FCC SAR Test Report

FCC ID: 2AAGE5081SB48W

Project No.	:	2111H055
Equipment	:	Tablet
Brand Name	:	Vantron
Test Model	:	VT-TABLET-5081S
Series Model	:	N/A
Date of Receipt	:	Nov. 29, 2021
Date of Test	:	Dec. 03, 2021 ~ Dec. 13, 2021
Issued Date	:	Dec. 23, 2021
Report Version	:	R01
Test Sample	:	Engineering Sample No.: SH20211129111-4.
Standard(s)	:	Please refer to page 2.
Applicant	:	Chengdu Vantron Technology Co., Ltd.
Address	:	No.5 GaoPeng Road, Hi-Tech Zone, Chengdu, SiChuan, P.R. China 610045
Manufacturer	:	Chengdu Vantron Technology Co., Ltd.
Address	:	No.5 GaoPeng Road, Hi-Tech Zone, Chengdu, SiChuan, P.R. China 610045

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

Prepared by : Seven Lu

Approved by : Herbort Liu

ACCREDITED
TESTING CERT #5123.02

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Standard(s) : **FCC 47CFR §2.1093** Radio frequency Radiation Exposure Evaluation: Portable Devices

ANSI Std C95.1-1992 Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz - 300 GHz. (IEEE Std C95.1-1991)

IEEE Std 1528-2013 Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

KDB616217 D04 SAR for laptop and tablets v01r02
KDB941225 D05 SAR for LTE Devices v02r05
KDB447498 D01 General RF Exposure Guidance v06
KDB248227 D01 802. 11 Wi-Fi SAR v02r02
KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
KDB865664 D02 RF Exposure Reporting v01r02
KDB690783 D01 SAR Listings on Grants v01r03

Declaration

BTL represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

BTL's reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

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BTL's laboratory quality assurance procedures are in compliance with the **ISO/IEC 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

BTL is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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REPORT ISSUED HISTORY

Report Version	Description	Issued Date
R00	Original Issue.	Dec. 20, 2021
R01	Modified the comments of TCB.	Dec. 23, 2021

1. GENERAL INFORMATION

1.1 STATEMENT OF COMPLIANCE

Mode	Highest Reported Body SAR-1g (W/kg)
LTE B48	1.400
2.4G WIFI	0.431
5.2G WIFI	0.350
5.8G WIFI	1.019
Bluetooth	0.091

Note:
1) The device is in compliance with Specific Absorption Rate (SAR) for general population uncontrolled exposure limits according to the FCC rule §2.1093, the ANSI C95.1:1992/IEEE C95.1:1991, the NCRP Report Number 86 for uncontrolled environment and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

1.2 LABORATORY ENVIRONMENT

Temperature	Min. = 20ºC, Max. = 24ºC
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

1.3 GENERAL DESCRIPTION OF EUT

<table>
<tr><td>Equipment</td><td colspan="4">Tablet</td></tr>
<tr><td>Test Model</td><td colspan="4">VT-TABLET-5081S</td></tr>
<tr><td>Hardware Version</td><td colspan="4">4.3</td></tr>
<tr><td>Firmware Version</td><td colspan="4">rev1.0.1fcc</td></tr>
<tr><td>Modulation</td><td colspan="4">LTE(QPSK/16QAM), WiFi(DSSS/OFDM), BT(GFSK/π/4-DQPSK/8-DPSK)</td></tr>
<tr><td rowspan="6">Operation Frequency Range(s)</td><td>Band</td><td colspan="3">TX (MHz)</td></tr>
<tr><td>LTE B48</td><td colspan="3">3550~3700</td></tr>
<tr><td>Bluetooth</td><td colspan="3">2400~2483.5</td></tr>
<tr><td>2.4G WLAN</td><td colspan="3">2400~2483.5</td></tr>
<tr><td>5.2G WLAN</td><td colspan="3">5150~5250</td></tr>
<tr><td>5.8G WLAN</td><td colspan="3">5725~5850</td></tr>
<tr><td>Power Class</td><td colspan="4">3, tested with power control “all Max” (LTE B48)</td></tr>
<tr><td rowspan="8">Test Channels (low-mid-high)</td><td colspan="4">55340-55990-56640 (LTE B48 BW=20M)</td></tr>
<tr><td colspan="4">0-39-78 (BT)</td></tr>
<tr><td colspan="4">0-19-39 (BLE)</td></tr>
<tr><td colspan="4">1-6-11 (2.4G WIFI 802.11b/g/n HT20)</td></tr>
<tr><td>Band</td><td colspan="2">5.2G WiFi</td><td>5.8G WiFi</td></tr>
<tr><td>802.11a/n HT20 /ac VHT20</td><td colspan="2">36-40-44-48</td><td>149-153-157-161-165</td></tr>
<tr><td>802.11n HT40 /ac VHT40</td><td colspan="2">38-46</td><td>151-159</td></tr>
<tr><td>802.11ac VHT80</td><td colspan="2">42</td><td>155</td></tr>
<tr><td rowspan="5">Antenna Gain (dBi)</td><td>Band</td><td>Ant 0</td><td>BT / WiFi Ant 1</td><td>WiFi Ant 2</td></tr>
<tr><td>LTE B48</td><td>1.00</td><td>/</td><td>/</td></tr>
<tr><td>Bluetooth</td><td>/</td><td>2.2</td><td>/</td></tr>
<tr><td>WLAN 2.4G</td><td>/</td><td>2.2</td><td>3.4</td></tr>
<tr><td>WLAN 5G</td><td>/</td><td>2.4</td><td>1.4</td></tr>
<tr><td colspan="5">Other Information</td></tr>
<tr><td rowspan="2">Battery</td><td>Model Name</td><td colspan="3">GSP27103107</td></tr>
<tr><td>Power Rating</td><td colspan="3">8000mAh 3.8V 30.4Wh</td></tr>
</table>

1.4 MAIN TEST INSTRUMENTS

Item	Equipment	Manufacturer	Model	Serial No.	Cal. Date	Cal. Interval
1	Data Acquisition Electronics	Speag	DAE4	760	Oct. 26, 2021	1 Year
2	Data Acquisition Electronics	Speag	DAE4	1423	Dec. 11, 2020	1 Year
3*	Data Acquisition Electronics	Speag	DAE4	420	Dec. 09, 2020	1 Year
4	E-field Probe	Speag	EX3DV4	3809	Oct. 14, 2021	1 Year
5	E-field Probe	Speag	ES3DV3	3162	Jun. 15, 2021	1 Year
6	System Validation Dipole	Speag	D2450V2	919	May 28, 2021	3 Years
7	System Validation Dipole	Speag	D3500V2	1095	Jan. 24, 2020	3 Years
8	System Validation Dipole	Speag	D3700V2	1064	Jan. 24, 2020	3 Years
9	System Validation Dipole	Speag	D5GHzV2	1160	May. 27, 2021	3 Years
10	ELI Phantom	Speag	ELI Phantom V5.0	1222	N/A	N/A
11	ELI Phantom	Speag	ELI Phantom V5.0	1128	N/A	N/A
12	Wideband radio communication tester	R&S	CMW500	152372	Feb. 27, 2021	1 Year
13	Wideband Radio Communication Tester	R&S	CMW500	104462	Jul. 27, 2021	1 Year
14	Power Amplifier	Mini-Circuits	ZHL-42W+	QA1333003	Dec. 29, 2020	1 Year
15	Power Amplifier	Mini-Circuits	ZVE-8G+	520701341	Mar. 02, 2021	1 Year
16	DC Source metter	Iteck	IT6154	006104126768201001	Jul. 24, 2021	1 Year
17	Signal Analyzer	R&S	FSV7	103120	Jul. 10, 2021	1 Year
18	Vector Network Analyzer	Agilent	E5071C	MY46102965	Feb. 28, 2021	1 Year
19	Signal Generator	Agilent	N5172B	MY53050758	Feb. 27, 2021	1 Year
20	Smart Power Sensor	R&S	NRP-Z21	102209	Feb. 28, 2021	1 Year
21	3.5mm Economy Calibration Kit	Agilent	85052D	MY43252246	Dec. 10, 2020	1 Year
22	Dielectric Assessment Kit	Speag	DAK-3.5	1226	N/A	N/A
23	Directional Coupler	Woken	TS-PCC0M-05	0107090019	Feb. 27, 2021	1 Year
24	Coupler	Woken	0110A05601O-10	COM5BNW1A2	Feb. 27, 2021	1 Year
25	Digital Themometer	LKM	DTM3000	3519	Jun. 24, 2021	1 Year

Remark:
1. “N/A” denotes no model name, serial No. or calibration specified.
2. 1) Per KDB865664 D01 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
   a) There is no physical damage on the dipole;
   b) System check with specific dipole is within 10% of calibrated value;
   c) The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement;
   d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
   2) Network analyzer probe calibration against air, distilled water and a short block performed before measuring liquid parameters.
3. The item 3 is test on the 12/3.

2. RF EMISSIONS MEASUREMENT

2.1 TEST FACILITY

The test facilities used to collect the test data in this report is SAR room at the location of Room 108, Building 2, No.1, Yile Road, Songshan Lake Zone, Dongguan City, Guangdong, People's Republic of China.
BTL's Designation Number for FCC: CN1240.

2.2 MEASUREMENT UNCERTAINTY

Uncertainty Budget for Frequency range of 300 MHz to 3 GHz (IEEE 1528, IEC/EN 62209-1)

Error Description	Uncertainty Value (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)	Vi V_{eff}
Measurement System								
Probe Calibration	6.05	Normal	1	1	1	± 6.05 %	± 6.05 %	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	0.7	± 3.9 %	± 3.9 %	∞
Boundary Effects	1	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	± 2.7 %	± 2.7 %	∞
Detection Limits	1	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %	∞
Modulation response	2.4	Rectangular	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	± 0.5%	± 0.5 %	∞
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	± 1.5 %	± 1.5 %	∞
RF Ambient – Noise	3	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient – Reflections	3	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	± 0.2 %	± 0.2 %	∞
Probe Positioning	2.9	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	±1.7 %	∞
Max.SAR Evaluation	4	Rectangular	$\sqrt{3}$	1	1	± 2.3 %	± 2.3 %	∞
Test Sample Related								
Device Positioning	1.7 1.9	Normal	1	1	1	± 1.8 %	± 1.9 %	145
Device Holder	2.2 2.3	Normal	1	1	1	± 1.7 %	± 1.9 %	5
Power Drift	5.0	Rectangular	$\sqrt{3}$	1	1	± 2.9 %	± 2.9 %	∞
Power Scaling	0	Rectangular	$\sqrt{3}$	1	1	± 0.0 %	± 0.0 %	∞
Phantom and Setup								
Phantom Production Tolerances	6.1	Rectangular	$\sqrt{3}$	1	1	3.5 %	3.5 %	∞
SAR correction	1.9	Rectangular	$\sqrt{3}$	1	0.84	1.1 %	0.9 %	
Liquid Conductivity (mea.)	2.5	Rectangular	$\sqrt{3}$	0.78	0.71	1.1 %	1.0 %	∞
Liquid Permittivity (mea.)	2.5	Rectangular	$\sqrt{3}$	0.26	0.26	0.4 %	0.4 %	∞
Temp. unc. - Conductivity	3.4	Rectangular	$\sqrt{3}$	0.78	0.71	1.5 %	1.4 %	∞
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.23	0.26	0.1 %	0.1 %	∞
Combined Standard Uncertainty (K = 1)						± 10.5 %	± 10.5 %	361
Expanded Uncertainty (K = 2)						**± 21.0 %**	**± 21.0 %**	

Uncertainty Budget for Frequency range of 3 GHz to 6 GHz (IEEE 1528, IEC/EN 62209-1)

Error Description	Uncertainty Value (± %)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)	Vi V_{eff}
Measurement System								
Probe Calibration	6.65	Normal	1	1	1	± 6.65 %	± 6.65 %	∞
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	0.7	± 1.9 %	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	0.7	± 3.9 %	± 3.9 %	∞
Boundary Effects	2	Rectangular	$\sqrt{3}$	1	1	± 1.2 %	± 1.2 %	∞
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	± 2.7 %	± 2.7 %	∞
Detection Limits	1	Rectangular	$\sqrt{3}$	1	1	± 0.6 %	± 0.6 %	∞
Modulation response	2.4	Rectangular	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %	∞
Response Time	0.8	Rectangular	$\sqrt{3}$	1	1	± 0.5%	± 0.5 %	∞
Integration Time	2.6	Rectangular	$\sqrt{3}$	1	1	± 1.5 %	± 1.5 %	∞
RF Ambient – Noise	3	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %	∞
RF Ambient – Reflections	3	Rectangular	$\sqrt{3}$	1	1	± 1.7 %	± 1.7 %	∞
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1	1	± 0.2 %	± 0.2 %	∞
Probe Positioning	6.7	Rectangular	$\sqrt{3}$	1	1	± 3.9 %	±3.9 %	∞
Max.SAR Evaluation	4	Rectangular	$\sqrt{3}$	1	1	± 2.3 %	± 2.3 %	∞
Test Sample Related								
Device Positioning	2.3 / 2.1	Normal	1	1	1	± 2.3 %	± 2.1 %	145
Device Holder	2.2 / 2.3	Normal	1	1	1	± 2.2 %	± 2.3 %	5
Power Drift	5.0	Rectangular	$\sqrt{3}$	1	1	± 2.9 %	± 2.9 %	∞
Phantom and Setup								
Phantom Production Tolerances	6.1	Rectangular	$\sqrt{3}$	1	1	2.31	2.31	∞
SAR correction	1.9	Rectangular	$\sqrt{3}$	1	0.84	1.10	1.10	
Liquid Conductivity (mea.)	2.5	Rectangular	$\sqrt{3}$	0.78	0.71	1.13	1.13	∞
Liquid Permittivity (mea.)	2.5	Rectangular	$\sqrt{3}$	0.26	0.26	0.38	0.38	∞
Temp. unc. - Conductivity	3.4	Rectangular	$\sqrt{3}$	0.78	0.71	1.53	1.53	∞
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.23	0.26	0.05	0.05	∞
Combined Standard Uncertainty (K = 1)						± 11.78 %	± 11.72 %	361
Expanded Uncertainty (K = 2)						**± 23.56 %**	**± 23.44 %**	

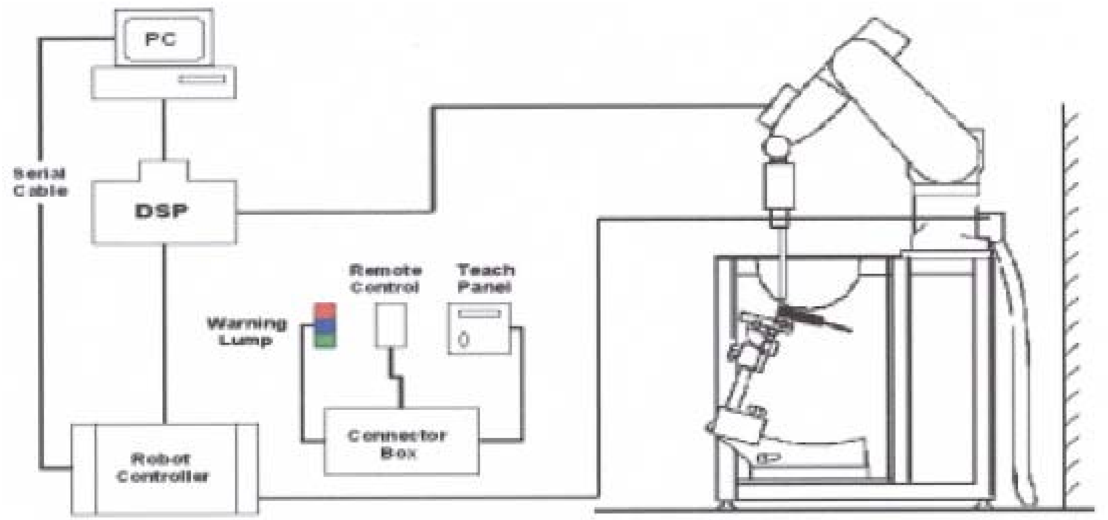
3. SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1 SAR MEASUREMENT SET-UP

The DASY5 system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
4. A unit to operate the optical surface detector which is connected to the EOC.
5. The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
6. TheDASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows.
7. DASY5 software and SEMCAD data evaluation software.
8. Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling the testing of left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. System validation dipoles allowing to validate the proper functioning of the system.

3.1.1 TEST SETUP LAYOUT



3.2 DASY5 E-FIELD PROBE SYSTEM

The SAR measurements were conducted with the dosimetric probe ES3DV3 and EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

3.2.1 EX3DV4 PROBE SPECIFICATION

ES3DV3

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 μW/g to > 100 mW/g Linearity:± 0.2dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 4 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm

EX3DV4

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
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:± 0.2dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm

E-field Probe

3.2.2 E-FIELD PROBE CALIBRATION

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ±10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\mathbf{SAR} = \mathbf{C}\frac{\Delta T}{\Delta t}$$

Where: Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where: σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m3).

3.2.3 OTHER TEST EQUIPMENT

3.2.3.1 Device Holder for Transmitters

Construction: Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices (e.g., laptops, cameras, etc.) It is light weight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin SAM, ELI and SAM v6.0 Phantoms.
Material: POM, Acrylic glass, Foam

3.2.3.2 Phantom

Model	ELI Phantom	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Shell Thickness	2±0.1 mm	
Filling Volume	Approx. 30 liters	
Dimensions	Length: 600 mm; Width: 190mm Height: adjustable feet	
Aailable	Special	

3.2.4 SCANNING PROCEDURE

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

- Area Scan

The “area scan” measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The standard scan uses large grid spacing for faster measurement. Standard grid spacing for head measurements is 15 mm in x- and y- dimension (≤2GHz), 12 mm in x- and y- dimension (2-4 GHz) and 10mm in x- and y- dimension (4-6GHz). If a finer resolution is needed, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation.

- Zoom Scan

A “zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous “coarse” scan. This is a fine grid with maximum scan spatial resolution: Δx_{zoom}, Δy_{zoom}≤2GHz -≤8mm, 2-4GHz -≤5 mm and 4-6 GHz-≤4mm; Δz_{zoom}≤3GHz -≤5 mm, 3-4 GHz-≤4mm and 4-6GHz-≤2mm where the robot additionally moves the probe along the z-axis away from the bottom of the Phantom. DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in Appendix B. Test results relevant for the specified standard (see chapter 1.4.) are shown in table form in chapter 7.2.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 2 mm steps. This measurement shows the continuity of the liquid and can - depending in the field strength – also show the liquid depth.

The following table summarizes the area scan and zoom scan resolutions per FCC KDB 865664D01:

Frequency	Maximun Area Scan resolution (Δx_{area}, Δy_{area})	Maximun Zoom Scan spatial resolution (Δx_{Zoom}, Δy_{Zoom})	Maximun Zoom Scan spatial resolution			Minimum zoom scan volume (x,y,z)
			Uniform Grid	Graded Grad		
			$\Delta z_{Zoom}(n)$	$\Delta z_{Zoom}(1)$*	$\Delta z_{Zoom}(n>1)$*	
≤2GHz	≤15mm	≤8mm	≤5mm	≤4mm	≤1.5*Δz_{Zoom}(n-1)	≥30mm
2-3GHz	≤12mm	≤5mm	≤5mm	≤4mm	≤1.5*Δz_{Zoom}(n-1)	≥30mm
3-4GHz	≤12mm	≤5mm	≤4mm	≤3mm	≤1.5*Δz_{Zoom}(n-1)	≥28mm
4-5GHz	≤10mm	≤4mm	≤3mm	≤2.5mm	≤1.5*Δz_{Zoom}(n-1)	≥25mm
5-6GHz	≤10mm	≤4mm	≤2mm	≤2mm	≤1.5*Δz_{Zoom}(n-1)	≥22mm

3.2.5 SPATIAL PEAK SAR EVALUATION

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of 5 x 5 x 7 points (with 8mm horizontal resolution) or 7 x 7 x 7 points (with 5mm horizontal resolution) or 8 x 8 x 7 points (with 4mm horizontal resolution). The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting “Graph Evaluated”.
- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.
- All neighboring volumes are evaluated until no neighboring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computer mathematic, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computer mathematic, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY5 uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

3.2.6 DATA STORAGE AND EVALUATION

3.2.6.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension “DAE”. The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

3.2.7 DATA EVALUATION BY SEMCAD

The SEMCAD software 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 factor	ConvF$_i$
	Diode compression point	Dcp$_i$
Device parameters:	Frequency	f
	Crest factor	cf
Media parameters:	Conductivity	
	Density	

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 DASY5 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:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

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: $E_i = (V_i \ / \ Norm_i \cdot ConvF \ )^{1/2}$

H-field probes: $H_i = (V_i \ )^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2 \ ) / f$

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

$Norm_i$ = sensor sensitivity of channel i (i = x, y, z)

[mV/(V/m)^2] for E-field Probes

ConvF = sensitivity enhancement in solution

aij = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

E_i = electric field strength of channel i in V/m

H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_X{}^2 + E_Y{}^2 + E_Z{}^2)^{1/2}$$

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

$$SAR = (E_{tot})^2 \cdot \boldsymbol{\sigma} / (\boldsymbol{\rho} \cdot 1000)$$

With SAR = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

= conductivity in [mho/m] or [Siemens/m]

= equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}{}^2 / 3770 \text{ or } P_{pwe} = H_{tot}{}^2 \cdot 37.7$$

With P_{pwe} = equivalent power density of a plane wave in mW/cm^2

E_{tot} = total field strength in V/m

H_{tot} = total magnetic field strength in A/m

4. SYSTEM VERIFICATION PROCEDURE

4.1 TISSUE VERIFICATION

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectic parameter are within the tolerances of the specified target values. The measured conductivity and relative permittivity should be within ± 5% of the target values.

The following materials are used for producing the tissue-equivalent materials.

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
Head 2450	-	45.0	-	0.1	-	-	54.9	-
Head 3500	-	7.99	-	0.16	-	19.97	71.88	-
Head 3700	-	7.99	-	0.16	-	19.97	71.88	-
Head 5G	-	-	-	-	-	17.2	65.5	17.3

Salt: 99+% Pure Sodium Chloride; Sugar: 98+% Pure Sucrose; Water: De-ionized, 16M + resistivity HEC: Hydroxyethyl Cellulose; DGBE: 99+% Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy)ethanol] Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

Tissue Verification									
Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (εr)	Targeted Conductivity (σ)	Targeted Permittivity (εr)	Deviation Conductivity (σ) (%)	Deviation Permittivity (εr) (%)	Date
Head	2450	22.2	1.786	39.696	1.80	39.2	-0.78	1.27	Dec. 03, 2021
Head	3500	22.3	2.952	38.203	2.91	37.9	1.44	0.80	Dec. 13, 2021
Head	3700	22.3	3.183	37.565	3.12	37.7	2.02	-0.36	Dec. 13, 2021
Head	5250	22.3	4.807	35.658	4.71	36.0	2.06	-0.81	Dec. 03, 2021
Head	5750	22.3	5.339	34.801	5.22	35.4	2.28	-1.55	Dec. 03, 2021

Note:
1) The dielectric parameters of the tissue-equivalent liquid should be measured under similar ambient conditions and within 2 °C of the conditions expected during the SAR evaluation to satisfy protocol requirements.
2) KDB 865664 was ensured to be applied for probe calibration frequencies greater than or equal to 50MHz of the EUT frequencies.
3) The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies. The SAR test plots may slightly differ from the table above since the DASY rounds to three significant digits.

4.2 SYSTEM CHECK

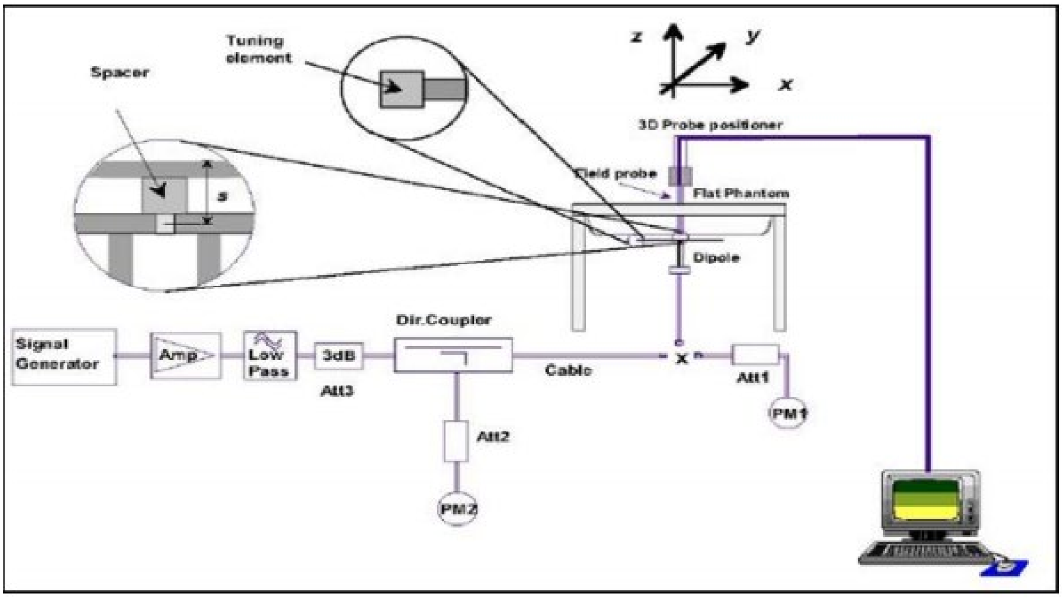
The system check is performed for verifying the accuracy of the complete measurement system and performance of the software. The system check is performed with tissue equivalent material according to IEEE P1528 (described above). The following table shows system check results for all frequency bands and tissue liquids used during the tests.

System Check	Date	Frequency (MHz)	Targeted SAR 1g (W/kg)	Measured SAR 1g (W/kg)	normalized SAR 1g (W/kg)	Deviation 1g (%)	Dipole S/N
Head	Dec. 03, 2021	2450	52.10	12.40	49.60	-4.80	919
Head	Dec. 13, 2021	3500	66.10	6.78	67.80	2.57	1095
Head	Dec. 13, 2021	3700	67.40	6.94	69.40	2.97	1064
Head	Dec. 03, 2021	5250	78.00	7.63	76.30	-2.18	1160
Head	Dec. 03, 2021	5750	76.50	8.00	80.00	4.58	1160

4.3 SYSTEM CHECK PROCEDURE

The system check is performed by using a system check dipole which is positioned parallel to the planar part of the SAM phantom at the reference point. The distance of the dipole to the SAM phantom is determined by a plexiglass spacer. The dipole is connected to the signal source consisting of signal generator and amplifier via a directional coupler, N-connector cable and adaption to SMA. It is fed with a power of 250mW (below 3GHz) or 100mW (3-6GHz). To adjust this power a power meter is used.
The power sensor is connected to the cable before the system check to measure the power at this point and do adjustments at the signal generator. At the outputs of the directional coupler both return loss as well as forward power are controlled during the system check to make sure that emitted power at the dipole is kept constant. This can also be checked by the power drift measurement after the test.

System check results have to be equal or near the values determined during dipole calibration (target SAR in table above) with the relevant liquids and test system (±10 %).



5. SAR MEASUREMENT VARIABILITY AND UNCERTAINTY

5.1 SAR MEASUREMENT VARIABILITY

Per KDB865664 D01 SAR measurement 100 MHz to 6 GHz, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

The detailed repeated measurement results are shown in Section 7.2.

6. OPERATIONAL CONDITIONS DURING TEST

6.1 TEST CONFIGURATION

6.1.1 LTE TEST CONFIGURATION

SAR for LTE band exposure configurations is measured according to the procedures of KDB 941225 D05 SAR for LTE Devices. The CMW500 Wide Band Radio Communication Tester was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR test were performed with the same number of RB and RB offsets transmitting on all TTI frames (Maximum TTI)

1. Spectrum Plots for RB configurations

A properly configured base station simulator was used for LTE output power measurements and SAR testing. Therefore, spectrum plots for RB configurations were not required to be included in this report.

2. MPR

When MPR is implemented permanently within the UE, regardless of network requirements, only those RB configurations allowed by 3GPP for the channel bandwidth and modulation combinations may be tested with MPR active. Configurations with RB allocations less than the RB thresholds required by 3GPP must be tested without MPR.

The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101:

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

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

3. A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by using Network Signaling Value of “NS_01” on the base station simulator.

4. LTE procedures for SAR testing

A) Largest channel bandwidth standalone SAR test requirements

i) QPSK with 1 RB allocation

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

ii) QPSK with 50% RB allocation

The procedures required for 1 RB allocation in i) are applied to measure the SAR for QPSK with 50% RB allocation

iii) QPSK with 100% RB allocation

For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in i) and ii) 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.

iv) Higher order modulations

For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in above sections to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

B) Other channel bandwidth standalone SAR test requirements

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

LTE (TDD) Test Configuration

According to KDB 941225 D05 SAR for LTE Devices V02r05, for Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.
TDD LTE B48 supports 3GPP TS 36 for Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.
TDD LTE B48 supports 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations and Table 4.2-1 for Special subframe configurations.

Figure 4.2-1: Frame structure type 2

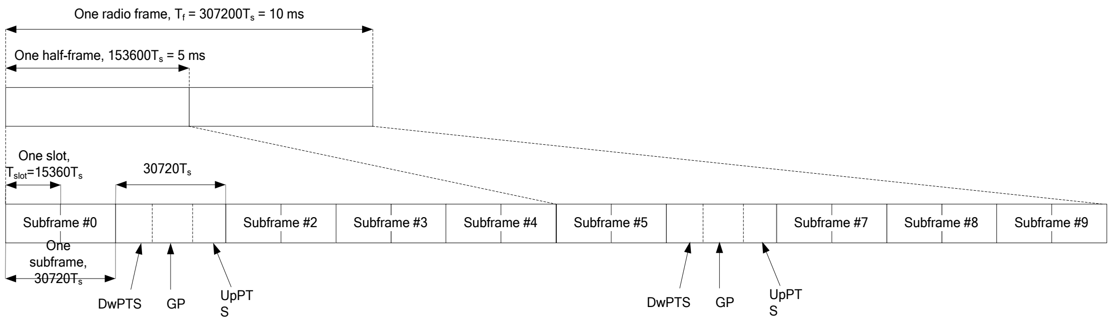


Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

<table>
<tr><th rowspan="3">Special subframe configuration</th><th colspan="3">Normal cyclic prefix in downlink</th><th colspan="3">Extended cyclic prefix in downlink</th></tr>
<tr><th>DwPTS</th><th colspan="2">UpPTS</th><th>DwPTS</th><th colspan="2">UpPTS</th></tr>
<tr><th></th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th><th></th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th></tr>
<tr><td>0</td><td>$6592 \cdot T_s$</td><td rowspan="5">$2192 \cdot T_s$</td><td rowspan="5">$2560 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$2192 \cdot T_s$</td><td rowspan="4">$2560 \cdot T_s$</td></tr>
<tr><td>1</td><td>$19760 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>2</td><td>$21952 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>3</td><td>$24144 \cdot T_s$</td><td>$25600 \cdot T_s$</td></tr>
<tr><td>4</td><td>$26336 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$4384 \cdot T_s$</td><td rowspan="4">$5120 \cdot T_s$</td></tr>
<tr><td>5</td><td>$6592 \cdot T_s$</td><td rowspan="5">$4384 \cdot T_s$</td><td rowspan="5">$5120 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>6</td><td>$19760 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>7</td><td>$21952 \cdot T_s$</td><td>$12800 \cdot T_s$</td></tr>
<tr><td>8</td><td>$24144 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>$13168 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Table 4.2-2: Uplink-downlink configurations

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

According to Figure 4.2-1, one radio frame is configured by 10 subframes, which consist of Uplink-subframe, Downlink-subframe and Special subframe. For TDD-LTE, the Duty Cycle should be calculated on Uplink-subframes and Special subframes, due to Special subframe containing both Uplink transmissions. So for one radio frame, Duty Cycle can be calculated with formula as below. The count of Uplink subframes are according to Table 4.2-2:

Duty cycle =(30720Ts*Ups+Uplink Component*Specials)/(307200Ts)

About the uplink component of Special subframes, we can figure out by Table 4.2-1:

Uplink Component=UpPTS

In conclusion, for the TDD LTE B48, Duty Cycle can be calculated with formula as below. All these sets are ok when we test, or we can set as below.

Duty cycle =[(30720Ts*Ups)+ UpPTS *Specials]/(307200Ts)

And we can get different Duty cycles under different configurations:

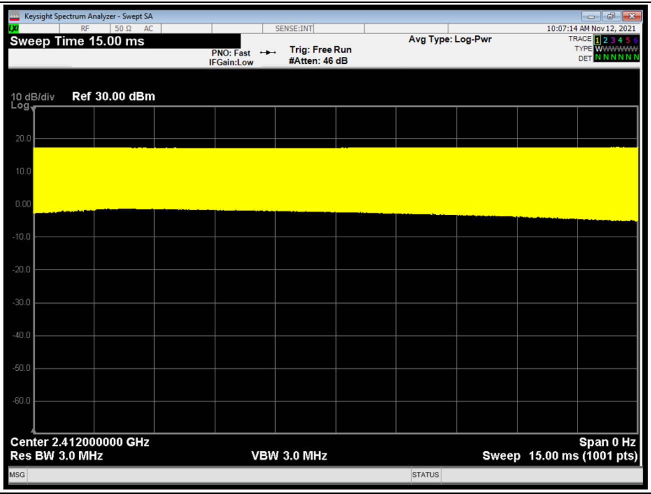
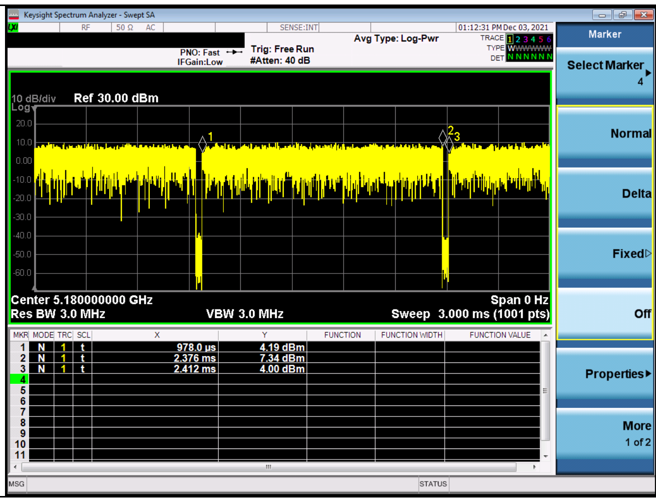
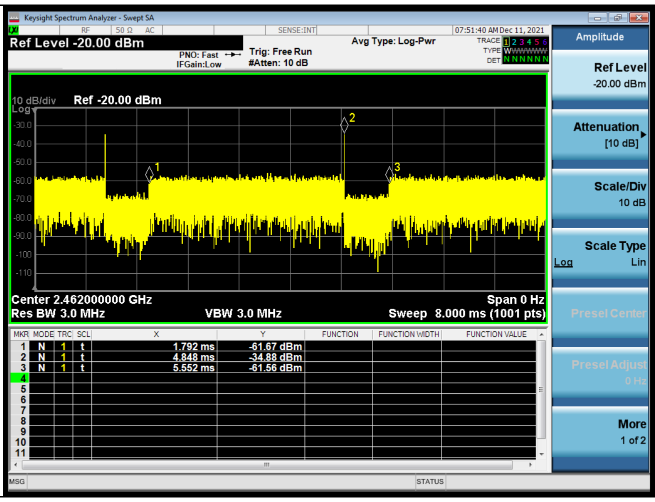
Uplink-downlink configuratin	Subframe number			Configuration of special subframe							
				Normal cyclic prefix in downlink				Extended cyclic prefix in downlink			
				Normal cyclic prefix in uplink		Extended cyclic prefix in uplink		Normal cyclic prefix in uplink		Extended cyclic prefix in uplink	
	D	S	U	configuration 0-4	configuration 5-9	configuration 0-4	configuration 5-9	configuration 0-3	configuration 4-7	configuration 0-3	configuration
0	2	2	6	61.43%	62.85%	61.67%	63.33%	61.43%	62.85%	61.67%	63.33%
1	4	2	4	41.43%	42.85%	41.67%	43.33%	41.43%	42.85%	41.67%	43.33%
2	6	2	2	21.43%	22.85%	21.67%	23.33%	21.43%	22.85%	21.67%	23.33%
3	6	1	3	30.71%	31.43%	30.83%	31.67%	30.71%	31.43%	30.83%	31.67%
4	7	1	2	20.71%	21.43%	20.83%	21.67%	20.71%	21.43%	20.83%	21.67%
5	8	1	1	10.71%	11.43%	10.83%	11.67%	10.71%	11.43%	10.83%	11.67%
6	3	2	5	51.43%	52.85%	51.67%	53.33%	51.43%	52.85%	51.67%	53.33%

For TDD LTE, SAR should be tested with the highest transmission duty factor (63.33%) using Uplink-downlink configuration 0 and Special subframe configuration 7 for Frame structure type 2.

6.1.2 WIFI TEST CONFIGURATION

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal.

For WiFi SAR testing, a communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode. The RF signal utilized in SAR measurement has 100% duty cycle and its crest factor is 1. The test procedures in KDB 248227 D01 are applied.

Duty Cycle	Duty Cycle
WiFi 2.4G	WiFi 5G
100.00%	97.49%
	
Duty Cycle	
BT	
81.28%	
	

6.1.4.1 2.4G SAR Test Requirements

802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) 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.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration 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.

2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.

2) When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

SAR Test Requirements for OFDM configurations

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, each standalone
And frequency aggregated band is considered separately for SAR test reduction. In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

6.1.4.2 5G SAR Test Requirements

✧ **U-NII-1 and U-NII-2A Band**

For devices that operate in both U-NII-1 and U-NII-2A bands, 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. 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.

✧ **U-NII-2C, 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, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification.

Unless band gap channels are permanently disabled, they must be considered for SAR testing.

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.11 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.

6.1.4.3 OFDM transmission mode and SAR test channel selection

For the 2.4GHz and 5GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations (for example 802.11a, 802.11n and 802.11ac, or 802.11g and 802.11n, with the same channel bandwidth, modulation, and data rate, etc.), the lower order 802.11 mode (i.e.802.11a then 802.11n and 802.11ac, or 802.11g then 802.11n) is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

6.1.4.4 Initial test configuration procedure

For OFDM, in both 2.4G and 5GHz bands, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, and lowest data rate. If the average RF output powers of the highest identical transmission modes are within 0.25 dB of each other, mid channel of the transmission mode with highest average RF output powers is the initial test channel. Otherwise, the channel of the transmission mode with the highest average RF output power will be the initial test configuration.
When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurement.

6.2 TEST POSITION

6.2.1 BODY TEST CONFIGURATION

The overall diagonal dimension of the display section of a tablet is 27.3cm>20cm, per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the Tablet touching the phantom. SAR evaluation for the front surface of tablet display screens is generally not necessary. The SAR Exclusion Threshold in KDB 447498 D01 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned adjacent the phantom and the edge containing the antenna positioned perpendicular to the phantom.

SAR test reduction and exclusion guidance

(1) The SAR exclusion threshold for distances<50mm is defined by the following equation:

$$\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \cdot \sqrt{\text{Frequency (GHz)}} \leq 3.0$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

(2) The SAR exclusion threshold for distances>50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to1500 MHz

$$\text{[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm)} \cdot \text{(f}_{\text{(MHz)}}\text{/150)] mW}$$

b) at >1500MHz and ≤6GHz

$$\text{[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm)} \cdot \text{10] mW}$$

The location of the antenna inside EUT and standalone SAR test exclussion, please refer to Appendix E.

7. TEST RESULT

7.1 CONDUCTED POWER RESULTS

7.1.1 CONDUCTED POWER MEASUREMENTS OF LTE

1. Conducted power measurement of LTE B48

LTE B48/BW=5M		Average Conducted Power(dBm)				LTE B48/BW=10M		Average Conducted Power(dBm)			
Modula-tion	RB Size/ Offset	Max. Tune-up	Channel/Frequency(MHz)			Modula-tion	RB Size/ Offset	Max. Tune-up	Channel/Frequency(MHz)		
			55265/ 3552.5	55990/ 3625	56715/ 3697.5				55290/ 3555	55990/ 3625	56690/ 3695
QPSK	1/0	22.00	20.13	20.08	20.90	QPSK	1/0	22.00	20.30	20.38	21.18
	1/12	22.00	20.31	20.16	20.92		1/24	22.00	20.10	20.35	20.95
	1/24	22.00	20.45	20.14	20.93		1/49	22.00	20.38	20.62	21.17
	12/0	22.00	20.65	20.41	21.18		25/0	22.00	20.03	20.29	20.71
	12/6	22.00	20.45	20.17	20.92		25/12	22.00	20.15	20.12	20.81
	12/13	22.00	20.38	20.11	20.88		25/25	22.00	20.13	20.19	20.69
	25/0	22.00	20.64	20.25	20.92		50/0	22.00	20.15	20.14	20.79
16QAM	1/0	22.00	20.07	20.46	20.59	16QAM	1/0	22.00	20.24	20.26	21.15
	1/12	22.00	20.23	20.34	20.78		1/24	22.00	20.04	20.02	20.97
	1/24	22.00	20.09	20.12	20.51		1/49	22.00	20.29	20.34	21.05
	12/0	22.00	20.46	20.06	21.14		25/0	22.00	20.28	20.13	20.70
	12/6	22.00	20.24	20.49	20.90		25/12	22.00	20.24	20.01	20.95
	12/13	22.00	20.22	20.36	20.87		25/25	22.00	20.16	20.00	20.74
	25/0	22.00	20.28	20.48	20.90		50/0	22.00	20.04	20.11	20.76
LTE B48/BW=15M		Average Conducted Power(dBm)				LTE B48/BW=20M		Average Conducted Power(dBm)			
Modula-tion	RB Size/ Offset	Max. Tune-up	Channel/Frequency(MHz)			Modula-tion	RB Size/ Offset	Max. Tune-up	Channel/Frequency(MHz)		
			55315/ 55340	55990/ 3625	56665/ 3692.5				55340/ 3560	55990/ 3625	56640/ 3690
QPSK	1/0	22.00	20.40	20.51	21.25	QPSK	1/0	22.00	20.57	20.52	21.22
	1/37	22.00	20.08	20.45	21.14		1/50	22.00	**20.87**	**20.69**	**21.71**
	1/74	22.00	20.45	20.68	21.23		1/99	22.00	20.63	20.39	21.54
	36/0	22.00	20.06	20.46	20.84		50/0	22.00	**20.52**	**20.58**	**21.66**
	36/19	22.00	20.01	20.21	21.00		50/25	22.00	20.46	20.55	21.17
	36/39	22.00	20.02	20.31	20.84		50/50	22.00	20.43	20.55	21.24
	75/0	22.00	20.04	20.34	20.83		100/0	22.00	20.40	20.24	**20.54**
16QAM	1/0	22.00	20.41	20.38	21.20	16QAM	1/0	22.00	20.84	20.30	21.55
	1/37	22.00	20.13	20.18	21.08		1/50	22.00	20.45	20.59	21.31
	1/74	22.00	20.36	20.54	21.21		1/99	22.00	20.95	20.56	21.62
	36/0	22.00	20.41	20.05	20.85		50/0	22.00	20.41	20.61	21.38
	36/19	22.00	20.26	20.11	21.04		50/25	22.00	20.50	20.13	21.10
	36/39	22.00	20.37	20.07	20.85		50/50	22.00	20.55	20.45	21.23
	75/0	22.00	20.06	20.09	20.87		100/0	22.00	20.52	20.42	21.31

Note: The tested channel results are marks in bold.

7.1.2 CONDUCTED POWER MEASUREMENTS OF BT

BT	Average Conducted Power(dBm)			
	Max. Tune up	CH0 2402MHz	CH39 2441MHz	CH78 2480MHz
DH5	7.00	**5.85**	5.77	5.81
2DH5	7.00	5.78	5.69	5.75
3DH5	7.00	5.68	5.23	5.65

BT	Average Conducted Power(dBm)			
	Max. Tune up	CH0 2402MHz	CH19 2440MHz	CH39 2480MHz
BLE(1M)	5.00	3.65	4.13	4.39
BLE(2M)	5.00	3.21	4.02	4.12

Note: The Average conducted power of BT is measured with RMS detector.

7.1.3 CONDUCTED POWER MEASUREMENTS OF WIFI

1. Conducted power measurement results of WiFi 2.4G

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
2.4G WIFI_ 1TX_ ANT 1	802.11b	1	2412	1	16.00	14.20
		6	2437		16.00	14.41
		11	2462		16.00	**14.50**
	802.11g	1	2412	6	14.00	Not Required
		6	2437		14.00	
		11	2462		14.00	
	802.11n HT20	1	2412	6.5	14.00	
		6	2437		14.00	
		11	2462		14.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
2.4G WIFI_ 1TX_ ANT 2	802.11b	1	2412	1	16.00	14.31
		6	2437		16.00	**14.95**
		11	2462		16.00	14.75
	802.11g	1	2412	6	14.00	Not Required
		6	2437		14.00	
		11	2462		14.00	
	802.11n HT20	1	2412	6.5	14.00	
		6	2437		14.00	
		11	2462		14.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	ANT 1 Average Power(dBm)	ANT 2 Average Power(dBm)	Max. Tune up	Total Average Power(dBm)
2.4G WIFI_ 2TX_ ANT 1+2	802.11b	1	2412	1	14.03	14.25	18.00	17.15
		6	2437		14.07	14.39	18.00	17.24
		11	2462		14.08	14.32	18.00	17.21
	802.11g	1	2412	6	12.56	12.75	17.00	Not Required
		6	2437		12.45	12.81	17.00	
		11	2462		12.48	13.03	17.00	
	802.11n HT20	1	2412	13	11.41	12.66	17.00	
		6	2437		12.74	13.36	17.00	
		11	2462		12.67	13.68	17.00	

Note:
1) The Average conducted power of WiFi 2.4GHz is measured with RMS detector.
2) Per KDB248227 D01, for WiFi 2.4GHz, the highest measured maximum output power Channel for DSSS modes (802.11b) was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required When the highest reported SAR for DSSS is adjusted by the ratio of OFDM modes (802.11g/n) to DSSS modes (802.11b) specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
3) The tested channel results are marks in bold.

2. Conducted power measurement results of WiFi 5.2G

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
5.2G WIFI_ 1TX_ ANT 1	**802.11a**	36	5180	6	13.00	**11.58**
		40	5200		13.00	11.53
		44	5220		13.00	11.40
		48	5240		13.00	11.39
	802.11n HT20	36	5180	MCS0	11.00	Not Required
		40	5200		11.00	
		44	5220		11.00	
		48	5240		11.00	
	802.11n HT40	38	5190	MCS0	11.00	
		46	5230		11.00	
	802.11ac VHT20	36	5180	MCS0	11.00	
		40	5200		11.00	
		44	5220		11.00	
		48	5240		11.00	
	802.11ac VHT40	38	5190	MCS0	11.00	
		46	5230		11.00	
	802.11ac VHT80	42	5210	MCS0	11.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
5.2G WIFI_ 1TX_ ANT 2	802.11a	36	5180	6	13.00	**11.28**
		40	5200		13.00	11.16
		44	5220		13.00	11.20
		48	5240		13.00	11.14
	802.11n HT20	36	5180	MCS0	11.00	Not Required
		40	5200		11.00	
		44	5220		11.00	
		48	5240		11.00	
	802.11n HT40	38	5190	MCS0	11.00	
		46	5230		11.00	
	802.11ac VHT20	36	5180	MCS0	11.00	
		40	5200		11.00	
		44	5220		11.00	
		48	5240		11.00	
	802.11ac VHT40	38	5190	MCS0	11.00	
		46	5230		11.00	
	802.11ac VHT80	42	5210	MCS0	11.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	ANT 1 Average Power(dBm)	ANT 2 Average Power(dBm)	Max. Tune up	Total Average Power(dBm)
5.2G WIFI_ 2TX_ ANT 1+2	**802.11a**	36	5180	6	12.23	12.21	16.00	15.23
		40	5200		12.19	12.18	16.00	15.20
		44	5220		12.13	12.09	16.00	15.12
		48	5240		12.23	12.39	16.00	15.32
	802.11n HT20	36	5180	MCS8	12.26	12.19	16.00	15.24
		40	5200		12.27	12.24	16.00	15.27
		44	5220		12.24	12.14	16.00	15.20
		48	5240		12.05	12.22	16.00	15.15
	802.11n HT40	38	5190	MCS8	10.63	9.26	14.00	13.01
		46	5230		10.77	9.27	14.00	13.09
	802.11ac VHT20	36	5180	MCS8	12.24	12.11	16.00	15.19
		40	5200		12.21	12.18	16.00	15.21
		44	5220		12.22	12.14	16.00	15.19
		48	5240		11.99	12.2	16.00	15.11
	802.11ac VHT40	38	5190	MCS8	10.03	9.42	13.00	12.75
		46	5230		9.97	9.25	13.00	12.64
	802.11ac VHT80	42	5210	MCS8	9.90	9.27	13.00	12.61

Note:
1) The Average conducted power of WiFi 5.2G is measured with RMS detector.
2) The tested channel results are marks in bold.

3. Conducted power measurement results of WiFi 5.8G

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
5.8G WIFI_ 1TX_ ANT 1	**802.11a**	149	5745	6	12.00	Not Required
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11n HT20	149	5745	MCS0	12.00	
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11n HT40	151	5755	MCS0	13.00	**11.91**
		159	5795		13.00	**11.46**
	802.11ac VHT20	149	5745	MCS0	12.00	Not Required
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11ac VHT40	151	5755	MCS0	12.00	
		159	5795		12.00	
	802.11ac VHT80	155	5775	MCS0	11.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Max. Tune up	Average Power(dBm)
5.8G WIFI_ 1TX_ ANT 2	802.11a	149	5745	6	12.00	Not Required
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11n HT20	149	5745	MCS0	12.00	
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11n HT40	151	5755	MCS0	13.00	**11.73**
		159	5795		13.00	11.42
	802.11ac VHT20	149	5745	MCS0	12.00	Not Required
		153	5765		12.00	
		157	5785		12.00	
		161	5805		12.00	
		165	5825		12.00	
	802.11ac VHT40	151	5755	MCS0	12.00	
		159	5795		12.00	
	802.11ac VHT80	155	5775	MCS0	11.00	

Band	Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	ANT 1 Average Power(dBm)	ANT 2 Average Power(dBm)	Max. Tune up	Total Average Power(dBm)
5.8G WIFI_ 2TX_ ANT 1+2	802.11a	149	5745	6	7.48	10.90	13.00	12.53
		153	5765		7.65	10.88	13.00	12.57
		157	5785		7.71	10.44	13.00	12.30
		161	5805		7.38	10.54	13.00	12.25
		165	5825		7.52	10.15	13.00	12.04
	802.11n HT20	149	5745	MCS8	11.36	11.04	15.00	14.21
		153	5765		11.27	10.92	15.00	14.11
		157	5785		11.10	10.74	15.00	13.93
		161	5805		10.92	10.57	15.00	13.76
		165	5825		10.85	10.30	15.00	13.59
	802.11n HT40	151	5755	MCS8	10.58	9.20	14.00	12.95
		159	5795		10.66	9.30	14.00	13.04
	802.11ac VHT20	149	5745	MCS8	11.44	11.27	15.00	14.37
		153	5765		11.25	10.83	15.00	14.06
		157	5785		11.10	10.72	15.00	13.92
		161	5805		11.02	10.64	15.00	13.84
		165	5825		10.95	10.35	15.00	13.67
	802.11ac VHT40	151	5755	MCS8	10.18	9.43	14.00	12.83
		159	5795		10.22	9.54	14.00	12.90
	802.11ac VHT80	155	5775	MCS8	10.09	9.43	13.00	12.78

Note:
1) The Average conducted power of WiFi 5.8G is measured with RMS detector.
2) The tested channel results are marks in bold.

7.2 SAR TEST RESULTS

General Notes:

1) Per KDB447498 D01, all measurement SAR results are scaled to the maximum tune-up tolerance limit to demonstrate compliant.
2) Per KDB447498 D01, 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. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
3) Per KDB865664 D01, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8W/kg; if the deviation among the repeated measurement is ≤ 20%, and the measured SAR < 1.45W/kg, only one repeated measurement is required.
4) Per KDB865664 D02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing.

GSM Notes:

Per KDB941225 D01, SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.

UMTS Notes:

Per KDB941225 D01, 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 or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

LTE notes:

1) The LTE test configurations are determined according to KDB941225 D05 SAR for LTE Devices. The general test procedures used for SAR testing can be found in Section 6.1.3.
2) A-MPR was disabled for all SAR test by setting NS_01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI)

WLAN Notes:

1. For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions. Otherwise, SAR is evaluated at the subsequent highest peak SAR position until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
2. Justification for test configurations for WLAN per KDB Publication 248227 for 2.4GHZ WIFI single transmission chain operations, the highest measured maximum output power Channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 6.1.4 for more information.
3. Justification for test configurations for WLAN per KDB Publication 248227 for 5GHZ WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed power. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg. See Section 6.1.4 for more information.

7.2.1 SAR MEASUREMENT RESULT

1. SAR measurement result of LTE

Test No.	Band	Mode	Channel	RB	offset	Test Position	Separation Distance (cm)	Ant	Maximum Tune-up (dBm)	Conducted Power (dBm)	Power Drift (dB)	SAR 1g (W/kg)	SAR 10g (W/kg)	Reported 1g SAR
L01	LTEB48	QPSK20M	56640	1	50	Rear Face	0	0	22	21.71	0.18	0.220	0.079	0.235
L02	LTEB48	QPSK20M	56640	1	50	Top Side	0	0	22	21.71	0.02	**1.310**	**0.509**	**1.400**
L03	LTEB48	QPSK20M	56640	1	50	Right SIde	0	0	22	21.71	0.01	0.414	0.156	0.443
L04	LTEB48	QPSK20M	56640	50	0	Rear Face	0	0	22	21.66	0.09	0.236	0.083	0.255
L05	LTEB48	QPSK20M	56640	50	0	Top Side	0	0	22	21.66	-0.02	1.160	0.529	1.254
L06	LTEB48	QPSK20M	56640	50	0	Right SIde	0	0	22	21.66	0.05	0.492	0.181	0.532
L07	LTEB48	QPSK20M	55340	1	50	Top Side	0	0	22	20.87	-0.13	1.020	0.166	1.323
L08	LTEB48	QPSK20M	55990	1	50	Top Side	0	0	22	20.69	0.11	1.010	0.200	1.366
L09	LTEB48	QPSK20M	55340	50	0	Top Side	0	0	22	20.52	-0.03	0.910	0.130	1.280
L10	LTEB48	QPSK20M	55990	50	0	Top Side	0	0	22	20.58	-0.07	1.000	0.206	1.387
L11	LTEB48	QPSK20M	56640	100	0	Top Side	0	0	22	20.54	0.09	0.980	0.262	1.372
L12	LTEB48	QPSK20M	56640	1	50	Top Side (Repeated)	0	0	22	21.71	-0.02	1.220	0.489	1.304

Note: The value with boldface is the maximum SAR Value of each test band.

2. SAR measurement result of WiFi 2.4G

Test No.	Band	Channel	Test Position	Separation Distance (cm)	Ant	Data Rate	Duty Cycle (%)	Maximum Tune-up (dBm)	Conducted Power (dBm)	Power Drift (dB)	SAR 1g (W/kg)	SAR 10g (W/kg)	Reported 1g SAR (W/kg)
W01	802.11b	11	Rear Face	0	1	1	100.00	16	14.50	0.06	**0.305**	**0.143**	**0.431**
W02	802.11b	11	Left Side	0	1	1	100.00	16	14.50	-0.01	0.038	0.014	0.054
W04	802.11b	6	Rear Face	0	2	1	100.00	16	14.95	0.18	**0.301**	**0.141**	**0.383**
W05	802.11b	6	Right Side	0	2	1	100.00	16	14.95	0.06	0.068	0.005	0.087

Note: The value with boldface is the maximum SAR Value of each test band.

3. SAR measurement result of BT

Test No.	Band	Channel	Test Position	Separation Distance (cm)	Ant	Data Rate	Duty Cycle (%)	Maximum Tune-up (dBm)	Conducted Power (dBm)	Power Drift (dB)	SAR 1g (W/kg)	SAR 10g (W/kg)	Reported 1g SAR (W/kg)
W07	BT DH5	0	Rear Face	0	1	1	81.28	7	5.85	0.03	**0.057**	**0.028**	**0.091**
W08	BT DH5	0	Left Side	0	1	1	81.28	7	5.85	0.02	0.030	0.010	0.048

Note: The value with boldface is the maximum SAR Value of each test band.

4. SAR measurement result of WiFi 5G

Test No.	Band	Channel	Test Position	Separation Distance (cm)	Ant	Data Rate	Duty Cycle (%)	Maximum Tune-up (dBm)	Conducted Power (dBm)	Power Drift (dB)	SAR 1g (W/kg)	SAR 10g (W/kg)	Reported 1g SAR (W/kg)
W10	802.11a	36	Rear Face	0	1	6	97.49	13	11.58	0	**0.246**	**0.086**	**0.350**
W11	802.11a	36	Left Side	0	1	6	97.49	13	11.58	0.06	0.050	0.014	0.071
W13	802.11a	36	Rear Face	0	2	6	97.49	13	11.28	0	**0.175**	**0.056**	**0.267**
W14	802.11a	36	Right Side	0	2	6	97.49	13	11.28	0.06	0.061	0.014	0.093
W16	802.11n HT40	151	Rear Face	0	1	MSC0	97.49	13	11.91	0.02	0.425	0.146	0.560
W17	802.11n HT40	151	Left Side	0	1	MSC0	97.49	13	11.91	-0.09	**0.773**	**0.226**	**1.019**
W18	802.11n HT40	159	Left Side	0	1	MSC0	97.49	13	11.46	-0.05	0.692	0.204	1.012
W19	802.11n HT40	151	Rear Face	0	2	MSC0	97.49	13	11.73	0	**0.413**	**0.128**	**0.568**
W20	802.11n HT40	151	Right Side	0	2	MSC0	97.49	13	11.73	0.01	0.061	0.022	0.084

Note: The value with boldface is the maximum SAR Value of each test band.

8. MULTIPLE TRANSMITTER EVALUATION

The following tables list information which is relevant for the decision if a simultaneous transmit evaluation is necessary according to FCC KDB 447498D01 General RF Exposure Guidance v06.

The location of the antenna inside EUT and standalone SAR test exclusion, please refer to Appendix E.

8.1 STAND-ALONE SAR TEST EXCLUSION

Per FCC KDB 447498D01, SAR compliance for simultaneous transmission must be considered when the maximum duration of overlapping transmissions, including network hand-offs, is greater than 30 seconds. This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis.

The Simultaneous Transmission Possibilities of this device are as below:

NO.	Simultaneous Tx Combination	Body
1	LTE + WiFi 2.4G (Ant 1)	Yes
2	LTE + WiFi 5G (Ant 1)	Yes
3	LTE + BT (Ant 1)	Yes
4	LTE + WiFi 2.4G (Ant 2)	Yes
5	LTE + WiFi 5G (Ant 2)	Yes
6	WiFi 2.4G (Ant1) + WiFi 2.4G (Ant 2)	Yes
8	WiFi 5G (Ant 1) + WiFi 5G (Ant 2)	Yes
9	LTE + WiFi 2.4G (Ant 1) + WiFi 2.4G (Ant 2)	Yes
10	LTE + WiFi 5G (Ant 1) + WiFi 5G (Ant 2)	Yes

Note: Only WiFi Ant 1 supports BT function.

8.2 SAR SUMMATION SCENARIO

LTE and BT / WiFi Ant 1

Position	Rear Face (0cm)	Left Side (0cm)	Right Side (0cm)	Top Side (0cm)
LTE B48	0.255	-	0.532	1.400
WiFi 2.4G	0.431	0.054	-	-
WiFi 5.2G	0.350	0.071	-	-
WiFi 5.8G	0.560	1.019	-	-
Bluetooth	0.091	0.048	-	-
MAX $\sum SAR_{1g}$	**0.815**	**1.019**	**0.532**	**1.400**

LTE and WiFi Ant 2

Position	Rear Face (0cm)	Left Side (0cm)	Right Side (0cm)	Top Side (0cm)
LTE B48	0.255	-	0.532	1.400
WiFi 2.4G	0.383	-	0.087	-
WiFi 5.2G	0.267	-	0.093	-
WiFi 5.8G	0.568	-	0.084	-
MAX $\sum SAR_{1g}$	**0.823**	**0.000**	**0.625**	**1.400**

WiFi 2.4G (Ant1) + WiFi 2.4G (Ant2)

Position	Rear Face (0cm)	Left Side (0cm)	Right Side (0cm)	Top Side (0cm)
WiFi 2.4G (Ant 1)	0.431	0.054	-	-
WiFi 2.4G (Ant 2)	0.383	-	0.087	-
MAX $\sum SAR_{1g}$	**0.814**	**0.054**	**0.087**	**0.000**

WiFi 5G (Ant1) + WiFi 5G (Ant2)

Position	Rear Face (0cm)	Left Side (0cm)	Right Side (0cm)	Top Side (0cm)
WiFi 5.2G (Ant 1)	0.350	0.071	-	-
WiFi 5.8G (Ant 2)	0.560	1.019	-	-
WiFi 5.2G (Ant 1)	0.267	-	0.093	-
WiFi 5.8G (Ant 2)	0.568	-	0.084	-
MAX $\sum SAR_{1g}$	**1.128**	**1.019**	**0.093**	**0.000**

LTE and WiFi Ant 1 + Ant 2

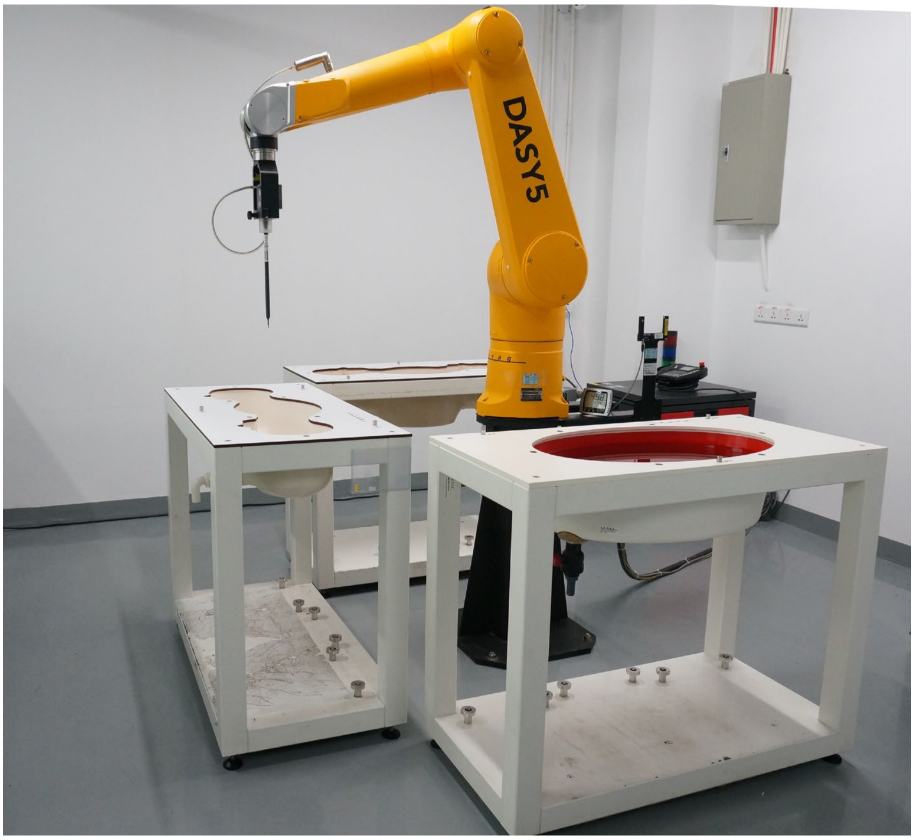
Position	Rear Face (0cm)	Left Side (0cm)	Right Side (0cm)	Top Side (0cm)
LTE B48	0.255	-	0.532	1.400
WiFi 2.4G (MIMO)	0.814	0.054	0.087	ss
WiFi 5G (MIMO)	1.128	1.019	0.093	-
MAX $\sum SAR_{1g}$	**1.383**	**1.019**	**0.625**	**1.400**

Note: Thus $SAR_{MAX.total}$= 1.400W/kg<1.6W/kg, it is compliant with 1999/519/EC, so Simultaneous SAR are not required for LTE and WiFi (Ant 1/Ant 2) antenna.

APPENDIX

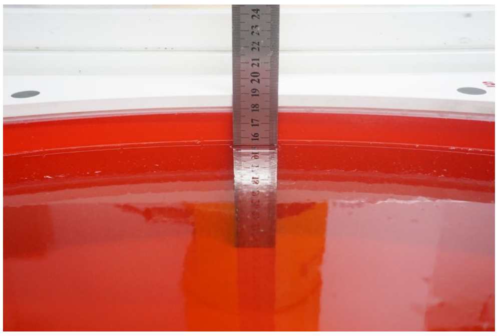
1. TEST LAYOUT

Specific Absorption Rate Test Layout

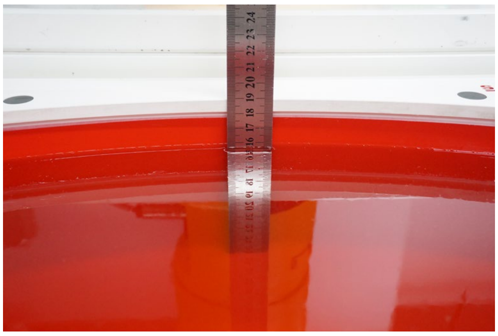


Liquid depth in the flat Phantom (≥15cm depth)

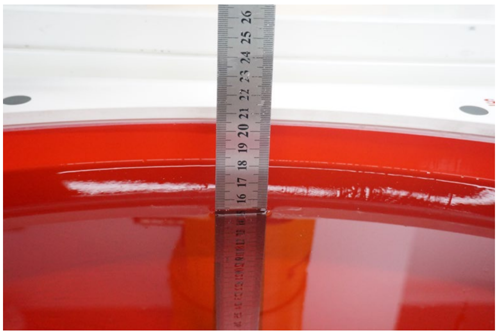
HSL_2300MHz-2700MHz_Body_15.6cm



HSL_3300MHz-4200MHz_Body_15.7cm



HSL_5000MHz-6000MHz_Body_15.4cm



Appendix A. SAR Plots of System Verification

(Pls See BTL-FCC SAR-1-2111H055_Appendix A.)

Appendix B. SAR Plots of SAR Measurement

(Pls See BTL-FCC SAR-1-2111H055_Appendix B.)

Appendix C. Calibration Certificate

(Pls See BTL-FCC SAR-1-2111H055_Appendix C.)

Appendix D. Photographs of the Test Set-Up

(Pls See BTL-FCC SAR-1-2111H055_Appendix D.)

Appendix E. Antenna location

(Pls See BTL-FCC SAR-1-2111H055_Appendix E.)

End of Test Report