SAR TEST REPORT

Test report No:	**EMC-FCC-A0006-1**
Type of Equipment:	**Smart RFID Dongle Reader**
Model Name:	**A100-U**
Applicant:	**PHYCHIPS Inc.**
FCCID:	**Y3DA100U**
Test standards:	**FCC OET Bulletin 6 supplement C**
	IEEE 1528 ,2003
	IEC 62209 :2006/IEC62209-2 :2010
	RSS-102
Max. SAR(1g)	**0.652 W/kg**

Test result: **Complied**

In the configuration tested, the EUT complied with the standards specified above.

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.
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Date of receipt: 2013. 08. 09

Date of testing: 2013. 08. 09

Issued date: 2013. 08. 13

Tested by: Chang-won, Lee

Approved by: Sang-Hun, Yu

Contents

1. Applicant information

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2. Laboratory information

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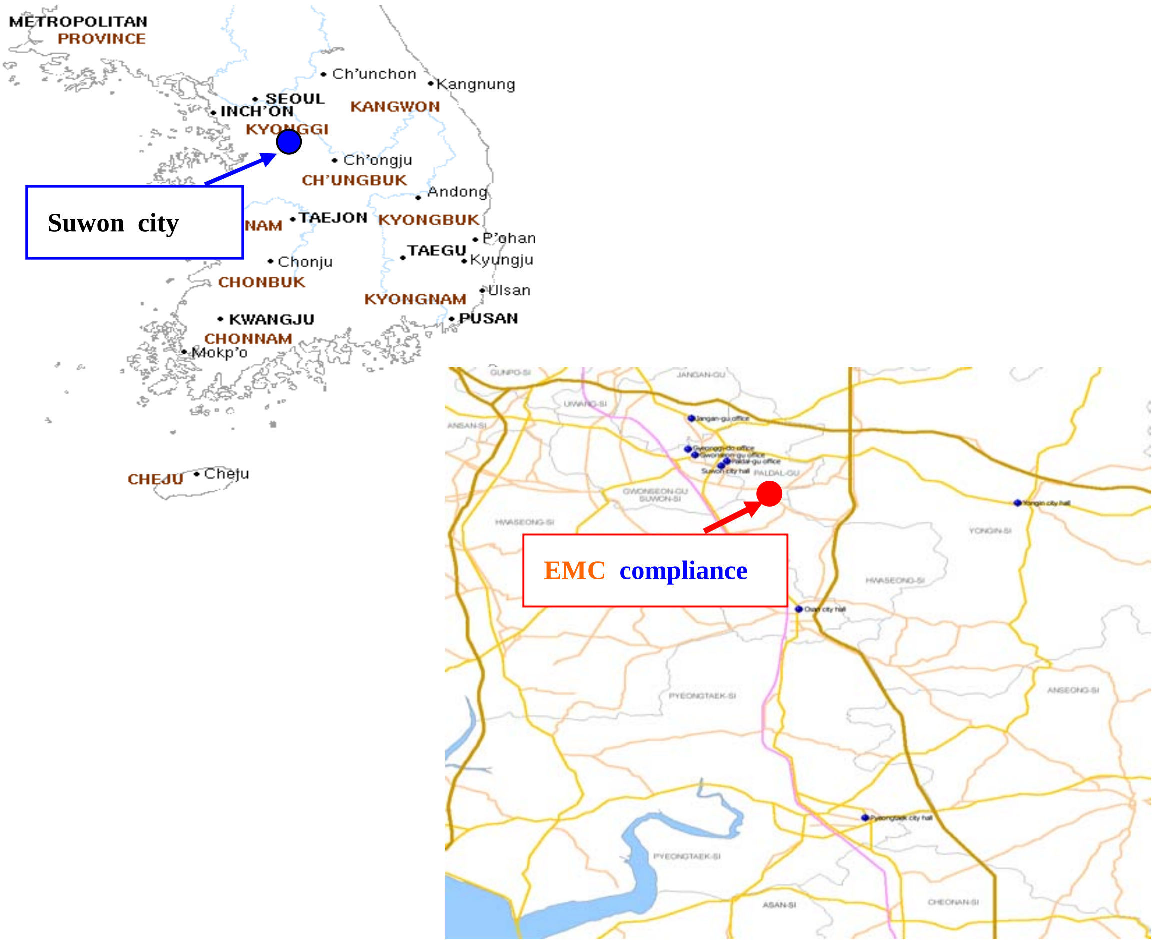
FCC CAB.: 508785
VCCI Registration No. : C-1713, R-1606, T-258
Industry Canada Registration No. : 8035A-2
KOLAS NO.: 231

SITE MAP



3. Identification of Sample

Mode of Operation	UHF RFID device
Model Number	A100-U
Serial Number	N/A
Sample Version	N/A
Tx Freq.Range	917.1 MHz ~ 926.9 MHz
Rx Freq.Range	917.1 MHz ~ 926.9 MHz
Maximum AVG Conducted Power (Unit : dBm)	316mW(25dBm)
Antenna Type	Circularly Polarized Antenna
Antenna Gain	-3.5 dBi
Normal Voltae	DC 3.7 V

4.Test Result Summary

EUT Position	AVG Power (dBm)	Max tune up power (dBm)	Traffic Channel		Measured 1 g SAR (W/kg)	Limit (W/kg)
			Frequency (MHz)	Ch.		
Edge3	24.92	25.00	917.1	1	**0.652**	1.6

* Contain the results of the worst test SAR including battery.

5. Report Overview

This report details the results of testing carried out on the samples listed in section 3, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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6. Test Lab Declaration or comments

None

7. Applicant Declaration or Comments

None

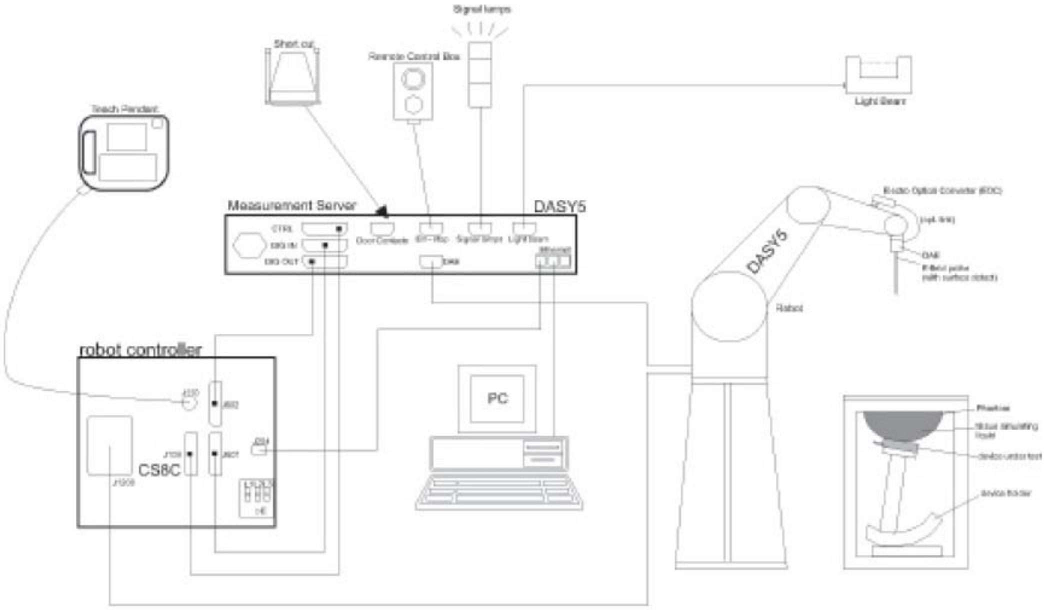
8. Measurement Uncertainty

Measurements and results are all in compliance with the standards listed in section 15 of this report. All measurements and results are recorded and maintained at the laboratory performing the tests and measurement uncertainties are taken into account when comparing measurements to pass / fail criteria.

Uncertainty of SAR equipments for measurement 300 MHz to 3GHz

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (10g)	1g ui (%)	Vi (Veff)
Measurement System							
Probe calibration	E.2.1	6.30	N	1	1	6.30	∞
Axial isotropy	E.2.2	0.50	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.60	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	0.80	R	1.73	1	0.46	∞
Linearity	E.2.4	0.60	R	1.73	1	0.35	∞
System detection limit	E.2.5	1.00	R	1.73	1	0.58	∞
Readout electronics	E.2.6	0.30	N	1	1	0.30	∞
Response time	E.2.7	0.80	R	1.73	1	0.46	∞
Integration time	E.2.8	2.60	R	1.73	1	1.50	∞
RF ambient Condition -Noise	E.6.1	3.00	R	1.73	1	1.73	∞
RF ambient Condition - reflections	E.6.1	3.00	R	1.73	1	1.73	∞
Probe positioning- mechanical tolerance	E.6.2	0.40	R	1.73	1	0.23	∞
Probe positioning- with respect to phantom	E.6.3	2.90	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	1.00	R	1.73	1	0.58	∞
Test Sample Related							
Test sample positioning	E.4.2	5.30	N	1	1	5.30	9
Device holder uncertainty	E.4.1	3.60	N	1	1	3.60	∞
Output power variation -SAR drift measurement	6.62	5.00	R	1.73	1	2.89	∞
Phantom and Setup							
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4.00	R	1.73	1	2.31	∞
Liquid conductivity - deviation from target values	E.3.2	5.00	R	1.73	0.43	1.24	∞
Liquid conductivity - measurement uncertainty	E.3.2	0.97	N	1	0.43	0.42	5
Liquid permittivity - deviation from target values	E.3.3	5.00	R	1.73	0.49	1.41	∞
Liquid permittivity - measurement uncertainty	E.3.3	0.39	N	1	0.49	0.19	5
Combined standard uncertainty				RSS		10.57	244
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		21.14	

9. The SAR Measurement System



<SAR System Configuration>

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- Data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY4 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.
-

9.1 Isotropic E-field Probe ES3DV3

<ES3DV3 E-field Probe>

Construction	**:**	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. DGBE).
Calibration	**:**	In air from 10 MHz to 3 GHz In brain simulating tissue (accuracy ± 6.3 %)
Frequency	**:**	10 MHz to 4 GHz; Linearity: ±0.2 dB (30 MHz to 4 GHz)
Directivity	**:**	±0.2 dB in brain tissue (rotation around probe axis) ±0.3 dB in brain tissue (rotation normal to probe axis)
Dynamic Range	**:**	5 µW/g to >100 mW/g; Linearity: ±0.2 dB
Srfce. Detect	**:**	±0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	**:**	Overall length: 337 mm Tip length: 20 mm Body diameter: 12 mm Tip diameter: 3.9 mm Distance from probe tip to dipole centers: 2 mm
Application	**:**	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing frequencies up to 6 GHz with precision of better 30%.

9.2 SAM Twin Phantom

<SAM Twin Phantom>

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

- Left head
- Right head
- Flat phantom

A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible.

On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

Phantom specification:

Description The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, IEC 62209-1 and IEC 62209-2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Shell Thickness 2 + 0.2 mm, Center ear point: 6 + 0.2 mm

Filling Volume Approx.25 liters

Dimensions Length: 1000 mm, Width: 500 mm, Height: 850 mm

9.3 Device Holder for Transmitters

<Device Holder for Transmitters>

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

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

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

10. Measurement for Tissue Simulant Liquid

The dielectric properties for this Tissue Simulant Liquids were measured by using the Agilent Model 85070D Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Agilent E5070B Network Analyzer (9 kHz -3000 MHz). The Conductivity (σ) and Permittivity (ρ) are listed in Table 1.For the SAR measurement given in this report. The temperature variation of the Tissue Simulant Liquids was (22 ± 2) °C

Freq (MHz)	Tissue Type	Limit/Measured	Permittivity (ρ)	Conductivity (σ)	Temp (°C)
900.0	Body	Recommended Limit	55.00 ± 5 % (52.25 ~ 57.75)	1.05 ± 5 % (0.9975 ~ 1.1025)	22 ± 2
		Measured, 2013-08-09	53.71	1.02	22.2
920.0	Body	Recommended Limit	55.00 ± 5 % (52.25 ~ 57.75)	1.05 ± 5 % (0.9975 ~ 1.1025)	22 ± 2
		Measured, 2013-08-09	53.55	1.04	22.2

<Measurement result of Tissue electric parameters>

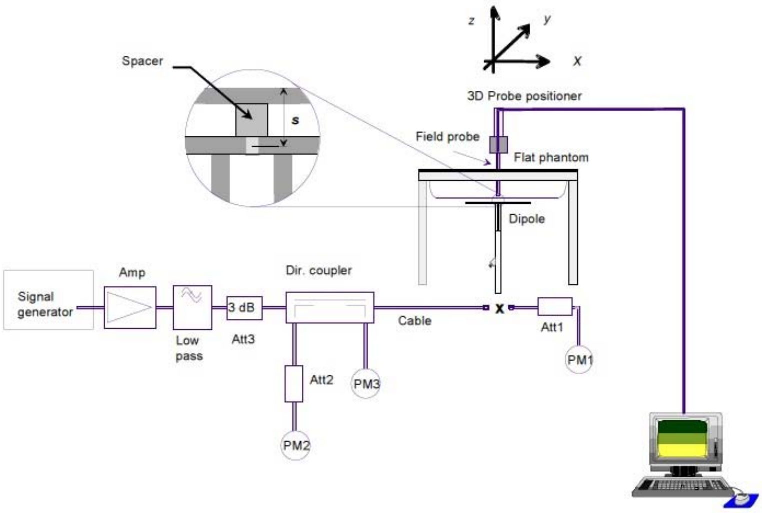
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (㎒)									
	450		835		915		1900		**2450**	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.5	56.7	41.5	55.2	42.0	56.8	40.0	53.3	39.2	52.7
Conductivity (S/m)	0.87	0.94	0.90	0.97	1.0	1.07	1.40	1.52	1.80	1.95

Salt: 99+% Pure Sodium Chloride　　Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 M☐+ resistivity　　HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

11. SAR System Validation

The microwave circuit arrangement for system verification is sketched below picture. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10 % from the target SAR values. These tests were done at 900/1800/1950/2450 MHz. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the table C-1 (A power level of 250 ㎽ was input to the dipole antenna). During the tests, the ambient temperature of the laboratory was in the range 22 °C, the relative humidity was in the range 60 % and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



Validation Kit	Frequency (MHz)	Tissue Type	Limit/Measurement (Normalized to 1 W)		
				1 g	10 g
D900V2	1d138	Head	Recommended Limit (Normalized)	10.90 ± 10 % (9.81 ~ 11.99)	7.00 ± 10 % (6.30 ~ 7.70)
			Measured, 2013-08-09	10.40	6.76

<SAR System Validation Result>

12. Operation Configurations

For the RFID Reader SAR tests, a communication link is set up with the test mode software for can be controlled by pc via USB test. The Absolute Radio Frequency Channel Number is allocated to 1,25and 50 respectively in the case of 917.1 ~ 926.9 MHz.During the test,at the each test frequency channel, theEUT is operated at the RF continuous emission mode.Each channel should be tested at the max power data rate.

13. SAR Measurement Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When either the x or y dimension of the test device in the measurement plane is smaller than the above, the measurement resolution must be ≤ the corresponding x and y dimensions of the test device, with at least one measurement point on the test device.</td></tr>
</table>

Step 3: Zoom Scan
Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures ☐7x7x9 (above 4.5 GHz) or 5x5x7 (below 3 GHz) points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measument 10 MHz to 6 GHz v01

			$\leq$ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm	3 – 4 GHz: $\leq$ 5 mm 4 – 6 GHz: $\leq$ 4 mm
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 22 mm

Step 4: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan
The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a onedimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

* Z Scan Report on Liquid Measure the height Annex A.4   Liquid Depth photo to replace

14. Test Equipment Information

SPEAG DASY4

Test Platform	SPEAG DASY4 System			
Location	EMC Compliance Lab			
Manufacture	SPEAG			
Description	SAR Test System (Frequency range 300MHz-6GHz) 450, 835, 900, 1 800, 1 900, 1 950, 2 450, 5 000 frequency band			
Software Reference	DASY4: V4.7, Build 80 SEMCAD: V1.8, Build 186			
Hardware Reference				
Equipment	Model	Serial Number	Date of Calibration	Due date of next Calibration
Robot	TX90XL Speag	F12/5L7FA1/A/01	N/A	N/A
Phantom	TwinSAM Phantom	1362	N/A	N/A
Phantom	TwinSAM Phantom	1363	N/A	N/A
Data Acquisition Unit (DAE)	DAE4	1342	2013-07-29	2014-07-29
Probes	ES3DV3	3302	2013-07-30	2014-07-30
Probes	EX3DV4	3928	2013-07-12	2014-07-12
Dipole Validation Kits	D300V3	1016	2012-07-24	2014-07-24
Dipole Validation Kits	D450V3	1080	2012-07-24	2014-07-24
Dipole Validation Kits	D850V2	1006	2012-08-07	2014-08-07
Dipole Validation Kits	D900V2	1d138	2012-08-07	2014-08-07
Dipole Validation Kits	D1750V2	1072	2012-07-19	2014-07-19
Dipole Validation Kits	D1900V2	5d160	2012-07-20	2014-07-20
Dipole Validation Kits	D2450V2	865	2012-07-24	2014-07-24
Dipole Validation Kits	D2600V2	1050	2012-07-24	2014-07-24
Dipole Validation Kits	D5GHzV2	1134	2012-07-27	2014-07-27
Network Analyzer	E5071B	MY42403524	2013-07-10	2014-07-10
Dual Directional Coupler	778D	16059	2012-09-21	2013-09-21
Dual Directional Coupler	772D	2839A00719	2012-09-21	2013-09-21
Signal Generator	E4438C	MY42080486	2013-02-18	2014-02-18

Power Amplifier	GRF5039	1062	2013-07-20	2014-07-20
Power Amplifier	2055	1005D/C0521	2013-05-13	2014-05-13
Power Amplifier	5190FE	1012	2012-09-21	2013-09-21
Dual Power Meter	E4419B	GB39290551	2013-05-13	2014-05-13
Power Sensor	8481H	3318A19674	2013-07-10	2014-07-10
Power Sensor	8481H	331BA17565	2013-05-13	2014-05-13
LP Filter	LA-15N	36543	2012-09-21	2013-09-21
WIDEBAND POWER SENSOR	NRP-Z81	100677	2013-05-06	2014-05-06

15. Average Power

Frequency (MHz)	Peak Output Power (dBm)	Average Reding (dBm)	Average Result (dBm)
917.1	25.488	22.05	24.92
921.9	25.488	22.13	**25.00**
926.9	25.483	22.01	24.88

16. SAR Test Results

EUT Position	Mode	Dist. (mm)	AVG Power (dBm)	Max tune up power (dBm)	Traffic Channel Frequency (MHz)	Traffic Channel Ch.	Measured 1 g SAR (W/kg)	Note
Front	UHF	0	24.92	25.00	917.1	1		1
			25.00	25.00	921.9	25	0.563	
			24.88	25.00	926.9	50		1
Back	UHF	0	24.92	25.00	917.1	1		1
			25.00	25.00	921.9	25	0.233	
			24.88	25.00	926.9	50		1
Edge2 (right side)	UHF	0	24.92	25.00	917.1	1		
			25.00	25.00	921.9	25	0.487	1
			24.88	25.00	926.9	50		
Edge3 (left side)	UHF	0	24.92	25.00	917.1	1	**0.652**	
			25.00	25.00	921.9	25	0.616	
			24.88	25.00	926.9	50	0.530	
Edge4 (top)	UHF	0	24.92	25.00	917.1	1		1
			25.00	25.00	921.9	25	0.526	
			24.88	25.00	926.9	50		1

<Note>

1. When the 1-g SAR for the mid-band channel, or the channel with the highest output power satisfy the following conditions,testing of the other channels in the band is not required. (Per KDB 447498)

=0.8 W/kg and transmission band =100 MHz
=0.6 W/kg and, 100 MHz < transmission bandwidth =200 MHz
=0.4 W/kg and transmission band > 200 MHz

17. Validation Test Results

System Validation for 900 MHz - Body(2013-08-09)

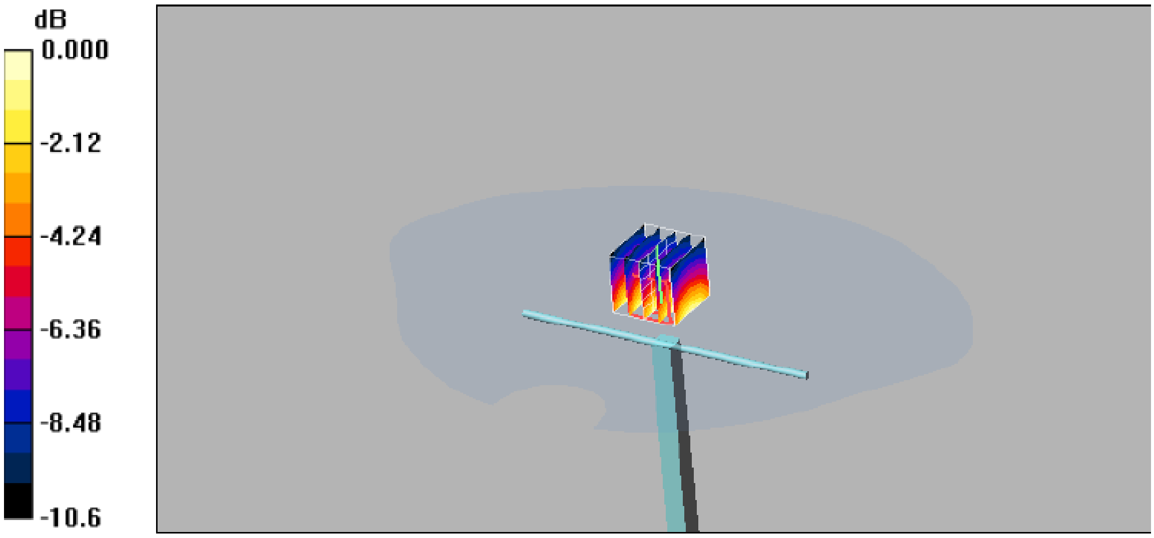
DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:1d138
Procedure Name: d=15mm, Pin=250mW

Communication System: CW; Frequency: 900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 900 MHz; σ = 1.02 mho/m; ε_r = 53.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM; Serial: TP-1362
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

d=15mm, Pin=250mW/Zoom Scan (7x7x7) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.6 V/m; Power Drift = -0.008 dB
Peak SAR (extrapolated) = 3.83 W/kg
SAR(1 g) = 2.6 mW/g; SAR(10 g) = 1.69 mW/g
Maximum value of SAR (measured) = 3.03 mW/g



0 dB = 3.03mW/g

18. Test Results

921.9 MHz_Front_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Front_Gap_0mm

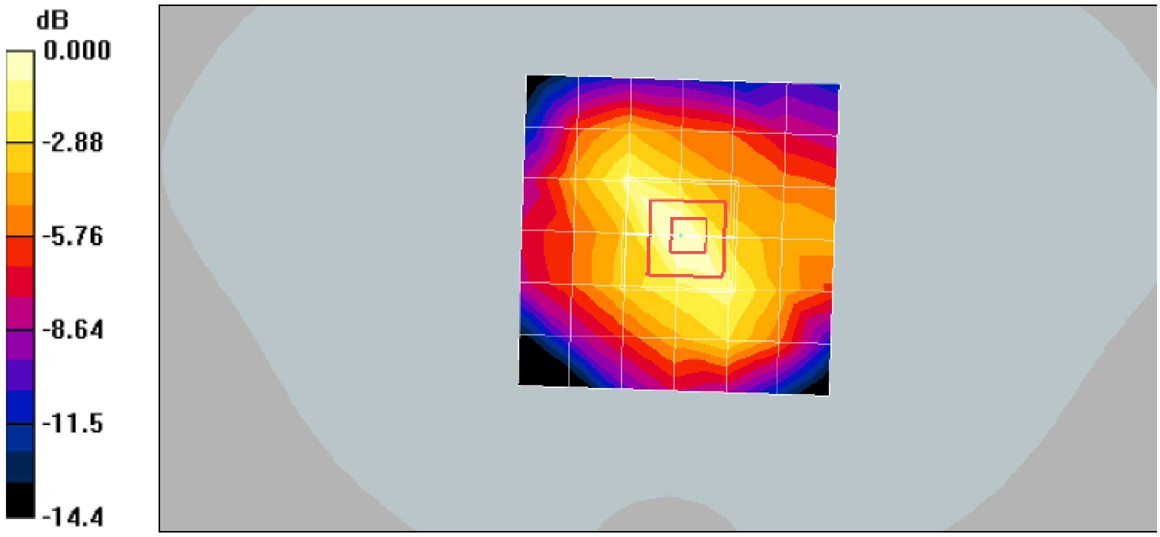
Communication System: RFID; Frequency: 921.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 921.9 MHz; σ = 1.04 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Front_Gap_0mm/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.798 mW/g

A100_900_Front_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.9 V/m; Power Drift = 0.138 dB
Peak SAR (extrapolated) = 1.07 W/kg
SAR(1 g) = 0.563 mW/g; SAR(10 g) = 0.322 mW/g.
Maximum value of SAR (measured) = 0.654 mW/g



0 dB = 0.654mW/g

921.9 MHz_Back_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Back_Gap_0mm

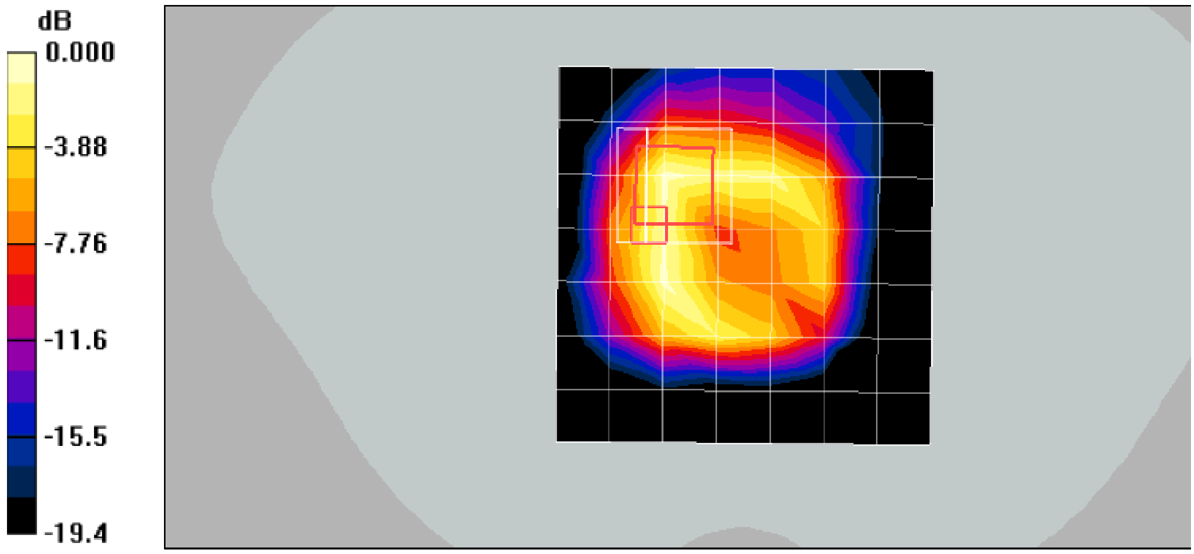
Communication System: RFID; Frequency: 921.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 921.9 MHz; σ = 1.04 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Back_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.344 mW/g

A100_900_Back_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.32 V/m; Power Drift = -0.073 dB
Peak SAR (extrapolated) = 0.576 W/kg
SAR(1 g) = 0.233 mW/g; SAR(10 g) = 0.122 mW/g
Maximum value of SAR (measured) = 0.404 mW/g



0 dB = 0.404mW/g

921.9 MHz_Edge2_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Edge2_Gap_0mm

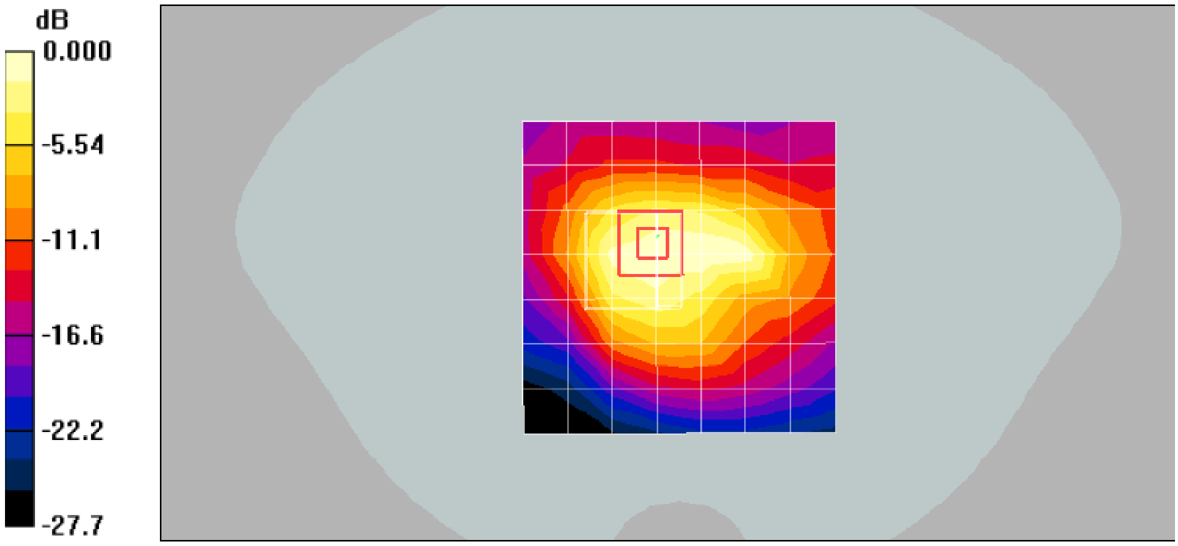
Communication System: RFID; Frequency: 921.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 921.9 MHz; σ = 1.04 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Edge2_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.497 mW/g

A100_900_Edge2_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.5 V/m; Power Drift = -0.030 dB
Peak SAR (extrapolated) = 1.14 W/kg
SAR(1 g) = 0.487 mW/g; SAR(10 g) = 0.245 mW/g
Maximum value of SAR (measured) = 0.649 mW/g



0 dB = 0.497mW/g

921.9 MHz_Edge3_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Edge3_Gap_0mm

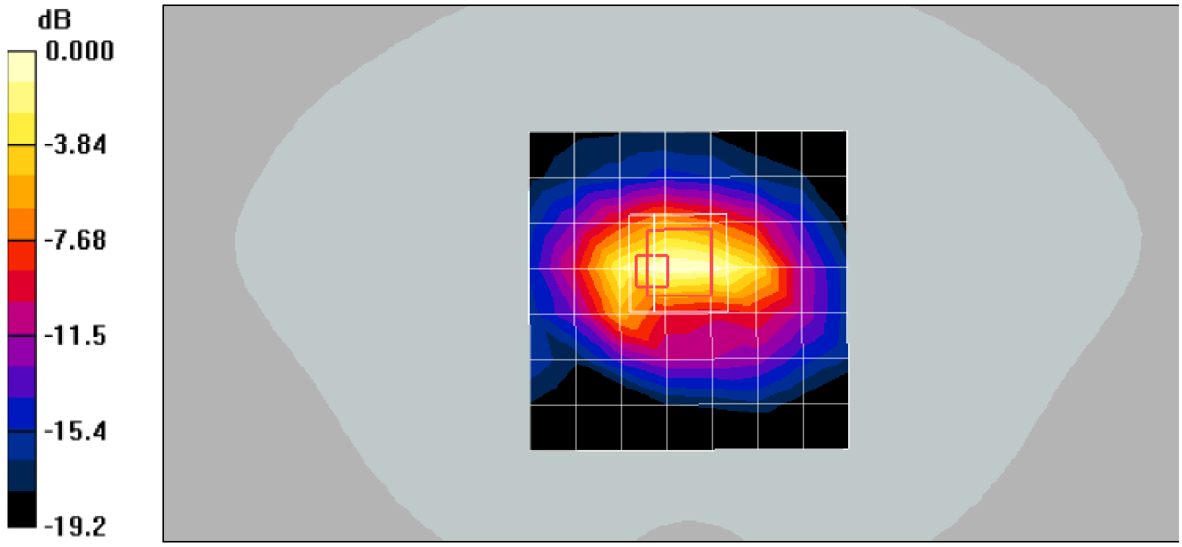
Communication System: RFID; Frequency: 921.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 921.9 MHz; σ = 1.04 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Edge3_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.737 mW/g

A100_900_Edge3_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.5 V/m; Power Drift = -0.117 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 0.616 mW/g; SAR(10 g) = 0.310 mW/g
Maximum value of SAR (measured) = 0.735 mW/g



0 dB = 0.735mW/g

921.9 MHz_Edge4_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Edge4_Gap_0mm

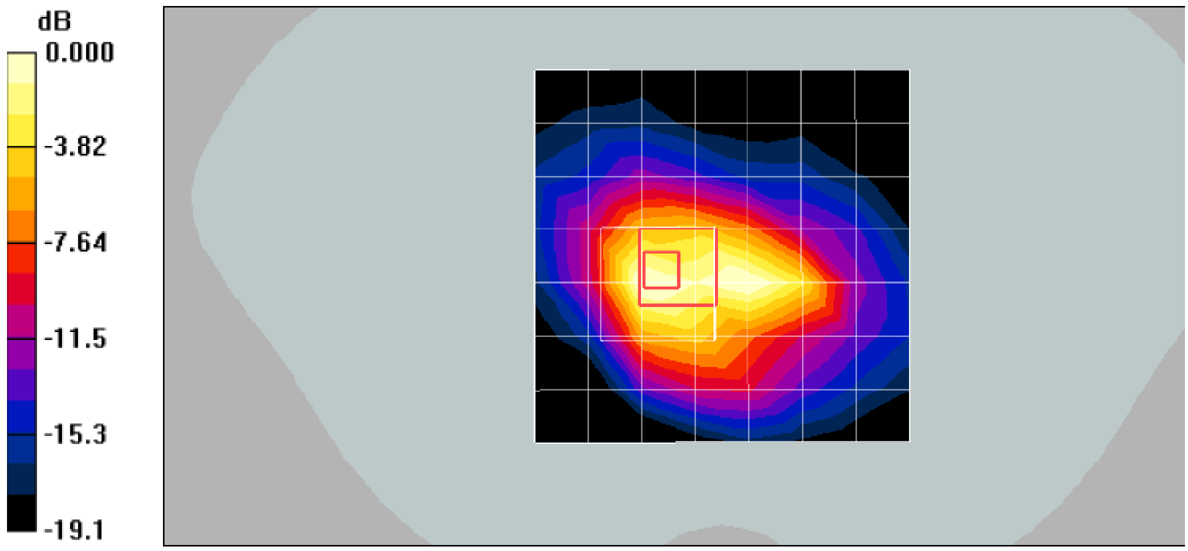
Communication System: RFID; Frequency: 921.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 921.9 MHz; σ = 1.04 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Edge4_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.714 mW/g

A100_900_Edge4_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.5 V/m; Power Drift = -0.184 dB
Peak SAR (extrapolated) = 1.16 W/kg
SAR(1 g) = 0.526 mW/g; SAR(10 g) = 0.266 mW/g
Maximum value of SAR (measured) = 0.637 mW/g



0 dB = 0.637mW/g

917.1 MHz_Edge3_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Edge3_Gap_0mm

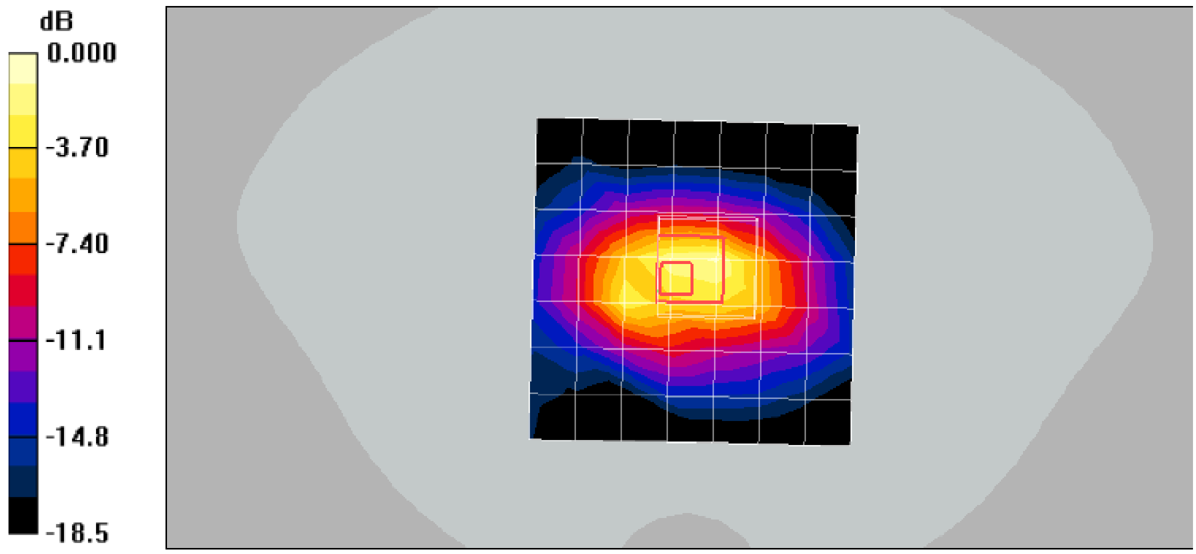
Communication System: RFID; Frequency: 917.1 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 917.1 MHz; σ = 1.04 mho/m; ε_r = 53.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Edge3_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.582 mW/g

A100_900_Edge3_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.9 V/m; Power Drift = 0.033 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 0.652 mW/g; SAR(10 g) = 0.328 mW/g
Maximum value of SAR (measured) = 0.745 mW/g



0 dB = 0.745mW/g

926.9 MHz_Edge3_gap 0mm

DUT: A100; Type: RFID Reader; Serial: N/A
Procedure Name: A100_900_Edge3_Gap_0mm

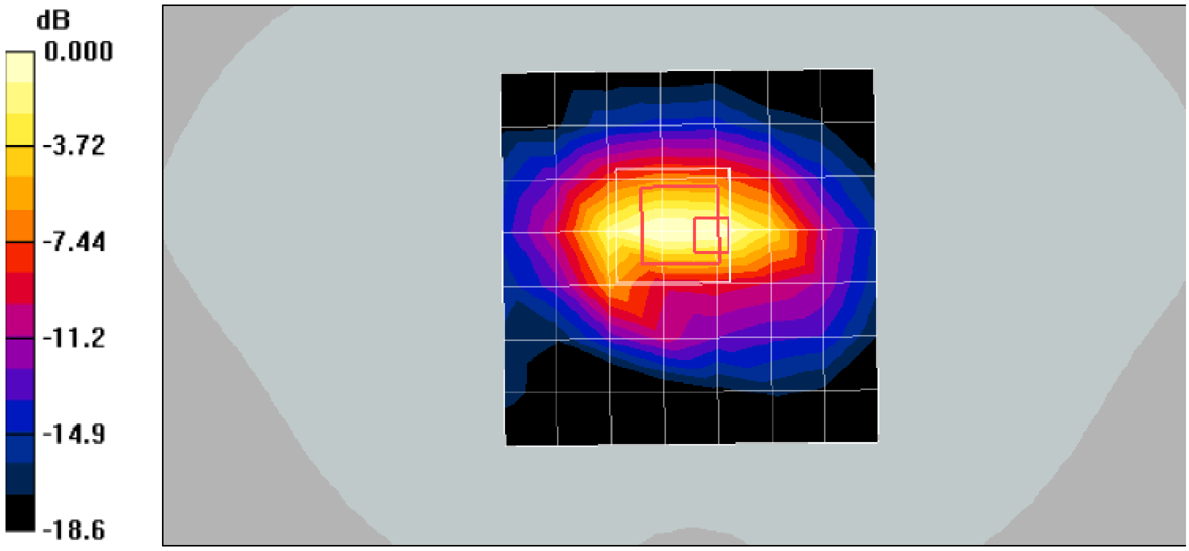
Communication System: RFID; Frequency: 926.9 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 926.9 MHz; σ = 1.05 mho/m; ε_r = 53.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3302; ConvF(5.76, 5.76, 5.76); Calibrated: 2013-07-30
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1342; Calibrated: 2013-07-29
- Phantom: SAM A; Type: SAM;
- ; Postprocessing SW: SEMCAD, V1.8 Build 186

A100_900_Edge3_Gap_0mm/Area Scan (8x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.774 mW/g

A100_900_Edge3_Gap_0mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = 0.086 dB
Peak SAR (extrapolated) = 1.28 W/kg
SAR(1 g) = 0.530 mW/g; SAR(10 g) = 0.278 mW/g
Maximum value of SAR (measured) = 0.651 mW/g

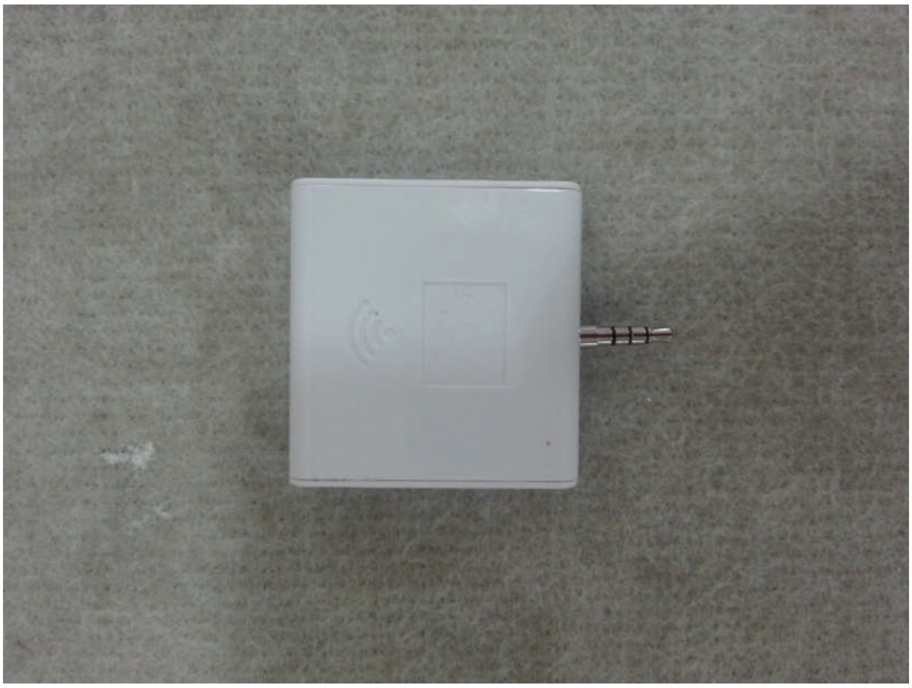


0 dB = 0.651mW/g

Annex A. Photographs

Annex A.1 EUT

Front View



Back View

Right side View

Left side View

Top side View

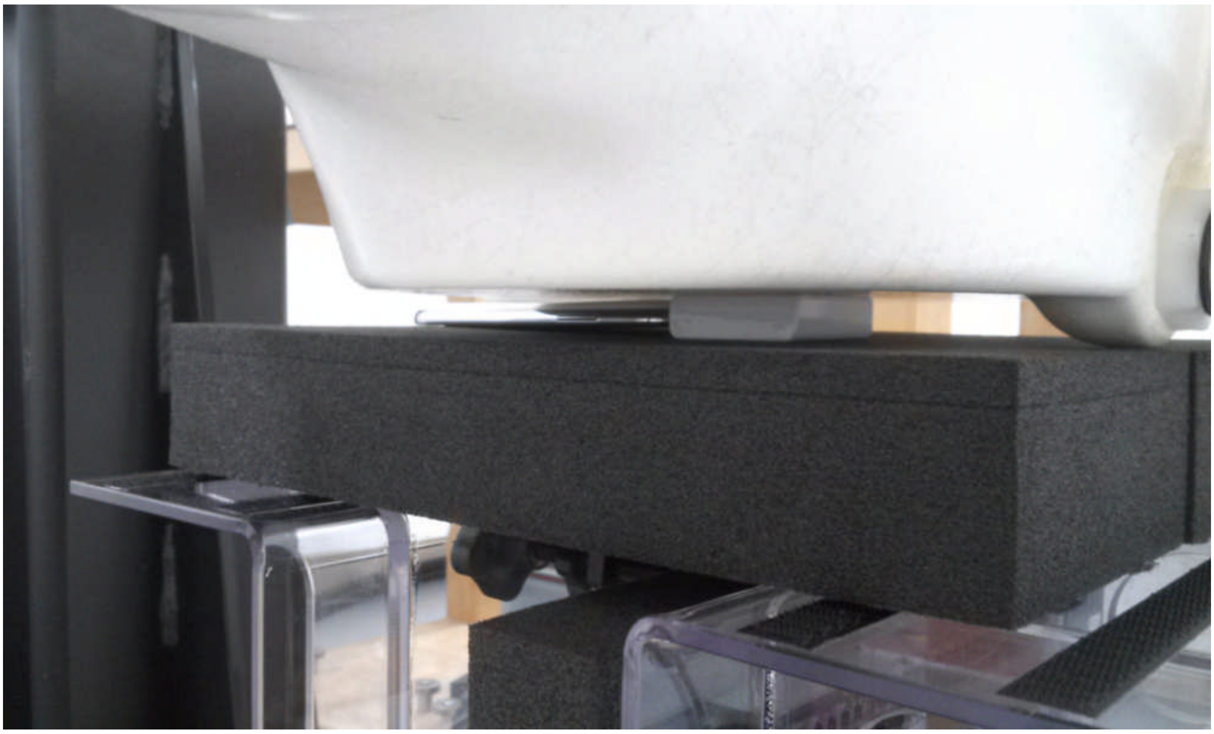
Bottom side View

Annex A.2 Photographs of Test Setup

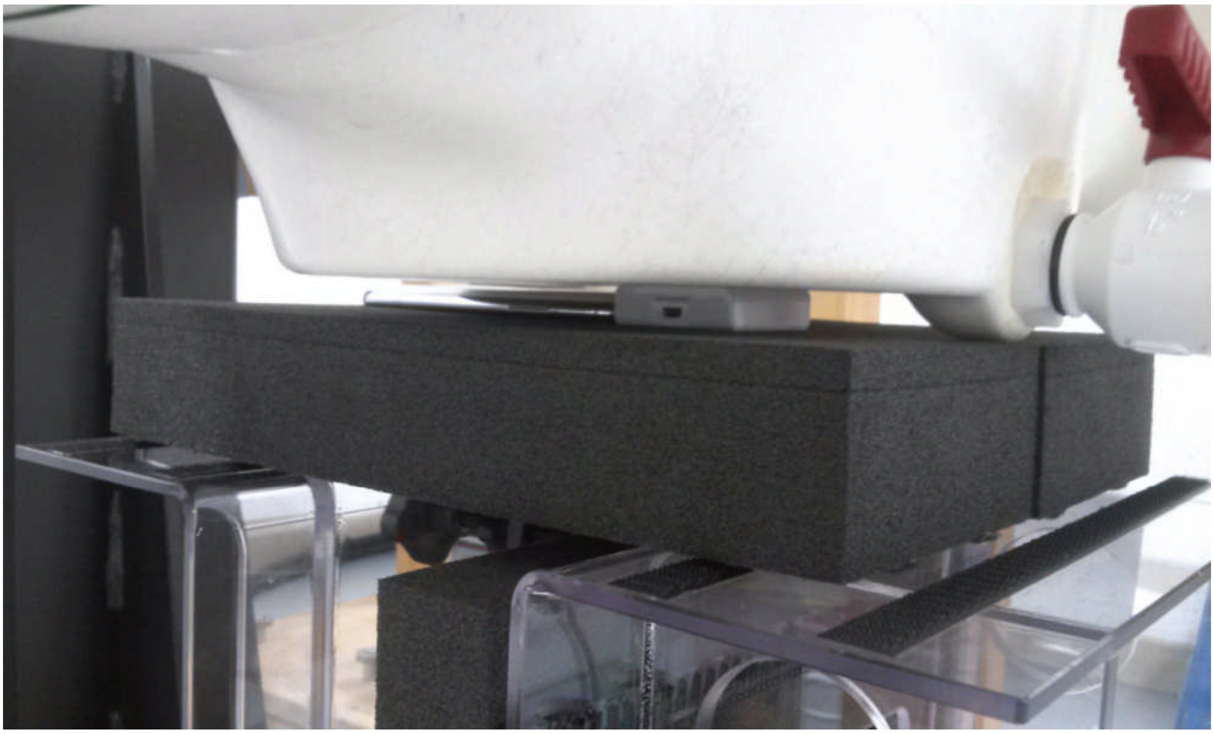
Photograph of the SAR measurement System

Annex A.3 Test Position

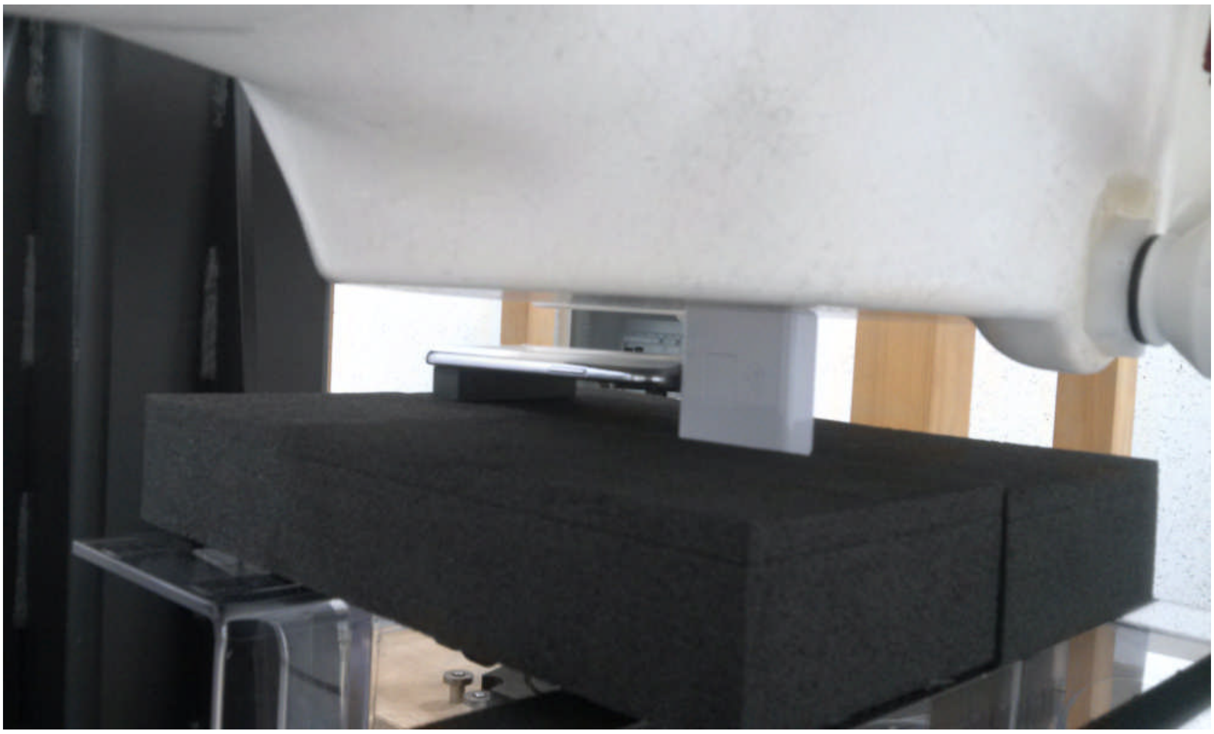
(a) Front



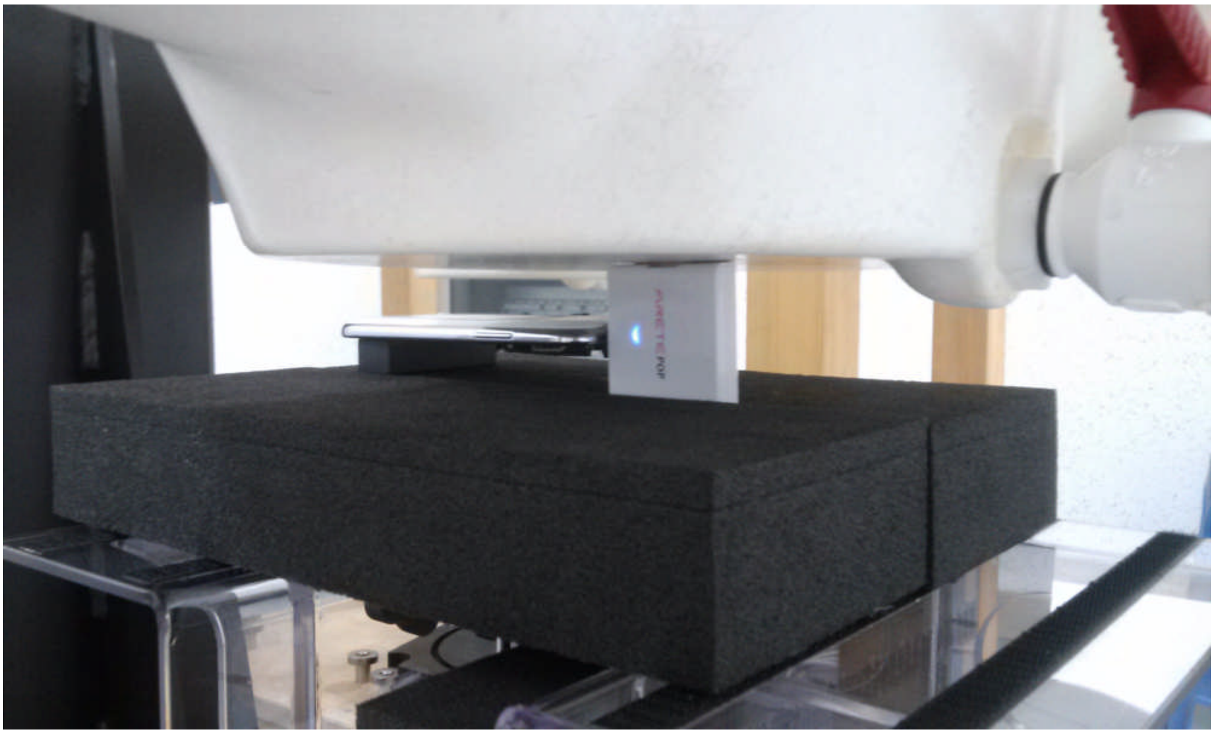
(b) Back



(c) Edge2

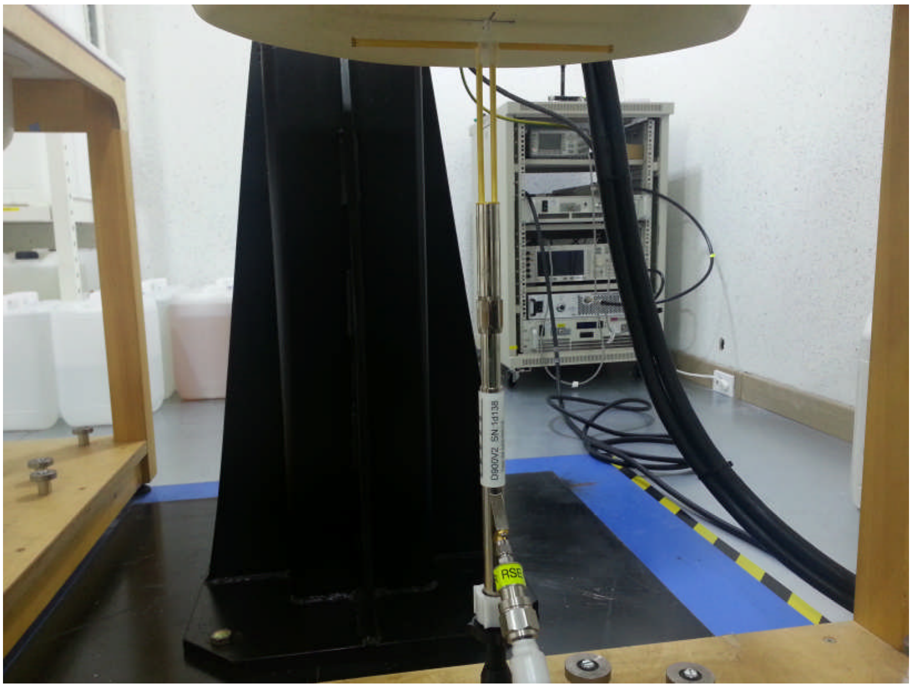


(d) Edge3

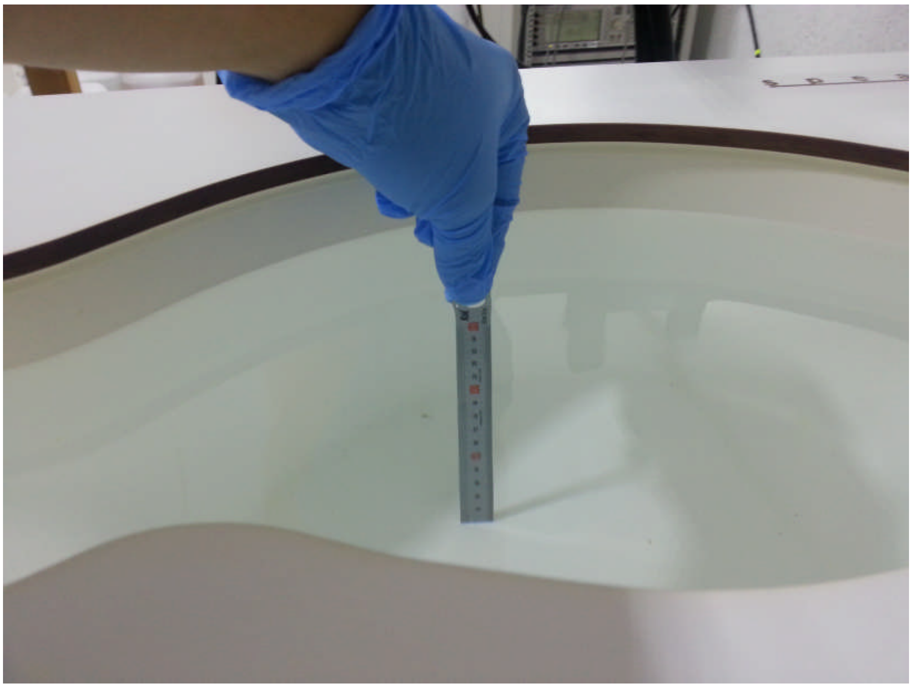


(e) Edge4

(f) Validation 900 MHz



Annex A.4 Liquid Depth



900 MHz

Annex B. Calibration certificate

Annex B.1 Probe Calibration certificate

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

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **EMC Compliance (Dymstec)**

Certificate No: **ES3-3302_Jul13**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3302

Calibration procedure(s): QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: July 30, 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	(signed)
Approved by:	Katja Pokovic	Technical Manager	(signed)

Issued: July 30, 2013

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

Certificate No: ES3-3302_Jul13 Page 1 of 11

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 ES3DV3

SN:3302

Manufactured: August 27, 2010
Calibrated: July 30, 2013

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

ES3DV3– SN:3302 July 30, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3302

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)²)[A]	1.19	1.38	1.32	± 10.1 %
DCP (mV)[B]	100.3	101.2	100.1	

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	148.9	±3.0 %
		Y	0.0	0.0	1.0		174.1	
		Z	0.0	0.0	1.0		164.6	

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.

ES3DV3– SN:3302

July 30, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3302

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)
300	45.3	0.87	6.78	6.78	6.78	0.26	1.18	± 13.4 %
450	43.5	0.87	6.77	6.77	6.77	0.19	2.20	± 13.4 %
850	41.5	0.92	5.88	5.88	5.88	0.42	1.57	± 12.0 %
900	41.5	0.97	5.77	5.77	5.77	0.56	1.38	± 12.0 %
1750	40.1	1.37	4.89	4.89	4.89	0.51	1.41	± 12.0 %
1900	40.0	1.40	4.76	4.76	4.76	0.62	1.27	± 12.0 %
2450	39.2	1.80	4.20	4.20	4.20	0.80	1.24	± 12.0 %
2600	39.0	1.96	4.09	4.09	4.09	0.80	1.24	± 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.

ES3DV3– SN:3302

July 30, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3302

Calibration Parameter Determined in Body Tissue Simulating Media

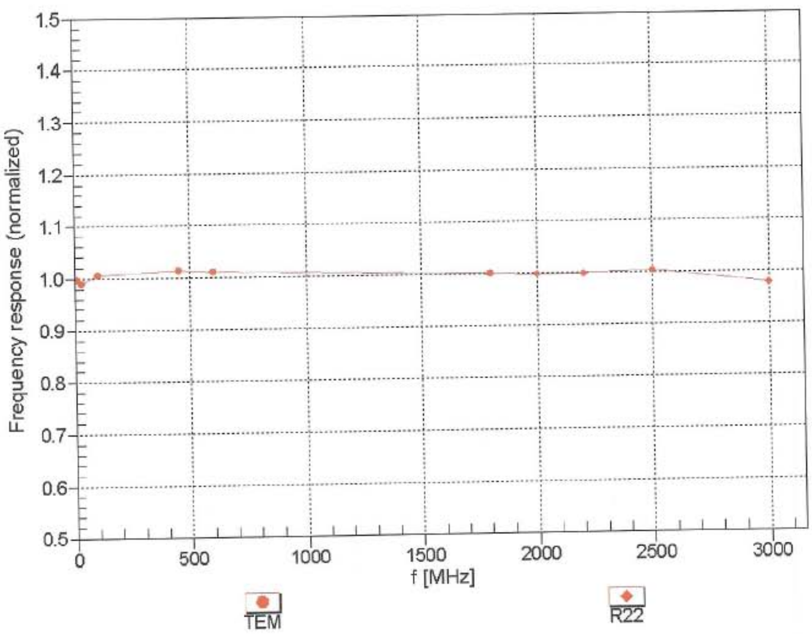
f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	58.2	0.92	6.57	6.57	6.57	0.21	1.50	± 13.4 %
450	56.7	0.94	6.86	6.86	6.86	0.10	1.20	± 13.4 %
850	55.2	0.99	5.83	5.83	5.83	0.80	1.16	± 12.0 %
900	55.0	1.05	5.76	5.76	5.76	0.80	1.20	± 12.0 %
1750	53.4	1.49	4.56	4.56	4.56	0.76	1.28	± 12.0 %
1900	53.3	1.52	4.37	4.37	4.37	0.44	1.87	± 12.0 %
2450	52.7	1.95	3.98	3.98	3.98	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.83	3.83	3.83	0.68	0.96	± 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.

ES3DV3– SN:3302 July 30, 2013

Frequency Response of E-Field

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

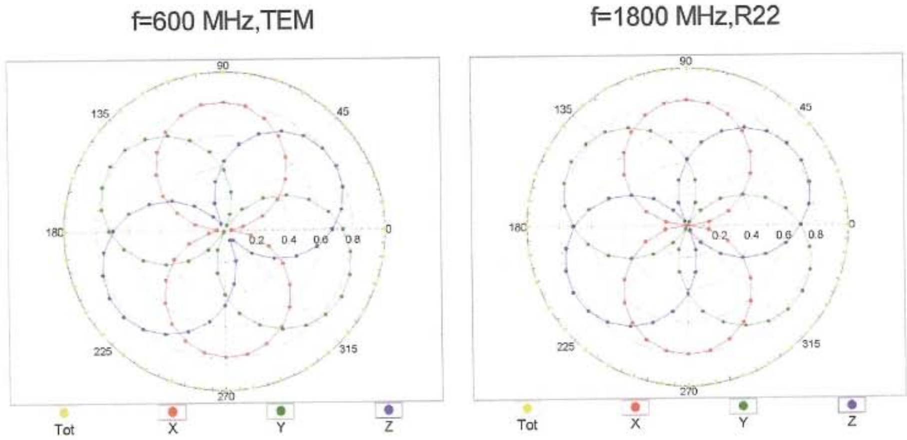


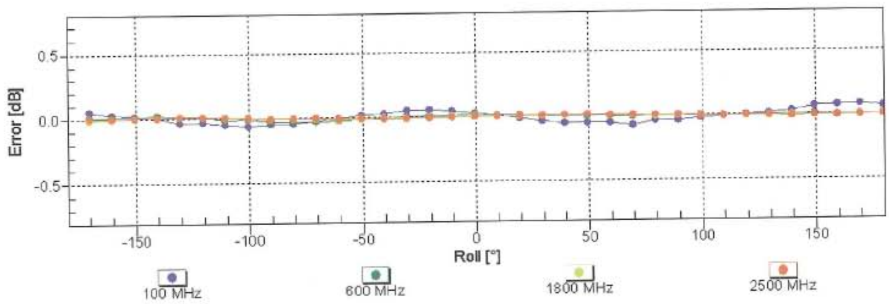
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ES3DV3– SN:3302

July 30, 2013

Receiving Pattern (ϕ), ϑ = 0°



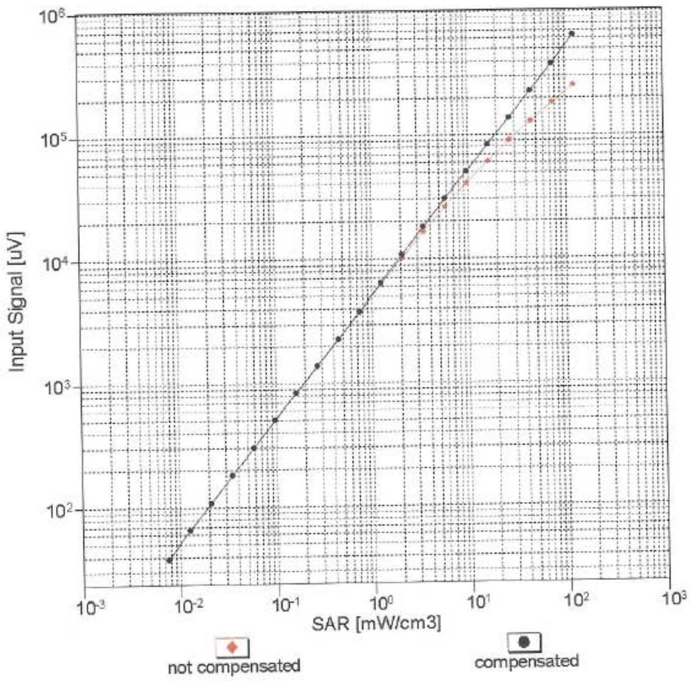


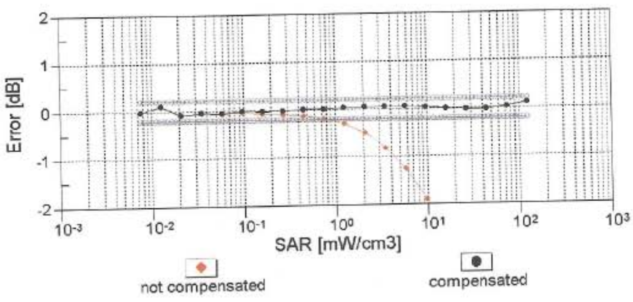
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ES3DV3– SN:3302 July 30, 2013

Dynamic Range f(SAR$_{head}$)

(TEM cell , f = 900 MHz)



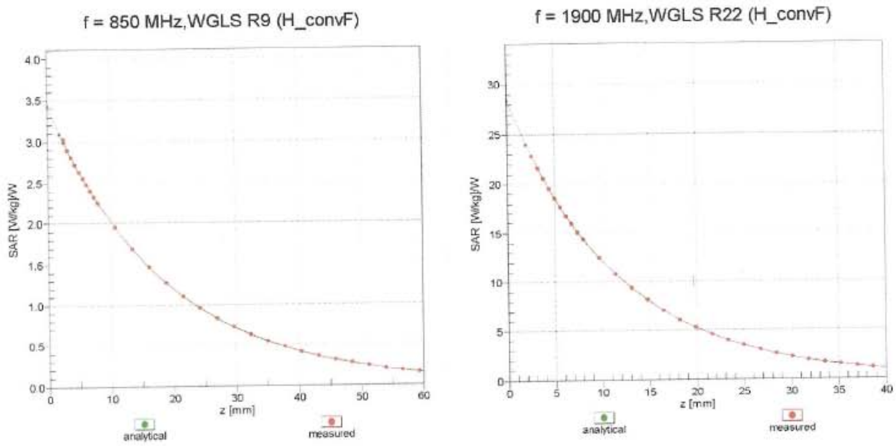


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3302

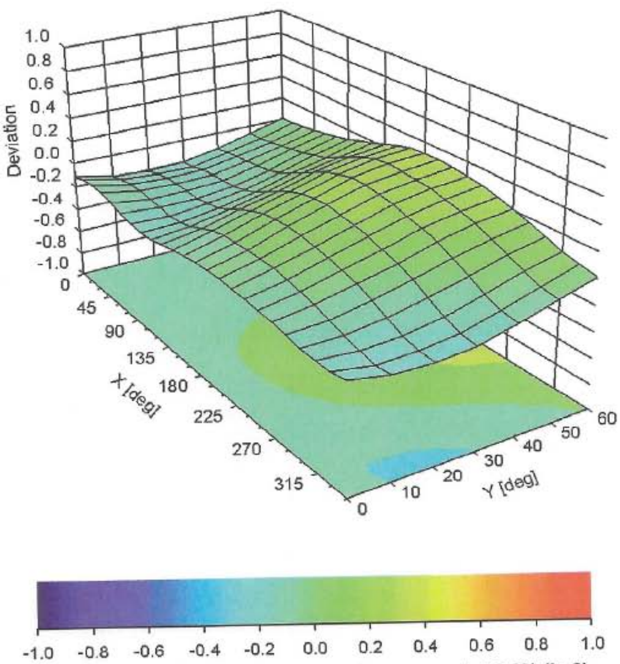
July 30, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

EMC Compliance Ltd. 480-5 Sin-dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, 443-390, Korea
TEL: 82 31 336 9919 FAX: 82 505 299 8311

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3302

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-130.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Annex B.2 DAE Calibration certification

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client: **EMC Compliance (Dymstec)**

Certificate No: **DAE4-1342_Jul13**

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BJ - SN: 1342

Calibration procedure(s): QA CAL-06.v26
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: July 29, 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
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: July 29, 2013

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Certificate No: DAE4-1342_Jul13 Page 1 of 5

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Accreditation No.: **SCS 108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
    - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
    - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
    - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
    - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
    - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
    - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
    - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
    - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
    - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.083 ± 0.02% (k=2)	404.233 ± 0.02% (k=2)	404.203 ± 0.02% (k=2)
Low Range	3.97261 ± 1.50% (k=2)	3.97908 ± 1.50% (k=2)	3.97967 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	36.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199997.53	-0.56	-0.00
Channel X	+ Input	20005.43	4.25	0.02
Channel X	- Input	-19998.03	2.34	-0.01
Channel Y	+ Input	199998.02	0.01	0.00
Channel Y	+ Input	20001.47	0.35	0.00
Channel Y	- Input	-20000.72	-0.24	0.00
Channel Z	+ Input	199998.18	0.09	0.00
Channel Z	+ Input	20000.42	-0.56	-0.00
Channel Z	- Input	-20000.83	-0.24	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.93	1.65	0.08
Channel X	+ Input	202.80	0.97	0.48
Channel X	- Input	-197.48	0.54	-0.27
Channel Y	+ Input	2002.71	1.43	0.07
Channel Y	+ Input	202.23	0.52	0.26
Channel Y	- Input	-198.64	-0.44	0.22
Channel Z	+ Input	2001.56	0.31	0.02
Channel Z	+ Input	201.13	-0.54	-0.27
Channel Z	- Input	-200.76	-2.51	1.27

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	11.62	9.65
	- 200	-8.38	-10.57
Channel Y	200	0.96	0.47
	- 200	-2.95	-2.22
Channel Z	200	0.38	0.38
	- 200	-3.20	-3.03

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.32	-2.90
Channel Y	200	9.87	-	5.86
Channel Z	200	10.22	7.18	-

Certificate No: DAE4-1342_Jul13 Page 4 of 5

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15935	13944
Channel Y	16474	14966
Channel Z	15663	13516

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.19	-2.12	1.41	0.62
Channel Y	-0.49	-1.78	1.16	0.55
Channel Z	-0.35	-1.85	1.13	0.62

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

Annex B.3 Dipole Calibration certification

D900V2

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

Client: **EMC Compliance (Dymstec)**

Certificate No: **D900V2-1d138_Aug12**

CALIBRATION CERTIFICATE

Object	D900V2 - SN: 1d138
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 07, 2012

결재	작성	검토	승인

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	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

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:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 7, 2012

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Certificate No: D900V2-1d138_Aug12 Page 1 of 8

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.6 ± 6 %	0.96 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	2.65 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**10.6 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.70 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.82 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	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.7 ± 6 %	1.05 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	2.75 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**10.9 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.76 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**7.00 mW / g ± 16.5 % (k=2)**

EMC Compliance Ltd. 480-5 Sin-dong, Yeongtong-gu, Suwon-city, Gyeonggi-do, 443-390, Korea
TEL: 82 31 336 9919 FAX: 82 505 299 8311

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω - 0.2 jΩ
Return Loss	- 33.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω - 2.0 jΩ
Return Loss	- 31.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.412 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 10, 2010

DASY5 Validation Report for Head TSL

Date: 07.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

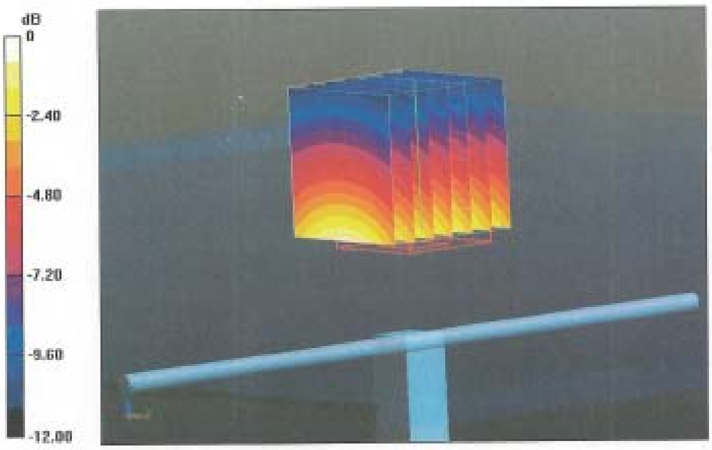
DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d138

Communication System: CW; Frequency: 900 MHz
Medium parameters used: f = 900 MHz; σ = 0.96 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

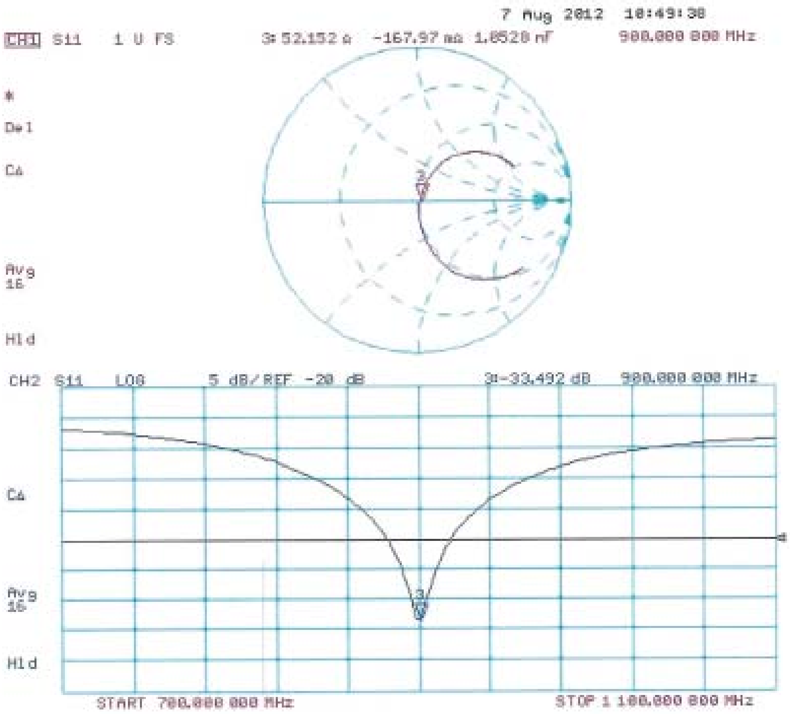
- Probe: ES3DV3 - SN3205; ConvF(5.97, 5.97, 5.97); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(961); SEMCAD X 14.6.6(6816)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 58.685 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.968 mW/g
SAR(1 g) = 2.65 mW/g; SAR(10 g) = 1.7 mW/g
Maximum value of SAR (measured) = 3.11 W/kg



0 dB = 3.11 W/kg = 9.86 dB W/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

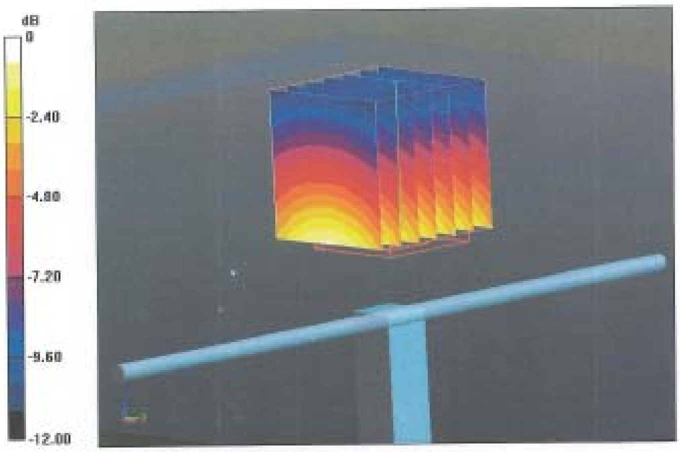
DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d138

Communication System: CW; Frequency: 900 MHz
Medium parameters used: f = 900 MHz; σ = 1.05 mho/m; ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

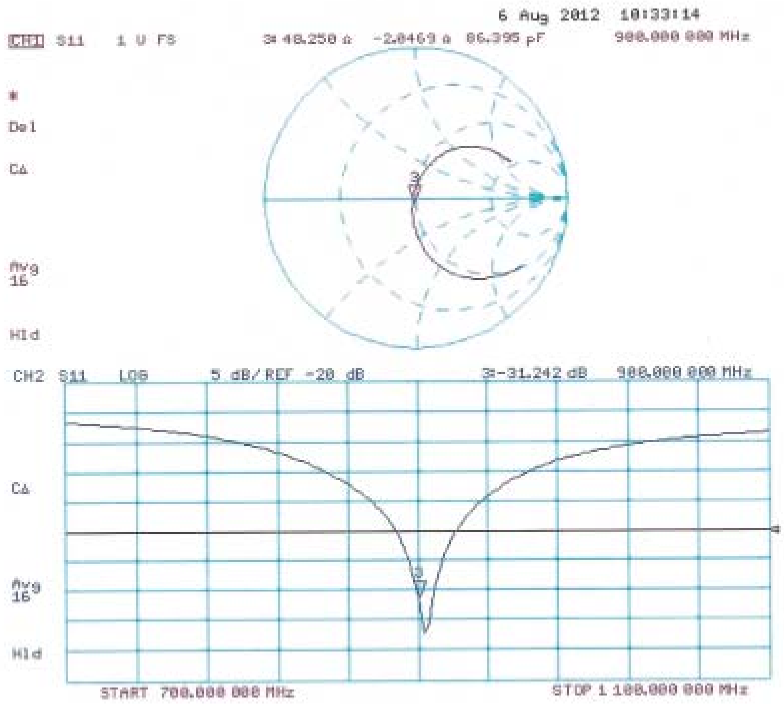
- Probe: ES3DV3 - SN3205; ConvF(5.94, 5.94, 5.94); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(961); SEMCAD X 14.6.6(6816)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.908 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 4.203 mW/g
SAR(1 g) = 2.75 mW/g; SAR(10 g) = 1.76 mW/g
Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 10.18 dB W/kg

Impedance Measurement Plot for Body TSL



- END OF REPORT -