FCC SAR Test Report

APPLICANT	:	**FUJITSU LIMITED**
EQUIPMENT	:	**Mobile Phone**
BRAND NAME	:	**FUJITSU**
MODEL NAME	:	**F-01F**
FCC ID	:	**VQK-F01F**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)**
		ANSI/IEEE C95.1-1992
		IEEE 1528-2003
Date of Start Test	:	**Aug. 24, 2013**
Date of End Test	:	**Sep. 01, 2013**

The product was completely tested on Sep. 01, 2013. We, SPORTON INTERNATIONAL 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 INC., the test report shall not be reproduced except in full.

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Reviewed by: Eric Huang / Deputy Manager

_____
Approved by: Jones Tsai / Manager

ilac-MRA

TAF
Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
No. 52, Hwa Ya 1ˢᵗ Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

SPORTON INTERNATIONAL INC.
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FCC ID : VQK-F01F

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA370119	Rev. 01	Initial issue of report	Sep. 06, 2013

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1. *Statement of Compliance*

The maximum results of Specific Absorption Rate (SAR) found during testing for **FUJITSU LIMITED Mobile Phone, FUJITSU** are as follows.

<Highest SAR Summary>

Exposure Position	Frequency Band	Reported 1g-SAR (W/kg)	Equipment Class	Highest Reported 1g-SAR (W/kg)
Head	GSM850	0.51	PCE	0.54
	GSM1900	0.54		
	WCDMA Band V	0.49		
	WLAN 5.2GHz Band	0.65	NII	0.80
	WLAN 5.3GHz Band	0.63		
	WLAN 5.5GHz Band	0.80		
	WLAN 2.4GHz Band	0.29	DTS	0.29
Hotspot (Separation 1cm)	GPRS850	0.68	PCE	0.68
	GPRS1900	0.66		
	WCDMA Band V	0.52		
	WLAN 2.4GHz Band	0.06	DTS	0.06
Body-worn (Separation 1cm)	GPRS850	0.60	PCE	0.60
	GPRS1900	0.60		
	WCDMA Band V	0.52		
	WLAN 5.2GHz Band	0.08	NII	0.14
	WLAN 5.3GHz Band	0.08		
	WLAN 5.5GHz Band	0.14		
	WLAN 2.4GHz Band	0.06	DTS	0.06

<Highest Simultaneous transmission SAR>

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM850	PCE	Head	0.79
WLAN 2.4GHz Band	DTS		

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM850	PCE	Head	1.30
WLAN 5.5GHz Band	NII		

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM850	PCE	Hotspot	0.81
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.

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2. *Administration Data*

2.1 *Testing Laboratory*

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

2.2 *Applicant*

Company Name	FUJITSU LIMITED
Address	1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki 211-8588, Japan

2.3 *Manufacturer*

Company Name	FUJITSU LIMITED
Address	1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki 211-8588, Japan

2.4 *Application Details*

Date of Start during the Test	Aug. 24, 2013
Date of End during the Test	Sep. 01, 2013

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3. *General Information*

3.1 *Description of Equipment Under Test (EUT)*

Product Feature & Specification	
EUT	Mobile Phone
Brand Name	FUJITSU
Model Name	F-01F
FCC ID	VQK-F01F
IMEI Code	Sample for WWAN SAR testing: 357611050020919 Sample for WLAN 2.4GHz SAR testing: 357611050023293 Sample for WLAN 5GHz SAR testing: 357611050021396
Tx Frequency	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz RFID: 13.56 MHz
Uplink Modulations	GSM / GPRS: GMSK WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK 802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac: OFDM (BPSK / QPSK / 16QAM / 64QAM/ 256QAM) Bluetooth: GFSK Bluetooth +EDR: π/4-DQPSK, 8-DPSK Bluetooth v4.0+LE: GFSK NFC : ASK RFID: ASK
Antenna Type	WWAN: λ/4 Monopole Antenna WLAN: λ/4 Monopole Antenna Bluetooth: λ/4 Monopole Antenna NFC: Loop Antenna RFID: Loop Antenna
HW Version	V2.1.0
SW Version	R19.8e
Dual Transfer Mode Category	Class A – EUT can support Packet Switched and Circuit Switched Network simultaneously.
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.
4. This device supports DTM operation up to multi-slot class 11 and GPRS up to multi-slot class 33.
5. IEEE 802.11ac standard is still "Draft" version.

3.2 Maximum RF output power among production units

Mode		Burst Average Power (dBm)	
		GSM 850	GSM 1900
GSM (GMSK, 1 Tx slot)		33.0	31.0
GPRS (GMSK, 1 Tx slot)		33.0	31.0
GPRS (GMSK, 2 Tx slots)		31.0	29.0
GPRS (GMSK, 3 Tx slots)		30.0	27.0
GPRS (GMSK, 4 Tx slots)		27.0	26.0
DTM5(2Txslots)	GSM (GMSK, 1 Tx slot)	31.0	29.0
	GPRS (GMSK, 1 Tx slot)	31.0	29.0
DTM9(2Txslots)	GSM (GMSK, 1 Tx slot)	31.0	29.0
	GPRS (GMSK, 1 Tx slot)	31.0	29.0
DTM11(3Txslots)	GSM (GMSK, 1 Tx slot)	30.0	27.0
	GPRS (GMSK, 2 Tx slots)	30.0	27.0

Mode	Average Power (dBm)
	WCDMA Band V
AMR 12.2K	25.0
RMC 12.2K	25.0
HSDPA Subtest-1	24.0
HSUPA Subtest-5	24.0

Mode	Average Power(dBm)
WLAN 2.4GHz 802.11b	14.5
WLAN 2.4GHz 802.11g	14.0
WLAN 2.4GHz 802.11n-HT20	13.0
WLAN 5GHz 802.11a	15.0
WLAN 5GHz 802.11n-HT20	14.0
WLAN 5GHz 802.11n-HT40	14.0
WLAN 5GHz 802.11ac-VHT20	14.0
WLAN 5GHz 802.11ac-VHT40	13.0
WLAN 5GHz 802.11ac-VHT80	12.5

Mode	Average Power(dBm)
Bluetooth BDR (1Mbps)	8.0
Bluetooth EDR (2Mbps)	8.0
Bluetooth EDR (3Mbps)	8.0
Bluetooth 4.0	2.0

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 v01r01
- FCC KDB 447498 D01 v05r01
- FCC KDB 648474 D04 v01r01
- FCC KDB 248227 D01 v01r02
- FCC KDB 644545 D01 v01r01
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D02 v02r02
- FCC KDB 941225 D03 v01
- FCC KDB 941225 D04 v01
- FCC KDB 941225 D06 v01r01

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

Ambient Condition

Ambient Temperature	20 to 24 ℃
Humidity	< 60 %

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.

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool, and the transmission duty factor was monitored on the spectrum analyzer with zero-span setting
Duty factor observed as below:

  802.11b, 1Mbps: 98.28%

  802.11a, 6Mbps: 88.94%

  802.11ac-VHT80, MCS0: 57.56%

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

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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:

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

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

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

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

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

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

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

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

5. SAR Measurement System
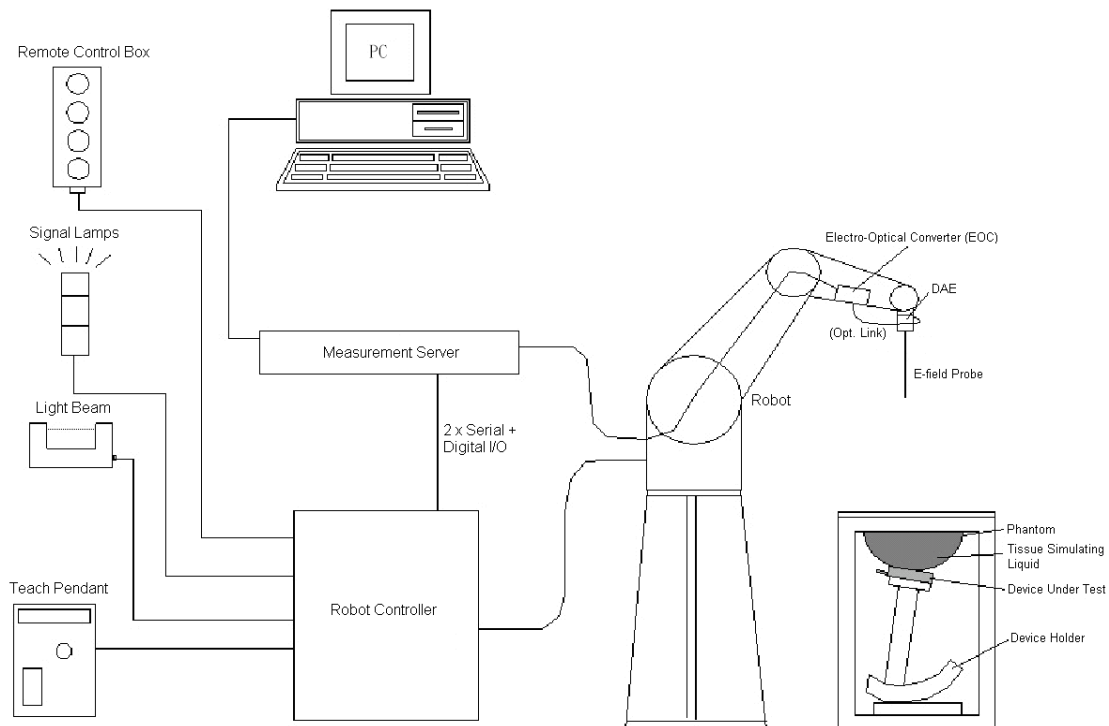
Fig 5.1 SPEAG DASY System Configurations

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.

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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

<ES3DV3 Probe >

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 10 mm) Tip diameter: 4 mm (Body: 10 mm) Distance from probe tip to dipole centers: 3 mm

Fig 5.2　Photo of ES3DV3

<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
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

Fig 5.3　Photo of EX3DV4/ES3DV4

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.

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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 5.4   Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; 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)
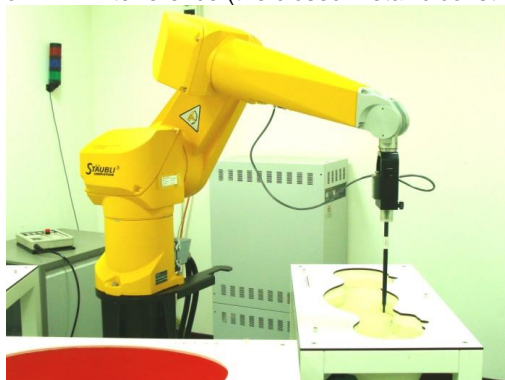
Fig 5.5   Photo of DASY4

Fig 5.6   Photo of DASY5

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, 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 5.7   Photo of Server for DASY4

Fig 5.8   Photo of Server for DASY5

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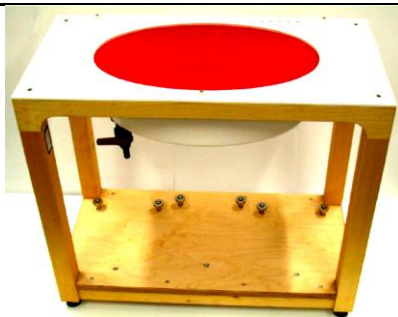
5.5 *Phantom*

<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 5.9 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.

<ELI4 Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	
		Fig 5.10 Photo of ELI4 Phantom

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

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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 5.11   Device Holder

<Laptop Extension Kit>

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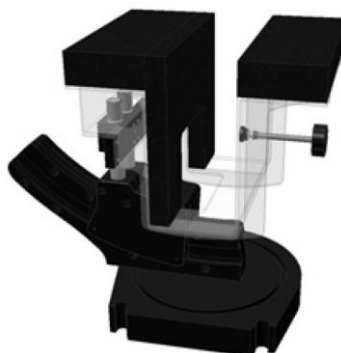

Fig 5.12   Laptop Extension Kit

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.

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The formula for each channel can be given as：

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

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：

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

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

with V_i = compensated signal of channel i, (i = x, y, z)
            $Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ 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)：

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

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

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

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	499	Mar. 18, 2013	Mar. 17, 2014
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 20, 2013	Mar. 19, 2014
SPEAG	2450MHz System Validation Kit	D2450V2	869	Jun. 11, 2013	Jun. 10, 2014
SPEAG	5GHz System Validation Kit	D5GHzV2	1128	Jul. 24, 2013	Jul. 23, 2014
SPEAG	Data Acquisition Electronics	DAE4	914	Jan. 16, 2013	Jan. 15, 2014
SPEAG	Data Acquisition Electronics	DAE3	495	May. 08, 2013	May. 07, 2014
SPEAG	Data Acquisition Electronics	DAE4	1338	May. 28, 2013	May. 27, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3792	Jun. 04, 2013	Jun. 03, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	Jun. 12, 2013	Jun. 11, 2014
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 28, 2012	Sep. 27, 2013
Wisewind	Thermometer	ETP-101	TM560	Nov. 13, 2012	Nov. 12, 2013
Wisewind	Thermometer	ETP-101	TM685	Nov. 13, 2012	Nov. 12, 2013
H.M.IRIS	Thermometer	TH-08	TM658	Nov. 13, 2012	Nov. 12, 2013
Agilent	Wireless Communication Test Set	E5515C	MY50264370	Apr. 30, 2013	Apr. 29, 2015
Agilent	Wireless Communication Test Set	E5515C	MY50266977	May. 06, 2013	May. 05, 2015
SPEAG	Device Holder	N/A	N/A	NCR	NCR
Agilent	ESG Vector Series Signal Generator	E4438C	MY49070755	Oct. 02, 2012	Oct. 01, 2013
Agilent	ENA Network Analyzer	E5071C	MY46316648	Feb. 07, 2013	Feb. 06, 2014
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 23, 2013	Jul. 22, 2014
Anritsu	Power Meter	ML2495A	1218006	Oct. 22, 2012	Oct. 21, 2013
Anritsu	Power Sensor	MA2411B	1207363	Oct. 24, 2012	Oct. 23, 2013
Agilent	Dual Directional Coupler	778D	50422	Note 2	
Woken	Attenuator 1	WK0602-XX	N/A	Note 2	
PE	Attenuator 2	PE7005-10	N/A	Note 2	
PE	Attenuator 3	PE7005- 3	N/A	Note 2	
AR	Power Amplifier	5S1G4M2	328767	Note 3	
R&S	Spectrum Analyzer	FSP 7	101131	Jul. 09, 2013	Jul. 08, 2014

Table 5.1 Test Equipment List

Note:
1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. 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
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.

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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								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7

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 an SPEAG DAK-3.5 Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Frequency (MHz)	Liquid Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
835	Head	22.3	0.890	41.011	0.90	41.50	-1.11	-1.18	±5	Aug. 27, 2013
835	Head	22.7	0.924	40.958	0.90	41.50	2.67	-1.31	±5	Aug. 29, 2013
835	Body	22.5	0.963	54.541	0.97	55.20	-0.72	-1.19	±5	Aug. 28, 2013
835	Body	22.5	0.960	54.539	0.97	55.20	-1.03	-1.20	±5	Aug. 29, 2013
835	Body	22.6	0.976	52.883	0.97	55.20	0.62	-4.20	±5	Aug. 30, 2013
1900	Head	22.3	1.436	41.250	1.40	40.00	2.57	3.13	±5	Aug. 27, 2013
1900	Body	22.4	1.517	53.129	1.52	53.30	-0.20	-0.32	±5	Aug. 24, 2013
2450	Head	22.7	1.842	38.618	1.80	39.20	2.33	-1.48	±5	Aug. 30, 2013
2450	Body	22.8	1.975	52.379	1.95	52.70	1.28	-0.61	±5	Aug. 30, 2013
5200	Head	22.5	4.513	37.508	4.66	36.00	-3.15	4.19	±5	Aug. 30, 2013
5200	Body	22.6	5.297	49.185	5.30	49.00	-0.06	0.38	±5	Sep. 01, 2013
5300	Head	22.5	4.615	37.369	4.76	35.87	-3.05	4.18	±5	Aug. 30, 2013
5300	Body	22.6	5.439	48.992	5.42	48.88	0.35	0.23	±5	Sep. 01, 2013
5600	Head	22.5	4.912	36.936	5.06	35.53	-2.92	3.96	±5	Aug. 30, 2013
5600	Body	22.6	5.872	48.306	5.77	48.47	1.77	-0.34	±5	Sep. 01, 2013

Table 6.2 Measuring Results for Simulating Liquid

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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:
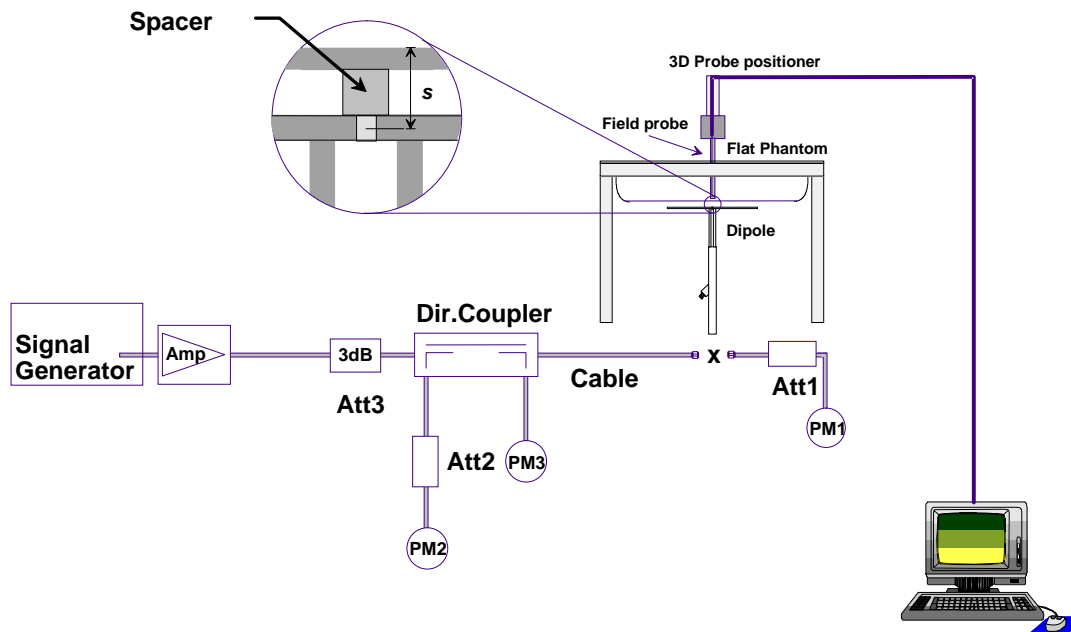
Fig 7.1 System Setup for System Evaluation

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)	Liquid Type	Power fed onto reference dipole (mW)	Targeted SAR (W/kg)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
Aug. 27, 2013	835	Head	250	9.57	2.49	9.96	4.08
Aug. 29, 2013	835	Head	250	9.57	2.58	10.32	7.84
Aug. 28, 2013	835	Body	250	9.63	2.40	9.60	-0.31
Aug. 29, 2013	835	Body	250	9.63	2.32	9.28	-3.63
Aug. 30, 2013	835	Body	250	9.63	2.32	9.28	-3.63
Aug. 27, 2013	1900	Head	250	40.6	9.60	38.40	-5.42
Aug. 24, 2013	1900	Body	250	40.8	9.54	38.16	-6.47
Aug. 30, 2013	2450	Head	250	53.8	13.20	52.80	-1.86
Aug. 30, 2013	2450	Body	250	51.5	12.80	51.20	-0.58
Aug. 30, 2013	5200	Head	100	78.2	7.57	75.70	-3.20
Sep. 01, 2013	5200	Body	100	73.4	7.41	74.10	0.95
Aug. 30, 2013	5300	Head	100	80.6	8.49	84.90	5.33
Sep. 01, 2013	5300	Body	100	74.3	7.35	73.50	-1.08
Aug. 30, 2013	5600	Head	100	80.5	8.22	82.20	2.11
Sep. 01, 2013	5600	Body	100	77.8	7.92	79.20	1.80

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.
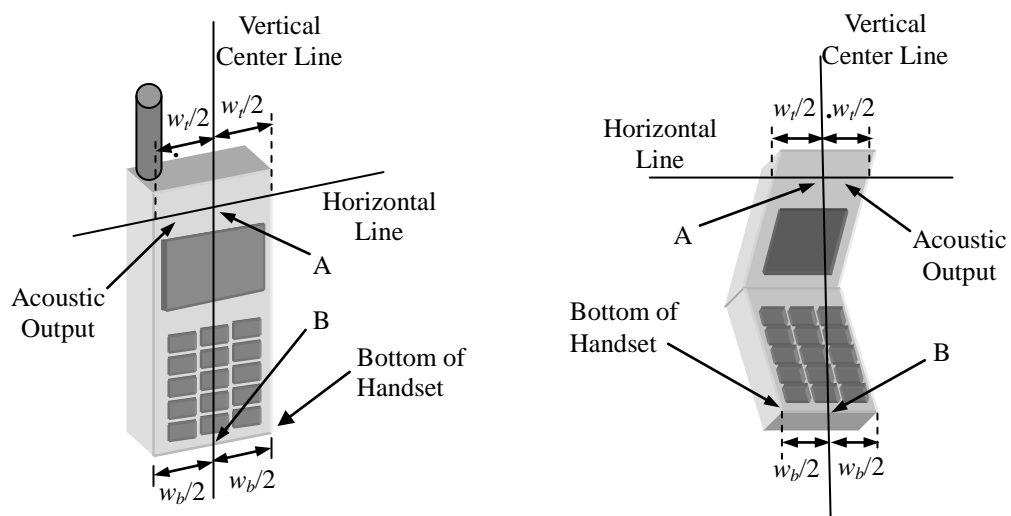
Fig 8.1   Illustration for Handset Vertical and Horizontal Reference Lines

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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).
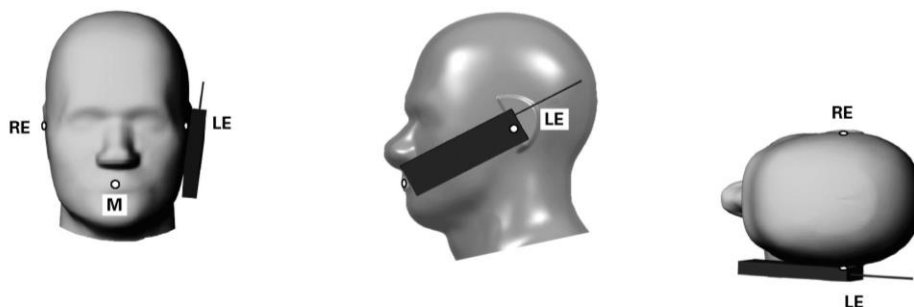
Fig 8.2   Illustration for Cheek Position

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).
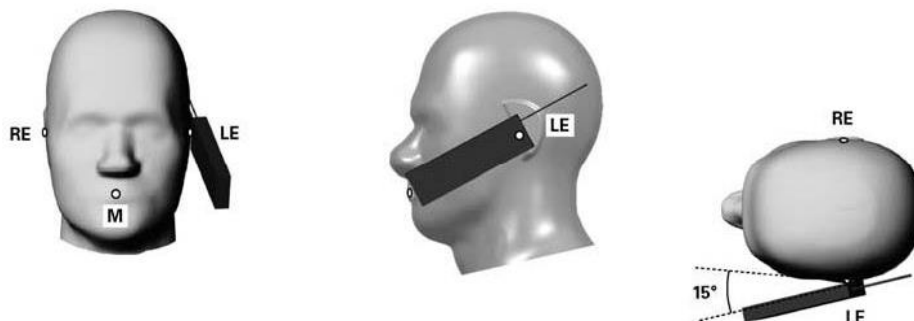
Fig 8.3   Illustration for Tilted Position

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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.
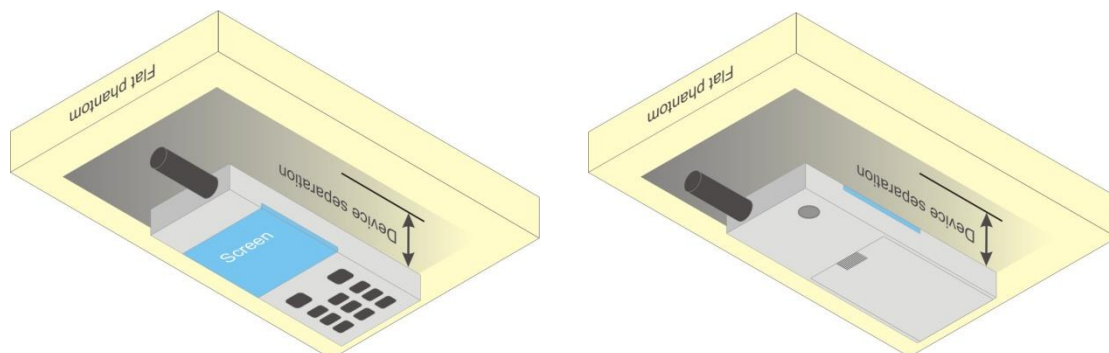
Fig 8.4   Illustration for Body Worn Position

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 1.0cm.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

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9. *Measurement Procedures*

The measurement procedures are as follows:

<u>Conducted power measurement</u>
(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

<u>SAR measurement</u>
(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 D01v01r01 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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30° \pm 1°$	$20° \pm 1°$
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 $\leq$ 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
	graded grid — $\Delta z_{Zoom}(n>1)$: 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.

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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>

Note:
1. Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. The EUT support DTM function.
3. For DTM multi-slot class mode, the device was linked with base station simulator (Agilent E5515C) and transmit maximum power on maximum number of TX slots, i.e. one CS timeslot, and additional PS timeslots (1 for DTM class 5 and 9, 2 for DTM class 11) in one TDMA frame.
4. Agilent E5515C was used to setup the device operated under DTM mode for power measurement and SAR testing. For conducted power, the power of the burst for voice and the power of the bursts for data was reported separately in the table above, and the frame-average power is derived below to determine SAR testing.

$$DTM\ frame\ average\ power\ (dBm) = 10*log\ [\textstyle\sum(power\ of\ each\ slot,\ in\ mW)/8]$$

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)		32.47	32.64	32.52	33.00	23.47	23.64	23.52	24.00
GPRS (GMSK, 1 Tx slot) – CS1		32.46	32.63	32.51	33.00	23.46	23.63	23.51	24.00
GPRS (GMSK, 2 Tx slots) – CS1		30.57	30.71	30.69	31.00	24.57	24.71	24.69	25.00
GPRS (GMSK, 3 Tx slots) – CS1		29.34	29.45	29.36	30.00	25.08	25.19	25.10	25.74
GPRS (GMSK, 4 Tx slots) – CS1		26.81	26.86	26.83	27.00	23.81	23.86	23.83	24.00
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	30.76	30.88	30.85	31.00	24.71	24.83	24.80	24.98
	GPRS (GMSK, 1 Tx slot) – CS1	30.70	30.82	30.80	31.00				
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	30.75	30.87	30.85	31.00	24.71	24.82	24.80	24.98
	GPRS (GMSK, 1 Tx slot) – CS1	30.71	30.81	30.79	31.00				
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	29.33	29.42	29.35	30.00	25.02	25.10	25.04	25.74
	GPRS (GMSK, 2 Tx slots) – CS1	29.25	29.33	29.28	30.00				

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
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

Note:
1. For Head and Body-worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM850 due to its highest frame-average power.
2. For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in GPRS 3 Tx slots for GSM850 due to its highest frame-average power.

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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)		30.18	30.14	30.10	31.00	21.18	21.14	21.10	22.00
GPRS (GMSK, 1 Tx slot) – CS1		30.17	30.13	30.09	31.00	21.17	21.13	21.09	22.00
GPRS (GMSK, 2 Tx slots) – CS1		28.19	28.08	28.04	29.00	22.19	22.08	22.04	23.00
GPRS (GMSK, 3 Tx slots) – CS1		26.66	26.61	26.57	27.00	22.40	22.35	22.31	22.74
GPRS (GMSK, 4 Tx slots) – CS1		25.63	25.55	25.43	26.00	22.63	22.55	22.43	23.00
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.17	28.14	28.10	29.00	22.17	22.11	22.07	22.98
	GPRS (GMSK, 1 Tx slot) – CS1	28.21	28.12	28.09	29.00				
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.21	28.17	28.09	29.00	22.18	22.13	22.06	22.98
	GPRS (GMSK, 1 Tx slot) – CS1	28.20	28.13	28.08	29.00				
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	26.65	26.60	26.57	27.00	22.36	22.33	22.27	22.74
	GPRS (GMSK, 2 Tx slots) – CS1	26.60	26.58	26.51	27.00				

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
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

Note:

1. For Head and Body-worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 11 for GSM850 due to its highest frame-average power.
2. For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in GPRS 4 Tx slots for GSM850 due to its highest frame-average power.

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<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 $\beta_{hs} = 30/15 * \beta_c$.

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

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

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

Setup Configuration

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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 $\beta_{hs} = 30/15 * \beta_c$.

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

<u>**<WCDMA Conducted Power>**</u>

Note:
1.   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.
2.   Per KDB 941225 D02v02r02, If HSDPA/HSUPA output power is < 0.25dB higher than RMC12.2Kbps, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.

Band			WCDMA V			Tune-up Limit (dBm)
TX Channel			4132	4182	4233	
Frequency (MHz)			826.4	836.4	846.6	
3GPP MPR (dB)	3GPP Rel 99	AMR 12.2Kbps	24.46	24.30	24.74	25.00
	3GPP Rel 99	RMC 12.2Kbps	24.49	24.32	24.76	25.00
0	3GPP Rel 6	HSDPA Subtest-1	23.51	23.34	23.75	24.00
0	3GPP Rel 6	HSDPA Subtest-2	23.50	23.32	23.68	24.00
0.5	3GPP Rel 6	HSDPA Subtest-3	22.79	22.66	23.05	23.50
0.5	3GPP Rel 6	HSDPA Subtest-4	22.75	22.61	23.03	23.50
0	3GPP Rel 6	HSUPA Subtest-1	23.49	23.34	23.66	24.00
2	3GPP Rel 6	HSUPA Subtest-2	22.52	22.24	22.71	23.00
1	3GPP Rel 6	HSUPA Subtest-3	22.33	22.12	22.60	23.00
2	3GPP Rel 6	HSUPA Subtest-4	22.83	22.59	22.95	23.00
0	3GPP Rel 6	HSUPA Subtest-5	23.61	23.50	23.68	24.00

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<WLAN 2.4GHz Conducted Power>

WLAN 2.4GHz 802.11b Average Power (dBm)							Tune up Limit (dBm)
Power vs. Channel			Power vs. Data Rate				
Channel	Frequency (MHz)	Data Rate	Channel	2Mbps	5.5Mbps	11Mbps	
		1Mbps					
CH 1	2412	14.16					
CH 6	2437	13.82	CH 1	14.15	14.13	14.12	14.5
CH 11	2462	13.25					

WLAN 2.4GHz 802.11g Average Power (dBm)										Tune up limit (dBm)
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	Data Rate	Channel	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps	
		6Mbps									
CH 1	2412	13.26									
CH 6	2437	12.72	CH 1	13.25	13.23	13.21	13.21	13.19	13.18	13.16	14.0
CH 11	2462	12.41									

WLAN 2.4GHz 802.11n-HT20 Average Power (dBm)										Tune up limit (dBm)
Power vs. Channel			Power vs. MCS Index							
Channel	Frequency (MHz)	MCS Index	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
		MCS0									
CH 1	2412	11.92									
CH 6	2437	11.13	CH 1	11.91	11.89	11.88	11.85	11.86	11.84	11.83	13.0
CH 11	2462	11.05									

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 11g, 11n-HT20 output power is less than 1/4dB higher than 11b mode, thus the SAR can be excluded.

<Bluetooth Conducted Power>

Bluetooth average power (dBm)				
Mode	GFSK	π/4-DQPSK	8-DPSK	BT4.0 LE, GFSK
Measured Power	7.79	6.79	6.81	0.47
Tune Up Limit	8.0	8.0	8.0	2.0

Note:
1. Per KDB 447498 D01v05r01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] · [$\sqrt{f(GHz)}$] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - · f(GHz) is the RF channel transmit frequency in GHz
   - · Power and distance are rounded to the nearest mW and mm before calculation
   - · The result is rounded to one decimal place for comparison

Bluetooth Max Power (dBm)	Test Distance (mm)	Frequency (GHz)	exclusion thresholds
8.0	5 mm	2.48	1.89

2. Per KDB 447498 D01v05r01 exclusion thresholds is 0.63 < 3, RF exposure evaluation is not required.

<WLAN 5GHz Conducted Power>

WLAN 5GHz 802.11a Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. Data Rate								
Channel	Frequency (MHz)	Data Rate 6Mbps	Channel	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps	
CH 36	5180	14.33									
CH 40	5200	14.39									
CH 44	5220	14.64	CH 48	14.64	14.63	14.61	14.60	14.58	14.56	14.55	
CH 48	5240	14.66									
CH 52	5260	14.71									
CH 56	5280	14.69	CH 52	14.69	14.67	14.66	14.65	14.63	14.61	14.60	15.0
CH 60	5300	14.67									
CH 64	5320	14.56									
CH 100	5500	13.99									
CH 104	5520	13.86									
CH 108	5540	13.92									
CH 112	5560	13.82	CH 140	14.22	14.21	14.19	14.18	14.16	14.13	14.13	
CH 116	5580	14.09									
CH 132	5660	14.19									
CH 136	5680	14.15									
CH 140	5700	14.24									

WLAN 5GHz 802.11n-HT20 Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index								
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
CH 36	5180	13.54									
CH 40	5200	13.36	CH 48	13.59	13.58	13.56	13.55	13.52	13.51	13.51	
CH 44	5220	13.44									
CH 48	5240	13.61									
CH 52	5260	13.43									
CH 56	5280	13.65	CH 56	13.63	13.61	13.59	13.57	13.56	13.54	13.53	
CH 60	5300	13.55									
CH 64	5320	13.61									14.0
CH 100	5500	13.53									
CH 104	5520	13.16									
CH 108	5540	13.13									
CH 112	5560	13.11	CH 100	13.51	13.50	13.48	13.46	13.45	13.43	13.42	
CH 116	5580	13.42									
CH 132	5660	13.29									
CH 136	5680	13.33									
CH 140	5700	13.35									

WLAN 5GHz 802.11n-HT40 Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index								
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
CH 38	5190	13.15	CH 46	13.18	13.16	13.15	13.13	13.12	13.10	13.10	
CH 46	5230	13.19									
CH 54	5270	12.92	CH 62	13.11	13.09	13.08	13.06	13.05	13.04	13.02	
CH 62	5310	13.13									14.0
CH 102	5510	12.42									
CH 110	5550	12.51	CH 134	12.60	12.58	12.56	12.55	12.54	12.52	12.51	
CH 134	5670	12.62									

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WLAN 5GHz 802.11ac-VHT20 Average Power (dBm)												Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index									
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	
CH 36	5180	13.45	CH 48	13.56	13.55	13.53	13.51	13.50	13.48	13.46	13.45	14.0
CH 40	5200	13.32										
CH 44	5220	13.41										
CH 48	5240	13.58										
CH 52	5260	13.39	CH 56	13.59	13.58	13.56	13.54	13.53	13.52	13.51	13.50	
CH 56	5280	13.61										
CH 60	5300	13.52										
CH 64	5320	13.58										
CH 100	5500	13.51	CH 100	13.49	13.48	13.47	13.45	13.43	13.41	13.41	13.40	
CH 104	5520	13.11										
CH 108	5540	13.09										
CH 112	5560	13.06										
CH 116	5580	13.37										
CH 132	5660	13.22										
CH 136	5680	13.25										
CH 140	5700	13.24										

WLAN 5GHz 802.11ac-VHT40 Average Power (dBm)													Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index										
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	
CH 38	5190	11.67	CH 46	11.82	11.81	11.79	11.77	11.75	11.74	11.72	0.00	11.69	13.0
CH 46	5230	11.84											
CH 54	5270	11.61	CH 54	11.59	11.58	11.56	11.55	11.54	11.52	11.50	11.48	11.47	
CH 62	5310	11.53											
CH 102	5510	11.32	CH 134	11.38	11.36	11.35	11.35	11.33	11.32	11.30	11.29	11.28	
CH 110	5550	11.33											
CH 134	5670	11.41											

WLAN 5GHz 802.11ac-VHT80 Average Power (dBm)													Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index										
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9	
CH 42	5210	12.14	CH 42	12.12	12.10	12.08	12.07	12.05	12.04	12.02	12.01	11.99	12.5
CH 58	5290	11.83	CH 58	11.81	11.79	11.77	11.75	11.74	11.72	11.70	11.69	11.68	
CH 106	5530	10.52	CH 106	10.50	10.48	10.47	10.46	10.44	10.42	10.40	10.38	10.36	

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/HT40 and 11ac-VHT20/VHT40 output power is less than 1/4dB higher than 802.11a mode, thus the SAR can be excluded.
4. For 802.11ac SAR evaluation for each frequency band, 802.11n VHT80 was verified at the worst case found in 802.11a SAR testing.

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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	137.6mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	125mm	58.9mm	≤ 25mm

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

Note:

1. 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

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12. SAR Test Results

Note:

1. 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. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v05r01, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   · ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   · ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   · ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. The device does not have limitation to operate VOIP in EGPRS wireless interface; considering the data rate of EGPRS to support VOIP quality and realistic operation, SAR testing was not performed evaluation VOIP operation in EGPRS mode.
4. Per KDB 941225 D02v02r02, If HSDPA/HSUPA output power is < 0.25dB higher than RMC12.2Kbps, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
5. Per KDB 648474 D04v01, 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.
6. Per KDB 865664 D01v01r01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.

12.1 Head SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
13	GSM850	DTM Multi-slot class 11	Right Cheek	189	836.4	29.42	30.0	1.143	0.02	0.440	0.503
14	GSM850	DTM Multi-slot class 11	Right Tilted	189	836.4	29.42	30.0	1.143	-0.14	0.270	0.309
15	GSM850	DTM Multi-slot class 11	Left Cheek	189	836.4	29.42	30.0	1.143	0.11	0.446	**0.510**
16	GSM850	DTM Multi-slot class 11	Left Tilted	189	836.4	29.42	30.0	1.143	-0.17	0.243	0.278
1	GSM1900	DTM Multi-slot class 11	Right Cheek	512	1850.2	26.65	27.0	1.084	-0.06	0.303	0.328
2	GSM1900	DTM Multi-slot class 11	Right Tilted	512	1850.2	26.65	27.0	1.084	-0.01	0.165	0.179
3	GSM1900	DTM Multi-slot class 11	Left Cheek	512	1850.2	26.65	27.0	1.084	0.09	0.494	**0.535**
4	GSM1900	DTM Multi-slot class 11	Left Tilted	512	1850.2	26.65	27.0	1.084	0.08	0.228	0.247

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
30	WCDMA V	RMC 12.2Kbps	Right Cheek	4233	846.6	24.76	25.0	1.057	0.08	0.464	**0.490**
31	WCDMA V	RMC 12.2Kbps	Right Tilted	4233	846.6	24.76	25.0	1.057	-0.07	0.156	0.165
32	WCDMA V	RMC 12.2Kbps	Left Cheek	4233	846.6	24.76	25.0	1.057	0.02	0.427	0.451
33	WCDMA V	RMC 12.2Kbps	Left Tilted	4233	846.6	24.76	25.0	1.057	0.03	0.224	0.237

<WLAN SAR-DTS>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
58	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	1	2412	14.16	14.5	1.081	98.28	1.018	0.11	0.260	0.287
59	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	1	2412	14.16	14.5	1.081	98.28	1.018	-0.01	0.163	0.180
60	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	1	2412	14.16	14.5	1.081	98.28	1.018	0.05	0.124	0.136
61	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	1	2412	14.16	14.5	1.081	98.28	1.018	0.12	0.113	0.124

<WLAN SAR-NII>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
50	WLAN5GHz	802.11a 6Mbps	Right Cheek	48	5240	14.66	15.0	1.081	88.94	1.124	0.04	0.534	0.649
51	WLAN5GHz	802.11a 6Mbps	Right Tilted	48	5240	14.66	15.0	1.081	88.94	1.124	0.05	0.274	0.333
52	WLAN5GHz	802.11a 6Mbps	Left Cheek	48	5240	14.66	15.0	1.081	88.94	1.124	0.06	0.157	0.191
53	WLAN5GHz	802.11a 6Mbps	Left Tilted	48	5240	14.66	15.0	1.081	88.94	1.124	0.09	0.108	0.131
77	WLAN5GHz	802.11ac-VHT80 MCS0	Right Cheek	42	5210	12.14	12.5	1.086	57.56	1.737	0.02	0.142	0.268
54	WLAN5GHz	802.11a 6Mbps	Right Cheek	52	5260	14.71	15.0	1.069	88.94	1.124	0.05	0.524	0.630
55	WLAN5GHz	802.11a 6Mbps	Right Tilted	52	5260	14.71	15.0	1.069	88.94	1.124	0.15	0.314	0.377
56	WLAN5GHz	802.11a 6Mbps	Left Cheek	52	5260	14.71	15.0	1.069	88.94	1.124	0.11	0.138	0.166
57	WLAN5GHz	802.11a 6Mbps	Left Tilted	52	5260	14.71	15.0	1.069	88.94	1.124	0.07	0.124	0.149
78	WLAN5GHz	802.11ac-VHT80 MCS0	Right Cheek	58	5290	11.83	12.5	1.167	57.56	1.737	0.18	0.175	0.355
62	WLAN5GHz	802.11a 6Mbps	Right Cheek	140	5700	14.24	15.0	1.191	88.94	1.124	-0.09	0.588	0.787
66	WLAN5GHz	802.11a 6Mbps	Right Cheek	100	5500	13.99	15.0	1.262	88.94	1.124	-0.01	0.556	0.789
68	WLAN5GHz	802.11a 6Mbps	Right Cheek	116	5580	14.09	15.0	1.233	88.94	1.124	0.05	0.571	0.792
63	WLAN5GHz	802.11a 6Mbps	Right Tilted	140	5700	14.24	15.0	1.191	88.94	1.124	0.12	0.491	0.658
67	WLAN5GHz	802.11a 6Mbps	Right Tilted	100	5500	13.99	15.0	1.262	88.94	1.124	0.11	0.423	0.601
69	WLAN5GHz	802.11a 6Mbps	Right Tilted	116	5580	14.09	15.0	1.233	88.94	1.124	0.11	0.431	0.598
64	WLAN5GHz	802.11a 6Mbps	Left Cheek	140	5700	14.24	15.0	1.191	88.94	1.124	0.09	0.343	0.460
75	WLAN5GHz	802.11a 6Mbps	Left Cheek	100	5500	13.99	15.0	1.262	88.94	1.124	0.02	0.229	0.324
76	WLAN5GHz	802.11a 6Mbps	Left Cheek	116	5580	14.09	15.0	1.233	88.94	1.124	0	0.293	0.406
65	WLAN5GHz	802.11a 6Mbps	Left Tilted	140	5700	14.24	15.0	1.191	88.94	1.124	0.16	0.298	0.399
79	WLAN5GHz	802.11ac-VHT80 MCS0	Right Cheek	106	5530	10.52	12.5	1.578	57.56	1.737	0.12	0.159	0.435

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12.2 Hotspot SAR

Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	137.6mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	125mm	58.9mm	≤ 25mm

Positions for SAR tests; Hotspot mode Test distance: 10 mm						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	Yes	No	No	Yes

Note:
1. 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

<GSM SAR>

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 SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
17	GSM850	GPRS (3 Tx slots)	Front	1cm	189	836.4	29.45	30.0	1.135	-0.1	0.601	**0.682**
18	GSM850	GPRS (3 Tx slots)	Back	1cm	189	836.4	29.45	30.0	1.135	-0.17	0.530	0.602
19	GSM850	GPRS (3 Tx slots)	Left Side	1cm	189	836.4	29.45	30.0	1.135	-0.06	0.322	0.365
20	GSM850	GPRS (3 Tx slots)	Right Side	1cm	189	836.4	29.45	30.0	1.135	-0.15	0.468	0.531
21	GSM850	GPRS (3 Tx slots)	Bottom Side	1cm	189	836.4	29.45	30.0	1.135	-0.11	0.301	0.342
5	GSM1900	GPRS (4 Tx slots)	Front	1cm	512	1850.2	25.63	26.0	1.089	0.06	0.498	0.542
6	GSM1900	GPRS (4 Tx slots)	Back	1cm	512	1850.2	25.63	26.0	1.089	0	0.606	**0.660**
7	GSM1900	GPRS (4 Tx slots)	Left Side	1cm	512	1850.2	25.63	26.0	1.089	0.04	0.319	0.347
8	GSM1900	GPRS (4 Tx slots)	Right Side	1cm	512	1850.2	25.63	26.0	1.089	0.02	0.100	0.109
10	GSM1900	GPRS (4 Tx slots)	Bottom Side	1cm	512	1850.2	25.63	26.0	1.089	0.05	0.427	0.465

<WCDMA SAR>

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 SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
26	WCDMA V	RMC 12.2Kbps	Front	1cm	4233	846.6	24.76	25.0	1.057	-0.02	0.487	**0.515**
27	WCDMA V	RMC 12.2Kbps	Back	1cm	4233	846.6	24.76	25.0	1.057	0.05	0.402	0.425
28	WCDMA V	RMC 12.2Kbps	Left Side	1cm	4233	846.6	24.76	25.0	1.057	-0.04	0.192	0.203
29	WCDMA V	RMC 12.2Kbps	Right Side	1cm	4233	846.6	24.76	25.0	1.057	-0.01	0.383	0.405
34	WCDMA V	RMC 12.2Kbps	Bottom Side	1cm	4233	846.6	24.76	25.0	1.057	-0.09	0.273	0.289

<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	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
70	WLAN2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	-0.06	0.050	0.055
71	WLAN2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	0.02	0.053	**0.058**
72	WLAN2.4GHz	802.11b 1Mbps	Left Side	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	-0.15	0.024	0.026
74	WLAN2.4GHz	802.11b 1Mbps	Top Side	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	0.06	0.051	0.056

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12.3 *Body Worn SAR*

<GSM SAR>

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 SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
24	GSM850	DTM Multi-slot class 11	Front	1cm	189	836.4	29.42	30.0	1.143	-0.08	0.523	**0.598**
25	GSM850	DTM Multi-slot class 11	Back	1cm	189	836.4	29.42	30.0	1.143	-0.17	0.439	0.502
11	GSM1900	DTM Multi-slot class 11	Front	1cm	512	1850.2	26.65	27.0	1.084	0.05	0.496	0.538
12	GSM1900	DTM Multi-slot class 11	Back	1cm	512	1850.2	26.65	27.0	1.084	0.01	0.555	**0.602**

<WCDMA SAR>

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 SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
26	WCDMA V	RMC 12.2Kbps	Front	1cm	4233	846.6	24.76	25.0	1.057	-0.02	0.487	**0.515**
27	WCDMA V	RMC 12.2Kbps	Back	1cm	4233	846.6	24.76	25.0	1.057	0.05	0.402	0.425

<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	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
70	WLAN2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	-0.06	0.050	0.055
71	WLAN2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	14.16	14.5	1.081	98.28	1.018	0.02	0.053	**0.058**

<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	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured SAR 1g (W/kg)	Scaled SAR 1g (W/kg)
80	WLAN5GHz	802.11a 6Mbps	Front	1cm	48	5240	14.66	15.0	1.081	88.94	1.124	-0.15	0.030	0.037
81	WLAN5GHz	802.11a 6Mbps	Back	1cm	48	5240	14.66	15.0	1.081	88.94	1.124	-0.04	0.062	**0.076**
82	WLAN5GHz	802.11ac-VHT80 MCS0	Back	1cm	42	5210	12.14	12.5	1.086	57.56	1.737	0.12	0.015	0.028
83	WLAN5GHz	802.11a 6Mbps	Front	1cm	52	5260	14.71	15.0	1.069	88.94	1.124	0.14	0.043	0.051
84	WLAN5GHz	802.11a 6Mbps	Back	1cm	52	5260	14.71	15.0	1.069	88.94	1.124	0	0.062	**0.075**
85	WLAN5GHz	802.11ac-VHT80 MCS0	Back	1cm	58	5290	11.83	12.5	1.167	57.56	1.737	0.14	0.016	0.033
86	WLAN5GHz	802.11a 6Mbps	Front	1cm	140	5700	14.24	15.0	1.191	88.94	1.124	0.15	0.100	0.133
87	WLAN5GHz	802.11a 6Mbps	Back	1cm	140	5700	14.24	15.0	1.191	88.94	1.124	0.13	0.101	**0.136**
88	WLAN5GHz	802.11ac-VHT80 MCS0	Back	1cm	106	5530	10.52	12.5	1.578	57.56	1.737	0.19	0.018	0.049

12.4 *Highest SAR Plot*

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/8/28

#17_GSM850_GPRS (3 Tx slots)_Front_1cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:2.77
Medium: MSL_850_130828 Medium parameters used: f = 836.4 MHz; σ = 0.964 S/m; ε_r = 54.526; ρ =

1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(10.02, 10.02, 10.02); Calibrated: 2013/6/12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM Right; Type: QD000P40CD; Serial: TP:1644
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Configuration/Ch189/Area Scan (61x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.733 W/kg

Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm,
dz=5mm
Reference Value = 27.759 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 0.849 W/kg
SAR(1 g) = 0.601 W/kg; SAR(10 g) = 0.439 W/kg
Maximum value of SAR (measured) = 0.725 W/kg

0 dB = 0.725 W/kg = -1.40 dBW/kg

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/8/24

#06_GSM1900_GPRS (4 Tx slots)_Back_1cm_Ch512

Communication System:PCS; Frequency: 1850.2 MHz;Duty Cycle: 1:2.08
Medium: MSL_1900_130824 Medium parameters used : f = 1850.2 MHz; σ = 1.458 S/m; ε_r = 53.273; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(4.67, 4.67, 4.67); Calibrated: 2012/9/28;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn914; Calibrated: 2013/1/16
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1478
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Configuration/Ch512/Area Scan (61x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
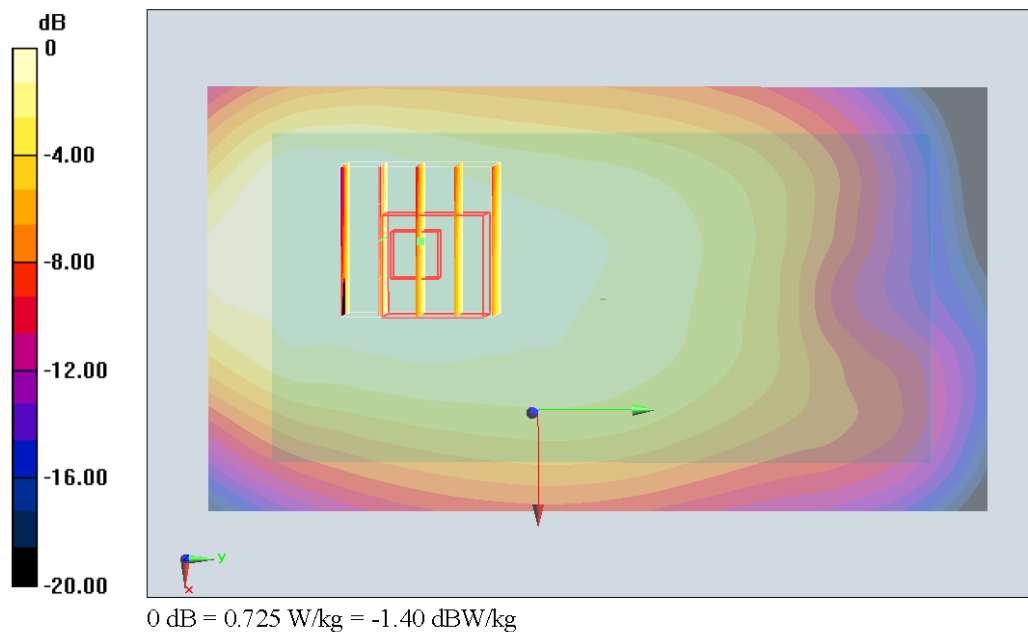Maximum value of SAR (interpolated) = 0.727 W/kg

Configuration/Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.749 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.921 W/kg
SAR(1 g) = 0.606 W/kg; SAR(10 g) = 0.395 W/kg
Maximum value of SAR (measured) = 0.698 W/kg

0 dB = 0.698 W/kg = -1.56 dBW/kg
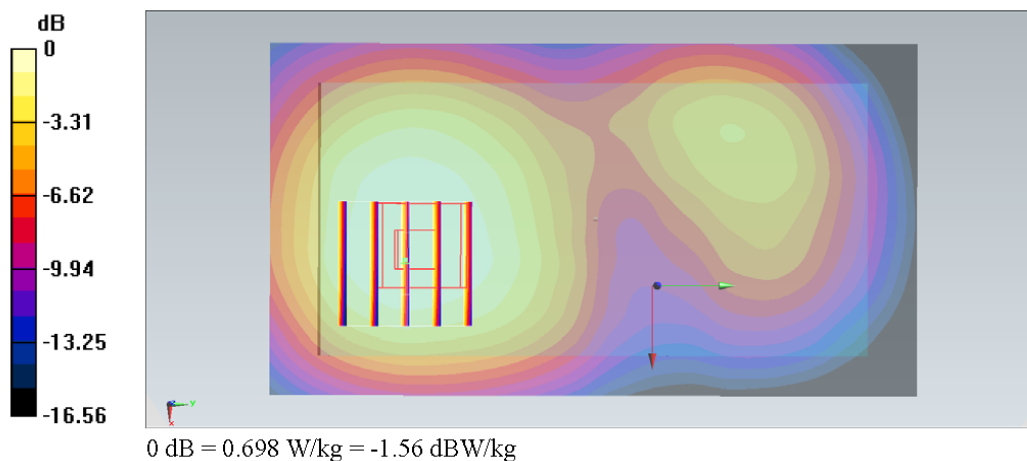
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/8/30

#58_WLAN2.4GHz_802.11b 1Mbps_Right Cheek_Ch1

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1.018
Medium: HSL_2450_130830 Medium parameters used: $f = 2412$ MHz; $\sigma = 1.801$ S/m; $\varepsilon_r = 38.74$; $\rho = 1000$ kg/m^3
Ambient Temperature：23.7 ℃；Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(7.25, 7.25, 7.25); Calibrated: 2013/6/12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM-Left; Type: QD 000 P40 C; Serial: TP-1478
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Configuration/Ch1/Area Scan (71x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.513 W/kg

Configuration/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.810 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.641 W/kg
SAR(1 g) = 0.260 W/kg; SAR(10 g) = 0.116 W/kg
Maximum value of SAR (measured) = 0.420 W/kg

0 dB = 0.420 W/kg = -3.77 dBW/kg

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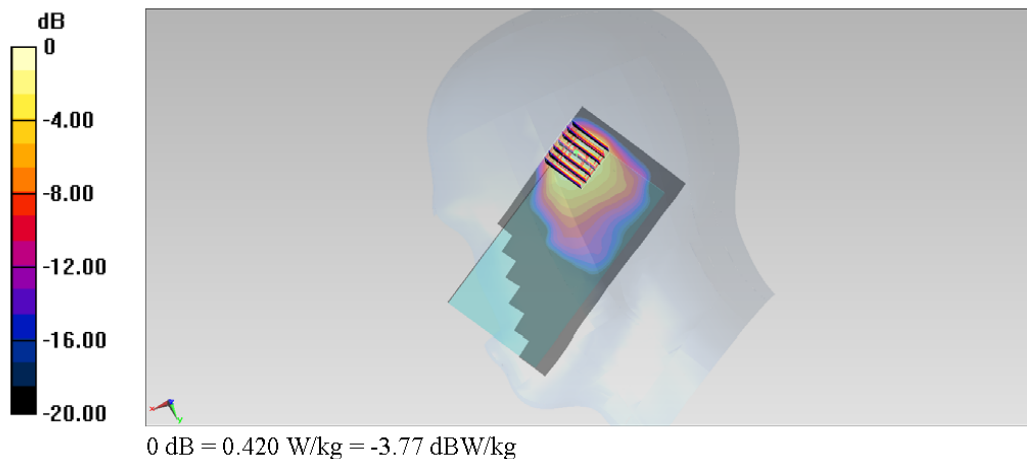
Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2013/8/30

#68_WLAN5GHz_802.11a 6Mbps_Right Cheek_Ch116

Communication System: 802.11a; Frequency: 5580 MHz;Duty Cycle: 1:1.124
Medium: HSL_5G_130830 Medium parameters used: f = 5580 MHz; σ = 4.891 S/m; ε_r = 36.973; ρ =

1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(4.73, 4.73, 4.73); Calibrated: 2013/6/12;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM-Right; Type: QD 000 P40 C; Serial: TP-1446
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Configuration/Ch116/Area Scan (91x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.89 W/kg

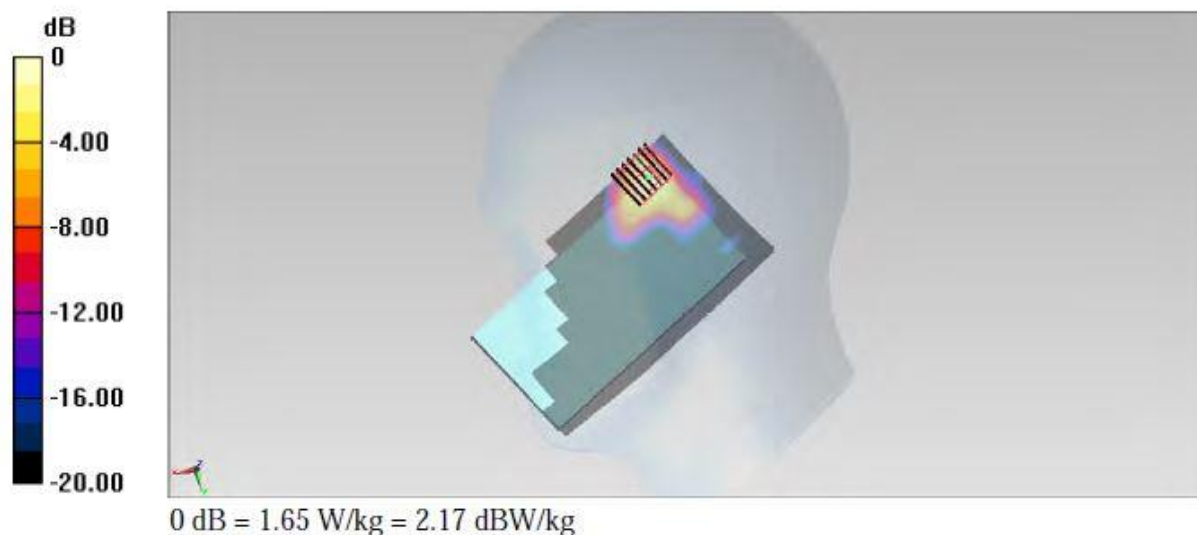**Configuration/Ch116/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm,
dz=1.4mm
Reference Value = 20.208 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 2.87 W/kg
SAR(1 g) = 0.571 W/kg; SAR(10 g) = 0.182 W/kg
Maximum value of SAR (measured) = 1.65 W/kg

0 dB = 1.65 W/kg = 2.17 dBW/kg

13. *Simultaneous Transmission Analysis*

NO.	Simultaneous Transmission Configurations	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	GSM(Voice) + WLAN2.4GHz(data)	Yes	Yes		
2.	WCDMA(Voice) + WLAN2.4GHz(data)	Yes	Yes		
3.	GSM(Voice) + Bluetooth(data)	Yes	Yes		
4.	WCDMA((Voice) + Bluetooth(data)	Yes	Yes		
5.	GSM(Voice) + WLAN5GHz(data)	Yes	Yes		
6.	WCDMA((Voice) + WLAN5GHz(data)	Yes	Yes		
7.	GPRS/EDGE(Data) + WLAN2.4GHz(data)	Yes[1]	Yes	Yes	2.4GHz Hotspot
8.	WCDMA(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
9.	GPRS/EDGE(Data) + Bluetooth(data)	Yes[1]	Yes	Yes	Bluetooth Tethering
10.	WCDMA(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering

Note:
1. Considering the possibility of 3rd party VoIP app installation by end users and the device does not have limitation to operate VoIP in EGPRS wireless interface; considering the data rate of EGPRS to support VOIP quality and realistic operation, SAR testing was not performed evaluation VOIP operation in EGPRS mode.
2. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
3. By design, WLAN 5GHz frequency band does not support mobile hotspot and WiFi Direct operation
4. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, they will not transmit simultaneously.
5. The Scaled SAR summation is calculated based on the same configuration and test position.
6. 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
7. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r01 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[$\sqrt{f(GHz)}/x$] W/kg for *test separation distances* ≤ 50 mm; where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
   ii) When the minimum test separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is > 50 mm.

Bluetooth Max Power	Exposure Position	Head	Hotspot	Body worn
	Test separation	0 mm	10 mm	10 mm
8.0 dBm	Estimated SAR (W/kg)	0.252 W/kg	0.126 W/kg	0.126 W/kg

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13.1 *Head Exposure Conditions*

< WWAN + WLAN2.4GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM850	13	0.503	58	0.287	**0.79**
	GSM1900	1	0.328	58	0.287	**0.62**
	WCDMA V	30	0.490	58	0.287	**0.78**
Right Tilted	GSM850	14	0.309	59	0.180	**0.49**
	GSM1900	2	0.179	59	0.180	**0.36**
	WCDMA V	31	0.165	59	0.180	**0.35**
Left Cheek	GSM850	15	0.510	60	0.136	**0.65**
	GSM1900	3	0.535	60	0.136	**0.67**
	WCDMA V	32	0.451	60	0.136	**0.59**
Left Tilted	GSM850	16	0.278	61	0.124	**0.40**
	GSM1900	4	0.247	61	0.124	**0.37**
	WCDMA V	33	0.237	61	0.124	**0.36**

<WWAN + WLAN5.2GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM850	13	0.503	50	0.649	**1.15**
	GSM1900	1	0.328	50	0.649	**0.98**
	WCDMA V	30	0.490	50	0.649	**1.14**
Right Tilted	GSM850	14	0.309	51	0.333	**0.64**
	GSM1900	2	0.179	51	0.333	**0.51**
	WCDMA V	31	0.165	51	0.333	**0.50**
Left Cheek	GSM850	15	0.510	52	0.191	**0.70**
	GSM1900	3	0.535	52	0.191	**0.73**
	WCDMA V	32	0.451	52	0.191	**0.64**
Left Tilted	GSM850	16	0.278	53	0.131	**0.41**
	GSM1900	4	0.247	53	0.131	**0.38**
	WCDMA V	33	0.237	53	0.131	**0.37**

<WWAN + WLAN5.3GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM850	13	0.503	54	0.630	**1.13**
	GSM1900	1	0.328	54	0.630	**0.96**
	WCDMA V	30	0.490	54	0.630	**1.12**
Right Tilted	GSM850	14	0.309	55	0.377	**0.69**
	GSM1900	2	0.179	55	0.377	**0.56**
	WCDMA V	31	0.165	55	0.377	**0.54**
Left Cheek	GSM850	15	0.510	56	0.166	**0.68**
	GSM1900	3	0.535	56	0.166	**0.70**
	WCDMA V	32	0.451	56	0.166	**0.62**
Left Tilted	GSM850	16	0.278	57	0.149	**0.43**
	GSM1900	4	0.247	57	0.149	**0.40**
	WCDMA V	33	0.237	57	0.149	**0.39**

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<WWAN + WLAN5.5GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM850	13	0.503	68	0.792	**1.30**
	GSM1900	1	0.328	68	0.792	**1.12**
	WCDMA V	30	0.490	68	0.792	**1.28**
Right Tilted	GSM850	14	0.309	63	0.658	**0.97**
	GSM1900	2	0.179	63	0.658	**0.84**
	WCDMA V	31	0.165	63	0.658	**0.82**
Left Cheek	GSM850	15	0.510	64	0.460	**0.97**
	GSM1900	3	0.535	64	0.460	**1.00**
	WCDMA V	32	0.451	64	0.460	**0.91**
Left Tilted	GSM850	16	0.278	65	0.399	**0.68**
	GSM1900	4	0.247	65	0.399	**0.65**
	WCDMA V	33	0.237	65	0.399	**0.64**

<WWAN + Bluetooth>

Position	WWAN			Bluetooth	Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Estimated SAR (W/kg)	
Right Cheek	GSM850	13	0.503	0.252	**0.76**
	GSM1900	1	0.328	0.252	**0.58**
	WCDMA V	30	0.490	0.252	**0.74**
Right Tilted	GSM850	14	0.309	0.252	**0.56**
	GSM1900	2	0.179	0.252	**0.43**
	WCDMA V	31	0.165	0.252	**0.42**
Left Cheek	GSM850	15	0.510	0.252	**0.76**
	GSM1900	3	0.535	0.252	**0.79**
	WCDMA V	32	0.451	0.252	**0.70**
Left Tilted	GSM850	16	0.278	0.252	**0.53**
	GSM1900	4	0.247	0.252	**0.50**
	WCDMA V	33	0.237	0.252	**0.49**

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13.2 Hotspot Exposure Conditions

< WWAN + WLAN2.4GHz Band>

Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	Summed SAR (W/kg)
		WWAN		WLAN		
Front	GSM850	17	0.682	70	0.055	**0.74**
	GSM1900	5	0.542	70	0.055	**0.60**
	WCDMA V	26	0.515	70	0.055	**0.57**
Back	GSM850	18	0.602	71	0.058	**0.66**
	GSM1900	6	0.660	71	0.058	**0.72**
	WCDMA V	27	0.425	71	0.058	**0.48**
Left Side	GSM850	19	0.365	72	0.026	**0.39**
	GSM1900	7	0.347	72	0.026	**0.37**
	WCDMA V	28	0.203	72	0.026	**0.23**
Right Side	GSM850	20	0.531			**0.53**
	GSM1900	8	0.109			**0.11**
	WCDMA V	29	0.405			**0.41**
Top Side				74	0.056	**0.06**
				74	0.056	**0.06**
				74	0.056	**0.06**
Bottom Side	GSM850	21	0.342			**0.34**
	GSM1900	10	0.465			**0.47**
	WCDMA V	34	0.289			**0.29**

<WWAN + Bluetooth>

Position	WWAN Band	Plot No	SAR (W/kg)	Bluetooth Estimated SAR (W/kg)	Summed SAR (W/kg)
		WWAN		Bluetooth	
Front	GSM850	17	0.682	0.126	**0.81**
	GSM1900	5	0.542	0.126	**0.67**
	WCDMA V	26	0.515	0.126	**0.64**
Back	GSM850	18	0.602	0.126	**0.73**
	GSM1900	6	0.660	0.126	**0.79**
	WCDMA V	27	0.425	0.126	**0.55**
Left Side	GSM850	19	0.365	0.126	**0.49**
	GSM1900	7	0.347	0.126	**0.47**
	WCDMA V	28	0.203	0.126	**0.33**
Right Side	GSM850	20	0.531		**0.53**
	GSM1900	8	0.109		**0.11**
	WCDMA V	29	0.405		**0.41**
Top Side				0.126	**0.13**
				0.126	**0.13**
				0.126	**0.13**
Bottom Side	GSM850	21	0.342		**0.34**
	GSM1900	10	0.465		**0.47**
	WCDMA V	34	0.289		**0.29**

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13.3 Body-Worn Exposure Conditions

<WWAN + WLAN2.4GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM850	24	0.598	70	0.055	**0.65**
	GSM1900	11	0.538	70	0.055	**0.59**
	WCDMA V	26	0.515	70	0.055	**0.57**
Back	GSM850	25	0.502	71	0.058	**0.56**
	GSM1900	12	0.602	71	0.058	**0.66**
	WCDMA V	27	0.425	71	0.058	**0.48**

<WWAN + WLAN5.2GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM850	24	0.598	80	0.037	**0.64**
	GSM1900	11	0.538	80	0.037	**0.58**
	WCDMA V	26	0.515	80	0.037	**0.55**
Back	GSM850	25	0.502	81	0.076	**0.58**
	GSM1900	12	0.602	81	0.076	**0.68**
	WCDMA V	27	0.425	81	0.076	**0.50**

<WWAN + WLAN5.3GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM850	24	0.598	83	0.051	**0.65**
	GSM1900	11	0.538	83	0.051	**0.59**
	WCDMA V	26	0.515	83	0.051	**0.57**
Back	GSM850	25	0.502	84	0.075	**0.58**
	GSM1900	12	0.602	84	0.075	**0.68**
	WCDMA V	27	0.425	84	0.075	**0.50**

<WWAN + WLAN5.5GHz Band>

Position	WWAN			WLAN		Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM850	24	0.598	86	0.133	**0.73**
	GSM1900	11	0.538	86	0.133	**0.67**
	WCDMA V	26	0.515	86	0.133	**0.65**
Back	GSM850	25	0.502	87	0.136	**0.64**
	GSM1900	12	0.602	87	0.136	**0.74**
	WCDMA V	27	0.425	87	0.136	**0.56**

<WWAN + Bluetooth>

Position	WWAN			Bluetooth	Summed SAR (W/kg)
	WWAN Band	Plot No	SAR (W/kg)	Estimated SAR (W/kg)	
Front	GSM850	24	0.598	0.126	**0.72**
	GSM1900	11	0.538	0.126	**0.66**
	WCDMA V	26	0.515	0.126	**0.64**
Back	GSM850	25	0.502	0.126	**0.63**
	GSM1900	12	0.602	0.126	**0.73**
	WCDMA V	27	0.425	0.126	**0.55**

Test Engineer： Angelo Chang, Ken Li, Galen Zhang, Tom Jiang, Nick Yu, Bevis Chang,

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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]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

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

   variations in the measured quantity

(b) κ is the coverage factor

Table 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.

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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

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