



FCC SAR TEST REPORT

FCC ID : XNAWPM06
Equipment : Withings BPM Connect Pro
Brand Name : Withings
Model Name : WPM06
Applicant : Withings SA
2 rue Maurice Hartmann
92130 Issy-Les-Moulineaux
France
Manufacturer : Withings SA
2 rue Maurice Hartmann
92130 Issy-Les-Moulineaux
France
Standard : FCC 47 CFR Part 2 (2.1093)

The product was received on Apr. 16, 2021 and testing was started from Apr. 24, 2021 and completed on Apr. 27, 2021. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

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

Cona Huang
Approved by: Cona Huang / Deputy Manager



Sporton International Inc. EMC & Wireless Communications Laboratory
No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan



Table of Contents

1. Statement of Compliance	4
2. Guidance Applied.....	4
3. Equipment Under Test (EUT) Information.....	5
3.1 General Information	5
3.2 General LTE SAR Test and Reporting Considerations	6
4. RF Exposure Limits.....	7
4.1 Uncontrolled Environment.....	7
4.2 Controlled Environment.....	7
5. Specific Absorption Rate (SAR).....	8
5.1 Introduction	8
5.2 SAR Definition.....	8
6. System Description and Setup	9
6.1 Test Site Location.....	9
6.2 E-Field Probe	10
6.3 Data Acquisition Electronics (DAE)	10
6.4 Phantom.....	11
6.5 Device Holder.....	12
7. Measurement Procedures	13
7.1 Spatial Peak SAR Evaluation.....	13
7.2 Power Reference Measurement.....	14
7.3 Area Scan	14
7.4 Zoom Scan.....	15
7.5 Volume Scan Procedures.....	15
7.6 Power Drift Monitoring.....	15
8. Test Equipment List.....	16
9. System Verification	17
9.1 Tissue Verification	17
9.2 System Performance Check Results.....	17
10. Cat M1 Output Power (Unit: dBm).....	18
11. WiFi/Bluetooth Output Power (Unit: dBm).....	21
12. Antenna Location	23
13. SAR Test Results	24
13.1 Body SAR	25
14. Simultaneous Transmission Analysis.....	26
14.1 Body Exposure Conditions	26
15. Uncertainty Assessment	27
16. References.....	27
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAR Measurement	
Appendix C. DASY Calibration Certificate	
Appendix D. Test Setup Photos	



History of this test report



1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Withings SA, Withings BPM Connect Pro, WPM06**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	
		Body (Separation 5mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
		1g SAR (W/kg)	
Licensed	CAT M1	LTE Band 2	0.04
		LTE Band 4	0.03
		LTE Band 12	0.07
DTS	WLAN	2.4GHz WLAN	0.09
DSS	2.4GHz Band	Bluetooth	< 0.01
Date of Testing:		2021/4/24 ~ 2021/4/27	

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190) and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

Reviewed by: Jason Wang

Report Producer: Daisy Peng

2. Guidance Applied

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

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D05 SAR for LTE Devices v02r05



3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	Withings BPM Connect Pro
Brand Name	Withings
Model Name	WPM06
SAR MAC ID	04:24:E4:C5:22:8A 04:24:E4:C5:21:D6
FCC ID	XNAWPM06
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2400 MHz ~ 2483.5 MHz
Mode	WLAN: 802.11b/g/n/HT20 Bluetooth BR/EDR/LE
HW Version	Main PCBA v2.a.3 and cell_a PCBA v4.b.4
SW Version	FW181
EUT Stage	Identical Prototype

The device contains a certified module as below information

Contain Module	
FCC ID	2AAGMGM02SA
Wireless Technology and Frequency Range	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 12: 699 MHz ~ 716 MHz
Mode	LTE: QPSK, 16QAM
Category	M1
Release Version	13



3.2 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r05												
FCC ID	XNAWPM06											
Equipment Name	Withings BPM Connect Pro											
Operating Frequency Range of each LTE transmission band	LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 12: 699 MHz ~ 716 MHz											
Channel Bandwidth	LTE Band 2: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 12: 1.4MHz, 3MHz, 5MHz, 10MHz											
uplink modulations used	QPSK / 16QAM											
LTE Voice / Data requirements	Data only											
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3												
LTE MPR permanently built-in by design	Modulation	Channel bandwidth / Transmission bandwidth (N _{RB})						MPR (dB)				
		1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	1.4 MHz	3.0 MHz	5 MHz	10 MHz	
	QPSK	> 5	> 4	> 8	> 12	> 16	> 18	> 1	> 1	> 1	> 1	
	16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1	≤ 1	≤ 1	≤ 1	
	16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2	≤ 2	≤ 2	≤ 2	
	64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2	≤ 2	≤ 2	≤ 2	
	64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3	≤ 3	≤ 3	≤ 3	
256 QAM												
≥ 1												
LTE A-MPR												
In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)												
Spectrum plots for RB configuration												
Transmission (H, M, L) channel numbers and frequencies in each LTE band												
LTE Band 2												
	Bandwidth 1.4 MHz	Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz		
		Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900
LTE Band 4												
	Bandwidth 1.4 MHz	Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz		
		Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745
LTE Band 12												
	Bandwidth 1.4 MHz	Bandwidth 3 MHz			Bandwidth 5 MHz			Bandwidth 10 MHz			Bandwidth 20 MHz	
		Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	
L	23017	699.7	23025	700.5	23035	701.5	23060	704				
M	23095	707.5	23095	707.5	23095	707.5	23095	707.5				
H	23173	715.3	23165	714.5	23155	713.5	23130	711				



4. RF Exposure Limits

4.1 Uncontrolled Environment

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

4.2 Controlled Environment

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

Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

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



5. Specific Absorption Rate (SAR)

5.1 Introduction

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

5.2 SAR Definition

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

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

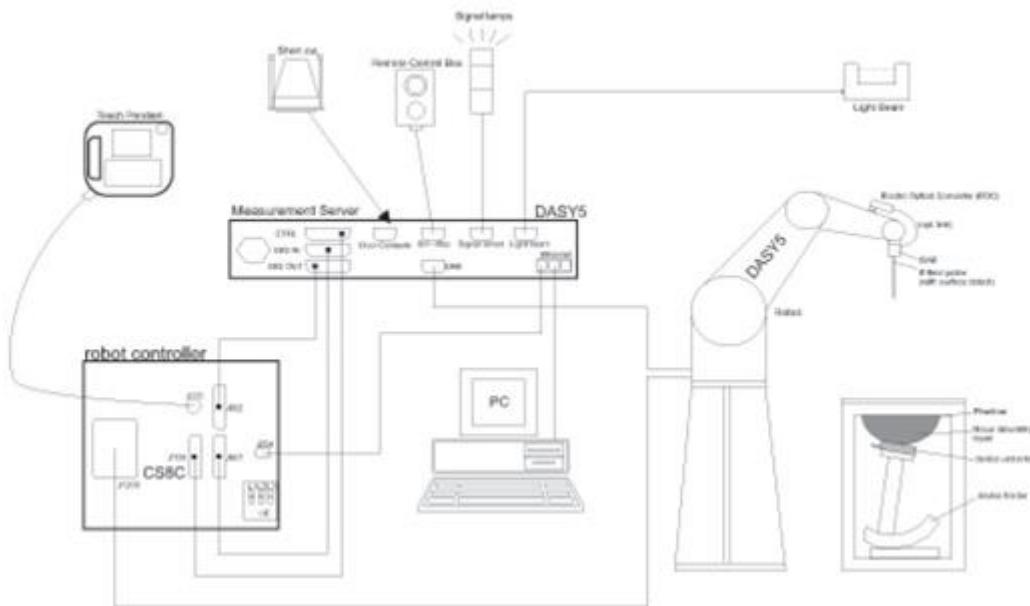
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

6. System Description and Setup

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



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

6.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

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

6.2 E-Field Probe

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

<ES3DV3 Probe>

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

<EX3DV4 Probe>

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

6.3 Data Acquisition Electronics (DAE)

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

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



Fig 5.1 Photo of DAE

6.4 Phantom

<SAM Twin Phantom>

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

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

<ELI Phantom>

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

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

6.5 Device Holder

<Mounting Device for Hand-Held Transmitter>

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



Mounting Device for Hand-Held
Transmitters



Mounting Device Adaptor for Wide-Phones

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

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



Mounting Device for Laptops



7. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

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

<SAR measurement>

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

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

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

7.1 Spatial Peak SAR Evaluation

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

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

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

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



7.2 Power Reference Measurement

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

7.3 Area Scan

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

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

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



7.4 Zoom Scan

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

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

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

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

7.5 Volume Scan Procedures

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

7.6 Power Drift Monitoring

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



8. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	750MHz System Validation Kit ⁽²⁾	D750V3	1107	Mar. 08, 2019	Mar. 05, 2022
SPEAG	1750MHz System Validation Kit ⁽²⁾	D1750V2	1112	Mar. 07, 2019	Mar. 04, 2022
SPEAG	1900MHz System Validation Kit ⁽²⁾	D1900V2	5d041	Sep. 11, 2018	Sep. 08, 2021
SPEAG	2450MHz System Validation Kit ⁽²⁾	D2450V2	929	Nov. 21, 2019	Nov. 19, 2021
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 16, 2020	Sep. 15, 2021
SPEAG	Data Acquisition Electronics	DAE4	699	Feb. 16, 2021	Feb. 15, 2022
SPEAG	Dosimetric E-Field Probe	ES3DV3	3169	May. 27, 2020	May. 26, 2021
SPEAG	Dosimetric E-Field Probe	EX3DV4	7306	Jul. 24, 2020	Jul. 23, 2021
RCPTWN	Thermometer	HTC-1	TM685-1	Nov. 10, 2020	Nov. 09, 2021
RCPTWN	Thermometer	HTC-1	TM560-2	Nov. 10, 2020	Nov. 09, 2021
Anritsu	Radio Communication Analyzer	MT8821C	6201341950	Nov. 10, 2020	Nov. 09, 2021
R&S	BT Base Station	CBT32	100519	Jun. 04, 2020	Jun. 03, 2021
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Nov. 11, 2020	Nov. 10, 2021
Keysight	ENA Network Analyzer	E5071C	MY46101588	Jun. 10, 2020	Jun. 09, 2021
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 16, 2020	Sep. 15, 2021
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Nov. 06, 2020	Nov. 05, 2021
Anritsu	Power Meter	ML2495A	1419002	Aug. 19, 2020	Aug. 18, 2021
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2020	Aug. 17, 2021
Anritsu	Power Meter	ML2495A	1804003	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Power Sensor	MA2411B	1726150	Oct. 21, 2020	Oct. 20, 2021
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 30, 2020	Jun. 29, 2021
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 15, 2021	Jan. 14, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 21, 2020	Oct. 20, 2021
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Aug. 26, 2020	Aug. 25, 2021
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

- Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
- The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18°C to 25°C, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18°C to 25°C and within $\pm 2^\circ\text{C}$ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.

The liquid tissue depth was at least 15cm in the phantom for all SAR testing

< Tissue Dielectric Parameter Check Results >

Frequency (MHz)	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
750	22.5	0.893	42.549	0.89	41.90	0.34	1.55	± 5	2021/4/24
1750	22.5	1.401	40.155	1.37	40.10	2.26	0.14	± 5	2021/4/24
1900	22.5	1.404	39.891	1.40	40.00	0.29	-0.27	± 5	2021/4/24
2450	22.5	1.825	40.225	1.80	39.20	1.39	2.61	± 5	2021/4/27

9.2 System Performance Check Results

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

Test Site	Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
SAR04-HY	2021/4/24	750	250	D750V3-1107	EX3DV4 - SN7306	DAE4 Sn699	2.22	8.32	8.88	6.73
SAR04-HY	2021/4/24	1750	50	D1750V2-1112	EX3DV4 - SN7306	DAE4 Sn699	1.83	36.70	36.6	-0.27
SAR04-HY	2021/4/24	1900	50	D1900V2-5d041	EX3DV4 - SN7306	DAE4 Sn699	1.98	40.20	39.6	-1.49
SAR06-HY	2021/4/27	2450	250	D2450V2-929	ES3DV3 - SN3169	DAE3 Sn577	12.60	53.10	50.4	-5.08

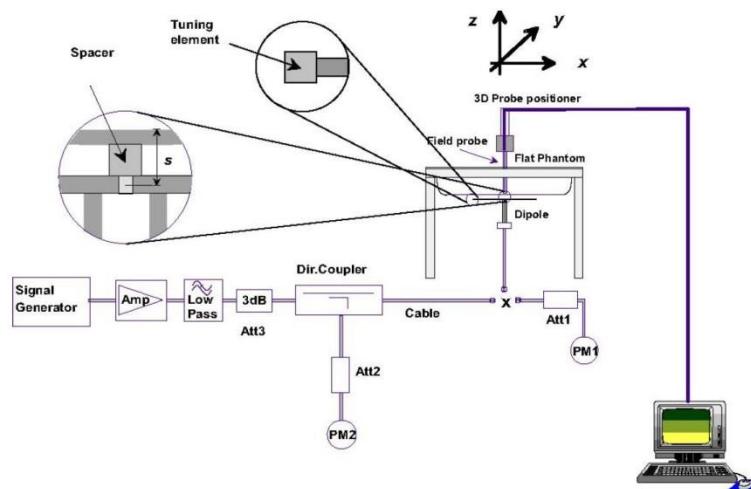


Fig 8.3.1 System Performance Check Setup



Fig 8.3.2 Setup Photo



10. Cat M1 Output Power (Unit: dBm)

General Note:

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. For Cat M1 SAR test start with the largest channel bandwidth and measure SAR for QPSK with the highest output allocation.
3. For 16QAM output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; 16QAM SAR testing is not required.
4. For Smaller bandwidth output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; smaller bandwidth SAR testing is not required.
5. For LTE B4/B12 the maximum bandwidth does not support three non-overlapping channels, 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.

<CAT M1 LTE Band 2>

BW [MHz]	Modulation	RB Size	RB Offset	Index			Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)			
				L	M	H							
Channel							18700	18900	19100				
Frequency (MHz)							1860	1880	1900				
20	QPSK	1	0	0	8	15	21.67	21.36	21.32	23.00			
20	QPSK	1	5	0	8	15	21.77	21.43	21.33				
20	QPSK	3	0	0	8	15	22.16	21.82	21.71				
20	QPSK	3	3	0	8	15	22.25	21.86	21.71				
20	QPSK	6	0	0	8	15	22.16	21.84	21.79				
20	16QAM	1	0	0	8	15	21.97	21.66	21.57				
20	16QAM	1	5	0	8	15	21.82	21.48	21.66				
20	16QAM	3	0	0	8	15	22.12	21.76	21.76				
20	16QAM	3	3	0	8	15	22.13	21.86	21.78				
20	16QAM	6	0	0	8	15	22.05	21.82	21.72				
Channel							18675	18900	19125	23.00			
Frequency (MHz)							1857.5	1880	1902.5				
15	QPSK	1	0	0	6	11	21.80	21.47	21.33				
15	QPSK	1	5	0	6	11	21.75	21.53	21.41				
15	QPSK	3	0	0	6	11	22.13	21.88	21.72				
15	QPSK	3	3	0	6	11	22.19	21.83	21.67				
15	QPSK	6	0	0	6	11	22.15	21.94	21.72				
15	16QAM	1	0	0	6	11	21.89	21.67	21.43				
15	16QAM	1	5	0	6	11	22.02	21.55	21.62				
15	16QAM	3	0	0	6	11	22.14	21.71	21.82				
15	16QAM	3	3	0	6	11	22.16	21.69	21.84				
15	16QAM	6	0	0	6	11	22.05	21.65	21.69				
Channel							18650	18900	19150	23.00			
Frequency (MHz)							1855	1880	1905				
10	QPSK	1	0	0	4	7	21.64	21.39	21.45				
10	QPSK	1	5	0	4	7	21.71	21.59	21.63				
10	QPSK	3	0	0	4	7	22.14	21.82	21.84				
10	QPSK	3	3	0	4	7	22.23	21.86	21.91				
10	QPSK	6	0	0	4	7	21.22	20.92	21.12				
10	16QAM	1	0	0	4	7	22.13	21.65	21.75				
10	16QAM	1	5	0	4	7	21.95	21.67	21.78				

**FCC SAR TEST REPORT****Report No. : FA133133**

10	16QAM	3	0	0	4	7	22.09	21.72	21.92	23.00
10	16QAM	3	3	0	4	7	22.20	21.95	21.82	
10	16QAM	6	0	0	4	7	20.33	20.03	20.12	
Channel				L	M	H	18625	18900	19175	Tune-up limit (dBm)
Frequency (MHz)							1852.5	1880	1907.5	
5	QPSK	1	0	0	2	3	21.55	21.44	21.54	23.00
5	QPSK	1	5	0	2	3	21.59	21.47	21.58	
5	QPSK	3	0	0	2	3	21.68	21.66	21.62	
5	QPSK	3	3	0	2	3	21.72	21.73	21.67	22.00
5	QPSK	6	0	0	2	3	21.07	20.96	21.05	
5	16QAM	1	0	0	2	3	21.15	20.89	21.02	
5	16QAM	1	5	0	2	3	21.18	20.98	21.06	23.00
5	16QAM	3	0	0	2	3	21.22	20.89	21.22	
5	16QAM	3	3	0	2	3	21.12	20.92	21.16	
5	16QAM	6	0	0	2	3	20.17	20.15	20.21	21.00

< CAT M1 LTE Band 4>

BW [MHz]	Modulation	RB Size	RB Offset	Index			Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)			
				L	M	H							
Channel				L	M	H	20050	20175	20300				
Frequency (MHz)							1720	1732.5	1745				
20	QPSK	1	0		0	8	15	21.71	21.56	21.28	23.00		
20	QPSK	1	5		0	8	15	21.72	21.59	21.36			
20	QPSK	3	0		0	8	15	22.12	21.92	21.72			
20	QPSK	3	3		0	8	15	22.17	21.96	21.74			
20	QPSK	6	0		0	8	15	22.04	22.03	21.74			
20	16QAM	1	0		0	8	15	21.86	21.77	21.55			
20	16QAM	1	5		0	8	15	21.73	21.72	21.69			
20	16QAM	3	0		0	8	15	22.15	21.87	21.86			
20	16QAM	3	3		0	8	15	22.16	22.04	21.94			
20	16QAM	6	0		0	8	15	22.04	21.94	21.72			
Channel				L	M	H	20025	20175	20325	Tune-up limit (dBm)			
Frequency (MHz)							1717.5	1732.5	1747.5				
15	QPSK	1	0		0	6	11	21.58	21.51	21.31	23.00		
15	QPSK	1	5		0	6	11	21.65	21.61	21.27			
15	QPSK	3	0		0	6	11	22.05	21.98	21.68			
15	QPSK	3	3		0	6	11	22.16	21.99	21.72			
15	QPSK	6	0		0	6	11	22.05	22.00	21.71			
15	16QAM	1	0		0	6	11	21.67	21.68	21.24			
15	16QAM	1	5		0	6	11	21.87	21.72	21.47			
15	16QAM	3	0		0	6	11	22.15	22.03	21.79			
15	16QAM	3	3		0	6	11	22.05	22.02	21.78			
15	16QAM	6	0		0	6	11	22.12	21.93	21.74			
Channel				L	M	H	20000	20175	20350	Tune-up limit (dBm)			
Frequency (MHz)							1715	1732.5	1750				
10	QPSK	1	0		0	4	7	21.56	21.53	21.41			
10	QPSK	1	5	0	4	7	21.64	21.59	21.52	23.00			
10	QPSK	3	0	0	4	7	22.03	21.96	21.92				
10	QPSK	3	3	0	4	7	22.14	22.02	21.93	23.00			
10	QPSK	6	0	0	4	7	21.22	21.05	21.02				
10	16QAM	1	0	0	4	7	21.76	21.76	21.92	23.00			
10	16QAM	1	5	0	4	7	21.98	21.78	21.86				

**FCC SAR TEST REPORT****Report No. : FA133133**

10	16QAM	3	0	0	4	7	22.03	21.89	22.02	23.00
10	16QAM	3	3	0	4	7	22.04	21.92	22.05	
10	16QAM	6	0	0	4	7	20.28	20.14	20.17	
Channel				L	M	H	19975	20175	20375	Tune-up limit (dBm)
Frequency (MHz)							1712.5	1732.5	1752.5	
5	QPSK	1	0	0	2	3	21.56	21.53	21.44	23.00
5	QPSK	1	5	0	2	3	21.58	21.62	21.56	
5	QPSK	3	0	0	2	3	21.73	21.76	21.72	
5	QPSK	3	3	0	2	3	21.86	21.98	21.75	22.00
5	QPSK	6	0	0	2	3	21.15	21.08	21.03	
5	16QAM	1	0	0	2	3	21.12	21.06	21.02	
5	16QAM	1	5	0	2	3	21.16	21.12	21.03	23.00
5	16QAM	3	0	0	2	3	21.26	21.06	21.11	
5	16QAM	3	3	0	2	3	21.18	21.16	21.13	
5	16QAM	6	0	0	2	3	20.17	20.16	20.12	21.00

< CAT M1 LTE Band 12>

BW [MHz]	Modulation	RB Size	RB Offset	Index			Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)
Channel				L	M	H	23060	23095	23130	
Frequency (MHz)							704	707.5	711	
10	QPSK	1	0	0	4	7	21.48	21.63	21.77	23.00
10	QPSK	1	5	0	4	7	21.58	21.72	21.82	
10	QPSK	3	0	0	4	7	21.99	22.03	22.11	
10	QPSK	3	3	0	4	7	22.13	21.93	22.05	23.00
10	QPSK	6	0	0	4	7	21.15	21.27	21.37	
10	16QAM	1	0	0	4	7	21.65	21.76	21.82	23.00
10	16QAM	1	5	0	4	7	21.71	21.67	21.87	
10	16QAM	3	0	0	4	7	21.89	22.02	22.09	
10	16QAM	3	3	0	4	7	21.95	22.03	22.10	23.00
10	16QAM	6	0	0	4	7	20.18	20.23	20.45	
Channel				L	M	H	23035	23095	23155	Tune-up limit (dBm)
Frequency (MHz)							701.5	707.5	713.5	
5	QPSK	1	0	0	2	3	21.51	21.62	21.65	23.00
5	QPSK	1	5	0	2	3	21.52	21.66	21.72	
5	QPSK	3	0	0	2	3	21.51	21.76	21.89	23.00
5	QPSK	3	3	0	2	3	21.62	21.95	22.18	
5	QPSK	6	0	0	2	3	21.13	21.22	21.36	22.00
5	16QAM	1	0	0	2	3	21.15	21.26	21.37	23.00
5	16QAM	1	5	0	2	3	21.18	21.29	21.37	
5	16QAM	3	0	0	2	3	21.08	21.12	21.37	
5	16QAM	3	3	0	2	3	21.14	21.16	21.21	23.00
5	16QAM	6	0	0	2	3	20.33	20.24	20.39	21.00



11. WiFi/Bluetooth Output Power (Unit: dBm)

General Note:

1. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.¹⁸ The initial test position procedure is described in the following:
 - a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

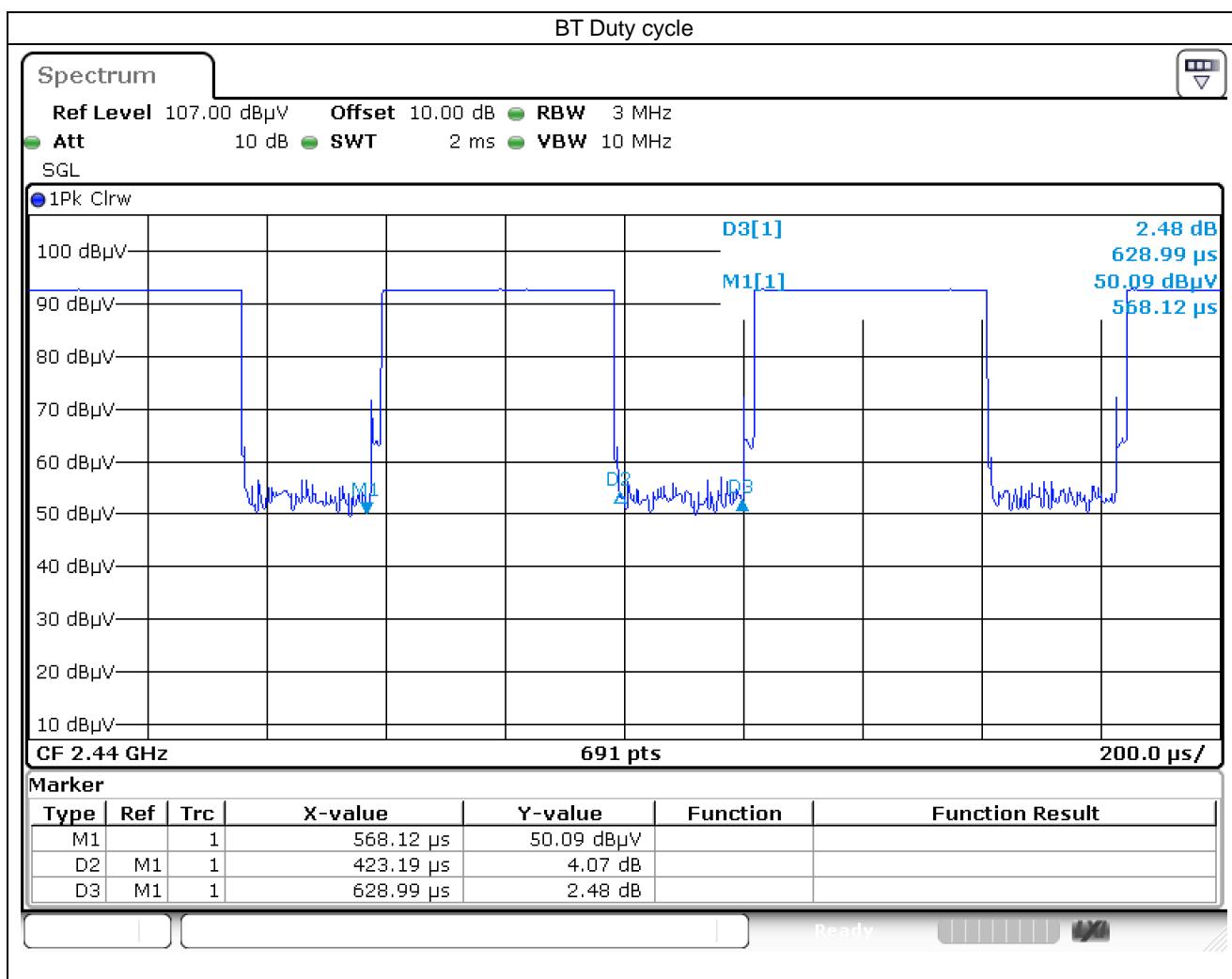
2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	7.55	8.00	98.80
		6	2437	6.89	8.00	
		11	2462	6.67	8.00	
	802.11g 6Mbps	1	2412	12.25	13.00	92.60
		6	2437	12.40	13.00	
		11	2462	12.59	13.00	
	802.11n-HT20 MCS0	1	2412	11.31	12.00	91.40
		6	2437	11.39	12.00	
		11	2462	11.50	12.00	

**<2.4GHz Bluetooth>****General Note:**

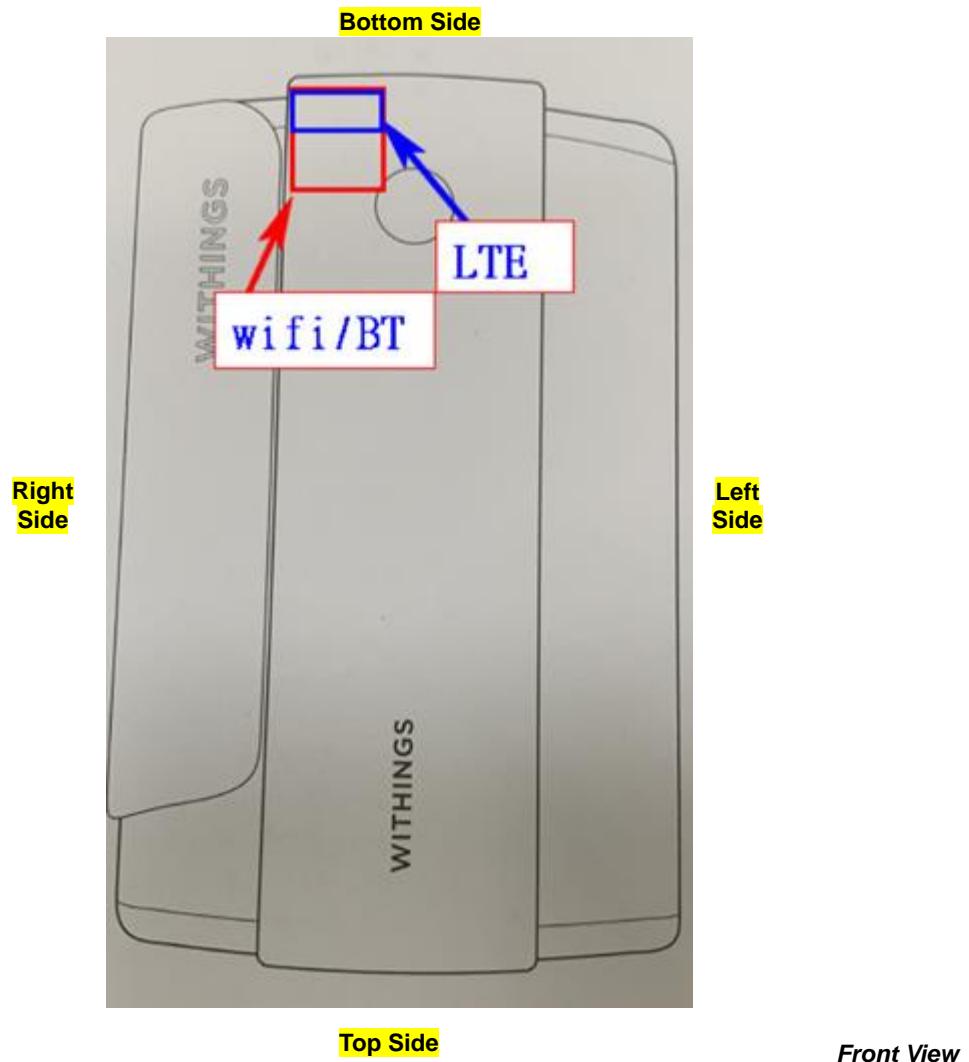
- For 2.4GHz Bluetooth SAR testing was selected 1Mbps due to its highest average power and duty cycle is 76% considered in SAR testing, and the duty cycle would be scaled to theoretical 83.3% in reported SAR calculation.

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
BR / EDR	CH 00	2402	-1.71	-8.50	-8.44
	CH 39	2441	-1.85	-8.72	-8.67
	CH 78	2480	-2.50	-8.03	-8.01
Tune-up Limit			-1	-8	-8

Mode	Channel	Frequency (MHz)	Average power (dBm)	
			GFSK	
LE	CH 00	2402	4.52	
	CH 19	2440	4.36	
	CH 39	2480	4.21	
Tune-up Limit			5	



12. Antenna Location





13. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - b. For 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
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:
 - $\leq 0.8 \text{ W/kg}$ or 2.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\leq 100 \text{ MHz}$
 - $\leq 0.6 \text{ W/kg}$ or 1.5 W/kg , for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - $\leq 0.4 \text{ W/kg}$ or 1.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\geq 200 \text{ MHz}$
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8 \text{ W/kg}$.

Cat M1 Note:

1. For Cat M1 SAR test start with the largest channel bandwidth and measure SAR for QPSK with the highest output allocation.
2. For 16QAM output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is $\leq 1.45 \text{ W/kg}$; 16QAM SAR testing is not required.
3. For Smaller bandwidth output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is $\leq 1.45 \text{ W/kg}$; smaller bandwidth SAR testing is not required.
4. For LTE B4/B12 the maximum bandwidth does not support three non-overlapping channels, 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.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing 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 $\leq 1.2 \text{ W/kg}$.
2. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is $\leq 1.2 \text{ W/kg}$, SAR is not required for U-NII-1 band.
3. When the reported SAR of the test position is $> 0.4 \text{ W/kg}$, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is $\leq 0.8 \text{ W/kg}$ or all required test position are tested.
4. For all positions / configurations, when the reported SAR is $> 0.8 \text{ W/kg}$, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is $\leq 1.2 \text{ W/kg}$ or all required channels are tested.
5. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

**13.1 Body SAR****<LTE SAR>**

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	CAT M1 LTE Band 2	20M	QPSK	3	3	Front	5mm	18700	1860	22.25	23.00	1.189	-0.12	0.001	0.001
	CAT M1 LTE Band 2	20M	QPSK	3	3	Back	5mm	18700	1860	22.25	23.00	1.189	-0.01	0.001	0.001
	CAT M1 LTE Band 2	20M	QPSK	3	3	Left Side	5mm	18700	1860	22.25	23.00	1.189	0.06	0.001	0.001
	CAT M1 LTE Band 2	20M	QPSK	3	3	Right Side	5mm	18700	1860	22.25	23.00	1.189	-0.11	0.032	0.038
	CAT M1 LTE Band 2	20M	QPSK	3	3	Top Side	5mm	18700	1860	22.25	23.00	1.189	0.01	0.001	0.001
	CAT M1 LTE Band 2	20M	QPSK	3	3	Bottom Side	5mm	18700	1860	22.25	23.00	1.189	-0.06	0.022	0.026
02	CAT M1 LTE Band 4	20M	QPSK	3	3	Front	5mm	20050	1720	22.17	23.00	1.211	0.12	0.001	0.001
	CAT M1 LTE Band 4	20M	QPSK	3	3	Back	5mm	20050	1720	22.17	23.00	1.211	-0.11	0.001	0.001
	CAT M1 LTE Band 4	20M	QPSK	3	3	Left Side	5mm	20050	1720	22.17	23.00	1.211	0.01	0.001	0.001
	CAT M1 LTE Band 4	20M	QPSK	3	3	Right Side	5mm	20050	1720	22.17	23.00	1.211	-0.13	0.024	0.029
	CAT M1 LTE Band 4	20M	QPSK	3	3	Top Side	5mm	20050	1720	22.17	23.00	1.211	0.06	0.001	0.001
	CAT M1 LTE Band 4	20M	QPSK	3	3	Bottom Side	5mm	20050	1720	22.17	23.00	1.211	-0.12	0.016	0.019
03	CAT M1 LTE Band 12	5M	QPSK	3	3	Front	5mm	23155	713.5	22.18	23.00	1.208	-0.12	0.001	0.001
	CAT M1 LTE Band 12	5M	QPSK	3	3	Back	5mm	23155	713.5	22.18	23.00	1.208	0.09	0.001	0.001
	CAT M1 LTE Band 12	5M	QPSK	3	3	Left Side	5mm	23155	713.5	22.18	23.00	1.208	0.04	0.001	0.001
	CAT M1 LTE Band 12	5M	QPSK	3	3	Right Side	5mm	23155	713.5	22.18	23.00	1.208	0.17	0.059	0.071
	CAT M1 LTE Band 12	5M	QPSK	3	3	Top Side	5mm	23155	713.5	22.18	23.00	1.208	0.13	0.001	0.001
	CAT M1 LTE Band 12	5M	QPSK	3	3	Bottom Side	5mm	23155	713.5	22.18	23.00	1.208	-0.19	0.018	0.022

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
04	WLAN2.4GHz	802.11b 1Mbps	Front	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0.14	0.079	0.089
	WLAN2.4GHz	802.11b 1Mbps	Back	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0.17	0.004	0.004
	WLAN2.4GHz	802.11b 1Mbps	Left Side	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0.11	0.005	0.006
	WLAN2.4GHz	802.11b 1Mbps	Right Side	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0.05	0.005	0.005
	WLAN2.4GHz	802.11b 1Mbps	Top Side	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0	0.001	0.001
	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	5mm	1	2412	7.55	8.00	1.109	98.8	1.012	0.14	0.039	0.044

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
05	Bluetooth	LE-1Mbps	Front	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.003	0.004
	Bluetooth	LE-1Mbps	Back	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.001	0.001
	Bluetooth	LE-1Mbps	Left Side	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.001	0.001
	Bluetooth	LE-1Mbps	Right Side	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.001	0.001
	Bluetooth	LE-1Mbps	Top Side	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.001	0.001
	Bluetooth	LE-1Mbps	Bottom Side	5mm	00	2402	4.52	5.00	1.117	76	1.096	0	0.001	0.001



14. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	WWAN + Bluetooth	Yes

General Note:

1. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
2. All licensed modes share the same antenna part and cannot transmit simultaneously
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation < 1.6W/kg.
 - ii) SPLSR = $(\text{SAR1} + \text{SAR2})^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$, where $(x1, y1, z1)$ and $(x2, y2, z2)$ are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - iii) If $\text{SPLSR} \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

14.1 Body Exposure Conditions

WWAN Band	Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
		WWAN	Bluetooth	
		1g SAR (W/kg)	1g SAR (W/kg)	
CAT M1 LTE Band 2	Front	0.001	0.004	0.005
	Back	0.001	0.001	0.002
	Left side	0.001	0.001	0.002
	Right side	0.038	0.001	0.039
	Top side	0.001	0.001	0.002
	Bottom side	0.026	0.001	0.027
CAT M1 LTE Band 4	Front	0.001	0.004	0.005
	Back	0.001	0.001	0.002
	Left side	0.001	0.001	0.002
	Right side	0.029	0.001	0.030
	Top side	0.001	0.001	0.002
	Bottom side	0.019	0.001	0.020
CAT M1 LTE Band 12	Front	0.001	0.004	0.005
	Back	0.001	0.001	0.002
	Left side	0.001	0.001	0.002
	Right side	0.071	0.001	0.072
	Top side	0.001	0.001	0.002
	Bottom side	0.022	0.001	0.023

Test Engineer : Carter Jhuang, EN Liu and Dennis Hsieh



15. Uncertainty Assessment

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

Declaration of Conformity:

The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

16. References

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992
- [3] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.
- [6] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
- [7] FCC KDB 941225 D05 v02r05, "SAR Evaluation Considerations for LTE Devices", Dec 2015
- [8] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [9] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.