SAR TEST REPORT

For

HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD

Mini 802.11ac Wireless USB Adapter

Test Model: 0611

Additional Model No. : WU650S

Prepared for	:	HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD
Address	:	4F, Building7, Districit3, Cuigang industrial park, Rd zhengfengnan, Fuyong,Baoan, shenzhen

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	August 12, 2020
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	August 12, 2020 ~ August 18, 2020
Date of Report	:	August 20, 2020

SAR TEST REPORT

Report Reference No......................:	**LCS200810087AEB**
Date Of Issue.....................................:	August 20, 2020
Testing Laboratory Name.............:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address...:	101, 201 Bldg A & 301 Bldg C, Juji Industrial Park Shajing Street, Baoan District, Shenzhen, China
Testing Location/ Procedure...........:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name........................... :	**HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD**
Address...:	4F, Building7, Districit3, Cuigang industrial park, Rd zhengfengnan, Fuyong,Baoan, shenzhen
Test Specification:	
Standard...:	IEEE Std C95.1-2019& IEEE Std 1528™-2013 & FCC Part 2.1093
Test Report Form No....................... :	LCSEMC-1.0
TRF Originator...................................:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF....................................... :	Dated 2014-09

Test Item Description.................... :	**Mini 802.11ac Wireless USB Adapter**
Trade Mark...:	N/A
Model/Type Reference.....................:	0611
Operation Frequency........................:	WIFI 5GWLAN (U-NI-1) , WIFI 5GWLAN (U-NI-2A) , WIFI 5GWLAN (U-NI-2C) , WIFI 5GWLAN (U-NI-3) WLAN2.4G
Modulation Type................................:	/
Ratings..:	DC 5.0V
Result ....:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Ping Li/ File administrators	Jin Wang/Technique principal	Gavin Liang/ Manager

SAR -- TEST REPORT

Test Report No. :	**LCS200810087AEB**	August 18, 2020 Date of issue

Type / Model.........................	:	0611
EUT.......................................	:	Mini 802.11ac Wireless USB Adapter
Applicant..............................	**:**	**HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD**
Address..................................	:	4F, Building7, Districit3, Cuigang industrial park, Rd zhengfengnan, Fuyong,Baoan, shenzhen
Telephone..............................	:	/
Fax..	:	/
Manufacturer.......................	**:**	**HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD**
Address..................................	:	4F, Building7, Districit3, Cuigang industrial park, Rd zhengfengnan, Fuyong,Baoan, shenzhen
Telephone..............................	:	/
Fax..	:	/
Factory.................................	**:**	**HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD**
Address..................................	:	4F, Building7, Districit3, Cuigang industrial park, Rd zhengfengnan, Fuyong,Baoan, shenzhen
Telephone..............................	:	/
Fax..	:	/

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revison History

Revision	Issue Date	Revisions	Revised By
000	August 20, 2020	Initial Issue	Gavin Liang

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1. TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

IEEE Std C95.1-2019: IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz.It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
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.
FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices
KDB447498 D01 General RF Exposure Guidance v06 : Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB447498 D02 SAR Procedures for Dongle Xmtr v02r01: SAR Measurement Procedures For USB Dongle Transmitters.
KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 : SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations
KDB 248227 D01 802.11 Wi-Fi SAR v02r02: SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power . And Test device is identical prototype.

1.3. General Remarks

Date of receipt of test sample	:	August 12, 2020
Testing commenced on	:	August 12, 2020
Testing concluded on	:	August 18, 2020

1.4. Product Description

The HAOLIYUAN(SHENZHEN) ELECTRONIC CO.,LTD's Model: 0611 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

General Description	
EUT :	Mini 802.11ac Wireless USB Adapter
Model/Type reference:	0611
Additional Model No.	WU650S
Hardware Version	V1.1
Firmware Version:	1030.28
Power supply:	DC 5.0V
Hotspot:	Not Supported
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Portable Device
The EUT is Mini 802.11ac Wireless USB Adapter. the Mini 802.11ac Wireless USB Adapter is intended for WLAN transmission. It is equipped with WiFi2.4G, WIFI(5G U-NI-1), WIFI (5G U-NI-2A) , WIFI (5G U-NI-2C) , WIFI(5G U-NI-3). For more information see the following datasheet	

Technical Characteristics	
WIFI 2.4G	
Supported Standards:	IEEE 802.11b/802.11g/802.11n(HT20 and HT40)
Frequency Range:	2412MHz-2472MHz
Operation frequency:	2412-2472MHz for 11b/g/n(HT20) 2422-2462MHz for 11n(HT40)
Type of Modulation:	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK); IEEE 802.11g/n: OFDM(64QAM, 16QAM, QPSK, BPSK)
Channel number:	13 channels for 20MHz bandwidth (2412~2472MHz) 9 channels for 40MHz bandwidth (2422~2462MHz)
Channel separation:	5MHz
WIFI(5G U-NI-1)	
Frequency Range:	5180MHz~5240MHz
Channel Number:	4 channels for 20MHz bandwidth(5180-5240MHz) 2 channels for 40MHz bandwidth(5190~5230MHz) 1 channels for 80MHz bandwidth (5210MHz)
Modulation Type:	IEEE 802.11a/n/ac: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK)
WIFI(5G U-NI-2A)	
Frequency Range:	5260MHz-5320MHz
Channel Number:	4 channels for 20MHz bandwidth (5260-5320MHz) 2 channels for 40MHz bandwidth (5270~5310MHz) 1 channels for 80MHz bandwidth (5290MHz)
Modulation Type:	IEEE 802.11a/n/ac: OFDM(256QAM,64QAM, 16QAM, QPSK, BPSK)
WIFI(5G U-NI-2C)	
Frequency Range:	5500MHz~5700MHz
Channel Number:	11 channels for 20MHz bandwidth (5500-5700MHz) 5 channels for 40MHz bandwidth (5510~5670MHz) 2channels for 80MHz bandwidth (5530MHz,5610MHz)
Modulation Type:	IEEE 802.11a/n/ac: OFDM (256QAM,64QAM, 16QAM, QPSK, BPSK)
WIFI(5G U-NI-3)	
Frequency Range:	5745MHz-5825MHz
Channel Number:	5 channels for 20MHz bandwidth (5745-5825MHz) 2 channels for 40MHz bandwidth (5755~5795MHz) 1 channels for 80MHz bandwidth (5775MHz)
Modulation Type:	IEEE 802.11a/n/ac: OFDM(256QAM,64QAM, 16QAM, QPSK, BPSK)
Antenna Description:	Internal Antenna, 2.0dBi(Max.)

1.5. Statement of Compliance

The maximum of results of SAR found during testing for 0611 are follows:

<Highest Reported standalone SAR Summary>

Classment Class	Frequency Band	Body-worn (Report $SAR_{1\text{-}g}$ (W/kg))
DTS	WIFI2.4G	0.218
NII	UNII Band 1	**0.144**
	UNII Band 2A	0.140
	UNII Band 2C	0.138
	UNII Band 3	0.111

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 C95.1-2019, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

2. TEST ENVIRONMENT

2.1. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

Site Description
EMC Lab. : NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.

2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

2.3. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	(Occupational / Controlled Exposure Environment)
Spatial Average(averaged over the whole body)	0.08	0.4
Spatial Peak(averaged over any 1 g of tissue)	1.6	8.0
Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.
Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

2.4. Equipments Used during the Test

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	PC	Lenovo	G5005	MY42081102	N/A	N/A
2	SAR Measurement system	SATIMO	4014_01	SAR_4014_01	N/A	N/A
3	Signal Generator	Agilent	E4438C	MY49072627	2020-06-11	2021-06-10
4	Multimeter	Keithley	MiltiMeter 2000	4059164	2019-11-15	2020-11-14
5	S-parameter Network Analyzer	Agilent	8753ES	US38432944	2019-11-15	2020-11-14
6	Wideband Radio Communication Tester	R&S	CMW500	103818-1	2019-11-22	2020-11-21
7	E-Field PROBE	MVG	SSE2	SN 17/14 EPGO324	2019-10-08	2020-10-07
8	DIPOLE 2450	SATIMO	SID 2450	SN 07/14 DIP 2G450-306	2018-10-01	2021-09-30
9	DIPOLE 5000-6000	SATIMO	SID 5000-6000	SN 49/16 WGA 43	2018-09-24	2021-09-23
10	COMOSAR OPENCoaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	2019-11-15	2020-11-14
11	SAR Locator	SATIMO	VPS51	SN 40/14 VPS51	2019-11-15	2020-11-14
12	Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	2019-11-15	2020-11-14
13	FEATURE PHONEPOSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
14	DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
15	SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
16	Liquid measurement Kit	HP	85033D	3423A03482	2019-11-15	2020-11-14
17	Power meter	Agilent	E4419B	MY45104493	2020-06-11	2021-06-10
18	Power meter	Agilent	E4419B	MY45100308	2019-11-22	2020-11-21
19	Power sensor	Agilent	E9301H	MY41495616	2019-11-22	2020-11-21
20	Power sensor	Agilent	E9301H	MY41495234	2020-06-11	2021-06-10
21	Directional Coupler	MCLI/USA	4426-20	03746	2020-06-11	2021-06-10

Note:

1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.

a) There is no physical damage on the dipole;

b) System check with specific dipole is within 10% of calibrated values;

c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;

d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the provious measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

3. SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1. SARMeasurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

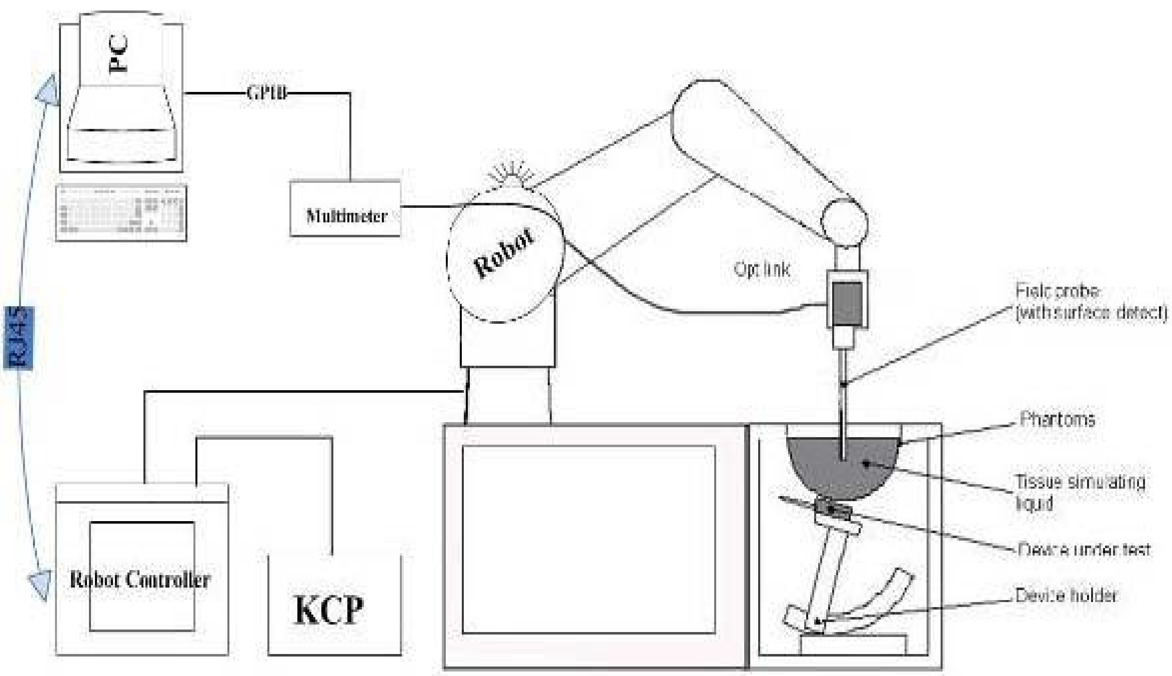
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

System validation dipoles to validate the proper functioning of the system.



3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EPGO324 (manufactured by MVG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

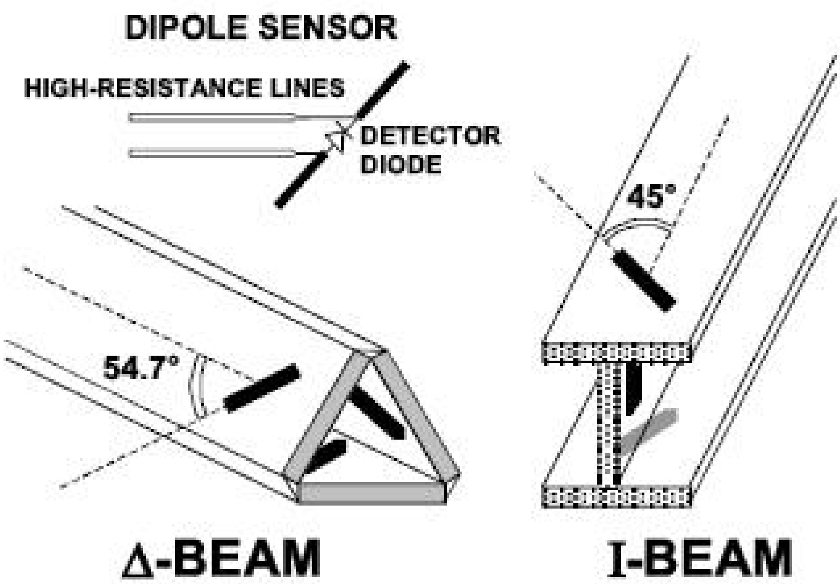
CalibrationISO/IEC 17025 calibration service available.

Frequency	450 MHz to 6 GHz; Linearity:0.25dB(450 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	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones

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.

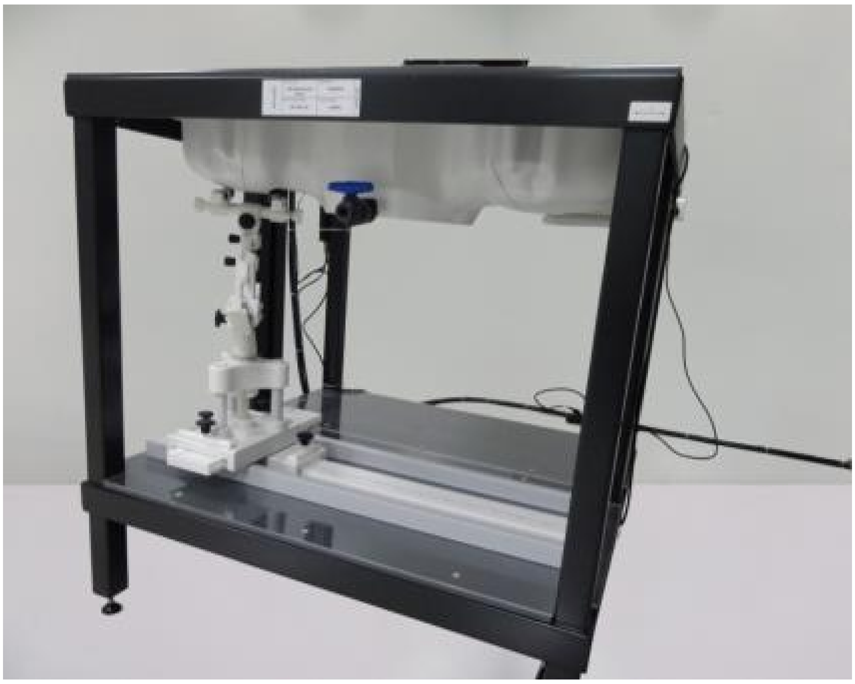
The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



3.3. Phantoms

The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE 1528 and EN62209-1 , EN62209-2.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

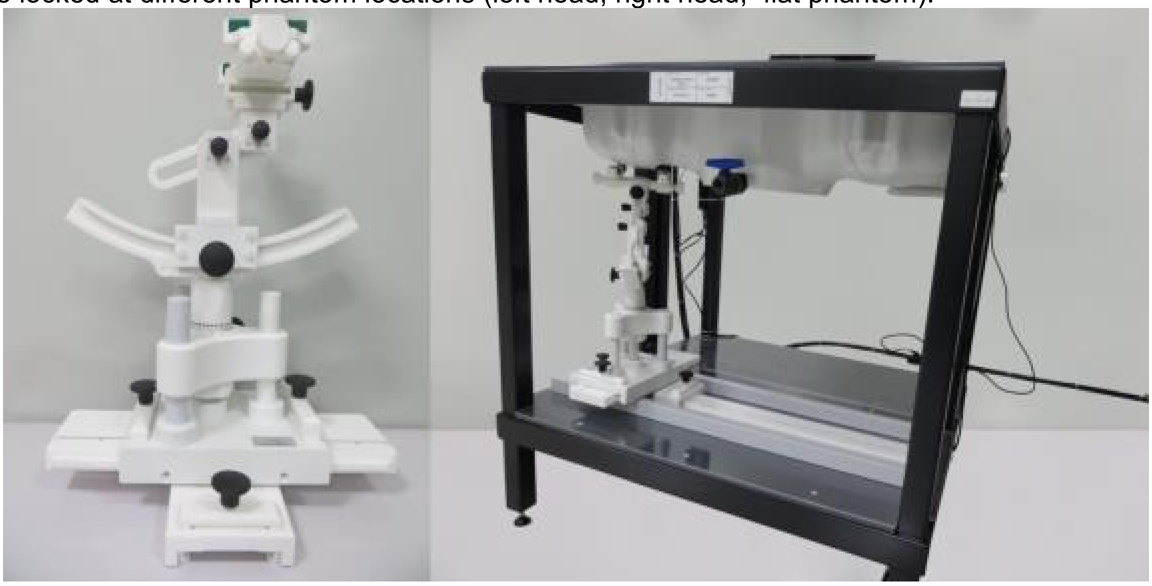
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

3.4. Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5. Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement
The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

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

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

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: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
Maximum zoom scan spatial resolution, normal to phantom surface	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
Maximum zoom scan spatial resolution, normal to phantom surface	graded grid	$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ $1.5\cdot\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details. * When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 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.				

Power Drift measurement
The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6. Data Storage and Evaluation

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

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

Data Evaluation
The OPENSAR software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

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

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

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

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field
dcpi = diode compression point

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E}-\text{fieldprobes}: \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

3.7. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Frequency (MHz)	Bactericide	DGBE	HEC	NaCl	Sucrose	1,2-Propanediol	X100	Water	Conductivity	Permittivity
	%	%	%	%	%	%	%	%	σ	εr
750	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
835	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
900	/	/	/	0.79	/	64.81	/	34.40	0.97	41.8
1800	/	13.84	/	0.35	/	/	30.45	55.36	1.38	41.0
1900	/	13.84	/	0.35	/	/	30.45	55.36	1.38	41.0
2000	/	7.99	/	0.16	/	/	19.97	71.88	1.55	41.1
2450	/	7.99	/	0.16	/	/	19.97	71.88	1.88	40.3
2600	/	7.99	/	0.16	/	/	19.97	71.88	1.88	40.3

Target Frequency (MHz)	Head		Body	
	ε_r	σ(S/m)	ε_r	σ(S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
2600	39.0	1.96	52.5	2.16
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

3.8. Tissue equivalent liquid properties

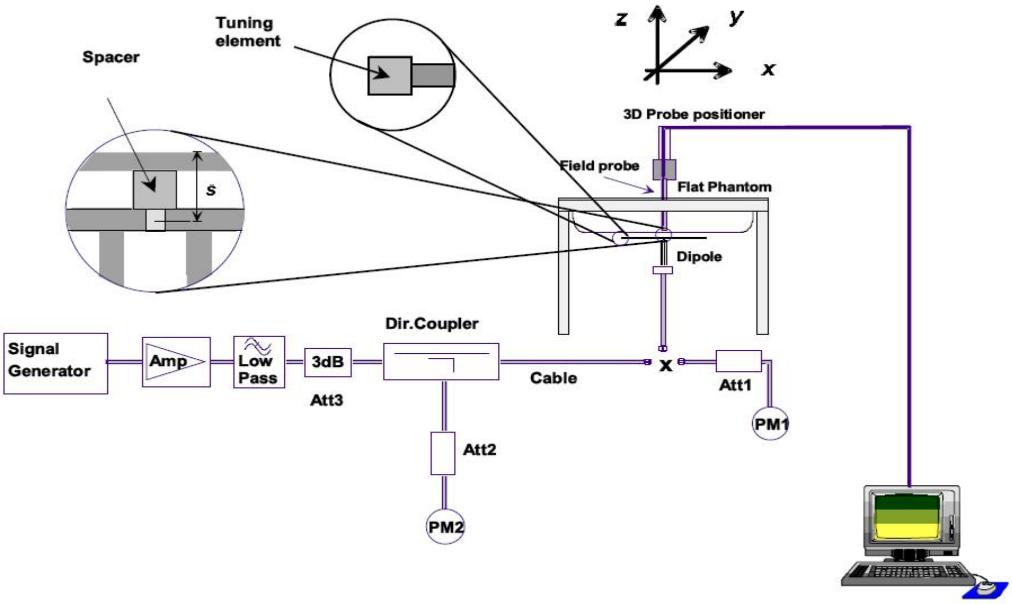
Dielectric Performance of Body Tissue Simulating Liquid

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		σ	ε_r	σ	Dev.	ε_r	Dev.		
2450B	2450	1.95	52.70	1.92	-1.54%	51.88	-1.56%	22.0	08/17/2020
5200B	5200	5.43	48.94	5.40	-0.55%	50.09	2.35%	22.0	08/18/2020
5400B	5400	5.48	48.88	5.53	0.91%	50.11	2.52%	22.0	08/18/2020
5600B	5600	5.86	48.38	5.95	1.54%	49.72	2.77%	22.0	08/18/2020
5800B	5800	6.00	48.20	6.18	3.00%	47.35	-1.76%	22.0	08/18/2020

3.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

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



The output power on dipole port must be calibrated to 20 dBm (100mW) before dipole is connected.

Photo of Dipole Setup

Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.While calibration intervals not exceed 3 years.

SID2450 SN 07/14 DIP 2G450-306 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-10-01	-25.59		52.3		-1.1	
2019-10-01	-25.68	0.35	51.6	0.1	-1.0	0.1

SID5200 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-09-24	-8.59		53.6		13.50	
2019-09-24	-8.62	0.35	52.8	-0.13	13.47	-0.03

SID5400 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-09-24	-10.58		53.2		1.81	
2019-09-24	-10.66	0.76	54.2	-0.11	1.76	-0.05

SID5600 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-09-24	-13.39		51.3		-7.75	
2019-09-24	-13.44	0.37	53.2	-0.18	-7.81	-0.06

SID5800 SN 49/16 DIP WGA43 Extend Dipole Calibrations

Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2018-09-24	-11.37		54.79		25.47	
2019-09-24	-11.42	0.44	54.68	-0.11	25.26	-0.21

Mixture Type	Frequency (MHz)	Power	SAR_{1g} (W/Kg)	SAR_{10g} (W/Kg)	Drift (%)	1W Target		Difference percentage		Liquid Temp	Date
						SAR_{1g} (W/Kg)	SAR_{10g} (W/Kg)	1g	10g		
Body	2450	100 mW	5.377	2.445	0.66	52.40	24.00	2.61%	1.88%	22.0	08/17/2020
		Normalize to 1 Watt	53.77	24.45							
Body	5200	100 mW	15.467	5.512	-3.02	159.00	56.90	-2.72%	-3.13%	22.0	08/18/2020
		Normalize to 1 Watt	154.67	55.12							
Body	5400	100 mW	15.814	5.812	0.45	166.40	58.43	-4.96%	-0.53%	22.0	08/18/2020
		Normalize to 1 Watt	158.14	58.12							
Body	5600	100 mW	17.626	6.015	-1.47	173.80	59.97	1.42%	0.30%	22.0	08/18/2020
		Normalize to 1 Watt	176.26	60.15							
Body	5800	100 mW	18.293	6.177	-1.01	181.20	61.50	0.95%	0.44%	22.0	08/18/2020
		Normalize to 1 Watt	182.93	61.77							

3.10. SAR measurement procedure

The measurement procedures are as follows:

3.10.1 Conducted power measurement

a. For WWAN power measurement, use base station simulator 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.

3.10.2 WIFI Test Configuration

The SAR measurement and test reduction procedures are structured according to either the DSSS or OFDM transmission mode configurations used in each standalone frequency band and aggregated band. For devices that operate in exposure configurations that require multiple test positions, additional SAR test reduction may be applied. The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band. SAR is measured using the highest measured maximum output power channel for the initial test configuration. SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:
1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.
2. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an “initial test configuration” is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.
a. 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 in the initial test configuration, for each frequency band.
b. SAR is measured for OFDM configurations using the initial test configuration procedures. Additional frequency band specific SAR test reduction may be considered for individual frequency bands
c. Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.
3. The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements and 802.11b DSSS procedures are used to establish the transmission configurations required for SAR measurement.
4. An “initial test position”is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions .
a. SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure using the exposure condition established by the initial test position.
b. SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration. 802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel.
5. The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures .
6. The “subsequent test configuration”procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial test configuration and maximum output power specified or measured for these other OFDM configurations.

2.4 GHz and 5GHz SAR Procedures
Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions. When SAR measurement is required for an OFDM configuration, the initial test configuration, subsequent test

configuration and initial test position procedures are applied. The SAR test exclusion requirements for 802.11g/n OFDM configurations are described in section 5.2.2.

1. 802.11b DSSS SAR Test Requirements

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

a. When the reported SAR of the highest measured maximum output power channel (section 3.1) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
b. When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

1. 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3). SAR is not required for the following 2.4 GHz OFDM conditions.

a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration
b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

2. SAR Test Requirements for OFDM Configurations

When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements.20 In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

3. OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements

The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures (section 4). When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

a. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
b. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
c. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
d. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.

a. Channels with measured maximum output power within ¼ dB of each other are considered to have the same maximum output.
b. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement.
c. When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

Initial Test Configuration Procedures

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode.23 For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is > 0.8 W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

4. Subsequent Test Configuration Procedures

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. The initial test position procedure is applied to next to the ear, UMPC mini-tablet and hotspot mode configurations. When the same maximum output power is specified for multiple transmission modes, the procedures in section 5.3.2 are applied to determine the test configuration. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. The subsequent test configuration and SAR measurement procedures are described in the following.

a. When SAR test exclusion provisions of KDB Publication 447498 are applicable and SAR measurement is not required for the initial test configuration, SAR is also not required for the next highest maximum output power transmission mode subsequent test configuration(s) in that frequency band or aggregated band and exposure configuration.
b. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.
c. The number of channels in the initial test configuration and subsequent test configuration can be different due to differences in channel bandwidth. When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel. This step requires additional power measurement to identify the highest maximum output power channel in the subsequent test configuration to determine SAR test reduction.

1). SAR should first be measured for the channel with highest measured output power in the subsequent test configuration.

2). SAR for subsequent highest measured maximum output power channels in the subsequent test configuration is required only when the reported SAR of the preceding higher maximum output power channel(s) in the subsequent test configuration is > 1.2 W/kg or until all required channels are tested.

a) For channels with the same measured maximum output power, SAR should be measured using the channel closest to the center frequency of the larger channel bandwidth channel in the initial test configuration.

d. SAR measurements for the remaining highest specified maximum output power OFDM transmission mode configurations that have not been tested in the initial test configuration (highest maximum output) or subsequent test configuration(s) (subsequent next highest maximum output power) is determined by applying the subsequent test configuration procedures in this section to the remaining configurations according to the following:

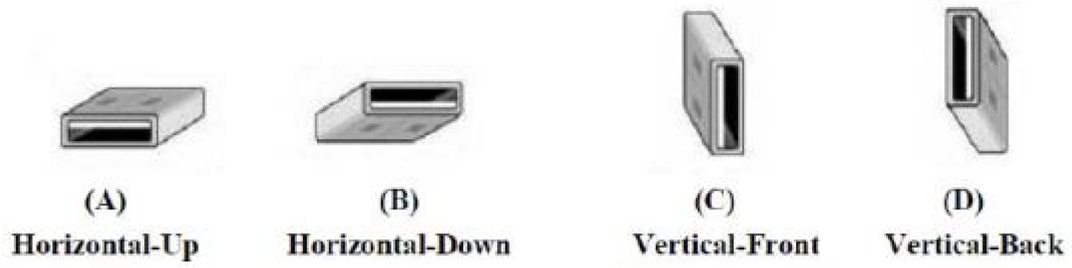
1) replace “subsequent test configuration” with “next subsequent test configuration” (i.e., subsequent next highest specified maximum output power configuration)
2) replace “initial test configuration” with “all tested higher output power configurations.

3.11. Configuration and Peripherals

The EUT was tested in the following configuration(s) unless otherwise stated:

• Powered via a USB port.

• Test all USB orientations [see figure below: (A) Horizontal-Up, (B) Horizontal-Down, (C) Vertical-Front, and (D) Vertical-Back] with a device-to-phantom separation distance of 5 mm or less, according to KDB Publication 447498 D01 requirements.



These test orientations are intended for the exposure conditions found in typical laptop/notebook/netbook or tablet computers with either horizontal or vertical USB connector configurations at various locations in the keyboard section of the computer. Current generation portable host computers should be used to establish the required SAR measurement separation distance.The same test separation distance must be used to test all frequency bands and modes in each USB orientation. The typical Horizontal-Up USB connection (A), found in the majority of host computers, must be tested using an appropriate host computer. A host computer with either Vertical-Front (C) or Vertical-Back (D) USB connection should be used to test one of the vertical USB orientations. If a suitable host computer is not available for testing the Horizontal-Down (B) or the remaining Vertical USB orientation, a high quality USB cable, 12 inches or less, may be used for testing these other orientations. It must be documented that the USB cable does not influence the radiating characteristics and output power of the transmitter

3.12. Power Reduction

The product without any power reduction.

3.13. Power Drift

To control the output power stability during the SAR test, SAR system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. This ensures that the power drift during one measurement is within 5%.

4. TEST CONDITIONS AND RESULTS

4.1. Conducted Power Results

Max Conducted power measurement results and power drift from tune-up tolerance provide by manufacturer:

<WLAN 2.4GHz Conducted Power>

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power(dBm)	Worst Case Test Rate Data
IEEE 802.11b	1	2412	18.09	1 Mbps
	6	2437	18.15	1 Mbps
	11	2462	17.92	1 Mbps
IEEE 802.11g	1	2412	18.12	6 Mbps
	6	2437	18.48	6 Mbps
	11	2462	18.72	6 Mbps
IEEE 802.11n HT20	1	2412	18.13	6.5 Mbps
	6	2437	18.34	6.5 Mbps
	11	2462	18.36	6.5 Mbps
IEEE 802.11n HT40	3	2422	18.45	13 Mbps
	6	2437	18.48	13 Mbps
	9	2452	18.57	13 Mbps

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power(dBm)	Worst Case Test Rate Data
IEEE 802.11b	12	2467	5.21	1 Mbps
	13	2472	4.23	1 Mbps
IEEE 802.11g	12	2467	5.63	6 Mbps
	13	2472	4.37	6 Mbps
IEEE 802.11n HT20	12	2467	5.65	6.5 Mbps
	13	2472	4.32	6.5 Mbps
IEEE 802.11n HT40	10	2457	5.37	13 Mbps
	11	2462	4.28	13 Mbps

<WLAN 5GHz U-NI-1 Conducted Power>

Mode	Channel	Frequency (MHz)	Average Conducted Output Power(dBm)	Worst Case Test Rate Data
IEEE 802.1a	36	5180	15.26	MCS0
	40	5200	15.10	MCS0
	48	5240	15.03	MCS0
IEEE 802.11n HT20	36	5180	15.32	MCS0
	40	5200	15.50	MCS0
	48	5240	15.54	MCS0
IEEE 802.11n HT40	38	5190	15.92	MCS0
	46	5230	15.43	MCS0
IEEE 802.11ac VHT20	36	5180	15.57	MCS0
	40	5200	15.05	MCS0
	48	5240	15.66	MCS0
IEEE 802.11ac VHT40	38	5190	15.86	MCS0
	46	5230	15.83	MCS0

IEEE 802.11ac VHT80	42	5210	15.61	MCS0

<WLAN 5GHz U-NI-2A Conducted Power>

Mode	Channel	Frequency (MHz)	Average Conducted Output Power(dBm)	Worst Case Test Rate Data
IEEE 802.1a	52	5260	14.46	MCS0
	56	5280	14.86	MCS0
	64	5320	14.22	MCS0
IEEE 802.11n HT20	52	5260	14.34	MCS0
	56	5280	14.62	MCS0
	64	5320	14.63	MCS0
IEEE 802.11n HT40	54	5270	14.32	MCS0
	62	5310	14.34	MCS0
IEEE 802.11ac VHT20	52	5260	14.23	MCS0
	56	5280	14.45	MCS0
	64	5320	14.21	MCS0
IEEE 802.11ac VHT40	54	5270	14.50	MCS0
	62	5310	13.50	MCS0
IEEE 802.11ac VHT80	58	5290	14.60	MCS0

<WLAN 5GHz U-NI-2C Conducted Power>

Mode	Channel	Frequency (MHz)	Average Conducted Output Power (dBm)	Worst Case Test Rate Data
IEEE 802.1a	100	5500	14.38	MCS0
	120	5600	14.65	MCS0
	140	5700	15.34	MCS0
IEEE 802.11n HT20	100	5500	14.11	MCS0
	120	5600	14.37	MCS0
	140	5700	15.28	MCS0
IEEE 802.11n HT40	102	5510	15.16	MCS0
	118	5590	14.36	MCS0
	134	5670	15.02	MCS0
IEEE 802.11ac VHT20	100	5500	14.14	MCS0
	120	5600	14.19	MCS0
	140	5700	15.35	MCS0
IEEE 802.11ac VHT40	102	5510	14.78	MCS0
	118	5590	14.39	MCS0
	134	5670	14.94	MCS0
IEEE 802.11ac VHT80	106	5530	14.91	MCS0
	122	5610	14.78	MCS0

<WLAN 5GHz U-NI-3 Conducted Power>

Mode	Channel	Frequency (MHz)	Average Conducted Output Power(dBm)	Worst Case Test Rate Data
IEEE 802.1a	149	5745	15.28	MCS0
	157	5785	14.99	MCS0
	165	5825	15.87	MCS0
IEEE 802.11n HT20	149	5745	15.14	MCS0
	157	5785	15.59	MCS0
	165	5825	15.57	MCS0
IEEE 802.11n HT40	151	5755	15.32	MCS0
	159	5795	15.67	MCS0
IEEE 802.11ac VHT20	149	5745	15.57	MCS0
	157	5785	15.05	MCS0
	165	5825	15.66	MCS0
IEEE 802.11ac VHT40	151	5755	15.86	MCS0
	159	5795	15.83	MCS0
IEEE 802.11ac VHT80	155	5775	15.10	MCS0

Note: SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

4.2. Manufacturing Tolerance

WiFi 2.4G

IEEE 802.11b (Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.0	18.0	17.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.0	18.0	18.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	18.0	18.0	18.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	18.0	18.0	18.0
Tolerance ±(dB)	1.0	1.0	1.0

IEEE 802.11b (Peak)		
Channel	Channel 12	Channel 13
Target (dBm)	5.0	4.0
Tolerance ±(dB)	1.0	1.0
IEEE 802.11g(Peak)		
Channel	Channel 12	Channel 13
Target (dBm)	5.0	4.0
Tolerance ±(dB)	1.0	1.0
IEEE 802.11n HT20(Peak)		
Channel	Channel 12	Channel 13
Target (dBm)	5.0	4.0
Tolerance ±(dB)	1.0	1.0
IEEE 802.11n HT40 (Peak)		
Channel	Channel 10	Channel 11
Target (dBm)	5.0	4.0
Tolerance ±(dB)	1.0	1.0

WLAN 5GHz U-NI-1

IEEE 802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 42		
Target (dBm)	15.0		

Tolerance ±(dB)	1.0

WLAN 5GHz U-NI-2A

IEEE 802.11a (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n(40MHz) (Average)			
Channel	Channel 54	Channel 62	
Target (dBm)	14.0	14.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac(20MHz) (Average)			
Channel	Channel 52	Channel 56	Channel 64
Target (dBm)	14.0	14.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11ac(40MHz) HT20 (Average)			
Channel	Channel 54	Channel 62	
Target (dBm)	14.0	13.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac(80MHz) Average)			
Channel	Channel 58		
Target (dBm)	14.0		
Tolerance ±(dB)	1.0		

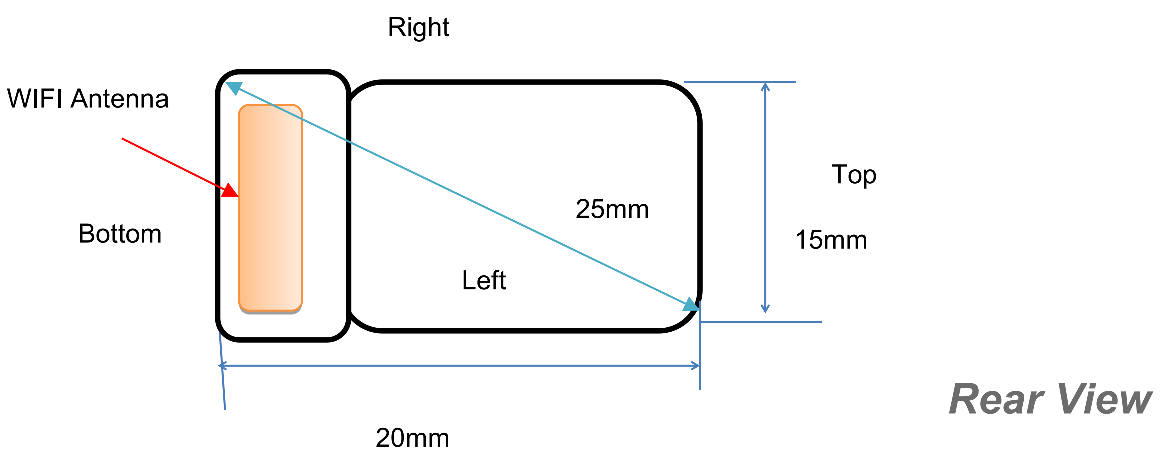
WLAN 5GHz U-NI-2C

IEEE 802.11a (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	14.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	14.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 102	Channel 134	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac VHT20 (Average)			
Channel	Channel 100	Channel 116	Channel 140
Target (dBm)	14.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 102	Channel 134	
Target (dBm)	14.0	14.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 106		
Target (dBm)	14.0		
Tolerance ±(dB)	1.0		

WLAN 5GHz U-NI-3

IEEE 802.11a (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	14.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11acVHT20 (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	15.0	15.0	15.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	15.0	15.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11ac VHT80 (Average)			
Channel	Channel 155		
Target (dBm)	15.0		
Tolerance ±(dB)	1.0		

4.3. Transmit Antennas and SAR Measurement Position



Antenna information:

WIFI Antenna	TX/RX

Measured Position:

Position 1	Horizontal-Up
Position 2	Horizontal-Down
Position 3	Vertical-Front
Position 4	Vertical-Back

4.4. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*10$^{(Ptarget-Pmeasured))/10}$

Scaling factor=10$^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

P_{target} is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

Duty Cycle

Test Mode	Duty Cycle
WLAN2450	1:1
5GWLAN	1:1

5.3.1 SAR Results

SAR Values [WIFI2.4G]

Ch.	Freq. (MHz)	Service	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (distance 5mm)										
6	2437	802.11g	Position 1	18.48	19.00	0.13	1.127	0.125	0.141	
6	2437	802.11g	Position 2	18.48	19.00	-0.53	1.127	**0.193**	**0.218**	**Plot 1**
1	2412	802.11g	Position 2	18.12	19.00	-1.00	1.225	0.176	0.216	
11	2462	802.11g	Position 2	18.72	19.00	0.53	1.067	0.188	0.201	
6	2437	802.11g	Position 3	18.48	19.00	3.01	1.127	0.137	0.154	
6	2437	802.11g	Position 4	18.48	19.00	4.18	1.127	0.104	0.117	

SAR Values [5GWIFI U-NII-1]

Ch.	Freq. (MHz)	Service	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (distance 5mm)										
38	5190	802.11n HT40	Position 1	15.92	16.00	0.37	1.019	0.122	0.124	
38	5190	802.11n HT40	Position 2	15.92	16.00	-1.26	1.019	0.116	0.118	
46	5230	802.11n HT40	Position 2	15.43	16.00	0.08	1.140	**0.126**	**0.144**	**Plot 2**
38	5190	802.11n HT40	Position 3	15.92	16.00	-2.69	1.019	0.097	0.099	
38	5190	802.11n HT40	Position 4	15.92	16.00	2.74	1.019	0.082	0.084	

SAR Values [5GWIFI U-NII-2A]

Ch.	Freq. (MHz)	Service	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR_{1-g} results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (distance 5mm)										
56	5280	802.11a	Position 1	14.86	15.00	-1.22	1.033	0.105	0.108	
56	5280	802.11a	Position 2	14.86	15.00	2.11	1.033	0.120	0.124	
52	5260	802.11a	Position 2	14.46	15.00	-0.19	1.132	**0.124**	**0.140**	**Plot 3**
64	5320	802.11a	Position 2	14.22	15.00	-1.50	1.197	0.114	0.136	
56	5280	802.11a	Position 3	14.86	15.00	-2.59	1.033	0.092	0.095	
56	5280	802.11a	Position 4	14.86	15.00	-3.70	1.033	0.087	0.090	

SAR Values [5GWIFI U-NII-2C]

Ch.	Freq. (MHz)	Service	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (distance 5mm)										
120	5600	802.11ac VHT20	Position 1	14.47	15.00	0.69	1.130	0.094	0.106	
120	5600	802.11ac VHT20	Position 2	14.47	15.00	-0.52	1.130	0.108	0.122	
100	5500	802.11ac VHT20	Position 2	14.14	15.00	-0.40	1.219	**0.113**	**0.138**	**Plot 4**
140	5700	802.11ac VHT20	Position 2	15.35	16.00	2.31	1.161	0.110	0.128	
120	5600	802.11ac VHT20	Position 3	14.47	15.00	0.07	1.130	0.088	0.099	
120	5600	802.11ac VHT20	Position 4	14.47	15.00	-1.34	1.130	0.074	0.084	

SAR Values [5GWIFI U-NII-3]

Ch.	Freq. (MHz)	Service	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power Drift (%)	Scaling Factor	SAR1-g results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Body (distance 5mm)										
157	5785	802.11a	Position 1	14.99	15.00	-1.40	1.002	0.075	0.075	
157	5785	802.11a	Position 2	14.99	15.00	3.14	1.002	0.084	0.084	
149	5745	802.11a	Position 2	15.28	16.00	-0.58	1.180	**0.094**	**0.111**	**Plot 5**
165	5825	802.11a	Position 2	15.87	16.00	2.38	1.030	0.084	0.087	
157	5785	802.11a	Position 3	14.99	15.00	-1.33	1.002	0.076	0.076	
157	5785	802.11a	Position 4	14.99	15.00	4.05	1.002	0.064	0.064	

Remark:
1. The value with blue color is the maximum SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).
3. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
4. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

4.5. Simultaneous TX SAR Considerations

4.6.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For the DUT,the sample only share one WLAN&BT modular and one WLAN&BT antenna, No need consider simultaneous.

4.6. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.19 The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783.Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

1) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

Frequency Band (MHz)	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR_{1-g} (W/Kg)	First Repeated	
						Measued SAR_{1-g} (W/Kg)	Largest to Smallest SAR Ratio
2450	2.4GWLAN	Standalone	Position 2	no	0.193	n/a	n/a
5200	UNII Band 1	Standalone	Position 2	no	0.126	n/a	n/a
5300	UNII Band 2A	Standalone	Position 2	no	0.124	n/a	n/a
5500	UNII Band 2C	Standalone	Position 2	no	0.113	n/a	n/a
5800	UNII Band 3	Standalone	Position 2	no	0.094	n/a	n/a

Remark:

1. *Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the orignal and first repeated measurement is not > 1.20 or 3 (1-g or 10-g respectively)*

4.7. General description of test procedures

1. Test positions as described in the tables above are in accordance with the specified test standard.
2. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
3. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
4. According to KDB 447498 D01 testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   ● ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   ● ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   ● ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
5. IEEE 1528-2003 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. 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.
6. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.19 If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
7. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower

maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

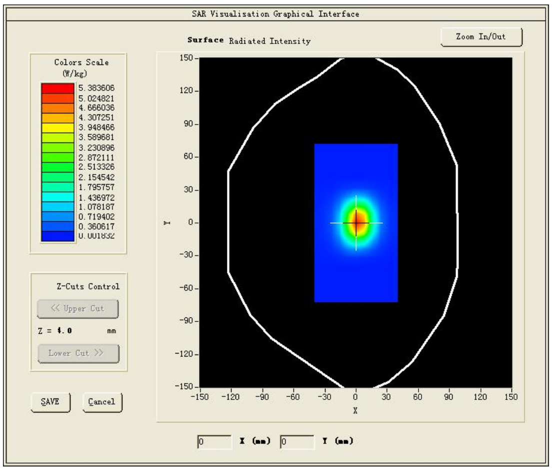
4.8. Measurement Uncertainty (450MHz-6GHz)

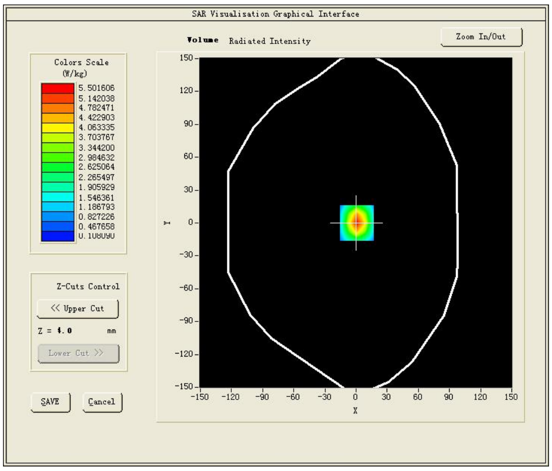
Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR accoridng to KDB865664D01.

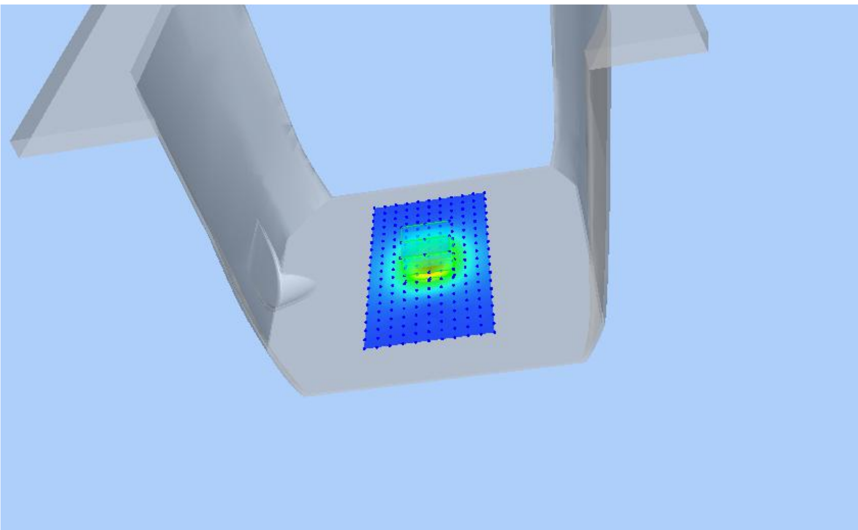
4.9. System Check Results

Test mode:2450MHz(Body)
Product Description:Validation
Model:Dipole SID2450
E-Field Probe:SSE2(SN 31/17 EPGO324)
Test Date: August 17, 2020

Medium(liquid type)	MSL_2450
Frequency (MHz)	2450.0000
Relative permittivity (real part)	51.94
Conductivity (S/m)	1.93
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.95
Variation (%)	0.660000
SAR 10g (W/Kg)	2.445401
SAR 1g (W/Kg)	5.377071
SURFACE SAR	**VOLUME SAR**

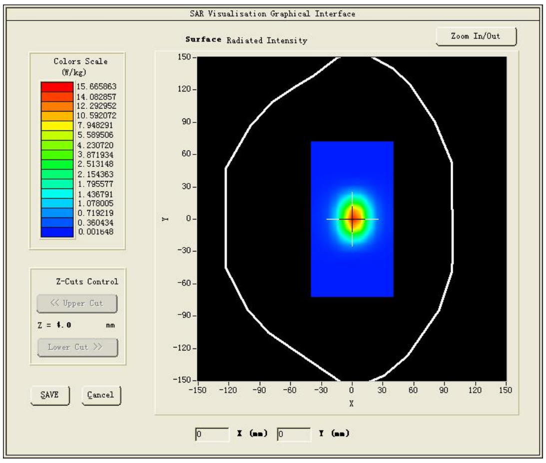


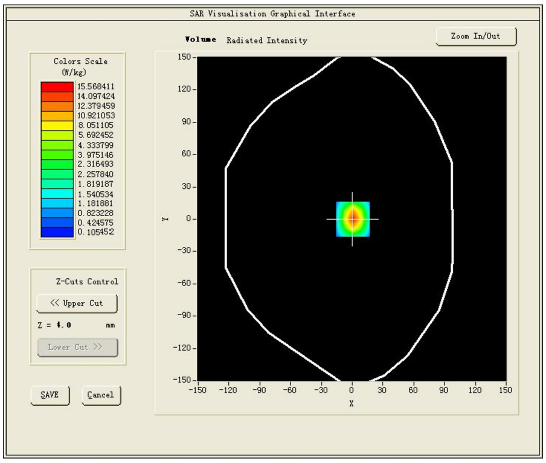


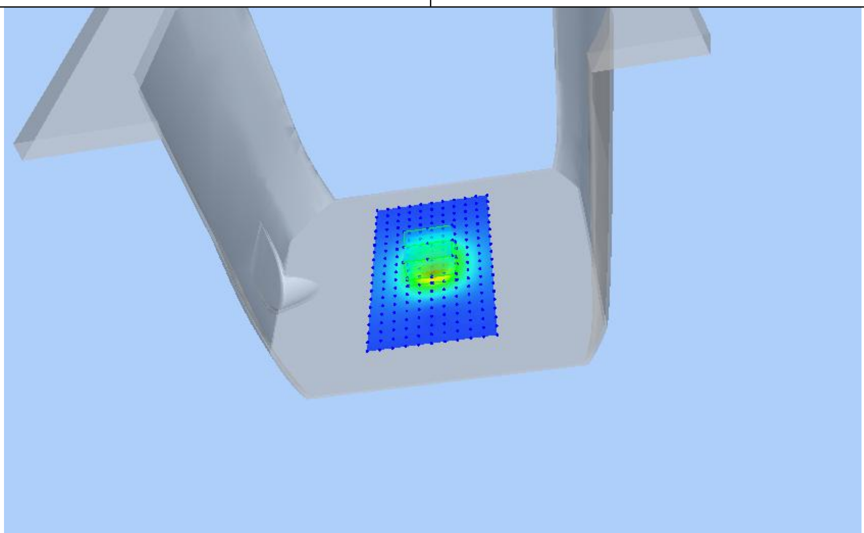


Test mode:5200MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 31/17 EPGO324)
Test Date: August 18, 2020

Medium(liquid type)	MSL_5000
Frequency (MHz)	5200.0000
Relative permittivity (real part)	50.11
Conductivity (S/m)	5.41
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.56
Variation (%)	-3.020000
SAR 10g (W/Kg)	5.512345
SAR 1g (W/Kg)	15.467434
SURFACE SAR	**VOLUME SAR**

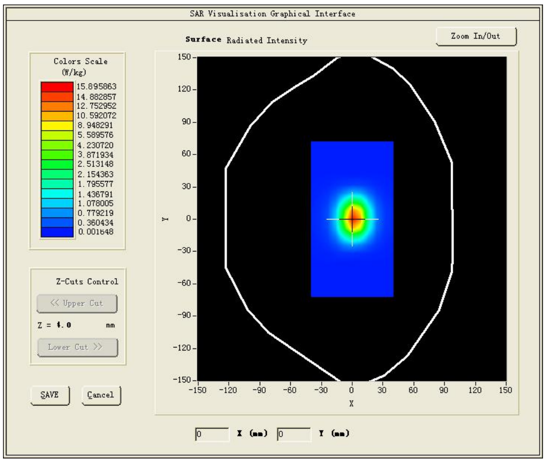


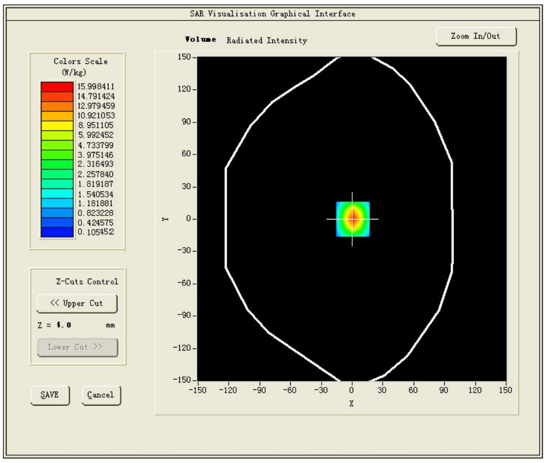


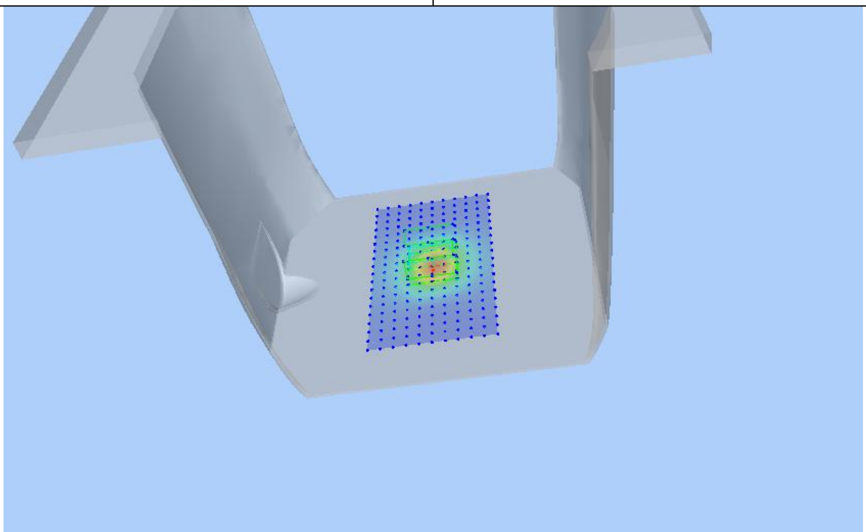


Test mode:5400MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 31/17 EPGO324)
Test Date: August 18, 2020

Medium(liquid type)	MSL_5000
Frequency (MHz)	5400.0000
Relative permittivity (real part)	50.05
Conductivity (S/m)	5.52
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.47
Variation (%)	0.450000
SAR 10g (W/Kg)	5.812425
SAR 1g (W/Kg)	15.814211
SURFACE SAR	**VOLUME SAR**

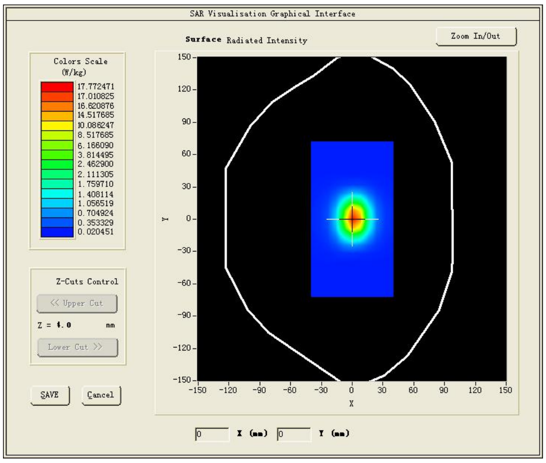


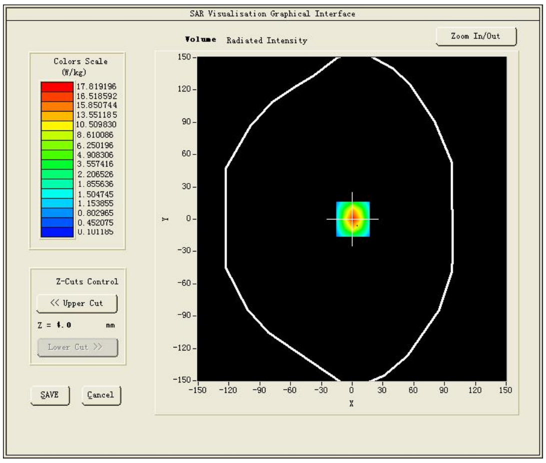


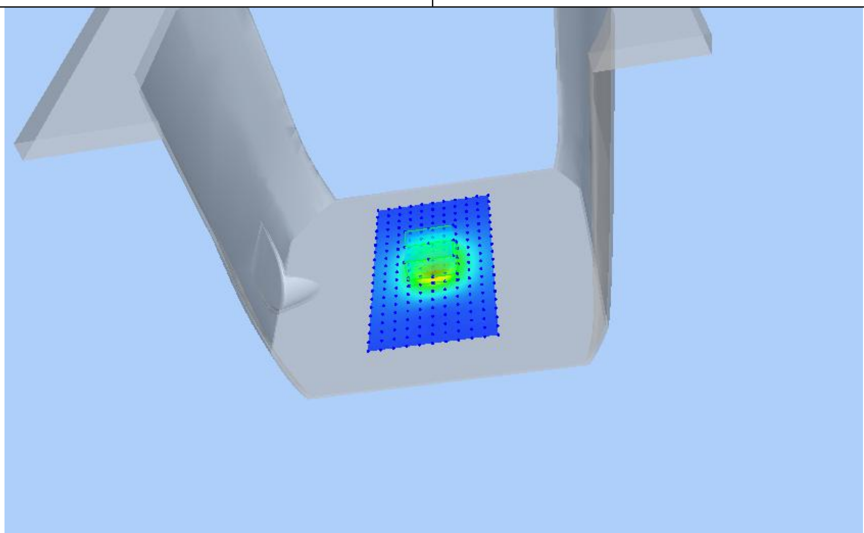


Test mode:5600MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 31/17 EPGO324)
Test Date: August 18, 2020

Medium(liquid type)	MSL_5000
Frequency (MHz)	5600.0000
Relative permittivity (real part)	49.77
Conductivity (S/m)	5.97
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.53
Variation (%)	-1.470000
SAR 10g (W/Kg)	6.015230
SAR 1g (W/Kg)	17.626041
SURFACE SAR	**VOLUME SAR**

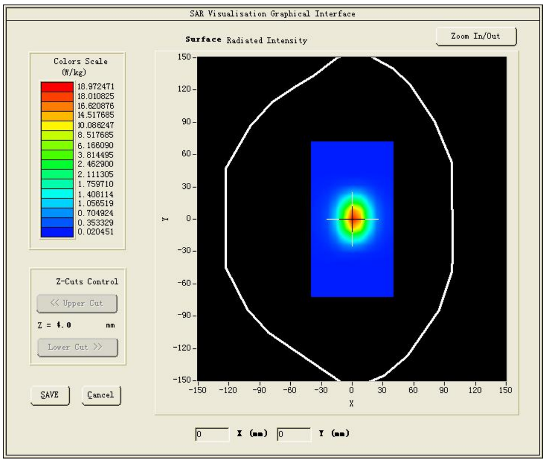


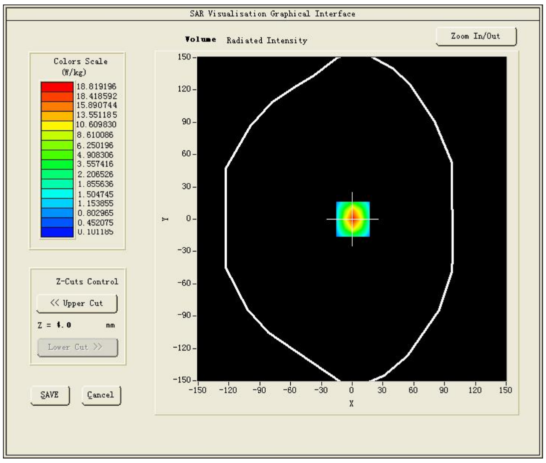


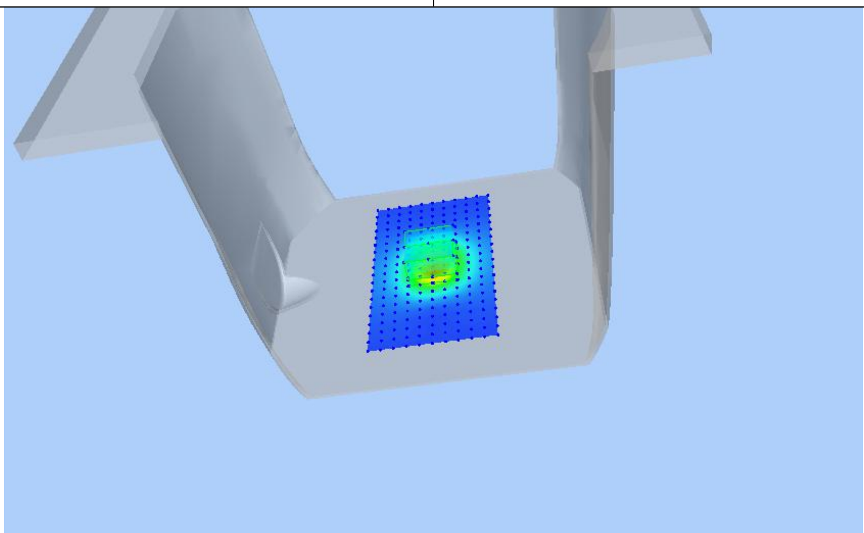


Test mode:5800MHz(Body)
Product Description:Validation
Model:Dipole SID5000
E-Field Probe: SSE2(SN 31/17 EPGO324)
Test Date: August 18, 2020

Medium(liquid type)	MSL_5000
Frequency (MHz)	5800.0000
Relative permittivity (real part)	47.39
Conductivity (S/m)	6.27
Input power	100mW
Crest Factor	1.0
Conversion Factor	1.55
Variation (%)	-1.010000
SAR 10g (W/Kg)	6.177085
SAR 1g (W/Kg)	18.293125
SURFACE SAR	**VOLUME SAR**





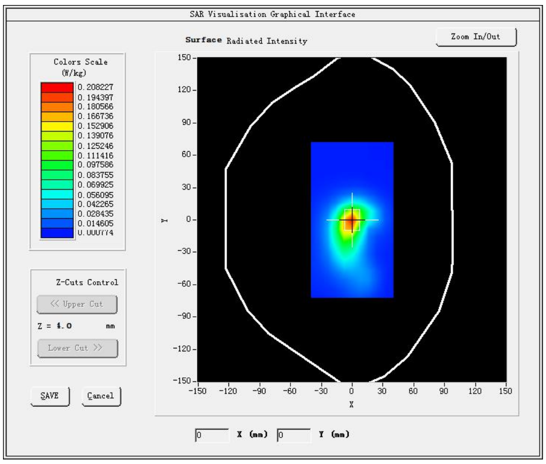
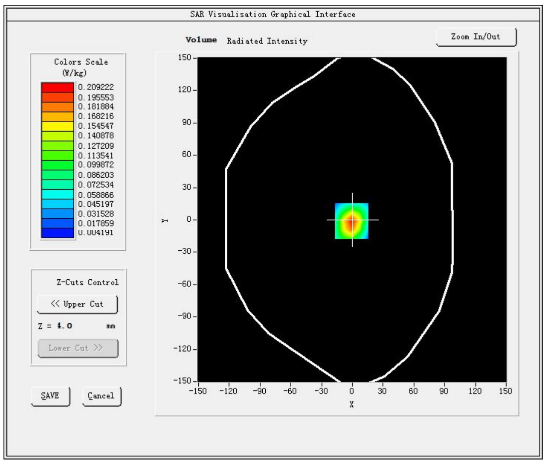
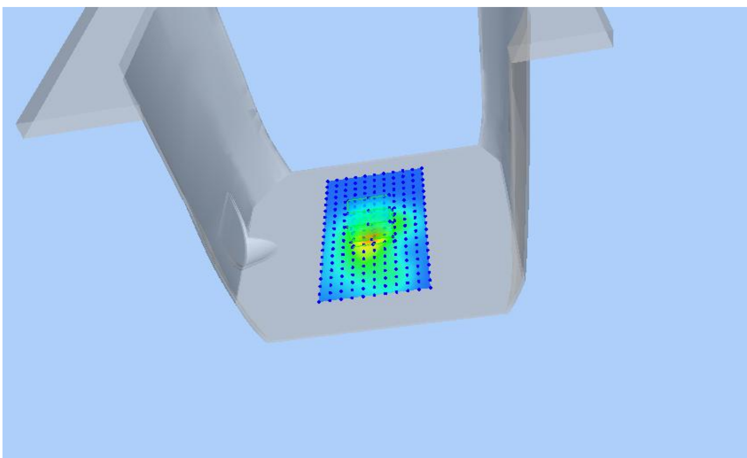
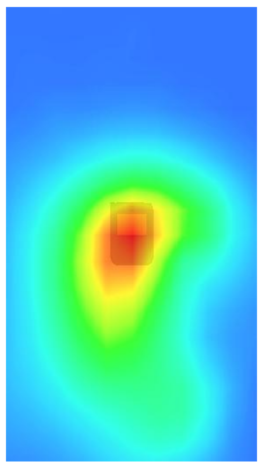


4.10. SAR Test Graph Results

SAR plots for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination

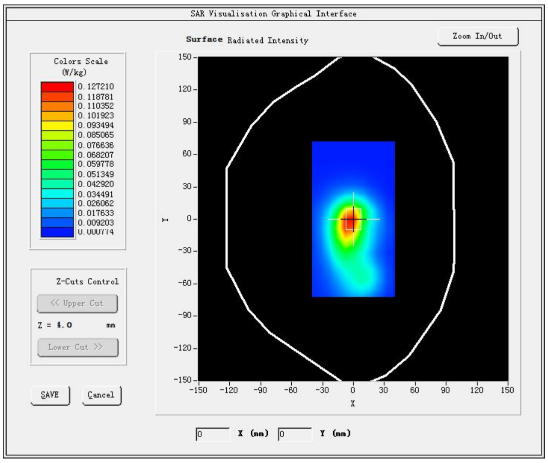
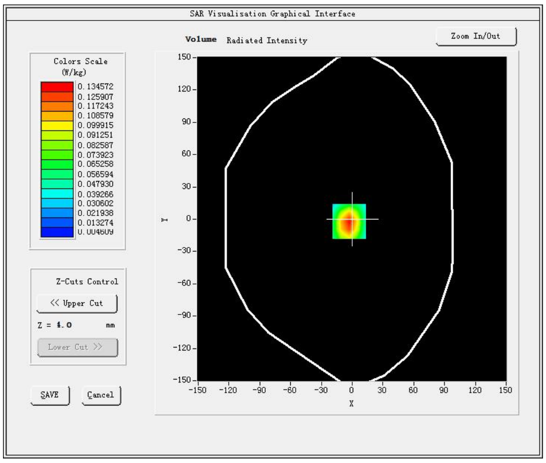
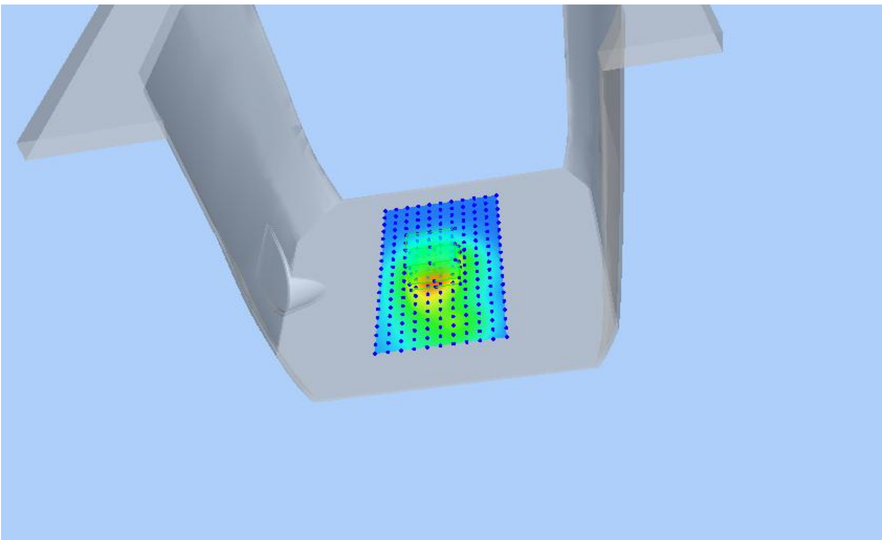
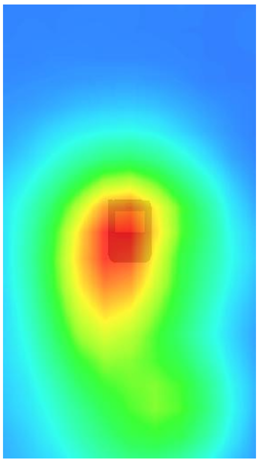
#1

Test Mode: 802.11g(WiFi2.4G),Middle channel (Test Position 2)
Product Description: Mini 802.11ac Wireless USB Adapter
Model: 0611
Test Date: August 17, 2020

Medium(liquid type)	MSL_2450
Frequency (MHz)	2437.0000
Relative permittivity (real part)	51.98
Conductivity (S/m)	1.93
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.95
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.530000
SAR 10g (W/Kg)	0.089808
SAR 1g (W/Kg)	0.193411
SURFACE SAR	**VOLUME SAR**
	
	

#2

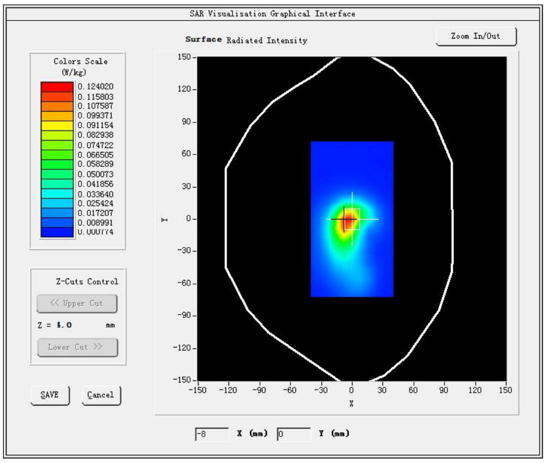
Test Mode:802.11n HT40 (WiFi5.2G), High channel (Test Position 2)
Product Description: Mini 802.11ac Wireless USB Adapter
Model: 0611
Test Date:August 18, 2020

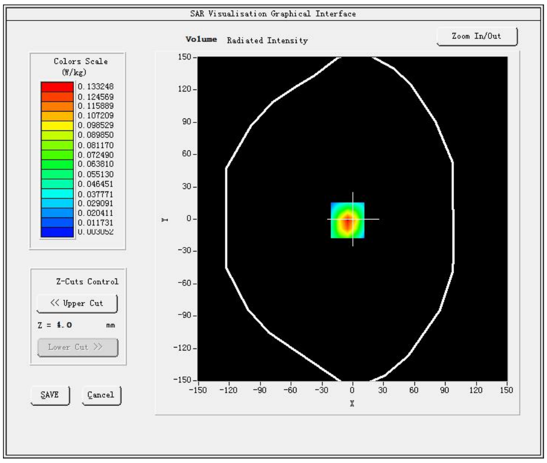
Medium(liquid type)	MSL_3.5-6G
Frequency (MHz)	5200.0000
Relative permittivity (real part)	49.98
Conductivity (S/m)	5.44
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.56
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	0.080000
SAR 10g (W/Kg)	0.063924
SAR 1g (W/Kg)	0.125545
SURFACE SAR	**VOLUME SAR**
	
	

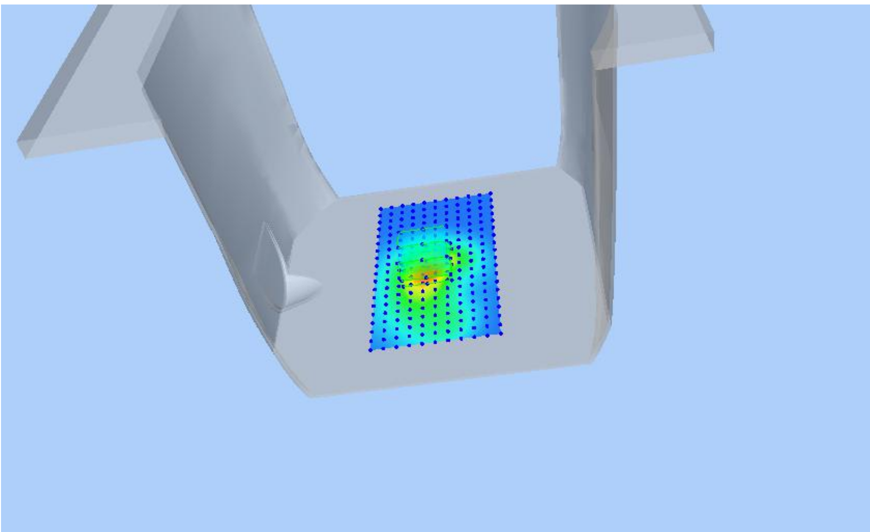
#3

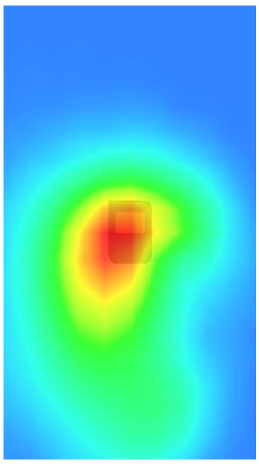
Test Mode:802.11a (WiFi5.3G),Low channel (Test Postion 2)
Product Description: Mini 802.11ac Wireless USB Adapter
Model: 0611
Test Date:August 18, 2020

Medium(liquid type)	MSL_3.5-6G
Frequency (MHz)	5200.0000
Relative permittivity (real part)	49.98
Conductivity (S/m)	5.44
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.56
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.190000
SAR 10g (W/Kg)	0.058247
SAR 1g (W/Kg)	0.123918
SURFACE SAR	**VOLUME SAR**





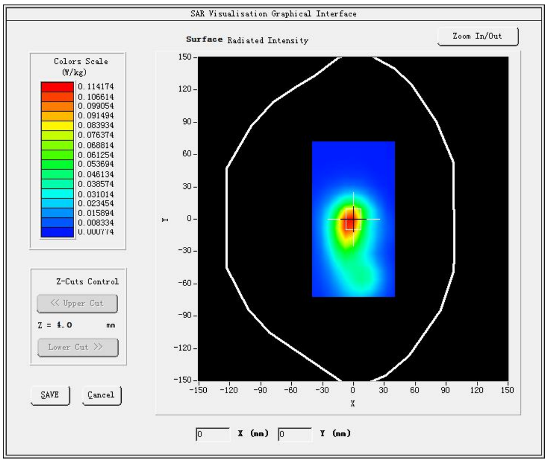


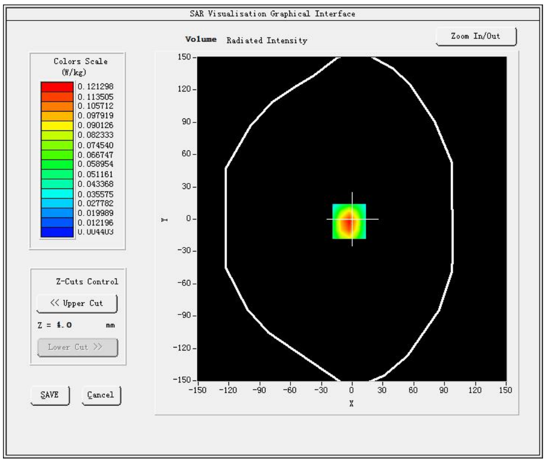


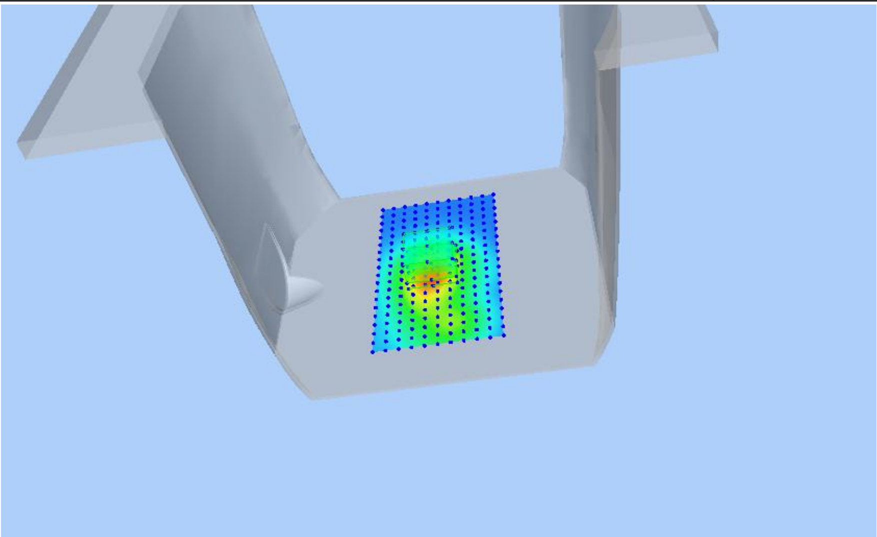
#4

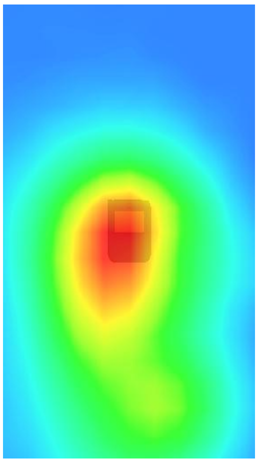
Test Mode: 802.11ac VHT20 (WiFi5.5G), Low channel (Test Postion 2)
Product Description: Mini 802.11ac Wireless USB Adapter
Model: 0611
Test Date:August 18, 2020

Medium(liquid type)	MSL_3.5-6G
Frequency (MHz)	5600.0000
Relative permittivity (real part)	49.77
Conductivity (S/m)	5.97
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.53
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.400000
SAR 10g (W/Kg)	0.058358
SAR 1g (W/Kg)	0.113374
SURFACE SAR	**VOLUME SAR**









#5

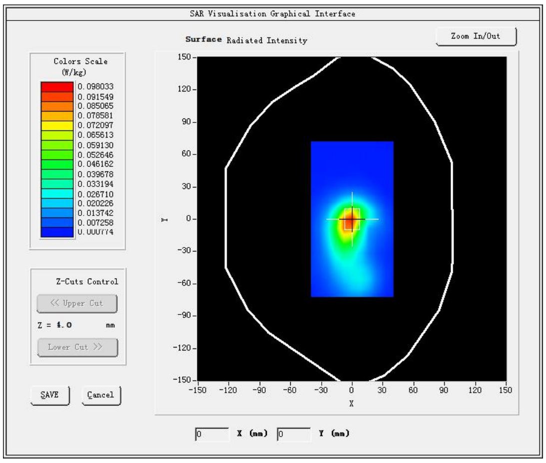
Test Mode: 802.11a (WiFi5.8G), Low channel (Test Position 2)

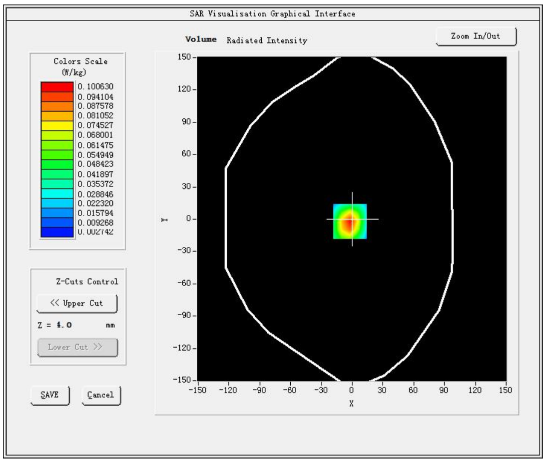
Product Description: Mini 802.11ac Wireless USB Adapter

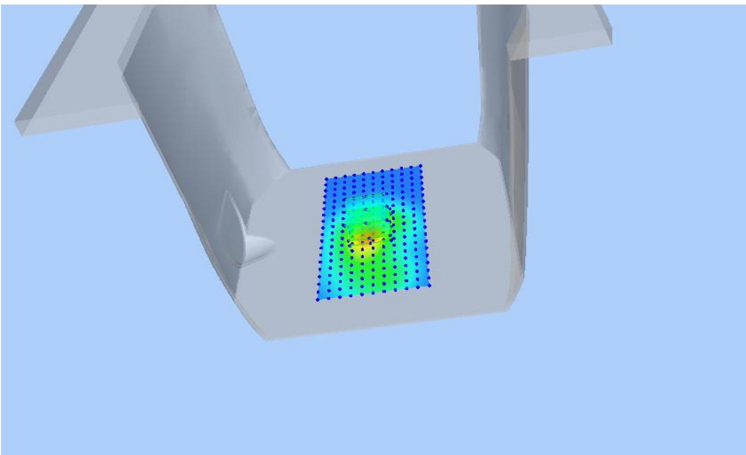
Model: 0611

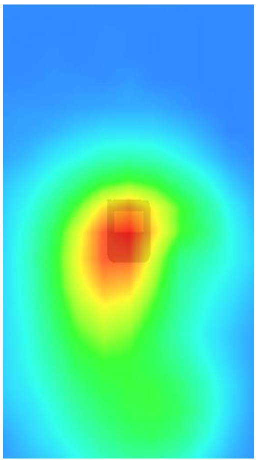
Test Date:August 18, 2020

Medium(liquid type)	MSL_3.5-6G
Frequency (MHz)	5795.0000
elative permittivity (real part)	47.39
Conductivity (S/m)	6.27
E-Field Probe	SN 31/17 EPGO324
Crest Factor	1.0
Conversion Factor	1.55
Sensor	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	-0.580000
SAR 10g (W/Kg)	0.045840
SAR 1g (W/Kg)	0.093518
SURFACE SAR	**VOLUME SAR**









5. CALIBRATION CERTIFICATES

5.1 Probe-EPGO281 Calibration Certificate

MVG
Microwave Vision Group

COMOSAR E-Field Probe Calibration Report

Ref : ACR.281.2.18.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
MVG COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 31/17 EPGO324

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

ilac-MRA

A2LA ACCREDITED
Calibration CERT #2246-02

Calibration Date: 10/08/2018

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.

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.281.2.18.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/8/2018	JS
Checked by :	Jérôme LUC	Product Manager	10/8/2018	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	10/8/2018	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/8/2018	Initial release

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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE2
Serial Number	SN 31/17 EPGO324
Product Condition (new / used)	New
Frequency Range of Probe	0.15 GHz-6GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.189 MΩ Dipole 2: R2=0.203 MΩ Dipole 3: R3=0.218 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 %

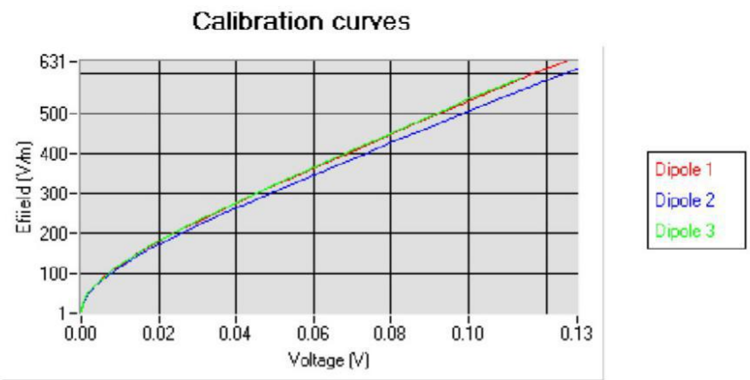
5.1 SENSITIVITY IN AIR

Normx dipole 1 (μV/(V/m)²)	Normy dipole 2 (μV/(V/m)²)	Normz dipole 3 (μV/(V/m)²)
0.80	0.83	0.68

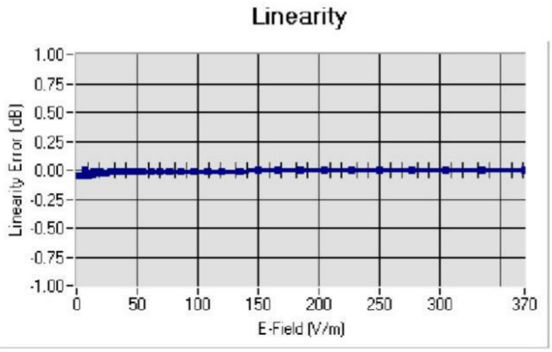
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
95	90	93

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:+/-1.13% (+/-0.05dB)

5.3 SENSITIVITY IN LIQUID

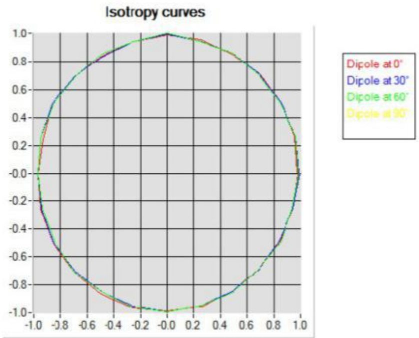
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	42.17	0.86	1.56
BL450	450	57.65	0.95	1.60
HL750	750	40.03	0.93	1.45
BL750	750	56.83	1.00	1.50
HL850	835	42.19	0.90	1.55
BL850	835	54.67	1.01	1.59
HL900	900	42.08	1.01	1.54
BL900	900	55.25	1.08	1.60
HL1800	1800	41.68	1.46	1.65
BL1800	1800	53.86	1.46	1.68
HL1900	1900	38.45	1.45	1.86
BL1900	1900	53.32	1.56	1.93
HL2000	2000	38.26	1.38	1.83
BL2000	2000	52.70	1.51	1.89
HL2300	2300	39.44	1.62	1.95
BL2300	2300	54.52	1.77	2.01
HL2450	2450	37.50	1.80	1.91
BL2450	2450	53.22	1.89	1.95
HL2600	2600	39.80	1.99	1.89
BL2600	2600	52.52	2.23	1.94
HL5200	5200	35.64	4.67	1.50
BL5200	5200	48.64	5.51	1.56
HL5400	5400	36.44	4.87	1.44
BL5400	5400	46.52	5.77	1.47
HL5600	5600	36.66	5.17	1.48
BL5600	5600	46.79	5.77	1.53
HL5800	5800	35.31	5.31	1.50
BL5800	5800	47.04	6.10	1.55

LOWER DETECTION LIMIT: 9mW/kg

5.4 ISOTROPY

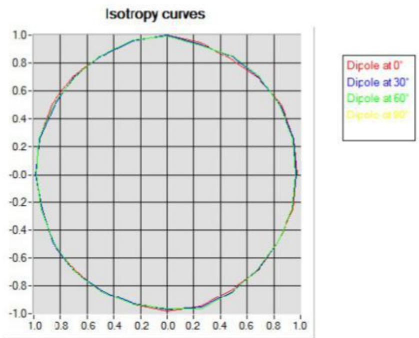
HL900 MHz

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



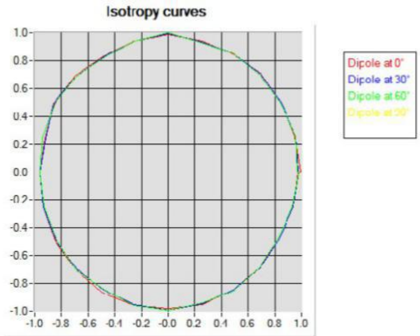
HL1800 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.07 dB



HL5600 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.10 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	02/2016	02/2019
Reference Probe	MVG	EP 94 SN 37/08	10/2017	10/2019
Multimeter	Keithley 2000	1188656	01/2017	01/2020
Signal Generator	Agilent E4438C	MY49070581	01/2017	01/2020
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	01/2017	01/2020
Power Sensor	HP ECP-E26A	US37181460	01/2017	01/2020
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	150798832	11/2017	11/2020

5.2 SID2450Dipole Calibration Ceriticate

SAR Reference Dipole Calibration Report

Ref : ACR.287.8.14.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 07/14 DIP 2G450-306

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

Calibration CERT #2246-02

10/01/2018

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	10/14/2018	JS
Checked by :	Jérôme LUC	Product Manager	10/14/2018	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	10/14/2018	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	*Date*	*Modifications*
A	10/14/2018	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 07/14 DIP 2G450-306
Product Condition (new / used)	New

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 %