FCC SAR Test Report

APPLICANT	:	**Verifone, Inc.**
EQUIPMENT	:	**Point of Sales Terminal**
BRAND NAME	:	**Verifone**
MODEL NAME	:	**C680 3G-BT-WiFi**
FCC ID	:	**B32C6803GBTW**
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

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA692114	Rev. 01	Initial issue of report	Oct. 24, 2016

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Verifone, Inc., Point of Sales Terminal, C680 3G-BT-WiFi** are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	
		Body (Separation 0mm)	Extremity (Separation 0mm)
		1g SAR (W/kg)	10g SAR (W/kg)
Licensed	GSM850	0.94	1.36
	GSM1900	0.20	1.10
	WCDMA II	0.45	2.66
	WCDMA V	1.08	1.43
NII	5GHz WLAN	0.14	0.34
Highest Simultaneous Transmission SAR (W/kg)		1.47	2.82
Date of Testing:		2016/10/4 ~ 2016/10/18	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body, 4.0 W/kg for Extremity) 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	Verifone, Inc.
Address	1400 West Stanford Ranch Road, Suite 100, 150 & 200, Rocklin CA 95765 USA

Manufacturer	
Company Name	Inventec Appliances (Pudong) Corporation
Address	Building 1 - 3, No.789 Pu Xing Road, Caohejing Export Processing Zone, Shanghai, P.R.C.

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

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Point of Sales Terminal
Brand Name	Verifone
Model Name	C680 3G-BT-WiFi
FCC ID	B32C6803GBTW
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 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
Mode	· GPRS/EGPRS · RMC 12.2Kbps · HSDPA · HSUPA · 802.11 b/g/n HT20/HT40 · Bluetooth BR/EDR/LE · NFC:ASK
EUT Stage	Identical Prototype
Remark: 1. 802.11n-HT40 is not supported in 2.4GHz WLAN. 2. Selected battery 1 as the main testing and battery 2 will select worst case found in battery 1 performs.	

Accessory		
Battery 1	Brand Name	Verifone, Inc.
	Manufacturer	Palladium Energy Inc.
	Model Name	BPK260-001
Battery 2	Brand Name	Verifone, Inc.
	Manufacturer	Panasonic Corporation
	Model Name	BPK260-001

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:

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

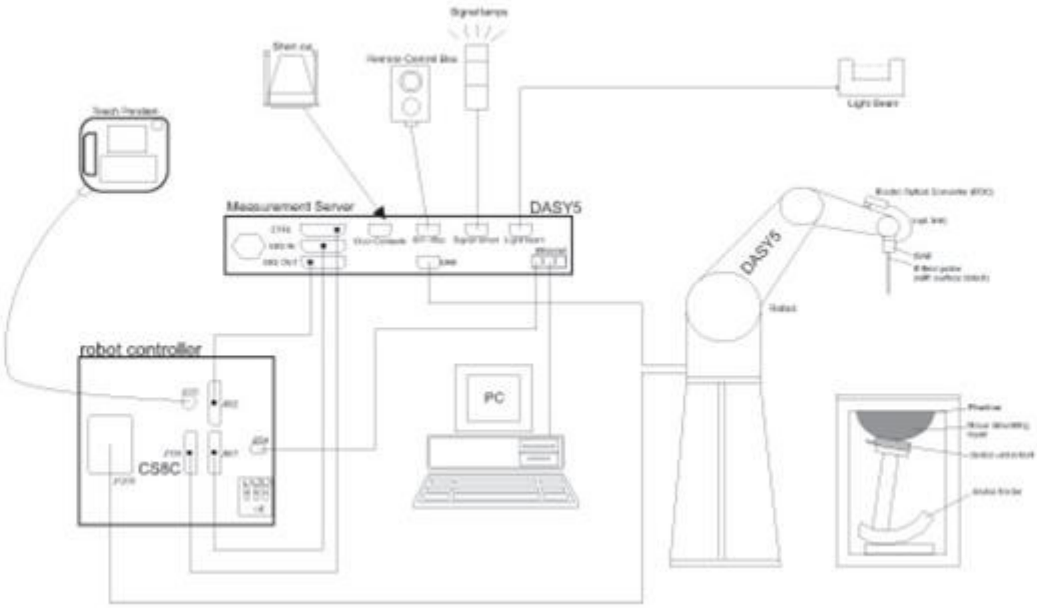
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

The 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 µW/g – >100 mW/g; Linearity: ±0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm

<EX3DV4 Probe>

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

7.2 Data Acquisition Electronics (DAE)

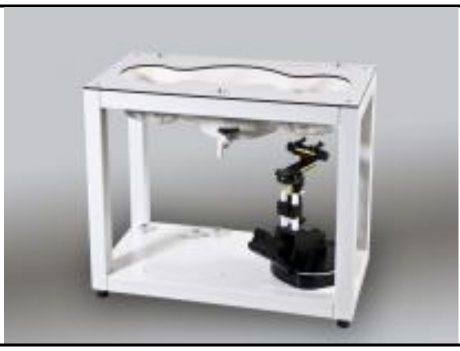
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an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

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

Fig 5.1 Photo of DAE

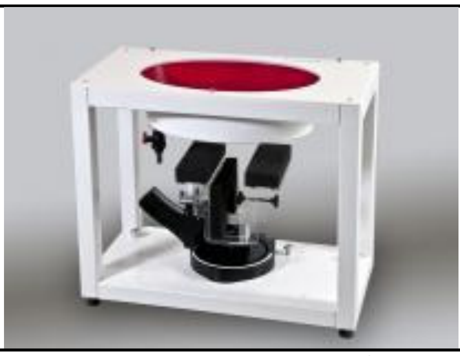
7.3 Phantom

<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 form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

8.2 Power Reference Measurement

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

8.3 Area Scan

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

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

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

8.4 Zoom Scan

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

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

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

8.5 Volume Scan Procedures

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

8.6 Power Drift Monitoring

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

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	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	5GHz System Validation Kit	D5GHzV2	1040	Jun. 17, 2016	Jun. 16, 2017
SPEAG	Data Acquisition Electronics	DAE3	393	Jan. 12, 2016	Jan. 11, 2017
SPEAG	Data Acquisition Electronics	DAE3	495	May. 27, 2016	May. 26, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	7351	Oct. 30, 2015	Oct. 29, 2016
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	May. 26, 2016	May. 25, 2017
TESTO	Hygro meter	608-H1	34913631	Aug. 18, 2016	Aug. 17, 2017
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
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 22, 2016	Aug. 21, 2017
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 16, 2016	Mar. 15, 2017
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	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.

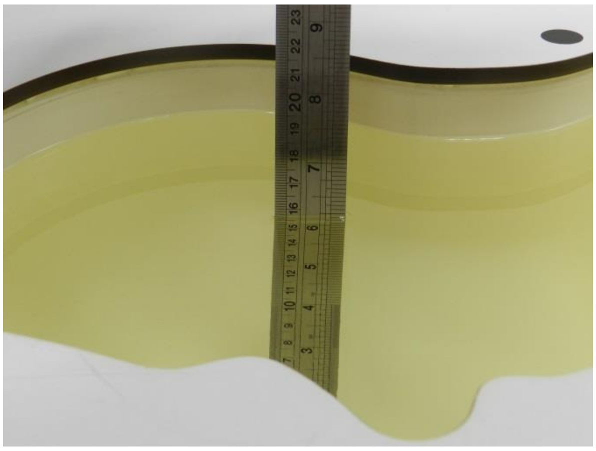


Fig 10.1Photo of Liquid Height for Head SAR

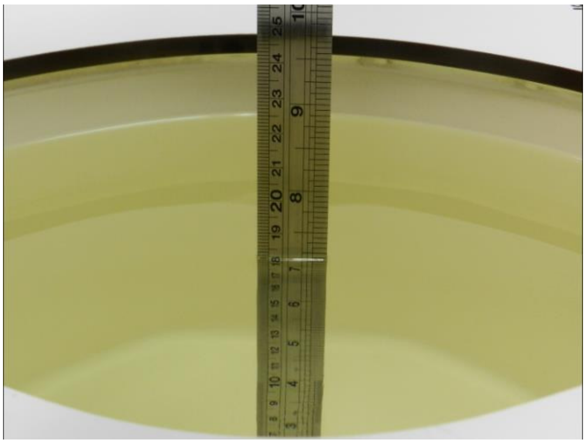


Fig 10.2 Photo of Liquid Height for Body SAR

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 (εr)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
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. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
835	MSL	22.4	0.985	56.376	0.97	55.20	1.55	2.13	±5	2016/10/4
1900	MSL	22.6	1.517	53.498	1.52	53.30	-0.20	0.37	±5	2016/10/5
5200	MSL	22.5	5.164	46.663	5.30	49.00	-2.57	-4.77	±5	2016/10/18

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 (%)
2016/10/4	835	MSL	250	D835V2-499	EX3DV4 - SN7351	DAE3 Sn393	2.45	9.52	9.80	2.94
2016/10/5	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3925	DAE3 Sn495	9.85	40.00	39.40	-1.50
2016/10/18	5200	MSL	100	D5GHzV2-1040	EX3DV4 - SN7351	DAE3 Sn393	7.44	72.90	74.40	2.06

<System Verification for 1g SAR Results>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2016/10/4	835	MSL	250	D835V2-499	EX3DV4 - SN7351	DAE3 Sn393	1.65	6.28	6.60	5.10
2016/10/5	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3925	DAE3 Sn495	5.15	21.20	20.60	-2.83
2016/10/18	5200	MSL	100	D5GHzV2-1040	EX3DV4 - SN7351	DAE3 Sn393	2.05	20.50	20.50	0.00

<System Verification for 10g SAR Results>

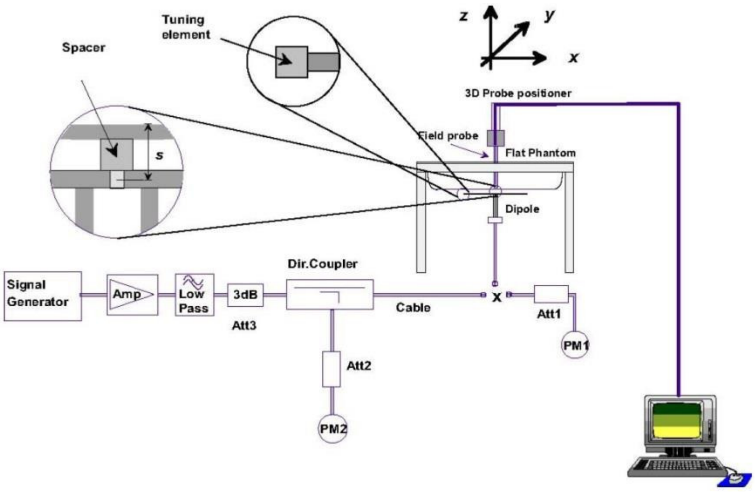


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

11. RF Exposure Positions

11.1 Body Position

(a) To position the device parallel to the phantom surface with either keypad up or down.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 0 mm.

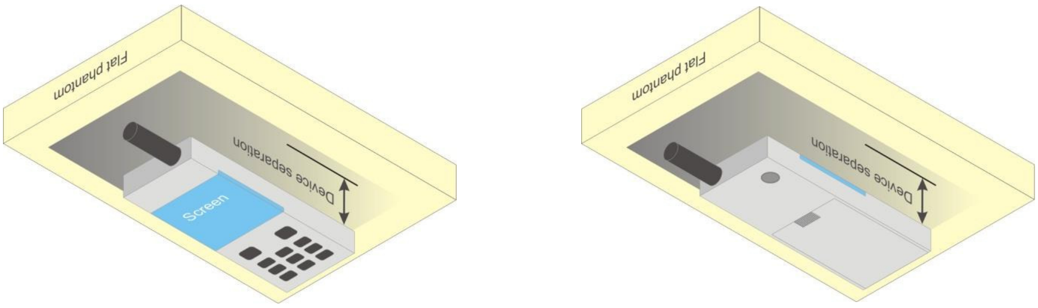


Fig 9.4 Body Position

<DUT Setup Photos>

Please refer to Appendix D for the test setup photos.

11.2 Extremity Exposure

Devices that are designed or intended for use on extremities, or mainly operated in extremity only exposure conditions, i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. When extremity SAR testing is required, a flat phantom must be used if the exposure condition is more conservative than the actual use conditions.

12. Conducted RF Output Power (Unit: dBm)

<GSM Conducted Power>

General Note:

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 / 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 GPRS (4Tx slots) for GSM850/GSM1900 is considered as the primary mode.
3. Other configurations of GPRS / EDGE are considered as secondary modes. The 3G SAR test reduction procedure is applied, when the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode, SAR measurement is not required for the secondary mode

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	32.01	32.03	31.92	32.50	23.01	23.03	22.92	23.50
GPRS 2 Tx slots	29.21	29.21	29.09	30.00	23.21	23.21	23.09	24.00
GPRS 3 Tx slots	27.42	27.42	27.30	28.00	23.16	23.16	23.04	23.74
GPRS 4 Tx slots	26.28	26.28	26.16	27.00	23.28	23.28	23.16	24.00
EDGE 1 Tx slot	26.22	26.21	26.08	27.00	17.22	17.21	17.08	18.00
EDGE 2 Tx slots	23.24	23.25	23.12	24.00	17.24	17.25	17.12	18.00
EDGE 3 Tx slots	21.43	21.43	21.30	22.00	17.17	17.17	17.04	17.74
EDGE 4 Tx slots	20.22	20.23	20.10	21.00	17.22	17.23	17.10	18.00

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	29.34	29.43	29.41	29.50	20.34	20.43	20.41	20.50
GPRS 2 Tx slots	26.49	26.57	26.55	27.00	20.49	20.57	20.55	21.00
GPRS 3 Tx slots	24.69	24.78	24.74	25.00	20.43	20.52	20.48	20.74
GPRS 4 Tx slots	23.51	23.60	23.55	24.00	20.51	20.60	20.55	21.00
EDGE 1 Tx slot	25.30	25.38	25.34	25.50	16.30	16.38	16.34	16.50
EDGE 2 Tx slots	22.31	22.38	22.34	22.50	16.31	16.38	16.34	16.50
EDGE 3 Tx slots	20.49	20.59	20.54	21.00	16.23	16.33	16.28	16.74
EDGE 4 Tx slots	19.32	19.41	19.37	20.00	16.32	16.41	16.37	17.00

<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} *(Note1, 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 Δ_{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 Δ_{NACK} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 24/15 with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, 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 β_c = 11/15 and β_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} (Note1)	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	209/225	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_{ed}1: 47/15 β_{ed}2: 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 Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_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 β_c = 10/15 and β_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 β_c = 14/15 and β_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 ≤ ¼ 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	22.97	23.00	22.60	24.00	23.25	23.13	23.08	24.00
3GPP Rel 6	HSDPA Subtest-1	22.41	22.38	22.16	23.50	22.04	21.97	21.94	23.50
3GPP Rel 6	HSDPA Subtest-2	22.29	22.28	22.06	23.50	22.02	21.93	21.93	23.50
3GPP Rel 6	HSDPA Subtest-3	22.20	22.26	21.97	23.00	22.05	21.96	21.92	23.00
3GPP Rel 6	HSDPA Subtest-4	22.16	22.21	21.95	23.00	22.04	21.96	21.92	23.00
3GPP Rel 6	HSUPA Subtest-1	22.02	22.00	21.74	23.00	21.79	21.71	21.63	23.00
3GPP Rel 6	HSUPA Subtest-2	20.91	20.87	20.57	21.00	20.54	20.47	20.43	21.00
3GPP Rel 6	HSUPA Subtest-3	21.75	21.72	21.41	22.00	21.54	21.37	21.36	22.00
3GPP Rel 6	HSUPA Subtest-4	20.92	21.00	20.70	21.00	20.77	20.70	20.64	21.00
3GPP Rel 6	HSUPA Subtest-5	22.55	22.57	22.17	23.00	22.62	22.51	22.36	23.00

<WLAN Conducted Power>

General Note:

1. 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.
2. 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).
3. 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.
4. 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 ≤ 0.4 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 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.
   c. 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.

<2.4GHz WLAN>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b	CH 1	2412	1Mbps	9.24	9.50	98.62
		CH 6	2437		9.18	9.50	
		CH 11	2462		9.22	9.50	
	802.11g	CH 1	2412	6Mbps	9.38	9.50	93.46
		CH 6	2437		9.35	9.50	
		CH 11	2462		9.40	9.50	
	802.11n-HT20	CH 1	2412	MCS0	9.29	9.50	92.41
		CH 6	2437		9.26	9.50	
		CH 11	2462		9.37	9.50	

<5GHz WLAN>

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a	CH 36	5180	6Mbps	11.19	11.50	93.46
		CH 40	5200		11.15	11.50	
		CH 44	5220		11.15	11.50	
		CH 48	5240		11.09	11.50	
	802.11n-HT20	CH 36	5180	MCS0	11.09	11.50	92.41
		CH 40	5200		11.07	11.50	
		CH 44	5220		11.07	11.50	
		CH 48	5240		11.02	11.50	
	802.11n-HT40	CH 38	5190	MCS0	11.34	11.50	90.70
		CH 46	5230		11.28	11.50	

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a	CH 52	5260	6Mbps	10.91	11.50	93.46
		CH 56	5280		10.84	11.50	
		CH 60	5300		10.80	11.50	
		CH 64	5320		10.50	11.50	
	802.11n-HT20	CH 52	5260	MCS0	10.87	11.50	92.41
		CH 56	5280		10.76	11.50	
		CH 60	5300		10.70	11.50	
		CH 64	5320		10.46	11.50	
	802.11n-HT40	CH 54	5270	MCS0	11.10	11.50	90.70
		CH 62	5310		10.81	11.50	

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a	CH 100	5500	6Mbps	7.86	8.00	93.46
		CH 116	5580		7.60	8.00	
		CH 124	5620		7.33	8.00	
		CH 132	5660		7.82	8.00	
		CH 140	5700		8.00	8.00	
	802.11n-HT20	CH 100	5500	MCS0	7.80	8.00	92.41
		CH 116	5580		7.54	8.00	
		CH 124	5620		7.24	8.00	
		CH 132	5660		7.69	8.00	
		CH 140	5700		7.95	8.00	
	802.11n-HT40	CH 102	5510	MCS0	7.88	8.00	90.70
		CH 110	5550		7.65	8.00	
		CH 126	5630		7.54	8.00	
		CH 134	5670		7.90	8.00	

	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a	CH 149	5745	MCS0	7.45	8.00	93.46
		CH 157	5785		7.84	8.00	
		CH 165	5825		7.97	8.00	
	802.11n-HT20	CH 149	5745	MCS0	7.37	8.00	92.41
		CH 157	5785		7.74	8.00	
		CH 165	5825		7.98	8.00	
	802.11n-HT40	CH 151	5755	MCS0	7.81	8.00	90.70
		CH 159	5795		7.95	8.00	

<Bluetooth Conducted Power>

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	8.25	4.52	4.52
	CH 39	2441	8.09	4.19	4.18
	CH 78	2480	8.11	4.17	4.21
Tune-up Limit			9	5	5

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
LE	CH 00	2402	3.89
	CH 19	2440	3.37
	CH 39	2480	3.24
Tune-up Limit			4

13. 2.4 / 5.5 / 5.8GHz WLAN and Bluetooth Exclusions Applied

Band	Maximum Output Average power (dBm)
2.4 GHz WLAN	9.5
5.5 GHz WLAN	8.0
5.8 GHz WLAN	8.0
Bluetooth (BR/EDR)	9.0
Bluetooth (LE)	4.0

Note:

1. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison

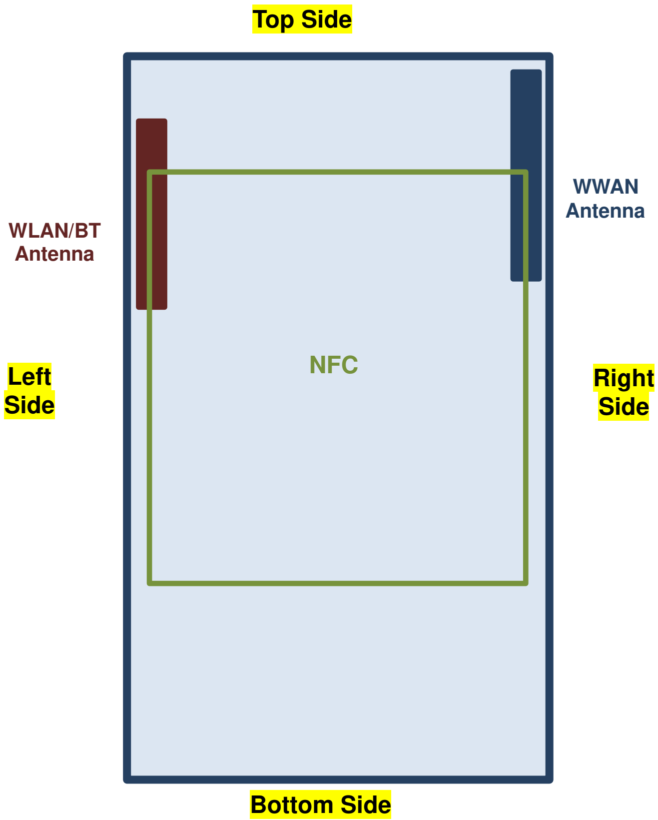
Band	Maximum Power (dBm)	Separation Distance (mm)	Frequency (GHz)	Exclusion thresholds
2.4 GHz WLAN	9.5	< 5	2.462	2.82
5.5 GHz WLAN	8.0	< 5	5.700	2.86
5.8 GHz WLAN	8.0	< 5	5.825	2.90
Bluetooth	9.0	< 5	2.480	2.52

Note:
Per KDB 447498 D01v06, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

For body (1-g SAR):
(1) 2.4GHz WLAN test exclusion threshold is 2.82 which is <= 3, SAR testing is not required.
(2) 5.5GHz WLAN test exclusion threshold is 2.86 which is <= 3, SAR testing is not required.
(3) 5.8GHz WLAN test exclusion threshold is 2.90 which is <= 3, SAR testing is not required.
(4) Bluetooth test exclusion threshold is 2.52 which is <= 3, SAR testing is not required.

For extremity (10-g SAR)
(1) 2.4GHz WLAN test exclusion threshold is 2.82 which is <= 7.5, SAR testing is not required.
(2) 5.5GHz WLAN test exclusion threshold is 2.86 which is <= 7.5, SAR testing is not required.
(3) 5.8GHz WLAN test exclusion threshold is 2.90 which is <= 7.5, SAR testing is not required.
(4) Bluetooth test exclusion threshold is 2.52 which is <= 7.5, SAR testing is not required.

14. Antenna Location



Front View

15. 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 ≥0.8W/kg.
4. Per KDB 865664 D01v01r04, for extremity SAR is the same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

GSM Note:

1. Per KDB 941225 D01v03r01, for SAR test reduction for GPRS / 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 GPRS (4Tx slots) for GSM850/GSM1900 is considered as the primary mode.
2. Other configurations of GPRS / EDGE are considered as secondary modes. The 3G SAR test reduction procedure is applied, when the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode, SAR measurement is not required for the secondary mode.

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 ≤ ¼ 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. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.
3. 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.
4. 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.
5. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

15.1 Body SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	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 (4 Tx slots)	Front	0mm	Battery 1	189	836.4	26.28	27.00	1.180	-0.11	0.679	0.801
	GSM850	GPRS (4 Tx slots)	Front	0mm	Battery 1	128	824.2	26.28	27.00	1.180	-0.14	0.537	0.634
	GSM850	GPRS (4 Tx slots)	Front	0mm	Battery 1	251	848.8	26.16	27.00	1.213	0.19	0.769	0.933
	GSM850	GPRS (4 Tx slots)	Back	0mm	Battery 1	189	836.4	26.28	27.00	1.180	-0.01	0.797	0.941
	GSM850	GPRS (4 Tx slots)	Back	0mm	Battery 1	128	824.2	26.28	27.00	1.180	0.02	0.708	0.836
01	GSM850	GPRS (4 Tx slots)	Back	0mm	Battery 1	251	848.8	26.16	27.00	1.213	0.03	0.776	0.942
	GSM850	GPRS (4 Tx slots)	Back	0mm	Battery 2	251	848.8	26.16	27.00	1.213	0.02	0.732	0.888
02	GSM1900	GPRS (4 Tx slots)	Front	0mm	Battery 1	661	1880	23.60	24.00	1.096	0.13	0.186	0.204
	GSM1900	GPRS (4 Tx slots)	Front	0mm	Battery 2	661	1880	23.60	24.00	1.096	0.14	0.153	0.168
	GSM1900	GPRS (4 Tx slots)	Back	0mm	Battery 1	661	1880	23.60	24.00	1.096	0.12	0.155	0.170

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	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)
03	WCDMA II	RMC 12.2Kbps	Front	0mm	Battery 1	9400	1880	23.00	24.00	1.259	0.11	0.355	0.447
	WCDMA II	RMC 12.2Kbps	Front	0mm	Battery 2	9400	1880	23.00	24.00	1.259	-0.1	0.328	0.413
	WCDMA II	RMC 12.2Kbps	Back	0mm	Battery 1	9400	1880	23.00	24.00	1.259	-0.15	0.318	0.400
	WCDMA V	RMC 12.2Kbps	Front	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	-0.14	0.736	0.875
	WCDMA V	RMC 12.2Kbps	Front	0mm	Battery 1	4182	836.4	23.13	24.00	1.222	-0.04	0.777	0.949
	WCDMA V	RMC 12.2Kbps	Front	0mm	Battery 1	4233	846.6	23.08	24.00	1.236	0.13	0.823	1.017
	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	0.01	0.853	1.014
	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 1	4182	836.4	23.13	24.00	1.222	-0.02	0.851	1.040
04	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 1	4233	846.6	23.08	24.00	1.236	0.01	0.877	1.084
	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 2	4233	846.6	23.08	24.00	1.236	0.02	0.841	1.039

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	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)
	WLAN5GHz	802.11n-HT40 MCS0	Front	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	-0.14	0.020	0.024
05	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	-0.04	0.117	0.142
	WLAN5GHz	802.11n-HT40 MCS0	Back	0mm	Battery 2	54	5270	11.10	11.50	1.096	90.7	1.103	-0.13	0.103	0.125

15.2 Extremity SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	GSM850	GPRS (4 Tx slots)	Left Side	0mm	Battery 1	189	836.4	26.28	27.00	1.180	-0.12	0.146	0.172
06	GSM850	GPRS (4 Tx slots)	Right Side	0mm	Battery 1	189	836.4	26.28	27.00	1.180	-0.19	1.150	1.357
	GSM850	GPRS (4 Tx slots)	Right Side	0mm	Battery 2	189	836.4	26.28	27.00	1.180	-0.17	0.819	0.967
	GSM850	GPRS (4 Tx slots)	Top Side	0mm	Battery 1	189	836.4	26.28	27.00	1.180	-0.01	0.196	0.231
	GSM850	GPRS (4 Tx slots)	Bottom Side	0mm	Battery 1	189	836.4	26.28	27.00	1.180	0.12	0.039	0.046
	GSM1900	GPRS (4 Tx slots)	Left Side	0mm	Battery 1	661	1880	23.60	24.00	1.096	-0.17	0.173	0.190
	GSM1900	GPRS (4 Tx slots)	Right Side	0mm	Battery 1	661	1880	23.60	24.00	1.096	-0.1	0.908	0.996
07	GSM1900	GPRS (4 Tx slots)	Right Side	0mm	Battery 2	661	1880	23.60	24.00	1.096	-0.07	1.000	1.096
	GSM1900	GPRS (4 Tx slots)	Top Side	0mm	Battery 1	661	1880	23.60	24.00	1.096	0.03	0.028	0.031
	GSM1900	GPRS (4 Tx slots)	Bottom Side	0mm	Battery 1	661	1880	23.60	24.00	1.096	0.13	0.021	0.023

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
	WCDMA II	RMC 12.2Kbps	Left Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	-0.16	0.420	0.529
	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	-0.16	2.010	2.530
	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 1	9262	1852.4	22.97	24.00	1.268	-0.19	1.640	2.079
08	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 1	9538	1907.6	22.60	24.00	1.380	-0.12	1.930	2.664
	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 2	9538	1907.6	22.60	24.00	1.380	-0.17	1.910	2.637
	WCDMA II	RMC 12.2Kbps	Top Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	-0.16	0.058	0.073
	WCDMA II	RMC 12.2Kbps	Bottom Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	0.17	0.047	0.059
	WCDMA V	RMC 12.2Kbps	Left Side	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	-0.08	0.175	0.208
09	WCDMA V	RMC 12.2Kbps	Right Side	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	-0.17	1.200	1.426
	WCDMA V	RMC 12.2Kbps	Right Side	0mm	Battery 2	4132	826.4	23.25	24.00	1.189	-0.17	1.120	1.331
	WCDMA V	RMC 12.2Kbps	Top Side	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	-0.11	0.228	0.271
	WCDMA V	RMC 12.2Kbps	Bottom Side	0mm	Battery 1	4132	826.4	23.25	24.00	1.189	0.18	0.030	0.036

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Battery	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
10	WLAN5GHz	802.11n-HT40 MCS0	Left Side	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	-0.1	0.277	0.335
	WLAN5GHz	802.11n-HT40 MCS0	Left Side	0mm	Battery 2	54	5270	11.10	11.50	1.096	90.7	1.103	-0.05	0.276	0.334
	WLAN5GHz	802.11n-HT40 MCS0	Right Side	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	0.14	0.014	0.017
	WLAN5GHz	802.11n-HT40 MCS0	Top Side	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	0.1	0.017	0.021
	WLAN5GHz	802.11n-HT40 MCS0	Bottom Side	0mm	Battery 1	54	5270	11.10	11.50	1.096	90.7	1.103	0.1	0.013	0.015

15.3 Repeated SAR Measurement

<Repeated SAR for Body 1g-SAR Results>

No.	Band	Mode	Test Position	Gap (mm)	Battery	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	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 1	4233	846.6	23.08	24.00	1.236	0.01	0.877	-	1.084
2nd	WCDMA V	RMC 12.2Kbps	Back	0mm	Battery 1	4233	846.6	23.08	24.00	1.236	0.04	0.861	1.02	1.064

<Repeated SAR for Extremity 10g-SAR Results>

No.	Band	Mode	Test Position	Gap (mm)	Antenna Vendor / Tuner	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	-0.16	2.010	-	2.530
2nd	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Battery 1	9400	1880	23.00	24.00	1.259	0.11	1.994	1.01	2.510

General Note:

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

16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body	Extremity
1.	WWAN + WLAN2.4GHz	Yes	Yes
2.	WWAN + WLAN5GHz	Yes	Yes
3.	WWAN + Bluetooth	Yes	Yes

General Note:

1. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
2. 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.
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.
5. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm; where *x* = 7.5 for 1-g SAR, and *x* = 18.75 for 10-g SAR.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is > 50 mm.

Band	Maximum Power (dBm)	Exposure Position	Body
		Test separation	< 5 mm
2.4 GHz WLAN	9.5 dBm	Estimated 1g-SAR	0.377
5.5/5.8 GHz WLAN	8.0 dBm	Estimated 1g-SAR	0.385
Bluetooth	9.0 dBm	Estimated 1g-SAR	0.378

Band	Maximum Power (dBm)	Exposure Position	Extremity
		Test separation	< 5mm
2.4 GHz WLAN	9.5 dBm	Estimated 10g-SAR	0.151
5.5/5.8 GHz WLAN	8.0 dBm	Estimated 10g-SAR	0.154
Bluetooth	9.0 dBm	Estimated 10g-SAR	0.134

16.1 Body Exposure Conditions

WWAN Band		Exposure Position	1 WWAN 1g SAR (W/kg)	2 2.4GHz WLAN Estimated 1g SAR (W/kg)	3 5.2GHz WLAN 1g SAR (W/kg)	4 5.5/5.8GHz WLAN Estimated 1g SAR (W/kg)	5 Bluetooth Estimated 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)
GSM	GSM850	Front	0.933	0.377	0.024	0.385	0.378	**1.310**	**0.957**	**1.318**	**1.311**
		Back	0.942	0.377	0.142	0.385	0.378	**1.319**	**1.084**	**1.327**	**1.320**
	GSM1900	Front	0.204	0.377	0.024	0.385	0.378	**0.581**	**0.228**	**0.589**	**0.582**
		Back	0.170	0.377	0.142	0.385	0.378	**0.547**	**0.312**	**0.555**	**0.548**
WCDMA	WCDMA II	Front	0.447	0.377	0.024	0.385	0.378	**0.824**	**0.471**	**0.832**	**0.825**
		Back	0.400	0.377	0.142	0.385	0.378	**0.777**	**0.542**	**0.785**	**0.778**
	WCDMA V	Front	1.017	0.377	0.024	0.385	0.378	**1.394**	**1.041**	**1.402**	**1.395**
		Back	1.084	0.377	0.142	0.385	0.378	**1.461**	**1.226**	**1.469**	**1.462**

16.2 Extremity Exposure Conditions

WWAN Band		Exposure Position	1 WWAN 10g SAR (W/kg)	2 2.4GHz WLAN Estimated 10g SAR (W/kg)	3 5.2GHz WLAN 10g SAR (W/kg)	4 5.5/5.8GHz WLAN Estimated 10g SAR (W/kg)	5 Bluetooth Estimated 10g SAR (W/kg)	1+2 Summed 10g SAR (W/kg)	1+3 Summed 10g SAR (W/kg)	1+4 Summed 10g SAR (W/kg)	1+5 Summed 1g SAR (0W/kg)
GSM	GSM850	Left side	0.172	0.151	0.335	0.154	0.134	**0.323**	**0.507**	**0.326**	**0.306**
		Right side	1.357	0.151	0.017	0.154	0.134	**1.508**	**1.374**	**1.511**	**1.491**
		Top side	0.231	0.151	0.021	0.154	0.134	**0.382**	**0.252**	**0.385**	**0.365**
		Bottom side	0.046	0.151	0.015	0.154	0.134	**0.197**	**0.061**	**0.200**	**0.180**
	GSM1900	Left side	0.190	0.151	0.335	0.154	0.134	**0.341**	**0.525**	**0.344**	**0.324**
		Right side	1.096	0.151	0.017	0.154	0.134	**1.247**	**1.113**	**1.250**	**1.230**
		Top side	0.031	0.151	0.021	0.154	0.134	**0.182**	**0.052**	**0.185**	**0.165**
		Bottom side	0.023	0.151	0.015	0.154	0.134	**0.174**	**0.038**	**0.177**	**0.157**
WCDMA	WCDMA II	Left side	0.529	0.151	0.335	0.154	0.134	**0.680**	**0.864**	**0.683**	**0.663**
		Right side	2.664	0.151	0.017	0.154	0.134	**2.815**	**2.681**	**2.818**	**2.798**
		Top side	0.073	0.151	0.021	0.154	0.134	**0.224**	**0.094**	**0.227**	**0.207**
		Bottom side	0.059	0.151	0.015	0.154	0.134	**0.210**	**0.074**	**0.213**	**0.193**
	WCDMA V	Left side	0.208	0.151	0.335	0.154	0.134	**0.359**	**0.543**	**0.362**	**0.342**
		Right side	1.426	0.151	0.017	0.154	0.134	**1.577**	**1.443**	**1.580**	**1.560**
		Top side	0.271	0.151	0.021	0.154	0.134	**0.422**	**0.292**	**0.425**	**0.405**
		Bottom side	0.036	0.151	0.015	0.154	0.134	**0.187**	**0.051**	**0.190**	**0.170**

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17. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An 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)]	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(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 17.1. 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 17.2. 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 17.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

18. 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 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015

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

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