SAR TEST REPORT

No. I14Z49085-SEM01

For

TCT Mobile Limited

HSDPA/HSUPA/HSPA+/CDMA dual band /LTE 1 band mobile phone

Model Name: A846L

With

Hardware Version: PIO

Software Version: 3JP6

FCC ID: RAD528

Issued Date: 2015-01-20

TESTING
CNAS L0570

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.

Test Laboratory:

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
I14Z49085-SEM01	Rev.0	2015-01-20	Initial creation of test report

TABLE OF CONTENT

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

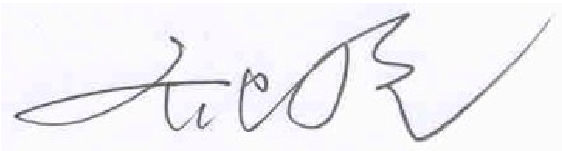
1.3 Project Data

Project Leader:	Qi Dianyuan
Test Engineer:	Lin Xiaojun
Testing Start Date:	December 23, 2014
Testing End Date:	December 26, 2014

1.4 Signature

Lin Xiaojun

(Prepared this test report)



Qi Dianyuan

(Reviewed this test report)

Xiao Li

Deputy Director of the laboratory

(Approved this test report)

2 Statement of Compliance

The maximum results found during testing for TCT Mobile Limited HSDPA/HSUPA/HSPA+/CDMA dual band /LTE 1 band mobile phone A846L 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)	CDMA BC0	0.74	PCE
	CDMA BC1	0.60	
	LTE Band 13	0.35	
	WLAN 2.4 GHz	0.57	DTS
Body-worn (Separation Distance 10mm)	CDMA BC0	1.01	PCE
	CDMA BC1	0.83	
	LTE Band 13	0.80	
	WLAN 2.4 GHz	0.28	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 C95.1-1999.

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

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

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.

The highest reported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.01 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, Tilt 15°	0.37	0.57	**0.94**
	Right hand, Touch cheek	0.74	0.40	**1.14**
Highest reported SAR value for Body	Rear	1.01	0.19	**1.20**
	Top	/	0.28	**0.28**

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

	Position	Main antenna	BT*	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.74	0.26	**1.00**
Highest reported SAR value for Body	Rear	1.01	0.13	**1.14**

BT* - Estimated SAR for Bluetooth (see the table 13.3)

According to the above tables, the highest sum of reported SAR values is **1.20 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

3 Client Information

3.1 Applicant Information

Company Name:	TCT Mobile Limited
Address /Post:	5F, E building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
City:	Shanghai
Postal Code:	201203
Country:	P.R.China
Contact:	Gong Zhizhou
Email:	zhizhou.gong@jrdcom.com
Telephone:	0086-21-6146089
Fax:	0086-21-61460602

3.2 Manufacturer Information

Company Name:	TCT Mobile Limited
Address /Post:	5F, E building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
City:	Shanghai
Postal Code:	201203
Country:	P.R.China
Contact:	Gong Zhizhou
Email:	zhizhou.gong@jrdcom.com
Telephone:	0086-21-6146089
Fax:	0086-21-61460602

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

4.1 About EUT

Description:	HSDPA/HSUPA/HSPA+/CDMA dual band /LTE 1 band mobile phone
Model Name:	A846L
Operating mode(s):	CDMA BC0/1, LTE Band13, BT, Wi-Fi
Tested Tx Frequency:	824.7 – 848.31 MHz (CDMA BC0)
	1851.25 – 1908.75 MHz (CDMA BC1)
	779.5 – 784.5 MHz (LTE Band13)
	2412 – 2462 MHz (Wi-Fi 2.4G)
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna
Hotspot mode:	Support simultaneous transmission of hotspot and voice(or data)

4.2 Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
EUT1	866183020105216	PIO	3JP6
EUT2	866183020105224	PIO	3JP6
EUT3	866183020003296	PIO	3JP6

*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.

4.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	TLp025A2	CAC2500028C2	SCUD

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

5 TEST METHODOLOGY

5.1 Applicable Limit Regulations

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

5.2 Applicable Measurement Standards

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

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

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

KDB941225 D01 SAR test for 3G devices v02: SAR Measurement Procedures for 3G Devices.

KDB941225 D06 Hotspot Mode SAR v01r01: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities.

KDB248227 D01 SAR meas for 802 11 a b g v01r02 : SAR measurement procedures for 802.112abg transmitters.

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

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

6 Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and ge neral population/uncontrolled, based on a per son's awareness and ab ility 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

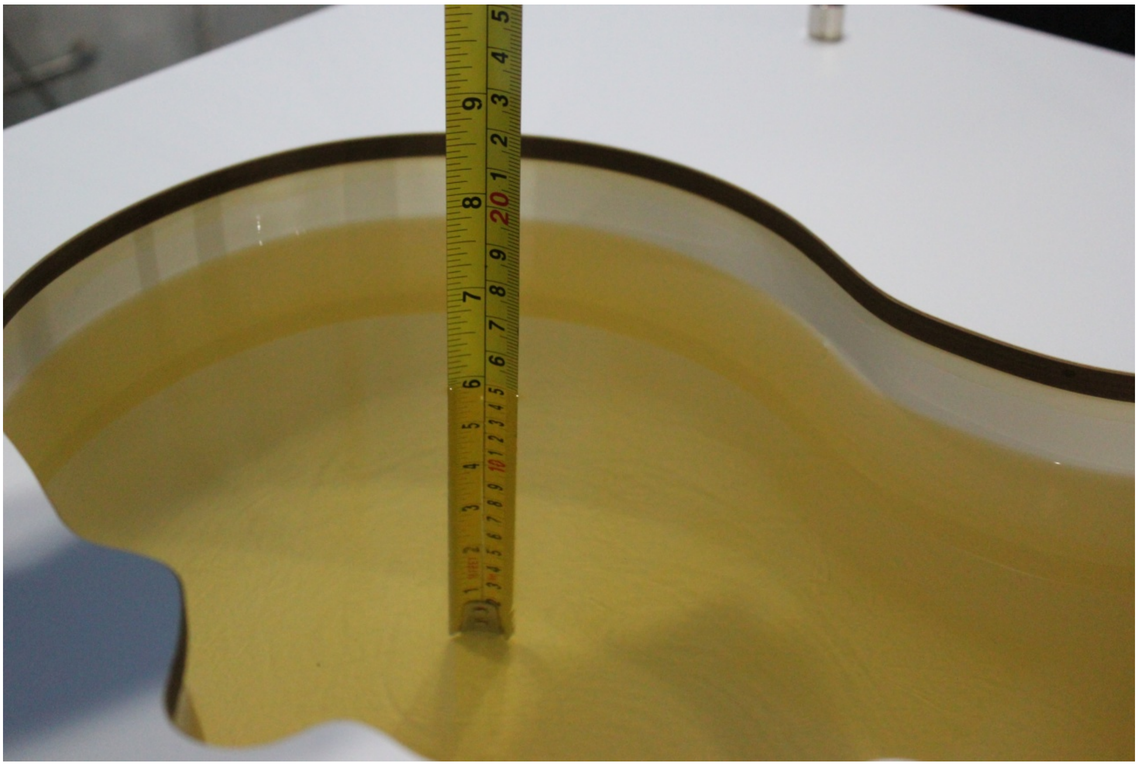
Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
835	Head	0.90	0.86～0.95	41.5	39.4～43.6
835	Body	0.97	0.92～1.02	55.2	52.4～58.0
1900	Head	1.40	1.33～1.47	40.0	38.0～42.0
1900	Body	1.52	1.44～1.60	53.3	50.6～56.0
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2
2450	Body	1.95	1.85～2.05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

7.2 Dielectric Performance

Table 7.2: Dielectric Performance of Tissue Simulating Liquid

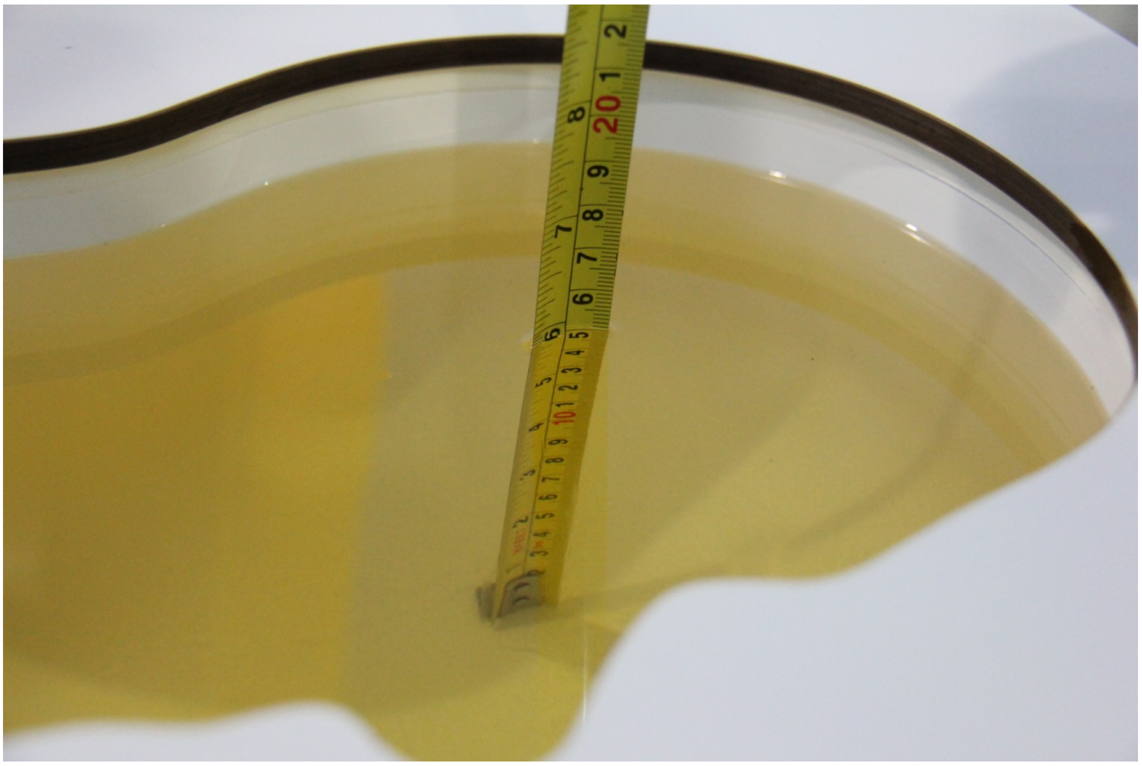
Measurement Date (yyyy-mm-dd)	Type	Frequency	Permittivity ε	Drift (%)	Conductivity σ (S/m)	Drift (%)
2014-12-23	Head	750 MHz	43.35	3.36	0.869	-2.36
	Body	750 MHz	55.53	0.05	0.925	-3.65
2014-12-24	Head	835 MHz	42.7	2.89	0.936	4.00
	Body	835 MHz	54.85	-0.63	0.963	-0.72
2014-12-25	Head	1900 MHz	40.18	0.45	1.389	-0.79
	Body	1900 MHz	54.06	1.43	1.508	-0.79
2014-12-26	Head	2450 MHz	40.2	2.55	1.84	2.22
	Body	2450 MHz	50.88	-3.45	2.018	3.49

Note: The liquid temperature is 22.0℃

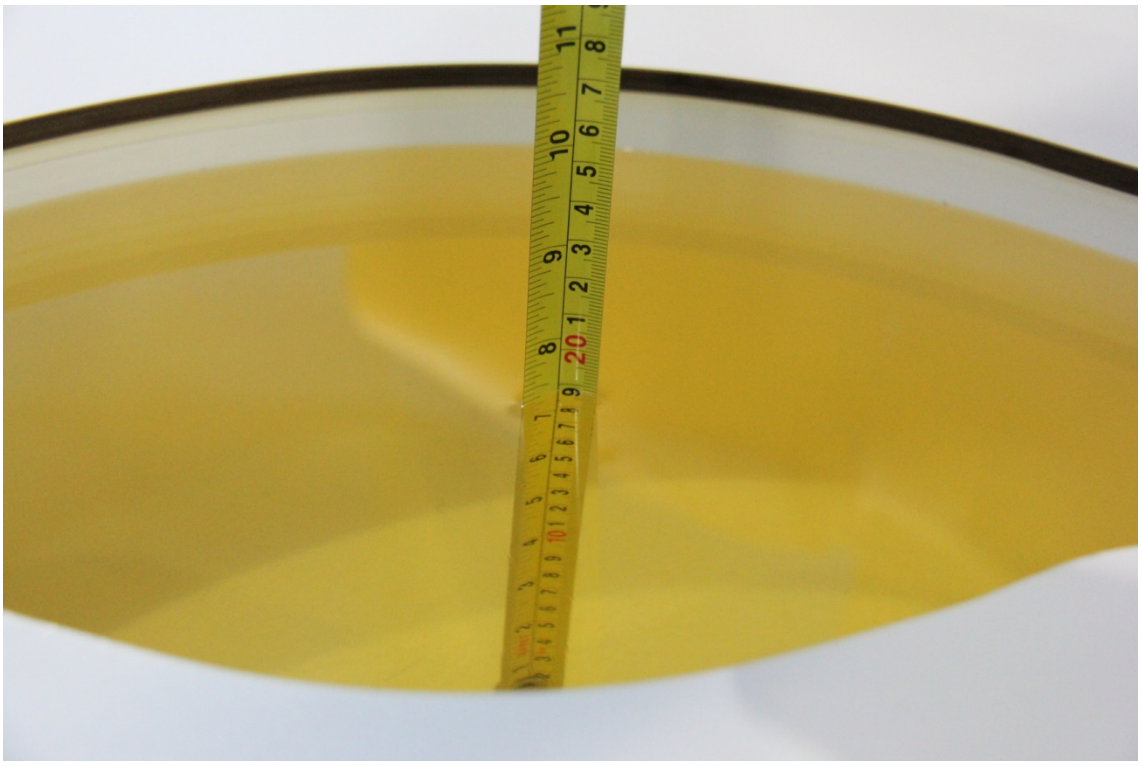


Picture 7-1: Liquid depth in the Head Phantom (750 MHz)

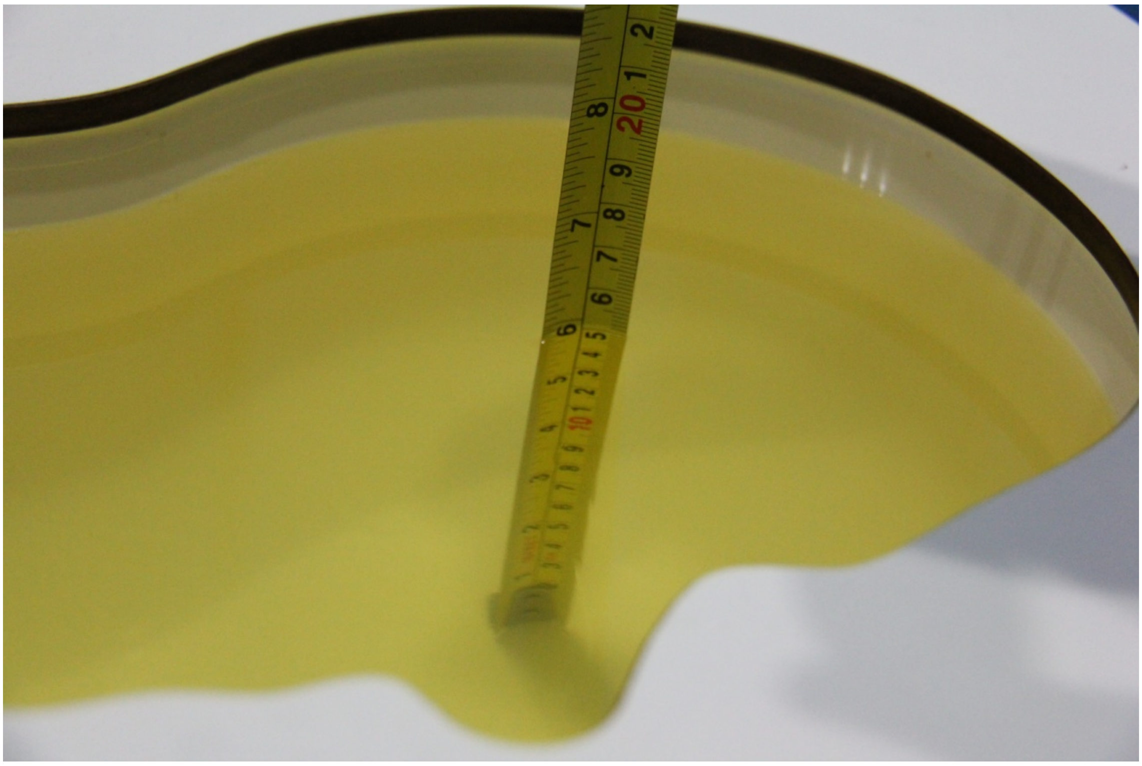
Picture 7-2: Liquid depth in the Flat Phantom (750 MHz)



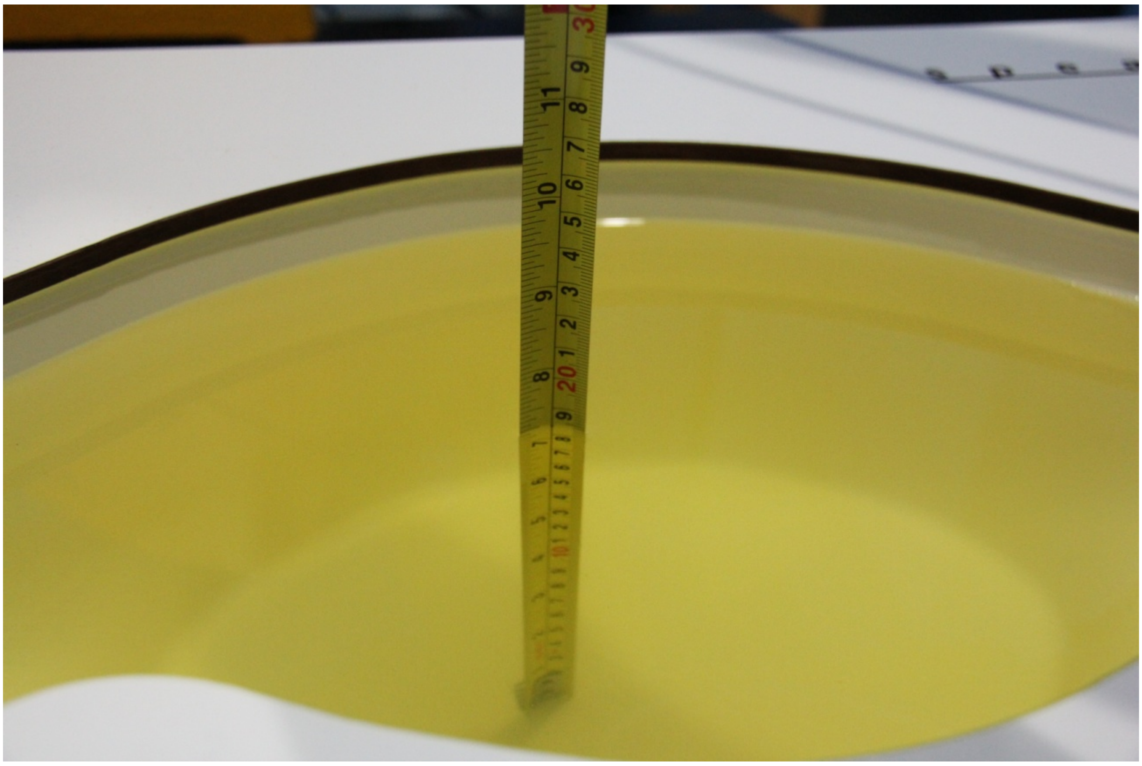
Picture 7-3: Liquid depth in the Head Phantom (835 MHz)



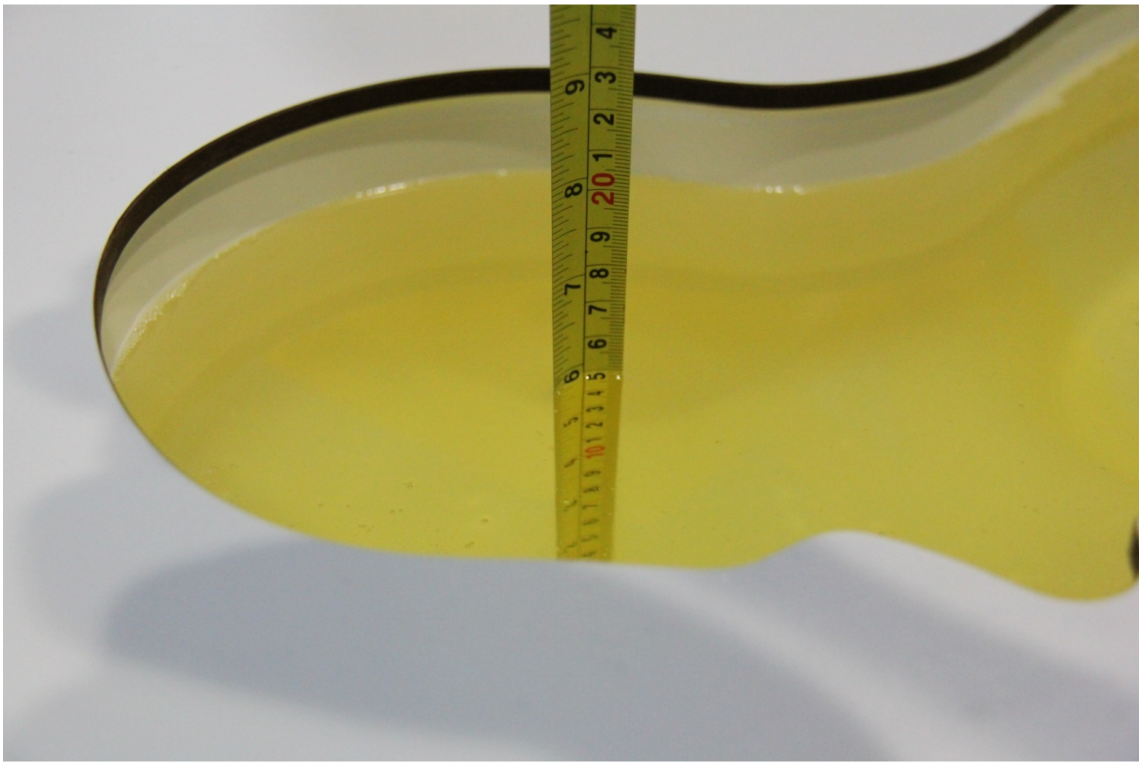
Picture 7-4: Liquid depth in the Flat Phantom (835 MHz)



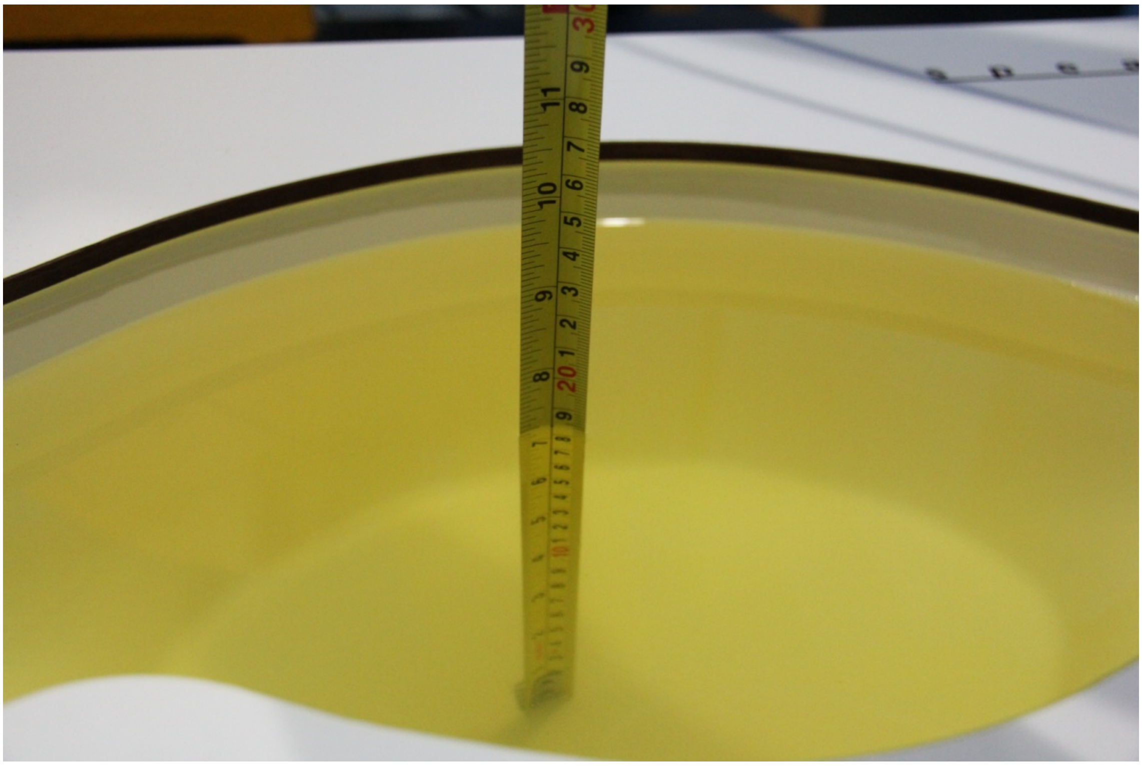
Picture 7-5: Liquid depth in the Head Phantom (1900 MHz)



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



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

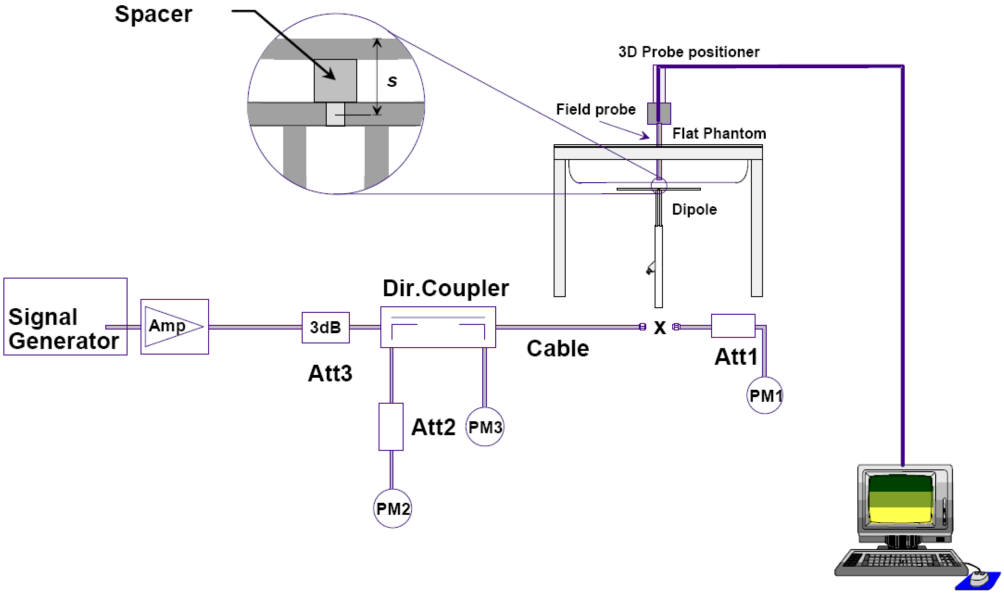


Picture 7-8 Liquid depth in the Flat Phantom (2450MHz)

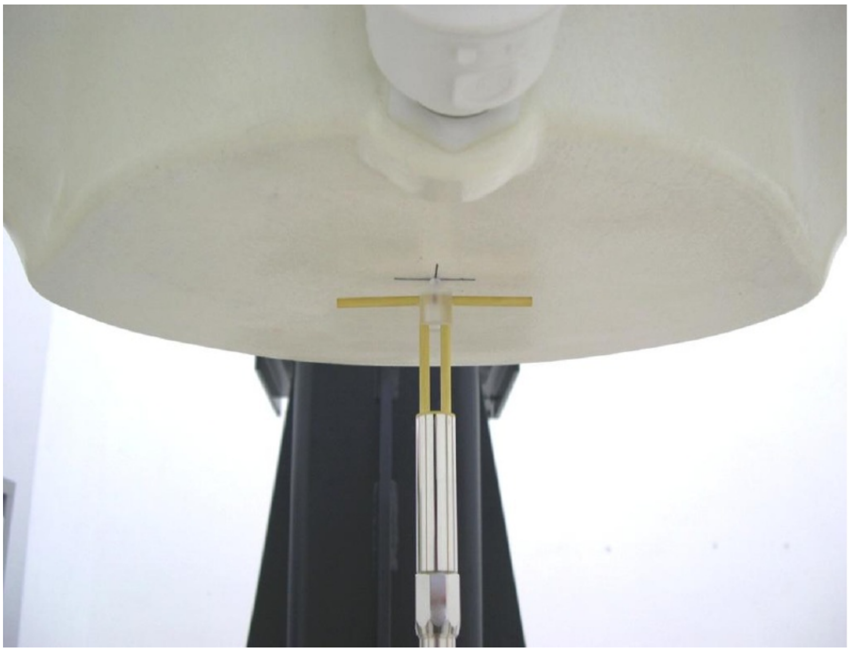
8 System verification

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
2014-12-23	750 MHz	5.49	8.31	5.60	8.56	2.00%	3.01%
2014-12-24	835 MHz	6.17	9.43	6.28	9.72	1.78%	3.08%
2014-12-25	1900 MHz	21.1	40.6	20.72	39.40	-1.80%	-2.96%
2014-12-26	2450 MHz	24.7	53.2	24.24	52.00	-1.86%	-2.26%

Table 8.2: System Verification of Body

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2014-12-23	750 MHz	5.85	8.75	5.80	8.92	-0.85%	1.94%
2014-12-24	835 MHz	6.33	9.55	6.20	9.52	-2.05%	-0.31%
2014-12-25	1900 MHz	21.4	40.4	21.72	41.20	1.50%	1.98%
2014-12-26	2450 MHz	23.9	51.3	23.36	49.60	-2.26%	-3.31%

9 Measurement Procedures

9.1 Tests to be performed

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

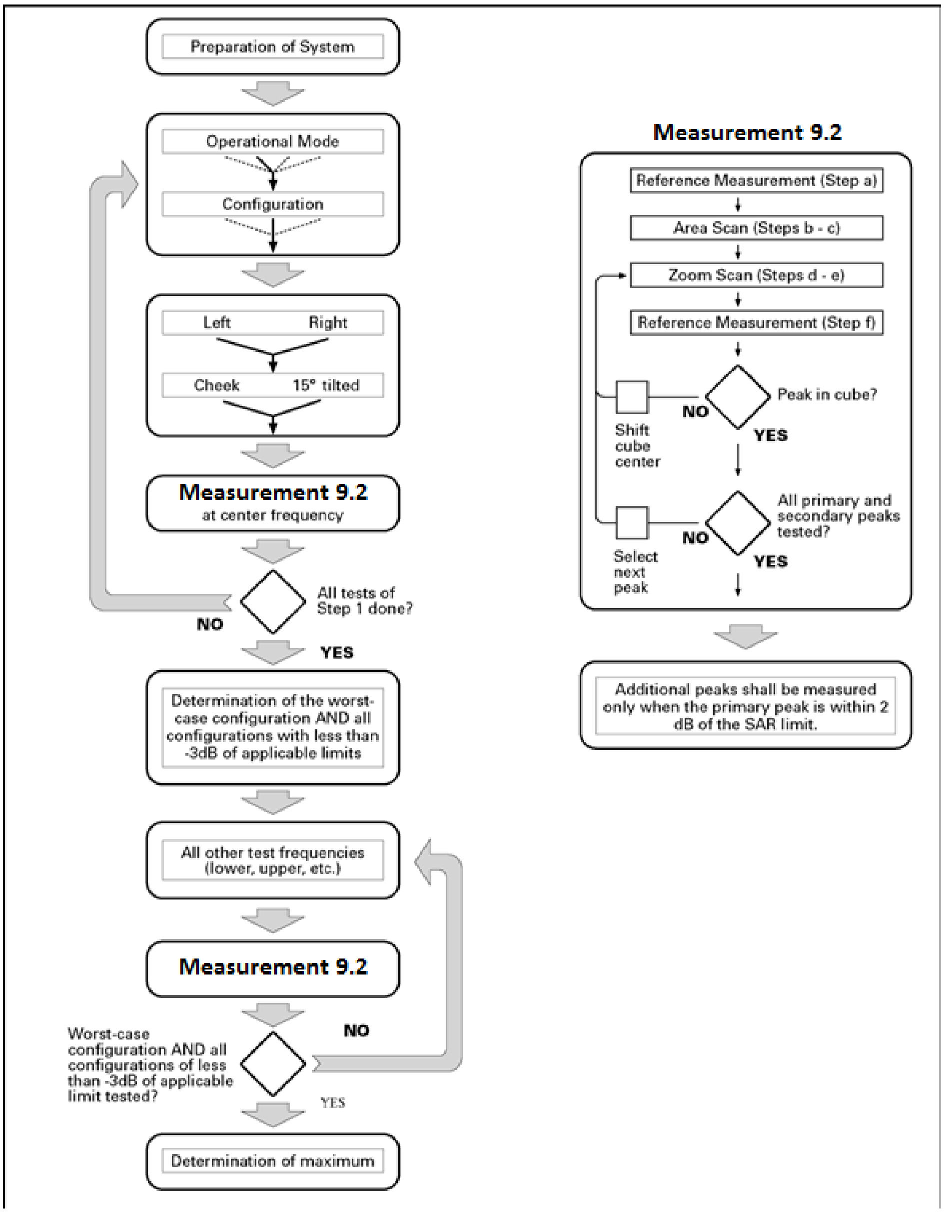
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

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

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

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

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



Picture 9.1 Block diagram of the tests to be performed

9.2 General Measurement Procedure

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

<table>
<tr><td colspan="3"></td><td>≤ 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>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ 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>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 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>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 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>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 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 ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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 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.

9.4 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.16 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

10 Area Scan Based 1-g SAR

10.1 Requirement of KDB

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

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

10.2 Fast SAR Algorithms

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

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

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

Both algorithms are implemented in DASY software.

11 Conducted Output Power

11.1 Manufacturing tolerance

Table 11.1: CDMA

CDMA BC0			
Channel	Channel 777	Channel 384	Channel 1013
Target (dBm)	24	24	24
Tune-up (dBm)	25	25	25
CDMA BC1			
Channel	Channel 1175	Channel 600	Channel 25
Target (dBm)	23	23	23
Tune-up (dBm)	24	24	24

Table 11.2: LTE

Mode	Target (dBm)	Tune-up (dBm)
LTE Band 13	23	24

LTE MPR will follow up 3GPP setting as below:

Modulation	Channel bandwidth / Transmission bandwidth (NRB)						MPR (dB)
	1.4MHz	3.0MHz	5MHz	10MHz	15MHz	20MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	2

Table 11.3: Bluetooth

Mode	Target (dBm)	Tune-up (dBm)
Bluetooth	6	8

Table 11.4: WiFi

Mode	Target (dBm)	Tune-up (dBm)
802.11 b	18	20
802.11 g, channel 1/6	13	15
802.11 g, channel 11, 6Mbps~24Mbps	14	16
802.11 g, channel 11, 36Mbps~54Mbps	12	14
802.11 n, channel 1/6	11	13
802.11 n, channel 11, MCS0~MCS3	12	14
802.11 n, channel 11, MCS4~MCS7	10	12

11.2 GSM Measurement result

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

Table 11.5: The conducted power measurement results for CDMA

CDMA BC0	Conducted Power (dBm)		
	Channel 777 (848.31MHz)	Channel 384 (836.52MHz)	Channel 1013 (824.7MHz)
SO55/RC3	24.02	24.01	24.08
SO55/RC1	24.14	24.09	24.18
SO32/RC3(FCH only)	24.07	24.04	24.10
SO32/RC3(FCH+SCH_n)	24.02	24.01	24.19
EVDO Rev.0	23.12	23.38	23.49
EVDO Rev.A	23.28	23.46	23.57
CDMA BC1	Conducted Power (dBm)		
	Channel 1175 (1908.75MHz)	Channel 600 (1880MHz)	Channel 25 (1851.25MHz)
SO55/RC3	23.24	23.34	23.80
SO55/RC1	23.40	23.42	23.85
SO32/RC3(FCH only)	23.38	23.38	23.83
SO32/RC3(FCH+SCH_n)	23.38	23.42	23.80
EVDO Rev.0	22.27	22.58	23.05
EVDO Rev.A	22.46	22.61	22.70

11.3 LTE Measurement result

Table 11.6: The conducted Power for LTE

Band 13							
Bandwidth (MHz)	RB allocation	Frequency (MHz)	Max. Target Power (dBm)	QPSK		16QAM	
	RB offset (Start RB)			Actual output power (dBm)	MPR	Actual output power (dBm)	MPR
5 MHz	1RB High (24)	784.5	24	23.40	0	22.24	1
		782	24	23.46	0	22.26	1
		779.5	24	23.06	0	21.88	1
	1RB Middle (12)	784.5	24	23.66	0	22.49	1
		782	24	23.26	0	22.36	1
		779.5	24	23.18	0	21.82	1
	1RB Low (0)	784.5	24	23.40	0	22.22	1
		782	24	23.30	0	22.17	1
		779.5	24	23.53	0	22.04	1

	12RB High (13)	784.5	24	22.00	1	21.49	2
		782	24	21.45	1	21.32	2
		779.5	24	22.51	1	21.68	2
	12RB Middle (6)	784.5	24	22.44	1	21.25	2
		782	24	22.56	1	21.59	2
		779.5	24	22.54	1	21.79	2
	12RB Low (0)	784.5	24	22.52	1	21.50	2
		782	24	22.52	1	21.68	2
		779.5	24	22.53	1	21.63	2
	25RB (0)	784.5	24	22.51	1	21.70	2
		782	24	22.55	1	21.48	2
		779.5	24	22.52	1	21.64	2
10 MHz	1RB High (49)	782	24	23.52	0	22.79	1
	1RB Middle (24)	782	24	23.54	0	22.60	1
	1RB Low (0)	782	24	23.73	0	22.76	1
	25RB High (25)	782	24	22.52	1	21.41	2
	25RB Middle (12)	782	24	22.60	1	21.48	2
	25RB Low (0)	782	24	22.61	1	21.55	2
	50RB (0)	782	24	22.60	1	21.60	2

11.4 Wi-Fi and BT Measurement result

The output power of BT antenna is as following:

Mode	Conducted Power (dBm)		
	Channel 0 (2402MHz)	Channel 39 (2441MHz)	Channel 78 (2480MHz)
GFSK	6.63	7.22	7.05

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

802.11b（dBm）

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
1	19.10	/	/	/
6	18.33	/	/	/
11	19.51	19.16	19.17	18.58

802.11g（dBm）

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
1	14.38	/	/	/	/	/	/	/
6	13.55	/	/	/	/	/	/	/
11	15.58	15.35	15.11	14.73	14.36	13.76	13.28	13.02

802.11n（dBm）- HT20 (2.4G)

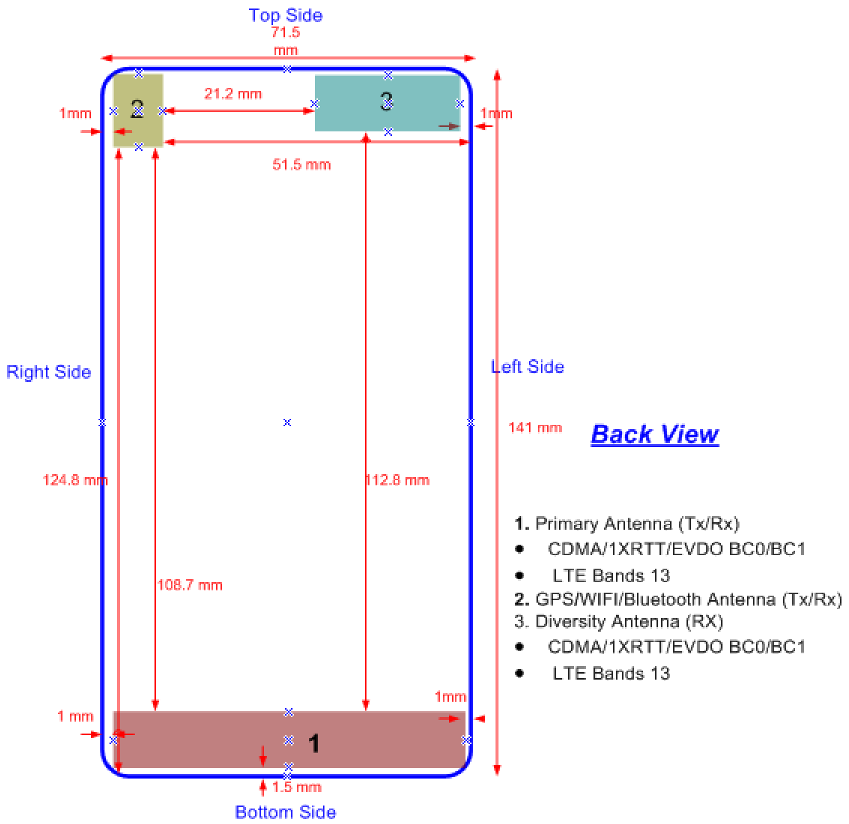
Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
1	12.30	/	/	/	/	/	/	/
6	11.62	/	/	/	/	/	/	/
11	13.84	13.24	12.84	12.48	11.89	11.56	11.34	11.02

12 Simultaneous TX SAR Considerations

12.1 Introduction

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

12.2 Transmit Antenna Separation Distances



Picture 12.1 Antenna Locations

12.3 SAR Measurement Positions

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

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	No	Yes	Yes	No

12.4 Standalone SAR Test Exclusion Considerations

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

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

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

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	7.22	5.27	Yes
		Body	19.20	7.22	5.27	Yes
2.4GHz WLAN 802.11 b	2.45	Head	9.58	19.51	89.33	No
		Body	19.17	19.51	89.33	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, Tilt 15°	0.37	0.57	**0.94**
	Right hand, Touch cheek	0.74	0.40	**1.14**
Highest reported SAR value for Body	Rear	1.01	0.19	**1.20**
	Top	/	0.28	**0.28**

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

	Position	Main antenna	BT*	Sum
Highest reported SAR value for Head	Right hand, Touch cheek	0.74	0.26	**1.00**
Highest reported SAR value for Body	Rear	1.01	0.13	**1.14**

BT* - Estimated SAR for Bluetooth (see the table 13.3)

Table 13.3: Estimated SAR for Bluetooth

Position	F (GHz)	Distance (mm)	Upper limit of power *		Estimated$_{1g}$ (W/kg)
			dBm	mW	
Head	2.441	5	8	6.31	0.26
Body	2.441	10	8	6.31	0.13

* - 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 10mm and just applied to the condition of body worn accessory.
It is performed for all SAR measurements with area scan based 1-g SAR estimation (Fast SAR). A zoom scan measurement is added when the estimated 1-g SAR is the highest measured SAR in each exposure configuration, wireless mode and frequency band combination or > 1.2W/kg.
The calculated SAR is obtained by the following formula:

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

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

Duty Cycle

Mode	**Duty Cycle**
CDMA & LTE & WiFi	1:1

14.1 SAR results for Fast SAR

Table 14.1: SAR Values (CDMA BC0 - Head)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
848.31	777	Left	Touch	/	24.02	25.0	0.204	**0.26**	0.296	**0.37**	-0.05
836.52	384	Left	Touch	/	24.01	25.0	0.244	**0.31**	0.354	**0.44**	-0.16
824.7	1013	Left	Touch	/	24.08	25.0	0.329	**0.41**	0.438	**0.54**	-0.04
848.31	777	Left	Tilt	/	24.02	25.0	0.155	**0.19**	0.222	**0.28**	-0.03
836.52	384	Left	Tilt	/	24.01	25.0	0.179	**0.22**	0.256	**0.32**	-0.08
824.7	1013	Left	Tilt	/	24.08	25.0	0.209	**0.26**	0.298	**0.37**	0.04
848.31	777	Right	Touch	/	24.02	25.0	0.305	**0.38**	0.453	**0.57**	-0.16
836.52	384	Right	Touch	/	24.01	25.0	0.350	**0.44**	0.518	**0.65**	-0.03
824.7	1013	Right	Touch	Fig.1	24.08	25.0	0.458	**0.57**	0.600	**0.74**	-0.13
848.31	777	Right	Tilt	/	24.02	25.0	0.158	**0.20**	0.227	**0.28**	0.01
836.52	384	Right	Tilt	/	24.01	25.0	0.181	**0.23**	0.259	**0.33**	-0.05
824.7	1013	Right	Tilt	/	24.08	25.0	0.205	**0.25**	0.294	**0.36**	0.10

Table 14.2: SAR Values (CDMA BC0 - Body)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
836.52	384	Front	/	24.04	25.0	0.376	**0.47**	0.529	**0.66**	0.03
848.31	777	Rear	/	24.07	25.0	0.510	**0.63**	0.724	**0.90**	0.05
836.52	384	Rear	/	24.04	25.0	0.533	**0.66**	0.787	**0.98**	-0.04
824.7	1013	Rear	Fig.2	24.10	25.0	0.628	**0.77**	0.821	**1.01**	-0.01
836.52	384	Left	/	24.04	25.0	0.205	**0.26**	0.303	**0.38**	-0.04
836.52	384	Right	/	24.04	25.0	0.416	**0.52**	0.615	**0.77**	-0.04
836.52	384	Bottom	/	24.04	25.0	0.125	**0.16**	0.200	**0.25**	0.07

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

Table 14.3: SAR Values (CDMA BC1 - Head)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1909.75	1175	Left	Touch	/	23.24	24.0	0.152	**0.18**	0.260	**0.31**	0.04
1880	600	Left	Touch	/	23.34	24.0	0.193	**0.22**	0.307	**0.36**	-0.13
1851.25	25	Left	Touch	/	23.80	24.0	0.153	**0.16**	0.259	**0.27**	0.07
1909.75	1175	Left	Tilt	/	23.24	24.0	0.118	**0.14**	0.222	**0.26**	0.09
1880	600	Left	Tilt	/	23.34	24.0	0.123	**0.14**	0.221	**0.26**	0.16
1851.25	25	Left	Tilt	/	23.80	24.0	0.119	**0.12**	0.219	**0.23**	-0.07
1909.75	1175	Right	Touch	/	23.24	24.0	0.260	**0.31**	0.467	**0.56**	0.05
1880	600	Right	Touch	Fig.3	23.34	24.0	0.320	**0.37**	0.519	**0.60**	0.08
1851.25	25	Right	Touch	/	23.80	24.0	0.252	**0.26**	0.446	**0.47**	0.02
1909.75	1175	Right	Tilt	/	23.24	24.0	0.123	**0.15**	0.237	**0.28**	0.09
1880	600	Right	Tilt	/	23.34	24.0	0.134	**0.16**	0.254	**0.30**	-0.04
1851.25	25	Right	Tilt	/	23.80	24.0	0.118	**0.12**	0.222	**0.23**	0.08

Table 14.4: SAR Values (CDMA BC1 - Body)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
1880	600	Front	/	23.38	24.0	0.428	**0.49**	0.695	**0.80**	0.00
1909.75	1175	Rear	/	23.38	24.0	0.384	**0.44**	0.665	**0.77**	0.16
1880	600	Rear	/	23.38	24.0	0.424	**0.49**	0.691	**0.80**	0.00
1851.25	25	Rear	Fig.4	23.83	24.0	0.493	**0.51**	0.799	**0.83**	0.04
1880	600	Left	/	23.38	24.0	0.163	**0.19**	0.302	**0.35**	-0.01
1880	600	Right	/	23.38	24.0	0.137	**0.16**	0.237	**0.27**	0.02
1880	600	Bottom	/	23.38	24.0	0.351	**0.40**	0.692	**0.80**	0.15

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

Table 14.5: SAR Values (LTE Band13 - Head)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C												
Frequency		Mode	Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.											
782	23230	1RB_Low	Left	Touch	/	23.73	24.0	0.171	**0.18**	0.248	**0.26**	0.15
782	23230	1RB_Low	Left	Tilt	/	23.73	24.0	0.125	**0.13**	0.179	**0.19**	-0.07
782	23230	1RB_Low	Right	Touch	Fig.5	23.73	24.0	0.254	**0.27**	0.329	**0.35**	0.04
782	23230	1RB_Low	Right	Tilt	/	23.73	24.0	0.135	**0.14**	0.190	**0.20**	0.03
782	23230	25RB_Low	Left	Touch	/	22.61	23.0	0.123	**0.13**	0.176	**0.19**	0.13
782	23230	25RB_Low	Left	Tilt	/	22.61	23.0	0.090	**0.10**	0.128	**0.14**	0.09
782	23230	25RB_Low	Right	Touch	/	22.61	23.0	0.156	**0.17**	0.227	**0.25**	0.07
782	23230	25RB_Low	Right	Tilt	/	22.61	23.0	0.100	**0.11**	0.140	**0.15**	0.13

Note1: The LTE mode is QPSK_10MHz.

Table 14.6: SAR Values (LTE Band13 - Body)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C											
Frequency		Mode	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
782	23230	1RB_Low	Front	/	23.73	24.0	0.329	**0.35**	0.464	**0.49**	0.22
782	23230	1RB_Low	Rear	Fig.6	23.73	24.0	0.582	**0.62**	0.748	**0.80**	-0.01
782	23230	1RB_Low	Left	/	23.73	24.0	0.366	**0.39**	0.541	**0.58**	-0.02
782	23230	1RB_Low	Right	/	23.73	24.0	0.428	**0.46**	0.625	**0.67**	0.09
782	23230	1RB_Low	Bottom	/	23.73	24.0	0.046	**0.05**	0.073	**0.08**	0.19
782	23230	25RB_Low	Front	/	22.61	23.0	0.236	**0.26**	0.332	**0.36**	0.11
782	23230	25RB_Low	Rear	/	22.61	23.0	0.380	**0.42**	0.539	**0.59**	0.07
782	23230	25RB_Low	Left	/	22.61	23.0	0.273	**0.30**	0.403	**0.44**	0.09
782	23230	25RB_Low	Right	/	22.61	23.0	0.323	**0.35**	0.475	**0.52**	0.00
782	23230	25RB_Low	Bottom	/	22.61	23.0	0.037	**0.04**	0.059	**0.06**	-0.09

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

Note2: The LTE mode is QPSK_10MHz.

Table 14.7: SAR Values (Wi-Fi 802.11b - Head)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2462	11	Left	Touch	/	19.51	20.0	0.238	**0.27**	0.431	**0.48**	0.16
2462	11	Left	Tilt	Fig.7	19.51	20.0	0.235	**0.26**	0.512	**0.57**	0.03
2462	11	Right	Touch	/	19.51	20.0	0.195	**0.22**	0.358	**0.40**	0.08
2462	11	Right	Tilt	/	19.51	20.0	0.221	**0.25**	0.426	**0.48**	0.05

Table 14.8: SAR Values (Wi-Fi 802.11b - Body)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
2462	11	Front	/	19.51	20.0	0.081	**0.09**	0.147	**0.16**	0.17
2462	11	Rear	/	19.51	20.0	0.091	**0.10**	0.169	**0.19**	-0.16
2462	11	Right	/	19.51	20.0	0.024	**0.03**	0.046	**0.05**	0.13
2462	11	Top	Fig.8	19.51	20.0	0.137	**0.15**	0.253	**0.28**	-0.02

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

14.2 SAR results for Standard procedure

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

Table 14.9: SAR Values (CDMA BC0 - Head)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
824.7	1013	Right	Touch	Fig.1	24.08	25.0	0.458	**0.57**	0.600	**0.74**	-0.13

Table 14.10: SAR Values (CDMA BC0 - Body)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
824.7	1013	Rear	Fig.2	24.10	25.0	0.628	**0.77**	0.821	**1.01**	-0.01

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

Table 14.11: SAR Values (CDMA BC1 - Head)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1880	600	Right	Touch	Fig.3	23.34	24.0	0.320	**0.37**	0.519	**0.60**	0.08

Table 14.12: SAR Values (CDMA BC1 - Body)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
1851.25	25	Rear	Fig.4	23.83	24.0	0.493	**0.51**	0.799	**0.83**	0.04

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

Table 14.13: SAR Values (LTE Band13 - Head)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C												
Frequency		Mode	Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.											
782	23230	1RB_Low	Right	Touch	Fig.5	23.73	24.0	0.254	**0.27**	0.329	**0.35**	0.04

Note1: The LTE mode is QPSK_10MHz.

Table 14.14: SAR Values (LTE Band13 - Body)

Ambient Temperature: 22.2 °C Liquid Temperature: 21.7 °C											
Frequency		Mode	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
782	23230	1RB_Low	Rear	Fig.6	23.73	24.0	0.582	**0.62**	0.748	**0.80**	-0.01

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

Note2: The LTE mode is QPSK_10MHz.

Table 14.15: SAR Values (Wi-Fi 802.11b - Head)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C											
Frequency		Side	Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2462	11	Left	Tilt	Fig.7	19.51	20.0	0.235	**0.26**	0.512	**0.57**	0.03

Table 14.16: SAR Values (Wi-Fi 802.11b - Body)

Ambient Temperature: 22.0 °C Liquid Temperature: 21.6 °C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
2462	11	Top	Fig.8	19.51	20.0	0.137	**0.15**	0.253	**0.28**	-0.02

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

15 SAR Measurement Variability

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

The following procedures are applied to determine if repeated measurements are required.
1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Table 15.1: SAR Measurement Variability for Body CDMA BC0 (1g)

Frequency		Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
824.7	1013	Rear	10	0.821	0.809	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	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521

Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.25	9.12	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.5	18.2	

16.2 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	6.5	N	1	1	1	6.5	6.5	∞
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	RF ambient 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 (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		$u_c^{'}=\sqrt{\sum_{i=1}^{21}c_i^2u_i^2}$						10.8	10.7	257
Expanded uncertainty (confidence interval of 95 %)		$u_e=2u_c$						21.6	21.4	

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

No.	Error Description	Type	Uncertainty value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	5.5	N	1	1	1	5.5	5.5	∞
2	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
14	Fast SAR z-Approximation	B	7.0	R	$\sqrt{3}$	1	1	4.0	4.0	∞
Test sample related										
15	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
17	Drift of output power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞

Phantom and set-up										
18	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
19	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
20	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
21	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
22	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.1	9.95	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.2	19.9	

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	6.5	N	1	1	1	6.5	6.5	∞
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	RF ambient 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 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		$u_c^{'} = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.3	13.2	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						26.6	26.4	

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	February 15, 2014	One year
02	Power meter	NRVD	102196	March 14, 2014	One year
03	Power sensor	NRV-Z5	100596		
04	Signal Generator	E4438C	MY49071430	February 08, 2014	One Year
05	Amplifier	60S1G4	0331848	No Calibration Requested	
06	BTS	E5515C	MY50263375	January 30, 2014	One year
07	BTS	CMW500	129942	March 11, 2014	One year
08	E-field Probe	SPEAG EX3DV4	3846	September 24, 2014	One year
09	DAE	SPEAG DAE4	777	September 17, 2014	One year
10	Dipole Validation Kit	SPEAG D750V3	1017	August 28, 2014	One year
11	Dipole Validation Kit	SPEAG D835V2	4d069	August 28, 2014	One year
12	Dipole Validation Kit	SPEAG D1900V2	5d101	July 23, 2014	One year
13	Dipole Validation Kit	SPEAG D2450V2	853	July 24, 2014	One year

END OF REPORT BODY

ANNEX A Graph Results

CDMA BC0 Head Right Cheek Low

Date: 2014-12-24
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used: f = 825 MHz; σ = 0.925 S/m; εr = 42.836; ρ = 1000 kg/m^3
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: CDMA BC0 Frequency: 824.7 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

Cheek Low/Area Scan (71x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.711 W/kg

Cheek Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.801 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.770 W/kg
SAR(1 g) = 0.600 W/kg; SAR(10 g) = 0.458 W/kg
Maximum value of SAR (measured) = 0.694 W/kg

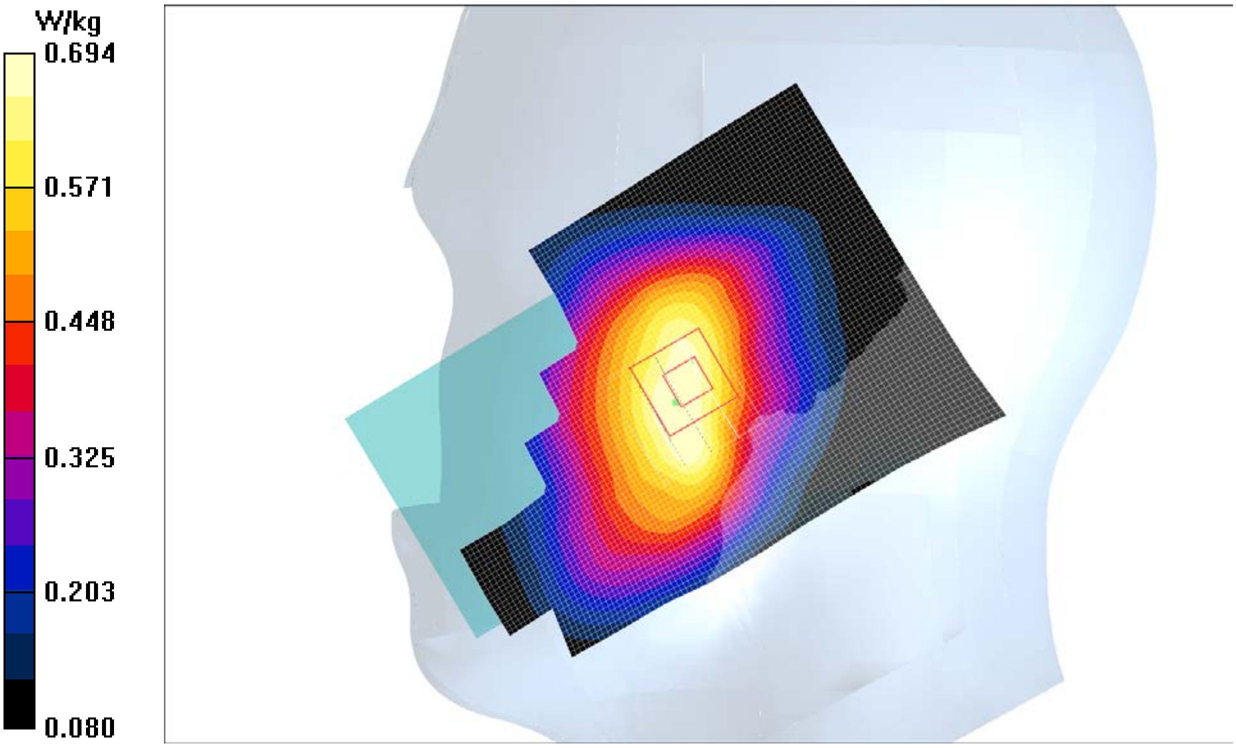


Fig.1 CDMA BC0

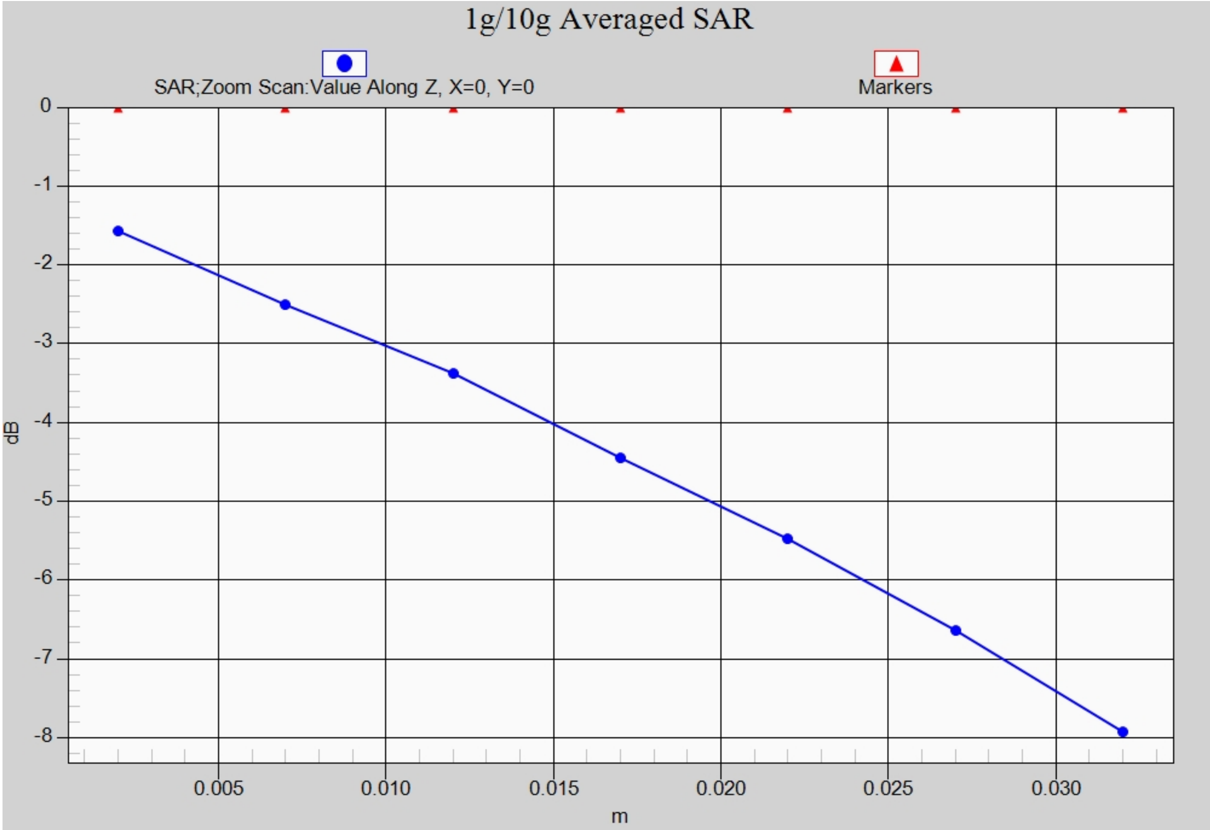


Fig. 1-1 Z-Scan at power reference point (CDMA BC0)

CDMA BC0 Body Rear Low
Date: 2014-12-24
Electronics: DAE4 Sn777
Medium: Body 850 MHz
Medium parameters used: f = 825 MHz; σ = 0.954 S/m; εr = 54.936; ρ = 1000 kg/m^3
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: CDMA BC0 Frequency: 824.7 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.09, 9.09, 9.09)

Rear Low/Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.899 W/kg

Rear Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.64 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.821 W/kg; SAR(10 g) = 0.628 W/kg
Maximum value of SAR (measured) = 0.900 W/kg

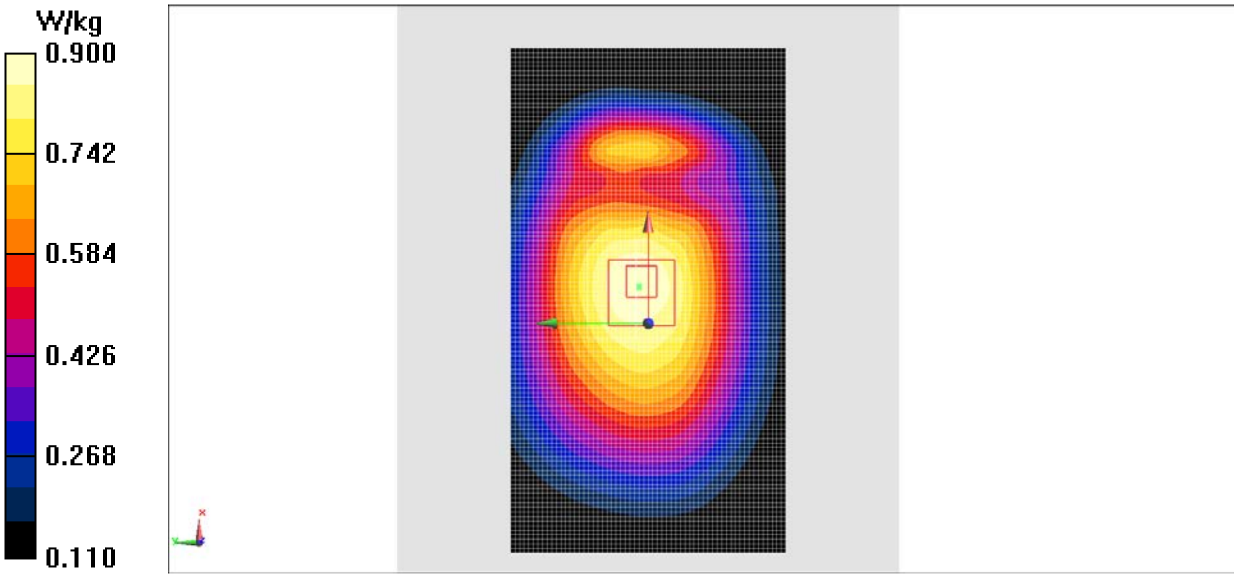


Fig.2 CDMA BC0

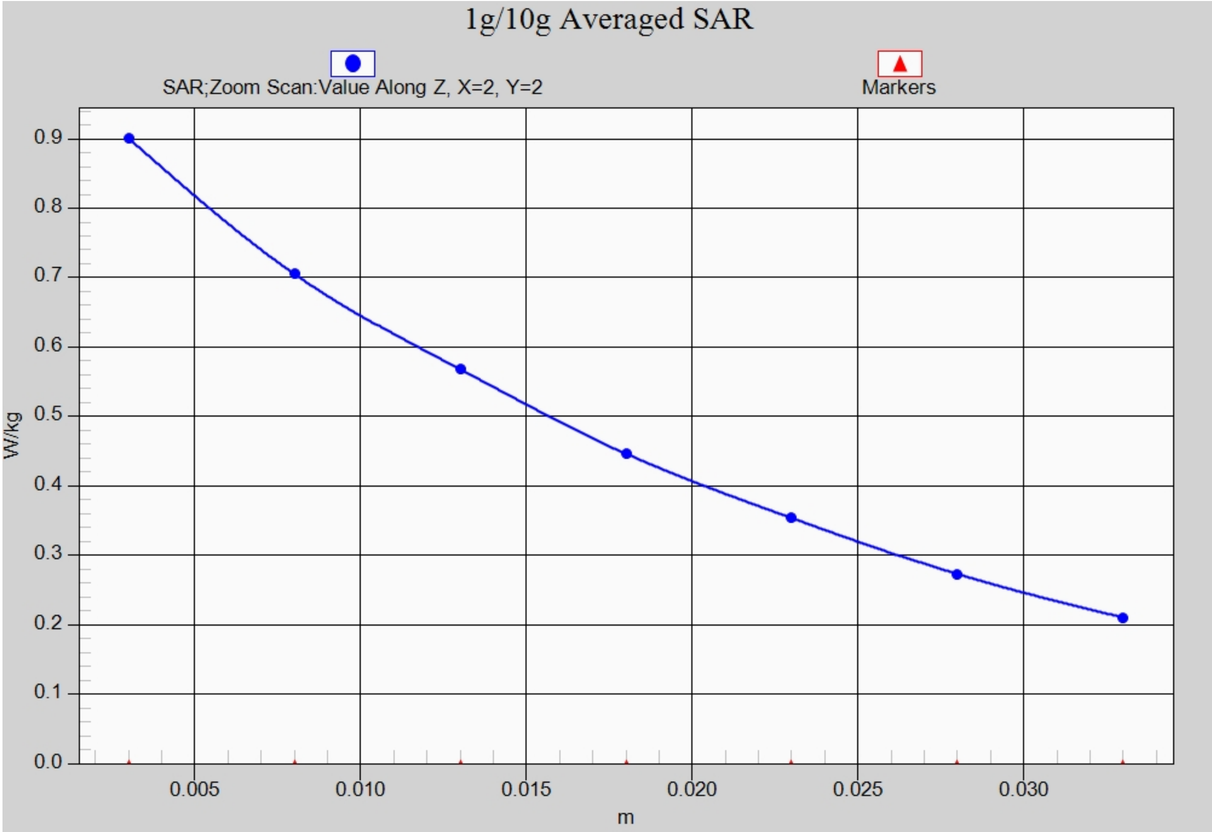


Fig. 2-1 Z-Scan at power reference point (CDMA BC0)

CDMA BC1 Head Right Cheek Middle

Date: 2014-12-25

Electronics: DAE4 Sn777

Medium: Head 1900 MHz

Medium parameters used: f = 1880 MHz; σ = 1.371 S/m; εr = 40.262; ρ = 1000 kg/m^3

Ambient Temperature: 22.0^{o}C Liquid Temperature: 21.6^{o}C

Communication System: CDMA BC1 Frequency: 1880 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3846 ConvF(7.26, 7.26, 7.26)

Cheek Middle/Area Scan (71x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.612 W/kg

Cheek Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.962 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.790 W/kg

SAR(1 g) = 0.519 W/kg; SAR(10 g) = 0.320 W/kg

Maximum value of SAR (measured) = 0.564 W/kg

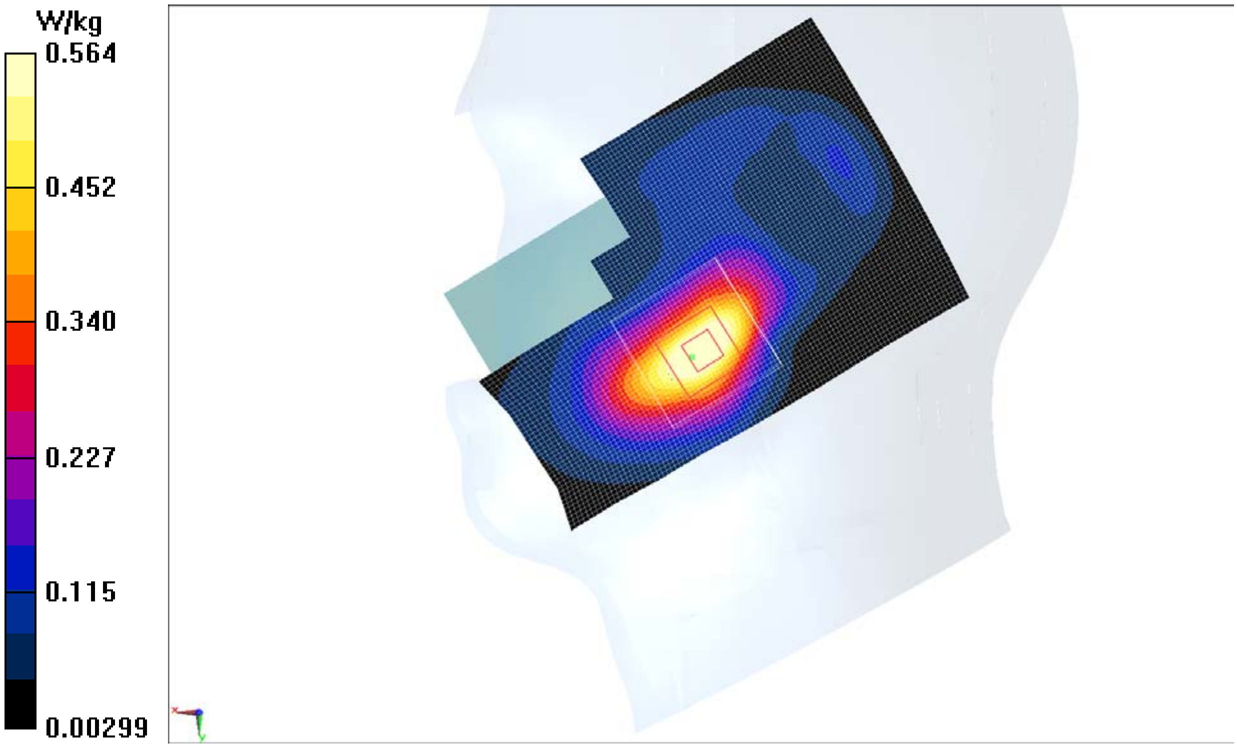


Fig.3 CDMA BC1

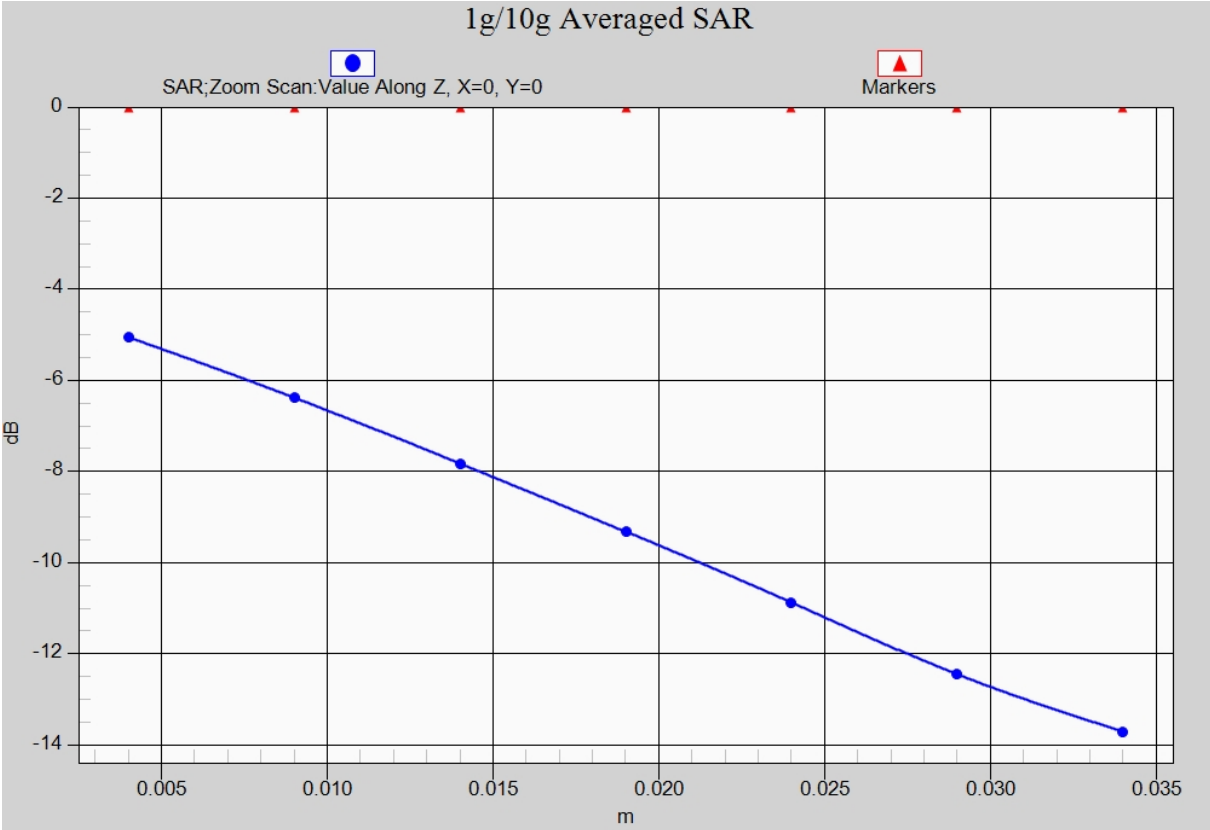


Fig. 3-1　Z-Scan at power reference point (CDMA BC1)

CDMA BC1 Body Rear Low

Date: 2014-12-25
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.46 S/m; εr = 54.211; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CDMA BC1 Frequency: 1851.25 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.15, 7.15, 7.15)

Rear Low/Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.960 W/kg

Rear Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.21 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.21 W/kg
SAR(1 g) = 0.799 W/kg; SAR(10 g) = 0.493 W/kg
Maximum value of SAR (measured) = 0.942 W/kg

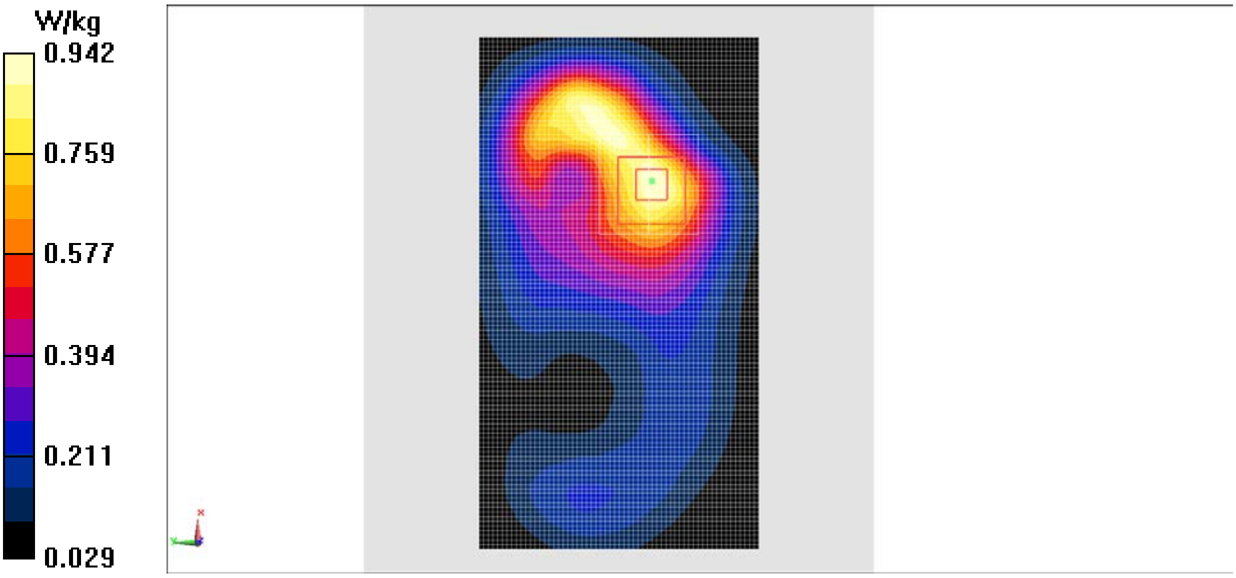


Fig.4 CDMA BC1

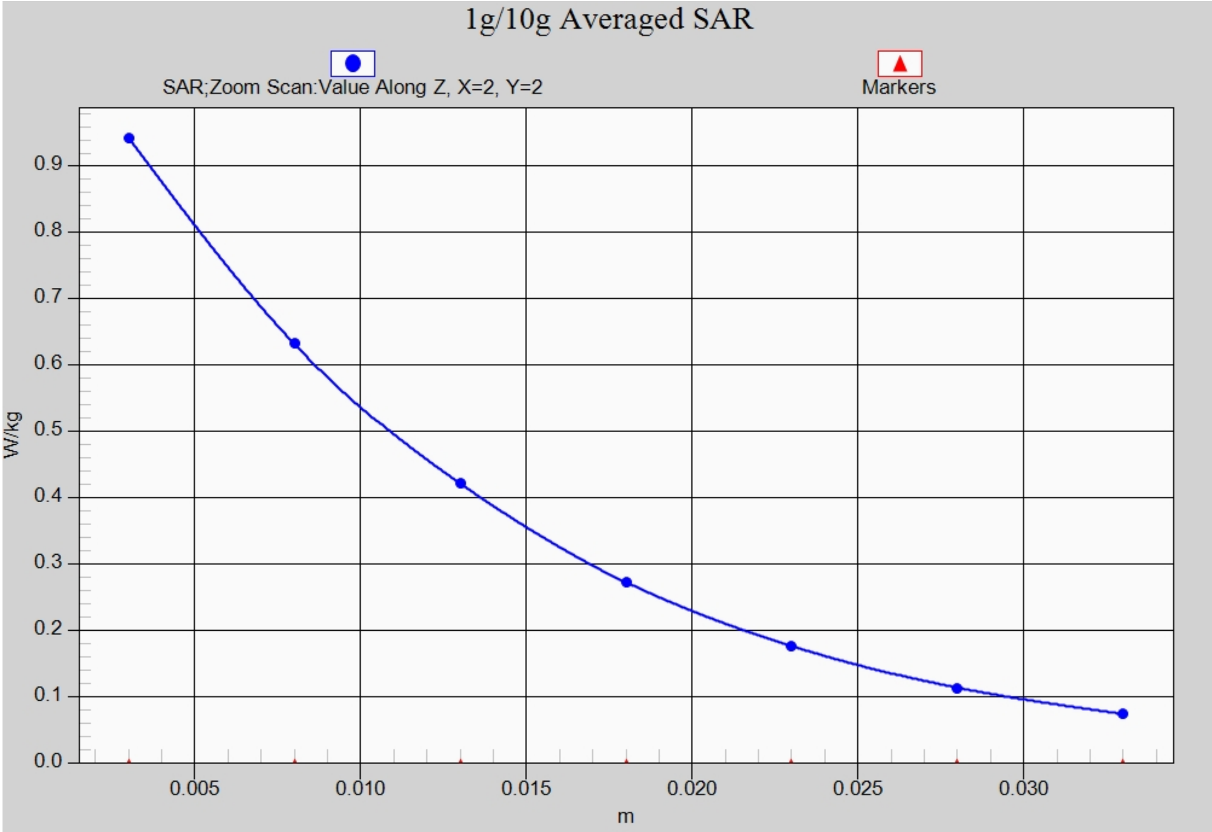


Fig.4-1 Z-Scan at power reference point (CDMA BC1)

LTE Band 13 Right Cheek Middle with QPSK_10M_1RB_Low
Date: 2014-12-23
Electronics: DAE4 Sn777
Medium: Head 750 MHz
Medium parameters used (interpolated): f = 782 MHz; σ = 0.905 mho/m; εr = 42.985; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: LTE Band13 Frequency: 782 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.53, 9.53, 9.53)

Cheek Middle/Area Scan (71x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.348 W/kg

Cheek Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.419 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.405 W/kg
SAR(1 g) = 0.329 W/kg; SAR(10 g) = 0.254 W/kg
Maximum value of SAR (measured) = 0.349 W/kg

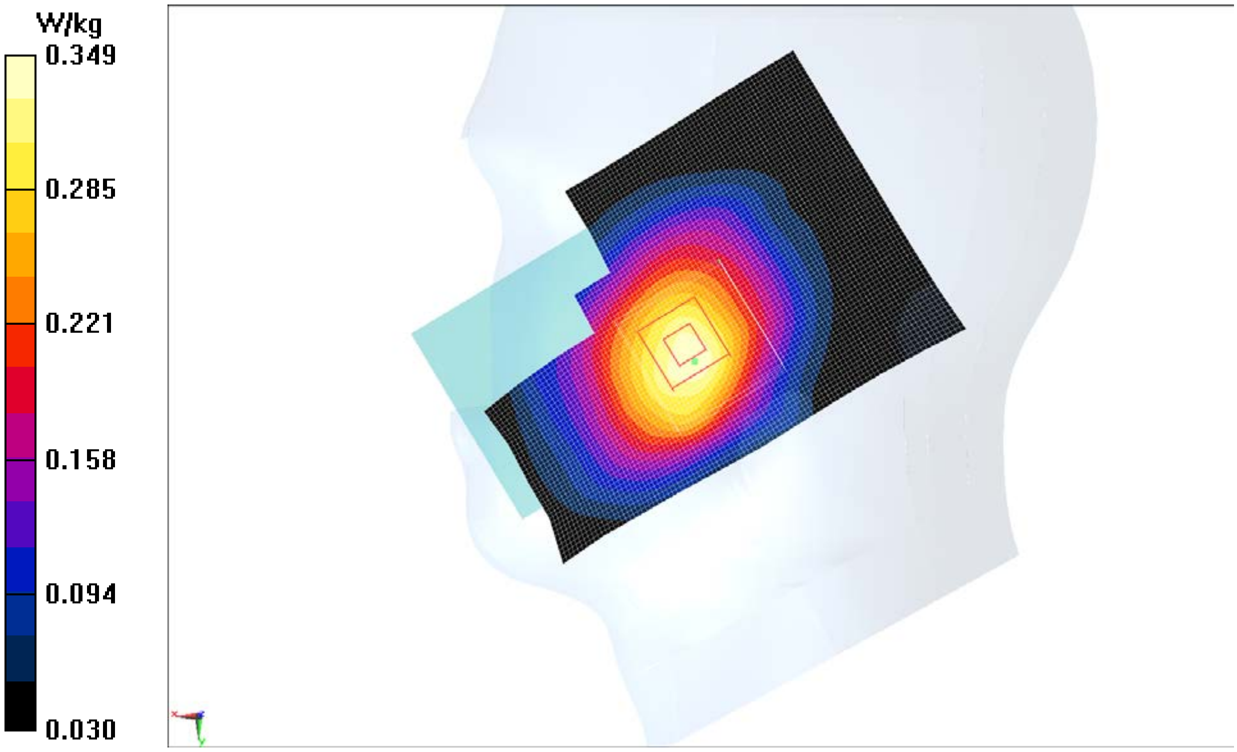


Fig.5 LTE Band 13

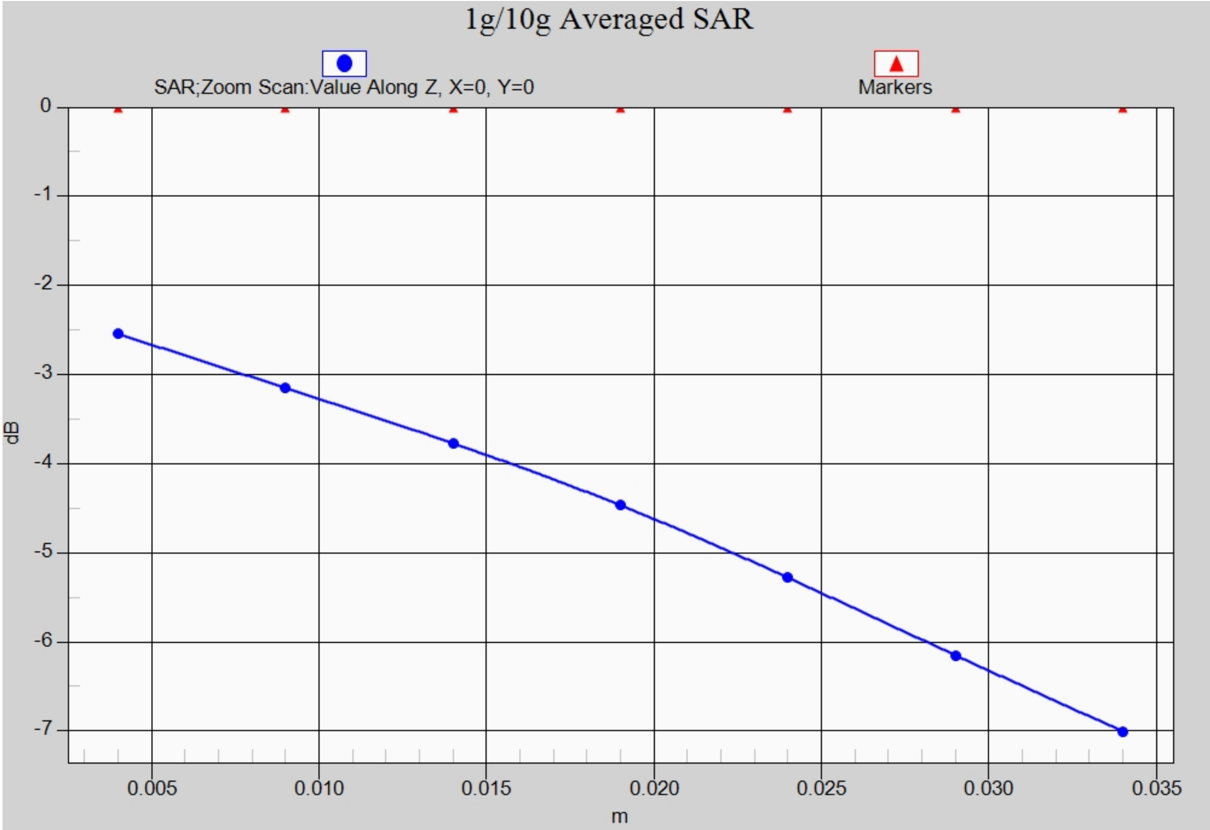


Fig. 5-1 Z-Scan at power reference point (LTE Band13)

LTE Band 13 Body Rear Middle with QPSK_10M_1RB_Low
Date: 2014-12-23
Electronics: DAE4 Sn777
Medium: Body 750 MHz
Medium parameters used (interpolated): f = 782 MHz; σ = 0.955 mho/m; εr = 55.265; ρ = 1000 kg/m^3
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: LTE Band13 Frequency: 782 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

Rear Middle/Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.815 W/kg

Rear Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 29.00 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.920 W/kg
SAR(1 g) = 0.748 W/kg; SAR(10 g) = 0.582 W/kg
Maximum value of SAR (measured) = 0.818 W/kg

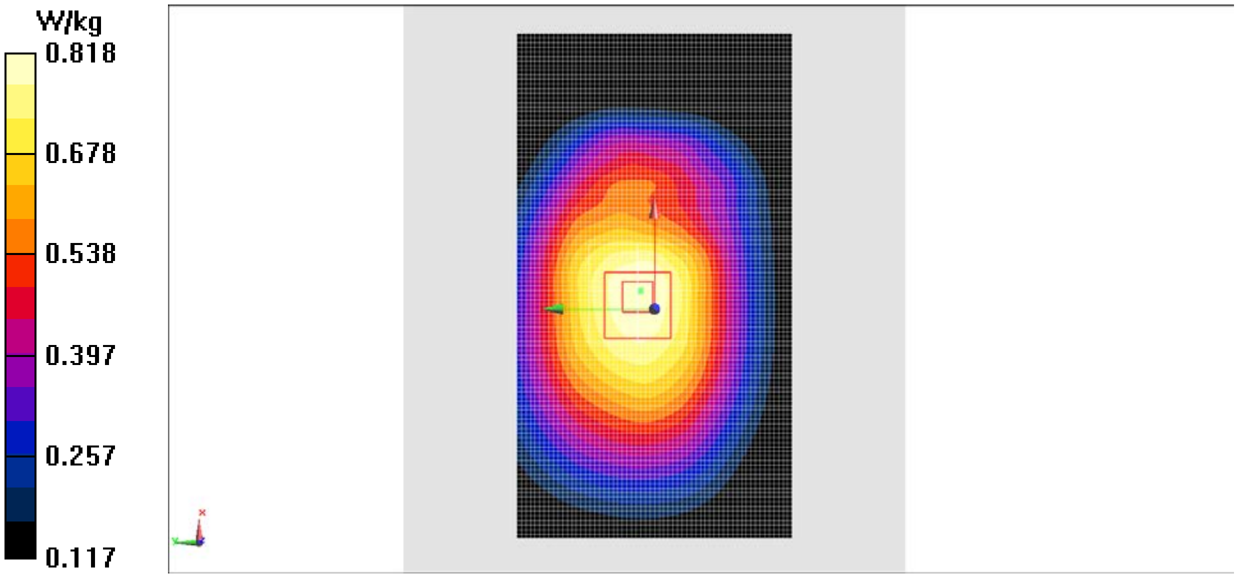


Fig.6 LTE Band 13

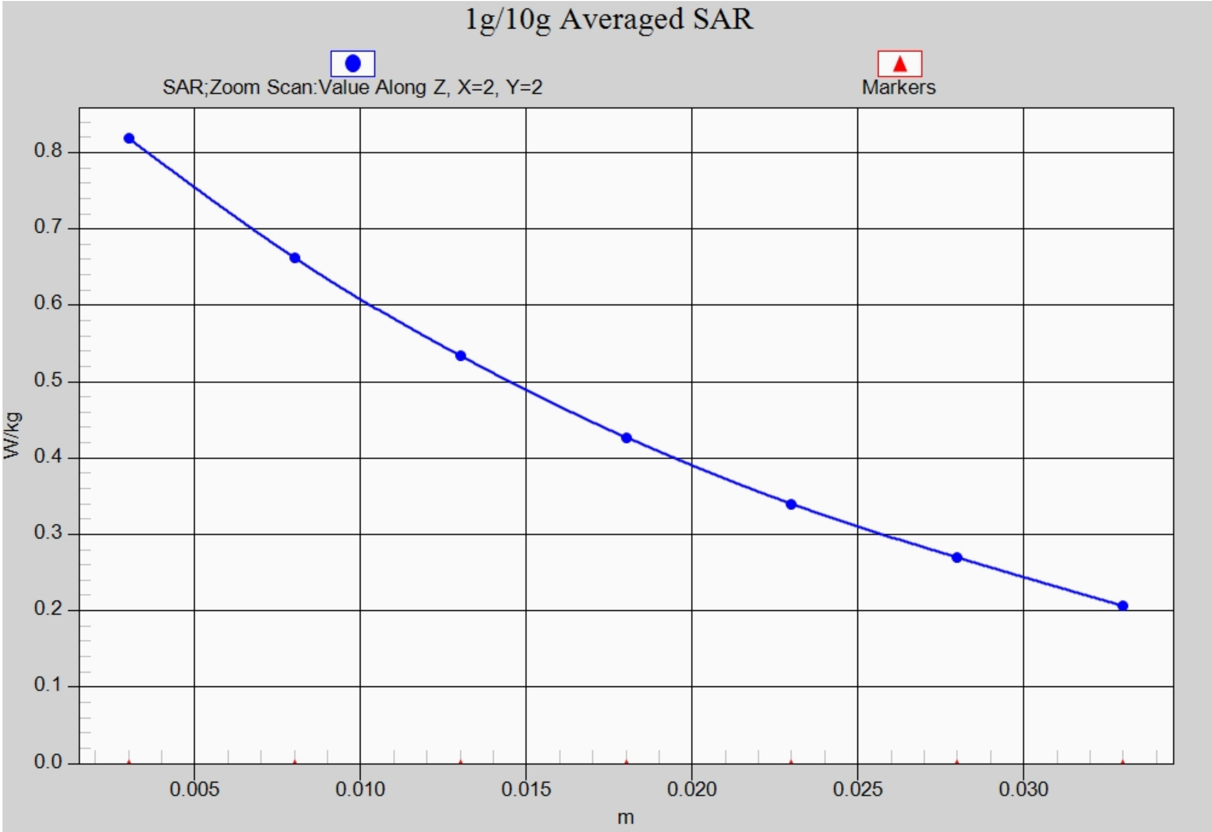


Fig. 6-1 Z-Scan at power reference point (LTE Band13)

Wifi 802.11b Left Tilt Channel 11
Date: 2014-12-26
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used (interpolated): f = 2462 MHz; σ = 1.85 S/m; ε_r = 40.155; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: WLan 2450 Frequency: 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.56, 6.56, 6.56)

Tilt High/Area Scan (71x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.586 W/kg

Tilt High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.54 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.16 W/kg
SAR(1 g) = 0.512 W/kg; SAR(10 g) = 0.235 W/kg
Maximum value of SAR (measured) = 0.614 W/kg

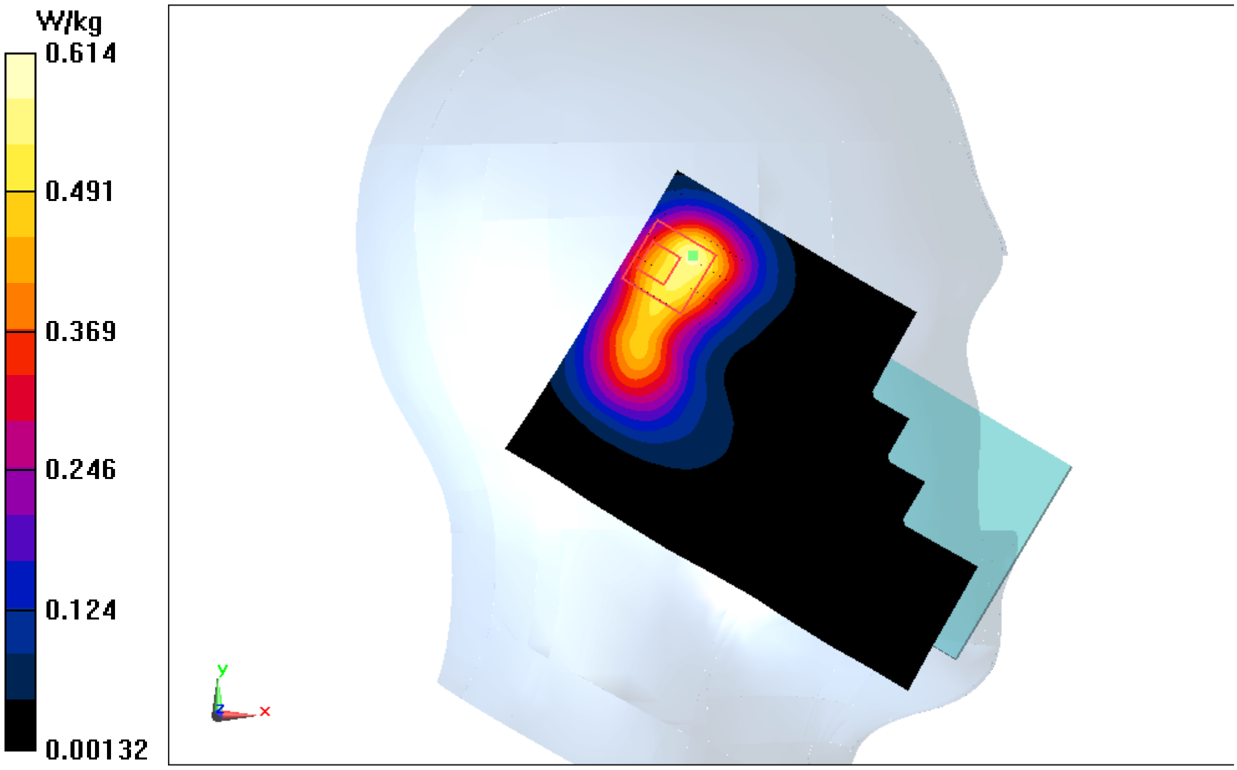


Fig.7 2450 MHz

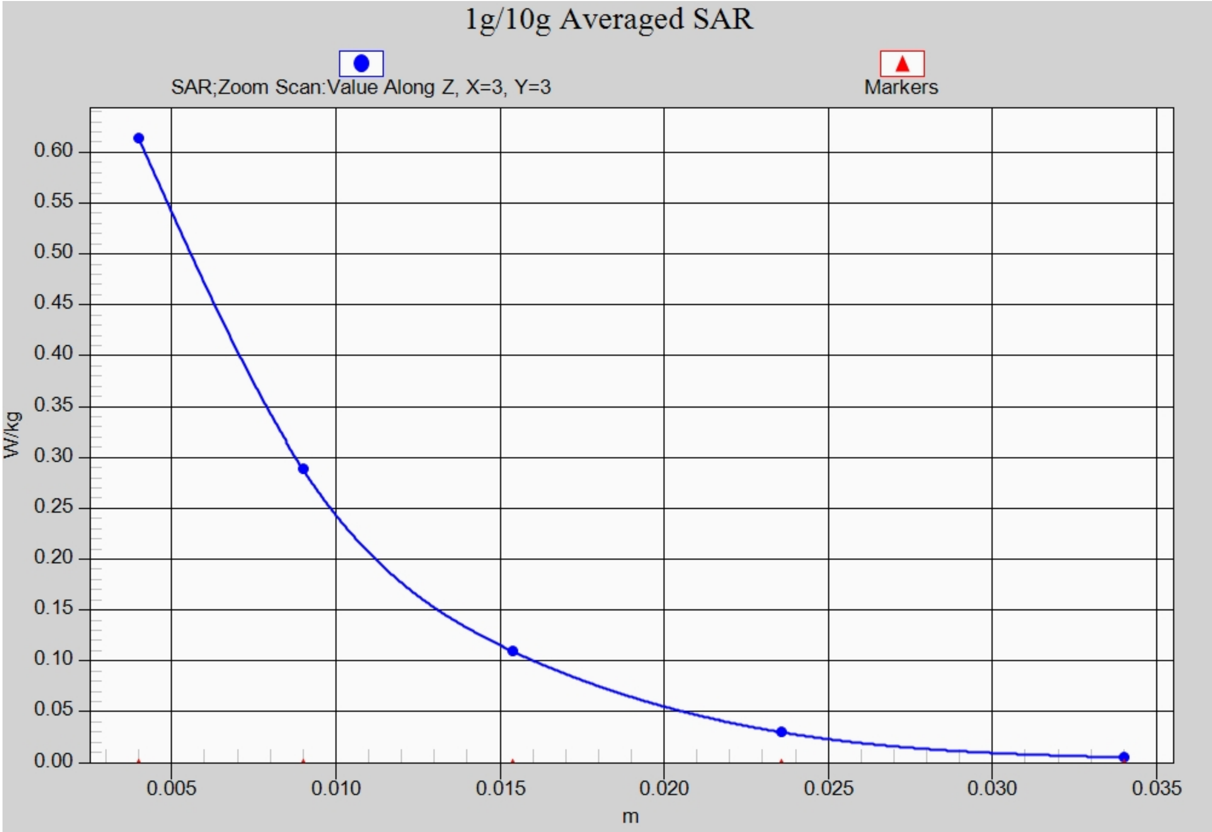


Fig. 7-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11b Body Top Channel 11
Date: 2014-12-26
Electronics: DAE4 Sn777
Medium: Body 2450 MHz
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.029 S/m; ε_r = 50.864; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C   Liquid Temperature: 21.6°C
Communication System: WLan 2450 Frequency: 2462 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.90, 6.90, 6.90)

Top High/Area Scan (131x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.335 W/kg

Top High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.69 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.532 W/kg
SAR(1 g) = 0.253 W/kg; SAR(10 g) = 0.137 W/kg
Maximum value of SAR (measured) = 0.329 W/kg

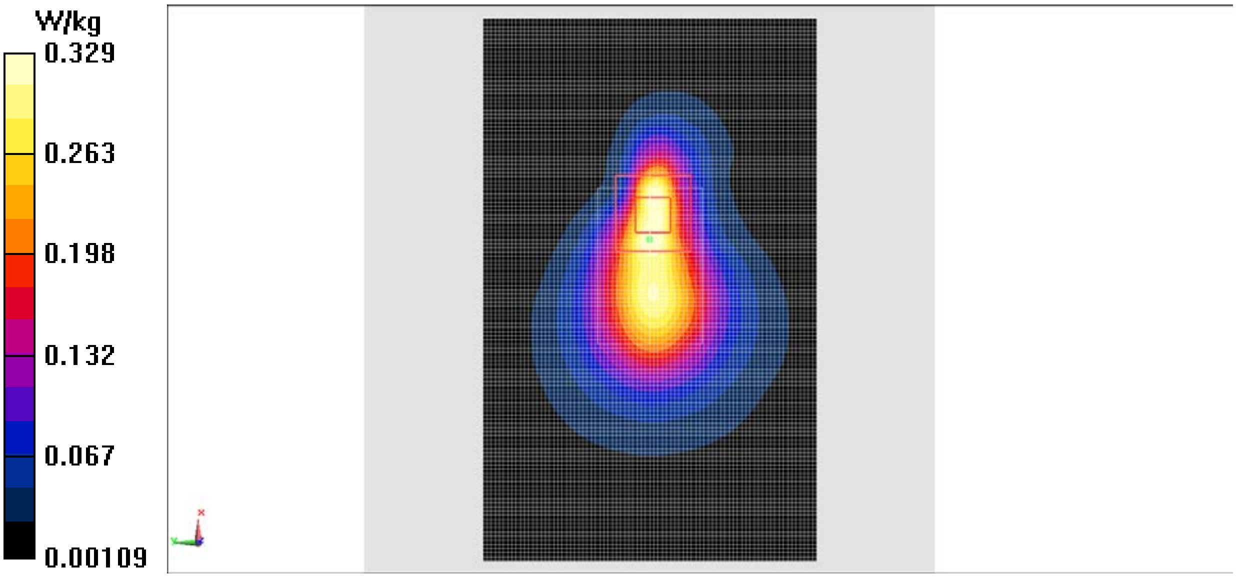


Fig.8 2450 MHz

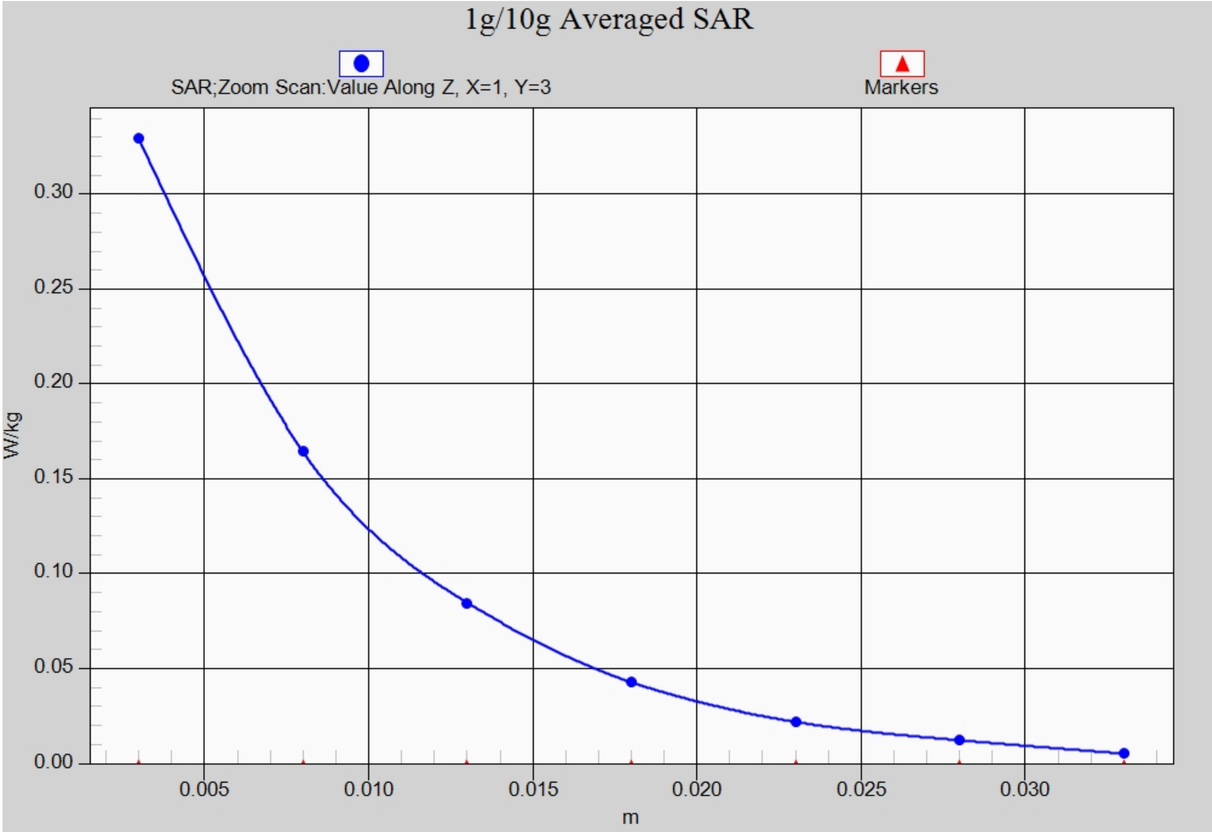


Fig. 8-1 Z-Scan at power reference point (2450 MHz)

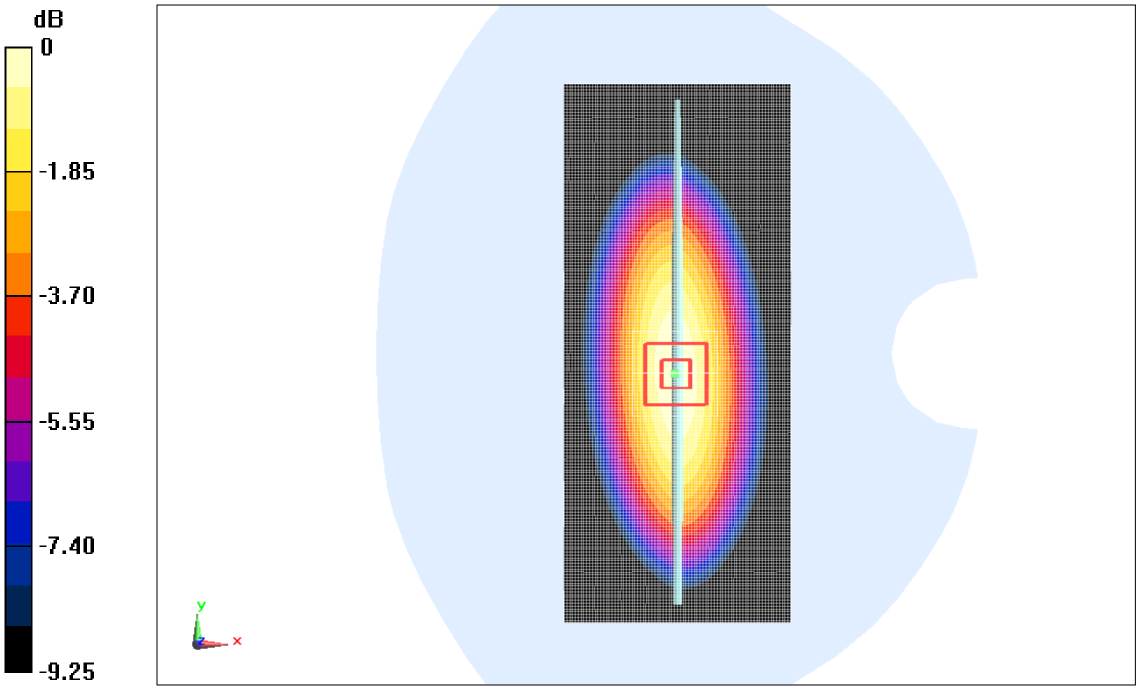
ANNEX B System Verification Results

750MHz

Date: 2014-12-23
Electronics: DAE4 Sn777
Medium: Head 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.869 mho/m; ε_r = 43.35; ρ = 1000 kg/m^3
Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C
Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.53, 9.53, 9.53)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 50.371 V/m; Power Drift = 0.06 dB
Fast SAR: SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.42 W/kg
Maximum value of SAR (interpolated) = 2.32 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 50.371 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 3.01 W/kg
SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.40 W/kg
Maximum value of SAR (measured) = 2.30 W/kg



0 dB = 2.30 W/kg = 3.62 dB W/kg

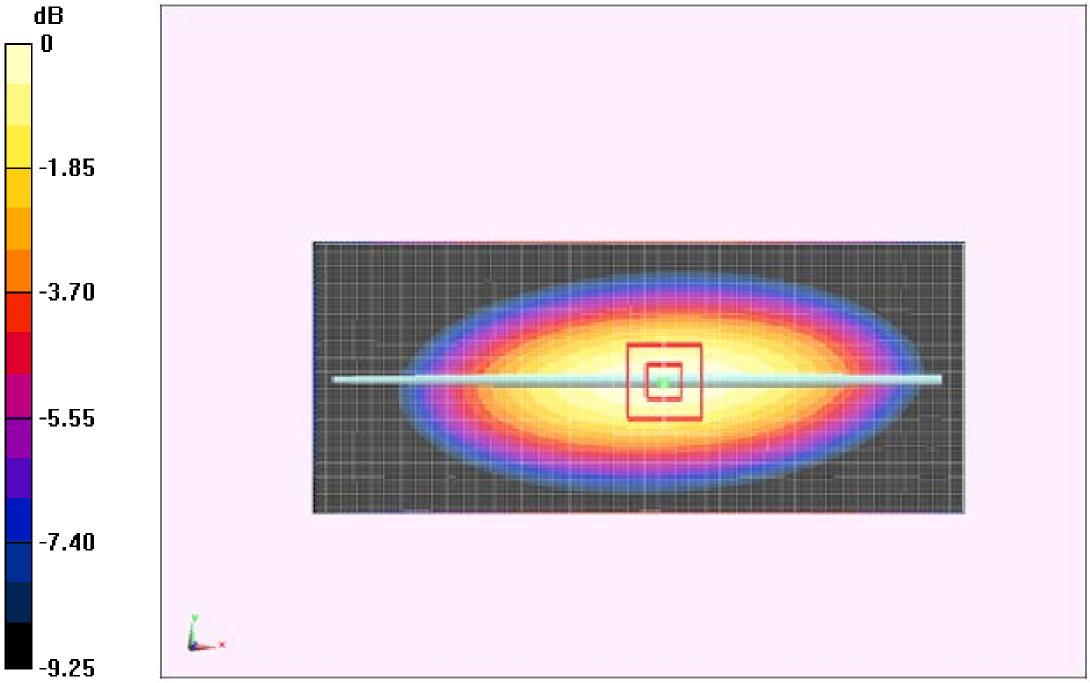
Fig.B.1 validation 750MHz 250mW

750MHz

Date: 2014-12-23
Electronics: DAE4 Sn777
Medium: Body 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.925 mho/m; ε_r = 55.53; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

System Validation /Area Scan (81x191x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 51.774 V/m; Power Drift = 0.05 dB
Fast SAR: SAR(1 g) = 2.26 W/kg; SAR(10 g) = 1.47 W/kg
Maximum value of SAR (interpolated) = 2.40 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.774 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.13 W/kg
SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.45 W/kg
Maximum value of SAR (measured) = 2.38 W/kg



0 dB = 2.38 W/kg = 3.77 dB W/kg

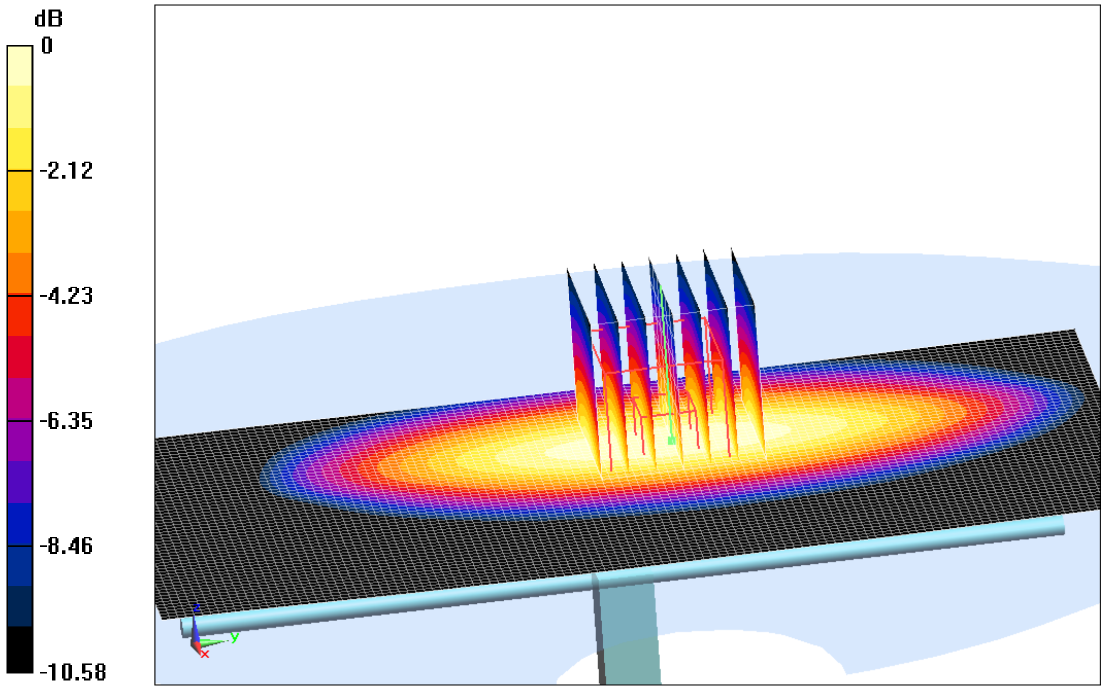
Fig.B.2 validation 750MHz 250mW

835MHz

Date: 2014-12-24
Electronics: DAE4 Sn777
Medium: Head 850 MHz
Medium parameters used: f = 835 MHz; σ = 0.936 mho/m; ε_r = 42.7; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C Liquid Temperature: 21.7^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.18, 9.18, 9.18)

System Validation /Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 48.905 V/m; Power Drift = -0.04 dB
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.54 W/kg
Maximum value of SAR (interpolated) = 2.83 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 48.905 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.43 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.85 W/kg



0 dB = 2.85 W/kg = 4.55 dBW/kg

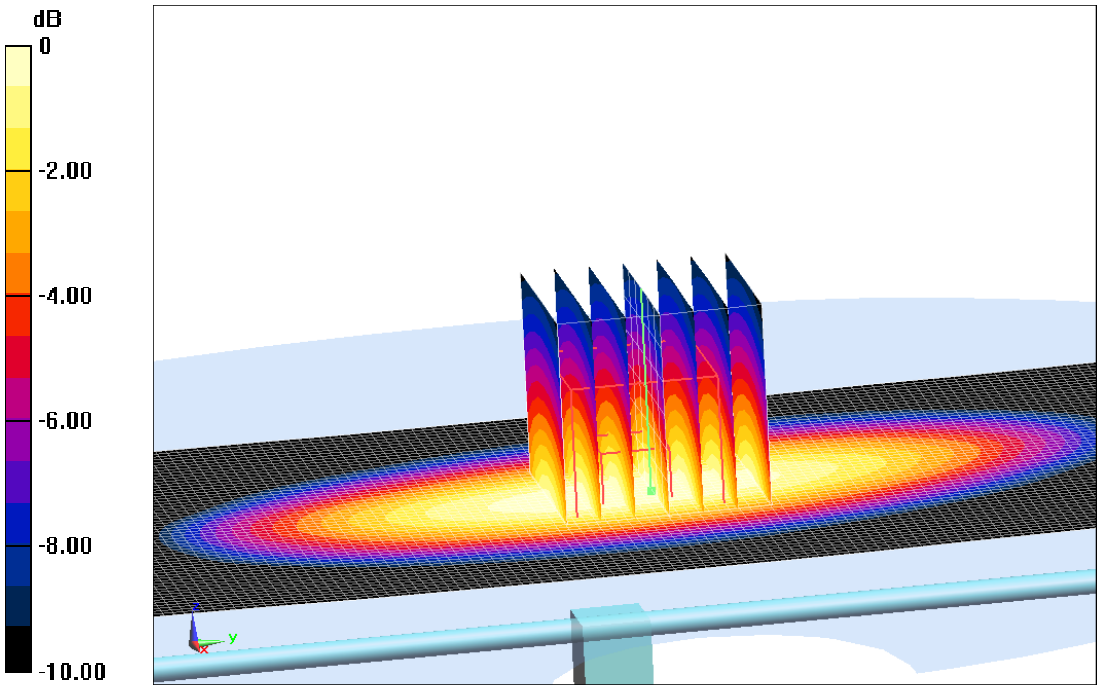
Fig.B.3 validation 835MHz 250mW

835MHz

Date: 2014-12-24
Electronics: DAE4 Sn777
Medium: Body 850 MHz
Medium parameters used: f = 835 MHz; σ = 0.963 S/m; ε_r = 54.85; ρ = 1000 kg/m^3
Ambient Temperature: 22.2^{o}C   Liquid Temperature: 21.7^{o}C
Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(9.09, 9.09, 9.09)

System Validation /Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 53.148 V/m; Power Drift = 0.09 dB
Fast SAR: SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (interpolated) = 2.78 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.148 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 3.44 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 2.75 W/kg



0 dB = 2.75 W/kg = 4.39 dBW/kg

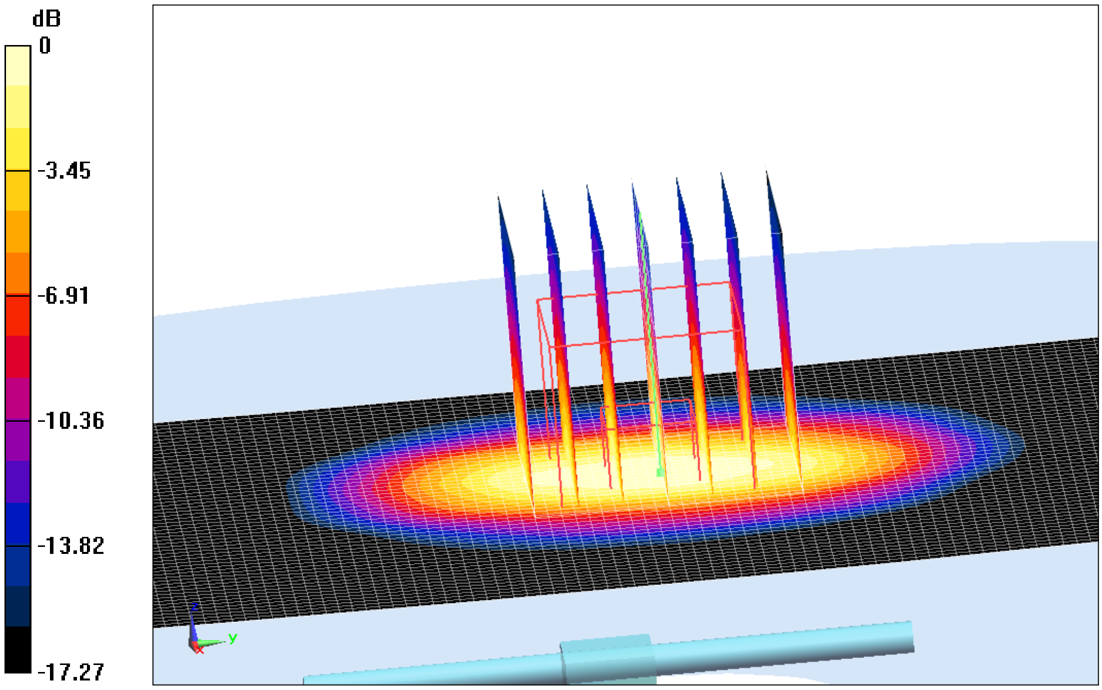
Fig.B.4 validation 835MHz 250mW

1900MHz

Date: 2014-12-25
Electronics: DAE4 Sn777
Medium: Head 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.389 mho/m; ε_r = 40.18; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.26, 7.26, 7.26)

System Validation /Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 91.547 V/m; Power Drift = 0.05 dB
SAR(1 g) = 9.97 W/kg; SAR(10 g) = 5.28 W/kg
Maximum value of SAR (interpolated) = 12.7 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.547 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 18.04 W/kg
SAR(1 g) = 9.85 W/kg; SAR(10 g) = 5.18 W/kg
Maximum value of SAR (measured) = 12.0 W/kg



0 dB = 12.0 W/kg = 10.79 dBW/kg

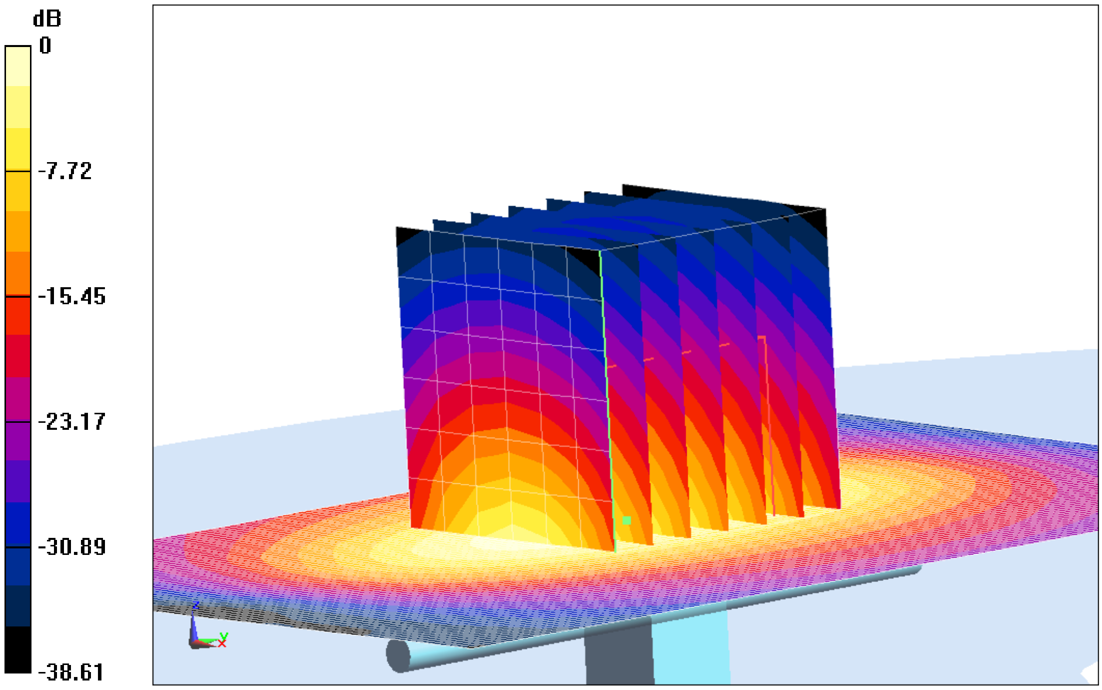
Fig.B.5 validation 1900MHz 250mW

1900MHz

Date: 2014-12-25
Electronics: DAE4 Sn777
Medium: Body 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.508 S/m; ε_r = 54.06; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(7.15, 7.15, 7.15)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 68.82 V/m; Power Drift = 0.06 dB
Fast SAR: SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.51 W/kg
Maximum value of SAR (interpolated) = 11.8 W/kg

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 68.82 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 19.23 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.43 W/kg
Maximum value of SAR (measured) = 11.7 W/kg



0 dB = 11.7 W/kg = 10.68 dB W/kg

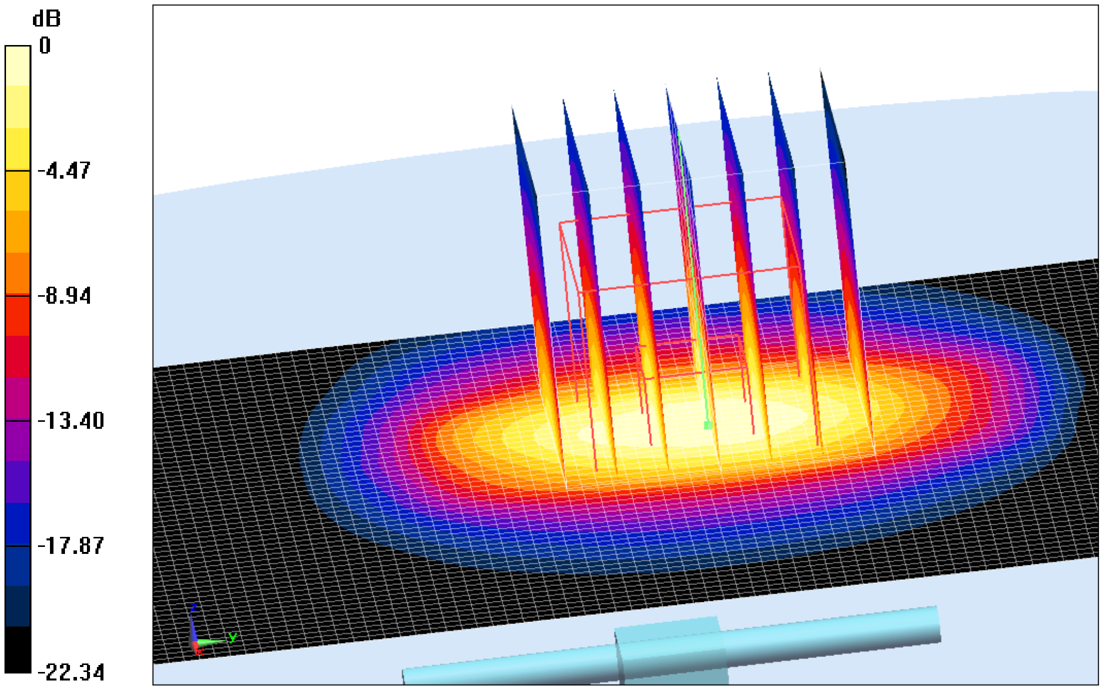
Fig.B.6 validation 1900MHz 250mW

2450MHz

Date: 2014-12-26
Electronics: DAE4 Sn777
Medium: Head 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 mho/m; ε_r = 40.2; ρ = 1000 kg/m^3
Ambient Temperature: 22.0^{o}C Liquid Temperature: 21.6^{o}C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.56, 6.56, 6.56)

System Validation /Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 87.004 V/m; Power Drift = -0.03 dB
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.19 W/kg
Maximum value of SAR (interpolated) = 17.3 W/kg

System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.004 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 27.01 W/kg
SAR(1 g) = 13.0 W/kg; SAR(10 g) = 6.06 W/kg
Maximum value of SAR (measured) = 16.3 W/kg



0 dB = 16.3 W/kg = 12.12 dBW/kg

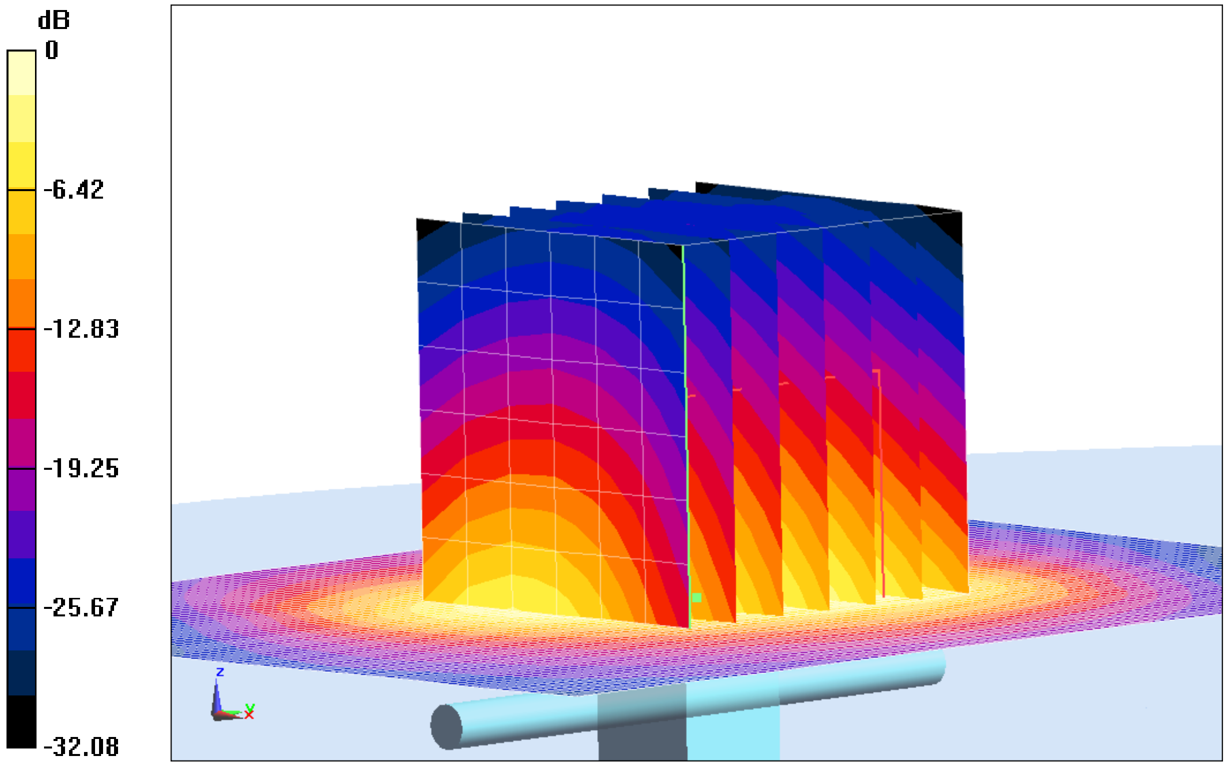
Fig.B.7 validation 2450MHz 250mW

2450MHz

Date: 2014-12-26
Electronics: DAE4 Sn777
Medium: Body 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.018 S/m; ε_r = 50.88; ρ = 1000 kg/m^3
Ambient Temperature: 22.0°C Liquid Temperature: 21.6°C
Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3846 ConvF(6.90, 6.90, 6.90)

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Reference Value = 87.792 V/m; Power Drift = 0.07 dB
SAR(1 g) = 12.3 W/kg; SAR(10 g) = 5.75 W/kg
Maximum value of SAR (interpolated) = 14.1 W/kg

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.792 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 24.49 W/kg
SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.84 W/kg
Maximum value of SAR (measured) = 14.2 W/kg



0 dB = 14.2 W/kg = 11.52 dB W/kg

Fig.B.8 validation 2450MHz 250mW

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

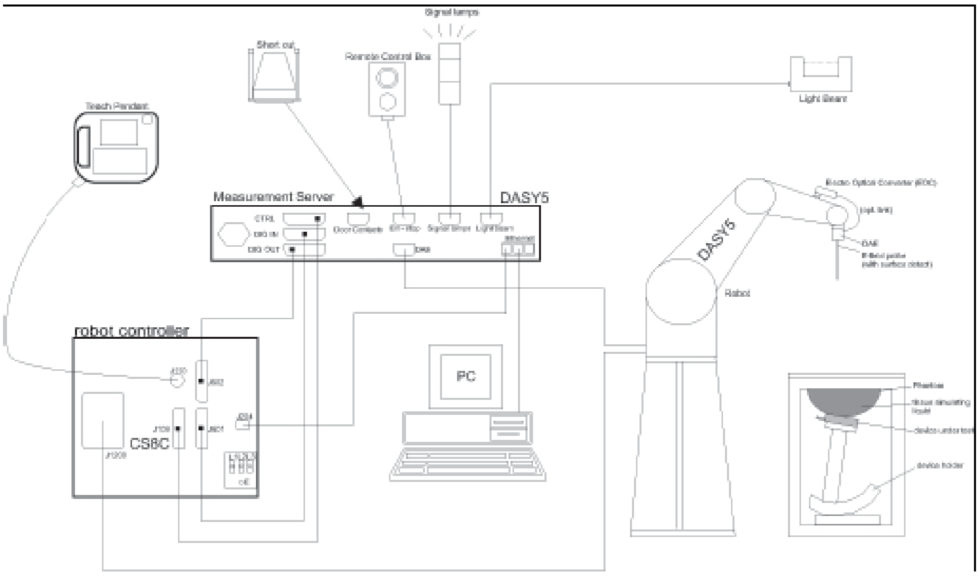
Table B.1 Comparison between area scan and zoom scan for system verification

Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
750	Head	2.18	2.14	1.87
750	Body	2.26	2.23	1.35
835	Head	2.38	2.43	-2.06
835	Body	2.42	2.38	1.68
1900	Head	9.97	9.85	1.22
1900	Body	10.4	10.3	0.97
2450	Head	13.2	13.0	1.54
2450	Body	12.3	12.4	-0.81

ANNEX C SAR Measurement Setup

C.1 Measurement Set-up

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



Picture C.1 SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY4 or DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

C.2 Dasy4 or DASY5 E-field Probe System

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

Probe Specifications:

Model: ES3DV3, EX3DV4

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

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

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

Dynamic Range: 10 mW/kg — 100W/kg

Probe Length: 330 mm

Probe Tip Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm (3.9 mm for ES3DV3)

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

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

Picture C.2 Near-field Probe

Picture C.3 E-field Probe

C.3 E-field Probe Calibration

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

The free space E-field from amplified probe outputs is determined in a t est 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 R F transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

C.4 Other Test Equipment

C.4.1 Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

PictureC.4: DAE

C.4.2 Robot

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

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

Picture C.5 DASY 4

Picture C.6 DASY 5

C.4.3 Measurement Server

The Measurement server is based on a P C/104 CPU broad with CPU (dasy4: 166 M Hz, Intel Pentium; DASY5: 400 M Hz, Intel Celeron), chipdisk (DASY4: 32 M B; 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.