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# SAR EVALUATION REPORT

**Applicant Name:**
Apple Inc.
One Apple Park Way
Cupertino, CA 95014 USA

**Date of Testing:**
07/10/2022
**Test Report Issue Date:**
06/07/2023
**Test Site/Location:**
Element Morgan Hill, CA, USA
**Document Serial No.:**
1C2305090017-02.BCG (Rev1)

**FCC ID:** **BCGA2435**

**APPLICANT:** **APPLE, INC.**

| | |
|---|---|
| **DUT Type:** | Tablet Device |
| **Application Type:** | Class II Permissive Change |
| **FCC Rule Part(s):** | CFR §2.1093 |
| **Models:** | A2435 |
| **Permissive Change(s):** | See FCC Change Document |
| **Date of Original Certification:** | 10/18/22 |

| Equipment Class | Band & Mode | Tx Frequency | SAR |
|---|---|---|---|
| | | | 1g Body (W/kg) |
| CBE | NR Band n48 | 3555.0 - 3694.98 MHz | 0.95 |

Note: This revised Test Report supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

Only operations relevant to this permissive change were evaluated for compliance. Please see the original compliance evaluation in RF Exposure Technical Report S/N 1C2205090025-26.BCG (Rev2) 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 1.8 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

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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

| Band & Mode | Operating Modes | Tx Frequency |
|---|---|---|
| UMTS 850 | Data | 826.40 - 846.60 MHz |
| UMTS 1750 | Data | 1712.4 - 1752.6 MHz |
| UMTS 1900 | 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 17 | Voice/Data | 706.5 - 713.5 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 48 | Voice/Data | 3552.5 - 3697.5 MHz |
| NR Band n71 | Data | 665.5 - 695.5 MHz |
| NR Band n12 | Data | 701.5 - 713.5 MHz |
| NR Band n14 | Data | 790.5 - 795.5 MHz |
| NR Band n26 (Cell) | Data | 816.5 - 846.5 MHz |
| NR Band n5 (Cell) | Data | 826.5 - 846.5 MHz |
| NR Band n70 | Data | 1697.5 - 1707.5 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 n7 | Data | 2502.5 - 2567.5 MHz |
| NR Band n41 | Data | 2506.02 - 2679.99 MHz |
| NR Band n48 | Data | 3555.00 - 3694.98 MHz |
| NR Band n77 DoD | Data | 3455.01 - 3544.98 MHz |
| NR Band n77 C | Data | 3705.00 - 3975.00 MHz |
| 2.4 GHz WLAN | Voice/Data | 2412 - 2472 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-5 | Voice/Data | 5955 - 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 |
| NB UNII-1 | Data | 5162 - 5245 MHz |
| NB UNII-3 | Data | 5733 - 5844 MHz |
| NR Band n258 | Data | 24250 - 24450 MHz<br>24750 - 25250 MHz |
| NR Band n260 | Data | 37000 - 40000 MHz |
| NR Band n261 | Data | 27500 - 28350 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 1.10 – 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., Plimit for sub-6 radio), for each characterized technology and band (see RF Exposure Part 0 Test Report, report SN could be found in Section 1.10 - Bibliography).

| Exposure Scenario: | Ant 1 Body | Ant 1 Maximum Tune-up Output Power* | Ant 2a/2b Body | Ant 2a/2b Maximum Tune-up Output Power* | Ant 3 Body | Ant 3 Maximum Tune-up Output Power* | Ant 4b Body | Ant 4b Maximum Tune-up Output Power* | Manufacturer's Smart Transmit Uncertainty (dB) | Plimit target and UHB Pmax Tolerance (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| Averaging Volume: | 1g | | 1g | | 1g | | 1g | | | |
| Spacing: | 0 mm | | 0 mm | | 0 mm | | 0 mm | | | |
| DSI: | 1 | | 1 | | 1 | | 1 | | | |
| Technology/Band | **Plimit corresponding to 0.8 W/kg** | Pmax | **Plimit corresponding to 0.8 W/kg** | Pmax | **Plimit corresponding to 0.8 W/kg** | Pmax | **Plimit corresponding to 0.8 W/kg** | Pmax | | |
| NR Band n48 | 11.00 | 22.20 | 10.50 | 19.20 | 11.20 | 21.00 | 10.30 | 22.60 | +/- 1.0 | +/- 1.0 |

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

*Maximum tune up output power Pmax is used to configure EUT during RF tune up procedure. The maximum allowed output power is equal to maximum Tune up output power +0.7/-1.0 dB tolerance and for UHB +/-1.0 dB tolerance

*Note all $P_{limit}$ EFS and maximum tune up output power $P_{max}$ levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (for e.g., LTE TDD).

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

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

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

## 1.3 Power Reduction for SAR

This device additionally utilizes a power reduction mechanism for Bluetooth and WLAN operations. When WLAN/Bluetooth is operating simultaneously with certain combinations of 3G/4G/5G and 5 GHz WLAN antennas, the output power of is permanently reduced.. SAR evaluations were additionally performed at the maximum allowed output power for these scenarios to evaluate simultaneous transmission compliance.

Additionally, this device uses an independent mechanism that limits WIFI powers to a time-averaged output power. For the purposes of this test report, all SAR measurements were performed with the algorithm disabled at the maximum time-averaged output power level. See the original filing for all other operations that were not evaluated in this permissive change.

## 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.

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.

### 1.4.1 5G Output Power for Portable Use Conditions

**Table 1-1**
**NR Bands**

| Mode / Band | | Modulated Average Output Power (in dBm) | | | |
|---|---|---|---|---|---|
| | | Ant 1 | Ant 2a | Ant 3 | Ant 4b |
| NR TDD Band n48 | Max allowed power | **12.00** | **11.50** | **12.20** | **11.30** |
| **[Burst Averaged]** | Nominal | **11.00** | **10.50** | **11.20** | **10.30** |

Note: For NR TDD, the above powers listed are TDD burst average and framed average values.

### 1.4.2 Maximum WLAN Time-Averaged 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.

### 1.4.3 Reduced WLAN Time-Averaged 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 diagonal dimension of the device is > 200 mm. A diagram showing the location of the device antennas can be found in Appendix E. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filings.

Note: See the original filing for all other operations that were not evaluated in this permissive change.

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

| Mode | Back | Front | Top | Bottom | Right | Left |
|---|---|---|---|---|---|---|
| NR Band n48 Antenna 1 | Yes | No | No | Yes | No | Yes |
| NR Band n48 Antenna 2a | Yes | No | No | Yes | Yes | No |
| NR Band n48 Antenna 3 | Yes | No | Yes | No | Yes | No |
| NR Band n48 Antenna 4b | Yes | No | Yes | No | No | No |

Note: Per FCC KDB Publication 616217 D04v01r01, particular edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01V06. Additional edges may have been evaluated for simultaneous transmission analysis.

## 1.6 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 | Body |
|---|---|---|
| 1 | Cellular Band + 2.4 GHz WIFI | Yes |
| 2 | Cellular Band + 5/6 GHz WIFI | Yes |
| 3 | Cellular Band + 2.4 GHz Bluetooth | Yes |
| 4 | Cellular Band+ 2.4 GHz WIFI MIMO | Yes |
| 5 | Cellular Band+ 5/6 GHz WIFI MIMO | Yes |
| 6 | Cellular Band + 2.4 GHz Bluetooth + 5/6 GHz WIFI | Yes |
| 7 | Cellular Band + 2.4 GHz Bluetooth + 5/6 GHz WIFI MIMO | Yes |
| 8 | 2.4 GHz Bluetooth + 5/6 GHz WIFI | Yes |
| 9 | 2.4 GHz Bluetooth + 5/6 GHz WIFI MIMO | Yes |
| 10 | Cellular Band + 2.4 GHz Bluetooth(TXBF) + 5/6 GHz WIFI | Yes |
| 11 | Cellular Band + 2.4 GHz Bluetooth(TXBF) + 5/6 GHz WIFI MIMO | Yes |
| 12 | 2.4 GHz Bluetooth(TXBF) + 5/6 GHz WIFI | Yes |
| 13 | 2.4 GHz Bluetooth (TXBF) + 5/6 GHZ WIFI MIMO | Yes |
| 14 | Cellular Band + NB UNII | Yes |
| 15 | Cellular Band + NB UNII + 2.4 GHz WIFI | Yes |
| 16 | Cellular Band + NB UNII + 2.4 GHz WIFI MIMO | Yes |
| 17 | NB UNII + 2.4 GHz WIFI | Yes |
| 18 | NB UNII + 2.4 GHz WIFI MIMO | Yes |
| 19 | Cellular Band + NB UNII(TXBF) + 2.4 GHz WIFI | Yes |
| 20 | Cellular Band + NB UNII(TXBF) + 2.4 GHz WIFI MIMO | Yes |
| 21 | Cellular Band + NB UNII(TXBF) | Yes |
| 22 | Cellular Band + 2.4 GHz Bluetooth(TXBF) | Yes |
| 23 | NB UNII(TXBF) + 2.4 GHz WIFI | Yes |
| 24 | NB UNII(TXBF) + 2.4 GHz WIFI MIMO | Yes |
| 25 | 2.4 GHz WIFI + 2.4 GHz Bluetooth | Yes |
| 26 | Cellular Band + 2.4 GHz WIFI + 2.4 GHz Bluetooth | Yes |

**Table 1-4**
**Simultaneous Transmission Scenarios of Inter-Band ULCA**

| No. | Capable Transmit Configuration | Body | Notes |
|---|---|---|---|
| 1 | Cellular Ant 1 LB + Cellular Ant 3 MB/HB | Yes | LTE Bands transmitting from Ant 1 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 3 MB/HB: LTE B2/4/7/66/30 |
| 2 | Cellular Ant 1 LB + Cellular Ant 2b MB/HB | Yes | LTE Bands transmitting from Ant 1 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 2b MB/HB: LTE B2/4/7/66/30 |
| 3 | Cellular Ant 1 LB + Cellular Ant 4b MB/HB | Yes | LTE Bands transmitting from Ant 1 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 4b MB/HB: LTE B2/4/7/66/30 |
| 4 | Cellular Ant 3 LB + Cellular Ant 1 MB/HB | Yes | LTE Bands transmitting from Ant 3 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 1 MB/HB: LTE B2/4/7/66/30 |
| 5 | Cellular Ant 3 LB + Cellular Ant 2b MB/HB | Yes | LTE Bands transmitting from Ant 3 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 2b MB/HB: LTE B2/4/7/66/30 |
| 6 | Cellular Ant 3 LB + Cellular Ant 4b MB/HB | Yes | LTE Bands transmitting from Ant 3 LB: LTE B5/12/13/14<br>LTE Bands transmitting from Ant 4b MB/HB: LTE B2/4/7/66/30 |

Note: The technical description includes all the possible Inter-band ULCA combinations.

**Table 1-5**
**Simultaneous Transmission Scenarios with Inter-Band ULCA Active**

| No. | Capable Transmit Configuration | Body |
|---|---|---|
| 1 | LTE Inter-Band ULCA + 2.4 GHz WI-FI | Yes |
| 2 | LTE Inter-Band ULCA + 5/6 GHz WI-FI | Yes |
| 3 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth | Yes |
| 4 | LTE Inter-Band ULCA + 2.4 GHz WI-FI MIMO | Yes |
| 5 | LTE Inter-Band ULCA + 5/6 GHz WI-FI MIMO | Yes |
| 6 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth + 5/6 GHz WI-FI | Yes |
| 7 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth + 5/6 GHz WI-FI MIMO | Yes |
| 8 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth(TXBF) + 5/6 GHz WI-FI | Yes |
| 9 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth(TXBF) + 5/6 GHz WI-FI MIMO | Yes |
| 10 | LTE Inter-Band ULCA + NB UNII | Yes |
| 11 | LTE Inter-Band ULCA + UNII NB + 2.4 GHz WI-FI | Yes |
| 12 | LTE Inter-Band ULCA + UNII NB + 2.4 GHz WI-FI MIMO | Yes |
| 13 | LTE Inter-Band ULCA + UNII NB(TXBF) + 2.4 GHz WI-FI | Yes |
| 14 | LTE Inter-Band ULCA + UNII NB(TXBF) + 2.4 GHz WI-FI MIMO | Yes |
| 15 | LTE Inter-Band ULCA + UNII NB(TXBF) | Yes |
| 16 | LTE Inter-Band ULCA + 2.4 GHz Bluetooth(TXBF) | Yes |
| 17 | LTE Inter-Band ULCA + 2.4 GHz WI-FI + 2.4 GHz Bluetooth | Yes |

Note: LTE inter-band ULCA can operate in any of the combinations in Table 1-9

1. There are no limitations in the above listed simultaneous transmission scenarios between cellular antennas and BT/WI-FI antennas.
2. Wi-Fi 2.4GHz and Bluetooth 2.4 GHz can transmit simultaneously on separate antennas. 2.4 GHz WLAN Antenna 4a can only transmit simultaneously with 2.4GHz Bluetooth Antenna 2a. In this scenario Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power.
3. This device supports 2x2 MIMO Tx for WLAN 802.11a/g/n/ac/ax. 802.11a/g/n/ac/ax supports CDD and STBC and 802.11n/ac/ax additionally supports SDM. Each WLAN antenna can transmit independently or together when operating with MIMO.
4. EN-DC operation is supported with LTE + 5G NR FR1 scenarios. The LTE anchor bands are shown in the NR FR1 checklist.
5. This device supports VoWIFI.
6. This device supports VoLTE.
7. 5G NR FR2 n258, n260, and n261 cannot transmit simultaneously.
8. LTE + 5G NR FR2 Scenarios are limited to EN-DC combinations with anchor bands as shown in the NR FR2 checklist.

## 1.7 Miscellaneous SAR Test Considerations

### (A) WIFI/BT

There were no 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)

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.

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

Only operations relevant to this permissive change were evaluated for compliance. Please see original filing for complete evaluation for all other operating modes. The operational description includes a description of all changed items.

## 1.8 Guidance Applied

- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01r02 (Tablet)

## 1.9 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 10.

## 1.10 Bibliography

| Report Type | Report Serial Number |
|---|---|
| RF Exposure Part 0 Test Report | 1C2305090017-03.BCG |
| Original RF Exposure Part 1 Test Report | Original Filing |

# 2 LTE INFORMATION

| LTE Information | | | | | |
|---|---|---|---|---|---|
| Form Factor | Tablet Device | | | | |
| 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 17 (706.5 - 713.5 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 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 17: 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 | | | | |
| | 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 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 17: 5 MHz | 706.5 (23755) | | 710 (23790) | 713.5 (23825) | |
| LTE Band 17: 10 MHz | 709 (23780) | | 710 (23790) | 711 (23800) | |
| 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 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 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 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 (QPSK, 16QAM, 64QAM, 256 QAM) , UL UE Cat 18 (QPSK, 16QAM, 64QAM, 256QAM) | | | | |
| 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 15. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. The following LTE Release 15 Features are not supported: Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA. | | | | |

| NR Information | | | | | | |
|---|---|---|---|---|---|---|
| Form Factor | Tablet | | | | | |
| 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 n14 (790.5 - 795.5 MHz)<br>NR Band n26 (Cell) (816.5 - 846.5 MHz)<br>NR Band n5 (Cell) (826.5 - 846.5 MHz)<br>NR Band n70 (1697.5-1707.5 MHz)<br>NR Band n66 (AWS) (1712.5 - 1777.5 MHz)<br>NR Band n25 (PCS) (1852.5 - 1912.5 MHz)<br>NR Band n2 (PCS) (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 (2506.02 - 2679.99 MHz)<br>NR Band n48 (3555.00 - 3694.98 MHz)<br>NR Band n77 DoD (3455.01 - 3544.98 MHz)<br>NR Band n77 C (3705.0 - 3975.0 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 n14: 5 MHz, 10 MHz<br>NR Band n26 (Cell): 5 MHz, 10 MHz<br>NR Band n5 (Cell): 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>NR Band n70: 5 MHz, 10 MHz, 15 MHz<br>NR Band n66 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz<br>NR Band n25 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz, 25 MHz, 30 MHz, 40 MHz<br>NR Band n2 (PCS): 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: 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz<br>NR Band n48: 10 MHz, 20 MHz, 30 MHz, 40 MHz<br>NR Band n77 DoD: 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 n77 C: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 40 MHz, 50 MHz, 60 MHz, 70 MHz, 80 MHz, 90 MHz, 100 MHz | | | | | |
| Channel Numbers and Frequencies (MHz) | Low | Low-Mid | Mid | | Mid-High | High |
| 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 n14: 5 MHz | 790.5 (158100) | | 793 (158600) | | 795.5 (159100) | |
| NR Band n14: 10 MHz | N/A | | 793 (158600) | | N/A | |
| NR Band n26 (Cell): 5 MHz | 816.5 (163300) | | 831.5 (166300) | | 846.5 (169300) | |
| NR Band n26 (Cell): 10 MHz | 819 (163800) | | 831.5 (166300) | | 844 (168800) | |
| 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 n70: 5 MHz | 1697.5 (339500) | | 1702.5 (340500) | | 1707.5 (341500) | |
| NR Band n70: 10 MHz | 1700 (340000) | | 1702.5 (340500) | | 1705 (341000) | |
| NR Band n70: 15 MHz | N/A | | 1702.5 (340500) | | N/A | |
| 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 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: 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 n48: 10 MHz | 3555 (637000) | 3601.68 (640112) | N/A | | 3648.33 (643222) | 3694.98 (646332) |
| NR Band n48: 20 MHz | 3560.01 (637234) | 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 | 3624.99 (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: 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 C: 10 MHz | 3705 (647000) | 3759 (650600) | 3813 (654200) | 3867 (657800) | 3921 (661400) | 3975 (665000) |
| NR Band n77 C: 15 MHz | 3707.52 (647168) | 3760.5 (650700) | 3813.51 (654234) | 3866.49 (657766) | 3919.5 (661300) | 3972.48 (664832) |
| NR Band n77 C: 20 MHz | 3710.01 (647334) | 3762 (650800) | 3813.99 (654266) | 3866.01 (657734) | 3918 (661200) | 3969.99 (664666) |
| NR Band n77 C: 30 MHz | 3715.02 (647668) | 3765 (651000) | 3815.01 (654334) | 3864.99 (657666) | 3915 (661000) | 3964.98 (664332) |
| NR Band n77 C: 40 MHz | 3720 (648000) | 3768 (651200) | 3816 (654400) | 3864 (657600) | 3912 (660800) | 3960 (664000) |
| NR Band n77 C: 50 MHz | 3725.01 (648334) | 3782.49 (652166) | 3840 (656000) | | 3897.51 (659834) | 3954.99 (663666) |
| NR Band n77 C: 60 MHz | 3730.02 (648668) | 3803.34 (653556) | N/A | N/A | 3876.66 (658444) | 3949.98 (663332) |
| NR Band n77 C: 70 MHz | 3735 (649000) | 3804.99 (653666) | N/A | | 3875.01 (658334) | 3945 (663000) |
| NR Band n77 C: 80 MHz | 3740.01 (649334) | N/A | 3840 (656000) | | N/A | 3939.99 (662666) |
| NR Band n77 C: 90 MHz | 3745.02 (649668) | N/A | 3840 (656000) | | N/A | 3934.98 (662332) |
| NR Band n77 C: 100 MHz | 3750 (650000) | N/A | N/A | N/A | N/A | 3930 (662000) |
| SCS for NR Band n71/n12/n14/n26/n5/n70/n66/n25/n2/n30/n7 | 15 kHz | | | | | |
| SCS for NR Band n41/n48/n77 DoD/n77 C | 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 66/2/7/48 | | | | | |
| LTE Anchor Bands for NR Band n12 | LTE Band 66/2/30/48 | | | | | |
| LTE Anchor Bands for NR Band n14 | LTE Band 66/2/30 | | | | | |
| LTE Anchor Bands for NR Band n26 (Cell) | N/A | | | | | |
| LTE Anchor Bands for NR Band n5 (Cell) | LTE Band 66/2/30/7/48 | | | | | |
| LTE Anchor Bands for NR Band n70 | N/A | | | | | |
| LTE Anchor Bands for NR Band n66 (AWS) | LTE Band 71/12/13/14/5/2/30/7/48 | | | | | |
| LTE Anchor Bands for NR Band n25 (PCS) | LTE Band 12/66/48 | | | | | |
| LTE Anchor Bands for NR Band n2 (PCS) | LTE Band 12/13/14/5/66 | | | | | |
| LTE Anchor Bands for NR Band n30 | LTE Band 12/14/5/66 | | | | | |
| LTE Anchor Bands for NR Band n7 | LTE Band 12/5/66 | | | | | |
| LTE Anchor Bands for NR Band n41 | LTE Band 26/4/66/2/25 | | | | | |
| LTE Anchor Bands for NR Band n48 | LTE Band 2/13/5/66 | | | | | |
| LTE Anchor Bands for NR Band n77 DoD | LTE Band 71/12/13/14/5/66/2/30/7/41 | | | | | |
| LTE Anchor Bands for NR Band n77 C | LTE Band 71/12/13/14/5/66/2/30/7/41 | | | | | |

# 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:

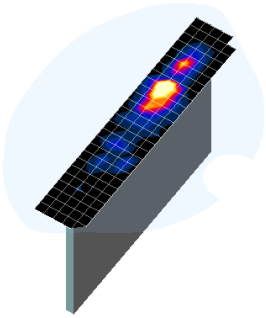

**Figure 4-1**
**Sample SAR Area Scan**

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 TEST CONFIGURATION POSITIONS

## 5.1 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.

## 5.2 SAR Testing for Tablet per KDB Publication 616217 D04v01r02

Per FCC KDB Publication 616217 D04v01r02, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

# 6 RF EXPOSURE LIMITS

## 6.1 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.

## 6.2 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 6-1**
**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.

# 7 FCC MEASUREMENT PROCEDURES

## 7.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

# 8 RF CONDUCTED POWERS

All conducted power measurements for 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).

Note: Lower bandwidth conducted powers for all NR bands can be found in NR Lower Bandwidth RF Conducted Powers Appendix.

Notes: 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 NR Lower Bandwidths RF Conducted Powers Appendix. 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.

## 8.1 NR Band n48

**Table 8-1**
**NR Band n48 Measured $P_{Limit}$ Antenna 1 - 40 MHz Bandwidth**

| NR Band n48<br>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 | 11.59 | 11.05 | 11.32 | 0 | 0.0 |
| | 1 | 53 | 11.05 | 11.07 | 11.37 | | 0.0 |
| | 1 | 104 | 11.12 | 11.10 | 11.26 | | 0.0 |
| | 50 | 0 | 11.05 | 11.05 | 11.35 | 0-0.5 | 0.0 |
| | 50 | 28 | 11.01 | 10.98 | 11.28 | 0 | 0.0 |
| | 50 | 56 | 10.98 | 10.96 | 11.16 | 0-0.5 | 0.0 |
| | 100 | 0 | 11.02 | 11.02 | 11.24 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | 11.58 | 11.10 | 11.40 | 0 | 0.0 |
| | 1 | 53 | 11.04 | 10.96 | 11.34 | | 0.0 |
| | 1 | 104 | 11.14 | 11.18 | 11.22 | | 0.0 |
| | 50 | 0 | 10.98 | 11.01 | 11.36 | 0-1 | 0.0 |
| | 50 | 28 | 11.00 | 10.99 | 11.27 | 0 | 0.0 |
| | 50 | 56 | 10.97 | 11.00 | 11.18 | 0-1 | 0.0 |
| | 100 | 0 | 11.00 | 11.01 | 11.29 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 11.74 | 11.41 | 11.51 | 0-1 | 0.0 |
| CP-OFDM QPSK | 1 | 1 | 11.49 | 10.98 | 11.25 | 0-1.5 | 0.0 |

### 8.1.1 NR Band n48

**Table 8-2**
**NR Band n48 Measured $P_{Limit}$ Antenna 2a - 40 MHz Bandwidth**

| NR Band n48<br>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 | 10.72 | 10.65 | 10.61 | 0 | 0.0 |
| | 1 | 53 | 10.66 | 10.48 | 10.52 | | 0.0 |
| | 1 | 104 | 10.71 | 10.59 | 10.50 | | 0.0 |
| | 50 | 0 | 10.67 | 10.49 | 10.48 | 0-0.5 | 0.0 |
| | 50 | 28 | 10.64 | 10.44 | 10.43 | 0 | 0.0 |
| | 50 | 56 | 10.62 | 10.37 | 10.37 | 0-0.5 | 0.0 |
| | 100 | 0 | 10.67 | 10.47 | 10.52 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | 10.73 | 10.62 | 10.77 | 0 | 0.0 |
| | 1 | 53 | 10.76 | 10.57 | 10.52 | | 0.0 |
| | 1 | 104 | 10.97 | 10.84 | 10.50 | | 0.0 |
| | 50 | 0 | 10.89 | 10.71 | 10.71 | 0-1 | 0.0 |
| | 50 | 28 | 10.63 | 10.42 | 10.44 | 0 | 0.0 |
| | 50 | 56 | 10.60 | 10.40 | 10.40 | 0-1 | 0.0 |
| | 100 | 0 | 10.65 | 10.45 | 10.50 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 10.95 | 10.86 | 10.75 | 0-1 | 0.0 |
| ⁼DM ɜK | 1 | 1 | 10.65 | 10.57 | 10.48 | 0-1.5 | 0.0 |

## 8.1.2 NR Band n48

**Table 8-3**
**NR Band n48 Measured $P_{Limit}$ Antenna 3 - 40 MHz Bandwidth**

| NR Band n48<br>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 | 11.13 | 11.25 | 11.31 | 0 | 0.0 |
| | 1 | 53 | 11.11 | 11.19 | 11.22 | | 0.0 |
| | 1 | 104 | 11.29 | 11.24 | 11.16 | | 0.0 |
| | 50 | 0 | 11.12 | 11.23 | 11.25 | 0-0.5 | 0.0 |
| | 50 | 28 | 11.07 | 11.17 | 11.14 | 0 | 0.0 |
| | 50 | 56 | 11.13 | 11.13 | 11.04 | 0-0.5 | 0.0 |
| | 100 | 0 | 11.14 | 11.21 | 11.13 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | 11.16 | 11.43 | 11.54 | 0 | 0.0 |
| | 1 | 53 | 11.21 | 11.20 | 11.16 | | 0.0 |
| | 1 | 104 | 11.40 | 11.26 | 11.17 | | 0.0 |
| | 50 | 0 | 11.25 | 11.32 | 11.44 | 0-1 | 0.0 |
| | 50 | 28 | 11.11 | 11.17 | 11.14 | 0 | 0.0 |
| | 50 | 56 | 11.13 | 11.11 | 11.05 | 0-1 | 0.0 |
| | 100 | 0 | 11.08 | 11.19 | 11.37 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 11.33 | 11.48 | 11.54 | 0-1 | 0.0 |
| CP-OFDM QPSK | 1 | 1 | 11.10 | 11.21 | 11.46 | 0-1.5 | 0.0 |

### 8.1.3 NR Band n48

**Table 8-4**
**NR Band n48 Measured $P_{Limit}$ Antenna 4b - 40 MHz Bandwidth**

| NR Band n48<br>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 | 10.65 | 10.48 | 10.52 | 0 | 0.0 |
| | 1 | 53 | 10.40 | 10.29 | 10.65 | | 0.0 |
| | 1 | 104 | 10.50 | 10.33 | 10.53 | | 0.0 |
| | 50 | 0 | 10.28 | 10.29 | 10.59 | 0-0.5 | 0.0 |
| | 50 | 28 | 10.33 | 10.24 | 10.60 | 0 | 0.0 |
| | 50 | 56 | 10.36 | 10.25 | 10.52 | 0-0.5 | 0.0 |
| | 100 | 0 | 10.30 | 10.29 | 10.60 | | 0.0 |
| DFT-s-OFDM QPSK | 1 | 1 | 10.70 | 10.44 | 10.53 | 0 | 0.0 |
| | 1 | 53 | 10.37 | 10.32 | 10.65 | | 0.0 |
| | 1 | 104 | 10.46 | 10.50 | 10.55 | | 0.0 |
| | 50 | 0 | 10.35 | 10.28 | 10.65 | 0-1 | 0.0 |
| | 50 | 28 | 10.28 | 10.24 | 10.60 | 0 | 0.0 |
| | 50 | 56 | 10.31 | 10.26 | 10.52 | 0-1 | 0.0 |
| | 100 | 0 | 10.31 | 10.31 | 10.56 | | 0.0 |
| DFT-s-OFDM 16QAM | 1 | 1 | 10.92 | 10.65 | 10.74 | 0-1 | 0.0 |
| CP-OFDM QPSK | 1 | 1 | 10.61 | 10.29 | 10.42 | 0-1.5 | 0.0 |

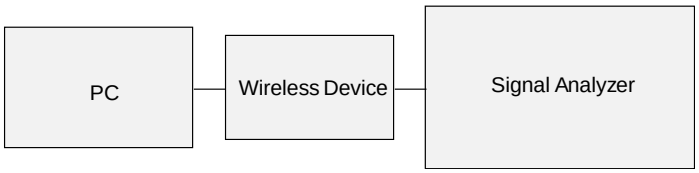


**Figure 8-1**
**Power Measurement Setup**

# 9 SYSTEM VERIFICATION

## 9.1 Tissue Verification

**Table 9-1**
**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 |
|---|---|---|---|---|---|---|---|---|---|
| 07/10/2022 | 3600 Head | 21.4 | 3300 | 2.760 | 36.732 | 2.708 | 38.157 | *1.92%* | *-3.73%* |
| | | | 3350 | 2.801 | 36.679 | 2.759 | 38.100 | *1.52%* | *-3.73%* |
| | | | 3450 | 2.874 | 36.566 | 2.861 | 37.986 | *0.45%* | *-3.74%* |
| | | | 3500 | 2.910 | 36.480 | 2.913 | 37.929 | *-0.10%* | *-3.82%* |
| | | | 3550 | 2.947 | 36.443 | 2.964 | 37.871 | *-0.57%* | *-3.77%* |
| | | | 3560 | 2.954 | 36.421 | 2.974 | 37.860 | *-0.67%* | *-3.80%* |
| | | | 3600 | 2.985 | 36.372 | 3.015 | 37.814 | *-1.00%* | *-3.81%* |
| | | | 3650 | 3.023 | 36.294 | 3.066 | 37.757 | *-1.40%* | *-3.87%* |
| | | | 3690 | 3.053 | 36.251 | 3.107 | 37.711 | *-1.74%* | *-3.87%* |
| | | | 3700 | 3.062 | 36.235 | 3.117 | 37.700 | *-1.76%* | *-3.89%* |
| | | | 3750 | 3.102 | 36.184 | 3.169 | 37.643 | *-2.11%* | *-3.88%* |
| | | | 3900 | 3.225 | 36.003 | 3.323 | 37.471 | *-2.95%* | *-3.92%* |
| | | | 3930 | 3.257 | 35.959 | 3.353 | 37.437 | *-2.86%* | *-3.95%* |
| | | | 4100 | 3.399 | 35.772 | 3.528 | 37.243 | *-3.66%* | *-3.95%* |
| | | | 4150 | 3.444 | 35.728 | 3.579 | 37.186 | *-3.77%* | *-3.92%* |

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.

Note: Per April 2019 TCB Workshop Notes, single head-tissue simulating liquid specified in IEC 62209-1 is permitted to use for all SAR tests.

## 9.2 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 the System Validation Appendix.

**Table 9-2**
**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 (%) |
| AM1 | 3500 | HEAD | 07/10/2022 | 21.6 | 20.6 | 0.10 | 1055 | 7639 | 6.840 | 67.80 | 68.400 | 0.88% |
| AM1 | 3700 | HEAD | 07/10/2022 | 21.6 | 20.6 | 0.10 | 1002 | 7639 | 6.730 | 68.80 | 67.300 | -2.18% |

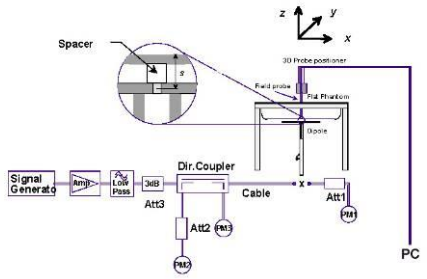


**Figure 9-1**
**System Verification Setup Diagram**

**Figure 9-2**
**System Verification Setup Photo**

# 10 SAR DATA SUMMARY

## 10.1 Standalone SAR Data

**Table 10-1**
**NR Band n48 Ant 1 Body SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Side | Spacing | 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) | SAR (10g) | Reported SAR (10g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | (W/kg) | (W/kg) | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.58 | 0 | -0.06 | 1:1 | 0.633 | 1.102 | 0.698 | 0.148 | 0.163 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 12.00 | 11.18 | 0 | -0.05 | 1:1 | 0.655 | 1.208 | 0.791 | 0.151 | 0.182 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.40 | 0 | -0.09 | 1:1 | 0.650 | 1.148 | 0.746 | 0.150 | 0.172 | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 28 | 12.00 | 11.00 | 0 | -0.05 | 1:1 | 0.606 | 1.259 | 0.763 | 0.141 | 0.178 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.01 | 0 | -0.09 | 1:1 | 0.666 | 1.256 | 0.836 | 0.155 | 0.195 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.36 | 0 | 0.01 | 1:1 | 0.553 | 1.159 | 0.641 | 0.127 | 0.147 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 12.00 | 11.29 | 0 | -0.02 | 1:1 | 0.612 | 1.178 | 0.721 | 0.141 | 0.166 | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | CP-OFDM | QPSK | 1 | 1 | 12.00 | 11.49 | 0 | 0.11 | 1:1 | 0.628 | 1.125 | 0.707 | 0.150 | 0.169 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.58 | 0 | 0.03 | 1:1 | 0.000 | 1.102 | 0.000 | 0.000 | 0.000 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.36 | 0 | 0.04 | 1:1 | 0.000 | 1.159 | 0.000 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.58 | 0 | -0.07 | 1:1 | 0.546 | 1.102 | 0.602 | 0.147 | 0.162 | |
| 3624.99 | 641666 | Mid | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 12.00 | 11.18 | 0 | 0.02 | 1:1 | 0.511 | 1.208 | 0.617 | 0.137 | 0.165 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.40 | 0 | 0.02 | 1:1 | 0.535 | 1.148 | 0.614 | 0.144 | 0.165 | |
| 3570.00 | 638000 | Low | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 28 | 12.00 | 11.00 | 0 | 0.06 | 1:1 | 0.480 | 1.259 | 0.604 | 0.128 | 0.161 | |
| 3624.99 | 641666 | Mid | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.01 | 0 | -0.08 | 1:1 | 0.509 | 1.256 | 0.639 | 0.137 | 0.172 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.36 | 0 | 0.04 | 1:1 | 0.524 | 1.159 | 0.607 | 0.140 | 0.162 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 12.00 | 11.29 | 0 | -0.06 | 1:1 | 0.508 | 1.178 | 0.598 | 0.136 | 0.160 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.58 | 0 | 0.06 | 1:1 | 0.005 | 1.102 | 0.006 | 0.000 | 0.000 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.36 | 0 | 0.02 | 1:1 | 0.008 | 1.159 | 0.009 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | left | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.00 | 11.58 | 0 | -0.06 | 1:1 | 0.268 | 1.102 | 0.295 | 0.074 | 0.082 | |
| 3679.98 | 645332 | High | left | 0 mm | NR Band n48 | Ant 1 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.00 | 11.36 | 0 | -0.09 | 1:1 | 0.289 | 1.159 | 0.335 | 0.078 | 0.090 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | | | | | | | |

**Table 10-2**
**NR Band n48 Ant 2a Body SAR**

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | | Side | Spacing | 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) | SAR (10g) | Reported SAR (10g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | (W/kg) | (W/kg) | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | 0.01 | 1:1 | 0.760 | 1.130 | 0.859 | 0.228 | 0.258 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.84 | 0 | 0.00 | 1:1 | 0.733 | 1.164 | 0.853 | 0.216 | 0.251 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.50 | 10.77 | 0 | 0.04 | 1:1 | 0.724 | 1.183 | 0.856 | 0.213 | 0.252 | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.89 | 0 | 0.08 | 1:1 | 0.748 | 1.151 | 0.861 | 0.230 | 0.265 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.71 | 0 | 0.01 | 1:1 | 0.738 | 1.199 | 0.885 | 0.217 | 0.260 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.71 | 0 | 0.00 | 1:1 | 0.683 | 1.199 | 0.819 | 0.202 | 0.242 | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 11.50 | 10.65 | 0 | 0.00 | 1:1 | 0.764 | 1.216 | 0.929 | 0.229 | 0.278 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | -0.16 | 1:1 | 0.005 | 1.130 | 0.006 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.89 | 0 | 0.06 | 1:1 | 0.006 | 1.151 | 0.007 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | bottom | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | -0.01 | 1:1 | 0.264 | 1.130 | 0.298 | 0.071 | 0.080 | |
| 3570.00 | 638000 | Low | bottom | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.89 | 0 | -0.02 | 1:1 | 0.262 | 1.151 | 0.302 | 0.070 | 0.081 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | 0.01 | 1:1 | 0.804 | 1.130 | 0.909 | 0.214 | 0.242 | A1 |
| 3624.99 | 641666 | Mid | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.84 | 0 | 0.01 | 1:1 | 0.786 | 1.164 | 0.915 | 0.206 | 0.240 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.50 | 10.77 | 0 | 0.01 | 1:1 | 0.786 | 1.183 | 0.930 | 0.206 | 0.244 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.89 | 0 | 0.01 | 1:1 | 0.792 | 1.151 | 0.912 | 0.211 | 0.243 | |
| 3624.99 | 641666 | Mid | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.71 | 0 | -0.02 | 1:1 | 0.740 | 1.199 | 0.887 | 0.195 | 0.234 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.71 | 0 | 0.01 | 1:1 | 0.773 | 1.199 | 0.927 | 0.201 | 0.241 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 11.50 | 10.65 | 0 | -0.03 | 1:1 | 0.777 | 1.216 | 0.945 | 0.207 | 0.252 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | CP-OFDM | QPSK | 1 | 1 | 11.50 | 10.65 | 0 | -0.03 | 1:1 | 0.729 | 1.216 | 0.886 | 0.199 | 0.242 | |
| 3570.00 | 638000 | Low | left | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | 0.06 | 1:1 | 0.000 | 1.130 | 0.000 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | left | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.50 | 10.89 | 0 | 0.04 | 1:1 | 0.000 | 1.151 | 0.000 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 2a | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.50 | 10.97 | 0 | 0.04 | 1:1 | 0.750 | 1.130 | 0.848 | 0.210 | 0.237 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | | | | | | | |

Note: Blue entry represents variability measurement.

## Table 10-3
## NR Band n48 Ant 3 Body SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Side | Spacing | 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) | SAR (10g) | Reported SAR (10g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | (W/kg) | (W/kg) | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 12.20 | 11.40 | 0.00 | 0.00 | 1:1 | 0.671 | 1.202 | 0.807 | 0.171 | 0.206 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.43 | 0.00 | 0.08 | 1:1 | 0.678 | 1.194 | 0.810 | 0.172 | 0.205 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.54 | 0.00 | -0.03 | 1:1 | 0.713 | 1.164 | 0.830 | 0.178 | 0.207 | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.25 | 0.00 | 0.08 | 1:1 | 0.631 | 1.245 | 0.786 | 0.161 | 0.200 | |
| 3624.99 | 641666 | Mid | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.32 | 0.00 | -0.02 | 1:1 | 0.670 | 1.225 | 0.821 | 0.169 | 0.207 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.44 | 0.00 | -0.07 | 1:1 | 0.696 | 1.191 | 0.829 | 0.174 | 0.207 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 12.20 | 11.37 | 0.00 | 0.01 | 1:1 | 0.771 | 1.211 | 0.934 | 0.190 | 0.230 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | CP-OFDM | QPSK | 1 | 1 | 12.20 | 11.46 | 0.00 | -0.05 | 1:1 | 0.712 | 1.186 | 0.844 | 0.177 | 0.210 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 12.20 | 11.40 | 0.00 | -0.04 | 1:1 | 0.465 | 1.202 | 0.559 | 0.128 | 0.154 | |
| 3624.99 | 641666 | Mid | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.43 | 0.00 | -0.02 | 1:1 | 0.452 | 1.194 | 0.540 | 0.123 | 0.147 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.54 | 0.00 | -0.13 | 1:1 | 0.519 | 1.164 | 0.604 | 0.140 | 0.163 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.25 | 0.00 | -0.03 | 1:1 | 0.450 | 1.245 | 0.560 | 0.123 | 0.153 | |
| 3624.99 | 641666 | Mid | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.32 | 0.00 | -0.05 | 1:1 | 0.477 | 1.225 | 0.584 | 0.129 | 0.158 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.44 | 0.00 | 0.07 | 1:1 | 0.524 | 1.191 | 0.624 | 0.140 | 0.167 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 12.20 | 11.37 | 0.00 | -0.01 | 1:1 | 0.502 | 1.211 | 0.608 | 0.137 | 0.166 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 3 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.54 | 0.00 | 0.03 | 1:1 | 0.000 | 1.164 | 0.000 | 0.000 | 0.000 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 3 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.44 | 0.00 | 0.06 | 1:1 | 0.000 | 1.191 | 0.000 | 0.000 | 0.000 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.54 | 0.00 | -0.15 | 1:1 | 0.027 | 1.164 | 0.031 | 0.009 | 0.010 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 3 | F70633NVTK | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.44 | 0.00 | -0.18 | 1:1 | 0.027 | 1.191 | 0.032 | 0.008 | 0.010 | |
| 3679.98 | 645332 | High | left | 0 mm | NR Band n48 | Ant 3 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 12.20 | 11.54 | 0.00 | 0.04 | 1:1 | 0.016 | 1.164 | 0.019 | 0.003 | 0.003 | |
| 3679.98 | 645332 | High | left | 0 mm | NR Band n48 | Ant 3 | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 12.20 | 11.44 | 0.00 | 0.03 | 1:1 | 0.013 | 1.191 | 0.015 | 0.002 | 0.002 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | | | |

## Table 10-4
## NR Band n48 Ant 4b Body SAR

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Side | Spacing | 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) | SAR (10g) | Reported SAR (10g) | Plot # |
| MHz | Ch. | | | | | | | | | | | | | | | | (W/kg) | | (W/kg) | (W/kg) | (W/kg) | |
| 3570.00 | 638000 | Low | back | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.30 | 10.70 | 0.00 | -0.06 | 1:1 | 0.465 | 1.148 | 0.534 | 0.130 | 0.149 | |
| 3679.98 | 645332 | High | back | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.65 | 0.00 | 0.02 | 1:1 | 0.515 | 1.161 | 0.598 | 0.145 | 0.168 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.30 | 10.70 | 0.00 | 0.04 | 1:1 | 0.628 | 1.148 | 0.721 | 0.177 | 0.203 | |
| 3624.99 | 641666 | Mid | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 104 | 11.30 | 10.50 | 0.00 | -0.13 | 1:1 | 0.699 | 1.202 | 0.840 | 0.193 | 0.232 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 53 | 11.30 | 10.65 | 0.00 | 0.04 | 1:1 | 0.748 | 1.161 | 0.868 | 0.208 | 0.241 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.35 | 0.00 | 0.06 | 1:1 | 0.630 | 1.245 | 0.784 | 0.176 | 0.219 | |
| 3624.99 | 641666 | Mid | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.28 | 0.00 | -0.21 | 1:1 | 0.639 | 1.265 | 0.808 | 0.178 | 0.225 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.65 | 0.00 | -0.13 | 1:1 | 0.722 | 1.161 | 0.838 | 0.189 | 0.231 | |
| 3679.98 | 645332 | High | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 100 | 0 | 11.30 | 10.56 | 0.00 | 0.01 | 1:1 | 0.690 | 1.186 | 0.818 | 0.193 | 0.229 | |
| 3570.00 | 638000 | Low | top | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | CP-OFDM | QPSK | 1 | 1 | 11.30 | 10.61 | 0.00 | 0.02 | 1:1 | 0.634 | 1.172 | 0.743 | 0.177 | 0.207 | |
| 3570.00 | 638000 | Low | bottom | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.30 | 10.70 | 0.00 | 0.03 | 1:1 | 0.000 | 1.148 | 0.000 | 0.000 | 0.000 | |
| 3679.98 | 645332 | High | bottom | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.65 | 0.00 | 0.08 | 1:1 | 0.000 | 1.161 | 0.000 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | right | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.30 | 10.70 | 0.00 | 0.04 | 1:1 | 0.008 | 1.148 | 0.009 | 0.001 | 0.001 | |
| 3679.98 | 645332 | High | right | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.65 | 0.00 | 0.03 | 1:1 | 0.006 | 1.161 | 0.007 | 0.000 | 0.000 | |
| 3570.00 | 638000 | Low | left | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 1 | 1 | 11.30 | 10.70 | 0.00 | 0.05 | 1:1 | 0.018 | 1.148 | 0.021 | 0.004 | 0.005 | |
| 3679.98 | 645332 | High | left | 0 mm | NR Band n48 | Ant 4b | QLWS63W0L | 40 | DFT-S-OFDM | QPSK | 50 | 0 | 11.30 | 10.65 | 0.00 | 0.07 | 1:1 | 0.013 | 1.161 | 0.015 | 0.002 | 0.002 | |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | | | | |

## 10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04v01r02, and 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. 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 12 for variability analysis
7. FCC KDB Publication 616217 D04v01r02 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v06 was applied to determine SAR test exclusion for adjacent edge configurations.
8. This device uses Smart Transmit for 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).
9. The orange highlights throughout the report represents the highest scaled SAR per Equipment Class.
10. See the original filing for all other operations that were not evaluated in this permissive change.

NR Notes:

1. NR implementation supports SA and NSA modes. NR implementation in EN-DC mode operates with the LTE Bands shown in the NR FR1 checklist acting as anchor bands. Per FCC guidance, SAR tests for NR Bands and LTE Anchors Bands were performed separately due to limitations in SAR probe calibration factors.
2. Due to test setup limitations, SAR testing for NR was performed using test mode software to establish the connection.
3. This device additionally supports some EN-DC conditions where additional LTE carriers are added on the downlink only.
4. 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.

# 11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

## 11.1 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.

## 11.2 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.

Note:
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 SAR MEASUREMENT VARIABILITY

## 12.1 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 12-1**
**Body SAR Measurement Variability Results**

| BODY VARIABILITY RESULTS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | FREQUENCY | | Mode | Waveform | Service | Ant | Side | Spacing | 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, 1 RB, 104 RB Offset | Ant 2a | right | 0 mm | 0.804 | 0.750 | 1.07 | N/A | N/A | N/A | N/A |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

## 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 | 3/24/2022 | Annual | 3/24/2023 | MY45093678 |
| Agilent | E4438C | ESG Vector Signal Generator | 3/22/2022 | Annual | 3/22/2023 | US41460739 |
| Agilent | N5182A | MXG Vector Signal Generator | 1/12/2022 | Annual | 1/12/2023 | MY47420837 |
| Agilent | N5182A | MXG Vector Signal Generator | 11/17/2021 | Annual | 11/17/2022 | US46240505 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 6/14/2022 | Annual | 6/14/2023 | US39170118 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 2/11/2022 | Annual | 2/11/2023 | MY40003841 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 343972 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 343971 |
| Anritsu | MA24106A | USB Power Sensor | 3/28/2022 | Annual | 3/28/2023 | 1520503 |
| Anritsu | MA24106A | USB Power Sensor | 3/28/2022 | Annual | 3/28/2023 | 1520501 |
| Control Company | 4353 | Long Stem Thermometer | 10/28/2020 | Biennial | 10/28/2022 | 200670623 |
| Control Company | 4353 | Long Stem Thermometer | 10/28/2020 | Biennial | 10/28/2022 | 200670633 |
| Control Company | 4353 | Long Stem Thermometer | 10/28/2020 | Biennial | 10/28/2022 | 200670635 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 1/21/2022 | Annual | 1/21/2023 | 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 | 4/14/2022 | Annual | 4/14/2023 | MY48010233 |
| 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 | 9/15/2021 | Annual | 9/15/2022 | 2111 |
| 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 | 7/8/2021 | Annual | 7/8/2022 | 47639-29 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 5/12/2022 | Annual | 5/12/2023 | 1070 |
| SPEAG | DAKS-3.5 | Portable Dielectric Assessment Kit | 10/7/2021 | Annual | 10/7/2022 | 1045 |
| SPEAG | MAIA | Modulation and Audio Interference Analyzer | N/A | N/A | N/A | 1237 |
| SPEAG | DAK-12 | Dielectric Assessment Kit (10MHz - 3GHz) | 11/16/2021 | Annual | 11/16/2022 | 1121 |
| SPEAG | D3500V2 | 3500 MHz SAR Dipole | 8/16/2019 | Triennial | 8/16/2022 | 1055 |
| SPEAG | D3700V2 | 3700 MHz SAR Dipole | 10/17/2019 | Triennial | 10/17/2022 | 1002 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 11/11/2021 | Annual | 11/11/2022 | 1646 |
| SPEAG | EX3DV4 | SAR Probe | 11/16/2021 | Annual | 11/16/2022 | 7639 |

*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.

# 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 | 1.73 | 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 | 1.73 | 1 | 1 | 0.1 | 0.1 | ∞ |
| Modulation Response | E.2.5 | 4.8 | R | 1.73 | 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 | 1.73 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Integration Time | E.2.8 | 2.6 | R | 1.73 | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions - Noise | E.6.1 | 3 | R | 1.73 | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | E.6.1 | 3 | R | 1.73 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E.6.2 | 0.8 | R | 1.73 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Probe Positioning w/ respect to Phantom | E.6.3 | 6.7 | R | 1.73 | 1 | 1 | 3.9 | 3.9 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5 | 4 | R | 1.73 | 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 | 1.73 | 1 | 1 | 2.9 | 2.9 | ∞ |
| SAR Scaling | E.6.5 | 0 | R | 1.73 | 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 | 1.73 | 0.78 | 0.71 | 1.5 | 1.4 | ∞ |
| Liquid Permittivity - Temperature Unceritainty | E.3.4 | 0.6 | R | 1.73 | 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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