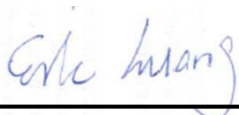


FCC SAR Test Report

APPLICANT : ZTE CORPORATION
EQUIPMENT : Vodafone Mobile WiFi
BRAND NAME : ZTE
MODEL NAME : MF980/R230
FCC ID : SRQ-R230
STANDARD : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2013

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had 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., the test report shall not be reproduced except in full.



Reviewed by: Eric Huang / Deputy Manager



Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA672004	Rev. 01	Initial issue of report	Sep. 29, 2016
FA672004	Rev. 02	Added remark in section 4.1	Oct. 26, 2016
FA672004	Rev. 03	Added note on page 32	Oct. 27, 2016



1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for ZTE CORPORATION, Vodafone Mobile WiFi, MF980/R230, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	Highest Simultaneous Transmission 1g SAR (W/kg)
		Body (Separation 10mm)	
		1g SAR (W/kg)	
Licensed	GSM850	1.20	1.52
	GSM1900	1.43	
	WCDMA II	1.16	
	WCDMA V	0.75	
DTS	2.4GHz WLAN	0.18	1.47
NII	5GHz WLAN	0.27	1.52
Date of Testing:		2016/8/29 ~ 2016/9/9	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) 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

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech, Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

Manufacturer	
Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech, Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

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 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Vodafone Mobile WiFi
Brand Name	ZTE
Model Name	MF980/R230
FCC ID	SRQ-R230
IMEI Code	861698030003742
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz
Mode	· GPRS/EGPRS · RMC 12.2Kbps · HSDPA · HSUPA · 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80
HW Version	dkhA
SW Version	EN_ZTE_MF980V1.0.0B02
Model Name of Processor Sets	MDM9240
Model Name of RF Transceiver	WTR-3925, WTR-4905
Model Name of WiFi Module	QCA-6174A-1
EUT Stage	Production Unit
Remark: 1. 802.11ac-VHT20/VHT40 is not supported in 2.4GHz WLAN. 2. This device WLAN 2.4GHz / 5.2GHz (U-NII-1) / 5.8GHz (U-NII-3) supports Hotspot operation.	

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

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.

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:

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

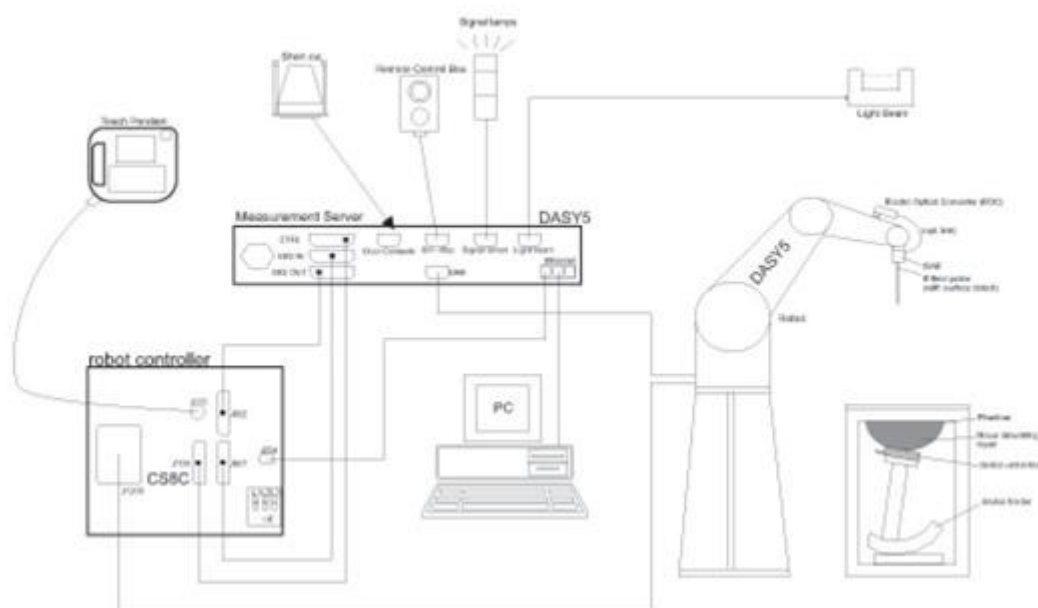
SAR is expressed in units of Watts per kilogram (W/kg)

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

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 DASY 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 Win7 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 μ W/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 μ W/g – >100 mW/g Linearity: ± 0.2 dB (noise: typically <1 μ W/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.



Fig 5.1 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 in the frequency range of 30 MHz to 6 GHz. ELI4 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 from 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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
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 $\leq$ 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 to 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 whose 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: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			≤ 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: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> 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.				

8.5 Volume Scan Procedures

The volume scan is used to 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	835MHz System Validation Kit	D835V2	499	Mar. 21, 2016	Mar. 20, 2017
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Oct. 22, 2015	Oct. 21, 2016
SPEAG	2450MHz System Validation Kit	D2450V2	926	Jul. 25, 2016	Jul. 24, 2017
SPEAG	5GHz System Validation Kit	D5GHzV2	1128	Jul. 27, 2016	Jul. 26, 2017
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 24, 2015	Sep. 23, 2016
SPEAG	Data Acquisition Electronics	DAE4	1388	Sep. 25, 2015	Sep. 24, 2016
SPEAG	Data Acquisition Electronics	DAE4	1424	Feb. 16, 2016	Feb. 15, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Oct. 01, 2015	Sep. 30, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Sep. 28, 2015	Sep. 27, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3976	Feb. 22, 2016	Feb. 21, 2017
WonDer	Thermometer	WD-5015	TM642	Oct. 16, 2015	Oct. 15, 2016
WonDer	Thermometer	WD-5015	TM281	Oct. 16, 2015	Oct. 15, 2016
Wisewind	Thermometer	HTC-1	TM560	Oct. 16, 2015	Oct. 15, 2016
Agilent	Wireless Communication Test Set	E5515C	MY50266977	May. 17, 2016	May. 16, 2017
SPEAG	Device Holder	N/A	N/A	N/A	N/A
R&S	Signal Generator	MG3710A	6201502524	Dec. 18, 2015	Dec. 17, 2016
Agilent	ENA Network Analyzer	E5071C	MY46316648	Jan. 12, 2016	Jan. 11, 2017
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 19, 2016	Jul. 18, 2017
Anritsu	Power Meter	ML2495A	1419002	May. 10, 2016	May. 09, 2017
Anritsu	Power Sensor	MA2411B	1339124	May. 10, 2016	May. 09, 2017
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 21, 2016	Jun. 20, 2017
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 16, 2016	Mar. 15, 2017
ATM	Dual Directional Coupler	C122H-10	P610410z-02	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.

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. 10.1. 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. 10.2.

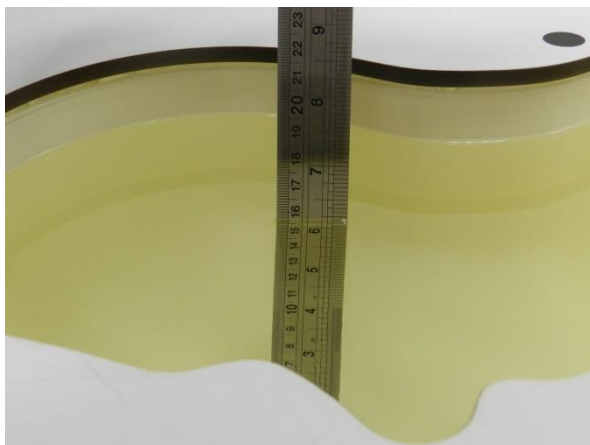


Fig 10.1 Photo of Liquid Height for Head SAR



Fig 10.2 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 (ϵ_r)
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
900	40.3	57.9	0.2	1.4	0.2	0	0.97	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
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

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. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
835	MSL	22.5	0.983	57.277	0.97	55.20	1.34	3.76	±5	2016/9/2
1900	MSL	22.4	1.540	55.300	1.52	53.30	1.32	3.75	±5	2016/9/9
1900	MSL	22.4	1.540	55.300	1.52	53.30	1.32	3.75	±5	2016/9/9
2450	MSL	22.6	1.913	52.183	1.95	52.70	-1.90	-0.98	±5	2016/8/29
5250	MSL	22.9	5.470	46.900	5.36	48.95	2.05	-4.19	±5	2016/9/9
5750	MSL	22.9	6.120	46.100	5.94	48.28	3.03	-4.52	±5	2016/9/9

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.

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 (%)
2016/9/2	835	MSL	250	D835V2-499	EX3DV4 - SN3697	DAE4 Sn1388	2.47	9.52	9.88	3.78
2016/9/9	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3931	DAE3 Sn577	9.90	40.00	39.60	-1.00
2016/9/9	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3697	DAE4 Sn1388	9.66	40.00	38.64	-3.40
2016/8/29	2450	MSL	250	D2450V2-926	EX3DV4 - SN3976	DAE4 Sn1424	12.60	51.20	50.40	-1.56
2016/9/9	5250	MSL	100	D5GHzV2-1128	EX3DV4 - SN3931	DAE3 Sn577	7.47	74.50	74.70	0.27
2016/9/9	5750	MSL	100	D5GHzV2-1128	EX3DV4 - SN3931	DAE3 Sn577	7.38	76.10	73.80	-3.02

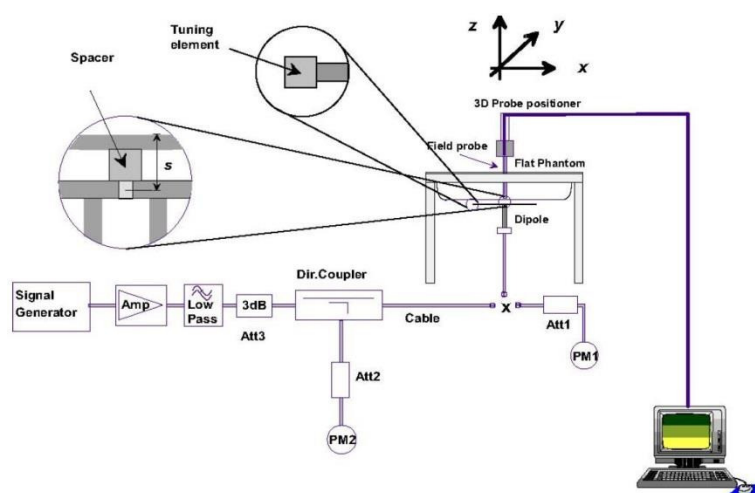


Fig 8.3.1 System Performance Check Setup



Fig 8.3.2 Setup Photo

11. RF Exposure Positions

11.1 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 ($L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$) 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 from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 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)

<GSM Conducted Power>

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. Per KDB 941225 D01v03r01, for SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance. The mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. Therefore, the EUT was set in GPRS (2Tx slots) for GSM850/GSM1900.

GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
TX Channel	128	189	251		128	189	251	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GPRS 1 Tx slot	32.11	32.22	31.83	33.00	23.11	23.22	22.83	24.00
GPRS 2 Tx slots	30.10	30.22	30.21	30.50	24.10	24.22	24.21	24.50
EDGE 1 Tx slot	24.17	24.30	24.23	25.00	15.17	15.30	15.23	16.00
EDGE 2 Tx slots	22.96	23.20	23.03	24.00	16.96	17.20	17.03	18.00
EDGE 3 Tx slots	21.02	21.27	20.89	21.50	16.76	17.01	16.63	17.24
EDGE 4 Tx slots	18.78	18.72	18.53	19.00	15.78	15.72	15.53	16.00

GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
TX Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GPRS 1 Tx slot	29.55	29.44	29.75	29.80	20.55	20.44	20.75	20.80
GPRS 2 Tx slots	29.35	29.23	29.61	29.80	23.35	23.23	23.61	23.80
EDGE 1 Tx slot	24.13	24.05	24.09	25.00	15.13	15.05	15.09	16.00
EDGE 2 Tx slots	23.05	22.92	23.05	24.00	17.05	16.92	17.05	18.00
EDGE 3 Tx slots	20.61	20.74	20.95	21.00	16.35	16.48	16.69	16.74
EDGE 4 Tx slots	18.33	18.36	18.55	19.00	15.33	15.36	15.55	16.00

<WCDMA Conducted Power>

1. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
2. The procedures in KDB 941225 D01v03r01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
 - i. Set Gain Factors (β_c and β_d) and parameters were set according to each
 - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
 - iii. Set RMC 12.2Kbps + HSDPA mode.
 - iv. Set Cell Power = -86 dBm
 - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
 - vi. Select HSDPA Uplink Parameters
 - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
 - viii. Set Ack-Nack Repetition Factor to 3
 - ix. Set CQI Feedback Cycle (k) to 4 ms
 - x. Set CQI Repetition Factor to 2
 - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$, and $\Delta_{CQI} = 24/15$ with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.

Setup Configuration

HSUPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting * :
 - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
 - ii. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
 - iii. Set Cell Power = -86 dBm
 - iv. Set Channel Type = 12.2k + HSPA
 - v. Set UE Target Power
 - vi. Power Ctrl Mode= Alternating bits
 - vii. Set and observe the E-TFCI
 - viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1)	β_{ec}	β_{ed} (Note 5) (Note 6)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/25	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1} : 47/15 β_{ed2} : 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

Setup Configuration

<WCDMA Conducted Power>
General Note:

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is $\leq \frac{1}{4}$ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA.

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	21.94	21.81	21.78	22.00	22.73	22.55	22.57	23.00
3GPP Rel 6	HSDPA Subtest-1	20.93	20.86	20.85	22.00	21.75	21.56	21.57	22.00
3GPP Rel 6	HSDPA Subtest-2	20.94	20.77	20.85	22.00	21.74	21.57	21.56	22.00
3GPP Rel 6	HSDPA Subtest-3	20.48	20.38	20.41	21.50	21.25	21.08	21.10	21.50
3GPP Rel 6	HSDPA Subtest-4	20.45	20.41	20.35	21.50	21.27	21.09	21.10	21.50
3GPP Rel 6	HSUPA Subtest-1	20.48	20.55	20.71	22.00	21.85	21.74	21.81	22.00
3GPP Rel 6	HSUPA Subtest-2	19.37	19.29	19.28	20.00	19.80	19.75	19.86	20.00
3GPP Rel 6	HSUPA Subtest-3	20.37	20.22	20.15	21.00	20.80	20.73	20.79	21.00
3GPP Rel 6	HSUPA Subtest-4	19.34	19.34	19.36	20.00	19.85	19.77	19.81	20.00
3GPP Rel 6	HSUPA Subtest-5	21.35	21.27	21.25	22.00	21.90	21.70	21.80	22.00

<WLAN Conducted Power>**General Note:**

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is $< 1.6\text{W/kg}$ and SAR peak to location ratio ≤ 0.04 , no additional SAR measurements for MIMO.
3. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
4. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
5. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
6. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
 - a. When the reported SAR of the initial test position is $\leq 0.4\text{ W/kg}$, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is $> 0.4\text{ W/kg}$, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is $\leq 0.8\text{ W/kg}$ or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is $> 0.8\text{ W/kg}$, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is $\leq 1.2\text{ W/kg}$ or all required channels are tested.

<2.4GHz WLAN ANT 1>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN ANT 1	802.11b	CH 1	2412	1Mbps	14.60	15.00	99.00
		CH 6	2437		13.80	15.00	
		CH 11	2462		13.20	15.00	
	802.11g	CH 1	2412	6Mbps	13.50	14.50	94.00
		CH 6	2437		12.70	14.00	
		CH 11	2462		12.20	14.00	
	802.11n-HT20	CH 1	2412	MCS0	12.30	13.00	93.00
		CH 6	2437		11.40	13.00	
		CH 11	2462		11.20	13.00	
	802.11n-HT40	CH 3	2422	MCS0	11.90	13.00	87.00
		CH 6	2437		11.20	13.00	
		CH 9	2452		11.20	13.00	

<2.4GHz WLAN ANT 2>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN ANT 2	802.11b	CH 1	2412	1Mbps	15.40	15.50	99.00
		CH 6	2437		14.90	15.50	
		CH 11	2462		14.70	15.50	
	802.11g	CH 1	2412	6Mbps	14.40	14.50	95.00
		CH 6	2437		13.80	14.00	
		CH 11	2462		13.70	14.00	
	802.11n-HT20	CH 1	2412	MCS0	13.30	13.50	94.00
		CH 6	2437		12.70	13.50	
		CH 11	2462		12.50	13.50	
	802.11n-HT40	CH 3	2422	MCS0	13.50	13.50	87.00
		CH 6	2437		13.10	13.50	
		CH 9	2452		13.00	13.50	

<2.4GHz WLAN ANT 1+2>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN ANT 1+2	802.11n-HT20	CH 1	2412	MCS0	15.80	16.30	94.00
		CH 6	2437		15.10	16.30	
		CH 11	2462		14.90	16.30	
	802.11n-HT40	CH 3	2422	MCS0	15.80	16.30	87.00
		CH 6	2437		15.30	16.30	
		CH 9	2452		15.20	16.30	

<5GHz WLAN ANT1>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN ANT 1	802.11a	CH 36	5180	6Mbps	12.60	13.00	94.00
		CH 44	5220		12.90	13.00	
		CH 48	5240		12.90	13.00	
	802.11n-HT20	CH 36	5180	MCS0	11.60	12.00	94.00
		CH 44	5220		11.90	12.00	
		CH 48	5240		12.00	12.00	
	802.11n-HT40	CH 38	5190	MCS0	10.20	11.00	89.00
		CH 46	5230		10.50	11.00	
	802.11ac-VHT20	CH 36	5180	MCS0	11.50	12.00	95.00
		CH 44	5220		11.80	12.00	
		CH 48	5240		11.70	12.00	
	802.11ac-VHT40	CH 38	5190	MCS0	11.70	12.00	88.00
		CH 46	5230		11.90	12.00	
	802.11ac-VHT80	CH 42	5210	MCS0	11.70	12.00	83.00

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN ANT 1	802.11a	CH 149	5745	MCS0	13.60	14.00	94.00
		CH 157	5785		13.60	14.00	
		CH 165	5825		13.40	14.00	
	802.11n-HT20	CH 149	5745	MCS0	12.50	13.00	94.00
		CH 157	5785		12.30	13.00	
		CH 165	5825		12.20	13.00	
	802.11n-HT40	CH 151	5755	MCS0	10.90	11.50	89.00
		CH 159	5795		10.80	11.50	
	802.11ac-VHT20	CH 149	5745	MCS0	12.50	13.00	95.00
		CH 157	5785		12.40	13.00	
		CH 165	5825		12.20	13.00	
	802.11ac-VHT40	CH 151	5755	MCS0	12.60	13.50	88.00
		CH 159	5795		12.50	13.50	
	802.11ac-VHT80	CH 155	5775	MCS0	12.30	13.00	83.00

<5GHz WLAN ANT2>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN ANT 2	802.11a	CH 36	5180	6Mbps	11.90	13.00	94.00
		CH 44	5220		12.30	13.00	
		CH 48	5240		12.30	13.00	
	802.11n-HT20	CH 36	5180	MCS0	11.00	12.00	94.00
		CH 44	5220		11.20	12.00	
		CH 48	5240		11.30	12.00	
	802.11n-HT40	CH 38	5190	MCS0	9.90	11.00	88.00
		CH 46	5230		10.10	11.00	
	802.11ac-VHT20	CH 36	5180	MCS0	10.70	12.00	95.00
		CH 44	5220		11.00	12.00	
		CH 48	5240		11.00	12.00	
	802.11ac-VHT40	CH 38	5190	MCS0	11.30	12.00	88.00
		CH 46	5230		11.50	12.00	
	802.11ac-VHT80	CH 42	5210	MCS0	11.40	12.00	83.00

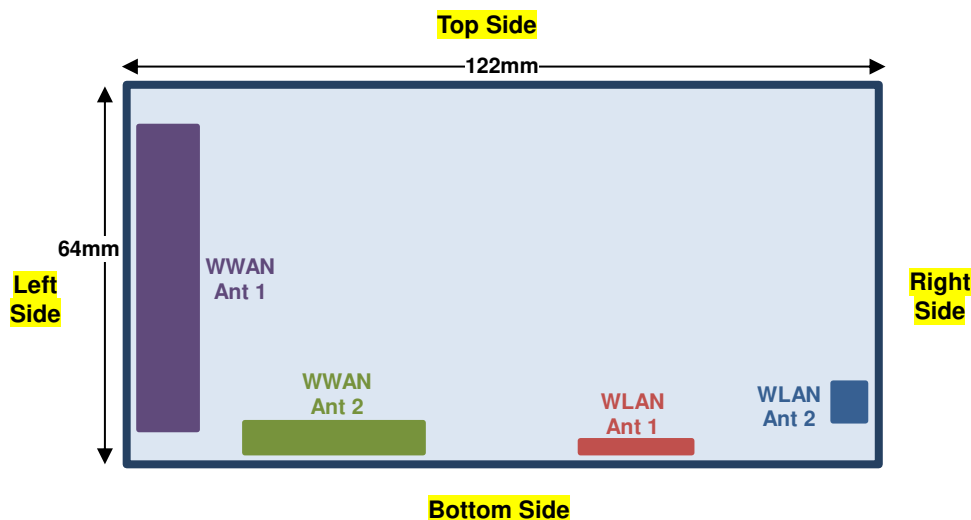
	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN ANT 2	802.11a	CH 149	5745	MCS0	13.80	14.00	94.00
		CH 157	5785		13.70	14.00	
		CH 165	5825		13.80	14.00	
	802.11n-HT20	CH 149	5745	MCS0	12.50	13.00	94.00
		CH 157	5785		12.30	13.00	
		CH 165	5825		12.20	13.00	
	802.11n-HT40	CH 151	5755	MCS0	11.00	11.50	88.00
		CH 159	5795		11.20	11.50	
	802.11ac-VHT20	CH 149	5745	MCS0	12.50	13.00	95.00
		CH 157	5785		12.50	13.00	
		CH 165	5825		12.50	13.00	
	802.11ac-VHT40	CH 151	5755	MCS0	13.10	13.50	88.00
		CH 159	5795		13.20	13.50	
	802.11ac-VHT80	CH 155	5775	MCS0	12.90	13.00	83.00

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN ANT 1+2	802.11n-HT20	CH 36	5180	MCS0	14.40	15.00	94.00
		CH 44	5220		14.60	15.00	
		CH 48	5240		14.70	15.00	
	802.11n-HT40	CH 38	5190	MCS0	13.10	14.00	88.00
		CH 46	5230		13.30	14.00	
	802.11ac-VHT20	CH 36	5180	MCS0	14.10	15.00	95.00
		CH 44	5220		14.40	15.00	
		CH 48	5240		14.40	15.00	
	802.11ac-VHT40	CH 38	5190	MCS0	14.50	15.00	88.00
		CH 46	5230		14.70	15.00	
	802.11ac-VHT80	CH 42	5210	MCS0	14.60	15.00	83.00

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN ANT 1+2	802.11n-HT20	CH 149	5745	MCS0	15.50	16.00	94.00
		CH 157	5785		15.30	16.00	
		CH 165	5825		15.20	16.00	
	802.11n-HT40	CH 151	5755	MCS0	14.00	14.50	88.00
		CH 159	5795		14.00	14.50	
	802.11ac-VHT20	CH 149	5745	MCS0	15.50	16.00	95.00
		CH 157	5785		15.50	16.00	
		CH 165	5825		15.40	16.00	
	802.11ac-VHT40	CH 151	5755	MCS0	15.90	16.50	88.00
		CH 159	5795		15.90	16.50	
	802.11ac-VHT80	CH 155	5775	MCS0	15.60	16.00	83.00

13. Antenna Location



Front View

Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Ant1	≤ 25mm	≤ 25mm	≤ 25mm	≤ 25mm	>25mm	≤ 25mm
WLAN Ant1	≤ 25mm	≤ 25mm	>25mm	≤ 25mm	>25mm	>25mm
WLAN Ant2	≤ 25mm	≤ 25mm	>25mm	≤ 25mm	≤ 25mm	>25mm

Positions for SAR tests						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Ant1	Yes	Yes	Yes	Yes	No	Yes
WLAN Ant1	Yes	Yes	No	Yes	No	No
WLAN Ant2	Yes	Yes	No	Yes	Yes	No

General Note:

- Referring to KDB 941225 D06 v02r01, when the overall device length and width are $\geq 9\text{cm} \times 5\text{cm}$, 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
- WWAN Ant 2 is not support FCC Band; therefore, in above table is not evaluation WWAN Ant 2 test position for SAR tests.

14. 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: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
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 ≥ 0.8 W/kg.

GSM Note:

1. Per KDB 941225 D01v03r01, for SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance. The mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. Therefore, the EUT was set in GPRS (2Tx slots) for GSM850/GSM1900.

UMTS Note:

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is $\leq \frac{1}{4}$ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
3. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
4. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
5. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6 W/kg and SAR peak to location ratio ≤ 0.04 , no additional SAR measurements for MIMO.
6. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

14.1 Body SAR

<GSM 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)
	GSM850	GPRS (2 Tx slots)	Front	10mm	189	836.4	30.22	30.50	1.067	0.19	1.060	1.131
	GSM850	GPRS (2 Tx slots)	Front	10mm	128	824.2	30.10	30.50	1.096	0.02	0.880	0.965
	GSM850	GPRS (2 Tx slots)	Front	10mm	251	848.8	30.21	30.50	1.069	0.08	1.010	1.080
01	GSM850	GPRS (2 Tx slots)	Back	10mm	189	836.4	30.22	30.50	1.067	0.19	1.120	1.195
	GSM850	GPRS (2 Tx slots)	Back	10mm	128	824.2	30.10	30.50	1.096	-0.1	0.944	1.035
	GSM850	GPRS (2 Tx slots)	Back	10mm	251	848.8	30.21	30.50	1.069	-0.16	1.100	1.176
	GSM850	GPRS (2 Tx slots)	Left Side	10mm	189	836.4	30.22	30.50	1.067	-0.11	0.106	0.113
	GSM850	GPRS (2 Tx slots)	Top Side	10mm	189	836.4	30.22	30.50	1.067	-0.13	0.474	0.506
	GSM850	GPRS (2 Tx slots)	Bottom Side	10mm	189	836.4	30.22	30.50	1.067	-0.09	0.501	0.534
	GSM1900	GPRS (2 Tx slots)	Front	10mm	810	1909.8	29.61	29.80	1.045	-0.14	1.120	1.170
	GSM1900	GPRS (2 Tx slots)	Front	10mm	512	1850.2	29.35	29.80	1.109	0.149	1.200	1.331
	GSM1900	GPRS (2 Tx slots)	Front	10mm	661	1880	29.23	29.80	1.140	-0.106	1.140	1.300
	GSM1900	GPRS (2 Tx slots)	Back	10mm	810	1909.8	29.61	29.80	1.045	-0.128	1.160	1.212
	GSM1900	GPRS (2 Tx slots)	Back	10mm	512	1850.2	29.35	29.80	1.109	-0.103	1.250	1.386
02	GSM1900	GPRS (2 Tx slots)	Back	10mm	661	1880	29.23	29.80	1.140	-0.172	1.250	1.425
	GSM1900	GPRS (2 Tx slots)	Left Side	10mm	810	1909.8	29.61	29.80	1.045	-0.04	1.130	1.181
	GSM1900	GPRS (2 Tx slots)	Left Side	10mm	512	1850.2	29.35	29.80	1.109	-0.101	1.070	1.187
	GSM1900	GPRS (2 Tx slots)	Left Side	10mm	661	1880	29.23	29.80	1.140	-0.176	1.140	1.300
	GSM1900	GPRS (2 Tx slots)	Top Side	10mm	810	1909.8	29.23	29.80	1.140	-0.104	0.146	0.166
	GSM1900	GPRS (2 Tx slots)	Bottom Side	10mm	810	1909.8	29.23	29.80	1.140	-0.167	0.437	0.498

<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)
	WCDMA II	RMC 12.2Kbps	Front	10mm	9262	1852.4	21.94	22.00	1.014	0.06	1.030	1.044
	WCDMA II	RMC 12.2Kbps	Front	10mm	9400	1880	21.81	22.00	1.045	-0.041	1.000	1.045
	WCDMA II	RMC 12.2Kbps	Front	10mm	9538	1907.6	21.78	22.00	1.052	-0.01	0.955	1.005
	WCDMA II	RMC 12.2Kbps	Back	10mm	9262	1852.4	21.94	22.00	1.014	0.024	1.110	1.125
03	WCDMA II	RMC 12.2Kbps	Back	10mm	9400	1880	21.81	22.00	1.045	0.02	1.110	1.160
	WCDMA II	RMC 12.2Kbps	Back	10mm	9538	1907.6	21.78	22.00	1.052	-0.029	1.070	1.126
	WCDMA II	RMC 12.2Kbps	Left Side	10mm	9262	1852.4	21.94	22.00	1.014	-0.063	1.030	1.044
	WCDMA II	RMC 12.2Kbps	Left Side	10mm	9400	1880	21.81	22.00	1.045	-0.099	1.080	1.128
	WCDMA II	RMC 12.2Kbps	Left Side	10mm	9538	1907.6	21.78	22.00	1.052	-0.055	1.050	1.105
	WCDMA II	RMC 12.2Kbps	Top Side	10mm	9262	1852.4	21.94	22.00	1.014	-0.055	0.126	0.128
	WCDMA II	RMC 12.2Kbps	Bottom Side	10mm	9262	1852.4	21.94	22.00	1.014	-0.079	0.316	0.320
	WCDMA V	RMC 12.2Kbps	Front	10mm	4132	826.4	22.73	23.00	1.064	-0.13	0.629	0.669
04	WCDMA V	RMC 12.2Kbps	Back	10mm	4132	826.4	22.73	23.00	1.064	-0.07	0.705	0.750
	WCDMA V	RMC 12.2Kbps	Left Side	10mm	4132	826.4	22.73	23.00	1.064	0.01	0.098	0.104
	WCDMA V	RMC 12.2Kbps	Top Side	10mm	4132	826.4	22.73	23.00	1.064	-0.01	0.262	0.279
	WCDMA V	RMC 12.2Kbps	Bottom Side	10mm	4132	826.4	22.73	23.00	1.064	-0.03	0.307	0.327



<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 1	1	2412	14.60	15.00	1.096	99.0	1.010	0.03	0.095	0.105
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 1	1	2412	14.60	15.00	1.096	99.0	1.010	0.11	0.108	0.120
	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	10mm	Ant 1	1	2412	14.60	15.00	1.096	99.0	1.010	0.03	0.085	0.094
05	WLAN2.4GHz	802.11b 1Mbps	Front	10mm	Ant 2	1	2412	15.40	15.50	1.023	99.0	1.010	-0.01	0.174	0.180
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 2	1	2412	15.40	15.50	1.023	99.0	1.010	0.15	0.153	0.158
	WLAN2.4GHz	802.11b 1Mbps	Right Side	10mm	Ant 2	1	2412	15.40	15.50	1.023	99.0	1.010	-0.04	0.032	0.033
	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	10mm	Ant 2	1	2412	15.40	15.50	1.023	99.0	1.010	0.02	0.169	0.175
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	44	5220	12.90	13.00	1.023	94.0	1.064	0.16	0.098	0.107
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 1	44	5220	12.90	13.00	1.023	94.0	1.064	-0.132	0.115	0.125
06	WLAN5GHz	802.11a 6Mbps	Bottom Side	10mm	Ant 1	44	5220	12.90	13.00	1.023	94.0	1.064	0.098	0.193	0.210
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 2	44	5220	12.30	13.00	1.175	94.0	1.064	0.167	0.036	0.045
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	44	5220	12.30	13.00	1.175	94.0	1.064	0.11	0.093	0.116
	WLAN5GHz	802.11a 6Mbps	Right Side	10mm	Ant 2	44	5220	12.30	13.00	1.175	94.0	1.064	0.167	0.074	0.093
	WLAN5GHz	802.11a 6Mbps	Bottom Side	10mm	Ant 2	44	5220	12.30	13.00	1.175	94.0	1.064	-0.16	0.045	0.056
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	149	5745	13.60	14.00	1.096	94.0	1.064	-0.146	0.070	0.082
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 1	149	5745	13.60	14.00	1.096	94.0	1.064	-0.107	0.138	0.161
07	WLAN5GHz	802.11a 6Mbps	Bottom Side	10mm	Ant 1	149	5745	13.60	14.00	1.096	94.0	1.064	0.057	0.235	0.274
	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 2	149	5745	13.80	14.00	1.047	94.0	1.064	0.192	0.072	0.080
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	149	5745	13.80	14.00	1.047	94.0	1.064	0.162	0.086	0.096
	WLAN5GHz	802.11a 6Mbps	Right Side	10mm	Ant 2	149	5745	13.80	14.00	1.047	94.0	1.064	-0.038	0.130	0.145
	WLAN5GHz	802.11a 6Mbps	Bottom Side	10mm	Ant 2	149	5745	13.80	14.00	1.047	94.0	1.064	0.127	0.082	0.091

Note: This device WLAN 2.4GHz / 5.2GHz (U-NII-1) / 5.8GHz (U-NII-3) supports Hotspot operation.

14.2 Repeated SAR Measurement

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)	Ratio	Reported 1g SAR (W/kg)
1st	GSM850	GPRS (2 Tx slots)	Back	10mm	189	836.4	30.22	30.50	1.067	0.19	1.120	-	1.195
2nd	GSM850	GPRS (2 Tx slots)	Back	10mm	189	836.4	30.22	30.50	1.067	-0.09	1.110	1.01	1.184
1st	GSM1900	GPRS (2 Tx slots)	Back	10mm	661	1880	29.23	29.80	1.140	-0.172	1.250	-	1.425
2nd	GSM1900	GPRS (2 Tx slots)	Back	10mm	661	1880	29.23	29.80	1.140	-0.127	1.180	1.06	1.345

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR < 1.45 W/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.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WWAN + WLAN2.4GHz ANT1 + WLAN2.4GHz ANT2	Yes
2.	WWAN + WLAN5GHz ANT1 + WLAN5GHz ANT2	Yes

General Note:

1. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
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. WLAN RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode. Therefore SPLSR calculation was choose worst case with SAR test results of each antenna in SISO mode perform evaluation.
4. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
5. The Scaled SAR summation is calculated based on the same configuration and test position.
6. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation < 1.6W/kg.
 - ii) $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$, 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 $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
 - v) The SPLSR calculated results please refer to section 15.2.

15.1 Body Exposure Conditions

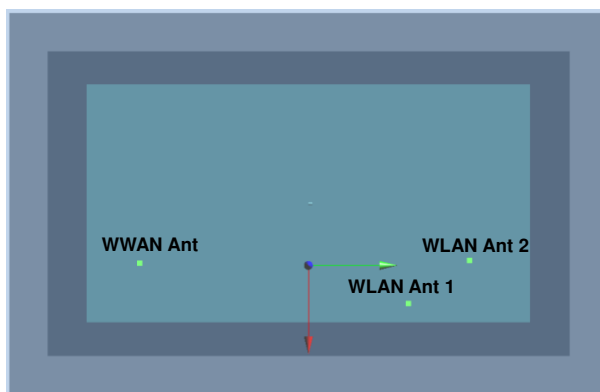
WWAN Band	Exposure Position	1	2	3	4	5	1+2+3 Summed 1g SAR (W/kg)	1+4+5 Summed 1g SAR (W/kg)	SPLSR	Case No	SPLSR	Case No
		WWAN	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2	5GHz WLAN Ant 1	5GHz WLAN Ant 2						
		1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)						
GSM	GSM850	Front	1.131	0.105	0.180	0.107	0.080	1.416	1.318			
		Back	1.195	0.120	0.158	0.161	0.116	1.473	1.472			
		Left side	0.113					0.113	0.113			
		Top side	0.506					0.506	0.506			
		Bottom side	0.534	0.094	0.175	0.274	0.091	0.803	0.899			
	GSM1900	Front	1.331	0.105	0.180	0.107	0.080	1.616	1.518	0.02	Case 1	
		Back	1.425	0.120	0.158	0.161	0.116	1.703	1.702	0.02	Case 2	0.03 Case 3
		Left side	1.300					1.300	1.300			
		Top side	0.166					0.166	0.166			
		Bottom side	0.498	0.094	0.175	0.274	0.091	0.767	0.863			
WCDMA	WCDMA II	Front	1.045	0.105	0.180	0.107	0.080	1.330	1.232			
		Back	1.160	0.120	0.158	0.161	0.116	1.438	1.437			
		Left side	1.128					1.128	1.128			
		Top side	0.128					0.128	0.128			
		Bottom side	0.320	0.094	0.175	0.274	0.091	0.589	0.685			
	WCDMA V	Front	0.669	0.105	0.180	0.107	0.080	0.954	0.856			
		Back	0.750	0.120	0.158	0.161	0.116	1.028	1.027			
		Left side	0.104					0.104	0.104			
		Top side	0.279					0.279	0.279			
		Bottom side	0.327	0.094	0.175	0.274	0.091	0.596	0.692			

15.2 SPLSR Evaluation and Analysis

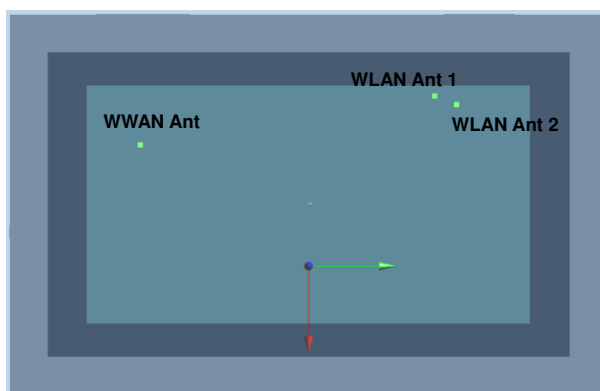
General Note:

1. $SPLSR = (SAR_1 + SAR_2)^{1.5} / (\text{min. separation distance, mm})$. If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary

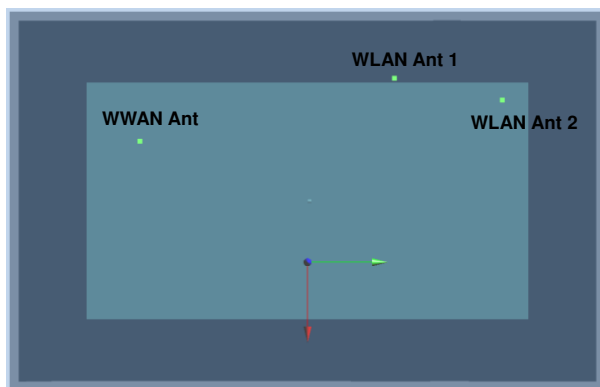
	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case 1	GSM1900	Front	1.331	10mm	1.87	-4.23	-0.01	71.3	1.44	0.02	Not required
	WLAN2.4G_Ant 1		0.105	10mm	2.66	2.86	-0.09				
	GSM1900	Front	1.331	10mm	1.87	-4.23	-0.01	88.8	1.51	0.02	Not required
	WLAN2.4G_Ant 2		0.18	10mm	1.46	4.64	-0.09				
	WLAN2.4G_Ant 1	Front	0.105	10mm	2.66	2.86	-0.09	21.5	0.29	0.01	Not required
	WLAN2.4G_Ant 2		0.18	10mm	1.46	4.64	-0.09				



	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case 2	GSM1900	Back	1.425	10mm	-1.91	-4.39	-0.02	77.0	1.55	0.02	Not required
	WLAN5G_Ant 1		0.120	10mm	-3.3	3.18	-0.1				
	GSM1900	Back	1.425	10mm	-1.91	-4.39	-0.02	82.3	1.58	0.02	Not required
	WLAN5G_Ant 2		0.158	10mm	-2.86	3.78	-0.1				
	WLAN5G_Ant 1	Back	0.120	10mm	-3.3	3.18	-0.1	7.4	0.28	0.02	Not required
	WLAN5G_Ant 2		0.158	10mm	-2.86	3.78	-0.1				



	Band	Position	SAR (W/kg)	Gap (mm)	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
					X	Y	Z				
Case 3	GSM1900	Back	1.425	10mm	-1.91	-4.39	-0.02	73.9	1.59	0.03	Not required
	WLAN5G_Ant 1		0.161	10mm	-3.1	2.9	-0.05				
	GSM1900	Back	1.425	10mm	-1.91	-4.39	-0.02	83.1	1.54	0.02	Not required
	WLAN5G_Ant 2		0.116	10mm	-1.38	3.9	-0.03				
	WLAN5G_Ant 1	Back	0.161	10mm	-3.1	2.9	-0.05	19.9	0.28	0.01	Not required
	WLAN5G_Ant 2		0.116	10mm	-1.38	3.9	-0.03				



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16. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/ κ ^(b)	1/ $\sqrt{3}$	1/ $\sqrt{6}$	1/ $\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 16.1. Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.4%	11.4%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						22.9%	22.7%

Table 16.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	7.0	N	1	1	1	7.0	7.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						12.8%	12.7%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						25.5%	25.4%

Table 16.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

17. References

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
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- [6] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
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