PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. +1.410.290.6652 / Fax +1.410.290.6654
http://www.pctest.com

SAR EVALUATION REPORT

Applicant Name:
LG Electronics U.S.A., Inc.
111 Sylvan Avenue, North Building
Englewood Cliffs, NJ 07632
United States

Date of Testing:
11/16/20 – 11/17/20
Test Site/Location:
PCTEST, Columbia, MD, USA
Document Serial No.:
1M2011050175-01-R1.ZNF

FCC ID: **ZNFF100VM**

APPLICANT: **LG ELECTRONICS U.S.A., INC.**

DUT Type: Portable Handset
Application Type: Class II Permissive Change
FCC Rule Part(s): CFR §2.1093
Model: LM-F100VM
Additional Model(s): LMF100VM, F100VM, LM-F101V, LMF101V, F101V
Permissive Change(s): See FCC Change Document
Date of Original Certification: 09/21/20

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1g Head (W/kg)	1g Body-Worn (W/kg)	1g Hotspot (W/kg)	10g Phablet (W/kg)
PCE	NR Band n77	3710.01 - 3969.99 MHz	**1.11**	**0.19**	**0.36**	N/A
Simultaneous SAR per KDB 690783 D01v01r03:			**1.56**	0.62	0.81	N/A

Note: This revised Test Report (S/N: 1M2011050175-01-R1.ZNF) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.10 of this report; for North American frequency bands only.
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. Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

The SAR Tick is an initiative of the Mobile & Wireless Forum (MWF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MWF. Further details can be obtained by emailing: sartick@mwfai.info.

TABLE OF CONTENTS

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1750	Voice/Data	1712.4 - 1752.6 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 14	Voice/Data	790.5 - 795.5 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 30	Voice/Data	2307.5 - 2312.5 MHz
LTE Band 48	Voice/Data	3552.5 - 3697.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n77	Data	3710.01 - 3969.99 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2462 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
WMC	Data	500 Hz - 4 kHz
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz

1.2 Time-Averaging Algorithm for RF Exposure Compliance

The equipment under test (EUT) contains:

Qualcomm® SM7250 modem supporting 2G/3G/4G/5G NR WWAN technologies

Qualcomm® SM7250 modem is enabled with Qualcomm® Smart Transmit feature. This feature performs time averaging algorithm in real time to control and manage transmitting power and ensure the time-averaged RF exposure is in compliance with FCC requirements all the time. Refer to Compliance Summary document for detailed description of Qualcomm® Smart Transmit feature (report SN could be found in Section 1.12 – Bibliography of the first C2PC RF Exposure Technical Reports S/N: 1M2007230114-02.ZNF).

Note that WLAN operations are not enabled with Smart Transmit.

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of *SAR_design_target*, below the predefined time-averaged power limit (i.e., P_{limit} for sub-6 radio, and input.power.limit for 5G mmW NR), for each characterized technology and band (see RF Exposure Part 0 Test Report, report SN could be found in Section 1.12 – Bibliography of the first C2PC RF Exposure Technical Reports S/N: 1M2007230114-02.ZNF).

Smart Transmit allows the device to transmit at higher power instantaneously, as high as P_{max}, when needed, but enforces power limiting to maintain time-averaged transmit power to P_{limit}. Below table shows P_{limit} EFS settings and maximum tune up output power P_{max} configured for this EUT for various transmit conditions (Device State Index DSI). Note that the device uncertainty for sub-6GHz WWAN is +1.0/-1.0 dB for this EUT.

Exposure Scenario:		Head	Body-Worn	Phablet	Head Swivel	Phablet Swivel	Hotspot	Maximum Tune-Up Output Power*
Averaging Volume:		1g	1g	10g	1g	10g	1g	
Spacing:		0 mm	10 mm	0 mm	0 mm	0 mm	10 mm	
DSI:		1			7		5	
Technology/Band	Antenna	**Plimit**						**Pmax**
CDMA/EVDO BC0	1	27.9			27.9		27.9	24.5
CDMA/EVDO BC1	2	22.5			22.5		22.5	24.5
GSM/GPRS/EDGE 850 MHz	1	27.5			27.5		27.5	24.8
GSM/GPRS/EDGE 1900 MHz	2	24.3			24.3		24.3	21.8
UMTS B5	1	28.0			28.0		28.0	24.5
UMTS B4	2	22.5			22.5		22.5	24.5
UMTS B2	2	22.5			22.5		22.5	24.5
LTE FDD B12	1	29.9			29.9		28.9	24.5
LTE FDD B12 ULCA	1	28.9			28.9		28.9	22.5
LTE FDD B13	1	27.9			27.9		27.9	24.5
LTE FDD B14	1	28.5			28.5		28.5	24.5
LTE FDD B5	1	27.2			27.2		27.2	24.5
LTE FDD B5 ULCA	1	28.4			28.4		27.2	22.5
LTE FDD B66/B4	2	22.5			22.5		22.5	24.5
LTE FDD B66 ULCA	3	24.4			24.4		24.4	22.5
LTE FDD B66 EN-DC	3	22.5			22.5		22.5	24.5
LTE FDD B2	2	22.5			22.5		22.5	24.5
LTE FDD B2 ULCA	3	23.8			23.8		23.8	22.5
LTE FDD B2 EN-DC	3	22.5			22.5		22.5	24.5
LTE FDD B30	2	24.0			24.0		24.0	24.5
LTE FDD B30 EN-DC	1	24.0			24.0		24.0	24.5
LTE TDD B48	9	19.5			19.5		19.5	21.0
LTE TDD B41	2	22.0			22.0		22.0	22.5
NR FDD n5	1	26.9			26.9		26.9	24.5
NR FDD n66	3	22.5			22.5		22.5	24.5
NR FDD n2	3	22.5			22.5		22.5	24.5
NR TDD n77	9	17.8			17.8		17.8	19.8

*Note all P_{limit} EFS and maximum tune up output power P_{max} levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (for e.g., GSM & LTE TDD). LTE B12/B5/B2/B66 is defined by ULCA PCC and Standalone, and LTE B12/B5/B2/B66 ULCA is defined by ULCA SCC. When they are operated by ULCA, the max power is 22.5 dBm (2 dB lower than standalone power).

*Maximum tune up output power P_{max} is used to configure EUT during RF tune up procedure. The maximum allowed output power is equal to maximum Tune up output power + 1.0dB device design uncertainty. For interband-ULCA scenarios, LTE Band 66/2/5/12 as SCC will operate as maximum allowed output power limited at 17.7 dBm according to software implementation in this model.

The maximum time-averaged output power (dBm) for any 2G/3G/4G/5G WWAN technology, band, and DSI = minimum of "P_{limit} EFS" and "Maximum tune up output power P_{max}" +1.0/-1.0 dB device uncertainty. SAR values in this report were scaled to this maximum time-averaged output power to determine compliance per KDB Publication 447498 D01v06.

The purpose of this report (Part 1 test) is to demonstrate that the EUT meets FCC SAR limits when transmitting in static transmission scenario at maximum allowable time-averaged power levels.

Measurement Condition: All conducted power and SAR measurements in this report (Part 1 test) were performed by setting *Reserve_power_margin* (Smart Transmit EFS entry) to 0dB.

1.3 Power Reduction for SAR

This device uses an independent fixed level power reduction mechanism for WLAN operations when 5G NR FR2 is active. Detailed descriptions of the power reduction mechanism are included in the operational description.

1.4 Mechanical Modes

This device supports four different mechanical modes: normal mode, normal mode + pop up, swivel mode, swivel mode + pop up. Per FCC guidance, SAR with the mechanical mode 3 was measured for the configurations with the highest reported SAR from mechanical mode 1 for each wireless technology, frequency band, operating mode, and applicable exposure condition (head, phablet). Additionally, overall worst-case hotspot and phablet (between normal and swivel modes) was checked for mechanical mode 2 (normal mode + pop-up) or mechanical mode 4 (swivel mode + pop-up). Full SAR tests were additionally performed for any mechanical mode 3 test configurations with 1g SAR >1.2 W/kg or 10g SAR >3.0 W/kg. There are no TX antennas present in the swivel-display. Appendix E contains positioning information in mechanical modes 2 and 3.

1.5 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v06.

1.5.1 5G Output Power

Mode / Band		Modulated Average Output Power (in dBm)		
		DSI = 1 (Head, Bodyworn, or Phablet)	DSI = 5 (Hotspot)	DSI = 7 (Swivel)
NR TDD Band n77	Max allowed power	21.8	21.8	21.8
	Nominal	20.8	20.8	20.8

Note: For NR TDD Band n77, the above powers listed are TDD burst average values.

1.5.2 Maximum 5GHz WLAN SISO/MIMO WLAN Output Power

Mode	Band	IEEE 802.11 (in dBm)																	
		SISO Antenna 1						SISO Antenna 2						MIMO					
		a		n		ac		a		n		ac		a (CDD + STBC)		n (CDD+STBC, SDM)		ac (CDD+STBC, SDM)	
Maximum / Nominal Power		Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.	Max	Nom.
5 GHz WIFI (20MHz BW)	5200 MHz	17.0	16.0	16.0	15.0	16.0	15.0	17.0	16.0	16.0	15.0	16.0	15.0	20.0	19.0	19.0	18.0	19.0	18.0
	5300 MHz	17.0	16.0	16.0	15.0	16.0	15.0	17.0	16.0	16.0	15.0	16.0	15.0	20.0	19.0	19.0	18.0	19.0	18.0
	5500 MHz	17.0	16.0	16.0	15.0	16.0	15.0	17.0	16.0	16.0	15.0	16.0	15.0	20.0	19.0	19.0	18.0	19.0	18.0
	5800 MHz	17.0	16.0	16.0	15.0	16.0	15.0	17.0	16.0	16.0	15.0	16.0	15.0	20.0	19.0	19.0	18.0	19.0	18.0
5 GHz WIFI (40MHz BW)	5200 MHz			16.0 ch. 38: 14.0	15.0 13.0	16.0 ch. 38: 14.0	15.0 13.0			16.0 ch. 38: 14.0	15.0 13.0	16.0 ch. 38: 14.0	15.0 13.0			19.0 ch. 38: 17.0	18.0 16.0	19.0 ch. 38: 17.0	18.0 16.0
	5300 MHz			16.0 ch. 62: 14.0	15.0 13.0	16.0 ch. 62: 14.0	15.0 13.0			16.0 ch. 62: 14.0	15.0 13.0	16.0 ch. 62: 14.0	15.0 13.0			19.0 ch. 62: 17.0	18.0 16.0	19.0 ch. 62: 17.0	18.0 16.0
	5500 MHz			16.0 ch. 102: 14.0	15.0 13.0	16.0 ch. 102: 14.0	15.0 13.0			16.0 ch. 102: 14.0	15.0 13.0	16.0 ch. 102: 14.0	15.0 13.0			19.0 ch. 102: 17.0	18.0 16.0	19.0 ch. 102: 17.0	18.0 16.0
	5800 MHz			16.0	15.0	16.0	15.0			16.0	15.0	16.0	15.0			19.0	18.0	19.0	18.0
5 GHz WIFI (80MHz BW)	5200 MHz					13.0	12.0					13.0	12.0					16.0	15.0
	5300 MHz					13.0	12.0					13.0	12.0					16.0	15.0
	5500 MHz					15.0 ch. 106: 13.0	14.0 12.0					15.0 ch. 106: 13.0	14.0 12.0					18.0 ch. 106: 16.0	17.0 15.0
	5800 MHz					15.0	14.0					15.0	14.0					18.0	17.0

1.6 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in Appendix E. Since the diagonal dimension of this device is > 160 mm and <200 mm, it is considered a "phablet."

Table 1-1
Device Edges/Sides for SAR Testing

	Back	Front	Top	Bottom	Right	Left
NR Band n77	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for wireless router SAR or phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v02r01 Section III and FCC KDB Publication 648474 D04v01r03. The distances between the transmit antennas and the edges of the device are included in the filing. When wireless router mode is enabled, U-NII-2A, U-NII-2C operations are disabled. Additional edges were also evaluated.

1.7 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the device for this model. Therefore, all SAR tests were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the NFC antenna can be found in Appendix E.

1.8 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
1	1x CDMA voice + 2.4 GHz WI-FI	Yes	Yes	N/A	Yes	
2	1x CDMA voice + 5 GHz WI-FI	Yes	Yes	N/A	Yes	
3	1x CDMA voice + 2.4 GHz Bluetooth	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
4	1x CDMA voice + 2.4 GHz WI-FI MIMO	Yes	Yes	N/A	Yes	
5	1x CDMA voice + 5 GHz WI-FI MIMO	Yes	Yes	N/A	Yes	
6	1x CDMA voice + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
7	1x CDMA voice + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
8	1x CDMA voice + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
9	1x CDMA voice + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes	Yes	N/A	Yes	
10	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	Yes	
11	GSM voice + 5 GHz WI-FI	Yes	Yes	N/A	Yes	
12	GSM voice + 2.4 GHz Bluetooth	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
13	GSM voice + 2.4 GHz WI-FI MIMO	Yes	Yes	N/A	Yes	
14	GSM voice + 5 GHz WI-FI MIMO	Yes	Yes	N/A	Yes	
15	GSM voice + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
16	GSM voice + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
17	GSM voice + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
18	GSM voice + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes	Yes	N/A	Yes	
19	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
20	UMTS + 5 GHz WI-FI	Yes	Yes	Yes	Yes	
21	UMTS + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
22	UMTS + 2.4 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
23	UMTS + 5 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
24	UMTS + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
25	UMTS + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
26	UMTS + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
27	UMTS + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes	Yes	Yes	Yes	
28	LTE + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
29	LTE + 5 GHz WI-FI	Yes	Yes	Yes	Yes	
30	LTE + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
31	LTE + 2.4 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
32	LTE + 5 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
33	LTE + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
34	LTE + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
35	LTE + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
36	LTE + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes	Yes	Yes	Yes	
37	CDMA/EVDO data + 2.4 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
38	CDMA/EVDO data + 5 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
39	CDMA/EVDO data + 2.4 GHz Bluetooth	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
40	CDMA/EVDO data + 2.4 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
41	CDMA/EVDO data + 5 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
42	CDMA/EVDO data + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
43	CDMA/EVDO data + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
44	CDMA/EVDO data + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
45	CDMA/EVDO data + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
46	GPRS/EDGE + 2.4 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
47	GPRS/EDGE + 5 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
48	GPRS/EDGE + 2.4 GHz Bluetooth	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
49	GPRS/EDGE + 2.4 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
50	GPRS/EDGE + 5 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
51	GPRS/EDGE + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
52	GPRS/EDGE + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
53	GPRS/EDGE + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
54	GPRS/EDGE + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
55	LTE + 5G NR	Yes	Yes	N/A	Yes	
56	LTE + 5G NR + 2.4 GHz WI-FI	Yes	Yes	Yes	Yes	
57	LTE + 5G NR + 5 GHz WI-FI	Yes	Yes	Yes	Yes	
58	LTE + 5G NR + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
59	LTE + 5G NR + 2.4 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
60	LTE + 5G NR + 5 GHz WI-FI MIMO	Yes	Yes	Yes	Yes	
61	LTE + 5G NR + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
62	LTE + 5G NR + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
63	LTE + 5G NR + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
64	LTE + 5G NR + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes	Yes	Yes	Yes	
65	5G NR + 2.4 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
66	5G NR + 5 GHz WI-FI	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
67	5G NR + 2.4 GHz Bluetooth	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
68	5G NR + 2.4 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
69	5G NR + 5 GHz WI-FI MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered
70	5G NR + 2.4 GHz Bluetooth + 2.4 GHz WI-FI Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
71	5G NR + 2.4 GHz Bluetooth + 5 GHz WI-FI	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
72	5G NR + 2.4 GHz Bluetooth + 5 GHz WI-FI MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered ^ Bluetooth Tethering is considered
73	5G NR + 2.4 GHz WI-FI Ant 1 + 5 GHz WI-FI Ant 2	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered

1. 2.4 GHz WLAN antenna 1 and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.

3. Per the manufacturer, WIFI Direct is expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.
4. 5 GHz Wireless Router is only supported for the U-NII-1 and U-NII-3 by S/W, therefore U-NII-2A, and U-NII-2C were not evaluated for wireless router conditions.
5. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac. 802.11a/g/n/ac supports CDD and STBC and 802.11n/ac additionally supports SDM. Each WLAN antenna can transmit independently or together when operating with MIMO.
6. This device supports VOLTE.
7. This device supports VOWIFI.
8. This device supports Bluetooth Tethering.
9. LTE + 5G NR FR1 Scenarios are limited to anchor bands shown in the NR FR1 Checklist.
10. LTE operations in the table above include intra-band and inter-band ULCA operations with 2 carriers transmitting in the uplink.
11. 5G NR FR2 n260 and n261 cannot transmit simultaneously
12. LTE + 5G NR FR2 n260 and n261 operations are possible only with LTE B2/4/5/12/13/48/66 under EN-DC mode.

1.9 Miscellaneous SAR Test Considerations

(A) WIFI/BT

There were no changes made to the WIFI and BT operations within this device. Please see the original compliance evaluation in RF Exposure Technical Reports S/N: 1M2007230114-02.ZNF for a complete evaluation of these operating modes.

(B) Licensed Transmitter(s)

Only operations relevant to this permissive change were evaluated for compliance. Please see the original compliance evaluation in RF Exposure Technical Reports S/N: 1M2007230114-02.ZNF for a complete evaluation of these operating modes. The operational description includes description of all changed items.

GSM/GPRS/EDGE DTM is not supported for US bands. Therefore, the GSM Voice modes in this report do not transmit simultaneously with GPRS/EDGE Data.

This device is only capable of QPSK HSUPA in the uplink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01v03r01.

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r04.

This device supports LTE Carrier Aggregation (CA) in the downlink. All uplink communications are identical to Release 8 specifications. Per FCC KDB Publication 941225 D05A v01r02, SAR for LTE CA operations was not needed since the maximum average output power in LTE CA mode was not >0.25 dB higher than the maximum output power when downlink carrier aggregation was inactive.

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is greater than 160mm and less than 200mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.

This device supports LTE capabilities with overlapping transmission frequency ranges. When the supported frequency range of an LTE Band falls completely within an LTE band with a larger transmission frequency range, both LTE bands have the same target power (or the band with the larger transmission frequency range

has a higher target power), and both LTE bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.

This device supports intra-band LTE Carrier Aggregation (CA) for LTE Band 5 with two component carriers in the uplink. SAR Measurements and conducted powers were evaluated per 2017 Fall TCB Workshop Notes.

This device supports uplink inter-band LTE Carrier Aggregation (CA) for LTE Bands 12, 5, 2, 66 with two component carriers in the uplink. For 2A-66A uplink conditions, LTE Band 2 PCC/SCC operate using Antenna 3 and LTE Band 66 PCC/SCC operate using Antenna 2. For other uplink conditions, LTE B66 and LTE B2 PCC/SCC operate using Antenna 3. SAR tests were performed separately for antenna 3 for LTE Band 2 and LTE Band 66.

This device supports downlink 4x4 MIMO operations for some LTE Bands. Per May 2017 TCB Workshop Notes, SAR for 4x4 DL MIMO was not needed since the maximum average output power in 4x4 DL MIMO mode was not more than 0.25 dB higher than the maximum output power with 4x4 DL MIMO inactive. Additionally, SAR for 4x4 MIMO Downlink Carrier Aggregation was not needed since the maximum average output power in 4x4 MIMO Downlink Carrier Aggregation mode was not more than 0.25 dB higher than the maximum output power with 4x4 MIMO Downlink and downlink carrier aggregation inactive.

NR implementation in EN-DC mode operates with LTE Bands shown in the NR FR1 Checklist acting as anchor bands. Per FCC Guidance, SAR tests for NR Bands and LTE Anchor Bands were performed separately due to equipment limitations in SAR probe calibration factors. Please see Section 11 for more details.

This device supports 64QAM on the uplink and 256QAM on the downlink for LTE Operations. Conducted powers for 64QAM uplink configurations were measured per Section 5.1 of FCC KDB Publication 941225D05v02r05. SAR was not required for 64QAM since the highest maximum output power for 64QAM is ≤ ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45W/kg, per Section 5.2.4 of FCC KDB Publication 941225 D05v02r05.

This device supports 5G NR for Bands n260, and n261. RF Exposure assessment and simultaneous transmission analysis for these bands can be found in the Near Field PD Report.

1.10 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04, D05Av01r02, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D04v01r03 (Phablet Procedures)

1.11 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. 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. The serial numbers used for each test are indicated alongside the results in Section 11.

2 LTE AND NR INFORMATION

LTE Information					
Form Factor	Portable Handset				
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)				
	LTE Band 13 (779.5 - 784.5 MHz)				
	LTE Band 14 (790.5 - 795.5 MHz)				
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)				
	LTE Band 66 (AWS) (1710.7 - 1779.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
	LTE Band 30 (2307.5 - 2312.5 MHz)				
	LTE Band 48 (3552.5 - 3697.5 MHz)				
	LTE Band 41 (2498.5 - 2687.5 MHz)				
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 13: 5 MHz, 10 MHz				
	LTE Band 14: 5 MHz, 10 MHz				
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 66 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 30: 5 MHz, 10 MHz				
	LTE Band 48: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Numbers and Frequencies (MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 12: 1.4 MHz	699.7 (23017)		707.5 (23095)	715.3 (23173)	
LTE Band 12: 3 MHz	700.5 (23025)		707.5 (23095)	714.5 (23165)	
LTE Band 12: 5 MHz	701.5 (23035)		707.5 (23095)	713.5 (23155)	
LTE Band 12: 10 MHz	704 (23060)		707.5 (23095)	711 (23130)	
LTE Band 13: 5 MHz	779.5 (23205)		782 (23230)	784.5 (23255)	
LTE Band 13: 10 MHz	N/A		782 (23230)	N/A	
LTE Band 14: 5 MHz	790.5 (23305)		793 (23330)	795.5 (23355)	
LTE Band 14: 10 MHz	N/A		793 (23330)	N/A	
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)		836.5 (20525)	848.3 (20643)	
LTE Band 5 (Cell): 3 MHz	825.5 (20415)		836.5 (20525)	847.5 (20635)	
LTE Band 5 (Cell): 5 MHz	826.5 (20425)		836.5 (20525)	846.5 (20625)	
LTE Band 5 (Cell): 10 MHz	829 (20450)		836.5 (20525)	844 (20600)	
LTE Band 66 (AWS): 1.4 MHz	1710.7 (131979)		1745 (132322)	1779.3 (132665)	
LTE Band 66 (AWS): 3 MHz	1711.5 (131987)		1745 (132322)	1778.5 (132657)	
LTE Band 66 (AWS): 5 MHz	1712.5 (131997)		1745 (132322)	1777.5 (132647)	
LTE Band 66 (AWS): 10 MHz	1715 (132022)		1745 (132322)	1775 (132622)	
LTE Band 66 (AWS): 15 MHz	1717.5 (132047)		1745 (132322)	1772.5 (132597)	
LTE Band 66 (AWS): 20 MHz	1720 (132072)		1745 (132322)	1770 (132572)	
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)		1732.5 (20175)	1754.3 (20393)	
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)		1732.5 (20175)	1753.5 (20385)	
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)		1732.5 (20175)	1752.5 (20375)	
LTE Band 4 (AWS): 10 MHz	1715 (20000)		1732.5 (20175)	1750 (20350)	
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)		1732.5 (20175)	1747.5 (20325)	
LTE Band 4 (AWS): 20 MHz	1720 (20050)		1732.5 (20175)	1745 (20300)	
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)		1880 (18900)	1909.3 (19193)	
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)		1880 (18900)	1908.5 (19185)	
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)		1880 (18900)	1907.5 (19175)	
LTE Band 2 (PCS): 10 MHz	1855 (18650)		1880 (18900)	1905 (19150)	
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)		1880 (18900)	1902.5 (19125)	
LTE Band 2 (PCS): 20 MHz	1860 (18700)		1880 (18900)	1900 (19100)	
LTE Band 30: 5 MHz	2307.5 (27685)		2310 (27710)	2312.5 (27735)	
LTE Band 30: 10 MHz	N/A		2310 (27710)	N/A	
LTE Band 48: 5 MHz	3552.5 (55265)	3600.8 (55748)	N/A	3649.2 (56232)	3697.5 (56715)
LTE Band 48: 10 MHz	3555 (55290)	3601.7 (55757)	N/A	3648.3 (56223)	3695 (56690)
LTE Band 48: 15 MHz	3557.5 (55315)	3602.5 (55765)	N/A	3647.5 (56215)	3692.5 (56665)
LTE Band 48: 20 MHz	3560 (55340)	3603.3 (55773)	N/A	3646.7 (56207)	3690 (56640)
LTE Band 41: 5 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 10 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 15 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
LTE Band 41: 20 MHz	2506 (39750)	2549.5 (40185)	2593 (40620)	2636.5 (41055)	2680 (41490)
UE Category	DL UE Cat 18, UL UE Cat 13				
Modulations Supported in UL	QPSK, 16QAM, 64QAM				
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES				
A-MPR (Additional MPR) disabled for SAR Testing?	YES				
LTE Carrier Aggregation Possible Combinations	The technical description includes all the possible carrier aggregation combinations				
LTE Additional Information	This device does not support full CA features on 3GPP Release 15. It supports carrier agregation, downlink MIMO, LAA features as shown in section 9 and Appendix F. All other uplink communications are identical to the Release 8 specification. Uplink communications are done on the PCC. The following LTE Release 15 Features are not supported: Relay, HetNet, Enhanced MIMO, eICIC, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.				

NR Information			
Form Factor	Portable Handset		
Frequency Range of each NR transmission band	NR Band n5 (Cell) (826.5 - 846.5 MHz)		
	NR Band n66 (AWS) (1712.5 - 1777.5 MHz)		
	NR Band n2 (PCS) (1852.5 - 1907.5 MHz)		
Channel Bandwidths	NR Band n5 (Cell): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	NR Band n66 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	NR Band n2 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
NR Band n5 (Cell): 5 MHz	826.5 (165300)	836.5 (167300)	846.5 (169300)
NR Band n5 (Cell): 10 MHz	829 (165800)	836.5 (167300)	844 (168800)
NR Band n5 (Cell): 15 MHz	831.5 (166300)	836.5 (167300)	841.5 (168300)
NR Band n5 (Cell): 20 MHz	834 (166800)	836.5 (167300)	839 (167800)
NR Band n66 (AWS): 5 MHz	1712.5 (342500)	1745 (349000)	1777.5 (355500)
NR Band n66 (AWS): 10 MHz	1715 (343000)	1745 (349000)	1775 (355000)
NR Band n66 (AWS): 15 MHz	1717.5 (343500)	1745 (349000)	1772.5 (354500)
NR Band n66 (AWS): 20 MHz	1720 (344000)	1745 (349000)	1770 (354000)
NR Band n2 (PCS): 5 MHz	1852.5 (370500)	1880 (376000)	1907.5 (381500)
NR Band n2 (PCS): 10 MHz	1855 (371000)	1880 (376000)	1905 (381000)
NR Band n2 (PCS): 15 MHz	1857.5 (371500)	1880 (376000)	1902.5 (380500)
NR Band n2 (PCS): 20 MHz	1860 (372000)	1880 (376000)	1900 (380000)
SCS for NR Band n5/n66/n2	15 kHz		
Modulations Supported in UL	DFT-s-OFDM: π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: QPSK, 16QAM, 64QAM, 256QAM		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
EN-DC Carrier Aggregation Possible Combinations	The technical description includes all the possible carrier aggregation combinations		
LTE Anchor Bands for NR Band n5 (Cell)	LTE Band 66/2/30/48		
LTE Anchor Bands for NR Band n66 (AWS)	LTE Band 12/13/14/5/2/30		
LTE Anchor Bands for NR Band n2 (PCS)	LTE Band 12/13/14/5/66/30		

NR Information						
Form Factor	Portable Handset					
Frequency Range of each LTE transmission band	NR Band n77 (3710.01 - 3969.99 MHz)					
Channel Bandwidths	NR Band n77: 20 MHz, 40 MHz, 50 MHz, 60 MHz, 80 MHz, 90 MHz, 100 MHz					
Channel Numbers and Frequencies (MHz)						
NR Band n77: 20 MHz	3710.01 (647334)	3762 (650800)	3813.99 (654266)	3866.01 (657734)	3918 (661200)	3969.99 (664666)
NR Band n77: 40 MHz	3720 (648000)	3768 (651200)	3816 (654400)	3864 (657600)	3912 (660800)	3960 (664000)
NR Band n77: 50 MHz	3725.01 (648334)	3782.49 (652166)	3840 (656000)		3897.51 (659834)	3954.99 (663666)
NR Band n77: 60 MHz	3730.02 (648668)	3803.34 (653556)	N/A	N/A	3876.66 (658444)	3949.98 (663332)
NR Band n77: 80 MHz	3740.01 (649334)	N/A	3840 (656000)		N/A	3939.99 (662666)
NR Band n77: 90 MHz	3745.02 (649668)	N/A	3840 (656000)		N/A	3934.98 (662332)
NR Band n77: 100 MHz	3750 (650000)	N/A	N/A	N/A	N/A	3930 (662000)
SCS for NR Band n77	30 kHz					
Modulations Supported in UL	DFT-s-OFDM: π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM CP-OFDM: QPSK, 16QAM, 64QAM, 256QAM					
A-MPR (Additional MPR) disabled for SAR Testing?	YES					
EN-DC Carrier Aggregation Possible Combinations	The technical description includes all the possible carrier aggregation combinations					
LTE Anchor Bands for NR Band n77	LTE Band 2/5/13/66					

3 INTRODUCTION

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

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 [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (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 International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. 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.

3.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = 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 relation 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]

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

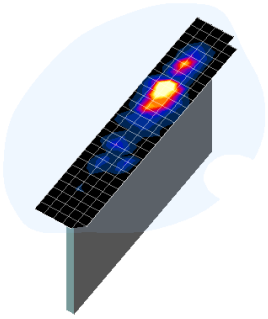

Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See 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 (see references or the DASY manual online for more details):

   a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

   b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 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 then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

   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 was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*Δz_{zoom}(n-1)	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*Δz_{zoom}(n-1)	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*Δz_{zoom}(n-1)	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 5-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

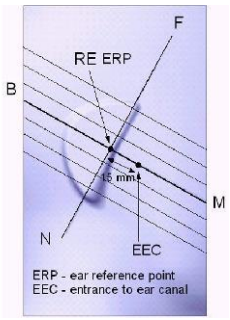

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 5-3). The acoustic output was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 5-2
Front, back and side view of SAM Twin Phantom

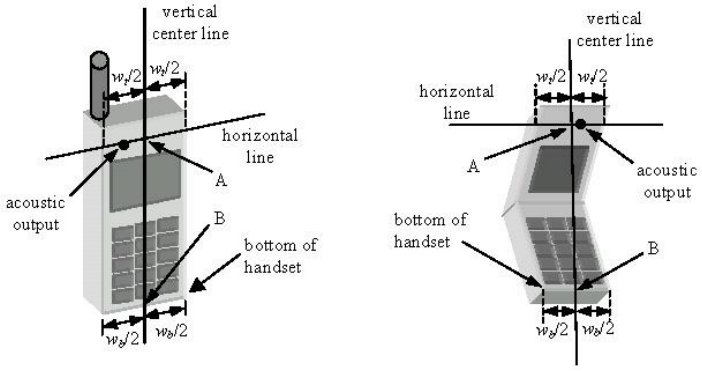

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

6 TEST CONFIGURATION POSITIONS

6.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

6.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

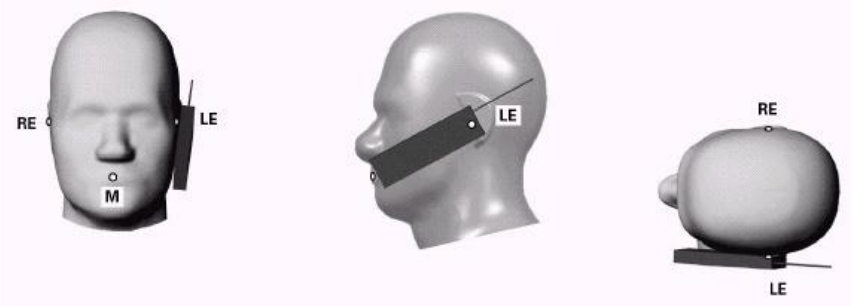

Figure 6-1 Front, Side and Top View of Cheek Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the pinna.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the reference plane.
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15º Tilt

With the test device aligned in the “Cheek Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6-2).

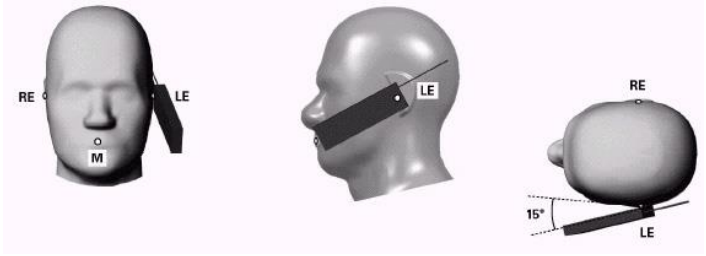

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

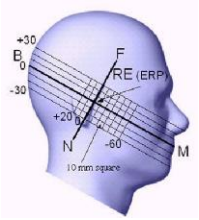

Figure 6-3
Side view w/ relevant markings

6.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. Per IEEE 1528-2013, a rotated SAM phantom is necessary to allow probe access to such regions. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed from the table for emptying and cleaning.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04v01r03. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

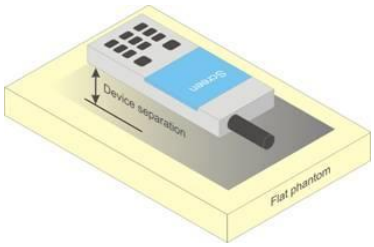

Figure 6-4
Sample Body-Worn Diagram

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that

dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.6 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1g body and 10g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.7 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

6.8 Phablet Configurations

For smart phones with a display diagonal dimension > 150 mm or an overall diagonal dimension > 160 mm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04v01r03 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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 made 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.

7.2 Controlled Environment

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.

Table 7-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, 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.

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01 “3G SAR Measurement Procedures.”

The device is placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

8.3 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.

8.3.1 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 systems 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.

8.3.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A 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. 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. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.3.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), 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 GHz 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. Each band is tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

8.3.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next 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, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.3.5 OFDM Transmission Mode and SAR Test Channel Selection

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. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. 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.

8.3.6 Initial Test Configuration Procedure

For OFDM, 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, lowest data rate and lowest order IEEE 802.11 mode. 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 (See Section 8.3.5). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.3.7 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 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, no additional SAR tests for the subsequent test configurations are required. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8.3.8 MIMO SAR Considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB Publication 447498 D01v06 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. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

9 RF CONDUCTED POWERS

9.1 NR Conducted Powers

9.1.1 NR Band n77

Table 9-1
NR Band n77 Measured P_{limit} for all DSI - 100 MHz Bandwidth

NR Band n77 100 MHz Bandwidth						
			Channel		MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	650000 (3750 MHz)	662000 (3930 MHz)		
			Conducted Power [dBm]			
DFT-s-OFDM π/2 BPSK	1	1	21.48	20.87	0	0.0
	1	137	20.78	20.56		0.0
	1	271	20.77	20.70		0.0
	135	0	21.25	20.47	0-0.5	0.0
	135	69	20.62	20.28	0	0.0
	135	138	20.57	20.55	0-0.5	0.0
	270	0	20.84	20.43		0.0
DFT-s-OFDM QPSK	1	1	**21.39**	20.91	0	0.0
	1	137	20.79	20.53		0.0
	1	271	20.75	20.75		0.0
	135	0	**21.22**	20.60	0-1	0.0
	135	69	20.85	20.29	0	0.0
	135	138	20.76	20.50	0-1	0.0
	270	0	20.87	20.48		0.0
DFT-s-OFDM 16QAM	1	1	21.21	21.03	0-1	0.0
CP-OFDM QPSK	1	1	20.89	20.81	0-1.5	0.0

Table 9-2
NR Band n77 Measured P_{limit} for all DSI - 90 MHz Bandwidth

NR Band n77 90 MHz Bandwidth							
Modulation	**RB Size**	**RB Offset**	**649668 (3745.02 MHz)**	**656000 (3840 MHz)**	**662332 (3934.98 MHz)**	**MPR Allowed per 3GPP [dB]**	**MPR [dB]**
			Conducted Power [dBm]				
DFT-s-OFDM π/2 BPSK	1	1	20.80	20.73	20.62	0	0.0
	1	123	20.86	20.86	20.83		0.0
	1	243	20.78	20.68	20.49		0.0
	120	0	20.75	20.69	20.80	0-0.5	0.0
	120	63	20.86	20.80	20.78	0	0.0
	120	125	20.80	20.79	20.69	0-0.5	0.0
	243	0	20.78	20.66	20.72		0.0
DFT-s-OFDM QPSK	1	1	20.71	20.80	20.79	0	0.0
	1	123	20.89	20.79	20.96		0.0
	1	243	20.77	20.82	20.57		0.0
	120	0	20.79	20.76	20.73	0-1	0.0
	120	63	20.74	20.82	20.75	0	0.0
	120	125	20.71	20.80	20.65	0-1	0.0
	243	0	20.80	20.74	20.79		0.0
DFT-s-OFDM 16QAM	1	1	20.73	20.32	20.24	0-1	0.0
CP-OFDM QPSK	1	1	20.89	20.38	20.01	0-1.5	0.0

Table 9-3
NR Band n77 Measured P_{limit} for all DSI - 80 MHz Bandwidth

NR Band n77 80 MHz Bandwidth							
			Channel			MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	649334 (3740.01 MHz)	656000 (3840 MHz)	662666 (3939.99 MHz)		
			Conducted Power [dBm]				
DFT-s-OFDM π/2 BPSK	1	1	20.98	20.59	20.63	0	0.0
	1	109	20.83	20.68	20.81		0.0
	1	215	20.66	20.64	20.51		0.0
	108	0	20.80	20.73	20.72	0-0.5	0.0
	108	55	20.73	20.81	20.69	0	0.0
	108	109	20.84	20.74	20.69	0-0.5	0.0
	216	0	20.69	20.75	20.70		0.0
DFT-s-OFDM QPSK	1	1	20.92	20.65	20.76	0	0.0
	1	109	20.82	20.81	20.85		0.0
	1	215	20.73	20.67	20.49		0.0
	108	0	20.84	20.73	20.64	0-1	0.0
	108	55	20.76	20.69	20.65	0	0.0
	108	109	20.74	20.79	20.70	0-1	0.0
	216	0	20.76	20.68	20.68		0.0
DFT-s-OFDM 16QAM	1	1	20.82	20.11	20.46	0-1	0.0
CP-OFDM QPSK	1	1	20.84	19.82	20.17	0-1.5	0.0

Table 9-4
NR Band n77 Measured P_{limit} for all DSI - 60 MHz Bandwidth

NR Band n77 60 MHz Bandwidth								
			Channel				MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	648668 (3730.02 MHz)	653556 (3803.34 MHz)	658444 (3876.66 MHz)	663332 (3949.98 MHz)		
			Conducted Power [dBm]					
DFT-s-OFDM π/2 BPSK	1	1	20.62	20.59	20.70	20.83	0	0.0
	1	81	20.68	20.71	20.66	20.92		0.0
	1	160	20.67	20.76	20.79	20.65		0.0
	81	0	20.75	20.68	20.75	20.89	0-0.5	0.0
	81	41	20.77	20.74	20.82	20.83	0	0.0
	81	81	20.66	20.79	20.75	20.80	0-0.5	0.0
	162	0	20.78	20.73	20.74	20.91		0.0
DFT-s-OFDM QPSK	1	1	20.65	20.67	20.75	21.11	0	0.0
	1	81	20.81	20.70	20.95	21.02		0.0
	1	160	20.70	20.87	20.81	20.88		0.0
	81	0	20.84	20.68	20.85	20.94	0-1	0.0
	81	41	20.79	20.69	20.78	20.81	0	0.0
	81	81	20.76	20.83	20.72	20.80	0-1	0.0
	162	0	20.83	20.73	20.80	20.88		0.0
DFT-s-OFDM 16QAM	1	1	20.50	20.51	20.57	21.19	0-1	0.0
CP-OFDM QPSK	1	1	20.67	20.62	20.73	20.81	0-1.5	0.0

Table 9-5
NR Band n77 Measured P_{limit} for all DSI - 50 MHz Bandwidth

NR Band n77 50 MHz Bandwidth									
			Channel					MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	648334 (3725.01 MHz)	652166 (3782.49 MHz)	656000 (3840 MHz)	659834 (3897.51 MHz)	663666 (3954.99 MHz)		
			Conducted Power [dBm]						
DFT-s-OFDM π/2 BPSK	1	1	20.54	20.63	20.64	20.68	20.76	0	0.0
	1	67	20.71	20.82	20.70	20.64	20.69		0.0
	1	131	20.76	20.79	20.78	20.84	20.62		0.0
	64	0	20.77	20.64	20.79	20.70	20.84	0-0.5	0.0
	64	35	20.85	20.71	20.79	20.65	20.63	0	0.0
	64	69	20.71	20.67	20.84	20.59	20.58	0-0.5	0.0
	128	0	20.81	20.73	20.73	20.68	20.66		0.0
DFT-s-OFDM QPSK	1	1	20.76	20.64	20.65	20.71	20.63	0	0.0
	1	67	20.95	20.72	20.74	20.68	20.76		0.0
	1	131	20.87	20.86	20.89	20.68	20.77		0.0
	64	0	20.72	20.59	20.75	20.75	20.36	0-1	0.0
	64	35	20.85	20.75	20.72	20.70	20.76	0	0.0
	64	69	20.86	20.72	20.66	20.69	20.50	0-1	0.0
	128	0	20.82	20.73	20.77	20.74	20.53		0.0
DFT-s-OFDM 16QAM	1	1	20.85	20.63	20.66	20.81	20.47	0-1	0.0
CP-OFDM QPSK	1	1	20.97	20.64	20.65	20.87	20.17	0-1.5	0.0

Table 9-6
NR Band n77 Measured P_{limit} for all DSI - 40 MHz Bandwidth

NR Band n77 40 MHz Bandwidth										
			Channel						MPR Allowed per 3GPP [dB]	MPR Allowed per 3GPP [dB]
Modulation	RB Size	RB Offset	648000 (3720 MHz)	651200 (3768 MHz)	654400 (3816 MHz)	657600 (3864 MHz)	660800 (3912 MHz)	664000 (3960 MHz)		
			Conducted Power [dBm]							
DFT-s-OFDM π/2 BPSK	1	1	21.02	21.16	21.08	21.16	21.08	21.10	0	0.0
	1	53	21.08	21.05	20.87	21.00	20.92	20.88		0.0
	1	104	21.16	21.27	21.05	20.98	20.99	21.01		0.0
	50	0	20.94	21.10	20.98	21.10	20.97	21.02	0-0.5	0.0
	50	28	20.96	20.97	20.95	20.99	20.91	20.88	0	0.0
	50	56	21.08	21.01	21.12	21.01	20.95	20.82	0-0.5	0.0
	100	0	20.98	21.06	20.99	21.04	20.98	20.89		0.0
DFT-s-OFDM QPSK	1	1	21.08	21.14	21.14	21.23	21.19	21.03	0	0.0
	1	53	21.02	20.88	20.91	21.16	21.00	20.92		0.0
	1	104	21.26	21.13	21.16	21.15	20.99	21.08		0.0
	50	0	21.02	20.94	20.75	20.94	20.92	21.01	0-1	0.0
	50	28	20.96	20.86	20.96	20.98	20.89	20.81	0	0.0
	50	56	21.09	21.10	20.98	21.02	20.92	20.31	0-1	0.0
	100	0	20.97	20.95	20.99	21.00	20.93	20.25		0.0
DFT-s-OFDM 16QAM	1	1	21.35	20.97	20.83	21.04	21.11	20.15	0-1	0.0
CP-OFDM QPSK	1	1	21.08	20.76	20.76	20.70	21.15	20.10	0-1.5	0.0

Table 9-7
NR Band n77 Measured P_{limit} for all DSI - 20 MHz Bandwidth

NR Band n77 20 MHz Bandwidth										
			Channel						MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	647334 (3710.01 MHz)	650800 (3762 MHz)	654266 (3813.99 MHz)	657734 (3866.01 MHz)	661200 (3918 MHz)	664666 (3969.99 MHz)		
			Conducted Power [dBm]							
DFT-s-OFDM π/2 BPSK	1	1	21.15	20.91	21.04	20.93	20.86	20.74	0	0.0
	1	26	20.82	20.96	20.92	20.96	20.82	20.25		0.0
	1	49	20.98	20.99	20.95	21.01	21.06	20.52		0.0
	25	0	20.91	21.09	21.02	20.99	20.90	20.74	0-0.5	0.0
	25	13	20.91	20.95	21.06	20.90	20.81	20.73	0	0.0
	25	26	20.96	21.09	20.97	21.02	20.86	20.66	0-0.5	0.0
	50	0	20.92	20.99	20.99	20.92	20.97	20.36		0.0
DFT-s-OFDM QPSK	1	1	20.98	21.09	21.04	21.10	21.03	20.59	0	0.0
	1	26	21.09	21.00	21.14	20.98	21.05	20.40		0.0
	1	49	21.11	21.15	21.08	21.05	20.98	20.46		0.0
	25	0	20.99	20.95	21.04	21.00	20.94	20.12	0-1	0.0
	25	13	20.88	20.85	20.98	20.89	20.91	20.59	0	0.0
	25	26	20.98	20.99	21.01	21.03	20.90	20.46	0-1	0.0
	50	0	21.02	21.04	21.03	20.92	20.91	20.39		0.0
DFT-s-OFDM 16QAM	1	1	21.24	21.26	21.34	21.31	21.23	20.28	0-1	0.0
CP-OFDM QPSK	1	1	20.72	20.48	20.87	20.96	20.72	19.84	0-1.5	0.0

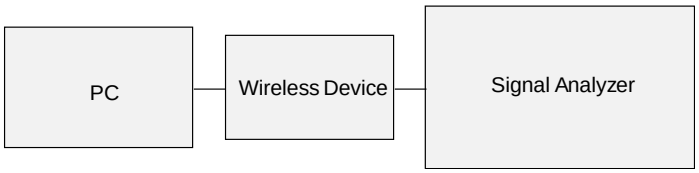

Figure 9-1
Power Measurement Setup

9.2 WLAN Conducted Powers

Table 9-8
5 GHz WLAN Maximum Average RF Power – MIMO

5GHz (20MHz) 802.11a Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
5180	36	16.66	16.76	19.72
5200	40	16.69	16.81	19.76
5220	44	16.74	16.88	19.82
5240	48	16.69	16.90	19.81
5260	52	16.36	16.84	19.62
5280	56	16.33	16.96	19.67
5300	60	16.25	16.68	19.48
5320	64	16.07	16.71	19.41
5500	100	16.43	16.98	19.72
5600	120	16.25	16.96	19.63
5620	124	16.51	16.95	19.75
5720	144	16.86	16.93	19.91
5745	149	16.53	16.97	19.77
5785	157	16.34	16.92	19.65
5825	165	16.33	16.79	19.58

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

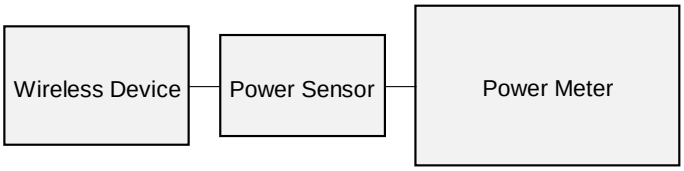

Figure 9-2
Power Measurement Setup

10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (°C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
11/16/2020	3600 Head	21.0	3700	3.018	37.377	3.117	37.700	-3.18%	-0.86%
			3750	3.072	37.310	3.169	37.643	-3.06%	-0.88%
			3900	3.221	37.060	3.323	37.471	-3.07%	-1.10%
			3930	3.256	36.990	3.353	37.437	-2.89%	-1.19%
			4150	3.486	36.613	3.579	37.186	-2.60%	-1.54%
11/17/2020	5200-5800 Head	21.4	5180	4.574	35.066	4.635	36.009	-1.32%	-2.62%
			5190	4.582	35.053	4.645	35.998	-1.36%	-2.63%
			5200	4.589	35.032	4.655	35.986	-1.42%	-2.65%
			5210	4.598	35.003	4.666	35.975	-1.46%	-2.70%
			5220	4.608	34.970	4.676	35.963	-1.45%	-2.76%
			5240	4.634	34.908	4.696	35.940	-1.32%	-2.87%
			5250	4.652	34.886	4.706	35.929	-1.15%	-2.90%
			5260	4.668	34.880	4.717	35.917	-1.04%	-2.89%
			5270	4.679	34.873	4.727	35.906	-1.02%	-2.88%
			5280	4.690	34.861	4.737	35.894	-0.99%	-2.88%
			5290	4.699	34.849	4.748	35.883	-1.03%	-2.88%
			5300	4.707	34.834	4.758	35.871	-1.07%	-2.89%
			5310	4.715	34.819	4.768	35.860	-1.11%	-2.90%
			5320	4.721	34.801	4.778	35.849	-1.19%	-2.92%
			5500	4.931	34.464	4.963	35.643	-0.64%	-3.31%
			5510	4.941	34.450	4.973	35.632	-0.64%	-3.32%
			5520	4.952	34.429	4.983	35.620	-0.62%	-3.34%
			5530	4.962	34.403	4.994	35.609	-0.64%	-3.39%
			5540	4.974	34.375	5.004	35.597	-0.60%	-3.43%
			5550	4.980	34.360	5.014	35.586	-0.68%	-3.45%
			5560	4.989	34.337	5.024	35.574	-0.70%	-3.48%
			5580	5.016	34.299	5.045	35.551	-0.57%	-3.52%
			5600	5.049	34.269	5.065	35.529	-0.32%	-3.55%
			5610	5.057	34.253	5.076	35.518	-0.37%	-3.56%
			5620	5.064	34.227	5.086	35.506	-0.43%	-3.60%
			5640	5.085	34.185	5.106	35.483	-0.41%	-3.66%
			5660	5.110	34.148	5.127	35.460	-0.33%	-3.70%
			5670	5.123	34.124	5.137	35.449	-0.27%	-3.74%
			5680	5.138	34.099	5.147	35.437	-0.17%	-3.78%
			5690	5.152	34.079	5.158	35.426	-0.12%	-3.80%
			5700	5.162	34.062	5.168	35.414	-0.12%	-3.82%
			5710	5.174	34.062	5.178	35.403	-0.08%	-3.79%
			5720	5.182	34.057	5.188	35.391	-0.12%	-3.77%
			5745	5.199	33.992	5.214	35.363	-0.29%	-3.88%
			5750	5.203	33.979	5.219	35.357	-0.31%	-3.90%
			5755	5.209	33.965	5.224	35.351	-0.29%	-3.92%
			5765	5.225	33.941	5.234	35.340	-0.17%	-3.96%
			5775	5.242	33.918	5.245	35.329	-0.06%	-3.99%
			5785	5.258	33.896	5.255	35.317	0.06%	-4.02%
			5795	5.273	33.884	5.265	35.305	0.15%	-4.02%
			5805	5.287	33.875	5.275	35.294	0.23%	-4.02%
			5825	5.309	33.871	5.296	35.271	0.25%	-3.97%
11/16/2020	3600 Body	20.0	3700	3.445	49.689	3.548	51.050	-2.90%	-2.67%
			3750	3.514	49.584	3.606	50.982	-2.55%	-2.74%
			3900	3.696	49.340	3.781	50.779	-2.25%	-2.83%
			3930	3.742	49.290	3.816	50.738	-1.94%	-2.85%
			4150	4.041	48.896	4.073	50.439	-0.79%	-3.06%

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

10.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix D.

Table 10-2
System Verification Results – 1g

System Verification TARGET & MEASURED												
SAR System #	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Source SN	Probe SN	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)
L	3700	HEAD	11/16/2020	21.5	21.0	0.100	1067	7539	7.150	67.200	71.500	6.40%
L	3900	HEAD	11/16/2020	21.5	21.0	0.100	1056	7539	7.270	68.900	72.700	5.52%
H	5250	HEAD	11/17/2020	21.6	21.4	0.050	1057	7357	3.750	79.200	75.000	-5.30%
H	5600	HEAD	11/17/2020	21.6	21.4	0.050	1057	7357	3.840	84.100	76.800	-8.68%
H	5750	HEAD	11/17/2020	21.6	21.4	0.050	1057	7357	3.870	80.500	77.400	-3.85%
L	3700	BODY	11/16/2020	21.5	20.0	0.100	1067	7539	6.740	65.200	67.400	3.37%
L	3900	BODY	11/16/2020	21.5	20.0	0.100	1056	7539	6.840	66.300	68.400	3.17%

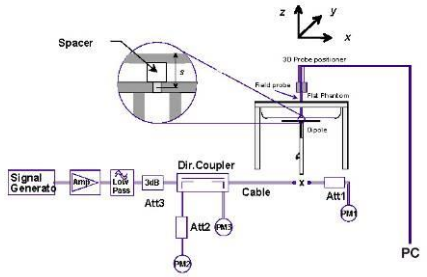

Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
NR Band n77 Head SAR

MEASUREMENT RESULTS																						
FREQUENCY			Mode	Bandwidth [MHz]	Mechanical Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Waveform	Modulation	RB Size	RB Offset	Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.																	(W/kg)		(W/kg)	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	0.19	0	Right	Cheek	DFT-S-OFDM	QPSK	1	1	16514	1:2	0.073	1.099	0.080	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	0.12	0	Right	Cheek	DFT-S-OFDM	QPSK	135	0	16514	1:2	0.066	1.143	0.075	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	0.06	0	Right	Tilt	DFT-S-OFDM	QPSK	1	1	16514	1:2	0.083	1.099	0.091	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	0.12	0	Right	Tilt	DFT-S-OFDM	QPSK	135	0	16514	1:2	0.078	1.143	0.089	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	-0.15	0	Left	Cheek	DFT-S-OFDM	QPSK	1	1	16514	1:2	0.392	1.099	0.431	
3930.00	662000	High	NR Band n77	100	1	21.8	20.91	-0.15	0	Left	Cheek	DFT-S-OFDM	QPSK	1	1	16514	1:2	0.384	1.227	0.471	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	-0.14	0	Left	Cheek	DFT-S-OFDM	QPSK	135	0	16514	1:2	0.386	1.143	0.441	
3930.00	662000	High	NR Band n77	100	1	21.8	20.60	-0.13	0	Left	Cheek	DFT-S-OFDM	QPSK	135	0	16514	1:2	0.364	1.318	0.480	
3750.00	650000	Low	NR Band n77	100	1	21.8	20.87	-0.21	0	Left	Cheek	DFT-S-OFDM	QPSK	270	0	16514	1:2	0.390	1.239	0.483	
3750.00	650000	Low	NR Band n77	100	1	21.8	20.89	0.20	0	Left	Cheek	CP-OFDM	QPSK	1	1	16514	1:2	0.393	1.233	0.485	A1
3750.00	650000	Low	NR Band n77	100	3	21.8	20.89	0.10	0	Left	Cheek	CP-OFDM	QPSK	1	1	16514	1:2	0.896	1.233	**1.105**	A2
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	-0.12	0	Left	Tilt	DFT-S-OFDM	QPSK	1	1	16514	1:2	0.172	1.099	0.189	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	0.14	0	Left	Tilt	DFT-S-OFDM	QPSK	135	0	16514	1:2	0.155	1.143	0.177	
3750.00	650000	Low	NR Band n77	100	3	21.8	20.89	-0.10	0	Left	Cheek	CP-OFDM	QPSK	1	1	16514	1:2	0.890	1.233	1.097	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram											

Note: 1) Green entry represents additional Head SAR Position (Mechanical Mode #3: Swivel). 2) Blue entry indicates variability data.

Table 11-2
NII MIMO Head SAR

MEASUREMENT RESULTS																						
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Mechanical Mode	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Peak SAR of Area Scan	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.																W/kg	(W/kg)			(W/kg)	
5260	52	802.11a	OFDM	20	17.0	16.36	17.0	16.84	0.13	Right	Cheek	MIMO	1	04395	6	98.8	0.973	0.447	1.159	1.012	0.524	
5280	56	802.11a	OFDM	20	17.0	16.33	17.0	16.96	0.15	Right	Cheek	MIMO	1	04395	6	98.8	0.983	0.532	1.167	1.012	0.628	A3
5280	56	802.11a	OFDM	20	17.0	16.33	17.0	16.96	0.19	Right	Cheek	MIMO	3	04395	6	98.8	0.891	0.360	1.167	1.012	0.425	
5300	60	802.11a	OFDM	20	17.0	16.25	17.0	16.68	0.08	Right	Cheek	MIMO	1	04395	6	98.8	0.853	0.416	1.189	1.012	0.501	
5320	64	802.11a	OFDM	20	17.0	16.07	17.0	16.71	0.16	Right	Cheek	MIMO	1	04395	6	98.8	0.763	0.371	1.239	1.012	0.465	
5280	56	802.11a	OFDM	20	17.0	16.33	17.0	16.96	0.13	Right	Tilt	MIMO	1	04395	6	98.8	1.099	0.494	1.167	1.012	0.583	
5280	56	802.11a	OFDM	20	17.0	16.33	17.0	16.96	0.15	Left	Cheek	MIMO	1	04395	6	98.8	0.543	0.305	1.167	1.012	0.360	
5280	56	802.11a	OFDM	20	17.0	16.33	17.0	16.96	0.17	Left	Tilt	MIMO	1	04395	6	98.8	0.641	-	1.167	1.012	-	
5720	144	802.11a	OFDM	20	17.0	16.86	17.0	16.93	0.15	Right	Cheek	MIMO	1	04395	6	98.8	0.478	0.210	1.033	1.012	0.220	
5720	144	802.11a	OFDM	20	17.0	16.86	17.0	16.93	0.13	Right	Tilt	MIMO	1	04395	6	98.8	0.296	-	1.033	1.012	-	
5720	144	802.11a	OFDM	20	17.0	16.86	17.0	16.93	0.06	Left	Cheek	MIMO	1	04395	6	98.8	0.380	0.121	1.033	1.012	0.126	
5720	144	802.11a	OFDM	20	17.0	16.86	17.0	16.93	0.21	Left	Tilt	MIMO	1	04395	6	98.8	0.289	-	1.033	1.012	-	
5745	149	802.11a	OFDM	20	17.0	16.53	17.0	16.97	0.19	Right	Cheek	MIMO	1	04395	6	98.8	0.596	0.155	1.114	1.012	0.175	
5745	149	802.11a	OFDM	20	17.0	16.53	17.0	16.97	0.15	Right	Tilt	MIMO	1	04395	6	98.8	0.346	-	1.114	1.012	-	
5745	149	802.11a	OFDM	20	17.0	16.53	17.0	16.97	-0.19	Left	Cheek	MIMO	1	04395	6	98.8	0.312	0.105	1.114	1.012	0.118	
5745	149	802.11a	OFDM	20	17.0	16.53	17.0	16.97	0.18	Left	Tilt	MIMO	1	04395	6	98.8	0.229	-	1.114	1.012	-	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram												

Note: 1) Green entry represents additional Head SAR Position (Mechanical Mode #3: Swivel). 2) To achieve the 20.0 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 17.0 dBm.

11.2 Standalone Body-Worn SAR Data

Table 11-3
NR Body-Worn SAR

MEASUREMENT RESULTS																					
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Serial Number	Waveform	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.																(W/kg)		(W/kg)	
3750.00	650000	Low	NR Band n77	100	21.8	21.39	-0.03	0	16514	DFT-S-OFDM	QPSK	1	1	10 mm	back	1:2	0.153	1.099	0.168	A4
3750.00	650000	Low	NR Band n77	100	21.8	21.22	-0.01	0	16514	DFT-S-OFDM	QPSK	135	0	10 mm	back	1:2	0.145	1.143	0.166	
3750.00	650000	Low	NR Band n77	100	21.8	20.89	0.03	0	16514	CP-OFDM	QPSK	1	1	10 mm	back	1:2	0.151	1.233	0.186	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population												Body 1.6 W/kg (mW/g) averaged over 1 gram								

11.3 Standalone Hotspot SAR Data

Table 11-4
NR Band n77 Hotspot SAR

MEASUREMENT RESULTS																					
FREQUENCY			Mode	Bandwidth [MHz]	Mechanical Mode	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Serial Number	Waveform	Modulation	RB Size	RB Offset	Spacing	MPR [dB]	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.																	(W/kg)		(W/kg)	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	-0.03	0	16514	DFT-S-OFDM	QPSK	1	1	10 mm	back	1:2	0.153	1.099	0.168	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	-0.01	0	16514	DFT-S-OFDM	QPSK	135	0	10 mm	back	1:2	0.145	1.143	0.166	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	0.10	0	16514	DFT-S-OFDM	QPSK	1	1	10 mm	front	1:2	0.079	1.099	0.087	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	0.19	0	16514	DFT-S-OFDM	QPSK	135	0	10 mm	front	1:2	0.081	1.143	0.093	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	0.12	0	16514	DFT-S-OFDM	QPSK	1	1	10 mm	top	1:2	0.086	1.099	0.095	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	-0.10	0	16514	DFT-S-OFDM	QPSK	135	0	10 mm	top	1:2	0.074	1.143	0.085	
3750.00	650000	Low	NR Band n77	100	1	21.8	21.39	-0.06	0	16514	DFT-S-OFDM	QPSK	1	1	10 mm	right	1:2	0.290	1.099	0.319	A5
3750.00	650000	Low	NR Band n77	100	1	21.8	21.22	0.05	0	16514	DFT-S-OFDM	QPSK	135	0	10 mm	right	1:2	0.284	1.143	0.325	
3750.00	650000	Low	NR Band n77	100	1	21.8	20.89	-0.05	0	16514	CP-OFDM	QPSK	1	1	10 mm	right	1:2	0.285	1.233	0.351	
3750.00	650000	Low	NR Band n77	100	2	21.8	20.89	0.14	0	16514	CP-OFDM	QPSK	1	1	10 mm	right	1:2	0.288	1.233	**0.355**	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population												Body 1.6 W/kg (mW/g) averaged over 1 gram									

Note: 1) Purple entry represents additional Hotspot SAR Position (Mechanical Mode #2: Normal + Pop-up)

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The orange highlights throughout the report represents the highest SAR per FCC Equipment Class reflected on the FCC Grant.
5. 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.
6. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
7. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
8. Per FCC KDB Publication 648474 D04v01r03, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.

9. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 13 for variability analysis.
10. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v02r01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
11. Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.
12. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.
13. This device uses Qualcomm Smart Transmit for 2G/3G/4G/5G operations to control and manage transmitting power in real time to ensure RF Exposure compliance. Per FCC Guidance, compliance was assessed at the minimum of the time averaged power and the maximum output power for each band/mode/exposure condition (DSI).
14. SAR with the additional mechanical mode #3 (swivel mode) was measured for the configurations with the highest reported SAR for each wireless technology, frequency band, operating mode for head and phablet exposure conditions.
15. SAR with mechanical mode #2 (normal mode + pop-up) or mechanical mode #4 (swivel mode + pop-up) was measured for the highest overall reported hotspot and phablet SAR configurations.
16. Only operations relevant to this permissive change were evaluated for compliance. Please see the first C2PC evaluation in RF Exposure Technical Reports S/N: 1M2007230114-02.ZNF for a complete evaluation of these operating modes. The operational description includes description of all changed items.

NR Notes:

1. NR implementation in EN-DC mode operates with the LTE Bands shown in the NR FR1 checklist acting as anchor bands. Per FCC guidance, SAR tests for NR Bands and LTE Anchors Bands were performed separately due to limitations in SAR probe calibration factors.
2. Due to test setup limitations, SAR testing for NR was performed using test mode software to establish the connection.
3. Simultaneous transmission analysis for EN-DC operations is addressed in the Part 2 Test Report from the original fillings.
4. This device additionally supports some EN-DC conditions where additional LTE carriers are added on the downlink only.
5. Per FCC Guidance, NR modulations and RB Sizes/Offsets were selected for testing such that configurations with the highest output power were evaluated for SAR tests.

WLAN Notes:

1. For held-to-ear, hotspot, and phablet operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg for 1g evaluations, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg for 1g evaluations. See Section 8.3.5 for more information.
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 for 1g evaluations or all test channels were measured.
4. The device was configured to transmit continuously at the required data rate, 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 EMC test reports.

5. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06 by either evaluating the sum of the 1g SAR values of each antenna transmitting independently or making a SAR measurement with both antennas transmitting simultaneously. Please see Section 12 for complete analysis.
6. There were no changes made to the WLAN operations within this device. The first C2PC evaluation SAR report contains a complete evaluation of WIFI modes. 5 GHz WLAN MIMO SAR was additionally evaluated in this filing to support simultaneous transmission analysis with NR Band n77 operations.

12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

Qualcomm Smart Transmit algorithm in WWAN adds directly the time-averaged RF exposure from 4G (including scenarios with inter-band ULCA active) and time-averaged RF exposure from 5G NR. Smart Transmit algorithm controls the total RF exposure from both 4G and 5G NR and during inter-band ULCA active conditions to not exceed FCC limit. Therefore, simultaneous transmission compliance between 4G+5G operations (including scenarios with inter-band ULCA active) is demonstrated in the Qualcomm Part 2 Report during algorithm validation.

Per FCC KDB Publication 941225 D06v02r01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR (“-“).

(*) For test positions that were not required to be evaluated for WLAN SAR per FCC KDB publication 248227, the worst case WLAN SAR result for the applicable exposure conditions was used for simultaneous transmission analysis.

12.3 Head SAR Simultaneous Transmission Analysis

Table 12-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Head SAR	Right Cheek	0.080	1.126	0.265	1.206	0.345	**1.471**
	Right Tilt	0.091	0.229	0.863	0.320	0.954	1.183
	Left Cheek	1.105	0.182	0.130	1.287	1.235	1.417
	Left Tilt	0.189	0.073	0.125	0.262	0.314	0.387

Table 12-2
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Configuration	Mode	5G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)	
		1	2	3	1+2	1+3
Head SAR	NR Band n77	1.105	0.285	0.269	**1.390**	1.374

Simult Tx	Configuration	NR Band n77 SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	Right Cheek	0.080	0.628	0.708
	Right Tilt	0.091	0.583	0.674
	Left Cheek	1.105	0.360	**1.465**
	Left Tilt	0.189	0.628*	0.817

Table 12-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 and 5 GHz WLAN Ant 2 (Held to Ear)

Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.080	1.126	0.120	1.326
	Right Tilt	0.091	0.229	0.269	0.589
	Left Cheek	1.105	0.182	0.269*	**1.556**
	Left Tilt	0.189	0.073	0.269*	0.531

Table 12-4
Simultaneous Transmission Scenario with Bluetooth (Held to Ear)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Head SAR	NR Band n77	1.105	0.265	**1.370**

Table 12-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN Antenna 2 and Bluetooth (Held to Ear)

Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.080	0.265	0.265	0.610
	Right Tilt	0.091	0.069	0.863	1.023
	Left Cheek	1.105	0.020	0.130	**1.255**
	Left Tilt	0.189	0.027	0.125	0.341

Table 12-6
Simultaneous Transmission Scenario with 5 GHz WLAN and Bluetooth (Held to Ear)

Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	Σ SAR (W/kg)
		1	2	2	1+2+3
Head SAR	Right Cheek	0.080	0.265	0.185	0.530
	Right Tilt	0.091	0.069	0.285	0.445
	Left Cheek	1.105	0.020	0.285*	**1.410**
	Left Tilt	0.189	0.027	0.285*	0.501
Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Head SAR	Right Cheek	0.080	0.265	0.120	0.465
	Right Tilt	0.091	0.069	0.269	0.429
	Left Cheek	1.105	0.020	0.269*	**1.394**
	Left Tilt	0.189	0.027	0.269*	0.485
Simult Tx	Configuration	NR Band n77 SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN MIMO SAR (W/kg)	Σ SAR (W/kg)
		1	2	2	1+2+3
Head SAR	Right Cheek	0.080	0.265	0.628	0.973
	Right Tilt	0.091	0.069	0.583	0.743
	Left Cheek	1.105	0.020	0.360	**1.485**
	Left Tilt	0.189	0.027	0.628*	0.844

12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body - Worn SAR	NR Band n77	0.186	0.201	0.107	0.387	0.293	**0.494**

Table 12-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	1+2	1+3	1+2+3
Body - Worn SAR	NR Band n77	0.186	0.229	0.158	0.415	0.344	**0.573**

Table 12-9
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 and 5 GHz WLAN Ant 2 (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body - Worn SAR	NR Band n77	0.186	0.201	0.158	**0.545**

Table 12-10
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body - Worn SAR	NR Band n77	0.186	0.048	**0.234**

Table 12-11
Simultaneous Transmission Scenario with 2.4 GHz WLAN Antenna 2 and Bluetooth (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Body - Worn SAR	NR Band n77	0.186	0.048	0.107	**0.341**

Table 12-12
Simultaneous Transmission Scenario with 5 GHz WLAN and Bluetooth (Body-Worn at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	4	1+2+3	1+2+3	1+2+3+4
Body - Worn SAR	NR Band n77	0.186	0.048	0.229	0.158	0.463	0.392	**0.621**

12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-13
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	2	1+2	1+3	1+2+3
Hotspot SAR	NR Band n77	0.355	0.301	0.157	0.656	0.512	**0.813**

Table 12-14
Simultaneous Transmission Scenario with 5 GHz WLAN (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	2	1+2	1+3	1+2+3
Hotspot SAR	NR Band n77	0.355	0.216	0.132	0.571	0.487	**0.703**

Table 12-15
Simultaneous Transmission Scenario with 2.4 GHz WLAN Ant 1 and 5 GHz WLAN Ant 2 (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	3	1+2+3
Hotspot SAR	NR Band n77	0.355	0.301	0.132	**0.788**

Table 12-16
Simultaneous Transmission Scenario with Bluetooth (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Hotspot SAR	NR Band n77	0.355	0.072	**0.427**

Table 12-17
Simultaneous Transmission Scenario with 2.4 GHz WLAN Antenna 2 and Bluetooth (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	2.4 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)
		1	2	2	1+2+3
Hotspot SAR	NR Band n77	0.355	0.072	0.157	**0.584**

Table 12-18
Simultaneous Transmission Scenario with 5 GHz WLAN and Bluetooth (Hotspot at 1.0 cm)

Configuration	Mode	5G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WLAN Ant 1 SAR (W/kg)	5 GHz WLAN Ant 2 SAR (W/kg)	Σ SAR (W/kg)		
		1	2	3	4	1+2+3	1+2+4	1+2+3+4
Hotspot SAR	NR Band n77	0.355	0.072	0.216	0.132	0.643	0.559	**0.775**

12.6 Phablet Simultaneous Transmission Analysis

Per FCC KDB Publication 648474 D04 Handset SAR, Phablet SAR tests were not required if wireless router 1g SAR (scaled to the maximum output power, including tolerance) < 1.2 W/kg. Therefore, no further analysis was required to determine that possible simultaneous transmission scenarios would not exceed the SAR limit.

12.7 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013 Section 6.3.4.1.2.

13 SAR MEASUREMENT VARIABILITY

13.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was 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) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
5) When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

Table 13-1
Head SAR Measurement Variability Results

HEAD VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	Side	Test Position	Mechanical Mode	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.						(W/kg)	(W/kg)		(W/kg)		(W/kg)	
3700	3750.00	650000	NR Band n77	CP-OFDM, QPSK, 1 RB, 1 RB Offset	Left	Cheek	3	0.896	0.890	1.01	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram									

13.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for 1g and <3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

14 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	85033E	3.5mm Standard Calibration Kit	6/6/2020	Annual	6/6/2021	MY53402352
Agilent	8753ES	S-Parameter Network Analyzer	12/31/2019	Annual	12/31/2020	US39170122
Agilent	E4438C	ESG Vector Signal Generator	12/13/2019	Annual	12/13/2020	MY42082659
Agilent	E5515C	8960 Series 10 Wireless Communications Test Set	2/10/2020	Annual	2/10/2021	GB42230325
Agilent	E5515C	Wireless Communications Test Set	2/26/2020	Annual	2/26/2021	GB44400860
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Agilent	N5182A	MXG Vector Signal Generator	2/19/2020	Annual	2/19/2021	MY47420651
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	MA24106A	USB Power Sensor	12/9/2019	Annual	12/9/2020	1349503
Anritsu	MA24106A	USB Power Sensor	12/9/2019	Annual	12/9/2020	1344554
Anritsu	MA2411B	Pulse Power Sensor	12/4/2019	Annual	12/4/2020	1126066
Anritsu	MA2411B	Pulse Power Sensor	1/21/2020	Annual	1/21/2021	1207470
Anritsu	ML2495A	Power Meter	12/17/2019	Annual	12/17/2020	941001
Anritsu	ML2496A	Power Meter	12/17/2019	Annual	12/17/2020	1138001
Anritsu	MT8862A	Wireless Connectivity Test Set	10/29/2020	Annual	10/29/2021	6261782395
Control Company	4040	Therm./ Clock/ Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113269
Control Company	4040	Therm./ Clock/ Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113274
Control Company	4352	Ultra Long Stem Thermometer	11/29/2018	Biennial	11/29/2020	181766816
Control Company	4352	Ultra Long Stem Thermometer	11/29/2018	Biennial	11/29/2020	181766817
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
KEYSIGHT	E4438C	VECTOR SIGNAL GENERATOR	6/22/2020	Annual	6/22/2021	MY45092078
Keysight Technologies	85033E	Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm)	9/1/2020	Annual	9/1/2021	MY53401181
Keysight Technologies	AT/N6705B	DC Power Supply	CBT	N/A	CBT	MY53001315
Keysight Technologies	N9020A	MXA Signal Analyzer	8/14/2020	Annual	8/14/2021	US46470561
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	8/17/2020	Annual	8/17/2021	MY52350166
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	9/29/2020	Annual	9/29/2021	101307
SPEAG	D3700V2	3700 MHz SAR Dipole	1/21/2020	Annual	1/21/2021	1067
SPEAG	D3900V2	3900 MHz SAR Dipole	10/9/2020	Annual	10/9/2021	1056
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/16/2018	Triennial	1/16/2021	1057
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/15/2020	Annual	4/15/2021	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/20/2020	Annual	5/20/2021	728
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/14/2020	Annual	10/14/2021	1091
SPEAG	EX3DV4	SAR Probe	4/21/2020	Annual	4/21/2021	7357
SPEAG	EX3DV4	SAR Probe	10/20/2020	Annual	10/20/2021	7539

Notes: 1) Equipment was solely used during its calibration period
2) CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

15 MEASUREMENT UNCERTAINTIES

a	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System								
Probe Calibration	6.55	N	1	1.0	1.0	6.6	6.6	∞
Axial Isotropy	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	2.0	R	1.73	1.0	1.0	1.2	1.2	∞
Linearity	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	0.25	R	1.73	1.0	1.0	0.1	0.1	∞
Readout Electronics	0.3	N	1	1.0	1.0	0.3	0.3	∞
Response Time	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions - Noise	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
RF Ambient Conditions - Reflections	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	6.7	R	1.73	1.0	1.0	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Test Sample Related								
Test Sample Positioning	2.7	N	1	1.0	1.0	2.7	2.7	35
Device Holder Uncertainty	1.67	N	1	1.0	1.0	1.7	1.7	5
Output Power Variation - SAR drift measurement	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
SAR Scaling	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
Phantom & Tissue Parameters								
Phantom Uncertainty (Shape & Thickness tolerances)	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	4.2	N	1	0.78	0.71	3.3	3.0	10
Liquid Permittivity - measurement uncertainty	4.1	N	1	0.23	0.26	1.0	1.1	10
Liquid Conductivity - Temperature Uncertainty	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)		RSS				11.5	11.3	60
Expanded Uncertainty (95% CONFIDENCE LEVEL)		k=2				23.0	22.6	

16 CONCLUSION

16.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF 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 absorption and distribution of electromagnetic energy in the body are very complex phenomena that 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. [3]

17 REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] IEEE Standards Coordinating Committee 39 –Standards Coordinating Committee 34 – 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.

[6] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies, ICECOM97, Oct. 1997, pp. 1 -124.

[9] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[17] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[18] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[19] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[20] IEC 62209-1, Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Part 1: Devices used next to the ear (Frequency range of 300 MHz to 6 GHz), July 2016.

[21] Innovation, Science, Economic Development Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 5, March 2015.

[22] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2015

[23] FCC SAR Test Procedures for 2G-3G Devices, Mobile Hotspot and UMPC Devices KDB Publications 941225, D01-D07

[24] SAR Measurement Guidance for IEEE 802.11 Transmitters, KDB Publication 248227 D01

[25] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB Publications 648474 D03-D04

[26] FCC SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers, FCC KDB Publication 616217 D04

[27] FCC SAR Measurement and Reporting Requirements for 100MHz – 6 GHz, KDB Publications 865664 D01-D02

[28] FCC General RF Exposure Guidance and SAR Procedures for Dongles, KDB Publication 447498, D01-D02

[29] Anexo à Resolução No. 533, de 10 de Septembro de 2009.

[30] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz), Mar. 2010.