SAR TEST REPORT

No. I14Z00915-SAR

For

Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd

Mobile Phone

Mode Name: vodafone 890N

With

Hardware Version: R38YL890N

Software Version: 4.4.150.00.T3.140821.KTU84P.VF.DE

FCC ID: R38YL890N

Issued Date: 2014-09-29

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of TMC Beijing.

Test Laboratory:

TMC Beijing, Telecommunication Metrology Center of MIIT

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Revision Version

Report Number	Revision	Date	Memo
I14Z00915-SEM01	00	2014-09-29	Initial creation of test report

TABLE OF CONTENT

1 Test Laboratory

1.1 Testing Location

Company Name:	TMC Shenzhen, Telecommunication Metrology Center of MIIT
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Postal Code:	518048
Telephone:	+86-755-33322000
Fax:	+86-755-33322001

1.2 Testing Environment

Temperature:	18°C~25 °C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω
Ambient noise & Reflection:	< 0.012 W/kg

1.3 Project Data

Project Leader:	Zhang Bojun
Test Engineer:	Cao Junfei
Testing Start Date:	September 2^{th}, 2014
Testing End Date:	September 29^{th}, 2014

1.4 Signature

Cao Junfei

(Prepared this test report)

Zhang Bojun

(Reviewed this test report)

Lu Minniu

Director of the laboratory

(Approved this test report)

2 Client Information

2.1 Applicant Information

Company Name:	Yulong Computer Telecommunication Scientific (Shenzhen) Co., Ltd
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2.2 Manufacturer Information

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Address /Post:	Coolpad Information Harbor, 2nd Mengxi Road, Hi-Tech Industrial Park(North), Nanshan district, Shenzhen, P.R.C
City:	Shenzhen
Postal Code:	518000
Country:	P.R.China
Contact:	Li Amei
Email:	liamei@yulong.com
Telephone:	+86 13410415799
Fax:	/

3 Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1 About EUT

Description:	Mobile phone
Mode Name:	Vodafone 890N
Marketing name:	Vodafone Smart 4 turbo
Operating mode(s):	GSM 850/900/1800/1900, WCDMA 900/2100, LTE Band 3/7/20, Wi-Fi, BT
Tested Tx Frequency:	1850.2 – 1910 MHz (GSM 1900)
	2502.5 – 2567.5 MHz (LTE Band 7)
	2412 – 2472 MHz (Wi-Fi 2.4G)
Test Channel: (Low-Middle-High)	512- 661- 810 (GSM1900)
	20850- 21100- 21350 (LTE Band 7)
	1-7-13 (WIFI 2450)
GPRS Multislot Class:	12
EGPRS Multislot Class:	12
GPRS capability Class:	B
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna
Accessories/Body-worn configurations:	Headset, Near Field Communication
Form factor:	134mm × 69mm

3.2 Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version
EUT1	IMEI: 353853061090994	T3	4.4.150.00.T3.140821.KTU84P.VF.DE

*EUT ID: is used to identify the test sample in the lab internally.

Note: It is performed to test SAR with the EUT1 and conducted power with the EUT1.

3.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	CPLD-315	/	ZHUHAI Coslight battery CO.,LTD.
AE2	Headset	JWEP0633-Y27	/	JWELL

*AE ID: is used to identify the test sample in the lab internally.

4 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for TCT Mobile Limited GSM Quad band &UMTS Dual band mobile phone 2052A are as follows:

Table 4.1: Highest Reported SAR (1g)

Exposure Configuration	Technology Band	Highest Reported SAR 1g (W/Kg)	Equipment Class
Head (Separation Distance 0mm)	PCS 1900	0.370	PCE
	LTE Band 7	0.369	
	WiFi 2.4GHz	0.222	
Body-worn (Separation Distance 10mm)	PCS 1900	0.873	PCE
	LTE Band 7	1.146	
	WiFi 2.4GHz	0.339	

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the ANSI C95.1-1999.

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and which provides a minimum separation distance of 10 mm between this device and the body of the user. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.
The highest reported SAR value is obtained at the case of **Table 4.1,** and the values are**: 1.146 W/kg (1g).**

Table 4.2: The sum of reported SAR values for main antenna and WiFi

	Position	Main antenna	WiFi	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.370	0.177	**0.547**
Highest reported SAR value for Body	Rear	1.146	0.339	**1.485**

Table 4.3: The sum of reported SAR values for main antenna, WiFi and Bluetooth

	Position	Main antenna	BT*	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.370	0.09	**0.460**
Highest reported SAR value for Body	Rear	1.146	0.05	**1.196**

BT* - Estimated SAR for Bluetooth (see the table 13.2)

Table 13.3: The sum of reported SAR values for main antenna and NFC

	Position	The Sum of Main antenna and NFC
Highest reported SAR value for Body	Rear	**1.366**

According to the above tables, the maximum sum of reported SAR values is **1.485 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

5 TEST METHODOLOGY

5.1 Applicable Limit Regulations

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2 Applicable Measurement Standards

IEEE 1528–2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

KDB447498 D01: General RF Exposure Guidance v05r02: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB648474 D04 Handset SAR v01r02: SAR Evaluation Considerations for Wireless Handsets.

KDB941225 D06: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

KDB248227 D01 Hotspot Mode SAR v02 r03: SAR Measurement Procedures for 802.11a/b/g transmitters.

KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03: SAR Measurement Requirements for 100 MHz to 6 GHz

KDB 865664 D02 RF Exposure Reporting v01r01: RF Exposure Compliance Reporting and Documentation Considerations

6 Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt}(\frac{dW}{dm}) = \frac{d}{dt}(\frac{dW}{\rho dv})$$

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c(\frac{\delta T}{\delta t})$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

7 Tissue Simulating Liquids

7.1 Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

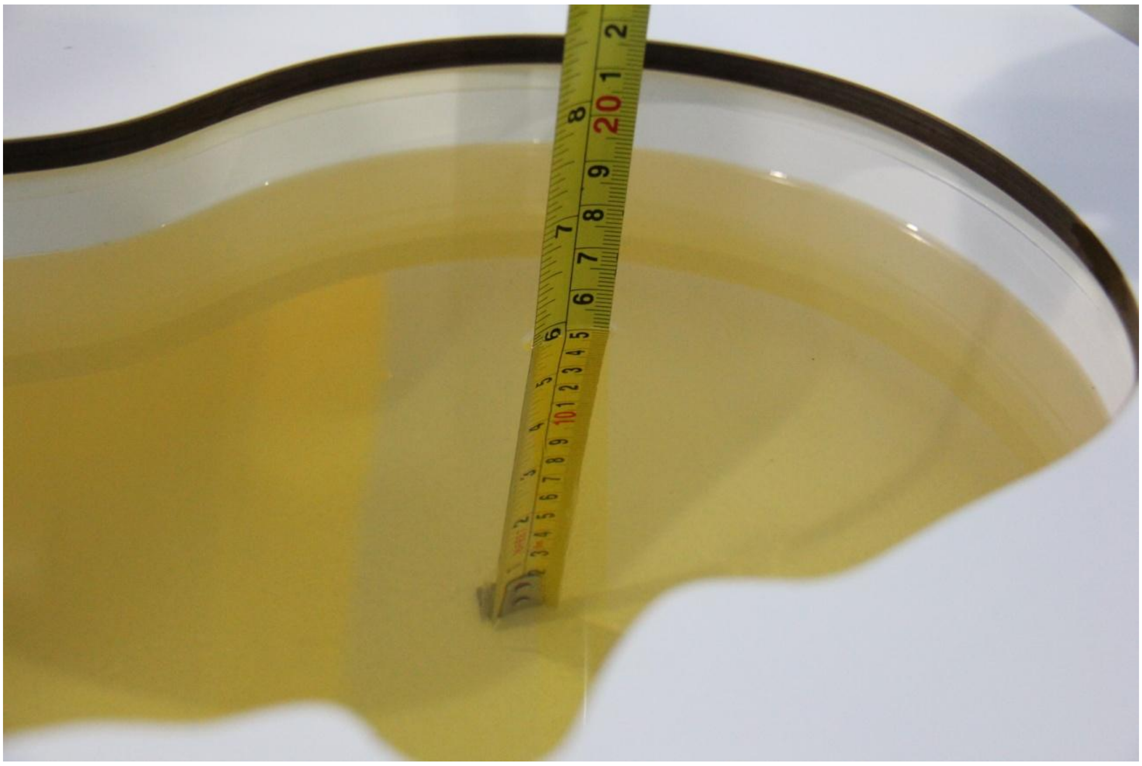
Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
835	Head	0.90	0.86～0.95	41.5	39.4～43.6
835	Body	0.97	0.92～1.02	55.2	52.4～58.0
1900	Head	1.40	1.33～1.47	40.0	38.0～42.0
1900	Body	1.52	1.44～1.60	53.3	50.6～56.0
2450	Head	1.80	1.71～1.89	39.2	37.3～41.1
2450	Body	1.95	1.85～2.05	52.7	50.1～55.3
2600	Head	1.96	1.86～2.06	39.0	37.1～41.0
2600	Body	2.16	2.05～2.27	52.5	49.8～55.1

7.2 Dielectric Performance

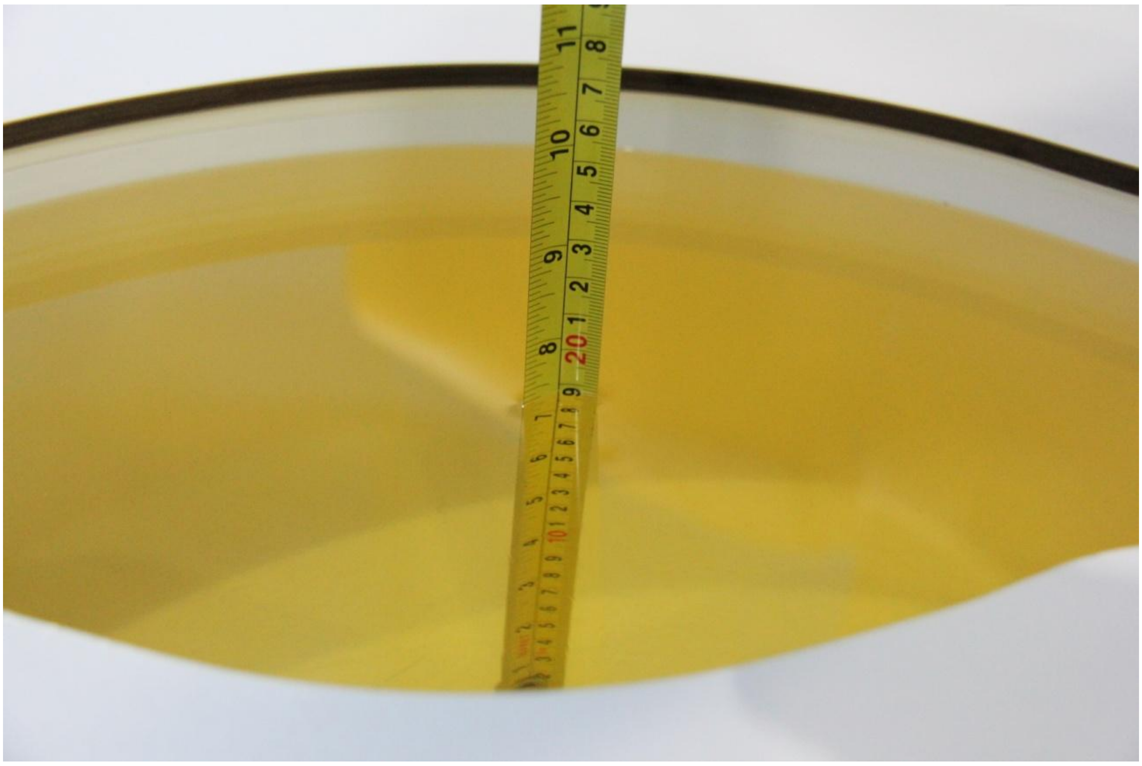
Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	**Type**	**Frequency**	**Permittivity ε**	**Drift (%)**	**Conductivity σ (S/m)**	**Drift (%)**
2014-09-06	Head	1900 MHz	39.16	-2.10	1.45	4.00
2014-09-02	Body	1900 MHz	52.61	-1.29	1.51	-0.53
2014-09-12	Head	2450 MHz	39.27	0.18	1.82	1.11
2014-09-14	Body	2450 MHz	51.10	-3.04	1.89	-3.08
2014-09-17	Head	2600 MHz	39.91	2.33	1.96	2.62
2014-09-17	Body	2600 MHz	50.67	-3.49	2.07	-4.17
2014-09-29	Body	2600 MHz	51.87	-1.20	2.09	-3.10

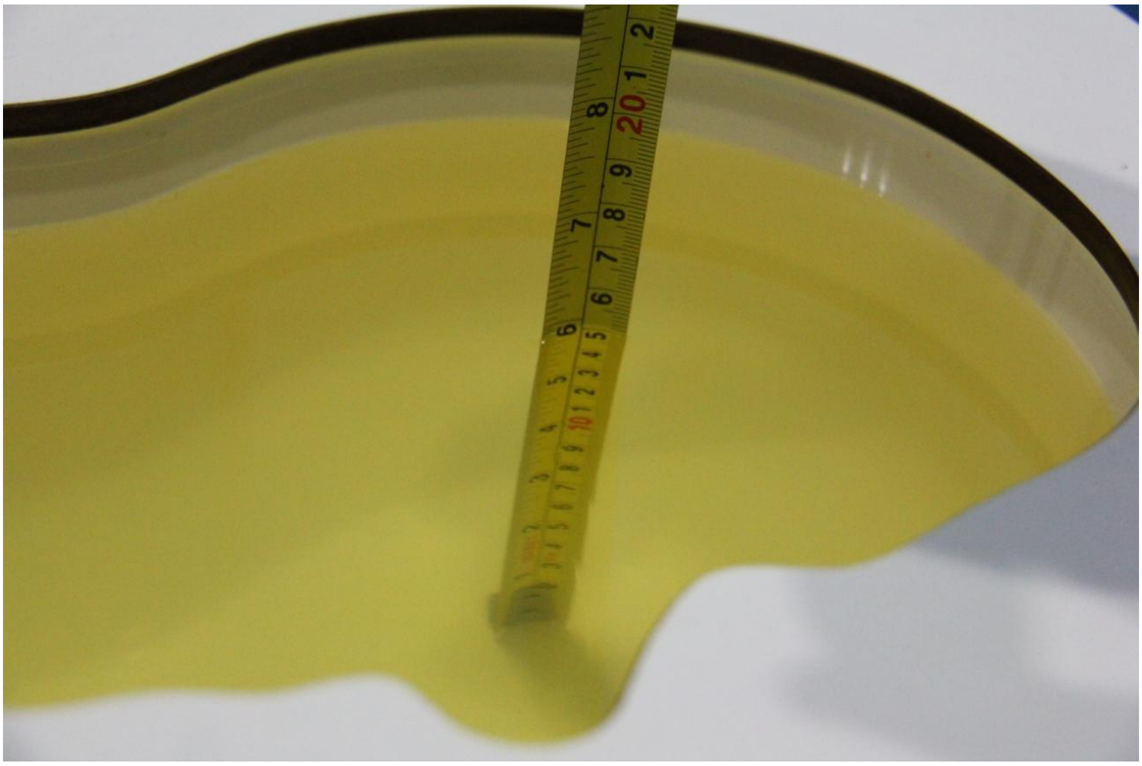
Note: The liquid temperature is 22.0°C



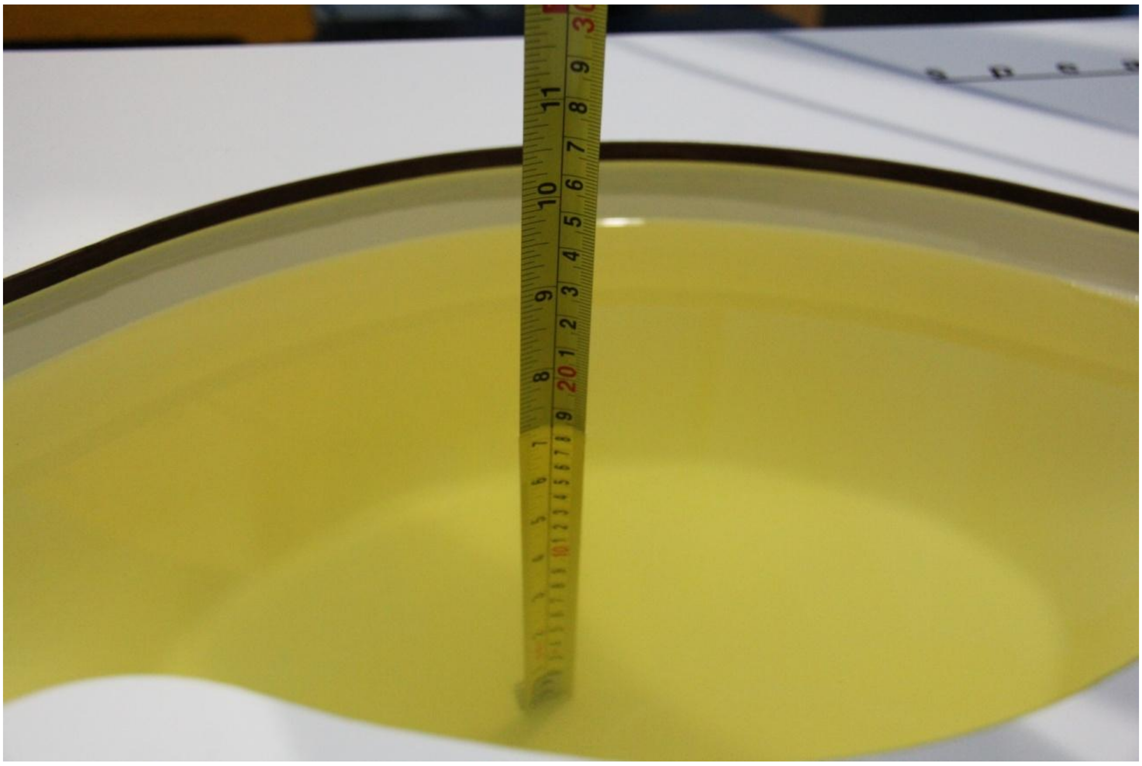
Picture 7-1: Liquid depth in the Head Phantom (1900 MHz)



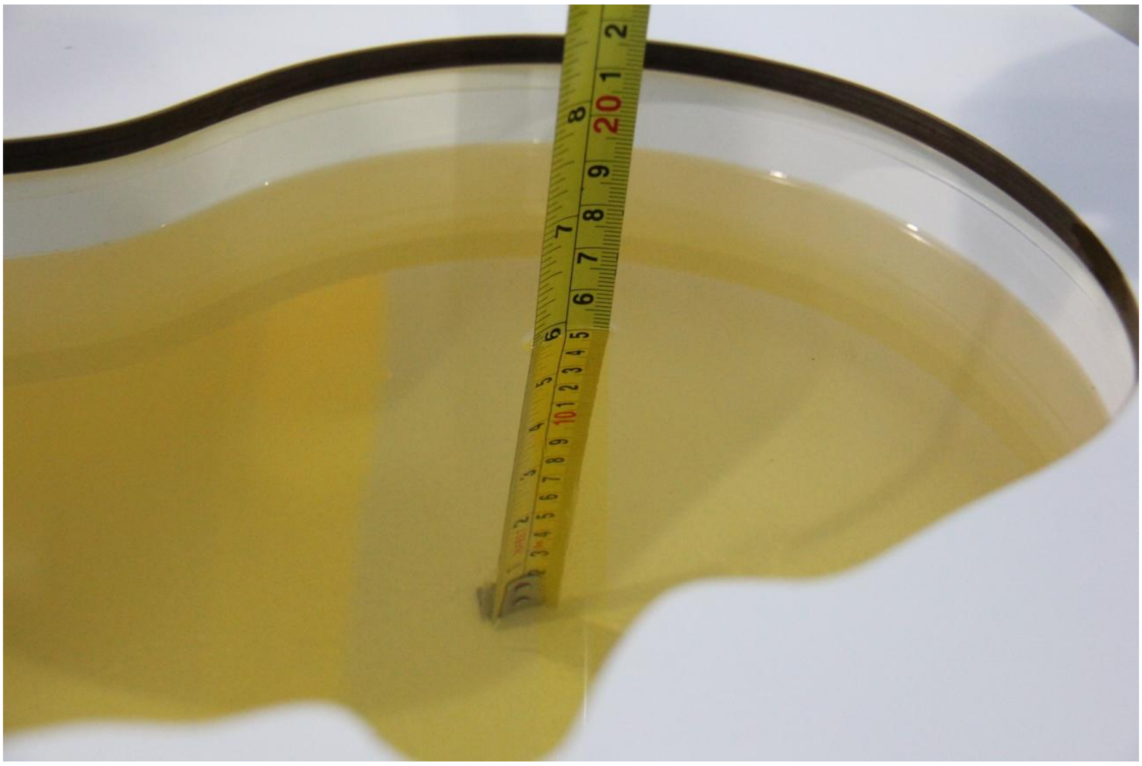
Picture 7-2: Liquid depth in the Flat Phantom (1900 MHz)



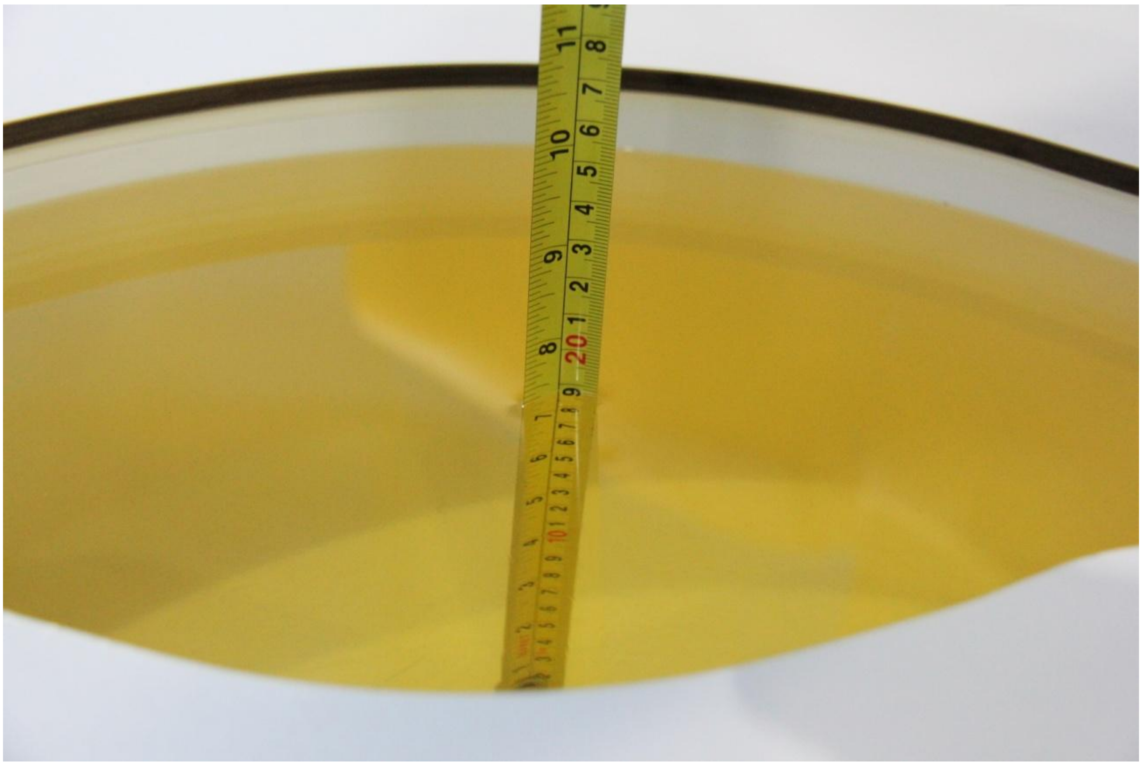
Picture 7-3: Liquid depth in the Head Phantom (2450 MHz)



Picture 7-4 Liquid depth in the Flat Phantom (2450MHz)



Picture 7-1: Liquid depth in the Head Phantom (2600 MHz)

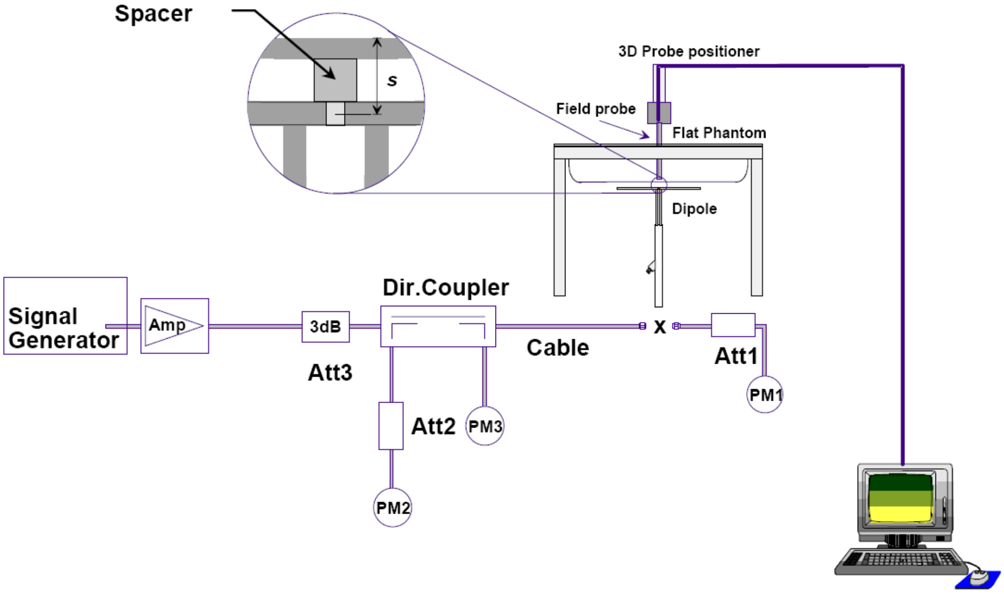


Picture 7-2: Liquid depth in the Flat Phantom (2600 MHz)

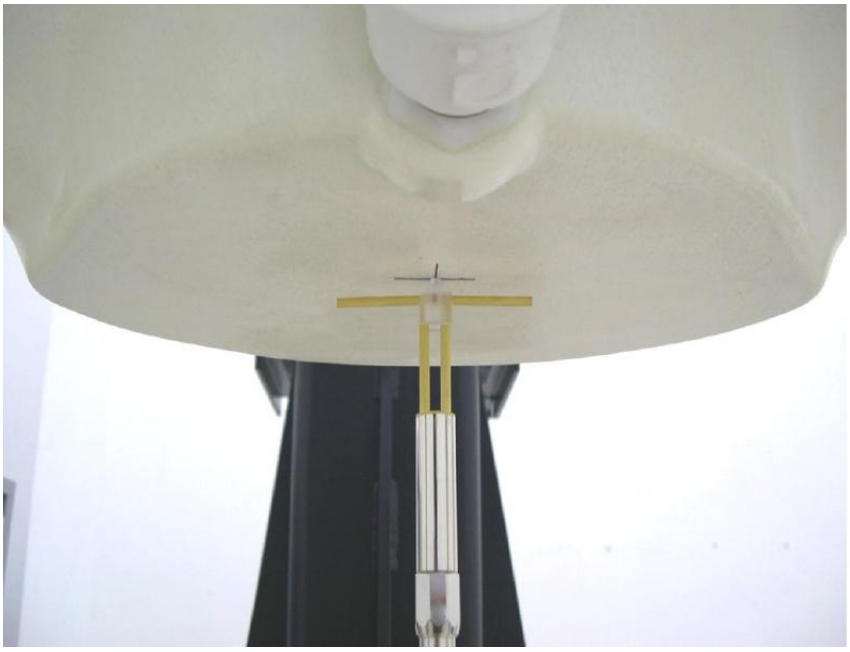
8 System verification

8.1 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



Picture 8.1 System Setup for System Evaluation



Picture 8.2 Photo of Dipole Setup

8.2 System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

The system verification results are required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR. The details are presented in annex B.

Table 8.1: System Verification of Head

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2014-09-06	1900 MHz	20.9	40.0	20.48	39.92	-2.01%	-0.20%
2014-09-12	2450 MHz	24.3	51.9	25.44	51.6	4.69%	-0.58%
2014-09-17	2550 MHz	26.0	57.2	26.32	58.8	1.23%	2.80%

Table 8.2: System Verification of Body

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2014-09-02	1900 MHz	21.4	40.3	21.92	41.2	2.43%	2.23%
2014-09-14	2450 MHz	23.7	50.8	24.8	51.7	4.64%	1.77%
2014-09-17	2550 MHz	24.4	54.1	24.7	53.36	1.23%	-1.37%
2014-09-29	2550 MHz	24.4	54.1	24.7	56.16	1.31%	3.81%

8.3 Justification for Extended SAR Dipole Calibrations

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< - 20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB 865664 D01:

Dipole D1900V2 SN: 5d088				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
10/17/2012	-29.3	/	53.2	/
10/16/2013	-28.2	3.7	51.5	1.7
Body Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
10/17/2012	-29.1	/	49.9	/
10/16/2013	-28.6	1.7	48.5	1.3
Dipole D2450V2 SN: 873				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
10/18/2012	-28.9	/	52.1	/
10/17/2013	-27.8	3.8	50.3	1.8
Body Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
10/18/2012	-32.8	/	49.5	/
10/17/2013	-32.1	2.1	48.1	1.4Ω

9 Measurement Procedures

9.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

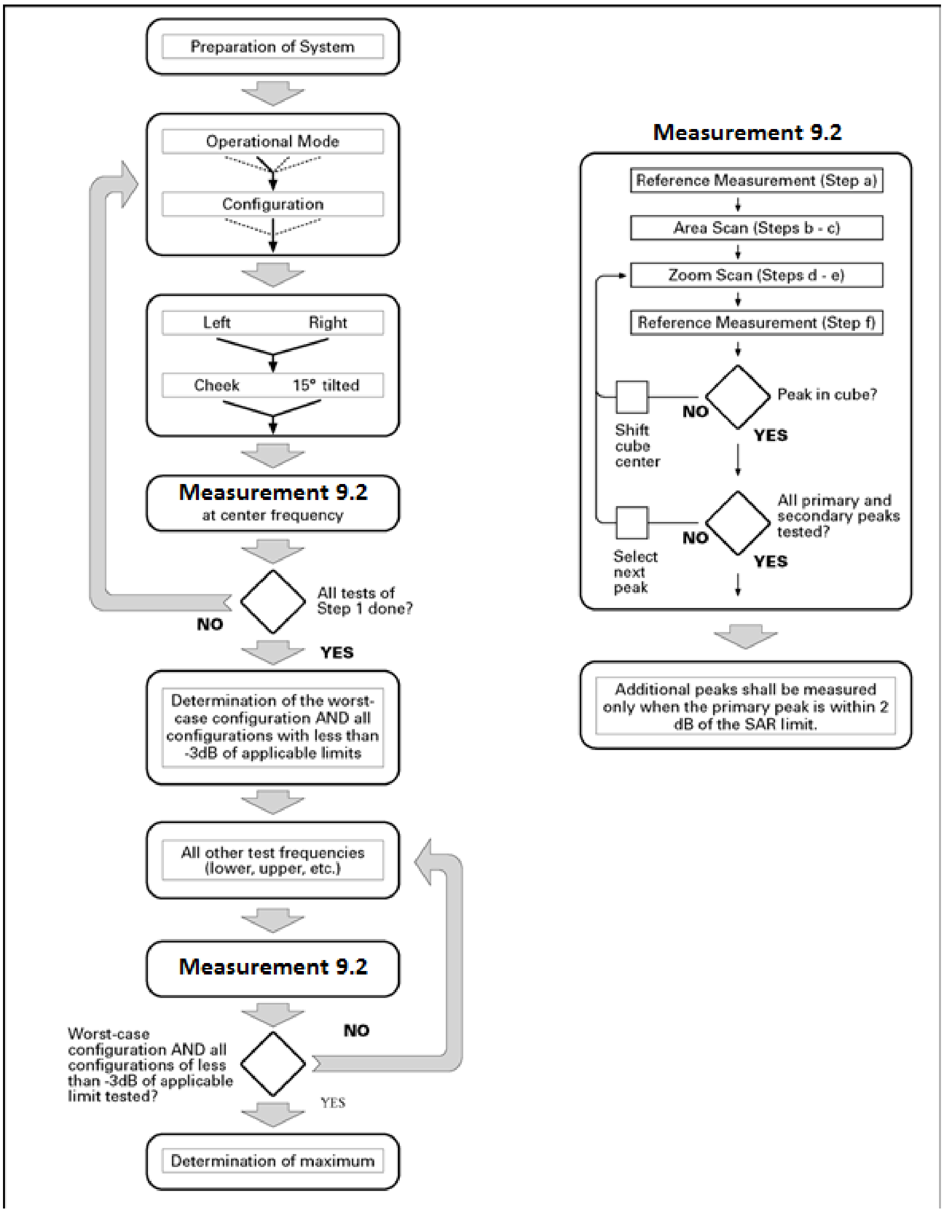
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., N_c > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.



Picture 9.1 Block diagram of the tests to be performed

9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">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 colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

9.3 WCDMA Measurement Procedures for SAR

The following procedures are applicable to WCDMA handsets operating under 3GPP Release99, Release 5 and Release 6. The default test configuration is to measure SAR with an established radio link between the DUT and a communication test set using a 12.2kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other physical channel configurations (DPCCH & $DPDCH_n$), HSDPA and HSPA (HSUPA/HSDPA) modes according to output power, exposure conditions and device operating capabilities. Both uplink and downlink should be configured with the same RMC or AMR, when required. SAR for Release 5 HSDPA and Release 6 HSPA are measured using the applicable FRC (fixed reference channel) and E-DCH reference channel configurations. Maximum output power is verified according to applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. When Maximum Power Reduction (MPR) is not implemented according to Cubic Metric (CM) requirements for Release 6 HSPA, the following procedures do not apply.

For Release 5 HSDPA Data Devices:

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}	CM/dB
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15	15/15	64	12/15	24/25	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

For Release 6 HSPA Data Devices

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs}	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM (dB)	MPR (dB)	AG Index	E-TFCI
1	11/15	15/15	64	11/15	22/15	209/225	1039/225	4	1	1.0	2.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	12/15	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	4/15	56/75	4	1	3.0	3.0	17	71
5	15/15	15/15	64	15/15	24/15	30/15	134/15	4	1	1.0	0.0	21	81

9.4 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

9.5 Near Field Communication

Near-Field Communication (NFC) is a set of standards for smartphones and other mobile devices to establish radiocommunication with each other by touching them together or bringing them into close proximity, usually no more than a few centimeters, which can be considered as collections of dipoles with a fixed phase relationship creates a stationary electromagnetic field pulsating at 13.56 MHz. Here we measure the NFC antenna by inducing its electric potential into the worst case of main antenna test position, and then evaluate the combined SAR test results.

9.6 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.2 to Table 14.17 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

10 Area Scan Based 1-g SAR

10.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

10.2 Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empirically determined by analyzing a large number of phones. The MOTOROLA FAST SAR was developed and validated by the MOTOROLA Research Group in Ft. Lauderdale.

In the initial study, an approximation algorithm based on Linear fit was developed. The accuracy of the algorithm has been demonstrated across a broad frequency range (136-2450 MHz) and for both 1- and 10-g averaged SAR using a sample of 264 SAR measurements from 55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm are 1.2% and 5.8% for 1- and 10-g averaged SAR, respectively. The paper describing the algorithm in detail is expected to be published in August 2004 within the Special Issue of Transactions on MTT.

In the second step, the same research group optimized the fitting algorithm to an Polynomial fit whereby the frequency validity was extended to cover the range 30-6000MHz. Details of this study can be found in the BEMS 2007 Proceedings.

Both algorithms are implemented in DASY software.

11 Conducted Output Power

11.1 Manufacturing tolerance

Note: Target Value is Average Output Power Value.

Table 11.1: GSM Speech

GSM 1900			
Channel	Channel 810	Channel 661	Channel 512
Target (dBm)	30	30	30
Tune-up (dBm)	31	31	31

Table 11.2: GPRS and EGPRS

GSM 1900 GPRS (GMSK)				
Channel		**810**	**661**	**512**
1 Txslot	Target (dBm)	30	30	30
	Tune-up (dBm)	31	31	31
2 Txslots	Target (dBm)	28	28	28
	Tune-up (dBm)	29	29	29
3Txslots	Target (dBm)	26	26	26
	Tune-up (dBm)	27	27	27
4 Txslots	Target (dBm)	24	24	24
	Tune-up (dBm)	25	25	25
GSM 1900 EGPRS (GMSK)				
Channel		**810**	**661**	**512**
1 Txslot	Target (dBm)	30	30	30
	Tune-up (dBm)	31	31	31
2 Txslots	Target (dBm)	28	28	28
	Tune-up (dBm)	29	29	29
3Txslots	Target (dBm)	26	26	26
	Tune-up (dBm)	27	27	27
4 Txslots	Target (dBm)	24	24	24
	Tune-up (dBm)	25	25	25

Table 11.3: LTE

LTE Band 7			
Channel	Channel 20800	Channel 21100	Channel 21400
Target (dBm)	22.5	22.5	22.5
Tune-up (dBm)	23.5	23.5	23.5

Table 11.5: WiFi

Channel		Channel 1	Channel 6	Channel 11
WiFi 802.11b	Target (dBm)	15	15	15
	Tune-up (dBm)	16	16	16
WiFi 802.11g	Target (dBm)	15	15	15
	Tune-up (dBm)	16	16	16
WiFi 802.11n	Target (dBm)	15	15	15
	Tune-up (dBm)	16	16	16

Table 11.4: Bluetooth

Bluetooth			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	-2.00	-2.00	-2.00
Tune-up (dBm)	-1.00	-1.00	-1.00

11.2 GSM Measurement result

During the process of testing, the EUT was controlled via Agilent Digital Radio Communication tester (E5515C) to ensure the maximum power transmission and proper modulation. This result contains conducted output power for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

Table 11.6: The conducted power measurement results for GSM1900

GSM 1900MHz	Conducted Power (dBm)		
	Channel 810(1909.8MHz)	Channel 661(1880MHz)	Channel 512(1850.2MHz)
	30.16	30.38	30.80

Table 11.7: The conducted power measurement results for GPRS and EGPRS（Hotspot on）

PCS1900 GPRS (GMSK)	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	810	**661**	**512**		**810**	**661**	**512**
1 Txslot	30.62	29.95	29.99	-9.03dB	21.59	20.92	20.96
2 Txslots	27.50	27.71	27.80	-6.02dB	21.48	21.69	21.78
3Txslots	26.31	26.65	26.67	-4.26dB	**22.05**	**22.39**	**22.41**
4 Txslots	23.91	23.99	24.10	-3.01dB	20.90	20.98	21.09
PCS1900 EGPRS (GMSK)	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	810	**661**	**512**		**810**	**661**	**512**
1 Txslot	28.95	28.68	28.51	-9.03dB	19.92	19.65	19.48
2 Txslots	27.21	27.24	27.40	-6.02dB	21.19	21.22	21.38
3Txslots	26.10	26.21	26.21	-4.26dB	**21.84**	**21.95**	**21.95**
4 Txslots	23.56	23.69	23.60	-3.01dB	20.55	20.68	20.59

Table 11.7: The conducted power measurement results for GPRS and EGPRS（Hotspot off）

PCS1900 GPRS (GMSK)	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	810	**661**	**512**		**810**	**661**	**512**
1 Txslot	30.62	29.95	29.99	-9.03dB	21.59	20.92	20.96
2 Txslots	27.50	27.71	27.80	-6.02dB	21.48	21.69	21.78
3Txslots	26.31	26.65	26.67	-4.26dB	**22.05**	**22.39**	**22.41**
4 Txslots	23.91	23.99	24.10	-3.01dB	20.90	20.98	21.09
PCS1900 EGPRS (GMSK)	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	810	**661**	**512**		**810**	**661**	**512**
1 Txslot	28.95	28.68	28.51	-9.03dB	19.92	19.65	19.48
2 Txslots	27.21	27.24	27.40	-6.02dB	21.19	21.22	21.38
3Txslots	26.10	26.21	26.21	-4.26dB	**21.84**	**21.95**	**21.95**
4 Txslots	23.56	23.69	23.60	-3.01dB	20.55	20.68	20.59

NOTES:

1) Division Factors

To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

According to the conducted power as above, the body measurements are performed with 3Txslots for PCS1900.

Note: According to the KDB941225 D03, “when SAR tests for EDGE or EGPRS mode is necessary, GMSK modulation should be used”.

11.3 LET-TDD Measurement result

Table 11.3: The conducted Power for LTE-FDD （Hotspot off）

LET-FDD Band 7				Actual output Power (dBm)		
Band-width	**RBallocation**	**RBoffset**	**Modulation**	**High**	**Middle**	**Low**
5 MHz				**852 MHz**	**847MHz**	**842MHz**
	1RB	High	QPSK	22.90	22.97	22.89
			16QAM	22.03	22.04	22.02
		Middle	QPSK	23.01	22.99	23.01
			16QAM	21.97	21.99	21.98
		Low	QPSK	23.11	23.09	23.08
			16QAM	22.09	22.17	22.13
	12RB	High	QPSK	22.03	22.09	22.07
			16QAM	21.02	21.03	21.04
		Middle	QPSK	22.08	22.11	22.09
			16QAM	21.08	21.11	21.11
		Low	QPSK	22.19	22.26	22.23
			16QAM	21.17	21.19	21.16
	25RB		QPSK	22.01	22.05	22.03
			16QAM	21.02	21.05	21.02
10 MHz				**857MHz**	**847MHz**	**837MHz**
	1RB	High	QPSK	22.82	22.86	22.78
			16QAM	22.02	22.04	22.05
		Middle	QPSK	22.95	22.98	22.96
			16QAM	21.98	21.99	21.98
		Low	QPSK	23.08	23.07	23.02
			16QAM	22.13	22.21	22.12
	25RB	High	QPSK	22.13	22.11	22.08
			16QAM	21.05	21.09	21.06
		Middle	QPSK	22.06	22.16	22.12
			16QAM	21.03	21.12	21.13

		Low	QPSK	22.25	22.33	22.26
			16QAM	21.16	21.15	21.16
	50RB		QPSK	22.05	22.08	22.06
			16QAM	21.01	21.06	21.03
15 MHz				854.5MHz	847MHz	839.5MHz
	1RB	High	QPSK	22.83	22.89	22.84
			16QAM	22.07	22.02	22.01
		Middle	QPSK	22.97	22.91	22.93
			16QAM	21.95	21.99	21.98
		Low	QPSK	23.13	23.12	23.08
			16QAM	22.23	22.23	22.16
	36RB	High	QPSK	22.11	22.21	22.15
			16QAM	21.06	21.13	21.14
		Middle	QPSK	22.15	22.14	22.08
			16QAM	21.08	21.13	21.12
		Low	QPSK	22.23	22.22	22.17
			16QAM	21.14	21.15	21.17
	75RB		QPSK	22.11	22.14	22.09
			16QAM	21.03	21.10	21.09
20 MHz				852MHz	847MHz	842MHz
	1RB	High	QPSK	22.88	22.95	22.87
			16QAM	22.01	22.05	22.02
		Middle	QPSK	22.99	22.98	22.97
			16QAM	22.12	22.14	22.13
		Low	QPSK	23.07	23.05	23.08
			16QAM	22.14	22.16	22.15
	50RB	High	QPSK	22.11	22.14	22.13
			16QAM	21.01	21.05	21.06
		Middle	QPSK	22.06	22.09	22.08
			16QAM	21.04	21.08	21.03
		Low	QPSK	22.24	22.26	22.22
			16QAM	21.23	21.20	21.21
	100RB		QPSK	22.03	22.10	22.06
			16QAM	21.08	21.09	21.07

Table 11.3: The conducted Power for LTE-FDD （Hotspot on）

LET-FDD Band 7				Actual output Power (dBm)		
Band-width	RBallocation	RBoffset	Modulation	High	Middle	Low
5 MHz				852 MHz	847MHz	842MHz
	1RB	High	QPSK	22.88	22.95	22.87
			16QAM	22.01	22.02	22.00
		Middle	QPSK	22.99	22.97	22.99
			16QAM	21.95	21.97	21.96

		Low	**QPSK**	23.09	23.07	23.06
			16QAM	22.07	22.15	22.11
	12RB	High	**QPSK**	22.01	22.07	22.05
			16QAM	21.00	21.01	21.02
		Middle	**QPSK**	22.06	22.09	22.07
			16QAM	21.06	21.09	21.09
		Low	**QPSK**	22.17	22.24	22.21
			16QAM	21.15	21.17	21.14
	25RB		**QPSK**	21.99	22.03	22.01
			16QAM	21.00	21.03	21.00
10 MHz				**857MHz**	**847MHz**	**837MHz**
	1RB	High	**QPSK**	22.80	22.84	22.76
			16QAM	22.00	22.02	22.03
		Middle	**QPSK**	22.93	22.96	22.94
			16QAM	21.96	21.97	21.96
		Low	**QPSK**	23.06	23.05	23.00
			16QAM	22.11	22.19	22.10
	25RB	High	**QPSK**	22.11	22.09	22.06
			16QAM	21.03	21.07	21.04
		Middle	**QPSK**	22.04	22.14	22.10
			16QAM	21.01	21.10	21.11
		Low	**QPSK**	22.23	22.31	22.24
			16QAM	21.14	21.13	21.14
	50RB		**QPSK**	22.03	22.06	22.04
			16QAM	20.99	21.04	21.01
15 MHz				**854.5MHz**	**847MHz**	**839.5MHz**
	1RB	High	**QPSK**	22.81	22.87	22.82
			16QAM	22.05	22.00	21.99
		Middle	**QPSK**	22.95	22.89	22.91
			16QAM	21.93	21.97	21.96
		Low	**QPSK**	23.11	23.10	23.06
			16QAM	22.21	22.21	22.14
	36RB	High	**QPSK**	22.09	22.19	22.13
			16QAM	21.04	21.11	21.12
		Middle	**QPSK**	22.13	22.12	22.06
			16QAM	21.06	21.11	21.10
		Low	**QPSK**	22.21	22.20	22.15
			16QAM	21.12	21.13	21.15
	75RB		**QPSK**	22.09	22.12	22.07
			16QAM	21.01	21.08	21.07
20 MHz				**852MHz**	**847MHz**	**842MHz**
	1RB	High	**QPSK**	22.86	22.93	22.85
			16QAM	21.99	22.03	22.00

		Middle	**QPSK**	22.97	22.96	22.95
			16QAM	22.10	22.12	22.11
		Low	**QPSK**	23.05	23.03	23.06
			16QAM	22.12	22.14	22.13
	50RB	**High**	**QPSK**	22.09	22.12	22.11
			16QAM	20.99	21.03	21.04
		Middle	**QPSK**	22.04	22.07	22.06
			16QAM	21.02	21.06	21.01
		Low	**QPSK**	22.22	22.24	22.20
			16QAM	21.21	21.18	21.19
	100RB		**QPSK**	22.01	22.08	22.04
			16QAM	21.06	21.07	21.05

11.4 Wi-Fi and BT Measurement result

The output power of BT antenna is as following:

Table 12.5: The conducted Power for BT(BLE)

	Measured Power (dBm)		
modle\Channel	**Ch 0 (2402 MHz)**	**Ch 39 (2441 Mhz)**	**Ch 78 (2480 MHz)**
GFSK	1.54	1.52	1.64
π /4 DQPSK	1.21	1.22	1.20
8DPSK	1.18	1.78	1.30
BLE	1.65	2.01	1.73

The conducted power for WiFi is as following:

Table 12.6: The conducted Power for WIFI

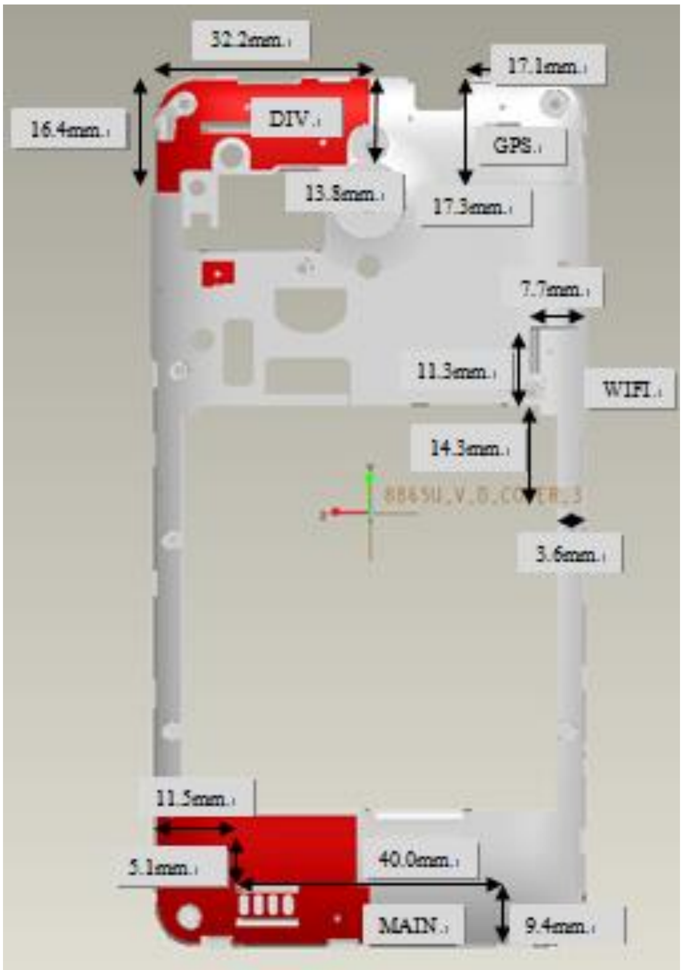
	Measured Power (dBm)		
modle\Channel	**Ch 1 (2412 MHz)**	**Ch 7 (2442Mhz)**	**Ch 13 (2472MHz)**
802.11b	15.55	15.24	15.63
802.11g	13.02	13.81	14.54
802.11n	13.53	13.32	13.91

12 Simultaneous TX SAR Considerations

12.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

12.2 Transmit Antenna Separation Distances



Picture 12.1 Antenna Locations

12.3 SAR Measurement Positions

According to the KDB941225 D06 Hot Spot SAR v01, the edges with less than 2.5 cm distance to the antennas need to be tested for SAR.

Table 11.1: SAR measurement positions

Mode	Front	Rear	Left edge	Right edge	Top edge	Bottom edge
Main antenna	Yes	Yes	Yes	Yes	No	Yes
WiFi antenna	Yes	Yes	Yes	Yes	Yes	No

12.4 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied. The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	SAR Test Exclusion Threshold (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

Picture 12.2 Power Thresholds

According to the KDB447498 appendix A, the SAR test exclusion threshold for 2450MHz at 10m test separation distances is 19mW.

Table 12.1: Standalone SAR test exclusion considerations

Band/Mode	F(GHz)	Position	SAR test exclusion threshold (mW)	RF output power		SAR test exclusion
				dBm	mW	
Bluetooth	2.441	Head	9.60	1.73	1.49	Yes
		Body	19.20	1.73	1.49	Yes

13 Evaluation of Simultaneous

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f_{(GHz)}}/x$] W/kg for *test separation distances* ≤ 50 mm;

Where x = 7.5 for 1-g SAR, AND X = 18.75 for 10-g SAR.

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Table 13.1: Estimated SAR for Bluetooth

Position	F (GHz)	Distance (mm)	Upper limit of power *		Estimated$_{1g}$ (W/kg)
			dBm	mW	
Head	2.441	5	-1.00	0.79	0.09
Body	2.441	10	-1.00	0.79	0.05

* - Maximum possible output power declared by manufacturer

Table 13.2: The sum of reported SAR values for main antenna and WiFi

	Position	Main antenna	WiFi	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.370	0.177	**0.547**
Highest reported SAR value for Body	Rear	1.146	0.339	**1.485**

Table 13.3: The sum of reported SAR values for main antenna and Bluetooth

	Position	Main antenna	BT*	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.370	0.09	**0.460**
Highest reported SAR value for Body	Rear	1.146	0.05	**1.196**

BT* - Estimated SAR for Bluetooth (see the table 13.1)

Table 13.3: The sum of reported SAR values for main antenna and NFC

	Position	The Sum of Main antenna and NFC
Highest reported SAR value for Body	Rear	**1.366**

Conclusion:

According to the above tables, the sum of reported SAR values is < 1.6W/kg. So the simultaneous transmission SAR with volume scans is not required.

14 SAR Test Result

It is determined by user manual for the distance between the EUT and the phantom bottom.
The distance is 10mm and just applied to the condition of body worn accessory.

It is performed for all SAR measurements with area scan based 1-g SAR estimation (Fast SAR). A zoom scan measurement is added when the estimated 1-g SAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or > 1.2W/kg.
The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{\text{Target}} - P_{\text{Measured}})/10}$$

Where P_{Target} is the power of manufacturing upper limit;
$P_{Measured}$ is the measured power in chapter 11.

Table 14.1: Duty Cycle

Mode	Duty Cycle
Speech for 1900	1:8.3
GPRS&EGPRS for GSM1900	1:2.67
LTE Band 7	1:1

14.1 SAR results for Fast SAR

Table 14.2: SAR Values (GSM 1900 MHz Band - Head)

Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1880	661	Left	Touch	/	30.38	31	0.126	**0.145**	0.203	**0.234**	0.12
1880	661	Left	Tilt	/	30.38	31	0.028	**0.032**	0.042	**0.048**	0.19
1880	661	Right	Touch	/	30.38	31	0.085	**0.098**	0.139	**0.160**	0.16
1880	661	Right	Tilt	/	30.38	31	0.120	**0.138**	0.193	**0.223**	0.17
1909.8	810	Right	Touch	Fig.1	30.16	31	0.189	**0.229**	0.305	**0.370**	0.15
1850.2	512	Right	Touch	/	30.80	31	0.044	**0.046**	0.067	**0.070**	-0.06

Table 14.3: SAR Values (GSM 1900 MHz Band - Body)

Frequency		Mode (number of timeslots)	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1880	661	GPRS (3)	Front	/	26.65	27	0.199	**0.216**	0.360	**0.390**	-0.01
1880	661	GPRS (3)	Rear	/	26.65	27	0.282	**0.306**	0.520	**0.564**	0.15

Table 14.4: SAR Values (GSM 1900 MHz Band – Body with Hotspot on)

Frequency		Mode (number of timeslots)	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1880	661	GPRS (3)	Front	/	26.65	27	0.199	**0.216**	0.360	**0.390**	-0.01
1880	661	GPRS (3)	Rear	/	26.65	27	0.282	**0.306**	0.520	**0.564**	0.15
1880	661	GPRS (3)	Left	/	26.65	27	0.029	**0.031**	0.051	**0.055**	-0.05
1880	661	GPRS (3)	Right	/	26.65	27	0.029	**0.031**	0.047	**0.051**	-0.12
1880	661	GPRS (3)	Bottom	/	26.65	27	0.394	**0.427**	0.731	**0.792**	-0.05
1909.8	810	GPRS (3)	Bottom	Fig.2	26.31	27	0.355	**0.416**	0.745	**0.873**	0.14
1850.2	512	GPRS (3)	Bottom	/	26.67	27	0.422	**0.455**	0.801	**0.864**	0.15
1850.2	512	Speech	Bottom Headset	/	26.21	27	0.070	**0.084**	0.130	**0.156**	-0.10

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.5: SAR Values (LTE Band 7-Head)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz_1RB_Low	Left Touch	23.08	23.5	Fig.3	0.179	**0.197**	0.335	**0.369**	0.15
2510	20850	QPSK_20MHz_50RB_Low	Left Tilt	23.08	23.5	/	0.128	**0.141**	0.242	**0.267**	0.18
2510	20850	QPSK_20MHz_1RB_Low	Left Touch	23.08	23.5	/	0.048	**0.053**	0.098	**0.108**	0.12
2510	20850	QPSK_20MHz_50RB_Low	Left Tilt	23.08	23.5	/	0.035	**0.039**	0.072	**0.079**	0.17
2510	20850	QPSK_20MHz_1RB_Low	Right Touch	23.08	23.5	/	0.111	**0.122**	0.197	**0.217**	0.19
2510	20850	QPSK_20MHz_50RB_Low	Right Tilt	23.08	23.5	/	0.088	**0.097**	0.153	**0.169**	0.11
2510	20850	QPSK_20MHz_1RB_Low	Right Touch	23.08	23.5	/	0.067	**0.074**	0.141	**0.155**	0.19
2510	20850	QPSK_20MHz_50RB_Low	Right Tilt	23.08	23.5	/	0.049	**0.054**	0.104	**0.115**	0.09

Table 14.6: SAR Values (LTE Band 7-Body)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz_1RB_Low	Front	23.08	23.5	/	0.261	**0.288**	0.511	**0.563**	-0.16
2510	20850	QPSK_20MHz_50RB_Low	Front	23.08	23.5	/	0.200	**0.220**	0.381	**0.420**	0.17
2510	20850	QPSK_20MHz_1RB_Low	Rear	23.08	23.5	/	0.488	**0.538**	1.040	**1.146**	0.09
2510	20850	QPSK_20MHz_50RB_Low	Rear	23.08	23.5	/	0.353	**0.389**	0.698	**0.769**	0.08

Table 14.7: SAR Values (LTE Band 7-Body with Hotspot on)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz_1RB_Low	Front	23.08	23.5	/	0.261	**0.288**	0.511	**0.563**	-0.16
2510	20850	QPSK_20MHz_50RB_Low	Front	23.08	23.5	/	0.200	**0.220**	0.381	**0.420**	0.17
2510	20850	QPSK_20MHz_1RB_Low	Rear	23.08	23.5	Fig.4	0.488	**0.538**	1.040	**1.146**	0.09
2510	20850	QPSK_20MHz_50RB_Low	Rear	23.08	23.5	/	0.353	**0.389**	0.698	**0.769**	0.08
2510	20850	QPSK_20MHz_1RB_Low	Left	23.08	23.5	/	0.039	**0.043**	0.074	**0.082**	-.012
2510	20850	QPSK_20MHz_50RB_Low	Left	23.08	23.5	/	0.031	**0.034**	0.068	**0.075**	0.10

2510	20850	QPSK_20MHz _1RB_Low	Right	23.08	23.5	/	0.099	**0.109**	0.191	**0.210**	0.04
2510	20850	QPSK_20MHz _50RB_Low	Right	23.08	23.5	/	0.129	**0.142**	0.250	**0.275**	-0.03
2510	20850	QPSK_20MHz _50RB_Low	Bottom	23.08	23.5	/	0.492	**0.542**	1.010	**1.113**	0.03
2510	20850	QPSK_20MHz _50RB_Low	Bottom	23.08	23.5	/	0.366	**0.403**	0.755	**0.832**	0.07

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1: SAR Values (WiFi 802.11b - Head)

Frequency		Mode/Band	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2442	7	802.11 b	Left Touch	15.24	16	/	0.031	**0.037**	0.082	**0.098**	-0.13
2442	7	802.11 b	Left Tilt	15.24	16	/	0.033	**0.039**	0.065	**0.077**	0.13
2442	7	802.11 b	Right Touch	15.24	16	/	0.068	**0.081**	0.149	**0.177**	0.19
2442	7	802.11 b	Right Tilt	15.24	16	Fig.5	0.087	**0.104**	0.186	**0.222**	0.13
2472	13	802.11 b	Left Touch	15.63	16	/	0.080	**0.087**	0.170	**0.185**	0.18
2412	1	802.11 b	Left Touch	15.55	16	/	0.023	**0.026**	0.040	**0.044**	0.14

Table 14.2: SAR Values (WiFi 802.11b - Body)

Frequency		Mode/Band	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2442	7	802.11 b	Front	15.24	16	/	0.025	**0.030**	0.048	**0.057**	0.16
2442	7	802.11 b	Rear	15.24	16	/	0.096	**0.114**	0.206	**0.245**	0.16

Table 14.3: SAR Values (WiFi 802.11b – Body with Hotspot on)

Frequency		Mode/Band	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2442	7	802.11 b	Front	15.24	16	/	0.025	**0.030**	0.048	**0.057**	0.16
2442	7	802.11 b	Rear	15.24	16	/	0.096	**0.114**	0.206	**0.245**	0.16
2442	7	802.11 b	Left	15.24	16	/	0.036	**0.043**	0.072	**0.086**	0.17
2442	7	802.11 b	Right	15.24	16	/	0.007	**0.008**	0.012	**0.014**	-0.39
2442	7	802.11 b	Top	15.24	16	/	0.005	**0.006**	0.008	**0.010**	0.07
2472	13	802.11 b	Rear	15.63	16	/	0.083	**0.090**	0.175	**0.191**	0.08
2442	1	802.11 b	Rear	15.55	16	Fig.6	0.146	**0.162**	0.306	**0.339**	0.16

Note: The distance between the EUT and the phantom bottom is 10mm.

14.2 SAR results for Standard procedure

There is zoom scan measurement to be added for the highest measured SAR in each exposure configuration/band.

Table 14.4: SAR Values (GSM 1900 MHz Band - Head)

Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1909.8	810	Right	Touch	Fig.1	30.16	31	0.189	**0.229**	0.305	**0.370**	0.15

Table 14.5: SAR Values (GSM 1900 MHz Band - Body with Hotspot on)

Frequency		Mode (number of timeslots)	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1909.8	810	GPRS (3)	Bottom	Fig.2	26.31	27	0.355	**0.416**	0.745	**0.873**	0.14

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.6: SAR Values (LTE Band 7-Head)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz_1RB_Low	Left Touch	23.08	23.5	Fig.3	0.179	**0.197**	0.335	**0.369**	0.15

Table 14.7: SAR Values (LTE Band 7-Body with Hotspot on)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz_50RB_Low	Front	23.08	23.5	Fig.4	0.200	**0.220**	1.040	**1.146**	0.09

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.8: SAR Values (WiFi 802.11b - Head)

Frequency		Mode/Band	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2442	7	802.11 b	Right Tilt	15.24	16	Fig.5	0.087	**0.104**	0.186	**0.222**	0.13

Table 14.9: SAR Values (WiFi 802.11b - Body)

Frequency		Mode/Band	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2442	1	802.11 b	Rear	15.55	16	Fig.6	0.146	**0.162**	0.306	**0.339**	0.16

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 14.10: SAR Values (LTE Band 7-Body with NFC on)

Frequency		Configuration	Test Position	Conducted Power (dBm)	Max. tune-up Power (dBm)	Figure No.	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2510	20850	QPSK_20MHz _1RB_Low	Front	23.08	23.5	/	0.308	**0.339**	0.641	**0.706**	0.16
2510	20850	QPSK_20MHz _1RB_Low	Rear	23.08	23.5	Fig.4	0.624	**0.687**	1.240	**1.366**	0.09
2510	20850	QPSK_20MHz _1RB_Low	Left	23.08	23.5	/	0.014	**0.015**	0.025	**0.028**	0.16
2510	20850	QPSK_20MHz _1RB_Low	Right	23.08	23.5	/	0.129	**0.142**	0.232	**0.256**	0.11

Note: The distance between the EUT and the phantom bottom is 10mm.

15 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Table 15.1: SAR Measurement Variability for Body GSM 1900 with Hotspot on (1g)

Frequency		Side	Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
1909.8	810	Right	Touch	0.873	0.852	1.02	/

Table 15.2: SAR Measurement Variability for Body LTE Band 7 with Hotspot on (1g)

Frequency		Side	Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
2510	20850	Left	Touch	1.146	1.105	1.01	/

Note: The distance between the EUT and the phantom bottom is 10mm.

Table 15.2: SAR Measurement Variability for Body LTE Band 7 with NFC on (1g)

Frequency		Side	Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
2510	20850	Left	Touch	1.366	1.157	1.18	/

Note: The distance between the EUT and the phantom bottom is 10mm.

16 Measurement Uncertainty

16.1 Measurement Uncertainty for Normal SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.25	9.12	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.5	18.2	

16.3 Measurement Uncertainty for Fast SAR Tests (300MHz~3GHz)

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	7.0	R	$\sqrt{3}$	1	1	4.0	4.0	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.1	9.95	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.2	19.9	

17 MAIN TEST INSTRUMENTS

Table 17.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071C	MY46103759	December 27,2013	One year
02	Power meter	NRVD	101253	March 6, 2014	One year
03	Power sensor	NRV-Z5	100333		
04	Signal Generator	E4438C	MY45095825	January 14, 2014	One year
05	Amplifier	VTL5400	0404	No Calibration Requested	
06	BTS	E5515C	GB47460133	September 4, 2014	One year
07	E-field Probe	SPEAG EX3DV4	3633	October 31, 2013	One year
08	DAE	SPEAG DAE4	786	November 25, 2013	One year
09	Dipole Validation Kit	SPEAG D1900V2	5d088	October 17,2 012	Two year
10	Dipole Validation Kit	SPEAG D2450V2	873	October 18, 2012	Two year
11	Dipole Validation Kit	SPEAG D2550V2	1010	June 7, 2013	Two year
12	E-field Probe	SPEAG ES3DV3	3151	September 1, 2014	One year

END OF REPORT BODY

ANNEX A Graph Results

GSM1900 Right Cheek High

Date/Time: 2014-9-5
Electronics: DAE4 Sn786
Medium: Head 1900
Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.381 S/m; ε_r = 41.643; ρ = 1000 kg/m^3
Ambient Temperature:23.7^{o}C   Liquid Temperature:23.2^{o}C
Communication System: GSM Frequency: 1850.2 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 - SN3633 ConvF(8.23, 8.23, 8.23);

Right Cheek High /Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.334 W/kg

Right Cheek High /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.556 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.454 W/kg
SAR(1 g) = 0.305 W/kg; SAR(10 g) = 0.189 W/kg
Maximum value of SAR (measured) = 0.334 W/kg

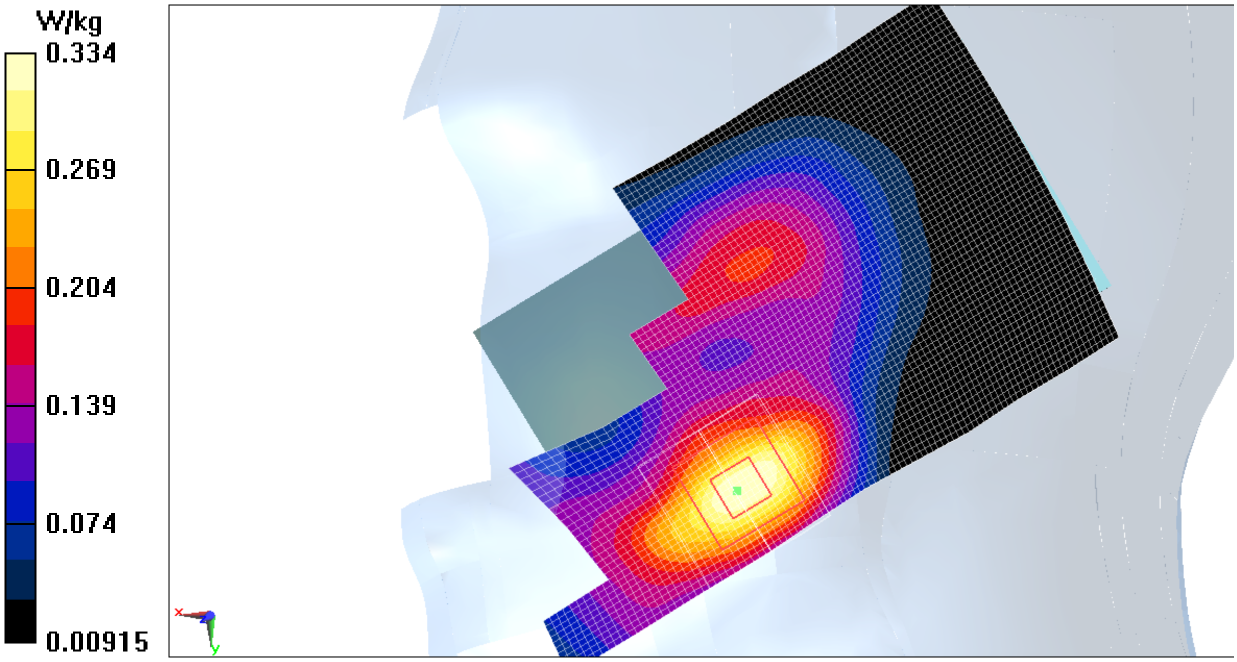


Fig.1 1900 MHz CH810

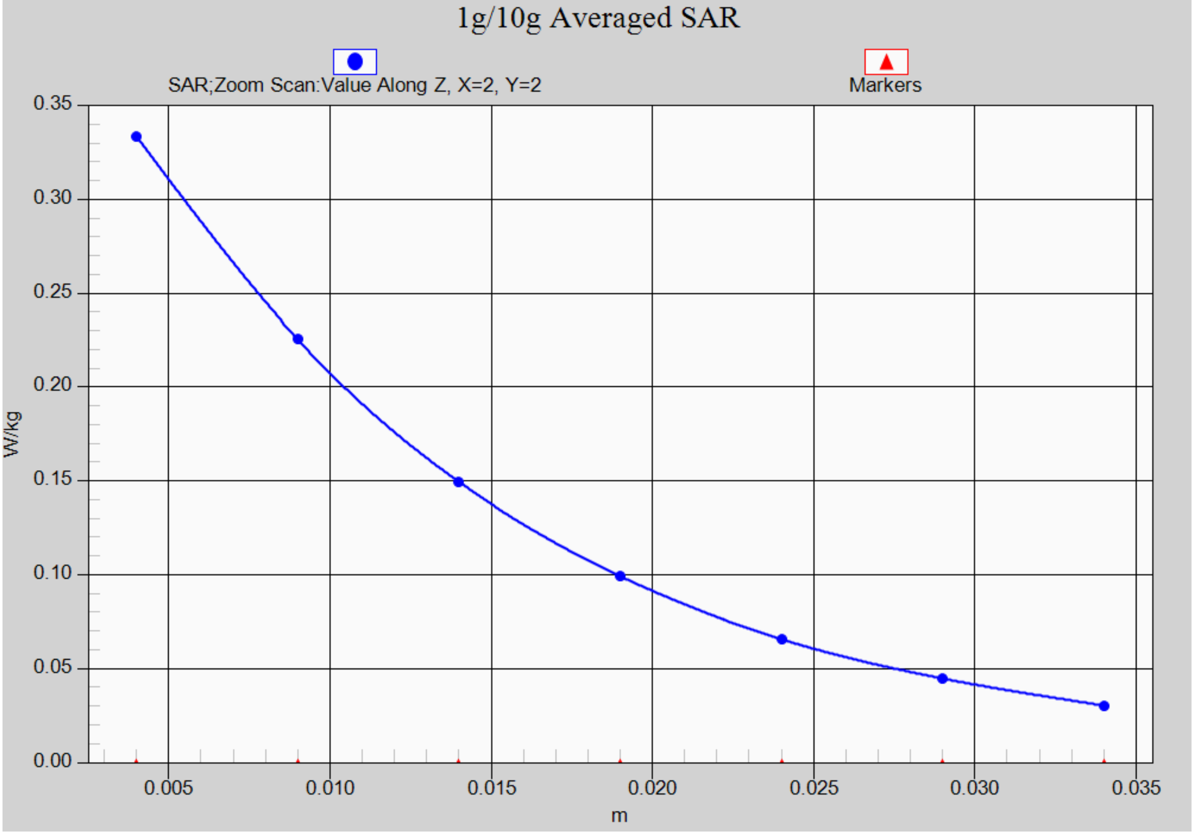


Fig. 1-1 Z-Scan at power reference point (1900 MHz CH810)

GSM1900 Body Rear High with Hotspot on

Date/Time: 2014-9-2

Electronics: DAE4 Sn786

Medium: Body 1900MHz

Medium parameters used: f = 1910 MHz; σ = 1.522 S/m; ε_r = 52.593; ρ = 1000 kg/m^3

Ambient Temperature:23.7^{o}C Liquid Temperature:23.2^{o}C

Communication System: 3 slot GPRS Frequency: 1909.8 MHz Duty Cycle: 1:2.67

Probe: EX3DV4 - SN3633 ConvF(7.74, 7.74, 7.74);

Bottom side High/Area Scan (51x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.772 W/kg

Bottom side High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 23.154 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.46 W/kg

SAR(1 g) = 0.745 W/kg; SAR(10 g) = 0.355 W/kg

Maximum value of SAR (measured) = 0.780 W/kg

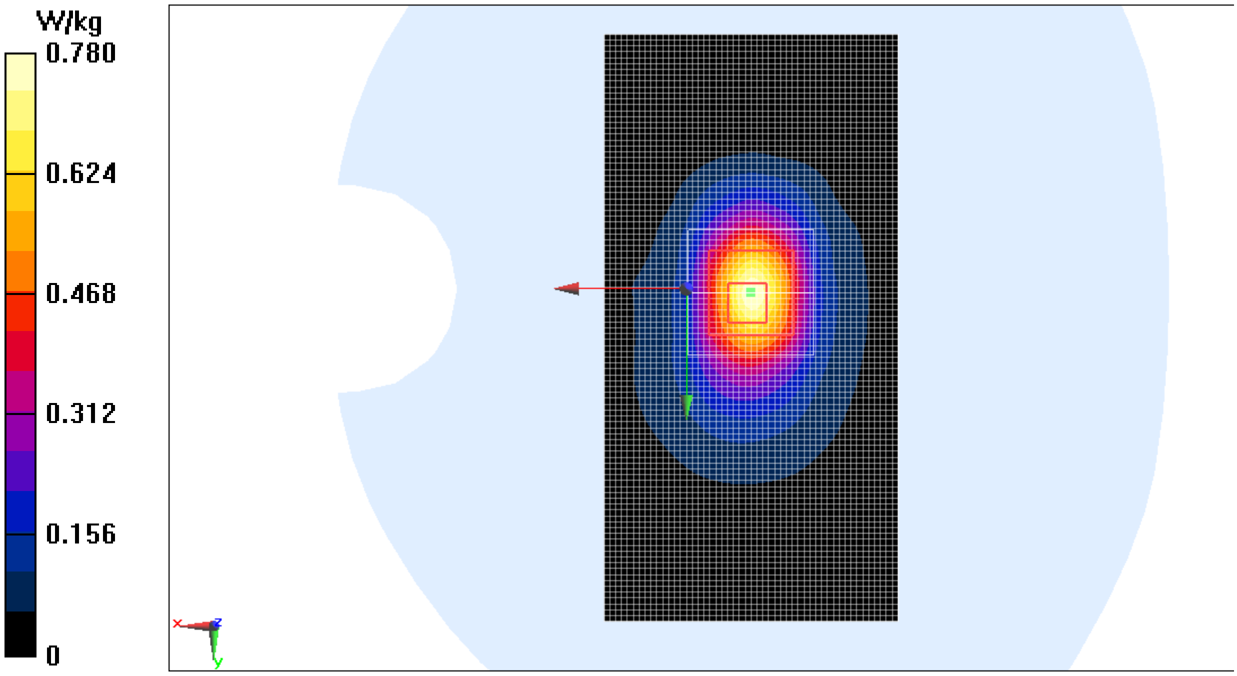


Fig.2 1900 MHz CH810 Hotspot on

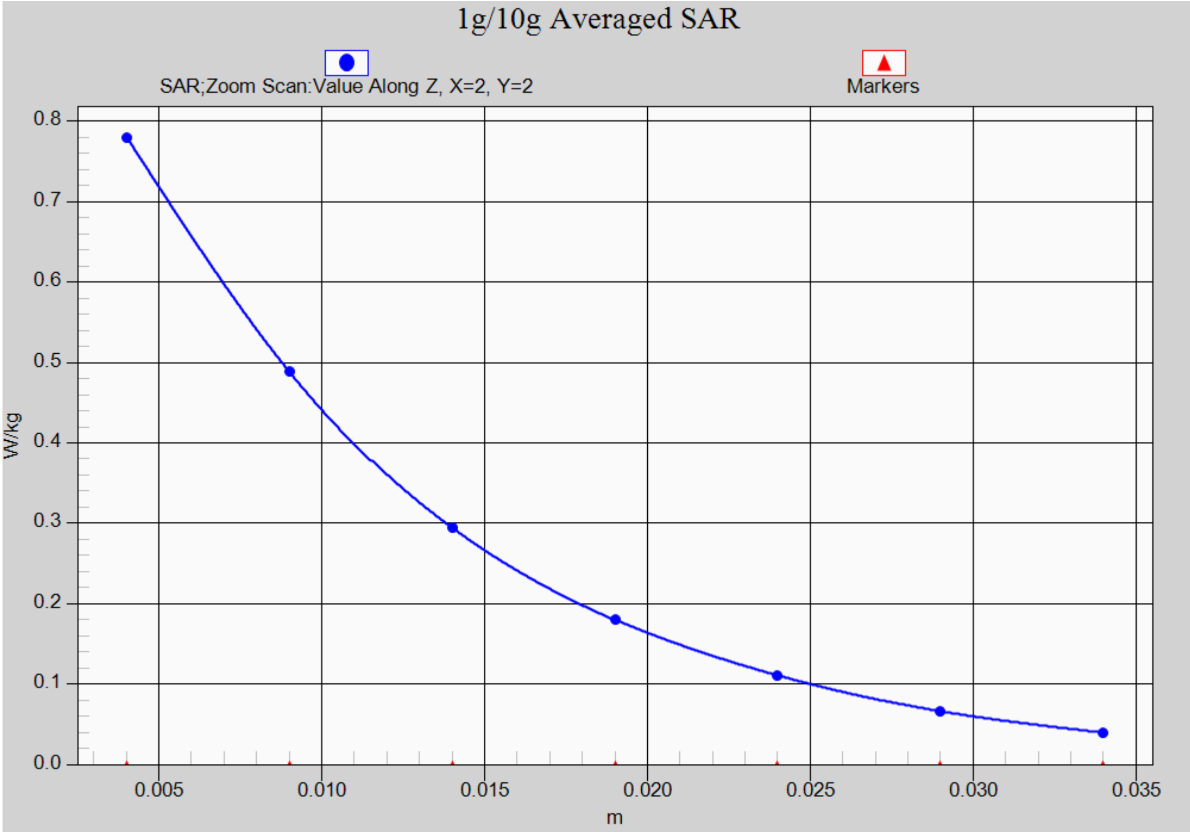


Fig.2-1 Z-Scan at power reference point (1900 MHz CH810) Hotspot on

LTE Band 7 Right Cheek Low with QPSK_20MHz_1RB_Low
Date/Time: 2014-9-17
Electronics: DAE4 Sn786
Medium: Head 2600
Medium parameters used: f = 2510 MHz; σ = 1.932 S/m; ε_r = 38.412; ρ = 1000 kg/m^3
Ambient Temperature:23.7^{o}C Liquid Temperature:23.2^{o}C
Communication System: LTE_FDD Frequency: 2510 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.85, 4.85, 4.85);

Right Cheek Low_1RB_Low/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.376 W/kg

Right Cheek Low_1RB_Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.261 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.609 W/kg
SAR(1 g) = 0.335 W/kg; SAR(10 g) = 0.179 W/kg
Maximum value of SAR (measured) = 0.374 W/kg

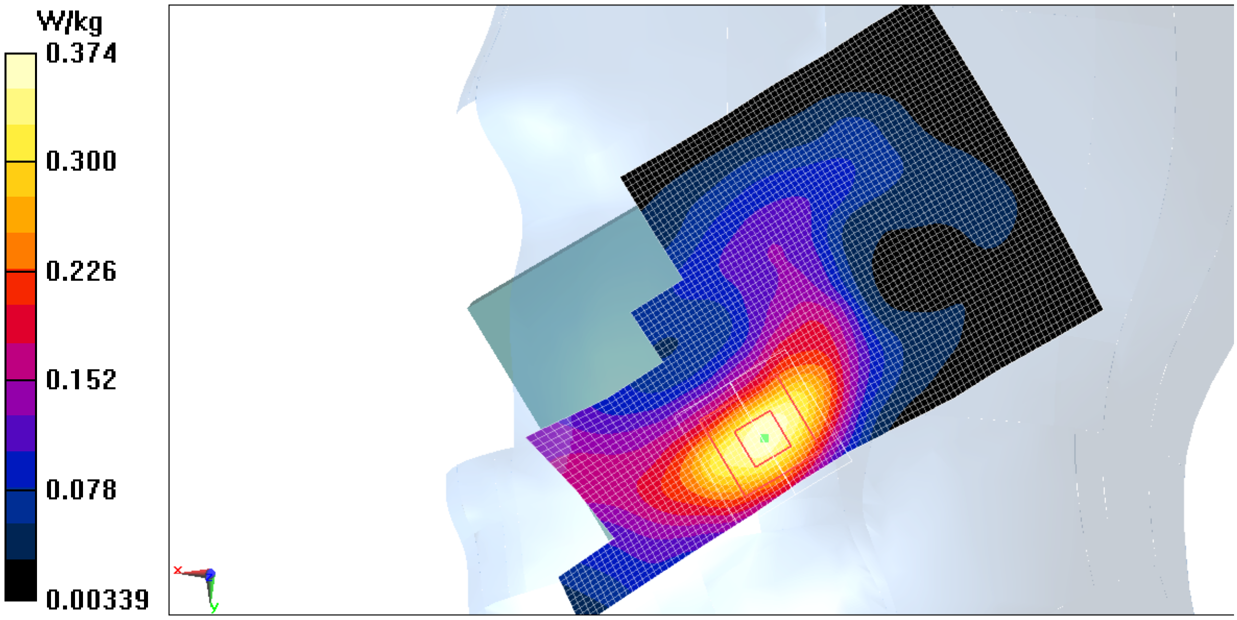


Fig. 3 LTE Band 7 CH20850

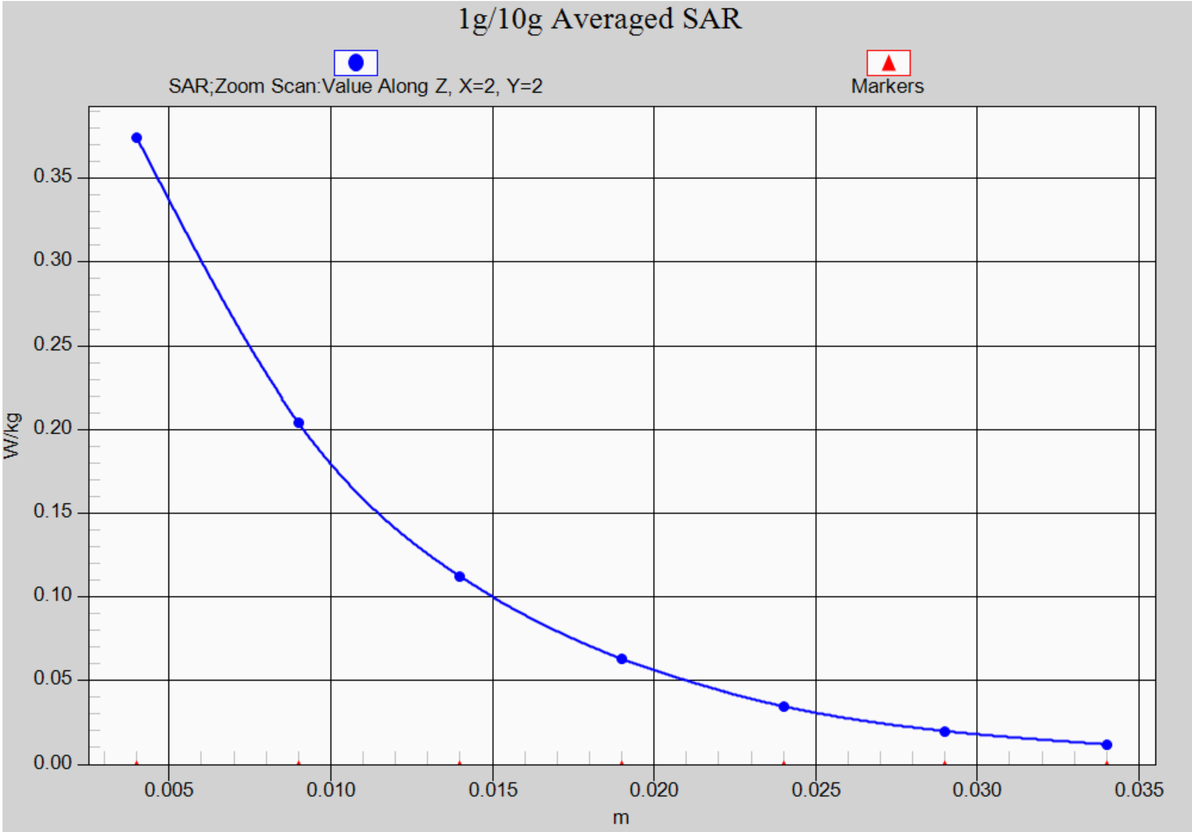


Fig.3-1 Z-Scan at power reference point (Band 7 CH20850)

LTE Band 7 Body Rear Low with QPSK_20MHz_1RB_Low with Hotspot on
Date/Time: 2014-9-17
Electronics: DAE4 Sn786
Medium: Body 2600
Medium parameters used: f = 2510 MHz; σ = 1.962 S/m; ε_r = 50.924; ρ = 1000 kg/m^3
Ambient Temperature:23.7^{o}C Liquid Temperature:23.2^{o}C
Communication System: LTE_FDD Frequency: 2510 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.54, 4.54, 4.54);

Rear side Low_1RB_Low/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.06 W/kg

Rear side Low_1RB_Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.661 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.07 W/kg
SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.488 W/kg
Maximum value of SAR (measured) = 1.21 W/kg

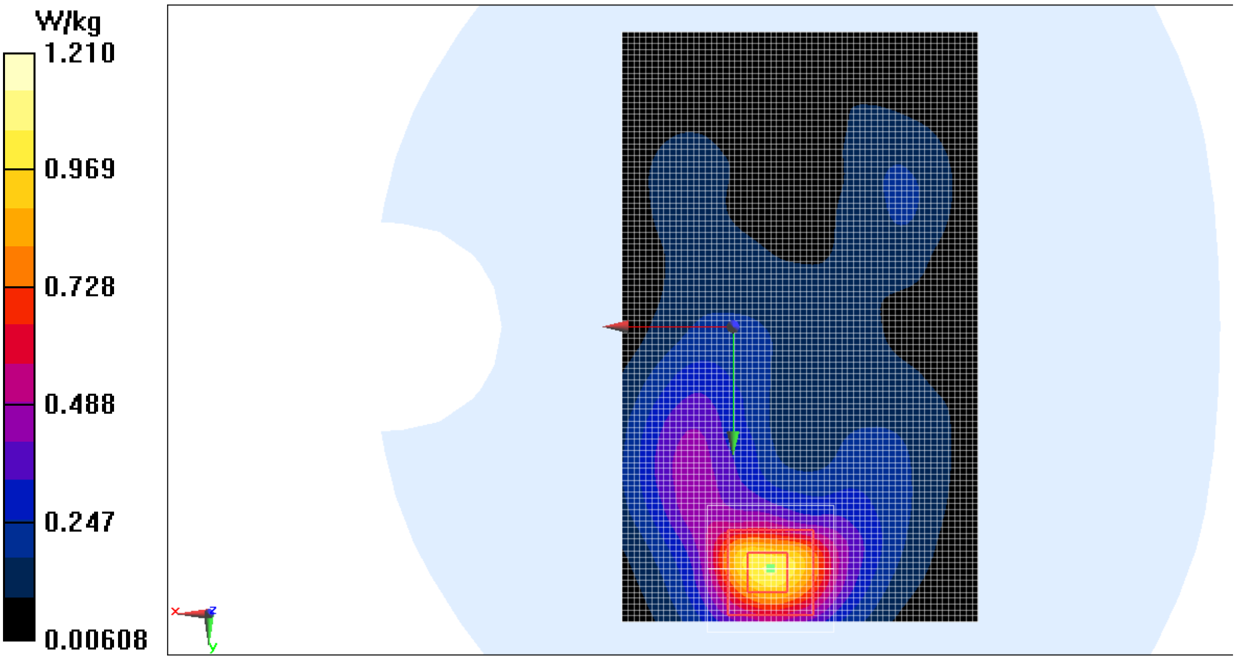


Fig. 4 LTE Band 7 CH20850 Hotspot on

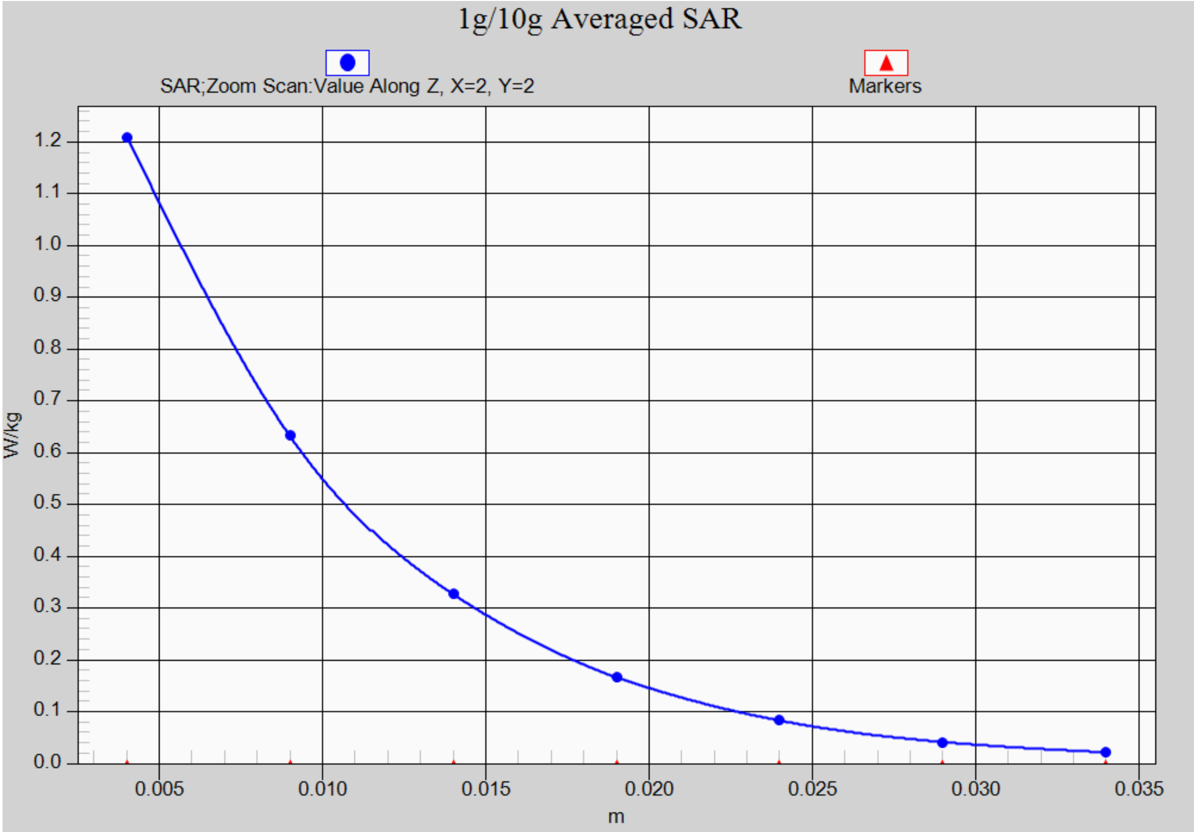


Fig.4-1 Z-Scan at power reference point (Band 7 CH20850) Hotspot on

WiFi 802.11b 1Mbps Right Cheek Channel 7
Date/Time: 2014-9-12
Electronics: DAE4 Sn786
Medium: Head 2450
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.8 S/m; ε_r = 39.318; ρ = 1000 kg/m^3
Ambient Temperature:23.7°C Liquid Temperature:23.2°C
Communication System: WiFi Frequency: 2437 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.78, 7.78, 7.78);

Cheek Middle/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.215 W/kg

Cheek Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.442 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.404 W/kg
SAR(1 g) = 0.186 W/kg; SAR(10 g) = 0.087 W/kg
Maximum value of SAR (measured) = 0.193 W/kg

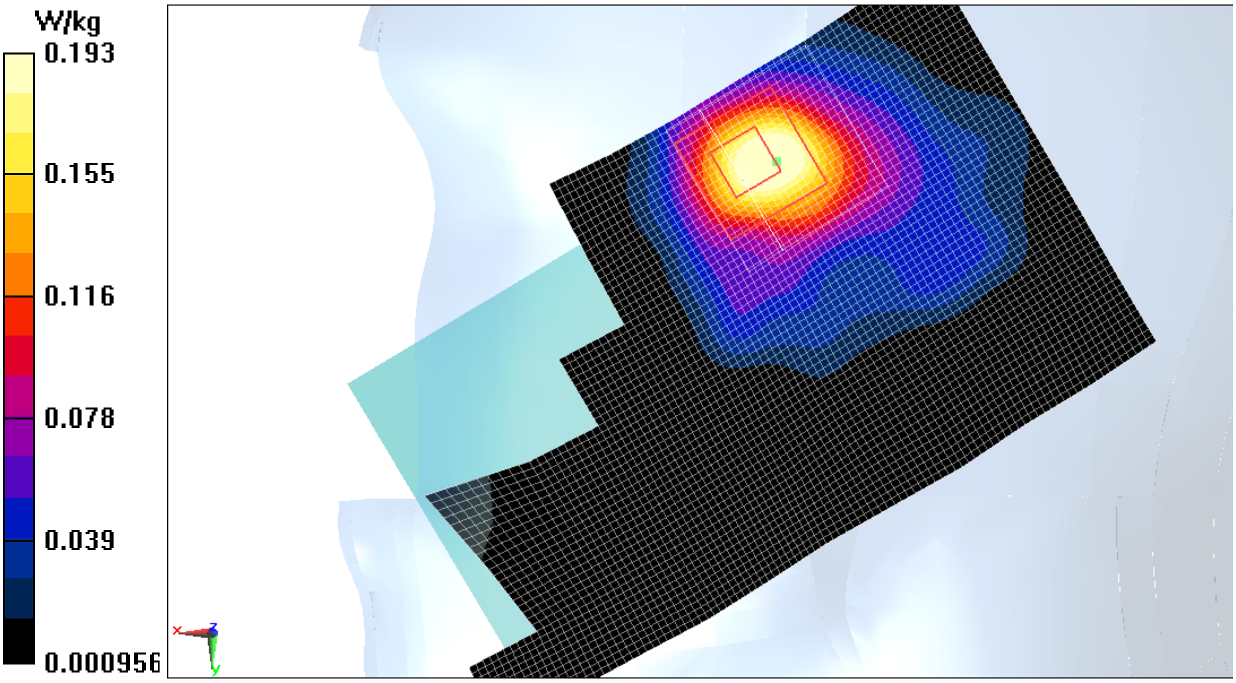


Fig.5 802.11b 1Mbps CH7

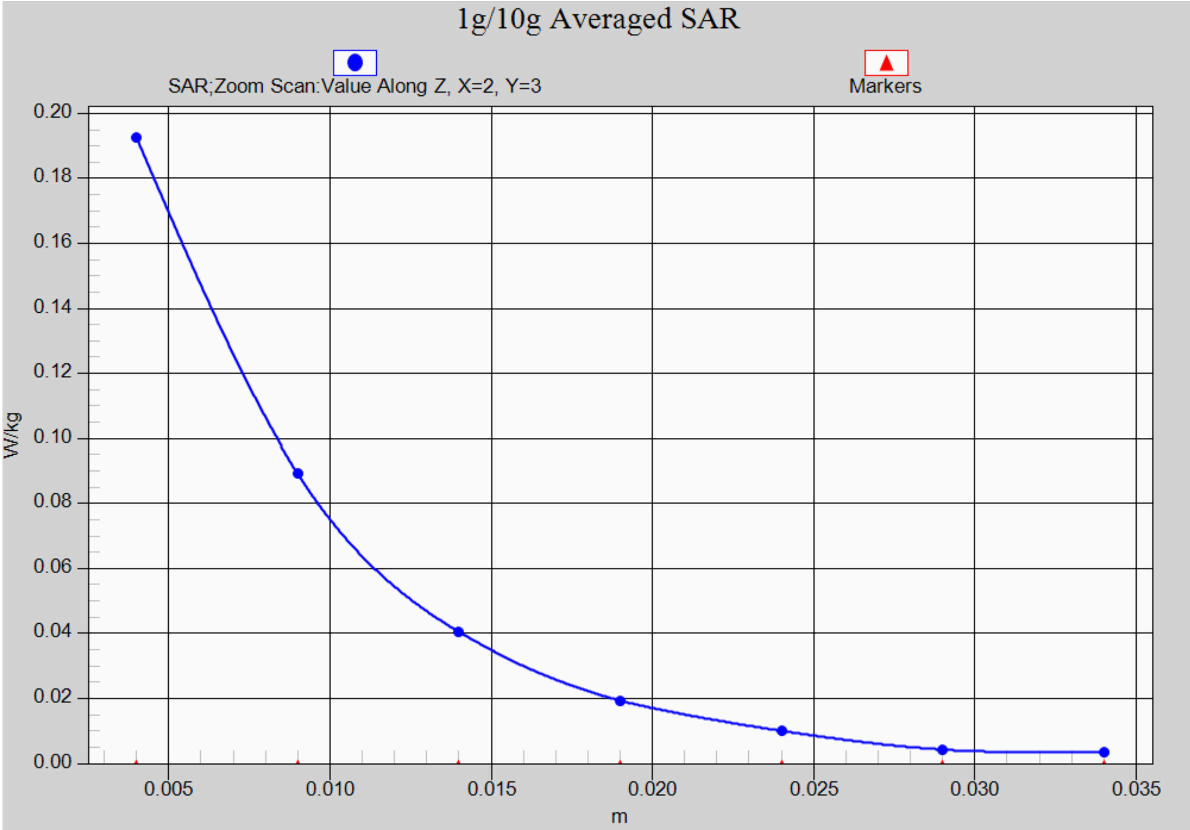


Fig. 5-1 Z-Scan at power reference point (802.11b 1Mbps CH7)

WiFi 802.11b 1Mbps Body Rear Channel 1
Date/Time: 2014-9-14
Electronics: DAE4 Sn786
Medium: Body 2450
Medium parameters used: f = 2412 MHz; σ = 1.847 S/m; ε_r = 51.19; ρ = 1000 kg/m^3
Ambient Temperature:23.7^{o}C Liquid Temperature:23.2^{o}C
Communication System: WiFi Frequency: 2412 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.6, 7.6, 7.6);

BODY/Rear side Low/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.355 W/kg

BODY/Rear side Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.492 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.633 W/kg
SAR(1 g) = 0.306 W/kg; SAR(10 g) = 0.146 W/kg
Maximum value of SAR (measured) = 0.339 W/kg

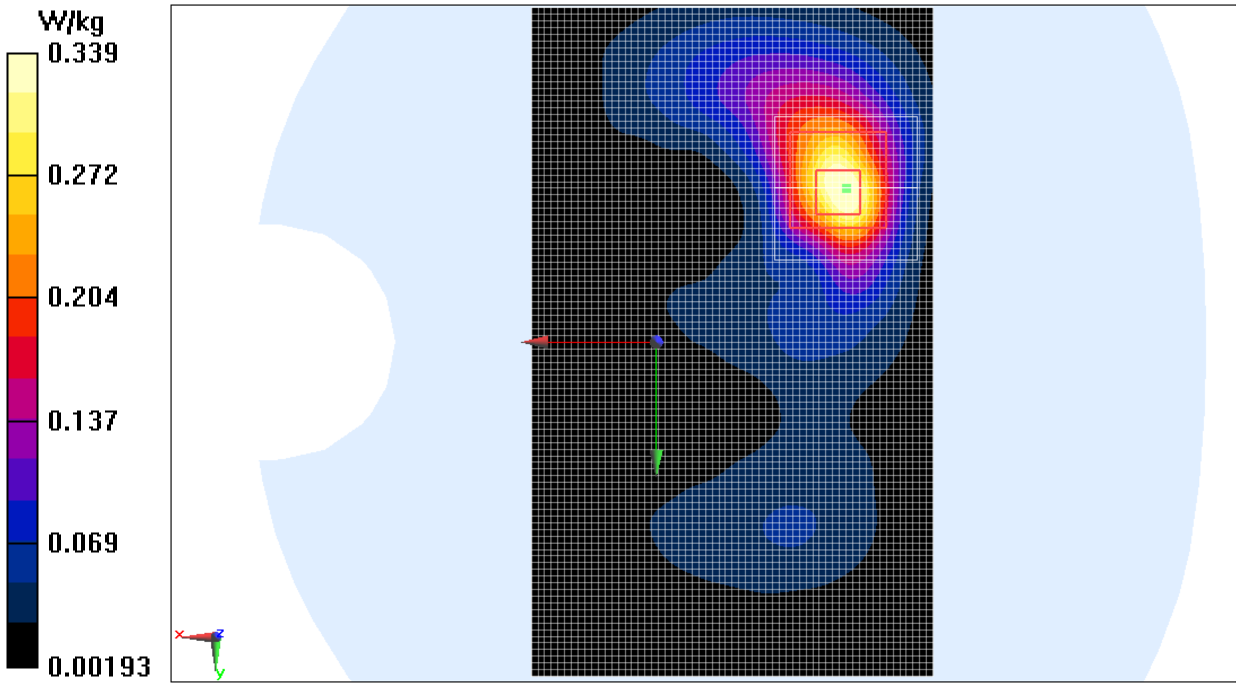


Fig.6 802.11b 1Mbps CH1

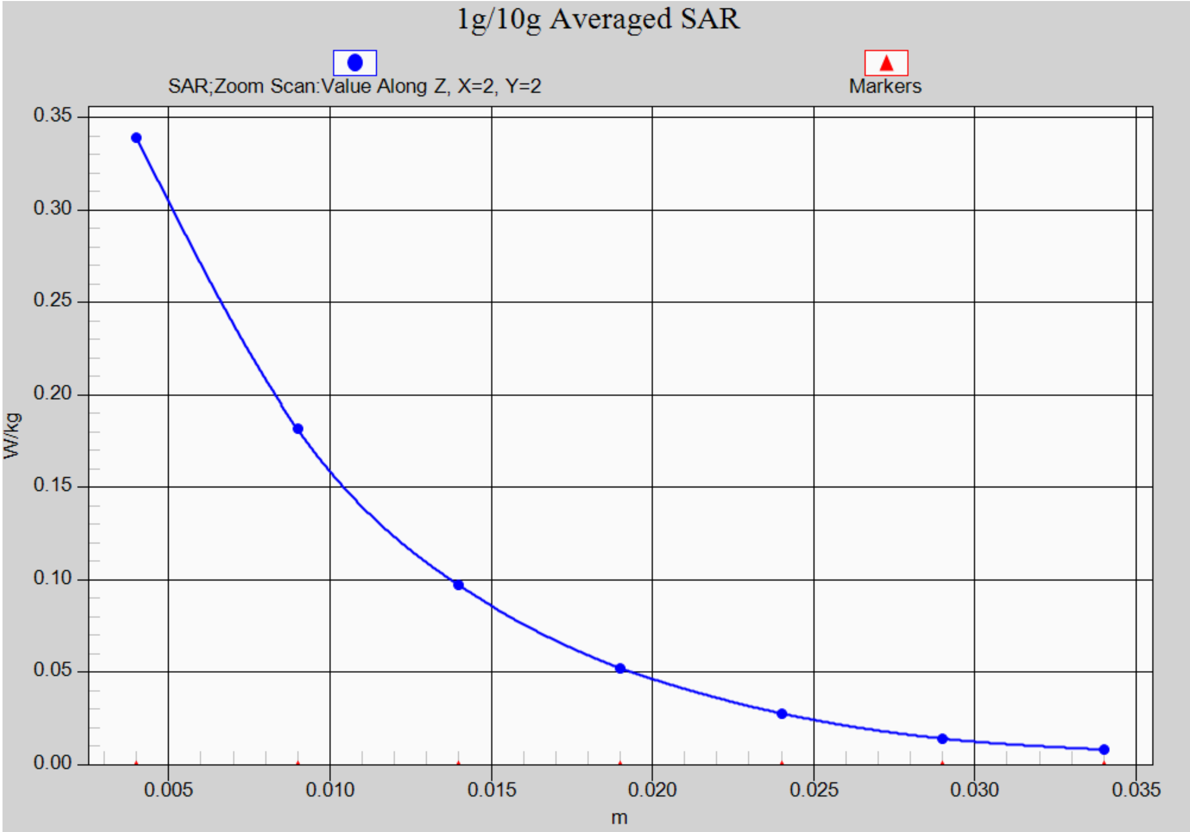


Fig. 6-1 Z-Scan at power reference point (802.11b 1Mbps CH1)

LTE Band 7 Body Rear Low with QPSK_20MHz_1RB_Low with NFC on
Date/Time: 2014-9-29
Electronics: DAE4 Sn786
Medium: Body 2600
Medium parameters used: f = 2510 MHz; σ = 1.953 S/m; ε_r = 51.906; ρ = 1000 kg/m^3
Ambient Temperature:23.7^{o}C Liquid Temperature:23.2^{o}C
Communication System: LTE_FDD Frequency: 2510 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.54, 4.54, 4.54);

Rear side Low_1RB_Low/Area Scan (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.46 W/kg

Rear side Low_1RB_Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.781 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.21 W/kg
SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.624 W/kg
Maximum value of SAR (measured) = 1.48 W/kg

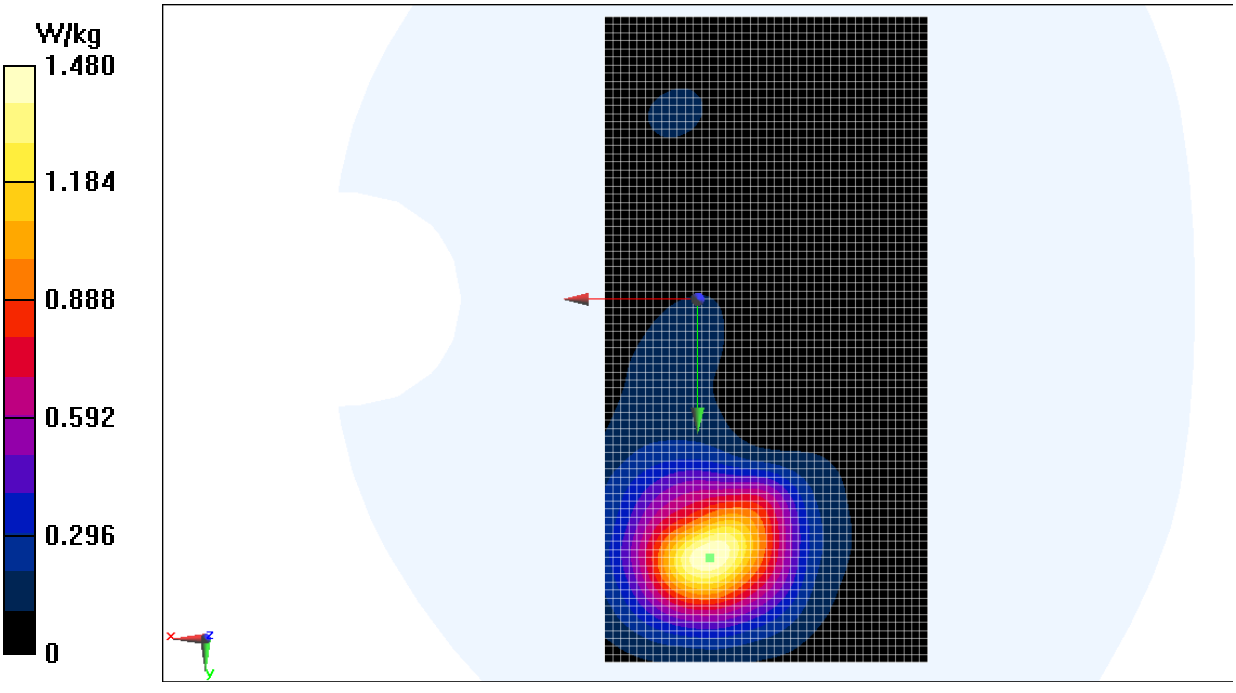


Fig. 7 LTE Band 7 CH20850 with NFC

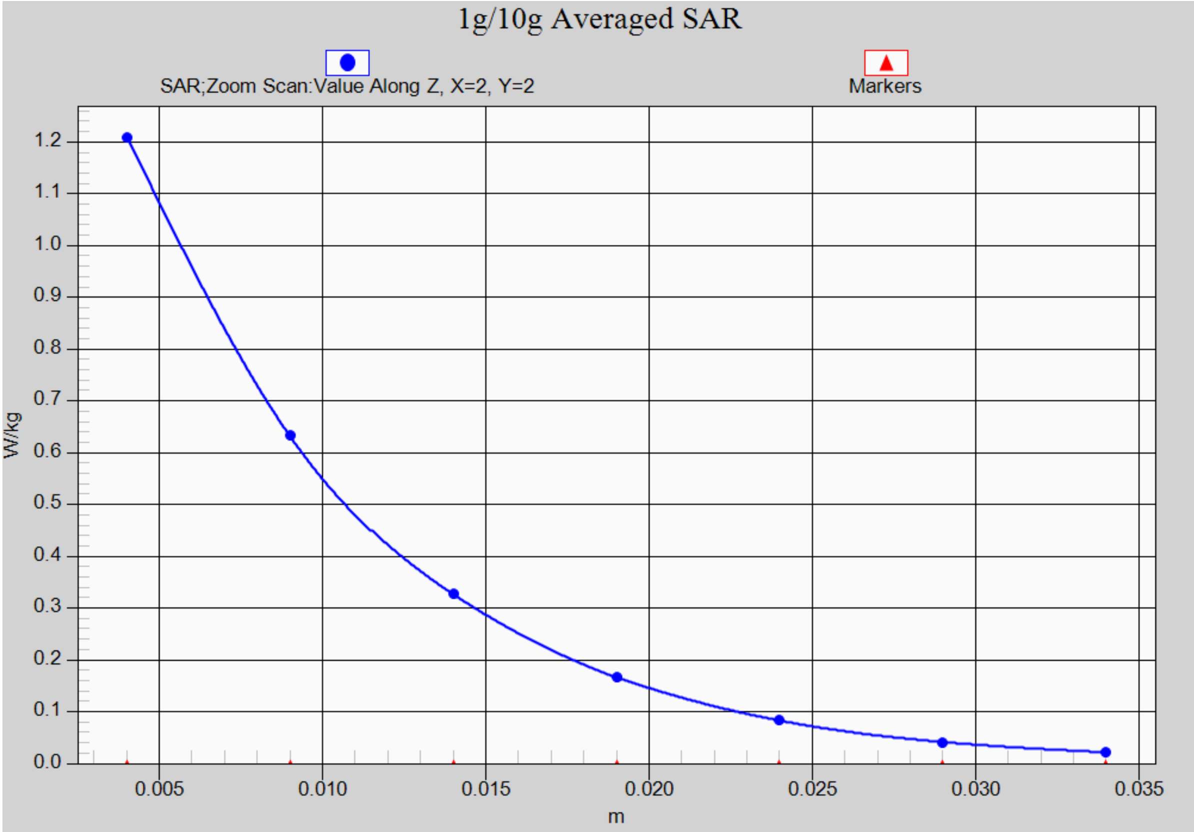


Fig.7-1 Z-Scan at power reference point (Band 7 CH20850) with NFC

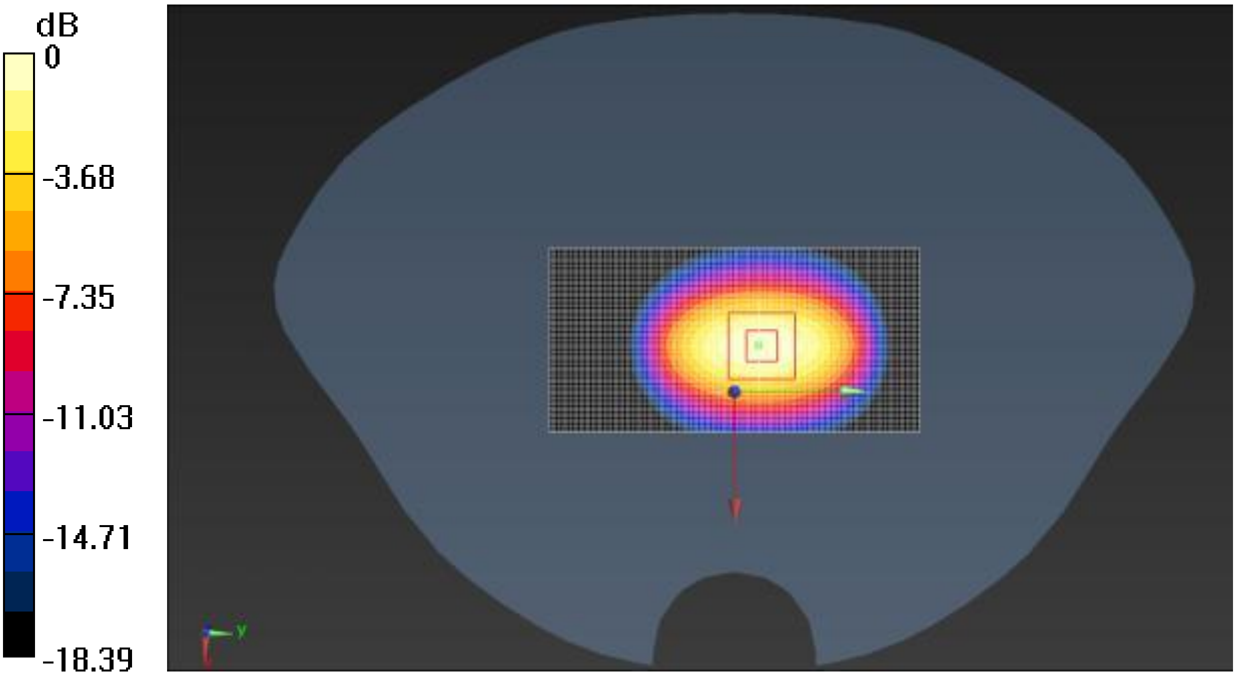
ANNEX B System Verification Results

1900MHz

Date: 8/6/2014
Electronics: DAE4 Sn786
Medium: Head 1900
Medium parameters used: f = 1900 MHz; σ = 1.456 S/m; ε_r = 39.162; ρ = 1000 kg/m^3
Ambient Temperature:24.3°C Liquid Temperature:23.8°C
Communication System: CW_TMC Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.92, 7.92, 7.92);

System Validation /Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 11.5 W/kg
Fast SAR: SAR(1 g) = 9.87 W/kg; SAR(10 g) = 5.07 W/kg
Maximum value of SAR (interpolated) = 13.5 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.259 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 11.6 W/kg



0 dB = 11.6 W/kg = 10.64 dBW/kg

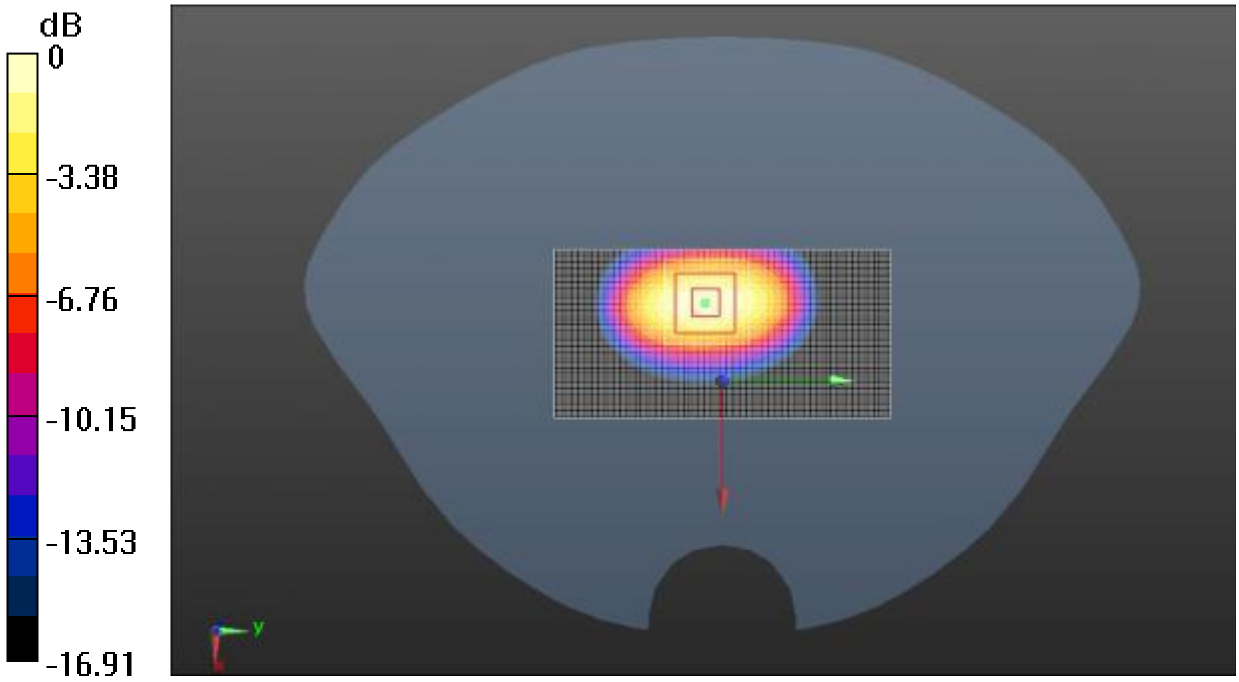
Fig.B.1 validation 1900MHz 250mW

1900MHz

Date: 8/7/2014
Electronics: DAE4 Sn786
Medium: Body 1900MHz
Medium parameters used: f = 1900 MHz; σ = 1.512 S/m; ε_r = 52.613; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 22.0^{o}C
Communication System: CW_TMC Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.37, 7.37, 7.37);

System validation /Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 12.4 W/kg
Fast SAR: SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.39 W/kg
Maximum value of SAR (interpolated) = 13.5 W/kg

System validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.339 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 19.3 W/kg
SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.48 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

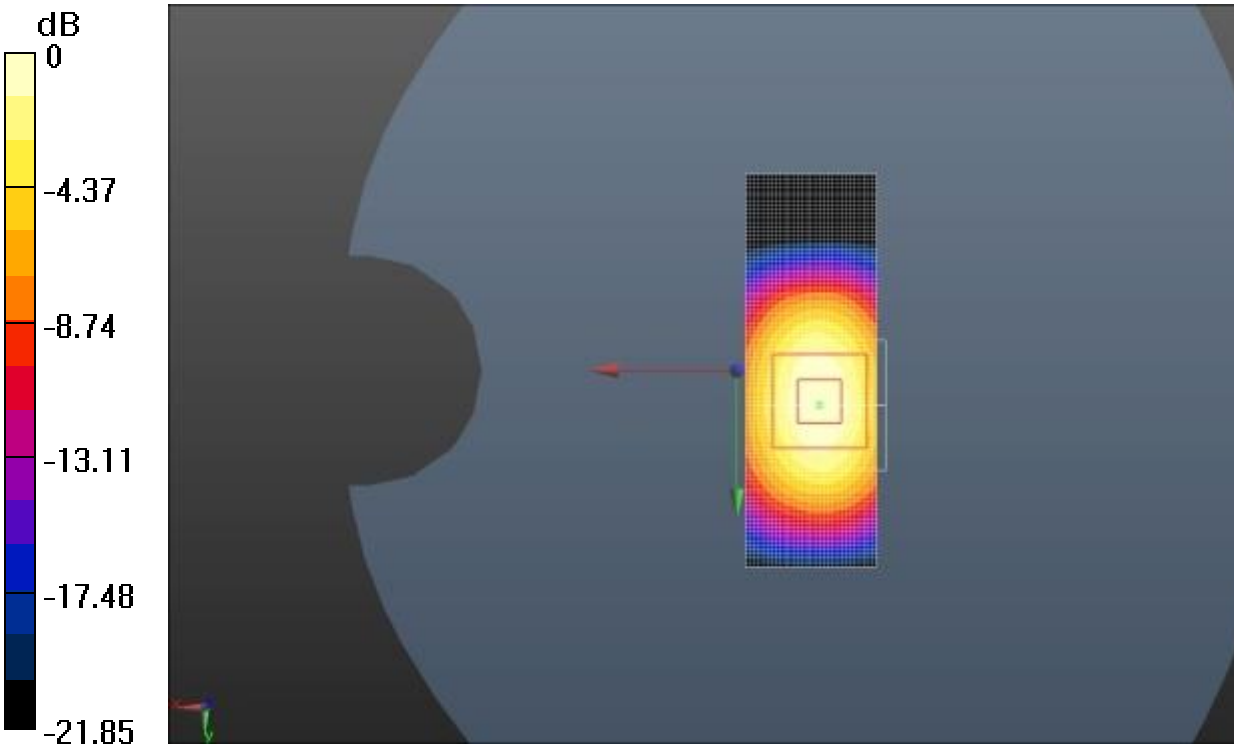
Fig.B.2 validation 1900MHz 250mW

2550MHz

Date/Time: 2014-9-17
Electronics: DAE4 Sn786
Medium: Head 2550 MHz
Medium parameters used: f = 2450 MHz; σ = 1.964 mho/m; ε_r = 39.908; ρ = 1000 kg/m3
Ambient Temperature:24.8°C Liquid Temperature:24.3°C
Communication System: CW_TMC Frequency: 2550 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.57 4.57, 4.57);

System Validation/Area Scan (31x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 27.5 W/kg
Fast SAR: SAR(1 g) = 14.39 W/kg; SAR(10 g) = 6.27 W/kg
Maximum value of SAR (interpolated) = 13.5 W/kg

system check 2600M /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.934 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 31.323 mW/g
SAR(1 g) = 14.7 mW/g; SAR(10 g) = 6.58 mW/g
Maximum value of SAR (measured) = 16.8 mW/g



0 dB = 16.8 W/kg = 47.86 dBW/kg

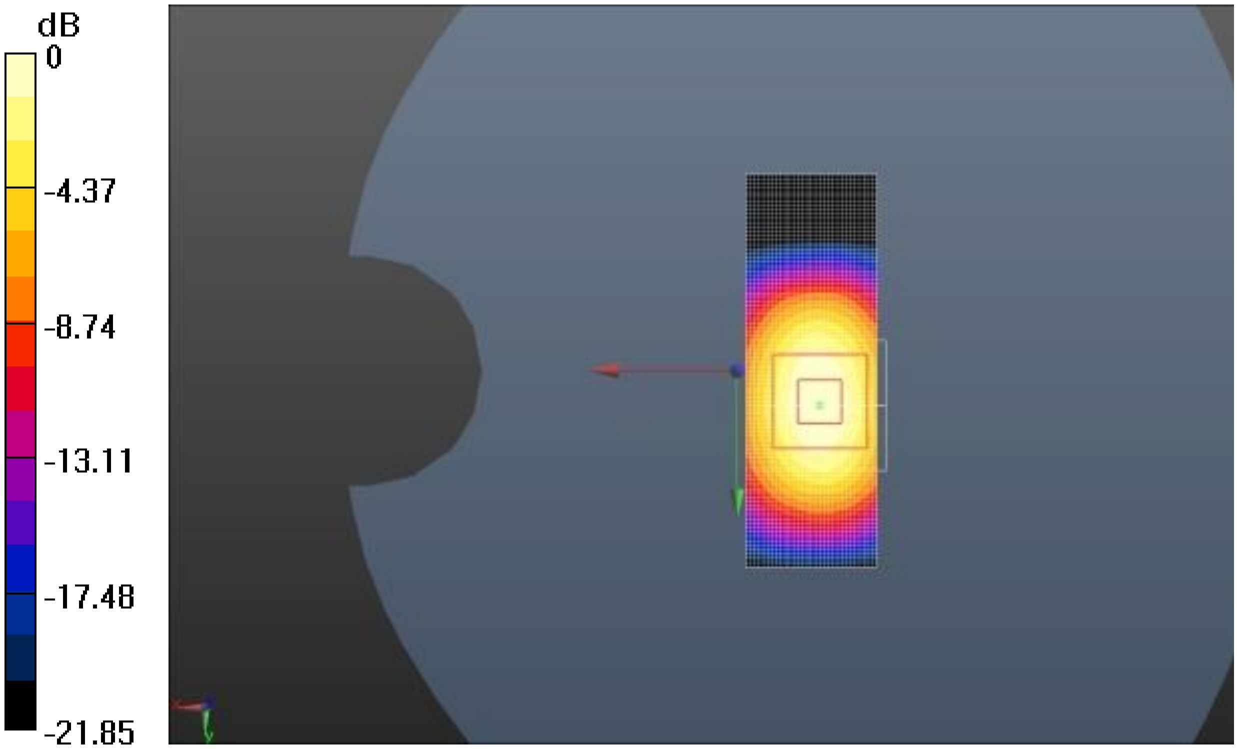
Fig.B.3 validation 2550MHz 250mW

2550MHz

Date/Time: 2014-9-17
Electronics: DAE4 Sn786
Medium: Body 2550 MHz
Medium parameters used: f = 2450 MHz; σ = 2.072 S/m; εr = 50.67; ρ = 1000 kg/m3
Ambient Temperature:24.8°C Liquid Temperature:24.3°C
Communication System: CW_TMC Frequency: 2550 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.26, 4.26, 4.26);

System Validation/Area Scan (31x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.9 W/kg
Fast SAR: SAR(1 g) = 12.97 W/kg; SAR(10 g) = 5.54 W/kg
Maximum value of SAR (interpolated) = 12.7 W/kg

system check 2450M /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.926 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 13.34 W/kg; SAR(10 g) = 6.18 W/kg
Maximum value of SAR (measured) = 15.8 W/kg



0 dB = 15.8 W/kg = 38.02 dBW/kg

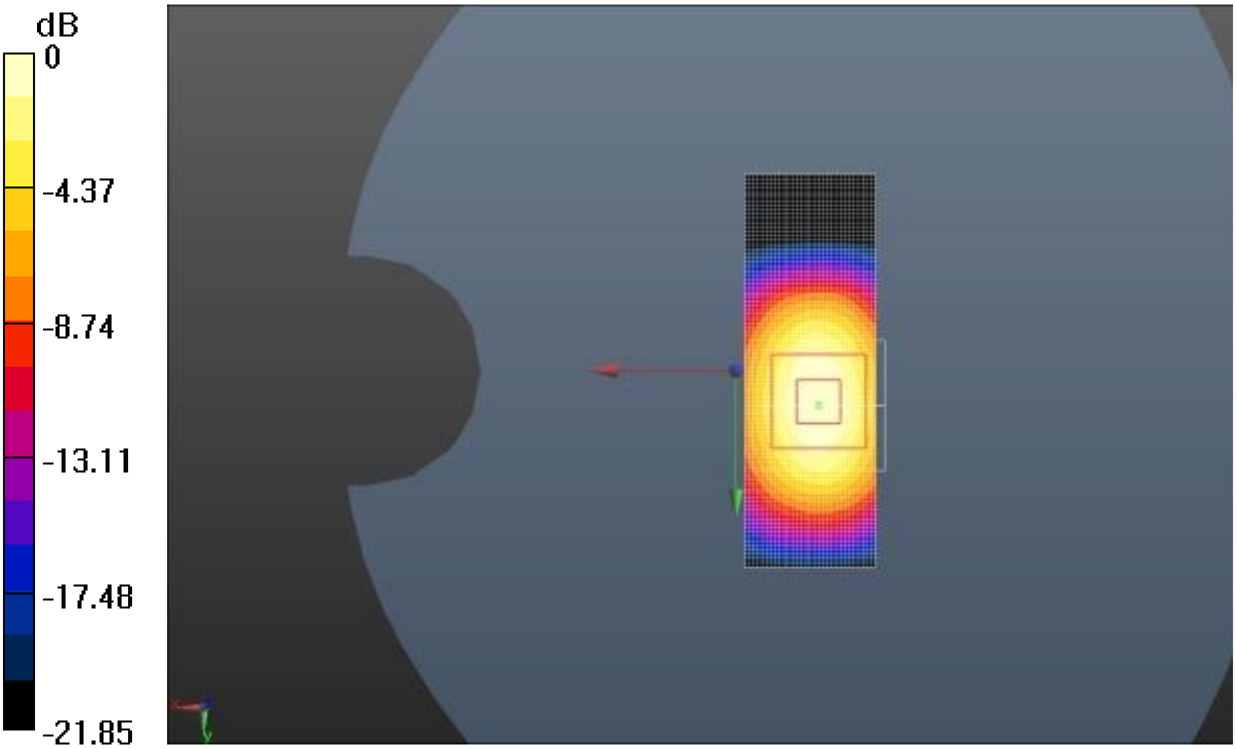
Fig.B.4 validation 2550MHz 250mW

2450MHz

Date/Time: 2014-9-12
Electronics: DAE4 Sn786
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.816 S/m; εr = 39.272; ρ = 1000 kg/m3
Ambient Temperature:24.8°C   Liquid Temperature:24.3°C
Communication System: CW_TMC Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.78, 7.78, 7.78);

System Validation/Area Scan (31x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.9 W/kg
Fast SAR: SAR(1 g) = 12.57 W/kg; SAR(10 g) = 6.24 W/kg
Maximum value of SAR (interpolated) = 11.5 W/kg

system check 2450M /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.926 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 22.1 W/kg
SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6.36 W/kg
Maximum value of SAR (measured) = 14.8 W/kg



0 dB = 14.8 W/kg = 23.41 dBW/kg

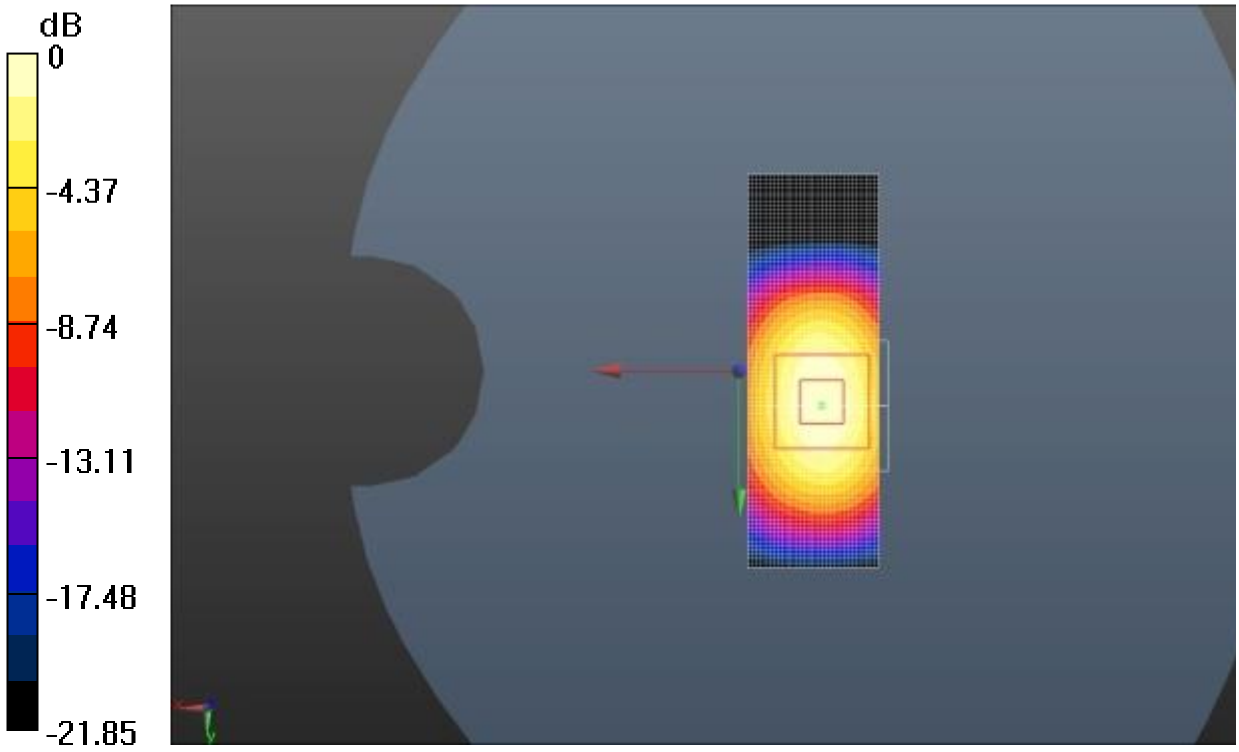
Fig.B.5 validation 2450MHz 250mW

2450MHz

Date/Time: 2014-9-14
Electronics: DAE4 Sn786
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.89 S/m; εr = 51.096; ρ = 1000 kg/m3
Ambient Temperature:24.8°C Liquid Temperature:24.3°C
Communication System: CW_TMC Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(7.60, 7.60, 7.60);

System Validation/Area Scan (31x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 15.3 W/kg
Fast SAR: SAR(1 g) = 12.86 W/kg; SAR(10 g) = 6.14 W/kg
Maximum value of SAR (interpolated) = 12.2 W/kg

system check 2450M /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.926 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 26.2 W/kg
SAR(1 g) = 12.93 W/kg; SAR(10 g) = 6.2 W/kg
Maximum value of SAR (measured) = 14.4 W/kg



0 dB = 14.4 W/kg = 27.54 dBW/kg

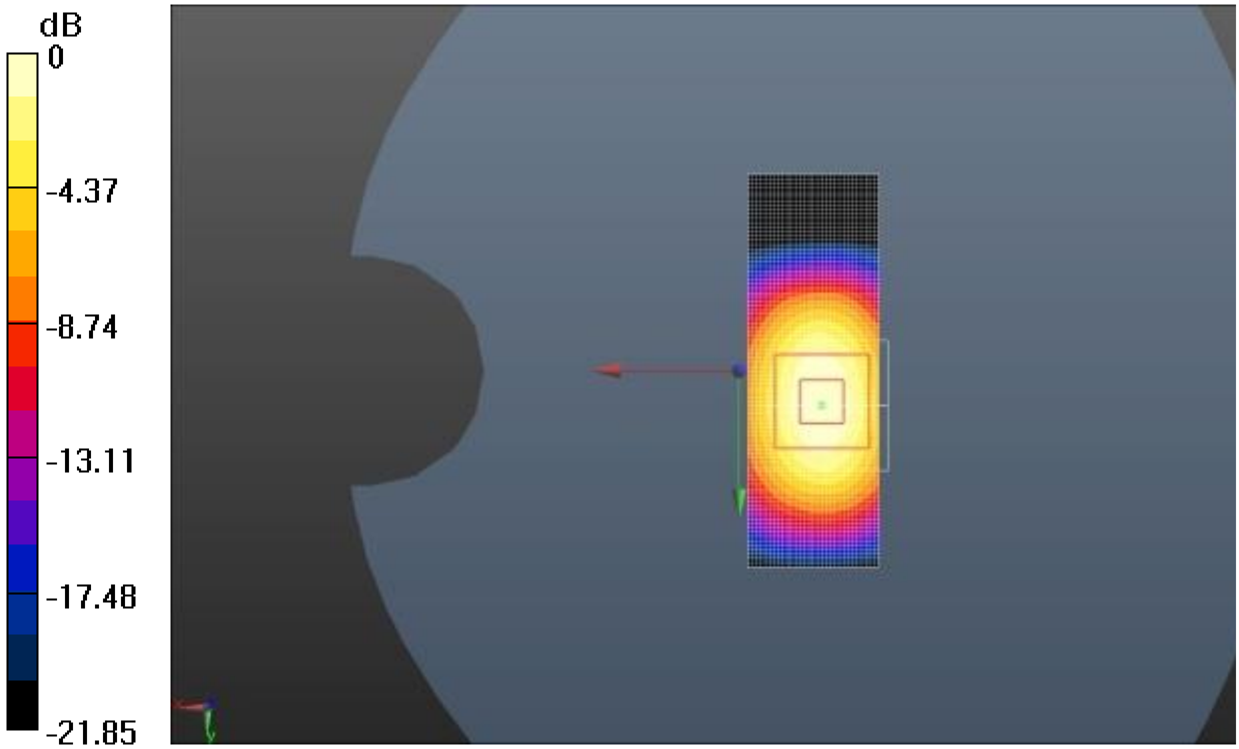
Fig.B.6 validation 2450MHz 250mW

2550MHz

Date/Time: 2014-9-29
Electronics: DAE4 Sn786
Medium: Body 2550 MHz
Medium parameters used: f = 2450 MHz; σ = 2.093 S/m; εr = 51.872; ρ = 1000 kg/m3
Ambient Temperature:24.8°C Liquid Temperature:24.3°C
Communication System: CW_TMC Frequency: 2550 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(4.26, 4.26, 4.26);

System Validation/Area Scan (31x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 15.9 W/kg
Fast SAR: SAR(1 g) = 13.97 W/kg; SAR(10 g) = 6.14 W/kg
Maximum value of SAR (interpolated) = 15.7 W/kg

system check 2450M /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.926 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 24.54 W/kg
SAR(1 g) = 14.04 W/kg; SAR(10 g) = 6.18 W/kg
Maximum value of SAR (measured) = 15.97 W/kg



0 dB = 15.97 W/kg = 39.54 dBW/kg

Fig.B.4 validation 2550MHz 250mW

The SAR system verification must be required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR.

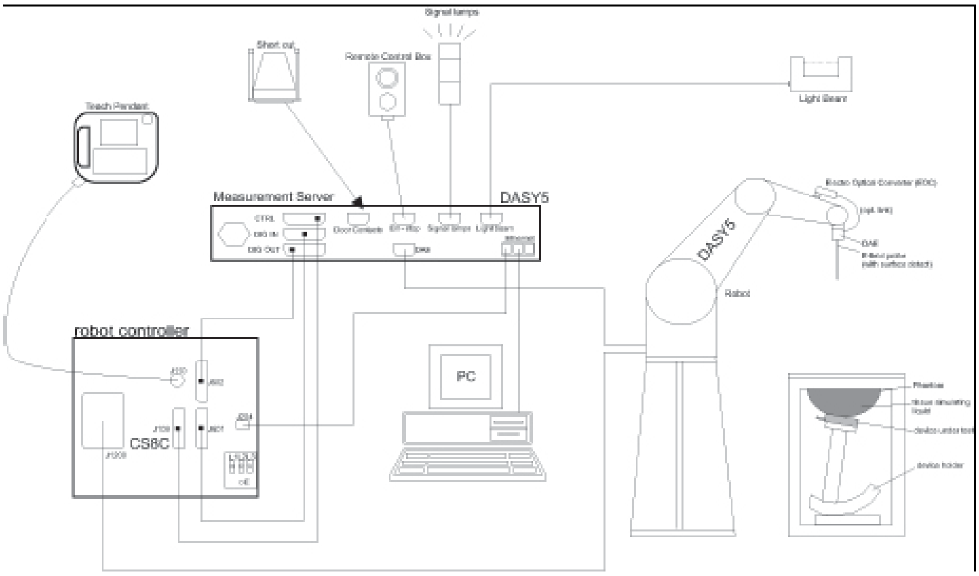
Table B.1 Comparison between area scan and zoom scan for system verification

Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
1900	Head	9.87	10.1	2.3
1900	Body	10.2	10.4	1.6
2550	Head	14.39	14.7	2.1
2550	Body	12.97	13.34	2.8
2450	Head	12.57	12.9	2.6
2450	Body	12.86	12.93	0.5
2550	Body	13.97	14.04	0.5

ANNEX C　SAR Measurement Setup

C.1 Measurement Set-up

The Dasy4 or DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:



Picture C.1 SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (Stäubli TX=RX family) 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.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion 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 and the DASY4 or DASY5 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.

C.2 Dasy4 or DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 or DASY5 software reads the reflection durning a software approach and looks for the maximum using 2^{nd} ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:

Model: ES3DV3, EX3DV4

Frequency Range: 10MHz — 6.0GHz(EX3DV4)
10MHz — 4GHz(ES3DV3)

Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz

Linearity: ± 0.2 dB(30 MHz to 6 GHz) for EX3DV4
± 0.2 dB(30 MHz to 4 GHz) for ES3DV3

Dynamic Range: 10 mW/kg — 100W/kg

Probe Length: 330 mm

Probe Tip Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm (3.9 mm for ES3DV3)

Tip-Center: 1 mm (2.0mm for ES3DV3)

Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

Picture C.2 Near-field Probe

Picture C.3 E-field Probe

C.3 E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed

in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2.
E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:
Δt = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
ΔT = Temperature increase due to RF exposure.

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m^3).

C.4 Other Test Equipment

C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist of 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 with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.
The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

PictureC.4: DAE

C.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90XL; DASY5: RX160L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

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

Picture C.5 DASY 5

C.4.3 Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (dasy4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128MB), RAM (DASY4: 64 MB, DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

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

Picture C.7 Server for DASY 4

Picture C.8 Server for DASY 5

C.4.4 Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. 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.

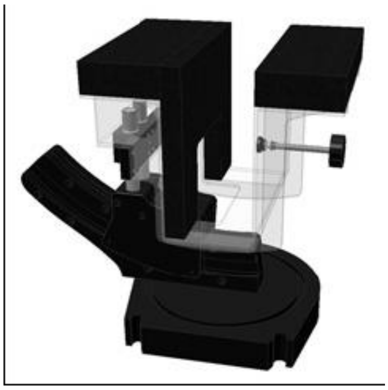
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference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

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

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

Picture C.9-1: Device Holder



Picture C.9-2: Laptop Extension Kit

C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

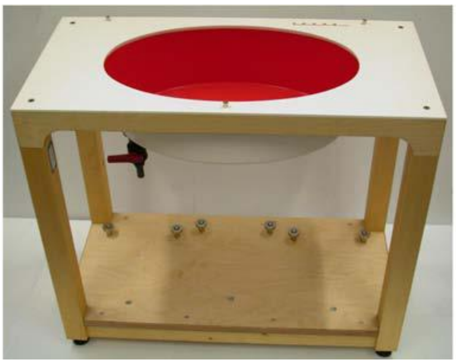
Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm
Filling Volume: Approx. 25 liters
Dimensions: 810 x l000 x 500 mm (H x L x W)
Available: Special

Picture C.10: SAM Twin Phantom

The ELI4 phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest standard IEC 62209-2 and all known tissue simulating liquids. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness 2±0. l mm
Filling Volume Approx. 20 liters
Dimensions 810 x l000 x 500 mm (H x L x W)
Available Special

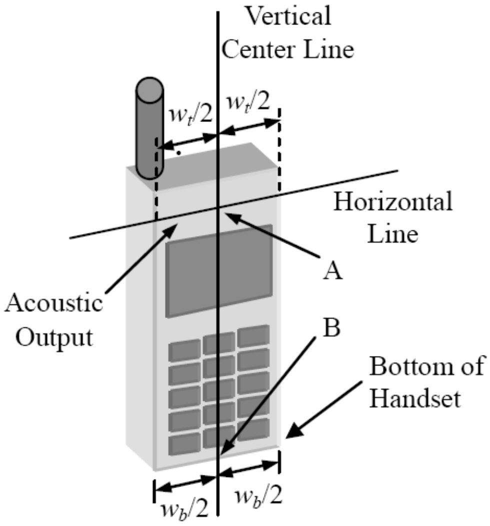


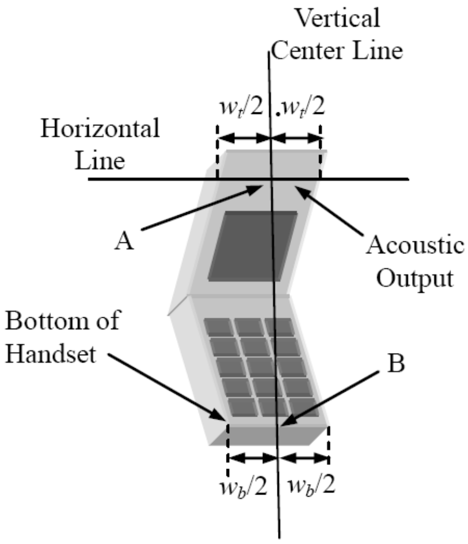
Picture C.10: SAM Twin Phantom

ANNEX D Position of the wireless device in relation to the phantom

D.1 General considerations

This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.





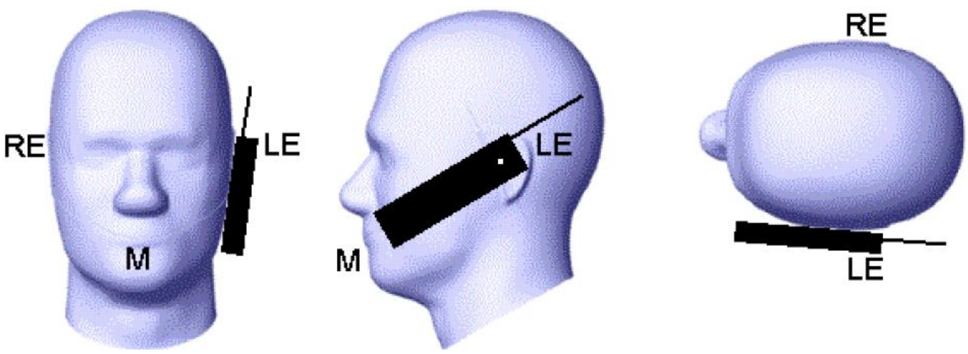
w_t Width of the handset at the level of the acoustic

w_b Width of the bottom of the handset

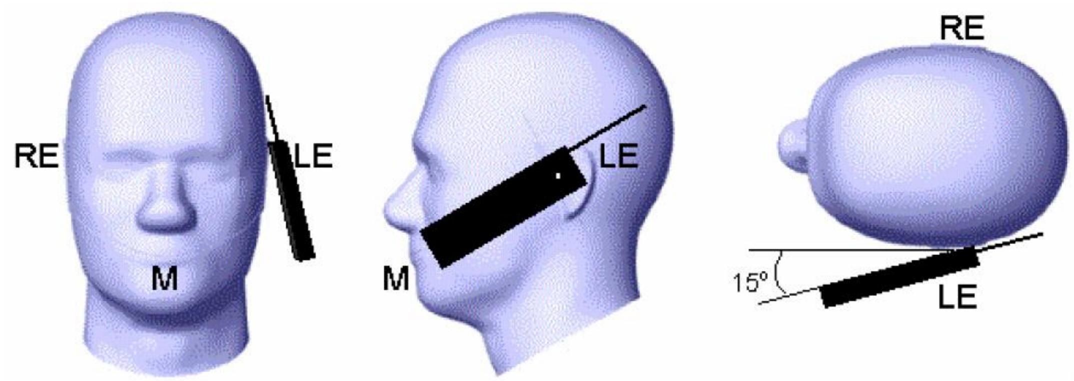
A Midpoint of the width w_t of the handset at the level of the acoustic output

B Midpoint of the width w_b of the bottom of the handset

Picture D.1-a Typical “fixed” case handset **Picture D.1-b Typical “clam-shell” case handset**



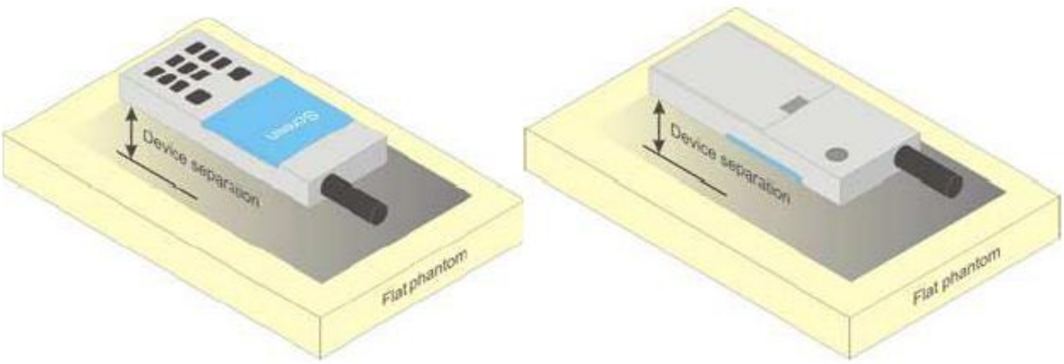
Picture D.2 Cheek position of the wireless device on the left side of SAM



Picture D.3 Tilt position of the wireless device on the left side of SAM

D.2 Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.

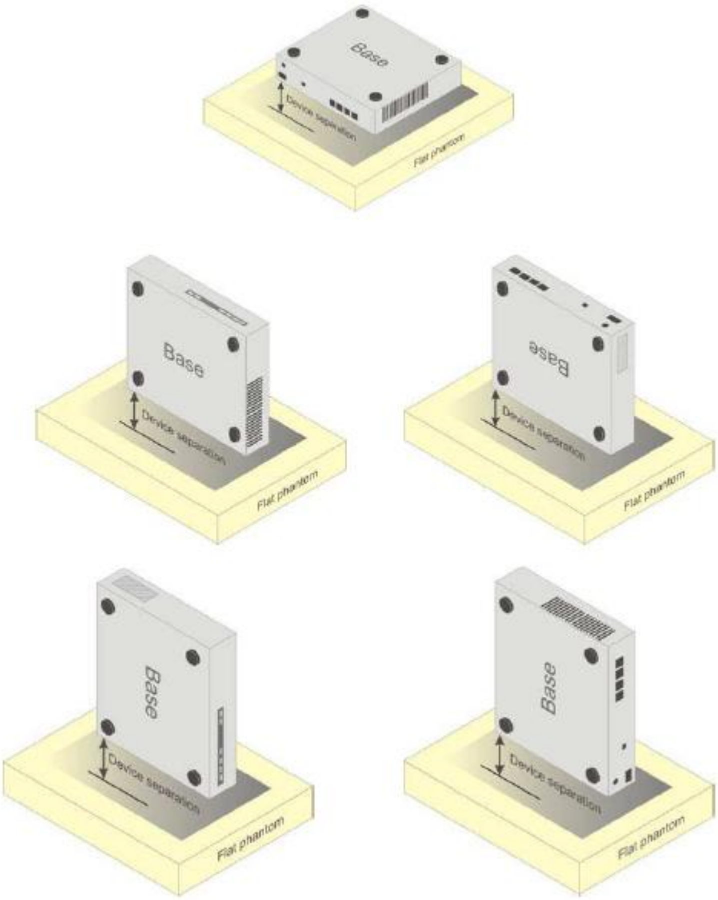


Picture D.4 Test positions for body-worn devices

D.3 Desktop device

A typical example of a desktop device is a wireless enabled desktop computer placed on a table or desk when used.

The DUT shall be positioned at the distance and in the orientation to the phantom that corresponds to the intended use as specified by the manufacturer in the user instructions. For devices that employ an external antenna with variable positions, tests shall be performed for all antenna positions specified. Picture 8.5 show positions for desktop device SAR tests. If the intended use is not specified, the device shall be tested directly against the flat phantom.



Picture D.5 Test positions for desktop devices

D.4 DUT Setup Photos

Picture D.6

ANNEX E Equivalent Media Recipes

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

Table E.1: Composition of the Tissue Equivalent Matter

Frequency (MHz)	835 Head	835 Body	1900 Head	1900 Body	2450 Head	2450 Body	5800 Head	5800 Body
Ingredients (% by weight)								
Water	41.45	52.5	55.242	69.91	58.79	72.60	65.53	65.53
Sugar	56.0	45.0	\	\	\	\	\	\
Salt	1.45	1.4	0.306	0.13	0.06	0.18	\	\
Preventol	0.1	0.1	\	\	\	\	\	\
Cellulose	1.0	1.0	\	\	\	\	\	\
Glycol Monobutyl	\	\	44.452	29.96	41.15	27.22	\	\
Diethylenglycol monohexylether	\	\	\	\	\	\	17.24	17.24
Triton X-100	\	\	\	\	\	\	17.24	17.24
Dielectric Parameters Target Value	ε=41.5 σ=0.90	ε=55.2 σ=0.97	ε=40.0 σ=1.40	ε=53.3 σ=1.52	ε=39.2 σ=1.80	ε=52.7 σ=1.95	ε=35.3 σ=5.27	ε=48.2 σ=6.00

ANNEX F System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

Table F.1: System Validation

Probe SN.	Liquid name	Validation date	Frequency point	Status (OK or Not)
3633	Head 850MHz	July. 06, 2014	850 MHz	OK
3633	Head 850MHz	July.. 06, 2014	900 MHz	OK
3633	Head 1800MHz	July.07, 2014	1800 MHz	OK
3633	Head 1900MHz	July.. 07, 2014	1900 MHz	OK
3633	Head 2000MHz	July.. 08, 2014	2000 MHz	OK
3633	Head 2100MHz	July.. 08, 2014	2100 MHz	OK
3633	Head 2450MHz	July.. 11, 2014	2450 MHz	OK
3633	Body 850MHz	August.. 12, 2014	850 MHz	OK
3633	Body 850MHz	August.. 12, 2014	900 MHz	OK
3633	Body 1800MHz	August.. 13, 2014	1800 MHz	OK
3633	Body 1900MHz	August.. 13, 2014	1900 MHz	OK
3633	Body 2000MHz	August.. 14, 2014	2000 MHz	OK
3633	Body 2100MHz	August.. 14, 2014	2100 MHz	OK
3633	Body 2450MHz	August.. 15, 2014	2450 MHz	OK

ANNEX G Probe Calibration Certificate

Probe ES3DV4-SN:3633 Calibration Certificate

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CNAS L0442

Client TMC(SZ)/CSZIT Certificate No: J13-2-2909

CALIBRATION CERTIFICATE

受控文件
TMC-CC-13-284-02

Object EX3DV4 - SN:3633

Calibration Procedure(s) TMC-OS-E-02-195
Calibration Procedures for Dosimetric E-field Probes

Calibration date: October 31, 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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101547	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101548	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Reference10dBAttenuator	BT0520	12-Dec-12(TMC,No.JZ12-867)	Dec-14
Reference20dBAttenuator	BT0267	12-Dec-12(TMC,No.JZ12-866)	Dec-14
Reference Probe EX3DV4	SN 3846	03-Sep-13(SPEAG,No.EX3-3846_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	01-Jul-13 (TMC, No.JW13-045)	Jun-14
Network Analyzer E5071C	MY46110673	15-Feb-13 (TMC, No.JZ13-781)	Feb-14

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	[signature]
Reviewed by:	Qi Dianyuan	SAR Project Leader	[signature]
Approved by:	Lu Bingsong	Deputy Director of the laboratory	[signature]

Issued: November 4, 2013

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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 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 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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Probe EX3DV4

SN: 3633

Calibrated: October 31, 2013

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY – Parameters of Probe: EX3DV4 - SN: 3633

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)²)[A]	0.38	0.39	0.37	±10.8%
DCP(mV)[B]	97.7	99.7	99.0	

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	95.5	±2.1%
		Y	0.0	0.0	1.0		97.6	
		Z	0.0	0.0	1.0		98.7	

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 Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY – Parameters of Probe: EX3DV4 - SN: 3633

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)
850	41.5	0.92	9.32	9.32	9.32	0.15	1.40	±12%
900	41.5	0.97	9.23	9.23	9.23	0.15	1.33	±12%
1810	40.0	1.40	8.07	8.07	8.07	0.14	1.93	±12%
1900	40.0	1.40	7.92	7.92	7.92	0.17	1.76	±12%
2000	40.0	1.40	8.01	8.01	8.01	0.12	3.32	±12%
2450	39.2	1.80	7.78	7.78	7.78	0.36	1.00	±12%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequency 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.

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DASY – Parameters of Probe: EX3DV4 - SN: 3633

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)
850	55.2	0.99	9.52	9.52	9.52	0.24	1.16	±12%
900	52.7	1.05	9.58	9.58	9.58	0.28	1.03	±12%
1810	53.3	1.52	7.71	7.71	7.71	0.14	2.61	±12%
1900	53.3	1.52	7.37	7.37	7.37	0.14	3.60	±12%
2000	53.3	1.52	7.73	7.73	7.73	0.15	3.47	±12%
2450	52.7	1.95	7.60	7.60	7.60	0.42	0.97	±12%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequency 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.

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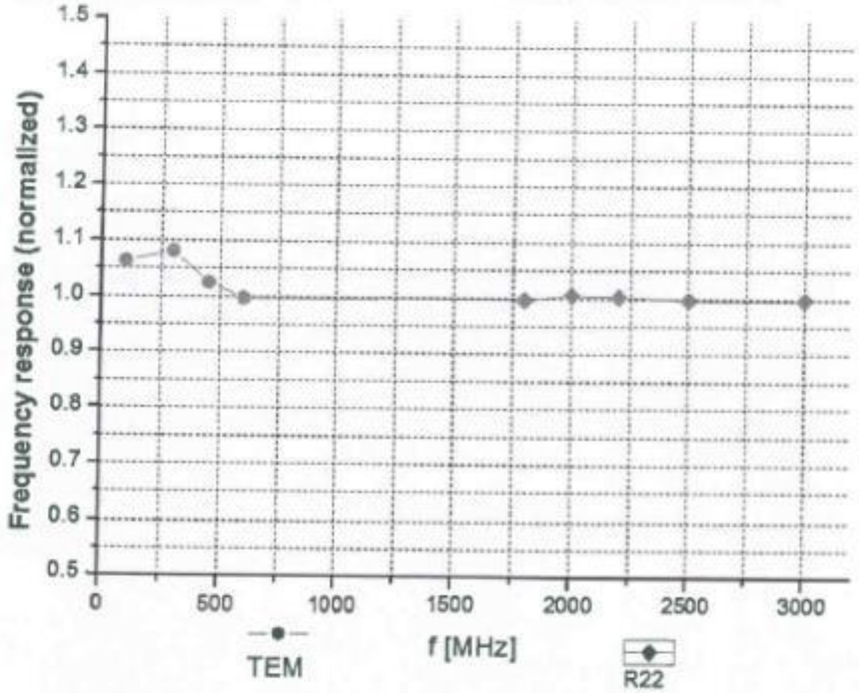
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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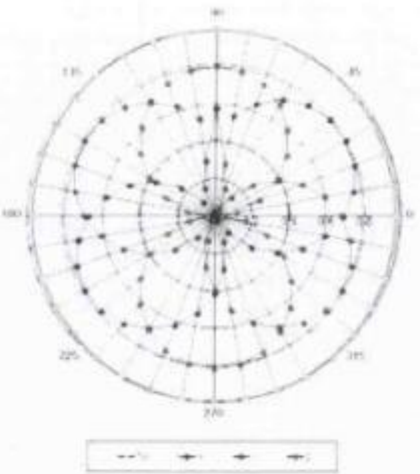
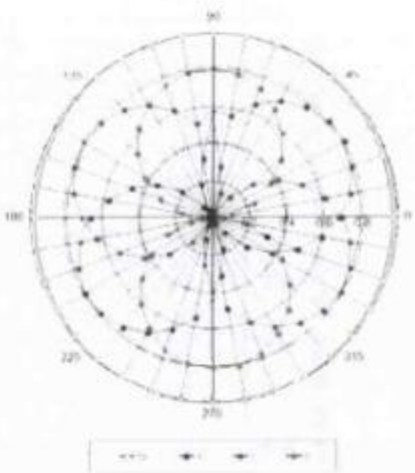
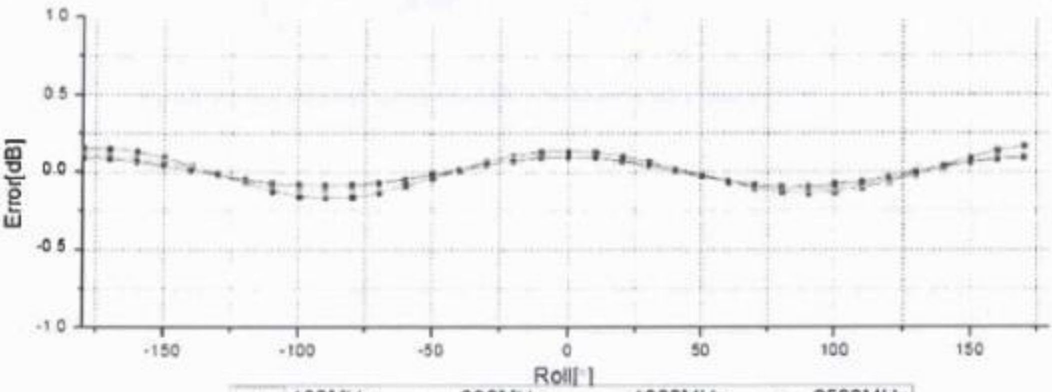
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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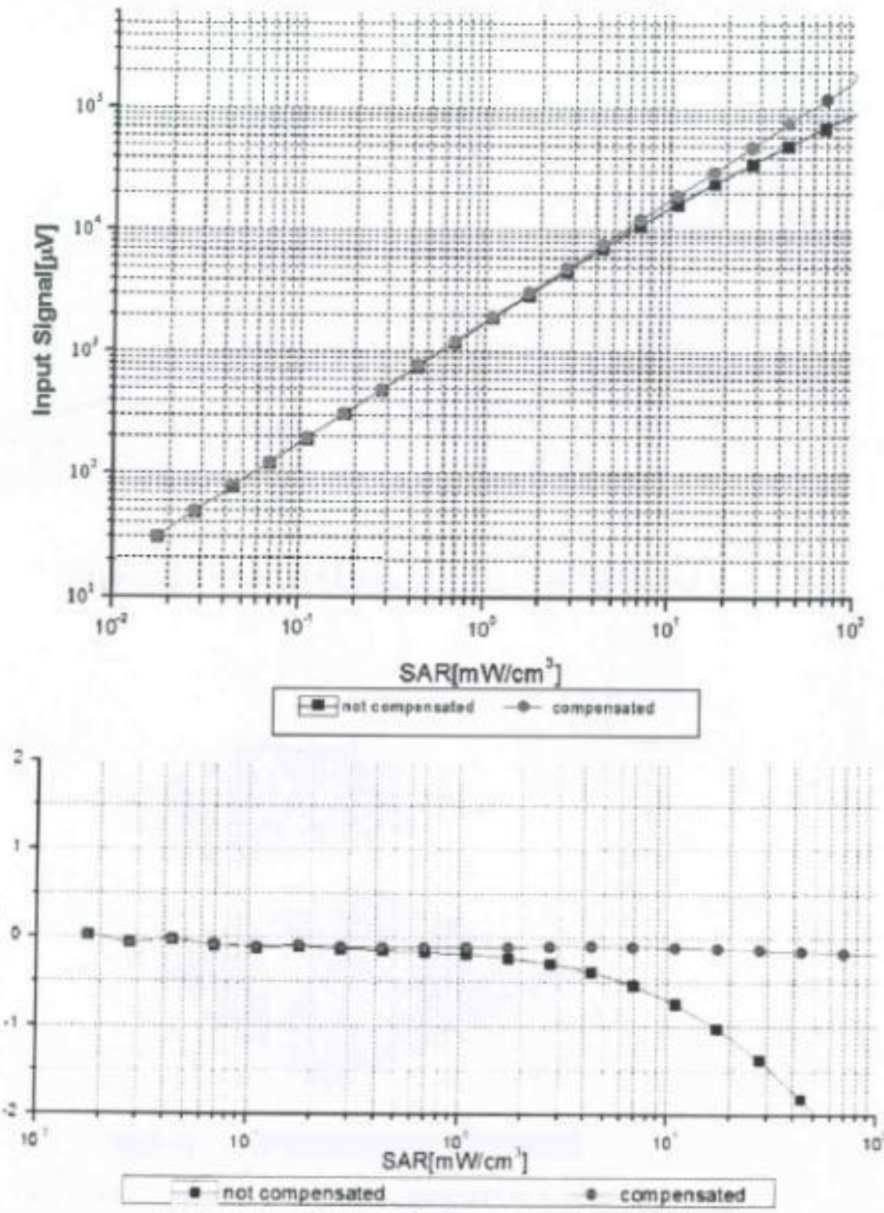
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)



Uncertainty of Linearity Assessment: ±0.9% (k=2)

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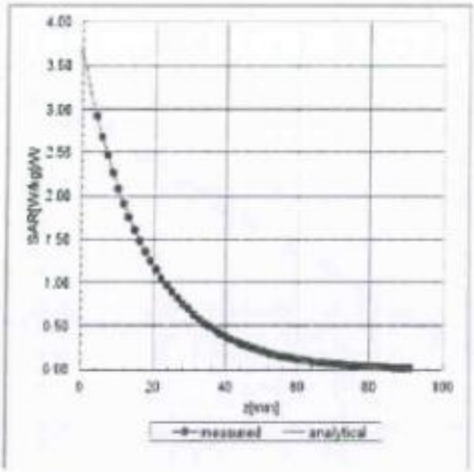
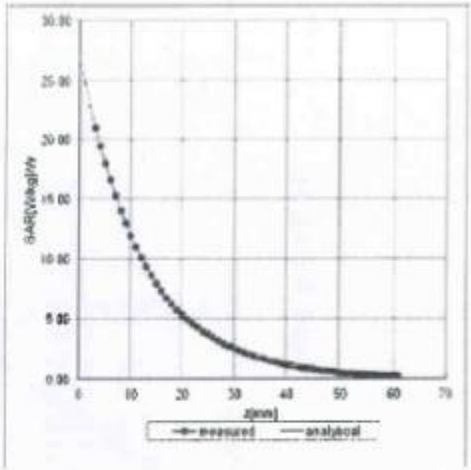
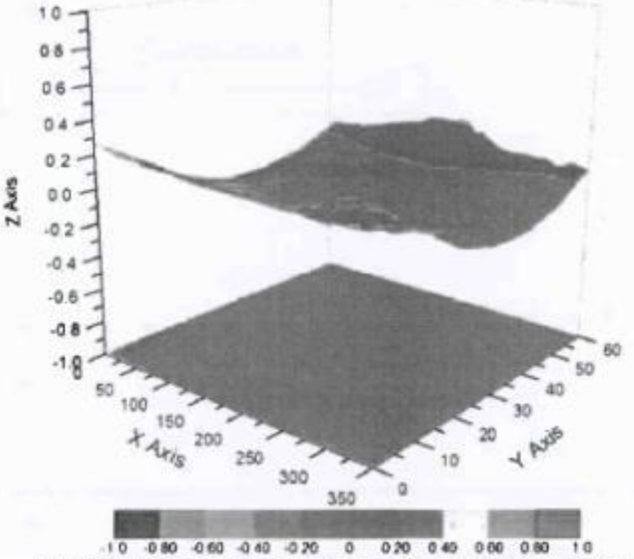
Conversion Factor Assessment

f=900 MHz, WGLS R9(H_convF) **f=1900 MHz, WGLS R22(H_convF)**





Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY - Parameters of Probe: EX3DV4 - SN: 3633

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	8
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	2mm

OET

June 26, 2013

Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MIIT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
   a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
      i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
      ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
   b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
   c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
   d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
   e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
   f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.

3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
   a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
   b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
   c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
   d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.

Probe ES3DV3-SN:3151 Calibration Certificate

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CALIBRATION
No. L0570

Client CTTL(South Branch) Certificate No: Z14-97077

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3151
Calibration Procedure(s)	TMC-OS-E-02-195 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	September 01, 2014

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Power sensor NRP-Z91	101547	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Power sensor NRP-Z91	101548	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Reference10dBAttenuator	BT0520	12-Dec-12(TMC,No.JZ12-867)	Dec-14
Reference20dBAttenuator	BT0267	12-Dec-12(TMC,No.JZ12-866)	Dec-14
Reference Probe EX3DV4	SN 3846	03-Sep-13(SPEAG,No.EX3-3846_Sep13)	Sep-14
DAE4	SN 1331	23-Jan-14 (SPEAG, DAE4-1331_Jan14)	Jan -15
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	01-Jul-14 (CTTL, No.J14X02145)	Jun-15
Network Analyzer E5071C	MY46110673	15-Feb-14 (TMC, No.JZ14-781)	Feb-15

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: September 02, 2014

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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 θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued 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±50MHz to±100MHz.
- *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.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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Probe ES3DV3

SN: 3151

Calibrated: September 01, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY – Parameters of Probe: ES3DV3 - SN: 3151

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m)^2)[A]	1.11	1.20	1.14	±10.8%
DCP(mV)[B]	103.4	103.3	102.9	

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	264.1	±2.3%
		Y	0.0	0.0	1.0		275.7	
		Z	0.0	0.0	1.0		268.7	

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 Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY – Parameters of Probe: ES3DV3 - SN: 3151

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[G]	Depth[G] (mm)	Unct. (k=2)
850	41.5	0.92	6.04	6.04	6.04	0.41	1.49	±12%
900	41.5	0.97	6.17	6.17	6.17	0.38	1.55	±12%
1810	40.0	1.40	5.44	5.44	5.44	0.57	1.49	±12%
1900	40.0	1.40	5.16	5.16	5.16	0.74	1.25	±12%
2000	40.0	1.40	5.23	5.23	5.23	0.50	1.57	±12%
2100	39.8	1.49	5.25	5.25	5.25	0.74	1.24	±12%
2300	39.5	1.67	4.91	4.91	4.91	0.73	1.21	±12%
2450	39.2	1.80	4.71	4.71	4.71	0.82	1.16	±12%
2600	39.0	1.96	4.57	4.57	4.57	0.89	1.14	±12%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

[F] At frequency 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.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY – Parameters of Probe: ES3DV3 - SN: 3151

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[G]	Depth[G] (mm)	Unct. (k=2)
850	55.2	0.99	6.14	6.14	6.14	0.34	1.78	±12%
900	55.0	1.05	6.08	6.08	6.08	0.51	1.43	±12%
1810	53.3	1.52	5.03	5.03	5.03	0.52	1.54	±12%
1900	53.3	1.52	4.77	4.77	4.77	0.48	1.66	±12%
2000	53.3	1.52	5.00	5.00	5.00	0.68	1.33	±12%
2100	53.2	1.62	5.04	5.04	5.04	0.73	1.32	±12%
2300	52.9	1.81	4.56	4.56	4.56	0.58	1.57	±12%
2450	52.7	1.95	4.42	4.42	4.42	0.67	1.39	±12%
2600	52.5	2.16	4.26	4.26	4.26	0.69	1.37	±12%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

[F] At frequency 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.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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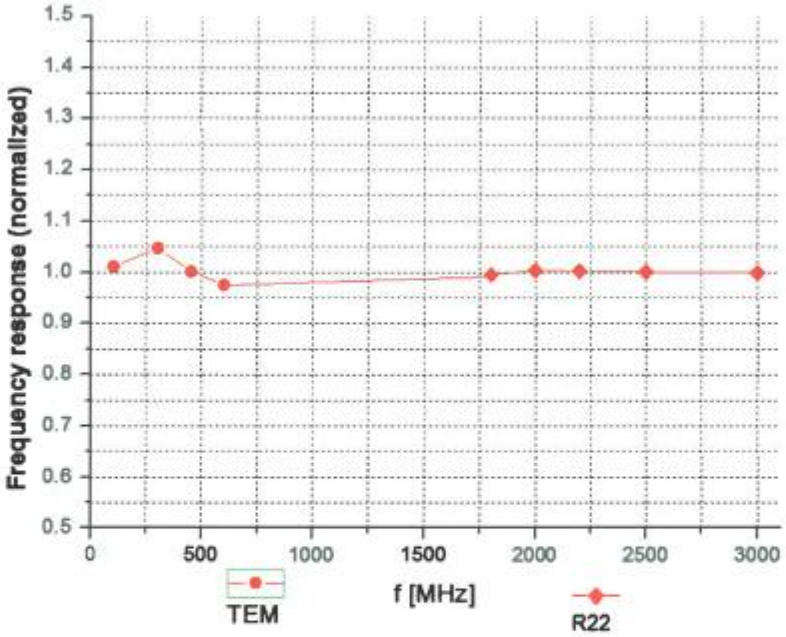
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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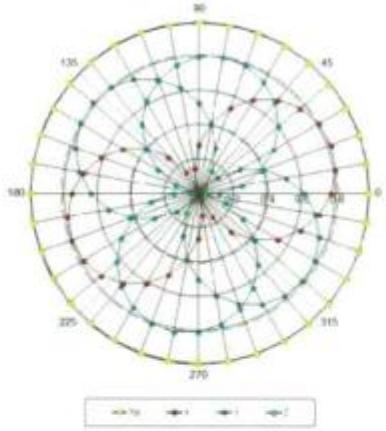
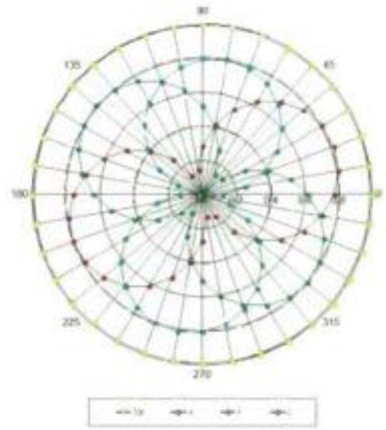
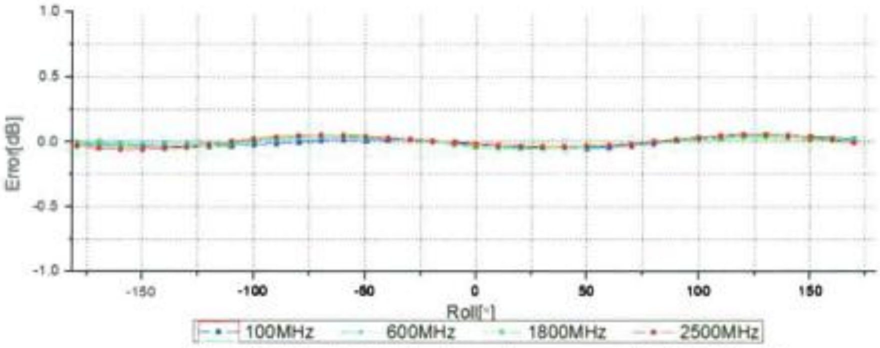
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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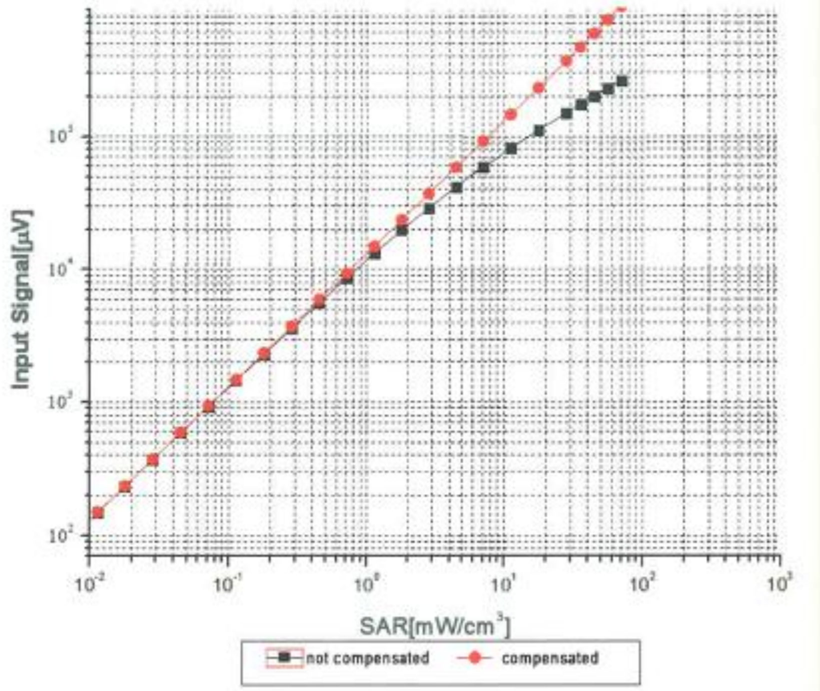
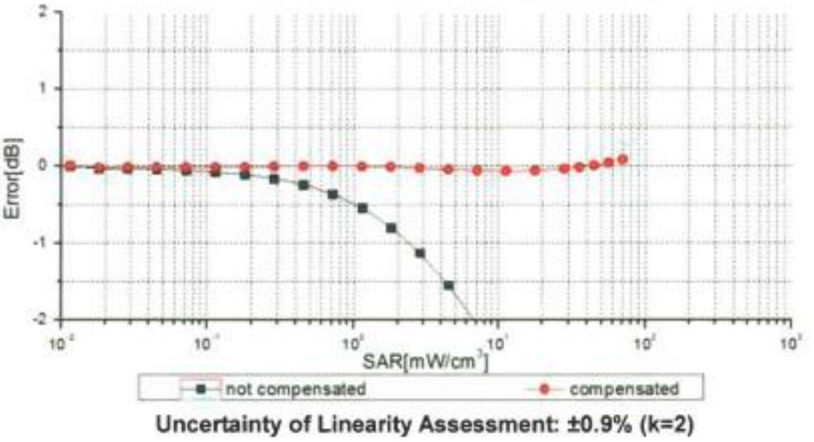
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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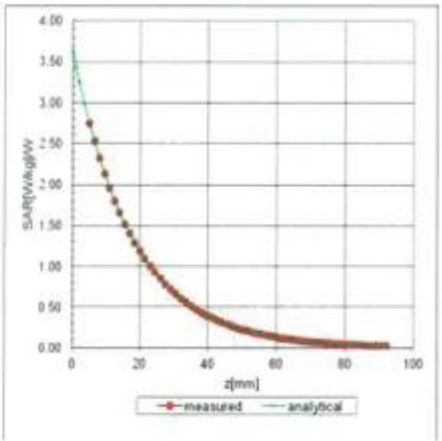
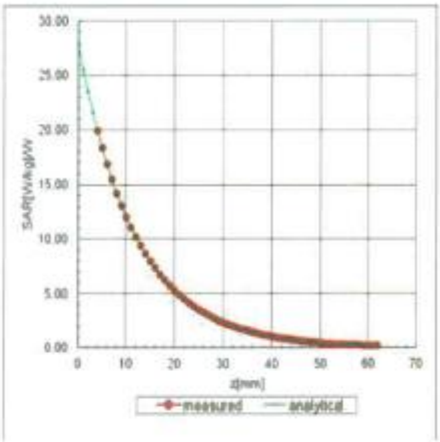
Conversion Factor Assessment

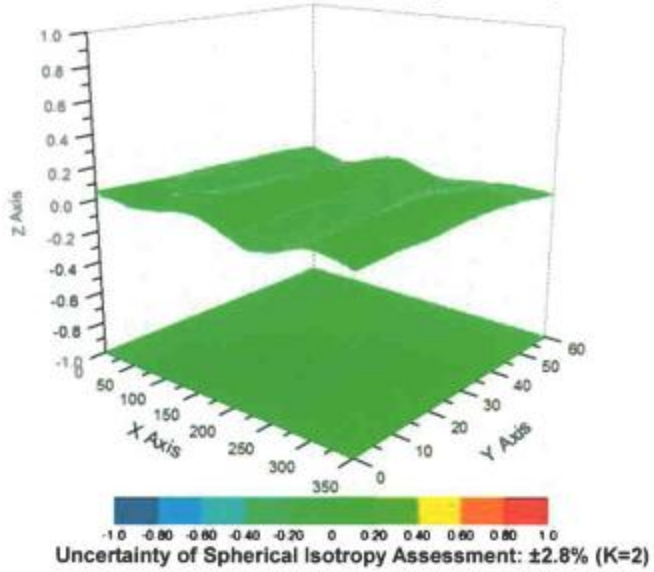
f=900 MHz, WGLS R9(H_convF)



f=1810 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY - Parameters of Probe: ES3DV3 - SN: 3151

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	85.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	4mm
Probe Tip to Sensor X Calibration Point	2mm
Probe Tip to Sensor Y Calibration Point	2mm
Probe Tip to Sensor Z Calibration Point	2mm
Recommended Measurement Distance from Surface	3mm

ANNEX H Dipole Calibration Certificate

1900 MHz Dipole Calibration Certificate

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

ilac-MRA

SWISS CALIBRATION

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 **TMC-SZ (Auden)**

Certificate No: **D1900V2-5d088_Oct12**

CALIBRATION CERTIFICATE

Object: D1900V2 - SN: 5d088

受控文件
TMC-CC- 12-037 SZ 01

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

Calibration date: October 17, 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	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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 17, 2012

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**

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	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.86 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.9 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.54 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.4 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0 Ω + 5.9 jΩ
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9 Ω + 6.2 jΩ
Return Loss	- 24.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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	June 28, 2006

DASY5 Validation Report for Head TSL

Date: 17.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

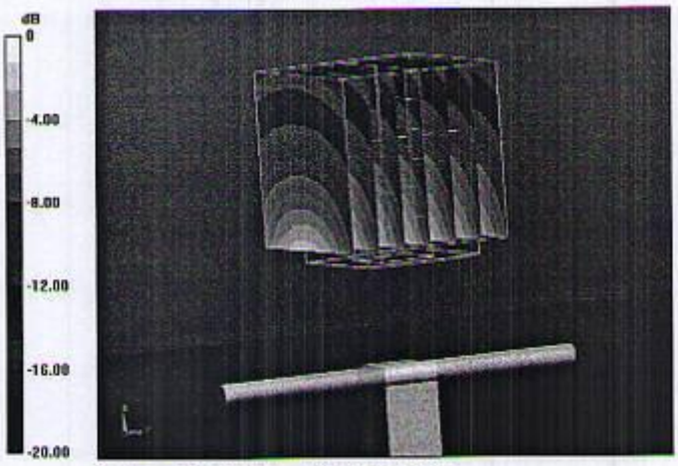
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 mho/m; ε_r = 40; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

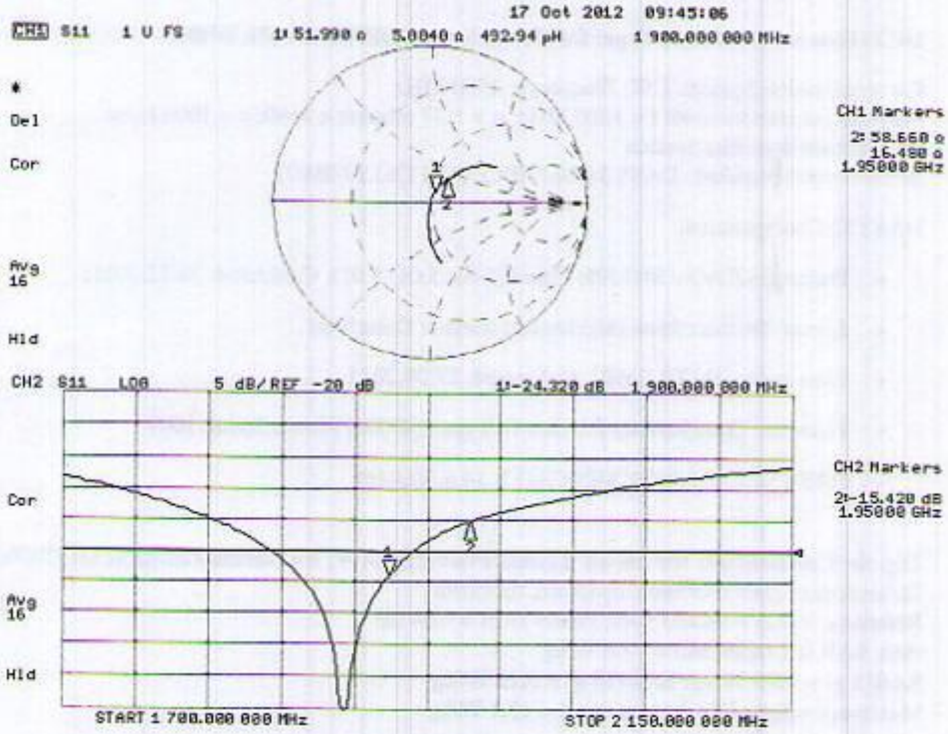
- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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 = 94.805 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 9.86 W/kg; SAR(10 g) = 5.19 W/kg
Maximum value of SAR (measured) = 12.1 W/kg



0 dB = 12.1 W/kg = 10.83 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 17.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

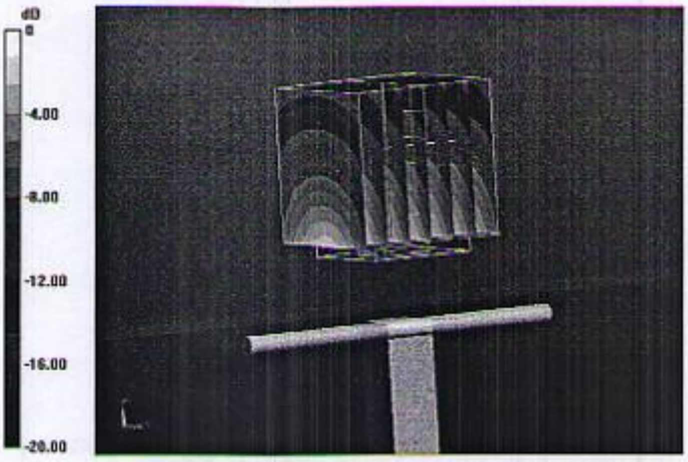
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d088

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.54 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

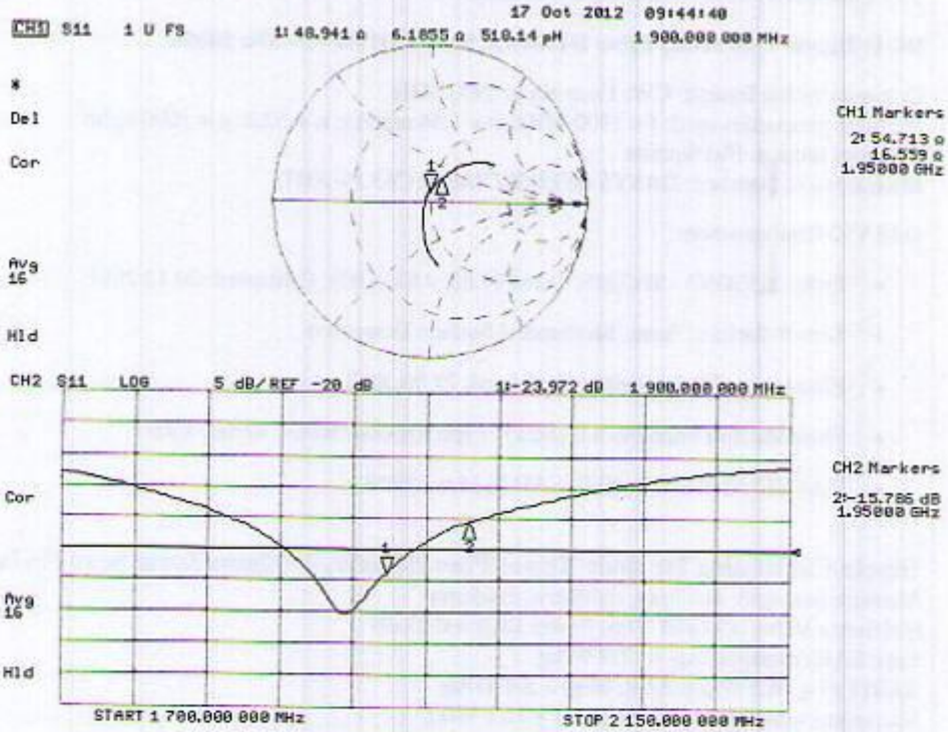
- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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 = 94.805 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 17.9 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.4 W/kg
Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Body TSL



2450 MHz Dipole Calibration Certificate

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **TMC-SZ (Auden)**

Certificate No: **D2450V2-873_Oct12**

CALIBRATION CERTIFICATE

受控文件
TMC-CC-12-268-02

Object	D2450V2 - SN: 873
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	October 18, 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	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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 18, 2012

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

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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	V52.8.3
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	38.4 ± 6 %	1.85 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 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	51.0 ± 6 %	2.02 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	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.01 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.7 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2 Ω + 1.5 jΩ
Return Loss	- 29.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.9 Ω + 3.5 jΩ
Return Loss	- 29.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 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	August 18, 2010

DASY5 Validation Report for Head TSL

Date: 18.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

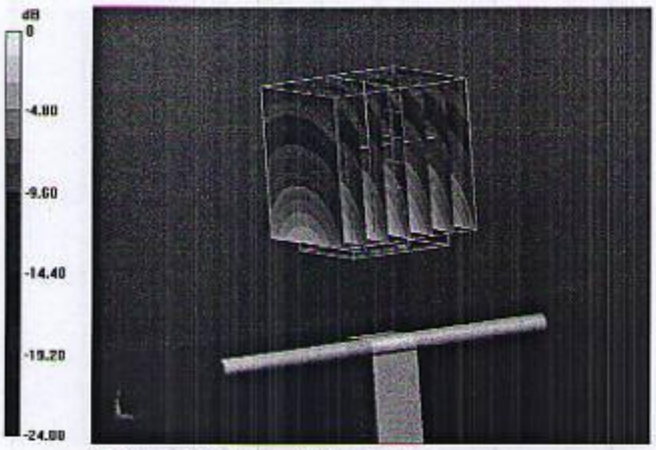
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 873

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 mho/m; ε_r = 38.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

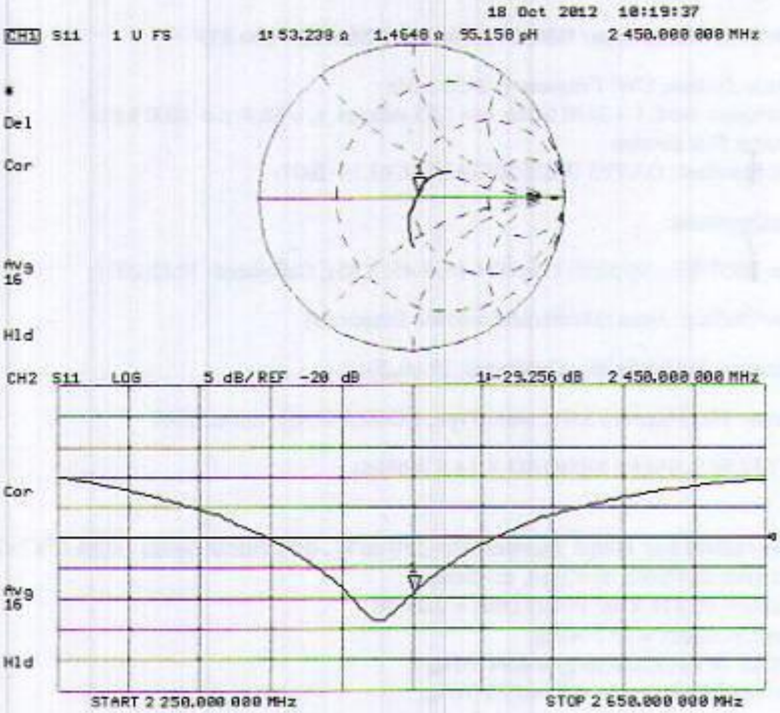
- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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 = 99.414 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 27.3 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.14 W/kg
Maximum value of SAR (measured) = 17.0 W/kg



0 dB = 17.0 W/kg = 12.30 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 18.10.2012

Test Laboratory: SPEAG, Zurich, Switzerland

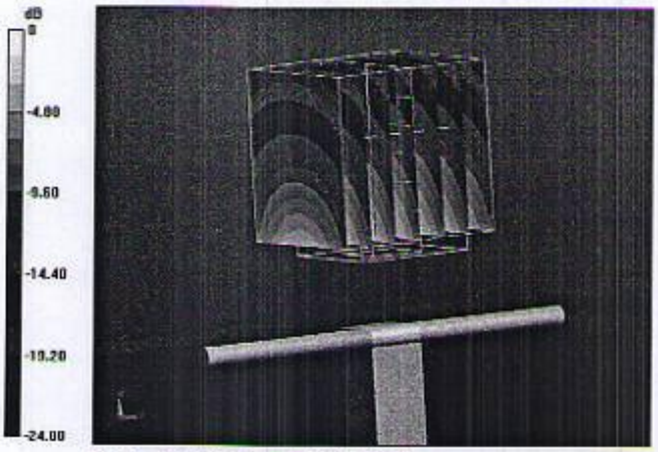
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 873

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 mho/m; ε_r = 51; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

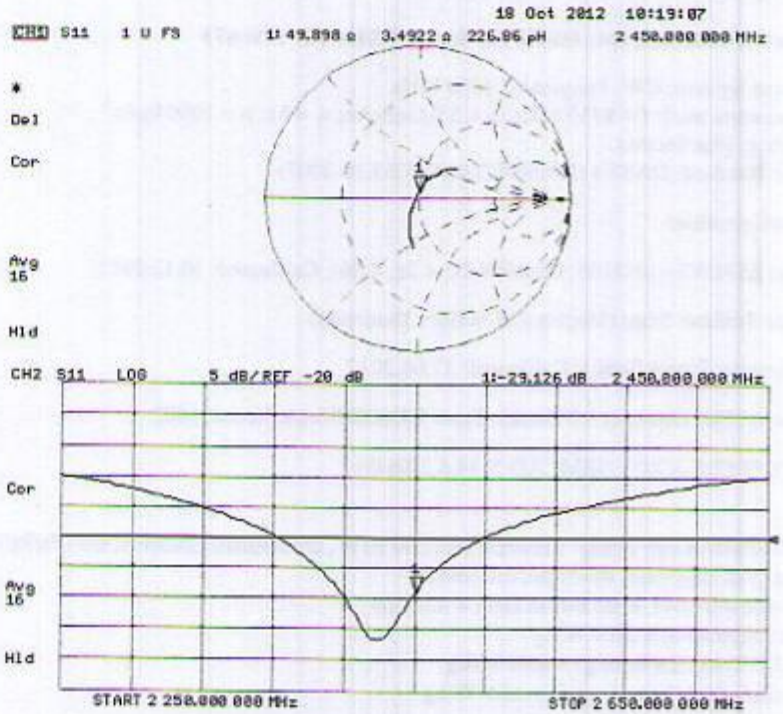
- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

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 = 94.642 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13 W/kg; SAR(10 g) = 6.01 W/kg
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg

Impedance Measurement Plot for Body TSL



2550 MHz Dipole Calibration Certificate

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Accreditation No.: **SCS 108**

Client **TMC-SZ (Auden)**

Certificate No: **D2550V2-1010_Jun13**

CALIBRATION CERTIFICATE

Object	D2550V2 - SN: 1010
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	June 07, 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 EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	*(signature)*
Approved by:	Katja Pokovic	Technical Manager	*(signature)*

Issued: June 7, 2013

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

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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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2550 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.1	1.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.3 ± 6 %	1.92 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	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**57.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**26.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.6	2.09 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.6 ± 6 %	2.11 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	13.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**54.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.4 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 Ω - 3.0 jΩ
Return Loss	- 28.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5 Ω - 2.2 jΩ
Return Loss	- 32.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.152 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	August 03, 2012

DASY5 Validation Report for Head TSL

Date: 07.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

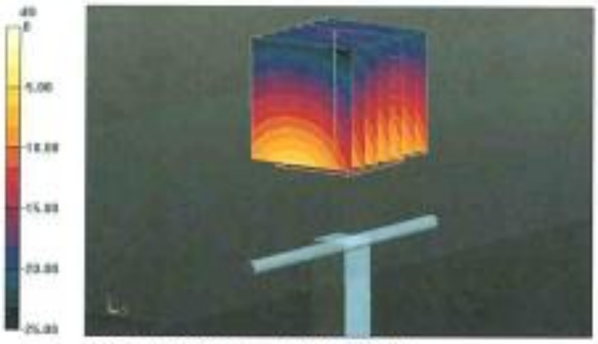
DUT: Dipole 2550 MHz; Type: D2550V2; Serial: D2550V2 - SN: 1010

Communication System: UID 0 - CW ; Frequency: 2550 MHz
Medium parameters used: f = 2550 MHz; σ = 1.92 S/m; ε_r = 37.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

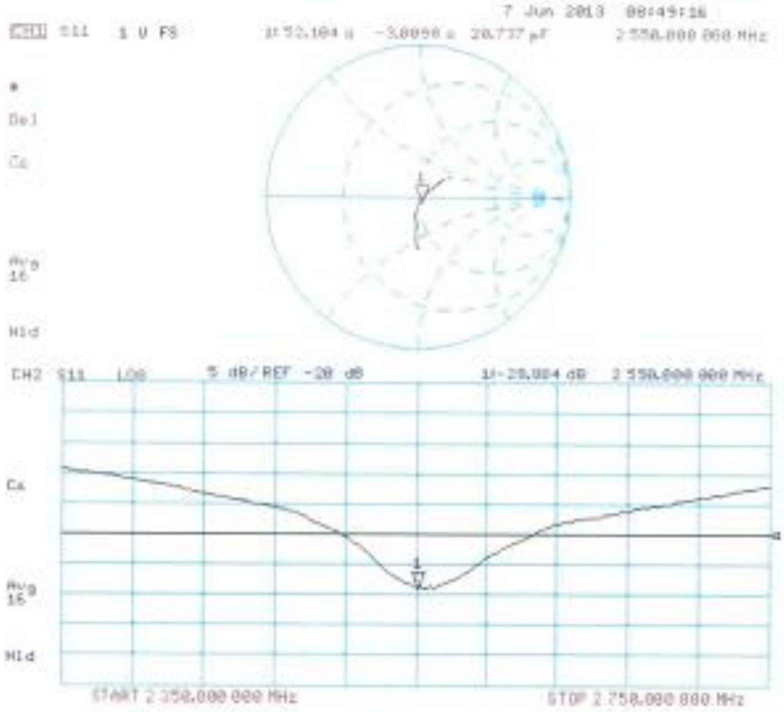
- Probe: ES3DV3 - SN3205; ConvF(4.49, 4.49, 4.49); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.909 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.8 W/kg
SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.55 W/kg
Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.06.2013

Test Laboratory: SPEAG, Zurich, Switzerland

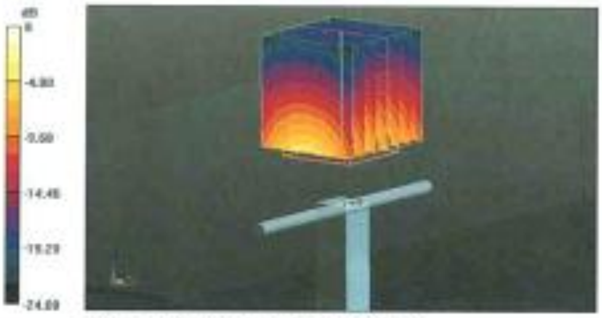
DUT: Dipole 2550 MHz; Type: D2550V2; Serial: D2550V2 - SN: 1010

Communication System: UID 0 - CW ; Frequency: 2550 MHz
Medium parameters used: f = 2550 MHz; σ = 2.11 S/m; ε_r = 50.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 95.694 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.16 W/kg
Maximum value of SAR (measured) = 18.2 W/kg



0 dB = 18.2 W/kg = 12.60 dBW/kg

Impedance Measurement Plot for Body TSL