FCC SAR TEST REPORT

Report No.:	SET2015-10897
Product:	Wireless AC1200 Dual Band USB 3.0 Adapter
Trade Name:	J5 create
Model No.:	JUE304
FCC ID:	2AD37JUE304
Applicant:	KaiJet Technology International Limited
Address:	6F.,No113,Zhongcheng Rd.,Tucheng Dist.,New Taipei City 236,Taiwan(R.O.C.)
Issued by:	CCIC-SET
Lab Location:	Electronic Testing Building, Shahe Road，Xili, Nanshan District, Shenzhen, 518055, P. R. China
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Test Report

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Model No. ……………..:	JUE304
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Applicant………………..:	KaiJet Technology International Limited
Applicant Address…….:	6F.,No113,Zhongcheng Rd.,Tucheng Dist.,New Taipei City 236,Taiwan(R.O.C.)
Manufacturer…………:	SHENZHEN MTN ELECTRONICS CO.,LTD.
Manufacturer Address:	No.5,9 South Futai Road,Pingxi Community ,Longgang District, Shenzhen City, China
Test Standards……….:	**47CFR § 2.1093-** Radiofrequency Radiation Exposure Evaluation: Portable Devices; **ANSI 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 1528–2013:** IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques;
Test Result……………:	Pass
Tested by …………..:	Mei Chun 2015-08-21 Mei Chun, Test Engineer
Reviewed by………….:	Shuangwen Zhang 2015-08-21 Shuangwen Zhang,Senior Egineer
Approved by……………:	Wu Li'an 2015-08-21 Wu Li’an , Manager

Contents

This Test Report consists of the following Annexes:

1. General Conditions

1.1 This report only refers to the item that has undergone the test.

1.2 This report standalone does not constitute or imply by its own an approval of the product by the certification Bodies or competent Authorities.

1.3 This document is only valid if complete; no partial reproduction can be made without written approval of CCIC-SET

1.4 This report cannot be used partially or in full for publicity and/or promotional purposes without previous written approval of CCIC-SET and the Accreditation Bodies, if it applies.

2. Administrative Date

2.1. Identification of the Responsible Testing Laboratory

Company Name:	CCIC-SET
Department:	EMC & RF Department
Address:	Electronic Testing Building, Shahe Road, Nanshan District, ShenZhen, P. R. China
Telephone:	+86-755-26629676
Fax:	+86-755-26627238
Responsible Test Lab Managers:	Mr. Wu Li'an

2.2. Identification of the Responsible Testing Location(s)

Company Name:	CCIC-SET
Address:	Electronic Testing Building, Shahe Road, Nanshan District, Shenzhen, P. R. China

2.3. Organization Item

CCIC-SET Report No.:	SET2015-10897
CCIC-SET Project Leader:	Mr. Li Sixiong
CCIC-SET Responsible for accreditation scope:	Mr. Wu Li'an
Start of Testing:	2015-08-06
End of Testing:	2015-08-07

2.4. Identification of Applicant

Company Name:	KaiJet Technology International Limited
Address:	6F.,No113,Zhongcheng Rd.,Tucheng Dist.,New Taipei City 236,Taiwan(R.O.C.)

2.5. Identification of Manufacture

Company Name:	SHENZHEN MTN ELECTRONICS CO.,LTD.
Address:	No.5,9 South Futai Road,Pingxi Community ,Longgang District, Shenzhen City, China

Notes: This data is based on the information by the applicant.

3. Equipment Under Test (EUT)

3.1.Identification of the Equipment under Test

device type :	portable device
DUT Name:	Wireless AC1200 Dual Band USB 3.0 Adapter
Type Identification:	JUE304
Modulation	WIFI(DSSS,OFDM) 802.11a/b/g/n/ac HT20/HT40/VHT20/VHT40/VHT80
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.8GHz Band: 5725 MHz ~ 5850 MHz
hardware version :	MT-WN838N-2.0
software version :	\
antenna type :	Integrated antenna

4 SAR Summary

The Highest Measured Standalone SAR Summary

Exposure Position	Frequency Band	Scaled 1g-SAR(W/kg)	Max. Reported 1g-SAR(W/kg)
Body (5mm Gap)	WIFI 2.4G	0.210	0.210
	WIFI 5.2G	0.043	
	WIFI 5.8G	0.045	

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 (). The equation description is as below:

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

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

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

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

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

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

where σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the rms electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

5.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SATIMO. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

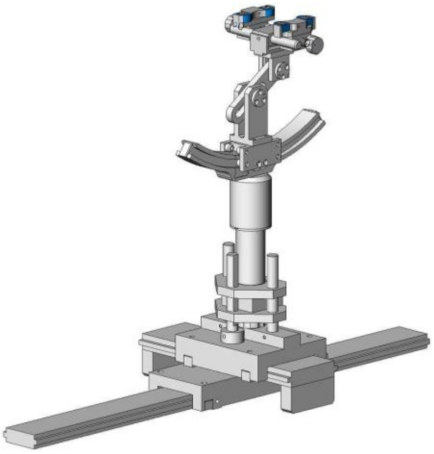
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

5.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SATIMO as an integral part of the COMOSAR test system.

The device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder

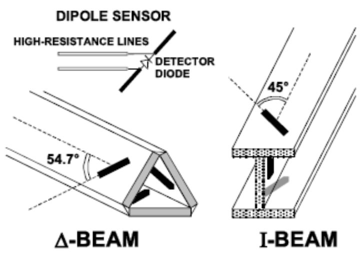
5.5 Probe Specification

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	700 MHz to 3 GHz; Linearity: ± 0.5 dB (700 MHz to 6 GHz)
Directivity	± 0.25 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	1.5 µW/g to 100 mW/g; Linearity: ± 0.5 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 5 mm Distance from probe tip to dipole centers: <2.7 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Frequency	5GHz to 6 GHz; Linearity: ± 0.5 dB (5GHz to 6 GHz)
Dimensions	Overall length: 330 mm Tip diameter: 2.5 mm Distance from probe tip to dipole centers: 1 mm
Compatibility	COMOSAR

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



6 OPERATIONAL CONDITIONS DURING TEST

6.1 General Description

WiFi 2.4G Test Configuration

For the 802.11b/g SAR tests, a communication link is set up with the test mode software for WiFi mode test. The Absolute Radio Frequency Channel Number(ARFCN) is allocated to 2 ,6 and 11 respectively in the case of 2450 MHz. During the test,at the each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate.

802.11b/g operating modes are tested independently according to the service requirements in each frquency band. 802.11b/g modes are tested on channel 1, 6, 11; however, if output power reduction is necessary for channels 2 and/or 11 to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 802.11g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

WiFi 5G Test Configuration

For the 802.11a ,802.11ac SAR tests, a communication link is set up with the test mode software for WIFI mode test. 802.11a operating modes are tested independently according to the service requirements in each 5G WIFI frequency band. During the test at each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate.

6.2 SAR Measurement System

The SAR measurement system being used is the SATIMO system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

6.2.1 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness Power drifts in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Dielectric Performance of Tissue

Ingredients (% by weight)	Frequency (MHz)					
	450	835	915	1800	1900	2450
Tissue Type	Body	Body	Body	Body	Body	Body
Water	51.16	52.4	56.0	69.91	69.91	73.2
Salt (Nacl)	1.49	1.4	0.76	0.13	0.13	0.04
Sugar	46.78	45.0	41.76	0.0	0.0	0.0
HEC	0.52	1.0	1.21	0.0	0.0	0.0
Bactericide	0.05	0.1	0.27	0.0	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	0.0	29.96	29.96	26.7

Frequency:5200/5400/5600/5800MHz	
Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

6.2.2 Simulant liquids

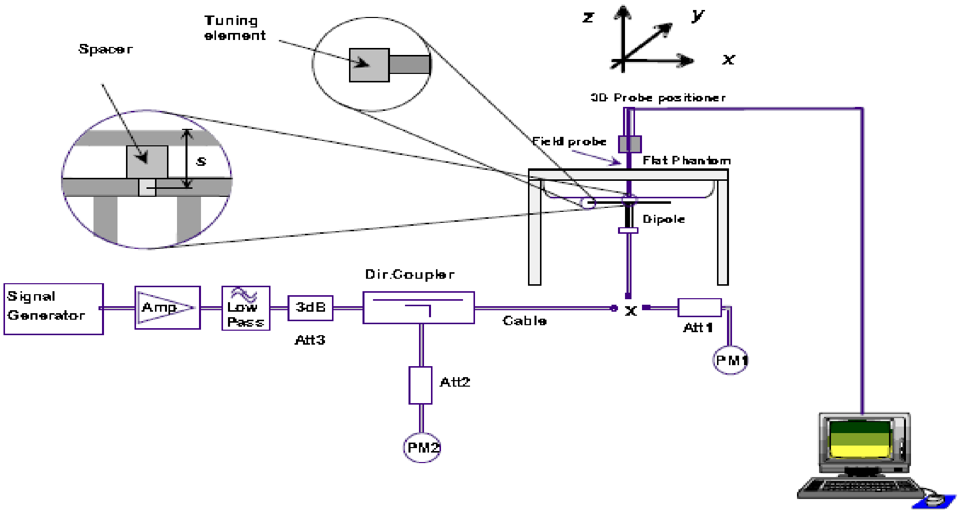
For body-worn measurements, the EUT was tested against flat phantom representing the user body. The EUT was put on in the belt holder. Simulant liquids that are used for testing at frequencies of Wi-Fi 2.4GHz, 5GHz, which are made mainly of sugar, salt and water solutions may be left in the phantoms.

Dielectric Performance of Body Tissue Simulating Liquid

Temperature: 23.2°C; Humidity: 64%;			
/	Frequency	Permittivity ε	Conductivity σ (S/m)
Target value	2450MHz	52.7±5%	1.93±5%
Validation value(Aug. 06th, 2015)	2450MHz	52.62	1.91
Target value	5200MHz	50.70±5%	5.11±5%
Validation value(Aug. 10th, 2015)	5200MHz	50.01	4.89
Target value	5800MHz	48.54±5%	6.22±5%
Validation value(Aug. 12th, 2015)	5800MHz	48.77	6.21

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the IEEE standard P1528-2003. Setup according to the setup diagram below :



With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.25W (24 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level. If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 1-gram averaged SAR values of the device against the phantom are provided in following table . The humidity and ambient temperature of test facility were 64% and 22.2°C respectively. The body phantom were full of the body tissue simulating liquid. The EUT was supplied with full-charged battery for each measurement.

The distance between the back of the EUT and the bottom of the flat phantom is 10 mm (taking into account of the IEEE 1528 and the place of the antenna).

Body SAR system validation (1g)

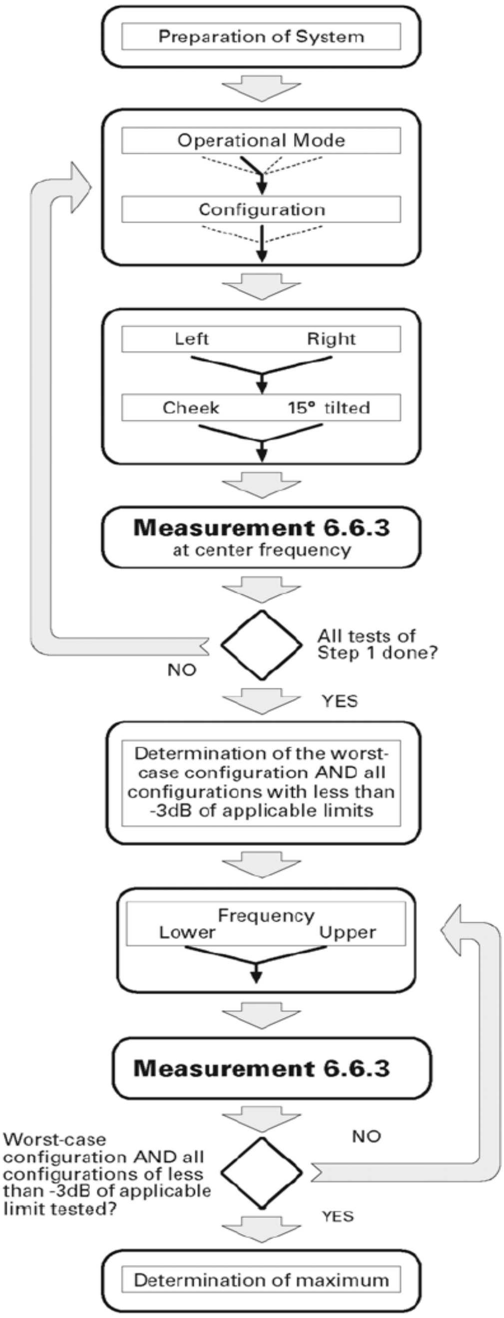
Frequency	Duty cycle	Target valueW/kg）	Test value (W/kg)	
			250 mW	1W
2450MHz(Aug. 06th, 2015)	1:1	52.66±10%	12.80	51.20
5200MHz(Aug. 10th, 2015)	1:1	15.88±10%	3.94	15.76
5800MHz(Aug. 12th, 2015)	1:1	17.67±10%	4.39	17.56

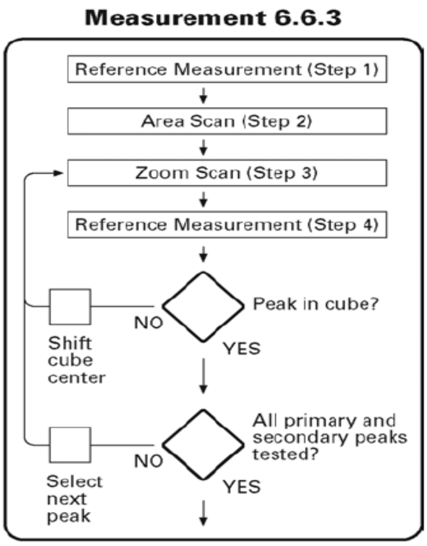
* Note: Target value was referring to the measured value in the calibration certificate of reference dipole.

Note: All SAR values are normalized to 1W forward power.

6.4 SAR measurement procedure

The SAR test against the head phantom was carried out as follow:





Establish a call with the maximum output power with a base station simulator, the connection between the EUT and the base station simulator is established via air interface.

After an area scan has been done at a fixed distance of 2mm from the surface of the phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

Above is the scanning procedure flow chart and table from the IEEEp1528 standard.

This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behaviour are tested.

For body-worn measurement, the EUT was tested under two position: face upward and back upward.

6.5 Transmitting antenna information

There are GSM &WCDMA antenna and WIFI antenna inside the EUT,

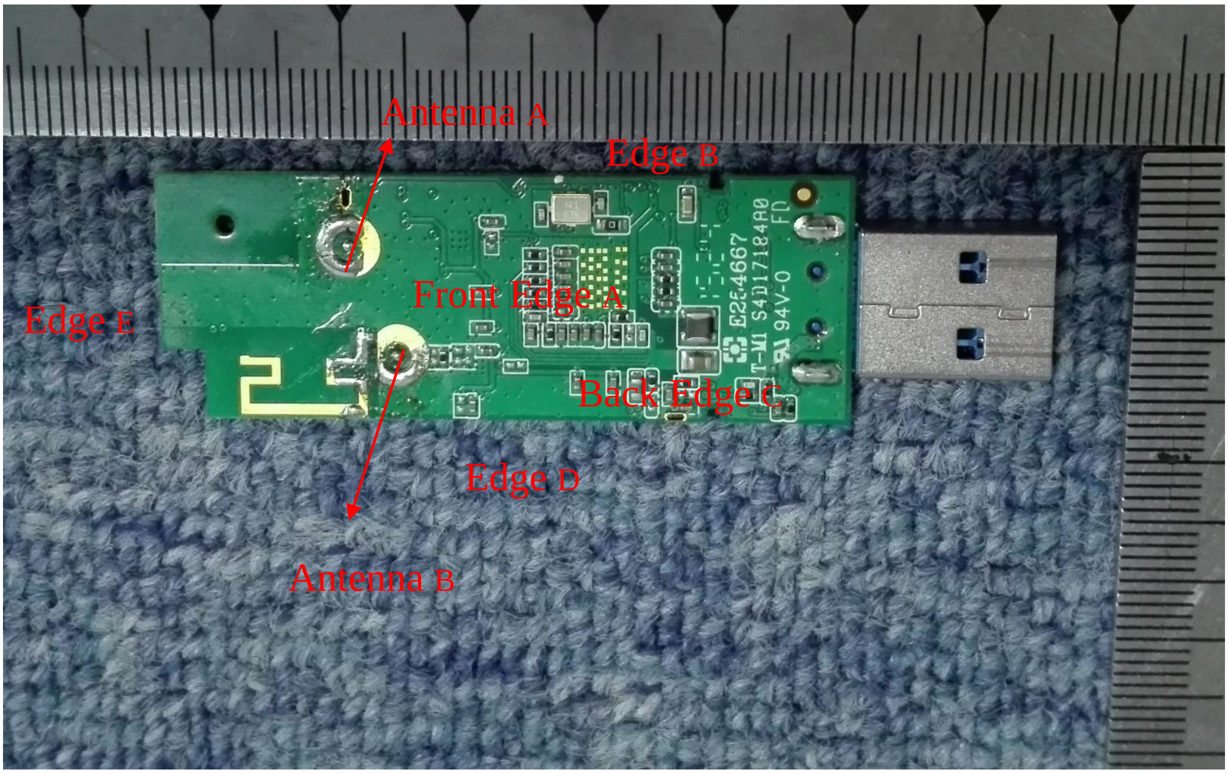
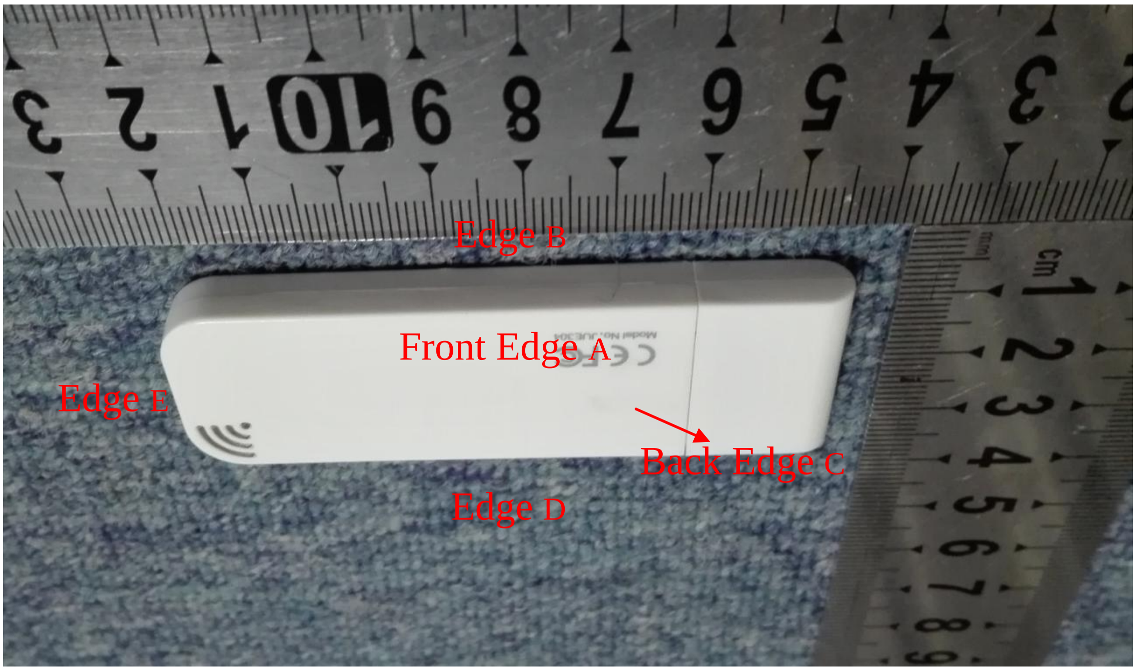


Fig. 3 Position of the antennas



7 Applicable Measurement Standards

47CFR §2.1093- Radiofrequency Radiation Exposure Evaluation: Portable Devices;

ANSI 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 1528–2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques;

IEEE Std 1528a-2005: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

FCC KDB 865664 D01 v01r04 SAR Measurement 100MHz to 6GHz

FCC KDB 865664 D02 v01r01 RF Exposure Reporting

FCC KDB 447498 D01 v05r02 General RF Exposure Guidance v05r02

FCC KDB 248227 D01 v02r01 802.11 Wi-Fi SAR

8 Laboratory Environment

8.1 The Ambient Conditions during SAR Test

Temperature	Min. = 22 °C, Max. = 25 °C
Atmospheric pressure	Min.=86 kPa, Max.=106 kPa
Relative humidity	Min. = 45%, Max. = 75%
Ground system resistance	< 0.5 Ω
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.	

9.Conducted RF Output Power

WLAN 2.4GHz Band Conducted Power

Antenna A

Wi-Fi 2.4GHz	Channel/Freq.(MHz)	Power (dBm) for Data Rates (Mbps)							
		1	2	5.5	11	/	/	/	/
802.11b	1(2412)	18.07	18.04	17.86	17.95	/	/	/	/
	6(2437)	18.11	18.10	18.07	18.04	/	/	/	/
	11(2462)	18.23	18.11	18.12	18.01	/	/	/	/
802.11g	Channel	6	9	12	18	24	36	48	54
	1(2412)	17.62	17.15	17.10	17.55	17.28	17.54	17.34	17.28
	6(2437)	17.77	17.64	17.53	17.68	17.34	17.42	17.28	17.45
	11(2462)	17.83	17.81	17.74	17.59	17.73	17.46	17.35	17.33
802.11n (HT20)	Channel	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	1(2412)	17.68	17.34	17.46	17.44	17.04	17.50	17.48	17.55
	6(2437)	17.65	17.26	17.34	17.63	17.52	17.61	17.51	17.52
	11(2462)	17.73	17.24	17.58	17.35	17.63	17.40	17.46	17.41
802.11n (HT40)	Channel	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	1(2422)	16.13	16.05	16.02	16.04	16.07	16.05	16.03	16.04
	6(2437)	16.27	16.07	16.02	16.03	16.05	16.25	16.11	16.08
	11(2452)	16.22	16.03	16.04	16.05	16.10	16.04	16.02	16.18

Antenna B

Wi-Fi 2.4GHz	Channel/Freq.(MHz)	Power (dBm) for Data Rates (Mbps)							
		1	2	5.5	11	/	/	/	/
802.11b	1(2412)	17.65	17.35	17.54	17.26	/	/	/	/
	6(2437)	17.79	17.26	17.42	17.62	/	/	/	/
	11(2462)	17.58	17.49	17.50	17.27	/	/	/	/
802.11g	Channel	6	9	12	18	24	36	48	54
	1(2412)	17.10	17.06	17.05	17.00	16.84	16.94	16.92	16.88
	6(2437)	17.21	17.10	17.13	17.16	17.09	17.05	17.20	17.06
	11(2462)	16.89	16.58	16.75	16.84	16.65	16.64	16.67	16.60
802.11n (HT20)	Channel	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	1(2412)	17.29	17.18	17.14	17.10	17.15	17.06	17.08	17.00
	6(2437)	17.43	17.08	17.34	17.26	17.05	17.24	17.17	17.19
	11(2462)	17.52	17.43	17.44	17.05	17.24	17.16	17.38	17.30
802.11n (HT40)	Channel	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	1(2422)	16.17	16.12	16.03	16.12	16.05	16.11	16.10	16.08
	6(2437)	16.22	16.10	16.12	16.05	16.08	16.19	16.20	16.07
	11(2452)	16.28	16.24	16.22	16.27	16.15	16.17	16.13	16.18

Antenna A+B

Wi-Fi 2.4GHz	Channel/Freq. (MHz)	Power (dBm) for Data Rates (Mbps)							
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n (HT20)	1(2412)	20.50	20.46	20.35	20.42	20.48	20.47	20.46	20.48
	6(2437)	20.55	20.52	20.51	20.50	20.53	20.52	20.51	20.51
	11(2462)	20.64	20.58	20.62	20.61	20.59	20.58	20.62	20.57
802.11n (HT40)	Channel	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	1(2422)	19.16	19.15	19.13	19.14	19.15	19.12	19.10	19.14
	6(2437)	19.25	19.24	19.19	19.20	19.21	19.22	19.24	19.23
	11(2452)	19.26	19.22	19.23	19.21	19.19	19.24	19.23	19.21

WLAN 5GHz Band Conducted Power

Test results of band U-NII-1 (5150 ~ 5250 MHz)

Antenna A

802.11a		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	6	9	12	18	24	36	48	54
CH36	5180	17.27	17.25	17.26	17.23	17.18	17.22	17.15	17.26
CH44	5220	17.43	17.38	17.40	17.36	17.41	17.42	17.35	17.40
CH48	5240	17.50	17.44	17.48	17.42	17.46	17.48	17.45	17.47

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	16.92	16.90	16.88	16.91	16.86	16.90	16.85	16.87
CH44	5220	16.78	16.77	16.72	16.71	16.75	16.73	16.74	16.69
CH48	5240	16.52	16.45	16.51	16.49	16.48	16.49	16.51	16.45

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	16.73	16.71	16.72	16.69	16.67	16.68	16.66	16.65
CH46	5230	16.76	16.66	16.75	16.73	16.69	16.71	16.72	16.67

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	16.41	16.39	16.40	16.38	16.34	16.40	16.39	16.40
CH44	5220	16.23	16.21	16.21	16.20	16.22	16.18	16.17	16.15
CH48	5240	16.33	16.31	16.32	16.26	16.29	16.24	16.23	16.27

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	16.52	16.50	16.51	16.49	16.51	16.48	16.51	16.48
CH46	5230	16.61	16.59	16.57	16.57	16.60	16.58	16.57	16.58

802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH42	5210	16.95	16.92	16.94	16.90	16.88	16.82	16.81	16.89

Antenna B

802.11a		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	6	9	12	18	24	36	48	54
CH36	5180	17.45	17.44	17.43	17.40	17.38	17.41	17.39	17.43
CH44	5220	17.51	17.50	17.48	17.49	17.46	17.48	17.50	17.49
CH48	5240	17.55	17.53	17.51	17.48	17.46	17.45	17.53	17.54

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	17.05	17.04	17.03	17.04	17.01	16.98	16.99	17.03
CH44	5220	16.91	16.88	16.90	16.89	16.87	16.90	16.89	16.86
CH48	5240	16.79	16.78	16.75	16.73	16.71	16.75	16.77	16.74

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	16.85	16.83	16.81	16.79	16.82	16.81	16.78	16.81
CH46	5230	16.79	16.75	16.78	16.74	16.75	16.76	16.78	16.74

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	16.53	16.52	16.51	16.50	16.49	16.48	16.50	16.52
CH44	5220	16.39	16.38	16.37	16.38	16.35	16.38	16.34	16.37
CH48	5240	16.42	16.41	16.40	16.39	16.38	16.40	16.38	16.41

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	16.67	16.65	16.59	16.61	16.63	16.65	16.66	16.59
CH46	5230	16.72	16.71	16.69	16.68	16.65	16.61	16.71	16.70

802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH42	5210	17.02	17.00	17.01	17.00	16.99	16.98	16.97	17.00

Antenna A+B

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	20.00	19.99	19.98	19.96	19.99	19.97	19.95	19.99
CH44	5220	19.87	19.85	19.84	19.83	19.86	19.86	19.85	19.84
CH48	5240	19.67	19.65	19.66	19.65	19.63	19.65	19.66	19.64

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	19.80	19.78	19.75	19.73	19.71	19.69	19.75	19.76
CH46	5230	19.79	19.75	19.78	19.74	19.73	19.75	19.74	19.76

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH36	5180	19.48	19.47	19.45	19.43	19.47	19.45	19.44	19.43
CH44	5220	19.32	19.31	19.29	19.31	19.28	19.31	19.27	19.29
CH48	5240	19.39	19.38	19.35	19.34	19.38	19.37	19.35	19.34

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH38	5190	19.60	19.58	19.57	19.57	19.59	19.54	19.58	19.58
CH46	5230	19.66	19.65	19.64	19.65	19.61	19.63	19.64	19.63

802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH42	5210	19.98	19.98	19.96	19.94	19.95	19.97	19.97	19.95

Test results of band U-NII-3 (5725 ~ 5850 MHz)

Antenna A

802.11a		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	6	9	12	18	24	36	48	54
CH149	5745	18.05	18.03	18.04	18.01	18.02	18.04	18.03	18.04
CH157	5785	17.94	17.91	17.93	17.92	17.89	17.85	17.88	17.91
CH165	5825	17.97	17.95	17.94	17.89	17.96	17.95	17.96	17.95

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	17.78	17.75	17.74	17.77	17.73	17.74	17.75	17.76
CH157	5785	17.53	17.51	17.52	17.52	17.51	17.49	17.51	17.52
CH165	5825	17.49	17.48	17.45	17.46	17.48	17.45	17.48	17.46

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	17.12	17.11	17.10	17.09	17.11	17.08	17.09	17.10
CH159	5795	17.35	17.33	17.30	17.34	17.33	17.31	17.34	17.31

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	16.52	16.51	16.49	16.50	16.51	16.48	16.51	16.47
CH157	5785	16.29	16.28	16.27	16.27	16.28	16.25	16.24	16.27
CH165	5825	16.41	16.39	16.38	16.40	16.38	16.40	16.39	16.40

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	16.43	16.41	16.42	16.42	16.39	16.37	16.38	16.39
CH159	5795	16.37	16.35	16.34	16.35	16.36	16.34	16.34	16.35

802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH155	5775	17.09	17.04	17.05	17.06	17.07	17.08	17.06	17.07

Antenna B

802.11a		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	6	9	12	18	24	36	48	54
CH149	5745	18.12	18.10	18.09	18.11	18.09	18.08	18.10	18.11
CH157	5785	18.03	18.02	18.01	18.02	18.01	18.02	18.01	18.02
CH165	5825	17.89	17.88	17.86	17.85	17.88	17.84	17.86	17.88

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	17.48	17.45	17.47	17.45	17.44	17.45	17.43	17.46
CH157	5785	17.19	17.18	17.16	17.18	17.17	17.16	17.18	17.16
CH165	5825	17.27	17.25	17.24	17.15	17.04	17.05	17.09	17.10

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	17.08	17.05	17.04	17.06	17.07	17.04	17.03	17.05
CH159	5795	17.13	17.11	17.12	17.10	17.08	17.09	17.11	17.12

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	16.27	16.25	16.23	16.24	16.26	16.24	16.21	16.18
CH157	5785	16.13	16.11	16.08	16.11	16.12	16.07	16.08	16.09
CH165	5825	16.25	16.21	16.24	16.23	16.21	16.24	16.23	16.24

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	16.08	16.07	16.05	16.04	16.07	16.06	16.05	16.04
CH159	5795	16.17	16.16	16.15	16.14	16.15	16.15	16.03	16.09
802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH155	5775	17.13	17.12	17.11	17.09	17.08	17.11	17.10	17.11

Antenna A+B

802.11n-HT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	20.64	20.61	20.63	20.62	20.58	20.55	20.51	20.54
CH157	5785	20.37	20.35	20.34	20.36	20.34	20.35	20.33	20.31
CH165	5825	20.39	20.36	20.35	20.34	20.36	20.38	20.34	20.36

802.11n-HT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	20.11	20.08	20.06	20.04	20.03	20.10	20.01	20.06
CH159	5795	20.25	20.22	20.23	20.24	20.18	20.15	20.16	20.13

802.11ac-VHT20		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH149	5745	19.40	19.33	19.31	19.35	19.30	19.29	19.27	19.25
CH157	5785	19.22	19.21	19.19	19.18	19.16	19.14	19.11	19.13
CH165	5825	19.34	19.32	19.31	19.30	19.28	19.25	19.24	19.31

802.11ac-VHT40		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH151	5755	19.27	19.25	19.24	19.23	19.24	19.25	19.18	19.16
CH159	5795	19.28	19.25	19.24	19.23	19.19	19.15	19.13	19.25

802.11ac-VHT80		Power (dBm) for Data Rate(Mbps)							
Channel	Frequency(MHz)	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH155	5775	20.12	20.09	20.08	20.04	20.06	20.08	20.09	20.10

Note:

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion.
2. During the test, at each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate. As Bold in the Output Power table above.
3. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at lowest data rate

9.4General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
2. Per KDB447498 D01v05r02, 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 KDB 865664 D01v01r04,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 D02v01r01, 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(Refer to appendix D for details).
5. Per KDB 248227 D01 v02r01, choose the highest output power channel to test SAR and determine further SAR exclusion.
6. Per KDB 248227 D01 v02r01, 802.11g /11n-HT20 is not required. . When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤1.2W/Kg. Thus the SAR can be excluded.

10 Test Results

10.1 Summary of SAR Measurement Results

According the description above, while the tests against the body-worn were carried out on the operation mode : WIFI 2.4G ,WIFI 5.2G,WIFI 5.8G.

Table 1: SAR Values of Wi-Fi 2.4GHz 802.11b, Antenna A

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
802.11b	Edge A	11/2462	18.23	18.50	1.064	0.009	0.010
	Edge B	11/2462	18.23	18.50	1.064	0.106	0.113
	Edge C	11/2462	18.23	18.50	1.064	**0.197**	**0.210**
	Edge D	11/2462	18.23	18.50	1.064	0.044	0.047
	Edge E	11/2462	18.23	18.50	1.064	0.035	0.037

Table 2: SAR Values of Wi-Fi 2.4GHz 802.11b, Antenna B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
802.11b	Edge A	6/2437	17.79	18.00	1.050	0.074	0.078
	Edge B	6/2437	17.79	18.00	1.050	0.005	0.005
	Edge C	6/2437	17.79	18.00	1.050	0.063	0.066
	Edge D	6/2437	17.79	18.00	1.050	0.082	0.086
	Edge E	6/2437	17.79	18.00	1.050	0.003	0.003

Table 3: SAR Values of Wi-Fi 2.4GHz 802.11n-HT20, Antenna A+B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
802.11n -HT20	Edge A	11/2462	20.64	21.00	1.086	0.051	0.055
	Edge B	11/2462	20.64	21.00	1.086	0.081	0.088
	Edge C	11/2462	20.64	21.00	1.086	0.050	0.054
	Edge D	11/2462	20.64	21.00	1.086	0.050	0.054
	Edge E	11/2462	20.64	21.00	1.086	0.157	0.171

Table 4: SAR Values of Wi-Fi 5.2GHz, Antenna A

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11a	Edge A	48/5240	17.50	18.00	1.122	0.010	0.011
	Edge B	48/5240	17.50	18.00	1.122	**0.038**	**0.043**
	Edge C	48/5240	17.50	18.00	1.122	0.014	0.016
	Edge D	48/5240	17.50	18.00	1.122	0.006	0.007
	Edge E	48/5240	17.50	18.00	1.122	0.007	0.008

Table 5: SAR Values of Wi-Fi 5.2GHz, Antenna B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11a	Edge A	48/5240	17.55	18.00	1.109	0.018	0.020
	Edge B	48/5240	17.55	18.00	1.109	0.004	0.004
	Edge C	48/5240	17.55	18.00	1.109	0.019	0.021
	Edge D	48/5240	17.55	18.00	1.109	0.017	0.019
	Edge E	48/5240	17.55	18.00	1.109	0.006	0.007

Table 6: SAR Values of Wi-Fi 5.2GHz, Antenna A+B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11n-HT20	Edge A	36/5180	20.00	20.30	1.072	0.022	0.024
	Edge B	36/5180	20.00	20.30	1.072	0.023	0.025
	Edge C	36/5180	20.00	20.30	1.072	0.018	0.019
	Edge D	36/5180	20.00	20.30	1.072	0.021	0.023
	Edge E	36/5180	20.00	20.30	1.072	0.025	0.027

Table 7: SAR Values of Wi-Fi 5.2GHz, Antenna A

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11ac-VHT80	Edge A	42/5210	16.95	17.50	1.135	0.008	0.009
	Edge B	42/5210	16.95	17.50	1.135	0.032	0.036
	Edge C	42/5210	16.95	17.50	1.135	0.016	0.018
	Edge D	42/5210	16.95	17.50	1.135	0.005	0.006
	Edge E	42/5210	16.95	17.50	1.135	0.008	0.009

Table 8: SAR Values of Wi-Fi 5.2GHz, Antenna B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11ac-VHT80	Edge A	42/5210	17.02	17.50	1.117	0.016	0.018
	Edge B	42/5210	17.02	17.50	1.117	0.006	0.007
	Edge C	42/5210	17.02	17.50	1.117	0.018	0.020
	Edge D	42/5210	17.02	17.50	1.117	0.015	0.017
	Edge E	42/5210	17.02	17.50	1.117	0.007	0.008

Table 9: SAR Values of Wi-Fi 5.2GHz, Antenna A+B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.2G 802.11ac-VHT80	Edge A	42/5210	19.98	20.30	1.076	0.021	0.023
	Edge B	42/5210	19.98	20.30	1.076	0.037	0.040
	Edge C	42/5210	19.98	20.30	1.076	0.028	0.030
	Edge D	42/5210	19.98	20.30	1.076	0.024	0.026
	Edge E	42/5210	19.98	20.30	1.076	0.023	0.025

Table 10: SAR Values of Wi-Fi 5.8GHz, Antenna A

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11a	Edge A	149/5745	18.05	18.50	1.109	0.019	0.021
	Edge B	149/5745	18.05	18.50	1.109	0.028	0.031
	Edge C	149/5745	18.05	18.50	1.109	0.024	0.027
	Edge D	149/5745	18.05	18.50	1.109	0.003	0.003
	Edge E	149/5745	18.05	18.50	1.109	0.007	0.008

Table 11: SAR Values of Wi-Fi 5.8GHz, Antenna B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11a	Edge A	149/5745	18.12	18.50	1.091	0.030	0.033
	Edge B	149/5745	18.12	18.50	1.091	0.031	0.034
	Edge C	149/5745	18.12	18.50	1.091	0.028	0.031
	Edge D	149/5745	18.12	18.50	1.091	0.005	0.005
	Edge E	149/5745	18.12	18.50	1.091	0.011	0.012

Table 12: SAR Values of Wi-Fi 5.8GHz, Antenna A+B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11n-HT20	Edge A	149/5745	20.64	21.00	1.086	0.031	0.034
	Edge B	149/5745	20.64	21.00	1.086	**0.041**	**0.045**
	Edge C	149/5745	20.64	21.00	1.086	0.024	0.026
	Edge D	149/5745	20.64	21.00	1.086	0.019	0.021
	Edge E	149/5745	20.64	21.00	1.086	0.034	0.037

Table 13: SAR Values of Wi-Fi 5.8GHz, Antenna A

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11ac-VHT80	Edge A	155/5775	17.09	17.50	1.099	0.023	0.025
	Edge B	155/5775	17.09	17.50	1.099	0.031	0.034
	Edge C	155/5775	17.09	17.50	1.099	0.028	0.031
	Edge D	155/5775	17.09	17.50	1.099	0.003	0.003
	Edge E	155/5775	17.09	17.50	1.099	0.009	0.010

Table 14: SAR Values of Wi-Fi 5.8GHz, Antenna B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11ac-VHT80	Edge A	155/5775	17.13	17.50	1.089	0.025	0.027
	Edge B	155/5775	17.13	17.50	1.089	0.033	0.036
	Edge C	155/5775	17.13	17.50	1.089	0.03	0.033
	Edge D	155/5775	17.13	17.50	1.089	0.006	0.007
	Edge E	155/5775	17.13	17.50	1.089	0.012	0.013

Table 15: SAR Values of Wi-Fi 5.8GHz, Antenna A+B

Body Positions (5mm separation)		Channel /Frequency (MHz)	Power (dBm)	Tune-up Limit (dBm)	Scaling Factor	SAR(W/Kg), 1.6 (1g average)	
						Measured SAR	Scaled SAR
5.8G 802.11ac -VHT80	Edge A	155/5775	20.12	20.30	1.042	0.027	0.028
	Edge B	155/5775	20.12	20.30	1.042	0.035	0.036
	Edge C	155/5775	20.12	20.30	1.042	0.021	0.022
	Edge D	155/5775	20.12	20.30	1.042	0.026	0.027
	Edge E	155/5775	20.12	20.30	1.042	0.032	0.033

Note: When the 1-g SAR for the mid-band channel or the channel with the Highest output power≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz, testing of the other channels in the band is not required.(Per KDB 447498 D01 General RF Exposure Guidance v05r02)

10.2 Conclusion

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 7 of this report. Maximum localized SAR is **below** exposure limits specified in the relevant standards.

11 Measurement Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	– Probe Calibration	B	5.8	N	1	1	5.8	∞
2	– Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	– Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	– Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞
5	– Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	– System Detection Limits	B	1.0	R	$\sqrt{3}$	1	0.58	∞
7	-Modulation response	B	3	N	1	1	3.00	∞
8	– Readout Electronics	B	0.5	N	1	1	0.50	∞
9	– Response Time	B	0	R	1	1	0	∞
10	– Integration Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
11	– RF Ambient Conditions-Noise	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	– RF Ambient Conditions-Reflections	B	3.0	R	$\sqrt{3}$	1	1.73	∞
13	– Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	– Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
15	– Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞
	Uncertainties of the DUT							
16	– Position of the DUT	A	2.6	N	$\sqrt{3}$	1	2.6	5

17	– Holder of the DUT	A	3	N	$\sqrt{3}$	1	3.0	5
18	– Output Power Variation –SAR drift measurement	B	5.0	R	$\sqrt{3}$	1	2.89	∞
19	–SAR Scaling	B	2	R	$\sqrt{3}$	1	1.15	∞
Phantom and Tissue Parameters								
20	– Phantom shell Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
21	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	∞
22	– Liquid Conductivity measurement	B	4	N	$\sqrt{3}$	1	0.92	9
23	– Liquid Permittivity measurement	B	5	N	$\sqrt{3}$	1	1.15	9
24	– Liquid Conductivity—temperature uncertainly	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
25	– Liquid Permittivity — temperature uncertainly	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
Combined Standard Uncertainty				RSS			10.63	
Expanded uncertainty (Confidence interval of 95 %)				K=2			21.26	

System Check Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	– Probe Calibration	B	5.8	N	1	1	5.8	∞
2	– Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	—Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	– Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞

5	– Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	– System Detection Limits	B	1	R	$\sqrt{3}$	1	0.58	∞
7	Modulation response	B	0	N	1	1	0.00	
8	– Readout Electronics	B	0.5	N	1	1	0.50	∞
9	– Response Time	B	0.00	R	$\sqrt{3}$	1	0.00	∞
10	– Integration Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
11	– RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	– Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
13	– Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	– Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞
	Uncertainties of the DUT							
15	Deviation of experimental source from numberical source	A	4	N	1	1	4.00	5
16	Input Power and SAR drift measurement	A	5	R	$\sqrt{3}$	1	2.89	5
17	Dipole Axis to Liquid Distance	B	2	R	$\sqrt{3}$	1	1.2	∞
Phantom and Tissue Parameters								
18	– Phantom Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
19	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	
20	– Liquid Conductivity Target –tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
21	– Liquid Conductivity –measurement Uncertainty)	B	4	N	$\sqrt{3}$	1	0.92	9

22	– Liquid Permittivity Target tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
23	– Liquid Permittivity –measurement uncertainty	B	5	N	$\sqrt{3}$	1	1.15	∞
Combined Standard Uncertainty				RSS			10.15	
Expanded uncertainty (Confidence interval of 95 %)				K=2			20.29	

12 Main Test Instruments

No.	EQUIPMENT	TYPE	Series No.	Last Calibration	Due Date
1	SAR Probe	E-Field Probe	SN 09/13 EP166	2014/08/14	1 Year
2	SAR Probe	E-Field Probe	SN 27/15 EPGO261	2015/07/09	1 Year
3	Dipole	SID2450	SN09/13 DIP2G450-220	2014/08/28	1 Year
4	Dipole	5GHz-6GHz	SN 15/15 WGA 39	2015/06/01	1 Year
5	Network Analyzer	ZVB8	A0802530	2015/06/13	1 Year
6	Signal Generator	SMR27	A0304219	2015/06/10	1 Year
7	Amplifier	Nucletudes	143060	2015/03/28	1 Year
8	Directional Coupler	DC6180A	305827	2014/06/10	1 Year
9	Power Meter	NRVS	1020.1809.02	2015/06/13	1 Year
10	Power Sensor	NRV-Z4	100069	2015/06/10	1 Year
11	Power Meter	NRP2	A140401673	2015/03/28	1 Year
12	Power Sensor	NPR-Z11	1138.3004.02-114072-nq	2015/03/28	1 Year
13	Multimeter	Keithley-2000	4014020	2015/03/28	1 Year

ANNEX A

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2015-10897

Wireless AC1200 Dual Band USB 3.0 Adapter

Type Name: JUE304

Hardware Version： **MT-WN838N-2.0**

Software Version： ****

System Performance Check Data and Highest SAR Plots

This Annex consists of 7 pages

Date of Report：2015-08-21

System Performance Check (Body, 2450MHz)

Type: Validation measurement

Date of measurement: 08/06/2015

Measurement duration: 22 minutes 59 seconds

Mobile Phone IMEI number: --

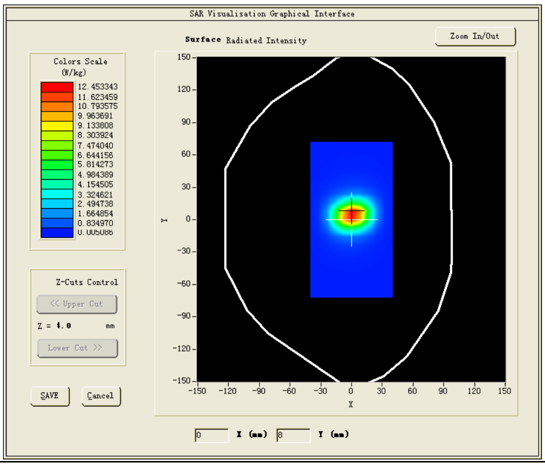
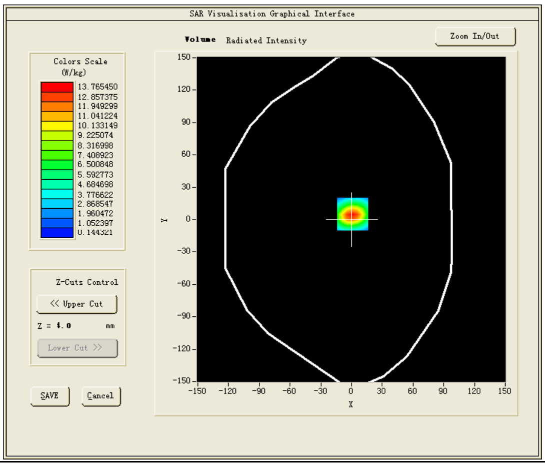
A. Experimental conditions.

Phantom File	dx=5mm,dy=5mm
Phantom	7x7x8,dx=5mm dy=5mm dz=4mm
Device Position	Dipole
Band	2450MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	2450
Relative permittivity (real part)	52.62
Relative permittivity	14.03
Conductivity (S/m)	1.91
Power Drift (%)	0.30
Ambient Temperature:	22.0 ℃
Liquid Temperature:	22.6 ℃
Duty factor:	1:1
ConvF:	5.07

SURFACE SAR	VOLUME SAR
	

Maximum location: X=1.00, Y=5.00

SAR Peak: 22.36 W/kg

SAR 10g (W/Kg)	6.1967342
SAR 1g (W/Kg)	12.799515

System Validation (Body, 5200MHz)

Type: Validation measurement
Date of measurement: 08/10/2014
Measurement duration: 23 minutes 12 seconds
Mobile Phone IMEI number: --

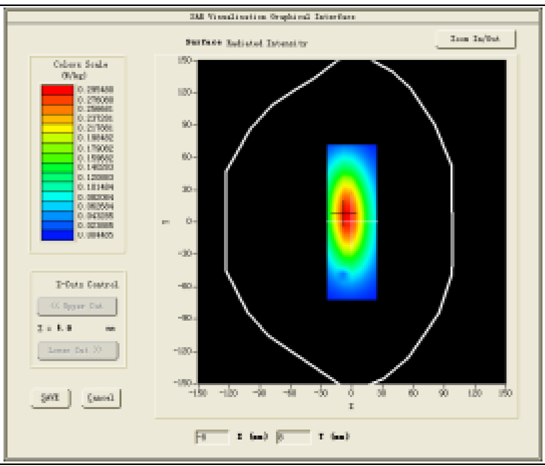
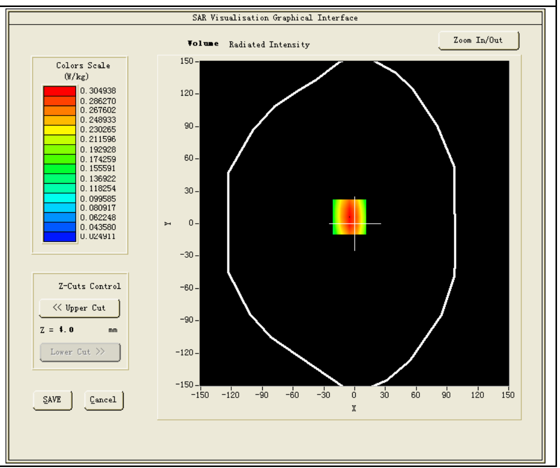
A. Experimental conditions.

Phantom File	dx=4mm,dy=4mm
Phantom	7x7x12,dx=4m, dy=4mm, dz=2mm
Device Position	Dipole
Band	5200MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	5200
Relative permittivity (real part)	50.01
Relative permittivity	16.93
Conductivity (S/m)	4.89
Power drift (%)	2.72
ConvF:	2.21
Crest factor:	1:1

SURFACE SAR	VOLUME SAR
	

Maximum location: X=-8.00, Y=8.00

SAR 10g (W/Kg)	1.532871
SAR 1g (W/Kg)	3.943587

System Validation (Body, 5800MHz)

Type: Validation measurement
Date of measurement: 08/12/2014
Measurement duration: 22 minutes 58 seconds
Mobile Phone IMEI number: --

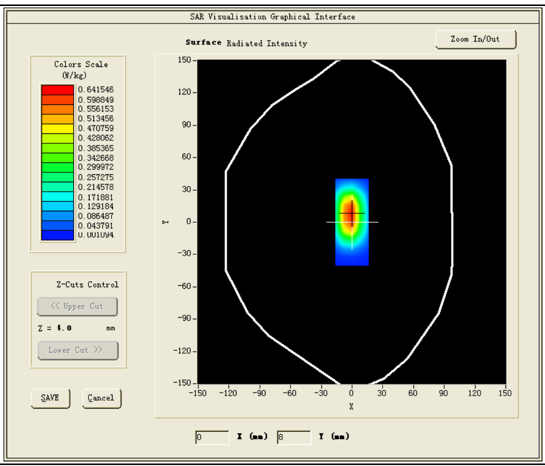
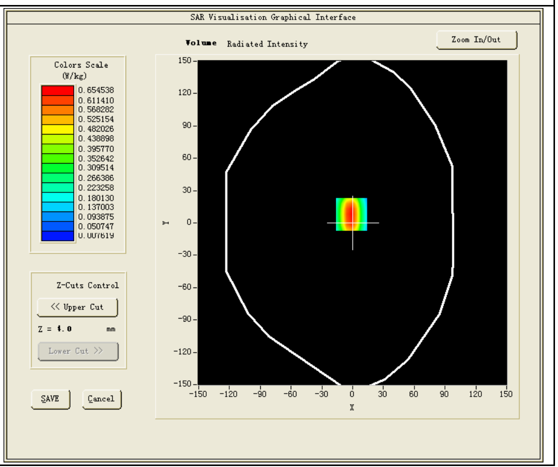
A. Experimental conditions.

Phantom File	dx=4mm,dy=4mm
Phantom	7x7x12,dx=4m, dy=4mm, dz=2mm
Device Position	Dipole
Band	5800MHz
Channels	
Signal	CW

B. SAR Measurement Results

Band SAR

Frequency (MHz)	5800
Relative permittivity (real part)	48.77
Relative permittivity	19.27
Conductivity (S/m)	6.21
Power Drift (%)	-2.62
Duty factor:	1:1
ConvF:	2.39

SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=8.00

SAR 10g (W/Kg)	1.632535
SAR 1g (W/Kg)	4.392574

Wi-Fi 802.11b , Edge C, High, Antenna A

Type: Phone measurement

Date of measurement: 08/06/2015

Measurement duration: 6 minutes 24 seconds

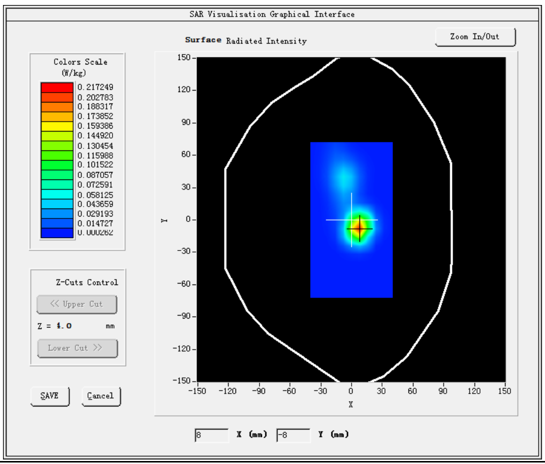
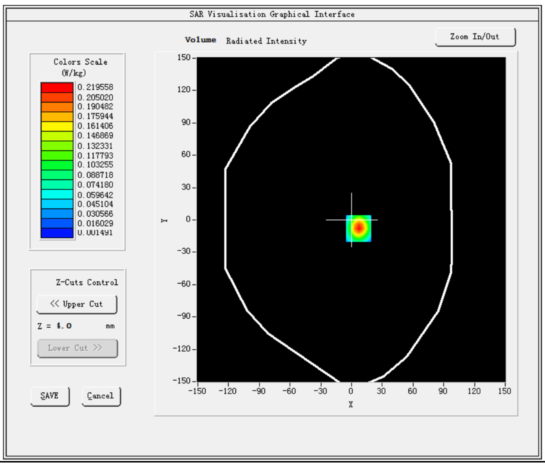
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=5mm,dy=5mm
ZoomScan	7x7x8,dx=5mm dy=5mm dz=4mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11b
Channels	11
Signal	DSSS (duty cycle: 1:1)

B. SAR Measurement Results

Frequency (MHz)	2462
Relative permittivity (real part)	52.62
Relative permittivity (imaginary part)	14.03
Conductivity (S/m)	1.91
Variation (%)	-1.39
ConvF:	5.07

SURFACE SAR	VOLUME SAR
	

Maximum location: X=7.00, Y=-8.00

SAR Peak: 0.43 W/kg

SAR 10g (W/Kg)	0.075353
SAR 1g (W/Kg)	0.196537

Wi-Fi 5.2G 802.11a , Edge B, High, Antenna A

Type: Phone measurement

Date of measurement: 08/10/2015

Measurement duration: 6 minutes 22 seconds

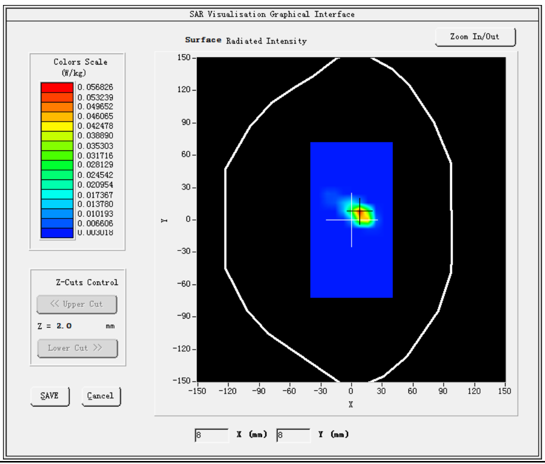
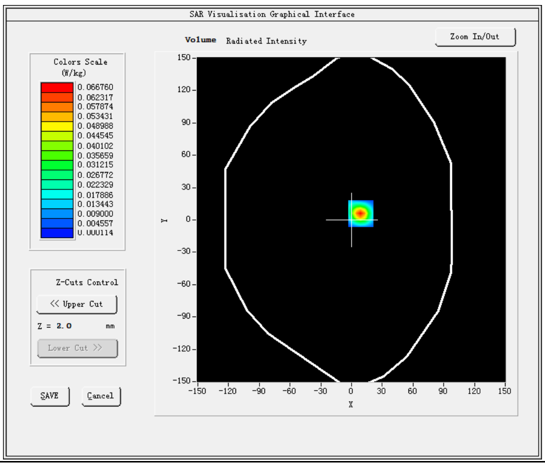
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=4mm,dy=4mm
ZoomScan	7x7x12,dx=4m, dy=4mm, dz=2mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11a
Channels	48
Signal	OFDM (duty cycle: 1:1)

B. SAR Measurement Results

Frequency (MHz)	5240
Relative permittivity (real part)	50.01
Relative permittivity (imaginary part)	16.93
Conductivity (S/m)	4.89
Variation (%)	-2.37
ConvF:	2.21

SURFACE SAR	VOLUME SAR
	

Maximum location: X=9.00, Y=6.00

SAR Peak: 0.12 W/kg

SAR 10g (W/Kg)	0.012146
SAR 1g (W/Kg)	0.037397

Wi-Fi 5.2G 802.11ac , Edge B, High, Antenna A+B

Type: Phone measurement

Date of measurement: 08/12/2015

Measurement duration: 6 minutes 24 seconds

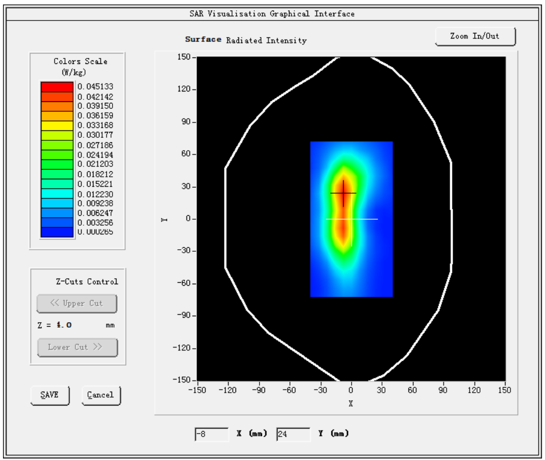
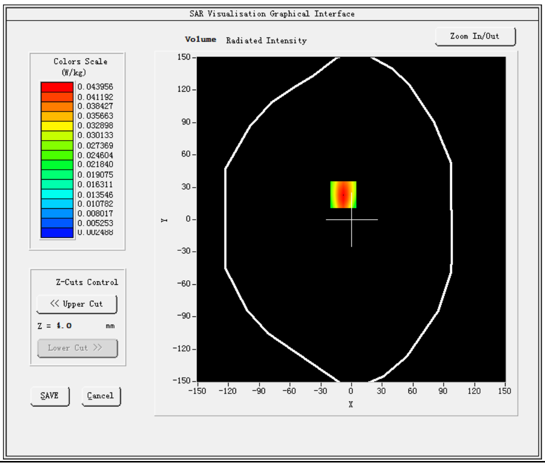
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=4mm,dy=4mm
ZoomScan	7x7x12,dx=4m, dy=4mm, dz=2mm
Phantom	Validation plane
Device Position	Body
Band	IEEE 802.11ac
Channels	149
Signal	OFDM (duty cycle: 1:1)

B. SAR Measurement Results

Frequency (MHz)	5745
Relative permittivity (real part)	48.77
Relative permittivity (imaginary part)	19.27
Conductivity (S/m)	6.21
Variation (%)	-4.73
ConvF:	2.39

SURFACE SAR	VOLUME SAR
	

Maximum location: X=-8.00, Y=23.00

SAR Peak: 0.08 W/kg

SAR 10g (W/Kg)	0.021570
SAR 1g (W/Kg)	0.041390

ANNEX B

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2015-10897

Wireless AC1200 Dual Band USB 3.0 Adapter

Type Name: JUE304

Hardware Version：MT-WN838N-2.0

Software Version：

Calibration Certificate of Probe and Dipoles

This Annex consists of 43 pages

Date of Report：2015-08-21

Probe Calibration Ceriticate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.227.15.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD
ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN
SHENZHEN, P.R. CHINA (POST CODE:518055)
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 04/13 EP166

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2246-02

08/14/2014

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	8/15/2014	JS
Checked by :	Jérôme LUC	Product Manager	8/15/2014	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	8/15/2014	Kim Rutkowski

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	*Date*	*Modifications*
A	8/15/2014	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 04/13 EP166
Product Condition (new / used)	Used
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.232 MΩ Dipole 2: R2=0.226 MΩ Dipole 3: R3=0.228 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

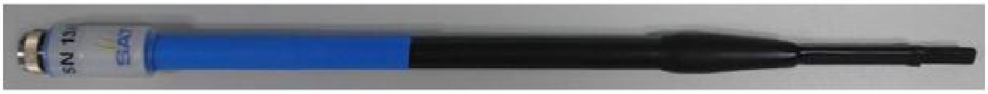


Figure 1 – *Satimo COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide

ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

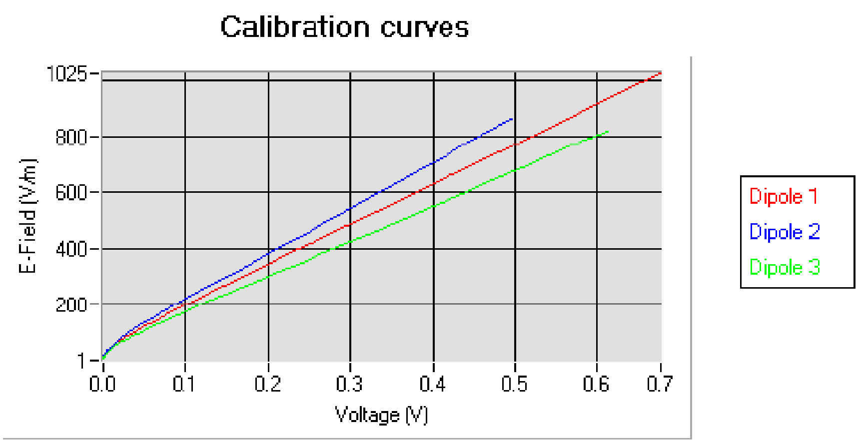
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
8.57	4.83	7.15

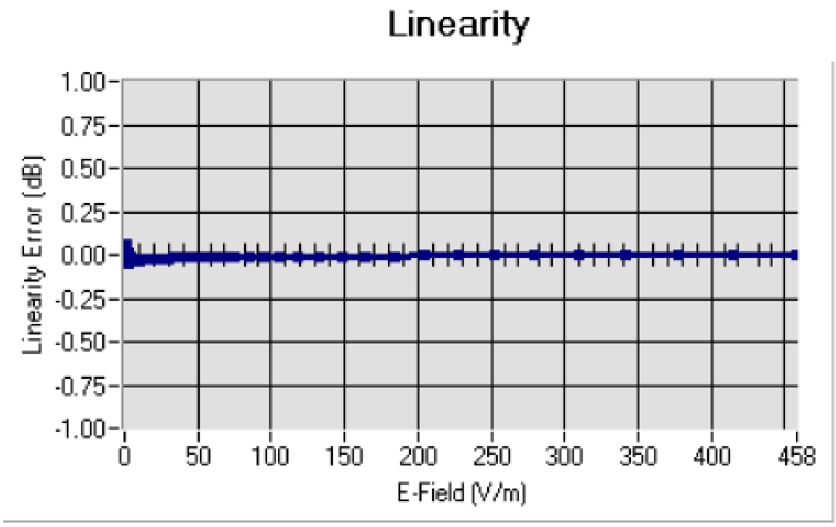
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
92	90	95

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity:+/-1.55% (+/-0.07dB)

5.3 SENSITIVITY IN LIQUID

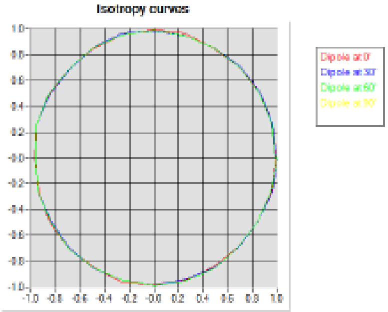
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL850	835	42.81	0.89	5.68
BL850	835	53.46	0.96	5.84
HL900	900	42.47	0.96	5.34
BL900	900	56.69	1.08	5.54
HL1800	1800	41.31	1.38	4.75
BL1800	1800	53.27	1.51	4.93
HL1900	1900	41.09	1.42	5.25
BL1900	1900	54.20	1.54	5.42
HL2000	2000	39.72	1.43	4.81
BL2000	2000	53.91	1.53	4.91
HL2450	2450	39.05	1.77	4.93
BL2450	2450	52.97	1.93	5.07
HL2600	2600	38.35	1.92	5.02
BL2600	2600	51.81	2.19	5.22

LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

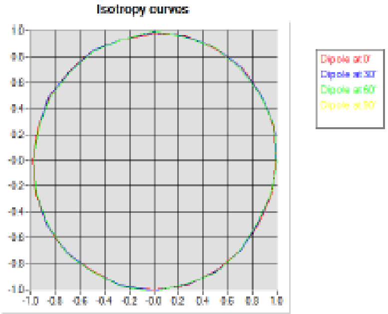
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



HL1800 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.07 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	Satimo	EP 94 SN 37/08	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

COMOSAR E-Field Probe Calibration Report

Ref : ACR.191.1.15.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD
ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN
SHENZHEN, P.R. CHINA (POST CODE:518055)
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 27/15 EPGO261

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 07/09/15

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in MVG USA using the CALISAR / CALIBAIR test bench, for use with a COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	7/10/2015	
Checked by :	Jérôme LUC	Product Manager	7/10/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	7/10/2015	Kim Rutkowski

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	Date	Modifications
A	7/10/2015	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 27/15 EPGO261
Product Condition (new / used)	New
Frequency Range of Probe	0.7 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.213 MΩ Dipole 2: R2=0.215 MΩ Dipole 3: R3=0.220 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

Figure 1 – *MVG COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

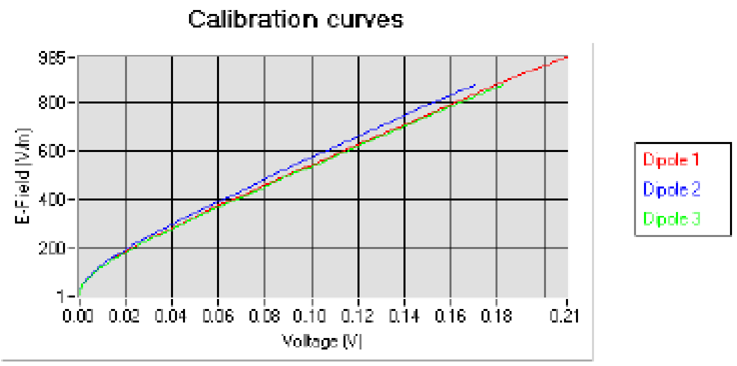
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
0.91	0.65	0.73

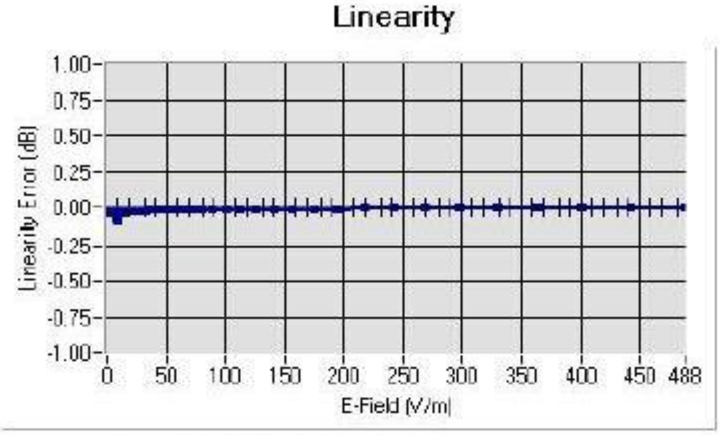
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
91	90	90

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity:+/-1.82% (+/-0.08dB)

5.3 SENSITIVITY IN LIQUID

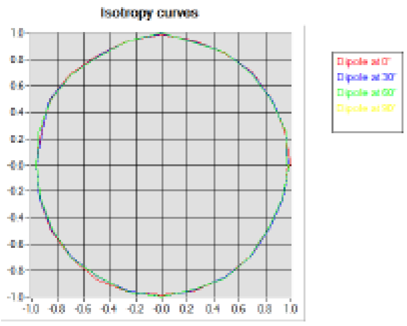
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL5200	5200	36.44	4.79	2.13
BL5200	5200	50.70	5.11	2.21
HL5400	5400	35.99	4.91	2.31
BL5400	5400	50.01	5.64	2.43
HL5600	5600	35.22	5.18	2.35
BL5600	5600	49.34	5.85	2.43
HL5800	5800	34.95	5.42	2.34
BL5800	5800	48.54	6.22	2.39

LOWER DETECTION LIMIT: 9mW/kg

5.4 ISOTROPY

HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.09 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	MVG	EP 94 SN 37/08	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

SID2450 Dipole Calibration Ceriticate

SAR Reference Dipole Calibration Report

Ref : ACR.240.6.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD
ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN
SHENZHEN, P.R. CHINA (POST CODE:518055)
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 09/13 DIP2G450-220

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2246-02

08/28/14

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	8/29/2014	
Checked by :	Jérôme LUC	Product Manager	8/29/2014	
Approved by :	Kim RUTKOWSKI	Quality Manager	8/29/2014	Kim Rutkowski

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	*Date*	*Modifications*
A	8/29/2014	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID2450
Serial Number	SN 09/13 DIP2G450-220
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *Satimo COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

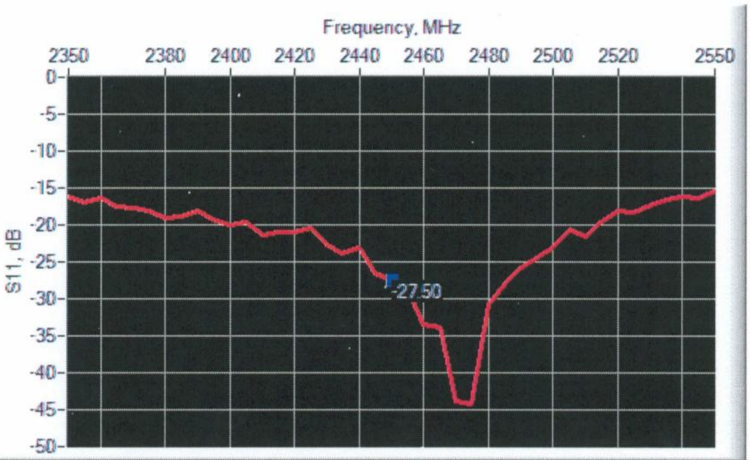
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

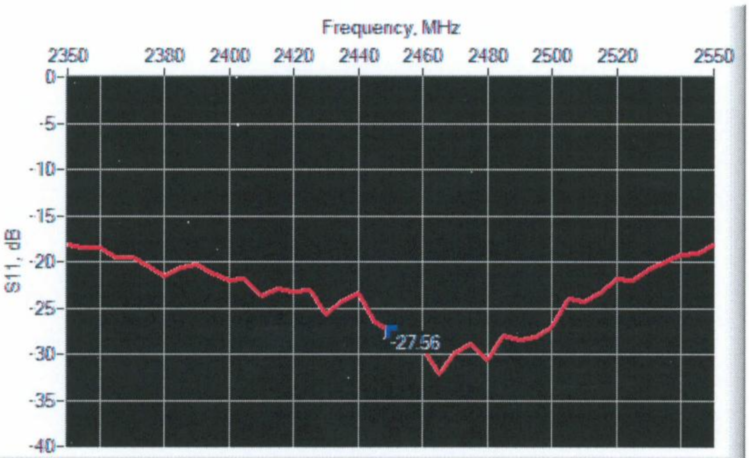
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-27.50	-20	51.7 Ω + 3.8 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-27.56	-20	54.3 Ω + 0.9 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	

900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	