SAR Test Report

FCC Rule Part	:	**CFR §2.1093**
Standards	:	**IEEE Std 1528:2013, KDB 865664 D01 v01r04, KDB 865664 D02 v01r02, KDB 447498 D01 v06, KDB 616217 D04 v01r02, KDB 941225 D01 v03r01, KDB 941225 D05 v02r05, KDB 941225 D05A v01r02**
Report No.	:	**SFBEDW-WTW-P24060498**
Applicant	:	**Dell Inc.**
Address	:	**One Dell Way, Round Rock, Texas 78682, USA**
Product	:	**LTE Module**
FCC ID	:	**E2KEXMG1A**
Brand	:	**COMPAL**
Model No.	:	**EXM-G1A**
Sample Received Date	:	**Nov. 06, 2024**
Date of Testing	:	**Nov. 26, 2024 ~ Nov. 29, 2024**
Lab Address	:	**No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan**
Test Location	:	**No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City, Taiwan**
FCC Accredited No.	:	**TW0003**

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch–Lin Kou Laboratories**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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Testing Laboratory 2021

Table of Contents

Release Control Record 3
1. Test Reference Guidance 4
2. Summary of Maximum SAR Value 5
3. Description of Equipment Under Test 6
4. SAR Measurement System 9
4.1 Definition of Specific Absorption Rate (SAR) 9
4.2 SPEAG DASY6 System 9
4.2.1 Robot 10
4.2.2 Probes 11
4.2.3 Data Acquisition Electronics (DAE) 11
4.2.4 Phantoms 11
4.2.5 Device Holder 12
4.2.6 System Validation Dipoles 13
4.2.7 Power Source 13
4.2.8 Tissue Simulating Liquids 14
4.3 SAR System Verification 16
4.4 SAR Measurement Procedure 18
4.4.1 Area Scan and Zoom Scan Procedure 18
4.4.2 Volume Scan Procedure 19
4.4.3 Power Drift Monitoring 20
4.4.4 Spatial Peak SAR Evaluation 20
4.4.5 SAR Averaged Methods 20
5. SAR Measurement Evaluation 21
5.1 EUT Configuration and Setting 21
5.2 EUT Testing Position 28
5.3 Tissue Verification 29
5.4 System Validation 29
5.5 System Verification 29
5.6 Maximum Output Power 29
5.6.1 Maximum Target Conducted Power 29
5.6.2 Measured Conducted Power Result 29
5.7 SAR Testing Results 30
5.7.1 SAR Test Reduction Considerations 30
5.7.2 SAR Test Results for Body Exposure Condition 31
5.7.3 SAR Measurement Variability 31
5.7.4 Simultaneous Multi-band Transmission Evaluation 32
6. Calibration of Test Equipment 38
7. Measurement Uncertainty 39
8. Information of the Testing Laboratories 40

Appendix A. Plots of SAR System Verification
Appendix B. Plots of SAR Measurement
Appendix C. Tissue & System Verification
Appendix D. Maximum Target Conducted Power
Appendix E. Measured Conducted Power Result
Appendix F. SAR Test Result
Appendix G. SAR Measurement Variability
Appendix J. Calibration of Test Equipment List
Appendix Z. Calibration Certificate for Probe and Dipole

Release Control Record

Report No.	Reason for Change	Date Issued
SFBEDW-WTW-P24060498	Initial release	Feb. 17, 2025

1. Test Reference Guidance

FCC Rule Part	:	**CFR §2.1093**
Measurement procedure	:	**IEEE STD 1528:2013, KDB 865664 D01 V01R04, KDB 865664 D02 V01R02, KDB 447498 D01 V06, KDB 616217 D04 V01R02, KDB 941225 D01 V03R01, KDB 941225 D05 V02R05, KDB 941225 D05A V01R02**

2. Summary of Maximum SAR Value

Equipment Class	Mode	Highest SAR_{1g} Body (W/kg)
PCB	WCDMA II	1.01
	WCDMA IV	1.15
	WCDMA V	0.79
	LTE 2	0.79
	LTE 4	0.90
	LTE 5	0.90
	LTE 7	0.79
	LTE 12	1.13
	LTE 13	0.70
	LTE 14	0.87
	LTE 25	0.85
	LTE 26	0.91
	LTE 38	0.82
	LTE 41	0.64
	LTE 48	0.98
	LTE 66	0.92
	LTE 71	1.10

Highest Simultaneous Transmission SAR	Highest SAR_{1g} Body (W/kg)	
	AX211NGW	BE201NGW
	1.452	1.572

Note:

1. The SAR criteria **(Head & Body: SAR-1g1.6 W/kg, and Extremity: SAR-10g 4.0 W/kg)** for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.
2. Per FCC guidance in Oct 2022 TCBC workshop, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density divided by power density limit. Numerical sum of the ratios should be less than 1.
3. Refer to Intel host report no.: 241004-04.TR01 for AX211NGW WLAN/BT SAR result.
4. Refer to Intel host report no.: 241004-02.TR01 for BE201NGW WLAN/BT SAR result.
5. Refer to BV CPS report no.: SFBEDW-WTW-P24060499 for RFID SAR result.

Test Reference Guidance: IEEE C95.1:1992

3. Description of Equipment Under Test

EUT Type	LTE Module
FCC ID	E2KEXMG1A
Brand Name	COMPAL
Model Name	EXM-G1A
Tx Frequency Bands (Unit: MHz)	WCDMA Band II : 1852.4 ~ 1907.6 WCDMA Band IV : 1712.4 ~ 1752.6 WCDMA Band V : 826.4 ~ 846.6 LTE Band 2 : 1850.7 ~ 1909.3 LTE Band 4 : 1710.7 ~ 1754.3 LTE Band 5 : 824.7 ~ 848.3 LTE Band 7 : 2502.5 ~ 2567.5 LTE Band 12 : 699.7 ~ 715.3 LTE Band 13 : 779.5 ~ 784.5 LTE Band 14 : 790.5 ~ 795.5 LTE Band 25 : 1850.7 ~ 1914.3 LTE Band 26 : 814.7 ~ 848.3 LTE Band 38 : 2572.5 ~ 2617.5 LTE Band 41 : 2498.5 ~ 2687.5 LTE Band 48 : 3552.5 ~ 3697.5 LTE Band 66 : 1710.7 ~ 1779.3 LTE Band 71 : 665.5 ~ 695.5
Uplink Modulations	WCDMA : QPSK LTE : QPSK, 16QAM, 64QAM
Maximum Tune-up Conducted Power (Unit: dBm)	Please refer to Appendix D.
Antenna Type	Refer to Note
EUT Stage	Engineering Sample

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below for more details.

Product	Brand	Model
Portable Computer	DELL	P200G

2. The antenna information is listed as below.

Ant. No.	Manufacturer	Type	P/N	Connector	Communication System	Band	Frequency (MHz) from low to high spectrum		Peak Gain W/ Cable loss (dBi)
1	Auden Techno Corp. (NB mode)	Monopole (Main/Aux) (Tx1/Rx1)	DC33002YB0L (A23128-00)	IPEX	WCDMA/ LTE FDD	2	1850	1910	2.14
					WCDMA/ LTE FDD	4	1710	1755	1.08
					WCDMA/ LTE FDD	5	824	849	-0.32
					LTE FDD	7	2500	2570	0.19
					LTE FDD	12	699	716	0.80
					LTE FDD	13	777	787	0.04
					LTE FDD	14	788	798	-0.38
					LTE FDD	25	1850	1915	2.13
					LTE FDD	26	814	849	-0.39
					LTE TDD	38	2570	2620	0.09
					LTE TDD	41	2496	2690	0.19
					LTE TDD	48	3550	3700	2.76
					LTE FDD	66	1710	1780	1.27
					LTE FDD	71	663	698	-0.77
2	Auden Techno Corp. (Tablet mode)	Monopole (Main/Aux) (Tx1/Rx1)	DC33002YB0L (A23128-00)	IPEX	WCDMA/ LTE FDD	2	1850	1910	0.42
					WCDMA/ LTE FDD	4	1710	1755	-0.53
					WCDMA/ LTE FDD	5	824	849	-3.52
					LTE FDD	7	2500	2570	1.63
					LTE FDD	12	699	716	-2.20
					LTE FDD	13	777	787	-2.38
					LTE FDD	14	788	798	-2.55
					LTE FDD	25	1850	1915	0.42
					LTE FDD	26	814	849	-3.53
					LTE TDD	38	2570	2620	0.76
					LTE TDD	41	2496	2690	1.64
					LTE TDD	48	3550	3700	-0.37
					LTE FDD	66	1710	1780	-0.24
					LTE FDD	71	663	698	-2.67
3	Wistron NeWeb Corp. (NB mode)	Monopole (Main/Aux) (Tx1/Rx1)	DC33002ZB0L (81ELBE15.G54)	IPEX	WCDMA/ LTE FDD	2	1850	1910	1.88
					WCDMA/ LTE FDD	4	1710	1755	1.03
					WCDMA/ LTE FDD	5	824	849	-0.08
					LTE FDD	7	2500	2570	0.01
					LTE FDD	12	699	716	0.92
					LTE FDD	13	777	787	0.11
					LTE FDD	14	788	798	-0.62
					LTE FDD	25	1850	1915	2.36
					LTE FDD	26	814	849	-0.04
					LTE TDD	38	2570	2620	-0.04
					LTE TDD	41	2496	2690	0.07
					LTE TDD	48	3550	3700	2.83
					LTE FDD	66	1710	1780	1.22
					LTE FDD	71	663	698	-1.11
4	Wistron NeWeb Corp. (Tablet mode)	Monopole (Main/Aux) (Tx1/Rx1)	DC33002ZB0L (81ELBE15.G54)	IPEX	WCDMA/ LTE FDD	2	1850	1910	0.38
					WCDMA/ LTE FDD	4	1710	1755	-0.46
					WCDMA/ LTE FDD	5	824	849	-3.49
					LTE FDD	7	2500	2570	1.6
					LTE FDD	12	699	716	-2.54
					LTE FDD	13	777	787	-2.32
					LTE FDD	14	788	798	-2.53
					LTE FDD	25	1850	1915	0.38
					LTE FDD	26	814	849	-3.49
					LTE TDD	38	2570	2620	0.71
					LTE TDD	41	2496	2690	1.64
					LTE TDD	48	3550	3700	-0.43
					LTE FDD	66	1710	1780	-0.28
					LTE FDD	71	663	698	-2.73

3. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

List of End-product Accessory:

Battery	**Brand Name**	DELL
	Model Name	VMV83
	Power Rating	11.7Vdc, 4700mAh, 55 Wh

4. SAR Measurement System

4.1 Definition of Specific Absorption Rate (SAR)

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.

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)

SAR measurement can be related to the electrical field in the tissue by

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

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

4.2 SPEAG DASY6 System

DASY6 system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY6 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (EOC). The EOC performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

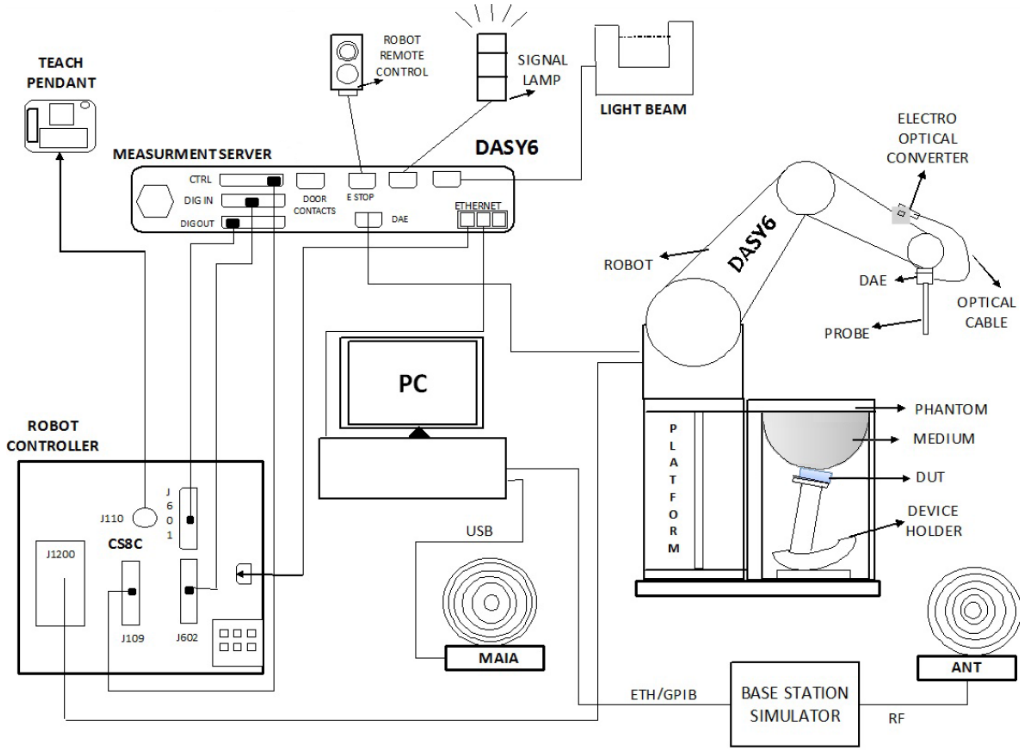


Fig-4.1 SPEAG DASY6 System Setup

4.2.1 Robot

The DASY6 system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version of CS8c from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

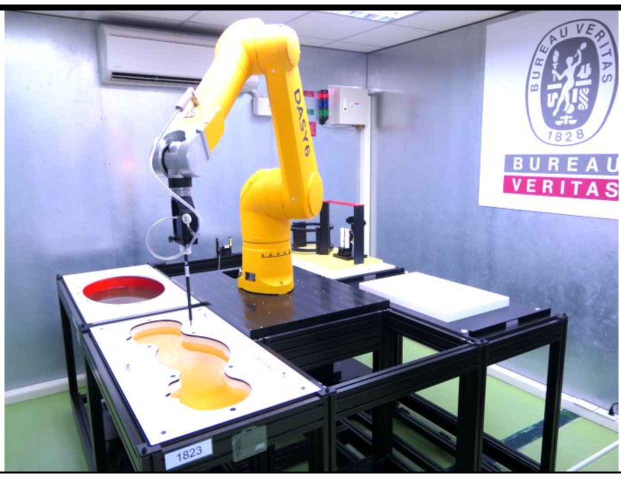


Fig-4.2 SPEAG DASY6 System

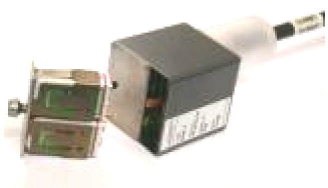
4.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. 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.

Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	4 MHz to 10 GHz Linearity: ± 0.2 dB
Directivity	± 0.1 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 μW/g to 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

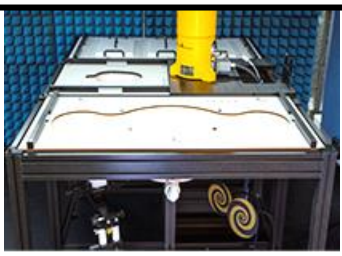
4.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5μV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm

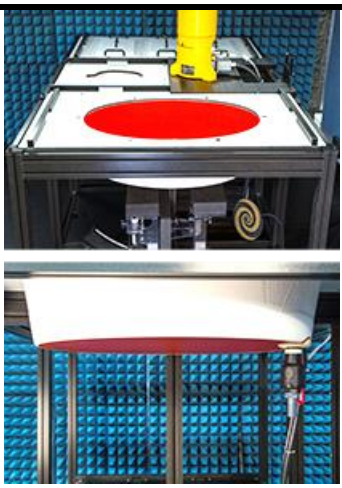


4.2.4 Phantoms

Model	SAM-Twin Phantom
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE Std 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body-mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.
Material	Vinylester, fiberglass reinforced (VE-GF)
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters



Model	ELI
Construction	The ELI phantom is used for compliance testing of handheld and body-mounted wireless devices. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.
Material	Vinylester, fiberglass reinforced (VE-GF)
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 liters



4.2.5 Device Holder

Model	MD4HHTV5 - Mounting Device for Hand-Held Transmitters
Construction	In combination with the Twin SAM 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).
Material	Polyoxymethylene (POM)

Model	MDA4WTV5 - Mounting Device Adaptor for Ultra Wide Transmitters
Construction	An 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.
Material	Polyoxymethylene (POM)

Model	MDA4SPV6 - Mounting Device Adaptor for Smart Phones
Construction	The solid low-density MDA4SPV6 adaptor assuring no impact on the DUT radiation performance and is conform with any DUT design and shape.
Material	ROHACELL

Model	MD4LAPV5 - Mounting Device for Laptops and other Body-Worn Transmitters	
Construction	In combination with the Twin SAM or ELI phantoms, the Mounting Device (Body-Worn) enables testing of transmitter devices according to IEC 62209-2 specifications. The device holder can be locked for positioning at a flat phantom section.	
Material	Polyoxymethylene (POM), PET-G, Foam	

4.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

4.2.7 Power Source

Model	Powersource1	
Signal Type	Continuous Wave	
Operating Frequencies	600 MHz to 5850 MHz	
Output Power	-5.0 dBm to +17.0 dBm	
Power Supply	5V DC, via USB jack	
Power Consumption	<3 W	
Applications	System performance check and validation with a CW signal.	

4.2.8 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. 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. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 10 % are listed in Table-4.1.

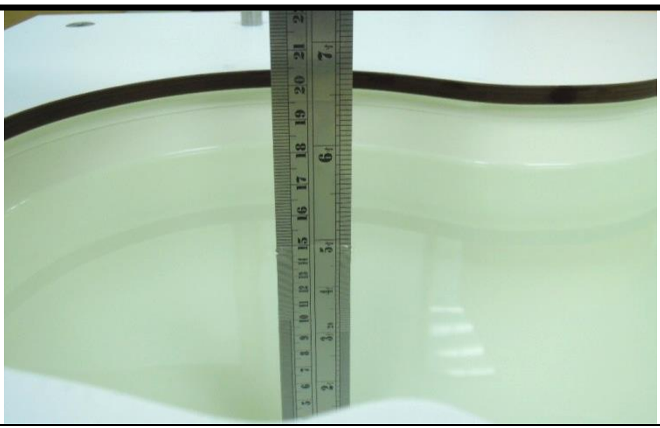


Photo of Liquid Height for Head Position

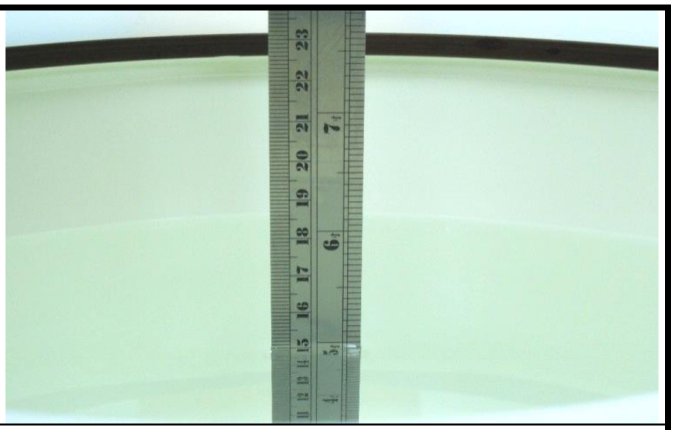


Photo of Liquid Height for Body Position

Table-4.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±10 %	Target Conductivity	Range of ±10 %
450	43.5	39.2 ~ 47.9	0.87	0.78 ~ 0.96
750	41.9	37.7 ~ 46.1	0.89	0.80 ~ 0.98
835	41.5	37.4 ~ 45.7	0.90	0.81 ~ 0.99
900	41.5	37.4 ~ 45.7	0.97	0.87 ~ 1.07
1450	40.5	36.5 ~ 44.6	1.20	1.08 ~ 1.32
1500	40.4	36.4 ~ 44.4	1.23	1.11 ~ 1.35
1640	40.2	36.2 ~ 44.2	1.31	1.18 ~ 1.44
1750	40.1	36.1 ~ 44.1	1.37	1.23 ~ 1.51
1800	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
1900	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2000	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2100	39.8	35.8 ~ 43.8	1.49	1.34 ~ 1.64
2300	39.5	35.6 ~ 43.5	1.67	1.50 ~ 1.84
2450	39.2	35.3 ~ 43.1	1.80	1.62 ~ 1.98
2600	39.0	35.1 ~ 42.9	1.96	1.76 ~ 2.16
3000	38.5	34.7 ~ 42.4	2.40	2.16 ~ 2.64
3500	37.9	34.1 ~ 41.7	2.91	2.62 ~ 3.20
4000	37.4	33.7 ~ 41.1	3.43	3.09 ~ 3.77
4500	36.8	33.1 ~ 40.5	3.94	3.55 ~ 4.33
5000	36.2	32.6 ~ 39.8	4.45	4.01 ~ 4.90
5200	36.0	32.4 ~ 39.6	4.66	4.19 ~ 5.13
5400	35.8	32.2 ~ 39.4	4.86	4.37 ~ 5.35
5600	35.5	32.0 ~ 39.1	5.07	4.56 ~ 5.58
5800	35.3	31.8 ~ 38.8	5.27	4.74 ~ 5.80
6000	35.1	31.6 ~ 38.6	5.48	4.93 ~ 6.03
6500	34.5	31.1 ~ 38.0	6.07	5.46 ~ 6.68

The dielectric properties of the tissue simulating liquids are defined in IEC 62209-1 and IEC 62209-2. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

Since the range of ±10 % of the required target values is used to measure relative permittivity and conductivity, the SAR correction procedure is applied to correct measured SAR for the deviations in permittivity and conductivity. Only positive correction has been used to scale up the measured SAR, and SAR result would not be corrected if the correction △SAR has a negative sign.

The following table gives the recipes for tissue simulating liquids.

Table-4.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether	Oxidized Mineral Oil
H750	0.2	-	0.2	1.5	56.0	-	42.1	-	-
H835	0.2	-	0.2	1.5	57.0	-	41.1	-	-
H900	0.2	-	0.2	1.4	58.0	-	40.2	-	-
H1450	-	43.3	-	0.6	-	-	56.1	-	-
H1640	-	45.8	-	0.5	-	-	53.7	-	-
H1750	-	47.0	-	0.4	-	-	52.6	-	-
H1800	-	44.5	-	0.3	-	-	55.2	-	-
H1900	-	44.5	-	0.2	-	-	55.3	-	-
H2000	-	44.5	-	0.1	-	-	55.4	-	-
H2300	-	44.9	-	0.1	-	-	55.0	-	-
H2450	-	45.0	-	0.1	-	-	54.9	-	-
H2600	-	45.1	-	0.1	-	-	54.8	-	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-	-
H5G	-	-	-	-	-	17.2	65.5	17.3	-
H6G	-	-	-	-	-	-	56.0	-	44.0

4.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

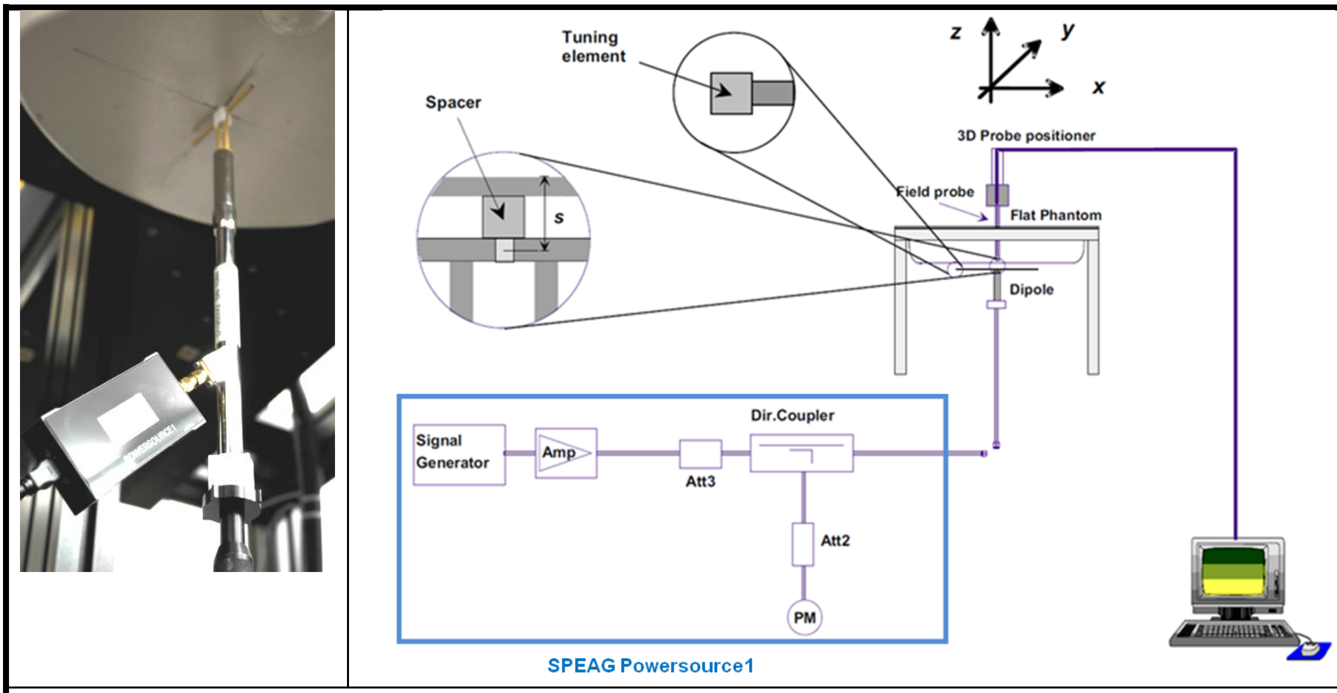


Fig-4.3a System Verification Setup for Frequency <= 6 GHz

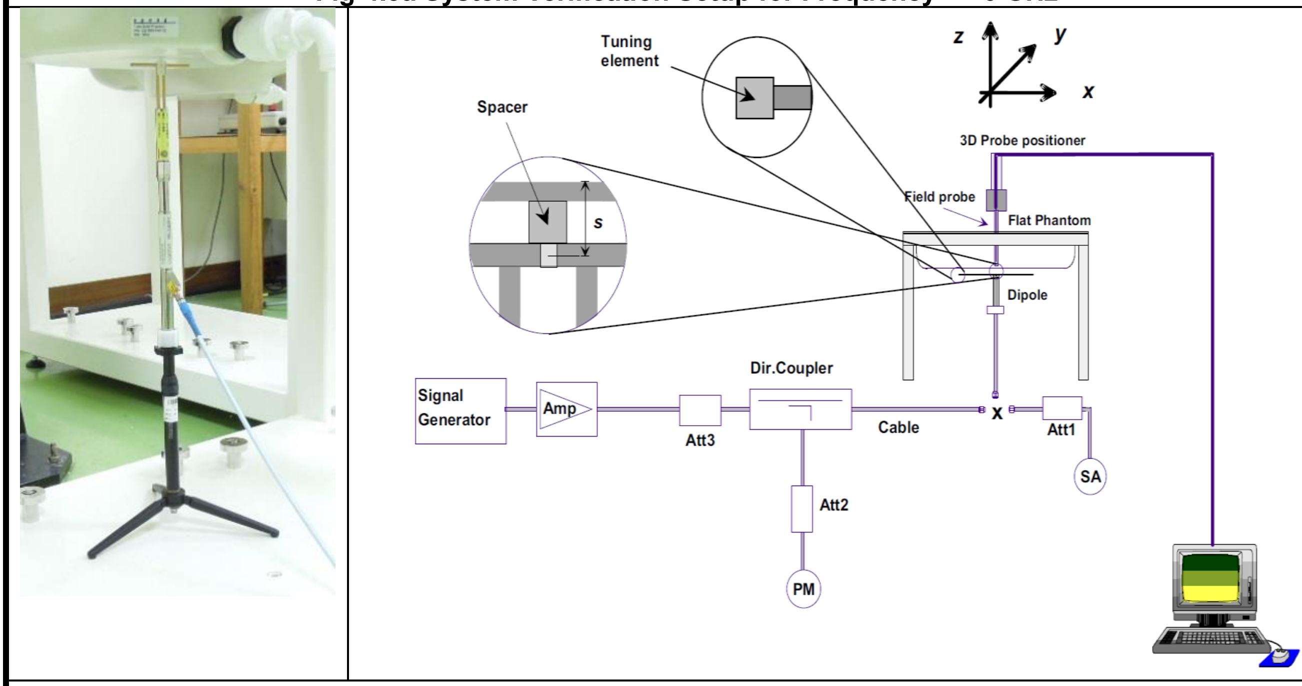


Fig-4.3b System Verification Setup for Frequency > 6 GHz

For frequency <= 6 GHz, the SPEAG Powersource1 is a portable and very stable RF source providing a continuous wave (CW) signal. It is designed for conducting SAR system checks and SAR system validation of DASY and is compatible with IEC/IEEE 62209-1528 and IEEE Std 1528 standards. The Powersource1 has been calibrated by SPEAG's ISO/IEC 17025-accredited calibration center. When using Powersource1, the setup can be simplified, as shown in Fig-4.3a. The signal purity is warranted by design. Since the Powersource1 is calibrated, no additional equipment is needed and the Powersource1 can directly be connected to the SMA connector of the dipole without a cable as all separate components (signal generator, amplifier, coupler and power meter) are built into the unit.

For frequency > 6 GHz, the setup is shown in Fig-4.3b. The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power as 100 mW at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The Powersource1 is adjusted for the desired forward power of 17 dBm or 20 dBm will be set for > 6 GHz at the dipole connector and the RF output power would be turned on. After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

4.4 SAR Measurement Procedure

According to the SAR 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

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

4.4.1 Area Scan and Zoom Scan Procedure

First area scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an area scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, zoom scan is required. The zoom scan is performed around the highest E-field value to determine the averaged SAR-distribution.

Measure the local SAR at a test point at 1.4 mm of the inner surface of the phantom recommended by SEPAG. The area scan (two-dimensional SAR distribution) is performed cover at least an area larger than the projection of the EUT or antenna. The measurement resolution and spatial resolution for interpolation shall be chosen to allow identification of the local peak locations to within one-half of the linear dimension of the corresponding side of the zoom scan volume. Following table provides the measurement parameters required for the area scan.

Parameter	$f \leqq$ 3 GHz	3 GHz < $f \leqq$ 10 GHz
Maximum distance from closest measurement point to phantom surface	5 ± 1	δ ln(2)/2 ±0.5
Maximum probe angle from probe axis to phantom surface normal at the measurement location	5° for flat phantom 30° for other phantom	5° for flat phantom 20° for other phantom
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 6 – 7 GHz: ≦7.5 mm

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks. Additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g. 1 W/kg for 1.6 W/kg, 1 g limit; or 1.26 W/kg for 2 W/kg, 10 g limit).

The zoom scan (three-dimensional SAR distribution) is performed at the local maxima locations identified in previous area scan procedure. The zoom scan volume must be larger than the required minimum dimensions. When graded grids are used, which only applies in the direction normal to the phantom surface, the initial grid separation closest to the phantom surface and subsequent graded grid increment ratios must satisfy the required protocols. The 1-g SAR averaging volume must be fully contained within the zoom scan measurement volume boundaries; otherwise, the measurement must be repeated by shifting or expanding the zoom scan volume. The similar requirements also apply to 10-g SAR measurements. Following table provides the measurement parameters required for the zoom scan.

Parameter		f ≦ 3 GHz	3 GHz < f ≦ 10 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 6 – 7 GHz: ≦3.4 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 6 – 7 GHz: ≦2 mm
	graded grids: $\Delta z_{Zoom}(1)$	≦4 mm	3 – 4 GHz: ≦3.0 mm 4 – 5 GHz: ≦2.5 mm 5 – 6 GHz: ≦2.0 mm 6 – 7 GHz: ≦1.7 mm
	$\Delta z_{Zoom}(n>1)$	≦$1.5 \cdot \Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume (x, y, z)		≥30 mm	3 – 4 GHz: ≥28 mm 4 – 5 GHz: ≥25 mm 5 – 6 GHz: ≥22 mm 6 – 7 GHz: ≥22 mm

Per IEC 62209-2 AMD1, the successively higher resolution zoom scan is required if the zoom scan measured as defined above complies with both of the following criteria, or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed:

(1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x and y directions (Δx, Δy). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance zM1.

(2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum SAR value shall be at least 30 %.

If one or both of the above criteria are not met, the zoom scan measurement shall be repeated using a finer resolution. New horizontal and vertical grid steps shall be determined from the measured SAR distribution so that the above criteria are met. Compliance with the above two criteria shall be demonstrated for the new measured zoom scan.

4.4.2 Volume Scan Procedure

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.

4.4.3 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 drift more than 5%, the SAR will be retested.

4.4.4 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

4.4.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard’s method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

5. SAR Measurement Evaluation

5.1 EUT Configuration and Setting

<Considerations Related to Proximity Sensor>

The device supports WWAN, WLAN, and Bluetooth capabilities. It is designed with a proximity sensor which can trigger/not trigger power reduction for WCDMA and LTE on Top Side of EUT for SAR compliance. Others RF capability (WLAN and Bluetooth) have no power reduction. The power levels for all wireless technologies and the power reduction please refer to section 5.6 of this report.

Proximity Sensor Triggering Distances (KDB 616217 D04 §6.2)

The proximity sensor triggering distance was determined per KDB 616217 for rear face and applicable edge. Summary for power verification per distance was tabulated in the below table.

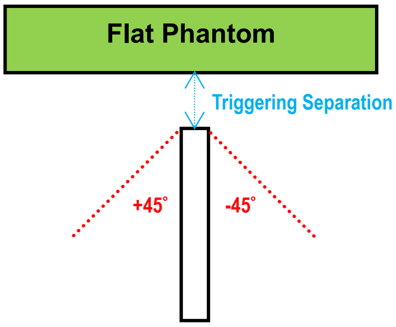
Output Power Verification in dBm for EUT Top Edge											
Distance (mm)	19	20	21	22	23	24	25	26	27	28	29
WCDMA II	19.5	19.5	20.0	19.9	19.9	19.8	23.8	23.6	23.7	24.1	23.7
WCDMA IV	19.7	19.7	19.7	19.4	19.5	19.4	23.5	23.4	23.6	23.6	23.4
LTE 2	19.1	19.0	19.2	19.3	19.1	19.1	23.0	23.2	23.0	22.9	23.1
LTE 4	19.7	19.8	19.9	19.6	19.6	20.1	23.0	22.8	23.0	22.7	22.9
LTE 7	20.1	20.3	20.1	20.2	20.4	20.3	23.4	23.2	23.4	23.5	23.2
LTE 25	19.3	19.0	19.4	19.1	18.9	19.1	23.2	22.9	23.0	23.3	23.2
LTE 38	21.4	21.3	21.3	21.0	21.5	21.3	23.5	23.1	23.3	23.4	23.3
LTE 41	21.1	21.0	21.3	21.2	21.2	21.4	23.9	23.5	23.6	23.7	23.8
LTE 48	14.8	14.6	14.7	14.7	14.6	14.3	21.6	21.6	21.8	21.9	21.5
LTE 66	19.8	20.0	19.8	19.9	20.1	20.1	23.0	23.0	23.2	22.8	23.3
LTE 71	23.6	23.6	23.8	23.9	23.9	23.9	23.8	23.6	23.5	23.9	23.7

Proximity Sensor Coverage (KDB 616217 D04 §6.3)

Since the proximity sensor is collocated with antenna in one component, the procedure for proximity sensor coverage is not required.

Proximity Sensor Tilt Angle Influences(KDB 616217 D04 §6.4)

The proximity sensor tilt angle influence was determined per KDB 616217 for applicable edge. Summary for proximity sensor tilt angle influence is shown in below.



Orientation	Separation Distance (mm)	Tilt Angle										
		-45˚	-40˚	-30˚	-20˚	-10˚	0˚	10˚	20˚	30˚	40˚	45˚
Top Edge	24	On	On	On	On	On	On	On	On	On	On	On

Summary for Proximity Sensor Triggering Test

According to the procedures noticed in KDB 616217 D04, the proximity sensor triggering distance is 24 mm for Top Side. The separation distance of 24 mm determined by the smallest triggering distance on Top Side is used to access the tilt angle influence and the sensor does not release during ±45 degree. Therefore, the smallest separation distance for tilt angle influence is 24 mm for the Top Side. The conservation triggering distances based on the separation distance for the sensor trigger / not triggered as EUT with power reduction at 0 mm, and EUT without power reduction at 23 mm for Top Side were used to test SAR.

The power reduction is depends on the proximity sensor input. For a steady SAR test, the power reduction was enabled or disabled manually by engineering software during SAR testing.

<Connections between EUT and System Simulator>

For WWAN SAR testing, the EUT was linked and controlled by base station emulator. Communication between the EUT and the emulator was established by air link. The distance between the EUT and the communicating antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during SAR testing.

<Considerations Related to WCDMA for Setup and Testing>

Release 5 HSDPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA.HSDPA is configured according to the applicable UE category of a test device. The number of HS-DSCH/HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms and a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors(β_c, β_d), and HS-DPCCH power offset parameters (Δ_{ACK}, Δ_{NACK}, Δ_{CQI}) are set according to values indicated in below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (1)(2)	CM (3) (dB)	MPR (3) (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (4)	15/15 (4)	64	12/15 (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.

Release 6 HSUPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode. Otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing. Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the β values indicated in below.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (1)	β_{ec}	β_{ed} (4)(5)	β_{ed} (SF)	β_{ed} (Codes)	CM (2) (dB)	MPR (2)(6) (dB)	AG (5) Index	E-TFCI
1	11/15 (3)	15/15 (3)	64	11/15 (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	β_{ed}1: 47/15 β_{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.

DC-HSDPA SAR Guidance

The 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Otherwise, when SAR is required for Rel. 5 HSDPA, SAR is required for Rel. 8 DC-HSDPA. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

<Considerations Related to LTE for Setup and Testing>

This device contains LTE transmitter which follows 3GPP standards, is category 3, supports both QPSK and QAM modulations, and supported LTE band and channel bandwidth is listed in below. The output power was tested per 3GPP TS 36.521-1 maximum transmit procedures for both QPSK and QAM modulation. The results please refer to section 5.6 of this report.

EUT Supported LTE Band and Channel Bandwidth						
LTE Band	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz
2	V	V	V	V	V	V
4	V	V	V	V	V	V
5	V	V	V	V		
7			V	V	V	V
12	V	V	V	V		
13			V	V		
14			V	V		
25	V	V	V	V	V	V
26	V	V	V	V	V	
38			V	V	V	V
41			V	V	V	V
48			V	V	V	V
66	V	V	V	V	V	V
71			V	V	V	V

The LTE maximum power reduction (MPR) in accordance with 3GPP TS 36.101 is active all times during LTE operation. The allowed MPR for the maximum output power is specified in below.

Modulation	Channel Bandwidth / RB Configurations						LTE MPR Setting (dB)
	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16QAM	<= 5	<= 4	<= 8	<= 12	<= 16	<= 18	1
16QAM	> 5	> 4	> 8	> 12	> 16	> 18	2
64QAM	<= 5	<= 4	<= 8	<= 12	<= 16	<= 18	2
64QAM	> 5	> 4	> 8	> 12	> 16	> 18	3

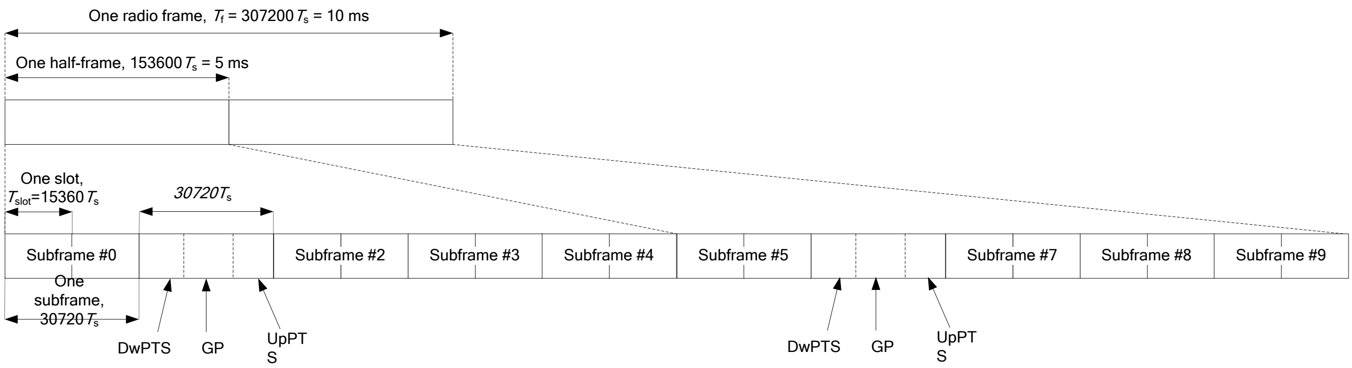
Note: MPR is according to the standard and implemented in the circuit (mandatory).

In addition, the device is compliant with additional maximum power reduction (A-MPR) requirements defined in 3GPP TS 36.101 section 6.2.4 that was disabled for all FCC compliance testing.

During LTE SAR testing, the related parameters of operating band, channel bandwidth, uplink channel number, modulation type, and RB was set in base station simulator. When the EUT has registered and communicated to base station simulator, the simulator set to make EUT transmitting the maximum radiated power.

TDD-LTE Setup Configurations

According to KDB 941225 D05, SAR testing for TDD-LTE device must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP TDD-LTE configurations. The TDD-LTE of this device supports frame structure type 2 defined in 3GPP TS 36.211 section 4.2, and the frame structure configuration can be referred to below.



3GPP TS 36.211 Figure 4.2-1: Frame Structure Type 2

Special Subframe Configuration	Normal Cyclic Prefix in Downlink			Extended Cyclic Prefix in Downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal Cyclic Prefix in Uplink	Extended Cyclic Prefix in Uplink		Normal Cyclic Prefix in Uplink	Extended Cyclic Prefix in Uplink
0	6592 · Ts			7680 · Ts		
1	19760 · Ts			20480 · Ts	2192 · Ts	2560 · Ts
2	21952 · Ts	2192 · Ts	2560 · Ts	23040 · Ts		
3	24144 · Ts			25600 · Ts		
4	26336 · Ts			7680 · Ts		
5	6592 · Ts			20480 · Ts	4384 · Ts	5120 · Ts
6	19760 · Ts			23040 · Ts		
7	21952 · Ts	4384 · Ts	5120 · Ts	12800 · Ts		
8	24144 · Ts			-	-	-
9	13168 · Ts			-	-	-

3GPP TS 36.211 Table 4.2-1: Configuration of Special Subframe

Uplink-Downlink Configuration	Downlink-to-Uplink Switch-Point Periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

3GPP TS 36.211 Table 4.2-2: Uplink-Downlink Configurations

The variety of different TD-LTE uplink-downlink configurations allows a network operator to allocate the network's capacity between uplink and downlink traffic to meet the needs of the network. The uplink duty cycle of these seven configurations can readily be computed and shown in below.

UL-DL Configuration	0	1	2	3	4	5	6
Highest Duty-Cycle	63.33%	43.33%	23.33%	31.67%	21.67%	11.67%	53.33%

Considering the highest transmission duty cycle, TDD-LTE was tested using Uplink-Downlink Configuration 0 with 6 uplink subframe and 2 special subframe. The special subframe was set to special subframe configuration 7 using extended cyclic prefix uplink. Therefore, SAR testing for TDD-LTE was performed at the maximum output power with highest transmission duty cycle of 63.33%.

LTE Uplink Carrier Aggregation (CA) Setup Configurations

The maximum output power for uplink intra-band contiguous CA specified in Table 6.2.2A-1 of 3GPP TS 36.101 is the same as single carrier specified in Table 6.2.2-1 of 3GPP TS 36.101. In Table 6.2.3A-1 of 3GPP TS 36.101, the MPR (maximum power reduction) for several dB is allowed due to modulation and contiguously aggregated transmit bandwidth configuration. All the RF parameters in this device have followed above 3GPP criteria.

Refer to Appendix E.

5.2 EUT Testing Position

For full-size tablet, according to KDB 616217 D04, SAR evaluation is required for back surface and edges of the devices. The back surface and edges of the tablet are tested with the tablet touching the phantom. Exposures from antennas through the front surface of the display section of a tablet are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required.

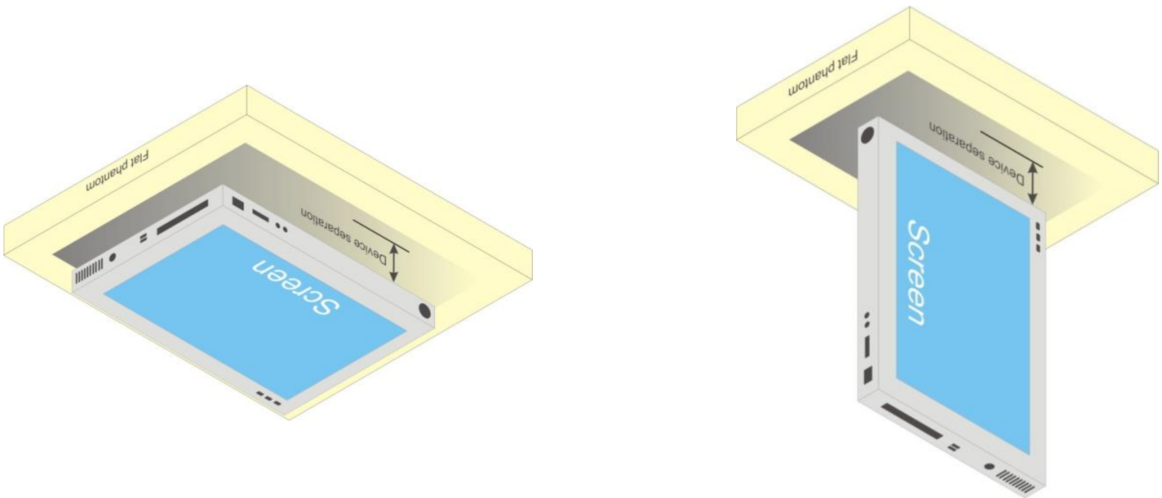


Fig-4.1 Illustration for Tablet Setup

For laptop PC, according to KDB 616217 D04, SAR evaluation is required for the bottom surface of the keyboard. This EUT was tested in the base of EUT directly against the flat phantom. The required minimum test separation distance for incorporating transmitters and antennas into laptop computer display is determined with the display screen opened at an angle of 90° to the keyboard compartment.

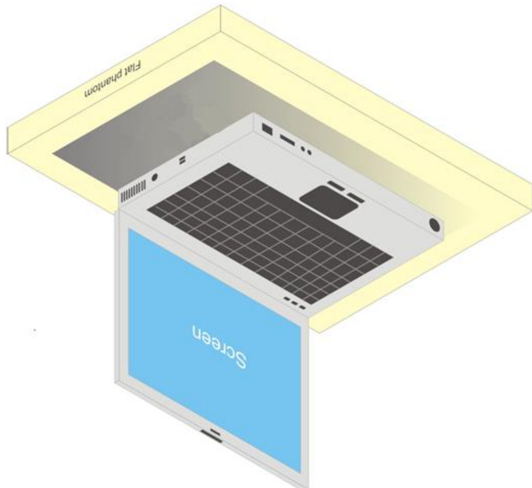


Fig-5.1 Illustration for Laptop Setup

5.3 Tissue Verification

Refer to Appendix C.

5.4 System Validation

Refer to Appendix C.

5.5 System Verification

Refer to Appendix C.

5.6 Maximum Output Power

5.6.1 Maximum Target Conducted Power

Refer to Appendix D.

5.6.2 Measured Conducted Power Result

Refer to Appendix E.

5.7 SAR Testing Results

5.7.1 SAR Test Reduction Considerations

<KDB 447498 D01, General RF Exposure Guidance>

Testing of other required channels within the operating mode of a frequency band is not required when the reported SAR for the mid-band or highest output power channel is:

(1) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz

(2) ≤ 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

(3) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

When SAR is not measured at the maximum power level allowed for production units, the measured SAR will be scaled to the maximum tune-up tolerance limit to determine compliance. The scaling factor for the tune-up power is defined as maximum tune-up limit (mW) / measured conducted power (mW). The reported SAR would be calculated by measured SAR x tune-up power scaling factor.

The SAR has been measured with highest transmission duty factor supported by the test mode tools for WLAN and/or Bluetooth. When the transmission duty factor could not achieve 100%, the reported SAR will be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up power. The scaling factor for the duty factor is defined as 100% / transmission duty cycle (%). The reported SAR would be calculated by measured SAR x tune-up power scaling factor x duty cycle scaling factor.

<KDB 941225 D01, 3G SAR Measurement Procedures>

The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ 1/4 dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

<KDB 941225 D05, SAR Evaluation Considerations for LTE Devices>

(1) QPSK with 1 RB and 50% RB allocation

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

(2) 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.

(3) Higher order modulations

SAR is required only when the highest maximum output power for the configuration in the higher order modulation is >1/2 dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

(4) Other channel bandwidth

SAR is required when the highest maximum output power of the smaller channel bandwidth is >1/2 dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

5.7.2 SAR Test Results for Body Exposure Condition

Refer to Appendix F.

5.7.3 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium maybe used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement are referring to Appendix G.

5.7.4 Simultaneous Multi-band Transmission Evaluation

<Possibilities of Simultaneous Transmission>

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous TX Combination	Capable Transmit Configurations	Body / Extremity / Bystander Exposure Condition
A	WWAN + WLAN 2.4G Ant0 + BT +RFID	Yes
B	WWAN + WLAN 2.4G Ant0 + WLAN 2.4G Ant1+RFID	Yes
C	WWAN + WLAN 5G Ant0 + BT+RFID	Yes
D	WWAN + WLAN 5G Ant0 + WLAN 5G Ant1+RFID	Yes
E	WWAN + WLAN 5G Ant0 + WLAN 5G Ant1 + BT+RFID	Yes
F	WWAN + WLAN 6G Ant0 + BT+RFID	Yes
G	WWAN + WLAN 6G Ant0 + WLAN 6G Ant1+RFID	Yes
H	WWAN + WLAN 6G Ant0 + WLAN 6G Ant1 + BT+RFID	Yes

Note:

1. The WLAN 2.4G, WLAN 5G, and WLAN6G cannot transmit simultaneously.
2. Simultaneous TX Combination D can be covered by E
3. Simultaneous TX Combination G can be covered by H

< AX211NGW _ SAR Summation Analysis >

Position	Simultaneous Tx Antenna Combination			Σ SAR 1g (W/kg)	Limit (W/kg)
	WWAN Ant. + RFID Ant.	Main Antenna	Aux Antenna		
Bottom of Laptop	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz	**2.38**	1.6
	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz+ BT	**2.58**	
	Max WWAN + RFID	WLAN 5GHz	BT	1.39	
	Max WWAN + RFID	WLAN 2.4GHz	WLAN 2.4GHz	**2.07**	
	Max WWAN + RFID	WLAN 2.4GHz	BT	1.27	
	Max WWAN + RFID	WLAN 6GHz	WLAN 6GHz	**2.09**	
	Max WWAN + RFID	WLAN 6GHz	WLAN 6GHz + BT	**2.29**	
	Max WWAN + RFID	WLAN 6GHz	BT	1.27	

Position	Simultaneous Tx Antenna Combination			Σ SAR 1g (W/kg)	Limit (W/kg)
	WWAN Ant. + RFID Ant.	Main Antenna	Aux Antenna		
Rear Face of Tablet	Max WWAN + RFID	WLAN 2.4GHz	WLAN 2.4GHz	**2.692** <Case 1>	1.6
	Max WWAN + RFID	WLAN 2.4GHz	BT	1.452	

< Case 1 >

Conditions	Exposure Condition	Test Position	SAR Value (W/kg)	Peak Location Separation Distance (R_i, mm)	SPLSR	Simultaneous Transmission SAR Test
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1	250.0	0.02	SPLSR ≤ 0.04, Not required
WLAN 2.4GHz Aux			1.48			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1	209.4	0.01	SPLSR ≤ 0.04, Not required
RFID			0.042			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1	301.2	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
WLAN 2.4GHz Aux	Body	Rear Face of Tablet	1.48	190.1	0.01	SPLSR ≤ 0.04, Not required
RFID			0.042			
WLAN 2.4GHz Aux	Body	Rear Face of Tablet	1.48	179.4	0.01	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
RFID	Body	Rear Face of Tablet	0.042	110.5	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			

< BE201NGW _ SAR Summation Analysis >

Position	Simultaneous Tx Antenna Combination			Σ SAR 1g (W/kg)	Limit (W/kg)
	WWAN Ant. + RFID Ant.	Main Antenna	Aux Antenna		
Bottom of Laptop	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz	**2.10**	1.6
	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz+ BT	**2.52**	
	Max WWAN + RFID	WLAN 5GHz	BT	1.33	
	Max WWAN + RFID	WLAN 2.4GHz	WLAN 2.4GHz	**2.05**	
	Max WWAN + RFID	WLAN 2.4GHz	BT	1.59	
	Max WWAN + RFID	WLAN 6GHz	WLAN 6GHz	**2.01**	
	Max WWAN + RFID	WLAN 6GHz	WLAN 6GHz + BT	**2.43**	
	Max WWAN + RFID	WLAN 6GHz	BT	1.30	

Position	Simultaneous Tx Antenna Combination			Σ SAR 1g (W/kg)	Limit (W/kg)
	WWAN Ant. + RFID Ant.	Main Antenna	Aux Antenna		
Rear Face of Tablet	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz	**2.822** <Case 2>	1.6
	Max WWAN + RFID	WLAN 5GHz	WLAN 5GHz+ BT	**3.162** <Case 3>	
	Max WWAN + RFID	WLAN 5GHz	BT	1.572	
	Max WWAN + RFID	WLAN 2.4GHz	WLAN 2.4GHz	**2.612** <Case 4>	
	Max WWAN + RFID	WLAN 2.4GHz	BT	**1.612** <Case 5>	

< Case 2 >

Conditions	Exposure Condition	Test Position	SAR Value (W/kg)	Peak Location Separation Distance (R_i, mm)	SPLSR	Simultaneous Transmission SAR Test
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	247.6	0.02	SPLSR ≤ 0.04,
WLAN 5GHz Aux			1.59			Not required
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	210.4	0.01	SPLSR ≤ 0.04,
RFID			0.042			Not required
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	302.0	0.00	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required
WLAN 5GHz Aux	Body	Rear Face of Tablet	1.59	190.1	0.01	SPLSR ≤ 0.04,
RFID			0.042			Not required
WLAN 5GHz Aux	Body	Rear Face of Tablet	1.59	179.4	0.01	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required
RFID	Body	Rear Face of Tablet	0.042	110.5	0.00	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required

< Case 3 >

Conditions	Exposure Condition	Test Position	SAR Value (W/kg)	Peak Location Separation Distance (R_i, mm)	SPLSR	Simultaneous Transmission SAR Test
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	243.2	0.02	SPLSR ≤ 0.04,
WLAN 5GHz Aux + BT Aux			1.93			Not required
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	210.4	0.01	SPLSR ≤ 0.04,
RFID			0.042			Not required
WLAN 5GHz Main	Body	Rear Face of Tablet	1.02	302.0	0.00	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required
WLAN 5GHz Aux + BT Aux	Body	Rear Face of Tablet	1.93	204.1	0.01	SPLSR ≤ 0.04,
RFID			0.042			Not required
WLAN 5GHz Aux + BT Aux	Body	Rear Face of Tablet	1.93	188.0	0.02	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required
RFID	Body	Rear Face of Tablet	0.042	110.5	0.00	SPLSR ≤ 0.04,
MAX WWAN			0.17			Not required

< Case 4 >

Conditions	Exposure Condition	Test Position	SAR Value (W/kg)	Peak Location Separation Distance (R_i, mm)	SPLSR	Simultaneous Transmission SAR Test
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	242.1	0.02	SPLSR ≤ 0.04, Not required
WLAN 2.4GHz Aux			1.34			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	209.4	0.01	SPLSR ≤ 0.04, Not required
RFID			0.042			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	301.2	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
WLAN 2.4GHz Aux	Body	Rear Face of Tablet	1.34	206.9	0.01	SPLSR ≤ 0.04, Not required
RFID			0.042			
WLAN 2.4GHz Aux	Body	Rear Face of Tablet	1.34	190.1	0.01	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
RFID	Body	Rear Face of Tablet	0.042	110.5	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			

< Case 5 >

Conditions	Exposure Condition	Test Position	SAR Value (W/kg)	Peak Location Separation Distance (R_i, mm)	SPLSR	Simultaneous Transmission SAR Test
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	240.1	0.01	SPLSR ≤ 0.04, Not required
BT Aux			0.34			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	209.4	0.01	SPLSR ≤ 0.04, Not required
RFID			0.042			
WLAN 2.4GHz Main	Body	Rear Face of Tablet	1.06	301.2	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
BT Aux	Body	Rear Face of Tablet	0.34	204.1	0.00	SPLSR ≤ 0.04, Not required
RFID			0.042			
BT Aux	Body	Rear Face of Tablet	0.34	188.0	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			
RFID	Body	Rear Face of Tablet	0.042	110.5	0.00	SPLSR ≤ 0.04, Not required
MAX WWAN			0.17			

Note :

1. The WWAN SAR and RFID SAR in the Bottom-of-Laptop mode show a value of '< 0.001,' which indicates either no detectable SAR value or that the SAR is too low to be measured. Therefore, the WWAN/RFID SAR value being 0 does not affect the Co-location/SPLSR analysis for WLAN/BT
2. For the SPLSR (Bottom-of-Laptop mode) evaluation, please refer to Intel report No. 241004-04.TR01 for details on the AX211NGW in Chapter A.8.
3. For the SPLSR (Bottom-of-Laptop mode) evaluation, please refer to Intel report No. 241004-02.TR01 for details on the BE201NGW in Chapter A.8.
4. The Scaled SAR summation is calculated based on the same configuration and test position.
5. Refer to Intel host report no.: 241004-04.TR01 for AX211NGW WLAN/BT SAR result.
6. Refer to Intel host report no.: 241004-02.TR01 for BE201NGW WLAN/BT SAR result.
7. Refer to BV CPS report no.: SFBEDW-WTW-P24060499 for RFID SAR result.

Test Engineer： Stephen Ho

6. Calibration of Test Equipment

Refer to Appendix J.

7. Measurement Uncertainty

According to KDB 865664 D01, SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR, and ≥ 3.75 W/kg for 10-g SAR. The procedures described in IEEE Std 1528-2013 should be applied. The expanded SAR measurement uncertainty must be ≤ 30%,for a confidence interval of k = 2. When the highest measured SAR within a frequency band is < 1.5 W/kg for 1-g and < 3.75 W/kg for 10-g, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. Hence, the measurement uncertainty analysis for SAR is not required in this SAR report because the test result met the condition.

8. Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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The address and road map of all our labs can be found in our web site also.

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