

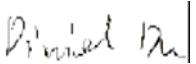
SAR EVALUATION REPORT

For

Novatel Wireless Technologies Ltd.

Suite 200, 6715 – 8th Street N.E.
Calgary, Alberta
Canada, T2E 7H7

MODEL: U630

This Report Concerns: <input checked="" type="checkbox"/> Second Edition	Equipment Type: Transmitter, Portable
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Report No.: <u>R0511221S</u>	
Report Date: <u>2005-12-05</u>	
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DECLARATION OF COMPLIANCE SAR EVALUATION

Rule Part(s):	FCC §2.1093 & IEEE 1528
Test Procedure(s):	FCC OET Bulletin 65 Supplement C & IEEE 1528
Device Classification:	Licensed Portable Transmitter
Device Type:	WIRELESS PCMCIA CARD
Model Number:	U630
Modulation:	GMSK
TX Frequency Range:	1850.2-1909.8 MHz
Max. Conducted Power Tested:	29.8 / 29.7 / 29.52 dBm
Antenna Type(s):	Integral Antenna
Body-Worn Accessories:	None
Face-Head Accessories:	None

Max. SAR Level(s) Measured: 0.791 W/kg (10g, 1850.2MHz, Body-Worn, Avertec) / 0.521 W/kg (10g, 1850.2MHz, Body-Worn, HP), 0.595 W/kg (10g, 1909.8MHz, Body-Worn, Toshiba)

BACL Corp. declares under its sole responsibility that this wireless portable device has been determined to be in compliance for localized specific absorption rate (SAR) for uncontrolled exposure and general population exposure limits specified in OEC 65 C and has been tested in accordance with the measurement procedures specified in IEEE 1528 and ANSI IEEE C95.3:2002

All measurements reported herein were performed under my supervision and believed to be accurate to the best of my knowledge. I further attest for the completeness of these measurements and vouch for the qualifications any and all personnel performing such measurements.

The results and statements contained in this report pertain only to the device(s) evaluated.

/signature/

Daniel Du

Daniel Du
Bay Area Compliance Laboratory Corp.



TABLE OF CONTENTS

REFERENCE, STANDARDS, AND GUIDELINES	4
SAR LIMITS.....	5
EUT DESCRIPTION	6
DESCRIPTION OF TEST SYSTEM	7
MEASUREMENT SYSTEM DIAGRAM	9
SYSTEM COMPONENTS	11
TESTING EQUIPMENT.....	20
EQUIPMENTS LIST & CALIBRATION INFO.....	20
SAR MEASUREMENT SYSTEM VERIFICATION.....	21
SYSTEM ACCURACY VERIFICATION	21
EUT TEST STRATEGY AND METHODOLOGY	22
SAR EVALUATION PROCEDURE.....	22
CONCLUSION	23
SAR BODY WORST-CASE TEST DATA.....	23
APPENDIX A – MEASUREMENT UNCERTAINTY	24
APPENDIX B – PROBE CALIBRATION CERTIFICATES.....	26
APPENDIX C – DIPOLE CALIBRATION CERTIFICATES	37
APPENDIX D - TEST SYSTEM VERIFICATIONS SCANS.....	47
LIQUID MEASUREMENT RESULT	47
APPENDIX E - EUT SCANS	49
APPENDIX F – CONDUCTED OUTPUT POWER MEASUREMENT	58
PROVISION APPLICABLE.....	58
TEST PROCEDURE	58
TEST EQUIPMENT	58
TEST RESULTS	58
APPENDIX G – EUT TEST POSITION PHOTOS	61
AVERATEC NOTEBOOK 1	61
AVERATEC NOTEBOOK 2	61
HP NOTEBOOK 1	62
HP NOTEBOOK 2	62
TOSHIBA NOTEBOOK 1	63
TOSHIBA NOTEBOOK 2	63
APPENDIX H – EUT & ACCESSORIES PHOTOS	64
EUT – FRONT VIEW	64
EUT – BACK VIEW	64
EUT – COVER OFF VIEW	65
PCB WITH SHIELDING VIEW 1	65
PCB WITH SHIELDING VIEW 2	66
PCB WITHOUT SHIELDING VIEW 1	66
PCB WITHOUT SHIELDING VIEW 2	67
ANTENNA VIEW	67
PORT VIEW	68
APPENDIX I - INFORMATIVE REFERENCES.....	69

REFERENCE, STANDARDS, AND GUILDELINEs

FCC:

The Report and 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.

CE:

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 2 mW/g as recommended by the EN50360 for an uncontrolled environment. According to the Standard, 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 Europe is 2 mW/g average over 10 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.

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

SAR Limits

FCC Limit (1g)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

CE Limit (10g)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	2.0	10
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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 Spatial Peak limit 1.6 w/kg (FCC) & 2.0w/kg (CE) applied to the EUT.

EUT DESCRIPTION

The *Novatel Wireless Technologies Ltd.* product, FCC ID: NBZNRM-U630 or the "EUT" as referred to in this report is Transmitter, Portable, which measures approximately 120mm(L) x 53mm(W) x 8mm(H). The EUT operates at the frequency of 1850.2 – 1909.8 MHz, maximum output power (ERP) 29.2dBm (0.832W), frequency tolerance 0.054ppm and emission designator 253KGXW.

This is a second edition report. The only different which compares with previous test item is an internal antenna. Due the change describes above, SAR was retested. The detail information please refers to R0408161.

** The test data gathered are from typical production sample, serial number: Novatel0804, provided by the manufacturer.*

DESCRIPTION OF TEST SYSTEM

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG) which is the fourth generation of the system shown in the figure hereinafter:



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 $\pm 0.02\text{mm}$. 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 SAR measurements were conducted with the dosimetric probe ET3DV6 SN: 1604 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure with accuracy of better than $\pm 10\%$. The spherical isotropy was evaluated with the procedure and found to be better than $\pm 0.25\text{dB}$.

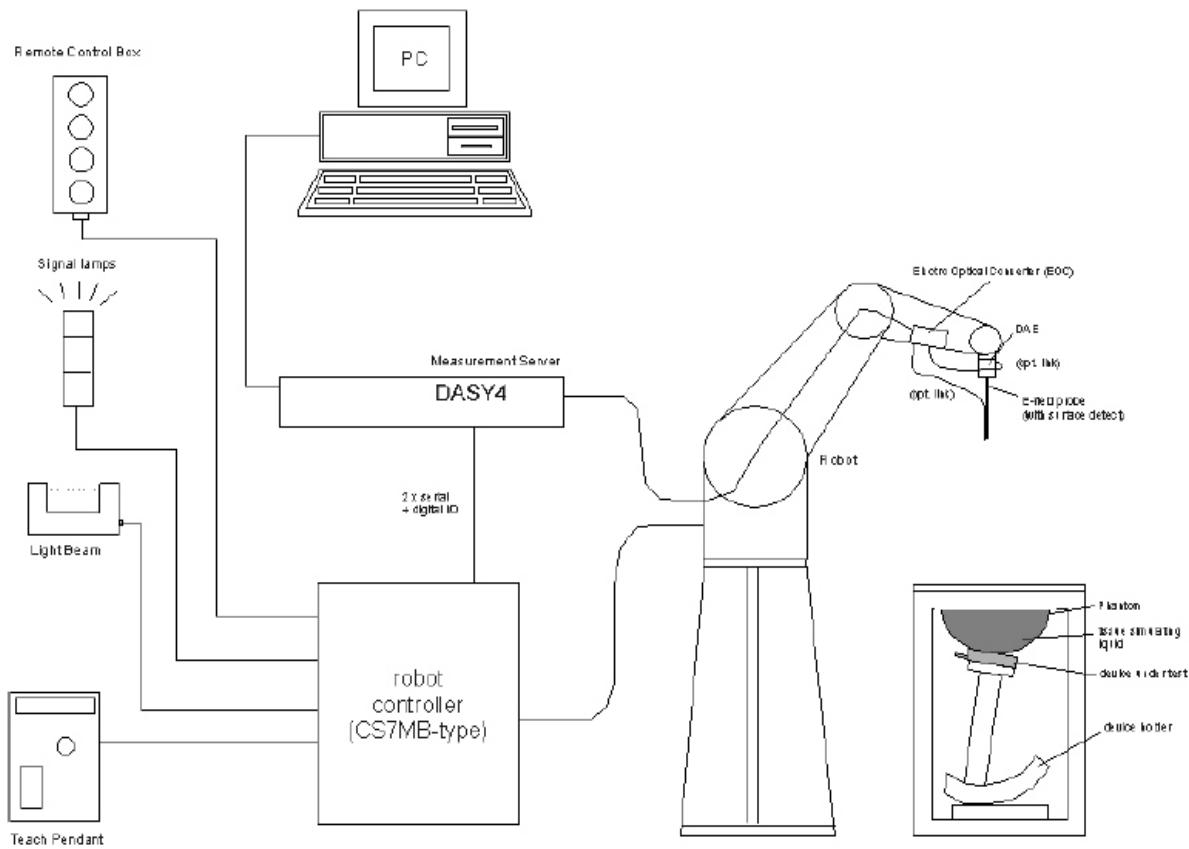
The phantom used was the Generic Twin Phantom". The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	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	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (s/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

IEEE SCC-34/SC-2 P1528 Recommended Tissue Dielectric Parameters

Frequency (MHz)	Head		Body	
	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

Measurement System Diagram



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- 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.
- A data acquisition electronics (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.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.

- DASY4 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

System Components

- DASY4 Measurement Server
- Data Acquisition Electronics
- Probes
- Light Beam Unit
- Medium
- SAM Twin Phantom
- Device Holder for SAM Twin Phantom
- System Validation Kits
- Robot

DASY4 Measurement Server

The DASY4 measurement server is based on a PC/104 CPU board with a 166MHz low-power pentium, 32MB chipdisk and 64MB RAM. The necessary circuits for communication with either the DAE4 (or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board.



The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server.

Data Acquisition Electronics

The data acquisition electronics DAE3 consists of a highly sensitive electrometergrade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.



Probes

The DASY system can support many different probe types.

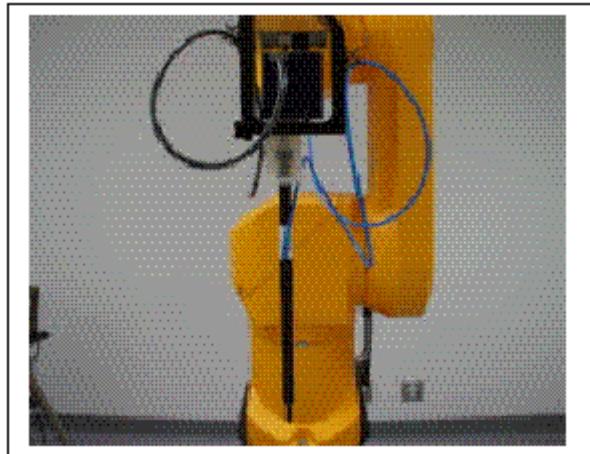
Dosimetric Probes: These probes are specially designed and calibrated for use in liquids with high permittivities. They should not be used in air, since the spherical isotropy in air is poor (± 2 dB). The dosimetric probes have special calibrations in various liquids at different frequencies.

Free Space Probes: These are electric and magnetic field probes specially designed for measurements in free space. The z-sensor is aligned to the probe axis and the rotation angle of the x-sensor is specified. This allows the DASY system to automatically align the probe to the measurement grid for field component measurement. The free space probes are generally not calibrated in liquid. (The H-field probes can be used in liquids without any change of parameters.)

Temperature Probes: Small and sensitive temperature probes for general use. They use a completely different parameter set and different evaluation procedures. Temperature rise features allow direct SAR evaluations with these probes.

ET3DV6 Probe Specification

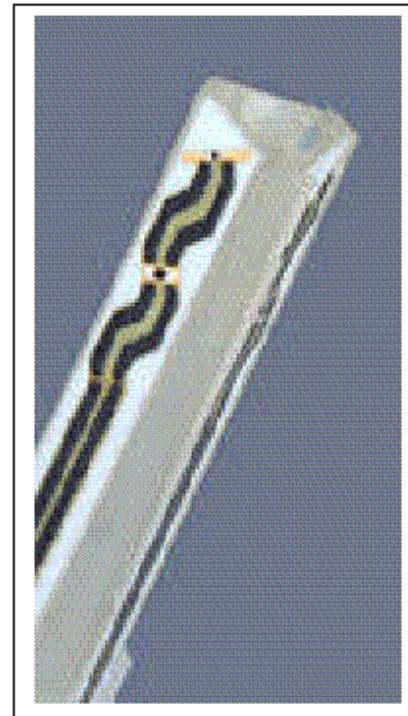
Construction Symmetrical design with triangular core
 Built-in optical fiber for surface detection System
 Built-in shielding against static charges
 Calibration In air from 10 MHz to 2.5 GHz
 In brain and muscle simulating tissue at
 Frequencies of 450 MHz, 900 MHz and
 1.8 GHz (accuracy $\pm 8\%$)
 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



Photograph of the probe

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

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 2nd 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 below 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 DASY4 postprocessing software (SEMCAD) 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 parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	dcp1

Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter 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:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With V_i = compensated signal of channel i (i = x, y, z)
 U_i = 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:

$$E - \text{fieldprobes} : \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$H - \text{fieldprobes} : \quad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With V_i = compensated signal of channel i (i = x, y, z)
 $Norm_i$ = sensor sensitivity of channel i (i = x, y, z)
 $\mu\text{V}/(\text{V}/\text{m})^2$ for E-field probes
 $ConF$ = sensitivity enhancement in solution
 a_{ij} = sensor sensitivity factors for H-field probes
 f = carrier frequency [GHz]
 E_i = electric field strength 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):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

With $SAR =$ local specific absorption rate in mW/g
 $E_{tot} =$ total field strength in V/m
 $\sigma =$ conductivity in [mho/m] or [Siemens/m]
 $\rho =$ equivalent tissue density in g/cm³

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

Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

Medium

Parameters

The parameters of the tissue simulating liquid strongly influence the SAR in the liquid. The parameters for the different frequencies are defined in the corresponding compliance standards (e.g., EN 50361, IEEE 1528-2003).

Parameter measurements

Several measurement systems are available for measuring the dielectric parameters of liquids:

- The open coax test method (e.g., HP85070 dielectric probe kit) is easy to use, but has only moderate accuracy. It is calibrated with open, short, and deionized water and the calibrations a critical process.
- The transmission line method (e.g., model 1500T from DAMASKOS, INC.) measures the transmission and reflection in a liquid filled high precision line. It needs standard two port calibration and is probably more accurate than the open coax method.
- The reflection line method measures the reflection in a liquid filled shorted precision line. The method is not suitable for these liquids because of its low sensitivity.
- The slotted line method scans the field magnitude and phase along a liquid filled line. The evaluation is straight forward and only needs a simple response calibration. The method is very accurate, but can only be used in high loss liquids and at frequencies above 100 to 200MHz. Cleaning the line can be tedious.

SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- Left hand
- Right hand
- Flat phantom

The phantom table comes in two sizes: A 100 x 50 x 85 cm (L x W x H) table for use with free standing robots (DASY4 professional system option) or as a second phantom and a 100 x 75 x 85 cm(L x W x H) table with reinforcements for table mounted robots (DASY4 compact system option) .

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different liquids) A white cover is provided to tap the phantom during o_-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.



The phantom can be used with the following tissue simulating liquids:

- Water-sugar based liquids can be left permanently in the phantom. Always cover the liquid if the system is not used, otherwise the parameters will change due to water evaporation.
- Glycol based liquids should be used with care. As glycol is a softener for most plastics, the liquid should be taken out of the phantom and the phantom should be dried when the system is not used (desirable at least once a week).
- Do not use other organic solvents without previously testing the phantom resistiveness.

Device Holder for SAM Twin Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5mm distance, a positioning uncertainty of $\pm 0.5\text{mm}$ would produce a SAR uncertainty of $\pm 20\%$. An accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions, in which the devices must be measured, are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r = 3$ and loss tangent $\tan \delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

System Validation Kits

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. For that purpose a well defined SAR distribution in the flat section of the SAM twin phantom is produced.

System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder. Dipoles are available for the variety of frequencies between 300MHz and 6 GHz (dipoles for other frequencies or media and other calibration conditions are available upon request).

The dipoles are highly symmetric and matched at the center frequency for the specified liquid and distance to the flat phantom (or flat section of the SAM-twin phantom). The accurate distance between the liquid surface and the dipole center is achieved with a distance holder that snaps on the dipole.

Robot

The DASY4 system uses the high precision industrial robots RX60L, RX90 and RX90L, as well as the RX60BL and RX90BL types out of the newer series from Staubli SA (France). The RX robot series offers many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance-free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (the closed metallic construction shields against motor control fields)

For the newly delivered DASY4 systems as well as for the older DASY3 systems delivered since 1999, the CS7MB robot controller version from Staubli is used. Previously delivered systems have either a CS7 or CS7M controller; the differences to the CS7MB are mainly in the hardware, but some procedures in the robot software from Staubli are also not completely the same. The following descriptions about robot hard- and software correspond to CS7MB controller with software version 13.1 (edit S5). The actual commands, procedures and configurations, also including details in hardware, might differ if an older robot controller is in use. In this case please also refer to the Staubli manuals for further information.



TESTING EQUIPMENT

Equipments List & Calibration Info

Type / Model	Cal. Date	S/N:
DASY4 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	CS7MBSP / 467
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Demension 3000	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	2005-10-18	456
DASY4 Measurement Server	N/A	1176
SPEAG E-Field Probe ET3DV6	2005-03-18	1604
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
Aprel Validation Dipole D-1800-S-2	2005-03-04	BCL-049
Brain Equivalent Matter (1900MHz)	Each Use	N/A
Muscle Equivalent Matter (1900MHz)	Each Use	N/A
Robot Table	Each Use	N/A
Phone Holder	Each Use	N/A
Phantom Cover	Each Use	N/A
HP Spectrum Analyzer HP8566A	N/A	2240A01930
Microwave Amp. 8349A	N/A	2644A02662
Power Meter Agilent E4919B	2005-08-31	MY4121511
Power Sensor Agilent E4412A	2005-09-08	US38488542
Network Analyzer HP-8752C	2005-2-22	3410A02356
Dielectric Probe Kit HP85070A	Each Use	US99360201
Signal Generator HP-83650B	2004-02-29	3614A002716
Amplifier, ST181-20	N/R	E012-0101
Antenna, Horn DRG-118A	2004-02-06	A052704
Analyzer, Communication, Agilent E5515C	2005-08-08	GB44051221

SAR MEASUREMENT SYSTEM VERIFICATION

System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of $\pm 10\%$. 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 for head

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

Validation Dipole SAR Reference Test Result for Body (1900 MHz)

Validation Measurement	SAR @ 0.126W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.126W Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	3.1	24.61	1.42	11.27
Test 2	3.1	24.61	1.41	11.20
Test 3	3.2	25.41	1.43	11.35
Test 4	3.2	25.41	1.42	11.27
Test 5	3.1	24.61	1.42	11.27
Test 6	3.2	25.61	1.41	11.20
Test 7	3.2	25.61	1.43	11.35
Test 8	3.1	24.61	1.42	11.27
Test 9	3.1	24.61	1.42	11.27
Test 10	3.1	24.61	1.43	11.35
Average	3.14	24.97	1.421	11.28

EUT TEST STRATEGY AND METHODOLOGY

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.

CONCLUSION

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 Appendix E.

SAR Body Worst-Case Test Data

Environmental Conditions

Ambient Temperature:	17° C
Relative Humidity:	44%
ATM Pressure:	1080 mbar

* Testing was performed by Daniel Du on 2005-12-05.

Averatec Notebook :

EUT position	Freq (MHz)	Output Power (W)	Liquid	Phantom	Measured (mW/g)		Limit (mW/g)	Plot #
					1 g	10 g		
Back touch Phantom	1850.2	0.955	Body	Flat	1.47	0.791	1.6	1
Back touch Phantom	1880	0.933	Body	Flat	1.29	0.698	1.6	2
Back touch Phantom	1909.8	0.895	Body	Flat	1.29	0.679	1.6	3

HP Notebook :

EUT position	Freq (MHz)	Output Power (W)	Liquid	Phantom	Measured (mW/g)		Limit (mW/g)	Plot #
					1 g	10 g		
Back touch Phantom	1850.2	0.955	Body	Flat	0.906	0.521	1.6	4
Back touch Phantom	1880	0.933	Body	Flat	0.779	0.437	1.6	5
Back touch Phantom	1909.8	0.895	Body	Flat	0.751	0.417	1.6	6

Toshiba Notebook :

EUT position	Freq (MHz)	Output Power (W)	Liquid	Phantom	Measured (mW/g)		Limit (mW/g)	Plot #
					1 g	10 g		
Back touch Phantom	1850.2	0.955	Body	Flat	1.03	0.552	1.6	7
Back touch Phantom	1880	0.933	Body	Flat	1.08	0.583	1.6	8
Back touch Phantom	1909.8	0.895	Body	Flat	1.12	0.595	1.6	9

APPENDIX A – MEASUREMENT UNCERTAINTY

The uncertainty budget has been determined for the DASY4 measurement system and is given in the following Table.

DASY4 Uncertainty Budget According to IEEE 1528 [1]								
Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±5.9 %	N	1	1	1	±5.9 %	±5.9 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Conditions	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Phantom and Setup								
Phantom Uncertainty	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Liquid Conductivity (target)	±5.0 %	R	$\sqrt{3}$	0.64	0.43	±1.8 %	±1.2 %	∞
Liquid Conductivity (meas.)	±2.5 %	N	1	0.64	0.43	±1.6 %	±1.1 %	∞
Liquid Permittivity (target)	±5.0 %	R	$\sqrt{3}$	0.6	0.49	±1.7 %	±1.4 %	∞
Liquid Permittivity (meas.)	±2.5 %	N	1	0.6	0.49	±1.5 %	±1.2 %	∞
Combined Std. Uncertainty						±10.8 %	±10.6 %	330
Expanded STD Uncertainty						±21.6 %	±21.1 %	

DASY4 Uncertainty Budget
According to CENELEC EN 50361 [2]

Error Description	Uncertainty value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement Equipment								
Probe Calibration	$\pm 5.9\%$	N	1	1	1	$\pm 5.9\%$	$\pm 5.9\%$	∞
Axial Isotropy	$\pm 4.7\%$	R	$\sqrt{3}$	0.7	0.7	$\pm 1.9\%$	$\pm 1.9\%$	∞
Spherical Isotropy	$\pm 9.6\%$	R	$\sqrt{3}$	0.7	0.7	$\pm 3.9\%$	$\pm 3.9\%$	∞
Probe Linearity	$\pm 4.7\%$	R	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7\%$	∞
Detection Limit	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$	∞
Boundary Effects	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$	∞
Readout Electronics	$\pm 0.3\%$	N	1	1	1	$\pm 0.3\%$	$\pm 0.3\%$	∞
Response Time	$\pm 0.8\%$	N	1	1	1	$\pm 0.8\%$	$\pm 0.8\%$	∞
Noise	$\pm 0\%$	N	1	1	1	$\pm 0\%$	$\pm 0\%$	∞
Integration Time	$\pm 2.6\%$	N	1	1	1	$\pm 2.6\%$	$\pm 2.6\%$	∞
Mechanical Constraints								
Scanning System	$\pm 0.4\%$	R	$\sqrt{3}$	1	1	$\pm 0.2\%$	$\pm 0.2\%$	∞
Phantom Shell	$\pm 4.0\%$	R	$\sqrt{3}$	1	1	$\pm 2.3\%$	$\pm 2.3\%$	∞
Probe Positioning	$\pm 2.9\%$	R	$\sqrt{3}$	1	1	$\pm 1.7\%$	$\pm 1.7\%$	∞
Device Positioning	$\pm 2.9\%$	N	1	1	1	$\pm 2.9\%$	$\pm 2.9\%$	145
Physical Parameters								
Liquid Conductivity (target)	$\pm 5.0\%$	R	$\sqrt{3}$	0.7	0.5	$\pm 2.0\%$	$\pm 1.4\%$	∞
Liquid Conductivity (meas.)	$\pm 4.3\%$	R	$\sqrt{3}$	0.7	0.5	$\pm 1.7\%$	$\pm 1.2\%$	∞
Liquid Permittivity (target)	$\pm 5.0\%$	R	$\sqrt{3}$	0.6	0.5	$\pm 1.7\%$	$\pm 1.4\%$	∞
Liquid Permittivity (meas.)	$\pm 4.3\%$	R	$\sqrt{3}$	0.6	0.5	$\pm 1.5\%$	$\pm 1.2\%$	∞
Power Drift	$\pm 5.0\%$	R	$\sqrt{3}$	1	1	$\pm 2.9\%$	$\pm 2.9\%$	∞
RF Ambient Conditions	$\pm 3.0\%$	R	$\sqrt{3}$	1	1	$\pm 1.7\%$	$\pm 1.7\%$	∞
Post-Processing								
Extrap. and Integration	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	$\pm 0.6\%$	∞
Combined Std. Uncertainty						$\pm 10.9\%$	$\pm 10.6\%$	18125
Expanded Std. Uncertainty						$\pm 21.7\%$	$\pm 12.1\%$	

APPENDIX B – PROBE CALIBRATION CERTIFICATES

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zuegihausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Bay Area

Certificate No: ET3-1604_Mar05

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1604

Calibration procedure(s)
QA CAL-01.v5 and QA CAL-12.v4
Calibration procedure for dosimetric E-field probes

Calibration date: March 18, 2005

Condition of the calibrated item In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5066 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 617	19-Jan-05 (SPEAG, No. DAE4-617_Jan05)	Jan-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-98 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390685	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05
Calibrated by:	Name Nico Vetterli	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 18, 2005

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: ET3-1604_Mar05

Page 1 of 9

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 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM_{x,y,z}	sensitivity in free space
ConF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
Polarization ϕ	ϕ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz)", July 2001

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)x,y,z = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCPx,y,z**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical Isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

ET3DV6 SN:1604

March 18, 2005

Probe ET3DV6

SN:1604

Manufactured: July 30, 2001
Last calibrated: July 10, 2004
Recalibrated: March 18, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1604

March 18, 2005

DASY - Parameters of Probe: ET3DV6 SN:1604**Sensitivity in Free Space^A**

NormX	1.88 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.79 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.91 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression^B

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

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR _{be} [%] Without Correction Algorithm	8.5	4.5
SAR _{be} [%] With Correction Algorithm	0.0	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
SAR _{be} [%] Without Correction Algorithm	13.2	9.0
SAR _{be} [%] With Correction Algorithm	1.0	0.0

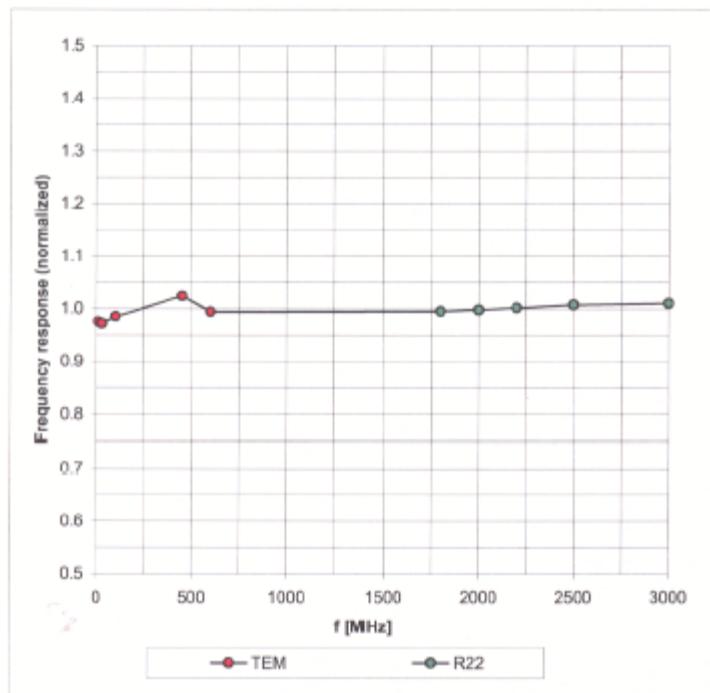
Sensor OffsetProbe Tip to Sensor Center **2.7** mm

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

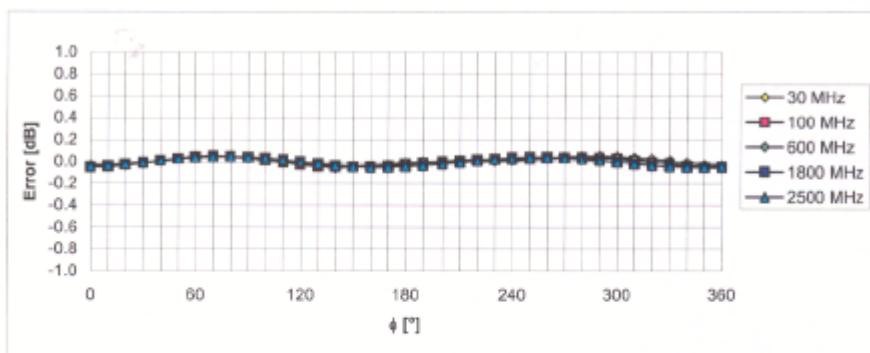
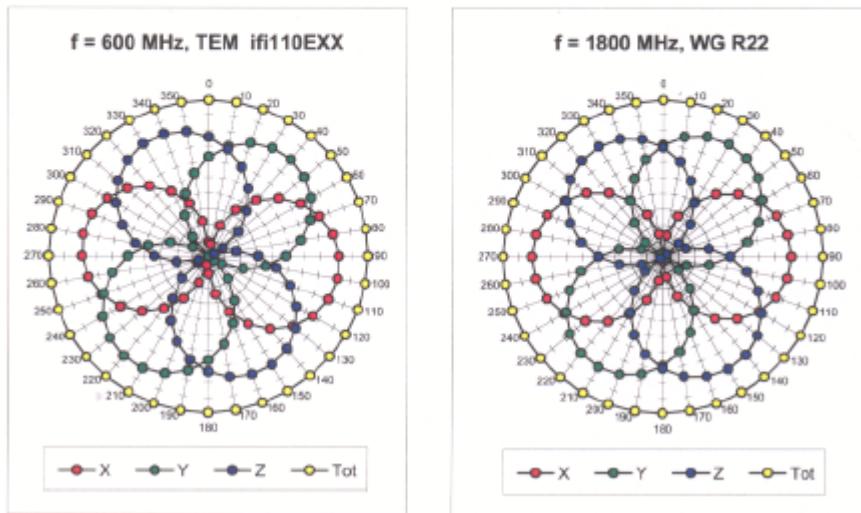
^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL. (see Page 8).^B Numerical linearization parameter: uncertainty not required.

Frequency Response of E-Field

(TEM-Cell:if1110 EXX, Waveguide: R22)

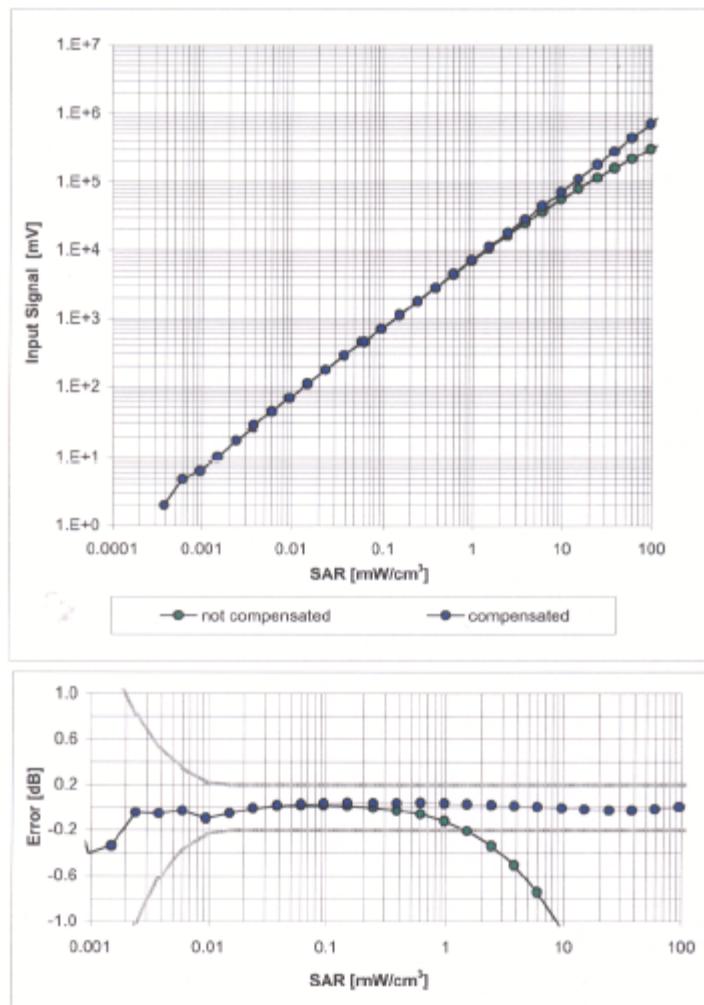


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$ Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

ET3DV6 SN:1604

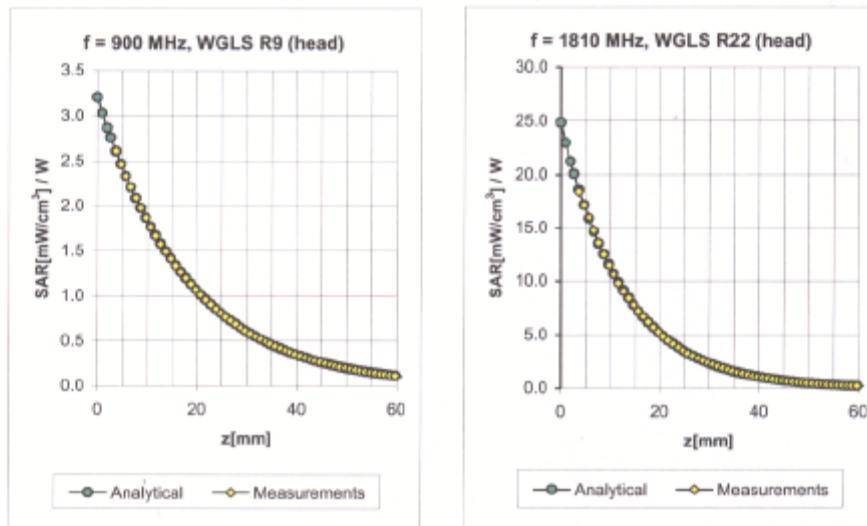
March 18, 2005

Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800$ MHz)Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

ET3DV6 SN:1604

March 18, 2005

Conversion Factor Assessment



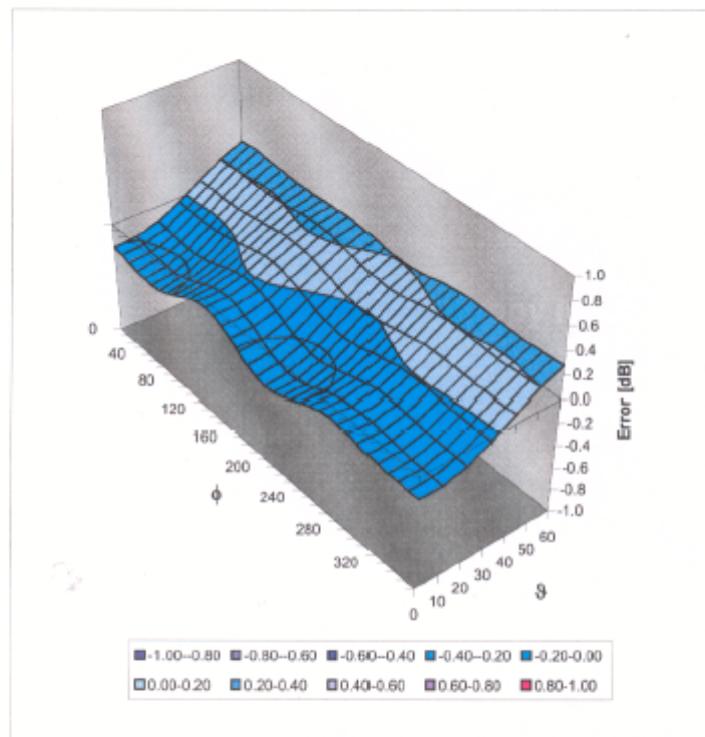
f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
300	$\pm 50 / \pm 100$	Head	45.3 \pm 5%	0.87 \pm 5%	0.10	1.14	8.44 \pm 13.3% (k=2)
450	$\pm 50 / \pm 100$	Head	43.5 \pm 5%	0.87 \pm 5%	0.10	1.10	8.10 \pm 13.3% (k=2)
900	$\pm 50 / \pm 100$	Head	41.5 \pm 5%	0.97 \pm 5%	0.63	1.78	6.62 \pm 11.0% (k=2)
1810	$\pm 50 / \pm 100$	Head	40.0 \pm 5%	1.40 \pm 5%	0.58	2.40	5.19 \pm 11.0% (k=2)
2450	$\pm 50 / \pm 100$	Head	39.2 \pm 5%	1.80 \pm 5%	0.66	2.25	4.58 \pm 11.8% (k=2)

450	$\pm 50 / \pm 100$	Body	56.7 \pm 5%	0.94 \pm 5%	0.06	1.40	7.54 \pm 13.3% (k=2)
900	$\pm 50 / \pm 100$	Body	55.0 \pm 5%	1.05 \pm 5%	0.53	2.02	6.27 \pm 11.0% (k=2)
1810	$\pm 50 / \pm 100$	Body	53.3 \pm 5%	1.52 \pm 5%	0.55	2.75	4.79 \pm 11.0% (k=2)
2450	$\pm 50 / \pm 100$	Body	52.7 \pm 5%	1.95 \pm 5%	0.70	2.13	4.24 \pm 11.8% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

ET3DV6 SN:1604

March 18, 2005

Deviation from Isotropy in HSLError (ϕ, θ), $f = 900$ MHzUncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.com

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1604

Place of Assessment:

Zurich

Date of Assessment:

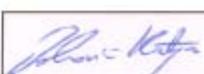
March 21, 2005

Probe Calibration Date:

March 18, 2005

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:



Schmid & Partner Engineering AG

s p e a g

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ET3DV6 SN:1604Conversion factor (\pm standard deviation)**f = 150 MHz** ConvF **9.0 \pm 10%** $\epsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m

(head tissue)

f = 150 MHz ConvF **8.6 \pm 10%** $\epsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m

(body tissue)

f = 300 MHz ConvF **7.9 \pm 9%** $\epsilon_r = 58.2 \pm 5\%$ $\sigma = 0.92 \pm 5\%$ mho/m

(body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.

APPENDIX C – DIPOLE CALIBRATION CERTIFICATES

NCL CALIBRATION LABORATORIES

Calibration File No: DC-0267
Project Number: BACL-CAL2450-3985

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

BACL Validation Dipole

Manufacturer: APREL Laboratories

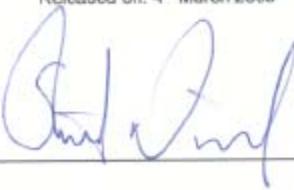
Part number: D-1800-S-1

Frequency: 1800 MHz

Serial No: BCL-049

Customer: Bay Area Compliance Laboratory

Calibrated: 4th March 2005
Released on: 4th March 2005

Released By: 

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2B 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

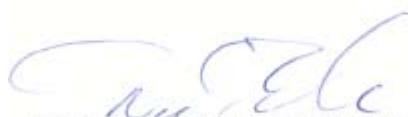
Dipole BCL-049 received from customer, with the attribute of having a repair to one radial arm, in good condition for re-calibration. SMA connector cleaned prior to calibration.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Stuart Nicol
Director Product Development



D. Brooks
Member of Engineering Staff
(Calibration Engineer)

This page has been reviewed for content and attested to by signature within this document.

NCL Calibration Laboratories
Division of APREL Laboratories.**Calibration Results Summary**

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

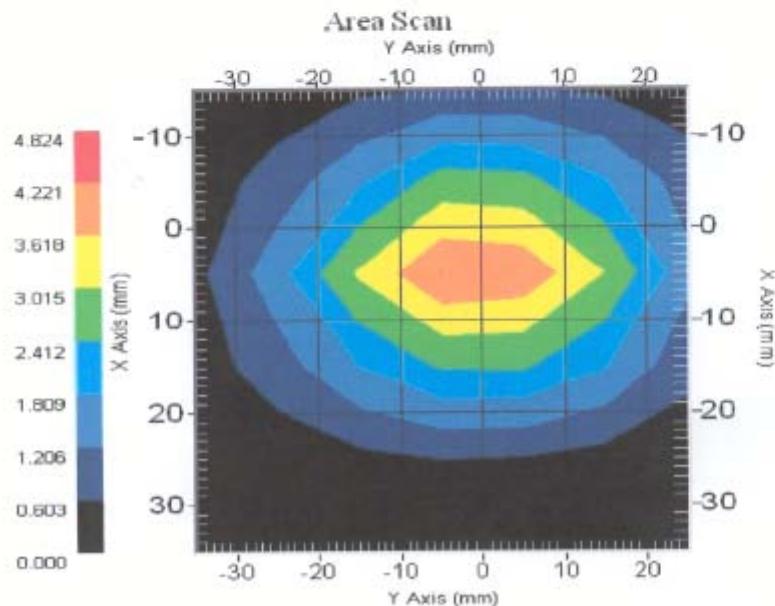
Length: 72.0 mm
Height: 41.7 mm

Electrical Specification

SWR: 1.09 U
Return Loss: -26.9 dB
Impedance: 50.9 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1800 MHz	38.81	20.01	71.56



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3

NCL Calibration Laboratories

Division of APREL Laboratories.

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole BCL-049. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with APREL E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure

SSI-TP-016 Tissue Calibration Procedure

IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

Conditions

Dipole BCL-049 received from customer in good condition, with the attribute of a repair of one radial arm.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 20 °C +/- 0.5°C

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Division of APREL Laboratories.

Dipole Calibration Results**Mechanical Verification**

APREL Length	APREL Height	Measured Length	Measured Height
72.0 mm	41.7 mm	71.6 mm	41.7 mm

Tissue Validation

Head Tissue 1800 MHz	Measured
Dielectric constant, ϵ_r	40.0
Conductivity, σ [S/m]	1.40

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5

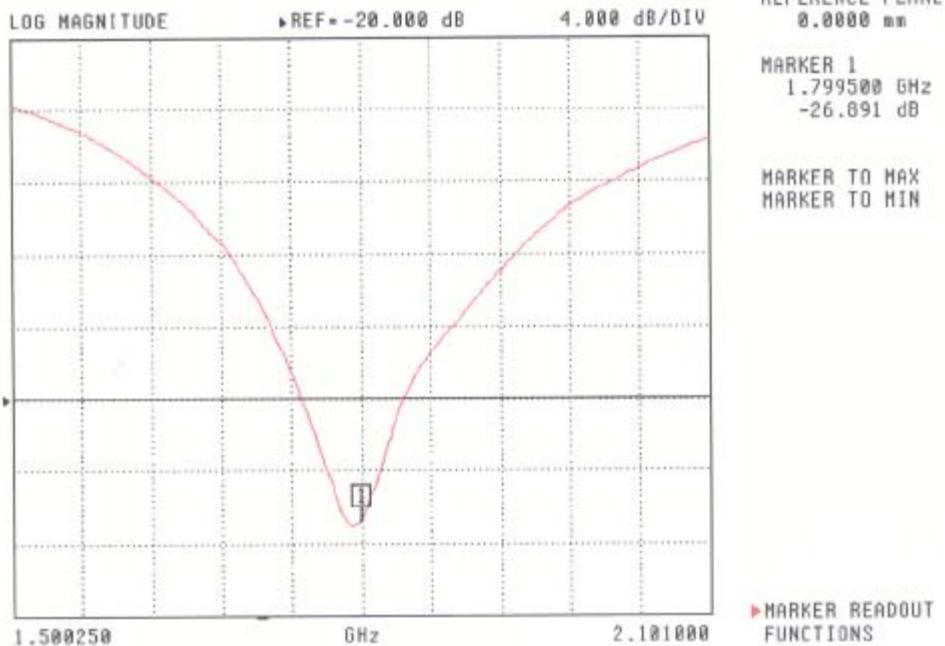
NCL Calibration Laboratories

Division of APREL Laboratories.

Electrical Calibration

Test	Result
S11 R/L	-26.9 dB
SWR	1.09 U
Impedance	50.9 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss**S22 REVERSE REFLECTION**

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NCL Calibration Laboratories
Division of APREL Laboratories.

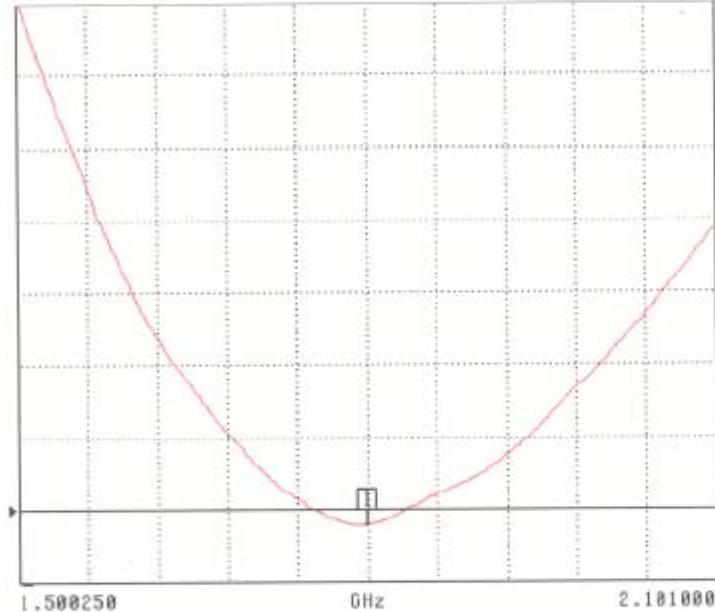
SWR

S22 REVERSE REFLECTION

SWR

REF = 1.200 U

500.000 mU/DIV



CH 4 - S22
REFERENCE PLANE
0.0000 nm

MARKER 1
1.799500 GHz
1.095 U

MARKER TO MAX
MARKER TO MIN

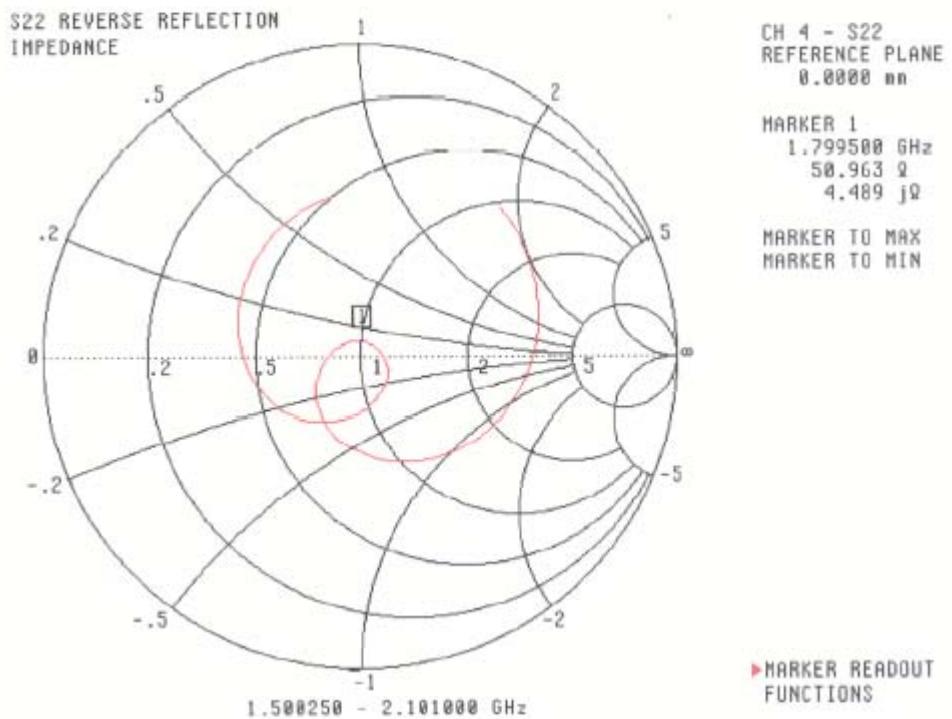
► MARKER READOUT
FUNCTIONS

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7

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Smith Chart Dipole Impedance

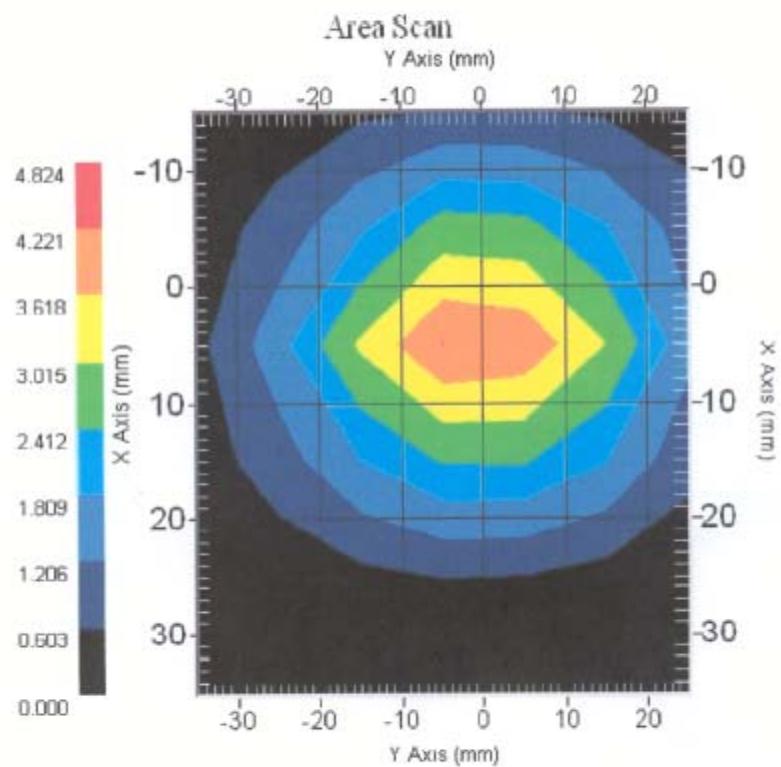
This page has been reviewed for content and attested to by signature within this document.

NCL Calibration Laboratories

Division of APREL Laboratories.

System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1800 MHz	38.81	20.01	71.56



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NCL Calibration Laboratories

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Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2004

10

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APPENDIX D - TEST SYSTEM VERIFICATIONS SCANS**Liquid Measurement Result**

Simulant	Freq [MHz]	Parameters	Liquid Temp [°C]	Target Value	Measured Value	Deviation	Limits [%]
Body	1900	ϵ_r	22.0	53.3	51.3	-3.75	± 5
		σ	22.0	1.52	1.58	3.95	± 5
		1g SAR	22.0	24.97	24	-3.88	± 10

Date/Time: 11/22/2005 9:57:04 AM

Test Laboratory: Bay Area Compliance Lab Corp.

SystemValidationCheck_D1900_Body**DUT: Dipole 1800 MHz; Type: D-1800-S-1; Serial: BCL-049**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

d=10mm, Pin=1W/Area Scan: Measurement grid: dx=10mm, dy=15mm

Maximum value of SAR (interpolated) = 29.4 mW/g

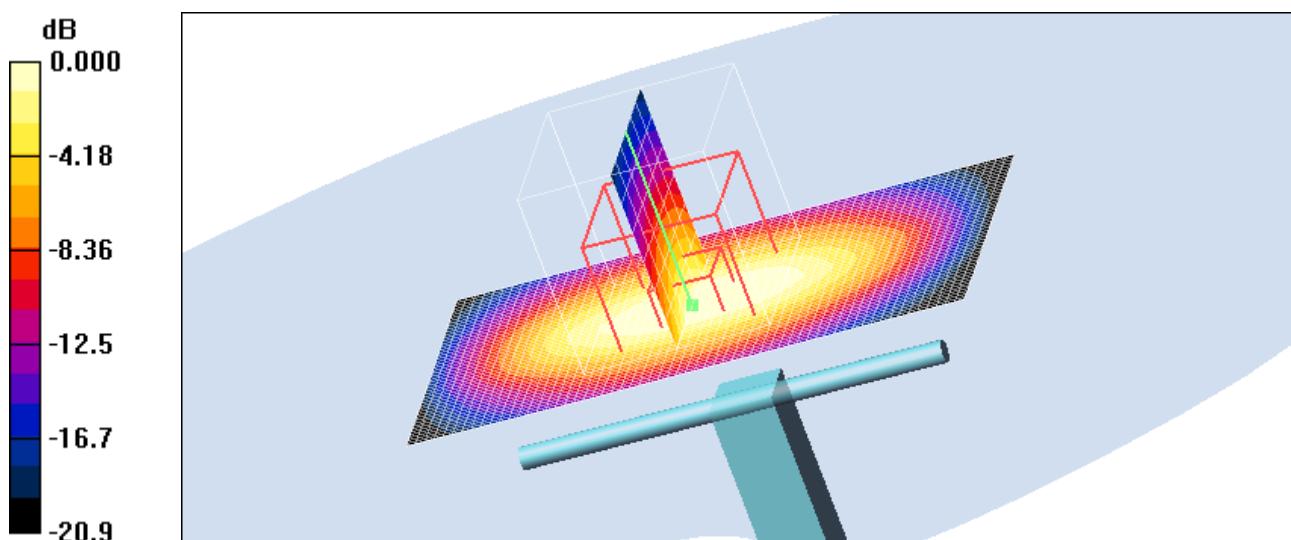
d=10mm, Pin=1W/Zoom Scan(7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 141.0 V/m; Power Drift = -0.032 dB

Peak SAR (extrapolated) = 46.3 W/kg

SAR(1 g) = 24 mW/g; SAR(10 g) = 11.8 mW/g

Maximum value of SAR (measured) = 27.3 mW/g



APPENDIX E - EUT SCANS

Averatec Low

Date/Time: 11/22/2005 5:57:51 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_AVERATEC

DUT: Novatec U630; Type: GSM PCMCIA; Serial:0001

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection) Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

AVERATEC LowCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.50 mW/g

AVERATEC LowCH/Z Scan: Measurement grid: dx=20mm, dy=20mm, dz=10mm

Maximum value of SAR (interpolated) = 0.562 mW/g

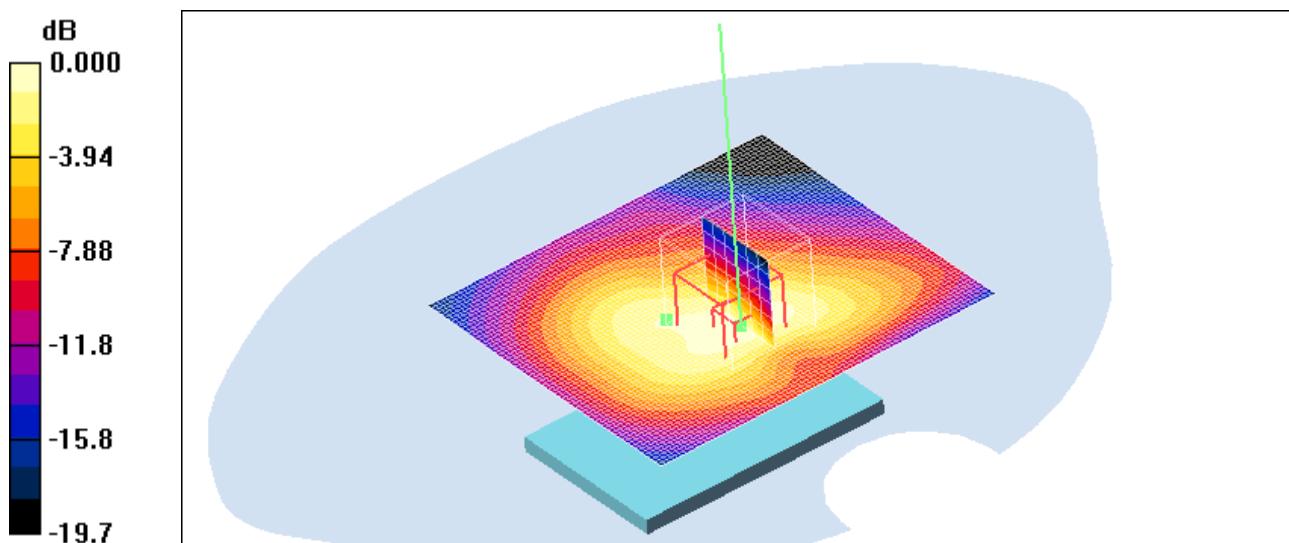
AVERATEC LowCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 30.7 V/m; Power Drift = -0.023 dB

Peak SAR (extrapolated) = 2.91 W/kg

SAR(1 g) = 1.47 mW/g; SAR(10 g) = 0.791 mW/g

Maximum value of SAR (measured) = 1.69 mW/g



0 dB = 1.69mW/g

Plot #1

Averatec Mid

Date/Time: 11/22/2005 5:35:23 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_AVERATEC**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.57$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

AVERATEC MidCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.40 mW/g

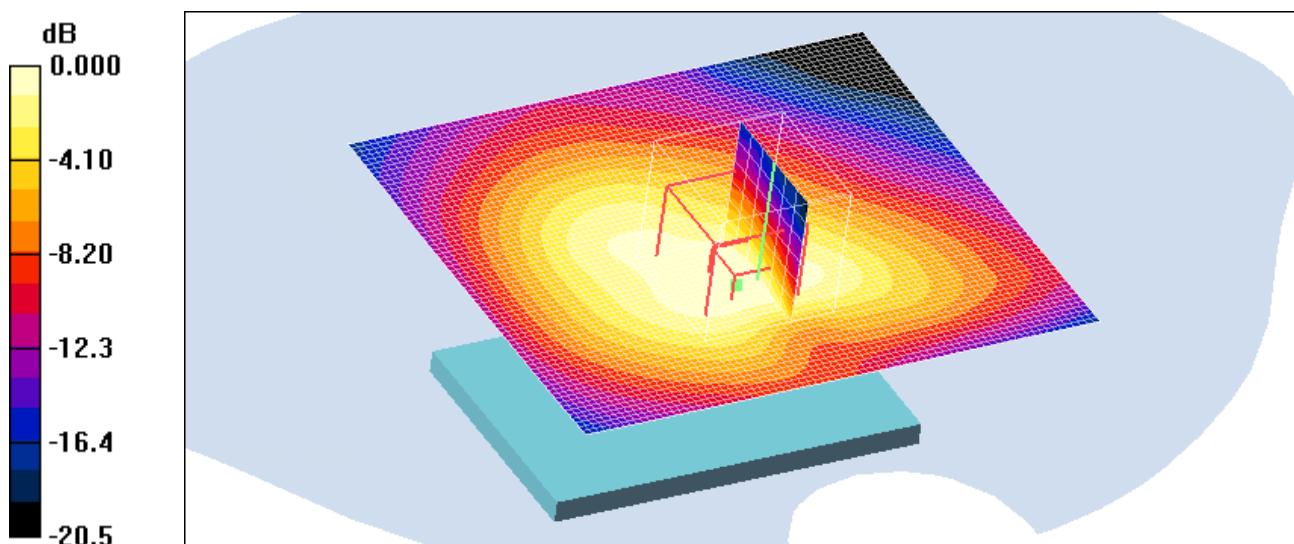
AVERATEC MidCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 27.4 V/m; Power Drift = 0.031 dB

Peak SAR (extrapolated) = 2.54 W/kg

SAR(1 g) = 1.29 mW/g; SAR(10 g) = 0.698 mW/g

Maximum value of SAR (measured) = 1.42 mW/g



0 dB = 1.42mW/g

Plot #2

Averatec High

Date/Time: 11/22/2005 6:20:17 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_AVERATEC**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1909.8$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

AVERATEC HighCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.39 mW/g

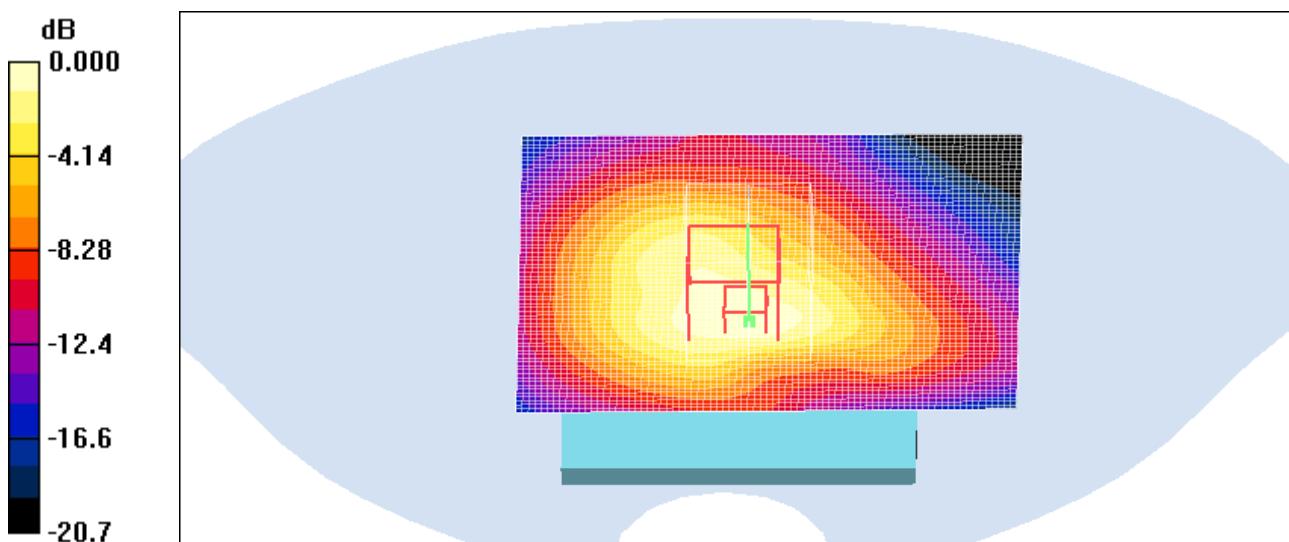
AVERATEC HighCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 26.9 V/m; Power Drift = 0.024 dB

Peak SAR (extrapolated) = 2.68 W/kg

SAR(1 g) = 1.29 mW/g; SAR(10 g) = 0.679 mW/g

Maximum value of SAR (measured) = 1.46 mW/g



0 dB = 1.46mW/g

Plot #3

HP Low

Date/Time: 11/22/2005 3:06:51 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_HP**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection) Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

HP LowCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.970 mW/g

HP LowCH/Z Scan: Measurement grid: dx=20mm, dy=20mm, dz=10mm

Maximum value of SAR (interpolated) = 0.347 mW/g

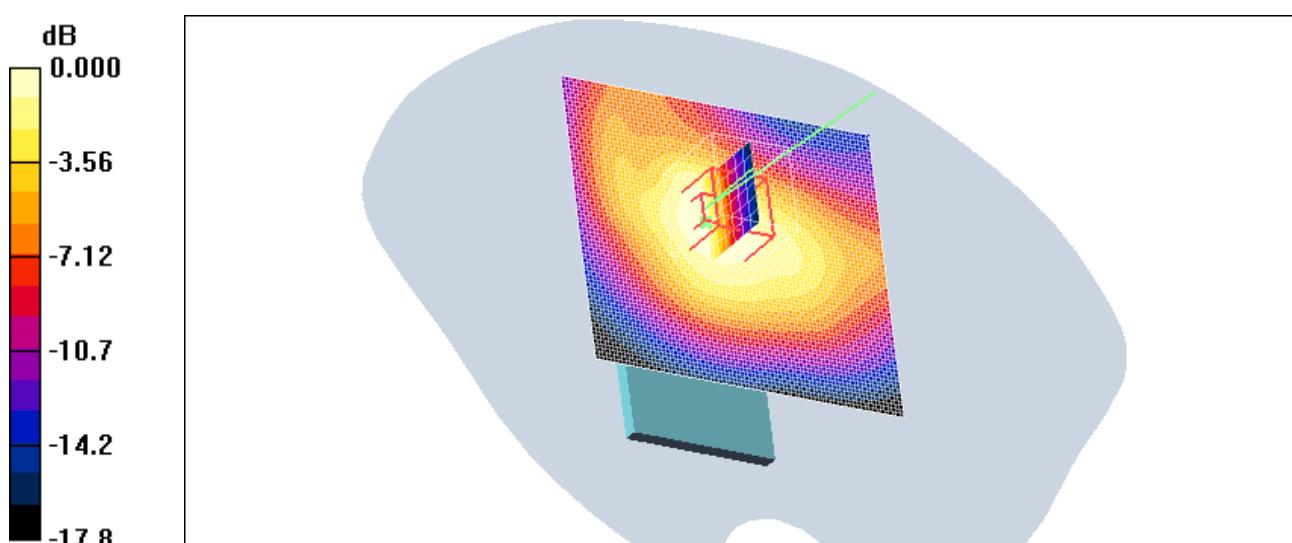
HP LowCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 15.6 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 1.69 W/kg

SAR(1 g) = 0.906 mW/g; SAR(10 g) = 0.521 mW/g

Maximum value of SAR (measured) = 1.01 mW/g

**Plot #4**

HP Mid

Date/Time: 11/22/2005 2:28:21 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_HP**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.57$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

HP MidCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.889 mW/g

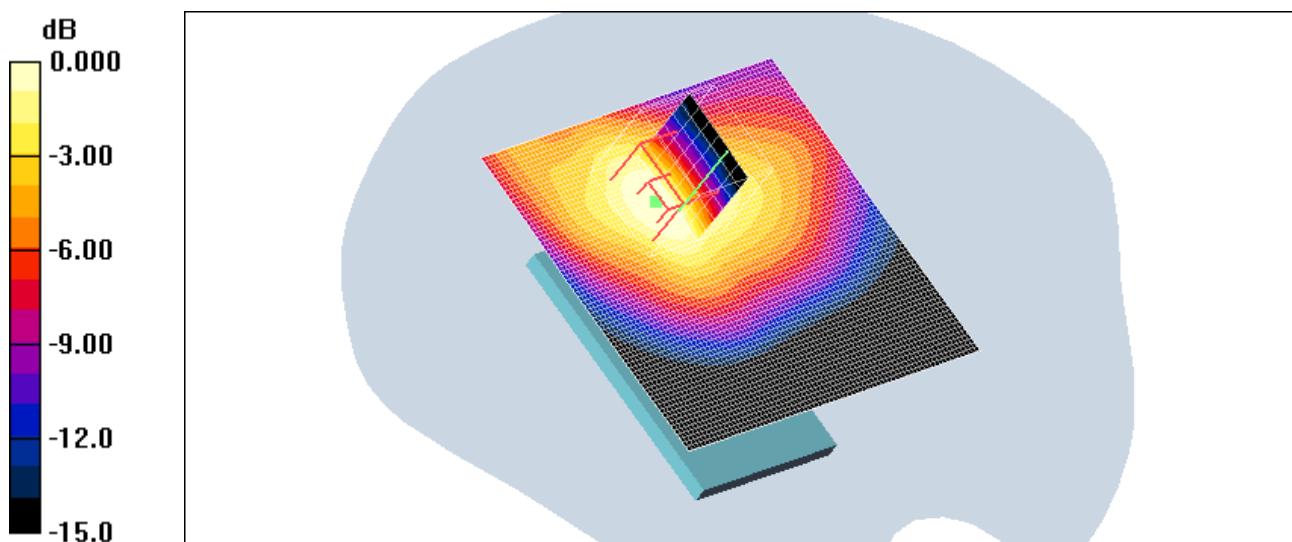
HP MidCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 8.66 V/m; Power Drift = -0.128 dB

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.779 mW/g; SAR(10 g) = 0.437 mW/g

Maximum value of SAR (measured) = 0.849 mW/g



0 dB = 0.849mW/g

Plot #5

HP High

Date/Time: 11/22/2005 4:07:57 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_HP**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1909.8$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

HP HighCH/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.781 mW/g

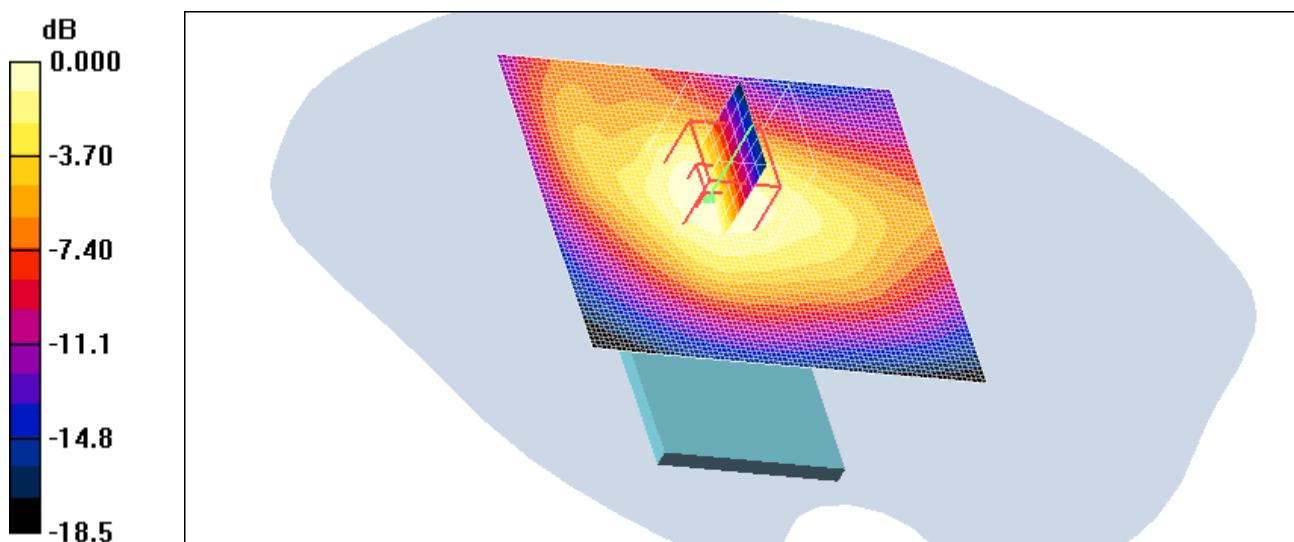
HP HighCH/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 13.1 V/m; Power Drift = 0.024 dB

Peak SAR (extrapolated) = 1.38 W/kg

SAR(1 g) = 0.751 mW/g; SAR(10 g) = 0.417 mW/g

Maximum value of SAR (measured) = 0.828 mW/g



0 dB = 0.828mW/g

Plot #6

Toshiba Low

Date/Time: 11/22/2005 12:48:53 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_TOSHIBA**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.55$ mho/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

TOSHIBA 2/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.15 mW/g

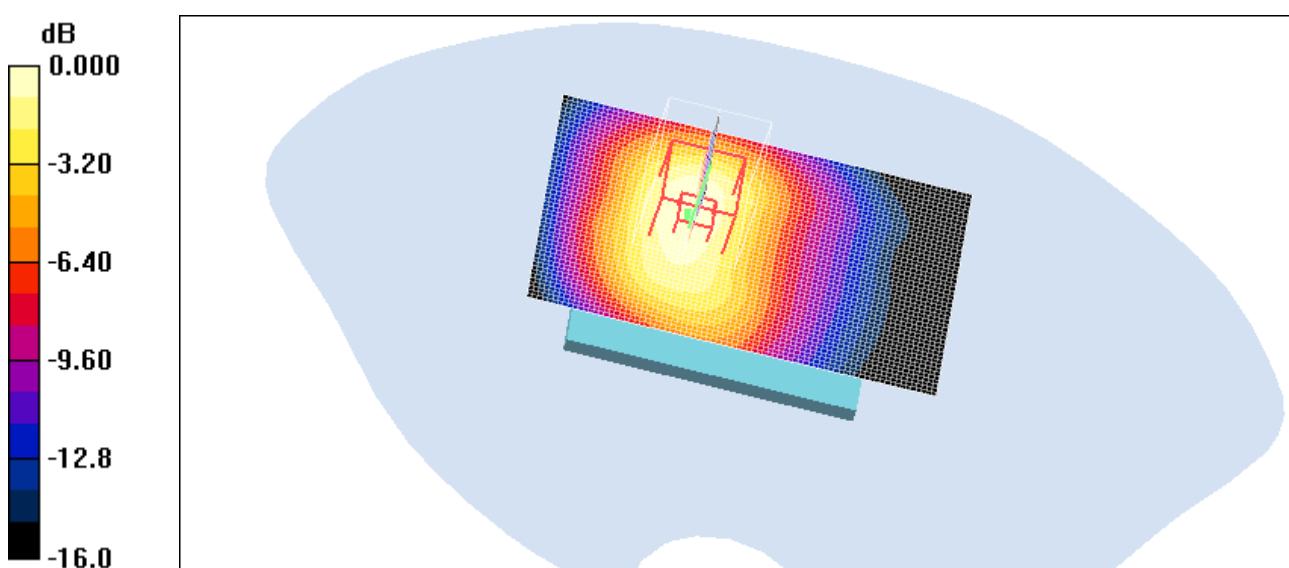
TOSHIBA 2/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 12.8 V/m; Power Drift = -0.209 dB

Peak SAR (extrapolated) = 2.04 W/kg

SAR(1 g) = 1.03 mW/g; SAR(10 g) = 0.552 mW/g

Maximum value of SAR (measured) = 1.14 mW/g



0 dB = 1.14mW/g

Plot #7

Toshiba Mid

Date/Time: 11/22/2005 12:11:01 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_TOSHIBA**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.57$ mho/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

TOSHIBA/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.14 mW/g

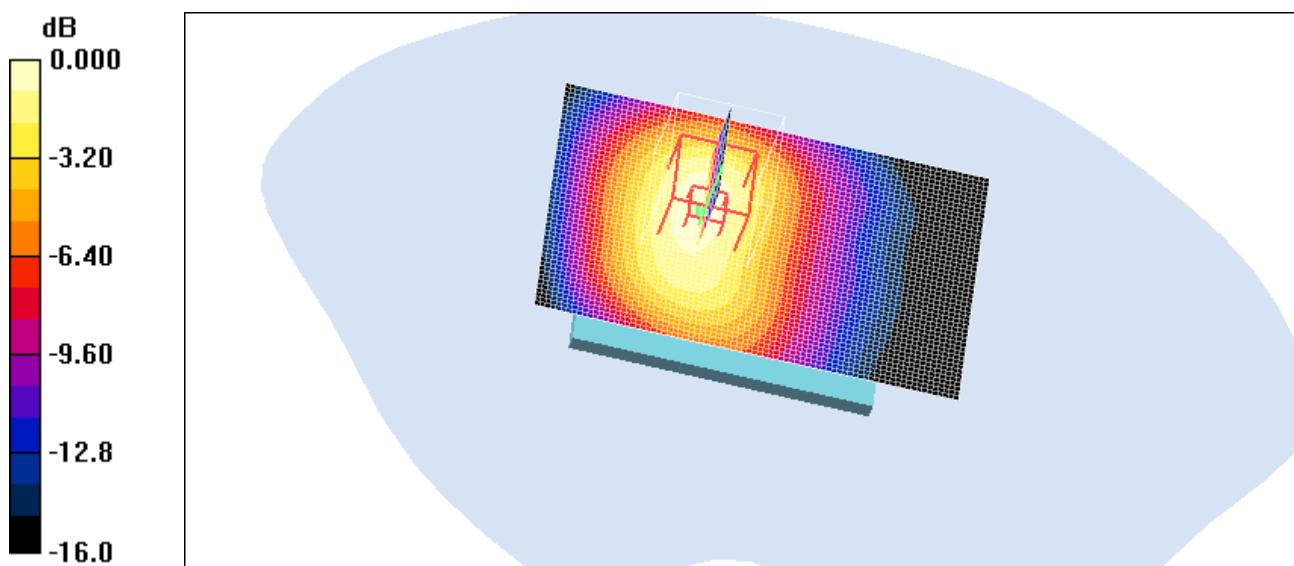
TOSHIBA/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 12.3 V/m; Power Drift = 0.050 dB

Peak SAR (extrapolated) = 2.18 W/kg

SAR(1 g) = 1.08 mW/g; SAR(10 g) = 0.583 mW/g

Maximum value of SAR (measured) = 1.23 mW/g



0 dB = 1.23mW/g

Plot #8

Toshiba High

Date/Time: 11/22/2005 1:15:04 PM

Test Laboratory: Bay Area Compliance Lab Corp.

U630_GSM_Body_TOSHIBA**DUT: Novatec U630; Type: GSM PCMCIA; Serial: 0001**

Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3

Medium parameters used: $f = 1909.8$ MHz; $\sigma = 1.58$ mho/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1604; ConvF(4.79, 4.79, 4.79); Calibrated: 3/18/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection) Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE3 Sn456; Calibrated: 10/18/2005
- Phantom: SAM with CRP; Type: Twin SAM; Serial: TP-1032
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

TOSHIBA 2 2/Area Scan: Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.18 mW/g

TOSHIBA 2 2/Z Scan: Measurement grid: dx=20mm, dy=20mm, dz=10mm

Maximum value of SAR (interpolated) = 0.422 mW/g

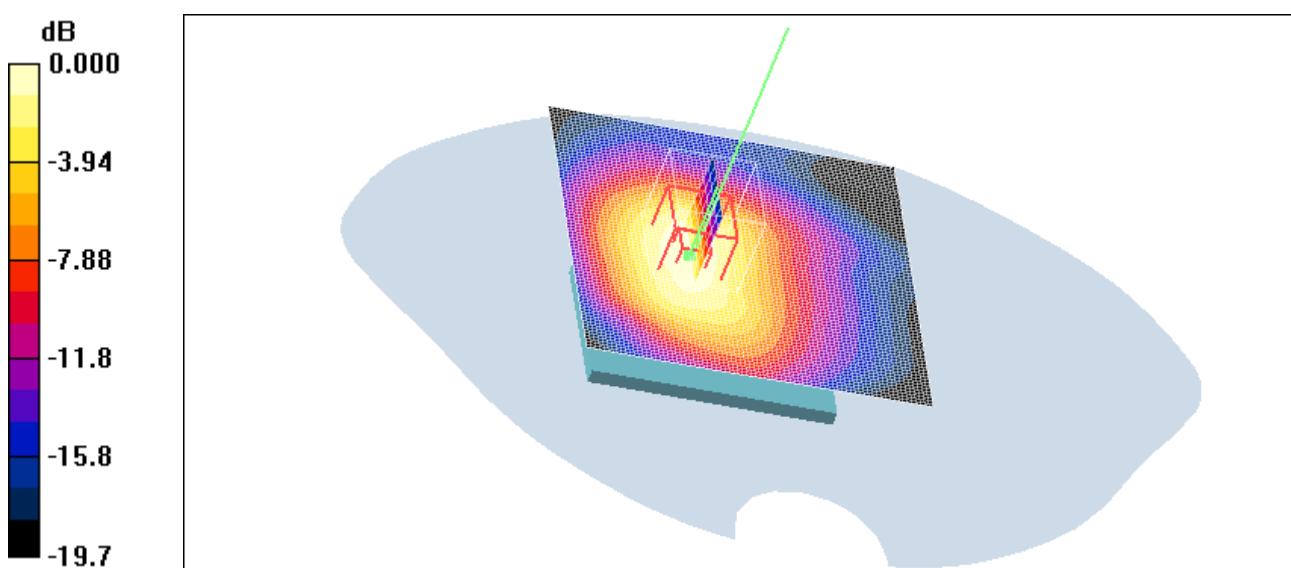
TOSHIBA 2 2/Zoom Scan (7x7x5): Measurement grid: dx=7mm, dy=7mm, dz=5mm

Reference Value = 12.4 V/m; Power Drift = -0.077 dB

Peak SAR (extrapolated) = 2.24 W/kg

SAR(1 g) = 1.12 mW/g; SAR(10 g) = 0.595 mW/g

Maximum value of SAR (measured) = 1.24 mW/g

**Plot #9**

APPENDIX F – CONDUCTED OUTPUT POWER MEASUREMENT

Provision Applicable

The measured peak output power should be greater and within 5% than EMI measurement.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Test equipment

Hewlett Packard HP8564E Spectrum Analyzer, Calibration Due Date: 2005-10-04.

Hewlett Packard HP 7470A Plotter, Calibration not required.

A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2005-05-31

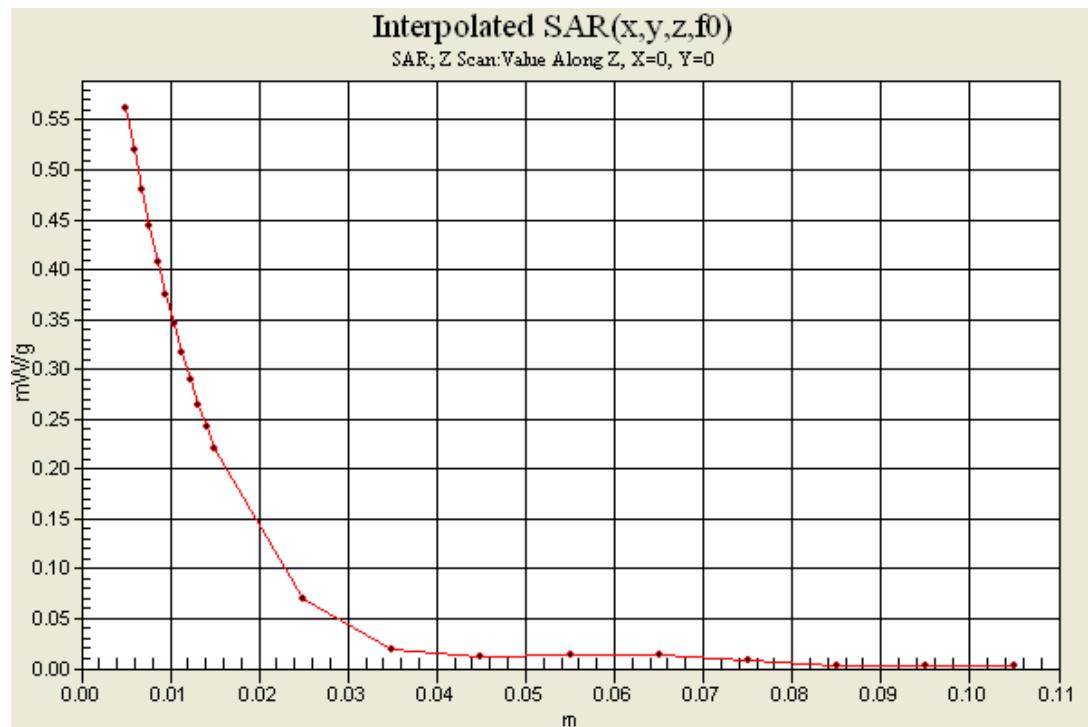
Com-Power AB-100 Dipole Antenna, Calibration Due Date: 2005-09-05

Test Results

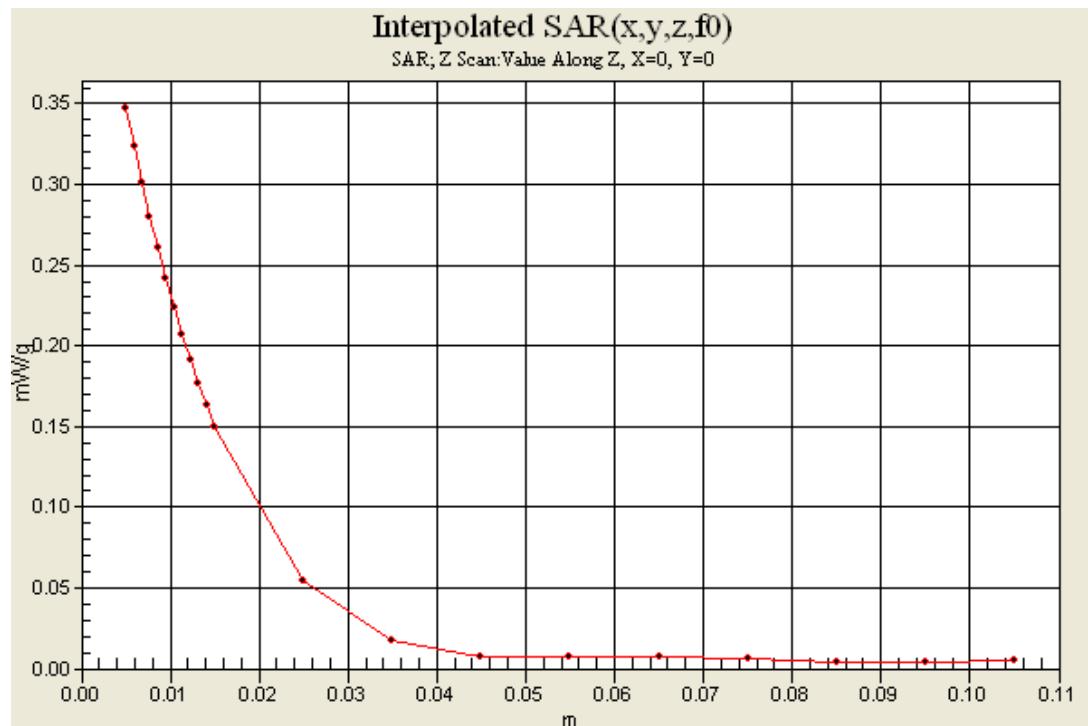
Frequency (MHz)	Output Power in dBm	Output Power in W
1850.2 (Low)	29.80	0.955
1880 (Mid)	29.70	0.933
1909.8 (High)	29.52	0.895

Please refer to the following plots.

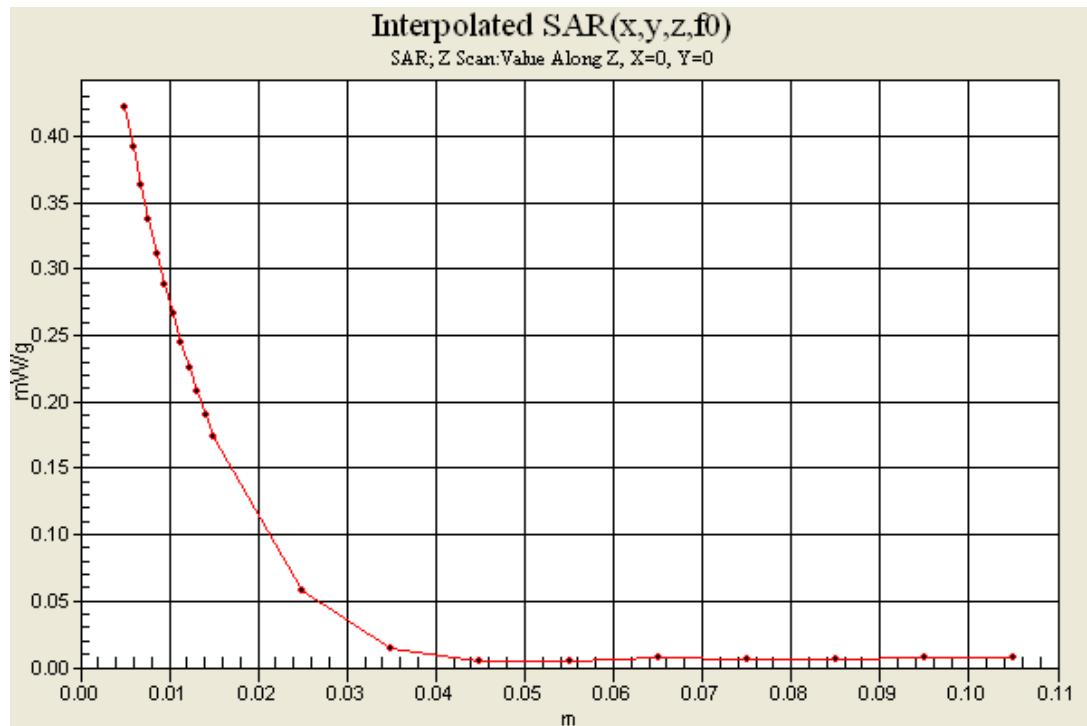
Averatec Notebook :



HP Notebook :



Toshiba Notebook :



APPENDIX G – EUT TEST POSITION PHOTOS

Averatec Notebook 1



Averatec Notebook 2



HP Notebook 1



HP Notebook 2



Toshiba Notebook 1



Toshiba Notebook 2



APPENDIX H – EUT & ACCESSORIES PHOTOS

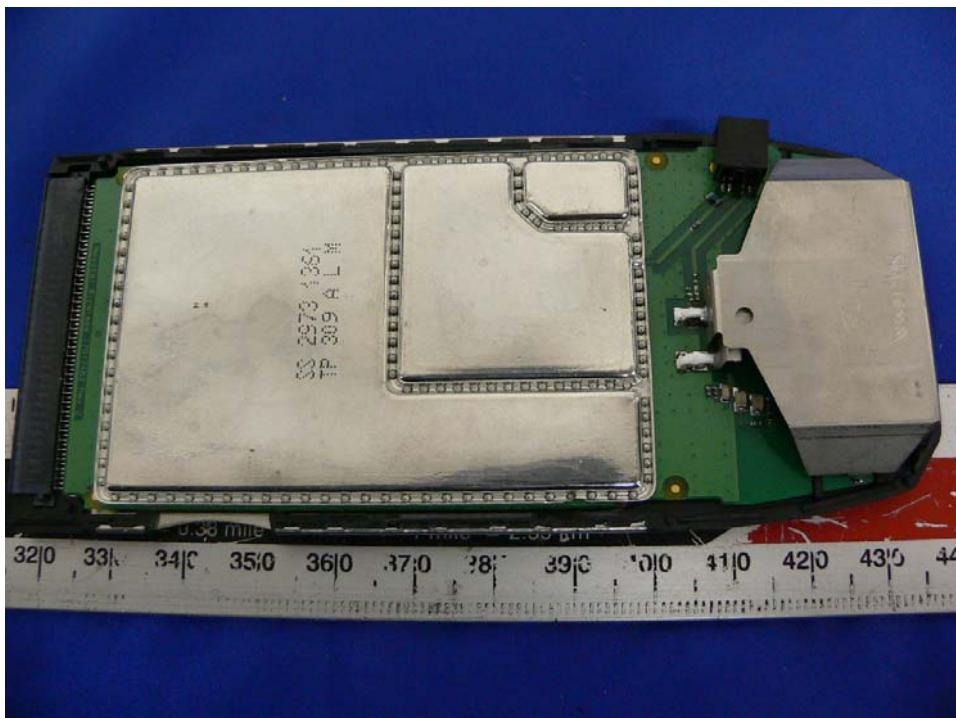
EUT – Front View



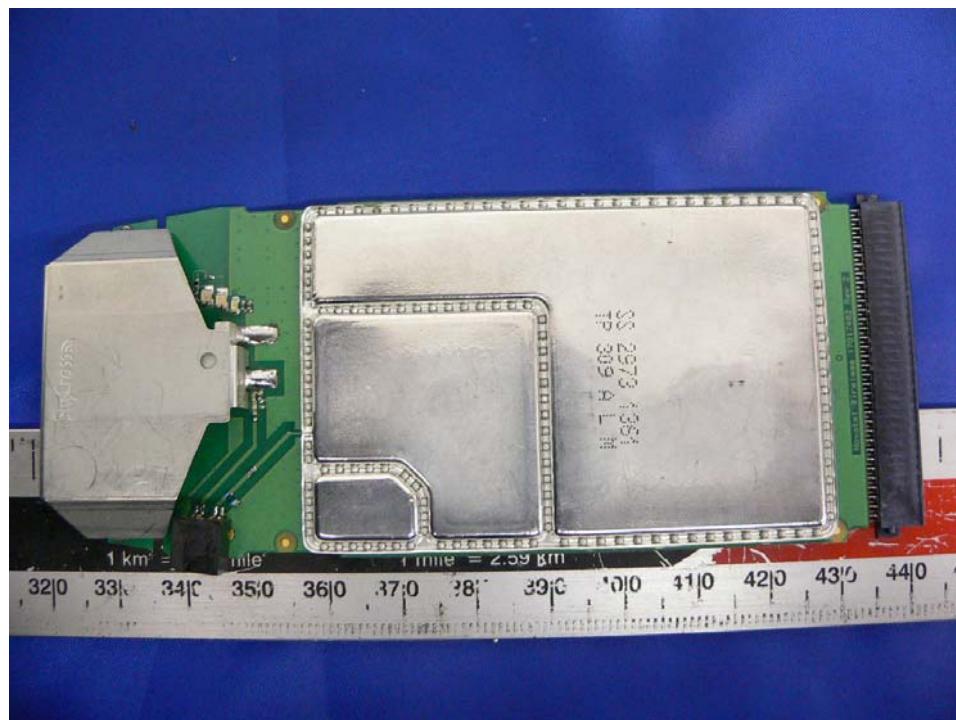
EUT – Back View

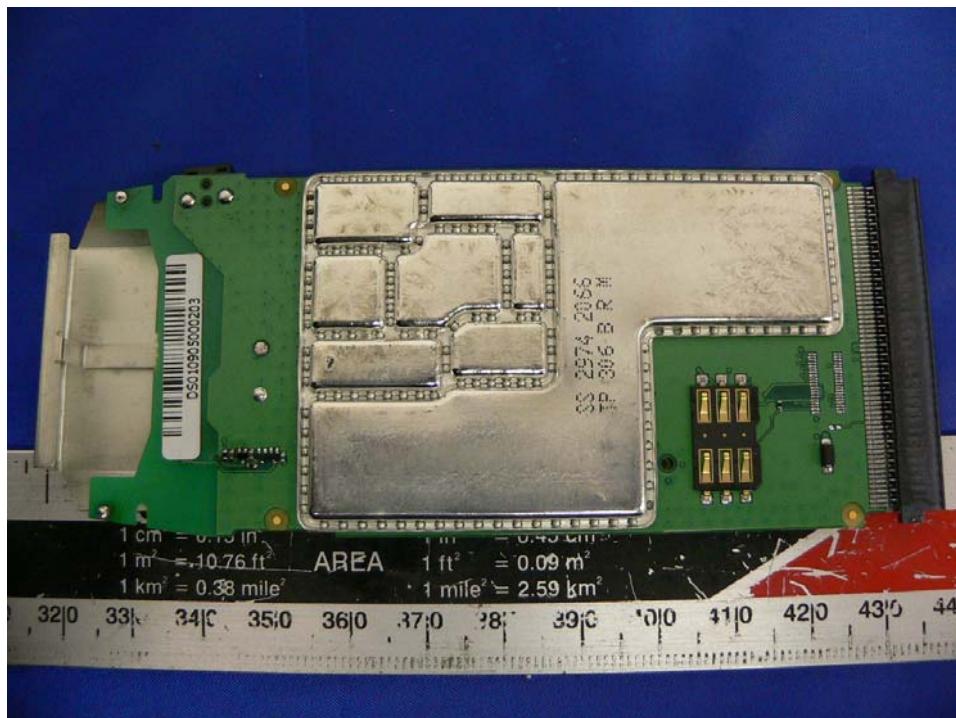
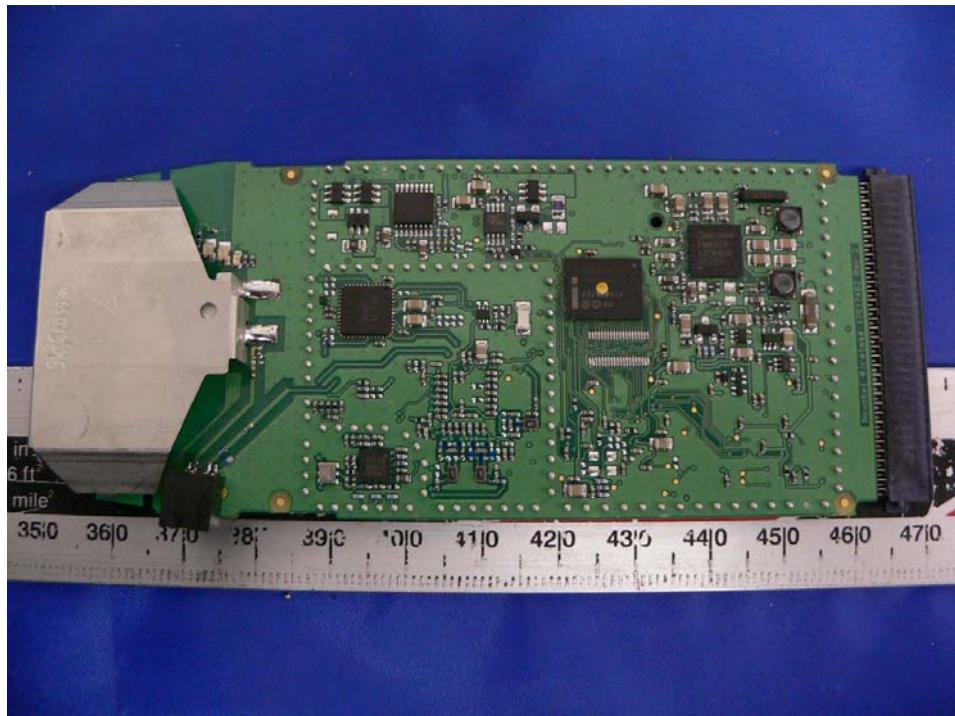


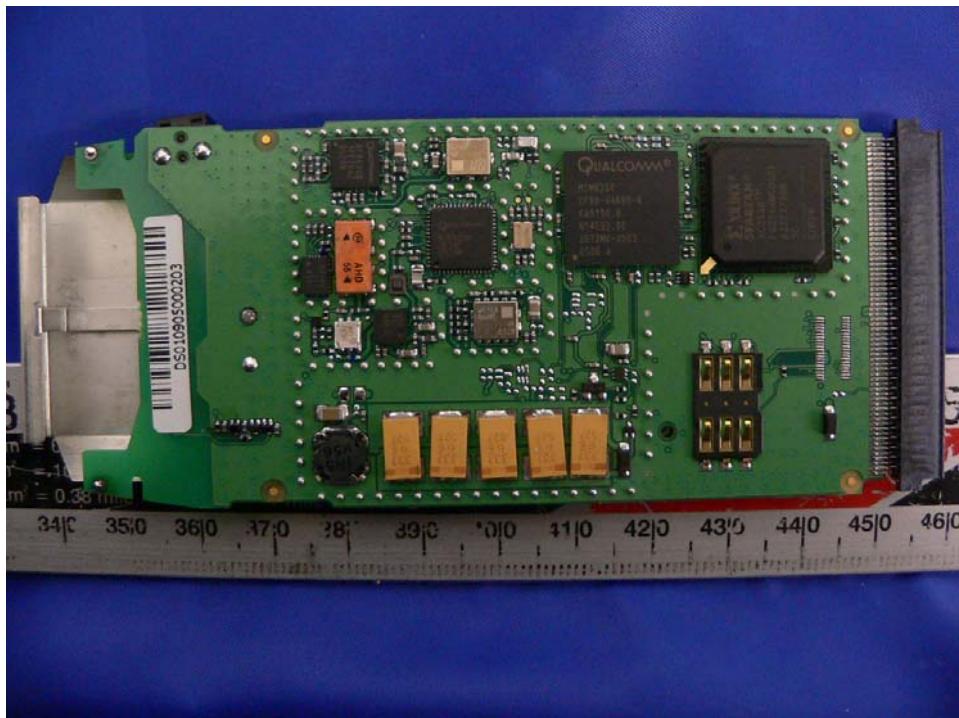
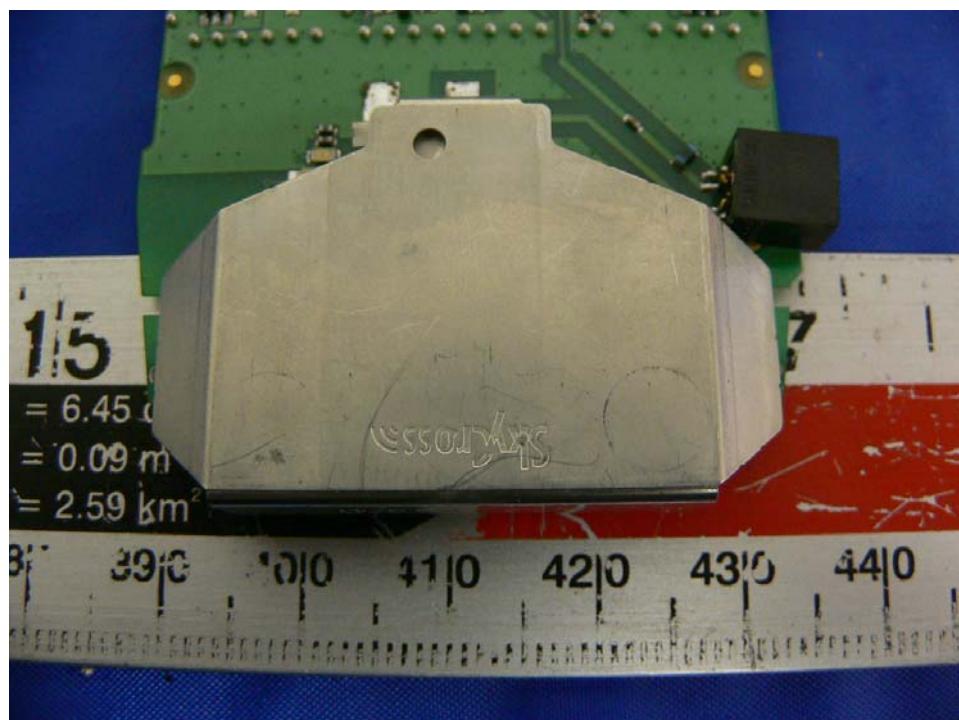
EUT – Cover Off View



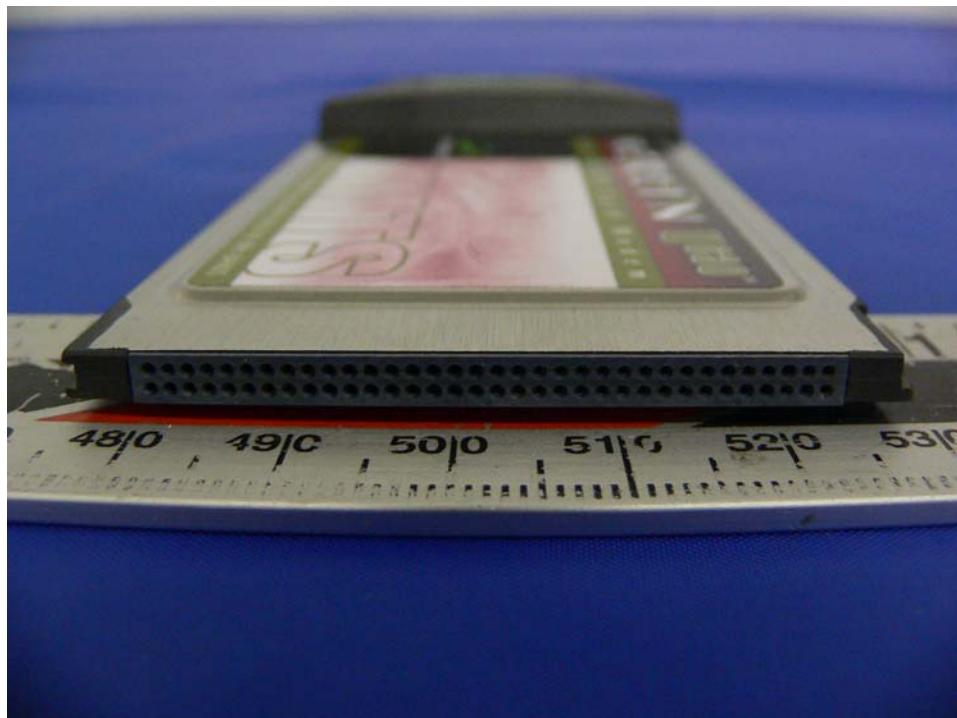
PCB with Shielding View 1



PCB with Shielding View 2**PCB without Shielding View 1**

PCB without Shielding View 2**Antenna View**

Port View



APPENDIX I - INFORMATIVE REFERENCES

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