FCC SAR Test Report (Class II Permissive Change)

Product Name : Intel Dual Band Wireless-AC 9260

Model No. : 9260D2WL

Applicant : ASUSTeK COMPUTER INC.

Address : 1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan

Date of Receipt : 2021/08/09

Issued Date : 2021/09/06

Report No. : 2180325R-SAUSSARV02

Report Version : V1.0

Test Report

Issued Date: 2021/09/06
Report No.: 2180325R-SAUSSARV02

Product Name	:	Intel Dual Band Wireless-AC 9260
Applicant	:	ASUSTeK COMPUTER INC.
Address	:	1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan
Manufacturer	:	Intel Mobile Communications
Model No.	:	9260D2WL
Trade Name	:	Intel
FCC ID	:	MSQ9260D2L
Applicable Standard	:	IEEE 1528-2013 KDB 447498 D01 v06 KDB 865664 D01 V01r04
Measurement procedures	:	47CFR § 2.1093 KDB 248227 D01 v02r02 KDB 616217 D04 V01r02
Test Result	:	Max. SAR Measurement (1g) 2.4GHz: **1.156** W/kg 5 GHz: **0.909** W/kg
Application Type	:	Certification

The above equipment has been tested by DEKRA, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report.

Documented By : Ida Tung
(Project Specialist / Ida Tung)

Tested By : Vorana Chen
(Senior Engineer / Vorana Chen)

Approved By : Wen Lee
(Supervisor / Wen Lee)

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Revision History

Report No.	Version	Description	Issued Date
2180325R-SAUSSARV02	V1.0	Initial issue of report.	2021/09/06

1. General Information

1.1 EUT Description

Product Name	Intel Dual Band Wireless-AC 9260				
Trade Name	Intel				
Model No.	9260D2WL				
FCC ID	MSQ9260D2L				
Frequency Range	802.11b/g/n-20: 2412-2472 MHz, 802.11n-40: 2422-2462 MHz 802.11a/n-20: 5180-5320 MHz, 5500-5700 MHz, 5745-5825MHz 802.11n-40: 5190-5310 MHz, 5510-5670 MHz, 5755-5795MHz 802.11ac-20MHz: 5720MHz, 802.11ac-40MHz: 5710MHz 802.11ac-80 MHz: 5210-5290 MHz, 5530-5610 MHz, 5775MHz 802.11ac-160: 5250MHz, 5570MHz, BT : 2402-2480MHz				
Number of Channels	802.11b/g/n-20MHz: 13, n-40MHz: 9 802.11a/n-20MHz: 24; 802.11n-40MHz: 11 802.11ac-20MHz: 1, 802.11ac-40MHz: 1,802.11ac-80MHz: 6 802.11ac-160MHz: 2, BT : 79 , BLE : 40				
Data Rate	802.11b: 1-11Mbps, 802.11a/g: 6-54Mbps, 802.11n: up to 300Mbps 802.11ac-80MHz: up to 866.7Mbps, 802.11ac-160: up to 1733.3Mbps BT : 3Mbps , BLE : 1Mpbs				
Channel Separation	802.11b/g/n-20MHz: 5 MHz, 802.11a/n-20/ac-20MHz: 20MHz 802.11n-40/ac-40MHz: 40MHz, 802.11ac-80MHz: 80MHz 802.11ac-160MHz: 320MHz, BT : 1MHz , BLE : 2MHz				
Type of Modulation	802.11b:DSSS, DBPSK, DQPSK, CCK 802.11a/g/n/ac: OFDM, BPSK, QPSK, 16QAM, 64QAM, 256QAM FHSS: GFSK(1Mbps) /π/4DQPSK(2Mbps) / 8DPSK(3Mbps)				
Antenna Type	PIFA Antenna				
Device Category	Portable				
RF Exposure Environment	Uncontrolled				
Summary of test result –Reported 1g SAR (W/Kg)					
Test configuration	DTS(Main)	DTS(Aux)	U-NII(Main)	U-NII(Aux)	DSS(BT)
Body-Standalone	0.905	1.156	0.868	0.909	0.255
Body-Simultaneous	DTS (Main + Aux)		U-NII (Main + Aux)		U-NII (Main+Aux)+ DTS(BT)
	2.061 (SPLSR=0.017)		1.311		1.566

Note:

(1) This is to request a Class II permissive change for FCC ID: MSQ9260D2L, originally granted on 05/14/2019. The major change filed under this application is:

Change

#1: Additional Chassis added, ASUSTeK, model number: UM535Q, UM5500Q, BM535Q, RM535Q.

Brand	Model	Difference
ASUS	UM535Q	All models are electrically identical, different model names are for marketing purpose.
	UM5500Q	
	BM535Q	
	RM535Q	
The representative test sample is UM535Q.		

#2 Reduce Main and Aux Wi-Fi Output Power through the Proximity Sensor(P-sensor) and BIOS respectively , and SAR were evaluated accordingly (Bluetooth Output Power don't be changed).

#3 Add three antennas(Main 0, Main 1, Aux) to WLAN module which have the same antenna's type (PIFA) with original grant, and each antenna gain is lower.

#4 Add 2 to 1 switch circuit to connect with Main port of WLAN Module for Main 0 and Main 1 antennas only one of the two antennas can be selected at the same time.

(2) 9260D2WL modular declaration compliance distance is 19mm which is smaller than 25mm of bystander requirement, so bystander SAR test exclusion.

1.2 Antenna List

No.	Manufacturer	Part No.	ASUS Part No.	Ant Type	Peak Gain
1	LUXSHARE	LA9RF274-CS-H (Main0) LA9RF274-CS-H (Main1) LA9RF275-CS-H (Aux)	14008-04150100 (Main0) 14008-04150100 (Main1) 14008-04150300 (Aux)	PIFA	0.94 dBi for 2.4GHz 3.42 dBi for 5.15~5.25GHz 3.55 dBi for 5.25~5.35GHz 4.62 dBi for 5.47~5.725GHz 4.62 dBi for 5.725~5.850GHz
2	INPAQ	MDA-LBLB-04-016 (Main0) MDA-LBLB-04-016 (Main1) MDA-LB-01-014 (Aux)	14008-04150000 (Main0) 14008-04150000 (Main1) 14008-04150200 (Aux)	PIFA	1.64 dBi for 2.4GHz 3.46 dBi for 5.15~5.25GHz 3.64 dBi for 5.25~5.35GHz 4.69 dBi for 5.47~5.725GHz 4.76 dBi for 5.725~5.850GHz

Note:

LUXSHARE (P/N: LA9RF274-CS-H (Main0/1)) and ASUS (P/N: 14008-04150100 (Main0/1)) both antennas are identical.

LUXSHARE (P/N: LA9RF275-CS-H (Aux)) and ASUS (P/N: 14008-04150300 (Aux)) both antennas are identical.

INPAQ (P/N: MDA-LBLB-04-016 (Main0/1)) and ASUS (P/N: 14008-04150000 (Main0/1)) both antennas are identical.

INPAQ (P/N: MDA-LB-01-014 (Aux)) and ASUS (P/N: 14008-04150200 (Aux)) both antennas are identical.

1.3 SAR Test Exclusion Calculation

According to KDB Publication 447498 D01, section 4.3.1, per the calculations of item 1 (Power(mW)/separation (mm)*sqrt(f(GHz)≤3.0), SAR is required as shown in the table below where calculated values are greater than 3.0 :

According to KDB Publication 616217 D04, section 4.2.b), When between the antenna and user is more than 5mm, edge SAR is not required for NB mode.

NB Mode SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna < 50mm from the user :

Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (≦3.0 SAR is not required)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Main0	WiFi	2462	17	50	230	59	272	218	4	7	>50mm	>50mm	>50mm	>50mm	15.7	11.2
Main0	WiFi	5240	13	20	230	59	272	218	4	7	>50mm	>50mm	>50mm	>50mm	9.1	6.5
Main0	WiFi	5320	13	20	230	59	272	218	4	7	>50mm	>50mm	>50mm	>50mm	9.2	6.6
Main0	WiFi	5700	13	20	230	59	272	218	4	7	>50mm	>50mm	>50mm	>50mm	9.5	6.8
Main0	WiFi	5825	13	20	230	59	272	218	4	7	>50mm	>50mm	>50mm	>50mm	9.6	6.9

NB ModeSAR exclusion calculations for WiFi-SISO and Bluetooth for antenna > 50mm from the user :

Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (SAR test exclusion power,mW)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Main0	WiFi	2462	17	50	230	59	272	218	4	7	1895.6	185.6	2315.6	1775.6	<50mm	<50mm
Main0	WiFi	5240	13	20	230	59	272	218	4	7	1865.5	155.5	2285.5	1745.5	<50mm	<50mm
Main0	WiFi	5320	13	20	230	59	272	218	4	7	1865.0	155.0	2285.0	1745.0	<50mm	<50mm
Main0	WiFi	5700	13	20	230	59	272	218	4	7	1862.8	152.8	2282.8	1742.8	<50mm	<50mm
Main0	WiFi	5825	13	20	230	59	272	218	4	7	1862.2	152.2	2282.2	1742.2	<50mm	<50mm

NB Mode SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna < 50mm from the user :

Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (≦3.0 SAR is not required)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Main1	WiFi	2462	17	50	228	85	260	218	7	7	>50mm	>50mm	>50mm	>50mm	11.2	11.2
Main1	WiFi	5240	13	20	228	85	260	218	7	7	>50mm	>50mm	>50mm	>50mm	6.5	6.5
Main1	WiFi	5320	13	20	228	85	260	218	7	7	>50mm	>50mm	>50mm	>50mm	6.6	6.6
Main1	WiFi	5700	13	20	228	85	260	218	7	7	>50mm	>50mm	>50mm	>50mm	6.8	6.8
Main1	WiFi	5825	13	20	228	85	260	218	7	7	>50mm	>50mm	>50mm	>50mm	6.9	6.9

NB ModeSAR exclusion calculations for WiFi-SISO and Bluetooth for antenna > 50mm from the user :

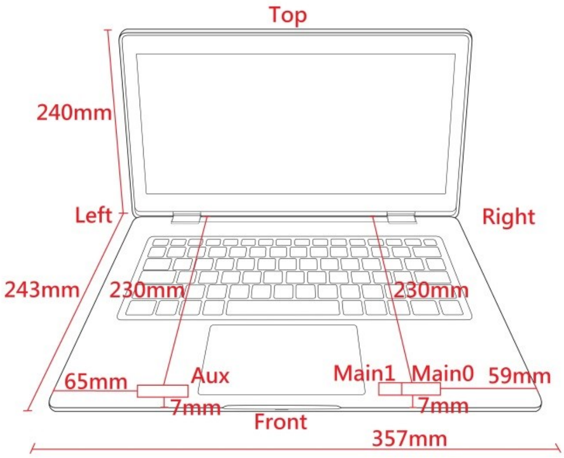
Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (SAR test exclusion power,mW)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Main1	WiFi	2462	17	50	228	85	260	218	7	7	1875.6	445.6	2195.6	1775.6	<50mm	<50mm
Main1	WiFi	5240	13	20	228	85	260	218	7	7	1845.5	415.5	2165.5	1745.5	<50mm	<50mm
Main1	WiFi	5320	13	20	228	85	260	218	7	7	1845.0	415.0	2165.0	1745.0	<50mm	<50mm
Main1	WiFi	5700	13	20	228	85	260	218	7	7	1842.8	412.8	2162.8	1742.8	<50mm	<50mm
Main1	WiFi	5825	13	20	228	85	260	218	7	7	1842.2	412.2	2162.2	1742.2	<50mm	<50mm

NB ModeSAR exclusion calculations for WiFi-SISO and Bluetooth for antenna < 50mm from the user :

Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (≦3.0 SAR is not required)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Aux	WiFi	2462	17.00	50	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	15.7	11.2
Aux	WiFi	5240	13.00	20	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	9.1	6.5
Aux	WiFi	5320	13.00	20	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	9.2	6.6
Aux	WiFi	5700	13.00	20	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	9.5	6.8
Aux	WiFi	5825	13.00	20	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	9.6	6.9
Aux	BT	2480	11.00	13	230	267	65	218	4	7	>50mm	>50mm	>50mm	>50mm	4.0	**2.8**

NB Mode SAR exclusion calculations for WiFi-SISO and Bluetooth for antenna > 50mm from the user :

Antenna	Tx	Frequency (MHz)	Output Power		Separation distances (mm)						Calculated Threshold Value (SAR test exclusion power,mW)					
			dBm	mW	Back	Right	Left	Top	Bottom	Front	Back	Right	Left	Top	Bottom	Front
Aux	WiFi	2462	17.00	50	230	267	65	218	4	7	1895.6	2265.6	245.6	1775.6	<50mm	<50mm
Aux	WiFi	5240	13.00	20	230	267	65	218	4	7	1865.5	2235.5	215.5	1745.5	<50mm	<50mm
Aux	WiFi	5320	13.00	20	230	267	65	218	4	7	1865.0	2235.0	215.0	1745.0	<50mm	<50mm
Aux	WiFi	5700	13.00	20	230	267	65	218	4	7	1862.8	2232.8	212.8	1742.8	<50mm	<50mm
Aux	WiFi	5825	13.00	20	230	267	65	218	4	7	1862.2	2232.2	212.2	1742.2	<50mm	<50mm
Aux	BT	2480	11.00	13	230	267	65	218	4	7	1895.3	2265.3	245.3	1775.3	<50mm	<50mm



1.3 Test Environment

Ambient conditions in the laboratory:

Test Date: Aug. 09, 2021

Items	Required	Actual
Temperature (°C)	18-25	23.3 ± 2
Humidity (%RH)	30-70	51

Test Date: Aug. 10, 2021

Items	Required	Actual
Temperature (°C)	18-25	23.0 ± 2
Humidity (%RH)	30-70	51

USA : FCC Registration Number: TW3023

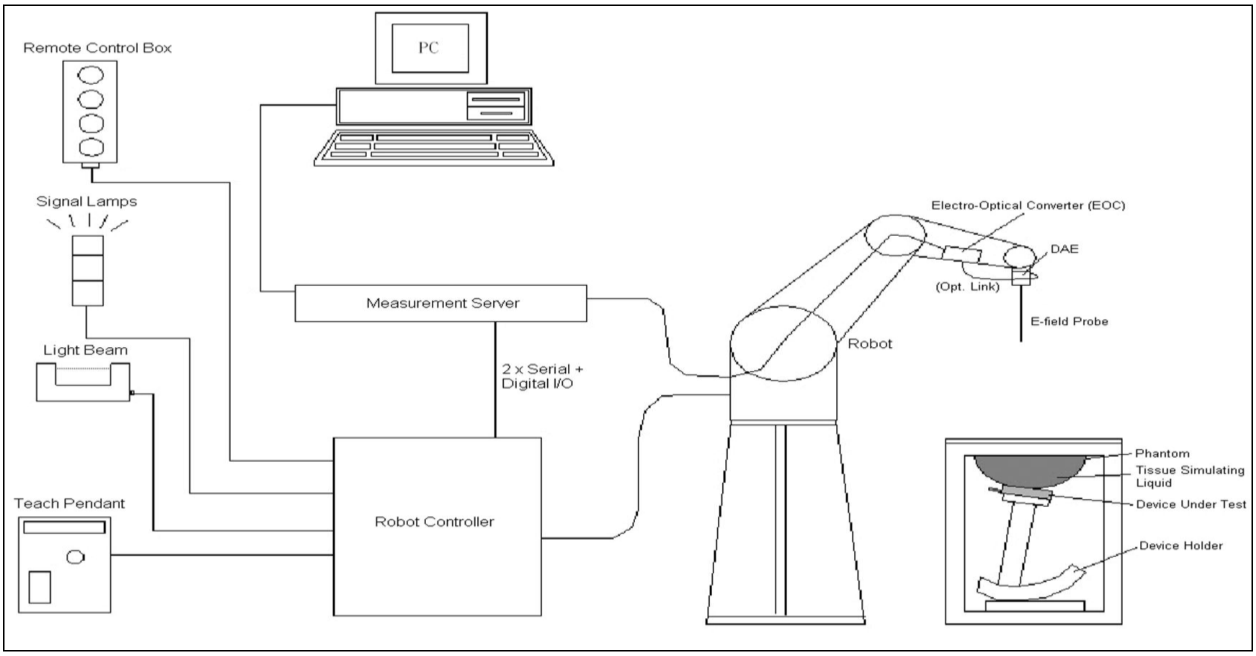
Canada : IC Registration Number: 4075A

Site Description : Accredited by TAF
Accredited Number: 3023

Test Laboratory : DEKRA Testing and Certification Co., Ltd
Address : No.5-22, Ruishukeng, Linkou Dist.,
New Taipei City 24451, Taiwan, R.O.C.
Phone number : 886-2-8601-3788
Fax number : 886-2-8601-3789
Email address : info.tw@dekra.com
Website : http://www.dekra.com.tw

2. SAR Measurement System

2.1 DASY5 System Description



The DASY5 system for performing compliance tests consists of the following items:

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

2.1.1 Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g., IEEE 1528, OET 65, IEC 62209-1, IEC 62209-2, EN 50360, EN 50383 and others.

2.1.2 Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a $10mm^2$ step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima 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 1528-2013, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

2.1.3 Zoom Scan (Cube Scan Averaging)

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. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

2.1.4 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.

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

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

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

2.2 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**.**

2.2.1 Isotropic E-Field Probe Specification

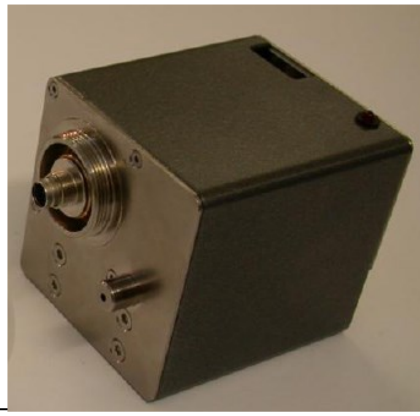
Model	Ex3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 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%.	

2.3 Boundary Detection Unit and Probe Mounting Device

The DASY probes use a precise connector and an additional holder for the probe, consisting of a plastic tube and a flexible silicon ring to center the probe. The connector at the DAE is flexibly mounted and held in the default position with magnets and springs. Two switching systems in the connector mount detect frontal and lateral probe collisions and trigger the necessary software response.

2.4 DATA Acquisition Electronics (DAE) and Measurement Server

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.



The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz Realtek 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.

2.5 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

2.6 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.

2.7 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.

2.8 SAM Twin 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 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.

3. Tissue Simulating Liquid

3.1 The composition of the tissue simulating liquid

INGREDIENT (% Weight)	2450MHz Head	5200MHz Head	5800MHz Head
Water	46.7	67.63	68.29
Salt	0.00	0.00	0.00
Sugar	0.00	0.00	0.00
HEC	0.00	0.00	0.00
Preventol	0.00	0.00	0.00
DGBE	53.3	3.38	2.44
Triton X-100	0.00	28.99	29.27

3.2 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using APREL Dielectric Probe Kit and Agilent E5071C Vector Network Analyzer.

Head Tissue Simulate Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε_r	σ [s/m]	
2450 MHz	Reference result ± 5% window	39.2 37.24 to 41.16	1.8 1.71 to 1.89	N/A
	10-Aug.-21	39.15	1.83	21.9
2412 MHz	Low channel	39.29	1.78	21.9
2437 MHz	Mid channel	39.20	1.81	21.9
2462 MHz	High channel	39.10	1.84	21.9

Head Tissue Simulate Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε r	σ [s/m]	
5250 MHz	Reference result ± 5% window	35.95 34.15 to 37.75	4.71 4.47 to 4.95	N/A
	09-Aug.-21	35.91	4.73	22.1
5210 MHz	Low channel	36.02	4.68	22.1
5250 MHz	Mid channel	35.91	4.73	22.1
5290 MHz	High channel	35.80	4.79	22.1

Head Tissue Simulate Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε r	σ [s/m]	
5600 MHz	Reference result ± 5% window	35.5 33.73 to 37.28	5.07 4.82 to 5.32	N/A
	09-Aug.-21	34.94	5.21	22.1
5530 MHz	Low channel	35.13	5.11	22.1
5610 MHz	Mid channel	34.92	5.22	22.1
5690 MHz	High channel	34.70	5.31	22.1

Head Tissue Simulate Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε r	σ [s/m]	
5800 MHz	Reference result ± 5% window	35.3 33.54 to 37.07	5.27 5.01 to 5.53	N/A
	09-Aug.-21	34.39	5.47	22.1
5755 MHz	Channel 155	34.46	5.43	22.1
5825 MHz	Channel 165	34.33	5.50	22.1

3.3 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEC 62209-1 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head tissue parameters that have not been specified are interpolated according to the head parameters specified in IEC 62209-1

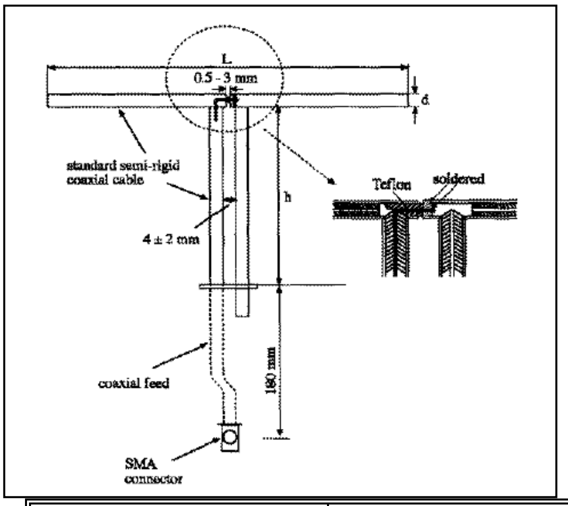
Target Frequency	Head	
(MHz)	ε_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1640	40.2	1.31
1750	40.1	1.37
1800 – 2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.3	5.27
5800	35.3	5.27
6000	35.1	5.48

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

4. SAR Measurement Procedure

4.1 SAR System Check

4.1.1 Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	51.5	30.4	3.6
5200M~5800MHz	20.6	40.3	3.6

4.1.2 System Check Result

System Performance Check at 2450MHz **Dipole Kit: D2450V2**				
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
2450 MHz	Reference result ± 10% window	53.1 47.79 to 58.41	24.6 22.14 to 27.06	N/A
	10-Aug.-21	54.0	23.88	21.9
Note: (1) The power level is used 250mW (2) All SAR values are normalized to 1W forward power. (3) The reference result is from Appendix E.				

System Performance Check at 5250MHz Dipole Kit: D5GHzV2				
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5250 MHz	Reference result ± 10% window	81.6 73.44 to 89.76	23.2 20.88 to 25.52	N/A
	09-Aug.-21	80.8	22.40	22.1
Note: (1) The power level is used 100mW (2) All SAR values are normalized to 1W forward power. (3) The reference result is from Appendix E.				

System Performance Check at 5600MHz Dipole Kit: D5GHzV2				
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5600 MHz	Reference result ± 10% window	85.9 77.31 to 94.49	24.2 21.78 to 26.62	N/A
	09-Aug.-21	83.3	23.10	22.1
Note: (1) The power level is used 100mW (2) All SAR values are normalized to 1W forward power. (3) The reference result is from Appendix E.				

System Performance Check at 5800MHz Dipole Kit: D5GHzV2				
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
5800 MHz	Reference result ± 10% window	82.0 73.80 to 90.20	22.8 20.52 to 25.08	N/A
	09-Aug.-21	80.5	21.60	22.1
Note: (1) The power level is used 100mW (2) All SAR values are normalized to 1W forward power. (3) The reference result is from Appendix E.				

4.2 SAR Measurement Procedure

The Dasy5 calculates SAR using the following equation,

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

σ: represents the simulated tissue conductivity

ρ: represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at $1mm^2$)which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at $1mm^3$).

5. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	**1.60 W/kg**
Spatial Average SAR (whole body)	**0.08 W/kg**
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	**4.00 W/kg**

6. Test Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Last Calibration	Next Calibration
Stäubli Robot TX60L	Stäubli	TX60L	F09/5BL1A1/A06	2009/05/18	only once
Controller	Speag	CS8c	N/A	2009/05/18	only once
Reference Dipole 2450MHz	Speag	D2450V2	930	2019/11/21	2022/11/20
Reference Dipole 5GHz	Speag	D5GHzV2	1041	2020/05/25	2023/05/24
SAM Twin Phantom	Speag	QD000 P40 CA	Tp 1515	N/A	N/A
Device Holder	Speag	N/A	N/A	N/A	N/A
Data Acquisition Electronic	Speag	DAE4	1425	2020/11/24	2021/11/23
E-Field Probe	Speag	EX3DV4	3979	2020/11/25	2021/11/24
SAR Software	Speag	DASY52	V52.10.0.1446	N/A	N/A
Aprel Dipole Spaccer	Aprel	ALS-DS-U	QTK-295	N/A	N/A
Power Amplifier	Mini-Circuit	ZHL-42	D051404-20	N/A	N/A
Directional Coupler	Agilent	87300C	MY44300353	N/A	N/A[1]
Attenuator	Woken	WATT-218FS-10	N/A	N/A	N/A[1]
Attenuator	Mini-Circuit	BW-S20W2+	N/A	N/A	N/A[1]
Vector Network	Agilent	E5071C	MY46106342	2020/10/04	2021/10/03
Signal Generator	Anritsu	MG3694A	041902	2020/08/31	2021/08/30
Power Meter	Anritsu	ML2487A	6K00001447	2020/11/06	2021/11/05
Wide Bandwidth Sensor	Anritsu	MA2411B	1339194	2020/11/06	2021/11/05

Note: 1. System Check, the path loss measured by the network analyzer, includes the signal generator, amplifier, cable, attenuator and directional coupler.

Note:

Per KDB 865664 D01 requirements for dipole calibration, the following are recommended FCC procedures for SAR dipole calibration.

1. After a dipole is damaged and properly repaired to meet required specifications

2. When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions;

3. When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	2450	Head	-25.16dB	Within 20%	2019.11.21
Measurement	2450	Head	-24.77dB		2020.11.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5250	Head	-26.86dB	Within 20%	2020.05.25
Measurement	5250	Head	-24.16dB		2021.05.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5600	Head	-24.43dB	Within 20%	2020.05.25
Measurement	5600	Head	-27.05dB		2021.05.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5800	Head	-26.80dB	Within 20%	2020.05.25
Measurement	5800	Head	-25.64dB		2021.05.18

4. When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement

	Frequency	Tissue	Impedance	Limit	Verified Date
Calibration	2450	Head	54.37	Within 5Ω	2020.05.25
Measurement	2450	Head	56.58		2021.05.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5250	Head	49.04	Within 5Ω	2020.05.25
Measurement	5250	Head	45.54		2021.05.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5600	Head	56.26	Within 5Ω	2020.05.25
Measurement	5600	Head	52.24		2021.05.18

	Frequency	Tissue	Return loss	Limit	Verified Date
Calibration	5800	Head	54.28	Within 5Ω	2020.05.25
Measurement	5800	Head	49.85		2021.05.18

7. Measurement Uncertainty

DASY5 Uncertainty (According to IEEE 1528-2013) Measurement uncertainty for 30 MHz to 3 GHz								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) V_{eff}
Measurement System								
Probe Calibration	±6%	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.	±4.0%	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	±0%	R	$\sqrt{3}$	1	1	±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 (meas.)	±2.5%	R	$\sqrt{3}$	0.78	0.71	±1.1%	±1.0%	∞
Liquid Permittivity (meas.)	±2.5%	R	$\sqrt{3}$	0.26	0.26	±0.3%	±0.4%	∞
Temp. unc. - Conductivity	±3.4%	R	$\sqrt{3}$	0.78	0.71	±1.5%	±1.4%	∞
Temp. unc. - Permittivity	±0.4%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%	∞
Combined Std. Uncertainty						±11.2%	±11.1%	361
Expanded STD Uncertainty						±22.3%	±22.2%	

DASY5 Uncertainty (According to IEEE 1528-2013) Measurement uncertainty for 3GHz to 6 GHz								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) V_{eff}
Measurement System								
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
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	±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%	∞
Post-processing	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
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	±0%	R	$\sqrt{3}$	1	1	±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	1	±1.1%	±0.9%	∞
Liquid Conductivity (meas.)	±2.5%	R	$\sqrt{3}$	1	0.84	±1.1%	±1.0%	∞
Liquid Permittivity (meas.)	±2.5%	R	$\sqrt{3}$	0.26	0.26	±0.3%	±0.4%	∞
Temp. unc. - Conductivity	±3.4%	R	$\sqrt{3}$	0.78	0.71	±1.5%	±1.4%	∞
Temp. unc. - Permittivity	±0.4%	R	$\sqrt{3}$	0.23	0.26	±0.1%	±0.1%	∞
Combined Std. Uncertainty						±12.3%	±12.2%	748
Expanded STD Uncertainty						±24.6%	±24.5%	

8. Conducted Power Measurement (Including tolerance allowed for production unit)

Mode	Antenna	Sensor "OFF" Power (Including tolerance)	Sensor "ON " Reduce Power (Including tolerance)
WLAN 2.4G	Main 0	20.5	17
	Main 1	20.5	17
	AUX	17	17
WLAN 5G Band1 (5150~5250MHz)	Main 0	20.5	13
	Main 1	20.5	13
	AUX	13	13
WLAN 5G Band2 (5250~5350MHz)	Main 0	20.375	13
	Main 1	20.375	13
	AUX	13	13
WLAN 5G Band3 (5470~5650MHz)	Main 0	20.375	13
	Main 1	20.375	13
	AUX	13	13
WLAN 5G Band3 (5720~5850MHz)	Main 0	20.25	13
	Main 1	20.25	13
	AUX	13	13
BT	AUX	11	11

WLAN 2.4G 2TX SISO-P-Sensor Off_10mm

DSSS/OFDM mode specified maximum output power at an antenna port	Frequency	Mode	BW	SISO-Main(TX1)				SISO-Aux(TX2)			
				CH	PK Power	AV Power	AV Target	CH	PK Power	AV Power	AV Target
	WLAN 2.4GHz	b	20	1	21.17	18.71	19.25	1	19.65	16.90	17
				6	22.25	20.41	20.5	6	19.70	16.98	17
				11	20.93	18.49	19	11	19.55	16.89	17
				12	19.36	16.87	17.25	12	19.41	16.80	17
				13	17.12	14.37	14.5	13	16.84	14.19	14.5
		g	20	1	21.13	16.40	16.5	1	21.45	16.79	17
				6	22.04	18.29	19	6	21.58	16.97	17
				11	21.21	16.37	16.5	11	21.21	16.41	16.5
				12	18.16	13.27	13.5	12	18.31	13.42	13.5
				13	2.17	-5.68	-5.5	13	2.23	-5.53	-5.5
		n(HT)	20	1	21.09	16.25	16.5	1	21.58	16.92	17
				6	22.05	18.15	18.75	6	21.64	16.79	17
				11	21.33	16.23	16.5	11	21.13	16.40	16.5
				12	18.43	13.43	13.5	12	18.46	13.42	13.5
				13	2.31	-5.80	-5.5	13	2.15	-5.62	-5.5
			40	3	19.93	14.42	14.5	3	20.44	14.93	15
				6	21.35	16.47	16.5	6	21.55	16.48	16.5
				9	20.87	15.35	15.5	9	21.12	15.43	15.5
				10	17.41	9.39	9.5	10	17.99	10.16	10.25
				11	11.52	3.42	3.5	11	10.92	2.87	3

WLAN 5G 2TX SISO-P-Sensor Off_10mm																		
	Frequency	Mode	BW	SISO-Main(TX1)			SISO-Aux(TX2)			Frequency	Mode	BW	SISO-Main(TX1)			SISO-Aux(TX2)		
				CH	AV Power	AV Target	CH	AV Power	AV Target				CH	AV Power	AV Target	CH	AV Power	AV Target
OFDM mode specified maximum output power at an antenna port	U-NII-1 (5150~5250MHz)	a	20	36	18.11	18.25	36	12.91	13	U-NII-2A (5250~5350MHz)	a	20	52	19.85	20	52	12.88	13
				40	20.16	20.25	40	12.89	13				56	20.07	20.125	56	12.89	13
				44	20.39	20.5	44	12.90	13				60	20.20	20.25	60	12.85	13
				48	20.34	20.375	48	12.91	13				64	17.84	18	64	12.78	13
		n(HT)	20	36	18.17	18.25	36	12.86	13		n(HT)	20	52	20.01	20.125	52	12.79	13
				40	20.21	20.25	40	12.88	13				56	20.25	20.375	56	12.86	13
				44	20.01	20.125	44	12.91	13				60	20.21	20.25	60	12.76	13
				48	20.12	20.25	48	12.92	13				64	17.83	18	64	12.74	13
			40	38	16.65	16.75	38	12.89	13			40	54	19.92	20	54	12.88	13
				46	19.82	19.875	46	12.88	13				62	15.66	15.75	62	12.85	13
		ac	80	42	16.44	16.5	42	12.94	13		ac	80	58	15.72	15.75	58	12.96	13
		U-NII-1 + U-NII-2A									ac	160	50	12.43	12.5	50	12.41	12.5
	U-NII-2C (5470~5650MHz)	a	20	100	18.14	18.25	100	12.84	13	5.65 GHz & U-NII-3 (5725~5850MHz)	a	20	132	19.93	20	132	12.92	13
				112	19.82	19.875	112	12.80	13				149	19.71	19.75	149	12.81	13
				116	19.95	20	116	12.79	13				165	20.23	20.25	165	12.87	13
				128	20.33	20.375	128	12.89	13		n(HT)	20	132	20.34	20.375	132	12.79	13
		n(HT)	20	100	18.23	18.25	100	12.83	13				149	19.92	20	149	12.82	13
				112	19.61	19.75	112	12.88	13				165	20.20	20.25	165	12.85	13
				116	19.69	19.875	116	12.84	13			40	134	19.17	19.25	134	12.90	13
				128	19.74	19.875	128	12.90	13				151	19.74	19.875	151	12.91	13
			40	102	17.16	17.25	102	12.90	13				159	19.73	19.875	159	12.87	13
				110	19.95	20	110	12.92	13		ac	20	144	20.07	20.125	144	12.85	13
				118	19.50	19.625	118	12.86	13			40	142	19.80	19.875	142	12.87	13
				126	19.60	19.75	126	12.89	13			80	138	19.90	20	138	12.85	13
		ac	80	106	16.72	16.75	106	12.90	13				155	18.70	18.75	155	12.95	13
				122	19.90	20	122	12.87	13									
			160	114	13.68	13.75	114	12.87	13									

WLAN 2.4G 2TX SISO-P-Sensor On_0mm

	Frequency	Mode	BW	SISO-Main(TX1)				SISO-Aux(TX2)			
				CH	PK Power	AV Power	AV Target	CH	PK Power	AV Power	AV Target
DSSS/OFDM mode specified maximum output power at an antenna port	WLAN 2.4GHz	b	20	1	19.61	16.90	17	1	19.65	16.90	17
				6	19.65	16.92	17	6	19.70	16.98	17
				11	19.57	16.91	17	11	19.55	16.89	17
				12	19.35	16.88	17	12	19.41	16.80	17
				13	17.12	14.37	14.5	13	16.84	14.19	14.5
		g	20	1	21.13	16.40	16.5	1	21.45	16.79	17
				6	21.47	16.93	17	6	21.58	16.97	17
				11	21.21	16.37	16.5	11	21.21	16.41	16.5
				12	18.16	13.27	13.5	12	18.31	13.42	13.5
				13	2.17	-5.68	-5.5	13	2.23	-5.53	-5.5
		n(HT)	20	1	21.09	16.25	16.5	1	21.58	16.92	17
				6	21.55	16.80	17	6	21.64	16.79	17
				11	21.33	16.23	16.5	11	21.13	16.40	16.5
				12	18.43	13.43	13.5	12	18.46	13.42	13.5
				13	2.31	-5.80	-5.5	13	2.15	-5.62	-5.5
			40	3	19.93	14.42	14.5	3	20.44	14.93	15
				6	21.35	16.47	16.5	6	21.55	16.48	16.5
				9	20.87	15.35	15.5	9	21.12	15.43	15.5
				10	17.41	9.39	9.5	10	17.99	10.16	10.25
				11	11.52	3.42	3.5	11	10.92	2.87	3

WLAN 5G 2TX SISO-Sensor On_0mm

OFDM mode specified maximum output power at an antenna port

Frequency	Mode	BW	SISO-Main(TX1) CH	SISO-Main(TX1) AV Power	SISO-Main(TX1) AV Target	SISO-Aux(TX2) CH	SISO-Aux(TX2) AV Power	SISO-Aux(TX2) AV Target
U-NII-1 (5150~5250MHz)	a	20	36	12.84	13	36	12.91	13
			40	12.95	13	40	12.89	13
			44	12.90	13	44	12.90	13
			48	12.88	13	48	12.91	13
	n(HT)	20	36	12.93	13	36	12.86	13
			40	12.89	13	40	12.88	13
			44	12.92	13	44	12.91	13
			48	12.83	13	48	12.92	13
		40	38	12.87	13	38	12.89	13
			46	12.86	13	46	12.88	13
	ac	80	42	12.92	13	42	12.94	13
U-NII-2C (5470~5650MHz)	a	20	100	12.93	13	100	12.84	13
			112	12.96	13	112	12.80	13
			116	12.96	13	116	12.79	13
			128	12.88	13	128	12.89	13
	n(HT)	20	100	12.83	13	100	12.83	13
			112	12.84	13	112	12.88	13
			116	12.96	13	116	12.84	13
			128	12.92	13	128	12.90	13
		40	102	12.86	13	102	12.90	13
			110	12.81	13	110	12.92	13
			118	12.93	13	118	12.86	13
			126	12.84	13	126	12.89	13
	ac	80	106	12.98	13	106	12.90	13
			122	12.89	13	122	12.87	13
		160	114	12.91	13	114	12.87	13

Frequency	Mode	BW	SISO-Main(TX1) CH	SISO-Main(TX1) AV Power	SISO-Main(TX1) AV Target	SISO-Aux(TX2) CH	SISO-Aux(TX2) AV Power	SISO-Aux(TX2) AV Target
U-NII-2A (5250~5350MHz)	a	20	52	12.84	13	52	12.88	13
			56	12.96	13	56	12.89	13
			60	12.94	13	60	12.85	13
			64	12.94	13	64	12.78	13
	n(HT)	20	52	12.86	13	52	12.79	13
			56	12.80	13	56	12.86	13
			60	12.92	13	60	12.76	13
			64	12.92	13	64	12.74	13
		40	54	12.85	13	54	12.88	13
			62	12.84	13	62	12.85	13
	ac	80	58	12.99	13	58	12.96	13
U-NII-1 + U-NII-2A	ac	160	50	12.43	12.5	50	12.41	12.5
5.65 GHz & U-NII-3 (5725~5850MHz)	a	20	132	12.97	13	132	12.92	13
			149	12.84	13	149	12.81	13
			165	12.83	13	165	12.87	13
	n(HT)	20	132	12.86	13	132	12.79	13
			149	12.94	13	149	12.82	13
			165	12.87	13	165	12.85	13
		40	134	12.91	13	134	12.90	13
			151	12.83	13	151	12.91	13
			159	12.82	13	159	12.87	13
	ac	20	144	12.86	13	144	12.85	13
		40	142	12.87	13	142	12.87	13
		80	138	12.92	13	138	12.85	13
			155	12.95	13	155	12.95	13

BT Only Support Aux-Sensor On_0mm / P-Sensor Off_10mm

Bluetooth mode maximum output power	Frequency	Mode	Modulation	SISO-Main(TX1)				SISO-Aux(TX2)			
				CH	PK Power	AV Power	AV Target	CH	PK Power	AV Power	AV Target
	BT 2.4GHz	BR	GFSK	0	N/A	N/A	N/A	0	9.95	8.75	11.00
				39	N/A	N/A	N/A	39	10.75	9.24	11.00
				78	N/A	N/A	N/A	78	10.55	9.59	11.00
		EDR	8DPSK	0	N/A	N/A	N/A	0	9.58	7.23	7.50
				39	N/A	N/A	N/A	39	10.05	7.36	7.50
				78	N/A	N/A	N/A	78	9.91	7.40	7.50
		BLE	GFSK	0	N/A	N/A	N/A	0	8.77	6.14	7.50
				19	N/A	N/A	N/A	19	8.92	6.42	7.50
				39	N/A	N/A	N/A	39	8.80	6.14	7.50

9. Proximity Sensor

9.1 proximity sensor triggering distances

According the KDB 616217 Section 6.2, The following procedures should be applied to determine proximity sensor triggering distances for the back surface and individual edges of a tablet.

a) The relevant transmitter should be set to operate at its normal maximum output power.

b) The entire back surface or edge of the tablet is positioned below a flat phantom filled with the required tissue-equivalent medium, and positioned at least 20 mm further than the distance that triggers power reduction.

c) It should be ensured that the cables required for power measurements are not interfering with the proximity sensor. Cable losses should be properly compensated to report the measured power results.

d) The back surface or edge is moved toward the phantom in 3 mm steps until the sensor triggers.

e) The back surface or edge is then moved back (further away) from the phantom by at least 5 mm or until maximum output power is returned to the normal maximum level.

f) The back surface or edge is again moved toward the phantom, but in 1 mm steps, until it is at least 5 mm past the triggering point or touching the phantom. If 1 mm resolution is not suitable for the sensor triggering sensitivity, a KDB inquiry should be submitted to determine alternative test configurations.

g) If the tablet is not touching the phantom, it is moved in 3 mm steps until it touches the phantom to confirm that the sensor remains triggered and the maximum power stays reduced.

h) The process is then reversed by moving the tablet away from the phantom according to steps d) to g), to determine triggering release, until it is at least 10 mm beyond the point that triggers the return of normal maximum power.

i) The measured output power within 5 mm of the triggering points, or until the tablet is touching the phantom, for movements to and from the phantom should be tabulated in the SAR report.

j) If the sensor design and implementation allow additional variations for triggering distance tolerances, multiple samples should be tested to determine the most conservative distance required for SAR evaluation.

k) To ensure all production units are compliant, it is generally necessary to reduce the triggering distance determined from the triggering tests by 1 mm, or more if it is necessary, and use the smallest distance for movements to and from the phantom, minus 1 mm, as the sensor triggering distance for determining the SAR measurement distance.

9.2 Procedures for determining antenna and proximity sensor coverage

Proximity sensors are not normally designed to cover the entire back surface or edges of a tablet. The sensing regions are usually limited to areas near the sensor element. The following are used to determine if additional SAR measurements may be necessary due to sensor and antenna offset.

a) The back surface or edge of the tablet is positioned at a test separation distance less than or equal to the distance required for back surface or edge triggering, with both the antenna and sensor pad located at least 20 mm laterally outside the edge (boundary) of the phantom, along the direction of maximum antenna and sensor offset. For the back surface, if the direction of maximum offset is not aligned with the tablet coordinates (physical edges) the tablet test position would not be aligned with the phantom coordinates (orientations). Each applicable tablet edge should be positioned perpendicularly to the phantom to determine sensor coverage. For antennas and/or sensors located near the corner of a tablet, both adjacent edges must be considered.

b) The similar sequence of steps applied to determine sensor triggering distance in 6.2 are used to verify back surface and edge sensor coverage by moving the tablet (sensor and antenna) horizontally toward the phantom while maintaining the same vertical separation between the back surface or edge and the phantom.

c) After the exact location where triggering of power reduction is determined, with respect to the sensor and antenna, the tablet movement should be continued, in 3 mm increments, until both the sensor and antenna(s) are fully under the phantom and at least 20 mm inside the phantom edge.

d) The process is then repeated from the opposite direction, starting at the other end of the maximum antenna and sensor offset, by rotating the tablet 180 along the vertical axis.

e) The triggering points should be documented graphically, with the antenna and sensor clearly identified, along with all relevant dimensions.

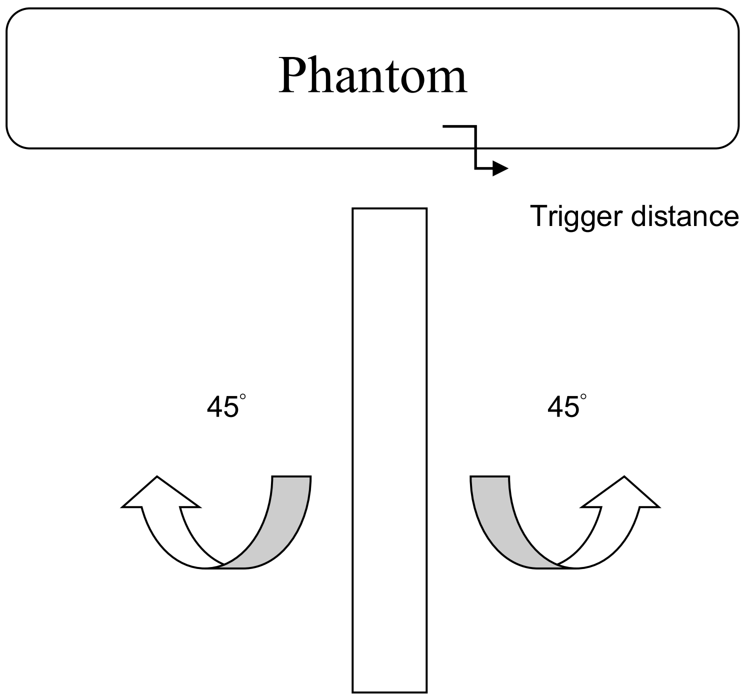
f) If the subsequently measured peak SAR location for the antenna is not between the triggering points, established by the sensor coverage tests from opposite ends of the antenna and sensor, additional SAR tests may be required for conditions where only part of the back surface or edge of a tablet corresponding to the antenna is in proximity to the user and the sensor may not be triggering as desired. A KDB inquiry must be submitted by the test lab to determine if additional tests are required and the proper test configurations to use for testing. This may include situations where the sensor coverage region is too small for the antenna, the sensor is located too far away from the antenna, the sensor location is insufficient to cover multiple antennas or the antenna is at the corner of a tablet etc.

9.3. Procedures for determining tablet tilt angle influences to proximity sensor triggering

a) The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in 9.1 and 9.2 by rotating the tablet around the edge next to the phantom in ≤ 10° increments until the tablet is 45° or more from the vertical position at 0°.

b) If sensor triggering is released and normal maximum output power is restored within the 45° range, the procedures in step a) should be repeated by reducing the tablet to phantom separation distance by 1 mm until the proximity sensor no longer releases triggering, and maximum output power remains in the reduced mode.

c) The smallest separation distance determined in steps a) and b), minus 1 mm, is the sensor triggering distance for tablet tilt coverage. The smallest separation distance determined in 9.1, 9.2 and 9.3 for each triggering condition minus 1 mm should be used in the SAR measurements.

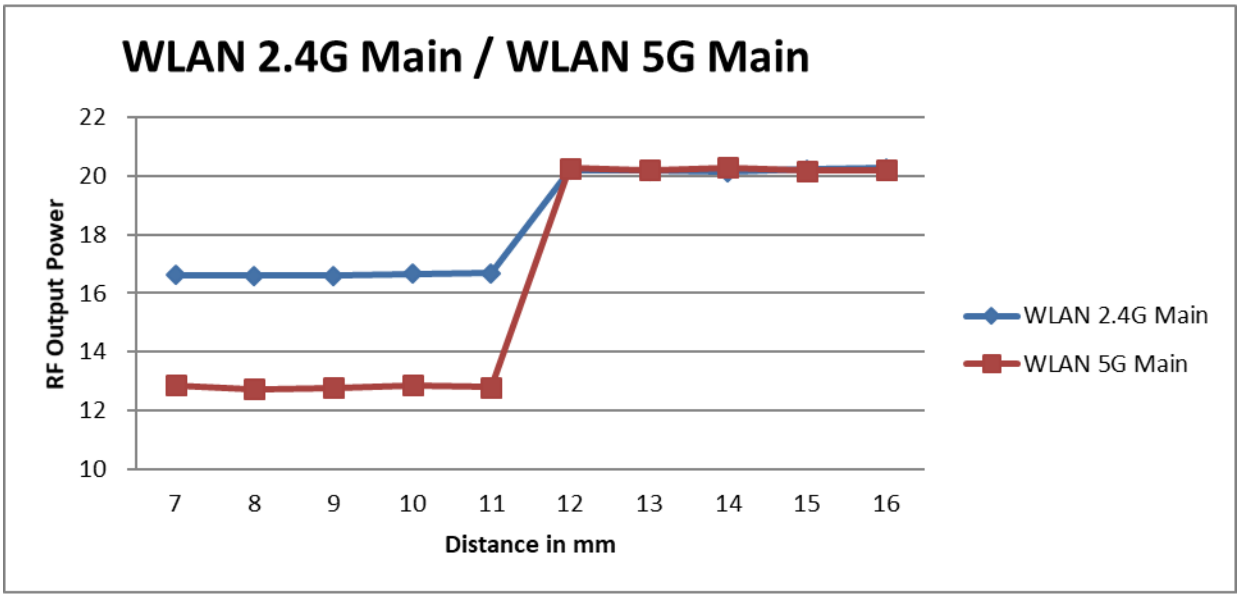


9.4. summary of Trigger Distance

Mode	Top	
	Triggering	Tilt
WLAN 2.4G Main	11mm	11mm
WLAN 5G Main	11mm	11mm
WLAN 2.4G Aux	N/A	N/A
WLAN 5G Aux	N/A	N/A
BT Aux	N/A	N/A

Note : The smallest separation distance determined in each triggering condition minus 1 mm should be used in the SAR measurements.

Distance to DUT vs. Output Power in dBm										
Distance (mm)	7	8	9	10	11	12	13	14	15	16
WLAN 2.4G Main	16.63	16.59	16.61	16.67	16.69	20.21	20.18	20.14	20.23	20.28
WLAN 5G Main	12.86	12.72	12.77	12.86	12.79	20.27	20.21	20.29	20.19	20.22



10. Test Results

10.1 SAR Test Results Summary

SAR MEASUREMENT									
Ambient Temperature (°C) : 23.0 ±2					Relative Humidity (%): 51				
Liquid Temperature (°C) : 21.9 ±2					Depth of Liquid (cm):>15				
Test Position Body	Pwr On-Off	Dist (mm)	Frequency		Conducted Power (dBm)		**SAR** 1g (W/kg)		Limit (W/kg)
			Channel	MHz	Measurement	Tune-up Limit	Measurement	Tune-up Scaled	
Test Mode: 802.11b – Main0(TX1) - INPAQ									
Bottom	Off	10	6	2437	20.41	20.5	0.338	0.345	1.6
Bottom	On	0	1	2412	16.90	17	0.812	0.831	1.6
Bottom	On	0	6	2437	16.92	17	0.819	0.834	1.6
Bottom	On	0	11	2462	16.91	17	0.743	0.759	1.6
Test Mode: 802.11b – Main1(TX1) - INPAQ									
Bottom	Off	10	6	2437	20.41	20.5	0.026	0.027	1.6
Bottom	On	0	6	2437	16.92	17	0.034	0.035	1.6
Test Mode: 802.11b – Aux(TX2) - INPAQ									
Bottom	On	0	1	2412	16.90	17	0.938	0.960	1.6
Bottom	On	0	6	2437	16.98	17	0.844	0.848	1.6
Bottom	On	0	11	2462	16.89	17	0.902	0.925	1.6
Test Mode: 802.11b – Main0(TX1) - LUXSHARE									
Bottom	Off	10	6	2437	20.46	20.5	0.334	0.337	1.6
Bottom	On	0	1	2412	16.91	17	0.886	0.905	1.6
Bottom	On	0	6	2437	16.95	17	0.821	0.831	1.6
Bottom	On	0	11	2462	16.92	17	0.680	0.693	1.6
Test Mode: 802.11b – Main1(TX1) - LUXSHARE									
Bottom	Off	10	6	2437	20.46	20.5	0.044	0.045	1.6
Bottom	On	0	6	2437	16.95	17	0.073	0.074	1.6
Test Mode: 802.11b – Aux(TX2) - LUXSHARE									
Bottom	N/A	0	1	2412	16.91	17	1.110	1.133	1.6
Bottom	N/A	0	6	2437	16.96	17	1.060	1.070	1.6
Bottom	N/A	0	11	2462	16.94	17	1.140	**1.156**	1.6
Test Mode: BT-1M – Aux(TX2) - LUXSHARE									
Bottom	N/A	0	39	2441	9.24	11	0.170	0.255	1.6

Note : 1. 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, SAR is not required.

2. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

SAR MEASUREMENT									
Ambient Temperature (°C) : 23.3 ±2						Relative Humidity (%): 51			
Liquid Temperature (°C) : 22.1 ±2						Depth of Liquid (cm):>15			
Test Position Body	Pwr On-Off	Dist (mm)	Frequency		Conducted Power (dBm)		**SAR** 1g (W/kg)		Limit (W/kg)
			Channel	MHz	Measurement	Tune-up Limit	Measurement	Tune-up Scaled	
Test Mode: 802.11a – Main0(TX1) - INPAQ									
Bottom	Off	10	44	5220	20.39	20.5	0.705	0.723	1.6
Bottom	Off	10	128	5640	20.33	20.375	0.855	0.864	1.6
Bottom	Off	10	165	5825	20.23	20.25	0.864	0.868	1.6
Test Mode: 802.11n20M – Main0(TX1) - INPAQ									
Bottom	Off	10	56	5280	20.25	20.375	0.762	0.784	1.6
Test Mode: 802.11ac80M - Main0(TX1) - INPAQ									
Bottom	On	0	58	5290	12.99	13	0.392	0.393	1.6
Bottom	On	0	106	5530	12.98	13	0.309	0.310	1.6
Bottom	On	0	155	5775	12.95	13	0.285	0.288	1.6
Test Mode: 802.11a – Main1(TX1) - INPAQ									
Bottom	Off	10	44	5220	20.39	20.5	0.707	0.725	1.6
Bottom	Off	10	128	5640	20.33	20.375	0.571	0.577	1.6
Bottom	Off	10	165	5825	20.23	20.25	0.322	0.323	1.6
Test Mode: 802.11n20M – Main1(TX1) - INPAQ									
Bottom	Off	10	56	5280	20.25	20.375	0.691	0.711	1.6
Test Mode: 802.11ac80M – Main1(TX1) - INPAQ									
Bottom	On	0	58	5290	12.99	13	0.356	0.357	1.6
Bottom	On	0	106	5530	12.98	13	0.400	0.402	1.6
Bottom	On	0	155	5775	12.95	13	0.171	0.173	1.6
Test Mode: 802.11ac80M – Aux(TX2) - INPAQ									
Bottom	N/A	0	42	5210	12.90	13	0.888	**0.909**	1.6
Bottom	N/A	0	58	5290	12.96	13	0.824	0.832	1.6
Bottom	N/A	0	106	5530	12.90	13	0.802	0.821	1.6
Bottom	N/A	0	122	5610	12.87	13	0.784	0.808	1.6
Bottom	N/A	0	138	5690	12.85	13	0.723	0.748	1.6
Bottom	N/A	0	155	5775	12.95	13	0.674	0.682	1.6
Test Mode: 802.11a – Main0(TX1) - LUXSHARE									
Bottom	Off	10	165	5825	20.16	20.25	0.731	0.746	1.6
Test Mode: 802.11ac80M – Aux(TX2) - LUXSHARE									
Bottom	N/A	0	42	5210	12.95	13	0.814	0.823	1.6

Note : 1. When multiple transmission modes (802.11 n) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected

2. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required in that exposure configuration.

3. When the reported SAR of the highest measured maximum U-NII-2A for the exposure configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.

10.2 Simultaneous Transmission

Simultaneous Transmission Configurations	
1	WLAN 2.4GHz Main + WLAN 2.4GHz Aux
2	WLAN 2.4GHz Main + BT Aux
3	WLAN 5GHz Main + BT Aux
4	WLAN 5GHz Main + WLAN 5GHz Aux
5	WLAN 5GHz Main + WLAN 5GHz Aux + BT Aux

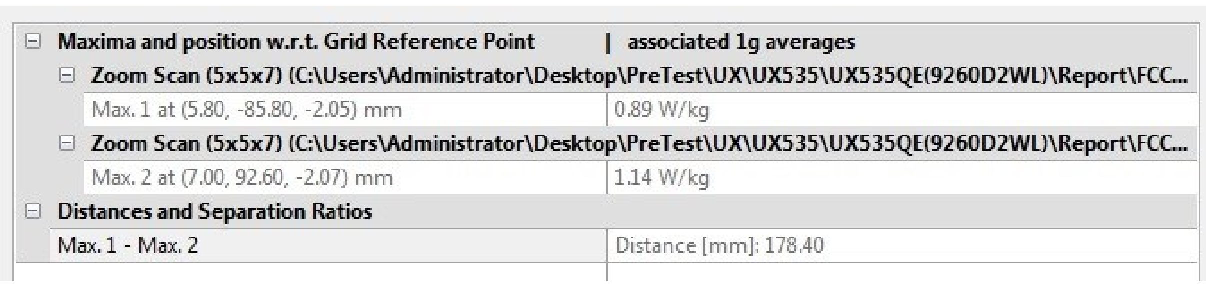
9.2.1 Simultaneous transmission of MIMO in 802.11 test exclusion considerations

Frequency (GHz)	Test Position (Body)	WLAN Main0 SAR (W/Kg)	WLAN Aux SAR W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
2.4	Bottom	0.905	1.156	2.061	178.40	0.017
5	Bottom	0.393	0.909	1.302	N/A	N/A

Frequency (GHz)	Test Position (Body)	WLAN Main1 SAR (W/Kg)	WLAN Aux SAR W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
2.4	Bottom	0.074	1.156	1.230	N/A	N/A
5	Bottom	0.402	0.909	1.311	N/A	N/A

Note : The sum of value is less than 1.6W/Kg or the ratio is determined by $(SAR1 + SAR2)^{1.5}/Ri$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for SAR test exclusion.

2.4G(M0+A) – Bottom:



10.2.2 simultaneous transmission of Wi-Fi and other wireless technologies

When the sum of SAR is larger than the limit, The ratio is determined by ***(SAR1 + SAR2)^1.5/Ri,*** rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. The estimation result as below:

For DTS Band:

Mode	WLAN Main0 SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.905	0.255	1.160	N/A	N/A

Mode	WLAN Main1 SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.074	0.255	0.329	N/A	N/A

The sum of value is less than 1.6W/Kg, thus simultaneous SAR testing is not needed.

For U-NII Band:

Mode	WLAN Main0 SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.393	0.255	0.648	N/A	N/A

Mode	WLAN Main1 SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.402	0.255	0.657	N/A	N/A

The sum of value is less than 1.6W/Kg, thus simultaneous SAR testing is not needed.

Mode	WLAN Main0 SAR (W/Kg)	WLAN Aux SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.393	0.909	0.255	1.557	N/A	N/A

Mode	WLAN Main1 SAR (W/Kg)	WLAN Aux SAR (W/Kg)	BT SAR (W/Kg)	Simultaneous Transmission (W/Kg)	Antenna pair in mm	Peak location separation ratio
Bottom	0.402	0.909	0.255	1.566	N/A	N/A

The ratio of value is less than 0.04, thus simultaneous SAR testing is not needed.

11. SAR measurement variability

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.

Frequency		**SAR** 1g (W/kg)						
Channel	MHz	Original	First Repeated		Second Repeated		Third Repeated	
			Value	Ratio	Value	Ratio	Value	Ratio
11	2462	1.140	1.130	1.009	N/A	N/A	N/A	N/A
42	5210	0.888	0.841	1.056	N/A	N/A	N/A	N/A

Appendix

Appendix A. SAR System Check Data
Appendix B. SAR measurement Data
Appendix C. Test Setup Photographs
Appendix D. Probe Calibration Data
Appendix E. Dipole Calibration Data
Appendix F. Product Photos-Please refer to the file: 2180325R-Product Photos