



TEST REPORT

APPLICANT : LG Electronics USA,Inc.
PRODUCT NAME : Smartphone
MODEL NAME : LM-X440IM
BRAND NAME : LG
FCC ID : ZNFX440IM
STANDARD(S) : 47CFR 2.1093
IEEE 1528-2013
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REPORT No. : SZ19060060S01

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Change History		
Version	Date	Description
1.0	2019-06-25	Original



1 SAR Results Summary

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

<Highest Reported standalone SAR Summary>

Frequency Band		Highest SAR Summary		
		Head (Separation 0mm)	Body-worn (Separation 10mm)	Hotspot (Separation 10mm)
		1g SAR (W/kg)		
GSM	GSM850	0.187	0.603	0.603
	GSM1900	0.171	0.584	0.584
LTE	LTE Band 5	0.105	0.322	0.322
	LTE Band 40	0.092	0.265	0.265
	LTE Band 41	0.166	0.370	0.370
WLAN	2.4GHz WLAN	1.056	0.375	0.375
2.4GHz Band	Bluetooth	0.209	0.104	0.104
Highest Simultaneous Transmission 1g SAR (W/kg)		Head	Body-worn	Hotspot
WWAN+WLAN 2.4GHz		1.169	0.978	0.978
WWAN+BT		0.396	0.707	0.707

Max Scaled SAR _{1g} (W/Kg):	Head	1.056W/kg	Limit(W/kg): 1.6 W/kg
	Body-worn	0.603W/kg	
	Hotspot	0.603W/kg	

Note:

1. The highest simultaneous transmission is scalar summation of Reported standalone SAR per FCC KDB 690783 D01 v01r03, and scalar SAR summation of all possible simultaneous transmission scenarios are < 1.6W/kg.
2. This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
3. The Bluetooth 2.4GHz Band is estimated result.



2 Technical Information

Note: Provide by Applicant.

2.1 Applicant and Manufacturer Information

Applicant:	LG Electronics USA, Inc.
Applicant Address:	1000 Sylvan Ave. Englewood Cliffe, New Jersey, United States 07632
Manufacturer:	OPTIEMUS ELECTRONICS LIMITED .
Manufacturer Address:	D-348, Sector 63, Gautam Budh Nagar, Noida, Uttar Pradesh 201307 India

2.2 Equipment Under Test (EUT) Description

EUT Type:	Smartphone
Hardware Version:	V0.10
Software Version:	LG_IM-X440IM_Software
Frequency Bands:	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz LTE Band 5: 824MHz ~ 849MHz LTE Band 40: Band 1 2305 MHz ~ 2315 MHz Band 2 2350 MHz ~ 2360 MHz LTE Band 41: 2535 MHz ~ 2655 MHz WLAN: 802.11b/g/n-HT20:2412 MHz ~2472 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Modulation Mode:	GSM/GPRS: GMSK, EDGE: 8PSK LTE: QPSK/16QAM/64QAM 802.11b: DSSS 802.11g/n HT20: OFDM Bluetooth: GFSK, $\pi/4$ -DQPSK, 8-DPSK BLE: GFSK
Multi-slot Class:	Multi-Slot Class 12
Operation Class	Class B
Hotspot Mode:	Support
Antenna Type:	N/A
SIM cards description:	For dual SIM card version, SIM 1 and SIM 2 are the same chipset unit and tested as a single chipset, the SIM 1 is chosen for test

Note:

1. For a more detailed description, please refer to specification or user's manual supplied by the applicant and/or manufacturer.



2.3 Environment of Test Site

Temperature:	20 ... 25 ° C
Humidity:	30 ... 75 %
Atmospheric Pressure:	980 ... 1020 hPa
Test frequency:	GSM 850MHz/1900MHz; FDD-LTE Band 5; TDD-LTE Band 40/41; WLAN 2.4GHz;
Operation mode:	Call established
Power Level:	GSM 850MHz Maximum output power(level 5); GSM 1900MHz Maximum output power(level 0); FDD-LTE Band 5 (Maximum output power) TDD-LTE Band 40/41 (Maximum output power); WLAN 2.4GHz (Power setting=22);

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.

For SAR testing, EUT is in GPRS mode. In GPRS link mode, its crest factor is 2, because EUT is set in GPRS multi-slot class 12 with 4 uplink slots.



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

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 (ρ). The equation description is as below:

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

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

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

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

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

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

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



4 RF Exposure Limits

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

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for head and trunk)	1.60W/kg
Spatial Peak SAR (10g cube tissue for limbs)	4.00W/kg
Spatial Peak SAR (1g cube tissue for whole body)	0.08W/kg

Note:

1. This limit is according to recommendation 1999/519/EC, Annex II (Basic Restrictions)
2. 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)

5 Applied Reference Documents

Leading reference documents for testing:

No.	Identity	Document Title
1	47 CFR§2.1093	Radio Frequency Radiation Exposure Evaluation: Portable Devices
2	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
3	KDB 447498 D01v06	General RF Exposure Guidance
4	KDB 865664 D01v01r04	SAR Measurement 100 MHz to 6 GHz
5	KDB 865664 D02v01r02	RF Exposure Reporting
6	KDB 648474 D04v01r03	Handset SAR
7	KDB 941225 D01v03r01	3G SAR MEAUREMENT PROCEDURES
8	KDB 941225 D05v02r05	SAR Evaluation Consideration for LTE Devices
9	KDB 941225 D06v02r01	SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities

6 SAR Measurement System

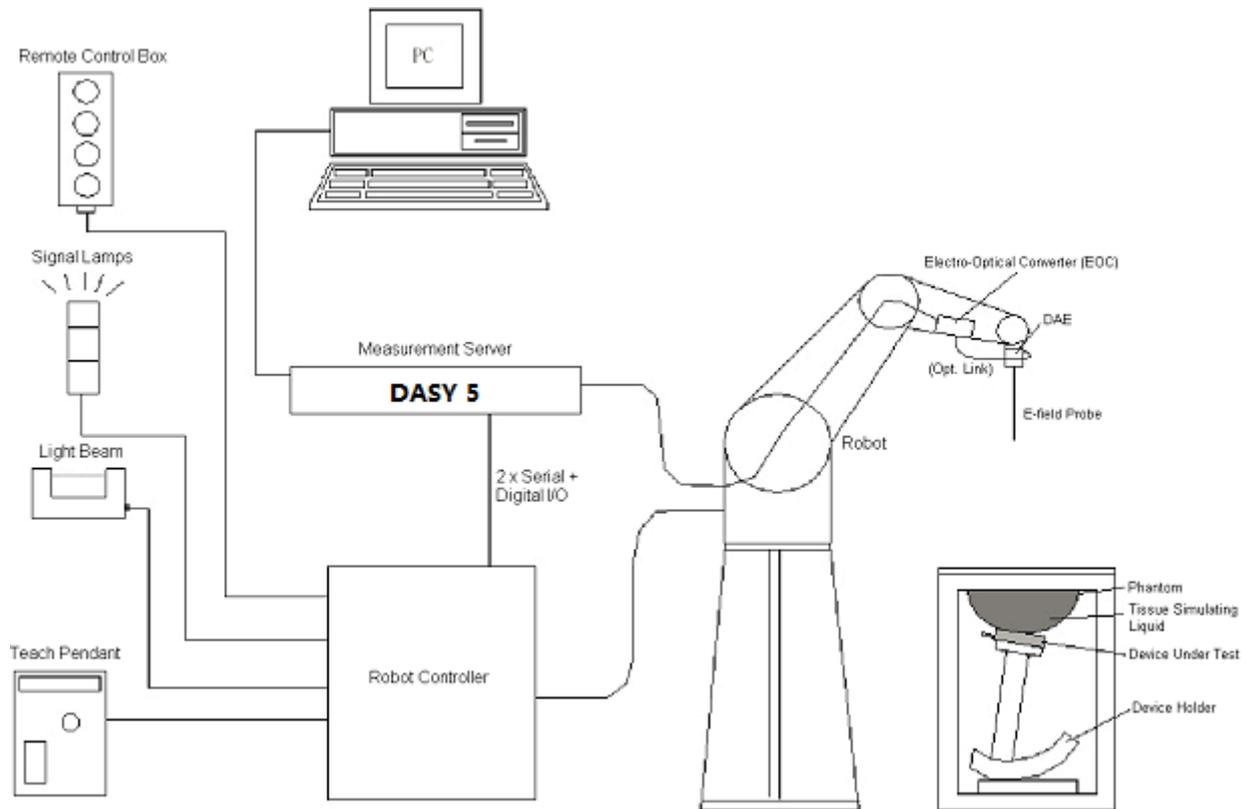


Fig.6.1 SPEAG DASY System Configurations

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>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

- **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 ± 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 appendix 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 (repeat ability 0.02 mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt 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 repeat ability 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>

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



Fig. 6.6Photo 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 ±0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP).

Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



Fig. 6.7 Photo of Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

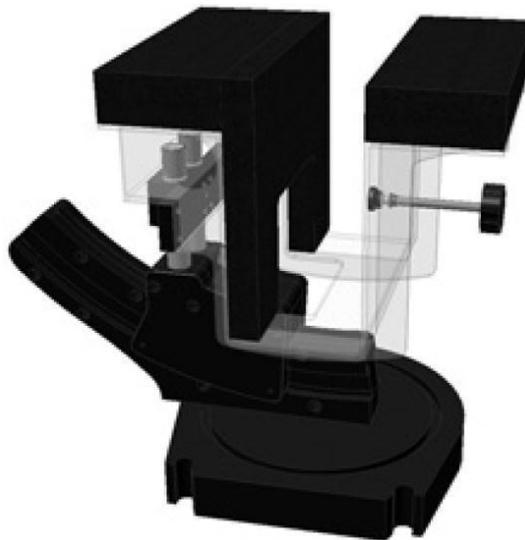


Fig 6.8 Laptop Extension Kit



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:

Probe Parameters:	- Sensitivity	Norm _i , a _{i0} , a _{i1} , a _{i2}
	- Conversion	ConvF _i
	- Diode compression point	dcp _i
Device Parameters:	- Frequency	f
	- Crest	cf
Media Parameters:	- Conductivity	σ
	- Density	ρ

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

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.



The formula for each channel can be given as:

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

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

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

cf = crest factor of exciting field (DASY parameter)

dcp_i = diode compression point (DASY parameter)

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

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

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

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

Norm_i = 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_{tot} = total field strength in V/m

σ = conductivity in (mho/m) or (Siemens/m)

ρ = equipment tissue density in g/cm^3

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



6.9 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d227	2018.06.22	2019.06.21
SPEAG	1900MHz System Validation Kit	D1900V2	5d221	2018.06.22	2019.06.21
SPEAG	2300MHz System Validation Kit	D2300V2	1056	2018.09.18	2019.09.17
SPEAG	2450MHz System Validation Kit	D2450V2	805	2018.10.26	2019.10.25
SPEAG	2600MHz System Validation Kit	D2600V2	1139	2018.06.25	2019.06.24
SPEAG	Dosimetric E-Field Probe	EX3DV4	3823	2018.11.12	2019.11.11
SPEAG	Data Acquisition Electronics	DAE4	480	2019.04.11	2020.04.10
SPEAG	Dielectric Assessment KIT	DAK-3.5	1279	2018.11.03	2019.11.02
SPEAG	SAM Twin Phantom 1	QD 000 P40 CB	TP-1471	NCR	NCR
SPEAG	SAM Twin Phantom 2	QD 000 P40 CB	TP-1464	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Network Emulator	CMW500	124534	2019.04.17	2020.04.16
Agilent	Network Analyzer	E5071B	MY42404762	2019.04.15	2020.04.14
mini-circuits	Amplifier	ZHL-42W+	608501717	NCR	NCR
Agilent	Signal Generator	N5182B	MY53050509	2019.04.17	2020.04.16
Agilent	Power Sensor	N8482A	MY41090849	2018.11.23	2019.11.22
Agilent	Power Meter	E4416A	MY45102093	2018.11.23	2019.11.22
Anritsu	Power Sensor	MA2411B	N/A	2018.11.23	2019.11.22
Anritsu	Power Meter	NRVD	101066	2018.11.23	2019.11.22
MCL	Attenuation1	351-218-010	N/A	NA	NA
Agilent	Dual Directional Coupler	778D	50422	NA	NA
THERMOMETER	Thermo meter	DC-803	N/A	2018.11.22	2019.11.21
N/A	Tissue Simulating Liquids	800-2600MHZ	N/A	24H	

Note:

1. The calibration certificate of DASY can be referred to appendix E of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. 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.
4. 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

5. Attenuator insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
6. N.C.R means No Calibration Requirement.

6.10 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.11, for body SAR testing, the liquid height from the center of the flat phantom to liquid top surface is larger than 15 cm, which is shown in Fig. 6.12.



Fig 6.10 Photo of Liquid Height for Head SAR

Fig 6.11 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 (σ)	Permittivity (ϵ_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
Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.96	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5



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	
	ϵ_r	σ (S/m)	ϵ_r	σ (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

(ϵ_r = relative permittivity, σ = 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.

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Conductivity Target (σ)	Delta (σ) (%)	Limit (%)	Date
835	HSL	22.5	0.922	0.90	2.44	±5	2019.06.16
1900	HSL	22.3	1.355	1.40	-3.21	±5	2019.06.17
2300	HSL	22.4	1.698	1.67	1.68	±5	2019.06.16
2450	HSL	22.7	1.838	1.80	2.11	±5	2019.06.19
2600	HSL	22.3	2.005	1.96	2.30	±5	2019.06.16

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Permittivity (ε)	Permittivity Target (ε)	Delta (ε) (%)	Limit (%)	Date
835	HSL	22.5	42.273	41.50	1.86	±5	2019.06.16
1900	HSL	22.3	41.316	40.00	3.29	±5	2019.06.17
2300	HSL	22.4	41.260	39.50	4.46	±5	2019.06.16
2450	HSL	22.7	40.920	39.20	4.39	±5	2019.06.19
2600	HSL	22.3	40.198	39.00	3.07	±5	2019.06.16

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Conductivity Target (σ)	Delta (σ) (%)	Limit (%)	Date
835	MSL	22.6	0.980	0.97	1.03	±5	2019.06.15
1900	MSL	22.7	1.518	1.52	-0.13	±5	2019.06.16
2300	MSL	22.5	1.769	1.81	-2.27	±5	2019.06.14
2450	MSL	22.5	1.898	1.95	-2.67	±5	2019.06.19
2600	MSL	22.2	2.170	2.16	0.46	±5	2019.06.13

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Permittivity (ε)	Permittivity Target (ε)	Delta (ε) (%)	Limit (%)	Date
835	MSL	22.6	55.749	55.20	0.99	±5	2019.06.15
1900	MSL	22.7	54.556	53.30	2.36	±5	2019.06.16
2300	MSL	22.5	53.478	52.90	1.09	±5	2019.06.14
2450	MSL	22.5	53.046	52.70	0.66	±5	2019.06.19
2600	MSL	22.2	52.511	52.50	0.02	±5	2019.06.13

7 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.

➤ 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 7.1 Photo of Dipole Setup

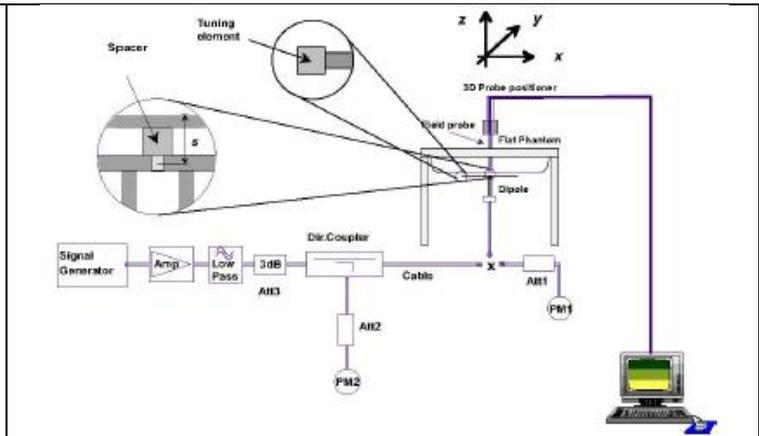


Fig 7.2 System Setup for System Evaluation

➤ 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 Appendix C of this report.



Dipole S/N	Probe S/N	DAE S/N
D835V2-4d227	3823	480
D1900V2_5d221	3823	480
D2300V2-1056	3823	480
D2450V2-805	3823	480
D2600V2-1139	3823	480

<1g SAR>

Date	Freq. (MHz)	Tissue Type	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2019.06.16	835	HSL	250	2.26	9.34	9.04	-3.21
2019.06.17	1900	HSL	250	9.59	39.50	38.36	-2.89
2019.06.16	2300	HSL	250	12.40	47.70	49.6	3.98
2019.06.19	2450	HSL	250	13.40	52.00	53.6	3.08
2019.06.16	2600	HSL	250	14.30	54.00	57.2	5.93
2019.06.15	835	MSL	250	2.38	9.61	9.52	-0.94
2019.06.16	1900	MSL	250	9.58	39.90	38.32	-3.96
2019.06.14	2300	MSL	250	12.51	47.90	50.04	4.47
2019.06.19	2450	MSL	250	12.30	50.50	49.2	-2.57
2019.06.13	2600	MSL	250	13.20	54.00	52.8	-2.22

<10g SAR>

Date	Freq. (MHz)	Tissue Type	Input Power (mW)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2019.06.16	835	HSL	250	1.50	6.07	6	-1.15
2019.06.17	1900	HSL	250	4.99	20.60	19.96	-3.11
2019.06.16	2300	HSL	250	5.59	23.10	22.36	-3.20
2019.06.19	2450	HSL	250	6.14	24.10	24.56	1.91
2019.06.16	2600	HSL	250	6.26	24.50	25.04	2.20
2019.06.15	835	MSL	250	1.59	6.31	6.36	0.79
2019.06.16	1900	MSL	250	5.01	20.70	20.04	-3.19
2019.06.14	2300	MSL	250	5.67	23.00	22.68	-1.39
2019.06.19	2450	MSL	250	5.73	23.50	22.92	-2.47
2019.06.13	2600	MSL	250	5.96	24.20	23.84	-1.49

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

8 EUT Testing Position

This EUT was tested in ten different positions. They are right cheek/right tilted/left cheek/left tilted for head, Front/Back/Right Side/Top Side/Bottom Side of the EUT with phantom 10 mm gap, as illustrated below, please refer to Appendix B for the test setup photos.

8.1 Handset Reference Points

- The vertical centreline passes through two points on the front side of the handset – the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.
- The horizontal line is perpendicular to the vertical centreline and passes the center of the acoustic output. The horizontal line is also tangential to the handset at point A.
- The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centreline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.



Fig.8.1 Illustration for Front, Back and Side of SAM Phantom

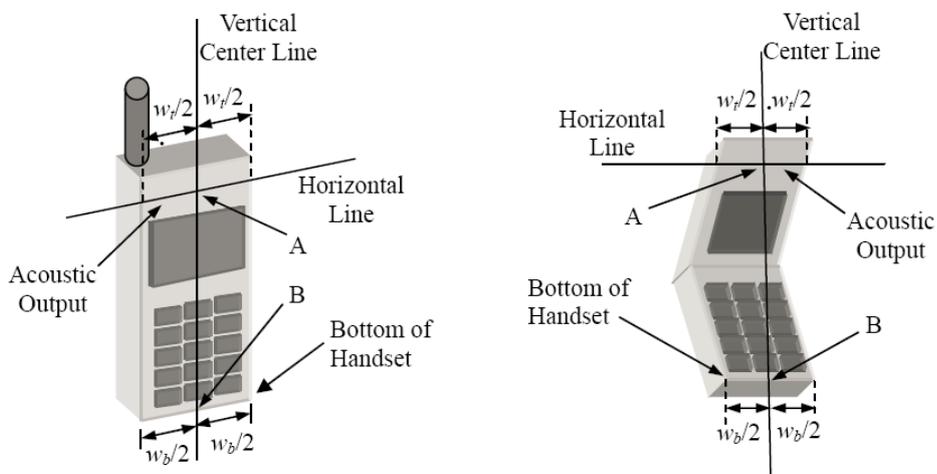


Fig. 8.2 Illustration for Handset Vertical and Horizontal Reference Lines

8.2 Positioning for Cheek / Touch

- To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
- To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see below figure)



Fig. 8.3 Illustration for Cheek Position

8.3 Positioning for Ear / 15° Tilt

- To position the device in the “cheek” position described above.
- While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see figure below).



Fig.8.4 Illustration for Tilted Position

8.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

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

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

8.5 Body Worn Accessory Configurations

- 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 10 mm or holster surface and the flat phantom to 0 mm.

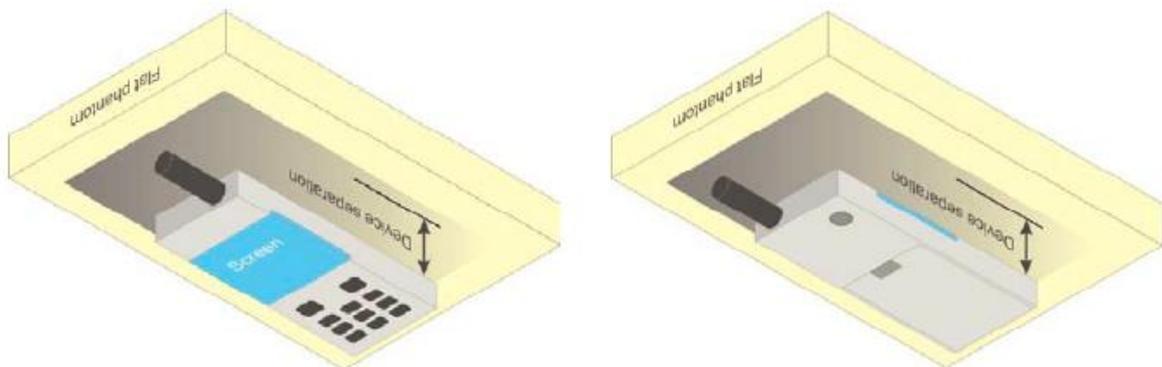


Fig.8.5 Illustration for Body Worn Position

8.6 Hotspot Mode Exposure Position Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions are tested according to the hotspot SAR procedures in KDB 941225. A test separation distance of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm x 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).

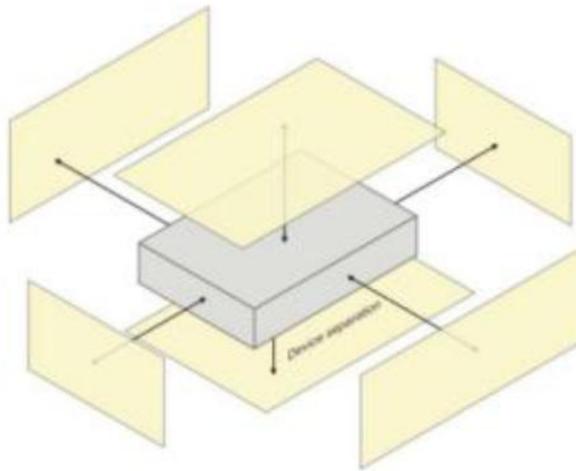


Fig 8.6 Illustration for Hotspot Position



9 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 Appendix 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



9.1 Spatial Peak SAR Evaluation

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

The base for the evaluation is a “cube” measurement. The measured volume must include the 1g and 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.

9.2 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.

9.3 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 10mm^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. For example, a 2 dB range is required in IEEE1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).



9.4 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 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.

9.5 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.

9.6 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.



10 Conducted RF Output Power

➤ GSM Conducted Power

GSM850 TX Channel	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	128	189	251		128	189	251	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GSM	33.04	33.01	33.02	34.00	24.04	24.01	24.02	25.00
GPRS 1Tx slots	33.05	33.01	33.04	34.00	24.05	24.01	24.04	25.00
GPRS 2Tx slots	32.04	32.15	32.15	33.00	26.04	26.15	26.15	27.00
GPRS 3Tx slots	29.97	30.08	30.06	31.00	25.71	25.82	25.80	26.74
GPRS 4Tx slots	28.87	28.92	28.93	30.00	25.87	25.92	25.93	27.00
EDGE 1Tx slots	26.34	26.24	26.17	27.00	17.34	17.24	17.17	18.00
EDGE 2Tx slots	25.33	25.18	25.13	26.00	19.33	19.18	19.13	20.00
EDGE 3Tx slots	23.21	23.12	23.08	24.00	18.95	18.86	18.82	19.74
EDGE 4Tx slots	22.31	22.14	22.10	23.00	19.31	19.14	19.10	20.00

GSM1900 TX Channel	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GSM	30.15	30.12	30.01	31.00	21.15	21.12	21.01	22.00
GPRS 1Tx slots	30.16	30.13	30.04	31.00	21.16	21.13	21.04	22.00
GPRS 2Tx slots	29.16	29.14	29.16	30.00	23.16	23.14	23.16	24.00
GPRS 3Tx slots	27.12	27.11	27.01	28.00	22.86	22.85	22.75	23.74
GPRS 4Tx slots	26.15	26.17	26.05	27.00	23.15	23.17	23.05	24.00
EDGE 1Tx slots	25.73	25.68	25.71	26.50	16.73	16.68	16.71	17.50
EDGE 2Tx slots	24.72	24.75	24.70	25.50	18.72	18.75	18.70	19.50
EDGE 3Tx slots	22.74	22.73	22.78	23.00	18.48	18.47	18.52	18.74
EDGE 4Tx slots	21.61	21.65	21.68	22.50	18.61	18.65	18.68	19.50

Timeslot consignations:

Remark:

- 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
- 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
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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

➤ **LTE Conducted Power**

Largest channel bandwidth standalone SAR test requirements

QPSK with 1 RB allocation

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 among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel.8 When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

QPSK with 50% RB allocation

The procedures required for 1 RB allocation in section 4.2.1 are applied to measure the SAR for QPSK with 50% RB allocation.9

QPSK with 100% RB allocation

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 in sections 4.2.1 and 4.2.2 are ≤ 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.

Higher order modulations

For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in sections 4.2.1, 5.2.2 and 4.2.3 to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is $> \frac{1}{2}$ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

Other channel bandwidth standalone SAR test requirements

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section 4.2 to determine the channels and RB



configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is $> \frac{1}{2}$ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg. The equivalent channel configuration for the RB allocation, RB offset and modulation etc. is determined for the smaller channel bandwidth according to the same number of RB allocated in the largest channel bandwidth. For example, 50 RB in 10 MHz channel bandwidth does not apply to 5 MHz channel bandwidth; therefore, this cannot be tested in the smaller channel bandwidth. However, 50% RB allocation in 10 MHz channel bandwidth is equivalent to 100% RB allocation in 5 MHz channel bandwidth; therefore, these are the equivalent configurations to be compared to determine the specific channel and configuration in the smaller channel bandwidth that need SAR testing.



<FDD LTE Band 5>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				20450	20525	20600	
Frequency (MHz)				829	836.5	844	
10	QPSK	1	0	23.65	23.78	23.55	24.50
10	QPSK	1	25	24.07	23.89	23.70	
10	QPSK	1	49	23.65	23.57	23.56	
10	QPSK	25	0	22.69	22.77	22.79	23.50
10	QPSK	25	12	22.74	22.79	22.75	
10	QPSK	25	25	22.86	22.82	22.76	
10	QPSK	50	0	22.83	22.64	22.76	23.50
10	16QAM	1	0	22.86	22.96	23.09	
10	16QAM	1	25	22.75	23.11	23.28	
10	16QAM	1	49	22.86	23.15	22.86	22.50
10	16QAM	25	0	21.68	21.67	21.73	
10	16QAM	25	12	21.68	21.87	21.78	
10	16QAM	25	25	21.88	21.82	21.62	22.50
10	16QAM	50	0	21.86	21.68	21.78	
10	64QAM	1	0	21.73	21.64	21.76	
10	64QAM	1	25	21.77	21.64	21.74	22.50
10	64QAM	1	49	21.65	21.77	21.62	
10	64QAM	25	0	21.12	21.16	21.17	
10	64QAM	25	12	21.15	21.14	21.11	21.50
10	64QAM	25	25	21.12	21.18	21.15	
10	64QAM	50	0	21.19	21.16	21.13	
Channel				20425	20525	20625	Tune-up limit (dBm)
Frequency (MHz)				826.5	836.5	846.5	
5	QPSK	1	0	23.56	23.57	23.59	24.50
5	QPSK	1	12	24.05	23.93	23.83	
5	QPSK	1	24	23.69	23.59	23.65	
5	QPSK	12	0	22.82	22.68	22.75	23.50
5	QPSK	12	7	22.81	22.75	22.82	
5	QPSK	12	13	22.87	22.76	22.76	
5	QPSK	25	0	22.81	22.79	22.77	23.50
5	16QAM	1	0	22.82	23.03	22.67	
5	16QAM	1	12	23.22	23.15	22.84	
5	16QAM	1	24	22.86	22.90	22.64	22.50
5	16QAM	12	0	21.69	21.69	21.66	
5	16QAM	12	7	21.87	21.74	21.85	
5	16QAM	12	13	21.89	21.63	21.76	22.50
5	16QAM	25	0	21.71	21.71	21.78	
5	64QAM	1	0	21.71	21.77	21.77	



5	64QAM	1	12	21.75	21.75	21.64	21.50
5	64QAM	1	24	21.60	21.62	21.78	
5	64QAM	12	0	21.14	21.15	21.11	
5	64QAM	12	7	21.19	21.15	21.15	
5	64QAM	12	13	21.13	21.12	21.10	
5	64QAM	25	0	21.18	21.14	21.17	
Channel				20415	20525	20635	Tune-up limit (dBm)
Frequency (MHz)				825.5	836.5	847.5	
3	QPSK	1	0	23.61	23.73	23.75	24.50
3	QPSK	1	8	23.62	23.65	23.66	
3	QPSK	1	14	23.70	23.73	23.67	
3	QPSK	8	0	22.71	22.66	22.77	23.50
3	QPSK	8	4	22.86	22.73	22.77	
3	QPSK	8	7	22.68	22.63	22.69	
3	QPSK	15	0	22.69	22.66	22.77	
3	16QAM	1	0	22.75	22.71	22.84	23.50
3	16QAM	1	8	22.63	23.03	22.60	
3	16QAM	1	14	22.60	22.68	22.81	
3	16QAM	8	0	21.81	21.86	21.78	22.50
3	16QAM	8	4	21.79	21.77	21.87	
3	16QAM	8	7	21.75	21.83	21.92	
3	16QAM	15	0	21.86	21.75	21.81	
3	64QAM	1	0	21.68	21.64	21.65	22.50
3	64QAM	1	8	21.69	21.65	21.69	
3	64QAM	1	14	21.78	21.79	21.68	
3	64QAM	8	0	21.17	21.15	21.13	21.50
3	64QAM	8	4	21.15	21.16	21.16	
3	64QAM	8	7	21.18	21.12	21.17	
3	64QAM	15	0	21.11	21.12	21.15	
Channel				20407	20525	20643	Tune-up limit (dBm)
Frequency (MHz)				824.7	836.5	848.3	
1.4	QPSK	1	0	23.74	23.63	23.69	24.50
1.4	QPSK	1	3	23.74	23.96	23.81	
1.4	QPSK	1	5	23.78	23.75	23.69	
1.4	QPSK	3	0	23.78	23.86	23.79	
1.4	QPSK	3	1	23.86	23.82	23.69	
1.4	QPSK	3	3	23.76	23.71	23.82	
1.4	QPSK	6	0	22.75	22.81	22.73	23.50
1.4	16QAM	1	0	23.11	22.52	22.79	23.50
1.4	16QAM	1	3	23.17	22.98	23.13	
1.4	16QAM	1	5	22.94	23.09	22.85	
1.4	16QAM	3	0	22.88	22.70	22.76	
1.4	16QAM	3	1	22.93	22.88	22.65	
1.4	16QAM	3	3	22.84	22.58	22.69	



1.4	16QAM	6	0	21.88	21.91	21.92	22.50
1.4	64QAM	1	0	21.77	21.72	21.69	22.50
1.4	64QAM	1	3	21.74	21.61	21.73	
1.4	64QAM	1	5	21.77	21.66	21.77	
1.4	64QAM	3	0	21.19	21.19	21.12	
1.4	64QAM	3	1	21.20	21.19	21.19	
1.4	64QAM	3	3	21.11	21.11	21.19	
1.4	64QAM	6	0	21.19	21.16	21.17	21.50

<TDD LTE Band 40>

Band 1:

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				38750			
Frequency (MHz)				2310			
10	QPSK	1	0		23.12		24.00
10	QPSK	1	25		23.01		
10	QPSK	1	49		22.99		
10	QPSK	25	0		22.07		23.00
10	QPSK	25	12		22.17		
10	QPSK	25	25		22.02		
10	QPSK	50	0		22.09		23.00
10	16QAM	1	0		22.44		
10	16QAM	1	25		22.42		
10	16QAM	1	49		22.19		22.00
10	16QAM	25	0		21.27		
10	16QAM	25	12		21.22		
10	16QAM	25	25		21.26		22.00
10	16QAM	50	0		21.15		
10	64QAM	1	0		21.18		
10	64QAM	1	25		21.21		22.00
10	64QAM	1	49		21.16		
10	64QAM	25	0		20.13		
10	64QAM	25	12		20.20		21.00
10	64QAM	25	25		20.19		
10	64QAM	50	0		20.20		
Channel				38725	38750	38775	Tune-up limit (dBm)
Frequency (MHz)				2307.5	2310	2312.5	
5	QPSK	1	0	22.96	22.83	22.96	24.00
5	QPSK	1	12	23.03	23.04	23.03	
5	QPSK	1	24	22.85	22.83	22.87	
5	QPSK	12	0	22.07	22.09	22.06	23.00
5	QPSK	12	7	22.09	22.15	22.08	



5	QPSK	12	13	22.05	22.03	22.06	
5	QPSK	25	0	22.08	22.04	22.12	
5	16QAM	1	0	22.31	22.27	22.28	
5	16QAM	1	12	22.38	22.37	22.33	23.00
5	16QAM	1	24	22.23	22.16	22.22	
5	16QAM	12	0	21.12	21.10	21.17	
5	16QAM	12	7	21.24	21.21	21.17	22.00
5	16QAM	12	13	21.23	21.17	21.20	
5	16QAM	25	0	21.21	21.17	21.22	
5	64QAM	1	0	21.15	21.18	21.12	22.00
5	64QAM	1	12	21.19	21.14	21.14	
5	64QAM	1	24	21.17	21.12	21.18	
5	64QAM	12	0	20.19	20.15	20.12	21.00
5	64QAM	12	7	20.12	20.15	20.10	
5	64QAM	12	13	20.15	20.18	20.14	
5	64QAM	25	0	20.11	20.15	20.18	

Band 2:

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				39200			
Frequency (MHz)				2355			
10	QPSK	1	0		23.25		24.00
10	QPSK	1	25		23.21		
10	QPSK	1	49		23.32		
10	QPSK	25	0		22.14		23.00
10	QPSK	25	12		22.11		
10	QPSK	25	25		22.11		
10	QPSK	50	0		22.12		
10	16QAM	1	0		22.51		23.00
10	16QAM	1	25		22.49		
10	16QAM	1	49		22.47		
10	16QAM	25	0		21.34		22.00
10	16QAM	25	12		21.30		
10	16QAM	25	25		21.22		
10	16QAM	50	0		21.26		
10	64QAM	1	0		21.17		22.00
10	64QAM	1	25		21.21		
10	64QAM	1	49		21.13		
10	64QAM	25	0		20.26		21.00
10	64QAM	25	12		20.30		
10	64QAM	25	25		20.20		
10	64QAM	50	0		20.39		



Channel				39175	39200	39225	Tune-up limit (dBm)
Frequency (MHz)				2352.5	2355	2357.5	
5	QPSK	1	0	23.12	23.04	23.01	24.00
5	QPSK	1	12	23.10	23.05	23.03	
5	QPSK	1	24	23.00	22.92	22.97	
5	QPSK	12	0	22.17	22.16	22.13	23.00
5	QPSK	12	7	22.18	22.16	22.18	
5	QPSK	12	13	22.12	22.11	22.11	
5	QPSK	25	0	22.18	22.19	22.16	
5	16QAM	1	0	22.35	22.39	22.24	23.00
5	16QAM	1	12	22.40	22.43	22.74	
5	16QAM	1	24	22.40	22.22	22.19	
5	16QAM	12	0	21.25	21.25	21.24	22.00
5	16QAM	12	7	21.24	21.22	21.27	
5	16QAM	12	13	21.21	21.15	21.22	
5	16QAM	25	0	21.31	21.32	21.26	
5	64QAM	1	0	21.16	21.18	21.20	
5	64QAM	1	12	21.10	21.10	21.13	22.00
5	64QAM	1	24	21.14	21.12	21.15	
5	64QAM	12	0	20.35	20.33	20.34	
5	64QAM	12	7	20.11	20.13	20.13	21.00
5	64QAM	12	13	20.20	20.19	20.12	
5	64QAM	12	13	20.20	20.19	20.12	
5	64QAM	25	0	20.13	20.15	20.10	



<TDD LTE Band 41>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Low Ch. / Freq.	Power Middle High Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				40340	40600	40870	41140	
Frequency (MHz)				2565	2591	2618	2645	
20	QPSK	1	0	21.76	21.76	21.77	21.66	23.00
20	QPSK	1	49	22.09	22.10	22.06	22.03	
20	QPSK	1	99	21.61	21.58	21.64	21.54	
20	QPSK	50	0	21.18	21.15	21.14	21.17	22.00
20	QPSK	50	24	21.11	21.19	21.10	21.04	
20	QPSK	50	50	21.16	21.09	21.08	20.96	
20	QPSK	100	0	21.15	21.15	21.04	21.07	22.00
20	16QAM	1	0	21.14	21.16	21.03	21.13	
20	16QAM	1	49	21.40	21.40	21.33	21.30	
20	16QAM	1	99	21.06	20.95	20.97	20.88	21.00
20	16QAM	50	0	20.27	20.18	20.10	20.26	
20	16QAM	50	24	20.23	20.17	20.05	20.15	
20	16QAM	50	50	20.23	20.12	20.05	19.91	21.00
20	16QAM	100	0	20.13	20.19	20.06	20.10	
20	64QAM	1	0	20.15	20.10	20.20	20.11	
20	64QAM	1	49	20.20	20.15	20.17	20.13	21.00
20	64QAM	1	99	20.19	20.19	20.16	20.19	
20	64QAM	50	0	19.14	19.20	19.30	19.46	
20	64QAM	50	24	19.18	19.15	19.22	19.18	20.00
20	64QAM	50	50	19.15	19.19	19.15	19.20	
20	64QAM	100	0	19.19	19.20	19.23	19.15	
Channel				40315	40595	40885	41165	Tune-up limit (dBm)
Frequency (MHz)				2562.5	2590.5	2619.5	2647.5	
15	QPSK	1	0	21.74	21.94	21.92	21.91	23.00
15	QPSK	1	37	22.03	22.02	22.02	21.99	
15	QPSK	1	74	21.94	21.93	21.83	21.79	
15	QPSK	36	0	21.17	21.13	21.15	21.15	22.00
15	QPSK	36	20	21.02	21.15	21.09	21.12	
15	QPSK	36	39	21.09	21.18	21.03	21.00	
15	QPSK	75	0	21.07	21.13	21.08	21.00	22.00
15	16QAM	1	0	21.26	21.35	21.25	21.12	
15	16QAM	1	37	21.36	21.40	21.31	21.30	
15	16QAM	1	74	21.20	21.23	21.11	21.04	21.00
15	16QAM	36	0	20.06	20.10	20.07	20.16	
15	16QAM	36	20	20.14	20.04	20.06	19.96	
15	16QAM	36	39	20.08	20.06	20.02	20.00	21.00
15	16QAM	75	0	20.11	20.11	20.01	20.03	



15	64QAM	1	0	20.11	20.15	20.12	20.17	21.00
15	64QAM	1	37	20.16	20.15	20.13	20.13	
15	64QAM	1	74	20.14	20.12	20.19	20.12	
15	64QAM	36	0	19.61	19.59	19.54	19.63	20.00
15	64QAM	36	20	19.65	19.67	19.61	19.64	
15	64QAM	36	39	19.58	19.61	19.56	19.60	
15	64QAM	75	0	19.57	19.69	19.51	19.62	
Channel				40290	40590	40890	41190	Tune-up limit (dBm)
Frequency (MHz)				2560	2590	2620	2650	
10	QPSK	1	0	22.02	21.98	21.89	21.88	23.00
10	QPSK	1	25	22.03	22.05	21.99	22.03	
10	QPSK	1	49	21.88	21.93	21.90	21.85	
10	QPSK	25	0	21.17	21.16	21.12	21.11	22.00
10	QPSK	25	12	21.17	21.14	21.12	21.09	
10	QPSK	25	25	21.03	21.14	21.13	21.07	
10	QPSK	50	0	21.07	21.13	21.11	21.09	
10	16QAM	1	0	21.37	21.46	21.32	21.33	22.00
10	16QAM	1	25	21.39	21.45	21.28	21.27	
10	16QAM	1	49	21.38	21.39	21.18	21.22	
10	16QAM	25	0	20.18	20.24	20.11	20.27	21.00
10	16QAM	25	12	20.16	20.17	20.09	20.14	
10	16QAM	25	25	20.11	20.16	20.09	20.14	
10	16QAM	50	0	20.14	20.20	20.10	20.13	
10	64QAM	1	0	20.19	20.10	20.11	20.16	21.00
10	64QAM	1	25	20.11	20.19	20.15	20.12	
10	64QAM	1	49	20.15	20.17	20.14	20.16	
10	64QAM	25	0	19.59	19.56	19.56	19.60	20.00
10	64QAM	25	12	19.57	19.55	19.60	19.61	
10	64QAM	25	25	19.50	19.58	19.57	19.65	
10	64QAM	50	0	19.65	19.64	19.58	19.69	
Channel				40265	40585	40905	41215	Tune-up limit (dBm)
Frequency (MHz)				2557.5	2589.5	2621.5	2652.5	
5	QPSK	1	0	21.52	21.80	21.84	21.84	23.00
5	QPSK	1	12	21.89	22.01	21.96	21.94	
5	QPSK	1	24	21.97	21.86	21.75	21.81	
5	QPSK	12	0	21.05	21.09	21.04	21.05	22.00
5	QPSK	12	7	21.16	21.12	21.08	21.13	
5	QPSK	12	13	21.10	21.12	20.99	21.05	
5	QPSK	25	0	21.05	21.09	20.99	21.04	
5	16QAM	1	0	21.19	21.24	21.15	21.12	22.00
5	16QAM	1	12	21.25	21.35	21.28	21.22	
5	16QAM	1	24	21.31	21.23	21.17	21.07	
5	16QAM	12	0	20.09	20.08	20.13	20.11	21.00
5	16QAM	12	7	20.15	20.20	20.04	20.13	
5	16QAM	12	13	20.06	20.10	20.08	20.04	



5	16QAM	25	0	20.13	20.10	20.00	20.15	
5	64QAM	1	0	20.15	20.10	20.16	20.15	21.00
5	64QAM	1	12	20.10	20.20	20.15	20.18	
5	64QAM	1	24	20.14	20.12	20.17	20.15	
5	64QAM	12	0	19.60	19.60	19.58	19.60	20.00
5	64QAM	12	7	19.54	19.59	19.60	19.61	
5	64QAM	12	13	19.57	19.65	19.59	19.60	
5	64QAM	25	0	19.67	19.56	19.52	19.57	



➤ **WLAN 2.4 GHz Conducted Power**

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit (dBm)	Power Setting	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	CH 1	2412	21.16	22.00	22.00	100
		CH 6	2437	21.21	22.00	22.00	
		CH 11	2462	20.58	21.50	22.00	
	802.11g 6Mbps	CH 1	2412	19.96	20.50	22.00	96.86
		CH 6	2437	20.67	21.50	22.00	
		CH 11	2462	20.07	21.00	22.00	
	802.11n-HT20 MCS0	CH 1	2412	19.88	20.50	22.00	33.46
		CH 6	2437	20.61	21.50	22.00	
		CH 11	2462	19.97	20.50	22.00	

Note:

- Per KDB 447498 D01v06, the 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Channel	Frequency (GHz)	Max. Tune-up Power (dBm)	Max. Power (mW)	Test distance (mm)	Result	exclusion thresholds for 1-g SAR
b/CH 06	2.437	22.00	158.49	5	49.48	3.0

- Base on the result of note1, RF exposure evaluation of 802.11 b and g mode is required.
- Per KDB 248227 D01v02r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
- 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:
 - 1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
 - 2) 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 ≤ 1.2 W/kg.
- The output power of all data rate were pre-scan, just the worst case (the lowest data rate) of all mode were shown in report.



➤ **Bluetooth Conducted Power**

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	6.44	3.51	3.71
	CH 39	2441	6.79	3.74	3.93
	CH 78	2480	4.24	0.75	0.91
Tune-up Limit (dBm)			7.00	4.00	4.50

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
LE	CH 00	2402	-3.55
	CH 19	2440	-3.39
	CH 39	2480	-5.06
Tune-up Limit (dBm)			-3.00

Note:

- Per KDB 447498 D01v06, the 1-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

Channel	Frequency (GHz)	Max. tune-up Power (dBm)	Max. Power (mW)	Test distance (mm)	Result	exclusion thresholds for 1-g SAR
CH 39	2.441	7.00	5.01	5	1.57	3.0

- The max. tune-up power was provided by manufacturer, base on the result of note 1, RF exposure evaluation is not required.
- The output power of all data rate were pre-scan, just the worst case of all mode were shown in report.
- When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine SAR test exclusion.



11 Exposure Positions Consideration

11.1 EUT Antenna Location

Note: Please see Annex B

11.2 Test Positions Consideration

Distance of Antennas to EUT edge/surface Test distance: 10mm						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
GSM/LTE	<25mm	<25mm	145mm	<25mm	<25mm	<25mm
WLAN/Bluetooth	<25mm	<25mm	<25mm	146mm	<25mm	45mm

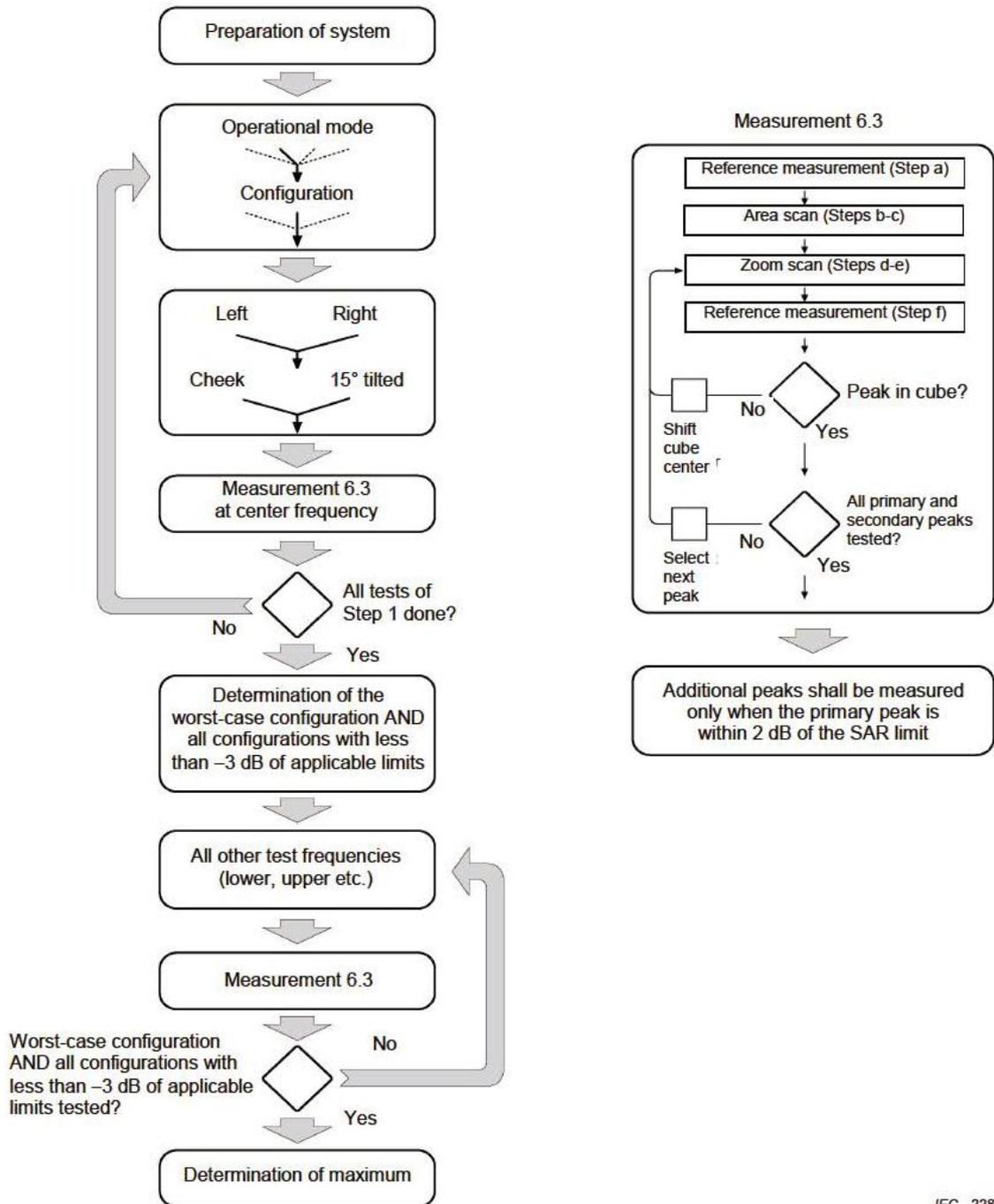
Test Positions Test distance: 10mm						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
GSM/LTE	Yes	Yes	No	Yes	Yes	Yes
WLAN/Bluetooth	Yes	Yes	Yes	No	No	Yes

Note:

1. Head/Body-worn/hotspot mode SAR assessments are required.
2. Per KDB 447498 D01v06, for handsets the test separation distance is determined by the smallest distance between the outer surface of the device and the user, which is 0 mm for head SAR and 10 mm for body-worn and hotspot SAR.

12 Block diagram of the tests to be performed

12.1 Head



IEC 228/05

12.2 Body

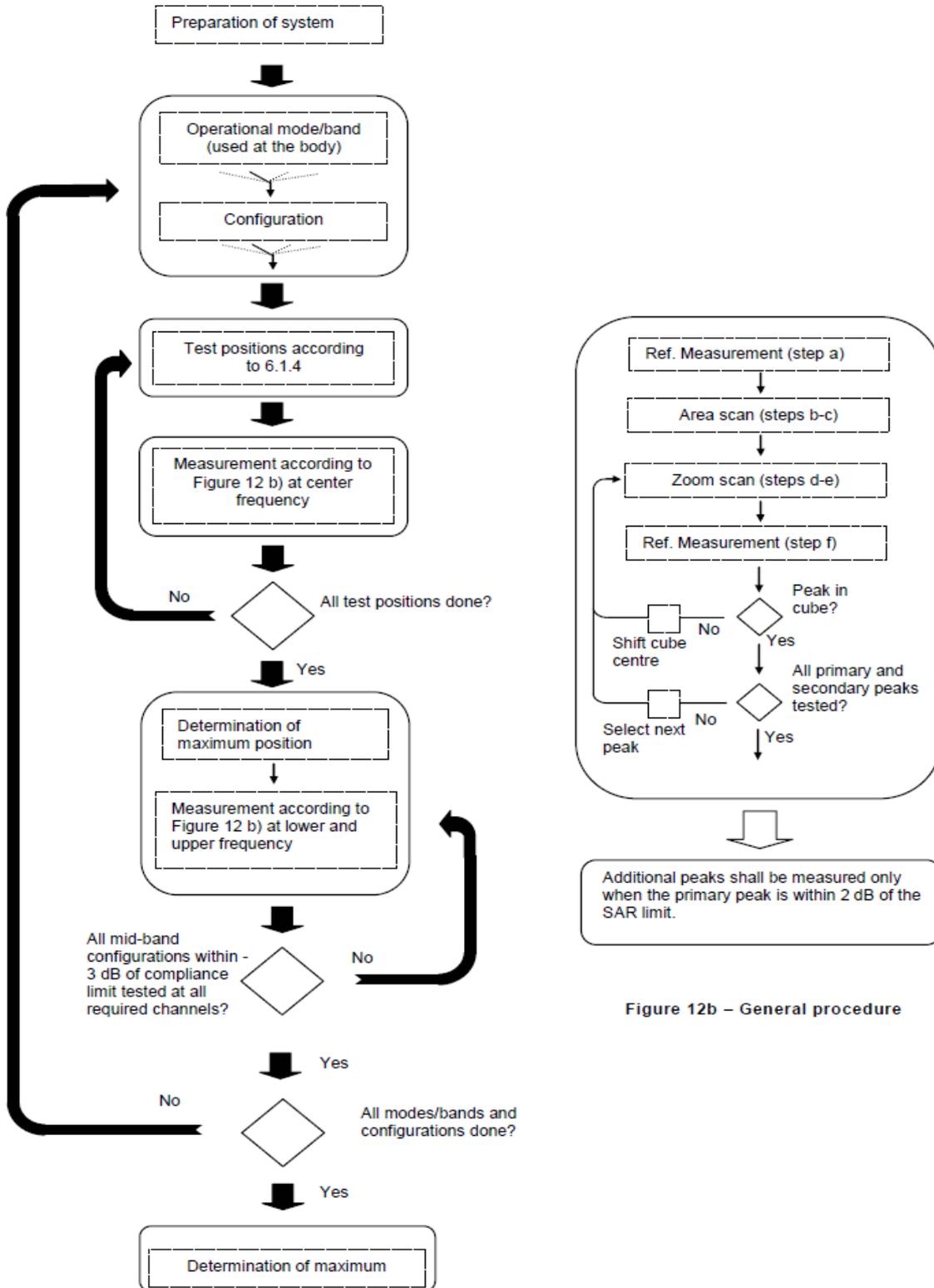


Figure 12b – General procedure



13 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 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
2. Per KDB 447498 D01v06, for each exposure position, if the highest output power channel Reported SAR ≤ 0.8 W/kg, other channels SAR testing is not necessary.
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8 W/kg.
4. Per KDB 941225 D05v02r05, 100% RB allocation SAR measurement is not required when the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg.
5. Per KDB 248227 D01v02r02, for 802.11b DSSS , when the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required in that exposure configuration.
6. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.
7. LTE band 17 SAR test was covered by Band 12; 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.



14 SAR Test Results Summary

14.1 Standalone Head SAR

➤ GSM Head SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
1#	GSM850/4Tx slots	Right Cheek	251	28.93	30.00	1.279	0.146	0.187
	GSM850/4Tx slots	Right Tilt	251	28.93	30.00	1.279	0.071	0.090
	GSM850/4Tx slots	Left Cheek	251	28.93	30.00	1.279	0.117	0.150
	GSM850/4Tx slots	Left Tilt	251	28.93	30.00	1.279	0.058	0.074
2#	GSM1900/4Tx slots	Right Cheek	661	26.17	27.00	1.211	0.104	0.126
	GSM1900/4Tx slots	Right Tilt	661	26.17	27.00	1.211	0.093	0.113
	GSM1900/4Tx slots	Left Cheek	661	26.17	27.00	1.211	0.141	0.171
	GSM1900/4Tx slots	Left Tilt	661	26.17	27.00	1.211	0.121	0.146

➤ FDD-LTE 10MHz QPSK Head SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
3#	Band 5/1RB#25	Right Cheek	20450	24.07	24.50	1.104	0.095	0.105
	Band 5/1RB#25	Right Tilt	20450	24.07	24.50	1.104	0.045	0.050
	Band 5/1RB#25	Left Cheek	20450	24.07	24.50	1.104	0.083	0.092
	Band 5/1RB#25	Left Tilt	20450	24.07	24.50	1.104	0.037	0.041
	Band 5/25RB#25	Right Cheek	20450	22.86	23.50	1.159	0.075	0.086
	Band 5/25RB#25	Right Tilt	20450	22.86	23.50	1.159	0.036	0.042
	Band 5/25RB#25	Left Cheek	20450	22.86	23.50	1.159	0.066	0.076
	Band 5/25RB#25	Left Tilt	20450	22.86	23.50	1.159	0.029	0.034

➤ TDD-LTE 10MHz QPSK Head SAR

Band 40_Band 1:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
4#	Band 40/1RB#0	Right Cheek	38750	23.12	24.00	1.225	0.053	0.065
	Band 40/1RB#0	Right Tilt	38750	23.12	24.00	1.225	0.047	0.058
	Band 40/1RB#0	Left Cheek	38750	23.12	24.00	1.225	0.075	0.092
	Band 40/1RB#0	Left Tilt	38750	23.12	24.00	1.225	0.029	0.036
	Band 40/25RB#12	Right Cheek	38750	22.17	23.00	1.211	0.047	0.056
	Band 40/25RB#12	Right Tilt	38750	22.17	23.00	1.211	0.041	0.050
	Band 40/25RB#12	Left Cheek	38750	22.17	23.00	1.211	0.058	0.070
	Band 40/25RB#12	Left Tilt	38750	22.17	23.00	1.211	0.024	0.028



Band 40_Band 2:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 40/1RB#49	Right Cheek	39200	23.32	24.00	1.169	0.055	0.065
	Band 40/1RB#49	Right Tilt	39200	23.32	24.00	1.169	0.072	0.085
5#	Band 40/1RB#49	Left Cheek	39200	23.32	24.00	1.169	0.074	0.087
	Band 40/1RB#49	Left Tilt	39200	23.32	24.00	1.169	0.034	0.040
	Band 40/25RB#0	Right Cheek	39200	22.14	23.00	1.219	0.045	0.055
	Band 40/25RB#0	Right Tilt	39200	22.14	23.00	1.219	0.057	0.069
	Band 40/25RB#0	Left Cheek	39200	22.14	23.00	1.219	0.061	0.074
	Band 40/25RB#0	Left Tilt	39200	22.14	23.00	1.219	0.026	0.031

➤ **TDD-LTE 20MHz QPSK Head SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 41/1RB#49	Right Cheek	40600	22.10	23.00	1.230	0.077	0.094
	Band 41/1RB#49	Right Tilt	40600	22.10	23.00	1.230	0.083	0.101
6#	Band 41/1RB#49	Left Cheek	40600	22.10	23.00	1.230	0.135	0.166
	Band 41/1RB#49	Left Tilt	40600	22.10	23.00	1.230	0.058	0.072
	Band 41/50RB#24	Right Cheek	40600	21.19	22.00	1.205	0.014	0.016
	Band 41/50RB#24	Right Tilt	40600	21.19	22.00	1.205	0.065	0.078
	Band 41/50RB#24	Left Cheek	40600	21.19	22.00	1.205	0.104	0.125
	Band 41/50RB#24	Left Tilt	40600	21.19	22.00	1.205	0.047	0.057

Note:

1. Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR ≤0.8W/kg, other channels SAR testing is not necessary.
2. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg.
3. The TDD-LTE Reported 1g SAR (W/kg) has been calculated together with the duty cycle scaling factor.

➤ **WLAN 2.4 GHz Head SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	2.4GHz/802.11b	Right Cheek	6	21.21	22.00	1.199	0.723	0.867
7#	2.4GHz/802.11b	Right Tilt	6	21.21	22.00	1.199	0.880	1.056
	2.4GHz/802.11b	Left Cheek	6	21.21	22.00	1.199	0.204	0.245
	2.4GHz/802.11b	Left Tilt	6	21.21	22.00	1.199	0.210	0.252
	2.4GHz/802.11b	Right Tilt	1	21.16	22.00	1.213	0.709	0.860
	2.4GHz/802.11b	Right Tilt	11	20.58	21.50	1.236	0.853	1.054

Note:

1. Per KDB 447498 D01v06, for each exposure position, if the highest output power channel Reported SAR ≤ 0.8 W/kg, other channels SAR testing is not necessary.
2. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8 W/kg.
3. Per KDB 941225 D05v02r05, 100% RB allocation SAR measurement is not required when the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg.
4. Per KDB 248227 D01v02r02, for 802.11b DSSS , when the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required in that exposure configuration.
5. Per KDB 248227 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 ≤ 1.2 W/kg. Cuz the maximum output power specified for OFDM and DSSS are 28.51mW(14.55dBm) and 46.03mW(16.63dBm), the scaled SAR would be $0.144 \times (28.51/46.03)=0.09$ W/Kg <1.2 W/kg, therefore, SAR is not required for OFDM.
6. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.



14.2 Standalone Body-worn SAR

> GSM Body-worn SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	GPRS850/4TX Slots	Front Side	251	28.93	30.00	1.279	0.163	0.209
8#	GPRS850/4TX Slots	Back Side	251	28.93	30.00	1.279	0.471	0.603
	GPRS1900/4TX Slots	Front Side	661	26.17	27.00	1.211	0.303	0.367
9#	GPRS1900/4TX Slots	Back Side	661	26.17	27.00	1.211	0.482	0.584

> FDD-LTE 10MHz QPSK Body-worn SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 5/1RB#25	Front Side	20450	24.07	24.50	1.104	0.104	0.115
10#	Band 5/1RB#25	Back Side	20450	24.07	24.50	1.104	0.292	0.322
	Band 5/25RB#25	Front Side	20450	22.86	23.50	1.159	0.082	0.095
	Band 5/25RB#25	Back Side	20450	22.86	23.50	1.159	0.227	0.263

> TDD-LTE 10MHz QPSK Body-worn SAR

Band 40_Band 1:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 40/1RB#0	Front Side	38750	23.12	24.00	1.225	0.105	0.129
11#	Band 40/1RB#0	Back Side	38750	23.12	24.00	1.225	0.216	0.265
	Band 40/25RB#12	Front Side	38750	22.17	23.00	1.211	0.090	0.109
	Band 40/25RB#12	Back Side	38750	22.17	23.00	1.211	0.151	0.183

Band 40_Band 2:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 40/1RB#49	Front Side	39200	23.32	24.00	1.169	0.162	0.189
12#	Band 40/1RB#49	Back Side	39200	23.32	24.00	1.169	0.227	0.265
	Band 40/25RB#0	Front Side	39200	22.14	23.00	1.219	0.123	0.150
	Band 40/25RB#0	Back Side	39200	22.14	23.00	1.219	0.179	0.218

> TDD-LTE 20MHz QPSK Body-worn SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 41/1RB#49	Front Side	40600	22.10	23.00	1.230	0.208	0.256
13#	Band 40/1RB#49	Back Side	39200	23.32	24.00	1.169	0.227	0.265
	Band 41/50RB#24	Front Side	40600	21.19	22.00	1.205	0.167	0.201
	Band 41/50RB#24	Back Side	40600	21.19	22.00	1.205	0.239	0.288

➤ **WLAN 2.4GHz Body-worn SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	2.4GHz/802.11b	Front Side	6	21.21	22.00	1.199	0.166	0.199
14#	2.4GHz/802.11b	Back Side	6	21.21	22.00	1.199	0.313	0.375

Note:

1. 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. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA output power is < 0.25dB higher than RMC 12.2kbps, or Reported SAR with RMC 12.2kbps setting is \leq 1.2W/kg, HSDPA SAR evaluation can be excluded.
3. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.



14.3 Standalone Hotspot SAR

> GSM Hotspot SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	GPRS850/4TX Slots	Front Side	251	28.93	30.00	1.279	0.163	0.209
15#	GPRS850/4TX Slots	Back Side	251	28.93	30.00	1.279	0.471	0.603
	GPRS850/4TX Slots	Left Side	251	28.93	30.00	1.279	0.064	0.082
	GPRS850/4TX Slots	Right Side	251	28.93	30.00	1.279	0.199	0.255
	GPRS850/4TX Slots	Bottom Side	251	28.93	30.00	1.279	0.182	0.233
	GPRS1900/4TX Slots	Front Side	661	26.17	27.00	1.211	0.303	0.367
16#	GPRS1900/4TX Slots	Back Side	661	26.17	27.00	1.211	0.482	0.584
	GPRS1900/4TX Slots	Left Side	661	26.17	27.00	1.211	0.277	0.335
	GPRS1900/4TX Slots	Right Side	661	26.17	27.00	1.211	0.107	0.130
	GPRS1900/4TX Slots	Bottom Side	661	26.17	27.00	1.211	0.474	0.574

> FDD-LTE 10MHz QPSK Hotspot SAR

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 5/1RB#25	Front Side	20450	24.07	24.50	1.104	0.104	0.115
17#	Band 5/1RB#25	Back Side	20450	24.07	24.50	1.104	0.292	0.322
	Band 5/1RB#25	Left Side	20450	24.07	24.50	1.104	0.049	0.054
	Band 5/1RB#25	Right Side	20450	24.07	24.50	1.104	0.187	0.206
	Band 5/1RB#25	Bottom Side	20450	24.07	24.50	1.104	0.126	0.139
	Band 5/25RB#25	Front Side	20450	22.86	23.50	1.159	0.082	0.095
	Band 5/25RB#25	Back Side	20450	22.86	23.50	1.159	0.227	0.263
	Band 5/25RB#25	Left Side	20450	22.86	23.50	1.159	0.037	0.042
	Band 5/25RB#25	Right Side	20450	22.86	23.50	1.159	0.145	0.168
	Band 5/25RB#25	Bottom Side	20450	22.86	23.50	1.159	0.096	0.111

> TDD-LTE 10MHz QPSK Hotspot SAR

Band 40_Band 1:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 40/1RB#0	Front Side	38750	23.12	24.00	1.225	0.105	0.129
18#	Band 40/1RB#0	Back Side	38750	23.12	24.00	1.225	0.216	0.265
	Band 40/1RB#0	Left Side	38750	23.12	24.00	1.225	0.111	0.136
	Band 40/1RB#0	Right Side	38750	23.12	24.00	1.225	0.029	0.036
	Band 40/1RB#0	Bottom Side	38750	23.12	24.00	1.225	0.174	0.213
	Band 40/25RB#12	Front Side	38750	22.17	23.00	1.211	0.090	0.109
	Band 40/25RB#12	Back Side	38750	22.17	23.00	1.211	0.151	0.183
	Band 40/25RB#12	Left Side	38750	22.17	23.00	1.211	0.088	0.107
	Band 40/25RB#12	Right Side	38750	22.17	23.00	1.211	0.025	0.031
	Band 40/25RB#12	Bottom Side	38750	22.17	23.00	1.211	0.135	0.163



Band 40_Band 2:

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 40/1RB#49	Front Side	39200	23.32	24.00	1.169	0.162	0.189
19#	Band 40/1RB#49	Back Side	39200	23.32	24.00	1.169	0.227	0.265
	Band 40/1RB#49	Left Side	39200	23.32	24.00	1.169	0.140	0.164
	Band 40/1RB#49	Right Side	39200	23.32	24.00	1.169	0.034	0.039
	Band 40/1RB#49	Bottom Side	39200	23.32	24.00	1.169	0.114	0.133
	Band 40/25RB#0	Front Side	39200	22.14	23.00	1.219	0.123	0.150
	Band 40/25RB#0	Back Side	39200	22.14	23.00	1.219	0.179	0.218
	Band 40/25RB#0	Left Side	39200	22.14	23.00	1.219	0.112	0.137
	Band 40/25RB#0	Right Side	39200	22.14	23.00	1.219	0.024	0.029
	Band 40/25RB#0	Bottom Side	39200	22.14	23.00	1.219	0.098	0.120

➤ **TDD-LTE 20MHz QPSK Hotspot SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-Up Limit (dBm)	Tune-Up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	Band 41/1RB#49	Front Side	40600	22.10	23.00	1.230	0.208	0.256
20#	Band 41/1RB#49	Back Side	40600	22.10	23.00	1.230	0.301	0.370
	Band 41/1RB#49	Left Side	40600	22.10	23.00	1.230	0.192	0.236
	Band 41/1RB#49	Right Side	40600	22.10	23.00	1.230	0.020	0.025
	Band 41/1RB#49	Bottom Side	40600	22.10	23.00	1.230	0.240	0.295
	Band 41/50RB#24	Front Side	40600	21.19	22.00	1.205	0.167	0.201
	Band 41/50RB#24	Back Side	40600	21.19	22.00	1.205	0.239	0.288
	Band 41/50RB#24	Left Side	40600	21.19	22.00	1.205	0.147	0.177
	Band 41/50RB#24	Right Side	40600	21.19	22.00	1.205	0.018	0.022
	Band 41/50RB#24	Bottom Side	40600	21.19	22.00	1.205	0.190	0.229

➤ **WLAN 2.4GHz Hotspot SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
	2.4GHz/802.11b	Front Side	6	21.21	22.00	1.199	0.166	0.199
21#	2.4GHz/802.11b	Back Side	6	21.21	22.00	1.199	0.313	0.375
	2.4GHz/802.11b	Left Side	6	21.21	22.00	1.199	0.214	0.257
	2.4GHz/802.11b	Top Side	6	21.21	22.00	1.199	0.132	0.158

Note:

1. 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. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA output power is < 0.25dB higher than RMC 12.2kbps, or Reported SAR with RMC 12.2kbps setting is \leq 1.2W/kg, HSDPA SAR evaluation can be excluded.
3. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.



14.4 Repeated SAR Measurement

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; steps 2)through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 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 ≥ 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 ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

➤ **Head Repeated SAR**

Plot No.	Band/Mode	Test Position	CH.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Meas. SAR _{1g} (W/kg)	Reported SAR _{1g} (W/kg)
OR	2.4GHz/802.11b	Right Tilt	6	21.21	22.00	1.199	0.880	1.056
Repeated	2.4GHz/802.11b	Right Tilt	6	21.21	22.00	1.199	0.879	1.054



15 Multi-Band Simultaneous Transmission Considerations

➤ Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown in below Figure and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

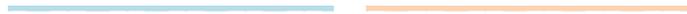


Fig.15.1 Simultaneous Transmission Paths

➤ Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤1.6 W/kg. 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 for simultaneous transmission assessment involving that transmitter.

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

Mode	Max. tune-up Power (dBm)	Exposure Position	Head	Body-worn	Hotspot
		Test Distance (mm)	0	10	10
Bluetooth	7.00	Estimated SAR (W/kg)	0.209	0.104	0.104

Note:

1. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine estimated SAR.



➤ **Multi-Band simultaneous Transmission Consideration**

Simultaneous Transmission Consideration	Position	Applicable Combination
	Head	2G/4G+WLAN 2.4GHz
		2G/4G+Bluetooth
	Body	2G/4G+WLAN 2.4GHz
		2G/4G+Bluetooth
	Hotspot	2G/4G+WLAN 2.4GHz
2G/4G+Bluetooth		

Note:

1. GSM/ LTE shares the same antenna, and cannot transmit simultaneously.
2. WLAN/Bluetooth shares the same antenna, and cannot transmit simultaneously.
3. The Report SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i. Scalar SAR summation < 1.6W/kg.
 - ii. $SPLSR = (SAR_1 + SAR_2)^{1.5} / (min. separation distance, mm)$, and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary
 - iii. Simultaneously transmission SAR measurement, and the Reported multi-band SAR < 1.6W/kg



15.1 SAR Simultaneous Transmission Analysis

➤ **Head Simultaneous Transmission**

WWAN Band		Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	Bluetooth		
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
GSM	GSM850	Right Cheek	0.187	0.867	0.209	1.054	0.396
		Right Tilt	0.090	1.056	0.209	1.146	0.299
		Left Cheek	0.150	0.245	0.209	0.395	0.359
		Left Tilt	0.074	0.252	0.209	0.326	0.283
	GSM1900	Right Cheek	0.126	0.867	0.209	0.993	0.335
		Right Tilt	0.113	1.056	0.209	1.169	0.322
		Left Cheek	0.171	0.245	0.209	0.416	0.380
		Left Tilt	0.146	0.252	0.209	0.398	0.355
LTE	LTE Band 5	Right Cheek	0.105	0.867	0.209	0.972	0.314
		Right Tilt	0.050	1.056	0.209	1.106	0.259
		Left Cheek	0.092	0.245	0.209	0.337	0.301
		Left Tilt	0.041	0.252	0.209	0.293	0.250
	LTE Band 40	Right Cheek	0.065	0.867	0.209	0.932	0.274
		Right Tilt	0.085	1.056	0.209	1.141	0.294
		Left Cheek	0.092	0.245	0.209	0.337	0.301
		Left Tilt	0.040	0.252	0.209	0.292	0.249
	LTE Band 41	Right Cheek	0.094	0.867	0.209	0.961	0.303
		Right Tilt	0.101	1.056	0.209	1.157	0.310
		Left Cheek	0.166	0.245	0.209	0.411	0.375
		Left Tilt	0.072	0.252	0.209	0.324	0.281

➤ **Body worn Simultaneous Transmission**

WWAN Band		Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	Bluetooth		
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)		
GSM	GSM850	Front	0.209	0.199	0.104	0.408	0.313
		Back	0.603	0.375	0.104	0.978	0.707
	GSM1900	Front	0.367	0.199	0.104	0.566	0.471
		Back	0.584	0.375	0.104	0.959	0.688
LTE	LTE Band 5	Front	0.115	0.199	0.104	0.314	0.219
		Back	0.322	0.375	0.104	0.697	0.426



LTE Band 40	Front	0.189	0.199	0.104	0.388	0.293
	Back	0.265	0.375	0.104	0.640	0.369
LTE Band 41	Front	0.256	0.199	0.104	0.455	0.360
	Back	0.370	0.375	0.104	0.745	0.474

➤ Hotspot Simultaneous Transmission

WWAN Band		Exposure Position	1	2	6	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
			WWAN 1g SAR (W/kg)	2.4GHz WLAN 1g SAR (W/kg)	Bluetooth Estimated 1g SAR (W/kg)		
GSM	GSM850	Front	0.209	0.199	0.104	0.408	0.313
		Back	0.603	0.375	0.104	0.978	0.707
		Left side	0.082	0.257	0.104	0.339	0.186
		Right side	0.255		0.104	0.255	0.359
		Top side		0.158	0.104	0.158	0.104
		Bottom side	0.233		0.104	0.233	0.337
	GSM1900	Front	0.367	0.199	0.104	0.566	0.471
		Back	0.584	0.375	0.104	0.959	0.688
		Left side	0.335	0.257	0.104	0.592	0.439
		Right side	0.130		0.104	0.130	0.234
		Top side		0.158	0.104	0.158	0.104
		Bottom side	0.574		0.104	0.574	0.678
LTE	LTE Band 5	Front	0.115	0.199	0.104	0.314	0.219
		Back	0.322	0.375	0.104	0.697	0.426
		Left side	0.054	0.257	0.104	0.311	0.158
		Right side	0.206		0.104	0.206	0.310
		Top side		0.158	0.104	0.158	0.104
		Bottom side	0.139		0.104	0.139	0.243
	LTE Band 40	Front	0.189	0.199	0.104	0.388	0.293
		Back	0.265	0.375	0.104	0.640	0.369
		Left side	0.164	0.257	0.104	0.421	0.268
		Right side	0.039		0.104	0.039	0.143
		Top side		0.158	0.104	0.158	0.104
		Bottom side	0.213		0.104	0.213	0.317
	LTE Band 41	Front	0.256	0.199	0.104	0.455	0.360
		Back	0.370	0.375	0.104	0.745	0.474
		Left side	0.236	0.257	0.104	0.493	0.340
		Right side	0.025		0.104	0.025	0.129
		Top side		0.158	0.104	0.158	0.104
		Bottom side	0.295		0.104	0.295	0.399



16 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 DASY uncertainty Budget is shown in the following tables.



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
Measurement System									
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	∞
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 Mechanical Tolerance	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	∞
Test sample Related									
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	5.11	5.11	∞
Output power Power drift - SAR drift measurement	6.6.2	5.0	R	$\sqrt{3}$	1	1	2.89	2.89	∞
Phantom and Tissue Parameters									
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	∞
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	∞
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			∞
Liquid permittivity – temperature uncertainty	E.3.4		R	$\sqrt{3}$	0.2 3	0.26			∞
Combined Standard Uncertainty			RSS				11.55	12.07	



Expanded Uncertainty (95% Confidence interval)			K=2				±23.20	±24.17	
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17 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the India, 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.