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Dosimetric Assessment
Test Report

For the

Ooma HD2 Handset

Tested and Evaluated In Accordance With
FCC OET 65 Supplement C: 01-01

Prepared for

Ooma, Inc.
1840 Embarcadero Road
Palo Alto, CA 94303

Engineering Statement: The measurements shown in this report were made in accordance with the procedures specified in Supplement C to OET Bulletin 65 of the Federal Communications Commission (FCC) Guidelines [FCC 2001] for uncontrolled exposure. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment evaluated is capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992.

SAR Evaluation

Applicant Name and Address:	**Ooma, Inc.** 1840 Embarcadero Road Palo Alto, CA 94303 USA
Test Location:	**MET Laboratories, Inc.** 3162 Belick Street Santa Clara, CA 95054 USA

EUT:	Ooma HD2 Handset			
FCC ID:	XFT-TELOHS400			
IC:	9769A-TELOHS400			
Date of Receipt:	July 27, 2012			
Device Category:	Portable			
RF exposure environment:	General Population / Uncontrolled Exposure			
RF exposure category:	Portable			
Production/prototype:	Production			
Antenna:	Internal			
Modulations Tested:	DECT			
Duty Cycle:	1:12			
TX Range:	1921.536 – 1928.448 MHz			
Frequencies Tested:	Worst Case Configuration	Frequency	Channel	**SAR 1g (mW/g)**
	Left Head Touch	1924.992 MHz	Mid	**0.0160**

Shawn McMillen
SAR Compliance Manager

Report Status Sheet

Revision	Report Date	Reason for Revision
0	June 14, 2012	Initial Issue.
1	June 25, 2012	Revised to reflect customer corrections.
2	July 27, 2012	Revised to reflect engineer corrections.
3	August 3, 2012	Addition of Appendix H.

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1 INTRODUCTION

The intent of this measurement report is to demonstrate that the Ooma HD2 Handset described within this report complies with the Specific Absorption Rate (SAR) RF exposure requirements specified in ANSI/IEEE Std. C95.1-1992 and FCC 47 CFR §2.1093 for the General Population/ Uncontrolled Exposure environment when used with a holster for body worn configuration. The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 were employed.

A description of the device under test, device operating configuration and test conditions, measurement and site description, methodology and procedures used in the evaluation, equipment used, detailed summary of the test results and the various provisions of the rules are included in this dosimetric assessment test report.

2 SAR DEFINITION

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (*dU*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element (*dV*) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1).

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

Figure 1.1
SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$\text{SAR} = \sigma E^2 / \rho$$

where:

σ - conductivity of the tissue - simulant material (S/m)
ρ - mass density of the tissue - simulant material (kg/m3)
E - Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

3 DESCRIPTION OF TEST PLATFORMS

Applicant:	Ooma, Inc.
Description of EUT:	Ooma HD2 Handset – DECT Phone
Model Number:	TELOHS400
Serial Number:	HS1145SA0006
Battery Type(s) Tested:	2 x GP NiMH AA 1.2V 1750mAh Rechargeable Batteries
Device Class:	Class C
Antenna Type(s) Tested:	Internal
Body Worn Accessories:	NA
Tested Modes and Bands of Operation:	DECT 1920 – 1930MHz
Maximum Duty Cycle Tested:	1:12
Tested Frequency:	1924.992MHz
Exposure Category:	General Population / Uncontrolled Exposure
FCC Rule Part(s):	FCC 47 CFR §2.1093,
Standards:	IEEE Std. 1528-2003, FCC OET Bulletin 65, Supplement C, Edition 01-01, IEC 62209-2 :2008

SAR MEASUREMENT SYSTEM

MET Laboratories, Inc SAR measurement facility utilizes the DASY4 Professional Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland for performing SAR compliance tests. The DASY4 measurement system is comprised of the measurement server, robot controller, computer, near-field probe, probe alignment sensor, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms for brain and/or body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). The Cell controller system contain the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the DASY4 measurement server. The DAE4 utilizes a highly sensitive electrometer-grade 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 DASY4 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

4 MEASUREMENT SUMMARY

OOMA HD2 HANDSET HEAD SAR MEASUREMENT RESULTS								
Freq (MHz)	**Chan**	**Mode Tested**	**Battery Type**	**Accessories**	**Antenna Position**	**EUT Test Position**	**Phantom Section**	**Measured SAR 1g (W/kg)**
1924.992	Mid	DECT	NiMH	NA	Internal	Touch	Left Head	**0.01600**
1924.992	Mid	DECT	NiMH	NA	Internal	Tilt	Left Head	**0.01400**
1924.992	Mid	DECT	NiMH	NA	Internal	Touch	Right Head	**0.01200**
1924.992	Mid	DECT	NiMH	NA	Internal	Tilt	Right Head	**0.00992**
ANSI/IEEE C95.1 1992 – SAFETY LIMIT: 1.6 W/kg (averaged over 1 gram) Spatial Peak – General Population / Uncontrolled Exposure								

Measured Mixture Type	1900 MHz Head		**Date Tested**	2/15/2012
Dielectric Constant εr	**IEEE Target**	**Measured**	**Duty Cycle**	1:12
	40.0	39.5	**Ambient Temperature (C)**	24.1
Conductivity σ (mho/m)	**IEEE Target**	**Measured**	**Fluid Temperature (C)**	22.4
	1.40	1.51	**Fluid Depth**	≥15cm

OOMA HD2 HANDSET BODY SAR MEASUREMENT RESULTS									
Freq (MHz)	**Chan**	**Mode Tested**	**Battery Type**	**Body-Worn Accessories**	**Antenna Position**	**EUT Test Position**	**Phantom Section**	**Host Sep. Dist. (cm)**	**Measured SAR 1g (W/kg)**
1924.992	Mid	DECT	NiMH	NA	Internal	Frontside	Planar	1.2	**0.014000**
1924.992	Mid	DECT	NiMH	NA	Internal	Backside	Planar	1.2	**0.016000**
ANSI/IEEE C95.1 1992 – SAFETY LIMIT: 1.6 W/kg (averaged over 1 gram) Spatial Peak – General Population / Uncontrolled Exposure									

Measured Mixture Type	1900 MHz Body		**Date Tested**	2/15/2012
Dielectric Constant εr	**IEEE Target**	**Measured**	**Duty Cycle**	1:12
	53.3	52.4	**Ambient Temperature (C)**	24.1
Conductivity σ (mho/m)	**IEEE Target**	**Measured**	**Fluid Temperature (C)**	22.4
	1.52	1.49	**Fluid Depth**	≥15cm

DETAILS OF SAR EVALUATION

The Ooma HD2 Handset was determined to be compliant for localized Specific Absorption Rate based on the test provisions and conditions described below. Detailed test setup photographs are shown in the Appendix.

1. The sole purpose of this SAR evaluation was to determine if Ooma's Ooma HD2 Handset is compliant within the specified limits.

2. The EUT was tested for both head and body SAR. For the head SAR, both touch and tilt positions were measured on the left and right side of the SAM phantom.

3. The EUT was placed into test mode using Ooma's proprietary software. The power level control was set to maximum and was measured prior to testing. The measured power is 18.42dBm at 1924.992MHz.

4. The SAR evaluations were performed with a fully charged battery.

5. The ambient and fluid temperatures were measured prior to each the SAR evaluation.

6. The dielectric parameters of the simulated body and head fluids were measured prior to the evaluation using an 85070D Dielectric Probe Kit and an 8722D Network Analyzer.

5 EVALUATION PROCEDURES

The evaluation was performed in the applicable area of the phantom depending on the type of device being tested.

(i) For devices held to the ear during normal operation, both the left and right ear positions were evaluated using the SAM phantom.
(ii) For body-worn and face-held devices a planar phantom was used.

The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 15mm x 15mm.

An area scan was determined as follows:

Based on the defined area scan grid, a more detailed grid is created to increase the points by a factor of 10. The interpolation function then evaluates all field values between corresponding measurement points.

A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.

A 1g and 10g spatial peak SAR was determined as follows:

Based on the area scan, a 32mm x 32mm x 34mm (7x7x7 data points) zoom scan was assessed at the position where the greatest V/m was detected. The data at the surface was extrapolated since the distance from the probes sensors to the surface is 3.9cm. A least squares fourth-order polynomial was used to generate points between the probe detector and the inner surface of the phantom.

Interpolated data is used to calculate the average SAR over 1g and 10g cubes by spatially discretizing the entire measured cube. The volume used to determine the averaged SAR is a 1mm grid (42875 interpolated points).

Z-Scan was determined as follows:

The Z-scan measures points along a vertical straight line. The line runs along a line normal to the inner surface of the phantom surface.

6 DATA EVALUATION PROCEDURES

The DASY4 post processing 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	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion Factor	$ConvF_i$
	- Dipole Compression Point	dcp_i
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 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:

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

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

with V_i = Compensated signal of channel i (i = x, y, z)
$Norm_i$ = Sensor sensitivity of channel i (i = x, y, z)
$\mu V/(V/m)^2$ for E-field probes
$ConvF$ = 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 = Magnetic field strength of channel i in A/m

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
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

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.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

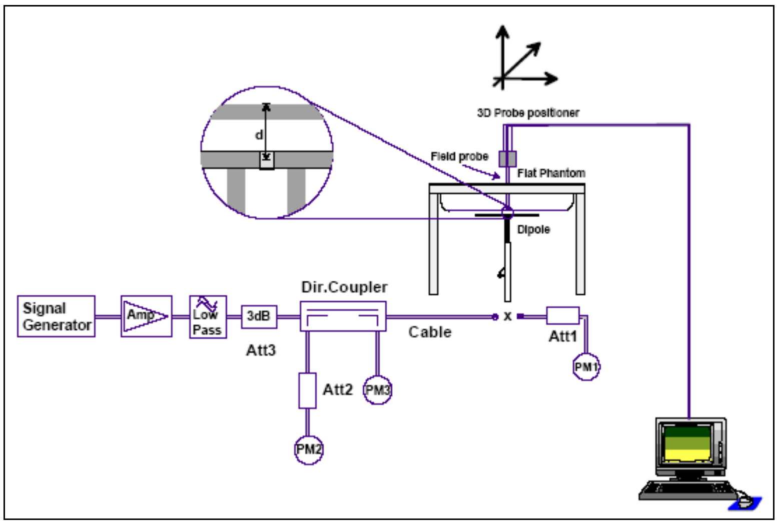
with P_{pwe} = Equivalent power density of a plane wave in mW/cm2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

7 SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed in the planar section of the SAM phantom with an 1800MHz dipole. The dielectric parameters of the simulated head fluid was measured prior to the system performance check using an 85070D Dielectric Probe Kit and an 8722D Network Analyzer. A forward power of 250mW was applied to the dipole and the system was verified to a tolerance of ±5%.

Test Date	1800MHz Equivalent Tissue	SAR 1g (W/kg)		Permittivity Constant εr		Conductivity σ (mho/m)		Ambient Temp. (C)	Fluid Temp. (C)	Fluid Depth (cm)
		Calibrated Target	Measured	IEEE Target	Measured	IEEE Target	Measured			
2/15/2012	Head	9.44±5%	9.37	40.0 ±5%	39.61	1.40 ±5%	1.35	24	23.6	≥15

Note: The ambient and fluid temperatures were measured prior to the fluid parameter check and the system performance check. The temperatures listed in the table above were consistent for all measurement periods.



8 SIMULATED EQUIVALENT TISSUES

Simulated Tissue Mixture		
Ingredient	**1900MHz Head**	**1900MHz Body**
Water	52.60%	70.17%
DGMBE	47.00%	29.44%
Salt	0.40%	0.39%

9 SAR SAFETY LIMITS

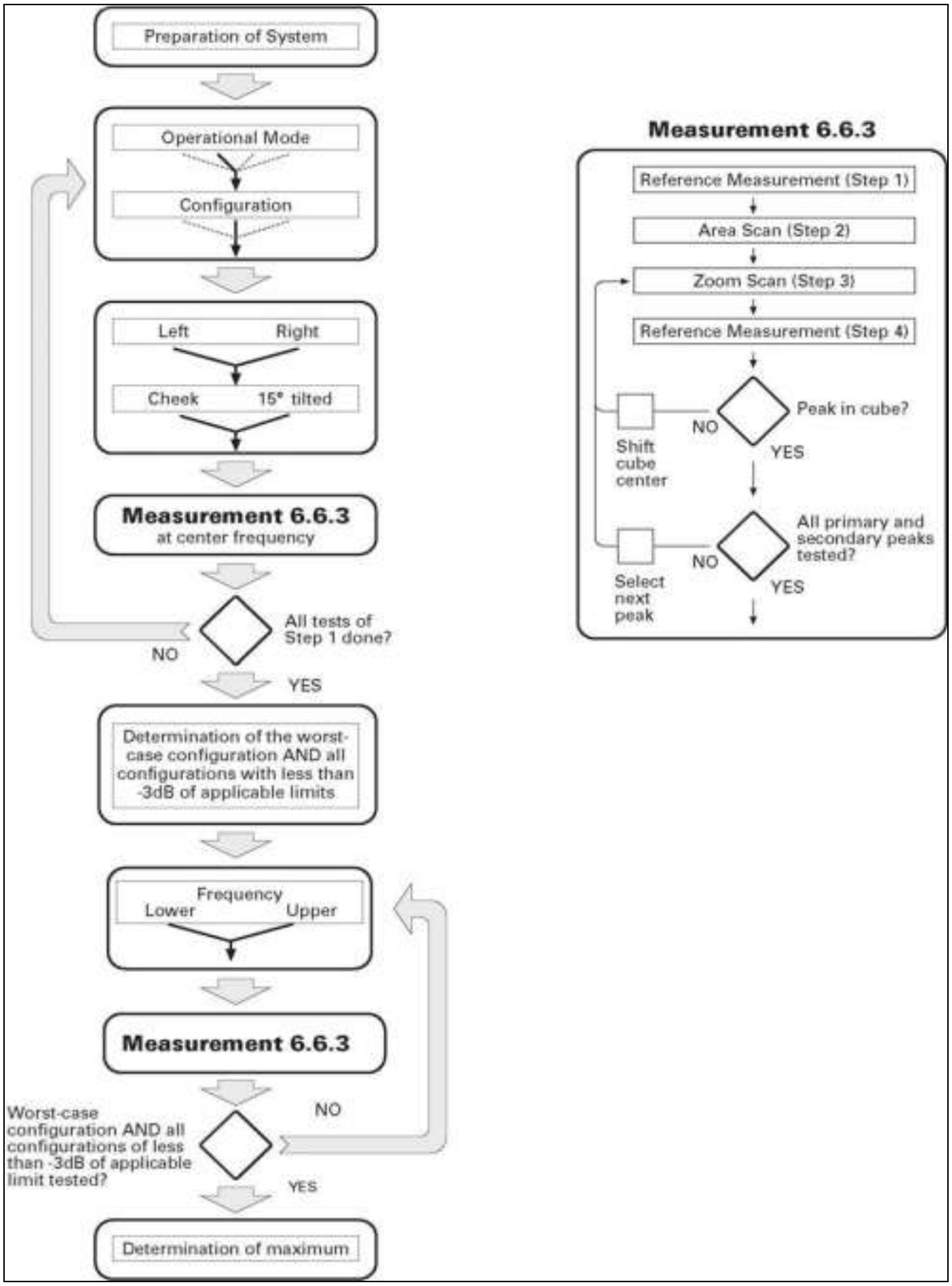
EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)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

Notes:

1. Uncontrolled exposure environments are locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.

2. Controlled exposure environments are locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

10 FLOW CHART OF THE RECOMMENDED PRACTICES AND PROCEDURES



11 DEFINITION OF REFERENCE POINTS

11.1. EAR REFERENCE POINT

Figure 12.1 shows the front, back and side views of the SAM Twin Phantom. The point M is the reference point for the center of the mouth, LE is the left ear reference point (ERP), and RE is the right ERP. The ERPs are 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 12.2. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting. Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

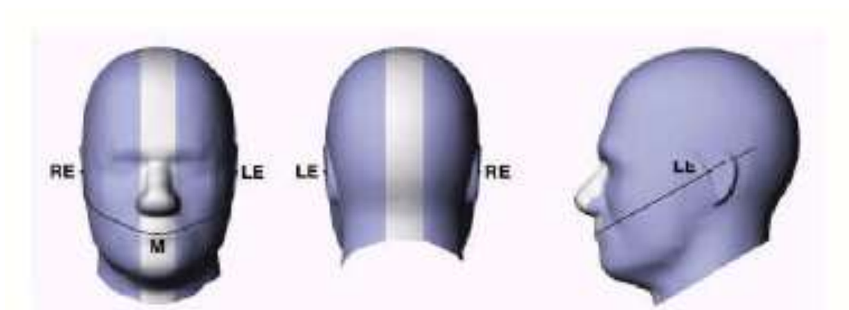


Figure 12.1
Front, back and side view of SAM Twin Phantom

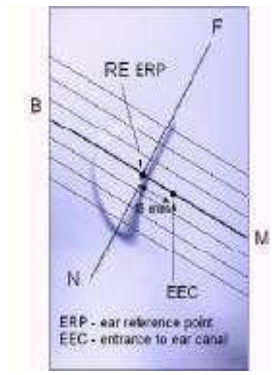


Figure 12.2
Side view of ERPs

11.2. HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the test device reference point located along the vertical centerline on the front of the device aligned to the ear reference point (See Fig. 12.3). The test device reference point was than located at the same level as the center of the ear reference point. The test device was positioned so that the vertical centerline was bisecting the front surface of the handset at it s top and bottom edges, positioning the ear reference point on the outer surface of the both the left and right head phantoms on the ear reference point.

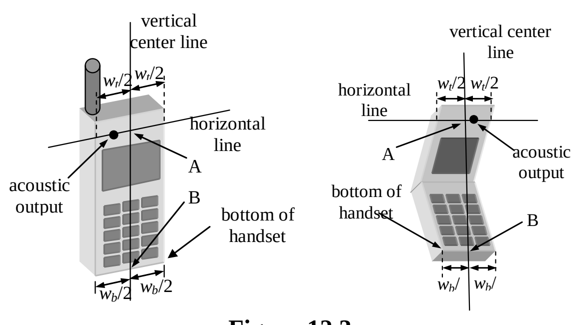


Figure 12.3
Handset Vertical Center & Horizontal Line Reference Points

11.3. POSITIONING FOR CHEEK/TOUCH

1. The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 12.4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.
2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).
4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). See Figure 12.5)

Figure 12.4
Front, Side and Top View of Cheek/Touch Position

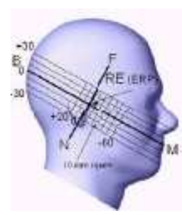


Figure 12.5
Side view with relevant markings

11.4. POSITIONING FOR EAR/15 DEGREE TILE

With the test device aligned in the Cheek/Touch Position:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 12.6).

Figure 12.6
Front, Side and Top View of Ear/15 Tilt Position

12 ROBOT SYSTEM SPECIFICATIONS

12.1. SPECIFICATION

Positioner:

Robot:	Staubli Unimation Corp. Robot Model: RX90
Repeatability:	0.02 mm
No. of axis:	6

12.2. DATA ACQUISITION ELECTRONIC (DAE) SYSTEM:

Cell Controller

Processor:	Compaq Evo Clock Speed:2.4 GHz Operating System: Windows XP Professional

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter, and control logic
Software:	DASY4 software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock

Dasy4 Measurement Server

Function:	Real-time data evaluation for field measurements and surface detection
Hardware:	PC/104 166MHz Pentium CPU; 32 MB chipdisk; 64 MB RAM
Connections:	COM1, COM2, DAE, Robot, Ethernet, Service Interface

E-Field Probe

Model:	ET3DV6
Serial No.:	1793
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

EX-Probe

Model:	EX3DV3
Serial No.	3511
Construction:	Triangular core
Frequency:	10 MHz to > 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

12.3. PHANTOM(S):

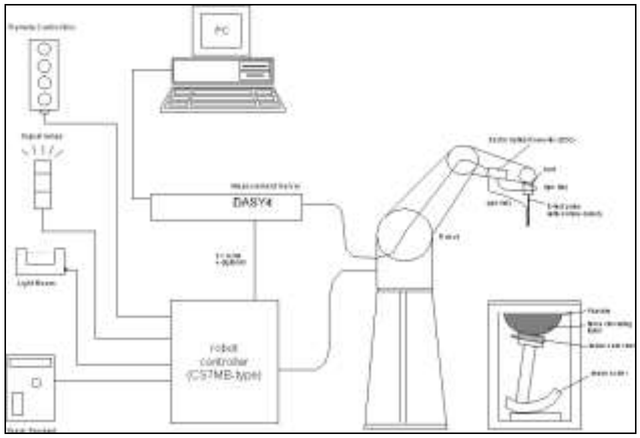
Validation & Evaluation Phantom

Type:	SAM V4.0C
Shell Material:	Fiberglass
Thickness:	2.0 ±0.1 mm
Volume:	Approx. 20 liters

12.4. ROBOT SPECIFICATIONS (ET3DV6)

Construction:	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycolether)
Calibration:	Basic Broadband calibration in air from 10 MHz to 3 GHz
Frequency:	10 MHz to 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic Range:	5 µ W/g to > 100 mW/g; Linearity: ± 0.2 dB
Surface Detection:	± 0.2 mm repeatability in air and clear liquid over diffuse reflecting surfaces
Dimensions:	Overall length: 330 mm (Tip: 16 mm) Tip diameter (including protective cover): 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetric measurements up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

13 SAR MEASUREMENT SYSTEM



Measurement System Diagram

13.1. RX90BL ROBOT

The Stäubli RX90BL Robot is a standard high precision 6-axis robot with an arm extension for accommodating the data acquisition electronics (DAE).

13.2. ROBOT CONTROLLER

The CS7MB Robot Controller system drives the robot motors. The system consists of a power supply, robot controller, and remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.

13.3. LIGHT BEAM SWITCH

The Light Beam Switch (Probe alignment tool) 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.

13.4. DATA ACQUISITION ELECTRONICS

The Data Acquisition Electronics consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16-bit A/D converter and a command decoder and control logic unit. Some of the task the DAE performs is signal amplification, signal multiplexing, A/D conversion, and offset measurements. The DAE also contains the mechanical probe-mounting device, which contains two different sensor systems for frontal and sideways probe contacts used for probe collision detection and mechanical surface detection for controlling the distance between the probe and the inner surface of the phantom shell. Transmission from the DAE to the measurement server, via the EOC, is through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

13.5. ELECTRO-OPTICAL CONVERTER (EOC)

The Electro-Optical Converter performs the conversion between the 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 connects to, and transfers data to, the DASY4 measurement server. The EOC also contains the fiber optical surface detection system for controlling the distance between the probe and the inner surface of the phantom shell.

13.6. MEASUREMENT SERVER

The Measurement Server performs time critical tasks such as signal filtering, 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. A watchdog supervises all connections, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements.

13.7. DOSIMETRIC PROBE

Dosimetric Probe is a symmetrical design with triangular core that incorporates three 3 mm long dipoles arranged so that the overall response is close to isotropic. The probe sensors are covered by an outer protective shell, which is resistant to organic solvents i.e. glycol. The probe is equipped with an optical multi-fiber line, ending at the front of the probe tip, for optical surface detection. This line connects to the EOC box on the robot arm and provides automatic detection of the phantom surface. The optical surface detection works in transparent liquids and on diffuse reflecting surfaces with a repeatability of better than ±0.1mm.

13.8. SAM PHANTOM

The SAM (Specific Anthropomorphic Mannequin) twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm) integrated into a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left hand, right hand phone usage as well as body mounted usage at the flat phantom region. The flat section is also used for system validation and the length and width of the flat section are at least 0.75 λO and 0.6 λO respectively at frequencies of 824 MHz and above (λO = wavelength in air).

Reference markings on the phantom top allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. A white cover is provided to cover the phantom during off-periods preventing water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible. The phantom is filled with a tissue simulating liquid to a depth of at least 15 cm at each ear reference point. The bottom plate of the wooden table contains three pair of bolts for locking the device holder.

13.9. PLANAR PHANTOM

The planar phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of handheld radio transceivers. The planar phantom is mounted on the wooden table of the DASY4 system.

13.10. VALIDATION PLANAR PHANTOM

The validation planar phantom is constructed of Plexiglas material with a 6.0 mm shell thickness for system validations at 450MHz and below. The validation planar phantom is mounted on the wooden table of the DASY4 system.

13.11. DEVICE HOLDER

The device holder is designed to cope with the different measurement positions in the three sections of the SAM phantom given in the standard. It has two scales, one for device rotation (with respect to the body axis) and one for device inclination (with respect to the line between the ear openings). The rotation center for both scales is the ear opening, thus the device needs no repositioning when changing the angles. The plane between the ear openings and the mouth tip has a rotation angle of 65°.

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$. 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.

The dielectric properties of the liquid conform to all the tabulated values [2-5]. Liquids are prepared according to Annex A and dielectric properties are measured according to Annex B.

13.12. SYSTEM VALIDATION KITS

Power Capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Construction: Symmetrical dipole with l/4 balun Enables measurement of feed point impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 300, 450, 835, 1900, 2450 MHz

Return loss: >20 dB at specified validation position

Dimensions:
300 MHz Dipole: Length: 396mm; Overall Height:430 mm; Diameter: 6 mm
450 MHz Dipole: Length: 270 mm; Overall Height: 347 mm; Diameter: 6 mm
835 MHz Dipole: Length: 161 mm; Overall Height: 270 mm; Diameter: 3.6 mm
1900 MHz Dipole: Length: 68 mm; Overall Height: 219 mm; Diameter: 3.6 mm
2450 MHz Dipole: Length: 51.5 mm; Overall Height: 300 mm; Diameter: 3.6 mm

TEST EQUIPMENT LIST

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
ROBOT	STAUBLI	RX90BL	FO3/SX19A1/A/01	N/A	N/A
PROBE	SPEAG	EX3DV4	3722	7/27/2011	7/27/2012
DATA AQUISITIONER	SPEAG	DAE3	584	7/22/2011	7/22/2012
SAM PHANTOM	SPEAG	SAM PHANTOM V4.0C	N/A	N/A	N/A
1800MHZ DIPOLE	INDEX SAR	IXD-090/IXD-180	1S2572	11/27/2010	11/27/2013
DIELECTRIC PROBE KIT	AGILENT	85070D	N/A	N/A	N/A
POWER METER	HP	E4418B	GB40205140	10/13/2010	10/13/2012
POWER SENSOR	HP	8482A	2607A11286	5/24/2011	5/24/2012
VECTOR NETWORK ANALYZER	HP	8722D	3S36140188	7/14/2011	7/14/2012
POWER METER	ANRITSU	ML2488A	6K00001832	8/8/2011	8/8/2012
POWER SENSOR	ANRITSU	MA2491A	30864	8/8/2011	8/8/2012
DIRECTIONAL COUPLER	KRYTAR	101020020	64428	NA	N/A
POWER AMPLIFIER	MINI-CIRCUITS	ZHL-4240W	D111903 #8	N/A	N/A

MEASUREMENT UNCERTAINTIES

UNCERTAINTY ASSESSMENT FOR EUT

Error Description	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	c_i **1g**	**Standard Uncertainty ±% (1g)**	v_i **or** v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.6	Rectangular	√3	(1-cp)1/2	± 1.9	∞
Spherical isotropy of the probe	± 9.7	Rectangular	√3	(cp)1/2	± 3.9	∞
Boundary effects	± 8.5	Rectangular	√3	1	± 4.8	∞
Probe linearity	± 4.5	Rectangular	√3	1	± 2.7	∞
Detection limit	± 0.9	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.9	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.2	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 0.54	Rectangular	√3	1	± 0.43	∞
Mech. constraints of robot	± 0.5	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 2.7	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 2.2	Normal	1	1	± 2.23	11
Device holder uncertainty	± 5.0	Normal	1	1	± 5.0	7
Power drift	± 5.0	Rectangular	√3		± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 3.5./1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 12.14/11.76	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 24.29/23.51	

Worst-case uncertainty for DASY4 assessed according to IEEE P1528.
The budget is valid for the frequency range 300MHz to 6GHz and represents a worst-case analysis.

DASY4 Uncertainty Budget

According to IEC 62209-2 (30 MHz - 6GHz range)								
Error Description	**Uncert. Value**	**Prob. Dist.**	**Div.**	**(c_i) 1g**	**(c_i) 10g**	**Std. Unc. (1g)**	**Std. Unc. (10g)**	**(v_i) v_{eff}**
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
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	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
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 Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	$\sqrt{3}$	1	1	±3.9%	±3.9%	∞
Post-processing	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Test Sample Related								
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Test sample Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Power Scaling	±0%	R	$\sqrt{3}$	1	1	±0.0%	±0.0%	∞
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±7.9%	R	$\sqrt{3}$	1	1	±4.6%	±4.6%	∞
SAR correction	±1.9%	R	$\sqrt{3}$	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity(meas.)	±2.5%	N	1	0.78	0.71	±2.0%	±1.8%	∞
Liquid Permittivity(meas.)	±2.5%	N	1	0.26	0.26	±0.6%	±0.7%	∞
Temp. unc.-Conductivity	±5.2%	R	$\sqrt{3}$	0.78	0.71	±2.3%	±2.1%	∞
Temp. unc.-Permittivity	±0.8%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%	∞
Combined Std. Uncertainty						**±12.8%**	**±12.7%**	748
Expanded STD Uncertainty						**±25.6%**	**±25.4%**	

UNCERTAINTY ASSESSMENT FOR SYSTEM VALIDATION

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	√3	(1-cp)1/2	± 2.7	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(cp)1/2	± 3.8	∞
Boundary effects	± 1.0	Rectangular	√3	1	± 0.0	∞
Probe linearity	± 4.7	Rectangular	√3	1	± 3.2	∞
Detection limit	± 1.0	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.3	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	√3	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 1.4	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Dipole						
Dipole Axis to liquid distance	± 2.0	Normal	1	1	± 1.2	11
Input Power	± 5.0	Normal	1	1	± 2.7	7
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 9.8	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 19.7	

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TEST SETUP

Photograph 1. Front Side

Photograph 2. Left Ear Tilt

Photograph 3. Left Ear Touch

Photograph 4. Right Ear Tilt

Photograph 5. Right Ear Touch

EUT Pictures

Photograph 6. Back View

Photograph 7. Batteries

Photograph 8. Bottom View

Photograph 9. Front View

Photograph 10. Left View

Photograph 11. Right View

Photograph 12. Top View

APPENDIX A – SAR MEASUREMENT DATA

1924.992 MHz, Mid Channel, Right Head Touch DECT

Date/Time: 2/15/2012 10:23:54 AM

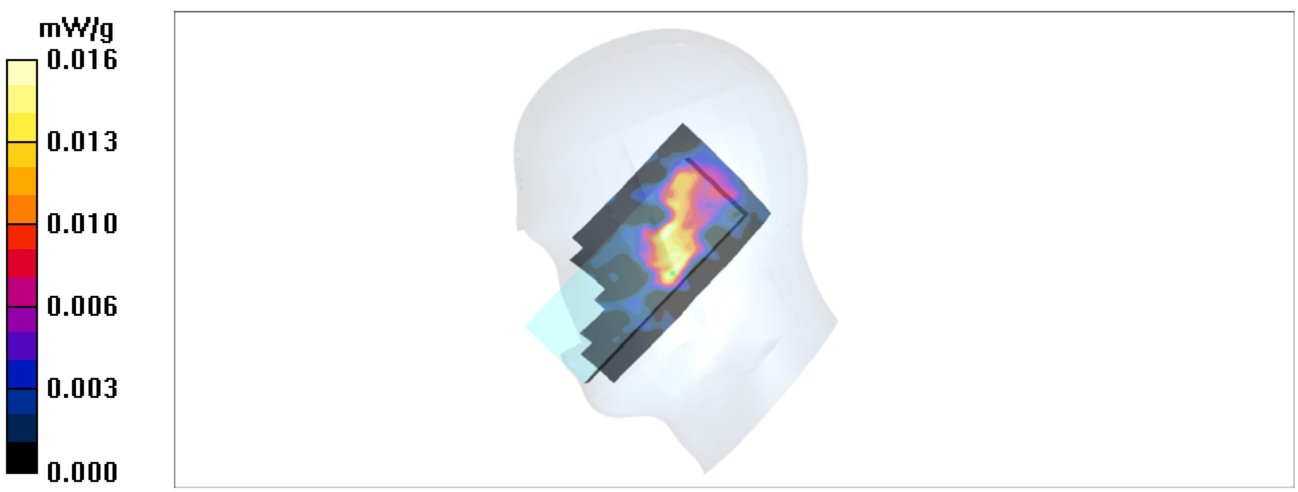
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: HSL1900 Medium parameters used: f = 1924.99 MHz; $\sigma = 1.51$ mho/m; $\varepsilon_r = 39.5$; $\rho = 1000$ kg/m^3
Phantom section: Right Section

- Probe: EX3DV4 - SN3722; ConvF(7.66, 7.66, 7.66); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.016 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.20 V/m; Power Drift = -0.035 dB
Peak SAR (extrapolated) = 0.022 W/kg
SAR(1 g) = 0.012 mW/g; SAR(10 g) = 0.00577 mW/g
Maximum value of SAR (measured) = 0.014 mW/g



1924.992 MHz, Mid Channel, Right Head Tilt DECT

Date/Time: 2/15/2012 11:36:01 AM

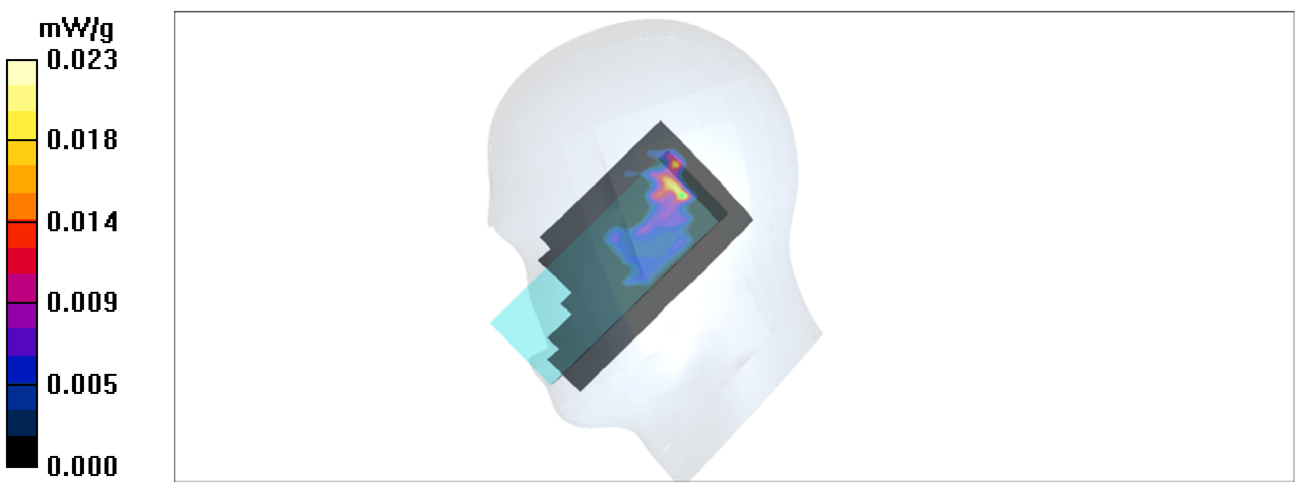
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: HSL1900 Medium parameters used: f = 1924.99 MHz; σ = 1.51 mho/m; ε_r = 39.5; ρ = 1000 kg/m^3
Phantom section: Right Section

- Probe: EX3DV4 - SN3722; ConvF(7.66, 7.66, 7.66); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.023 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.03 V/m; Power Drift = 0.099 dB
Peak SAR (extrapolated) = 0.057 W/kg
SAR(1 g) = 0.00992 mW/g; SAR(10 g) = 0.00288 mW/g
Maximum value of SAR (measured) = 0.011 mW/g



1924.992 MHz, Mid Channel, Left Head Touch DECT

Date/Time: 2/15/2012 2:00:05 PM

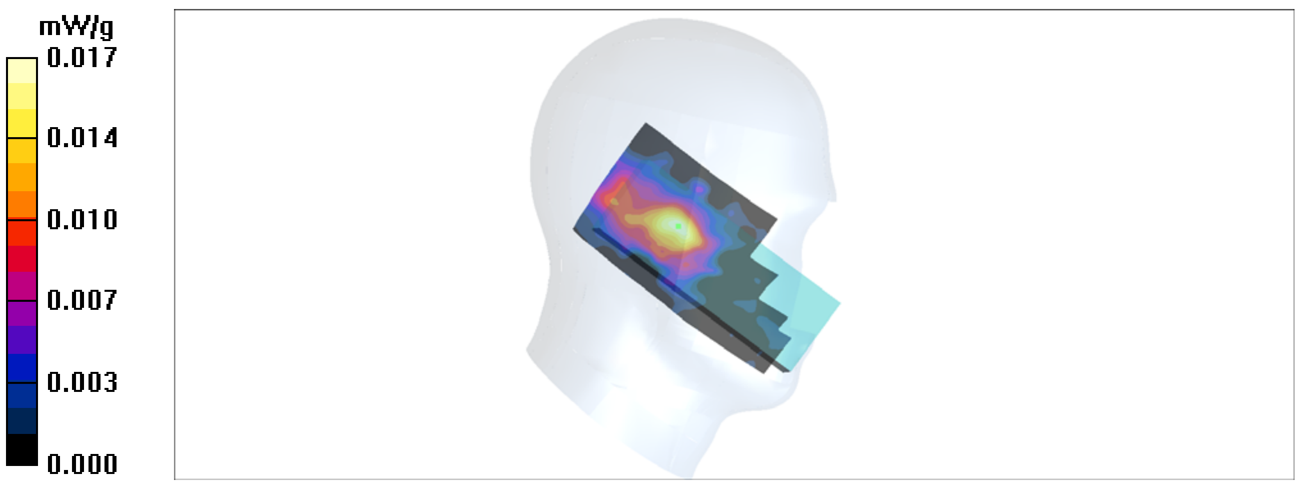
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: HSL1900 Medium parameters used: f = 1924.99 MHz; σ = 1.51 mho/m; ε_r = 39.5; ρ = 1000 kg/m^3
Phantom section: Left Section

- Probe: EX3DV4 - SN3722; ConvF(7.66, 7.66, 7.66); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.017 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.63 V/m; Power Drift = -0.757 dB
Peak SAR (extrapolated) = 0.027 W/kg
SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00989 mW/g
Maximum value of SAR (measured) = 0.018 mW/g



1924.992 MHz, Mid Channel, Left Head Tilt DECT

Date/Time: 2/15/2012 2:25:02 PM

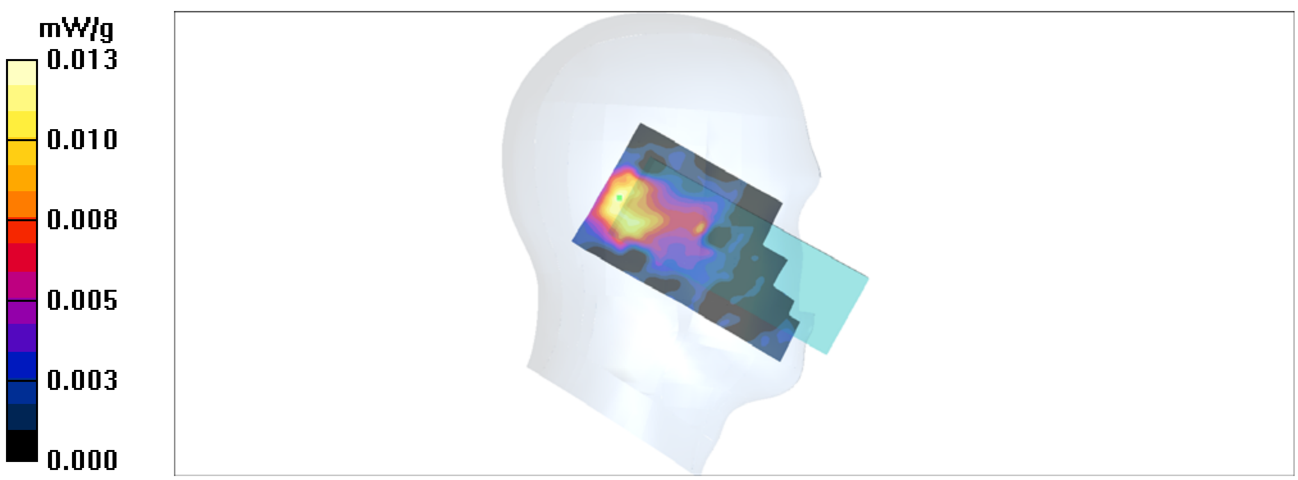
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: HSL1900 Medium parameters used: f = 1924.99 MHz; $\sigma = 1.51$ mho/m; $\varepsilon_r = 39.5$; $\rho = 1000$ kg/m^3
Phantom section: Left Section

- Probe: EX3DV4 - SN3722; ConvF(7.66, 7.66, 7.66); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.013 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.45 V/m; Power Drift = 0.015 dB
Peak SAR (extrapolated) = 0.028 W/kg
SAR(1 g) = 0.014 mW/g; SAR(10 g) = 0.0075 mW/g
Maximum value of SAR (measured) = 0.015 mW/g



1924.992 MHz, Mid Channel, Body Backside DECT

Date/Time: 2/15/2012 4:14:21 PM

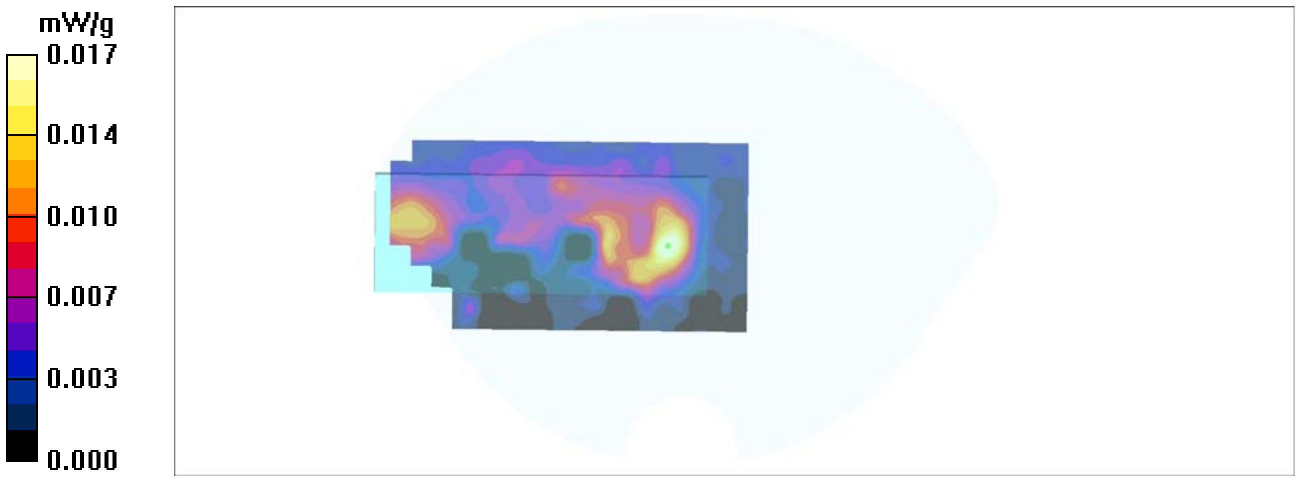
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: MSL1900 Medium parameters used: f = 1924.99 MHz; σ = 1.49 mho/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: EX3DV4 - SN3722; ConvF(7.11, 7.11, 7.11); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.017 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.77 V/m; Power Drift = -0.297 dB
Peak SAR (extrapolated) = 0.032 W/kg
SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00843 mW/g
Maximum value of SAR (measured) = 0.018 mW/g



1924.992 MHz, Mid Channel, Body Frontside DECT

Date/Time: 2/15/2012 4:41:59 PM

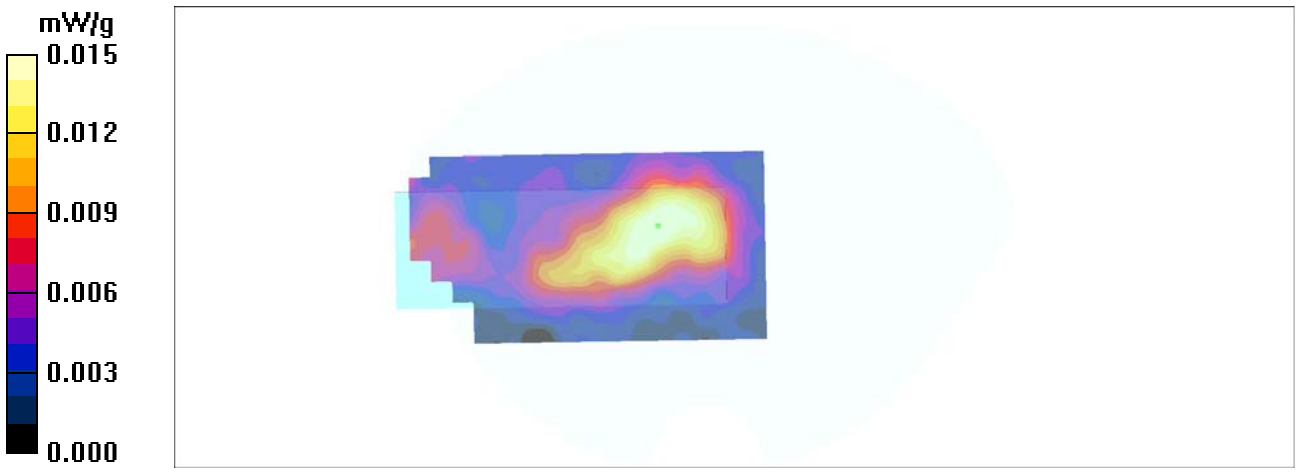
DUT: Ooma Wallace; Type: Handset

Communication System: DECT; ; Frequency: 1924.99 MHz;Duty Cycle: 1:12
Medium: MSL1900 Medium parameters used: f = 1924.99 MHz; $\sigma = 1.49$ mho/m; $\varepsilon_r = 52.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: EX3DV4 - SN3722; ConvF(7.11, 7.11, 7.11); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (91x191x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.015 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.72 V/m; Power Drift = -0.049 dB
Peak SAR (extrapolated) = 0.029 W/kg
SAR(1 g) = 0.014 mW/g; SAR(10 g) = 0.00884 mW/g
Maximum value of SAR (measured) = 0.016 mW/g



APPENDIX B – SYSTEM PERFORMANCE CHECK

1800MHz Head System Check

Date/Time: 2/15/2012 9:00:20 AM

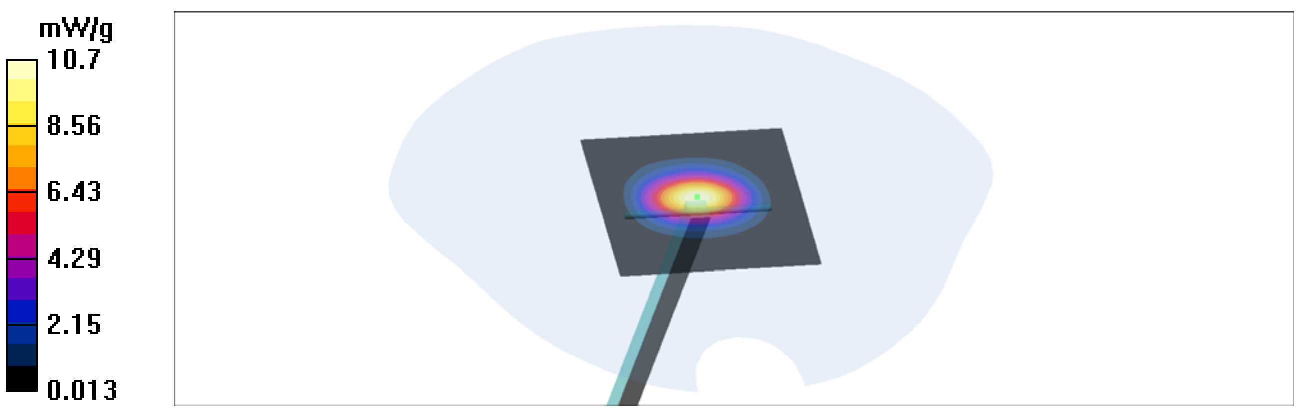
DUT: Dipole 1S2572; Type: 1800MHz Dipole

Communication System: CW; ; Frequency: 1800 MHz;Duty Cycle: 1:1
Medium: M1800 Medium parameters used: f = 1800 MHz; σ = 1.36 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: EX3DV4 - SN3722; ConvF(7.75, 7.75, 7.75); Calibrated: 7/27/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 7/22/2011
- Phantom: SAM with CRP; Type: SAM; Serial: TP 1310
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

Area Scan (81x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 10.7 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.2 V/m; Power Drift = -0.027 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 9.37 mW/g; SAR(10 g) = 4.86 mW/g
Maximum value of SAR (measured) = 10.6 mW/g



APPENDIX C – PROBE CALIBRATION CERTIFICATE

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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Swiss Calibration Service

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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 **MET Laboratories**

Certificate No: EX3-3722_Jul11

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3722

Calibration procedure(s): QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: July 27, 2011

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: July 27, 2011

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
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., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) 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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 *NORMx,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.

Probe EX3DV4

SN:3722

Manufactured: August 14, 2009
Calibrated: July 27, 2011

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3722

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.54	0.50	0.58	± 10.1 %
DCP (mV)[B]	100.1	99.7	98.9	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	123.6	±3.0 %
			Y	0.00	0.00	1.00	120.5	
			Z	0.00	0.00	1.00	129.1	

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 E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3722

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
900	41.5	0.97	8.46	8.46	8.46	0.80	0.67	± 12.0 %
1810	40.0	1.40	7.75	7.75	7.75	0.66	0.72	± 12.0 %
2000	40.0	1.40	7.66	7.66	7.66	0.73	0.67	± 12.0 %
2450	39.2	1.80	6.89	6.89	6.89	0.65	0.71	± 12.0 %
5200	36.0	4.66	4.74	4.74	4.74	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.48	4.48	4.48	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.37	4.37	4.37	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.28	4.28	4.28	0.45	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4- SN:3722

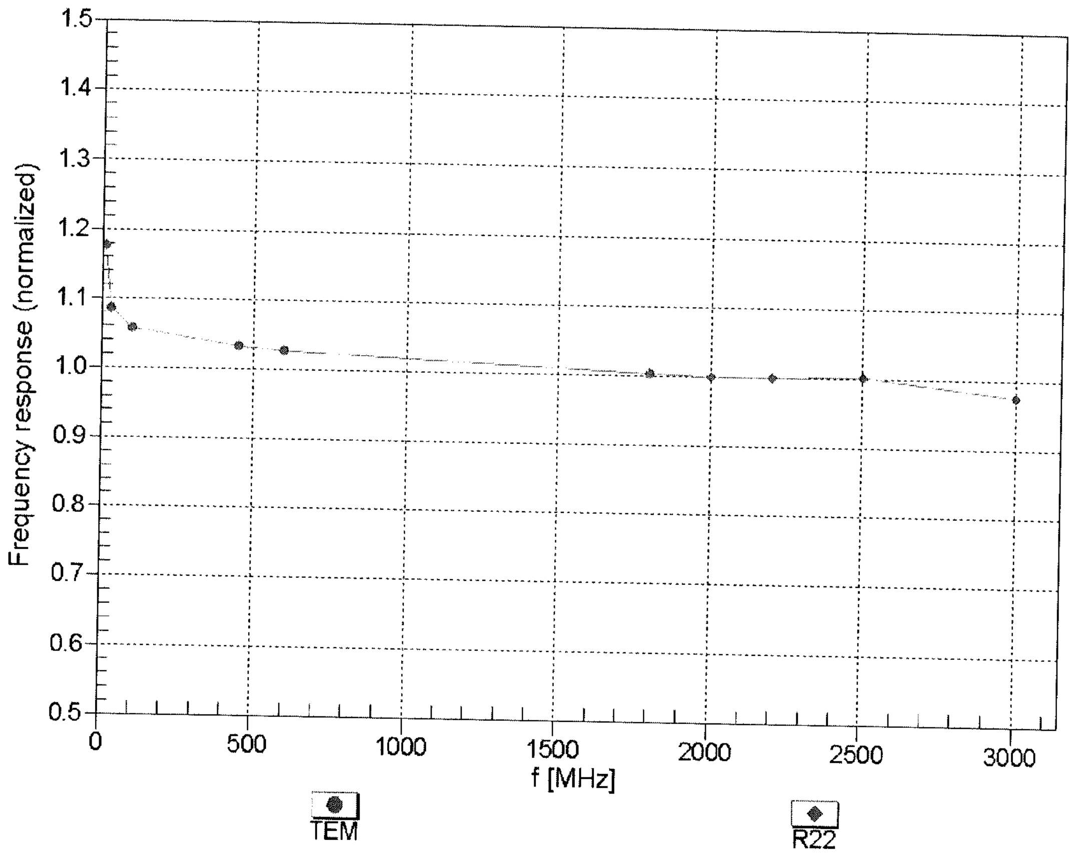
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
900	55.0	1.05	8.65	8.65	8.65	0.80	0.72	± 12.0 %
1810	53.3	1.52	7.36	7.36	7.36	0.80	0.66	± 12.0 %
2000	53.3	1.52	7.11	7.11	7.11	0.80	0.63	± 12.0 %
2450	52.7	1.95	6.68	6.68	6.68	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.00	4.00	4.00	0.55	1.90	± 13.1 %
5300	48.9	5.42	3.80	3.80	3.80	0.55	1.90	± 13.1 %
5500	48.6	5.65	3.69	3.69	3.69	0.55	1.90	± 13.1 %
5800	48.2	6.00	3.81	3.81	3.81	0.60	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

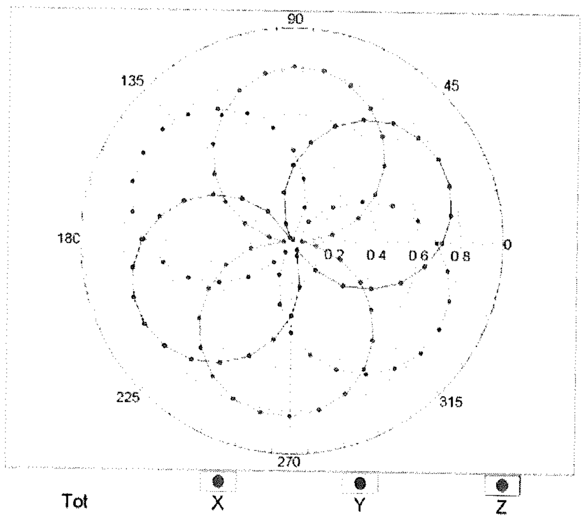
(TEM-Cell:ifi110 EXX, Waveguide: R22)



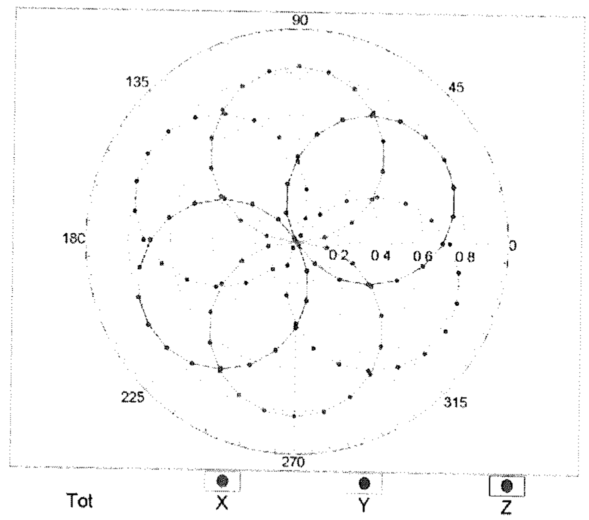
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

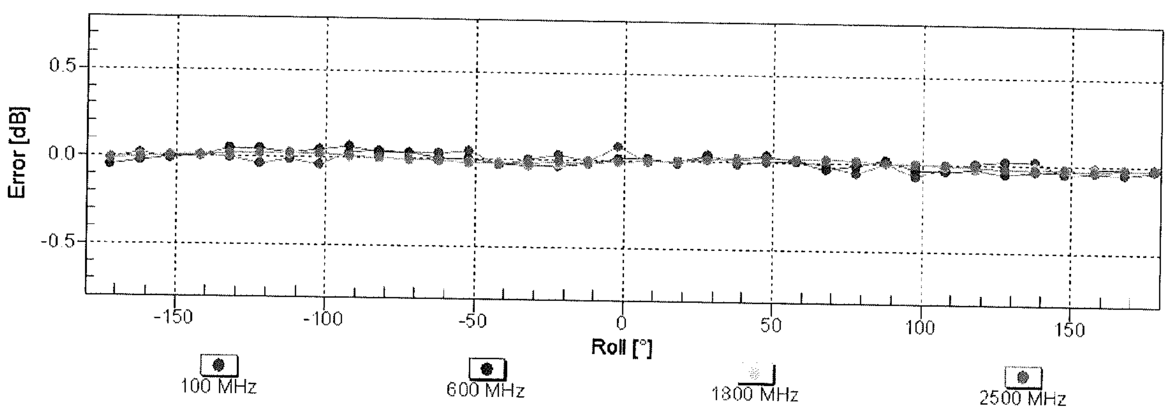
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



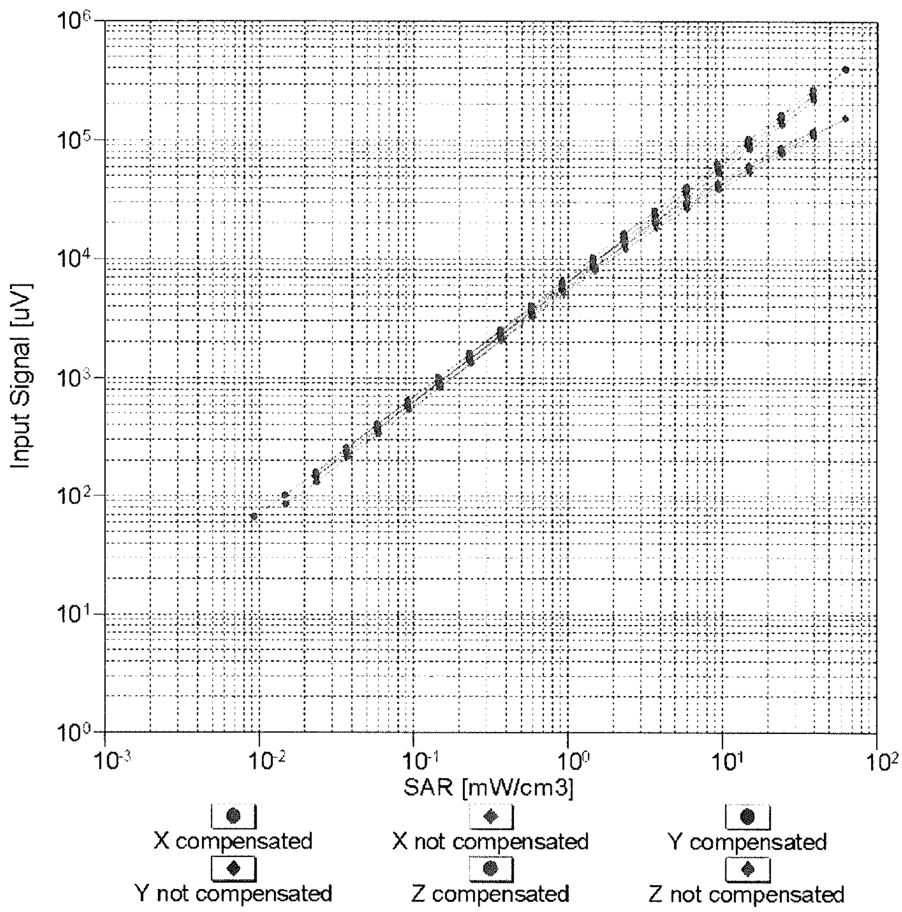
f=1800 MHz,R22

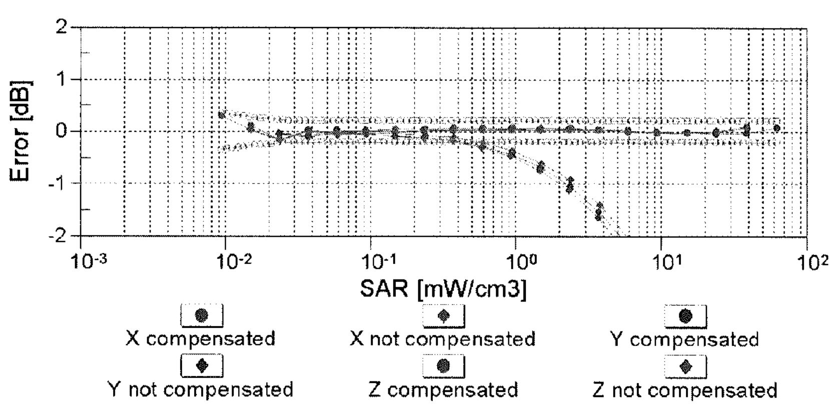




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

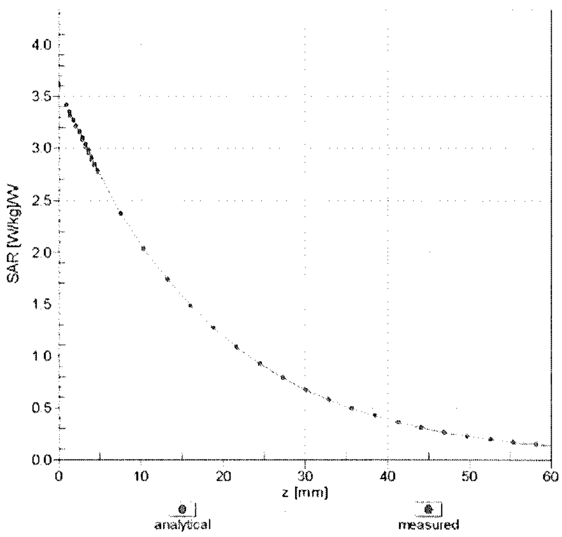
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

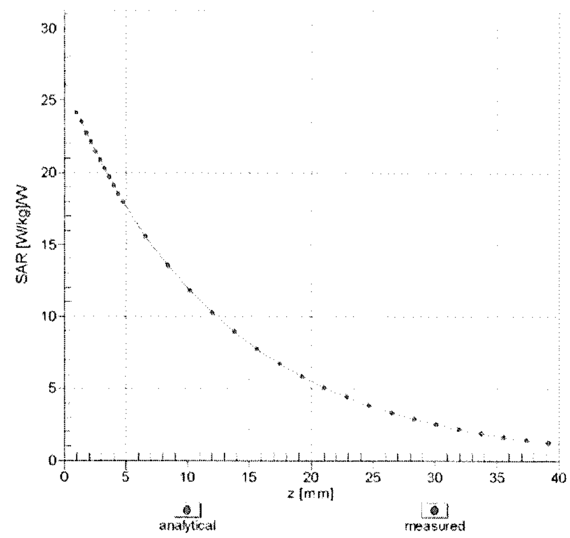




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

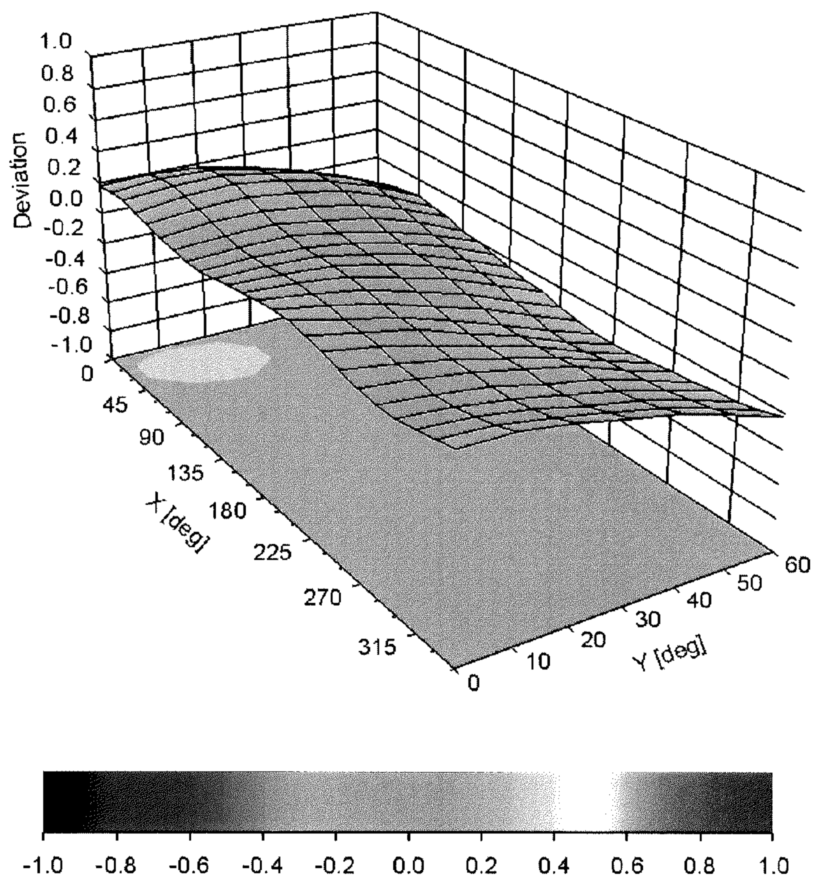
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3722

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

APPENDIX D – DIPOLE CALIBRATION CERTIFICATE

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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 **MET Laboratories**

Certificate No: IndexSAR-1S2572_Nov10

CALIBRATION CERTIFICATE

Object	IndexSAR - SN: 1S2572
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	November 25, 2010

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 27, 2010

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

S Schweizerischer Kalibrierdienst
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S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) 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
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1800 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.35 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.44 mW / g
SAR normalized	normalized to 1W	37.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**38.5 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.97 mW / g
SAR normalized	normalized to 1W	19.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.1 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.9 ± 6 %	1.45 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.51 mW / g
SAR normalized	normalized to 1W	38.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**39.1 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.06 mW / g
SAR normalized	normalized to 1W	20.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.5 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.2 Ω - 2.2 jΩ
Return Loss	- 33.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.6 Ω - 3.2 jΩ
Return Loss	- 24.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.377 ns

Dipole designed and manufactured by IndexSAR. Please see details on http://www.indexsar.com/balanced.htm

Additional EUT Data

Manufactured by	IndexSAR
Manufactured on	unknown

DASY5 Validation Report for Head TSL

Date/Time: 25.11.2010 11:52:26

Test Laboratory: SPEAG, Zurich, Switzerland

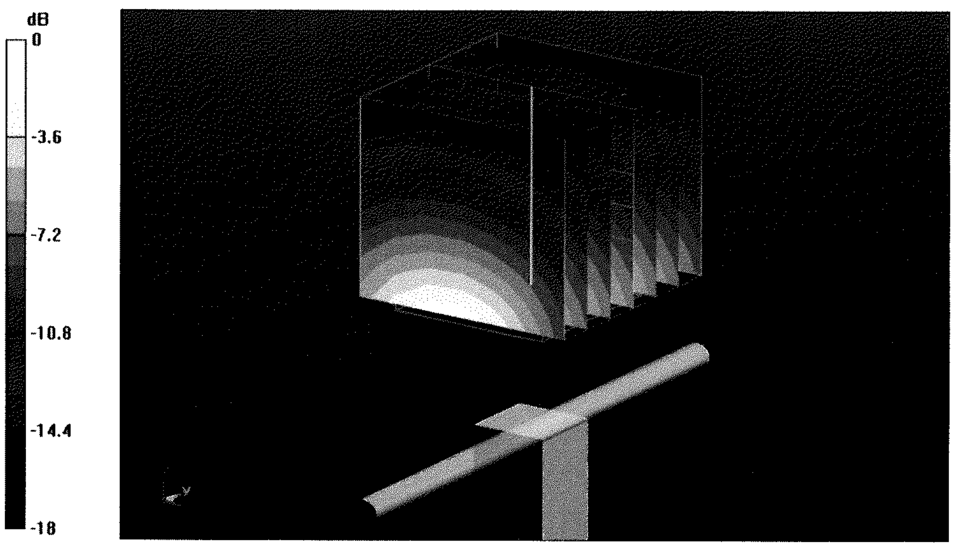
DUT: Dipole 1800 MHz; Type: IndexSAR; Serial: IndexSAR - SN:1S2572

Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium: HSL U12 BB
Medium parameters used: f = 1800 MHz; $\sigma = 1.35$ mho/m; $\varepsilon_r = 39.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

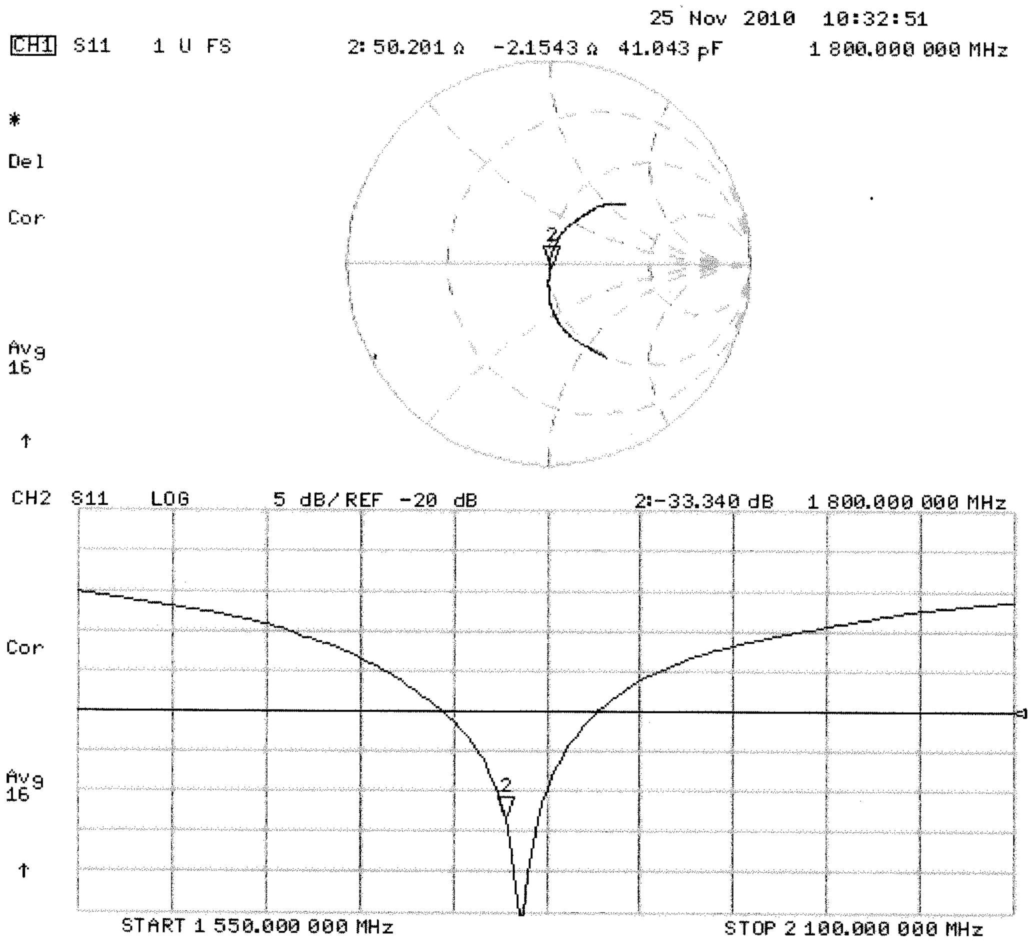
- Probe: ES3DV3 - SN3205; ConvF(5.05, 5.05, 5.05); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

Head/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = 0.048 dB
Peak SAR (extrapolated) = 17.1 W/kg
SAR(1 g) = 9.44 mW/g; SAR(10 g) = 4.97 mW/g
Maximum value of SAR (measured) = 11.7 mW/g



0 dB = 11.7mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 24.11.2010 15:55:08

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1800 MHz; Type: IndexSAR; Serial: IndexSAR - SN:1S2572

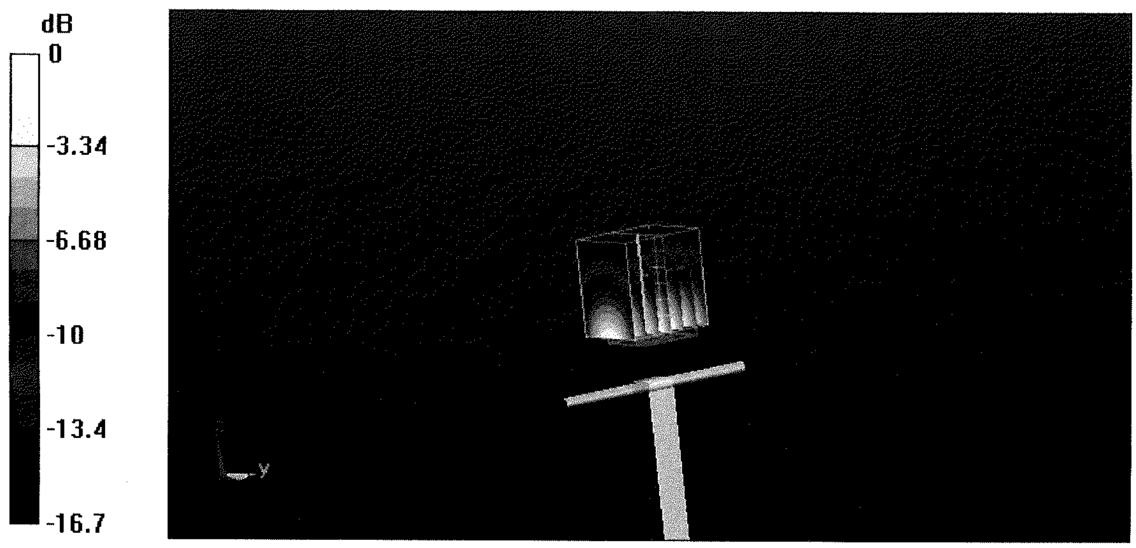
Communication System: CW; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium: MSL U12 BB
Medium parameters used: f = 1800 MHz; σ = 1.45 mho/m; ε_r = 52.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.74, 4.74, 4.74); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.2 Build 0, Version 52.2.0 (163)
- Postprocessing SW: SEMCAD X, V14.2 Build 2, Version 14.2.2 (1685)

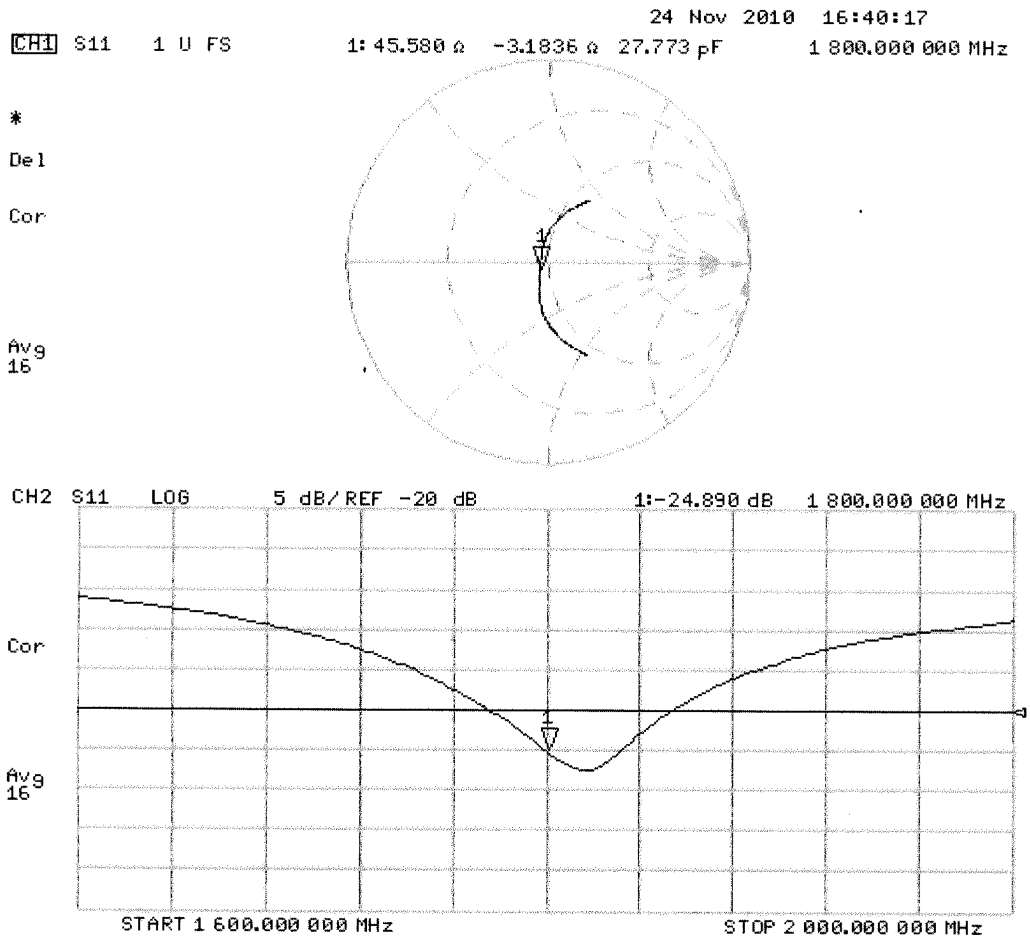
Body/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.5 V/m; Power Drift = -0.00118 dB
Peak SAR (extrapolated) = 16.3 W/kg
SAR(1 g) = 9.51 mW/g; SAR(10 g) = 5.06 mW/g
Maximum value of SAR (measured) = 12 mW/g



0 dB = 12mW/g

Impedance Measurement Plot for Body TSL



APPENDIX E – MEASURED FLUID DIELECTRIC PARAMETERS

Title

SubTitle

February 15, 2012 7:32 AM

Frequency	e'	e''
1.850000000 GI	39.759	13.9664
1.852000000 GI	39.771	13.9674
1.854000000 GI	39.774	13.9593
1.856000000 GI	39.777	13.9570
1.858000000 GI	39.783	13.9636
1.860000000 GI	39.779	13.9625
1.862000000 GI	39.795	13.9678
1.864000000 GI	39.798	13.9772
1.866000000 GI	39.813	13.9780
1.868000000 GI	39.807	13.9899
1.870000000 GI	39.807	13.9961
1.872000000 GI	39.809	13.9979
1.874000000 GI	39.798	13.9979
1.876000000 GI	39.824	14.0047
1.878000000 GI	39.777	13.9935
1.880000000 GI	39.775	14.0009
1.882000000 GI	39.782	14.0071
1.884000000 GI	39.769	14.0288
1.886000000 GI	39.771	14.0218
1.888000000 GI	39.755	14.0230
1.890000000 GI	39.750	14.0288
1.892000000 GI	39.744	14.0128
1.894000000 GI	39.743	14.0317
1.896000000 GI	39.749	14.0348
1.898000000 GI	39.722	14.0502
1.900000000 GI	39.713	14.0399
1.902000000 GI	39.728	14.0517
1.904000000 GI	39.709	14.0543
1.906000000 GI	39.719	14.0486
1.908000000 GI	39.710	14.1207
1.910000000 GI	39.569	14.0298
1.912000000 GI	39.560	14.1333
1.914000000 GI	39.610	14.1313
1.916000000 GI	39.624	14.1445
1.918000000 GI	39.602	14.1613

1.920000000 GH	39.5834	14.1579
1.922000000 GH	39.5817	14.1663
1.924000000 GH	39.5572	14.1686
1.926000000 GH	39.5260	14.1822
1.928000000 GH	39.5104	14.2047
1.930000000 GH	39.5005	14.1985
1.932000000 GH	39.4617	14.2034
1.934000000 GH	39.4629	14.2261
1.936000000 GH	39.4387	14.2284
1.938000000 GH	39.4260	14.2250
1.940000000 GH	39.4102	14.2531
1.942000000 GH	39.3805	14.2437
1.944000000 GH	39.3762	14.2662
1.946000000 GH	39.3607	14.2771
1.948000000 GH	39.3282	14.2763
1.950000000 GH	39.3215	14.2844

Title

SubTitle

February 15, 2012 3:11 PM

Frequency	e'	e''
1.850000000 GI	52.617	13.5838
1.852000000 GI	52.619	13.5931
1.854000000 GI	52.607	13.5985
1.856000000 GI	52.604	13.5989
1.858000000 GI	52.589	13.6015
1.860000000 GI	52.585	13.6118
1.862000000 GI	52.583	13.6184
1.864000000 GI	52.576	13.6242
1.866000000 GI	52.582	13.6439
1.868000000 GI	52.570	13.6621
1.870000000 GI	52.556	13.6677
1.872000000 GI	52.552	13.6809
1.874000000 GI	52.528	13.6901
1.876000000 GI	52.540	13.7002
1.878000000 GI	52.487	13.7066
1.880000000 GI	52.476	13.7114
1.882000000 GI	52.480	13.7233
1.884000000 GI	52.465	13.7418
1.886000000 GI	52.465	13.7460
1.888000000 GI	52.427	13.7562
1.890000000 GI	52.423	13.7740
1.892000000 GI	52.415	13.7670
1.894000000 GI	52.419	13.7866
1.896000000 GI	52.423	13.8063
1.898000000 GI	52.406	13.8121
1.900000000 GI	52.402	13.8155
1.902000000 GI	52.402	13.8213
1.904000000 GI	52.409	13.8482
1.906000000 GI	52.422	13.8416
1.908000000 GI	52.427	13.9043
1.910000000 GI	52.338	13.9311
1.912000000 GI	52.327	13.9130
1.914000000 GI	52.361	13.9471
1.916000000 GI	52.384	13.9514
1.918000000 GI	52.380	13.9545

1.920000000 GI	52.363	13.9860
1.922000000 GI	52.367	13.9778
1.924000000 GI	52.359	13.9882
1.926000000 GI	52.350	14.0084
1.928000000 GI	52.354	14.0162
1.930000000 GI	52.355	14.0116
1.932000000 GI	52.331	14.0220
1.934000000 GI	52.331	14.0370
1.936000000 GI	52.327	14.0336
1.938000000 GI	52.324	14.0523
1.940000000 GI	52.330	14.0660
1.942000000 GI	52.298	14.0554
1.944000000 GI	52.297	14.0721
1.946000000 GI	52.286	14.0668
1.948000000 GI	52.289	14.0890
1.950000000 GI	52.268	14.0924

APPENDIX F – PHANTOM CERTIFICATE OF CONFORMITY

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 C
Series No	TP-1150 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas; 6mm +/- 0.2mm at ERP	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions	DEGMBE based simulating liquids	Pre-series, First article, Samples

Standards

[1] CENELEC EN 50361
[2] IEEE Std 1528-200x Draft CD 1.1 (Dec 02)
[3] IEC 62209/CD (Nov 02)
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

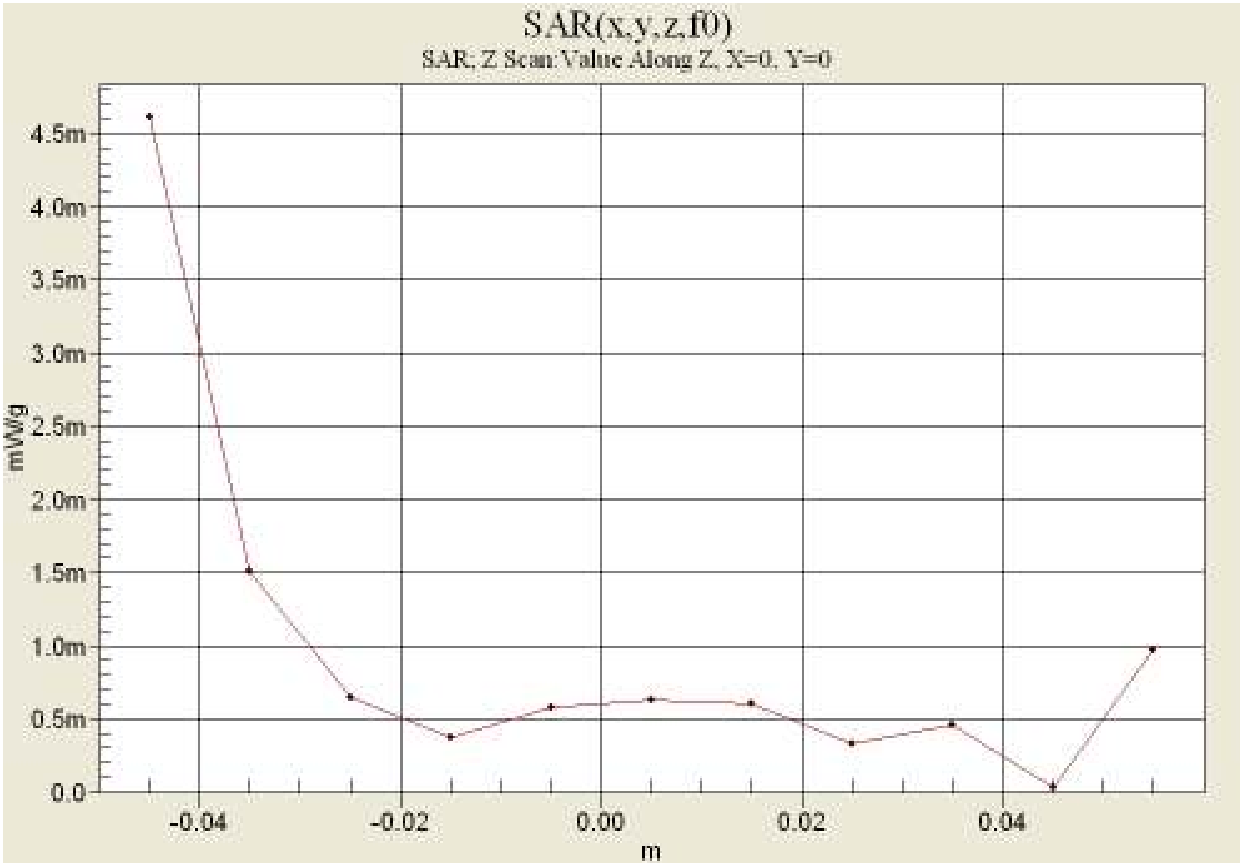
Date 7.8.2003

Signature / Stamp

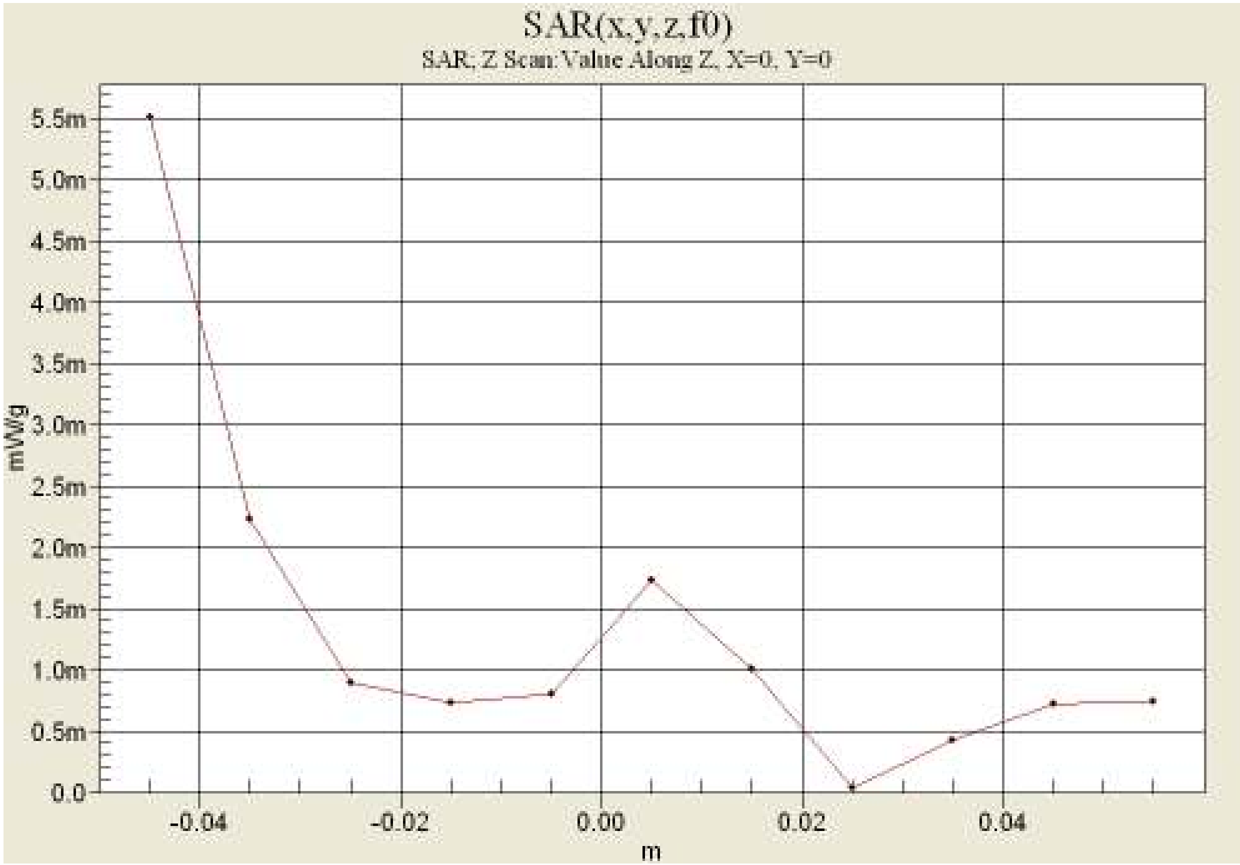
s p e a g
Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

APPENDIX G – Z-SCAN

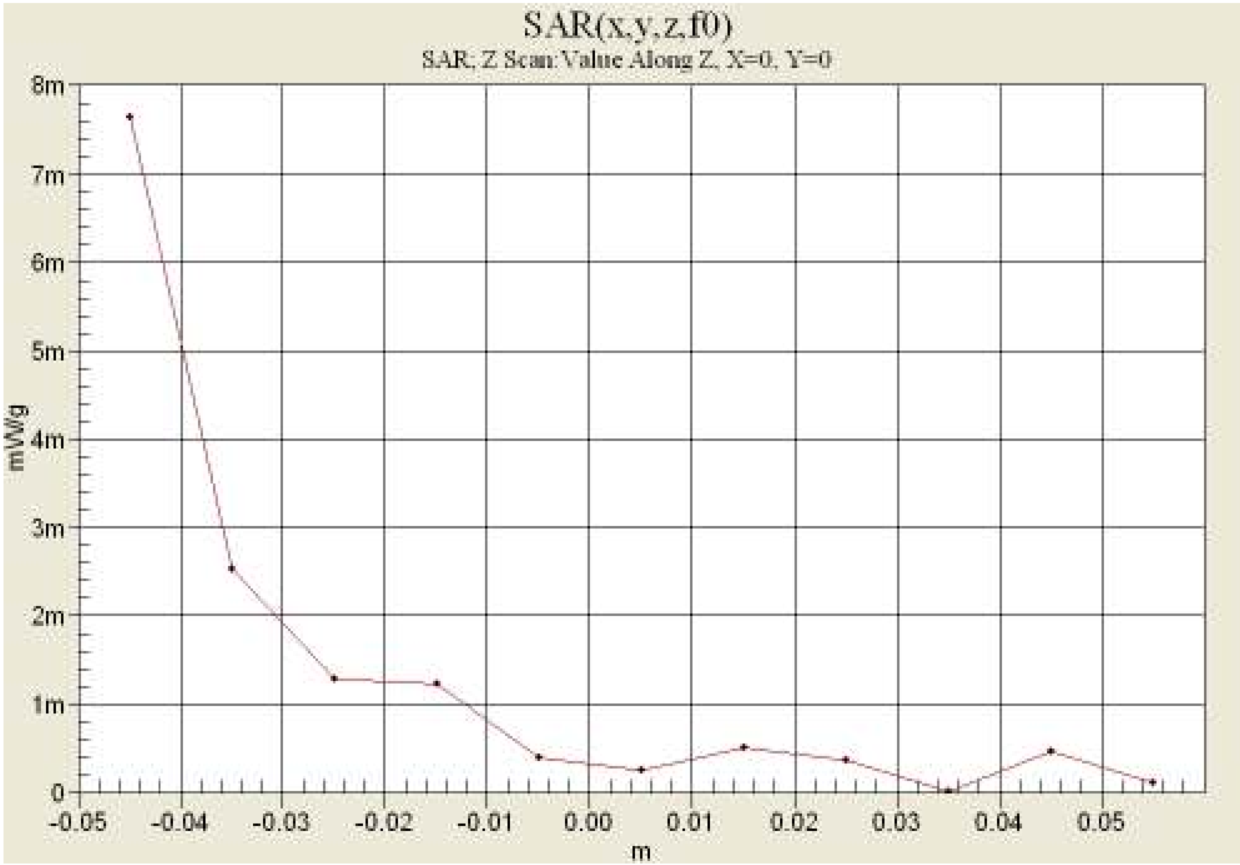
Mid Channel, Right Head Touch DECT (Z Scan)



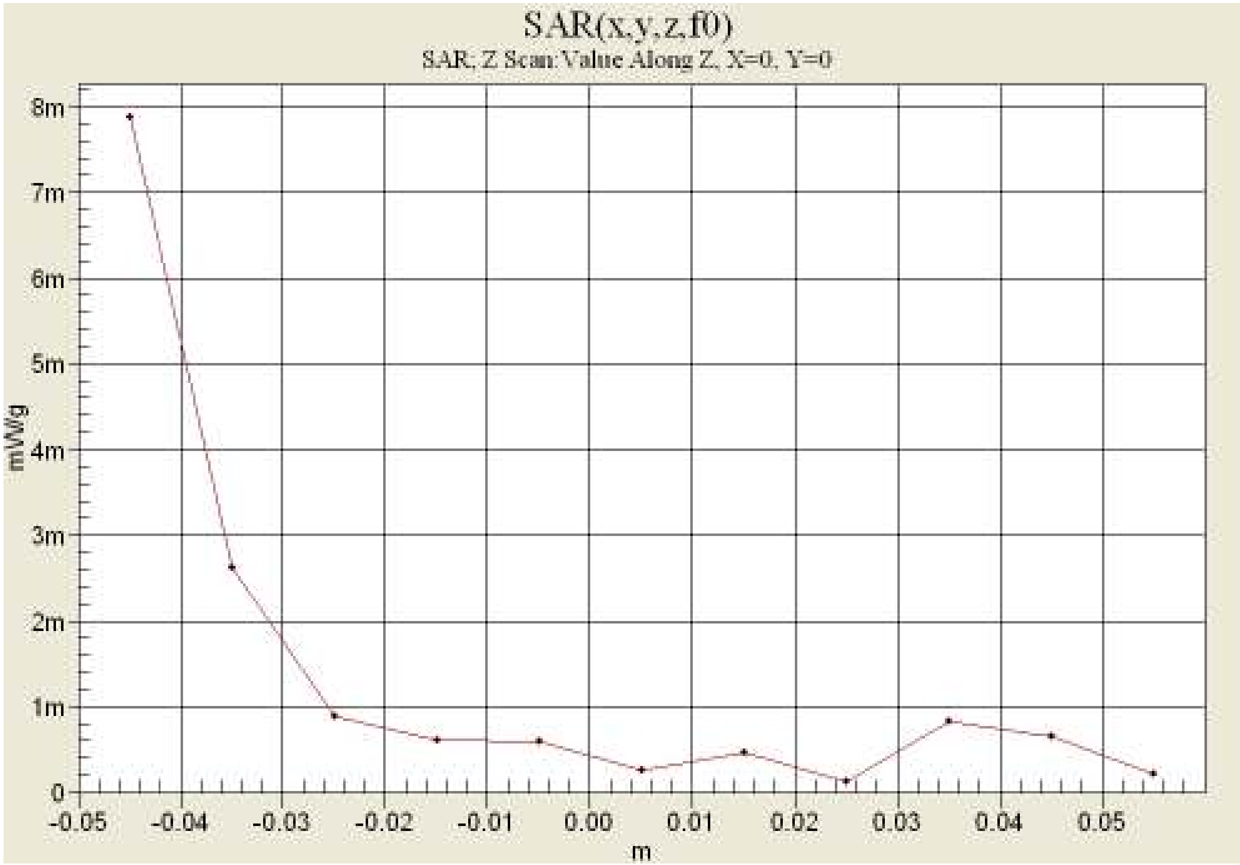
Mid Channel, Right Head Tilt DECT (Z Scan)



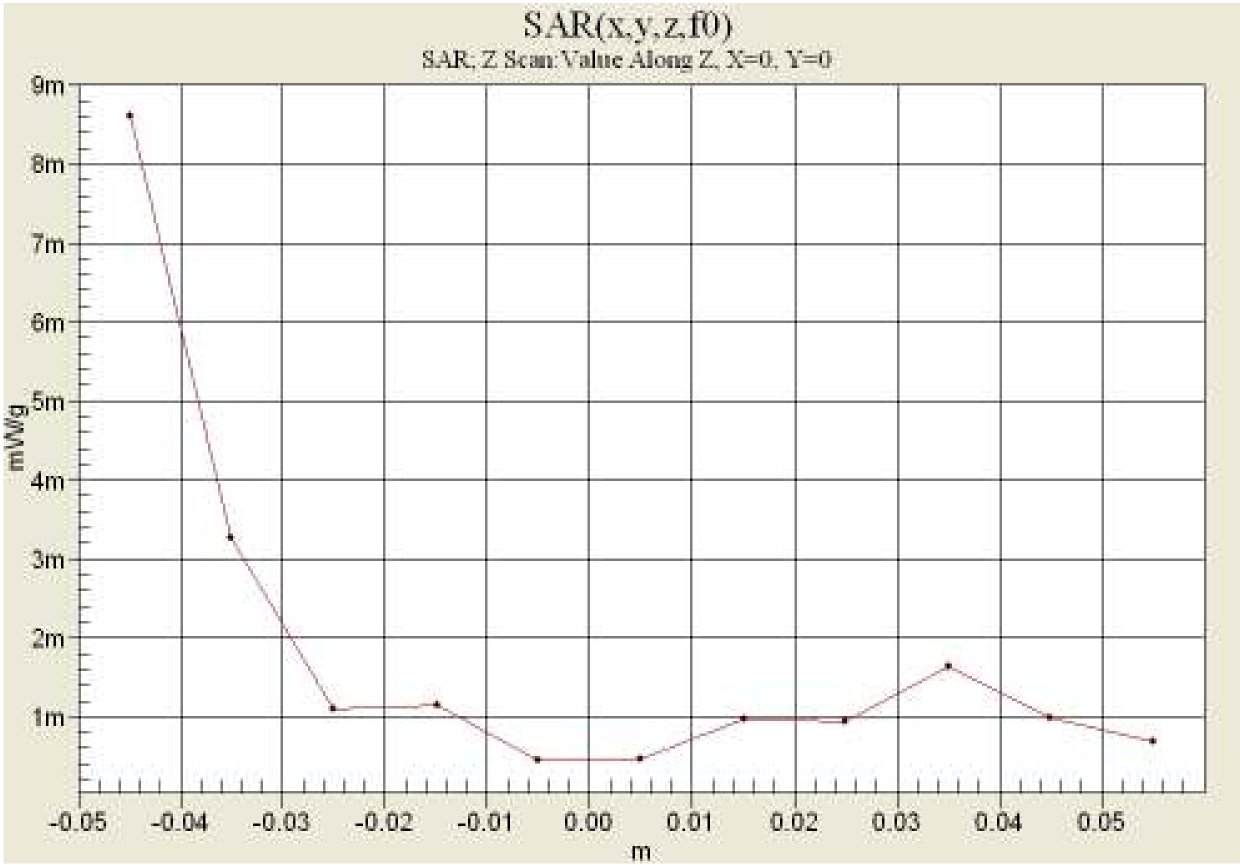
Mid Channel, Left Head Touch DECT (Z Scan)



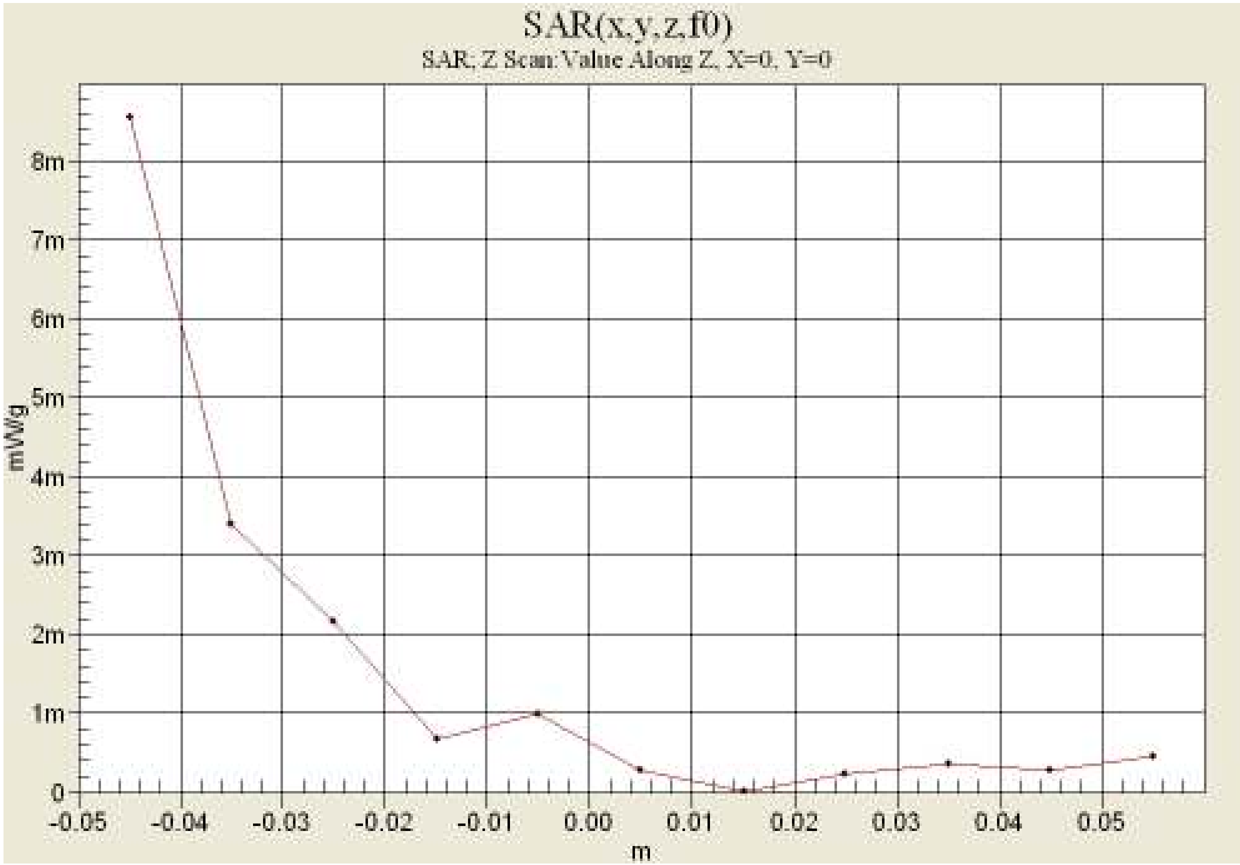
Mid Channel, Left Head Tilt DECT (Z Scan)



Mid Channel, Body Frontside DECT (Z Scan)

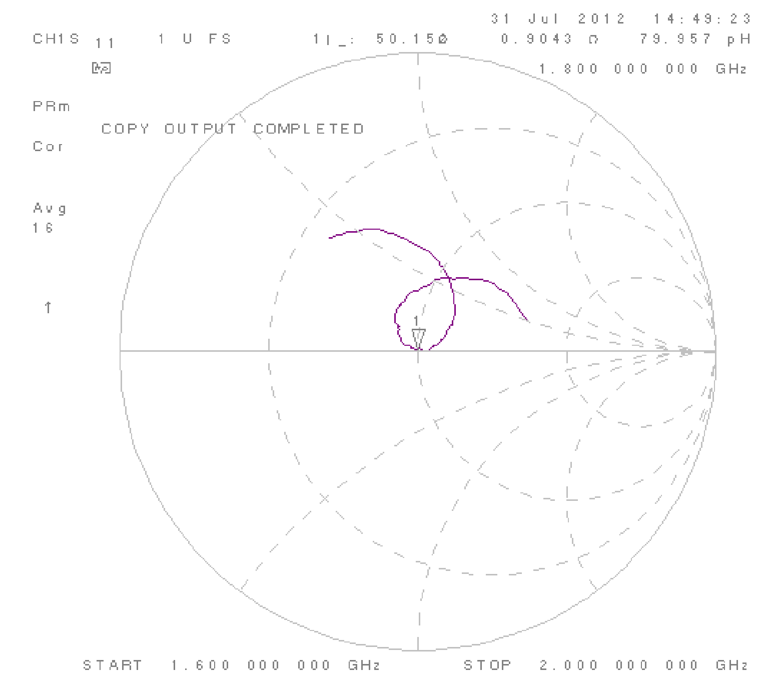


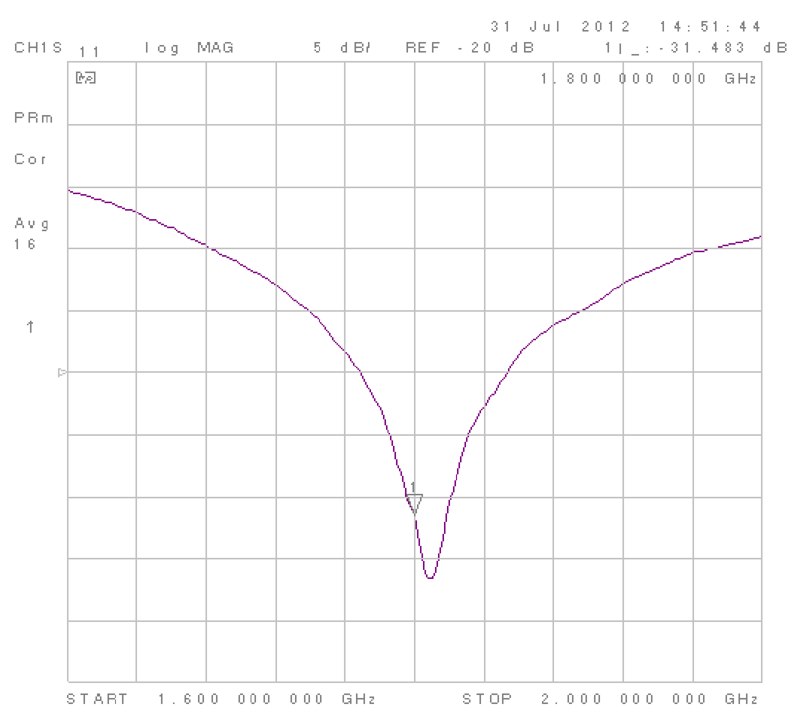
Mid Channel, Body Backside DECT (Z Scan)



APPENDIX H – DIPOLE RETURN LOSS AND IMPEDANCE MEASUREMENTS

DIPOLE RETURN LOSS AND IMPEDANCE MEASUREMENTS FOR HEAD





DIPOLE RETURN LOSS AND IMPEDANCE MEASUREMENTS FOR BODY