FCC SAR TEST REPORT

FCC ID : RF41539C
Equipment : Handheld Terminal
Brand Name : KEYENCE
Model Name : DX-A400
Applicant : KEYENCE CORPORATION
1-3-14 HIGASHI-NAKAJIMA, HIGASHI-YODOGAWA-KU,
OSAKA, JAPAN
Manufacturer : KEYENCE CORPORATION
1-3-14 HIGASHI-NAKAJIMA, HIGASHI-YODOGAWA-KU,
OSAKA, JAPAN
Standard : FCC 47 CFR Part 2 (2.1093)

The product was received on Jul. 12, 2023 and testing was started from Jul. 13, 2023 and completed on Aug. 02, 2023. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Laboratory, the test report shall not be reproduced except in full.

Cona Huang

Approved by: Cona Huang / Deputy Manager

Testing Laboratory
1190

Sporton International Inc. EMC & Wireless Communications Laboratory
No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan

Table of Contents

History of this test report

Report No.	Version	Description	Issued Date
FA181627-01	01	Initial issue of report	Aug. 10, 2023

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) for KEYENCE CORPORATION, Handheld Terminal, DX-A400, are as follows.

Equipment Class	Frequency Band		Highest SAR Summary				Highest Simultaneous Transmission 1g SAR (W/kg)
			Head (Separation 0mm)	Body-worn (Separation 10mm)	Hotspot (Separation 10mm)	Product Specific (Separation 0mm)	
			1g SAR (W/kg)			10g SAR (W/kg)	
Licensed	WCDMA	WCDMA II	0.47	1.03	1.07		1.55
		WCDMA V	0.54	0.55	0.55		
	LTE	LTE Band 2	0.67	1.11	1.19		
		LTE Band 4	0.46	0.88	0.88		
		LTE Band 5	0.48	0.43	0.43		
		LTE Band 41	0.09	0.94	1.19		
DTS	WLAN	2.4GHz WLAN	0.38	0.13	0.13		1.24
NII		5GHz WLAN	1.01	0.15			1.55
DSS	2.4GHz Band	Bluetooth	0.05	0.01	0.03		1.19
DXX	NFC	13.56MHz				< 0.01	
Date of Testing:			2023/7/13 ~ 2023/8/2				

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No.TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. 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.

Reviewed by: Jason Wang
Report Producer: Daisy Peng

2. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards, the below KDB standard may not including in the TAF code without accreditation.

- 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 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

3. Equipment Under Test (EUT) Information

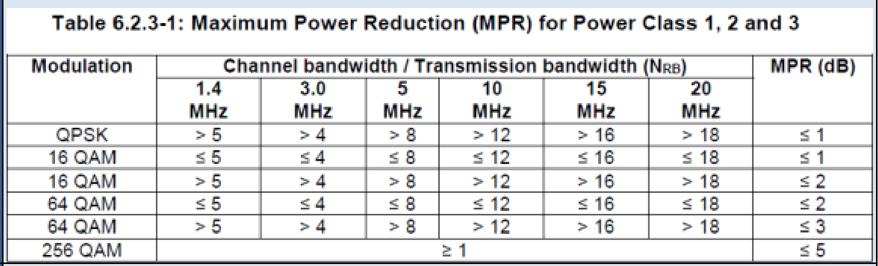
3.1 General Information

Product Feature & Specification	
Equipment Name	Handheld Terminal
Brand Name	KEYENCE
Model Name	DX-A400
FCC ID	RF41539C
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 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 41: 2555 MHz ~ 2655 MHz WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz NFC : 13.56 MHz
Mode	RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ (16QAM uplink) LTE: QPSK, 16QAM WLAN: 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC: ASK
HW Version	R004
SW Version (WWAN)	MOLY.LR12A.R3.MP.V145.10
SW Version (NFC MW)	NFC_AR_00_18c0_10.04.00
EUT Stage	Identical Prototype

Remark:

1. Add NFC and spot check worst case found in original report test data, which can be referred to Sporton SAR Test Report, Report No.: FA181627, the max SAR summary was list highest SAR result between original report and this report, and the WLAN conducted power also referred to original report.

3.2 General LTE SAR Test and Reporting Considerations

<table>
<tr><th colspan="2">Summarized necessary items addressed in KDB 941225 D05 v02r05</th></tr>
<tr><td>FCC ID</td><td>RF41539C</td></tr>
<tr><td>Equipment Name</td><td>Handheld Terminal</td></tr>
<tr><td>Operating Frequency Range of each LTE transmission band</td><td>LTE Band 2: 1850 MHz ~ 1910 MHz
LTE Band 4: 1710 MHz ~ 1755 MHz
LTE Band 5: 824 MHz ~ 849 MHz
LTE Band 41: 2555 MHz ~ 2655 MHz</td></tr>
<tr><td>Channel Bandwidth</td><td>LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 41: 5MHz, 10MHz, 15MHz, 20MHz</td></tr>
<tr><td>uplink modulations used</td><td>QPSK / 16QAM</td></tr>
<tr><td>LTE Voice / Data requirements</td><td>Voice and Data</td></tr>
<tr><td>LTE MPR permanently built-in by design</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th>Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{RB})</th><th>MPR (dB)</th></tr>
<tr><th></th><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th><th></th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table></td></tr>
<tr><td>LTE A-MPR</td><td>In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)</td></tr>
<tr><td>Spectrum plots for RB configuration</td><td>A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

Transmission (H, M, L) channel numbers and frequencies in each LTE band

LTE Band 2

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900

LTE Band 4

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745

LTE Band 5

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5
H	20643	848.3	20635	847.5	20625	846.5	20600	844

LTE Band 41

	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	40265	2557.5	40290	2560	40315	2562.5	40340	2565
M	40740	2605	40740	2605	40740	2605	40740	2605
H	41215	2652.5	41190	2650	41165	2647.5	41140	2645

4. RF Exposure Limits

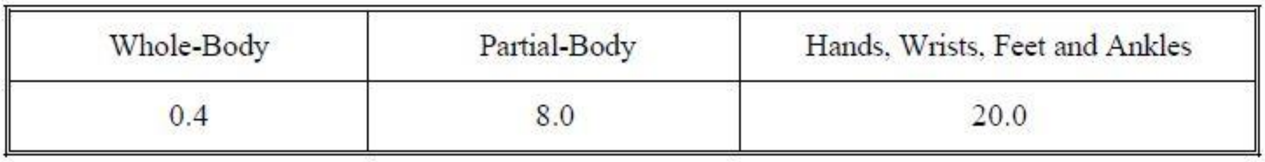
4.1 Uncontrolled Environment

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.

4.2 Controlled Environment

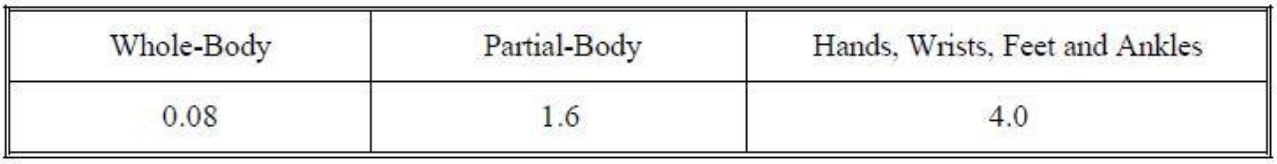
Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed 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

1. 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.

5. Specific Absorption Rate (SAR)

5.1 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.

5.2 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:

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

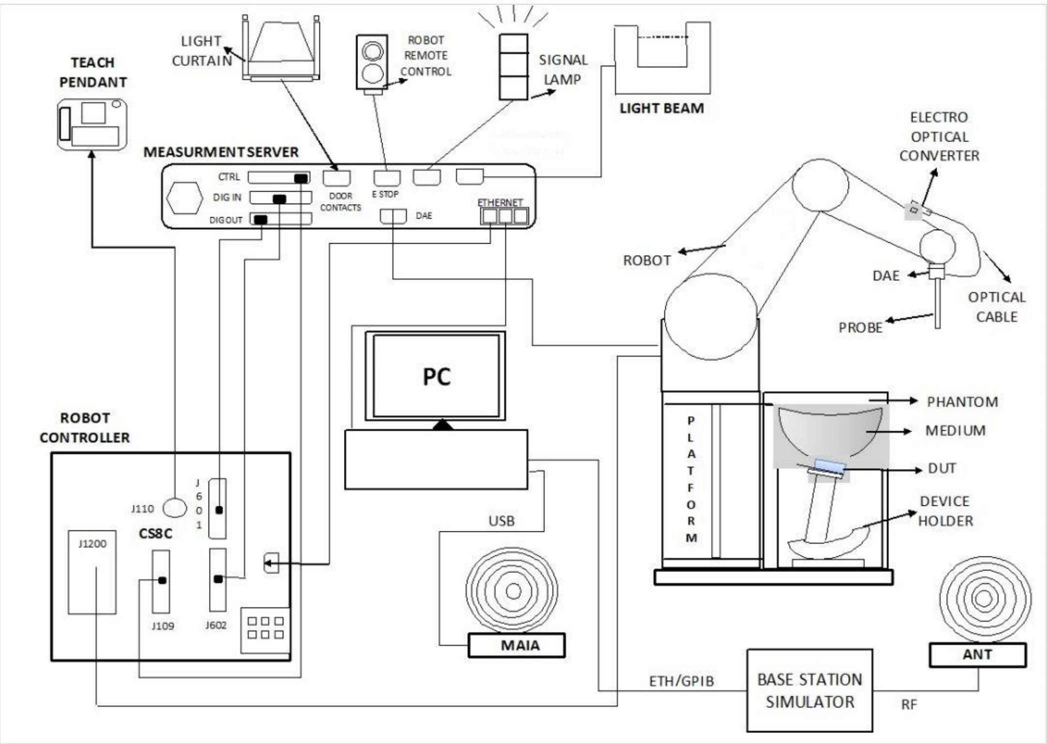
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

6. System Description and Setup

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



- The DASY system in SAR Configuration is shown above
- 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 windows software and the DASY 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.

6.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	SAR16-HY
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	SAR17-HY

6.2 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	

6.3 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.

Fig 5.1 Photo of DAE

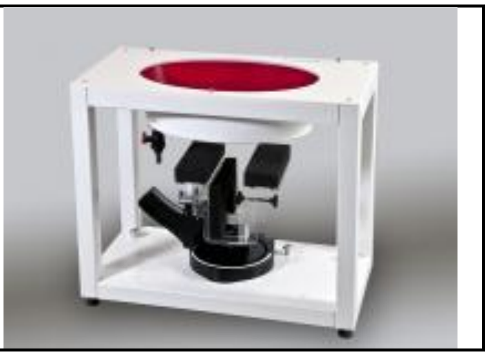
6.4 Phantom

<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 in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

6.5 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

7. Measurement Procedures

The measurement procedures are as follows:

(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

7.1 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

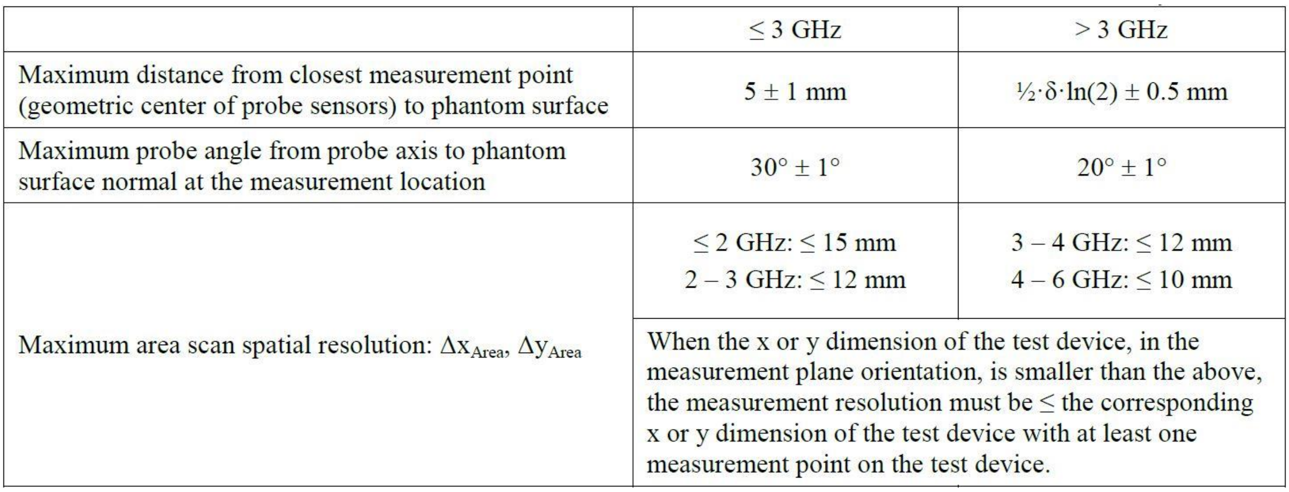
7.2 Power Reference Measurement

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.

7.3 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.

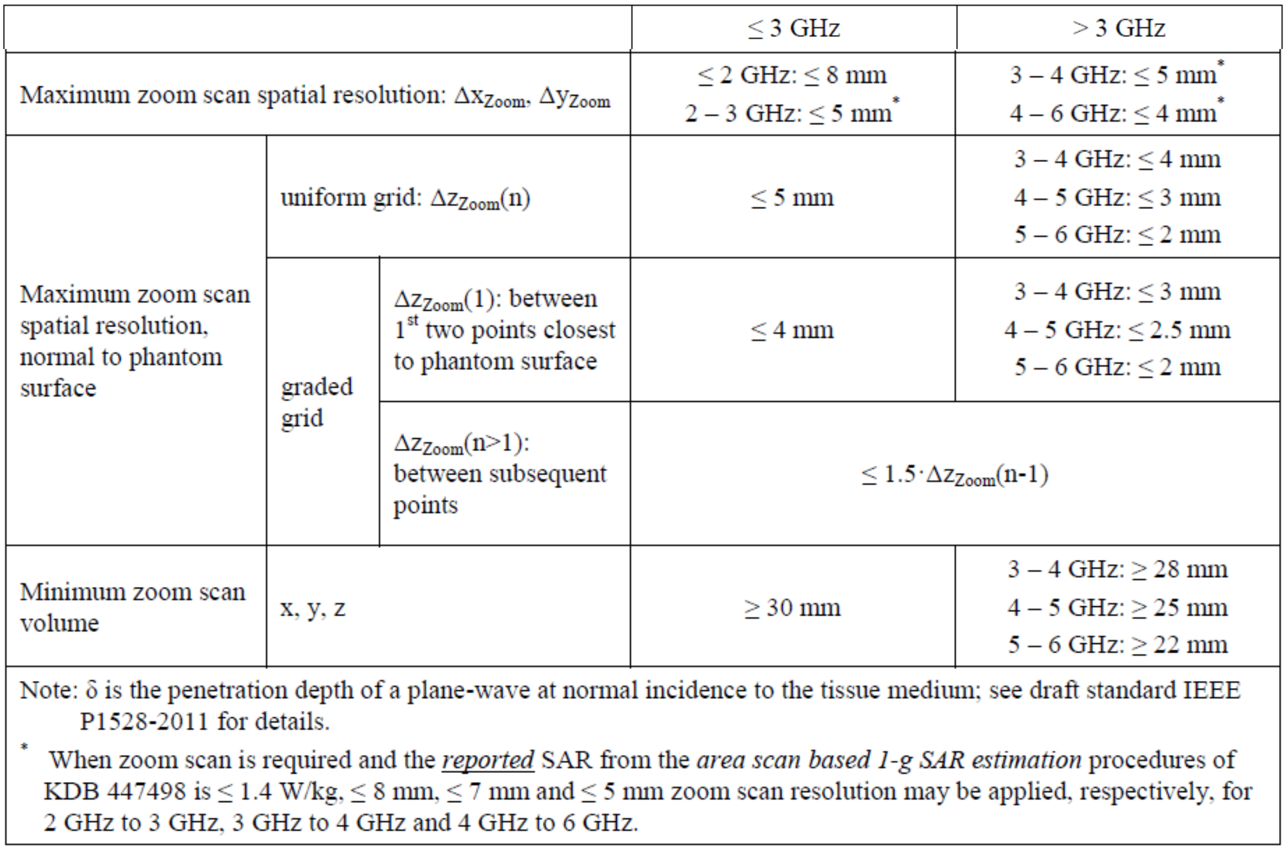


	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, 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.	

7.4 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.



			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
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 *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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.				

7.5 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.

7.6 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.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit(2)	D835V2	4d060	Mar. 24, 2022	Mar. 22, 2024
SPEAG	1750MHz System Validation Kit	D1750V2	1068	Nov. 21, 2022	Nov. 20, 2023
SPEAG	1900MHz System Validation Kit(2)	D1900V2	5d093	Mar. 25, 2022	Mar. 23, 2024
SPEAG	2450MHz System Validation Kit(2)	D2450V2	736	Aug. 17, 2021	Aug. 15, 2023
SPEAG	2600MHz System Validation Kit(2)	D2600V2	1008	Aug. 17, 2021	Aug. 15, 2023
SPEAG	5GHz System Validation Kit(2)	D5GHzV2	1171	Apr. 20, 2021	Apr. 17, 2024
SPEAG	13MHz System Validation Kit(2)	CLA13	1011	Jul. 10, 2023	Jul. 07, 2026
SPEAG	Data Acquisition Electronics	DAE4	853	Jul. 14, 2023	Jul. 13, 2024
SPEAG	Data Acquisition Electronics	DAE4	1512	Mar. 20, 2023	Mar. 19, 2024
SPEAG	Dosimetric E-Field Probe	EX3DV4	3728	Mar. 22, 2023	Mar. 21, 2024
SPEAG	Dosimetric E-Field Probe	EX3DV4	7306	Jul. 18, 2023	Jul. 17, 2024
RCPTWN	Thermometer	HTC-1	TM685-1	Mar. 21, 2023	Mar. 20, 2024
RCPTWN	Thermometer	HTC-1	TM560-2	Mar. 21, 2023	Mar. 20, 2024
Anritsu	Radio Communication Analyzer	MT8821C	6201341950	Oct. 31, 2022	Oct. 30, 2023
Keysight	5G Wireless Test Platform	E7515B	MY59321826	Apr. 26, 2023	Apr. 25, 2024
R&S	BT Base Station	CBT32	101136	Oct. 25, 2022	Oct. 24, 2023
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 12, 2022	Oct. 11, 2023
Keysight	ENA Network Analyzer	E5071C	MY46104758	Sep. 22, 2022	Sep. 21, 2023
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 28, 2022	Sep. 27, 2023
SPEAG	Dielectric Probe Kit	DAK-12	1169	Aug. 29, 2022	Aug. 28, 2023
LINE SEIKI	Digital Thermometer	DTM3000-spezial	3796	Jan. 13, 2023	Jan. 12, 2024
Anritsu	Power Meter	ML2495A	1419002	Aug. 16, 2022	Aug. 15, 2023
Anritsu	Power Sensor	MA2411B	1911176	Aug. 16, 2022	Aug. 15, 2023
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 10, 2023	Jul. 09, 2024
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 14, 2022	Oct. 13, 2023
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Warison	Directional Coupler	WCOU-10-50S-10	WR889BMC4B1	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General 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 source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
13	22.5	0.757	53.400	0.75	55.00	0.93	-2.91	±5	2023/8/2
835	22.2	0.923	41.936	0.90	41.50	2.56	1.05	±5	2023/7/17
1750	22.2	1.370	40.633	1.37	40.10	0.00	1.33	±5	2023/7/17
1900	22.2	1.385	40.380	1.40	40.00	-1.07	0.95	±5	2023/7/17
2450	22.2	1.775	39.806	1.80	39.20	-1.39	1.55	±5	2023/7/13
2600	22.2	2.007	39.516	1.96	39.00	2.40	1.32	±5	2023/7/17
5250	22.2	4.844	36.254	4.71	35.95	2.85	0.85	±5	2023/7/13

9.2 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.

Date	Frequency (MHz)	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 (%)	Test Site
2023/8/2	13	250	CLA13-1011	EX3DV4 - SN7306	DAE4 Sn853	0.083	0.340	0.332	-2.35	SAR05

Date	Frequency (MHz)	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 (%)	Test Site)
2023/7/17	835	50	D835V2-4d060	EX3DV4 - SN3728	DAE4 Sn1512	0.489	9.730	9.78	0.51	SAR05
2023/7/17	1750	50	D1750V2-1068	EX3DV4 - SN3728	DAE4 Sn1512	1.760	36.700	35.2	-4.09	SAR05
2023/7/17	1900	50	D1900V2-5d093	EX3DV4 - SN3728	DAE4 Sn1512	1.840	39.900	36.8	-7.77	SAR05
2023/7/13	2450	50	D2450V2-736	EX3DV4 - SN3728	DAE4 Sn1512	2.520	54.200	50.4	-7.01	SAR05
2023/7/17	2600	50	D2600V2-1008	EX3DV4 - SN3728	DAE4 Sn1512	2.820	58.000	56.4	-2.76	SAR05
2023/7/13	5250	50	D5GHzV2-1171-5250	EX3DV4 - SN3728	DAE4 Sn1512	3.700	80.300	74	-7.85	SAR05

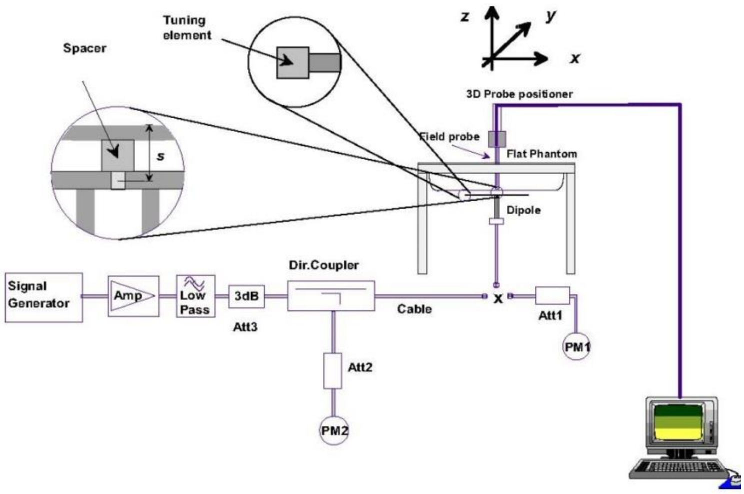


Fig 8.3.1 System Performance Check Setup

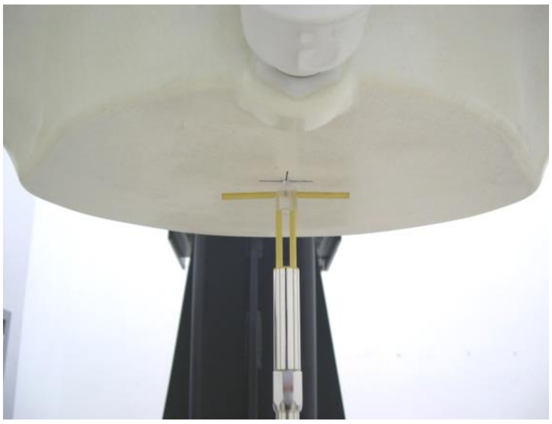


Fig 8.3.2 Setup Photo

10. RF Exposure Positions

10.1 Ear and handset reference point

Figure 9.1.1 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 9.1.2 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 9.1.3). 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 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

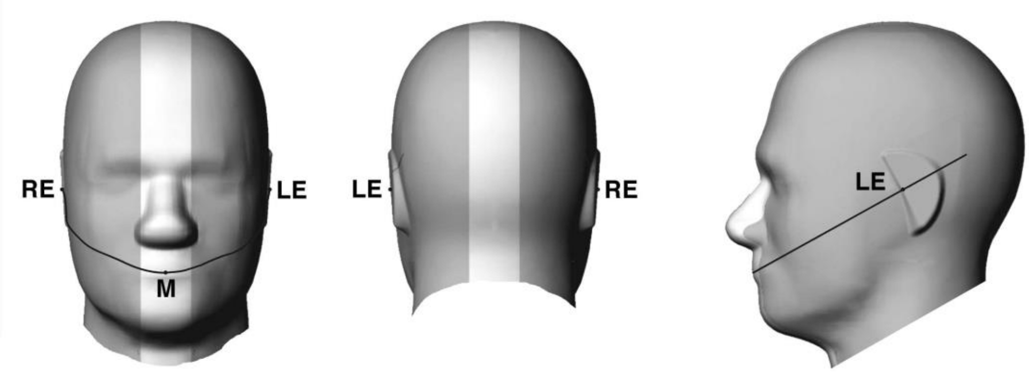
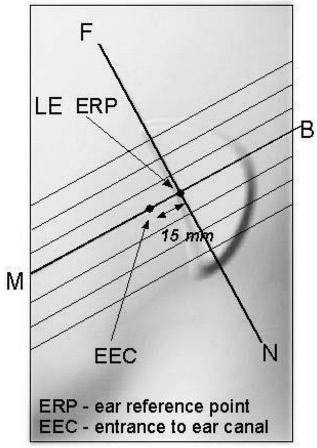


Fig 9.1.1 Front, back, and side views of SAM twin phantom



ERP - ear reference point
EEC - entrance to ear canal

Fig 9.1.2 Close-up side view of phantom showing the ear region.

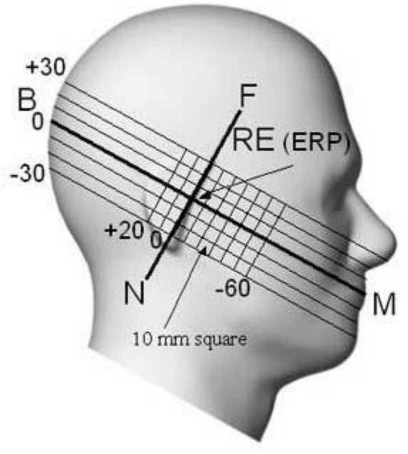


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

10.2 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 9.2.1 and Figure 9.2.2), 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 9.2.1). 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 9.2.2), 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 9.2.3), 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 9.2.3. The actual rotation angles should be documented in the test report.

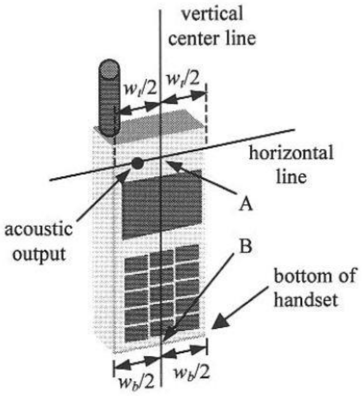


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case

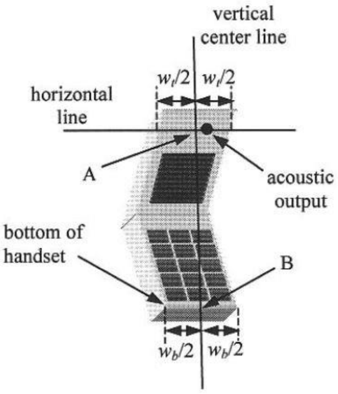


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

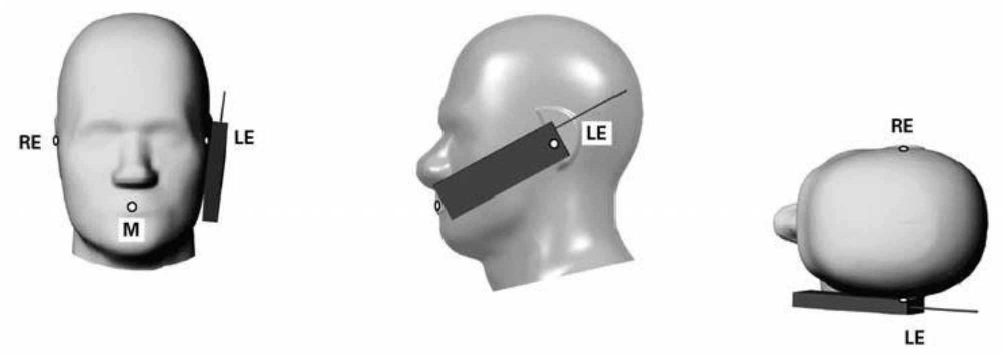


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

10.3 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 9.3.1. 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

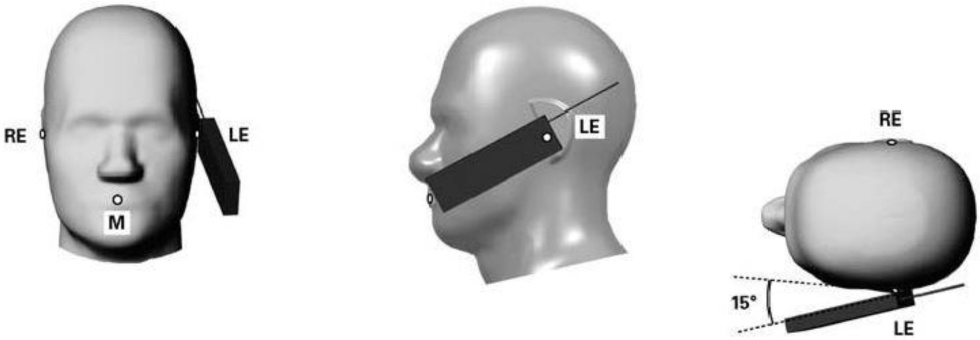


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

10.4 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 9.4). 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 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.

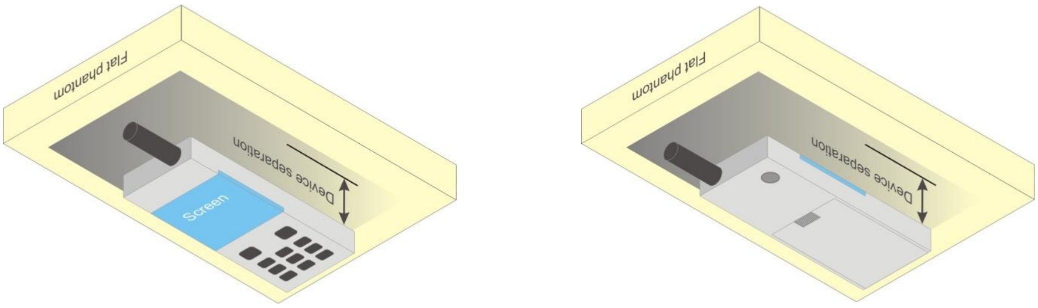


Fig 9.4 Body Worn Position

10.5 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.

11. UMTS/LTE Output Power (Unit: dBm)

<WCDMA>

Band		WCDMA II			Tune-up Limit (dBm)	WCDMA V			Tune-up Limit (dBm)
TX Channel		9262	9400	9538		4132	4182	4233	
Rx Channel		9662	9800	9938		4357	4407	4458	
Frequency (MHz)		1852.4	1880	1907.6		826.4	836.4	846.6	
3GPP Rel 99	RMC 12.2Kbps	20.59	20.78	20.78	22.00	23.54	23.43	23.86	24.00

<LTE Band 2>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				18700	18900	19100	
Frequency (MHz)				1860	1880	1900	
20	QPSK	1	49	21.33	21.02	21.39	22

<LTE Band 4>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				20050	20175	20300	
Frequency (MHz)				1720	1732.5	1745	
20	QPSK	1	49	23.41	23.36	23.28	23.5

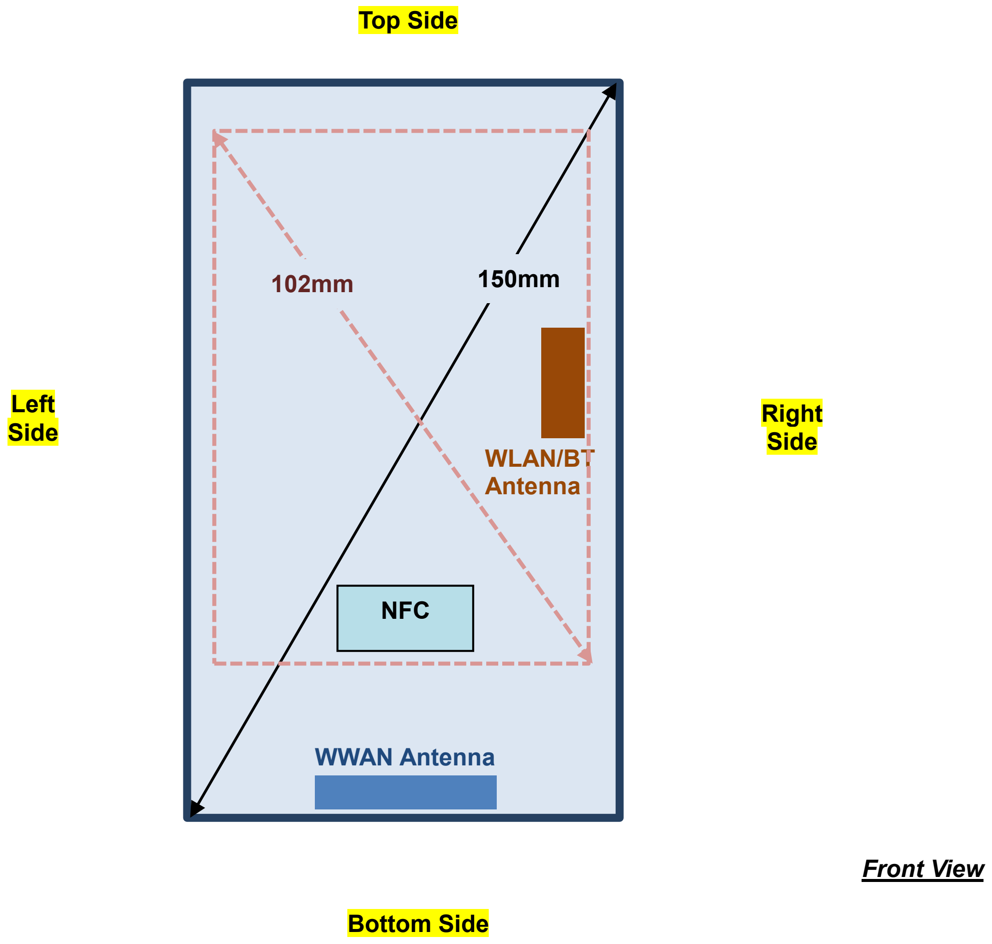
<LTE Band 5>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				20450	20525	20600	
Frequency (MHz)				829	836.5	844	
10	QPSK	1	25	23.55	23.39	23.21	23.5

<LTE Band 41>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Low Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				40340	40740	41140	
Frequency (MHz)				2565	2605	2645	
20	QPSK	1	49	20.56	20.34	20.12	21

12. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	>25mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	>25mm	>25mm	≤ 25mm	>25mm
NFC	≤ 25mm	≤ 25mm	≤ 25mm	≤ 25mm	≤ 25mm	≤ 25mm

Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	Yes	No
NFC	Yes	Yes	Yes	Yes	Yes	Yes

General Note:

1. Referring to KDB 941225 D06 v02r01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

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 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 WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
    e. For TDD LTE SAR measurement, 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 = 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 only when the measured SAR is ≥0.8W/kg.

NFC Note:

1. NFC mainly operate in hand-held extremity exposure conditions and NFC sensing distance with other device or reading tag is about 20cm, therefore Standalone 10-g extremity SAR testing for NFC will be performed by test software with 100% duty cycle at 0mm separation distance.
2. NFC SAR is measured for all edges and surfaces of the device with a transmitting antenna located within 25 mm from that surface or edge.
3. NFC 13.56MHz antenna port is not available on the device to support conducted power measurement, therefore the measured results are referred to as reported SAR.
4. NFC SAR test tissue-simulating liquid parameter: refer to IEC/IEEE 62209-1528 2020.

13.1 Head SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	WCDMA II	RMC 12.2Kbps	Left Cheek	0mm	9400	1880	20.78	22.00	1.324	-0.05	0.160	0.212
02	WCDMA V	RMC 12.2Kbps	Right Cheek	0mm	4233	846.6	23.86	24.00	1.033	-0.03	0.526	0.543

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	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)
03	LTE Band 2	20M	QPSK	1	49	Left Cheek	0mm	18900	1880	21.02	22.00	1.253			0.03	0.531	0.665
04	LTE Band 4	20M	QPSK	1	49	Left Cheek	0mm	20175	1732.5	23.36	23.50	1.033			0.02	0.399	0.412
05	LTE Band 5	10M	QPSK	1	25	Left Cheek	0mm	20525	836.5	23.39	23.50	1.026			0.03	0.464	0.476
06	LTE Band 41	20M	QPSK	1	49	Left Cheek	0mm	40340	2565	20.56	21.00	1.107	62.9	1.006	0.06	0.003	0.003

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
07	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	0mm	6	2437	13.84	14.00	1.038	99.88	1.001	0.15	0.264	0.274
08	WLAN5GHz	802.11n-HT40 MCS0	Right Cheek	0mm	62	5310	14.51	15.00	1.119	94.55	1.058	0.02	0.852	1.009
	WLAN5GHz	802.11n-HT40 MCS0	Right Cheek	0mm	54	5270	14.18	15.00	1.208	94.55	1.058	0.09	0.841	1.075

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
09	Bluetooth	1Mbps	Right Cheek	0mm	78	2480	9.29	9.50	1.050	77.78	1.071	-0.08	0.034	0.038

13.2 Hotspot SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
10	WCDMA II	RMC 12.2Kbps	Bottom Side	10mm	9538	1907.6	20.78	22.00	1.324	-0.01	0.496	0.657
11	WCDMA V	RMC 12.2Kbps	Front	10mm	4132	826.4	23.54	24.00	1.112	-0.01	0.494	0.549

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	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)
12	LTE Band 2	20M	QPSK	1	49	Bottom Side	10mm	18900	1880	21.02	22.00	1.253			-0.11	0.873	1.094
	LTE Band 2	20M	QPSK	1	49	Bottom Side	10mm	18700	1860	21.33	22.00	1.167			-0.05	0.839	0.979
	LTE Band 2	20M	QPSK	1	49	Bottom Side	10mm	19100	1900	21.39	22.00	1.151			-0.09	0.851	0.979
13	LTE Band 4	20M	QPSK	1	49	Front	10mm	20175	1732.5	23.36	23.50	1.033			-0.03	0.645	0.666
14	LTE Band 5	10M	QPSK	1	25	Front	10mm	20525	836.5	23.39	23.50	1.026			-0.07	0.408	0.418
15	LTE Band 41	20M	QPSK	1	49	Bottom Side	10mm	40340	2565	20.56	21.00	1.107	62.9	1.006	0.02	0.289	0.322

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
16	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	11	2462	13.81	14.00	1.045	99.88	1.001	-0.06	0.124	0.130

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
17	Bluetooth	1Mbps	Right Side	10mm	39	2441	9.23	9.50	1.064	77.78	1.071	0.03	0.022	0.025

13.3 Body Worn Accessory SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
18	WCDMA II	RMC 12.2Kbps	Front	10mm	9538	1907.6	20.78	22.00	1.324	-0.01	0.392	0.519
19	WCDMA V	RMC 12.2Kbps	Front	10mm	4132	826.4	23.54	24.00	1.112	-0.01	0.494	0.549

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	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)
20	LTE Band 2	20M	QPSK	1	49	Front	10mm	19100	1900	21.39	22.00	1.151			0	0.767	0.883
	LTE Band 2	20M	QPSK	1	49	Front	10mm	18700	1860	21.33	22.00	1.167			0.09	0.661	0.771
	LTE Band 2	20M	QPSK	1	49	Front	10mm	18900	1880	21.02	22.00	1.253			-0.14	0.645	0.808
21	LTE Band 4	20M	QPSK	1	49	Front	10mm	20175	1732.5	23.36	23.50	1.033			-0.03	0.645	0.666
22	LTE Band 5	10M	QPSK	1	25	Front	10mm	20525	836.5	23.39	23.50	1.026			-0.07	0.408	0.418
23	LTE Band 41	20M	QPSK	1	49	Front	10mm	40340	2565	20.56	21.00	1.107	62.9	1.006	0.14	0.258	0.287

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
24	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	11	2462	13.81	14.00	1.045	99.88	1.001	-0.06	0.124	0.130
25	WLAN5GHz	802.11n-HT40 MCS0	Front	10mm	62	5310	14.51	15.00	1.119	94.55	1.058	-0.08	0.125	0.148

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
26	Bluetooth	1Mbps	Front	10mm	78	2480	9.29	9.50	1.050	77.78	1.071	0.01	0.004	0.004

13.4 Product Specific SAR

<NFC SAR>

Plot No.	Band	Test Position	Gap (mm)	Freq. (MHz)	Power Drift (dB)	Measured 10g SAR (W/kg)
27	NFC	Front	0mm	13.56	0.02	< 0.001
	NFC	Back	0mm	13.56	0.09	< 0.001
	NFC	Right Side	0mm	13.56	-0.01	< 0.001
	NFC	Left Side	0mm	13.56	0.04	< 0.001
	NFC	Top Side	0mm	13.56	-0.01	< 0.001
	NFC	Bottom Side	0mm	13.56	0.03	< 0.001

13.5 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (mm)	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	WLAN5GHz	802.11n-HT40 MCS0	Right Cheek	0mm	62	5310	14.51	15.00	1.119	94.55	1.058	0.02	0.852		1.009
2nd	WLAN5GHz	802.11n-HT40 MCS0	Right Cheek	0mm	62	5310	14.51	15.00	1.119	94.55	1.058	0.05	0.833	1.02	0.987
1st	LTE Band 2	20M_QPSK_1_49	Bottom Side	10mm	18900	1880	21.02	22.00	1.253			-0.11	0.873		1.094
2nd	LTE Band 2	20M_QPSK_1_49	Bottom Side	10mm	18900	1880	21.02	22.00	1.253			-0.08	0.851	1.03	1.066

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. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. 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
1.	WWAN + WLAN2.4GHz	Yes	Yes	Yes
2.	WWAN + WLAN5GHz	Yes	Yes	No
3.	WWAN + Bluetooth	Yes	Yes	Yes

General Note:

1. This device WLAN 2.4GHz supports Hotspot operation and Bluetooth support tethering applications.
2. The worst case WLAN reported SAR for each configuration was used for SAR summation. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with WLAN.
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   - i) Scalar SAR summation < 1.6W/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, simultaneously transmission SAR measurement is not necessary.
   - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

14.1 Head Exposure Conditions

WWAN Band	Exposure Position	1	2	3	4	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)
		WWAN	WLAN2.4GHz	WLAN5GHz	Bluetooth			
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
WCDMA II	Right Cheek	0.194	0.380	1.009	0.048	**0.574**	**1.203**	**0.242**
	Right Tilted	0.076	0.025	0.063	0.001	**0.101**	**0.139**	**0.077**
	Left Cheek	0.467	0.093	0.339	0.001	**0.560**	**0.806**	**0.468**
	Left Tilted	0.073	0.038	0.172	0.001	**0.111**	**0.245**	**0.074**
WCDMA V	Right Cheek	0.543	0.380	1.009	0.048	**0.923**	**1.552**	**0.591**
	Right Tilted	0.256	0.025	0.063	0.001	**0.281**	**0.319**	**0.257**
	Left Cheek	0.389	0.093	0.339	0.001	**0.482**	**0.728**	**0.390**
	Left Tilted	0.237	0.038	0.172	0.001	**0.275**	**0.409**	**0.238**
LTE Band 2	Right Cheek	0.272	0.380	1.009	0.048	**0.652**	**1.281**	**0.320**
	Right Tilted	0.103	0.025	0.063	0.001	**0.128**	**0.166**	**0.104**
	Left Cheek	0.665	0.093	0.339	0.001	**0.758**	**1.004**	**0.666**
	Left Tilted	0.181	0.038	0.172	0.001	**0.219**	**0.353**	**0.182**
LTE Band 4	Right Cheek	0.286	0.380	1.009	0.048	**0.666**	**1.295**	**0.334**
	Right Tilted	0.052	0.025	0.063	0.001	**0.077**	**0.115**	**0.053**
	Left Cheek	0.461	0.093	0.339	0.001	**0.554**	**0.800**	**0.462**
	Left Tilted	0.081	0.038	0.172	0.001	**0.119**	**0.253**	**0.082**
LTE Band 5	Right Cheek	0.336	0.380	1.009	0.048	**0.716**	**1.345**	**0.384**
	Right Tilted	0.213	0.025	0.063	0.001	**0.238**	**0.276**	**0.214**
	Left Cheek	0.476	0.093	0.339	0.001	**0.569**	**0.815**	**0.477**
	Left Tilted	0.188	0.038	0.172	0.001	**0.226**	**0.360**	**0.189**
LTE Band 41	Right Cheek	0.025	0.380	1.009	0.048	**0.405**	**1.034**	**0.073**
	Right Tilted	0.031	0.025	0.063	0.001	**0.056**	**0.094**	**0.032**
	Left Cheek	0.091	0.093	0.339	0.001	**0.184**	**0.430**	**0.092**
	Left Tilted	0.023	0.038	0.172	0.001	**0.061**	**0.195**	**0.024**

14.2 Hotspot Exposure Conditions

WWAN Band	Exposure Position	1	2	3	4	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)
		WWAN	WLAN2.4GHz	WLAN5GHz	Bluetooth			
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
WCDMA II	Front	1.032	0.130		0.007	**1.162**		**1.039**
	Back	0.315	0.006		0.006	**0.321**		**0.321**
	Left side	0.275				**0.275**		**0.275**
	Right side	0.091	0.035		0.025	**0.126**		**0.116**
	Top side					**0.000**		**0.000**
	Bottom side	1.069				**1.069**		**1.069**
WCDMA V	Front	0.549	0.130		0.007	**0.679**		**0.556**
	Back	0.343	0.006		0.006	**0.349**		**0.349**
	Left side	0.272				**0.272**		**0.272**
	Right side	0.379	0.035		0.025	**0.414**		**0.404**
	Top side					**0.000**		**0.000**
	Bottom side	0.167				**0.167**		**0.167**
LTE Band 2	Front	1.106	0.130		0.007	**1.236**		**1.113**
	Back	0.372	0.006		0.006	**0.378**		**0.378**
	Left side	0.400				**0.400**		**0.400**
	Right side	0.119	0.035		0.025	**0.154**		**0.144**
	Top side					**0.000**		**0.000**
	Bottom side	1.189				**1.189**		**1.189**
LTE Band 4	Front	0.878	0.130		0.007	**1.008**		**0.885**
	Back	0.314	0.006		0.006	**0.320**		**0.320**
	Left side	0.229				**0.229**		**0.229**
	Right side	0.113	0.035		0.025	**0.148**		**0.138**
	Top side					**0.000**		**0.000**
	Bottom side	0.799				**0.799**		**0.799**
LTE Band 5	Front	0.426	0.130		0.007	**0.556**		**0.433**
	Back	0.293	0.006		0.006	**0.299**		**0.299**
	Left side	0.251				**0.251**		**0.251**
	Right side	0.316	0.035		0.025	**0.351**		**0.341**
	Top side					**0.000**		**0.000**
	Bottom side	0.114				**0.114**		**0.114**
LTE Band 41	Front	0.936	0.130		0.007	**1.066**		**0.943**
	Back	0.211	0.006		0.006	**0.217**		**0.217**
	Left side	0.046				**0.046**		**0.046**
	Right side	0.049	0.035		0.025	**0.084**		**0.074**
	Top side					**0.000**		**0.000**
	Bottom side	1.188				**1.188**		**1.188**

14.3 Body-Worn Accessory Exposure Conditions

WWAN Band	Exposure Position	1	2	3	4	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)
		WWAN	WLAN2.4GHz	WLAN5GHz	Bluetooth			
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
WCDMA II	Front	1.032	0.130	0.154	0.007	**1.162**	**1.186**	**1.039**
	Back	0.315	0.006	0.075	0.006	**0.321**	**0.390**	**0.321**
WCDMA V	Front	0.549	0.130	0.154	0.007	**0.679**	**0.703**	**0.556**
	Back	0.343	0.006	0.075	0.006	**0.349**	**0.418**	**0.349**
LTE Band 2	Front	1.106	0.130	0.154	0.007	**1.236**	**1.260**	**1.113**
	Back	0.372	0.006	0.075	0.006	**0.378**	**0.447**	**0.378**
LTE Band 4	Front	0.878	0.130	0.154	0.007	**1.008**	**1.032**	**0.885**
	Back	0.314	0.006	0.075	0.006	**0.320**	**0.389**	**0.320**
LTE Band 5	Front	0.426	0.130	0.154	0.007	**0.556**	**0.580**	**0.433**
	Back	0.293	0.006	0.075	0.006	**0.299**	**0.368**	**0.299**
LTE Band 41	Front	0.936	0.130	0.154	0.007	**1.066**	**1.090**	**0.943**
	Back	0.211	0.006	0.075	0.006	**0.217**	**0.286**	**0.217**

Test Engineer： Bevis Chang and Kells Chen

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. Therefore, the measurement uncertainty table is not required in this report.

Declaration of Conformity:

The test results with all measurement uncertainty excluded is 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.

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 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

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

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

[8] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015

[9] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015

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

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

[12] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.