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SAR TEST REPORT

Applicant Name: **SAMSUNG Electronics Co., Ltd.** 129, Samsung-ro, Yeongtong-gu, Suwon-Si, Gyeonggi-do, 16677 Rep. of Korea	**Date of Issue: May 16, 2023** **Test Report No.: HCT-SR-2305-FC010** **Test Site: HCT CO., LTD.**

FCC ID: **A3LSMX810**

Equipment Type:	**Tablet**
Application Type	**Certification**
FCC Rule Part(s):	**CFR §2.1093**
Model Name:	**SM-X810**
Date of Test:	**Apr. 10. 2023 ~ May 10. 2023**

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in FCC KDB procedures and had been tested in accordance with the measurement procedures specified in FCC KDB procedures.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested By

Jin-Wook, Ko
Test Engineer
SAR Team
Certification Division

Reviewed By

Yun-jeang, Heo
Technical Manager
SAR Team
Certification Division

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	May 16, 2023	Initial Release

This test results were applied only to the test methods required by the standard.

The above Test Report is not related to the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA.

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Appendix

1. Test Regulations

The tests documented in this report were performed in accordance with FCC CFR § 2.1093, IEEE 1528-2013, ANSI C63.26-2015 the following FCC Published RF exposure KDB procedures:

- FCC KDB Publication 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB Publication 447498 D04 Interim General RF Exposure Guidance v01
- FCC KDB Publication 616217 D04 SAR Tablets v01r02
- FCC KDB Publication 865664 D01 SAR measurement 100 ㎒ to 6 ㎓ v01r04
- FCC KDB Publication 865664 D02 SAR Reporting v01r02
- FCC KDB Publication 690783 D01 SAR Listings on Grants v01r03
- FCC KDB Publication 971168 D01 Power Meas License Digital Systems v03r01

In Addition to the above, the following information was used.

- April 2015 TCB Workshop Notes (Simultaneous transmission summation clarified)
- October 2016 TCB Workshop Notes (Bluetooth Duty Factor)
- April 2019 TCBC Workshop Notes (IEEE 802.11 ax)

2. Test Location

2.1 Test Laboratory

Company Name	HCT Co., Ltd.
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
Telephone	031-645-6300
Fax.	031-645-6401

2.2 Test Facilities

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

Korea	National Radio Research Agency (Designation No. KR0032)
	KOLAS (Testing No. KT197)

3. Information of the EUT

3.1 General Information of the EUT

Model Name	SM-X810
Equipment Type	Tablet
FCC ID	A3LSMX810
Application Type	Certification
Applicant	SAMSUNG Electronics Co., Ltd.

3.2 Attestation of test result of device under test

Band	Tx. Frequency	Equipment Class	SAR (W/kg)
			Reported 1g Body SAR
2.4 ㎓ WLAN	2 412 ㎒ ~ 2 472 ㎒	DTS	0.45
U-NII-1	5 180 ㎒ ~ 5 240 ㎒	NII	N/A
U-NII-2A	5 260 ㎒ ~ 5 320 ㎒	NII	0.85
U-NII-2C	5 500 ㎒ ~ 5 720 ㎒	NII	0.95
U-NII-3	5 745 ㎒ ~ 5 825 ㎒	NII	0.96
U-NII-4	5 845 ㎒ ~ 5 885 ㎒	NII	1.10
Bluetooth	2 402 ㎒ ~ 2 480 ㎒	DSS/DTS	0.42
Simultaneous SAR per KDB 690783 D01v01r03			**1.53**
Date(s) of Tests:	Apr. 10. 2023 ~ May. 10. 2023		

4. Device Under Test Description

4.1 DUT specification

Device Wireless specification overview		
Band & Mode	**Operating Mode**	**Tx Frequency**
2.4 GHz WLAN	Data	2 412 MHz ~ 2 472 MHz
U-NII-1	Data	5 180 MHz ~ 5 240 MHz
U-NII-2A	Data	5 260 MHz ~ 5 320 MHz
U-NII-2C	Data	5 500 MHz ~ 5 720 MHz
U-NII-3	Data	5 745 MHz ~ 5 825 MHz
U-NII-4	Data	5 845 MHz ~ 5 885 MHz
U-NII-5	Data	5 935 MHz ~ 6 415 MHz
U-NII-6	Data	6 435 MHz ~ 6 515 MHz
U-NII-7	Data	6 535 MHz ~ 6 875 MHz
U-NII-8	Data	6 875 MHz ~ 7 115 MHz
Bluetooth / LE 5.3	Data	2 402 MHz ~ 2 480 MHz
S-Pen	Data	531 kHz

Device Description		
H/W	REV1.0	
S/W	X810.001	
Battery	EB-BT975ABY (SDI)	
S-Pen	EJ-PX710(SAMSUNG)	
Keyboard	EF-DX815, EF-DX810 (SAMSUNG)	
Device Serial Numbers	**Mode**	**Serial Number**
	Bluetooth	WCN0332M
	WLAN	WCN0332M, WCN0327M
	The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics are within operational tolerances expected for production units.	

4.2 Power Reduction for SAR

This device uses an independent fixed level power reduction mechanism for WLAN operations When 2.4 GHz WLAN mode and 5 GHz/6 GHz WLAN mode are simultaneously transmitted, and also during activating in close proximity to the user's Body
FCC KDB Publication 616217 D04v01r02 Sec.6 was used as a guideline for selection SAR test distances for device.

The reduced powers for the power reduction mechanisms were conformed via conducted power measurements at the RF Port.

4.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB publication 447498 D04v01.

4.3.1 Maximum 2.4 GHz, 5 GHz WIFI output power

Mode	SISO						MIMO					
	a	b	g	n	ac	ax(SU)	a	b	g	n	ac	ax(SU)
2.4 GHz		15.0 12ch: 2 13ch: -1	17.0 1ch: 15 2ch: 15 11ch: 15	17.0 1ch: 15 2ch: 15 11ch: 15		17.0 1ch: 13 2ch: 14 3~4ch: 15 10ch: 15 11ch: 14		18.0 12ch: 5 13ch: 2	20.0 1ch: 18 2ch: 18 11ch: 18	20.0 1ch: 18 2ch: 18 11ch: 18		20.0 1ch: 16 2ch: 17 3~4ch: 18 10ch: 18 11ch: 17
5 GHz(20 MHz BW)	16.0			16.0	16.0	16.0	19.0			19.0	19.0	19.0
5 GHz(40 MHz BW)				16.0 38ch 15.5 62ch 15.0 102ch 15.0	16.0 38ch 15.5 62ch 15.0 102ch 15.5	16.0				19.0 38ch 18.5 62ch 18 102ch 18	19.0 38ch 18.5 62ch 18 102ch 18.5	19.0
5 GHz(80 MHz BW)					15.0 58ch 14.5	15.0					18.0 58ch 17.5	18.0
5 GHz(160 MHz BW)						14.0					58ch 14.5 114ch 14.5 163ch 17.0	17.0

(Upper Tolerance: target ~ +1.0 dB)

4.3.2 Reduced 2.4 GHz, 5 GHz WIFI output power - Grip Active.

Mode	SISO						MIMO					
	a	b	g	n	ac	ax(SU)	a	b	g	n	ac	ax(SU)
2.4 GHz		11.0	11.0	11.0		11.0		14.0	14.0	14.0		14.0
2.4 GHz (Ch.12,13)		12ch 2 13ch -1	12ch 2 13ch -1	12ch 2 13ch -1		12ch 2 13ch -1		12ch 5 13ch 2	12ch 5 13ch 2	12ch 5 13ch 2		12ch 5 13ch 2
5 GHz 20 MHz)	7.5			7.5	7.5	7.5	10.5			10.5	10.5	10.5
5 GHz 40 MHz)				7.5	7.5	7.5				10.5	10.5	10.5
5 GHz (80 MHz)					7.5	7.5					10.5	10.5
5 GHz (160 MHz)					7.5	7.5					10.5	10.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.3 Reduced 2.4 GHz, 5 GHz WIFI output power - RSDB Active.

Mode	SISO						MIMO					
	a	b	g	n	ac	ax(SU)	a	b	g	n	ac	ax(SU)
2.4 GHz		10.0	10.0	10.0		10.0		13.0	13.0	13.0		13.0
2.4 GHz (Ch.12,13)		12ch 2 13ch -1	12ch 2 13ch -1	12ch 2 13ch -1		12ch 2 13ch -1		12ch 5 13ch 2	12ch 5 13ch 2	12ch 5 13ch 2		12ch 5 13ch 2
5 GHz (20 MHz)	7.0			7.0	7.0	7.0	10.0			10.0	10.0	10.0
5 GHz (40 MHz)				7.0	7.0	7.0				10.0	10.0	10.0
5 GHz (80 MHz)					7.0	7.0					10.0	10.0
5 GHz (160 MHz)					7.0	7.0					10.0	10.0

(Upper Tolerance: target ~ +1.0 dB)

4.3.4 Maximum Power 802.11ax RU Power

Tones	SISO (ANT1/2) /in dBm					MIMO (ALL) /in dBm				
	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz
26T	13.0 12ch : 2 13ch : -4					16.0 12ch : 5 13ch: -1	10.5	10.5	10.5	50ch : 8 114ch : 6 163ch : 6
52T	14.0 12ch : 2 13ch: -2					17.0 12ch : 5 13ch: 1	12.5	12.5	12.5	50ch : 8 114ch : 7 163ch : 11
106T	14.0 12ch : 2 13ch: -1					17.0 12ch : 5 13ch : 2	14.0	14.0	14.0	8.0
242T	14.0 12ch : 2 13ch: -1					17.0 12ch : 5 13ch : 2	16.0	15.0	14.0	13.0
484T								15.0	14.0	13.0
996T									14.0	13.0
996T*2										13.0

(Upper Tolerance: target ~ +1.0 dB)

4.3.5 Reduced Power 802.11ax RU Tx power - Grip Active

Tones	SISO (ANT1/2) /in dBm					MIMO (ALL) /in dBm				
	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz
26T	11.0 12ch: 2 13ch: -4					14.0 12ch: 5 13ch:-1	10.5	10.5	10.5	10.5
52T	11.0 12ch: 2 13ch: -2					14.0 12ch: 5 13ch: 1	10.5	10.5	10.5	10.5
106T	11.0 12ch: 2 13ch: -1					14.0 12ch: 5 13ch: 2	10.5	10.5	10.5	10.5
242T	11.0 12ch: 2 13ch: -1					14.0 12ch: 5 13ch: 2	10.5	10.5	10.5	10.5
484T								10.5	10.5	10.5
996T									10.5	10.5
996T*2									10.5	10.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.6 Reduced Power 802.11ax RU Tx power - RSDB Active.

Tones	SISO (ANT1/2) /in dBm					MIMO (ALL) /in dBm				
	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz	2.4G	5G/20 MHz	5G/40 MHz	5G/80 MHz	5G/160 MHz
26T	8.0 12ch: 2 13ch: -4					11.0 12ch: 5 13ch:-1	10.0	10.0	10.0	10.0
52T	8.0 12ch: 2 13ch: -2					11.0 12ch: 5 13ch: 1	10.0	10.0	10.0	10.0
106T	8.0 12ch: 2 13ch: -1					11.0 12ch: 5 13ch: 2	10.0	10.0	10.0	10.0
242T	8.0 12ch: 2 13ch: -1					11.0 12ch: 5 13ch: 2	10.0	10.0	10.0	10.0
484T								10.0	10.0	10.0
996T									10.0	10.0
996T*2										10.0

(Upper Tolerance: target ~ +1.0 dB)

4.3.7 Maximum 6 GHz WIFI output power () : power for 6E dual client.

Mode	MIMO			
	802.11a		802.11 ax(SU)	
	Nominal	Maximum	Nominal	Maximum
U-NII 6-7 GHz (20 MHz BW)	12.0	13.0	12.0 (12.0)	13.0 (13.0)
U-NII 6-7 GHz (40 MHz BW)			12.0 (12.0)	13.0 (13.0)
U-NII 6-7 GHz (80 MHz BW)			12.0 (12.0)	13.0 (13.0)
U-NII 6-7 GHz (160 MHz BW)			12.0 (12.0)	13.0 (13.0)

(Upper Tolerance: target ~ +1.0 dB)

4.3.8 Reduced Power 6 GHz WIFI output power - Grip Active.

Mode	MIMO			
	802.11a		802.11 ax(SU)	
	Nominal	Maximum	Nominal	Maximum
U-NII 6-7 GHz (20 MHz BW)	11.0	12.0	11.0	12.0
U-NII 6-7 GHz (40 MHz BW)			10.5	11.5
U-NII 6-7 GHz (80 MHz BW)			10.5	11.5
U-NII 6-7 GHz (160 MHz BW)			10.5	11.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.9 Reduced Power 6 GHz WIFI output power - RSDB Active.

Mode	MIMO			
	802.11a		802.11 ax(SU)	
	Nominal	Maximum	Nominal	Maximum
U-NII 6-7 GHz (20 MHz BW)	9.0	10.0	9.0	10.0
U-NII 6-7 GHz (40 MHz BW)			8.5	9.5
U-NII 6-7 GHz (80 MHz BW)			8.5	9.5
U-NII 6-7 GHz (160 MHz BW)			8.5	9.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.10 Maximum 6 GHz 802.11ax RU Power () : power for 6E dual client

Tones	MIMO			
	6G/20 MHz	6G/40 MHz	6G/80 MHz	6G/160 MHz
26T	3.0 (12.0) 2ch : 0 (0)	3.0 (12.0)	3.0 (12.0)	3.0 (12.0)
52T	6.0 (12.0) 2ch : 3.0 (3.0)	6.0 (12.0)	6.0 (12.0)	6.0 (12.0)
106T	9.0 (12.0) 2ch : 5.0 (5.0)	9.0 (12.0)	9.0 (12.0)	9.0 (12.0)
242T	12.0 (12.0) 2ch : 8.0 (8.0)	11.5 (12.0)	11.5 (12.0)	11.5 (12.0)
484T		11.5 (12.0)	11.5 (12.0)	11.5 (12.0)
996T			11.5 (12.0)	11.5 (12.0)
996T*2				11.5 (12.0)

(Upper Tolerance: target ~ +1.0 dB)

4.3.11 Reduced Power 6 GHz 802.11ax RU Power - Grip Active.

Tones	MIMO			
	6G/20 MHz	6G/40 MHz	6G/80 MHz	6G/160 MHz
26T	3.0	3.0	3.0	3.0
52T	6.0	6.0	6.0	6.0
106T	9.0	9.0	9.0	9.0
242T	11.0	10.5	10.5	10.5
484T		10.5	10.5	10.5
996T			10.5	10.5
996T*2				10.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.12 Reduced Power 6 GHz 802.11ax RU Power - RSDB Active.

Tones	MIMO			
	6G/20 MHz	6G/40 MHz	6G/80 MHz	6G/160 MHz
26T	3.0	3.0	3.0	3.0
52T	6.0	6.0	6.0	6.0
106T	9.0	8.5	8.5	8.5
242T	9.0	8.5	8.5	8.5
484T		8.5	8.5	8.5
996T			8.5	8.5
996T*2				8.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.13 Maximum Bluetooth Power

Mode / Band		Modulated Average (dBm)	
		Ant.1	Ant.2
Bluetooth BDR DH5	2402	16.0	15.5
	2440		
	2480		
Bluetooth EDR 2-DH5	2402	14.0	13.5
	2440		
	2480		
Bluetooth EDR 3-DH5	2402	14.0	13.5
	2440		
	2480		
Bluetooth LE High Power 1M/2M		8.5	8.0
Bluetooth LE High Power 125/500kbps		8.5	8.0

(Upper Tolerance: target ~ +1.0 dB)

4.3.14 Reduced Bluetooth Power - Grip Active

Mode / Band		Modulated Average (dBm)	
		Ant.1	Ant.2
Bluetooth BDR DH5	2402	8.0	7.5
	2440	8.0	7.5
	2480	7.0	6.5
Bluetooth EDR 2-DH5	2402	8.0	7.5
	2440	8.0	7.5
	2480	7.0	6.5
Bluetooth EDR 3-DH5	2402	8.0	7.5
	2440	8.0	7.5
	2480	7.0	6.5

(Upper Tolerance: target ~ +1.0 dB)

4.3.15 Reduced Bluetooth Power - RSDB Active.

Mode / Band		Modulated Average (dBm)	
		Ant.1	Ant.2
Bluetooth BDR DH5	2402	7.0	6.5
	2440	7.0	6.5
	2480	6.0	5.5
Bluetooth EDR 2-DH5	2402	7.0	6.5
	2440	7.0	6.5
	2480	6.0	5.5
Bluetooth EDR 3-DH5	2402	7.0	6.5
	2440	7.0	6.5
	2480	6.0	5.5

(Upper Tolerance: target ~ +1.0 dB)

4.4 SAR Test Configurations for DUT Antenna Locations

Antenna	Band	Device Conifigurations for SAR Testing				
		Rear	Top	Left	Right	Bottom
WiFi 1	2.4 GHz WLAN / Bluetooth	Yes	Yes	No	Yes	No
WiFi 1	5 /6 GHz WLAN	Yes	Yes	No	Yes	No
WiFi 2	2.4 GHz WLAN / Bluetooth	Yes	Yes	Yes	No	No
WiFi 2	5 /6 GHz WLAN	Yes	Yes	Yes	No	No

Note; All test configurations are based on front view.
Per FCC KDB Publication 616217 D04v01r02, the rear surface and edges of tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D04v01 can be applied to determine SAR test exclusion for adjacent edge configurations. The closet distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

Since the Dedicated Host Approach is applied, the standalone SAR test exclusion procedure in KDB 447498 D04v01 2.1.1 is applied in conjunction with KDB 616217 D04v01r02 4.3 to determine the minimum test separation distance:
This device was tested considering the Rear/left/right/top/bottom side for simultaneous transmission analysis of multiple transmitter conditions. The bottom side of the upper antenna excluded according to KDB 6162717.
bottom surface, excluding SAR test by FCC KDB 616217 D04v01r02, were analyzed by applying 0.4 w/kg according to FCC KDB 447498 D04v01 during simultaneous transmission analysis.

4.5 SAR Summation Scenario

According to FCC KDB 447498 D04v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown below paths and are mode in same rectangle to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.
This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB 447498 D04v01.

No.	CapableTransmit Configuration	Body
1	Bluetooth ANT 2 + WI-FI 6E MIMO	Yes
2	Bluetooth ANT 2 + 5GHz WI-FI MIMO	Yes
3	Bluetooth ANT 1 + WI-FI 6E MIMO	Yes
4	Bluetooth ANT 1 + 5GHz WI-FI MIMO	Yes
5	Bluetooth ANT 1 + 2.4GHz WI-FI Ant 2	Yes
6	Bluetooth ANT 1 + 2.4GHz WI-FI Ant 2 + 5GHz WI-FI MIMO	Yes
7	Bluetooth ANT 1 + 2.4GHz WI-FI Ant 2 + WI-FI 6E MIMO	Yes
8	2.4 WI-FI MIMO + WI-FI 6E MIMO	Yes
9	2.4 WI-FI MIMO + 5GHz WI-FI MIMO	Yes

Note:
1. 2.4GHz bluetooth ANT1 and 2.4GHz Bluetooth ANT 2 cannot transmit simultaneously.
2. This device supports Bluetooth tethering.
3. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac/ax. 802.11a/g/n/ac/ax supports CDD and STBC and 802.11n/ac/ax additionally supports SDM. Each WLAN antenna can transmit independently or together when operating with MIMO.

4.6 SAR Test Considerations

4.6.1 Un-Licensed Transmitter(s)

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg for 1g SAR and is less than 3.0 W/kg for 10g SAR, SAR is not required for U-NII-1 band according to FCC KDB 248227D01v02r02.

This device supports IEEE 802.11ax with the following features:

a) Up to 160 MHz Bandwidth only for 5/6 GHz
b) Up to 20 MHz Bandwidth only for 2.4 GHz
c) No aggregate channel configurations
d) 2 Tx antenna output
e) Up to 1024 QAM is supported
f) TDWR and Band gap channels are supported for 5/6 GHz
g) MU-MIMO UL Operations are not supported

Per April 2019 TCB Workshop Notes, SAR testing was not required for 802.11ax when applying the initial test configuration procedures of KDB 248227, with 802.11ax considered a higher order 802.11 mode.

5. Introduction

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio Frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative of the incremental electromagnetic energy (d*W*) absorbed by (dissipated in) an incremental mass (d*m*) contained in a volume element (d*V*) of a given density (*r*). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right)$$

Figure 1. SAR Mathematical Equation
SAR is expressed in units of Watts per Kilogram (W/kg)

Where:
= conductivity of the tissue-simulant material (S/m)
= mass density of the tissue-simulant material (kg/m^3)
= Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

6. Description of test equipment

6.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure.2).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC with Windows XP or Windows 7 is working with SAR Measurement system DASY4 & DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

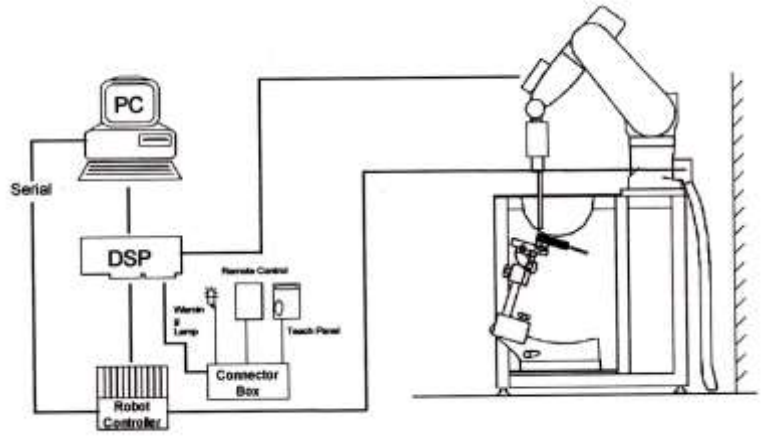


Figure 2. HCT SAR Lab. Test Measurement Set-up

The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

7. SAR Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013.

1. The SAR distribution at the exposed side of the head or body was measured at a distance no more than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the DUT's head and body area and the horizontal grid resolution was depending on the FCC KDB 865664 D01v01r04 table 4-1 & IEEE 1528-2013.

2. Based on step, the area of the maximum absorption was determined by sophisticated interpolations routines implemented in DASY software. When an Area Scan has measured all reachable point. DASY system computes the field maximal found in the scanned are, within a range of the maximum. SAR at this fixed point was measured and used as a reference value.

3. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB 865664 D01v01r04 table 4-1 and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (reference from the DASY manual.)

   a. The data at the surface were extrapolated, since the center of the dipoles is no more than 2.7 mm away from the tip of the probe (it is different from the probe type) and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan. If the value changed by more than 5 %, the SAR evaluation and drift measurements were repeated.

Area scan and zoom scan resolution setting follow KDB 865664 D01v01r04 quoted below.

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

8. Description of Test Position

8.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε and loss tangent δ=0.02.

8.2 SAR Testing for Tablet Per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D04v01 can be applied to determine SAR test exclusion for adjacent edge configuration. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

8.3 Proximity Sensor Considerations.

This device uses a sensor to reduce output powers in certain use conditions when the device is used close the user's body.

When the sensor detects a user is touching the device on or near to the antenna the device reduces the maximum allowed output power However, the proximity sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

FCC KDB 616217 D04 Section 8 and additional FCC guidance were used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. The smallest separation distance determined by the sensor triggering and sensor coverage for each applicable edge, minus 1 mm. was used as the test separation distance for SAR testing. Sensor triggering distance evaluation is provided in a separate document.

The required separation distance to evaluate SAR at full powers were:

Wireless technologies	Position	§6.2 Triggering Distance [mm]	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for Body SAR [mm]
WLAN /BT Ant 1	Rear	20	N/A	N/A	19
	Right	10	N/A	N/A	9
	Top	20	N/A	N/A	19
WLAN /BT Ant 2	Rear	20	N/A	N/A	19
	Left	10	N/A	N/A	9
	Top	18	N/A	N/A	17

9. RF Exposure Limits

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Partial Body)	1.6	8.0
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.4
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.0	20.0

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

*** The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be mad fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

10. FCC SAR General Measurement Procedures

Power Measurements for licensed transmitters are performed using a base simulator under digital average power.

10.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D04v01, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as Reported SAR. The highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

10.2 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

10.2.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR system to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92-96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

10.2.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg for 1g SAR or > 3.0 W/kg for 10g SAR. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg for 1g SAR or > 3.0 W/kg for 10g SAR.

10.2.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 ㎒ (5.47 ㎓ – 5.85 ㎓), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 ㎓ – 5.65 ㎓ in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, SAR must be considered for these channels.

10.2.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating nest to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg for 1g SAR and ≤ 1.0 W/kg for 10g SAR, no additional testing for the remaining test position is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg for 1g SAR and ≤ 2.0 W/kg for 10g SAR or all test positions are measured.

10.2.5 2.4 GHz SAR test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
1) 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 is that exposure configuration.
2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.
2.4 GHz 802.11 g/n/ax OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed.

10.2.6 OFDM Transmission Mode and SAR Test Channel Selection

For the 2.4 GHz and 5 GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate and lowest order 802.11 a/g/n/ac mode. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11 ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.2., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. Per April 2019 TCB Workshop guidance 802.11ax was considered the highest order 802.11 mode. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

10.2.7 Initial Test Configuration Procedure

For OFDM, in both 2.4 GHz and 5 GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output power is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements.

10.2.8 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position on procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg for 1g SAR and ≤ 3.0 W/kg for 10g SAR, no additional SAR tests for the subsequent test configurations are required.

10.2.9 MIMO SAR Considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 D04v01 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, no additional SAR Measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

11. Output Power Specifications

11.1 WIFI Conducted Power measurement method

Un-Licensed bands (DTS Band)

Test Description	Test Procedure Used
Conducted Output Power	- KDB 558074 v05 - Section 8.3.2.3 - ANSI 63.10-2013 - Section 11.9.2.3

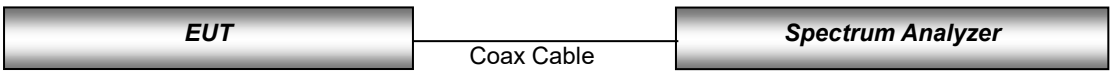
Test Procedure
1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Un-Licensed bands (NII Band)

Test Description	Test Procedure Used
Conducted Output Power	- KDB 789033 D02 v02r01 - Section E.3.a

Test Procedure
1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Test setup



11.1.1 IEEE 802.11 (2.4 ㎓) Maximum Conducted Power

Mode	Frequency [㎒]	Channel	IEEE 802.11 (2.4 ㎓) Average RF Conducted Power [dBm]		
			Ant.1	Ant.2	MIMO
802.11b	2 412	1	15.07	14.99	18.04
	2 437	6	15.08	15.33	18.22
	2 462	11	14.92	15.55	18.26
	2 467	12	2.24	2.13	5.20
	2 472	13	-0.96	-0.35	2.37
802.11g	2 412	1	17.18	16.84	20.02
	2 437	6	17.15	17.10	20.14
	2 462	11	17.19	17.49	20.35
	2 467	12	2.21	2.72	5.48
	2 472	13	-1.25	-0.40	2.21
802.11n (HT20)	2 412	1	17.06	16.58	19.84
	2 437	6	16.86	16.96	19.92
	2 462	11	17.08	17.46	20.28
	2 467	12	2.18	2.64	5.43
	2 472	13	-0.73	-0.37	2.46
802.11ax (HE20)	2 412	1	17.26	16.84	20.07
	2 437	6	16.96	17.13	20.06
	2 462	11	17.09	17.58	20.35
	2 467	12	1.87	2.26	5.08
	2 472	13	-1.42	-0.77	1.93

11.1.2 IEEE 802.11 (2.4 ㎓) Reduced Conducted Power (Grip Active)

Mode	Frequency [㎒]	Channel	IEEE 802.11 (2.4 ㎓) Average RF Conducted Power [dBm]		
			Ant.1	Ant.2	MIMO
802.11b	2 412	1	11.23	11.10	14.17
	2 437	6	11.30	11.47	14.40
	2 462	11	11.27	11.44	14.37
802.11g	2 412	1	11.01	11.00	14.02
	2 437	6	11.09	11.42	14.27
	2 462	11	11.04	11.24	14.15
802.11n (HT20)	2 412	1	10.88	10.93	13.92
	2 437	6	10.94	11.26	14.11
	2 462	11	10.94	11.10	14.03
802.11ax (HE20)	2 412	1	10.96	10.99	13.99
	2 437	6	11.05	11.31	14.19
	2 462	11	11.03	11.18	14.12

11.1.3 IEEE 802.11 (2.4 ㎓) Reduced Conducted Power (RSDB Active)

Mode	Frequency [㎒]	Channel	IEEE 802.11 (2.4 ㎓) Average RF Conducted Power [dBm]		
			Ant.1	Ant.2	MIMO
802.11b	2 412	1	10.13	10.14	13.14
	2 437	6	10.57	10.38	13.49
	2 462	11	10.12	10.65	13.40
802.11g	2 412	1	9.91	10.02	12.98
	2 437	6	10.42	10.32	13.38
	2 462	11	9.95	10.63	13.31
802.11n (HT20)	2 412	1	9.75	9.90	12.84
	2 437	6	10.30	10.18	13.25
	2 462	11	9.85	10.48	13.19
802.11ax (HE20)	2 412	1	9.79	9.96	12.89
	2 437	6	10.33	10.19	13.27
	2 462	11	9.86	10.56	13.23

11.1.4 IEEE 802.11 (5 ㎓) Maximum Conducted Power

Frequency [㎒]	Channel	IEEE 802.11 n(40 ㎒ BW) Conducted Power [dBm]		
		Ant.1	Ant.2	MIMO
5 190	38	15.62	16.07	18.86
5 230	46	16.33	16.70	19.53
5 270	54	16.25	16.62	19.45
5 310	62	15.66	15.76	18.72
5 510	102	15.89	15.96	18.93
5 590	118	16.41	16.74	19.59
5 630	126	16.31	16.58	19.46
5 710	142	16.58	16.87	19.74
5 755	151	16.55	16.93	19.75
5 795	159	16.04	16.70	19.39
5 835	167	16.39	16.62	19.52
5 875	175	15.75	16.72	19.27

11.1.5 IEEE 802.11 (5 ㎓) Reduced Conducted Power (Grip Active)

Frequency [㎒]	Channel	IEEE 802.11 ac(80 ㎒ BW) Conducted Power [dBm]		
		Ant.1	Ant.2	MIMO
5 210	42	8.25	8.15	11.21
5 290	58	7.86	8.16	11.02
5 530	106	7.87	8.35	11.12
5 610	122	7.63	8.24	10.95
5 690	138	7.73	8.33	11.05
5 775	155	7.87	8.50	11.20
5 855	171	7.88	8.33	11.12

11.1.6 IEEE 802.11 (5 ㎓) Reduced Conducted Power (RSDB Active)

Frequency [㎒]	Channel	IEEE 802.11 ac(80 ㎒ BW) Conducted Power [dBm]		
		Ant.1	Ant.2	MIMO
5 210	42	7.94	7.71	10.83
5 290	58	7.45	7.74	10.61
5 530	106	7.37	7.87	10.64
5 610	122	7.18	7.81	10.51
5 690	138	7.36	7.92	10.66
5 775	155	7.31	7.97	10.66
5 855	171	7.22	7.81	10.53

11.2 Bluetooth

11.2.1 Bluetooth Maximum Conducted Power

The Burst averaged-conducted power (Maximum)

Mode	Channel	Bluetooth Power [dBm]	
		Ant1	Ant2
DH5	0	15.43	15.02
	39	16.36	15.42
	78	15.03	14.58
2-DH5	0	13.33	12.87
	39	14.19	13.26
	78	12.78	12.35
3-DH5	0	13.32	12.88
	39	14.16	13.23
	78	12.76	12.30

The Burst averaged-conducted power (Maximum)

Mode	Packet Length	Channel	Bluetooth Power [dBm]	
			Ant1	Ant2
LE 1M	37	0	8.82	7.96
		19	9.37	8.72
		39	8.09	7.63
	255	0	8.75	7.90
		19	9.34	8.69
		39	8.03	7.57
LE 2M	37	0	8.74	7.93
		19	9.36	8.70
		39	8.07	7.52
	255	0	8.74	7.84
		19	9.34	8.66
		39	8.02	7.53
LE 125K	37	0	8.75	7.94
		19	9.36	8.72
		39	8.07	7.54
	255	0	8.77	7.92
		19	9.36	8.71
		39	8.06	7.56
LE 500K	37	0	8.78	7.97
		19	9.41	8.78
		39	8.13	7.57
	255	0	8.78	7.81
		19	9.35	8.77
		39	8.05	7.61

11.2.2 Bluetooth Reduced Conducted Power

The Burst averaged-conducted power Grip sensor active (Reduced)

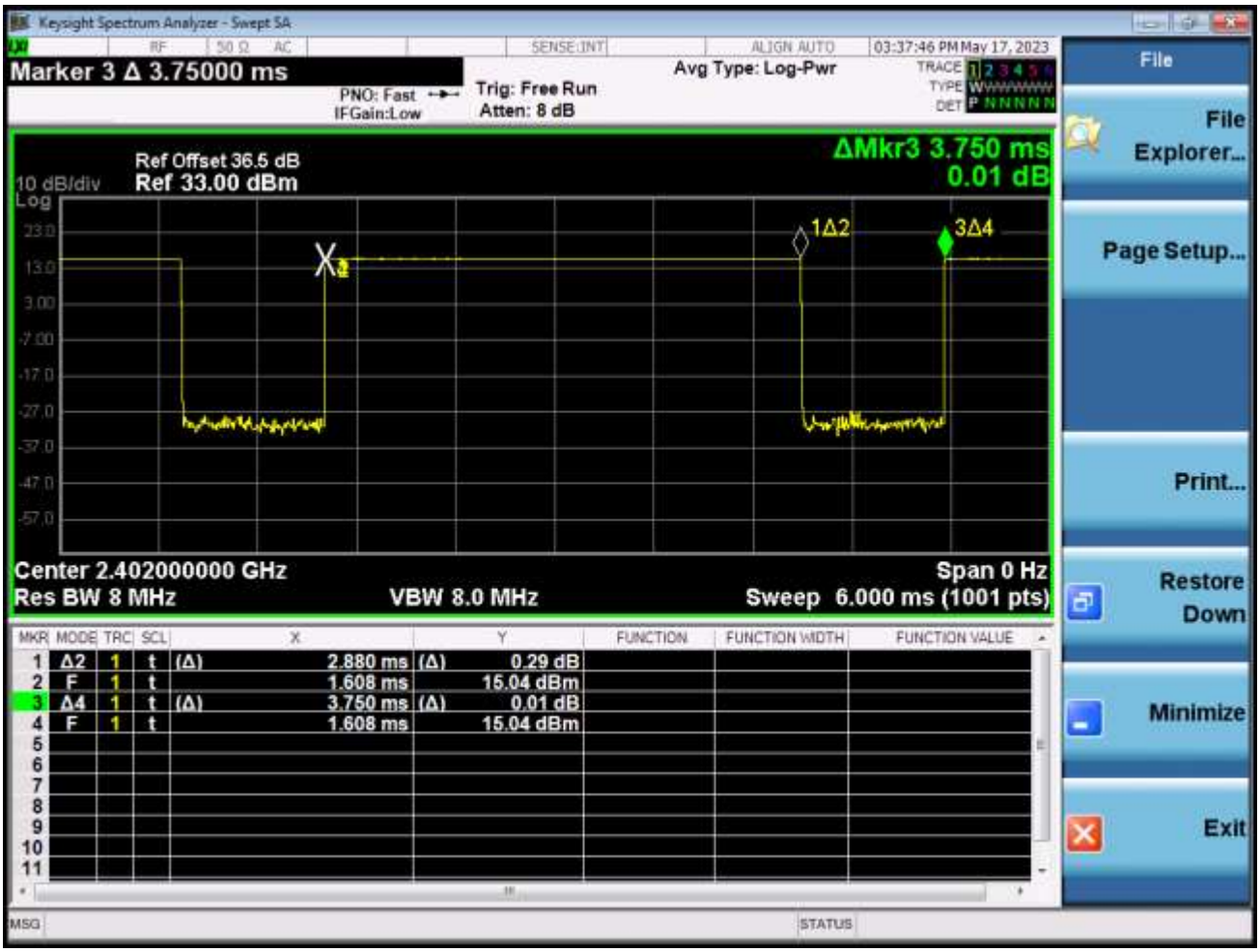
Mode	Channel	Bluetooth Power [dBm]	
		Ant1	Ant2
DH5	0	8.45	7.98
	39	8.79	8.14
	78	7.80	7.22
2-DH5	0	8.57	8.14
	39	8.97	8.45
	78	7.89	7.45
3-DH5	0	8.57	8.12
	39	8.98	8.43
	78	7.88	7.44

The Burst averaged-conducted power RSDB active (Reduced)

Mode	Channel	Bluetooth Power [dBm]	
		Ant1	Ant2
DH5	0	7.58	7.11
	39	7.94	7.29
	78	6.93	6.37
2-DH5	0	7.15	6.70
	39	7.51	6.88
	78	6.55	5.96
3-DH5	0	7.10	6.68
	39	7.49	6.87
	78	6.47	5.94

Per October 2016 TCB Workshop Notes:
When call box and Bluetooth protocol are used for Bluetooth SAR measurement, time-domain plot is required to identify duty factor for supporting the test setup and result.
Bluetooth duty cycle was measured using Bluetooth tester equipment (CBT / R&S) with Bluetooth protocol. DH5 mode is the highest duty cycle and conducted power. SAR test were performed at DH5 mode.

Bluetooth DH5 mode



Bluetooth Duty Cycle [BDR]

Duty Cycle = (BT-On time /BT-Full time) = (2.880/3.750) = 0.768 (DH5)

BT DH5 Maximum Duty Factor:
The theoretical maximum duty cycle defined by chipset manufacturer is 76.75 % In the ideal theory Duty Cycle, the test error tolerance [1%] of the test equipment was considered and applied to the measurement results.The duty cycle of DH5 measured by DUT was 76.80 %, and the duty cycle was compensated by applying test error tolerance 1 %.

12. System Verification

12.1 Tissue Verification

The body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity.

Table for Head Tissue Verification

Date of Tests	Tissue Temp. (°C)	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
05/02/2023	20.1	2450H	2400	1.743	38.660	1.756	39.290	- 0.74	- 1.60
			2450	1.803	38.450	1.800	39.200	+ 0.17	- 1.91
			2500	1.859	38.269	1.855	39.140	+ 0.22	- 2.23
04/10/2023	20.3	2450H	2400	1.757	38.762	1.756	39.290	+ 0.06	- 1.34
			2450	1.817	38.553	1.800	39.200	+ 0.94	- 1.65
			2500	1.873	38.371	1.855	39.140	+ 0.97	- 1.96
04/11/2023	20.3	2450H	2400	1.696	38.294	1.756	39.290	- 3.42	- 2.53
			2450	1.754	38.103	1.800	39.200	- 2.56	- 2.80
			2500	1.808	37.909	1.855	39.140	- 2.53	- 3.15
04/12/2023	20.5	2450H	2400	1.677	38.161	1.756	39.290	- 4.50	- 2.87
			2450	1.735	37.973	1.800	39.200	- 3.61	- 3.13
			2500	1.789	37.778	1.855	39.140	- 3.56	- 3.48
05/03/2023	20.5	2450H	2400	1.689	38.249	1.756	39.290	- 3.82	- 2.65
			2450	1.747	38.049	1.800	39.200	- 2.94	- 2.94
			2500	1.800	37.856	1.855	39.140	- 2.96	- 3.28
04/17/2023	20.3	5 180H-5 885H	5180	4.583	36.921	4.635	36.010	- 1.12	+ 2.53
			5250	4.730	36.728	4.706	35.930	+ 0.51	+ 2.22
			5280	4.778	36.705	4.737	35.894	+ 0.87	+ 2.26
			5320	4.832	36.723	4.778	35.846	+ 1.13	+ 2.45
			5500	4.965	36.681	4.963	35.640	+ 0.04	+ 2.92
			5600	5.035	36.430	5.065	35.530	- 0.59	+ 2.53
			5750	5.249	36.230	5.219	35.360	+ 0.57	+ 2.46
			5800	5.211	36.225	5.270	35.300	- 1.12	+ 2.62
			5825	5.194	36.172	5.296	35.270	- 1.93	+ 2.56
			5835	5.196	36.143	5.306	35.258	- 2.07	+ 2.51
			5855	5.210	36.078	5.326	35.235	- 2.18	+ 2.39
			5875	5.231	35.999	5.347	35.215	- 2.17	+ 2.23
			5885	5.242	35.960	5.357	35.205	- 2.15	+ 2.14

Table for Head Tissue Verification									
Date of Tests	Tissue Temp. (°C)	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
04/20/2023	20.7	5 180H-5 320H	5180	4.586	36.913	4.635	36.010	- 1.06	+ 2.51
			5250	4.726	36.728	4.706	35.930	+ 0.42	+ 2.22
			5280	4.770	36.691	4.737	35.894	+ 0.70	+ 2.22
			5320	4.828	36.712	4.778	35.846	+ 1.05	+ 2.42
04/21/2023	20.2	5 500H-5 600H	5500	4.969	36.660	4.963	35.640	+ 0.12	+ 2.86
			5600	5.037	36.427	5.065	35.530	- 0.55	+ 2.52
04/24/2023	20.2	5 750H-5 825H	5750	5.239	36.175	5.219	35.360	+ 0.38	+ 2.30
			5800	5.194	36.189	5.270	35.300	- 1.44	+ 2.52
			5825	5.188	36.146	5.296	35.270	- 2.04	+ 2.48
04/26/2023	21.3	5 800H-5 885H	5800	5.199	36.183	5.270	35.300	- 1.35	+ 2.50
			5835	5.186	36.103	5.306	35.258	- 2.26	+ 2.40
			5855	5.198	36.036	5.326	35.235	- 2.40	+ 2.27
			5875	5.218	35.958	5.347	35.215	- 2.41	+ 2.11
			5885	5.230	35.922	5.357	35.205	- 2.37	+ 2.04
05/10/2023	20.1	5 800H-5 885H	5800	5.123	35.946	5.270	35.300	- 2.79	+ 1.83
			5835	5.108	35.872	5.306	35.258	- 3.73	+ 1.74
			5855	5.123	35.800	5.326	35.235	- 3.81	+ 1.60
			5875	5.142	35.721	5.347	35.215	- 3.83	+ 1.44
			5885	5.154	35.686	5.357	35.205	- 3.79	+ 1.37

12.2 System Verification

Input Power: 50 mW

Freq.	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp.	Liquid Temp.	1 W Target SAR_{1g} (SPEAG)	50 mW Measured SAR_{1g}	1 W Normalized SAR_{1g}	Deviation	Limit
[㎒]					[°C]	[°C]	[W/kg]	[W/kg]	[W/kg]	[%]	[%]
2 450	05/02/2023	7654	743	Head	20.2	20.1	53.2	2.570	51.4	- 3.38	± 10
2 450	04/10/2023	7654		Head	20.4	20.3	53.2	2.840	56.8	+ 6.77	± 10
2 450	04/11/2023	7654		Head	20.4	20.3	53.2	2.490	49.8	- 6.39	± 10
2 450	04/12/2023	7654		Head	20.6	20.5	53.2	2.480	49.6	- 6.77	± 10
2 450	05/03/2023	7654		Head	20.6	20.5	53.2	2.470	49.4	- 7.14	± 10
5 250	04/17/2023	7654	1253	Head	20.4	20.3	80.4	4.350	87.0	+ 8.21	± 10
5 600	04/17/2023	7654		Head	20.4	20.3	82.1	3.930	78.6	- 4.26	± 10
5 750	04/17/2023	7654		Head	20.4	20.3	79.9	3.770	75.4	- 5.63	± 10
5 800	04/17/2023	7654	1107	Head	20.4	20.3	81.3	3.910	78.2	- 3.81	± 10
5 250	04/20/2023	7654	1253	Head	20.8	20.7	80.4	3.860	77.2	- 3.98	± 10
5 600	04/21/2023	7654		Head	20.3	20.2	82.1	4.050	81.0	- 1.34	± 10
5 750	04/24/2023	7654		Head	20.3	20.2	79.9	3.880	77.6	- 2.88	± 10
5 800	04/26/2023	7654	1107	Head	21.4	21.3	81.3	4.320	86.4	+ 6.27	± 10
5 800	05/10/2023	3768	1107	Head	20.2	20.1	81.3	4.110	82.2	+ 1.11	± 10

12.3 System Verification Procedure

SAR measurement was prior to assessment; the system is verified to the ± 10 % of the specifications at each frequency band by using the system verification kit. (Graphic Plots Attached)
- Cabling the system, using the verification kit equipment.
- Generate about 50 ㎽ Input level from the signal generator to the Dipole Antenna.
- Dipole antenna was placed below the flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

Note;
SAR Verification was performed according to the FCC KDB 865664 D01v01r04.

13. SAR Test Data Summary

13.1 SAR Measurement Results

Wi-Fi (DTS) Body SAR																	
Frequency		Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.																
2 462	11	802.11b	20	1	16.0	15.55	0.09	Rear	Ant2	98.9	19	0.0958	0.060	1.109	1.011	0.067	-
2 462	11	802.11b	20	1	16.0	15.55	0.00	Left	Ant2	98.9	9	0.271	**0.168**	1.109	1.011	**0.188**	1
2 462	11	802.11b	20	1	16.0	15.55	-0.18	Top	Ant2	98.9	17	0.0682	0.043	1.109	1.011	0.048	-
2 462	11	802.11b	20	1	19.0	18.26	0.05	Rear	MIMO	98.9	19	0.088	0.056	1.282	1.011	0.073	-
2 462	11	802.11b	20	1	19.0	18.26	0.00	Left	MIMO	98.9	7	0.271	**0.153**	1.282	1.011	**0.198**	2
2 462	11	802.11b	20	1	19.0	18.26	0.08	Right	MIMO	98.9	7	0.240	0.139	1.282	1.011	0.180	-
2 462	11	802.11b	20	1	19.0	18.26	0.17	Top	MIMO	98.9	17	0.105	0.062	1.282	1.011	0.080	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population											Body 1.6 W/kg Averaged over 1 gram						

Wi-Fi (DTS) Body SAR – Grip Active																	
Frequency		Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.																
2 437	6	802.11b	20	1	12.0	11.47	-0.00	Rear	Ant2	98.9	0	0.911	0.317	1.130	1.011	0.362	-
2 437	6	802.11b	20	1	12.0	11.47	0.09	Left	Ant2	98.9	0	0.188	0.172	1.130	1.011	0.196	-
2 437	6	802.11b	20	1	12.0	11.47	0.13	Top	Ant2	98.9	0	0.514	0.244	1.130	1.011	0.279	-
2 437	6	802.11b	20	1	15.0	14.40	-0.13	Rear	MIMO	98.9	0	0.857	0.316	1.175	1.011	0.375	-
2 437	6	802.11b	20	1	15.0	14.40	0.07	Left	MIMO	98.9	0	0.479	0.204	1.175	1.011	0.242	-
2 437	6	802.11b	20	1	15.0	14.40	-0.09	Right	MIMO	98.9	0	0.691	**0.382**	1.175	1.011	**0.454**	3
2 437	6	802.11b	20	1	15.0	14.40	-0.15	Top	MIMO	98.9	0	0.378	0.185	1.175	1.011	0.220	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population											Body 1.6 W/kg Averaged over 1 gram						

Wi-Fi (DTS) Body SAR – RSDB Active																	
Frequency		Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.																
2 462	11	802.11b	20	1	11.0	10.65	0.15	Rear	Ant2	98.9	0	0.773	0.262	1.084	1.011	0.287	-
2 462	11	802.11b	20	1	11.0	10.65	0.00	Left	Ant2	98.9	0	0.447	0.152	1.084	1.011	0.167	-
2 462	11	802.11b	20	1	11.0	10.65	0.10	Top	Ant2	98.9	0	0.459	0.229	1.084	1.011	0.251	-
2 437	6	802.11b	20	1	14.0	13.49	-0.15	Rear	MIMO	98.9	0	0.656	0.233	1.153	1.011	0.272	-
2 437	6	802.11b	20	1	14.0	13.49	-0.10	Left	MIMO	98.9	0	0.390	0.151	1.153	1.011	0.176	-
2 437	6	802.11b	20	1	14.0	13.49	0.11	Right	MIMO	98.9	0	0.582	**0.305**	1.153	1.011	**0.356**	4
2 437	6	802.11b	20	1	14.0	13.49	0.13	Top	MIMO	98.9	0	0.292	0.141	1.153	1.011	0.164	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population											Body 1.6 W/kg Averaged over 1 gram						

Wi-Fi (NII) Body SAR

Frequency MHz	Ch.	Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
5 270	54	802.11n	40	MCS8	20.0	19.45	0.00	Rear	MIMO	92.7	19	0.123	0.051	1.189	1.079	0.065	-
5 270	54	802.11n	40	MCS8	20.0	19.45	0.18	Left	MIMO	92.7	9	0.814	0.400	1.189	1.079	0.513	-
5 270	54	802.11n	40	MCS8	20.0	19.45	0.09	Right	MIMO	92.7	9	1.120	**0.539**	1.189	1.079	**0.691**	5
5 270	54	802.11n	40	MCS8	20.0	19.45	-0.13	Top	MIMO	92.7	17	0.106	0.044	1.189	1.079	0.056	-
5 710	142	802.11n	40	MCS8	20.0	19.74	0.00	Rear	MIMO	92.7	19	0.186	0.077	1.102	1.079	0.092	-
5 710	142	802.11n	40	MCS8	20.0	19.74	0.13	Left	MIMO	92.7	9	0.648	0.293	1.102	1.079	0.348	-
5 710	142	802.11n	40	MCS8	20.0	19.74	0.10	Right	MIMO	92.7	9	0.981	0.437	1.102	1.079	0.519	-
5 710	142	802.11n	40	MCS8	20.0	19.74	-0.07	Top	MIMO	92.7	17	0.155	0.064	1.102	1.079	0.076	-
5 755	151	802.11n	40	MCS8	20.0	19.75	0.09	Rear	MIMO	92.7	19	0.201	0.074	1.109	1.079	0.089	-
5 755	151	802.11n	40	MCS8	20.0	19.75	0.07	Left	MIMO	92.7	9	0.633	0.274	1.109	1.079	0.328	-
5 755	151	802.11n	40	MCS8	20.0	19.75	0.05	Right	MIMO	92.7	9	0.901	0.400	1.109	1.079	0.479	-
5 755	151	802.11n	40	MCS8	20.0	19.75	-0.19	Top	MIMO	92.7	17	0.172	0.070	1.109	1.079	0.084	-
5 835	167	802.11n	40	MCS8	20.0	19.52	0.00	Rear	MIMO	92.7	19	0.183	0.065	1.151	1.079	0.081	-
5 835	167	802.11n	40	MCS8	20.0	19.52	0.12	Left	MIMO	92.7	9	0.492	0.231	1.151	1.079	0.287	-
5 835	167	802.11n	40	MCS8	20.0	19.52	0.08	Right	MIMO	92.7	9	0.810	0.347	1.151	1.079	0.431	-
5 835	167	802.11n	40	MCS8	20.0	19.52	0.09	Top	MIMO	92.7	17	0.130	0.047	1.151	1.079	0.058	-

ANSI/ IEEE C95.1 - 2005– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population	Body 1.6 W/kg Averaged over 1 gram

When testing the MIMO mode of WLAN Ant in Grip off condition, the closer sensor separation distance of WLAN Ant 1 and WLAN Ant 2 was applied to test.

Wi-Fi (NII) Body SAR – Grip Active

Frequency MHz	Ch.	Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
5 290	58	802.11ac	80	MCS0	11.5	11.02	-0.16	Rear	MIMO	92.3	0	2.430	0.673	1.159	1.083	0.845	-
5 290	58	802.11ac	80	MCS0	11.5	11.02	0.18	Left	MIMO	92.3	0	1.920	0.537	1.159	1.083	0.674	-
5 290	58	802.11ac	80	MCS0	11.5	11.02	0.14	Right	MIMO	92.3	0	1.430	0.462	1.159	1.083	0.580	-
5 290	58	802.11ac	80	MCS0	11.5	11.02	-0.09	Top	MIMO	92.3	0	0.256	0.095	1.159	1.083	0.119	-
5 530	106	802.11ac	80	MCS0	11.5	11.12	-0.18	Rear	MIMO	92.3	0	2.480	0.818	1.156	1.083	1.024	-
5 530	106	802.11ac	80	MCS0	11.5	11.12	0.10	Left	MIMO	92.3	0	1.960	0.526	1.156	1.083	0.659	-
5 530	106	802.11ac	80	MCS0	11.5	11.12	0.11	Right	MIMO	92.3	0	1.400	0.464	1.156	1.083	0.581	-
5 530	106	802.11ac	80	MCS0	11.5	11.12	-0.14	Top	MIMO	92.3	0	0.193	0.075	1.156	1.083	0.094	
5 690	138	802.11ac	80	MCS0	11.5	11.05	-0.19	Rear	MIMO	92.3	0	2.670	0.843	1.194	1.083	1.090	-
5 775	155	802.11ac	80	MCS0	11.5	11.20	-0.19	Rear	MIMO	92.3	0	2.190	0.769	1.156	1.083	0.963	-
5 775	155	802.11ac	80	MCS0	11.5	11.20	0.15	Left	MIMO	92.3	0	2.130	0.514	1.156	1.083	0.644	-
5 775	155	802.11ac	80	MCS0	11.5	11.20	0.12	Right	MIMO	92.3	0	0.836	0.287	1.156	1.083	0.359	-
5 775	155	802.11ac	80	MCS0	11.5	11.20	-0.09	Top	MIMO	92.3	0	0.168	0.026	1.156	1.083	0.033	-
5 855	171	802.11ac	80	MCS0	11.5	11.12	-0.16	Rear	MIMO	92.3	0	3.880	**0.879**	1.153	1.083	**1.098**	6
5 855	171	802.11ac	80	MCS0	11.5	11.12	0.15	Left	MIMO	92.3	0	2.250	0.536	1.153	1.083	0.670	-
5 855	171	802.11ac	80	MCS0	11.5	11.12	0.15	Right	MIMO	92.3	0	0.966	0.400	1.153	1.083	0.500	-
5 855	171	802.11ac	80	MCS0	11.5	11.12	0.00	Top	MIMO	92.3	0	0.205	0.037	1.153	1.083	0.046	-
5 855	171	802.11ac	80	MCS0	11.5	11.12	0.15	Rear	MIMO	92.3	0	3.910	0.849	1.153	1.083	1.061	*

ANSI/ IEEE C95.1 - 2005– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population	Body1.6 W/kg Averaged over 1 gram

Note : * Data entry indicate Variability measurement

Wi-Fi (NII) Body SAR – RSDB Active																	
Frequency		Mode	Band width (MHz)	Data Rate (Mbps)	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Duty Cycle	Distance (mm)	Area Scan Peak SAR (W/kg)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.																
5 290	58	802.11ac	80	MCS0	11.0	10.61	0.00	Rear	MIMO	92.3	0	2.290	0.620	1.135	1.083	0.762	-
5 290	58	802.11ac	80	MCS0	11.0	10.61	0.19	Left	MIMO	92.3	0	1.540	0.487	1.135	1.083	0.599	-
5 290	58	802.11ac	80	MCS0	11.0	10.61	0.10	Right	MIMO	92.3	0	1.400	0.408	1.135	1.083	0.502	-
5 290	58	802.11ac	80	MCS0	11.0	10.61	-0.13	Top	MIMO	92.3	0	0.202	0.068	1.135	1.083	0.084	-
5 690	138	802.11ac	80	MCS0	11.0	10.66	-0.14	Rear	MIMO	92.3	0	1.720	0.625	1.159	1.083	0.784	-
5 690	138	802.11ac	80	MCS0	11.0	10.66	-0.17	Left	MIMO	92.3	0	1.580	0.364	1.159	1.083	0.457	-
5 690	138	802.11ac	80	MCS0	11.0	10.66	-0.06	Right	MIMO	92.3	0	0.872	0.265	1.159	1.083	0.333	-
5 690	138	802.11ac	80	MCS0	11.0	10.66	0.00	Top	MIMO	92.3	0	0.274	0.039	1.159	1.083	0.049	-
5 775	155	802.11ac	80	MCS0	11.0	10.66	-0.11	Rear	MIMO	92.3	0	2.940	0.662	1.172	1.083	0.840	-
5 775	155	802.11ac	80	MCS0	11.0	10.66	0.13	Left	MIMO	92.3	0	1.920	0.454	1.172	1.083	0.576	-
5 775	155	802.11ac	80	MCS0	11.0	10.66	0.17	Right	MIMO	92.3	0	1.010	0.292	1.172	1.083	0.371	-
5 775	155	802.11ac	80	MCS0	11.0	10.66	-0.09	Top	MIMO	92.3	0	0.167	0.025	1.172	1.083	0.032	-
5 855	171	802.11ac	80	MCS0	11.0	10.53	-0.08	Rear	MIMO	92.3	0	2.480	**0.719**	1.197	1.083	**0.932**	7
5 855	171	802.11ac	80	MCS0	11.0	10.53	-0.16	Left	MIMO	92.3	0	2.090	0.477	1.197	1.083	0.618	-
5 855	171	802.11ac	80	MCS0	11.0	10.53	-0.13	Right	MIMO	92.3	0	0.751	0.312	1.197	1.083	0.404	-
5 855	171	802.11ac	80	MCS0	11.0	10.53	0.01	Top	MIMO	92.3	0	0.123	0.028	1.197	1.083	0.036	-
ANSI/ IEEE C95.1 - 2005– Safety Limit Spatial Peak Uncontrolled Exposure/ General Population												Body 1.6 W/kg Averaged over 1 gram					

DSS Body SAR

Frequency		Mode	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Distance (mm)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.												
2 441	39	Bluetooth DH5	17.0	16.36	-0.09	Rear	Ant1	19	0.139	1.159	1.010	0.163	-
2 441	39	Bluetooth DH5	17.0	16.36	0.00	Right	Ant1	9	**0.334**	1.159	1.010	**0.391**	8
2 441	39	Bluetooth DH5	17.0	16.36	-0.19	Top	Ant1	19	0.075	1.159	1.010	0.088	-
2 441	39	Bluetooth DH5	9.0	8.79	-0.16	Rear	Ant1	0	0.291	1.050	1.010	0.308	-
2 441	39	Bluetooth DH5	9.0	8.79	0.00	Right	Ant1	0	0.315	1.050	1.010	0.334	-
2 441	39	Bluetooth DH5	9.0	8.79	-0.10	Top	Ant1	0	0.137	1.050	1.010	0.145	-
2 441	39	Bluetooth DH5	16.5	15.42	0.10	Rear	Ant2	19	0.095	1.282	1.010	0.123	-
2 441	39	Bluetooth DH5	16.5	15.42	0.00	Left	Ant2	9	0.085	1.282	1.010	0.110	-
2 441	39	Bluetooth DH5	16.5	15.42	0.08	Top	Ant2	17	0.04	1.282	1.010	0.052	-
2 441	39	Bluetooth DH5	9.0	8.14	-0.06	Rear	Ant2	0	0.187	1.219	1.010	0.230	-
2 441	39	Bluetooth DH5	9.0	8.14	0.10	Left	Ant2	0	0.106	1.219	1.010	0.131	-
2 441	39	Bluetooth DH5	9.0	8.14	0.13	Top	Ant2	0	0.098	1.219	1.010	0.121	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram					

DSS Body SAR – RSDB Active

Frequency		Mode	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Distance (mm)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.												
2 441	39	Bluetooth DH5	8.0	7.94	0.01	Rear	Ant1	0	0.222	1.014	1.010	0.227	-
2 441	39	Bluetooth DH5	8.0	7.94	0.00	Right	Ant1	0	**0.252**	1.014	1.010	**0.258**	9
2 441	39	Bluetooth DH5	8.0	7.94	0.12	Top	Ant1	0	0.110	1.014	1.010	0.113	-
2 441	39	Bluetooth DH5	8.0	7.29	-0.12	Rear	Ant2	0	0.151	1.178	1.010	0.180	-
2 441	39	Bluetooth DH5	8.0	7.29	0.17	Left	Ant2	0	0.087	1.178	1.010	0.103	-
2 441	39	Bluetooth DH5	8.0	7.29	0.01	Top	Ant2	0	0.081	1.178	1.010	0.096	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram					

Bluetooth Low Energy Body SAR

Frequency		Mode	Tune-Up Limit (dBm)	Meas. Power (dBm)	Power Drift (dB)	Test Position	Ant Config.	Distance (mm)	Meas. SAR (W/kg)	Scaling Factor	Scaling Factor (Duty)	Reported SAR (W/kg)	Plot No.
MHz	Ch.												
2 440	19	LE 125K	9.5	9.36	0.10	Rear	Ant1	0	0.257	1.033	1.000	0.265	-
2 440	19	LE 125K	9.5	9.36	-0.07	Right	Ant1	0	**0.408**	1.033	1.000	**0.421**	10
2 440	19	LE 125K	9.5	9.36	0.12	Top	Ant1	0	0.176	1.033	1.000	0.182	-
2 440	19	LE 125K	9.0	8.71	-0.16	Rear	Ant2	0	0.200	1.069	1.000	0.214	-
2 440	19	LE 125K	9.0	8.71	0.00	Left	Ant2	0	0.126	1.069	1.000	0.135	-
2 440	19	LE 125K	9.0	8.71	0.00	Top	Ant2	0	0.133	1.069	1.000	0.142	-
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Uncontrolled Exposure/ General Population								Body 1.6 W/kg Averaged over 1 gram					

13.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02 and KDB Publication 447498 D04v01
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D04v01.
6. Per FCC KDB 865664 D01v01r04, variability SAR measurement were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg for 1g SAR and >2 for 10g SAR Please see Section 15 for variability analysis. the maximum tune-up tolerance limit.
7. This device utilizes power reduction for some wireless mode and technologies, as outlined in sec. 4.3 The maximum output power allowed for each transmitter and exposure condition was evaluated for SAR compliance based on expected use conditions and simultaneous scenarios.
8. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D04v01 was applied to determine SAR test exclusion for adjacent edge configurations

WLAN Notes:

1. Per KDB 2482227 D01v02r02 justification for test configurations of 2.4 GHzWiFi Single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz802.11 g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
2. Per KDB 2482227 D01v02r02 justification for test configurations of 5 GHzWiFi Single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission mode were not investigated since the highest reported SAR for initial test configuration adjusted by the ration of maximum output powers is less than 1.2 W/kg for 1g SAR and less than 3.0 W/kg for 10 g SAR.
3. When the maximum reported 1g averaged SAR is ≤ 0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg or all test channels were measured.
4. The device was configured to transmit continuously at the required data rated, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance. Procedures used to measure the duty factor are identical to that in the associated WLAN test reports.

Bluetooth Notes:

1. Bluetooth SAR was measured with the device connected to a call box with hopping disabled with DH5 / 3DH5 operation and Tx Tests mode type. Per October 2016 TCBC Workshop Notes, the reported SAR was scaled to additional 1% transmission duty factor to determine compliance. Please see sec.11 for the time-domain plot and calculation for duty factor of the device.

14. Simultaneous SAR Analysis

14.1 Body SAR Simultaneous Transmission Analysis

14.1.1 Simultaneous Transmission Scenario with 2.4 GHz MIMO and WLAN 5 GHz MIMO WLAN and 6 GHz MIMO WLAN

Band		2.4GHz MIMO RSDB WLAN SAR	5GHz MIMO RSDB WLAN SAR	6GHz MIMO RSDB WLAN SAR	∑ 1-g SAR	∑ 1-g SAR
		(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)
		1	2	3	1+2	1+3
Body SAR	Rear	0.272	0.932	0.528	1.204	0.800
	Left	0.176	0.618	0.187	0.794	0.363
	Right	0.356	0.502	0.124	0.858	0.480
	Top	0.164	0.084	0.011	0.248	0.175

14.1.2 Simultaneous Transmission Scenario with Bluetooth Ant.1 and 2.4 GHz Ant.2 WLAN 5 GHz MIMO WLAN and 6 GHz MIMO WLAN

Band		Bluetooth Ant.1 SAR	2.4GHz Ant.2 WLAN SAR	5GHz MIMO WLAN SAR	6GHz MIMO WLAN SAR	∑ 1-g SAR	∑ 1-g SAR	∑ 1-g SAR
		(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)
		1	2	3	4	1+2	1+3	1+4
Body SAR	Rear	0.308	0.362	1.098	0.900	0.670	1.406	1.208
	Left	0.000	0.196	0.674	0.342	0.196	0.674	0.342
	Right	0.421	0.000	0.691	0.250	0.421	1.112	0.671
	Top	0.182	0.279	0.119	0.027	0.461	0.301	0.209

Band		Bluetooth Ant.1 SAR	2.4GHz Ant.2 RSDB WLAN SAR	5GHz MIMO RSDB WLAN SAR	6GHz MIMO RSDB WLAN SAR	∑ 1-g SAR	∑ 1-g SAR
		(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)
		1	2	3	4	1+2+3	1+2+4
Body SAR	Rear	0.308	0.287	0.932	0.528	**1.527**	1.123
	Left	0.000	0.167	0.618	0.187	0.785	0.354
	Right	0.421	0.000	0.502	0.124	0.923	0.545
	Top	0.182	0.251	0.084	0.011	0.517	0.444

14.1.3 Simultaneous Transmission Scenario with Bluetooth Ant.2 and WLAN 5 GHz MIMO WLAN and 6 GHz MIMO WLAN

Band		Bluetooth Ant.2 SAR	5GHz MIMO WLAN SAR	6GHz MIMO WLAN SAR	∑ 1-g SAR	∑ 1-g SAR
		(W/kg)	(W/kg)	(W/kg)	(W/kg)	(W/kg)
		1	2	3	1+2	1+3
Body SAR	Rear	0.230	1.098	0.900	1.328	1.130
	Left	0.135	0.674	0.342	0.809	0.477
	Right	0	0.691	0.250	0.691	0.250
	Top	0.142	0.119	0.027	0.261	0.169

14.2 Simultaneous Transmission Conclusion

The above numerical summed SAR Results are sufficient to determine that simultaneous transmission cases will not exceed the SAR Limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D04v01 and IEEE1528-2013.

15. The Total Exposure Ratio

The Total Exposure Ratio (TER) is calculated by combining all SAR measurements and S-pen WPT measurements after normalizing to their respective limits. The general expression is below.

$$TER = \sum_{a=1}^{A} \frac{SAR_a}{SARa_a, limit} + \sum_{b=1}^{B} \frac{H-field_b}{H-field_b, limit} < 1$$

The TER shall be less than unity to ensure compliance with the limits.

Simultaneous Transmission Scenarios	**Evaluation Report**
WPT	S-pen RF exposure Report

15.1 Total Exposure Ratio with S-pen WPT

Configuration	Applicable Limit	H-Field	SAR						
		S-pen	2.4GHz MIMO	2.4GHz MIMO RSDB	5GHz MIMO	5GHz MIMO RSDB	WI-FI 6E MIMO	WI-FI 6E MIMO RSDB	Bluetooth Ant.1
		1	2	3	4	5	6	7	8
		A/m	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg	W/kg
		1.63	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Rear side	Reported Value	0.187	0.375	0.272	1.098	0.932	0.900	0.528	0.308
	Ratio to Limit	0.115	0.234	0.170	0.686	0.583	0.563	0.330	0.193
Left side	Reported Value	0.0029	0.242	0.176	0.690	0.618	0.342	0.187	0.000
	Ratio to Limit	0.002	0.151	0.110	0.431	0.386	0.214	0.117	0.000
Right side	Reported Value	0.027	0.454	0.356	0.691	0.502	0.250	0.124	0.421
	Ratio to Limit	0.017	0.284	0.223	0.432	0.314	0.156	0.078	0.263
Top side	Reported Value	0.017	0.220	0.164	0.119	0.084	0.027	0.011	0.182
	Ratio to Limit	0.010	0.138	0.103	0.074	0.053	0.017	0.007	0.114

Configuration	Applicable Limit	Total Exposure Ratio					
		∑	∑	∑	∑	∑	∑
		1+4+8	1+6+8	1+5+8	1+6+8	1+3+5	1+3+7
		1.0	1.0	1.0	1.0	1.0	1.0
Rear side	Reported Value						
	Ratio to Limit	0.994	0.871	0.891	0.871	0.868	0.615
Left side	Reported Value						
	Ratio to Limit	0.433	0.216	0.388	0.216	0.498	0.229
Right side	Reported Value						
	Ratio to Limit	0.712	0.436	0.594	0.436	0.554	0.318
Top side	Reported Value						
	Ratio to Limit	0.198	0.141	0.177	0.141	0.166	0.12

Note:
1. Worst case of H-field measurement result is used for TER evaluation.
2. WLAN Ant.2 is not considered. Because H-field coil and Ant.2 are too far separated.

16. SAR Measurement Variability and Uncertainty

In accordance with KDB procedure 865664 D01v01r04 SAR measurement 100 ㎒ to 6 ㎓, SAR additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement variability was assessed using the following procedures for each frequency band:

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg for 1g SAR or < 2.0 W/kg for 10g SAR; steps 2) through 4) do not apply.

2) When the original highest measured 1g SAR is ≥ 0.80 W/kg or 10g SAR ≥ 2.0W/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 for 1g SAR or ≥ 3.625 W/kg for 10g SAR (~ 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 for 1g SAR or ≥3.75 W/kg for 10g SAR and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Body SAR measurement variability Results

Frequency		Mode/Band	Configuration	Measured SAR	Measured SAR	SAR Ratio
㎒	Channel			(W/kg)	(W/kg)	
5 885	171	5GHz WLAN 802.11ac80	Rear (Active)	0.879	0.849	- 3.41

17. Measurement Uncertainty

The measured SAR was <1.5 W/Kg for 1g SAR and <3.75 W/Kg For 10g SAR for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE1528-2013 was not required.

18. SAR Test Equipment

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	ELI Phantom		N/A	N/A	N/A
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	CS8Cspeag-TX90	F17/ 59CHA1/ C/ 01	N/A	N/A	N/A
Staubli	TX90 XLspeag	F17/ 59CHA1/ A/ 01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	010963	N/A	N/A	N/A
TESTO	175-H1	40331915309	12/29/2022	Annual	12/29/2023
SPEAG	DAE4	1254	06/15/2022	Annual	06/15/2023
SPEAG	DAE4	1629	08/17/2022	Annual	08/17/2023
SPEAG	E-Field Probe EX3DV4	7654	05/31/2022	Annual	05/31/2023
SPEAG	E-Field Probe EX3DV4	3768	06/30/2022	Annual	06/30/2023
SPEAG	Dipole D2450V2	743	05/31/2022	Annual	05/31/2023
SPEAG	Dipole D5 GHz V2	1253	05/31/2022	Annual	05/31/2023
SPEAG	Dipole D5 GHz V2	1107	07/19/2022	Annual	07/19/2023
SPEAG	Dipole D6.5 GHz V2	1012	09/20/2022	Annual	09/20/2023
Agilent	Power Meter E4419B	MY41291386	09/27/2022	Annual	09/27/2023
Agilent	Power Meter N1911A	MY45101406	06/27/2022	Annual	06/27/2023
Agilent	Power Sensor 8481A	SG1091286	09/272022	Annual	09/27/2023
Agilent	Power Sensor 8481A	MY41090675	09/27/2022	Annual	09/27/2023
Agilent	Wideband Power Sensor N1921A	MY55220026	08/02/2022	Annual	08/02/2023
Agilent	Power Divider	58698	01/26/2023	Annual	01/26/2024
SPEAG	DAKS 3.5	1038	01/25/2023	Annual	01/25/2024
SPEAG	Vector Reflectometer	00141013	02/13/2023	Annual	02/13/2024
Agilent	SIGNAL GENERATOR N5182A	MY47070230	03/23/2023	Annual	03/23/2024
Agilent	Attenuator (3dB) 8693B	MY39260298	08/25/2022	Annual	08/25/2023
HP	Attenuator (3dB) 33340A	02427	08/25/2022	Annual	08/25/2023
HP	Attenuator (20dB) 8493C	09271	08/25/2022	Annual	08/25/2023
Agilent	Directional Bridge 86205A	3140A04581	05/26/2022	Annual	05/26/2023
Agilent	Directional Bridge 86205A	3140A04581	04/25/2023	Annual	04/25/2024
HP	Dual Directional Coupler	16072	09/27/2022	Annual	09/27/2023
EMPOWER	RF Power Amplifier	1084	06/20/2022	Annual	06/20/2023
EMPOWER	RF Power Amplifier	1011	09/27/2022	Annual	09/27/2023
MICRO LAB	LP Filter / LA-30N	-	09/27/2022	Annual	09/27/2023
MICRO LAB	LP Filter / LA-60N	32011	09/27/2022	Annual	09/27/2023
KEYSIGHT	MXA Signal Analyzer	MY49100108	01/13/2023	Annual	01/13/2024
ROHDE&SCHWARZ	BLUETOOTH TESTER CBT	100272	01/25/2023	Annual	01/25/2024

* The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

19. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/ IEEE C95.1 - 2005.

These measurements were taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the abortion and distribution of electromagnetic energy in the body are very complex phenomena the depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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Appendix *A.* DUT Ant. Information & SETUP PHOTO

Please refer to test DUT Ant. Information &setup photo file no. as follows:

Report No.
HCT-SR-2305-FC010