

TEST REPORT

Report No.: BCTC2312348005E

Applicant: Hypertechnologie Ciara Inc. Ciara Technologies Inc

Product Name: Notebook PC

Model/Type reference: CRIUS N310-G1, CRIUS N310-G1-BL
CRIUS N320-G1, CRIUS N320-G1-BL
CRIUS CO310-G1, CRIUS CO310-G1-BL

Tested Date: 2023-12-05 to 2023-12-13

Issued Date: 2024-03-13



Shenzhen BCTC Testing Co., Ltd.

FCC ID: 2BDS2-CRIUS

Product Name: Notebook PC

Trademark: N/A

Model/Type Ref.: CRIUS N310-G1, CRIUS N310-G1-BL
CRIUS N320-G1, CRIUS N320-G1-BL
CRIUS CO310-G1, CRIUS CO310-G1-BL

Applicant: Hypertechnologie Ciara Inc. Ciara Technologies Inc

Address: 9300 Transcanadienne St-Laurent, Quebec H4S 1K5 Canada

Manufacturer: Hypertechnologie Ciara Inc. Ciara Technologies Inc

Address: 9300 Transcanadienne St-Laurent, Quebec H4S 1K5 Canada

Prepared By: Shenzhen BCTC Testing Co., Ltd.

Address: 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhanche
ng , Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China

Sample Received Date: 2023-12-05

Sample tested Date: 2023-12-05 to 2023-12-13

Issue Date: 2024-03-13

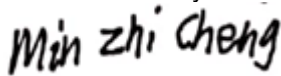
SAR Max. Values is : CRIUS N310-G1:0.818W/kg (1g) for Body
CRIUS N320-G1:0.926 W/kg (1g) for Body
CRIUS CO310-G1:1.335 W/kg (1g) for Body

Test Standards: IEEE Std C95.1, 2019/ IEEE Std 1528™-2013/FCC Part 2.1093

Test Results: PASS

Remark: This is SAR test report

Tested by:



Min Zhi Cheng/ Project Handler

Approved by:



Zero Zhou/Reviewer

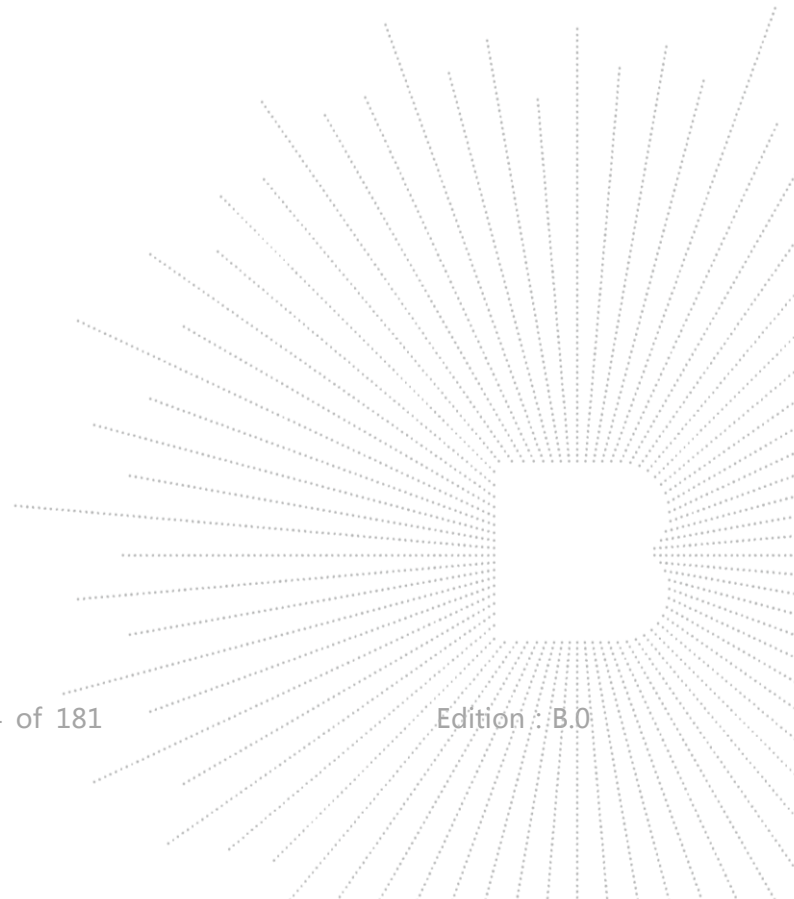
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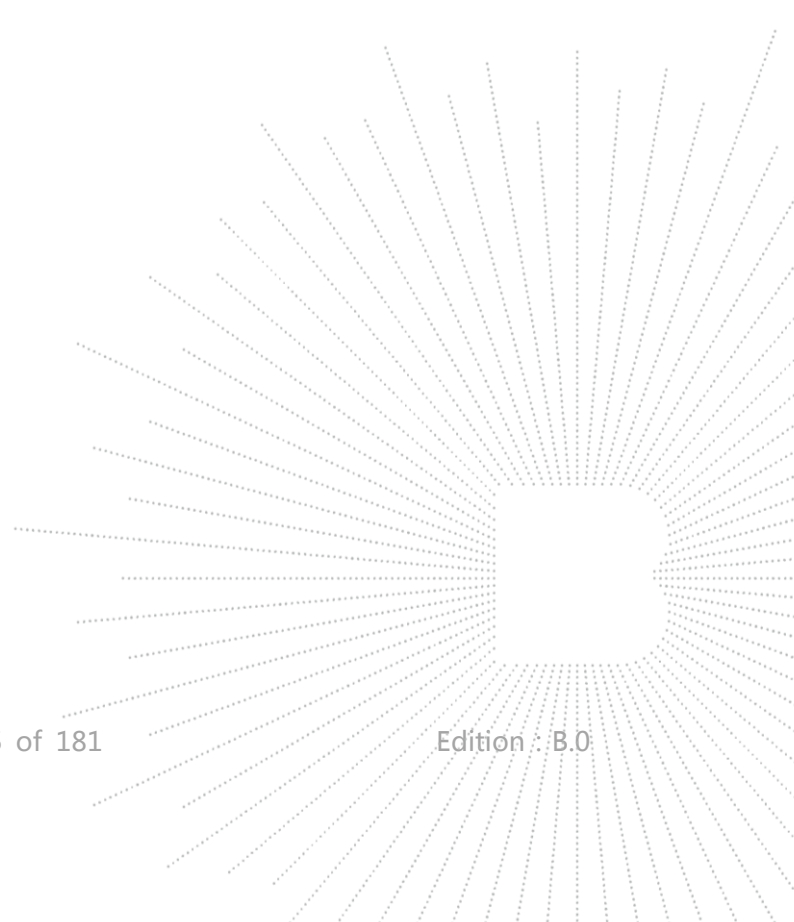
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(Note: N/A Means Not Applicable)



1. Version

Report No.	Issue Date	Description	Approved
BCTC2312348005E	2024-03-13	Original	Valid



2. Test Standards

IEEE Std C95.1-2019: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

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

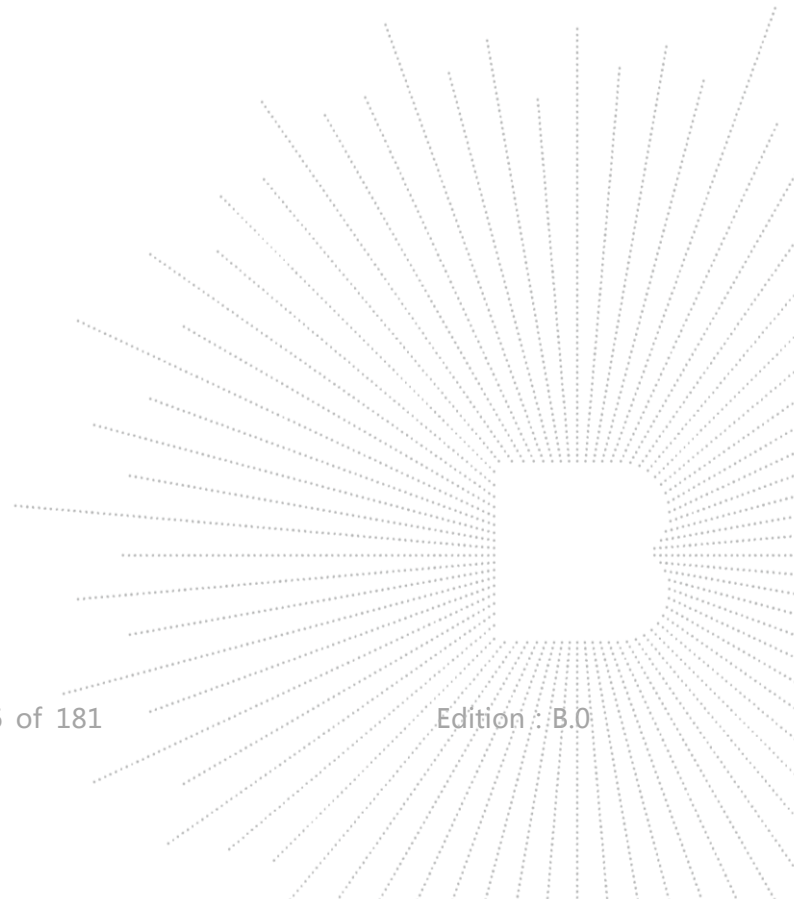
FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices

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

KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz

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

KDB 248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS



3. Test Summary

The maximum results of Specific Absorption Rate (SAR) have found during testing are as follows:

CRIUS N310-G1

Frequency Band	Report SAR _{1g} (W/kg)	SAR _{1g} Limit (W/kg)
	Body (0mm Gap)	
Bluetooth	0.334	1.6
WIFI2.4 G (ANT-A)	0.171	1.6
WIFI2.4 G (ANT-B)	0.295	1.6
WIFI5G (ANT-A)	0.818	1.6
WIFI5G (ANT-B)	0.728	1.6
Simultaneous Transmission	1.546	1.6

CRIUS N320-G1

Frequency Band	Report SAR _{1g} (W/kg)	SAR _{1g} Limit (W/kg)
	Body (0mm Gap)	
Bluetooth	0.254	1.6
WIFI2.4 G (ANT-A)	0.212	1.6
WIFI2.4 G (ANT-B)	0.336	1.6
WIFI5G (ANT-A)	0.926	1.6
WIFI5G (ANT-B)	0.561	1.6
Simultaneous Transmission	1.487	1.6

CRIUS CO310-G1

Frequency Band	Report SAR _{1g} (W/kg)	SAR _{1g} Limit (W/kg)
	Body (0mm Gap)	
Bluetooth	0.310	1.6
WIFI2.4 G (ANT-A)	0.871	1.6
WIFI2.4 G (ANT-B)	0.179	1.6
WIFI5G (ANT-A)	1.335	1.6
WIFI5G (ANT-B)	0.971	1.6
Simultaneous Transmission	1.482	1.6

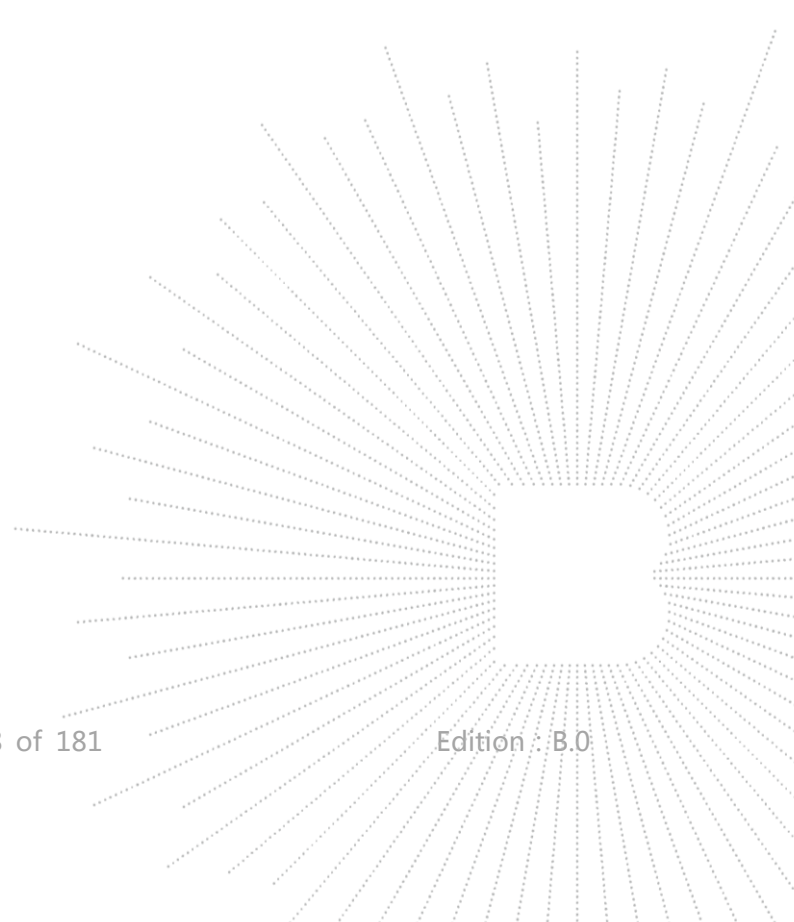
The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2019, and had been tested in accordance with the measurement methods and procedure specified in IEEE 1528-2013.

4. SAR Limits

EXPOSURE LIMITS	FCC Limit (1g Tissue)	
	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average(averaged over the whole body)	0.08	0.4
Spatial Peak(averaged over any 1 g of tissue)	1.6	8.0
Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

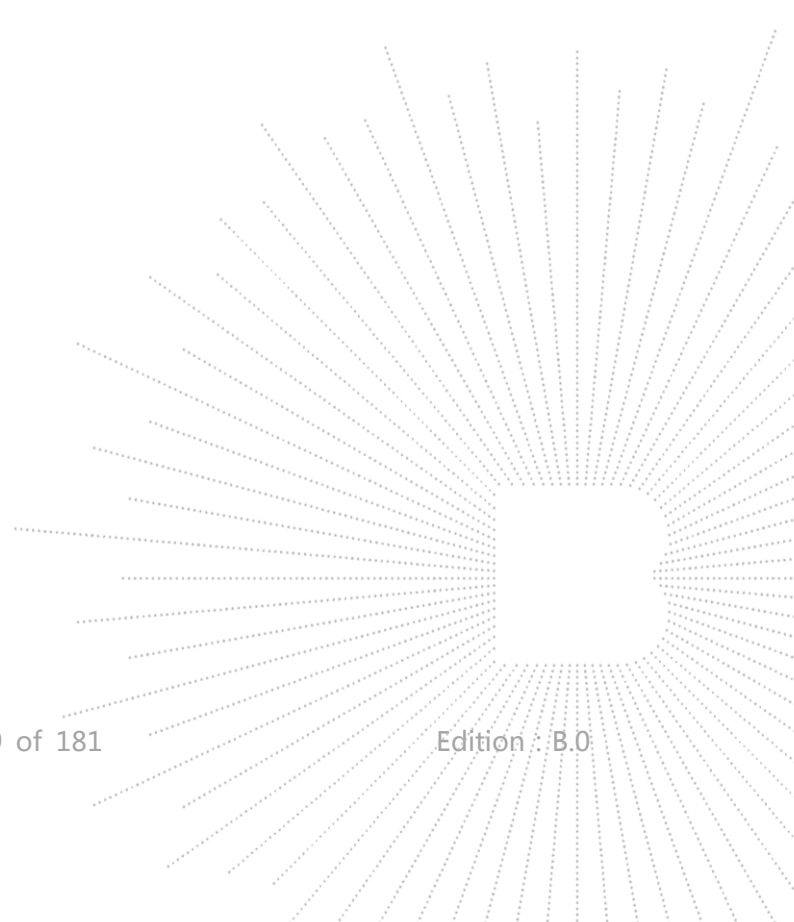
Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).



5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be $\leq 30\%$, for a confidence interval of $k=2$. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.



6. Product Information and Test Setup

6.1 Product Information

Model/Type Ref.:	CRIUS N310-G1, CRIUS N310-G1-BL CRIUS N320-G1, CRIUS N320-G1-BL CRIUS CO310-G1, CRIUS CO310-G1-BL
HVIN:	CO310-G1, N320-G1, N310-G1
Model differences:	The Motherboard and Circuit principle are identical except different antenna gain, HVIN, appearance, keyboard, Interface Board, battery. More details please refer to Product Similarity Declaration.
Hardware Version:	N/A
Software Version:	N/A
Ratings:	AC 100-240,50/60Hz
Adapter:	Model: A869-200325C-US1 Input:AC100-240V,50/60Hz,1.7A Output: DC5V,3.0A
Battery:	DC11.4V,4700mAh/53.58Wh

Bluetooth (CRIUS N310-G1)

Operation Frequency:	2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number Of Channel	79CH
Antenna installation:	Internal antenna
Antenna Gain:	2.27 dBi

BLE (CRIUS N310-G1)

Operation Frequency:	Bluetooth: 2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	Bluetooth: GFSK,1Mbps,2Mbps
Number Of Channel	40channel
Antenna installation:	Internal antenna
Antenna Gain:	2.27 dBi

WLAN (CRIUS N310-G1)

WIFI2.4G	
Operation Frequency:	802.11b/g/n20/ax20MHz:2412~2462 MHz 802.11n40/ax40MHz:2422~2452 MHz
Bit Rate of Transmitter	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n/ax Up to 150Mbps
Type of Modulation:	OFDM/DSSS
Number Of Channel	802.11b/g/n20/ax20MHz:11 CH 802.11n40/ax40MHz: 7 CH
Antenna Gain:	A: 2.27 dBi B: -0.46 dBi
WIFI5G	
IEEE 802.11 WLAN Mode Supported	802.11a/n/ac/ax(20MHz channel bandwidth) 802.11n/ac/ax(40MHz channel bandwidth) 802.11ac/ax(80MHz channel bandwidth) 802.11ac/ax(160MHz channel bandwidth)
Operation Frequency:	5180-5240MHz for 802.11a/n/ac/ax(HT20) 5190-5230MHz for 802.11n/ac/ax(HT40) 5210MHz for 802.11ac/ax(HT80) 5250MHz for 802.11ac/ax(HT160) 5260-5320MHz for 802.11a/n/ac/ax(HT20) 5270-5310MHz for 802.11n/ac/ax(HT40) 5290MHz for 802.11ac/ax(HT80) 5500-5700MHz for 802.11a/n/ac/ax(HT20) 5510-5670MHz for 802.11n/ac/ax(HT40) 5530MHz for 802.11ac/ax(HT80) 5570MHz for 802.11ac/ax(HT160) 5745-5825 MHz for 802.11a/ n/ac/ax(HT20) 5755-5795 MHz for 802.11 n/ac/ax(HT40) 5775MHz for 802.11 ac/ax(HT80)
Type of Modulation:	OFDM with BPSK/QPSK/16QAM/64QAM/256QAM for 802.11a/n/ac/ax;
Number Of Channel	4 channels for 802.11a/n20/ac20/ax20 in the 5180-5240MHz band 2 channels for 802.11n40/ac40/ax40 in the 5190-5230MHz band 1 channels for 802.11ac80/ax80 in the 5210MHz band 1 channels for 802.11ac160/ax160 in the 5250MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5260-5320MHz band 2 channels for 802.11n40/ac40/ax40 in the 5270-5310MHz band 1 channels for 802.11ac80/ax80 in the 5290MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5500-5700MHz band 2 channels for 802.11n40/ac40/ax40 in the 5510-5670MHz band 1 channels for 802.11ac80/ax80 in the 5530MHz band 1 channels for 802.11ac160/ax160 in the 5570MHz band 5 channels for 802.11a/n20/ax20 in the 5745-5825MHz band 2 channels for 802.11n40/ax40 in the 5755-5795MHz band 1 channels for 802.11ac80/ax80 in the 5775MHz band
Antenna installation:	Internal antenna
Antenna Gain:	5.1G: A: -0.13 dBi, B: -0.59 dBi 5.3G: A: -0.13 dBi, B: -0.57 dBi 5.5G: A: 0.90 dBi, B: 3.39 dBi 5.8G: A: 0.77 dBi, B: 0.57 dBi

Bluetooth (CRIUS N320-G1)

Operation Frequency:	2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number Of Channel	79CH
Antenna installation:	Internal antenna
Antenna Gain:	4.27 dBi

BLE (CRIUS N320-G1)

Operation Frequency:	Bluetooth: 2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	Bluetooth: GFSK, 1Mbps, 2Mbps
Number Of Channel	40channel
Antenna installation:	Internal antenna
Antenna Gain:	4.27 dBi

WLAN (CRIUS N320-G1)

WIFI2.4G	
Operation Frequency:	802.11b/g/n20/ax20MHz:2412~2462 MHz 802.11n40/ax40MHz:2422~2452 MHz
Bit Rate of Transmitter	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n/ax Up to 150Mbps
Type of Modulation:	OFDM/DSSS
Number Of Channel	802.11b/g/n20/ax20MHz:11 CH 802.11n40/ax40MHz: 7 CH
Antenna Gain:	A: 4.27 dBi B: 3.83 dBi
WIFI5G	
IEEE 802.11 WLAN Mode Supported	802.11a/n/ac/ax(20MHz channel bandwidth) 802.11n/ac/ax(40MHz channel bandwidth) 802.11ac/ax(80MHz channel bandwidth) 802.11ac/ax(160MHz channel bandwidth)
Operation Frequency:	5180-5240MHz for 802.11a/n/ac/ax(HT20) 5190-5230MHz for 802.11n/ac/ax(HT40) 5210MHz for 802.11ac/ax(HT80) 5250MHz for 802.11ac/ax(HT160) 5260-5320MHz for 802.11a/n/ac/ax(HT20) 5270-5310MHz for 802.11n/ac/ax(HT40) 5290MHz for 802.11ac/ax(HT80) 5500-5700MHz for 802.11a/n/ac/ax(HT20) 5510-5670MHz for 802.11n/ac/ax(HT40) 5530MHz for 802.11ac/ax(HT80) 5570MHz for 802.11ac/ax(HT160) 5745-5825 MHz for 802.11a/ n/ac/ax(HT20) 5755-5795 MHz for 802.11 n/ac/ax(HT40) 5775MHz for 802.11 ac/ax(HT80)
Type of Modulation:	OFDM with BPSK/QPSK/16QAM/64QAM/256QAM for 802.11a/n/ac/ax;
Number Of Channel	4 channels for 802.11a/n20/ac20/ax20 in the 5180-5240MHz band

	2 channels for 802.11n40/ac40/ax40 in the 5190-5230MHz band 1 channels for 802.11ac80/ax80 in the 5210MHz band 1 channels for 802.11ac160/ax160 in the 5250MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5260-5320MHz band 2 channels for 802.11n40/ac40/ax40 in the 5270-5310MHz band 1 channels for 802.11ac80/ax80 in the 5290MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5500-5700MHz band 2 channels for 802.11n40/ac40/ax40 in the 5510-5670MHz band 1 channels for 802.11ac80/ax80 in the 5530MHz band 1 channels for 802.11ac160/ax160 in the 5570MHz band 5 channels for 802.11a/n20/ax20 in the 5745-5825MHz band 2 channels for 802.11n40/ax40 in the 5755-5795MHz band 1 channels for 802.11ac80/ax80 in the 5775MHz band
Antenna installation:	Internal antenna
Antenna Gain:	5.2G: A: 3.90 dBi, B: 2.13 dBi 5.3G: A: 3.99 dBi, B: 1.95 dBi 5.6G: A: 1.88 dBi, B: 1.33 dBi 5.8G: A: 3.36 dBi, B: 3.37 dBi

Bluetooth (CRIUS CO310-G1)

Operation Frequency:	2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Number Of Channel	79CH
Antenna installation:	Internal antenna
Antenna Gain:	-0.40 dBi

BLE (CRIUS CO310-G1)

Operation Frequency:	Bluetooth: 2402-2480MHz
Bluetooth Version:	N/A
Type of Modulation:	Bluetooth: GFSK, 1Mbps, 2Mbps
Number Of Channel	40channel
Antenna installation:	Internal antenna
Antenna Gain:	-0.40 dBi

WLAN (CRIUS CO310-G1)

WIFI2.4G	
Operation Frequency:	802.11b/g/n20/ax20MHz:2412~2462 MHz 802.11n40/ax40MHz:2422~2452 MHz
Bit Rate of Transmitter	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n/ax Up to 150Mbps
Type of Modulation:	OFDM/DSSS
Number Of Channel	802.11b/g/n20/ax20MHz:11 CH 802.11n40/ax40MHz: 7 CH
Antenna Gain:	A: -0.40 dBi B: 2.06 dBi
WIFI5G	
IEEE 802.11 WLAN Mode Supported	802.11a/n/ac/ax(20MHz channel bandwidth) 802.11n/ac/ax(40MHz channel bandwidth) 802.11ac/ax(80MHz channel bandwidth) 802.11ac/ax(160MHz channel bandwidth)
Operation Frequency:	5180-5240MHz for 802.11a/n/ac/ax(HT20) 5190-5230MHz for 802.11n/ac/ax(HT40) 5210MHz for 802.11ac/ax(HT80) 5250MHz for 802.11ac/ax(HT160) 5260-5320MHz for 802.11a/n/ac/ax(HT20) 5270-5310MHz for 802.11n/ac/ax(HT40) 5290MHz for 802.11ac/ax(HT80) 5500-5700MHz for 802.11a/n/ac/ax(HT20) 5510-5670MHz for 802.11n/ac/ax(HT40) 5530MHz for 802.11ac/ax(HT80) 5570MHz for 802.11ac/ax(HT160) 5745-5825 MHz for 802.11a/ n/ac/ax(HT20) 5755-5795 MHz for 802.11 n/ac/ax(HT40) 5775MHz for 802.11 ac/ax(HT80)
Type of Modulation:	OFDM with BPSK/QPSK/16QAM/64QAM/256QAM for 802.11a/n/ac/ax;
Number Of Channel	4 channels for 802.11a/n20/ac20/ax20 in the 5180-5240MHz band 2 channels for 802.11n40/ac40/ax40 in the 5190-5230MHz band 1 channels for 802.11ac80/ax80 in the 5210MHz band 1 channels for 802.11ac160/ax160 in the 5250MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5260-5320MHz band 2 channels for 802.11n40/ac40/ax40 in the 5270-5310MHz band 1 channels for 802.11ac80/ax80 in the 5290MHz band 4 channels for 802.11a/n20/ac20/ax20 in the 5500-5700MHz band 2 channels for 802.11n40/ac40/ax40 in the 5510-5670MHz band 1 channels for 802.11ac80/ax80 in the 5530MHz band 1 channels for 802.11ac160/ax160 in the 5570MHz band 5 channels for 802.11a/n20/ax20 in the 5745-5825MHz band 2 channels for 802.11n40/ax40 in the 5755-5795MHz band 1 channels for 802.11ac80/ax80 in the 5775MHz band
Antenna installation:	Internal antenna
Antenna Gain:	5.1G: A: 5.70 dBi, B: 3.59 dBi 5.3G: A: 6.08 dBi, B: 3.59 dBi 5.5G: A: 5.69 dBi, B: 3.27 dBi 5.8G: A: 5.56 dBi, B: 2.52 dBi

6.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

6.3 Support Equipment

Cable of Product

No.	Cable Type	Quantity	Provider	Length (m)	Shielded	Note
1	--	--	Applicant	---	Yes/No	--
2	--	--	BCTC	--	Yes/No	--

No.	Device Type	Brand	Model	Series No.	Note
1.	---	---	---	---	---
2.	--	--	--	--	--

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

6.4 Test Environment

1. Normal Test Conditions:

Humidity(%):	35-75
Atmospheric Pressure(kPa):	95-105
Temperature(°C):	18-25

2. Extreme Test Conditions:

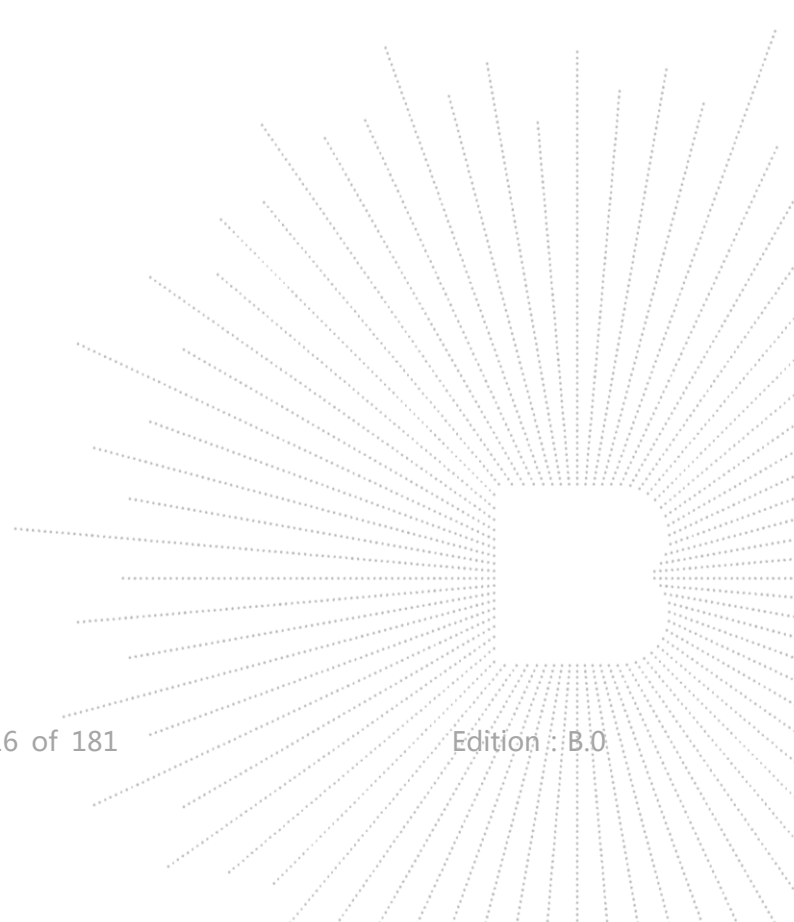
N/A

7. Test Facility and Test Instrument Used

7.1 Test Facility

All measurement facilities used to collect the measurement data are located at Shenzhen BCTC Testing Co., Ltd. Address: 1-2/F., Building B, Pengzhou Industrial Park, No.158, Fuyuan 1st Road, Zhancheng, Fuhai Subdistrict, Bao'an District, Shenzhen, Guangdong, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

FCC Test Firm Registration Number: 712850
A2LA certificate registration number is: CN1212
ISED Registered No.: 23583
ISED CAB identifier: CN0017



7.2 Test Instrument Used

Equipment	Manufacturer	Model#	Serial#	Last Cal.	Next Cal.
PC	DELL	\	\	N/A	N/A
SAR Measurement system	SATIMO	\	\	N/A	N/A
Signal Generator	Keysight	83711B	US37100131	Aug. 29, 2023	Aug. 28, 2024
Multimeter	Keithley	1160271	\	Nov. 10, 2023	Nov 09, 2024
S-parameter Network Analyzer	R&S	ZVB 8	101353	Dec. 07, 2023	Dec. 06, 2024
Wideband Radio Communication Tester	R&S	CMW500	\	Nov. 10, 2023	Nov 09, 2024
E SAR PROBE 6GHz	MVG	SSE2	2623-EPGO-420	July 18, 2023	July 17, 2024
DIPOLE 2450	SATIMO	SID 2450	SN 47/21 DIP 2G450-627	Nov. 25, 2021	Nov. 24, 2024
DIPOLE 5000	SATIMO	SID5000	SN 47/21 DIP 2G450-629	Nov. 25, 2021	Nov. 24, 2024
COMOSAR OPENCoaxial Probe	SATIMO	\	\	Nov. 18, 2023	Nov. 17, 2024
SAR Locator	SATIMO	\	\	Nov. 18, 2023	Nov. 17, 2024
Communication Antenna	SATIMO	\	\	Nov. 18, 2023	Nov. 17, 2024
FEATURE PHONEPOSITIONING DEVICE	SATIMO	\	\	N/A	N/A
DUMMY PROBE	SATIMO	\	\	N/A	N/A
SAM Phantom	MVG	\	SN 13/09 SAM68	N/A	N/A
Liquid measurement Kit	HP	85033D	3423A08186	N/A	N/A
Power meter	Agilent	E4419	\	May 15, 2023	May 14, 2024
Power meter	Agilent	E4419	\	May 15, 2023	May 14, 2024
Power sensor	Agilent	E9300A	\	May 15, 2023	May 14, 2024
Power sensor	Agilent	E9300A	\	May 15, 2023	May 14, 2024
Directional Coupler	Krytar 158020	131467	\	Nov. 10, 2023	Nov 09, 2024
Thermometer	BTE	\	\	Dec. 02, 2023	Dec. 01, 2024
Broad Band Tissue Simulation Liquid	Schmid	\	\	N/A	N/A

Note:

Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evaluate with following criteria at least on annual interval.

1. There is no physical damage on the dipole;
2. System check with specific dipole is within 10% of calibrated values;
3. The most recent return-loss results, measured at least annually, deviates by no more than 20% from the previous measurement;
4. The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.

Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

8. Specific Absorption Rate (SAR)

8.1 Introduction

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

8.2 SAR Definition

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

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

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

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

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

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the

electrical field in the tissue by

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

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

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

9. SAR Measurement System

9.1 The Measurement System

Comosar is a system that is able to determine the SAR distribution inside a phantom of human being according to different standards. The Comosar system consists of the following items:

- Main computer to control all the system
- 6 axis robot
- Data acquisition system
- Miniature E-field probe
- Phone holder
- Head simulating tissue

The following figure shows the system.



The EUT under test operating at the maximum power level is placed in the phone holder, under the phantom, which is filled with head simulating liquid. The E-Field probe measures the electric field inside the phantom. The OpenSAR software computes the results to give a SAR value in a 1g or 10g mass.

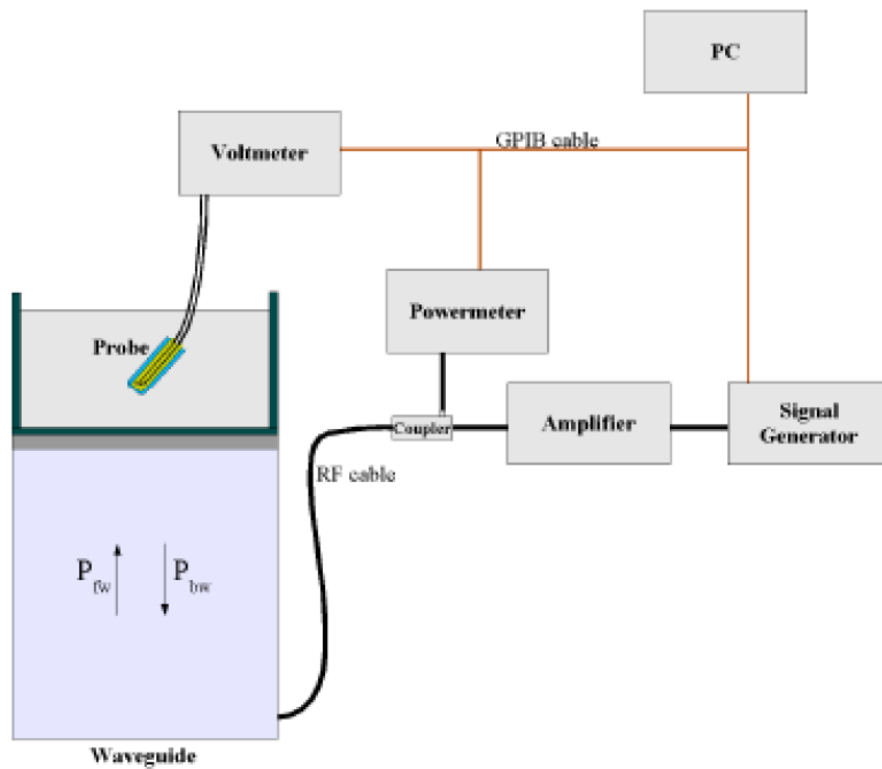
9.2 Probe

For the measurements the Specific Dosimetric E-Field Probe SN 46/21 EPGO362 with following specifications is used

- Dynamic range: 0.01-100 W/kg
- Tip Diameter : 5 mm
- Distance between probe tip and sensor center: 2.10mm
- Distance between sensor center and the inner phantom surface: 4 mm (repeatability better than +/- 1mm)
- Probe linearity: <0.25 dB
- Axial Isotropy: <0.25 dB
- Spherical Isotropy: <0.50 dB
- Calibration range: 835 to 2500MHz for head & body simulating liquid.

Angle between probe axis (evaluation axis) and surface normal line: less than 30°

Probe calibration is realized, in compliance with EN 62209-1 and IEEE 1528 STD, with CALISAR, Antennassa proprietary calibration system. The calibration is performed with the EN 62209-1 annex technique using reference guide at the five frequencies.



$$SAR = \frac{4(p_{fw} - p_{pbw})}{ab\delta} \cos^2 \left(\pi \frac{y}{a} \right) c^{(2\pi/\delta)}$$

Where :

Pfw = Forward Power

Pbw = Backward Power

a and b = Waveguide dimensions

l = Skin depth

Keithley configuration:

Rate = Medium; Filter = ON; RDGS = 10; Filter type = Moving Average; Range auto after each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.

The calibration factors, CF(N), for the 3 sensors corresponding to dipole 1, dipole 2 and dipole 3 are:

$$CF(N) = SAR(N)/Vlin(N) \quad (N=1,2,3)$$

The linearised output voltage Vlin(N) is obtained from the displayed output voltage V(N) using

$$Vlin(N) = V(N) * (1 + V(N)/DCP(N)) \quad (N=1,2,3)$$

where DCP is the diode compression point in mV.

9.3 Probe Calibration Process

Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. SATIMO Probe calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm²) using an with CALISAR, Antenna proprietary calibration system.

Free Space Assessment Procedure

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1mW/cm².

Temperature Assessment Procedure

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

Where:

$$SAR = C \frac{\Delta T}{\Delta t}$$

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

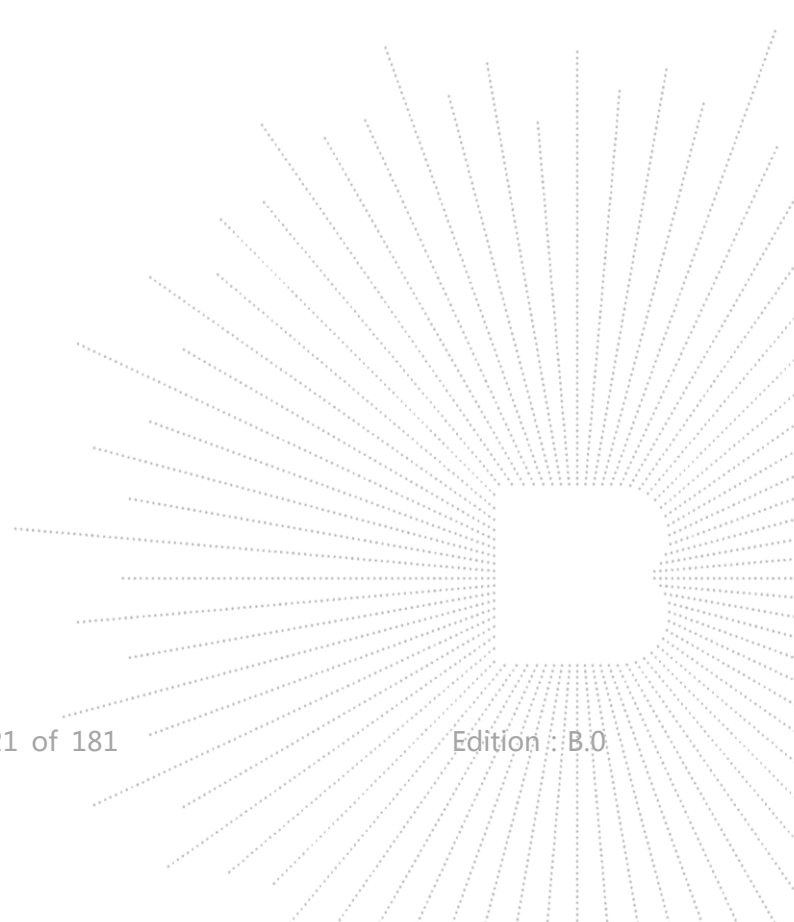
SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

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

Where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm³ for brain tissue)

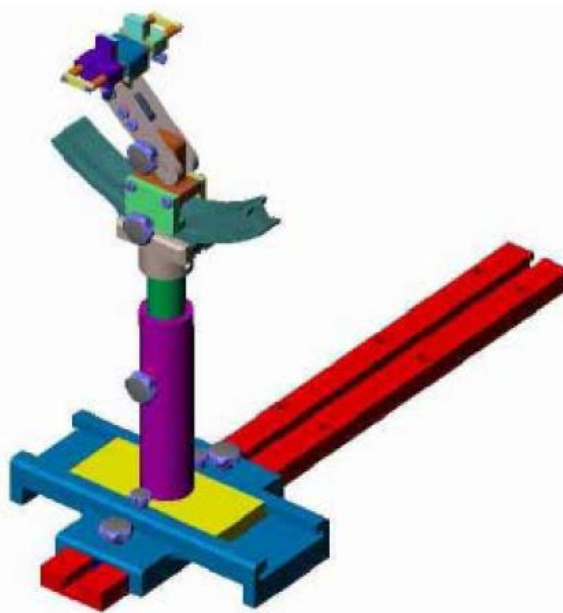


9.4 Phantom

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.

9.5 Device Holder

The positioning system allows obtaining cheek and tilting position with a very good accuracy. In compliance with CENELEC, the tilt angle uncertainty is lower than 1°.



System Material	Permittivity	Loss Tangent
Delrin	3.7	0.005

10. Tissue Simulating Liquids

10.1 Composition of Tissue Simulating Liquid

For the measurement of the field distribution inside the SAM phantom with SMTIMO, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. Please see the following photos for the liquid height.



Liquid Height for Body SAR

The Composition of Tissue Simulating Liquid

Frequency (MHz)	Water (%)	Salt (%)	1,2-Propane diol (%)	HEC (%)	Preventol (%)	DGBE (%)
Head/Body						
835	40.3	1.4	57.9	0.2	0.2	0
900	40.3	1.4	57.9	0.2	0.2	0
1800-2000	55.2	0.3	0	0	0	44.5
2450	55.0	0.1	0	0	0	44.9
2600	54.9	0.1	0	0	0	45.0

Frequency (MHz)	Water (%)	Hexyl Carbitol (%)	Triton X-100 (%)
Head/Body			
5000-6000	65.52	17.24	17.24

10.2 Limit

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 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 and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters

computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Target Frequency (MHz)	Head	
	Conductivity (σ)	Permittivity (ϵ_r)
150	0.76	52.3
300	0.87	45.3
450	0.87	43.5
750	0.89	41.9
835	0.90	41.5
900	0.97	41.5
915	0.98	41.5
1450	1.20	40.5
1610	1.29	40.3
1800-2000	1.40	40.0
2450	1.80	39.2
2600	1.96	39.0
3000	2.40	38.5
5200	4.66	36.0
5400	4.86	35.8
5600	5.07	35.5
5800	5.27	35.3

10.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an R&S ZVB 8. Dielectric Probe Kit and an Agilent Network Analyzer.

Calibration Result for Dielectric Parameters of Tissue Simulating Liquid

Frequency(MHz)	Liquid	Target Conductivity (σ)	Target Permittivity (ϵ_r)	Measured Conductivity (σ)	Measured Permittivity (ϵ_r)	Delta (σ)%	Delta (ϵ_r)%	Limit (%)	Temp. TSL ($^{\circ}$ C)	Date
2450	Head	1.80	39.20	1.827	38.354	1.50	-2.16	± 5	23.1	05/12/2023
5200	Head	4.66	36.00	4.782	37.356	2.62	3.77	± 5	22.9	07/12/2023
5400	Head	4.86	35.80	4.865	35.015	0.10	-2.19	± 5	22.9	07/12/2023
5600	Head	5.07	35.50	5.039	36.440	-0.61	2.65	± 5	22.8	11/12/2023
5800	Head	5.27	35.30	5.085	35.816	-3.51	1.46	± 5	22.8	11/12/2023

Remark:

1. The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within $\pm 2^{\circ}$ C of the temperature when the tissue parameters are characterized.
2. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

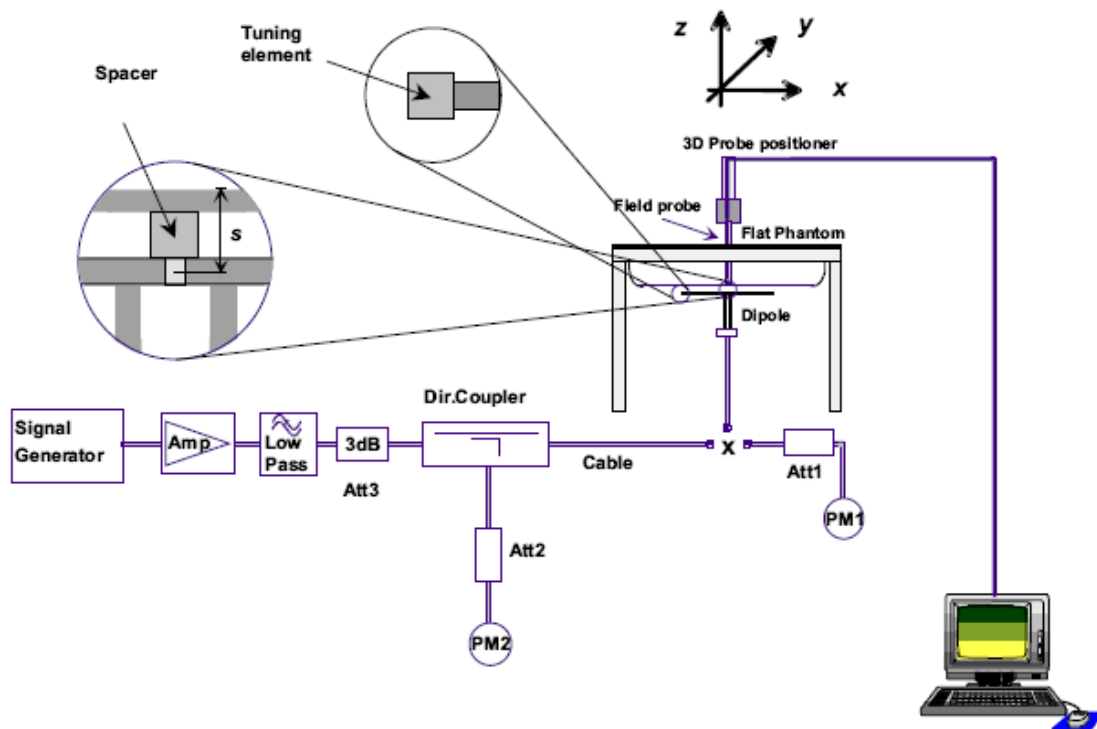
11. System Check

11.1 Purpose of System Performance Check

At the device test frequencies. System check verifies the measurement repeatability of a SAR system before compliance testing and is not a validation of all system specifications. The latter is not required for testing a device but is mandatory before the system is deployed. The system check detects possible short-term drift and unacceptable measurement errors or uncertainties in the system.

11.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave which comes from a signal generator at frequency 600MHz-6000MHz. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The output power on dipole port must be calibrated to 20 dBm (100 mW) before dipole is connected.



System Verification Setup Block Diagram



Setup Photo of Dipole Antenna

11.3 Validation Results

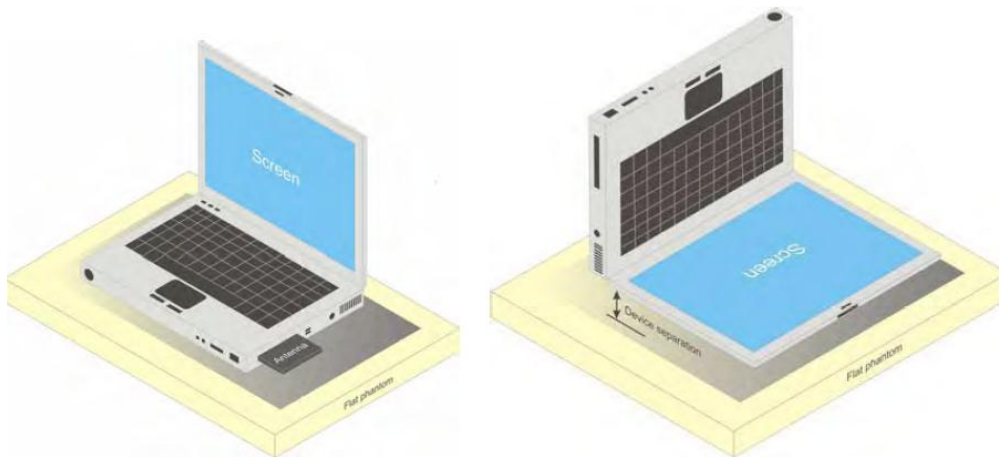
Comparing to the original SAR value provided by SATIMO, the validation data should be within its specification of 10 %. The following table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion.

Frequency (MHz)	Power	Measured SAR _{1g} (W/Kg)	Normalize to 1 Watt	Drift (%)	1W Target	Difference Percentage (%)	Limit (%)	Liquid Temp	Date
					SAR _{1g} (W/Kg)				
2450	250mW	14.318	57.272	-1.574	55.16	3.830	±10	23.1	05/12/2023
5200	250mW	18.525	74.100	-0.372	76.41	-3.023	±10	22.9	07/12/2023
5400	250mW	20.697	82.787	-0.520	80.52	2.815	±10	22.9	07/12/2023
5600	250mW	19.408	77.631	2.928	79.08	-1.832	±10	22.8	11/12/2023
5800	250mW	19.746	78.985	3.842	76.49	3.262	±10	22.8	11/12/2023

12. EUT Testing Position

Body Position

A typical example of a body supported device is a wireless enabled laptop device that among other orientations may be supported on the thighs of a sitting user. To represent this orientation, the device shall be positioned with its base against the flat phantom. Other orientations may be specified by the manufacturer in the user instructions. If the intended use is not specified, the device shall be tested directly against the flat phantom in all usable orientations.



Test positions for Body-supported Device

13. SAR Measurement Procedures

13.1 Measurement Procedures

The measurement procedures are as follows:

- (a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the highest power channel.
- (b) Keep EUT to radiate maximum output power or 100% factor (if applicable)
- (c) Measure output power through RF cable and power meter.
- (d) Place the EUT in the positions as Annex D demonstrates.
- (e) Set scan area, grid size and other setting on the SATIMO software.
- (f) Measure SAR results for the highest power channel on each testing position.
- (g) Find out the largest SAR result on these testing positions of each band
- (h) Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

13.2 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The SATIMO software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine. The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

13.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm \pm 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm \pm 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30° \pm 1°	20° \pm 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 \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the <u>area scan based 1-g SAR estimation</u> procedures of KDB Publication 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.				

13.4 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software can combine and subsequently superpose these measurement data to calculating the multiband SAR.

13.5 SAR Averaged Methods

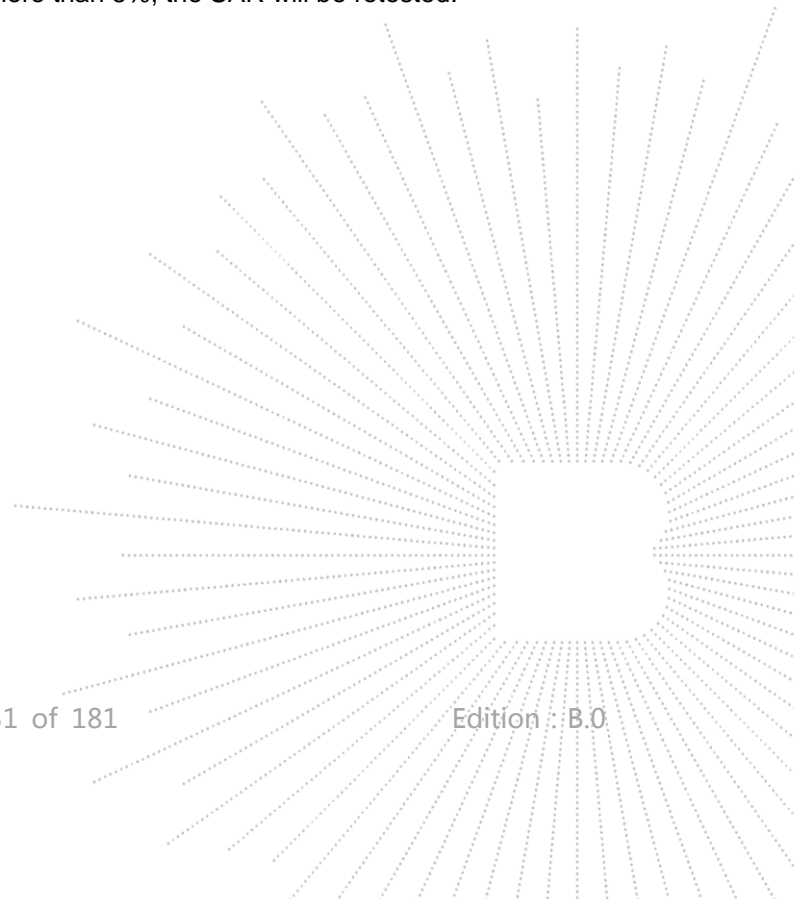
The local SAR inside the phantom is measured using small dipole sensing elements inside a probe body. The probe tip must not be in contact with the phantom surface in order to minimize measurements errors, but the highest local SAR will occur at the surface of the phantom.

An extrapolation is using to determinate this highest local SAR values. The extrapolation is based on a fourth-order least-square polynomial fit of measured data. The local SAR value is then extrapolated from the liquid surface with a 1mm step.

The measurements have to be performed over a limited time (due to the duration of the battery) so the step of measurement is high. It could vary between 5 and 8 mm. To obtain an accurate assessment of the maximum SAR averaged over 10g and 1 g requires a very fine resolution in the three dimensional scanned data array.

13.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In SATIMO measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.



14. SAR Test Result

14.1 Conducted RF Output Power

Bluetooth			
Modulation	Frequency (MHz)	Output Power (dBm)	Tune-up power (dBm)
1-DH5	2402	7.22	9.5
	2441	7.62	
	2480	8.76	
2-DH5	2402	5.27	7.5
	2441	5.85	
	2480	6.98	
3-DH5	2402	5.34	7.5
	2441	5.95	
	2480	7.08	

BLE			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
GFSK BLE 1M	2402	7.30	9.5
	2440	7.92	
	2480	8.99	

WLAN 2.4G (ANT-A)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
b	2412	20.19	20.5
	2437	20.13	
	2462	20.15	
g	2412	25.34	26.0
	2437	25.34	
	2462	25.27	
n20	2412	25.50	26.0
	2437	25.42	
	2462	25.35	
n40	2422	26.76	27.5
	2437	26.27	
	2452	25.97	
ax20	2412	26.16	26.5
	2437	26.05	
	2462	25.86	
ax40	2422	26.88	27.5
	2437	26.72	
	2452	26.52	

WLAN 2.4G (ANT-B)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
b	2412	20.05	20.5
	2437	20.09	
	2462	20.06	
g	2412	25.25	26.0
	2437	25.27	
	2462	25.21	
n20	2412	25.29	26.0
	2437	25.22	
	2462	25.14	
n40	2422	25.67	26.0
	2437	25.71	
	2452	25.70	
ax20	2412	25.82	26.5
	2437	25.82	
	2462	26.34	
ax40	2422	26.20	27.0
	2437	26.24	
	2452	26.28	

WLAN 5.2G (ANT-A)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5180	15.21	16.0
	5220	15.45	
	5240	15.68	
n20	5180	9.14	10.0
	5220	9.20	
	5240	9.29	
n40	5190	9.57	10.0
	5230	9.68	
ac20	5180	9.43	10.0
	5220	9.38	
	5240	9.42	
ac40	5190	9.78	10.5
	5230	9.85	
ac80	5210	13.60	14.0
ac160	5250	14.28	15.0
ax20	5180	9.54	10.0
	5200	9.47	
	5240	9.58	
ax40	5190	9.63	10.0
	5230	9.55	
ax80	5210	13.43	14.0
ax160	5250	13.88	14.5

WLAN 5.2G (ANT-B)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5180	15.09	15.5
	5220	15.13	
	5240	15.23	
n20	5180	8.89	9.5
	5220	8.92	
	5240	8.75	
n40	5190	8.95	9.5
	5230	9.15	
ac20	5180	9.03	9.5
	5220	9.12	
	5240	9.08	
ac40	5190	9.15	10.0
	5230	9.39	
ac80	5210	13.41	14.0
ac160	5250	13.90	14.5
ax20	5180	9.18	9.5
	5200	9.23	
	5240	9.17	
ax40	5190	9.26	10.0
	5230	9.22	
ax80	5210	13.24	13.5
ax160	5250	13.56	14.0

WLAN 5.4G (ANT-A)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5260	15.76	16.5
	5300	15.69	
	5320	15.56	
n20	5260	12.48	13.0
	5300	12.51	
	5320	12.32	
n40	5270	13.87	14.5
	5310	13.56	
ac20	5260	12.63	13.0
	5300	12.68	
	5320	12.52	
ac40	5270	14.08	14.5
	5310	13.91	
ac80	5290	13.95	14.5
ax20	5260	13.18	14.0
	5300	13.13	
	5320	13.38	
ax40	5270	14.05	14.5
	5310	13.90	
ax80	5290	13.74	14.0

WLAN 5.4G (ANT-B)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5260	15.39	16.0
	5300	15.59	
	5320	15.69	
n20	5260	11.42	12.5
	5300	11.89	
	5320	12.10	
n40	5270	13.58	14.5
	5310	13.78	
ac20	5260	11.84	12.5
	5300	12.00	
	5320	12.14	
ac40	5270	13.97	14.5
	5310	14.06	
ac80	5290	13.77	14.5
ax20	5260	12.71	13.5
	5300	12.95	
	5320	13.06	
ax40	5270	13.70	14.0
	5310	13.71	
ax80	5290	13.61	14.0

WLAN 5.6G (ANT-A)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5500	15.10	16.0
	5580	15.39	
	5700	15.66	
n20	5500	11.89	13.5
	5580	12.05	
	5700	12.43	
n40	5510	13.30	14.0
	5550	13.39	
	5670	13.57	
ac20	5500	12.00	13.0
	5580	12.19	
	5700	12.55	
ac40	5510	13.40	14.5
	5550	13.56	
	5670	13.79	
ac80	5530	13.33	14.0
ac80	5610	13.70	14.0
ax20	5500	13.82	14.5
	5580	12.52	
	5700	12.68	
ax40	5510	13.10	14.0
	5550	13.32	
	5670	13.49	
ax80	5530	13.89	14.5
ax80	5610	13.09	13.5
ax160	5570	13.49	14.0

WLAN 5.6G (ANT-B)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5500	14.90	16.0
	5580	14.60	
	5700	15.43	
n20	5500	11.16	12.5
	5580	10.89	
	5700	11.93	
n40	5510	13.18	14.5
	5550	13.02	
	5670	13.68	
ac20	5500	11.21	12.5
	5580	11.06	
	5700	12.07	
ac40	5510	13.36	14.5
	5550	13.12	
	5670	13.79	
ac80	5530	12.77	13.5
ac80	5610	13.10	13.5
ax20	5500	13.26	14.0
	5580	12.12	
	5700	11.98	
ax40	5510	13.01	13.5
	5550	13.03	
	5670	12.82	
ax80	5530	13.50	14.0
ax80	5610	12.58	13.0
ax160	5570	12.81	13.5

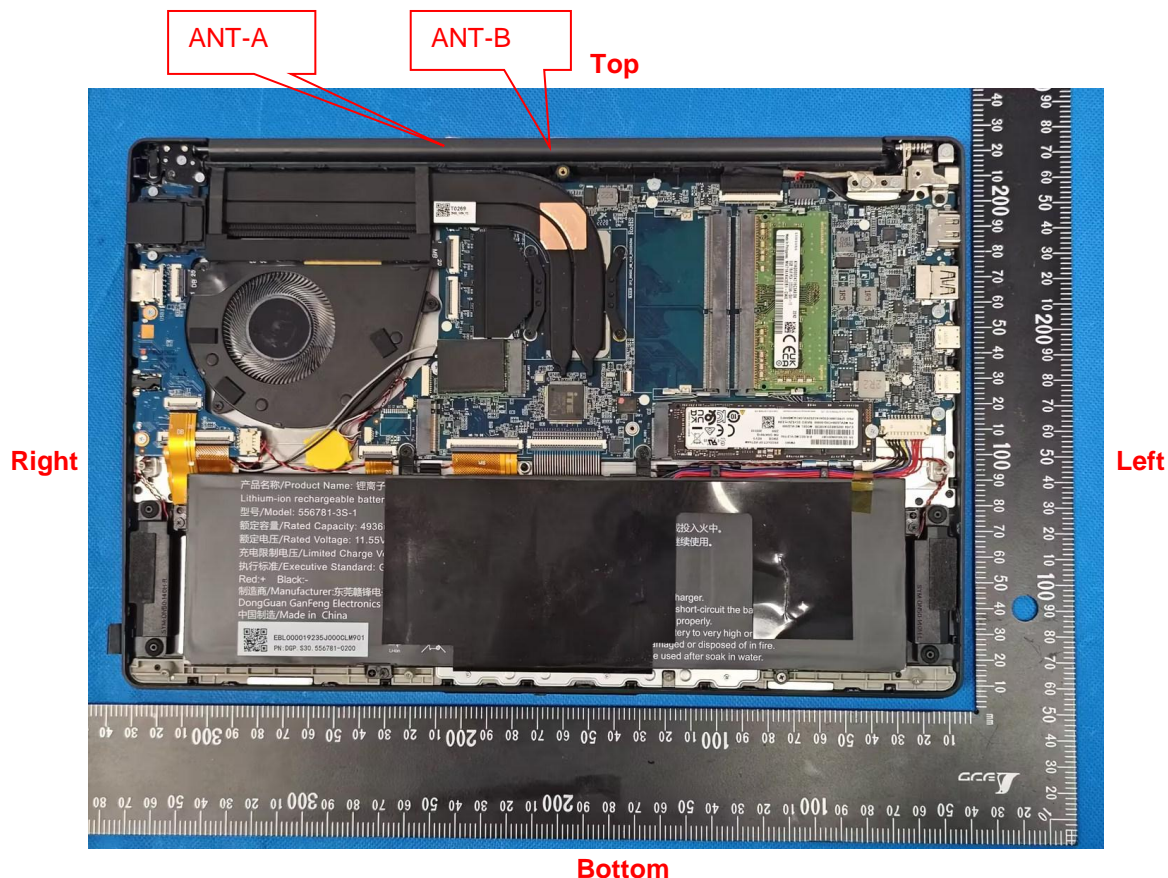
WLAN 5.8G (ANT-A)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5745	19.64	20.0
	5785	19.65	
	5825	19.54	
n20	5745	19.72	20.0
	5785	19.66	
	5825	19.00	
n40	5755	19.76	21.0
	5795	20.35	
ac20	5745	19.82	20.5
	5785	19.76	
	5825	19.92	
ac40	5755	20.07	21.0
	5795	20.54	
ac80	5775	16.85	17.5
ax20	5745	19.38	20.0
	5785	19.46	
	5825	19.49	
ax40	5755	19.05	20.0
	5795	19.26	
ax80	5775	16.76	17.5

WLAN 5.8G (ANT-B)			
Mode	Frequency	Maximum Conducted Output Power	Tune-up power
	(MHz)	(dBm)	(dBm)
a	5745	19.45	20.0
	5785	19.51	
	5825	19.61	
n20	5745	19.35	20.0
	5785	19.17	
	5825	19.38	
n40	5755	19.57	20.5
	5795	20.04	
ac20	5745	19.56	20.0
	5785	19.59	
	5825	19.68	
ac40	5755	19.64	20.5
	5795	20.20	
ac80	5775	17.91	18.5
ax20	5745	20.16	20.5
	5785	20.12	
	5825	20.25	
ax40	5755	19.52	20.5
	5795	20.06	
ax80	5775	17.67	18.0

14.2 Transmit Antennas and SAR Measurement Position

EUT Antenna Location:

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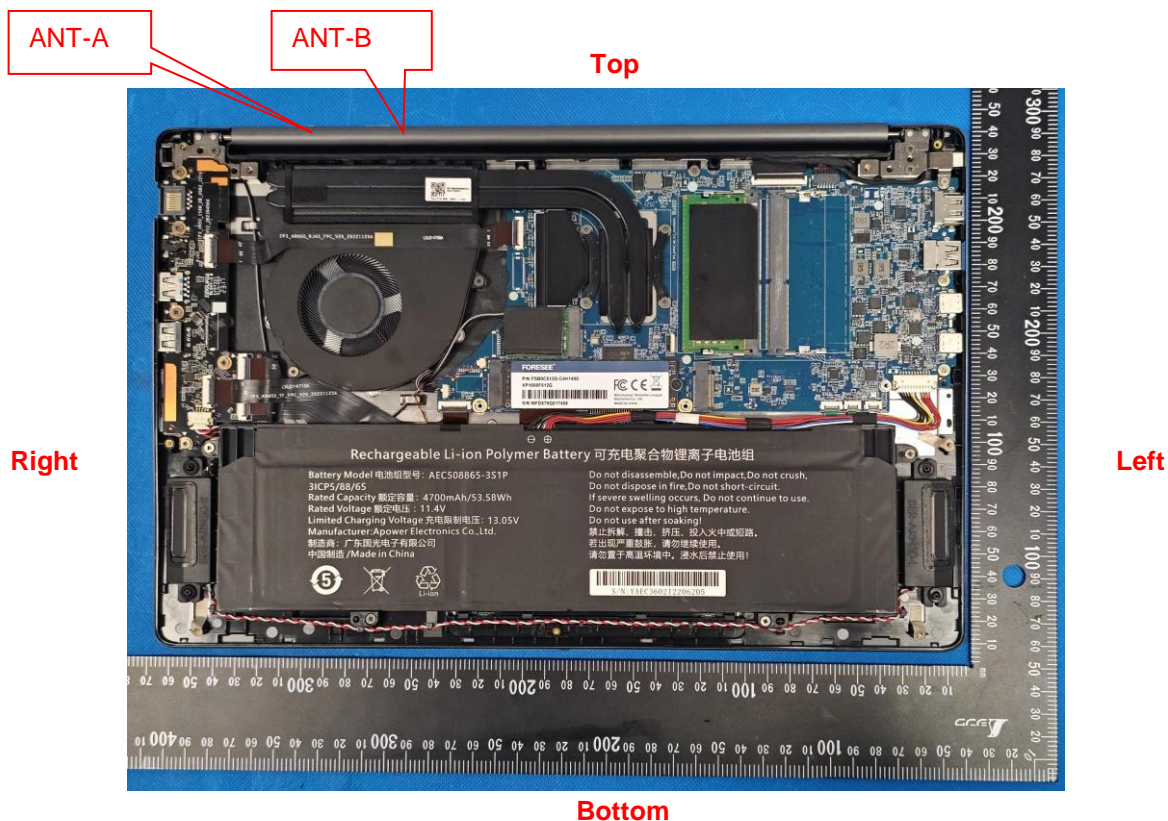
Antenna information	
Antenna	Function
ANT-A	WIFI+ Bluetooth
ANT-B	WIFI

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	<5	<5	210	194	115
ANT-B	N/A	<5	<5	210	150	163

Body mode: Positions for SAR tests; Test distance: 0mm						
Mode	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	Yes	Yes	No	No	No
ANT-B	N/A	Yes	Yes	No	No	No

Yes: The distance to Edge is less than 25mm, testing is required.

No: The distance to Edge is more than 25 mm, testing is not required.

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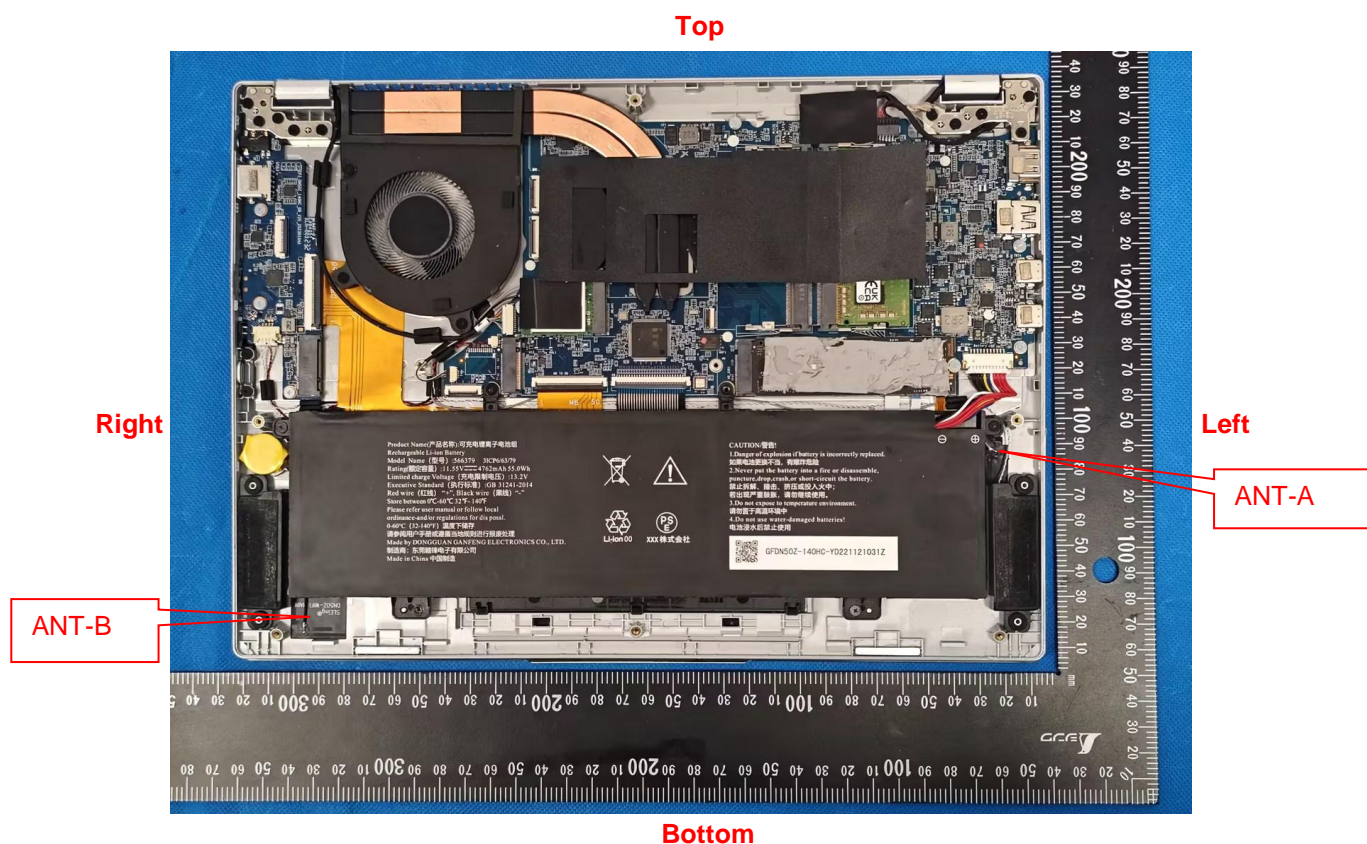
Antenna information	
Antenna	Function
ANT-A	WIFI+ Bluetooth
ANT-B	WIFI

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	<5	<5	225	290	57
ANT-B	N/A	<5	<5	225	255	93

Body mode: Positions for SAR tests; Test distance: 0mm						
Mode	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	Yes	Yes	No	No	No
ANT-B	N/A	Yes	Yes	No	No	No

Yes: The distance to Edge is less than 25mm, testing is required.

No: The distance to Edge is more than 25 mm, testing is not required.

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Antenna information	
Antenna	Function
ANT-A	WIFI+ Bluetooth
ANT-B	WIFI

Distance of The Antenna to the EUT surface and edge (mm)						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	<5	139	69	15	285
ANT-B	N/A	<5	200	7	272	22

Body mode: Positions for SAR tests; Test distance: 0mm						
Mode	Front	Back	Top Side	Bottom Side	Left Side	Right Side
ANT-A	N/A	Yes	No	No	Yes	No
ANT-B	N/A	Yes	No	Yes	No	Yes

Yes: The distance to Edge is less than 25mm, testing is required.

No: The distance to Edge is more than 25 mm, testing is not required.

14.3 Measured and Reported (Scaled) SAR Results

The calculated SAR is obtained by the following formula:

1. Reported SAR for WWAN=Measured SAR * Tune-up Scaling factor
2. Reported SAR for WLAN and Bluetooth=Measured SAR * Tune-up Scaling factor * Duty Cycle Scaling factor
3. Duty Cycle Scaling factor=1/ Duty Cycle (%)

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 248227 D01 802.11 Wi-Fi SAR

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements.

For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions.

DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.16 The initial test position procedure is described in the following:

- a) When the *reported* SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).
- b) When the *reported* SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest extrapolated or estimated 1-g SAR conditions determined by area scans or next closest/smallest test separation distance and maximum RF coupling test positions based on manufacturer justification, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.
- c) For all positions/configurations tested using the initial test position and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required channels are tested.

Additional power measurements may be required for this step, which should be limited to those necessary for identifying the subsequent highest output power channels.

When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.

When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR

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Bluetooth												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	GFSK	Back	39	2480	100	8.99	9.5	1.125	0.143	0.161	
		GFSK	Top	39	2480	100	8.99	9.5	1.125	0.121	0.136	
		GFSK	Back	0	2402	100	7.30	9.5	1.660	0.201	0.334	1
		GFSK	Back	19	2440	100	7.92	9.5	1.439	0.160	0.230	

WIFI 2.4G (ANT-A)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ax40	Back	1	2422	100	26.88	27.5	1.153	0.148	0.171	2
		ax40	Top	1	2422	100	26.88	27.5	1.153	0.130	0.150	
		ax40	Back	6	2437	100	26.72	27.5	1.197	0.100	0.120	
		ax40	Back	12	2452	100	26.52	27.5	1.253	0.117	0.147	

WIFI 2.4G (ANT-B)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ax40	Back	12	2452	100	26.28	27.0	1.180	0.227	0.268	
		ax40	Top	12	2452	100	26.28	27.0	1.180	0.161	0.190	
		ax40	Back	1	2422	100	26.20	27.0	1.202	0.185	0.222	
		ax40	Back	6	2437	100	26.24	27.0	1.191	0.248	0.295	3

WIFI 5.2G (ANT-A)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	48	5240	100	15.68	16.0	1.076	0.551	0.593	
		a	Top	48	5240	100	15.68	16.0	1.076	0.342	0.368	
		a	Back	36	5180	100	15.21	16.0	1.199	0.437	0.524	
		a	Back	44	5220	100	15.45	16.0	1.135	0.568	0.645	4

WIFI 5.2G (ANT-B)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	48	5240	100	15.23	15.5	1.064	0.264	0.281	
		a	Top	48	5240	100	15.23	15.5	1.064	0.414	0.441	5
		a	Top	36	5180	100	15.09	15.5	1.099	0.377	0.414	
		a	Top	44	5220	100	15.13	15.5	1.089	0.315	0.343	

WIFI 5.4G (ANT-A)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	52	5260	100	15.76	16.5	1.186	0.690	0.818	6
		a	Top	52	5260	100	15.76	16.5	1.186	0.448	0.531	
		a	Back	60	5300	100	15.69	16.5	1.205	0.604	0.728	
		a	Back	64	5320	100	15.56	16.5	1.242	0.655	0.813	

WIFI 5.4G (ANT-B)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	64	5320	100	15.69	16.0	1.074	0.678	0.728	7
		a	Top	64	5320	100	15.69	16.0	1.074	0.370	0.397	
		a	Back	52	5260	100	15.39	16.0	1.151	0.580	0.667	
		a	Back	60	5300	100	15.59	16.0	1.099	0.634	0.697	

WIFI 5.6G (ANT-A)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	140	5700	100	15.66	16.0	1.081	0.553	0.598	
		a	Top	140	5700	100	15.66	16.0	1.081	0.534	0.577	
		a	Back	100	5500	100	15.10	16.0	1.230	0.517	0.636	8
		a	Back	116	5580	100	15.39	16.0	1.151	0.466	0.536	

WIFI 5.6G (ANT-B)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	140	5700	100	15.43	16.0	1.140	0.493	0.562	
		a	Top	140	5700	100	15.43	16.0	1.140	0.535	0.610	9
		a	Top	100	5500	100	14.90	16.0	1.288	0.364	0.469	
		a	Top	116	5580	100	14.60	16.0	1.380	0.256	0.353	

WIFI 5.8G (ANT-A)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ac40	Back	159	5795	100	20.54	21.0	1.112	0.560	0.623	10
		ac40	Top	159	5795	100	20.54	21.0	1.112	0.367	0.408	
		ac40	Back	151	5755	100	20.07	21.0	1.239	0.452	0.560	

WIFI 5.8G (ANT-B)

RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ax20	Back	165	5825	100	20.25	20.5	1.059	0.370	0.392	
		ax20	Top	165	5825	100	20.25	20.5	1.059	0.464	0.491	11
		ax20	Back	149	5745	100	20.16	20.5	1.081	0.365	0.395	
		ax20	Back	157	5785	100	20.12	20.5	1.091	0.303	0.331	

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Bluetooth												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	GFSK	Back	39	2480	100	8.99	9.5	1.125	0.135	0.152	
		GFSK	Top	39	2480	100	8.99	9.5	1.125	0.143	0.161	
		GFSK	Back	0	2402	100	7.30	9.5	1.660	0.153	0.254	1
		GFSK	Back	19	2440	100	7.92	9.5	1.439	0.136	0.196	

WIFI 2.4G (ANT-A)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ax40	Back	1	2422	100	26.88	27.5	1.153	0.184	0.212	2
		ax40	Top	1	2422	100	26.88	27.5	1.153	0.108	0.125	
		ax40	Back	6	2437	100	26.72	27.5	1.197	0.152	0.182	
		ax40	Back	12	2452	100	26.52	27.5	1.253	0.147	0.184	

WIFI 2.4G (ANT-B)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	ax40	Back	12	2452	100	26.28	27.0	1.180	0.285	0.336	3
		ax40	Top	12	2452	100	26.28	27.0	1.180	0.120	0.142	
		ax40	Back	1	2422	100	26.20	27.0	1.202	0.212	0.255	
		ax40	Back	6	2437	100	26.24	27.0	1.191	0.251	0.299	

WIFI 5.2G (ANT-A)												
RF Exposure Conditions	Dist. (mm)	Mode	Test Position	CH.	Freq. (MHz)	Duty Cycle (%)	Output Power (dBm)	Turn up (dBm)	Turn-up Scaling Factor	SAR1g (W/kg)		Plot No.
										Meas.	Scaled	
Body	0	a	Back	48	5240	100	15.68	16.0	1.076	0.797	0.858	4
		a	Top	48	5240	100	15.68	16.0	1.076	0.406	0.437	
		a	Back	36	5180	100	15.21	16.0	1.199	0.670	0.804	
		a	Back	44	5220	100	15.45	16.0	1.135	0.642	0.729	