FCC SAR TEST REPORT

FCC ID	:	**GKR-LN100EG3L**
Equipment	:	**Notebook Computer**
Brand Name	:	**Lenovo**
Model Name	:	**Lenovo 100e Chromebook Gen 3**********(*=0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product)**
Applicant	:	**Compal Electronics Inc No. 581 & 581-1, Ruiguang Rd., Neihu District, Taipei City 11492, Taiwan, R.O.C**
Standard	:	**FCC 47 CFR Part 2 (2.1093)**

Equipment: Fibocom NL668-AM-00 is tested inside of Lenovo Notebook Computer.

The product was received on Apr 28, 2021 and testing was started from May 05, 2021 and completed on May 08, 2021. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

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

Cona Huang

Approved by: Cona Huang / Deputy Manager

ilac-MRA TAF Testing Laboratory 1190

Sporton International Inc. EMC & Wireless Communications Laboratory

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History of this test report

Report No.	Version	Description	Issued Date
FA142034-01	01	Initial issue of report	Jun. 10, 2021

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Compal Electronics Inc, Notebook Computer, Lenovo 100e Chromebook Gen 3**********(*=0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product), are as follows.

Equipment Class	Frequency Band	Highest SAR Summary Body (Separation 0mm) 1g SAR (W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)
Licensed	WCDMA II	0.06	1.53
	WCDMA IV	0.03	
	WCDMA V	0.13	
	LTE Band 2	0.07	
	LTE Band 5	0.08	
	LTE Band 12 / 17	0.07	
	LTE Band 13	0.04	
	LTE Band 4 / 66	0.01	
	LTE Band 71	0.03	
Date of Testing:		2021/5/5 ~ 2021/5/8	

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. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) 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

Reviewed by: Jason Wang
Report Producer: Carlie Tsai

2. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards, the below KDB standard may not including in the TAF code without accreditation.

- 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 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05

3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	Lenovo 100e Chromebook Gen 3**********(*=0~9, A~Z, a~z, "-" or blank, for marketing use only, with no impact on RF compliance of the product)
FCC ID	GKR-LN100EG3L
Integrated WWAN Module	Brand Name: Fibocom Model Name: NL668-AM-00
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz
Mode	RMC 12.2Kbps HSDPA HSUPA LTE: QPSK, 16QAM
Remark: 1. This device has two antenna vendors, RF exposure evaluation selects South Star as the main test, Maglayers will spot check worst case found in South Star.	

WWAN Antenna Information				
Main Antenna	Manufacturer	Maglayers	Peak gain(dbi)	-1.32
	Part number	DC33002K410 (FPA-8011-4G0C7-A1)	Type	Couple
	Manufacturer	South Star	Peak gain(dbi)	-1.63
	Part number	DC33002IZ10 (N19-0848-R0A)	Type	PIFA

WLAN Module Information	
Integrated WLAN Module	Brand Name: Intel® Wi-Fi AX200 Model Name: AX200NGW
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz WLAN U-NII 1: 5150 MHz ~ 5250 MHz WLAN U-NII 2: 5250 MHz ~ 5350 MHz WLAN U-NII 3: 5470 MHz ~ 5725 MHz WLAN U-NII 4: 5725 MHz ~ 5825 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Mode	WLAN: 802.11a/b/g/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
Remark: 1. The AX200NGW is also integrated into this host, the WLAN and Bluetooth SAR results are referenced to FCC ID: O57AX200NGW, Sporton SAR report no.: FA142034 and the results are used to perform simultaneous transmission analysis	

WLAN Antenna Information				
Antenna 1	Antenna Part Number	Manufacture	Antenna Type	Peak Gain(dBi)
	Aux Antenna DC33002IZ20 (N12-7697-R0A)	South Star	Monopole	2400-2500MHz: -4.11 dBi
				5150-5350 MHz:-4.99 dBi
				5470-5725MHz:-6.02 dBi
				5725-5875MHz:-6.71 dBi
	Aux Antenna DC33002K420 (PCA-4010-25GC7-A1)	Maglayers	Monopole	2400-2500MHz: -3.97 dBi
				5150-5350 MHz:-4.83 dBi
				5470-5725MHz:-5.91 dBi
				5725-5875MHz:-6.62 dBi
Antenna 2	Antenna Part Number	Manufacture	Antenna Type	Peak Gain(dBi)
	Main Antenna DC33002IZ20 (N12-7697-R0A)	South Star	Monopole	2400-2500MHz: -2.92 dBi
				5150-5350 MHz:-3.92 dBi
				5470-5725MHz:-3.87 dBi
				5725-5875MHz:-4.77 dBi
	Main Antenna DC33002K420 (PCA-4010-25GC7-A1)	Maglayers	Monopole	2400-2500MHz: -2.77 dBi
				5150-5350 MHz:-3.79 dBi
				5470-5725MHz:-3.51 dBi
				5725-5875MHz:-4.58 dBi

3.2 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r05	
FCC ID	GKR-LN100EG3L
Equipment Name	Notebook Computer
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz
Channel Bandwidth	LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz LTE Band 13: 5MHz, 10MHz LTE Band 17: 5MHz, 10MHz LTE Band 66:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 71: 5MHz, 10MHz, 15MHz, 20MHz
uplink modulations used	QPSK / 16QAM
LTE Voice / Data requirements	Data only
LTE MPR permanently built-in by design	**Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3** Modulation | Channel bandwidth / Transmission bandwidth (N_{RB}) 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | MPR (dB) 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 12								
	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	23017	699.7	23025	700.5	23035	701.5	23060	704
M	23095	707.5	23095	707.5	23095	707.5	23095	707.5
H	23173	715.3	23165	714.5	23155	713.5	23130	711

LTE Band 13				
	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Freq.(MHz)	Channel #	Freq.(MHz)
L	23205	779.5	23230	782
M	23230	782		
H	23255	784.5		

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

LTE Band 66												
	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	131979	1710.7	131987	1711.5	131997	1712.5	132022	1715	132047	1717.5	132072	1720
M	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745
H	132665	1779.3	132657	1778.5	132647	1777.5	132622	1775	132597	1772.5	132572	1770

LTE Band 71								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	133147	665.5	133172	668	133197	670.5	133222	673
M	133297	680.5	133297	680.5	133297	680.5	133297	680.5
H	133447	695.5	133422	693	133397	690.5	133372	688

4. RF Exposure Limits

4.1 Uncontrolled Environment

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

4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. 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.

5. Specific Absorption Rate (SAR)

5.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

5.2 SAR Definition

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

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

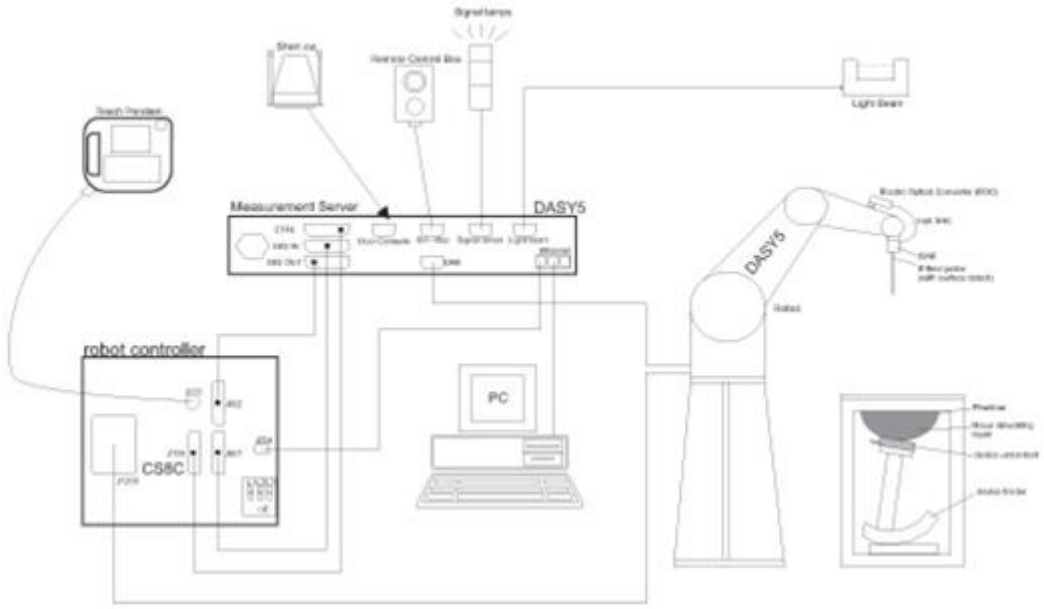
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

6. 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.

6.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. In system validation list test site number, if the test site number is include in the Wensan Laboratory, that's mean the test data are subcontracted to Sporton International Inc. Wensan Laboratory.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	

6.2 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	

6.3 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.

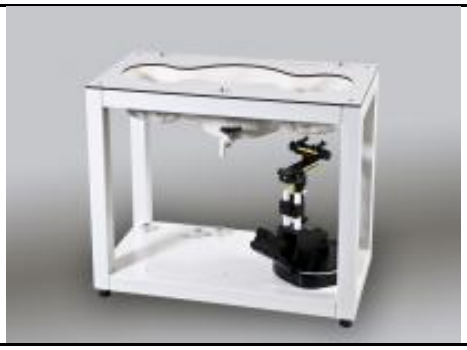
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

6.4 Phantom

<SAM Twin Phantom>

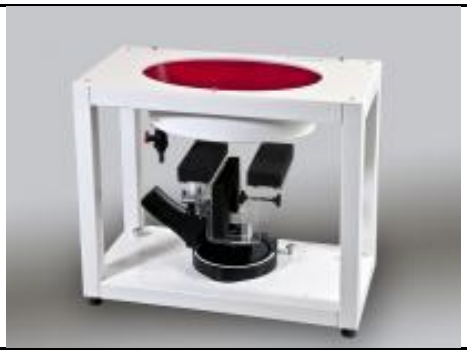
Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom



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.

6.5 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

7. 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

7.1 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

7.2 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.

7.3 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.

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

7.4 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.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

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 *reported* 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.

7.5 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.

7.6 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.

8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit(2)	D750V3	1107	Mar. 08, 2019	Mar. 05, 2022
SPEAG	835MHz System Validation Kit(2)	D835V2	4d167	Nov. 25, 2019	Nov. 23, 2021
SPEAG	1750MHz System Validation Kit(2)	D1750V2	1112	Mar. 07, 2019	Mar. 04, 2022
SPEAG	1900MHz System Validation Kit(2)	D1900V2	5d041	Sep. 11, 2018	Sep. 08, 2021
SPEAG	Data Acquisition Electronics	DAE3	495	Jul. 21, 2020	Jul. 20, 2021
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 23, 2020	Sep. 22, 2021
SPEAG	Dosimetric E-Field Probe	EX3DV4	7590	Mar. 25, 2021	Mar. 24, 2022
Testo	Hygro meter	608-H1	45196600	Nov. 10, 2020	Nov. 09, 2021
Testo	Hygro meter	608-H1	45207528	Nov. 10, 2020	Nov. 09, 2021
Anritsu	Radio Communication Analyzer	MT8821C	6201341950	Nov. 10, 2020	Nov. 09, 2021
Keysight	Wireless Communication Test Set	E5515C	MY50266977	May. 24, 2020	May. 23, 2021
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Nov. 11, 2020	Nov. 10, 2021
Keysight	ENA Network Analyzer	E5071C	MY46101588	Jun. 10, 2020	Jun. 09, 2021
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 16, 2020	Sep. 15, 2021
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Nov. 06, 2020	Nov. 05, 2021
Anritsu	Power Meter	ML2495A	1419002	Aug. 19, 2020	Aug. 18, 2021
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2020	Aug. 17, 2021
Anritsu	Power Meter	ML2495A	1804003	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Power Sensor	MA2411B	1726150	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 30, 2020	Jun. 29, 2021
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 15, 2021	Jan. 14, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 21, 2020	Oct. 20, 2021
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Aug. 26, 2020	Aug. 25, 2021
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Warison	Directional Coupler	WCOU-10-50S-10	WR889BMC4B1	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.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
750	22.3	0.893	41.403	0.89	41.90	0.34	-1.19	±5	2021/5/5
835	22.3	0.910	42.525	0.90	41.50	1.11	2.47	±5	2021/5/5
835	22.6	0.918	43.156	0.90	41.50	2.00	3.99	±5	2021/5/8
1750	22.6	1.376	39.754	1.37	40.10	0.44	-0.86	±5	2021/5/8
1900	22.6	1.425	39.551	1.40	40.00	1.79	-1.12	±5	2021/5/8

9.2 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.

Test Site	Date	Frequency (MHz)	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 (%)
SAR11	2021/5/5	750	250	D750V3-1107	ES3DV3 - SN3270	DAE3 Sn495	2.25	8.32	9	8.17
SAR11	2021/5/5	835	250	D835V2-4d167	ES3DV3 - SN3270	DAE3 Sn495	2.51	9.55	10.04	5.13
SAR05	2021/5/8	835	250	D835V2-4d167	EX3DV4 - SN7590	DAE3 Sn495	2.47	9.55	9.88	3.46
SAR05	2021/5/8	1750	250	D1750V2-1112	EX3DV4 - SN7590	DAE3 Sn495	9.85	36.70	39.4	7.36
SAR05	2021/5/8	1900	250	D1900V2-5d041	EX3DV4 - SN7590	DAE3 Sn495	10.60	40.20	42.4	5.47

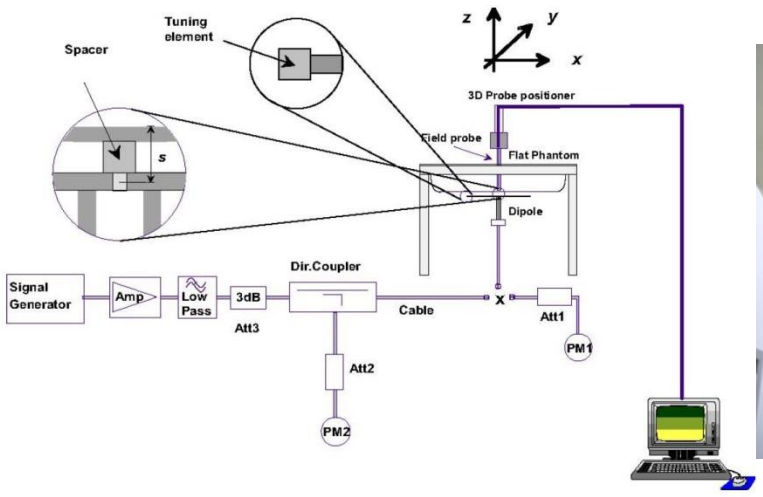


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

10. UMTS/ LTE Output Power (Unit: dBm)

<WCDMA Conducted Power>

1. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
2. The procedures in KDB 941225 D01v03r01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting:
   i. Set Gain Factors (β_c and β_d) and parameters were set according to each
   ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
   iii. Set RMC 12.2Kbps + HSDPA mode.
   iv. Set Cell Power = -86 dBm
   v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
   vi. Select HSDPA Uplink Parameters
   vii. Set Delta ACK, Delta NACK and Delta CQI = 8
   viii. Set Ack-Nack Repetition Factor to 3
   ix. Set CQI Feedback Cycle (k) to 4 ms
   x. Set CQI Repetition Factor to 2
   xi. Power Ctrl Mode = All Up bits
d. The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with β_{hs} = 30/15 * β_c, and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_c.

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

Setup Configuration

HSUPA Setup Configuration:

a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting * :
   i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
   ii. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
   iii. Set Cell Power = -86 dBm
   iv. Set Channel Type = 12.2k + HSPA
   v. Set UE Target Power
   vi. Power Ctrl Mode= Alternating bits
   vii. Set and observe the E-TFCI
   viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
d. The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (Note 4) (Note 5)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2) (Note 6)	AG Index (Note 5)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed}1$: 47/15 $\beta_{ed}2$: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	0	-	-	5/15	5/15	47/15	4	1	1.0	0.0	12	67

Note 1: For sub-test 1 to 4, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c. For sub-test 5, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 5/15 with β_{hs} = 5/15 * β_c.

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

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

Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5: β_{ed} can not be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

Setup Configuration

<WCDMA Conducted Power>

General Note:

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. The maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is ≤ ¼ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA, and according to the following RF output power, the output power results of the secondary modes (HSUPA, HSDPA) are less than ¼ dB higher than the primary modes; therefore, SAR measurement is not required for HSDPA / HSUPA.

Band		WCDMA II(New Moudule)			Tune-up Limit (dBm)	WCDMA IV(New Moudule)			Tune-up Limit (dBm)	WCDMA V(New Moudule)			Tune-up Limit (dBm)
TX Channel		9262	9400	9538		1312	1413	1513		4132	4182	4233	
Rx Channel		9662	9800	9938		1537	1638	1738		4357	4407	4458	
Frequency (MHz)		1852.4	1880	1907.6		1712.4	1732.6	1752.6		826.4	836.4	846.6	
3GPP Rel 99	RMC 12.2Kbps	23.18	23.21	23.32	24.50	22.82	23.22	22.75	24.50	23.33	23.42	23.49	24.50
3GPP Rel 6	HSDPA Subtest-1	22.24	22.46	22.55	23.50	22.00	22.07	21.90	23.50	22.53	22.61	22.56	23.50
3GPP Rel 6	HSDPA Subtest-2	22.24	22.47	22.55	23.50	22.03	22.10	21.91	23.50	22.56	22.68	22.60	23.50
3GPP Rel 6	HSDPA Subtest-3	21.74	21.98	22.17	23.00	21.57	21.61	21.42	23.00	22.06	22.20	22.10	23.00
3GPP Rel 6	HSDPA Subtest-4	21.73	21.97	22.16	23.00	21.56	21.61	21.42	23.00	22.05	22.19	22.10	23.00
3GPP Rel 6	HSUPA Subtest-1	21.76	22.33	22.17	23.50	21.65	21.69	21.53	23.50	22.59	21.99	22.63	23.50
3GPP Rel 6	HSUPA Subtest-2	21.35	21.46	21.50	21.50	21.15	21.30	20.86	21.50	21.42	21.50	21.23	21.50
3GPP Rel 6	HSUPA Subtest-3	20.95	21.27	21.50	22.50	20.78	20.92	20.76	22.50	21.32	21.33	21.35	22.50
3GPP Rel 6	HSUPA Subtest-4	21.30	21.46	21.47	21.50	21.07	21.49	21.35	21.50	21.42	21.31	21.44	21.50
3GPP Rel 6	HSUPA Subtest-5	22.50	22.70	22.80	23.50	22.20	22.30	22.20	23.50	22.60	22.70	22.70	23.50

<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/B12/B17/B71 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.
9. LTE band 4/17 SAR test was covered by Band 66/12; 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 ≤ 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

<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	22.22	22.26	22.51	24	0
20	QPSK	1	49	22.15	22.46	22.20		
20	QPSK	1	99	22.13	22.14	22.18		
20	QPSK	50	0	21.19	21.30	21.48	23	1
20	QPSK	50	24	21.12	21.31	21.30		
20	QPSK	50	50	20.15	21.32	21.28		
20	QPSK	100	0	21.06	21.28	21.36		
20	16QAM	1	0	21.13	21.47	21.28	23	1
20	16QAM	1	49	21.09	21.21	21.13		
20	16QAM	1	99	21.08	21.18	21.15		
20	16QAM	50	0	20.12	20.42	20.36	22	2
20	16QAM	50	24	20.11	20.51	20.49		
20	16QAM	50	50	20.12	20.44	20.08		
20	16QAM	100	0	20.08	20.30	20.25		
Channel				18675	18900	19125	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1857.5	1880	1902.5		
15	QPSK	1	0	22.37	22.48	22.48	24	0
15	QPSK	1	37	22.24	22.40	22.50		
15	QPSK	1	74	22.04	22.50	22.27		
15	QPSK	36	0	21.27	21.39	21.30	23	1
15	QPSK	36	20	21.15	21.37	21.30		
15	QPSK	36	39	21.13	21.36	21.43		
15	QPSK	75	0	21.13	21.42	21.38		
15	16QAM	1	0	21.18	21.29	21.42	23	1
15	16QAM	1	37	21.15	21.33	21.28		
15	16QAM	1	74	21.02	21.26	21.26		
15	16QAM	36	0	20.28	20.42	20.32	22	2
15	16QAM	36	20	20.28	20.42	20.27		
15	16QAM	36	39	20.07	20.41	20.29		
15	16QAM	75	0	20.14	20.55	20.49		
Channel				18650	18900	19150	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1855	1880	1905		
10	QPSK	1	0	22.20	22.21	22.48	24	0
10	QPSK	1	25	22.13	22.40	22.18		
10	QPSK	1	49	22.10	22.09	22.08		
10	QPSK	25	0	21.13	21.21	21.44	23	1
10	QPSK	25	12	21.09	21.22	21.26		
10	QPSK	25	25	21.13	21.26	21.21		
10	QPSK	50	0	21.06	21.24	21.32		
10	16QAM	1	0	21.10	21.47	21.26	23	1
10	16QAM	1	25	21.09	21.14	21.06		
10	16QAM	1	49	21.04	21.18	21.11		
10	16QAM	25	0	20.06	20.32	20.29	22	2
10	16QAM	25	12	20.08	20.50	20.43		
10	16QAM	25	25	20.12	20.42	20.08		
10	16QAM	50	0	20.04	20.28	20.15		
Channel				18625	18900	19175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1852.5	1880	1907.5		
5	QPSK	1	0	22.20	22.21	22.44	24	0
5	QPSK	1	12	22.07	22.42	22.13		
5	QPSK	1	24	22.11	22.04	22.18		

5	QPSK	12	0	21.14	21.26	21.42	23	1
5	QPSK	12	7	21.09	21.26	21.25		
5	QPSK	12	13	21.15	21.23	21.20		
5	QPSK	25	0	21.04	21.20	21.31		
5	16QAM	1	0	21.04	21.45	21.25	23	1
5	16QAM	1	12	21.08	21.15	21.03		
5	16QAM	1	24	21.03	21.15	21.11		
5	16QAM	12	0	20.12	20.40	20.33	22	2
5	16QAM	12	7	20.09	20.44	20.48		
5	16QAM	12	13	20.11	20.36	20.04		
5	16QAM	25	0	20.02	20.24	20.16		
Channel				18615	18900	19185	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1851.5	1880	1908.5		
3	QPSK	1	0	22.22	22.20	22.44	24	0
3	QPSK	1	8	22.08	22.44	22.14		
3	QPSK	1	14	22.03	22.14	22.13		
3	QPSK	8	0	21.11	21.23	21.41	23	1
3	QPSK	8	4	21.12	21.21	21.30		
3	QPSK	8	7	21.15	21.24	21.23		
3	QPSK	15	0	21.05	21.22	21.29		
3	16QAM	1	0	21.09	21.47	21.20	23	1
3	16QAM	1	8	21.03	21.15	21.08		
3	16QAM	1	14	21.08	21.17	21.14		
3	16QAM	8	0	20.05	20.41	20.27	22	2
3	16QAM	8	4	20.02	20.48	20.40		
3	16QAM	8	7	20.07	20.35	20.01		
3	16QAM	15	0	20.07	20.26	20.21		
Channel				18607	18900	19193	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1850.7	1880	1909.3		
1.4	QPSK	1	0	22.14	22.26	22.47	24	0
1.4	QPSK	1	3	22.05	22.39	22.11		
1.4	QPSK	1	5	22.11	22.11	22.10		
1.4	QPSK	3	0	22.22	22.18	22.49		
1.4	QPSK	3	1	22.08	22.38	22.17		
1.4	QPSK	3	3	22.10	22.10	22.08		
1.4	QPSK	6	0	21.11	21.27	21.48	23	1
1.4	16QAM	1	0	21.11	21.26	21.22	23	1
1.4	16QAM	1	3	21.15	21.27	21.21		
1.4	16QAM	1	5	21.07	21.23	21.29		
1.4	16QAM	3	0	21.13	21.38	21.23		
1.4	16QAM	3	1	21.06	21.11	21.10		
1.4	16QAM	3	3	21.13	21.38	21.23		
1.4	16QAM	6	0	20.05	20.33	20.23	22	2

<LTE Band 4>

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	23.14	22.98	22.85	24	0
20	QPSK	1	49	23.96	23.80	23.97		
20	QPSK	1	99	22.75	23.14	23.71		
20	QPSK	50	0	22.90	22.69	22.98	23	1
20	QPSK	50	24	22.70	22.71	22.96		
20	QPSK	50	50	22.66	22.79	23.00		

20	QPSK	100	0	22.67	22.86	23.00		
20	16QAM	1	0	22.40	22.14	22.20	23	1
20	16QAM	1	49	22.92	22.42	22.91		
20	16QAM	1	99	21.89	22.31	22.91		
20	16QAM	50	0	21.77	21.79	21.89	22	2
20	16QAM	50	24	21.73	21.77	21.81		
20	16QAM	50	50	21.69	21.88	21.86		
20	16QAM	100	0	21.75	21.84	21.97		
Channel				20025	20175	20325	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1717.5	1732.5	1747.5		
15	QPSK	1	0	23.06	22.89	22.81	24	0
15	QPSK	1	37	23.93	23.75	23.94		
15	QPSK	1	74	22.69	22.95	23.71		
15	QPSK	36	0	22.80	22.59	22.78	23	1
15	QPSK	36	20	22.64	22.55	22.89		
15	QPSK	36	39	22.59	22.60	22.93		
15	QPSK	75	0	22.53	22.85	22.87		
15	16QAM	1	0	22.27	22.00	22.05	23	1
15	16QAM	1	37	22.81	22.23	22.82		
15	16QAM	1	74	21.84	22.25	22.79		
15	16QAM	36	0	21.70	21.62	21.70	22	2
15	16QAM	36	20	21.59	21.68	21.75		
15	16QAM	36	39	21.63	21.71	21.84		
15	16QAM	75	0	21.66	21.73	21.90		
Channel				20000	20175	20350	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1732.5	1750		
10	QPSK	1	0	23.02	22.81	22.72	24	0
10	QPSK	1	25	23.91	23.69	23.89		
10	QPSK	1	49	22.66	22.98	23.65		
10	QPSK	25	0	22.86	22.67	22.93	23	1
10	QPSK	25	12	22.55	22.70	22.95		
10	QPSK	25	25	22.62	22.77	22.84		
10	QPSK	50	0	22.55	22.84	22.88		
10	16QAM	1	0	22.34	22.11	22.19	23	1
10	16QAM	1	25	22.80	22.29	22.87		
10	16QAM	1	49	21.82	22.24	22.82		
10	16QAM	25	0	21.71	21.59	21.75	22	2
10	16QAM	25	12	21.63	21.74	21.81		
10	16QAM	25	25	21.68	21.74	21.82		
10	16QAM	50	0	21.55	21.79	21.86		
Channel				19975	20175	20375	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1732.5	1752.5		
5	QPSK	1	0	23.06	22.92	22.80	24	0
5	QPSK	1	12	23.88	23.63	23.96		
5	QPSK	1	24	22.64	23.02	23.68		
5	QPSK	12	0	22.79	22.56	22.96	23	1
5	QPSK	12	7	22.68	22.70	22.89		
5	QPSK	12	13	22.52	22.66	23.00		
5	QPSK	25	0	22.57	22.77	22.87		
5	16QAM	1	0	22.35	22.02	22.18	23	1
5	16QAM	1	12	22.89	22.34	22.79		
5	16QAM	1	24	21.76	22.20	22.88		
5	16QAM	12	0	21.69	21.70	21.76	22	2
5	16QAM	12	7	21.70	21.62	21.68		
5	16QAM	12	13	21.66	21.77	21.67		
5	16QAM	25	0	21.69	21.74	21.83		

Channel				19965	20175	20385	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1732.5	1753.5		
3	QPSK	1	0	23.04	22.95	22.72	24	0
3	QPSK	1	8	23.84	23.71	23.85		
3	QPSK	1	14	22.70	23.05	23.59		
3	QPSK	8	0	22.74	22.62	22.82	23	1
3	QPSK	8	4	22.61	22.70	22.79		
3	QPSK	8	7	22.55	22.78	23.00		
3	QPSK	15	0	22.65	22.70	22.88		
3	16QAM	1	0	22.31	22.09	22.10	23	1
3	16QAM	1	8	22.92	22.33	22.73		
3	16QAM	1	14	21.72	22.17	22.89		
3	16QAM	8	0	21.70	21.61	21.88	22	2
3	16QAM	8	4	21.71	21.63	21.78		
3	16QAM	8	7	21.51	21.83	21.81		
3	16QAM	15	0	21.64	21.80	21.83		
Channel				19957	20175	20393	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1732.5	1754.3		
1.4	QPSK	1	0	23.00	22.81	22.81	24	0
1.4	QPSK	1	3	23.90	23.71	23.77		
1.4	QPSK	1	5	22.57	23.12	23.68		
1.4	QPSK	3	0	22.86	22.56	22.92		
1.4	QPSK	3	1	22.58	22.52	22.86		
1.4	QPSK	3	3	22.57	22.60	22.87		
1.4	QPSK	6	0	22.61	22.84	22.91	23	1
1.4	16QAM	1	0	22.37	22.03	22.08	23	1
1.4	16QAM	1	3	22.75	22.25	22.83		
1.4	16QAM	1	5	21.85	22.20	22.91		
1.4	16QAM	3	0	21.63	21.72	21.84		
1.4	16QAM	3	1	21.58	21.63	21.61		
1.4	16QAM	3	3	21.60	21.79	21.78		
1.4	16QAM	6	0	21.61	21.83	21.87	22	2

<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)	MPR (dB)
Channel				20450	20525	20600		
Frequency (MHz)				829	836.5	844		
10	QPSK	1	0	23.42	23.27	23.31	24	0
10	QPSK	1	25	23.46	23.37	23.40		
10	QPSK	1	49	23.42	23.19	23.67		
10	QPSK	25	0	22.43	22.42	22.44	23	1
10	QPSK	25	12	22.38	22.40	22.51		
10	QPSK	25	25	22.43	22.41	22.54		
10	QPSK	50	0	22.42	22.33	22.44		
10	16QAM	1	0	22.29	22.34	22.10	23	1
10	16QAM	1	25	22.28	22.06	22.12		
10	16QAM	1	49	21.91	21.79	21.92		
10	16QAM	25	0	21.45	21.41	21.53	22	2
10	16QAM	25	12	21.55	21.43	21.75		
10	16QAM	25	25	21.63	21.74	21.72		
10	16QAM	50	0	21.36	21.25	21.51		
Channel				20425	20525	20625	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				826.5	836.5	846.5		
5	QPSK	1	0	23.31	23.20	23.20	24	0

5	QPSK	1	12	23.32	23.21	23.37		
5	QPSK	1	24	23.23	23.02	23.49		
5	QPSK	12	0	22.28	22.30	22.42	23	1
5	QPSK	12	7	22.37	22.30	22.48		
5	QPSK	12	13	22.27	22.40	22.47		
5	QPSK	25	0	22.26	22.19	22.40		
5	16QAM	1	0	22.21	22.33	22.03	23	1
5	16QAM	1	12	22.11	22.01	21.92		
5	16QAM	1	24	21.89	21.62	21.83		
5	16QAM	12	0	21.27	21.40	21.34	22	2
5	16QAM	12	7	21.36	21.32	21.55		
5	16QAM	12	13	21.63	21.64	21.55		
5	16QAM	25	0	21.18	21.22	21.32		
Channel				20415	20525	20635	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				825.5	836.5	847.5		
3	QPSK	1	0	23.38	23.25	23.23	24	0
3	QPSK	1	8	23.38	23.17	23.39		
3	QPSK	1	14	23.40	23.10	23.57		
3	QPSK	8	0	22.23	22.26	22.29	23	1
3	QPSK	8	4	22.31	22.27	22.45		
3	QPSK	8	7	22.33	22.21	22.53		
3	QPSK	15	0	22.23	22.23	22.40		
3	16QAM	1	0	22.13	22.18	21.99	23	1
3	16QAM	1	8	22.26	21.96	22.09		
3	16QAM	1	14	21.79	21.74	21.92		
3	16QAM	8	0	21.31	21.31	21.42	22	2
3	16QAM	8	4	21.38	21.32	21.60		
3	16QAM	8	7	21.57	21.68	21.66		
3	16QAM	15	0	21.31	21.05	21.37		
Channel				20407	20525	20643	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				824.7	836.5	848.3		
1.4	QPSK	1	0	23.32	23.21	23.30	24	0
1.4	QPSK	1	3	23.33	23.27	23.34		
1.4	QPSK	1	5	23.31	23.13	23.48		
1.4	QPSK	3	0	22.41	22.28	22.28		
1.4	QPSK	3	1	22.27	22.39	22.50		
1.4	QPSK	3	3	22.36	22.35	22.41		
1.4	QPSK	6	0	22.39	22.22	22.39	23	1
1.4	16QAM	1	0	22.16	22.27	22.02	23	1
1.4	16QAM	1	3	22.27	21.86	22.09		
1.4	16QAM	1	5	21.71	21.78	21.91		
1.4	16QAM	3	0	21.44	21.35	21.48		
1.4	16QAM	3	1	21.47	21.25	21.70		
1.4	16QAM	3	3	21.48	21.61	21.72		
1.4	16QAM	6	0	21.35	21.23	21.47	22	2

<LTE Band 12>

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				23060	23095	23130		
Frequency (MHz)				704	707.5	711		
10	QPSK	1	0	23.86	23.78	23.59	24	0
10	QPSK	1	25	23.89	23.69	23.94		
10	QPSK	1	49	23.42	23.84	23.92		
10	QPSK	25	0	22.80	22.84	22.96	23	1

10	QPSK	25	12	22.98	22.78	22.95		
10	QPSK	25	25	22.86	22.95	22.90		
10	QPSK	50	0	22.84	22.98	22.89		
10	16QAM	1	0	22.11	22.89	22.47	23	1
10	16QAM	1	25	22.78	22.57	22.79		
10	16QAM	1	49	22.01	22.85	22.70		
10	16QAM	25	0	21.93	21.87	21.95	22	2
10	16QAM	25	12	21.97	21.83	21.94		
10	16QAM	25	25	21.85	21.96	21.83		
10	16QAM	50	0	21.94	21.92	21.95		
Channel				23035	23095	23155	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				701.5	707.5	713.5		
5	QPSK	1	0	23.76	23.70	23.43	24	0
5	QPSK	1	12	23.75	23.66	23.79		
5	QPSK	1	24	23.23	23.83	23.72		
5	QPSK	12	0	22.65	22.65	22.83	23	1
5	QPSK	12	7	22.95	22.69	22.92		
5	QPSK	12	13	22.80	22.86	22.85		
5	QPSK	25	0	22.71	22.81	22.78		
5	16QAM	1	0	21.92	22.73	22.27	23	1
5	16QAM	1	12	22.64	22.45	22.72		
5	16QAM	1	24	21.94	22.70	22.70		
5	16QAM	12	0	21.93	21.76	21.76	22	2
5	16QAM	12	7	21.88	21.66	21.92		
5	16QAM	12	13	21.69	21.78	21.79		
5	16QAM	25	0	21.89	21.73	21.95		
Channel				23025	23095	23165	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				700.5	707.5	714.5		
3	QPSK	1	0	23.71	23.69	23.45	24	0
3	QPSK	1	8	23.74	23.52	23.89		
3	QPSK	1	14	23.39	23.68	23.81		
3	QPSK	8	0	22.80	22.68	22.93	23	1
3	QPSK	8	4	22.81	22.60	22.95		
3	QPSK	8	7	22.85	22.77	22.78		
3	QPSK	15	0	22.84	22.84	22.88		
3	16QAM	1	0	21.96	22.82	22.46	23	1
3	16QAM	1	8	22.72	22.50	22.64		
3	16QAM	1	14	21.88	22.67	22.67		
3	16QAM	8	0	21.73	21.85	21.95	22	2
3	16QAM	8	4	21.83	21.82	21.77		
3	16QAM	8	7	21.67	21.87	21.71		
3	16QAM	15	0	21.91	21.80	21.95		
Channel				23017	23095	23173	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				699.7	707.5	715.3		
1.4	QPSK	1	0	23.85	23.60	23.41	24	0
1.4	QPSK	1	3	23.84	23.51	23.86		
1.4	QPSK	1	5	23.30	23.81	23.76		
1.4	QPSK	3	0	22.70	22.75	22.89		
1.4	QPSK	3	1	22.85	22.78	22.76		
1.4	QPSK	3	3	22.74	22.81	22.79		
1.4	QPSK	6	0	22.71	22.87	22.85	23	1
1.4	16QAM	1	0	22.10	22.85	22.27	23	1
1.4	16QAM	1	3	22.62	22.56	22.78		
1.4	16QAM	1	5	21.83	22.75	22.62		
1.4	16QAM	3	0	21.76	21.71	21.95		
1.4	16QAM	3	1	21.88	21.83	21.79		

1.4	16QAM	3	3	21.65	21.77	21.79		
1.4	16QAM	6	0	21.79	21.79	21.77	22	2

<LTE Band 13>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel					23230		
Frequency (MHz)					782		
10	QPSK	1	0		23.43		24
10	QPSK	1	25		23.39		
10	QPSK	1	49		22.90		
10	QPSK	25	0		22.37		23
10	QPSK	25	12		22.32		
10	QPSK	25	25		22.31		
10	QPSK	50	0		22.34		
10	16QAM	1	0		22.11		23
10	16QAM	1	25		22.17		
10	16QAM	1	49		21.55		
10	16QAM	25	0		21.46		22
10	16QAM	25	12		21.43		
10	16QAM	25	25		21.39		
10	16QAM	50	0		21.26		
Channel				23205	23230	23255	Tune-up limit (dBm)
Frequency (MHz)				779.5	782	784.5	
5	QPSK	1	0	23.39	22.99	23.49	24
5	QPSK	1	12	23.40	23.59	23.52	
5	QPSK	1	24	23.04	22.99	23.01	
5	QPSK	12	0	22.22	22.33	22.40	23
5	QPSK	12	7	22.24	22.20	22.27	
5	QPSK	12	13	22.29	22.10	22.26	
5	QPSK	25	0	22.24	22.32	22.28	
5	16QAM	1	0	21.92	22.47	22.02	23
5	16QAM	1	12	21.89	22.33	22.02	
5	16QAM	1	24	22.03	22.28	21.95	
5	16QAM	12	0	21.19	21.31	21.24	22
5	16QAM	12	7	21.17	21.08	21.15	
5	16QAM	12	13	21.22	21.11	21.01	
5	16QAM	25	0	21.17	21.39	21.12	

<LTE Band 17>

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	22.39	22.15	22.33	24	0
10	QPSK	1	25	22.73	22.37	22.57		
10	QPSK	1	49	22.49	22.43	22.20		
10	QPSK	25	0	21.54	21.39	21.43	23	1
10	QPSK	25	12	21.51	21.48	21.40		
10	QPSK	25	25	21.54	21.45	21.46		
10	QPSK	50	0	21.53	21.45	21.43		
10	16QAM	1	0	21.34	21.11	21.18	23	1
10	16QAM	1	25	21.28	21.39	21.31		

10	16QAM	1	49	21.39	21.16	21.11		
10	16QAM	25	0	20.55	20.46	20.28	22	2
10	16QAM	25	12	20.61	20.55	20.36		
10	16QAM	25	25	20.60	20.41	20.42		
10	16QAM	50	0	20.43	20.43	20.40		
Channel				23755	23790	23825	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				706.5	710	713.5		
5	QPSK	1	0	22.38	22.08	22.26	24	0
5	QPSK	1	12	22.63	22.32	22.55		
5	QPSK	1	24	22.44	22.42	22.18		
5	QPSK	12	0	21.54	21.35	21.43	23	1
5	QPSK	12	7	21.41	21.42	21.38		
5	QPSK	12	13	21.45	21.41	21.42		
5	QPSK	25	0	21.48	21.39	21.40		
5	16QAM	1	0	21.31	21.03	21.15	23	1
5	16QAM	1	12	21.22	21.33	21.25		
5	16QAM	1	24	21.34	21.14	21.06		
5	16QAM	12	0	20.47	20.42	20.27	22	2
5	16QAM	12	7	20.52	20.54	20.34		
5	16QAM	12	13	20.58	20.40	20.40		
5	16QAM	25	0	20.36	20.42	20.31		

<LTE Band 66>

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				132072	132322	132572		
Frequency (MHz)				1720	1745	1770		
20	QPSK	1	0	22.46	22.54	22.02	24	0
20	QPSK	1	49	22.21	22.38	22.60		
20	QPSK	1	99	22.37	22.17	22.22		
20	QPSK	50	0	21.41	21.53	21.54	23	1
20	QPSK	50	24	21.33	21.44	21.22		
20	QPSK	50	50	21.28	21.28	21.26		
20	QPSK	100	0	21.31	21.37	21.23		
20	16QAM	1	0	21.55	21.47	21.17	23	1
20	16QAM	1	49	21.17	21.11	21.09		
20	16QAM	1	99	21.12	21.12	21.10		
20	16QAM	50	0	20.48	20.58	20.19	22	2
20	16QAM	50	24	20.43	20.50	20.29		
20	16QAM	50	50	20.43	20.23	20.23		
20	16QAM	100	0	20.37	20.32	20.29		
Channel				132047	132322	132597	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1717.5	1745	1772.5		
15	QPSK	1	0	22.38	22.46	22.08	24	0
15	QPSK	1	37	22.52	22.53	22.24		
15	QPSK	1	74	22.45	22.28	22.32		
15	QPSK	36	0	21.45	21.59	21.28	23	1
15	QPSK	36	20	21.39	21.36	21.28		
15	QPSK	36	39	21.38	21.28	21.29		
15	QPSK	75	0	21.40	21.51	21.27		
15	16QAM	1	0	21.25	21.38	21.03	23	1
15	16QAM	1	37	21.18	21.13	21.20		
15	16QAM	1	74	21.19	21.11	21.18		
15	16QAM	36	0	20.51	20.61	20.16	22	2
15	16QAM	36	20	20.46	20.29	20.35		

15	16QAM	36	39	20.45	20.23	20.18		
15	16QAM	75	0	20.39	20.46	20.24		
Channel				132022	132322	132622	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1715	1745	1775		
10	QPSK	1	0	22.39	22.45	22.01	24	0
10	QPSK	1	25	22.20	22.28	22.50		
10	QPSK	1	49	22.34	22.14	22.17		
10	QPSK	25	0	21.32	21.43	21.50	23	1
10	QPSK	25	12	21.25	21.35	21.15		
10	QPSK	25	25	21.19	21.28	21.24		
10	QPSK	50	0	21.31	21.31	21.15		
10	16QAM	1	0	21.47	21.37	21.09	23	1
10	16QAM	1	25	21.17	21.04	21.06		
10	16QAM	1	49	21.03	21.10	21.04		
10	16QAM	25	0	20.41	20.52	20.11	22	2
10	16QAM	25	12	20.40	20.44	20.26		
10	16QAM	25	25	20.39	20.21	20.14		
10	16QAM	50	0	20.29	20.26	20.22		
Channel				131997	132322	132647	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1712.5	1745	1777.5		
5	QPSK	1	0	22.45	22.54	22.04	24	0
5	QPSK	1	12	22.14	22.30	22.51		
5	QPSK	1	24	22.30	22.13	22.19		
5	QPSK	12	0	21.35	21.45	21.46	23	1
5	QPSK	12	7	21.31	21.44	21.18		
5	QPSK	12	13	21.22	21.28	21.18		
5	QPSK	25	0	21.21	21.35	21.21		
5	16QAM	1	0	21.45	21.41	21.07	23	1
5	16QAM	1	12	21.12	21.04	21.05		
5	16QAM	1	24	21.10	21.11	21.02		
5	16QAM	12	0	20.42	20.58	20.18	22	2
5	16QAM	12	7	20.39	20.48	20.20		
5	16QAM	12	13	20.36	20.21	20.13		
5	16QAM	25	0	20.28	20.31	20.20		
Channel				131987	132322	132657	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1711.5	1745	1778.5		
3	QPSK	1	0	22.42	22.44	22.00	24	0
3	QPSK	1	8	22.20	22.35	22.50		
3	QPSK	1	14	22.27	22.11	22.20		
3	QPSK	8	0	21.38	21.51	21.48	23	1
3	QPSK	8	4	21.25	21.40	21.17		
3	QPSK	8	7	21.20	21.26	21.20		
3	QPSK	15	0	21.21	21.29	21.16		
3	16QAM	1	0	21.53	21.43	21.11	23	1
3	16QAM	1	8	21.14	21.10	21.04		
3	16QAM	1	14	21.02	21.05	21.06		
3	16QAM	8	0	20.47	20.57	20.09	22	2
3	16QAM	8	4	20.37	20.41	20.26		
3	16QAM	8	7	20.43	20.20	20.15		
3	16QAM	15	0	20.36	20.30	20.27		
Channel				131979	132322	132665	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				1710.7	1745	1779.3		
1.4	QPSK	1	0	22.43	22.47	22.02	24	0
1.4	QPSK	1	3	22.18	22.30	22.58		
1.4	QPSK	1	5	22.31	22.15	22.20		
1.4	QPSK	3	0	22.40	22.46	22.00		

1.4	QPSK	3	1	22.18	22.28	22.51		
1.4	QPSK	3	3	22.28	22.11	22.17		
1.4	QPSK	6	0	21.36	21.53	21.54	23	1
1.4	16QAM	1	0	21.33	21.39	21.13		
1.4	16QAM	1	3	21.21	21.18	21.16		
1.4	16QAM	1	5	21.31	21.37	21.17	23	1
1.4	16QAM	3	0	21.54	21.43	21.12		
1.4	16QAM	3	1	21.12	21.06	21.05		
1.4	16QAM	3	3	21.04	21.02	21.01		
1.4	16QAM	6	0	20.43	20.55	20.09	22	2

<LTE Band 71>

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				133222	133322	133372		
Frequency (MHz)				673	683	688		
20	QPSK	1	0	23.21	23.30	23.27		
20	QPSK	1	49	23.55	23.87	23.69	24	0
20	QPSK	1	99	23.63	23.64	23.36		
20	QPSK	50	0	22.47	22.53	22.57		
20	QPSK	50	24	22.49	22.38	22.66	23	1
20	QPSK	50	50	22.42	22.59	22.64		
20	QPSK	100	0	22.51	22.46	22.76		
20	16QAM	1	0	22.44	22.16	22.23		
20	16QAM	1	49	22.29	22.16	22.47	23	1
20	16QAM	1	99	22.28	22.01	22.78		
20	16QAM	50	0	21.41	21.54	21.72		
20	16QAM	50	24	21.48	21.57	21.72	22	2
20	16QAM	50	50	21.54	21.68	21.57		
20	16QAM	100	0	21.38	21.54	21.70		
Channel				133197	133297	133397	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				670.5	680.5	690.5		
15	QPSK	1	0	23.19	23.13	23.11		
15	QPSK	1	37	23.35	23.80	23.65	24	0
15	QPSK	1	74	23.59	23.49	23.34		
15	QPSK	36	0	22.34	22.47	22.55		
15	QPSK	36	20	22.40	22.30	22.61	23	1
15	QPSK	36	39	22.40	22.54	22.55		
15	QPSK	75	0	22.38	22.38	22.63		
15	16QAM	1	0	22.33	22.16	22.10		
15	16QAM	1	37	22.10	22.01	22.43	23	1
15	16QAM	1	74	22.17	22.01	22.75		
15	16QAM	36	0	21.40	21.54	21.72		
15	16QAM	36	20	21.45	21.44	21.56	22	2
15	16QAM	36	39	21.47	21.60	21.38		
15	16QAM	75	0	21.30	21.41	21.50		
Channel				133172	133272	133422	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				668	678	693		
10	QPSK	1	0	23.18	23.18	23.15		
10	QPSK	1	25	23.55	23.80	23.67	24	0
10	QPSK	1	49	23.63	23.60	23.17		
10	QPSK	25	0	22.36	22.41	22.42		
10	QPSK	25	12	22.43	22.19	22.53	23	1
10	QPSK	25	25	22.28	22.40	22.46		

10	QPSK	50	0	22.46	22.28	22.56		
10	16QAM	1	0	22.44	22.16	22.04	23	1
10	16QAM	1	25	22.17	21.97	22.40		
10	16QAM	1	49	22.16	21.82	22.62		
10	16QAM	25	0	21.21	21.39	21.63	22	2
10	16QAM	25	12	21.45	21.46	21.68		
10	16QAM	25	25	21.42	21.50	21.56		
10	16QAM	50	0	21.22	21.50	21.68		
Channel				133147	133247	133447	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				665.5	675.5	695.5		
5	QPSK	1	0	23.08	23.28	23.07	24	0
5	QPSK	1	12	23.42	23.85	23.54		
5	QPSK	1	24	23.53	23.59	23.26		
5	QPSK	12	0	22.33	22.49	22.44	23	1
5	QPSK	12	7	22.45	22.18	22.53		
5	QPSK	12	13	22.42	22.58	22.59		
5	QPSK	25	0	22.44	22.27	22.68		
5	16QAM	1	0	22.44	21.96	22.13	23	1
5	16QAM	1	12	22.29	22.16	22.33		
5	16QAM	1	24	22.24	21.93	22.63		
5	16QAM	12	0	21.40	21.44	21.72	22	2
5	16QAM	12	7	21.41	21.53	21.69		
5	16QAM	12	13	21.40	21.66	21.49		
5	16QAM	25	0	21.34	21.41	21.59		

11. 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.

UMTS Note:

1. Per KDB 941225 D01v03r01, for SAR testing is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. The maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is ≤ ¼ dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA, and according to the following RF output power, the output power results of the secondary modes (HSUPA, HSDPA) are less than ¼ dB higher than the primary modes; therefore, SAR measurement is not required for HSDPA / HSUPA.

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/B12/B17/B71 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.
7. LTE band 4/17 SAR test was covered by Band 66/12; according to TCB workshop, SAR test for overlapping LTE bands can be reduced if
   a. The maximum output power, including tolerance, for the smaller band is ≤ 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.

11.1 Body SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna Vendor	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)
01	WCDMA II	RMC 12.2Kbps	Bottom of Laptop	0mm	South Star	9538	1907.6	23.32	24.50	1.312	-0.13	0.046	0.060
	WCDMA II	RMC 12.2Kbps	Bottom of Laptop	0mm	Maglayers	9538	1907.6	23.32	24.50	1.312	0.08	0.040	0.052
02	WCDMA IV	RMC 12.2Kbps	Bottom of Laptop	0mm	South Star	1413	1732.6	23.22	24.50	1.343	-0.08	0.021	0.028
	WCDMA IV	RMC 12.2Kbps	Bottom of Laptop	0mm	Maglayers	1413	1732.6	23.22	24.50	1.343	0.02	0.017	0.023
03	WCDMA V	RMC 12.2Kbps	Bottom of Laptop	0mm	South Star	4233	846.6	23.49	24.50	1.262	-0.03	0.102	0.129
	WCDMA V	RMC 12.2Kbps	Bottom of Laptop	0mm	Maglayers	4233	846.6	23.49	24.50	1.262	0.05	0.089	0.112

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Antenna Vendor	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)
04	LTE Band 2	20M	QPSK	1	0	Bottom of Laptop	0mm	South Star	19100	1900	22.51	24.00	1.409	-0.02	0.051	0.072
	LTE Band 2	20M	QPSK	50	0	Bottom of Laptop	0mm	South Star	19100	1900	21.48	23.00	1.419	0.02	0.042	0.060
	LTE Band 2	20M	QPSK	1	0	Bottom of Laptop	0mm	Maglayers	19100	1900	22.51	24.00	1.409	0.09	0.046	0.065
05	LTE Band 5	10M	QPSK	1	25	Bottom of Laptop	0mm	South Star	20525	836.5	23.37	24.00	1.156	-0.13	0.070	0.081
	LTE Band 5	10M	QPSK	25	0	Bottom of Laptop	0mm	South Star	20525	836.5	22.42	23.00	1.143	-0.01	0.050	0.057
	LTE Band 5	10M	QPSK	1	25	Bottom of Laptop	0mm	Maglayers	20525	836.5	23.37	24.00	1.156	0.05	0.058	0.067
06	LTE Band 12	10M	QPSK	1	49	Bottom of Laptop	0mm	South Star	23095	707.5	23.84	24.00	1.038	-0.18	0.065	0.067
	LTE Band 12	10M	QPSK	25	25	Bottom of Laptop	0mm	South Star	23095	707.5	22.95	23.00	1.012	-0.15	0.044	0.045
	LTE Band 12	10M	QPSK	1	49	Bottom of Laptop	0mm	Maglayers	23095	707.5	23.84	24.00	1.038	0.04	0.060	0.062
07	LTE Band 13	10M	QPSK	1	0	Bottom of Laptop	0mm	South Star	23230	782	23.43	24.00	1.140	0.01	0.035	0.040
	LTE Band 13	10M	QPSK	25	0	Bottom of Laptop	0mm	South Star	23230	782	22.37	23.00	1.156	-0.18	0.021	0.024
	LTE Band 13	10M	QPSK	1	0	Bottom of Laptop	0mm	Maglayers	23230	782	23.43	24.00	1.140	0.07	0.030	0.034
08	LTE Band 66	20M	QPSK	1	49	Bottom of Laptop	0mm	South Star	132572	1770	22.60	24.00	1.380	0.12	0.008	0.010
	LTE Band 66	20M	QPSK	50	0	Bottom of Laptop	0mm	South Star	132572	1770	21.54	23.00	1.400	0.18	0.004	0.006
	LTE Band 66	20M	QPSK	1	49	Bottom of Laptop	0mm	Maglayers	132572	1770	22.60	24.00	1.380	-0.06	0.006	0.008
09	LTE Band 71	20M	QPSK	1	49	Bottom of Laptop	0mm	South Star	133322	683	23.87	24.00	1.030	0.06	0.024	0.025
	LTE Band 71	20M	QPSK	50	50	Bottom of Laptop	0mm	South Star	133322	683	22.59	23.00	1.099	0.02	0.016	0.018
	LTE Band 71	20M	QPSK	1	49	Bottom of Laptop	0mm	Maglayers	133322	683	23.87	24.00	1.030	0.19	0.021	0.022

12. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WWAN + 2.4GHz WLAN Ant 1 + 2.4GHz WLAN Ant 2	Yes
2.	WWAN + 2.4GHz WLAN Ant 2 + Bluetooth Ant 1	Yes
3.	WWAN + 5GHz WLAN Ant 1 +5GHz WLAN Ant 2 + Bluetooth Ant 1	Yes

General Note:

1. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
2. The Scaled SAR summation is calculated based on the same configuration and test position.
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.

12.1 Body Exposure Conditions

0	1	2	3	4	5	0+1+2 Summed 1g SAR (W/kg)	0+2+5 Summed 1g SAR (W/kg)	0+3+4+5 Summed 1g SAR (W/kg)
Maximum WWAN	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2	5GHz WLAN Ant 1	5GHz WLAN Ant 2	Bluetooth Ant 1			
1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
0.129	0.575	0.643	0.664	0.635	0.104	**1.347**	**0.876**	**1.532**

Test Engineer： Charles Shen

13. Uncertainty Assessment

Per 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.

Declaration of Conformity:
The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

14. 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 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

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

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