

# FCC SAR Test Report

**APPLICANT** : VERTU Corporation Limited  
**EQUIPMENT** : GSM/WCDMA Cellular Telephone with BT and WLAN  
**BRAND NAME** : VERTU  
**MODEL NAME** : RM-828V  
**MARKETING NAME** : VERTU Ti  
**FCC ID** : P7QRM-828V  
**STANDARD** : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2003  
FCC OET Bulletin 65 Supplement C (Edition 01-01)

The product was completely tested on Nov. 16, 2012. 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.

Reviewed by:



---

Jones Tsai / Manager



## **SPORTON INTERNATIONAL INC.**

**No. 52, Hwa Ya 1<sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.**

---

**SPORTON INTERNATIONAL INC.**

TEL : 886-3-327-3456

FAX : 886-3-328-4978

FCC ID : P7QRM-828V

Page Number : 1 of 49

Report Issued Date : Nov. 16, 2012

Report Version : Rev. 01



## **Table of Contents**

<b>1. Statement of Compliance .....</b>	<b>4</b>
<b>2. Administration Data .....</b>	<b>5</b>
2.1 Testing Laboratory.....	5
2.2 Applicant .....	5
2.3 Manufacturer .....	5
2.4 Application Details.....	5
<b>3. General Information .....</b>	<b>6</b>
3.1 Description of Equipment Under Test (EUT) .....	6
3.2 Product Photos.....	8
3.3 Applied Standard.....	8
3.4 Device Category and SAR Limits .....	8
3.5 Test Conditions.....	9
<b>4. Specific Absorption Rate (SAR).....</b>	<b>10</b>
4.1 Introduction .....	10
4.2 SAR Definition.....	10
<b>5. SAR Measurement System.....</b>	<b>11</b>
5.1 E-Field Probe .....	12
5.2 Data Acquisition Electronics (DAE) .....	13
5.3 Robot .....	13
5.4 Measurement Server.....	13
5.5 Phantom.....	14
5.6 Device Holder.....	15
5.7 Data Storage and Evaluation .....	16
5.8 Test Equipment List.....	18
<b>6. Tissue Simulating Liquids.....</b>	<b>19</b>
<b>7. SAR Measurement Evaluation .....</b>	<b>21</b>
7.1 Purpose of System Performance check .....	21
7.2 System Setup.....	21
7.3 SAR System Verification Results .....	22
<b>8. EUT Testing Position .....</b>	<b>23</b>
8.1 Define two imaginary lines on the handset.....	23
8.2 Cheek Position .....	24
8.3 Tilted Position.....	24
8.4 Body Worn Position.....	25
<b>9. Measurement Procedures .....</b>	<b>26</b>
9.1 Spatial Peak SAR Evaluation.....	26
9.2 Area & Zoom Scan Procedures.....	26
9.3 Volume Scan Procedures.....	27
9.4 SAR Averaged Methods .....	27
9.5 Power Drift Monitoring.....	27
<b>10. SAR Test Configurations.....</b>	<b>28</b>
10.1 Exposure Positions Consideration .....	28
10.2 Conducted RF Output Power (Unit: dBm) .....	30
<b>11. SAR Test Results .....</b>	<b>38</b>
11.1 Test Records for Head SAR Test.....	38
11.2 Test Records for Hotspot SAR Test .....	40
11.3 Test Records for Body-worn SAR Test .....	41
11.4 Simultaneous Multi-band Transmission Analysis.....	43
<b>12. Uncertainty Assessment .....</b>	<b>46</b>
<b>13. References.....</b>	<b>49</b>
<b>Appendix A. Plots of System Performance Check</b>	
<b>Appendix B. Plots of SAR Measurement</b>	
<b>Appendix C. DASY Calibration Certificate</b>	
<b>Appendix D. Product Photos</b>	
<b>Appendix E. Test Setup Photos</b>	



## Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA291928	Rev. 01	Initial issue of report	Nov. 16, 2012

## 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **VERTU Corporation Limited GSM/WCDMA Cellular Telephone with BT and WLAN, VERTU, RM-828V, VERTU Ti** are as follows.

### <Standalone SAR>

Band	Position	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
GSM850	Head	0.277	0.298
GSM1900	Head	0.24	0.306
WCDMA Band V	Head	0.372	0.47
WCDMA Band IV	Head	0.644	0.828
WCDMA Band II	Head	0.633	0.831
WLAN 2.4G	Head	0.105	0.143
WLAN 5G	Head	0.088	0.133
GSM850	Hotspot (1 cm Gap)	0.679	0.701
GSM1900	Hotspot (1 cm Gap)	0.327	0.415
WCDMA Band V	Hotspot (1 cm Gap)	0.687	0.869
WCDMA Band IV	Hotspot (1 cm Gap)	1	1.294
WCDMA Band II	Hotspot (1 cm Gap)	1.04	1.384
WLAN 2.4G	Hotspot (1 cm Gap)	0.116	0.158
GSM850	Body-worn (1 cm Gap)	0.364	0.392
GSM1900	Body-worn (1 cm Gap)	0.361	0.46
WCDMA Band V	Body-worn (1 cm Gap)	0.506	0.64
WCDMA Band IV	Body-worn (1 cm Gap)	1	1.294
WCDMA Band II	Body-worn (1 cm Gap)	1.04	1.384
WLAN 2.4G	Body-worn (1 cm Gap)	0.116	0.158
WLAN 5G	Body-worn (1 cm Gap)	0.843	1.238

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 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

## **2. Administration Data**

### **2.1 Testing Laboratory**

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1 <sup>st</sup> 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	VERTU Corporation Limited
Address	Beacon Hill Road, Church Crookham, Hampshire GU52 8DY, United Kingdom

### **2.3 Manufacturer**

Company Name	VERTU Corporation Limited
Address	Beacon Hill Road, Church Crookham, Hampshire GU52 8DY, United Kingdom

### **2.4 Application Details**

Date of Start during the Test	Oct. 16, 2012
Date of End during the Test	Nov. 16, 2012

### **3. General Information**

#### **3.1 Description of Equipment Under Test (EUT)**

<b>Product Feature &amp; Specification</b>	
<b>EUT</b>	GSM/WCDMA Cellular Telephone with BT and WLAN
<b>Brand Name</b>	VERTU
<b>Model Name</b>	RM-828V
<b>Marketing Name</b>	VERTU Ti
<b>FCC ID</b>	P7QRM-828V
<b>Tx Frequency</b>	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WLAN2.4G: 2412 MHz ~ 2462 MHz WLAN5G: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5700 MHz; 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
<b>Measure Maximum Average Output Power to Antenna</b>	GSM850: 32.45 dBm GSM1900: 29.45 dBm WCDMA Band V: 23.48 dBm WCDMA Band II: 23.32 dBm WCDMA Band IV: 23.41 dBm 802.11b: 16.16 dBm 802.11g: 13.17 dBm 802.11n-HT20 (2.4GHz) : 10.27 dBm 802.11n-HT40 (2.4GHz) : 10.37 dBm 802.11a : 11.31 dBm 802.11n-HT20 (5GHz) : 10.88 dBm 802.11n-HT40 (5GHz) : 10.90 dBm Bluetooth: 8.20 dBm

Product Feature & Specification	
<b>Antenna Type</b>	WWAN: PIFA Antenna WLAN/BT: Monopole with Couple Antenna NFC: Loop Antenna
<b>HW Version</b>	F2.0
<b>SW Version</b>	4.0.4.A.0.1.30
<b>Uplink Modulations</b>	GSM: GMSK GPRS: GMSK EDGE: GMSK / 8PSK WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK 802.11b: DSSS (BPSK / QPSK / CCK) 802.11a/g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) Bluetooth : GFSK Bluetooth EDR : $\pi/4$ -DQPSK, 8-DPSK Bluetooth 4.0 LE: GFSK NFC : ASK
<b>Dual Transfer Mode (DTM) Category</b>	Class A – EUT can support Packet Switched and Circuit Switched Network simultaneously.
<b>EUT Stage</b>	Identical Prototype
<b>Remark:</b> 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description. 2. 5600 MHz ~ 5650 MHz is notched. 3. WLAN5G does not support hotspot mode.	

Per KDB 941225 D04 requirement, the required test configuration for this device is as below:

1. This EUT is class A device
2. This EUT supports (E)GPRS multi-slot class 12 (max. uplink : 4, max. downlink : 4, total timeslots : 5)
3. This EUT supports DTM multi-slot class 11 (max. uplink : 3 for 1 CS & 2 PS, max. downlink : 4, total timeslots : 5)
4. The measured maximum conducted power can be referred to section 10.2 of this report
5. For DTM multi-slot class 11 link mode, the device was linked with system emulator (Agilent E5515C) and transmit maximum power on maximum number of Tx slots (one CS timeslot and two PS timeslots per frame).

Specification of Accessories complied with Test		
AC Adapter	Brand Name	VERTU
	Model Name	AC-31
Car Charger	Brand Name	VERTU
	Model Name	DC-30V
Portable Power Charger	Brand Name	VERTU
	Model Name	DC-15V
Battery	Brand Name	NOKIA
	Model Name	BL-5K
Earphone	Brand Name	VERTU
	Model Name	WH-3V
USB Cable 1	Brand Name	VERTU
	Model Name	CA-209DV
	Signal Line	1.2 meter shielded cable without ferrite core
USB Cable 2	Brand Name	VERTU
	Model Name	CA-210DV
	Signal Line	0.25 meter shielded cable without ferrite core
LCD Panel	Brand Name	CMI
	Model Name	Cleo
Camera (Main)	Brand Name	Toshiba
	Model Name	TCM8615MD
Camera (Front)	Brand Name	Sharp
	Model Name	RJ66HA101

### 3.2 Product Photos

Please refer to Appendix D.

### 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 OET Bulletin 65 Supplement C (Edition 01-01)
- FCC KDB 447498 D01 v04
- FCC KDB 648474 D01 v01r05
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D03 v01
- FCC KDB 941225 D04 v01
- FCC KDB 941225 D06 v01
- FCC KDB 248227 D01 v01r02

### 3.4 Device Category and SAR Limits

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



### **3.5 Test Conditions**

#### **3.5.1 Ambient Condition**

<b>Ambient Temperature</b>	20 to 24 °C
<b>Humidity</b>	< 60 %

#### **3.5.2 Test Configuration**

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. The EUT was set from the emulator to radiate maximum output power during all tests.

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

The maximum rated power of WWAN and WLAN is listed in "Tune-Up Procedure" exhibit, exhibit; the scaling factor is calculated according to the difference between measured output power and maximum tolerance power on this device.

## **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 ( $\rho$ ). The equation description is as below:

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

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

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

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

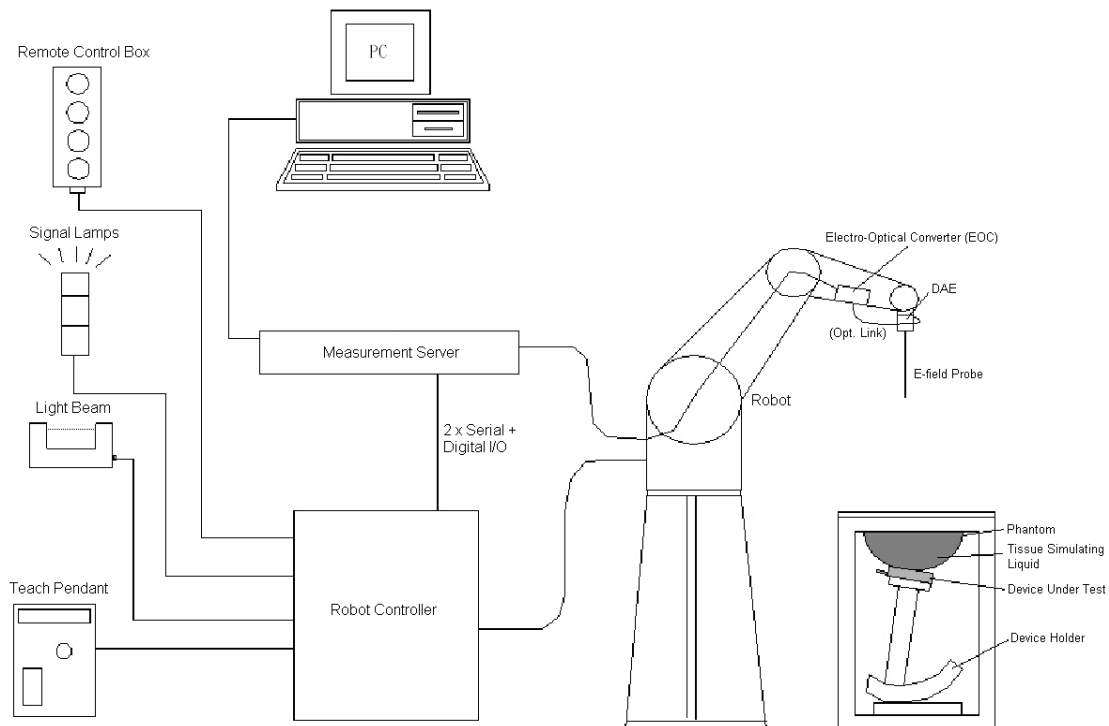
Where: C is the specific heat capacity,  $\delta T$  is the temperature rise and  $\delta t$  is the exposure duration, or related to the electrical field in the tissue by

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  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
- Remote control with teach pendant and additional circuitry for robot safety such as warning 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

#### <ES3DV3 Probe >

<b>Construction</b>	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)	
<b>Frequency</b>	10 MHz to 3 GHz; Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.4$ dB in HSL (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB	
<b>Dimensions</b>	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 / ES3DV4 Probe>

<b>Construction</b>	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
<b>Frequency</b>	10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB (noise: typically $< 1$ $\mu$ W/g)	
<b>Dimensions</b>	Overall length: 337 mm (Tip: 9 mm) Tip diameter: 2.5 mm (Body: 10 mm) Typical distance from probe tip to dipole centers: 2 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  $\pm 10\%$ . The spherical isotropy shall be evaluated and within  $\pm 0.25$ dB. 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 5.4 Photo of DAE**

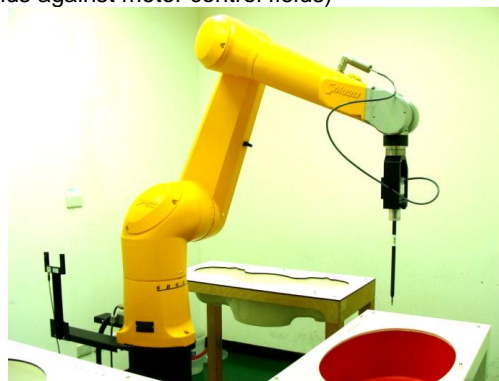
## 5.3 Robot

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  $\pm 0.035$  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**

## 5.5 Phantom

### <SAM Twin Phantom>

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

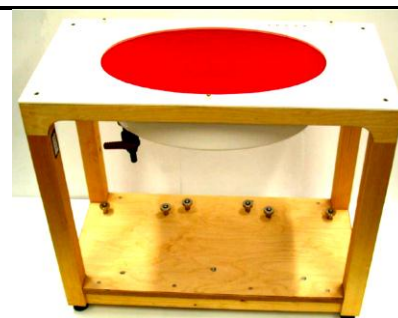


**Fig 5.9 Photo of SAM Phantom**

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>

<b>Shell Thickness</b>	2 ± 0.2 mm (sagging: <1%)
<b>Filling Volume</b>	Approx. 30 liters
<b>Dimensions</b>	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.

## 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  $\pm 0.5$  mm would produce a SAR uncertainty of  $\pm 20$  %. 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  $\epsilon = 3$  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 5.11 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.

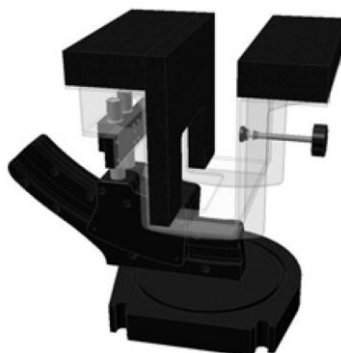


Fig 5.12 Laptop Extension Kit



## 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 :

<b>Probe parameters :</b>	- Sensitivity	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion factor	ConvF <sub>i</sub>
	- Diode compression point	dcp <sub>i</sub>
<b>Device parameters :</b>	- Frequency	f
	- Crest factor	cf
<b>Media parameters :</b>	- 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 :

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

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<sub>i</sub> = diode compression point (DASY parameter)

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

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

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

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

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

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

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

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

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. 22, 2010	Mar. 21, 2013
SPEAG	1750MHz System Validation Kit	D1750V2	1023	Jun. 20, 2012	Jun. 19, 2013
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 23, 2010	Mar. 22, 2013
SPEAG	2450MHz System Validation Kit	D2450V2	736	Jul. 25, 2011	Jul. 24, 2013
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Jan. 18, 2012	Jan. 17, 2013
SPEAG	Data Acquisition Electronics	DAE4	1338	Jun. 12, 2012	Jun. 11, 2013
SPEAG	Data Acquisition Electronics	DAE4	778	Aug. 27, 2012	Aug. 26, 2013
SPEAG	Data Acquisition Electronics	DAE4	1279	May 03, 2012	May 02, 2013
SPEAG	Data Acquisition Electronics	DAE4	915	Jun. 21, 2012	Jun. 20, 2013
SPEAG	Data Acquisition Electronics	DAE3	495	Apr. 23, 2012	Apr. 22, 2013
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 28, 2012	Sep. 27, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3801	Jun. 22, 2012	Jun. 21, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3792	Jun. 21, 2012	Jun. 20, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Sep. 28, 2012	Sep. 27, 2013
Wisewind	Thermometer	ETP-101	TM560	Nov. 16, 2011	Nov. 15, 2012
Wisewind	Thermometer	HTC-1	TM685	Nov. 16, 2011	Nov. 15, 2012
Wisewind	Thermometer	HTC-1	TM659	Nov. 16, 2011	Nov. 15, 2012
H.M.IRIS	Thermometer	TH-08	TM658	Nov. 16, 2011	Nov. 15, 2012
SPEAG	Device Holder	N/A	N/A	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1383	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1477	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1719	NCR	NCR
SPEAG	SAM Phantom	QD 000 P41 C	TP-1150	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 CD	TP-1644	NCR	NCR
SPEAG	SAM Phantom	SM 000 T01 DA	TP-1542	NCR	NCR
Agilent	Network Analyzer	E5071C	MY46101588	May 11, 2012	May 10, 2013
Agilent	ESG Vector Series Signal Generator	E4438C	MY49070755	Oct. 02, 2012	Oct. 01, 2013
Anritsu	Power Meter	ML2495A	1132003	Aug. 14, 2012	Aug. 13, 2013
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 05, 2012	Jan. 04, 2014
R&S	Universal Digital Radio communication Tester	CMU200	114256	Jun. 29, 2012	Jun. 28, 2013
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
Woken	Attenuator	WK0602-XX	N/A	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Spectrum Analyzer	FSP	101131	Jul. 23, 2012	Jul. 22, 2013

**Table 5.1 Test Equipment List**

**Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 450824 D02, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole D835V2, SN: 499, D1900V2, SN: 5d041, and D2450V2, SN: 736 can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

## 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 ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
<b>For Head</b>								
835	40.3	57.9	0.2	1.4	0.2	0	0.90	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
<b>For Body</b>								
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
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 Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Freq. (MHz)	Liquid Type	Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
835	Head	21.3	0.873	41.054	0.9	41.5	-3.00	-1.07	±5	Oct. 17, 2012
835	Head	21.4	0.898	41.252	0.9	41.5	-0.22	-0.60	±5	Oct. 25, 2012
835	Body	21.5	0.964	54.398	0.97	55.2	-0.62	-1.45	±5	Oct. 17, 2012
835	Body	21.4	0.962	54.42	0.97	55.2	-0.82	-1.41	±5	Oct. 25, 2012
835	Body	21.6	0.963	54.1	0.97	55.2	-0.72	-1.99	±5	Oct. 27, 2012
1750	Head	21.4	1.409	39.382	1.4	40	0.64	-1.55	±5	Oct. 17, 2012
1750	Body	21.6	1.505	52.347	1.52	53.3	-0.99	-1.79	±5	Oct. 17, 2012
1750	Body	21.5	1.479	52.368	1.52	53.3	-2.70	-1.75	±5	Oct. 27, 2012
1900	Head	21.6	1.429	38.693	1.40	40.0	2.07	-3.27	±5	Oct. 16, 2012
1900	Body	21.5	1.545	53.277	1.52	53.3	1.64	-0.04	±5	Oct. 16, 2012
1900	Body	21.5	1.526	53.367	1.52	53.3	0.39	0.13	±5	Oct. 16, 2012
1900	Body	21.7	1.53	52.859	1.52	53.3	0.66	-0.83	±5	Oct. 23, 2012
1900	Body	21.4	1.523	52.215	1.52	53.3	0.20	-2.04	±5	Oct. 27, 2012
1900	Body	21.3	1.535	52.471	1.52	53.3	0.99	-1.56	±5	Nov. 16, 2012
2450	Head	21.3	1.828	38.807	1.8	39.2	1.56	-1.00	±5	Oct. 19, 2012
2450	Body	21.3	1.968	53.802	1.95	52.7	0.92	2.09	±5	Oct. 19, 2012
2450	Body	21.4	1.969	52.278	1.95	52.7	0.97	-0.80	±5	Oct. 27, 2012
5200	Head	21.4	4.786	35.42	4.66	36	2.70	-1.61	±5	Oct. 19, 2012
5200	Body	21.7	5.257	47.536	5.3	49	-0.81	-2.99	±5	Oct. 24, 2012
5500	Head	21.4	5.098	34.948	4.96	35.6	2.78	-1.83	±5	Oct. 19, 2012
5500	Body	21.7	5.645	47.008	5.65	48.6	-0.09	-3.28	±5	Oct. 24, 2012
5800	Head	21.4	5.393	34.361	5.27	35.3	2.33	-2.66	±5	Oct. 19, 2012
5800	Body	21.7	6.144	46.492	6	48.2	2.40	-3.54	±5	Oct. 24, 2012

**Table 6.2 Measuring Results for Simulating Liquid**

## **7. SAR Measurement Evaluation**

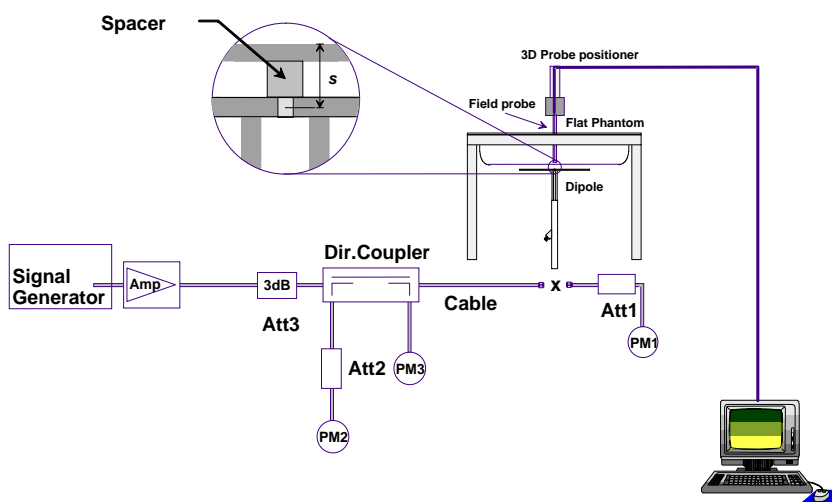
Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix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



**Fig 7.2 Photo of Dipole Setup**

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

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.

### 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 verification criterion and the plots can be referred to Appendix A of this report.

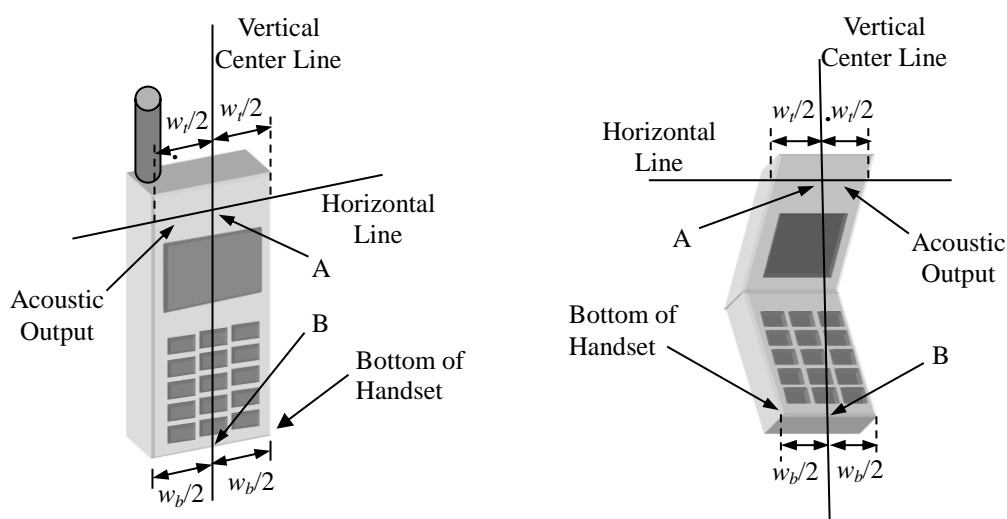
Measurement Date	Frequency (MHz)	Liquid Type	Targeted SAR <sub>1g</sub> (W/kg)	Measured SAR <sub>1g</sub> (W/kg)	Normalized SAR <sub>1g</sub> (W/kg)	Deviation (%)
Oct. 17, 2012	835	Head	9.71	2.35	9.40	-3.19
Oct. 25, 2012	835	Head	9.71	2.43	9.72	0.10
Oct. 17, 2012	835	Body	9.82	2.34	9.36	-4.68
Oct. 25, 2012	835	Body	9.82	2.55	10.20	3.87
Oct. 27, 2012	835	Body	9.82	2.28	9.12	-7.13
Oct. 17, 2012	1750	Head	35.8	9.18	36.72	2.57
Oct. 17, 2012	1750	Body	37.0	9.27	37.08	0.22
Oct. 27, 2012	1750	Body	37.0	9.30	37.20	0.54
Oct. 16, 2012	1900	Head	39.8	9.65	38.60	-3.02
Oct. 16, 2012	1900	Body	40.0	10	40.00	0.00
Oct. 16, 2012	1900	Body	40.0	10.4	41.60	4.00
Oct. 23, 2012	1900	Body	40.0	10.3	41.20	3.00
Oct. 27, 2012	1900	Body	40.0	10.1	40.40	1.00
Nov. 16, 2012	1900	Body	40.0	9.48	37.92	-5.20
Oct. 19, 2012	2450	Head	54.8	13.2	52.80	-3.65
Oct. 19, 2012	2450	Body	52.3	12.4	49.60	-5.16
Oct. 27, 2012	2450	Body	52.3	13.4	53.60	2.49
Oct. 19, 2012	5200	Head	79.2	20.6	82.40	4.04
Oct. 24, 2012	5200	Body	72.6	16.9	67.60	-6.89
Oct. 19, 2012	5500	Head	85.2	21.6	86.40	1.41
Oct. 24, 2012	5500	Body	78.8	18.9	75.60	-4.06
Oct. 19, 2012	5800	Head	79.0	19.8	79.20	0.25
Oct. 24, 2012	5800	Body	73.1	17.4	69.60	-4.79

**Table 7.1 Target and Measurement SAR after Normalized**

## 8. EUT Testing Position

### 8.1 Define two imaginary lines on the handset

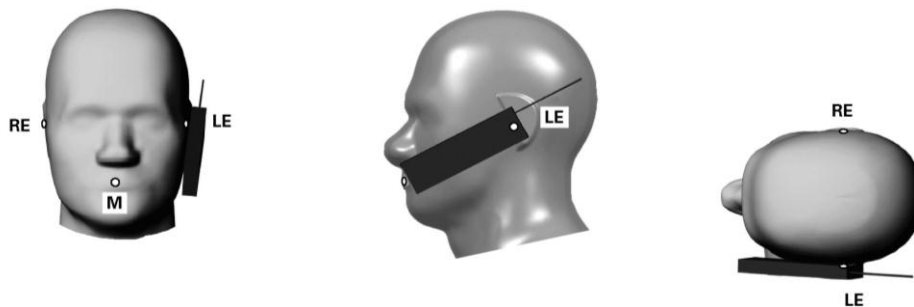
- The vertical centerline passes through two points on the front side of the handset - the midpoint of the width  $w_t$  of the handset at the level of the acoustic output, and the midpoint of the width  $w_b$  of the bottom of the handset.
- The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
- 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**

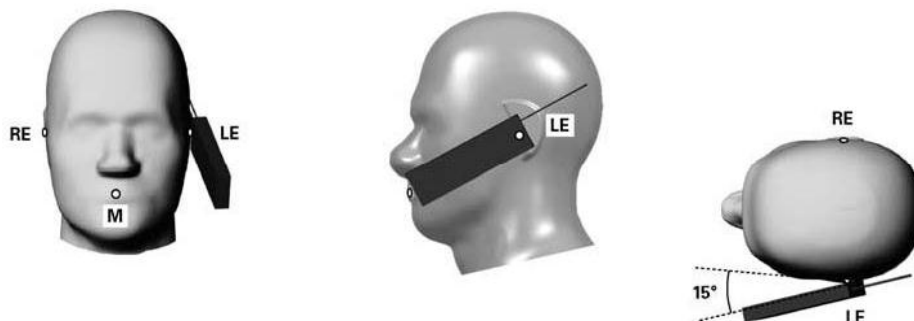
- (a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing 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).

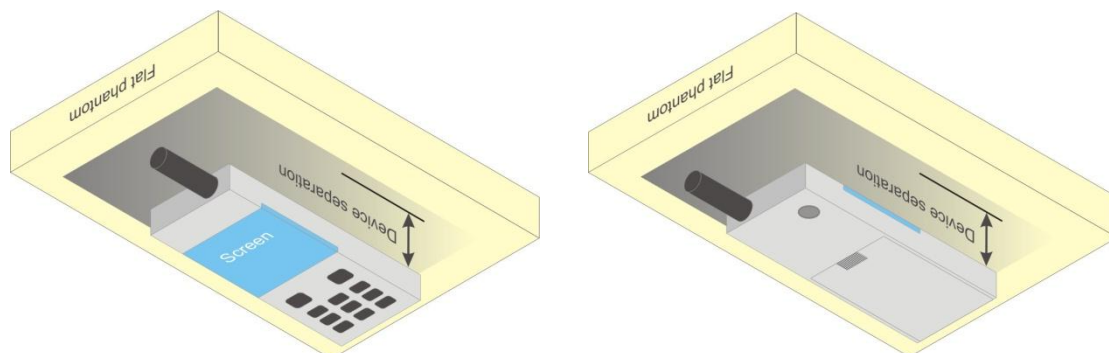


**Fig 8.3 Illustration for Tilted Position**



### **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 1.5cm.



**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 E for the test setup photos.

## 9. Measurement Procedures

The measurement procedures are as follows:

### <Conducted power measurement>

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

### <SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix E 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 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 from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

### 9.2 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 measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.



### **9.3 Volume Scan Procedures**

The volume scan is used to assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remains in the same test position for all measurements and all volume scans use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scans are completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculate the multiband SAR.

### **9.4 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.

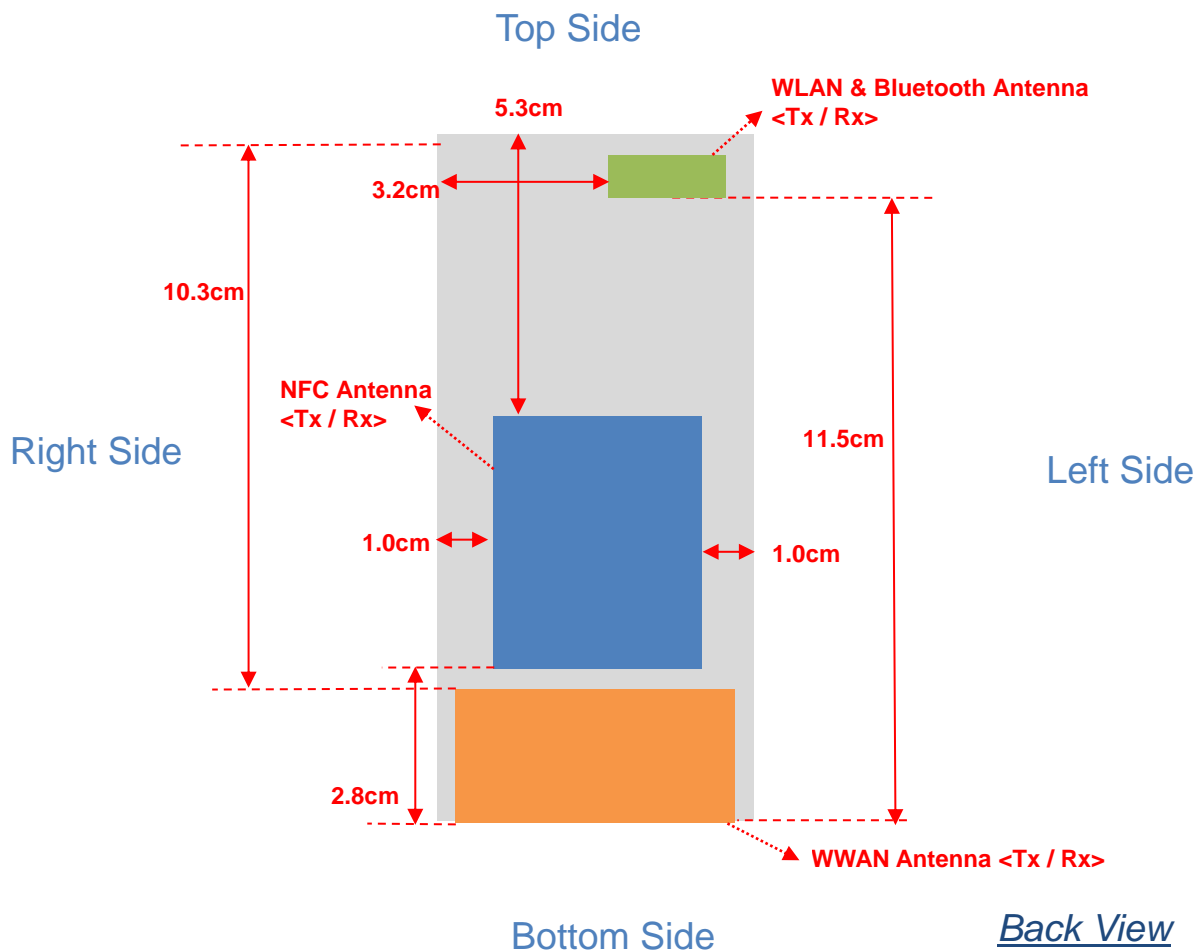
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty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

### **9.5 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. SAR Test Configurations

### 10.1 Exposure Positions Consideration



Antennas	Wireless Interface
WWAN Antenna (Tx / Rx)	GSM850 GSM1900 WCDMA Band V WCDMA Band IV WCDMA Band II
BT&WLAN Antenna (Tx / Rx)	WLAN 2.4GHz WLAN 5GHz Bluetooth

Sides for SAR tests; Hotspot mode Test distance: 10 mm						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN	YES	YES	NO	YES	YES	YES
BT&WLAN	YES	YES	YES	NO	NO	YES

**Note:**

1. Head/Body-worn/Hotspot mode SAR assessments are required.
2. Referring to KDB 941225 D06, when the overall device length and width are  $\geq 9\text{cm} \times 5\text{cm}$ , the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.
3. For WWAN antenna, SAR measurements at Top side is not required since the distance between the transmitting antenna and surface of device is  $> 25\text{mm}$ .
4. For BT&WLAN antenna, SAR measurements Bottom/Right side are not required since the distance between the transmitting antenna and surface of device is  $> 25\text{mm}$ .
5. Per KDB 648474 D01, Bluetooth output power  $\leq 2 \times P_{\text{Ref}}$  and the distance to WWAN antennas  $\geq 5\text{cm}$ , therefore, stand-alone SAR is not required.

## 10.2 Conducted RF Output Power (Unit: dBm)

### <GSM Conducted Power>

Band: GSM850		Burst Average Power (dBm)			Frame-Average Power (dBm)		
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)		32.38	32.39	32.45	23.38	23.39	23.45
GPRS (GMSK, 1 Tx slot) – CS1		32.27	32.33	32.40	23.27	23.33	23.40
GPRS (GMSK, 2 Tx slots) – CS1		30.11	30.30	30.36	24.11	24.30	24.36
GPRS (GMSK, 3 Tx slots) – CS1		28.11	28.26	28.32	23.85	24.00	24.06
GPRS (GMSK, 4 Tx slots) – CS1		26.71	26.76	26.84	23.71	23.76	23.84
EDGE (GMSK, 1 Tx slot) – MCS1		32.21	32.24	32.26	23.21	23.24	23.26
EDGE (GMSK, 2 Tx slots) – MCS1		30.01	30.19	30.24	24.01	24.19	24.24
EDGE (GMSK, 3 Tx slots) – MCS1		28.01	28.18	28.21	23.75	23.92	23.95
EDGE (GMSK, 4 Tx slots) – MCS1		26.65	26.68	26.74	23.65	23.68	23.74
EDGE (8PSK, 1 Tx slot) – MCS5		26.93	27.00	27.07	17.93	18.00	18.07
EDGE (8PSK, 2 Tx slots) – MCS5		23.67	23.68	23.70	17.67	17.68	17.70
EDGE (8PSK, 3 Tx slots) – MCS5		22.02	22.15	22.18	17.76	17.89	17.92
EDGE (8PSK, 4 Tx slots) – MCS5		20.93	20.95	21.01	17.93	17.95	18.01
DTM 5	GSM (GMSK, 1 Tx slot)	30.04	30.10	30.18	23.87	23.98	24.05
	GPRS (GMSK, 1 Tx slot) – CS1	29.74	29.89	29.96			
DTM 9	GSM (GMSK, 1 Tx slot)	29.92	30.08	30.16	23.81	23.96	24.04
	GPRS (GMSK, 1 Tx slot) – CS1	29.73	29.88	29.95			
DTM 11	GSM (GMSK, 1 Tx slot)	28.06	28.23	28.27	23.75	23.94	23.98
	GPRS (GMSK, 2 Tx slots) – CS1	27.99	28.19	28.23			
DTM 5	GSM (GMSK, 1 Tx slot)	29.88	29.93	30.02	21.76	21.80	21.88
	EDGE (8PSK, 1 Tx slot) – MCS5	23.54	23.57	23.62			
DTM 9	GSM (GMSK, 1 Tx slot)	29.85	29.94	30.01	21.72	21.80	21.87
	EDGE (8PSK, 1 Tx slot) – MCS5	23.50	23.53	23.60			
DTM 11	GSM (GMSK, 1 Tx slot)	28.13	28.30	28.40	20.84	20.97	21.08
	EDGE (8PSK, 2 Tx slots) – MCS5	22.06	22.10	22.24			
<b>Remark:</b> 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:

- For Head SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 5 for GSM850 due to its highest frame-average power.
- For Body-worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in DTM Multi-slot class 5 for GSM850 due to its highest frame-average power.
- For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in GPRS 2 Tx slots for GSM850 due to its highest frame-average power.
- Per KDB 648474, the maximum output power channel is used for SAR testing and for further SAR test reduction.

Band: GSM1900		Burst Average Power (dBm)			Frame-Average Power (dBm)		
Channel		512	661	810	512	661	810
Frequency (MHz)		1850.2	1880.0	1909.8	1850.2	1880.0	1909.8
GSM (GMSK, 1 Tx slot)		29.45	29.44	29.42	20.45	20.44	20.42
GPRS (GMSK, 1 Tx slot) – CS1		29.42	29.37	29.32	20.42	20.37	20.32
GPRS (GMSK, 2 Tx slots) – CS1		26.46	26.39	26.28	20.46	20.39	20.28
GPRS (GMSK, 3 Tx slots) – CS1		24.57	24.48	24.40	20.31	20.22	20.14
GPRS (GMSK, 4 Tx slots) – CS1		23.41	23.39	23.37	20.41	20.39	20.37
EDGE (GMSK, 1 Tx slot) – MCS1		29.41	29.38	29.36	20.41	20.38	20.36
EDGE (GMSK, 2 Tx slots) – MCS1		26.44	26.43	26.40	20.44	20.43	20.40
EDGE (GMSK, 3 Tx slots) – MCS1		24.67	24.62	24.46	20.41	20.36	20.20
EDGE (GMSK, 4 Tx slots) – MCS1		23.39	23.31	23.22	20.39	20.31	20.22
EDGE (8PSK, 1 Tx slot) – MCS5		26.11	25.92	25.90	17.11	16.92	16.90
EDGE (8PSK, 2 Tx slots) – MCS5		23.14	23.03	23.02	17.14	17.03	17.02
EDGE (8PSK, 3 Tx slots) – MCS5		21.44	21.39	21.38	17.18	17.13	17.12
EDGE (8PSK, 4 Tx slots) – MCS5		20.25	20.24	20.14	17.25	17.24	17.14
DTM 5	GSM (GMSK, 1 Tx slot)	26.31	26.27	26.20	20.24	20.20	20.12
	GPRS (GMSK, 1 Tx slot) – CS1	26.22	26.17	26.08			
DTM 9	GSM (GMSK, 1 Tx slot)	26.30	26.22	26.15	20.23	20.15	20.08
	GPRS (GMSK, 1 Tx slot) – CS1	26.21	26.12	26.05			
DTM 11	GSM (GMSK, 1 Tx slot)	24.53	24.40	24.31	20.28	20.14	20.06
	GPRS (GMSK, 2 Tx slots) – CS1	24.55	24.40	24.33			
DTM 5	GSM (GMSK, 1 Tx slot)	26.54	26.35	26.33	19.11	18.95	18.91
	EDGE (8PSK, 1 Tx slot) – MCS5	23.03	22.94	22.85			
DTM 9	GSM (GMSK, 1 Tx slot)	26.63	26.57	26.54	19.17	19.08	19.02
	EDGE (8PSK, 1 Tx slot) – MCS5	23.01	22.86	22.73			
DTM 11	GSM (GMSK, 1 Tx slot)	24.80	24.70	24.61	18.53	18.45	18.38
	EDGE (8PSK, 2 Tx slots) – MCS5	21.27	21.22	21.18			

**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:**

- For Head SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in GSM Voice for GSM1900 due to its highest frame-average power.
- For Body-worn SAR testing, GSM and DTM should be evaluated, therefore the EUT was set in GSM Voice for GSM1900 due to its highest frame-average power.
- For hotspot mode SAR testing, GPRS, EDGE and DTM should be evaluated, therefore the EUT was set in GPRS 2 Tx slots for GSM850 due to its highest frame-average power.
- Per KDB 648474, the maximum output power channel is used for SAR testing and for further SAR test reduction.

### <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 referred to the drawing of 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 ( $\beta_c$  and  $\beta_d$ ) 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:  $\beta$  values for transmitter characteristics tests with HS-DPCCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{hs}$ (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

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

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

Note 3: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of 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  $\beta_c/\beta_d$  ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$ .

### Setup Configuration



**HSUPA Setup Configuration:**

- a. The EUT was connected to Base Station referred to the drawing of 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 ( $\beta_c$  and  $\beta_d$ ) 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:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1)	$\beta_{ec}$	$\beta_{ed}$ (Note 5) (Note 6)	$\beta_{ed}$ (SF)	$\beta_{ed}$ (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	$\beta_{ed1}$ : 47/15 $\beta_{ed2}$ : 47/15	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: $\Delta_{ACK}$ , $\Delta_{NACK}$ and $\Delta_{CQI} = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$ . Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$ , $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference. Note 3: For subtest 1 the $\beta_c/\beta_d$ ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$ . Note 4: For subtest 5 the $\beta_c/\beta_d$ ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$ . Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g. Note 6: $\beta_{ed}$ can not be set directly, it is set by Absolute Grant Value.													

**Setup Configuration**

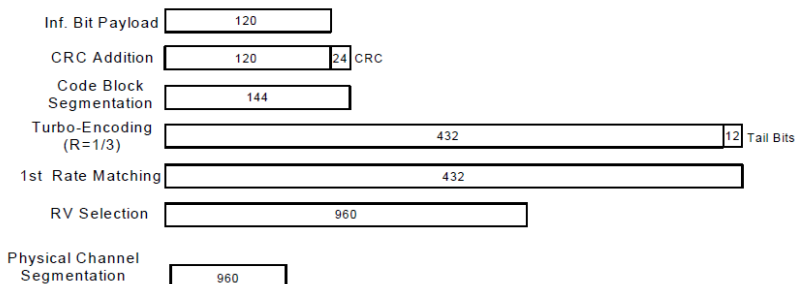
**DC-HSDPA 3GPP release 8 Setup Configuration:**

- a. The EUT was connected to Base Station referred to the drawing of 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 RMC 12.2Kbps + HSDPA mode.
  - ii. Set Cell Power = -25 dBm
  - iii. Set HS-DSCH Configuration Type to FRC (H-set 12, QPSK)
  - iv. Select HSDPA Uplink Parameters
  - v. Set Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters were set according to each Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
    - a). Subtest 1:  $\beta_c/\beta_d=2/15$
    - b). Subtest 2:  $\beta_c/\beta_d=12/15$
    - c). Subtest 3:  $\beta_c/\beta_d=15/8$
    - d). Subtest 4:  $\beta_c/\beta_d=15/4$
  - vi. Set Delta ACK, Delta NACK and Delta CQI = 8
  - vii. Set Ack-Nack Repetition Factor to 3
  - viii. Set CQI Feedback Cycle (k) to 4 ms
  - ix. Set CQI Repetition Factor to 2
  - x. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

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:

**C.8.1.12 Fixed Reference Channel Definition H-Set 12**
**Table C.8.1.12: Fixed Reference Channel H-Set 12**

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload ( $N_{INF}$ )	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.		
Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		


**Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)**
**Setup Configuration**

WCDMA Average power (dBm)										
Band		WCDMA Band V			WCDMA Band II			WCDMA Band IV		
Channel		4132	4182	4233	9262	9400	9538	1312	1413	1513
Frequency (MHz)		826.4	836.4	846.6	1852.4	1880.0	1907.6	1712.4	1732.6	1752.6
3GPP Rel 99	AMR 12.2K	23.38	23.29	23.45	23.21	23.30	23.29	23.37	23.39	23.36
3GPP Rel 99	RMC 12.2K	23.41	23.32	23.48	23.26	23.32	23.31	23.40	23.41	23.38
3GPP Rel 8	HSDPA Subtest-1	21.15	21.10	21.21	21.34	21.58	21.44	21.96	21.98	22.05
3GPP Rel 8	HSDPA Subtest-2	21.14	21.07	21.20	21.37	21.34	21.47	21.99	21.94	21.98
3GPP Rel 8	HSDPA Subtest-3	21.13	21.07	21.19	20.84	20.88	20.89	21.65	21.72	21.70
3GPP Rel 8	HSDPA Subtest-4	21.11	21.04	21.20	20.88	20.93	20.91	21.72	21.69	21.71
3GPP Rel 8	DC-HSDPA Subtest-1	21.11	21.14	21.18	21.33	21.54	21.45	22.01	21.96	22.03
3GPP Rel 8	DC-HSDPA Subtest-2	21.09	21.11	21.15	21.31	21.38	21.44	21.95	21.93	21.96
3GPP Rel 8	DC-HSDPA Subtest-3	21.08	21.12	21.15	20.89	20.91	20.86	21.68	21.70	21.74
3GPP Rel 8	DC-HSDPA Subtest-4	21.04	21.09	21.14	20.85	20.90	20.85	21.73	21.68	21.72
3GPP Rel 8	HSUPA Subtest-1	21.09	21.04	21.15	21.15	21.21	21.07	22.06	22.13	22.12
3GPP Rel 8	HSUPA Subtest-2	19.12	19.03	19.20	19.03	19.07	19.04	20.00	20.08	20.06
3GPP Rel 8	HSUPA Subtest-3	20.30	20.57	20.61	20.80	20.84	20.69	21.38	21.43	21.41
3GPP Rel 8	HSUPA Subtest-4	19.11	19.04	19.15	19.02	19.04	18.98	22.01	22.08	21.98
3GPP Rel 8	HSUPA Subtest-5	21.52	21.48	21.60	21.18	21.30	21.25	22.36	22.38	22.37

MPR (dB)											
3GPP MPR	Subtest			WCDMA Band V			WCDMA Band II			WCDMA Band IV	
0	3GPP Rel 8	HSDPA Subtest-1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	3GPP Rel 8	HSDPA Subtest-2		0.01	0.03	0.01	-0.03	0.24	-0.03	-0.03	0.04
≤ 0.5	3GPP Rel 8	HSDPA Subtest-3		0.02	0.03	0.02	0.50	0.70	0.55	0.31	0.26
≤ 0.5	3GPP Rel 8	HSDPA Subtest-4		0.04	0.06	0.01	0.46	0.65	0.53	0.24	0.29
0	3GPP Rel 8	HSUPA Subtest-1		0.43	0.44	0.45	0.03	0.09	0.18	0.30	0.25
≤ 2	3GPP Rel 8	HSUPA Subtest-2		2.40	2.45	2.40	2.15	2.23	2.21	2.36	2.30
≤ 1	3GPP Rel 8	HSUPA Subtest-3		1.22	0.91	0.99	0.38	0.46	0.56	0.98	0.95
≤ 2	3GPP Rel 8	HSUPA Subtest-4		2.41	2.44	2.45	2.16	2.26	2.27	0.35	0.30
0	3GPP Rel 8	HSUPA Subtest-5		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

**Note:**

- Applying the subtest setup in Table C.11.1.3 of 3GPP TS 34.121-1 V9.1.0 to Rel. 6 HSPA.
- For Head SAR, per KDB 941225 D01, 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.
- For Body SAR, per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
- By design, AMR, HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
- It is expected by the manufacturer that MPR for some HSDPA/HSUPA, subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.
- WCDMA supports release 8 DC-HSDPA downlink, but does not support HSPA+ 16QAM uplink

**<WLAN 2.4GHz Conducted Power>**

WLAN 2.4G 802.11b Average Power (dBm)						
Power vs. Channel			Power vs. Data Rate			
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)		
		1M		2M	5.5M	11M
CH 01	2412	15.58	11	15.92	15.93	15.81
CH 06	2437	15.54				
CH 11	2462	16.16				

WLAN 2.4G 802.11g Average Power (dBm)									
Power vs. Channel			Power vs. Data Rate						
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)					
		6M		9M	12M	18M	24M	36M	48M
CH 01	2412	13.12	11	13.07	13.14	13.14	13.13	13.11	13.04
CH 06	2437	12.92							
CH 11	2462	13.17							

WLAN 2.4G 802.11n (BW 20MHz) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 01	2412	10.16	11	10.25	10.21	10.24	10.25	10.25	10.20	10.23
CH 06	2437	9.65								
CH 11	2462	10.27								

WLAN 2.4G 802.11n (BW 40MHz) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 03	2422	9.57	09	10.31	10.35	10.33	10.34	10.30	10.29	10.34
CH 06	2437	9.59								
CH 09	2452	10.37								

**Note:**

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion
2. Per KDB 248227, 11g, 11n-HT20 and 11n-HT40 output power is less than 0.25dB higher than 11b mode, thus the SAR can be excluded.
3. 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 0.25dB higher than those measured at the lowest data rate.

**<Bluetooth Conducted Power>**

Channel	Frequency (MHz)	Average power (dBm)		
		Mode		
		GFSK	π/4-DQPSK	8-DPSK
CH 0	2402	8.20	6.77	6.78
CH 39	2441	7.90	6.56	6.51
CH 78	2480	7.76	6.40	6.37

Channel	Frequency (MHz)	Average power (dBm)	
		Mode	
		BT v4.0 LE, GFSK	
CH 0	2402	0.53	
CH 19	2440	0.23	
CH 39	2480	-0.15	

**<WLAN 5GHz Conducted Power>**

WLAN 5G 802.11a Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	Data Rate (bps)	Channel	Data Rate (bps)						
		6M		9M	12M	18M	24M	36M	48M	54M
CH 36	5180	11.29	36	11.18	11.17	11.14	11.20	11.08	11.22	11.28
CH 40	5200	10.70								
CH 44	5220	10.75								
CH 48	5240	11.15								
CH 52	5260	10.65	60	10.50	10.57	10.56	10.55	10.67	10.70	10.75
CH 56	5280	10.82								
CH 60	5300	10.83								
CH 64	5320	10.56								
CH 100	5500	11.31	100	11.08	10.93	11.07	10.89	11.03	11.11	11.18
CH 104	5520	10.62								
CH 108	5540	10.66								
CH 112	5560	10.72								
CH 116	5580	11.10								
CH 132	5660	10.77								
CH 136	5680	10.62								
CH 140	5700	11.22								
CH 149	5745	10.62	157	10.72	10.67	10.57	10.65	10.65	10.59	10.78
CH 153	5765	10.89								
CH 157	5785	10.94								
CH 161	5805	10.93								
CH 165	5825	10.71								

WLAN 5G 802.11n (BW 20M) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 36	5180	10.21	40	10.22	10.19	10.12	10.14	10.07	10.02	10.05
CH 40	5200	10.26								
CH 44	5220	10.14								
CH 48	5240	10.10								
CH 52	5260	10.27	60	10.32	10.32	10.36	10.32	10.31	10.34	10.20
CH 56	5280	9.82								
CH 60	5300	10.38								
CH 64	5320	10.20								
CH 100	5500	9.96	132	10.31	10.24	10.27	10.21	10.16	10.18	10.18
CH 104	5520	10.07								
CH 108	5540	10.16								
CH 112	5560	10.15								
CH 116	5580	10.07								
CH 132	5660	10.35								
CH 136	5680	10.25								
CH 140	5700	10.12								
CH 149	5745	10.55	157	10.86	10.84	10.60	10.83	10.63	10.66	10.71
CH 153	5765	9.68								
CH 157	5785	10.88								
CH 161	5805	9.82								
CH 165	5825	10.23								

WLAN 5G 802.11n (BW 40M) Average Power (dBm)										
Power vs. Channel			Power vs. Data Rate							
Channel	Frequency (MHz)	MCS Index	Channel	MCS Index						
		MCS0		MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 38	5190	10.47	38	10.26	10.33	10.24	10.36	10.42	10.36	10.43
CH 46	5230	9.84								
CH 54	5270	9.89	62	10.42	10.41	10.42	10.39	10.30	10.32	10.40
CH 62	5310	10.45								
CH 102	5510	10.04	102	9.93	9.87	9.82	9.80	9.91	9.81	9.88
CH 110	5550	9.95								
CH 134	5670	9.50								
CH 151	5755	10.62	159	10.84	10.86	10.87	10.84	10.82	10.83	10.87
CH 159	5795	10.90								

**Note:**

1. Per KDB 248227, choose the highest output power channel to test SAR and determine further SAR exclusion
2. Per KDB 248227, 11n-HT20 and 11n-HT40 output power is less than 0.25dB higher than 11a mode, thus the SAR can be excluded.
3. 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 0.25dB higher than those measured at the lowest data rate.

## 11. SAR Test Results

### 11.1 Test Records for Head SAR Test

#### <GSM SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
37	GSM 850	DTM Multi-slot class 5	Right Cheek	251	848.8	30.18	30.50	1.076	-0.03	0.248	0.267
38	GSM 850	DTM Multi-slot class 5	Right Tilted	251	848.8	30.18	30.50	1.076	-0.11	0.202	0.217
39	GSM 850	DTM Multi-slot class 5	Left Cheek	251	848.8	30.18	30.50	1.076	0.15	0.277	0.298
40	GSM 850	DTM Multi-slot class 5	Left Tilted	251	848.8	30.18	30.50	1.076	0.02	0.178	0.192
1	GSM1900	GSM Voice	Right Cheek	512	1850.2	29.45	30.50	1.274	-0.16	0.24	0.306
2	GSM1900	GSM Voice	Right Tilted	512	1850.2	29.45	30.50	1.274	0.02	0.08	0.102
3	GSM1900	GSM Voice	Left Cheek	512	1850.2	29.45	30.50	1.274	-0.01	0.169	0.215
4	GSM1900	GSM Voice	Left Tilted	512	1850.2	29.45	30.50	1.274	-0.02	0.068	0.087

**Note:** Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.

**<WCDMA SAR>**

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
94	WCDMA V	RMC12.2K	Right Cheek	4233	846.6	23.48	24.50	1.265	0.12	0.372	0.47
95	WCDMA V	RMC12.2K	Right Tilted	4233	846.6	23.48	24.50	1.265	-0.05	0.131	0.166
96	WCDMA V	RMC12.2K	Left Cheek	4233	846.6	23.48	24.50	1.265	-0.04	0.246	0.311
97	WCDMA V	RMC12.2K	Left Tilted	4233	846.6	23.48	24.50	1.265	-0.02	0.151	0.191
51	WCDMA IV	RMC12.2K	Right Cheek	1413	1732.6	23.41	24.50	1.285	-0.08	0.639	0.821
52	WCDMA IV	RMC12.2K	Right Tilted	1413	1732.6	23.41	24.50	1.285	-0.07	0.291	0.374
53	WCDMA IV	RMC12.2K	Left Cheek	1413	1732.6	23.41	24.50	1.285	0.133	0.644	0.828
54	WCDMA IV	RMC12.2K	Left Tilted	1413	1732.6	23.41	24.50	1.285	0.03	0.306	0.393
5	WCDMA II	RMC12.2K	Right Cheek	9400	1880	23.32	24.50	1.312	0.135	0.633	0.831
6	WCDMA II	RMC12.2K	Right Tilted	9400	1880	23.32	24.50	1.312	0.08	0.209	0.274
7	WCDMA II	RMC12.2K	Left Cheek	9400	1880	23.32	24.50	1.312	0.03	0.443	0.581
8	WCDMA II	RMC12.2K	Left Tilted	9400	1880	23.32	24.50	1.312	-0.01	0.196	0.257

**Note:** Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.

**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	Duty Cycle	Duty Cycle Compensate Factor	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR	Scaled SAR <sub>1g</sub> (W/kg)
55	WLAN2.4G	802.11b	Right Cheek	11	2462	16.16	17.5	1.360	0.02	97.63	1	0.105	0.105	0.143
56	WLAN2.4G	802.11b	Right Tilted	11	2462	16.16	17.5	1.360	-0.021	97.63	1	0.078	0.078	0.106
57	WLAN2.4G	802.11b	Left Cheek	11	2462	16.16	17.5	1.360	-0.09	97.63	1	0.079	0.079	0.107
58	WLAN2.4G	802.11b	Left Tilted	11	2462	16.16	17.5	1.360	-0.03	97.63	1	0.073	0.073	0.099
66	WLAN5G	802.11a	Right Cheek	36	5180	11.29	12.5	1.321	0.14	87.26	1.146	0.033	0.038	0.050
67	WLAN5G	802.11a	Right Tilted	36	5180	11.29	12.5	1.321	0.08	87.26	1.146	0.061	0.070	0.092
68	WLAN5G	802.11a	Left Cheek	36	5180	11.29	12.5	1.321	0.185	87.26	1.146	0.045	0.052	0.069
69	WLAN5G	802.11a	Left Tilted	36	5180	11.29	12.5	1.321	0.15	87.26	1.146	0.088	0.101	0.133
70	WLAN5G	802.11a	Right Cheek	60	5300	10.83	12.5	1.469	0.18	87.26	1.146	0.04	0.046	0.068
71	WLAN5G	802.11a	Right Tilted	60	5300	10.83	12.5	1.469	0.14	87.26	1.146	0.063	0.072	0.106
72	WLAN5G	802.11a	Left Cheek	60	5300	10.83	12.5	1.469	0.08	87.26	1.146	0.04	0.046	0.068
73	WLAN5G	802.11a	Left Tilted	60	5300	10.83	12.5	1.469	0.16	87.26	1.146	0.071	0.081	0.119
74	WLAN5G	802.11a	Right Cheek	140	5700	11.22	12.5	1.342	0.16	87.26	1.146	0.037	0.042	0.056
75	WLAN5G	802.11a	Right Tilted	140	5700	11.22	12.5	1.342	0.12	87.26	1.146	0.063	0.072	0.097
76	WLAN5G	802.11a	Left Cheek	140	5700	11.22	12.5	1.342	0.15	87.26	1.146	0.046	0.053	0.071
77	WLAN5G	802.11a	Left Tilted	140	5700	11.22	12.5	1.342	0.02	87.26	1.146	0.085	0.097	0.130
78	WLAN5G	802.11a	Right Cheek	157	5785	10.94	12.5	1.432	0.19	87.18	1.147	0.061	0.070	0.100
79	WLAN5G	802.11a	Right Tilted	157	5785	10.94	12.5	1.432	0.12	87.18	1.147	0.054	0.062	0.089
80	WLAN5G	802.11a	Left Cheek	157	5785	10.94	12.5	1.432	0.19	87.18	1.147	0.036	0.041	0.059
81	WLAN5G	802.11a	Left Tilted	157	5785	10.94	12.5	1.432	0.18	87.18	1.147	0.065	0.075	0.107

**Note:** Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.



## 11.2 Test Records for Hotspot SAR Test

### <GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
31	GSM 850	GPRS (2 Tx slots)	Front	1	251	848.8	30.36	30.50	1.033	-0.15	0.396	0.409
32	GSM 850	GPRS (2 Tx slots)	Back	1	251	848.8	30.36	30.50	1.033	0.03	0.406	0.419
33	GSM 850	GPRS (2 Tx slots)	Left Side	1	251	848.8	30.36	30.50	1.033	-0.05	0.426	0.440
34	GSM 850	GPRS (2 Tx slots)	Right Side	1	251	848.8	30.36	30.50	1.033	0.01	0.362	0.374
35	<b>GSM 850</b>	<b>GPRS (2 Tx slots)</b>	<b>Bottom Side</b>	<b>1</b>	<b>251</b>	<b>848.8</b>	<b>30.36</b>	<b>30.50</b>	<b>1.033</b>	<b>-0.09</b>	<b>0.679</b>	<b>0.701</b>
9	GSM1900	GPRS (2 Tx slots)	Front	1	512	1850.2	26.46	27.50	1.271	0.04	0.178	0.226
10	<b>GSM1900</b>	<b>GPRS (2 Tx slots)</b>	<b>Back</b>	<b>1</b>	<b>512</b>	<b>1850.2</b>	<b>26.46</b>	<b>27.50</b>	<b>1.271</b>	<b>0.133</b>	<b>0.327</b>	<b>0.415</b>
11	GSM1900	GPRS (2 Tx slots)	Left Side	1	512	1850.2	26.46	27.50	1.271	-0.143	0.069	0.088
12	GSM1900	GPRS (2 Tx slots)	Right Side	1	512	1850.2	26.46	27.50	1.271	0.1	0.141	0.179
13	GSM1900	GPRS (2 Tx slots)	Bottom Side	1	512	1850.2	26.46	27.50	1.271	-0.03	0.078	0.099

#### Note:

1. Per KDB 941225 D06, for EUT dimension  $\geq 9\text{cm} \times 5\text{cm}$ , the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
2. As in (1), SAR for Front / Back / Bottom Side / Left Side / Right Side is necessary.
3. Per KDB 648474 and KDB 447498 if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.

### <WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
25	WCDMA V	RMC12.2K	Front	1	4233	846.6	23.48	24.50	1.265	0.11	0.538	0.680
26	WCDMA V	RMC12.2K	Back	1	4233	846.6	23.48	24.50	1.265	0.05	0.577	0.730
27	<b>WCDMA V</b>	<b>RMC12.2K</b>	<b>Left Side</b>	<b>1</b>	<b>4233</b>	<b>846.6</b>	<b>23.48</b>	<b>24.50</b>	<b>1.265</b>	<b>0.05</b>	<b>0.687</b>	<b>0.869</b>
28	WCDMA V	RMC12.2K	Right Side	1	4233	846.6	23.48	24.50	1.265	0.09	0.526	0.665
29	WCDMA V	RMC12.2K	Bottom Side	1	4233	846.6	23.48	24.50	1.265	0.14	0.077	0.097
41	WCDMA IV	RMC12.2K	Front	1	1413	1732.6	23.41	24.50	1.285	-0.09	0.662	0.851
42	WCDMA IV	RMC12.2K	Back	1	1312	1712.4	23.40	24.50	1.288	-0.1	0.95	1.224
43	WCDMA IV	RMC12.2K	Back	1	1413	1732.6	23.41	24.50	1.285	-0.01	0.98	1.260
44	<b>WCDMA IV</b>	<b>RMC12.2K</b>	<b>Back</b>	<b>1</b>	<b>1513</b>	<b>1752.6</b>	<b>23.38</b>	<b>24.50</b>	<b>1.294</b>	<b>0.11</b>	<b>1</b>	<b>1.294</b>
45	WCDMA IV	RMC12.2K	Left Side	1	1413	1732.6	23.41	24.50	1.285	-0.08	0.244	0.314
46	WCDMA IV	RMC12.2K	Right Side	1	1413	1732.6	23.41	24.50	1.285	0.01	0.431	0.554
47	WCDMA IV	RMC12.2K	Bottom Side	1	1413	1732.6	23.41	24.50	1.285	-0.02	0.27	0.347
15	WCDMA II	RMC12.2K	Front	1	9400	1880	23.32	24.50	1.312	-0.11	0.536	0.703
16	WCDMA II	RMC12.2K	Back	1	9400	1880	23.32	24.50	1.312	-0.18	0.996	1.307
17	<b>WCDMA II</b>	<b>RMC12.2K</b>	<b>Back</b>	<b>1</b>	<b>9262</b>	<b>1852.4</b>	<b>23.26</b>	<b>24.50</b>	<b>1.330</b>	<b>0.13</b>	<b>1.04</b>	<b>1.384</b>
18	WCDMA II	RMC12.2K	Back	1	9538	1907.6	23.31	24.50	1.315	-0.09	0.968	1.273
19	WCDMA II	RMC12.2K	Left Side	1	9400	1880	23.32	24.50	1.312	0.09	0.204	0.268
20	WCDMA II	RMC12.2K	Right Side	1	9400	1880	23.32	24.50	1.312	-0.02	0.448	0.588
21	WCDMA II	RMC12.2K	Bottom Side	1	9400	1880	23.32	24.50	1.312	0.15	0.227	0.298

#### Note:

1. Per KDB 941225 D06, for EUT dimension  $\geq 9\text{cm} \times 5\text{cm}$ , the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
2. As in (1), SAR for Front / Back / Bottom Side / Left Side / Right Side is necessary.
3. Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.



**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Duty Cycle %	Duty Cycle Compensate Factor	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR	Scaled SAR <sub>1g</sub> (W/kg)
59	WLAN2.4G	802.11b	Front	1	11	2462	16.16	17.5	97.63	1	1.360	-0.06	0.043	0.043	0.058
60	WLAN2.4G	802.11b	Back	1	11	2462	16.16	17.5	97.63	1	1.360	-0.06	0.116	0.116	0.158
62	WLAN2.4G	802.11b	Left Side	1	11	2462	16.16	17.5	97.63	1	1.360	-0.02	0.044	0.044	0.060
64	WLAN2.4G	802.11b	Top Side	1	11	2462	16.16	17.5	97.63	1	1.360	0.036	0.069	0.069	0.094

**Note:**

- Per KDB 941225 D06, for EUT dimension  $\geq 9\text{cm} \times 5\text{cm}$ , the test distance is 1cm. SAR must be measured for all surfaces and sides with a transmitting antenna located within 2.5cm from that surface or edge.
- As in (1), SAR for Front / Back / Top Side / Left Side is necessary.
- Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position  $\leq 0.8 \text{ W/kg}$  other channels SAR tests are not necessary.

**11.3 Test Records for Body-worn SAR Test**
**<GSM SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Headset	Ch.	Freq. (MHz)	Burst Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
98	GSM 850	DTM Multi-slot class 5	Front	1.5	-	251	848.8	30.18	30.50	1.076	-0.04	0.322	0.347
99	GSM 850	DTM Multi-slot class 5	Back	1.5	-	251	848.8	30.18	30.50	1.076	-0.12	0.334	0.360
100	GSM 850	DTM Multi-slot class 5	Back	1.5	v	251	848.8	30.18	30.50	1.076	0.149	0.289	0.311
36	GSM 850	DTM Multi-slot class 5	Back	1	v	251	848.8	30.18	30.50	1.076	-0.08	0.364	0.392
104	GSM 1900	GSM Voice	Front	1.5	-	512	1850.2	26.46	27.50	1.271	-0.148	0.14	0.178
105	GSM 1900	GSM Voice	Back	1.5	-	512	1850.2	29.45	30.50	1.274	0.09	0.165	0.210
106	GSM 1900	GSM Voice	Back	1.5	v	512	1850.2	29.45	30.5	1.274	0.135	0.17	0.216
14	GSM1900	GSM Voice	Back	1	v	512	1850.2	29.45	30.50	1.274	0.17	0.361	0.460

**Note:**

- Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8 \text{ W/kg}$  other channels SAR tests are not necessary.
- "V" in the Headset column means the Headset is plugged during SAR testing.

**<WCDMA SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Headset	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR <sub>1g</sub> (W/kg)	Scaled SAR <sub>1g</sub> (W/kg)
101	WCDMA V	RMC12.2K	Front	1.5	-	4233	846.6	23.48	24.50	1.265	-0.146	0.369	0.467
102	WCDMA V	RMC12.2K	Back	1.5	-	4233	846.6	23.48	24.50	1.265	0.11	0.391	0.495
103	WCDMA V	RMC12.2K	Back	1.5	v	4233	846.6	23.48	24.50	1.265	0.01	0.35	0.443
30	WCDMA V	RMC12.2K	Back	1	v	4233	846.6	23.48	24.50	1.265	-0.08	0.506	0.640
110	WCDMA IV	RMC12.2K	Front	1.5	-	1413	1732.6	23.41	24.50	1.285	-0.09	0.464	0.596
111	WCDMA IV	RMC12.2K	Back	1.5	-	1413	1732.6	23.41	24.50	1.285	0.142	0.579	0.744
112	WCDMA IV	RMC12.2K	Back	1.5	v	1413	1732.6	23.41	24.50	1.285	0.001	0.565	0.726
48	WCDMA IV	RMC12.2K	Back	1	v	1312	1712.4	23.40	24.50	1.288	-0.03	0.907	1.168
49	WCDMA IV	RMC12.2K	Back	1	v	1413	1732.6	23.41	24.50	1.285	0.01	0.939	1.207
50	WCDMA IV	RMC12.2K	Back	1	v	1513	1752.6	23.38	24.50	1.294	-0.03	0.989	1.280
107	WCDMA II	RMC12.2K	Front	1.5	-	9400	1880	23.32	24.50	1.312	0.03	0.359	0.471
108	WCDMA II	RMC12.2K	Back	1.5	-	9400	1880	23.32	24.50	1.312	0.15	0.463	0.608
109	WCDMA II	RMC12.2K	Back	1.5	v	9400	1880	23.32	24.50	1.312	0.04	0.448	0.588
23	WCDMA II	RMC12.2K	Back	1	v	9400	1880	23.32	24.50	1.312	0.08	0.965	1.266
24	WCDMA II	RMC12.2K	Back	1	v	9538	1907.6	23.31	24.50	1.315	0.06	0.943	1.240
22	WCDMA II	RMC12.2K	Back	1	v	9262	1852.4	23.26	24.50	1.330	0.098	0.953	1.267

**Note:**

- Per KDB 648474 and KDB 447498, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.
- "V" in the Headset column means the Headset is plugged during SAR testing.

**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (cm)	Headset	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	Duty cycle%	Duty Cycle Compensate Factor	SAR <sub>1g</sub> (W/kg)	Duty Cycle Compensated 1g SAR	Scaled SAR <sub>1g</sub> (W/kg)
113	WLAN2.4G	802.11b	Front	1.5	-	11	2462	16.16	17.5	1.360	-0.05	97.63	1	0.00409	0.004	0.006
114	WLAN2.4G	802.11b	Back	1.5	-	11	2462	16.16	17.5	1.360	0.046	97.63	1	0.023	0.023	0.031
115	WLAN2.4G	802.11b	Back	1.5	v	11	2462	16.16	17.5	1.360	0.132	97.63	1	0.022	0.022	0.030
61	WLAN2.4G	802.11b	Back	1	v	11	2462	16.16	17.5	1.360	-0.053	97.63	1	0.112	0.112	0.152
82	WLAN5G	802.11a	Front	1.5	-	36	5180	11.29	12.5	1.321	-0.118	87.26	1.146	0.007	0.008	0.011
83	WLAN5G	802.11a	Back	1.5	-	36	5180	11.29	12.5	1.321	0.042	87.26	1.146	0.111	0.127	0.168
84	WLAN5G	802.11a	Back	1.5	v	36	5180	11.29	12.5	1.321	-0.069	87.26	1.146	0.137	0.157	0.207
95	WLAN5G	802.11a	Back	1	v	36	5180	11.29	12.5	1.321	0.01	87.26	1.146	0.753	0.863	1.140
85	WLAN5G	802.11a	Front	1.5	-	60	5300	10.83	12.5	1.469	-0.109	87.26	1.146	0.00084	0.001	0.001
86	WLAN5G	802.11a	Back	1.5	-	60	5300	10.83	12.5	1.469	-0.094	87.26	1.146	0.152	0.174	0.256
87	WLAN5G	802.11a	Back	1.5	v	60	5300	10.83	12.5	1.469	0.035	87.26	1.146	0.147	0.168	0.247
96	WLAN5G	802.11a	Back	1	v	36	5180	10.83	12.5	1.469	-0.014	87.26	1.146	0.736	0.843	1.238
88	WLAN5G	802.11a	Front	1.5	-	140	5700	11.22	12.5	1.342	-0.0011	87.26	1.146	0.0027	0.003	0.004
89	WLAN5G	802.11a	Back	1.5	-	140	5700	11.22	12.5	1.342	-0.025	87.26	1.146	0.123	0.141	0.189
90	WLAN5G	802.11a	Back	1.5	v	140	5700	11.22	12.5	1.342	0.028	87.26	1.146	0.127	0.146	0.196
97	WLAN5G	802.11a	Back	1	v	140	5700	11.22	12.5	1.342	-0.14	87.26	1.146	0.546	0.626	0.840
91	WLAN5G	802.11a	Front	1.5	-	157	5785	10.94	12.5	1.432	0	87.18	1.147	0.00024	0.000	0.000
92	WLAN5G	802.11a	Back	1.5	-	157	5785	10.94	12.5	1.432	-0.075	87.18	1.147	0.088	0.101	0.145
93	WLAN5G	802.11a	Back	1.5	v	157	5785	10.94	12.5	1.432	-0.059	87.18	1.147	0.094	0.108	0.155
98	WLAN5G	802.11a	Back	1	v	157	5785	10.94	12.5	1.432	0.07	87.18	1.147	0.443	0.508	0.728

**Note:**

- Per KDB 648474 and KDB 248227, if the highest output channel SAR for each exposure position  $\leq 0.8$  W/kg other channels SAR tests are not necessary.
- "V" in the Headset column means the Headset is plugged during SAR testing.

### 11.4 Simultaneous Multi-band Transmission Analysis

No.	Applicable Simultaneous Transmission Combination
1.	WWAN + BT
2.	WWAN+ WLAN

**Note:**

1. WLAN 2.4G and BT share the same antenna, and cannot transmit simultaneously.
2. GSM/WCDMA share the same antenna, and cannot transmit simultaneously.
3. EUT will choose either WLAN2.4G or WLAN5G according to the network signal condition; therefore, they will not transmit simultaneously.
4. EUT will choose either GSM/WCDMA according to the network signal condition; therefore, they will not transmit simultaneously.
5. The maximum SAR summation is calculated based on the same configuration and test position.
6. If 1g-SAR scalar summation < 1.6W/kg, simultaneous SAR measurement is not necessary.

#### <Head SAR>

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN2.4G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Right Cheek	GSM850	37	0.248	30.18	30.5	1.076	0.267	55	0.105	16.16	17.5	1.360	0.143	0.35	<b>0.41</b>
	GSM1900	1	0.24	29.45	30.5	1.274	0.306	55	0.105	16.16	17.5	1.360	0.143	0.35	<b>0.45</b>
	WCDMA V	94	0.372	23.48	24.5	1.265	0.470	55	0.105	16.16	17.5	1.360	0.143	0.48	<b>0.61</b>
	WCDMA IV	51	0.639	23.41	24.5	1.285	0.821	55	0.105	16.16	17.5	1.360	0.143	0.74	<b>0.96</b>
Right Tilted	WCDMA II	5	0.633	23.32	24.5	1.312	0.831	55	0.105	16.16	17.5	1.360	0.143	0.74	<b>0.97</b>
	GSM850	38	0.202	30.18	30.5	1.076	0.217	56	0.078	16.16	17.5	1.360	0.106	0.28	<b>0.32</b>
	GSM1900	2	0.08	29.45	30.5	1.274	0.102	56	0.078	16.16	17.5	1.360	0.106	0.16	<b>0.21</b>
	WCDMA V	95	0.131	23.48	24.5	1.265	0.166	56	0.078	16.16	17.5	1.360	0.106	0.21	<b>0.27</b>
Left Cheek	WCDMA IV	52	0.291	23.41	24.5	1.285	0.374	56	0.078	16.16	17.5	1.360	0.106	0.37	<b>0.48</b>
	WCDMA II	6	0.209	23.32	24.5	1.312	0.274	56	0.078	16.16	17.5	1.360	0.106	0.29	<b>0.38</b>
	GSM850	39	0.277	30.18	30.5	1.076	0.298	57	0.079	16.16	17.5	1.360	0.107	0.36	<b>0.41</b>
	GSM1900	3	0.169	29.45	30.5	1.274	0.215	57	0.079	16.16	17.5	1.360	0.107	0.25	<b>0.32</b>
Left Tilted	WCDMA V	96	0.246	23.48	24.5	1.265	0.311	57	0.079	16.16	17.5	1.360	0.107	0.33	<b>0.42</b>
	WCDMA IV	53	0.644	23.41	24.5	1.285	0.828	57	0.079	16.16	17.5	1.360	0.107	0.72	<b>0.94</b>
	WCDMA II	7	0.443	23.32	24.5	1.312	0.581	57	0.079	16.16	17.5	1.360	0.107	0.52	<b>0.69</b>
	GSM850	40	0.178	30.18	30.5	1.076	0.192	58	0.073	16.16	17.5	1.360	0.099	0.25	<b>0.29</b>
	GSM1900	4	0.068	29.45	30.5	1.274	0.087	58	0.073	16.16	17.5	1.360	0.099	0.14	<b>0.19</b>
	WCDMA V	97	0.151	23.48	24.5	1.265	0.191	58	0.073	16.16	17.5	1.360	0.099	0.22	<b>0.29</b>
	WCDMA IV	54	0.306	23.41	24.5	1.285	0.393	58	0.073	16.16	17.5	1.360	0.099	0.38	<b>0.49</b>
	WCDMA II	8	0.196	23.32	24.5	1.312	0.257	58	0.073	16.16	17.5	1.360	0.099	0.27	<b>0.36</b>

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN5G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Right Cheek	GSM850	37	0.248	30.18	30.5	1.076	0.267	78	0.070	10.94	12.50	1.432	0.100	0.32	0.37
	GSM1900	1	0.24	29.45	30.5	1.274	0.306	78	0.070	10.94	12.50	1.432	0.100	0.31	0.41
	WCDMA V	94	0.372	23.48	24.5	1.265	0.470	78	0.070	10.94	12.50	1.432	0.100	0.44	0.57
	WCDMA IV	51	0.639	23.41	24.5	1.285	0.821	78	0.070	10.94	12.50	1.432	0.100	0.71	0.92
	WCDMA II	5	0.633	23.32	24.5	1.312	0.831	78	0.070	10.94	12.50	1.432	0.100	0.70	0.93
Right Tilted	GSM850	38	0.202	30.18	30.5	1.076	0.217	71	0.072	10.83	12.50	1.469	0.106	0.27	0.32
	GSM1900	2	0.08	29.45	30.5	1.274	0.102	71	0.072	10.83	12.50	1.469	0.106	0.15	0.21
	WCDMA V	95	0.131	23.48	24.5	1.265	0.166	71	0.072	10.83	12.50	1.469	0.106	0.20	0.27
	WCDMA IV	52	0.291	23.41	24.5	1.285	0.374	71	0.063	10.83	12.50	1.469	0.106	0.36	0.48
	WCDMA II	6	0.209	23.32	24.5	1.312	0.274	71	0.063	10.83	12.50	1.469	0.106	0.28	0.38
Left Cheek	GSM850	39	0.277	30.18	30.5	1.076	0.298	76	0.053	11.22	12.50	1.342	0.071	0.33	0.37
	GSM1900	3	0.169	29.45	30.5	1.274	0.215	76	0.053	11.22	12.50	1.342	0.071	0.22	0.29
	WCDMA V	96	0.246	23.48	24.5	1.265	0.311	76	0.053	11.22	12.50	1.342	0.071	0.30	0.38
	WCDMA IV	53	0.644	23.41	24.5	1.285	0.828	76	0.053	11.22	12.50	1.342	0.071	0.70	0.90
	WCDMA II	7	0.443	23.32	24.5	1.312	0.581	76	0.053	11.22	12.50	1.342	0.071	0.50	0.65
Left Tilted	GSM850	40	0.178	30.18	30.5	1.076	0.192	69	0.101	11.29	12.50	1.321	0.133	0.28	0.33
	GSM1900	4	0.068	29.45	30.5	1.274	0.087	69	0.101	11.29	12.50	1.321	0.133	0.17	0.22
	WCDMA V	97	0.151	23.48	24.5	1.265	0.191	69	0.101	11.29	12.50	1.321	0.133	0.25	0.32
	WCDMA IV	54	0.306	23.41	24.5	1.285	0.393	69	0.101	11.29	12.50	1.321	0.133	0.41	0.53
	WCDMA II	8	0.196	23.32	24.5	1.312	0.257	69	0.101	11.29	12.50	1.321	0.133	0.30	0.39

**<Hotspot SAR>**

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN2.4G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Front	GSM850	31	0.396	30.36	30.5	1.033	0.409	59	0.043	16.16	17.5	1.360	0.058	0.44	0.47
	GSM1900	9	0.178	26.46	27.5	1.271	0.226	59	0.043	16.16	17.5	1.360	0.058	0.22	0.28
	WCDMA V	25	0.538	23.48	24.5	1.265	0.680	59	0.043	16.16	17.5	1.360	0.058	0.58	0.74
	WCDMA IV	41	0.662	23.41	24.5	1.285	0.851	59	0.043	16.16	17.5	1.360	0.058	0.71	0.91
	WCDMA II	15	0.536	23.32	24.5	1.312	0.703	59	0.043	16.16	17.5	1.360	0.058	0.58	0.76
Back	GSM850	32	0.406	30.36	30.5	1.033	0.419	60	0.116	16.16	17.5	1.360	0.158	0.52	0.58
	GSM1900	10	0.327	26.46	27.5	1.271	0.415	60	0.116	16.16	17.5	1.360	0.158	0.44	0.57
	WCDMA V	26	0.577	23.48	24.5	1.265	0.730	60	0.116	16.16	17.5	1.360	0.158	0.69	0.89
	WCDMA IV	44	1	23.38	24.5	1.294	1.294	60	0.116	16.16	17.5	1.360	0.158	1.12	1.45
	WCDMA II	17	1.04	23.26	24.5	1.330	1.384	60	0.116	16.16	17.5	1.360	0.158	1.16	1.54
Left Side	GSM850	33	0.426	30.36	30.50	1.033	0.440	62	0.044	16.16	17.5	1.360	0.060	0.47	0.50
	GSM1900	11	0.069	26.46	27.5	1.271	0.088	62	0.044	16.16	17.5	1.360	0.060	0.11	0.15
	WCDMA V	27	0.687	23.48	24.5	1.265	0.869	62	0.044	16.16	17.5	1.360	0.060	0.73	0.93
	WCDMA IV	45	0.244	23.41	24.5	1.285	0.314	62	0.044	16.16	17.5	1.360	0.060	0.29	0.37
	WCDMA II	19	0.204	23.32	24.5	1.312	0.268	62	0.044	16.16	17.5	1.360	0.060	0.25	0.33
Right Side	GSM850	34	0.362	30.36	30.50	1.033	0.374	-	-	-	-	-	-	0.36	0.37
	GSM1900	12	0.141	26.46	27.5	1.271	0.179	-	-	-	-	-	-	0.14	0.18
	WCDMA V	28	0.526	23.48	24.5	1.265	0.665	-	-	-	-	-	-	0.53	0.67
	WCDMA IV	46	0.431	23.41	24.5	1.285	0.554	-	-	-	-	-	-	0.43	0.55
	WCDMA II	20	0.448	23.32	24.5	1.312	0.588	-	-	-	-	-	-	0.45	0.59
Top Side	GSM850	-	-	-	-	-	-	64	0.069	16.16	17.5	1.360	0.094	0.07	0.09
	GSM1900	-	-	-	-	-	-	64	0.069	16.16	17.5	1.360	0.094	0.07	0.09
	WCDMA V	-	-	-	-	-	-	64	0.069	16.16	17.5	1.360	0.094	0.07	0.09
	WCDMA IV	-	-	-	-	-	-	64	0.069	16.16	17.5	1.360	0.094	0.07	0.09
	WCDMA II	-	-	-	-	-	-	64	0.069	16.16	17.5	1.360	0.094	0.07	0.09
Bottom Side	GSM850	35	0.679	30.36	30.5	1.033	0.701	-	-	-	-	-	-	0.68	0.70
	GSM1900	13	0.078	26.46	27.5	1.271	0.099	-	-	-	-	-	-	0.08	0.10
	WCDMA V	29	0.077	23.48	24.5	1.265	0.097	-	-	-	-	-	-	0.51	0.64
	WCDMA IV	47	0.27	23.41	24.5	1.285	0.347	-	-	-	-	-	-	0.27	0.35
	WCDMA II	21	0.227	23.32	24.5	1.312	0.298	-	-	-	-	-	-	0.23	0.30

**<Body-worn SAR>**

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN2.4G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Front At 1.5cm	GSM850	98	0.322	30.18	30.5	1.076	0.347	113	0.004	16.16	17.5	1.360	0.006	0.33	0.35
	GSM1900	104	0.14	29.45	30.5	1.274	0.178	113	0.004	16.16	17.5	1.360	0.006	0.14	0.18
	WCDMA V	101	0.369	23.48	24.5	1.265	0.467	113	0.004	16.16	17.5	1.360	0.006	0.37	0.47
	WCDMA IV	110	0.464	23.41	24.5	1.285	0.596	113	0.004	16.16	17.5	1.360	0.006	0.47	0.60
	WCDMA II	107	0.359	23.32	24.5	1.312	0.471	113	0.004	16.16	17.5	1.360	0.006	0.36	0.48
Back At 1.5cm	GSM850	99	0.334	30.18	30.5	1.076	0.360	114	0.023	16.16	17.5	1.360	0.031	0.36	0.39
	GSM1900	105	0.165	29.45	30.5	1.274	0.210	114	0.023	16.16	17.5	1.360	0.031	0.19	0.24
	WCDMA V	102	0.391	23.48	24.5	1.265	0.495	114	0.023	16.16	17.5	1.360	0.031	0.41	0.53
	WCDMA IV	111	0.579	23.41	24.5	1.285	0.744	114	0.023	16.16	17.5	1.360	0.031	0.60	0.78
	WCDMA II	108	0.463	23.32	24.5	1.312	0.608	114	0.023	16.16	17.5	1.360	0.031	0.49	0.64
Back (w/ Headset) At 1.5cm	GSM850	100	0.289	30.18	30.5	1.076	0.311	115	0.022	16.16	17.5	1.360	0.030	0.31	0.34
	GSM1900	106	0.17	29.45	30.5	1.274	0.216	115	0.022	16.16	17.5	1.360	0.030	0.19	0.25
	WCDMA V	103	0.35	23.48	24.5	1.265	0.443	115	0.022	16.16	17.5	1.360	0.030	0.37	0.47
	WCDMA IV	112	0.565	23.41	24.5	1.285	0.726	115	0.022	16.16	17.5	1.360	0.030	0.59	0.76
	WCDMA II	109	0.448	23.32	24.5	1.312	0.588	115	0.022	16.16	17.5	1.360	0.030	0.47	0.62

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN5G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Front At 1.5cm	GSM850	98	0.322	30.18	30.5	1.076	0.347	82	0.008	11.29	12.50	1.321	0.011	0.33	0.36
	GSM1900	104	0.14	29.45	30.5	1.274	0.178	82	0.008	11.29	12.50	1.321	0.011	0.15	0.19
	WCDMA V	101	0.369	23.48	24.5	1.265	0.467	82	0.008	11.29	12.50	1.321	0.011	0.38	0.48
	WCDMA IV	110	0.464	23.41	24.5	1.285	0.596	82	0.008	11.29	12.50	1.321	0.011	0.47	0.61
	WCDMA II	107	0.359	23.32	24.5	1.312	0.471	82	0.008	11.29	12.50	1.321	0.011	0.37	0.48
Back At 1.5cm	GSM850	99	0.334	30.18	30.5	1.076	0.360	86	0.174	10.83	12.50	1.469	0.256	0.51	0.62
	GSM1900	105	0.165	29.45	30.5	1.274	0.210	86	0.174	10.83	12.50	1.469	0.256	0.34	0.47
	WCDMA V	102	0.391	23.48	24.5	1.265	0.495	86	0.174	10.83	12.50	1.469	0.256	0.57	0.75
	WCDMA IV	111	0.579	23.41	24.5	1.285	0.744	86	0.174	10.83	12.50	1.469	0.256	0.75	1.00
	WCDMA II	108	0.463	23.32	24.5	1.312	0.608	86	0.174	10.83	12.50	1.469	0.256	0.64	0.86
Back (w/ Headset) At 1.5cm	GSM850	100	0.289	30.18	30.5	1.076	0.311	87	0.168	10.83	12.50	1.469	0.247	0.46	0.56
	GSM1900	106	0.17	29.45	30.5	1.274	0.216	87	0.168	10.83	12.50	1.469	0.247	0.34	0.46
	WCDMA V	103	0.35	23.48	24.5	1.265	0.443	87	0.168	10.83	12.50	1.469	0.247	0.52	0.69
	WCDMA IV	112	0.565	23.41	24.5	1.285	0.726	87	0.168	10.83	12.50	1.469	0.247	0.73	0.97
	WCDMA II	109	0.448	23.32	24.5	1.312	0.588	87	0.168	10.83	12.50	1.469	0.247	0.62	0.84

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN2.4G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Back (w/ Headset) At 1cm	GSM850	36	0.364	30.18	30.5	1.076	0.392	61	0.112	16.16	17.5	1.360	0.152	0.48	0.54
	GSM1900	14	0.361	29.45	30.5	1.274	0.460	61	0.112	16.16	17.5	1.360	0.152	0.47	0.61
	WCDMA V	30	0.506	23.48	24.5	1.265	0.640	61	0.112	16.16	17.5	1.360	0.152	0.62	0.79
	WCDMA IV	50	0.989	23.38	24.5	1.294	1.280	61	0.112	16.16	17.5	1.360	0.152	1.10	1.43
	WCDMA II	22	0.953	23.26	24.5	1.330	1.267	61	0.112	16.16	17.5	1.360	0.152	1.07	1.42

Position	WWAN			Scaled WWAN				WLAN		Scaled WLAN5G				WWAN + WLAN	Scaled WWAN + Scaled WLAN
	WWAN Band	Plot No	Max. WWAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WWAN (W/kg)	Plot No	Max. WLAN SAR (W/kg)	Average Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	Scaled WLAN (W/kg)		
Back (w/ Headset) At 1cm	GSM850	36	0.364	30.18	30.5	1.076	0.392	87	0.168	10.83	12.50	1.469	0.247	0.53	0.64
	GSM1900	14	0.361	29.45	30.5	1.274	0.460	87	0.168	10.83	12.50	1.469	0.247	0.53	0.71
	WCDMA V	30	0.506	23.48	24.5	1.265	0.640	87	0.168	10.83	12.50	1.469	0.247	0.67	0.89
	WCDMA IV	50	0.989	23.38	24.5	1.294	1.280	87	0.168	10.83	12.50	1.469	0.247	1.16	1.53
	WCDMA II	22	0.953	23.26	24.5	1.330	1.267	87	0.168	10.83	12.50	1.469	0.247	1.12	1.51

**Test Engineer :** Bevis Chang, Nick Yu, Jack Wu, San Lin, Aaron Chen, and Cona Huang

## 12. Uncertainty Assessment

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

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

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 12.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor <sup>(a)</sup>	1/ $\kappa$ <sup>(b)</sup>	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)  $\kappa$  is the coverage factor

**Table 12.1 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 ( $\pm\%$ )	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
<b>Measurement System</b>							
Probe Calibration	6.0	Normal	1	1	1	$\pm 6.0 \%$	$\pm 6.0 \%$
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	0.7	$\pm 1.9 \%$	$\pm 1.9 \%$
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	0.7	$\pm 3.9 \%$	$\pm 3.9 \%$
Boundary Effects	1.0	Rectangular	$\sqrt{3}$	1	1	$\pm 0.6 \%$	$\pm 0.6 \%$
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	$\pm 2.7 \%$	$\pm 2.7 \%$
System Detection Limits	1.0	Rectangular	$\sqrt{3}$	1	1	$\pm 0.6 \%$	$\pm 0.6 \%$
Readout Electronics	0.3	Normal	1	1	1	$\pm 0.3 \%$	$\pm 0.3 \%$
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	$\pm 0.5 \%$	$\pm 0.5 \%$
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	$\pm 1.5 \%$	$\pm 1.5 \%$
RF Ambient Noise	3.0	Rectangular	$\sqrt{3}$	1	1	$\pm 1.7 \%$	$\pm 1.7 \%$
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1	1	$\pm 1.7 \%$	$\pm 1.7 \%$
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	$\pm 0.2 \%$	$\pm 0.2 \%$
Probe Positioning	2.9	Rectangular	$\sqrt{3}$	1	1	$\pm 1.7 \%$	$\pm 1.7 \%$
Max. SAR Eval.	1.0	Rectangular	$\sqrt{3}$	1	1	$\pm 0.6 \%$	$\pm 0.6 \%$
<b>Test Sample Related</b>							
Device Positioning	2.9	Normal	1	1	1	$\pm 2.9 \%$	$\pm 2.9 \%$
Device Holder	3.6	Normal	1	1	1	$\pm 3.6 \%$	$\pm 3.6 \%$
Power Drift	5.0	Rectangular	$\sqrt{3}$	1	1	$\pm 2.9 \%$	$\pm 2.9 \%$
<b>Phantom and Setup</b>							
Phantom Uncertainty	4.0	Rectangular	$\sqrt{3}$	1	1	$\pm 2.3 \%$	$\pm 2.3 \%$
Liquid Conductivity (Target)	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	$\pm 1.8 \%$	$\pm 1.2 \%$
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	$\pm 1.6 \%$	$\pm 1.1 \%$
Liquid Permittivity (Target)	5.0	Rectangular	$\sqrt{3}$	0.6	0.49	$\pm 1.7 \%$	$\pm 1.4 \%$
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	$\pm 1.5 \%$	$\pm 1.2 \%$
<b>Combined Standard Uncertainty</b>						$\pm 11.0 \%$	$\pm 10.8 \%$
<b>Coverage Factor for 95 %</b>						K=2	
<b>Expanded Uncertainty</b>						$\pm 22.0 \%$	$\pm 21.5 \%$

**Table 12.2 Uncertainty Budget of DASY 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)
<b>Measurement System</b>							
Probe Calibration	6.55	Normal	1	1	1	± 6.55 %	± 6.55 %
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	2.0	Rectangular	$\sqrt{3}$	1	1	± 1.2 %	± 1.2 %
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.8	Rectangular	$\sqrt{3}$	1	1	± 0.5 %	± 0.5 %
Probe Positioning	9.9	Rectangular	$\sqrt{3}$	1	1	± 5.7 %	± 5.7 %
Max. SAR Eval.	4.0	Rectangular	$\sqrt{3}$	1	1	± 2.3 %	± 2.3 %
<b>Test Sample Related</b>							
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	$\sqrt{3}$	1	1	± 2.9 %	± 2.9 %
<b>Phantom and Setup</b>							
Phantom Uncertainty	4.0	Rectangular	$\sqrt{3}$	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	$\sqrt{3}$	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	$\sqrt{3}$	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
<b>Combined Standard Uncertainty</b>						± 12.8 %	± 12.6 %
<b>Coverage Factor for 95 %</b>						K=2	
<b>Expanded Uncertainty</b>						± 25.6 %	± 25.2 %

**Table 12.3 Uncertainty Budget of DASY for frequency range 3 GHz to 6 GHz**



### **13. 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] FCC OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, June 2001
- [5] SPEAG DASY System Handbook
- [6] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007
- [7] FCC KDB 447498 D01 v04, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, November 2009
- [8] FCC KDB 648474 D01 v01r05, “SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas”, September 2008
- [9] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007
- [10] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008
- [11] FCC KDB 941225 D04 v01, “Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode”, January 27 2010
- [12] FCC KDB 941225 D06 v01, “SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities”, April 2011



## ***Appendix A. Plots of System Performance Check***

The plots are shown as follows.



## ***Appendix B. Plots of SAR Measurement***

The plots are shown as follows.



## ***Appendix C. DASY Calibration Certificate***

The DASY calibration certificates are shown as follows.