Shenzhen Academy of Information and Communications Technology

SAR TEST REPORT

No. B17N01624-SAR

For

Roam Data Inc.

POS Tablet

Model Name: Moby/M70

With

Hardware Version: 9888C

Software Version: M70

FCC: 2ABY6-M70

Issued Date: 2017-11-30

Designation Number: CN1210

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 SAICT.

Test Laboratory:

Shenzhen Academy of Information and Communications Technology

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
B17N01624-SAR	Rev.0	2017-11-30	Initial creation of test report

TABLE OF CONTENT

1 Test Laboratory

1.1 Testing Location

Company Name:	Shenzhen Academy of Information and Communications Technology
Address:	Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, China

1.2 Testing Environment

Temperature:	18°C~25 °C
Relative humidity:	30%~ 70%
Ground system resistance:	< 4Ω
Ambient noise & Reflection:	< 0.012 W/kg

1.3 Project Data

Project Leader:	Zhang Yunzhuan
Test Engineer:	Li Yongfu
Testing Start Date:	November 19, 2017
Testing End Date:	November 20, 2017

1.4 Signature

Li Yongfu

(Prepared this test report)

Zhang Yunzhuan

(Reviewed this test report)

Cao Junfei

Deputy Director of the laboratory

(Approved this test report)

2 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Roam Data Inc. POS Tablet Moby/M70 are as follows:

Table 2.1: Highest Reported SAR (1g)

Exposure Configuration	Technology Band	Highest Reported SAR 1g(W/Kg)	Equipment Class
Body (Data) (Separation Distance 0mm)	WLAN 2.4GHz	0.55	DTS
	WLAN 5GHz	1.34	

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

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

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

The highest reported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.34W/kg(1g).**

3 Client Information

3.1 Applicant Information

Company Name:	Roam Data Inc.
Address /Post:	101 Federal Street, Suite 700, Boston, MA 02110 USA
Contact:	Christopher Rotsaert
Email:	christopher.rotsaert@ingenico.com
Telephone:	857-350-7418
Fax:	/

3.2 Manufacturer Information

Company Name:	Roam Data Inc.
Address /Post:	101 Federal Street, Suite 700, Boston, MA 02110 USA
Contact:	Christopher Rotsaert
Email:	christopher.rotsaert@ingenico.com
Telephone:	857-350-7418
Fax:	/

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

4.1 About EUT

Description:	POS Tablet
Model Name:	Moby/M70
Operating mode(s):	BT, Wi-Fi 2.4G/5G
Tested Tx Frequency:	2412 – 2462 MHz (Wi-Fi 2.4G)
	5180 – 5825 MHz (Wi-Fi 5G)
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Integrated antenna
Hotspot mode:	Support

4.2 Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version
EUT1	/	9888C	M70

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

5 TEST METHODOLOGY

5.1 Applicable Limit Regulations

ANSI C95.1–1999:IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2 Applicable Measurement Standards

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

KDB 447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB 248227 D01 802.11 Wi-Fi SAR v02r02: SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters.

KDB 865664 D01SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz.

KDB 865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations

KDB 616217 D04 SAR for laptop and tablets v01r02: SAR evaluation considerations for laptop, notebook, netbook and tablet computers

6 Specific Absorption Rate (SAR)

6.1 Introduction

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

6.2 SAR Definition

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

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

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

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

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

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

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

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

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

7 Tissue Simulating Liquids

7.1 Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

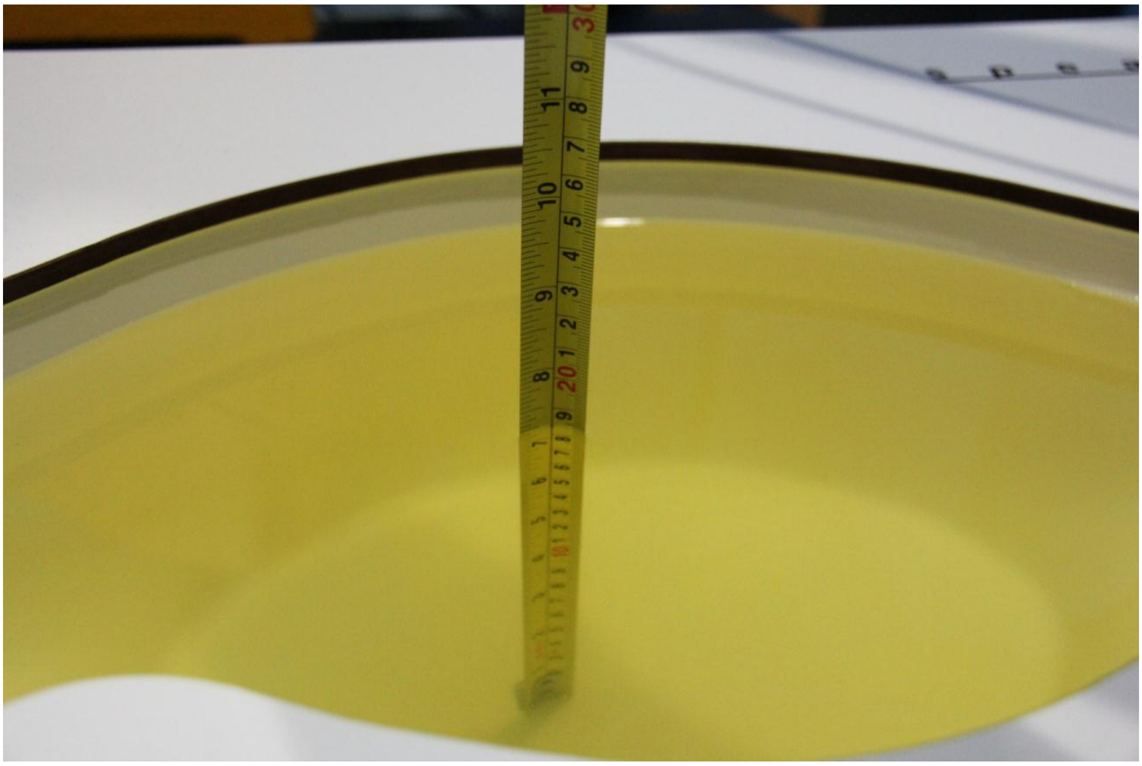
Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
2450	Body	1.95	1.85～2.05	52.7	50.1～55.3
5300	Body	5.42	5.15～5.69	48.9	46.5～51.3
5600	Body	5.77	5.48～6.06	48.5	46.1～50.9
5800	Body	6.00	5.70～6.30	48.2	45.8～50.6

7.2 Dielectric Performance

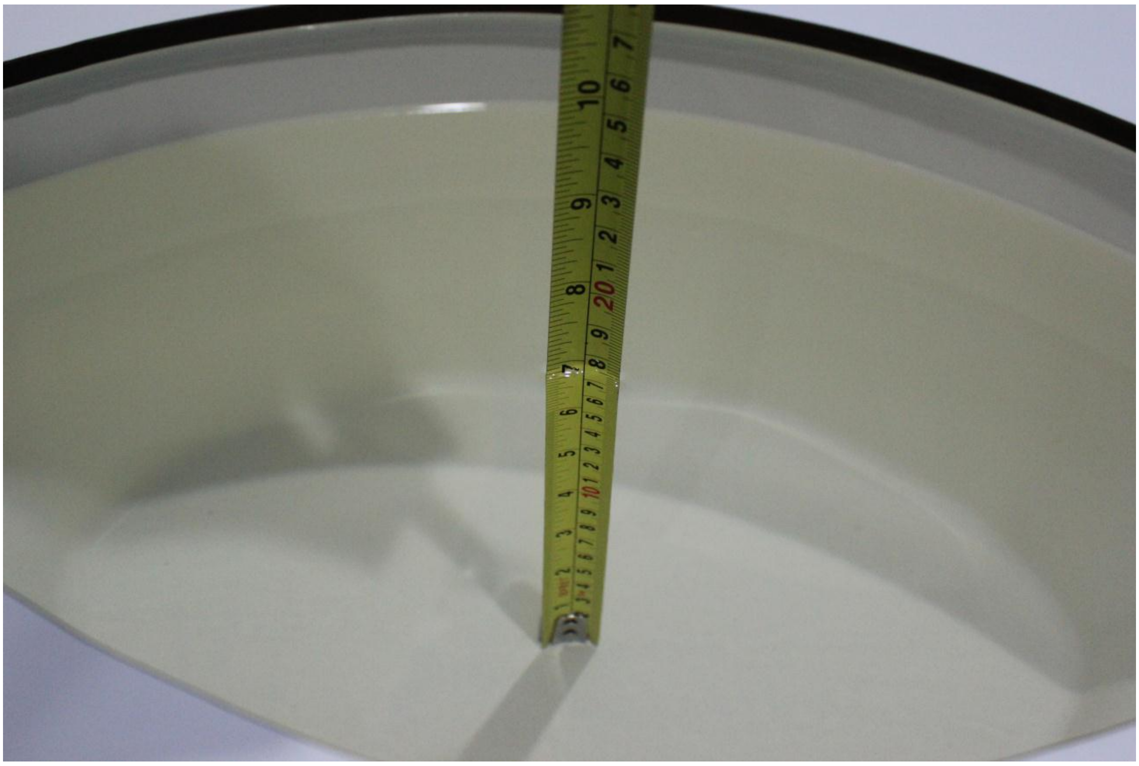
Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date (yyyy-mm-dd)	**Type**	**Frequency**	**Conductivity (σ)**	**Drift (%)**	**Permittivity (ε)**	**Drift (%)**
2017-11-19	Body	2450	1.924	-1.33	51.65	-1.99
2017-11-20	Body	5300	5.288	-2.44	50.14	2.54
2017-11-20	Body	5600	5.617	-2.65	48.28	-0.45
2017-11-20	Body	5800	5.965	-0.58	47.16	-2.16

Note: The liquid temperature is 22.0^{o}C



Picture 7-1: Liquid depth in the Flat Phantom(2450MHz)

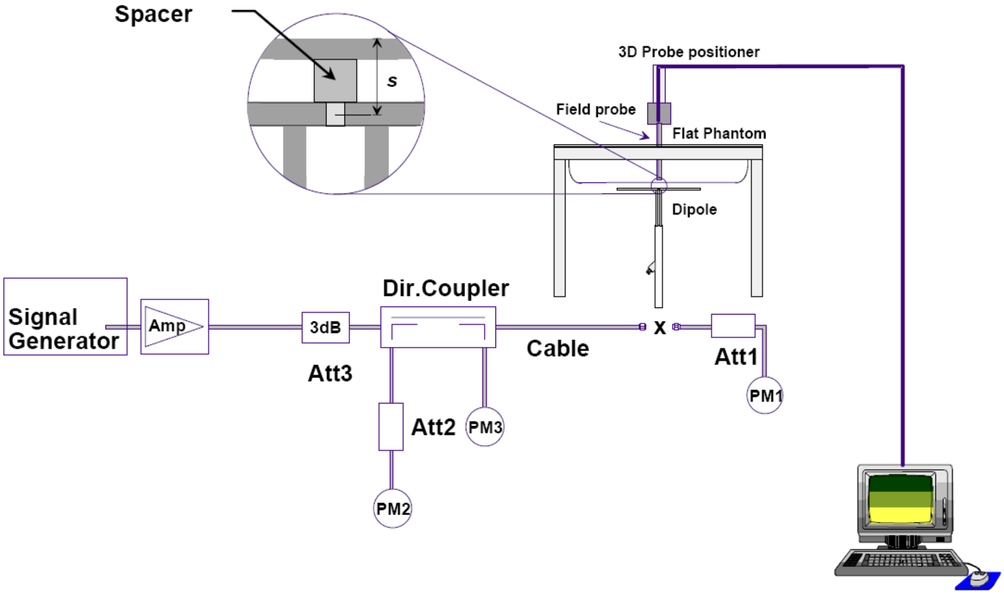


Picture 7-2: Liquid depth in the Flat Phantom(5GHz)

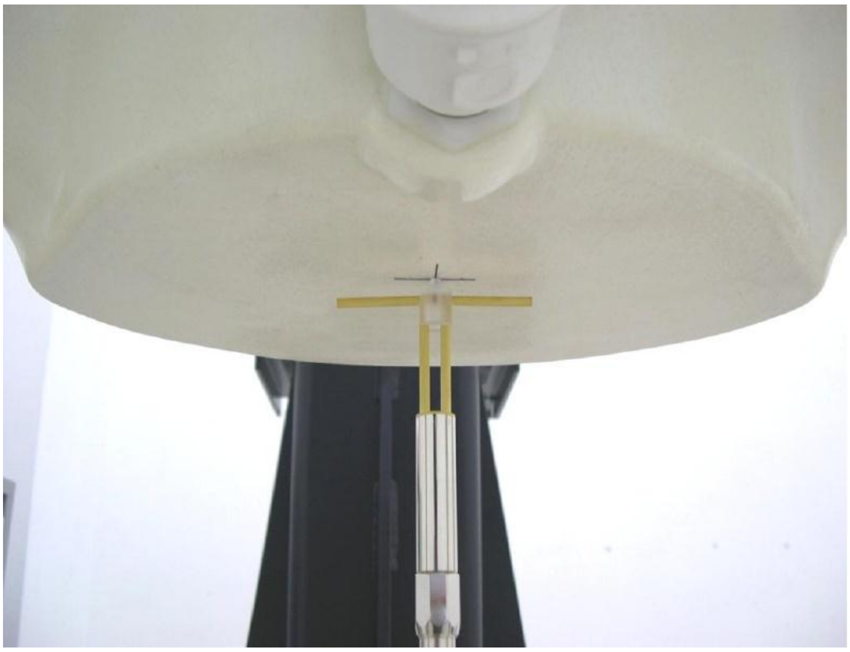
8 System verification

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 Body

Measurement Date (yyyy-mm-dd)	Frequency	Target value (W/kg)		Measured value (W/kg)		Deviation (%)	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
2017-11-19	2450 MHz	24.4	52.3	24.24	51.20	-0.66	-2.10
2017-11-20	5300 MHz	22.1	79.9	21.7	77.5	-1.81	-3.00
2017-11-20	5600 MHz	22.1	79.1	22.4	81.2	1.36	2.65
2017-11-20	5800 MHz	21.1	76.2	20.7	74.4	-1.90	-2.36

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.

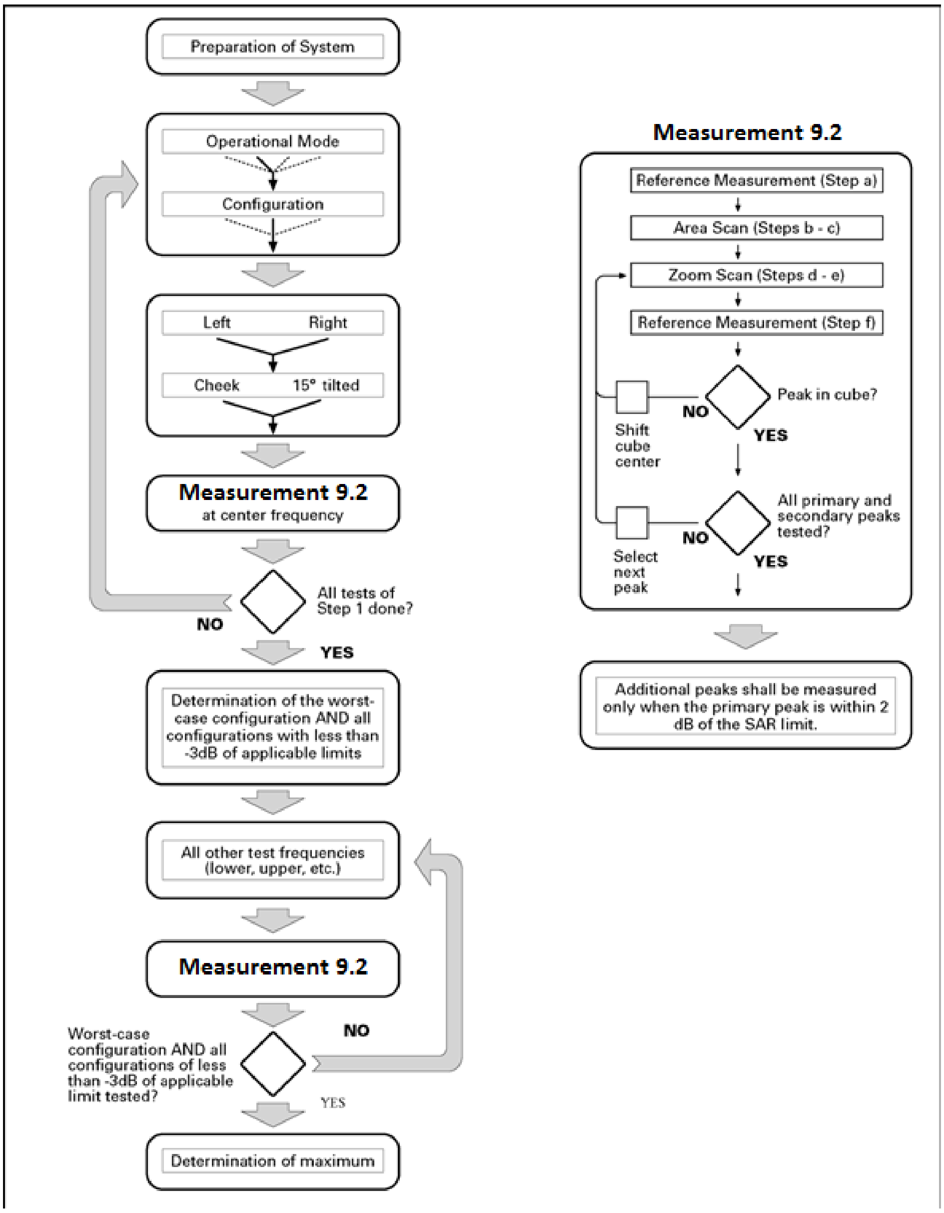
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band (f_c) for:

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 9.1Block diagram of the tests to be performed

9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

9.3 Bluetooth & Wi-Fi Measurement Procedures for SAR

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

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

9.4 Power Drift

To control the output power stability during the SAR test, DASY5 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 Conducted Output Power

10.1 Wi-Fi and BT Measurement result

Table 10.1: The conducted Power for BT

Mode	Tune-up	Averaged Power (dBm)		
		Channel 0 (2402MHz)	Channel 39 (2441MHz)	Channel 78 (2480MHz)
GFSK	**3**	0.48	1.69	2.39
π/4 DQPSK	**3**	0.36	1.51	2.20
8DPSK	**3**	0.52	1.67	2.36
BLE	**7**	4.89	5.10	6.34

Table 10.2: The conducted Power for 2.4G WIFI

WiFi 2.4GHz	Tune-up	Averaged Power (dBm)		
Mode		Channel 1 (2412 MHz)	Channel 6 (2437Mhz)	Channel 11 (2462MHz)
802.11b	**16.0**	14.84	**14.90**	14.89
802.11g	**15.5**	14.55	14.68	14.70
802.11n(20MHz)	**15.0**	13.95	14.06	14.10
802.11n(40MHz)	**15.0**	13.82	13.98	14.01

Table 10.3: The conducted Power for 5G WIFI

5G Wi-Fi	Averaged Power (dBm)								
	Mode	802.11a	802.11n -20MHz	802.11ac -20MHz	Mode	802.11 n-40M Hz	802.11ac -40MHz	Mode	802.11ac -80MHz
	Ch	6Mbps	MCS0	MCS0	Ch	MCS0	MCS0	Ch	MCS0
U-NII-1	36(5180MHz)	14.12	13.53	13.49	38 (5190MHz)	12.40	13.47	42 (5120 MHz)	13.41
	40(5200MHz)	14.05	13.50	13.44					
	48(5240MHz)	14.10	13.49	13.57	46 (5230MHz)	12.40	13.47		
	/	/	/	/					
U-NII-2A	52(5260MHz)	13.77	13.38	13.40	54 (5270MHz)	13.33	13.43	58 (5290 MHz)	13.22
	56(5280MHz)	13.88	13.46	13.46					
	64(5320MHz)	**13.96**	13.44	13.48	62 (5310MHz)	13.33	13.43		
	/	**/**	/	/					
U-NII-2C	100(5500MHz)	**13.81**	13.16	13.15	102 (5510MHz)	13.06	13,09	106(5530MHz)	12.91
	116(5580MHz)	13.64	13.03	12.97	110 (5550MHz)	12.86	13.05	122(5610MHz)	12.78
	140(5700MHz)	13.75	13.05	13.07	134 (5550MHz)	12.67	12.78	138(5690MHz)	12.80
U-NII-3	149(5745MHz)	13.50	12.95	13.10	151 (5755MHz)	12.89	12.97	155(5775MHz)	13.05
	157(5785MHz)	13.78	13.12	13.24	159 (5795MHz)	12.95	13.12	/	/
	165(5825MHz)	**13.83**	13.28	13.42	/	/	/	/	/

Table 10.4: Tune-up procedure for 5G WIFI

Mode	802.11a	802.11n -20MHz	802.11ac -20MHz	802.11n -40MHz	802.11ac -40MHz	802.11ac -80MHz
Tune-up	**15.5**	**14.5**	**14.5**	**14**	**14**	**14**

11 Considerations

11.1 Introduction

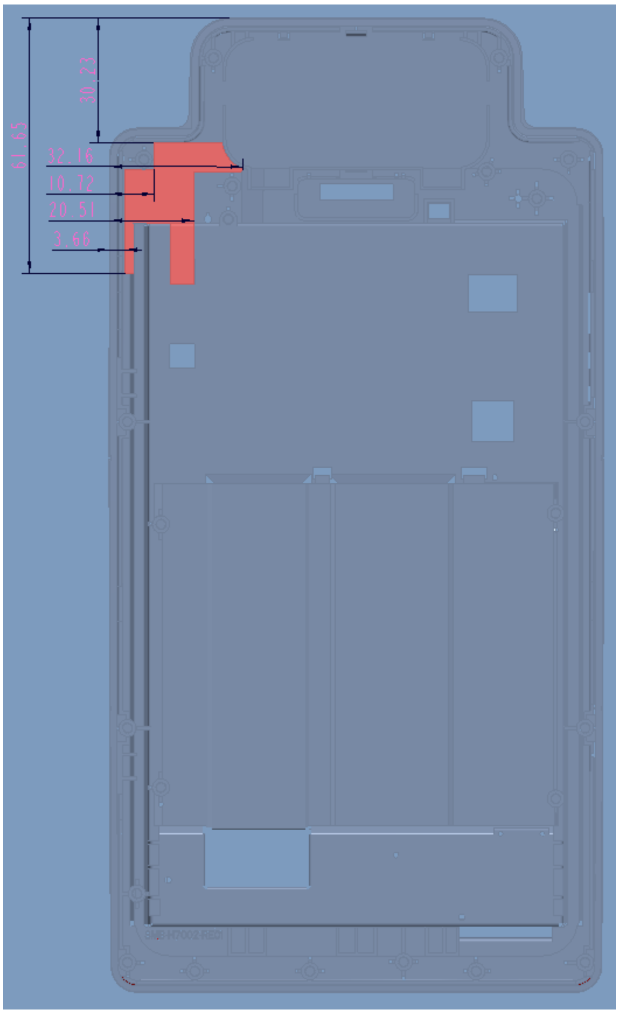
The following procedures adopted from "FCC SAR Considerations for Cell Phones with Multiple Transmitters" are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

11.2 Antenna Locations

Top

Right



Left

Bottom

Rear View

Mode	Rear	Left edge	Right edge	Top edge	Bottom edge
WLAN	Yes	No	Yes	Yes	No

11.3 Standalone SAR Test Exclusion Considerations

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

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

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

Table 11.1: Standalone SAR test exclusion considerations

Band/Mode	f(GHz)	Position	SAR test exclusion threshold (mW)	RF output power		SAR test exclusion
				dBm	mW	
Bluetooth	2.44	Body	9.60	7..0	5.01	Yes
2.4GHz WLAN	2.45	Body	9.58	16.0	39.8	No
5GHz WLAN	5.2	Body	6.58	15.5	35.5	No
	5.3	Body	6.52	15.5	35.5	No
	5.5	Body	6.34	15.5	35.5	No
	5.8	Body	6.23	15.5	35.5	No

Table 11.2: Estimated SAR for Bluetooth

Position	f (GHz)	Distance (mm)	Upper limit of power *		Estimated$_{1g}$ (W/kg)
			dBm	mW	
Body	2.44	5	7.0	5.01	0.21

* - Maximum possible output power declared by manufacturer

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

(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[√f(GHz)/x] W/kg for test separation distances ≤ 50 mm;

Where x = 7.5 for 1-g SAR.

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

12 SAR Test Result

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 10.

12.1 WLAN Evaluation for 2.4G

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

Body Evaluation

Table 12.1: SAR Values (WLAN - Body)– 802.11b 1Mbps

Ambient Temperature: 22.2°C Liquid Temperature: 21.7°C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
2437	6	Rear	/	14.90	16	0.078	**0.10**	0.154	**0.20**	0.10
2437	6	Right	Fig.1	14.90	16	0.194	**0.25**	0.416	**0.54**	0.14
2437	6	Top	/	14.90	16	0.033	**0.04**	0.058	**0.07**	-0.06

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

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. A maximum transmission duty factor of 97.5% is achievable for WLAN in this project and the scaled reported SAR is presented as below.

Table 12.2: 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.					
2437	6	Rear	97.5%	100%	0.54	**0.55**

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

12.2 WLAN Evaluation for 5G

Table 12.3: SAR Values (WLAN - Body)– 802.11a 6Mbps

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C										
Frequency		Test Position	Figure No.	Conducted Power (dBm)	Max. tune-up Power (dBm)	Measured SAR(10g) (W/kg)	Reported SAR(10g) (W/kg)	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.									
5320	64	Rear	/	13.96	15.5	0.083	**0.12**	0.215	**0.31**	0.01
5320	64	Right	/	13.96	15.5	0.177	**0.25**	0.495	**0.71**	-0.02
5320	64	Top	/	13.96	15.5	0.021	**0.03**	0.052	**0.07**	0.03
5500	100	Rear	/	13.81	15.5	0.029	**0.04**	0.066	**0.10**	0.11
5500	100	Right	/	13.81	15.5	0.268	**0.40**	0.749	**1.11**	-0.08
5500	100	Top	/	13.81	15.5	0.009	**0.01**	0.023	**0.03**	0.05
5700	140	Right	Fig.2	13.75	15.5	0.304	**0.45**	0.863	**1.29**	0.08
5580	116	Right	/	13.64	15.5	0.217	**0.33**	0.604	**0.93**	0.13
5825	165	Rear	/	13.83	15.5	0.065	**0.10**	0.166	**0.24**	0.05
5825	165	Right	/	13.83	15.5	0.110	**0.16**	0.306	**0.45**	-0.02
5825	165	Top	/	13.83	15.5	0.037	**0.05**	0.087	**0.13**	0.11

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

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. A maximum transmission duty factor of 95.7% is achievable for WLAN in this project and the scaled reported SAR is presented as below.

Table 12.4: SAR Values (WLAN - Body) – 802.11a 6Mbps (Scaled Reported SAR)

Ambient Temperature: 22.0°C Liquid Temperature: 21.5°C						
Frequency		Test Position	Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
MHz	Ch.					
2437	6	Rear	95.7%	100%	1.29	**1.34**

13 SAR Measurement Variability

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

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

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

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

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

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

Table 15.1: SAR Measurement Variability for Body – 5G WLAN (1g)

Frequency		Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
MHz	Ch.						
5700	140	Right	0	0.863	0.852	1.01	/

14 Measurement Uncertainty

14.1 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	12	N	2	1	1	6.0	6.0	∞
2	Isotropy	B	7.4	R	$\sqrt{3}$	1	1	4.3	4.3	∞
3	Boundary effect	B	1.1	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	1.0	N	1	1	1	1.0	1.0	∞
7	Response time	B	0.0	R	$\sqrt{3}$	1	1	0.0	0.0	∞
8	Integration time	B	1.7	R	$\sqrt{3}$	1	1	1.0	1.0	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. restrictions	B	0.35	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	5
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	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	9
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	0.96	0.78	9
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.4	10.3	95.5
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						20.8	20.6	

14.2 Measurement Uncertainty for Normal SAR Tests (3GHz~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	13	N	2	1	1	6.5	6.5	∞
2	Isotropy	B	7.4	R	$\sqrt{3}$	1	1	4.3	4.3	∞
3	Boundary effect	B	2.3	R	$\sqrt{3}$	1	1	1.3	1.3	∞
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	1.0	N	1	1	1	1.0	1.0	∞
7	Response time	B	0.0	R	$\sqrt{3}$	1	1	0.0	0.0	∞
8	Integration time	B	1.7	R	$\sqrt{3}$	1	1	1.0	1.0	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. restrictions	B	0.71	R	$\sqrt{3}$	1	1	0.4	0.4	∞
12	Probe positioning with respect to phantom shell	B	5.7	R	$\sqrt{3}$	1	1	3.3	3.3	∞
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	5
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	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	1.3	N	1	0.64	0.43	0.83	0.56	9
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	0.96	0.78	9
Combined standard uncertainty		$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						11.3	11.2	95.5
Expanded uncertainty (Confidence interval of 95 %)		$u_e = 2u_c$						22.6	22.4	

15 MAIN TEST INSTRUMENTS

Table 15.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071C	MY46103759	2017-11-17	One year
02	Dielectric probe	85070E	MY44300317	/	
03	Power meter	NRP	102603	2017-01-06	One year
04	Power sensor	NRP-Z51	102211		
05	Power meter	NRP	101460	2017-02-06	One year
06	Power sensor	NRP-Z91	100553		
07	Signal Generator	E8257D	MY47461211	2017-06-06	One year
08	Amplifier	VTL5400	0404	/	
09	DAE	SPEAG DAE4	786	2016-12-08	One year
10	E-field Probe	SPEAG EX3DV4	3633	2017-01-23	One year
11	Dipole Validation Kit	SPEAG D2450V2	873	2015-10-30	Three year
12	Dipole Validation Kit	SPEAG D5GHzV2	1238	2016-09-21	Three year

END OF REPORT BODY

ANNEX A Graph Results

Wi-Fi 2.45G Body

Date: 2017-11-19

Electronics: DAE4 Sn786

Medium: Body 2450 MHz

Medium parameters used: f = 2437 MHz; σ = 1.910 S/m; ε_r = 51.679; ρ = 1000 kg/m^3

Ambient Temperature: 22.3^{o}C Liquid Temperature: 21.8^{o}C

Communication System: UID 0, WiFi (0) Frequency: 2437 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633 ConvF (7.37, 7.37, 7.37);

Right side Mid/Area Scan (151x51x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.425 W/kg

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

Reference Value = 15.20 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.850 W/kg

SAR(1 g) = 0.416 W/kg; SAR(10 g) = 0.194 W/kg

Maximum value of SAR (measured) = 0.480 W/kg

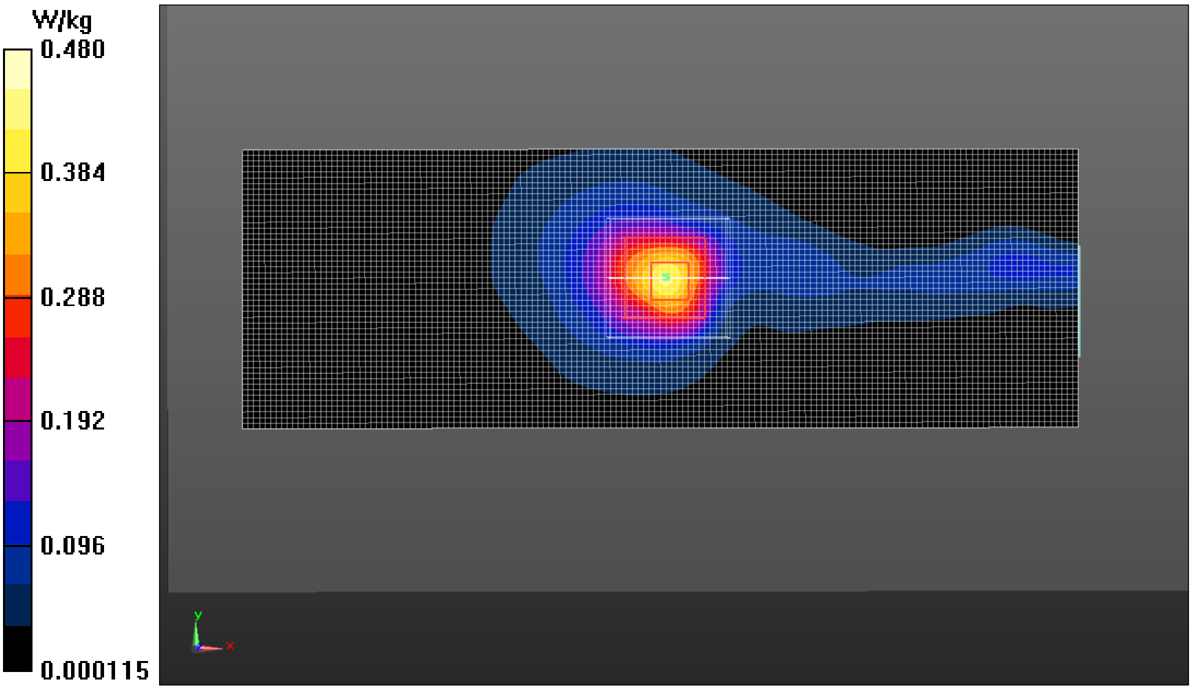


Fig.1 Wi-Fi 2450 MHz Body

Wi-Fi 5G Body

Date: 2017-11-20

Electronics: DAE4 Sn786

Medium: Body 5600 MHz

Medium parameters used: f = 5700 MHz; σ = 5.847 S/m; ε_r = 47.708; ρ = 1000 kg/m^3

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

Communication System: UID 0, WiFi (0) Frequency: 5700 MHz Duty Cycle: 1:1

Probe: EX3DV4 - SN3633 ConvF (4.16, 4.16, 4.16);

Right side CH140/Area Scan (171x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.672 W/kg

Right side CH140/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0.4780 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 4.72 W/kg

SAR(1 g) = 0.863 W/kg; SAR(10 g) = 0.304 W/kg

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

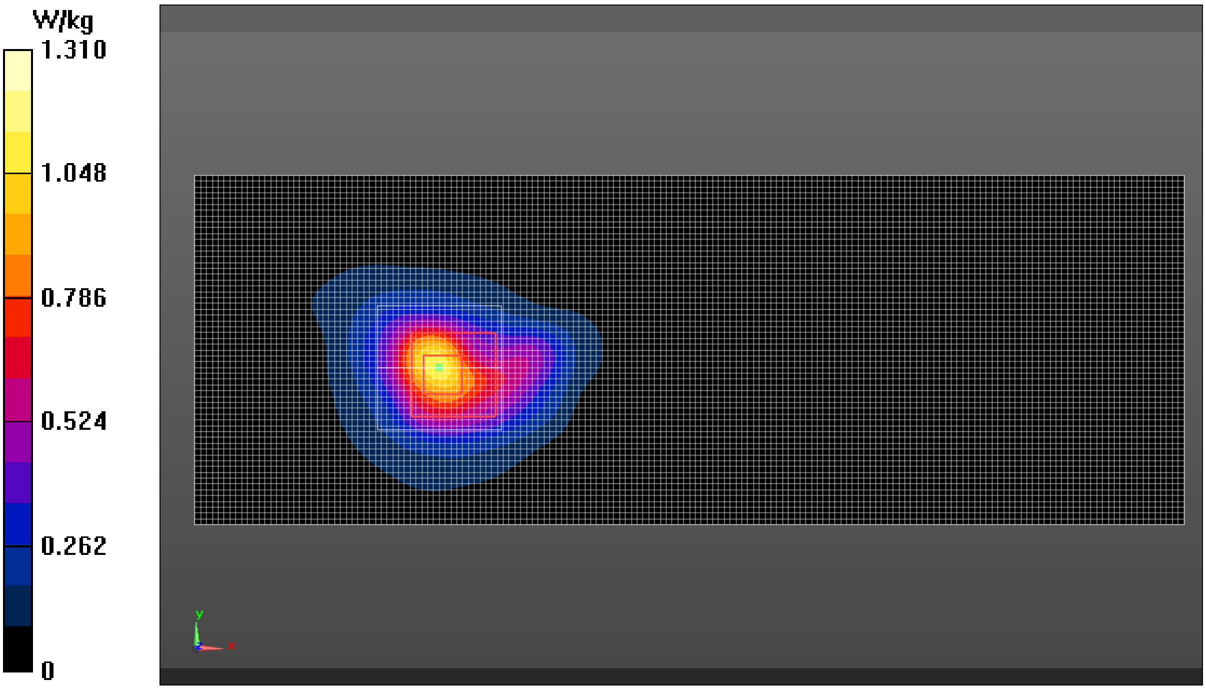


Fig.2 Wi-Fi 5G Hz Body

ANNEX B SystemVerification Results

2450MHz

Date: 2017-11-19

Electronics: DAE4 Sn786

Medium: Body 2450 MHz

Medium parameters used: f = 2450 MHz; σ = 1.924 S/m; ε_r = 51.646; ρ = 1000 kg/m^3

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

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

Probe: EX3DV4 - SN3633 ConvF (7.37, 7.37, 7.37);

System Validation/Area Scan (81x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Reference Value = 88.556 V/m; Power Drift = 0.01 dB

SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.82 W/kg

Maximum value of SAR (interpolated) = 14.0 W/kg

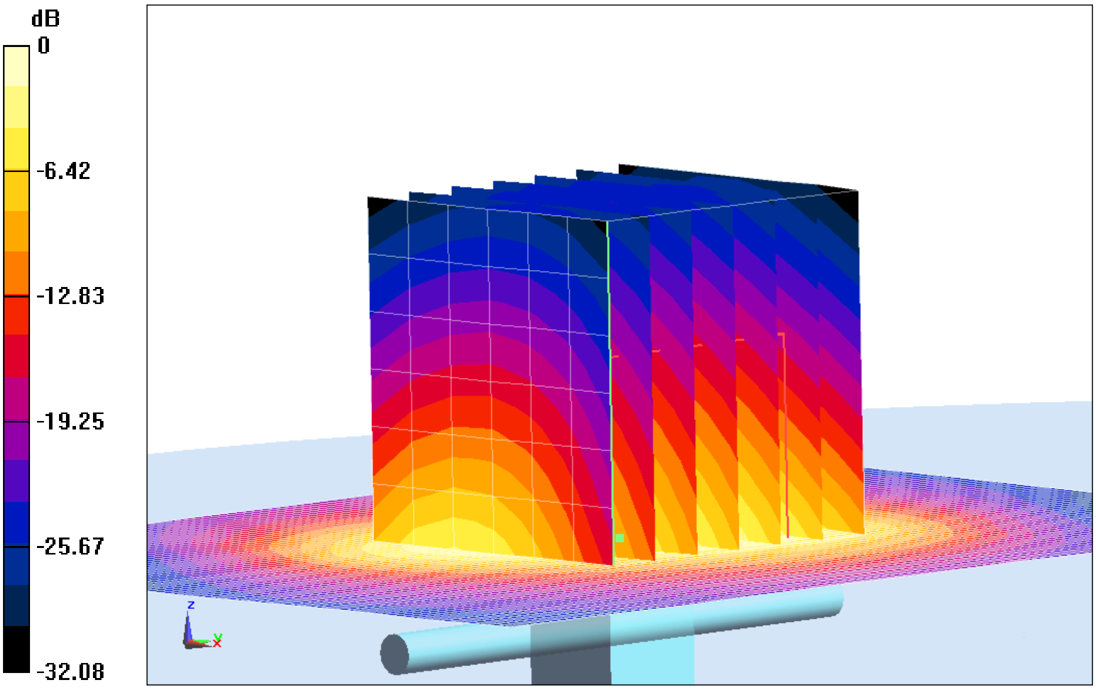
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.556 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.27 W/kg

SAR(1 g) = 12.6 W/kg; SAR(10 g) = 5.88 W/kg

Maximum value of SAR (measured) = 14.6 W/kg



0 dB = 14.6 W/kg = 11.64 dB W/kg

Fig.B.1 validation 2450MHz 250mW