



REPORT No.: SZ23070065S01

# TEST REPORT

**APPLICANT** : Shenzhen Chainway Information  
Technology Co., Ltd

**PRODUCT NAME** : Industrial Tablet

**MODEL NAME** : P80

**BRAND NAME** : CHAINWAY

**FCC ID** : 2AC6AP80P

**STANDARD(S)** : FCC 47 CFR Part 2(2.1093)  
IEEE 1528-2013

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REPORT No.: SZ23070065S01

## Annex G DASY Calibration Certificate

| Change History |            |                   |
|----------------|------------|-------------------|
| Version        | Date       | Reason for Change |
| 1.0            | 2023-11-28 | First edition     |
|                |            |                   |

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# 1 SAR Results Summary

The maximum results of Specific Absorption Rate (SAR) found during test as bellows:

| Frequency Band |             | Highest SAR Summary      |
|----------------|-------------|--------------------------|
|                |             | Body<br>(Separation 0mm) |
|                |             | 1g SAR (W/kg)            |
| GSM            | GSM850      | 1.034                    |
|                | GSM1900     | 0.636                    |
| WCDMA          | Band II     | 1.041                    |
|                | Band V      | 0.924                    |
| CDMA2000       | BC0         | 0.340                    |
| LTE            | Band 2      | 1.183                    |
|                | Band 4      | 0.909                    |
|                | Band 5      | 0.664                    |
|                | Band 7      | 1.163                    |
|                | Band 12/17  | 1.072                    |
|                | Band 13     | 1.144                    |
|                | Band 40     | 0.582                    |
|                | Band 41     | 0.649                    |
| WLAN           | 2.4GHz WLAN | 0.606                    |
|                | 5GHz WLAN   | 1.216                    |
| 2.4GHz Band    | Bluetooth   | 0.075                    |

|                                                    |            |                       |
|----------------------------------------------------|------------|-----------------------|
| Highest Simultaneous Transmission<br>1g SAR (W/kg) | 1.556 W/kg | Limit(W/kg): 1.6 W/kg |
|----------------------------------------------------|------------|-----------------------|

**Note:**

1. This device is compliance with Specific Absorption Rate (SAR) for general population or uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 1 (1.1310) and IEEE C95.1-1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
2. For FDD-LTE Band17 is full covered by FDD-LTE Band 12, therefore only FDD-LTE Band 12 was tested.
3. When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.



## 2 Technical Information

**Note:** Provide by applicant.

### 2.1 Applicant and Manufacturer Information

|                              |                                                                                                                                    |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant:</b>            | Shenzhen Chainway Information Technology Co., Ltd                                                                                  |
| <b>Applicant Address:</b>    | 9F Building 2, Daqian Industrial Park, District 67, XingDong Community, Xin'an Street, Bao'an District, Shenzhen, Guangdong, China |
| <b>Manufacturer:</b>         | Shenzhen Chainway Information Technology Co., Ltd                                                                                  |
| <b>Manufacturer Address:</b> | 9F Building 2, Daqian Industrial Park, District 67, XingDong Community, Xin'an Street, Bao'an District, Shenzhen, Guangdong, China |

### 2.2 Equipment under Test (EUT) Description

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Name:</b>        | Industrial Tablet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>EUT No.:</b>             | 20#                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Hardware Version:</b>    | P80_Hardware_version                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Software Version:</b>    | P80_Software_version                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Operation Frequency:</b> | GSM 850: 824 MHz ~ 849 MHz<br>GSM 1900: 1850 MHz ~ 1910 MHz<br>WCDMA Band II: 1850 MHz ~ 1910 MHz<br>WCDMA Band V: 824 MHz ~ 849 MHz<br>CDMA2000 BC0: 824 MHz ~ 849 MHz<br>LTE Band 2: 1850 MHz ~ 1910 MHz<br>LTE Band 4: 1710 MHz ~ 1755 MHz<br>LTE Band 5: 824 MHz ~ 849 MHz<br>LTE Band 7: 2500 MHz ~ 2570 MHz<br>LTE Band 12: 699 MHz ~ 716 MHz<br>LTE Band 13: 777 MHz ~ 787 MHz<br>LTE Band 17: 704 MHz ~ 716 MHz<br>LTE Band 40A: 2305 MHz ~ 2315 MHz<br>LTE Band 40B: 2350 MHz ~ 2360 MHz<br>LTE Band 41: 2496 MHz ~ 2690 MHz<br>WLAN 2.4GHz: 2412 MHz ~ 2472 MHz |



|                               |                                                                                                                                                                                                                                                                                                                      |                        |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
|                               | WLAN 5.2GHz: 5180 MHz ~ 5240 MHz<br>WLAN 5.3GHz: 5260 MHz ~ 5320 MHz<br>WLAN 5.5GHz: 5500 MHz ~ 5720 MHz<br>WLAN 5.8GHz: 5745 MHz ~ 5825 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz<br>NFC: 13.56 MHz                                                                                                                     |                        |
| <b>Modulation Technology:</b> | GSM/GPRS: GMSK<br>EDGE: 8PSK<br>WCDMA: QPSK, 16QAM<br>CDMA2000 1xRTT: QPSK, 16QAM, 8PSK<br>1x EV-DO: QPSK, 16QAM, 8PSK<br>LTE: QPSK, 16QAM, 64QAM<br>802.11b: DSSS<br>802.11a/g/n-HT20/HT40/ac-VHT20/40/80: OFDM<br>BR+EDR: GFSK(1Mbps), $\pi/4$ -DQPSK(2Mbps), 8-DPSK(3Mbps)<br>BLE: GFSK(1Mbps, 2Mbps)<br>NFC: ASK |                        |
| <b>Multi-slot Class:</b>      | GPRS: Multi-slot Class 12<br>EDGE: Multi-slot Class 12                                                                                                                                                                                                                                                               |                        |
| <b>Antenna Type:</b>          | WWAN: PIFA Internal<br>WLAN: PIFA Antenna<br>Bluetooth: PIFA Antenna<br>NFC: PIFA Antenna                                                                                                                                                                                                                            |                        |
| <b>SIM Cards Description:</b> | SIM 1                                                                                                                                                                                                                                                                                                                | GSM+WCDMA+CDMA2000+LTE |
|                               | SIM 2                                                                                                                                                                                                                                                                                                                | GSM+WCDMA+CDMA2000+LTE |

**Note:** For more detailed description, please refer to specification or user manual supplied by the applicant and/or manufacturer.



## 2.3 Environment of Test Site

|                              |            |
|------------------------------|------------|
| <b>Temperature:</b>          | 18°C ~25°C |
| <b>Humidity:</b>             | 35%~75% RH |
| <b>Atmospheric Pressure:</b> | 1010 mbar  |

|                        |                                                                                                                                                                                                                                                                                                                |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Frequency:</b> | GSM 850MHz/1900MHz<br>WCDMA Band II/V<br>CDMA2000 BC0<br>FDD-LTE Band 2/4/5/7/12/13/17<br>TDD-LTE Band 40/41<br>WLAN 2.4GHz<br>WLAN 5GHz<br>Bluetooth                                                                                                                                                          |
| <b>Operation Mode:</b> | Call established                                                                                                                                                                                                                                                                                               |
| <b>Power Level:</b>    | GSM 850 MHz Maximum output power(level 5)<br>GSM 1900MHz Maximum output power(level 0)<br>WCDMA Band II/V (All Up Bits)<br>CDMA2000 BC0 (All Up Bits)<br>FDD-LTE Band 2/4/5/7/12/13/17 (Maximum output power)<br>TDD-LTE Band 40/41 (Maximum output power)<br>WLAN 2.4GHz/WLAN5GHz/Bluetooth Refers to Annex E |

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the Factory. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 35 dB.

## 3 Specific Absorption Rate (SAR)

### 3.1 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 or controlled and general population or uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational or controlled exposure limits are higher than the limits for general population or uncontrolled.

### 3.2 SAR Definition

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

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

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

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

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

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

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and E is the RMS electrical field strength. However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

## 4 RF Exposure Limits

### 4.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### 4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Limits for General Population/Uncontrolled Exposure (W/kg)**

| Type Exposure                                        | Uncontrolled Environment Limit |
|------------------------------------------------------|--------------------------------|
| Spatial Peak SAR (1g cube tissue for head and trunk) | 1.6 W/kg                       |
| Spatial Peak SAR (10g cube tissue for limbs)         | 4.0 W/kg                       |
| Spatial Peak SAR (1g cube tissue for whole body)     | 0.08 W/kg                      |

**Note:**

1. Occupational/Uncontrolled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).
2. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.



## 5 Applied Reference Documents

Leading reference documents for testing:

| Identity                                                                                                                                                                                                                              | Document Title                                                                                                                                                                   | Method Determination /Remark |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| FCC 47 CFR Part 2(2.1093)                                                                                                                                                                                                             | Radio Frequency Radiation Exposure valuation: Portable Devices                                                                                                                   | No deviation                 |
| IEEE 1528-2013                                                                                                                                                                                                                        | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques | No deviation                 |
| KDB 447498 D01v06                                                                                                                                                                                                                     | General RF Exposure Guidance                                                                                                                                                     | No deviation                 |
| KDB 248227 D01v02r02                                                                                                                                                                                                                  | SAR Measurement Procedures for 802.11 Transmitters                                                                                                                               | No deviation                 |
| KDB 616217 D04 v01r01                                                                                                                                                                                                                 | SAR Evaluation Considerations for Laptop, Notebook, Notebook and Tablet Computers                                                                                                | No deviation                 |
| KDB 865664 D01v01r04                                                                                                                                                                                                                  | SAR Measurement 100 MHz to 6 GHz                                                                                                                                                 | No deviation                 |
| KDB 865664 D02v01r02                                                                                                                                                                                                                  | RF Exposure Reporting                                                                                                                                                            | No deviation                 |
| KDB 941225 D01v03r01                                                                                                                                                                                                                  | 3G SAR MEAUREMENT PROCEDURES                                                                                                                                                     | No deviation                 |
| KDB 941225 D05v02r05                                                                                                                                                                                                                  | SAR Evaluation Consideration for LTE Devices                                                                                                                                     | No deviation                 |
| KDB 941225 D06v02r01                                                                                                                                                                                                                  | SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities                                                                                                 | No deviation                 |
| <b>Note 1:</b> Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table. |                                                                                                                                                                                  |                              |

## 6 SAR Measurement System

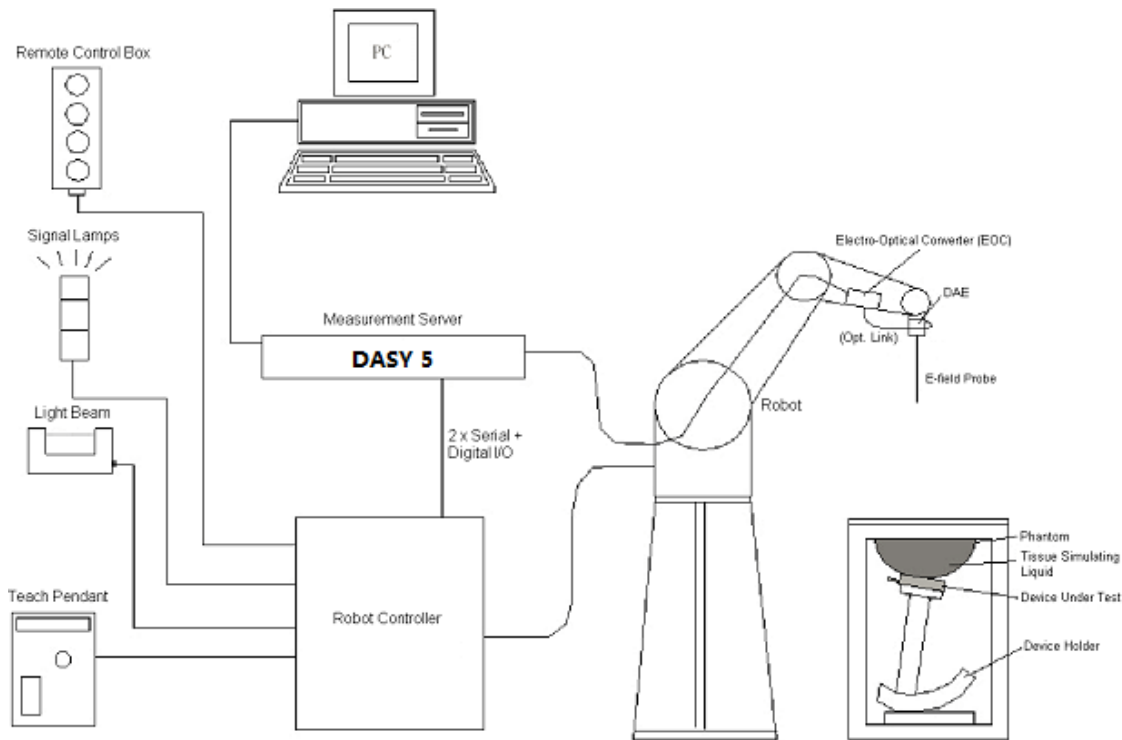


**Fig.6.1 SPEAG DASY System Configurations**

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 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.

### ➤ E-Field Probe Specification

#### <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                                                                                                           |                                                                                      |
| <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 6.2 Photo of EX3DV4**

### ➤ 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 (Norm X, Norm Y and Norm Z), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to Annex E 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.

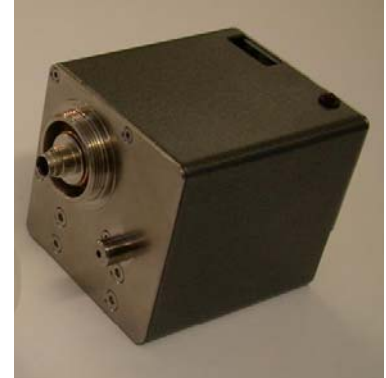


Fig 6.2 Photo of DAE

## 6.3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; nobelt drives)
- Jerk-free straight movements
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)



Fig. 6.3 Photo of Robot

## 6.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY 5: 400MHz, Intel Celeron), chip-disk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

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



Fig. 6.4 Photo of Server for DASYS5

## 6.5 Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



Fig. 6.5 Photo of Light Beam

## 6.6 Phantom

### <SAM Twin Phantom>

|                                  |                                                                                 |
|----------------------------------|---------------------------------------------------------------------------------|
| <b>Shell Thickness</b>           | 2 ± 0.2 mm (sagging: <1%)<br>Center ear point: 6 ± 0.2 mm                       |
| <b>Filling Volume Dimensions</b> | Approx. 25 liters<br>Length: 1000 mm; Width: 500 mm;<br>Height: adjustable feet |
| <b>Measurement Areas</b>         | Left Head, Right Head, Flat phantom                                             |



Fig. 6.6 Photo of SAM Phantom

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

phantom position with respect to the robot.

## 6.7 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.

### <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 6.7 Device Holder

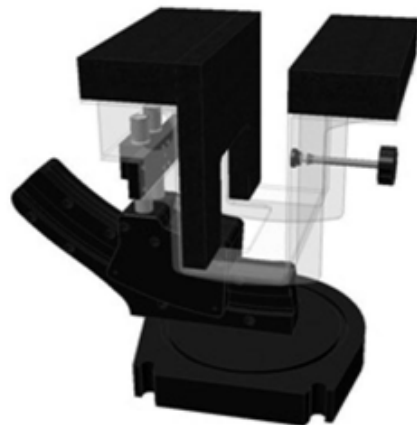


Fig 6.8 Laptop Extension Kit

## 6.8 Data storage and Evaluation

### ➤ 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 verifications 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], [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.

### ➤ 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              | ConvF <sub>i</sub>                                                      |
|                           | - Diode compression point | dcp <sub>i</sub>                                                        |
| <b>Device Parameters:</b> | - Frequency               | f                                                                       |
|                           | - Crest                   | cf                                                                      |
| <b>Media Parameters:</b>  | - Conductivity            | σ                                                                       |
|                           | - Density                 | ρ                                                                       |

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the



exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as:

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

With  $V_i$  = compensated signal of channel i, (i = x, y, z)

$U_i$  = input signal of channel i, (i = x, y, z)

cf = crest factor of exciting field (DASY parameter)

dcp<sup>i</sup> = 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)

Norm<sub>i</sub> = sensor sensitivity of channel i, (i = x, y, z),  $\mu\text{V}/(\text{V/m})^2$

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)

$\rho$  = equipment tissue density in g/cm<sup>3</sup>

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



## 6.9 Test Equipment List

| Manufacturer  | Name of Equipment             | Type/Model  | Serial No./<br>SW Version | Calibration |            |
|---------------|-------------------------------|-------------|---------------------------|-------------|------------|
|               |                               |             |                           | Last Cal.   | Due Date   |
| SPEAG         | 750MHz System Validation Kit  | D750V3      | 1223                      | 2022.08.22  | 2025.08.21 |
| SPEAG         | 900MHz System Validation Kit  | D900V2      | 1d064                     | 2021.12.17  | 2024.12.16 |
| SPEAG         | 1800MHz System Validation Kit | D1800V2     | 2d158                     | 2021.12.17  | 2024.12.16 |
| SPEAG         | 2000MHz System Validation Kit | D2000V2     | 1050                      | 2021.12.18  | 2024.12.17 |
| SPEAG         | 2300MHz System Validation Kit | D2300V2     | 1107                      | 2023.06.03  | 2026.06.02 |
| SPEAG         | 2450MHz System Validation Kit | D2450V2     | 805                       | 2021.12.17  | 2024.12.16 |
| SPEAG         | 2600MHz System Validation Kit | D2600V2     | 1198                      | 2022.08.17  | 2025.08.16 |
| SPEAG         | 5000MHz System Validation Kit | D5GHzV2     | 1176                      | 2021.12.19  | 2024.12.18 |
| SPEAG         | DOSIMETRIC ASSESSMENT SYSTEM  | DASY52      | 52.10.4.1527              | NCR         | NCR        |
| SPEAG         | Dosimetric E-Field Probe      | EX3DV4      | 3823                      | 2023.09.14  | 2024.09.13 |
| SPEAG         | Dosimetric E-Field Probe      | EX3DV4      | 7380                      | 2023.06.21  | 2024.06.20 |
| SPEAG         | Data Acquisition Electronics  | DAE3        | 373                       | 2022.12.28  | 2023.12.27 |
| SPEAG         | ELI Phantom                   | QD OVA004Ax | N/A                       | NCR         | NCR        |
| SPEAG         | Phone Positioner              | N/A         | N/A                       | NCR         | NCR        |
| R&S           | Network Emulator              | CMW500      | 165755                    | 2023.02.09  | 2024.02.08 |
| Anritsu       | Network Emulator              | MT8820C     | 6201274521                | 2023.02.09  | 2024.02.08 |
| Agilent       | Network Analyzer              | E5071B      | MY42404762                | 2023.02.09  | 2024.02.08 |
| SPEAG         | Dielectric Assessment KIT     | DAK-3.5     | 1279                      | 2023.08.03  | 2024.08.02 |
| mini-circuits | Amplifier                     | ZHL-42W+    | 608501717                 | NCR         | NCR        |
| mini-circuits | Amplifier                     | ZVE-8G+     | 754401735                 | NCR         | NCR        |
| Agilent       | Signal Generator              | N5182B      | MY53050509                | 2022.11.30  | 2023.11.29 |
| Agilent       | Signal Generator              | N5182B      | MY53050509                | 2023.09.19  | 2024.09.18 |
| R&S           | Power Sensor                  | NRP8S       | 103215                    | 2023.02.09  | 2024.02.08 |
| Agilent       | Power Meter                   | E4416A      | MY45102093                | 2022.10.11  | 2023.10.10 |
| Agilent       | Power Meter                   | E4416A      | MY45102093                | 2023.09.19  | 2024.09.18 |
| R&S           | Power Sensor                  | NRP8S       | 103240                    | 2023.02.09  | 2024.02.08 |
| Anritsu       | Power Meter                   | E4418B      | GB43318055                | 2023.06.21  | 2024.06.20 |
| Agilent       | Dual Directional Coupler      | 778D        | 50422                     | NA          | NA         |
| MCL           | Attenuation                   | 351-218-010 | N/A                       | NA          | NA         |
| R&S           | Spectrum Analyzer             | N9030A      | MY54170556                | 2022.10.10  | 2023.10.09 |



|     |                           |                 |            |            |            |
|-----|---------------------------|-----------------|------------|------------|------------|
| R&S | Spectrum Analyzer         | N9030A          | MY54170556 | 2023.10.07 | 2024.10.06 |
| KTJ | Thermo meter              | TA298           | N/A        | 2022.12.08 | 2023.12.07 |
| N/A | Tissue Simulating Liquids | HBBL600-10000V6 |            | 24H        |            |

**Note:**

1. The calibration certificate of DASY can be referred to annex G of this report.
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
4. The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Speag.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
6. Attenuator insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
7. N.C.R means No Calibration Requirement.

## 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. 7.1, for body SAR testing, the liquid height from the centre of the flat phantom to liquid top surface is larger than 15 cm, which is shown in Fig. 7.2.

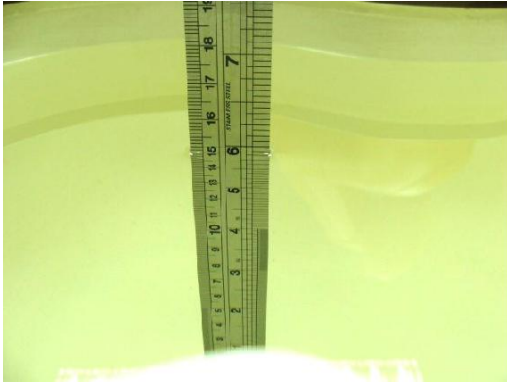


**Fig 7.1 Photo of Liquid Height for Head SAR**



**Fig 7.2 Photo of Liquid Height for Body SAR**

The following table gives the recipes for tissue simulating liquids

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) |
|-----------------|-----------|-----------|---------------|----------|---------------|----------|---------------------------|-------------------------------|
| Head            |           |           |               |          |               |          |                           |                               |
| 750             | 41.1      | 57.0      | 0.2           | 1.4      | 0.2           | 0        | 0.89                      | 41.9                          |
| 835             | 40.3      | 57.9      | 0.2           | 1.4      | 0.2           | 0        | 0.90                      | 41.5                          |
| 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                          |
| 2600            | 54.8      | 0         | 0             | 0.1      | 0             | 45.1     | 1.96                      | 39.0                          |

Simulating Liquid for 5GHz, Manufactured by SPEAG

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

The relative permittivity and conductivity of the tissue material should be within  $\pm 5\%$  of the values given in the table below recommended by the FCC OET 65supplement C and RSS 102 Issue 5.

| Target Frequency (MHz) | Head         |                | Body         |                |
|------------------------|--------------|----------------|--------------|----------------|
|                        | $\epsilon_r$ | $\sigma$ (S/m) | $\epsilon_r$ | $\sigma$ (S/m) |
| 150                    | 52.3         | 0.76           | 61.9         | 0.80           |
| 300                    | 45.3         | 0.87           | 58.2         | 0.92           |
| 450                    | 43.5         | 0.87           | 56.7         | 0.94           |



|           |      |      |      |      |
|-----------|------|------|------|------|
| 835       | 41.5 | 0.90 | 55.2 | 0.97 |
| 900       | 41.5 | 0.97 | 55.0 | 1.05 |
| 915       | 41.5 | 0.98 | 55.0 | 1.06 |
| 1450      | 40.5 | 1.20 | 54.0 | 1.30 |
| 1610      | 40.3 | 1.29 | 53.8 | 1.40 |
| 1800-2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450      | 39.2 | 1.80 | 52.7 | 1.95 |
| 3000      | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800      | 35.3 | 5.27 | 48.2 | 6.00 |

(  $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho$  = 1000 kg/m<sup>3</sup>)

The dielectric parameters of liquids were verified prior to the SAR evaluation using a Speag Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

**Table 1: Dielectric Performance of Tissue Simulating Liquid**

| Frequency (MHz) | Tissue Type | Liquid Temp.(°C) | Conductivity ( $\sigma$ ) | Conductivity Target ( $\sigma$ ) | Delta ( $\sigma$ ) (%) | Limit (%) | Date       |
|-----------------|-------------|------------------|---------------------------|----------------------------------|------------------------|-----------|------------|
| 750             | HSL         | 22.1             | 0.894                     | 0.89                             | 0.45                   | ±5        | 2023.09.18 |
| 900             | HSL         | 22.3             | 0.975                     | 0.97                             | 0.52                   | ±5        | 2023.11.09 |
| 1800            | HSL         | 22.2             | 1.371                     | 1.40                             | -2.07                  | ±5        | 2023.10.25 |
| 2000            | HSL         | 22.4             | 1.451                     | 1.40                             | 3.64                   | ±5        | 2023.10.12 |
| 2300            | HSL         | 22.2             | 1.659                     | 1.67                             | -0.66                  | ±5        | 2023.11.10 |
| 2450            | HSL         | 22.3             | 1.823                     | 1.80                             | 1.28                   | ±5        | 2023.11.09 |
| 2600            | HSL         | 22.4             | 1.966                     | 1.96                             | 0.31                   | ±5        | 2023.11.08 |
| 5250            | HSL         | 22.5             | 4.684                     | 4.71                             | -0.55                  | ±5        | 2023.11.07 |
| 5600            | HSL         | 22.4             | 4.893                     | 5.07                             | -3.49                  | ±5        | 2023.11.08 |
| 5750            | HSL         | 22.2             | 5.284                     | 5.22                             | 1.23                   | ±5        | 2023.11.10 |

| Frequency (MHz) | Tissue Type | Liquid Temp.(°C) | Permittivity ( $\epsilon_r$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date       |
|-----------------|-------------|------------------|-------------------------------|--------------------------------------|----------------------------|-----------|------------|
| 750             | HSL         | 22.1             | 43.253                        | 41.90                                | 3.23                       | ±5        | 2023.09.18 |
| 900             | HSL         | 22.3             | 41.855                        | 41.50                                | 0.86                       | ±5        | 2023.11.09 |
| 1800            | HSL         | 22.2             | 39.883                        | 40.00                                | -0.29                      | ±5        | 2023.10.25 |
| 2000            | HSL         | 22.4             | 39.871                        | 40.00                                | -0.32                      | ±5        | 2023.10.12 |
| 2300            | HSL         | 22.2             | 39.542                        | 39.50                                | 0.11                       | ±5        | 2023.11.10 |
| 2450            | HSL         | 22.3             | 38.922                        | 39.20                                | -0.71                      | ±5        | 2023.11.09 |
| 2600            | HSL         | 22.4             | 38.532                        | 39.00                                | -1.20                      | ±5        | 2023.11.08 |
| 5250            | HSL         | 22.5             | 35.729                        | 35.95                                | -0.61                      | ±5        | 2023.11.07 |
| 5600            | HSL         | 22.4             | 36.551                        | 35.50                                | 2.96                       | ±5        | 2023.11.08 |
| 5750            | HSL         | 22.2             | 35.109                        | 35.35                                | -0.68                      | ±5        | 2023.11.10 |

**Note:**

According to April 2019 TCB Workshop that FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

## 8 SAR System Verification

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.

### ➤ System Validation

According to FCC KDB 865664 D02, SAR system verification is required to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles are used with the required tissue-equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point must be validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media. A tabulated summary of the system validation status, measurement frequencies, SAR probes, calibrated signal type(s) and tissue dielectric parameters has been included.

### ➤ 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.

### ➤ 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 8.1 Photo of Dipole Setup

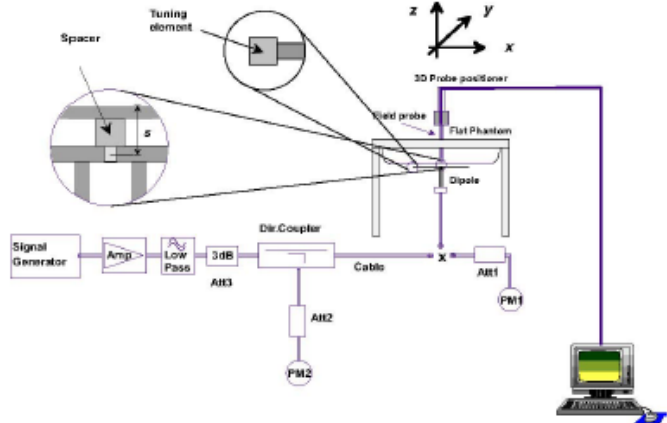


Fig 8.2 System Setup for System Evaluation

### ➤ System Verification Results

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

| Dipole<br>S/N     | Probe<br>S/N | DAE<br>S/N |
|-------------------|--------------|------------|
| D750V3-1223       | 7380         | 373        |
| D900V2-1d064      | 3823         | 373        |
| D1800V2-2d158     | 3823         | 373        |
| D2000V2-1050      | 3823         | 373        |
| D2300V2-1107      | 3823         | 373        |
| D2450V2-805       | 3823         | 373        |
| D2600V2-1198      | 3823         | 373        |
| D5GHzV2-1176-5250 | 3823         | 373        |
| D5GHzV2-1176-5600 | 3823         | 373        |
| D5GHzV2-1176-5750 | 3823         | 373        |



| Frequency<br>(MHz) | Tissue<br>Type | Conductivity<br>( $\sigma$ ) | Permittivity<br>( $\epsilon_r$ ) | CW Signal Validation |                    |                   |
|--------------------|----------------|------------------------------|----------------------------------|----------------------|--------------------|-------------------|
|                    |                |                              |                                  | Sensitivity          | Probe<br>Linearity | Probe<br>Isotropy |
| 750                | HSL            | 0.851                        | 42.43                            | PASS                 | PASS               | PASS              |
| 835                | HSL            | 0.898                        | 41.88                            | PASS                 | PASS               | PASS              |
| 1750               | HSL            | 1.386                        | 39.91                            | PASS                 | PASS               | PASS              |
| 1800               | HSL            | 1.449                        | 41.26                            | PASS                 | PASS               | PASS              |
| 1900               | HSL            | 1.435                        | 39.65                            | PASS                 | PASS               | PASS              |
| 2000               | HSL            | 1.451                        | 39.42                            | PASS                 | PASS               | PASS              |
| 2300               | HSL            | 1.764                        | 38.99                            | PASS                 | PASS               | PASS              |
| 2450               | HSL            | 1.863                        | 38.85                            | PASS                 | PASS               | PASS              |
| 2600               | HSL            | 1.973                        | 38.58                            | PASS                 | PASS               | PASS              |
| 5250               | HSL            | 4.528                        | 35.32                            | PASS                 | PASS               | PASS              |
| 5600               | HSL            | 4.905                        | 34.89                            | PASS                 | PASS               | PASS              |
| 5750               | HSL            | 5.077                        | 34.28                            | PASS                 | PASS               | PASS              |

| Frequency<br>(MHz) | Tissue<br>Type | Conductivity<br>( $\sigma$ ) | Permittivity<br>( $\epsilon_r$ ) | Modulation Signal Validation |                |      |
|--------------------|----------------|------------------------------|----------------------------------|------------------------------|----------------|------|
|                    |                |                              |                                  | Mod.<br>Type                 | Duty<br>Factor | PAR  |
| 750                | HSL            | 0.851                        | 42.43                            | N/A                          | N/A            | N/A  |
| 835                | HSL            | 0.898                        | 41.88                            | GMSK                         | PASS           | N/A  |
| 1750               | HSL            | 1.386                        | 39.91                            | N/A                          | N/A            | N/A  |
| 1800               | HSL            | 1.449                        | 41.26                            | N/A                          | N/A            | N/A  |
| 1900               | HSL            | 1.435                        | 39.65                            | GMSK                         | PASS           | N/A  |
| 2000               | HSL            | 1.451                        | 39.42                            | GMSK                         | PASS           | N/A  |
| 2300               | HSL            | 1.764                        | 38.99                            | OFDM                         | PASS           | PASS |
| 2450               | HSL            | 1.863                        | 38.85                            | OFDM                         | PASS           | PASS |
| 2600               | HSL            | 1.973                        | 38.58                            | TDD                          | PASS           | N/A  |
| 5250               | HSL            | 4.528                        | 35.32                            | OFDM                         | N/A            | PASS |
| 5600               | HSL            | 4.905                        | 34.89                            | OFDM                         | N/A            | PASS |
| 5750               | HSL            | 5.077                        | 34.28                            | OFDM                         | N/A            | PASS |



## &lt;Validation Results&gt;

| Date       | Freq.<br>(MHz) | Tissue<br>Type | Input<br>Power<br>(mW) | Measured<br>1g SAR<br>(W/kg) | Targeted<br>1g SAR<br>(W/kg) | Normalized<br>1g SAR<br>(W/kg) | Deviation<br>(%) |
|------------|----------------|----------------|------------------------|------------------------------|------------------------------|--------------------------------|------------------|
| 2023.09.18 | 750            | HSL            | 250                    | 2.21                         | 8.54                         | 8.84                           | 3.51             |
| 2023.11.09 | 900            | HSL            | 250                    | 2.85                         | 11.20                        | 11.4                           | 1.79             |
| 2023.10.25 | 1800           | HSL            | 250                    | 10.20                        | 39.20                        | 40.8                           | 4.08             |
| 2023.10.12 | 2000           | HSL            | 250                    | 10.62                        | 41.60                        | 42.48                          | 2.12             |
| 2023.11.10 | 2300           | HSL            | 250                    | 12.00                        | 48.40                        | 48                             | -0.83            |
| 2023.11.09 | 2450           | HSL            | 250                    | 12.86                        | 52.30                        | 51.44                          | -1.64            |
| 2023.11.08 | 2600           | HSL            | 250                    | 14.00                        | 57.00                        | 56                             | -1.75            |
| 2023.11.07 | 5250           | HSL            | 100                    | 8.05                         | 76.70                        | 80.5                           | 4.95             |
| 2023.11.08 | 5600           | HSL            | 100                    | 8.27                         | 80.80                        | 82.7                           | 2.35             |
| 2023.11.10 | 5750           | HSL            | 100                    | 8.41                         | 78.70                        | 84.1                           | 6.86             |

| Date       | Freq.<br>(MHz) | Tissue<br>Type | Input<br>Power<br>(mW) | Measured<br>10g SAR<br>(W/kg) | Targeted<br>10g SAR<br>(W/kg) | Normalized<br>10g SAR<br>(W/kg) | Deviation<br>(%) |
|------------|----------------|----------------|------------------------|-------------------------------|-------------------------------|---------------------------------|------------------|
| 2023.09.18 | 750            | HSL            | 250                    | 1.41                          | 5.57                          | 5.64                            | 1.26             |
| 2023.11.09 | 900            | HSL            | 250                    | 1.93                          | 7.19                          | 7.72                            | 7.37             |
| 2023.10.25 | 1800           | HSL            | 250                    | 5.26                          | 20.10                         | 21.04                           | 4.68             |
| 2023.10.12 | 2000           | HSL            | 250                    | 5.28                          | 20.70                         | 21.12                           | 2.03             |
| 2023.11.10 | 2300           | HSL            | 250                    | 5.47                          | 23.00                         | 21.88                           | -4.87            |
| 2023.11.09 | 2450           | HSL            | 250                    | 6.51                          | 23.90                         | 26.04                           | 8.95             |
| 2023.11.08 | 2600           | HSL            | 250                    | 6.55                          | 25.70                         | 26.2                            | 1.95             |
| 2023.11.07 | 5250           | HSL            | 100                    | 2.29                          | 22.10                         | 22.9                            | 3.62             |
| 2023.11.08 | 5600           | HSL            | 100                    | 2.42                          | 23.30                         | 24.2                            | 3.86             |
| 2023.11.10 | 5750           | HSL            | 100                    | 2.32                          | 22.50                         | 23.2                            | 3.11             |

**Note:** System checks the specific test data please see Annex C.

## 9 EUT Testing Position

This EUT was tested in four different positions. They are Bottom Face/Edge 1/Edge 3/ Edge 4 of the EUT with phantom 0 mm gap, as illustrated below, please refer to Annex B for the test setup photos.

### 9.1 SAR Evaluation to the Mouth/Jaw Regions of the Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04v01r03. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR locations identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

### 9.2 Body-Supported Device Configurations

According to KDB 616217 section 4.3, SAR should be separately assessed with each surface and separation distance positioned against the flat phantom that correspond to the intended use as specified by the manufacturer. The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the display section of a full-size tablet, away from the edges, are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s).

- To position the device parallel to the phantom surface with either keypad up or down.
- To adjust the device parallel to the flat phantom.

- To adjust the distance between the device surface and the flat phantom to 0 mm.
- When each surface is measurement, the SAR Test Exclusion Threshold in KDB 447498 should be applied.

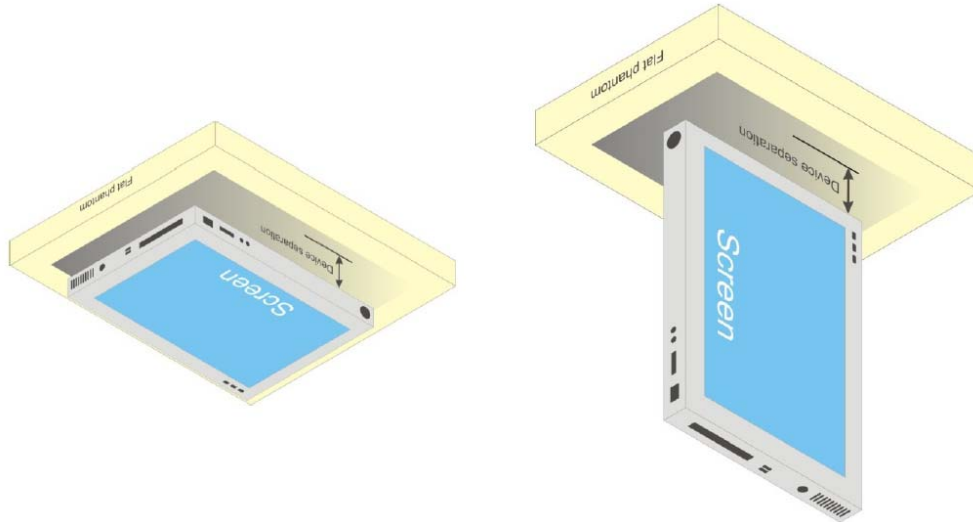


**Fig.9.5 Illustration for Body Position**

### 9.3 Wireless Router (Hotspot) Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 where SAR test considerations for handsets ( $L \times W \geq$

9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device with antennas 2.5 cm or closer to the edge of the device, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

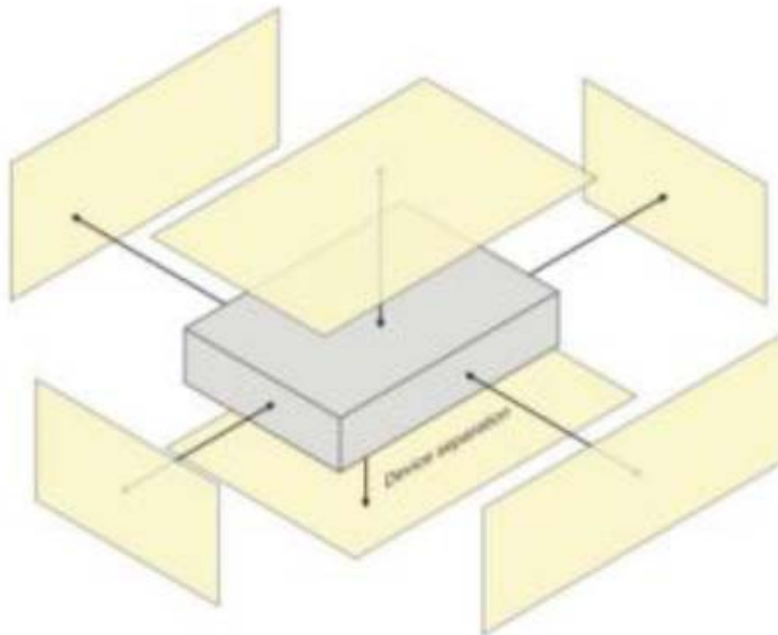


**Fig.9.6 Illustration for Hotspot Position**

## 10 Measurement Procedures

The measurement procedures are as bellows:

### <Conducted power measurement>

- For WWAN power measurement, use base station simulator to configure EUT WWAN transition in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- Read the WWAN RF power level from the base station simulator.
- 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.
- Connect EUT RF port through RF cable to the power meter or spectrum analyzer, and measure WLAN/BT output power.

### <Conducted power measurement>

- 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.
- Place the EUT in positions as Annex B demonstrates.
- Set scan area, grid size and other setting on the DASY software.
- Measure SAR results for the highest power channel on each testing position.
- Find out the largest SAR result on these testing positions of each band.
- Measure SAR results for other channels in worst SAR testing position if the Reported SAR or 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:

- Power reference measurement.
- Area scan.
- Zoom scan.
- 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 10 g 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 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

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

## 10.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement 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 Scan Procedures

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a  $10\text{mm}^2$  step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.



When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing.

## 10.4 Zoom Scan Procedures

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of  $1000 \text{ kg/m}^3$  is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1g cube is 10mm, with the side length of the 10 g cube 21,5mm. The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

## 10.5 SAR Averaged Methods

In DASYS, the interpolation and extrapolation are both based on the modified Quadratic Sheppard'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 1g and 10g 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 SAR Test Configuration

### <GSM Mode>

A summary of these settings are illustrated below:

For GSM850 frequency band, the power control is set to 5 for GSM/GPRS mode (GSMK-CS1) and set to 8 for EDGE mode (MCS5); For GSM1900 frequency band, the power control is set to 0 for GSM/GPRS mode (GSMK-CS1) and set to 2 for EDGE mode (MCS5).

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. Per KDB 941225 D01v03r01, SAR test reduction for GSM / GPRS / EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance. The mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. Therefore, the GPRS (4Tx slots) for GSM850/GSM1900 is considered as the primary mode.
3. Other configurations of GSM / GPRS / EDGE are considered as secondary modes.

### Timeslot consignations:

#### Remark:

1. The frame-averaged power is linearly reported the maximum burst averaged power over 8 time slots. The calculated method are shown as below:  
The duty cycle "x" of different time slots as below:  
1 TX slot is 1/8, 2 TX slots is 2/8, 3 TX slots is 3/8 and 4 TX slots is 4/8  
Based on the calculation formula:  
Frame-averaged power = Burst averaged power + 10 log (x)  
So,  
Frame-averaged power (1 TX slot) = Burst averaged power (1 TX slot)– 9.03  
Frame-averaged power (2 TX slots) = Burst averaged power (2 TX slots)– 6.02  
Frame-averaged power (3 TX slots) = Burst averaged power (3 TX slots)– 4.26  
Frame-averaged power (4 TX slots) = Burst averaged power (4 TX slots) – 3.01
2. CS1 coding scheme was used in GPRS conducted power measurements and SAR testing, MCS5 coding scheme was used in EGPRS conducted power measurements and SAR testing (if necessary).

| No. of Slots:      | Slot 1    | Slot 2    | Slot 3    | Slot 4    |
|--------------------|-----------|-----------|-----------|-----------|
| Slot Consignation: | 1Up 4Down | 2Up 3Down | 3Up 2Down | 4Up 1Down |
| Duty Cycle:        | 1:8.3     | 1:4.15    | 1:2.77    | 1:2.08    |
| Correct Factor:    | -9.03dB   | -6.02dB   | -4.26dB   | -3.01dB   |

## <WCDMA Mode>

Summary of UMTS conducted power measurement:

1. The 3G SAR test reduction procedure is applied, when the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq \frac{1}{4}$  dB higher than the primary mode, SAR measurement is not required for the secondary mode.
2. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
3. The procedures in KDB 941225 D01v03r01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.
4. For HSPA+ devices supporting 16 QAM in the uplink, power measurements procedure is according to the configurations in Table C.11.1.4 of 3GPP TS 34.121-1.
5. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. The maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA / DC-HSDPA / HSPA+ is  $\leq \frac{1}{4}$  dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA / DC-HSDPA / HSPA+ to RMC12.2Kbps and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for HSDPA / HSUPA / DC-HSDPA / HSPA+, and according to the following RF output power, the output power results of the secondary modes (HSDPA / HSUPA / DC-HSDPA / HSPA+) are less than  $\frac{1}{4}$  dB higher than the primary modes; therefore, SAR measurement is not required for HSDPA / HSUPA / DC-HSDPA / HSPA+.
6. A fixed level power reduction is applied for WCDMA Band II when handset open Hotspot mode, the power reduction triggered.

## HSDPA Setup Configuration

| Sub-test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | $\beta_c$            | $\beta_d$            | $\beta_d$<br>(SF) | $\beta_c/\beta_d$    | $\beta_{hs}^{(2)}$ | CM (dB) <sup>(2)</sup> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|-------------------|----------------------|--------------------|------------------------|
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2/15                 | 15/15                | 64                | 2/15                 | 4/15               | 0.0                    |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 12/15 <sup>(3)</sup> | 15/15 <sup>(3)</sup> | 64                | 12/15 <sup>(3)</sup> | 24/15              | 1.0                    |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15/15                | 8/15                 | 64                | 15/8                 | 30/15              | 1.5                    |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 15/15                | 4/15                 | 64                | 15/4                 | 30/15              | 1.5                    |
| Note 1: $\Delta_{ACK}, \Delta_{NACK}$ and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$<br>Note 2: CM = 1 for $\beta_c/\beta_d = 12/15, \beta_{hs}/\beta_c = 24/15$ .<br>Note 3: For subtest 2 the $\beta_c/\beta_d$ ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$ . |                      |                      |                   |                      |                    |                        |

## HSUPA Setup Configuration

| Sub-test | $\beta_c$            | $\beta_d$            | $\beta_d$ (SF) | $\beta_c/\beta_d$    | $\beta_{hs}^{(1)}$ | $\beta_{ec}$ | $\beta_{ed}$                                 | $\beta_{ed}$ (SF) | $\beta_{ed}$ (codes) | CM <sup>(2)</sup> (dB) | MPR (dB) | AG <sup>(4)</sup> Index | E-TFCI |
|----------|----------------------|----------------------|----------------|----------------------|--------------------|--------------|----------------------------------------------|-------------------|----------------------|------------------------|----------|-------------------------|--------|
| 1        | 11/15 <sup>(3)</sup> | 15/15 <sup>(3)</sup> | 64             | 11/15 <sup>(3)</sup> | 22/15              | 209/225      | 1039/225                                     | 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                 | 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 <sup>(4)</sup> | 15/15 <sup>(4)</sup> | 64             | 15/15 <sup>(4)</sup> | 30/15              | 24/15        | 134/15                                       | 4                 | 1                    | 1.0                    | 0.0      | 21                      | 81     |

Note 1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$ .

Note 2: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 10/15$  and  $\beta_d = 15/15$ .

Note 4: For subtest 5 the  $\beta_c/\beta_d$  ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 14/15$  and  $\beta_d = 15/15$ .

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

Note 6:  $\beta_{ed}$  cannot be set directly; it is set by Absolute Grant Value.

## HSPA+ 3GPP release 7 (uplink category 7) 16QAM, Setup Configuration:

**Table C.11.1.4:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH with 16QAM**

| Sub-test | $\beta_c$ (Note 3) | $\beta_d$ | $\beta_{hs}$ (Note 1) | $\beta_{ec}$ | $\beta_{ed}$ (2xSF2) (Note 4)                | $\beta_{ed}$ (2xSF4) (Note 4)                | CM (dB) (Note 2) | MPR (dB) (Note 2) | AG Index (Note 4) | E-TFCI (Note 5) | E-TFCI (boost) |
|----------|--------------------|-----------|-----------------------|--------------|----------------------------------------------|----------------------------------------------|------------------|-------------------|-------------------|-----------------|----------------|
| 1        | 1                  | 0         | 30/15                 | 30/15        | $\beta_{ed1}: 30/15$<br>$\beta_{ed2}: 30/15$ | $\beta_{ed3}: 24/15$<br>$\beta_{ed4}: 24/15$ | 3.5              | 2.5               | 14                | 105             | 105            |

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

Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).

Note 3: DPDCH is not configured, therefore the  $\beta_c$  is set to 1 and  $\beta_d = 0$  by default.

Note 4:  $\beta_{ed}$  can not be set directly; it is set by Absolute Grant Value.

Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signaled to use the extrapolation algorithm.

**DC-HSDPA Setup Configuration**

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108 v9.5.0. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.

**Table E.5.0: Levels for HSDPA connection setup**

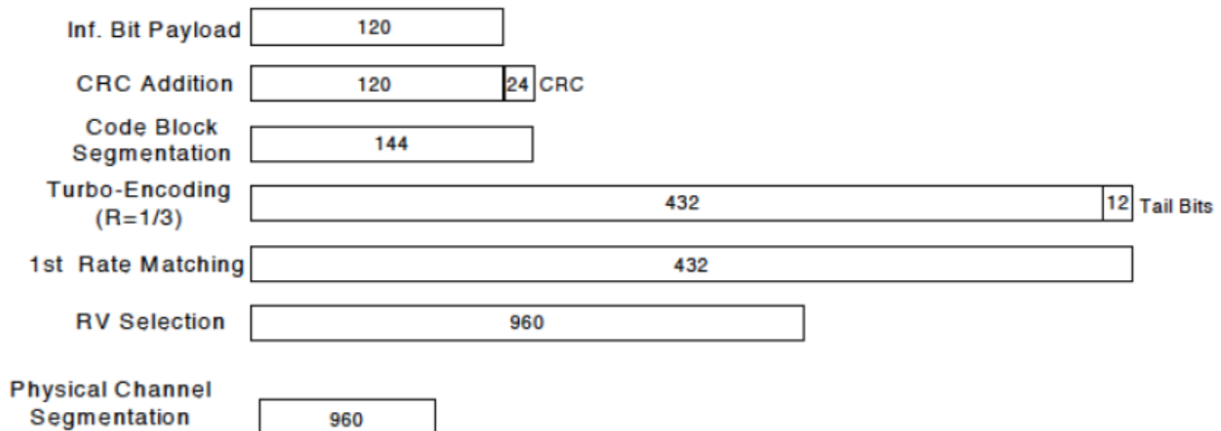
| <b>Parameter<br/>During Connection setup</b> | <b>Unit</b> | <b>Value</b> |
|----------------------------------------------|-------------|--------------|
| P-CPICH_Ec/Ior                               | dB          | -10          |
| P-CCPCH and SCH_Ec/Ior                       | dB          | -12          |
| PICH_Ec/Ior                                  | dB          | -15          |
| HS-PDSCH                                     | dB          | off          |
| HS-SCCH_1                                    | dB          | off          |
| DPCH_Ec/Ior                                  | dB          | -5           |
| OCNS_Ec/Ior                                  | dB          | -3.1         |

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

**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.<br>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)**



## &lt;CDMA Mode&gt;

**1xEV-DO Rev. B**

Call box setup procedure

1xEV-DO Release B

1&gt; CMW 500 Signal Generator &gt; 1xEV-DO Taskbar Enable

2&gt; CMW 500 1xEV-DO Signaling Configuration Window &gt;

3&gt; 1xEV-DO Signaling On Window:

Under Access Network Control:

Band Class: BC0: US Cellular

RF Channel: 31

1xEV-DO Power: -70 dBm

4&gt; 1xEV-DO Signaling Configuration Window

Under RF Frequency Band / Channel: Enter Ch. Frequency

- Under Carrier Configuration: RF Frequency  
For Two Carriers: Low Channel (1013)

|             | <u>RF Channel</u> | <u>RF Channel Offset</u> |
|-------------|-------------------|--------------------------|
| Carrier [0] | 31                | 0                        |
| Carrier [1] | 1013              | 982                      |

- Under Carrier Configuration: RF Pilot
- |           | <u>Carrier Sector</u> | <u>Active on AN</u> | <u>Assigned to AT</u> |
|-----------|-----------------------|---------------------|-----------------------|
| Pilot [0] | C0/S0                 | ✓                   | ✓                     |
|           | CA/S1                 | ✓                   | ✓                     |

For Three Carriers: Low Channel (1013)

|             | <u>RF Channel</u> | <u>RF Channel Offset</u> |
|-------------|-------------------|--------------------------|
| Carrier [0] | 72                | 0                        |
| Carrier [1] | 31                | -41                      |
| Carrier [2] | 1013              | 941                      |

- Under Carrier Configuration: RF Pilot
- |           | <u>Carrier Sector</u> | <u>Active on AN</u> | <u>Assigned to AT</u> |
|-----------|-----------------------|---------------------|-----------------------|
| Pilot [0] | C0/S0                 | ✓                   | ✓                     |
| Pilot [1] | C1/S1                 | ✓                   | ✓                     |
| Pilot [2] | C2/S2                 | ✓                   | ✓                     |



## &lt;LTE Mode&gt;

**LTE Target MPR level**

The device implements maximum power reduction per 3GPP 36.101 requirements where the MPR target is as below table. The MPR settings are implemented configured into firmware and cannot be disabled by the end user or LTE carrier network.

| Modulation | Channel bandwidth/Transmission bandwidth configuration[RB] |     |     |      |      |      | MPR    | 3GPP |
|------------|------------------------------------------------------------|-----|-----|------|------|------|--------|------|
|            | 1.4                                                        | 3.0 | 5   | 10   | 15   | 20   | Target |      |
|            | MHz                                                        | MHz | MHz | MHz  | MHz  | MHz  | (dB)   |      |
| QPSK       | > 5                                                        | > 4 | > 8 | > 12 | > 16 | > 18 | 1      | ≤ 1  |
| 16 QAM     | ≤ 5                                                        | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | 1      | ≤ 1  |
| 64 QAM     | > 5                                                        | > 4 | > 8 | > 12 | > 16 | > 18 | 2      | ≤ 2  |

**Note:** The measurement result showed some difference from the target MPR level, due to expected 0.5dB measurement tolerance

**LTE Bands**

| LTE Bands | Channel bandwidth/Transmission bandwidth configuration [RB] |     |     |     |     |     |
|-----------|-------------------------------------------------------------|-----|-----|-----|-----|-----|
|           | 1.4                                                         | 3.0 | 5   | 10  | 15  | 20  |
|           | MHz                                                         | MHz | MHz | MHz | MHz | MHz |
| 2         | ✓                                                           | ✓   | ✓   | ✓   | ✓   | ✓   |
| 4         | ✓                                                           | ✓   | ✓   | ✓   | ✓   | ✓   |
| 5         | ✓                                                           | ✓   | ✓   | ✓   | N/A | N/A |
| 7         | N/A                                                         | N/A | ✓   | ✓   | ✓   | ✓   |
| 12        | ✓                                                           | ✓   | ✓   | ✓   | N/A | N/A |
| 13        | N/A                                                         | N/A | ✓   | ✓   | N/A | N/A |
| 17        | N/A                                                         | N/A | ✓   | ✓   | N/A | N/A |
| 40A       | N/A                                                         | N/A | ✓   | ✓   | N/A | N/A |
| 40B       | N/A                                                         | N/A | ✓   | ✓   | N/A | N/A |
| 41        | N/A                                                         | N/A | ✓   | ✓   | ✓   | ✓   |

**Note:**

1. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
2. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
3. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.



4. Per KDB 941225 D05v02r05, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are  $\leq 0.8$  W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is  $> 1.45$  W/kg, the remaining required test channels must also be tested.
5. Per KDB 941225 D05v02r05, 16QAM/64QAM output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is  $\leq 1.45$  W/kg; Per KDB941225 D05v02r05, 16QAM/64QAM SAR testing is not required.
6. Per KDB 941225 D05v02r05, smaller bandwidth output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  Db higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported band width is  $\leq 1.45$  W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
7. For LTE B4 / B5 / B7 / B17 the maximum bandwidth does not support three non-overlapping channels, per KDB941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.
8. LTE band 2 / 4 / 12 SAR test was covered by Band 25 / 66 / 17; according to April 2015 TCB workshop, SAR test for overlapping LTE bands can be reduced if
  - a. The maximum output power, including tolerance, for the smaller band is  $\leq$  the larger band to qualify for the SAR test exclusion.
  - b. The channel bandwidth and other operating parameters for the smaller band are fully supported by the larger band.
9. According to 2017 TCB workshop, for 64 QAM and 16 QAM should be verified by checking the signal constellation with a call box to avoid incorrect maximum power levels due to MPR and other requirements associated with signal modulation, and the following figure is taken from the "Fundamental Measurement >> Modulation Analysis >>constellation" mode of the device connect to the CMW500 base station, therefore, the device 64QAM and 16QAMsignal modulation are correct. Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design: only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards: b) A-MPR (additional MPR) must be disabled.
10. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up

by the duty cycle scaling factor which is equal to "1/(duty cycle)"

- c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
  - d. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)\* Duty Cycle scaling factor \* Tune-up scaling factor
  - e. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix  $63.3\%/62.9\% = 1.006$  is applied to scale-up the measured SAR result. The Reported TDD LTE SAR = measured SAR (W/kg)\* Tune-up Scaling Factor\* scaling factor for extended cyclic prefix.
11. Per KDB 447498 D01v06, 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:  $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz  $\leq 0.6$  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  $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz
12. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$  W/kg.
13. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is  $\leq 1.2$  W/kg, SAR testing with a headset connected to the handset is not required.

#### <WLAN 2.4GHz>

1. SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
  - a. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
  - b. When the reported SAR is  $> 0.8$  W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.
2. 2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is  $> 1.2$  W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test configuration Procedures should be followed.
3. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is  $\leq 0.4$  W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest

peak SAR positions until the reported SAR result is  $\leq 0.8$  W/kg or all test positions are measured.

4. Justification for test configurations for WLAN per KDB Publication 248227 D02DR02-41929 for 2.4 GHz WI-FI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported SAR.
5. A fixed level power reduction is applied for WiFi when handset operates "held to the body" condition or "held to the ear" condition, the power reduction triggered by audio receiver detection and call establish status.
6. Per KDB 248227 D01v02r02, In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. SAR is not required for the following 2.4 GHz OFDM conditions:
  - a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
  - b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

#### <WLAN 5GHz>

##### A) U-NII-1 and U-NII-2A Bands

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following:

1. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is  $\leq 1.2$  W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, both bands are tested independently for SAR.
2. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is  $\leq 1.2$  W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, both bands are tested independently for SAR.
3. The two U-NII bands may be aggregated to support a 160 MHz channel on channel number 50.
4. Without additional testing, the maximum output power for this is limited to the lower of the maximum output power certified for the two bands. When SAR measurement is required for at least one of the bands and the highest reported SAR adjusted by the ratio of specified maximum output power of aggregated to standalone band is  $> 1.2$  W/kg, SAR is required for the 160 MHz channel. This procedure does not apply to an aggregated band with maximum output higher than



the standalone band(s); the aggregated band must be tested independently for SAR. SAR is not required when the 160 MHz channel is operating at a reduced maximum power and also qualifies for SAR test exclusion.

#### **B) U-NII-2C and U-NII-3 Bands**

The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. when Terminal Doppler Weather Radar (TDWR) restriction applies, all channels that operate at 5.60 – 5.65 GHz must be included to apply the SAR test reduction and measurement procedures. When the same transmitter and antenna(s) are used for U-NII-2C band and U-NII-3 band or 5.8 GHz band of §15.247, the bands may be aggregated to enable additional channels with 20, 40 or 80 MHz bandwidth to span across the band gap, as illustrated in Appendix B. The maximum output power for the additional band gap channels is limited to the lower of those certified for the bands. Unless band gap channels are permanently disabled, they must be considered for SAR testing. The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz may be grouped with the 5.8 GHz channels in U-NII-3 or §15.247 band to enable two SAR probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are supported and the bands are not aggregated for SAR testing, band gap channels must be considered independently in each band according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

#### **C) OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements**

The initial test configuration for 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures. When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

1. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
2. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
3. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.

4. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n. After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.
5. The channel closest to mid-band frequency is selected for SAR measurement.
6. For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

#### **D) SAR Test Requirements for OFDM configurations**

When SAR measurement is required for 802.11 a/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements. In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.



## 12 Conducted Output Power

Remark: The output power of GSM/WCDMA/CDMA 2000/LTE/WLAN/Bluetooth were recorded in annex E of this report.

## 13 Exposure Positions Consideration

### ➤ EUT Antenna Locations

|                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The antenna location was shown in annex B.                                                                                                                                                                                                                                                |
| MAIN-ANT:<br>TX: GSM 850/1900, WCDMA Band II/V, CDMA 2000 BC0,<br>LTE Band 2/4/5/7/12/13/17/40/41<br><br>DIV-ANT:<br>RX: GSM 850/1900, WCDMA Band II/V, CDMA 2000 BC0,<br>LTE Band 2/4/5/7/12/13/17/40/41<br><br>GPS/BT/WIFI:<br>TX/RX: WLAN 2.4GHz/5GHz, Bluetooth<br>RX: GPS<br><br>NFC |

### ➤ Test Positions Consideration

1. The test position consideration was recorded in annex F.
2. Per KDB 616217 D04v01r02, when the overall diagonal dimension of display is > 20 cm, the test distance is 0mm; the SAR Test Exclusion Threshold in KDB 447498 section 4.3.1 can be applied to determine SAR test exclusion for adjacent edge configurations.
3. Per KDB 616217 D04v01r02, SAR evaluation for the front surface of tablet display screens is generally not necessary.
4. Per KDB 616217 D04v01r02, additional testing for hotspot SAR is not required.
5. For WWAN bands, bottom face, edge 1 and edge 2 would be tested in this report.
6. For WLAN bands, bottom face, edge 1 and edge 4 would be tested in this report.



## 14 SAR Test Results Summary

### 14.1 Test Guidance

1. The reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  1. 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.
  2. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)".
  3. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor.
  4. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)\* Duty Cycle scaling factor \* Tune-up scaling factor.
2. Per KDB 447498 D01v06, 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:
  - a.  $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz
  - b.  $\leq 0.6$  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
  - c.  $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz
3. For TDD-LTE Band 40, the entire band is unable to be used that as per 27.5; only 2 paired block (2305 to 2315MHz, 2350 to 2360MHz) are allowed with regards to "TDD" operation. the channel allocation, and bandwidth covert to test channels shall be re-adjusted; furthermore, as per 27.50, the duty cycle must be adjusted that TDD in this band must not exceed 38%. Before testing, the special combination must be set in the base station before the periodic measurement can be carried out.
4. Per KDB248227 D01v02r02, a Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actual channel frequencies required for operations in the U.S. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. Unless it is permitted by specific KDB procedures or continuous transmission is specifically restricted by the device, the reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. When a device is



not capable of sustaining continuous transmission or the output can become nonlinear, and it is limited by hardware design and unable to transmit at higher than 85% duty factor, a periodic duty factor within 15% of the maximum duty factor the device is capable of transmitting should be used. The reported SAR must be scaled to the maximum transmission duty factor to determine compliance. Descriptions of the procedures applied to establish the specific duty factor used for SAR testing are required in SAR reports to support the test results.

5. The maximum power of NFC is less than 1mW per the manual information, therefore it is not required for RF exposure.

## 14.2 Body SAR Data

### ➤ GSM Body SAR

| Plot No. | Band/Mode             | Test Position | CH. | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|----------|-----------------------|---------------|-----|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
|          | GPRS 850(3 TX slots)  | Bottom Face   | 189 | 24.55            | 25.50               | 1.245                  | 0.735                          | 0.915                             |
|          | GPRS 850(3 TX slots)  | Edge 1        | 189 | 24.55            | 25.50               | 1.245                  | 0.461                          | 0.574                             |
|          | GPRS 850(3 TX slots)  | Edge 2        | 189 | 24.55            | 25.50               | 1.245                  | 0.182                          | 0.226                             |
| 1#       | GPRS 850(3 TX slots)  | Bottom Face   | 128 | 24.38            | 25.50               | 1.294                  | 0.799                          | 1.034                             |
|          | GPRS 850(3 TX slots)  | Bottom Face   | 251 | 24.53            | 25.50               | 1.250                  | 0.705                          | 0.881                             |
| 2#       | GPRS 1900(4 TX slots) | Bottom Face   | 661 | 20.11            | 21.00               | 1.227                  | 0.518                          | 0.636                             |
|          | GPRS 1900(4 TX slots) | Edge 1        | 661 | 20.11            | 21.00               | 1.227                  | 0.261                          | 0.320                             |
|          | GPRS 1900(4 TX slots) | Edge 2        | 661 | 20.11            | 21.00               | 1.227                  | 0.068                          | 0.083                             |

### ➤ WCDMA Body SAR

| Plot No. | Band/Mode            | Test Position | CH.  | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|----------|----------------------|---------------|------|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
|          | Band II/RMC 12.2Kbps | Bottom Face   | 9400 | 15.95            | 16.50               | 1.135                  | 0.720                          | 0.817                             |
|          | Band II/RMC 12.2Kbps | Edge 1        | 9400 | 15.95            | 16.50               | 1.135                  | 0.419                          | 0.476                             |
|          | Band II/RMC 12.2Kbps | Edge 2        | 9400 | 15.95            | 16.50               | 1.135                  | 0.119                          | 0.135                             |
|          | Band II/RMC 12.2Kbps | Bottom Face   | 9262 | 15.81            | 16.50               | 1.172                  | 0.851                          | 0.998                             |
| 3#       | Band II/RMC 12.2Kbps | Bottom Face   | 9538 | 15.78            | 16.50               | 1.180                  | 0.882                          | 1.041                             |
|          | Band V/RMC 12.2Kbps  | Bottom Face   | 4182 | 19.92            | 20.50               | 1.143                  | 0.700                          | 0.800                             |
|          | Band V/RMC 12.2Kbps  | Edge 1        | 4182 | 19.92            | 20.50               | 1.143                  | 0.247                          | 0.282                             |
|          | Band V/RMC 12.2Kbps  | Edge 2        | 4182 | 19.92            | 20.50               | 1.143                  | 0.094                          | 0.108                             |
|          | Band V/RMC 12.2Kbps  | Bottom Face   | 4132 | 19.81            | 20.50               | 1.172                  | 0.669                          | 0.785                             |



|    |                     |             |      |       |       |       |       |       |
|----|---------------------|-------------|------|-------|-------|-------|-------|-------|
| 4# | Band V/RMC 12.2Kbps | Bottom Face | 4233 | 19.87 | 20.50 | 1.156 | 0.799 | 0.924 |
|----|---------------------|-------------|------|-------|-------|-------|-------|-------|

➤ **CDMA2000 SAR**

| Plot No. | Band/Mode           | Test Position | CH. | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|----------|---------------------|---------------|-----|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| 5#       | BC0/RC3 SO32(F+SCH) | Bottom Face   | 384 | 24.34            | 25.00               | 1.164                  | 0.292                          | 0.340                             |
|          | BC0/RC3 SO32(F+SCH) | Edge 1        | 384 | 24.34            | 25.00               | 1.164                  | 0.034                          | 0.040                             |
|          | BC0/RC3 SO32(F+SCH) | Edge 2        | 384 | 24.34            | 25.00               | 1.164                  | 0.104                          | 0.121                             |

➤ **LTE QPSK Body SAR**

| Plot No. | Band/Mode                     | Test Position | CH.   | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|----------|-------------------------------|---------------|-------|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
|          | LTE Band 2/1RB#0 20M          | Bottom Face   | 18900 | 15.56            | 16.50               | 1.242                  | 0.800                          | 0.993                             |
|          | LTE Band 2/1RB#0 20M          | Edge 1        | 18900 | 15.56            | 16.50               | 1.242                  | 0.341                          | 0.423                             |
|          | LTE Band 2/1RB#0 20M          | Edge 2        | 18900 | 15.56            | 16.50               | 1.242                  | 0.116                          | 0.145                             |
|          | LTE Band 2/1RB#0 20M          | Bottom Face   | 18700 | 15.40            | 16.50               | 1.288                  | 0.911                          | 1.174                             |
| 6#       | LTE Band 2/1RB#0 20M          | Bottom Face   | 19100 | 15.51            | 16.50               | 1.256                  | 0.942                          | 1.183                             |
|          | LTE Band 2/50RB#0 20M         | Bottom Face   | 18900 | 15.21            | 15.50               | 1.069                  | 0.711                          | 0.760                             |
|          | LTE Band 2/50RB#0 20M         | Edge 1        | 18900 | 15.21            | 15.50               | 1.069                  | 0.239                          | 0.255                             |
|          | LTE Band 2/50RB#0 20M         | Edge 2        | 18900 | 15.21            | 15.50               | 1.069                  | 0.081                          | 0.087                             |
|          | <b>LTE Band 2/100RB#0 20M</b> | Bottom Face   | 18900 | 15.12            | 15.50               | 1.091                  | 0.588                          | 0.642                             |
|          |                               |               |       |                  |                     |                        |                                |                                   |
| 7#       | LTE Band 4/1RB#0 20M          | Bottom Face   | 20175 | 18.29            | 19.00               | 1.178                  | 0.772                          | 0.909                             |
|          | LTE Band 4/1RB#0 20M          | Edge 1        | 20175 | 18.29            | 19.00               | 1.178                  | 0.733                          | 0.863                             |
|          | LTE Band 4/1RB#0 20M          | Edge 2        | 20175 | 18.29            | 19.00               | 1.178                  | 0.198                          | 0.233                             |
|          | LTE Band 4/1RB#0 20M          | Edge 1        | 20050 | 18.11            | 19.00               | 1.227                  | 0.667                          | 0.818                             |
|          | LTE Band 4/1RB#0 20M          | Edge 1        | 20300 | 18.20            | 19.00               | 1.202                  | 0.741                          | 0.891                             |
|          | LTE Band 4/1RB#0 20M          | Bottom Face   | 20050 | 18.11            | 19.00               | 1.227                  | 0.703                          | 0.863                             |
|          | LTE Band 4/1RB#0 20M          | Bottom Face   | 20300 | 18.20            | 19.00               | 1.202                  | 0.694                          | 0.834                             |
|          | LTE Band 4/50RB#0 20M         | Bottom Face   | 20175 | 17.83            | 18.00               | 1.040                  | 0.540                          | 0.562                             |
|          | LTE Band 4/50RB#0 20M         | Edge 1        | 20175 | 17.83            | 18.00               | 1.040                  | 0.513                          | 0.533                             |
|          | LTE Band 4/50RB#0 20M         | Edge 2        | 20175 | 17.83            | 18.00               | 1.040                  | 0.138                          | 0.144                             |
|          | <b>LTE Band 4/100RB#0 20M</b> | Bottom Face   | 20175 | 17.45            | 18.00               | 1.135                  | 0.428                          | 0.486                             |
|          |                               |               |       |                  |                     |                        |                                |                                   |
| 8#       | LTE Band 5/1RB#0 10M          | Bottom Face   | 20525 | 19.76            | 20.50               | 1.186                  | 0.560                          | 0.664                             |
|          | LTE Band 5/1RB#0 10M          | Edge 1        | 20525 | 19.76            | 20.50               | 1.186                  | 0.188                          | 0.222                             |
|          | LTE Band 5/1RB#0 10M          | Edge 2        | 20525 | 19.76            | 20.50               | 1.186                  | 0.089                          | 0.105                             |



|     |                               |             |       |       |       |       |       |       |
|-----|-------------------------------|-------------|-------|-------|-------|-------|-------|-------|
|     | LTE Band 5/25RB#0 10M         | Bottom Face | 20525 | 19.16 | 19.50 | 1.081 | 0.304 | 0.329 |
|     | LTE Band 5/25RB#0 10M         | Edge 1      | 20525 | 19.16 | 19.50 | 1.081 | 0.131 | 0.142 |
|     | LTE Band 5/25RB#0 10M         | Edge 2      | 20525 | 19.16 | 19.50 | 1.081 | 0.062 | 0.067 |
|     |                               |             |       |       |       |       |       |       |
|     | LTE Band 7/1RB#0 20M          | Bottom Face | 21100 | 13.01 | 13.50 | 1.119 | 0.900 | 1.007 |
|     | LTE Band 7/1RB#0 20M          | Edge 1      | 21100 | 13.01 | 13.50 | 1.119 | 0.280 | 0.314 |
|     | LTE Band 7/1RB#0 20M          | Edge 2      | 21100 | 13.01 | 13.50 | 1.119 | 0.061 | 0.068 |
|     | LTE Band 7/1RB#0 20M          | Bottom Face | 20850 | 12.90 | 13.50 | 1.148 | 0.874 | 1.003 |
| 9#  | LTE Band 7/1RB#0 20M          | Bottom Face | 21350 | 12.93 | 13.50 | 1.140 | 1.020 | 1.163 |
|     | LTE Band 7/50RB#0 20M         | Bottom Face | 21100 | 11.82 | 12.50 | 1.169 | 0.630 | 0.737 |
|     | LTE Band 7/50RB#0 20M         | Edge 1      | 21100 | 11.82 | 12.50 | 1.169 | 0.196 | 0.229 |
|     | LTE Band 7/50RB#0 20M         | Edge 2      | 21100 | 11.82 | 12.50 | 1.169 | 0.043 | 0.050 |
|     | <b>LTE Band 7/100RB#0 20M</b> | Bottom Face | 21100 | 11.62 | 12.50 | 1.225 | 0.540 | 0.661 |
|     |                               |             |       |       |       |       |       |       |
|     | LTE Band 12/1RB#0 10M         | Bottom Face | 23095 | 23.18 | 24.00 | 1.208 | 0.709 | 0.857 |
|     | LTE Band 12/1RB#0 10M         | Edge 1      | 23095 | 23.18 | 24.00 | 1.208 | 0.112 | 0.136 |
|     | LTE Band 12/1RB#0 10M         | Edge 2      | 23095 | 23.18 | 24.00 | 1.208 | 0.108 | 0.130 |
|     | LTE Band 12/1RB#0 10M         | Bottom Face | 23060 | 23.01 | 24.00 | 1.256 | 0.677 | 0.851 |
| 10# | LTE Band 12/1RB#0 10M         | Bottom Face | 23130 | 23.10 | 24.00 | 1.230 | 0.871 | 1.072 |
|     | LTE Band 12/25RB#0 10M        | Bottom Face | 23095 | 22.51 | 23.00 | 1.119 | 0.497 | 0.556 |
|     | LTE Band 12/25RB#0 10M        | Edge 1      | 23095 | 22.51 | 23.00 | 1.119 | 0.079 | 0.088 |
|     | LTE Band 12/25RB#0 10M        | Edge 2      | 23095 | 22.51 | 23.00 | 1.119 | 0.076 | 0.085 |
|     | <b>LTE Band 12/50RB#0 10M</b> | Bottom Face | 23095 | 22.40 | 23.00 | 1.148 | 0.380 | 0.436 |
|     |                               |             |       |       |       |       |       |       |
| 11# | LTE Band 13/1RB#0 10M         | Bottom Face | 23230 | 21.58 | 22.50 | 1.236 | 0.926 | 1.144 |
|     | LTE Band 13/1RB#0 10M         | Edge 1      | 23230 | 21.58 | 22.50 | 1.236 | 0.284 | 0.351 |
|     | LTE Band 13/1RB#0 10M         | Edge 2      | 23230 | 21.58 | 22.50 | 1.236 | 0.210 | 0.260 |
|     | LTE Band 13/25RB#0 10M        | Bottom Face | 23230 | 20.89 | 21.50 | 1.151 | 0.664 | 0.764 |
|     | LTE Band 13/25RB#0 10M        | Edge 1      | 23230 | 20.89 | 21.50 | 1.151 | 0.199 | 0.229 |
|     | LTE Band 13/25RB#0 10M        | Edge 2      | 23230 | 20.89 | 21.50 | 1.151 | 0.147 | 0.169 |
|     | <b>LTE Band 13/50RB#0 10M</b> | Edge 2      | 23230 | 20.63 | 21.50 | 1.222 | 0.580 | 0.709 |
|     |                               |             |       |       |       |       |       |       |
| 12# | LTE Band 40A/1RB#0 10M        | Bottom Face | 38750 | 17.72 | 18.50 | 1.197 | 0.486 | 0.582 |
|     | LTE Band 40A/1RB#0 10M        | Edge 1      | 38750 | 17.72 | 18.50 | 1.197 | 0.195 | 0.233 |
|     | LTE Band 40A/1RB#0 10M        | Edge 2      | 38750 | 17.72 | 18.50 | 1.197 | 0.041 | 0.049 |
|     | LTE Band 40A/25RB#0 10M       | Bottom Face | 38750 | 16.77 | 17.50 | 1.183 | 0.340 | 0.402 |
|     | LTE Band 40A/25RB#0 10M       | Edge 1      | 38750 | 16.77 | 17.50 | 1.183 | 0.136 | 0.161 |
|     | LTE Band 40A/25RB#0 10M       | Edge 2      | 38750 | 16.77 | 17.50 | 1.183 | 0.029 | 0.034 |



|     |                         |             |       |       |       |       |       |       |
|-----|-------------------------|-------------|-------|-------|-------|-------|-------|-------|
|     | LTE Band 40B/1RB#0 10M  | Bottom Face | 39200 | 17.71 | 18.50 | 1.199 | 0.475 | 0.570 |
|     | LTE Band 40B/1RB#0 10M  | Edge 1      | 39200 | 17.71 | 18.50 | 1.199 | 0.175 | 0.210 |
|     | LTE Band 40B/1RB#0 10M  | Edge 2      | 39200 | 17.71 | 18.50 | 1.199 | 0.041 | 0.049 |
|     | LTE Band 40B/50RB#0 10M | Bottom Face | 39200 | 16.68 | 17.50 | 1.208 | 0.333 | 0.402 |
|     | LTE Band 40B/50RB#0 10M | Edge 1      | 39200 | 16.68 | 17.50 | 1.208 | 0.123 | 0.148 |
|     | LTE Band 40B/50RB#0 10M | Edge 2      | 39200 | 16.68 | 17.50 | 1.208 | 0.029 | 0.034 |
| 13# | LTE Band 41/1RB#0 20M   | Bottom Face | 40620 | 15.67 | 16.50 | 1.211 | 0.536 | 0.649 |
|     | LTE Band 41/1RB#0 20M   | Edge 1      | 40620 | 15.67 | 16.50 | 1.211 | 0.349 | 0.423 |
|     | LTE Band 41/1RB#0 20M   | Edge 2      | 40620 | 15.67 | 16.50 | 1.211 | 0.061 | 0.074 |
|     | LTE Band 41/50RB#0 20M  | Bottom Face | 40620 | 14.86 | 15.50 | 1.159 | 0.375 | 0.435 |
|     | LTE Band 41/50RB#0 20M  | Edge 1      | 40620 | 14.86 | 15.50 | 1.159 | 0.245 | 0.283 |
|     | LTE Band 41/50RB#0 20M  | Edge 2      | 40620 | 14.86 | 15.50 | 1.159 | 0.043 | 0.050 |

➤ **WLAN Body SAR**

| Plot No. | Band/Mode             | Test Position | CH. | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|----------|-----------------------|---------------|-----|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| 14#      | WLAN2.4GHz/802.11b    | Bottom Face   | 13  | 14.46            | 15.00               | 1.132                  | 0.533                          | 0.606                             |
|          | WLAN2.4GHz/802.11b    | Edge 1        | 13  | 14.46            | 15.00               | 1.132                  | 0.151                          | 0.172                             |
|          | WLAN2.4GHz/802.11b    | Edge 4        | 13  | 14.46            | 15.00               | 1.132                  | 0.500                          | 0.568                             |
|          | WLAN5.2GHz/802.11n20  | Bottom Face   | 36  | 5.50             | 6.00                | 1.122                  | 0.877                          | 1.017                             |
|          | WLAN5.2GHz/802.11n20  | Edge 1        | 36  | 5.50             | 6.00                | 1.122                  | 0.042                          | 0.049                             |
|          | WLAN5.2GHz/802.11n20  | Edge 4        | 36  | 5.50             | 6.00                | 1.122                  | 0.205                          | 0.238                             |
|          | WLAN5.2GHz/802.11n20  | Bottom Face   | 44  | 4.84             | 5.50                | 1.164                  | 0.844                          | 1.016                             |
| 15#      | WLAN5.2GHz/802.11n20  | Bottom Face   | 48  | 4.63             | 5.00                | 1.089                  | 1.080                          | 1.216                             |
| 16#      | WLAN5.3GHz/802.11ac20 | Bottom Face   | 52  | 4.32             | 4.50                | 1.042                  | 1.100                          | 1.184                             |
|          | WLAN5.3GHz/802.11ac20 | Edge 1        | 52  | 4.32             | 4.50                | 1.042                  | 0.043                          | 0.046                             |
|          | WLAN5.3GHz/802.11ac20 | Edge 4        | 52  | 4.32             | 4.50                | 1.042                  | 0.217                          | 0.233                             |
|          | WLAN5.3GHz/802.11ac20 | Bottom Face   | 60  | 3.92             | 4.50                | 1.143                  | 0.971                          | 1.146                             |
|          | WLAN5.3GHz/802.11ac20 | Bottom Face   | 64  | 3.26             | 3.50                | 1.057                  | 0.973                          | 1.062                             |
|          | WLAN5.5GHz/802.11ac80 | Bottom Face   | 138 | 2.81             | 3.50                | 1.172                  | 0.638                          | 0.850                             |
|          | WLAN5.5GHz/802.11ac80 | Edge 1        | 138 | 2.81             | 3.50                | 1.172                  | 0.185                          | 0.247                             |
|          | WLAN5.5GHz/802.11ac80 | Edge 4        | 138 | 2.81             | 3.50                | 1.172                  | 0.191                          | 0.255                             |
| 17#      | WLAN5.5GHz/802.11ac80 | Bottom Face   | 106 | 2.67             | 3.00                | 1.079                  | 0.745                          | 0.913                             |



|     |                       |             |     |      |      |       |       |       |
|-----|-----------------------|-------------|-----|------|------|-------|-------|-------|
|     | WLAN5.5GHz/802.11ac80 | Bottom Face | 122 | 2.61 | 3.00 | 1.094 | 0.711 | 0.884 |
|     |                       |             |     |      |      |       |       |       |
|     | WLAN5.8GHz/802.11a    | Bottom Face | 165 | 6.46 | 7.00 | 1.132 | 0.900 | 1.052 |
|     | WLAN5.8GHz/802.11a    | Edge 1      | 165 | 6.46 | 7.00 | 1.132 | 0.204 | 0.239 |
|     | WLAN5.8GHz/802.11a    | Edge 4      | 165 | 6.46 | 7.00 | 1.132 | 0.173 | 0.203 |
|     | WLAN5.8GHz/802.11a    | Bottom Face | 149 | 5.89 | 6.50 | 1.151 | 0.923 | 1.096 |
| 18# | WLAN5.8GHz/802.11a    | Bottom Face | 157 | 5.93 | 6.50 | 1.140 | 0.966 | 1.137 |
|     |                       |             |     |      |      |       |       |       |
| 19# | Bluetooth/DH5         | Bottom Face | 0   | 8.11 | 8.50 | 1.094 | 0.063 | 0.075 |
|     | Bluetooth/DH5         | Edge 1      | 0   | 8.11 | 8.50 | 1.094 | 0.023 | 0.027 |
|     | Bluetooth/DH5         | Edge 4      | 0   | 8.11 | 8.50 | 1.094 | 0.038 | 0.045 |

**Note:**

1. Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR  $\leq 0.8\text{W/kg}$ , other channels SAR testing is not necessary.
2. Additional WLAN SAR testing was performed for simultaneous transmission analysis.
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is  $\geq 0.8\text{W/kg}$ .
4. Per KDB248227 D01v02r02, OFDM SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2\text{ W/kg}$ .
5. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.
6. The WLAN Reported 1g SAR (W/kg) should be scaled with the duty cycle scaling factor 1.004 for WLAN 2.4GHz 802.11b, 1.034 for WLAN 5.2G 802.11n20, 1.033 for WLAN 5.3GHz 802.11ac20, 1.036 for WLAN 5.5GHz 802.11ac80 and 1.032 for WLAN 5.8GHz 802.11a.
7. According to 2016 Oct. TCB workshop for Bluetooth SAR consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation. The duty cycle of Bluetooth is 77.07%, therefore the duty cycle scaling factor 1.081 should be used to calculating the reported SAR.

## 14.3 Repeated SAR Assessment

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1. Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg;
2. When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
3. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg ( $\sim 10\%$  from the 1-g SAR limit).
4. Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

### ➤ Repeated SAR

| Plot No.        | Band/Mode             | Test Position | CH.   | Ave. Power (dBm) | Tune-up Limit (dBm) | Tune-up Scaling Factor | Meas. SAR <sub>1g</sub> (W/kg) | Reported SAR <sub>1g</sub> (W/kg) |
|-----------------|-----------------------|---------------|-------|------------------|---------------------|------------------------|--------------------------------|-----------------------------------|
| OR.             | Band II/RMC 12.2Kbps  | Bottom Face   | 9538  | 15.78            | 16.50               | 1.180                  | 0.882                          | 1.041                             |
| 1 <sup>st</sup> | Band II/RMC 12.2Kbps  | Bottom Face   | 9538  | 15.78            | 16.50               | 1.180                  | 0.857                          | 1.012                             |
| OR.             | LTE Band 2/1RB#0 20M  | Bottom Face   | 19100 | 15.51            | 16.50               | 1.256                  | 0.942                          | 1.183                             |
| 1 <sup>st</sup> | LTE Band 2/1RB#0 20M  | Bottom Face   | 19100 | 15.51            | 16.50               | 1.256                  | 0.936                          | 1.176                             |
| OR.             | LTE Band 7/1RB#0 20M  | Bottom Face   | 21350 | 12.93            | 13.50               | 1.140                  | 1.020                          | 1.163                             |
| 1 <sup>st</sup> | LTE Band 7/1RB#0 20M  | Bottom Face   | 21350 | 12.93            | 13.50               | 1.140                  | 1.000                          | 1.140                             |
| OR.             | LTE Band 12/1RB#0 10M | Bottom Face   | 23130 | 23.10            | 24.00               | 1.230                  | 0.871                          | 1.072                             |
| 1 <sup>st</sup> | LTE Band 12/1RB#0 10M | Bottom Face   | 23130 | 23.10            | 24.00               | 1.230                  | 0.855                          | 1.052                             |
| OR.             | LTE Band 13/1RB#0 10M | Bottom Face   | 23230 | 21.58            | 22.50               | 1.236                  | 0.926                          | 1.144                             |
| 1 <sup>st</sup> | LTE Band 13/1RB#0 10M | Bottom Face   | 23230 | 21.58            | 22.50               | 1.236                  | 0.900                          | 1.112                             |
| OR.             | WLAN5.2GHz/802.11n20  | Bottom Face   | 48    | 4.63             | 5.00                | 1.089                  | 1.080                          | 1.216                             |



|                 |                       |             |     |      |      |       |       |       |
|-----------------|-----------------------|-------------|-----|------|------|-------|-------|-------|
| 1 <sup>st</sup> | WLAN5.2GHz/802.11n20  | Bottom Face | 48  | 4.63 | 5.00 | 1.089 | 1.000 | 1.126 |
|                 |                       |             |     |      |      |       |       |       |
| OR.             | WLAN5.3GHz/802.11ac20 | Bottom Face | 52  | 4.32 | 4.50 | 1.042 | 1.100 | 1.184 |
| 1 <sup>st</sup> | WLAN5.3GHz/802.11ac20 | Bottom Face | 52  | 4.32 | 4.50 | 1.042 | 1.020 | 1.098 |
|                 |                       |             |     |      |      |       |       |       |
| OR.             | WLAN5.8GHz/802.11a    | Bottom Face | 157 | 5.93 | 6.50 | 1.140 | 0.966 | 1.137 |
| 1 <sup>st</sup> | WLAN5.8GHz/802.11a    | Bottom Face | 157 | 5.93 | 6.50 | 1.140 | 0.929 | 1.093 |



## 15 Simultaneous Transmission Analysis

### 15.1 Simultaneous Transmission Consideration

| No. | Simultaneous Transmission Consideration | Exposure Position |
|-----|-----------------------------------------|-------------------|
|     |                                         | Body              |
| 1   | WWAN + WLAN 2.4GHz/5GHz                 | Yes               |
| 2   | WWAN + Bluetooth                        | Yes               |

**Note:**

1. Simultaneous Transmission SAR evaluation is not required for BT and WLAN, because the software mechanism have been incorporated to guarantee that the WLAN and Bluetooth transmitters would not simultaneously operate at the same time.
2. Per KDB 447498D01v06, simultaneous transmission SAR evaluation procedures is as followed:

Step 1: If sum of 1 g SAR <1.6 W/kg, Simultaneous SAR measurement is not required.

Step 2: If sum of 1 g SAR >1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

Step 3: If the ratio of SAR to peak separation distance is  $\leq 0.04$ , Simultaneous SAR measurement is not required.

Step 4: If the ratio of SAR to peak separation distance is  $> 0.04$ , Simultaneous SAR measurement is required and simultaneous transmission SAR value is calculated.

(The ratio is determined by:  $(SAR_1 + SAR_2) \wedge 1.5/R_i \leq 0.04$ ,

$R_i$  is the separation distance between the peak SAR locations for the antenna pair in mm.



## 15.2 Simultaneous Transmission Analysis

### ➤ Body Simultaneous Transmission for WWAN + WLAN 2.4GHz/5GHz

| WWAN Band     | Exposure Position  | 1             | 2             | 3             | 1+2 Summed 1g SAR (W/kg) | 1+3 Summed 1g SAR (W/kg) |
|---------------|--------------------|---------------|---------------|---------------|--------------------------|--------------------------|
|               |                    | WWAN          | 2.4GHz WLAN   | 5GHz WLAN     |                          |                          |
|               |                    | 1g SAR (W/kg) | 1g SAR (W/kg) | 1g SAR (W/kg) |                          |                          |
| GSM 850       | Bottom Face at 0mm | 1.034         | 0.606         | 1.216         | 1.640                    | 2.250                    |
|               | Edge 1 at 0mm      | 0.574         | 0.172         | 0.247         | 0.746                    | 0.821                    |
|               | Edge 2 at 0mm      | 0.226         | /             | /             | 0.226                    | 0.226                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| GSM 1900      | Bottom Face at 0mm | 0.636         | 0.606         | 1.216         | 1.242                    | 1.852                    |
|               | Edge 1 at 0mm      | 0.320         | 0.172         | 0.247         | 0.492                    | 0.567                    |
|               | Edge 2 at 0mm      | 0.083         | /             | /             | 0.083                    | 0.083                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| WCDMA Band II | Bottom Face at 0mm | 1.041         | 0.606         | 1.216         | 1.647                    | 2.257                    |
|               | Edge 1 at 0mm      | 0.476         | 0.172         | 0.247         | 0.648                    | 0.723                    |
|               | Edge 2 at 0mm      | 0.135         | /             | /             | 0.135                    | 0.135                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| WCDMA Band V  | Bottom Face at 0mm | 0.924         | 0.606         | 1.216         | 1.530                    | 2.140                    |
|               | Edge 1 at 0mm      | 0.282         | 0.172         | 0.247         | 0.454                    | 0.529                    |
|               | Edge 2 at 0mm      | 0.108         | /             | /             | 0.108                    | 0.108                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| CDMA2000 BC0  | Bottom Face at 0mm | 0.340         | 0.606         | 1.216         | 0.946                    | 1.556                    |
|               | Edge 1 at 0mm      | 0.040         | 0.172         | 0.247         | 0.212                    | 0.287                    |
|               | Edge 2 at 0mm      | 0.121         | /             | /             | 0.121                    | 0.121                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| LTE Band 2    | Bottom Face at 0mm | 1.183         | 0.606         | 1.216         | 1.789                    | 2.399                    |
|               | Edge 1 at 0mm      | 0.423         | 0.172         | 0.247         | 0.595                    | 0.670                    |
|               | Edge 2 at 0mm      | 0.145         | /             | /             | 0.145                    | 0.145                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| LTE Band 4    | Bottom Face at 0mm | 0.909         | 0.606         | 1.216         | 1.515                    | 2.125                    |
|               | Edge 1 at 0mm      | 0.891         | 0.172         | 0.247         | 1.063                    | 1.138                    |
|               | Edge 2 at 0mm      | 0.233         | /             | /             | 0.233                    | 0.233                    |
|               | Edge 4 at 0mm      | /             | 0.568         | 0.255         | 0.568                    | 0.255                    |
| LTE Band 5    | Bottom Face at 0mm | 0.664         | 0.606         | 1.216         | 1.270                    | 1.880                    |
|               | Edge 1 at 0mm      | 0.222         | 0.172         | 0.247         | 0.394                    | 0.469                    |



|                |                    |       |       |       |       |       |
|----------------|--------------------|-------|-------|-------|-------|-------|
|                | Edge 2 at 0mm      | 0.105 | /     | /     | 0.105 | 0.105 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |
| LTE Band 7     | Bottom Face at 0mm | 1.163 | 0.606 | 1.216 | 1.769 | 2.379 |
|                | Edge 1 at 0mm      | 0.314 | 0.172 | 0.247 | 0.486 | 0.561 |
|                | Edge 2 at 0mm      | 0.068 | /     | /     | 0.068 | 0.068 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |
| LTE Band 12/17 | Bottom Face at 0mm | 1.072 | 0.606 | 1.216 | 1.678 | 2.288 |
|                | Edge 1 at 0mm      | 0.136 | 0.172 | 0.247 | 0.308 | 0.383 |
|                | Edge 2 at 0mm      | 0.130 | /     | /     | 0.130 | 0.130 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |
| LTE Band 13    | Bottom Face at 0mm | 1.144 | 0.606 | 1.216 | 1.750 | 2.360 |
|                | Edge 1 at 0mm      | 0.351 | 0.172 | 0.247 | 0.523 | 0.598 |
|                | Edge 2 at 0mm      | 0.709 | /     | /     | 0.709 | 0.709 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |
| LTE Band 40    | Bottom Face at 0mm | 0.582 | 0.606 | 1.216 | 1.188 | 1.798 |
|                | Edge 1 at 0mm      | 0.233 | 0.172 | 0.247 | 0.405 | 0.480 |
|                | Edge 2 at 0mm      | 0.049 | /     | /     | 0.049 | 0.049 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |
| LTE Band 41    | Bottom Face at 0mm | 0.649 | 0.606 | 1.216 | 1.255 | 1.865 |
|                | Edge 1 at 0mm      | 0.423 | 0.172 | 0.247 | 0.595 | 0.670 |
|                | Edge 2 at 0mm      | 0.074 | /     | /     | 0.074 | 0.074 |
|                | Edge 4 at 0mm      | /     | 0.568 | 0.255 | 0.568 | 0.255 |

➤ **Body Simultaneous Transmission for WWAN + Bluetooth**

| WWAN Band     | Exposure Position  | 1             | 2             | 1+2<br>Summed<br>1g SAR (W/kg) |
|---------------|--------------------|---------------|---------------|--------------------------------|
|               |                    | WWAN          | Bluetooth     |                                |
|               |                    | 1g SAR (W/kg) | 1g SAR (W/kg) |                                |
| GSM 850       | Bottom Face at 0mm | 1.034         | 0.075         | 1.109                          |
|               | Edge 1 at 0mm      | 0.574         | 0.027         | 0.601                          |
|               | Edge 2 at 0mm      | 0.226         | /             | 0.226                          |
|               | Edge 4 at 0mm      | /             | 0.045         | 0.045                          |
| GSM 1900      | Bottom Face at 0mm | 0.636         | 0.075         | 0.711                          |
|               | Edge 1 at 0mm      | 0.320         | 0.027         | 0.347                          |
|               | Edge 2 at 0mm      | 0.083         | /             | 0.083                          |
|               | Edge 4 at 0mm      | /             | 0.045         | 0.045                          |
| WCDMA Band II | Bottom Face at 0mm | 1.041         | 0.075         | 1.116                          |
|               | Edge 1 at 0mm      | 0.476         | 0.027         | 0.503                          |



|                   |                    |       |       |       |
|-------------------|--------------------|-------|-------|-------|
|                   | Edge 2 at 0mm      | 0.135 | /     | 0.135 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| WCDMA<br>Band V   | Bottom Face at 0mm | 0.924 | 0.075 | 0.999 |
|                   | Edge 1 at 0mm      | 0.282 | 0.027 | 0.309 |
|                   | Edge 2 at 0mm      | 0.108 | /     | 0.108 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| CDMA2000<br>BC0   | Bottom Face at 0mm | 0.340 | 0.075 | 0.415 |
|                   | Edge 1 at 0mm      | 0.040 | 0.027 | 0.067 |
|                   | Edge 2 at 0mm      | 0.121 | /     | 0.121 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band 2        | Bottom Face at 0mm | 1.183 | 0.075 | 1.258 |
|                   | Edge 1 at 0mm      | 0.423 | 0.027 | 0.450 |
|                   | Edge 2 at 0mm      | 0.145 | /     | 0.145 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band 4        | Bottom Face at 0mm | 0.909 | 0.075 | 0.984 |
|                   | Edge 1 at 0mm      | 0.891 | 0.027 | 0.918 |
|                   | Edge 2 at 0mm      | 0.233 | /     | 0.233 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band 5        | Bottom Face at 0mm | 0.664 | 0.075 | 0.739 |
|                   | Edge 1 at 0mm      | 0.222 | 0.027 | 0.249 |
|                   | Edge 2 at 0mm      | 0.105 | /     | 0.105 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band 7        | Bottom Face at 0mm | 1.163 | 0.075 | 1.238 |
|                   | Edge 1 at 0mm      | 0.314 | 0.027 | 0.341 |
|                   | Edge 2 at 0mm      | 0.068 | /     | 0.068 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band<br>12/17 | Bottom Face at 0mm | 1.072 | 0.075 | 1.147 |
|                   | Edge 1 at 0mm      | 0.136 | 0.027 | 0.163 |
|                   | Edge 2 at 0mm      | 0.130 | /     | 0.130 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band<br>13    | Bottom Face at 0mm | 1.144 | 0.075 | 1.219 |
|                   | Edge 1 at 0mm      | 0.351 | 0.027 | 0.378 |
|                   | Edge 2 at 0mm      | 0.709 | /     | 0.709 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |
| LTE Band<br>40    | Bottom Face at 0mm | 0.582 | 0.075 | 0.657 |
|                   | Edge 1 at 0mm      | 0.233 | 0.027 | 0.260 |
|                   | Edge 2 at 0mm      | 0.049 | /     | 0.049 |
|                   | Edge 4 at 0mm      | /     | 0.045 | 0.045 |

|                |                    |       |       |       |
|----------------|--------------------|-------|-------|-------|
| LTE Band<br>41 | Bottom Face at 0mm | 0.649 | 0.075 | 0.724 |
|                | Edge 1 at 0mm      | 0.423 | 0.027 | 0.450 |
|                | Edge 2 at 0mm      | 0.074 | /     | 0.074 |
|                | Edge 4 at 0mm      | /     | 0.045 | 0.045 |

## 15.3 SPLSR Assessment and Analysis

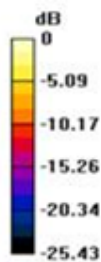
### ➤ General Guidance

- Per KDB 447498, When standalone SAR is measured, the peak location is determined by the x, y, z coordinates of the extrapolated and interpolated results reported by the zoom scan measurement, or area scan measurement when area scan based 1-g SAR estimation is applicable.
- When standalone SAR is measured for both antennas in the pair, the peak location separation distance is computed by 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 in the area scans or extrapolated peak SAR locations in the zoom scans, as appropriate.

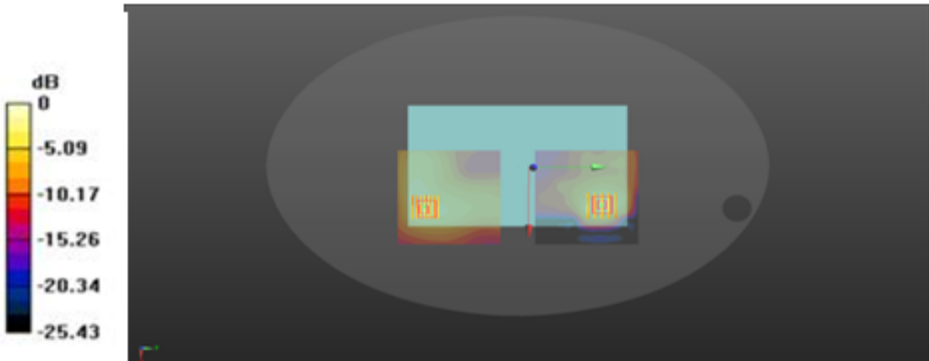
The ratio is determined by  $(SAR_1 + SAR_2)1.5/R_i$ , rounded to two decimal digits, and must be  $\leq 0.04$  for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

### ➤ Results of SPLSR Analysis

| Band       | Position       | SAR<br>(W/kg) | SAR peak location (cm) |        |        | 3D<br>distance<br>(mm) | Summed<br>SAR(W/kg) | SPLSR<br>Results | Simultaneous<br>SAR |
|------------|----------------|---------------|------------------------|--------|--------|------------------------|---------------------|------------------|---------------------|
|            |                |               | X                      | Y      | Z      |                        |                     |                  |                     |
| LTE Band 2 | Bottom<br>Face | 1.183         | 0.0505                 | 0.0965 | -0.175 | 205.5                  | 2.40                | 0.02             | Not required        |
| 5G WLAN    |                | 1.216         | 0.05                   | -0.109 | -0.175 |                        |                     |                  |                     |



| Band       | Position | SAR<br>(W/kg) | SAR peak location (cm) |        |        | 3D<br>distance<br>(mm) | Summed<br>SAR(W/kg) | SPLSR<br>Results | Simultaneous<br>SAR |
|------------|----------|---------------|------------------------|--------|--------|------------------------|---------------------|------------------|---------------------|
|            |          |               | X                      | Y      | Z      |                        |                     |                  |                     |
| LTE Band 2 | Bottom   | 1.183         | 0.0505                 | 0.0965 | -0.175 | 106.7                  | 1.79                | 0.02             | Not required        |
| 2.4G WLAN  | Face     | 0.606         | -0.0495                | 0.122  | -0.148 |                        |                     |                  |                     |



**Note:** This report only records SPLSR analysis for the worst-case WWAN+WLAN 2.4GHz/5GHz simultaneous transmission combination.

## 16 Measurement Uncertainty

According to KDB 865664 D01 SAR measurement 100 MHz to 6GHz, when the highest measured 1-g SAR is less than 1.5 W/kg and 10-g extremity SAR less than 3.75 W/kg, the expanded SAR measurement uncertainty must be less than 30% with a confidence interval of  $k=2$ . When these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE 1528-2013 is not required in the SAR report and submitted for equipment approval. For this device, both the 1-g SAR is less than 1.5 W/kg, therefore the measurement uncertainty table is not required in this report.

## 17 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested. Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.



## Annex A General Information

### 1. Identification of the Responsible Testing Laboratory

|                     |                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Laboratory Name:    | Shenzhen Morlab Communications Technology Co., Ltd.                                                                                      |
| Laboratory Address: | FL.1-3, Building A, FeiYang Science Park, No.8<br>LongChang Road, Block 67, BaoAn District, ShenZhen,<br>GuangDong Province, P. R. China |
| Telephone:          | +86 755 36698555                                                                                                                         |
| Facsimile:          | +86 755 36698525                                                                                                                         |

### 2. Identification of the Responsible Testing Location

|          |                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------|
| Name:    | Shenzhen Morlab Communications Technology Co., Ltd.                                                                                      |
| Address: | FL.1-3, Building A, FeiYang Science Park, No.8<br>LongChang Road, Block 67, BaoAn District, ShenZhen,<br>GuangDong Province, P. R. China |

### 3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

#### Note:

The main report is end here and the other Annex (B,C,D,E,F,G) will be submitted separately.

\*\*\*\*\* END OF MAIN REPORT \*\*\*\*\*