TEST REPORT

APPLICANT	:	Rhino Mobility LLC
PRODUCT NAME	:	Tablet
MODEL NAME	:	T105
PART NUMBER	:	T105-001-RHN-0A-001
BRAND NAME	:	RHINO
FCC ID	:	2AUOUT105
STANDARD(S)	:	FCC 47 CFR Part 2(2.1093) IEEE 1528-2013
RECEIPT DATE	:	2024-10-14
TEST DATE	:	2024-10-20 to 2024-11-20
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Change History		
Version	**Date**	**Reason for Change**
1.0	2024-11-29	First edition

1 SAR Results Summary

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

Frequency Band		Highest SAR Summary Body (Separation 0mm) 1g SAR (W/kg)
WCDMA	Band II	0.945
	Band IV	1.150
	Band V	1.112
	Band XIX	1.129
LTE	Band 7	1.188
	Band 12/17	1.134
	Band 13	1.083
	Band 14	1.081
	Band 25/2	1.001
	Band 26/5/18/19	1.040
	Band 30	1.081
	Band 41/38	1.003
	Band 48	1.191
	Band 66/4	1.188
	Band 71	1.089
5G NR	n2	1.057
	n5	0.945
	n7	0.833
	n25	1.150
	n26	1.139
	n30	1.167
	n41	1.121
	n48	1.190
	n66	1.161
	n71	1.172
	n77	1.193
	n78	1.146
WLAN	2.4GHz WLAN	1.168
	5GHz WLAN	1.193
2.4GHz Band	Bluetooth	1.140

Highest Simultaneous Transmission 1g SAR (W/kg)	1.509	Limit (W/kg): 1.6

Note:

1. This device is compliance with Specific Absorption Rate (SAR) for general population or uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 1 (1.1310) and IEEE C95.1-1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.
2. For LTE Band 2/4/17/5/18/19/38 are fully covered by LTE Band 25/66/12/26/41, therefore only LTE Band 25/66/12/26/41 were tested.
3. When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

2 Technical Information

Note: Provide by applicant.

2.1 Applicant and Manufacturer Information

Applicant:	Rhino Mobility LLC
Applicant Address:	8 The Green, Suite A, Dover, Delaware,19901, USA
Manufacturer:	Rhino Mobility LLC
Manufacturer Address:	8 The Green, Suite A, Dover, Delaware,19901, USA

2.2 Equipment under Test (EUT) Description

Product Name:	Tablet
EUT No.:	9#
Hardware Version:	T1007-MB_V1.0
Software Version:	T105(001)_20241114
Operation Frequency:	WCDMA II: 1850 MHz ~ 1910 MHz WCDMA IV: 1710 MHz ~ 1755 MHz WCDMA V: 824 MHz ~ 849 MHz WCDMA XIX: 830 MHz ~ 845 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 18: 815 MHz ~ 830 MHz LTE Band 19: 830 MHz ~ 845 MHz LTE Band 25: 1850 MHz ~1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 29 (RX): 717 MHz ~ 728 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 48: 3550 MHz ~ 3700 MHz

	LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2: 1850 MHz ~ 1910 MHz 5G NR n5: 824 MHz ~ 849 MHz 5G NR n7: 2500 MHz ~ 2570 MHz 5G NR n12: 699 MHz ~ 716 MHz 5G NR n25: 1850 MHz ~ 1915 MHz 5G NR n26: 814 MHz ~ 824 MHz; 824 MHz ~ 849 MHz 5G NR n29 (RX): 717 MHz ~ 728 MHz 5G NR n30: 2305 MHz ~ 2315 MHz 5G NR n41: 2496 MHz ~ 2690 MHz 5G NR n48: 3550 MHz ~ 3700 MHz 5G NR n66: 1710 MHz ~ 1780 MHz 5G NR n71: 663 MHz ~ 698 MHz 5G NR n77: 3450 MHz ~ 3550 MHz; 3700 MHz ~3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz; 3700 MHz ~ 3800 MHz WLAN 2.4GHz: 2412 MHz ~ 2472 MHz WLAN 5.2GHz: 5180 MHz ~ 5240 MHz WLAN 5.3GHz: 5260 MHz ~ 5320 MHz WLAN 5.5GHz: 5500 MHz ~ 5720 MHz WLAN 5.8GHz: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz	
Modulation Technology:	WCDMA: QPSK, 16QAM LTE: QPSK, 16QAM, 64QAM 5G NR: DFT-s-OFDM/CP-OFDM, PI/2 BPSK QPSK, 16QAM, 64QAM, 256QAM 802.11b: DSSS 802.11a/g/n-HT20/HT40: OFDM 802.11ac-VHT20/40/80: OFDM BR+EDR: GFSK (1Mbps), π/4-DQPSK (2Mbps), 8-DPSK (3Mbps) BLE: GFSK (1Mbps, 2Mbps)	
Carrier Aggregation:	CA Uplink & Downlink	
Antenna Type:	WWAN: PIFA Internal Antenna WLAN: PIFA Antenna Bluetooth: PIFA Antenna	
SIM Cards Description:	SIM 1	WCDMA+LTE+5G NR
	SIM 2	WCDMA+LTE+5G NR

Note: For more detailed description, please refer to specification or user manual supplied by the applicant and/or manufacturer.

2.3 Environment of Test Site

Temperature:	18°C ~25°C
Humidity:	35%~75% RH
Atmospheric Pressure:	1010 mbar

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the Factory. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.
The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 35 dB.

3 Specific Absorption Rate (SAR)

3.1 Introduction

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

3.2 SAR Definition

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

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

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

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

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

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

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

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

4 RF Exposure Limits

4.1 Uncontrolled Environment

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

4.2 Controlled Environment

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

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

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for head and trunk)	1.6 W/kg
Spatial Peak SAR (10g cube tissue for limbs)	4.0 W/kg
Spatial Peak SAR (1g cube tissue for whole body)	0.08 W/kg

Note:

1. Occupational/Uncontrolled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).
2. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

5 Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method Determination /Remark
FCC 47 CFR Part 2 (2.1093)	Radio Frequency Radiation Exposure valuation: Portable Devices	No deviation
IEEE 1528-2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques	No deviation
KDB 447498 D01v06	General RF Exposure Guidance	No deviation
KDB 248227 D01v02r02	SAR Measurement Procedures for 802.11 Transmitters	No deviation
KDB 616217 D04 v01r01	SAR Evaluation Considerations for Laptop, Notebook, Notebook and Tablet Computers	No deviation
KDB 865664 D01v01r04	SAR Measurement 100 MHz to 6 GHz	No deviation
KDB 865664 D02v01r02	RF Exposure Reporting	No deviation
KDB 941225 D01v03r01	3G SAR MEAUREMENT PROCEDURES	No deviation
KDB 941225 D05v02r05	SAR Evaluation Consideration for LTE Devices	No deviation
KDB 941225 D06v02r01	SAR Evaluation Procedures For Portable Devices With Wireless Router Capabilities	No deviation
Note 1: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.		

6 SAR Measurement System

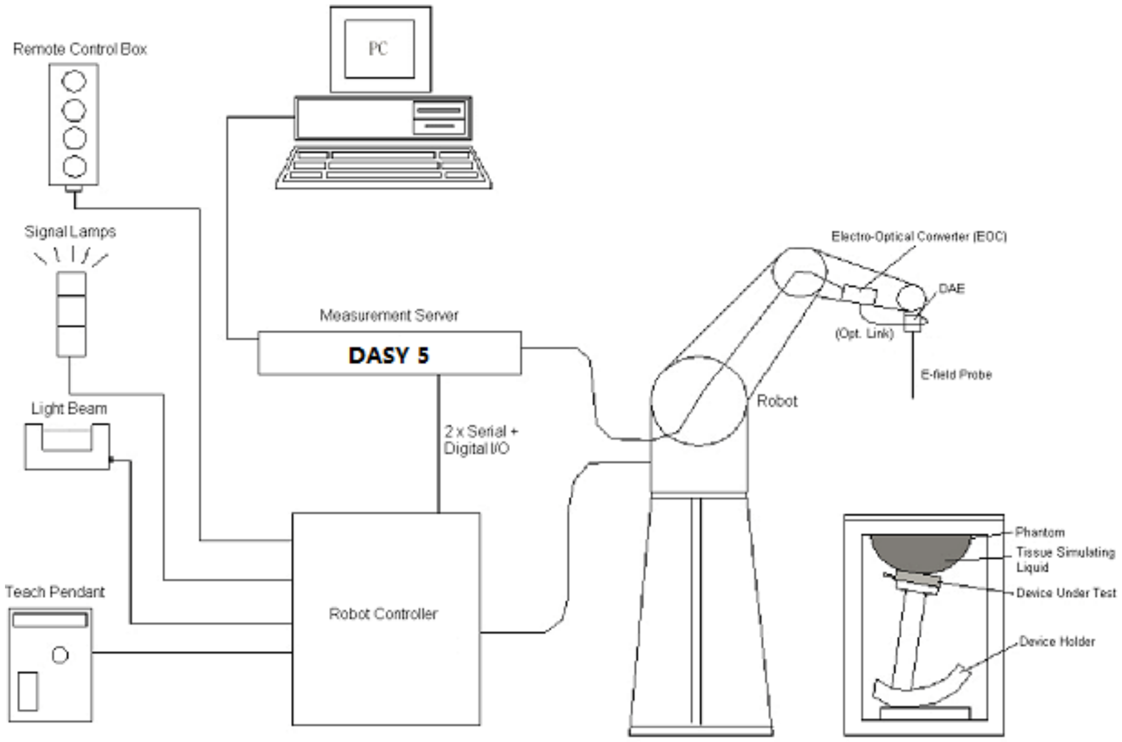

Fig.6.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software.
- A data acquisition electronic (DAE) attached to the robot arm extension.
- A dosimetric probe equipped with an optical surface detector system.
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals.
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning.
- A computer operating Windows XP.
- DASY software.
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom.
- A device holder.
- Tissue simulating liquid.
- Dipole for evaluating the proper functioning of the system.

Component details are described in the following sub-sections.

6.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG). The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

➢ **E-Field Probe Specification**

<EX3DV4 Probe>

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	**Fig 6.2 Photo of EX3DV4**

➢ **E-Field Probe Calibration**

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy shall be evaluated and within ±0.25 dB. The sensitivity parameters (Norm X, Norm Y and Norm Z), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to Annex E of this report.

6.2 Data Acquisition Electronics (DAE)

The Data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

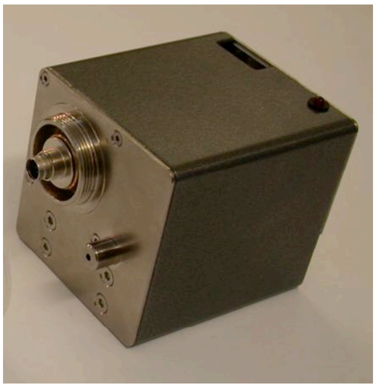

Fig 6.2 Photo of DAE

6.3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubliis used. The Stäublirobot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; nobelt drives)
- Jerk-free straight movements
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Fig. 6.3 Photo of Robot

6.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY 5: 400MHz, Intel Celeron), chip-disk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.
The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig. 6.4 Photo of Server for DASY5

6.5 Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.
The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

Fig. 6.5 Photo of Light Beam

6.6 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%) Center ear point: 6 ± 0.2 mm	 **Fig. 6.6 Photo of SAM Phantom**
Filling Volume **Dimensions**	Approx. 25 liters Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Head, Right Head, 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.

6.7 Device Holder

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ±0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

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

Thus the device needs no repositioning when changing the angles.

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

<Laptop Extension Kit>

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

Fig 6.7 Device Holder

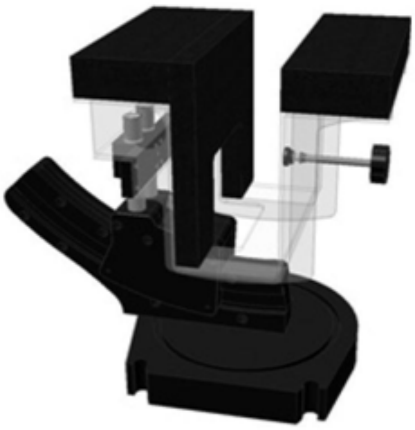

Fig 6.8 Laptop Extension Kit

6.8 Data storage and Evaluation

- **Data Storage**

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verifications of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

- **Data Evaluation**

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe Parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion	$ConvF_i$
	- Diode compression point	dcp_i
Device Parameters:	- Frequency	f
	- Crest	cf
Media Parameters:	- Conductivity	σ
	- Density	ρ

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

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

The formula for each channel can be given as:

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

With V_i = compensated signal of channel i, (i = x, y, z)
U_i= input signal of channel i, (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp^i= diode compression point (DASY parameter)
From the compensated input signals, the primary field data for each channel can be evaluated:

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

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

With V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$= senor sensitivity of channel i, (i = x, y, z), μV/ $(V/m)^2$
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency (GHz)
E_i = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m
The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

With SAR = local specific absorption rate in mW/g
Etot= total field strength in V/m
σ = conductivity in (mho/m) or (Siemens/m)
ρ= equipment tissue density in g/cm3
Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

6.9 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial No./ SW Version	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1223	2022.08.22	2025.08.21
SPEAG	900MHz System Validation Kit	D900V2	1d064	2021.12.17	2024.12.16
SPEAG	1800MHz System Validation Kit	D1800V2	2d158	2021.12.17	2024.12.16
SPEAG	2000MHz System Validation Kit	D2000V2	1050	2021.12.18	2024.12.17
SPEAG	2300MHz System Validation Kit	D2300V2	1107	2023.06.03	2026.06.02
SPEAG	2450MHz System Validation Kit	D2450V2	805	2021.12.17	2024.12.16
SPEAG	2600MHz System Validation Kit	D2600V2	1198	2022.08.17	2025.08.16
SPEAG	3500MHz System Validation Kit	D3500V2	1104	2023.06.03	2026.06.02
SPEAG	3700MHz System Validation Kit	D3700V2	1076	2023.06.03	2026.06.02
SPEAG	3900MHz System Validation Kit	D3900V2	1046	2023.06.02	2026.06.01
SPEAG	5000MHz System Validation Kit	D5GHzV2	1176	2021.12.19	2024.12.18
SPEAG	DOSIMETRIC ASSESSMENT SYSTEM	DASY52	52.10.4.1527	NCR	NCR
SPEAG	Dosimetric E-Field Probe	EX3DV4	7608	2024.03.21	2025.03.20
SPEAG	Data Acquisition Electronics	DAE4	1643	2024.03.27	2025.03.26
SPEAG	ELI Phantom	QD OVA004Ax	N/A	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Network Emulator	MT8820C	6201274521	2024.01.25	2025.01.24
Anritsu	Network Emulator	MT8821C	6261830572	2024.01.25	2025.01.24
Agilent	Network Analyzer	E5071B	MY42404762	2023.02.09	2024.02.08
Speag	Dielectric Assessment KIT	DAK-3.5	1279	2024.03.18	2025.03.17
mini-circuits	Amplifier	ZHL-42W+	608501717	NCR	NCR
mini-circuits	Amplifier	ZVE-8G+	754401735	NCR	NCR
Agilent	Signal Generator	N5182B	MY53050509	2024.09.11	2025.09.10
R&S	Power Senor	NRP8S	103215	2024.01.25	2025.01.24
Agilent	Power Meter	E4416A	MY45102093	2024.09.11	2025.09.10
R&S	Power Sensor	NRP8S	103240	2024.01.25	2025.01.24
Anritsu	Power Meter	E4418B	GB43318055	2024.05.30	2025.05.29
Agilent	Dual Directional Coupler	778D	50422	NA	NA
MCL	Attenuation	351-218-010	N/A	NA	NA
R&S	Spectrum Analyzer	N9030A	MY54170556	2024.09.18	2025.09.17

KTJ	Thermo meter	TA298	N/A	2023.11.22	2024.11.21
N/A	Tissue Simulating Liquids	HBBL600-10000V6		24H	

Note:

1. The calibration certificate of DASY can be referred to annex J of this report.
2. Referring to KDB 865664 D01v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
4. The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Speag.
5. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
6. Attenuator insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
7. N.C.R means No Calibration Requirement.

7 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 7.1, for body SAR testing, the liquid height from the centre of the flat phantom to liquid top surface is larger than 15 cm, which is shown in Fig. 7.2.

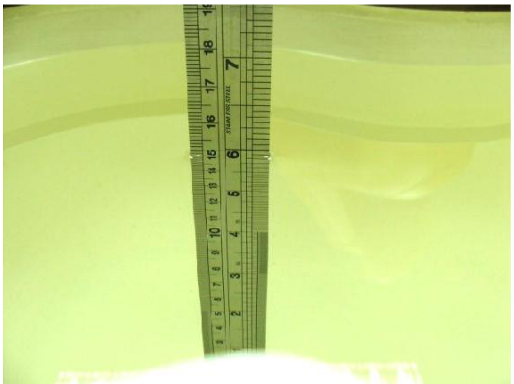

Fig 7.1 Photo of Liquid Height for Head SAR **Fig 7.2 Photo of Liquid Height for Body SAR**

The following table gives the recipes for tissue simulating liquids

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800,1900,2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

The relative permittivity and conductivity of the tissue material should be within ±5% of the values given in the table below recommended by the FCC OET 65supplement C and RSS 102 Issue 5.

Target Frequency	Head		Body	
(MHz)	ε r	σ (S/m)	ε r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94

835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

The dielectric parameters of liquids were verified prior to the SAR evaluation using a Speag Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Table 1: Dielectric Performance of Tissue Simulating Liquid

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Conductivity Target (σ)	Delta (σ) (%)	Limit (%)	Date
750	HSL	22.1	0.886	0.89	-0.45	±5	2024/10/23
750	HSL	22.2	0.897	0.89	0.79	±5	2024/11/2
750	HSL	22.1	0.866	0.89	-2.70	±5	2024/11/3
900	HSL	22.1	0.984	0.97	1.44	±5	2024/10/24
900	HSL	22.2	0.985	0.97	1.55	±5	2024/11/5
900	HSL	22.1	0.998	0.97	2.89	±5	2024/11/6
1800	HSL	22.2	1.369	1.40	-2.21	±5	2024/10/28
1800	HSL	22.3	1.412	1.40	0.86	±5	2024/11/7
1800	HSL	22.1	1.399	1.40	-0.07	±5	2024/11/8
1800	HSL	22.2	1.382	1.40	-1.29	±5	2024/11/21
2000	HSL	22.2	1.426	1.40	1.86	±5	2024/11/9
2300	HSL	22.3	1.698	1.67	1.68	±5	2024/11/10
2450	HSL	22.3	1.823	1.80	1.28	±5	2024/11/16
2600	HSL	22.3	1.985	1.96	1.28	±5	2024/10/18
2600	HSL	22.4	1.967	1.96	0.36	±5	2024/10/19
2600	HSL	22.4	1.953	1.96	-0.36	±5	2024/11/9
2600	HSL	22.2	1.983	1.96	1.17	±5	2024/11/11
2600	HSL	22.4	1.942	1.96	-0.92	±5	2024/11/12
2600	HSL	22.5	1.933	1.96	-1.38	±5	2024/11/13
2600	HSL	22.5	1.966	1.96	0.31	±5	2024/11/14
2600	HSL	22.6	1.934	1.96	-1.33	±5	2024/11/19
2600	HSL	22.5	1.944	1.96	-0.82	±5	2024/11/22
3500	HSL	22.3	2.961	2.91	1.75	±5	2024/11/4

3500	HSL	22.3	2.977	2.91	2.30	±5	2024/11/16
3500	HSL	22.4	2.945	2.91	1.20	±5	2024/11/23
3700	HSL	22.5	3.123	3.05	2.39	±5	2024/10/20
3700	HSL	22.4	3.152	3.05	3.34	±5	2024/11/17
3700	HSL	22.3	3.089	3.05	1.28	±5	2024/11/18
3700	HSL	22.4	2.945	2.91	1.20	±5	2024/11/24
3900	HSL	22.5	3.154	3.05	3.41	±5	2024/11/15
5250	HSL	22.4	4.611	4.71	-2.10	±5	2024/11/20
5600	HSL	22.4	5.125	5.07	1.08	±5	2024/11/20
5750	HSL	22.4	5.366	5.22	2.80	±5	2024/11/20

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Permittivity (εr)	Permittivity Target (εr)	Delta (εr) (%)	Limit (%)	Date
750	HSL	22.1	41.199	41.90	-1.67	±5	2024/10/23
750	HSL	22.2	42.266	41.90	0.87	±5	2024/11/2
750	HSL	22.1	42.371	41.90	1.12	±5	2024/11/3
900	HSL	22.1	42.034	41.50	1.29	±5	2024/10/24
900	HSL	22.2	41.678	41.50	0.43	±5	2024/11/5
900	HSL	22.1	40.966	41.50	-1.29	±5	2024/11/6
1800	HSL	22.2	40.171	40.00	0.43	±5	2024/10/28
1800	HSL	22.3	39.966	40.00	-0.08	±5	2024/11/7
1800	HSL	22.1	39.898	40.00	-0.25	±5	2024/11/8
1800	HSL	22.2	40.089	40.00	0.22	±5	2024/11/21
2000	HSL	22.2	40.111	40.00	0.28	±5	2024/11/9
2300	HSL	22.3	39.492	39.50	-0.02	±5	2024/11/10
2450	HSL	22.3	39.344	39.20	0.37	±5	2024/11/16
2600	HSL	22.3	39.112	39.00	0.29	±5	2024/10/18
2600	HSL	22.4	39.242	39.00	0.62	±5	2024/10/19
2600	HSL	22.4	39.211	39.00	0.54	±5	2024/11/9
2600	HSL	22.2	39.266	39.00	0.68	±5	2024/11/11
2600	HSL	22.4	39.196	39.00	0.50	±5	2024/11/12
2600	HSL	22.5	39.102	39.00	0.26	±5	2024/11/13
2600	HSL	22.5	39.134	39.00	0.34	±5	2024/11/14
2600	HSL	22.6	39.222	39.00	0.57	±5	2024/11/19
2600	HSL	22.5	39.216	39.00	0.55	±5	2024/11/22
3500	HSL	22.3	38.125	37.90	0.59	±5	2024/11/4
3500	HSL	22.3	37.977	37.90	0.20	±5	2024/11/16
3500	HSL	22.4	38.101	37.90	0.53	±5	2024/11/23
3700	HSL	22.5	37.848	37.70	0.39	±5	2024/10/20
3700	HSL	22.4	38.142	37.70	1.17	±5	2024/11/17

3700	HSL	22.3	38.166	37.70	1.24	±5	2024/11/18
3700	HSL	22.4	37.848	37.70	0.39	±5	2024/11/24
3900	HSL	22.5	38.222	37.70	1.38	±5	2024/11/15
5250	HSL	22.4	36.123	35.95	0.48	±5	2024/11/20
5600	HSL	22.4	35.634	35.50	0.38	±5	2024/11/20
5750	HSL	22.4	35.214	35.35	-0.38	±5	2024/11/20

Note:

According to April 2019 TCB Workshop that FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

8 SAR System Verification

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

- **System Validation**

According to FCC KDB 865664 D02, SAR system verification is required to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles are used with the required tissue-equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point must be validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media. A tabulated summary of the system validation status, measurement frequencies, SAR probes, calibrated signal type(s) and tissue dielectric parameters has been included.

- **Purpose of System Performance Check**

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

- **System Setup**

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

Fig 8.1 Photo of Dipole Setup

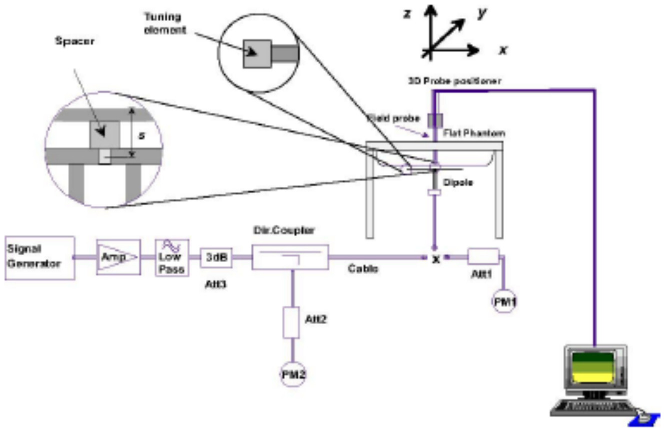

Fig 8.2 System Setup for System Evaluation

- **System Verification Results**

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10%. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table as below indicates the system performance check can meet the variation criterion and the plots can be referred to Annex C of this report.

<Validation Setup>

Dipole S/N	Probe S/N	DAE S/N	Input Power (mW)
D750V3-1223	3295	1324	250
D750V3-1223	3974	1423	250
D900V2-1d064	3295	1324	250
D900V2-1d064	3974	1423	250
D1800V2-2d158	3295	1324	250
D1800V2-2d158	3974	1423	250
D2000V2-1050	3974	1423	250
D2300V2-1107	7608	1643	250
D2450V2-805	7608	1643	250
D2600V2-1198	3295	1643	250
D2600V2-1198	3295	1324	250

D2600V2-1198	7608	1643	250
D3500V2-1104	7608	1643	100
D3700V2-1076	7608	1643	100
D3900V2-1176	7608	1643	100
D5GHzV2-1176-5250	7608	1643	100
D5GHzV2-1176-5600	7608	1643	100
D5GHzV2-1176-5750	7608	1643	100

Frequency (MHz)	Tissue Type	Conductivity (σ)	Permittivity (εr)	CW Signal Validation		
				Sensitivity	Probe Linearity	Probe Isotropy
750	HSL	0.851	42.43	PASS	PASS	PASS
835	HSL	0.898	41.88	PASS	PASS	PASS
1750	HSL	1.386	39.91	PASS	PASS	PASS
1800	HSL	1.449	41.26	PASS	PASS	PASS
1900	HSL	1.435	39.65	PASS	PASS	PASS
2000	HSL	1.451	39.42	PASS	PASS	PASS
2300	HSL	1.764	38.99	PASS	PASS	PASS
2450	HSL	1.863	38.85	PASS	PASS	PASS
2600	HSL	1.973	38.58	PASS	PASS	PASS
5250	HSL	4.528	35.32	PASS	PASS	PASS
5600	HSL	4.905	34.89	PASS	PASS	PASS
5750	HSL	5.077	34.28	PASS	PASS	PASS

Frequency (MHz)	Tissue Type	Conductivity (σ)	Permittivity (εr)	Modulation Signal Validation		
				Mod. Type	Duty Factor	PAR
750	HSL	0.851	42.43	N/A	N/A	N/A
835	HSL	0.898	41.88	GMSK	PASS	N/A
1750	HSL	1.386	39.91	N/A	N/A	N/A
1800	HSL	1.449	41.26	N/A	N/A	N/A
1900	HSL	1.435	39.65	GMSK	PASS	N/A
2000	HSL	1.451	39.42	GMSK	PASS	N/A
2300	HSL	1.764	38.99	OFDM	PASS	PASS
2450	HSL	1.863	38.85	OFDM	PASS	PASS
2600	HSL	1.973	38.58	TDD	PASS	N/A
5250	HSL	4.528	35.32	OFDM	N/A	PASS
5600	HSL	4.905	34.89	OFDM	N/A	PASS

5750	HSL	5.077	34.28	OFDM	N/A	PASS

<Validation Results>

Date	Frequency (MHz)	Tissue Type	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2024/10/23	750	HSL	2.11	8.54	8.44	-1.17
2024/11/2	750	HSL	2.21	8.54	8.84	3.51
2024/11/3	750	HSL	2.18	8.54	8.72	2.11
2024/10/24	900	HSL	2.79	11.20	11.16	-0.36
2024/11/5	900	HSL	2.84	11.20	11.36	1.43
2024/11/6	900	HSL	2.87	11.20	11.48	2.50
2024/10/28	1800	HSL	9.66	39.20	38.64	-1.43
2024/11/7	1800	HSL	9.44	39.20	37.76	-3.67
2024/11/8	1800	HSL	9.56	39.20	38.24	-2.45
2024/11/21	1800	HSL	9.72	39.20	38.88	-0.82
2024/11/9	2000	HSL	10.18	41.60	40.72	-2.12
2024/11/10	2300	HSL	11.69	48.40	46.76	-3.39
2024/11/16	2450	HSL	12.68	52.30	50.72	-3.02
2024/10/18	2600	HSL	13.96	57.00	55.84	-2.04
2024/10/19	2600	HSL	14.22	57.00	56.88	-0.21
2024/11/9	2600	HSL	14.18	57.00	56.72	-0.49
2024/11/11	2600	HSL	13.85	57.00	55.4	-2.81
2024/11/12	2600	HSL	14.26	57.00	57.04	0.07
2024/11/13	2600	HSL	14.22	57.00	56.88	-0.21
2024/11/14	2600	HSL	14.35	57.00	57.4	0.70
2024/11/19	2600	HSL	14.32	57.00	57.28	0.49
2024/11/22	2600	HSL	14.21	57.00	56.84	-0.28
2024/11/4	3500	HSL	6.77	67.20	67.7	0.74
2024/11/16	3500	HSL	6.88	67.20	68.8	2.38
2024/11/23	3500	HSL	6.62	67.20	66.2	-1.49
2024/10/20	3700	HSL	6.75	67.50	67.5	0.00
2024/11/17	3700	HSL	6.72	67.50	67.2	-0.44
2024/11/18	3700	HSL	6.81	67.50	68.1	0.89
2024/11/24	3700	HSL	6.84	67.50	68.4	1.33
2024/11/15	3900	HSL	6.79	69.90	67.9	-2.86
2024/11/20	5250	HSL	7.45	76.70	74.5	-2.87
2024/11/20	5600	HSL	8.15	80.80	81.5	0.87
2024/11/20	5750	HSL	8.11	78.70	81.1	3.05

Date	Frequency (MHz)	Tissue Type	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
2024/10/23	750	HSL	1.38	5.57	5.52	-0.90
2024/11/2	750	HSL	1.34	5.57	5.36	-3.77
2024/11/3	750	HSL	1.42	5.57	5.68	1.97
2024/10/24	900	HSL	1.78	7.19	7.12	-0.97
2024/11/5	900	HSL	1.75	7.19	7	-2.64
2024/11/6	900	HSL	1.76	7.19	7.04	-2.09
2024/10/28	1800	HSL	5.16	20.10	20.64	2.69
2024/11/7	1800	HSL	5.16	20.10	20.64	2.69
2024/11/8	1800	HSL	5.08	20.10	20.32	1.09
2024/11/21	1800	HSL	5.09	20.10	20.36	1.29
2024/11/9	2000	HSL	5.22	20.70	20.88	0.87
2024/11/10	2300	HSL	5.82	23.00	23.28	1.22
2024/11/16	2450	HSL	6.15	23.90	24.6	2.93
2024/10/18	2600	HSL	6.27	25.70	25.08	-2.41
2024/10/19	2600	HSL	6.35	25.70	25.4	-1.17
2024/11/9	2600	HSL	6.47	25.70	25.88	0.70
2024/11/11	2600	HSL	6.23	25.70	24.92	-3.04
2024/11/12	2600	HSL	6.44	25.70	25.76	0.23
2024/11/13	2600	HSL	6.54	25.70	26.16	1.79
2024/11/14	2600	HSL	6.48	25.70	25.92	0.86
2024/11/19	2600	HSL	6.42	25.70	25.68	-0.08
2024/11/22	2600	HSL	6.41	25.70	25.64	-0.23
2024/11/4	3500	HSL	2.45	25.10	24.5	-2.39
2024/11/16	3500	HSL	2.56	25.10	25.6	1.99
2024/11/23	3500	HSL	2.49	25.10	24.9	-0.80
2024/10/20	3700	HSL	2.52	24.20	25.2	4.13
2024/11/17	3700	HSL	2.33	24.20	23.3	-3.72
2024/11/18	3700	HSL	2.42	24.20	24.2	0.00
2024/11/24	3700	HSL	2.47	24.20	24.7	2.07
2024/11/15	3900	HSL	2.39	24.10	23.9	-0.83
2024/11/20	5250	HSL	2.26	22.10	22.6	2.26
2024/11/20	5600	HSL	2.34	23.30	23.4	0.43
2024/11/20	5750	HSL	2.24	22.50	22.4	-0.44

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

9 EUT Testing Position

This EUT was tested in four different positions. They are Bottom Face/Edge 1/Edge 2/ Edge 4 of the EUT with phantom 0 mm gap, as illustrated below, please refer to Annex B for the test setup photos.

9.1 SAR Evaluation to the Mouth/Jaw Regions of the Phantom

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

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

9.2 Body-Supported Device Configurations

According to KDB 616217 section 4.3, SAR should be separately assessed with each surface and separation distance positioned against the flat phantom that correspond to the intended use as specified by the manufacturer. The antennas in tablets are typically located near the back (bottom) surface and/or along the edges of the devices; therefore, SAR evaluation is required for these configurations. Exposures from antennas through the front (top) surface of the display section of a full-size tablet, away from the edges, are generally limited to the user’s hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna(s).

- To position the device parallel to the phantom surface with either keypad up or down.
- To adjust the device parallel to the flat phantom.

- To adjust the distance between the device surface and the flat phantom to 0 mm.
- When each surface is measurement, the SAR Test Exclusion Threshold in KDB 447498 should be applied.

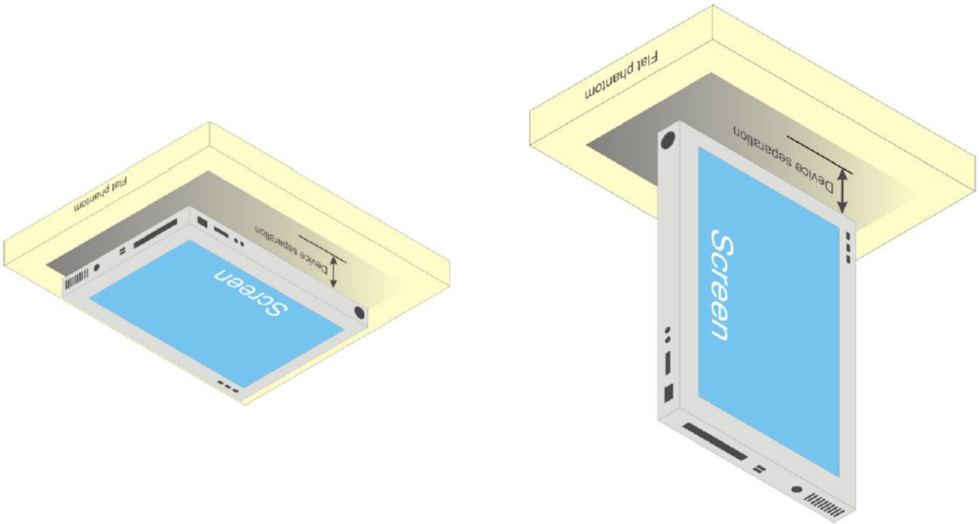

Fig.9.5 Illustration for Body Position

9.3 Wireless Router (Hotspot) Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 where SAR test considerations for handsets (L x W ≥
9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device with antennas 2.5 cm or closer to the edge of the device, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

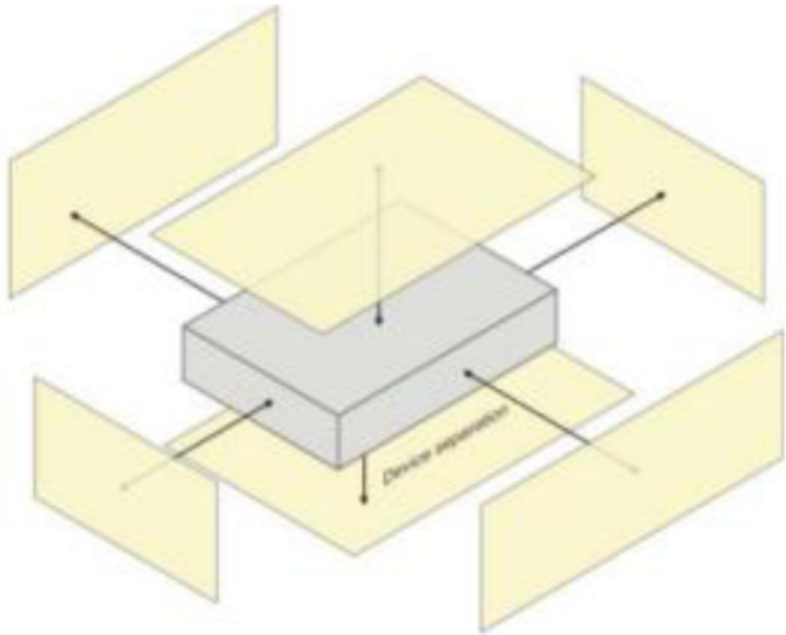

Fig.9.6 Illustration for Hotspot Position

10 Measurement Procedures

The measurement procedures are as bellows:

<Conducted power measurement>

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

<Conducted power measurement>

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

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

- Power reference measurement.
- Area scan.
- Zoom scan.
- Power drift measurement.

10.1 Spatial Peak SAR Evaluation

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

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

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

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

10.2 Power Reference Measurement

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

10.3 Area Scan Procedures

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a10mm^2 step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing.

10.4 Zoom Scan Procedures

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1g cube is 10mm, with the side length of the 10 g cube 21,5mm.The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

10.5 SAR Averaged Methods

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

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

10.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In 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.

11 SAR Test Configuration

<WCDMA Mode>

Summary of UMTS conducted power measurement:

1. The 3G SAR test reduction procedure is applied, when the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode, SAR measurement is not required for the secondary mode.
2. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
3. The procedures in KDB 941225 D01v03r01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.
4. For HSPA+ devices supporting 16 QAM in the uplink, power measurements procedure is according to the configurations in Table C.11.1.4 of 3GPP TS 34.121-1.
5. Per KDB 941225 D01v03r01, RMC 12.2kbps setting is used to evaluate SAR. The maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA / DC-HSDPA / HSPA+ is ≤ 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 / DC-HSDPA / HSPA+ to RMC12.2Kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA / DC-HSDPA / HSPA+, and according to the following RF output power, the output power results of the secondary modes (HSDPA / HSUPA / DC-HSDPA / HSPA+) are less than ¼ dB higher than the primary modes; therefore, SAR measurement is not required for HSDPA / HSUPA / DC-HSDPA / HSPA+.
6. A fixed level power reduction is applied for WCDMA Band II when handset open Hotspot mode, the power reduction triggered.

HSDPA Setup Configuration

Sub-test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{hs} (1)	CM (dB) (2)
1	2/15	15/15	64	2/15	4/15	0.0
2	12/15 (3)	15/15 (3)	64	12/15 (3)	24/15	1.0
3	15/15	8/15	64	15/8	30/15	1.5
4	15/15	4/15	64	15/4	30/15	1.5

Note 1: Δ_{ACK}, Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15.
Note 3: 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 signaled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

HSUPA Setup Configuration

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (1)	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM(2) (dB)	MPR (dB)	AG(4) Index	E-TFCI
1	11/15(3)	15/15(3)	64	11/15(3)	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1}: 47/15 β_{ed2}: 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15(4)	15/15(4)	64	15/15(4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$.
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 signaled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.
Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.
Note 6: β_{ed} cannot be set directly; it is set by Absolute Grant Value.

HSPA+ 3GPP release 7 (uplink category 7) 16QAM, Setup Configuration:

Table C.11.1.4: β values for transmitter characteristics tests with HS-DPCCH and E-DCH with 16QAM

Sub-test	β_c (Note3)	β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (2xSF2) (Note 4)	β_{ed} (2xSF4) (Note 4)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 4)	E-TFCI (Note 5)	E-TFCI (boost)
1	1	0	30/15	30/15	β_{ed}1: 30/15 β_{ed}2: 30/15	β_{ed}3: 24/15 β_{ed}4: 24/15	3.5	2.5	14	105	105

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.
Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).
Note 3: DPDCH is not configured, therefore the β_c is set to 1 and β_d = 0 by default.
Note 4: β_{ed} can not be set directly; it is set by Absolute Grant Value.
Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signaled to use the extrapolation algorithm.

DC-HSDPA Setup Configuration

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108 v9.5.0. A summary of these settings are illustrated below:
Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.

Table E.5.0: Levels for HSDPA connection setup

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

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

Table C.8.1.12: Fixed Reference Channel H-Set 12

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table. Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		

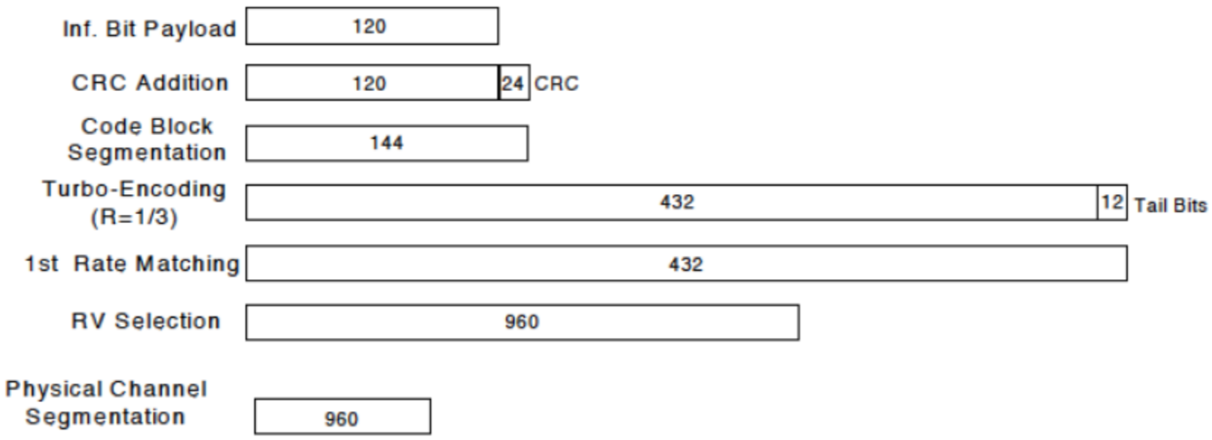

Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

<LTE Mode>

LTE Target MPR level

The device implements maximum power reduction per 3GPP 36.101 requirements where the MPR target is as below table. The MPR settings are implemented configured into firmware and cannot be disabled by the end user or LTE carrier network.

Modulation	Channel bandwidth/Transmission bandwidth configuration[RB]						MPR Target (dB)	3GPP
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz		
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1	≤ 1
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	2	≤ 2

Note: The measurement result showed some difference from the target MPR level, due to expected 0.5dBmeasurement tolerance

LTE Bands

LTE Bands	Channel bandwidth/Transmission bandwidth configuration [RB]					
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
2	√	√	√	√	√	√
4	√	√	√	√	√	√
5	√	√	√	√	N/A	N/A
7	N/A	N/A	√	√	√	√
12	√	√	√	√	N/A	N/A
13	N/A	N/A	√	√	N/A	N/A
14	N/A	N/A	√	√	N/A	N/A
17	N/A	N/A	√	√	N/A	N/A
18	N/A	N/A	√	√	√	N/A
19	N/A	N/A	√	√	√	N/A
25	√	√	√	√	√	√
26	√	√	√	√	√	N/A
30	N/A	N/A	√	√	N/A	N/A
38	N/A	N/A	√	√	√	√
41	N/A	N/A	√	√	√	√
48	N/A	N/A	√	√	√	√
66	√	√	√	√	√	√
71	N/A	N/A	√	√	√	√

Note:

1. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
2. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
3. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
4. Per KDB 941225 D05v02r05, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
5. Per KDB 941225 D05v02r05, 16QAM/64QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB941225 D05v02r05, 16QAM/64QAM SAR testing is not required.
6. Per KDB 941225 D05v02r05, smaller bandwidth output power for each RB allocation configuration is > not ½ Db higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported band width is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
7. For LTE B4 / B5 / B7 / B17 the maximum bandwidth does not support three non-overlapping channels, per KDB941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.
8. LTE band 2 / 4 / 12 SAR test was covered by Band 25 / 66 / 17; according to April 2015 TCB workshop, SAR test for overlapping LTE bands can be reduced if
    a. The maximum output power, including tolerance, for the smaller band is ≤ the larger band to qualify for the SAR test exclusion.
    b. The channel bandwidth and other operating parameters for the smaller band are fully supported by the larger band.
9. According to 2017 TCB workshop, for 64 QAM and 16 QAM should be verified by checking the signal constellation with a call box to avoid incorrect maximum power levels due to MPR and other requirements associated with signal modulation, and the following figure is taken from the "Fundamental Measurement >> Modulation Analysis >>constellation" mode of the device connect to the CMW500 base station, therefore, the device 64QAM and 16QAMsignal modulation are correct. Identify if Maximum Power Reduction (MPR) is optional or mandatory,

i.e. built-in by design: only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards: b) A-MPR (additional MPR) must be disabled.

10. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
    a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
    b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
    c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
    d. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
    e. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The Reported TDD LTE SAR = measured SAR (W/kg)* Tune-up Scaling Factor* scaling factor for extended cyclic prefix.
11. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel 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
12. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
13. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.

<WLAN 2.4GHz>

1. SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:
    a. When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
    b. When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is

required for the third channel; i.e., all channels require testing.

2. 2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test configuration Procedures should be followed.
3. For held-to-ear and hotspot operations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions was required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
4. Justification for test configurations for WLAN per KDB Publication 248227 D02DR02-41929 for 2.4 GHz WI-FI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz802.11g/n) was not required due to the maximum allowed powers and the highest reported SAR.
5. A fixed level power reduction is applied for WiFi when handset operates "held to the body" condition or "held to the ear" condition, the power reduction triggered by audio receiver detection and call establish status.
6. Per KDB 248227 D01v02r02, In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements.SAR is not required for the following 2.4 GHz OFDM conditions:
   a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.
   b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

<WLAN 5GHz>

A) U-NII-1 and U-NII-2A Bands

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following：

1. When the same maximum output power is specified for both bands, begin SAR measurement in U- NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, both bands are tested independently for SAR.
2. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the

two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, both bands are tested independently for SAR.

3. The two U-NII bands may be aggregated to support a 160 MHz channel on channel number 50.
4. Without additional testing, the maximum output power for this is limited to the lower of the maximum output power certified for the two bands. When SAR measurement is required for at least one of the bands and the highest reported SAR adjusted by the ratio of specified maximum output power of aggregated to standalone band is > 1.2 W/kg, SAR is required for the 160 MHz channel. This procedure does not apply to an aggregated band with maximum output higher than the standalone band(s); the aggregated band must be tested independently for SAR. SAR is not required when the 160 MHz channel is operating at a reduced maximum power and also qualifies for SAR test exclusion.

B) U-NII-2C and U-NII-3 Bands

The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. when Terminal Doppler Weather Radar (TDWR) restriction applies, all channels that operate at 5.60 – 5.65 GHz must be included to apply the SAR test reduction and measurement procedures. When the same transmitter and antenna(s) are used for U-NII-2C band and U-NII-3 band or 5.8 GHz band of §15.247, the bands may be aggregated to enable additional channels with 20, 40 or 80 MHz bandwidth to span across the band gap, as illustrated in Appendix B. The maximum output power for the additional band gap channels is limited to the lower of those certified for the bands. Unless band gap channels are permanently disabled, they must be considered for SAR testing. The frequency range covered by these bands is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. To maintain SAR measurement accuracy and to facilitate test reduction, the channels in U-NII-2C band above 5.65 GHz may be grouped with the 5.8 GHz channels in U-NII-3 or §15.247 band to enable two SAR probe calibration frequency points to cover the bands, including the band gap channels. When band gap channels are supported and the bands are not aggregated for SAR testing, band gap channels must be considered independently in each band according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

C) OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements

The initial test configuration for 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures. When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

1. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
2. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
3. If multiple configurations have the same specified maximum output power, largest channel band width and lowest order modulation, the lowest data rate configuration among these configurations is selected.
4. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n. After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.
5. The channel closest to mid-band frequency is selected for SAR measurement.
6. For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

D) SAR Test Requirements for OFDM configurations

When SAR measurement is required for 802.11 a/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the sametransmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction Vapplies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 bandare supported, the highest maximum output power transmission mode configuration and maximumoutput power channel across the bands must be used to determine SAR test reduction, accordingto the initial test configuration and subsequent test configuration requirements. In applying theinitial test configuration and subsequent test configuration procedures, the 802.11 transmissionconfiguration with the highest specified maximum output power and the channel within a testconfiguration with the highest measured maximum output power should be clearly distinguished toapply the procedures.

12 Conducted Output Power

Remark: The output power of WCDMA/LTE/5G NR/WLAN/Bluetooth were recorded in annex E of this report.

13 Carrier Aggregation

13.1 LTE Uplink Carrier Aggregation

➢ **Carrier Aggregation Configuration**

<Intra-band>

2CC Uplink Carrier Aggregation for Intra-band				
No.	Combination	MIMO	Restriction	Completely Covered by Measurement Superset
1	CA_7C	7C	-	No
2	CA_12B	12B	-	No
3	CA_38C	38C	-	No
4	CA_41C	41C	-	No
5	CA_48C	48C	-	No
6	CA_66B	66B	-	No
7	CA_66C	66C	-	No

<Inter-band>

2CC Uplink Carrier Aggregation for Intra-band				
No.	Combination	MIMO	Restriction	Completely Covered by Measurement Superset
1	CA_2A-5A	2A-5A	-	No
2	CA_2A-4A	2A-4A	-	No
3	CA_2A-7A	2A-7A	-	No
4	CA_2A-12A	A-12A	-	No
5	CA_2A-13A	2A-13A	-	No
6	CA_2A-66A	2A-66A	-	No
7	CA_2A-71A	2A-71A	-	No
8	CA_4A-5A	4A-5A	-	No

9	CA_4A-12A	4A-12A	-	No
10	CA_4A-13A	4A-13A	-	No
11	CA_4A-17A	4A-17A	-	No
12	CA_4A-71A	4A-71A	-	No
13	CA_5A-7A	5A-7A	-	No
14	CA_5A-30A	5A-30A	-	No
15	CA_5A-66A	5A-66A	-	No
16	CA_7A-12A	7A-12A	-	No
17	CA_12A-30A	12A-30A	-	No
18	CA_12A-66A	12A-66A	-	No
19	CA_13A-66A	13A-66A	-	No
20	CA_66A-71A	66A-71A	-	No

Note:

1. According to the 3GPP 36.101 table 6.2.2A-1 specifics that the aggregation maximum allowed output power is equivalent to the signal carrier scenario for intra-band contiguous carrier aggregation scenarios. When the non-contiguous RB allocation is applied the MPR shell complies with the table 6.2.3A defined in 3GPP 36.101.
2. According to the TCB Workshop publication, the output power of uplink CA would be measured with the wideband signal integration over the component carriers. And SAR measurement would be performed at the worst exposure condition of each band.
3. Additional SAR measurement for LTE UL CA with other DL CA combinations are not required when the maximum output power of this configuration is not ＞ 1/4 dB higher than the maximum output power for UL CA active.
4. According to October 2018 TCB Workshop publication, LTE uplink CA SAR assessment should follow:
5. If the signal uplink 1-g SAR values for each band are both less than 0.8 W/kg and the algebraic summation of the 1-g SAR values are less than 1.45 W/kg no additional measurements need to be performed.
6. If one or the signal uplink1-g SAR values is greater than 0.8 W/kg, instead of algebraically summing the 1-g SAR values, sum up the SAR distributions, similar to the enlarged zoom scan (volume scan) procedures found in FCC KDB Publication 865664 D01. And PAG is required for this case.
7. If the algebraic sum of the 1-g SAR values is > 1.45 W/kg additional measurements may have to be made. Submit a KDB inquiry for additional guidance. And PAG is required for this case.

13.2 LTE Downlink Carrier Aggregation

➢ **Carrier Aggregation Configuration**

For the device supports bands and bandwidths and configurations are provided as follow table was according to 3GPP.

Downlink Carrier Aggregation				
No.	Combination	UL/ULCA	DL 4 × 4 MIMO	Restriction
1	CA_12A-25A	12A, 25A	-	-
2	CA_12A-30A	12A, 30A	-	-
3	CA_12A-66A	12A, 66A, 12A-66A	-	-
4	CA_12A-66A-66A	12A, 66A, 12A-66A	-	-
5	CA_12A-66C	12A, 66A	-	-
6	CA_12B	12A	-	-
7	CA_12B-66A	12A, 66A	-	-
8	CA_12B-66A-66A	12A, 66A	-	-
9	CA_13A-48A	13A	48A	-
10	CA_13A-48A-48A	13A	48A-48A	-
11	CA_13A-48A-48C	13A	48A, 48C	-
12	CA_13A-48A-66A	13A, 66A	48A	-
13	CA_13A-48A-66B	13A, 66A	48A	-
14	CA_13A-48A-66C	13A, 66A	48A	-
15	CA_13A-48C	13A	48C	-
16	CA_13A-48C-66A	13A, 66A	48C	-
17	CA_13A-48D	13A	-	-
18	CA_13A-66A	13A, 66A, 13A-66A	-	-
19	CA_13A-66A-66A	13A, 66A, 13A-66A	-	-
20	CA_13A-66A-66B	13A, 66A	-	-
21	CA_13A-66A-66C	13A, 66A	-	-
22	CA_13A-66B	13A, 66A	-	-
23	CA_13A-66C	13A, 66A	-	-
24	CA_13A-66D	13A, 66A	-	-
25	CA_14A-30A	14A, 30A	-	-

26	CA_14A-66A	14A, 66A	-	-
27	CA_14A-66A-66A	14A, 66A	-	-
28	CA_14A-66A-66A-66A	14A, 66A	-	-
29	CA_25A-25A	25A	-	-
30	CA_25A-25A-25A	25A	-	-
31	CA_25A-25A-26A	25A, 26A	-	-
32	CA_25A-26A	25A, 26A	-	-
33	CA_26A-41A	26A	41A	-
34	CA_26A-41C	26A	41C	-
35	CA_29A-30A	30A	-	-
36	CA_29A-66A	66A	-	-
37	CA_29A-66A-66A	66A	-	-
38	CA_2A-12A	2A, 12A, 2A-12A	-	-
39	CA_2A-12A-66A	2A, 12A, 66A, 2A-12A, 12A-66A	-	-
40	CA_2A-12A-66A-66A	2A, 12A, 66A, 2A-12A	-	-
41	CA_2A-12A-66C	2A, 12A, 66A	-	-
42	CA_2A-12B	2A, 12A	-	-
43	CA_2A-12B-66A	2A, 12A, 66A	-	-
44	CA_2A-13A	2A, 13A, 2A-13A	-	-
45	CA_2A-13A-48A	2A, 13A	48A	-
46	CA_2A-13A-48C	2A, 13A	48C	-
47	CA_2A-13A-66A	2A, 13A, 66A, 13A-66A, 2A-13A	-	-
48	CA_2A-13A-66A-66A	2A, 13A, 66A	-	-
49	CA_2A-13A-66B	2A, 13A, 66A	-	-
50	CA_2A-13A-66C	2A, 13A, 66A	-	-
51	CA_2A-14A	2A, 14A	-	-
52	CA_2A-14A-66A	2A, 14A, 66A	-	-
53	CA_2A-14A-66A-66A	2A, 14A, 66A	-	-
54	CA_2A-17A	2A, 17A	-	-
55	CA_2A-29A	2A	-	-
56	CA_2A-29A-66A	2A, 66A	-	-

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57	CA_2A-29A-66A-66A	2A, 66A	-	-
58	CA_2A-2A	2A	-	-
59	CA_2A-2A-12A	2A, 12A, 2A-12A	-	-
60	CA_2A-2A-12A-66A	2A, 12A, 66A	-	-
61	CA_2A-2A-12B	2A, 12A	-	-
62	CA_2A-2A-13A	2A, 13A, 2A-13A	-	-
63	CA_2A-2A-13A-66A	2A, 13A, 66A	-	-
64	CA_2A-2A-14A	2A, 14A	-	-
65	CA_2A-2A-14A-66A	2A, 14A, 66A	-	-
66	CA_2A-2A-29A	2A	-	-
67	CA_2A-2A-29A-66A	2A, 66A	-	-
68	CA_2A-2A-4A	2A, 4A	-	-
69	CA_2A-2A-4A-12A	2A, 4A, 12A, 2A-12A, 4A-12A	-	-
70	CA_2A-2A-4A-4A	2A, 4A	-	-
71	CA_2A-2A-4A-5A	2A, 4A, 5A	-	-
72	CA_2A-2A-4A-71A	2A, 4A, 71A	-	-
73	CA_2A-2A-5A	2A, 5A	-	-
74	CA_2A-2A-5A-66A	2A, 5A, 66A	-	-
75	CA_2A-2A-5B	2A, 5A	-	-
76	CA_2A-2A-66A	2A, 66A, 2A-66A	-	-
77	CA_2A-2A-66A-66A	2A, 66A	-	-
78	CA_2A-2A-66A-71A	2A, 66A, 71A	-	-
79	CA_2A-2A-66B	2A, 66A	-	-
80	CA_2A-2A-66C	2A, 66A	-	-
81	CA_2A-2A-71A	2A, 71A	-	-
82	CA_2A-48A	2A	-	-
83	CA_2A-48A-48A	2A	-	-
84	CA_2A-48A-48C	2A	-	-
85	CA_2A-48A-66A	2A, 66A	-	-
86	CA_2A-48A-66A-66A	2A, 66A	-	-
87	CA_2A-48C	2A	-	-

88	CA_2A-48C-66A	2A, 66A	-	-
89	CA_2A-48D	2A	-	-
90	CA_2A-4A	2A, 4A, 2A-4A	-	-
91	CA_2A-4A-12B	2A, 4A, 12A	-	-
92	CA_2A-4A-13A	2A, 4A, 13A, 4A-13A, 2A-13A	-	-
93	CA_2A-4A-29A	2A, 4A, 2A-4A	-	-
94	CA_2A-4A-4A	2A, 4A	-	-
95	CA_2A-4A-4A-12A	2A, 4A, 12A, 2A-12A, 4A-12A	-	-
96	CA_2A-4A-4A-5A	2A, 4A, 5A	-	-
97	CA_2A-4A-5A	2A, 4A, 5A, 2A-4A	-	-
98	CA_2A-4A-5B	2A, 4A, 5A	-	-
99	CA_2A-4A-71A	2A, 4A, 71A	-	-
100	CA_2A-5A	2A, 5A, 2A-5A	-	-
101	CA_2A-5A-48A	2A, 5A	48A	-
102	CA_2A-5A-48C	2A, 5A	48C	-
103	CA_2A-5A-66A	2A, 5A, 66A, 2A-5A	-	-
104	CA_2A-5A-66A-66A	2A, 5A, 66A	-	-
105	CA_2A-5A-66B	2A, 5A, 66A	-	-
106	CA_2A-5A-66C	2A, 5A, 66A	-	-
107	CA_2A-5B	2A, 5A	-	-
108	CA_2A-5B-66A	2A, 5A, 66A	-	-
109	CA_2A-66A	2A, 66A, 2A-66A	-	-
110	CA_2A-66A-66A	2A, 66A, 2A-66A	-	-
111	CA_2A-66A-66A-66A	2A, 66A	-	-
112	CA_2A-66A-66A-71A	2A, 66A, 71A	-	-
113	CA_2A-66A-66B	2A, 66A	-	-
114	CA_2A-66A-66C	2A, 66A	-	-
115	CA_2A-66A-71A	2A, 66A, 71A	-	-
116	CA_2A-66B	2A, 66A	-	-
117	CA_2A-66C	2A, 66A	-	-
118	CA_2A-66C-71A	2A, 66A, 71A	-	-

119	CA_2A-66D	2A, 66A	-	-
120	CA_2A-71A	2A, 71A	-	-
121	CA_2A-66A-66A-66A	2A, 66A	-	-
123	CA_2A-71A	2A, 71A	-	-
124	CA_2C	2A	-	-
125	CA_2C-12A	2A, 12A	-	-
126	CA_2C-29A	2A, 2C	-	-
127	CA_2C-5A	2A, 5A	-	-
128	CA_2C-66A	2A, 66A	-	-
129	CA_2C-66A-66A	2A, 66A	-	-
130	CA_38C	38A	38C	-
131	CA_41A-41A	41A	41A-41A	-
132	CA_41A-41A-41A	41A	41A-41A	-
133	CA_41A-41A-41C	41A	41A-41A, 41C	-
134	CA_41A-41C	41A	41A-41C	-
135	CA_41A-41D	41A	41A	-
136	CA_41A-48A	41A, 48A	41A-48A	-
137	CA_41C	41A	41C	-
138	CA_41C-41C	41A	41C	-
139	CA_41D	41A	41D	-
140	CA_41E	41A, 41C		-
141	CA_48A-48A	48A	48A-48A	-
142	CA_48A-48A-66A	66A	48A-48A, 48A	-
143	CA_48A-48A-66A-66A	66A	48A-48A, 48A	-
144	CA_48A-48A-66B	66A	48A-48A	-
145	CA_48A-48A-66C	66A	48A-48A	-
146	CA_48A-48A-71A	71A	48A-48A	-
147	CA_48A-48C	48A	48A-48C	-
148	CA_48A-48C-66A	66A	48A, 48C	-
149	CA_48A-48D	48A	48A	-
150	CA_48A-66A	66A	48A	-

151	CA_48A-66C	66A	48A	-
152	CA_48A-71A	71A	48A	-
153	CA_48B	48A	48B	-
154	CA_48C	48A	48C	-
155	CA_48C-48C	48A	48C	-
156	CA_48C-66A	66A	48C	-
157	CA_48C-66A-66A	66A	48C	-
158	CA_48C-66B	66A	48C	-
159	CA_48C-66C	66A	48C	-
160	CA_48C-71A	71A	48C	-
161	CA_48D	48A	48D	-
162	CA_48D-66A	66A	-	-
163	CA_48E	48A, 48C	-	-
164	CA_4A-12A	4A, 12A, 4A-12A	-	-
165	CA_4A-12B	4A, 12A	-	-
166	CA_4A-13A	4A, 13A, 4A-13A	-	-
167	CA_4A-17A	4A, 17A	-	-
168	CA_4A-29A	4A	-	-
169	CA_4A-48A	4A	48A	
170	CA_4A-48C	4A	48C	
171	CA_4A-48D	4A	-	-
172	CA_4A-4A	4A	-	-
173	CA_4A-4A-12A	4A, 12A, 4A-12A	-	-
174	CA_4A-4A-12B	4A, 12A	-	-
175	CA_4A-4A-13A	4A, 13A, 4A-13A	-	-
176	CA_4A-4A-29A	4A	-	-
177	CA_4A-4A-5A	4A, 5A	-	-
178	CA_4A-4A-5B	4A, 5A	-	-
179	CA_4A-4A-71A	4A, 71A	-	-
180	CA_4A-5A	4A, 5A, 4A-5A	-	-
181	CA_4A-5B	4A, 5A	-	-

182	CA_4A-71A	4A, 71A	-	-
183	CA_5A-25A	5A, 25A	-	-
184	CA_5A-30A	5A, 30A	-	-
185	CA_5A-38A	5A	38A	-
186	CA_5A-41A	5A	41A	-
187	CA_5A-48A	5A	48A	-
188	CA_5A-48A-66A	5A, 66A	48A	-
189	CA_5A-48C	5A	48C	-
190	CA_5A-48C-66A	5A, 66A	48C	-
191	CA_5A-48D	5A	-	-
192	CA_5A-5A	5A	-	-
193	CA_5A-5A-66A	5A, 66A	-	-
194	CA_5A-5A-66A-66A	5A, 66A	-	-
195	CA_5A-5A-66B	5A, 66A	-	-
196	CA_5A-5A-66C	5A, 66A	-	-
197	CA_5A-66A	5A, 66A, 5A-66A	-	-
198	CA_5A-66A-66A	5A, 66A, 5A-66A	-	-
199	CA_5A-66A-66B	5A, 66A	-	-
200	CA_5A-66A-66C	5A, 66A	-	-
201	CA_5A-66B	5A, 66A	-	-
202	CA_5A-66C	5A, 66A	-	-
203	CA_5A-66D	5A, 66A	-	-
204	CA_5A-7A	5A, 7A	-	-
205	CA_5A-7A-7A	5A, 7A	-	-
206	CA_5A-7C	5A, 7A	-	-
207	CA_5B	5A, 5B	-	-
208	CA_5B-30A	5A, 30A	-	-
209	CA_5B-66A	5A, 66A	-	-
210	CA_5B-66A-66A	5A, 66A	-	-
211	CA_5B-66B	5A, 66A	-	-
212	CA_5B-66C	5A, 66A	-	-

213	CA_66A-66A	66A	-	-
214	CA_66A-66A-66A	66A	-	-
215	CA_66A-66A-71A	66A, 71A	-	-
216	CA_66A-66B	66A	-	-
217	CA_66A-66C	66A	-	-
218	CA_66A-71A	66A, 71A	-	-
219	CA_66B	66A, 66B	-	-
220	CA_66C	66A, 66C	-	-
221	CA_66C-71A	66A, 71A	-	-
222	CA_66D	66A	-	-
223	CA_7A-12A	7A, 12A	7A	-
224	CA_7A-12B	7A, 12A	7A	-
225	CA_7A-13A	7A, 13A	7A	-
226	CA_7A-26A	7A, 26A	7A	-
227	CA_7A-29A	7A	7A	-
228	CA_7A-7A	7A	7A-7A	-
229	CA_7A-7A-13A	7A, 13A	7A-7A	-
230	CA_7A-7A-26A	7A, 26A	7A-7A	-
231	CA_7A-7A-29A	7A	7A-7A	-
232	CA_7A-7A-8A	7A, 8A	7A-7A	-
233	CA_7A-8A	7A, 8A	7A	-
234	CA_7B	7A	7B	-
235	CA_7C	7A	7C	-
236	CA_7C-13A	7A, 13A	7C	-
237	CA_7C-29A	7A	7C	-
238	CA_8A-38A	8A	38A	-
239	CA_8A-41A	8A	41A	-
240	CA_8A-41C	8A	41C	-
241	CA_8A-41D	8A	-	-
242	CA_1A-1A-3A-3A	1A, 3A	-	-
243	CA_13A-48A-66A-66A	13A, 66A	48A	-

244	CA_5A-48A-66A-66A	5A, 66A	48A	-
245	CA_2A-26A-66A	2A, 26A, 66A	-	-
246	CA_2A-26A	2A, 26A	-	-

➢ **LTE Downlink Carrier Aggregation Conducted Power**

1. According to KDB941225 D05A v01r02, Uplink maximum output power measurement with downlink carrier aggregation active should be measured, using the highest output channel measured without downlink carrier aggregation, to confirm that uplink maximum output power with downlink carrier aggregation active remains within the specified tune-up tolerance limits and not more than ¼ dB higher than the maximum output measured without downlink carrier aggregation active.
2. Uplink maximum output power with downlink carrier aggregation active does not show more than ¼ dB higher than the maximum output power without downlink carrier aggregation active, therefore SAR evaluation with downlink carrier aggregation active can be excluded.
3. For power measurement were control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.
4. Selected highest measured power when downlink carrier aggregation is inactive for conducted power comparison with downlink carrier aggregation is active, to confirm that when downlink carrier aggregation is active uplink maximum output power remains within the specified tune-up tolerance limits and not more than ¼ dB higher than the maximum output power measured when downlink carrier aggregation inactive.
5. For non-contiguous intra-band CA, the SCC selected to provide maximum separation from the PCC and must remain fully within the downlink transmission band.
6. For Intra-band, contiguous CA, the downlink channels selected to perform the uplink power measurement must satisfy
7. 3GPP channel spacing (5.4.1A of 3GPP TS 36.521 or equivalent) and channel bandwidth (5.4.2A) requirements.
8. $$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 0.1\left|BW_{Channel(1)} - BW_{Channel(2)}\right|}{0.6} \right\rfloor 0.3 \quad [\text{MHz}]$$
9. The output power of CA uplink & downlink refers to the annex E of this report.

13.3 5G NR Downlink Carrier Aggregation

2CC Downlink Carrier Aggregation				
No.	Combination	NR UL 4 X 4 MIMO	NR DL 4 X 4 MIMO	Restriction
1	CA_n2A-n5A	n2A, n5A	-	-
2	CA_n2A-n66A	n2A, n66A	-	-
3	CA_n2A-n77A	n2A, n77A	n77A	-
4	CA_n2A-n78A	n2A, n78A	n78A	-
5	CA_n5A-n25A	n5A, n25A	n25A	-
6	CA_n5A-n66A	n5A, n66A	-	-
7	CA_n5A-n77A	n5A-n77A	n77A	-
8	CA_n5A-n78A	n5A-n78A	n78A	-
9	CA_n25A-n48A	n77A	-	-
10	CA_n25A-n71A	n25A-n71A	n25A	-
11	CA_n25A-n77A	n25A, n77A	n77A	-
12	CA_n25A-n78A	n25A, n78A	n78A	-
13	CA_n66A-n71A	n66A, n71A	n66A	-
14	CA_n66A-n77A	n66A, n77A	n77A	-
15	CA_n66A-n78A	n66A, n78A	n78A	-
16	CA_n48A-n66A	n48A, n66A	n48A	-
17	CA_n48A-n71A	n48A, n71A	n71A	-
18	CA_n71A-n77A	n71A, n77A	n77A	-
19	CA_n71B	n71A	n71B	-

Note:

1. 3GPP channel spacing (5.4.1A of 3GPP TS 38.521 or equivalent) and channel bandwidth (5.3.2A) requirements.

For NR operating bands with 100 kHz channel raster:

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 2\left|GB_{Channel(1)} - GB_{Channel(2)}\right|}{0.6} \right\rfloor 0.3\ [\text{MHz}]$$

For NR operating bands with 15 kHz channel raster:

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 2\left|GB_{Channel(1)} - GB_{Channel(2)}\right|}{0.015 * 2^{n+1}} \right\rfloor 0.015 * 2^{n}\ [\text{MHz}]$$

2. The output power of CA uplink & downlink refers to the annex E of this report.

14 5G NR EN-DC Consideration

- **General Guidance**

1. It is operate at EN-DC (NSA)/SA for 5G NR implementation according to the character of the device. SAR measurement should be performed separately for the limitations of the probe calculation factors.
2. When the EN-DC is active the output power of the LTE anchors is equal or less than the standalone carrier, therefore the LTE output power and SAR were estimated based on the standalone carrier to performed sim-TX analysis with 5G NR, WLAN and Bluetooth.
3. According to October 2020 TCB Workshop publication, EN-DC SAR assessment should follow:
   a. If the signal uplink 1-g SAR values for each band are both less than 0.8 W/kg and the algebraic summation of the 1-g SAR values are less than 1.45 W/kg no additional measurements need to be performed.
   b. If one or the signal uplink 1-g SAR values is greater than 0.8 W/kg, instead of algebraically summing the 1-g SAR values, sum up the SAR distributions, similar to the enlarged zoom scan (volume scan) procedures found in FCC KDB Publication 865664 D01. And PAG is required for this case.
   c. If the algebraic sum of the 1-g SAR values is > 1.45 W/kg additional measurements may have to be made. Submit a KDB inquiry for additional guidance and PAG is required for this case.
   d. When the algebraic sum of the 1-g SAR values is > 1.6 W/kg, SPLSR analysis procedure should be applied.

- **5G NR Anchor Combination (EN-DC UL)**

5G-NR	EN-DC Combination	LTE Uplink	5G-NR Uplink	SCS (kHz)	Maximum Bandwidth (MHz)
FDD	DC_5A-n2A	5	n2	15	20
FDD	DC_12A-n2A	12	n2	15	20
FDD	DC_13A-n2A	13	n2	15	20
FDD	DC_14A-n2A	14	n2	15	20
FDD	DC_48A-n2A	48	n2	15	20
FDD	DC_66A-n2A	66	n2	15	20
FDD	DC_71A-n2A	71	n2	15	20
FDD	DC_2A-n5A	2	n5	15	20
FDD	DC_7A-n5A	7	n5	15	20
FDD	DC_30A-n5A	30	n5	15	20
FDD	DC_48A-n5A	48	n5	15	20
FDD	DC_66A-n5A	66	n5	15	20
FDD	DC_12A-n25A	12	n25	15	20
FDD	DC_66A-n25A	66	n25	15	20
TDD	DC_5A-n41A	5	n41	30	100
TDD	DC_12A-n41A	12	n41	30	100
TDD	DC_26A-n41A	26	n41	30	100
TDD	DC_71A-n41A	71	n41	30	100

FDD	DC_2A-n66A	2	n66	15	20
FDD	DC_5A-n66A	5	n66	15	20
FDD	DC_12A-n66A	12	n66	15	20
FDD	DC_13A-n66A	13	n66	15	20
FDD	DC_14A-n66A	14	n66	15	20
FDD	DC_48A-n66A	48	n66	15	20
FDD	DC_71A-n66A	71	n66	15	20
TDD	DC_2A-n77A	2	n77	30	100
TDD	DC_5A-n77A	5	n77	30	100
TDD	DC_12A-n77A	12	n77	30	100
TDD	DC_13A-n77A	13	n77	30	100
TDD	DC_14A-n77A	14	n77	30	100
TDD	DC_30A-n77A	30	n77	30	100
TDD	DC_41A-n77A	41	n77	30	100
TDD	DC_66A-n77A	66	n77	30	100
TDD	DC_2A-n78A	2	n78	30	100
TDD	DC_4A-n78A	4	n78	30	100
TDD	DC_5A-n78A	5	n78	30	100
TDD	DC_7A-n78A	7	n78	30	100
TDD	DC_12A-n78A	12	n78	30	100
TDD	DC_13A-n78A	13	n78	30	100
TDD	DC_26A-n78A	26	n78	30	100
TDD	DC_38A-n78A	38	n78	30	100
TDD	DC_41A-n78A	41	n78	30	100
TDD	DC_66A-n78A	66	n78	30	100
TDD	DC_71A-n78A	71	n78	30	100

15 Exposure Positions Consideration

➢ **EUT Antenna Locations**

The location of antenna was recorded in annex B	
Antenna	Support band
ANT1	LB TRx: B5/B12/B13/B14/B17/B18/B19/B26/B29/B71, n5/n26/n29/n71 MB PRx MIMO: B2/B4/B25/B66, n2/n25/n66
ANT2	LB DRx: B5/B12/B13/B14/B17/B18/B19/B26/B29/B71, n5/n26/n29/n71 MB DRx MIMO: B2/B4/B25/B66, n2/n25/n66
ANT3	MHB Tx1/DRx: B1/B2/B3/B4/B7/B25/B30/B38/B41/B66, n2/n7/n25/n30/n41/n66
ANT4	MB TRx: B2/B4/B25/B66, n2/n25/n66 HB PRx MIMO: B7/B30/B38/B41, n7/n30/n41
ANT5	HB TRx: B7/B30/B38/B41, n7/n30/n41 UHB DRX: B48,n48/n77/n78
ANT6	UHB TRx:B48,n48/n77/n78
ANT7	UHB DRx MIMO: B48,n48/n77/n78 HB DRx MIMO: B7/B30/B38/B41, n7/n30/n41
ANT8	UHB PRx MIMO: B48,n48/n77/n78
ANT0	WIFI 2.4G/5G ,GPS L1

➢ **Test Positions Consideration**

1. The test position consideration was recorded in annex F.
2. Per KDB 616217 D04v01r02, when the overall diagonal dimension of display is > 20 cm, the test distance is 0mm; the SAR Test Exclusion Threshold in KDB 447498 section 4.3.1 can be applied to determine SAR test exclusion for adjacent edge configurations.
3. Per KDB 616217 D04v01r02, SAR evaluation for the front surface of tablet display screens is generally not necessary.
4. Per KDB 616217 D04v01r02, additional testing for hotspot SAR is not required.

16 Proximity Sensor Considerations

16.1 Proximity Sensor Triggering Distances

➢ **P-sensor Triggering Distance Testing**

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

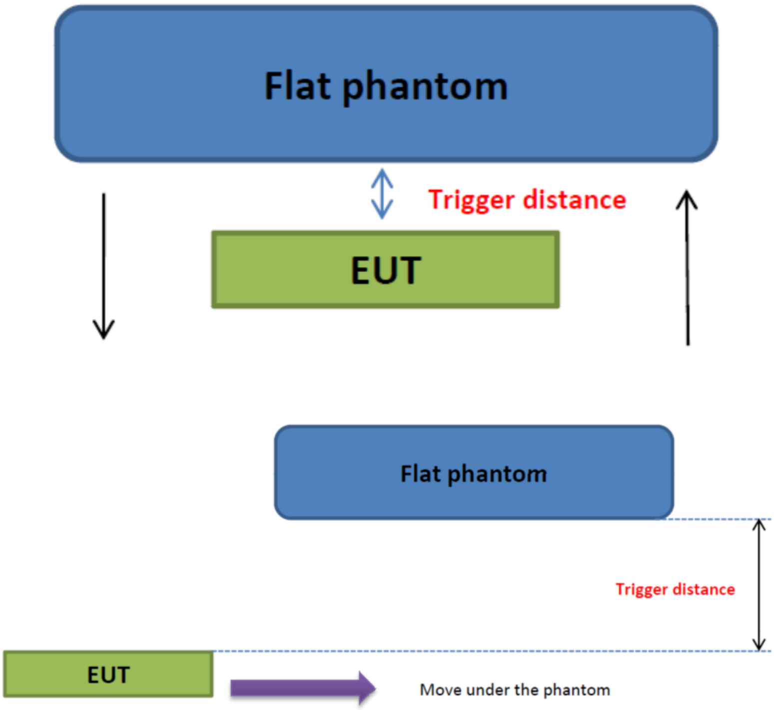

Fig.14.1 Illustration for proximity sensor trigger

➢ **P-sensor Triggering Distance**

<WWAN for ANT 1>

Proximity Sensor Trigger Distance (mm)			
Exposure Position	Bottom Face	Edge 3	Edge 4
Minimum	31	31	31

<WWAN for ANT 3 & 4>

Proximity Sensor Trigger Distance (mm)				
Exposure Position	Bottom Face	Edge 1	Edge 3	Edge 4
Minimum	16	16	16	16

<WWAN for ANT 5>

Proximity Sensor Trigger Distance (mm)		
Exposure Position	Bottom Face	Edge 1
Minimum	22	21

<WWAN for ANT 6>

Proximity Sensor Trigger Distance (mm)		
Exposure Position	Bottom Face	Edge 4
Minimum	29	29

<WLAN/BT for ANT 0>

Proximity Sensor Trigger Distance (mm)		
Exposure Position	Bottom Face	Edge 4
Minimum	29	29

16.2 Proximity Sensor Coverage

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

16.3 Tablet Tilt Angle Influences to P-Sensor Triggering

- **P-sensor Triggering Distance Testing**

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

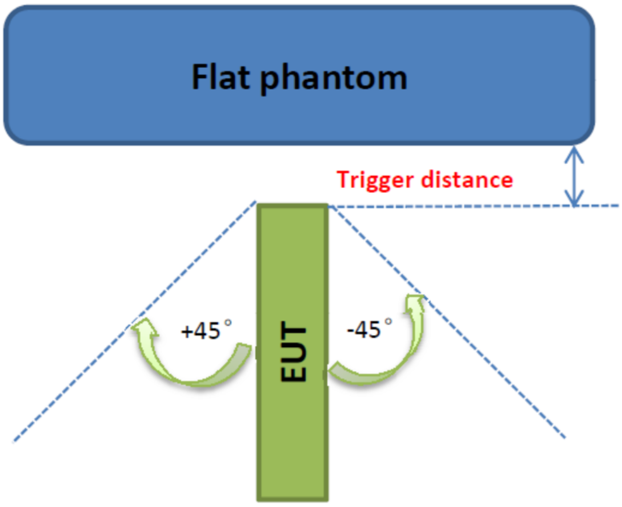

Fig.14.2 Illustration for proximity sensor trigger for tablet tilt angle influences

16.4 Proximity Sensor Power Reduction

Remark: The power reduction list and graphs were recorded in annex G.

17 SAR Test Results Summary

17.1 Test Guidance

1. The reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   1. 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.
   2. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)".
   3. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor.
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   a. ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   b. ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   c. ≤ 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 KDB248227 D01v02r02, a Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actual channel frequencies required for operations in the U.S. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. Unless it is permitted by specific KDB procedures or continuous transmission is specifically restricted by the device, the reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. When a device is not capable of sustaining continuous transmission or the output can become nonlinear, and it is limited by hardware design and unable to transmit at higher than 85% duty factor, a periodic duty factor within 15% of the maximum duty factor the device is capable of transmitting should be used. The reported SAR must be scaled to the maximum transmission duty factor to determine compliance. Descriptions of the procedures applied to establish the specific duty factor used for SAR testing are required in SAR reports to support the test results.

4. For CA UL SAR measurement, the worst condition of standalone transmission would be tested.
5. When the proximity sensor is active, the reduced power of WWAN will be applied to bottom face, edge 1, and edge 4, and the reduced power of WLAN will be applied to bottom face, edge 1, and edge 2.
6. The maximum power of NFC is less than 1mW per the manual information, therefore it is not required for RF exposure.
7. The reduced power level 1 of WWAN/WLAN will be applied to standalone transmission and the reduced power level 2 of WWAN/WLAN/Bluetooth will be applied to simultaneous transmission.
8. The Ant 3 is only transmitted in the EN-DC combination state and does not support independent transmission.

17.2 Body SAR Data

Remark:

1. SAR test results were recorded annex H.
2. Per KDB 447498 D01v06, for each exposure position, if the highest output channel Reported SAR ≤0.8W/kg, other channels SAR testing is not necessary.
3. Additional WLAN SAR testing was performed for simultaneous transmission analysis.
4. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥0.8W/kg.
5. Per KDB248227 D01v02r02, OFDM SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
6. According to KDB 865664 D02v01r02, SAR plot is required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination.
7. The WLAN Reported 1g SAR (W/kg) should be scaled with the duty cycle scaling factor 1.011 for 802.11b, 802.11 n40 with 1.035 and 802.11ac40 with 1.035.
8. According to 2016 Oct. TCB workshop for Bluetooth SAR consideration and the theoretical dut y cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation. The duty cycle of Bluetooth is 76.96%, therefore the duty cycle scaling factor 1.082 should be used to calculating the reported SAR.

17.3 Repeated SAR Assessment

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1. Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg;
2. When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3. Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4. Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

- **Repeated SAR**

The repeated SAR test results were recorded annex H.

18 Simultaneous Transmission Analysis

18.1 Simultaneous Transmission Consideration

No.	Simultaneous Transmission Consideration	Exposure Position
		Body
1	WWAN (3G/4G/5G SA/NSA) + WLAN 2.4GHz/5GHz	Yes
2	WWAN (3G/4G/5G SA/NSA) + WLAN 5GHz	Yes
3	WWAN (3G/4G/5G SA/NSA) + Bluetooth	Yes

Note:

1. Simultaneous Transmission SAR evaluation is not required for BT and WLAN, because the software mechanism have been incorporated to guarantee that the WLAN and Bluetooth transmitters would not simultaneously operate at the same time.
2. Per KDB 447498D01v06, simultaneous transmission SAR evaluation procedures is as followed:

Step 1: If sum of 1 g SAR <1.6 W/kg, Simultaneous SAR measurement is not required.

Step 2: If sum of 1 g SAR >1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

Step 3: If the ratio of SAR to peak separation distance is ≤0.04, Simultaneous SAR measurement is not required.

Step 4: If the ratio of SAR to peak separation distance is >0.04, Simultaneous SAR measurement is required and simultaneous transmission SAR value is calculated.

(The ratio is determined by: $(SAR_1 + SAR_2)$ ^ 1.5/Ri ≤0.04,

R_i is the separation distance between the peak SAR locations for the antenna pair in mm.

18.2 Simultaneous Transmission Analysis

Remark:

The simultaneous transmission data was shown in annex I.

19 Measurement Uncertainty

According to KDB 865664 D01 SAR measurement 100 MHz to 6GHz, when the highest measured 1-g SAR is less than 1.5 W/kg and 10-g extremity SAR less than 3.75 W/kg, the expanded SAR measurement uncertainty must be less than 30% with a confidence interval of k=2. When these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE 1528-2013 is not required in the SAR report and submitted for equipment approval. For this device, both the 1-g SAR is less than 1.5 W/kg, therefore the measurement uncertainty table is not required in this report.

20 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested. Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

Note:

The main report is end here and the other Annex (B,C,D,E,F,G,H,I,J) will be submitted separately.

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