SAR TEST REPORT

No. I17Z60667-SEM01

For

TCL Communication Ltd.

UMTS/GSM Smart Phone

Model name: 5011A

With

Hardware Version: PIO

Software Version: V1.0

FCC ID: 2ACCJB091

Issued Date: 2017-6-12

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 CTTL.

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
I17Z60667-SEM01	Rev.0	2017-6-12	Initial creation of test report

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1 Test Laboratory

1.1 Testing Location

Company Name:	CTTL(Shouxiang)
Address:	No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China100191

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

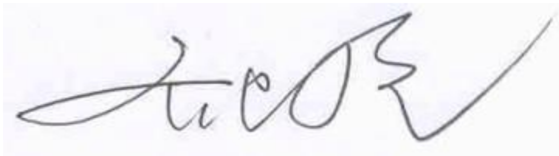
1.3 Project Data

Project Leader:	Qi Dianyuan
Test Engineer:	Lin Xiaojun
Testing Start Date:	May 12, 2017
Testing End Date:	May 15, 2017

1.4 Signature

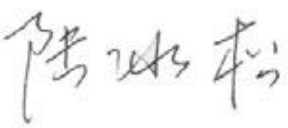
Lin Xiaojun

(Prepared this test report)



Qi Dianyuan

(Reviewed this test report)



Lu Bingsong

Deputy Director of the laboratory

(Approved this test report)

2 Statement of Compliance

The maximum results of SAR found during testing for TCL Communication Ltd. UMTS/GSM Smart Phone 5011A are as follows:

Table 2.1: Highest Reported SAR (1g)

Exposure Configuration	Technology Band	Highest Reported SAR 1g(W/Kg)	Equipment Class
Head (Separation Distance 0mm)	GSM 850	0.28	PCE
	PCS 1900	0.18	
	UMTS FDD 5	0.18	
	UMTS FDD 4	0.24	
	UMTS FDD 2	0.30	
	WLAN 2.4 GHz	0.64	DTS
Hotspot (Separation Distance 10mm)	GSM 850	0.71	PCE
	PCS 1900	1.37	
	UMTS FDD 5	0.33	
	UMTS FDD 4	0.92	
	UMTS FDD 2	1.24	
	WLAN 2.4 GHz	0.08	DTS

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 C95.1-1992.

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 2.1),** and the values are**: 1.37 W/kg(1g).**

Table 2.2: The sum of reported SAR values for main antenna and WiFi

	Position	Main antenna	WiFi	Sum
Highest reported SAR value for Head	Left hand, Touch cheek	0.30	0.59	**0.89**
	Left hand, Tilt 15°	0.15	0.64	**0.79**
Highest reported SAR value for Body	Rear	1.37	0.07	**1.44**
	Top	/	0.08	**0.08**

Table 2.3: The sum of reported SAR values for main antenna and BT

	Position	Main antenna	BT	Sum
Maximum reported SAR value for Head	Left hand, Touch cheek	0.30	0.17[1]	**0.47**
Maximum reported SAR value for Body	Rear	1.37	0.09[1]	**1.46**

[1] - Estimated SAR for Bluetooth (see the table 13.3)

According to the above tables, the highest sum of reported SAR values is **1.46 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

According to the KDB648474 D04, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB Publication 865664 D01 to address interactive hand use exposure conditions. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg

Table 2.4: 0mm Reported SAR for phablet (10g)

Exposure Configuration	Technology Band	Position	Highest Reported SAR10g(W/kg)	Limit 10g (W/kg)
Hotspot (Separation Distance 0mm)	GSM 1900	Rear	3.85	4.0
		Bottom	3.59	4.0
	WCDMA 1900	Rear	3.01	4.0

3 Client Information

3.1 Applicant Information

Company Name:	TCL Communication Ltd.
Address/Post:	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
City:	Shanghai
Country:	China
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Telephone:	0086-21-31363544
Fax:	0086-21-61460602

3.2 Manufacturer Information

Company Name:	TCL Communication Ltd.
Address/Post:	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
City:	Shanghai
Country:	China
Contact Person:	Gong Zhizhou
E-mail:	zhizhou.gong@tcl.com
Telephone:	0086-21-31363544
Fax:	0086-21-61460602

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

4.1 About EUT

Description:	UMTS/GSM Smart Phone
Model name:	5011A
Operating mode(s):	GSM 850/900/1800/1900, WCDMA 850/900/1700/1900/2100 BT, Wi-Fi
Tested Tx Frequency:	825 – 848.8 MHz (GSM 850)
	1850.2 – 1910 MHz (GSM 1900)
	826.4–846.6 MHz (WCDMA 850 Band V)
	1712.4 – 1752.6 MHz (WCDMA 1700 Band IV)
	1852.4–1907.6 MHz (WCDMA1900 Band II)
	2412 – 2462 MHz (Wi-Fi 2.4G)
GPRS/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
Hotspot mode:	Support
Product dimension	Long 152.7mm ; Wide 77mm ; Diagonal 170.8mm

4.2 Internal Identification of EUT used during the test

EUT ID*	IMEI	HW	SW Version
EUT1	358269080006249	PIO	V1.0
EUT2	358269080006223	PIO	V1.0
EUT3	358269080007411	PIO	V1.0
EUT4	358269080007726	PIO	V1.0

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

Note: It is performed to test SAR with the EUT1&2 and conducted power with the EUT 3&4.

4.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	CAB2500006C7	/	VEKEN
AE2	Headset	CCB0046A11C1	/	JUWEI
AE3	Headset	CCB0046A11C6	/	SHENGHUA

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

5 TEST METHODOLOGY

5.1 Applicable Limit Regulations

ANSI C95.1–1992: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 Head from Wireless Communications Devices: Measurement Techniques.

KDB447498 D01: General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB648474 D04 Handset SAR v01r03: SAR Evaluation Considerations for Wireless Handsets.

KDB941225 D01 SAR test for 3G devices v03r01: SAR Measurement Procedures for 3G Devices

KDB941225 D06 Hotspot Mode SAR v02r01: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

KDB248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

KDB865664 D01SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz.

KDB865664 D02RF Exposure Reporting v01r02: 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:

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

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

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

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

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

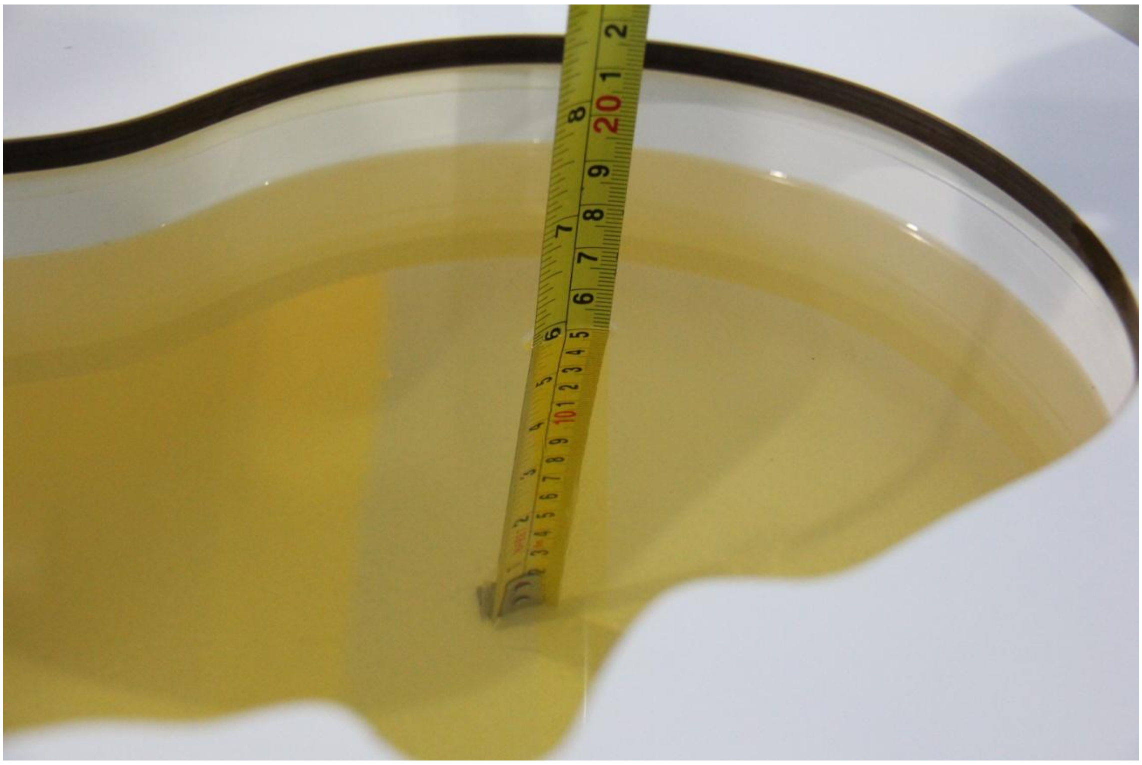
Frequency(MHz)	Liquid Type	Conductivity(σ)	± 5% Range	Permittivity(ε)	± 5% Range
835	Head	0.90	0.86～0.95	41.5	39.4～43.6
835	Body	0.97	0.92～1.02	55.2	52.4～58.0
1750	Head	1.37	1.30～1.44	40.08	38.1～42.1
1750	Body	1.49	1.42～1.56	53.4	50.7～56.1
1900	Head	1.40	1.33～1.47	40.0	38.0～42.0
1900	Body	1.52	1.44～1.60	53.3	50.6～56.0
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2
2450	Body	1.95	1.85～2.05	52.7	50.1～55.3

7.2 Dielectric Performance

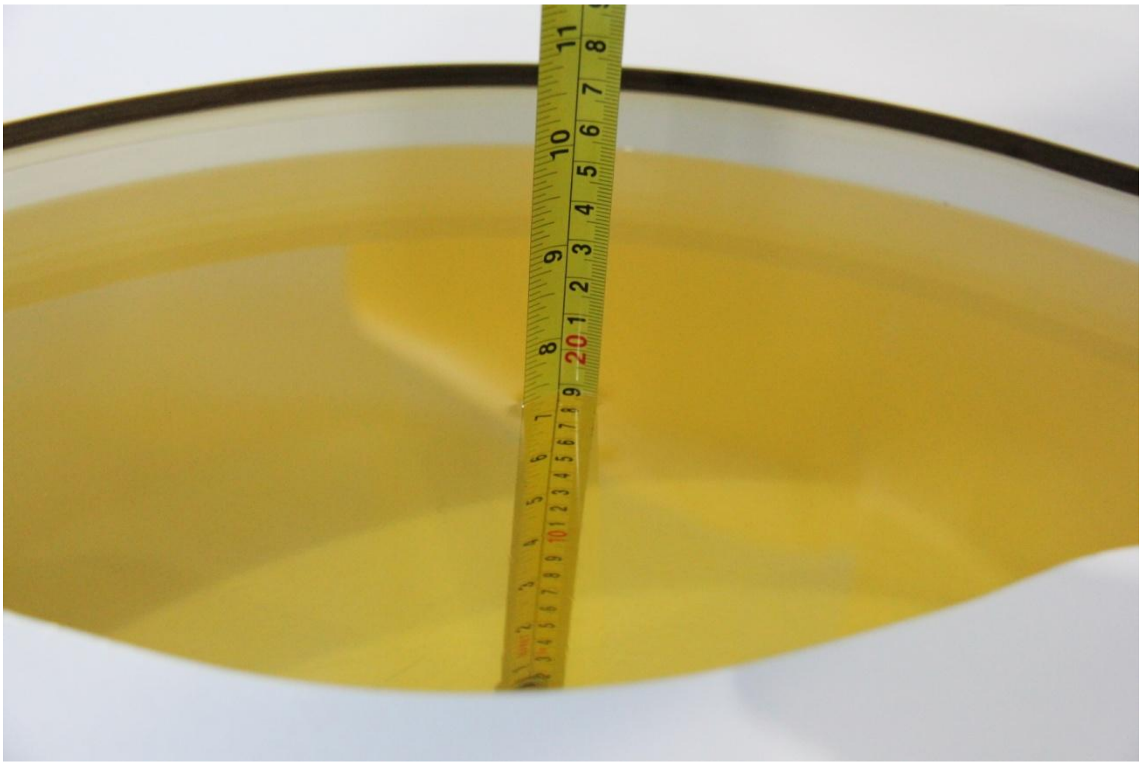
Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	Type	Frequency	Permittivity ε	Drift (%)	Conductivity σ (S/m)	Drift (%)
2017-5-12	Head	835 MHz	41.27	-0.55	0.89	-1.11
	Body	835 MHz	56.03	1.50	0.973	0.31
2017-5-13	Head	1750 MHz	40.13	0.12	1.345	-1.82
	Body	1750 MHz	53.53	0.24	1.503	0.87
2017-5-14	Head	1900 MHz	39.77	-0.57	1.413	0.93
	Body	1900 MHz	53.16	-0.26	1.506	-0.92
2017-5-15	Head	2450 MHz	39.29	0.23	1.801	0.06
	Body	2450 MHz	53.56	1.63	1.986	1.85

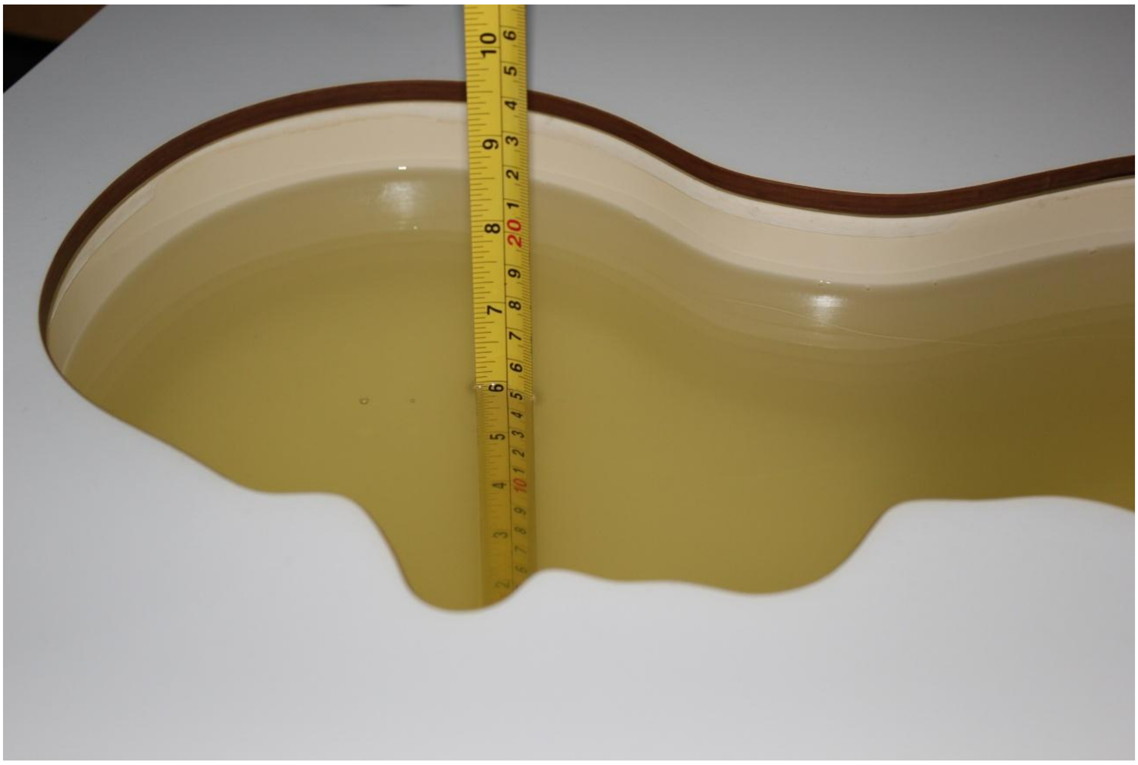
Note: The liquid temperature is 22.0°C



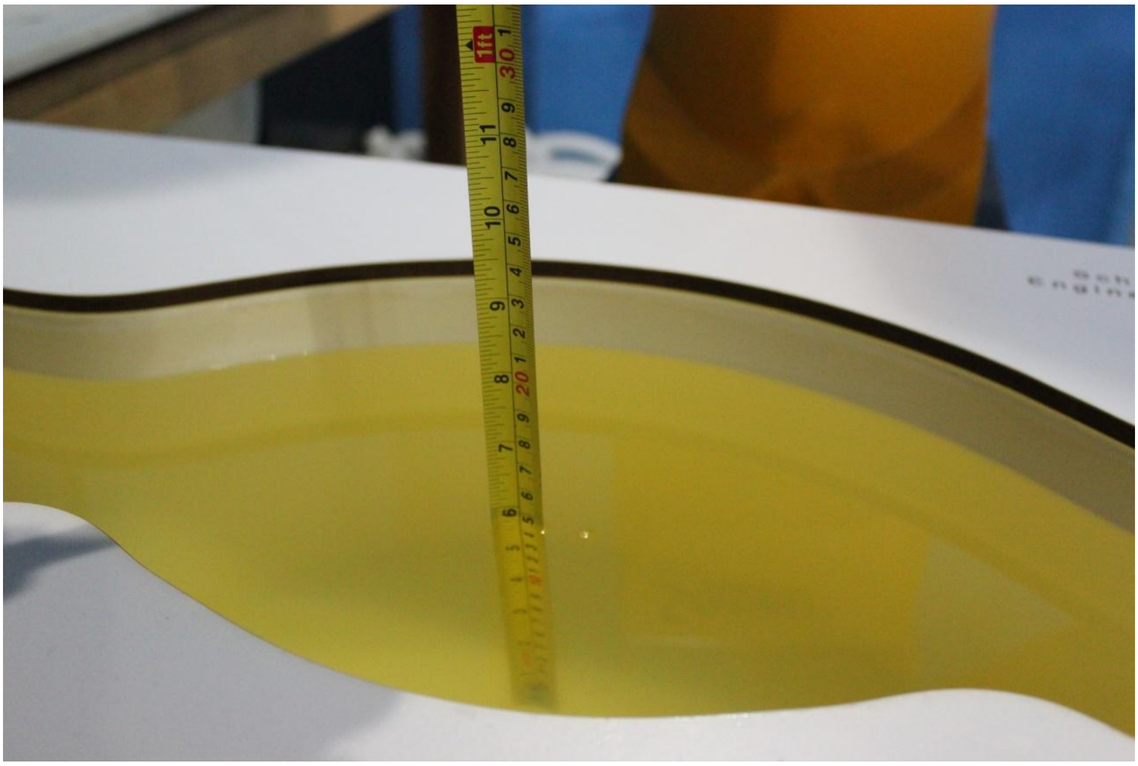
Picture 7-1 Liquid depth in the Head Phantom (835 MHz)



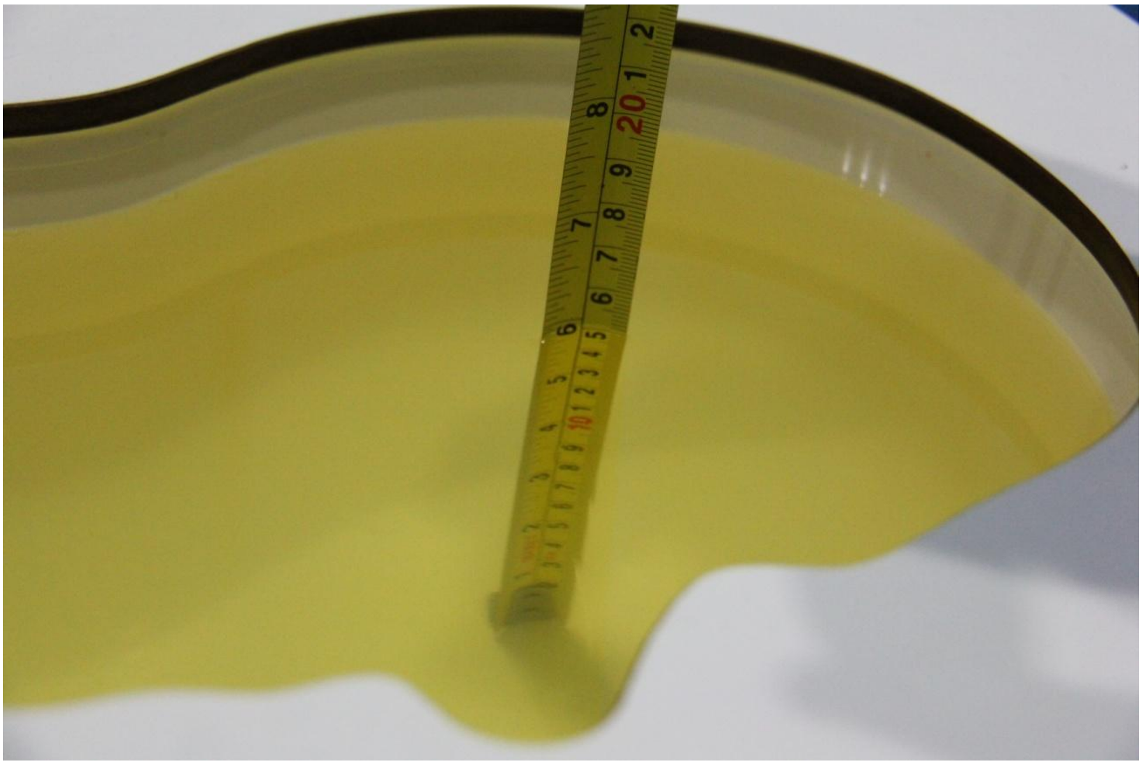
Picture 7-2 Liquid depth in the Flat Phantom (835 MHz)



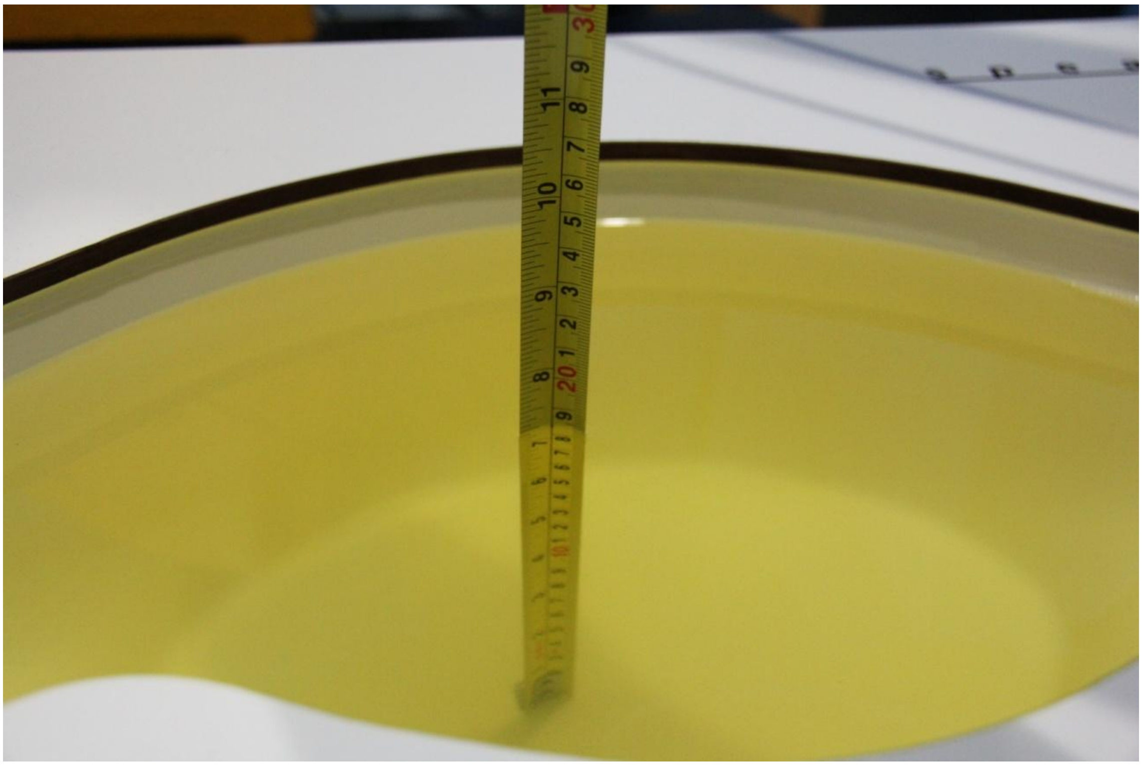
Picture 7-3 Liquid depth in the Head Phantom (1750 MHz)



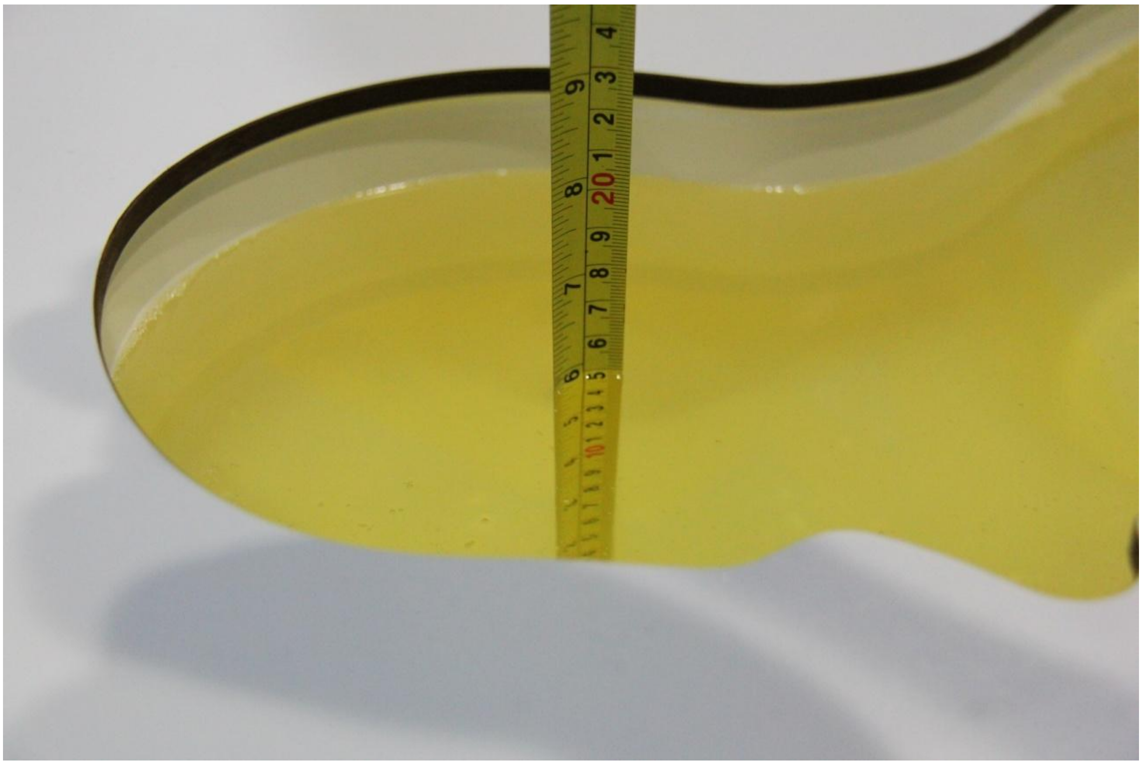
Picture 7-4 Liquid depth in the Flat Phantom (1750MHz)



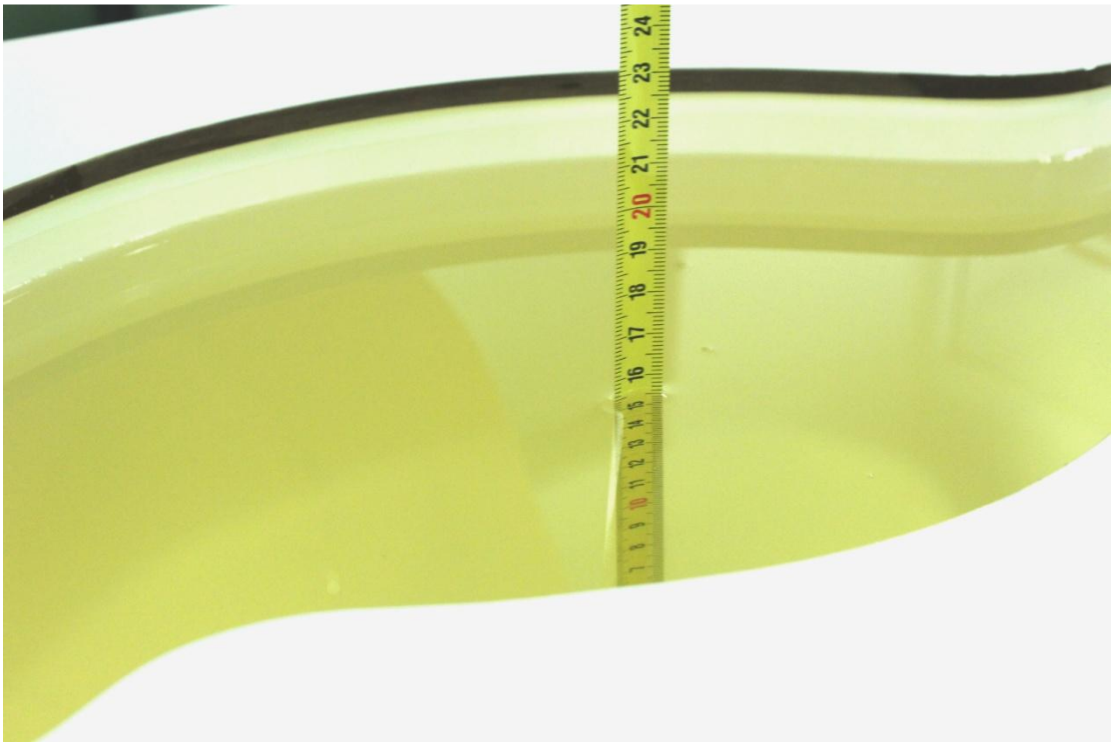
Picture 7-5 Liquid depth in the Head Phantom (1900 MHz)



Picture 7-6 Liquid depth in the Flat Phantom (1900MHz)



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

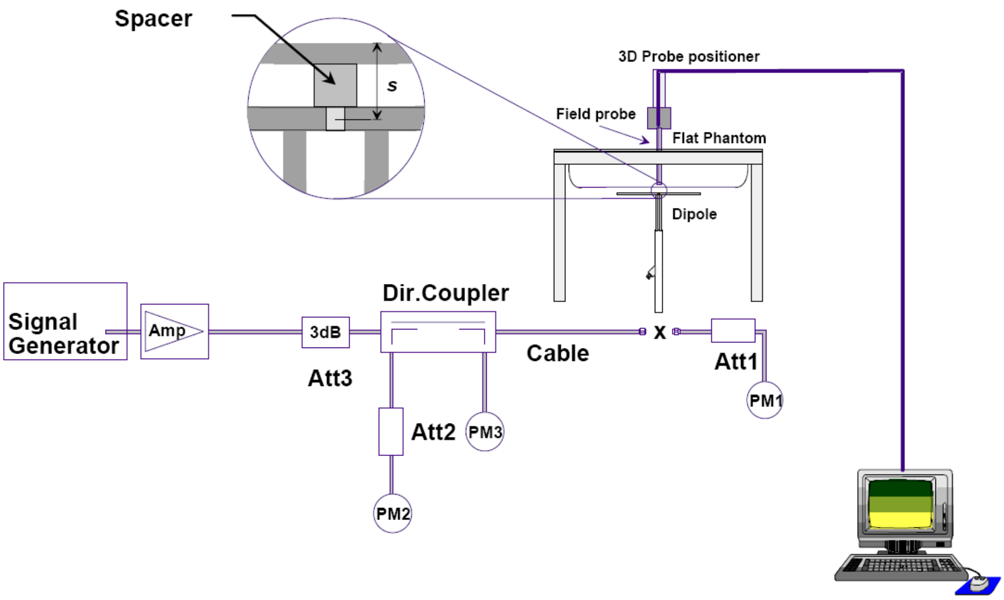


Picture 7-8 Liquid depth in the Flat Phantom (2450MHz)

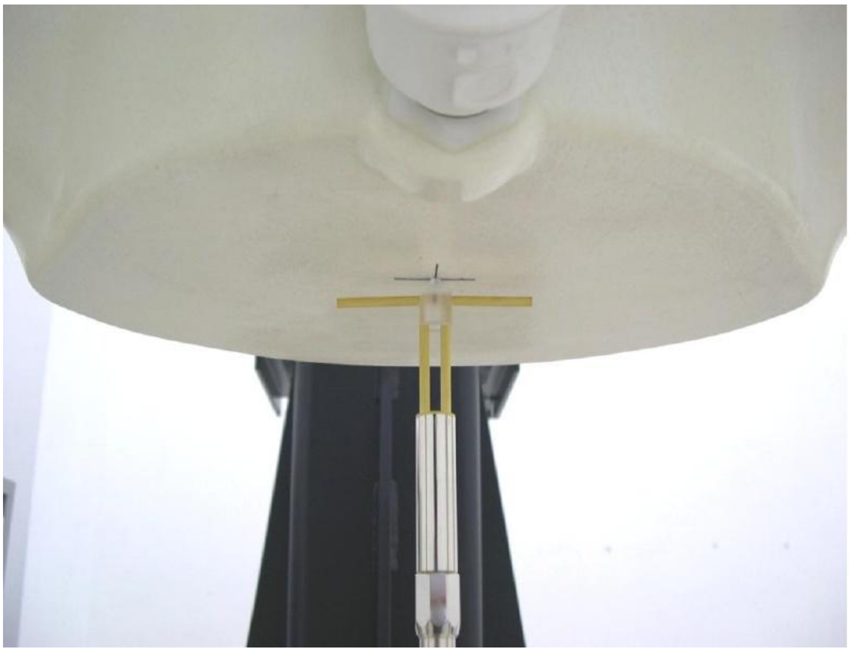
8 System verification

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
2017-5-12	835 MHz	6.18	9.44	6.24	9.28	0.97%	-1.69%
2017-5-13	1750 MHz	19.5	36.8	19.44	36.08	-0.31%	-1.96%
2017-5-14	1900 MHz	21.2	40.7	20.96	40.68	-1.13%	-0.05%
2017-5-15	2450 MHz	24.6	52.8	24.6	53.4	0.00%	1.14%

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
2017-5-12	835 MHz	6.36	9.69	6.32	9.52	-0.63%	-1.75%
2017-5-13	1750 MHz	19.6	37.0	19.44	36.88	-0.82%	-0.32%
2017-5-14	1900 MHz	21.3	40.1	21.2	40.84	-0.47%	1.85%
2017-5-15	2450 MHz	24.1	51.2	24.36	50.28	1.08%	-1.80%

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.

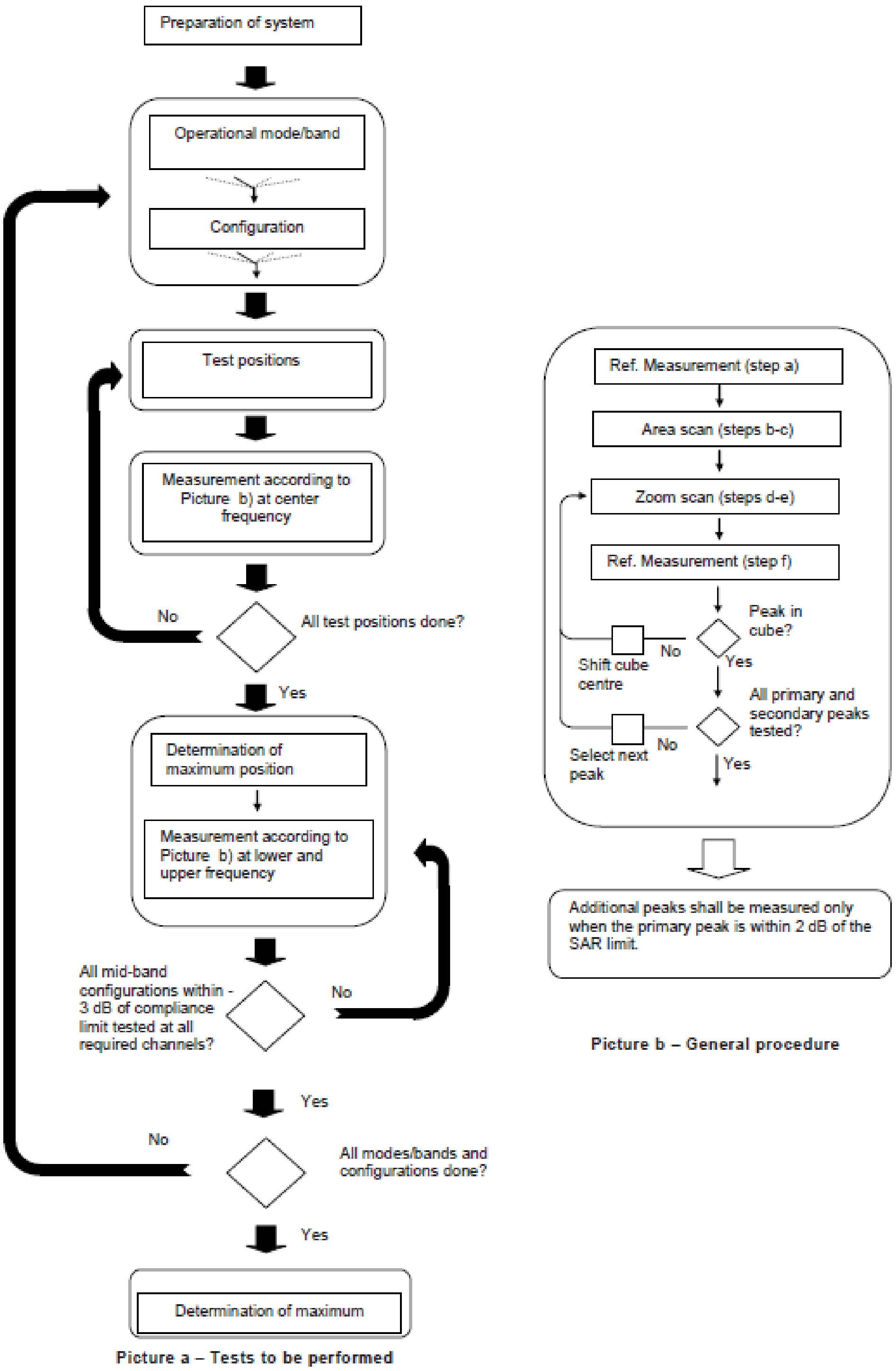
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

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 within3 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 9.1Block 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	1.5	1.5	20	75
2	6/15	15/15	64	6/15	12/15	12/15	12/15	4	1	1.5	1.5	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}:47/15 β_{ed2}:47/15	4	2	1.5	1.5	15	92
4	2/15	15/15	64	2/15	4/15	4/15	56/75	4	1	1.5	1.5	17	71
5	15/15	15/15	64	15/15	24/15	30/15	134/15	4	1	1.5	1.5	21	81

Rel.8 DC-HSDPA (Cat 24)

SAR test exclusion for Rel.8 DC-HSDPA must satisfy the SAR test exclusion requirements of Rel.5 HSDPA. SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion.

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 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 section14 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-gSAR 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 55wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm mare 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 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 11.1-1: The conducted power measurement results for GSM850/1900

GSM 850MHz	Tune up	Conducted Power (dBm)		
		Channel 251(848.8MHz)	Channel 190(836.6MHz)	Channel 128(824.2MHz)
	33.8	33.41	33.38	33.30
GSM 1900MHz	Tune up	Conducted Power(dBm)		
		Channel 810(1909.8MHz)	Channel 661(1880MHz)	Channel 512(1850.2MHz)
	29.6	28.87	28.67	29.06

Table 11.1-2: The conducted power measurement results for GPRS and EGPRS

GSM 850 GPRS (GMSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		251	190	128		251	190	128
1 Txslot	33.80	33.41	33.38	33.30	-9.03	24.38	24.35	24.27
2 Txslots	33.00	32.46	32.42	32.34	-6.02	**26.44**	**26.40**	**26.32**
3Txslots	30.70	30.16	30.13	30.03	-4.26	25.90	25.87	25.77
4 Txslots	29.70	29.18	29.15	29.13	-3.01	26.17	26.14	26.12
GSM 850 EGPRS (GMSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		251	190	128		251	190	128
1 Txslot	33.80	33.37	33.35	33.27	-9.03	24.34	24.32	24.24
2 Txslots	33.00	32.44	32.39	32.32	-6.02	**26.42**	**26.37**	**26.30**
3Txslots	30.70	30.14	30.10	30.00	-4.26	25.88	25.84	25.74
4 Txslots	29.70	29.13	29.13	29.08	-3.01	26.12	26.12	26.07
GSM 850 EGPRS (8PSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		251	190	128		251	190	128
1 Txslot	26.70	26.27	26.09	26.04	-9.03	17.24	17.06	17.01
2 Txslots	25.50	25.02	24.95	24.93	-6.02	19.00	18.93	18.91
3Txslots	23.20	22.77	22.67	22.68	-4.26	18.51	18.41	18.42
4 Txslots	22.00	21.56	21.54	21.52	-3.01	18.55	18.53	18.51
PCS1900 GPRS (GMSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		810	661	512		810	661	512
1 Txslot	29.60	28.87	28.57	29.08	-9.03	19.84	19.54	20.05
2 Txslots	29.00	28.29	28.01	28.49	-6.02	22.27	21.99	22.47
3Txslots	27.40	26.83	26.45	26.95	-4.26	22.57	22.19	22.69
4 Txslots	26.40	25.70	25.41	25.82	-3.01	**22.69**	**22.40**	**22.81**

PCS1900 EGPRS (GMSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		810	661	512		810	661	512
1 Txslot	29.60	28.85	28.57	29.06	-9.03	19.82	19.54	20.03
2 Txslots	29.00	28.27	28.00	28.49	-6.02	22.25	21.98	22.47
3Txslots	27.40	26.81	26.44	26.93	-4.26	22.55	22.18	22.67
4 Txslots	26.40	25.69	25.40	25.80	-3.01	**22.68**	**22.39**	**22.79**
PCS1900 EGPRS (8PSK)	Tune up	Measured Power (dBm)			calculation	Averaged Power (dBm)		
		810	661	512		810	661	512
1 Txslot	26.20	25.58	25.68	25.61	-9.03	16.55	16.65	16.58
2 Txslots	25.00	24.42	24.46	24.46	-6.02	18.40	18.44	18.44
3Txslots	22.50	21.87	21.94	21.80	-4.26	17.61	17.68	17.54
4 Txslots	21.00	20.36	20.41	20.31	-3.01	17.35	17.40	17.30

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 2Txslots for GSM850 and 4Txslots for PCS1900.

11.2 WCDMA Measurement result

Table 11.2-1: The conducted Power for WCDMA

Item	band	Tune up	FDDV result		
	ARFCN		4233(846.6MHz)	4182(836.4MHz)	4132(826.4MHz)
WCDMA	\	23.20	22.66	22.87	22.61
HSUPA	1	21.00	20.19	19.74	19.62
	2	21.00	19.68	19.77	19.60
	3	21.00	20.65	20.74	20.61
	4	20.00	19.13	19.21	19.05
	5	22.00	21.62	21.69	21.57
Item	band	Tune up	FDDIV result		
	ARFCN		1513(1752.6MHz)	1412(1732.4MHz)	1312(1712.4MHz)
WCDMA	\	22.00	21.22	21.29	21.31
HSUPA	1	21.00	20.40	19.90	19.98
	2	21.00	19.90	19.88	19.99
	3	21.00	20.87	20.84	20.95
	4	20.00	19.35	19.32	19.42
	5	22.00	21.86	21.84	21.95
Item	band	Tune up	FDDII result		
	ARFCN		9538(1907.6MHz)	9400(1880MHz)	9262(1852.4MHz)
WCDMA	\	23.00	22.23	22.20	22.31
HSUPA	1	21.00	19.86	19.37	19.39
	2	21.00	19.39	19.37	19.39
	3	21.00	20.36	20.35	20.40
	4	20.00	18.85	18.83	18.88
	5	22.00	21.37	21.37	21.41

11.3 Wi-Fi and BT Measurement result

The output power of BT antenna is as following:

Mode	Tune up	Conducted Power (dBm)		
		Channel 0 (2402MHz)	Channel 39 (2441MHz)	Channel 78(2480MHz)
GFSK	6.2	5.94	5.67	5.98
EDR2M-4_DQPSK	6	5.49	5.23	5.51
EDR3M-8DPSK	6	5.43	5.20	5.52

The average conducted power for Wi-Fi is as following:

802.11b (dBm)

Channel\data rate	Tune up	1Mbps	2Mbps	5.5Mbps	11Mbps
11	18	17.78	17.77	17.94	17.76
6	18	17.59	/	17.73	/
1	18	17.27	/	17.38	/

802.11g (dBm)

Channel\data rate	Tune up	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
11	16	15.74	15.63	15.17	15.11	14.96	14.84	14.88	14.81
6	16	15.58	/	/	/	/	/	/	/
1	14.5	13.85	/	/	/	/	/	/	/

802.11n (dBm) - HT20 (2.4G)

Channel\data rate	Tune up	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
11	15	14.85	14.76	14.68	14.61	14.45	14.48	14.42	14.35
6	15	14.61	/	/	/	/	/	/	/
1	14.5	13.94	/	/	/	/	/	/	/

802.11n (dBm) – HT40 (2.4G)

Channel\data rate	Tune up	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
9	15	14.84	14.69	14.54	14.19	13.97	13.90	13.63	13.48
6	15	14.73	/	/	/	/	/	/	/
3	15	14.61	/	/	/	/	/	/	/

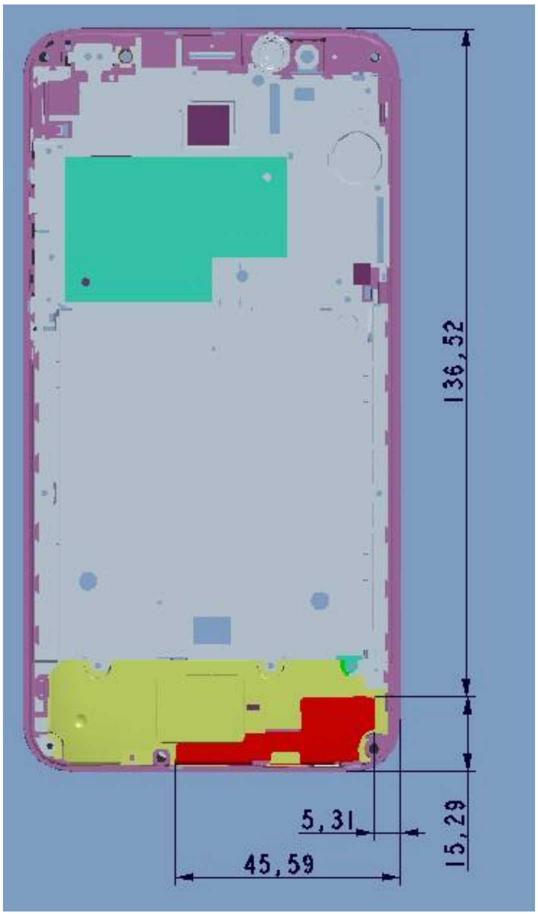
12 Simultaneous TX SAR Considerations

12.1 Introduction

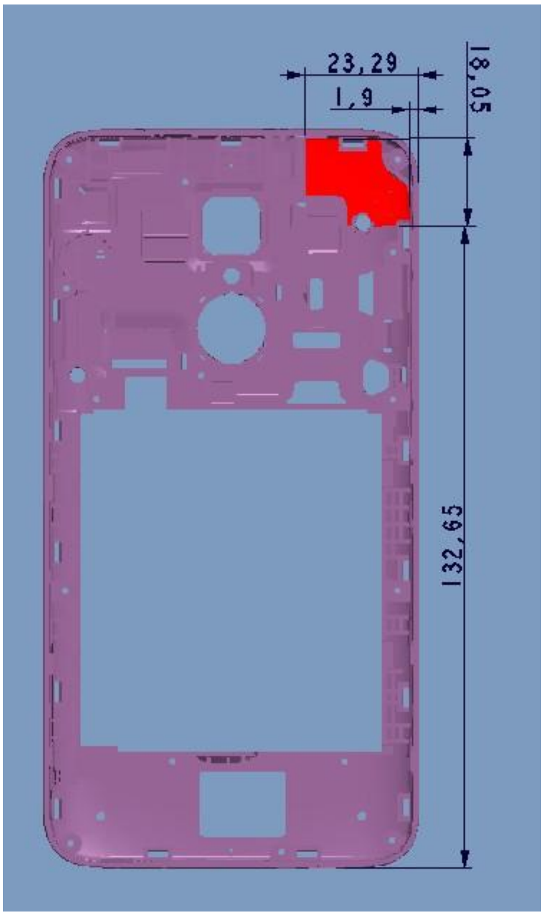
The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For this device, the BT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

12.2 Transmit Antenna Separation Distances

Main Antenna



WIFI/BT/GPS Antenna



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.

SAR measurement positions						
Mode	Front	Rear	Left edge	Right edge	Top edge	Bottom edge
Main antenna	Yes	Yes	Yes	Yes	No	Yes
WLAN	Yes	Yes	Yes	No	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

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	6.2	4.17	Yes
		Body	19.20	6.2	4.17	Yes
2.4GHz WLAN	2.45	Head	9.58	18	63.10	No
		Body	19.17	18	63.10	No

13 Evaluation of Simultaneous

Table 13.1: The sum of reported SAR values for main antenna and WiFi

	Position	Main antenna	WiFi	Sum
Highest reported SAR value for Head	Left hand, Touch cheek	0.30	0.59	**0.89**
	Left hand, Tilt 15°	0.15	0.64	**0.79**
Highest reported SAR value for Body	Rear	1.37	0.07	**1.44**
	Top	/	0.08	**0.08**

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

	Position	Main antenna	BT	Sum
Maximum reported SAR value for Head	Left hand, Touch cheek	0.30	0.17[1]	**0.47**
Maximum reported SAR value for Body	Rear	1.37	0.09[1]	**1.46**

[1] - Estimated SAR for Bluetooth (see the table 13.3)

Table 13.3: Estimated SAR for Bluetooth

Mode/Band	F (GHz)	Position	Distance (mm)	Upper limit of power *		Estimated$_{1g}$ (W/kg)
				dBm	mW	
Bluetooth	2.441	Head	5	6.2	4.17	0.17
Bluetooth	2.441	Body	10	6.2	4.17	0.09

* - Maximum possible output power declared by manufacturer

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)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;
where x = 7.5 for 1-g SAR.
When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

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 10 mm 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-gSAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or more than 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 GSM850/1900	1:8.3
GPRS&EGPRS for GSM850	1:4
GPRS&EGPRS for GSM1900	1:2
WCDMA	1:1

Note:
H1: The headset of CCB0046A11C1
H2: The headset of CCB0046A11C6

14.1 SAR results for Fast SAR

Table 14.1-1: SAR Values (GSM 850 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
251	848.8	Left	Touch	Fig.1	33.41	33.8	0.201	**0.22**	0.258	**0.28**	-0.06
190	836.6	Left	Touch	/	33.38	33.8	0.181	**0.20**	0.247	**0.27**	0.03
128	824.2	Left	Touch	/	33.30	33.8	0.173	**0.19**	0.236	**0.26**	0.04
190	836.6	Left	Tilt	/	33.38	33.8	0.103	**0.11**	0.138	**0.15**	0.09
190	836.6	Right	Touch	/	33.38	33.8	0.166	**0.18**	0.235	**0.26**	0.04
190	836.6	Right	Tilt	/	33.38	33.8	0.107	**0.12**	0.144	**0.16**	0.05

Table 14.1-2: SAR Values (GSM 850 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Mode (number of timeslots)	Test Position	Figure No./Note	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)
Ch.	MHz										
190	836.6	GPRS (2)	Front	/	32.42	33	0.310	**0.35**	0.398	**0.45**	0.06
251	848.8	GPRS (2)	Rear	/	32.46	33	0.438	**0.50**	0.585	**0.66**	0.09
190	836.6	GPRS (2)	Rear	/	32.42	33	0.424	**0.48**	0.543	**0.62**	0.11
128	824.2	GPRS (2)	Rear	Fig.2	32.34	33	0.473	**0.55**	0.608	**0.71**	0.04
190	836.6	GPRS (2)	Left	/	32.42	33	0.242	**0.28**	0.342	**0.39**	0.15
190	836.6	GPRS (2)	Right	/	32.42	33	0.124	**0.14**	0.244	**0.28**	0.08
190	836.6	GPRS (2)	Bottom	/	32.42	33	0.181	**0.21**	0.306	**0.35**	0.04
128	824.2	EGPRS (2)	Rear	/	32.32	33	0.446	**0.52**	0.589	**0.69**	0.13

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1-3: SAR Values (GSM 1900 MHz Band - Head)

Ambient Temperature: 22.5 °C							Liquid Temperature: 23.3°C				
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
810	1909.8	Left	Touch	/	28.87	29.6	0.075	**0.09**	0.118	**0.14**	0.02
661	1880	Left	Touch	/	28.67	29.6	0.064	**0.08**	0.104	**0.13**	-0.06
512	1850.2	Left	Touch	Fig.3	29.06	29.6	0.102	**0.12**	0.163	**0.18**	0.07
661	1880	Left	Tilt	/	28.67	29.6	0.027	**0.03**	0.043	**0.05**	0.03
661	1880	Right	Touch	/	28.67	29.6	0.043	**0.05**	0.057	**0.07**	-0.08
661	1880	Right	Tilt	/	28.67	29.6	0.032	**0.04**	0.048	**0.06**	0.04

Table 14.1-4: SAR Values (GSM 1900 MHz Band - Body)

Ambient Temperature: 22.5 °C							Liquid Temperature: 23.3°C				
Frequency		Mode (number of timeslots)	Test Position	Figure No./Note	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)
Ch.	MHz										
810	1909.8	GPRS (4)	Front	/	25.70	26.4	0.448	**0.53**	0.821	**0.96**	0.02
661	1880	GPRS (4)	Front	/	25.41	26.4	0.406	**0.51**	0.742	**0.93**	0.08
512	1850.2	GPRS (4)	Front	/	25.82	26.4	0.482	**0.55**	0.904	**1.03**	0.12
810	1909.8	GPRS (4)	Rear	Fig.4	25.70	26.4	0.633	**0.74**	1.17	**1.37**	-0.03
661	1880	GPRS (4)	Rear	/	25.41	26.4	0.529	**0.66**	1.01	**1.26**	-0.04
512	1850.2	GPRS (4)	Rear	/	25.82	26.4	0.608	**0.69**	1.14	**1.30**	0.02
661	1880	GPRS (4)	Left	/	25.41	26.4	0.082	**0.10**	0.136	**0.17**	0.16
661	1880	GPRS (4)	Right	/	25.41	26.4	0.060	**0.08**	0.101	**0.13**	0.05
810	1909.8	GPRS (4)	Bottom	/	25.70	26.4	0.579	**0.68**	1.10	**1.29**	-0.11
661	1880	GPRS (4)	Bottom	/	25.41	26.4	0.484	**0.61**	0.912	**1.15**	0.09
512	1850.2	GPRS (4)	Bottom	/	25.82	26.4	0.627	**0.72**	1.15	**1.31**	-0.14
810	1909.8	EGPRS (4)	Rear	/	25.69	26.4	0.605	**0.71**	1.14	**1.34**	0.16
810	1909.8	Speech	Rear	H1	28.87	29.6	0.369	**0.44**	0.658	**0.78**	0.11
810	1909.8	Speech	Rear	H2	28.87	29.6	0.365	**0.43**	0.649	**0.77**	0.02

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1-4-1: SAR Values (GSM 1900 MHz Band - Body) – 0mm

Ambient Temperature: 22.5 °C							Liquid Temperature: 23.3°C				
Frequency		Mode (number of timeslots)	Test Position	Figure No./Note	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)
Ch.	MHz										
810	1909.8	GPRS (4)	Rear	/	25.70	26.4	3.28	**3.85**	7.28	**8.55**	0.05
512	1850.2	GPRS (4)	Bottom	/	25.82	26.4	3.14	**3.59**	7.11	**8.13**	0.07

Note1: The distance between the EUT and the phantom bottom is 0mm.

Table 14.1-5: SAR Values (WCDMA 850 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
4233	846.6	Left	Touch	/	22.66	23.2	0.109	**0.12**	0.143	**0.16**	0.09
4182	836.4	Left	Touch	/	22.87	23.2	0.111	**0.12**	0.145	**0.16**	0.12
4132	826.4	Left	Touch	Fig.5	22.61	23.2	0.117	**0.13**	0.153	**0.18**	-0.05
4182	836.4	Left	Tilt	/	22.87	23.2	0.081	**0.09**	0.102	**0.11**	0.02
4182	836.4	Right	Touch	/	22.87	23.2	0.107	**0.12**	0.144	**0.16**	0.07
4182	836.4	Right	Tilt	/	22.87	23.2	0.074	**0.08**	0.096	**0.10**	0.14

Table 14.1-6: SAR Values (WCDMA 850 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
4182	836.4	Front	/	22.87	23.2	0.139	**0.15**	0.181	**0.20**	0.06
4233	846.6	Rear	/	22.66	23.2	0.197	**0.22**	0.255	**0.29**	-0.07
4182	836.4	Rear	/	22.87	23.2	0.219	**0.24**	0.284	**0.31**	-0.03
4132	826.4	Rear	Fig.6	22.61	23.2	0.221	**0.25**	0.286	**0.33**	0.01
4182	836.4	Left	/	22.87	23.2	0.109	**0.12**	0.156	**0.17**	0.08
4182	836.4	Right	/	22.87	23.2	0.103	**0.11**	0.149	**0.16**	-0.05
4182	836.4	Bottom	/	22.87	23.2	0.075	**0.08**	0.125	**0.13**	-0.13

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1-7: SAR Values (WCDMA 1700 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
1738	1752.6	Left	Touch	Fig.7	21.22	22	0.123	**0.15**	0.198	**0.24**	0.09
1637	1732.4	Left	Touch	/	21.29	22	0.121	**0.14**	0.196	**0.23**	0.12
1537	1712.4	Left	Touch	/	21.31	22	0.115	**0.13**	0.184	**0.22**	-0.10
1637	1732.4	Left	Tilt	/	21.29	22	0.036	**0.04**	0.067	**0.08**	0.08
1637	1732.4	Right	Touch	/	21.29	22	0.074	**0.09**	0.119	**0.14**	-0.04
1637	1732.4	Right	Tilt	/	21.29	22	0.039	**0.05**	0.066	**0.08**	0.11

Table 14.1-8: SAR Values (WCDMA 1700 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
1637	1732.4	Front	/	21.29	22	0.402	**0.47**	0.675	**0.79**	-0.08
1738	1752.6	Rear	/	21.22	22	0.412	**0.49**	0.728	**0.87**	0.01
1637	1732.4	Rear	Fig.8	21.29	22	0.432	**0.51**	0.778	**0.92**	0.05
1537	1712.4	Rear	/	21.31	22	0.353	**0.41**	0.615	**0.72**	0.06
1637	1732.4	Left	/	21.29	22	0.088	**0.10**	0.142	**0.17**	-0.02
1637	1732.4	Right	/	21.29	22	0.071	**0.08**	0.112	**0.13**	0.15
1637	1732.4	Bottom	/	21.29	22	0.360	**0.42**	0.672	**0.79**	0.01

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1-9: SAR Values(WCDMA 1900 MHz Band - Head)

Ambient Temperature: 22.5°C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
9938	1907.6	Left	Touch	/	22.23	23	0.105	**0.13**	0.176	**0.21**	0.07
9800	1880	Left	Touch	Fig.9	22.20	23	0.152	**0.18**	0.253	**0.30**	0.19
9662	1852.4	Left	Touch	/	22.31	23	0.149	**0.17**	0.247	**0.29**	0.04
9800	1880	Left	Tilt	/	22.20	23	0.056	**0.07**	0.096	**0.12**	0.11
9800	1880	Right	Touch	/	22.20	23	0.069	**0.08**	0.105	**0.13**	-0.06
9800	1880	Right	Tilt	/	22.20	23	0.062	**0.07**	0.103	**0.12**	-0.15

Table 14.1-10: SAR Values (WCDMA 1900 MHz Band - Body)

Ambient Temperature: 22.5°C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
9938	1907.6	Front	/	22.23	23	0.338	**0.40**	0.602	**0.72**	0.03
9800	1880	Front	/	22.20	23	0.439	**0.53**	0.777	**0.93**	0.01
9662	1852.4	Front	/	22.31	23	0.436	**0.51**	0.775	**0.91**	0.14
9938	1907.6	Rear	/	22.23	23	0.463	**0.55**	0.852	**1.02**	0.09
9800	1880	Rear	Fig.10	22.20	23	0.557	**0.67**	1.03	**1.24**	-0.12
9662	1852.4	Rear	/	22.31	23	0.514	**0.60**	0.921	**1.08**	-0.09
9800	1880	Left	/	22.20	23	0.084	**0.10**	0.129	**0.16**	0.03
9800	1880	Right	/	22.20	23	0.070	**0.08**	0.108	**0.13**	0.18
9938	1907.6	Bottom	/	22.23	23	0.467	**0.56**	0.832	**0.99**	0.06
9800	1880	Bottom	/	22.20	23	0.531	**0.64**	0.948	**1.14**	0.04
9662	1852.4	Bottom	/	22.31	23	0.472	**0.55**	0.837	**0.98**	0.01
9800	1880	Rear	H1	22.20	23	0.538	**0.65**	0.981	**1.18**	0.05
9800	1880	Rear	H2	22.20	23	0.536	**0.64**	0.990	**1.19**	-0.02

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.1-10-1: SAR Values (WCDMA 1900 MHz Band - Body) – 0mm

Ambient Temperature: 22.5°C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
9800	1880	Rear	/	22.20	23	2.50	**3.01**	5.59	**6.72**	-0.16

Note1: The distance between the EUT and the phantom bottom is 0mm.

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 14.2-1: SAR Values (GSM 850 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
251	848.8	Left	Touch	Fig.1	33.41	33.8	0.201	**0.22**	0.258	**0.28**	-0.06

Table 14.2-2: SAR Values (GSM 850 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Mode (number of timeslots)	Test Position	Figure No./Note	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)
Ch.	MHz										
128	824.2	GPRS (2)	Rear	Fig.2	32.34	33	0.473	**0.55**	0.608	**0.71**	0.04

Table 14.2-3: SAR Values (GSM 1900 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
512	1850.2	Left	Touch	Fig.3	29.06	29.6	0.102	**0.12**	0.163	**0.18**	0.07

Table 14.2-4: SAR Values (GSM 1900 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Mode (number of timeslots)	Test Position	Figure No./Note	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)
Ch.	MHz										
810	1909.8	GPRS (4)	Rear	Fig.4	25.70	26.4	0.633	**0.74**	1.17	**1.37**	-0.03

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-5: SAR Values (WCDMA 850 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
4132	826.4	Left	Touch	Fig.5	22.61	23.2	0.117	**0.13**	0.153	**0.18**	-0.05

Table 14.2-6: SAR Values (WCDMA 850 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
4132	826.4	Rear	Fig.6	22.61	23.2	0.221	**0.25**	0.286	**0.33**	0.01

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-7: SAR Values (WCDMA 1700 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
1738	1752.6	Left	Touch	Fig.7	21.22	22	0.123	**0.15**	0.198	**0.24**	0.09

Table 14.2-8: SAR Values (WCDMA 1700 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
1637	1732.4	Rear	Fig.8	21.29	22	0.432	**0.51**	0.778	**0.92**	0.05

Note1: The distance between the EUT and the phantom bottom is 10mm.

Table 14.2-9: SAR Values(WCDMA 1900 MHz Band - Head)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./Note	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)
Ch.	MHz										
9800	1880	Left	Touch	Fig.9	22.20	23	0.152	**0.18**	0.253	**0.30**	0.19

Table 14.2-10: SAR Values (WCDMA 1900 MHz Band - Body)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./Note	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)
Ch.	MHz									
9800	1880	Rear	Fig.10	22.20	23	0.557	**0.67**	1.03	**1.24**	-0.12

Note1: The distance between the EUT and the phantom bottom is 10mm.

14.3 WLAN Evaluation

According to the KDB248227 D01, SAR is measured for 2.4GHz 802.11b DSSS using the initial test position procedure.

Head Evaluation

Table 14.3-1: SAR Values(WLAN - Head)– 802.11b (Fast SAR)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./ Note	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.										
2462	11	Left	Touch	/	17.94	18	0.262	**0.27**	0.580	**0.59**	0.03
2462	11	Left	Tilt	/	17.94	18	0.275	**0.28**	0.617	**0.63**	-0.07
2462	11	Right	Touch	/	17.94	18	0.100	**0.10**	0.185	**0.19**	0.09
2462	11	Right	Tilt	/	17.94	18	0.122	**0.12**	0.238	**0.24**	-0.02

As shown above table, the initial test position for head is “Left Tilt”. So the head SAR of WLAN is presented as below:

Table 14.3-2: SAR Values(WLAN - Head)– 802.11b (Full SAR)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C											
Frequency		Side	Test Position	Figure No./ Note	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.										
2462	11	Left	Tilt	Fig.11	17.94	18	0.246	**0.25**	0.625	**0.63**	-0.07
2462	11	Left	Touch	/	17.94	18	0.229	**0.23**	0.574	**0.58**	0.03
Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg. Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.											

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

Table 14.3-3: SAR Values (WLAN - Head) – 802.11b (Scaled Reported SAR)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C							
Frequency		Side	Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
MHz	Ch.						
2462	11	Left	Tilt	98.60%	100%	**0.63**	**0.64**
2462	11	Left	Touch	98.60%	100%	**0.58**	**0.59**

SAR is not required for OFDM because the 802.11b adjusted SAR ≤ 1.2 W/kg.

Body Evaluation

Table 14.3-4: SAR Values(WLAN - Body)– 802.11b (Fast SAR)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./ Note	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.									
2462	11	Front	/	17.94	18	0.036	**0.04**	0.059	**0.06**	0.04
2462	11	Rear	/	17.94	18	0.044	**0.04**	0.073	**0.07**	0.02
2462	11	Left	/	17.94	18	0.021	**0.02**	0.035	**0.04**	-0.09
2462	11	Top	/	17.94	18	0.043	**0.04**	0.082	**0.08**	-0.06

As shown above table, the initial test position for body is "Top". So the body SAR of WLAN is presented as below:

Table 14.4-5: SAR Values(WLAN - Body)– 802.11b (Full SAR)

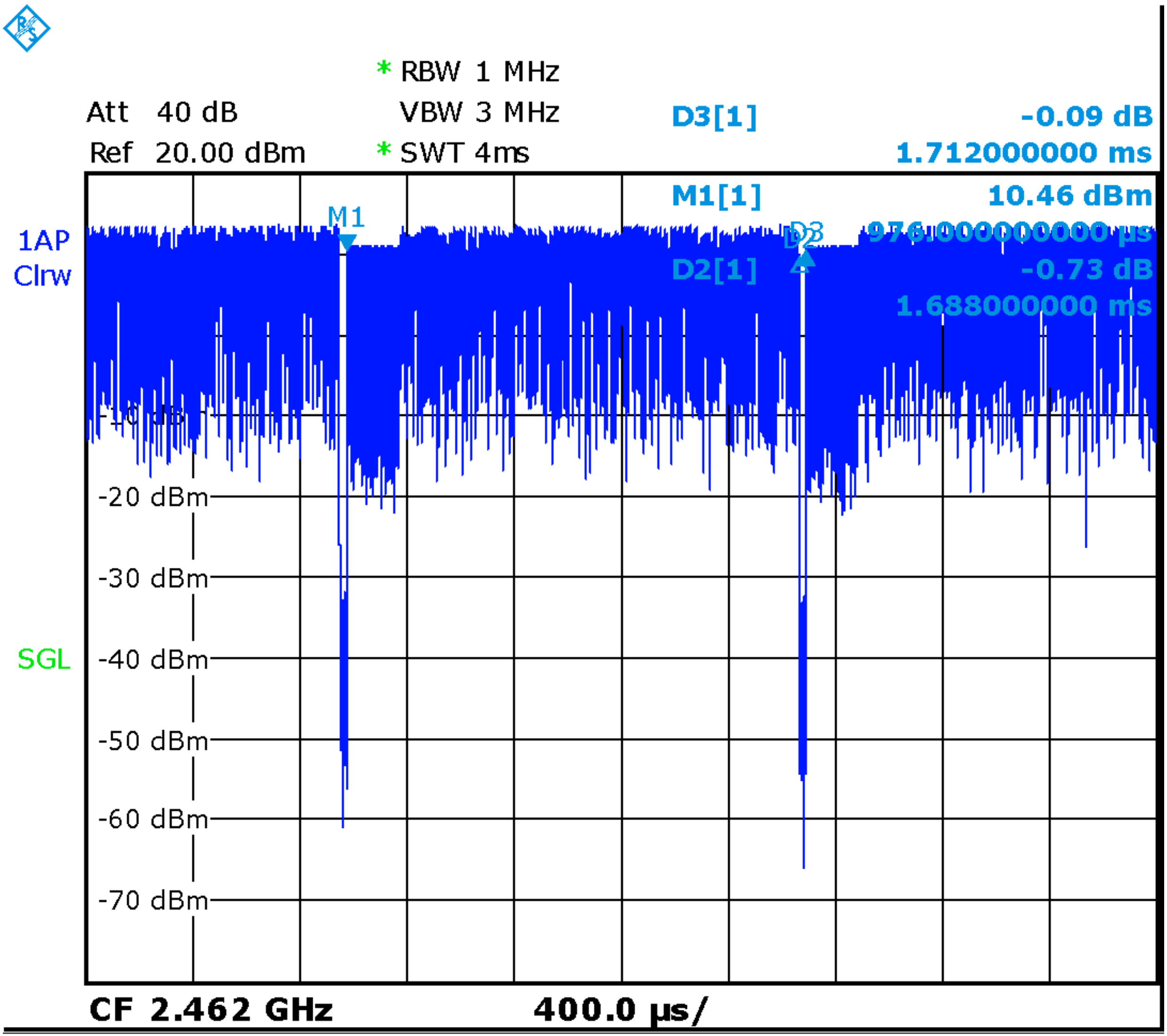
Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C										
Frequency		Test Position	Figure No./ Note	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	Power Drift (dB)
MHz	Ch.									
2462	11	Top	Fig.12	17.94	18	0.045	**0.05**	0.083	**0.08**	-0.06
Note1: When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest estimated 1-g SAR conditions determined by area scans, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg. Note2: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.										

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. The scaled reported SAR is presented as below.

Table 14.4-6: SAR Values (WLAN - Body) – 802.11b (Scaled Reported SAR)

Ambient Temperature: 22.5 °C Liquid Temperature: 23.3°C						
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
MHz	Ch.					
2462	11	Top	98.60%	100%	**0.08**	**0.08**
2462	11	Rear	98.60%	100%	**0.07**	**0.07**

SAR is not required for OFDM because the 802.11b adjusted SAR ≤ 1.2 W/kg.



Picture 14.1 Duty factor plot

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; steps2) 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 ≥ 1.45W/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 1900 (1g)

Frequency		Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
Ch.	MHz						
810	1909.8	Rear	10	1.17	1.15	1.02	/

Table 15.2: SAR Measurement Variability for Body W1900 (1g)

Frequency		Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
Ch.	MHz						
9800	1880	Rear	10	1.03	1.02	1.01	/

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	6.0	N	1	1	1	6.0	6.0	∞
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	RFambient 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	$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$					9.55	9.43	257
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$					19.1	18.9	

16.2 Measurement Uncertainty for Normal SAR Tests (3~6GHz)

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	6.55	N	1	1	1	6.55	6.55	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
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	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
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	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞

	(target)									
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.7	10.6	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						21.4	21.1	

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	6.0	N	1	1	1	6.0	6.0	∞
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	RFambient 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		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.4	10.3	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.8	20.6	

16.4 Measurement Uncertainty for Fast SAR Tests (3~6GHz)

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	6.55	N	1	1	1	6.55	6.55	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
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	RFambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	14.0	R	$\sqrt{3}$	1	1	8.1	8.1	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder	A	3.4	N	1	1	1	3.4	3.4	5

	uncertainty									
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		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.5	13.4	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						27.0	26.8	

17 MAIN TEST INSTRUMENTS

Table 17.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	E5071C	MY46110673	January 13, 2017	One year
02	Power meter	NRVD	102083	September 22,2016	One year
03	Power sensor	NRV-Z5	100595		
04	Signal Generator	E4438C	MY49071430	January 13,2017	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	E5515C	MY50263375	January 16, 2017	One year
07	E-field Probe	SPEAG EX3DV4	3846	January 13,2017	One year
08	DAE	SPEAG DAE4	1331	January 19, 2017	One year
09	Dipole Validation Kit	SPEAG D835V2	4d069	July 20,2016	One year
10	Dipole Validation Kit	SPEAG D1750V2	1003	July 21,2016	One year
11	Dipole Validation Kit	SPEAG D1900V2	5d101	July 28,2016	One year
12	Dipole Validation Kit	SPEAG D2450V2	853	July 25,2016	One year

END OF REPORT BODY

ANNEX A Graph Results

GSM850_CH251 Left Cheek
Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: head835 MHz
Medium parameters used: f = 848.8 MHz; σ = 0.903 mho/m; εr = 41.25; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: GSM850 848.8 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 – SN3846ConvF(9.33,9.33,9.33)

Area Scan (71x131x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.312 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.184 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.321 W/kg
SAR(1 g) = 0.258 W/kg; SAR(10 g) = 0.201 W/kg
Maximum value of SAR (measured) = 0.281 W/kg

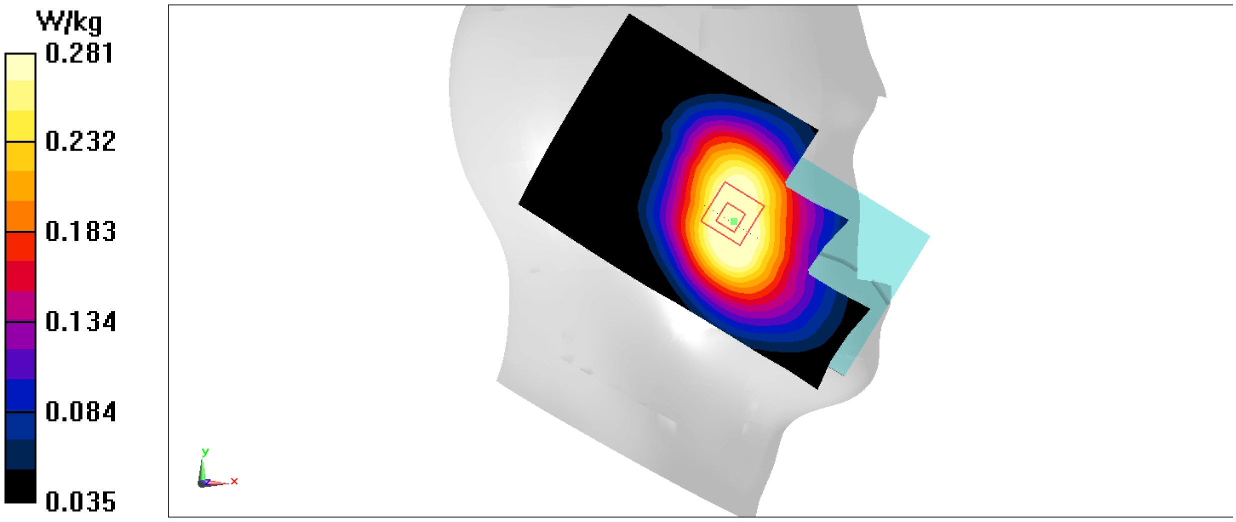
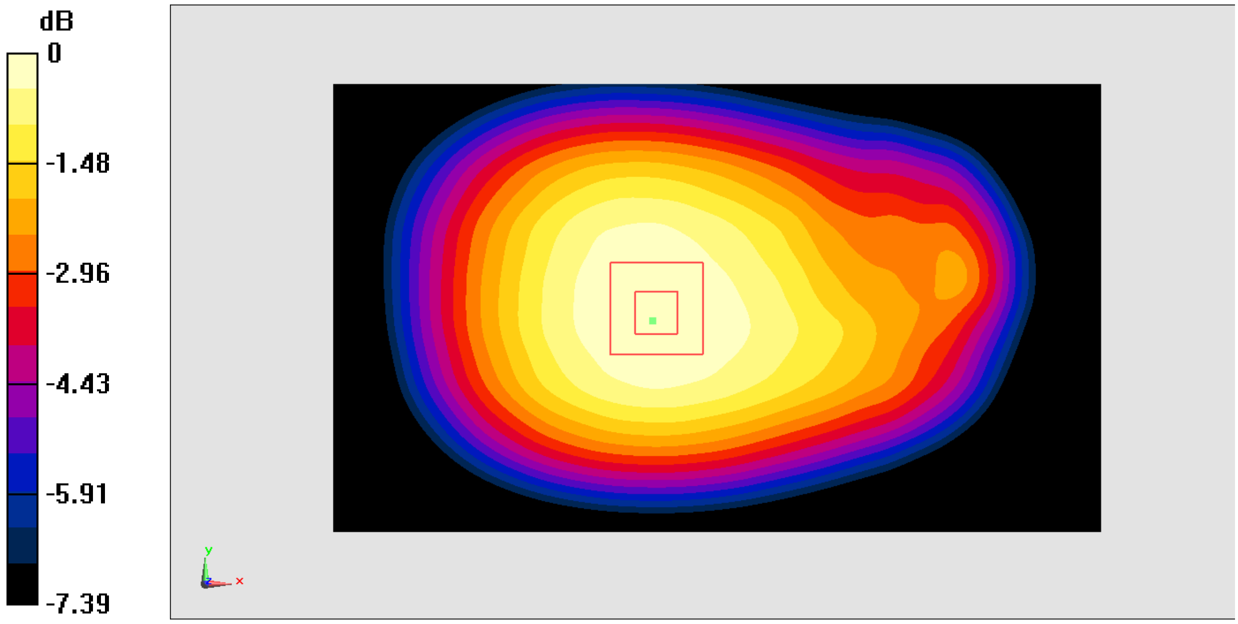


Figure 1

GSM850_CH128 Rear
Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: body835 MHz
Medium parameters used: f = 824.2 MHz; σ = 0.962 mho/m; εr = 56.24; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: GSM850 824.2 MHz Duty Cycle: 1:4
Probe: EX3DV4 – SN3846ConvF(9.52,9.52,9.52)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.664 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 25.26 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.760 W/kg
SAR(1 g) = 0.608 W/kg; SAR(10 g) = 0.473 W/kg
Maximum value of SAR (measured) = 0.664 W/kg



0 dB = 0.664 W/kg = -1.78 dBW/kg

Figure 2

PCS1900_CH512 Left Cheek
Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: head1900 MHz
Medium parameters used: f = 1850.2 MHz; σ = 1.366 mho/m; εr = 39.83; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C, Liquid Temperature: 23.3°C
Communication System: PCS1900 1850.2 MHz Duty Cycle: 1:8.3
Probe: EX3DV4 – SN3846ConvF(7.89,7.89,7.89)

Area Scan (71x131x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.195 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.179 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.246 W/kg
SAR(1 g) = 0.163 W/kg; SAR(10 g) = 0.102 W/kg
Maximum value of SAR (measured) = 0.190 W/kg

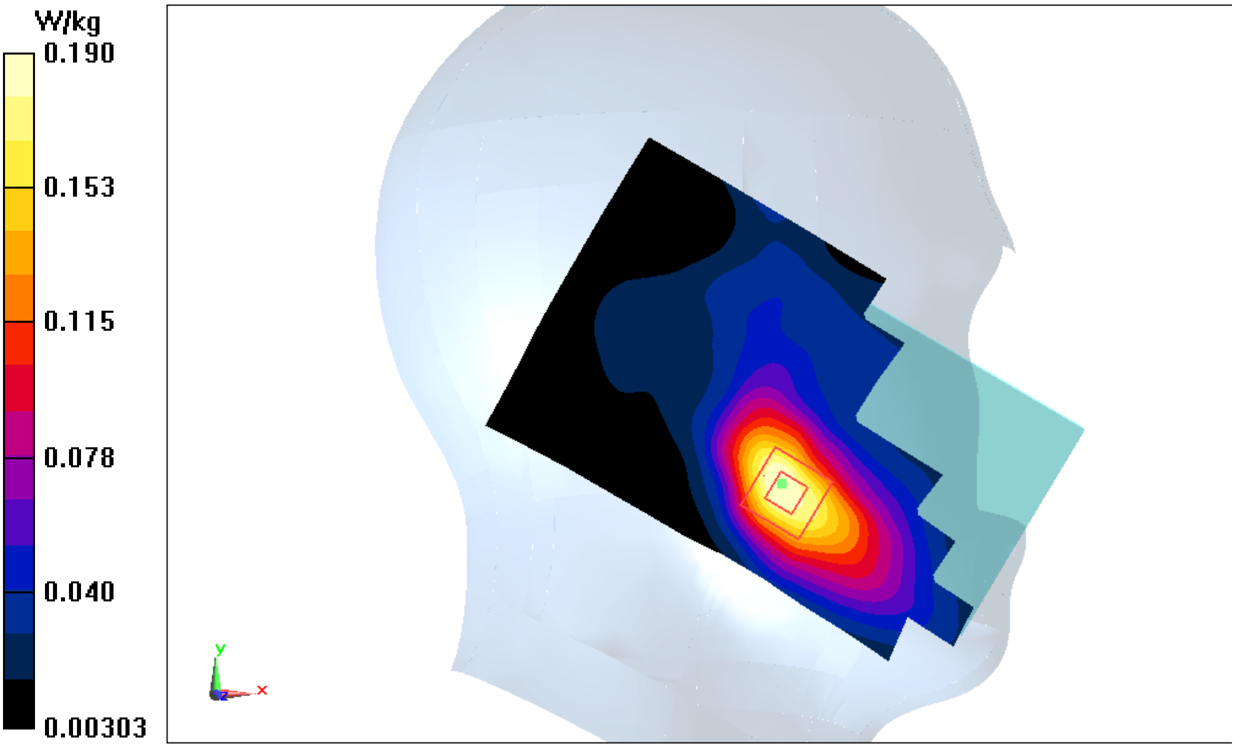


Figure 3

PCS1900_CH810 Rear
Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: body1900 MHz
Medium parameters used: f = 1909.8 MHz; σ = 1.516 mho/m; εr = 53.15; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: PCS1900 1909.8 MHz Duty Cycle: 1:2
Probe: EX3DV4 – SN3846ConvF(7.57,7.57,7.57)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.52 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.95 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.97 W/kg
SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.633 W/kg
Maximum value of SAR (measured) = 1.56 W/kg

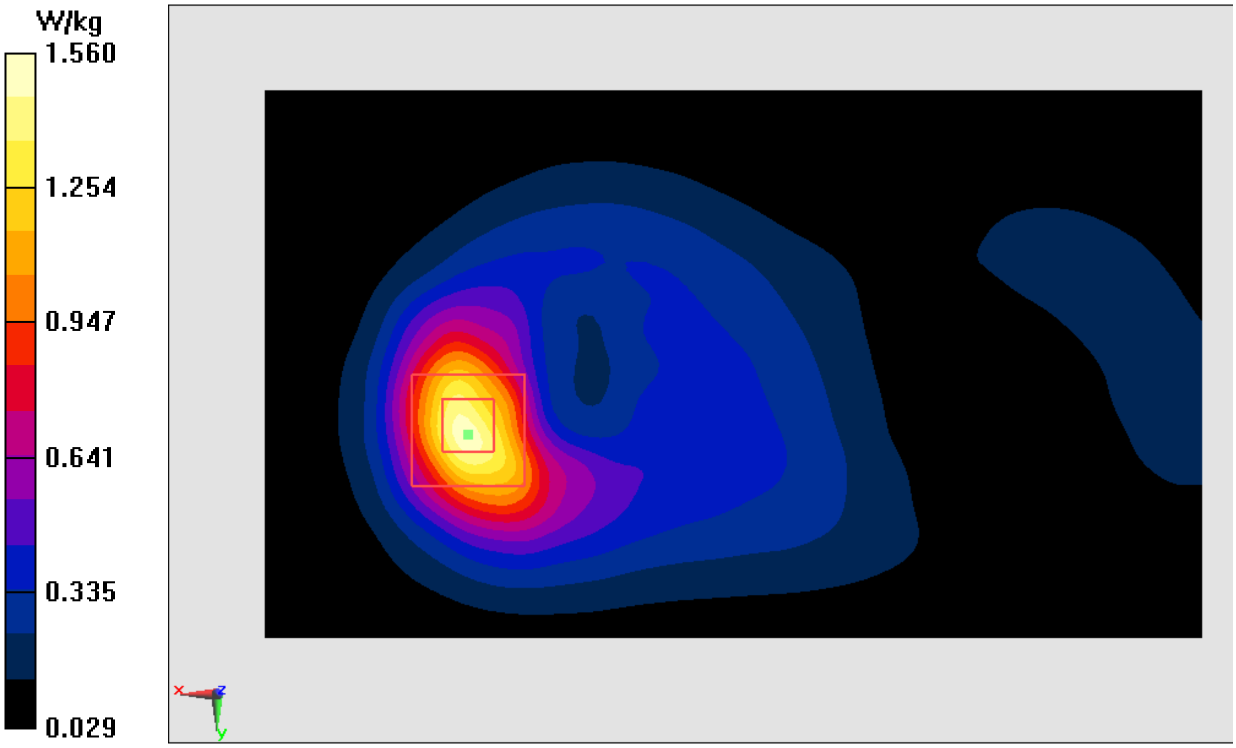


Figure 4

WCDMA850-BV_CH4132 Left Cheek
Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: head835 MHz
Medium parameters used: f = 826.4 MHz; σ = 0.881 mho/m; εr = 41.28; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WCDMA850-BV 826.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(9.33,9.33,9.33)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.188 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.005 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.204 W/kg
SAR(1 g) = 0.153 W/kg; SAR(10 g) = 0.117 W/kg
Maximum value of SAR (measured) = 0.185 W/kg

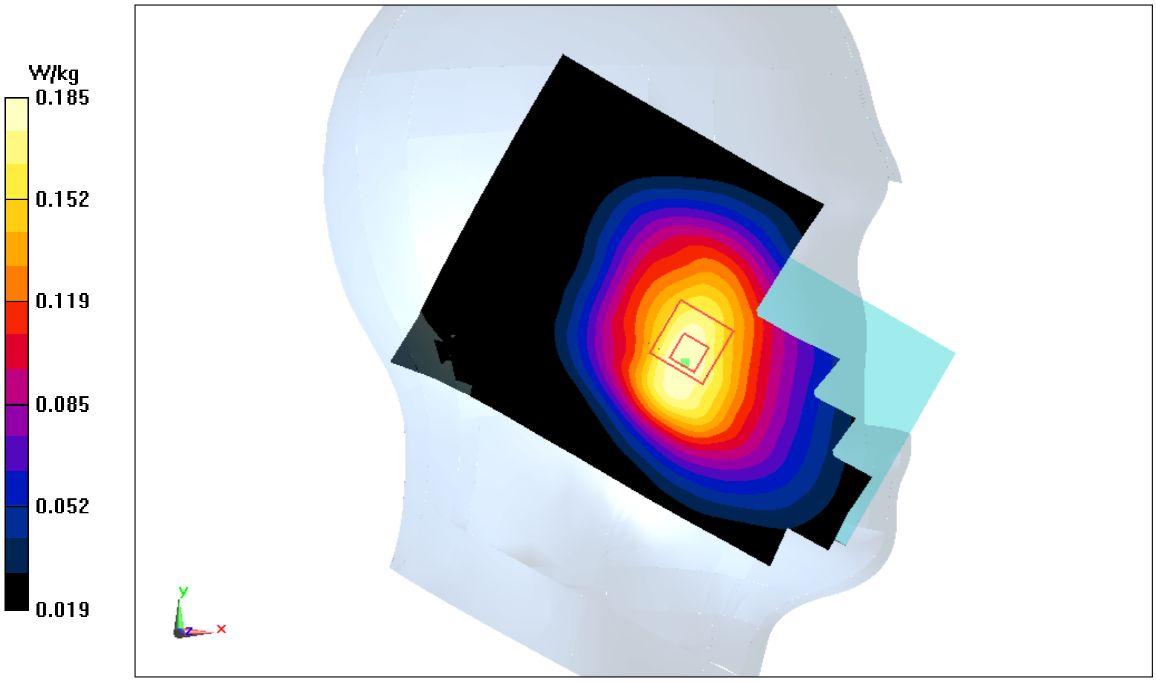


Figure 5

WCDMA850-BV_CH4132 Rear
Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: body835 MHz
Medium parameters used: f = 826.4 MHz; σ = 0.964 mho/m; εr = 56.04; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WCDMA850-BV 826.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(9.52,9.52,9.52)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.347 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.22 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.375 W/kg
SAR(1 g) = 0.286 W/kg; SAR(10 g) = 0.221 W/kg
Maximum value of SAR (measured) = 0.345 W/kg

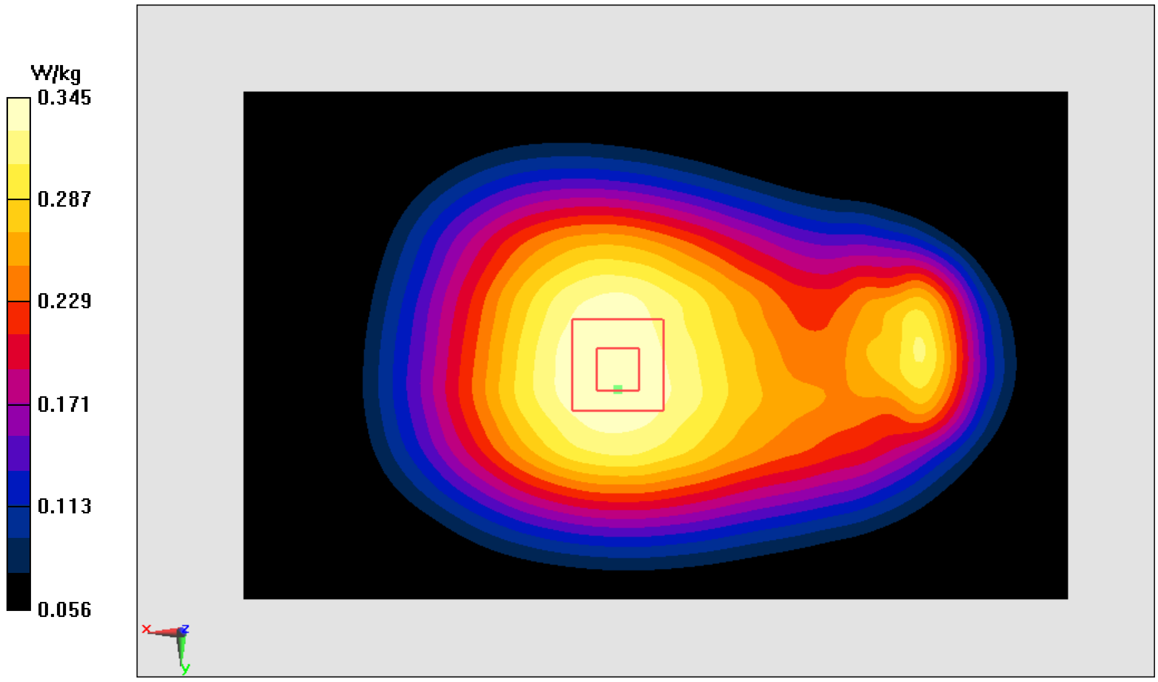


Figure 6

WCDMA1700-BIV_CH1513 Left Cheek
Date: 5/13/2017
Electronics: DAE4 Sn1331
Medium: head1750 MHz
Medium parameters used: f = 1752.6 MHz; σ = 1.348 mho/m; εr = 40.13; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C, Liquid Temperature: 23.3°C
Communication System: WCDMA1700-BIV 1752.6 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(8.16,8.16,8.16)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.258 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.905 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.286 W/kg
SAR(1 g) = 0.198 W/kg; SAR(10 g) = 0.123 W/kg
Maximum value of SAR (measured) = 0.25 W/kg

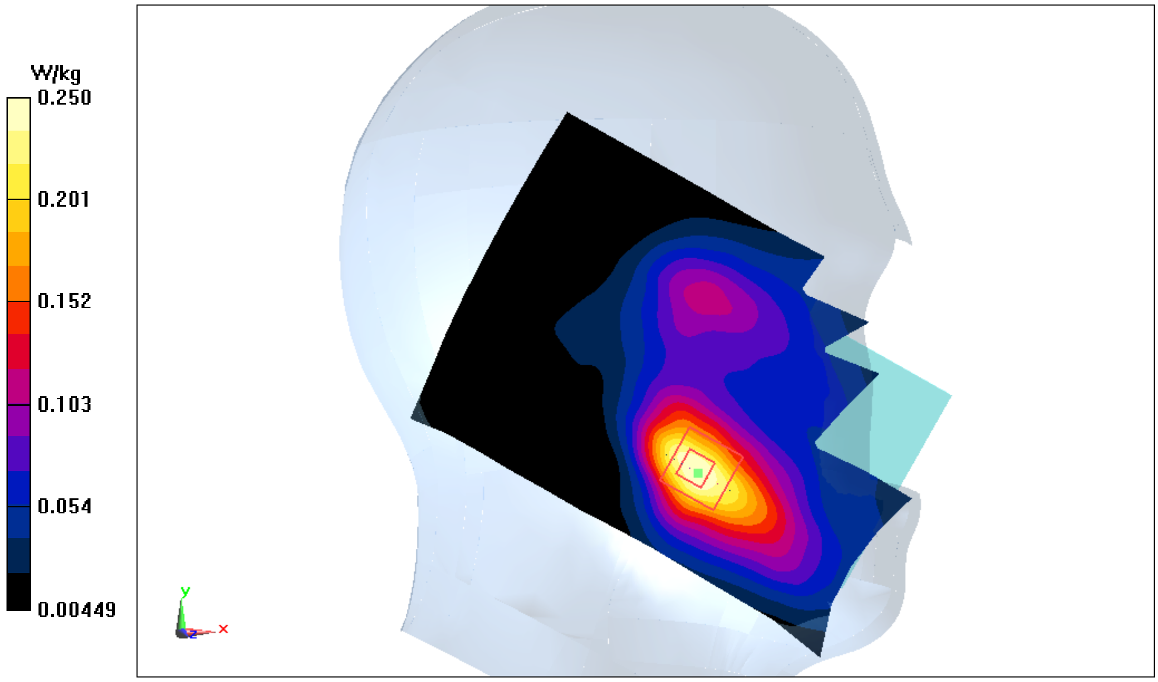


Figure 7

WCDMA1700-BIV_CH1412 Rear
Date: 5/13/2017
Electronics: DAE4 Sn1331
Medium: body1750 MHz
Medium parameters used: f = 1732.4 MHz; σ = 1.486 mho/m; εr = 53.55; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WCDMA1700-BIV 1732.4 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(7.90,7.90,7.90)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.08 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.9 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.35 W/kg
SAR(1 g) = 0.778 W/kg; SAR(10 g) = 0.432 W/kg
Maximum value of SAR (measured) = 1.08 W/kg

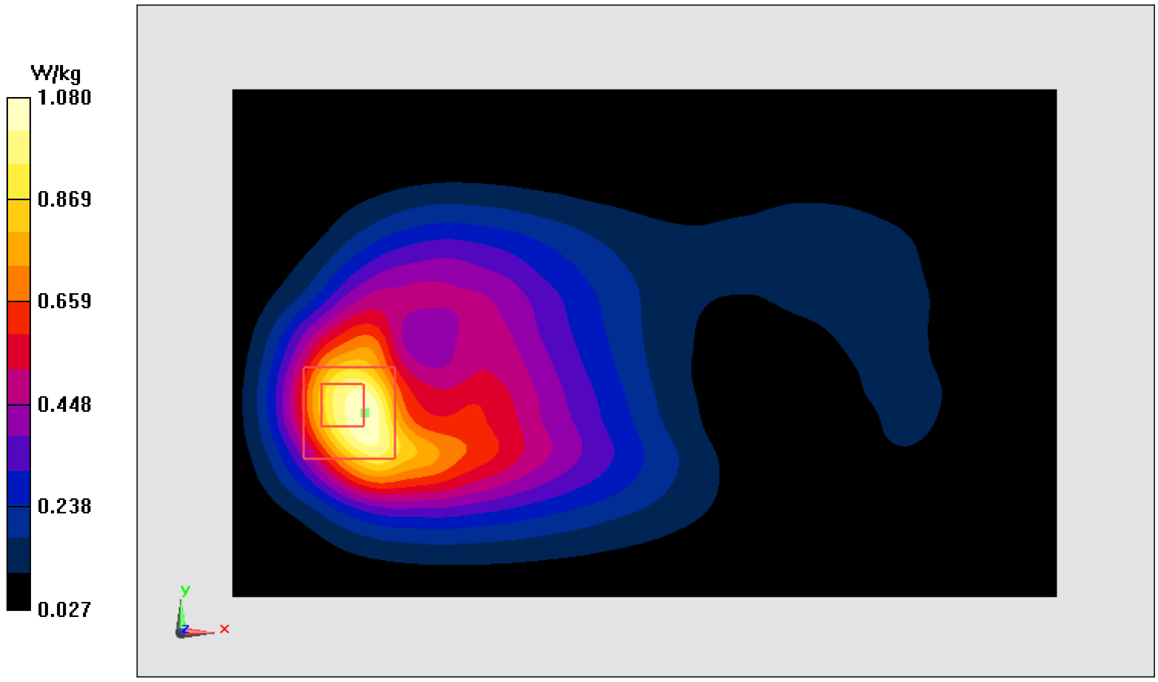


Figure 8

WCDMA1900-BII_CH9400 Left Cheek
Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: head1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.394 mho/m; εr = 39.79; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WCDMA1900-BII 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(7.89,7.89,7.89)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.364 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.914 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 0.409 W/kg
SAR(1 g) = 0.253 W/kg; SAR(10 g) = 0.152 W/kg
Maximum value of SAR (measured) = 0.353 W/kg

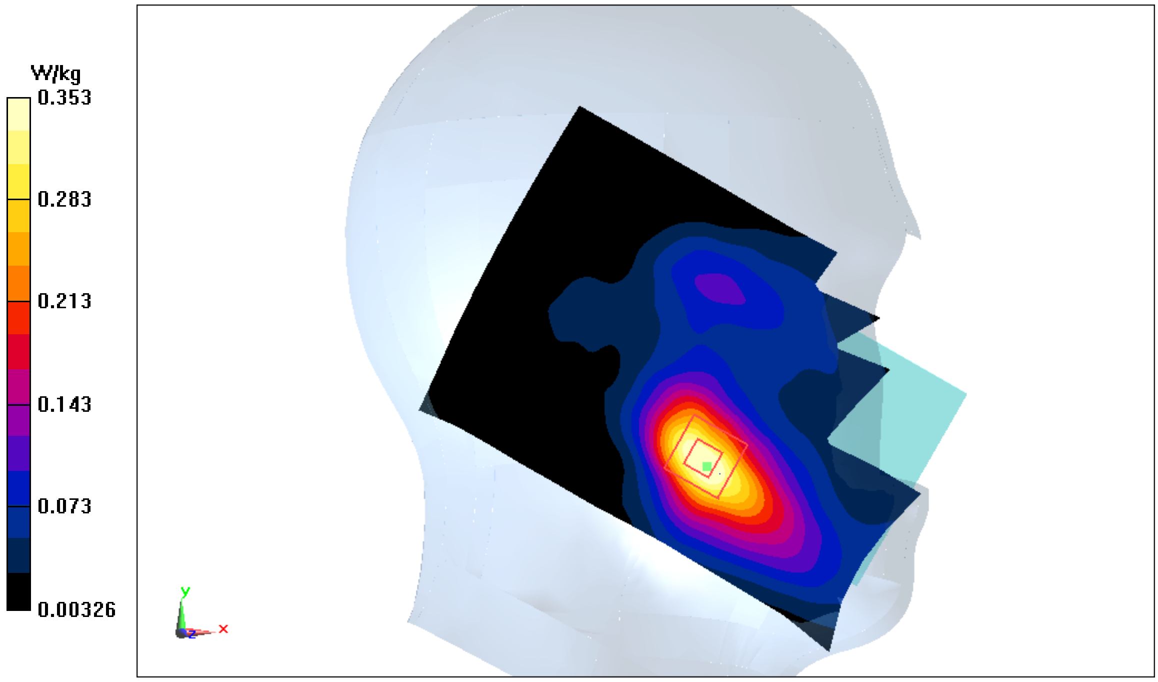


Figure 9

WCDMA1900-BII_CH9400 Rear
Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: body1900 MHz
Medium parameters used: f = 1880 MHz; σ = 1.487 mho/m; εr = 53.18; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WCDMA1900-BII 1880 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(7.57,7.57,7.57)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.26 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.25 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 1.75 W/kg
SAR(1 g) = 1.03 W/kg; SAR(10 g) = 0.557 W/kg
Maximum value of SAR (measured) = 1.28 W/kg

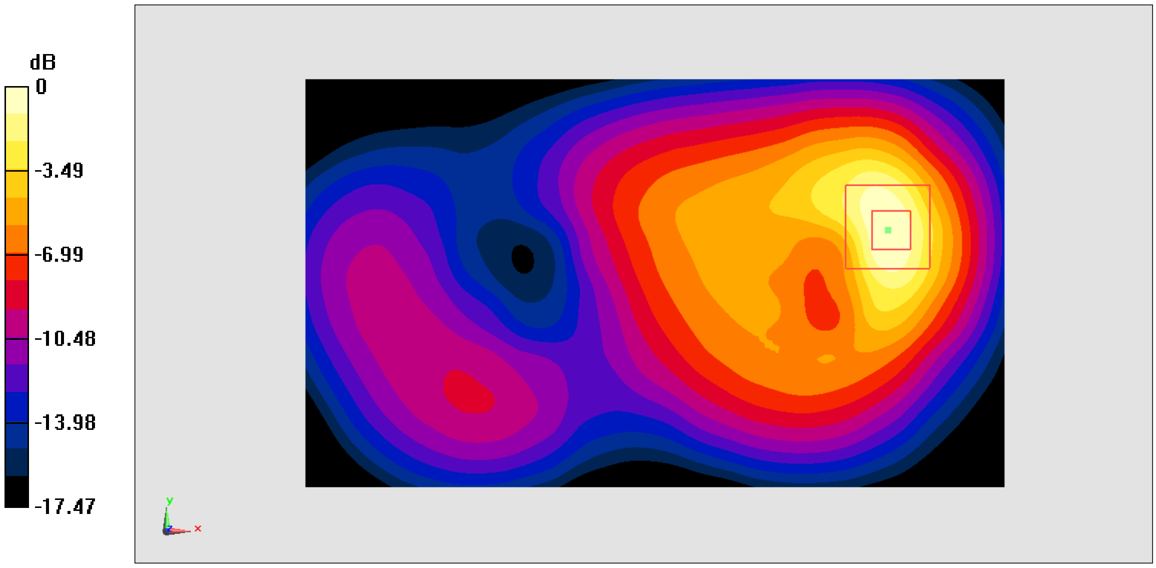


Figure 10

WLAN2450_CH11 Left Tilt
Date: 5/15/2017
Electronics: DAE4 Sn1331
Medium: head2450 MHz
Medium parameters used: f = 2462 MHz; σ = 1.812 mho/m; εr = 39.28; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C, Liquid Temperature: 23.3^{o}C
Communication System: WLAN2450 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(7.22,7.22,7.22)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.16 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.58 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.57 W/kg
SAR(1 g) = 0.625 W/kg; SAR(10 g) = 0.246 W/kg
Maximum value of SAR (measured) = 1.24 W/kg

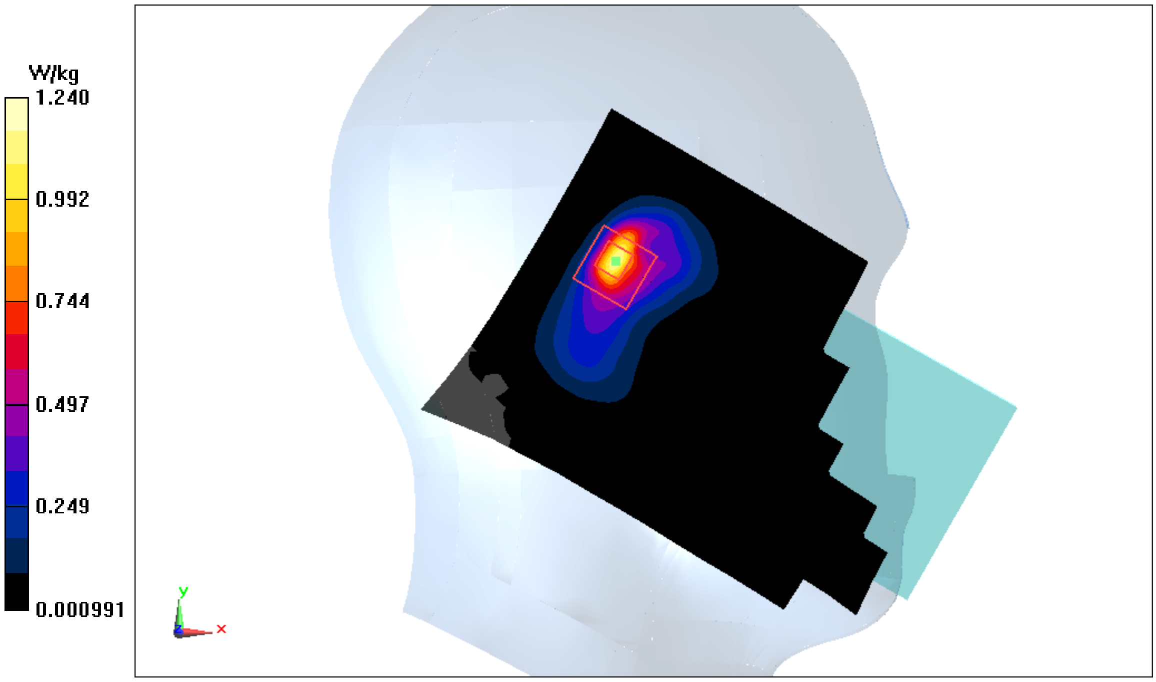


Figure 11

WLAN2450_CH11 Top
Date: 5/15/2017
Electronics: DAE4 Sn1331
Medium: body2450 MHz
Medium parameters used: f = 2462 MHz; σ = 1.997 mho/m; εr = 53.55; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C,   Liquid Temperature: 23.3^{o}C
Communication System: WLAN2450 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846ConvF(7.31,7.31,7.31)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.127 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.458 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.15 W/kg
SAR(1 g) = 0.083 W/kg; SAR(10 g) = 0.045 W/kg
Maximum value of SAR (measured) = 0.126 W/kg

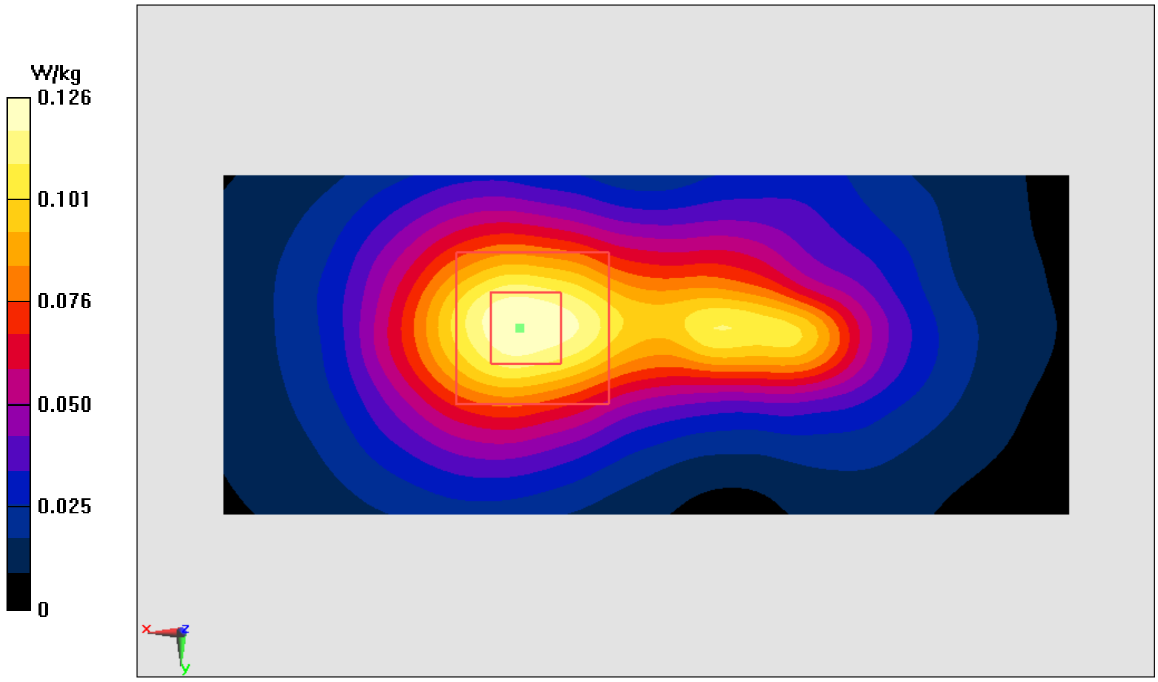


Figure 12

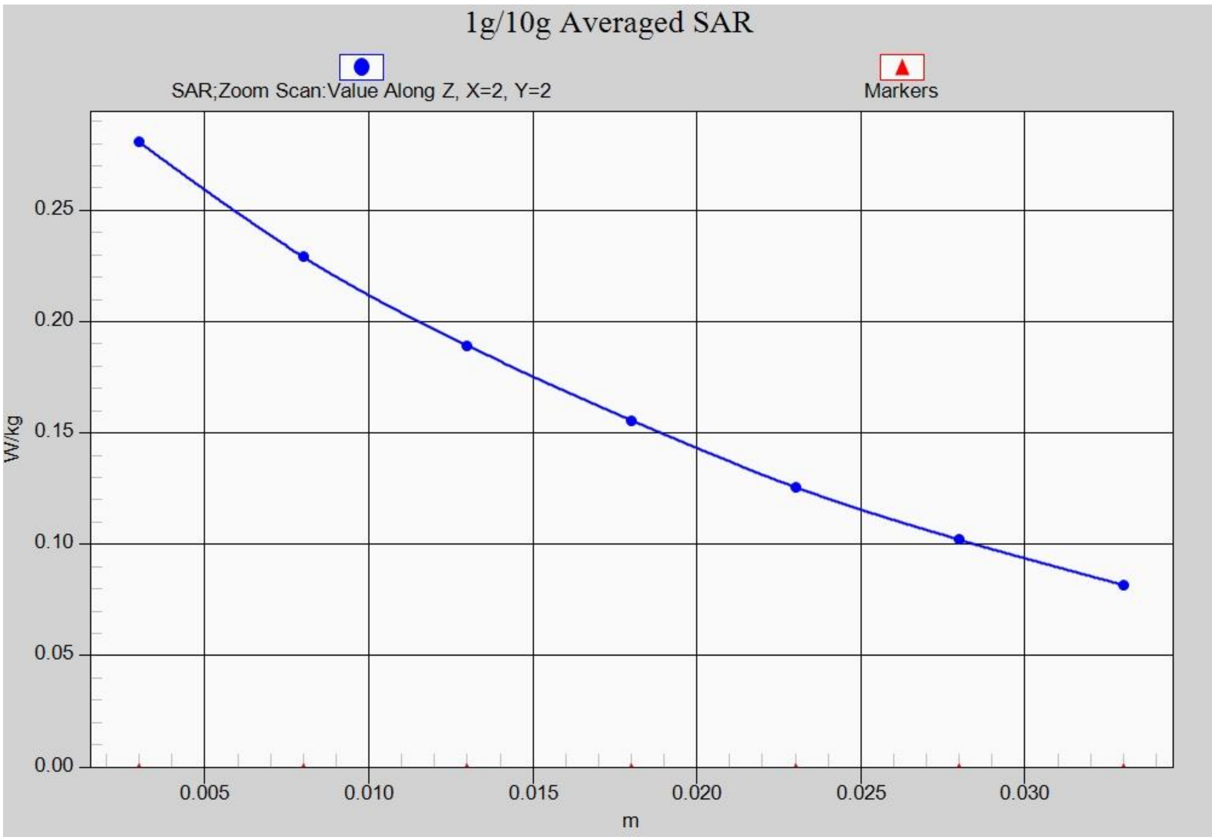


Fig.1- 1 Z-Scan at power reference point (GSM850)

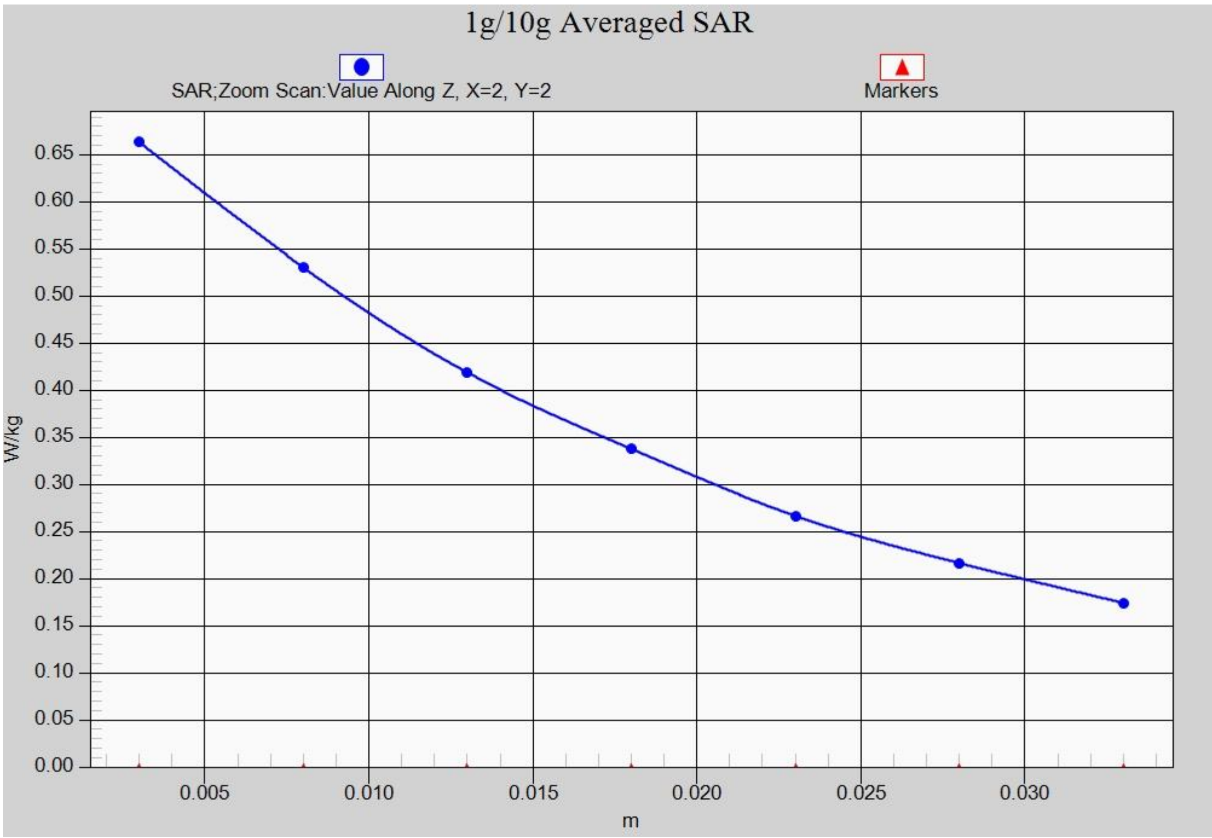


Fig.1- 2 Z-Scan at power reference point (GSM850)

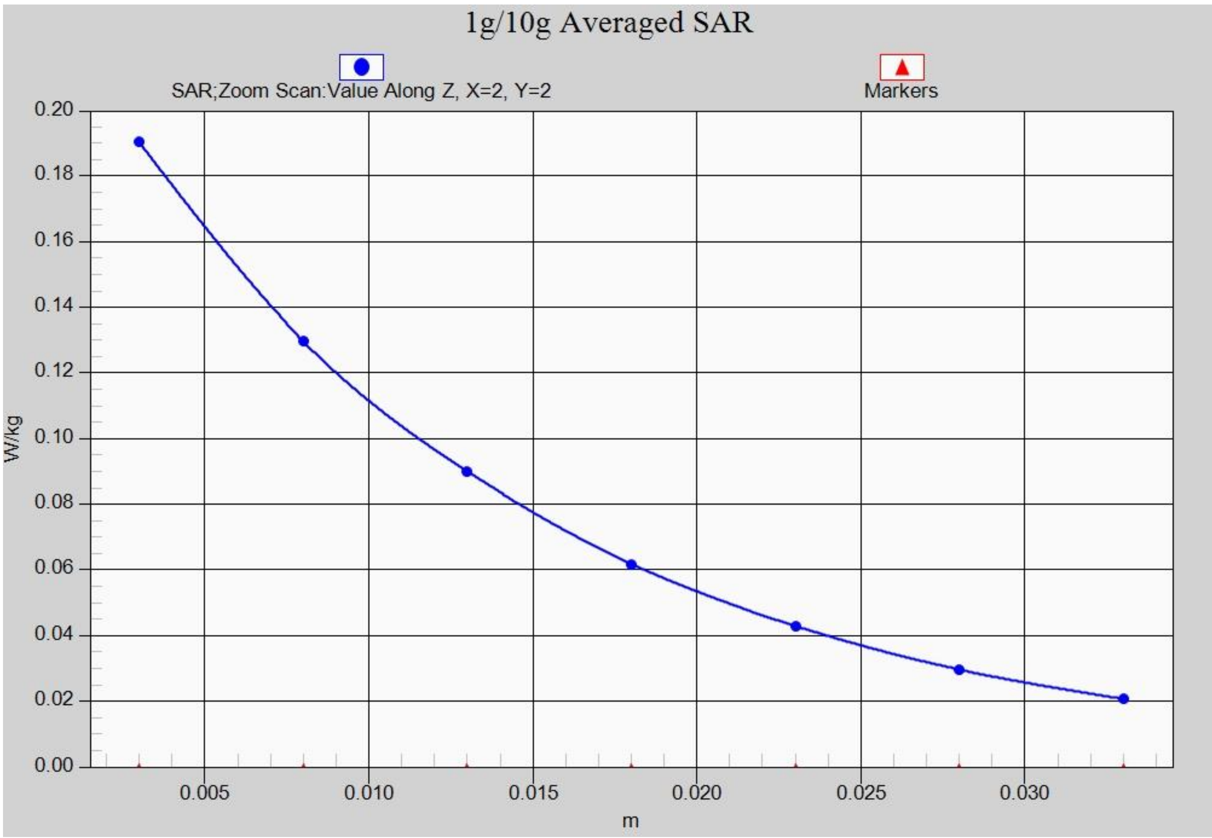


Fig.1- 3 Z-Scan at power reference point (PCS1900)

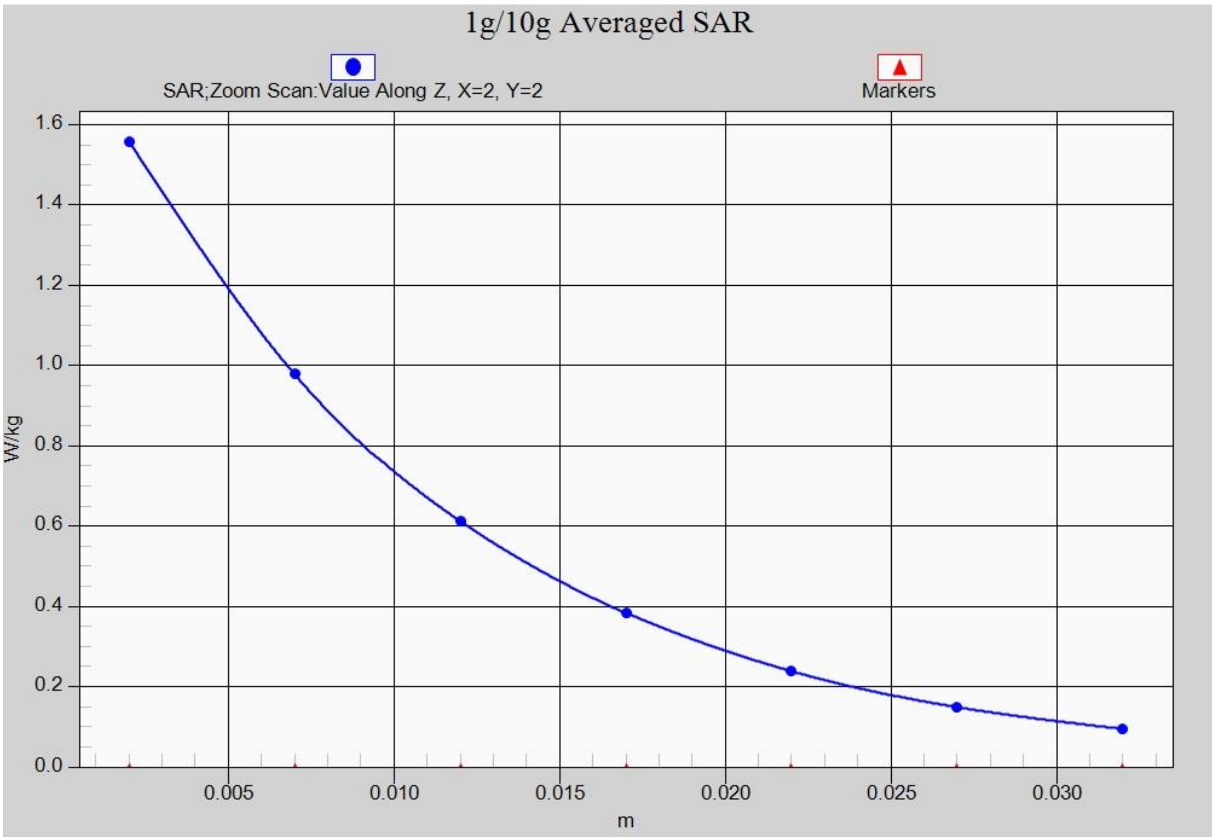


Fig.1- 4 Z-Scan at power reference point (PCS1900)

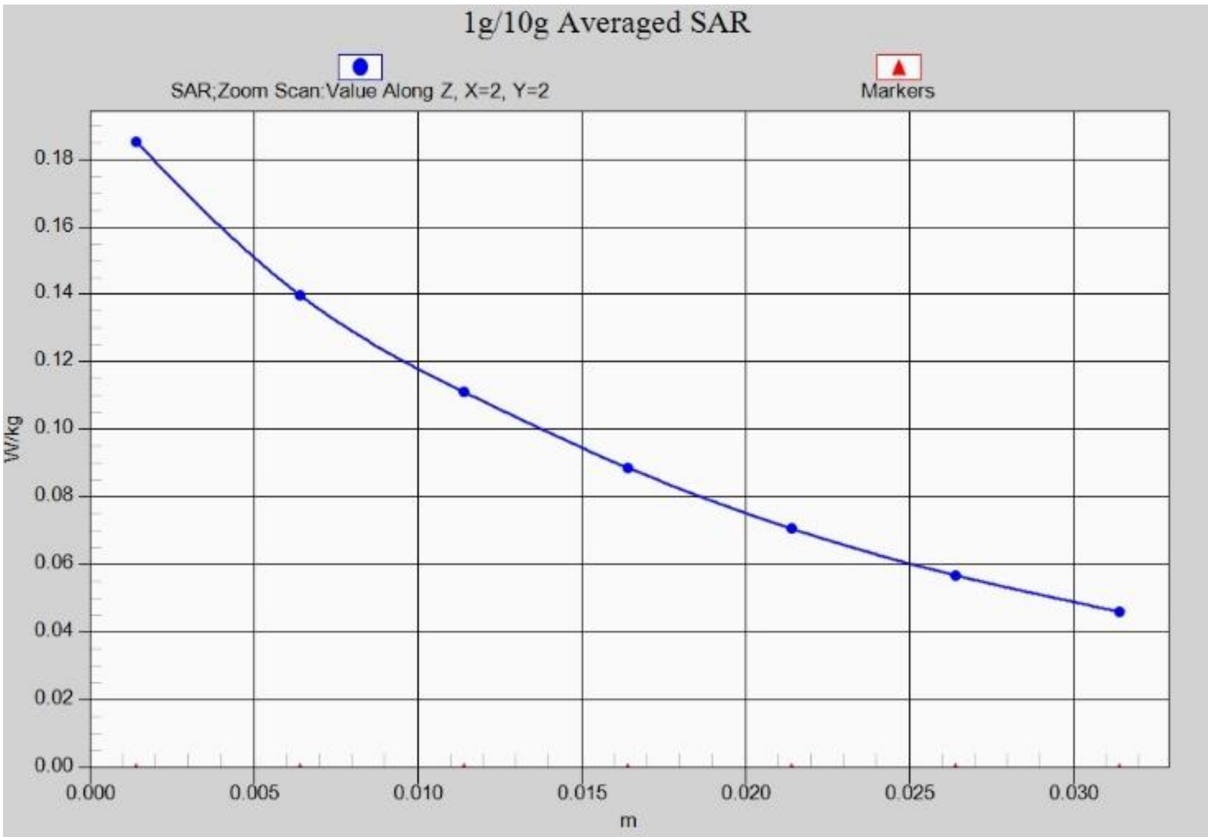


Fig.1- 5 Z-Scan at power reference point (W850)

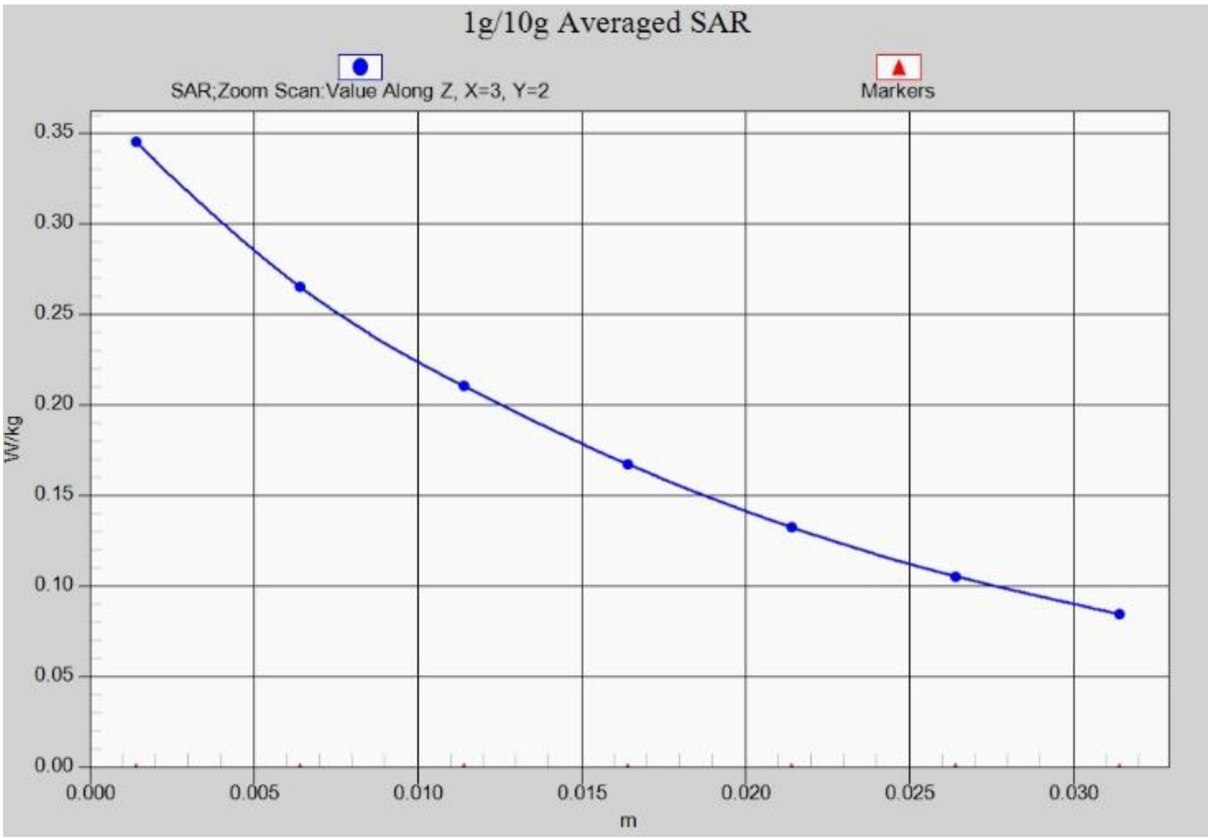


Fig.1- 6 Z-Scan at power reference point (W850)

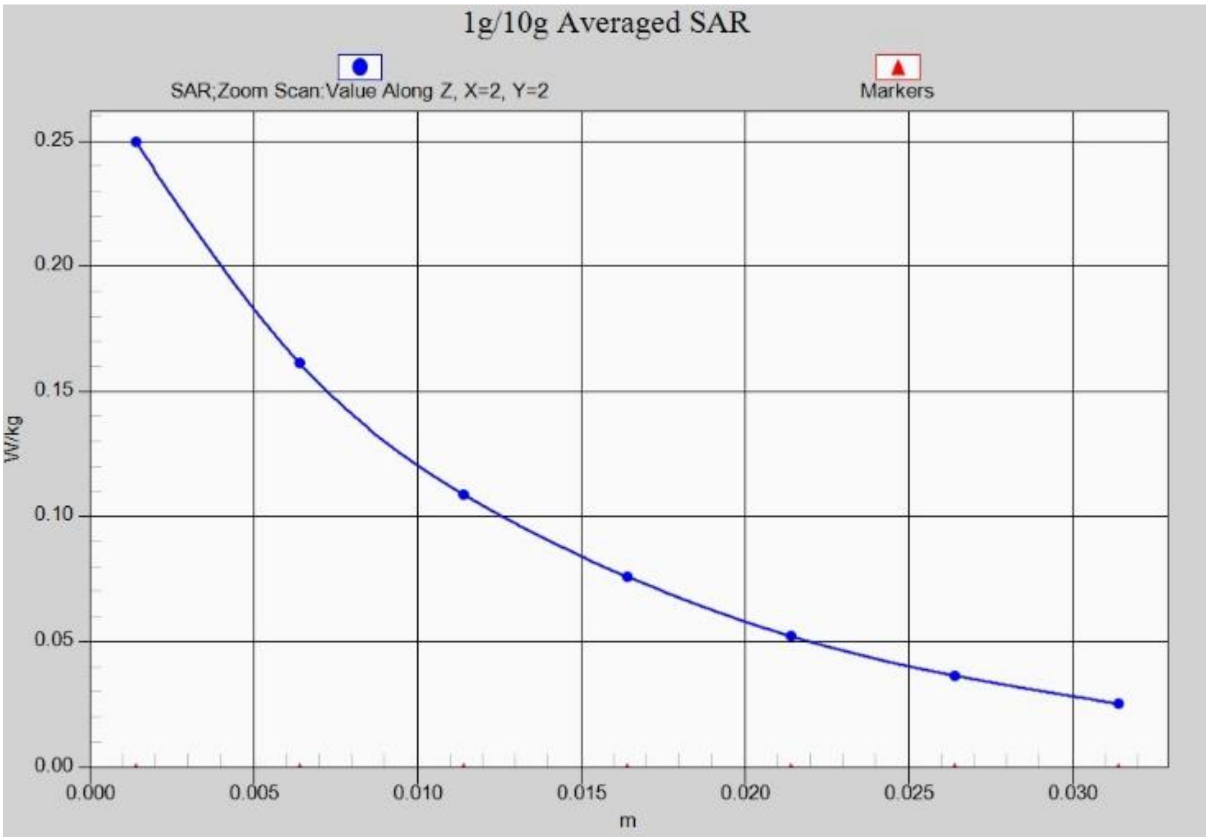


Fig. 1- 5 Z-Scan at power reference point (W1700)

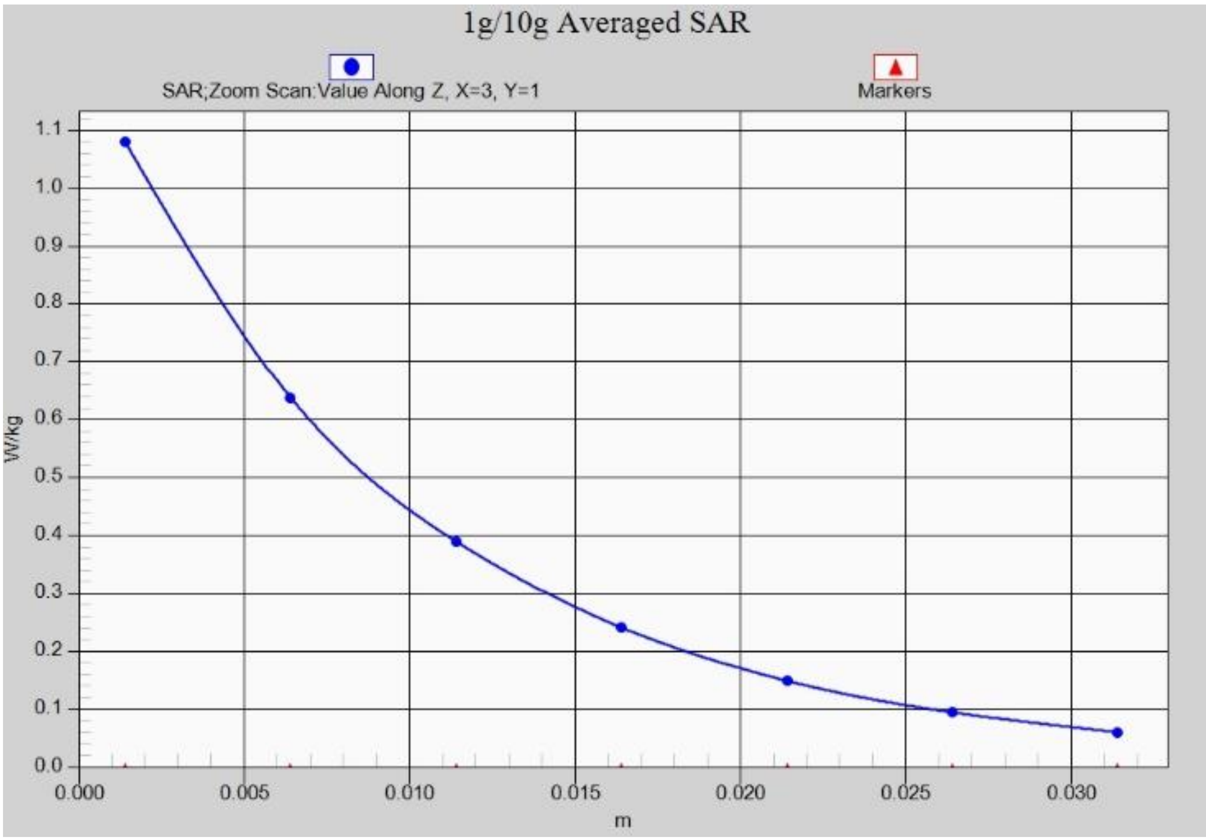


Fig.1- 6 Z-Scan at power reference point (W1700)

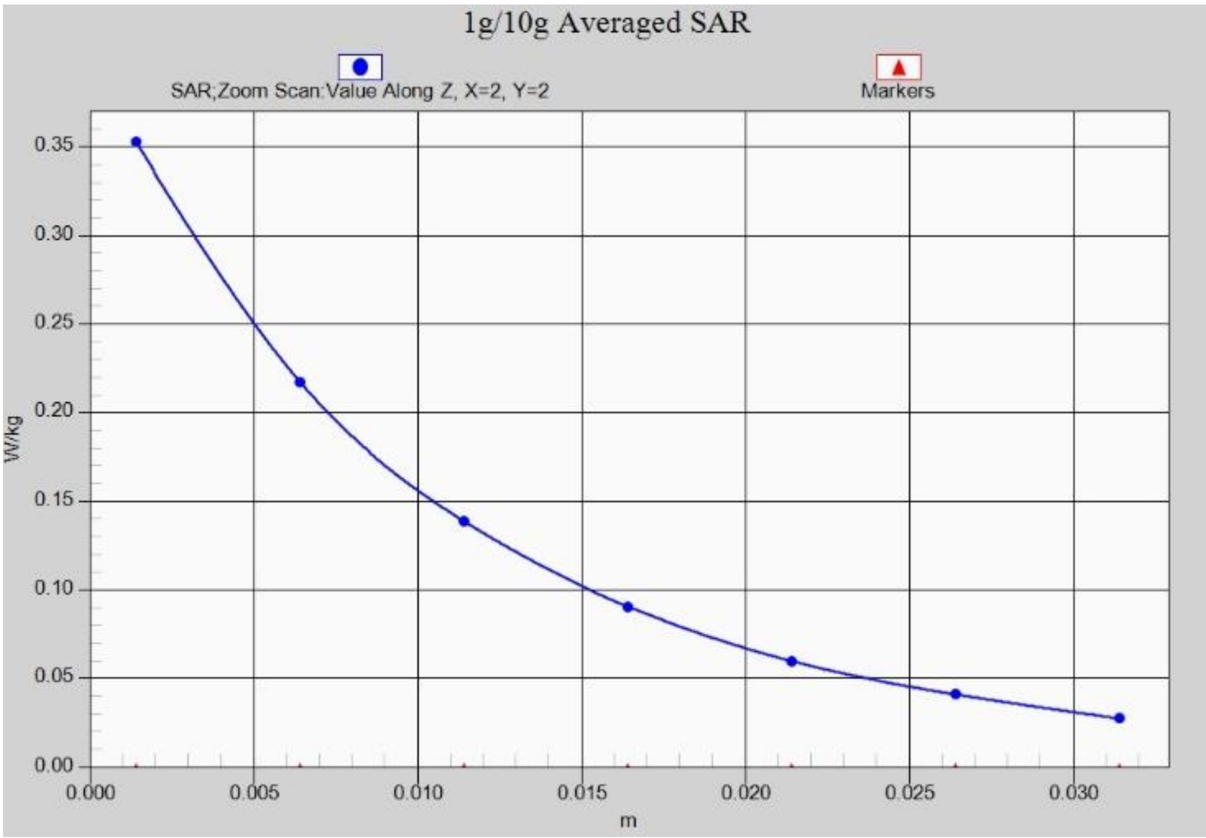


Fig.1- 9 Z-Scan at power reference point (W1900)

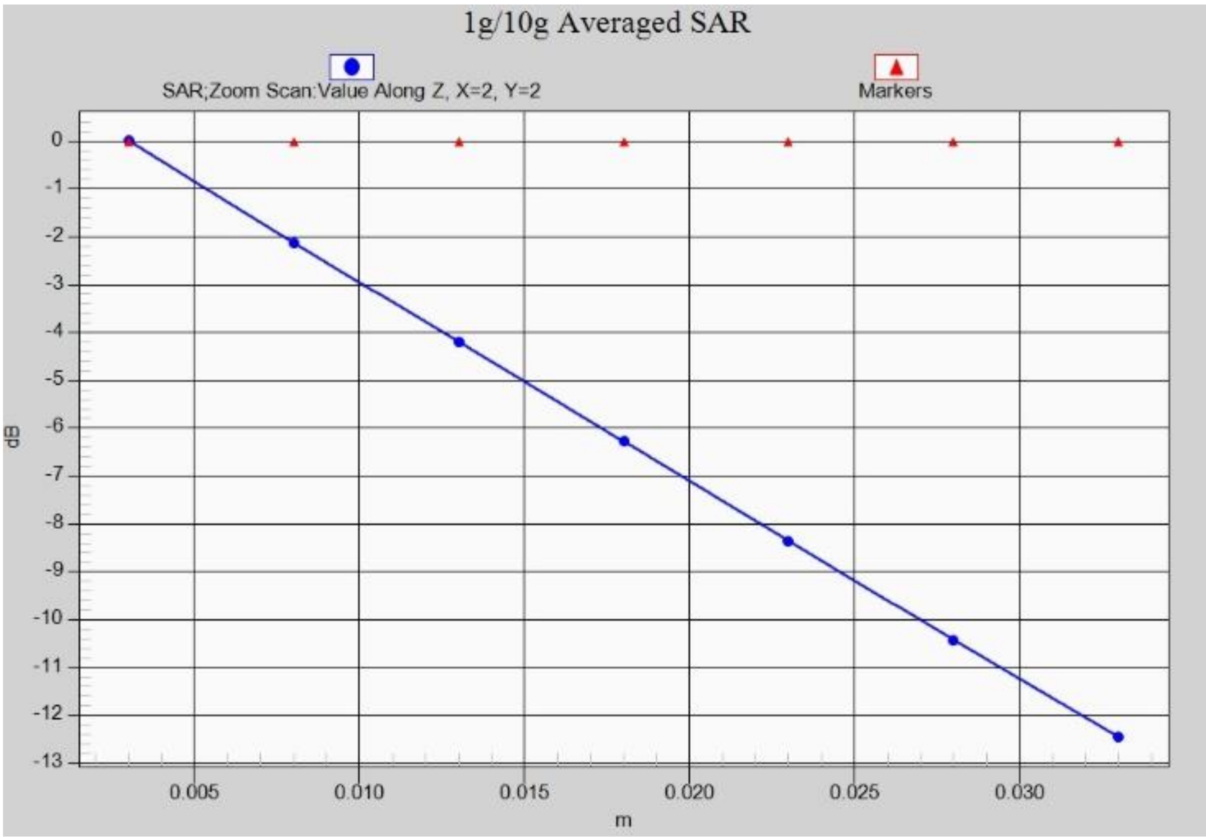


Fig.1- 10 Z-Scan at power reference point (W1900)

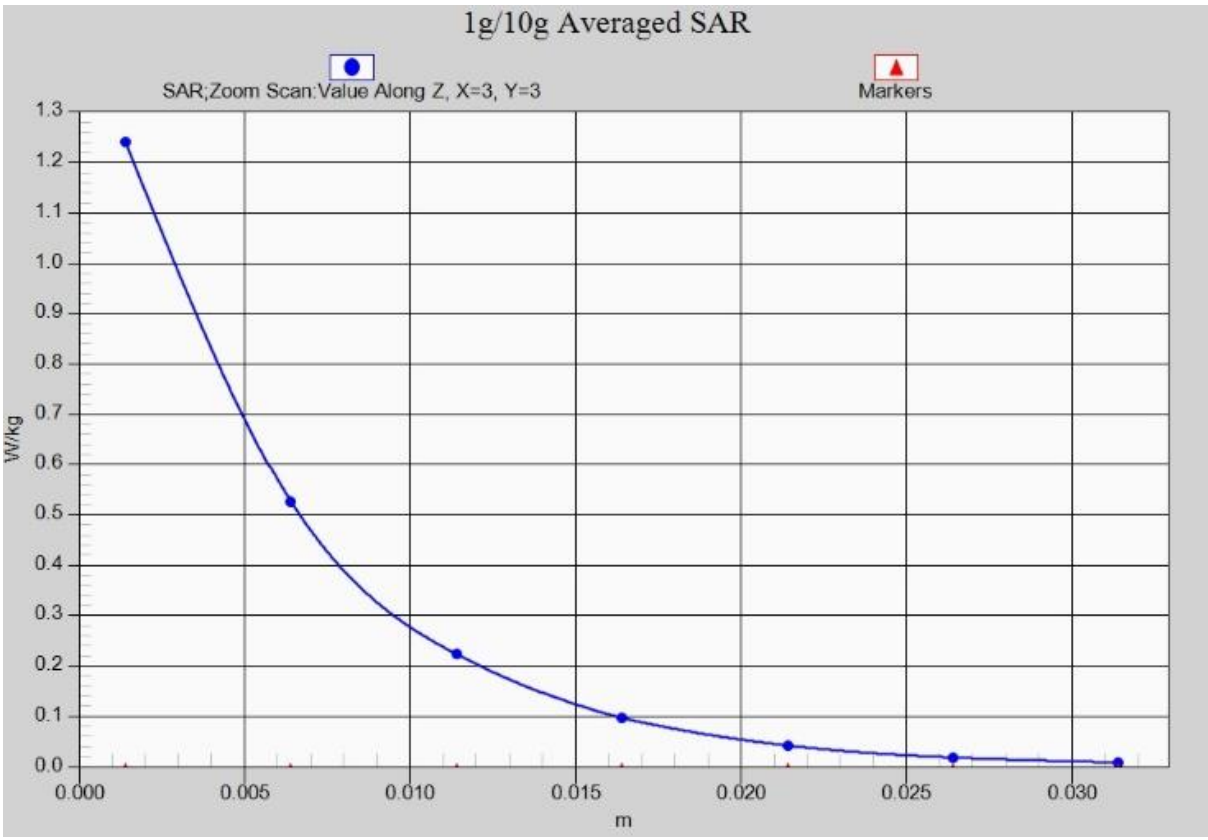


Fig.1- 7 Z-Scan at power reference point (WLAN)

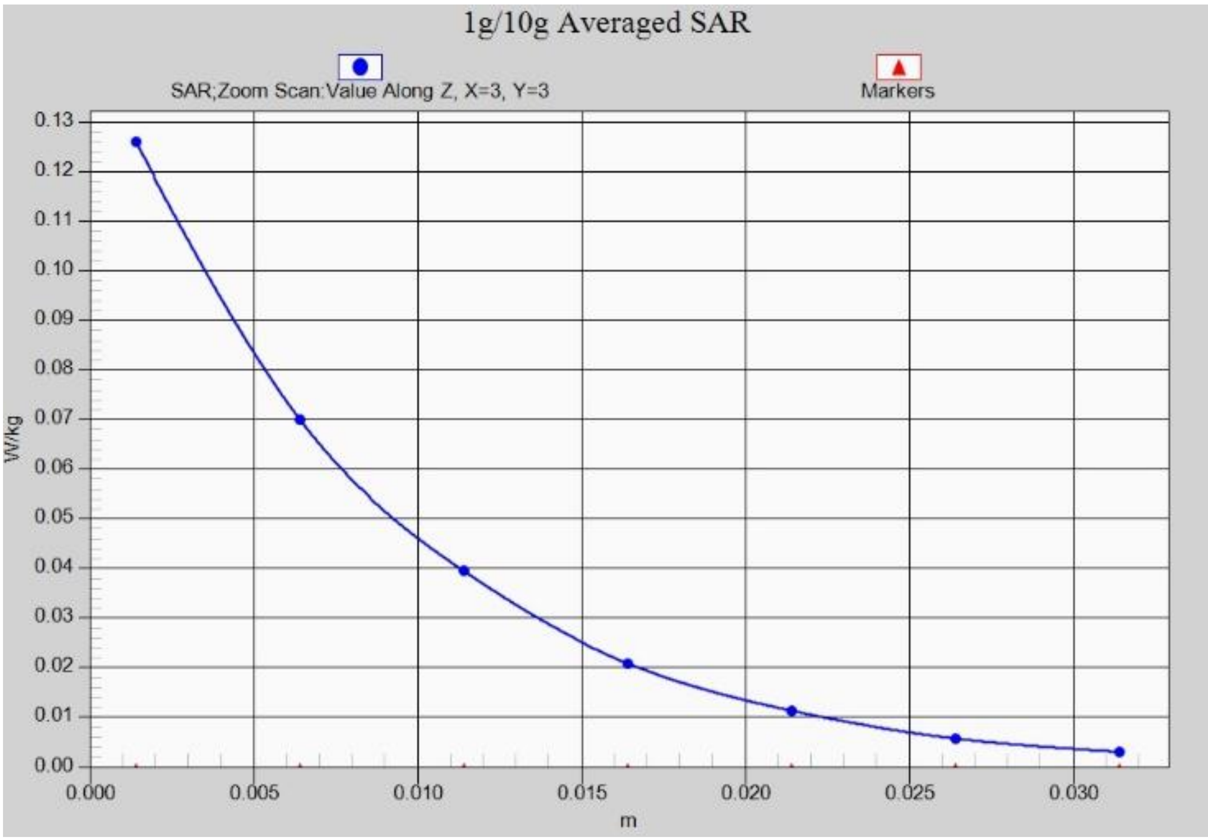


Fig.1- 8 Z-Scan at power reference point (WLAN)

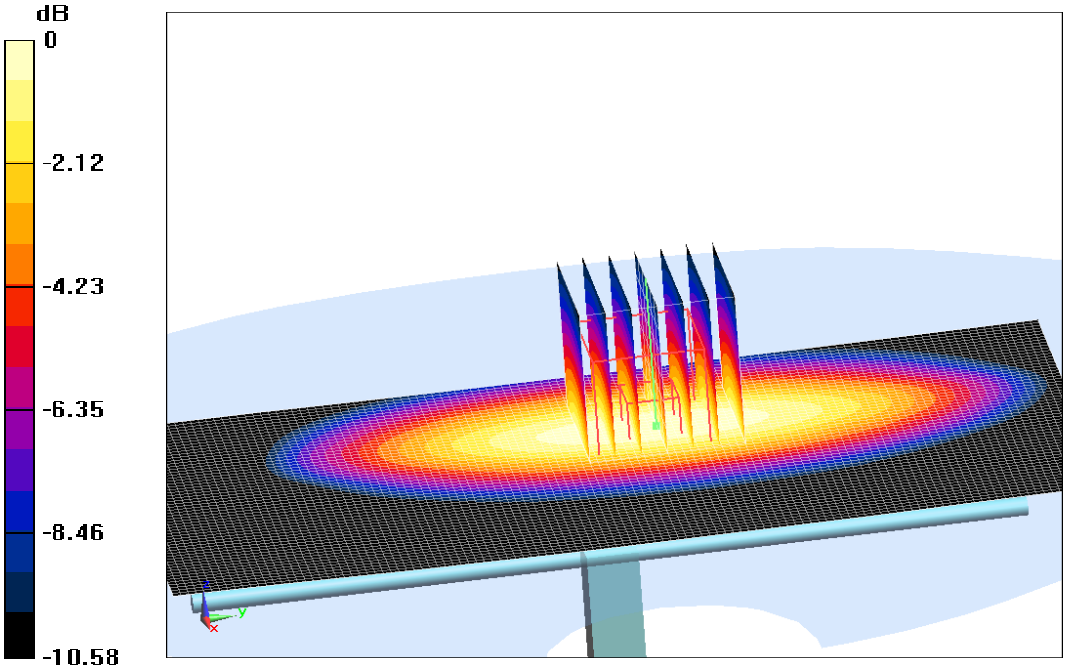
ANNEX B System Verification Results

835 MHz

Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: Head835 MHz
Medium parameters used: f = 835 MHz; σ =0.89 mho/m; ε_r = 41.27; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(9.33,9.33,9.33)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 62.04 V/m; Power Drift = 0.01
Fast SAR: SAR(1 g) = 2.33W/kg; SAR(10 g) = 1.53 W/kg
Maximum value of SAR (interpolated) = 3.16 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =62.04 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.7 W/kg
SAR(1 g) = 2.32W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dB W/kg

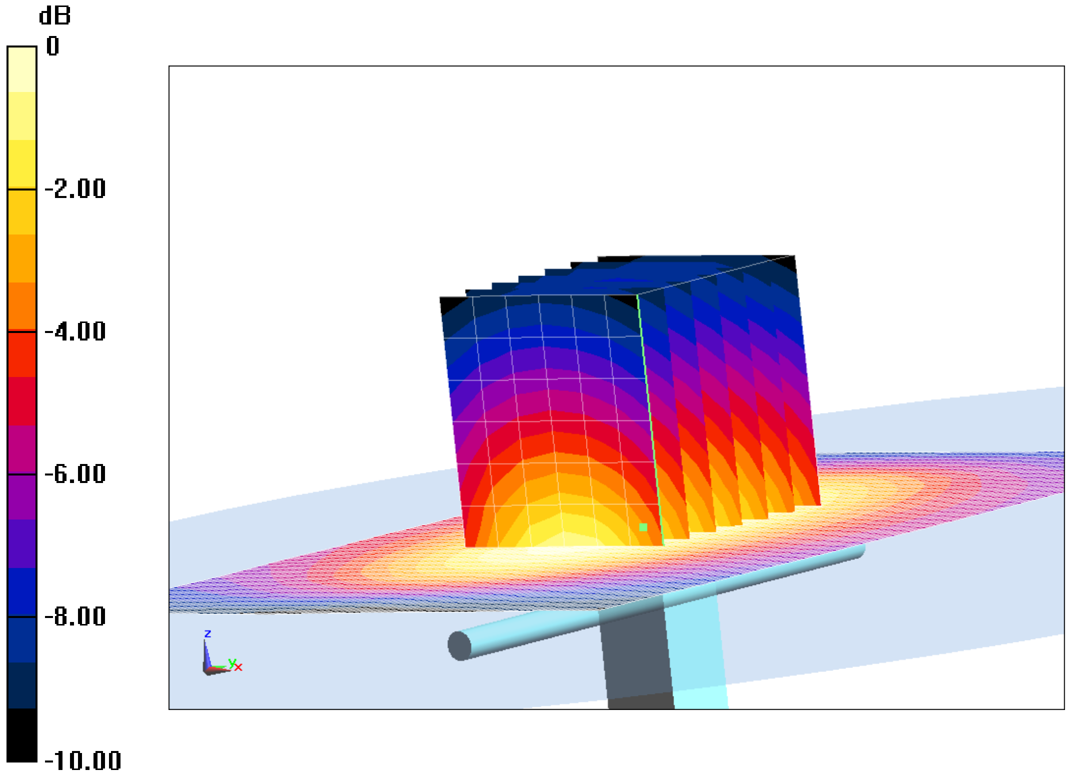
Fig.B.1 validation 835 MHz 250mW

835 MHz

Date: 5/12/2017
Electronics: DAE4 Sn1331
Medium: Body835 MHz
Medium parameters used: f = 835 MHz; σ =0.973 mho/m; ε_r = 56.03; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(9.52,9.52,9.52)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 59.89 V/m; Power Drift = 0.01
Fast SAR: SAR(1 g) = 2.45W/kg; SAR(10 g) = 1.62 W/kg
Maximum value of SAR (interpolated) = 3.35 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =59.89 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.72 W/kg
SAR(1 g) = 2.38W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 3.26 W/kg



0 dB = 3.26 W/kg = 5.13 dB W/kg

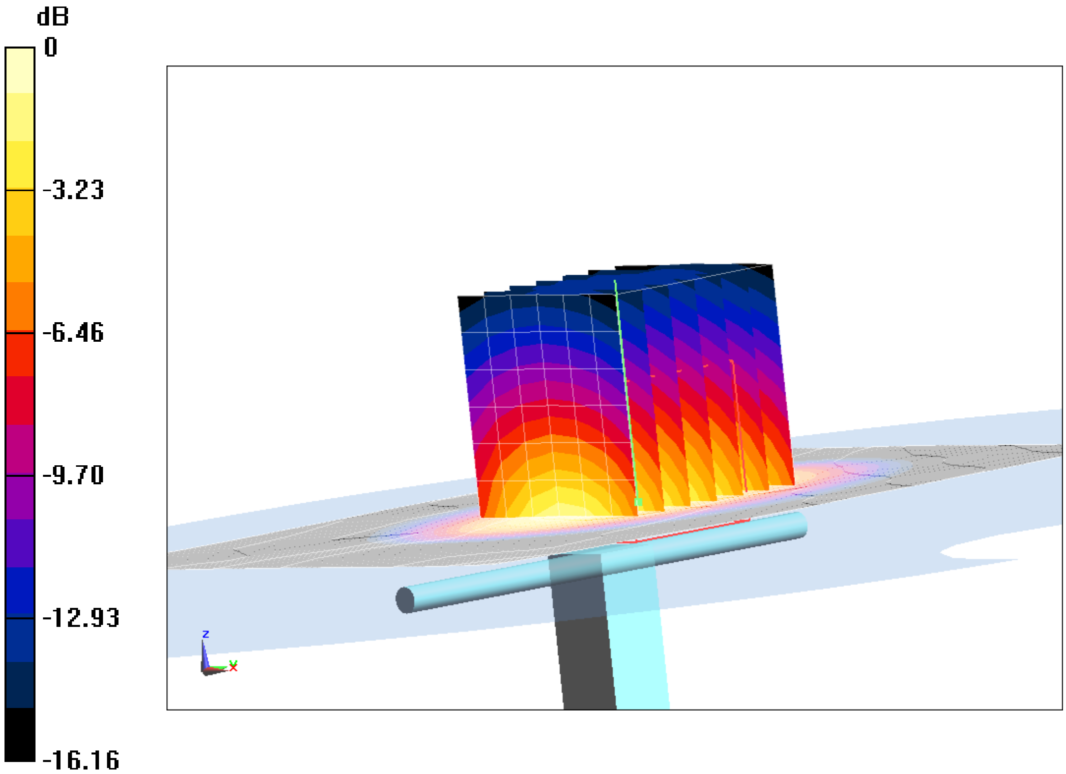
Fig.B.2 validation 835 MHz 250mW

1750 MHz

Date: 5/13/2017
Electronics: DAE4 Sn1331
Medium: Head1750 MHz
Medium parameters used: f = 1750 MHz; σ =1.345 mho/m; ε_r = 40.13; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(8.16,8.16,8.16)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 104.4 V/m; Power Drift = 0.01
Fast SAR: SAR(1 g) = 9.29W/kg; SAR(10 g) = 4.9 W/kg
Maximum value of SAR (interpolated) = 14.48 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =104.4 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 16.93 W/kg
SAR(1 g) = 9.02W/kg; SAR(10 g) = 4.86 W/kg
Maximum value of SAR (measured) = 14.48 W/kg



0 dB = 14.48 W/kg = 11.61 dB W/kg

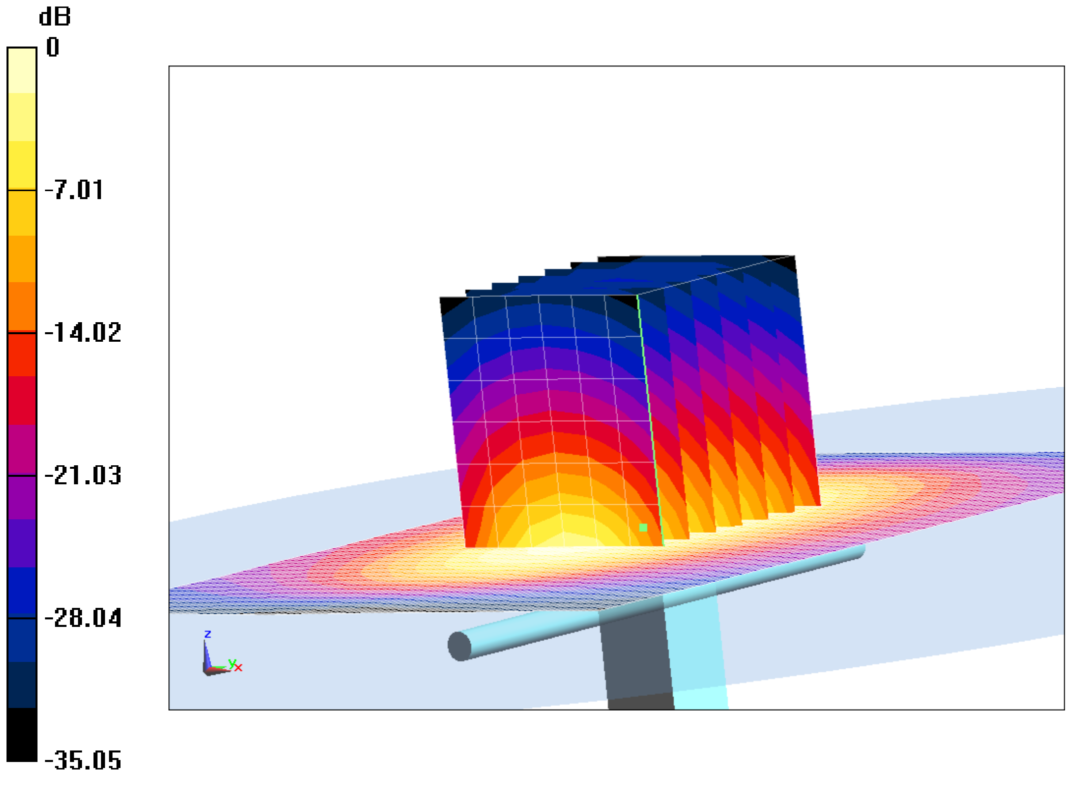
Fig.B.3 validation 1750 MHz 250mW

1750 MHz

Date: 5/13/2017
Electronics: DAE4 Sn1331
Medium: Body1750 MHz
Medium parameters used: f = 1750 MHz; σ =1.503 mho/m; ε_r = 53.53; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(7.9,7.9,7.9)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 101.17 V/m; Power Drift = 0.02
Fast SAR: SAR(1 g) = 9.1W/kg; SAR(10 g) = 4.94 W/kg
Maximum value of SAR (interpolated) = 13.65 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =101.17 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 16.56 W/kg
SAR(1 g) = 9.22W/kg; SAR(10 g) = 4.86 W/kg
Maximum value of SAR (measured) = 14.07 W/kg



0 dB = 14.07 W/kg = 11.48 dB W/kg

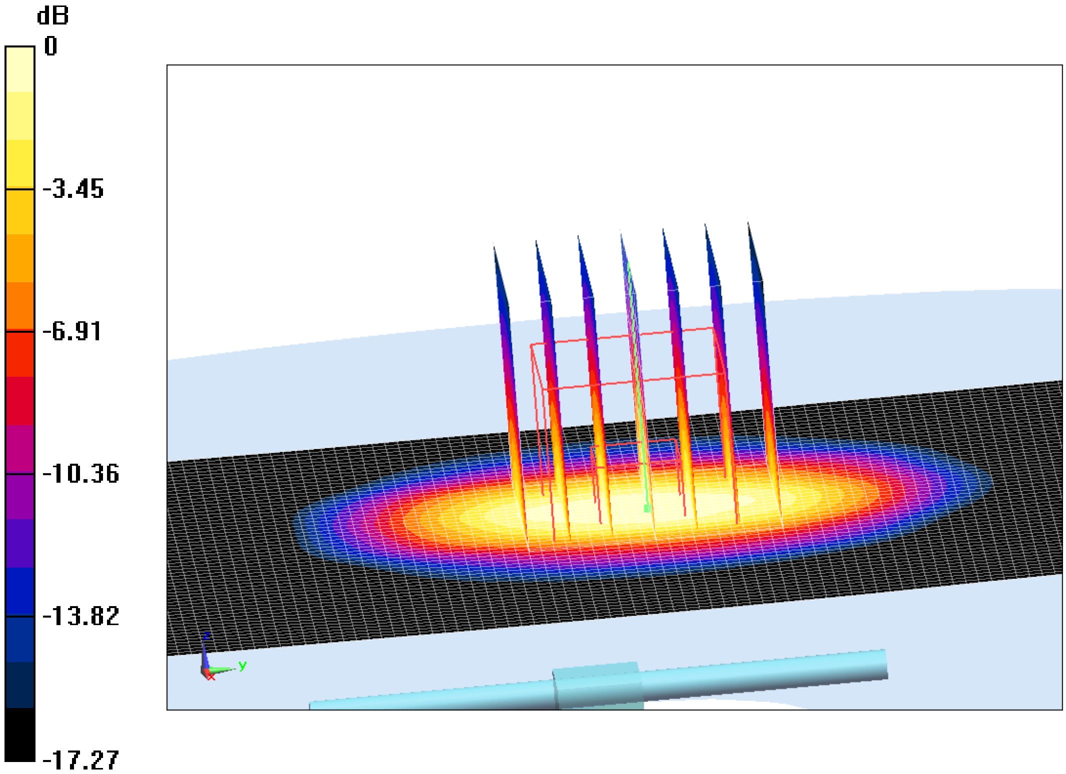
Fig.B.4 validation 1750 MHz 250mW

1900 MHz

Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: Head1900 MHz
Medium parameters used: f = 1900 MHz; σ =1.413 mho/m; ε_r = 39.77; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C Liquid Temperature: 23.3°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(7.89,7.89,7.89)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 109.82 V/m; Power Drift = 0.01
Fast SAR: SAR(1 g) = 10W/kg; SAR(10 g) = 5.4 W/kg
Maximum value of SAR (interpolated) = 15.32 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =109.82 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 18.7 W/kg
SAR(1 g) = 10.17W/kg; SAR(10 g) = 5.24 W/kg
Maximum value of SAR (measured) = 15.73 W/kg



0 dB = 15.73 W/kg = 11.97 dB W/kg

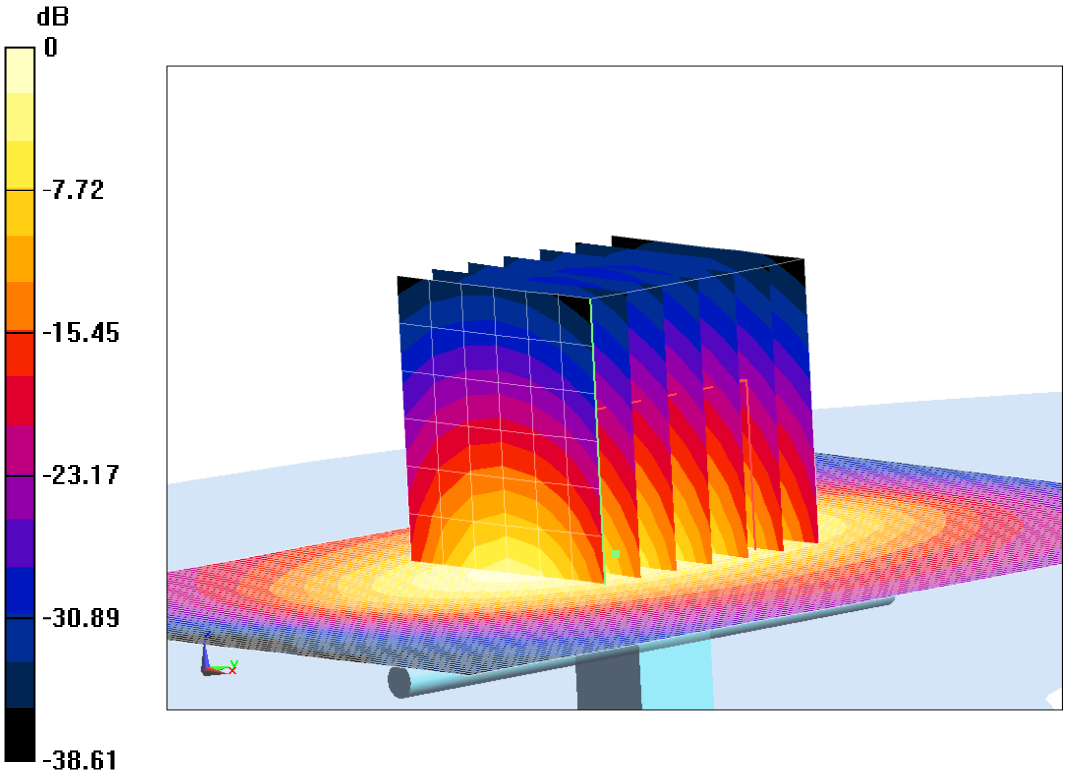
Fig.B.5 validation 1900 MHz 250mW

1900 MHz

Date: 5/14/2017
Electronics: DAE4 Sn1331
Medium: Body1900 MHz
Medium parameters used: f = 1900 MHz; σ =1.506 mho/m; ε_r = 53.16; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(7.57,7.57,7.57)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 102.62 V/m; Power Drift = -0.01
Fast SAR: SAR(1 g) = 10W/kg; SAR(10 g) = 5.33 W/kg
Maximum value of SAR (interpolated) = 14.43 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =102.62 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.38 W/kg
SAR(1 g) = 10.21W/kg; SAR(10 g) = 5.3 W/kg
Maximum value of SAR (measured) = 14.87 W/kg



0 dB = 14.87 W/kg = 11.72 dB W/kg

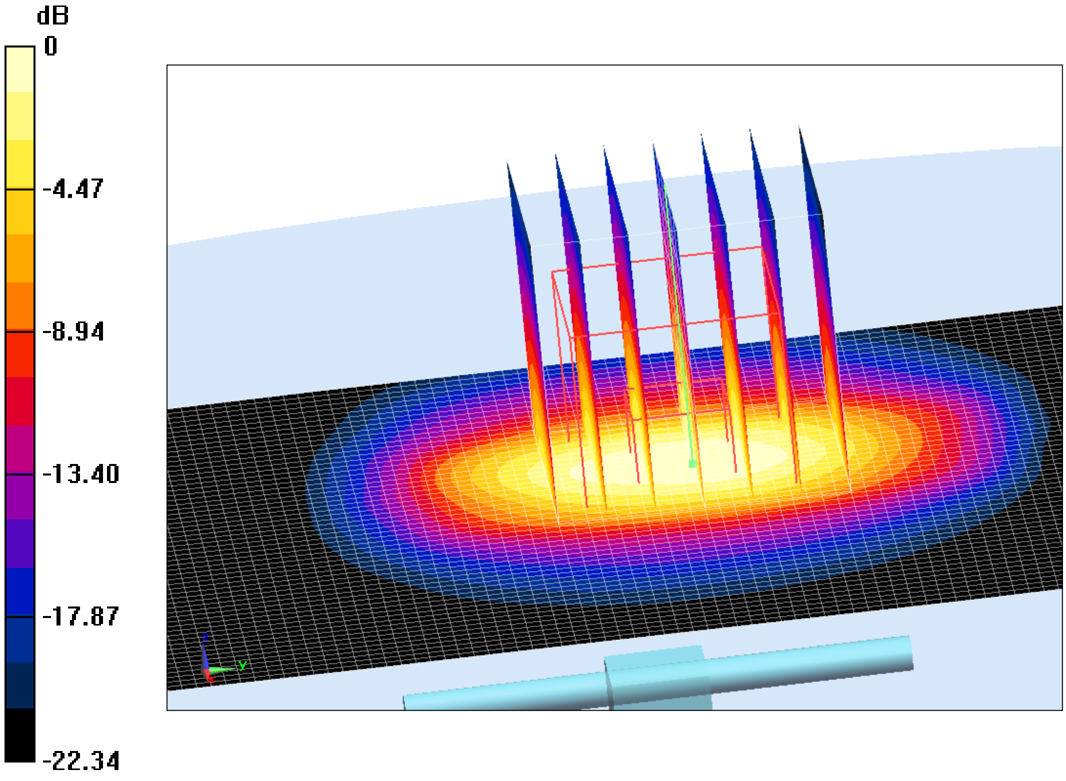
Fig.B.6 validation 1900 MHz 250mW

2450 MHz

Date: 5/15/2017
Electronics: DAE4 Sn1331
Medium: Head2450 MHz
Medium parameters used: f = 2450 MHz; σ =1.801 mho/m; ε_r = 39.29; ρ = 1000 kg/m^3
Ambient Temperature: 22.5^{o}C Liquid Temperature: 23.3^{o}C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(7.22,7.22,7.22)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 115.72 V/m; Power Drift = 0.01
Fast SAR: SAR(1 g) = 13.2W/kg; SAR(10 g) = 6.08 W/kg
Maximum value of SAR (interpolated) = 23 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =115.72 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 27.78 W/kg
SAR(1 g) = 13.35W/kg; SAR(10 g) = 6.15 W/kg
Maximum value of SAR (measured) = 22.47 W/kg



0 dB = 22.47 W/kg = 13.52 dB W/kg

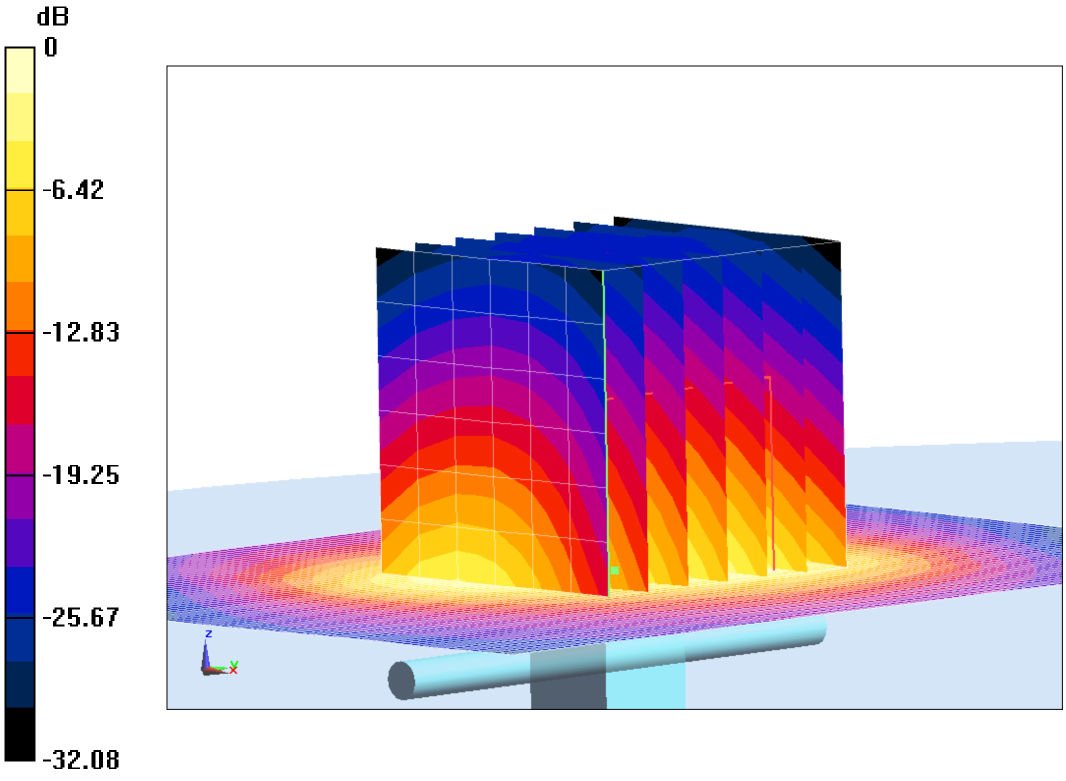
Fig.B.7 validation 2450 MHz 250mW

2450 MHz

Date: 5/15/2017
Electronics: DAE4 Sn1331
Medium: Body2450 MHz
Medium parameters used: f = 2450 MHz; σ =1.986 mho/m; ε_r = 53.56; ρ = 1000 kg/m^3
Ambient Temperature: 22.5°C Liquid Temperature: 23.3°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 – SN3846 ConvF(7.31,7.31,7.31)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 107.15 V/m; Power Drift = -0.03
Fast SAR: SAR(1 g) = 12.62W/kg; SAR(10 g) = 5.98 W/kg
Maximum value of SAR (interpolated) = 21.96 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value =107.15 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 26.51 W/kg
SAR(1 g) = 12.57W/kg; SAR(10 g) = 6.09 W/kg
Maximum value of SAR (measured) = 21.45 W/kg



0 dB = 21.45 W/kg = 13.31 dB W/kg

Fig.B.8 validation 2450 MHz 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.

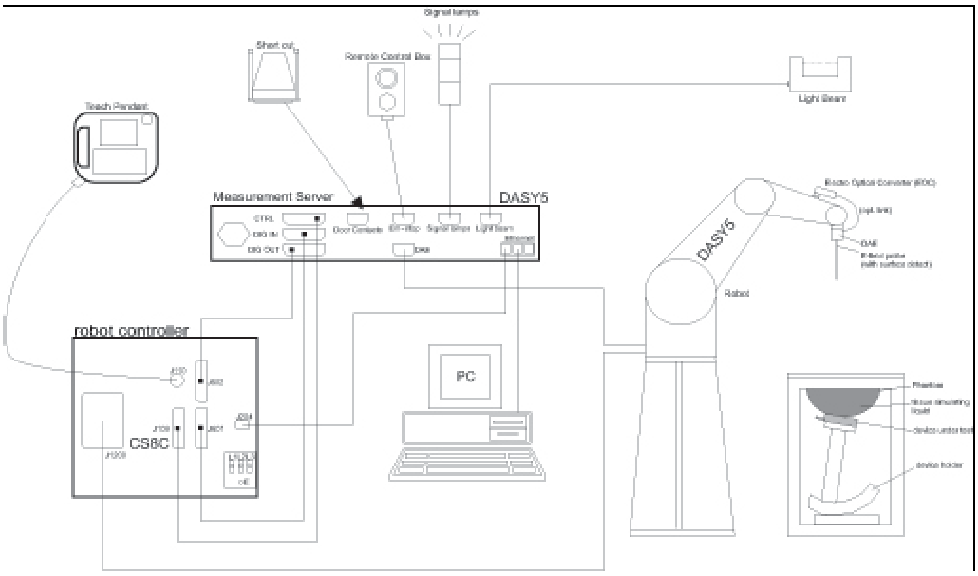
Table B.1 Comparison between area scan and zoom scan for system verification

Date	Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
2017-5-12	835	Head	2.33	2.32	0.43
	835	Body	2.45	2.38	2.94
2017-5-13	1750	Head	9.29	9.02	2.99
	1750	Body	9.1	9.22	-1.30
2017-5-14	1900	Head	10	10.17	-1.67
	1900	Body	10	10.21	-2.06
2017-5-15	2450	Head	13.2	13.35	-1.12
	2450	Body	12.62	12.57	0.40

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.1SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (StäubliTX=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 2nd ord curve fitting. The approach is stopped at reaching the maximum.

Picture C.2Near-field Probe

Probe Specifications:
Model: ES3DV3, EX3DV4
Frequency 10MHz — 6.0GHz(EX3DV4)
Range: 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
DynamicRange: 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 ofmobile phones
Dosimetry in strong gradient fields

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.5DASY 4

Picture C.6DASY 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

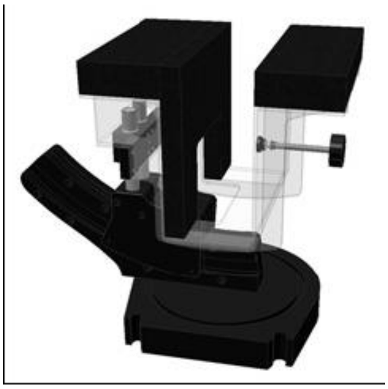
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate 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 are 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 ε=3 and loss tangent δ =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