FCC SAR Report

Report No.	**:**	**SESF1701088**
Client/Manufacturer	**:**	**Qualcomm Atheros, Inc.**
Address	**:**	**1700 Technology Drive, San Jose, CA 95110**
Product	**:**	**802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card**
Brand	**:**	**Qualcomm Atheros**
Model	**:**	**QCNFA344A**
FCC ID	**:**	**PPD-QCNFA344AH**
Standards	**:**	**FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:2005 / IEEE 1528-2013 / KDB 865664 D01 v01r04 / KDB 248227 D01 v02r02 / KDB 447498 D01 v06 / KDB 616217 D04 v01r02**
Test Date	**:**	**March 21th, 2017~ March 22th, 2017**

Statement of Compliance:

The SAR values measured for the test sample are below the maximum recommended level of 1.6W/kg averaged over any 1g tissue according to FCC Knowledge Data Base/ FCC 47CFR Part 2 (2.1093) / IEEE Std.1528-2013.

The test result only corresponds to the tested sample. It is not permitted to copy this report, in part or in full, without the permission of the test laboratory.

The testing described in this report has been carried out to the best of our knowledge and ability, and our responsibility is limited to the exercise of reasonable care. This certification is not intended to believe the sellers from their legal and/or contractual obligations.

Prepared By: Leo Chen

Approved By: Miro Chueh

ilac-MRA

TAF Testing Laboratory 2877

Release Version

Report No.	Issue Date	Description
SESF1701088	2017-03-22	Initial release

Contents

1. Summary of Maximum SAR Value

Equipment Class	Highest Reported SAR_{1-g}(W/kg)
DTS	0.30
U-NII	0.54
Highest Simultaneous SAR	
DTS+DTS	0.56
U-NII+ U-NII	0.83

2. Description of Equipment under Test

Product Name	802.11a/b/g/n/ac + BT 4.1 M.2 2230 Type Card
Model No.	QCNFA344A
Brand Name	Qualcomm Atheros
Product Type	WLAN (2TX, 2RX)
Antenna Type	PIFA
Antenna Peak Gain	Amphenol: 2.4GHz: -1dBi,5.2GHz: -1.73dBi,5.5GHz: -0.68dBi,5.8GHz: -1.81dBi Speed: 2.4GHz: 0.65dBi,5.2GHz: 0.86dBi,5.5GHz: -1.29dBi,5.8GHz: -3.0dBi
Bus Interface	PCIE
Device Category	Portable
RF Exposure Environment	Uncontrolled
Bluetooth	
Bluetooth Frequency	2402~2480MHz
Data Rate	1 Mbps, 2Mbps and Up to 3Mbps
Channel Separation	1MHz for BT3.0, 2MHz for BLE
Modulation technology	BLE4.0 (GFSK), V3.0+EDR(GFSK), V3.0+EDR(8-DPSK)
Wi-Fi	
Modulation Techniques:	**802.11b:** CCK, DQPSK, DBPSK **802.11a/g:** 64QAM, 16QAM, QPSK, BPSK **802.11n:** BPSK, QPSK, 16QAM, 64QAM
Data Rate	802.11b: 11, 5.5, 2, 1 Mbps 802.11a/g: 54, 48, 36, 24, 18, 12, 9, 6 Mbps 802.11n: MCS 0 to 15 for HT20MHz, MCS 0 to 15 for HT40MHz 802.11ac: MCS 0 to 8 for HT20MHz, MCS 0 to 9 for HT40MHz, MCS 0 to 9 for HT80MHz
Wi-Fi Frequency	**For 15.247:** 2.4GHz: 2.412 ~ 2.462GHz
	For 15.407: 802.11a: 5.18 ~ 5.24GHz, 5.26 ~ 5.32GHz, 5.5~5.72GHz, 5.745 ~ 5.825GHz
Modulation Technology	**For 15.247(2.4GHz):** 802.11b, 802.11g, 802.11n (HT20), 802.11n (HT40)
	For 15.247(5GHz): 802.11a, 802.11n (HT20), 802.11n (HT40), 802.11ac (VHT80)
	For 15.407: 802.11a, 802.11n (HT20), 802.11n (HT40), 802.11ac (VHT80)

Additional Information

1. Antenna information

Ant Type	Manufacturer	Part Number
1	Speed	Main Antenna: DC33001GV00 / Aux Antenna: DC33001GV10
2	Amphenol	Main Antenna: DC33001GX00 / Aux Antenna: DC33001GX10

2. WLAN/BT coexistence mode:

◆ 2x2 WLAN + BT:

➢ 5GHz 802.11a/an (or 11ac) transmit concurrent with BT.

➢ 2.4GHz: timely shared coexistence.

3. General Information

Host Details,

Host Manufacture	Host Type	Host Model
Lenovo	Notebook computer	Lenovo Ideapad 520-15IKB

Our Lab,

Test Site	Cerpass Technology (Suzhou) Co.,Ltd
Test Site Location	No.66,Tangzhuang Road, Suzhou Industrial Park, Jiangsu 215006, China

4. Basic restrictions and Standards

4.1. Test Standards

1. IEEE 1528-2013
2. FCC KDB Publication 447498 D01 General RF Exposure Guidance v06
3. FCC KDB Publication 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
4. FCC KDB Publication 616217 D04 SAR for laptop and tablets v01r02
5. FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02

4.2. Environment Condition

Item	Target	Measured
Ambient Temperature(℃)	18~25	21.5±2
Temperature of Simulant(℃)	20~22	21±2
Relative Humidity(%RH)	30~70	52

4.3. RF Exposure Limits

Human Exposure	Basic restrictions for electric, magnetic and electromagnetic fields. (Unit in mW/g or W/kg)
Spatial Peak SAR[1](Head and Body)	1.60
Spatial Average SAR[2](Whole Body)	0.08
Spatial Peak SAR[3](Arms and Legs)	4.00

Notes:

1. The Spatial Peak value of the SAR averaged over any 1gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over appropriate averaging time.

5. DASY5 Measurement System

DASY5 Measurement System

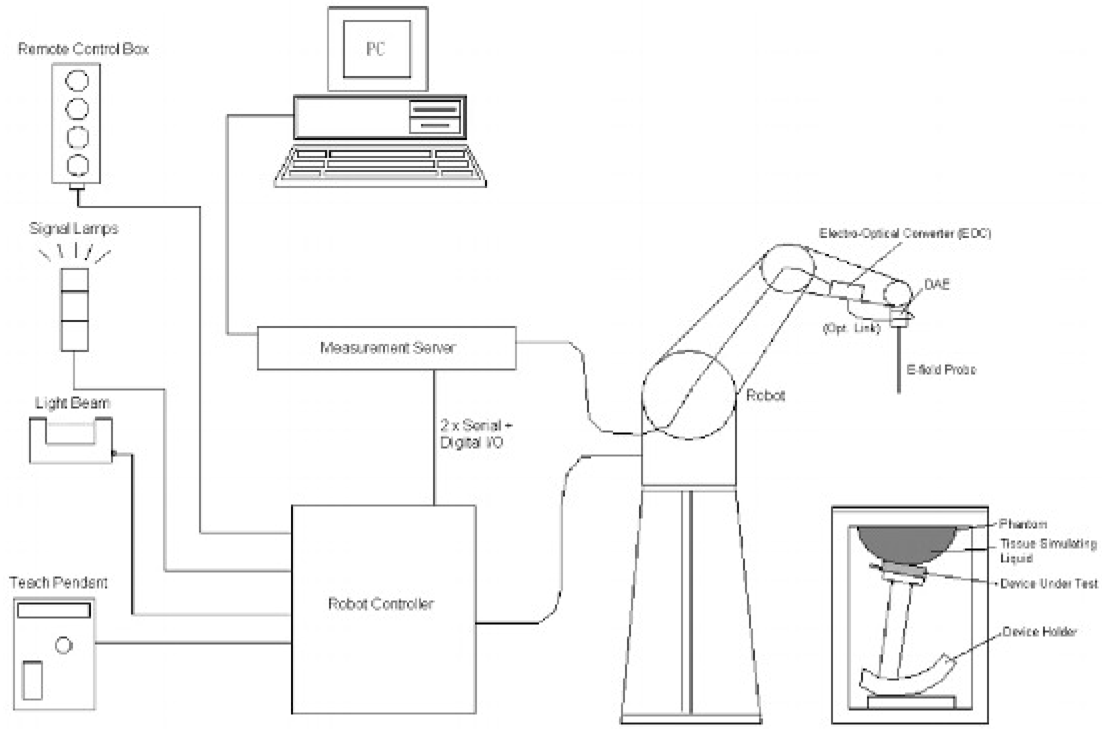


Figure 2.1 SPEAG DASY5 System Configurations

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

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic(DAE)attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter(ECO)performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows 7
- DASY5 software
- Remove control with teach pendant additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

5.1. Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528.The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets. The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x,y,z) = Ae^{-\frac{z}{2a}} \cos^2\left(\frac{\pi}{2}\frac{\sqrt{x'^2+y'^2}}{5a}\right)$$

$$f_2(x,y,z) = Ae^{-\frac{z}{a}} \frac{a^2}{a^2+x'^2}\left(3-e^{-\frac{2z}{a}}\right)\cos^2\left(\frac{\pi}{2}\frac{y'}{3a}\right)$$

$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4}+x'^2+y'^2}\left(e^{-\frac{2z}{a}}+\frac{a^2}{2(a+2z)^2}\right)$$

5.2. DASY5 E-Field Probe

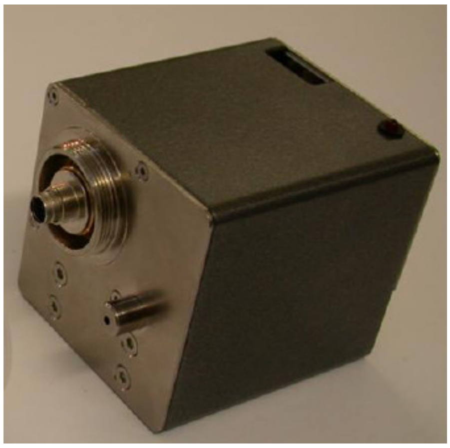
The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix D.

Model	EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

5.3. Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists 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 and 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 input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.



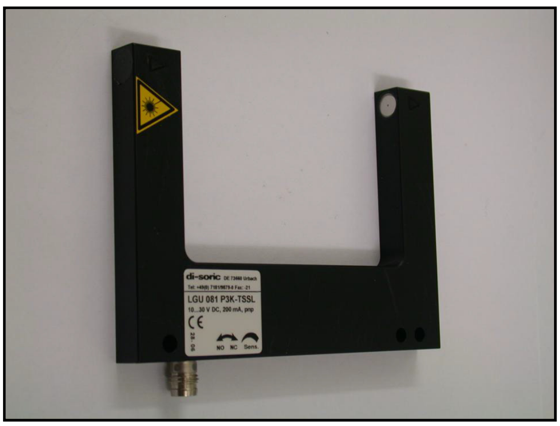
5.4. Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used.
The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

5.5. Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.
The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



5.6. Measurement Server

The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chipdisk and 128MB RAM. The necessary circuits for communication with the DAE electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.

5.7. SAM Phantom

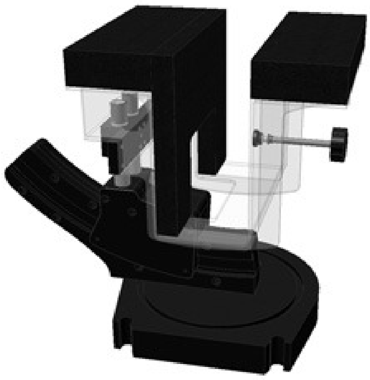
The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- Left head
- Right head
- Flat phantom

The ELI4 Phantom also is a fiberglass shell phantom with 2mm shell thickness. It has 30 liters filling volume, and with a dimension of 600mm for major ellipse axis, 400mm for minor axis. It is intended for compliance testing of handheld and body-mounted wireless devices in frequency range of 30 MHz to 6GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

5.8. Device Holder

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR).Thus the device needs no repositioning when changing the angles. The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.	
The laptop extension is lightweight and made of POM, acrylic glass and foam. It fits easily on upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.	

5.9. Test Equipment List

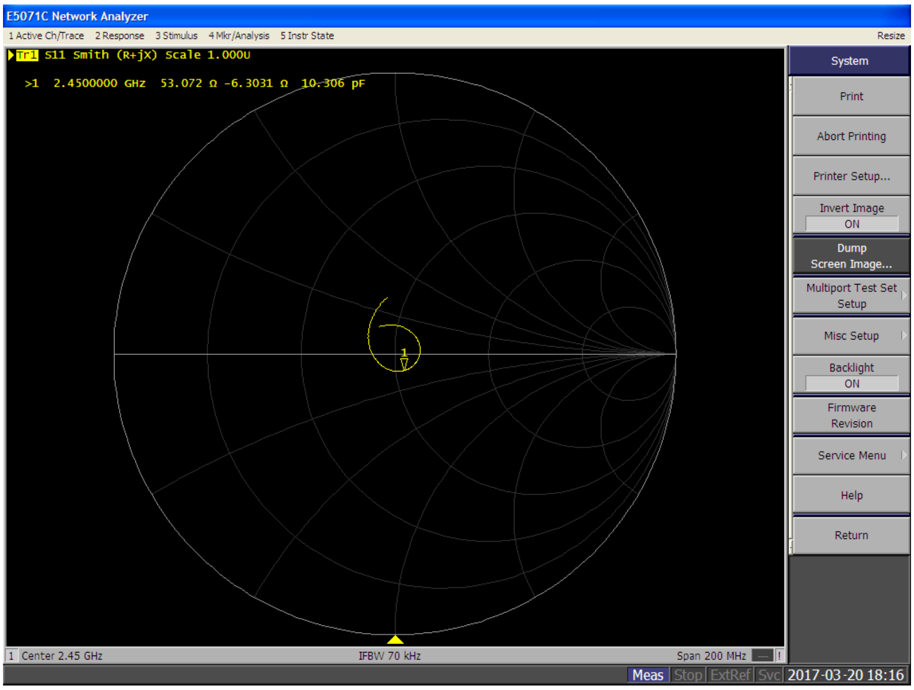
Instrument	Manufacturer	Model No.	Serial No.	Cali. Date	Cali. Due Date
Stäubli Robot TX60L	Stäubli	TX60L	5P6VA1/A/01	only once	only once
Robot Controller	Stäubli	CS8C	5P6VA1/C/01	only once	only once
Dipole Validation Kits	Speag	D2450V2	914	2015.05.19	2017.05.18[Note]
Dipole Validation Kits	Speag	D5GHzV2	1156	2015.05.22	2017.05.21[Note]
SAM ELI Phantom	Speag	SAM	1211	N/A	N/A
Laptop Holder	Speag	SM LH1 001CD	N/A	N/A	N/A
Data Acquisition Electronic	Speag	DAE4	1379	2016.05.23	2017.05.22
E-Field Probe	Speag	EX3DV4	3927	2016.05.25	2017.05.24
SAR Software	Speag	DASY5	V5.2 Build 162	N/A	N/A
Power Amplifier	Mini-Circuit	ZVA-183W-S+	MN136701248	2015.09.03	2017.09.02
Directional Coupler	Agilent	772D	MY52180104	2015.09.03	2017.09.02
Spectrum Analyzer	R&S	FSP40	100324	2016.03.26	2017.03.25
Vector Network	Agilent	E5071C	MY4631693	2016.03.26	2017.03.25
Signal Generator	R&S	SML	103287	2016.03.26	2017.03.25
Power Meter	R&S	BLWA0830-160/100/40D	76659	2016.03.26	2017.03.25
AUG Power Sensor	R&S	NRP-Z91	100384	2016.03.26	2017.03.25

Note: For dipole calibration, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the requirements in KDB 865664 Section 3.2.2. We usually return the dipoles to the SAR system manufacturer or its designated calibration facilities for re-calibration every two years. The supporting information internal check of dipole is as follows.

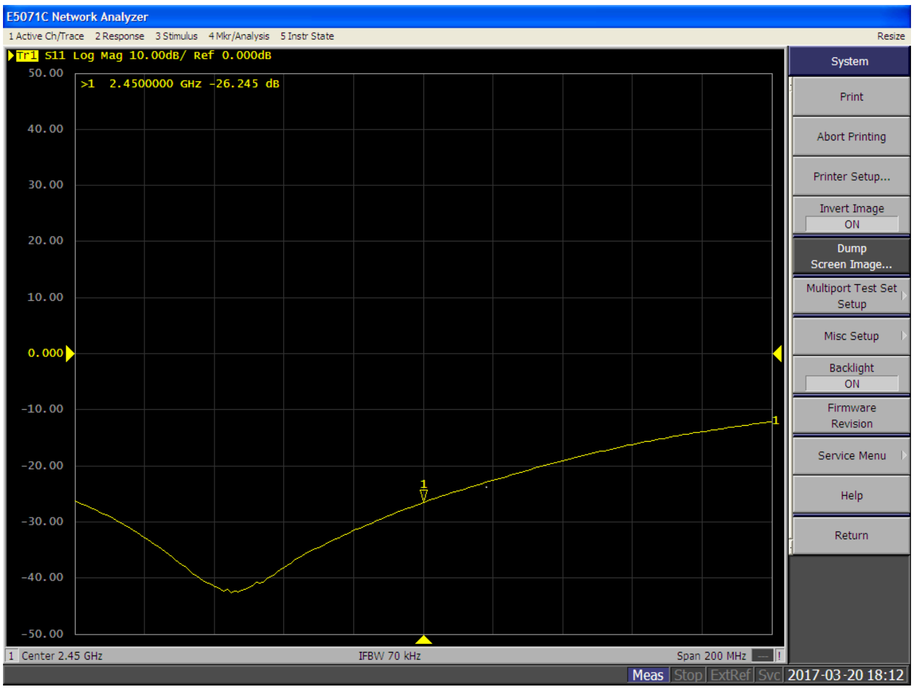
5.10. Internal Check of Dipole

Dipole Validation Kits	Internal check Date
D2450V2	2017-03-20
D5GHzV2	2017-03-20

2450MHz Body calibrated impedance 53.027Ω; measured impedance: 53.072Ω (within 5Ω)



2450MHz Body calibrated return loss: -26.642 dB; Measured return loss: -26.245dB (within 20%)

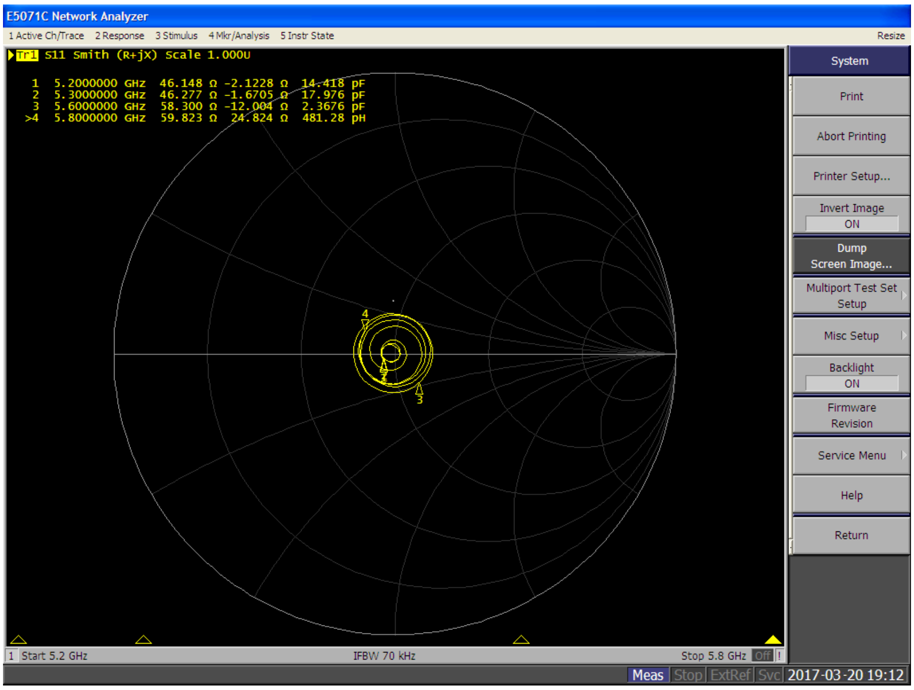


5200MHz Body calibrated impedance 50.602Ω; measured impedance: 46.148Ω (within 5Ω)

5300MHz Body calibrated impedance 50.607Ω; measured impedance: 46.277Ω (within 5Ω)

5600MHz Body calibrated impedance 57.824Ω; measured impedance: 58.300Ω (within 5Ω)

5800MHz Body calibrated impedance 58.828Ω; measured impedance: 56.823Ω (within 5Ω)

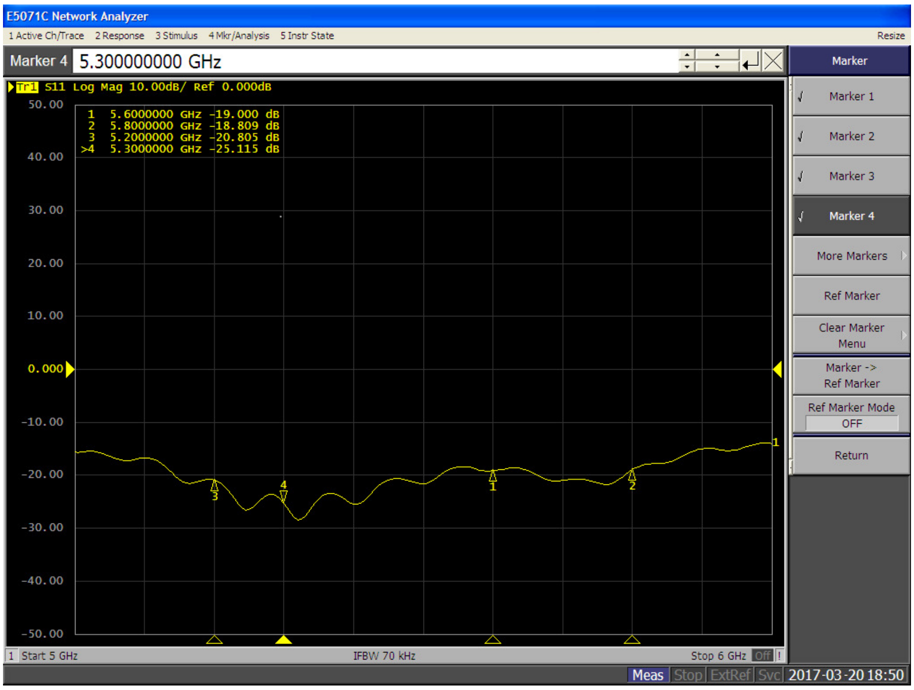


5200MHz Body calibrated return loss: -24.413 dB; Measured return loss: -20.805dB (within 20%)

5300MHz Body calibrated return loss: -25.153 dB; Measured return loss: -25.115dB (within 20%)

5600MHz Body calibrated return loss: -22.766 dB; Measured return loss: -19.000dB (within 20%)

5800MHz Body calibrated return loss: -20.937 dB; Measured return loss: -18.809dB (within 20%)



6. The SAR Measurement Procedure

6.1. System Performance Check

6.1.1 Purpose

1. To verify the simulating liquids are valid for testing.
2. To verify the performance of testing system is valid for testing.

6.1.2 Tissue Dielectric Parameters for Head and Body Phantoms

Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
850	41.5	0.92	55.2	0.99
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	**52.7**	**1.95**
3000	38.5	2.40	52.0	2.73
5200	36.0	4.66	49.0	5.30
5300	35.87	4.76	**48.88**	**5.42**
5600	35.5	5.07	**48.5**	**5.77**
5800	35.3	5.27	**48.2**	**6.00**

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

6.1.3 Tissue Simulating Liquid Information

Our simulating Liquid is manufactured by SPEAG, the main information is listed below:

Item Name	Product No.	Test Frequency (MHz)	Main Ingredients
Body Tissue Simulating Liquid (MBBL1900-3800V3)	SL AAM 196 AB	1900-3800	Water, Tween
Body Tissue Simulating Liquid (MBBL3500-5800V5)	SL AAM 501 EA	3500-5800	Water, Oil

6.1.4 Tissue Calibration Result

■ The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Diel -ectric Assessment Kit and Agilent Vector Network Analyzer E5071C.

Tissue parameter for body							
Fre. <MHz>	Permittivity	Conductivity	Target Permittivity	Target Conductivity	Delta Permittivity%	Delta Conductivity %	Tissue Temperature℃
21-03-2017							
2450	52.48	1.92	52.70	1.95	0.00	-0.02	21.0
2437	52.51	1.90	52.73	1.93	0.00	-0.02	21.0
21-03-2017							
5300	49.05	5.38	48.88	5.42	0.00	-0.01	21.0
5260	49.12	5.36	48.95	5.37	0.00	0.00	21.0
21-03-2017							
5600	48.49	5.75	48.50	5.77	0.00	0.00	21.0
5580	48.52	5.71	48.52	5.75	0.00	-0.01	21.0
5680	48.41	5.81	48.37	5.85	0.00	-0.01	21.0
22-03-2017							
5800	48.22	5.92	48.20	6.00	0.00	-0.01	21.0
5785	48.25	5.89	48.24	5.97	0.00	-0.01	21.0

Note: 1. The Delta Permittivity% and Delta Conductivity% should be both within ±5% limit of target values.

2. Refer to KDB 865664 D01 v01r04, The depth of body tissue-equivalent liquid in a phantom must be ≥ 15.0 cm with ≤ ± 0.5 cm variation for SAR measurements ≤ 3 GHz and ≥ 10.0 cm with ≤ ± 0.5 cm variation for measurements > 3 GHz.

6.1.5 System Performance Check Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and the system performance check. They are read-only document files and destined as fully defined but unmeasured masks, so the finished system performance check must be saved under a different name. The system performance check document requires the SAM Twin Phantom or ELI4 Phantom, so the phantom must be properly installed in your system. (User defined measurement procedures can be created by opening a new document or editing an existing document file). Before you start the system performance check, you need only to tell the system with which components (probe, medium, and device) you are performing the system performance check; the system will take care of all parameters.

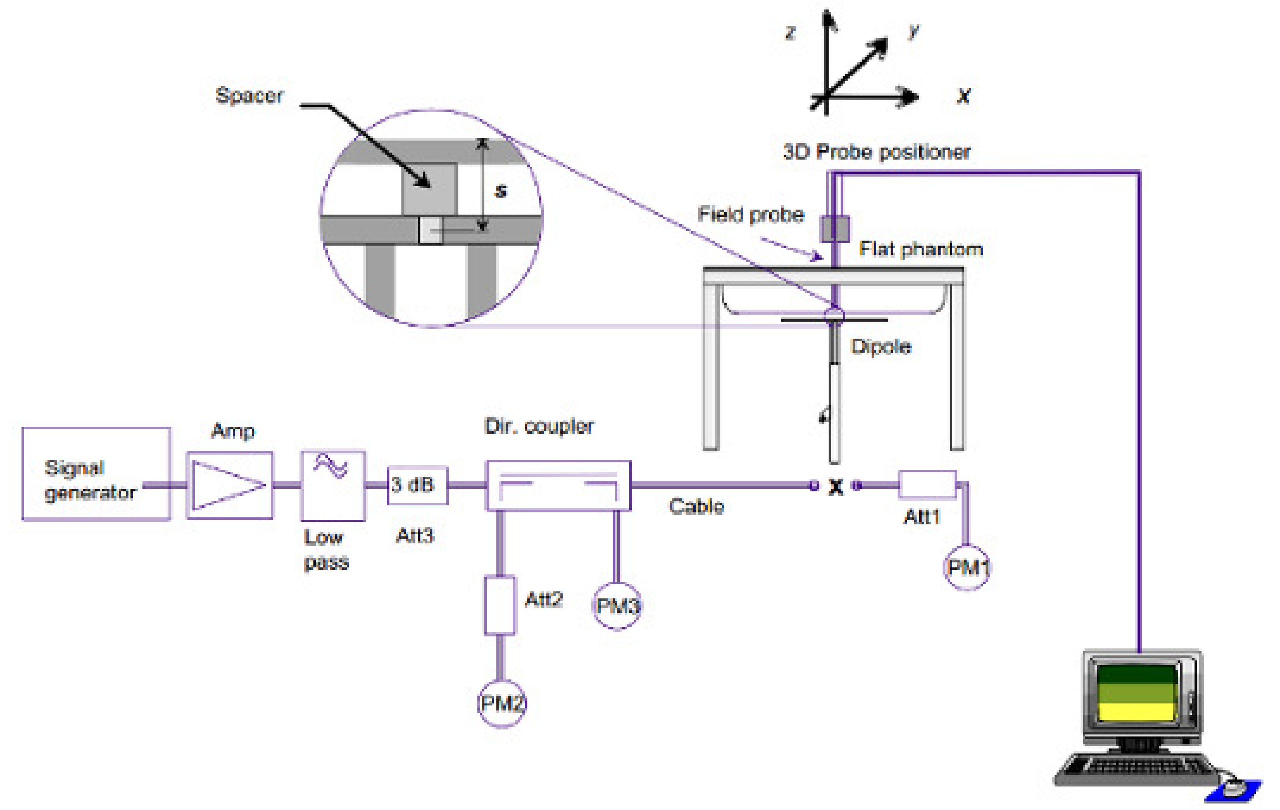
■ **The Power Reference Measurement and Power Drift Measurement** jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the Dipole output power. If it is too high (above ±0.2 dB), the system performance check should be repeated;

■ **The Surface Check** job tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ±0.1mm). In that case it is better to abort the system performance check and stir the liquid;

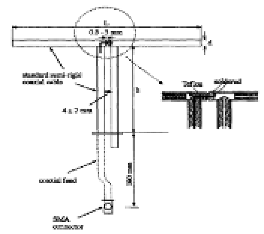
■ **The Area Scan** job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable;

■ **The Zoom Scan** job measures the field in a volume around the peak SAR value assessed in the previous Area Scan job (for more information see the application note on SAR evaluation). If the system performance check gives reasonable results. The dipole input power(forward power) was 250mW, 1 g and 10 g spatial average SAR values normalized to 1W dipole input power give reference data for comparisons and it's equal to 10x(dipole forward power). The next sections analyze the expected uncertainties of these values, as well as additional checks for further information or troubleshooting.

6.1.6 System Performance Check Setup



6.1.7 Validation Dipoles

The dipoles use is based on the IEEE Std.1528-2013 and FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 standard, and is complied with mechanical and electrical specifications in line with the requirements of both EN62209-1 and EN62209-2. The table below provides details for the mechanical and electrical specifications for the dipoles.	

6.1.8 Result of System Performance Check: Valid Result

System Performance Check at 2450MHz, 5300MHz, 5600MHz and 5800MHz for Body.

Validation Dipole: D2450V2-SN 914

Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
2450 MHz	Reference result ± 10% window	52.5 47.25 to 57.75	24.6 22.14 to 27.06	21.0
	21-03-2017	49.6	22.84	

Validation Dipole: D5GHzV2-SN1156

Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5300MHz	Reference result ± 10% window	75.8 68.22 to 83.38	21.1 18.99 to 23.21	21.0
	21-03-2017	76.4	22.5	
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5600MHz	Reference result ± 10% window	79.5 71.55 to 87.45	22.0 19.8 to 24.2	21.0
	21-03-2017	81.9	23.2	
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5800MHz	Reference result ± 10% window	76.6 68.94 to 84.26	21.1 18.99 to 23.21	21.0
	22-03-2017	76.2	21.3	

Note: All SAR values are normalized to 1W forward power.

6.2. Test Requirements

6.2.1 Test Procedures

Step 1 Setup a Connection

First, engineer should record the conducted power before the test. Then establish a call in handset at the maximum power level with a base station simulator via air interface, or make the EUT estimate by itself in testing band. Place the EUT to the specific test location. After the testing, must export SAR test data by SEMCAD. Then writing down the conducted power of the EUT into the report, also the SAR values tested.

Step 2 Power Reference Measurements

To measure the local E-field value at a fixed location which value will be taken as a reference value for calculating a possible power drift.

Step 3 Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01v01r04

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 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 ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 4 Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 v01r04

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></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">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 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 reported 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>

Step 5 Power Drift Measurements

Repetition of the E-field measurement at the fixed location mentioned in Step 1 to make sure the two results differ by less than ± 0.2 dB.

6.2.2 Test Channel

Per KDB248227 D01 v02r01, channel selection procedures below apply to both the initial test configu -ration and subsequent test configureation(s):

1) 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

2) The largest channel bandwidth configuration is selected among the multiple configurations in a freq -uency band with the same specified maximum output power.

3) If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is sele -cted.

4) If multiple configurations have the same specified maximum output power, largest channel band -width and lowest order modulation, the lowest data rate configuration among these configurations is seleced.

5) The same procedures also apply to subsequent highest output power channel(s) selection.

a> The channel closest to mid-band frequency is selected for SAR measurement.

b> For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

7. Wi-Fi/Bluetooth SAR Exclusion and Results

7.1. Maximum Tune-up Conducted Average Power

1.5dBm for 2.4GHz and 2dBm for 5GHz manufacture tolerance is included for tune up power in 802.11 a/b/g/n/ac SAR evaluation (excluding Bluetooth).

<QCNFA344A _WIFI 2x2Tx_ Single Chain Power> (Unit: dBm)

Ch.	Freq(MHz)	11b	11g	HT20/VHT20	HT40/ VHT40
1	2412	20.5	18.0	17.0	--
3	2422	--	--	--	13.0
6	2437	20.5	19.5	19.5	18.5
9	2452	--	--	--	11.0
11	2462	20.5	18.0	16.0	--

Ch.	Freq(MHz)	11a	HT20	VHT20
36	5180	15	15	15
38	5200	15	15	15
44	5220	15	15	15
48	5240	15	15	15
52	5260	16.5	16.5	16.5
56	5280	15	15	15
60	5300	15	15	15
64	5320	15	15	15
100	5500	15	15	15
104	5520	16.5	16.5	16.5
108	5540	16.5	16.5	16.5
112	5560	16.5	16.5	16.5
116	5580	16.5	16.5	16.5
120	5600	16.5	16.5	16.5
124	5620	16.5	16.5	16.5
128	5640	16.5	16.5	16.5
132	5660	16.5	16.5	16.5
136	5680	16.5	16.5	16.5
140	5700	15	15	15
144	5720	16.5	16.5	16.5
149	5745	15	15	15
153	5765	16.5	16.5	16.5
157	5785	16.5	16.5	16.5
161	5805	16.5	16.5	16.5
165	5825	16.5	16.5	16.5

Ch.	Freq(MHz)	HT40	VHT40
38	5190	11.5	11.5
46	5230	14	14
54	5270	14	14
62	5310	14	14
102	5510	11.5	11.5
110	5550	16	16
118	5590	16	16
126	5630	16	16
134	5670	14.5	14.5
142	5710	16	16
151	5755	11.5	11.5
159	5795	16	16

Ch.	Freq(MHz)	VHT80
42	5210	10.5
58	5290	12
106	5530	12
122	5610	15.5
138	5690	15.5
155	5775	10

<QCNFA344A _Bluetooth > (Unit: dBm)

Bluetooth Max. Tune-up power
7.0dBm

7.2. Measured Conducted Average Power

< QCNFA344A _Chain0_Main> (Unit: dBm)

<table>
<tr><td rowspan="2">Configurations</td><td colspan="12">Mode</td></tr>
<tr><td colspan="12">Channel / Frequency (MHz)</td></tr>
<tr><td rowspan="18">2.4GHz WLAN Average Power</td><td colspan="12">802.11b</td></tr>
<tr><td colspan="4">1/2412</td><td colspan="4">6/2437</td><td colspan="4">11/2462</td></tr>
<tr><td colspan="4">20.36</td><td colspan="4">20.43</td><td colspan="4">20.31</td></tr>
<tr><td colspan="12">802.11g</td></tr>
<tr><td colspan="4">1/2412</td><td colspan="4">6/2437</td><td colspan="4">11/2462</td></tr>
<tr><td colspan="4">17.85</td><td colspan="4">19.35</td><td colspan="4">17.93</td></tr>
<tr><td colspan="12">802.11n(HT20)</td></tr>
<tr><td colspan="4">1/2412</td><td colspan="4">6/2437</td><td colspan="4">11/2462</td></tr>
<tr><td colspan="4">16.84</td><td colspan="4">19.41</td><td colspan="4">15.75</td></tr>
<tr><td colspan="12">802.11n(VHT20)</td></tr>
<tr><td colspan="4">1/2412</td><td colspan="4">6/2437</td><td colspan="4">11/2462</td></tr>
<tr><td colspan="4">16.79</td><td colspan="4">19.27</td><td colspan="4">15.87</td></tr>
<tr><td colspan="12">802.11n(HT40)</td></tr>
<tr><td colspan="4">3/2422</td><td colspan="4">6/2437</td><td colspan="4">9/2452</td></tr>
<tr><td colspan="4">12.82</td><td colspan="4">18.39</td><td colspan="4">10.86</td></tr>
<tr><td colspan="12">802.11n(VHT40)</td></tr>
<tr><td colspan="4">3/2422</td><td colspan="4">6/2437</td><td colspan="4">9/2452</td></tr>
<tr><td colspan="4">12.93</td><td colspan="4">18.31</td><td colspan="4">10.97</td></tr>
<tr><td rowspan="18">5.2GHz WLAN Average Power</td><td colspan="12">802.11a</td></tr>
<tr><td colspan="3">36/5180</td><td colspan="3">40/5200</td><td colspan="3">44/5220</td><td colspan="3">48/5240</td></tr>
<tr><td colspan="3">14.36</td><td colspan="3">14.39</td><td colspan="3">14.41</td><td colspan="3">14.25</td></tr>
<tr><td colspan="12">802.11n(HT20)</td></tr>
<tr><td colspan="3">36/5180</td><td colspan="3">40/5200</td><td colspan="3">44/5220</td><td colspan="3">48/5240</td></tr>
<tr><td colspan="3">14.39</td><td colspan="3">14.27</td><td colspan="3">14.42</td><td colspan="3">14.33</td></tr>
<tr><td colspan="12">802.11ac(VHT20)</td></tr>
<tr><td colspan="3">36/5180</td><td colspan="3">40/5200</td><td colspan="3">44/5220</td><td colspan="3">48/5240</td></tr>
<tr><td colspan="3">14.26</td><td colspan="3">14.34</td><td colspan="3">14.35</td><td colspan="3">14.45</td></tr>
<tr><td colspan="12">802.11n(HT40)</td></tr>
<tr><td colspan="6">38/5190</td><td colspan="6">46/5230</td></tr>
<tr><td colspan="6">11.36</td><td colspan="6">13.85</td></tr>
<tr><td colspan="12">802.11ac(VHT40)</td></tr>
<tr><td colspan="6">38/5190</td><td colspan="6">38/5230</td></tr>
<tr><td colspan="6">11.41</td><td colspan="6">13.92</td></tr>
<tr><td colspan="12">802.11ac(VHT80)</td></tr>
<tr><td colspan="12">42/5210</td></tr>
<tr><td colspan="12">10.29</td></tr>
</table>

Configurations	Mode Channel / Frequency (MHz)			
5.3GHz WLAN Average Power	802.11a			
	52/5260	56/5280	60/5300	64/5320
	16.46	14.78	14.89	14.83
	802.11n(HT20)			
	52/5260	56/5280	60/5300	64/5320
	16.37	14.63	14.77	14.86
	802.11ac(VHT20)			
	52/5260	56/5280	60/5300	64/5320
	16.35	14.66	14.72	14.81
	802.11n(HT40)			
	54/5270		62/5310	
	13.79		13.82	
	802.11ac(VHT40)			
	54/5270		62/5310	
	13.86		13.87	
	802.11ac(VHT80)			
	58/5290			
	11.93			

Configurations	Mode Channel / Frequency (MHz)							
5.6GHz WLAN Average Power	802.11a							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.92	16.36	16.47	16.23	16.35	16.45	14.89	16.27
	802.11n(HT20)							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.87	16.31	16.22	16.32	16.28	16.27	14.76	16.23
	802.11ac(VHT20)							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.73	16.26	16.29	16.31	16.16	16.24	14.77	16.27
	802.11n(HT40)							
	102/5510	110/5550	118/5590	126/5630	134/5670	142/5710		
	11.41	15.89	15.93	15.82	14.43	15.79		
	802.11ac(VHT40)							
	102/5510	110/5550	118/5590	126/5630	134/5670	142/5710		
	11.39	15.75	15.81	15.86	14.37	15.76		
	802.11ac(VHT80)							
	106/5530	122/5610	138/5690					
	11.87	15.46	15.31					

Configurations	Mode				
	Channel / Frequency (MHz)				
5.8GHz WLAN Average Power	802.11a				
	149/5745	153/5765	157/5785	161/5805	165/5825
	14.75	16.33	16.47	16.41	16.29
	802.11n(HT20)				
	149/5745	153/5765	157/5785	161/5805	165/5825
	14.77	16.34	16.37	16.39	16.23
	802.11ac(VHT20)				
	149/5745	153/5765	157/5785	161/5805	165/5825
	14.81	16.25	16.36	16.27	16.13
	802.11n(HT40)				
	151/5755		159/5795		
	11.41		15.74		
	802.11ac(VHT40)				
	151/5755		159/5795		
	11.37		15.81		
	802.11ac(VHT80)				
	155/5775				
	9.93				

< QCNFA344A _Chain1_Aux> (Unit: dBm)

Configurations	Mode / Channel / Frequency (MHz)			
2.4GHz WLAN Average Power	802.11b			
	1/2412	6/2437	11/2462	
	20.37	20.46	20.35	
	802.11g			
	1/2412	6/2437	11/2462	
	17.81	19.34	17.97	
	802.11n(HT20)			
	1/2412	6/2437	11/2462	
	16.81	19.35	15.81	
	802.11n(VHT20)			
	1/2412	6/2437	11/2462	
	16.82	19.21	15.89	
	802.11n(HT40)			
	3/2422	6/2437	9/2452	
	12.85	18.29	10.85	
	802.11n(VHT40)			
	3/2422	6/2437	9/2452	
	12.91	18.39	10.93	
5.2GHz WLAN Average Power	802.11a			
	36/5180	40/5200	44/5220	48/5240
	14.31	14.41	14.43	14.26
	802.11n(HT20)			
	36/5180	40/5200	44/5220	48/5240
	14.38	14.25	14.43	14.36
	802.11ac(VHT20)			
	36/5180	40/5200	44/5220	48/5240
	14.25	14.29	14.31	14.22
	802.11n(HT40)			
	38/5190		46/5230	
	11.37		13.84	
	802.11ac(VHT40)			
	38/5190		38/5230	
	11.46		13.89	
	802.11ac(VHT80)			
	42/5210			
	10.31			

Configurations	Mode Channel / Frequency (MHz)			
5.3GHz WLAN Average Power	802.11a			
	52/5260	56/5280	60/5300	64/5320
	16.45	14.76	14.92	14.84
	802.11n(HT20)			
	52/5260	56/5280	60/5300	64/5320
	16.37	14.61	14.71	14.83
	802.11ac(VHT20)			
	52/5260	56/5280	60/5300	64/5320
	16.29	14.57	14.69	14.83
	802.11n(HT40)			
	54/5270	62/5310		
	13.74	13.86		
	802.11ac(VHT40)			
	54/5270	62/5310		
	13.81	13.84		
	802.11ac(VHT80)			
	58/5290			
	11.92			

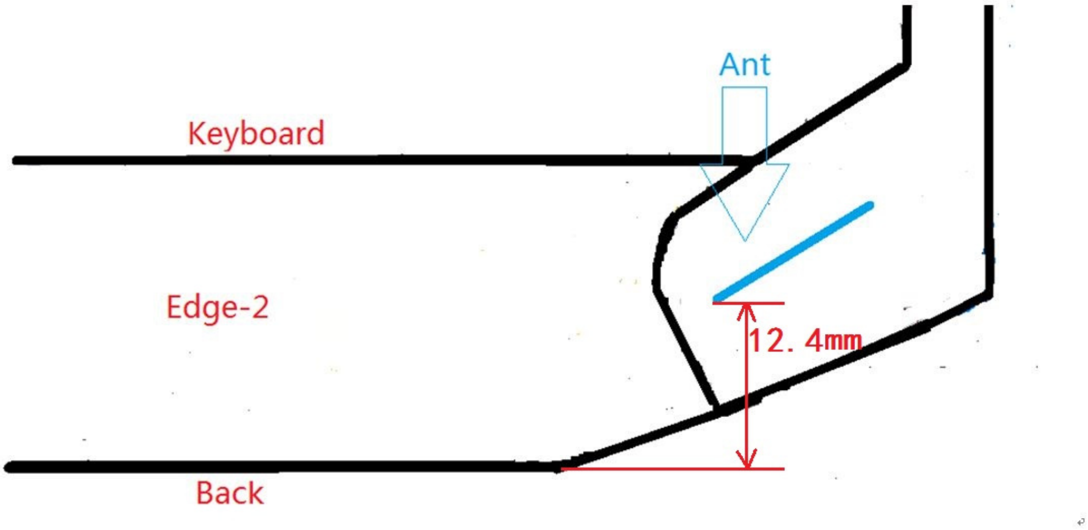
Configurations	Mode Channel / Frequency (MHz)							
5.6GHz WLAN Average Power	802.11a							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.89	16.37	16.47	16.21	16.36	16.43	14.87	16.29
	802.11n(HT20)							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.81	16.33	16.24	16.31	16.24	16.25	14.79	16.26
	802.11ac(VHT20)							
	100/5500	112/5560	116/5580	128/5640	132/5660	136/5680	140/5700	144/5720
	14.74	16.27	16.25	16.33	16.26	16.19	14.83	16.24
	802.11n(HT40)							
	102/5510	110/5550	118/5590	126/5630	134/5670	142/5710		
	11.43	15.91	15.94	15.79	14.45	15.73		
	802.11ac(VHT40)							
	102/5510	110/5550	118/5590	126/5630	134/5670	142/5710		
	11.31	15.65	15.82	15.87	14.21	15.82		
	802.11ac(VHT80)							
	106/5530	122/5610	138/5690					
	11.79	15.41	15.39					

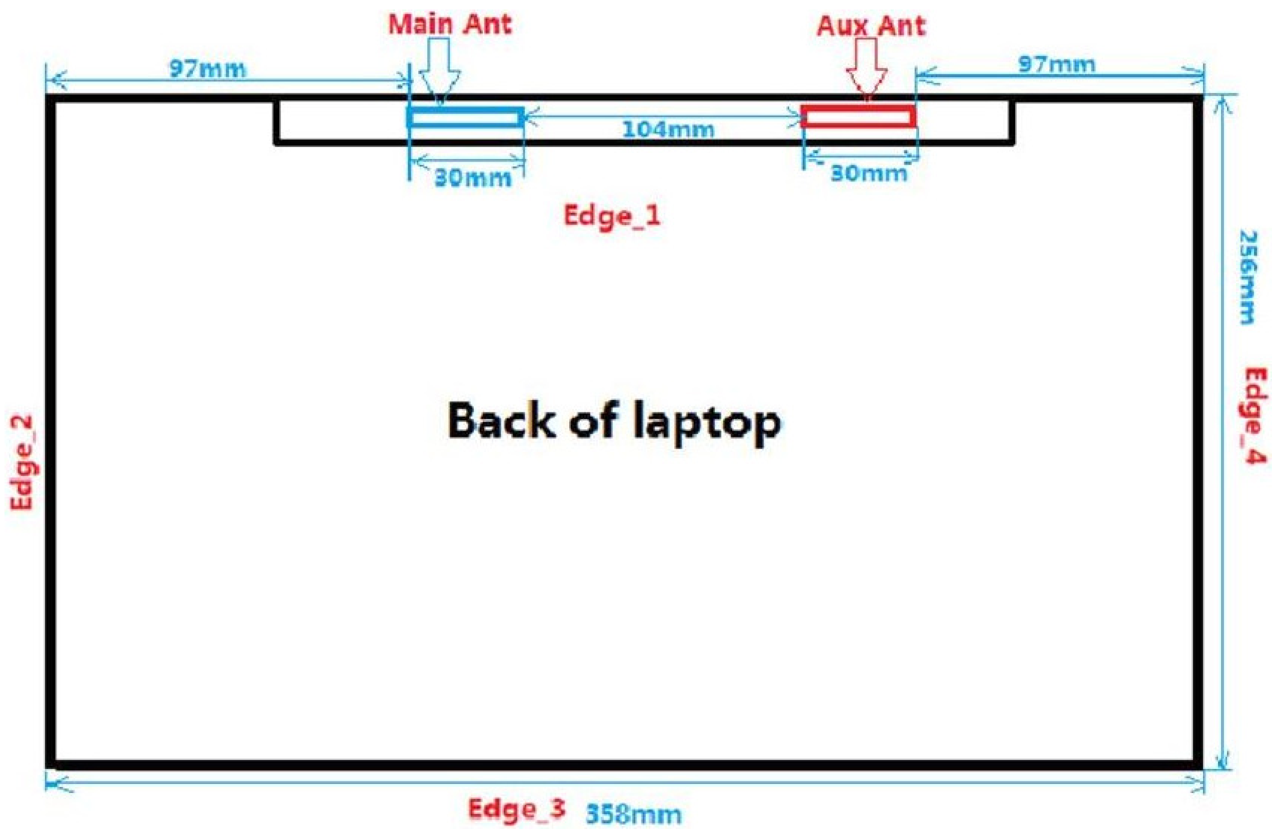
<table>
<tr><td rowspan="2">Configurations</td><td colspan="5">Mode</td></tr>
<tr><td colspan="5">Channel / Frequency (MHz)</td></tr>
<tr><td rowspan="18">5.8GHz WLAN
Average Power</td><td colspan="5">802.11a</td></tr>
<tr><td>149/5745</td><td>153/5765</td><td>157/5785</td><td>161/5805</td><td>165/5825</td></tr>
<tr><td>14.77</td><td>16.34</td><td>16.45</td><td>16.40</td><td>16.31</td></tr>
<tr><td colspan="5">802.11n(HT20)</td></tr>
<tr><td>149/5745</td><td>153/5765</td><td>157/5785</td><td>161/5805</td><td>165/5825</td></tr>
<tr><td>14.63</td><td>16.32</td><td>16.31</td><td>16.37</td><td>16.21</td></tr>
<tr><td colspan="5">802.11ac(VHT20)</td></tr>
<tr><td>149/5745</td><td>153/5765</td><td>157/5785</td><td>161/5805</td><td>165/5825</td></tr>
<tr><td>14.71</td><td>16.26</td><td>16.37</td><td>16.28</td><td>16.15</td></tr>
<tr><td colspan="5">802.11n(HT40)</td></tr>
<tr><td colspan="2">151/5755</td><td colspan="3">159/5795</td></tr>
<tr><td colspan="2">11.45</td><td colspan="3">15.73</td></tr>
<tr><td colspan="5">802.11ac(VHT40)</td></tr>
<tr><td colspan="2">151/5755</td><td colspan="3">159/5795</td></tr>
<tr><td colspan="2">11.38</td><td colspan="3">15.82</td></tr>
<tr><td colspan="5">802.11ac(VHT80)</td></tr>
<tr><td colspan="5">155/5775</td></tr>
<tr><td colspan="5">9.97</td></tr>
</table>

< QCNFA344A _Bluetooth > (Unit: dBm)

Max. Bluetooth Power	
2441MHz GFSK	7.0

7.3. Antenna Location





Antenna	Antenna Distance to Edges(mm)
	Back
Main(Tx1)	12.4
Aux(Tx2)	12.4

7.4. SAR exclusion

Per FCC KDB 447498 D01v06 section 4.3:

For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [$\sqrt{f_{(GHz)}}$] ≤ *3.0* for 1-g SAR, and ≤ *7.5* for 10-g extremity 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

5mm Test Separation

Test Mode	Frq. (MHz)	Test separation distance (mm)	Max. Tune-up Power(dBm)	Max. Tune-up Power(mW)	Test threshold	SAR Test (Y/N)
Bluetooth	2441	5	7	5	1.57	N
802.11b	2437	5	20.5	112	35.03	Y
802.11g	2437	5	19.5	89	27.83	Y
802.11n(HT20)	2437	5	19.5	89	27.83	Y
802.11n(HT40)	2437	5	18.5	71	22.10	Y
802.11a	5220	5	15	32	14.45	Y
802.11n(HT20)	5220	5	15	32	14.45	Y
802.11n(HT40)	5230	5	14	25	11.49	Y
802.11ac(VHT80)	5210	5	10.5	11	5.12	Y
802.11a	5260	5	16.5	45	20.49	Y
802.11n(HT20)	5260	5	15	32	14.51	Y
802.11n(HT40)	5310	5	14	25	11.58	Y
802.11ac(VHT80)	5290	5	12	16	7.29	Y
802.11a	5580	5	16.5	45	21.10	Y
802.11n(HT20)	5580	5	16.5	45	21.10	Y
802.11n(HT40)	5550	5	16	40	18.76	Y
802.11ac(VHT80)	5610	5	15.5	35	16.81	Y
802.11a	5785	5	16.5	45	21.49	Y
802.11n(HT20)	5785	5	16.5	45	21.49	Y
802.11n(HT40)	5795	5	16	40	19.17	Y
802.11ac(VHT80)	5775	5	10	10	4.81	Y

Note: Per KDB 447498 D01 v06 section4.1 f), the test separation distance is determined by the smallest distance between the outer surface of the device and the user; therefore, 0mm between outer surface and phantom is a conservative test separation distance for laptop.

7.5. Required Edges for SAR Testing

Test Mode	Frq.(MHz)	Main Antenna	Aux Antenna
		Back	Back
BT(GFSK)	2441	NO	NO
802.11b	2437	YES	YES
802.11g	2437	YES	YES
802.11n(HT20)	2437	YES	YES
802.11n(HT40)	2437	YES	YES
802.11a	5220	YES	YES
802.11n(HT20)	5220	YES	YES
802.11n(HT40)	5230	YES	YES
802.11ac(VHT80)	5210	YES	YES
802.11a	5300	YES	YES
802.11n(HT20)	5300	YES	YES
802.11n(HT40)	5310	YES	YES
802.11ac(VHT80)	5290	YES	YES
802.11a	5580	YES	YES
802.11n(HT20)	5580	YES	YES
802.11n(HT40)	5550	YES	YES
802.11ac(VHT80)	5610	YES	YES
802.11a	5785	YES	YES
802.11n(HT20)	5785	YES	YES
802.11n(HT40)	5795	YES	YES
802.11ac(VHT80)	5775	YES	YES

Note: According to KDB 248227 D01 v02r01, SAR configuration may be reduced.

7.6. Estimated SAR

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is≤1.6W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2 2, the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter.

$$Estimated\ SAR = \frac{\sqrt{f(GHz)}}{7.5} * \frac{(Max\ Power\ of\ channel, mW)}{Min.\ Separation, mm}$$

Where: Test separation distances ≤ 50mm.

Bluetooth

Test Position	Test Mode	Frq.(MHz)	Test Separations	Max. Tune-up Power(dBm)	Max. Tune-up Power(mW)	Estimated SAR(W/kg)
Main Ant						
Back	Bluetooth GFSK	2441	12.4	7.0	5.0	0.08
Aux Ant						
Back	Bluetooth GFSK	2441	12.4	7.0	5.0	0.08

Note: An estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR for test separate on distances >50mm per 447498 D01v06.

7.7. SAR Test Results Summary

■ **Laptop Mode- DTS_WLAN 2.4GHz**

Plot No.	Ant Type	Ant Port	Band	Mode	Test Position	Dist. mm	Ch.	Fre.	Max. Tune-up Power(dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift(dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Initial Test configuration of Speed Antenna														
01	1	main	802.11b	CCK	Back	0	6	2437	20.5	20.43	1.003	0.07	0.30	**0.30**
	1	aux	802.11b	CCK	Back	0	6	2437	20.5	20.46	1.002	0.08	0.26	0.26
Initial Test configuration of Amphenol Antenna														
	2	main	802.11b	CCK	Back	0	6	2437	20.5	20.43	1.003	0.13	0.27	0.27
	2	aux	802.11b	CCK	Back	0	6	2437	20.5	20.46	1.002	-0.07	0.24	0.24

Note:

1. **Per KDB248227 D01 v02r02 section 5.1.1 a), When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the remaining frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).**
2. **When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, 802.11g/n OFDM SAR is not required, per KDB248227 D01 v02r01 section 5.2.2 2).**

■ Laptop Mode- U-NII-1 _WLAN 5.2GHz

Note: Due to U-NII-2A band highest reported SAR is 0.55W/kg and U-NII-1 have lower maximum power than U-NII-2A, therefore per KDB248227 D01v02r02 section 5.3.1 a), if U-NII-2A band highest reported SAR is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.

■ Laptop Mode- U-NII-2A _WLAN 5.3GHz

Plot No.	Ant Type	Ant Port	Band	Mode	Test Position	Dist. mm	Ch.	Fre.	Max. Tune-up Power(dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift(dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Initial Test configuration of Speed Antenna														
02	1	main	802.11a	OFDM	Back	0	52	5260	16.5	16.46	1.002	0.09	0.54	**0.54**
	1	main	802.11n	HT20	Back	0	52	5260	16.5	16.37	1.008	0.17	0.46	0.47
	1	aux	802.11a	OFDM	Back	0	52	5260	16.5	16.45	1.003	0.05	0.29	0.29
Initial Test configuration of Amphenol Antenna														
	2	main	802.11a	OFDM	Back	0	52	5260	16.5	16.46	1.002	-0.04	0.29	0.29
	2	aux	802.11a	OFDM	Back	0	52	5260	16.5	16.45	1.003	0.14	0.21	0.21

Note:

1. Per KDB248227 D01 v02r02 section 5.1.1 a), When the reported SAR of the initial test position is ⩽ 0.4 W/kg, further SAR measurement is not required for the remaining frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).
2. Per KDB248227 D01 v02r02 section 5.3.3 initial test configuration procedures, when the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for subsequent next highest measured output power channel(s) in the initial test configuration until reported SAR is ≤ 1.2 W/kg.
3. Per KDB248227 D01 v02r02 section 5.3.4, the ratio is adjusted of subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

■ Laptop Mode- U-NII-2C_ WLAN 5.6GHz

Below 5.65GHz

Plot No.	Ant Type	Ant Port	Band	Mode	Test Position	Dist. mm	Ch.	Fre.	Max. Tune-up Power(dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift(dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Initial Test configuration of Speed Antenna														
03	1	main	802.11a	OFDM	Back	0	116	5580	16.5	16.47	1.00	0.17	0.27	**0.27**
	1	aux	802.11a	OFDM	Back	0	116	5580	16.5	16.47	1.00	-0.12	0.16	0.16
Initial Test configuration of Amphenol Antenna														
	2	main	802.11a	OFDM	Back	0	116	5580	16.5	16.47	1.00	0.09	0.11	0.11
	2	aux	802.11a	OFDM	Back	0	116	5580	16.5	16.47	1.00	0.05	0.12	0.12

Above 5.65GHz

Plot No.	Ant Type	Ant Port	Band	Mode	Test Position	Dist. mm	Ch.	Fre.	Max. Tune-up Power(dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift(dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Initial Test configuration of Speed Antenna														
	1	main	802.11a	OFDM	Back	0	136	5680	16.5	16.45	1.00	0.12	0.18	0.18
	1	aux	802.11a	OFDM	Back	0	136	5680	16.5	16.43	1.00	-0.14	0.16	0.16
Initial Test configuration of Amphenol Antenna														
	2	main	802.11a	OFDM	Back	0	136	5680	16.5	16.45	1.00	0.16	0.13	0.13
	2	aux	802.11a	OFDM	Back	0	136	5680	16.5	16.43	1.00	0.04	0.12	0.12

Note:

1. **Per KDB248227 D01 v02r02 section 5.1.1 a), When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the remaining frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).**

■ Laptop Mode- U-NII-3_ WLAN 5.8GHz

Plot No.	Ant Type	Ant Port	Band	Mode	Test Position	Dist. mm	Ch.	Fre.	Max. Tune-up Power(dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift(dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
Initial Test configuration of Speed Antenna														
	1	main	802.11a	OFDM	Back	0	157	5785	16.5	16.47	1.002	0.07	0.12	0.12
04	1	aux	802.11a	OFDM	Back	0	157	5785	16.5	16.45	1.003	0.16	0.19	**0.19**
Initial Test configuration of Amphenol Antenna														
	2	main	802.11a	OFDM	Back	0	157	5785	16.5	16.47	1.002	0.14	0.12	0.12
	2	aux	802.11a	OFDM	Back	0	157	5785	16.5	16.45	1.003	-0.09	0.15	0.15

Note:

1. **Per KDB248227 D01 v02r02 section 5.1.1 a), When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the remaining frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).**

8. Simultaneous Transmission Analysis

8.1. Max. Simultaneous SAR

■ **WLAN1 + WLAN2(Main Ant+ Aux Ant)**

Speed Antenna

Configurations	WLAN1 SAR (W/kg)	WLAN2 SAR (W/kg)	Σ SAR(W/kg)	Peak SAR1 Coordinate			Peak SAR2 Coordinates			Ri	SPLSR	Conclusion
				x, mm	y, mm	z, mm	x, mm	y, mm	z, mm			
Tablet Mode 802.11b CH6	0.30	0.26	0.56	N/A								Pass
Tablet Mode 802.11a CH52	0.54	0.29	0.83	N/A								Pass
Tablet Mode 802.11ac	0.27	0.16	0.43	N/A								Pass
Tablet Mode 802.11a CH157	0.12	0.19	0.31	N/A								Pass

Amphenol Antenna

Configurations	WLAN1 SAR (W/kg)	WLAN2 SAR (W/kg)	Σ SAR(W/kg)	Peak SAR1 Coordinate			Peak SAR2 Coordinates			Ri	SPLSR	Conclusion
				x, mm	y, mm	z, mm	x, mm	y, mm	z, mm			
Tablet Mode 802.11b CH6	0.27	0.24	0.51	N/A								Pass
Tablet Mode 802.11a CH52	0.29	0.21	0.50	N/A								Pass
Tablet Mode 802.11a	0.13	0.12	0.25	N/A								Pass
Tablet Mode 802.11a	0.12	0.15	0.27	N/A								Pass

Note: When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio per KDB 447498 D01v05r01; *Ratio =* $(SAR_1+SAR_2)^{1.5}/R_i \leq 0.04$ for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. The peak separation distance R_i is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where ($x_1$, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated and interpolated peak SAR locations in the zoom scan.

■WLAN+ Bluetooth

Speed Antenna

Configurations	Test Position	WLAN SAR(W/kg)	BT SAR(W/kg)	∑ SAR(W/kg)
WLAN(UNII) + BT(DSS)	Body-Back	0.55	0.08	0.63

Amphenol Antenna

Configurations	Test Position	WLAN SAR(W/kg)	BT SAR(W/kg)	∑ SAR(W/kg)
WLAN(UNII) + BT(DSS)	Body-Back	0.29	0.08	0.37

Note:

1.An estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR for test separate on distances >50mm per 447498 D01v06.

8.2. Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06.

9. Measurement Uncertainty

Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std.Unc. (1g)	Std. nc. (10g)	(vi) veff
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Modulation Response	±2.4%	R	$\sqrt{3}$	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max.SAR Eval.	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Power Scalingp	±0%	R	$\sqrt{3}$	0	0	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.1%	R	$\sqrt{3}$	1	1	±3.5%	±3.5%	∞
SAR correction	±1.9%	R	$\sqrt{3}$	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)DAK	±2.5%	R	$\sqrt{3}$	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)DAK	±2.5%	R	$\sqrt{3}$	0.26	0.26	±0.3%	±0.4%	∞
Temp. unc. –ConductivityBB	±3.4%	R	$\sqrt{3}$	0.78	0.71	±1.5%	±1.4%	∞
Temp. unc. – PermittivityBB	±0.4%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%	∞
Combined Std. Uncertainty						±11.2%	±11.1%	361
Expanded STD Uncertainty(k=2)						**±22.3%**	**±22.2%**	

DASY5 Uncertainty Budget, according to IEEE 1528/2011 and IEC 62209-1/2011(0.3-3GHz)

Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std.Unc. (1g)	Std. nc. (10g)	(vi) veff
Measurement System								
Probe Calibration	±6.55%	N	1	0	0			
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Modulation Response^{m}	±2.4%	R	$\sqrt{3}$	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Probe Positioning	±6.7%	R	$\sqrt{3}$	1	1	±3.9%	±3.9%	∞
Max.SAR Eval.	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Power Scaling^{p}	±0%	R	$\sqrt{3}$	0	0	±0%	±0%	∞
Phantom and Setup								
Phantom Uncertainty	±6.6%	R	$\sqrt{3}$	1	1	±3.8%	±3.8%	∞
SAR correction	±1.9%	R	$\sqrt{3}$	1	0.84	±1.1%	±0.9%	∞
Liquid Conductivity (mea.)^{DAK}	±2.5%	R	$\sqrt{3}$	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (mea.)^{DAK}	±2.5%	R	$\sqrt{3}$	0.26	0.26	±0.3%	±0.4%	∞
Temp. unc. –Conductivity^{BB}	±3.4%	R	$\sqrt{3}$	0.78	0.71	±1.5%	±1.4%	∞
Temp. unc. – Permittivity^{BB}	±0.4%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%	∞
Combined Std. Uncertainty						±12.3%	±12.2%	748
Expanded STD Uncertainty(Coverage factor=2)						**±24.6%**	**±24.5%**	

DASY5 Uncertainty Budget, according to IEEE 1528/2011 and IEC 62209-1/2011(3-6GHz)

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