SAR EVALUATION REPORT

For

RELM Communications Corp.

7100 Technology Drive
West Melbourne, FL 32904

FCC ID: ARURPV599A

September 9, 2002

This Report Concerns:	**Equipment Type:**
☒ Original Report	VHF Portable 2-way Radio

Test Engineer:	Jeff Lee
Report No.:	R0208193S
Test Date:	August 30, 2002
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SUMMARY

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1].

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

The investigation was limited to the worst-case scenario from the device usage point of view. For the clarity of data analysis, and clarity of presentation, only one tissue simulation was used for the head and body simulation. This means that if SAR was found at the headset position, the magnitude of SAR would be overestimated comparing to SAR to a headset placed in the ear region.

There was no SAR of any concern measured on the device for any of the investigated configurations.

1 - REFERENCE

[1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

[4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.

[5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.

[6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

[7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-_eld probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9

[13] NIS81 NAMAS, \The treatment of uncertainity in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.

[14] Barry N. Taylor and Christ E. Kuyatt, \Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10

2 - TESTING EQUIPMENT

2.1 Equipments List & Calibration Info

Type / Model	Cal. Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	F00/5H31A1/A/01
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A
Pentium III, Windows NT	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	6/03	456
SPEAG E-Field Probe ET3DV6	9/7/03	1604
SPEAG Dummy Probe	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
SPEAG Validation Dipole D-1800-S-2	11/6/01	BCL-049
SPEAG Validation Dipole D900V2	9/3/03	122
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	N/A
Robot Table	N/A	N/A
Phone Holder	N/A	N/A
Phantom Cover	N/A	N/A
HP Spectrum Analyzer HP8593GM	6/20/03	3009A00791
Microwave Amp. 8349B	N/A	2644A02662
Power Meter HP436A	4/2/03	2709A29209
Power Sensor HP8482A	4/2/03	2349A08568
Signal Generator RS SMIQ O3	2/10/03	1084800403
Network Analyzer HP-8753ES	7/30/03	820079
Dielectric Probe Kit HP85070A	N/A	N/A

2.2 Equipment Calibration Certificate

Please see the attached file.

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:	**1604**
Place of Calibration:	**Zurich**
Date of Calibration:	**August 26, 2002**
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	N. Vetter
Approved by:	[signature]

ET3DV6 SN:1604

August 26, 20

DASY3 - Parameters of Probe: ET3DV6 SN:1604

Sensitivity in Free Space

NormX	1.73 $\mu V/(V/m)^2$
NormY	1.68 $\mu V/(V/m)^2$
NormZ	1.72 $\mu V/(V/m)^2$

Diode Compression

DCP X	93	mV
DCP Y	93	mV
DCP Z	93	mV

Sensitivity in Tissue Simulating Liquid

Head	900 MHz	ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m
Head	835 MHz	ε_r = 41.5 ± 5%	σ = 0.90 ± 5% mho/m

ConvF X	6.5	± 9.5% (k=2)
ConvF Y	6.5	± 9.5% (k=2)
ConvF Z	6.5	± 9.5% (k=2)

Boundary effect:

Alpha	0.36
Depth	2.82

Head	1800 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m
Head	1900 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m

ConvF X	5.5	± 9.5% (k=2)
ConvF Y	5.5	± 9.5% (k=2)
ConvF Z	5.5	± 9.5% (k=2)

Boundary effect:

Alpha	0.50
Depth	2.46

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	11.1	6.6
SAR_{be} [%]	With Correction Algorithm	0.4	

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	12.3	8.1
SAR_{be} [%]	With Correction Algorithm	0.1	0.1

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 ± 0.2	mm

Dosimetric E-Field Probe ET3DV6 SN:1604

Conversion factor (± standard deviation)

148 MHz	ConvF	**9.0 ± 8%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
460 MHz	ConvF	**7.4 ± 8%**	ε_r = 43.5 ± 5% σ = 0.87 ± 5% mho/m (head tissue)

Frequency	ε'	ε''
100000000.0000	67.9607	138.9816
102000000.0000	67.2844	136.3085
104000000.0000	66.7497	134.0129
106000000.0000	66.5297	132.3536
108000000.0000	66.2426	130.0068
110000000.0000	66.2341	128.4792
112000000.0000	65.3939	127.1337
114000000.0000	65.3806	125.1797
116000000.0000	65.0589	123.8129
118000000.0000	64.3406	121.3387
120000000.0000	64.2360	119.8752
122000000.0000	64.3630	118.3660
124000000.0000	64.0192	116.6564
126000000.0000	63.6412	114.9402
128000000.0000	63.5867	113.6412
130000000.0000	63.4970	112.1146
132000000.0000	63.1671	110.6494
134000000.0000	62.8074	109.4996
136000000.0000	62.6437	108.6830
138000000.0000	62.5748	106.8504
140000000.0000	62.5313	105.8272
142000000.0000	61.8833	104.7433
144000000.0000	62.1281	103.5764
146000000.0000	62.1634	101.8671
148000000.0000	61.9087	101.1520
150000000.0000	61.9321	99.5631
152000000.0000	61.7205	98.6789
154000000.0000	61.8133	97.4325
156000000.0000	61.8848	96.6844
158000000.0000	61.8835	95.6334
160000000.0000	61.6285	94.2309
162000000.0000	61.6433	93.1261
164000000.0000	61.3709	92.3663
166000000.0000	61.5621	91.3997
168000000.0000	61.1577	90.6241
170000000.0000	61.0336	89.6015
172000000.0000	61.0514	88.7556
174000000.0000	60.9014	87.7440
176000000.0000	60.9172	86.9026
178000000.0000	60.8745	85.8974
180000000.0000	60.7114	85.1271
182000000.0000	60.6290	84.2384
184000000.0000	60.4698	83.6127
186000000.0000	60.3439	82.5116
188000000.0000	60.2314	82.0994
190000000.0000	60.0828	81.5794
192000000.0000	59.8083	80.5195
194000000.0000	59.4659	80.1775
196000000.0000	59.4093	79.2666
198000000.0000	59.2503	78.8606
200000000.0000	58.7367	77.8862

3 - EUT DESCRIPTION

Applicant:	RELM Communications Corp.
Product Description:	VHF Portable 2-way Radio
Product Name:	RPV599A
FCC ID:	ARURPV599A
Serial Number:	None
Transmitter Frequency:	148~174MHz
Maximum Output Power:	4.37W (EIRP)
Dimension:	3.8" L x 2.5"W x 0.2"H approximately
RF Exposure environment:	General Population/Uncontrolled
Power Supply:	Fed by RELM AC/DC adapter, M/N: 48-12-900D
Applicable Standard	FCC CFR 47, Part 22, 74, 80 and 90
Application Type:	Certification

1 Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).
2 IEEE/ANSI Std. C95.1-1992 limits are used to determine compliance with FCC ET Docket 93-62.

Note: The test data was good for test sample only. It may have deviation for other test samples.

4 - DOSIMETRIC ASSESSMENT SETUP

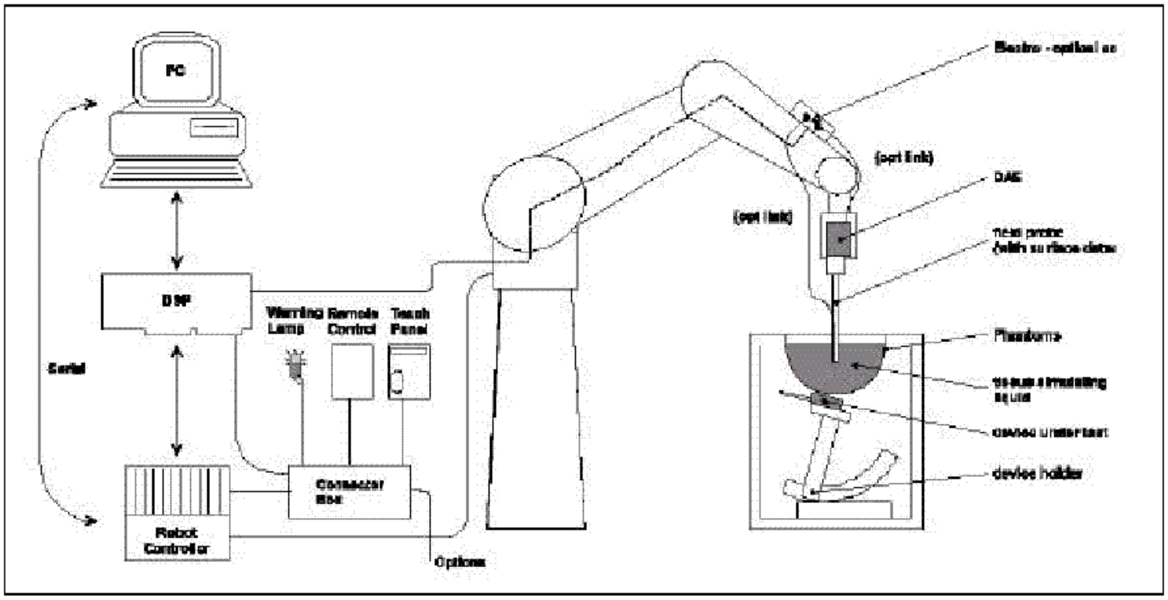
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The system is described in detail in [3].

The SAR measurements were conducted with the dosimetric probe ET3DV6 SN: 1577 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25dB.

The phantom used was the \Generic Twin Phantom" described in [4]. The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)													
	150		300		450		835		900		1800		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.35	46.6	37.56	46.6	38.56	51.16	41.45	52.4	40.71	56.0	54.90	40.4	62.7	73.2
Salt (Nacl)	5.15	2.6	5.95	2.6	3.95	1.49	1.45	1.4	1.48	0.76	0.18	0.5	0.5	0.04
Sugar	55.5	49.7	55.32	49.7	56.32	46.78	56.0	45.0	56.63	41.76	0.0	58.0	0.0	0.0
HEC	0.9	1.0	0.98	1.0	0.98	0.52	1.0	1.0	0.99	1.21	0.0	1.0	0.0	0.0
Bactericide	0.1	0.1	0.19	0.1	0.19	0.05	0.1	0.1	0.19	0.27	0.0	0.1	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.7
Dielectric Constant	52.3	61.9	45.3	61.9	43.5	58.0	41.5	56.1	41.5	56.8	40.0	54.0	39.8	52.5
Conductivity (s/m)	0.76	0.80	0.87	0.80	0.87	0.83	0.90	0.95	0.97	1.07	1.40	1.45	1.88	1.78

4.1 Measurement System Diagram

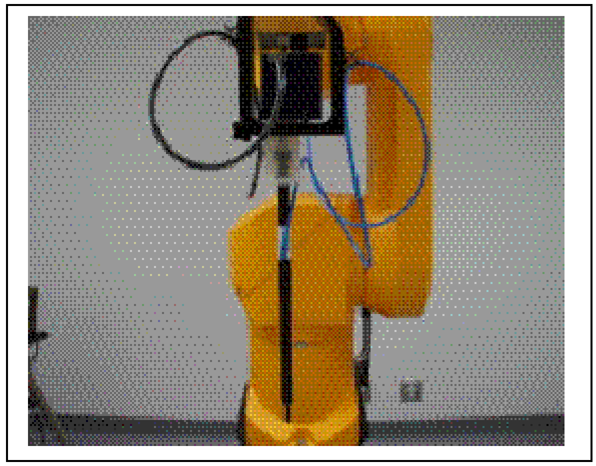


The DASY3 system for performing compliance tests consist of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
2. An arm extension for accommodating the data acquisition electronics (DAE).
3. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
4. A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
5. A unit to operate the optical surface detector, which is connected to the EOC. The Electro-optical coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the PC plug-in card. The functions of the PC plug-in card based on a DSP is to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.
6. A computer operating Windows 95 or larger
7. DASY3 software
8. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld EUT.
11. Tissue simulating liquid mixed according to the given recipes (see Application Note).
12. System validation dipoles to validate the proper functioning of the system.

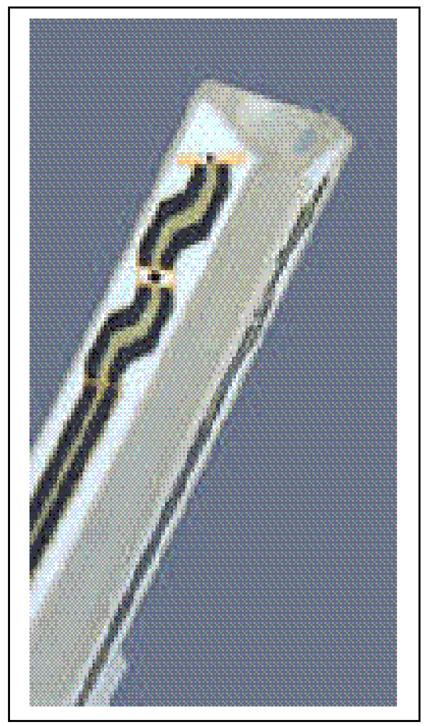
4.2. System Components

ET3DV5 Probe Specification
Construction Symmetrical design with triangular core
Built-in optical fiber for surface detection System
Built-in shielding against static charges
Calibration In air from 10 MHz to 2.5 GHz
In brain and muscle simulating tissue at
Frequencies of 450 MHz, 900 MHz and
1.8 GHz (accuracy ± 8%)
Frequency 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity ± 0.2 dB in brain tissue (rotation around
probe axis)
± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic 5 mW/g to > 100 mW/g;
Range Linearity: ± 0.2 dB
Surface ± 0.2 mm repeatability in air and clear liquids
Detection over diffuse reflecting surfaces.
Dimensions Overall length: 330 mm
Tip length: 16 mm
Body diameter: 12 mm
Tip diameter: 6.8 mm
Distance from probe tip to dipole centers: 2.7 mm
Application General dosimetric up to 3 GHz
Compliance tests of mobile phones
Fast automatic scanning in arbitrary phantoms



Photograph of the probe

The SAR measurements were conducted with the dosimetric probe ET3DV6 designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY3 software reads the reflection during a software approach and looks for the maximum using a 2 nd order fitting. The approach is stopped when reaching the maximum.



Inside view of ET3DV6 E-field Probe

E-Field Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

Data Evaluation

The DASY3 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe Parameter:	-Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	-Conversion Factor	ConvFi
	-Diode compression point	Dcp_i
Device parameter:	-Frequency	f
	-Crest Factor	cf
Media parameter:	-Conductivity	σ
	-Density	ρ

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the DASY3 components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$Vi = Ui + (Ui)^2 \, cf / dcp_i$$

With Vi = compensated signal of channel i (i =x, y, z)
Ui = input signal of channel i (i =x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes: $$H_i = \sqrt{Vi} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

With Vi = compensated signal of channel i (i =x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i =x, y, z)
$\mu V/(V/m)^2$ for E-field probes
ConF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strenggy of channel i in V/m
H_i = diode compression point (DASY parameter)

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \text{Square Root } [(E_x)^2 + (E_y)^2 + (E_z)^2]$$

The primary field data are used to calculate the derived field units.

$$SAR = (E_{tot})^2 \cdot \sigma / (\rho \cdot 1000)$$

With SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

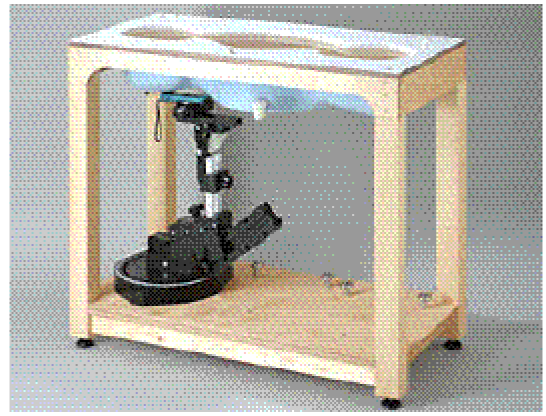
The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = (E_{tot})^2 / 3770 \text{ or } P_{pwe} = (H_{tot})2 \cdot 37.7$$

With P_{pwe} = equivalent power density of a plane wave in mW/cm3
E_{tot} = total electric filed strength in V/m
H_{tot} = total magnetic filed strength in V/m

Generic Twin Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [9][10]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.
Shell Thickness 2 ± 0.1 mm
Filling Volume Approx. 20 liters
Dimensions 810 x 1000 x 500 mm (H x L x W)

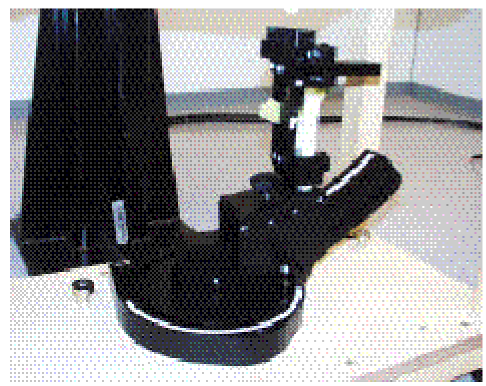


Generic Twin Phantom

Device Holder

In combination with the Generic Twin Phantom V3.0, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Device Holder

4.3 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [13] and the NIST1297 [14] documents and is given in the following Table.

Uncertainty Description	Error	Distrib.	Weight	Std. Dev.	Offset
Probe Uncertainty					
Axial isotropy	± 0.2 dB	U-shape	0.5	±2.4 %	/
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %	/
Isotropy from gradient	±0.5 dB	U-shape	0	/	/
Spatial resolution	±0.5 %	Normal	1	±0.5 %	/
Linearity error	±0.2 dB	Rectangle	1	±2.7 %	/
Calibration error	±3.3 %	Normal	1	± 3.3 %	/
SAR Evaluation Uncertainty					
Data acquisition error	±1%	Rectangle	1	±0.6 %	/
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %	/
Conductivity assessment	±10 %	Rectangle	1	± 5.8 %	/
Spatial Peak SAR Evaluation Uncertainty					
Extrapol boundary effect	±3%	Normal	1	±3%	± 5%
Probe positioning error	±0.1 mm	Normal	1	± 1%	/
Integrat. and cube orient	±3%	Normal	1	±3%	/
Cube shape inaccuracies	±2%	Rectangle	1	±1.2 %	/
Device positioning	±6%	Normal	1	± 6%	/
Combined Uncertainties	/	/	1	±11.7 %	± 5%
Extended uncertainty (K = 2)	/	/	/	± 23.5 %.	/

5 - SYSTEM EVALUATION

5.1 Simulated Tissue Liquid Parameter Confirmation

The dielectric parameters were checked prior to assessment using the HP85070A dielectric probe kit. The dielectric parameters measured are reported in each correspondent section:

5.2 System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

IEEE P1528 recommended reference value

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (above feed point)	Local SAR at surface (v=2cm offset from feed point)
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	14.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2000	41.1	21.1	74.6	6.5
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

System validation result

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation	Limits [%]
Body	900	ε_r	24.0	55.9	56.1	0.4	±5
		σ	24.0	0.98	1.02	4.1	±5
		1g SAR	24.0	10.8	10.9	-0.9	±10

ε_r = relative permittivity, σ = conductivity and ρ=1000kg/m^3

Note: Input power = 17.8mW

5.3 SAR Evaluation Procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the ear point or central position was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the head was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the head or EUT and the horizontal grid spacing was 20 mm x 20 mm. Based on these data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

1. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm [11]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

2. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three onedimensional splines with the “Not a knot"-condition (in x, y and z-directions) [11], [12]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

3. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation was repeated.

5.4 Exposure Limits

Table 1: Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.4	8.0	20.0

Table 2: Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.08	1.6	4.0

Note: Whole-body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube SAR for hands, writs, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

Population/uncontrolled environments Partial-body limit 1.6W/kg applied to the EUT.

6 - TEST RESULTS

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device could be found in the following pages.

6.1 SAR Body-Worn Test Data

Ambient Temperature (ºC): 29.0
Relative Humidity (%): 49.3

Worst case SAR reading

Position	Ch	Conducted Power (dBm)	Worst case SAR, averaged over 1g [mW/g]			
			Setup condition (applicable checked)		Measured	Limit
			Antenna	Phantom		
Body Coarse	148	4.37	Built-in	EUT Back Side direct touch phantom	1.220	1.6
Body Coarse	163	4.07			0.753	1.6
Body Coarse	174	3.89			0.341	1.6
Body Belt Clip	148	4.37	Built-in	EUT Back Side direct touch phantom	0.651	1.6
Body Belt Clip	163	4.07			0.501	1.6
Body Belt Clip	174	3.89			0.341	1.6

6.2 Liquid Measurement Result

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation	Limits [%]
Body	150	ε_r	24.0	61.9	62.5	1.0	±5
		σ	24.0	0.80	0.78	-2.5	±5

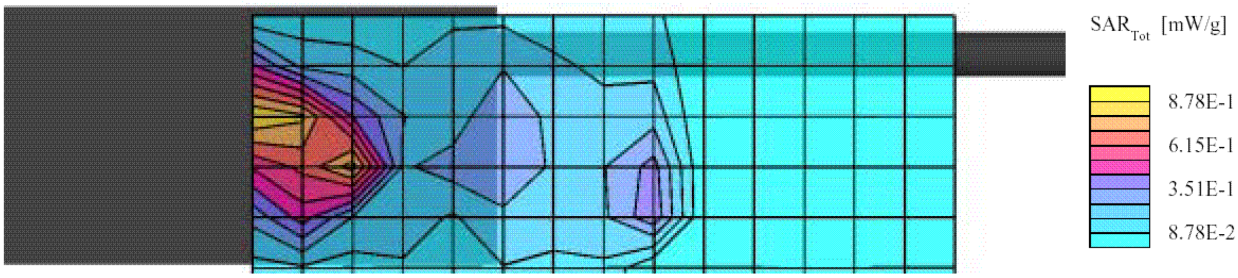
6.3 Plots of Test Result

The plots of test result were attached as reference.

Flat Coarse, Low Channel

RELM Wireless RPV599A (w/o beltclip, 24 Deg, 8/30/02)

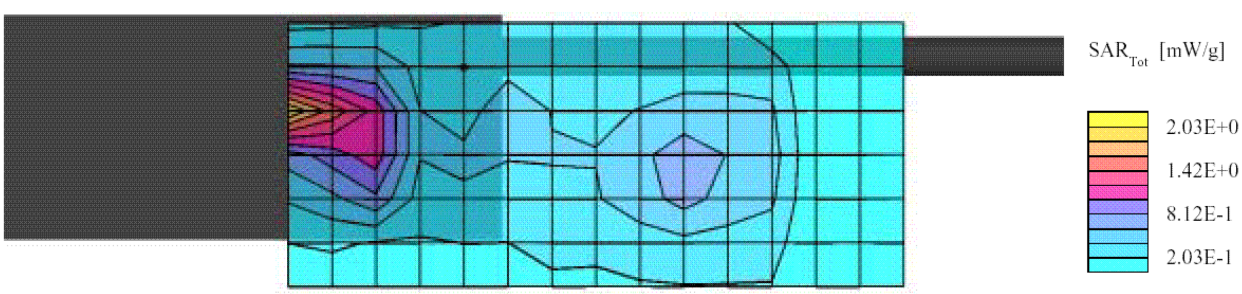
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 148 MHz
Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Head 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 1.22 mW/g, SAR (10g): 0.572 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.02 dB



Flat Coarse, Middle Channel

RELM Wireless RPV599A (w/o beltclip, 24 Deg, 8/30/02)

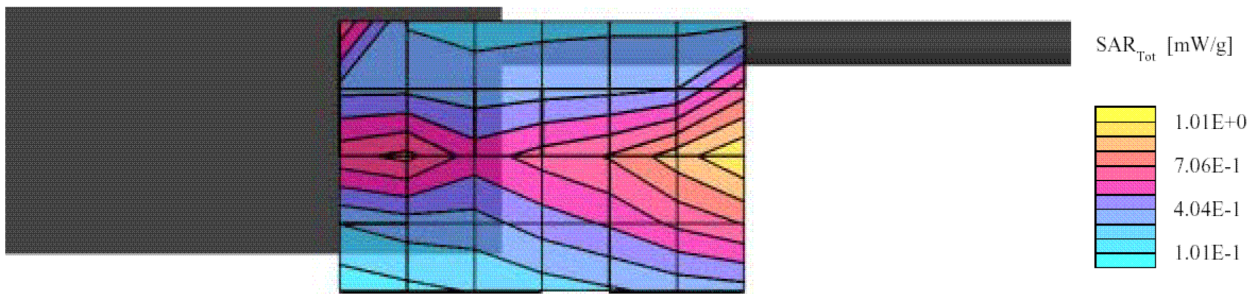
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 163 MHz
Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Body 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.753 mW/g, SAR (10g): 0.333 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.04 dB



Flat Coarse, Worst Case, High Channel

RELM Wireless RPV599A (w/o beltclip, 24 Deg, 8/30/02)

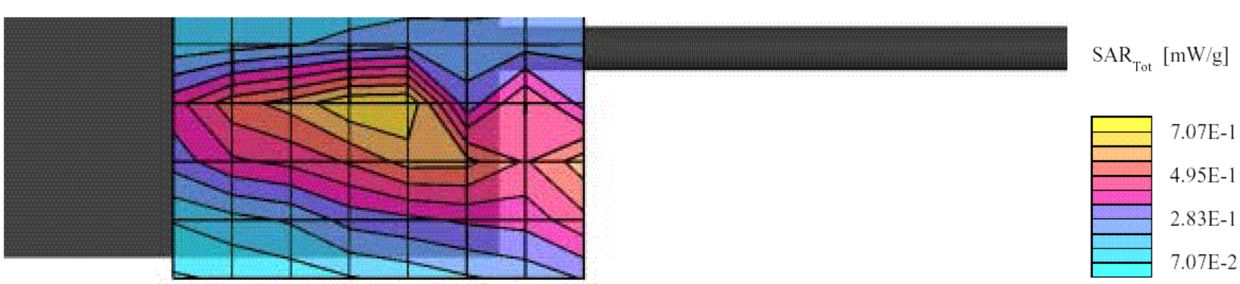
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 174 MHz
Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Body 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.929 mW/g, SAR (10g): 0.615 mW/g, (Worst-case extrapolation)
Coarse: Dx = 16.0, Dy = 16.0, Dz = 14.0
Powerdrift: -0.10 dB



Flat with Accessories, Low Channel

RELM Wireless RPV599A (w/ beltclip, 24 Deg, 8/30/02)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 148 MHz
Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Body 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.651 mW/g, SAR (10g): 0.396 mW/g, (Worst-case extrapolation)
Coarse: Dx = 14.0, Dy = 14.0, Dz = 12.0
Powerdrift: -0.11 dB



Flat with accessories, Middle Channel

RELM Wireless RPV599A (w/ beltclip, 24 Deg, 8/30/02)

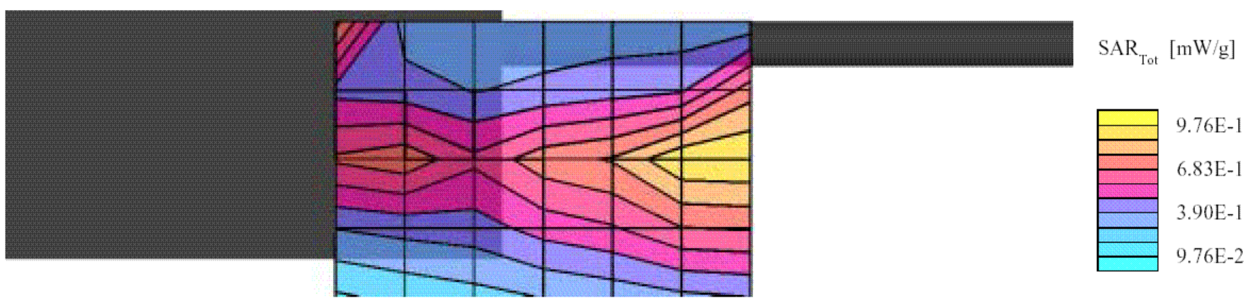
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 163 MHz

Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Body 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³

Cube 5x5x7: SAR (1g): 0.501 mW/g, SAR (10g): 0.325 mW/g, (Worst-case extrapolation)

Coarse: Dx = 16.0, Dy = 16.0, Dz = 14.0

Powerdrift: -0.07 dB



Flat with accessories, High Channel

RELM Wireless RPV599A (w/ beltclip, 24 Deg, 8/30/02)

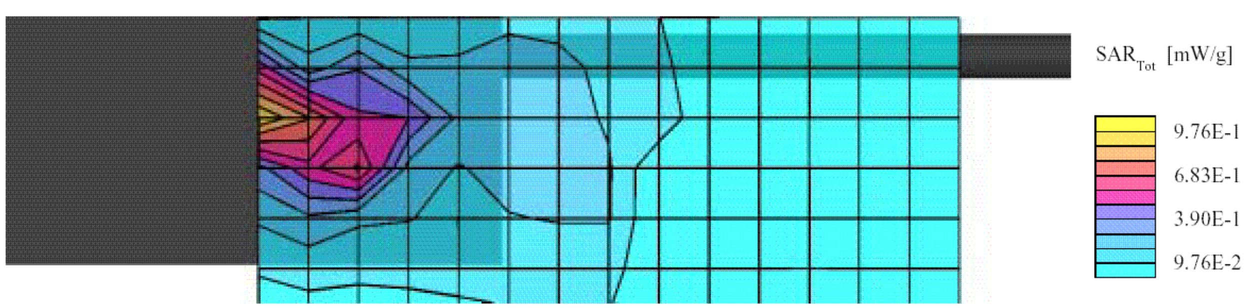
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 174 MHz

Probe: ET3DV6 - SN1604; ConvF(6.77,6.77,6.77); Crest factor: 1.0; Body 150 MHz: σ = 0.78 mho/m ε_r = 62.5 ρ = 1.00 g/cm³

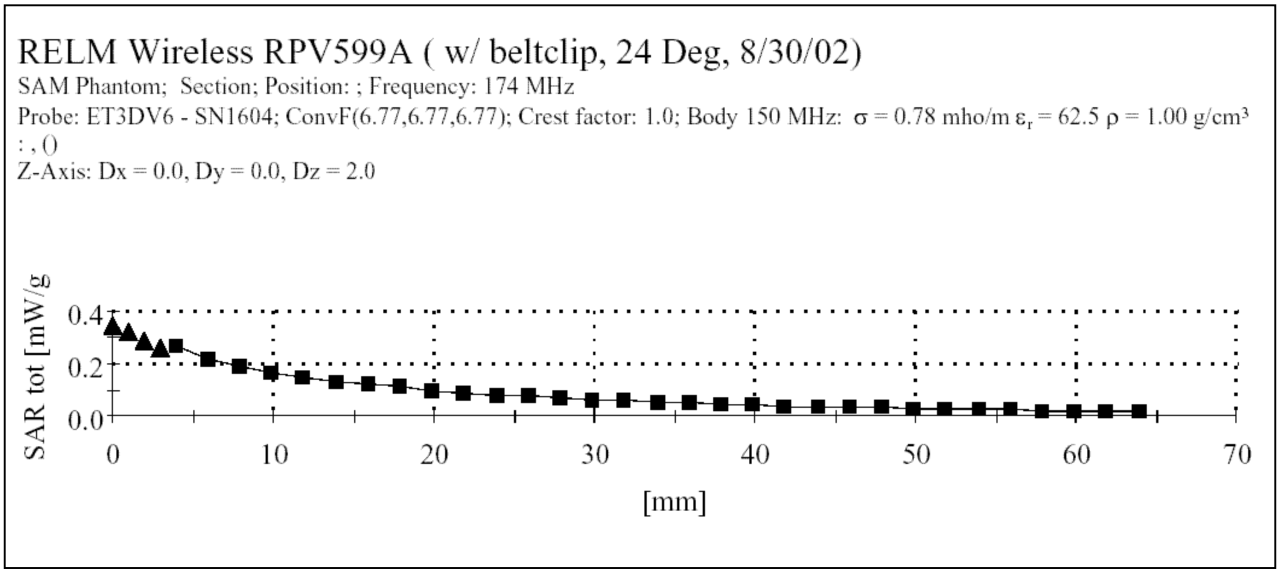
Cube 5x5x7: SAR (1g): 0.341 mW/g, SAR (10g): 0.151 mW/g, (Worst-case extrapolation)

Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0

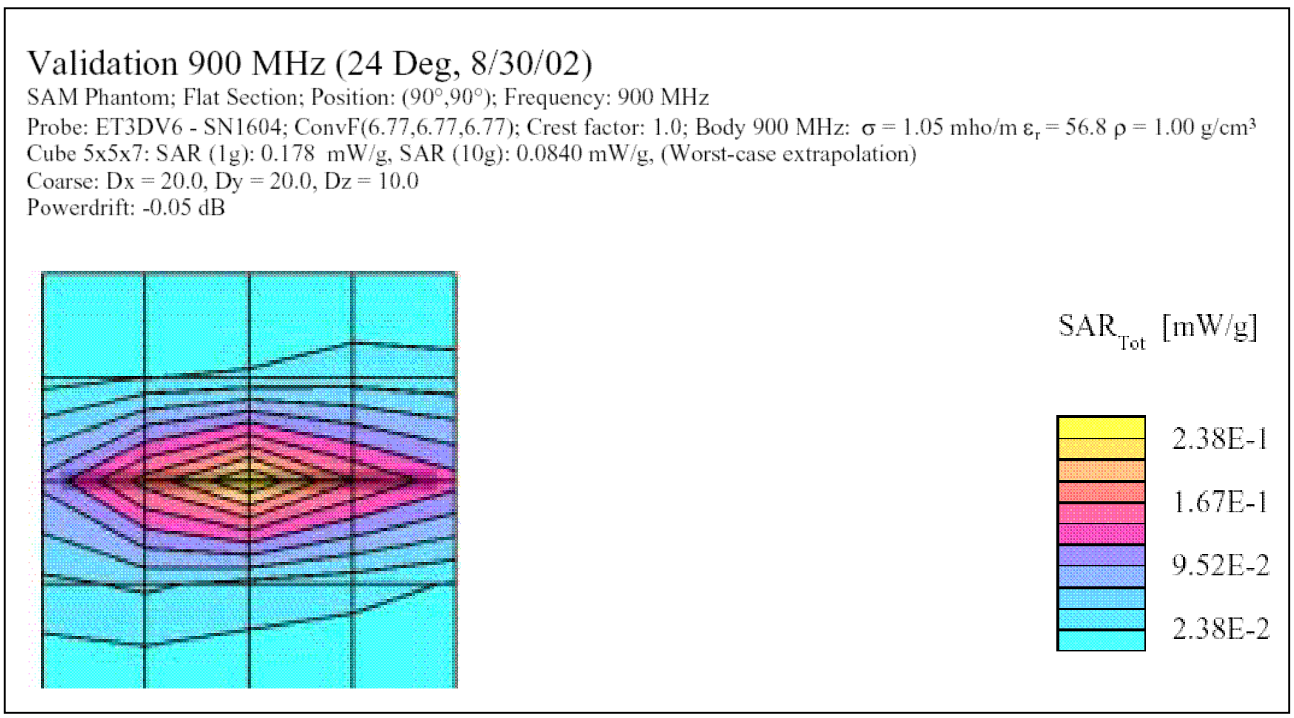
Powerdrift: -0.01 dB



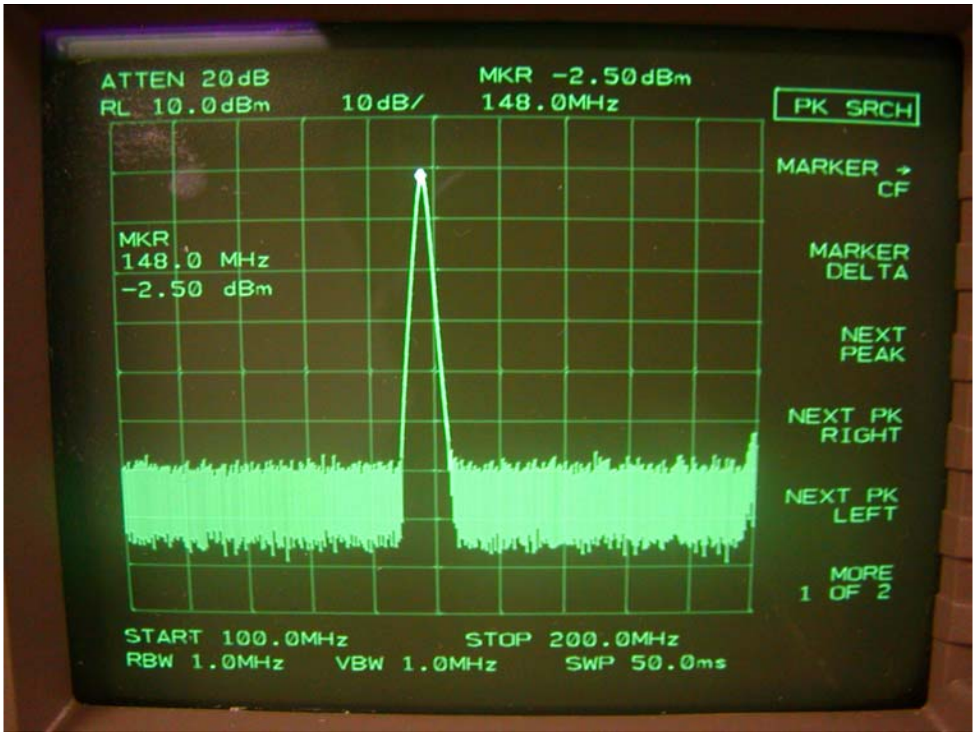
Flat, Z-Axis



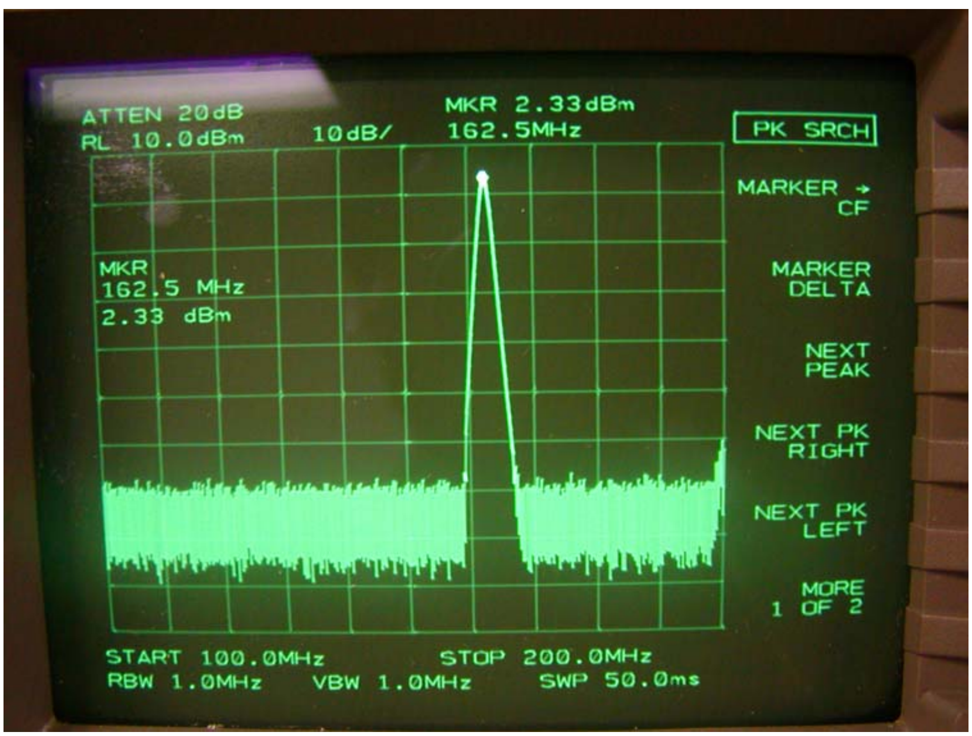
900MHz Body Validation



148MHz



163MHz



174MHz

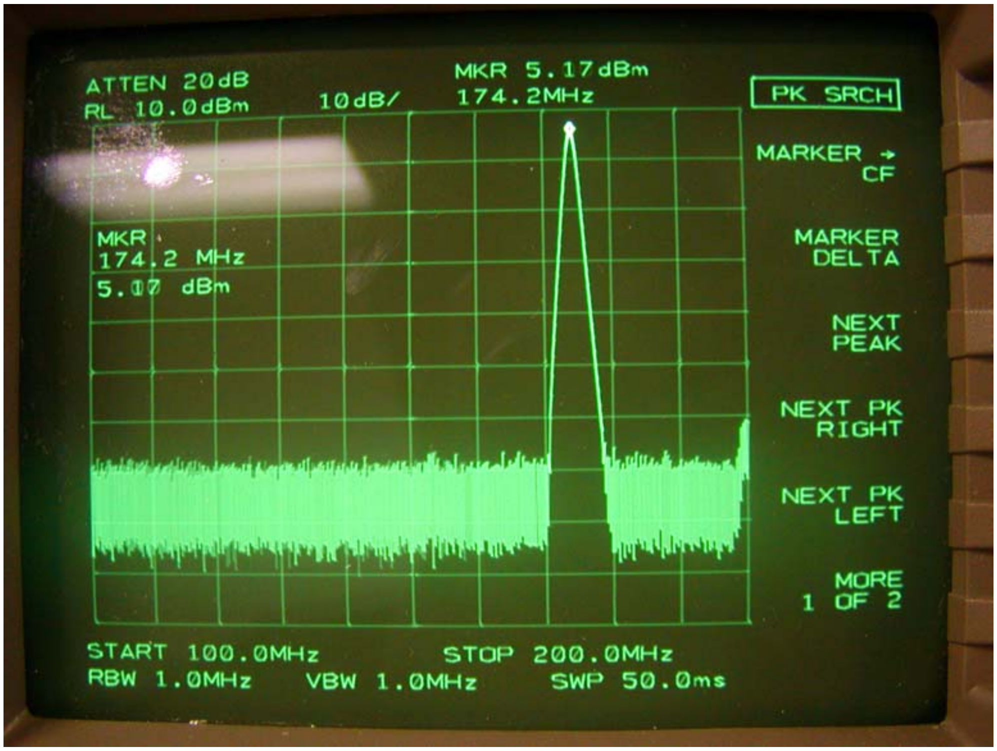
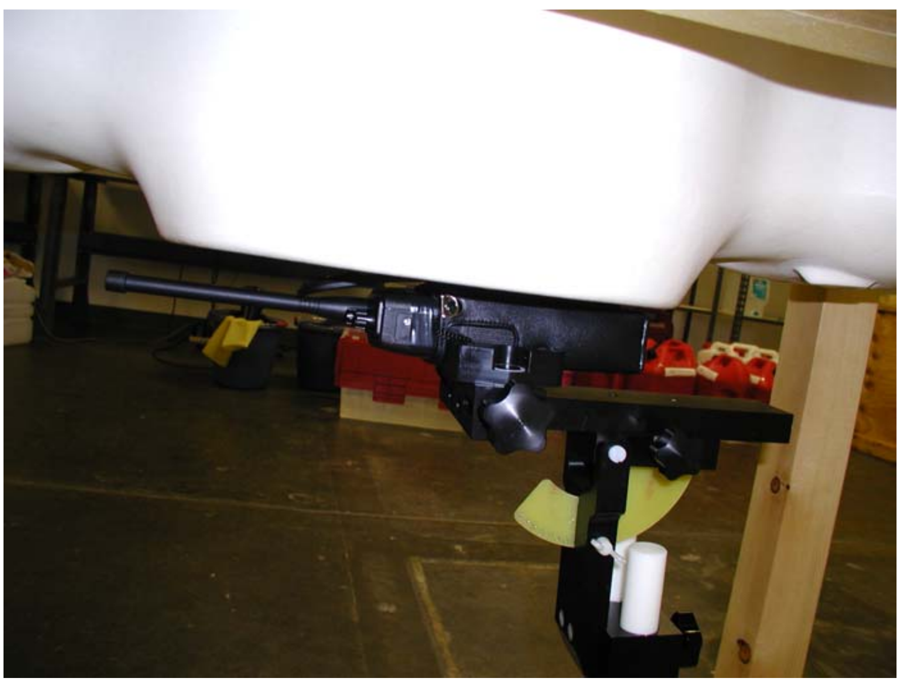
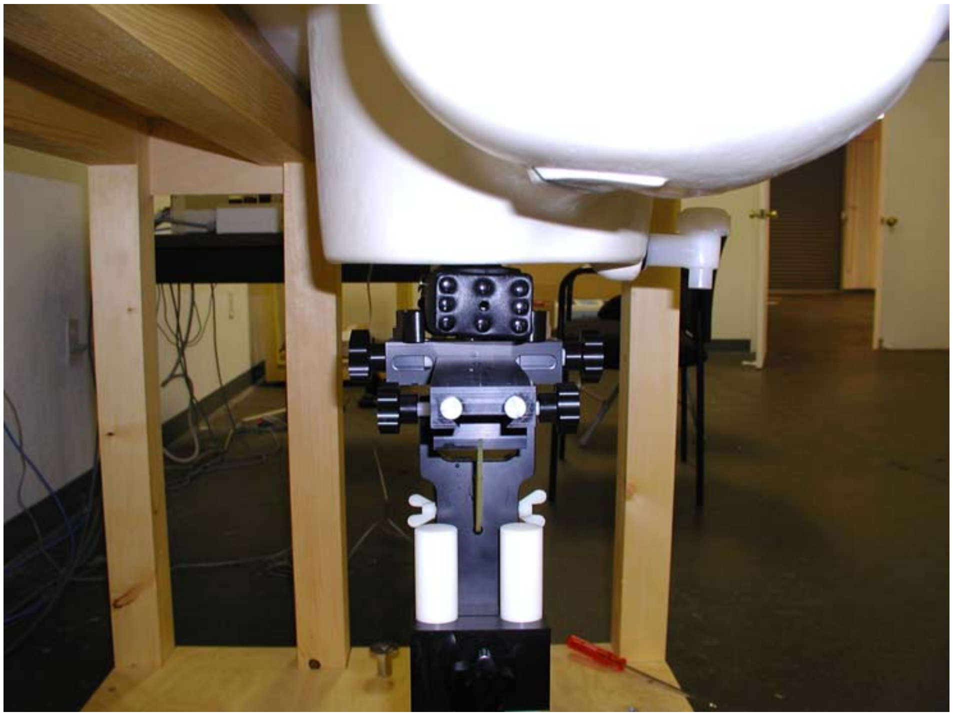

ATTEN 20dB
RL 10.0dBm
10dB/
MKR 5.17dBm
174.2MHz
PK SRCH
MKR
174.2 MHz
5.17 dBm
MARKER → CF
MARKER DELTA
NEXT PEAK
NEXT PK RIGHT
NEXT PK LEFT
MORE 1 OF 2
START 100.0MHz
STOP 200.0MHz
RBW 1.0MHz
VBW 1.0MHz
SWP 50.0ms

EXHIBIT A - SAR SETUP PHOTOGRAPHS

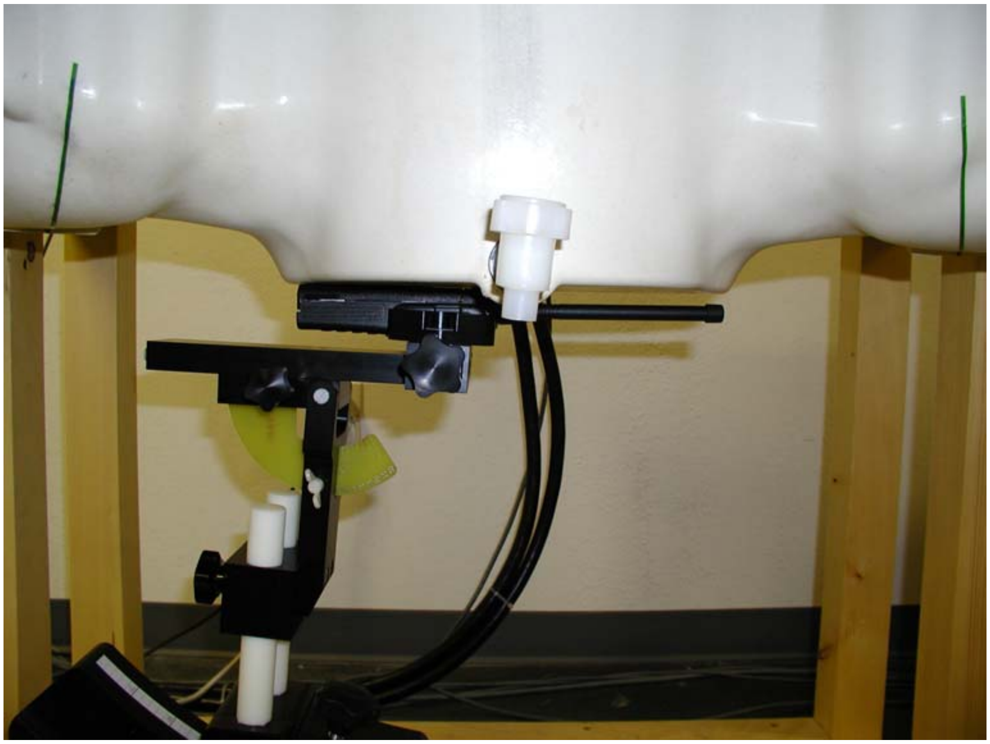
With Accessories - Front/Rear View



With Accessories - Left/Right View



Without Accessories - Front/Rear View



Without Accessories - Left/Right View

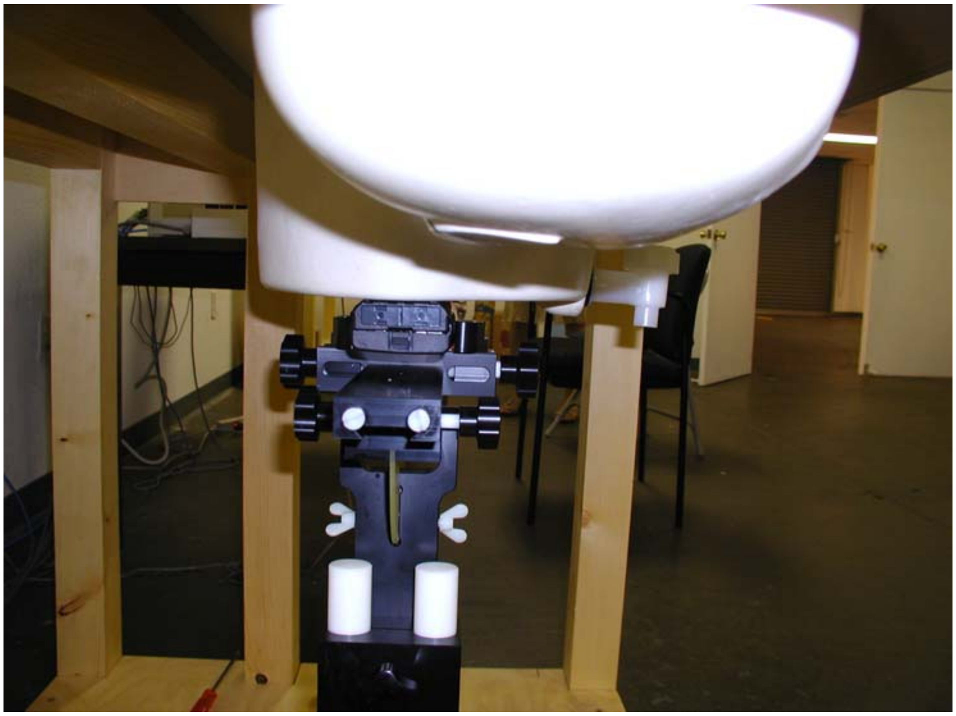


EXHIBIT B - EUT PHOTOGRAPHS

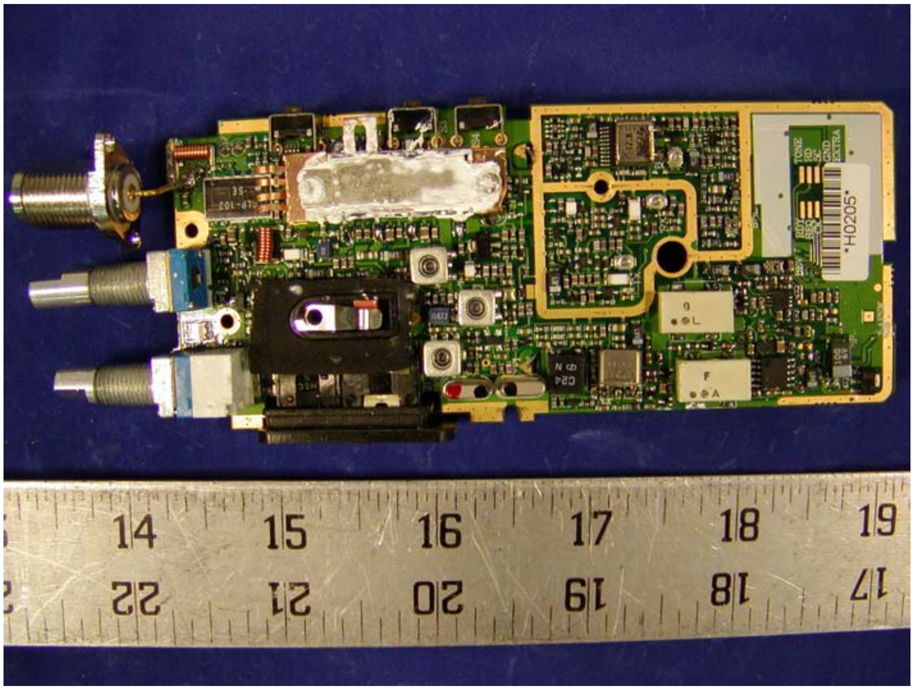
Chassis - Front View

Chassis - Back View

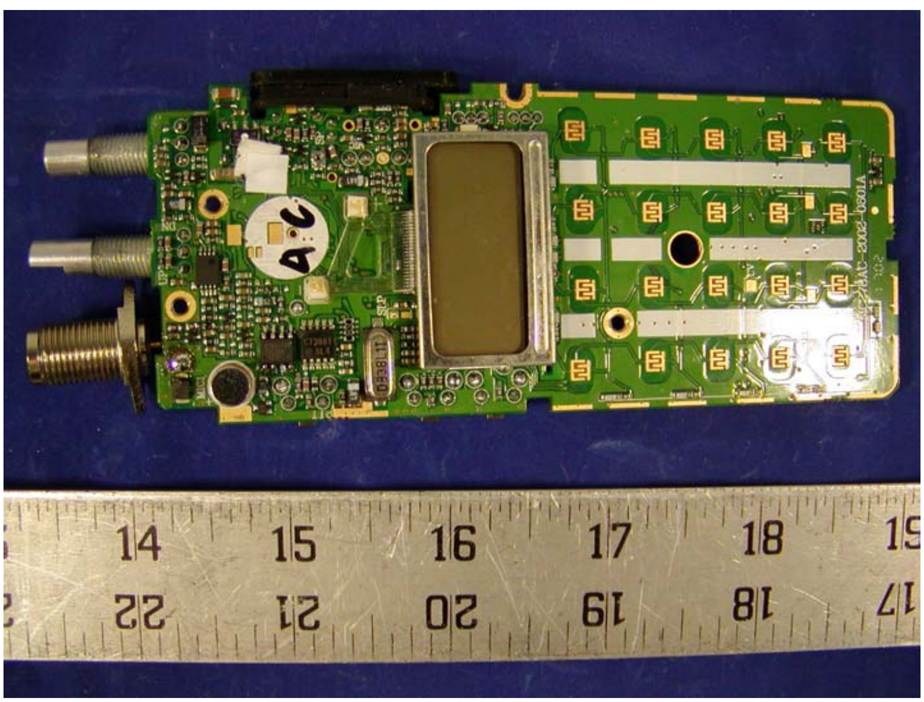
Chassis - Top View

Chassis - Side View

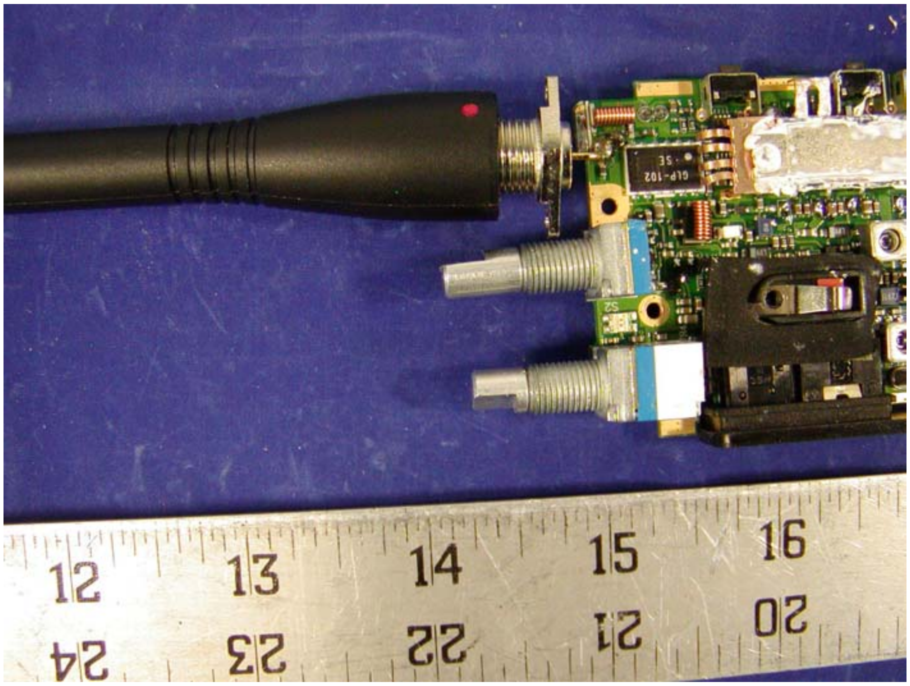
Main Board - Component View



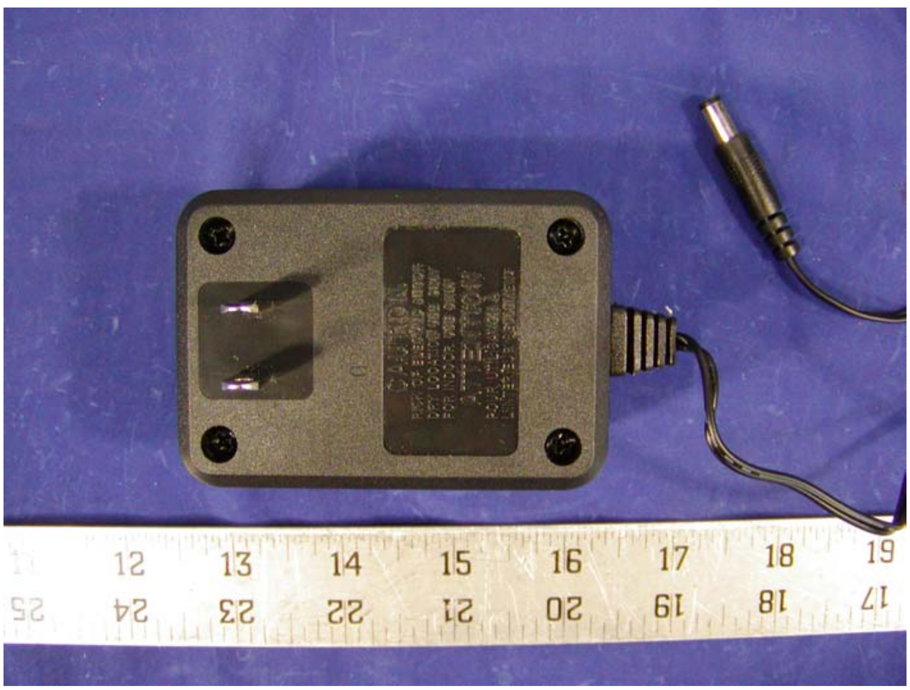
Main Board - Solder View



Antenna Attachment



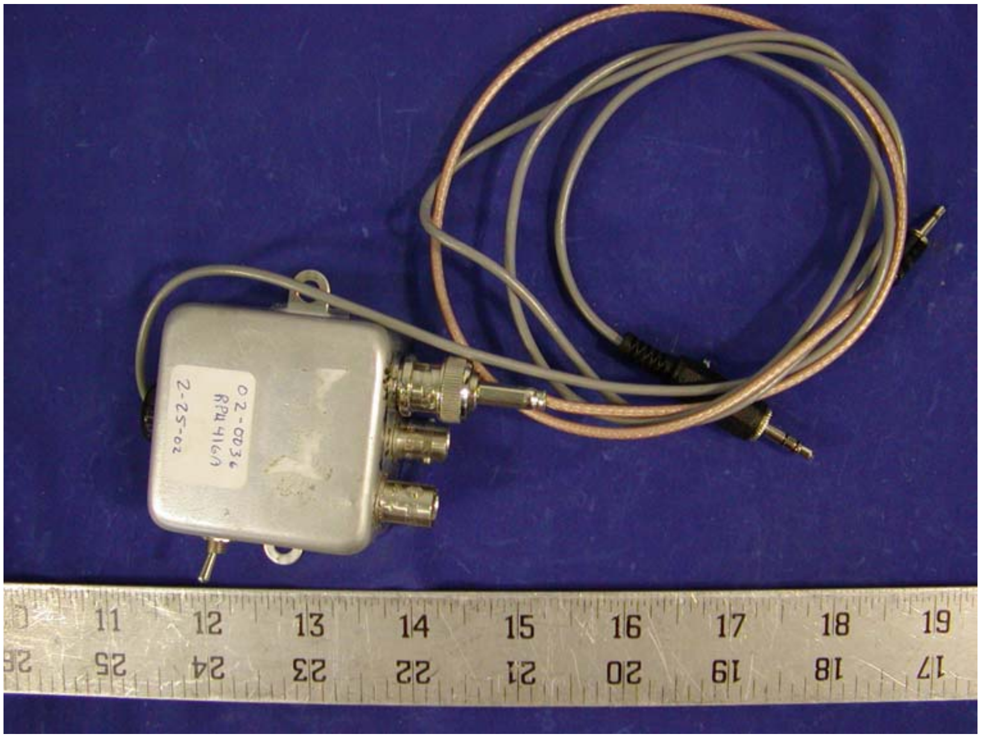
Power Adapter



Charger Top View

Charger Bottom View

Radio Interface Box



Speaker