



SAR TEST REPORT

No. I17Z40052-SEM03

For

TCL Communication Ltd.

CDMA EVDO BC0/BC1/LTE 2 band Mobile phone

Model Name: 5046S

With

HW version: PIO

SW version: vEBAF

FCC ID: 2ACCJB076

Issued Date: 2017-2-25



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
I17Z40052-SEM03	Rev.0	2017-2-25	Initial creation of test report

TABLE OF CONTENT

1 TEST LABORATORY	5
1.1 TESTING LOCATION	5
1.2 TESTING ENVIRONMENT.....	5
1.3 PROJECT DATA	5
1.4 SIGNATURE.....	5
2 STATEMENT OF COMPLIANCE	6
3 CLIENT INFORMATION.....	7
3.1 APPLICANT INFORMATION	7
3.2 MANUFACTURER INFORMATION	7
4 EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE)	8
4.1 ABOUT EUT.....	8
4.2 INTERNAL IDENTIFICATION OF EUT USED DURING THE TEST	8
4.3 INTERNAL IDENTIFICATION OF AE USED DURING THE TEST.....	8
5 TEST METHODOLOGY	9
5.1 APPLICABLE LIMIT REGULATIONS	9
5.2 APPLICABLE MEASUREMENT STANDARDS.....	9
6 SPECIFIC ABSORPTION RATE (SAR).....	10
6.1 INTRODUCTION.....	10
6.2 SAR DEFINITION.....	10
7 TISSUE SIMULATING LIQUIDS	11
7.1 TARGETS FOR TISSUE SIMULATING LIQUID	11
7.2 DIELECTRIC PERFORMANCE	11
8 SYSTEM VERIFICATION.....	17
8.1 SYSTEM SETUP	17
8.2 SYSTEM VERIFICATION.....	18
9 MEASUREMENT PROCEDURES	19
9.1 TESTS TO BE PERFORMED	19
9.2 GENERAL MEASUREMENT PROCEDURE	21
9.3 SAR MEASUREMENT FOR LTE	21
9.4 BLUETOOTH &WI-FI MEASUREMENT PROCEDURES FOR SAR	22
9.5 POWER DRIFT.....	22
10 AREA SCAN BASED 1-G SAR	23
10.1 REQUIREMENT OF KDB.....	23
10.2 FAST SAR ALGORITHMS	23
11 CONDUCTED OUTPUT POWER.....	24

11.1 MANUFACTURING TOLERANCE	24
11.2 HOTSPOT	25
11.3 CDMA MEASUREMENT RESULT	29
11.4 LTE MEASUREMENT RESULT	30
11.5 WI-FI AND BT MEASUREMENT RESULT	33
12 SIMULTANEOUS TX SAR CONSIDERATIONS	35
12.1 INTRODUCTION.....	35
12.2 TRANSMIT ANTENNA SEPARATION DISTANCES	35
12.3 SAR MEASUREMENT POSITIONS	35
12.4 STANDALONE SAR TEST EXCLUSION CONSIDERATIONS	36
13 EVALUATION OF SIMULTANEOUS.....	36
14 SAR TEST RESULT.....	41
14.1 SAR RESULTS FOR FAST SAR.....	41
14.2 SAR RESULTS FOR STANDARD PROCEDURE.....	45
14.3 WLAN EVALUATION.....	48
15 SAR MEASUREMENT VARIABILITY.....	52
16 MEASUREMENT UNCERTAINTY	53
16.1 MEASUREMENT UNCERTAINTY FOR NORMAL SAR TESTS (300MHz~3GHz)	53
16.2 MEASUREMENT UNCERTAINTY FOR NORMAL SAR TESTS (3~6GHz)	54
16.3 MEASUREMENT UNCERTAINTY FOR FAST SAR TESTS (300MHz~3GHz)	55
16.4 MEASUREMENT UNCERTAINTY FOR FAST SAR TESTS (3~6GHz).....	57
17 MAIN TEST INSTRUMENTS	58
ANNEX A GRAPH RESULTS.....	59
ANNEX B SYSTEM VERIFICATION RESULTS.....	85
ANNEX C SAR MEASUREMENT SETUP	106
ANNEX D POSITION OF THE WIRELESS DEVICE IN RELATION TO THE PHANTOM	112
ANNEX E EQUIVALENT MEDIA RECIPES	115
ANNEX F SYSTEM VALIDATION	116
ANNEX G PROBE CALIBRATION CERTIFICATE	117
ANNEX H DIPOLE CALIBRATION CERTIFICATE.....	128
ANNEX I SPOT CHECK TEST.....	168
ANNEX J ACCREDITATION CERTIFICATE	185

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

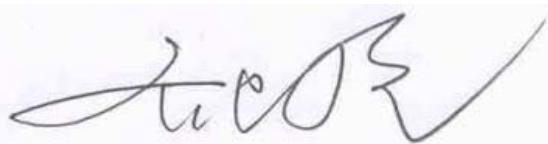
Project Leader:	Qi Dianyuan
Test Engineer:	Lin Xiaojun
Testing Start Date:	November 22, 2016
Testing End Date:	February 18, 2017

1.4 Signature



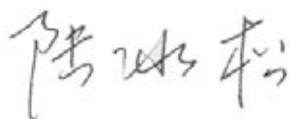
Lin Xiaojun

(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

This EUT is a variant product and the report of original sample is No.I16Z42183-SEM01. According to the client request, we share the test results of original sample and do the spot check. The results of spot check are presented in the annex I.

The maximum results found during testing for TCL Communication Ltd. CDMA EVDO BC0/BC1/LTE 2 band Mobile phone 5046S 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	0.38	PCE
	CDMA BC1	0.60	PCE
	LTE Band 4	0.65	PCE
	LTE Band 13	0.37	PCE
	WLAN 2.4 GHz(11b)	1.42	DTS
	WLAN 2.4 GHz(11n)	1.53	
Hotspot (Separation Distance 10mm)	CDMA BC0	0.67	PCE
	CDMA BC1	1.35	PCE
	LTE Band 4	1.23	PCE
	LTE Band 13	0.51	PCE
	WLAN 2.4 GHz	0.20	DTS
Body-worn (Separation Distance 15mm)	CDMA BC1	1.10	PCE
	LTE Band 4	0.59	PCE

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 or 15mm 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 in Table 2.1, and the values are:**1.53 W/kg (1g)**.

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

	Position	Main antenna	WiFi	Sum	Distance (mm)	Ratio
Highest reported SAR value for Head	Left hand, Touch cheek	0.65	1.42	2.07	96.27	0.03
		0.65	1.22	1.87	96.99	0.02
		0.65	1.28	1.93	95.91	0.03
		0.65	1.53	2.18	92.30	0.03
		0.65	1.39	2.04	94.76	0.03
		0.65	1.45	2.10	95.30	0.03
Highest reported SAR value for Body	Front	1.23	0.20	1.43	/	/
	Bottom	1.35	/	1.35	/	/

According to the KDB 447498 D01, when the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The ratio is determined by $(\text{SAR1} + \text{SAR2})^{1.5}/R_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

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	Left hand, Touch cheek	0.65	0.29	0.94
Highest reported SAR value for Body	Rear	1.27	0.15	1.42
	Bottom	1.35	/	1.35

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

According to the above tables, the highest sum of reported SAR values is **2.07 W/kg (1g)**. The detail for simultaneous transmission consideration is described in chapter 13.

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
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3.2 Manufacturer Information

Company Name:	TCL Communication Ltd.
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Email:	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:	CDMA EVDO BC0/BC1/LTE 2 band Mobile phone
Model Name:	5046S
Operating mode(s):	CDMA BC0/1, LTE Band4/13, BT, WLAN
Tested Tx Frequency:	824.7 – 848.31 MHz (CDMA BC0)
	1851.25 – 1908.75 MHz (CDMA BC1)
	779.5 – 784.5 MHz (LTE Band13)
	1710.7 – 1754.3 MHz (LTE Band4)
	2412 – 2462 MHz (Wi-Fi 2.4G)
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna
Hotspot	Support

4.2 Internal Identification of EUT used during the test

EUT ID*	MEID	HW Version	SW Version
EUT1	354349080001327	PIO	v6SV3
EUT2	354349080001293	PIO	v6SV3
EUT3	354349080001319	PIO	v6SV3
EUT4	354349080001285	PIO	v6SV3
EUT5	355068080004482	PIO	vEBAF
EUT6	355068080004508	PIO	vEBAF

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

Note: It is performed to test SAR with the EUT1&2&3&5 and conducted power with the EUT 4&6.

4.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	TLp024CJ	CAC2400006CJ	Coslight

*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 D05 SAR for LTE Devices v02r05: SAR Evaluation Considerations for LTE 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 D01 SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz.

KDB865664 D02 RF 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 heat 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

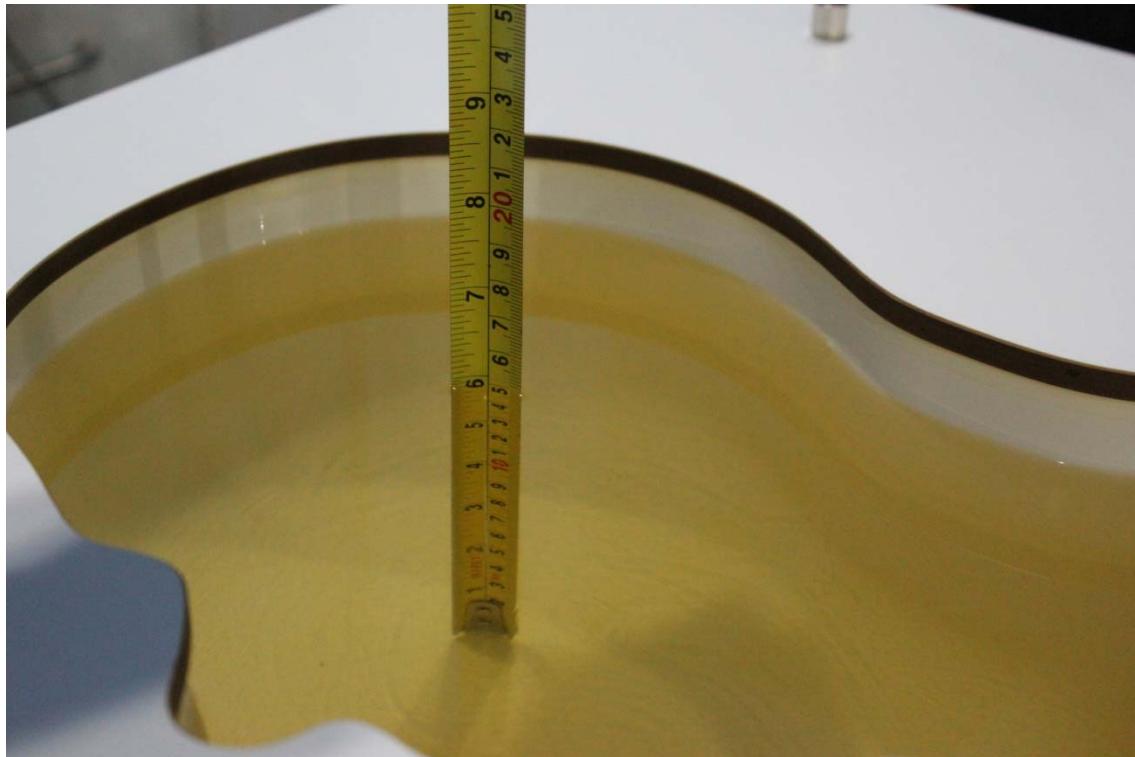
Frequency (MHz)	Liquid Type	Conductivity (σ)	$\pm 5\%$ Range	Permittivity (ϵ)	$\pm 5\%$ Range
750	Head	0.89	0.85~0.93	41.94	39.8~44.0
750	Body	0.96	0.91~1.01	55.5	52.7~58.3
835	Head	0.90	0.86~0.95	41.5	39.4~43.6
835	Body	0.97	0.92~1.02	55.2	52.4~58.0
1750	Head	1.37	1.30~1.44	40.08	38.1~42.1
1750	Body	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 (%)
2016-11-22	Head	750 MHz	42.94	2.38	0.905	1.69
	Body	750 MHz	54.89	-1.10	0.954	-0.63
2016-11-23	Head	835 MHz	41.21	-0.70	0.916	1.78
	Body	835 MHz	56.18	1.78	0.971	0.10
2016-11-24	Head	1750 MHz	39.81	-0.67	1.365	-0.36
	Body	1750 MHz	53.11	-0.54	1.489	-0.07
2016-11-25	Head	1900 MHz	39.91	-0.23	1.416	1.14
	Body	1900 MHz	53.24	-0.11	1.531	0.72
2016-11-26	Head	2450 MHz	40.03	2.12	1.825	1.39
	Body	2450 MHz	52.78	0.15	1.951	0.05
2017-2-14	Head	750 MHz	41.32	-1.48	0.895	0.56
	Body	750 MHz	54.89	-1.10	0.956	-0.42
2017-2-15	Head	835 MHz	41.26	-0.58	0.896	-0.44
	Body	835 MHz	56.21	1.83	0.961	-0.93
2017-2-16	Head	1750 MHz	39.37	-1.77	1.356	-1.02
	Body	1750 MHz	53.23	-0.32	1.469	-1.41
2017-2-17	Head	1900 MHz	39.95	-0.12	1.405	0.36
	Body	1900 MHz	53.11	-0.36	1.511	-0.59
2017-2-18	Head	2450 MHz	38.86	-0.87	1.835	1.94
	Body	2450 MHz	51.98	-1.37	1.989	2.00

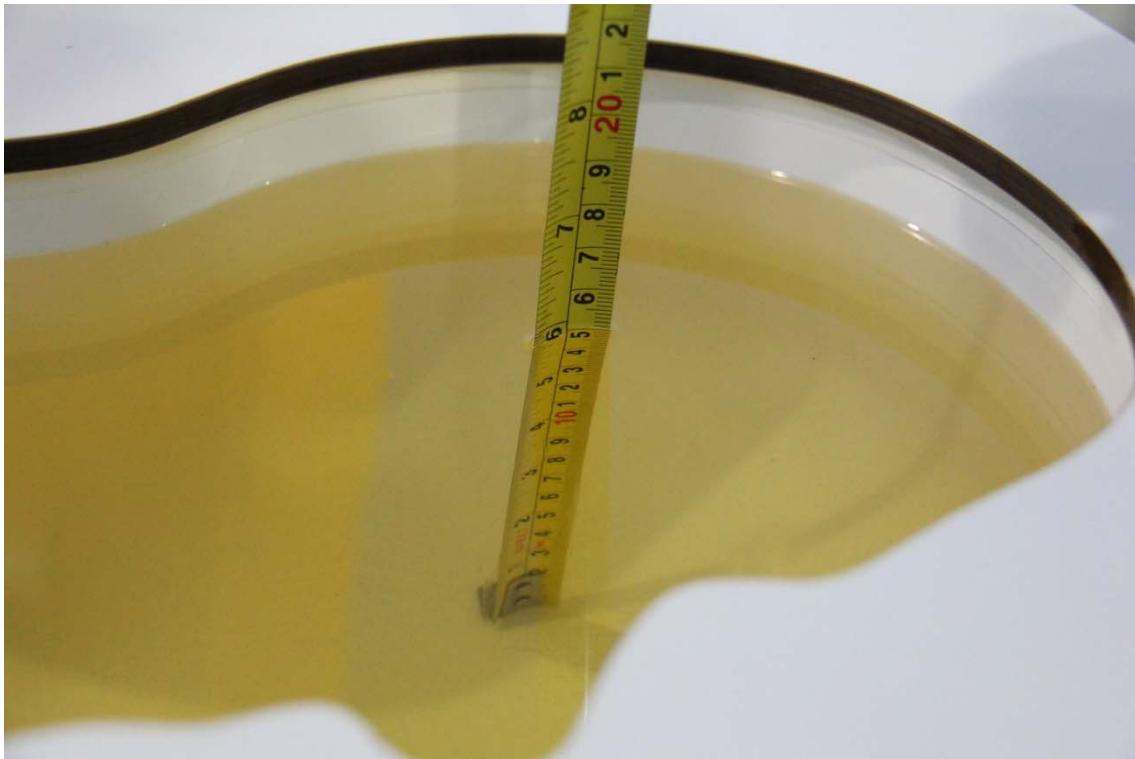
Note: The liquid temperature is 22.0 °C



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



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



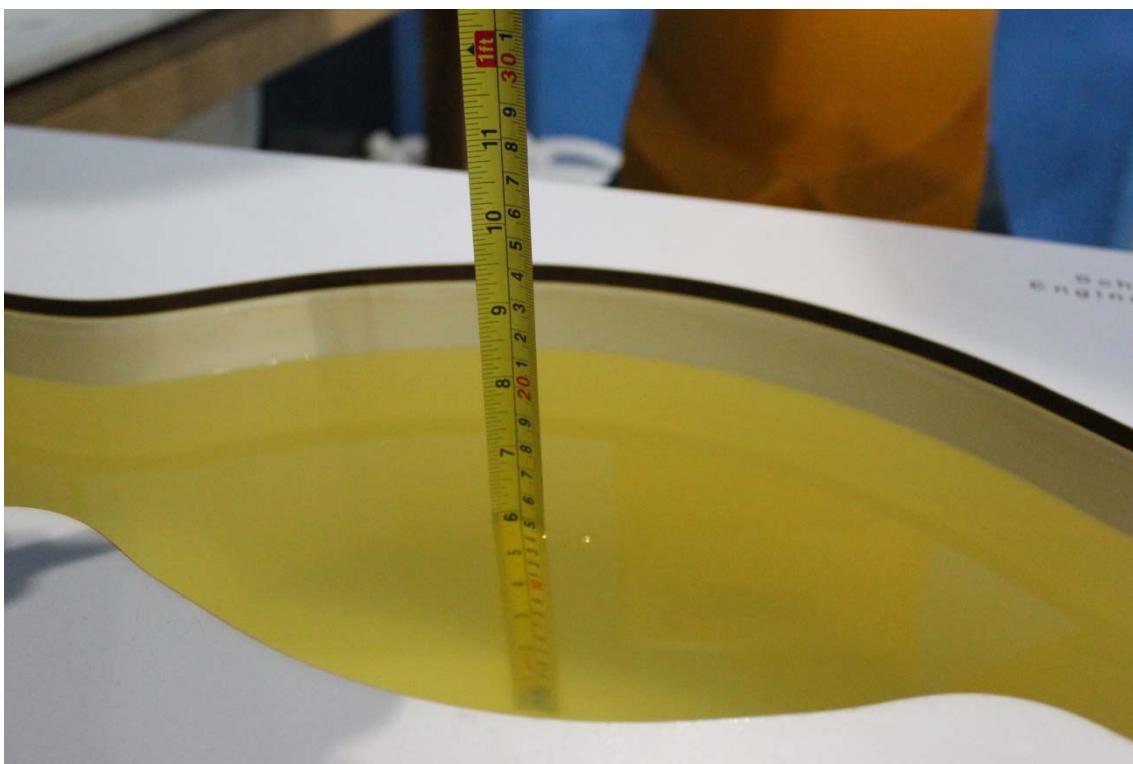
Picture 7-3 Liquid depth in the Head Phantom (835 MHz)



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



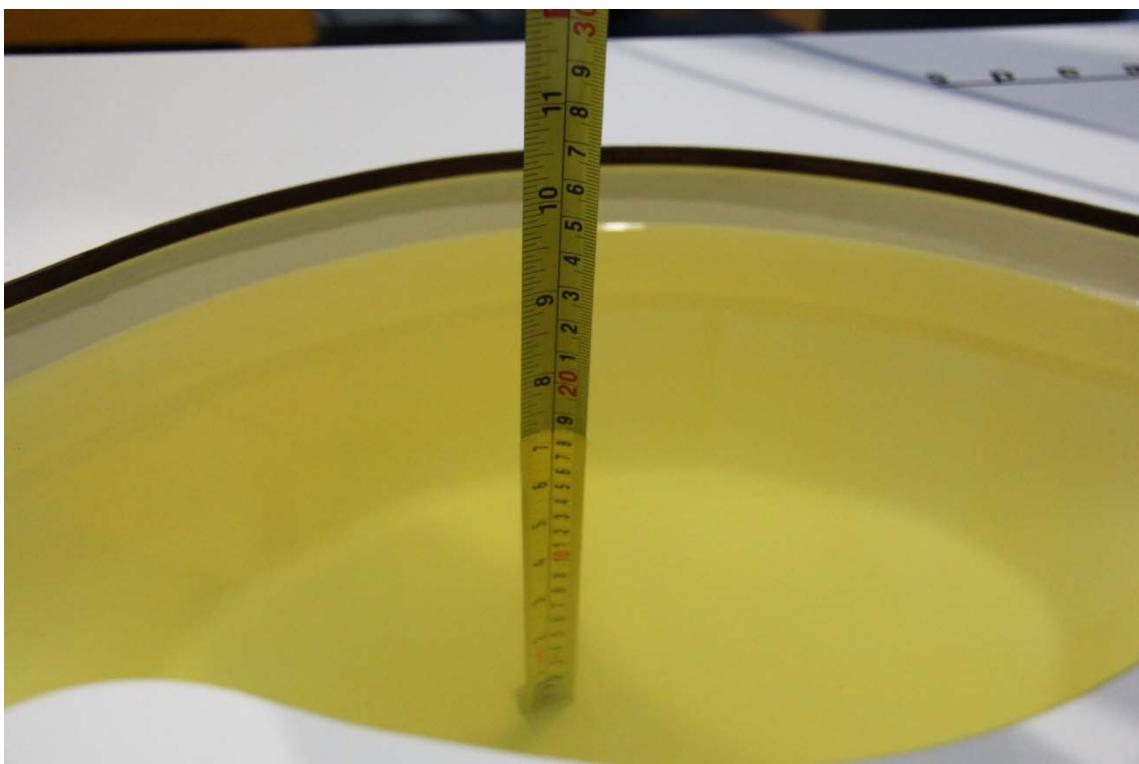
Picture 7-5 Liquid depth in the Head Phantom (1750 MHz)



Picture 7-6 Liquid depth in the Flat Phantom (1750MHz)



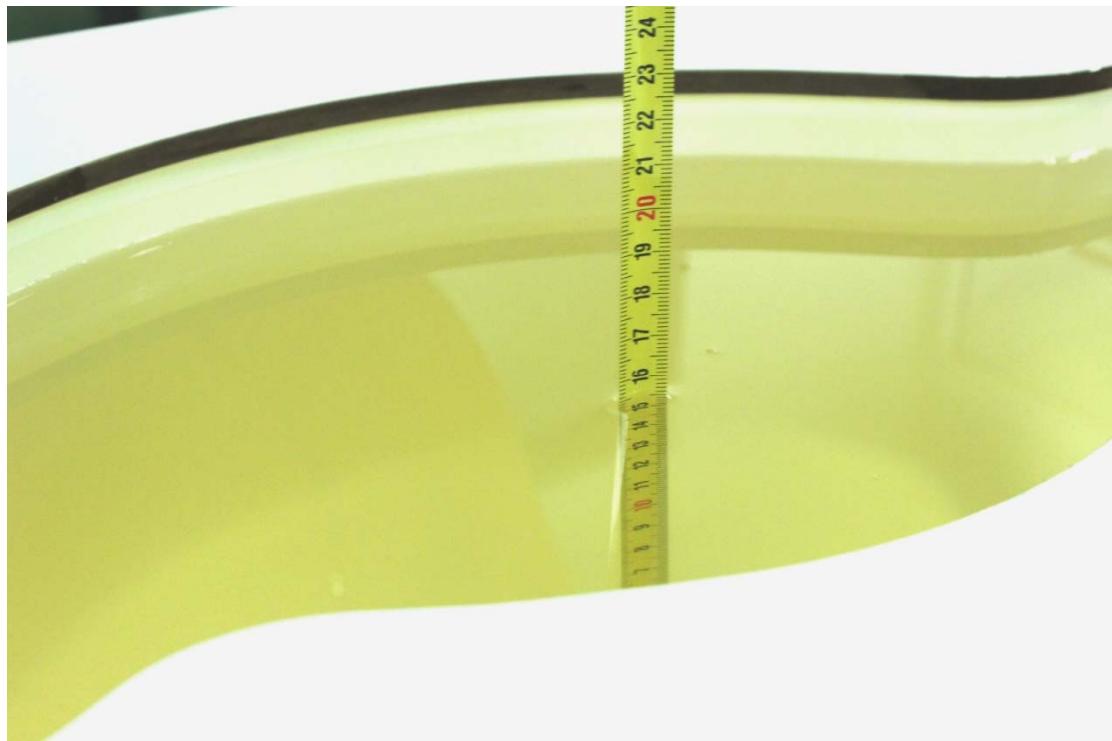
Picture 7-7 Liquid depth in the Head Phantom (1900 MHz)



Picture 7-8 Liquid depth in the Flat Phantom (1900MHz)



Picture 7-9 Liquid depth in the Head Phantom (2450MHz)

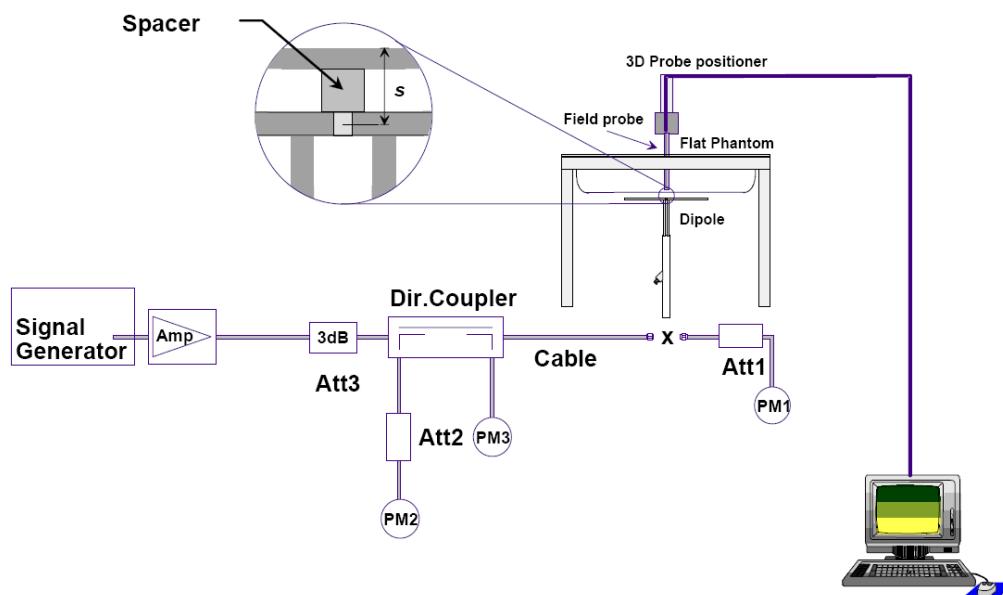


Picture 7-10 Liquid depth in the Flat Phantom (2450MHz)

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
2016-11-22	750 MHz	5.46	8.33	5.52	8.28	1.10%	-0.60%
2016-11-23	835 MHz	6.18	9.44	6.08	9.08	-1.62%	-3.81%
2016-11-24	1750 MHz	19.50	36.80	19.44	36.96	-0.31%	0.43%
2016-11-25	1900 MHz	21.20	40.70	21.64	42.00	2.08%	3.19%
2016-11-26	2450 MHz	24.60	52.80	24.60	53.12	0.00%	0.61%
2017-2-14	750 MHz	5.46	8.33	5.36	8.20	-1.83%	-1.56%
2017-2-15	835 MHz	6.18	9.44	6.04	9.52	-2.27%	0.85%
2017-2-16	1750 MHz	19.50	36.80	19.48	36.96	-0.10%	0.43%
2017-2-17	1900 MHz	21.20	40.70	21.68	41.64	2.26%	2.31%
2017-2-18	2450 MHz	24.6	52.8	24.5	52.4	-0.49%	-0.76%

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
2016-11-22	750 MHz	5.76	8.78	5.64	8.68	-2.08%	-1.14%
2016-11-23	835 MHz	6.36	9.69	6.44	9.52	1.26%	-1.75%
2016-11-24	1750 MHz	19.60	37.00	19.72	37.24	0.61%	0.65%
2016-11-25	1900 MHz	21.30	40.10	21.28	40.20	-0.09%	0.25%
2016-11-26	2450 MHz	24.10	51.20	24.12	51.24	0.08%	0.08%
2017-2-14	750 MHz	5.76	8.78	5.84	9.12	1.39%	3.87%
2017-2-15	835 MHz	6.36	9.69	6.20	9.68	-2.52%	-0.10%
2017-2-16	1750 MHz	19.60	37.00	20.16	36.72	2.86%	-0.76%
2017-2-17	1900 MHz	21.30	40.10	21.04	40.44	-1.22%	0.85%
2017-2-18	2450 MHz	24.10	51.20	24.56	50.80	1.91%	-0.78%

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.

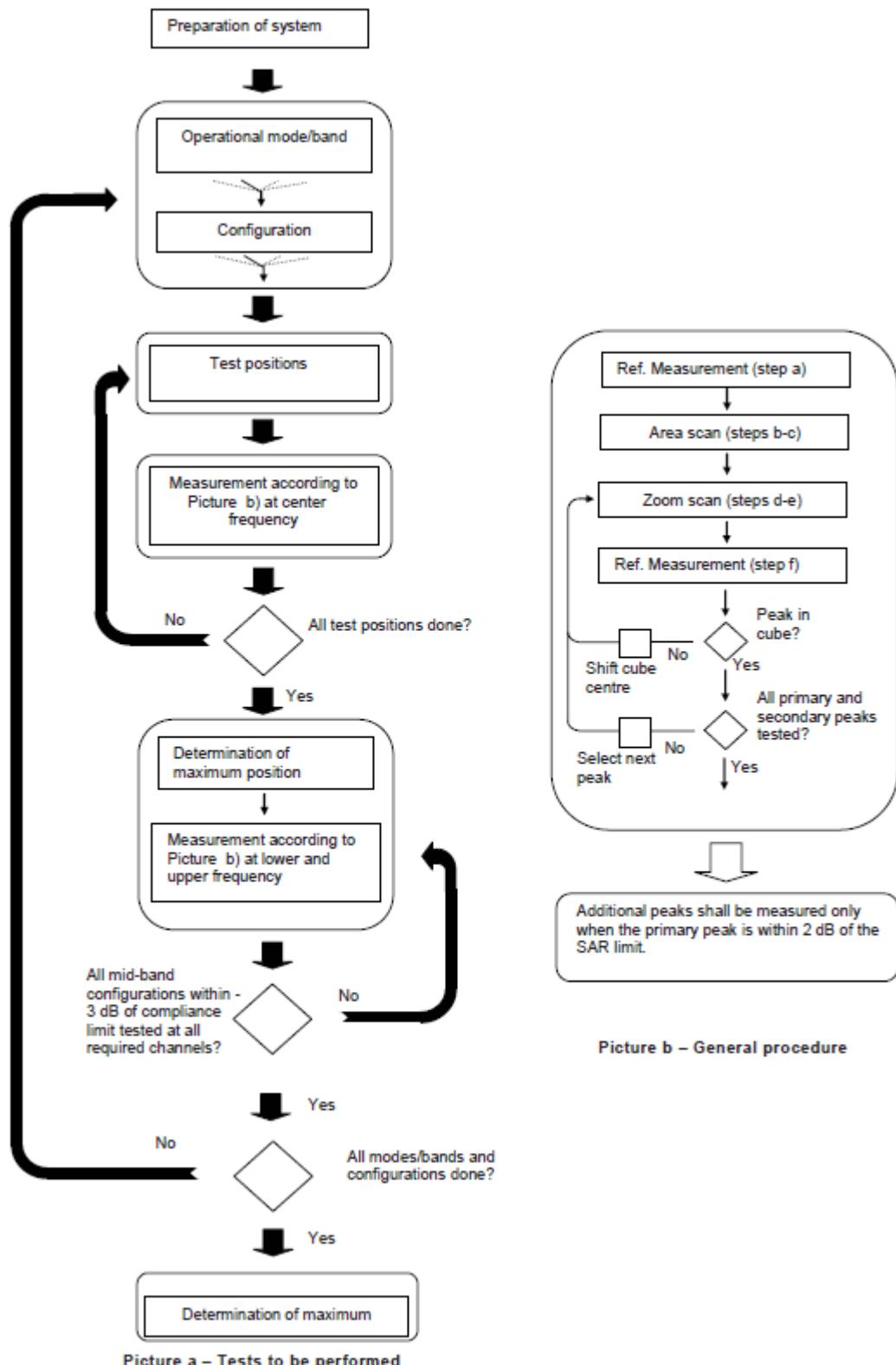
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

- 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.

		$\leq 3 \text{ GHz}$	$> 3 \text{ GHz}$
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		$5 \pm 1 \text{ mm}$	$\frac{1}{4} \cdot 5 \cdot \ln(2) \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$		$\leq 2 \text{ GHz}: \leq 15 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 12 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 12 \text{ mm}$ $4 - 6 \text{ GHz}: \leq 10 \text{ mm}$
		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.	
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		$\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$3 - 4 \text{ GHz}: \leq 4 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 3 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
	graded grid	$\Delta z_{\text{Zoom}}(1): \text{between } 1^{\text{st}}$ two points closest to phantom surface	$3 - 4 \text{ GHz}: \leq 3 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
		$\Delta z_{\text{Zoom}}(n>1): \text{between}$ subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$
Minimum zoom scan volume	x, y, z	$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz}: \geq 28 \text{ mm}$ $4 - 5 \text{ GHz}: \geq 25 \text{ mm}$ $5 - 6 \text{ GHz}: \geq 22 \text{ mm}$
Note: 5 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 <i>reported</i> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

9.3 SAR Measurement for LTE

SAR tests for LTE are performed with a base station simulator, Rohde & Rchwarz CMW500. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. All powers were measured with the CMW 500.

It is performed for conducted power and SAR based on the KDB941225 D05.

SAR is evaluated separately according to the following procedures for the different test positions in each exposure condition – head, body, body-worn accessories and other use conditions. The procedures in the following subsections are applied separately to test each LTE frequency band.

1) QPSK with 1 RB allocation

Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

2) QPSK with 50% RB allocation

The procedures required for 1 RB allocation in 1) are applied to measure the SAR for QPSK with 50% RB allocation.

3) QPSK with 100% RB allocation

For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in 1) and 2) are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

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 section 14 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 $\leq 1.2 \text{ W/kg}$, 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

When WLAN Hotspot mode is activated (AP ON), the conducted output power will be reduced for CDMA BC1. When WLAN Hotspot mode is deactivated (AP OFF), the RF output power level return to their normal RF power level.

11.1 Manufacturing tolerance

When the hotspot mode is ON:

Table 11.1: CDMA

CDMA BC1			
Channel	Channel 1175	Channel 600	Channel 25
Target (dBm)	21.3	21.3	21.3
Tune-up (dBm)	22.3	22.3	22.3

Table 11.2: LTE Band4

LTE Band4			
Channel	Channel 20000	Channel 20175	Channel 20350
Target (dBm)	23.7	23.7	23.7
Hotspot reduction power (dB)	1	1	1
Tune-up (dBm)	23.7	23.7	23.7

When the hotspot mode is OFF:

Table 11.3: CDMA

CDMA BC0			
Channel	Channel 777	Channel 384	Channel 1013
Target (dBm)	23.5	23.5	23.5
Tune-up (dBm)	24.5	24.5	24.5
CDMA BC1			
Channel	Channel 1175	Channel 600	Channel 25
Target (dBm)	23.5	23.5	23.5
Tune-up (dBm)	24.5	24.5	24.5

Table 11.4: Bluetooth

Mode	GFSK		
Channel	0	39	78
Target (dBm)	7	7	7
Tune-up (dBm)	8.5	8.5	8.5
Mode	EDR2M-4_DQPSK		
Channel	0	39	78
Target (dBm)	7	7	7
Tune-up (dBm)	8.5	8.5	8.5
Mode	EDR3M-8DPSK		
Channel	0	39	78

Target (dBm)	7	7	7
Tune-up (dBm)	8.5	8.5	8.5
Mode	BLE		
Channel	0	39	78
Target (dBm)	-2	-2	-2
Tune-up (dBm)	-0.5	-0.5	-0.5

Table 11.5: LTE

LTE Band4			
Channel	Channel 20000	Channel 20175	Channel 20350
Target (dBm)	23.7	23.7	23.7
Tune-up (dBm)	24.7	24.7	24.7
LTE Band13			
Channel	Channel 23230		
Target (dBm)	23		
Tune-up (dBm)	24		

Table 11.6: WiFi

Mode	Target (dBm)	Tune-up(dBm)
802.11 b (2.4GHz)	15.2	16.2
802.11 g (2.4GHz) 6Mbps~24Mbps	15.2	16.2
802.11 g (2.4GHz) 36Mbps~54Mbps	14	15
802.11 n (2.4GHz HT20) MCS0-MCS4	16	17
802.11 n (2.4GHz HT20) MCS5-MCS6	14	15
802.11 n (2.4GHz HT20) MCS7	13	14
802.11 n (2.4GHz HT40) MCS0-MCS4	16	17
802.11 n (2.4GHz HT40) MCS5-MCS6	14.2	15.2
802.11 n (2.4GHz HT40) MCS7	13	14

11.2 Hotspot

The conducted power is normal for all bands except CDMA BC1 and LTE Band 4. There is power reduction enabled for CDMA BC1 and LTE Band 4. The power reduction is enabled when the user enables hotspot mode via the manufacturer software. The tables below show the measured powers with hotspot.

Table 11.7: The conducted power measurement results for CDMA for Body

CDMA BC1	Conducted Power (dBm)		
	Channel 1175 (1908.75MHz)	Channel 600 (1880MHz)	Channel 25 (1851.25MHz)
SO32/RC3(FCH only)	20.99	21.04	20.79
SO32/RC3(FCH+SCHn)	20.95	21.03	20.81
EVDO Rev.0	20.98	21.26	21.01
EVDO Rev.A	20.87	21.25	20.83

Table 11.8: The conducted Power for LTE

Band 4							
Bandwidth (MHz)	RB allocation	Frequency (MHz)	Max. Target Power (dBm)	QPSK		16QAM	
				Actual output power (dBm)	MPR	Actual output power (dBm)	MPR
1.4 MHz	1RB High (5)	1754.3	23.7	22.81	0	22.88	0
		1732.5	23.7	22.95	0	23.15	0
		1710.7	23.7	22.71	0	22.70	0
	1RB Middle (3)	1754.3	23.7	23.05	0	23.16	0
		1732.5	23.7	22.86	0	23.08	0
		1710.7	23.7	22.98	0	22.83	0
	1RB Low (0)	1754.3	23.7	22.62	0	22.53	0
		1732.5	23.7	23.01	0	22.96	0
		1710.7	23.7	22.88	0	22.87	0
	3RB High (3)	1754.3	23.7	22.74	0	22.53	0
		1732.5	23.7	22.87	0	22.87	0
		1710.7	23.7	22.77	0	22.96	0
	3RB Middle (1)	1754.3	23.7	22.98	0	22.97	0
		1732.5	23.7	22.87	0	22.90	0
		1710.7	23.7	22.92	0	23.02	0
	3RB Low (0)	1754.3	23.7	22.60	0	22.36	0
		1732.5	23.7	22.86	0	22.84	0
		1710.7	23.7	22.84	0	23.07	0
	6RB (0)	1754.3	23.7	22.67	0	21.96	0
		1732.5	23.7	22.80	0	21.66	0
		1710.7	23.7	22.83	0	22.17	0
3 MHz	1RB High (14)	1753.5	23.7	22.51	0	23.13	0
		1732.5	23.7	22.66	0	22.90	0
		1711.5	23.7	22.69	0	22.71	0
	1RB Middle (7)	1753.5	23.7	22.62	0	23.15	0
		1732.5	23.7	22.70	0	22.87	0
		1711.5	23.7	22.62	0	23.05	0
	1RB Low (0)	1753.5	23.7	22.60	0	22.91	0
		1732.5	23.7	22.70	0	23.38	0
		1711.5	23.7	22.88	0	23.02	0
	8RB High (7)	1753.5	23.7	22.68	0	21.40	0
		1732.5	23.7	22.92	0	21.85	0
		1711.5	23.7	22.79	0	21.77	0
	8RB Middle (4)	1753.5	23.7	22.66	0	21.59	0
		1732.5	23.7	22.81	0	21.83	0
		1711.5	23.7	22.90	0	21.93	0
	8RB Low (0)	1753.5	23.7	22.78	0	21.65	0
		1732.5	23.7	22.89	0	21.91	0
		1711.5	23.7	22.95	0	22.01	0
	15RB	1753.5	23.7	22.80	0	21.77	0

	(0)	1732.5	23.7	22.85	0	21.90	0
		1711.5	23.7	22.98	0	22.02	0
5 MHz	1RB High (24)	1752.5	23.7	22.67	0	21.79	0
		1732.5	23.7	22.91	0	22.22	0
		1712.5	23.7	22.55	0	21.89	0
	1RB Middle (12)	1752.5	23.7	22.65	0	21.96	0
		1732.5	23.7	22.76	0	22.22	0
		1712.5	23.7	22.62	0	21.96	0
	1RB Low (0)	1752.5	23.7	22.64	0	22.03	0
		1732.5	23.7	22.67	0	22.05	0
		1712.5	23.7	22.78	0	22.20	0
	12RB High (13)	1752.5	23.7	22.78	0	21.85	0
		1732.5	23.7	22.82	0	21.81	0
		1712.5	23.7	22.73	0	21.70	0
	12RB Middle (6)	1752.5	23.7	22.76	0	21.86	0
		1732.5	23.7	22.88	0	21.78	0
		1712.5	23.7	22.89	0	21.89	0
	12RB Low (0)	1752.5	23.7	22.73	0	21.82	0
		1732.5	23.7	22.85	0	21.75	0
		1712.5	23.7	22.96	0	21.98	0
	25RB (0)	1752.5	23.7	22.76	0	21.80	0
		1732.5	23.7	22.91	0	21.95	0
		1712.5	23.7	22.78	0	22.03	0
10 MHz	1RB High (49)	1750	23.7	22.72	0	23.23	0
		1732.5	23.7	22.79	0	23.06	0
		1715	23.7	22.75	0	23.37	0
	1RB Middle (24)	1750	23.7	22.83	0	23.21	0
		1732.5	23.7	23.02	0	23.01	0
		1715	23.7	22.83	0	23.22	0
	1RB Low (0)	1750	23.7	22.86	0	23.06	0
		1732.5	23.7	22.88	0	22.96	0
		1715	23.7	22.95	0	23.05	0
	25RB High (25)	1750	23.7	22.67	0	21.68	0
		1732.5	23.7	22.89	0	21.80	0
		1715	23.7	22.86	0	21.75	0
	25RB Middle (12)	1750	23.7	22.68	0	21.73	0
		1732.5	23.7	22.91	0	22.02	0
		1715	23.7	22.86	0	21.75	0
	25RB Low (0)	1750	23.7	22.75	0	21.91	0
		1732.5	23.7	22.90	0	21.93	0
		1715	23.7	22.83	0	21.74	0
	50RB	1750	23.7	22.80	0	21.83	0

	(0)	1732.5	23.7	22.95	0	21.96	0
		1715	23.7	22.82	0	21.73	0
15 MHz	1RB High (74)	1747.5	23.7	22.72	0	22.85	0
		1732.5	23.7	22.74	0	22.96	0
		1717.5	23.7	22.80	0	23.06	0
	1RB Middle (37)	1747.5	23.7	22.63	0	22.79	0
		1732.5	23.7	22.76	0	22.83	0
		1717.5	23.7	22.79	0	23.23	0
	1RB Low (0)	1747.5	23.7	22.87	0	23.07	0
		1732.5	23.7	22.83	0	23.03	0
		1717.5	23.7	23.04	0	23.48	0
	36RB High (38)	1747.5	23.7	22.82	0	21.84	0
		1732.5	23.7	22.81	0	21.90	0
		1717.5	23.7	22.75	0	21.71	0
	36RB Middle (19)	1747.5	23.7	22.74	0	21.89	0
		1732.5	23.7	22.86	0	21.83	0
		1717.5	23.7	22.74	0	21.81	0
	36RB Low (0)	1747.5	23.7	22.83	0	21.97	0
		1732.5	23.7	22.90	0	21.89	0
		1717.5	23.7	22.75	0	21.93	0
	75RB (0)	1747.5	23.7	22.84	0	21.79	0
		1732.5	23.7	22.84	0	21.86	0
		1717.5	23.7	22.82	0	21.84	0
20 MHz	1RB High (99)	1745	23.7	22.86	0	22.97	0
		1732.5	23.7	22.89	0	22.56	0
		1720	23.7	22.72	0	22.78	0
	1RB Middle (50)	1745	23.7	22.84	0	22.40	0
		1732.5	23.7	23.00	0	22.59	0
		1720	23.7	22.75	0	23.09	0
	1RB Low (0)	1745	23.7	22.97	0	22.57	0
		1732.5	23.7	22.96	0	23.49	0
		1720	23.7	22.93	0	23.06	0
	50RB High (50)	1745	23.7	22.76	0	21.86	0
		1732.5	23.7	22.86	0	21.88	0
		1720	23.7	22.75	0	21.77	0
	50RB Middle (25)	1745	23.7	22.88	0	21.94	0
		1732.5	23.7	22.85	0	21.79	0
		1720	23.7	22.81	0	21.73	0
	50RB Low (0)	1745	23.7	22.85	0	22.01	0
		1732.5	23.7	22.89	0	21.87	0
		1720	23.7	22.83	0	21.86	0
	100RB (0)	1745	23.7	22.93	0	22.00	0
		1732.5	23.7	22.94	0	22.00	0
		1720	23.7	22.79	0	21.81	0

11.3 CDMA 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 11.9: The conducted power measurement results for CDMA - Head

CDMA BC0	Conducted Power (dBm)		
	Channel 777 (848.31MHz)	Channel 384 (836.52MHz)	Channel 1013 (824.7MHz)
SO55/RC3	23.66	23.84	24.00
SO55/RC1	24.14	24.31	23.79
CDMA BC1	Conducted Power (dBm)		
	Channel 1175 (1908.75MHz)	Channel 600 (1880MHz)	Channel 25 (1851.25MHz)
SO55/RC3	23.67	24.48	23.80
SO55/RC1	23.64	24.15	23.79

Table 11.10: The conducted power measurement results for CDMA - Body

CDMA BC0	Conducted Power (dBm)		
	Channel 777 (848.31MHz)	Channel 384 (836.52MHz)	Channel 1013 (824.7MHz)
SO32/RC3(FCH only)	24.02	24.33	24.36
SO32/RC3(FCH+SCH _n)	24.01	24.37	24.38
EVDO Rev.0	24.08	24.41	24.30
EVDO Rev.A	23.90	24.12	24.08
CDMA BC1	Conducted Power (dBm)		
	Channel 1175 (1908.75MHz)	Channel 600 (1880MHz)	Channel 25 (1851.25MHz)
SO32/RC3(FCH only)	23.76	24.42	23.80
SO32/RC3(FCH+SCH _n)	23.74	24.44	23.79
EVDO Rev.0	23.84	24.33	23.83
EVDO Rev.A	23.85	24.35	23.89

11.4 LTE Measurement result
Table 11.11: The conducted Power for LTE

Band 4							
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
1.4 MHz	1RB High (5)	1754.3	24.7	23.55	0	22.96	1
		1732.5	24.7	23.57	0	23.15	1
		1710.7	24.7	23.68	0	23.13	1
	1RB Middle (3)	1754.3	24.7	23.78	0	23.03	1
		1732.5	24.7	23.76	0	23.27	1
		1710.7	24.7	23.89	0	23.48	1
	1RB Low (0)	1754.3	24.7	23.75	0	22.76	1
		1732.5	24.7	24.02	0	22.87	1
		1710.7	24.7	23.93	0	23.06	1
	3RB High (3)	1754.3	24.7	23.91	0	22.65	1
		1732.5	24.7	23.71	0	22.93	1
		1710.7	24.7	23.82	0	22.96	1
	3RB Middle (1)	1754.3	24.7	23.84	0	22.92	1
		1732.5	24.7	23.90	0	22.96	1
		1710.7	24.7	23.85	0	23.03	1
	3RB Low (0)	1754.3	24.7	23.65	0	22.85	1
		1732.5	24.7	23.79	0	23.07	1
		1710.7	24.7	23.86	0	23.04	1
	6RB (0)	1754.3	24.7	22.68	1	21.79	2
		1732.5	24.7	22.86	1	21.75	2
		1710.7	24.7	22.92	1	21.98	2
3 MHz	1RB High (14)	1753.5	24.7	23.59	0	23.16	1
		1732.5	24.7	23.73	0	22.89	1
		1711.5	24.7	23.55	0	22.83	1
	1RB Middle (7)	1753.5	24.7	23.71	0	23.11	1
		1732.5	24.7	23.58	0	23.09	1
		1711.5	24.7	23.58	0	22.77	1
	1RB Low (0)	1753.5	24.7	23.70	0	23.02	1
		1732.5	24.7	23.76	0	23.19	1
		1711.5	24.7	23.74	0	23.14	1
	8RB High (7)	1753.5	24.7	22.66	1	21.57	2
		1732.5	24.7	22.81	1	22.01	2
		1711.5	24.7	22.82	1	22.01	2
	8RB Middle (4)	1753.5	24.7	22.72	1	21.94	2
		1732.5	24.7	22.78	1	22.01	2
		1711.5	24.7	22.85	1	21.72	2
	8RB Low (0)	1753.5	24.7	22.74	1	21.60	2
		1732.5	24.7	22.86	1	21.68	2
		1711.5	24.7	22.85	1	21.68	2

	15RB (0)	1753.5	24.7	22.77	1	21.83	2
		1732.5	24.7	22.84	1	21.89	2
		1711.5	24.7	22.95	1	22.04	2
5 MHz	1RB High (24)	1752.5	24.7	23.58	0	22.39	1
		1732.5	24.7	23.66	0	22.60	1
		1712.5	24.7	23.46	0	22.21	1
	1RB Middle (12)	1752.5	24.7	23.38	0	22.30	1
		1732.5	24.7	23.63	0	22.55	1
		1712.5	24.7	23.32	0	22.12	1
	1RB Low (0)	1752.5	24.7	23.51	0	22.03	1
		1732.5	24.7	23.74	0	22.44	1
		1712.5	24.7	23.76	0	22.45	1
	12RB High (13)	1752.5	24.7	22.76	1	21.74	2
		1732.5	24.7	22.82	1	21.73	2
		1712.5	24.7	22.73	1	21.79	2
	12RB Middle (6)	1752.5	24.7	22.76	1	21.75	2
		1732.5	24.7	22.78	1	21.67	2
		1712.5	24.7	22.78	1	21.77	2
	12RB Low (0)	1752.5	24.7	22.73	1	21.74	2
		1732.5	24.7	22.85	1	21.79	2
		1712.5	24.7	22.85	1	21.76	2
	25RB (0)	1752.5	24.7	22.76	1	21.81	2
		1732.5	24.7	22.80	1	21.84	2
		1712.5	24.7	22.76	1	21.79	2
10 MHz	1RB High (49)	1750	24.7	23.74	0	22.83	1
		1732.5	24.7	23.66	0	22.86	1
		1715	24.7	23.59	0	22.93	1
	1RB Middle (24)	1750	24.7	23.78	0	22.84	1
		1732.5	24.7	23.79	0	23.11	1
		1715	24.7	23.73	0	23.24	1
	1RB Low (0)	1750	24.7	23.63	0	22.80	1
		1732.5	24.7	23.87	0	23.04	1
		1715	24.7	23.83	0	23.12	1
	25RB High (25)	1750	24.7	22.75	1	21.80	2
		1732.5	24.7	22.86	1	21.77	2
		1715	24.7	22.76	1	21.78	2
	25RB Middle (12)	1750	24.7	22.79	1	21.74	2
		1732.5	24.7	22.86	1	21.78	2
		1715	24.7	22.82	1	21.77	2
	25RB Low (0)	1750	24.7	22.77	1	21.73	2
		1732.5	24.7	22.84	1	21.87	2
		1715	24.7	22.80	1	21.83	2

	50RB (0)	1750	24.7	22.73	1	21.76	2
		1732.5	24.7	22.88	1	21.89	2
		1715	24.7	22.87	1	21.75	2
15 MHz	1RB High (74)	1747.5	24.7	23.62	0	23.10	1
		1732.5	24.7	23.68	0	23.22	1
		1717.5	24.7	23.66	0	22.91	1
	1RB Middle (37)	1747.5	24.7	23.61	0	23.11	1
		1732.5	24.7	23.72	0	23.24	1
		1717.5	24.7	23.60	0	22.79	1
	1RB Low (0)	1747.5	24.7	23.92	0	23.62	1
		1732.5	24.7	23.76	0	23.25	1
		1717.5	24.7	23.84	0	23.06	1
	36RB High (38)	1747.5	24.7	22.78	1	21.65	2
		1732.5	24.7	22.82	1	21.67	2
		1717.5	24.7	22.74	1	21.68	2
	36RB Middle (19)	1747.5	24.7	22.69	1	21.82	2
		1732.5	24.7	22.81	1	21.62	2
		1717.5	24.7	22.73	1	21.80	2
	36RB Low (0)	1747.5	24.7	22.86	1	21.90	2
		1732.5	24.7	22.89	1	21.77	2
		1717.5	24.7	22.77	1	21.82	2
	75RB (0)	1747.5	24.7	22.77	1	21.81	2
		1732.5	24.7	22.91	1	21.93	2
		1717.5	24.7	22.73	1	21.77	2
20 MHz	1RB High (99)	1745	24.7	23.63	0	22.90	1
		1732.5	24.7	23.65	0	23.03	1
		1720	24.7	23.76	0	23.03	1
	1RB Middle (50)	1745	24.7	23.60	0	23.02	1
		1732.5	24.7	24.17	0	23.19	1
		1720	24.7	23.70	0	23.09	1
	1RB Low (0)	1745	24.7	23.74	0	23.06	1
		1732.5	24.7	23.71	0	23.15	1
		1720	24.7	23.85	0	22.98	1
	50RB High (50)	1745	24.7	22.71	1	21.64	2
		1732.5	24.7	22.85	1	21.91	2
		1720	24.7	22.82	1	21.87	2
	50RB Middle (25)	1745	24.7	22.77	1	21.71	2
		1732.5	24.7	22.90	1	21.94	2
		1720	24.7	22.79	1	21.91	2
	50RB Low (0)	1745	24.7	22.89	1	21.84	2
		1732.5	24.7	22.94	1	21.97	2
		1720	24.7	22.83	1	21.96	2
	100RB (0)	1745	24.7	22.86	1	21.84	2
		1732.5	24.7	22.86	1	21.92	2
		1720	24.7	22.75	1	21.77	2
Band 13							
Bandwidth (MHz)	RB allocation RB offset (Start RB)	Frequency (MHz)	Max. Target Power (dBm)	QPSK		16QAM	
				Actual output power (dBm)	MPR	Actual output power (dBm)	MPR

5 MHz	1RB High (24)	784.5	24	23.22	0	22.23	1
		782	24	23.14	0	21.44	1
		779.5	24	23.53	0	22.66	1
	1RB Middle (12)	784.5	24	23.25	0	21.72	1
		782	24	23.23	0	21.73	1
		779.5	24	23.47	0	22.39	1
	1RB Low (0)	784.5	24	23.49	0	21.61	1
		782	24	23.57	0	21.60	1
		779.5	24	23.41	0	22.01	1
	12RB High (13)	784.5	24	22.36	1	21.43	2
		782	24	22.43	1	21.42	2
		779.5	24	22.49	1	21.45	2
	12RB Middle (6)	784.5	24	22.40	1	21.51	2
		782	24	22.51	1	21.59	2
		779.5	24	22.52	1	21.60	2
	12RB Low (0)	784.5	24	22.49	1	21.59	2
		782	24	22.49	1	21.58	2
		779.5	24	22.54	1	21.46	2
	25RB (0)	784.5	24	22.44	1	21.50	2
		782	24	22.47	1	21.61	2
		779.5	24	22.46	1	21.48	2
10 MHz	1RB High (49)	782	24	23.31	0	22.48	1
	1RB Middle (24)	782	24	23.58	0	22.95	1
	1RB Low (0)	782	24	23.49	0	22.78	1
	25RB High (25)	782	24	22.47	1	21.48	2
	25RB Middle (12)	782	24	22.57	1	21.49	2
	25RB Low (0)	782	24	22.56	1	21.50	2
	50RB (0)	782	24	22.46	1	21.48	2

11.5 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	7.46	7.71	7.80
EDR2M-4_DQPSK	7.96	7.94	8.35
EDR3M-8DPSK	8.00	7.38	7.47
BLE	-2.48	-1.98	-1.78

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

802.11b (dBm)

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
1	16.08	16.03	15.98	15.99
6	15.68	/	/	/
11	15.49	/	/	/

802.11g (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
1	15.97	15.95	15.92	15.88	15.81	14.77	14.64	14.52
6	15.87	/	/	/	/	/	/	/
11	15.40	/	/	/	/	/	/	/

802.11n (dBm) - HT20 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
1	16.15	16.14	16.12	15.81	15.75	14.72	14.68	12.55
6	16.04	/	/	/	/	/	/	/
11	15.58	/	/	/	/	/	/	/

802.11n (dBm) - HT40 (2.4G)

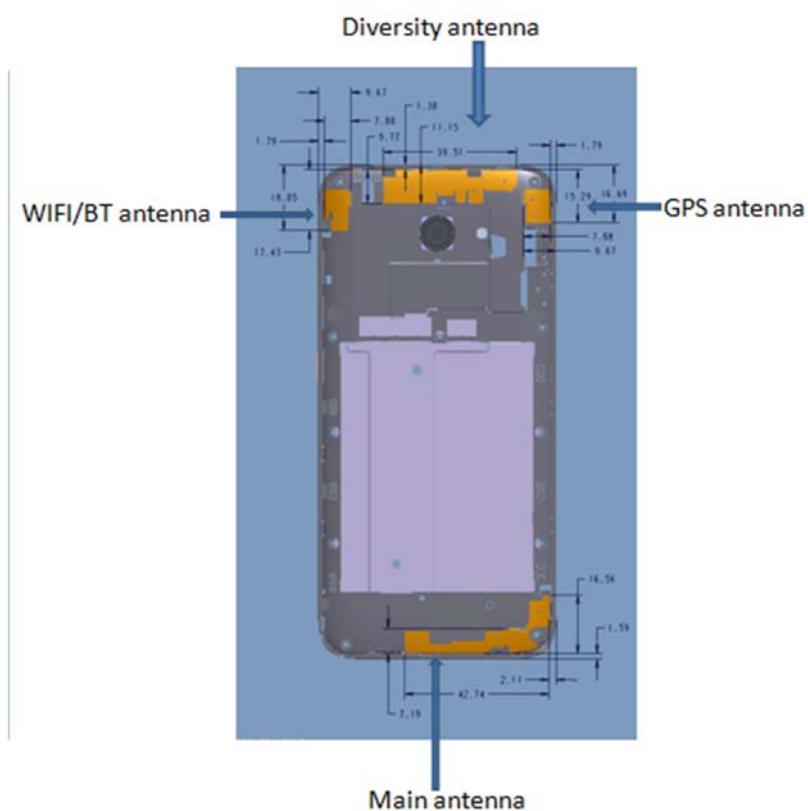
Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
3	15.45	/	/	/	/	/	/	/
6	16.18	/	/	/	/	/	/	/
9	16.66	16.65	16.54	16.44	16.33	15.09	15.07	13.03

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:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, where

- $f(\text{GHz})$ 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

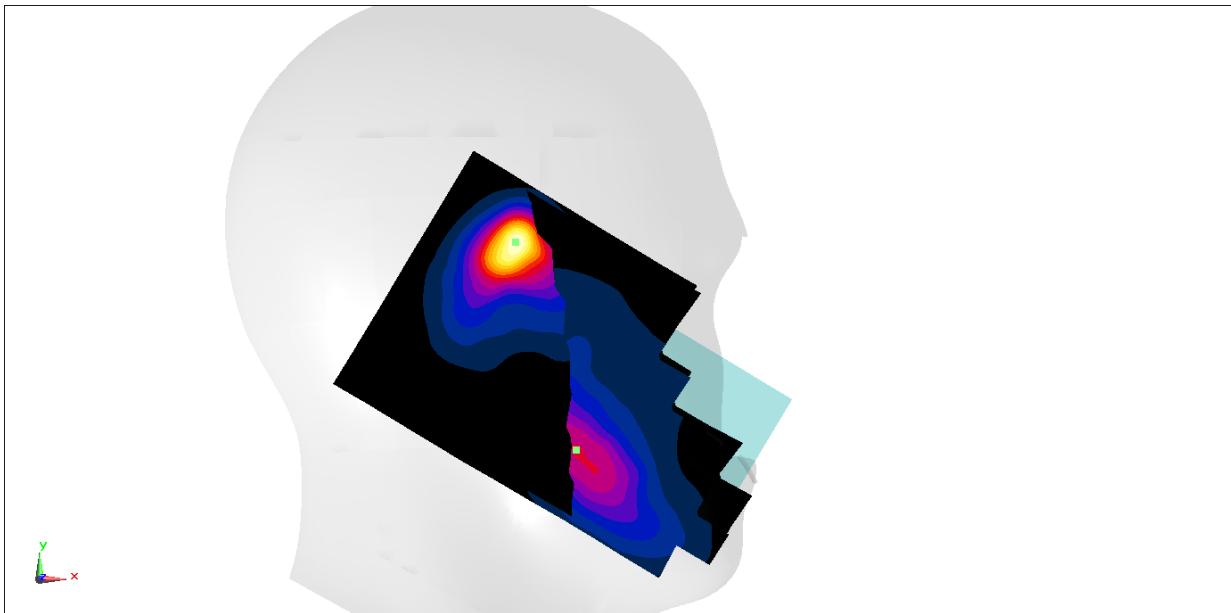
Table 12.1: Standalone SAR test exclusion considerations

Band/Mode	F(GHz)	Position	SAR test exclusion threshold (mW)	RF output power		SAR test exclusion
				dBm	mW	
Bluetooth	2.441	Head	9.60	9.5	8.91	Yes
		Body	19.20	9.5	8.91	Yes
2.4GHz WLAN 802.11b	2.45	Head	9.58	17	50.12	No
		Body	19.17	17	50.12	No

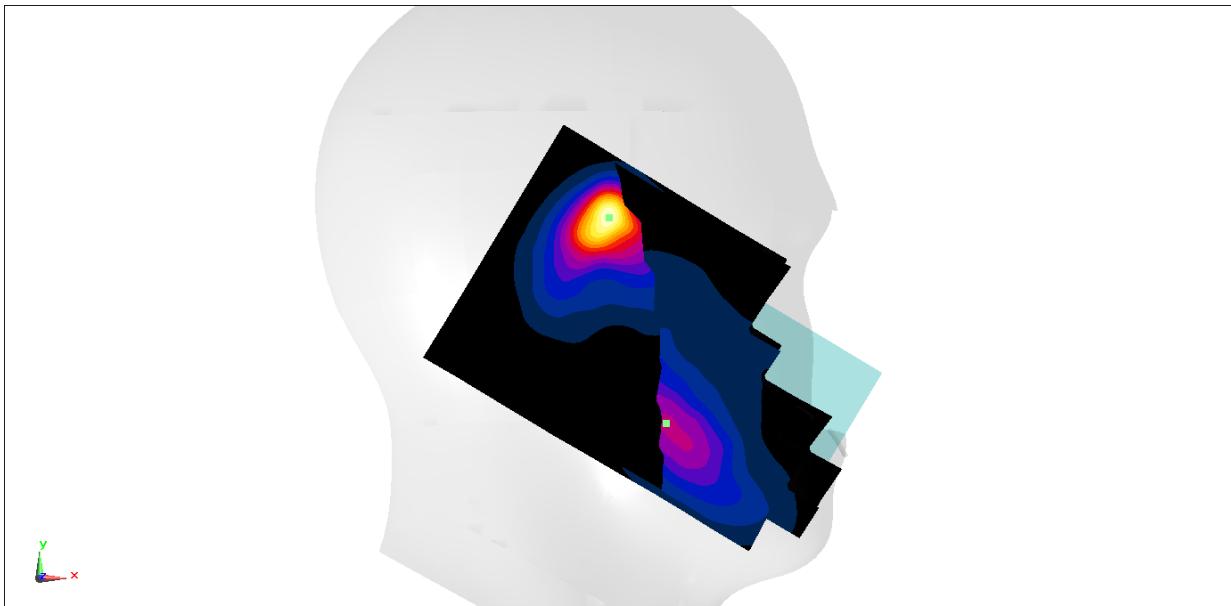
13 Evaluation of Simultaneous

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

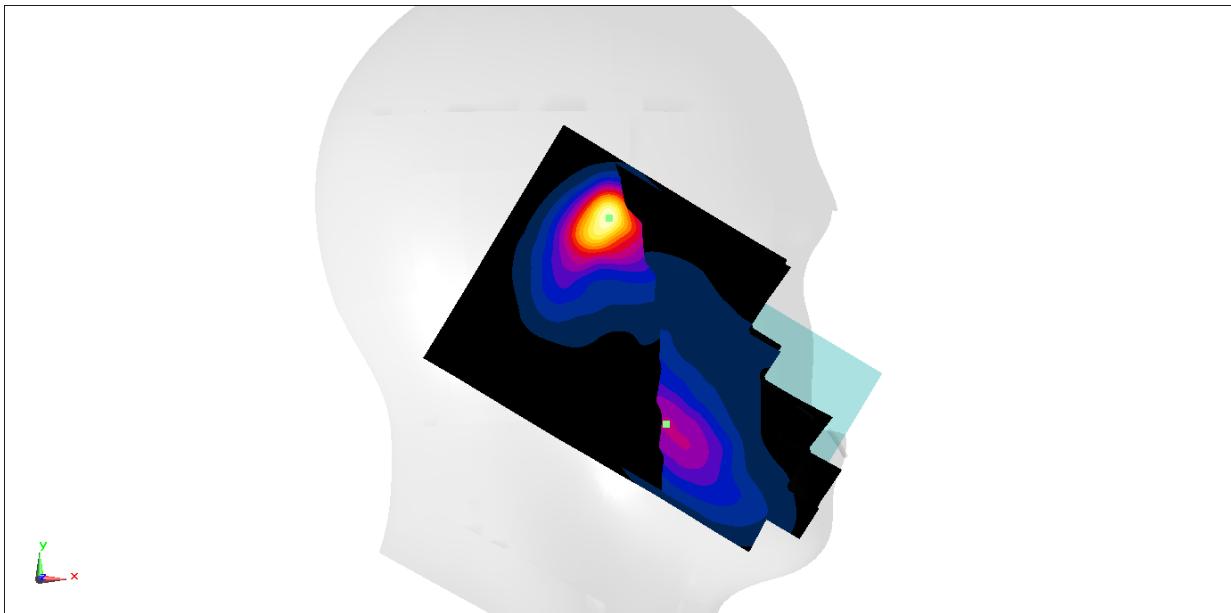
	Position	Main antenna	WiFi	Sum	Distance (mm)	Ratio
Highest reported SAR value for Head	Left hand, Touch cheek	0.65	1.42	2.07	96.27	0.03
		0.65	1.22	1.87	96.99	0.02
		0.65	1.28	1.93	95.91	0.03
		0.65	1.53	2.18	92.30	0.03
		0.65	1.39	2.04	94.76	0.03
		0.65	1.45	2.10	95.30	0.03
Highest reported SAR value for Body	Front	1.23	0.20	1.43	/	/
	Bottom	1.35	/	1.35	/	/



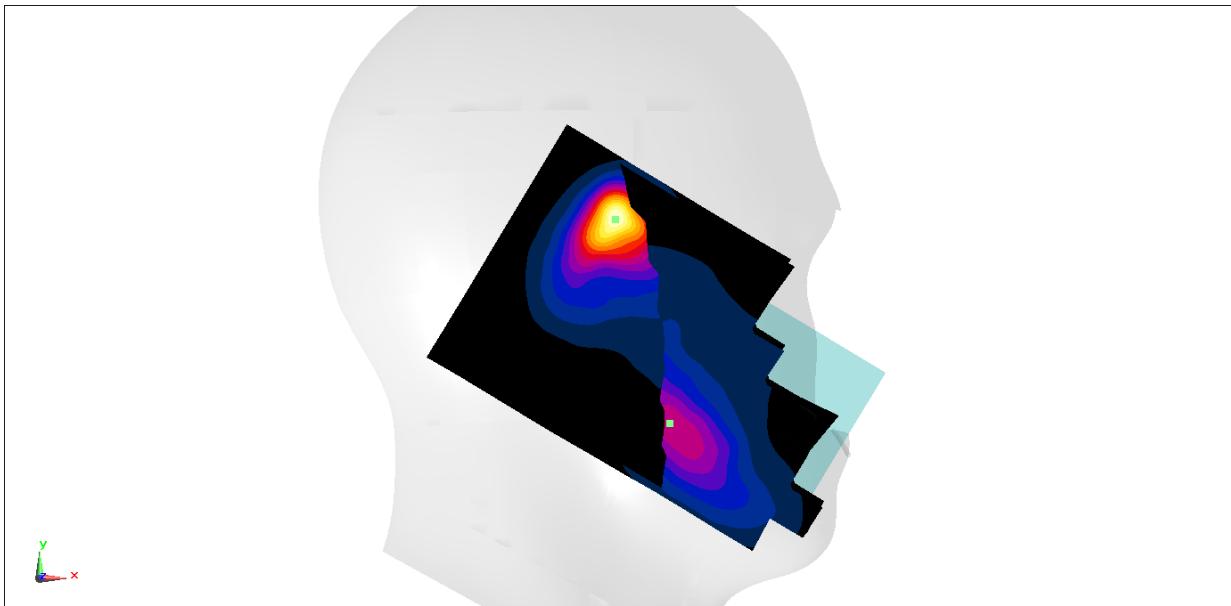
Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Zoom Scan (C:\Users\dasy\Desktop\Wifi 2.45G Head 02a 11.24 .da53:3/Cheek High)	
Max. 2 at (13.30, 23.02, -1.01) mm	1.08 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 95.91 / Separation ratio [W/kg/mm]: 0.02



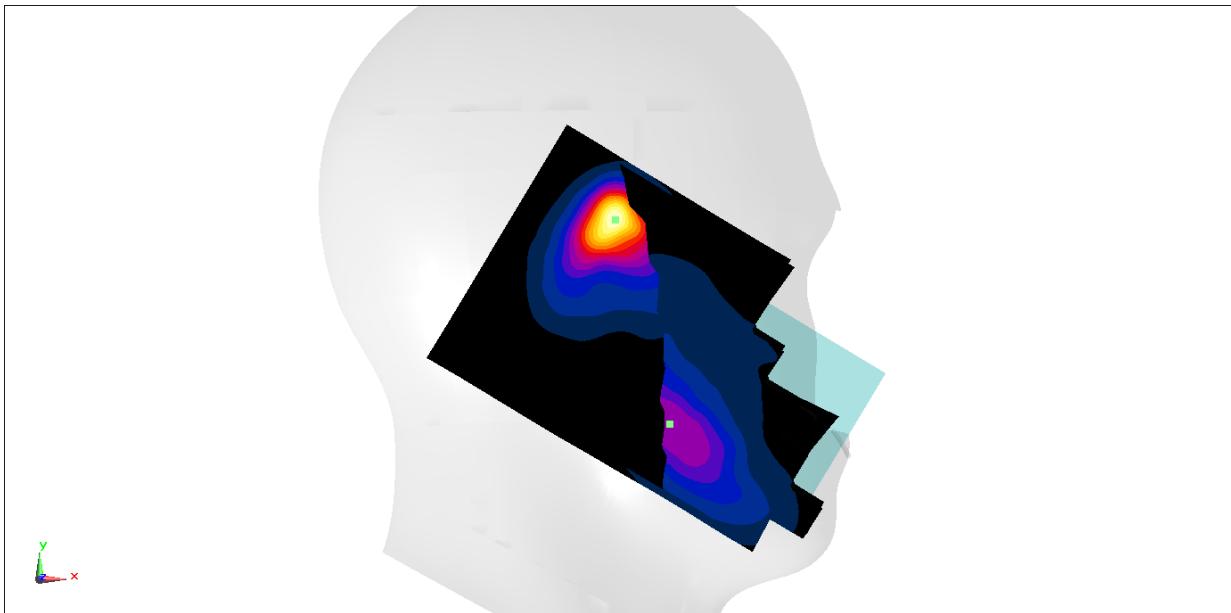
Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Zoom Scan (C:\Users\dasy\Desktop\Wifi 2.45G Head 02a 11.24 .da53:3/Cheek Low)	
Max. 2 at (12.84, 23.99, -0.93) mm	1.18 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 96.99 / Separation ratio [W/kg/mm]: 0.02



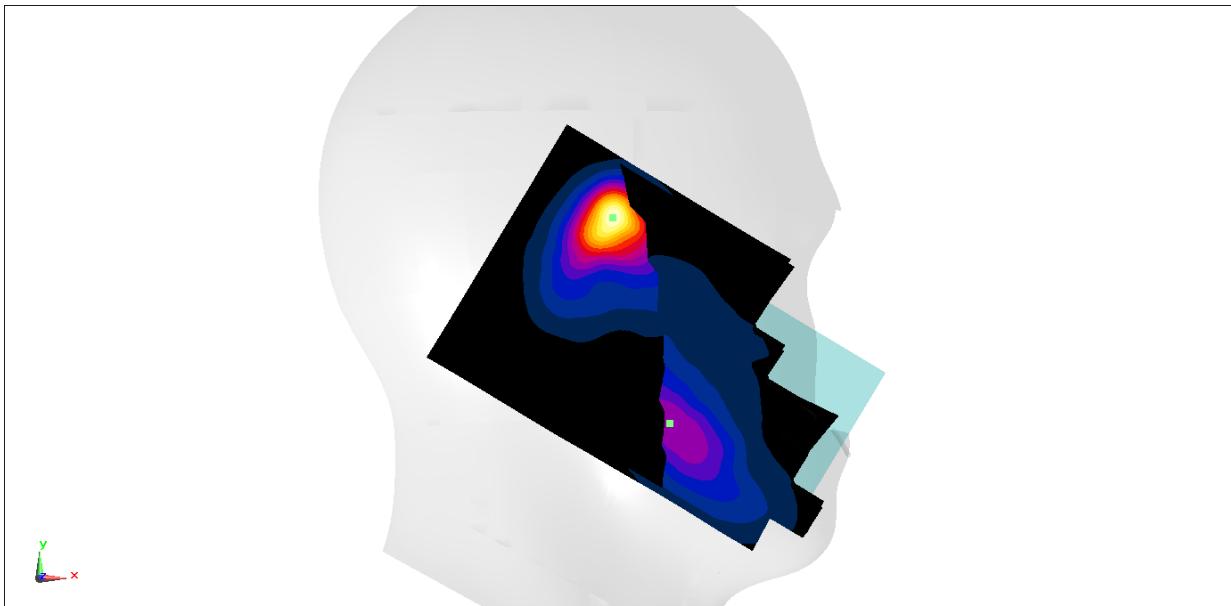
Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 96.27 / Separation ratio [W/kg/mm]: 0.03



Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Zoom Scan (C:\Users\dasy\Desktop\Wifi 2.45G Head 11n 40M 02a 11.24 .da53:1/Cheek Low 2)	
Max. 2 at (18.89, 21.42, -1.42) mm	1.04 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 92.30 / Separation ratio [W/kg/mm]: 0.02



Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Zoom Scan (C:\Users\dasy\Desktop\Wifi 2.45G Head 11n 40M 02a 11.24 .da53:1/Cheek Middle)	
Max. 2 at (16.42, 23.67, -1.15) mm	1.17 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 95.30 / Separation ratio [W/kg/mm]: 0.02



Maxima and position w.r.t. Grid Reference Point associated 1g averages	
Zoom Scan (C:\Users\dasy\Desktop\LTE Band 4 Head 04a.da53:1/Cheek high)	
Max. 1 at (52.08, -64.69, 0.02) mm	0.58 W/kg
Zoom Scan (C:\Users\dasy\Desktop\Wifi 2.45G Head 11n 40M 02a 11.24 .da53:1/Cheek High)	
Max. 2 at (16.23, 23.01, -1.18) mm	1.25 W/kg
Distances and Separation Ratios	
Max. 1 - Max. 2	Distance [mm]: 94.76 / Separation ratio [W/kg/mm]: 0.03

Note: There are two points in the picture. The top one is WiFi, and the bottom one is main antenna.

According to the KDB 447498 D01, when the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio. The ratio is determined by $(\text{SAR1} + \text{SAR2})^{1.5}/R_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

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	Left hand, Touch cheek	0.65	0.29	0.94
Highest reported SAR value for Body	Rear	1.27	0.15	1.42
	Bottom	1.35	/	1.35

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	8.5	7.08	0.29
Body	2.441	10	8.5	7.08	0.15

* - 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)]·[$\sqrt{f(\text{GHz})/x}$] 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 > 1.6 W/kg, but the SAR to peak location separation ratio < 0.04 . 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 or 15mm 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	1:1
LTE	1:1

14.1 SAR results for Fast SAR

Table 14.1-1: 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(1g) (W/kg)	Reported SAR(1g) (W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
848.31	777	Left	Touch	/	23.66	24.5	0.278	0.34	0.213	0.26	-0.02
836.52	384	Left	Touch	/	23.84	24.5	0.322	0.37	0.246	0.29	-0.09
824.7	1013	Left	Touch	Fig.1	24	24.5	0.342	0.38	0.261	0.29	-0.05
836.52	384	Left	Tilt	/	23.84	24.5	0.265	0.31	0.213	0.25	-0.11
836.52	384	Right	Touch	/	23.84	24.5	0.277	0.32	0.215	0.25	-0.03
836.52	384	Right	Tilt	/	23.84	24.5	0.218	0.25	0.172	0.20	-0.03

Table 14.1-2: 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(1g) (W/kg)	Reported SAR(1g) (W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.									
836.52	384	Front	/	24.33	24.5	0.477	0.50	0.361	0.38	-0.05
848.31	777	Rear	/	24.02	24.5	0.595	0.66	0.453	0.51	-0.11
836.52	384	Rear	/	24.33	24.5	0.486	0.51	0.371	0.39	-0.03
824.7	1013	Rear	Fig.2	24.36	24.5	0.645	0.67	0.487	0.50	-0.09
836.52	384	Left	/	24.33	24.5	0.466	0.48	0.323	0.34	-0.02
836.52	384	Right	/	24.33	24.5	0.421	0.44	0.289	0.30	-0.09
836.52	384	Bottom	/	24.33	24.5	0.183	0.19	0.117	0.12	-0.05

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

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Table 14.1-3: SAR Values (CDMA BC1 - 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1908.75	1175	Left	Touch	/	23.67	24.5	0.448	0.54	0.278	0.34	0.01
1880	600	Left	Touch	/	24.48	24.5	0.539	0.54	0.33	0.33	-0.08
1851.25	25	Left	Touch	Fig.3	23.8	24.5	0.513	0.60	0.323	0.38	0.02
1880	600	Left	Tilt	/	24.48	24.5	0.088	0.09	0.06	0.06	-0.07
1880	600	Right	Touch	/	24.48	24.5	0.274	0.28	0.186	0.19	-0.12
1880	600	Right	Tilt	/	24.48	24.5	0.132	0.13	0.084	0.08	0.13

Table 14.1-4: SAR Values (CDMA BC1 - Body) – AP ON

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)	
MHz	Ch.										
1909.75	1175	Front	/	20.99	22.3	0.368	0.50	0.208	0.28	0.01	
1880	600	Front	/	21.04	22.3	0.687	0.92	0.362	0.48	0.09	
1851.25	25	Front	/	20.79	22.3	0.768	1.09	0.408	0.58	0.08	
1909.75	1175	Rear	/	20.99	22.3	0.942	1.27	0.499	0.67	-0.04	
1880	600	Rear	/	21.04	22.3	0.882	1.18	0.471	0.63	-0.11	
1851.25	25	Rear	/	20.79	22.3	0.862	1.22	0.467	0.66	0.03	
1880	600	Left	/	21.04	22.3	0.177	0.24	0.105	0.14	0.01	
1880	600	Right	/	21.04	22.3	0.042	0.06	0.027	0.04	0.08	
1909.75	1175	Bottom	Fig.4	20.99	22.3	0.996	1.35	0.500	0.68	0.07	
1880	600	Bottom	/	21.04	22.3	0.894	1.19	0.456	0.61	-0.13	
1851.25	25	Bottom	/	20.79	22.3	0.891	1.26	0.455	0.64	0.05	

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

Table 14.1-5: SAR Values (CDMA BC1 - Body) – AP OFF

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)	
MHz	Ch.										
1880	600	Front	/	24.42	24.5	0.647	0.66	0.369	0.38	0.02	
1908.75	1175	Rear	/	23.76	24.5	0.859	1.02	0.439	0.52	-0.04	
1880	600	Rear	Fig.5	24.42	24.5	1.08	1.10	0.598	0.61	-0.09	
1851.25	25	Rear	/	23.8	24.5	0.883	1.04	0.490	0.58	0.05	

Note1: The distance between the EUT and the phantom bottom is 15mm.

Table 14.1-6: SAR Values (LTE Band4 - 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.											
1732.5	20175	1RB_Mid	Left	Touch	Fig.6	24.17	24.7	0.576	0.65	0.355	0.40	-0.02
1732.5	20175	1RB_Mid	Left	Tilt	/	24.17	24.7	0.097	0.11	0.066	0.07	0.04
1732.5	20175	1RB_Mid	Right	Touch	/	24.17	24.7	0.328	0.37	0.207	0.23	-0.01
1732.5	20175	1RB_Mid	Right	Tilt	/	24.17	24.7	0.097	0.11	0.059	0.07	-0.02
1732.5	20175	50RB_Low	Left	Touch	/	22.94	23.7	0.526	0.63	0.322	0.38	0.06
1732.5	20175	50RB_Low	Left	Tilt	/	22.94	23.7	0.090	0.11	0.061	0.07	-0.06
1732.5	20175	50RB_Low	Right	Touch	/	22.94	23.7	0.456	0.54	0.285	0.34	-0.01
1732.5	20175	50RB_Low	Right	Tilt	/	22.94	23.7	0.099	0.12	0.061	0.07	-0.03

Note1: The LTE mode is QPSK_20MHz.

Table 14.1-7: SAR Values (LTE Band4 - Body) AP ON

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.										
1745	20300	1RB_Low	Front	Fig.7	22.97	23.7	1.04	1.23	0.576	0.68	-0.02
1732.5	20175	1RB_Mid	Front	/	23	23.7	0.989	1.16	0.530	0.62	0.17
1720	20050	1RB_Low	Front	/	22.93	23.7	0.751	0.90	0.404	0.48	0.09
1745	20300	1RB_Low	Rear	/	22.97	23.7	0.757	0.90	0.431	0.51	0.07
1732.5	20175	1RB_Mid	Rear	/	23	23.7	0.790	0.93	0.476	0.56	0.15
1720	20050	1RB_Low	Rear	/	22.93	23.7	0.596	0.71	0.377	0.45	0.08
1732.5	20175	1RB_Mid	Left	/	23	23.7	0.428	0.50	0.236	0.28	-0.01
1732.5	20175	1RB_Mid	Right	/	23	23.7	0.103	0.12	0.064	0.08	-0.04
1745	20300	1RB_Low	Bottom	/	22.97	23.7	0.918	1.09	0.466	0.55	0.08
1732.5	20175	1RB_Mid	Bottom	/	23	23.7	0.898	1.06	0.474	0.56	-0.14
1720	20050	1RB_Low	Bottom	/	22.93	23.7	0.739	0.88	0.376	0.45	-0.02
1745	20300	50RB_Mid	Front	/	22.88	23.7	0.889	1.07	0.473	0.57	0.08
1732.5	20175	50RB_Low	Front	/	22.89	23.7	0.946	1.14	0.492	0.59	0.06
1720	20050	50RB_Low	Front	/	22.83	23.7	0.774	0.95	0.416	0.51	0.04
1745	20300	50RB_Mid	Rear	/	22.88	23.7	0.715	0.86	0.404	0.49	0.07
1732.5	20175	50RB_Low	Rear	/	22.89	23.7	0.760	0.92	0.462	0.56	0.01
1720	20050	50RB_Low	Rear	/	22.83	23.7	0.595	0.73	0.365	0.45	0.00
1732.5	20175	50RB_Low	Left	/	22.89	23.7	0.405	0.49	0.223	0.27	0.04
1732.5	20175	50RB_Low	Right	/	22.89	23.7	0.108	0.13	0.067	0.08	-0.10
1745	20300	50RB_Mid	Bottom	/	22.88	23.7	0.871	1.05	0.424	0.51	-0.12
1732.5	20175	50RB_Low	Bottom	/	22.89	23.7	0.869	1.05	0.441	0.53	-0.06

1720	20050	50RB_Low	Bottom	/	22.83	23.7	0.769	0.94	0.376	0.46	0.18
1732.5	20175	100RB	Front	/	22.94	23.7	0.939	1.12	0.448	0.53	0.03
1732.5	20175	100RB	Rear	/	22.94	23.7	0.735	0.88	0.420	0.50	0.05
1732.5	20175	100RB	Bottom	/	22.94	23.7	0.942	1.12	0.467	0.56	0.02

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

Note2: The LTE mode is QPSK_20MHz.

Table 14.1-8: SAR Values (LTE Band4 - Body) AP OFF

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(1g) (W/kg)	Reported SAR(1g) (W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1732.5	20175	1RB_Mid	Front	/	24.17	24.7	0.514	0.58	0.293	0.33	0.06
1732.5	20175	1RB_Mid	Rear	Fig.8	24.17	24.7	0.518	0.59	0.322	0.36	0.10
1732.5	20175	50RB_Low	Front	/	24.17	24.7	0.379	0.43	0.241	0.27	-0.04
1732.5	20175	50RB_Low	Rear	/	24.17	24.7	0.386	0.44	0.259	0.29	0.02

Note1: The distance between the EUT and the phantom bottom is 15mm.

Note2: The LTE mode is QPSK_20MHz.

Table 14.1-9: 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(1g) (W/kg)	Reported SAR(1g) (W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.											
782	23230	1RB_Mid	Left	Touch	Fig.9	23.58	24	0.339	0.37	0.262	0.29	-0.06
782	23230	1RB_Mid	Left	Tilt	/	23.58	24	0.237	0.26	0.198	0.22	0.01
782	23230	1RB_Mid	Right	Touch	/	23.58	24	0.295	0.32	0.240	0.26	-0.04
782	23230	1RB_Mid	Right	Tilt	/	23.58	24	0.193	0.21	0.160	0.18	-0.05
782	23230	25RB_Mid	Left	Touch	/	22.57	23	0.274	0.30	0.215	0.24	-0.01
782	23230	25RB_Mid	Left	Tilt	/	22.57	23	0.187	0.21	0.157	0.17	0.07
782	23230	25RB_Mid	Right	Touch	/	22.57	23	0.230	0.25	0.186	0.21	0.01
782	23230	25RB_Mid	Right	Tilt	/	22.57	23	0.155	0.17	0.128	0.14	0.02

Note1: The LTE mode is QPSK_10MHz.

Table 14.1-10: 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
782	23230	1RB_Mid	Front	/	23.58	24	0.435	0.48	0.326	0.36	0.02
782	23230	1RB_Mid	Rear	Fig.10	23.58	24	0.466	0.51	0.34	0.37	-0.11
782	23230	1RB_Mid	Left	/	23.58	24	0.424	0.47	0.291	0.32	0.08
782	23230	1RB_Mid	Right	/	23.58	24	0.224	0.25	0.154	0.17	0.03
782	23230	1RB_Mid	Bottom	/	23.58	24	0.136	0.15	0.0824	0.09	-0.11
782	23230	25RB_Mid	Front	/	22.57	23	0.322	0.36	0.239	0.26	0.09
782	23230	25RB_Mid	Rear	/	22.57	23	0.376	0.42	0.275	0.30	-0.12
782	23230	25RB_Mid	Left	/	22.57	23	0.340	0.38	0.231	0.26	0.08
782	23230	25RB_Mid	Right	/	22.57	23	0.175	0.19	0.120	0.13	-0.1
782	23230	25RB_Mid	Bottom	/	22.57	23	0.108	0.12	0.065	0.07	-0.14

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

Note2: The LTE mode is QPSK_10MHz.

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 (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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
824.7	1013	Left	Touch	Fig.1	24	24.5	0.342	0.38	0.261	0.29	-0.05

Table 14.2-2: 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)	
MHz	Ch.										
824.7	1013	Rear	Fig.2	24.36	24.5	0.645	0.67	0.487	0.50	-0.09	

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

Table 14.2-3: SAR Values (CDMA BC1 - 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1851.25	25	Left	Touch	Fig.3	23.8	24.5	0.513	0.60	0.323	0.38	0.02

Table 14.2-4: SAR Values (CDMA BC1 - Body) – AP ON

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.			(dBm)	(dBm)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(dB)
1909.75	1175	Bottom	Fig.4	20.99	22.3	0.996	1.35	0.5	0.68	0.07

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

Table 14.2-5: SAR Values (CDMA BC1 - Body) – AP OFF

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.			(dBm)	(dBm)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(dB)
1880	600	Rear	Fig.5	24.42	24.5	1.08	1.10	0.598	0.61	-0.09

Note1: The distance between the EUT and the phantom bottom is 15mm.

Table 14.2-6: SAR Values (LTE Band4 - 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.					(dBm)	(dBm)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(dB)
1732.5	20175	1RB_Mid	Left	Touch	Fig.6	24.17	24.7	0.576	0.65	0.355	0.40	-0.02

Note1: The LTE mode is QPSK_20MHz.

Table 14.2-7: SAR Values (LTE Band4 - Body) AP ON

Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C							
Frequency		Mode	Test Position	Figure No.	Conducte	Max. tune-up	Measured	Reported	Measured	Reported	Power
MHz	Ch.				d Power (dBm)	Power (dBm)	SAR(1g) (W/kg)	SAR(1g)(W/kg)	SAR(10g) (W/kg)	SAR(10g) (W/kg)	Drift (dB)
1745	20300	1RB_Low	Front	Fig.7	22.97	23.7	1.04	1.23	0.576	0.68	-0.02

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

Note2: The LTE mode is QPSK_20MHz.

Table 14.2-8: SAR Values (LTE Band4 - Body) AP OFF

Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C							
Frequency		Mode	Test Position	Figure No.	Conducte	Max. tune-up	Measured	Reported	Measured	Reported	Power
MHz	Ch.				d Power (dBm)	Power (dBm)	SAR(1g) (W/kg)	SAR(1g)(W/kg)	SAR(10g) (W/kg)	SAR(10g) (W/kg)	Drift (dB)
1732.5	20175	1RB_Mid	Rear	Fig.8	24.17	24.7	0.518	0.59	0.322	0.36	0.10

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

Note2: The LTE mode is QPSK_20MHz.

Table 14.2-9: 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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)
MHz	Ch.											
782	23230	1RB_Mid	Left	Touch	Fig.9	23.58	24	0.339	0.37	0.262	0.29	-0.06

Note1: The LTE mode is QPSK_10MHz.

Table 14.2-10: SAR Values (LTE Band13 - Body)

Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C								
Frequency		Mode	Test Position	Figure No.	Conduct ed Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Power Drift (dB)	
MHz	Ch.											
782	23230	1RB_Mid	Rear	Fig.10	23.58	24	0.466	0.51	0.34	0.37	-0.11	

Note1: The distance between the EUT and the phantom bottom is 15mm.

Note2: The LTE mode is QPSK_10MHz.

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 1Mbps (Fast SAR)

		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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.										
2412	1	Left	Touch	/	16.08	16.2	1.14	1.17	0.555	0.57	0.04
2412	1	Left	Tilt	/	16.08	16.2	0.756	0.78	0.378	0.39	0.09
2412	1	Right	Touch	/	16.08	16.2	0.49	0.50	0.264	0.27	-0.05
2412	1	Right	Tilt	/	16.08	16.2	0.496	0.51	0.253	0.26	0.00

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

Table 14.3-2: SAR Values (WLAN - Head) – 802.11b 1Mbps (Full SAR)

		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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.										
2412	1	Left	Touch	/	16.08	16.2	1.18	1.21	0.561	0.58	0.04
2437	6	Left	Touch	Fig.11	15.68	16.2	1.24	1.40	0.575	0.65	0.04
2462	11	Left	Touch	/	15.49	16.2	1.08	1.27	0.501	0.59	0.02
2412	1	Left	Tilt	/	16.08	16.2	0.74	0.76	0.378	0.39	0.09

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 1Mbps (Scaled Reported SAR)

		Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C					
Frequency		Side	Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g) (W/kg)	Scaled reported SAR (1g) (W/kg)				
MHz	Ch.										
2437	6	Left	Touch	98.87%	100%	1.40	1.42				
2412	1	Left	Touch	98.87%	100%	1.21	1.22				
2462	11	Left	Touch	98.87%	100%	1.27	1.28				

SAR is required for OFDM because the 802.11b adjusted SAR >1.2 W/kg. According to the maximum output power and tune up of WLAN, 802.11n HT40 is required to be tested.

Table 14.3-4: SAR Values (WLAN - Head) – 802.11n HT40 MCS0 (Fast SAR)

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.										
2452	9	Left	Touch	/	16.66	17	1.22	1.32	0.595	0.64	0.02
2452	9	Left	Tilt	/	16.66	17	0.725	0.78	0.350	0.38	0.02
2452	9	Right	Touch	/	16.66	17	0.537	0.58	0.281	0.30	0.08
2452	9	Right	Tilt	/	16.66	17	0.500	0.54	0.250	0.27	-0.02

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

Table 14.3-5: SAR Values (WLAN - Head) – 802.11n HT40 MCS0 (Full SAR)

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.										
2452	9	Left	Touch	/	16.66	17	1.25	1.35	0.575	0.62	0.02
2452	9	Left	Tilt	/	16.66	17	0.719	0.78	0.327	0.35	0.02
2437	6	Left	Touch	/	16.18	17	1.17	1.41	0.547	0.66	0.08
2422	3	Left	Touch	Fig.12	15.45	17	1.04	1.49	0.486	0.69	0.08

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 14.3-6: SAR Values (WLAN - Head) – 802.11n HT40 MCS0 (Scaled Reported SAR)

Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C			
Frequency		Side	Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g) (W/kg)	Scaled reported SAR (1g) (W/kg)
MHz	Ch.						
2422	3	Left	Touch	97.29%	100%	1.49	1.53
2452	9	Left	Touch	97.29%	100%	1.35	1.39
2437	6	Left	Touch	97.29%	100%	1.41	1.45

Body Evaluation
Table 14.3-7: SAR Values (WLAN - Body) – 802.11b 1Mbps (Fast SAR)

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(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.									
2412	1	Front	/	16.08	16.2	0.202	0.21	0.107	0.11	0.11
2412	1	Rear	/	16.08	16.2	0.142	0.15	0.0744	0.08	-0.16
2412	1	Right	/	16.08	16.2	0.116	0.12	0.0575	0.06	0.07
2412	1	Top	/	16.08	16.2	0.166	0.17	0.0857	0.09	-0.04

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

Table 14.3-8: SAR Values (WLAN - Body) – 802.11b 1Mbps (Full SAR)

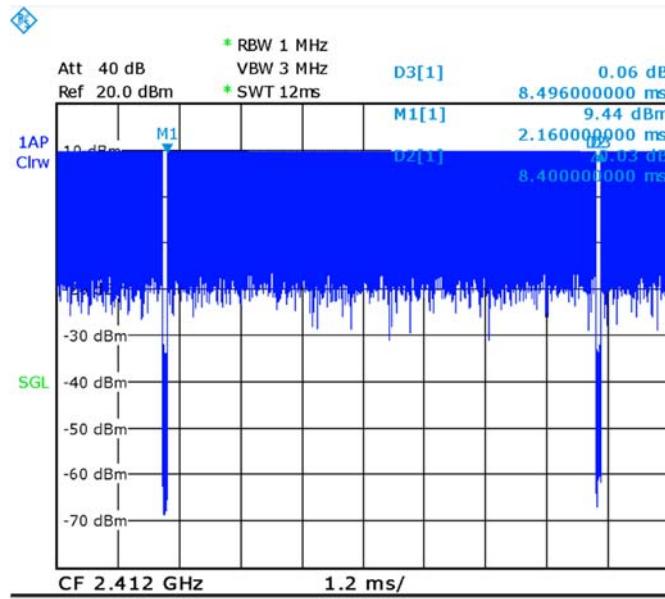
Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C						
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(1g) (W/kg)	Reported SAR(1g)(W/kg)	Measured SAR(10g) (W/kg)	Reported SAR(10g)(W/kg)	Power Drift (dB)
MHz	Ch.									
2412	1	Front	Fig.13	16.08	16.2	0.195	0.20	0.105	0.11	0.11

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.

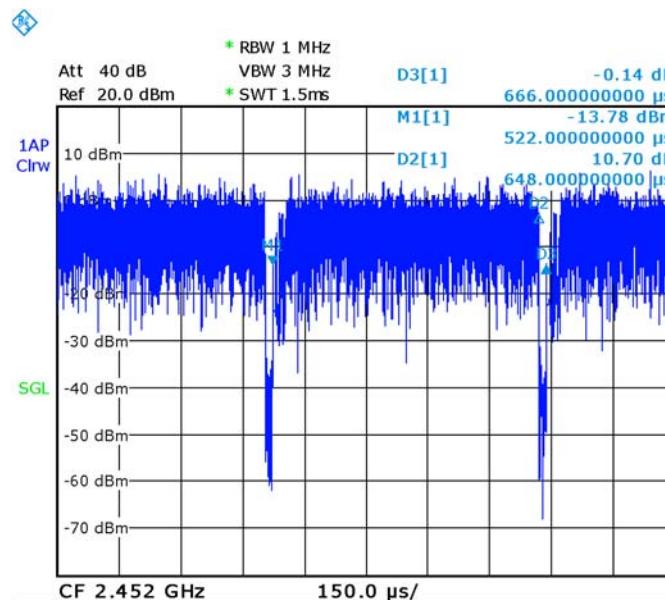
Table 14.3-9: SAR Values (WLAN - Body) – 802.11b 1Mbps (Scaled Reported SAR)

Ambient Temperature: 22.2 °C				Liquid Temperature: 21.7 °C			
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g) (W/kg)		Scaled reported SAR (1g) (W/kg)
MHz	Ch.						
2412	1	Front	98.87%	100%	0.2		0.2

SAR is not required for OFDM because the 802.11b adjusted SAR $\leq 1.2 \text{ W/kg}$.



Picture 14.1 The plot of duty factor for Head 802.11b



Picture 14.2 The plot of duty factor for Head 802.11n HT40

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 ($\sim 10\%$ 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 BC1 (1g) AP ON

Frequency		Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.					
1909.75	1175	Bottom	0.996	0.994	1.00	/

Table 15.2: SAR Measurement Variability for Body CDMA BC1 (1g) AP OFF

Frequency		Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.					
1880	600	Rear	1.08	1.04	1.04	/

Table 15.3: SAR Measurement Variability for Body LTE Band 4 (1g) AP ON

Frequency		Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.					
1745	20300	Front	1.04	1.01	1.03	/

Table 15.3: SAR Measurement Variability for Head WLAN 802.11b (1g)

Frequency		Side	Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
2437	6	Left	Touch	1.24	1.21	1.02	/

Table 15.4: SAR Measurement Variability for Head WLAN 802.11n HT40 (1g)

Frequency		Side	Test Position	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
2422	3	Left	Touch	1.25	1.23	1.02	/

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	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		$u_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.55	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	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	B	6.7	R	$\sqrt{3}$	1	1	3.9	3.9	∞

	phantom shell									
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		$u_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						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	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		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						10.4	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	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		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$						13.5	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	102196	March 03, 2016	One year
03	Power sensor	NRV-Z5	100596		
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	BTS	CMW500	129942	March 03, 2016	One year
08	E-field Probe	SPEAG EX3DV4	7307	February 19, 2016	One year
09	DAE	SPEAG DAE4	1331	January 19, 2017	One year
10	Dipole Validation Kit	SPEAG D750V3	1017	July 20, 2016	One year
11	Dipole Validation Kit	SPEAG D835V2	4d069	July 20, 2016	One year
12	Dipole Validation Kit	SPEAG D1750V2	1003	July 21, 2016	One year
13	Dipole Validation Kit	SPEAG D1900V2	5d101	July 28, 2016	One year
14	Dipole Validation Kit	SPEAG D2450V2	853	July 25, 2016	One year

END OF REPORT BODY

ANNEX A Graph Results

CDMA BC0 Head Left Cheek Low

Date: 2016-11-23

Electronics: DAE4 Sn1331

Medium: Head 850 MHz

Medium parameters used: $f = 824.7 \text{ MHz}$; $\sigma = 0.911 \text{ mho/m}$; $\epsilon_r = 41.25$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: CDMA BC0 Frequency: 824.7 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(10.01, 10.01, 10.01)

Area Scan (71x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.389 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.829 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.436 W/kg

SAR(1 g) = 0.342 W/kg; SAR(10 g) = 0.261 W/kg

Maximum value of SAR (measured) = 0.370 W/kg

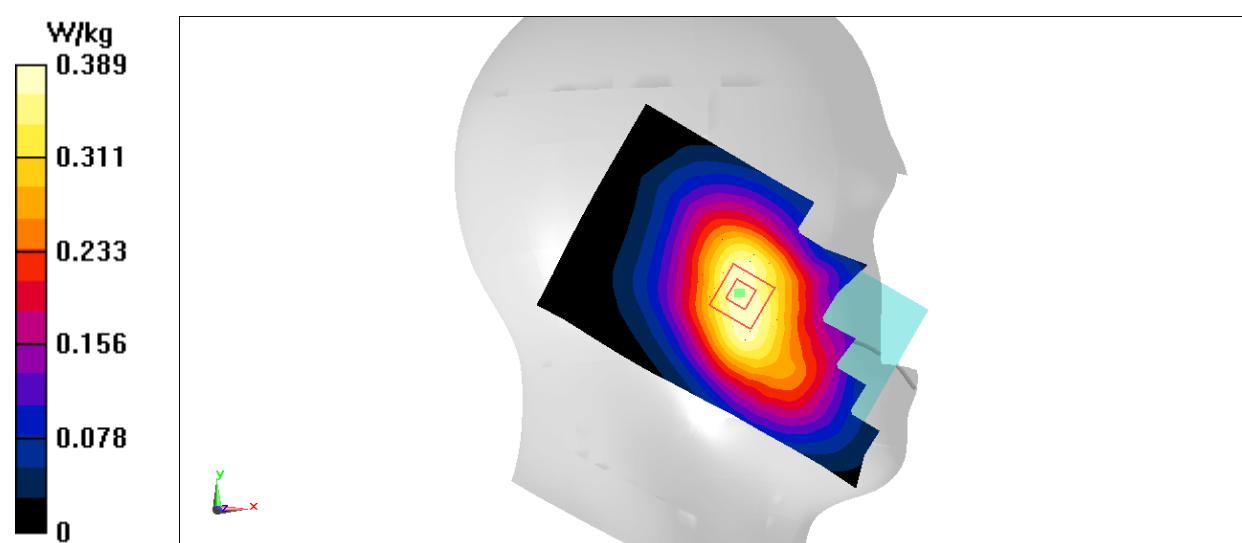


Fig.1 CDMA BC0

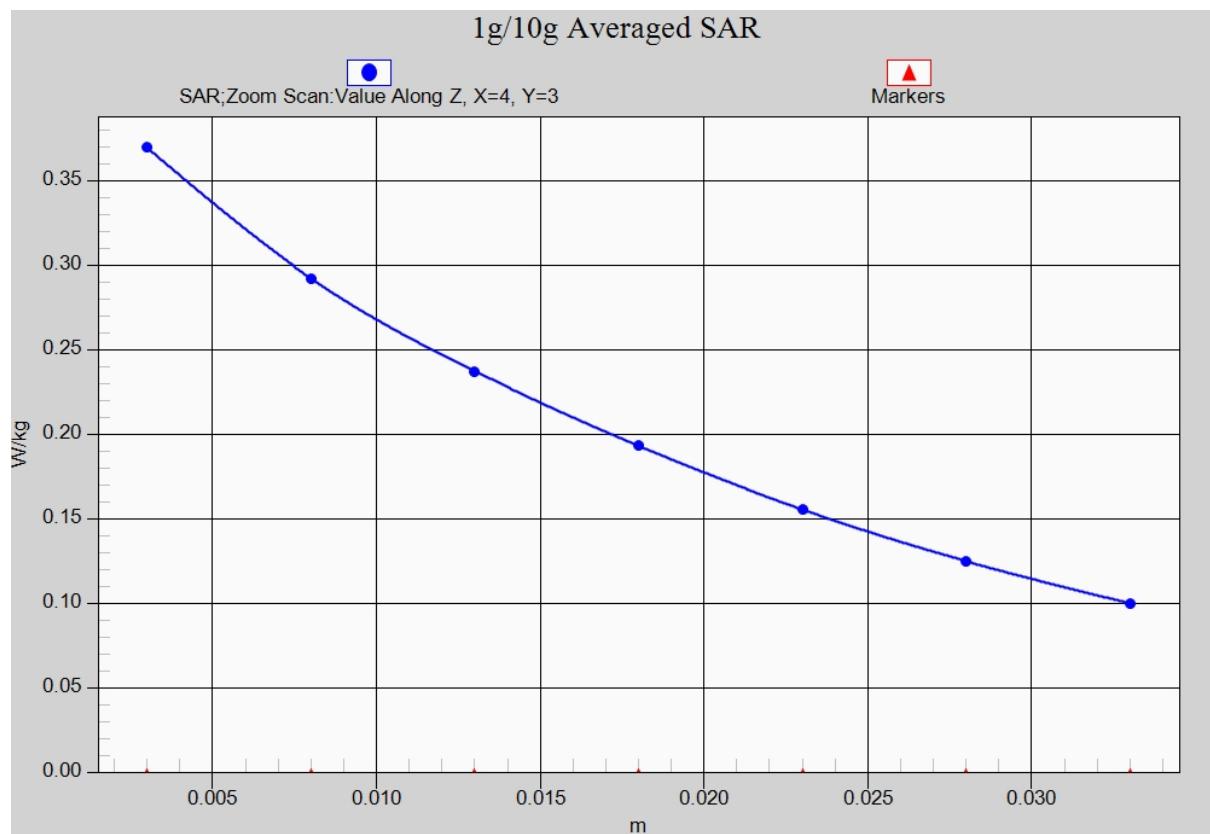


Fig. 1-1 Z-Scan at power reference point (CDMA BC0)

CDMA BC0 Body Rear Low

Date: 2016-11-23

Electronics: DAE4 Sn1331

Medium: Body 850 MHz

Medium parameters used: $f = 824.7 \text{ MHz}$; $\sigma = 0.965 \text{ S/m}$; $\epsilon_r = 56.24$; $\rho = 1000 \text{ kg/m}^3$ Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C

Communication System: CDMA BC0 Frequency: 824.7 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(9.83, 9.83, 9.83)

Area Scan (111x61x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.717 W/kg

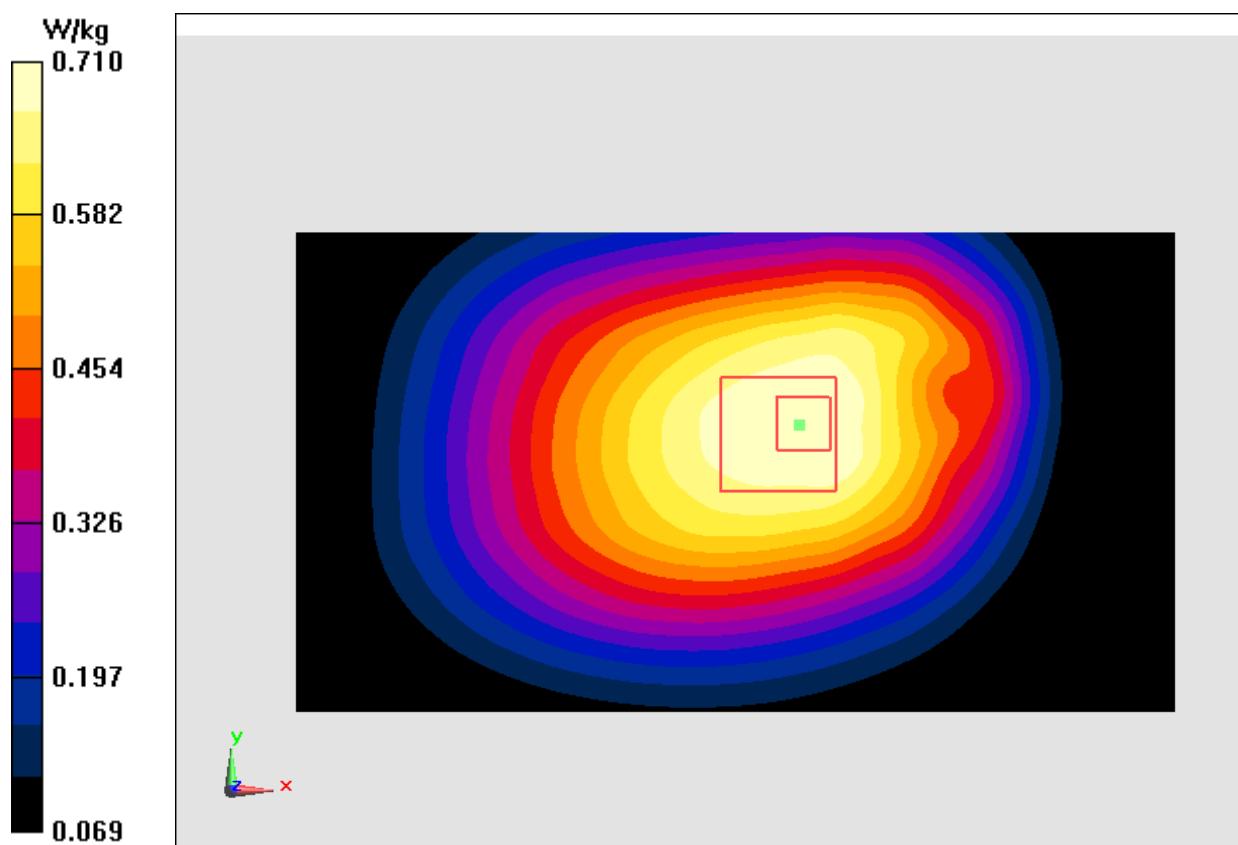
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 24.58 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.838 W/kg

SAR(1 g) = 0.645 W/kg; SAR(10 g) = 0.487 W/kg

Maximum value of SAR (measured) = 0.710 W/kg

**Fig.2 CDMA BC0**

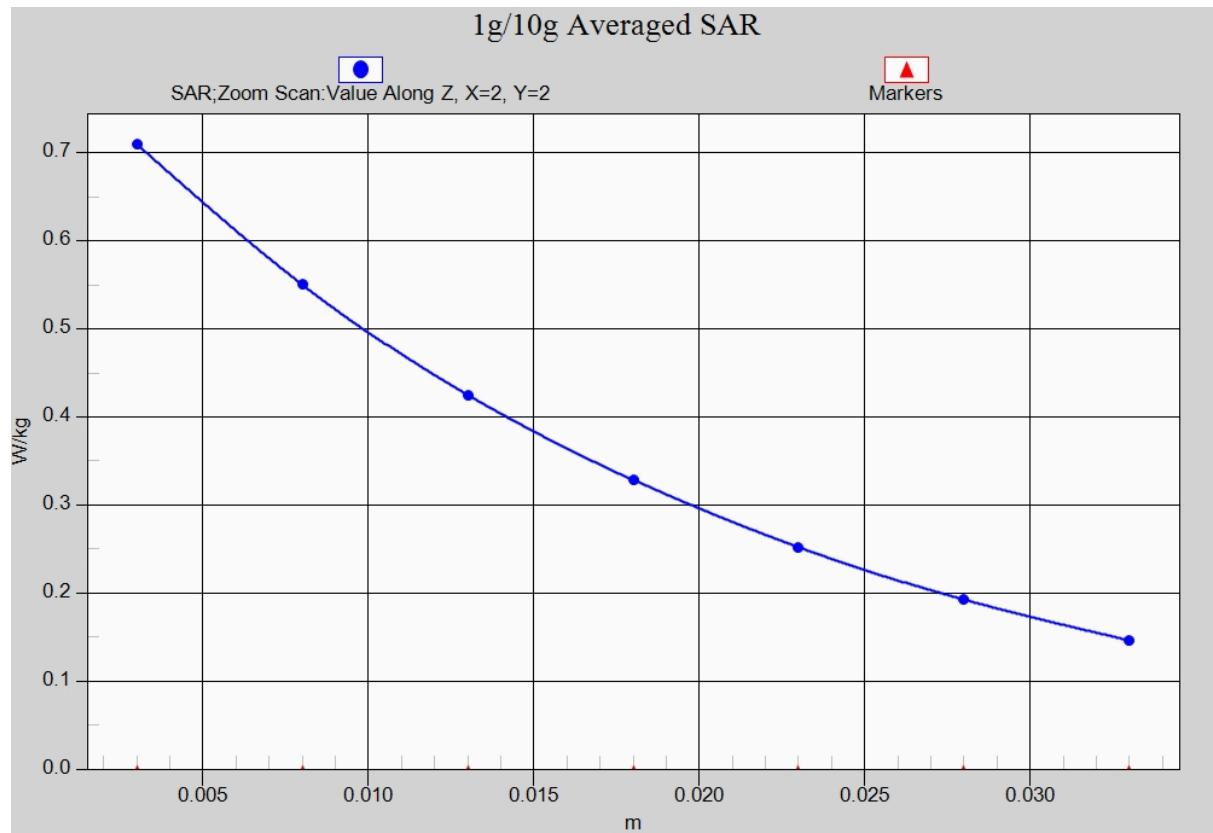


Fig. 2-1 Z-Scan at power reference point (CDMA BC0)

CDMA BC1 Head Left Cheek Low

Date: 2016-11-25

Electronics: DAE4 Sn1331

Medium: Head 1900 MHz

Medium parameters used (interpolated): $f = 1851.3$ MHz; $\sigma = 1.409$ mho/m; $\epsilon_r = 39.95$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: CDMA BC1 Frequency: 1851.3 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.10, 8.10, 8.10)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.598 W/kg

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

Reference Value = 3.054 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.781 W/kg

SAR(1 g) = 0.513 W/kg; SAR(10 g) = 0.323 W/kg

Maximum value of SAR (measured) = 0.602 W/kg

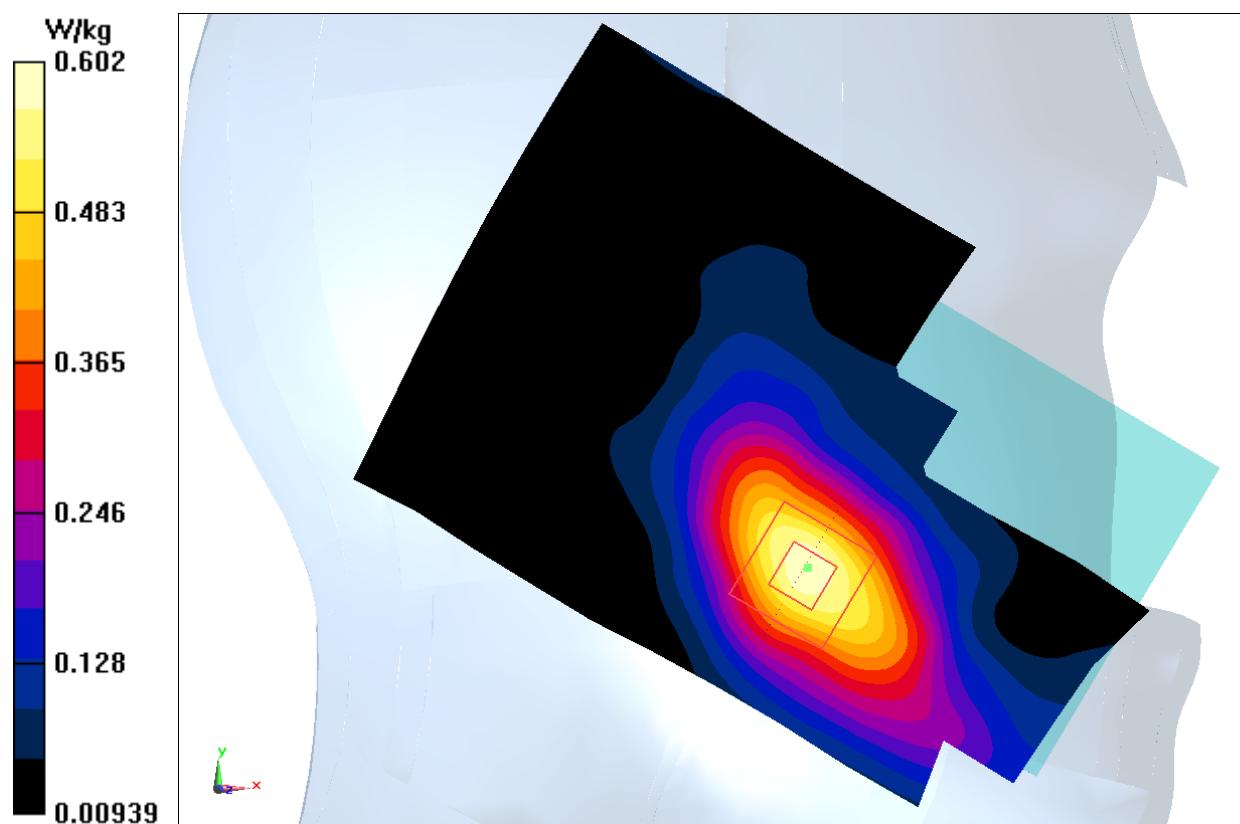


Fig.3 CDMA BC1

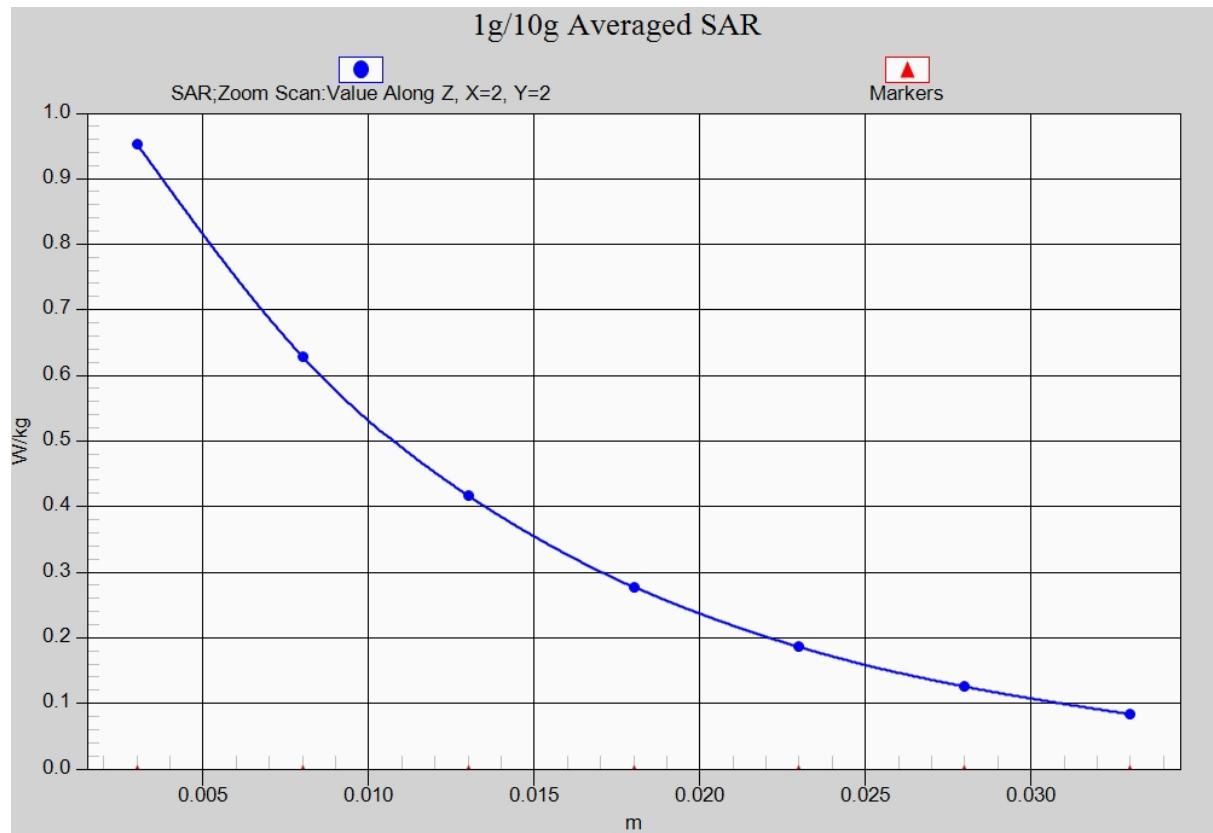


Fig. 3-1 Z-Scan at power reference point (CDMA BC1)

CDMA BC1 Body Bottom High – AP ON

Date: 2016-11-25

Electronics: DAE4 Sn1331

Medium: Body 1900 MHz

Medium parameters used (interpolated): $f = 1908.8$ MHz; $\sigma = 1.532$ mho/m; $\epsilon_r = 53.23$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C

Communication System: CDMA BC1 Frequency: 1908.8 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.67, 7.67, 7.67)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.15 W/kg

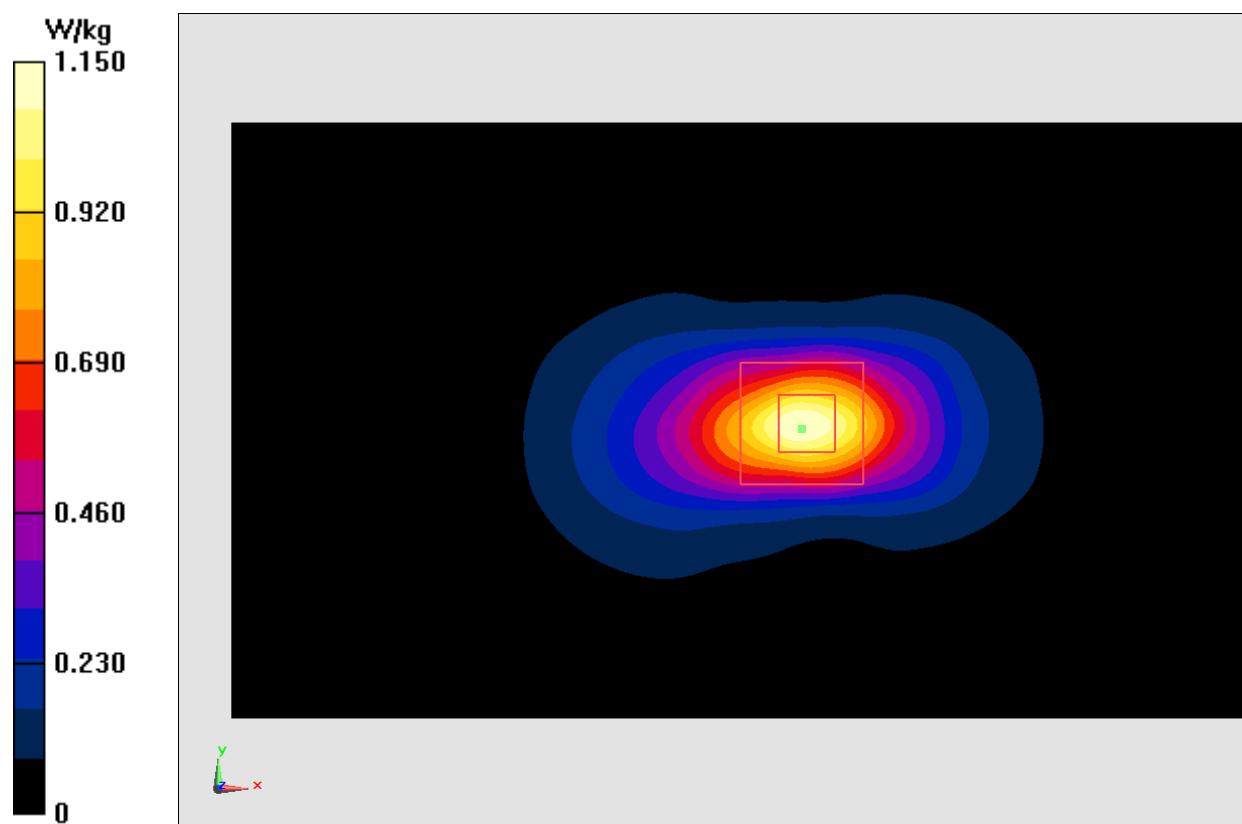
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.38 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 1.77 W/kg

SAR(1 g) = 0.996 W/kg; SAR(10 g) = 0.500 W/kg

Maximum value of SAR (measured) = 1.27 W/kg

**Fig.4 CDMA BC1**

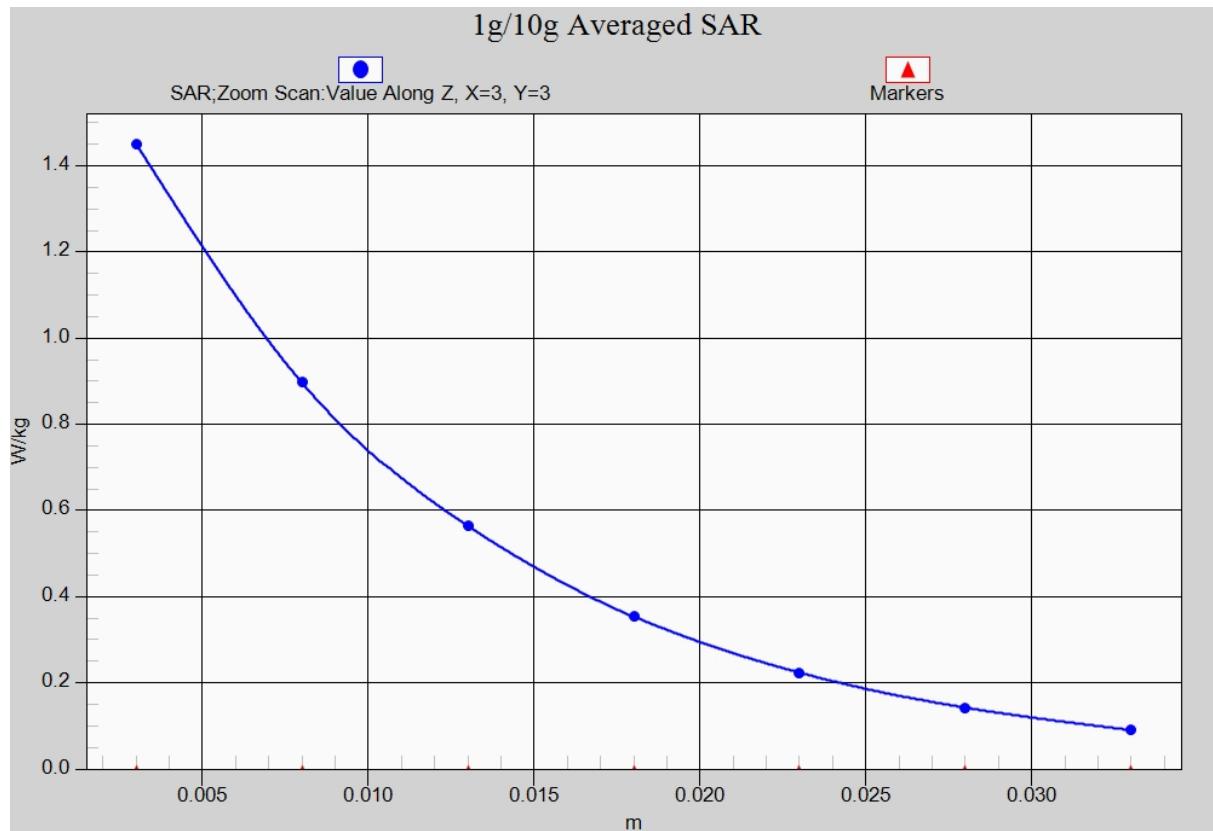


Fig.4-1 Z-Scan at power reference point (CDMA BC1)

CDMA BC1 Body Rear High – AP OFF

Date: 2016-11-25

Electronics: DAE4 Sn1331

Medium: Body 1900 MHz

Medium parameters used: $f = 1880$ MHz; $\sigma = 1.578$ mho/m; $\epsilon_r = 53.234$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C

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

Probe: EX3DV4 – SN7307 ConvF(7.67, 7.67, 7.67)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.35 W/kg

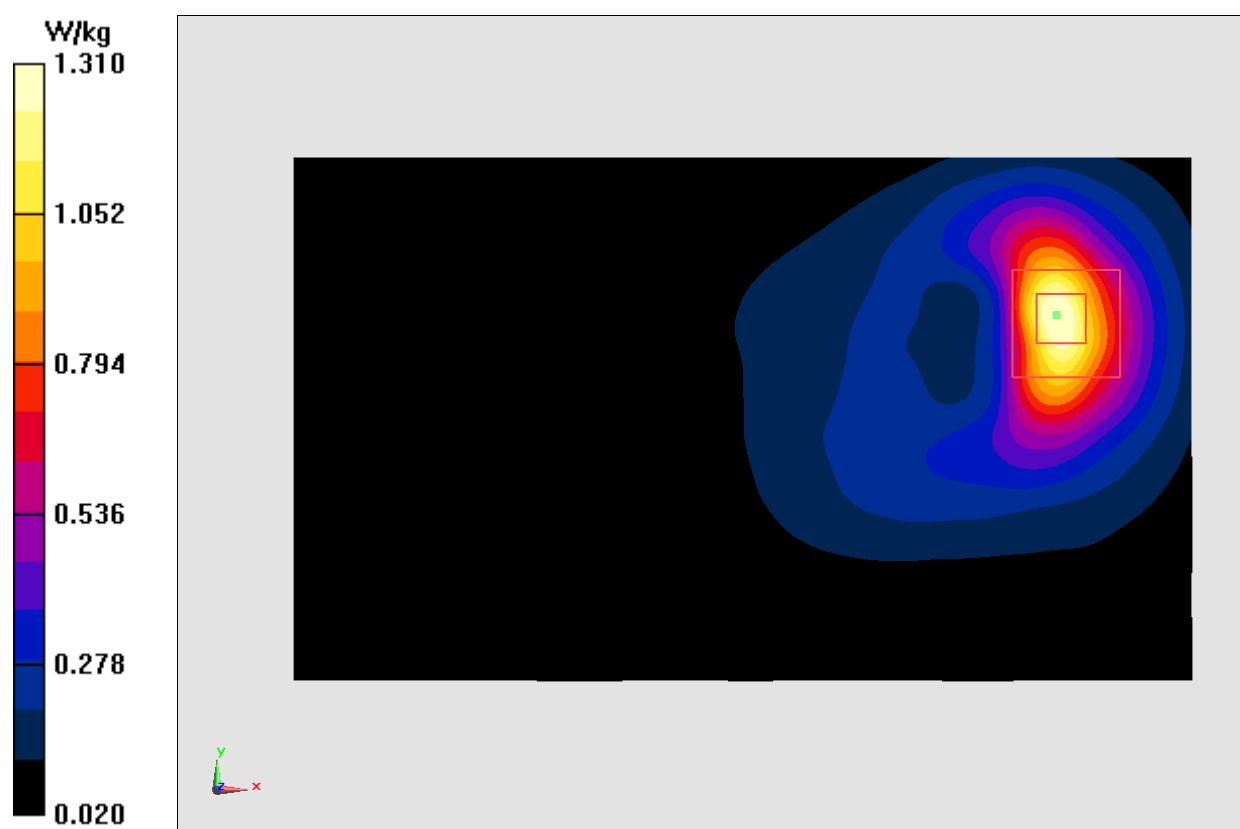
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.427 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 1.80 W/kg

SAR(1 g) = 1.08 W/kg; SAR(10 g) = 0.598 W/kg

Maximum value of SAR (measured) = 1.31 W/kg

**Fig.5 CDMA BC1**

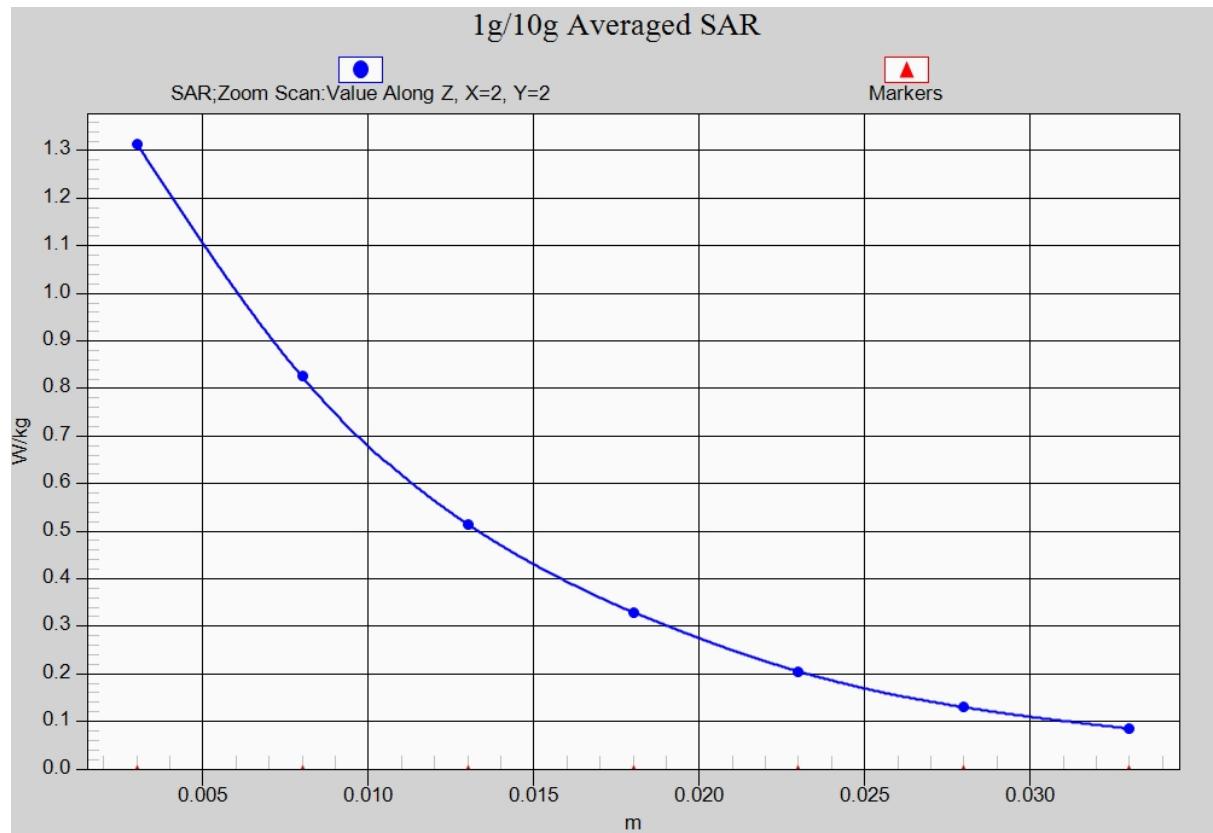


Fig.5-1 Z-Scan at power reference point (CDMA BC1)

LTE Band4 Left Cheek Middle with QPSK_20M_1RB_Middle

Date: 2016-11-24

Electronics: DAE4 Sn1331

Medium: Head 1750 MHz

Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.359$ mho/m; $\epsilon_r = 39.86$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: LTE Band4 Frequency: 1732.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.656 W/kg

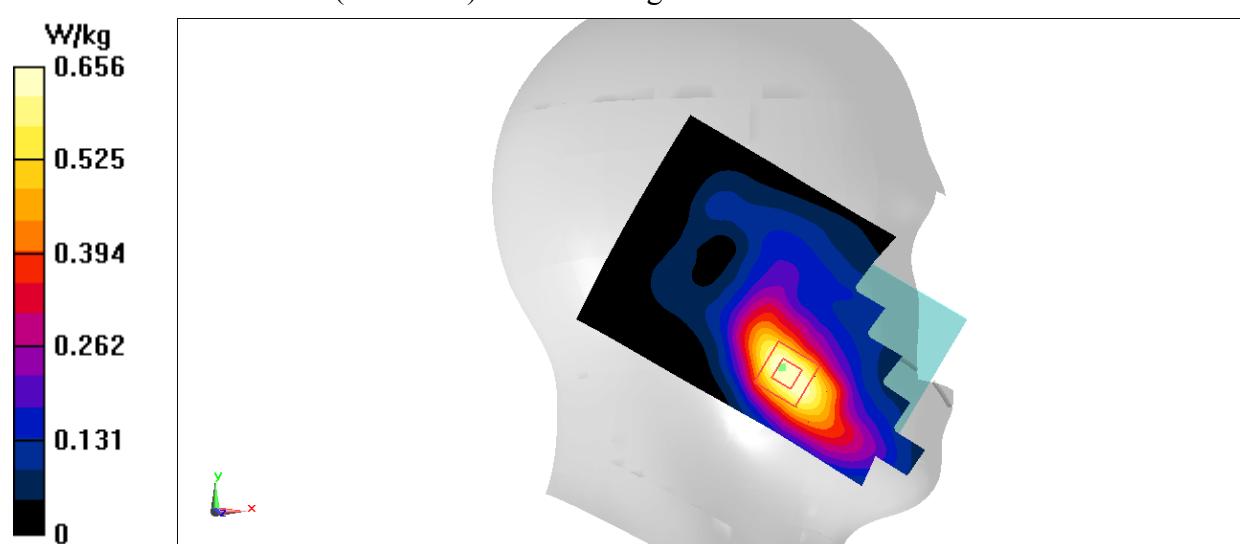
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.333 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.867 W/kg

SAR(1 g) = 0.576 W/kg; SAR(10 g) = 0.355 W/kg

Maximum value of SAR (measured) = 0.675 W/kg

**Fig.6 LTE Band4**

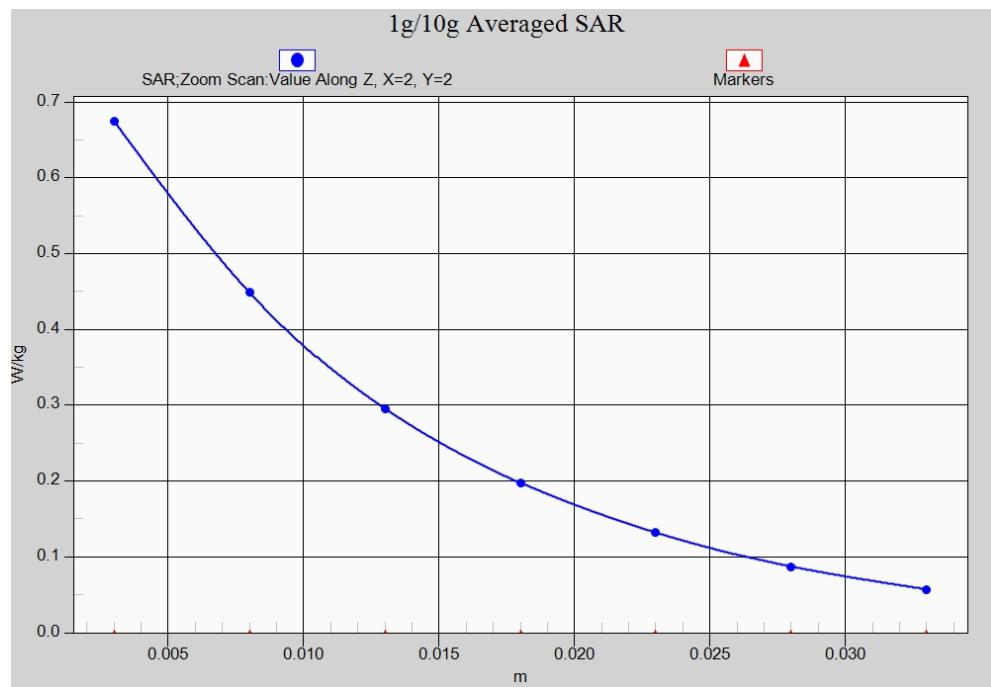


Fig.6-1 Z-Scan at power reference point (LTE Band4)

LTE Band4 Body Front High with QPSK_20M_1RB_Low AP ON

Date: 2016-11-24

Electronics: DAE4 Sn1331

Medium: Body 1750 MHz

Medium parameters used: $f = 1745$ MHz; $\sigma = 1.485$ mho/m; $\epsilon_r = 53.12$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: LTE Band4 Frequency: 1745 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.10, 8.10, 8.10)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.16 W/kg

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 14.87 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.72 W/kg

SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.576 W/kg

Maximum value of SAR (measured) = 1.32 W/kg

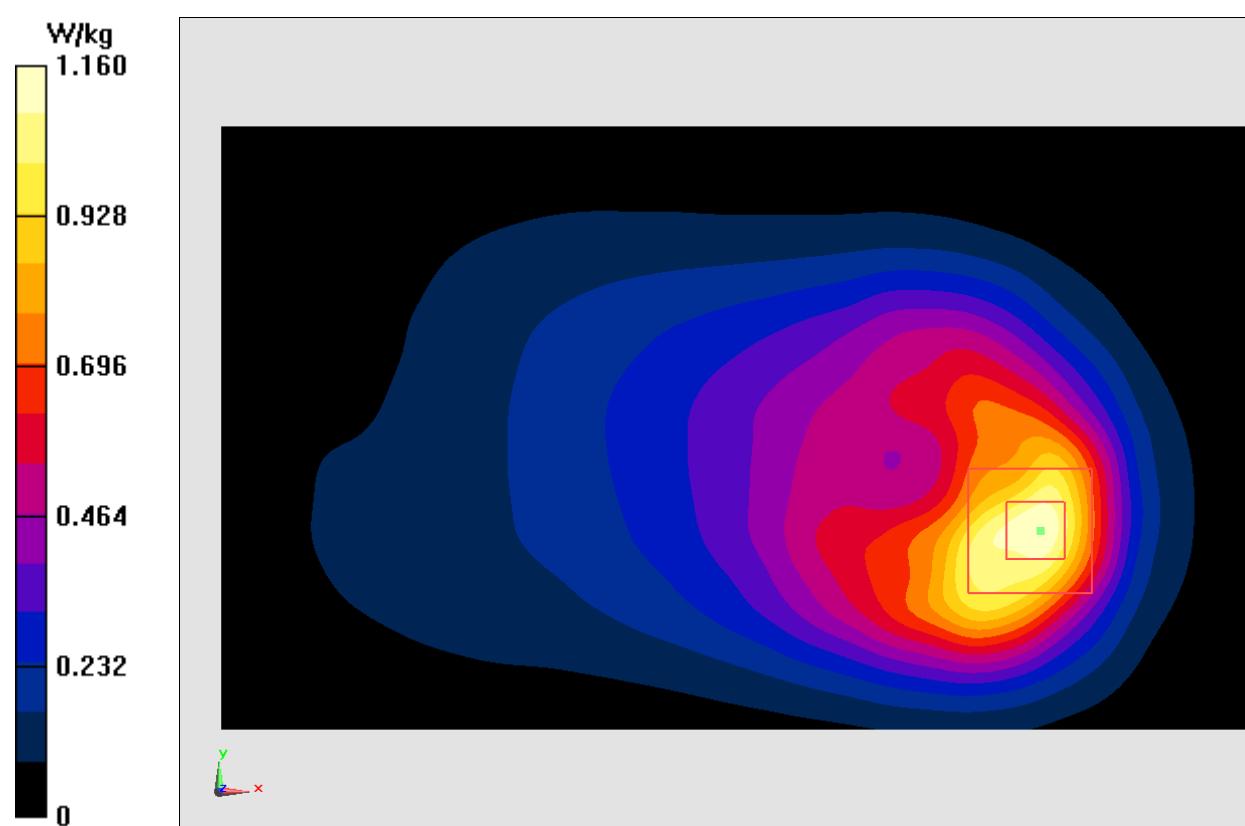


Fig.7 LTE Band4

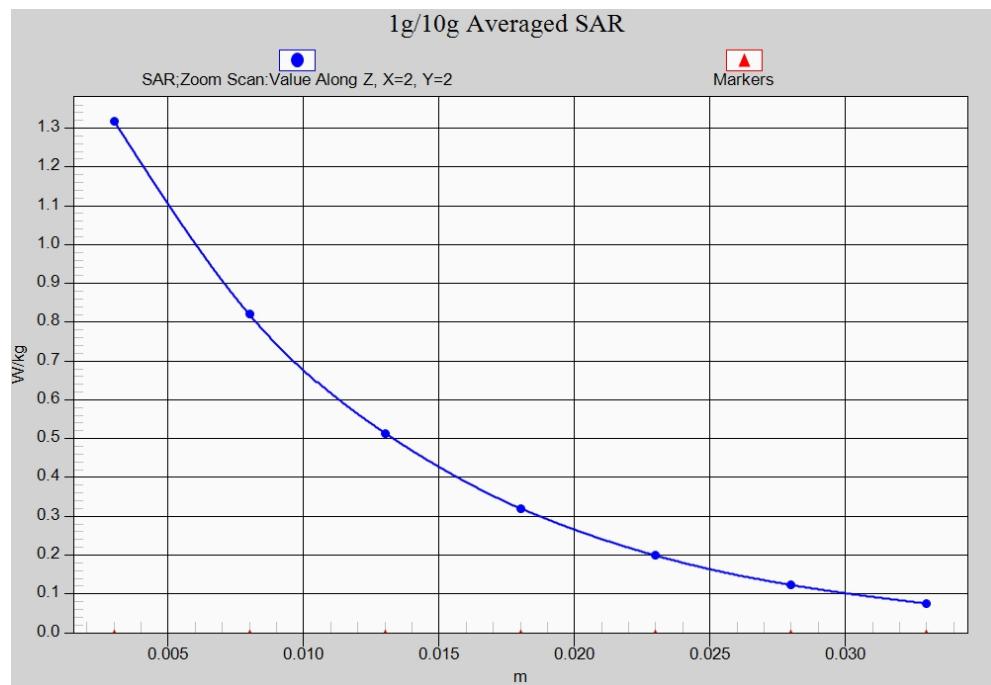


Fig.7-1 Z-Scan at power reference point (LTE Band4)

LTE Band4 Body Rear Middle with QPSK_20M_1RB_Middle AP OFF

Date: 2016-11-24

Electronics: DAE4 Sn1331

Medium: Body 1750 MHz

Medium parameters used: $f = 1732.5$ MHz; $\sigma = 1.478$ mho/m; $\epsilon_r = 53.16$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: LTE Band4 Frequency: 1732.5 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.10, 8.10, 8.10)

Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.623 W/kg

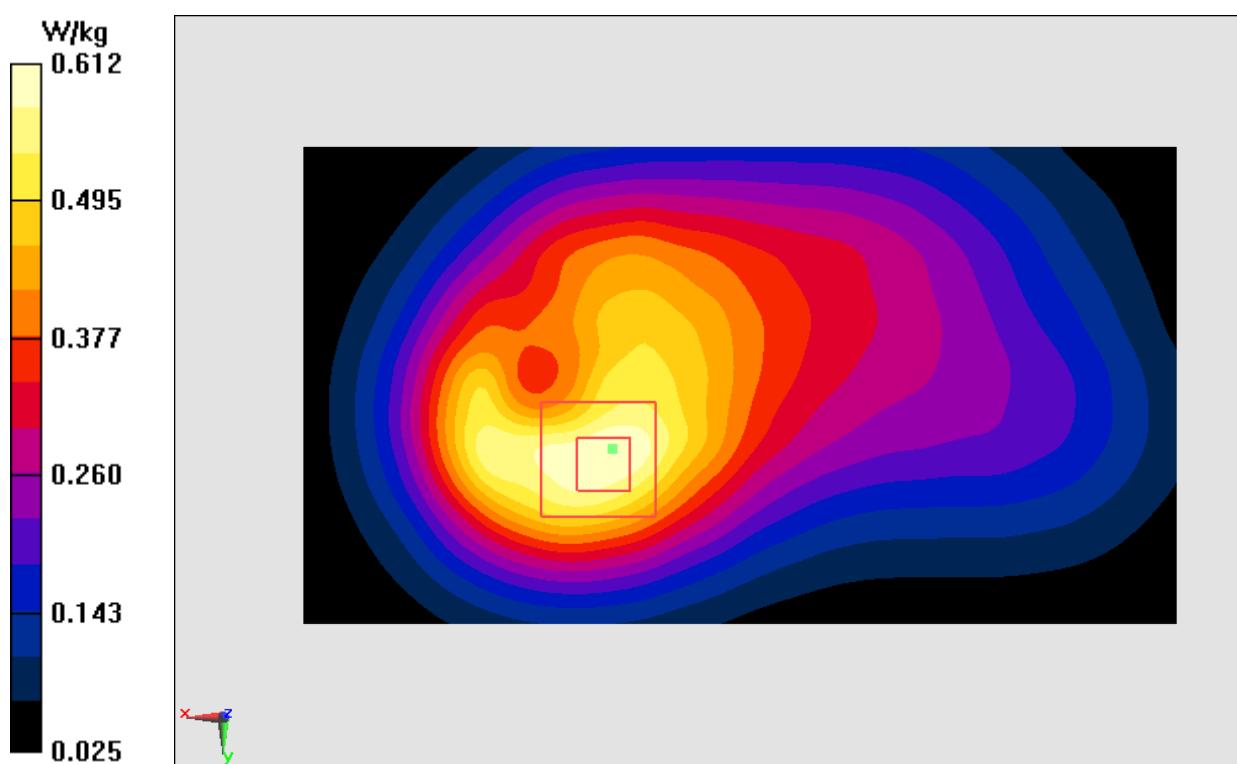
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 13.77 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.807 W/kg

SAR(1 g) = 0.518 W/kg; SAR(10 g) = 0.322 W/kg

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

**Fig.8 LTE Band4**

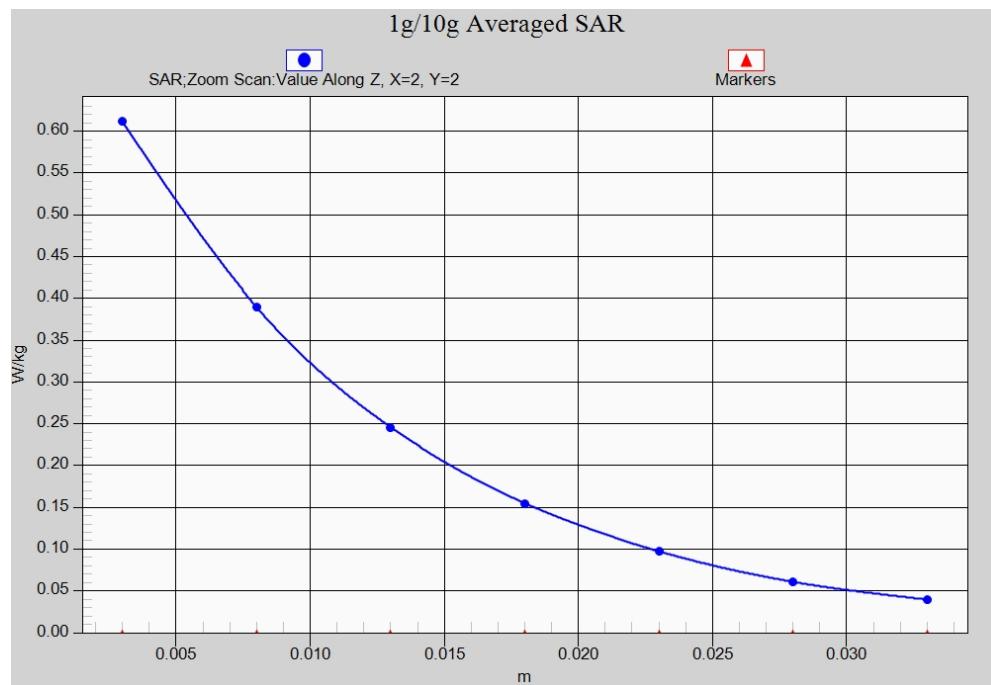


Fig.8-1 Z-Scan at power reference point (LTE Band4)

LTE Band 13 Left Cheek with QPSK_10M_1RB_Middle

Date: 2016-11-22

Electronics: DAE4 Sn1331

Medium: Head 750 MHz

Medium parameters used (interpolated): $f = 782$ MHz; $\sigma = 0.912$ mho/m; $\epsilon_r = 42.89$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: LTE Band13 Frequency: 782 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(10.47, 10.47, 10.47)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.380 W/kg

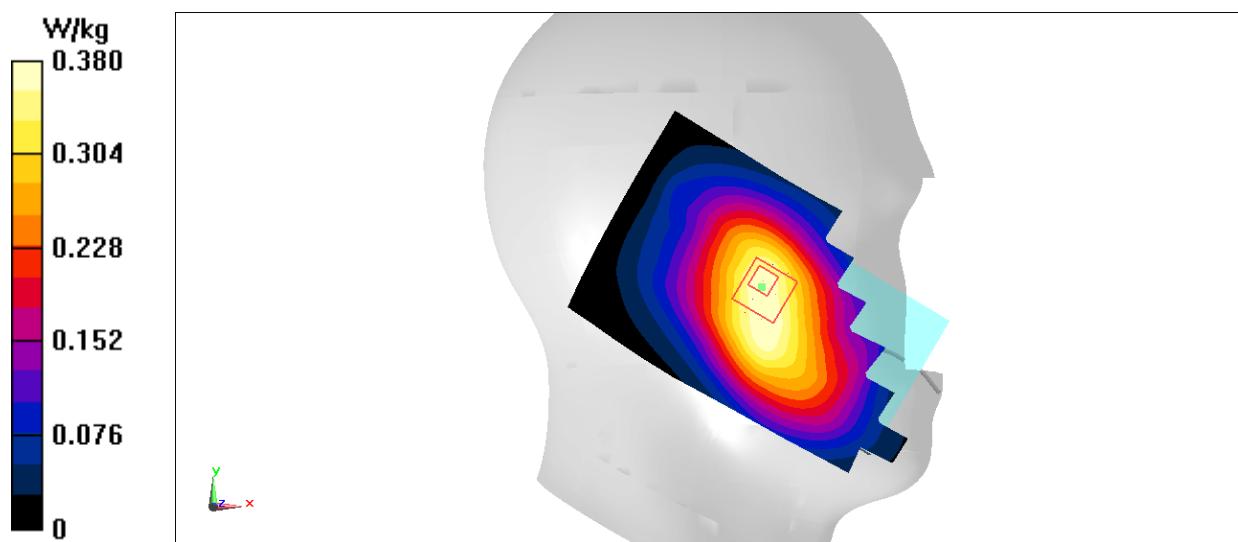
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.814 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.423 W/kg

SAR(1 g) = 0.339 W/kg; SAR(10 g) = 0.262 W/kg

Maximum value of SAR (measured) = 0.373 W/kg

**Fig.9 LTE Band 13**

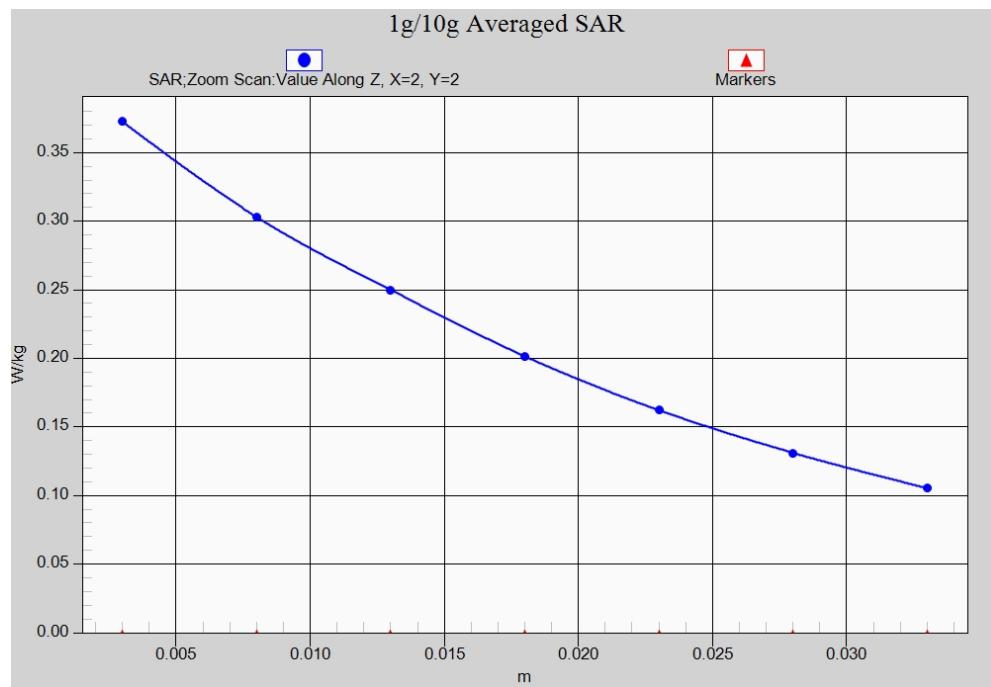


Fig. 9-1 Z-Scan at power reference point (LTE Band13)

LTE Band 13 Body Rear Middle with QPSK_10M_1RB_Middle

Date: 2016-11-22

Electronics: DAE4 Sn1331

Medium: Body 750 MHz

Medium parameters used (interpolated): $f = 782$ MHz; $\sigma = 0.961$ mho/m; $\epsilon_r = 54.83$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: LTE Band13 Frequency: 782 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(9.93, 9.93, 9.93)

Area Scan (111x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.521 W/kg

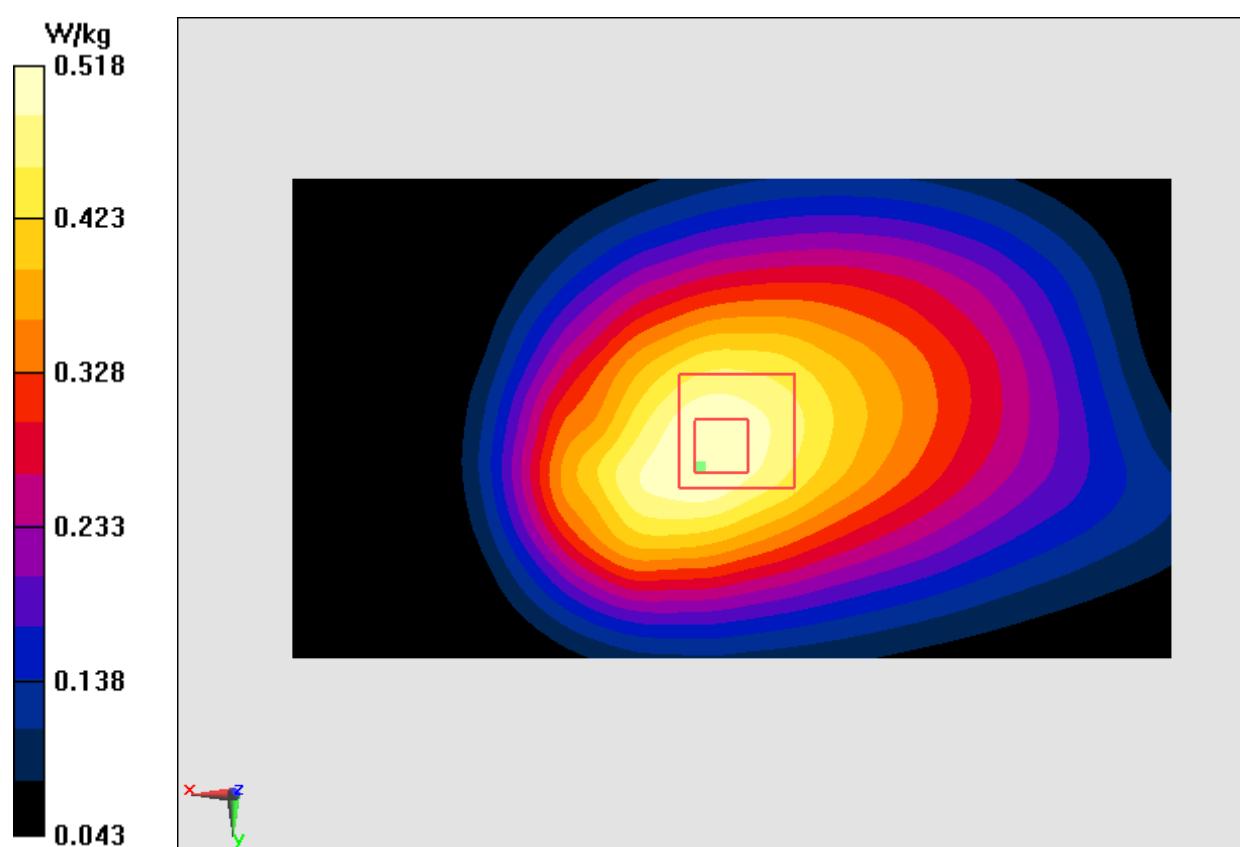
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 21.14 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 0.636 W/kg

SAR(1 g) = 0.466 W/kg; SAR(10 g) = 0.340 W/kg

Maximum value of SAR (measured) = 0.518 W/kg

**Fig.10 LTE Band 13**

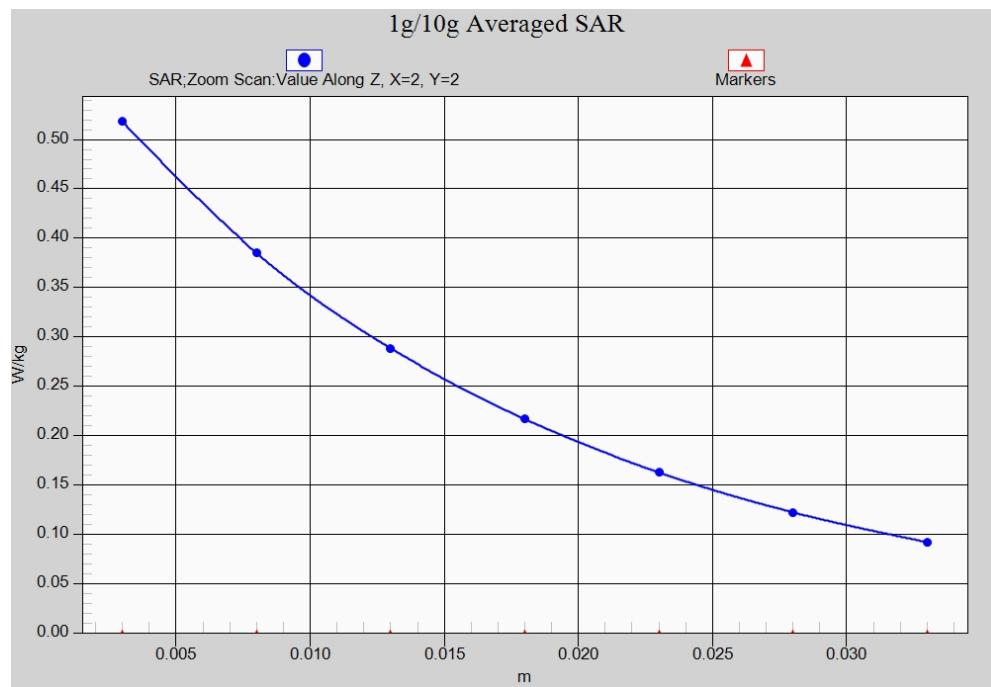


Fig. 10-1 Z-Scan at power reference point (LTE Band13)

Wifi 802.11b Left Cheek Channel 6

Date: 2016-11-16

Electronics: DAE4 Sn1331

Medium: Head 2450 MHz

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.821$ S/m; $\epsilon_r = 40.23$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: WLan 2450 Frequency: 2437 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.60 W/kg

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

Reference Value = 16.57 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 2.74 W/kg

SAR(1 g) = 1.24 W/kg; SAR(10 g) = 0.575 W/kg

Maximum value of SAR (measured) = 1.58 W/kg

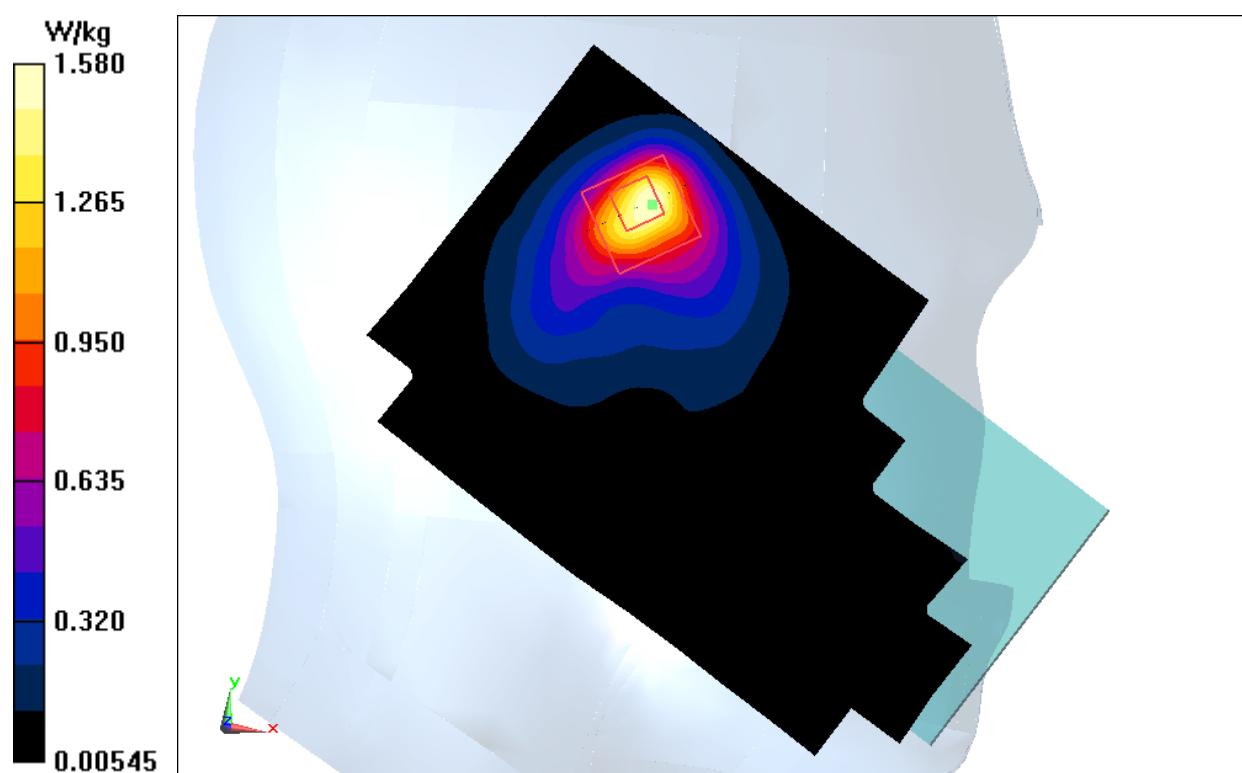


Fig.11 2450 MHz

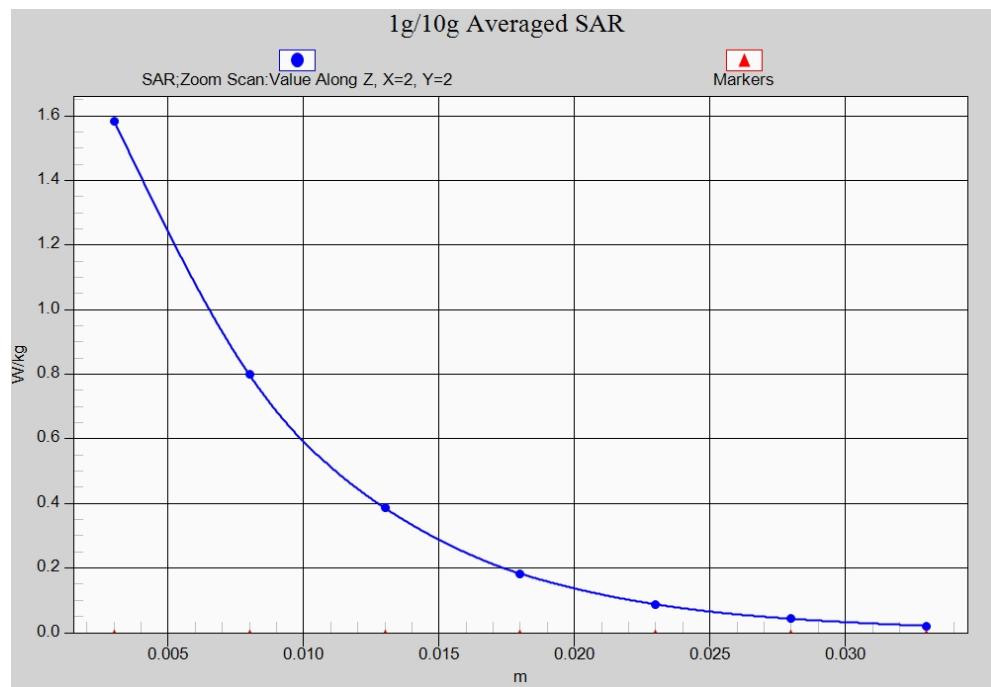


Fig. 11-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11n HT40 Left Cheek Channel 3

Date: 2016-11-16

Electronics: DAE4 Sn1331

Medium: Head 2450 MHz

Medium parameters used (interpolated): $f = 2422$ MHz; $\sigma = 1.815$ S/m; $\epsilon_r = 40.24$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C

Communication System: WLan 2450 Frequency: 2422 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

Area Scan (71x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.48 W/kg

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

Reference Value = 14.95 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 2.38 W/kg

SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.486 W/kg

Maximum value of SAR (measured) = 1.31 W/kg

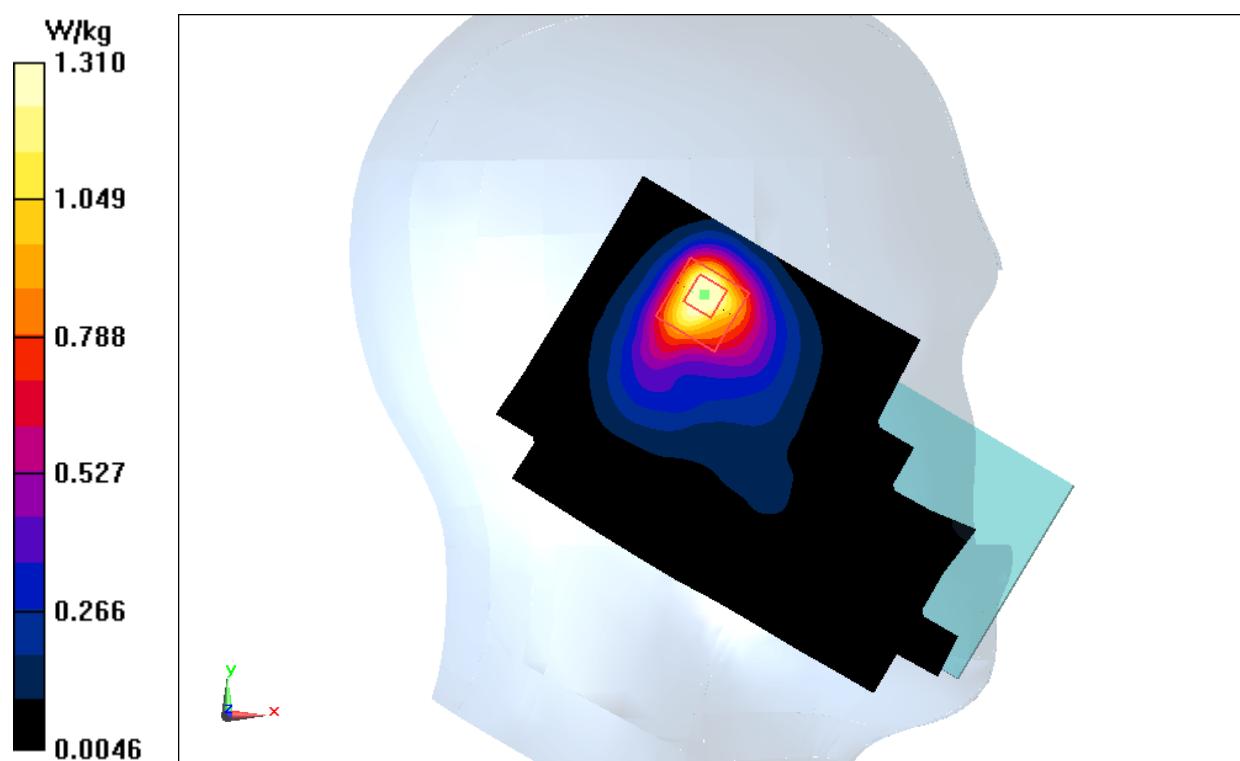


Fig.12 2450 MHz

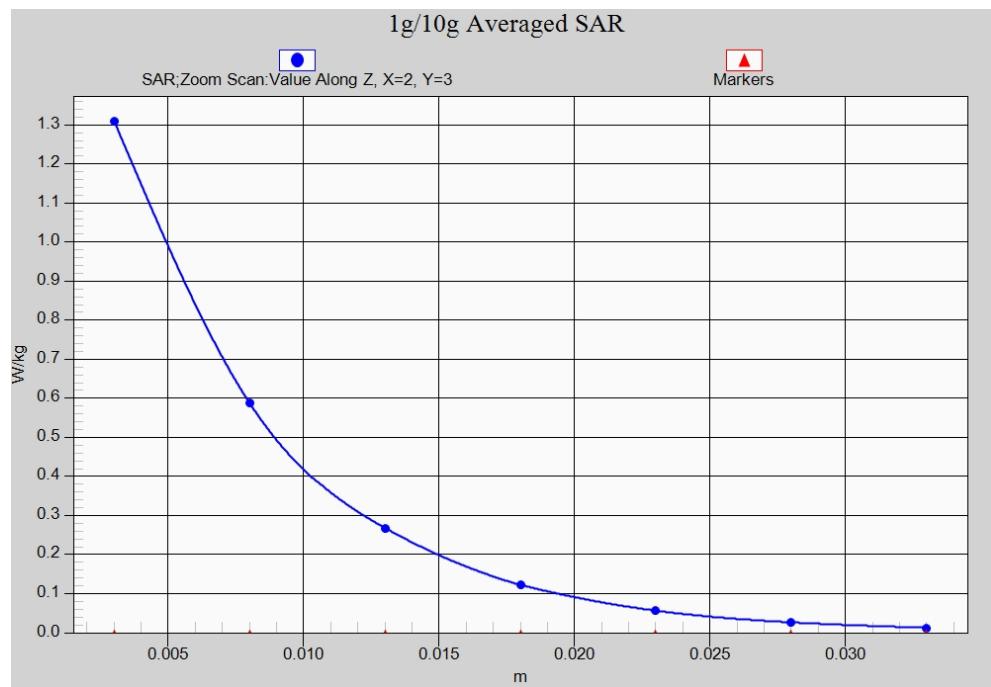


Fig. 12-1 Z-Scan at power reference point (2450 MHz)

Wifi 802.11b Body Front Channel 1

Date: 2016-11-26

Electronics: DAE4 Sn1331

Medium: Body 2450 MHz

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.941$ S/m; $\epsilon_r = 52.86$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.7°C Liquid Temperature: 22.2°C

Communication System: WLan 2450 Frequency: 2412 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.36, 7.36, 7.36)

Area Scan (121x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.263 W/kg

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

Reference Value = 6.063 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.370 W/kg

SAR(1 g) = 0.195 W/kg; SAR(10 g) = 0.105 W/kg

Maximum value of SAR (measured) = 0.239 W/kg

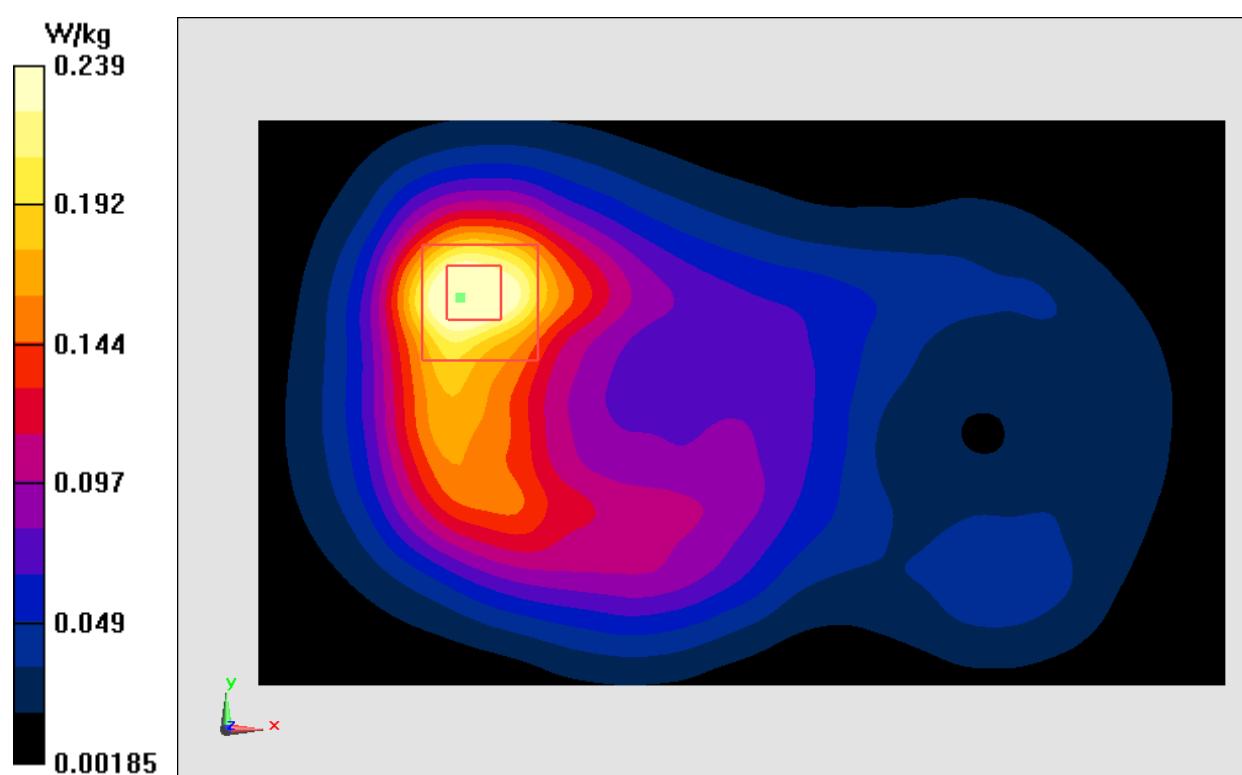


Fig.13 2450 MHz

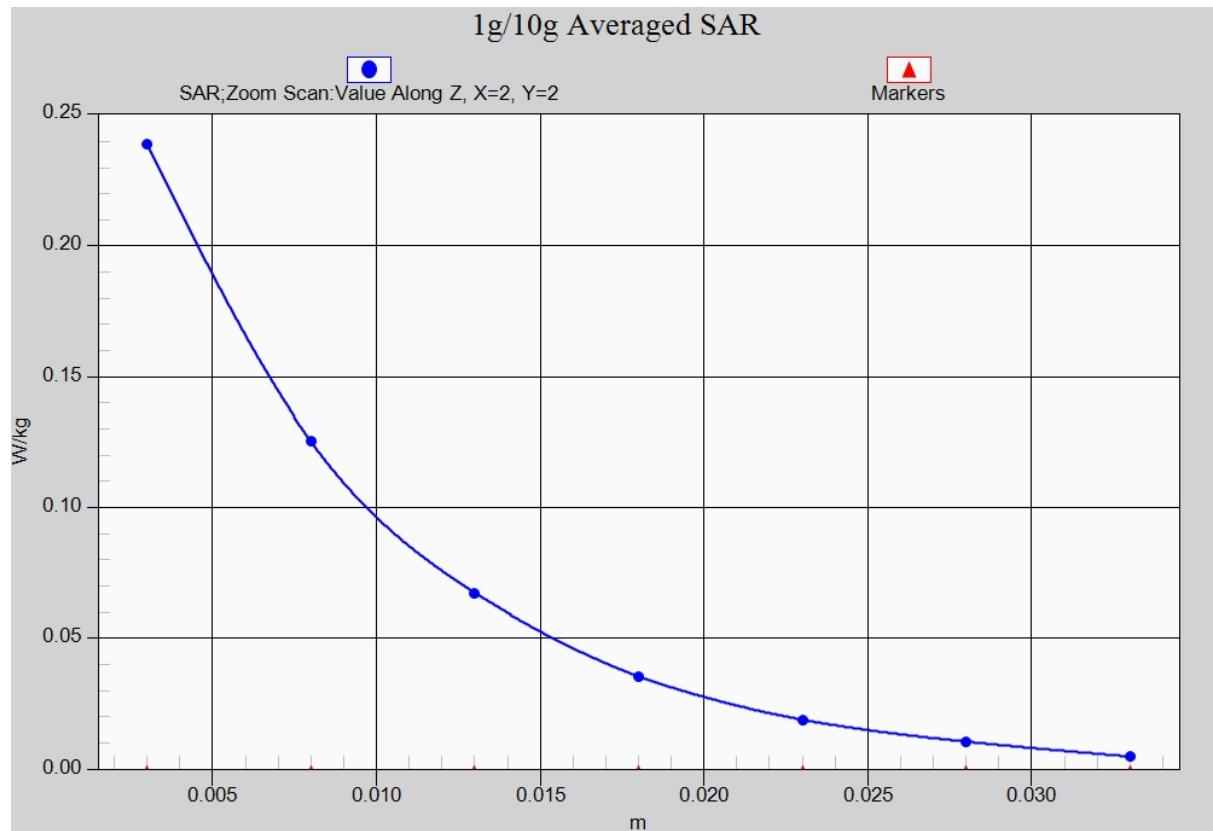


Fig. 13-1 Z-Scan at power reference point (2450 MHz)

ANNEX B System Verification Results

750MHz

Date: 2016-11-22

Electronics: DAE4 Sn1331

Medium: Head 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.905 \text{ mho/m}$; $\epsilon_r = 42.94$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(10.47, 10.47, 10.47)

System Validation /Area Scan (81x191x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 50.514 V/m; Power Drift = -0.07 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.09 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.39 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.28 W/kg

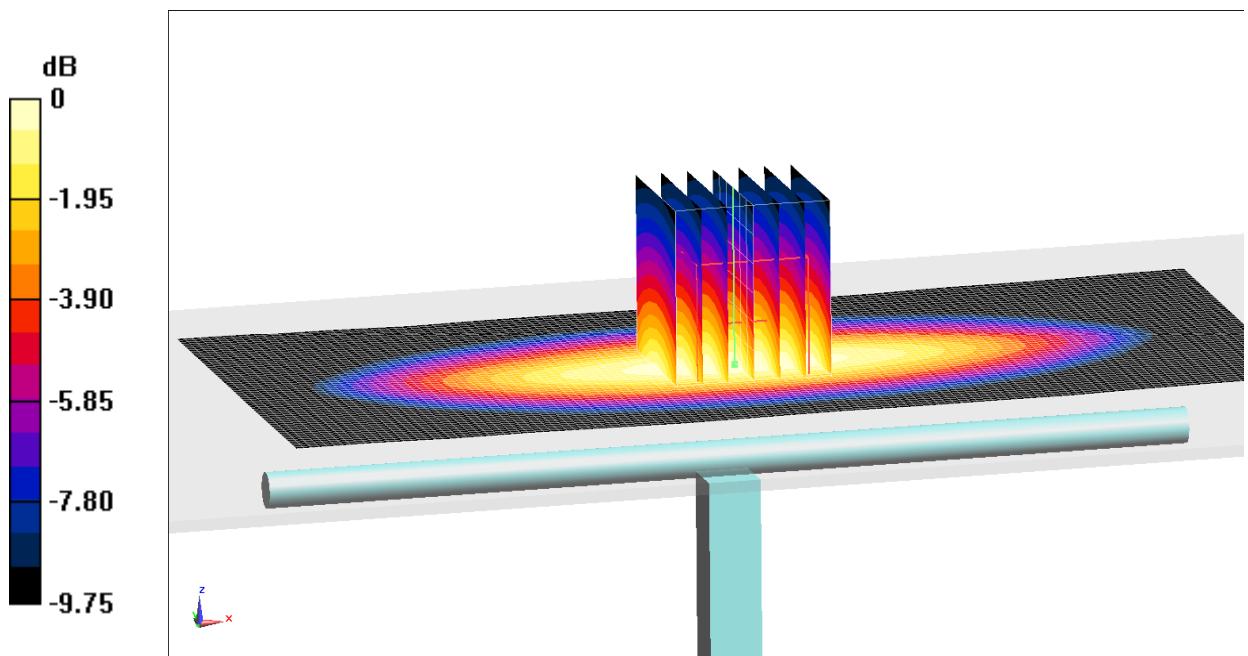
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 50.514 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.93 W/kg

SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.38 W/kg

Maximum value of SAR (measured) = 2.29 W/kg



0 dB = 2.29 W/kg = 3.59 dB W/kg

Fig.B.1 validation 750MHz 250mW

835MHz

Date: 2016-11-23

Electronics: DAE4 Sn1331

Medium: Head 850 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.916 \text{ S/m}$; $\epsilon_r = 41.21$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(10.01, 10.01, 10.01)

System Validation /Area Scan (81x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 51.522 V/m; Power Drift = -0.09 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.26 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.49 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.52 W/kg

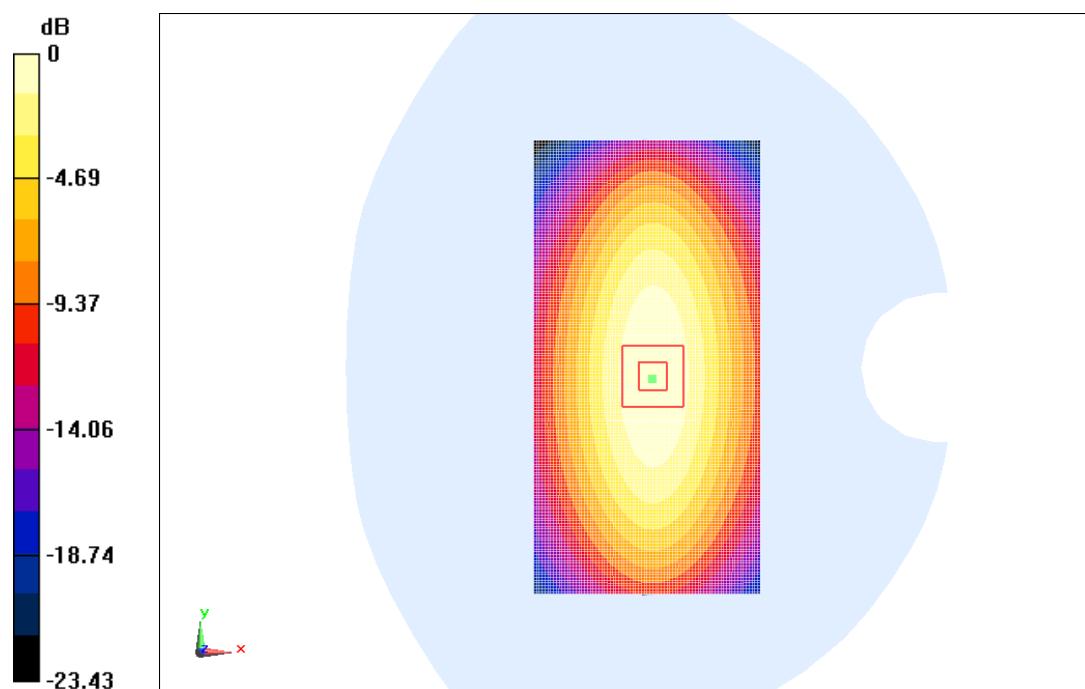
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 51.532 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.6 W/kg

SAR(1 g) = 2.27 W/kg; SAR(10 g) = 1.52 W/kg

Maximum value of SAR (measured) = 2.54 W/kg



$$0 \text{ dB} = 2.54 \text{ W/kg} = 4.05 \text{ dBW/kg}$$

Fig.B.2 validation 835MHz 250mW

1750MHz

Date: 2016-11-24

Electronics: DAE4 Sn1331

Medium: Head 1750 MHz

Medium parameters used: $f=1750$ MHz; $\sigma = 1.365$ mho/m; $\epsilon_r = 39.81$; $\rho = 1000$ kg/m 3

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 91.157 V/m; Power Drift = -0.05 dB

Fast SAR: SAR(1 g) = 9.22 W/kg; SAR(10 g) = 4.95 W/kg

Maximum value of SAR (interpolated) = 10.2 W/kg

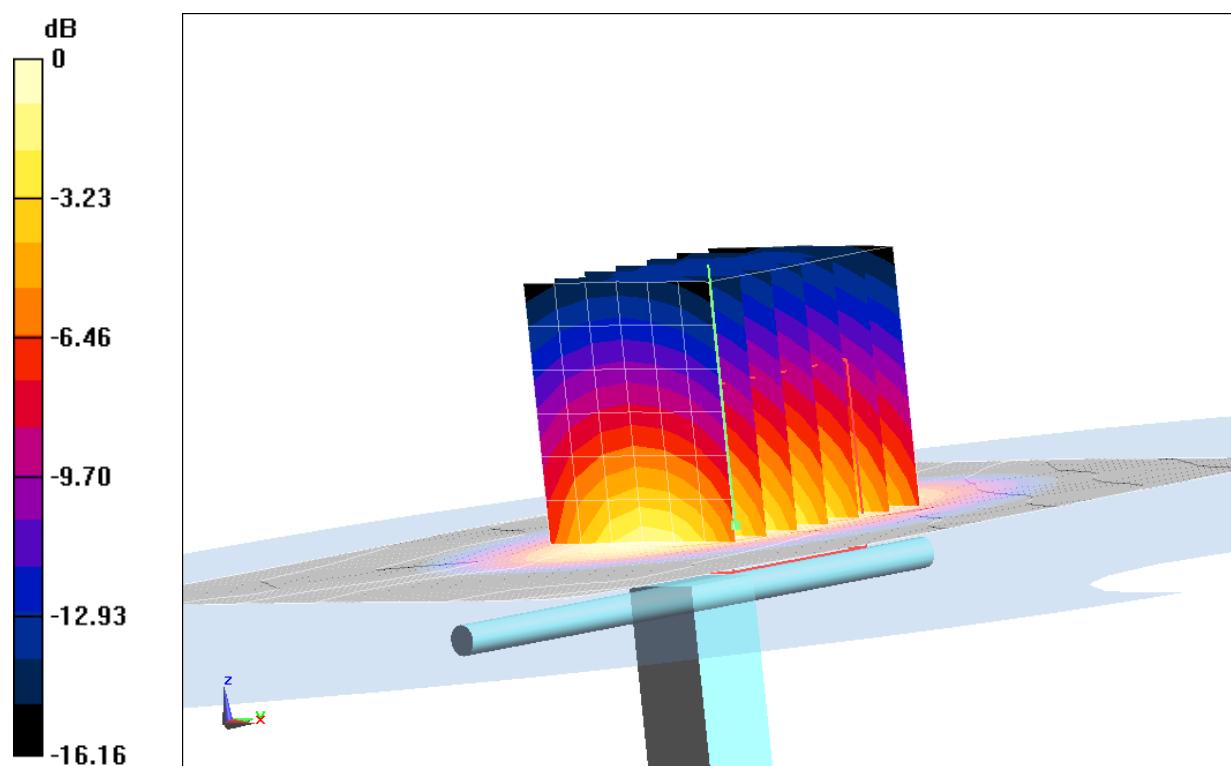
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.157 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 15.87 W/kg

SAR(1 g) = 9.24 W/kg; SAR(10 g) = 4.86 W/kg

Maximum value of SAR (measured) = 10.21 W/kg



0 dB = 10.21 W/kg = 10.09 dB W/kg

Fig.B.3 validation 1750MHz 250mW

1900MHz

Date: 2016-11-25

Electronics: DAE4 Sn1331

Medium: Head 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.416 \text{ S/m}$; $\epsilon_r = 39.91$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.10, 8.10, 8.10)

System Validation /Area Scan (81x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 90.624 V/m; Power Drift = -0.03 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 10.6 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 5.53 \text{ W/kg}$

Maximum value of SAR (interpolated) = 12.0 W/kg

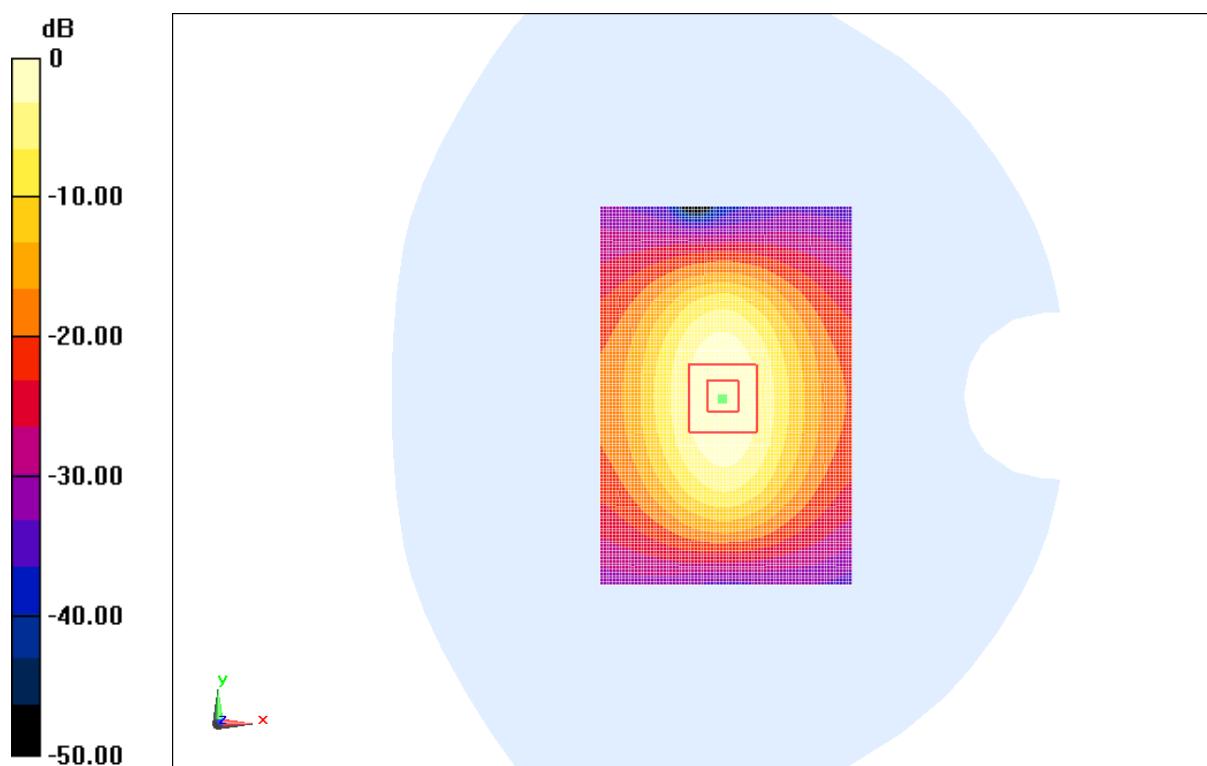
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.624 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 18.95 W/kg

SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 11.82 W/kg



$$0 \text{ dB} = 11.82 \text{ W/kg} = 10.73 \text{ dBW/kg}$$

Fig.B.4 validation 1900MHz 250mW

2450MHz

Date: 2016-11-26

Electronics: DAE4 Sn1331

Medium: Head 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.825 \text{ mho/m}$; $\epsilon_r = 40.03$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

System Validation /Area Scan (61x81x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 90.13 V/m; Power Drift = -0.02 dB

SAR(1 g) = 13.25 W/kg; SAR(10 g) = 6.26 W/kg

Maximum value of SAR (interpolated) = 17.1 W/kg

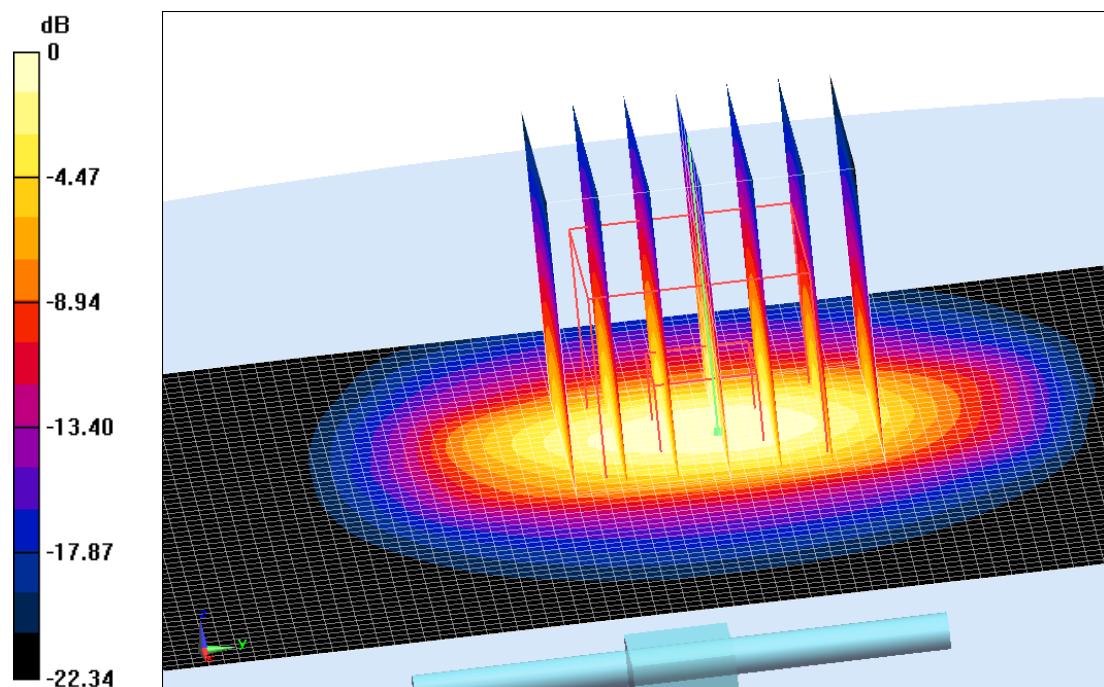
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.13 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.37 W/kg

SAR(1 g) = 13.28 W/kg; SAR(10 g) = 6.15 W/kg

Maximum value of SAR (measured) = 16.39 W/kg



0 dB = 16.39 W/kg = 12.15 dBW/kg

Fig.B.5 validation 2450MHz 250mW

750MHz

Date: 2016-11-22

Electronics: DAE4 Sn1331

Medium: Body750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.954 \text{ mho/m}$; $\epsilon_r = 54.89$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(9.93, 9.93, 9.93)

System Validation/Area Scan (81x191x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 50.779 V/m; Power Drift = 0.11 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.16 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.40 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.30 W/kg

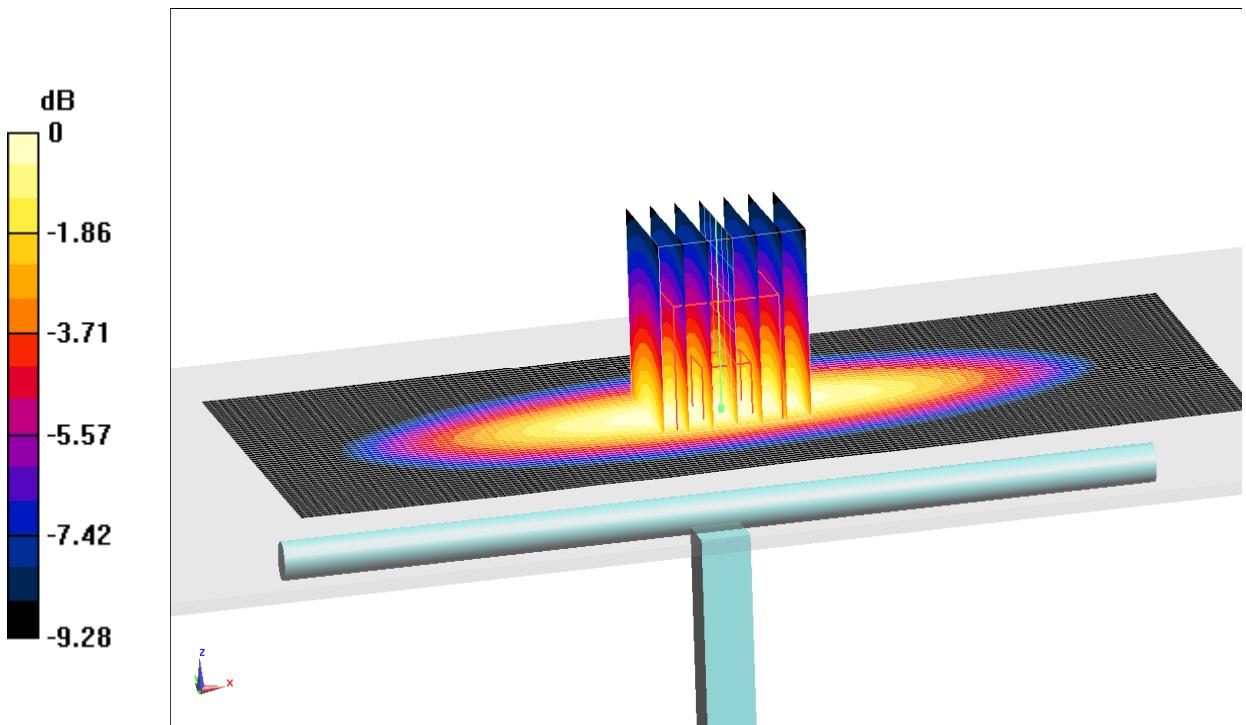
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 50.779 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.96 W/kg

SAR(1 g) = 2.17 W/kg; SAR(10 g) = 1.41 W/kg

Maximum value of SAR (measured) = 2.31 W/kg



$$0 \text{ dB} = 2.31 \text{ W/kg} = 3.64 \text{ dB W/kg}$$

Fig.B.6 validation 750MHz 250mW

835MHz

Date: 2016-11-23

Electronics: DAE4 Sn1331

Medium: Body 850 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.971 \text{ S/m}$; $\epsilon_r = 56.18$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(9.83, 9.83, 9.83)

System Validation /Area Scan (81x171x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 51.917 V/m; Power Drift = 0.08 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.36 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.58 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.52 W/kg

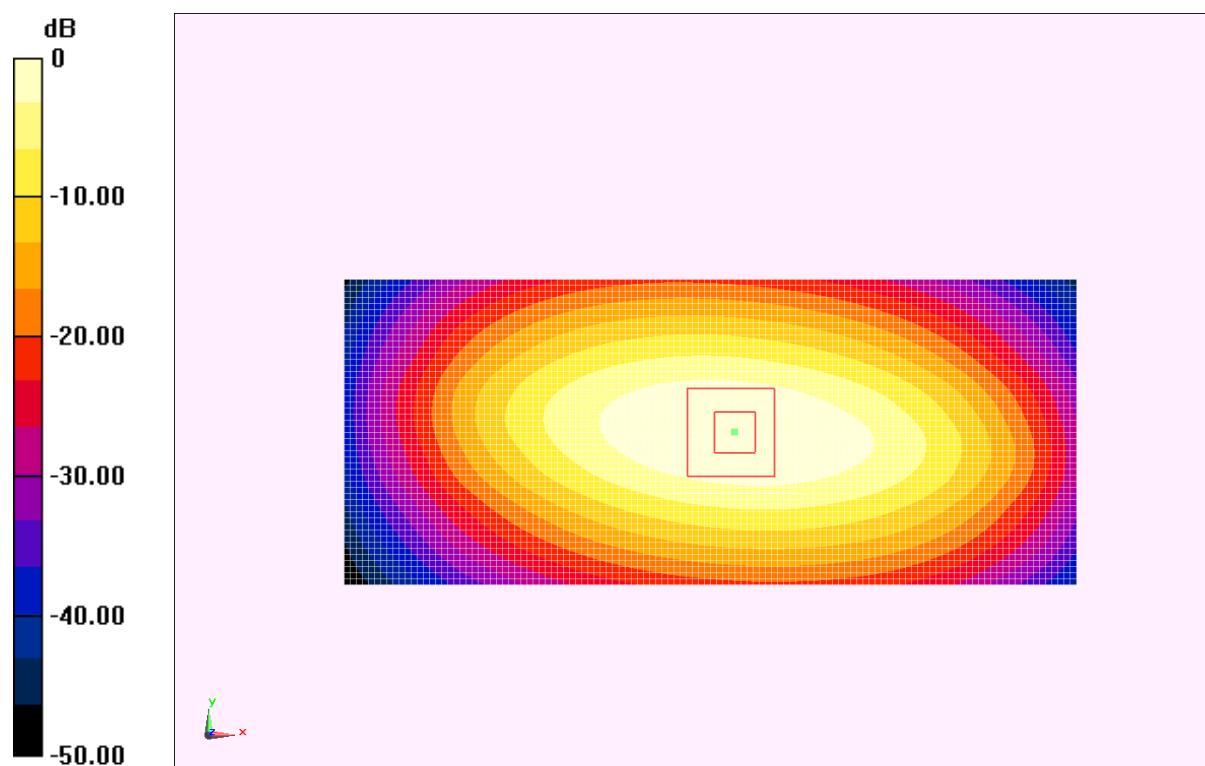
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 51.917 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 3.54 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.61 W/kg

Maximum value of SAR (measured) = 2.52 W/kg



$$0 \text{ dB} = 2.52 \text{ W/kg} = 4.01 \text{ dBW/kg}$$

Fig.B.7 validation 835MHz 250mW

1750MHz

Date: 2016-11-24

Electronics: DAE4 Sn1331

Medium: Body 1750 MHz

Medium parameters used: $f=1750$ MHz; $\sigma = 1.489$ mho/m; $\epsilon_r = 53.11$; $\rho = 1000$ kg/m³

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.10, 8.10, 8.10)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 96.035 V/m; Power Drift = -0.02 dB

Fast SAR: SAR(1 g) = 9.34 W/kg; SAR(10 g) = 5.01 W/kg

Maximum value of SAR (interpolated) = 10.2 W/kg

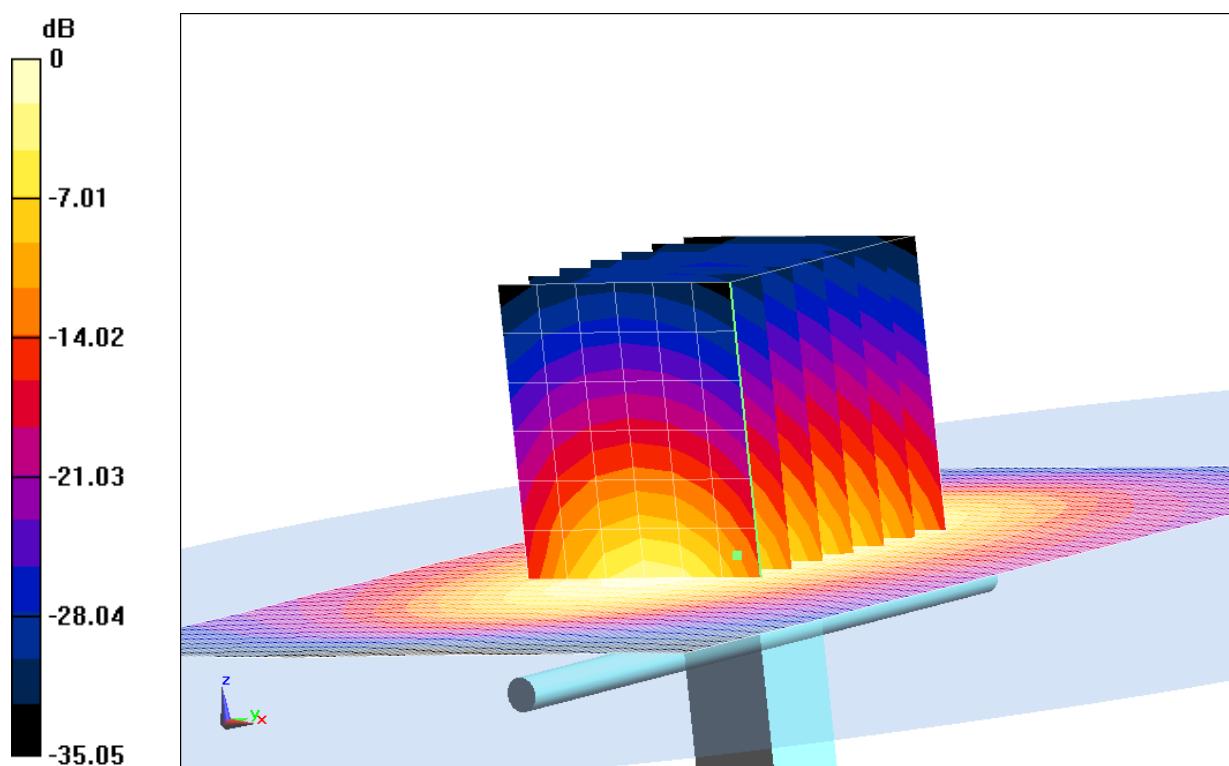
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.039 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.25 W/kg

SAR(1 g) = 9.31 W/kg; SAR(10 g) = 4.92 W/kg

Maximum value of SAR (measured) = 10.25 W/kg



0 dB = 10.25 W/kg = 10.11 dB W/kg

Fig.B.8 validation 1750MHz 250mW

1900MHz

Date: 2016-11-25

Electronics: DAE4 Sn1331

Medium: Body 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.531 \text{ S/m}$; $\epsilon_r = 53.24$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.67, 7.67, 7.67)

System validation /Area Scan (81x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 60.572 V/m; Power Drift = 0.02 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 10.11 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 5.29 \text{ W/kg}$

Maximum value of SAR (interpolated) = 12.6 W/kg

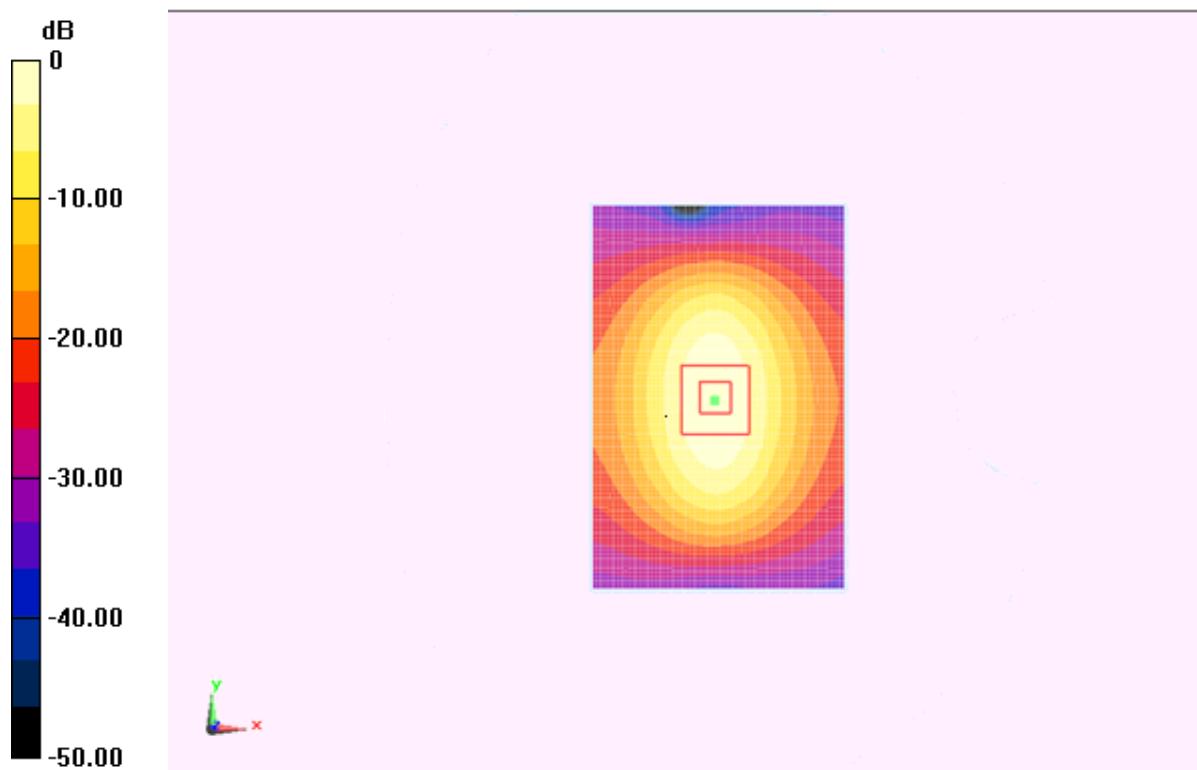
System validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 60.572 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 19.26 W/kg

SAR(1 g) = 10.03 W/kg; SAR(10 g) = 5.34 W/kg

Maximum value of SAR (measured) = 12.44 W/kg



$$0 \text{ dB} = 12.44 \text{ W/kg} = 10.95 \text{ dBW/kg}$$

Fig.B.9 validation 1900MHz 250mW

2450MHz

Date: 2016-11-26

Electronics: DAE4 Sn1331

Medium: Body 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.951 \text{ S/m}$; $\epsilon_r = 52.78$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.0°C Liquid Temperature: 22.5°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.36, 7.36, 7.36)

System Validation/Area Scan (81x101x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 88.921 V/m; Power Drift = 0.07 dB

SAR(1 g) = 12.79 W/kg; SAR(10 g) = 5.97 W/kg

Maximum value of SAR (interpolated) = 14.2 W/kg

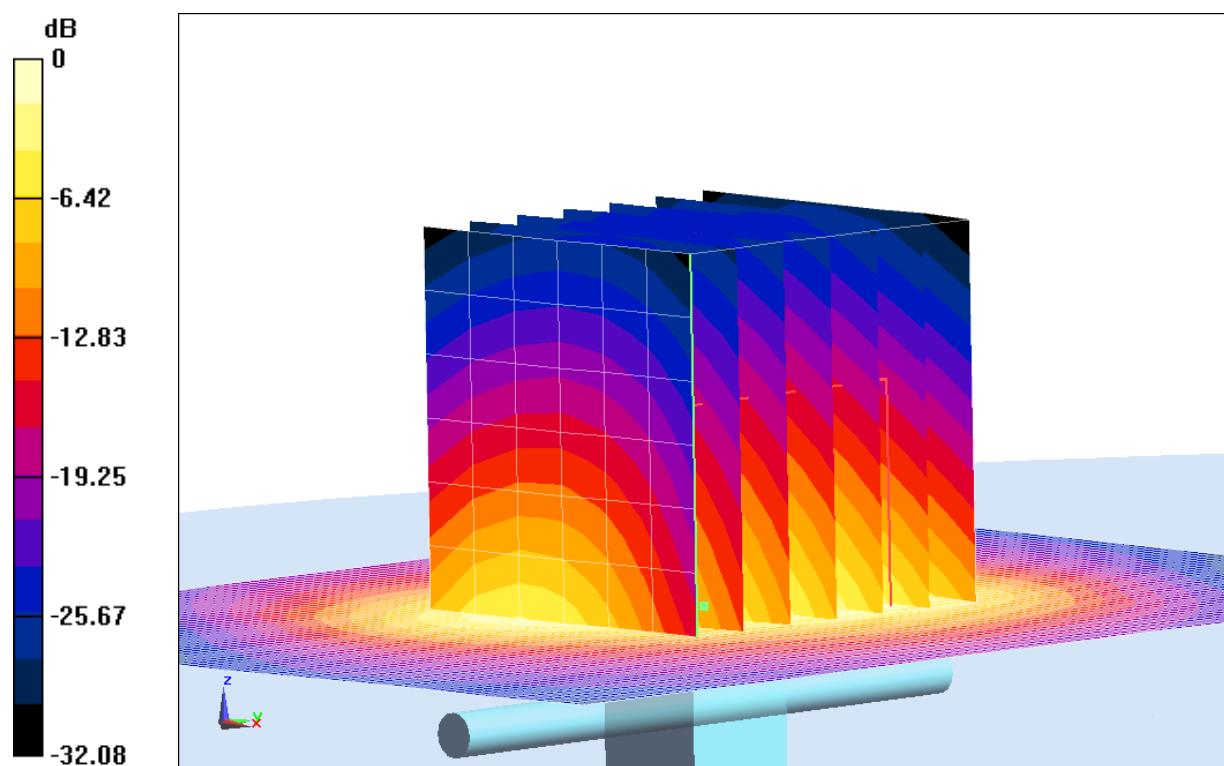
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 88.921 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 24.62 W/kg

SAR(1 g) = 12.81 W/kg; SAR(10 g) = 6.03 W/kg

Maximum value of SAR (measured) = 14.39 W/kg



$0 \text{ dB} = 14.39 \text{ W/kg} = 11.58 \text{ dB W/kg}$

Fig.B.10 validation 2450MHz 250mW

750MHz

Date: 2017-2-14

Electronics: DAE4 Sn1331

Medium: Head 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.895 \text{ mho/m}$; $\epsilon_r = 41.32$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7307 ConvF(10.47, 10.47, 10.47)

System Validation /Area Scan (81x191x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 49.509 V/m; Power Drift = -0.01 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.07 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.35 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.19 W/kg

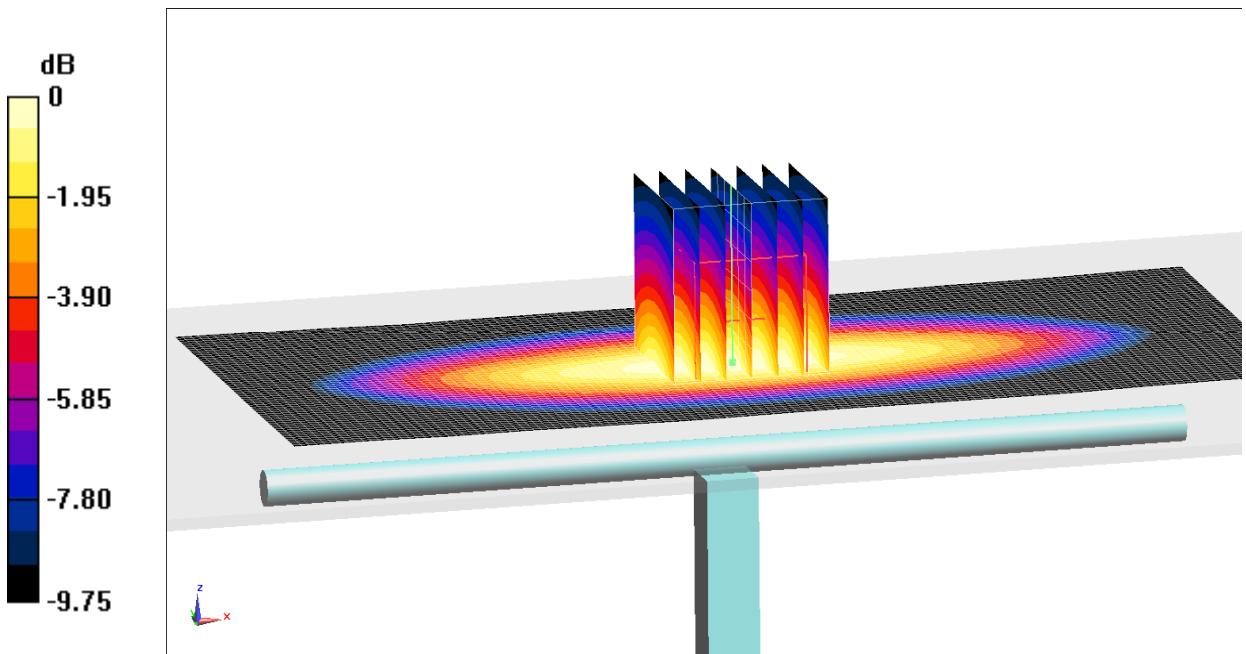
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 49.509 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 2.85 W/kg

SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.34 W/kg

Maximum value of SAR (measured) = 2.15 W/kg



$$0 \text{ dB} = 2.15 \text{ W/kg} = 3.32 \text{ dB W/kg}$$

Fig.B.11 validation 750MHz 250mW

750MHz

Date: 2017-2-14

Electronics: DAE4 Sn1331

Medium: Body750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.956 \text{ mho/m}$; $\epsilon_r = 54.89$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 750 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7307 ConvF(9.93, 9.93, 9.93)

System Validation/Area Scan (81x191x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 52.673 V/m; Power Drift = 0.06 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.26 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.49 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.44 W/kg

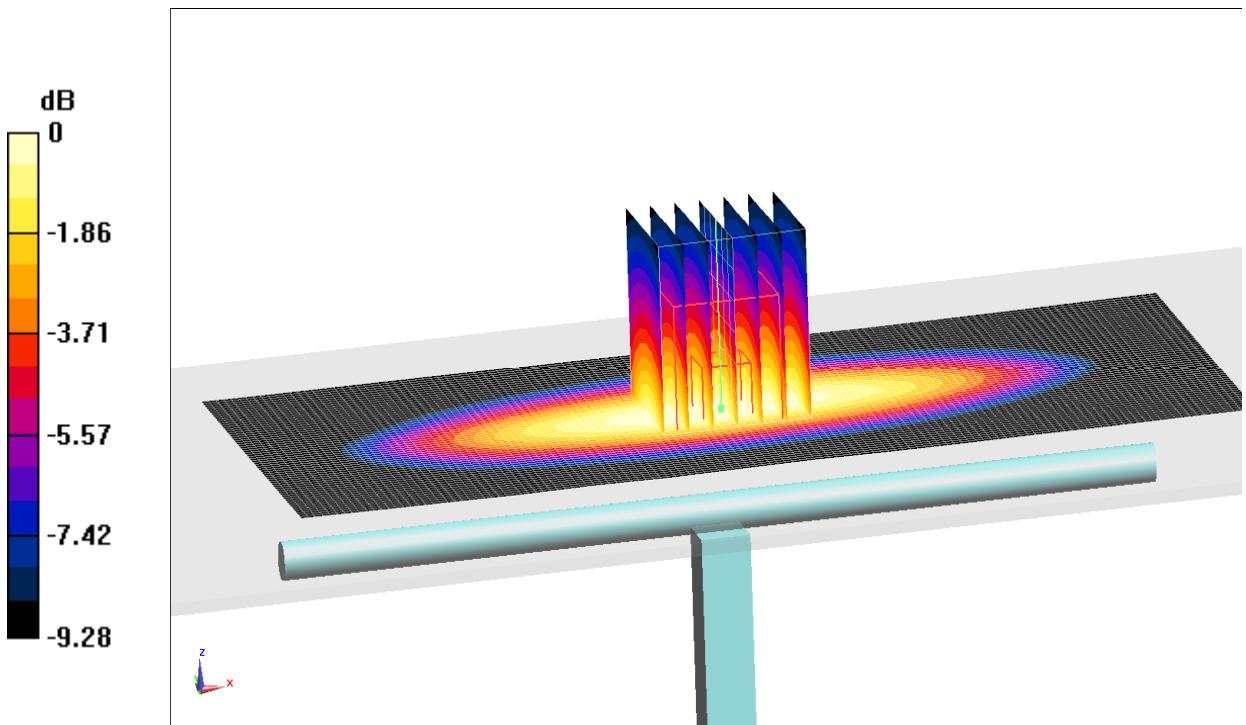
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.673 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 3.13 W/kg

SAR(1 g) = 2.28 W/kg; SAR(10 g) = 1.46 W/kg

Maximum value of SAR (measured) = 2.43 W/kg



$$0 \text{ dB} = 2.43 \text{ W/kg} = 3.86 \text{ dB W/kg}$$

Fig.B.12 validation 750MHz 250mW

835MHz

Date: 2017-2-15

Electronics: DAE4 Sn1331

Medium: Head 850 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.896 \text{ S/m}$; $\epsilon_r = 41.26$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(10.01, 10.01, 10.01)

System Validation /Area Scan (81x161x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 53.33 V/m; Power Drift = 0.08 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.33 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.54 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.60 W/kg

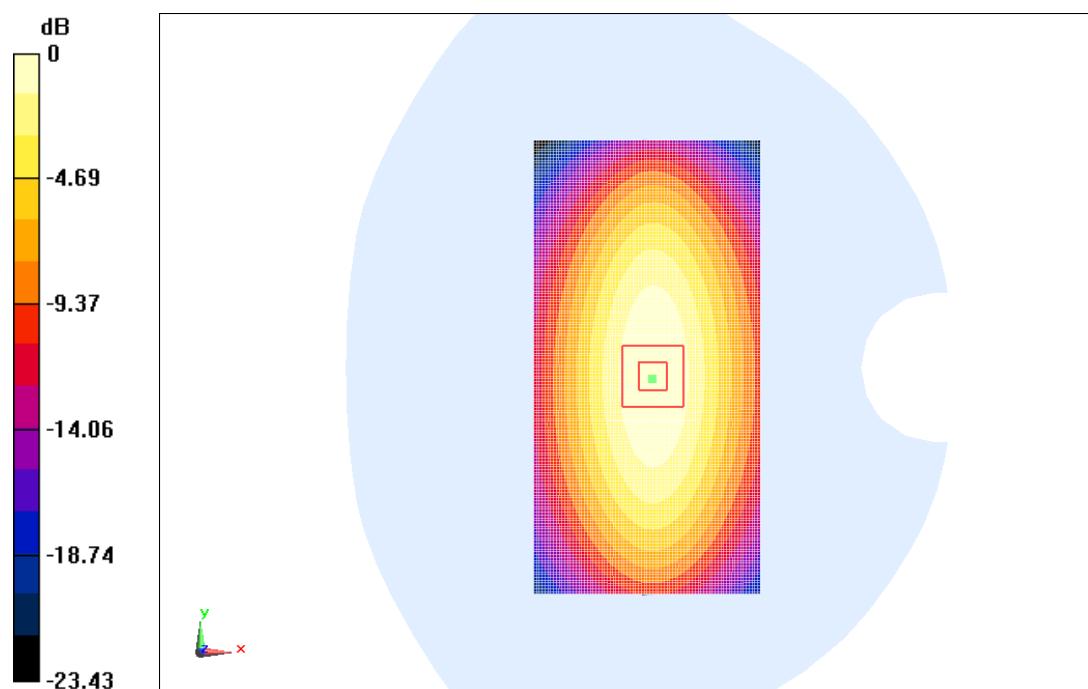
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 53.33 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 3.68 W/kg

SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.51 W/kg

Maximum value of SAR (measured) = 2.61 W/kg



$$0 \text{ dB} = 2.61 \text{ W/kg} = 4.17 \text{ dBW/kg}$$

Fig.B.13 validation 835MHz 250mW

835MHz

Date: 2017-2-15

Electronics: DAE4 Sn1331

Medium: Body 850 MHz

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.961 \text{ S/m}$; $\epsilon_r = 56.21$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 835 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(9.83, 9.83, 9.83)

System Validation /Area Scan (81x171x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 51.81 V/m; Power Drift = -0.01 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 2.37 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 1.51 \text{ W/kg}$

Maximum value of SAR (interpolated) = 2.54 W/kg

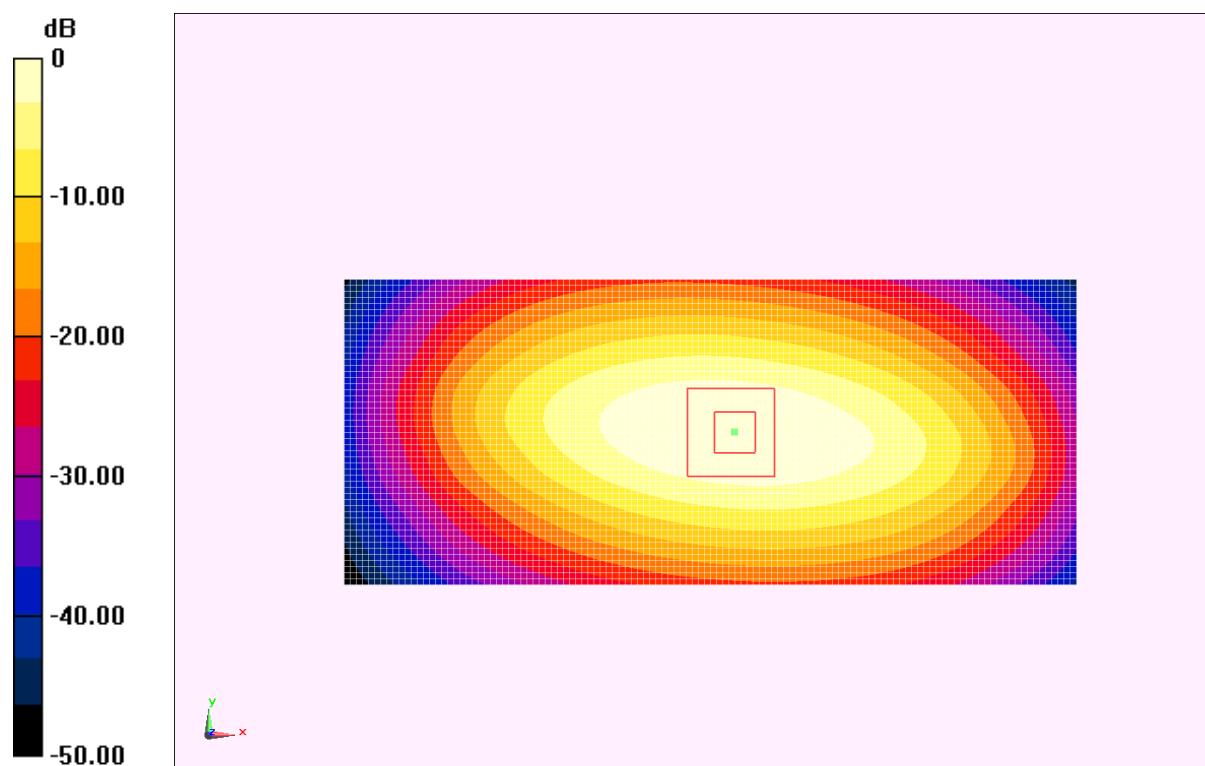
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 51.81 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.55 W/kg

SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.55 W/kg

Maximum value of SAR (measured) = 2.58 W/kg



$$0 \text{ dB} = 2.58 \text{ W/kg} = 4.12 \text{ dBW/kg}$$

Fig.B.14 validation 835MHz 250mW

1750MHz

Date: 2017-2-16

Electronics: DAE4 Sn1331

Medium: Head 1750 MHz

Medium parameters used: $f=1750$ MHz; $\sigma = 1.356$ mho/m; $\epsilon_r = 39.37$; $\rho = 1000$ kg/m 3

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7307 ConvF(8.37, 8.37, 8.37)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 93.198 V/m; Power Drift = -0.02 dB

Fast SAR: SAR(1 g) = 9.21 W/kg; SAR(10 g) = 4.81 W/kg

Maximum value of SAR (interpolated) = 10.1 W/kg

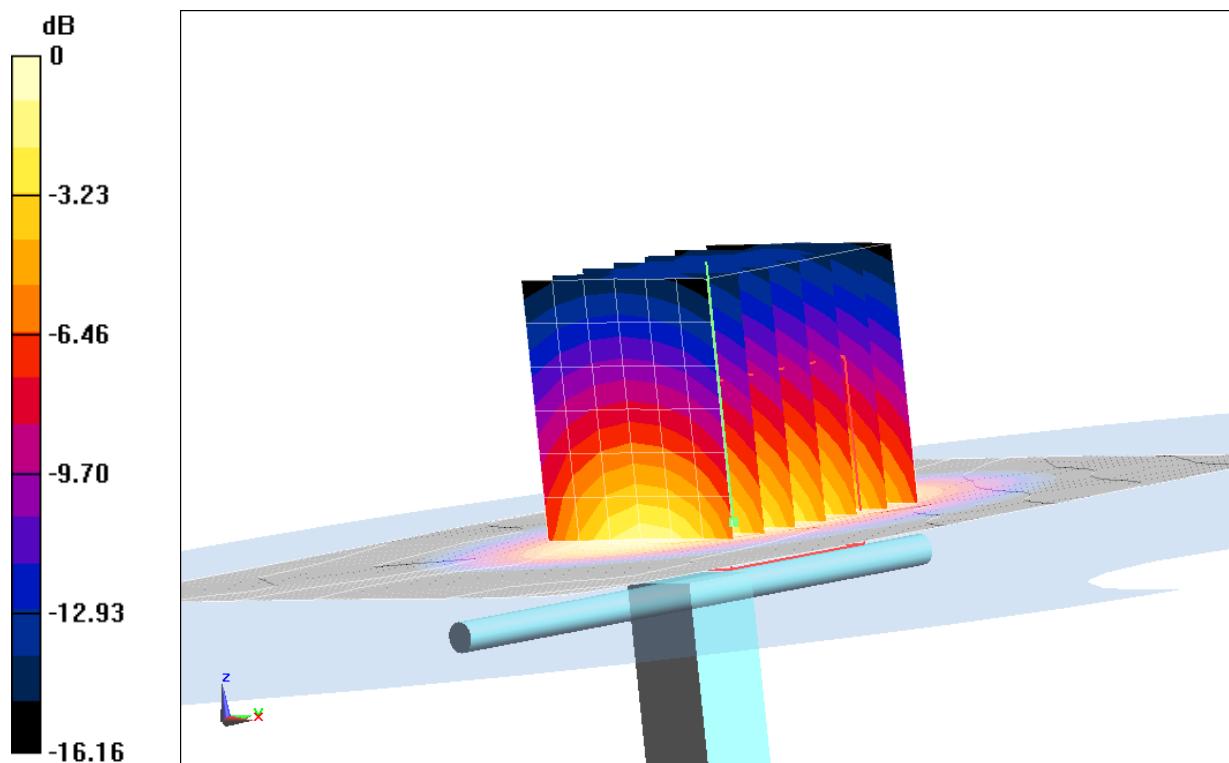
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.198 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 15.73 W/kg

SAR(1 g) = 9.24 W/kg; SAR(10 g) = 4.87 W/kg

Maximum value of SAR (measured) = 10.25 W/kg



$$0 \text{ dB} = 10.25 \text{ W/kg} = 10.11 \text{ dB W/kg}$$

Fig.B.15 validation 1750MHz 250mW

1750MHz

Date: 2017-2-16

Electronics: DAE4 Sn1331

Medium: Body 1750 MHz

Medium parameters used: $f=1750$ MHz; $\sigma = 1.469$ mho/m; $\epsilon_r = 52.23$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 1750 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.18, 8.18, 8.18)

System Validation/Area Scan (81x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 95.74 V/m; Power Drift = -0.04 dB

Fast SAR: SAR(1 g) = 9.16 W/kg; SAR(10 g) = 5.03 W/kg

Maximum value of SAR (interpolated) = 10.2 W/kg

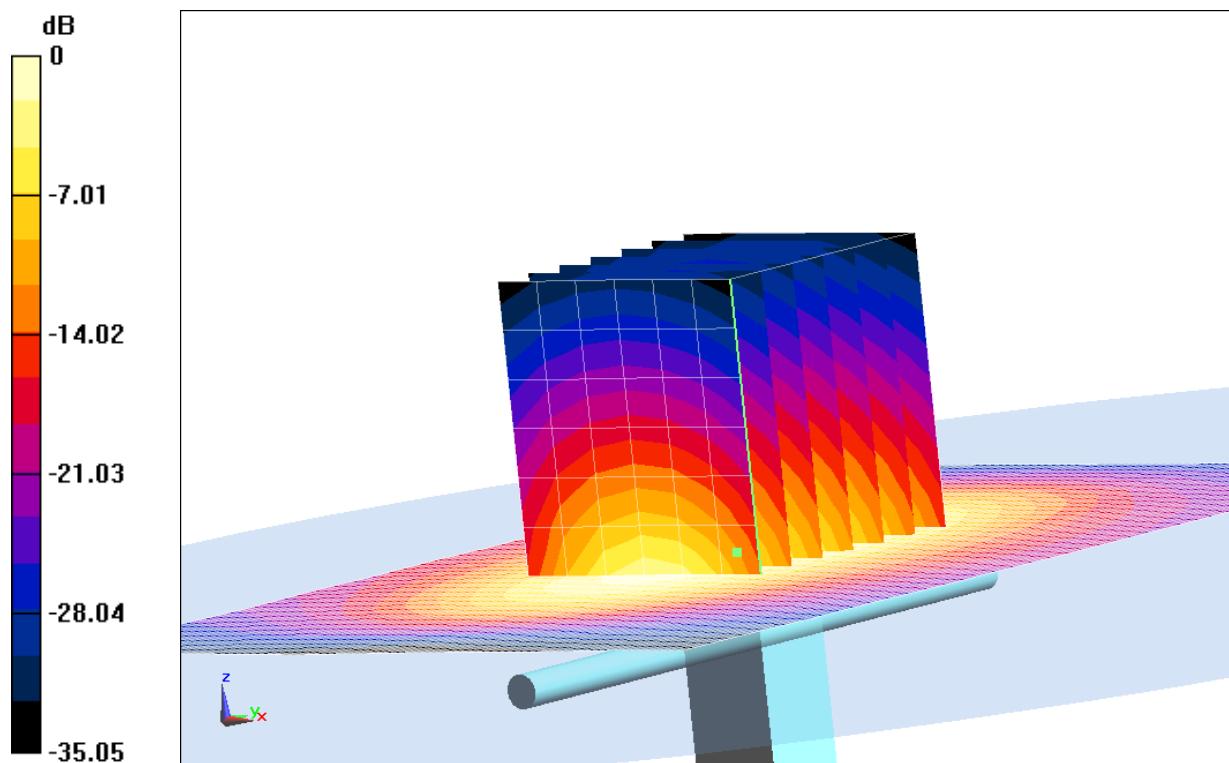
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.74 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 16.24 W/kg

SAR(1 g) = 9.18 W/kg; SAR(10 g) = 5.04 W/kg

Maximum value of SAR (measured) = 10.23 W/kg



$$0 \text{ dB} = 10.23 \text{ W/kg} = 10.10 \text{ dB W/kg}$$

Fig.B.16 validation 1750MHz 250mW

1900MHz

Date: 2017-2-17

Electronics: DAE4 Sn1331

Medium: Head 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.405 \text{ S/m}$; $\epsilon_r = 39.95$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN7307 ConvF(8.10, 8.10, 8.10)

System Validation /Area Scan (81x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 93.723 V/m; Power Drift = 0.05 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 10.43 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 5.51 \text{ W/kg}$

Maximum value of SAR (interpolated) = 12.0 W/kg

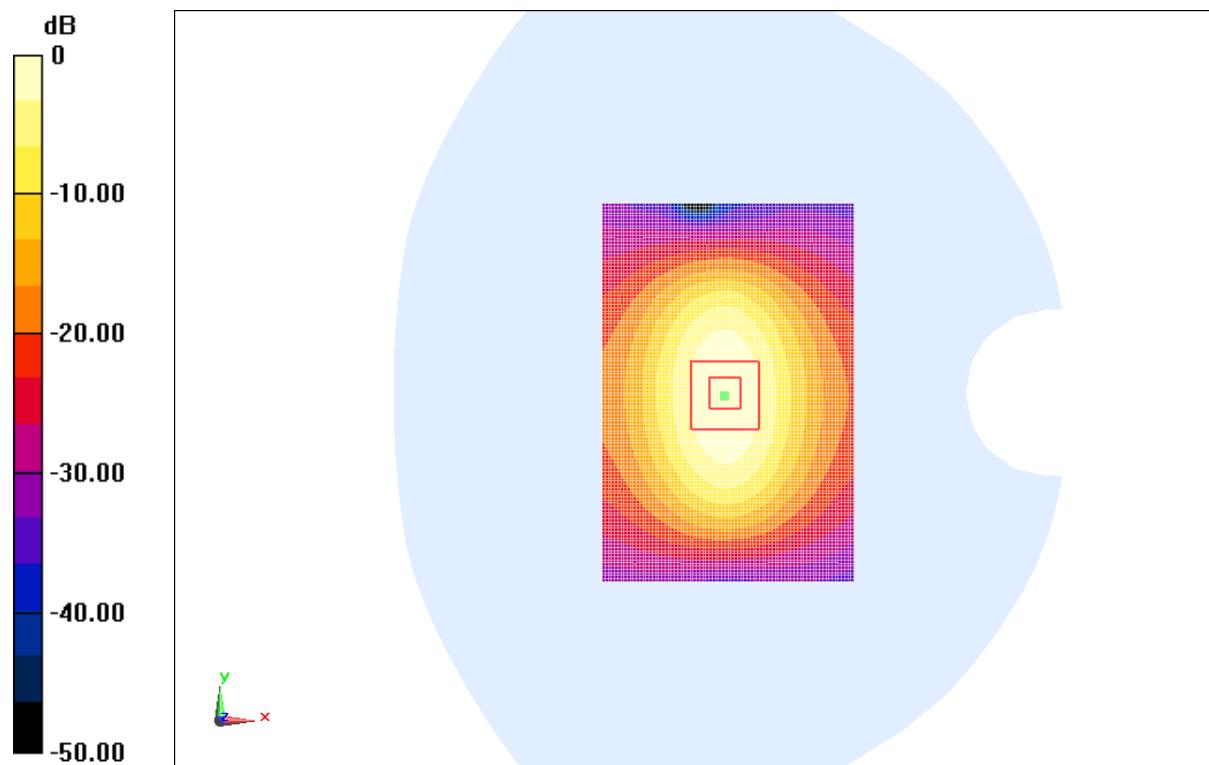
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 93.723 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.91 W/kg

SAR(1 g) = 10.41 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 11.82 W/kg



$$0 \text{ dB} = 11.82 \text{ W/kg} = 10.73 \text{ dBW/kg}$$

Fig.B.17 validation 1900MHz 250mW

1900MHz

Date: 2017-2-17

Electronics: DAE4 Sn1331

Medium: Body 1900 MHz

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.511 \text{ S/m}$; $\epsilon_r = 53.11$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 1900 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.67, 7.67, 7.67)

System validation /Area Scan (81x121x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 57.81 V/m; Power Drift = -0.02 dB

Fast SAR: $\text{SAR}(1 \text{ g}) = 10.13 \text{ W/kg}$; $\text{SAR}(10 \text{ g}) = 5.31 \text{ W/kg}$

Maximum value of SAR (interpolated) = 12.4 W/kg

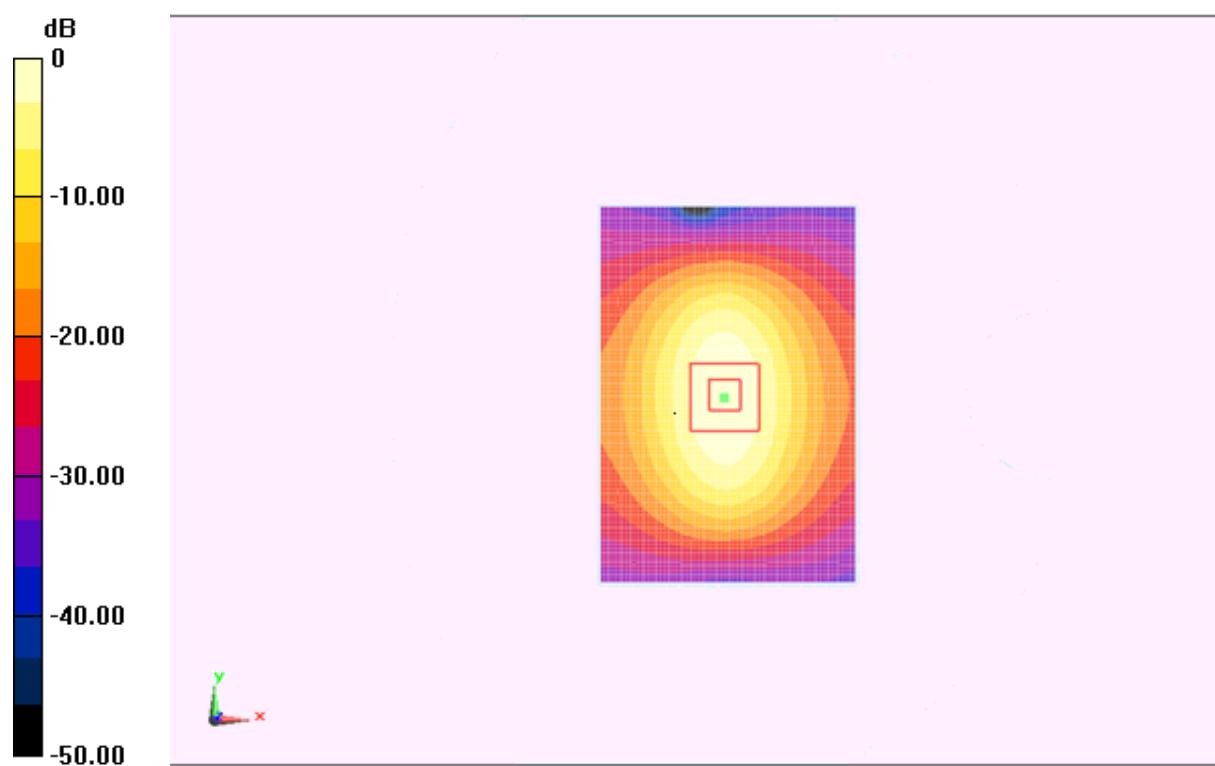
System validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 57.81 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 19.01 W/kg

SAR(1 g) = 10.11 W/kg; SAR(10 g) = 5.26 W/kg

Maximum value of SAR (measured) = 12.22 W/kg



$$0 \text{ dB} = 12.22 \text{ W/kg} = 10.87 \text{ dBW/kg}$$

Fig.B.18 validation 1900MHz 250mW

2450MHz

Date: 2017-2-18

Electronics: DAE4 Sn1331

Medium: Head 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.835 \text{ mho/m}$; $\epsilon_r = 38.86$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(8.37, 8.37, 8.37)

System Validation /Area Scan (61x81x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 90.13 V/m; Power Drift = -0.02 dB

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.10 W/kg

Maximum value of SAR (interpolated) = 17.1 W/kg

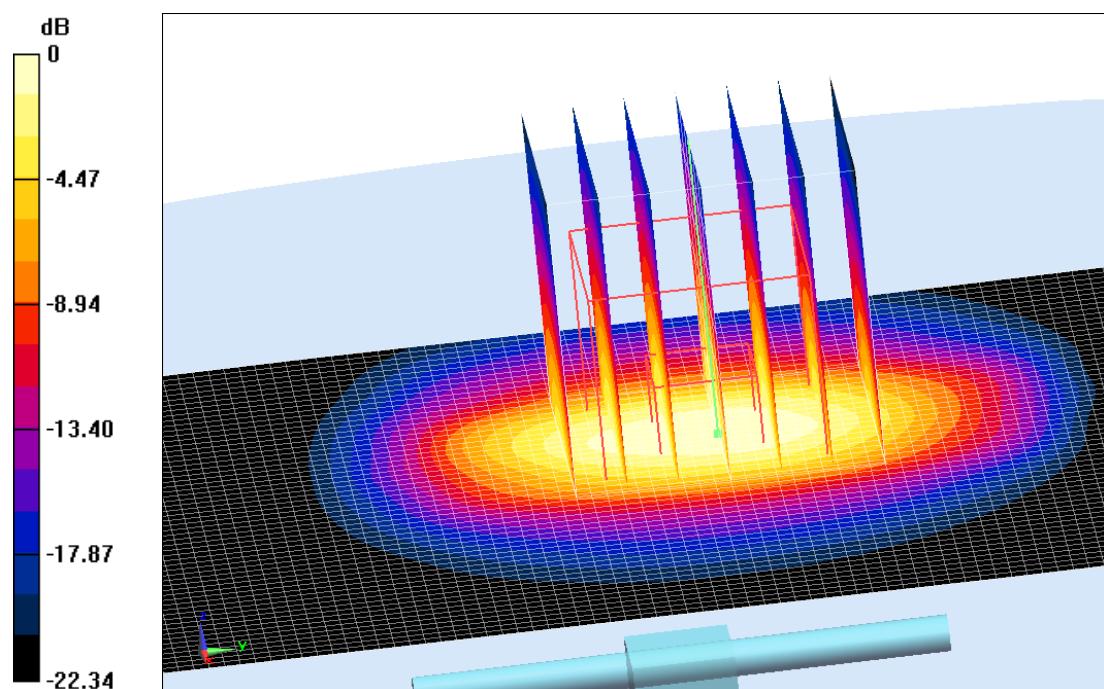
System Validation /Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 90.13 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.37 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.12 W/kg

Maximum value of SAR (measured) = 16.39 W/kg



0 dB = 16.39 W/kg = 12.15 dBW/kg

Fig.B.19 validation 2450MHz 250mW

2450MHz

Date: 2017-2-18

Electronics: DAE4 Sn1331

Medium: Body 2450 MHz

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.989 \text{ S/m}$; $\epsilon_r = 51.98$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.5°C Liquid Temperature: 22.0°C

Communication System: CW Frequency: 2450 MHz Duty Cycle: 1:1

Probe: EX3DV4 – SN7307 ConvF(7.36, 7.36, 7.36)

System Validation/Area Scan (81x101x1): Interpolated grid: $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 88.921 V/m; Power Drift = 0.07 dB

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 6.08 W/kg

Maximum value of SAR (interpolated) = 14.2 W/kg

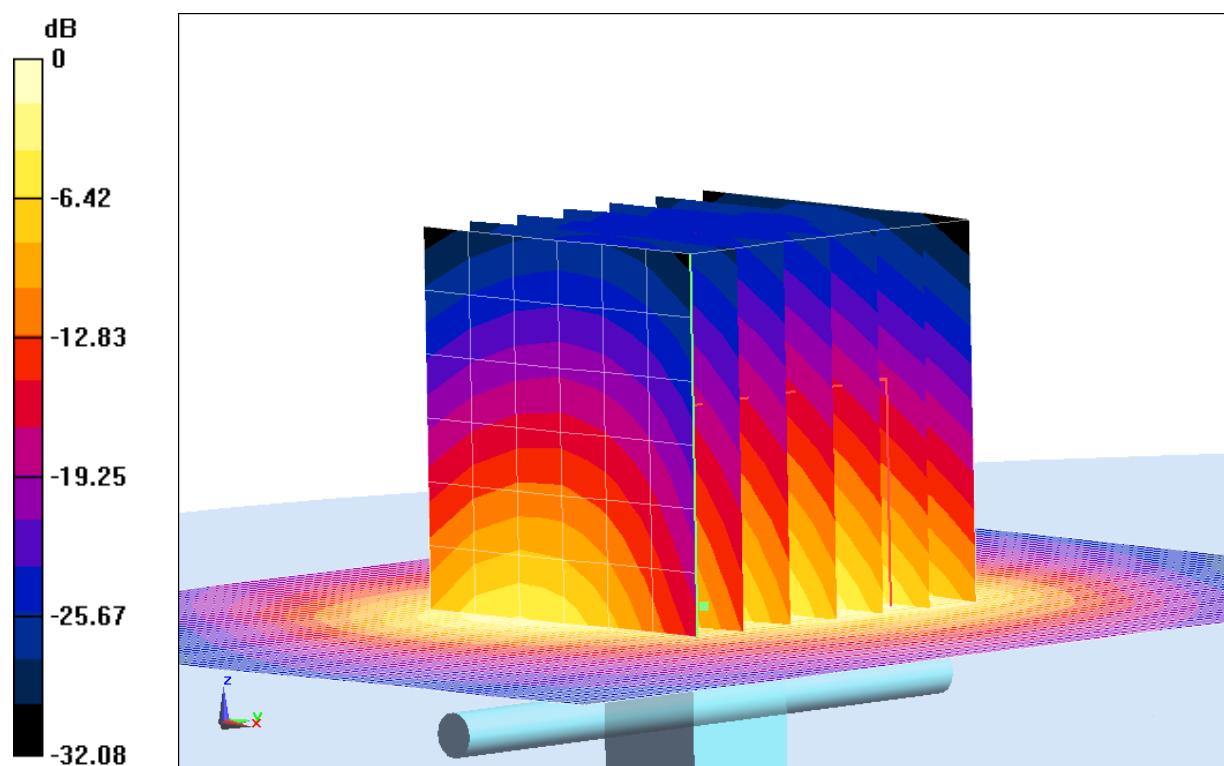
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 88.921 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 24.62 W/kg

SAR(1 g) = 12.7 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 14.39 W/kg



0 dB = 14.39 W/kg = 11.58 dB W/kg

Fig.B.20 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.

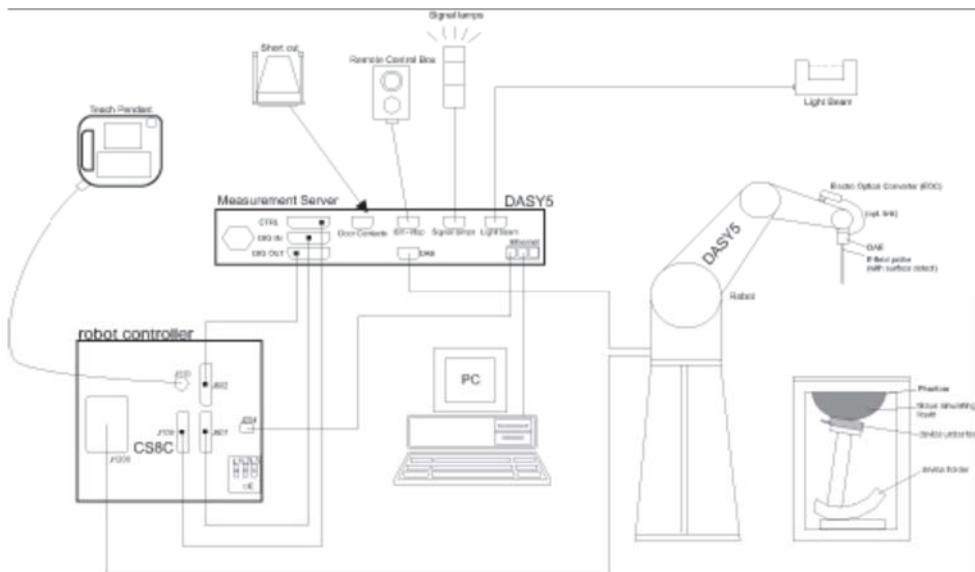
Table B.1 Comparison between area scan and zoom scan for system verification

Date	Band	Position	Area scan (1g)	Zoom scan (1g)	Drift (%)
2016-11-22	750	Head	2.09	2.07	0.97
	750	Body	2.16	2.17	-0.46
2016-11-23	835	Head	2.26	2.27	-0.44
	835	Body	2.38	2.36	0.85
2016-11-24	1750	Head	9.22	9.24	-0.22
	1750	Body	9.34	9.31	0.32
2016-11-25	1900	Head	10.6	10.5	0.95
	1900	Body	10.11	10.05	0.60
2016-11-26	2450	Head	13.25	13.28	-0.23
	2450	Body	12.79	12.81	-0.16
2017-2-14	750	Head	2.07	2.05	0.98
	750	Body	2.26	2.28	-0.88
2017-2-15	835	Head	2.33	2.38	-2.10
	835	Body	2.37	2.42	-2.07
2017-2-16	1750	Head	9.21	9.24	-0.32
	1750	Body	9.16	9.18	-0.22
2017-2-17	1900	Head	10.43	10.41	0.19
	1900	Body	10.13	10.11	0.20
2017-2-18	2450	Head	13.2	13.1	0.76
	2450	Body	12.6	12.7	-0.79

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 during 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	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
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/cm²) 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 in 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/ cm².

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/m³).

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 MΩ; 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 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 $\pm 0.5\text{mm}$ would produce a SAR uncertainty of $\pm 20\%$. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

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

The DASY device holder is constructed of low-loss POM material having the following dielectric

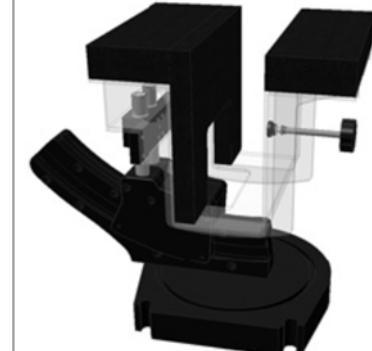
parameters: relative permittivity $\epsilon_r = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

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



Picture C.9-1: Device Holder



Picture C.9-2: Laptop Extension Kit

C.4.5 Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: 810 x 1000 x 500 mm (H x L x W)

Available: Special

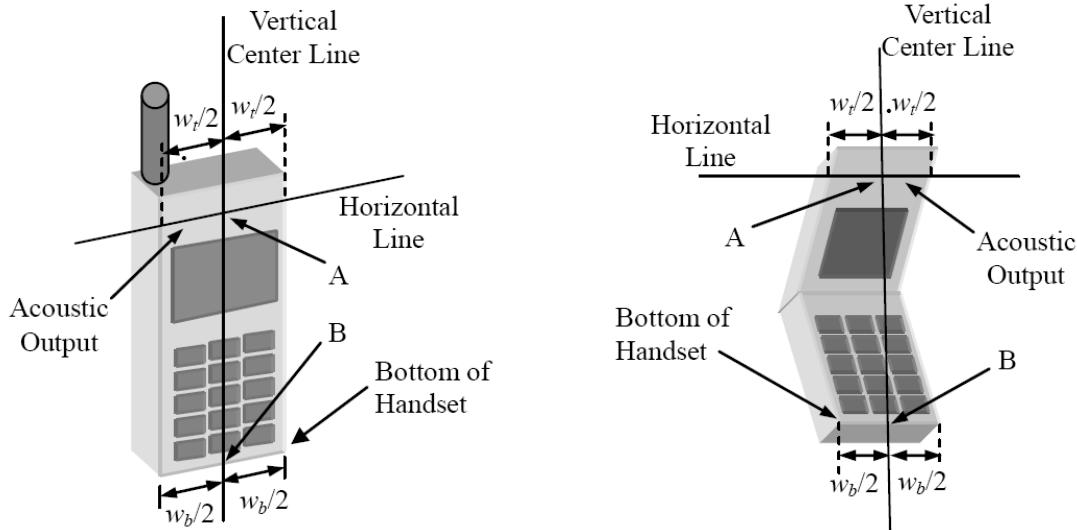


Picture C.10: SAM Twin Phantom

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

D.1 General considerations

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



w_t

Width of the handset at the level of the acoustic

w_b

Width of the bottom of the handset

A

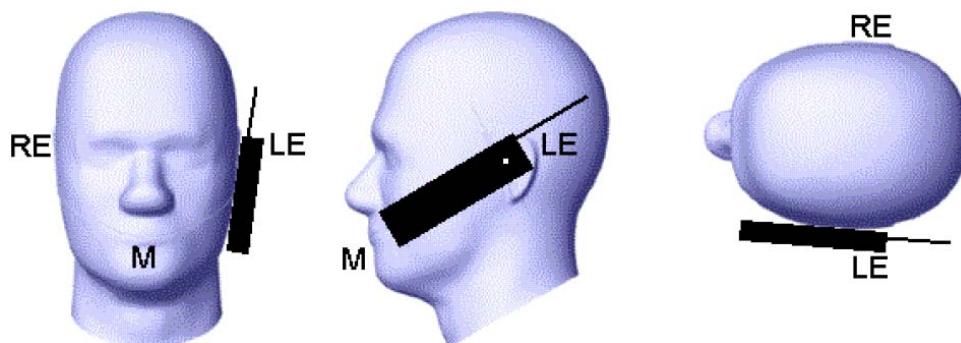
Midpoint of the width w_t of the handset at the level of the acoustic output

B

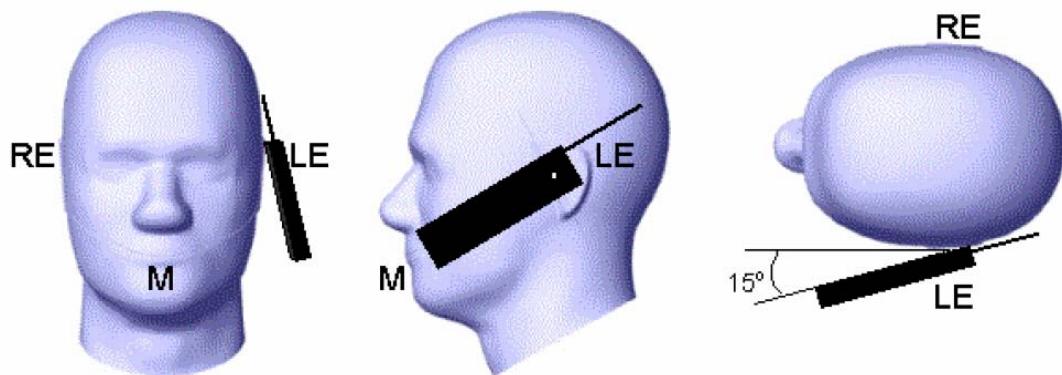
Midpoint of the width w_b of the bottom of the handset

Picture D.1-a Typical “fixed” case handset

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



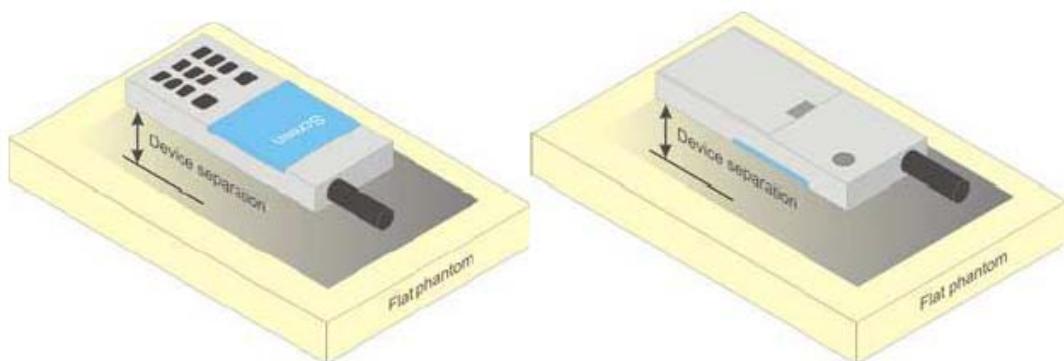
Picture D.2 Cheek position of the wireless device on the left side of SAM



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

D.2 Body-worn device

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

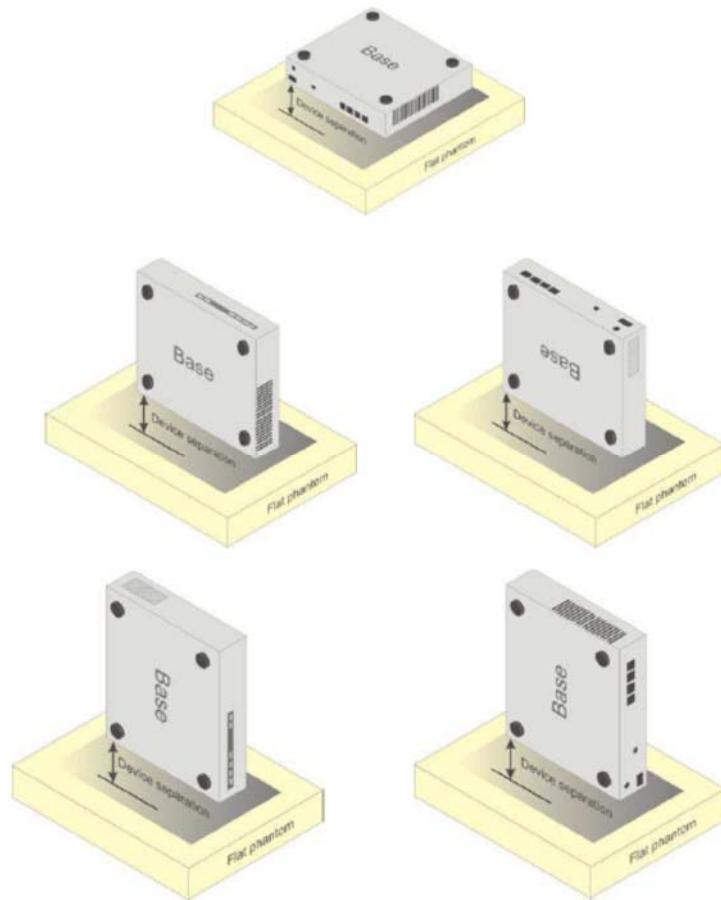


Picture D.4 Test positions for body-worn devices

D.3 Desktop device

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

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



Picture D.5 Test positions for desktop devices

D.4 DUT Setup Photos



Picture D.6

ANNEX E Equivalent Media Recipes

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

Table E.1: Composition of the Tissue Equivalent Matter

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

Note: There are a little adjustment respectively for 750, 1750 based on the recipe of closest frequency in table E.1.

ANNEX F System Validation

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

Table F.1: System Validation for 7307

Probe SN.	Liquid name	Validation date	Frequency point	Status (OK or Not)
7307	Head 750MHz	Mar.15,2016	750 MHz	OK
7307	Head 850MHz	Mar.15,2016	850 MHz	OK
7307	Head 900MHz	Mar.16,2016	900 MHz	OK
7307	Head 1450MHz	Mar.16,2016	1450 MHz	OK
7307	Head 1640MHz	Mar.17,2016	1640 MHz	OK
7307	Head 1750MHz	Mar.17,2016	1750 MHz	OK
7307	Head 1810MHz	Mar.18,2016	1810 MHz	OK
7307	Head 1900MHz	Mar.18,2016	1900 MHz	OK
7307	Head 2000MHz	Mar.19,2016	2000 MHz	OK
7307	Head 2100MHz	Mar.19,2016	2100 MHz	OK
7307	Head 2300MHz	Mar. 20,2016	2300 MHz	OK
7307	Head 2450MHz	Mar.20,2016	2450 MHz	OK
7307	Head 2600MHz	Mar.21,2016	2600 MHz	OK
7307	Head 3500MHz	Mar.21,2016	3500 MHz	OK
7307	Head 3700MHz	Mar.22,2016	3700 MHz	OK
7307	Head 5200MHz	Mar.22,2016	5200 MHz	OK
7307	Head 5300MHz	Mar.23,2016	5300 MHz	OK
7307	Head 5500MHz	Mar.23,2016	5500 MHz	OK
7307	Head 5600MHz	Mar.24,2016	5600 MHz	OK
7307	Head 5800MHz	Mar.24,2016	5800 MHz	OK
7307	Body 750MHz	Mar.15,2016	750 MHz	OK
7307	Body 850MHz	Mar.15,2016	850 MHz	OK
7307	Body 900MHz	Mar.16,2016	900 MHz	OK
7307	Body 1450MHz	Mar.16,2016	1450 MHz	OK
7307	Body 1640MHz	Mar.17,2016	1640 MHz	OK
7307	Body 1750MHz	Mar.17,2016	1750 MHz	OK
7307	Body 1810MHz	Mar.18,2016	1810 MHz	OK
7307	Body 1900MHz	Mar.18,2016	1900 MHz	OK
7307	Body 2000MHz	Mar.19,2016	2000 MHz	OK
7307	Body 2100MHz	Mar.19,2016	2100 MHz	OK
7307	Body 2300MHz	Mar. 20,2016	2300 MHz	OK
7307	Body 2450MHz	Mar.20,2016	2450 MHz	OK
7307	Body 2600MHz	Mar.21,2016	2600 MHz	OK
7307	Body 3500MHz	Mar.21,2016	3500 MHz	OK
7307	Body 3700MHz	Mar.22,2016	3700 MHz	OK
7307	Body 5200MHz	Mar.22,2016	5200 MHz	OK



ANNEX G Probe Calibration Certificate

Probe 7307 Calibration Certificate

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



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

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

Accreditation No.: SCS 0108

Client

CTTL (Auden)

Certificate No: EX3-7307_Feb16

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7307
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 19, 2016
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.	
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	
Calibration Equipment used (M&TE critical for calibration)	

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: February 20, 2016

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

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



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

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

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORM x,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORM x,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency_response$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCPx,y,z$: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR : PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- $Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z; A, B, C, D$ are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle*: The angle is assessed using the information gained by determining the $NORM_x$ (no uncertainty required).



EX3DV4 – SN:7307

February 19, 2016

Probe EX3DV4

SN:7307

Manufactured: March 11, 2014
Calibrated: February 19, 2016

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



EX3DV4- SN:7307

February 19, 2016

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7307

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.40	0.62	0.65	$\pm 10.1 \%$
DCP (mV) ^B	101.6	97.3	97.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	146.6	$\pm 3.3 \%$
		Y	0.0	0.0	1.0		133.9	
		Z	0.0	0.0	1.0		135.8	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



DASY/EASY - Parameters of Probe: EX3DV4 - SN:7307

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc (k=2)
750	41.9	0.89	10.47	10.47	10.47	0.50	0.80	± 12.0 %
835	41.5	0.90	10.01	10.01	10.01	0.49	0.83	± 12.0 %
900	41.5	0.97	9.82	9.82	9.82	0.43	0.85	± 12.0 %
1450	40.5	1.20	8.72	8.72	8.72	0.43	0.80	± 12.0 %
1640	40.3	1.29	8.46	8.46	8.46	0.31	0.85	± 12.0 %
1750	40.1	1.37	8.37	8.37	8.37	0.39	0.80	± 12.0 %
1810	40.0	1.40	8.14	8.14	8.14	0.36	0.83	± 12.0 %
1900	40.0	1.40	8.10	8.10	8.10	0.34	0.85	± 12.0 %
2000	40.0	1.40	8.02	8.02	8.02	0.39	0.84	± 12.0 %
2100	39.8	1.49	8.22	8.22	8.22	0.31	0.85	± 12.0 %
2300	39.5	1.67	7.65	7.65	7.65	0.41	0.80	± 12.0 %
2450	39.2	1.80	7.36	7.36	7.36	0.44	0.80	± 12.0 %
2600	39.0	1.96	7.21	7.21	7.21	0.50	0.80	± 12.0 %
3500	37.9	2.91	7.11	7.11	7.11	0.45	0.89	± 13.1 %
3700	37.7	3.12	6.65	6.65	6.65	0.31	1.23	± 13.1 %
5200	36.0	4.66	5.32	5.32	5.32	0.35	1.80	± 13.1 %
5300	35.9	4.76	5.02	5.02	5.02	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.85	4.85	4.85	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.52	4.52	4.52	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.45	4.45	4.45	0.50	1.80	± 13.1 %

^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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