Certificate Number: 1449-02

ELECTROMAGNETIC EXPOSURE (EME)
TESTING LABORATORY

8000 West Sunrise Blvd.
Fort-Lauderdale, Florida

S.A.R. TEST REPORT

FCC ID: AZ489FT5807
H48WAH6RR1AN

May 22, 2001 –Rev. O

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REVISION HISTORY

Date	Revision	Comments
5/22/01	O	

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 i80s Portable Radio Product, model number H48WAH6RR1AN (FCC ID: AZ489FT5807)

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

The Portable Radio, Model number H48WAH6RR1AN operates in 806-825 MHz band with a rated conducted power of 0.6W 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.
This portable radio also marketed with optional batteries and accessories, listed below. (Refer to appendix D for a complete illustration of Body-worn accessories.)

Antenna: Fixed retractable antenna, 10.57cm long,
Quarter wave when retracted, gain -0.2 dBi (-2.35 dBd),
Half wave when extended, gain +2.3 dBi (+0.15 dBd).

Battery:
NTN9809A Slim battery (500mAH) titanium color.
NTN9810A Mid size battery (680mAH) titanium color.

Body-worn accessory:
NTN1823A Leather carry case (NTN9811A) with belt clip
NTN1824A Swivel carry clip

And representative samples of the available audio/data accessories:

NTN8497A Over the ear head set with boom microphone.
SYN8608A Hearing aid neck loop.
NTN9618A Privacy earpiece with microphone and remote PTT.
NTN8513A Heavy duty head set with microphone.
NKN6544A RS232 data cable.

3.1 Test Signal

Test Signal Source:

Test Mode [X] Base Station [ ] Simulator [ ] Native Tranmission Mode [ ]

Signal Modulation:

CW	
TDMA	**16.67%**
Other	

3.2 Test Output Power

The conducted output power was measured across the transmit band using a HP power meter model HP437B.

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 1545 probe. It was calibrated at SPEAG™, and has a calibration date 11/14/2000. A copy of the calibration certificate is included in appendix C. Dipole Antenna Kit type 835MHz (serial number 835-002) was used to perform system check at 835MHz. The system performance check result is 9.64mW/g when normalized to 1W compared to the target of 9.38mW/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 System Performance 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

4.2.1 Flat Phantom:

A rectangular shaped box made of flexi-glass and mounted on a supporting non-metallic structure that has an opening at the center for positioning the device.

Shell Thickness (cm)	0.2

4.2.2 Head Phantom :

Shell Thickness (cm)	0.15
Ear Spacer Thickness (cm)	0.50
Total Thickness (cm)	0.65

4.3 Simulated Tissue Properties:

4.3.1 Type of Simulated Tissue

Muscle	X
Brain	X

4.3.2 Simulated Tissue Composition

	Frequency (835MHz)	
	Muscle	**Brain**
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 within ±5% of target parameter 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.

Target tissue parameters

	813 MHz	
	Muscle	**Brain**
Di-electric Constant	52.3	44.2
Conductivity – S/m	1.09	0.89

5.0 Description of Test Procedure

All antenna positions, batteries, and accessories listed in section 3.0 were included in the SAR search pattern to determine the combinations providing the highest measured SAR results.

All SAR measurements were 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 test positions used to perform SAR measurements on the portable radio:

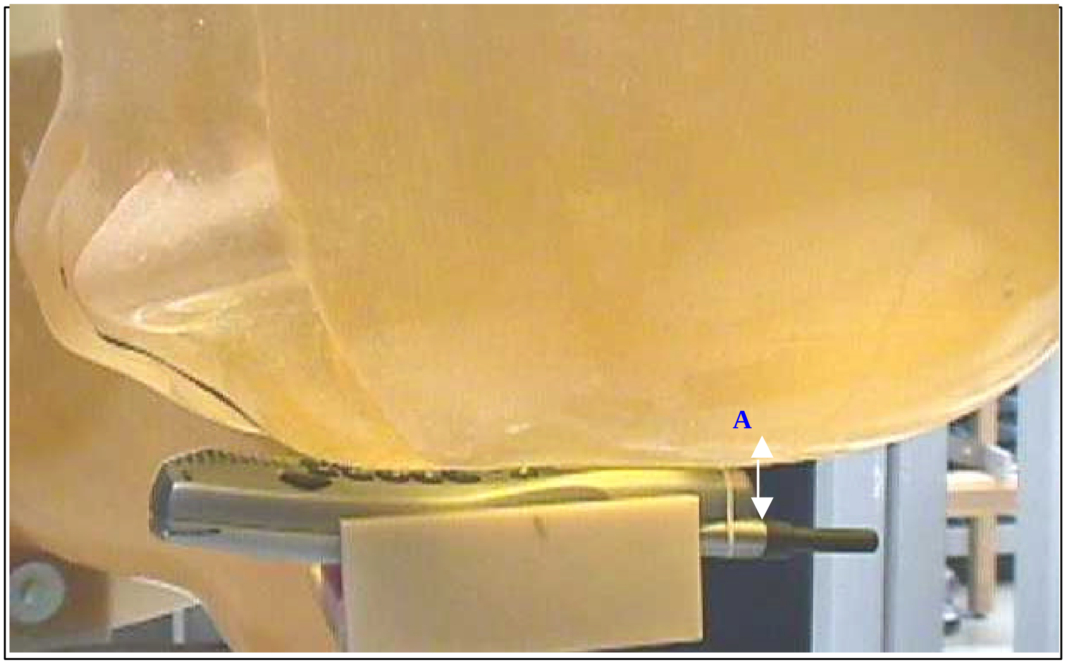
Head - The portable radio is positioned in a normal telephone operating position by aligning the axis of the radio with a line from the center of the ear to the center of the lips. The center the listening area of the test radio is positioned over the ear canal. Next, position the radio as close as possible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

Face - The portable is positioned under a flat phantom with radio housing parallel to the phantom, and radio’s microphone is 2.5cm from the phantom. SAR measurements were performed with the radio antenna extended and retracted.

Abdomen - The portable radio is positioned in a leather carry case and/or belt clip attached beneath the flat phantom with the back of the carry accessory facing and parallel to the abdomen. An accessory cable is connected to the radio to allow telephone or two-way radio or RF modem (packet data mode) operation while carried on belt. SAR measurements were performed with the radio antenna extended and retracted.

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

Figure 1a: Head Position – Left Ear.

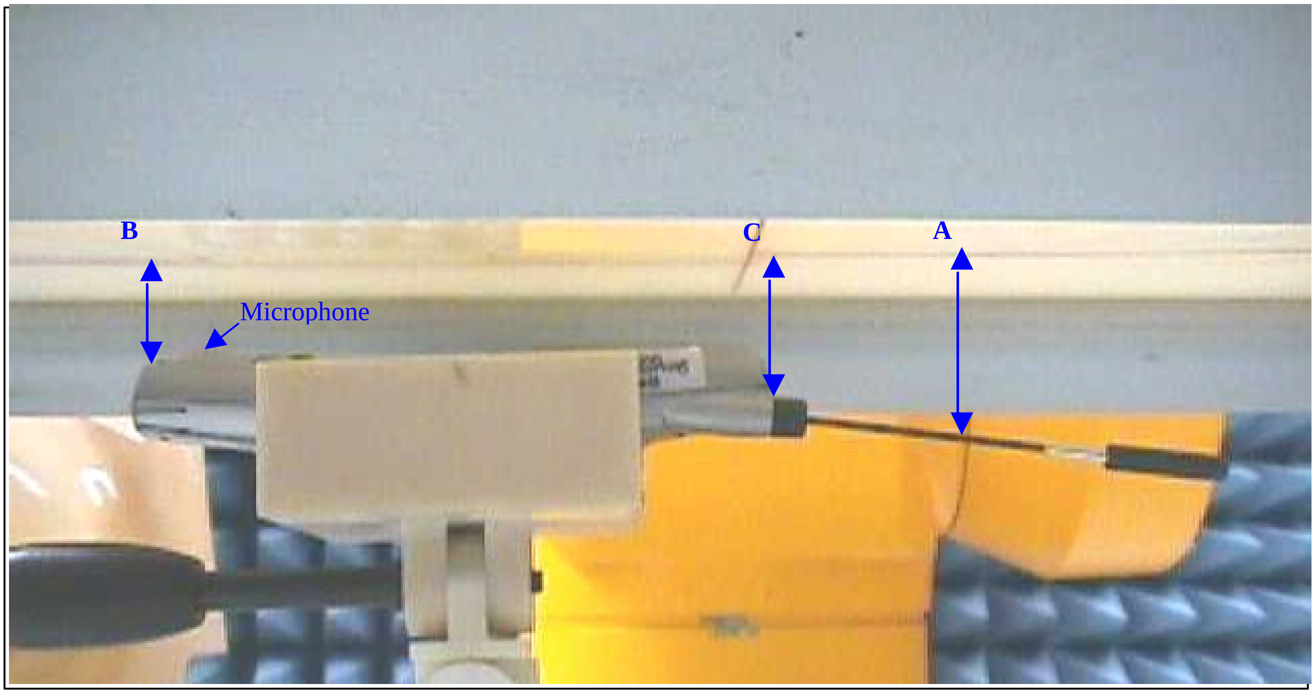


DIM A = Distance from surface of antenna base to phantom head = 20mm

Figure 1b: Head Position - Right Ear.

DIM A = Distance from surface of antenna base to phantom head = 27 mm

Figure 2: Facial Position



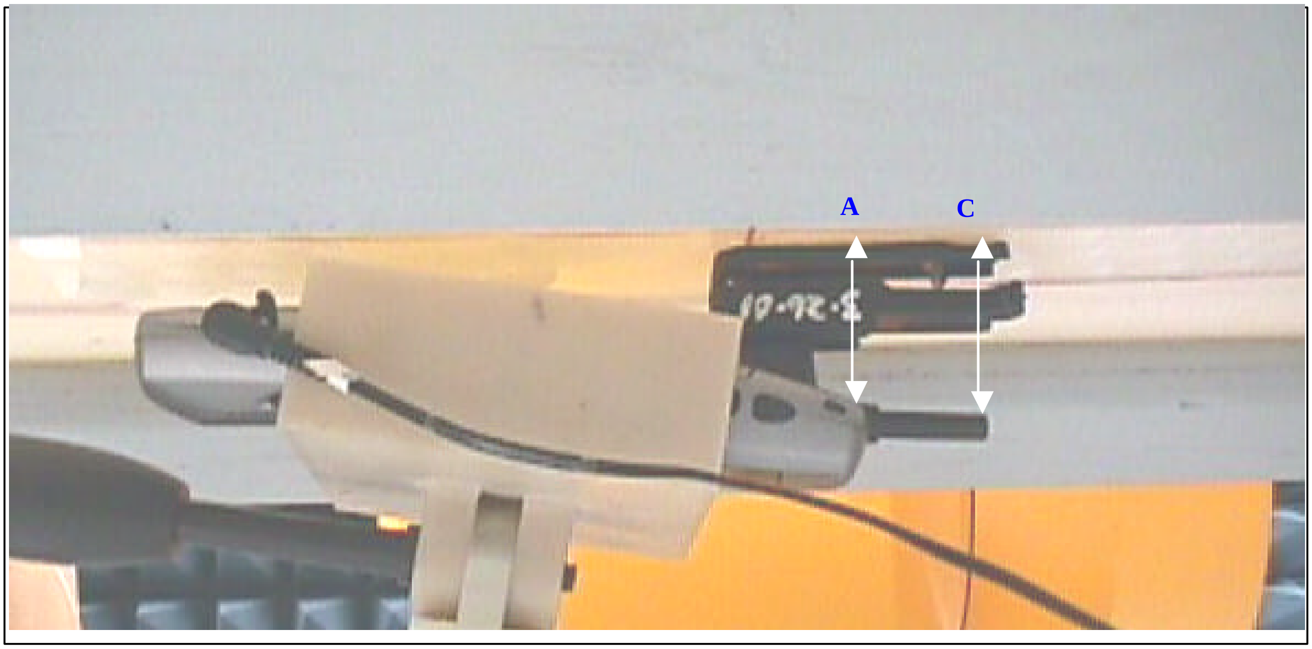
DIM A = Distance from center of antenna surface to phantom = 47 mm

DIM B = Closest distance between bottom of radio to phantom = 29 mm

DIM C = Closest distance between base of antenna to phantom = 39 mm

Note: Radio is positioned with microphone 2.5cm from flat phantom.

Figure 3: Abdominal Position



Dim A = Distance from surface of antenna base to phantom = 28 mm

Dim B = Distance from surface of antenna center to phantom = N/M

Dim C = Distance from surface of antenna tip to phantom = 32 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 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	± 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

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 highest maximum calculated values for each body position are indicated in bold and full data set output from DASY™ measurement system for these results are provided in Appendix A.

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB drift from initial power @ end of SAR (W)	Highest Measured SAR		Max Calculated SAR	
				Left Ear (16.67%)	Right Ear (16.67%)	Left Ear (33.33%)	Right Ear (33.33%)
806	IN	0.587	+ 0.07	0.57	0.51	1.34	1.22
813	IN	0.575	+ 0.07	0.55	0.52	1.33	1.25
821	IN	0.556	+ 0.07	0.55	0.51	**1.37**	1.26
825	IN	0.550	+ 0.07	0.54	0.49	1.36	1.24
806	OUT	0.587	+ 0.07	0.26	0.24	0.62	0.57
813	OUT	0.575	+ 0.07	0.25	0.25	0.61	0.59
821	OUT	0.556	+ 0.07	0.23	0.22	0.58	0.56
825	OUT	0.550	+ 0.07	0.22	0.20	0.56	0.52

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB loss from initial power @ end of SAR (W)	Highest Measured SAR @ Face (16.67%)	Max Calculated SAR @ Face (16.67%)
806	IN	0.608	+ 0.07	0.13	0.15
813	IN	0.593	+ 0.07	0.14	0.16
821	IN	0.602	+ 0.07	0.13	0.16
825	IN	0.609	+ 0.07	0.14	0.16
806	OUT	0.608	+ 0.07	0.15	0.18
813	OUT	0.593	+ 0.07	0.15	**0.18**
821	OUT	0.602	+ 0.07	0.15	0.17
825	OUT	0.609	+ 0.07	0.15	0.17

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB loss from initial power @ end of SAR (W)	Highest Measured SAR @ Abdomen		Max Calculated SAR @ Abdomen	
				Audio Cable	Data Cable	Phone Mode (33.33%)	Data Mode (67.5%)
806	IN	0.587	+ 0.07	0.23	0.16	0.54	0.75
813	IN	0.575	+ 0.07	0.23	0.14	0.56	0.70
821	IN	0.556	+ 0.07	0.24	0.16	**0.60**	0.80
825	IN	0.550	+ 0.07	0.22	0.17	0.55	**0.89**
806	OUT	0.587	+ 0.07	0.14	0.12	0.32	0.57
813	OUT	0.575	+ 0.07	0.19	0.13	0.45	0.63
821	OUT	0.556	+ 0.07	0.13	0.12	0.33	0.61
825	OUT	0.550	+ 0.07	0.13	0.12	0.34	0.59

The configuration for the abdomen results included NTN9810A battery, NTN1824A swivel carry clip.
The configuration for left ear and right ear results included NTN9809A battery.
The configuration for the face results included the NTN9810A battery.

The calculated maximum 1-gram averaged SAR value is determined by scaling up the SAR to adjust for any condition of permissible factory tuning, frequency, voltage and temperature; which is 0.7W in this case. For this reason, the radio Maximum Calculated 1-gram and 10-gram averaged peak SAR becomes:

Formula to calculate max SAR :

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

P_{max} = Maximum power delivered to the antenna connector under any conditions of permissible factory 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 .

Service mode duty cycle: the transmission mode duty cycle, i.e., the ratio of the service mode and the tested mode.

Test mode duty cycle: 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.

Maximum Calculated 1-gram Average Peak SAR @ the HEAD

$$= \frac{0.70W}{0.556W} \times \frac{0.556W}{0.565W} \times \frac{0.556W+0.565W}{2 \times 0.556W} \times \frac{33.33\%}{16.67\%} \times 0.55mW/g = 1.37\ mW/g$$

Maximum Calculated 1-gram Average Peak SAR @ the FACE

$$= \frac{0.70W}{0.593W} \times \frac{0.593\ W}{0.602W} \times \frac{0.593W+0.602W}{2x0.593W} \times \frac{16.67\%}{16.67\%} \times 0.15mW/g = 0.18\ mW/g$$

Maximum Calculated 1-gram Average Peak SAR @ ABDOMEN for PHONE MODE

$$= \frac{0.70W}{0.556W} \times \frac{0.556\ W}{0.565W} \times \frac{0.556W+0.565W}{2x0.556W} \times \frac{33.33\%}{16.67\%} \times 0.24mW/g = 0.60\ mW/g$$

Maximum Calculated 1-gram Average Peak SAR @ ABDOMEN for DATA MODE

$$= \frac{0.70W}{0.55W} \times \frac{0.55\ W}{0.559W} \times \frac{0.55W+0.559W}{2x0.55W} \times \frac{67.5\ \%}{16.67\%} \times 0.17mW/g = 0.89\ mW/g$$

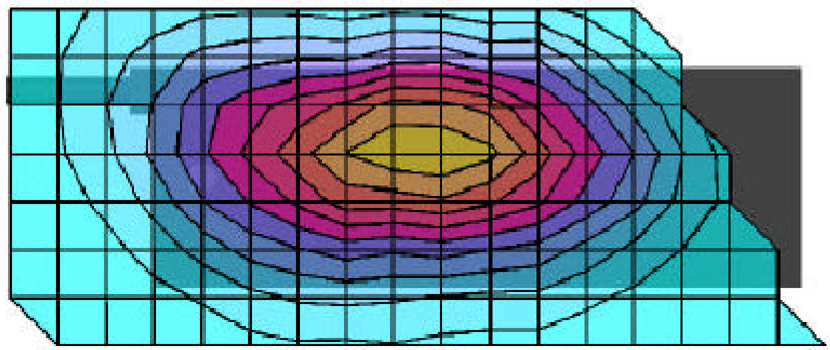
8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number H48WAH6RR1AN was 1.37mW/g . These results are fully compliant to the General Population/Uncontrolled Environment limit of 1.6 mW/g.

Appendix A: Data Results

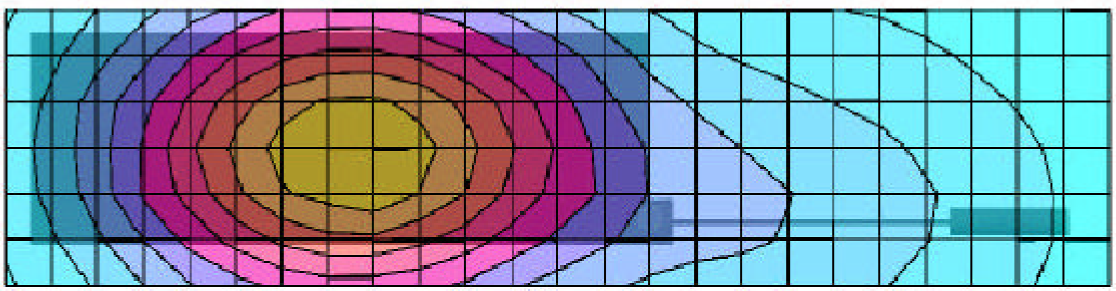
i80s Phone Left Head ; Test Date: 05/07/01

Run #: i80s_01050707.
Model #: H48WAH6RR1AN, S/N: 021TBC0152.
Tx freq: 820.9875MHz,
Antenna Position: in, Battery: NTN9809A
HEAD_L_1 Phantom; Probe: ET3DV6 - SN1545; ConvF(6.29,6.29,6.29)
Crest factor: 6.0; Brain 813MHz: σ = 0.88 mho/m ε_r = 44.9 ρ = 1.04 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.548 mW/g, SAR (10g): 0.372 mW/g, (Worst-case extrapolation);



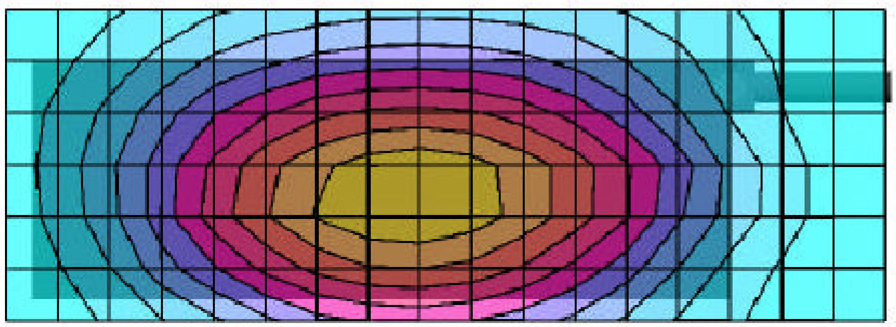
i80s Phone Face; Test Date: 05/11/01

Run #: i80s_01051110.
Model #: H48WAH6RR1AN, S/N: 021TBC0060.
Tx freq: 813.5625MHz,
Antenna Position: out, Battery: NTN9810A
Flat Phantom; Probe: ET3DV6 - SN1545; ConvF(6.24,6.24,6.24)
Crest factor: 6.0; Muscle 813MHz: σ = 1.05 mho/m ε_r = 53.2 ρ = 1.07 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.154 mW/g, SAR (10g): 0.111 mW/g, (Worst-case extrapolation);



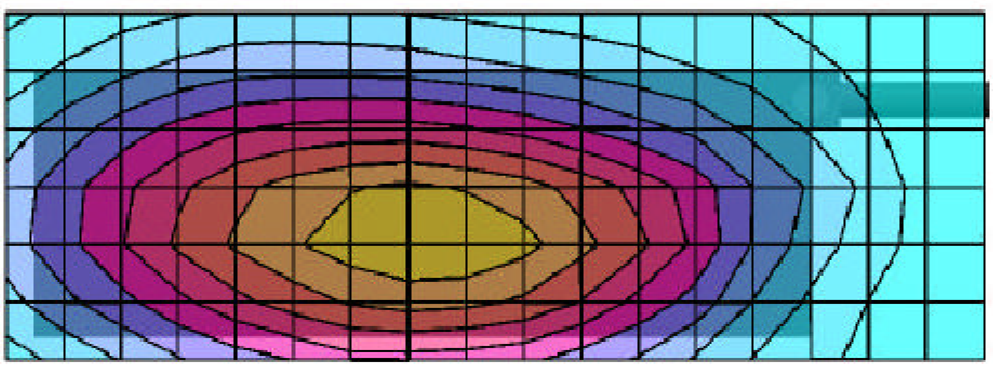
i80s Phone Ab; Test Date: 05/11/01

Run #: i80s_01051102.
Model #: H48WAH6RR1AN, S/N: 021TBC0152.
Tx freq: 820.9875MHz,
Antenna Position: in, Battery: NTN9810A
Swivel Carry Clip: NTN1824A, Over Ear Headset w/Boom Mic: NTN8497A
Flat Phantom; Probe: ET3DV6 - SN1545; ConvF(6.24,6.24,6.24)
Crest factor: 6.0; Muscle 813MHz: σ = 1.05 mho/m ε_r = 53.2 ρ = 1.07 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.238 mW/g, SAR (10g): 0.168 mW/g, (Worst-case extrapolation);



i80s Phone Ab; Test Date: 05/10/01

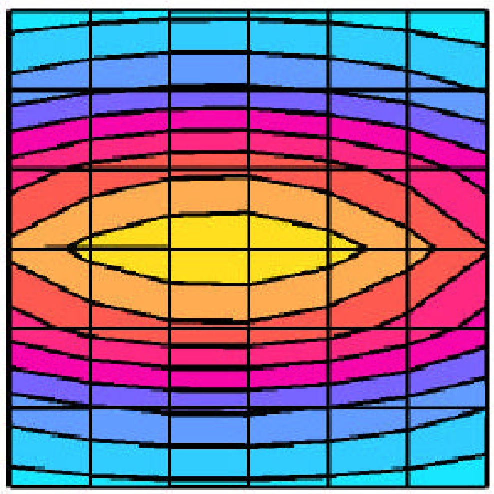
Run #: i80s_01051007.
Model #: H48WAH6RR1AN, S/N: 021TBC0152.
Tx freq: 824.9875MHz,
Antenna Position: in, Battery: NTN9810A
Swivel Carry Clip: NTN1824A, Data Cable: NKN6544A
Flat Phantom; Probe: ET3DV6 - SN1545; ConvF(6.24,6.24,6.24)
Crest factor: 6.0; Muscle 813MHz: σ = 1.05 mho/m ε_r = 53.2 ρ = 1.07 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.174 mW/g, SAR (10g): 0.122 mW/g, (Worst-case extrapolation);



Appendix B: Dipole Validation Data Results

Dipole 835 MHz; Test Date:05/02/01

835 Dipole S/N 002 . Input power: 500mW.
Target: 9.38 mW/g when nomalized to 1W.
Flat; Flat_High Freq
Probe: ET3DV6 - SN1545; ConvF(6.24,6.24,6.24); Crest factor: 1.0; Muscle 835MHz: σ = 1.08 mho/m ε r = 52.5 ρ = 1.07 g/cm 3
Cube 5x5x7: SAR (1g): 4.84 mW/g, SAR (10g): 3.14 mW/g, (Worst-case extrapolation),
Peak: 7.58 mW/g,
Penetration depth: 12.2 (10.8, 14.0) [mm]
Powerdrift: 0.02 dB



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:	1545
Place of Calibration:	Zurich
Date of Calibration:	Nov. 14, 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:	
Approved by:	

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:	1545
Place of Assessment:	Zurich
Date of Assessment:	Nov. 16, 2000
Probe Calibration Due Date:	Nov. 14, 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.

Assessed by:

Dosimetric E-Field Probe ET3DV6 SN:1545

Conversion factor (± standard deviation)

150 MHz	ConvF	**8.18 ± 8%**	ε_r = 70.0 σ = 0.75 mho/m (muscle tissue)
450 MHz	ConvF	**6.88 ± 8%**	ε_r = 58.0 σ = 1.0 mho/m (muscle tissue)
784 MHz	ConvF	**6.33 ± 8%**	ε_r = 52.79 σ = 1.09 mho/m (muscle tissue)
835 MHz	ConvF	**6.24 ± 8%**	ε_r = 52.0 σ = 1.10 mho/m (muscle tissue)
925 MHz	ConvF	**6.10 ± 8%**	ε_r = 52.0 σ = 1.20 mho/m (muscle tissue)
1500 MHz	ConvF	**5.41 ± 8%**	ε_r = 52.74 σ = 1.35 mho/m (muscle tissue)
1900 MHz	ConvF	**4.97 ± 8%**	ε_r = 50.16 σ = 1.83 mho/m *(muscle tissue)*
2450 MHz	ConvF	**4.37 ± 8%**	ε_r = 47.11 σ = 2.56 mho/m (muscle tissue)

Dosimetric E-Field Probe ET3DV6 SN:1545

Conversion factor (± standard deviation)

450 MHz	ConvF	**6.91 ± 8%**	$\varepsilon_r = 47.0$ $\sigma = 0.63$ mho/m (brain tissue)
835 MHz	ConvF	**6.29 ± 8%**	$\varepsilon_r = 44.0$ $\sigma = 0.9$ mho/m (brain tissue)
925 MHz	ConvF	**6.12 ± 8%**	$\varepsilon_r = 44.0$ $\sigma = 0.93$ mho/m (brain tissue)
1500 MHz	ConvF	**5.68 ± 8%**	$\varepsilon_r = 41.1$ $\sigma = 1.0$ mho/m (brain tissue)
1900 MHz	ConvF	**5.17 ± 8%**	$\varepsilon_r = 39.9$ $\sigma = 1.42$ mho/m (brain tissue)
2450 MHz	ConvF	**4.52 ± 8%**	$\varepsilon_r = 36.34$ $\sigma = 1.94$ mho/m (brain tissue)

Appendix D: Illustrations of Body-worn Accessories

Swivel Carry Clip NTN1824A .

Leather carry case and belt clip NTN1823A.