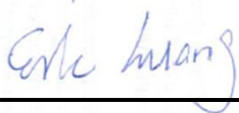


# FCC SAR Test Report

APPLICANT : Mosby LLC  
EQUIPMENT : Tablet PC  
MODEL NAME : GR043KL  
FCC ID : S5R-5580  
STANDARD : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2003

The product was testing completed on Sep. 14, 2013. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.



Reviewed by: Eric Huang / Deputy Manager



Approved 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.

# 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 Application Details.....                             | 5         |
| <b>3. General Information .....</b>                      | <b>6</b>  |
| 3.1 Description of Equipment Under Test (EUT) .....      | 6         |
| 3.2 Maximum RF output power among production units ..... | 7         |
| 3.3 Applied Standard.....                                | 8         |
| 3.4 Device Category and SAR Limits .....                 | 8         |
| 3.5 Test Conditions.....                                 | 8         |
| <b>4. Sensor Trigger distance and power levels .....</b> | <b>9</b>  |
| <b>5. Specific Absorption Rate (SAR).....</b>            | <b>12</b> |
| 5.1 Introduction .....                                   | 12        |
| 5.2 SAR Definition.....                                  | 12        |
| <b>6. SAR Measurement System .....</b>                   | <b>13</b> |
| 6.1 E-Field Probe .....                                  | 14        |
| 6.2 Data Acquisition Electronics (DAE) .....             | 15        |
| 6.3 Robot .....                                          | 15        |
| 6.4 Measurement Server.....                              | 15        |
| 6.5 Phantom.....                                         | 16        |
| 6.6 Device Holder.....                                   | 17        |
| 6.7 Data Storage and Evaluation .....                    | 18        |
| 6.8 Test Equipment List.....                             | 20        |
| <b>7. Tissue Simulating Liquids .....</b>                | <b>21</b> |
| <b>8. System Verification Procedures .....</b>           | <b>23</b> |
| 8.1 Purpose of System Performance check .....            | 23        |
| 8.2 System Setup.....                                    | 23        |
| 8.3 SAR System Verification Results .....                | 24        |
| <b>9. EUT Testing Position .....</b>                     | <b>25</b> |
| <b>10. Measurement Procedures .....</b>                  | <b>25</b> |
| 10.1 Spatial Peak SAR Evaluation.....                    | 25        |
| 10.2 Power Reference Measurement.....                    | 26        |
| 10.3 Area & Zoom Scan Procedures.....                    | 26        |
| 10.4 Volume Scan Procedures.....                         | 27        |
| 10.5 SAR Averaged Methods .....                          | 27        |
| 10.6 Power Drift Monitoring.....                         | 27        |
| <b>11. Conducted RF Output Power (Unit: dBm).....</b>    | <b>28</b> |
| <b>12. Exposure Position Conditions .....</b>            | <b>41</b> |
| <b>13. SAR Test Results .....</b>                        | <b>42</b> |
| 13.1 Body SAR .....                                      | 42        |
| 13.2 Repeated SAR Measurement .....                      | 45        |
| <b>14. Simultaneous Transmission Analysis .....</b>      | <b>46</b> |
| 14.1 Body Exposure Conditions .....                      | 47        |
| 14.2 SPLSR Evaluation and Analysis.....                  | 50        |
| <b>15. Uncertainty Assessment .....</b>                  | <b>55</b> |
| <b>16. References.....</b>                               | <b>58</b> |
| <b>Appendix A. Plots of System Performance Check</b>     |           |
| <b>Appendix B. Plots of High SAR Measurement</b>         |           |
| <b>Appendix C. DASY Calibration Certificate</b>          |           |
| <b>Appendix D. Test Setup Photos</b>                     |           |

## Revision History

[illegible]

## **1. Statement of Compliance**

The maximum results of Specific Absorption Rate (SAR) found during testing for **Mosby LLC Tablet PC, GR043KL** are as follows.

### **<Highest SAR Summary>**

| Exposure Position | Frequency Band   | Reported 1g-SAR (W/kg) | Equipment Class | Highest Reported 1g-SAR (W/kg) |
|-------------------|------------------|------------------------|-----------------|--------------------------------|
| Body              | GSM850           | 1.10                   | PCB             | 1.19                           |
|                   | WCDMA Band V     | 1.19                   |                 |                                |
|                   | WLAN 2.4GHz Band | 1.19                   | DTS             | 1.25                           |
|                   | WLAN 5.8GHz Band | 1.25                   |                 |                                |
|                   | WLAN 5.2GHz Band | 1.22                   | NII             | 1.29                           |
|                   | WLAN 5.3GHz Band | 1.29                   |                 |                                |
|                   | WLAN 5.5GHz Band | 1.27                   |                 |                                |

### **<Highest Simultaneous transmission SAR>**

| Exposure Position | Frequency Band | Equipment Class | Highest Reported Simultaneous Transmission 1g-SAR (W/kg) |
|-------------------|----------------|-----------------|----------------------------------------------------------|
| Body              | WCDMA V        | PCB             | 1.59                                                     |
|                   | Bluetooth      | DSS             |                                                          |

| Exposure Position | Frequency Band    | Equipment Class | Highest Reported Simultaneous Transmission 1g-SAR (W/kg) |
|-------------------|-------------------|-----------------|----------------------------------------------------------|
| Body              | WLAN2.4GHz (Ant1) | DTS             | 1.51                                                     |
|                   | WLAN2.4GHz (Ant2) | DTS             |                                                          |

| Exposure Position | Frequency Band    | Equipment Class | Highest Reported Simultaneous Transmission 1g-SAR (W/kg) |
|-------------------|-------------------|-----------------|----------------------------------------------------------|
| Body              | WLAN5.2GHz (Ant1) | NII             | 1.35                                                     |
|                   | WLAN5.2GHz (Ant2) | NII             |                                                          |

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

## **2. Administration Data**

### **2.1 Testing Laboratory**

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

### **2.2 Applicant**

|                     |                                                                 |
|---------------------|-----------------------------------------------------------------|
| <b>Company Name</b> | Mosby LLC                                                       |
| <b>Address</b>      | 2825 E. Cottonwood Parkway Suite 500 Salt Lake City, Utah 84121 |

### **2.3 Application Details**

|                                      |               |
|--------------------------------------|---------------|
| <b>Date of Start during the Test</b> | Jul. 27, 2013 |
| <b>Date of End during the Test</b>   | Sep. 14, 2013 |

### 3. General Information

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

| Product Feature & Specification                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EUT                                                                                                                                                                                                                                                                              | Tablet PC                                                                                                                                                                                                                                                                                                                                  |
| Model Name                                                                                                                                                                                                                                                                       | GR043KL                                                                                                                                                                                                                                                                                                                                    |
| FCC ID                                                                                                                                                                                                                                                                           | S5R-5580                                                                                                                                                                                                                                                                                                                                   |
| Wireless Technology and Frequency Range                                                                                                                                                                                                                                          | GSM850: 824.2 MHz ~ 848.8 MHz<br>WCDMA Band V: 826.4 MHz ~ 846.6 MHz<br>WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz<br>WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz<br>WLAN 5.5GHz Band: 5500 MHz ~ 5580 MHz and 5660 MHz ~ 5700MHz<br>WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz |
| Mode                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"><li>• GPRS/EGPRS</li><li>• WCDMA</li><li>• HSDPA</li><li>• HSUPA</li><li>• 802.11a/b/g/n HT20/HT40</li><li>• Bluetooth v3.0</li></ul>                                                                                                                                                                    |
| Antenna Type                                                                                                                                                                                                                                                                     | WWAN: Fixed Internal Antenna<br>WLAN: Fixed Internal Antenna<br>Bluetooth: Fixed Internal Antenna                                                                                                                                                                                                                                          |
| <b>Remark:</b><br>1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.<br>2. 802.11n-HT40 is not supported in WLAN2.4GHz.<br>3. WLAN5GHz operation in 5600 MHz ~ 5650 MHz is notched. |                                                                                                                                                                                                                                                                                                                                            |

### 3.2 Maximum RF output power among production units

| Band                    | Burst average power (dBm) |                    |
|-------------------------|---------------------------|--------------------|
|                         | GSM 850                   |                    |
| Output Power Status     | Full Power Mode           | Reduced Power Mode |
| GPRS (GMSK, 1 Tx slot)  | 33.5                      | 25.0               |
| GPRS (GMSK, 2 Tx slots) | 32.0                      | 23.0               |
| EDGE (8PSK, 1 Tx slot)  | 27.5                      | 19.5               |
| EDGE (8PSK, 2 Tx slots) | 27.5                      | 19.5               |

| Band                | average power (dBm) |                    |
|---------------------|---------------------|--------------------|
|                     | WCDMA V             |                    |
| Output Power Status | Full Power Mode     | Reduced Power Mode |
| RMC 12.2Kbps        | 23.5                | 18.0               |
| HSDPA Subset 1      | 22.5                | 18.0               |
| DC-HSDPA Subset 1   | 22.5                | 18.0               |
| HSUPA Subset 5      | 22.5                | 18.0               |

| Band / Mode       | Average power(dBm) |                            |                   |
|-------------------|--------------------|----------------------------|-------------------|
|                   | 1Mbps<br>(GFSK)    | 2Mbps<br>( $\pi/4$ -DQPSK) | 3Mbps<br>(8-DPSK) |
| 2.4 GHz Bluetooth | 5.5                | 5.5                        | 5.5               |

| Band / Mode     | IEEE 802.11 average power(dBm) |           |             |           |           |             |           |           |             |
|-----------------|--------------------------------|-----------|-------------|-----------|-----------|-------------|-----------|-----------|-------------|
|                 | 11b                            |           |             | 11g       |           |             | HT20      |           |             |
|                 | Antenna 1                      | Antenna 2 | Antenna 1+2 | Antenna 1 | Antenna 2 | Antenna 1+2 | Antenna 1 | Antenna 2 | Antenna 1+2 |
| WLNA2.4GHz Band | 16.0                           | 16.0      | 19.0        | 16.0      | 16.0      | 19.0        | 16.0      | 16.0      | 19.0        |

| Band / Mode     | IEEE 802.11 average power(dBm) |           |             |           |           |             |           |           |             |
|-----------------|--------------------------------|-----------|-------------|-----------|-----------|-------------|-----------|-----------|-------------|
|                 | 11a                            |           |             | HT20      |           |             | HT40      |           |             |
|                 | Antenna 1                      | Antenna 2 | Antenna 1+2 | Antenna 1 | Antenna 2 | Antenna 1+2 | Antenna 1 | Antenna 2 | Antenna 1+2 |
| WLNA5.2GHz Band | 13.0                           | 11.0      | 15.1        | 13.0      | 11.0      | 15.1        | 13.0      | 11.0      | 15.1        |
| WLNA5.3GHz Band | 13.0                           | 8.5       | 14.3        | 13.0      | 8.5       | 14.3        | 13.0      | 8.5       | 14.3        |
| WLNA5.5GHz Band | 13.0                           | 10.0      | 14.8        | 13.0      | 10.0      | 14.8        | 13.0      | 10.0      | 14.8        |
| WLNA5.8GHz Band | 13.0                           | 13.0      | 16.0        | 13.0      | 13.0      | 16.0        | 13.0      | 13.0      | 16.0        |

### **3.3 Applied Standard**

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2003
- FCC KDB 865664 D01 v01r01
- FCC KDB 447498 D01 v05r01
- FCC KDB 248227 D01 v01r02
- FCC KDB 616217 D04 v01r01
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D02 v02r02
- FCC KDB 941225 D03 v01

### **3.4 Device Category and SAR Limits**

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

### **3.5 Test Conditions**

#### **3.5.1 Ambient Condition**

|                     |             |
|---------------------|-------------|
| Ambient Temperature | 20 to 24 °C |
| Humidity            | < 60 %      |

#### **3.5.2 Test Configuration**

1. For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT.
2. For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.
3. Full power mode SAR testing was performed at the distance smaller than the trigger distance; the test separation distance was used 13mm at Bottom Slant of Edge2, 11mm at Edge2. The detail proximity sensor trigger distance testing is reference operation description.

#### **4. Sensor Trigger distance and power levels**

##### **Target Power reduction applied for each wireless mode and orientation**

| <b>Exposure Position /<br/>wireless mode</b> | <b>Bottom Face <sup>(1)</sup></b> | <b>Bottom Slant<br/>of Edge 2 <sup>(1)</sup></b> | <b>Edge 2 <sup>(1)</sup></b> | <b>Edge 1</b> | <b>Edge 3</b> | <b>Edge 4</b> |
|----------------------------------------------|-----------------------------------|--------------------------------------------------|------------------------------|---------------|---------------|---------------|
| GSM850 GPRS (GMSK 1 Tx slot)                 | 8.5 dB                            | 8.5 dB                                           | 8.5 dB                       | 0 dB          | 0 dB          | 0 dB          |
| GSM850 GPRS (GMSK 2 Tx slots)                | 9.0 dB                            | 9.0 dB                                           | 9.0 dB                       | 0 dB          | 0 dB          | 0 dB          |
| GSM850 EDGE (8PSK 1 Tx slot)                 | 8.0 dB                            | 8.0 dB                                           | 8.0 dB                       | 0 dB          | 0 dB          | 0 dB          |
| GSM850 EDGE (8PSK 2 Tx slots)                | 8.0 dB                            | 8.0 dB                                           | 8.0 dB                       | 0 dB          | 0 dB          | 0 dB          |
| WCDMA Band V                                 | 5.5 dB                            | 5.5 dB                                           | 5.5 dB                       | 0 dB          | 0 dB          | 0 dB          |

##### **General Note:**

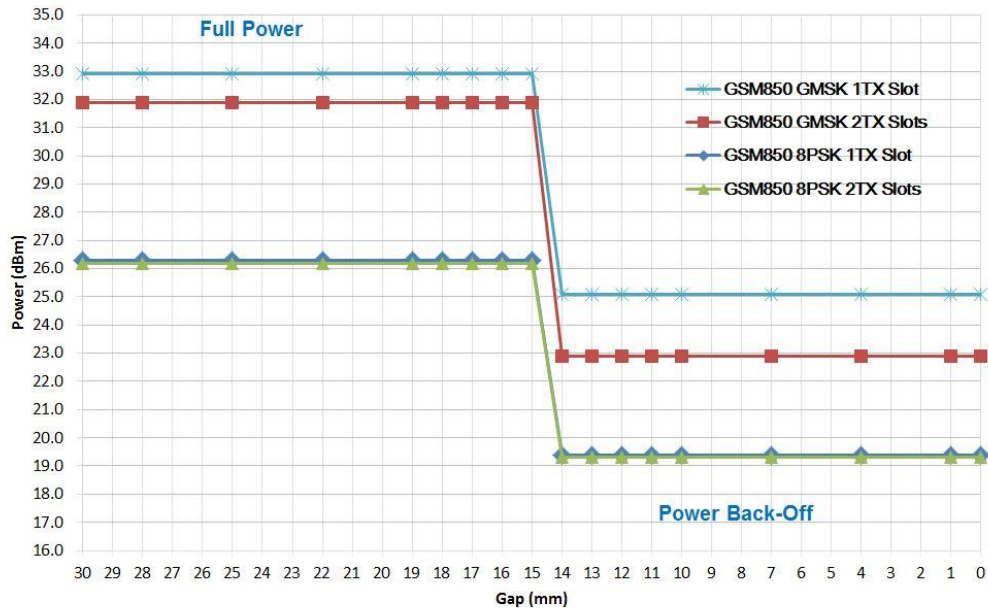
1. <sup>(1)</sup>: Reduced maximum limit applied by activation of proximity sensor.
2. Power reduction is not applicable for WLAN and Bluetooth.

##### **Measurement on EUT:**

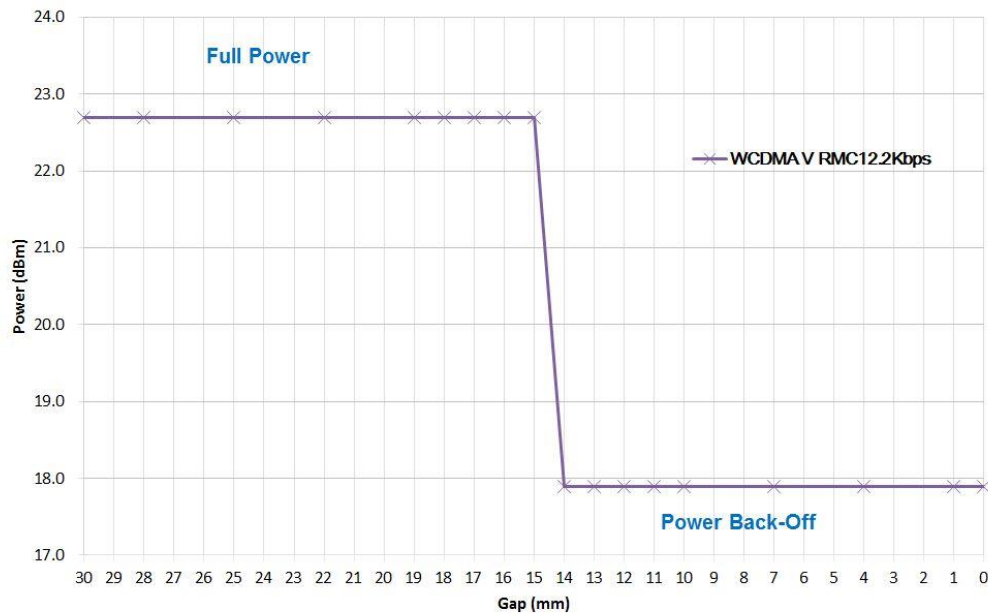
| <b>Band/Mode</b>              | <b>Ch</b> | <b>Measured power reduction (dBm)</b> |                          | <b>Reduction Levels<br/>(dB)</b> |
|-------------------------------|-----------|---------------------------------------|--------------------------|----------------------------------|
|                               |           | <b>w/o power back-off</b>             | <b>w/ power back-off</b> |                                  |
| GSM850 GPRS (GMSK 1 Tx slot)  | 251       | 32.9                                  | 25.0                     | 7.9                              |
| GSM850 GPRS (GMSK 2 Tx slots) | 251       | 31.9                                  | 22.9                     | 9.0                              |
| GSM850 GPRS (8PSK 1 Tx slot)  | 251       | 26.3                                  | 19.4                     | 6.9                              |
| GSM850 GPRS (8PSK 2 Tx slots) | 251       | 26.2                                  | 19.3                     | 6.9                              |
| WCDMA Band V (RMC 12.2Kbps)   | 4132      | 22.7                                  | 17.9                     | 4.8                              |

# Proximity Sensor for Bottom Slant of Edge 2

## GSM850 Distance from the EUT (mm)

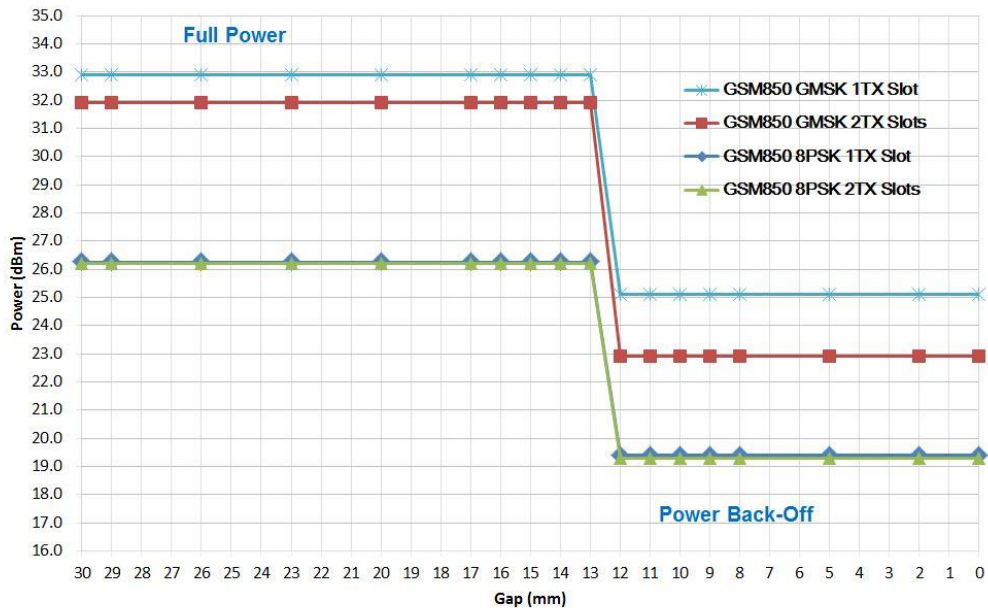


## WCDMA V Distance from the EUT (mm)

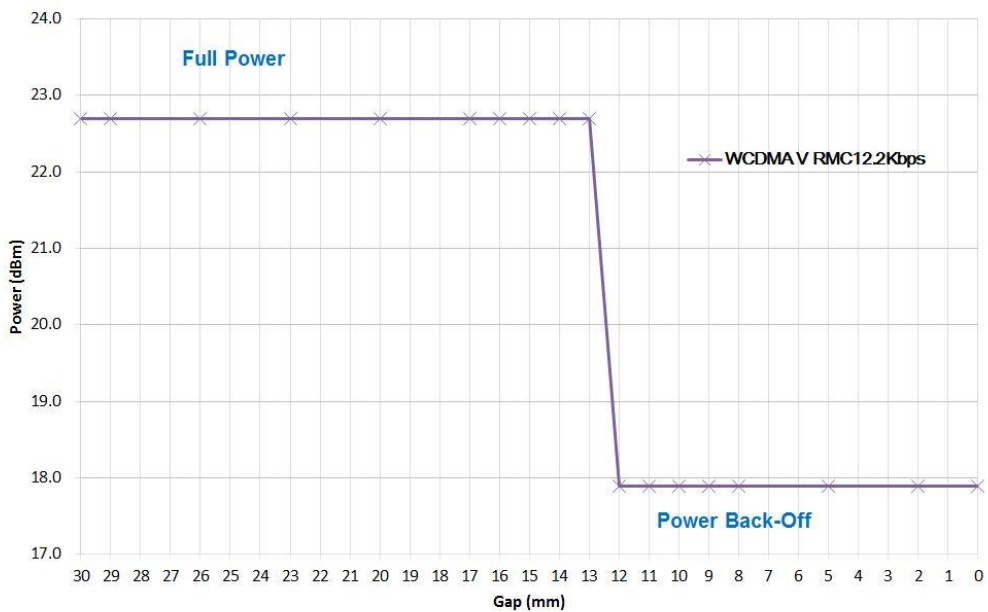


## Proximity Sensor for Edge 2

### GSM850 Distance from the EUT (mm)



### WCDMA V Distance from the EUT (mm)



## **5. Specific Absorption Rate (SAR)**

### **5.1 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.

### **5.2 SAR Definition**

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

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

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

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

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

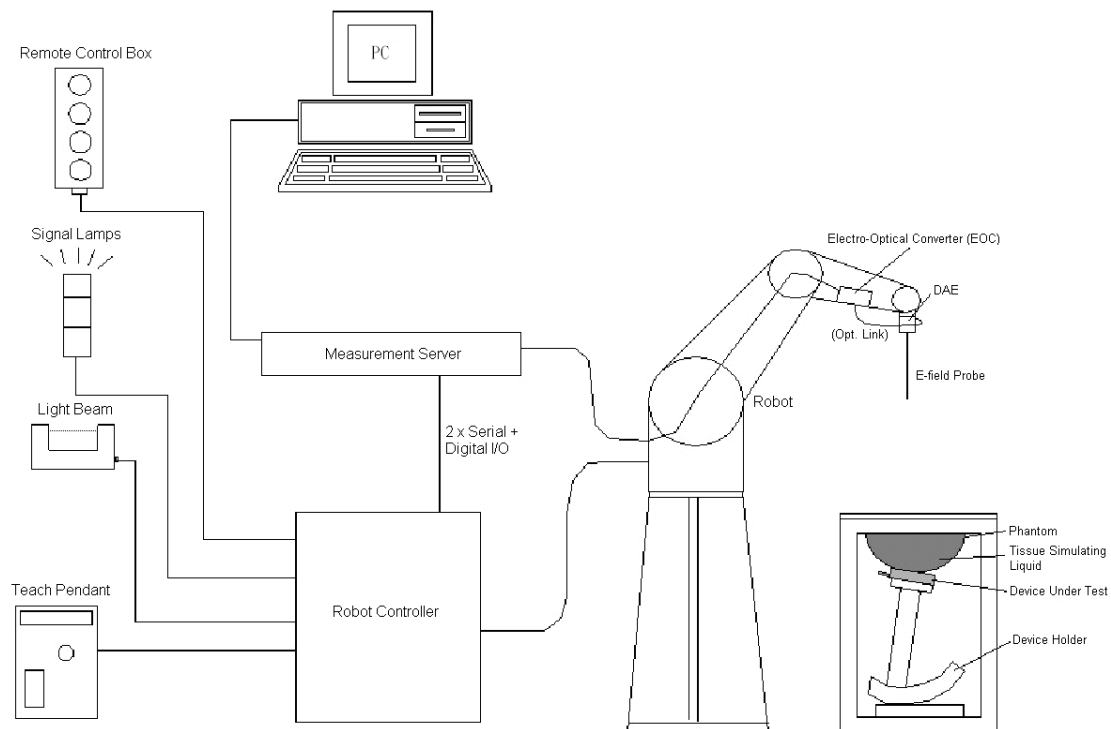
Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

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

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

## 6. 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.

## 6.1 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<br>Built-in optical fiber for surface detection system.<br>Built-in shielding against static charges.<br>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)<br>$\pm 0.4$ dB in HSL (rotation normal to probe axis)                                                                                                              |
| <b>Dynamic Range</b> | 5 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB                                                                                                                                                                     |
| <b>Dimensions</b>    | Overall length: 337 mm (Tip: 10 mm)<br>Tip diameter: 4 mm (Body: 10 mm)<br>Distance from probe tip to dipole centers: 3 mm                                                                                           |



Fig 5.2 Photo of ES3DV3

#### <EX3DV4 Probe>

|                      |                                                                                                                                                             |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Construction</b>  | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>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)<br>$\pm 0.5$ 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<br>(noise: typically $< 1$ $\mu$ W/g)                                                                     |
| <b>Dimensions</b>    | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm                        |



Fig 5.3 Photo of EX3DV4/ES3DV4

### 5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . 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.

## 6.2 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

## 6.3 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

## 6.4 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

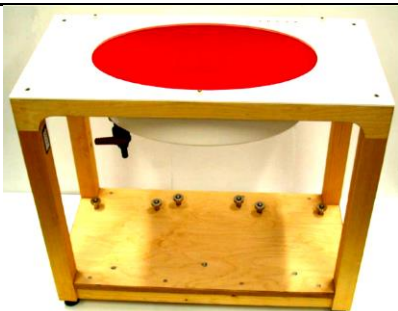
## 6.5 Phantom

### <SAM Twin Phantom>

|                   |                                                            |                                                                                                                            |
|-------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Shell Thickness   | $2 \pm 0.2$ mm;<br>Center ear point: $6 \pm 0.2$ mm        | <br><b>Fig 5.9 Photo of SAM Phantom</b> |
| Filling Volume    | Approx. 25 liters                                          |                                                                                                                            |
| Dimensions        | Length: 1000 mm; Width: 500 mm;<br>Height: adjustable feet |                                                                                                                            |
| Measurement Areas | Left Hand, Right Hand, Flat Phantom                        |                                                                                                                            |

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

### <ELI4 Phantom>

|                 |                                                  |                                                                                                                               |
|-----------------|--------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Shell Thickness | $2 \pm 0.2$ mm (sagging: <1%)                    | <br><b>Fig 5.10 Photo of ELI4 Phantom</b> |
| Filling Volume  | Approx. 30 liters                                |                                                                                                                               |
| Dimensions      | Major ellipse axis: 600 mm<br>Minor axis: 400 mm |                                                                                                                               |

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.

## 6.6 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.

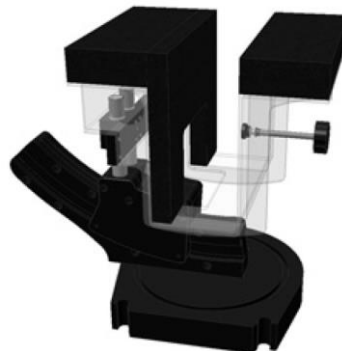


Fig 5.12 Laptop Extension Kit

## 6.7 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>                                                      |
| <b>Device parameters :</b> | - Diode compression point | dcpi                                                                    |
|                            | - Frequency               | f                                                                       |
| <b>Media parameters :</b>  | - Crest factor            | cf                                                                      |
|                            | - Conductivity            | $\sigma$                                                                |
|                            | - Density                 | $\rho$                                                                  |

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)  
 $dcp_i$  = diode compression point (DASY parameter)

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

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

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

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  
 $\text{ConvF}$  = 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.

## 6.8 Test Equipment List

| Manufacturer | Name of Equipment                  | Type/Model | Serial Number | Calibration   |               |
|--------------|------------------------------------|------------|---------------|---------------|---------------|
|              |                                    |            |               | Last Cal.     | Due Date      |
| SPEAG        | 835MHz System Validation Kit       | D835V2     | 499           | Mar. 18, 2013 | Mar. 17, 2014 |
| SPEAG        | 2450MHz System Validation Kit      | D2450V2    | 869           | Jun. 11, 2013 | Jun. 10, 2014 |
| SPEAG        | 5GHz System Validation Kit         | D5GHzV2    | 1128          | Jul. 24, 2013 | Jul. 23, 2014 |
| SPEAG        | Data Acquisition Electronics       | DAE4       | 778           | Aug. 21, 2013 | Aug. 20, 2014 |
| SPEAG        | Data Acquisition Electronics       | DAE4       | 1279          | Jan. 28, 2013 | Jan. 27, 2014 |
| SPEAG        | Data Acquisition Electronics       | DAE4       | 1338          | May. 28, 2013 | May. 27, 2014 |
| SPEAG        | Dosimetric E-Field Probe           | ES3DV3     | 3071          | Jun. 18, 2013 | Jun. 17, 2014 |
| SPEAG        | Dosimetric E-Field Probe           | EX3DV4     | 3801          | Jun. 20, 2013 | Jun. 19, 2014 |
| SPEAG        | Dosimetric E-Field Probe           | EX3DV4     | 3697          | Sep. 28, 2012 | Sep. 27, 2013 |
| SPEAG        | Dosimetric E-Field Probe           | EX3DV4     | 3792          | Jun. 04, 2013 | Jun. 03, 2014 |
| SPEAG        | Dosimetric E-Field Probe           | ES3DV3     | 3270          | Sep. 28, 2012 | Sep. 27, 2013 |
| Wisewind     | Thermometer                        | ETP-101    | TM560         | Nov. 13, 2012 | Nov. 12, 2013 |
| Wisewind     | Thermometer                        | ETP-101    | TM685         | Nov. 13, 2012 | Nov. 12, 2013 |
| Wisewind     | Thermometer                        | HTC-1      | TM281         | Nov. 13, 2012 | Nov. 12, 2013 |
| Agilent      | Wireless Communication Test Set    | E5515C     | MY50266977    | May. 06, 2013 | May. 05, 2015 |
| SPEAG        | Device Holder                      | N/A        | N/A           | NCR           | NCR           |
| Agilent      | ESG Vector Series Signal Generator | E4438C     | MY49070755    | Oct. 02, 2012 | Oct. 01, 2013 |
| SPEAG        | Dielectric Probe Kit               | DAK-3.5    | 1126          | Jul. 23, 2013 | Jul. 22, 2014 |
| Agilent      | ENA Network Analyzer               | E5071C     | MY46316648    | Feb. 07, 2013 | Feb. 06, 2014 |
| Anritsu      | Power Meter                        | ML2495A    | 1218006       | Oct. 22, 2012 | Oct. 21, 2013 |
| Anritsu      | Power Sensor                       | MA2411B    | 1207363       | Oct. 24, 2012 | Oct. 23, 2013 |
| Agilent      | Dual Directional Coupler           | 778D       | 50422         | Note 2        |               |
| Woken        | Attenuator 1                       | WK0602-XX  | N/A           | Note 2        |               |
| PE           | Attenuator 2                       | PE7005-10  | N/A           | Note 2        |               |
| PE           | Attenuator 3                       | PE7005- 3  | N/A           | Note 2        |               |
| AR           | Power Amplifier                    | 5S1G4M2    | 328767        | Note 3        |               |
| R&S          | Spectrum Analyzer                  | FSP 7      | 101131        | Jul. 09, 2013 | Jul. 08, 2014 |

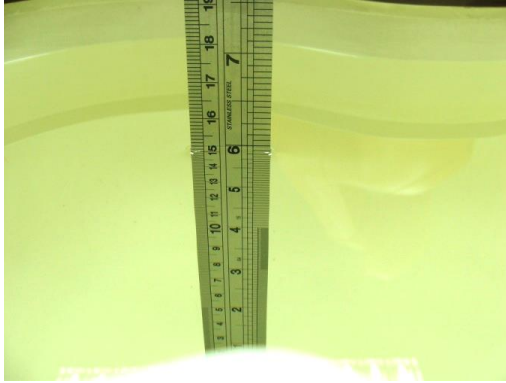
**Table 5.1 Test Equipment List**

**General Note:**

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.

## 7. 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>  |           |           |               |          |               |          |                           |                               |
| 750              | 41.1      | 57.0      | 0.2           | 1.4      | 0.2           | 0        | 0.89                      | 41.9                          |
| 835              | 40.3      | 57.9      | 0.2           | 1.4      | 0.2           | 0        | 0.90                      | 41.5                          |
| 900              | 40.3      | 57.9      | 0.2           | 1.4      | 0.2           | 0        | 0.97                      | 41.5                          |
| 1800, 1900, 2000 | 55.2      | 0         | 0             | 0.3      | 0             | 44.5     | 1.40                      | 40.0                          |
| 2450             | 55.0      | 0         | 0             | 0        | 0             | 45.0     | 1.80                      | 39.2                          |
| <b>For Body</b>  |           |           |               |          |               |          |                           |                               |
| 750              | 51.7      | 47.2      | 0             | 0.9      | 0.1           | 0        | 0.96                      | 55.5                          |
| 835              | 50.8      | 48.2      | 0             | 0.9      | 0.1           | 0        | 0.97                      | 55.2                          |
| 900              | 50.8      | 48.2      | 0             | 0.9      | 0.1           | 0        | 1.05                      | 55.0                          |
| 1800, 1900, 2000 | 70.2      | 0         | 0             | 0.4      | 0             | 29.4     | 1.52                      | 53.3                          |
| 2450             | 68.6      | 0         | 0             | 0        | 0             | 31.4     | 1.95                      | 52.7                          |

**Table 6.1 Recipes of Tissue Simulating Liquid**

### **Simulating Liquid for 5G, Manufactured by SPEAG**

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

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SPEAG DAK-3.5 Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

| Frequency (MHz) | Liquid Type | Liquid Temp. (°C) | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date      |
|-----------------|-------------|-------------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|-----------|
| 850             | Body        | 22.5              | 0.963                     | 54.536                        | 0.97                             | 55.20                                | -0.72                  | -1.20                      | ±5        | 2013/9/10 |
| 850             | Body        | 22.4              | 0.985                     | 54.535                        | 0.97                             | 55.20                                | 1.55                   | -1.20                      | ±5        | 2013/9/14 |
| 850             | Body        | 22.4              | 0.985                     | 54.535                        | 0.97                             | 55.20                                | 1.55                   | -1.20                      | ±5        | 2013/9/14 |
| 2450            | Body        | 22.2              | 1.955                     | 53.805                        | 1.95                             | 52.70                                | 0.26                   | 2.10                       | ±5        | 2013/7/27 |
| 2450            | Body        | 22.5              | 2.020                     | 53.936                        | 1.95                             | 52.70                                | 3.59                   | 2.35                       | ±5        | 2013/7/31 |
| 2450            | Body        | 22.4              | 1.968                     | 50.766                        | 1.95                             | 52.70                                | 0.92                   | -3.67                      | ±5        | 2013/8/2  |
| 5200            | Body        | 22.5              | 5.432                     | 47.503                        | 5.30                             | 49.00                                | 2.49                   | -3.06                      | ±5        | 2013/7/27 |
| 5200            | Body        | 22.3              | 5.346                     | 47.813                        | 5.30                             | 49.00                                | 0.87                   | -2.42                      | ±5        | 2013/8/2  |
| 5300            | Body        | 22.3              | 5.396                     | 48.698                        | 5.42                             | 48.88                                | -0.44                  | -0.37                      | ±5        | 2013/7/28 |
| 5300            | Body        | 22.3              | 5.470                     | 47.643                        | 5.42                             | 48.88                                | 0.92                   | -2.53                      | ±5        | 2013/8/2  |
| 5600            | Body        | 22.5              | 5.956                     | 46.803                        | 5.77                             | 48.47                                | 3.22                   | -3.44                      | ±5        | 2013/7/27 |
| 5600            | Body        | 22.5              | 5.881                     | 46.699                        | 5.77                             | 48.47                                | 1.92                   | -3.65                      | ±5        | 2013/7/30 |
| 5600            | Body        | 22.3              | 5.858                     | 47.179                        | 5.77                             | 48.47                                | 1.53                   | -2.66                      | ±5        | 2013/8/2  |
| 5800            | Body        | 22.5              | 6.204                     | 46.490                        | 6.00                             | 48.20                                | 3.40                   | -3.55                      | ±5        | 2013/7/27 |
| 5800            | Body        | 22.3              | 6.125                     | 46.858                        | 6.00                             | 48.20                                | 2.08                   | -2.78                      | ±5        | 2013/8/2  |

**Table 6.2 Measuring Results for Simulating Liquid**

## 8. System Verification Procedures

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

### 8.1 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.

### 8.2 System Setup

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

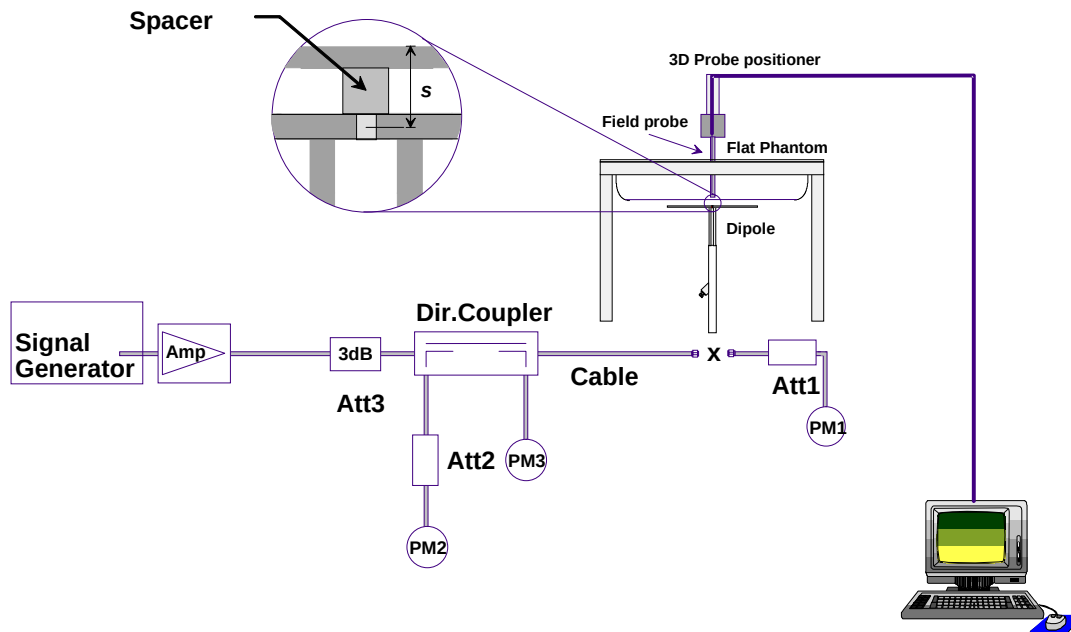


Fig 7.1 System Setup for System Evaluation

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



**Fig 7.2 Photo of Dipole Setup**

### **8.3 SAR System Verification Results**

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

| Date      | Frequency (MHz) | Liquid Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured SAR (W/kg) | Targeted SAR (W/kg) | Normalized SAR (W/kg) | Deviation (%) |
|-----------|-----------------|-------------|------------------|------------|-----------|---------|---------------------|---------------------|-----------------------|---------------|
| 2013/9/10 | 850             | Body        | 250              | 499        | 3792      | 1338    | 2.29                | 9.63                | 9.16                  | -4.88         |
| 2013/9/14 | 850             | Body        | 250              | 499        | 3801      | 778     | 2.46                | 9.63                | 9.84                  | 2.18          |
| 2013/9/14 | 850             | Body        | 250              | 499        | 3071      | 1279    | 2.44                | 9.63                | 9.76                  | 1.35          |
| 2013/7/27 | 2450            | Body        | 250              | 869        | 3697      | 1279    | 12.60               | 51.5                | 50.40                 | -2.14         |
| 2013/7/31 | 2450            | Body        | 250              | 869        | 3270      | 778     | 13.60               | 51.5                | 54.40                 | 5.63          |
| 2013/8/2  | 2450            | Body        | 250              | 869        | 3270      | 778     | 13.50               | 51.5                | 54.00                 | 4.85          |
| 2013/7/27 | 5200            | Body        | 100              | 1128       | 3697      | 1279    | 7.55                | 73.4                | 75.5                  | 2.86          |
| 2013/8/2  | 5200            | Body        | 100              | 1128       | 3697      | 1279    | 6.90                | 73.4                | 69.00                 | -5.99         |
| 2013/7/28 | 5300            | Body        | 100              | 1128       | 3697      | 1279    | 7.21                | 74.3                | 72.10                 | -2.96         |
| 2013/8/2  | 5300            | Body        | 100              | 1128       | 3697      | 1279    | 7.00                | 74.3                | 70.00                 | -5.79         |
| 2013/7/27 | 5600            | Body        | 100              | 1128       | 3697      | 1279    | 8.00                | 77.8                | 80.00                 | 2.83          |
| 2013/7/30 | 5600            | Body        | 100              | 1128       | 3792      | 1338    | 8.15                | 77.8                | 81.50                 | 4.76          |
| 2013/8/2  | 5600            | Body        | 100              | 1128       | 3697      | 1279    | 7.87                | 77.8                | 78.70                 | 1.16          |
| 2013/7/27 | 5800            | Body        | 100              | 1128       | 3697      | 1279    | 6.98                | 72.2                | 69.80                 | -3.32         |
| 2013/8/2  | 5800            | Body        | 100              | 1128       | 3697      | 1279    | 6.90                | 72.2                | 69.00                 | -4.43         |

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

## **9. EUT Testing Position**

Please refer to the test setup photos.

## **10. Measurement Procedures**

The measurement procedures are as follows:

### **<Conducted power measurement>**

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

### **<SAR measurement>**

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

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

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

### **10.1 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

## 10.2 Power Reference Measurement

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

## 10.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r01 quoted below.

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

|                                                                                                                                                                                                                                                                                                      |                                    |                                                                                      | $\leq 3$ GHz                                                                                                                                                                                                                                                           | $> 3$ GHz                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface                                                                                                                                                                                               |                                    |                                                                                      | $5 \pm 1$ mm                                                                                                                                                                                                                                                           | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm                            |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location                                                                                                                                                                                                            |                                    |                                                                                      | $30^\circ \pm 1^\circ$                                                                                                                                                                                                                                                 | $20^\circ \pm 1^\circ$                                                        |
| Maximum area scan spatial resolution: $\Delta x_{Area}$ , $\Delta y_{Area}$                                                                                                                                                                                                                          |                                    |                                                                                      | $\leq 2$ GHz: $\leq 15$ mm<br>2 – 3 GHz: $\leq 12$ mm                                                                                                                                                                                                                  | 3 – 4 GHz: $\leq 12$ mm<br>4 – 6 GHz: $\leq 10$ mm                            |
|                                                                                                                                                                                                                                                                                                      |                                    |                                                                                      | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                                               |
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$                                                                                                                                                                                                                          |                                    |                                                                                      | $\leq 2$ GHz: $\leq 8$ mm<br>2 – 3 GHz: $\leq 5$ mm*                                                                                                                                                                                                                   | 3 – 4 GHz: $\leq 5$ mm*<br>4 – 6 GHz: $\leq 4$ mm*                            |
| Maximum zoom scan spatial resolution, normal to phantom surface                                                                                                                                                                                                                                      | uniform grid: $\Delta z_{Zoom}(n)$ |                                                                                      | $\leq 5$ mm                                                                                                                                                                                                                                                            | 3 – 4 GHz: $\leq 4$ mm<br>4 – 5 GHz: $\leq 3$ mm<br>5 – 6 GHz: $\leq 2$ mm    |
|                                                                                                                                                                                                                                                                                                      | graded grid                        | $\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4$ mm                                                                                                                                                                                                                                                            | 3 – 4 GHz: $\leq 3$ mm<br>4 – 5 GHz: $\leq 2.5$ mm<br>5 – 6 GHz: $\leq 2$ mm  |
|                                                                                                                                                                                                                                                                                                      |                                    | $\Delta z_{Zoom}(n>1)$ : between subsequent points                                   | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$                                                                                                                                                                                                                                  |                                                                               |
| Minimum zoom scan volume                                                                                                                                                                                                                                                                             | x, y, z                            |                                                                                      | $\geq 30$ mm                                                                                                                                                                                                                                                           | 3 – 4 GHz: $\geq 28$ mm<br>4 – 5 GHz: $\geq 25$ mm<br>5 – 6 GHz: $\geq 22$ mm |
| Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.                                                                                                                                                    |                                    |                                                                                      |                                                                                                                                                                                                                                                                        |                                                                               |
| * When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. |                                    |                                                                                      |                                                                                                                                                                                                                                                                        |                                                                               |

#### **10.4 Volume Scan Procedures**

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

#### **10.5 SAR Averaged Methods**

In DASYS, 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.

#### **10.6 Power Drift Monitoring**

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASYS 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.

## 11. Conducted RF Output Power (Unit: dBm)

### <GSM Conducted Power>

#### General Note:

1. Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. Following KDB 941225 D03v01, for Body SAR testing, the EUT operating without power back-off was set in GPRS (2 Tx slots) and the EUT operating with power back-off was set in GPRS (2 Tx slots) due to its highest frame-average power.

#### Full Power Mode (Proximity Sensor Inactive)

| Band GSM850                    | Burst Average Power (dBm) |       |       | Frame-Average Power (dBm) |       |       |
|--------------------------------|---------------------------|-------|-------|---------------------------|-------|-------|
| TX Channel                     | 128                       | 189   | 251   | 128                       | 189   | 251   |
| Frequency (MHz)                | 824.2                     | 836.4 | 848.8 | 824.2                     | 836.4 | 848.8 |
| GPRS (GMSK, 1 Tx slot) – CS1   | 32.7                      | 32.8  | 32.9  | 23.7                      | 23.8  | 23.9  |
| GPRS (GMSK, 2 Tx slots) – CS1  | 31.6                      | 31.7  | 31.9  | 25.6                      | 25.7  | 25.9  |
| EDGE (8PSK, 1 Tx slot) – MCS5  | 26.2                      | 26.3  | 26.3  | 17.2                      | 17.3  | 17.3  |
| EDGE (8PSK, 2 Tx slots) – MCS5 | 26.1                      | 26.2  | 26.2  | 20.1                      | 20.2  | 20.2  |

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

#### Reduced Power Mode (Proximity Sensor active)

| Band GSM850                    | Burst Average Power (dBm) |       |       | Frame-Average Power (dBm) |       |       |
|--------------------------------|---------------------------|-------|-------|---------------------------|-------|-------|
| TX Channel                     | 128                       | 189   | 251   | 128                       | 189   | 251   |
| Frequency (MHz)                | 824.2                     | 836.4 | 848.8 | 824.2                     | 836.4 | 848.8 |
| GPRS (GMSK, 1 Tx slot) – CS1   | 24.9                      | 25.0  | 25.0  | 15.9                      | 16.0  | 16.0  |
| GPRS (GMSK, 2 Tx slots) – CS1  | 22.7                      | 22.8  | 22.9  | 16.7                      | 16.8  | 16.9  |
| EDGE (8PSK, 1 Tx slot) – MCS5  | 19.4                      | 19.3  | 19.4  | 10.4                      | 10.3  | 10.4  |
| EDGE (8PSK, 2 Tx slots) – MCS5 | 19.3                      | 19.2  | 19.3  | 13.3                      | 13.2  | 13.3  |

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

### <WCDMA Conducted Power>

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

A summary of these settings are illustrated below:

#### **HSDPA Setup Configuration:**

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
  - i. Set Gain Factors ( $\beta_c$  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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $\beta_c$         | $\beta_d$         | $\beta_d$<br>(SF) | $\beta_c/\beta_d$ | $\beta_{hs}$<br>(Note 1,<br>Note 2) | CM (dB)<br>(Note 3) | MPR (dB)<br>(Note 3) |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------------------------|---------------------|----------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2/15              | 15/15             | 64                | 2/15              | 4/15                                | 0.0                 | 0.0                  |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 12/15<br>(Note 4) | 15/15<br>(Note 4) | 64                | 12/15<br>(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                  |
| <p>Note 1: <math>\Delta_{ACK}</math>, <math>\Delta_{NACK}</math> and <math>\Delta_{CQI} = 30/15</math> with <math>\beta_{hs} = 30/15 * \beta_c</math>.</p> <p>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, <math>\Delta_{ACK}</math> and <math>\Delta_{NACK} = 30/15</math> with <math>\beta_{hs} = 30/15 * \beta_c</math>, and <math>\Delta_{CQI} = 24/15</math> with <math>\beta_{hs} = 24/15 * \beta_c</math>.</p> <p>Note 3: CM = 1 for <math>\beta_c/\beta_d = 12/15</math>, <math>\beta_{hs}/\beta_c = 24/15</math>. 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.</p> <p>Note 4: For subtest 2 the <math>\beta_c/\beta_d</math> 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 <math>\beta_c = 11/15</math> and <math>\beta_d = 15/15</math>.</p> |                   |                   |                   |                   |                                     |                     |                      |

#### **Setup Configuration**

**HSUPA Setup Configuration:**

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting \* :
  - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
  - ii. Set the Gain Factors ( $\beta_c$  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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | $\beta_c$         | $\beta_d$         | $\beta_d$<br>(SF) | $\beta_c/\beta_d$ | $\beta_{HS}$<br>(Note 1) | $\beta_{ec}$ | $\beta_{ed}$<br>(Note 5)<br>(Note 6)           | $\beta_{ed}$<br>(SF) | $\beta_{ed}$<br>(Codes) | CM<br>(dB)<br>(Note 2) | MPR<br>(dB)<br>(Note 2) | AG<br>Index<br>(Note 6) | E-TFCI |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|--------------------------|--------------|------------------------------------------------|----------------------|-------------------------|------------------------|-------------------------|-------------------------|--------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 11/15<br>(Note 3) | 15/15<br>(Note 3) | 64                | 11/15<br>(Note 3) | 22/15                    | 209/25       | 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<br>$\beta_{ed2}$ : 47/15 | 4<br>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<br>(Note 4) | 15/15<br>(Note 4) | 64                | 15/15<br>(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 $\beta_{hs} = 30/15 * \beta_c$ .<br>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.<br>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 $\beta_d = 15/15$ .<br>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 $\beta_d = 15/15$ .<br>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.<br>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 Agilent E5515C referred to the Setup Configuration below
- 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. |           |       |

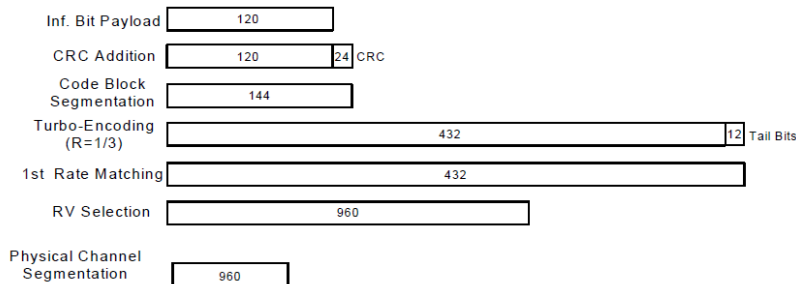


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

#### Setup Configuration

## <WCDMA Conducted Power>

### General Note:

1. Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA/DC-HSDPA output power is < 0.25dB higher than RMC12.2Kbps, or reported SAR with RMC 12.2kbps setting is  $\leq 1.2\text{W/kg}$ , HSDPA/HSUPA/DC-HSDPA SAR evaluation can be excluded.

### Full Power Mode (Proximity Sensor Inactive)

| Band            |             |                    | WCDMA V |       |       |
|-----------------|-------------|--------------------|---------|-------|-------|
| TX Channel      |             |                    | 4132    | 4182  | 4233  |
| Frequency (MHz) |             |                    | 826.4   | 836.4 | 846.6 |
| MPR(dB)         | 3GPP Rel 99 | RMC 12.2Kbps       | 22.7    | 22.5  | 22.3  |
| 0               | 3GPP Rel 6  | HSDPA Subtest-1    | 22.3    | 22.2  | 22.0  |
| 0               | 3GPP Rel 6  | HSDPA Subtest-2    | 22.3    | 22.2  | 22.0  |
| 0.5             | 3GPP Rel 6  | HSDPA Subtest-3    | 21.9    | 21.8  | 21.8  |
| 0.5             | 3GPP Rel 6  | HSDPA Subtest-4    | 21.9    | 21.7  | 21.7  |
| 0               | 3GPP Rel 8  | DC-HSDPA Subtest-1 | 22.2    | 22.2  | 21.9  |
| 0               | 3GPP Rel 8  | DC-HSDPA Subtest-2 | 22.2    | 22.1  | 21.9  |
| 0.5             | 3GPP Rel 8  | DC-HSDPA Subtest-3 | 21.9    | 21.8  | 21.8  |
| 0.5             | 3GPP Rel 8  | DC-HSDPA Subtest-4 | 21.9    | 21.7  | 21.7  |
| 0               | 3GPP Rel 6  | HSUPA Subtest-1    | 22.1    | 21.8  | 21.7  |
| 2               | 3GPP Rel 6  | HSUPA Subtest-2    | 21.8    | 21.7  | 21.7  |
| 1               | 3GPP Rel 6  | HSUPA Subtest-3    | 21.5    | 21.4  | 21.4  |
| 2               | 3GPP Rel 6  | HSUPA Subtest-4    | 21.2    | 21.1  | 21.2  |
| 0               | 3GPP Rel 6  | HSUPA Subtest-5    | 22.2    | 21.7  | 22.0  |

### Reduced Power Mode (Proximity Sensor active)

| Band            |             |                    | WCDMA V |       |       |
|-----------------|-------------|--------------------|---------|-------|-------|
| TX Channel      |             |                    | 4132    | 4182  | 4233  |
| Frequency (MHz) |             |                    | 826.4   | 836.4 | 846.6 |
| MPR(dB)         | 3GPP Rel 99 | RMC 12.2Kbps       | 17.9    | 17.8  | 17.8  |
| 0               | 3GPP Rel 6  | HSDPA Subtest-1    | 17.7    | 17.6  | 17.6  |
| 0               | 3GPP Rel 6  | HSDPA Subtest-2    | 17.7    | 17.6  | 17.6  |
| 0.5             | 3GPP Rel 6  | HSDPA Subtest-3    | 17.2    | 17.1  | 17.2  |
| 0.5             | 3GPP Rel 6  | HSDPA Subtest-4    | 17.1    | 17.2  | 17.2  |
| 0               | 3GPP Rel 8  | DC-HSDPA Subtest-1 | 17.6    | 17.5  | 17.6  |
| 0               | 3GPP Rel 8  | DC-HSDPA Subtest-2 | 17.6    | 17.5  | 17.5  |
| 0.5             | 3GPP Rel 8  | DC-HSDPA Subtest-3 | 17.2    | 17.2  | 17.2  |
| 0.5             | 3GPP Rel 8  | DC-HSDPA Subtest-4 | 17.2    | 17.1  | 17.1  |
| 0               | 3GPP Rel 6  | HSUPA Subtest-1    | 17.4    | 17.3  | 17.2  |
| 2               | 3GPP Rel 6  | HSUPA Subtest-2    | 17.0    | 16.8  | 16.9  |
| 1               | 3GPP Rel 6  | HSUPA Subtest-3    | 16.8    | 16.6  | 16.7  |
| 2               | 3GPP Rel 6  | HSUPA Subtest-4    | 16.7    | 16.7  | 16.7  |
| 0               | 3GPP Rel 6  | HSUPA Subtest-5    | 17.5    | 17.7  | 17.4  |

### <WLAN 2.4GHz Conducted Power>

#### General Note:

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

### <Total power of Antenna 1+2>

| WLAN 2.4GHz 802.11b Average Power (dBm) |                 |           |                     |         |        |
|-----------------------------------------|-----------------|-----------|---------------------|---------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |         |        |
| Channel                                 | Frequency (MHz) | Data Rate | 2Mbps               | 5.5Mbps | 11Mbps |
|                                         |                 | 1Mbps     |                     |         |        |
| CH 1                                    | 2412            | 18.9      | 18.7                | 19.0    | 18.9   |
| CH 6                                    | 2437            | 19.0      |                     |         |        |
| CH 11                                   | 2462            | 18.8      |                     |         |        |

| WLAN 2.4GHz 802.11g Average Power (dBm) |                 |           |                     |        |        |        |        |        |        |
|-----------------------------------------|-----------------|-----------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                                 | Frequency (MHz) | Data Rate | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
|                                         |                 | 6Mbps     |                     |        |        |        |        |        |        |
| CH 01                                   | 2412            | 13.4      | 17.9                | 17.7   | 17.8   | 14.4   | 14.4   | 14.5   | 14.4   |
| CH 02                                   | 2417            | 15.1      |                     |        |        |        |        |        |        |
| CH 06                                   | 2437            | 17.9      |                     |        |        |        |        |        |        |
| CH 10                                   | 2457            | 15.8      |                     |        |        |        |        |        |        |
| CH 11                                   | 2462            | 12.9      |                     |        |        |        |        |        |        |

| WLAN 2.4GHz 802.11n-HT20 Average Power (dBm) |                 |           |                     |      |      |      |      |      |      |
|----------------------------------------------|-----------------|-----------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                            |                 |           | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                      | Frequency (MHz) | MCS Index | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|                                              |                 | MCS0      |                     |      |      |      |      |      |      |
| CH 01                                        | 2412            | 8.8       | 17.7                | 17.3 | 15.6 | 15.3 | 15.0 | 14.3 | 13.9 |
| CH 02                                        | 2417            | 15.4      |                     |      |      |      |      |      |      |
| CH 06                                        | 2437            | 17.8      |                     |      |      |      |      |      |      |
| CH 10                                        | 2457            | 16.2      |                     |      |      |      |      |      |      |
| CH 11                                        | 2462            | 9.4       |                     |      |      |      |      |      |      |

**<Antenna 1>**

| WLAN 2.4GHz 802.11b Average Power (dBm) |                 |           |                     |         |        |
|-----------------------------------------|-----------------|-----------|---------------------|---------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |         |        |
| Channel                                 | Frequency (MHz) | Data Rate | 2Mbps               | 5.5Mbps | 11Mbps |
|                                         |                 | 1Mbps     |                     |         |        |
| CH 1                                    | 2412            | 16.0      | 16.0                | 16.0    | 16.0   |
| CH 6                                    | 2437            | 16.0      |                     |         |        |
| CH 11                                   | 2462            | 16.0      |                     |         |        |

| WLAN 2.4GHz 802.11g Average Power (dBm) |                 |           |                     |        |        |        |        |        |        |
|-----------------------------------------|-----------------|-----------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                                 | Frequency (MHz) | Data Rate | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
|                                         |                 | 6Mbps     |                     |        |        |        |        |        |        |
| CH 01                                   | 2412            | 10.2      | 14.8                | 14.8   | 14.9   | 11.5   | 11.7   | 11.6   | 11.4   |
| CH 02                                   | 2417            | 12.0      |                     |        |        |        |        |        |        |
| CH 06                                   | 2437            | 15.0      |                     |        |        |        |        |        |        |
| CH 10                                   | 2457            | 13.1      |                     |        |        |        |        |        |        |
| CH 11                                   | 2462            | 9.8       |                     |        |        |        |        |        |        |

| WLAN 2.4GHz 802.11n-HT20 Average Power (dBm) |                 |           |                     |      |      |      |      |      |      |
|----------------------------------------------|-----------------|-----------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                            |                 |           | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                      | Frequency (MHz) | MCS Index | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|                                              |                 | MCS0      |                     |      |      |      |      |      |      |
| CH 01                                        | 2412            | 5.9       | 15.0                | 14.8 | 11.7 | 11.7 | 11.6 | 11.0 | 10.9 |
| CH 02                                        | 2417            | 12.2      |                     |      |      |      |      |      |      |
| CH 06                                        | 2437            | 15.0      |                     |      |      |      |      |      |      |
| CH 10                                        | 2457            | 13.8      |                     |      |      |      |      |      |      |
| CH 11                                        | 2462            | 6.5       |                     |      |      |      |      |      |      |

**<Antenna 2>**

| WLAN 2.4GHz 802.11b Average Power (dBm) |                 |           |                     |         |        |
|-----------------------------------------|-----------------|-----------|---------------------|---------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |         |        |
| Channel                                 | Frequency (MHz) | Data Rate | 2Mbps               | 5.5Mbps | 11Mbps |
|                                         |                 | 1Mbps     |                     |         |        |
| CH 1                                    | 2412            | 15.8      | 15.4                | 15.9    | 15.8   |
| CH 6                                    | 2437            | 15.9      |                     |         |        |
| CH 11                                   | 2462            | 15.6      |                     |         |        |

| WLAN 2.4GHz 802.11g Average Power (dBm) |                 |           |                     |        |        |        |        |        |        |
|-----------------------------------------|-----------------|-----------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                       |                 |           | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                                 | Frequency (MHz) | Data Rate | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
|                                         |                 | 6Mbps     |                     |        |        |        |        |        |        |
| CH 01                                   | 2412            | 10.6      | 14.9                | 14.6   | 14.7   | 11.3   | 11.1   | 11.4   | 11.3   |
| CH 02                                   | 2417            | 12.2      |                     |        |        |        |        |        |        |
| CH 06                                   | 2437            | 14.8      |                     |        |        |        |        |        |        |
| CH 10                                   | 2457            | 12.5      |                     |        |        |        |        |        |        |
| CH 11                                   | 2462            | 9.9       |                     |        |        |        |        |        |        |

| WLAN 2.4GHz 802.11n-HT20 Average Power (dBm) |                 |           |                     |      |      |      |      |      |      |
|----------------------------------------------|-----------------|-----------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                            |                 |           | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                      | Frequency (MHz) | MCS Index | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
|                                              |                 | MCS0      |                     |      |      |      |      |      |      |
| CH 01                                        | 2412            | 5.6       | 14.3                | 13.7 | 13.3 | 12.8 | 12.3 | 11.6 | 10.9 |
| CH 02                                        | 2417            | 12.5      |                     |      |      |      |      |      |      |
| CH 06                                        | 2437            | 14.5      |                     |      |      |      |      |      |      |
| CH 10                                        | 2457            | 12.4      |                     |      |      |      |      |      |      |
| CH 11                                        | 2462            | 6.2       |                     |      |      |      |      |      |      |

**<Bluetooth Conducted Power>**

| Channel | Frequency (MHz) | Average power (dBm) |           |        |
|---------|-----------------|---------------------|-----------|--------|
|         |                 | Mode                |           |        |
|         |                 | GFSK                | π/4-DQPSK | 8-DPSK |
| CH 0    | 2402            | 4.7                 | 4.8       | 4.6    |
| CH 39   | 2441            | 5.0                 | 5.1       | 4.9    |
| CH 78   | 2480            | 5.4                 | 5.5       | 5.2    |

**General Note:**

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

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

| Bluetooth Max Power (dBm) | Distance (mm) | Frequency (GHz) | exclusion thresholds |
|---------------------------|---------------|-----------------|----------------------|
| 5.5                       | 5             | 2.48            | 1.26                 |

- Per KDB 447498 D01v05r01 exclusion thresholds is  $1.26 < 3$ , RF exposure evaluation is not required.

### <WLAN 5GHz Conducted Power>

#### General Note:

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion
2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate
3. Apply the test exclusion rule in KDB 248227 D01 v01r02 11n-HT20 and 11n-HT40 output power is less than 1/4dB higher than 11a mode, thus the SAR can be excluded.
4. The measured power of antenna 1 and antenna 2 is summed to a total power.

### <Total power of Antenna 1+2>

| WLAN 5GHz 802.11a Average Power (dBm) |                 |                 |                     |        |        |        |        |        |        |
|---------------------------------------|-----------------|-----------------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                     |                 |                 | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                               | Frequency (MHz) | Data Rate 6Mbps | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| CH 36                                 | 5180            | 15.1            | 14.8                | 14.9   | 14.9   | 14.8   | 14.9   | 14.9   | 14.9   |
| CH 40                                 | 5200            | 15.1            |                     |        |        |        |        |        |        |
| CH 44                                 | 5220            | 15.0            |                     |        |        |        |        |        |        |
| CH 48                                 | 5240            | 15.0            |                     |        |        |        |        |        |        |
| CH 52                                 | 5260            | 14.3            | 14.0                | 14.0   | 14.1   | 14.1   | 14.0   | 14.0   | 14.0   |
| CH 56                                 | 5280            | 14.2            |                     |        |        |        |        |        |        |
| CH 60                                 | 5300            | 14.3            |                     |        |        |        |        |        |        |
| CH 64                                 | 5320            | 14.3            |                     |        |        |        |        |        |        |
| CH 100                                | 5500            | 14.7            | 14.5                | 14.6   | 14.6   | 14.6   | 14.7   | 14.6   | 14.6   |
| CH 104                                | 5520            | 14.8            |                     |        |        |        |        |        |        |
| CH 108                                | 5540            | 14.8            |                     |        |        |        |        |        |        |
| CH 112                                | 5560            | 14.6            |                     |        |        |        |        |        |        |
| CH 116                                | 5580            | 14.8            |                     |        |        |        |        |        |        |
| CH 132                                | 5660            | 14.6            |                     |        |        |        |        |        |        |
| CH 136                                | 5680            | 14.8            |                     |        |        |        |        |        |        |
| CH 140                                | 5700            | 14.7            |                     |        |        |        |        |        |        |
| CH 144                                | 5720            | 14.7            | 15.7                | 15.7   | 15.8   | 12.2   | 12.4   | 12.4   | 12.4   |
| CH 149                                | 5745            | 16.0            |                     |        |        |        |        |        |        |
| CH 153                                | 5765            | 16.0            |                     |        |        |        |        |        |        |
| CH 157                                | 5785            | 16.0            |                     |        |        |        |        |        |        |
| CH 161                                | 5805            | 16.0            |                     |        |        |        |        |        |        |
| CH 165                                | 5825            | 15.9            |                     |        |        |        |        |        |        |

| WLAN 5GHz 802.11n-HT20 Average Power (dBm) |                 |                   |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|-------------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                   | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index<br>MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 36                                      | 5180            | 15.1              | 14.9                | 15.0 | 14.8 | 14.9 | 14.9 | 14.9 | 14.9 |
| CH 40                                      | 5200            | 14.9              |                     |      |      |      |      |      |      |
| CH 44                                      | 5220            | 15.0              |                     |      |      |      |      |      |      |
| CH 48                                      | 5240            | 15.0              |                     |      |      |      |      |      |      |
| CH 52                                      | 5260            | 14.3              | 14.2                | 14.1 | 14.2 | 14.1 | 14.1 | 14.0 | 14.1 |
| CH 56                                      | 5280            | 14.1              |                     |      |      |      |      |      |      |
| CH 60                                      | 5300            | 14.2              |                     |      |      |      |      |      |      |
| CH 64                                      | 5320            | 14.1              |                     |      |      |      |      |      |      |
| CH 100                                     | 5500            | 14.8              | 14.6                | 14.5 | 14.6 | 14.6 | 14.5 | 14.6 | 14.7 |
| CH 104                                     | 5520            | 14.6              |                     |      |      |      |      |      |      |
| CH 108                                     | 5540            | 14.3              |                     |      |      |      |      |      |      |
| CH 112                                     | 5560            | 14.4              |                     |      |      |      |      |      |      |
| CH 116                                     | 5580            | 14.4              |                     |      |      |      |      |      |      |
| CH 144                                     | 5720            | 14.5              |                     |      |      |      |      |      |      |
| CH 149                                     | 5745            | 16.0              | 15.9                | 15.9 | 13.6 | 13.5 | 13.7 | 12.4 | 12.4 |
| CH 153                                     | 5765            | 15.9              |                     |      |      |      |      |      |      |
| CH 157                                     | 5785            | 16.0              |                     |      |      |      |      |      |      |
| CH 161                                     | 5805            | 16.0              |                     |      |      |      |      |      |      |
| CH 165                                     | 5825            | 15.7              |                     |      |      |      |      |      |      |

| WLAN 5GHz 802.11n-HT40 Average Power (dBm) |                 |                   |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|-------------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                   | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index<br>MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 38                                      | 5190            | 15.7              | 15.7                | 15.6 | 13.8 | 14.4 | 14.5 | 14.5 | 14.6 |
| CH 46                                      | 5230            | 15.8              |                     |      |      |      |      |      |      |
| CH 54                                      | 5270            | 14.0              | 13.9                | 13.8 | 13.0 | 13.3 | 13.4 | 13.3 | 13.2 |
| CH 62                                      | 5310            | 13.5              |                     |      |      |      |      |      |      |
| CH 102                                     | 5510            | 14.3              | 14.5                | 14.5 | 13.6 | 13.6 | 13.6 | 13.6 | 13.7 |
| CH 110                                     | 5550            | 14.7              |                     |      |      |      |      |      |      |
| CH 134                                     | 5670            | 14.8              |                     |      |      |      |      |      |      |
| CH 142                                     | 5710            | 14.6              |                     |      |      |      |      |      |      |
| CH 151                                     | 5755            | 16.0              | 15.9                | 15.9 | 12.2 | 12.3 | 12.2 | 12.2 | 12.2 |
| CH 159                                     | 5795            | 15.9              |                     |      |      |      |      |      |      |

# <Antenna 1>

| WLAN 5GHz 802.11a Average Power (dBm) |                 |                 |                     |        |        |        |        |        |        |
|---------------------------------------|-----------------|-----------------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                     |                 |                 | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                               | Frequency (MHz) | Data Rate 6Mbps | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| CH 36                                 | 5180            | 13.0            | 12.6                | 12.7   | 12.7   | 12.6   | 12.6   | 12.6   | 12.7   |
| CH 40                                 | 5200            | 13.0            |                     |        |        |        |        |        |        |
| CH 44                                 | 5220            | 13.0            |                     |        |        |        |        |        |        |
| CH 48                                 | 5240            | 13.0            |                     |        |        |        |        |        |        |
| CH 52                                 | 5260            | 13.0            | 12.6                | 12.7   | 12.8   | 12.8   | 12.7   | 12.7   | 12.7   |
| CH 56                                 | 5280            | 12.9            |                     |        |        |        |        |        |        |
| CH 60                                 | 5300            | 13.0            |                     |        |        |        |        |        |        |
| CH 64                                 | 5320            | 13.0            |                     |        |        |        |        |        |        |
| CH 100                                | 5500            | 12.9            | 12.8                | 12.9   | 12.8   | 12.8   | 12.9   | 12.9   | 12.8   |
| CH 104                                | 5520            | 13.0            |                     |        |        |        |        |        |        |
| CH 108                                | 5540            | 13.0            |                     |        |        |        |        |        |        |
| CH 112                                | 5560            | 12.9            |                     |        |        |        |        |        |        |
| CH 116                                | 5580            | 13.0            |                     |        |        |        |        |        |        |
| CH 132                                | 5660            | 12.9            |                     |        |        |        |        |        |        |
| CH 136                                | 5680            | 13.0            |                     |        |        |        |        |        |        |
| CH 140                                | 5700            | 12.9            |                     |        |        |        |        |        |        |
| CH 144                                | 5720            | 12.9            | 12.8                | 12.7   | 12.8   | 9.2    | 9.3    | 9.4    | 9.5    |
| CH 149                                | 5745            | 13.0            |                     |        |        |        |        |        |        |
| CH 153                                | 5765            | 13.0            |                     |        |        |        |        |        |        |
| CH 157                                | 5785            | 13.0            |                     |        |        |        |        |        |        |
| CH 161                                | 5805            | 13.0            |                     |        |        |        |        |        |        |
| CH 165                                | 5825            | 13.0            |                     |        |        |        |        |        |        |

| WLAN 5GHz 802.11n-HT20 Average Power (dBm) |                 |                |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|----------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 36                                      | 5180            | 13.0           | 12.7                | 12.8 | 12.6 | 12.8 | 12.7 | 12.7 | 12.7 |
| CH 40                                      | 5200            | 12.7           |                     |      |      |      |      |      |      |
| CH 44                                      | 5220            | 12.8           |                     |      |      |      |      |      |      |
| CH 48                                      | 5240            | 13.0           |                     |      |      |      |      |      |      |
| CH 52                                      | 5260            | 13.0           | 12.9                | 12.7 | 12.9 | 12.8 | 12.7 | 12.7 | 12.7 |
| CH 56                                      | 5280            | 12.8           |                     |      |      |      |      |      |      |
| CH 60                                      | 5300            | 13.0           |                     |      |      |      |      |      |      |
| CH 64                                      | 5320            | 12.8           |                     |      |      |      |      |      |      |
| CH 100                                     | 5500            | 13.0           | 12.8                | 12.8 | 12.9 | 12.9 | 12.7 | 12.7 | 12.9 |
| CH 104                                     | 5520            | 12.7           |                     |      |      |      |      |      |      |
| CH 108                                     | 5540            | 12.7           |                     |      |      |      |      |      |      |
| CH 112                                     | 5560            | 12.8           |                     |      |      |      |      |      |      |
| CH 116                                     | 5580            | 12.7           |                     |      |      |      |      |      |      |
| CH 132                                     | 5660            | 13.0           |                     |      |      |      |      |      |      |
| CH 136                                     | 5680            | 12.8           |                     |      |      |      |      |      |      |
| CH 140                                     | 5700            | 13.0           |                     |      |      |      |      |      |      |
| CH 144                                     | 5720            | 12.8           | 12.9                | 13.0 | 10.8 | 10.6 | 10.8 | 9.5  | 9.6  |
| CH 149                                     | 5745            | 12.9           |                     |      |      |      |      |      |      |
| CH 153                                     | 5765            | 12.8           |                     |      |      |      |      |      |      |
| CH 157                                     | 5785            | 12.9           |                     |      |      |      |      |      |      |
| CH 161                                     | 5805            | 13.0           |                     |      |      |      |      |      |      |
| CH 165                                     | 5825            | 12.8           |                     |      |      |      |      |      |      |

| WLAN 5GHz 802.11n-HT40 Average Power (dBm) |                 |                   |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|-------------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                   | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index<br>MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 38                                      | 5190            | 12.7              | 12.7                | 12.6 | 11.6 | 11.8 | 11.8 | 11.8 | 11.8 |
| CH 46                                      | 5230            | 12.8              |                     |      |      |      |      |      |      |
| CH 54                                      | 5270            | 12.6              |                     |      |      |      |      |      |      |
| CH 62                                      | 5310            | 12.0              | 12.4                | 12.5 | 11.4 | 11.7 | 11.8 | 11.7 | 11.9 |
| CH 102                                     | 5510            | 12.4              |                     |      |      |      |      |      |      |
| CH 110                                     | 5550            | 12.9              |                     |      |      |      |      |      |      |
| CH 134                                     | 5670            | 13.0              | 12.7                | 12.6 | 11.8 | 11.8 | 11.7 | 11.8 | 11.8 |
| CH 142                                     | 5710            | 12.8              |                     |      |      |      |      |      |      |
| CH 151                                     | 5755            | 12.9              |                     |      |      |      |      |      |      |
| CH 159                                     | 5795            | 12.9              | 12.8                | 12.8 | 8.8  | 8.9  | 8.8  | 8.8  | 8.9  |

## <Antenna 2>

| WLAN 5GHz 802.11a Average Power (dBm) |                 |                    |                     |        |        |        |        |        |        |
|---------------------------------------|-----------------|--------------------|---------------------|--------|--------|--------|--------|--------|--------|
| Power vs. Channel                     |                 |                    | Power vs. Data Rate |        |        |        |        |        |        |
| Channel                               | Frequency (MHz) | Data Rate<br>6Mbps | 9Mbps               | 12Mbps | 18Mbps | 24Mbps | 36Mbps | 48Mbps | 54Mbps |
| CH 36                                 | 5180            | 11.0               | 10.9                | 10.9   | 10.9   | 10.9   | 11.0   | 11.0   | 11.0   |
| CH 40                                 | 5200            | 11.0               |                     |        |        |        |        |        |        |
| CH 44                                 | 5220            | 10.7               |                     |        |        |        |        |        |        |
| CH 48                                 | 5240            | 10.7               |                     |        |        |        |        |        |        |
| CH 52                                 | 5260            | 8.5                | 8.4                 | 8.3    | 8.2    | 8.2    | 8.1    | 8.3    | 8.3    |
| CH 56                                 | 5280            | 8.5                |                     |        |        |        |        |        |        |
| CH 60                                 | 5300            | 8.5                |                     |        |        |        |        |        |        |
| CH 64                                 | 5320            | 8.3                |                     |        |        |        |        |        |        |
| CH 100                                | 5500            | 10.0               | 9.7                 | 9.8    | 9.8    | 9.8    | 10.0   | 9.8    | 9.9    |
| CH 104                                | 5520            | 10.0               |                     |        |        |        |        |        |        |
| CH 108                                | 5540            | 10.0               |                     |        |        |        |        |        |        |
| CH 112                                | 5560            | 9.6                |                     |        |        |        |        |        |        |
| CH 116                                | 5580            | 10.0               |                     |        |        |        |        |        |        |
| CH 132                                | 5660            | 9.6                |                     |        |        |        |        |        |        |
| CH 136                                | 5680            | 10.0               |                     |        |        |        |        |        |        |
| CH 140                                | 5700            | 10.0               |                     |        |        |        |        |        |        |
| CH 144                                | 5720            | 10.0               |                     |        |        |        |        |        |        |
| CH 149                                | 5745            | 13.0               | 12.6                | 12.7   | 12.7   | 9.1    | 9.5    | 9.4    | 9.3    |
| CH 153                                | 5765            | 13.0               |                     |        |        |        |        |        |        |
| CH 157                                | 5785            | 12.9               |                     |        |        |        |        |        |        |
| CH 161                                | 5805            | 13.0               |                     |        |        |        |        |        |        |
| CH 165                                | 5825            | 12.8               |                     |        |        |        |        |        |        |

| WLAN 5GHz 802.11n-HT20 Average Power (dBm) |                 |                   |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|-------------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                   | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index<br>MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 36                                      | 5180            | 11.0              | 11.0                | 10.8 | 10.8 | 10.8 | 10.9 | 11.0 | 10.9 |
| CH 40                                      | 5200            | 10.9              |                     |      |      |      |      |      |      |
| CH 44                                      | 5220            | 10.9              |                     |      |      |      |      |      |      |
| CH 48                                      | 5240            | 10.8              |                     |      |      |      |      |      |      |
| CH 52                                      | 5260            | 8.5               | 8.3                 | 8.4  | 8.3  | 8.2  | 8.3  | 8.3  | 8.5  |
| CH 56                                      | 5280            | 8.1               |                     |      |      |      |      |      |      |
| CH 60                                      | 5300            | 8.0               |                     |      |      |      |      |      |      |
| CH 64                                      | 5320            | 8.2               |                     |      |      |      |      |      |      |
| CH 100                                     | 5500            | 10.0              | 9.9                 | 9.8  | 9.8  | 9.8  | 9.7  | 10.0 | 9.8  |
| CH 104                                     | 5520            | 10.0              |                     |      |      |      |      |      |      |
| CH 108                                     | 5540            | 9.3               |                     |      |      |      |      |      |      |
| CH 112                                     | 5560            | 9.3               |                     |      |      |      |      |      |      |
| CH 116                                     | 5580            | 9.5               |                     |      |      |      |      |      |      |
| CH 132                                     | 5660            | 9.4               |                     |      |      |      |      |      |      |
| CH 136                                     | 5680            | 9.9               |                     |      |      |      |      |      |      |
| CH 140                                     | 5700            | 9.8               |                     |      |      |      |      |      |      |
| CH 144                                     | 5720            | 9.7               |                     |      |      |      |      |      |      |
| CH 149                                     | 5745            | 13.0              | 12.9                | 12.8 | 10.3 | 10.4 | 10.5 | 9.2  | 9.3  |
| CH 153                                     | 5765            | 13.0              |                     |      |      |      |      |      |      |
| CH 157                                     | 5785            | 13.0              |                     |      |      |      |      |      |      |
| CH 161                                     | 5805            | 13.0              |                     |      |      |      |      |      |      |
| CH 165                                     | 5825            | 12.6              |                     |      |      |      |      |      |      |

| WLAN 5GHz 802.11n-HT40 Average Power (dBm) |                 |                   |                     |      |      |      |      |      |      |
|--------------------------------------------|-----------------|-------------------|---------------------|------|------|------|------|------|------|
| Power vs. Channel                          |                 |                   | Power vs. MCS Index |      |      |      |      |      |      |
| Channel                                    | Frequency (MHz) | MCS Index<br>MCS0 | MCS1                | MCS2 | MCS3 | MCS4 | MCS5 | MCS6 | MCS7 |
| CH 38                                      | 5190            | 12.7              | 12.6                | 12.6 | 9.8  | 11.0 | 11.1 | 11.2 | 11.3 |
| CH 46                                      | 5230            | 12.8              |                     |      |      |      |      |      |      |
| CH 54                                      | 5270            | 8.5               |                     |      |      |      |      |      |      |
| CH 62                                      | 5310            | 8.0               | 8.4                 | 7.9  | 8.0  | 8.2  | 8.2  | 8.2  | 7.6  |
| CH 102                                     | 5510            | 9.7               |                     |      |      |      |      |      |      |
| CH 110                                     | 5550            | 10.0              |                     |      |      |      |      |      |      |
| CH 134                                     | 5670            | 10.0              |                     |      |      |      |      |      |      |
| CH 142                                     | 5710            | 10.0              | 9.8                 | 9.9  | 8.9  | 9.0  | 9.1  | 8.9  | 9.2  |
| CH 151                                     | 5755            | 13.0              |                     |      |      |      |      |      |      |
| CH 159                                     | 5795            | 12.9              |                     |      |      |      |      |      |      |
|                                            |                 |                   | 13.0                | 12.9 | 9.5  | 9.6  | 9.5  | 9.5  | 9.5  |

## 12. Exposure Position Conditions

### <Distance from the antenna to the edge>

**General Note:**

1. The detail antenna locations please refer to setup photo.
2. This device overall diagonal dimension is 272mm, and according to KDB 616217 D04v01r01, if the diagonal is greater than 200mm, SAR evaluation for the front surface of tablet display screens are generally not necessary.

| Exposure Position                       | Bottom Face | Edge1  | Edge2  | Edge3  | Edge4    |
|-----------------------------------------|-------------|--------|--------|--------|----------|
| WLAN Antenna1 to the Edge distance (mm) | < 5 mm      | < 5 mm | 163 mm | 138 mm | 49 mm    |
| WLAN Antenna2 to the Edge distance (mm) | < 5 mm      | 116 mm | 216 mm | 21 mm  | < 5 mm   |
| WWAN Antenna to the Edge distance (mm)  | < 5 mm      | 28 mm  | < 5 mm | 43 mm  | 216.4 mm |

### <SAR test exclusion table>

**General Note:**

1. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
2. Per KDB 447498 D01v05r01, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D01v05r01, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold
4. Per KDB 447498 D01v05r01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:  

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR}$$
  - f(GHz) is the RF channel transmit frequency in GHz
  - Power and distance are rounded to the nearest mW and mm before calculation
  - The result is rounded to one decimal place for comparison
  - For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.  
This formula is  $[3.0] / [\sqrt{f(\text{GHz})}] \cdot [(\text{min. test separation distance, mm})] = \text{exclusion threshold of mW.}$
5. Per KDB 447498 D01v05r01, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
  - a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW, at 100 MHz to 1500 MHz
  - b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz

| Exposure Position | Wireless Interface      | GPRS850 Class 10 | WCDMA Band V | 802.11b Ant 1 | 802.11b Ant 2 | 802.11a Ant 1 | 802.11a Ant 2 |
|-------------------|-------------------------|------------------|--------------|---------------|---------------|---------------|---------------|
| Bottom Face       | Maximum power           | 26               | 23.5         | 16            | 16            | 13            | 13            |
|                   | Maximum rated power(mW) | 398.11           | 223.87       | 39.81         | 39.81         | 19.95         | 19.95         |
|                   | Antenna to user (mm)    | 5                |              | 5             | 5             | 5             | 5             |
| Edge 1            | SAR exclusion threshold | 73.32            | 41.18        | 12.49         | 12.49         | 9.63          | 9.63          |
|                   | SAR testing required?   | Yes              | Yes          | Yes           | Yes           | Yes           | Yes           |
|                   | Antenna to user (mm)    | 28               |              | 5             | 116           | 5             | 116           |
| Edge 2            | SAR exclusion threshold | 13.09            | 7.35         | 12.49         | 755.6         | 9.63          | 722.15        |
|                   | SAR testing required?   | Yes              | Yes          | Yes           | No            | Yes           | No            |
|                   | Antenna to user (mm)    | 5                |              | 163           | 216           | 163           | 216           |
| Edge 3            | SAR exclusion threshold | 73.32            | 41.18        | 1225.6        | 1755.6        | 1192.15       | 1722.15       |
|                   | SAR testing required?   | Yes              | Yes          | No            | No            | No            | No            |
|                   | Antenna to user (mm)    | 43               |              | 138           | 21            | 138           | 21            |
| Edge 4            | SAR exclusion threshold | 8.53             | 4.79         | 975.6         | 2.97          | 942.15        | 2.29          |
|                   | SAR testing required?   | Yes              | Yes          | No            | No            | No            | No            |
|                   | Antenna to user (mm)    | 216.4            |              | 49            | 5             | 49            | 5             |
| Edge 4            | SAR exclusion threshold | 1103.60          | 1101.58      | 1.27          | 12.49         | 0.98          | 9.63          |
|                   | SAR testing required?   | No               | No           | No            | Yes           | No            | Yes           |
|                   | Antenna to user (mm)    | 216.4            |              | 49            | 5             | 49            | 5             |

## 13. SAR Test Results

### General Note:

- Per KDB 447498 D01v05r01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - For WWAN/WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
- Per KDB 447498 D01v05r01, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
  - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
  - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
- During the SAR testing, the additional separation between EUT and the phantom surface introduced by the protrusion is <5mm, and the reported SAR with the protrusions in place is < 1.2 W/kg, additional consideration of test setup is not required. Detailed information is included in the test setup photo exhibit.
- Single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
- For the exposure positions that proximity sensor power reduction is applied for SAR compliance, additional SAR testing with EUT transmitting full power in normal mode was performed; 13mm for Bottom - Slant of Edge 2, 11mm for Edge 2

### GSM Note:

- Justification for reduced test configuration s per KDB 941225 D03v01, the source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR Measurement.

### UMTS Note:

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

## 13.1 Body SAR

### <GSM SAR>

| Plot No. | Band   | Mode             | Test Position            | Gap (cm) | Ch. | Freq. (MHz) | Power Back-off | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|--------|------------------|--------------------------|----------|-----|-------------|----------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | GSM850 | GPRS (2Tx slots) | Bottom - Slant of Edge 2 | 1.3cm    | 128 | 824.2       | OFF            | 31.6                | 32                  | 1.096                  | -0.09            | 0.842                  | 0.923                  |
|          | GSM850 | GPRS (2Tx slots) | Bottom - Slant of Edge 2 | 1.3cm    | 189 | 836.4       | OFF            | 31.7                | 32                  | 1.072                  | 0.01             | 0.872                  | 0.934                  |
|          | GSM850 | GPRS (2Tx slots) | Bottom - Slant of Edge 2 | 1.3cm    | 251 | 848.8       | OFF            | 31.9                | 32                  | 1.023                  | -0.03            | 0.953                  | 0.975                  |
|          | GSM850 | GPRS (2Tx slots) | Edge 1                   | 0cm      | 251 | 848.8       | OFF            | 31.9                | 32                  | 1.023                  | 0.11             | 0.151                  | 0.155                  |
|          | GSM850 | GPRS (2Tx slots) | Edge 2                   | 1.1cm    | 251 | 848.8       | OFF            | 31.9                | 32                  | 1.023                  | -0.03            | 1.040                  | 1.064                  |
| 01       | GSM850 | GPRS (2Tx slots) | Edge 2                   | 1.1cm    | 128 | 824.2       | OFF            | 31.6                | 32                  | 1.096                  | 0.01             | 1.000                  | 1.096                  |
|          | GSM850 | GPRS (2Tx slots) | Edge 2                   | 1.1cm    | 189 | 836.4       | OFF            | 31.7                | 32                  | 1.072                  | -0.06            | 0.996                  | 1.067                  |
|          | GSM850 | GPRS (2Tx slots) | Edge 3                   | 0cm      | 251 | 848.8       | OFF            | 31.9                | 32                  | 1.023                  | -0.14            | 0.139                  | 0.142                  |
|          | GSM850 | GPRS (2Tx slots) | Bottom - Slant of Edge 2 | 0cm      | 251 | 848.8       | ON             | 22.9                | 23                  | 1.023                  | 0.01             | 0.636                  | 0.651                  |
|          | GSM850 | GPRS (2Tx slots) | Edge 2                   | 0cm      | 251 | 848.8       | ON             | 22.9                | 23                  | 1.023                  | -0.15            | 0.408                  | 0.418                  |
|          | GSM850 | GPRS (2Tx slots) | Bottom Face              | 0cm      | 251 | 848.8       | ON             | 22.9                | 23                  | 1.023                  | -0.03            | 0.581                  | 0.595                  |

**<WCDMA SAR>**

| Plot No. | Band    | Mode         | Test Position            | Gap (cm) | Ch.  | Freq. (MHz) | Power Back-off | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|---------|--------------|--------------------------|----------|------|-------------|----------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | WCDMA V | RMC 12.2Kbps | Bottom - Slant of Edge 2 | 1.3cm    | 4132 | 826.4       | OFF            | 22.7                | 23.5                | 1.202                  | -0.01            | 0.663                  | 0.797                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 1                   | 0cm      | 4132 | 826.4       | OFF            | 22.7                | 23.5                | 1.202                  | 0.03             | 0.120                  | 0.144                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 1.1cm    | 4233 | 846.6       | OFF            | 22.3                | 23.5                | 1.318                  | -0.01            | 0.895                  | 1.180                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 1.1cm    | 4132 | 826.4       | OFF            | 22.7                | 23.5                | 1.202                  | 0.01             | 0.857                  | 1.030                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 1.1cm    | 4182 | 836.4       | OFF            | 22.5                | 23.5                | 1.259                  | -0.01            | 0.870                  | 1.095                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 3                   | 0cm      | 4132 | 826.4       | OFF            | 22.7                | 23.5                | 1.202                  | -0.15            | 0.082                  | 0.099                  |
|          | WCDMA V | RMC 12.2Kbps | Bottom - Slant of Edge 2 | 0cm      | 4132 | 826.4       | ON             | 17.9                | 18                  | 1.023                  | 0.07             | 1.090                  | 1.115                  |
|          | WCDMA V | RMC 12.2Kbps | Bottom - Slant of Edge 2 | 0cm      | 4182 | 836.4       | ON             | 17.8                | 18                  | 1.047                  | 0.03             | 1.020                  | 1.068                  |
| 02       | WCDMA V | RMC 12.2Kbps | Bottom - Slant of Edge 2 | 0cm      | 4233 | 846.6       | ON             | 17.8                | 18                  | 1.047                  | -0.15            | 1.140                  | 1.194                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 0cm      | 4132 | 826.4       | ON             | 17.9                | 18                  | 1.023                  | -0.13            | 0.895                  | 0.916                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 0cm      | 4182 | 836.4       | ON             | 17.8                | 18                  | 1.047                  | -0.16            | 0.854                  | 0.894                  |
|          | WCDMA V | RMC 12.2Kbps | Edge 2                   | 0cm      | 4233 | 846.6       | ON             | 17.8                | 18                  | 1.047                  | 0.08             | 0.975                  | 1.021                  |
|          | WCDMA V | RMC 12.2Kbps | Bottom Face              | 0cm      | 4233 | 846.6       | ON             | 17.9                | 18                  | 1.023                  | -0.09            | 1.140                  | 1.167                  |
|          | WCDMA V | RMC 12.2Kbps | Bottom Face              | 0cm      | 4132 | 826.4       | ON             | 17.8                | 18                  | 1.047                  | 0.01             | 1.060                  | 1.110                  |
|          | WCDMA V | RMC 12.2Kbps | Bottom Face              | 0cm      | 4182 | 836.4       | ON             | 17.8                | 18                  | 1.047                  | -0.07            | 0.980                  | 1.026                  |

**<WLAN SAR-DTS>**

| Plot No. | Band       | Mode          | Test Position            | Gap (cm) | Antenna | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|------------|---------------|--------------------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | WLAN2.4GHz | 802.11b 1Mbps | Bottom Face              | 0cm      | Ant 1   | 6   | 2437        | 16.0                | 16.0                | 1.000                  | -0.06            | 0.789                  | 0.789                  |
|          | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 6   | 2437        | 16.0                | 16.0                | 1.000                  | -0.03            | 0.910                  | 0.910                  |
| 03       | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 1   | 2412        | 16.0                | 16.0                | 1.000                  | 0.05             | 1.190                  | 1.190                  |
|          | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 11  | 2462        | 16.0                | 16.0                | 1.000                  | -0.04            | 1.150                  | 1.150                  |
|          | WLAN2.4GHz | 802.11b 1Mbps | Edge 1                   | 0cm      | Ant 1   | 6   | 2437        | 16.0                | 16.0                | 1.000                  | 0.15             | 0.575                  | 0.575                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | 0.02             | 0.663                  | 0.663                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 153 | 5765        | 13.0                | 13.0                | 1.000                  | 0.02             | 0.651                  | 0.651                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 157 | 5785        | 13.0                | 13.0                | 1.000                  | 0.02             | 0.657                  | 0.657                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | -0.14            | 0.893                  | 0.893                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 153 | 5765        | 13.0                | 13.0                | 1.000                  | -0.13            | 0.793                  | 0.793                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 157 | 5785        | 13.0                | 13.0                | 1.000                  | -0.12            | 0.762                  | 0.762                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Edge 1                   | 0cm      | Ant 1   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | -0.19            | 0.234                  | 0.234                  |

| Plot No. | Band       | Mode          | Test Position            | Gap (cm) | Antenna | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|------------|---------------|--------------------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | WLAN2.4GHz | 802.11b 1Mbps | Bottom Face              | 0cm      | Ant 2   | 6   | 2437        | 15.9                | 16.0                | 1.023                  | 0.03             | 0.706                  | 0.722                  |
|          | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 6   | 2437        | 15.9                | 16.0                | 1.023                  | -0.16            | 0.659                  | 0.674                  |
|          | WLAN2.4GHz | 802.11b 1Mbps | Edge 4                   | 0cm      | Ant 2   | 6   | 2437        | 15.9                | 16.0                | 1.023                  | 0.12             | 0.569                  | 0.582                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | -0.13            | 0.726                  | 0.726                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 153 | 5765        | 13.0                | 13.0                | 1.000                  | -0.03            | 0.712                  | 0.712                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 157 | 5785        | 12.9                | 13.0                | 1.023                  | -0.13            | 0.719                  | 0.736                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | -0.02            | 1.240                  | 1.240                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 153 | 5765        | 13.0                | 13.0                | 1.000                  | 0.03             | 1.200                  | 1.200                  |
| 04       | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 157 | 5785        | 12.9                | 13.0                | 1.023                  | -0.01            | 1.220                  | 1.248                  |
|          | WLAN5GHz   | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 161 | 5805        | 13.0                | 13.0                | 1.000                  | 0.15             | 0.324                  | 0.324                  |

**<WLAN SAR-NII>**

| Plot No. | Band     | Mode          | Test Position            | Gap (cm) | Antenna | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|----------|---------------|--------------------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 40  | 5200        | 13.0                | 13.0                | 1.000                  | -0.08            | 0.503                  | 0.503                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 40  | 5200        | 13.0                | 13.0                | 1.000                  | 0.15             | 0.650                  | 0.650                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 1                   | 0cm      | Ant 1   | 40  | 5200        | 13.0                | 13.0                | 1.000                  | 0.13             | 0.468                  | 0.468                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 60  | 5300        | 13.0                | 13.0                | 1.000                  | 0.14             | 0.427                  | 0.427                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 60  | 5300        | 13.0                | 13.0                | 1.000                  | -0.16            | 0.589                  | 0.589                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 1                   | 0cm      | Ant 1   | 60  | 5300        | 13.0                | 13.0                | 1.000                  | 0.1              | 0.444                  | 0.444                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 116 | 5580        | 13.0                | 13.0                | 1.000                  | -0.18            | 0.855                  | 0.855                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 108 | 5540        | 13.0                | 13.0                | 1.000                  | -0.01            | 0.949                  | 0.949                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 1   | 136 | 5680        | 13.0                | 13.0                | 1.000                  | -0.04            | 0.981                  | 0.981                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 116 | 5580        | 13.0                | 13.0                | 1.000                  | 0.13             | 1.060                  | 1.060                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 108 | 5540        | 13.0                | 13.0                | 1.000                  | -0.03            | 0.931                  | 0.931                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 136 | 5680        | 13.0                | 13.0                | 1.000                  | -0.11            | 1.040                  | 1.040                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 1                   | 0cm      | Ant 1   | 116 | 5580        | 13.0                | 13.0                | 1.000                  | 0.09             | 0.393                  | 0.393                  |

| Plot No. | Band     | Mode          | Test Position            | Gap (cm) | Antenna | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|----------|---------------|--------------------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 40  | 5200        | 11.0                | 11.0                | 1.000                  | -0.12            | 0.843                  | 0.843                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 44  | 5220        | 10.7                | 11.0                | 1.072                  | -0.13            | 0.655                  | 0.702                  |
| 05       | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 40  | 5200        | 11.0                | 11.0                | 1.000                  | 0.02             | 1.220                  | 1.220                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 44  | 5220        | 10.7                | 11.0                | 1.072                  | -0.07            | 1.110                  | 1.189                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 40  | 5200        | 11.0                | 11.0                | 1.000                  | -0.13            | 0.580                  | 0.580                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 60  | 5300        | 8.5                 | 8.5                 | 1.000                  | 0.03             | 0.647                  | 0.647                  |
| 06       | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 60  | 5300        | 8.5                 | 8.5                 | 1.000                  | -0.19            | 1.290                  | 1.290                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 56  | 5280        | 8.5                 | 8.5                 | 1.000                  | 0.14             | 1.230                  | 1.230                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 60  | 5300        | 8.5                 | 8.5                 | 1.000                  | -0.16            | 0.401                  | 0.401                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 136 | 5680        | 10.0                | 10.0                | 1.000                  | -0.16            | 0.496                  | 0.496                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 108 | 5540        | 10.0                | 10.0                | 1.000                  | -0.16            | 0.520                  | 0.520                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom Face              | 0cm      | Ant 2   | 116 | 5580        | 10.0                | 10.0                | 1.000                  | 0.15             | 0.665                  | 0.665                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 136 | 5680        | 10.0                | 10.0                | 1.000                  | -0.14            | 1.230                  | 1.230                  |
|          | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 108 | 5540        | 10.0                | 10.0                | 1.000                  | -0.11            | 1.180                  | 1.180                  |
| 07       | WLAN5GHz | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 116 | 5580        | 10.0                | 10.0                | 1.000                  | -0.03            | 1.270                  | 1.270                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 136 | 5680        | 10.0                | 10.0                | 1.000                  | -0.13            | 0.614                  | 0.614                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 108 | 5540        | 10.0                | 10.0                | 1.000                  | 0.12             | 0.518                  | 0.518                  |
|          | WLAN5GHz | 802.11a 6Mbps | Edge 4                   | 0cm      | Ant 2   | 116 | 5580        | 10.0                | 10.0                | 1.000                  | -0.06            | 0.495                  | 0.495                  |

### 13.2 Repeated SAR Measurement

**General Note:**

1. Per KDB 865664 D01v01r01, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8 \text{ W/kg}$
2. Per KDB 865664 D01v01r01, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45 \text{ W/kg}$ , only one repeated measurement is required.
3. The ratio is the largest SAR to the smallest SAR among original and repeated measurement.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

| Plot No. | Band       | Mode          | Test Position            | Gap (cm) | Antenna | Ch.  | Freq. (MHz) | Power Back-off | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Ratio | Reported 1g SAR (W/kg) |
|----------|------------|---------------|--------------------------|----------|---------|------|-------------|----------------|---------------------|---------------------|------------------------|------------------|------------------------|-------|------------------------|
| 1st      | WCDMA V    | RMC 12.2Kbps  | Bottom - Slant of Edge 2 | 0cm      | -       | 4233 | 846.6       | ON             | 17.8                | 18                  | 1.047                  | -0.15            | 1.140                  | -     | 1.194                  |
| 2nd      | WCDMA V    | RMC 12.2Kbps  | Bottom - Slant of Edge 2 | 0cm      | -       | 4233 | 846.6       | ON             | 17.8                | 18                  | 1.047                  | -0.1             | 1.100                  | 1.04  | 1.152                  |
| 1st      | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 1    | 2412        | -              | 16.0                | 16.0                | 1.000                  | 0.05             | 1.190                  | -     | 1.190                  |
| 2nd      | WLAN2.4GHz | 802.11b 1Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 1    | 2412        | -              | 16.0                | 16.0                | 1.000                  | -0.11            | 1.160                  | 1.03  | 1.160                  |
| 1st      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 40   | 5200        | -              | 11.0                | 11.0                | 1.000                  | 0.02             | 1.220                  | -     | 1.220                  |
| 2nd      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 40   | 5200        | -              | 11.0                | 11.0                | 1.000                  | -0.07            | 1.100                  | 1.11  | 1.100                  |
| 1st      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 60   | 5300        | -              | 8.5                 | 8.5                 | 1.000                  | -0.19            | 1.290                  | -     | 1.290                  |
| 2nd      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 60   | 5300        | -              | 8.5                 | 8.5                 | 1.000                  | 0.04             | 1.250                  | 1.03  | 1.250                  |
| 1st      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 116  | 5580        | -              | 13.0                | 13.0                | 1.000                  | 0.13             | 1.060                  | -     | 1.060                  |
| 2nd      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 1 | 0cm      | Ant 1   | 116  | 5580        | -              | 13.0                | 13.0                | 1.002                  | -0.02            | 0.920                  | 1.15  | 0.922                  |
| 1st      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 161  | 5805        | -              | 13.0                | 13.0                | 1.000                  | -0.02            | 1.240                  | -     | 1.240                  |
| 2nd      | WLAN5GHz   | 802.11a 6Mbps | Bottom - Slant of Edge 4 | 0cm      | Ant 2   | 161  | 5805        | -              | 13.0                | 13.0                | 1.000                  | -0.01            | 1.230                  | 1.01  | 1.230                  |

## 14. Simultaneous Transmission Analysis

| NO. | Simultaneous Transmission Configurations | Supported |
|-----|------------------------------------------|-----------|
| 1.  | WWAN + Bluetooth                         | Yes       |
| 2.  | WWAN + WLAN Antenna 1 + WLAN Antenna 2   | Yes       |
| 3.  | WLAN Antenna 1 + WLAN Antenna 2          | Yes       |

### General Note:

- WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
- This device does not supported SISO mode operation.
- EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
- Hotspot operation is supported in 2.4GHz frequency band only. WiFi Direct (Group Owner/Group Client) is supported in 2.4GHz frequency band, and WiFi Direct (Group Client only) supported in 5GHz frequency band.
- The Scaled SAR summation is calculated based on the same configuration and test position.
- Per KDB 447498 D01v05r01, summation SAR is compliant if,
  - Scalar SAR summation  $< 1.6\text{W/kg}$ .
  - $\text{SPLSR} = (\text{SAR}_1 + \text{SAR}_2)^{1.5} / (\min. \text{ separation distance, mm})$ , and the peak separation distance is determined from the square root of  $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$ , where  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  are the coordinates of the extrapolated peak SAR locations in the zoom scan  
If  $\text{SPLSR} \leq 0.04$ , Summation SAR measurement is not necessary
  - Summation SAR measurement, and the reported multi-band SAR  $< 1.6\text{W/kg}$
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r01 based on the formula below.
  - $(\text{max. power of channel, including tune-up tolerance, mW}) / (\min. \text{ test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})}/x] \text{ W/kg}$  for test separation distances  $\leq 50 \text{ mm}$ ; where  $x = 7.5$  for 1-g SAR, and  $x = 18.75$  for 10-g SAR.
  - When the minimum separation distance is  $< 5\text{mm}$ , the distance is used 5mm to determine SAR test exclusion.
  - 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the *test separation distances* is  $> 50 \text{ mm}$ .

| Bluetooth Max Power | Exposure Position    | Bottom Face at 0mm | Edge 1 at 0mm | Edge 2 at 0mm | Bottom – Slant of Edge 2 at 0mm | Edge 3 at 0mm |
|---------------------|----------------------|--------------------|---------------|---------------|---------------------------------|---------------|
|                     | Antenna to user      | $< 5 \text{ mm}$   | 116 mm        | 216 mm        | 216 mm                          | 21 mm         |
| 5.5 dBm             | Estimated SAR (W/kg) | 0.168 W/kg         | 0.400 W/kg    | 0.400 W/kg    | 0.400 W/kg                      | 0.040 W/kg    |

## 14.1 Body Exposure Conditions

### <WWAN + WLAN Antenna 1 + WLAN Antenna 2>

| Position    | WWAN    |            | WLAN Ant 1  |            | WLAN Ant 2  |            | Summed SAR (W/kg) | SPLSR Results | Case No |
|-------------|---------|------------|-------------|------------|-------------|------------|-------------------|---------------|---------|
|             | Band    | SAR (W/kg) | Band        | SAR (W/kg) | Band        | SAR (W/kg) |                   |               |         |
| Bottom Face | GSM 850 | 0.595      | WLAN 2.4GHz | 0.789      | WLAN 2.4GHz | 0.722      | 2.11              | 0.02          | Case 1  |
|             | WCDMA V | 1.167      |             | 0.789      |             | 0.722      | 2.68              | 0.02          | Case 2  |
|             | GSM 850 | 0.595      | WLAN 5.2GHz | 0.503      | WLAN 5.2GHz | 0.843      | 1.94              | 0.01          | Case 3  |
|             | WCDMA V | 1.167      |             | 0.503      |             | 0.843      | 2.51              | 0.01          | Case 4  |
|             | GSM 850 | 0.595      | WLAN 5.3GHz | 0.427      | WLAN 5.3GHz | 0.647      | 1.67              | 0.01          | Case 5  |
|             | WCDMA V | 1.167      |             | 0.427      |             | 0.647      | 2.24              | 0.01          | Case 6  |
|             | GSM 850 | 0.595      | WLAN 5.6GHz | 0.981      | WLAN 5.6GHz | 0.665      | 2.24              | 0.02          | Case 7  |
|             | WCDMA V | 1.167      |             | 0.981      |             | 0.665      | 2.81              | 0.02          | Case 8  |
|             | GSM 850 | 0.595      | WLAN 5.8GHz | 0.663      | WLAN 5.8GHz | 0.726      | 1.98              | 0.01          | Case 9  |
|             | WCDMA V | 1.167      |             | 0.663      |             | 0.726      | 2.56              | 0.01          | Case 10 |
| Edge 1      | GSM 850 | 0.155      | WLAN 2.4GHz | 0.575      | WLAN 2.4GHz |            | 0.73              |               |         |
|             | WCDMA V | 0.144      |             | 0.575      |             |            | 0.72              |               |         |
|             | GSM 850 | 0.155      | WLAN 5.2GHz | 0.468      | WLAN 5.2GHz |            | 0.62              |               |         |
|             | WCDMA V | 0.144      |             | 0.468      |             |            | 0.61              |               |         |
|             | GSM 850 | 0.155      | WLAN 5.3GHz | 0.444      | WLAN 5.3GHz |            | 0.60              |               |         |
|             | WCDMA V | 0.144      |             | 0.444      |             |            | 0.59              |               |         |
|             | GSM 850 | 0.155      | WLAN 5.6GHz | 0.393      | WLAN 5.6GHz |            | 0.55              |               |         |
|             | WCDMA V | 0.144      |             | 0.393      |             |            | 0.54              |               |         |
|             | GSM 850 | 0.155      | WLAN 5.8GHz | 0.234      | WLAN 5.8GHz |            | 0.39              |               |         |
|             | WCDMA V | 0.144      |             | 0.234      |             |            | 0.38              |               |         |

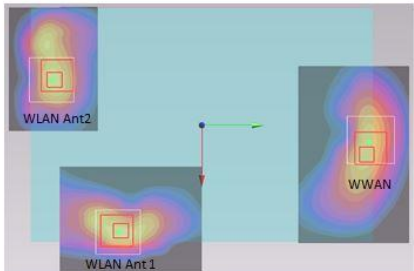
**<WLAN Antenna 1 + WLAN Antenna 2> (MIMO)**

| Position                 | WLAN Ant 1 |            | WLAN Ant 2 |            | Summed SAR (W/kg) | SPLSR Results | Case No |
|--------------------------|------------|------------|------------|------------|-------------------|---------------|---------|
|                          | Band       | SAR (W/kg) | Band       | SAR (W/kg) |                   |               |         |
| Bottom Face              | WLAN2.4GHz | 0.789      | WLAN2.4GHz | 0.722      | <b>1.51</b>       |               |         |
|                          | WLAN5.2GHz | 0.503      | WLAN5.2GHz | 0.843      | <b>1.35</b>       |               |         |
|                          | WLAN5.3GHz | 0.427      | WLAN5.3GHz | 0.647      | <b>1.07</b>       |               |         |
|                          | WLAN5.5GHz | 0.981      | WLAN5.5GHz | 0.665      | <b>1.65</b>       | 0.02          | Case 8  |
|                          | WLAN5.8GHz | 0.663      | WLAN5.8GHz | 0.726      | <b>1.39</b>       |               |         |
| Bottom - Slant of Edge 1 | WLAN2.4GHz | 1.190      | WLAN2.4GHz |            | <b>1.19</b>       |               |         |
|                          | WLAN5.2GHz | 0.650      | WLAN5.2GHz |            | <b>0.65</b>       |               |         |
|                          | WLAN5.3GHz | 0.589      | WLAN5.3GHz |            | <b>0.59</b>       |               |         |
|                          | WLAN5.5GHz | 1.060      | WLAN5.5GHz |            | <b>1.06</b>       |               |         |
|                          | WLAN5.8GHz | 0.893      | WLAN5.8GHz |            | <b>0.89</b>       |               |         |
| Edge 1                   | WLAN2.4GHz | 0.575      | WLAN2.4GHz |            | <b>0.58</b>       |               |         |
|                          | WLAN5.2GHz | 0.468      | WLAN5.2GHz |            | <b>0.47</b>       |               |         |
|                          | WLAN5.3GHz | 0.444      | WLAN5.3GHz |            | <b>0.44</b>       |               |         |
|                          | WLAN5.5GHz | 0.393      | WLAN5.5GHz |            | <b>0.39</b>       |               |         |
|                          | WLAN5.8GHz | 0.234      | WLAN5.8GHz |            | <b>0.23</b>       |               |         |
| Bottom - Slant of Edge 4 | WLAN2.4GHz |            | WLAN2.4GHz | 0.674      | <b>0.67</b>       |               |         |
|                          | WLAN5.2GHz |            | WLAN5.2GHz | 1.220      | <b>1.22</b>       |               |         |
|                          | WLAN5.3GHz |            | WLAN5.3GHz | 1.290      | <b>1.29</b>       |               |         |
|                          | WLAN5.5GHz |            | WLAN5.5GHz | 1.270      | <b>1.27</b>       |               |         |
|                          | WLAN5.8GHz |            | WLAN5.8GHz | 1.248      | <b>1.25</b>       |               |         |
| Edge 4                   | WLAN2.4GHz |            | WLAN2.4GHz | 0.582      | <b>0.58</b>       |               |         |
|                          | WLAN5.2GHz |            | WLAN5.2GHz | 0.580      | <b>0.58</b>       |               |         |
|                          | WLAN5.3GHz |            | WLAN5.3GHz | 0.401      | <b>0.40</b>       |               |         |
|                          | WLAN5.5GHz |            | WLAN5.5GHz | 0.614      | <b>0.61</b>       |               |         |
|                          | WLAN5.8GHz |            | WLAN5.8GHz | 0.324      | <b>0.32</b>       |               |         |

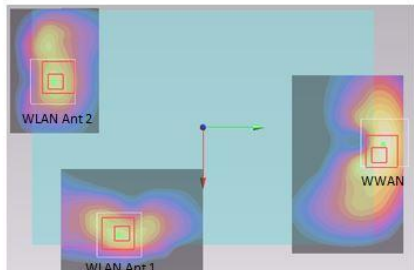
**<WWAN + Bluetooth>**

| Position               | WWAN    |               | Bluetooth               | Summed<br>SAR (W/kg) | SPLSR | Case No |
|------------------------|---------|---------------|-------------------------|----------------------|-------|---------|
|                        | Band    | SAR<br>(W/kg) | Estimated<br>SAR (W/kg) |                      |       |         |
| Bottom Face            | GSM 850 | 0.595         | 0.168                   | <b>0.76</b>          |       |         |
|                        | WCDMA V | 1.167         | 0.168                   | <b>1.34</b>          |       |         |
| Edge 1                 | GSM 850 | 0.155         | 0.400                   | <b>0.56</b>          |       |         |
|                        | WCDMA V | 0.144         | 0.400                   | <b>0.54</b>          |       |         |
| Edge 2                 | GSM 850 | 0.418         | 0.400                   | <b>0.82</b>          |       |         |
|                        | WCDMA V | 1.021         | 0.400                   | <b>1.42</b>          |       |         |
| Bottom Slant of Edge 2 | GSM 850 | 0.651         | 0.400                   | <b>1.05</b>          |       |         |
|                        | WCDMA V | 1.194         | 0.400                   | <b>1.59</b>          |       |         |
| Edge 3                 | GSM 850 | 0.142         | 0.040                   | <b>0.18</b>          |       |         |
|                        | WCDMA V | 0.099         | 0.040                   | <b>0.14</b>          |       |         |

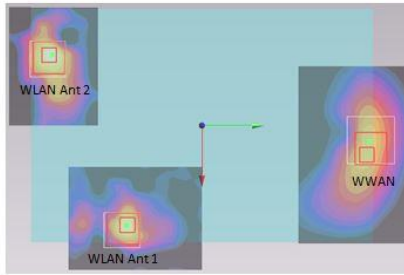
## 14.2 SPLSR Evaluation and Analysis

|                                                                                   | Position    | Band              | SAR<br>(W/kg) | Gap  | SAR peak location (m) |         |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|-----------------------------------------------------------------------------------|-------------|-------------------|---------------|------|-----------------------|---------|--------|---------------------|------------------------|---------------------|------------------|
|                                                                                   |             |                   |               | (cm) | X                     | Y       | Z      |                     |                        |                     |                  |
| Case 1                                                                            | Bottom Face | GSM 850           | 0.595         | 0    | 0.01                  | 0.114   | -0.177 | 176.8               | 1.38                   | 0.01                | Not required     |
|                                                                                   |             | WLAN2.4GHz(Ant 1) | 0.789         | 0    | 0.0724                | -0.0514 | -0.177 |                     |                        |                     |                  |
|                                                                                   |             | GSM 850           | 0.595         | 0    | 0.01                  | 0.114   | -0.177 | 218.8               | 1.32                   | 0.01                | Not required     |
|                                                                                   |             | WLAN2.4GHz(Ant 2) | 0.722         | 0    | -0.0307               | -0.101  | -0.175 |                     |                        |                     |                  |
|                                                                                   |             | WLAN2.4GHz(Ant 1) | 0.789         | 0    | 0.0724                | -0.0514 | -0.177 | 114.4               | 1.51                   | 0.02                | Not required     |
|                                                                                   |             | WLAN2.4GHz(Ant 2) | 0.722         | 0    | -0.0307               | -0.101  | -0.175 |                     |                        |                     |                  |
|  |             |                   |               |      |                       |         |        |                     |                        |                     |                  |

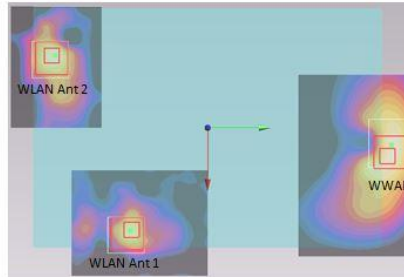
| Case 2            | Position    | Band              | SAR (W/kg) | Gap (cm) | SAR peak location (m) |         |        | 3D distance (mm) | Pair SAR sum (W/kg) | SPLSR Calculated | Simultaneous SAR |
|-------------------|-------------|-------------------|------------|----------|-----------------------|---------|--------|------------------|---------------------|------------------|------------------|
|                   | Bottom Face | WCDMA V           | 1.167      | 0        | 0.0265                | 0.115   | -0.183 | 172.7            | 1.96                | 0.02             | Not required     |
|                   |             | WLAN2.4GHz(Ant 1) | 0.789      | 0        | 0.0724                | -0.0514 | -0.177 |                  |                     |                  |                  |
| WCDMA V           |             | 1.167             | 0          | 0.0265   | 0.115                 | -0.183  | 223.6  | 1.89             | 0.01                | Not required     |                  |
| WLAN2.4GHz(Ant 2) |             | 0.722             | 0          | -0.0307  | -0.101                | -0.175  |        |                  |                     |                  |                  |
| WLAN2.4GHz(Ant 1) |             | 0.789             | 0          | 0.0724   | -0.0514               | -0.177  | 114.4  | 1.51             | 0.02                | Not required     |                  |
| WLAN2.4GHz(Ant 2) | 0.722       | 0                 | -0.0307    | -0.101   | -0.175                |         |        |                  |                     |                  |                  |



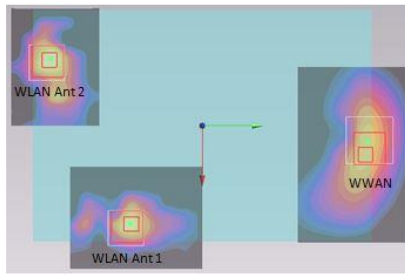
| Case 3 | Position    | Band              | SAR<br>(W/kg) | Gap<br>(cm) | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|-------------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        |             |                   |               |             | X                     | Y      | Z      |                     |                        |                     |                  |
|        |             |                   |               |             | (cm)                  | (cm)   | (cm)   |                     |                        |                     |                  |
| Case 3 | Bottom Face | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 173.6               | 1.10                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 1) | 0.503         | 0           | 0.067                 | -0.05  | -0.178 |                     |                        |                     |                  |
|        |             | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 225.8               | 1.44                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 2) | 0.843         | 0           | -0.049                | -0.104 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.2GHz(Ant 1) | 0.503         | 0           | 0.067                 | -0.05  | -0.178 | 128.0               | 1.35                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 2) | 0.843         | 0           | -0.049                | -0.104 | -0.177 |                     |                        |                     |                  |



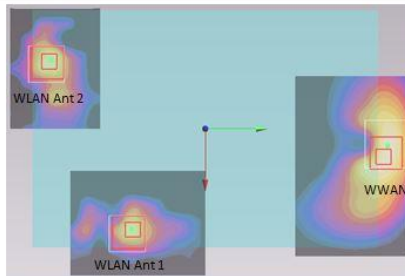
| Case 4 | Position    | Band              | SAR<br>(W/kg) | Gap<br>(cm) | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|-------------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        |             |                   |               |             | X                     | Y      | Z      |                     |                        |                     |                  |
|        |             |                   |               |             | (cm)                  | (cm)   | (cm)   |                     |                        |                     |                  |
| Case 4 | Bottom Face | WCDMA V           | 1.167         | 0           | 0.0265                | 0.115  | -0.183 | 170.0               | 1.67                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 1) | 0.503         | 0           | 0.067                 | -0.05  | -0.178 |                     |                        |                     |                  |
|        |             | WCDMA V           | 1.167         | 0           | 0.0265                | 0.115  | -0.183 | 231.7               | 2.01                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 2) | 0.843         | 0           | -0.049                | -0.104 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.2GHz(Ant 1) | 0.503         | 0           | 0.067                 | -0.05  | -0.178 | 128.0               | 1.35                   | 0.01                | Not required     |
|        |             | WLAN5.2GHz(Ant 2) | 0.843         | 0           | -0.049                | -0.104 | -0.177 |                     |                        |                     |                  |

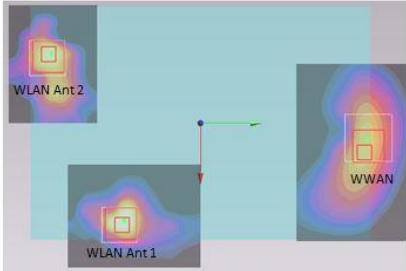


|        | Position    | Band              | SAR<br>(W/kg) | Gap<br>(cm) | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|-------------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        |             |                   |               |             | X                     | Y      | Z      |                     |                        |                     |                  |
| Case 5 | Bottom Face | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 171.4               | 1.02                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 1) | 0.427         | 0           | 0.066                 | -0.048 | -0.178 |                     |                        |                     |                  |
|        |             | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 223.4               | 1.24                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 2) | 0.647         | 0           | -0.047                | -0.102 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.3GHz(Ant 1) | 0.427         | 0           | 0.066                 | -0.048 | -0.178 | 125.2               | 1.07                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 2) | 0.647         | 0           | -0.047                | -0.102 | -0.177 |                     |                        |                     |                  |



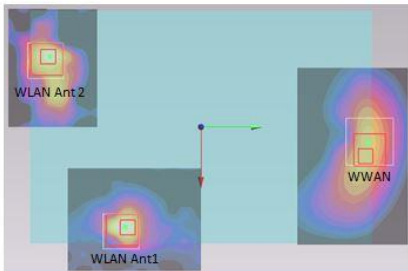
|        | Position    | Band              | SAR<br>(W/kg) | Gap<br>(cm) | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|-------------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        |             |                   |               |             | X                     | Y      | Z      |                     |                        |                     |                  |
| Case 6 | Bottom Face | WCDMA V           | 1.167         | 0           | 0.0265                | 0.115  | -0.183 | 167.8               | 1.59                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 1) | 0.427         | 0           | 0.066                 | -0.048 | -0.178 |                     |                        |                     |                  |
|        |             | WCDMA V           | 1.167         | 0           | 0.0265                | 0.115  | -0.183 | 229.2               | 1.81                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 2) | 0.647         | 0           | -0.047                | -0.102 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.3GHz(Ant 1) | 0.427         | 0           | 0.066                 | -0.048 | -0.178 | 125.2               | 1.07                   | 0.01                | Not required     |
|        |             | WLAN5.3GHz(Ant 2) | 0.647         | 0           | -0.047                | -0.102 | -0.177 |                     |                        |                     |                  |



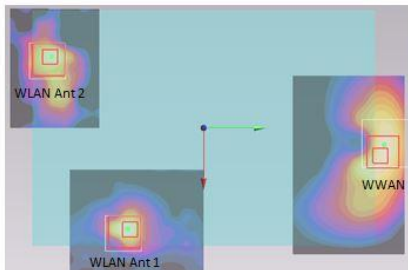
| Case 7                                                                            | Position    | Band              | SAR<br>(W/kg) | Gap<br>(cm) | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR Calculate | Simultaneous SAR |
|-----------------------------------------------------------------------------------|-------------|-------------------|---------------|-------------|-----------------------|--------|--------|---------------------|------------------------|-----------------|------------------|
|                                                                                   | Bottom Face | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 179.0               | 1.58                   | 0.01            | Not required     |
|                                                                                   |             | WLAN5.5GHz(Ant 1) | 0.981         | 0           | 0.069                 | -0.055 | -0.177 |                     |                        |                 |                  |
|                                                                                   |             | GSM 850           | 0.595         | 0           | 0.01                  | 0.114  | -0.177 | 224.6               | 1.26                   | 0.01            | Not required     |
|                                                                                   |             | WLAN5.5GHz(Ant 2) | 0.665         | 0           | -0.044                | -0.104 | -0.177 |                     |                        |                 |                  |
|                                                                                   |             | WLAN5.5GHz(Ant 1) | 0.981         | 0           | 0.069                 | -0.055 | -0.177 | 123.2               | 1.65                   | 0.02            | Not required     |
|                                                                                   |             | WLAN5.5GHz(Ant 2) | 0.665         | 0           | -0.044                | -0.104 | -0.177 |                     |                        |                 |                  |
|  |             |                   |               |             |                       |        |        |                     |                        |                 |                  |

| Case 8 | Position    | Band              | SAR<br>(W/kg) | Gap | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|-----|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        | Bottom Face | WCDMA V           | 1.167         | 0   | X                     | Y      | Z      |                     |                        |                     |                  |
|        |             |                   |               |     | (cm)                  |        |        |                     |                        |                     |                  |
|        |             | WCDMA V           | 1.167         | 0   | 0.0265                | 0.115  | -0.183 | 175.3               | 2.15                   | 0.02                | Not required     |
|        |             | WLAN5.5GHz(Ant 1) | 0.981         | 0   | 0.069                 | -0.055 | -0.177 |                     |                        |                     |                  |
|        |             | WCDMA V           | 1.167         | 0   | 0.0265                | 0.115  | -0.183 | 230.1               | 1.83                   | 0.01                | Not required     |
|        |             | WLAN5.5GHz(Ant 2) | 0.665         | 0   | -0.044                | -0.104 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.5GHz(Ant 1) | 0.981         | 0   | 0.069                 | -0.055 | -0.177 | 123.2               | 1.65                   | 0.02                | Not required     |
|        |             | WLAN5.5GHz(Ant 2) | 0.665         | 0   | -0.044                | -0.104 | -0.177 |                     |                        |                     |                  |

| Case 9 | Position    | Band              | SAR<br>(W/kg) | Gap  | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|--------|-------------|-------------------|---------------|------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|        | Bottom Face |                   |               | (cm) | X                     | Y      | Z      |                     |                        |                     |                  |
|        |             |                   |               |      | GSM 850               | 0.595  | 0      | 0.01                | 0.114                  | -0.177              | 173.6            |
|        |             | WLAN5.8GHz(Ant 1) | 0.663         | 0    | 0.067                 | -0.05  | -0.177 |                     |                        |                     |                  |
|        |             | GSM 850           | 0.595         | 0    | 0.01                  | 0.114  | -0.177 | 222.9               | 1.32                   | 0.01                | Not required     |
|        |             | WLAN5.8GHz(Ant 2) | 0.726         | 0    | -0.049                | -0.101 | -0.177 |                     |                        |                     |                  |
|        |             | WLAN5.8GHz(Ant 1) | 0.663         | 0    | 0.067                 | -0.05  | -0.177 | 126.7               | 1.39                   | 0.01                | Not required     |
|        |             | WLAN5.8GHz(Ant 2) | 0.726         | 0    | -0.049                | -0.101 | -0.177 |                     |                        |                     |                  |



| Case 10           | Position    | Band              | SAR<br>(W/kg) | Gap    | SAR peak location (m) |        |        | 3D distance<br>(mm) | Pair SAR sum<br>(W/kg) | SPLSR<br>Calculated | Simultaneous SAR |
|-------------------|-------------|-------------------|---------------|--------|-----------------------|--------|--------|---------------------|------------------------|---------------------|------------------|
|                   | Bottom Face | WCDMA V           | 1.167         | 0      | X                     | Y      | Z      | 173.6               | 1.83                   | 0.01                | Not required     |
|                   |             | WLAN5.8GHz(Ant 1) | 0.663         | 0      | 0.067                 | -0.05  | -0.177 |                     |                        |                     |                  |
| WCDMA V           |             | 1.167             | 0             | 0.01   | 0.114                 | -0.177 |        |                     |                        |                     |                  |
| WLAN5.8GHz(Ant 2) |             | 0.726             | 0             | -0.049 | -0.101                | -0.177 | 222.9  | 1.89                | 0.01                   | Not required        |                  |
| WLAN5.8GHz(Ant 1) |             | 0.663             | 0             | 0.067  | -0.05                 | -0.177 |        |                     |                        |                     |                  |
| WLAN5.8GHz(Ant 2) |             | 0.726             | 0             | -0.049 | -0.101                | -0.177 |        |                     |                        |                     |                  |
|                   |             |                   |               |        |                       |        | 126.7  | 1.39                | 0.01                   | Not required        |                  |



**Test Engineer :** Ken Li, Ted Sun, Jack Wu, Frank Wu, Nick Yu, Angelo Chang, San Lin,  
Tom Jiang, and Galen Zhang

## 15. 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 observations is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

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

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

| Uncertainty Distributions          | Normal                     | Rectangular   | Triangular    | U-Shape       |
|------------------------------------|----------------------------|---------------|---------------|---------------|
| Multi-plying Factor <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 14.1. Standard Uncertainty for Assumed Distribution**

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

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

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

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

| Error Description                    | Uncertainty Value (±%) | Probability Distribution | Divisor    | Ci (1g) | Ci (10g) | Standard Uncertainty (1g) | Standard Uncertainty (10g) |
|--------------------------------------|------------------------|--------------------------|------------|---------|----------|---------------------------|----------------------------|
| <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 14.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz**

## **16. References**

- [1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
- [2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992
- [3] IEEE Std. 1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, December 2003
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007
- [6] FCC KDB 447498 D01 v05r01, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, May 2013
- [7] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008
- [8] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007
- [9] FCC KDB 941225 D02 v02r02, “SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced”, May 2013.
- [10] FCC KDB 616217 D04 v01r01, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, May 2013
- [11] FCC KDB 865664 D01 v01r01, “SAR Measurement Requirements for 100 MHz to 6 GHz”, May 2013.