FCC SAR Test Report

APPLICANT	:	Samsung Electronics Co., Ltd.
EQUIPMENT	:	Mobile Phone
BRAND NAME	:	SAMSUNG
MODEL NAME	:	SCH-P709E
FCC ID	:	A3LSCHP709E
STANDARD	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2003

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

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager

Testing Laboratory
2353

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA410803	Rev. 01	Initial issue of report	Feb. 14, 2014

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Samsung Electronics Co., Ltd., Mobile Phone, SCH-P709E** are as follows.

<Highest SAR Summary>

Exposure Position	Frequency Band	Reported 1g-SAR (W/kg)	Equipment Class	Highest Reported 1g-SAR (W/kg)
Head (Separation 0cm)	GSM850	0.16	PCE	0.16
	GSM1900	0.11		
	WCDMA Band V	0.16		
	WCDMA Band II	0.15		
	WLAN 2.4GHz Band	0.08	DTS	
	WLAN 5.8GHz Band	0.03		
	WLAN 5.2GHz Band	0.01	NII	
	WLAN 5.3GHz Band	< 0.01		
	WLAN 5.5GHz Band	0.04		
	Bluetooth	0.01	DSS	
Hotspot (Separation 1cm)	GSM850	0.65	PCE	1.09
	GSM1900	0.71		
	WCDMA Band V	0.55		
	WCDMA Band II	1.09		
	WLAN 2.4GHz Band	0.20	DTS	
	WLAN 5.8GHz Band	0.13		
	Bluetooth	0.02	DSS	
Body-worn (Separation 1cm)	GSM850	0.65	PCE	1.09
	GSM1900	0.71		
	WCDMA Band V	0.55		
	WCDMA Band II	1.09		
	WLAN 2.4GHz Band	0.20	DTS	
	WLAN 5.8GHz Band	0.13		
	WLAN 5.2GHz Band	0.07	NII	
	WLAN 5.3GHz Band	0.01		
	WLAN 5.5GHz Band	0.15		
	Bluetooth	0.02	DSS	

<Highest Simultaneous transmission SAR>

Exposure Position	Frequency Band	Equipment Class	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
Body-Worn (Separation 1cm)	GSM1900 Main Antenna	PCE	1.45
	GSM1900 Second Antenna	PCE	
	WLAN2.4GHz Band	DTS	

Exposure Position	Frequency Band	Equipment Class	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
Body-Worn (Separation 1cm)	GSM1900 Main Antenna	PCE	1.40
	GSM1900 Second Antenna	PCE	
	WLAN5.5GHz Band	NII	

Exposure Position	Frequency Band	Equipment Class	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
Body-Worn (Separation 1cm)	GSM1900 Main Antenna	PCE	1.27
	GSM1900 Second Antenna	PCE	
	Bluetooth	DSS	

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 1528-2003.

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL (SHENZHEN) INC.
Test Site Location	No. 101, Complex Building C, Guanlong Village, Xili Town, Nanshan District, Shenzhen, Guangdong, P.R.C. TEL: +86-755-8637-9589 FAX: +86-755-8637-9595

2.2 Applicant

Company Name	Samsung Electronics Co., Ltd.
Address	A3 Building, No.185 Kexue Avenue, Science City, Guang Zhou, P.R.C.

2.3 Manufacturer

Company Name	Samsung Electronics Co., Ltd.
Address	129, Samsung-ro, Yeongtong-gu, Suwon-city,Gyeonggi-do, 443-742, Korea

2.4 Application Details

Date of Start during the Test	Jan. 15, 2014
Date of End during the Test	Feb. 10, 2014

3. General Information

3.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT	Mobile Phone
Brand Name	SAMSUNG
Model Name	SCH-P709E
FCC ID	A3LSCHP709E
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 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	• GSM/GPRS/EGPRS • RMC/AMR 12.2Kbps Rel 99 • HSDPA Rel 7 Cat 14 • HSUPA Rel 6, Cat 6 • 802.11a/b/g/n HT20/HT40 • Bluetooth v3.0+EDR, Bluetooth v4.0 LE
HW Version	P709E.03
SW Version	P709EKEUAMK1
EUT Stage	Pre-Production

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. WLAN5GHz operation in 5600 MHz ~ 5650 MHz is notched.
3. 802.11n- HT40 is not supported in 2.4GHz frequency band and supports EGPRS mode multi slot up to class10.
4. This device supported VoIP in GSM and WCDMA (e.g. 3rd party VoIP).
5. This device 2.4GHz WLAN supports hotspot operation, and 2.4GHz / 5.8GHz WLAN supports WiFi Direct (GC/GO), and 5.2GHz / 5.3GHz / 5.5GHz supports WiFi Direct (GC only).
6. This supports dual SIM dual active, the SIM1 for the main antenna supports GSM850 / 1900, UMTS Band 2 / 5, the SIM2 for the second antenna supports GSM1900 only, the WWAN radio can simultaneous transmission at the same time.

3.2 Maximum RF output power among production units

Band / Mode	GSM Voice(dBm)	GMSK Burst Average Power (dBm)	
	1 Tx Slot	1 Tx Slot	2 Tx Slots
GSM850	33.5	33.5	29.0
GSM1900 Main Antenna	31.0	31.0	27.5
GSM1900 Second Antenna	29.5	29.5	27.0

Band / Mode	8PSK Burst Average Power (dBm)	
	1 Tx Slot	2 Tx Slots
GSM850	28.0	27.5
GSM1900 Main Antenna	27.0	27.0
GSM1900 Second Antenna	26.5	26.5

Band / Mode			Average Power (dBm)
UMTS	Band V	AMR / RCM 12.2Kbps	23.5
		HSDPA	22.5
		HSUPA	22.5
	Band II	AMR / RCM 12.2Kbps	23.0
		HSDPA	22.0
		HSUPA	22.0

Mode			Average Power (dBm)
2.4GHz	802.11b		18.0
	802.11g		15.0
	802.11n-HT20		14.0
5GHz	802.11a	5.2GHz	14.0
		5.3GHz	14.0
		5.5GHz	15.0
		5.8GHz	15.5
	802.11n-HT20	5.2GHz	12.5
		5.3GHz	11.5
		5.5GHz	14.0
		5.8GHz	14.0
	802.11n-HT40	5.2GHz	15.0
		5.3GHz	14.5
		5.5GHz	15.0
		5.8GHz	17.5
Bluetooth v3.0+EDR			10.5
Bluetooth v4.0 LE			4.0

3.3 Applied Standard

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 1528-2003
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r02
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r01
- FCC KDB 648474 D04 Handset SAR v01r02
- FCC KDB 248227 D01 SAR meas for 802 11abg v01r02
- FCC KDB 941225 D01 SAR test for 3G devices v02
- FCC KDB 941225 D02 HSPA and 1x Advanced v02r02
- FCC KDB 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- FCC KDB 941225 D06 Hotspot Mode SAR v01r01
- October 2013 TCB workshop notes (GSM/GPRS/EDGE SAR testing criteria)

3.4 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

3.5 Test Conditions

3.5.1 Ambient Condition

Ambient Temperature	20 to 24 ℃
Humidity	< 60 %

3.5.2 Test Configuration

For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT.

For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.

4. Specific Absorption Rate (SAR)

4.1 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.

4.2 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)

SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\boldsymbol{\delta}\mathbf{T}}{\boldsymbol{\delta}\mathbf{t}}\right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

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

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

5. SAR Measurement System

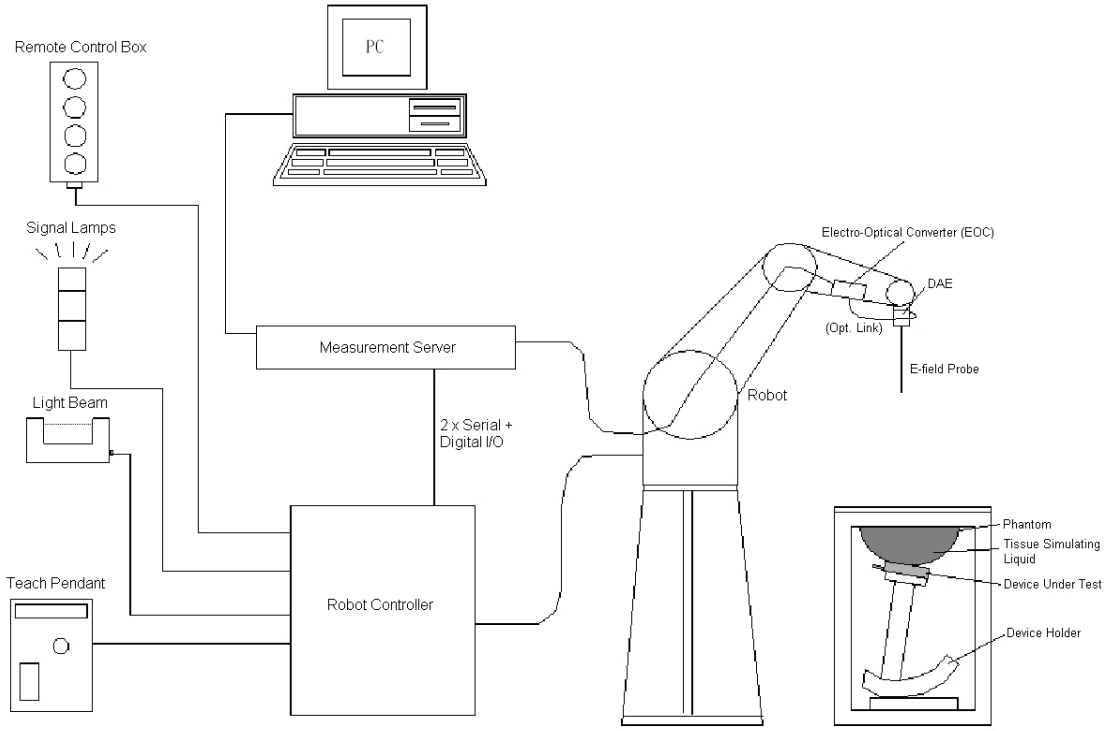


Fig 5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY software
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Component details are described in in the following sub-sections.

5.1 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.

5.1.1 E-Field Probe Specification

<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	 **Fig 5.2 Photo of EX3DV4**
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

5.2 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 5.3 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

Fig 5.4 Photo of DASY5

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig 5.5 Photo of Server for DASY5

5.5 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

Fig 5.6 Photo of SAM 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.

5.6 Device Holder

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Fig 5.7 Device Holder

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software：

Probe parameters：	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters：	- Frequency	f
	- Crest factor	cf
Media parameters：	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as：

$$\mathbf{V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}}$$

with V_i = compensated signal of channel i, (i = x, y, z)
U_i = input signal of channel i, (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated：

E-field Probes：$\mathbf{E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}}$

H-field Probes：$\mathbf{H_i = \sqrt{V_i} \cdot \frac{a_{i0}+a_{i1}f+a_{i2}f^2}{f}}$

with V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), μV/(V/m)^2 for E-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude)：

$$\mathbf{E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}}$$

The primary field data are used to calculate the derived field units.

$$\mathbf{SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}}$$

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d091	Nov. 18, 2011	Nov. 17, 2014
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	Nov. 21, 2011	Nov. 20, 2014
SPEAG	2450MHz System Validation Kit	D2450V2	840	Mar. 26. 2013	Mar. 25. 2014
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 23, 2013	Sep. 22, 2014
SPEAG	Data Acquisition Electronics	DAE4	1303	Nov. 22, 2013	Nov. 21, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3819	Nov. 27, 2013	Nov. 26, 2014
Agilent	Wireless Communication Test Set	E5515C	MY50267224	Oct. 10, 2013	Oct. 09, 2014
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1670	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CD	TP-1671	NCR	NCR
SPEAG	Dielectric Assessment Kit	DAK-3.5	1032	NCR	NCR
R&S	Network Analyzer	ZVB8	100106	Nov. 07, 2013	Nov. 06, 2014
Anritsu	Power Meter	ML2495A	1218010	Mar. 28, 2013	Mar. 27, 2014
Anritsu	Power Sensor	MA2411B	1207253	Mar. 28, 2013	Mar. 27, 2014
ARRA	Power Divider	A3200-2	N/A	NA	NA
Agilent	Dual Directional Coupler	778D	50422	Note 4	
Woken	Attenuator 1	WK0602-XX	N/A	Note 4	
PE	Attenuator 2	PE7005-10	N/A	Note 4	
PE	Attenuator 3	PE7005- 3	N/A	Note 4	
AR	Power Amplifier	5S1G4M2	328767	Note 5	
R&S	Spectrum Analyzer	FSP7	101230	Jun 13, 2013	Jun. 12, 2014

Table 5.1 Test Equipment List

Note:

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 865664 D01v01r02, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole D835V2, SN: 4d091 and D1900V2, SN: 5d118 can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.
4. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
6. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.

6. 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. 6.1. 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. 6.2.

Fig 6.1 Photo of Liquid Height for Head SAR

Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ε_r)
For Head								
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
For Body								
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

Table 6.1 Recipes of Tissue Simulating Liquid

Simulating Liquid for 5G, Manufactured by SPEAG

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

The dielectric parameters of the liquids were verified prior to the SAR evaluation using a SPEAG DAK-3.5 Dielectric Probe Kit and a R&S ZVB8 Network Analyzer.

The following table shows the measuring results for simulating liquid.

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	Head	22.6	0.910	42.910	0.90	41.50	1.11	3.40	±5	Feb. 08, 2014
1900	Head	22.7	1.417	40.994	1.40	40.00	1.21	2.49	±5	Jan. 30, 2014
1900	Head	22.5	1.440	41.011	1.40	40.00	2.86	2.53	±5	Feb. 08, 2014
2450	Head	22.8	1.878	40.464	1.80	39.20	4.33	3.22	±5	Feb. 08, 2014
5200	Head	22.6	4.696	37.048	4.66	36.00	0.77	2.91	±5	Feb. 09, 2014
5300	Head	22.5	4.819	36.839	4.76	35.90	1.24	2.62	±5	Feb. 09, 2014
5600	Head	22.5	5.199	36.179	5.07	35.50	2.54	1.91	±5	Feb. 10, 2014
5800	Head	22.6	5.432	35.732	5.27	35.30	3.07	1.22	±5	Feb. 10, 2014
835	Body	22.7	0.976	54.382	0.97	55.20	0.62	-1.48	±5	Jan. 15, 2014
1900	Body	22.6	1.533	54.611	1.52	53.30	0.86	2.46	±5	Jan. 15, 2014
1900	Body	22.8	1.529	53.216	1.52	53.30	0.59	-0.16	±5	Feb. 08, 2014
2450	Body	22.7	1.949	51.667	1.95	52.70	-0.05	-1.96	±5	Feb. 09, 2014
5200	Body	22.7	5.137	48.164	5.30	49.00	-3.08	-1.71	±5	Feb. 10, 2014
5300	Body	22.8	5.251	47.988	5.42	48.90	-3.12	-1.87	±5	Feb. 10, 2014
5600	Body	22.7	5.644	47.452	5.77	48.50	-2.18	-2.16	±5	Feb. 10, 2014
5800	Body	22.8	5.868	46.994	6.00	48.20	-2.20	-2.50	±5	Feb. 10, 2014

Table 6.2 Measuring Results for Simulating Liquid

7. System Verification Procedures

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

7.1 Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

7.2 System Setup

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

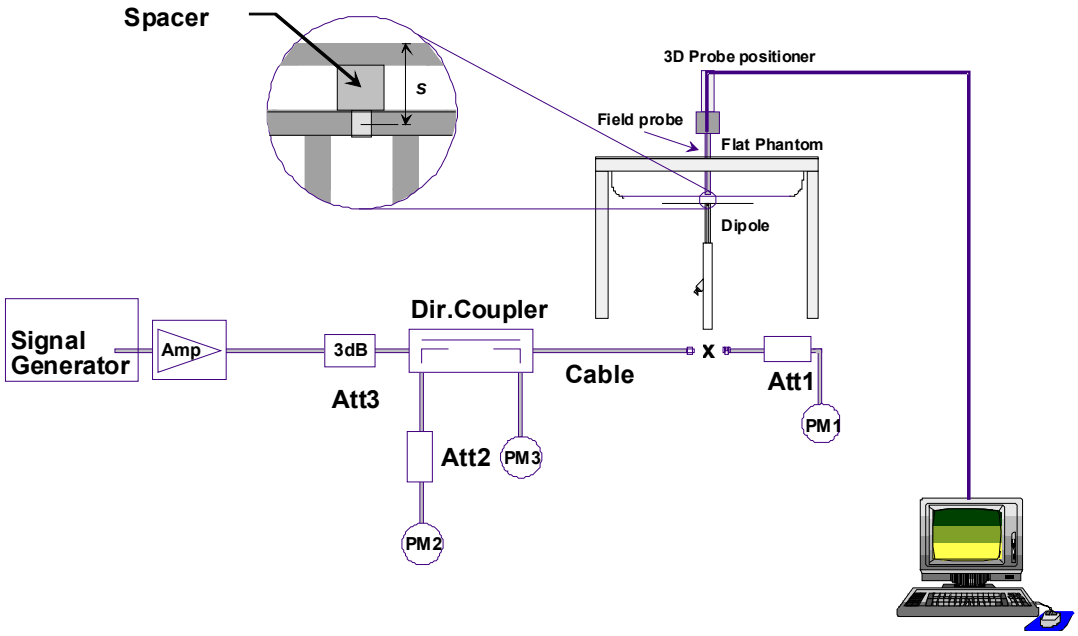


Fig 7.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

Fig 7.2 Photo of Dipole Setup

7.3 SAR System Verification Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 7.1 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 SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
Feb. 08, 2014	835	Head	250	4d091	3819	1303	2.47	9.40	9.88	5.11
Jan. 30, 2014	1900	Head	250	5d118	3819	1303	9.82	40.30	39.28	-2.53
Feb. 08, 2014	1900	Head	250	5d118	3819	1303	9.42	40.30	37.68	-6.50
Feb. 08, 2014	2450	Head	250	840	3819	1303	14.00	53.60	56	4.48
Feb. 09, 2014	5200	Head	100	1006	3819	1303	7.52	76.6	75.2	-1.83
Feb. 09, 2014	5300	Head	100	1006	3819	1303	7.89	80.4	78.9	-1.87
Feb. 10, 2014	5600	Head	100	1006	3819	1303	7.94	79.9	79.4	-0.63
Feb. 10, 2014	5800	Head	100	1006	3819	1303	7.54	76.3	75.4	-1.18
Jan. 15, 2014	835	Body	250	4d091	3819	1303	2.33	9.42	9.32	-1.06
Jan. 15, 2014	1900	Body	250	5d118	3819	1303	10.60	41.80	42.4	1.44
Feb. 08, 2014	1900	Body	250	5d118	3819	1303	10.50	41.80	42	0.48
Feb. 09, 2014	2450	Body	250	840	3819	1303	13.00	50.40	52	3.17
Feb. 10, 2014	5200	Body	100	1006	3819	1303	7.28	71.5	72.8	1.82
Feb. 10, 2014	5300	Body	100	1006	3819	1303	7.68	75.2	76.8	2.13
Feb. 10, 2014	5600	Body	100	1006	3819	1303	8.12	77.8	81.2	4.37
Feb. 10, 2014	5800	Body	100	1006	3819	1303	7.46	72.3	74.6	3.18

Table 7.1 Target and Measurement SAR after Normalized

8. EUT Testing Position

8.1 Define two imaginary lines on the handset

(a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.

(b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.

(c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

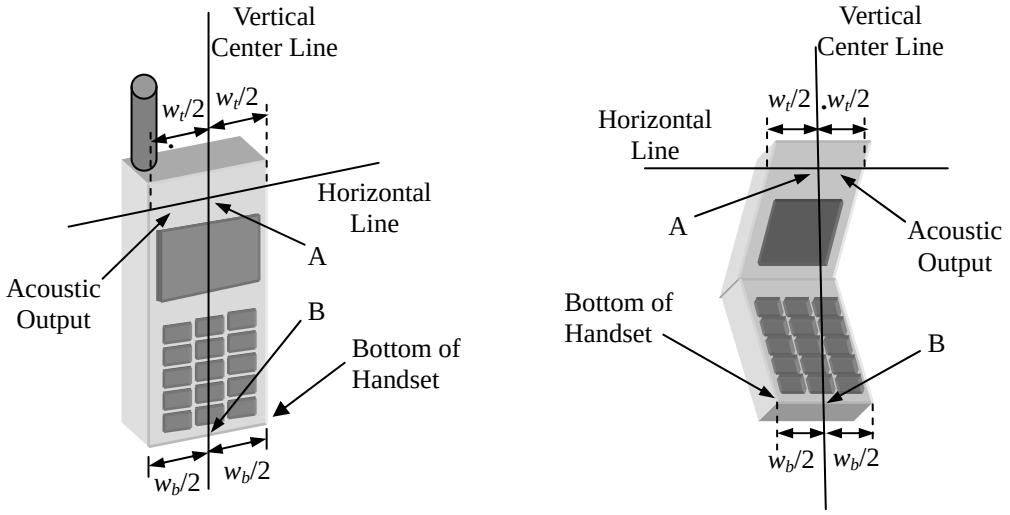


Fig 8.1 Illustration for Handset Vertical and Horizontal Reference Lines

8.2 Cheek Position

(a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.

(b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig. 8.2).

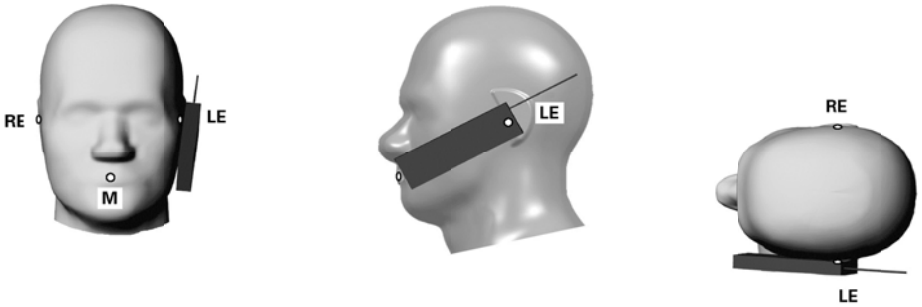


Fig 8.2 Illustration for Cheek Position

8.3 Tilted Position

(a) To position the device in the “cheek” position described above.

(b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 8.3).

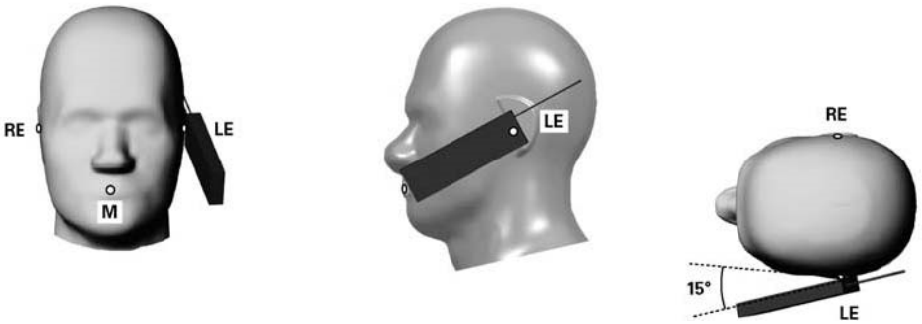


Fig 8.3 Illustration for Tilted Position

8.4 Body Worn 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 1 cm.

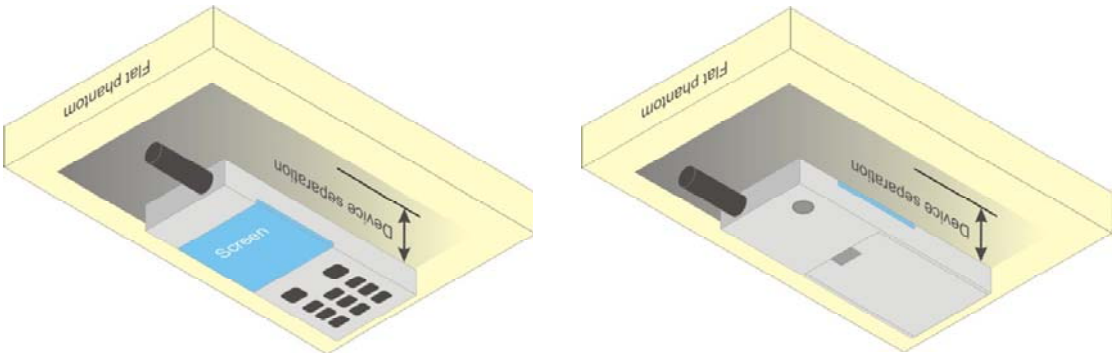


Fig 8.4 Illustration for Body Worn Position

8.5 Hotspot Position

(a) To position the device parallel to the phantom surface with all sides and either keypad up or down.
(b) To adjust the device parallel to the flat phantom.
(c) To adjust the distance between the device and the flat phantom to 1 cm.

<EUT Setup Photos>

Please refer to Appendix E for the test setup photos.

9. 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

9.1 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

9.2 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.

9.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r02 quoted below.

When the 1-g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

			≤ 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.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

9.4 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.

9.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

9.6 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.

10. Conducted RF Output Power (Unit: dBm)

<GSM Conducted Power>

(Main Antenna)

General Note:

1. Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. According to October 2013TCB Workshop, For GSM / EGPRS, the number of time slots to test for SAR should correspond to the highest source-based time-averaged maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation for head SAR testing, the EUT was set in GSM Voice for GSM850/GSM1900 band due to its highest frame-average power.
3. For hotspot and body-worn SAR testing, GPRS and EDGE should be evaluated, therefore the EUT was set in GPRS 1 Tx slot for GSM850/GSM1900 band due to its highest frame-average power.

Band 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	
GSM (GMSK, 1 Tx slot)	33.28	33.34	**33.46**	33.5	24.28	24.34	**24.46**	24.50
GPRS (GMSK, 1 Tx slot) – CS1	33.26	33.21	33.38	33.5	24.26	24.21	24.38	24.50
GPRS (GMSK, 2 Tx slots) – CS1	28.74	28.79	28.77	29.0	22.74	22.79	22.77	23.00
EDGE (8PSK, 1 Tx slot) – MCS5	27.31	27.35	27.36	28.0	18.31	18.35	18.36	19.00
EDGE (8PSK, 2 Tx slots) – MCS5	27.28	27.29	27.33	27.5	21.28	21.29	21.33	21.50
Band 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	
GSM (GMSK, 1 Tx slot)	30.86	30.50	**30.90**	31.0	21.86	21.50	**21.90**	22.00
GPRS (GMSK, 1 Tx slot) – CS1	30.83	30.43	30.88	31.0	21.83	21.43	21.88	22.00
GPRS (GMSK, 2 Tx slots) – CS1	26.95	26.34	26.96	27.5	20.95	20.34	20.96	21.50
EDGE (8PSK, 1 Tx slot) – MCS5	26.62	26.08	26.65	27.0	17.62	17.08	17.65	18.00
EDGE (8PSK, 2 Tx slots) – MCS5	26.49	25.98	26.56	27.0	20.49	19.98	20.56	21.00

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

(Second Antenna)

General Note:

1. Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. According to October 2013TCB Workshop, for GSM / GPRS, the number of time slots to test for SAR should correspond to the highest source-based time-averaged maximum output power configuration; When time slots with equivalent maximum average output power specifications, including tolerance, if the measured maximum output power levels are within 0.25 dB of each other, test the configuration with the most number of time slots.
3. For head and body-worn SAR testing, the EUT was set in GPRS 2 Tx slots for GSM1900 band due to its highest frame-average power.
4. For hotspot SAR testing, GPRS and EDGE should be evaluated, therefore the EUT was set in GPRS 2 Tx slots for GSM1900 band due to its highest frame-average power.

Band 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	
GSM (GMSK, 1 Tx slot)	28.98	28.54	29.09	29.5	19.98	19.54	20.09	20.50
GPRS (GMSK, 1 Tx slot) – CS1	28.92	28.53	29.06	29.5	19.92	19.53	20.06	20.50
GPRS (GMSK, 2 Tx slots) – CS1	26.72	26.27	26.75	27.0	20.72	20.27	20.75	21.00
EDGE (8PSK, 1 Tx slot) – MCS5	26.31	25.92	26.36	26.5	17.31	16.92	17.36	17.50
EDGE (8PSK, 2 Tx slots) – MCS5	26.16	25.79	26.33	26.5	20.16	19.79	20.33	20.50

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

<WCDMA Conducted Power>

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.

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 β_{hs} = 30/15 * β_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 β_{hs} = 30/15 * β_c, and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_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. Applying the subtest setup in Table C.11.1.3 of 3GPP TS 34.121-1 V9.1.0 to Rel. 6 HSPA.
2. Per KDB 941225 D01v02, RMC 12.2kbps setting is used to evaluate SAR. If AMR 12.2kbps power is < 0.25dB higher than RMC 12.2kbps, SAR tests with AMR 12.2kbps can be excluded.
3. By design, AMR, HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
4. It is expected by the manufacturer that MPR for some HSDPA/HSUPA subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.
5. Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.

(Main Antenna)

Band			WCDMA Band V				WCDMA Band II			
Tx Channel			4132	4182	4233	Tune-up Limit (dBm)	9262	9400	9538	Tune-up Limit (dBm)
Rx Channel			4357	4407	4458		9662	9800	9938	
Frequency (MHz)			826.4	836.4	846.6		1852.4	1880	1907.6	
MPR (dB)	3GPP Rel 99	AMR 12.2Kbps	22.57	22.70	22.63	23.50	22.60	22.68	22.79	23.00
	3GPP Rel 99	RMC 12.2Kbps	22.59	22.73	22.65	23.50	22.62	22.71	22.80	23.00
0	3GPP Rel 6	HSDPA Subtest-1	21.14	21.25	21.26	22.50	21.16	21.24	21.38	22.00
0	3GPP Rel 6	HSDPA Subtest-2	21.13	21.24	21.17	22.50	21.17	21.22	21.39	22.00
0.5	3GPP Rel 6	HSDPA Subtest-3	21.14	21.26	21.18	22.50	21.19	21.42	21.41	22.00
0.5	3GPP Rel 6	HSDPA Subtest-4	21.13	21.24	21.17	22.50	21.16	21.50	21.39	22.00
0	3GPP Rel 6	HSUPA Subtest-1	20.78	20.84	21.41	22.50	20.90	21.36	20.96	22.00
2	3GPP Rel 6	HSUPA Subtest-2	20.66	20.77	20.61	22.50	20.71	20.70	21.00	22.00
1	3GPP Rel 6	HSUPA Subtest-3	20.46	20.13	20.11	22.50	20.28	20.15	20.38	22.00
2	3GPP Rel 6	HSUPA Subtest-4	21.38	21.23	21.06	22.50	21.16	21.42	21.24	22.00
0	3GPP Rel 6	HSUPA Subtest-5	20.56	20.83	20.77	22.50	20.56	20.58	20.13	22.00

<WLAN 2.4GHz Band Conducted Power>

General Note:

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate.
3. Per KDB 248227 D01 v01r02, 11g and 11n-HT20 output power is less than 1/4dB higher than 11b mode, thus the SAR can be excluded.

802.11b Average Power (dBm)						Tune up Limit (dBm)
Channel	Frequency (MHz)	Data Rate (bps)				
		1M bps	2M bps	5.5M bps	11M bps	
CH 01	2412	17.36	17.29	17.33	17.34	18.00
CH 06	2437	16.85	16.78	16.82	16.83	18.00
CH 11	2462	17.57	17.50	17.54	17.55	18.00

802.11g Average Power (dBm)										Tune up Limit (dBm)
Channel	Frequency (MHz)	Data Rate (bps)								
		6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps	
CH 01	2412	14.47	14.40	14.38	14.37	14.39	14.46	14.43	14.40	15.00
CH 06	2437	14.52	14.45	14.43	14.42	14.44	14.51	14.48	14.45	15.00
CH 11	2462	14.76	14.69	14.67	14.66	14.68	14.75	14.72	14.69	15.00

802.11n-HT20 Average Power (dBm)										Tune up Limit (dBm)
Channel	Frequency (MHz)	MCS Index								
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
CH 01	2412	13.62	13.45	13.58	13.54	13.61	13.60	13.60	13.61	14.00
CH 06	2437	13.77	13.60	13.73	13.69	13.76	13.75	13.75	13.76	14.00
CH 11	2462	13.90	13.73	13.86	13.82	13.89	13.88	13.88	13.89	14.00

<Bluetooth Conducted Power>

General Note:

1. The burst average power is the average power level during the “ON” burst of Bluetooth transmitter.
2. Bluetooth SAR testing was performed at the data rate of 1Mbps and at DH5 due to highest duty factor which is theoretically maximum 83.3%.

Bluetooth Burst Average Power (dBm)_DH5					Tune up Limit (dBm)
Channel	Frequency (MHz)	v3.0+EDR			
		1Mbps	2Mbps	3Mbps	
CH 00	2402	9.87	8.68	8.71	10.50
CH 39	2441	9.39	8.20	8.55	10.50
CH 78	2480	9.58	8.39	8.39	10.50

Channel	Frequency (MHz)	Bluetooth Burst Average power (dBm)	Tune up Limit (dBm)
		v4.0 LE	
CH 00	2402	2.91	4.00
CH 19	2440	2.34	4.00
CH 39	2480	2.37	4.00

<WLAN 5GHz Band Conducted Power>

General Note:

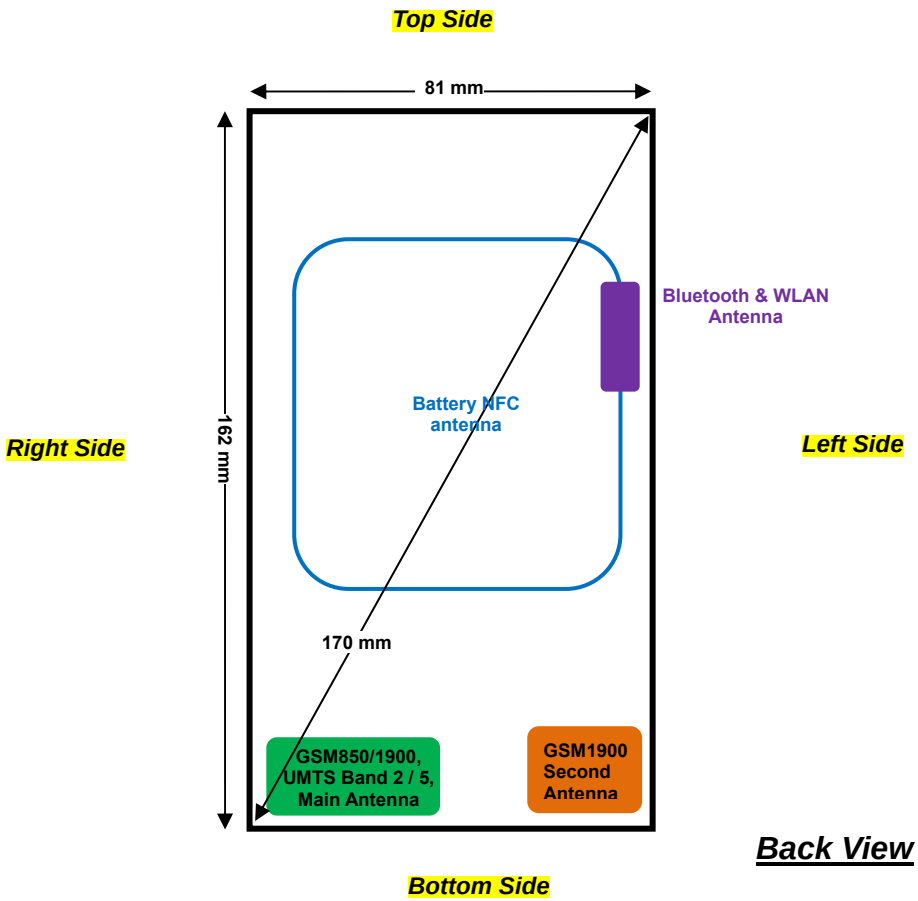
1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate.
3. Apply the test exclusion rule in KDB 248227 D01 v01r02, 11n-HT20 output power is less than 1/4dB higher than 802.11a mode, thus the SAR can be excluded.
4. Per KDB 248227 D01 v01r02, for WLAN 5.2/5.5/5.8GHz Band, 11n-HT40 average output power is higher than 1/4dB higher than 802.11a mode, these modes SAR will be verified at the highest RF exposure position found in 802.11a SAR testing. For WLAN 5.5GHz Band, 11n-HT40 output power is less than 1/4dB higher than 802.11a mode, thus the SAR can be excluded.

Mode	Channel	Frequency (MHz)	Average Power (dBm)								Tune up Limit (dBm)
			Data Rate								
			6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps	
802.11a	CH 36	5180	13.23	13.15	13.16	13.17	13.15	13.21	13.20	13.21	14.00
	CH 40	5200	13.34	13.26	13.27	13.28	13.26	13.32	13.31	13.32	14.00
	CH 44	5220	13.60	13.52	13.53	13.54	13.52	13.58	13.57	13.58	14.00
	CH 48	5240	12.94	12.86	12.87	12.88	12.86	12.92	12.91	12.92	14.00
	CH 52	5260	12.42	12.34	12.35	12.36	12.34	12.40	12.39	12.40	14.00
	CH 56	5280	12.78	12.70	12.71	12.72	12.70	12.76	12.75	12.76	14.00
	CH 60	5300	13.02	12.94	12.95	12.96	12.94	13.00	12.99	13.00	14.00
	CH 64	5320	12.83	12.75	12.76	12.77	12.75	12.81	12.80	12.81	14.00
	CH 100	5500	13.51	13.43	13.44	13.45	13.43	13.49	13.48	13.49	15.00
	CH 104	5520	13.67	13.59	13.60	13.61	13.59	13.65	13.64	13.65	15.00
	CH 108	5540	13.78	13.70	13.71	13.72	13.70	13.76	13.75	13.76	15.00
	CH 112	5560	13.80	13.72	13.73	13.74	13.72	13.78	13.77	13.78	15.00
	CH 116	5580	14.20	14.12	14.13	14.14	14.12	14.18	14.17	14.18	15.00
	CH 136	5680	14.81	14.73	14.74	14.75	14.73	14.79	14.78	14.79	15.00
	CH 140	5700	14.57	14.49	14.50	14.51	14.49	14.55	14.54	14.55	15.00
	CH 149	5745	14.72	14.64	14.65	14.66	14.64	14.70	14.69	14.70	15.50
	CH 153	5765	14.50	14.42	14.43	14.44	14.42	14.48	14.47	14.48	15.00
	CH 157	5785	15.29	15.21	15.22	15.23	15.21	15.27	15.26	15.27	15.00
	CH 161	5805	13.80	13.72	13.73	13.74	13.72	13.78	13.77	13.78	15.00
	CH 165	5825	15.00	14.92	14.93	14.94	14.92	14.98	14.97	14.98	15.00

Mode	Channel	Frequency (MHz)	Average Power (dBm)								Tune up Limit (dBm)
			MCS Index								
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
802.11n HT20	CH 36	5180	11.60	11.52	11.56	11.53	11.55	11.55	11.57	11.58	12.50
	CH 40	5200	11.63	11.55	11.59	11.56	11.58	11.58	11.60	11.61	12.50
	CH 44	5220	11.97	11.89	11.93	11.90	11.92	11.92	11.94	11.95	12.50
	CH 48	5240	11.31	11.23	11.27	11.24	11.26	11.26	11.28	11.29	12.50
	CH 52	5260	10.67	10.59	10.63	10.60	10.62	10.62	10.64	10.65	11.50
	CH 56	5280	11.07	10.99	11.03	11.00	11.02	11.02	11.04	11.05	11.50
	CH 60	5300	11.35	11.27	11.31	11.28	11.30	11.30	11.32	11.33	11.50
	CH 64	5320	11.09	11.01	11.05	11.02	11.04	11.04	11.06	11.07	11.50
	CH 100	5500	12.79	12.71	12.75	12.72	12.74	12.74	12.76	12.77	14.00
	CH 104	5520	12.53	12.45	12.49	12.46	12.48	12.48	12.50	12.51	14.00
	CH 108	5540	12.68	12.60	12.64	12.61	12.63	12.63	12.65	12.66	14.00
	CH 112	5560	12.71	12.63	12.67	12.64	12.66	12.66	12.68	12.69	14.00
	CH 116	5580	12.75	12.67	12.71	12.68	12.70	12.70	12.72	12.73	14.00
	CH 136	5680	13.78	13.70	13.74	13.71	13.73	13.73	13.75	13.76	14.00
	CH 140	5700	12.86	12.78	12.82	12.79	12.81	12.81	12.83	12.84	14.00
	CH 149	5745	12.91	12.83	12.87	12.84	12.86	12.86	12.88	12.89	14.00
	CH 153	5765	12.36	12.28	12.32	12.29	12.31	12.31	12.33	12.34	14.00
	CH 157	5785	13.53	13.45	13.49	13.46	13.48	13.48	13.50	13.51	14.00
	CH 161	5805	13.68	13.60	13.64	13.61	13.63	13.63	13.65	13.66	14.00
	CH 165	5825	13.21	13.13	13.17	13.14	13.16	13.16	13.18	13.19	14.00

Mode	Channel	Frequency (MHz)	Average Power (dBm)								Tune up Limit (dBm)
			MCS Index								
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
802.11n HT40	CH 38	5190	14.16	14.14	14.12	14.09	14.10	14.12	14.10	14.13	15.00
	CH 46	5230	14.02	14.00	13.98	13.95	13.96	13.98	13.96	13.99	15.00
	CH 54	5270	13.70	13.68	13.66	13.63	13.64	13.66	13.64	13.67	14.50
	CH 62	5310	14.00	13.98	13.96	13.93	13.94	13.96	13.94	13.97	14.50
	CH 102	5510	13.58	13.56	13.54	13.51	13.52	13.54	13.52	13.55	15.00
	CH 110	5550	13.80	13.78	13.76	13.73	13.74	13.76	13.74	13.77	15.00
	CH 134	5670	14.75	14.73	14.71	14.68	14.69	14.71	14.69	14.72	15.00
	CH 151	5755	16.21	16.19	16.17	16.14	16.15	16.17	16.15	16.18	17.50
	CH 159	5795	16.90	16.88	16.86	16.83	16.84	16.86	16.84	16.87	17.50

11. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	132mm	≤ 25mm	≤ 25mm	47mm
WWAN Second	≤ 25mm	≤ 25mm	131mm	≤ 25mm	47mm	≤ 25mm
Bluetooth & WLAN	≤ 25mm	≤ 25mm	64mm	76mm	71mm	≤ 25mm

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

Note: Referring to KDB 941225 D06 v01r01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge

12. SAR Test Results

General Note:

1. This supports dual SIM dual active, the SIM1 for the main antenna supports GSM850 / 1900, UMTS Band 2 / 5, the SIM2 for the second antenna supports GSM1900 only, the WWAN radio can simultaneous transmission at the same time.
2. Per KDB 447498 D01v05r01, 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. Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
3. Per KDB 447498 D01v05r01, for each exposure position, if the highest output channel reported SAR ≤0.8W/kg, other channels SAR testing is not necessary.
4. According to October 2013TCB Workshop, For GSM / EGPRS, the number of time slots to test for SAR should correspond to the highest source-based time-averaged maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation, for the main antenna head SAR testing, the EUT was set in GSM Voice for GSM850/GSM1900 band due to its highest frame-average power; for the second antenna head and body-worn SAR testing, the EUT was set in GPRS 2 Tx slots for GSM1900 band due to its highest frame-average power.
5. For hotspot SAR testing, per KDB 941225 D06v01r01, for EUT dimension ≥ 9cm*5cm, the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
6. For hotspot mode SAR testing, GPRS and EDGE should be evaluated, therefore, for the main antenna, the EUT was set in GPRS 1 Tx slot for GSM850/GSM1900 band due to its highest frame-average power; and for the second antenna, the EUT was set in GPRS 2 Tx slots for GSM1900 band due to its highest frame-average power
7. Body-worn SAR testing was performed at 10mm separation, and this distance is determined by the handset manufacturer that there will be body-worn accessories that users may acquire at the time of equipment certification, to enable users to purchase aftermarket body-worn accessories with the required minimum separation.
8. Per KDB 941225 D06 v01r01, when the same wireless mode and device transmission configurations are required for testing body-worn accessories and hotspot mode, it is not necessary to test body-worn accessory SAR for the same device orientation if the test separation distance for hotspot mode is more conservative than that used for body-worn accessories.
9. Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA / HSUPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA / HSUPA SAR evaluation can be excluded.
10. Per KDB 648474 D04v01r02, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.
11. Per KDB 648474 D04v01r02, when the diagonal dimension > 16.0cm and hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

12.1 Head SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
#01	GSM850	GSM Voice	Right Cheek	Main	251	848.8	33.46	33.5	1.009	-0.06	0.156	**0.157**
	GSM850	GSM Voice	Right Tilted	Main	251	848.8	33.46	33.5	1.009	-0.02	0.098	0.099
	GSM850	GSM Voice	Left Cheek	Main	251	848.8	33.46	33.5	1.009	0.05	0.154	0.155
	GSM850	GSM Voice	Left Tilted	Main	251	848.8	33.46	33.5	1.009	0.03	0.077	0.078
#02	GSM1900	GSM Voice	Right Cheek	Main	810	1909.8	30.90	31	1.023	-0.01	0.108	**0.111**
	GSM1900	GSM Voice	Right Tilted	Main	810	1909.8	30.90	31	1.023	-0.03	0.057	0.058
	GSM1900	GSM Voice	Left Cheek	Main	810	1909.8	30.90	31	1.023	0.09	0.065	0.067
	GSM1900	GSM Voice	Left Tilted	Main	810	1909.8	30.90	31	1.023	0.01	0.060	0.061
#03	GSM1900	GPRS(2 Tx slots)	Right Cheek	Second	810	1909.8	26.75	27	1.059	0.05	0.096	**0.102**
	GSM1900	GPRS(2 Tx slots)	Right Tilted	Second	810	1909.8	26.75	27	1.059	-0.08	0.048	0.051
	GSM1900	GPRS(2 Tx slots)	Left Cheek	Second	810	1909.8	26.75	27	1.059	0.07	0.06	0.064
	GSM1900	GPRS(2 Tx slots)	Left Tilted	Second	810	1909.8	26.75	27	1.059	0.05	0.054	0.057

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Antenna	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)
#04	WCDMA Band V	RMC 12.2K	Right Cheek	Main	4182	836.4	22.73	23.5	1.194	-0.02	0.134	**0.160**
	WCDMA Band V	RMC 12.2K	Right Tilted	Main	4182	836.4	22.73	23.5	1.194	-0.08	0.083	0.099
	WCDMA Band V	RMC 12.2K	Left Cheek	Main	4182	836.4	22.73	23.5	1.194	-0.07	0.133	0.159
	WCDMA Band V	RMC 12.2K	Left Tilted	Main	4182	836.4	22.73	23.5	1.194	-0.03	0.068	0.081
#05	WCDMA Band II	RMC 12.2K	Right Cheek	Main	9538	1907.6	22.80	23	1.047	-0.02	0.146	**0.153**
	WCDMA Band II	RMC 12.2K	Right Tilted	Main	9538	1907.6	22.80	23	1.047	-0.06	0.077	0.081
	WCDMA Band II	RMC 12.2K	Left Cheek	Main	9538	1907.6	22.80	23	1.047	0.04	0.088	0.092
	WCDMA Band II	RMC 12.2K	Left Tilted	Main	9538	1907.6	22.80	23	1.047	0.01	0.083	0.087

<WLAN SAR DTS>

Plot No.	Band	Mode	Test Position	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)
	WLAN 2.4GHz	802.11b 1Mbps	Right Cheek	11	2462	17.57	18	1.104	-0.09	0.037	0.041
	WLAN 2.4GHz	802.11b 1Mbps	Right Tilted	11	2462	17.57	18	1.104	-0.02	0.018	0.020
#06	WLAN 2.4GHz	802.11b 1Mbps	Left Cheek	11	2462	17.57	18	1.104	0.07	0.068	**0.075**
	WLAN 2.4GHz	802.11b 1Mbps	Left Tilted	11	2462	17.57	18	1.104	-0.04	0.018	0.020
	WLAN 5.8GHz	802.11a 6Mbps	Right Cheek	157	5785	15.29	15.5	1.050	0	< 0.001	< 0.001
	WLAN 5.8GHz	802.11a 6Mbps	Right Tilted	157	5785	15.29	15.5	1.050	0.12	0.00294	0.003
	WLAN 5.8GHz	802.11a 6Mbps	Left Cheek	157	5785	15.29	15.5	1.050	0.05	0.026	0.027
	WLAN 5.8GHz	802.11a 6Mbps	Left Tilted	157	5785	15.29	15.5	1.050	0.06	< 0.001	< 0.001
#07	WLAN 5.8GHz	802.11n HT40 MCS0	Left Cheek	159	5795	16.90	17.5	1.148	0.07	0.024	**0.028**

<WLAN SAR NII>

Plot No.	Band	Mode	Test Position	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)
	WLAN 5.2GHz	802.11a 6Mbps	Right Cheek	44	5220	13.60	14	1.096	0	< 0.001	< 0.001
	WLAN 5.2GHz	802.11a 6Mbps	Right Tilted	44	5220	13.60	14	1.096	-0.07	0.00275	0.003
	WLAN 5.2GHz	802.11a 6Mbps	Left Cheek	44	5220	13.60	14	1.096	0	< 0.001	< 0.001
	WLAN 5.2GHz	802.11a 6Mbps	Left Tilted	44	5220	13.60	14	1.096	0	< 0.001	< 0.001
#08	WLAN 5.2GHz	802.11n HT40 MCS0	Right Tilted	38	5190	14.16	15	1.213	-0.09	0.011	**0.013**
#09	WLAN 5.3GHz	802.11a 6Mbps	Right Cheek	60	5300	13.02	14	1.253	0	< 0.001	< 0.001
	WLAN 5.3GHz	802.11a 6Mbps	Right Tilted	60	5300	13.02	14	1.253	0	< 0.001	< 0.001
	WLAN 5.3GHz	802.11a 6Mbps	Left Cheek	60	5300	13.02	14	1.253	0	< 0.001	< 0.001
	WLAN 5.3GHz	802.11a 6Mbps	Left Tilted	60	5300	13.02	14	1.253	0	< 0.001	< 0.001
	WLAN 5.3GHz	802.11n HT40 MCS0	Right Cheek	62	5310	14.00	14.5	1.122	0	< 0.001	< 0.001
	WLAN 5.5GHz	802.11a 6Mbps	Right Cheek	136	5680	14.81	15	1.045	0.01	0.028	0.029
	WLAN 5.5GHz	802.11a 6Mbps	Right Tilted	136	5680	14.81	15	1.045	0.06	0.012	0.013
#10	WLAN 5.5GHz	802.11a 6Mbps	Left Cheek	136	5680	14.81	15	1.045	0.05	0.036	**0.038**
	WLAN 5.5GHz	802.11a 6Mbps	Left Tilted	136	5680	14.81	15	1.045	-0.07	0.013	0.014

< Bluetooth SAR DSS >

Plot No.	Band	Mode	Test Position	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)
	Bluetooth	1Mbps DH5	Right Cheek	00	2402	9.87	10.5	1.156	-0.03	0.00654	0.008
	Bluetooth	1Mbps DH5	Right Tilted	00	2402	9.87	10.5	1.156	-0.05	0.00178	0.002
#11	Bluetooth	1Mbps DH5	Left Cheek	00	2402	9.87	10.5	1.156	-0.08	0.00833	**0.010**
	Bluetooth	1Mbps DH5	Left Tilted	00	2402	9.87	10.5	1.156	0.09	0.00348	0.004

12.2 Hotspot SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Antenna	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(1 Tx slot)	Front	1	Main	251	848.8	33.38	33.5	1.028	-0.09	0.291	0.299
#12	GSM850	GPRS(1 Tx slot)	Back	1	Main	251	848.8	33.38	33.5	1.028	-0.01	0.631	**0.649**
	GSM850	GPRS(1 Tx slot)	Right Side	1	Main	251	848.8	33.38	33.5	1.028	0.04	0.237	0.244
	GSM850	GPRS(1 Tx slot)	Bottom Side	1	Main	251	848.8	33.38	33.5	1.028	-0.07	0.439	0.451
	GSM1900	GPRS(1 Tx slot)	Front	1	Main	810	1909.8	30.88	31	1.028	-0.14	0.329	0.338
#13	GSM1900	GPRS(1 Tx slot)	Back	1	Main	810	1909.8	30.88	31	1.028	0.07	0.686	**0.705**
	GSM1900	GPRS(1 Tx slot)	Right Side	1	Main	810	1909.8	30.88	31	1.028	-0.11	0.183	0.188
	GSM1900	GPRS(1 Tx slot)	Bottom Side	1	Main	810	1909.8	30.88	31	1.028	-0.04	0.490	0.504
	GSM1900	GPRS(2 Tx slots)	Front	1	Second	810	1909.8	26.75	27	1.059	-0.01	0.139	0.147
#14	GSM1900	GPRS(2 Tx slots)	Back	1	Second	810	1909.8	26.75	27	1.059	-0.02	0.510	**0.540**
	GSM1900	GPRS(2 Tx slots)	Left Side	1	Second	810	1909.8	26.75	27	1.059	-0.02	0.065	0.069
	GSM1900	GPRS(2 Tx slots)	Bottom Side	1	Second	810	1909.8	26.75	27	1.059	0.1	0.251	0.266

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Antenna	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 Band V	RMC 12.2K	Front	1	Main	4182	836.4	22.73	23.5	1.194	-0.03	0.22	0.263
#15	WCDMA Band V	RMC 12.2K	Back	1	Main	4182	836.4	22.73	23.5	1.194	-0.05	0.462	**0.552**
	WCDMA Band V	RMC 12.2K	Right Side	1	Main	4182	836.4	22.73	23.5	1.194	-0.07	0.214	0.256
	WCDMA Band V	RMC 12.2K	Bottom Side	1	Main	4182	836.4	22.73	23.5	1.194	-0.07	0.342	0.408
	WCDMA Band II	RMC 12.2K	Front	1	Main	9538	1907.6	22.80	23	1.047	-0.07	0.508	0.532
	WCDMA Band II	RMC 12.2K	Back	1	Main	9538	1907.6	22.80	23	1.047	0.02	1.010	1.058
	WCDMA Band II	RMC 12.2K	Right Side	1	Main	9538	1907.6	22.80	23	1.047	-0.05	0.284	0.297
	WCDMA Band II	RMC 12.2K	Bottom Side	1	Main	9538	1907.6	22.80	23	1.047	-0.01	0.762	0.798
#16	WCDMA Band II	RMC 12.2K	Back	1	Main	9262	1852.4	22.62	23	1.091	-0.02	1.000	**1.091**
	WCDMA Band II	RMC 12.2K	Back	1	Main	9400	1880	22.71	23	1.069	-0.05	1.020	1.090

<WLAN SAR DTS>

Plot No.	Band	Mode	Test Position	Gap (cm)	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)
	WLAN 2.4GHz	802.11b 1Mbps	Front	1	11	2462	17.57	18	1.104	-0.08	0.031	0.034
#17	WLAN 2.4GHz	802.11b 1Mbps	Back	1	11	2462	17.57	18	1.104	0.03	0.185	**0.204**
	WLAN 2.4GHz	802.11b 1Mbps	Left Side	1	11	2462	17.57	18	1.104	0.04	0.067	0.074
	WLAN 5.8GHz	802.11a 6Mbps	Front	1	157	5785	15.29	15.5	1.050	-0.01	0.00988	0.010
	WLAN 5.8GHz	802.11a 6Mbps	Back	1	157	5785	15.29	15.5	1.050	0.06	0.096	0.101
	WLAN 5.8GHz	802.11a 6Mbps	Left Side	1	157	5785	15.29	15.5	1.050	0.04	0.047	0.049
#18	WLAN 5.8GHz	802.11n HT40 MCS0	Back	1	159	5795	16.90	17.5	1.148	0.02	0.116	**0.133**

<Bluetooth SAR DSS>

Plot No.	Band	Mode	Test Position	Gap (cm)	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)
	Bluetooth	1Mbps DH5	Front	1	00	2402	9.87	10.5	1.156	0.08	0.00481	0.006
19	Bluetooth	1Mbps DH5	Back	1	00	2402	9.87	10.5	1.156	0.13	0.020	**0.023**
	Bluetooth	1Mbps DH5	Left Side	1	00	2402	9.87	10.5	1.156	0.06	0.00946	0.011

12.3 Body Worn SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Antenna	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(1 Tx slot)	Front	1	Main	251	848.8	33.38	33.5	1.028	-0.09	0.291	0.299
12	GSM850	GPRS(1 Tx slot)	Back	1	Main	251	848.8	33.38	33.5	1.028	-0.01	0.631	**0.649**
	GSM1900	GPRS(1 Tx slot)	Front	1	Main	810	1909.8	30.88	31	1.028	-0.14	0.329	0.338
13	GSM1900	GPRS(1 Tx slot)	Back	1	Main	810	1909.8	30.88	31	1.028	0.07	0.686	**0.705**
	GSM1900	GPRS(2 Tx slots)	Front	1	Second	810	1909.8	26.75	27	1.059	-0.01	0.139	0.147
14	GSM1900	GPRS(2 Tx slots)	Back	1	Second	810	1909.8	26.75	27	1.059	-0.02	0.51	**0.540**

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Antenna	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 Band V	RMC 12.2K	Front	1	Main	4182	836.4	22.73	23.5	1.194	-0.03	0.22	0.263
15	WCDMA Band V	RMC 12.2K	Back	1	Main	4182	836.4	22.73	23.5	1.194	-0.05	0.462	**0.552**
	WCDMA Band II	RMC 12.2K	Front	1	Main	9538	1907.6	22.80	23	1.047	-0.07	0.508	0.532
	WCDMA Band II	RMC 12.2K	Back	1	Main	9538	1907.6	22.80	23	1.047	0.02	1.010	1.058
16	WCDMA Band II	RMC 12.2K	Back	1	Main	9262	1852.4	22.62	23	1.091	-0.02	1.000	**1.091**
	WCDMA Band II	RMC 12.2K	Back	1	Main	9400	1880	22.71	23	1.069	-0.05	1.020	1.090

<WLAN SAR DTS>

Plot No.	Band	Mode	Test Position	Gap (cm)	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)
	WLAN 2.4GHz	802.11b 1Mbps	Front	1	11	2462	17.57	18	1.104	-0.08	0.031	0.034
17	WLAN 2.4GHz	802.11b 1Mbps	Back	1	11	2462	17.57	18	1.104	0.03	0.185	**0.204**
	WLAN 5.8GHz	802.11a 6Mbps	Front	1	157	5785	15.29	15.5	1.050	-0.01	0.00988	0.010
	WLAN 5.8GHz	802.11a 6Mbps	Back	1	157	5785	15.29	15.5	1.050	0.06	0.096	0.101
18	WLAN 5.8GHz	802.11n HT40 MCS0	Back	1	159	5795	16.90	17.5	1.148	0.02	0.116	**0.133**

<WLAN SAR NII>

Plot No.	Band	Mode	Test Position	Gap (cm)	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)
	WLAN 5.2GHz	802.11a 6Mbps	Front	1	44	5220	13.60	14	1.096	0.07	0.00146	0.002
20	WLAN 5.2GHz	802.11a 6Mbps	Back	1	44	5220	13.60	14	1.096	-0.09	0.065	**0.071**
	WLAN 5.2GHz	802.11n HT40 MCS0	Back	1	38	5190	14.16	15	1.213	0.09	0.040	0.049
	WLAN 5.3GHz	802.11a 6Mbps	Front	1	60	5300	13.02	14	1.253	0.04	0.00139	0.002
21	WLAN 5.3GHz	802.11a 6Mbps	Back	1	60	5300	13.02	14	1.253	-0.08	0.00777	**0.010**
	WLAN 5.3GHz	802.11n HT40 MCS0	Back	1	62	5310	14.00	14.5	1.122	0.09	0.00756	0.008
	WLAN5.5GHz	802.11a 6Mbps	Front	1	136	5680	14.81	15	1.045	0.02	0.022	0.023
22	WLAN5.5GHz	802.11a 6Mbps	Back	1	136	5680	14.81	15	1.045	0.06	0.144	**0.150**

<Bluetooth SAR DSS>

Plot No.	Band	Mode	Test Position	Gap (cm)	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)
	Bluetooth	1Mbps DH5	Front	1	00	2402	9.87	10.5	1.156	0.08	0.00481	0.006
19	Bluetooth	1Mbps DH5	Back	1	00	2402	9.87	10.5	1.156	0.13	0.020	**0.023**

12.4 Repeated SAR Measurement

Plot No.	Band	Mode	Test Position	Gap (cm)	Antenna	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 Band II	RMC 12.2K	Back	1	Main	9400	1880	22.71	23	1.069	-0.05	1.020	-	1.090
2nd	WCDMA Band II	RMC 12.2K	Back	1	Main	9400	1880	22.71	23	1.069	-0.04	0.919	1.11	0.982

Note:

1. Per KDB 865664 D01v01r02, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg
2. Per KDB 865664 D01v01r02, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the largest SAR to the smallest SAR among original and repeated measurement.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

13. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Head	Body-worn	Hotspot
1.	GSM 850 / 1900 Voice + 2.4GHz WLAN	Yes	Yes	
2.	GSM 850 / 1900 Voice + Bluetooth	Yes	Yes	
3.	GSM 850 / 1900 Voice + 5GHz WLAN	Yes	Yes	
4.	GPRS 850 / 1900 data + 2.4GHz WLAN	Yes	Yes	Yes
5.	GPRS 850 / 1900 data + Bluetooth	Yes	Yes	Yes
6.	GPRS 850 / 1900 data + 5.8GHz WLAN	Yes	Yes	Yes
7.	UMTS 850 / 1900 Voice + 2.4GHz WLAN	Yes	Yes	
8.	UMTS 850 / 1900 Voice + Bluetooth	Yes	Yes	
9.	UMTS 850 / 1900 Voice + 5GHz WLAN	Yes	Yes	
10.	UMTS 850 / 1900 data + 2.4GHz WLAN	Yes	Yes	Yes
11.	UMTS 850 / 1900 data + Bluetooth	Yes	Yes	Yes
12.	UMTS 850 / 1900 data + 5.8GHz WLAN	Yes	Yes	Yes
13.	GSM 850 / 1900 Voice + GPRS1900 data	Yes	Yes	
14.	GSM 850 / 1900 Voice + GPRS1900 data + 2.4GHz WLAN	Yes	Yes	
15.	GSM 850 / 1900 Voice + GPRS1900 data + Bluetooth	Yes	Yes	
16.	GSM 850 / 1900 Voice + GPRS1900 data + 5.8GHz WLAN	Yes	Yes	
17.	GPRS 850 / 1900 data + GSM 1900 Voice	Yes	Yes	
18.	GPRS 850 / 1900 data + GSM 1900 Voice + 2.4GHz WLAN	Yes	Yes	
19.	GPRS 850 / 1900 data + GSM 1900 Voice + Bluetooth	Yes	Yes	
20.	GPRS 850 / 1900 data + GSM 1900 Voice + 5.8GHz WLAN	Yes	Yes	
21.	UMTS 850 / 1900 Voice + GPRS1900 data	Yes	Yes	
22.	UMTS 850 / 1900 Voice + GPRS1900 data + 2.4GHz WLAN	Yes	Yes	
23.	UMTS 850 / 1900 Voice + GPRS1900 data + Bluetooth	Yes	Yes	
24.	UMTS 850 / 1900 Voice + GPRS1900 data + 5.8GHz WLAN	Yes	Yes	
25.	UMTS 850 / 1900 data + GSM 1900 Voice	Yes	Yes	
26.	UMTS 850 / 1900 data + GSM 1900 Voice + 2.4GHz WLAN	Yes	Yes	
27.	UMTS 850 / 1900 data + GSM 1900 Voice + Bluetooth	Yes	Yes	
28.	UMTS 850 / 1900 data + GSM 1900 Voice + 5.8GHz WLAN	Yes	Yes	

Note:

1. This device supported VoIP in GSM and WCDMA (e.g. 3rd party VoIP).
2. This device 2.4GHz WLAN supports hotspot operation, and 2.4GHz / 5.8GHz WLAN supports WiFi Direct (GC/GO), and 5.2GHz / 5.3GHz / 5.5GHz supports WiFi Direct (GC only).
3. This supports dual SIM dual active, the SIM1 for the main antenna supports GSM850 / 1900, UMTS Band 2 / 5, the SIM2 for the second antenna supports GSM1900 only, the WWAN radio can simultaneous transmission at the same time.
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 worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WiFi Direct and Hotspot capability. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.
6. The reported SAR summation is calculated based on the same configuration and test position.
7. Per KDB 447498 D01v05r01, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*), and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
   If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary
   iii) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg
8. For Head and Body-worn simultaneously analysis, since the SAR summation of 3 transmitters can cover others combination of 2 transmitters, therefore in this section did not additional to evaluate 2TX combination of simultaneously transmission.

13.1 Head Exposure Conditions

<WWAN Main + WWAN Second + WLAN DTS>

	WWAN Main		WWAN Second		WLAN DTS		Summed SAR (W/kg)
Position	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)	
Right Cheek	GSM850	0.157	GSM1900	0.102	2.4GHz Band	0.041	0.30
	GSM1900	0.111	GSM1900	0.102	2.4GHz Band	0.041	0.25
	WCDMA Band V	0.160	GSM1900	0.102	2.4GHz Band	0.041	0.30
	WCDMA Band II	0.153	GSM1900	0.102	2.4GHz Band	0.041	0.30
Right Tilted	GSM850	0.099	GSM1900	0.051	2.4GHz Band	0.020	0.17
	GSM1900	0.058	GSM1900	0.051	2.4GHz Band	0.020	0.13
	WCDMA Band V	0.099	GSM1900	0.051	2.4GHz Band	0.020	0.17
	WCDMA Band II	0.081	GSM1900	0.051	2.4GHz Band	0.020	0.15
Left Cheek	GSM850	0.155	GSM1900	0.064	2.4GHz Band	0.075	0.29
	GSM1900	0.067	GSM1900	0.064	2.4GHz Band	0.075	0.21
	WCDMA Band V	0.159	GSM1900	0.064	2.4GHz Band	0.075	0.30
	WCDMA Band II	0.092	GSM1900	0.064	2.4GHz Band	0.075	0.23
Left Tilted	GSM850	0.078	GSM1900	0.057	2.4GHz Band	0.020	0.16
	GSM1900	0.061	GSM1900	0.057	2.4GHz Band	0.020	0.14
	WCDMA Band V	0.081	GSM1900	0.057	2.4GHz Band	0.020	0.16
	WCDMA Band II	0.087	GSM1900	0.057	2.4GHz Band	0.020	0.16

<WWAN Main + WWAN Second + WLAN NII>

	WWAN Main		WWAN Second		WLAN NII		Summed SAR (W/kg)
Position	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)	
Right Cheek	GSM850	0.157	GSM1900	0.102	5.5GHz Band	0.029	0.29
	GSM1900	0.111	GSM1900	0.102	5.5GHz Band	0.029	0.24
	WCDMA Band V	0.160	GSM1900	0.102	5.5GHz Band	0.029	0.29
	WCDMA Band II	0.153	GSM1900	0.102	5.5GHz Band	0.029	0.28
Right Tilted	GSM850	0.099	GSM1900	0.051	5.5GHz Band	0.013	0.16
	GSM1900	0.058	GSM1900	0.051	5.5GHz Band	0.013	0.12
	WCDMA Band V	0.099	GSM1900	0.051	5.5GHz Band	0.013	0.16
	WCDMA Band II	0.081	GSM1900	0.051	5.5GHz Band	0.013	0.15
Left Cheek	GSM850	0.155	GSM1900	0.064	5.5GHz Band	0.038	0.26
	GSM1900	0.067	GSM1900	0.064	5.5GHz Band	0.038	0.17
	WCDMA Band V	0.159	GSM1900	0.064	5.5GHz Band	0.038	0.26
	WCDMA Band II	0.092	GSM1900	0.064	5.5GHz Band	0.038	0.19
Left Tilted	GSM850	0.078	GSM1900	0.057	5.5GHz Band	0.014	0.15
	GSM1900	0.061	GSM1900	0.057	5.5GHz Band	0.014	0.13
	WCDMA Band V	0.081	GSM1900	0.057	5.5GHz Band	0.014	0.15
	WCDMA Band II	0.087	GSM1900	0.057	5.5GHz Band	0.014	0.16

<WWAN Main + WWAN Second + Bluetooth DSS>

	WWAN Main		WWAN Second		Bluetooth	Summed SAR (W/kg)
Position	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	SAR (W/kg)	
Right Cheek	GSM850	0.157	GSM1900	0.102	0.008	0.27
	GSM1900	0.111	GSM1900	0.102	0.008	0.22
	WCDMA Band V	0.160	GSM1900	0.102	0.008	0.27
	WCDMA Band II	0.153	GSM1900	0.102	0.008	0.26
Right Tilted	GSM850	0.099	GSM1900	0.051	0.002	0.15
	GSM1900	0.058	GSM1900	0.051	0.002	0.11
	WCDMA Band V	0.099	GSM1900	0.051	0.002	0.15
	WCDMA Band II	0.081	GSM1900	0.051	0.002	0.13
Left Cheek	GSM850	0.155	GSM1900	0.064	0.010	0.23
	GSM1900	0.067	GSM1900	0.064	0.010	0.14
	WCDMA Band V	0.159	GSM1900	0.064	0.010	0.23
	WCDMA Band II	0.092	GSM1900	0.064	0.010	0.17
Left Tilted	GSM850	0.078	GSM1900	0.057	0.004	0.14
	GSM1900	0.061	GSM1900	0.057	0.004	0.12
	WCDMA Band V	0.081	GSM1900	0.057	0.004	0.14
	WCDMA Band II	0.087	GSM1900	0.057	0.004	0.15

13.2 Hotspot Exposure Conditions

<WWAN Main + WLAN DTS>

	WWAN Main		WLAN DTS		Summed SAR (W/kg)
Position	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)	
Front	GSM850	0.299	2.4GHz Band	0.034	0.33
	GSM1900	0.338	2.4GHz Band	0.034	0.37
	WCDMA Band V	0.263	2.4GHz Band	0.034	0.30
	WCDMA Band II	0.532	2.4GHz Band	0.034	0.57
Back	GSM850	0.649	2.4GHz Band	0.204	0.85
	GSM1900	0.705	2.4GHz Band	0.204	0.91
	WCDMA Band V	0.552	2.4GHz Band	0.204	0.76
	WCDMA Band II	1.091	2.4GHz Band	0.204	1.30
Left Side	GSM850		2.4GHz Band	0.074	0.07
	GSM1900		2.4GHz Band	0.074	0.07
	WCDMA Band V		2.4GHz Band	0.074	0.07
	WCDMA Band II		2.4GHz Band	0.074	0.07
Right Side	GSM850	0.244	2.4GHz Band		0.24
	GSM1900	0.188	2.4GHz Band		0.19
	WCDMA Band V	0.256	2.4GHz Band		0.26
	WCDMA Band II	0.297	2.4GHz Band		0.30
Bottom Side	GSM850	0.451	2.4GHz Band		0.45
	GSM1900	0.504	2.4GHz Band		0.50
	WCDMA Band V	0.408	2.4GHz Band		0.41
	WCDMA Band II	0.798	2.4GHz Band		0.80

<WWAN Second + WLAN DTS>

	WWAN Second		WLAN DTS		Summed SAR (W/kg)
Position	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)	
Front	GSM1900	0.147	2.4GHz Band	0.034	0.18
Back	GSM1900	0.540	2.4GHz Band	0.204	0.74
Left Side	GSM1900	0.069	2.4GHz Band	0.074	0.14
Bottom Side	GSM1900	0.266	2.4GHz Band		0.27

<WWAN Main + Bluetooth DSS>

Position	WWAN Main		Bluetooth	Summed SAR (W/kg)
	WWAN Band	SAR (W/kg)	SAR (W/kg)	
Front	GSM850	0.299	0.006	0.31
	GSM1900	0.338	0.006	0.34
	WCDMA Band V	0.263	0.006	0.27
	WCDMA Band II	0.532	0.006	0.54
Back	GSM850	0.649	0.023	0.67
	GSM1900	0.705	0.023	0.73
	WCDMA Band V	0.552	0.023	0.58
	WCDMA Band II	1.091	0.023	1.11
Left Side	GSM850		0.011	0.01
	GSM1900		0.011	0.01
	WCDMA Band V		0.011	0.01
	WCDMA Band II		0.011	0.01
Right Side	GSM850	0.244		0.24
	GSM1900	0.188		0.19
	WCDMA Band V	0.256		0.26
	WCDMA Band II	0.297		0.30
Bottom Side	GSM850	0.451		0.45
	GSM1900	0.504		0.50
	WCDMA Band V	0.408		0.41
	WCDMA Band II	0.798		0.80

<WWAN Second + Bluetooth DSS>

Position	WWAN Second		Bluetooth	Summed SAR (W/kg)
	WWAN Band	SAR (W/kg)	SAR (W/kg)	
Front	GSM1900	0.147	0.006	0.15
Back	GSM1900	0.540	0.023	0.56
Left Side	GSM1900	0.069	0.011	0.08
Bottom Side	GSM1900	0.266		0.27

13.3 Body-Worn Exposure Conditions

<WWAN Main + WWAN Second + WLAN DTS>

Position	WWAN Main		WWAN Second		WLAN DTS		Summed SAR (W/kg)	SPLSR	Case No
	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)			
Front	GSM850	0.299	GSM1900	0.147	2.4GHz Band	0.034	0.48		
	GSM1900	0.338	GSM1900	0.147	2.4GHz Band	0.034	0.52		
	WCDMA Band V	0.263	GSM1900	0.147	2.4GHz Band	0.034	0.44		
	WCDMA Band II	0.532	GSM1900	0.147	2.4GHz Band	0.034	0.71		
Back	GSM850	0.649	GSM1900	0.540	2.4GHz Band	0.204	1.39		
	GSM1900	0.705	GSM1900	0.540	2.4GHz Band	0.204	**1.45**		
	WCDMA Band V	0.552	GSM1900	0.540	2.4GHz Band	0.204	1.30		
	WCDMA Band II	1.091	GSM1900	0.540	2.4GHz Band	0.204	**1.84**	0.04	#1

<WWAN Main + WWAN Second + WLAN NII>

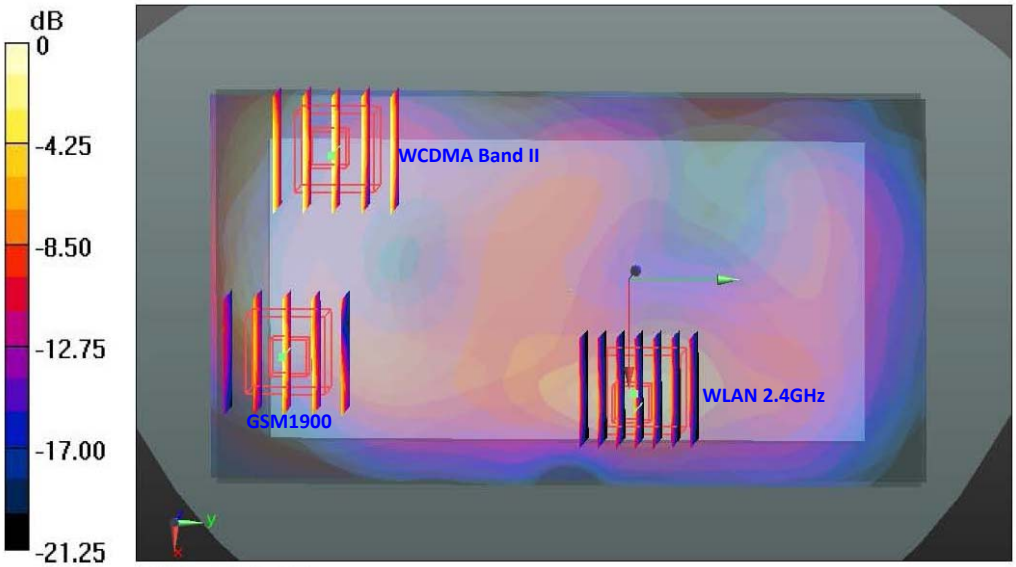
Position	WWAN Main		WWAN Second		WLAN NII		Summed SAR (W/kg)	SPLSR	Case No
	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	WLAN Band	SAR (W/kg)			
Front	GSM850	0.299	GSM1900	0.147	5.5GHz Band	0.023	0.47		
	GSM1900	0.338	GSM1900	0.147	5.5GHz Band	0.023	0.51		
	WCDMA Band V	0.263	GSM1900	0.147	5.5GHz Band	0.023	0.43		
	WCDMA Band II	0.532	GSM1900	0.147	5.5GHz Band	0.023	0.70		
Back	GSM850	0.649	GSM1900	0.540	5.5GHz Band	0.150	1.34		
	GSM1900	0.705	GSM1900	0.540	5.5GHz Band	0.150	**1.40**		
	WCDMA Band V	0.552	GSM1900	0.540	5.5GHz Band	0.150	1.24		
	WCDMA Band II	1.091	GSM1900	0.540	5.5GHz Band	0.150	**1.78**	0.04	#2

<WWAN Main + WWAN Second + Bluetooth DSS>

Position	WWAN Main		WWAN Second		Bluetooth	Summed SAR (W/kg)	SPLSR	Case No
	WWAN Band	SAR (W/kg)	WWAN Band	SAR (W/kg)	SAR (W/kg)			
Front	GSM850	0.299	GSM1900	0.147	0.006	0.45		
	GSM1900	0.338	GSM1900	0.147	0.006	0.49		
	WCDMA Band V	0.263	GSM1900	0.147	0.006	0.42		
	WCDMA Band II	0.532	GSM1900	0.147	0.006	0.69		
Back	GSM850	0.649	GSM1900	0.540	0.023	1.21		
	GSM1900	0.705	GSM1900	0.540	0.023	**1.27**		
	WCDMA Band V	0.552	GSM1900	0.540	0.023	1.12		
	WCDMA Band II	1.091	GSM1900	0.540	0.023	**1.65**	0.04	#3

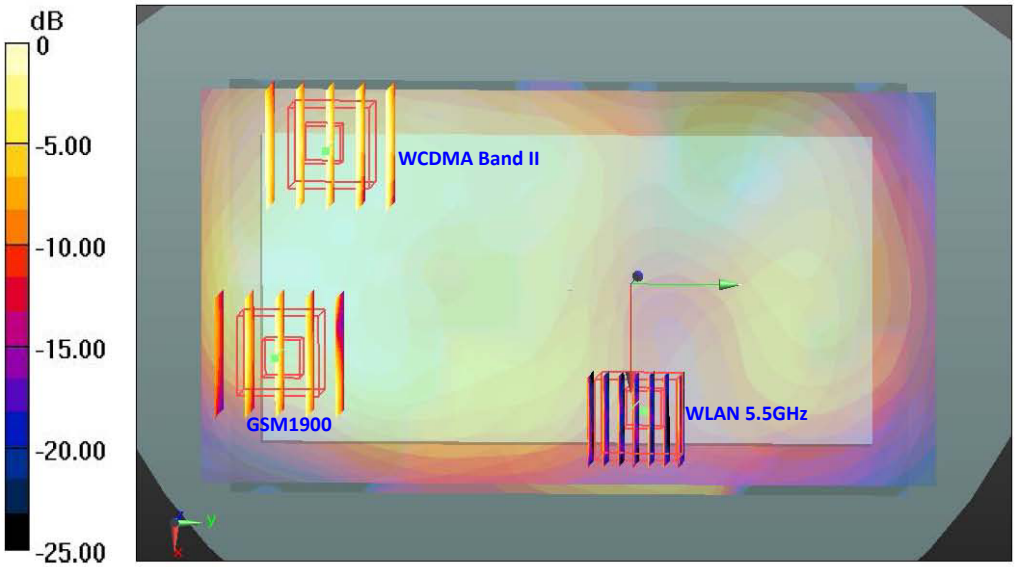
13.4 SPLSR Evaluation and Analysis

Case No #1 Position	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	57.1	1.63	0.04	Not required
	GSM1900	0.540	1	0.0025	-0.078	-0.205				
	GSM1900	0.540	1	0.0025	-0.078	-0.205	97.1	0.74	0.01	Not required
	WLAN 2.4GHz	0.204	1	0.0168	0.018	-0.205				
	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	108.1	1.30	0.01	Not required
	WLAN 2.4GHz	0.204	1	0.0168	0.018	-0.205				



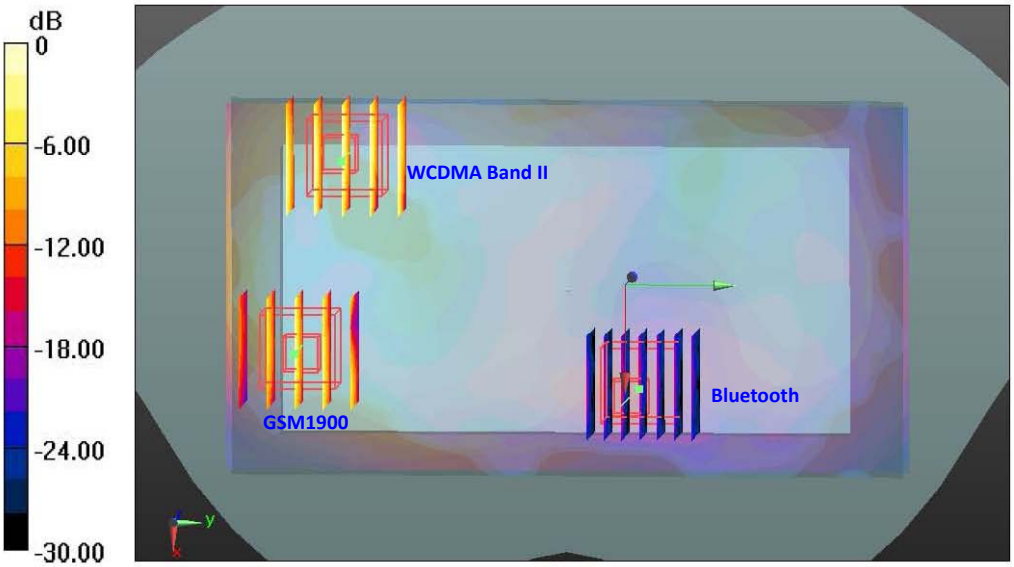
0 dB = 0.717 W/kg

Case No #2 Position	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	57.1	1.63	0.04	Not required
	GSM1900	0.540	1	0.0025	-0.078	-0.205				
	GSM1900	0.540	1	0.0025	-0.078	-0.205	95.8	0.69	0.01	Not required
	WLAN 5.5GHz	0.150	1	0.015	0.017	-0.206				
	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	106.1	1.24	0.01	Not required
	WLAN 5.5GHz	0.150	1	0.015	0.017	-0.206				



0 dB = 0.346 W/kg

Case No #3 Position	Band	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Pair SAR sum (W/kg)	SPLSR	Simultaneous SAR
				X	Y	Z				
Back	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	57.1	1.63	0.04	Not required
	GSM1900	0.540	1	0.0025	-0.078	-0.205				
	GSM1900	0.540	1	0.0025	-0.078	-0.205	94.5	0.56	0.00	Not required
	Bluetooth	0.023	1	0.0168	0.0154	-0.205				
	WCDMA Band II	1.091	1	-0.053	-0.0645	-0.206	106.1	1.11	0.01	Not required
	Bluetooth	0.023	1	0.0168	0.0154	-0.205				



0 dB = 0.717 W/kg

Remark:

1. Per KDB 447498 D01v05r01, SAR test exclusion is determined by the SAR to peak location separation ratio, SPLSR.
2. If SPLSR ≤ 0.04, simultaneously transmission SAR is not necessary.

Test Engineer： Luke Lu

14. 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 14.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	1/√3	1/√6	1/√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 14.1. 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 Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.0	Normal	1	1	1	± 6.0 %	± 6.0 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Test Sample Related							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
Phantom and Setup							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
Combined Standard Uncertainty						± 11.0 %	± 10.8 %
Coverage Factor for 95 %						K=2	
Expanded Uncertainty						**± 22.0 %**	**± 21.5 %**

Table 14.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.55	Normal	1	1	1	± 6.55 %	± 6.55 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Probe Positioning	9.9	Rectangular	√3	1	1	± 5.7 %	± 5.7 %
Max. SAR Eval.	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Test Sample Related							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
Phantom and Setup							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
Combined Standard Uncertainty						± 12.8 %	± 12.6 %
Coverage Factor for 95 %						K=2	
Expanded Uncertainty						**± 25.6 %**	**± 25.2 %**

Table 14.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

15. 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. 1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, December 2003

[4] SPEAG DASY System Handbook

[5] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007

[6] FCC KDB 447498 D01 v05r01, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, May 2013

[7] FCC KDB 648474 D04 v01r01r02, “SAR Evaluation Considerations for Wireless Handsets”, Dec 2013

[8] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008

[9] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007

[10] FCC KDB 941225 D02 v02r02, “SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced”, May 2013.

[11] FCC KDB 941225 D06 v01r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", May 2013

[12] FCC KDB 865664 D01 v01r02, "SAR Measurement Requirements for 100 MHz to 6 GHz", Dec 2013.

[13] FCC KDB 865664 D02 v01r01, “RF Exposure Compliance Reporting and Documentation Considerations”, May 2013

[14] October 2013 TCB workshop notes (GSM/GPRS/EDGE SAR testing criteria)

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Appendix B. Plots of SAR Measurement

The plots are shown as follows.

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.