DECLARATION OF COMPLIANCE | SAR RF EXPOSURE EVALUATION | FCC & IC

Test Lab Information	**Name**	**CELLTECH LABS INC.**		**Address**	21-364 Lougheed Road, Kelowna, BC. V1X 7R8 Canada		
Applicant Information	**Name**	**VOCOLLECT INC.**		**Address**	703 Rodi Road, Pittsburgh PA 15235 United States		
Test Lab Accreditation	**A2LA**	ISO/IEC 17025:2005 (A2LA Test Lab Certificate No. 2470.01)					
Standard(s) Applied	**FCC**	47 CFR §2.1093			**IC**	Health Canada Safety Code 6	
Procedure(s) Applied	**FCC**	OET Bulletin 65, Supplement C (01-01)					
		KDB 447498 - Mobile and Portable RF Exposure Procedures					
		KDB 248227 - SAR Measurement Procedures for 802.11a/b/g Transmitters					
	IC	RSS-102 Issue 4					
	IEEE	1528-2003		**IEC**	62209-2:2010		
Device RF Exposure Category	**FCC/IC**	General Population / Uncontrolled Environment					
Device Classification(s)	**FCC**	DTS - Digital Transmission System (Part 15 Subpart C)					
		NII - Unlicensed National Information Infrastructure Transmitter (Part 15 Subpart E)					
	IC	Low Power License-Exempt Radio-communication Device (RSS-210)					
Device Identifier(s)	**FCC ID:**	MQO-TAP801-01			**IC:**	2570A-TAP80101	
Device Model Name	A500 Terminal			**Device Model No.**	TAP801-01		
Test Sample Serial No.	#5 FCC (Identical Prototype)						
Test Sample Hardware Rev. No.	Rev B		**Test Sample Firmware Rev. No.**		VIPV_29		
Measurement Date(s)	November 17, 2011		**Date of Sample Receipt**		November 16, 2011		
Device Description	Portable Body-worn Voice-Controlled Wireless Data Terminal						
Internal Transmitter(s) Type	802.11b/g WLAN + Bluetooth Combo Module						
Transmitter Type Tested	802.11b/g WLAN						
Co-located Transmitter(s)	Class 2 Bluetooth	3 dBm typical (+1.0/-2.0 dB)		< 60/$f_{(GHz)}$ mW	Simultaneous transmission with WLAN		
	Minimum Antenna-to-Antenna Distance (Bluetooth to 802.11b/g) = 60 mm						
	SAR evaluation for simultaneous transmission not required per FCC KDB 447498 D01v04 Section 3)b)ii)(1)(a) & (c)						
Modulation Type(s)	**802.11b**	DSS, DBPSK, DQPSK, CCK			**802.11g**	OFDM	
Data Rates	**802.11b**	1, 2, 5.5, 11 Mbps			**802.11g**	6, 9, 12, 24, 36, 48, 54 Mbps	
Transmit Frequency Range(s)	**802.11b/g**	2412 - 2462 MHz			**Bluetooth**	2402 - 2480 MHz	
RF Output Power Levels Tested	**802.11b**	Channel 1, 2412 MHz, 1Mbps	14.9 dBm		30.9 mW	Source-Based Time-Averaged	
Maximum Duty Cycle Tested	**802.11b**	Channel 1, 2412 MHz, 1Mbps	88% (measured)			Source-Based Time-Averaged	
Antenna Type(s) Tested	Internal (802.11b/g)						
Battery Type(s) Tested	Lithium-ion (3.6V, 4400mAh)					P/N: 730022	
Body-worn Accessories Tested	Belt-Clip & Belt Strap					P/N: BL-700-4	
Audio Accessories Tested	Headset-Microphone					P/N: 070334878	
Max. SAR Level(s) Evaluated	**BODY**	**802.11b**	**0.027 W/kg**	**1g average**	**FCC/IC SAR Limit**	**1.6 W/kg**	**1g average**

Celltech Labs Inc. declares under its sole responsibility that this wireless portable device was compliant with the Specific Absorption Rate (SAR) RF exposure requirements specified in FCC 47 CFR §2.1093 and Health Canada's Safety Code 6 for the General Population / Uncontrolled Exposure environment. The device was tested in accordance with the measurement procedures specified in FCC OET Bulletin 65, Supplement C (Edition 01-01), Industry Canada RSS-102 Issue 4, IEEE Standard 1528-2003 and IEC International Standard 62209-2:2010. All measurements were performed in accordance with the SAR system manufacturer recommendations.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

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

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Test Report Approved By	Sean Johnston	**Sean Johnston**	**Lab Manager**	**Celltech Labs Inc.**

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REVISION HISTORY			
REVISION NO.	**DESCRIPTION**	**IMPLEMENTED BY**	**RELEASE DATE**
1.0	1st Release	Jon Hughes	December 01, 2011

TEST REPORT SIGN-OFF			
DEVICE TESTED BY	**REPORT PREPARED BY**	**QA REVIEW BY**	**REPORT APPROVED BY**
Mike Meaker	Mike Meaker	Jon Hughes	Sean Johnston

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1.0 INTRODUCTION

This measurement report demonstrates that the Vocollect Inc. Model: TAP801-01 Portable Body-worn Voice-Controlled Wireless Data Terminal with 802.11b/g WLAN and Bluetooth complies with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) and Health Canada's Safety Code 6 (see reference [2]) for the General Population / Uncontrolled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [3]), IC RSS-102 Issue 4 (see reference [4]), IEEE Standard 1528-2003 (see reference [5]) and IEC International Standard 62209-2:2010 (see reference [6]) were employed. A description of the product, operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 SAR MEASUREMENT SYSTEM

Celltech Labs Inc. SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, SwitzeWLANd. 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 Head 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). A cell controller system contains 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 utilizes a controller with built in VME-bus computer.

DASY4 System with SAM Twin Phantom V4.0C

DASY4 Measurement Server

3.0 SAR PROBE CALIBRATION & MEASUREMENT FREQUENCIES (150MHz-3GHz)

The following procedures are recommended for measurements at 150 MHz - 3 GHz to minimize probe calibration and tissue dielectric parameter discrepancies. In general, SAR measurements below 300 MHz should be within ±50 MHz of the probe calibration frequency. At 300 MHz to 3 GHz, measurements should be within ±100 MHz of the probe calibration frequency. Measurements exceeding 50% of these intervals, ±25 MHz < 300 MHz and ±50 MHz ≥300 MHz, require additional steps (per FCC KDB 450824 D01 v01r01, SAR Probe Calibration and System Verification Considerations for Measurements at 150 MHz - 3 GHz - see reference [9]).

Probe Calibration Freq.	Device Measurement Freq.	Frequency Interval	±50 MHz ≥ 300 MHz
2450 MHz	2412 MHz	38 MHz	< 50 MHz

The probe calibration and measurement frequency interval is < 50 MHz; therefore the additional steps are not required for this evaluation.

4.0 CONDUCTED OUTPUT POWER MEASUREMENTS

MEASURED RF CONDUCTED OUTPUT POWER LEVELS

Freq. (MHz)	Channel	Average Conducted RF Output Power Levels (dBm)							
802.11b Mode		1 Mbps		2 Mbps		5.5 Mbps		11 Mbps	
2412	1	14.9		14.5		12.2		11.7	
2437	6	14.1		13.9		11.5		11.0	
2462	11	14.1		13.6		11.4		10.9	
802.11g Mode		6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
2412	1	11.1	10.6	10.1	8.6	7.3	5.8	2.7	2.4
2437	6	10.7	10.3	9.8	8.4	7.2	5.5	2.3	2.0
2462	11	10.6	10.1	9.6	8.2	6.8	5.3	2.3	1.9

Notes

1. The RF conducted average output power levels of the DUT were measured by Celltech prior to the SAR evaluations using a Gigatronics 8652A Universal Power Meter at the internal connector in accordance with FCC 47 CFR §2.1046 (see reference [13]) and IC RSS-Gen (see reference [14]).

2. The RF conducted output power levels measured in 802.11g mode were < 0.25 dB > 802.11b mode; therefore SAR evaluations were not required for 802.11g mode (per FCC KDB 248277 D01v01r02 - see reference [8]).

3. The RF conducted output power levels measured for the higher data rates were < 0.25 dB > the lowest data rate conducted output power levels; therefore SAR evaluations were not required for the higher data rates (per FCC KDB 248227 D01v01r02 - see reference [8]).

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5.0 FLUID DIELECTRIC PARAMETERS

FLUID DIELECTRIC PARAMETERS						
Date: 11/17/2011		Frequency: 2450 MHz			Tissue: Body	
Freq	Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2.350	49.78	1.85	52.7	1.95	-5.54%	-5.13%
2.360	49.61	1.87	52.7	1.95	-5.86%	-4.10%
2.370	49.54	1.86	52.7	1.95	-6.00%	-4.62%
2.380	49.63	1.86	52.7	1.95	-5.83%	-4.62%
2.390	49.56	1.91	52.7	1.95	-5.96%	-2.05%
2.400	49.52	1.91	52.7	1.95	-6.03%	-2.05%
2.410	49.51	1.92	52.7	1.95	-6.05%	-1.54%
2.412*	49.5	1.92	52.7	1.95	-6.07%	-1.54%
2.420	49.31	1.92	52.7	1.95	-6.43%	-1.54%
2.430	49.52	1.94	52.7	1.95	-6.03%	-0.51%
2.440	49.37	1.97	52.7	1.95	-6.32%	1.03%
2.450	49.36	1.99	52.7	1.95	-6.34%	2.05%
2.460	49.33	1.99	52.7	1.95	-6.39%	2.05%
2.470	49.53	2	52.7	1.95	-6.02%	2.56%
2.480	49.4	2.01	52.7	1.95	-6.26%	3.08%
2.490	49.24	1.99	52.7	1.95	-6.57%	2.05%
2.500	49.21	2.03	52.7	1.95	-6.62%	4.10%
2.510	49.26	2.05	52.7	1.95	-6.53%	5.13%
2.520	49.27	2.05	52.7	1.95	-6.51%	5.13%
2.530	49.19	2.09	52.7	1.95	-6.66%	7.18%
2.540	49.08	2.1	52.7	1.95	-6.87%	7.69%
2.550	49.17	2.1	52.7	1.95	-6.70%	7.69%

*interpolated using DASY4 software

Test Date	Fluid Type	Ambient Temperature	Fluid Temperature	Fluid Depth	Atmospheric Pressure	Relative Humidity	ρ (Kg/m^3)
Nov 17	2450 Body	22.0°C	24.0 °C	≥ 15 cm	101.1 kPa	30%	1000

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6.0 SAR MEASUREMENT SUMMARY

BODY SAR EVALUATION RESULTS

WLAN Mode	Test Mode	Test Freq.	Test Chan.	Data Rate	Duty Cycle & Crest Factor	Accessories		DUT Position to Planar Phantom Section	Conducted Power Before Test	SAR Drift During Test	Measured SAR (1g)
		MHz		Mbps		Body-worn	Audio		dBm	dB	W/kg
802.11b	DSSS	2412	1	1	88% d/c c/f = 1:1.14	Belt-clip & Belt-strap	Headset	Bottom Touch	14.9	0.039	**0.027**

SAR SAFETY LIMIT(S)		BODY	SPATIAL PEAK	RF EXPOSURE CATEGORY
FCC 47 CFR 2.1093	Health Canada Safety Code 6	1.6 W/kg	1g average	General Population / Uncontrolled

Test Date(s):	Nov. 17, 2011

Notes

1.	Detailed measurement data and plots showing the maximum SAR location of the DUT are reported in Appendix A.
2.	The test frequency/channel is the default test frequency in accordance with the procedures described in FCC KDB 248227 D01v01r02 (see reference [8]).
3.	The default channel and data rate evaluated for SAR was determined based on the maximum conducted output power level measured prior to the SAR evaluations in accordance with the requirements specified in FCC KDB 248227 D01v01r02 (see reference [8]).
4.	If the SAR levels measured at the maximum output channel were ≥ 3 dB below the SAR limit, SAR evaluations for the remaining channels were not required (per FCC KDB 248227 D01v01r02 - see reference [8]).
5.	The SAR drift of the DUT was measured by the DASY4 system for the duration of the SAR evaluation.
6.	The DUT battery was fully charged prior to the SAR evaluation.
7.	The fluid temperature remained within +/-2°C from the dielectric parameter measurement to the completion of the SAR test.
8.	The dielectric parameters of the simulated tissue mixture were measured prior to the SAR evaluations using a Dielectric Probe Kit and a Network Analyzer (see Section 5.0 and Appendix C).

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7.0 SAR LEVEL ADJUSTMENT FOR FLUID SENSITIVITY

The measured fluid dielectric properties for 2450 MHz Body tissue simulant were outside the 5% measurement protocol tolerance as reported in the table below. Chapter 22 of the SAR system manufacturer's DASY4 Manual (see reference [10]) provides the following calculation formula for making fluid sensitivity adjustments to the measured SAR value:

% Change in SAR = Sensitivity * % Change in Value

Measured Fluid Parameters:

Test Date	Freq (GHz)	Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
Nov 17	2.412*	49.5	1.92	52.7	1.95	-6.07%	-1.54%
Nov 17	2.450**	49.36	1.99	52.7	1.95	-6.34%	2.05%

**interpolated using DASY4 software*

*** System Performance Check freq.*

Since the measured permittivity is lower than the target value and the measured conductivity is within the 5% tolerance, the measured SAR value is already overestimated. Therefore, no adjustment is required to the measured SAR value.

Note:

FCC KDB 450824 (see reference [9]) refers to probe calibrations with fluid parameter tolerances +/- 5%; SPEAG's current probe calibration is valid for fluid parameter tolerances of +/- 10% (See Appendix F). We have accounted for the > 5% measured fluid parameter tolerance in the measurement uncertainty table (see Section 20) and have still applied the same sensitivity calculation adjustment to the SAR levels as required.

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8.0 DETAILS OF SAR EVALUATION

The Vocollect Inc. Model: TAP801-01 Portable Body-worn Voice-Controlled Wireless Data Terminal with 802.11b/g WLAN and Bluetooth was compliant for localized Specific Absorption Rate (Uncontrolled Exposure) based on the test provisions and conditions described below. The detailed test setup photographs are shown in Appendix D.

Test Configuration(s)

1. The DUT was evaluated for body-worn SAR with the plastic belt-clip and belt-strap accessory attached to the DUT. The back side (belt-clip side) of the DUT was placed parallel and touching the outer surface of the planar phantom.
2. The headset-microphone audio accessory was connected to the DUT for the duration of the body-worn evaluation.

Test Mode(s) & Power Setting(s)

3. The DUT was placed into test mode using a terminal program on a PC with a serial cable connected to the DUT. Instructions for setting the WLAN channel and data rate were provided by the customer and used to set the device in the correct mode. The serial cable was removed from the DUT prior to SAR evaluations.
4. The DUT was tested with a modulated DSSS signal in 802.11b mode.

Simultaneous Transmission

Class 2 Bluetooth	3 dBm typical (+1.0/-2.0 dB)	o/p < $60/f_{(GHz)}$ mW	Simultaneous transmission with WLAN
Minimum Antenna-to-Antenna Distance (Bluetooth to 802.11b/g) = 60 mm			
SAR evaluation for simultaneous transmission not required per FCC KDB 447498 D01v04 Section 3)b)ii)(1)(a) & (c)			

9.0 SAR EVALUATION PROCEDURES

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

b. The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference and optical surface 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:

c. 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.

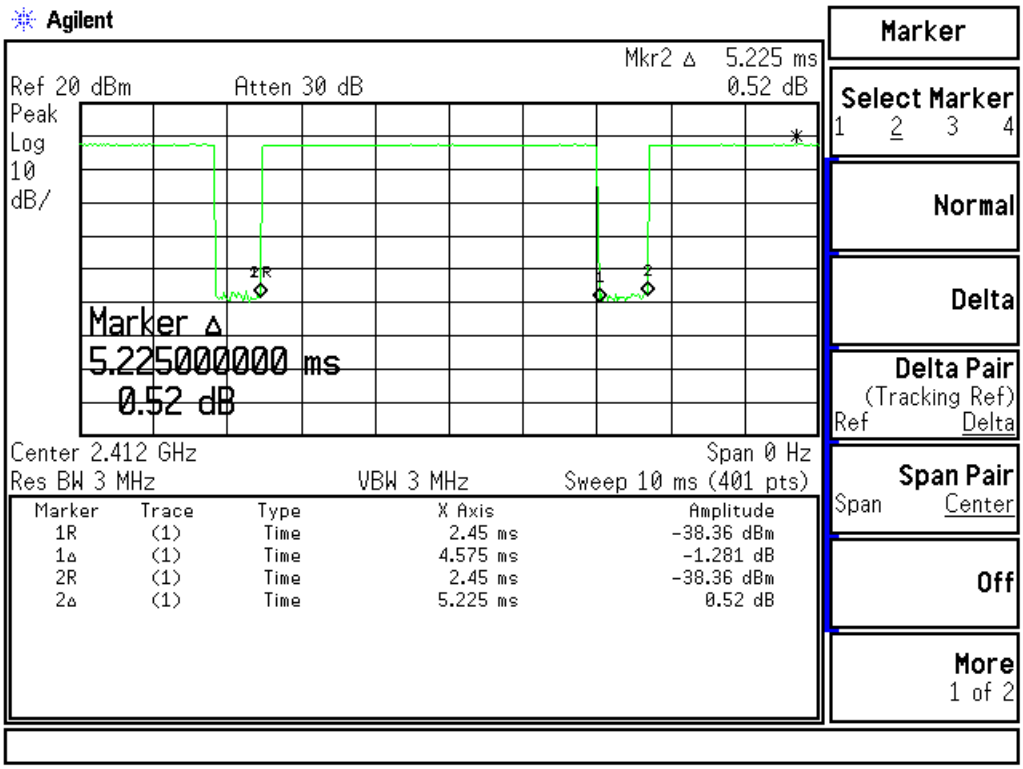
d. A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.
A 1g and 10g spatial peak SAR was determined as follows:

e. Extrapolation is used to determine the values between the dipole center of the probe and the surface of the phantom. This data cannot be measured because the center of the dipole sensors is 1.0 mm away from the probe tip and the distance between the probe and the boundary must be larger than 25% of the probe diameter. The probe diameter is 2.4 mm. In the DASY4 software, the distance between the sensor center and phantom surface is set to 2.0 mm. This provides a distance of 1.0 mm between the probe tip and the surface. The extrapolation of the values between the dipole center and the surface of the phantom was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.

f. 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).

g. A zoom scan volume of 30 mm x 30 mm x 30 mm (5x5x7 points) centered at the peak SAR location determined from the area scan is used for all zoom scans for devices with a transmit frequency < 800 MHz. Zoom scans for frequencies ≥ 800 MHz are determined with a scan volume of 30 mm x 30 mm x 30 mm (7x7x7 points) to ensure complete capture of the peak spatial-average SAR.

10.0 TIMING PLOT



Transmit Mode: 802.11b - Ch. 1 - 1Mbps
4.575ms / 5.225ms
= 88 % Duty Cycle

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11.0 SYSTEM PERFORMANCE CHECK

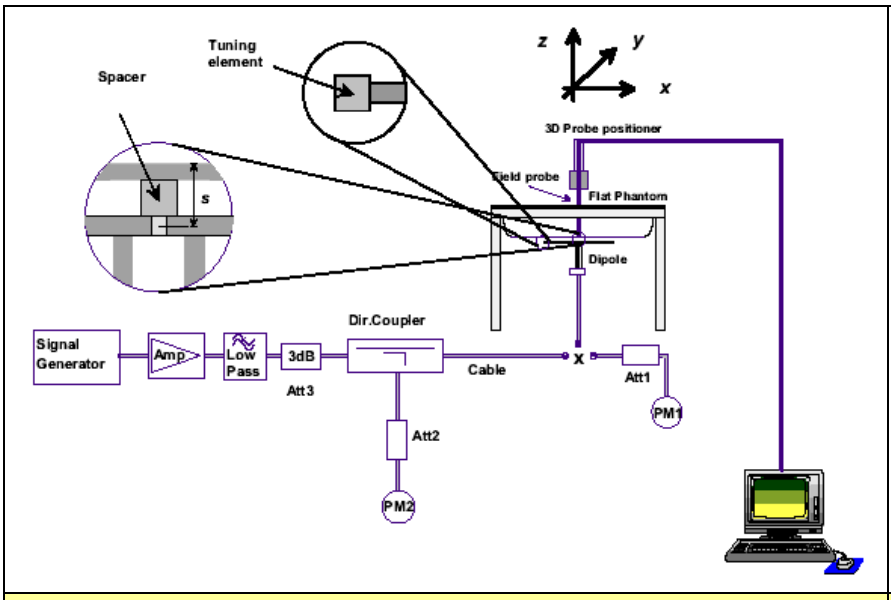
Prior to the SAR evaluations, a daily system check was performed at the planar section of the SAM phantom with a 2450MHz SPEAG validation dipole (see Appendix B for system performance check test plot) in accordance with the procedures described in IEEE Standard 1528-2003 (see reference [5]) and IEC 62209-2:2010 (see reference [6]). A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of ±10% from the system manufacturer's dipole calibration target SAR value (see Appendix E for system manufacturer's dipole calibration procedures).

SYSTEM PERFORMANCE CHECK EVALUATION

Test Date	Equiv. Tissue	SAR 1g (W/kg)			Dielectric Constant ε_r			Conductivity σ (mho/m)			ρ (Kg/m³)	Amb. Temp. (°C)	Fluid Temp. (°C)	Fluid Depth (cm)	Humid. (%)	Barom. Press. (kPa)
	Freq. (MHz)	Target	Meas.	Dev.	Target	Meas.	Dev.	Target	Meas.	Dev.						
Nov 17	BODY 2450	12.9 ±10%	13.8	+7.0%	52.7 ±5%	49.4	-6.3%	1.95 ±5%	1.99	+2.1%	1000	22.0	24.0	≥ 15	30	101.1

Notes

1. The target SAR value is the measured value from the dipole calibration performed by the system manufacturer (see Appendix E).
2. The target dielectric parameters are the nominal values from the dipole calibration performed by SPEAG (see Appendix E) and specified in IC RSS-102 Issue 4 (see reference [4]).
3. The measured fluid dielectric properties for 2450 MHz Head tissue simulant were outside the 5% measurement protocol tolerance. Please refer to Section 7.0 of this report for SAR sensitivity adjustment procedures applied in accordance with the DASY4 manual.
4. The fluid temperature remained within +/-2°C from the dielectric parameter measurement to the completion of the system performance check evaluation.
5. The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using a Dielectric Probe Kit and a Network Analyzer (see Appendix C).



System Performance Check Measurement Setup Diagram

2450 MHz Validation Dipole Setup

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12.0 SIMULATED EQUIVALENT TISSUES

The simulated equivalent tissue recipe listed in the table below is derived from the SAR system manufacturer's suggested recipe in the DASY4 manual (see reference [11]). The ingredient percentage may have been adjusted minimally in order to achieve the appropriate target dielectric parameters within the specified tolerance.

2450 MHz SIMULATED TISSUE MIXTURES	
INGREDIENT	**2450 MHz Body**
Water	69.98 %
Glycol Monobutyl	30.00 %
Salt	0.02 %

13.0 SAR LIMITS

SAR RF EXPOSURE LIMITS			
FCC 47 CFR 2.1093	**Health Canada Safety Code 6**	**(General Population / Uncontrolled Exposure)**	**(Occupational / Controlled Exposure)**
Spatial Average (averaged over the whole body)		0.08 W/kg	0.4 W/kg
Spatial Peak (averaged over any 1 g of tissue)		**1.6 W/kg**	8.0 W/kg
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)		4.0 W/kg	20.0 W/kg
The Spatial Average value of the SAR averaged over the whole body.			
The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.			
The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.			
Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.			
Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.			

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14.0 ROBOT SYSTEM SPECIFICATIONS

Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: RX60L
Repeatability	0.02 mm
No. of axis	6
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	AMD Athlon XP 2400+
Clock Speed	2.0 GHz
Operating System	Windows XP Professional
Data Converter	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY4, V4.7 Build 44
	Postprocessing Software: SEMCAD, V1.8 Build 171
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	EX3DV4
Serial No.	3600
Construction	Symmetrical design with triangular core
Frequency	10 MHz to 6 GHz
Linearity	±0.2 dB (30 MHz to 3 GHz)
Phantom(s)	
Type	SAM V4.0C
Shell Material	Fiberglass
Thickness	2.0 ±0.1 mm
Volume	Approx. 25 liters

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15.0 PROBE SPECIFICATION (EX3DV4)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. DGBE)
Calibration:	Basic Broadband Calibration in air: 10-3000 MHz Conversion Factors (CF) for HSL 900 and HSL 1750
Frequency:	10 MHz to >6 GHz; Linearity: ±0.2 dB (30 MHz to 3 GHz)
Directivity:	±0.3 dB in HSL (rotation around probe axis) ±0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range:	10 μW/g to >100 mW/g; Linearity: ±0.2 dB (noise: typically < 1 μW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1.0 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better than 30%.

EX3DV4 E-Field Probe

16.0 SAM TWIN PHANTOM V4.0C

The SAM Twin Phantom V4.0C is a fiberglass shell phantom with a 2.0 mm (+/-0.2 mm) shell thickness for left and right head and flat planar area integrated in a wooden table. The shape of the fiberglass shell corresponds to the phantom defined by SCC34-SC2. The device holder positions are adjusted to the standard measurement positions in the three sections (see Appendix G for specifications of the SAM Twin Phantom V4.0C).

SAM Twin Phantom V4.0C

17.0 DEVICE HOLDER

The DASY4 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. 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. For evaluations of larger devices a Plexiglas platform is attached to the device holder.

Device Holder

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18.0 TEST EQUIPMENT LIST

TEST EQUIPMENT		ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION INTERVAL
USED	DESCRIPTION				
x	Schmid & Partner DASY4 System	-	-	-	-
x	-DASY4 Measurement Server	00158	1078	CNR	CNR
x	-Robot	00046	599396-01	CNR	CNR
x	-DAE4	00019	353	27Apr10	Biennial
x	-EX3DV4 E-Field Probe	00213	3600	23Jun11	Annual
x	-D2450V2 Validation Dipole	00219	825	21Apr09	Triennial
x	-SAM Twin Phantom V4.0C	00154	1033	CNR	CNR
x	HP 85070C Dielectric Probe Kit	00033	None	CNR	CNR
x	Gigatronics 8652A Power Meter	00007	1835272	04May10	Biennial
x	Gigatronics 80701A Power Sensor	00014	1833699	04May10	Biennial
x	HP 8753ET Network Analyzer	00134	US39170292	04May10	Biennial
x	Rohde & Schwarz SMR20 Signal Generator	00006	100104	CNR	CNR
x	Amplifier Research 5S1G4 Power Amplifier	00106	26235	CNR	CNR
Abbr.	CNR = Calibration Not Required; N/A = Not Applicable				

19.0 JUSTIFICATION FOR EXTENDED SAR DIPOLE CALIBRATION

SAR dipoles calibrated less than three years ago but more than one year ago were confirmed by maintaining return loss (< -20dB, within 20% of prior calibration) and impedance (within 5Ω from prior calibration) requirements per extended calibration procedures specified in FCC KDB 450824 (see reference [9]).

SPEAG D2450V2 SN: 825							
Date of Measurement	**Location of Measurement**	**Frequency**	**Fluid Type**	**Return Loss (dB)**	**Δ %**	**Impedance (Ω)**	**Δ Ω**
Apr. 17, 2009	SPEAG	2450 MHz	Body	-24.8	-	49.2	-
Feb. 18, 2011	Celltech			- 23.7	4.4%	54.2	5

20.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION									
Uncertainty Component	**IEEE 1528 Section**	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	**ci 1g**	**ci 10g**	**Uncertainty Value ±% (1g)**	**Uncertainty Value ±% (10g)**	**V_i or V_{eff}**
Measurement System									
Probe Calibration (2450 MHz)	E.2.1	6.0	Normal	1	1	1	6.0	6.0	∞
Axial Isotropy	E.2.2	4.7	Rectangular	1.732050808	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	Rectangular	1.732050808	0.7	0.7	3.9	3.9	∞
Boundary Effect	E.2.3	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	Rectangular	1.732050808	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	Rectangular	1.732050808	1	1	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3	Rectangular	1.732050808	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	Rectangular	1.732050808	1	1	0.2	0.2	∞
Probe Positioning wrt Phantom Shell	E.6.3	2.9	Rectangular	1.732050808	1	1	1.7	1.7	∞
Extrapolation, interpolation & integration algorithms for max. SAR evaluation	E.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	2.9	Normal	1	1	1	2.9	2.9	12
Device Holder Uncertainty	E.4.1	3.6	Normal	1	1	1	3.6	3.6	8
SAR Drift Measurement	6.6.2	5	Rectangular	1.732050808	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4	Rectangular	1.732050808	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5	Rectangular	1.732050808	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measured)	E.3.3	1.54	Normal	1	0.64	0.43	1.0	0.7	∞
Liquid Permittivity (target)	E.3.2	5	Rectangular	1.732050808	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measured)	E.3.3	6.07	Normal	1	0.6	0.49	3.6	3.0	∞
Combined Standard Uncertainty			**RSS**				**11.27**	**10.92**	
Expanded Uncertainty (95% Confidence Interval)			**k=2**				**22.55**	**21.84**	
Measurement Uncertainty Table in accordance with IEEE Standard 1528-2003									
This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2									

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21.0 REFERENCES

[1] Federal Communications Commission - "Radiofrequency radiation exposure evaluation: portable devices", Rule Part 47 CFR §2.1093.

[2] Health Canada - "Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz", Safety Code 6: 1999.

[3] Federal Communications Commission - "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.

[4] Industry Canada - "Radio Frequency Exposure Compliance of Radio Communication Apparatus (All Frequency Bands)", Radio Standards Specification RSS-102 Issue 4: March 2010.

[5] IEEE Standard 1528-2003 - "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques": December 2003.

[6] International Standard IEC 62209-2 Edition 1.0 2010-03 - "Human exposure to radio frequency fields from hand-held & body-mounted wireless communication devices - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)".

[7] Federal Communications Commission, Office of Engineering and Technology - "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies"; KDB 447498 D01 v04: November 2009.

[8] Federal Communications Commission, Office of Engineering and Technology - "SAR Measurement Procedures for 802.11a/b/g Transmitters"; KDB 248227 D01 v01r02: May 2007.

[9] Federal Communications Commission, Office of Engineering and Technology - "Application Note: SAR Probe 0Calibration and System Verification Considerations for Measurements at 150 MHz - 3 GHz"; KDB 450824 D01 v01r01: January 2007.

[10] Schmid & Partner Engineering AG - DASY4 Manual V4.6, Chapter 22 Application Note, SAR Sensitivities: Sept. 2005.

[11] Schmid & Partner Engineering AG - DASY4 Manual V4.6, Chapter 17 Application Note, Body Tissue Recipe: Sept. 2005.

[12] International Standard ISO/IEC 17025:2005 - "General requirements for the competence of testing and calibration laboratories".

[13] Federal Communications Commission - "Measurements Required: RF Power Output"; Rule Part 47 CFR §2.1046.

[14] Industry Canada - "General Requirements and Information for the Certification of Radiocommunication Equipment", Radio Standards Specification RSS-Gen Issue 2: June 2007.

APPENDIX A - SAR MEASUREMENT PLOTS

Test Date: 11/17/2011

Body-worn - 802.11b - Ch. 1 - 2412 MHz - 1Mbps

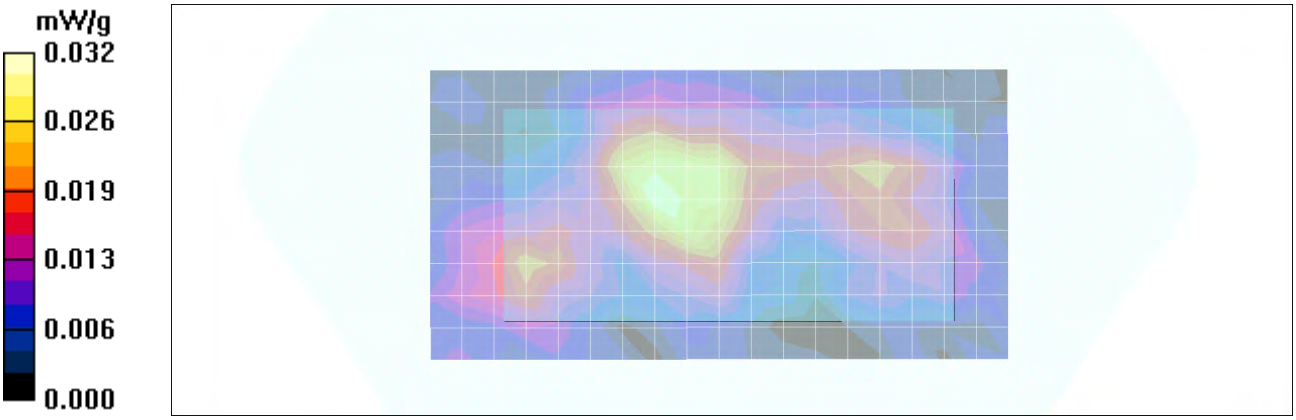
DUT: Vocollect A500; Type: Waist-Worn Terminal; Serial: FCC #5

Ambient Temp: 22C; Fluid Temp: 24.0C; Barometric Pressure: 101.1 kPa; Humidity: 30%

Communication System: DSSS WLAN
Frequency: 2412 MHz; Duty Cycle: 1:1.14
Medium: M2450 Medium parameters used (interpolated): f = 2412 MHz; σ = 1.92 mho/m; ε_r = 49.5; ρ = 1000 kg/m^3

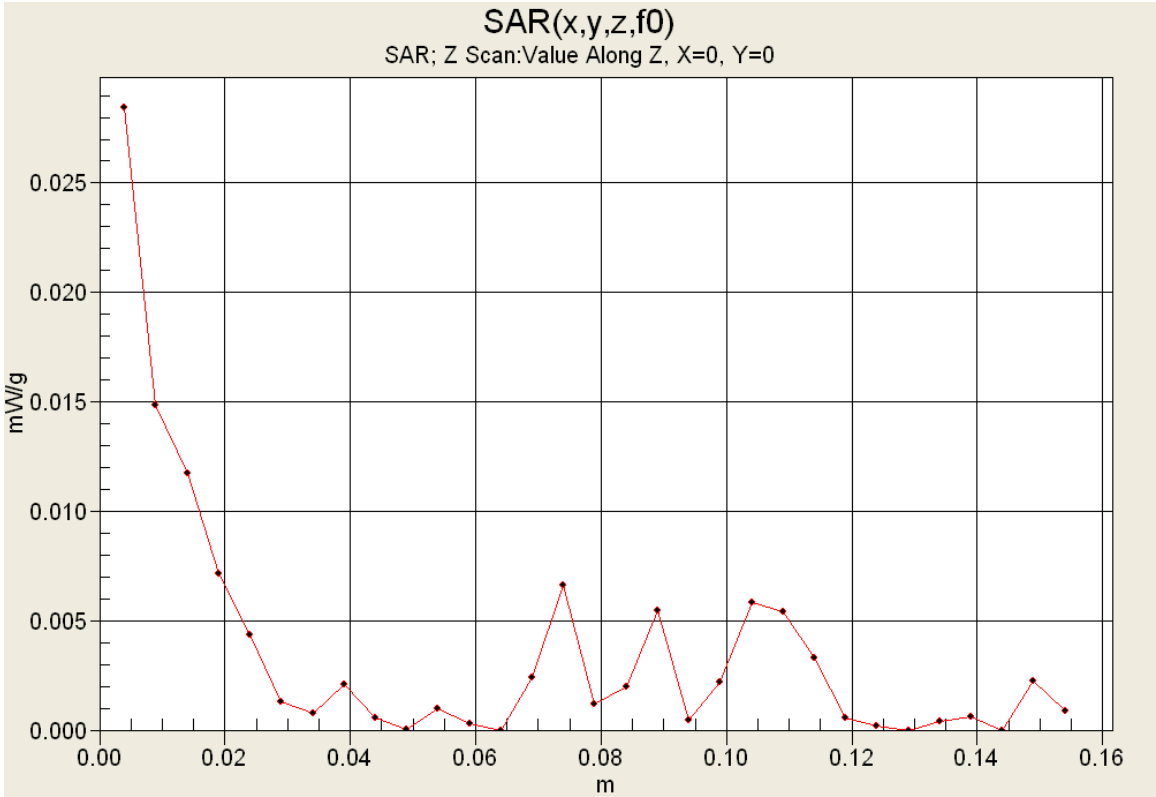
- Probe: EX3DV4 - SN3600; ConvF(6.15, 6.15, 6.15); Calibrated: 23/06/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 27/04/2010
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Belt-Clip Side of DUT - 2412 MHz - 802.11b
Area Scan (10x19x1): Measurement grid: dx=10mm, dy=10mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.030 mW/g
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.75 V/m; Power Drift = 0.039 dB
Peak SAR (extrapolated) = 0.049 W/kg
SAR(1 g) = 0.027 mW/g; SAR(10 g) = 0.016 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.032 mW/g



DUT orientation under planar phantom

Z-axis Scan



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APPENDIX B - SYSTEM PERFORMANCE CHECK PLOTS

Test Date: 11/17/2011

System Performance Check - 2450 MHz Dipole - Body

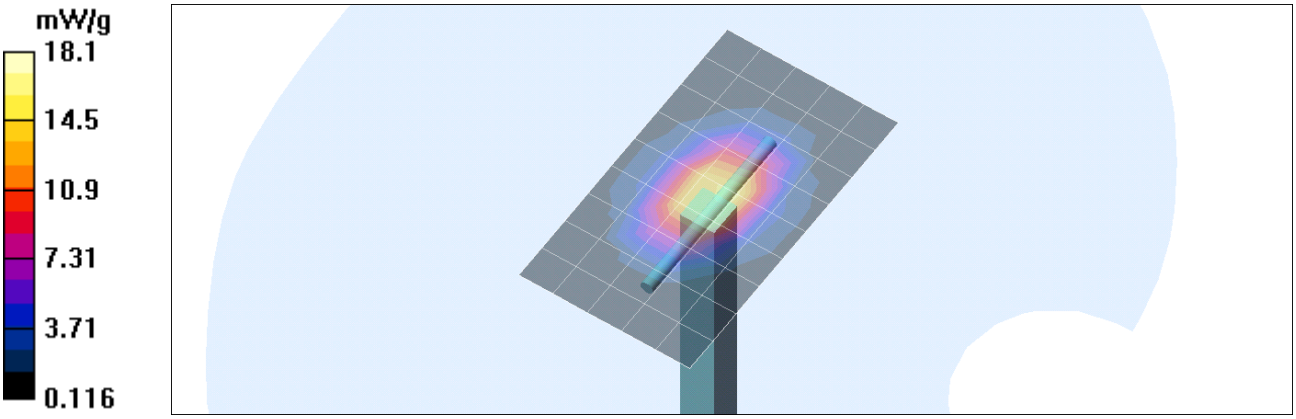
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 825; Calibrated: 17/04/2009

Ambient Temp: 22C; Fluid Temp: 24.0C; Barometric Pressure: 101.1 kPa; Humidity: 30%

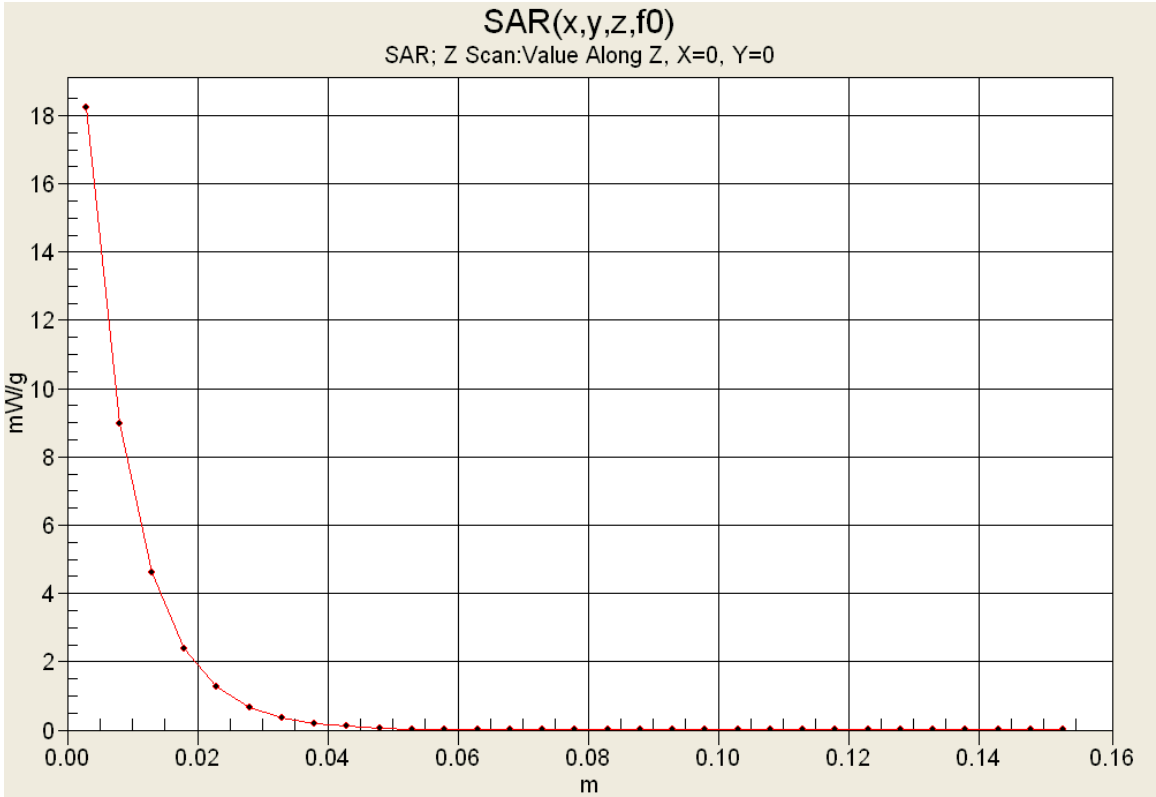
Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: M2450 Medium parameters used: f = 2450 MHz; σ = 1.99 mho/m; ε_r = 49.4; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3600; ConvF(6.15, 6.15, 6.15); Calibrated: 23/06/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 27/04/2010
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

2450 MHz System Performance Check/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.2 mW/g
2450 MHz System Performance Check/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.5 V/m; Power Drift = 0.006 dB
Peak SAR (extrapolated) = 28.8 W/kg
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.29 mW/g
Maximum value of SAR (measured) = 18.1 mW/g



Z-axis Scan



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APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz Body

****

Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
17/Nov/2011
Frequency (GHz)
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.3500	52.83	1.85	49.78	1.85
2.3600	52.82	1.86	49.61	1.87
2.3700	52.81	1.87	49.54	1.86
2.3800	52.79	1.88	49.63	1.86
2.3900	52.78	1.89	49.56	1.91
2.4000	52.77	1.90	49.52	1.91
2.4100	52.75	1.91	49.51	1.92
2.4200	52.74	1.92	49.31	1.92
2.4300	52.73	1.93	49.52	1.94
2.4400	52.71	1.94	49.37	1.97
2.4500	52.70	1.95	49.36	1.99
2.4600	52.69	1.96	49.33	1.99
2.4700	52.67	1.98	49.53	2.00
2.4800	52.66	1.99	49.40	2.01
2.4900	52.65	2.01	49.24	1.99
2.5000	52.64	2.02	49.21	2.03
2.5100	52.62	2.04	49.26	2.05
2.5200	52.61	2.05	49.27	2.05
2.5300	52.60	2.06	49.19	2.09
2.5400	52.59	2.08	49.08	2.10
2.5500	52.57	2.09	49.17	2.10

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APPENDIX D - SAR TEST SETUP & DUT PHOTOGRAPHS

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SAR TEST SETUP PHOTOGRAPHS

Body-worn Test setup - Belt-clip & Belt-strap Body-worn accessory with Headset-Microphone Audio Accessory

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SAR TEST SETUP PHOTOGRAPHS

Body-worn Test setup close-up - Belt-clip & Belt-strap Body-worn accessory with Headset-Microphone Audio Accessory

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DUT PHOTOGRAPHS

Button Side of DUT

Opposite Side of DUT

Battery Side of DUT (Front Side)

Belt-clip Side of DUT (Back Side)

Audio Connector end of DUT

Opposite end of DUT

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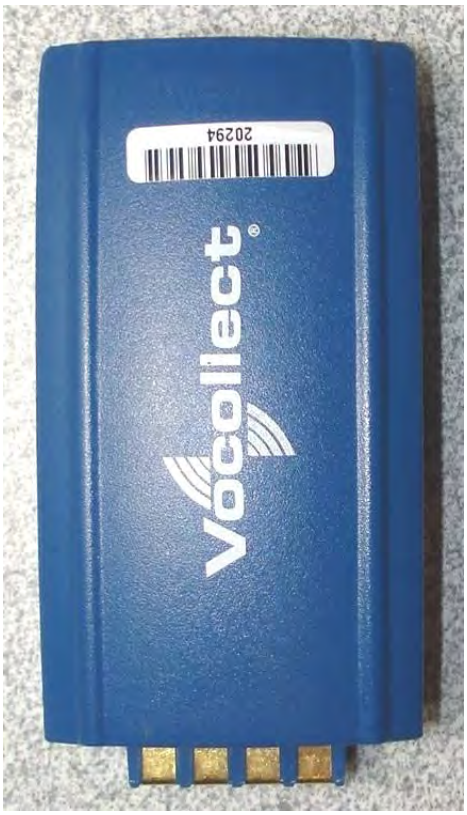
DUT PHOTOGRAPHS

DUT with Battery Removed



Top Side of Battery

Bottom Side of Battery

Connection End of Battery

Opposite End of Battery

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DUT PHOTOGRAPHS

Belt-clip and Belt-strap

Front of Belt-clip

Back of Belt-clip

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DUT PHOTOGRAPHS

Headset Audio Accessory

DUT with Headset and Belt-clip/Belt strap accessories

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APPENDIX E - DIPOLE CALIBRATION

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

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

Client Celltech

Certificate No.: D2450V2-825_Apr09

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 825
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	April 17, 2009
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 ± 3)°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 EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: April 22, 2009

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

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	V5.0
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	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.0 ± 6 %	1.82 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 mW / g
SAR normalized	normalized to 1W	54.4 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**53.7 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.29 mW / g
SAR normalized	normalized to 1W	25.2 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**25.0 mW /g ± 16.5 % (k=2)**

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.4 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	—	—

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR normalized	normalized to 1W	51.6 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**51.6 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.05 mW / g
SAR normalized	normalized to 1W	24.2 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**24.2 mW /g ± 16.5 % (k=2)**

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 4.7 jΩ
Return Loss	- 24.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω + 5.6 jΩ
Return Loss	- 24.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	December 11, 2008

DASY5 Validation Report for Head TSL

Date/Time: 17.04.2009 12:17:23

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN825

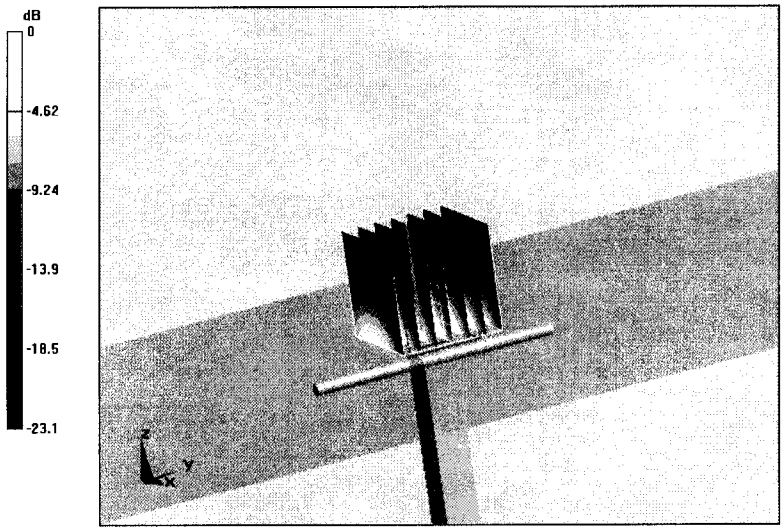
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U10 BB
Medium parameters used: f = 2450 MHz; σ = 1.82 mho/m; ε_r = 38; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 28.04.2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

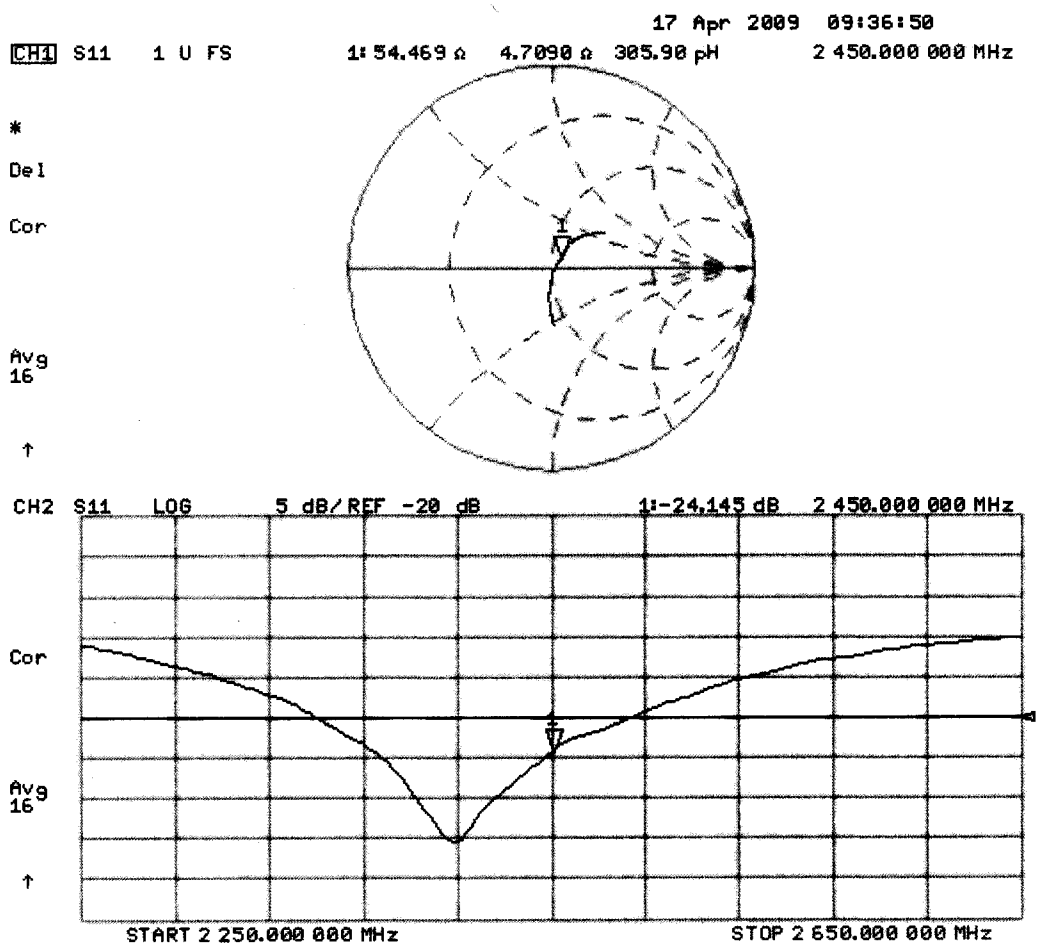
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.1 V/m; Power Drift = 0.026 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.29 mW/g
Maximum value of SAR (measured) = 17.7 mW/g



0 dB = 17.7mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 17.04.2009 14:54:34

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:825

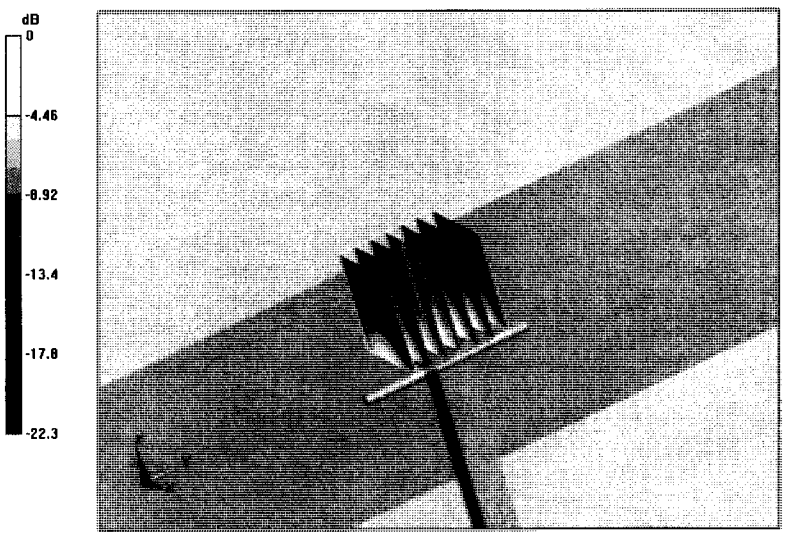
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB
Medium parameters used: f = 2450 MHz; σ = 1.98 mho/m; ε_r = 54.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.07, 4.07, 4.07); Calibrated: 28.04.2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

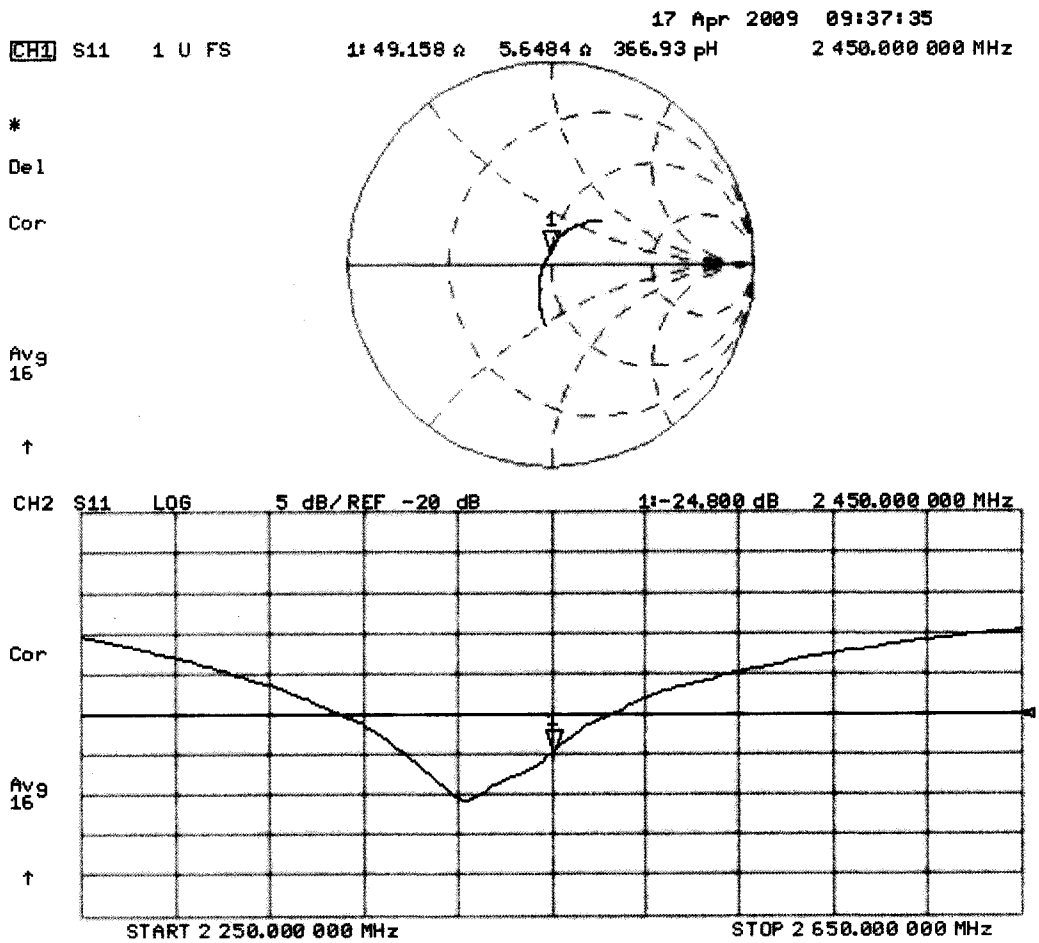
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.6 V/m; Power Drift = 0.046 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6.05 mW/g
Maximum value of SAR (measured) = 16.6 mW/g



0 dB = 16.6mW/g

Impedance Measurement Plot for Body TSL



APPENDIX F - PROBE CALIBRATION

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

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

Client Celltech

Certificate No: EX3-3600_Jun11

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3600
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:	June 23, 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: June 23, 2011

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

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:3600

Manufactured: January 10, 2007
Calibrated: June 23, 2011

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3600

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.49	0.39	± 10.1 %
DCP (mV)[B]	97.5	102.4	99.3	

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	119.9	±3.0 %
			Y	0.00	0.00	1.00	105.4	
			Z	0.00	0.00	1.00	102.1	

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:3600

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)
1810	40.0	1.40	7.38	7.38	7.38	0.69	0.66	± 12.0 %
1950	40.0	1.40	7.10	7.10	7.10	0.71	0.64	± 12.0 %
2450	39.2	1.80	6.55	6.55	6.55	0.56	0.73	± 12.0 %

[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:3600

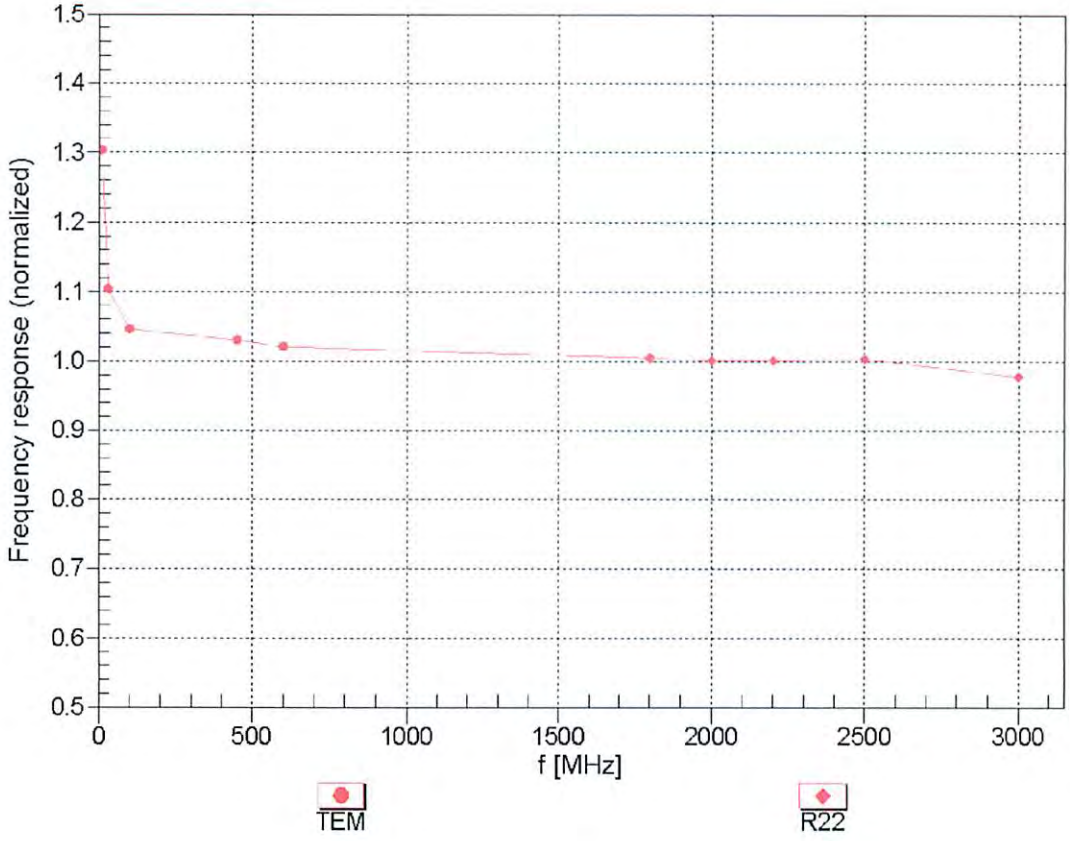
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
1810	53.3	1.52	6.71	6.71	6.71	0.79	0.66	± 12.0 %
1950	53.3	1.52	6.61	6.61	6.61	0.79	0.64	± 12.0 %
2450	52.7	1.95	6.15	6.15	6.15	0.79	0.61	± 12.0 %
5200	49.0	5.30	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.38	3.38	3.38	0.55	1.90	± 13.1 %
5800	48.2	6.00	3.39	3.39	3.39	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

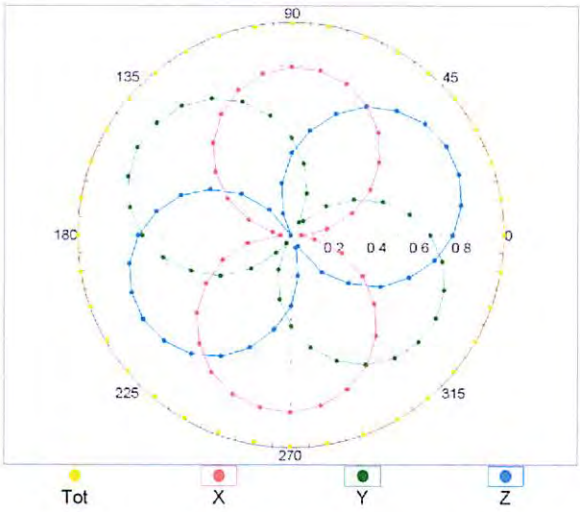
(TEM-Cell:ifi110 EXX, Waveguide: R22)



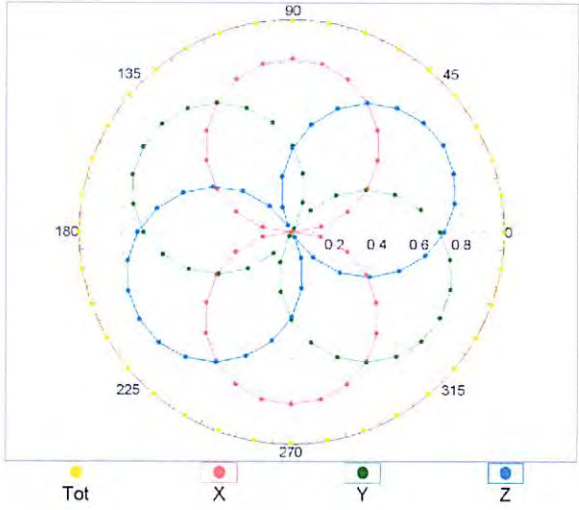
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

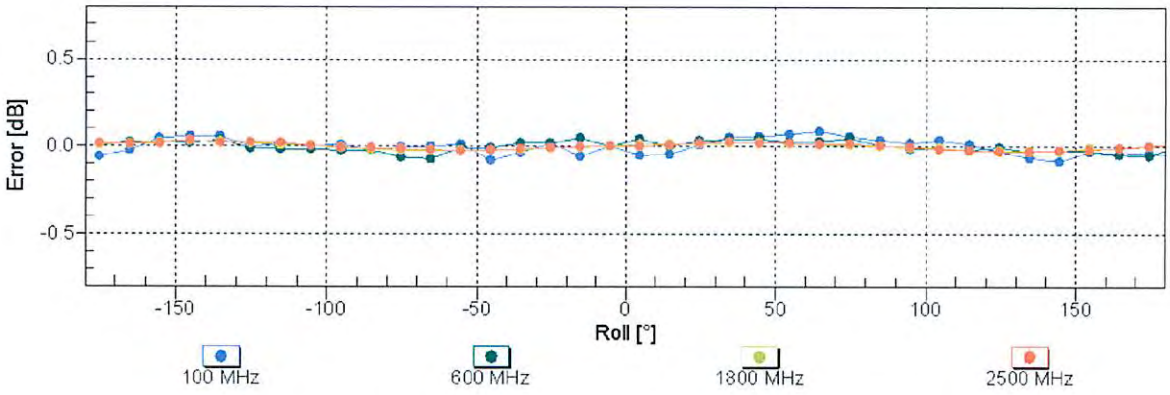
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



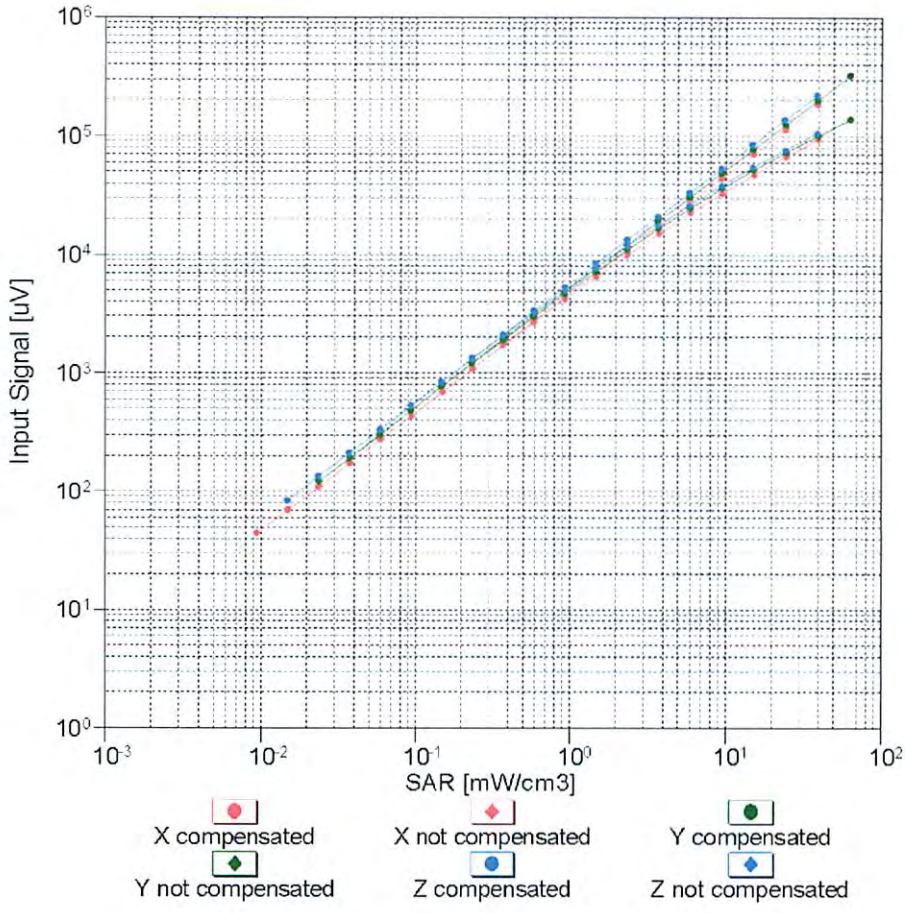
f=1800 MHz,R22

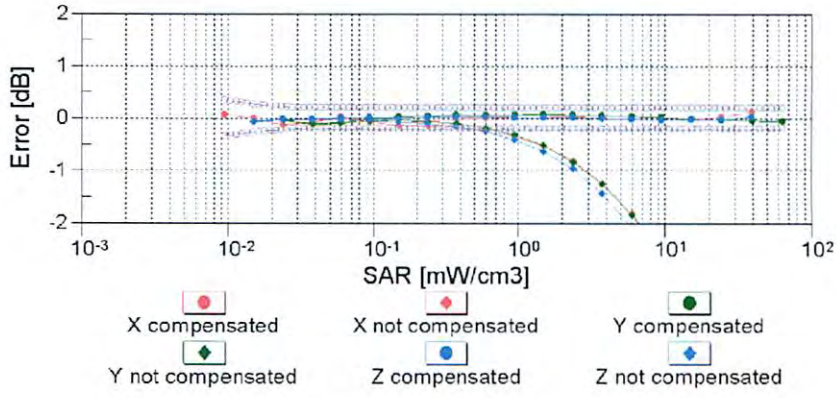




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

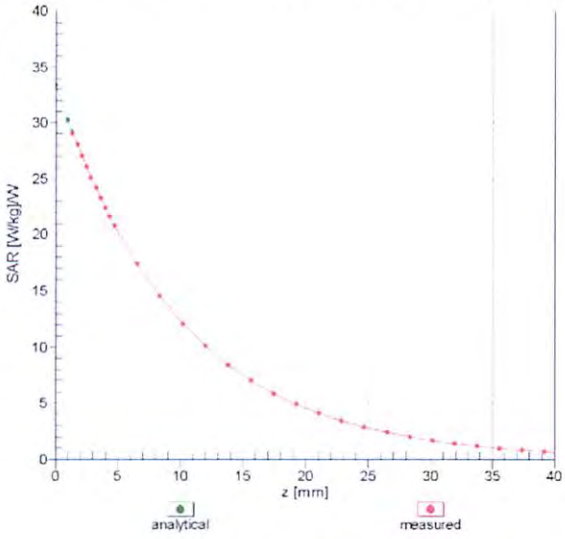




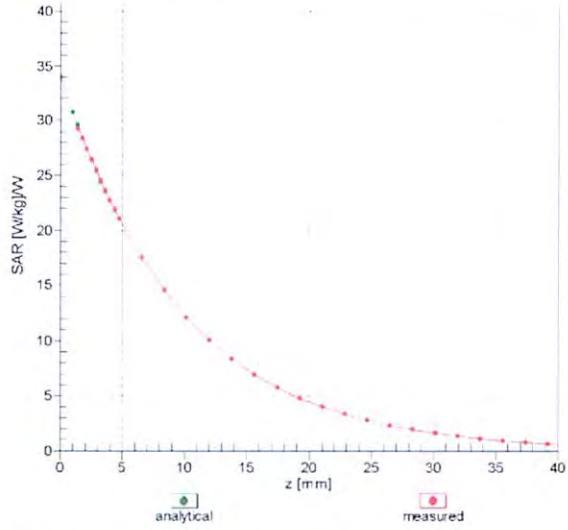
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 2450 MHz,WGLS R22 (H_convF)

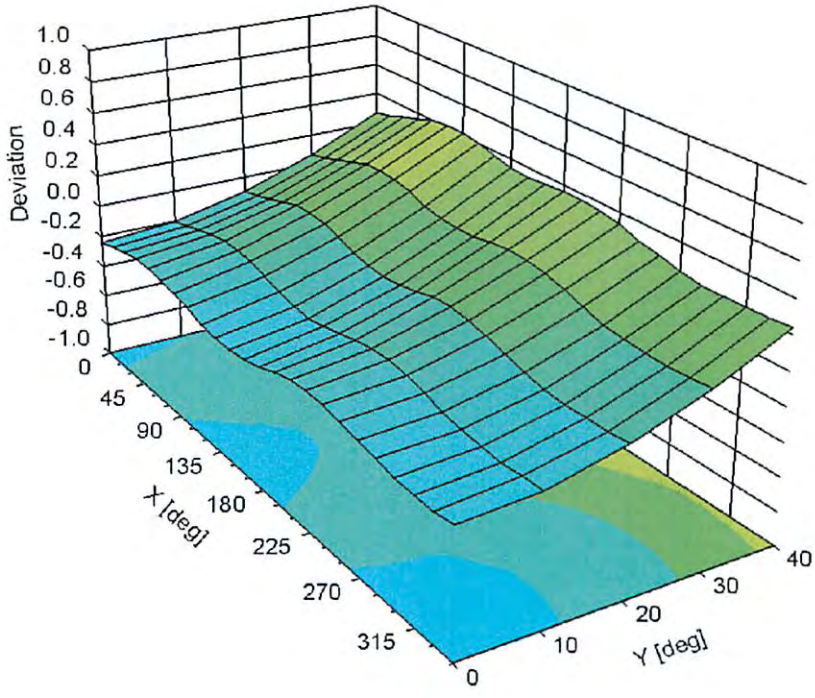


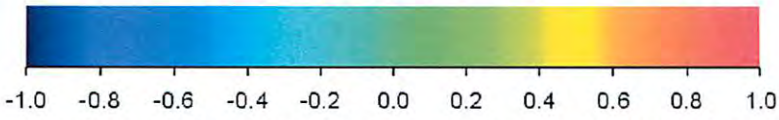
f = 2450 MHz,WGLS R22 (M_convF)



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:3600

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 G - SAM PHANTOM CERTIFICATE OF CONFORMITY

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Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 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	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	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

[1] CENELEC EN 50361
[2] IEEE P1528-200x draft 6.5
[3] IEC PT 62209 draft 0.9
(*) 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 18.11.2001

Signature / Stamp

Schmid & Partner
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Tel. +41 1 245 97 00, Fax +41 1 245 97 79