nylon with belt loop (HLN9701B) refer to photos 6-8.



Photo 6, Side view of HLN9701B (nylon)



Photo 7, Front view of HLN9701B (nylon)



Photo 8, Rear view of HLN9701B (nylon)

3) Thin Leather Carry Case

Thin leather carry cases are available in two styles, full thin (PMLN4280A) and basic thin (PMLN4418A). These two styles are the same except for a clear plastic window located on the front of the full thin leather (PMLN4280A) refer to photo 11 below. This window can be used for viewing displays and/or keypads.



Photo 9, Side view PMLN4280 (full thin)



Photo 10, Side view PMLN4281 (basic thin)

Clear plastic window



Photo 11, Front view PMLN4280A (full thin) and PMLN4281A (basic thin)

Metallic support and belt clip



Photo 12, Rear view PMLN4280A (full thin) and PMLN4281A (basic thin)

4) Standard Leather Belt Loop Carry Cases

Standard leather belt loop carry cases are available in two styles, swivel belt loop (HLN9690A) and belt loop (HLN9677A) refer to the photos 13-17 below. Motorola manufactures a variety of radios with/without displays and keypads. For this reason Motorola has designed similar leather carry cases that allow for these options. The swivel belt loop and belt loop carry cases are available in three models; 1) Leather cut-outs for the speaker, key pad and display 2) Leather cut outs for the speaker and key pad 3) Leather cut-outs for the speaker. Each of the three models has the option for a thin or standard battery. All swivel belt loop carry cases are the same and all belt loop carry cases are the same, except for specific leather cut-outs and battery size (see list below).

Swivel belt loop

Kit number

HLN9690A
HLN9694A
HLN9955A
HLN9998A
HLN9670A
HLN9676A

Belt loop

Kit number

HLN9677A
HLN9689A
HLN9945A
HLN9946A
HLN9652A
HLN9665A

Leather cut-outs

speaker, keypad, display
speaker, keypad, display
speaker, keypad
speaker, keypad
speaker
speaker

Battery size

thin
standard
thin
standard
thin
standard



Photo 13, Side view
HLN9690A (swivel)



Photo 14, Side view
HLN9677A

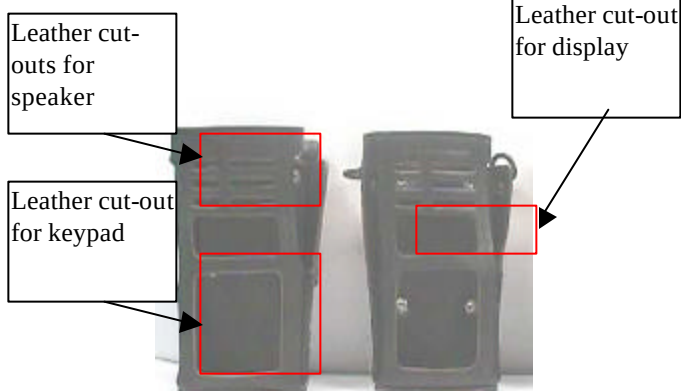


Photo 15, Front view
HLN9690A (swivel) and
HLN9677A



Photo 16, Rear view of
HLN9690A (swivel) and
HLN9677A

Metallic support



Metallic support

Photo 17, The HLN9690A has
metallic supports for swivel
purpose.

