SAR TEST REPORT

No. I17Z61065-SEM02

For

Lenovo PC HK Limited

Portable Tablet Computer

Model Name: Lenovo TB-7504F

With

Hardware Version: Lenovo Tablet TB-7504F

Software Version: TB-7504F_RF01_170712

FCC ID: O57TB7504F

Issued Date: 2017-8-11

TESTING
NVLAP LAB CODE 600118-0

Note:

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Test Laboratory:

CTTL, Telecommunication Technology Labs, CAICT

No. 51, Xueyuan Road, Haidian District, Beijing, P. R. China 100191.

Tel:+86(0)10-62304633-2512, Fax:+86(0)10-62304633-2504

Email: cttl_terminals@caict.ac.cn, website: www.caict.ac.cn

REPORT HISTORY

Report Number	Revision	Issue Date	Description
I17Z61065-SEM02	Rev.0	2017-8-3	Initial creation of test report
I17Z61065-SEM02	Rev.1	2017-8-11	Add the annex I on page 59&60

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1 Test Laboratory

1.1 Testing Location

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

1.2 Testing Environment

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

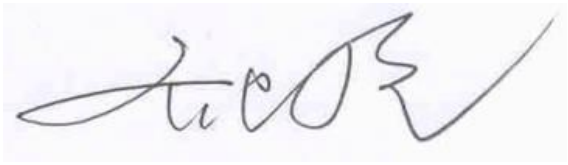
1.3 Project Data

Project Leader:	Qi Dianyuan
Test Engineer:	Lin Xiaojun
Testing Start Date:	July 18, 2017
Testing End Date:	July 18, 2017

1.4 Signature

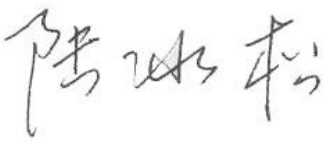
Lin Xiaojun

(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

The maximum results of SAR found during testing for Lenovo PC HK Limited Portable Tablet Computer Lenovo TB-7504F is as follows:

Table 2.1: Highest Reported SAR (1g)

Exposure Configuration	Technology Band	Highest Reported SAR 1g(W/Kg)	Equipment Class
Body (Separation Distance 0mm)	WLAN 2.4 GHz	1.01	DTS

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the ANSI C95.1-1992.

For body 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 0 mm between this device and the body of the user. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

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

The measurement together with the test system set-up is described in annex C of this test report. A detailed description of the equipment under test can be found in chapter 4 of this test report.
The highest reported SAR value is obtained at the case of **(Table 2.1),** and the values are**: 1.01 W/kg(1g).**

3 Client Information

3.1 3.1 Applicant Information

Company Name:	Lenovo(Shanghai) Electronics Technology Co., Ltd.
Address/Post:	NO.68 BUILDING, 199 FENJU RD, Pilot Free Trade Zone, 200131, China
City:	/
Postal Code:	200131
Country:	China
Contact Person:	Spring Zhou
E-mail:	zhoucb1@lenovo.com
Telephone:	+86-21-50504500-8281
Fax:	+86-21-50807240

3.2 3.2 Manufacturer Information

Company Name:	Lenovo PC HK Limited
Address/Post:	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong
City:	Hong Kong
Postal Code:	/
Country:	China
Contact Person:	Joanna Yu
E-mail:	yujia8@lenovo.com
Telephone:	+86-21-50504500-8281
Fax:	+86-21-50807240

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

4.1 About EUT

Description:	Portable Tablet Computer
Model name:	Lenovo TB-7504F
Operating mode(s):	BT, WLAN
Tx Frequency:	2402 – 2480 MHz (Bluetooth)
	2412 – 2462 MHz (Wi-Fi 2.4G)
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	HW Version	SW Version
1	HA0TYU6A	Lenovo Tablet TB-7504F	TB-7504F_RF01_170712
2	HA0TRXN6	Lenovo Tablet TB-7504F	TB-7504F_RF01_170712
3	HA0TY83B	Lenovo Tablet TB-7504F	TB-7504F_RF01_170712

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

Note: It is performed to test SAR with the EUT1&2 and conducted power with the EUT3.

4.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	L16D1P33	/	Sunwoda Electronic Co.,Ltd
AE2	Battery	L16D1P33	/	SCUD(FUJIAN) Electronic Co.,Ltd

There are three kinds of combination modes to be tested and the detail information is as follows:

SKU1			SKU2			SKU3		
Material description	Model	Supplier	Material description	Model	Supplier	Material description	Model	Supplier
LPDDR3 Emcp	KMQX10013M-B419	Samsung	LPDDR3 Emcp2	KMFE10012M-B214013	Samsung	LPDDR3 Emcp	KMQX10013M-B419	Samsung
Battery	Sunwoda+ATL(3.85V 3500mAh)	Sunwoda	Battery2	SCUD+Veken(3.85V 3500mAh)	SCUD	Battery	SCUD+Veken(3.85V 3500mAh)	SCUD
Speaker Box1	1511	Midi	Speaker Box2	1511	Xichun	Speaker Box2	1511	Xichun
LCM	TLCM TV070HDM-TL8 BOE NEG CG	BOE	LCM	TLCM TV070HDM-TL8 BOE NEG CG	BOE	LCM	TLCM TV070HDM-TL9 BOE NEG CG	BOE
Camera_ Back	L545A20	Oflim	Camera_ Back	L545A20	Oflim	Camera_ Back	L545A20	Oflim
Camera_ Front1	BLX2590W-P98997AA1-F V1.0	brodsands	Camera_ Front2	G7P2-P98997AA1FF	Kingcome	Camera_ Front2	G7P2-P98997AA1FF	Kingcome

We'll perform the SAR measurement with SKU1 and retest on highest value point with SKU3.

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.

KDB616217 D04 SAR for laptop and tablets v01r02 SAR Evaluation Considerations for Laptop, Notebook, Notebook and Tablet Computers.

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

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

KDB865664 D02RF Exposure Reporting v01r02 RF Exposure Compliance Reporting and Documentation Considerations

6 Specific Absorption Rate (SAR)

6.1 Introduction

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

6.2 SAR Definition

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

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

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

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

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

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

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

7 Tissue Simulating Liquids

7.1 Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

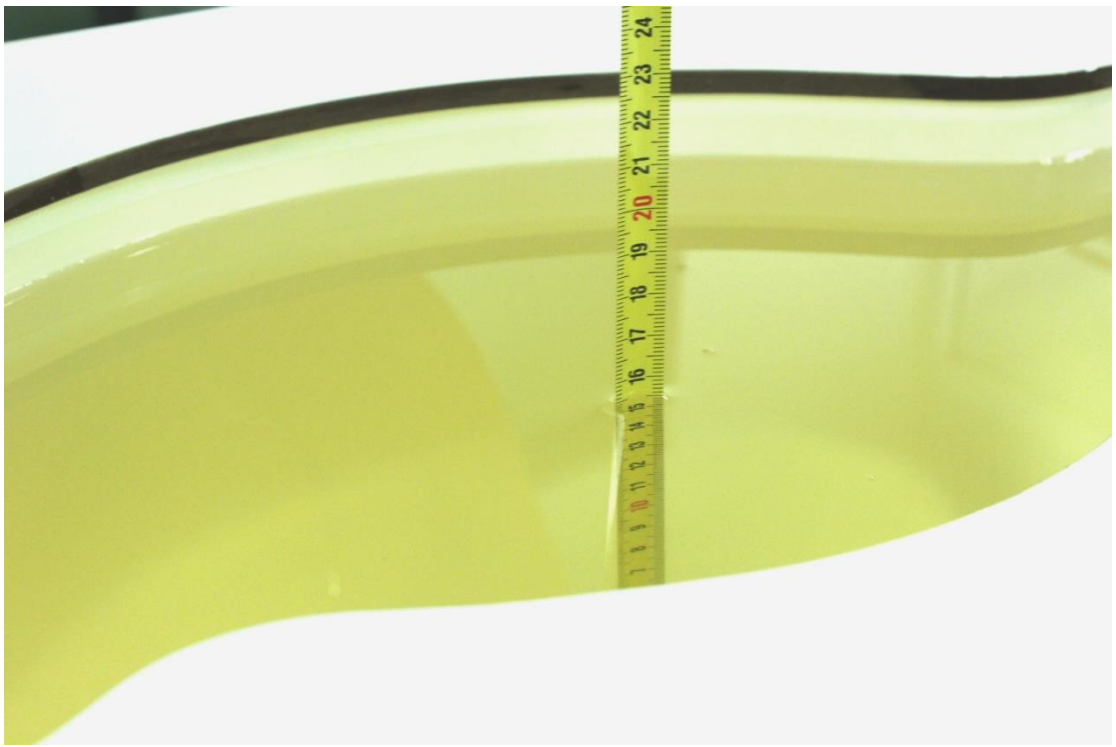
Frequency(MHz)	Liquid Type	Conductivity(σ)	± 5% Range	Permittivity(ε)	± 5% Range
2450	Body	1.95	1.85～2.05	52.7	50.1～55.3

7.2 Dielectric Performance

Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Date yyyy/mm/dd	Frequency	Type	Permittivity ε	Drift (%)	Conductivity σ (S/m)	Drift (%)
2017/7/18	2450 MHz	Body	51.92	-1.48	1.935	-0.77

Note: The liquid temperature is 22.0 ℃

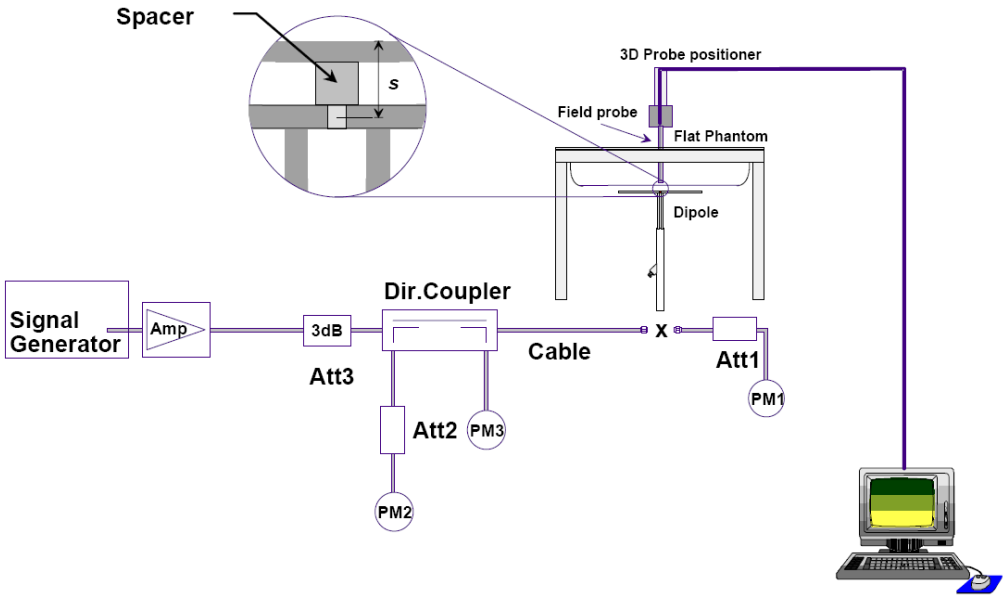


Picture 7-1 Liquid depth in the Flat Phantom (2450MHz)

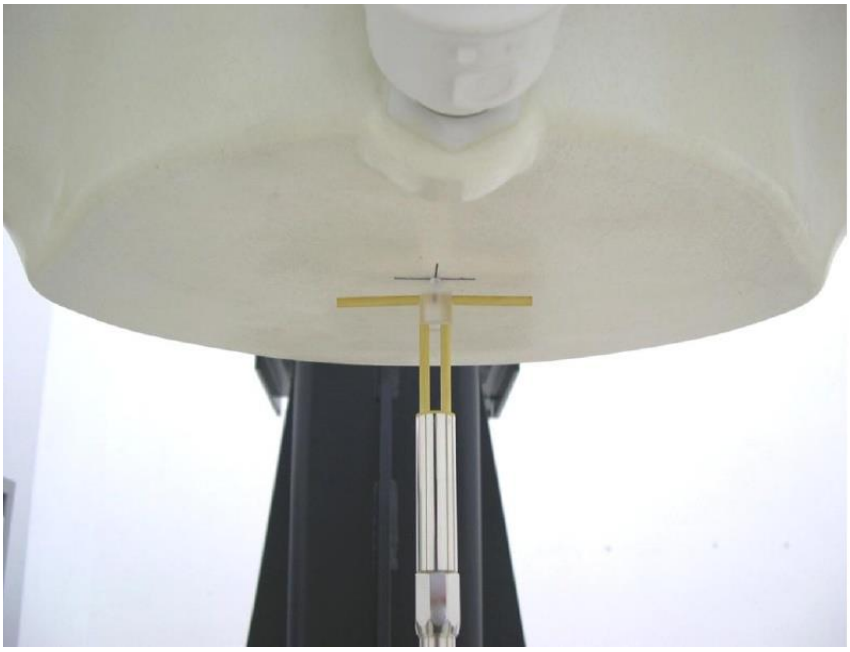
8 System verification

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 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
2017-7-18	2450 MHz	24	50.4	24.88	52.4	3.67%	3.97%

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.

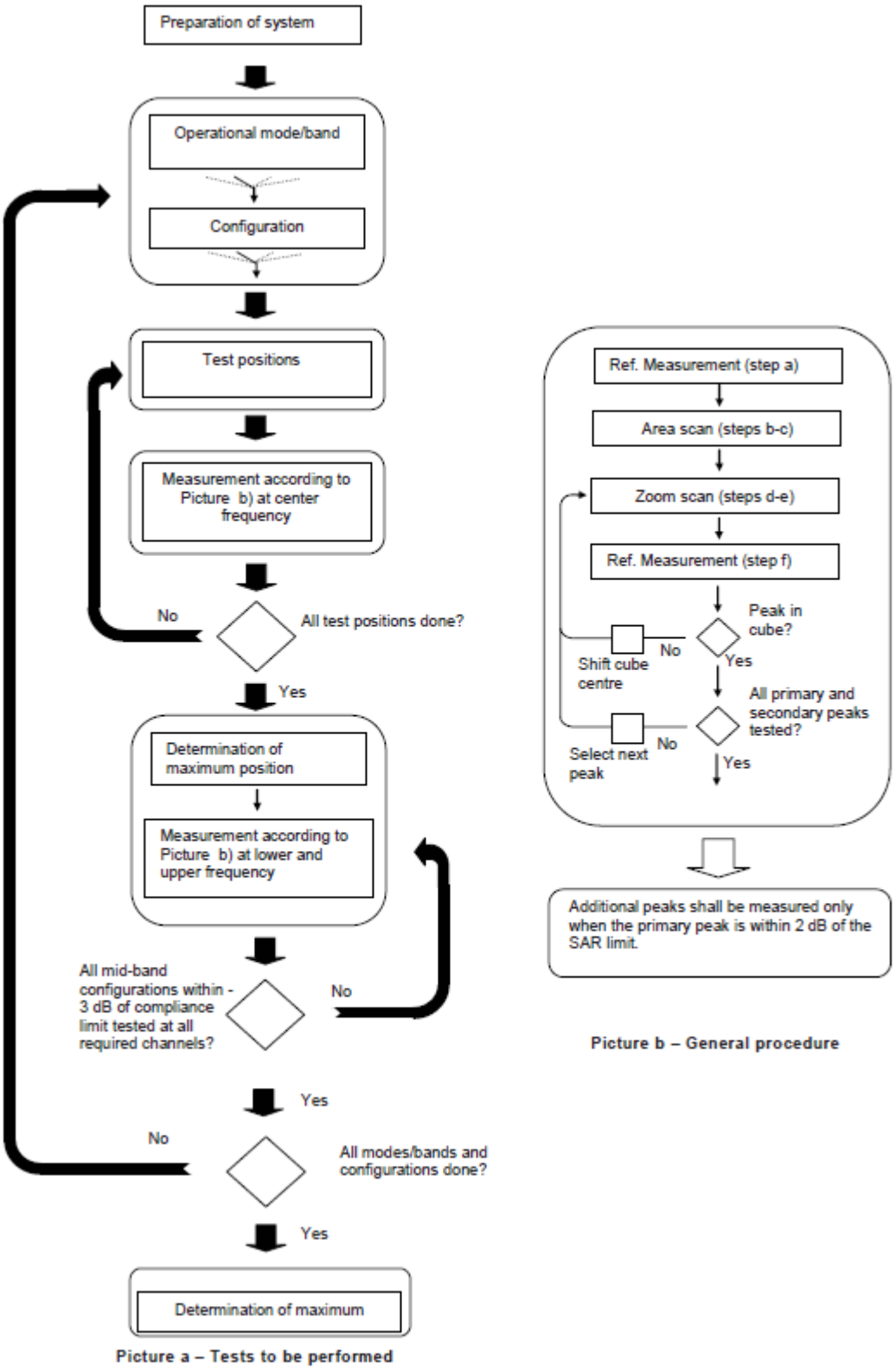
Step 1: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band (f_c) for:

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 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

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

9.3 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.
Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

9.4 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in section12 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

10 Conducted Output Power

This device uses a proximity sensor for SAR compliance. The proximity sensor is activated when the device is used in close proximity to the user's body. The proximity sensors trigger power reduction for WiFi. There is no power reduction mechanism for BT modes for SAR purposes.

The output power of BT antenna is as following:

Mode	Conducted Power (dBm)			Tune up
	Channel 0 (2402MHz)	Channel 39 (2441MHz)	Channel 78(2480MHz)	
GFSK	4.64	5.97	5.33	**6**
EDR2M-4_DQPSK	3.67	5.20	4.22	**5.5**
EDR3M-8DPSK	3.76	5.29	4.32	**5.5**

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

Normal Power – Proximity sensor not active

802.11b (dBm)

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
1	17.05	17.10	/	/
6	17.52	17.75	17.55	17.45
11	17.47	17.46	/	/
Tune up	**18**	**18**	**18**	**18**

802.11g (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
1	15.05	/	15.10	/	/	/	/	/
6	15.68	15.65	15.69	15.60	15.24	15.07	15.19	15.12
11	15.25	/	15.37	/	/	/	/	/
Tune up	**16**	**16**	**16**	**16**	**16**	**16**	**16**	**16**

802.11n (dBm) - HT20 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
1	14.57	15.59	/	/	/	/	/	/
6	14.99	15.06	14.99	14.69	14.55	14.65	14.37	14.32
11	14.83	14.70	/	/	/	/	/	/
Tune up	**15.5**	**15.5**	**15.5**	**15.5**	**15.5**	**15.5**	**15.5**	**15.5**

802.11n (dBm) – HT40 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
3	11.53	/	/	/	/	/	/	/
6	11.74	11.56	11.42	11.27	11.05	10.82	10.21	10.13
9	11.59	/	/	/	/	/	/	/
Tune up	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**

Low Power – Proximity sensor active

802.11b (dBm)

Channel\data rate	1Mbps	2Mbps	5.5Mbps	11Mbps
1	11.39	11.46	/	/
6	11.68	11.90	11.85	11.59
11	11.64	11.62	/	/
Tune up	**12**	**12**	**12**	**12**

802.11g (dBm)

Channel\data rate	6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
1	9.51	/	/	/	/	/	/	/
6	9.91	9.82	9.56	9.48	9.55	9.40	9.04	8.98
11	9.59	/	/	/	/	/	/	/
Tune up	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**	**10.5**

802.11n (dBm) - HT20 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
1	8.81	/	/	/	/	/	/	/
6	9.24	9.14	9.06	8.96	8.82	8.47	8.41	8.36
11	9.07	/	/	/	/	/	/	/
Tune up	**9.5**	**9.5**	**9.5**	**9.5**	**9.5**	**9.5**	**9.5**	**9.5**

802.11n (dBm) – HT40 (2.4G)

Channel\data rate	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
3	5.46	/	/	/	/	/	/	/
6	5.90	5.77	5.40	5.25	5.02	4.75	4.33	4.26
9	5,73	/	/	/	/	/	/	/
Tune up	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**