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SAR EVALUATION REPORT

Applicant Name:
Samsung Electronics Co., Ltd.
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Gyeonggi-do, 16677, Korea

Date of Testing:
12/14/21 - 12/21/21 & 02/07/22
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
1M2112280172-01.A3L

FCC ID: **A3LSMF711U1**

APPLICANT: **SAMSUNG ELECTRONICS CO., LTD.**

DUT Type:	Portable Handset
Application Type:	Class II Permissive Change
FCC Rule Part(s):	CFR §2.1093
Model(s):	SM-F711U1, SM-F711U
Permissive Change(s):	See FCC Change Document
Date of Original Certification:	09/23/21

Equipment Class	Band & Mode	Tx Frequency	SAR			
			1g Head (W/kg)	1g Body-Worn (W/kg)	1g Hotspot (W/kg)	10g Phablet (W/kg)
CBE	NR Band n48	3555 - 3694.98 MHz	0.78	0.17	1.07	3.00

Only operations relevant to this permissive change were evaluated for compliance. Please see the original compliance evaluation in RF Exposure Technical Report S/N 1M2107290086-21.A3L (Rev1) for complete evaluation of all other operating modes. The operational description includes a description of all changed items.

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 1.9 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 71	Voice/Data	665.5 - 695.5 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 26 (Cell)	Voice/Data	814.7 - 848.3 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 25 (PCS)	Voice/Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 30	Voice/Data	2307.5 - 2312.5 MHz
LTE Band 7	Voice/Data	2502.5 - 2567.5 MHz
LTE Band 48	Voice/Data	3552.5 - 3697.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
LTE Band 38	Voice/Data	2572.5 - 2617.5 MHz
NR Band n71	Data	665.5 - 695.5 MHz
NR Band n12	Data	701.5 - 713.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n30	Data	2307.5 - 2312.5 MHz
NR Band n41	Data	2506.02 - 2679.99 MHz
NR Band n48	Data	3555 - 3694.98 MHz
NR Band n77 DoD	Data	3460.02 - 3540 MHz
NR Band n77	Data	2506.02 - 2679.99 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
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz
NFC	Data	13.56 MHz

1.2 Time-Averaging Algorithm for RF Exposure Compliance

This Device is enabled with the 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 1.11 – Bibliography).

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), for each characterized technology and band (see RF Exposure Part 0 Test Report, report SN could be found in Section 1.11 - Bibliography).

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 1.0dB for this EUT.

Exposure Scenario:		Body-Worn	Phablet	Phablet	Head	Hotspot	Earjack	Maximum Tune-up Output Power*
Averaging Volume:		1g	10g	10g	1g	1g	10g	
Spacing:		15 mm	8, 6, 11 mm	0 mm	0 mm	10 mm, 5 mm	0 mm	
DSI:		0	0	1	2	3	4	
Technology/Band								Pmax
NR TDD n48	F	18.5		18.5	15.0	17.5	18.5	24.0

Notes:

*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 (e.g. GSM and LTE TDD).

*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 + 1dB device design uncertainty.

The maximum time-averaged output power (dBm) for any 2G/3G/4G/5G Sub6 WWAN technology, band, and DSI = minimum of "P_{limit} EFS" and "Maximum tune up output power P_{max}" + 1dB 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 used an independent fixed level power reduction mechanism for WLAN/BT when 5G NR is active and also for WLAN/BT during all voice or VoIP held to ear scenarios. Per FCC Guidance, the held-to-ear exposure conditions were evaluated at reduced power according to the head SAR positions described in IEEE 1528-2013. Detailed descriptions of the power reduction mechanism are included in the operational description.

1.4 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.

1.4.1 5G Output Power

Mode / Band	Antenna		Modulated Average Output Power (in dBm)					
			Pmax	DSI =0 (Body-Worn or Phablet Max)	DSI =1 (Phablet Reduced)	DSI =2 (Head)	DSI =3 (Hotspot)	DSI =4 (Earjack)
NR Band n48	F	Max Allowed Power	25.0	19.5	19.5	16.0	18.5	19.5
		Nominal	24.0	18.5	18.5	15.0	17.5	18.5

1.4.2 WLAN and Bluetooth Maximum and Reduced Output Powers

Only Operations relevant to this permissive change were evaluated for compliance. No other target changes have been made. Targets for all other bands/exposure conditions can be found I the original filling.

1.5 DUT Antenna Locations

A diagram showing the location of the device antennas for both open and closed configurations can be found in Appendix E. When the device is open, the overall dimensions of this device are > 9 x 5 cm. Since the diagonal dimension of this device when open is > 160 mm and <200 mm, it is considered a “phablet.” and operates similar to a traditional portable handset. In the closed configuration, only a simple display/interaction of notifications occurs and overall dimensions are < 9 x5 cm. Therefore, when the device is closed, the only testing considered is for body-worn and hotspot.

Table 1-1
Device Edges/Sides for SAR Testing Open

Mode	Back	Front	Top	Bottom	Right	Left
NR Band n48	Yes	Yes	Yes	No	No	Yes

Table 1-2
Device Edges/Sides for SAR Testing Closed

Mode	Back	Front	Top	Bottom	Right	Left
NR Band n48	Yes	Yes	No	Yes	No	Yes

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-1, U-NII-2A, U-NII-2C operations are disabled.

1.6 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.

1.7 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 1-3
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
1	1x CDMA voice + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
2	1x CDMA voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
3	1x CDMA voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
4	1x CDMA voice + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
5	1x CDMA voice + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
6	1x CDMA voice + 5 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
7	1x CDMA voice + 2.4 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
8	1x CDMA voice + 2.4 GHz Bluetooth Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
9	1x CDMA voice + 2.4 GHz Bluetooth Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
10	1x CDMA voice + 5 GHz WLAN Ant 1	Yes	Yes	N/A	Yes	
11	1x CDMA voice + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
12	1x CDMA voice + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
13	1x CDMA voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
14	GSM voice + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
15	GSM voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
16	GSM voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
17	GSM voice + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
18	GSM voice + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
19	GSM voice + 5 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
20	GSM voice + 2.4 GHz WLAN MIMO	Yes	Yes	N/A	Yes	
21	GSM voice + 2.4 GHz Bluetooth Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
22	GSM voice + 2.4 GHz Bluetooth Ant 2	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
23	GSM voice + 5 GHz WLAN Ant 1	Yes	Yes	N/A	Yes	
24	GSM voice + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
25	GSM voice + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
26	GSM voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	N/A	Yes	^ Bluetooth Tethering is considered
27	UMTS + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
28	UMTS + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
29	UMTS + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
30	UMTS + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
31	UMTS + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
32	UMTS + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
33	UMTS + 2.4 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
34	UMTS + 2.4 GHz Bluetooth Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
35	UMTS + 2.4 GHz Bluetooth Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
36	UMTS + 5 GHz WLAN Ant 1	Yes	Yes	Yes	Yes	
37	UMTS + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
38	UMTS + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
39	UMTS + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
40	LTE + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
41	LTE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
42	LTE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
43	LTE + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
44	LTE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
45	LTE + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
46	LTE + 2.4 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
47	LTE + 2.4 GHz Bluetooth Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
48	LTE + 2.4 GHz Bluetooth Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
49	LTE + 5 GHz WLAN Ant 1	Yes	Yes	Yes	Yes	
50	LTE + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
51	LTE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
52	LTE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Phablet	Notes
53	LTE + NR	Yes	Yes	N/A	Yes	
54	LTE + NR + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
55	LTE + NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
56	LTE + NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
57	LTE + NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
58	LTE + NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
59	LTE + NR + 5 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
60	LTE + NR + 2.4 GHz WLAN MIMO	Yes	Yes	Yes	Yes	
61	LTE + NR + 2.4 GHz Bluetooth Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
62	LTE + NR + 2.4 GHz Bluetooth Ant 2	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
63	LTE + NR + 5 GHz WLAN Ant 1	Yes	Yes	Yes	Yes	
64	LTE + NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
65	LTE + NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
66	LTE + NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes^	Yes	Yes^	Yes	^ Bluetooth Tethering is considered
67	NR + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
68	NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
69	NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
70	NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
71	NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
72	NR + 5 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
73	NR + 2.4 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
74	NR + 2.4 GHz Bluetooth Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
75	NR + 2.4 GHz Bluetooth Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
76	NR + 5 GHz WLAN Ant 1	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
77	NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
78	NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
79	NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered.
80	CDMA/EVDO data + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
81	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
82	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
83	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
84	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
85	CDMA/EVDO data + 5 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
86	CDMA/EVDO data + 2.4 GHz WLAN MIMO	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
87	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
88	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 2	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
89	CDMA/EVDO data + 5 GHz WLAN Ant 1	Yes*	Yes*	Yes	Yes	* Pre-installed VOIP applications are considered.
90	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
91	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
92	CDMA/EVDO data + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	Yes*^	Yes*	Yes^	Yes	* Pre-installed VOIP applications are considered. ^ Bluetooth Tethering is considered
93	GPRS/EDGE + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO	N/A	N/A	Yes	Yes	
94	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN MIMO	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
95	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
96	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
97	GPRS/EDGE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
98	GPRS/EDGE + 5 GHz WLAN MIMO	N/A	N/A	Yes	Yes	
99	GPRS/EDGE + 2.4 GHz WLAN MIMO	N/A	N/A	Yes	Yes	
100	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
101	GPRS/EDGE + 2.4 GHz Bluetooth Ant 2	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
102	GPRS/EDGE + 5 GHz WLAN Ant 1	N/A	N/A	Yes	Yes	
103	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN Ant 1	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
104	GPRS/EDGE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN Ant 1	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered
105	GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 5 GHz WLAN Ant 1	N/A	N/A	Yes^	Yes	^ Bluetooth Tethering is considered

1. 2.4 GHz WLAN and 2.4 GHz Bluetooth share the same antenna path and cannot transmit simultaneously.
2. All licensed modes share the same antenna path and cannot transmit simultaneously.
3. 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.

4. Per the manufacturer, WIFI Direct is not 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.
5. 5 GHz Wireless Router is only supported for the U-NII-3 by S/W, therefore U-NII-1, U-NII2A, and U-NII2C were not evaluated for wireless router conditions.
6. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac/ax. 802.11a/g/n/ac/ax supports CDD and STBC and 802.11n/ac/ax additionally supports SDM. 2.4 GHz WLAN antenna can transmit independently or together when operating with MIMO.
7. This device supports VoWIFI.
8. This device supports Bluetooth Tethering.
9. This device supports VoLTE.
10. LTE + 5G NR FR1 Scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR1 checklist.
11. 5G NR FR2 n260 and n261 cannot transmit simultaneously.
12. LTE + 5G NR FR2 Scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR2 checklist.

1.8 Miscellaneous SAR Test Considerations

(A) WIFI/BT

There were not changes made to the WIFI and BT operations within this device. Please see original filing for 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 filling for complete evaluation of all other operating modes. The operational description includes a description of all changed items.

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 NR capabilities with overlapping transmission frequency ranges. When the supported frequency range of an NR Band falls completely within an NR band with a larger transmission frequency range, both NR bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both NR bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.

NR implementation supports SA and NSA mode. In EN-DC mode, NR 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.

1.9 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D05v02r04, D05Av01r02
- 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)
- FCC KDB Publication 616217 D04v01r02 (Proximity Sensor)

1.10 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.

1.11 Bibliography

Report Type	Report Serial Number
RF Exposure Part 0 Test Report	1M2112280172-02.A3L
Original RF Exposure Part 1 Test Report	1M2107290086-21.A3L (Rev1)

2 LTE AND NR INFORMATION

LTE Information					
Form Factor	Portable Handset				
Frequency Range of each LTE transmission band	LTE Band 71 (665.5 - 695.5 MHz)				
	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 26 (Cell) (814.7 - 848.3 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 25 (PCS) (1850.7 - 1914.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
	LTE Band 30 (2307.5 - 2312.5 MHz)				
	LTE Band 7 (2502.5 - 2567.5 MHz)				
	LTE Band 48 (3552.5 - 3697.5 MHz)				
	LTE Band 41 (2498.5 - 2687.5 MHz)				
	LTE Band 38 (2572.5 - 2617.5 MHz)				
Channel Bandwidths	LTE Band 71: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	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 26 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 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 25 (PCS): 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 7: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 48: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 38: 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Numbers and Frequencies (MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 71: 5 MHz	665.5 (133147)		680.5 (133297)	695.5 (133447)	
LTE Band 71: 10 MHz	668 (133172)		680.5 (133297)	693 (133422)	
LTE Band 71: 15 MHz	670.5 (133197)		680.5 (133297)	690.5 (133397)	
LTE Band 71: 20 MHz	673 (133222)		680.5 (133297)	688 (133372)	
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 26 (Cell): 1.4 MHz	814.7 (26697)		831.5 (26865)	848.3 (27033)	
LTE Band 26 (Cell): 3 MHz	815.5 (26705)		831.5 (26865)	847.5 (27025)	
LTE Band 26 (Cell): 5 MHz	816.5 (26715)		831.5 (26865)	846.5 (27015)	
LTE Band 26 (Cell): 10 MHz	819 (26740)		831.5 (26865)	844 (26990)	
LTE Band 26 (Cell): 15 MHz	821.5 (26765)		831.5 (26865)	841.5 (26965)	
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 25 (PCS): 1.4 MHz	1850.7 (26047)		1882.5 (26365)	1914.3 (26683)	
LTE Band 25 (PCS): 3 MHz	1851.5 (26055)		1882.5 (26365)	1913.5 (26675)	
LTE Band 25 (PCS): 5 MHz	1852.5 (26065)		1882.5 (26365)	1912.5 (26665)	
LTE Band 25 (PCS): 10 MHz	1855 (26090)		1882.5 (26365)	1910 (26640)	
LTE Band 25 (PCS): 15 MHz	1857.5 (26115)		1882.5 (26365)	1907.5 (26615)	
LTE Band 25 (PCS): 20 MHz	1860 (26140)		1882.5 (26365)	1905 (26590)	
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 7: 5 MHz	2502.5 (20775)		2535 (21100)	2567.5 (21425)	
LTE Band 7: 10 MHz	2505 (20800)		2535 (21100)	2565 (21400)	
LTE Band 7: 15 MHz	2507.5 (20825)		2535 (21100)	2562.5 (21375)	
LTE Band 7: 20 MHz	2510 (20850)		2535 (21100)	2560 (21350)	
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)
LTE Band 38: 5 MHz	2572.5 (37775)		2595 (38000)	2617.5 (38225)	
LTE Band 38: 10 MHz	2575 (37800)		2595 (38000)	2615 (38200)	
LTE Band 38: 15 MHz	2577.5 (37825)		2595 (38000)	2612.5 (38175)	
LTE Band 38: 20 MHz	2580 (37850)		2595 (38000)	2610 (38150)	
UE Category	DL UE Cat 20, UL UE Cat 18				
Modulations Supported in UL	QPSK, 16QAM, 64QAM, 256QAM				
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 16. It supports carrier aggregation, downlink MIMO, LAA features as shown in Section 9 and Appendix F. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. The following LTE Release 16 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 n71 (665.5 - 695.5 MHz)					
	NR Band n12 (701.5 - 713.5 MHz)					
	NR Band n5 (Cell) (826.5 - 846.5 MHz)					
	NR Band n66 (AWS) (1712.5 - 1777.5 MHz)					
	NR Band n25 (PCS) (1852.5 - 1912.5 MHz)					
	NR Band n2 (PCS) (1852.5 - 1907.5 MHz)					
	NR Band n30 (2307.5 - 2312.5 MHz)					
	NR Band n41 (2506.02 - 2679.99 MHz)					
	NR Band n77 DoD (3460.02 - 3540 MHz)					
	NR Band n77 (3710.01 - 3969.99 MHz)					
Channel Bandwidths	NR Band n71 5 MHz, 10 MHz, 15 MHz, 20 MHz					
	NR Band n12: 5 MHz, 10 MHz, 15 MHz					
	NR Band n5 (Cell): 5 MHz, 10 MHz, 15 MHz, 20 MHz					
	NR Band n66 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz					
	NR Band n25 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz					
	NR Band n2 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz					
	NR Band n30: 5 MHz, 10 MHz					
	NR Band n41: 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 80 MHz, 90 MHz, 100 MHz					
	NR Band n77 DoD: 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz					
	NR Band n77: 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz					
Channel Numbers and Frequencies (MHz)						
NR Band n71: 5 MHz	665.5 (133147)		680.5 (136100)		695.5 (133447)	
NR Band n71: 10 MHz	668 (133600)		680.5 (136100)		693 (138600)	
NR Band n71: 15 MHz	670.5 (134100)		680.5 (136100)		690.5 (138100)	
NR Band n71: 20 MHz	673 (134600)		680.5 (136100)		688 (137600)	
NR Band n12: 5 MHz	701.5 (140300)		707.5 (141500)		713.5 (142700)	
NR Band n12: 10 MHz	704 (140800)		707.5 (141500)		711 (142200)	
NR Band n12: 15 MHz	706.5 (141300)		707.5 (141500)		708.5 (141700)	
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 n66 (AWS): 30 MHz	1725 (345000)		1745 (349000)		1765 (353000)	
NR Band n66 (AWS): 40 MHz	1730 (346000)		1745 (349000)		1760 (352000)	
NR Band n25 (PCS): 5 MHz	1852.5 (370500)		1882.5 (376500)		1912.5 (382500)	
NR Band n25 (PCS): 10 MHz	1855 (371000)		1882.5 (376500)		1910 (382000)	
NR Band n25 (PCS): 15 MHz	1857.5 (371500)		1882.5 (376500)		1907.5 (381500)	
NR Band n25 (PCS): 20 MHz	1860 (372000)		1882.5 (376500)		1905 (381000)	
NR Band n25 (PCS): 25 MHz	1862.5 (372500)		1882.5 (376500)		1902.5 (380500)	
NR Band n25 (PCS): 30 MHz	1865 (373000)		1882.5 (376500)		1900 (380000)	
NR Band n25 (PCS): 40 MHz	1870 (374000)		1882.5 (376500)		1895 (379000)	
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)	
NR Band n30: 5 MHz	2307.5 (461500)		2310 (462000)		2312.5 (462500)	
NR Band n30: 10 MHz	N/A		2310 (462000)		N/A	
NR Band n41: 20 MHz	2506.02 (501204)	2549.49 (509898)	2592.99 (518598)		2636.49 (527298)	2679.99 (535998)
NR Band n41: 30 MHz	2511 (502200)	2552.01 (510402)	2592.99 (518598)		2634 (526800)	2674.98 (534996)
NR Band n41: 40 MHz	2516.01 (503202)	2567.34 (513468)	N/A		2618.67 (523734)	2670 (534000)
NR Band n41: 50 MHz	2521.02 (504204)		2592.99 (518598)		2664.99 (532998)	
NR Band n41: 60 MHz	2526 (505200)		2592.99 (518598)		2659.98 (531996)	
NR Band n41: 80 MHz	2536.02 (507204)		N/A		2649.99 (529998)	
NR Band n41: 90 MHz	2541 (508200)		N/A		2644.98 (528996)	
NR Band n41: 100 MHz	2546.01 (509202)		2592.99 (518598)		2640 (528000)	
NR Band n77 DoD: 20 MHz	3460.02 (630668)		3500.01 (633334)		3540 (636000)	
NR Band n77 DoD: 30 MHz	3465 (631000)		3500.01 (633334)		3534.99 (635666)	
NR Band n77 DoD: 40 MHz	3470.01 (631334)		N/A		3529.98 (635332)	
NR Band n77 DoD: 50 MHz	3475.02 (631668)		N/A		3525 (635000)	
NR Band n77 DoD: 60 MHz	N/A		3500.01 (633334)		N/A	
NR Band n77 DoD: 70 MHz	N/A		3500.01 (633334)		N/A	
NR Band n77 DoD: 80 MHz	N/A		3500.01 (633334)		N/A	
NR Band n77 DoD: 90 MHz	N/A		3500.01 (633334)		N/A	
NR Band n77 DoD: 100 MHz	N/A		3500.01 (633334)		N/A	
NR Band n77: 20 MHz	3710.01 (647334)	3762 (650800)	3813.99 (654266)	3866.01 (657734)	3918 (661200)	3969.99 (664666)
NR Band n77: 30 MHz	3715.02 (647668)	3765 (651000)	3815.01 (654334)	3864.99 (657666)	3915 (661000)	3964.98 (664332)
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		3876.66 (658444)	3949.98 (663332)
NR Band n77: 70 MHz	3735 (649000)	3804.99 (653666)	N/A		3875.01 (658334)	3945 (663000)
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	3930 (662000)
SCS for NR Band n71/n12/n5/n66/n25/n2/n30	15 kHz					
SCS for NR Band n41//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 n71	LTE Band 66/2					
LTE Anchor Bands for NR Band n12	LTE Band 66/2					
LTE Anchor Bands for NR Band n5 (Cell)	LTE Band 66/2/30/48					
LTE Anchor Bands for NR Band n66 (AWS)	LTE Band 2/5/12/13/14/30/48					
LTE Anchor Bands for NR Band n25 (PCS)	LTE Band 12/66					
LTE Anchor Bands for NR Band n2 (PCS)	LTE Band 5/12/13/14/30/48/66					
LTE Anchor Bands for NR Band n30	LTE Band 12/14/5					
LTE Anchor Bands for NR Band n41	LTE Band 12/66/25/2/41					
LTE Anchor Bands for NR Band n77 DoD/n77	LTE Band 2/5/12/13/14/30/66					

NR Information					
Form Factor	Portable Handset				
Frequency Range of each NR transmission band	NR Band n48 (3555 - 3694.98 MHz)				
Channel Bandwidths	NR Band n48: 10 MHz, 20 MHz, 40 MHz				
Channel Numbers and Frequencies (MHz)					
NR Band n48: 10 MHz	3555 (637000)	3601.68 (640112)	N/A	3648.33 (643222)	3694.98 (646332)
NR Band n48: 20 MHz	3560.01 (637334)	3603.33 (640222)	N/A	3646.68 (643112)	3690 (646000)
NR Band n48: 40 MHz	3570 (638000)	N/A	3624.99 (641666)	N/A	3679.98 (645332)
SCS for NR Band n48	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 n48	LTE Band 66/2				

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:

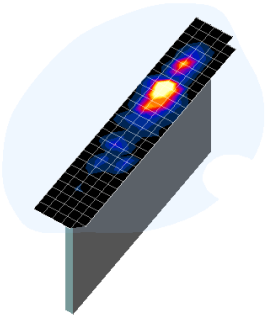

Figure 4-1
Sample SAR Area Scan

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].

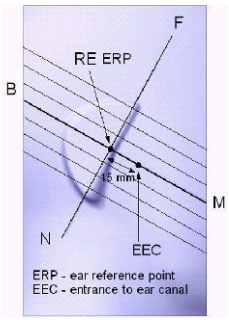

Figure 5-1
Close-Up Side view of ERP

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.

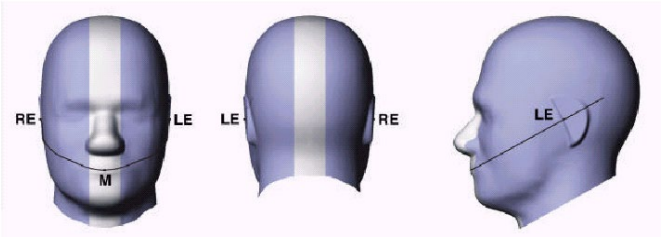

Figure 5-2
Front, back and side view of SAM Twin Phantom

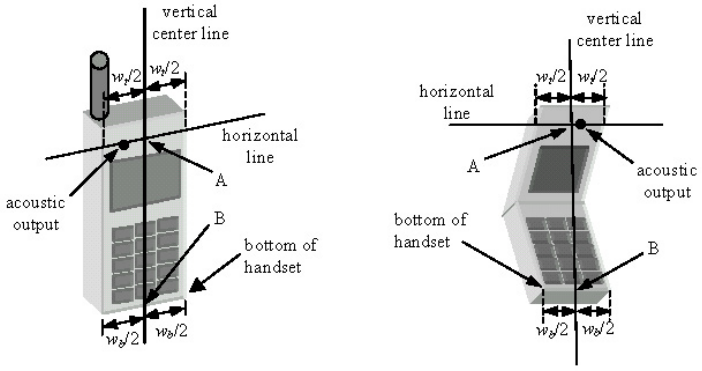

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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.

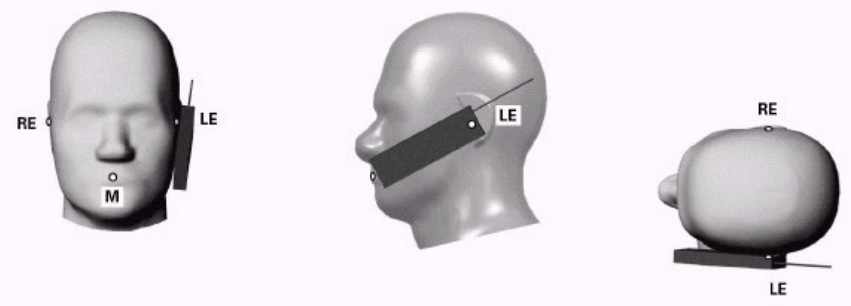

Figure 6-1 Front, Side and Top View of Cheek Position

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).

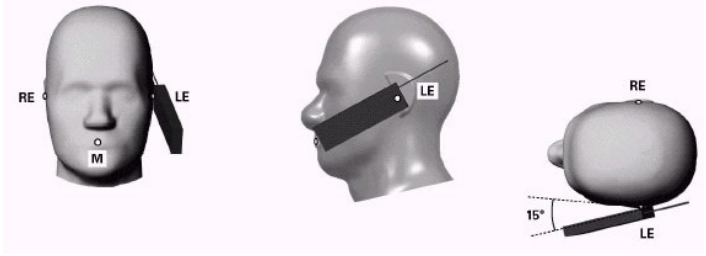

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

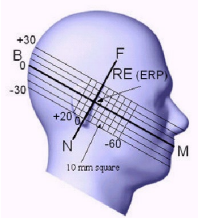

Figure 6-3
Side view w/ relevant markings

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.

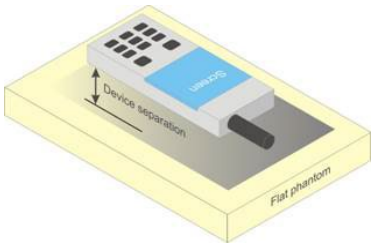

Figure 6-4
Sample Body-Worn Diagram

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. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna <=25 mm from that surface or edge, in direct contact with the phantom, for 10g SAR. The UMPC mini-tablet 1g SAR at 5 mm is not required. When hotspot mode applies, 10g SAR is required only for the surfaces and edges with hotspot mode 1g SAR > 1.2 W/kg.

6.9 Proximity Sensor Considerations

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

When the device's antenna is within a certain distance of the user, the sensor activates and reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, additional evaluation is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level. FCC KDB Publication 616217 D04v01r02 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional test positions. Sensor triggering distance summary data is included in Appendix G.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antennas.

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.

9 RF CONDUCTED POWERS

All conducted power measurements for 2G/3G/4G/5G Sub6 WWAN technologies and bands in this section were performed by setting Reserve_power_margin (Qualcomm® Smart Transmit EFS entry) to 0dB, so that the EUT transmits continuously at minimum (Plimit, maximum tune up output power Pmax).

9.1 NR Conducted Powers

Per October 2020 TCB Workshop Guidance, NR FR1 SAR evaluations are being generally based on adapting the existing LTE SAR procedures (FCC KDB Publication 941225 D05v02r05). Therefore, NR SAR for the lower bandwidths was not required for testing based on the measured output power and the reported NR SAR for the highest bandwidth. Lower bandwidth conducted powers for NR band n48 can be found in appendix F.

Note: Some bands do not support non-overlapping channels. Per FCC Guidance, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

9.1.1 NR Band n48

Table 9-1
NR Band n48 Measured P_{Limit} for DSI = 0/1 (Body-worn, or Phablet with grip sensor active) and/or DSI = 4 (Earjack Active) - 40 MHz Bandwidth

NR Band n48 40 MHz Bandwidth							
			Channel			MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	638000 (3570 MHz)	641666 (3624.99 MHz)	645332 (3679.98 MHz)		
			Conducted Power [dBm]				
DFT-s-OFDM π/2 BPSK	1	1	18.50	18.65	18.84	0	0.0
	1	53	18.42	18.53	18.70		0.0
	1	104	18.54	18.76	18.89		0.0
	50	0	18.41	18.76	18.77	0-0.5	0.0
	50	28	18.47	18.62	18.76	0	0.0
	50	56	18.58	18.67	18.85	0-0.5	0.0
	100	0	18.52	18.65	18.76		0.0
DFT-s-OFDM QPSK	1	1	18.58	18.76	18.80	0	0.0
	1	53	18.59	18.57	18.67		0.0
	1	104	18.60	18.79	**18.91**		0.0
	50	0	18.45	18.60	18.78	0-1	0.0
	50	28	18.49	18.61	18.76	0	0.0
	50	56	18.59	18.64	**18.86**	0-1	0.0
	100	0	18.49	18.63	18.82		0.0
DFT-s-OFDM 16QAM	1	1	18.52	18.72	18.50	0-1	0.0
CP-OFDM QPSK	1	1	18.45	18.63	18.82	0-1.5	0.0

Table 9-2
NR Band n48 Measured P_{Limit} for DSI = 2 (Head) - 40 MHz Bandwidth

NR Band n48 40 MHz Bandwidth							
			Channel			MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	638000 (3570 MHz)	641666 (3624.99 MHz)	645332 (3679.98 MHz)		
			Conducted Power [dBm]				
DFT-s-OFDM π/2 BPSK	1	1	15.06	15.28	15.38	0	0.0
	1	53	14.99	15.28	15.31		0.0
	1	104	15.25	15.33	15.51		0.0
	50	0	15.08	15.31	15.37	0-0.5	0.0
	50	28	15.05	15.24	15.37	0	0.0
	50	56	15.26	15.26	15.46	0-0.5	0.0
	100	0	15.09	15.25	15.41		0.0
DFT-s-OFDM QPSK	1	1	15.14	15.19	15.41	0	0.0
	1	53	15.13	15.20	15.39		0.0
	1	104	15.16	15.37	**15.63**		0.0
	50	0	15.05	15.26	15.41	0-1	0.0
	50	28	15.07	15.18	15.37	0	0.0
	50	56	15.24	15.28	**15.48**	0-1	0.0
	100	0	15.10	15.24	15.44		0.0
DFT-s-OFDM 16QAM	1	1	15.10	15.18	15.38	0-1	0.0
CP-OFDM QPSK	1	1	15.05	15.15	15.35	0-1.5	0.0

Table 9-3
NR Band n48 Measured P_{Limit} for DSI = 3 (Hotspot) - 40 MHz Bandwidth

NR Band n48 40 MHz Bandwidth							
			Channel			MPR Allowed per 3GPP [dB]	MPR [dB]
Modulation	RB Size	RB Offset	638000 (3570 MHz)	641666 (3624.99 MHz)	645332 (3679.98 MHz)		
			Conducted Power [dBm]				
DFT-s-OFDM π/2 BPSK	1	1	17.60	17.69	17.96	0	0.0
	1	53	17.57	17.70	17.95		0.0
	1	104	17.78	17.84	18.08		0.0
	50	0	17.65	17.75	17.93	0-0.5	0.0
	50	28	17.62	17.76	17.87	0	0.0
	50	56	17.81	17.83	17.96	0-0.5	0.0
	100	0	17.70	17.86	17.91		0.0
DFT-s-OFDM QPSK	1	1	17.61	17.82	17.89	0	0.0
	1	53	17.73	17.76	17.81		0.0
	1	104	17.87	17.97	**18.20**		0.0
	50	0	17.62	17.85	17.87	0-1	0.0
	50	28	17.64	17.82	17.87	0	0.0
	50	56	17.79	17.90	**18.25**	0-1	0.0
	100	0	17.65	17.87	18.19		0.0
DFT-s-OFDM 16QAM	1	1	17.63	17.85	17.90	0-1	0.0
CP-OFDM QPSK	1	1	17.61	17.80	18.30	0-1.5	0.0

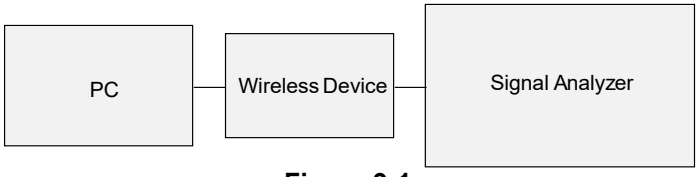

Figure 9-1
Power Measurement Setup – NR TDD

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
12/21/2021	3600 Head	18.5	3300	2.690	38.954	2.708	38.157	-0.66%	2.09%
			3350	2.735	38.857	2.759	38.100	-0.87%	1.99%
			3450	2.830	38.675	2.861	37.986	-1.08%	1.81%
			3500	2.879	38.570	2.913	37.929	-1.17%	1.69%
			3550	2.925	38.494	2.964	37.871	-1.32%	1.65%
			3560	2.936	38.460	2.974	37.860	-1.28%	1.58%
			3600	2.975	38.392	3.015	37.814	-1.33%	1.53%
			3650	3.025	38.290	3.066	37.757	-1.34%	1.41%
			3690	3.065	38.219	3.107	37.711	-1.35%	1.35%
			3700	3.075	38.206	3.117	37.700	-1.35%	1.34%
			3750	3.128	38.111	3.169	37.643	-1.29%	1.24%
			3900	3.281	37.842	3.323	37.471	-1.26%	0.99%
			3930	3.317	37.787	3.353	37.437	-1.07%	0.93%
			4100	3.499	37.492	3.528	37.243	-0.82%	0.67%
			4150	3.555	37.394	3.579	37.186	-0.67%	0.56%
12/14/2021	3600 Body	20.2	3300	3.018	51.351	3.080	51.593	-2.01%	-0.47%
			3350	3.076	51.243	3.139	51.525	-2.01%	-0.55%
			3450	3.193	51.048	3.256	51.389	-1.93%	-0.66%
			3500	3.251	50.966	3.314	51.321	-1.90%	-0.69%
			3550	3.311	50.890	3.372	51.254	-1.81%	-0.71%
			3560	3.323	50.869	3.384	51.240	-1.80%	-0.72%
			3600	3.372	50.800	3.431	51.186	-1.72%	-0.75%
			3650	3.434	50.715	3.489	51.118	-1.58%	-0.79%
			3690	3.484	50.645	3.536	51.063	-1.47%	-0.82%
			3700	3.496	50.624	3.548	51.050	-1.47%	-0.83%
			3750	3.561	50.546	3.606	50.982	-1.25%	-0.86%
			3900	3.759	50.280	3.781	50.779	-0.58%	-0.98%
			3930	3.799	50.243	3.816	50.738	-0.45%	-0.98%
			4100	4.032	49.917	4.015	50.507	0.42%	-1.17%
			4150	4.103	49.823	4.073	50.439	0.74%	-1.22%
02/07/2022	3600 Body	21.0	3300	2.955	49.479	3.080	51.593	-4.06%	-4.10%
			3350	3.010	49.425	3.139	51.525	-4.11%	-4.08%
			3450	3.120	49.263	3.256	51.389	-4.18%	-4.14%
			3500	3.175	49.188	3.314	51.321	-4.19%	-4.16%
			3550	3.230	49.108	3.372	51.254	-4.21%	-4.19%
			3560	3.240	49.101	3.384	51.240	-4.26%	-4.17%
			3600	3.284	49.042	3.431	51.186	-4.28%	-4.19%
			3650	3.337	48.959	3.489	51.118	-4.36%	-4.22%
			3690	3.382	48.872	3.536	51.063	-4.36%	-4.29%
			3700	3.393	48.854	3.548	51.050	-4.37%	-4.30%
			3750	3.451	48.763	3.606	50.982	-4.30%	-4.35%
			3900	3.631	48.439	3.781	50.779	-3.97%	-4.61%
			3930	3.670	48.372	3.816	50.738	-3.83%	-4.66%
			4100	3.896	48.067	4.015	50.507	-2.96%	-4.83%
			4150	3.964	47.972	4.073	50.439	-2.68%	-4.89%

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 SAR1g (W/kg)	1W Target SAR1g (W/kg)	1W Normalized SAR 1g (W/kg)	Deviation1g (%)
L	3500	HEAD	12/21/2021	20.9	18.4	0.10	1097	7670	6.450	66.40	64.500	-2.86%
L	3700	HEAD	12/21/2021	20.9	18.4	0.10	1067	7670	6.860	67.20	68.600	2.08%
I	3500	BODY	12/14/2021	20.1	20.5	0.10	1059	7661	6.290	63.00	62.900	-0.16%
I	3500	BODY	02/07/2022	21.3	21.0	0.10	1097	7661	6.480	64.20	64.800	0.93%
I	3700	BODY	12/14/2021	20.1	20.5	0.10	1018	7661	6.400	63.50	64.000	0.79%
I	3700	BODY	02/07/2022	21.3	21.0	0.10	1018	7661	6.450	63.50	64.500	1.57%

Table 10-3
System Verification Results – 10g

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 SAR10g (W/kg)	1W Target SAR10g (W/kg)	1W Normalized SAR10g (W/kg)	Deviation10g (%)
I	3500	BODY	02/07/2022	21.3	21.0	0.10	1097	7661	2.430	23.80	24.300	2.10%
I	3700	BODY	02/07/2022	21.3	21.0	0.10	1018	7661	2.360	22.50	23.600	4.89%

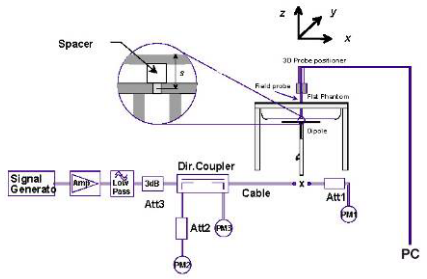

Figure 10-1
System Verification Setup Diagram

Figure 10-2
System Verification Setup Photo

11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
NR Band n48 Head SAR

MEASUREMENT RESULTS																							
FREQUENCY			Mode	Bandwidth [MHz]	Form Factor	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Antenna Config	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)	
3570.00	638000	Low	NR Band n48	40	Open	16.0	15.16	F	0.10	0	Right	Cheek	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.525	1.213	0.637	
3624.99	641666	Mid	NR Band n48	40	Open	16.0	15.37	F	-0.02	0	Right	Cheek	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.673	1.156	**0.778**	A1
3679.98	645332	High	NR Band n48	40	Open	16.0	15.63	F	-0.19	0	Right	Cheek	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.598	1.089	0.651	
3570.00	638000	Low	NR Band n48	40	Open	16.0	15.24	F	0.05	0	Right	Cheek	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.526	1.191	0.626	
3624.99	641666	Mid	NR Band n48	40	Open	16.0	15.28	F	0.00	0	Right	Cheek	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.649	1.180	0.766	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.48	F	0.07	0	Right	Cheek	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.606	1.127	0.683	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.44	F	0.04	0	Right	Cheek	DFT-S-OFDM	QPSK	100	0	1456M	1:1	0.604	1.138	0.687	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.35	F	0.03	0	Right	Cheek	CP-OFDM	QPSK	1	1	1456M	1:1	0.612	1.161	0.711	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.63	F	0.08	0	Right	Tilt	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.524	1.089	0.571	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.48	F	0.08	0	Right	Tilt	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.509	1.127	0.574	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.63	F	0.00	0	Left	Cheek	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.175	1.089	0.191	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.48	F	0.05	0	Left	Cheek	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.171	1.127	0.193	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.63	F	0.15	0	Left	Tilt	DFT-S-OFDM	QPSK	1	104	1456M	1:1	0.108	1.089	0.118	
3679.98	645332	High	NR Band n48	40	Open	16.0	15.48	F	0.09	0	Left	Tilt	DFT-S-OFDM	QPSK	50	56	1456M	1:1	0.116	1.127	0.131	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population															Head 1.6 W/kg (mW/g) averaged over 1 gram							

11.2 Standalone Body-Worn SAR Data

Table 11-2
NR Band n48 Body-Worn SAR

MEASUREMENT RESULTS																						
FREQUENCY			Mode	Bandwidth [MHz]	Cover Type	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Antenna Config	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)	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.91	F	0.00	0	1456M	DFT-S-OFDM	QPSK	1	104	15 mm	back	1:1	0.137	1.146	0.157	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.86	F	-0.05	0	1456M	DFT-S-OFDM	QPSK	50	56	15 mm	back	1:1	0.148	1.159	**0.172**	A2
3679.98	645332	High	NR Band n48	40	Open	19.5	18.82	F	0.05	0	1456M	CP-OFDM	QPSK	1	1	15 mm	back	1:1	0.146	1.169	0.171	
3679.98	645332	High	NR Band n48	40	Closed	19.5	18.91	F	-0.14	0	1456M	DFT-S-OFDM	QPSK	1	104	15 mm	back	1:1	0.055	1.146	0.063	
3679.98	645332	High	NR Band n48	40	Closed	19.5	18.86	F	-0.18	0	1456M	DFT-S-OFDM	QPSK	50	56	15 mm	back	1:1	0.050	1.159	0.058	
3679.98	645332	High	NR Band n48	40	Closed	19.5	18.82	F	-0.20	0	1456M	CP-OFDM	QPSK	1	1	15 mm	back	1:1	0.053	1.169	0.062	
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 11-3
NR Band n48 Hotspot SAR

MEASUREMENT RESULTS																							
FREQUENCY			Mode	Bandwidth [MHz]	Form Factor	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Antenna Config	Power Drift [dB]	MPR [dB]	Serial Number	Waveform	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g) (W/kg)	Scaling Factor	Reported SAR (1g) (W/kg)	Plot #
MHz	Ch.																						
3679.98	645332	High	NR Band n48	40	Open	18.5	18.20	F	0.01	0	1456M	DFT-S-OFDM	QPSK	1	104	10 mm	back	1:1	0.235	1.072	0.252	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.25	F	0.01	0	1456M	DFT-S-OFDM	QPSK	50	56	10 mm	back	1:1	0.230	1.059	0.244	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.20	F	-0.01	0	1456M	DFT-S-OFDM	QPSK	1	104	10 mm	front	1:1	0.213	1.072	0.228	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.25	F	0.00	0	1456M	DFT-S-OFDM	QPSK	50	56	10 mm	front	1:1	0.211	1.059	0.223	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.20	F	-0.12	0	1456M	DFT-S-OFDM	QPSK	1	104	10 mm	top	1:1	0.202	1.072	0.217	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.25	F	-0.05	0	1456M	DFT-S-OFDM	QPSK	50	56	10 mm	top	1:1	0.200	1.059	0.212	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.20	F	-0.05	0	1456M	DFT-S-OFDM	QPSK	1	104	10 mm	left	1:1	0.335	1.072	0.359	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.25	F	0.01	0	1456M	DFT-S-OFDM	QPSK	50	56	10 mm	left	1:1	0.337	1.059	0.357	
3679.98	645332	High	NR Band n48	40	Open	18.5	18.30	F	-0.01	0	1456M	CP-OFDM	QPSK	1	1	10 mm	left	1:1	0.354	1.047	0.371	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.20	F	-0.11	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	back	1:1	0.102	1.072	0.109	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.25	F	0.05	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	back	1:1	0.104	1.059	0.110	
3570.00	638000	Low	NR Band n48	40	Closed	18.5	17.87	F	-0.02	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	front	1:1	0.545	1.156	0.630	
3624.99	641666	Mid	NR Band n48	40	Closed	18.5	17.97	F	0.05	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	front	1:1	0.551	1.130	0.623	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.20	F	-0.11	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	front	1:1	0.560	1.072	0.600	
3570.00	638000	Low	NR Band n48	40	Closed	18.5	17.79	F	0.01	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	front	1:1	0.523	1.178	0.616	
3624.99	641666	Mid	NR Band n48	40	Closed	18.5	17.90	F	0.08	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	front	1:1	0.560	1.148	0.643	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.25	F	-0.07	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	front	1:1	0.551	1.059	0.584	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.19	F	-0.01	0	1456M	DFT-S-OFDM	QPSK	100	0	5 mm	front	1:1	0.561	1.074	0.603	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.20	F	0.10	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	bottom	1:1	0.297	1.072	0.318	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.25	F	0.17	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	bottom	1:1	0.313	1.059	0.331	
3570.00	638000	Low	NR Band n48	40	Closed	18.5	17.87	F	0.12	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	left	1:1	0.775	1.156	0.896	
3624.99	641666	Mid	NR Band n48	40	Closed	18.5	17.97	F	0.09	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	left	1:1	0.933	1.130	1.054	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.20	F	0.00	0	1456M	DFT-S-OFDM	QPSK	1	104	5 mm	left	1:1	0.932	1.072	0.999	
3570.00	638000	Low	NR Band n48	40	Closed	18.5	17.79	F	0.09	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	left	1:1	0.870	1.178	1.025	
3624.99	641666	Mid	NR Band n48	40	Closed	18.5	17.90	F	0.00	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	left	1:1	0.932	1.148	**1.070**	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.25	F	0.00	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	left	1:1	0.931	1.059	0.986	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.19	F	0.00	0	1456M	DFT-S-OFDM	QPSK	100	0	5 mm	left	1:1	0.917	1.074	0.985	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.30	F	0.07	0	1456M	CP-OFDM	QPSK	1	1	5 mm	left	1:1	1.010	1.047	1.057	A3
3570.00	638000	Low	NR Band n48	40	Closed	18.5	17.79	F	0.06	0	1456M	DFT-S-OFDM	QPSK	50	56	5 mm	left	1:1	0.806	1.178	0.949	
3679.98	645332	High	NR Band n48	40	Closed	18.5	18.30	F	0.00	0	1456M	CP-OFDM	QPSK	1	1	5 mm	left	1:1	1.010	1.047	1.057	
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: Blue Entries represent variability measurement.

11.4 Standalone Phablet SAR Data

Table 11-4
NR Band n48 Phablet SAR Data

MEASUREMENT RESULTS																							
FREQUENCY			Mode	Bandwidth [MHz]	Form Factor	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Antenna Config	Power Drift [dB]	MPR [dB]	Serial Number	Waveform	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (10g) (W/kg)	Scaling Factor	Reported SAR (10g) (W/kg)	Plot #
MHz	Ch.																						
3570.00	638000	Low	NR Band n48	40	Open	19.5	18.60	F	0.03	0	1456M	DFT-S-OFDM	QPSK	1	104	0 mm	left	1:1	2.250	1.230	2.768	
3624.99	641666	Mid	NR Band n48	40	Open	19.5	18.79	F	0.11	0	1456M	DFT-S-OFDM	QPSK	1	104	0 mm	left	1:1	2.300	1.178	2.709	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.91	F	0.05	0	1456M	DFT-S-OFDM	QPSK	1	104	0 mm	left	1:1	2.440	1.146	2.796	
3570.00	638000	Low	NR Band n48	40	Open	19.5	18.59	F	0.04	0	1456M	DFT-S-OFDM	QPSK	50	56	0 mm	left	1:1	2.060	1.233	2.540	
3624.99	641666	Mid	NR Band n48	40	Open	19.5	18.64	F	0.12	0	1456M	DFT-S-OFDM	QPSK	50	56	0 mm	left	1:1	2.360	1.219	2.877	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.86	F	0.15	0	1456M	DFT-S-OFDM	QPSK	50	56	0 mm	left	1:1	2.330	1.159	2.700	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.82	F	0.01	0	1456M	DFT-S-OFDM	QPSK	100	0	0 mm	left	1:1	2.380	1.169	2.782	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.82	F	0.07	0	1456M	CP-OFDM	QPSK	1	1	0 mm	left	1:1	2.570	1.169	**3.004**	A4
3570.00	638000	Low	NR Band n48	40	Open	19.5	18.60	F	0.05	0	1456M	DFT-S-OFDM	QPSK	1	104	0 mm	left	1:1	2.150	1.230	2.645	
3679.98	645332	High	NR Band n48	40	Open	19.5	18.82	F	0.03	0	1456M	CP-OFDM	QPSK	1	1	0 mm	left	1:1	2.460	1.169	2.876	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population													Phablet 4.0 W/kg (mW/g) averaged over 10 grams										

Note: Blue Entries represent variability measurement.

11.5 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 manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 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.
7. 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.
8. 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.
9. 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).
10. 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.
11. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
12. Additional SAR tests for phablet SAR were evaluated per KDB 616217 Section 6 (See Section 6.9 for more information).
13. This device has an open and closed configuration. When closed, 1g SAR test are required for back side at a test separation distance of 15mm for body-worn, and on all surfaces and edges with an antenna <=25 mm from that surface or edge at a test separation distance 10mm for hotspot.
14. 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 for was assessed at the minimum of the time averaged power and the maximum output power for each band/mode/exposure condition (DSI).

NR Notes:

1. NR implementation supports SA and NSA mode. In EN-DC mode, NR 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. Simultaneous transmission analysis for EN-DC operations is addressed in the Part 2 Test Report (Serial Number can be found in the bibliography of the original test report).
3. Due to test setup limitations, SAR testing for NR was performed using test mode software to establish the connection.
4. Simultaneous transmission analysis for EN-DC operations is included in Section 12. This device additionally supports some EN-DC conditions where additional LTE carriers are added on the downlink only. Per FCC guidance, all unique uplink combinations were assessed.
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.

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.

The standalone reported SAR in the original filing was used to determine simultaneous transmission compliance as it is more conservative. Please see the original filing for complete evaluation of simultaneous transmission analysis.

12.3 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis are sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528- 2013 Section 6.3.4.1.

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
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	Side	Spacing	Antenna Config	Form Factor	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)	
3500	3570.00	638000	NR Band n48, 40 MHz Bandwidth	DFT-S-OFDM, QPSK, 50 RB, 56 RB Offset	left	5 mm	F	Closed	0.870	0.806	1.08	N/A	N/A	N/A	N/A
3700	3679.98	645332	NR Band n48, 40 MHz Bandwidth	CP-OFDM, QPSK, 1 RB, 1 RB Offset	left	5 mm	F	Closed	1.010	1.010	1.00	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 13-2
Phablet SAR Measurement Variability Results

PHABLET VARIABILITY RESULTS															
Band	FREQUENCY		Mode	Service	Side	Spacing	Antenna Config	Form Factor	Measured SAR (10g)	1st Repeated SAR (10g)	Ratio	2nd Repeated SAR (10g)	Ratio	3rd Repeated SAR (10g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)		(W/kg)		(W/kg)	
3500	3570.00	638000	NR Band n48, 40 MHz Bandwidth	DFT-S-OFDM, QPSK, 1 RB, 104 RB Offset	left	0 mm	F	Open	2.250	2.150	1.05	N/A	N/A	N/A	N/A
3700	3679.98	645332	NR Band n48, 40 MHz Bandwidth	CP-OFDM, QPSK, 1 RB, 1 RB Offset	left	0 mm	F	Open	2.570	2.460	1.04	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT) Spatial Peak Uncontrolled Exposure/General Population									Phablet 4.0 W/kg (mW/g) averaged over 10 grams						

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	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	85033E	3.5mm Standard Calibration Kit	7/7/2021	Annual	7/7/2022	MY53402352
Agilent	E4438C	ESG Vector Signal Generator	12/14/2020	Biennial	12/14/2022	MY42082385
Agilent	N5182A	MXG Vector Signal Generator	6/21/2021	Annual	6/21/2022	MY47420603
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/19/2021	Annual	2/19/2022	MY40001472
Agilent	E5515C	Wireless Communications Test Set	5/6/2021	Annual	5/6/2022	GB44400860
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	353317
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	353468
Anritsu	MA24106A	USB Power Sensor	3/2/2021	Annual	3/2/2022	1244524
Anritsu	MA24106A	USB Power Sensor	3/3/2021	Annual	3/3/2022	1344556
Control Company	4352	Long Stem Thermometer	5/16/2020	Biennial	5/16/2022	200294409
Control Company	4352	Long Stem Thermometer	5/16/2020	Biennial	5/16/2022	200294416
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
Insize	1108-150	Digital Caliper	1/17/2020	Biennial	1/17/2022	409193536
Keysight Technologies	N9020A	MXA Signal Analyzer	2/24/2021	Annual	2/24/2022	MY48010233
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
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+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	1445
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
SPEAG	D3500V2	3500 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	1059
SPEAG	D3500V2	3500 MHz SAR Dipole	1/21/2020	Triennial	1/21/2023	1097
SPEAG	D3700V2	3700 MHz SAR Dipole	1/19/2021	Biennial	1/19/2023	1018
SPEAG	D3700V2	3700 MHz SAR Dipole	1/21/2020	Biennial	1/21/2022	1067
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/16/2021	Annual	8/16/2022	1450
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/3/2021	Annual	8/3/2022	1681
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/20/2021	Annual	10/20/2022	1091
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	N/A
SPEAG	EX3DV4	SAR Probe	8/5/2021	Annual	8/5/2022	7670
SPEAG	EX3DV4	SAR Probe	6/28/2021	Annual	6/28/2022	7661

Note: all equipment was used solely within its respective calibration period.
Note: 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	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System									
Probe Calibration	E.2.1	7	N	1	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞
Modulation Response	E.2.5	4.8	R	1.732	1	1	2.8	2.8	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	3.12	N	1	1	1	3.1	3.1	35
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)			RSS				12.2	12.0	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.4	24.0	

The above measurement uncertainties are according to IEEE Std. 1528-2013

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]

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