Certificate Number: 1449-02

ELECTROMAGNETIC EXPOSURE (EME) TESTING LABORATORY

8000 West Sunrise Blvd.
Fort-Lauderdale, Florida

S.A.R. TEST REPORT

FCC ID: AZ489FT5808
H41UAH6RR1AN

June 19, 2001 –Rev. O

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REVISION HISTORY

Date	Revision	Comments
6/19/01	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 i90c Portable Radio Product, model number H41UAH6RR1AN (FCC ID: AZ489FT5808)

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


Picture #1: Radio front view


Picture #2: Radio side view

The Portable Radio, Model number H41UAH6RR1AN 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, 10.96cm long,
Quarter wave when retracted, gain –1.25 dBi,
Quarter wave when extended, gain +1.15 dBi.

Battery:
SNN5705B 750 mAH Lithium Ion battery.
SNN5717B 450 mAH Lithium Ion battery.
SNN5704A 550 mAH Lithium Polymer battery.

Battery Cover:
NTN9850A Battery cover, 750mAH
NTN9849A Battery cover, 450/550mAH

Body-worn accessory:
NTN9687A Plastic carry holster w/ swivel belt clip

And representative samples of the available audio/data accessories:

SYN8608A Hearing aid neck loop.
SYN8390B Privacy earpiece and microphone
NTN8513A Heavy duty head set with microphone.
NKN6544A RS232 data cable.
SKN6311A USB data cable
NKN6540A Y 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 E4419B.

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 and 1383 probes. They were calibrated at SPEAG™, and have calibration dates of 11/14/2000 and 5/23/2001. A copy of the calibration certificate is included in appendix C, and the print out of System Performance test results from the DASY™ measurement system are included in appendix B.

Probe	Probe Calibration date	Dipole Antenna Kit - (S/N)	SAR result when normalized to 1W (mW/g)	Reference SAR (mW/g)
ET3DV6-1545	11/14/00	835 (835-002)	9.63	9.38 ± 10%
ET3DV6-1383	5/23/2001	835 (835-002)	9.32	9.38 ± 10%

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

Body Position>>	Abdomen	Face	Head
Muscle	X		
Head		X	X

4.3.2 Simulated Tissue Composition

	Frequency (835MHz)	
	Muscle	**Head**
Di-Water	53.50 %	56.00 %
Sugar	44.25 %	41.50 %
Salt	1.15 %	1.40 %
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. The simulated muscle tissue 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, and head tissue measurement was done using the HP probe kit model 85070C. A HP8753D Network Analyzer is used to perform the measurements.

Target tissue parameters

	813 MHz	
	Muscle	**Head**
Di-electric Constant	52.3	41.6
Conductivity – S/m	1.09	0.90

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. Additional available audio and data cables beyond those listed in section 3.0 did not require test due to their similarity and therefore no expected measurable difference in SAR beyond those tested.

All SAR measurements were performed with the radio positioned in the described test positions, and all test 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:

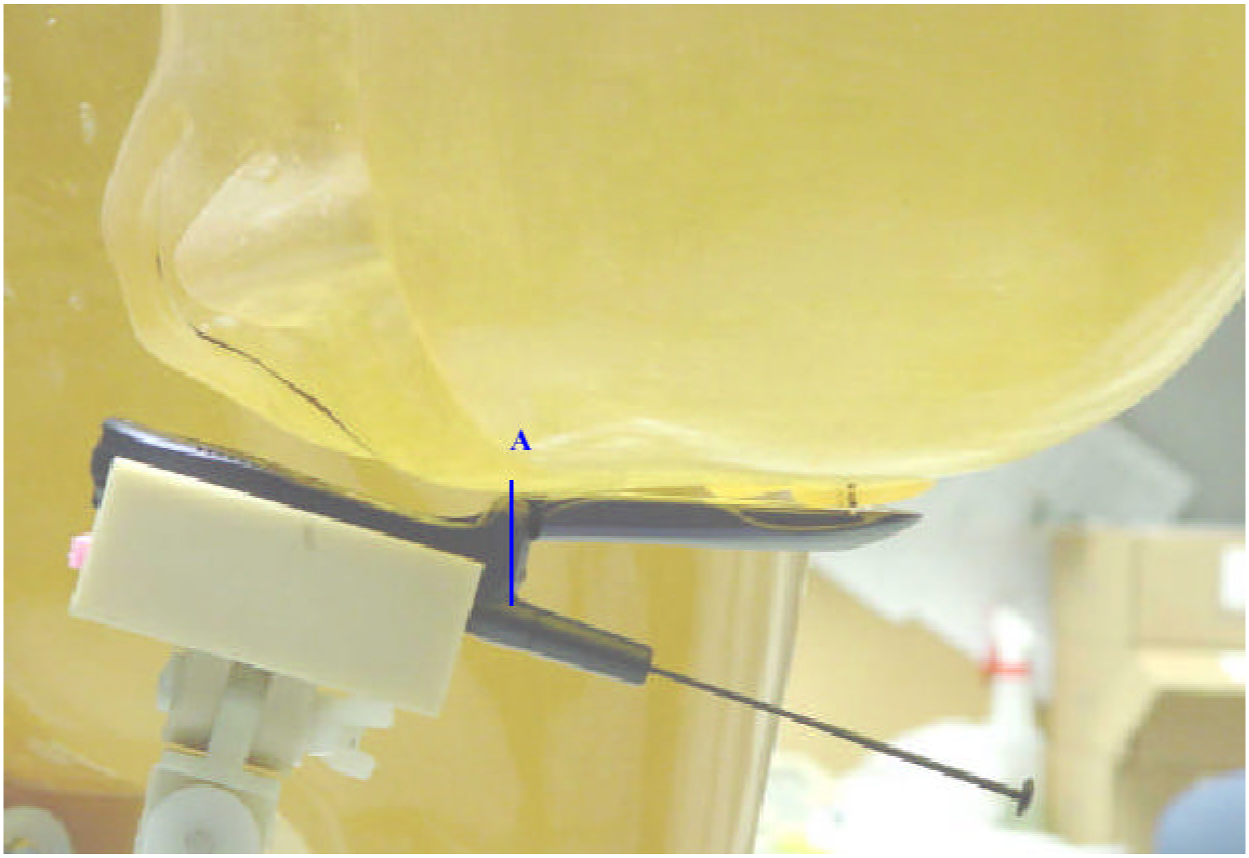
Head - The portable radio is positioned in a normal telephone operating position by aligning the axis of the radio with a line from the center of the ear to the center of the lips. The center the listening area of the test radio is positioned over the ear canal. Next, position the radio as close as possible 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 plastic carry holster with swivel belt clip attached beneath the flat phantom with the back of the carry accessory adjacent and parallel to the phantom. 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.

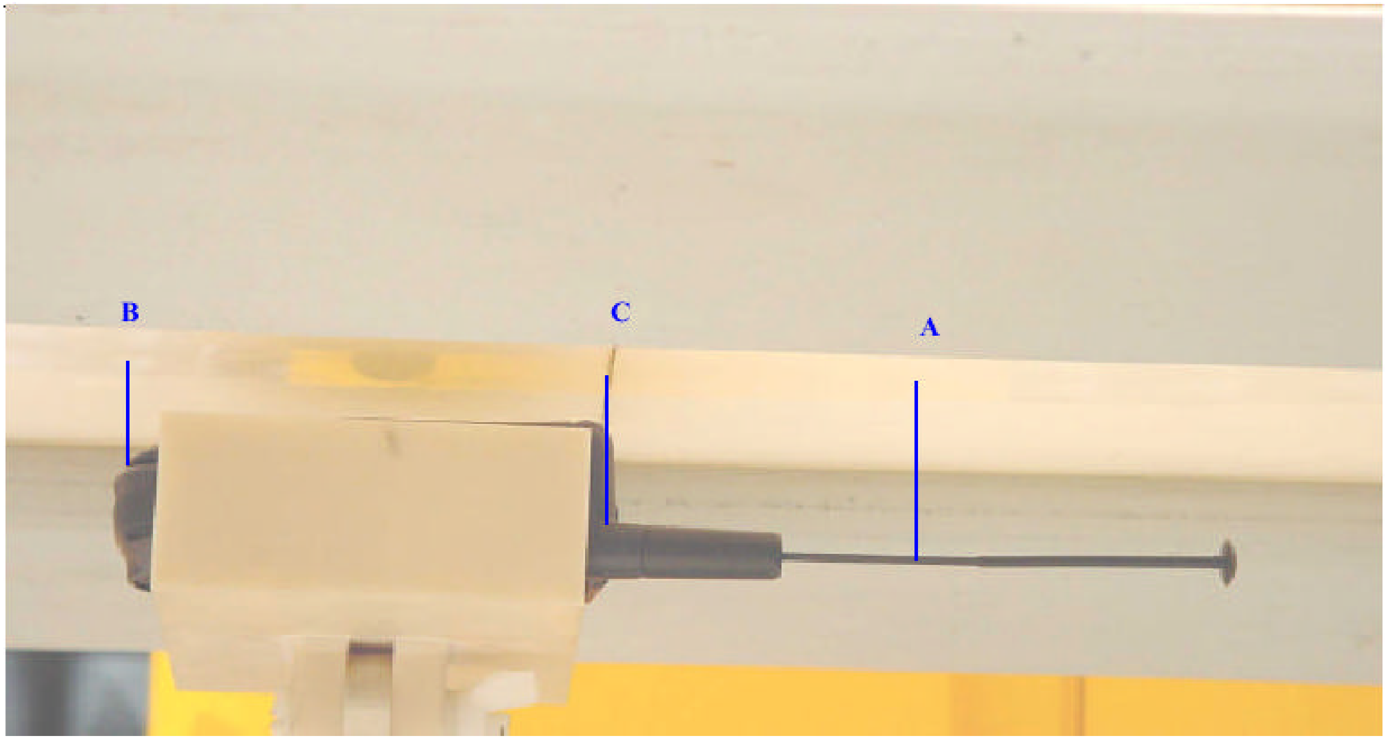
Reference figures 1, 2, and 3 for portable radio antenna orientation and distances relative to phantoms.

Figure 1: Head Position – Left Ear.



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

Figure 2: Facial Position



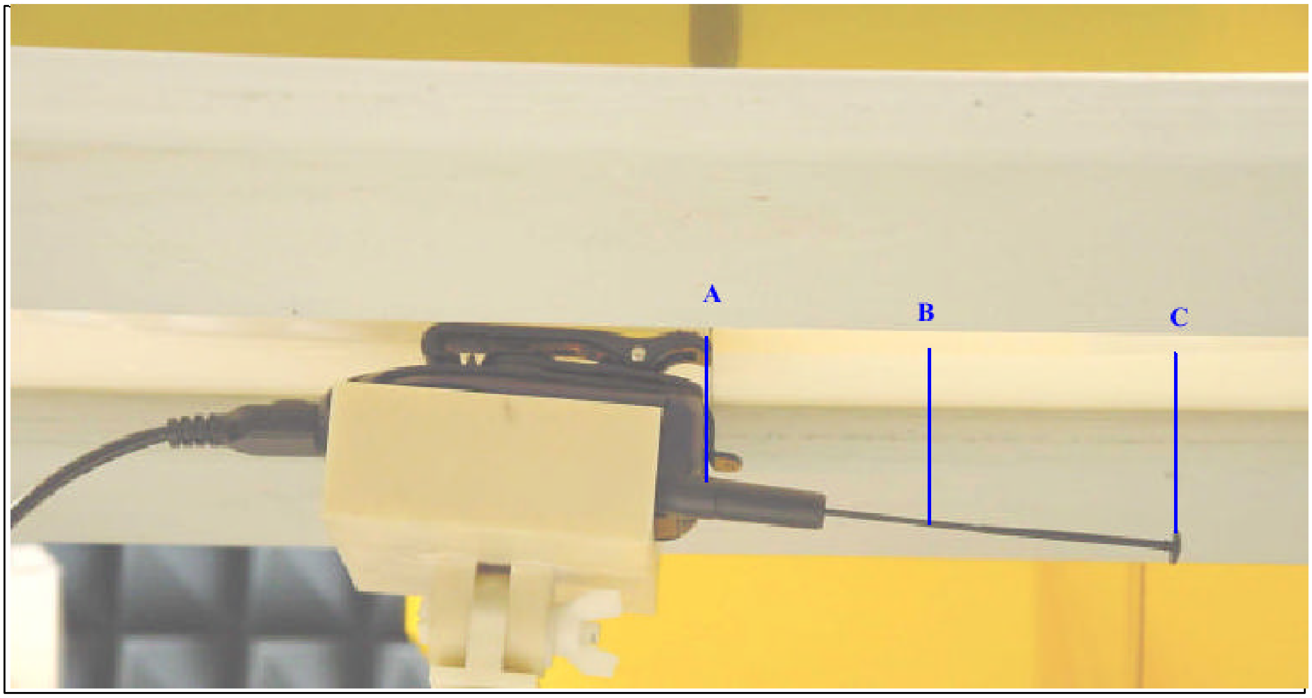
DIM A = Distance from center of antenna surface to phantom = 40 mm

DIM B = Closest distance between bottom of radio to phantom = 22 mm

DIM C = Closest distance between base of antenna to phantom = 35 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 = 40 mm

Dim B = Distance from surface of antenna center to phantom = 50 mm

Dim C = Distance from surface of antenna tip to phantom = 52 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.

Table 7.1: SAR results at Head

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB drift from initial power @ end of SAR (dB)	Highest Measured SAR		Max Calculated SAR	
				Left Ear (16.67%)	Right Ear (16.67%)	Left Ear (33.33%)	Right Ear (33.33%)
806	IN	0.630	-0.01	0.360 [(a)]	0.225	0.80	0.50
813	IN	0.630	-0.01	0.373	0.268	0.83	0.60
821	IN	0.634	-0.01	0.443 [(a)]	0.286	0.98	0.63
825	IN	0.610	-0.01	0.476 [(a)]	0.304	1.10	0.70
806	OUT	0.630	-0.01	0.583 [(a)]	0.378	1.30	0.84
813	OUT	0.630	-0.01	0.609 [(a)]	0.404	1.36	0.90
821	OUT	0.634	-0.01	0.606 [(a)]	0.402	1.34	0.89
825	OUT	0.610	-0.01	0.604	0.433	**1.39**	**1.00**

Note:

[(a)] The configuration for the head included SNN5717B battery. All other included SNN5705B battery.

Table 7.2: SAR results at Face

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB loss from initial power @ end of SAR (dB)	Highest Measured SAR @ Face (16.67%)	Max Calculated SAR @ Face (16.67%)
806	IN	0.630	-0.01	0.145	0.16
813	IN	0.630	-0.01	0.160	0.18
821	IN	0.634	-0.01	0.180	0.20
825	IN	0.610	-0.01	0.190	0.22
806	OUT	0.630	-0.01	0.265	**0.30**
813	OUT	0.630	-0.01	0.253	0.28
821	OUT	0.634	-0.01	0.253	0.28
825	OUT	0.610	-0.01	0.254	0.29

The configuration for the face results included SNN5717B battery.

Table 7.3: SAR results at Abdomen

Test Freq. (MHz)	Ant Pos	Initial Cond. Power (W)	dB loss from initial power @ end of SAR (dB)	Highest Measured SAR @ Abdomen		Max Calculated SAR @ Abdomen	
				Audio Cable	Data Cable	Phone Mode (33.33%)	Data Mode (67.5%)
806	IN	0.630	-0.01	0.155	0.099	0.35	0.45
813	IN	0.630	-0.01	0.155	0.103	0.35	0.47
821	IN	0.634	-0.01	0.172	0.102	0.38	0.46
825	IN	0.610	-0.01	0.194	0.111	0.45	0.52
806	OUT	0.630	-0.01	0.221	0.172	0.49	0.78
813	OUT	0.630	-0.01	0.257	0.196	**0.57**	**0.88**
821	OUT	0.634	-0.01	0.246	0.167	0.55	0.75
825	OUT	0.610	-0.01	0.236	0.168	0.54	0.78

The configuration for the abdomen results included SNN5705B battery, NTN9687A plastic carry holster w/ swivel belt clip.

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 :

$$\text{Maximum Calculated 1-gram Average Peak SAR} = \frac{P_{max}}{P_{end}} \times \text{Service mode duty cycle} \times \text{Test mode duty cycle} \times SAR_{meas}.$$

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

P_{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.

$$\textbf{Maximum Calculated 1-gram Average Peak SAR @ the HEAD} = \frac{0.70W}{0.608W} \times \frac{33.33\%}{16.67\%} \times 1 \times 0.604\ mW/g = 1.39\ mW/g$$

$$\textbf{Maximum Calculated 1-gram Average Peak SAR @ the FACE} = \frac{0.70W}{0.628W} \times \frac{16.67\%}{16.67\%} \times 1 \times 0.265mW/g = 0.30\ mW/g$$

$$\textbf{Maximum Calculated 1-gram Average Peak SAR @ ABDOMEN for PHONE MODE} = \frac{0.70W}{0.628W} \times \frac{33.33\%}{16.67\%} \times 1 \times 0.257mW/g = 0.57\ mW/g$$

$$\text{Maximum Calculated 1-gram Average Peak SAR @ ABDOMEN for DATA MODE} = \frac{0.70W}{0.628W} \times \frac{67.5\%}{16.67\%} \times 1 \times 0.196mW/g = 0.88\ mW/g$$

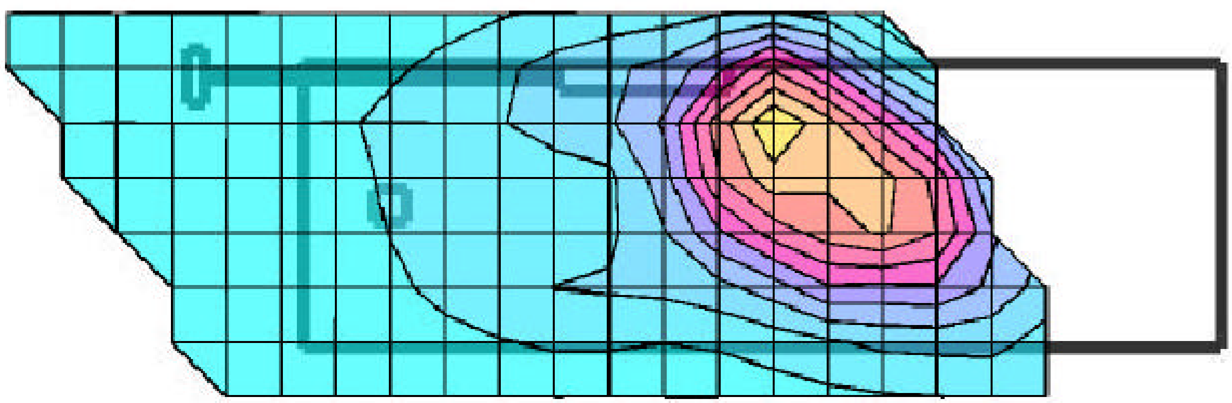
8.0 Conclusion

The highest Operational Maximum Calculated 1-gram average SAR values found for the portable radio model number H41UAH6RR1AN was 1.39 mW/g . These results are fully compliant to the General Population/Uncontrolled Environment limit of 1.6 mW/g.

Appendix A: Data Results

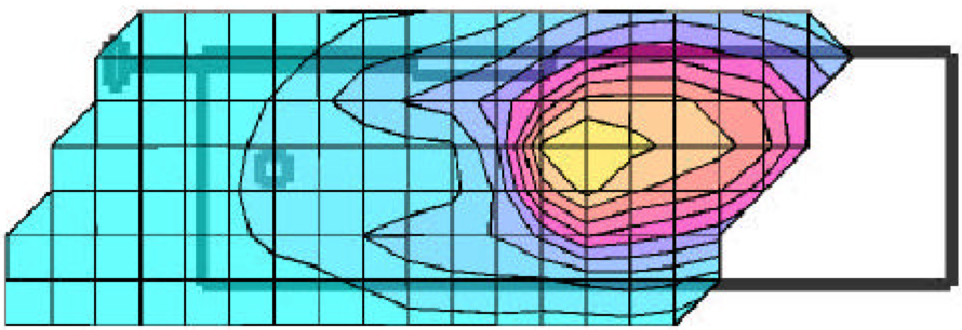
i90c Phone Left Head Flip open; Test Date: 06/14/01

Run#: i90_01061403. Run time: 30min
Model #: H41UAH6RR1AN, S/N: 919ABJ66Q7
Tx freq: 824.9875MHz, Antenna Position: out
Battery: SNN5705B, Battery cover: NTN9850A
HEAD_L_1 Phantom; Probe: ET3DV6 - SN1383; ConvF(6.53,6.53,6.53)
Crest factor: 6.0; IEEE Head 813MHz: σ = 0.88 mho/m ε_r = 43.5 ρ = 1.04 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.604 mW/g, SAR (10g): 0.415 mW/g, (Worst-case extrapolation);



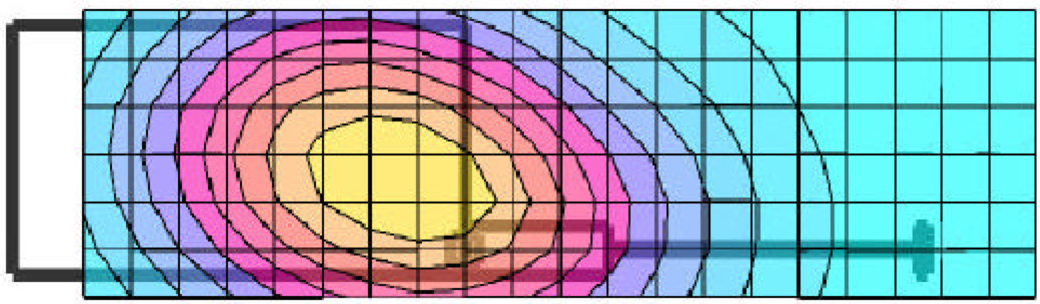
i90 Hawk Phone Right Head Flip open; Test Date: 06/13/01

Run#: i90_01061305. Run time: 31-40 min
Model #: H41UAH6RR1AN, S/N: 919ABJ66Q7
Tx freq: 824.9875MHz, Antenna Position: out
Battery: SNN5705B, Battery cover: NTN9850A
HEAD_R_1 Phantom; Probe: ET3DV6 - SN1383; ConvF(6.53,6.53,6.53)
Crest factor: 6.0; IEEE Head 813MHz: σ = 0.88 mho/m ε_r = 43.5 ρ = 1.04 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.433 mW/g, SAR (10g): 0.289 mW/g, (Worst-case extrapolation);



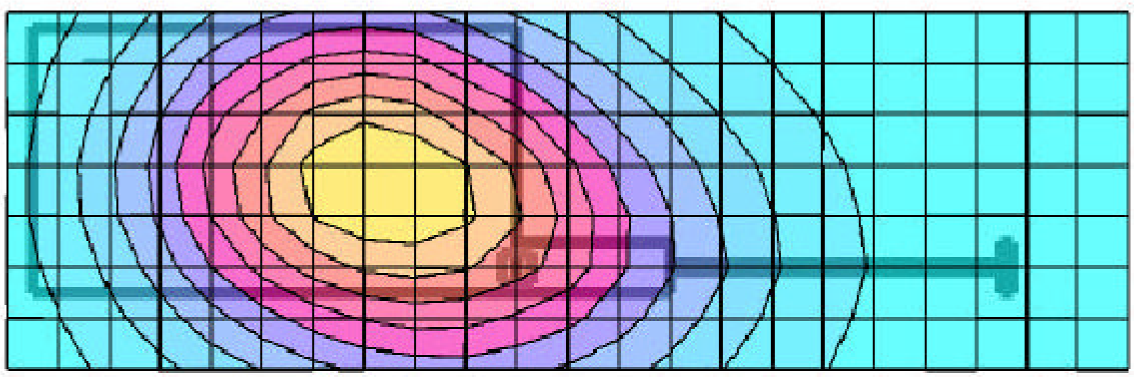
i90c Face Flip close; Test Date: 06/15/01

Run#: i90_01061512a. Run time: 24min
Model #: H41UAH6RR1AN, S/N: 919ABJ66Q7
Tx freq: 806.0625MHz, Antenna Position: in
Battery: SNN5717B, Battery cover: NTN9849A
Radio's mic is 2.5cm from phantom. Flip close
Flat Phantom; Probe: ET3DV6 - SN1383; ConvF(6.53,6.53,6.53)
Crest factor: 6.0; IEEE Head 813MHz: σ = 0.89 mho/m ε_r = 43.6 ρ = 1.04 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.265 mW/g, SAR (10g): 0.191 mW/g, (Worst-case extrapolation);



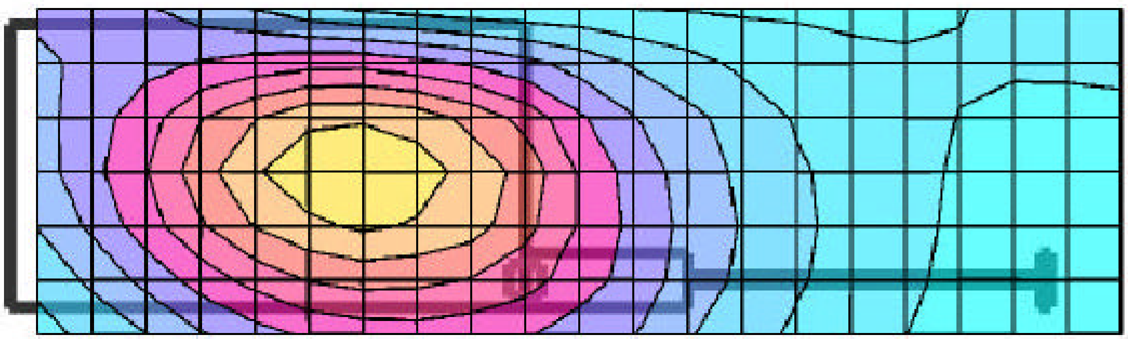
i90c Phone Abdomen Flip close; Test Date: 05/31/01

Run#: i90_01053102A. Run time: 36min
Model #: H41UAH6RR1AN, S/N: 919ABJ66Q7
Tx freq: 813.5625MHz, Antenna Position: OUT
Battery: SNN5705B, Battery cover: NTN9850A (Blue)
Plastic Holder w/ belt clip: NTN9687, Audio cable: SYN8390B
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 = 53.0 ρ = 1.07 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.257 mW/g, SAR (10g): 0.186 mW/g, (Worst-case extrapolation);



i90c Phone Abdomen Flip close; Test Date: 06/01/01

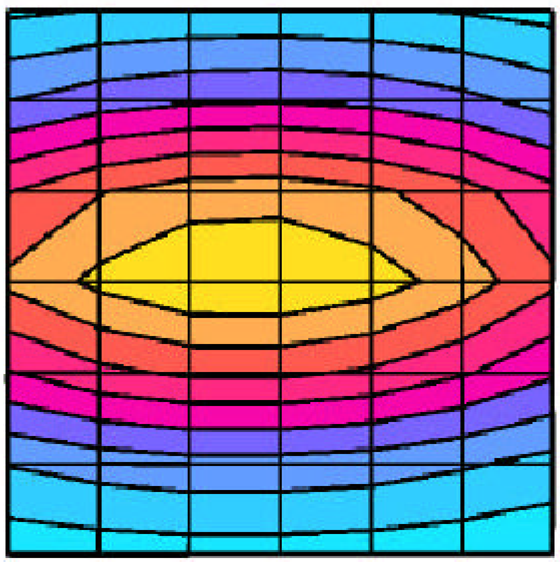
Run#: i90_01060106. Run time: 30 min
Model #: H41UAH6RR1AN, S/N: 919ABJ66Q7
Tx freq: 813.5625MHz, Antenna Position: out
Battery: SNN5705B, Battery cover: NTN9850A
Plastic Holder w/ belt clip: NTN9687, Data cable: NKN6544A
Flat Phantom; Probe: ET3DV6 - SN1545; ConvF(6.24,6.24,6.24)
Crest factor: 6.0; Muscle 813MHz: σ = 1.05 mho/m ε_r = 53.0 ρ = 1.07 g/cm ^{3}
Cube 5x5x7: SAR (1g): 0.196 mW/g, SAR (10g): 0.141 mW/g, (Worst-case extrapolation);



Appendix B: Dipole Validation Data Results

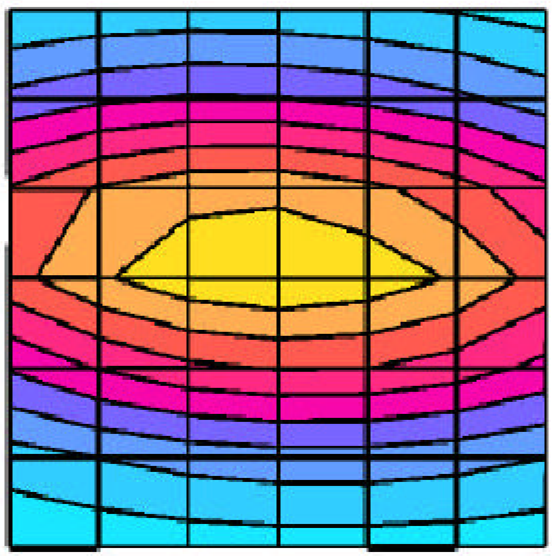
Dipole 835 MHz; Test Date:05/30/01

835 Dipole S/N 002 Validation. 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 = 1.07 mho/m ε r = 53.0 ρ = 1.07 g/cm 3
Cube 5x5x7: SAR (1g): 4.78 mW/g, SAR (10g): 3.11 mW/g, (Worst-case extrapolation),
Peak: 7.49 mW/g,
Penetration depth: 12.2 (10.9, 14.0) [mm]
Powerdrift: -0.03 dB



Dipole 835 MHz; Test Date:06/11/01

835 Dipole S/N 002 Validation. Input power :500mW.
Target: 9.38 mW/g when nomalized to 1W.
Flat; Flat_High Freq
Probe: ET3DV6 - SN1383; ConvF(6.45,6.45,6.45); Crest factor: 1.0; Muscle 835MHz: σ = 1.07 mho/m ε r = 52.5 ρ = 1.07 g/cm 3
Cube 5x5x7: SAR (1g): 4.67 mW/g, SAR (10g): 3.03 mW/g, (Worst-case extrapolation),
Peak: 7.25 mW/g,
Penetration depth: 12.2 (11.1, 13.8) [mm]
Powerdrift: 0.01 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:	[signature]
Approved by:	[signature]

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:	**May 23, 2001**
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:	

Appendix D: Illustrations of Body-worn Accessories

Picture #3: Plastic carry holster with swivel belt clip

Picture #4 Radio with plastic carry holster