FCC SAR Test Report

APPLICANT	**:**	**Fujitsu Mobile Communications Ltd.**
EQUIPMENT	**:**	**Mobile Phone**
BRAND NAME	**:**	**FUJITSU**
MODEL NAME	**:**	**301F**
FCC ID	**:**	**YUW-301F**
STANDARD	**:**	**FCC 47 CFR Part 2 (2.1093)** **ANSI/IEEE C95.1-1992** **IEEE 1528-2003**
Date of Start Test	**:**	**Sep. 29, 2013**
Date of End Test	**:**	**Oct. 12, 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.

Eric Huang

Reviewed by: Eric Huang / Deputy Manager

Jones Tsai

Approved by: Jones Tsai / Manager

ilac-MRA

TAF
Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA391350	Rev. 01	Initial issue of report	Oct. 28, 2013

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Fujitsu Mobile Communications Ltd. Mobile Phone, 301F** are as follows.

<Highest SAR Summary>

Exposure Position	Frequency Band	Reported 1g-SAR (W/kg)	Equipment Class	Highest Reported 1g-SAR (W/kg)
Head	GSM1900	0.21	PCE	0.41
	WLAN 5.2GHz Band	0.30	NII	
	WLAN 5.3GHz Band	0.16		
	WLAN 5.5GHz Band	0.41		
	WLAN 2.4GHz Band	0.25	DTS	
Hotspot (Separation 1cm)	GSM1900	0.34	PCE	0.34
	WLAN 2.4GHz Band	0.08	DTS	
Body-worn (Separation 1cm)	GSM1900	0.27	PCE	0.27
	WLAN 5.2GHz Band	0.10	NII	
	WLAN 5.3GHz Band	0.10		
	WLAN 5.5GHz Band	0.13		
	WLAN 2.4GHz Band	0.08	DTS	

<Highest Simultaneous transmission SAR>

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM1900	PCE	Head	0.55
Bluetooth	DSS		

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM1900	PCE	Head	0.42
WLAN 2.4GHz Band	DTS		

Frequency Band	Equipment Class	Exposure Position	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
GSM1900	PCE	Head	0.58
WLAN 5.5GHz Band	NII		

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003.

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL 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 Mobile Communications Ltd.
Address	1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki 211-8588, Japan

2.3 Manufacturer

Company Name	Fujitsu Mobile Communications Ltd.
Address	1-1, Kamikodanaka 4-chome, Nakahara-ku, Kawasaki 211-8588, Japan

2.4 Application Details

Date of Start during the Test	Sep. 29, 2013
Date of End during the Test	Oct. 12, 2013

3. General Information

3.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT	Mobile Phone
Brand Name	FUJITSU
Model Name	301F
FCC ID	YUW-301F
IMEI Code	357613050018539
Wireless Technology and Frequency Range	GSM1900: 1850.2 MHz ~ 1909.8 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
Mode	• GSM/GPRS • 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80 • Bluetooth v3.0+EDR，Bluetooth v4.0+LE • 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	R25.1e
Transfer Mode Category	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
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. 802.11n- HT40 is not supported in 2.4GHz frequency band.
3. IEEE 11ac standard is still "Draft" version.

3.2 Maximum RF output power among production units

Mode	Burst Average Power (dBm)
	GSM 1900
GSM (GMSK, 1 Tx slot)	31.0
GPRS (GMSK, 1 Tx slot)	31.0
GPRS (GMSK, 2 Tx slots)	28.0
GPRS (GMSK, 3 Tx slots)	26.0
GPRS (GMSK, 4 Tx slots)	25.0

Mode	Average Power(dBm)
WLAN 2.4GHz 802.11b	14.0
WLAN 2.4GHz 802.11g	13.0
WLAN 2.4GHz 802.11n-HT20	12.0
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	12.0

Mode	Average Power(dBm)
Bluetooth v3.0+EDR	9.0
Bluetooth v4.0+LE	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 D03 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

3.5.1Ambient Condition

Ambient Temperature	20 to 24 ℃
Humidity	< 60 %

3.5.2 Test Configuration

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

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: 88.79%

802.11ac-VHT80 MCS0: 57.07%

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

4. Specific Absorption Rate (SAR)

4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

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

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

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

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

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

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

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

5. SAR Measurement System

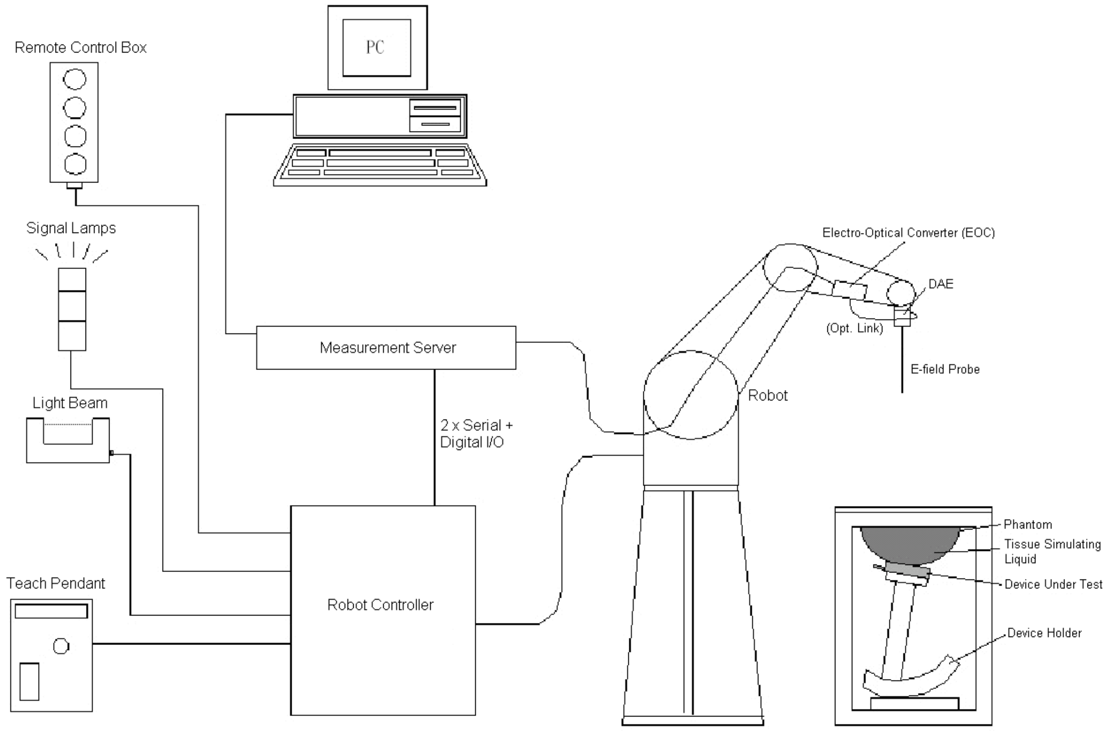


Fig 5.1 SPEAG DASY System Configurations

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

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

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

5.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

5.1.1 E-Field Probe Specification

<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
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 5.2 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.

5.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.3 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (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)

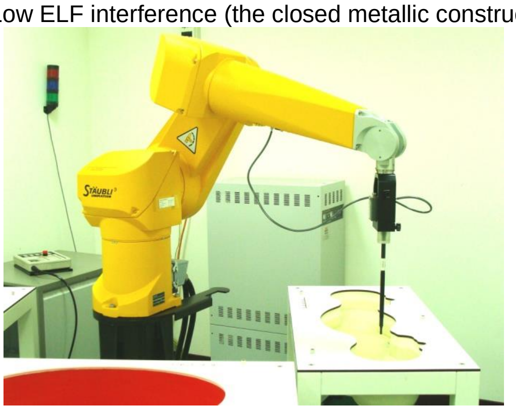


Fig 5.4 Photo of DASY4

Fig 5.5 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 5.6 Photo of Server for DASY4

Fig 5.7 Photo of Server for DASY5

5.5 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

Fig 5.8 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

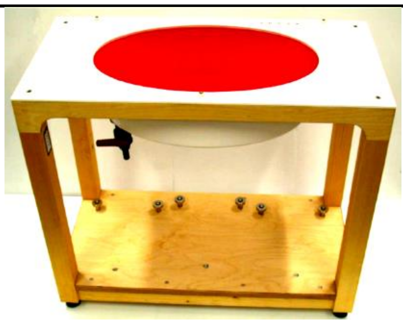


Fig 5.9 Photo of ELI4 Phantom

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.

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 $\varepsilon = 3$ and loss tangent $\delta = 0.02$. 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 5.10 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.

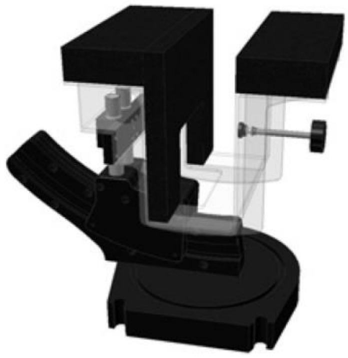


Fig 5.11 Laptop Extension Kit

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.

The formula for each channel can be given as：

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

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

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

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

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

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

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

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

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

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

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

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

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	1900MHz System Validation Kit	D1900V2	5d170	Mar. 27,2013	Mar. 26,2014
SPEAG	2450MHz System Validation Kit	D2450V2	736	Aug. 23, 2013	Aug. 22, 2014
SPEAG	5GHz System Validation Kit	D5GHzV2	1128	Jul. 24, 2013	Jul. 23, 2014
SPEAG	Data Acquisition Electronics	DAE4	1358	Apr. 08,2013	Apr. 07,2014
SPEAG	Data Acquisition Electronics	DAE4	913	Jan. 17, 2013	Jan. 16, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3911	Apr. 11,2013	Apr. 10,2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3820	Dec. 10, 2012	Dec. 09, 2013
Wisewind	Thermometer	HTC-1	TM642	Nov. 13, 2012	Nov. 12, 2013
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 05, 2012	Jan. 04, 2014
R&S	Radio communication Tester	CMW500	116160	Jan. 09, 2013	Jan. 08, 2014
SPEAG	Device Holder	N/A	N/A	NCR	NCR
R&S	Signal Generator	SMF 100A	101107	May. 27, 2013	May. 26, 2014
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 23, 2013	Jul. 22, 2014
Agilent	ENA Network Analyzer	E5071C	MY46316648	Feb. 07, 2013	Feb. 06, 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.

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.

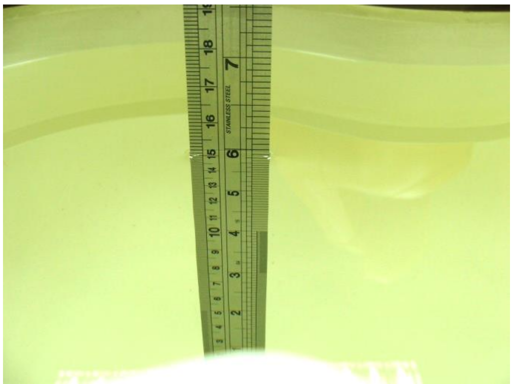


Fig 6.1 Photo of Liquid Height for Head SAR

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)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
1900	Head	22.7	1.417	39.706	1.40	40.0	1.21	-0.73	±5	2013/9/29
1900	Body	22.6	1.535	54.579	1.52	53.3	0.99	2.40	±5	2013/9/29
2450	Head	22.4	1.850	39.300	1.80	39.20	2.78	0.26	±5	2013/10/10
2450	Body	22.5	2.020	53.800	1.95	52.70	3.59	2.09	±5	2013/10/12
5200	Head	22.3	4.800	35.500	4.66	36.00	3.00	-1.39	±5	2013/10/11
5200	Body	22.6	5.290	47.600	5.30	49.00	-0.19	-2.86	±5	2013/10/12
5300	Head	22.3	4.910	35.300	4.76	35.87	3.15	-1.59	±5	2013/10/11
5300	Body	22.6	5.430	47.400	5.42	48.88	0.18	-3.03	±5	2013/10/12
5600	Head	22.5	5.220	34.700	5.06	35.53	3.16	-2.34	±5	2013/10/11
5600	Body	22.6	5.830	46.800	5.77	48.47	1.04	-3.45	±5	2013/10/12

Table 6.2 Measuring Results for Simulating Liquid

7. System Verification Procedures

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

7.1 Purpose of System Performance check

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

7.2 System Setup

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

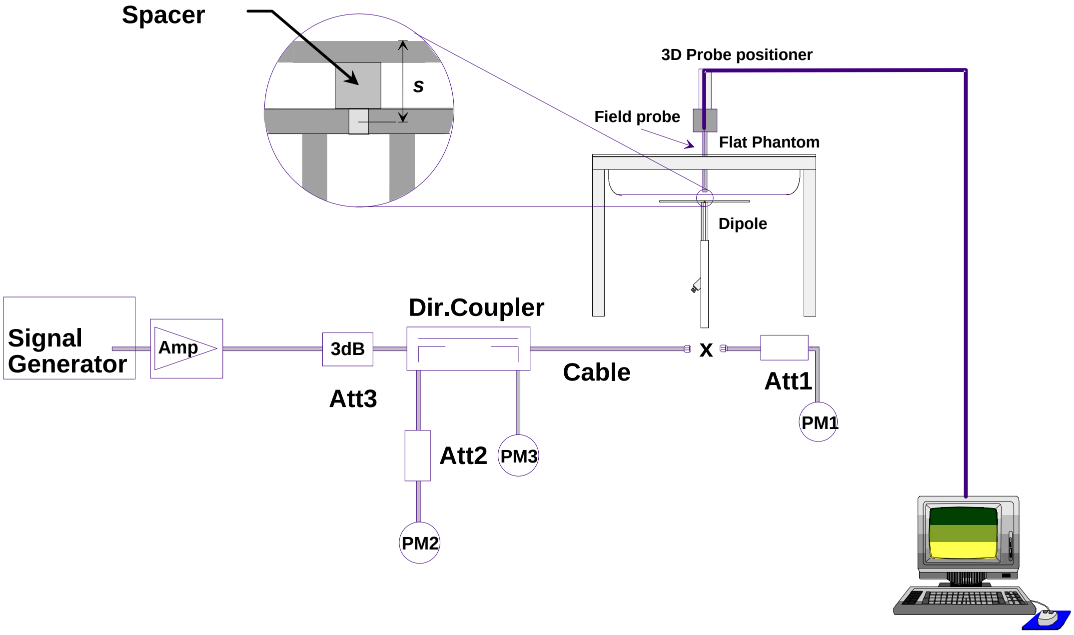


Fig 7.1 System Setup for System Evaluation

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

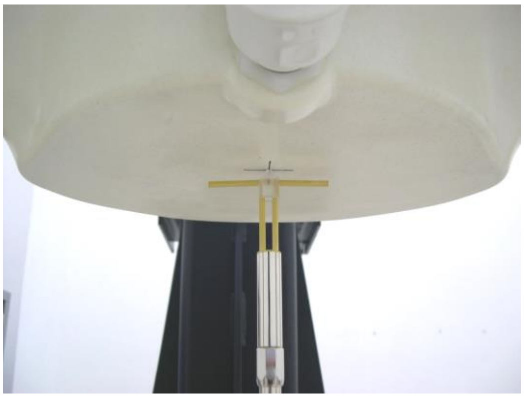


Fig 7.2 Photo of Dipole Setup

7.3 SAR System Verification Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 7.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2013/9/29	1900	Head	250	5d170	3911	1358	9.41	40.2	37.64	-6.37
2013/9/29	1900	Body	250	5d170	3911	1358	10.3	41.2	41.2	0.00
2013/10/10	2450	Head	250	736	3820	913	13.10	53.20	52.4	-1.50
2013/10/12	2450	Body	250	736	3820	913	13.50	51.30	54	5.26
2013/10/11	5200	Head	100	1128	3820	913	7.79	78.20	77.9	-0.38
2013/10/12	5200	Body	100	1128	3820	913	7.44	73.40	74.4	1.36
2013/10/11	5300	Head	100	1128	3820	913	8.06	80.60	80.6	0.00
2013/10/12	5300	Body	100	1128	3820	913	7.65	74.30	76.5	2.96
2013/10/11	5600	Head	100	1128	3820	913	8.69	80.50	86.9	7.95
2013/10/12	5600	Body	100	1128	3820	913	7.97	77.80	79.7	2.44

Table 7.1 Target and Measurement SAR after Normalized

8. EUT Testing Position

8.1 Define two imaginary lines on the handset

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

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

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

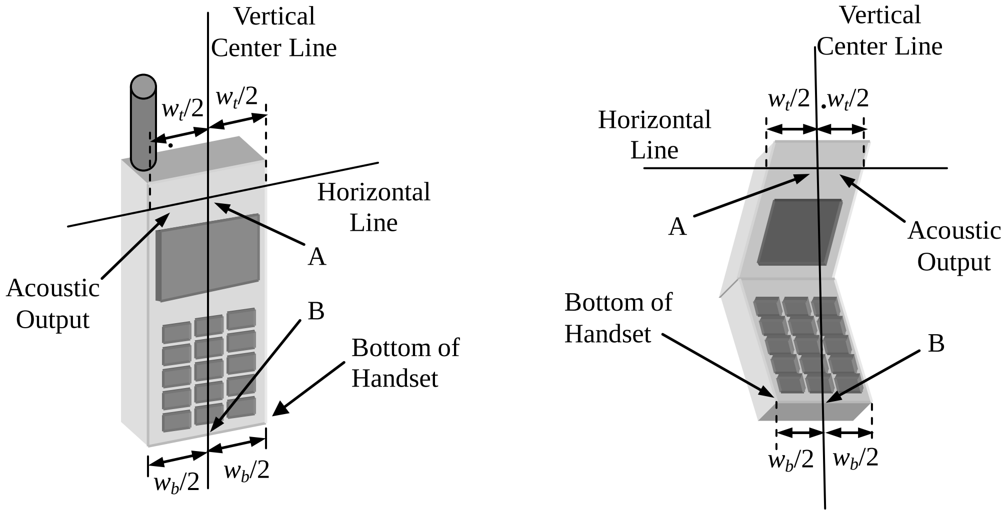


Fig 8.1 Illustration for Handset Vertical and Horizontal Reference Lines

8.2 Cheek Position

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

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

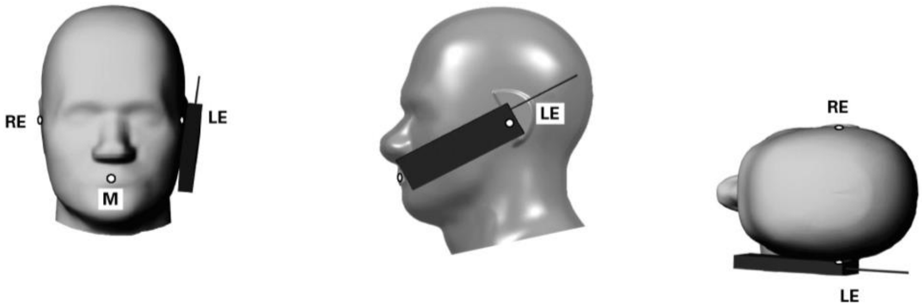


Fig 8.2 Illustration for Cheek Position

8.3 Tilted Position

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

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

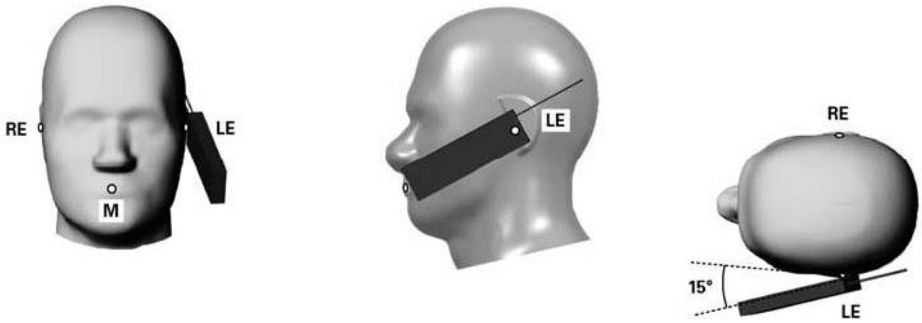


Fig 8.3 Illustration for Tilted Position

8.4 Body Worn Position

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

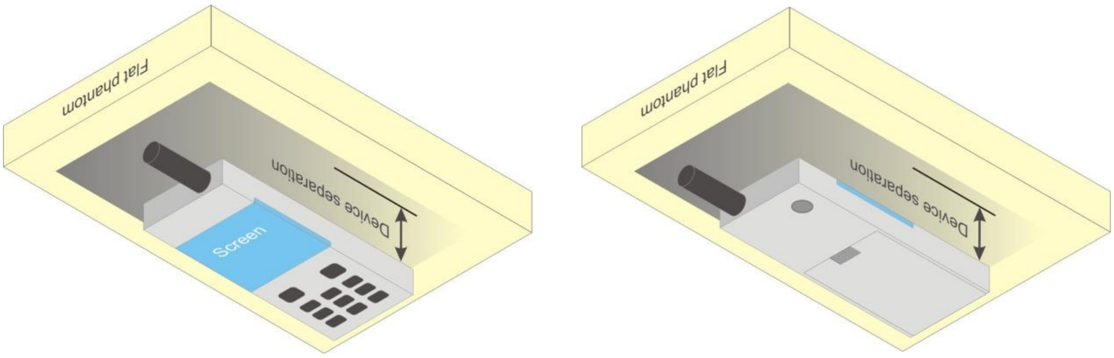


Fig 8.4 Illustration for Body Worn Position

8.5 Hotspot Position

(a) To position the device parallel to the phantom surface with all sides and either keypad up or down.
(b) To adjust the device parallel to the flat phantom.
(c) To adjust the distance between the device and the flat phantom to 1.0cm.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

9. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

9.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

9.2 Power Reference Measurement

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

9.3 Area & Zoom Scan Procedures

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

<table>
<tr><td colspan="3"></td><td>$\leq$ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>$\leq$ 2 GHz: $\leq$ 8 mm
2 – 3 GHz: $\leq$ 5 mm*</td><td>3 – 4 GHz: $\leq$ 5 mm*
4 – 6 GHz: $\leq$ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>$\leq$ 5 mm</td><td>3 – 4 GHz: $\leq$ 4 mm
4 – 5 GHz: $\leq$ 3 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>$\leq$ 4 mm</td><td>3 – 4 GHz: $\leq$ 3 mm
4 – 5 GHz: $\leq$ 2.5 mm
5 – 6 GHz: $\leq$ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>$\geq$ 30 mm</td><td>3 – 4 GHz: $\geq$ 28 mm
4 – 5 GHz: $\geq$ 25 mm
5 – 6 GHz: $\geq$ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

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. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v3.0+EDR	Bluetooth v4.0+LE
2.4GHz Bluetooth	9.0	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
9.0	5 mm	2.48	2.52

2. Per KDB 447498 D01v05r01 exclusion thresholds is 2.52 < 3, RF exposure evaluation is not required.

11. 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. For Head and Body-worn SAR testing, the EUT was set in GSM Voice for GSM1900.
3. For hotspot mode SAR testing, the EUT was set in GPRS 1 Tx slot for GSM1900 due to its highest frame-average power.

Band GSM1900	Burst Average Power (dBm)			Tune-up Limit	Frame-Average Power (dBm)			Tune-up Limit
TX Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GSM (GMSK, 1 Tx slot)	30.86	30.72	30.98	31.00	21.86	21.72	21.98	22.00
GPRS (GMSK, 1 Tx slot) – CS1	30.76	30.70	30.97	31.00	21.76	21.70	21.97	22.00
GPRS (GMSK, 2 Tx slots) – CS1	27.70	27.66	27.95	28.50	21.70	21.66	21.95	22.50
GPRS (GMSK, 3 Tx slots) – CS1	26.01	25.94	26.12	27.00	21.75	21.68	21.86	22.74
GPRS (GMSK, 4 Tx slots) – CS1	24.76	24.71	24.85	26.00	21.76	21.71	21.85	23.00

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

<WLAN 2.4GHz Conducted Power>

WLAN 2.4GHz 802.11b Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	Data Rate	
		1Mbps	
CH 1	2412	13.61	14.0
CH 6	2437	13.42	
CH 11	2462	13.15	

WLAN 2.4GHz 802.11g Average Power (dBm)			Tune up limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	Data Rate	
		6Mbps	
CH 1	2412	12.71	13.0
CH 6	2437	12.46	
CH 11	2462	12.33	

WLAN 2.4GHz 802.11n-HT20 Average Power (dBm)			Tune up limits (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 1	2412	11.19	12.0
CH 6	2437	10.88	
CH 11	2462	10.65	

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.

<WLAN 5GHz Conducted Power>

WLAN 5GHz 802.11a Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	Data Rate	
		6Mbps	
CH 36	5180	14.55	15.0
CH 40	5200	14.39	
CH 44	5220	14.36	
CH 48	5240	14.43	
CH 52	5260	14.39	
CH 56	5280	14.31	
CH 60	5300	14.42	
CH 64	5320	14.56	
CH 100	5500	14.01	
CH 104	5520	13.92	
CH 108	5540	13.99	
CH 112	5560	13.95	
CH 116	5580	14.32	
CH 132	5660	14.10	
CH 136	5680	14.06	
CH 140	5700	14.21	

WLAN 5GHz 802.11n-HT20 Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 36	5180	13.83	14.0
CH 40	5200	13.65	
CH 44	5220	13.56	
CH 48	5240	13.72	
CH 52	5260	13.66	
CH 56	5280	13.38	
CH 60	5300	13.41	
CH 64	5320	13.49	
CH 100	5500	13.31	
CH 104	5520	13.24	
CH 108	5540	13.16	
CH 112	5560	13.12	
CH 116	5580	13.38	
CH 132	5660	13.32	
CH 136	5680	13.29	
CH 140	5700	13.46	

WLAN 5GHz 802.11n-HT40 Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 38	5190	13.21	14.0
CH 46	5230	13.42	
CH 54	5270	13.05	
CH 62	5310	12.96	
CH 102	5510	12.02	
CH 110	5550	12.23	
CH 134	5670	12.43	

WLAN 5GHz 802.11ac-VHT20 Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 36	5180	13.89	14.0
CH 40	5200	13.67	
CH 44	5220	13.61	
CH 48	5240	13.86	
CH 52	5260	13.69	
CH 56	5280	13.41	
CH 60	5300	13.43	
CH 64	5320	13.52	
CH 100	5500	13.36	
CH 104	5520	13.26	
CH 108	5540	13.18	
CH 112	5560	13.16	
CH 116	5580	13.43	
CH 132	5660	13.36	
CH 136	5680	13.31	
CH 140	5700	13.53	

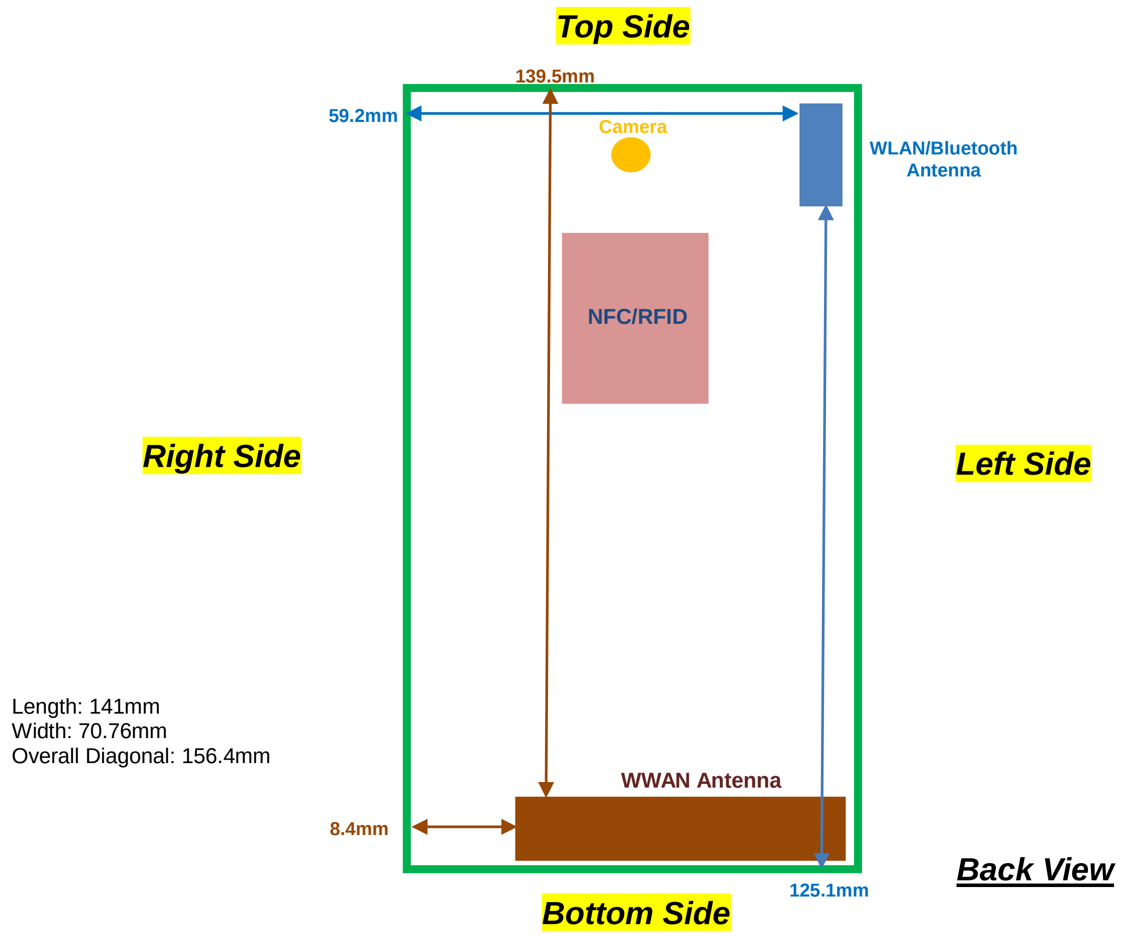
WLAN 5GHz 802.11ac-VHT40 Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 38	5190	11.60	13.0
CH 46	5230	11.72	
CH 54	5270	11.55	
CH 62	5310	11.73	
CH 102	5510	11.03	
CH 110	5550	10.93	
CH 134	5670	10.86	

WLAN 5GHz 802.11ac-VHT80 Average Power (dBm)			Tune up Limit (dBm)
Power vs. Channel			
Channel	Frequency (MHz)	MCS Index	
		MCS0	
CH 42	5210	11.86	12.0
CH 58	5290	11.73	
CH 106	5530	10.43	

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.

12. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	139.5mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	125.1mm	59.2mm	≤ 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

13. 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 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.
5. Per KDB 865664 D01v01r01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.

13.1 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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
8	GSM1900	GSM Voice	Right Cheek	810	1909.8	30.98	31	1.005	-0.07	0.168	0.169
9	GSM1900	GSM Voice	Right Tilted	810	1909.8	30.98	31	1.005	-0.1	0.076	0.076
10	GSM1900	GSM Voice	Left Cheek	810	1909.8	30.98	31	1.005	-0.04	0.208	0.209
11	GSM1900	GSM Voice	Left Tilted	810	1909.8	30.98	31	1.005	-0.09	0.095	0.095

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
34	WLAN 2.4GHz	802.11b 1Mbps	Right Cheek	1	2412	13.61	14	1.094	98.28	1.018	-0.034	0.227	0.253
35	WLAN 2.4GHz	802.11b 1Mbps	Right Tilted	1	2412	13.61	14	1.094	98.28	1.018	0.003	0.149	0.166
36	WLAN 2.4GHz	802.11b 1Mbps	Left Cheek	1	2412	13.61	14	1.094	98.28	1.018	0.07	0.146	0.163
37	WLAN 2.4GHz	802.11b 1Mbps	Left Tilted	1	2412	13.61	14	1.094	98.28	1.018	0.063	0.156	0.174

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
38	WLAN 5GHz	802.11a 6Mbps	Right Cheek	36	5180	14.55	15	1.109	88.79	1.126	-0.037	0.223	0.278
39	WLAN 5GHz	802.11a 6Mbps	Right Tilted	36	5180	14.55	15	1.109	88.79	1.126	0.028	0.240	0.299
40	WLAN 5GHz	802.11a 6Mbps	Left Cheek	36	5180	14.55	15	1.109	88.79	1.126	0.051	0.193	0.241
41	WLAN 5GHz	802.11a 6Mbps	Left Tilted	36	5180	14.55	15	1.109	88.79	1.126	0.002	0.186	0.232
42	WLAN 5GHz	802.11ac-VHT80 MCS0	Right Tilted	42	5210	11.86	12	1.033	57.07	1.752	0.042	0.076	0.137
43	WLAN 5GHz	802.11a 6Mbps	Right Cheek	64	5320	14.56	15	1.107	88.79	1.126	-0.088	0.104	0.129
44	WLAN 5GHz	802.11a 6Mbps	Right Tilted	64	5320	14.56	15	1.107	88.79	1.126	0.064	0.125	0.156
12	WLAN 5GHz	802.11a 6Mbps	Left Cheek	64	5320	14.56	15	1.107	88.79	1.126	0.004	0.091	0.113
13	WLAN 5GHz	802.11a 6Mbps	Left Tilted	64	5320	14.56	15	1.107	88.79	1.126	0.076	0.088	0.110
14	WLAN 5GHz	802.11ac-VHT80 MCS0	Right Tilted	58	5290	11.73	12	1.064	57.07	1.752	-0.054	0.062	0.116
15	WLAN 5GHz	802.11a 6Mbps	Right Cheek	116	5580	14.32	15	1.169	88.79	1.126	-0.006	0.308	0.406
16	WLAN 5GHz	802.11a 6Mbps	Right Tilted	116	5580	14.32	15	1.169	88.79	1.126	0.145	0.298	0.393
17	WLAN 5GHz	802.11a 6Mbps	Left Cheek	116	5580	14.32	15	1.169	88.79	1.126	0.168	0.262	0.345
18	WLAN 5GHz	802.11a 6Mbps	Left Tilted	116	5580	14.32	15	1.169	88.79	1.126	0.032	0.252	0.332
19	WLAN 5GHz	802.11ac-VHT80 MCS0	Right Cheek	106	5530	10.43	12	1.435	57.07	1.752	0.031	0.070	0.177

13.2 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	139.5mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	125.1mm	59.2mm	≤ 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

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1	GSM1900	GPRS (GMSK 1 Tx slots)	Front	1cm	810	1909.8	30.97	31	1.007	-0.04	0.262	0.264
2	GSM1900	GPRS (GMSK 1 Tx slots)	Back	1cm	810	1909.8	30.97	31	1.007	-0.12	0.271	0.273
3	GSM1900	GPRS (GMSK 1 Tx slots)	Left side	1cm	810	1909.8	30.97	31	1.007	-0.02	0.180	0.181
4	GSM1900	GPRS (GMSK 1 Tx slots)	Right side	1cm	810	1909.8	30.97	31	1.007	-0.07	0.047	0.047
5	GSM1900	GPRS (GMSK 1 Tx slots)	Bottom side	1cm	810	1909.8	30.97	31	1.007	-0.05	0.338	**0.340**

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
29	WLAN 2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	13.61	14	1.094	98.28	1.018	-0.074	0.060	0.067
30	WLAN 2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	13.61	14	1.094	98.28	1.018	-0.039	0.073	**0.081**
31	WLAN 2.4GHz	802.11b 1Mbps	Left Side	1cm	1	2412	13.61	14	1.094	98.28	1.018	0.103	0.028	0.031
33	WLAN 2.4GHz	802.11b 1Mbps	Top Side	1cm	1	2412	13.61	14	1.094	98.28	1.018	-0.048	0.054	0.060

13.3 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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
6	GSM1900	GSM Voice	Front	1cm	810	1909.8	30.98	31	1.005	-0.09	0.256	0.257
7	GSM1900	GSM Voice	Back	1cm	810	1909.8	30.98	31	1.005	-0.1	0.265	**0.266**

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
29	WLAN 2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	13.61	14	1.094	98.28	1.018	-0.074	0.060	0.067
30	WLAN 2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	13.61	14	1.094	98.28	1.018	-0.039	0.073	**0.081**

<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 1g SAR (W/kg)	Reported 1g SAR (W/kg)
20	WLAN 5GHz	802.11a 6Mbps	Front	1cm	36	5180	14.55	15	1.109	88.79	1.126	0.114	0.066	0.082
21	WLAN 5GHz	802.11a 6Mbps	Back	1cm	36	5180	14.55	15	1.109	88.79	1.126	0.053	0.080	**0.100**
22	WLAN 5GHz	802.11ac-VHT80 MCS0	Back	1cm	42	5210	11.86	12	1.033	57.07	1.752	-0.11	0.030	0.055
23	WLAN 5GHz	802.11a 6Mbps	Front	1cm	64	5320	14.56	15	1.107	88.79	1.126	0.147	0.065	0.081
24	WLAN 5GHz	802.11a 6Mbps	Back	1cm	64	5320	14.56	15	1.107	88.79	1.126	-0.196	0.077	**0.096**
25	WLAN 5GHz	802.11ac-VHT80 MCS0	Back	1cm	58	5290	11.73	12	1.064	57.07	1.752	-0.089	0.024	0.045
26	WLAN 5GHz	802.11a 6Mbps	Front	1cm	116	5580	14.32	15	1.169	88.79	1.126	0.116	0.079	0.104
27	WLAN 5GHz	802.11a 6Mbps	Back	1cm	116	5580	14.32	15	1.169	88.79	1.126	-0.056	0.096	**0.126**
28	WLAN 5GHz	802.11ac-VHT80 MCS0	Back	1cm	106	5530	10.43	12	1.435	57.07	1.752	0.095	0.026	0.066

13.4 Highest SAR Plot

TestLaboratory: Sporton International Inc. SAR/HAC TestingLab Date: 2013.09.29

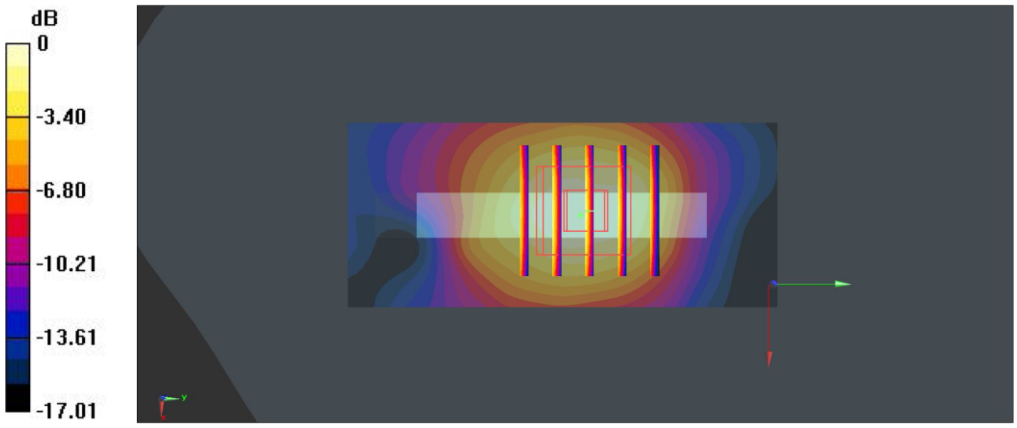
05 GSM1900_GPRS (GMSK 1 Tx slots)_Bottom side_1Cm_Ch810

Communication System: GPRS/EDGE (1 Tx slot);Frequency: 1909.8 MHz;Duty Cycle: 1:8.3
Medium: MSL_1900_130929 Medium parameters used: f = 1910 MHz; σ = 1.544 S/m; ε_r = 54.559; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3911; ConvF(7.7, 7.7, 7.7); Calibrated: 2013.04.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2013.04.08
- Phantom: SAM 1; Type: QD 000 P40 C; Serial: TP-1753
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

Ch810/Area Scan (31x71x1): Interpolated grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.480 W/kg

Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.965 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.529 W/kg
SAR(1 g) = 0.338 W/kg; SAR(10 g) = 0.196 W/kg
Maximum value of SAR (measured) = 0.451 W/kg



0 dB = 0.451 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2013/10/10

#34_WLAN 2.4GHz_802.11b 1Mbps_Right Cheek_Ch1

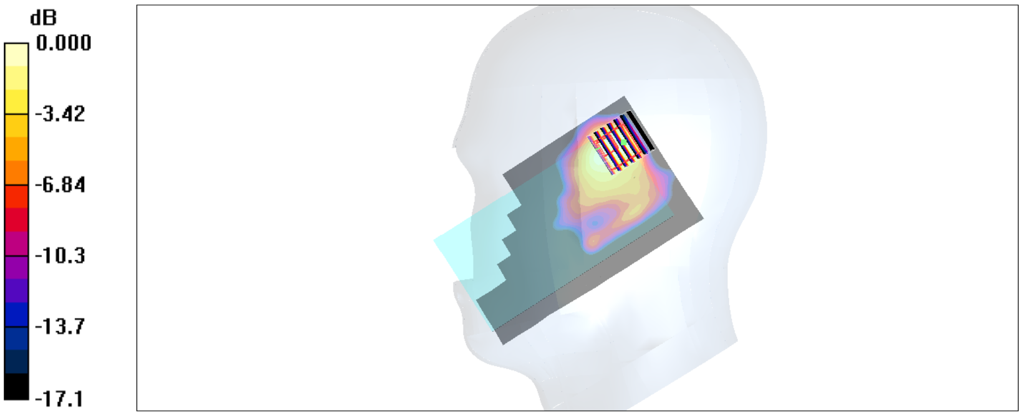
Communication System: 802.11b ; Frequency: 2412 MHz;Duty Cycle: 1:1.018
Medium: HSL_2450_131010 Medium parameters used: f = 2412 MHz; σ = 1.81 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3

Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3820; ConvF(6.74, 6.74, 6.74); Calibrated: 2012/12/10
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn913; Calibrated: 2013/1/17
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch1/Area Scan (81x131x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.385 mW/g

Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.3 V/m; Power Drift = -0.034 dB
Peak SAR (extrapolated) = 0.555 W/kg
SAR(1 g) = 0.227 mW/g; SAR(10 g) = 0.106 mW/g
Maximum value of SAR (measured) = 0.368 mW/g



0 dB = 0.368mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2013/10/11

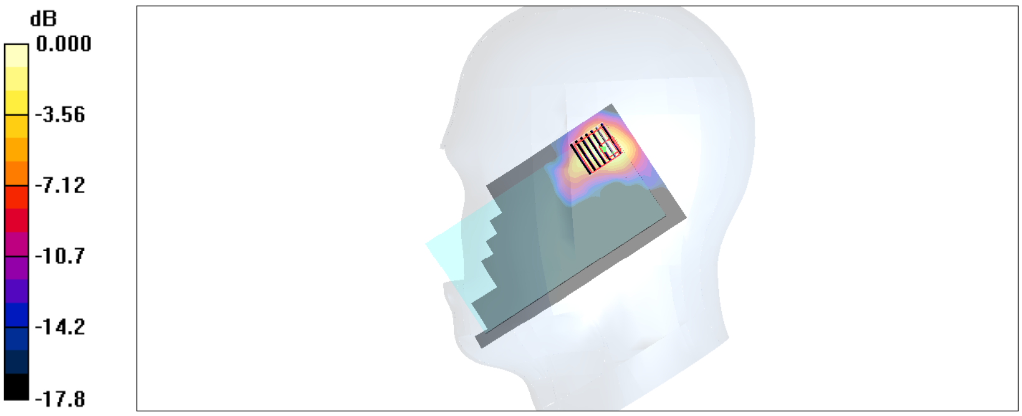
#15_WLAN 5GHz_802.11a 6Mbps_Right Cheek_Ch116

Communication System: 802.11a; Frequency: 5580 MHz;Duty Cycle: 1:1.126
Medium: HSL_5G_131011 Medium parameters used: f = 5580 MHz; σ = 5.19 mho/m; ε_r = 34.8; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3820; ConvF(4.31, 4.31, 4.31); Calibrated: 2012/12/10
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn913; Calibrated: 2013/1/17
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch116/Area Scan (91x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.653 mW/g

Ch116/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 12.7 V/m; Power Drift = -0.006 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.308 mW/g; SAR(10 g) = 0.098 mW/g
Maximum value of SAR (measured) = 0.728 mW/g



0 dB = 0.728mW/g

14. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	GSM(Voice) + WLAN2.4GHz(data)	Yes	Yes		
2.	GSM(Voice) + Bluetooth(data)	Yes	Yes		
3.	GSM(Voice) + WLAN5GHz(data)	Yes	Yes		
4.	GPRS/EDGE(Data) + WLAN2.4GHz(data)	Yes(1)	Yes(1)	Yes	2.4GHz Hotspot
5.	GPRS/EDGE(Data) + Bluetooth(data)	Yes(1)	Yes(1)	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
9.0 dBm	Estimated SAR (W/kg)	0.252 W/kg	0.126 W/kg	0.126 W/kg

14.1 Head Exposure Conditions

< WWAN + WLAN2.4GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM1900	8	0.169	34	0.253	**0.42**
Right Tilted	GSM1900	9	0.076	35	0.166	**0.24**
Left Cheek	GSM1900	10	0.209	36	0.163	**0.37**
Left Tilted	GSM1900	11	0.095	37	0.174	**0.27**

<WWAN + WLAN5.2GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM1900	8	0.169	38	0.278	**0.45**
Right Tilted	GSM1900	9	0.076	39	0.299	**0.38**
Left Cheek	GSM1900	10	0.209	40	0.241	**0.45**
Left Tilted	GSM1900	11	0.095	41	0.232	**0.33**

<WWAN + WLAN5.3GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM1900	8	0.169	43	0.129	**0.30**
Right Tilted	GSM1900	9	0.076	44	0.156	**0.23**
Left Cheek	GSM1900	10	0.209	12	0.113	**0.32**
Left Tilted	GSM1900	11	0.095	13	0.110	**0.21**

<WWAN + WLAN5.5GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Right Cheek	GSM1900	8	0.169	15	0.406	**0.58**
Right Tilted	GSM1900	9	0.076	16	0.393	**0.47**
Left Cheek	GSM1900	10	0.209	17	0.345	**0.55**
Left Tilted	GSM1900	11	0.095	18	0.332	**0.43**

<WWAN + Bluetooth>

	WWAN			Bluetooth	Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Estimated SAR (W/kg)	
Right Cheek	GSM1900	8	0.169	0.336	**0.51**
Right Tilted	GSM1900	9	0.076	0.336	**0.41**
Left Cheek	GSM1900	10	0.209	0.336	**0.55**
Left Tilted	GSM1900	11	0.095	0.336	**0.43**

14.2 Hotspot Exposure Conditions

<WWAN + WLAN2.4GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM1900	1	0.264	29	0.067	**0.33**
Back	GSM1900	2	0.273	30	0.081	**0.35**
Left Side	GSM1900	3	0.181	31	0.031	**0.21**
Right Side	GSM1900	4	0.047			**0.05**
Top Side				33	0.060	**0.06**
Bottom Side	GSM1900	5	0.340			**0.34**

<WWAN + Bluetooth>

	WWAN			Bluetooth	Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Estimated SAR (W/kg)	
Front	GSM1900	1	0.264	0.168	**0.39**
Back	GSM1900	2	0.273	0.168	**0.40**
Left Side	GSM1900	3	0.181	0.168	**0.31**
Right Side	GSM1900	4	0.047		**0.17**
Top Side				0.168	**0.13**
Bottom Side	GSM1900	5	0.340		**0.47**

14.3 Body-Worn Exposure Conditions

<WWAN + WLAN2.4GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM1900	6	0.257	29	0.067	**0.32**
Back	GSM1900	7	0.266	30	0.081	**0.35**

<WWAN + WLAN5.2GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM1900	6	0.257	20	0.082	**0.34**
Back	GSM1900	7	0.266	21	0.100	**0.37**

<WWAN + WLAN5.3GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM1900	6	0.257	23	0.081	**0.34**
Back	GSM1900	7	0.266	24	0.096	**0.36**

<WWAN + WLAN5.5GHz Band>

	WWAN			WLAN		Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Plot No	SAR (W/kg)	
Front	GSM1900	6	0.257	26	0.104	**0.36**
Back	GSM1900	7	0.266	27	0.126	**0.39**

<WWAN + Bluetooth>

	WWAN			Bluetooth	Summed SAR (W/kg)
Position	WWAN Band	Plot No	SAR (W/kg)	Estimated SAR (W/kg)	
Front	GSM1900	6	0.257	0.168	**0.43**
Back	GSM1900	7	0.266	0.168	**0.43**

Test Engineer： Mood Huang, Galen Zhang, and San Lin

15. Uncertainty Assessment

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

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

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 14.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	1/√3	1/√6	1/√2

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

(b) κ is the coverage factor

Table 15.1. Standard Uncertainty for Assumed Distribution

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

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

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

Table 15.2. 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 15.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

16. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

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

[4] SPEAG DASY System Handbook

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

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

[7] FCC KDB 648474 D04 v01r01, “SAR Evaluation Considerations for Wireless Handsets”, May 2013

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[10] FCC KDB 865664 D01 v01r01, "SAR Measurement Requirements for 100 MHz to 6 GHz", May 2013.

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