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

Test Lab Information	**CELLTECH LABS INC.** 21-364 Lougheed Road, Kelowna, BC. V1X 7R8 Canada						
Test Lab Accreditation	**A2LA -** ISO/IEC 17025:2005 (A2LA TEST LAB CERTIFICATE NO. 2470.01)						
Applicant Information	**NAVICO AUCKLAND LTD.** 3-5 OMEGA STREET, ALBANY, 0632, AUCKLAND, NZ						
Application Type(s)	**FCC**	TCB Certification		**IC**	CB Certification		
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 D01v05r01 - General RF Exposure Procedures					
	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**	DXX - Low Power Communication Device Transmitter (Part 15 Subpart C)					
	IC	Low Power License-Exempt Radio-communication Device (RSS-210)					
Device Identifier(s)	**FCC ID:**	RAYHS35		**IC:**	4697A-HS35		
Device Model No.	HS35						
Test Sample Serial No.	20121207002 (Identical Prototype)						
Test Sample Hardware Rev. No.	3		**Test Sample Firmware Rev. No.**	1.017			
Measurement Date(s)	Jul. 12, 2013		**Date of Sample Receipt**	Jul. 2, 2013			
Device Description	2.4GHz Handset Module for Marine Transceiver						
Internal Transmitter(s) Type	2.4GHz FHSS						
Transmitter Type Tested	2.4GHz FHSS						
Transmitter Specifications	Frequency Range - 2400 - 2483 MHz FHSS Rated Conducted Output Power = 24 mW Max						
Co-located Transmitter(s)	n/a						
Antenna Type(s) Tested	Integral 0 to -3 dBi monopole (2.4 GHz)						
Battery Type(s) Tested	Internal Lithium- Polymer (3.7V, 850 mAh)						

Max. SAR Level(s) Evaluated	**FACE**	**2.4GHz**	**0.004 W/kg**	**PEAK**	**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.

This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Labs Inc.

Test Report Approved By		**Mike Meaker**	**Engineering Technologist**	**Celltech Labs Inc.**

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REVISION HISTORY			
REVISION NO.	**DESCRIPTION**	**IMPLEMENTED BY**	**RELEASE DATE**
1.0	1st Release	Mike Meaker	Aug. 1, 2013

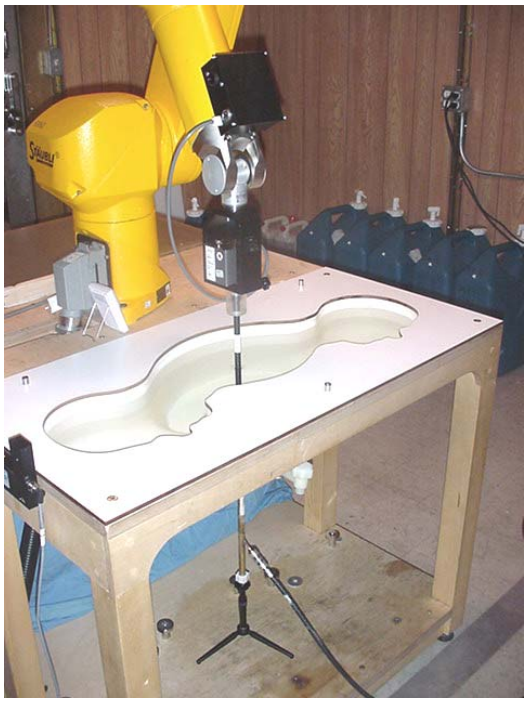
TEST REPORT SIGN-OFF			
DEVICE TESTED BY	**REPORT PREPARED BY**	**QA REVIEW BY**	**REPORT APPROVED BY**
Mike Meaker	Mike Meaker	Glen Westwell	Mike Meaker

1.0 INTRODUCTION

This measurement report demonstrates that the Navico Model: HS35 Portable 2.4GHz Handset Module 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 62209-1:2005 (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, Switzerland. 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

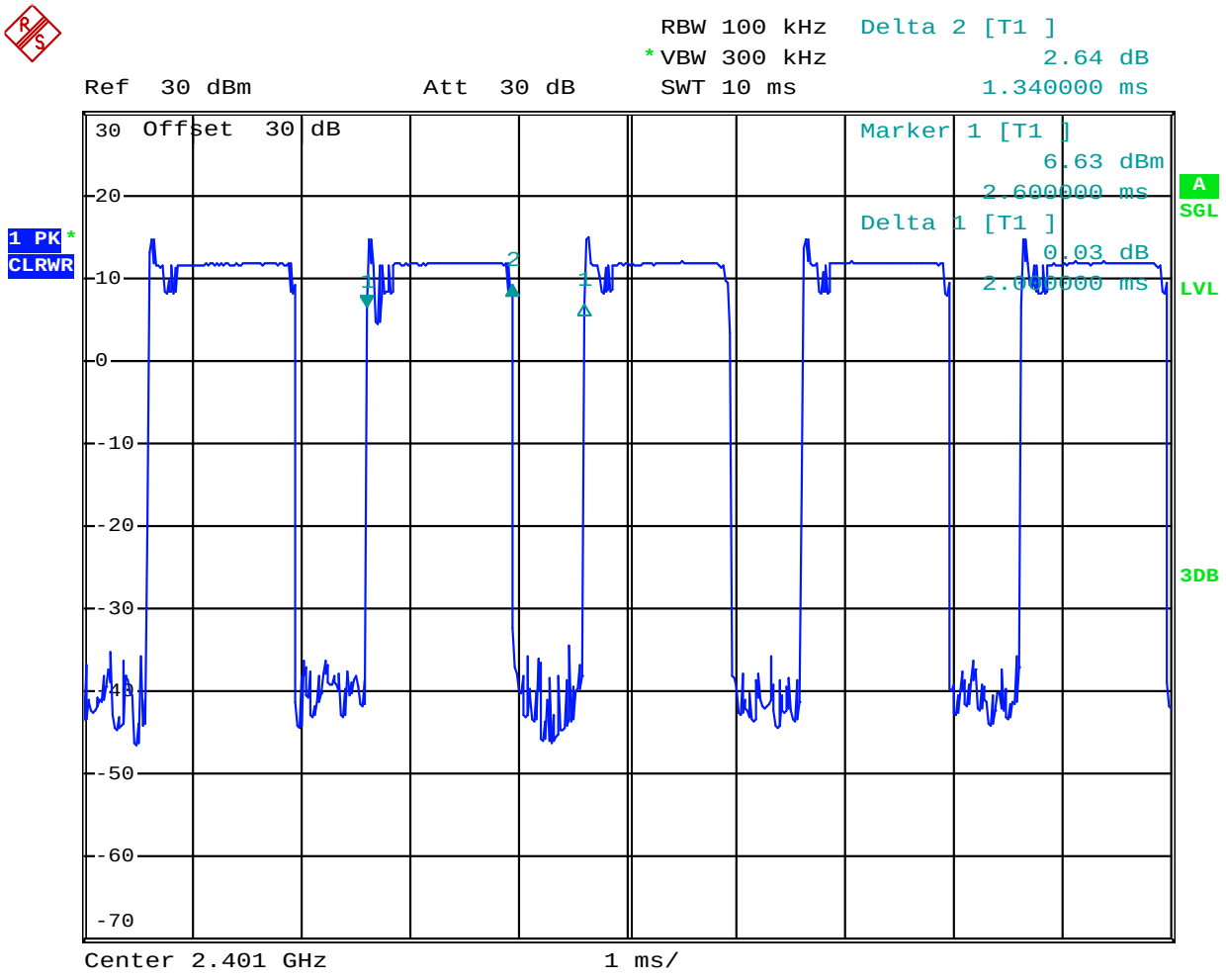
DASY4 Measurement Server

3.0 CONDUCTED OUTPUT POWER MEASUREMENTS

MEASURED RF CONDUCTED OUTPUT POWER LEVELS		
Freq. (MHz)	**Channel**	**Average Conducted RF Output Power Levels (mW)**
2401	1	21.5 mW
2442	25	20.6 mW
2483	50	18.9 mW

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 [11]) and IC RSS-Gen (see reference [12]).



Duty Cycle measurement = 67%

4.0 FLUID DIELECTRIC PARAMETERS

FLUID DIELECTRIC PARAMETERS

Date: 07/12/2013		Frequency: 2450 MHz			Tissue: Head	
Freq	Test_e	Test_s	Target_e	Target_s	Deviation Permittivity	Deviation Conductivity
2.350	40.78	1.76	39.2	1.8	4.03%	-2.22%
2.360	40.86	1.77	39.2	1.8	4.23%	-1.67%
2.370	40.91	1.77	39.2	1.8	4.36%	-1.67%
2.380	40.77	1.77	39.2	1.8	4.01%	-1.67%
2.390	40.66	1.8	39.2	1.8	3.72%	0.00%
2.400	40.59	1.8	39.2	1.8	3.55%	0.00%
2.401*	40.6	1.8	39.2	1.8	3.57%	0.00%
2.410	40.65	1.84	39.2	1.8	3.70%	2.22%
2.420	40.63	1.84	39.2	1.8	3.65%	2.22%
2.430	40.66	1.83	39.2	1.8	3.72%	1.67%
2.440	40.59	1.86	39.2	1.8	3.55%	3.33%
2.450	40.57	1.88	39.2	1.8	3.49%	4.44%
2.460	40.55	1.86	39.2	1.8	3.44%	3.33%
2.470	40.42	1.9	39.2	1.8	3.11%	5.56%
2.480	40.52	1.9	39.2	1.8	3.37%	5.56%
2.490	40.27	1.91	39.2	1.8	2.73%	6.11%
2.500	40.44	1.94	39.2	1.8	3.16%	7.78%
2.510	40.17	1.94	39.2	1.8	2.47%	7.78%
2.520	40.19	1.96	39.2	1.8	2.53%	8.89%
2.530	40.24	1.97	39.2	1.8	2.65%	9.44%
2.540	40.29	2.02	39.2	1.8	2.78%	12.22%
2.550	40.18	2	39.2	1.8	2.50%	11.11%

**interpolated using DASY4 software*

Test Date	Fluid Type	Ambient Temperature	Fluid Temperature	Fluid Depth	Atmospheric Pressure	Relative Humidity	ρ (Kg/m^3)
Jul 12	2450 Head	24.0°C	24.5 °C	≥ 15 cm	101.5 kPa	30%	1000

5.0 SAR MEASUREMENT SUMMARY

SAR EVALUATION RESULTS

Test Config.	Test Freq.	Test Chan.	Duty Cycle	DUT Distance to Phantom	Conducted Power Before Test	SAR Drift During Test	Measured SAR (PEAK)
	MHz				dBm	dB	W/kg
Face Held	2401	1	67%	25mm	13.3	0.2	0.004

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):	Jul. 12, 2013

Notes

1.	Detailed measurement data and plots showing the maximum SAR location of the DUT are reported in Appendix A.
2.	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.
3.	No SAR peak was detected in the area scan for 25mm distance, therefore the maximum measured value is reported.
4.	SAR levels measured at the maximum output channel are ≤ 0.8 W/kg therefore, SAR evaluations for the remaining default channels are not required (per FCC KDB 447498 D01v05r01 - see reference [7]).
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).

6.0 SAR SCALING FOR TUNE-UP TOLERANCE

SCALED SAR

Test Config.	Freq. (MHz)	Test Ch.	Duty Cycle	Measured Conducted Power (dBm)	Maximum Rated Conducted Power (dBm)	Measured SAR Level 1g (W/kg)	Scaled SAR 1g (W/kg)
Face Held	2401	1	70%	13.3	13.8	0.004	**0.0044**

7.0 DETAILS OF SAR EVALUATION

1. The DUT was evaluated for face held SAR in accordance with the test positions required by FCC KDB 447498 D01v05r01 (see reference [7]). Based on the device being used like a PTT Radio the front of the device required testing at a distance of 25mm to the phantom surface.
2. The DUT does not support body-worn transmission.
3. The DUT was supplied with test mode software that was able to transmit at any selected channel required for SAR testing.
4. The DUT was tested with a modulated signal at a duty cycle of 67%. The frequency hopping was disabled.

8.0 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 12mm x 12mm.
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.

9.0 SYSTEM PERFORMANCE CHECK

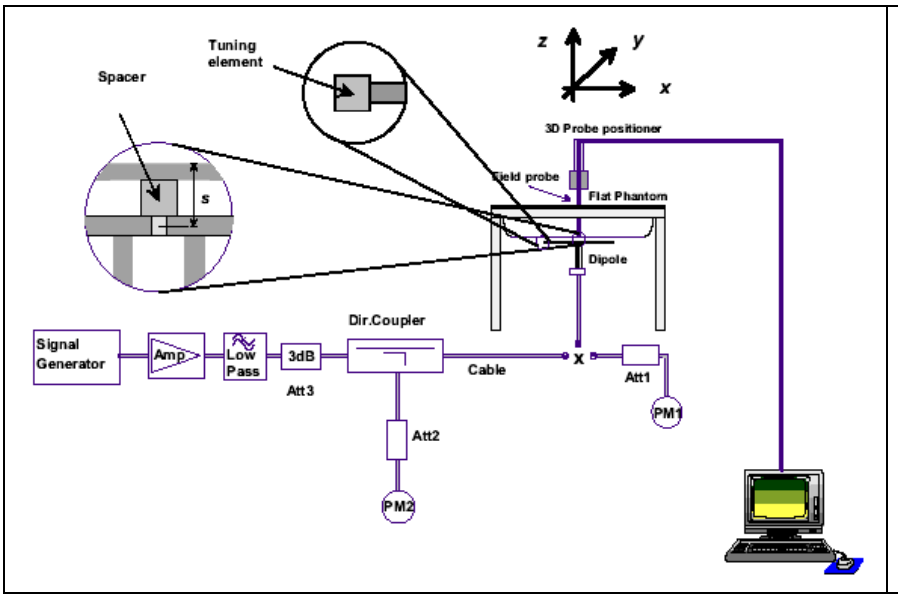
Prior to the SAR evaluations, a system check was performed at the planar section of the SAM phantom with a 2450MHz SPEAG validation dipole (see Appendix B for system performance check test plot) in accordance with the procedures described in IEEE Standard 1528-2003 (see reference [5]) and IEC 62209-1:2005 (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.						
Jul 12	Head 2450	12.7 ±10%	13.0	+2.4%	39.2 ±5%	40.6	+3.5%	1.80 ±5%	1.88	+4.4%	1000	24.0	24.5	≥ 15	30	101.5

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 fluid temperature remained within +/-2°C from the dielectric parameter measurement to the completion of the system performance check evaluation.
4. 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

10.0 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 [9]). 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 Head**
Water	52%
Glycol Monobutyl	48%

11.0 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.			

12.0 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 80
	Postprocessing Software: SEMCAD, V1.8 Build 186
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

13.0 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

14.0 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

15.0 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

16.0 TEST EQUIPMENT LIST

TEST EQUIPMENT DESCRIPTION	ASSET NO.	SERIAL NO.	DATE CALIBRATED	CALIBRATION INTERVAL
Schmid & Partner DASY4 System	-	-	-	-
-DASY4 Measurement Server	00158	1078	CNR	CNR
-Robot	00046	599396-01	CNR	CNR
-DAE4	00019	353	19-Apr-12	Biennial
-EX3DV4 E-Field Probe	00213	3600	27-Apr-13	Annual
-D2450V2 Validation Dipole	00219	825	25-Apr-12	Triennial
-SAM Twin Phantom V4.0C	00154	1033	CNR	CNR
HP 85070C Dielectric Probe Kit	00033	None	CNR	CNR
Gigatronics 8652A Power Meter	00007	1835272	03-May-12	Biennial
Gigatronics 80701A Power Sensor	00014	1833542	03-May-12	Biennial
Gigatronics 80334A Power Sensor	-	1837001	03-May-12	Biennial
HP 8753ET Network Analyzer	00134	US39170292	26-Apr-12	Biennial
Rohde & Schwarz SMR20 Signal Generator	00006	100104	02-May-12	Biennial
Amplifier Research 5S1G4 Power Amplifier	00106	26235	CNR	CNR
CNR = Calibration Not Required				

17.0 MEASUREMENT UNCERTAINTY (IC RSS-102 / IEC 62209-2)

UNCERTAINTY BUDGET FOR DEVICE EVALUATION (IEC 62209-2:2010)

Source of Uncertainty	IEC 62209-2 Section	Tolerance / Uncertainty ±%	Probability Distribution	Divisor	ci 1g	ci 10g	Standard Uncertainty ±% (1g)	Standard Uncertainty ±% (10g)	V_i or V_{eff}
Measurement System									
Probe Calibration (450 MHz)	7.2.2.1	6.0	Normal	1	1	1	6.0	6.0	∞
Isotropy	7.2.2.2	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
Boundary Effect	7.2.2.6	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Linearity	7.2.2.3	4.7	Rectangular	1.732050808	1	1	2.7	2.7	∞
Detection Limits	7.2.2.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Readout Electronics	7.2.2.7	0.3	Normal	1	1	1	0.3	0.3	∞
Response Time	7.2.2.8	0.8	Rectangular	1.732050808	1	1	0.5	0.5	∞
Integration Time	7.2.2.9	2.6	Rectangular	1.732050808	1	1	1.5	1.5	∞
RF Ambient Conditions	7.2.4.5	3	Rectangular	1.732050808	1	1	1.7	1.7	∞
Probe Positioner Mechanical Restrictions	7.2.3.1	0.4	Rectangular	1.732050808	1	1	0.2	0.2	∞
Probe Positioning wrt Phantom Shell	7.2.3.3	2.9	Rectangular	1.732050808	1	1	1.7	1.7	∞
Post-processing	7.2.5	1	Rectangular	1.732050808	1	1	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	7.2.3.4.3	2.9	Normal	1	1	1	2.9	2.9	12
Device Holder Uncertainty	7.2.3.4.2	3.6	Normal	1	1	1	3.6	3.6	8
Drift of Output Power (meas. SAR drift)	7.2.2.10	5	Rectangular	1.732050808	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	7.2.3.2	4	Rectangular	1.732050808	1	1	2.3	2.3	∞
SAR Correction Algorithm for deviations in permittivity and conductivity	7.2.4.3	1.2	Normal	1	1	0.81	1.2	0.97	∞
Liquid Conductivity (measured)	7.2.4.3	0	Normal	1	0.78	0.71	0.0	0.0	∞
Liquid Permittivity (measured)	7.2.4.3	3.57	Normal	1	0.23	0.26	0.8	0.9	∞
Liquid Permittivity - temp. uncertainty	7.2.4.4	1.23	Rectangular	1.732050808	0.78	0.71	0.6	0.5	∞
Liquid Conductivity - temp. uncertainty	7.2.4.4	0.93	Rectangular	1.732050808	0.23	0.26	0.1	0.1	∞
Combined Standard Uncertainty	**7.3.1**		**RSS**				**9.88**	**9.86**	
Expanded Uncertainty (95% Confidence Interval)	**7.3.2**		**k=2**				**19.76**	**19.72**	

Measurement Uncertainty Table in accordance with International Standard IEC 62209-2:2010

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2

18.0 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 62209-1:2005 - “Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures.”

[7] Federal Communications Commission, Office of Engineering and Technology - “Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies”; KDB 447498 D01 v05r01: May 2013.

[8] Federal Communications Commission, Office of Engineering and Technology - “SAR Measurements Requirements for 100MHz - 6 GHz”; KDB 865664 D01v01: May 2013.

[9] Schmid & Partner Engineering AG - DASY4 Manual V4.6, Chapter 16 Application Note, Head Tissue Recipe: Sept. 2005.

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

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

[12] Industry Canada - “General Requirements and Information for the Certification of Radiocommunication Equipment”, Radio Standards Specification RSS-Gen Issue 3: December 2010.

APPENDIX A - SAR MEASUREMENT PLOTS

Test Date: 07/12/2013

DUT: Navico HS35; Type: 2.4GHz Radio Transceiver; Serial: Not Specified

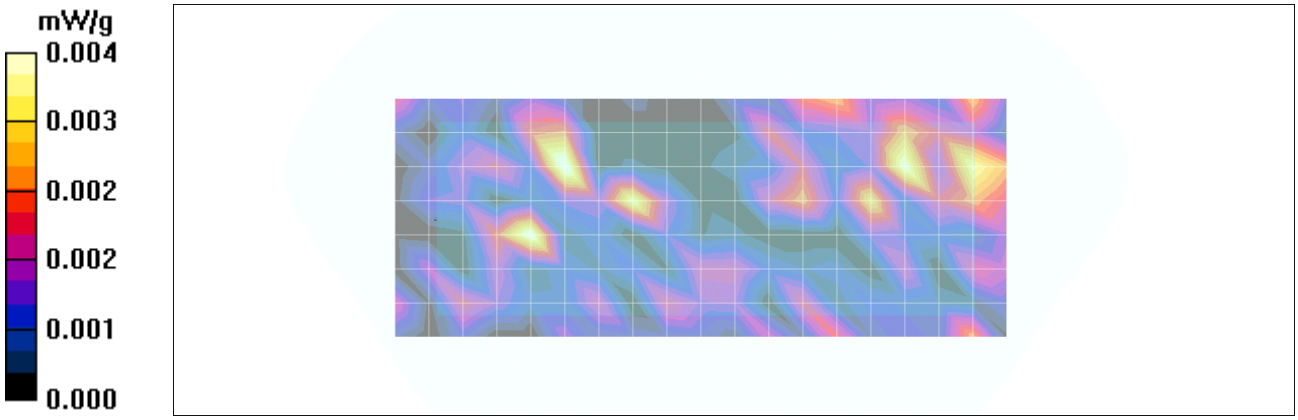
Program Notes: Ambient Temp: 24C; Fluid Temp: 24.5C; Barometric Pressure: 101.5 kPa; Humidity: 30%

Procedure Notes:

Communication System: 2.4GHz
Frequency: 2401 MHz; Duty Cycle: 1:1.38
Medium: HSL2450 Medium parameters used: f = 2400 MHz; σ = 1.8 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3600; ConvF(6.25, 6.25, 6.25); Calibrated: 26/04/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 19/04/2012
- Phantom: SAM 4.0; Type: Fiberglass; Serial: 1033
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Low/Area Scan (8x19x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.004 mW/g



DUT orientation: top edge to the right.

APPENDIX B - SYSTEM PERFORMANCE CHECK PLOTS

Test Date: 07/12/2013

System Performance Check - 2450 MHz Dipole - Body

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 825; Calibrated: 25/04/2012

Program Notes: Ambient Temp: 24C; Fluid Temp: 24.5C; Barometric Pressure: 101.5 kPa; Humidity: 30%

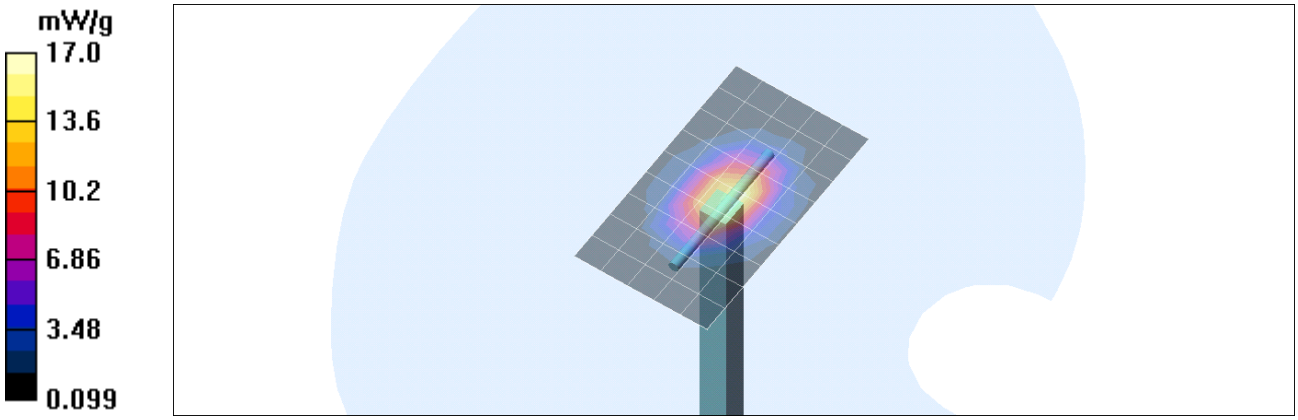
Procedure Notes:

Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2450 MHz; σ = 1.88 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3

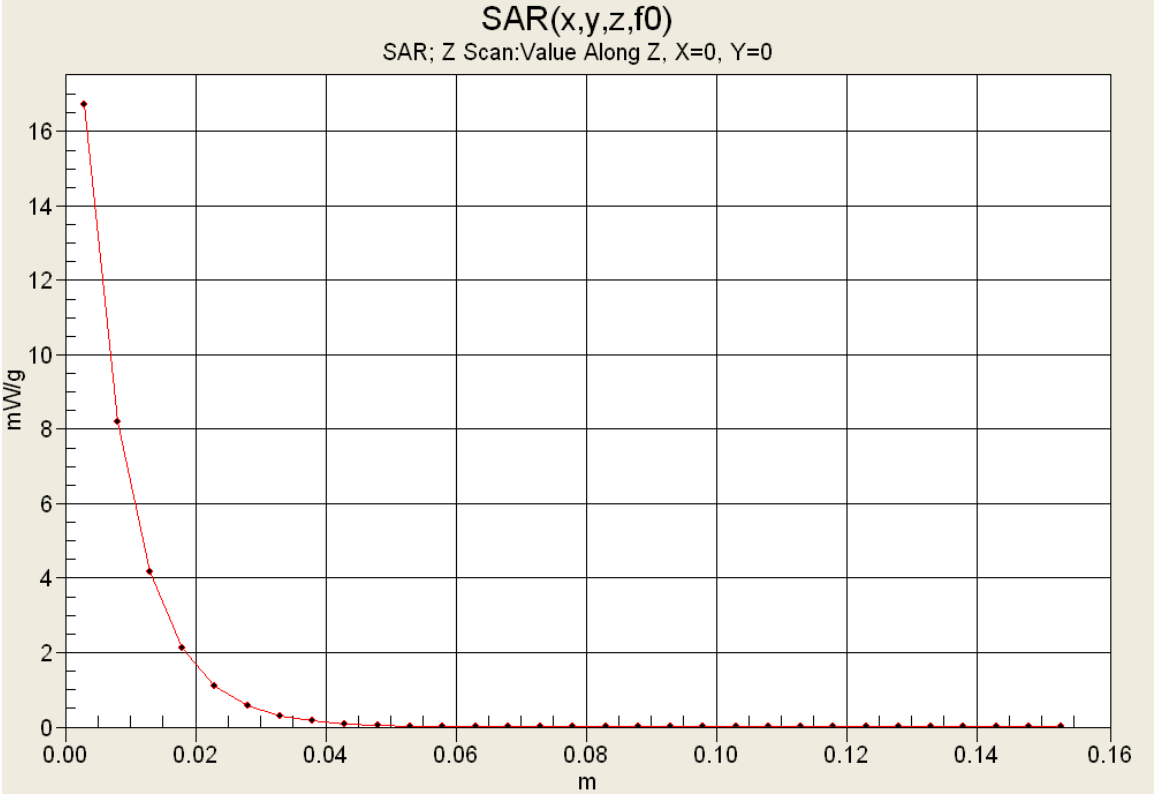
- Probe: EX3DV4 - SN3600; ConvF(6.25, 6.25, 6.25); Calibrated: 26/04/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used))Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 19/04/2012
- Phantom: SAM 4.0; Type: Fiberglass; Serial: 1033
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

2450 MHz Dipole d=10mm P=250mW 2/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 15.6 mW/g

2450 MHz Dipole d=10mm P=250mW 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.5 V/m; Power Drift = -0.235 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 13 mW/g; SAR(10 g) = 5.98 mW/g
Maximum value of SAR (measured) = 17.0 mW/g



Z-axis Scan



APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz Head

****

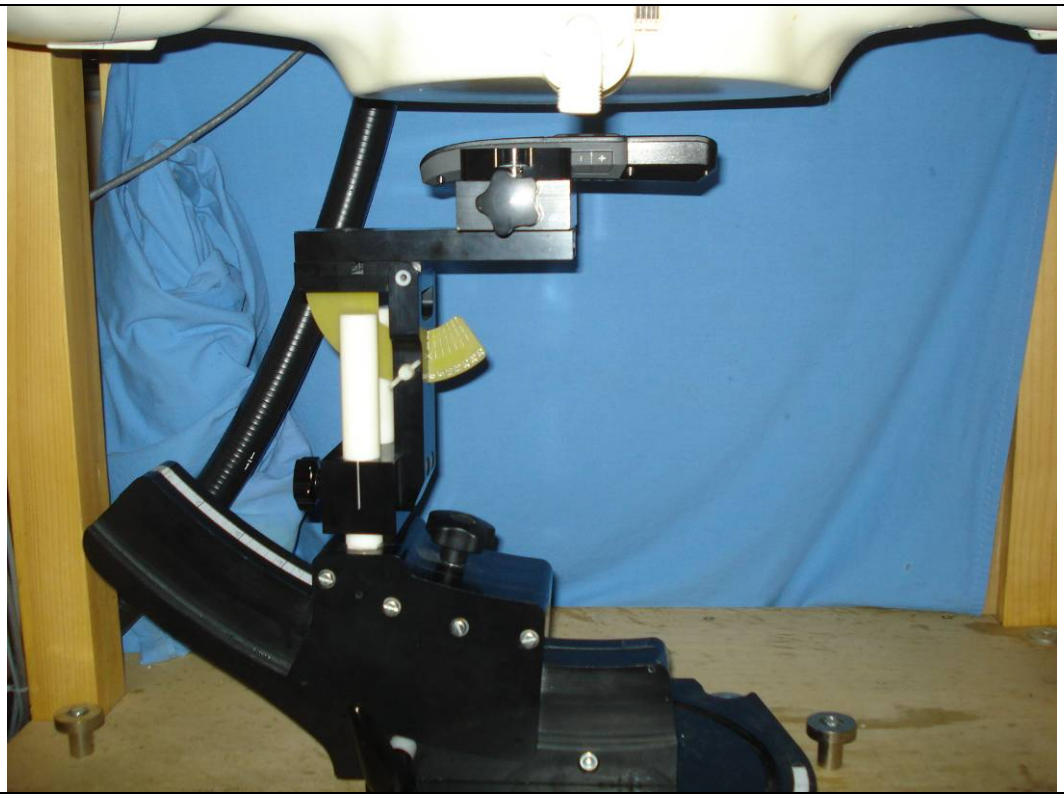
Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
12/Jul/2013
Frequency(GHz)
FCC_eH FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC OET 65 Supplement C (June 2001) Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

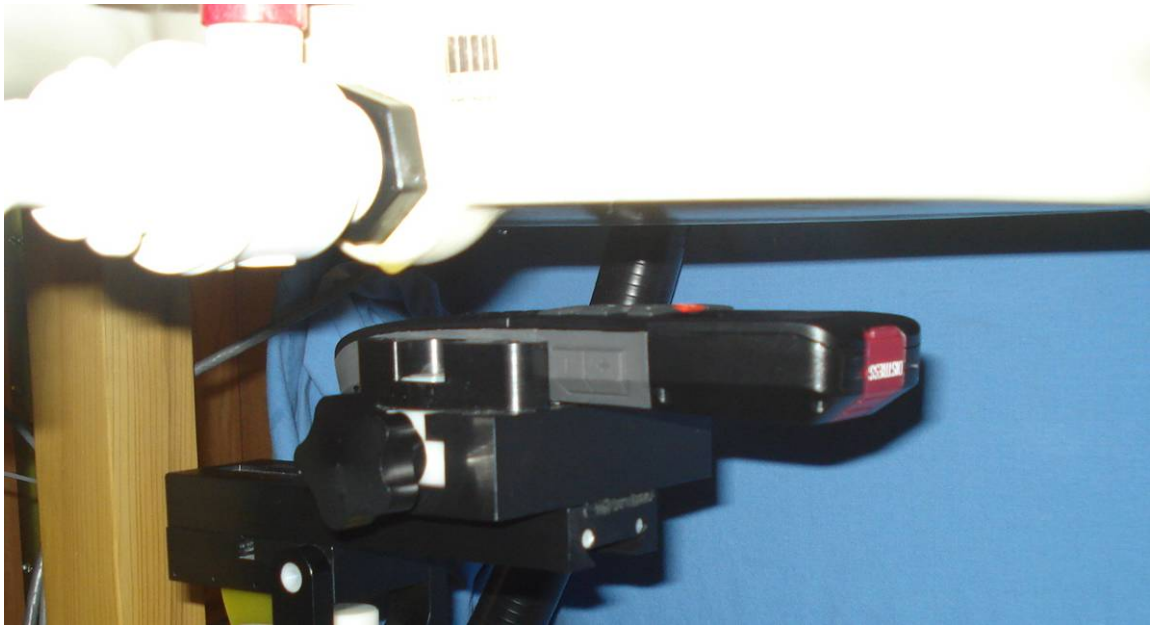
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.3500	39.38	1.71	40.78	1.76
2.3600	39.36	1.72	40.86	1.77
2.3700	39.34	1.73	40.91	1.77
2.3800	39.32	1.74	40.77	1.77
2.3900	39.31	1.75	40.66	1.80
2.4000	39.29	1.76	40.59	1.80
2.4100	39.27	1.76	40.65	1.84
2.4200	39.25	1.77	40.63	1.84
2.4300	39.24	1.78	40.66	1.83
2.4400	39.22	1.79	40.59	1.86
2.4500	39.20	1.80	40.57	1.88
2.4600	39.19	1.81	40.55	1.86
2.4700	39.17	1.82	40.42	1.90
2.4800	39.16	1.83	40.52	1.90
2.4900	39.15	1.84	40.27	1.91
2.5000	39.14	1.85	40.44	1.94
2.5100	39.12	1.87	40.17	1.94
2.5200	39.11	1.88	40.19	1.96
2.5300	39.10	1.89	40.24	1.97
2.5400	39.09	1.90	40.29	2.02
2.5500	39.07	1.91	40.18	2.00

APPENDIX D - SAR TEST SETUP & DUT PHOTOGRAPHS

SAR TEST SETUP PHOTOGRAPHS





DUT front (screen side) facing phantom - 25mm spacing

DUT PHOTOGRAPHS

			
Front	**Right**	**Back**	**Left**

APPENDIX E - DIPOLE CALIBRATION

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
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_Apr12

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 825

Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: April 25, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 25, 2012

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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	39.6 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.7 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**50.8 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.90 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 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	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.4 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.4 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 5.5 jΩ
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.4 Ω + 6.1 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
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: 25.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

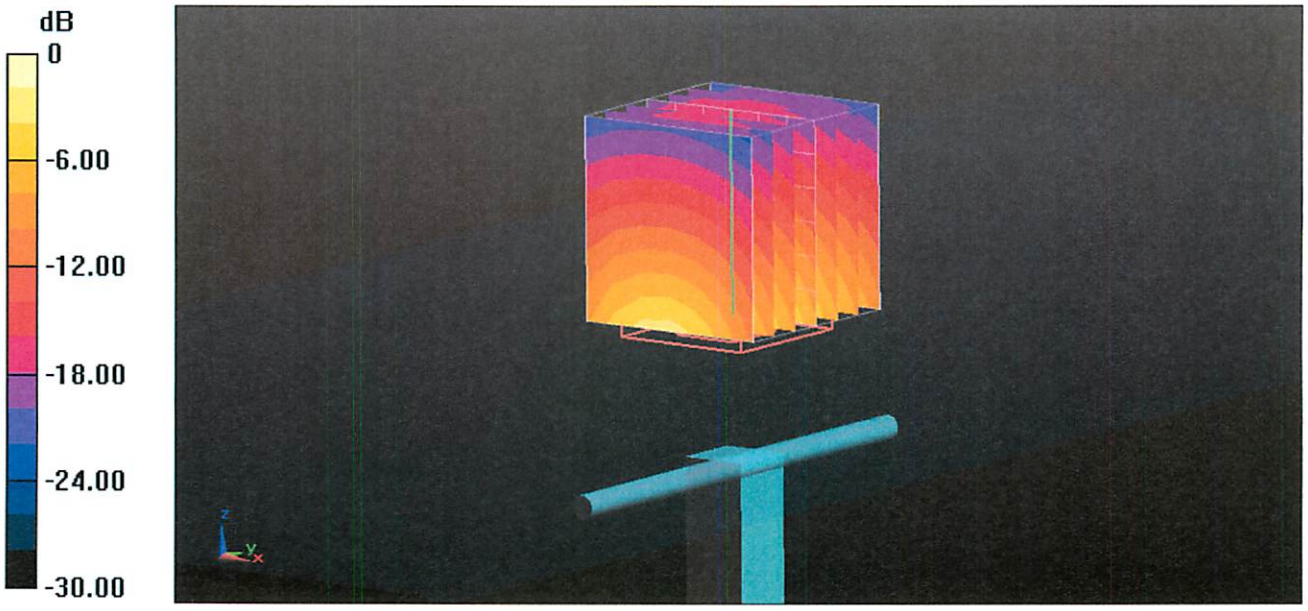
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.81 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

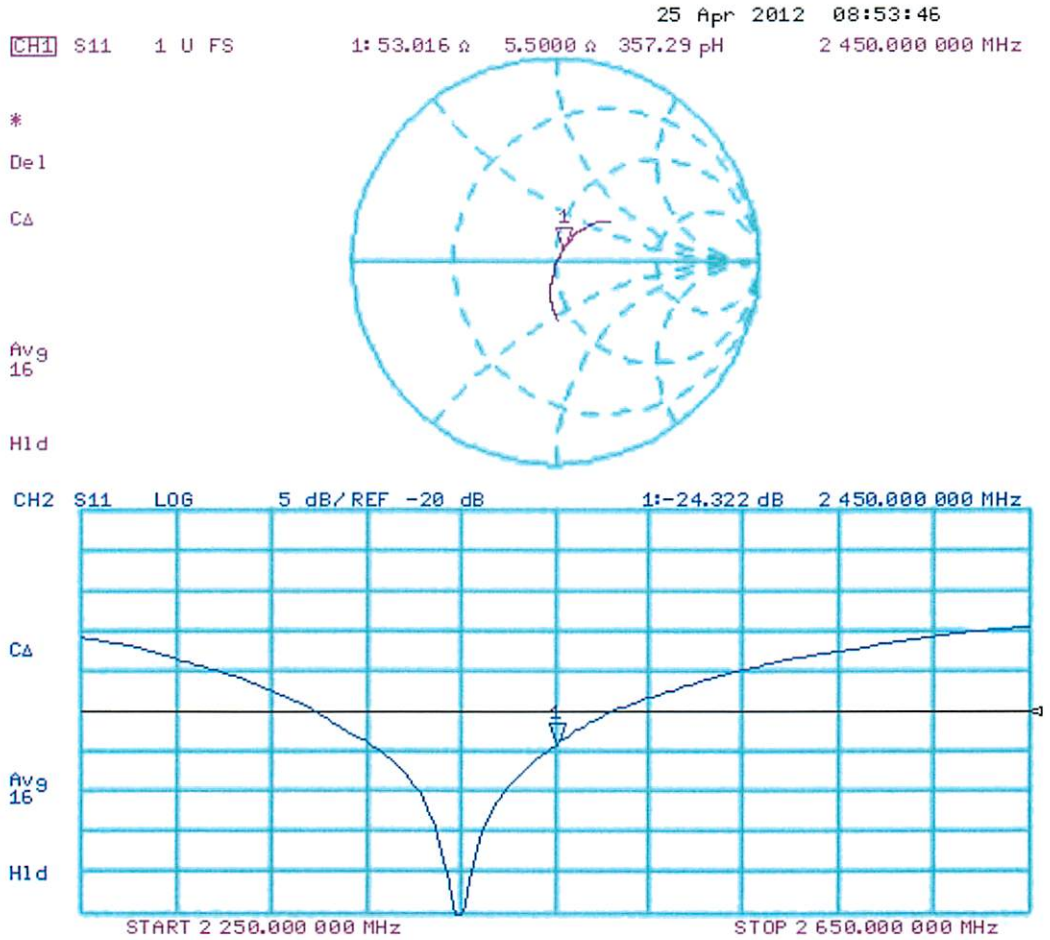
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.271 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 26.216 mW/g
SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.9 mW/g
Maximum value of SAR (measured) = 16.5 mW/g



0 dB = 16.5 mW/g = 24.35 dB mW/g

Impedance Measurement Plot for Head TSL



Date: 25.04.2012

Test Laboratory: SPEAG, Zurich, Switzerland

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

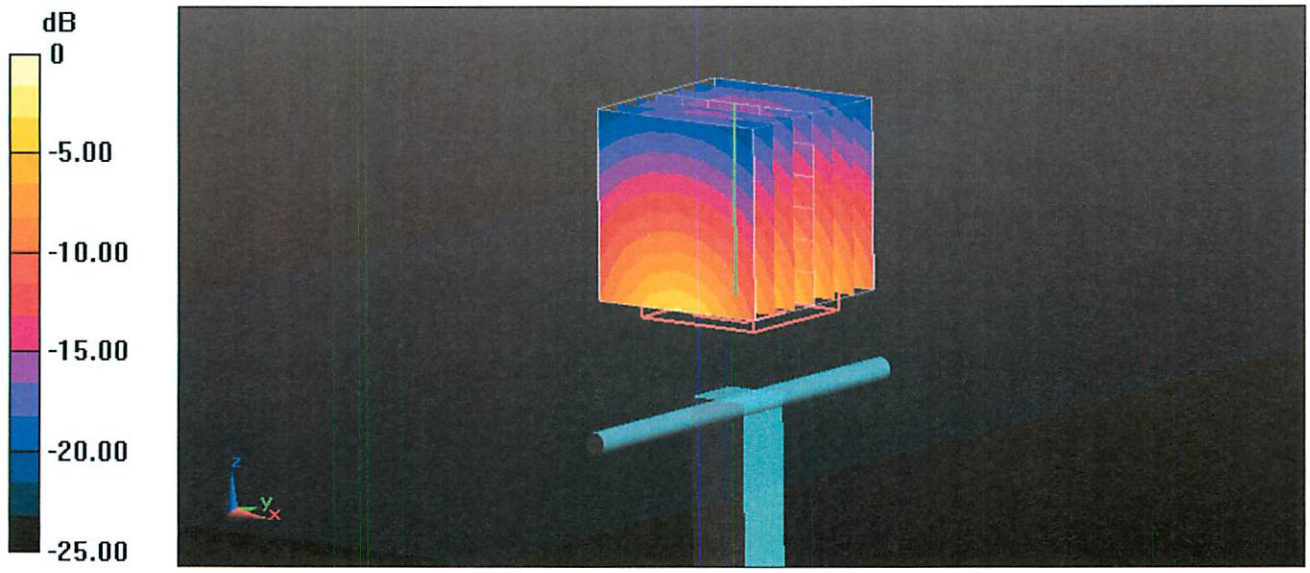
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.98 mho/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

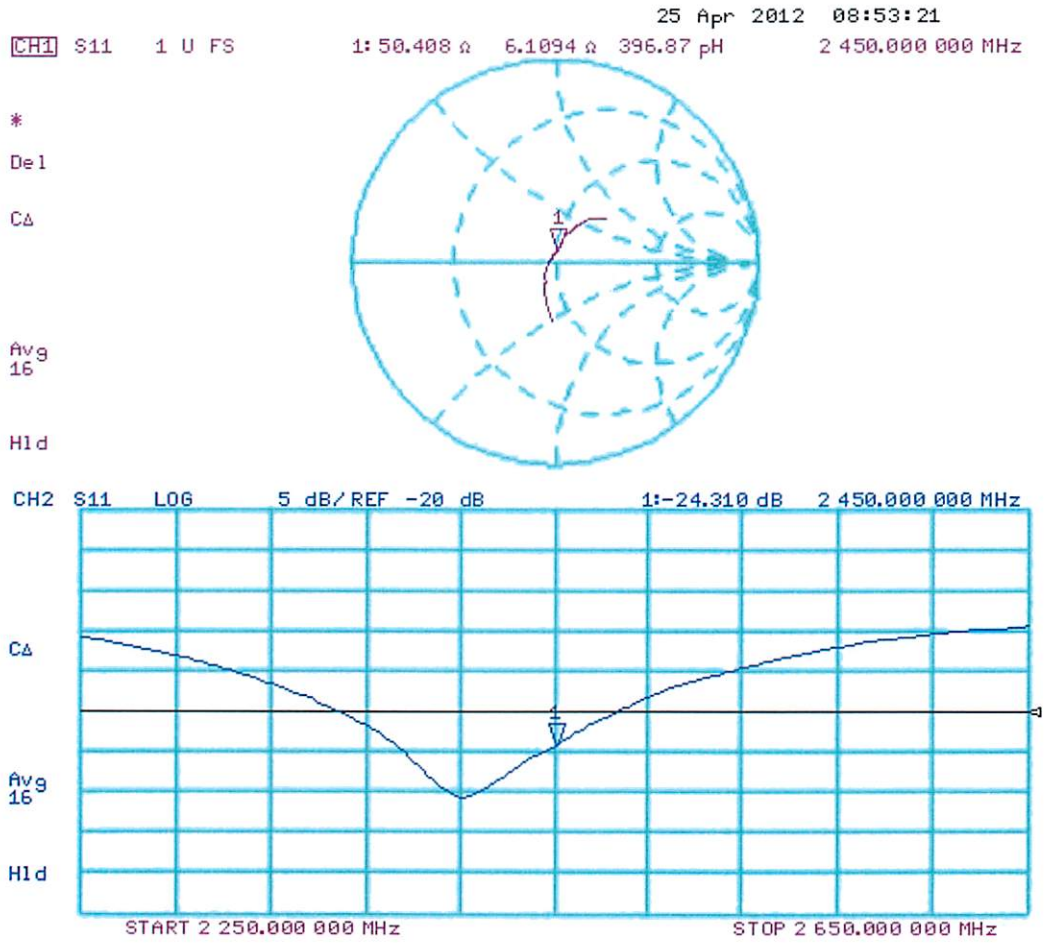
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.157 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 25.807 mW/g
SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.91 mW/g
Maximum value of SAR (measured) = 16.7 mW/g



0 dB = 16.7 mW/g = 24.45 dB mW/g

Impedance Measurement Plot for Body TSL



Dipole: D2450V2
Serial Number: 825
Last Calibrated: Apr. 25, 2012

Antenna Parameters with Head TSL						
	Impedance Real (ohms)	Deviation from cal	Impedance Imaginary (ohms)	Deviation from cal	Return Loss (dB)	Deviation from Cal
Last Calibration	53.0	-	+5.5	-	-24.3	-
Extended Cal Jul 10, 2013	53.0	0	+7.5	2.0	-22.3	8.2%

Antenna Parameters with Body TSL						
	Impedance Real (ohms)	Deviation from cal (ohms)	Impedance Imaginary (ohms)	Deviation from cal (ohms)	Return Loss (dB)	Deviation from Cal (%)
Last Calibration	50.4	-	+6.1	-	-24.3	-
Extended Cal Jun 17, 2013	49.0	1.4	+7.9	1.8	-21.3	12.3%

APPENDIX F - PROBE CALIBRATION

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
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_Apr13

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: April 26, 2013

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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: April 27, 2013

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

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, D	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; Dx,y,z; VRx,y,z: A, B, C, D* 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: April 26, 2013

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]	0.48	0.49	0.40	± 10.1 %
DCP (mV)[B]	99.8	97.4	99.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	127.7	±3.5 %
		Y	0.0	0.0	1.0		153.3	
		Z	0.0	0.0	1.0		154.7	

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	6.98	6.98	6.98	0.56	0.72	± 12.0 %
1950	40.0	1.40	6.75	6.75	6.75	0.75	0.63	± 12.0 %
2450	39.2	1.80	6.25	6.25	6.25	0.34	0.89	± 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

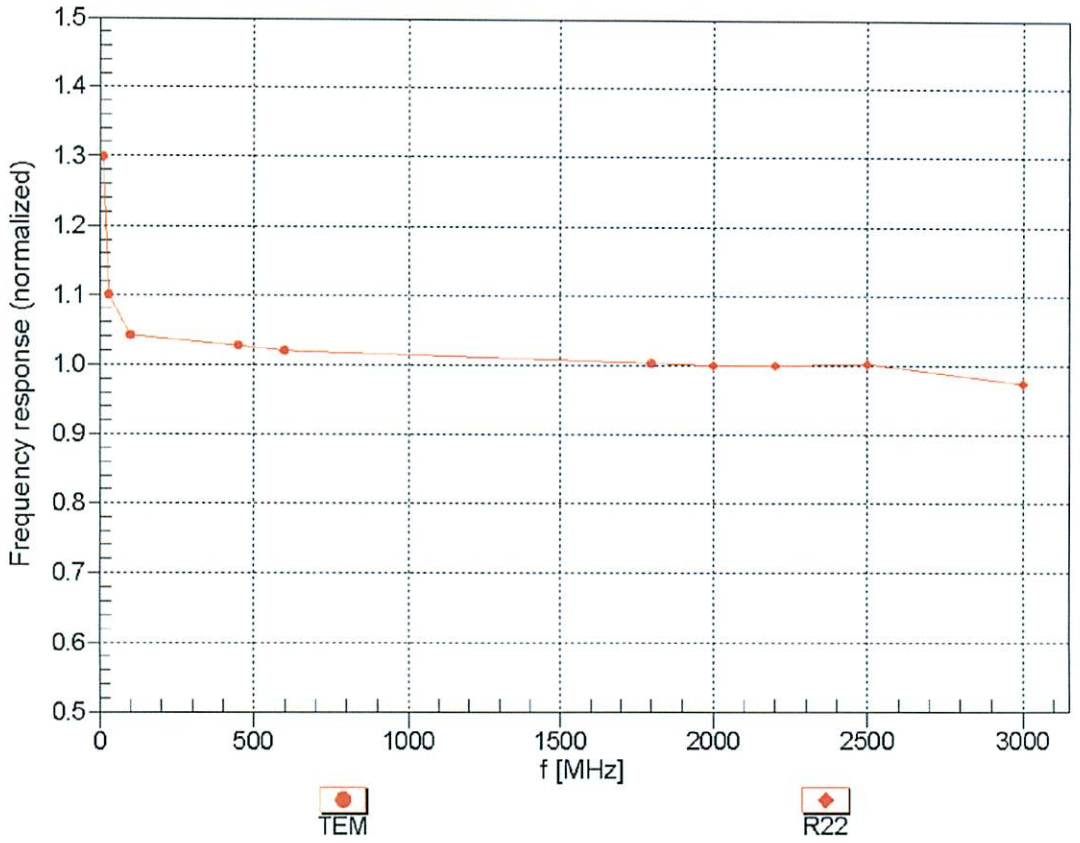
Calibration Parameter Determined in Body Tissue Simulating Media

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	7.02	7.02	7.02	0.52	0.75	± 12.0 %
1950	53.3	1.52	7.07	7.07	7.07	0.36	0.88	± 12.0 %
2450	52.7	1.95	6.61	6.61	6.61	0.73	0.57	± 12.0 %
5200	49.0	5.30	4.00	4.00	4.00	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.58	3.58	3.58	0.45	1.90	± 13.1 %
5800	48.2	6.00	3.64	3.64	3.64	0.50	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

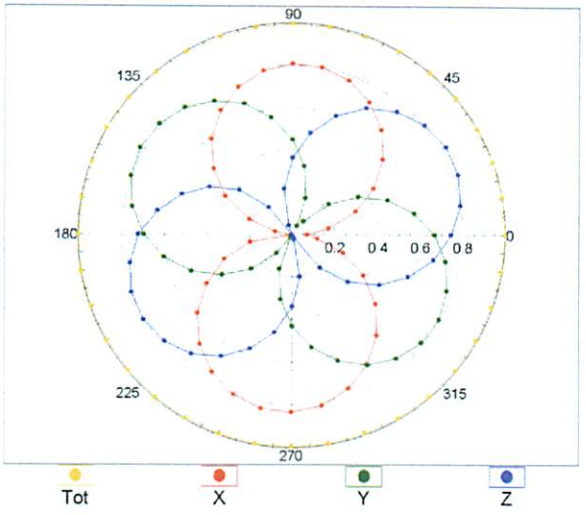
(TEM-Cell:ifi110 EXX, Waveguide: R22)



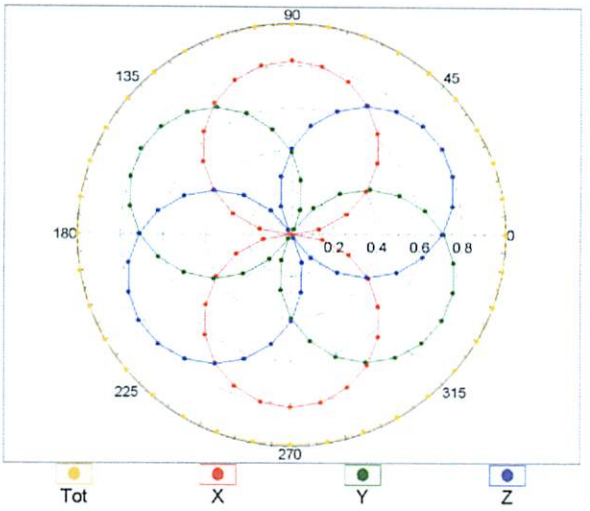
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

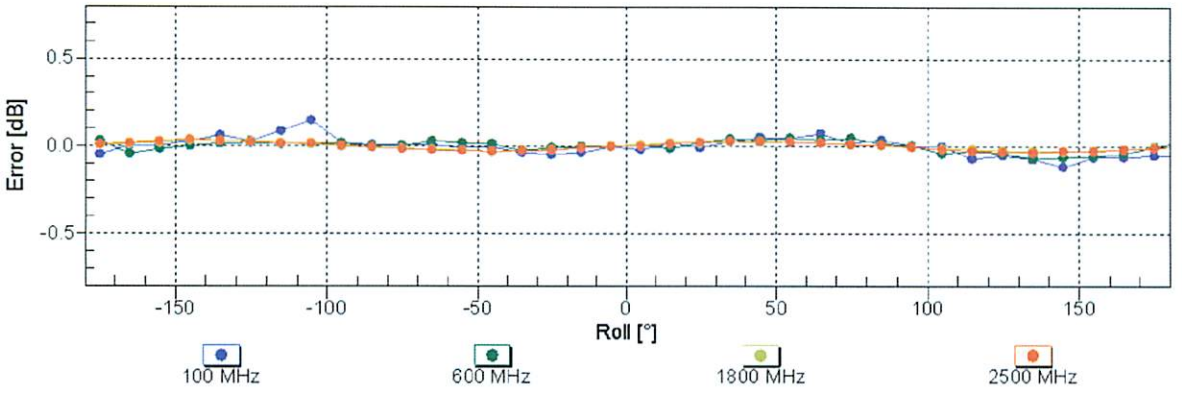
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



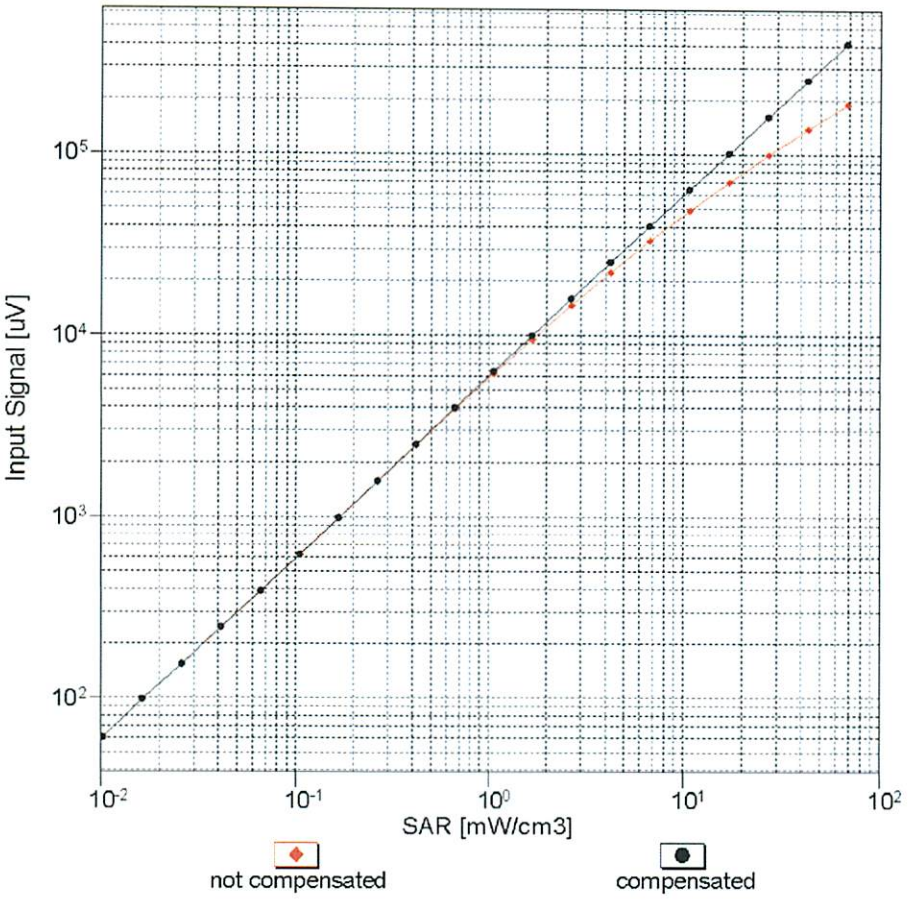
f=1800 MHz,R22

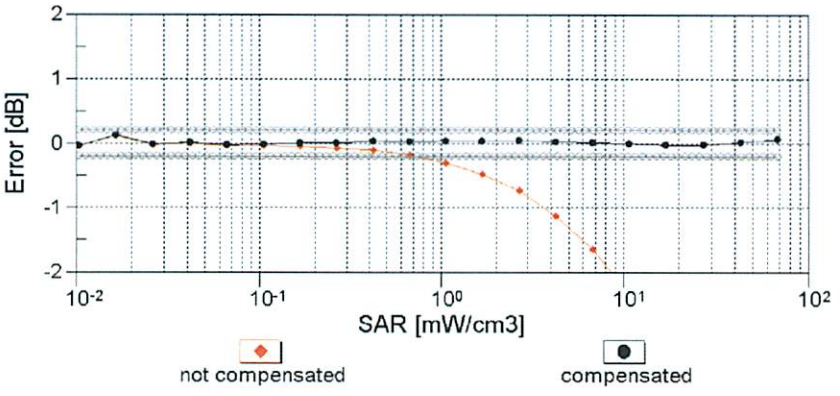




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

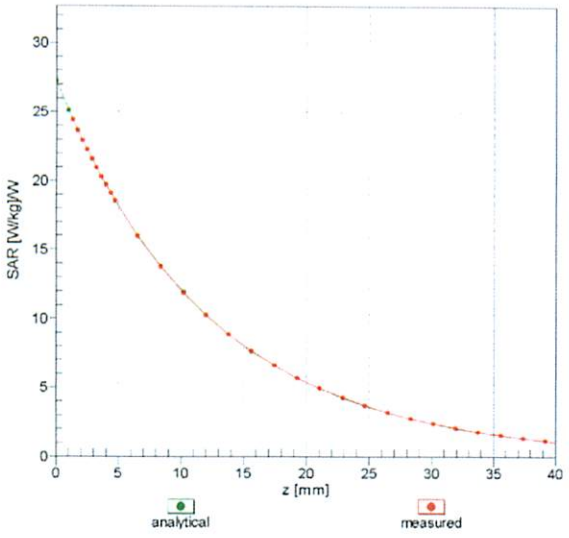




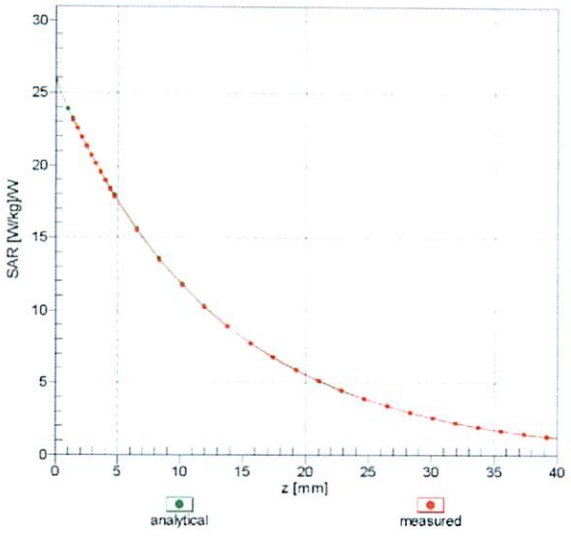
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 1810 MHz,WGLS R22 (H_convF)

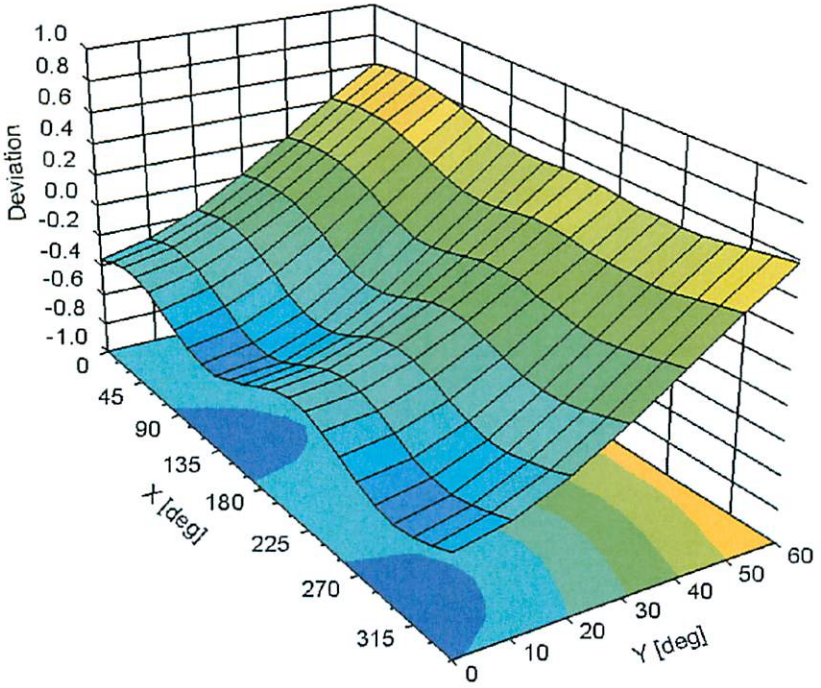


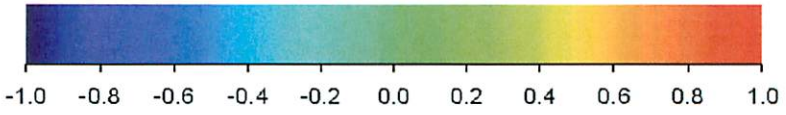
f = 1810 MHz,WGLS R22 (M_convF)



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 (°)	34.7
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

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 Engineering AG
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