FCC SAR Test Report

APPLICANT	:	Sony Corporation
EQUIPMENT	:	IoT Product
BRAND NAME	:	Sony
MODEL NAME	:	AL001
FCC ID	:	AK8145899511
STANDARD	:	FCC 47 CFR Part 2 (2.1093) ANSI/IEEE C95.1-1992 IEEE 1528-2013

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

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

Reviewed by: Eric Huang / Manager

Approved by: Jones Tsai / Manager

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.)

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA7D0542A	Rev. 01	Initial issue of report	Apr. 20, 2018

1. Statement of Compliance

Applicant Name	Sony Corporation
EUT Description	IoT Product
Brand Name	Sony
Model Name	AL001
FCC ID	AK8145899511
HW Version	A
WWAN Antenna Type	Monopole
Equipment Class	Licensed
Body (1g SAR W/kg)	0.93
Highest Simultaneous Transmission (1g SAR W/kg)	1.03
Date Tested	2017/12/19
Test Result	Pass
Remark: 1. The WiFi/BT module is also integrated into this device and the SAR test results are referenced from Sporton SAR report, report number: FA7D0542B (FCC ID: AK8145890811) and these SAR results are also used to perform simultaneous transmission analysis.	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	Sony Corporation
Address	1-7-1 Konan, Minato-ku, Tokyo, 108-0075, Japan

Manufacturer	
Company Name	Sony Corporation
Address	1-7-1 Konan, Minato-ku, Tokyo, 108-0075, Japan

3. Guidance Applied

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

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 941225 D05 SAR for LTE Devices v02r05

4. Equipment Under Test (EUT) Information

Wireless Technologies	Frequency	Operating Mode
LTE	Band 2 Band 4 Band 5 Band 17	QPSK 16QAM

4.1 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r05	
FCC ID	AK8145899511
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz
Channel Bandwidth	LTE Band 02:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 04:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 05:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 17: 5MHz, 10MHz
uplink modulations used	QPSK / 16QAM
Release	9
Category	4
LTE Voice / Data requirements	Data only
LTE MPR permanently built-in by design	(see Table 6.2.3-1 below)

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3
256 QAM	≥ 1						≤ 5

LTE A-MPR	In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)
Spectrum plots for RB configuration	A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.

Transmission (H, M, L) channel numbers and frequencies in each LTE band

LTE Band 2

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900

LTE Band 4

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745

LTE Band 5

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5
H	20643	848.3	20635	847.5	20625	846.5	20600	844

LTE Band 17

	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Freq.(MHz)	Channel #	Freq. (MHz)
L	23755	706.5	23780	709
M	23790	710	23790	710
H	23825	713.5	23800	711

5. RF Exposure Limits

5.1 Uncontrolled Environment

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

5.2 Controlled Environment

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

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

6. Specific Absorption Rate (SAR)

6.1 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.

6.2 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:

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

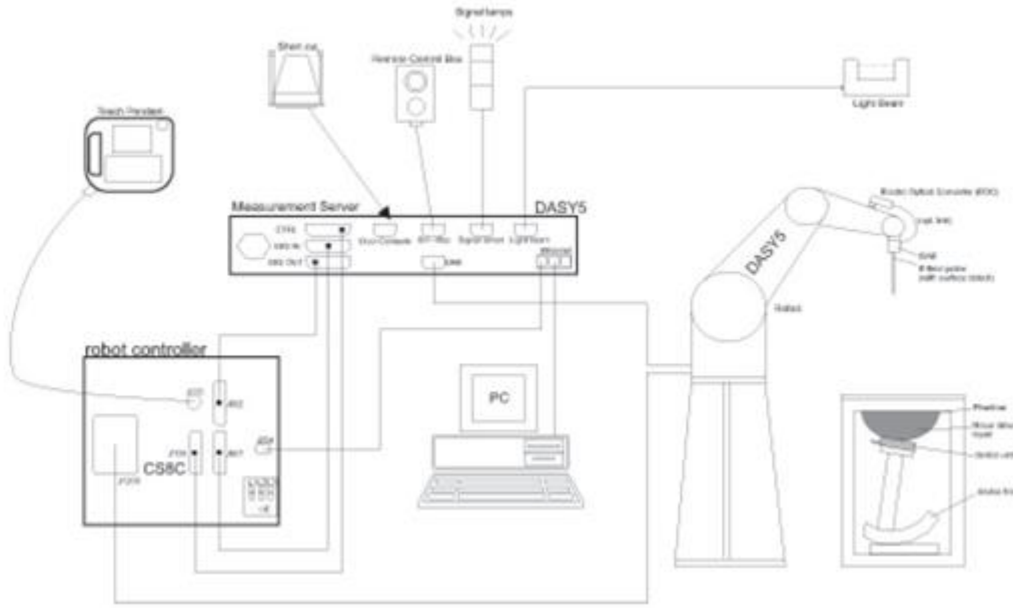
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.1 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.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)	
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	5 µW/g – >100 mW/g; Linearity: ±0.2 dB	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm	

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 µW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 µW/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

7.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

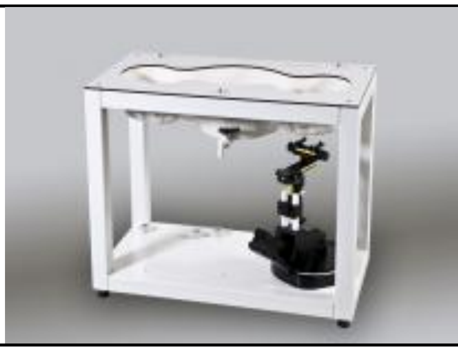
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

7.3 Phantom

<SAM Twin Phantom>

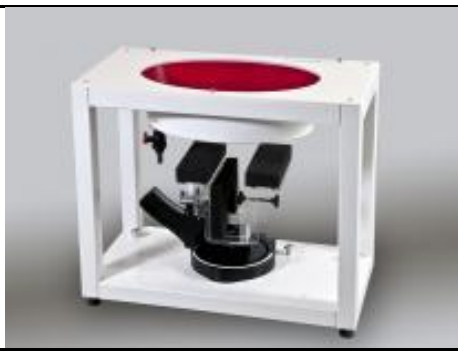
Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom



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

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm



The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

7.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

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.

Mounting Device for Laptops

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

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

<SAR measurement>

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

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

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

8.1 Spatial Peak SAR Evaluation

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

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

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

8.2 Power Reference Measurement

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

8.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

8.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.5 Volume Scan Procedures

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

8.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1012	May. 22, 2017	May. 21, 2018
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 21, 2017	Mar. 20, 2018
SPEAG	1750MHz System Validation Kit	D1750V2	1068	Nov. 15, 2017	Nov. 14, 2018
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Sep. 28, 2017	Sep. 27, 2018
SPEAG	Data Acquisition Electronics	DAE4	854	May. 02, 2017	May. 01, 2018
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	May. 24, 2017	May. 23, 2018
Gencom	Thermometer	TE1	TM685-1	Mar. 21, 2017	Mar. 20, 2018
Anritsu	Radio Communication Analyzer	MT8820C	6201074414	Apr. 03, 2016	Apr. 02, 2018
SPEAG	Device Holder	N/A	N/A	N/A	N/A
R&S	Signal Generator	SMA100A	101091	Jul. 06, 2017	Jul. 05, 2018
Agilent	ENA Network Analyzer	E5071C	MY46104758	Aug. 24, 2017	Aug. 23, 2018
SPEAG	Dielectric Probe Kit	DAK-3.5	1146	Jul. 18, 2017	Jul. 17, 2018
LINE SEIKI	Digital Thermometer	LKMelectronic	DTM3000SPEZIAL	Sep. 06, 2017	Sep. 05, 2018
Anritsu	Power Meter	ML2495A	1419002	May. 15, 2017	May. 14, 2018
Anritsu	Power Sensor	MA2411B	1339124	May. 15, 2017	May. 14, 2018
Anritsu	Power Meter	ML2495A	1218006	Oct. 06, 2017	Oct. 05, 2018
Anritsu	Power Sensor	MA2411B	1207363	Oct. 06, 2017	Oct. 05, 2018
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 23, 2017	Aug. 22, 2018
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 26, 2017	Jun. 25, 2018
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 09, 2017	Mar. 08, 2018
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	Mar. 09, 2017	Mar. 08, 2018
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

10. System Verification

10.1 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. 10.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.2.

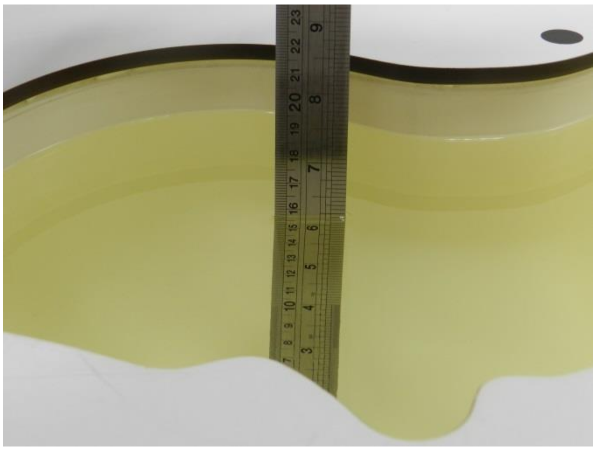


Fig 10.1Photo of Liquid Height for Head SAR

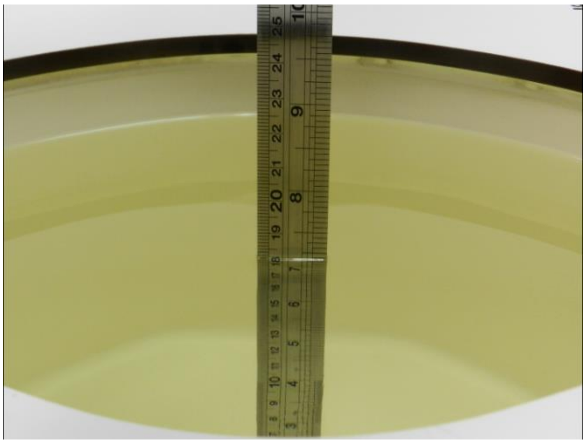


Fig 10.2 Photo of Liquid Height for Body SAR

10.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For 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
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For 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
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
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%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
750	MSL	22.3	0.976	54.334	0.96	55.50	1.67	-2.10	±5	2017/12/19
835	MSL	22.3	0.975	56.301	0.97	55.20	0.52	1.99	±5	2017/12/19
1750	MSL	22.3	1.444	55.140	1.49	53.40	-3.09	3.26	±5	2017/12/19
1900	MSL	22.3	1.513	55.751	1.52	53.30	-0.46	4.60	±5	2017/12/19

10.3 System Performance Check 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 below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2017/12/19	750	MSL	250	D750V3-1012	EX3DV4 - SN3925	DAE4 Sn854	2.19	8.71	8.76	0.57
2017/12/19	835	MSL	250	D835V2-499	EX3DV4 - SN3925	DAE4 Sn854	2.33	9.67	9.32	-3.62
2017/12/19	1750	MSL	250	D1750V2-1068	EX3DV4 - SN3925	DAE4 Sn854	9.63	37.20	38.52	3.55
2017/12/19	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3925	DAE4 Sn854	9.90	40.70	39.6	-2.70

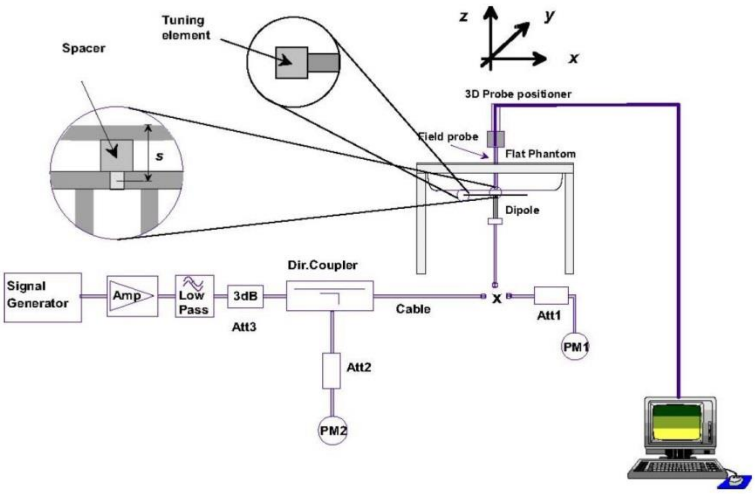


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

11. Conducted RF Output Power (Unit: dBm)

<LTE Conducted Power>

General Note:

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 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.
6. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
8. For LTE B4 / B5 / B17 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

<LTE 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)	MPR (dB)
Channel				18700	18900	19100		
Frequency (MHz)				1860	1880	1900		
20	QPSK	1	0	23.47	23.33	23.51	24	0
20	QPSK	1	49	22.86	22.90	23.21		
20	QPSK	1	99	22.63	22.95	22.96		
20	QPSK	50	0	22.53	22.50	22.96	23	1
20	QPSK	50	24	22.19	22.26	22.62		
20	QPSK	50	50	22.03	22.30	22.54		
20	QPSK	100	0	22.26	22.42	22.75		
20	16QAM	1	0	22.98	22.81	22.98	23	1
20	16QAM	1	49	22.40	22.39	22.71		
20	16QAM	1	99	22.38	22.43	22.50		
20	16QAM	50	0	21.47	21.50	21.97	22	2
20	16QAM	50	24	21.23	21.27	21.61		
20	16QAM	50	50	21.15	21.31	21.51		
20	16QAM	100	0	21.20	21.41	21.74		
Channel				18675	18900	19125	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	23.05	23.02	23.27	24	0
15	QPSK	1	37	22.58	22.72	22.88		
15	QPSK	1	74	22.40	22.76	22.57		
15	QPSK	36	0	22.37	22.41	22.81	23	1
15	QPSK	36	20	22.10	22.25	22.53		
15	QPSK	36	39	22.05	22.30	22.36		
15	QPSK	75	0	22.17	22.39	22.63		
15	16QAM	1	0	22.98	22.83	22.99	23	1
15	16QAM	1	37	22.43	22.54	22.65		
15	16QAM	1	74	22.38	22.67	22.45		
15	16QAM	36	0	21.40	21.48	21.81	22	2
15	16QAM	36	20	21.18	21.23	21.48		
15	16QAM	36	39	21.10	21.26	21.33		
15	16QAM	75	0	21.20	21.42	21.56		
Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	23.16	23.14	23.58	24	0
10	QPSK	1	25	22.76	22.69	22.82		
10	QPSK	1	49	22.72	22.93	22.71		
10	QPSK	25	0	22.28	22.38	22.64	23	1
10	QPSK	25	12	22.10	22.21	22.36		
10	QPSK	25	25	22.06	22.27	22.24		
10	QPSK	50	0	22.20	22.31	22.39		
10	16QAM	1	0	22.85	22.77	22.95	23	1
10	16QAM	1	25	22.40	22.46	22.54		
10	16QAM	1	49	22.41	22.68	22.44		
10	16QAM	25	0	21.37	21.41	21.64	22	2
10	16QAM	25	12	21.15	21.27	21.37		
10	16QAM	25	25	21.15	21.30	21.27		
10	16QAM	50	0	21.23	21.36	21.46		

Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	23.12	23.05	23.28	24	0
5	QPSK	1	12	22.93	23.01	22.68		
5	QPSK	1	24	22.92	22.87	22.64		
5	QPSK	12	0	22.31	22.26	22.41	23	1
5	QPSK	12	7	22.15	22.22	22.30		
5	QPSK	12	13	22.14	22.22	22.22		
5	QPSK	25	0	22.18	22.23	22.27		
5	16QAM	1	0	22.79	22.58	22.80	23	1
5	16QAM	1	12	22.46	22.54	22.56		
5	16QAM	1	24	22.39	22.45	22.33		
5	16QAM	12	0	21.34	21.35	21.44	22	2
5	16QAM	12	7	21.23	21.27	21.31		
5	16QAM	12	13	21.16	21.27	21.25		
5	16QAM	25	0	21.21	21.30	21.34		
Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	23.01	22.79	22.78	24	0
3	QPSK	1	8	22.97	22.71	22.64		
3	QPSK	1	14	22.92	22.70	22.52		
3	QPSK	8	0	22.25	22.26	22.26	23	1
3	QPSK	8	4	22.23	22.26	22.27		
3	QPSK	8	7	22.20	22.24	22.18		
3	QPSK	15	0	22.20	22.25	22.26		
3	16QAM	1	0	22.44	22.53	22.57	23	1
3	16QAM	1	8	22.41	22.52	22.44		
3	16QAM	1	14	22.38	22.47	22.29		
3	16QAM	8	0	21.32	21.28	21.34	22	2
3	16QAM	8	4	21.23	21.25	21.24		
3	16QAM	8	7	21.23	21.28	21.23		
3	16QAM	15	0	21.31	21.33	21.29		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	22.96	22.72	22.64	24	0
1.4	QPSK	1	3	22.91	22.71	22.56		
1.4	QPSK	1	5	22.78	22.70	22.55		
1.4	QPSK	3	0	22.69	22.78	22.67		
1.4	QPSK	3	1	22.68	22.76	22.64		
1.4	QPSK	3	3	22.70	22.74	22.62		
1.4	QPSK	6	0	22.12	22.16	22.14	23	1
1.4	16QAM	1	0	22.46	22.49	22.42	23	1
1.4	16QAM	1	3	22.50	22.51	22.39		
1.4	16QAM	1	5	22.41	22.47	22.30		
1.4	16QAM	3	0	22.29	22.32	22.20		
1.4	16QAM	3	1	22.24	22.33	22.16		
1.4	16QAM	3	3	22.20	22.33	22.15		
1.4	16QAM	6	0	21.23	21.28	21.21	22	2

<u><LTE Band 4></u>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				20050	20175	20300		
Frequency (MHz)				1720	1732.5	1745		
20	QPSK	1	0	23.25	23.10	23.28	24	0
20	QPSK	1	49	22.72	22.77	22.99		
20	QPSK	1	99	22.72	22.66	23.06		
20	QPSK	50	0	22.59	22.40	22.79	23	1
20	QPSK	50	24	22.19	22.13	22.46		
20	QPSK	50	50	22.23	22.14	22.57		
20	QPSK	100	0	22.39	22.30	22.66		
20	16QAM	1	0	22.96	22.64	22.95	24	0
20	16QAM	1	49	22.49	22.41	22.67		
20	16QAM	1	99	22.45	22.33	22.73		
20	16QAM	50	0	21.68	21.49	21.85	22	2
20	16QAM	50	24	21.26	21.24	21.53		
20	16QAM	50	50	21.31	21.21	21.62		
20	16QAM	100	0	21.42	21.32	21.73		
Channel				20025	20175	20325	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1717.5	1732.5	1747.5		
15	QPSK	1	0	23.21	23.18	23.26	24	0
15	QPSK	1	37	22.87	22.83	23.16		
15	QPSK	1	74	22.69	22.90	23.07		
15	QPSK	36	0	22.42	22.46	22.68	23	1
15	QPSK	36	20	22.16	22.27	22.52		
15	QPSK	36	39	22.09	22.29	22.51		
15	QPSK	75	0	22.22	22.38	22.63		
15	16QAM	1	0	23.00	22.93	23.00	24	0
15	16QAM	1	37	22.52	22.47	22.83		
15	16QAM	1	74	22.35	22.56	22.76		
15	16QAM	36	0	21.55	21.57	21.80	22	2
15	16QAM	36	20	21.28	21.34	21.63		
15	16QAM	36	39	21.22	21.34	21.63		
15	16QAM	75	0	21.32	21.42	21.68		
Channel				20000	20175	20350	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1732.5	1750		
10	QPSK	1	0	22.95	22.97	23.28	24	0
10	QPSK	1	25	22.63	22.70	23.18		
10	QPSK	1	49	22.57	22.99	23.24		
10	QPSK	25	0	22.30	22.40	22.72	23	1
10	QPSK	25	12	22.16	22.20	22.56		
10	QPSK	25	25	22.12	22.23	22.60		
10	QPSK	50	0	22.21	22.28	22.66		
10	16QAM	1	0	22.80	22.79	22.99	24	0
10	16QAM	1	25	22.46	22.43	22.72		
10	16QAM	1	49	22.39	22.56	22.79		
10	16QAM	25	0	21.43	21.48	21.83	22	2
10	16QAM	25	12	21.29	21.32	21.68		
10	16QAM	25	25	21.23	21.33	21.70		
10	16QAM	50	0	21.31	21.38	21.76		

Channel				19975	20175	20375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1732.5	1752.5		
5	QPSK	1	0	23.02	22.93	23.12	24	0
5	QPSK	1	12	22.85	22.80	23.21		
5	QPSK	1	24	22.81	22.85	23.15		
5	QPSK	12	0	22.27	22.29	22.66	23	1
5	QPSK	12	7	22.18	22.21	22.57		
5	QPSK	12	13	22.16	22.21	22.53		
5	QPSK	25	0	22.19	22.21	22.55		
5	16QAM	1	0	22.60	22.43	22.73	24	0
5	16QAM	1	12	22.38	22.35	22.72		
5	16QAM	1	24	22.34	22.33	22.67		
5	16QAM	12	0	21.33	21.33	21.69	22	2
5	16QAM	12	7	21.24	21.22	21.62		
5	16QAM	12	13	21.19	21.20	21.54		
5	16QAM	25	0	21.22	21.24	21.56		
Channel				19965	20175	20385	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1732.5	1753.5		
3	QPSK	1	0	22.75	22.60	23.25	24	0
3	QPSK	1	8	22.66	22.54	23.21		
3	QPSK	1	14	22.59	22.53	23.19		
3	QPSK	8	0	22.20	22.16	22.59	23	1
3	QPSK	8	4	22.16	22.18	22.58		
3	QPSK	8	7	22.14	22.16	22.56		
3	QPSK	15	0	22.17	22.14	22.57		
3	16QAM	1	0	22.51	22.38	22.86	24	0
3	16QAM	1	8	22.45	22.34	22.77		
3	16QAM	1	14	22.37	22.31	22.73		
3	16QAM	8	0	21.29	21.32	21.70	22	2
3	16QAM	8	4	21.21	21.27	21.65		
3	16QAM	8	7	21.26	21.27	21.68		
3	16QAM	15	0	21.34	21.27	21.72		
Channel				19957	20175	20393	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1732.5	1754.3		
1.4	QPSK	1	0	22.97	22.86	23.23	24	0
1.4	QPSK	1	3	22.94	22.85	23.21		
1.4	QPSK	1	5	22.90	22.85	23.23		
1.4	QPSK	3	0	22.96	22.90	23.24		
1.4	QPSK	3	1	22.95	22.92	23.22		
1.4	QPSK	3	3	22.91	22.93	23.25		
1.4	QPSK	6	0	22.24	22.20	22.55	23	1
1.4	16QAM	1	0	22.59	22.44	22.89	24	0
1.4	16QAM	1	3	22.57	22.51	22.83		
1.4	16QAM	1	5	22.51	22.46	22.80		
1.4	16QAM	3	0	22.31	22.28	22.66		
1.4	16QAM	3	1	22.31	22.31	22.66		
1.4	16QAM	3	3	22.32	22.30	22.65		
1.4	16QAM	6	0	21.39	21.35	21.73	22	2

<u><LTE Band 5></u>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				20450	20525	20600		
Frequency (MHz)				829	836.5	844		
10	QPSK	1	0	22.78	22.98	22.77	24	0
10	QPSK	1	25	22.56	22.78	22.64		
10	QPSK	1	49	22.58	22.70	22.45		
10	QPSK	25	0	22.24	22.18	22.01	23	1
10	QPSK	25	12	22.12	22.08	21.93		
10	QPSK	25	25	22.13	22.05	21.85		
10	QPSK	50	0	22.19	22.12	21.95		
10	16QAM	1	0	22.38	22.31	22.20	23	1
10	16QAM	1	25	22.22	22.07	22.11		
10	16QAM	1	49	22.12	22.02	21.88		
10	16QAM	25	0	21.09	21.00	20.93	22	2
10	16QAM	25	12	20.98	20.88	20.86		
10	16QAM	25	25	20.96	20.85	20.78		
10	16QAM	50	0	21.01	20.90	20.85		
Channel				20425	20525	20625	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				826.5	836.5	846.5		
5	QPSK	1	0	22.80	22.95	22.83	24	0
5	QPSK	1	12	22.72	22.89	22.80		
5	QPSK	1	24	22.65	22.82	22.69		
5	QPSK	12	0	22.32	22.29	22.16	23	1
5	QPSK	12	7	22.29	22.22	22.08		
5	QPSK	12	13	22.26	22.20	22.06		
5	QPSK	25	0	22.28	22.25	22.11		
5	16QAM	1	0	22.30	22.26	22.15	23	1
5	16QAM	1	12	22.35	22.18	22.12		
5	16QAM	1	24	22.23	22.11	22.00		
5	16QAM	12	0	21.17	21.05	20.95	22	2
5	16QAM	12	7	21.16	20.97	20.91		
5	16QAM	12	13	21.11	21.00	20.86		
5	16QAM	25	0	21.10	21.02	20.93		
Channel				20415	20525	20635	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				825.5	836.5	847.5		
3	QPSK	1	0	22.75	22.94	22.77	24	0
3	QPSK	1	8	22.73	22.90	22.73		
3	QPSK	1	14	22.72	22.86	22.71		
3	QPSK	8	0	22.29	22.20	22.05	23	1
3	QPSK	8	4	22.27	22.19	22.04		
3	QPSK	8	7	22.26	22.16	22.02		
3	QPSK	15	0	22.27	22.18	22.03		
3	16QAM	1	0	22.50	22.47	22.31	23	1
3	16QAM	1	8	22.55	22.46	22.30		
3	16QAM	1	14	22.46	22.37	22.20		
3	16QAM	8	0	21.40	21.33	21.15	22	2
3	16QAM	8	4	21.40	21.28	21.12		
3	16QAM	8	7	21.45	21.28	21.13		
3	16QAM	15	0	21.49	21.32	21.17		

Channel				20407	20525	20643	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				824.7	836.5	848.3		
1.4	QPSK	1	0	22.81	22.66	22.80	24	0
1.4	QPSK	1	3	22.79	22.70	22.80		
1.4	QPSK	1	5	22.81	22.89	22.81		
1.4	QPSK	3	0	22.79	22.97	22.80		
1.4	QPSK	3	1	22.79	22.95	22.80		
1.4	QPSK	3	3	22.81	22.95	22.81		
1.4	QPSK	6	0	22.28	22.21	22.07	23	1
1.4	16QAM	1	0	22.61	22.52	22.42	23	1
1.4	16QAM	1	3	22.63	22.51	22.41		
1.4	16QAM	1	5	22.63	22.47	22.38		
1.4	16QAM	3	0	22.41	22.33	22.17		
1.4	16QAM	3	1	22.44	22.34	22.17		
1.4	16QAM	3	3	22.39	22.30	22.17		
1.4	16QAM	6	0	21.41	21.34	21.17	22	2

<u><LTE Band 17></u>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				23780	23790	23800		
Frequency (MHz)				709	710	711		
10	QPSK	1	0	22.48	22.49	22.57	24	0
10	QPSK	1	25	22.54	22.50	22.49		
10	QPSK	1	49	22.39	22.39	22.50		
10	QPSK	25	0	22.03	22.02	22.08	23	1
10	QPSK	25	12	22.02	22.03	22.06		
10	QPSK	25	25	22.04	22.02	22.07		
10	QPSK	50	0	22.00	22.05	22.07		
10	16QAM	1	0	22.16	22.09	22.29	23	1
10	16QAM	1	25	22.23	21.96	22.16		
10	16QAM	1	49	22.02	21.90	22.10		
10	16QAM	25	0	20.99	20.81	21.01	22	2
10	16QAM	25	12	20.97	20.79	20.99		
10	16QAM	25	25	20.98	20.77	20.97		
10	16QAM	50	0	20.94	20.78	20.98		
Channel				23755	23790	23825	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				706.5	710	713.5		
5	QPSK	1	0	22.74	22.73	22.82	24	0
5	QPSK	1	12	22.74	22.78	22.73		
5	QPSK	1	24	22.73	22.75	22.67		
5	QPSK	12	0	22.09	22.14	22.11	23	1
5	QPSK	12	7	22.08	22.10	22.06		
5	QPSK	12	13	22.09	22.09	22.06		
5	QPSK	25	0	22.03	22.11	22.12		
5	16QAM	1	0	22.13	22.23	22.21	23	1
5	16QAM	1	12	22.19	22.24	22.11		
5	16QAM	1	24	22.12	22.16	21.99		
5	16QAM	12	0	21.02	21.02	20.93	22	2
5	16QAM	12	7	21.02	21.00	20.88		
5	16QAM	12	13	21.01	20.99	20.88		
5	16QAM	25	0	20.99	21.01	20.92		

12. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. Test positions were confirmed as acceptable with the FCC via KDB enquiry.

LTE Note:

1. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
2. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
3. Per KDB 941225 D05v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 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.
4. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
5. Per KDB 941225 D05v02r05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
6. For LTE B4 / B5 / B17 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

12.1 Body SAR

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 2	20M	QPSK	1	0	Front	0mm	19100	1900	23.51	24.00	1.119	0.09	0.016	0.018
	LTE Band 2	20M	QPSK	50	0	Front	0mm	19100	1900	22.96	23.00	1.009	-0.08	0.012	0.012
	LTE Band 2	20M	QPSK	1	0	Back	0mm	19100	1900	23.51	24.00	1.119	-0.03	0.056	0.063
	LTE Band 2	20M	QPSK	50	0	Back	0mm	19100	1900	22.96	23.00	1.009	-0.1	0.047	0.047
	LTE Band 2	20M	QPSK	1	0	Right Side	0mm	19100	1900	23.51	24.00	1.119	0.06	0.102	0.114
	LTE Band 2	20M	QPSK	50	0	Right Side	0mm	19100	1900	22.96	23.00	1.009	0.08	0.082	0.083
01	LTE Band 2	20M	QPSK	1	0	Top Side	0mm	19100	1900	23.51	24.00	1.119	-0.17	0.482	0.540
	LTE Band 2	20M	QPSK	1	0	Top Side	0mm	18700	1860	23.47	24.00	1.130	-0.17	0.430	0.486
	LTE Band 2	20M	QPSK	1	0	Top Side	0mm	18900	1880	23.33	24.00	1.167	-0.08	0.407	0.475
	LTE Band 2	20M	QPSK	50	0	Top Side	0mm	19100	1900	22.96	23.00	1.009	-0.1	0.395	0.399
	LTE Band 4	20M	QPSK	1	0	Front	0mm	20175	1732.5	23.10	24.00	1.230	-0.15	0.024	0.030
	LTE Band 4	20M	QPSK	50	0	Front	0mm	20175	1732.5	22.40	23.00	1.148	0.11	0.019	0.022
	LTE Band 4	20M	QPSK	1	0	Back	0mm	20175	1732.5	23.10	24.00	1.230	-0.01	0.128	0.157
	LTE Band 4	20M	QPSK	50	0	Back	0mm	20175	1732.5	22.40	23.00	1.148	-0.09	0.114	0.131
	LTE Band 4	20M	QPSK	1	0	Right Side	0mm	20175	1732.5	23.10	24.00	1.230	-0.13	0.116	0.143
	LTE Band 4	20M	QPSK	50	0	Right Side	0mm	20175	1732.5	22.40	23.00	1.148	0.09	0.100	0.115
02	LTE Band 4	20M	QPSK	1	0	Top Side	0mm	20175	1732.5	23.10	24.00	1.230	-0.11	0.754	0.928
	LTE Band 4	20M	QPSK	50	0	Top Side	0mm	20175	1732.5	22.40	23.00	1.148	-0.02	0.656	0.753
	LTE Band 4	20M	QPSK	100	0	Top Side	0mm	20175	1732.5	22.30	23.00	1.175	-0.18	0.591	0.694
	LTE Band 5	10M	QPSK	1	0	Front	0mm	20525	836.5	22.98	24.00	1.265	-0.19	0.028	0.035
	LTE Band 5	10M	QPSK	25	0	Front	0mm	20525	836.5	22.18	23.00	1.208	0.06	0.023	0.028
	LTE Band 5	10M	QPSK	1	0	Back	0mm	20525	836.5	22.98	24.00	1.265	-0.11	0.026	0.033
	LTE Band 5	10M	QPSK	25	0	Back	0mm	20525	836.5	22.18	23.00	1.208	0.11	0.021	0.025
	LTE Band 5	10M	QPSK	1	0	Right Side	0mm	20525	836.5	22.98	24.00	1.265	-0.05	0.042	0.053
	LTE Band 5	10M	QPSK	25	0	Right Side	0mm	20525	836.5	22.18	23.00	1.208	0.01	0.035	0.042
03	LTE Band 5	10M	QPSK	1	0	Top Side	0mm	20525	836.5	22.98	24.00	1.265	0	0.373	0.472
	LTE Band 5	10M	QPSK	25	0	Top Side	0mm	20525	836.5	22.18	23.00	1.208	-0.06	0.318	0.384
	LTE Band 17	10M	QPSK	1	0	Front	0mm	23790	710	22.49	24.00	1.416	-0.16	0.034	0.048
	LTE Band 17	10M	QPSK	25	0	Front	0mm	23790	710	22.02	23.00	1.253	0.18	0.033	0.041
	LTE Band 17	10M	QPSK	1	0	Back	0mm	23790	710	22.49	24.00	1.416	-0.12	0.067	0.095
	LTE Band 17	10M	QPSK	25	0	Back	0mm	23790	710	22.02	23.00	1.253	-0.08	0.059	0.074
	LTE Band 17	10M	QPSK	1	0	Right Side	0mm	23790	710	22.49	24.00	1.416	-0.16	0.057	0.081
	LTE Band 17	10M	QPSK	25	0	Right Side	0mm	23790	710	22.02	23.00	1.253	0.02	0.056	0.070
04	LTE Band 17	10M	QPSK	1	0	Top Side	0mm	23790	710	22.49	24.00	1.416	-0.17	0.457	0.647
	LTE Band 17	10M	QPSK	25	0	Top Side	0mm	23790	710	22.02	23.00	1.253	-0.16	0.420	0.526

13. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WWAN + 2.4GHz WLAN	Yes
2.	WWAN + Bluetooth	Yes

General Note:

1. The WiFi/BT module is also integrated into this device and the SAR test results are referenced from Sporton SAR report, report number: FA7D0542B (FCC ID: AK8145890811) and these SAR results are also used to perform simultaneous transmission analysis.
2. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
3. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

13.1 Body Exposure Conditions

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)	1g SAR (W/kg)		
LTE	LTE Band 2	Front	0.018	0.099	0.029	**0.117**	**0.047**
		Back	0.063	0.099	0.029	**0.162**	**0.092**
		Right side	0.114	0.099	0.029	**0.213**	**0.143**
		Top side	0.540	0.099	0.029	**0.639**	**0.569**
	LTE Band 4	Front	0.030	0.099	0.029	**0.129**	**0.059**
		Back	0.157	0.099	0.029	**0.256**	**0.186**
		Right side	0.143	0.099	0.029	**0.242**	**0.172**
		Top side	0.928	0.099	0.029	**1.027**	**0.957**
	LTE Band 5	Front	0.035	0.099	0.029	**0.134**	**0.064**
		Back	0.033	0.099	0.029	**0.132**	**0.062**
		Right side	0.053	0.099	0.029	**0.152**	**0.082**
		Top side	0.472	0.099	0.029	**0.571**	**0.501**
	LTE Band 17	Front	0.048	0.099	0.029	**0.147**	**0.077**
		Back	0.095	0.099	0.029	**0.194**	**0.124**
		Right side	0.081	0.099	0.029	**0.180**	**0.110**
		Top side	0.647	0.099	0.029	**0.746**	**0.676**

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14. Uncertainty Assessment

Pre KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg. Therefore, the measurement uncertainty table is not required in this report.

15. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[6] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015

[7] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[8] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.