FCC SAR Test Report

APPLICANT	**: Sonim Technologies, Inc.**
EQUIPMENT	**: Smart phone**
BRAND NAME	**: Sonim**
MODEL NAME	**: XP9900 (P14001)**
FCC ID	**: WYPP14010**
STANDARD	**: FCC 47 CFR Part 2 (2.1093)**

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

ACCREDITED Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA371405	Rev. 01	Initial issue of report.	Nov. 02, 2023

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Sonim Technologies, Inc., Smart phone, XP9900 (P14001),** are as follows.

Highest 1g SAR Summary

Equipment Class	Frequency Band		Head (Separation 0mm)	Hotspot (Separation 10mm)	Body-worn (Separation 15mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)			
Licensed	5G NR	FR1 n25	0.25	0.99	0.38	1.56
		FR1 n30	0.22	0.77	0.45	
		FR1 n48	**0.37**	**1.09**	**0.81**	

Highest 10g SAR Summary

Equipment Class	Frequency Band		Product Specific 10g SAR (W/kg) (Separation 0mm)	Highest Simultaneous Transmission 10g SAR (W/kg)
Licensed	5G NR	FR1 n48	**2.75**	3.91
NII	WLAN	5GHz WLAN	1.83	3.91
Date of Testing:			2023/8/15 ~ 2023/8/20	

Note: This is a variant report for XP9900 (P14001), the difference between previous and current project please refer to the XP9900 (P14001)_Class II Permissive Change letter which is exhibit separately. According to the difference, the 5GNR NSA mode power level is not less than 5GNR SA mode, only 5GNR n25/n30 ant1 and 5GNR n48 ant5 performed full SAR testing and added new EN-DC combination evaluation to do co-located with WLAN analysis, and added WLAN 5G ant9 standalone SAR, and WLAN 5G ant 9 simultaneous SAR test at extremity exposure conditions for simultaneously transmission SAR analysis, all other Bands test results can be referred to original test report (CTTL report No. B22N01108-SAR).

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992 and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR02-KS	CN1257	314309

Applicant	
Company Name	Sonim Technologies, Inc.
Address	4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA

Manufacturer	
Company Name	Sonim Technologies, Inc.
Address	4445 Eastgate Mall, Suite 200, San Diego, CA 92121, USA

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D05A Rel.10 LTE SAR Test Guidance v01r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Smart phone
Brand Name	Sonim
Model Name	XP9900 (P14001)
FCC ID	WYPP14010
IMEI Code	016188000786074
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 42: 3450 MHz ~ 3550MHz, 3550 MHz ~ 3600MHz LTE Band 43: 3600 MHz ~ 3700MHz LTE Band 48: 3550 MHz ~3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 689 MHz 5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n14: 788 MHz ~ 798 MHz 5G NR n25: 1850 MHz ~ 1915 MHz 5G NR n30: 2305 MHz ~ 2315 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n71: 663 MHz ~ 689 MHz 5G NR n41: 2496 MHz ~ 2690 MHz 5G NR n48: 3550 MHz ~ 3700 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz
Mode	RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+(16QAM uplink is supported) LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR: CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC: ASK
HW Version	V1.0

SW Version	10.0.0-01-12.0.0-10.60.10
EUT Stage	Identical Prototype

Remark:
1. This device supports VoIP in WCDMA and LTE (e.g. for 3rd-party VoIP), LTE supports VoLTE operation.
2. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
3. This device 5.2GHz WLAN/5.8GHz WLAN support hotspot operation, and 5.2GHz WLAN/5.8GHz WLAN supports WiFi Direct (GC/GO), and 5.3GHz / 5.5GHz supports WiFi Direct (GC only).
4. The device implements receiver detection/hotspot mode for SAR compliance at different exposure conditions (head, body-worn, hotspot, extremity). This device uses the receiver to indicate whether the user is making a call-in head scenario or not. The selection between head and body power levels is based on the receiver detection mechanism. It can determine proximity to head or body and set the relevant power level for WWAN and WiFi/BT antennas accordingly. And the device will invoke corresponding work scenarios power level base on frequency bands/antennas, which can refer to power table at original report.
5. This device has NFC function and the NFC SAR report will be separately submitted.
6. This device supports 5GNR FR1 bands as following table, including NSA mode and SA mode. NSA and SA mode performed SAR separately.

<5G NR>

Mode	Band	Duplex	SCS(KHz)	Bandwidths (BW)
NSA	n48	TDD	30	10, 20, 40
	n25	FDD	15	5, 10, 15, 20
	n30	FDD	15	5, 10
SA	n48	TDD	30	10, 20, 40
	n25	FDD	15	5, 10, 15, 20
	n30	FDD	15	5, 10

5. RF Exposure Limits

5.1 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.

5.2 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. The 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.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

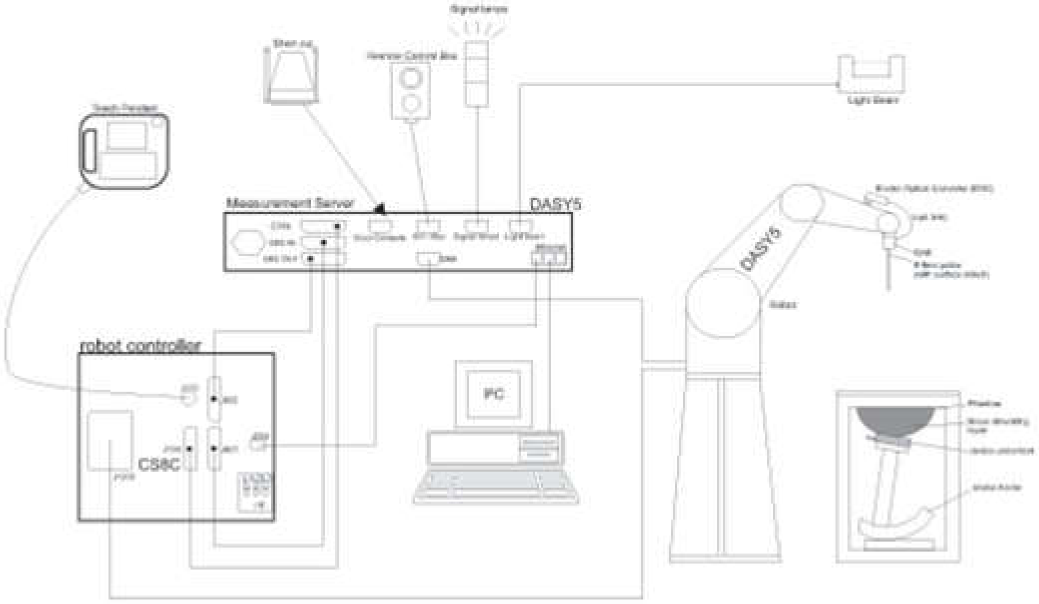
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

7. System Description and Setup

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win10 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 μW/g – >100 mW/g; Linearity: ±0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 μW/g)
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

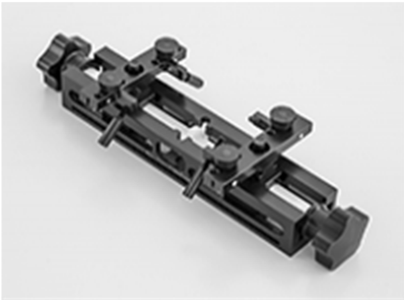
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices or for evaluating transmitters operating at low frequencies. ELI is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>$>$ 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	2022/3/30	2025/3/29
SPEAG	2300MHz System Validation Kit	D2300V2	1055	2020/9/15	2023/9/13
SPEAG	3500MHz System Validation Kit	D3500V2	1037	2020/11/25	2023/11/23
SPEAG	3700MHz System Validation Kit	D3700V2	1008	2020/11/25	2023/11/23
SPEAG	5000MHz System Validation Kit	D5GHzV2	1113	2022/9/23	2023/9/22
SPEAG	Data Acquisition Electronics	DAE4	1279	2023/6/7	2024/6/6
SPEAG	Dosimetric E-Field Probe	ES3DV3	3293	2022/11/22	2023/11/21
SPEAG	Dosimetric E-Field Probe	EX3DV4	3857	2022/12/14	2023/12/13
SPEAG	SAM Twin Phantom	SAM Twin	1842	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio Communication Analyzer	MT8821C	6262306175	2023/7/5	2024/7/4
Agilent	Dual Directional Coupler	11691D	MY48151020	2023/7/5	2024/7/4
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2023/7/5	2024/7/4
SPEAG	Dielectric Probe Kit	DAK-3.5	1071	2023/2/20	2024/2/19
Anritsu	Vector Signal Generator	MG3710A	6201682672	2023/1/5	2024/1/4
Rohde & Schwarz	Power Meter	NRVD	102081	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	2023/7/5	2024/7/4
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	2023/7/5	2024/7/4
Rohde & Schwarz	Spectrum Analyzer	FSV7	101631	2022/10/12	2023/10/11
CHIGO	Thermo-Hygrometer	HTC-1	55011	2023/1/8	2024/1/7
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
TES	DIGITAC THERMOMETER	1310	220305411	Note 1	
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuation1	BW-S10W5+	N/A	Note 1	
MCL	Attenuation2	BW-S10W5+	N/A	Note 1	
MCL	Attenuation3	BW-S10W5+	N/A	Note 1	

Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 11.2.

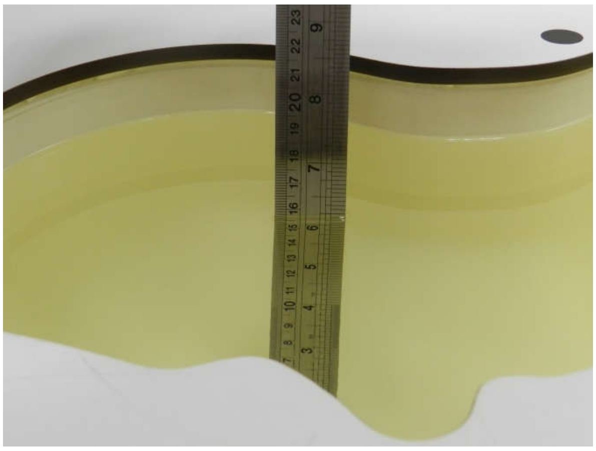


Fig 11.1 Photo of Liquid Height for Head SAR

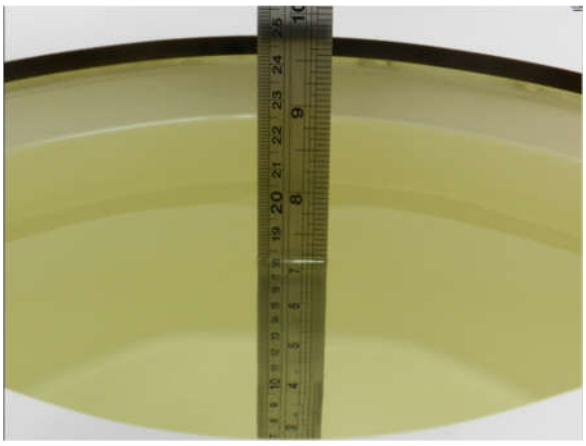


Fig 11.2 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
1900	Head	22.8	1.406	40.200	1.40	40.00	0.43	0.50	±5	2023/8/15
2300	Head	22.6	1.652	39.643	1.67	39.50	-1.08	0.36	±5	2023/8/16
3500	Head	22.8	2.813	38.733	2.91	37.90	-3.33	2.20	±5	2023/8/17
3700	Head	22.9	2.991	38.380	3.12	37.70	-4.13	1.80	±5	2023/8/20
5250	Head	22.9	4.579	35.731	4.71	35.90	-2.78	-0.47	±5	2023/8/18
5600	Head	22.7	4.954	35.110	5.07	35.50	-2.29	-1.10	±5	2023/8/19

10.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2023/8/15	1900	Head	50	5d118	3293	1279	1.920	39.30	38.4	-2.29
2023/8/16	2300	Head	50	1055	3293	1279	2.350	47.70	47	-1.47
2023/8/17	3500	Head	50	1037	3857	1279	3.330	68.00	66.6	-2.06
2023/8/20	3700	Head	50	1008	3857	1279	3.610	67.60	72.2	6.80
2023/8/18	5250	Head	50	1113	3857	1279	3.820	81.50	76.4	-6.26
2023/8/19	5600	Head	50	1113	3857	1279	4.380	82.60	87.6	6.05

<10g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2023/8/15	1900	Head	50	5d118	3293	1279	1.010	20.40	20.2	-0.98
2023/8/16	2300	Head	50	1055	3293	1279	1.140	22.90	22.8	-0.44
2023/8/17	3500	Head	50	1037	3857	1279	1.280	25.40	25.6	0.79
2023/8/20	3700	Head	50	1008	3857	1279	1.250	24.40	25	2.46
2023/8/18	5250	Head	50	1113	3857	1279	1.090	23.30	21.8	-6.44
2023/8/19	5600	Head	50	1113	3857	1279	1.230	23.70	24.6	3.80

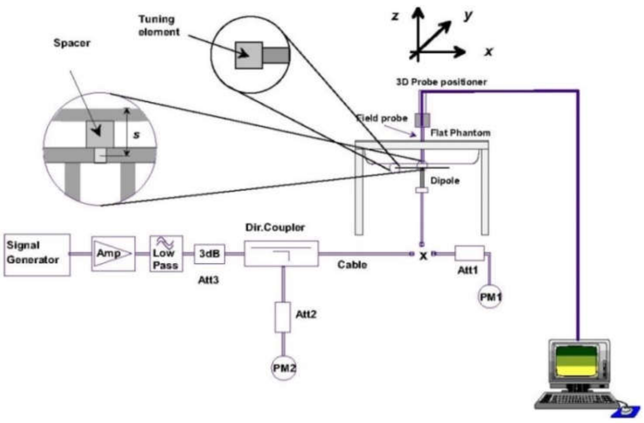


Fig 11.3.1 System Performance Check Setup

Fig 11.3.2 Setup Photo

11. RF Exposure Positions

11.1 Ear and handset reference point

Figure 12.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled "M," the left ear reference point (ERP) is marked "LE," and the right ERP is marked "RE." Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 12.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 12.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 12.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

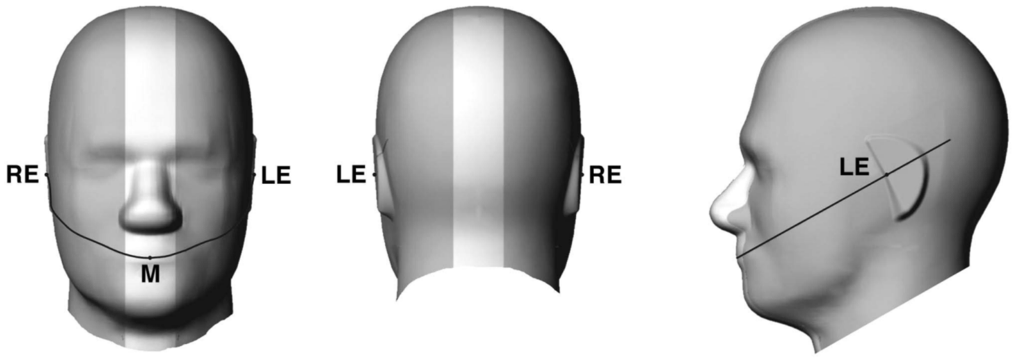


Fig 12.1.1 Front, back, and side views of SAM twin phantom

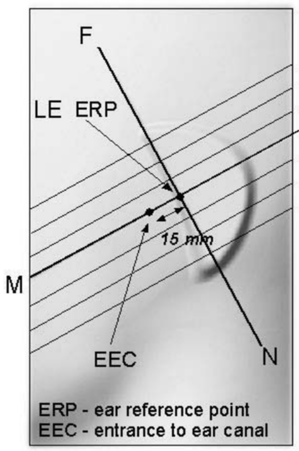


Fig 12.1.2 Close-up side view of phantom showing the ear region.

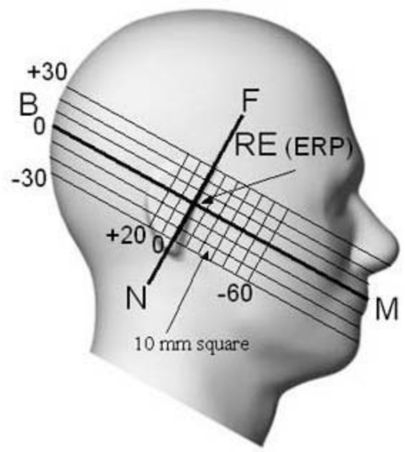


Fig 12.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

11.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Figure 12.2.1 and Figure 12.2.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 12.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 12.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 12.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 12.2.3. The actual rotation angles should be documented in the test report.

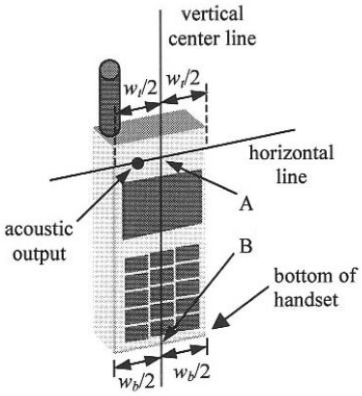


Fig 12.2.1 Handset vertical and horizontal reference lines—"fixed case

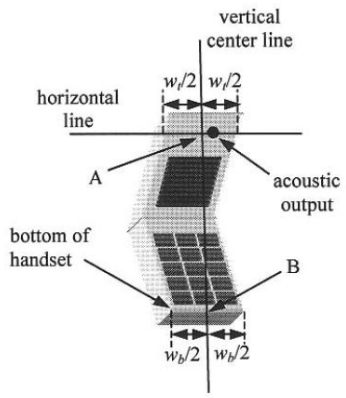


Fig 12.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

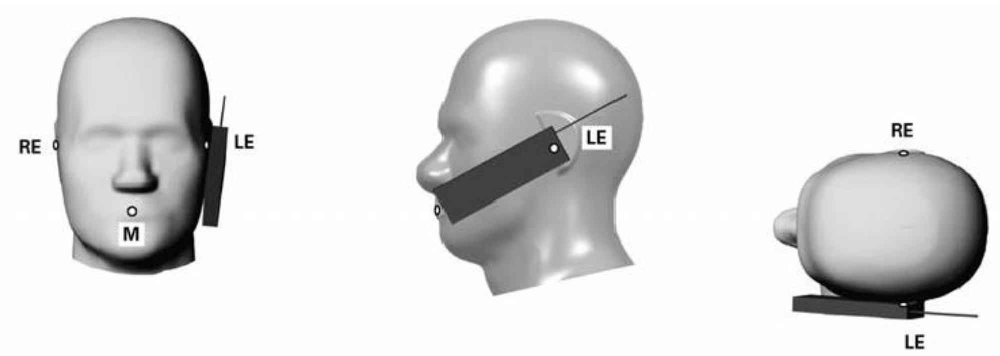


Fig 12.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

11.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 12.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

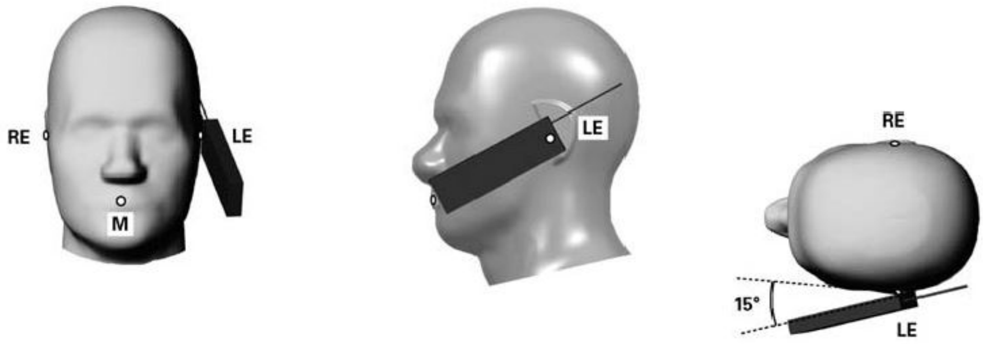


Fig 12.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

11.4 Body Worn Accessory

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 11.4). Per KDB648474 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 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for 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 handset attached to the handset.

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

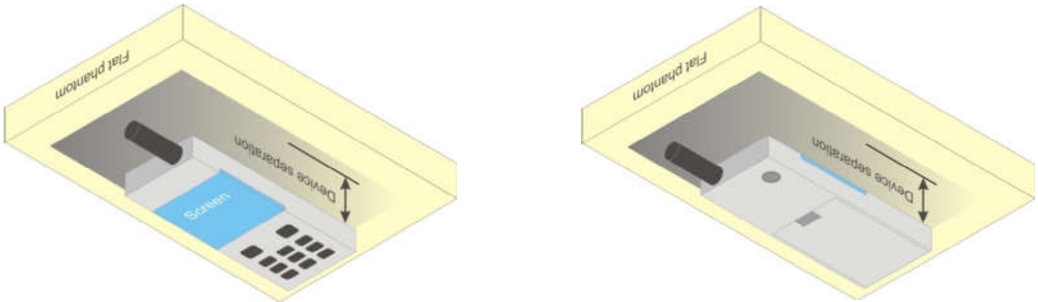


Fig 12.4 Body Worn Position

11.5 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, that can provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets and support voice calls next to the ear, According to KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.6 The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

11.6 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

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

12. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

5G NR Output Power (Unit: dBm)

General Note:

1. 5G NR n2/n5/n14/n25/n30/n66/n71/n41/n48/n77/n78 is SA mode and NSA mode.
2. For 5G NR test procedure was following step similar FCC KDB 941225 D05:
    a. For DFT-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for power class2 and 3, the CP-OFDM mode will not higher than DFT-OFDM mode, therefore, similar FCC KDB 941225 D05 procedure for other modulation output power for each RB allocation configuration is > not ½ dB higher than the same configuration in DFT-s QPSK and the reported SAR for the DFT-s QPSK configuration is ≤ 1.45 W/kg; CP-OFDM testing is not required.
    b. For DFT-OFDM output power measurement reduction, according to 38.101 maximum power reduction for power class2 and 3, for 16QAM/64QAM/256QAM and smaller bandwidth output power will spot check largest channel bandwidth worst RB configuration to ensure the 16QAM/64QAM/256QAM and smaller bandwidth output power will not ½ dB higher than the same configuration in the largest supported bandwidth.
    c. SAR testing start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel
    d. 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure
    e. QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested
    f. PI/2 BPSK/16QAM/64QAM/256QAM output powers according to 3GPP MPR will not ½ dB higher than the same configuration in QPSK, also reported SAR for the QPSK configuration is less than 1.45 W/kg, PI/2 BPSK /16QAM/64QAM/256QAM SAR testing are not required.
    g. Smaller bandwidth output power for each RB allocation configuration for this device will not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg, smaller bandwidth SAR testing is not required for this device
3. For 5G NR bands test, using FTM (Factory Test Mode) with default 100% duty cycle transmission to perform SAR testing.
4. NSA and SA mode should perform SAR separately. For the maximum power of NSA mode is the same as SA total power level, so SA SAR can represent NSA mode SAR.
5. 5GNR NSA mode, the power level is the same as 5GNR SA mode, so 5GNR NSA mode and SA mode power table only show one time.
6. 5G NR supports CP-OFDM and DFT-s-OFDM modulation, for DFT-s-OFDM power is higher than CP-OFDM, so only show DFT-s-OFDM power table and chose DFT-s-OFDM to perform SAR testing.
7. For DFT-s-OFDM and CP-OFDM output power measurement reduction, according to 38.101 maximum power reduction for the CP-OFDM mode will not higher than DFT-s-OFDM mode, therefore, CP-OFDM measurement is unnecessary.
8. Only operations relevant to this permissive change were evaluated for compliance, other test results can be referred to original report.

<3GPP 38.101 MPR for EN-DC>

Table 6.2.2-1 Maximum power reduction (MPR) for power class 3

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5[1]	≤ 1.2[1]	≤ 0.2[1]
		≤ 0.5[2]	≤ 0.5[2]	0[2]
	QPSK	≤ 1		0
	16 QAM	≤ 2		≤ 1
	64 QAM	≤ 2.5		
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3		≤ 1.5
	16 QAM	≤ 3		≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		

NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0 dB MPR is 26 dBm.

NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 with Pi/2 BPSK modulation and if the IE *powerBoostPi2BPSK* is set to 0 and if more than 40 % of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.

Table 6.2.2-2 Maximum power reduction (MPR) for power class 2

Modulation		MPR (dB)		
		Edge RB allocations	Outer RB allocations	Inner RB allocations
DFT-s-OFDM	Pi/2 BPSK	≤ 3.5	≤ 0.5	0
	QPSK	≤ 3.5	≤ 1	0
	16 QAM	≤ 3.5	≤ 2	≤ 1
	64 QAM	≤ 3.5	≤ 2.5	
	256 QAM	≤ 4.5		
CP-OFDM	QPSK	≤ 3.5	≤ 3	≤ 1.5
	16 QAM	≤ 3.5	≤ 3	≤ 2
	64 QAM	≤ 3.5		
	256 QAM	≤ 6.5		

<EN-DC combination>

ENDC	LTE TX	NR TX
DC_13A_n48	Ant 1	Ant 5
DC_66A_n2A	Ant 1	Ant 6
DC_2A_n41A	Ant 1	Ant 2
DC_5A_n78A	Ant 1	Ant 5
DC_12A_n78A	Ant 1	Ant 5

13. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of BT/WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For BT/WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
   e. For TDD LTE SAR measurement of power class 3, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The reported TDD LTE SAR (W/kg) = Measured SAR (W/kg)* Tune-up Scaling Factor* scaling factor for extended cyclic prefix.
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

5G NR Note:

1. For 5G NR test procedure was following step similar FCC KDB 941225 D05:
   a. SAR testing start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
   b. 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure
   c. QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
   d. PI/2 BPSK/16QAM/64QAM/256QAM output powers according to 3GPP MPR will not ½ dB higher than the same configuration in QPSK, also reported SAR for the QPSK configuration is less than 1.45 W/kg, PI/2 BPSK /16QAM/64QAM/256QAM SAR testing are not required.
   e. Smaller bandwidth output power for each RB allocation configuration for this device will not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg, smaller bandwidth SAR testing is not required for this device
   f. For 5G FR1 n25/n48 the maximum bandwidth does not support three non-overlapping channels, 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.

13.1 Head SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
										1900MHz										
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Right Cheek	0mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	-0.18	0.182	0.213
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Right Cheek	0mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.01	0.166	0.200
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Right Tilted	0mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.03	0.150	0.176
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Right Tilted	0mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	-0.08	0.144	0.174
01	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Left Cheek	0mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.15	0.215	**0.252**
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Left Cheek	0mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	-0.08	0.208	0.251
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Left Tilted	0mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.1	0.171	0.200
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Left Tilted	0mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.08	0.161	0.194
										2300MHz										
02	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Right Cheek	0mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.14	0.187	**0.219**
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Right Cheek	0mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.1	0.180	0.212
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Right Tilted	0mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	-0.17	0.085	0.099
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Right Tilted	0mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.04	0.081	0.096
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Left Cheek	0mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	-0.01	0.114	0.133
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Left Cheek	0mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	-0.08	0.112	0.132
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Left Tilted	0mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.05	0.153	0.179
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Left Tilted	0mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.06	0.147	0.174
										3500MHz-3700MHz										
03	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Right Cheek	0mm	Ant 5	Full Power	641666	3624.99	23.72	24.00	1.067		1.000	-0.05	0.348	**0.371**
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Right Cheek	0mm	Ant 5	Full Power	641666	3624.99	23.58	24.00	1.102		1.000	0.01	0.311	0.343
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Right Tilted	0mm	Ant 5	Full Power	641666	3624.99	23.72	24.00	1.067		1.000	-0.08	0.133	0.142
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Right Tilted	0mm	Ant 5	Full Power	641666	3624.99	23.58	24.00	1.102		1.000	0.13	0.122	0.134
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Left Cheek	0mm	Ant 5	Full Power	641666	3624.99	23.72	24.00	1.067		1.000	0.12	0.241	0.257
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Left Cheek	0mm	Ant 5	Full Power	641666	3624.99	23.58	24.00	1.102		1.000	0.03	0.217	0.239
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Left Tilted	0mm	Ant 5	Full Power	641666	3624.99	23.72	24.00	1.067		1.000	0.18	0.091	0.097
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Left Tilted	0mm	Ant 5	Full Power	641666	3624.99	23.58	24.00	1.102		1.000	0.16	0.099	0.109

13.2 Hotspot SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1900MHz																				
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Front	10mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.08	0.290	0.340
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Front	10mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.01	0.263	0.317
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.03	0.754	0.884
04	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	372000	1860	23.17	24.00	1.211		1.000	0	0.814	0.985
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	381000	1905	23.17	24.00	1.211		1.000	-0.08	0.643	0.778
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	-0.08	0.723	0.871
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	372000	1860	23.14	24.00	1.219		1.000	0.02	0.711	0.867
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	381000	1905	23.14	24.00	1.219		1.000	0.01	0.658	0.802
	FR1 n25	20M	QPSK	100	0	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	376500	1882.5	22.41	23.00	1.146		1.000	0.03	0.701	0.803
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Left Side	10mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.1	0.001	0.001
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Left Side	10mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	-0.18	0.001	0.001
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Right Side	10mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.1	0.001	0.001
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Right Side	10mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.12	0.001	0.001
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Bottom Side	10mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	0.08	0.413	0.484
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Bottom Side	10mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	-0.17	0.397	0.478
2300MHz																				
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Front	10mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	-0.03	0.279	0.326
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Front	10mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.14	0.240	0.283
05	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.04	0.661	0.773
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.11	0.624	0.737
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Left Side	10mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	-0.05	0.245	0.287
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Left Side	10mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.18	0.233	0.275
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Right Side	10mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.14	0.167	0.195
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Right Side	10mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	-0.17	0.165	0.195
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Bottom Side	10mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.17	0.352	0.412
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Bottom Side	10mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	-0.05	0.307	0.362
3500MHz-3700MHz																				
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Front	10mm	Ant 5	Hotspot On	641666	3624.99	19.71	20.00	1.069		1.000	0.08	0.044	0.047
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Front	10mm	Ant 5	Hotspot On	641666	3624.99	19.65	20.00	1.084		1.000	0.01	0.046	0.050
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	641666	3624.99	19.71	20.00	1.069		1.000	0.03	0.957	1.023
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	638000	3570	19.69	20.00	1.074		1.000	-0.08	0.874	0.939
06	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	645332	3679.98	19.68	20.00	1.076		1.000	-0.01	1.010	1.087
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	641666	3624.99	19.65	20.00	1.084		1.000	-0.08	0.925	1.003
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	638000	3570	19.51	20.00	1.119		1.000	0.1	0.798	0.893
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	645332	3679.98	19.41	20.00	1.146		1.000	-0.18	0.911	1.044
	FR1 n48	40M	QPSK	100	0	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	641666	3624.99	19.59	20.00	1.099		1.000	0.1	0.825	0.907
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Left Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.71	20.00	1.069		1.000	0.12	0.307	0.328
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Left Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.65	20.00	1.084		1.000	-0.03	0.302	0.327
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Right Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.71	20.00	1.069		1.000	0.18	0.023	0.025
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Right Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.65	20.00	1.084		1.000	0.14	0.022	0.024
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Top Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.71	20.00	1.069		1.000	-0.17	0.071	0.076
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Top Side	10mm	Ant 5	Hotspot On	641666	3624.99	19.65	20.00	1.084		1.000	0.17	0.070	0.076

13.3 Body Worn Accessory SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1900MHz																				
	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Front	15mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	-0.1	0.140	0.164
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Front	15mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.07	0.132	0.159
07	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	15mm	Ant 1	Full Power	376500	1882.5	23.31	24.00	1.172		1.000	-0.01	0.322	**0.377**
	FR1 n25	20M	QPSK	50	28	DFT-SCS-15KHz	Back	15mm	Ant 1	Full Power	376500	1882.5	23.19	24.00	1.205		1.000	0.18	0.309	0.372
2300MHz																				
	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Front	15mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.01	0.152	0.178
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Front	15mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.06	0.144	0.170
08	FR1 n30	10M	QPSK	1	1	DFT-SCS-15KHz	Back	15mm	Ant 1	Full Power	462000	2310	23.32	24.00	1.169		1.000	0.03	0.381	**0.446**
	FR1 n30	10M	QPSK	25	14	DFT-SCS-15KHz	Back	15mm	Ant 1	Full Power	462000	2310	23.28	24.00	1.180		1.000	0.01	0.355	0.419
3500MHz-3700MHz																				
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Front	15mm	Ant 5	Receive Off	641666	3624.99	20.81	21.00	1.045		1.000	-0.1	0.022	0.023
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Front	15mm	Ant 5	Receive Off	641666	3624.99	20.71	21.00	1.069		1.000	0.01	0.017	0.018
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	15mm	Ant 5	Receive Off	641666	3624.99	20.81	21.00	1.045		1.000	-0.15	0.755	0.800
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	15mm	Ant 5	Receive Off	638000	3570	20.58	21.00	1.102		1.000	0.19	0.654	0.720
09	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	15mm	Ant 5	Receive Off	645332	3679.98	20.74	21.00	1.062		1.000	-0.05	0.762	**0.809**
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	15mm	Ant 5	Receive Off	641666	3624.99	20.71	21.00	1.069		1.000	0.07	0.688	0.736
	FR1 n48	40M	QPSK	100	0	DFT-SCS-30KHz	Back	15mm	Ant 5	Receive Off	641666	3624.99	20.62	21.00	1.091		1.000	-0.15	0.368	0.402

13.4 Product specific 10g SAR

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
3500MHz-3700MHz																				
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	641666	3624.99	20.81	21.00	1.045		1.000	0.08	2.520	2.633
	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	638000	3570	20.58	21.00	1.102		1.000	0.01	2.100	2.313
10	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	645332	3679.98	20.74	21.00	1.062		1.000	0.06	2.590	**2.750**
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	641666	3624.99	20.71	21.00	1.069		1.000	0.03	2.280	2.437
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	638000	3570	20.62	21.00	1.091		1.000	-0.08	2.160	2.358
	FR1 n48	40M	QPSK	50	28	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	645332	3679.98	20.51	21.00	1.119		1.000	-0.08	2.410	2.698
	FR1 n48	40M	QPSK	100	0	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	641666	3624.99	20.62	21.00	1.091		1.000	0.1	1.930	2.106

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
WIFI 5GHz																
11	WLAN 5.3GHz	802.11a 6Mbps	Back	0mm	Ant 9	Standalone	52	5260	16.61	17.50	1.227	100	1.000	0.07	1.490	**1.829**
	WLAN 5.3GHz	802.11a 6Mbps	Back	0mm	Ant 9	simultaneous	52	5260	13.58	14.50	1.236	100	1.000	0.06	0.815	1.007
12	WLAN 5.5GHz	802.11a 6Mbps	Back	0mm	Ant 9	Standalone	100	5500	16.49	17.50	1.262	100	1.000	0.09	1.420	**1.792**
	WLAN 5.5GHz	802.11a 6Mbps	Back	0mm	Ant 9	simultaneous	100	5500	13.45	14.50	1.274	100	1.000	0.02	0.750	0.955

13.5 Repeated SAR Measurement

<1g>

No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Mode	Test Position	Gap (mm)	Antenna	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	372000	1860	23.17	24.00	1.211		1.000	0	0.814	1	0.985
2st	FR1 n25	20M	QPSK	1	1	DFT-SCS-15KHz	Back	10mm	Ant 1	Full Power	372000	1860	23.17	24.00	1.211		1.000	0.03	0.755	1.078	0.914
1st	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	645332	3679.98	19.68	20.00	1.076	-	1.000	-0.01	1.010	1	1.087
2st	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	10mm	Ant 5	Hotspot On	645332	3679.98	19.68	20.00	1.076	-	1.000	0.03	0.955	1.058	1.028

<10g>

No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Mode	Test Position	Gap (mm)	Antenna	Power State	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	645332	3679.98	20.74	21.00	1.062	-	1.000	0.06	2.590	1	2.750
2st	FR1 n48	40M	QPSK	1	1	DFT-SCS-30KHz	Back	0mm	Ant 5	Receive Off	645332	3679.98	20.74	21.00	1.062	-	1.000	0.03	2.520	1.028	2.675

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.
4. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

14. Simultaneous Transmission Analysis

No.	Simultaneous Transmission Configurations	Portable Handset			
		Head	Body-worn	Hotspot	Product specific 10g SAR
1.	WWAN + WLAN2.4GHz	Yes	Yes	Yes	Yes
2.	WWAN + WLAN5GHz	Yes	Yes	Yes	Yes
3.	WWAN + Bluetooth	Yes	Yes	Yes	Yes
4.	WLAN5GHz + Bluetooth	Yes	Yes	Yes	Yes
5.	WWAN + WLAN5GHz+ Bluetooth	Yes	Yes	Yes	Yes
6.	WLAN2.4GHz(Ant.8)+ Bluetooth	Yes	Yes	Yes	Yes
7.	WWAN + WLAN2.4GH z(Ant.8)+ Bluetooth	Yes	Yes	Yes	Yes

General Note:

1. For simultaneously transmission SAR analysis, some WWAN bands/WLAN/BT SAR Chose higher SAR between original project (CTTL report No. B22N01108-SAR) and variant project for each exposure position to perform co-located SAR analysis. For the SAR values considered full tested bands and new EN-DC combination, they were evaluated to do simultaneous transmission analysis with WLAN/BT.
2. This device supports VoIP in WCDMA and LTE (e.g. for 3rd-party VoIP), LTE supports VoLTE operation.
3. WWAN above includes 5G NR bands and EN-DC combination.
4. EUT will choose each WCDMA, LTE and 5GNR according to the network signal condition; therefore, they will not operate simultaneously at any moment.
5. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
6. This device 5.2GHz WLAN/5.8GHz WLAN support hotspot operation, and 5.2GHz WLAN/5.8GHz WLAN supports WLAN Direct (GC/GO), and 5.3GHz / 5.5GHz supports WLAN Direct (GC only).
7. The worst case 5 GHz WLAN SAR for each configuration was used for SAR summation.
8. WLAN 2.4GHz and Bluetooth share the same antenna, and they cannot transmit simultaneously.
9. According to the EUT characteristic, WLAN 5GHz and Bluetooth can transmit simultaneously.
10. According to the EUT characteristic, WLAN 2.4GHz (Ant.8) and Bluetooth can transmit simultaneously.
11. According to the EUT characteristic, WLAN 5GHz and WLAN 2.4GHz can't transmit simultaneously.
12. NFC can transmit simultaneously with other Radios in extremity exposure condition.
13. For standalone WWAN, always choose the highest SAR among the selected WWAN bands within the selected antenna for head each exposure position to perform simultaneous transmission analysis with WLAN/BT. This is the worst co-located analysis and can represent each band.
14. The maximum SAR summation is calculated based on the same configuration and test position.
15. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
    i) 1g Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/kg.
    ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
    iii) If SPLSR ≤ 0.04 for 1g SAR and SPLSR≤ 0.10 for 10g SAR, simultaneously transmission SAR measurement is not necessary.
    iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg and 10g SAR < 4.0W/kg.

14.1 Head Exposure Conditions

FR1 Band	Exposure Position	1	2	1+2
		FR1	WLAN+Bluetooth MAX SAR	Summed
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n25 Ant 1	Right Cheek	0.213	0.380	0.59
	Right Tilted	0.176	0.420	0.60
	Left Cheek	0.252	0.610	0.86
	Left Tilted	0.200	0.520	0.72
FR1 n30 Ant 1	Right Cheek	0.219	0.380	0.60
	Right Tilted	0.099	0.420	0.52
	Left Cheek	0.133	0.610	0.74
	Left Tilted	0.179	0.520	0.70
FR1 n48 Ant 5	Right Cheek	0.371	0.380	0.75
	Right Tilted	0.142	0.420	0.56
	Left Cheek	0.257	0.610	0.87
	Left Tilted	0.109	0.520	0.63

WWAN Band	FR1 Band	Exposure Position	1	2	3	4	5	6	7	1+2+3+7	1+2+3+4	1+2+5+6+7
			WWAN	FR1	WLAN2.4GHz Ant 8	WLAN2.4GHz Ant 9	WLAN5GHz Ant 8	WLAN5GHz Ant 9	Bluetooth Ant 9	Summed	Summed	Summed
			1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
LTE Band 13 Ant 1	FR1 n48 Ant 5	Right Cheek	0.320	0.380	0.160	0.190	0.220	0.120	0.040	0.90	1.05	1.08
		Right Tilted	0.180	0.420	0.110	0.170	0.250	0.120	0.050	0.76	0.88	1.02
		Left Cheek	0.340	0.610	0.270	0.320	0.260	0.280	0.070	1.29	1.54	**1.56**
		Left Tilted	0.110	0.520	0.190	0.160	0.290	0.180	0.050	0.87	0.98	1.15
LTE Band 66 Ant 1	FR1 n2 Ant 6	Right Cheek	0.300	0.770	0.160	0.190	0.220	0.120	0.040	1.27	1.42	1.45
		Right Tilted	0.180	0.510	0.110	0.170	0.250	0.120	0.050	0.85	0.97	1.11
		Left Cheek	0.160	0.580	0.270	0.320	0.260	0.280	0.070	1.08	1.33	1.35
		Left Tilted	0.170	0.520	0.190	0.160	0.290	0.180	0.050	0.93	1.04	1.21
LTE Band 2 Ant 1	FR1 n41 Ant 2	Right Cheek	0.150	0.320	0.160	0.190	0.220	0.120	0.040	0.67	0.82	0.85
		Right Tilted	0.140	0.380	0.110	0.170	0.250	0.120	0.050	0.68	0.80	0.94
		Left Cheek	0.270	0.650	0.270	0.320	0.260	0.280	0.070	1.26	1.51	1.53
		Left Tilted	0.160	0.200	0.190	0.160	0.290	0.180	0.050	0.60	0.71	0.88
LTE Band 5 Ant 1	FR1 n78 Ant 5	Right Cheek	0.360	0.250	0.160	0.190	0.220	0.120	0.040	0.81	0.96	0.99
		Right Tilted	0.200	0.140	0.110	0.170	0.250	0.120	0.050	0.50	0.62	0.76
		Left Cheek	0.350	0.130	0.270	0.320	0.260	0.280	0.070	0.82	1.07	1.09
		Left Tilted	0.130	0.080	0.190	0.160	0.290	0.180	0.050	0.45	0.56	0.73
LTE Band 12 Ant 1	FR1 n78 Ant 5	Right Cheek	0.330	0.250	0.160	0.190	0.220	0.120	0.040	0.78	0.93	0.96
		Right Tilted	0.180	0.140	0.110	0.170	0.250	0.120	0.050	0.48	0.60	0.74
		Left Cheek	0.330	0.130	0.270	0.320	0.260	0.280	0.070	0.80	1.05	1.07
		Left Tilted	0.090	0.080	0.190	0.160	0.290	0.180	0.050	0.41	0.52	0.69

14.2 Hotspot Exposure Conditions

FR1 Band	Exposure Position	1	2	1+2
		FR1	WLAN+Bluetooth MAX SAR	Summed
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n25 Ant 1	Front	0.340	0.140	0.48
	Back	0.985	0.390	1.38
	Left side	0.001		0.00
	Right side	0.001	0.260	0.26
	Top side		0.180	0.18
	Bottom side	0.484		0.48
FR1 n30 Ant 1	Front	0.326	0.140	0.47
	Back	0.773	0.390	1.16
	Left side	0.287		0.29
	Right side	0.195	0.260	0.46
	Top side		0.180	0.18
	Bottom side	0.412		0.41
FR1 n48 Ant 5	Front	0.050	0.140	0.19
	Back	1.087	0.390	1.48
	Left side	0.328		0.33
	Right side	0.025	0.260	0.29
	Top side	0.076	0.180	0.26
	Bottom side			0.00

WWAN Band	FR1 Band	Exposure Position	1	2	3	1+2+3
			WWAN	FR1	WLAN+Bluetooth MAX SAR	Summed
			1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
LTE Band 13 Ant 1	FR1 n48 Ant 5	Front	0.330	0.140	0.140	0.61
		Back	0.480	0.390	0.390	1.26
		Left side	0.310			0.31
		Right side	0.370	0.260	0.260	0.89
		Top side		0.180	0.140	0.32
		Bottom side	0.060		0.390	0.45
LTE Band 66 Ant 1	FR1 n2 Ant 6	Front	0.080	0.220		0.30
		Back	0.540	0.330	0.260	1.13
		Left side	0.030	0.180	0.140	0.35
		Right side	0.080	0.120	0.390	0.59
		Top side		0.350		0.35
		Bottom side	0.170		0.260	0.43
LTE Band 2 Ant 1	FR1 n41 Ant 2	Front	0.200	0.340		0.54
		Back	0.610	0.610	0.260	1.48
		Left side	0.130	0.500	0.140	0.77
		Right side	0.160	0.030	0.390	0.58
		Top side				0.00
		Bottom side	0.280	0.130	0.260	0.67
LTE Band 5 Ant 1	FR1 n78 Ant 5	Front	0.330	0.020		0.35
		Back	0.460	0.510	0.260	1.23
		Left side	0.280	0.190	0.140	0.61
		Right side	0.290	0.010	0.390	0.69
		Top side		0.040		0.04
		Bottom side	0.090		0.260	0.35
LTE Band 12 Ant 1	FR1 n78 Ant 5	Front	0.390	0.020		0.41
		Back	0.500	0.510	0.260	1.27
		Left side	0.360	0.190	0.140	0.69
		Right side	0.400	0.010	0.390	0.80
		Top side		0.040		0.04
		Bottom side	0.050		0.260	0.31

14.3 Body-Worn Accessory Exposure Conditions

WWAN Band	WWAN Band	Exposure Position	1	2	1+2
			FR1	WLAN+Bluetooth MAX SAR	Summed
			1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
FR1 n25 Ant 1	FR1 n25 Ant 1	Front	0.164	0.160	0.32
		Back	0.377	0.520	0.90
FR1 n30 Ant 1	FR1 n30 Ant 1	Front	0.178	0.160	0.34
		Back	0.446	0.520	0.97
FR1 n48 Ant 5	FR1 n48 Ant 5	Front	0.023	0.160	0.18
		Back	0.809	0.520	1.33

WWAN Band	FR1	Exposure Position	1	2	3	1+2+3
			WWAN	FR1	WLAN+Bluetooth MAX SAR	Summed
			1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)
LTE Band 13 Ant 1	FR1 n48 Ant 5	Front	0.330	0.160	0.160	0.65
		Back	0.480	0.520	0.520	1.52
LTE Band 66 Ant 1	FR1 n2 Ant 6	Front	0.050	0.220	0.160	0.43
		Back	0.250	0.330	0.520	1.10
LTE Band 2 Ant 1	FR1 n41 Ant 2	Front	0.100	0.360	0.160	0.62
		Back	0.280	0.780	0.520	1.58
LTE Band 5 Ant 1	FR1 n78 Ant 5	Front	0.330	0.010	0.160	0.50
		Back	0.460	0.480	0.520	1.46
LTE Band 12 Ant 1	FR1 n78 Ant 5	Front	0.210	0.010	0.160	0.38
		Back	0.290	0.480	0.520	1.29

14.4 Product specific 10g SAR Exposure Conditions

Remark:

1. For Bluetooth Product specific 10g stand-alone SAR is not required for a transmitter or antenna, due to 1g hotspot SAR is <1.2W/kg.

FR1 Band	Exposure Position	1	2	3	4	1+2+3+4
		FR1	WLAN5GHz Ant 8	WLAN5GHz Ant 9	NFC Ant 10	Summed
		10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)	10g SAR (W/kg)
FR1 n48 Ant 5	Front		0.650	1.007	0.001	1.66
	Back	2.750	0.140	1.007	0.015	3.91
	Left side				0.001	0.00
	Right side		0.160	1.007	0.001	1.17
	Top side		0.330	1.007	0.001	1.34
	Bottom side				0.001	0.00

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15. Uncertainty Assessment

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

16. References

[1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"

[2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992

[3] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.

[7] FCC KDB 648474 D04 v01r03, "SAR Evaluation Considerations for Wireless Handsets", Oct 2015.

[8] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.

[9] FCC KDB 616217 D04 v01r02, "SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers", Oct 2015

[10] FCC KDB 941225 D01 v03r01, "3G SAR MEAUREMENT PROCEDURES", Oct 2015

[11] FCC KDB 941225 D05 v02r05, "SAR Evaluation Considerations for LTE Devices", Dec 2015

[12] FCC KDB 941225 D05A v01r02, "Rel. 10 LTE SAR Test Guidance and KDB Inquiries", Oct 2015

[13] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

[14] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015

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