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# SAR EVALUATION REPORT

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

**Date of Testing:**
2/27/23
**Test Site/Location:**
Element, Columbia, MD, USA
**Document Serial No.:**
1M2302220014-01.A3L

**FCC ID:** **A3LSMS918U**

**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-S918U, SM-S918U1 |
| **Permissive Change(s):** | See FCC Change Document |
| **Date of Original Certification:** | 12/08/2022 |

| Equipment Class | Band & Mode | Tx Frequency | SAR 1g Head (W/kg) |
|---|---|---|---|
| PCE | NR Band n77 DoD | 3455.01 - 3544.98 MHz | 0.67 |
| PCE | NR Band n77 | 3705 - 3975 MHz | 0.83 |
| Simultaneous SAR per KDB 690783 D01v01r03: | | | 1.58 |

Only operations relevant to this permissive change were evaluated for compliance. Please see the original compliance evaluation in RF Exposure Technical Report S/N: 1M2209010098-03.A3L for complete evaluation of all other operating modes. The operation 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.

RJ Ortanez
Executive Vice 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 |
|---|---|---|
| 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 41 | Voice/Data | 2498.5 - 2687.5 MHz |
| LTE Band 38 | Voice/Data | 2572.5 - 2617.5 MHz |
| LTE Band 48 | Voice/Data | 3552.5 - 3697.5 MHz |
| NR Band n71 | Voice/Data | 665.5 - 695.5 MHz |
| NR Band n12 | Voice/Data | 701.5 - 713.5 MHz |
| NR Band n26 | Voice/Data | 816.5 - 846.5 MHz |
| NR Band n5 | Voice/Data | 826.5 - 846.5 MHz |
| NR Band n66 | Voice/Data | 1712.5 - 1777.5 MHz |
| NR Band n25 | Voice/Data | 1852.5 - 1912.5 MHz |
| NR Band n2 | Voice/Data | 1852.5 - 1907.5 MHz |
| NR Band n30 | Voice/Data | 2307.5 - 2312.5 MHz |
| NR Band n7 | Voice/Data | 2502.5 - 2567.5 MHz |
| NR Band n41 | Voice/Data | 2501.01 - 2685 MHz |
| NR Band n38 | Voice/Data | 2575 - 2615 MHz |
| NR Band n48 | Voice/Data | 3555 - 3694.98 MHz |
| NR Band n77 DoD | Voice/Data | 3455.01 - 3544.98 MHz |
| NR Band n77 | Voice/Data | 3705 - 3975 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 |
| U-NII-4 | Voice/Data | 5845 - 5885 MHz |
| U-NII-5 | Voice/Data | 5935 - 6415 MHz |
| U-NII-6 | Voice/Data | 6435 - 6515 MHz |
| U-NII-7 | Voice/Data | 6535 - 6875 MHz |
| U-NII-8 | Voice/Data | 6895 - 7115 MHz |
| Bluetooth | Data | 2402 - 2480 MHz |
| NFC | Data | 13.56 MHz |
| NR Band n258 | Data | 24250 - 24450 MHz; 24750 - 25250 MHz |
| NR Band n260 | Data | 37000 - 40000 MHz |
| NR Band n261 | Data | 27500 - 28350 MHz |
| UWB | Data | 6489.6 - 7987.2 MHz |

## 1.2 Time-Averaging Algorithm for RF Exposure Compliance

This Device is enabled with the Qualcomm® Smart Transmit Gen2 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).

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of *SAR_design_target* or *PD_design_target*, below the predefined time-averaged power limit (i.e., $P_{limit}$ for sub-6 radio, and *input.power.limit* for 5G mmW NR), for each characterized technology and band (see RF Exposure Part 0 Test Report, report SN can 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 Senario | | | Body-Worn | Extremity | Head | Hotspot | Maximum Tune-Up Output Power* |
|---|---|---|---|---|---|---|---|
| Averaging Volume | | | 1g | 10g | 1g | 1g | |
| Spacing | | | 15 mm | 0 mm | 0 mm | 10 mm | |
| DSI | | | 0 | 0 | 2 | 3 | |
| Technology/Band | Antenna | Antenna Group | | | | | Pmax |
| GSM 850 | A | AG0 | 28.5 | | 31.4 | 25.6 | 25.3 |
| GSM 1900 | A | AG0 | 20.0 | | 33.2 | 18.0 | 22.1 |
| UMTS 850 | A | AG0 | 27.4 | | 31.3 | 26.2 | 24.0 |
| UMTS 1750 | A | AG0 | 19.0 | | 31.8 | 19.0 | 23.0 |
| UMTS 1900 | A | AG0 | 19.5 | | 32.2 | 17.5 | 23.0 |
| LTE Band 71 | A | AG0 | 27.8 | | 34.3 | 27.8 | 24.5 |
| LTE Band 12 | A | AG0 | 27.5 | | 33.4 | 27.5 | 24.5 |
| LTE Band 13 | A | AG0 | 28.6 | | 31.9 | 27.6 | 24.5 |
| LTE Band 14 | A | AG0 | 27.9 | | 31.7 | 27.9 | 24.5 |
| LTE Band 26 (Cell) | A | AG0 | 27.6 | | 31.1 | 26.7 | 24.5 |
| LTE Band 5 (Cell) | A | AG0 | 27.8 | | 30.9 | 26.6 | 24.5 |
| LTE Band 66/4 (AWS) | A | AG0 | 20.0 | | 31.4 | 19.5 | 23.5 |
| LTE Band 66/4 (AWS) | F | AG1 | 20.0 | | 18.0 | 20.0 | 23.5 |
| LTE Band 25/2 (PCS) | A | AG0 | 20.0 | | 33.9 | 17.5 | 23.5 |
| LTE Band 25/2 (PCS) | F | AG1 | 18.0 | | 17.0 | 18.0 | 23.5 |
| LTE Band 30 | A | AG0 | 21.5 | | 33.2 | 19.0 | 22.5 |
| LTE Band 30 | F | AG1 | 20.0 | | 17.0 | 20.0 | 22.5 |
| LTE Band 7 | B | AG0 | 20.0 | | 37.7 | 20.0 | 23.0 |
| LTE Band 7 | F | AG1 | 18.5 | | 16.0 | 18.5 | 23.0 |
| LTE Band 48 | G | AG1 | 18.0 | | 16.0 | 18.0 | 20.5 |
| LTE Band 41/38 (PC3) | B | AG0 | 20.0 | | 22.0 | 20.0 | 22.0 |
| LTE Band 41 (PC2) | B | AG0 | 20.0 | | 22.0 | 20.0 | 22.1 |
| LTE Band 41/38 (PC3) | F | AG1 | 19.0 | | 17.0 | 19.0 | 22.0 |
| LTE Band 41 (PC2) | F | AG1 | 19.0 | | 17.0 | 19.0 | 22.1 |
| NR Band n71 | A | AG0 | 27.3 | | 33.7 | 27.3 | 24.5 |
| NR Band n12 | A | AG0 | 27.0 | | 32.8 | 27.0 | 24.5 |
| NR Band n26/n5 | A | AG0 | 27.4 | | 31.6 | 25.8 | 24.5 |
| NR Band n66 | A | AG0 | 20.0 | | 32.3 | 19.5 | 23.5 |
| NR Band n66 | F | AG1 | 20.0 | | 18.0 | 20.0 | 23.5 |
| NR Band n25/n2 (PCS) | A | AG0 | 20.0 | | 33.6 | 17.5 | 23.5 |
| NR Band n25/n2 (PCS) | F | AG1 | 20.0 | | 17.0 | 20.0 | 23.5 |
| NR Band n30 | A | AG0 | 21.5 | | 35.4 | 19.0 | 22.5 |
| NR Band n30 | F | AG1 | 20.0 | | 17.0 | 20.0 | 22.5 |
| NR Band n7 | B | AG0 | 20.0 | | 36.7 | 20.0 | 23.0 |
| NR Band n7 | F | AG1 | 18.5 | | 16.0 | 18.5 | 23.0 |
| NR Band n41 Path 1 (PC2) | F | AG1 | 19.0 | | 17.0 | 19.0 | 26.0 |
| NR Band n41 Path 1 (PC2) | B | AG0 | 17.0 | | 15.0 | 17.0 | 22.0 |
| NR Band n41 Path 1 (PC2) | E | AG1 | 15.0 | | 13.0 | 15.0 | 20.0 |
| NR Band n41 Path 1 (PC2) | D | AG0 | 16.5 | | 15.5 | 16.5 | 21.0 |
| NR Band n41 Path 2 (PC2) | B | AG0 | 19.0 | | 17.0 | 19.0 | 26.0 |
| NR Band n41 Path 2 (PC2) | F | AG1 | 17.0 | | 16.0 | 17.0 | 22.0 |
| NR Band n41 Path 2 (PC2) | D | AG0 | 16.0 | | 14.5 | 16.0 | 19.0 |
| NR Band n41 Path 2 (PC2) | E | AG1 | 14.0 | | 12.5 | 14.0 | 20.0 |
| NR Band n38 | F | AG1 | 19.0 | | 17.0 | 19.0 | 24.0 |
| NR Band n38 | B | AG0 | 19.0 | | 17.0 | 19.0 | 24.0 |
| NR Band n48 | G | AG1 | 18.0 | | 16.0 | 18.0 | 22.5 |
| NR Band n48 | C | AG0 | 13.5 | | 11.5 | 13.5 | 18.5 |
| NR Band n48 | I | AG1 | 15.5 | | 13.5 | 15.5 | 21.0 |
| NR Band n48 | D | AG0 | 13.5 | | 11.5 | 13.5 | 19.0 |
| NR Band n77 DoD (PC2) | G | AG1 | 18.0 | | 17.0 | 18.0 | 26.0 |
| NR Band n77 DoD (PC2) | C | AG0 | 14.0 | | 14.0 | 14.0 | 20.5 |
| NR Band n77 DoD (PC2) | I | AG1 | 17.0 | | 17.0 | 17.0 | 23.0 |
| NR Band n77 DoD (PC2) | D | AG0 | 14.5 | | 14.5 | 14.5 | 21.0 |
| NR Band n77 (PC2) | G | AG1 | 18.0 | | 17.0 | 18.0 | 26.0 |
| NR Band n77 (PC2) | C | AG0 | 14.0 | | 14.0 | 14.0 | 20.5 |
| NR Band n77 (PC2) | I | AG1 | 17.0 | | 17.0 | 17.0 | 23.0 |
| NR Band n77 (PC2) | D | AG0 | 14.5 | | 14.5 | 14.5 | 21.0 |

*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 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 D04v01.

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

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

## 1.3 Power Reduction for SAR

This device uses an independent fixed level power reduction mechanism for WLAN/BT operations during voice or VoIP held to ear scenarios and when 5G NR is active. 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 D04v01.

Note: Targets for 802.11ax RU operations can be found in 802.11ax RU SAR Exclusion Appendix in the original filing.

### 1.4.1 Licensed Output Power

| Mode / Band | Antenna | | Modulated Average Output Power (in dBm) | | | |
|---|---|---|---|---|---|---|
| | | | Pmax | DSI = 0 (Body-Worn or Extremity) | DSI = 2 (Head) | DSI = 3 (Hotspot) |
| NR Band n77 DoD (PC2) | G | Max Allowed Power | 27.0 | 19.0 | 18.0 | 19.0 |
| | | Nominal | 26.0 | 18.0 | 17.0 | 18.0 |
| NR Band n77 (PC2) | G | Max Allowed Power | 27.0 | 19.0 | 18.0 | 19.0 |
| | | Nominal | 26.0 | 18.0 | 17.0 | 18.0 |

For NR TDD the above powers listed are TDD burst average values.

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 in the original filing.

### 1.4.2 WLAN and Bluetooth Output Power

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 in the original filing.

## 1.5 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in DUT Antenna Diagram & SAR Test Setup Photographs Appendix. Since the display diagonal dimension of this device is > 150 mm and <200 mm, it is considered a “phablet.” Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing.

## 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 DUT Antenna Diagram & SAR Test Setup Photographs Appendix in the original filling.

## 1.7 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D04v01, 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 D04v01 procedures.

**Table 1-1**
**Simultaneous Transmission Scenarios**

| No. | Capable Transmit Configuration | Head | Body-Worn Accessory | Wireless Router | Phablet | Notes |
|---|---|---|---|---|---|---|
| 1 | GSM voice + 2.4 GHz Bluetooth Ant 1 | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 2 | GSM voice + 2.4 GHz Bluetooth Ant 2 | Yes | Yes | N/A | Yes | |
| 3 | GSM voice + 2.4 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 4 | GSM voice + 5 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 5 | GSM voice + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 6 | GSM voice + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 7 | GSM voice + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 8 | GSM voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 9 | GSM voice + 2.4 GHz Bluetooth MIMO | Yes | Yes | N/A | Yes | |
| 10 | GSM voice + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 11 | GSM voice + 2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 12 | GSM voice + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 13 | GSM voice + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 14 | GSM voice + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 15 | GSM voice + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 16 | 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 |
| 17 | GSM voice + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 18 | UMTS + 2.4 GHz Bluetooth Ant 1 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 19 | UMTS + 2.4 GHz Bluetooth Ant 2 | Yes | Yes | Yes | Yes | |
| 20 | UMTS + 2.4 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 21 | UMTS + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 22 | UMTS + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 23 | UMTS + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 24 | UMTS + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 25 | UMTS + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 26 | UMTS + 2.4 GHz Bluetooth MIMO | Yes | Yes | Yes | Yes | |
| 27 | UMTS + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 28 | UMTS + 2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 29 | UMTS + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 30 | UMTS + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 31 | UMTS + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 32 | UMTS + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 33 | 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 |
| 34 | UMTS + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 35 | LTE + 2.4 GHz Bluetooth Ant 1 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 36 | LTE + 2.4 GHz Bluetooth Ant 2 | Yes | Yes | Yes | Yes | |
| 37 | LTE + 2.4 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 38 | LTE + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 39 | LTE + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 40 | LTE + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 41 | LTE + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 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 MIMO | Yes | Yes | Yes | Yes | |
| 44 | LTE + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 45 | LTE + 2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 46 | LTE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 47 | LTE + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 48 | LTE + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 49 | LTE + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 50 | 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 |
| 51 | LTE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 52 | LTE + NR | Yes | Yes | N/A | Yes | |
| 53 | LTE + NR + 2.4 GHz Bluetooth Ant 1 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 54 | LTE + NR + 2.4 GHz Bluetooth Ant 2 | Yes | Yes | Yes | Yes | |
| 55 | LTE + NR + 2.4 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 56 | LTE + NR + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 57 | LTE + NR + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 58 | LTE + NR + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 59 | LTE + NR + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 60 | LTE + NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 61 | LTE + NR + 2.4 GHz Bluetooth MIMO | Yes | Yes | Yes | Yes | |
| 62 | LTE + NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 63 | LTE + NR + 2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 64 | LTE + NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 65 | LTE + NR + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 66 | LTE + NR + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 67 | LTE + NR + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 68 | 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 |
| 69 | LTE + NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 70 | NR + 2.4 GHz Bluetooth Ant 1 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 71 | NR + 2.4 GHz Bluetooth Ant 2 | Yes | Yes | Yes | Yes | |
| 72 | NR + 2.4 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 73 | NR + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 74 | NR + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 75 | NR + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 76 | NR + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 77 | NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 78 | NR + 2.4 GHz Bluetooth MIMO | Yes | Yes | Yes | Yes | |
| 79 | NR + 2.4 GHz Bluetooth Ant 1 + 5 GHz WLAN MIMO | Yes^ | Yes | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 80 | NR + 2.4 GHz Bluetooth Ant 1 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 81 | NR + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 82 | NR + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 83 | NR + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | Yes | Yes | Yes | Yes | |
| 84 | NR + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | Yes | Yes | N/A | Yes | |
| 85 | 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 |
| 86 | NR + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | Yes^ | Yes | N/A | Yes | ^ Bluetooth Tethering is considered |
| 87 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 | N/A | N/A | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 88 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 2 | N/A | N/A | Yes | Yes | |
| 89 | GPRS/EDGE + 2.4 GHz WLAN MIMO | N/A | N/A | Yes | Yes | |
| 90 | GPRS/EDGE + 5 GHz WLAN MIMO | N/A | N/A | Yes | Yes | |
| 91 | GPRS/EDGE + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |
| 92 | GPRS/EDGE + 2.4 GHz WLAN MIMO + 5 GHz WLAN MIMO | N/A | N/A | Yes | Yes | |
| 93 | GPRS/EDGE + 2.4 GHz WLAN MIMO + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |
| 94 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 | N/A | N/A | Yes^ | Yes | ^ Bluetooth Tethering is considered |
| 95 | GPRS/EDGE + 2.4 GHz Bluetooth MIMO | N/A | N/A | Yes | Yes | |
| 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 1 + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |
| 98 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 2 + 5 GHz WLAN MIMO | N/A | N/A | Yes | Yes | |
| 99 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 2 + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |
| 100 | GPRS/EDGE + 2.4 GHz Bluetooth MIMO + 5 GHz WLAN MIMO | N/A | N/A | Yes | Yes | |
| 101 | GPRS/EDGE + 2.4 GHz Bluetooth MIMO + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |
| 102 | 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 |
| 103 | GPRS/EDGE + 2.4 GHz Bluetooth Ant 1 + 2.4 GHz WLAN Ant 2 + 6 GHz WLAN MIMO | N/A | N/A | N/A | Yes | |

1. No other simultaneous scenarios besides described above is supported for this model.
2. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
3. Per the manufacturer, WIFI Direct is 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.

4. 5 GHz Wireless Router is only supported for the U-NII-3 by S/W, therefore U-NII-1, U-NII-2A, U-NII-2C, and U-NII-4 were not evaluated for wireless router conditions.
5. 6 GHz Wireless Router is not supported, therefore it was not evaluated for wireless router conditions.
6. This device supports 2x2 MIMO Tx for WLAN 802.11a/b/g/n/ac/ax. 802.11a/b/g/n/ac/ax supports CDD and STBC and 802.11n/ac/ax additionally supports SDM.
7. This device supports VoWIFI.
8. This device supports Bluetooth Tethering on Ant 1 only.
9. This device supports VoLTE.
10. This device supports VoNR.
11. LTE + 5G NR FR1 Scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR1 checklist.
12. 5G NR FR2 n258, n260, and n261 cannot transmit simultaneously.
13. LTE + 5G NR FR2 Scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR2 checklist.
14. UWB and NFC were evaluated for phablet based on expected usage conditions.

## 1.8 Miscellaneous SAR Test Considerations

### (A) WIFI/BT

There were no changes made to the WIFI and BT operations within this device. Please see the original 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 original filing for complete evaluation of all other operating modes. The operational description includes a description of all changed items.

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 D01v03r01, D05v02r05, D05Av01r02 (2G/3G/4G)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)

## 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 | 1M2212020131-02.A3L |
| RF Exposure Part 1 Test Report | Original Filing |
| RF Exposure Part 2 Original Filing Test Report | 1M2209010098-04.A3L |

# 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 41 (2498.5 - 2687.5 MHz) | | | | |
| | LTE Band 38 (2572.5 - 2617.5 MHz) | | | | |
| | LTE Band 48 (3552.5 - 3697.5 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 41: 5 MHz, 10 MHz, 15 MHz, 20 MHz | | | | |
| | LTE Band 38: 5 MHz, 10 MHz, 15 MHz, 20 MHz | | | | |
| | LTE Band 48: 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) | | 2405 (21100) | 2562.5 (21375) | |
| LTE Band 7: 20 MHz | 2510 (20850) | | 2535 (21100) | 2560 (21350) | |
| LTE Band 41: 5 MHz | 2506 (39750) | 2549.5 (40185) | 2549.5 (40185) | 2593 (40620) | 2636.5 (41055) |
| LTE Band 41: 10 MHz | 2506 (39750) | 2549.5 (40185) | 2549.5 (40185) | 2593 (40620) | 2636.5 (41055) |
| LTE Band 41: 15 MHz | 2506 (39750) | 2549.5 (40185) | 2549.5 (40185) | 2593 (40620) | 2636.5 (41055) |
| LTE Band 41: 20 MHz | 2506 (39750) | 2549.5 (40185) | 2549.5 (40185) | 2593 (40620) | 2636.5 (41055) |
| 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) | |
| 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) |
| 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 the RF Conducted Powers section of this report and the Downlink LTE CA RF Conducted Powers Appendix in the original filing. 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)<br>NR Band n12 (701.5 - 713.5 MHz)<br>NR Band n26 (816.5 - 846.5 MHz)<br>NR Band n5 (826.5 - 846.5 MHz)<br>NR Band n66 (1712.5 - 1777.5 MHz)<br>NR Band n25 (1852.5 - 1912.5 MHz)<br>NR Band n2 (1852.5 - 1907.5 MHz)<br>NR Band n30 (2307.5 - 2312.5 MHz)<br>NR Band n7 (2502.5 - 2567.5 MHz)<br>NR Band n41 (2501.01 - 2685 MHz)<br>NR Band n38 (2575 - 2615 MHz)<br>NR Band n48 (3555 - 3694.98 MHz)<br>NR Band n77 DoD (3455.01 - 3544.98 MHz)<br>NR Band n77 (3705 - 3975 MHz) | | | | | | |
| Channel Bandwidths | NR Band n71: 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>NR Band n12: 5 MHz, 10 MHz, 15 MHz<br>NR Band n26: 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>NR Band n5: 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>NR Band n66: 5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz<br>NR Band n25: 5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz<br>NR Band n2: 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>NR Band n30: 5 MHz, 10 MHz<br>NR Band n7: 5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz<br>NR Band n41: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz<br>NR Band n38: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz<br>NR Band n48: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz<br>NR Band n77 DoD: 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz<br>NR Band n77: 10 MHz, 15 MHz, 20 MHz, 25 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 (133100) | | 680.5 (136100) | | 695.5 (139100) | |
| 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 n26: 5 MHz | 816.5 (163300) | | 831.5 (166300) | | 846.5 (169300) | |
| NR Band n26: 10 MHz | 819 (163800) | | 831.5 (166300) | | 844 (168800) | |
| NR Band n26: 15 MHz | 821.5 (164300) | | 831.5 (166300) | | 841.5 (168300) | |
| NR Band n26: 20 MHz | 824 (164800) | | 831.5 (166300) | | 839 (167800) | |
| NR Band n5: 5 MHz | 826.5 (165300) | | 836.5 (167300) | | 846.5 (169300) | |
| NR Band n5: 10 MHz | 829 (165800) | | 836.5 (167300) | | 844 (168800) | |
| NR Band n5: 15 MHz | 831.5 (166300) | | 836.5 (167300) | | 841.5 (168300) | |
| NR Band n5: 20 MHz | 834 (166800) | | 836.5 (167300) | | 839 (167800) | |
| NR Band n66: 5 MHz | 1712.5 (342500) | | 1745 (349000) | | 1777.5 (355500) | |
| NR Band n66: 10 MHz | 1715 (343000) | | 1745 (349000) | | 1775 (355000) | |
| NR Band n66: 15 MHz | 1717.5 (343500) | | 1745 (349000) | | 1772.5 (354500) | |
| NR Band n66: 20 MHz | 1720 (344000) | | 1745 (349000) | | 1770 (354000) | |
| NR Band n66: 25 MHz | 1722.5 (344500) | | 1745 (349000) | | 1767.5 (353500) | |
| NR Band n66: 30 MHz | 1725 (345000) | | 1745 (349000) | | 1765 (353000) | |
| NR Band n66: 40 MHz | 1730 (346000) | | 1745 (349000) | | 1760 (352000) | |
| NR Band n25: 5 MHz | 1852.5 (370500) | | 1882.5 (376500) | | 1912.5 (382500) | |
| NR Band n25: 10 MHz | 1855 (371000) | | 1882.5 (376500) | | 1910 (382000) | |
| NR Band n25: 15 MHz | 1857.5 (371500) | | 1882.5 (376500) | | 1907.5 (381500) | |
| NR Band n25: 20 MHz | 1860 (372000) | | 1882.5 (376500) | | 1905 (381000) | |
| NR Band n25: 25 MHz | 1862.5 (372500) | | 1882.5 (376500) | | 1902.5 (380500) | |
| NR Band n25: 30 MHz | 1865 (373000) | | 1882.5 (376500) | | 1900 (380000) | |
| NR Band n25: 40 MHz | 1870 (374000) | | 1882.5 (376500) | | 1895 (379000) | |
| NR Band n2: 5 MHz | 1852.5 (370500) | | 1880 (376000) | | 1907.5 (381500) | |
| NR Band n2: 10 MHz | 1855 (371000) | | 1880 (376000) | | 1905 (381000) | |
| NR Band n2: 15 MHz | 1857.5 (371500) | | 1880 (376000) | | 1902.5 (380500) | |
| NR Band n2: 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 n7: 5 MHz | 2502.5 (500500) | | 2535 (507000) | | 2567.5 (513500) | |
| NR Band n7: 10 MHz | 2505 (501000) | | 2535 (507000) | | 2565 (513000) | |
| NR Band n7: 15 MHz | 2507.5 (501500) | | 2535 (507000) | | 2562.5 (512500) | |
| NR Band n7: 20 MHz | 2510 (502000) | | 2535 (507000) | | 2560 (512000) | |
| NR Band n7: 25 MHz | 2512.5 (502500) | | 2535 (507000) | | 2557.5 (511500) | |
| NR Band n7: 30 MHz | 2515 (503000) | | 2535 (507000) | | 2555 (511000) | |
| NR Band n7: 40 MHz | 2520 (504000) | | 2535 (507000) | | 2550 (510000) | |
| NR Band n41: 10 MHz | 2501.01 (500202) | 2547 (509400) | 2592.99 (518598) | | 2639.01 (527802) | 2685 (537000) |
| NR Band n41: 15 MHz | 2503.5 (500700) | 2548.26 (509652) | 2592.99 (518598) | | 2637.75 (527550) | 2682.51 (536602) |
| 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: 70 MHz | 2531.01 (506202) | | N/A | | 2655 (531000) | |
| 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 n38: 10 MHz | 2575 (515000) | | 2595 (519000) | | 2615 (523000) | |
| NR Band n38: 15 MHz | 2577.5 (515500) | | 2595 (519000) | | 2612.5 (522500) | |
| NR Band n38: 20 MHz | 2580 (516000) | | 2595 (519000) | | 2610 (522000) | |
| NR Band n38: 30 MHz | 2585 (517000) | | 2595 (519000) | | 2605 (521000) | |
| NR Band n38: 40 MHz | 2590 (518000) | | 2595 (519000) | | 2600 (520000) | |
| NR Band n48: 10 MHz | 3555 (637000) | 3601.68 (640112) | N/A | | 3648.33 (643222) | 3694.98 (646332) |
| NR Band n48: 15 MHz | 3557.52 (637168) | 3602.49 (640166) | N/A | | 3647.49 (643166) | 3692.49 (646166) |
| NR Band n48: 20 MHz | 3560.01 (637334) | 3603.33 (640222) | N/A | | 3646.68 (643112) | 3690 (646000) |
| NR Band n48: 30 MHz | 3565.02 (637668) | 3605.01 (640334) | N/A | | 3645 (643000) | 3684.99 (645666) |
| NR Band n48: 40 MHz | 3570 (638000) | N/A | 3624.96 (641666) | | N/A | 3679.98 (645332) |
| NR Band n77 DoD: 10 MHz | 3455.01 (630334) | | 3500.01 (633334) | | 3544.98 (636332) | |
| NR Band n77 DoD: 15 MHz | 3457.5 (630500) | | 3500.01 (633334) | | 3542.49 (636166) | |
| NR Band n77 DoD: 20 MHz | 3460.02 (630668) | | 3500.01 (633334) | | 3540 (636000) | |
| NR Band n77 DoD: 25 MHz | 3462.51 (630834) | | 3500.01 (633334) | | 3537.48 (635832) | |
| 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 | | 3470.01 (631334) | |
| NR Band n77 DoD: 50 MHz | 3475.02 (631668) | | N/A | | 3475.02 (631668) | |
| 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: 10 MHz | 3705 (647000) | 3759 (650600) | 3813 (654200) | 3867 (657800) | 3921 (661400) | 3975 (665000) |
| NR Band n77: 15 MHz | 3707.52 (647168) | 3760.5 (650700) | 3813.51 (654234) | 3866.49 (657766) | 3919.5 (661300) | 3972.48 (664832) |
| NR Band n77: 20 MHz | 3710.01 (647334) | 3762 (650800) | 3813.99 (654266) | 3866.01 (657734) | 3918 (661200) | 3969.99 (664666) |
| NR Band n77: 25 MHz | 3712.5 (647500) | 3763.5 (650900) | 3814.5 (654300) | 3865.5 (657700) | 3916.5 (661100) | 3967.5 (664500) |
| 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 | 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 | N/A | 3930 (662000) |
| SCS for NR Band n71/n12/n26/n5/n66/n25/n2/n30/n7 | 15 kHz | | | | | |
| SCS for NR Band n41/n38/n48/n77 | 30 kHz | | | | | |
| Modulations Supported in UL | DFT-s-OFDM: π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM<br>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 2/48/66 | | | | | |
| LTE Anchor Bands for NR Band n12 | LTE Band 2/48/66 | | | | | |
| LTE Anchor Bands for NR Band n26 | N/A | | | | | |
| LTE Anchor Bands for NR Band n5 | LTE Band 2/30/48/66 | | | | | |
| LTE Anchor Bands for NR Band n66 | LTE Band 2/5/12/13/14/30/48 | | | | | |
| LTE Anchor Bands for NR Band n25 | LTE Band 12/66 | | | | | |
| LTE Anchor Bands for NR Band n2 | LTE Band 4/5/12/13/14/30/48/66 | | | | | |
| LTE Anchor Bands for NR Band n30 | LTE Band 2/5/12/14/66 | | | | | |
| LTE Anchor Bands for NR Band n7 | N/A | | | | | |
| LTE Anchor Bands for NR Band n41 | LTE Band 2/25/66 | | | | | |
| LTE Anchor Bands for NR Band n38 | N/A | | | | | |
| LTE Anchor Bands for NR Band n48 | LTE Band 2/66 | | | | | |
| LTE Anchor Bands for NR Band n77 | LTE Band 2/5/12/13/14/30/66/71 | | | | | |

# 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 ($\rho$). 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:

$\sigma$ = conductivity of the tissue-simulating material (S/m)
$\rho$ = 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:

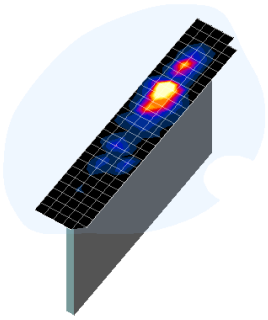

**Figure 4-1**
**Sample SAR Area Scan**

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) ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution (mm) ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | 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*$\Delta z_{zoom}$(n-1) | ≥ 30 |
| 2-3 GHz | ≤ 12 | ≤ 5 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}$(n-1) | ≥ 30 |
| 3-4 GHz | ≤ 12 | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 1.5*$\Delta z_{zoom}$(n-1) | ≥ 28 |
| 4-5 GHz | ≤ 10 | ≤ 4 | ≤ 3 | ≤ 2.5 | ≤ 1.5*$\Delta z_{zoom}$(n-1) | ≥ 25 |
| 5-6 GHz | ≤ 10 | ≤ 4 | ≤ 2 | ≤ 2 | ≤ 1.5*$\Delta z_{zoom}$(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].

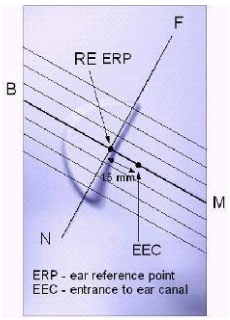


**Figure 5-1**
**Close-Up Side view of ERP**

## 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**

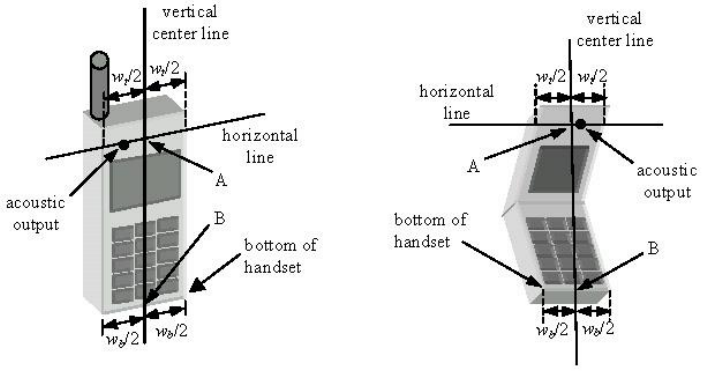


**Figure 5-3**
**Handset Vertical Center & Horizontal Line Reference Points**

# 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 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 6-1). 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 D04v01 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.

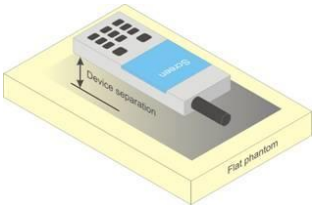


**Figure 6-1**
**Sample Body-Worn Diagram**

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.

## 6.3 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 D04v01 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D04v01, 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.

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

## 8.2 3G SAR Test Reduction Procedure

In FCC KDB Publication 941225 D01v03r01, certain transmission modes within a frequency band and wireless mode evaluated for SAR are defined as primary modes. The equivalent modes considered for SAR test reduction are denoted as secondary modes. When the maximum output power including tune-up tolerance specified for production units in a secondary mode is ≤ 0.25 dB higher than the primary mode or when the highest reported SAR of the primary mode, scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode, is ≤ 1.2 W/kg, SAR measurements are not required for the secondary mode. These criteria are referred to as the 3G SAR test reduction procedure. When the 3G SAR test reduction procedure is not satisfied, SAR measurements are additionally required for the secondary mode.

## 8.3 Procedures Used to Establish RF Signal for SAR

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

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

# 9 RF CONDUCTED POWERS

All conducted power measurements for 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 ($P_{limit}$, maximum tune up output power $P_{max}$).

## 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 all NR bands can be found in LTE and NR Lower Bandwidth RF Conducted Powers Appendix of the original filing.

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 n77 Antenna G

**Table 2**
**NR Band n77 Antenna G Measured $P_{Limit}$ for DSI = 2 (Head) - 100 MHz Bandwidth**

| NR Band n77 100 MHz Bandwidth | | | | | | |
|---|---|---|---|---|---|---|
| | | | Channel | | MPR Allowed per 3GPP [dB] | MPR [dB] |
| Modulation | RB Size | RB Offset | 650000 (3750 MHz) | 662000 (3930 MHz) | | |
| | | | Conducted Power [dBm] | | | |
| DFT-s-OFDM π/2 BPSK | 1 | 1 | 16.34 | 16.36 | 0 | 0.0 |
| | 1 | 137 | 16.10 | 16.32 | | 0.0 |
| | 1 | 271 | 15.64 | 16.07 | | 0.0 |
| | 135 | 0 | 16.25 | 16.35 | 0-0.5 | 0.0 |
| | 135 | 69 | 15.97 | 16.37 | 0 | 0.0 |
| | 135 | 138 | 15.74 | 16.28 | 0-0.5 | 0.0 |
| | 270 | 0 | 15.92 | 16.32 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | 16.35 | **16.37** | 0 | 0.0 |
| | 1 | 137 | 16.10 | 16.30 | | 0.0 |
| | 1 | 271 | 15.67 | 16.10 | | 0.0 |
| | 135 | 0 | 16.26 | 16.33 | 0-1 | 0.0 |
| | 135 | 69 | 15.98 | **16.34** | 0 | 0.0 |
| | 135 | 138 | 15.77 | 16.27 | 0-1 | 0.0 |
| | 270 | 0 | 15.96 | 16.31 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 16.55 | 16.37 | 0-1 | 0.0 |
| CP-OFDM QPSK | 1 | 1 | 16.42 | 16.27 | 0-1.5 | 0.0 |

### 9.1.1 NR Band n77 Antenna G DoD

**Table 3**
**NR Band n77 Antenna G DoD Measured $P_{Limit}$ for DSI = 2 (Head) - 100 MHz Bandwidth**

| NR Band n77 DoD 100 MHz Bandwidth | | | | | |
|---|---|---|---|---|---|
| | | | Channel | MPR Allowed per 3GPP [dB] | MPR [dB] |
| Modulation | RB Size | RB Offset | 633334 (3500.01 MHz) Conducted Power [dBm] | | |
| DFT-s-OFDM π/2 BPSK | 1 | 1 | 15.98 | 0 | 0.0 |
| | 1 | 137 | 16.03 | | 0.0 |
| | 1 | 271 | 15.93 | | 0.0 |
| | 135 | 0 | 16.08 | 0-0.5 | 0.0 |
| | 135 | 69 | 16.14 | 0 | 0.0 |
| | 135 | 138 | 16.07 | 0-0.5 | 0.0 |
| | 270 | 0 | 16.09 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | **16.20** | 0 | 0.0 |
| | 1 | 137 | 16.16 | | 0.0 |
| | 1 | 271 | 16.10 | | 0.0 |
| | 135 | 0 | **16.10** | 0-1 | 0.0 |
| | 135 | 69 | 16.09 | 0 | 0.0 |
| | 135 | 138 | 16.06 | 0-1 | 0.0 |
| | 270 | 0 | 16.09 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 16.24 | 0-1 | 0.0 |
| CP-OFDM QPSK | 1 | 1 | 16.08 | 0-1.5 | 0.0 |

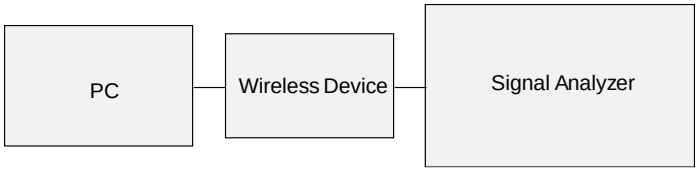


**Figure 9-1**
**Power Measurement Setup**

# 10 SYSTEM VERIFICATION

## 10.1 Tissue Verification

**Table 10-1**
**Measured Head 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 |
|---|---|---|---|---|---|---|---|---|---|
| 02/27/2023 | 3600 Head | 19.5 | 3300 | 2.599 | 39.486 | 2.708 | 38.157 | -4.03% | 3.48% |
| | | | 3350 | 2.652 | 39.437 | 2.759 | 38.100 | -3.88% | 3.51% |
| | | | 3450 | 2.749 | 39.225 | 2.861 | 37.986 | -3.91% | 3.26% |
| | | | 3500 | 2.781 | 39.150 | 2.913 | 37.929 | -4.53% | 3.22% |
| | | | 3550 | 2.845 | 39.035 | 2.964 | 37.871 | -4.01% | 3.07% |
| | | | 3560 | 2.856 | 39.028 | 2.974 | 37.860 | -3.97% | 3.09% |
| | | | 3600 | 2.878 | 38.990 | 3.015 | 37.814 | -4.54% | 3.11% |
| | | | 3650 | 2.936 | 38.866 | 3.066 | 37.757 | -4.24% | 2.94% |
| | | | 3690 | 2.977 | 38.831 | 3.107 | 37.711 | -4.18% | 2.97% |
| | | | 3700 | 2.981 | 38.821 | 3.117 | 37.700 | -4.36% | 2.97% |
| | | | 3750 | 3.032 | 38.700 | 3.169 | 37.643 | -4.32% | 2.81% |
| | | | 3900 | 3.196 | 38.489 | 3.323 | 37.471 | -3.82% | 2.72% |
| | | | 3930 | 3.213 | 38.468 | 3.353 | 37.437 | -4.18% | 2.75% |
| | | | 4100 | 3.409 | 38.116 | 3.528 | 37.243 | -3.37% | 2.34% |
| | | | 4150 | 3.452 | 38.094 | 3.579 | 37.186 | -3.55% | 2.44% |

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 SAR System Validation Appendix.

**Table 10-2**
**System Verification Results - Head**

| 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 | DAE | Measured SAR 1g (W/kg) | 1W Target SAR 1g (W/kg) | 1W Normalized SAR 1g (W/kg) | Deviation 1g (%) | Measured SAR 10g (W/kg) | 1W Target SAR 10g (W/kg) | 1W Normalized SAR 10g (W/kg) | Deviation 10g (%) |
| L | 3500 | HEAD | 02/27/2023 | 22.9 | 20.8 | 0.10 | 1059 | 7410 | 1583 | 6.170 | 63.700 | 61.700 | -3.14% | 2.380 | 23.900 | 23.800 | -0.42% |
| L | 3700 | HEAD | 02/27/2023 | 22.9 | 20.8 | 0.10 | 1067 | 7410 | 1583 | 6.520 | 66.900 | 65.200 | -2.54% | 2.430 | 24.300 | 24.300 | 0.00% |
| L | 3900 | HEAD | 02/27/2023 | 22.9 | 20.8 | 0.10 | 1056 | 7410 | 1583 | 6.640 | 68.900 | 66.400 | -3.63% | 2.380 | 24.100 | 23.800 | -1.24% |

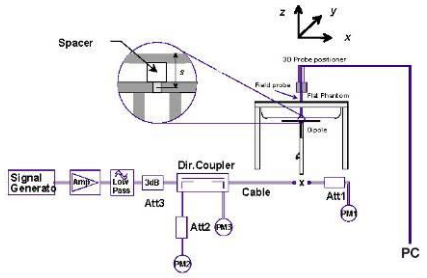


**Figure 10-1**
**System Verification Setup Diagram**

**Figure 10-2**
**System Verification Setup Photo**

# 11 SAR DATA SUMMARY

## 11.1 Standalone Head SAR Data

**Table 11-1**
**NR Band n77 Head SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Side | Test Position | Mode | Antenna Config | Serial Number | Bandwidth [MHz] | Waveform | Modulation | RB Size | RB Offset | Maximum Allowed Power [dBm] | Conducted Power [dBm] | MPR [dB] | Power Drift [dB] | Duty Cycle | SAR (1g) | Scaling Factor | Reported SAR (1g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | |
| 3750.00 | 650000 | Low | Right | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.35 | 0 | 0.10 | 1:1 | 0.564 | 1.462 | 0.825 | |
| 3930.00 | 662000 | High | Right | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.37 | 0 | 0.02 | 1:1 | 0.484 | 1.455 | 0.704 | |
| 3750.00 | 650000 | Low | Right | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 0 | 18.0 | 16.26 | 0 | 0.02 | 1:1 | 0.547 | 1.493 | 0.817 | |
| 3930.00 | 662000 | High | Right | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 69 | 18.0 | 16.34 | 0 | 0.00 | 1:1 | 0.475 | 1.466 | 0.696 | |
| 3930.00 | 662000 | High | Right | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 270 | 0 | 18.0 | 16.31 | 0 | 0.03 | 1:1 | 0.466 | 1.476 | 0.688 | |
| 3750.00 | 650000 | Low | Right | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.35 | 0 | -0.06 | 1:1 | 0.568 | 1.462 | **0.830** | A1 |
| 3930.00 | 662000 | High | Right | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.37 | 0 | -0.01 | 1:1 | 0.472 | 1.455 | 0.687 | |
| 3750.00 | 650000 | Low | Right | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 0 | 18.0 | 16.26 | 0 | 0.01 | 1:1 | 0.529 | 1.493 | 0.790 | |
| 3930.00 | 662000 | High | Right | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 69 | 18.0 | 16.34 | 0 | 0.01 | 1:1 | 0.466 | 1.466 | 0.683 | |
| 3930.00 | 662000 | High | Right | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 270 | 0 | 18.0 | 16.31 | 0 | 0.02 | 1:1 | 0.466 | 1.476 | 0.688 | |
| 3750.00 | 650000 | Low | Right | Tilt | NR Band n77 | G | 0809M | 100 | CP-OFDM | QPSK | 1 | 1 | 18.0 | 16.42 | 0 | 0.09 | 1:1 | 0.551 | 1.439 | 0.793 | |
| 3500.01 | 633334 | Mid | Right | Tilt | NR Band n77 DoD | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.20 | 0 | 0.00 | 1:1 | 0.443 | 1.514 | 0.671 | |
| 3930.00 | 662000 | High | Left | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.37 | 0 | -0.10 | 1:1 | 0.156 | 1.455 | 0.227 | |
| 3930.00 | 662000 | High | Left | Cheek | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 69 | 18.0 | 16.34 | 0 | 0.06 | 1:1 | 0.154 | 1.466 | 0.226 | |
| 3930.00 | 662000 | High | Left | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 1 | 1 | 18.0 | 16.37 | 0 | -0.07 | 1:1 | 0.166 | 1.455 | 0.242 | |
| 3930.00 | 662000 | High | Left | Tilt | NR Band n77 | G | 0809M | 100 | DFT-S-OFDM | QPSK | 135 | 69 | 18.0 | 16.34 | 0 | -0.09 | 1:1 | 0.168 | 1.466 | 0.246 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | |

## 11.2 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 D04v01.
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 D04v01.
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 not required since measured SAR for all frequency bands were less than 0.8 W/kg.
9. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.
10. This device uses Qualcomm Smart Transmit for WWAN 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. Due to test setup limitations, SAR testing for NR TDD was performed using test mode software to establish the connection.
3. Simultaneous transmission analysis for EN-DC operations is addressed in the Part 2 Test Report in the original filing (Serial Number can be found in the bibliography).
4. This device additionally supports some EN-DC conditions where additional LTE carriers are added on the downlink only.
5. Per FCC Guidance, NR modulations and RB Sizes/Offsets were selected for testing such that configurations with the highest output power were evaluated for SAR tests.
6. Per FCC KDB Publication 447498 D04v01, when the reported NR Band n77 C-Band SAR measured at the highest output power channel in a given a test configuration was > 0.4 W/kg for 1g evaluations and > 1 W/kg for 10g evaluation, testing at the other channels was required for such test configurations.
7. For final implementation, NR Band n77 slot configuration is synchronized using maximum duty cycle of 100%. SAR testing was performed using FTM mode with a 100% duty cycle applied to match final duty cycle.
8. Per FCC Guidance, C-Band for NR n77 (3705 – 3975 MHz) was fully tested according to FCC procedures. For each exposure condition and antenna, the worst-case position was additionally evaluated for the NR n77 DoD (3455.01 – 3544.98 MHz).

# 12 SAR MEASUREMENT VARIABILITY

## 12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg.

## 12.2 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.

# 13 EQUIPMENT LIST

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Agilent | E4404B | Spectrum Analyzer | N/A | N/A | N/A | MY45113242 |
| Agilent | E4438C | ESG Vector Signal Generator | 1/18/2023 | Annual | 1/18/2024 | MY47270002 |
| Agilent | E4438C | ESG Vector Signal Generator | 5/10/2022 | Annual | 5/10/2023 | MY42082659 |
| Agilent | N5182A | MXG Vector Signal Generator | 11/30/2022 | Annual | 11/30/2023 | MY47420603 |
| Agilent | N5182A | MXG Vector Signal Generator | 7/20/2022 | Annual | 7/20/2023 | MY47420800 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 6/14/2022 | Annual | 6/14/2023 | US39170118 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 1/12/2023 | Annual | 1/12/2024 | MY40001472 |
| Agilent | E5515C | Wireless Communications Test Set | 5/12/2022 | Annual | 5/12/2023 | GB43304278 |
| Agilent | E5515C | Wireless Communications Test Set | 4/24/2019 | Triennial | CBT | GB46310798 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 433972 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 433974 |
| Amplifier Research | 150A100C | Amplifier | CBT | N/A | CBT | 350132 |
| Anritsu | MN8110B | I/O Adaptor | N/A | N/A | N/A | 6261747881 |
| Anritsu | ML2496A | Power Meter | 8/16/2022 | Annual | 8/16/2023 | 1351001 |
| Anritsu | ML2495A | Power Meter | 3/17/2022 | Annual | 3/17/2023 | 941001 |
| Anritsu | MA2411B | Pulse Power Sensor | 1/10/2023 | Annual | 1/10/2024 | 1315051 |
| Anritsu | MA2411B | Pulse Power Sensor | 10/21/2022 | Annual | 10/21/2023 | 1207364 |
| Anritsu | MA24106A | USB Power Sensor | 2/9/2023 | Annual | 2/9/2024 | 1520505 |
| Anritsu | MA24106A | USB Power Sensor | 2/9/2023 | Annual | 2/9/2024 | 2148505 |
| Mini-Circuits | PWR-4GHS | USB Power Sensor | 11/11/2022 | Annual | 11/11/2023 | 11710030062 |
| Control Company | 4352 | Long Stem Thermometer | 9/10/2021 | Biennial | 9/10/2023 | 210774678 |
| Control Company | 4352 | Long Stem Thermometer | 9/10/2021 | Biennial | 9/10/2023 | 210774685 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 1/17/2023 | Annual | 1/17/2024 | 160574418 |
| Mitutoyo | 500-196-30 | CD-6"ASX 6Inch Digital Caliper | 2/16/2022 | Triennial | 2/16/2025 | A20238413 |
| Keysight Technologies | N6705B | DC Power Analyzer | 5/5/2021 | Triennial | 5/5/2024 | MY53004059 |
| Keysight Technologies | N9020A | MXA Signal Analyzer | 3/4/2022 | Annual | 3/4/2023 | US46470561 |
| MCL | BW-N6W5+ | 6dB Attenuator | CBT | N/A | CBT | 1139 |
| Mini-Circuits | VLF-6000+ | Low Pass Filter DC to 6000 MHz | 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 | NLP-1200+ | Low Pass Filter DC to 1000 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | BW-N20W5 | Power Attenuator | CBT | N/A | CBT | 1226 |
| Mini-Circuits | ZUDC10-83-S+ | Directional Coupler | CBT | N/A | CBT | 2050 |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Narda | BW-S3W2 | Attenuator (3dB) | CBT | N/A | CBT | 120 |
| Seekonk | TSF-100 | Torque Wrench | 7/11/2022 | Annual | 7/11/2023 | 47639-29 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 12/15/2022 | Annual | 12/15/2023 | 1278 |
| SPEAG | DAKS-3.5 | Portable Dielectric Assessment Kit | 8/15/2022 | Annual | 8/15/2023 | 1041 |
| SPEAG | MAIA | Modulation and Audio Interference Analyzer | N/A | N/A | N/A | 1379 |
| SPEAG | D3500V2 | 3500 MHz SAR Dipole | 1/19/2021 | Triennial | 1/19/2024 | 1059 |
| SPEAG | D3700V2 | 3700 MHz SAR Dipole | 1/13/2023 | Annual | 1/13/2024 | 1067 |
| SPEAG | D3900V2 | 3900 MHz SAR Dipole | 10/9/2020 | Triennial | 10/9/2023 | 1056 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 7/18/2022 | Annual | 7/18/2023 | 1583 |
| SPEAG | EX3DV4 | SAR Probe | 7/19/2022 | Annual | 7/19/2023 | 7410 |

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.
Note: All equipment was used solely within its respective calibration period.

# 14 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

# 15 CONCLUSION

## 15.1 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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