



# TEST REPORT

**APPLICANT** : BLU Products, Inc.  
**PRODUCT NAME** : Tablet  
**MODEL NAME** : M8L  
**BRAND NAME** : BLU  
**FCC ID** : YHLBLUM8L  
**STANDARD(S)** : FCC 47CFR Part 2(2.1093)  
IEEE 1528-2013  
**RECEIPT DATE** : 2021-06-02  
**TEST DATE** : 2021-06-24 to 2021-07-22  
**ISSUE DATE** : 2021-08-02



Edited by:

*Liang Yumei*

Liang Yumei (Rapporteur)

Approved by:

*Shen Junsheng*

Shen Junsheng (Supervisor)

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Change History		
Version	Date	Reason for Change
1.0	2021-08-02	First edition



# 1 SAR Results Summary

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

Frequency Band		Highest SAR Summary
		Body 1g SAR (W/kg)
GSM	GSM 850	0.293
	GSM 1900	0.796
WCDMA	Band II	0.692
	Band IV	0.535
	Band V	0.151
LTE	Band 2	1.165
	Band 4	0.641
	Band 5	0.195
	Band 7	0.844
	Band 12/17	0.100
	Band 66	1.049
WLAN	2.4GHz WLAN	0.136
2.4GHz Band	Bluetooth (Estimated)	0.025

Max Scaled SAR <sub>1g</sub> (W/Kg):	Body:	1.165 W/kg	Limit(W/kg): 1.6 W/kg
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Highest Simultaneous Transmission 1g SAR (W/kg)	1.165 W/kg	Limit(W/kg): 1.6 W/kg
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**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 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
2. The FDD-LTE Band 17 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% risk level.



## 2 Technical Information

**Note:** Provide by applicant.

### 2.1 Applicant and Manufacturer Information

<b>Applicant:</b>	BLU Products, Inc.
<b>Applicant Address:</b>	10814 NW 33rd St # 100 Doral, FL 33172,USA
<b>Manufacturer:</b>	BLU Products, Inc.
<b>Manufacturer Address:</b>	10814 NW 33rd St # 100 Doral, FL 33172,USA

### 2.2 Equipment under Test (EUT) Description

<b>Product Name:</b>	Tablet
<b>IMEI:</b>	869181029977228/01 869181029977236/01
<b>Hardware Version:</b>	AD153-V0.2B
<b>Software Version:</b>	BLU_M0171WW_V11.0.G.03.01_GENERIC_21-07-2021_1534
<b>Operation Frequency:</b>	GSM 850: 824 MHz ~ 849 MHz GSM 1900: 1850 MHz ~ 1910 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 17: 703 MHz ~ 716 MHz LTE Band 66: 1710 MHz ~ 1780 MHz WLAN 2.4GHz: 2412 MHz ~ 2472 MHz Bluetooth: 2402 MHz ~ 2480 MHz
<b>Modulation technology:</b>	GSM/GPRS: GMSK EDGE: 8PSK WCDMA: QPSK, 16QAM LTE: QPSK, 16QAM, 64QAM



	802.11b: DSSS 802.11g/n-HT20: OFDM Bluetooth BR+EDR: GFSK, $\pi/4$ -DQPSK, 8-DPSK Bluetooth LE: GFSK
<b>Antenna Type:</b>	PIFA Antenna
<b>SIM Cards Description:</b>	GSM+WCDMA+LTE
	Single SIM card



## 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 WCDMA Band II/IV/V FDD-LTE Band 2/4/5/7/12/17/66 WLAN2.4GHz
<b>Power Level:</b>	GSM 850 MHz (Maximum output power(level 5)) GSM 1900MHz (Maximum output power(level 0)) WCDMA Band II/IV/V (All Up Bits) FDD-LTE Band 2/4/5/7/12/17/66 (Maximum output power) WLAN 2.4GHz
<b>Operation Mode:</b>	Call established

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 Introduction

### 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.

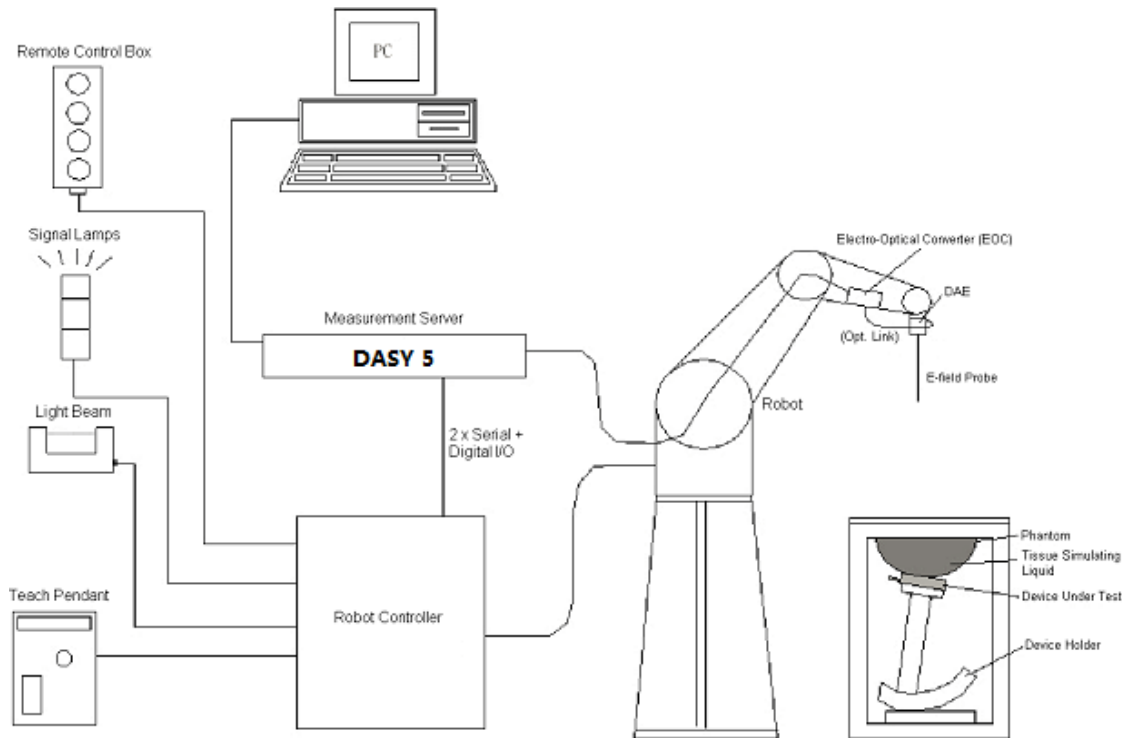


## 5 Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method Determination /Remark
FCC 47CFR 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 D06v02r01	SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities	No deviation
<p><b>Note 1:</b> The test item is not applicable.</p> <p><b>Note 2:</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.</p>		

## 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 Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	 <p style="text-align: center;"><b>Fig 6.2 Photo of EX3DV4</b></p>
<b>Frequency</b>	10 MHz to 6 GHz; Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g; Linearity: $\pm 0.2$ dB	
<b>Dimensions</b>	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

- **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.

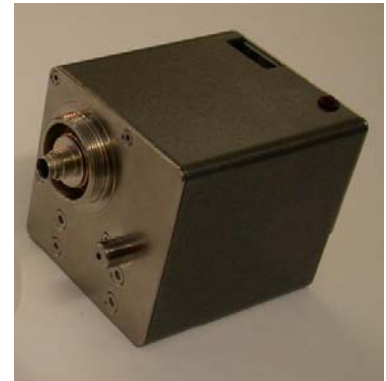


Fig 6.2 Photo of DAE

## 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 DASY5

## 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%) Center ear point: 6 ± 0.2 mm
<b>Filling Volume Dimensions</b>	Approx. 25 liters Length: 1000 mm; Width: 500 mm; Height: adjustable feet
<b>Measurement Areas</b>	Left Head, Right Head, Flat phantom

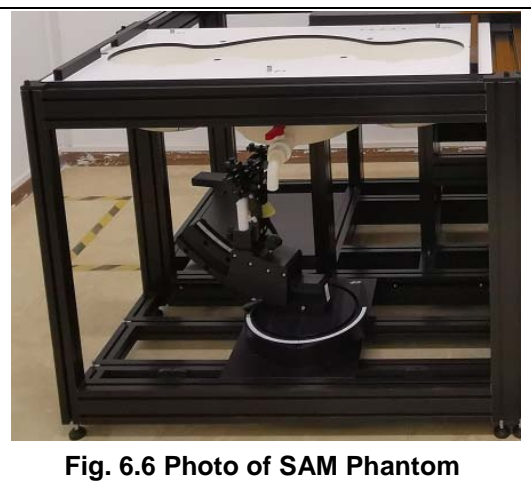


Fig. 6.6 Photo of SAM Phantom

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

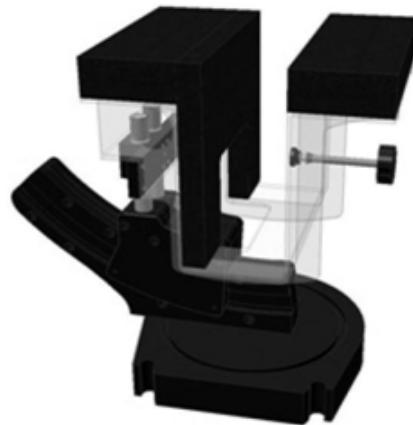


Fig 6.8 Laptop Extension Kit





## 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 Num.	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1173	2021.06.21	2023.06.20
SPEAG	900MHz System Validation Kit	D900V2	1d064	2018.10.29	2021.10.28
SPEAG	1800MHz System Validation Kit	D1800V2	2d158	2018.10.31	2021.10.30
SPEAG	2000MHz System Validation Kit	D2000V2	1050	2018.10.31	2021.10.30
SPEAG	2450MHz System Validation Kit	D2450V2	805	2018.10.26	2021.10.25
SPEAG	2600MHz System Validation Kit	D2600V2	1139	2021.06.25	2023.06.24
SPEAG	DOSIMETRIC ASSESSMENT SYSTEM	DASY52	52.10.4.1527	NCR	NCR
SPEAG	Dosimetric E-Field Probe	EX3DV4	3823	2021.01.22	2022.01.21
SPEAG	Dosimetric E-Field Probe	EX3DV4	7608	2020.11.27	2021.11.26
SPEAG	Data Acquisition Electronics	DAE4	540	2020.12.11	2021.12.10
SPEAG	Data Acquisition Electronics	DAE4	480	2021.06.22	2022.06.21
SPEAG	Dielectric Assessment KIT	DAK-3.5	1279	2020.10.20	2021.10.19
SPEAG	SAM Phantom 2	QD 000 P40 CB	TP-1464	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Network Emulator	CMW500	165755	2021.02.25	2022.02.24
Agilent	Network Analyzer	E5071B	MY42404762	2021.03.29	2022.03.28
mini-circuits	Amplifier	ZHL-42W+	608501717	NCR	NCR
Agilent	Signal Generator	N5182B	MY53050509	2021.03.29	2022.03.28
Agilent	Power Sensor	N8482A	MY41090849	2020.10.19	2021.10.18
Agilent	Power Meter	E4416A	MY45102093	2020.10.19	2021.10.18
Anritsu	Power Sensor	MA2411B	N/A	2020.10.19	2021.10.18
Anritsu	Power Meter	NRVD	101066	2020.10.19	2021.10.18
Agilent	Dual Directional Coupler	778D	50422	NA	NA
MCL	Attenuation	351-218-010	N/A	NA	NA
KTJ	Thermo meter	TA298	N/A	2021.01.15	2022.01.14
N/A	Tissue Simulating Liquids	700-6000MHZ	N/A	24H	

**Note:**

1. The calibration certificate of DASY can be referred to Annex F 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 65 supplement 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  $\rho = 1000 \text{ kg/m}^3$ )

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	0.892	0.89	0.22	$\pm 5$	2021.06.29
835	HSL	22.2	0.922	0.90	2.44	$\pm 5$	2021.06.24
1750	HSL	22.2	1.359	1.37	-0.80	$\pm 5$	2021.07.22
1900	HSL	22.2	1.395	1.40	-0.36	$\pm 5$	2021.07.10
2450	HSL	22.2	1.806	1.80	0.33	$\pm 5$	2021.07.15
2600	HSL	22.1	2.012	1.96	2.65	$\pm 5$	2021.07.05



Frequency (MHz)	Tissue Type	Liquid Temp.(°C)	Permittivity ( $\epsilon_r$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
750	HSL	22.1	40.775	41.90	-2.68	±5	2021.06.29
835	HSL	22.2	42.582	41.50	2.61	±5	2021.06.24
1750	HSL	22.2	39.583	40.10	-1.29	±5	2021.07.22
1900	HSL	22.2	39.753	40.00	-0.62	±5	2021.07.10
2450	HSL	22.2	38.914	39.20	-0.73	±5	2021.07.15
2600	HSL	22.1	38.966	39.00	-0.09	±5	2021.07.05

**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

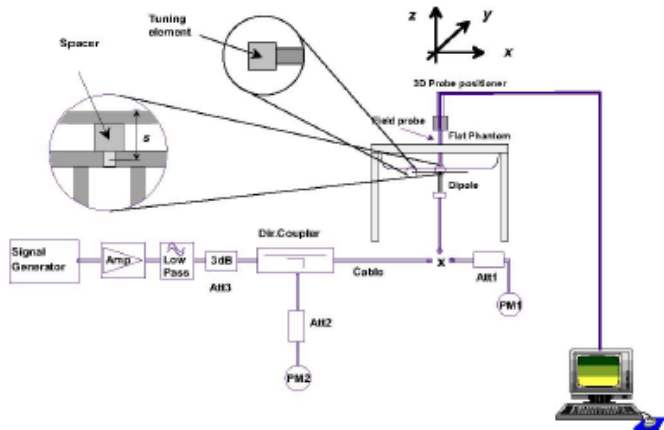


Fig 8.2 System Setup for System Evaluation

➤ **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 S/N	Probe S/N	DAE S/N
D750V3-1173	7608	540
D900V2-1d064	3823	540
D1800V2-2d158	3823	480
D2000V2-1050	3823	480
D2450V2-805	3823	480
D2600V2-1139	3823	480

Frequency (MHz)	Tissue Type	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	CW Signal Validation		
				Sensitivity	Probe Linearity	Probe 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 (MHz)	Tissue Type	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Modulation Signal Validation		
				Mod. Type	Duty 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. (MHz)	Tissue Type	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2021.06.29	750	HSL	250	2.11	8.26	8.44	2.18
2021.06.24	835	HSL	250	2.61	10.90	10.44	-4.22
2021.07.22	1750	HSL	250	9.51	39.30	38.04	-3.21
2021.07.10	1900	HSL	250	10.06	40.90	40.24	-1.61
2021.07.15	2450	HSL	250	12.86	52.00	51.44	-1.08
2021.07.05	2600	HSL	250	13.26	54.00	53.04	-1.78

Date	Freq. (MHz)	Tissue Type	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2021.06.29	750	HSL	250	1.35	5.45	5.4	-0.92
2021.06.24	835	HSL	250	1.68	6.97	6.72	-3.59
2021.07.22	1750	HSL	250	5.11	20.60	20.44	-0.78
2021.07.10	1900	HSL	250	5.08	20.90	20.32	-2.78
2021.07.15	2450	HSL	250	6.11	24.10	24.44	1.41
2021.07.05	2600	HSL	250	6.12	24.50	24.48	-0.08

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

## 9 EUT Testing Position

This EUT was tested in six different positions. They are right cheek/right tilted/left cheek/left tilted for head, Front/Back of the EUT with phantom 15 mm gap, as illustrated below, please refer to Annex B for the test setup photos.

### 9.1 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.

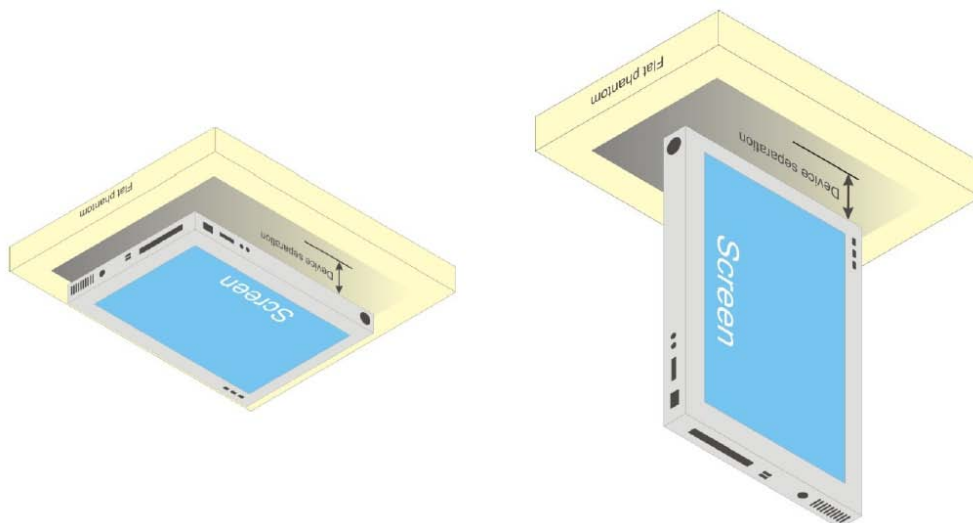
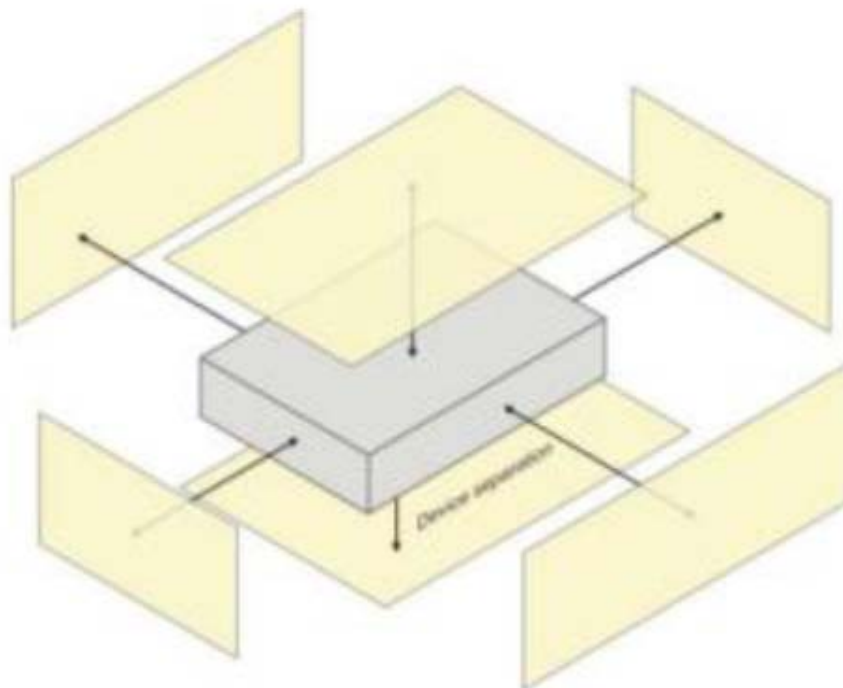


Fig.9.1 Illustration for Body Position

## 9.2 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 ( $L \times W \geq 9 \text{ cm} \times 5 \text{ cm}$ ) 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.9.2 Illustration for Hotspot Position**

## 10 Measurement Procedures

The measurement procedures are as follows:

### <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:	1Up4Down	2Up3Down	3Up2Down	4Up1Down
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	$\beta_c$	$\beta_a$	$\beta_a$ (SF)	$\beta_c/\beta_a$	$\beta_{hs}^{(2)}$	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  $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$   
 Note 2: CM = 1 for  $\beta_c/\beta_a = 12/15, \beta_{hs}/\beta_c = 24/15$ .  
 Note 3: For subtest 2 the  $\beta_c/\beta_a$  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  $\beta_a = 15/15$ .



**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	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	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	$\beta_c$ (Note3)	$\beta_d$	$\beta_{hs}$ (Note1)	$\beta_{ec}$	$\beta_{ed}$ (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	$\beta_{ed1}: 30/15$ $\beta_{ed2}: 30/15$	$\beta_{ed3}: 24/15$ $\beta_{ed4}: 24/15$	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**

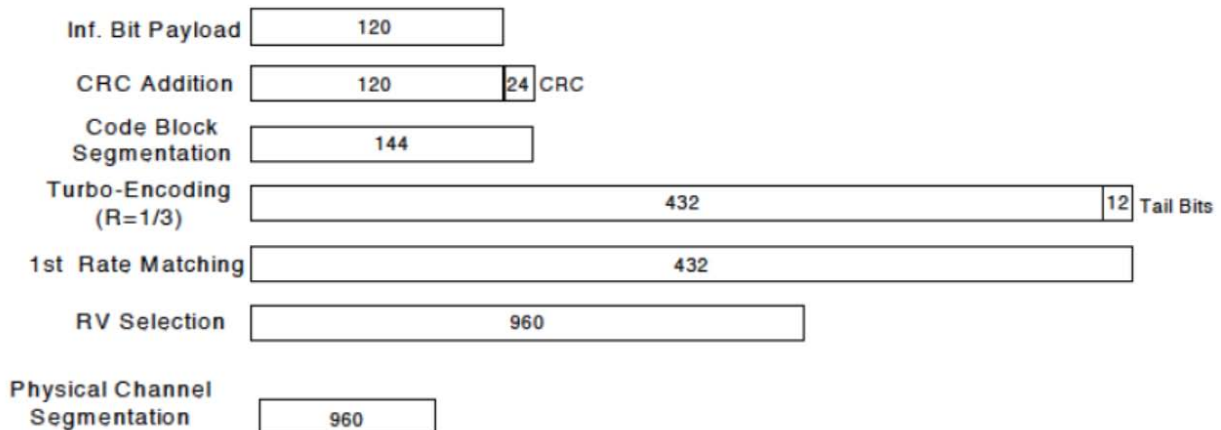
<b>Parameter During Connection setup</b>	<b>Unit</b>	<b>Value</b>
P-CPICH_Ec/Ior	dB	-10
P-CCPCH and SCH_Ec/Ior	dB	-12
PICH_Ec/Ior	dB	-15
HS-PDSCH	dB	off
HS-SCCH_1	dB	off
DPCH_Ec/Ior	dB	-5
OCNS_Ec/Ior	dB	-3.1

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. 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)**





<LTE Mode>

**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	el bandwidth / Transmission bandwidth configuration [RB]						MPR Target (dB)	3GPP
	1.4	3.0	5	10	15	20		
	MHz	MHz						
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	el 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
17	✓	✓	✓	✓	N/A	N/A
66	✓	✓	✓	✓	✓	✓

**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 / 12 SAR test was covered by Band 25 / 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 16QAM signal 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  $\leq 0.8$  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.

# 12 Proximity Sensor Considerations

## 12.1 Proximity Sensor Triggering Distances

### ➤ P-sensor triggering distance Testing

Proximity sensor triggering distances measurement was performed according to the procedures outlined in KDB 616217 D04 section 6.2. The EUT should be moved further away from and toward the flat phantom that fill with the tissue simulating liquid to determine the proximity sensor triggering distances. Conducted power is monitored qualitatively to identify the general triggering characteristics and recorded quantitatively, versus spacing, as required by the procedures.

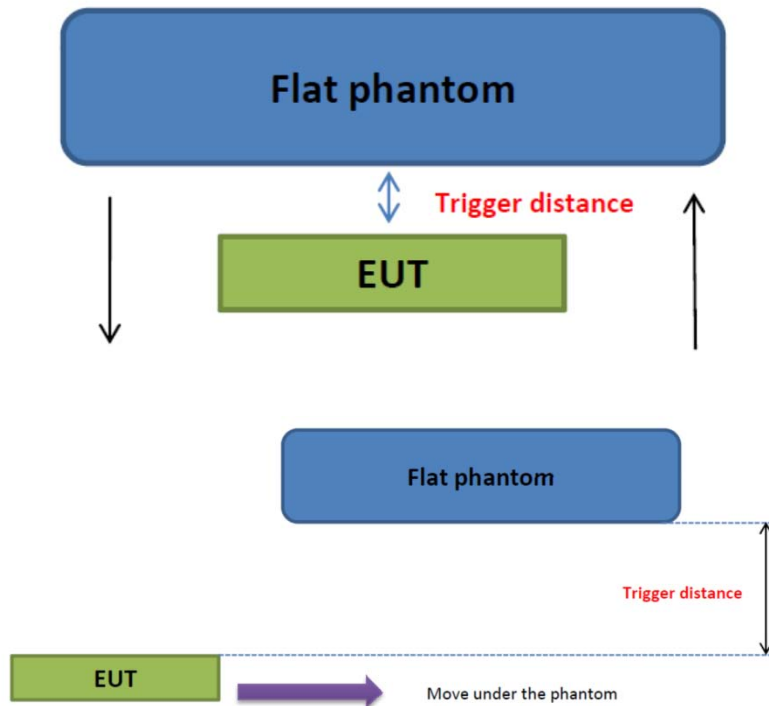


Fig.12.1 Illustration for proximity sensor trigger

### ➤ P-sensor triggering distance

<WWAN>

Proximity Sensor Trigger Distance (mm)		
Exposure Position	Bottom Face	Edge 3
Minimum	18	10

## 12.2 Proximity Sensor Coverage

Proximity sensors are not normally designed to cover the entire back surface or edges of a tablet. The sensing regions are usually limited to areas near the sensor element. If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For P-sensor coverage testing, the device is moved and “along the direction of maximum antenna and sensor offset”. Illustrating in the internal photo exhibit, although the sensor spatially offset, there is no trigger condition where the antenna is next to the user, the sensor is laterally further away, therefore proximity sensor coverage testing is not required.

This procedure is not required since the antenna, sensor and peak SAR location is overlapped with the sensor.

## 12.3 Tablet Tilt Angle Influences to P-Sensor Triggering

### ➤ P-sensor triggering distance Testing

The influence of table tilt angles to proximity sensor triggering is determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at the smallest sensor triggering test distance determined in 6.2 and 6.3 by rotating the tablet around the edge next to the phantom in  $\leq 10$  increments until the tablet is  $45^\circ$  or more from the vertical position at  $0^\circ$ . □

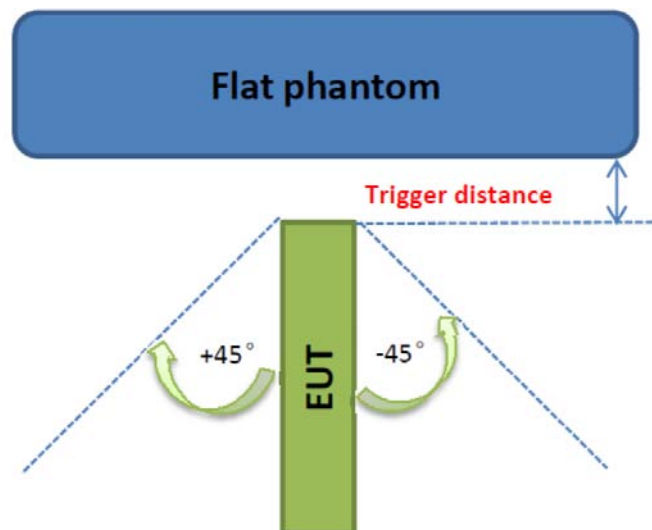


Fig.12.2 Illustration for proximity sensor trigger for tablet tilt angle influences

➤ **P-sensor triggering distance**

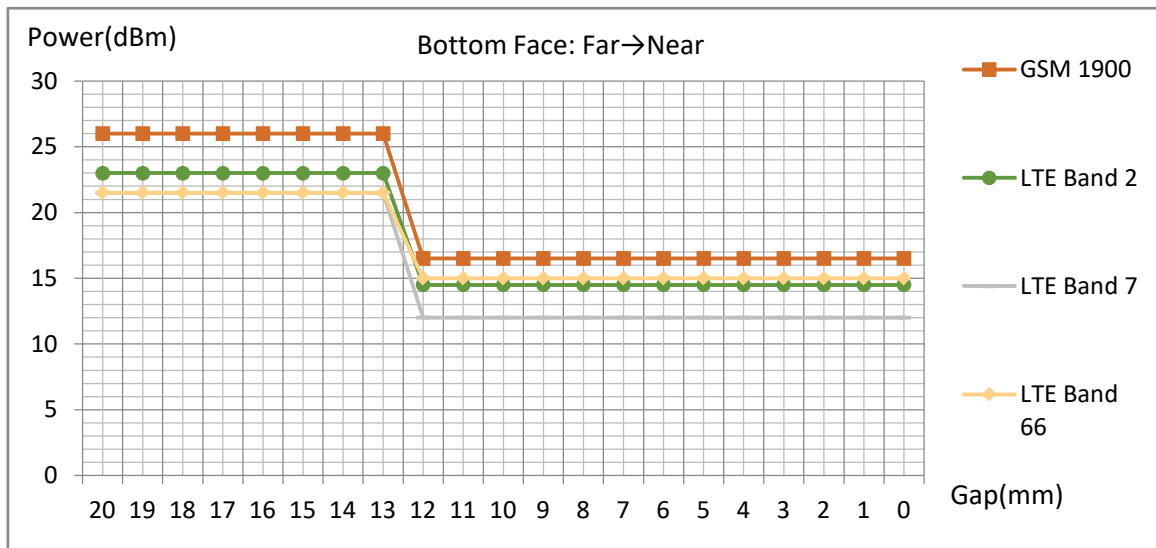
Proximity Sensor Trigger Distance (mm)	
Exposure Position	Curved surface of Edge3
Minimum	10

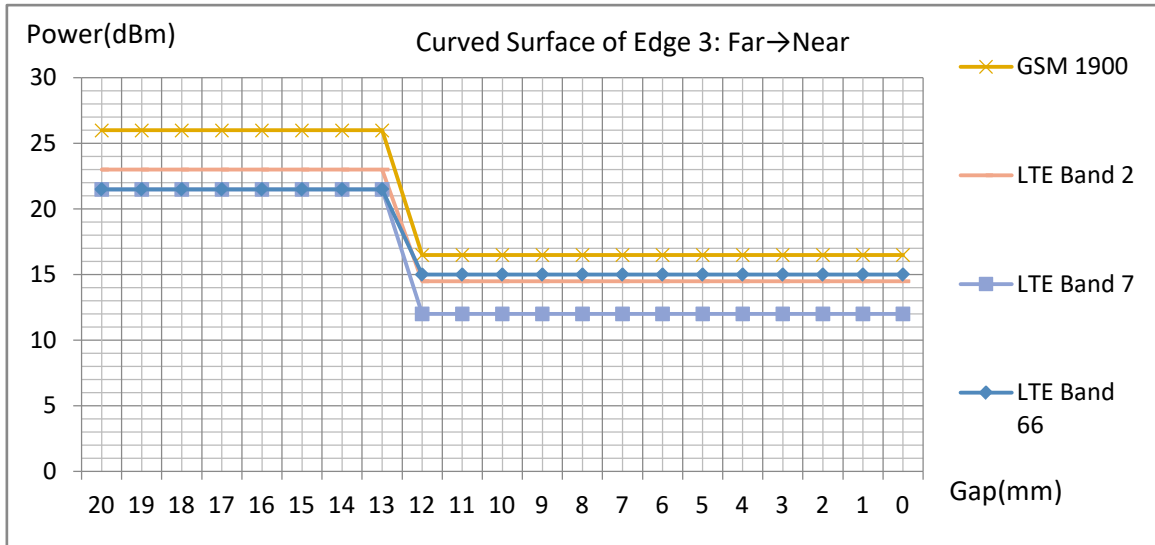
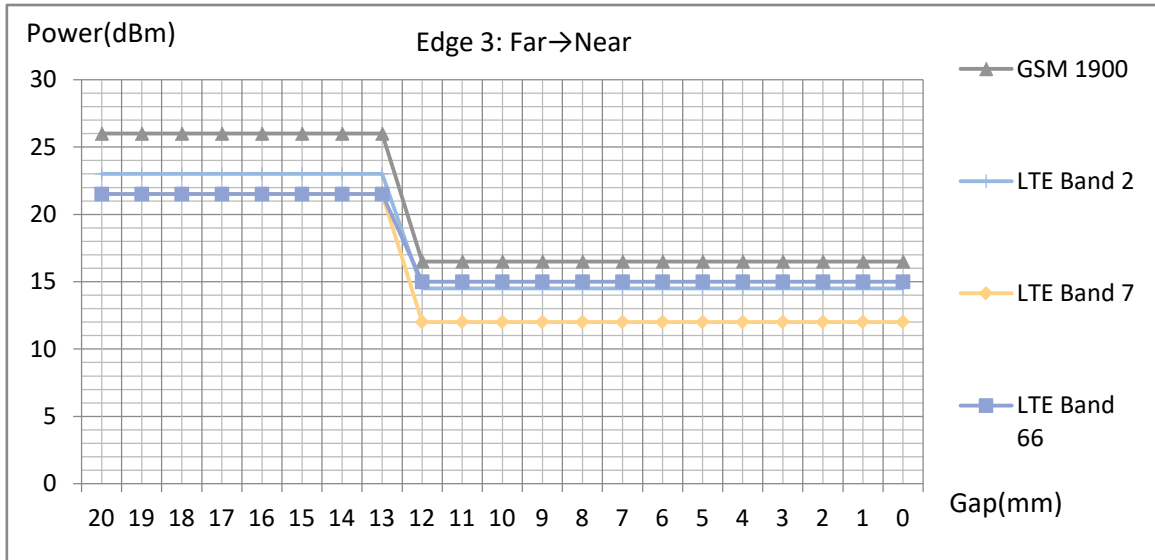
## 12.4 Proximity Sensor Power Reduction

➤ **Power Reduction List**

Wireless band	Bottom Face	Edge 1	Edge 2	Edge 3	Edge 4
GSM 1900	9.5dB	0	0	9.5dB	0
LTE Band 2	8.5dB	0	0	8.5dB	0
LTE Band 7	9.5dB	0	0	9.5dB	0
LTE Band 66	6.5dB	0	0	6.5dB	0

➤ **Graphs of Power Reduction**





### 13 Conducted Output Power

Remark: The output power of GSM/WCDMA/LTE/WLAN/Bluetooth refers to the annex E of this report.

# 14 Exposure Positions Consideration

## 14.1 EUT Antenna Locations

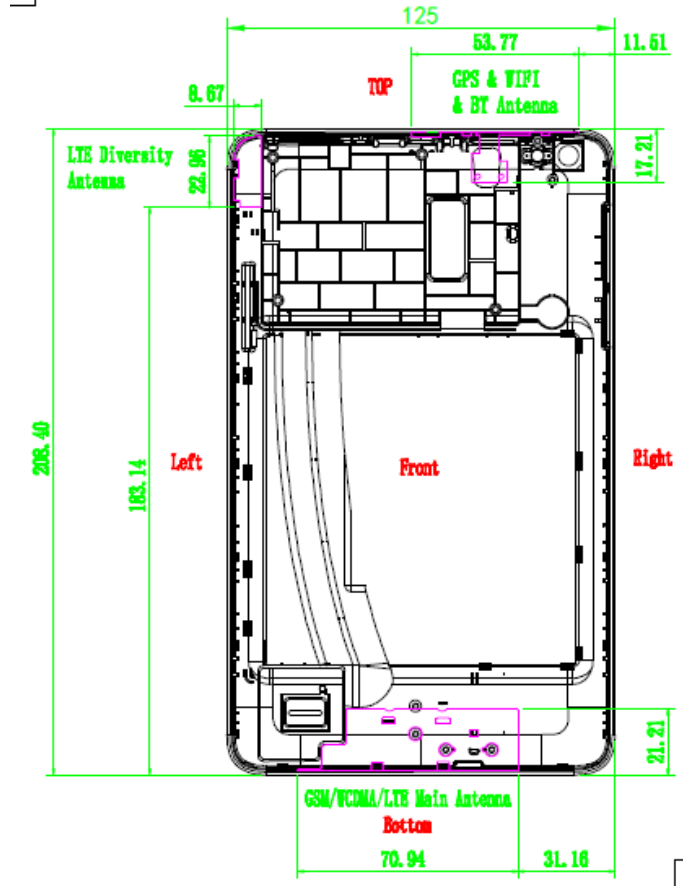


Fig.11.1 EUT Antenna Locations

## 14.2 Test Positions Consideration

Bands	Frequency (MHz)	Maximum Power		Exposure Position/Distance between the antennas and edge/surface of EUT (mm)				
		dBm	mW	Bottom Face	Edge 1	Edge 2	Edge 3	Edge 4
GSM 850	849	31.0	1258.93	0.5	91	13.4	0.3	13.7
GSM 1900	1910	26.0	398.11	0.5	91	13.4	0.3	13.7
WCDMA II	1910	22.0	158.49	0.5	91	13.4	0.3	13.7
WCDMA IV	1755	22.5	177.83	0.5	91	13.4	0.3	13.7
WCDMA V	849	23.0	199.53	0.5	91	13.4	0.3	13.7
LTE Band 2	1910	23.0	199.53	0.5	91	13.4	0.3	13.7



LTE Band 4	1755	24.0	251.19	0.5	91	13.4	0.3	13.7
LTE Band 5	849	24.0	251.19	0.5	91	13.4	0.3	13.7
LTE Band 7	2570	21.5	141.25	0.5	91	13.4	0.3	13.7
LTE Band 12	716	24.0	251.19	0.5	91	13.4	0.3	13.7
LTE Band 17	716	24.0	251.19	0.5	91	13.4	0.3	13.7
LTE Band 66	1780	21.5	141.25	0.5	91	13.4	0.3	13.7
WLAN 2.4G	2472	12.5	17.78	0.5	0.3	11.6	188.9	59.6
Bluetooth	2480	-3.0	0.50	0.5	0.3	11.6	188.9	59.6

Bands	Frequency (MHz)	Exposure Position/Calculated Threshold Value (SAR test exclusion power, mW)				
		Bottom Face	Edge 1	Edge 2	Edge 3	Edge 4
GSM 850	849	231.9	395.0	86.5	231.9	84.6
GSM 1900	1910	110.0	519.0	41.0	110.0	40.1
WCDMA II	1910	43.6	519.0	16.3	43.6	15.9
WCDMA IV	1755	47.1	523.0	17.6	47.1	17.2
WCDMA V	849	36.8	394.0	13.7	36.8	13.4
LTE Band 2	1910	55.3	519.0	20.6	55.3	20.2
LTE Band 4	1755	66.5	523.0	24.8	66.5	24.3
LTE Band 5	849	46.2	395.0	17.3	46.2	16.9
LTE Band 7	2570	45.2	504.0	16.9	45.2	16.5
LTE Band 12	716	69.5	518.0	25.9	69.5	25.4
LTE Band 17	716	69.5	518.0	25.9	69.5	25.4
LTE Band 66	1780	46.2	501.0	17.3	46.2	16.9
WLAN 2.4G	2472	5.7	5.7	2.4	1484.0	192.0
Bluetooth	2480	0.3	0.3	0.1	1484.0	191.0

**Note:**

1. 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.
2. Per KDB 616217 D04v01r02, SAR evaluation for the front surface of tablet display screens is generally not necessary.
3. Per KDB 616217 D04v01r02, additional testing for hotspot SAR is not required.



# 15 SAR Test Results Summary

## 15.1 Test Guidance

1. 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 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. 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.





## 15.2 Body SAR Data

Band/Mode	Test Position	Gap (mm)	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR1g (W/kg)	Reported SAR1g (W/kg)
Sensor off/Full Power								
GPRS850/2TX slots	Bottom Face	0mm	189	30.57	31.00	1.104	0.265	0.293
GPRS850/2TX slots	Edge 1	0mm	189	30.57	31.00	1.104	0.044	0.049
GPRS850/2TX slots	Edge 2	0mm	189	30.57	31.00	1.104	0.118	0.130
GPRS850/2TX slots	Edge 3	0mm	189	30.57	31.00	1.104	0.214	0.236
GPRS850/2TX slots	Edge 4	0mm	189	30.57	31.00	1.104	0.070	0.077
GPRS850/2TX slots	Curved surface of Edge 3	0mm	189	30.57	31.00	1.104	0.156	0.172
Sensor off/Full Power								
GPRS1900/3TX slots	Bottom Face	18mm	661	25.45	26.00	1.135	0.269	0.305
GPRS1900/3TX slots	Edge 2	0mm	661	25.45	26.00	1.135	0.064	0.072
GPRS1900/3TX slots	Edge 3	10mm	661	25.45	26.00	1.135	0.557	0.632
GPRS1900/3TX slots	Edge 4	0mm	661	25.45	26.00	1.135	0.349	0.396
GPRS1900/3TX slots	Curved surface of Edge 3	10mm	661	25.45	26.00	1.135	0.701	0.796
Sensor on/Reduced Power								
GPRS1900/3TX slots	Bottom Face	0mm	661	15.81	16.50	1.172	0.283	0.332
GPRS1900/3TX slots	Edge 3	0mm	661	15.81	16.50	1.172	0.183	0.215
GPRS1900/3TX slots	Curved surface of Edge 3	0mm	661	15.81	16.50	1.172	0.224	0.263
Sensor off/Full Power								
Band II/RMC 12.2Kbps	Bottom Face	0mm	9400	21.32	22.00	1.169	0.592	0.692
Band II/RMC 12.2Kbps	Edge 2	0mm	9400	21.32	22.00	1.169	0.129	0.151
Band II/RMC 12.2Kbps	Edge 3	0mm	9400	21.32	22.00	1.169	0.187	0.219
Band II/RMC 12.2Kbps	Edge 4	0mm	9400	21.32	22.00	1.169	0.093	0.109
Band II/RMC 12.2Kbps	Curved surface of Edge 3	0mm	9400	21.32	22.00	1.169	0.313	0.366
Sensor off/Full Power								
Band IV/RMC 12.2Kbps	Bottom Face	0mm	1413	21.78	22.50	1.180	0.453	0.535
Band IV/RMC 12.2Kbps	Edge 2	0mm	1413	21.78	22.50	1.180	0.038	0.045
Band IV/RMC 12.2Kbps	Edge 3	0mm	1413	21.78	22.50	1.180	0.102	0.120
Band IV/RMC 12.2Kbps	Edge 4	0mm	1413	21.78	22.50	1.180	0.163	0.192
Band IV/RMC 12.2Kbps	Curved surface of Edge 3	0mm	1413	21.78	22.50	1.180	0.171	0.202
Sensor off/Full Power								
Band V/RMC 12.2Kbps	Bottom Face	0mm	4182	22.51	23.00	1.119	0.135	0.151
Band V/RMC 12.2Kbps	Edge 2	0mm	4182	22.51	23.00	1.119	0.134	0.150
Band V/RMC 12.2Kbps	Edge 3	0mm	4182	22.51	23.00	1.119	0.110	0.123



Band V/RMC 12.2Kbps	Edge 4	0mm	4182	22.51	23.00	1.119	0.100	0.112
Band V/RMC 12.2Kbps	Curved surface of Edge 3	0mm	4182	22.51	23.00	1.119	0.103	0.115
Sensor off/Full Power								
LTE Band 2/1RB#0 20M	Bottom Face	18mm	18900	22.82	23.00	1.042	0.260	0.271
LTE Band 2/1RB#0 20M	Edge 2	0mm	18900	22.82	23.00	1.042	0.155	0.162
LTE Band 2/1RB#0 20M	Edge 3	10mm	18900	22.82	23.00	1.042	0.635	0.662
LTE Band 2/1RB#0 20M	Edge 4	0mm	18900	22.82	23.00	1.042	0.548	0.571
LTE Band 2/1RB#0 20M	Curved surface of Edge 3	10mm	18900	22.82	23.00	1.042	1.070	1.115
LTE Band 2/1RB#0 20M	Curved surface of Edge 3	10mm	18700	22.79	23.00	1.050	1.110	1.165
LTE Band 2/1RB#0 20M	Curved surface of Edge 3	10mm	19100	22.59	23.00	1.099	1.000	1.099
LTE Band 2/100RB#0 20M	Curved surface of Edge 3	10mm	18700	21.24	22.00	1.191	0.781	0.930
Sensor on/Reduced Power								
LTE Band 2/1RB#0 20M	Bottom Face	0mm	18900	14.03	14.50	1.114	0.547	0.610
LTE Band 2/1RB#0 20M	Edge 3	0mm	18900	14.03	14.50	1.114	0.279	0.311
LTE Band 2/1RB#0 20M	Curved surface of Edge 3	0mm	18900	14.03	14.50	1.114	0.351	0.391
Sensor off/Full Power								
LTE Band 2/50RB#0 20M	Bottom Face	18mm	18900	21.26	22.00	1.186	0.211	0.250
LTE Band 2/50RB#0 20M	Edge 2	0mm	18900	21.26	22.00	1.186	0.126	0.149
LTE Band 2/50RB#0 20M	Edge 3	10mm	18900	21.26	22.00	1.186	0.456	0.541
LTE Band 2/50RB#0 20M	Edge 4	0mm	18900	21.26	22.00	1.186	0.362	0.429
LTE Band 2/50RB#0 20M	Curved surface of Edge 3	10mm	18900	21.26	22.00	1.186	0.672	0.797
Sensor on/Reduced Power								
LTE Band 2/50RB#0 20M	Bottom Face	0mm	18900	12.76	13.50	1.186	0.359	0.426
LTE Band 2/50RB#0 20M	Edge 3	0mm	18900	12.76	13.50	1.186	0.200	0.237
LTE Band 2/50RB#0 20M	Curved surface of Edge 3	0mm	18900	12.76	13.50	1.186	0.234	0.277
Sensor off/Full Power								
LTE Band 4/1RB#0 20M	Bottom Face	0mm	20175	22.87	24.00	1.297	0.441	0.572
LTE Band 4/1RB#0 20M	Edge 2	0mm	20175	22.87	24.00	1.297	0.051	0.066
LTE Band 4/1RB#0 20M	Edge 3	0mm	20175	22.87	24.00	1.297	0.094	0.122
LTE Band 4/1RB#0 20M	Edge 4	0mm	20175	22.87	24.00	1.297	0.494	0.641
LTE Band 4/1RB#0 20M	Curved surface of Edge 3	0mm	20175	22.87	24.00	1.297	0.211	0.274
Sensor off/Full Power								
LTE Band 4/50RB#0 20M	Bottom Face	0mm	20175	21.64	22.00	1.086	0.351	0.381
LTE Band 4/50RB#0 20M	Edge 2	0mm	20175	21.64	22.00	1.086	0.042	0.046
LTE Band 4/50RB#0 20M	Edge 3	0mm	20175	21.64	22.00	1.086	0.072	0.078
LTE Band 4/50RB#0 20M	Edge 4	0mm	20175	21.64	22.00	1.086	0.382	0.415
LTE Band 4/50RB#0 20M	Curved surface of Edge 3	0mm	20175	21.64	22.00	1.086	0.182	0.198
Sensor off/Full Power								



LTE Band 5/1RB#0 10M	Bottom Face	0mm	20525	23.41	24.00	1.146	0.142	0.163
LTE Band 5/1RB#0 10M	Edge 2	0mm	20525	23.41	24.00	1.146	0.170	0.195
LTE Band 5/1RB#0 10M	Edge 3	0mm	20525	23.41	24.00	1.146	0.105	0.120
LTE Band 5/1RB#0 10M	Edge 4	0mm	20525	23.41	24.00	1.146	0.131	0.150
LTE Band 5/1RB#0 10M	Curved surface of Edge 3	0mm	20525	23.41	24.00	1.146	0.117	0.134
Sensor off/Full Power								
LTE Band 5/25RB#0 10M	Bottom Face	0mm	20525	22.37	23.00	1.156	0.123	0.142
LTE Band 5/25RB#0 10M	Edge 2	0mm	20525	22.37	23.00	1.156	0.142	0.164
LTE Band 5/25RB#0 10M	Edge 3	0mm	20525	22.37	23.00	1.156	0.091	0.105
LTE Band 5/25RB#0 10M	Edge 4	0mm	20525	22.37	23.00	1.156	0.100	0.116
LTE Band 5/25RB#0 10M	Curved surface of Edge 3	0mm	20525	22.37	23.00	1.156	0.094	0.109
Sensor off/Full Power								
LTE Band 7/1RB#0 20M	Bottom Face	18mm	21100	20.80	21.50	1.175	0.288	0.338
LTE Band 7/1RB#0 20M	Edge 2	0mm	21100	20.80	21.50	1.175	0.101	0.119
LTE Band 7/1RB#0 20M	Edge 3	10mm	21100	20.80	21.50	1.175	0.631	0.741
LTE Band 7/1RB#0 20M	Edge 4	0mm	21100	20.80	21.50	1.175	0.112	0.132
LTE Band 7/1RB#0 20M	Curved surface of Edge 3	10mm	21100	20.80	21.50	1.175	0.718	0.844
LTE Band 7/1RB#0 20M	Curved surface of Edge 3	10mm	20850	20.61	21.50	1.227	0.670	0.822
LTE Band 7/1RB#0 20M	Curved surface of Edge 3	10mm	21350	20.64	21.50	1.219	0.681	0.830
LTE Band 7/100RB#0 20M	Curved surface of Edge 3	10mm	21100	19.74	20.50	1.191	0.540	0.643
Sensor on/Reduced Power								
LTE Band 7/1RB#0 20M	Bottom Face	0mm	21100	11.30	12.00	1.175	0.479	0.563
LTE Band 7/1RB#0 20M	Edge 3	0mm	21100	11.30	12.00	1.175	0.163	0.192
LTE Band 7/1RB#0 20M	Curved surface of Edge 3	0mm	21100	11.30	12.00	1.175	0.286	0.336
Sensor off/Full Power								
LTE Band 7/50RB#0 20M	Bottom Face	18mm	21100	19.78	20.50	1.180	0.220	0.260
LTE Band 7/50RB#0 20M	Edge 2	0mm	21100	19.78	20.50	1.180	0.092	0.109
LTE Band 7/50RB#0 20M	Edge 3	10mm	21100	19.78	20.50	1.180	0.453	0.535
LTE Band 7/50RB#0 20M	Edge 4	0mm	21100	19.78	20.50	1.180	0.085	0.100
LTE Band 7/50RB#0 20M	Curved surface of Edge 3	10mm	21100	19.78	20.50	1.180	0.580	0.685
Sensor on/Reduced Power								
LTE Band 7/50RB#0 20M	Bottom Face	0mm	21100	10.28	11.00	1.180	0.300	0.354
LTE Band 7/50RB#0 20M	Edge 3	0mm	21100	10.28	11.00	1.180	0.131	0.155
LTE Band 7/50RB#0 20M	Curved surface of Edge 3	0mm	21100	10.28	11.00	1.180	0.214	0.253
Sensor off/Full Power								
LTE Band 12/1RB#0 10M	Bottom Face	0mm	23095	23.27	24.00	1.183	0.084	0.100
LTE Band 12/1RB#0 10M	Edge 2	0mm	23095	23.27	24.00	1.183	0.066	0.078
LTE Band 12/1RB#0 10M	Edge 3	0mm	23095	23.27	24.00	1.183	0.063	0.074



LTE Band 12/1RB#0 10M	Edge 4	0mm	23095	23.27	24.00	1.183	0.040	0.047
LTE Band 12/1RB#0 10M	Curved surface of Edge 3	0mm	23095	23.27	24.00	1.183	0.044	0.052
Sensor on/Reduced Power								
LTE Band 12/25RB#0 10M	Bottom Face	0mm	23095	22.46	23.00	1.132	0.072	0.082
LTE Band 12/25RB#0 10M	Edge 2	0mm	23095	22.46	23.00	1.132	0.042	0.048
LTE Band 12/25RB#0 10M	Edge 3	0mm	23095	22.46	23.00	1.132	0.040	0.045
LTE Band 12/25RB#0 10M	Edge 4	0mm	23095	22.46	23.00	1.132	0.031	0.035
LTE Band 12/25RB#0 10M	Curved surface of Edge 3	0mm	23095	22.46	23.00	1.132	0.040	0.045
Sensor off/Full Power								
LTE Band 66/1RB#0 20M	Bottom Face	18mm	132322	20.79	21.50	1.178	0.305	0.359
LTE Band 66/1RB#0 20M	Edge 2	0mm	132322	20.79	21.50	1.178	0.041	0.048
LTE Band 66/1RB#0 20M	Edge 3	10mm	132322	20.79	21.50	1.178	0.204	0.240
LTE Band 66/1RB#0 20M	Edge 4	0mm	132322	20.79	21.50	1.178	0.103	0.121
LTE Band 66/1RB#0 20M	Curved surface of Edge 3	10mm	132322	20.79	21.50	1.178	0.779	0.917
LTE Band 66/1RB#0 20M	Curved surface of Edge 3	10mm	132072	20.57	21.50	1.239	0.608	0.753
LTE Band 66/1RB#0 20M	Curved surface of Edge 3	10mm	132572	20.74	21.50	1.191	0.881	1.049
LTE Band 66/100RB#0 20M	Curved surface of Edge 3	10mm	132322	19.49	20.50	1.262	0.520	0.656
Sensor on/Reduced Power								
LTE Band 66/1RB#0 20M	Bottom Face	0mm	132322	14.32	15.00	1.169	0.575	0.672
LTE Band 66/1RB#0 20M	Edge 3	0mm	132322	14.32	15.00	1.169	0.139	0.163
LTE Band 66/1RB#0 20M	Curved surface of Edge 3	0mm	132322	14.32	15.00	1.169	0.264	0.309
Sensor off/Full Power								
LTE Band 66/50RB#0 20M	Bottom Face	18mm	132322	19.75	20.50	1.189	0.238	0.283
LTE Band 66/50RB#0 20M	Edge 2	0mm	132322	19.75	20.50	1.189	0.046	0.055
LTE Band 66/50RB#0 20M	Edge 3	10mm	132322	19.75	20.50	1.189	0.139	0.165
LTE Band 66/50RB#0 20M	Edge 4	0mm	132322	19.75	20.50	1.189	0.088	0.105
LTE Band 66/50RB#0 20M	Curved surface of Edge 3	10mm	132322	19.75	20.50	1.189	0.508	0.604
Sensor on/Reduced Power								
LTE Band 66/50RB#0 20M	Bottom Face	0mm	132322	13.28	14.00	1.180	0.426	0.503
LTE Band 66/50RB#0 20M	Edge 3	0mm	132322	13.28	14.00	1.180	0.117	0.138
LTE Band 66/50RB#0 20M	Curved surface of Edge 3	0mm	132322	13.28	14.00	1.180	0.115	0.136
Sensor off/Full Power								
WLAN 2.4GHz/802.11b	Bottom Face	0mm	1	11.91	12.50	1.146	0.119	0.136
WLAN 2.4GHz/802.11b	Edge 1	0mm	1	11.91	12.50	1.146	0.082	0.093
WLAN 2.4GHz/802.11b	Edge 2	0mm	1	11.91	12.50	1.146	0.003	0.003

**Note:**

- Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR  $\leq 0.8W/kg$ , 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  $\geq 0.8$ 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  $\leq 1.2$  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) has been calculated together with the duty cycle scaling factor 1.0.
7. The curved surface of edge 3 is tested at tilt 45 degree in this report.

➤ **Bluetooth Body SAR**

When standalone SAR is not required to be measured, per FCC KDB 447498 D01v06 4.3.2), the following equation must be used to estimate the standalone 1g SAR.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} \cdot \frac{\text{Max. power of channel, mW}}{\text{Min. Separation Distance, mm}}$$

Channel	Frequency (GHz)	Max. Tune-up Power (dBm)	Max. Power(mW)	Test Distance (mm)	Result	Exclusion Thresholds for 1-g SAR
CH 39	2.402	-3.0	0.50	5	0.16	3.0

Mode	Max. Tune-up Power (dBm)	Exposure Position	Body
		Test Distance (mm)	5
Bluetooth	-3.0	Estimated SAR (W/kg)	0.021

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR1g (W/kg)	Reported SAR1g (W/kg)
Bluetooth/1Mbps	Bottom Face	0mm	1	-3.47	-3.00	1.114	0.021	0.025
Bluetooth/1Mbps	Edge 1	0mm	1	-3.47	-3.00	1.114	0.021	0.025
Bluetooth/1Mbps	Edge 2	0mm	1	-3.47	-3.00	1.114	0.021	0.025

**Note:**

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 77.6%, Therefore the duty cycle scaling factor 1.073 should be used to calculating the reported SAR.



### 15.3 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 (~ 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**

Band/Mode	Test Position	Gap (mm)	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR1g (W/kg)	Reported SAR1g (W/kg)
Sensor off/Full Power								
LTE Band 2/1RB#0 20M	Curved surface of Edge 3	10mm	18700	22.79	23.00	1.050	1.107	1.162
Sensor off/Full Power								
LTE Band 66/1RB#0 20M	Curved surface of Edge 3	10mm	132572	20.74	21.50	1.191	0.879	1.047



# 16 Simultaneous Transmission Analysis

## 16.1 Simultaneous Transmission Consideration

No.	Simultaneous Transmission Consideration	Body
1	WWAN(2G/3G/4G)+WLAN 2.4GHz	Yes
2	WWAN(2G/3G/4G)+Bluetooth	Yes

**Note:**

1. Simultaneous Transmission SAR evaluation is not required for BT and Wi-Fi, because the software mechanism have been incorporated to guarantee that the WLAN and Bluetooth transmitters would not simultaneously operate.
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.





## 16.2 Simultaneous Transmission Analysis

### ➤ Body Simultaneous Transmission for WWAN(2/3/4G)+WLAN(2.4GHz)

WWAN Band	Exposure Position	1	2	6	1+2 Summed 1g SAR (W/kg)	1+6 Summed 1g SAR (W/kg)
		WWAN	2.4GHz WLAN	Bluetooth		
		1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
GSM850	Bottom Face at 0mm	0.293	0.136	0.025	0.429	0.318
	Edge 1 at 0mm	0.049	0.093	0.025	0.142	0.074
	Edge 2 at 0mm	0.130	0.003	0.025	0.133	0.155
	Edge 3 at 0mm	0.236	0.000	0.000	0.236	0.236
	Edge 4 at 0mm	0.077	0.000	0.000	0.077	0.077
GSM1900	Bottom Face at 18mm	0.305	0.136	0.025	0.441	0.330
	Edge 3 at 10mm	0.632	0.000	0.000	0.632	0.632
	Curved surface of Edge 3 at 10mm	0.796	0.000	0.000	0.796	0.796
	Bottom Face at 0mm	0.332	0.136	0.025	0.468	0.357
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.072	0.003	0.025	0.075	0.097
	Edge 3 at 0mm	0.215	0.000	0.000	0.215	0.215
	Edge 4 at 0mm	0.396	0.000	0.000	0.396	0.396
	Curved surface of Edge 3 at 0mm	0.263	0.000	0.000	0.263	0.263
WCDMA Band II	Bottom Face at 0mm	0.692	0.136	0.025	0.828	0.717
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.151	0.003	0.025	0.154	0.176
	Edge 3 at 0mm	0.219	0.000	0.000	0.219	0.219
	Edge 4 at 0mm	0.109	0.000	0.000	0.109	0.109
WCDMA Band IV	Bottom Face at 0mm	0.535	0.136	0.025	0.671	0.560
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.045	0.003	0.025	0.048	0.070
	Edge 3 at 0mm	0.120	0.000	0.000	0.120	0.120
	Edge 4 at 0mm	0.192	0.000	0.000	0.192	0.192
WCDMA Band V	Bottom Face at 0mm	0.151	0.136	0.025	0.287	0.176
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.150	0.003	0.025	0.153	0.175
	Edge 3 at 0mm	0.123	0.000	0.000	0.123	0.123
	Edge 4 at 0mm	0.112	0.000	0.000	0.112	0.112
LTE Band 2	Bottom Face at 18mm	0.271	0.136	0.025	0.407	0.296





	Edge 3 at 10mm	0.662	0.000	0.000	0.662	0.662
	Curved surface of Edge 3 at 10mm	1.165	0.000	0.000	1.165	1.165
	Bottom Face at 0mm	0.610	0.136	0.025	0.746	0.635
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.162	0.003	0.025	0.165	0.187
	Edge 3 at 0mm	0.311	0.000	0.000	0.311	0.311
	Edge 4 at 0mm	0.571	0.000	0.000	0.571	0.571
	Curved surface of Edge 3 at 0mm	0.391	0.000	0.000	0.391	0.391
LTE Band 4	Bottom Face at 0mm	0.572	0.136	0.025	0.708	0.597
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.066	0.003	0.025	0.069	0.091
	Edge 3 at 0mm	0.122	0.000	0.000	0.122	0.122
	Edge 4 at 0mm	0.641	0.000	0.000	0.641	0.641
LTE Band 5	Bottom Face at 0mm	0.163	0.136	0.025	0.299	0.188
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.195	0.003	0.025	0.198	0.220
	Edge 3 at 0mm	0.120	0.000	0.000	0.120	0.120
	Edge 4 at 0mm	0.150	0.000	0.000	0.150	0.150
LTE Band 7	Bottom Face at 18mm	0.338	0.136	0.025	0.474	0.363
	Edge 3 at 10mm	0.741	0.000	0.000	0.741	0.741
	Curved surface of Edge 3 at 10mm	0.844	0.000	0.000	0.844	0.844
	Bottom Face at 0mm	0.563	0.136	0.025	0.699	0.588
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.119	0.003	0.025	0.122	0.144
	Edge 3 at 0mm	0.192	0.000	0.000	0.192	0.192
	Edge 4 at 0mm	0.132	0.000	0.000	0.132	0.132
Curved surface of Edge 3 at 0mm	0.336	0.000	0.000	0.336	0.336	
LTE Band 12	Bottom Face at 0mm	0.100	0.136	0.025	0.236	0.125
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.078	0.003	0.025	0.081	0.103
	Edge 3 at 0mm	0.074	0.000	0.000	0.074	0.074
	Edge 4 at 0mm	0.047	0.000	0.000	0.047	0.047
LTE Band 66	Bottom Face at 18mm	0.359	0.136	0.025	0.495	0.384
	Edge 3 at 10mm	0.240	0.000	0.000	0.240	0.240
	Curved surface of Edge 3 at 10mm	1.049	0.000	0.000	1.049	1.049
	Bottom Face at 0mm	0.672	0.136	0.025	0.808	0.697
	Edge 1 at 0mm	0.000	0.093	0.025	0.093	0.025
	Edge 2 at 0mm	0.055	0.003	0.025	0.058	0.080



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	Edge 3 at 0mm	0.163	0.000	0.000	0.163	0.163
	Edge 4 at 0mm	0.121	0.000	0.000	0.121	0.121
	Curved surface of Edge 3 at 0mm	0.309	0.000	0.000	0.309	0.309

## 17 Measurement Uncertainty

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

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

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

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor	$1/k(b)$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

### Standard Uncertainty for Assumed Distribution

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

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



## 17.1 Uncertainty Evaluation For Handset SAR Test

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	j
Uncertainty Component	Sec.	Tol (+-%)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
<b>Measurement System</b>									
Probe calibration	E.2.1	5.83	N	1	1	1	5.83	5.83	∞
Axial Isotropy	E.2.2	3.5	R	$\sqrt{3}$	1	1	2.02	2.02	∞
Hemispherical Isotropy	E.2.2	5.9	R	$\sqrt{3}$	1	1	3.41	3.41	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	4.7	R	$\sqrt{3}$	1	1	2.71	2.71	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Modulation Response	E.2.4	4.1	R	$\sqrt{3}$	1	1	2.4	2.4	∞
Readout Electronics	E.2.6	0.5	N	1	1	1	0.5	0.5	∞
Reponse Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	3.0	3.0	∞
Integration Time	E.2.8	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	∞
Probe positioner	E.6.2	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Probe positioning with respect to Phantom Shell	E.6.3	1.4	R	$\sqrt{3}$	1	1	0.81	0.81	∞
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	E.5.2	2.3	R	$\sqrt{3}$	1	1	1.33	1.33	∞
<b>Test sample Related</b>									
Test sample positioning	E.4.2.1	2.6	N	1	1	1	2.6	2.6	N-1
Device Holder Uncertainty	E.4.1.1	3.0	N	1	1	1	3.0	3.0	N-1
Output power Power drift - SAR drift measurement	6.6.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
<b>Phantom and Tissue Parameters</b>									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	4.0	R	$\sqrt{3}$	1	1	2.31	2.31	∞



Liquid conductivity - deviation from target value	E.3.2	2.0	R	$\sqrt{3}$	0.6 4	0.43	1.69	1.13	$\infty$
Liquid conductivity - measurement uncertainty	E.3.3	2.5	N	1	0.6 4	0.43	3.20	2.15	M
Liquid permittivity - deviation from target value	E.3.2	2.5	R	$\sqrt{3}$	0.6	0.49	1.28	1.04	$\infty$
Liquid permittivity - measurement uncertainty	E.3.3	5.0	N	1	0.6	0.49	6.00	4.90	M
Liquid conductivity -temperature uncertainty	E.3.4		R	$\sqrt{3}$	0.7 8	0.41			$\infty$
Liquid permittivity -temperature uncertainty	E.3.4		R	$\sqrt{3}$	0.2 3	0.26			$\infty$
Combined Standard Uncertainty			RSS				11.55	12.07	
Expanded Uncertainty (95% Confidence interval)			K=2				$\pm 23.20$	$\pm 24.17$	

## 17.2 Uncertainty For System Performance Check

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+ - %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
<b>Measurement System</b>									
Probe calibration	E.2.1	4.76	N	1	1	1	4.76	4.76	$\infty$
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	1	1	1.44	1.41	$\infty$
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	1	1	2.31	2.32	$\infty$
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	$\infty$
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	$\infty$
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	$\infty$
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	$\infty$
Reponse Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	$\infty$
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	$\infty$



RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.73	1.73	$\infty$
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	$\infty$
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	$\infty$
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	$\infty$
<b>Dipole</b>									
Dipole axis to liquid Distance	8,E.4.2	1.00	N	$\sqrt{3}$	1	1	0.58	0.58	$\infty$
Input power and SAR drift measurement	8,6.6.2	4.04	R	$\sqrt{3}$	1	1	2.33	2.33	$\infty$
<b>Phantom and Tissue Parameters</b>									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	$\infty$
Liquid conductivity - deviation from target value	E.3.2	4.57	R	$\sqrt{3}$	0.64	0.43	1.69	1.13	$\infty$
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	$\sqrt{3}$	0.64	0.43	1.85	1.24	M
Liquid permittivity - deviation from target value	E.3.2	3.69	R	$\sqrt{3}$	0.6	0.49	1.28	1.04	$\infty$
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	$\sqrt{3}$	0.6	0.49	3.46	2.83	M
CombinedStandard Uncertainty			RSS				8.83	8.37	
Expanded Uncertainty (95% Confidence interval)			K=2				17.66	16.73	



## 18 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 LongChang Road, Block 67, BaoAn District, ShenZhen, 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 LongChang Road, Block 67, BaoAn District, ShenZhen, 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) will be submitted separately.

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